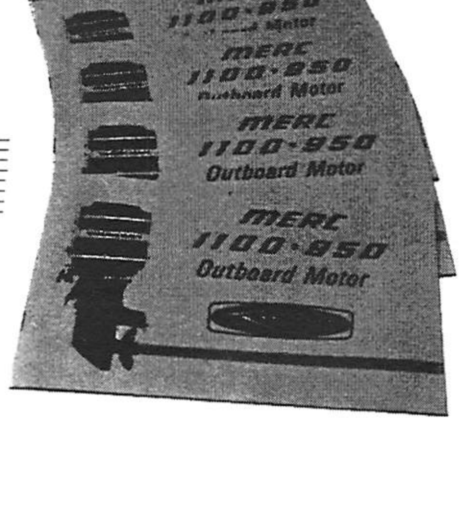
section I

general information - tuneup & service hints



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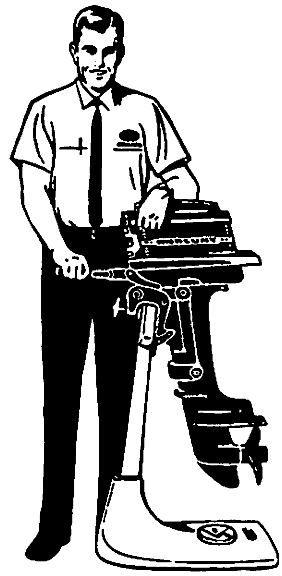
MASTER SERVICE MANUAL



General Instructions

SERVICE RECOMMENDATIONS

Your new Master Service Manual includes all of the important general and detail information on all Kiekhaefer Mercury Outboard Motor models. All material is compiled from former service manuals, owners' guides, service bulletins and other sources, relative to individual Mercury engines, and brought up-to-date. New and revised pages are added periodically to Franchised Kiekhaefer Mercury Dealers only -- to keep the book current. (Observe dateline at bottom of each page.)

In preparation of this book, careful consideration was given to all adjustment and service operations, maintenance and repairs which are encountered in the operation of internal combustion engines, specifically the Mercury Outboard Motor. In the text, "suffix models" (e.g. Merc 1250BP, Merc 650-5, Mark 20H) are included in the instructions for the basic model (e.g. Merc 1250, Merc 650, Mark 20), unless listed separately.

The procedures followed are based on a general overhaul. Refer to the dealer's Mercury Parts Manual for all correct parts' numbers. For tools, which are referred to in this manual, see Tool Section IX, if the correct use of the tool is in doubt. Specifications for all models are listed under "Master Specifications Chart", Section VIII.

IMPORTANT: Major repairs, particularly those which require extensive disassembly or replacement of internal parts, should be done only where the necessary factory-designed tools and equipment are at hand.

DIRECTIONAL REFERENCES

In this book, all directions are given as "right" or "left" as they appear when viewing the boat from the stern (rear)

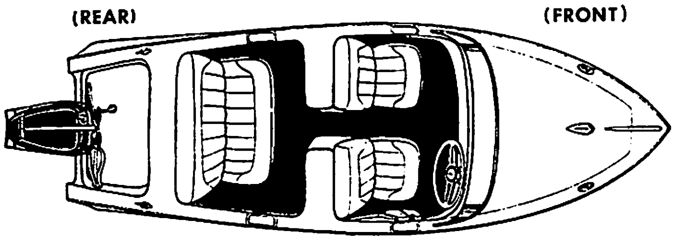


Figure 1. Directional References

looking toward bow (front). In marine publications, "right" is known as "starboard" and "left" as "port". (Figure 1)

RATING OF OUTBOARDS -MERCURY HORSEPOWER

Horsepower ratings for Mercury Outboard Motors are in terms of standard horsepower, as recognized and used internationally by the Society of Automotive Engineers, the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the American Society of Civil Engineers for rating electric motors, diesel engines, steam engines, marine engines or any other prime movers.

A standard horsepower is defined as the amount of energy required to raise 33,000 pounds one foot in one minute.

Not only are Mercury Motors rated according to this world standard of horsepower, they are also rated at safe, continuous duty ratings rather than flash peak ratings. This means that instead of being given a horsepower designation based on the peak performance of a new motor (a rating which that motor may not attain again in normal operating conditions), Mercurys are rated at the horsepower they'll deliver month after month, year after year.

Just as the definition of horsepower is unusual, so too is the method of computation. The Engine Test Code of the Society of Automotive Engineers standardizes the computation of horsepower from the data obtained on the dynamometer, or power-measuring device, correcting all values to the power which the engine would produce at sea level altitude and the 60°F (15.5°C) temperature.

It is in the choice of conditions at which the rated or advertised horsepower shall be taken that various manufacturers differ, some taking flash or peak readings obtained during short bursts of full power operation, while others are more conservative in using conditions of steady operations at safe working revolutions per minute.

Kiekhaefer Mercury rates its Mercury Outboards at the horsepower which they will develop when run under continuous duty at normal operating speed, holding a little extra power in reserve for higher speed operation.

Then too, it takes more than rated horsepower alone to provide top performance for the outboard user. Outboard horsepower is measured at the engine crankshaft and does not account for losses encountered in the exhaust system or in the gears and bearings joining the crankshaft to the propeller. Here Mercury's vacuum exhaust and full-jeweled design insure that the largest possible percentage of that rated horsepower reaches the propeller without being lost in friction or in the exhaust system. Then Mercury's modern propeller design takes over to convert that horsepower to the thrust or push needed to propel a boat at maximum speed, the correct design of the underwater structure minimizing hydrodynamic losses.

FUEL and FUEL MIXING PROCEDURE

It is recommended that regular leaded automotive gasolines be used in Mercury Outboards which are equipped with Thunderbolt Ignition Systems and Polar Gap Spark Plugs. (Figure 1)

Some marine white gasolines have been known to give trouble because of their very low octane number, thereby causing detonation, or to their "dirty" components which cause ring sticking and port plugging.

Regular gasolines are of a more closely-controlled, uniform quality and are readily available at any service station or marina.

Figure 1. Polar Gap Spark Plug

Figure 2. Conventional Spark Plug

Mercury Outboards with conventional ignition systems and spark plugs (Figure 2) operate with higher plug temperatures than those with Thunderbolt Ignition. This requires that they be operated, preferably, on non-leaded, white fuels such as marine or light aircraft or low-lead content gasolines.

Any Mercury Outboard Engine may be operated satisfactorily on white gasolines of high quality known to have been satisfactory in the past.

RECOMMENDED FUEL MIXTURE

Use only AUTOMOTIVE REGULAR or Amoco lead-free premium gasoline in all engines which have Polar Gap spark plugs. (Figure 1)

Marine white, automotive white, light aircraft or Amoco lead-free premium gasolines are preferred for older Mercury Outboards with conventional spark plugs. (Figure 2) If not available, use good grade automotive gasoline.

AUTOMOTIVE PREMIUM gasolines should not be used, since they contain harmful additives.

1. When using new FORMULA 50 Quicksilver 2-Cycle Super Outboard Motor Oil, thoroughly mix one 12-ounce can with each 5 gallons of gasoline (8 ounces with each 3 gallons) in your remote fuel tank. (Figure 3)
2. If using Formula 2 Quicksilver 2-Cycle Outboard Motor Oil, thoroughly mix one 30-ounce can with each 6 gallons of gasoline or 15 ounces with 3 gallons in your remote fuel tank.
3. In emergency, when new FORMULA 50 and Formula 2 Quicksilver Oil are not available, substitute a high quality 2-cycle oil that is intended for outboard use. Use manufacturer's recommended gasoline-oil mixture.

> **CAUTION: The use of other than FORMUAL 50 Oil in the 50:1 ratio may cause piston scoring, bearing failure or both.**
>
> **Do not, under any circumstances, use multigrade or other highly detergent automobile oils or oils which contain metallic additives. This type of oil may result in piston burning, scoring or both.**

OPERATION IN CANADA: Use 15 ounces of FORMULA 50 Quicksilver 2-Cycle Super Outboard Motor Oil to each 5 Imperial gallons of gasoline or 35 ounces of Formula 2 Quicksilver 2-Cycle Outboard Motor Oil to 5 Imperial gallons of gasoline in the remote fuel tank. See your Mercury dealer for approved oils in your area.

Figure 3. New FORMULA 50 Motor Oil

CORRECT FUEL MIXING PROCEDURE

Observe fire prevention rules, particularly in the matter of smoking. Mix fuel outdoors or at least in a well-ventilated location. Mix fuel directly in the remote tank.

Measure accurately the required amounts of oil and gasoline. Pour a small amount of gasoline into remote tank and add a small amount of oil (about the same amount as gas). Mix thoroughly by shaking or stirring vigorously; then add balance of oil and gasoline and mix again. Cleanliness is of prime importance in mixing fuel, as even a very small particle of dirt can cause carburetion trouble.

Always use fresh gasoline. Gasoline contains certain gum and varnish deposits and, when kept in a tank for a length of time, may give carburetor trouble and cause spark plug fouling.

BREAK-IN PROCEDURE FOR FUEL-OIL MIXTURE

CAUTION

1. New FORMULA 50 Quicksilver 2-Cycle Super Outboard Motor Oil

For the first two tank-fulls, thoroughly mix two 12-ounce cans to each 6-gallon tank of fuel (or one 12-ounce can to each 3-gallon tank of fuel). After break-in, refer to "Recommended Fuel Mixture", preceding.

2. Formula 2 Quicksilver 2-Cycle Outboard Motor Oil

For the first two tank-fulls, thoroughly mix one 30-ounce can to each 6-gallon tank of fuel (or 15 ounces to each 3-gallon tank of fuel). After break-in, refer to "Recommended Fuel Mixture", preceding.

3. Operate a new motor at ½-throttle (2500-3500 RPM) for 2 hours. After 2 hours, the motor may run at any speed, although sustained operation at full throttle should be avoided for an additional 8 hours.

NOTE: If using metric or Imperial measure, one U.S. ounce is .03 liter; one U.S. gallon is .83 Imperial gallon or 3.8 liters.

IMPORTANCE OF CONSISTENT FUEL MIXTURES

Carburetor idle adjustment is sensitive to fuel mixture variations which result from use of different gasolines and oils or due to inaccurate measuring or mixing. This may necessitate frequent readjustment of the carburetor idle needle. Be consistent. Prepare each batch of fuel exactly the same as previous ones.

Using less than the recommended proportion of oil may result in very serious motor damage due to lack of sufficient lubrication. Using more than the recommended proportion of oil will cause spark plug fouling, erratic carburetion, excessive smoking and faster-than-normal carbon accumulation.

CRUISING FUEL ECONOMY

A special feature of 4 and 6-cylinder and Merc 350 models provided far greater fuel economy than ever before provided on any outboard motor. This is obtained by a specially designed linkage between the carburetor and ignition system. It is automatically brought into operation by pulling control lever back to give cruising speed 70 to 90 percent of maximum speed. The special feature increases cruising range (or miles per gallon) and reduces fuel consumption (gallons per hour).

WARNING TO MERCURY OUTBOARD DEALERS AND OWNERS

WARNING: The use of any other oil than Kiekhaefer Quicksilver FORMULA 50 Oil in the 50:1 ratio may cause piston scoring, bearing failure or both. The motor warranty may be void if failure should occur with the use of other oils in the 50:1 fuel-oil mixture.

Examination of outboard motors with scored pistons, which have been returned to our Service Department, show that the use of certain types of so-called "outboard motor oils" have caused piston scoring.

Do not -- under any circumstances - use multi-grade or highly detergent automobile oils or oils which contain metallic additives in any fuel mixture. This type of oil may result in piston burning, scoring or both.

QUICKSILVER 2-CYCLE ENGINE OIL

Good Ingredients And Proper Chemical Composition Are Basic Requirements For Outboard Engine Oil. Most Top Quality Automobile Oils Are Not Acceptable For Outboard Motor Service

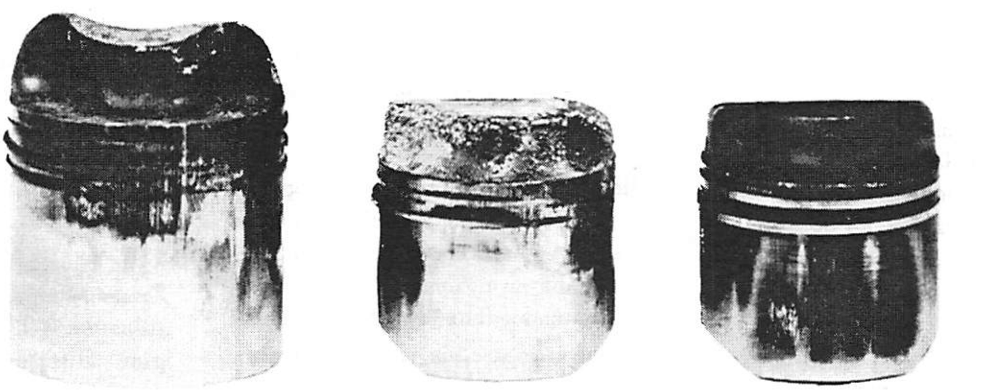
A universal, all-purpose lubricant to accommodate every conceivable application requirement would certainly have tremendous military and industrial advantages. Yet lubrication engineers continue to develop ever-wider varieties of special lubricants for special applications like jet engines, Diesel engines, firearms, speedometers, gyroscopes, refrigerators, water pumps, air compressors, vacuum pumps, electric motors, electric generators, hydraulic controls, hydraulic power systems, differentials, torque converters, transmissions, power steering mechanisms, chain saws, tank tracks, chain-and-sprocket drives, power tools, calculating machines, typewriters, printing presses, steam turbines, textile machinery, steel mill machinery, fishing reels, clocks and watches.

The familiar words, "good and proper", are particularly appropriate when applied to lubricants, because GOOD ingredients of PROPER chemical composition are necessary to achieve satisfactory performance, reliability and service life of the equipment in which a lubricant is used. For example, in an automobile such as you drive, the engine alone requires three different kinds of oil, depending upon sub-zero, cold or hot-weather driving conditions. In the transmission, at least two different kinds of oil are used, depending upon whether it is a conventional shift or an automatic transmission. In the rear axle, at least two different types of lubricant are used, depending upon whether it is a conventional or a "limited slip" differential.

Isn't it reasonable that the high-precision outboard engine, yielding more horsepower per pound than any standard-production internal combustion engine and admired by the rest of the engine industry as a marvel of compactness and durability, should require a special lubricant?

Base oil quality is only one factor determining the suitability of a lubricating oil for any particular engine. An oil rated as "excellent" for automobile engines would most likely be rated as "unacceptable" for outboard motor use. One reason is that automobile engine oil contains a special additive which is essential to protect the very highly-loaded cam and lifter surfaces in the valve gear of modern engines from scuff and wear.

Oil is exposed to high temperatures in 2-cycle engines, and automobile oil would break down to form harmful deposits which may promote pre-ignition.



Some automobile engine oils are made so that they do not readily mix with gasoline. This is desirable to prevent dilution of sump oil but may promote separation in a 2-cycle engine fuel mix.

Gasoline-oil separation puts a layer of oil at the bottom of the tank, with gasoline at the top and various proportions of gasoline and oil between. Since the fuel pick-up is located at the bottom of the tank, the engine may get a high proportion of oil when the tank is full and almost straight gasoline when the tank is nearly empty. Therefore the engine may smoke excessively and foul plugs at first, then overheat and possibly score the pistons because the remaining fuel contains insufficient oil.

There's another reason why high-quality automobile engine oils are unacceptable for outboard engine use: The advent of high-compression, high-output automotive engines presented new lubrication problems which necessitated the addition of detergents to the oil for the purpose of inhibiting varnish formation and piston ring sticking. Most of the detergents used are metal compounds.

In four-cycle automotive engines, the oil is effectively confined to the crankcase and very little leaks past the piston rings into the combustion chamber. In a two-cycle engine, the oil must be mixed with the gasoline and so practically all of these metallic detergents enter the cylinders (above the pistons) and form ash deposits when they come in contact with the hot surfaces of spark plugs, piston crowns and combustion chambers. These deposits may become incandescent on exposure to the combustion flame, causing preignition and detonation which result in piston crown burning, piston scuffing and cylinder wall scoring. Frequently metallic deposits bridge a spark plug gap so it cannot fire.

Oil testing is a ceaseless operation at Kiekhaefer Mercury, primarily to keep in touch with developments in oil refining and additives made by others and to test our own modifications made for the improvement of our oils.

To properly evaluate the suitability of oils for various applications, it is necessary to understand something about the nature of oils. For example, no two wells deliver crude oils of identical chemical composition. Crude oils are a product of nature and, according to geographical location, vary in type such as napthenic, asphaltic or paraffinic base. Even beyond this, there are differences in the composition of crudes from different wells in the same geographic location. Consequently the processes of refining oils vary between individual refineries.

The oil refineries are doing a tremendous job in the very complex processes of blending, compounding and refining oils to meet a more-or-less uniform standard. Obviously a universal lubricant standard is impossible, but the art of compounding special lubricants has been developed to the extent that standards set up for specific applications can be satisfactorily met with oils of different basic types. However, to find that an oil compounded for one specific application is also completely satisfactory for another application would be pure coincidence.

Wrestling with this problem for the past 20 years, the Kiekhaefer Corporation decided to conduct its own oil processing, canning and marketing operations, with standardization accomplished as follows:

1. Only one selected brand of paraffinic base oil is used.
2. With this base stock, ashless organic detergents, rather than metallic detergents are blended along with special chemical ingredients necessary for rust prevention and a unique additive to prevent the formation of bacteriological slimes, a major problem in some areas.
3. By marketing one quality-controlled oil on a national basis, more consistent duplication of results can be expected.
4. Until a few years ago, no oil manufacturer had seen fit to duplicate the general specification set up for Quicksilver 2-Cycle Engine Oils to accomplish the following purposes -
   a. To mix more readily with gasoline and, once thoroughly mixed, to stay mixed, even when the tank is allowed to stand idle for indefinite periods.
   b. To achieve superior lubricating qualities.
   c. To incorporate good anti-sticking qualities which keep piston rings working freely in their grooves without using ash-forming detergents.
   d. To minimize carbon deposits and port clogging.
   e. To inhibit varnish formation.
   f. To give best results with both white marine gasolines and with good quality regular gasolines.

Many oil companies are making oils very similar to the Quicksilver Oils that we were making a few years ago, and some of our competitors are selling such oils under their own brand names.

These oils are, in general, inferior to our current product which contains a little less of the expensive ashless detergent additive and appreciably less bright stock. This last is a base oil component which forms an adherent layer over the surfaces of cylinder liners and bearing components to protect them against wear and scuff. None, at present, contains anti-slime additives, the reason being that some oil companies have to squeeze the maximum possible profit from the oil which they sell, while we are satisfied to make the best product possible, taking, if necessary, little or no profit out of it. Unlike the oil companies, we can afford to do this, because oil is not our primary product, and our principal interest in making it is to allow our engine customers to get the best possible performance from their outboards.

There are other advantages in using Quicksilver Oils. Petroleum company products, sold under the same names in different parts of the country, do not always contain the same additives and base oils.

Oil companies save on freight by distributing oils from their fields nearest each market area. Mercury has gone to great expense to determine the type of oil best able to meet the lubrication requirements of 2-cycle engines and to pinpoint the exact type of crude oil required to meet its specifications. All Quicksilver 2-Cycle Engine Oil comes from one same blending plant, and this is one reason why they cost slightly more than ordinary oils.

In Florida, Maine, Oregon, Missouri, Texas -- coast-to-coast and border-to-border -- Quicksilver 2-Cycle Engine Oils are the same product, a proved product, made exclusively by Kiekhaefer Mercury for Mercury Outboards. If you want the best results from your investment in outboarding, give your outboard "good and proper" lubrication with Quicksilver 2-Cycle Engine Oils. Many competitive products have been benefited by the use of these superior oils. What's good for Mercurys is better for other 2-cycle engines.

QUICKSILVER ENGINE CLEANER

Kiekhaefer Quicksilver Engine Cleaner (C-92-47949-12) is a new laboratory and field-tested blend of chemicals designed to purge power-robbing deposits that accumulate in gasoline engines. It eliminates costly dismantling of the engine to remove carbon deposits caused by certain types of gasolines.

Heavy carbon deposits in combustion chambers result in spark plug burning, pre-ignition and reduction of RPM.

Quicksilver Engine Cleaner is effective in removing gum, varnish and carbon from the following:

* Outboards
* Chainsaws
* Inboards
* Power Lawn Mowers
* Snowmobiles
* Garden Tractors
* Other 2 and 4-Cycle Engines

Figure 1. Engine Cleaner (C-92-47949)

HOW TO USE

Run engine to normal operating temperature. Quicksilver Engine Cleaner is most effective when engine is warm. While operating engine at lowest RPM above stalling, spray a sufficient quantity of Engine Cleaner into throat of one carburetor. Allow engine to run until it is again firing on all cylinders and repeat process for other sets of carburetors. Next, flood entire engine thru carburetor(s) and allow to stand for ½-hour.

SEVERELY CARBONED ENGINES

Tilt engine in horizontal position and close as many intake and exhaust ports as possible by turning flywheel so that pistons cover ports. Spray Engine Cleaner thru spark plug holes. Allow engine to set for not more than a 6-to-8 hour period. After setting, place vertically and pull starter over several times to remove excess accumulation. Ready engine to run and repeat the regular cleaning process, as explained under "How to Use", preceding.

ADDITIONAL CLEANING BENEFITS

Mix one can of Quicksilver Engine Cleaner to one (1) gallon of fuel mixture. Run this special mixture until depleted, then follow normal application as outlined under "How to Use", preceding.

OTHER SUGGESTED USES

PENETRATING OIL

Quicksilver Engine Cleaner has a tremendous penetrating and soaking action. Frees engines, which are tight from rust and corrosion caused by submersion.

PROTECTION for SUBMERGED ENGINES

Emulsifies with water and gives protective coat to parts. Remove water from engine and spray Engine Cleaner thru spark plug holes. Turn engine over several times, allowing it to drain into crankcase.

EXTERNAL CLEANER

Cleans and removes external marine growth, grease, oil and dirt deposits from engines. Spray on and allow to set for ½-hour.

WINTERIZING

It is good policy to clean the combustion chamber of engines with Quicksilver Engine Cleaner at time of winterizing, tuneup or (if engine has been in dealer storage) before delivery in spring. Apply Quicksilver Storage Seal (C-92-28143) for winterizing (after cleaning combustion chamber).

Figure 2. Storage Seal (C-92-28143)

ANTI-CORROSION LUBRICANTS

ANTI-CORROSION OIL and GREASE

Quicksilver Anti-Corrosion Oil (C-92-39928A1) and Grease (C-92-45134A1) are specially processed to provide a good lubricating coat for all external moving surfaces, such as propeller shafts, linkages, hinge pins, yokes, swivels, etc, on outboard motors, stern drive units, 4-cycle marine engines and for other 2 and 4-cylinder engine applications.

DO NOT USE on ball, roller or needle bearings. Observe the chart, below.
Both lubricants are non-conductors on electrical connections and are suitable for high temperature and high pressure applications. The lubricant does not deteriorate, dry out or harden under adverse conditions, and it is easy to apply.

WHERE TO USE ANTI-CORROSION OIL	
Throttle Control Shaft Flexible Bushing OD to Steering	X
Throttle, Choke and Shift Linkage & Swivels	X
Throttle Control Shaft Sq.	X
Reverse Lock Cam Surfaces	X
Thumb Screw Threads	X
Head Bolt Threads	X
Manifold Screw Threads	X
Reverse Lock Pivot Shaft	X
Exterior Nut, Bolt & Screw Threads	X
Reverse Lock Mechanism	X

WHERE TO USE ANTI-CORROSION GREASE	
Gear Hsg. Cover & Wtr. Pump Cover Retainer Threads	X
Water Pump Cartridge Between Insert & Housing	X
Propeller Shaft Splines, Nut, etc.	X
Shift Shaft Splines	X
Shift Shaft Coupler Splines	X
Engine Water Pump Seals	X
Tilt Tube to Swivel Bracket	X
Hinge Tilt Pins	X
Swivel Pins	X

LUBRICANT GUNS

Where Quicksilver New Multipurpose Lubricant (C-92-49588) is to be dispensed, the Pistoluber Grease Gun (C-91-37299) and Lube Gun (C-91-30500) speed the job.

Squeeze-grip design of Pistoluber Gun permits one-hand operation. High pressure 12" (30cm) flexible hose attaches easily to grease fittings on outboards and stern drives. Multipurpose tube screws directly on lightweight gun to prevent possible contamination of lubricant.

Lube Gun (C-91-30500) facilitates application on all linkage and exterior moving surfaces on outboards, stern drives, power mowers, chain saw parts and industrial units, where all-purpose lube is specified by the manufacturer, and on boat trailer wheel bearings. Also for application on Ride-Guide cables, shafts and other moving parts of marine accessories which require external lubrication.

OTHER MARINE LUBRICANTS

STORAGE SEAL

Protects interior metal surfaces during extended storage periods. Quicksilver Storage Seal (C-92-28143) is applied thru carburetor and spark plug openings.

MARINE CLEANER

Removes dirt, grease and scum from all boat and motor surfaces, as well as from power mowers, automobile engines, and grease-marked walls, floors and shop equipment. Quicksilver Marine Cleaner (C-92-32182) is non-flammable and leaves no odor nor insoluble residue.

CORROSION and RUST PREVENTIVE

Protects exterior metal surfaces from corrosion and rust during use and in storage. Quicksilver Corrosion and Rust Preventive (C-92-29152) also is handy to have around home workshops.

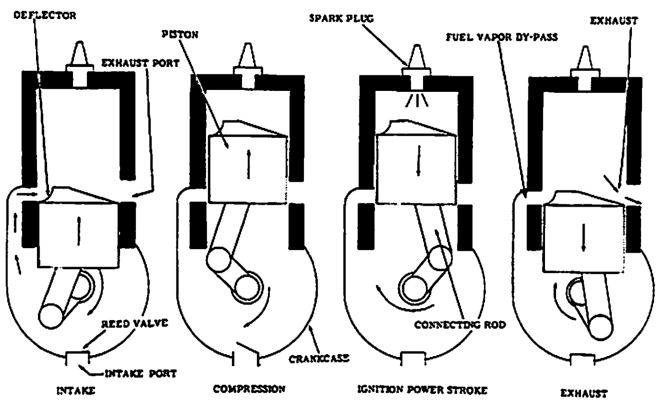
PRINCIPLE OF OPERATION - TWO-CYCLE ENGINES

Description

This brief description, "Principle of Operation", attempts only to make a simple comparison between a 2-cycle and a 4-cycle gasoline engine to familiarize the individual who may not be acquainted with the principles of internal combustion engines.

There are two basic types of gasoline engines: 1) Those operating on a 4-stroke cycle (commonly known as a 4-cycle engine), and 2) Those operating on a 2-stroke cycle (2-cycle engine). The principal difference between the 2 types is that the 4-cycle engine (even though only one cylinder) fires every other time the piston reaches the top of its travel or stroke (away from the center of the crankshaft). A 4-cycle engine may be made up of more than one cylinder (generally 4, 6 or 8, as in automobiles). It also has individual inlet and exhaust valves for each cylinder.

Another basic difference of a 4-cycle engine is its method of lubrication. In a 4-cycle engine, lubricating oil for the bearings and piston is provided in a crankcase, the clear gasoline is utilized for the fuel. In a 2-cycle engine, oil is mixed directly with the gasoline fuel for lubricating the bearings and pistons. All Mercury Outboard Motors are of the 2-cycle principle.



Two-Cycle Principle

By contrast, the piston in a 2-cycle engine acts as both an inlet and exhaust valve. In starting a 2-cycle engine, the crankshaft turns over and the piston rises, assuming that the cylinder is filled with a mixture of air and fuel which is compressed (squeezed into a small space). Then, at its high point of travel, BTDC (before top dead center), the compressed mixture is ignited by the spark via the spark plugs. The resulting explosion within the cylinder forces the piston down, exerting its working energy to the crankshaft. During its upward stroke, the piston has drawn a fresh charge of fuel and air through the intake valve (which is in the center main bearing) into the crankcase. This crankcase, which is airtight, contains the crankshaft and connecting rod. On the downward stroke, the charge of fuel and air, previously drawn in, is compressed and, when the piston reaches its maximum travel (bottom), an exhaust port is uncovered on the side of the cylinder wall through which the unburned gases escape, and the pressure falls. An instant later, the momentum created uncovers an inlet port on the opposite side, and the fresh charge forces its way up from the crankcase and drives the remainder of the unburned gases before it. A projection on the top of the piston, on the intake side, deflects the fresh charge and prevents it from passing directly across the cylinder and out the exhaust.

Alternate Firing

On an alternate firing twin cylinder outboard motor, one cylinder is delivering its power stroke while the other is on the suction stroke. The firing order of the pistons is governed by the utilization of a magneto which is connected to one end of the crankshaft of the engine. On every 180° rotation of the crankshaft, an electrical spark is created by the making and breaking of an electrical impulse through the breaker points and transmitted to the spark plugs to fire the pistons alternately. An offset cam, mounted on the crankshaft within the magneto, opens and closes the breaker points to produce this spark.

Therefore, the pistons which are connected to the crankshaft at a 180° angle, and a power stroke delivered at 180°, produce the reciprocating motion which in turn is transferred to the shaft to create the rotation motion of the engine.

A simple explanation of the physics of motion in an internal combustion engine may be had by observing the use of a brace and bit when drilling a hole. The arm and elbow move back and forth, but the hand goes around in circles. The elbow corresponds to that of the piston, the forearm would be the connecting rod and the bracket is like the throw of the crankshaft.

In the Mercury 2-cycle engine, reed inlet valves are used. They operate automatically in that they do not open until pressure in the crankcase is low enough to overcome reed tension. The rate of speed at which the motor is operating varies the crankcase pressure and regulates the degree of opening of the reeds. This allows a more satisfactory performance throughout the entire speed range of the motor, because the reeds only open to the demand created at various motor speeds.

Cylinder Numbering and Firing Order

The 6-cylinder Mercury engine fires at 60° intervals, giving 6 equally-spaced power impulses for each revolution of the crankshaft; 4-cylinder engines fire at 90° intervals, giving 4 equally-spaced power impulses for each revolution; 2-cylinder engines fire at 180° intervals, giving 2 equally-spaced impulses. Cylinders are numbered consecutively from top to bottom, top cylinder being No. 1. Firing Order:

Merc 700-600 & Mark 78A-78-75A-75	1-6-4-2-5-3
All Other 6-Cylinder Mercs	1-4-5-2-3-6
4-Cylinder	1-3-2-4
2-Cylinder	1-2

BOAT PERFORMANCE AND PROPELLER SELECTION

DESCRIPTION

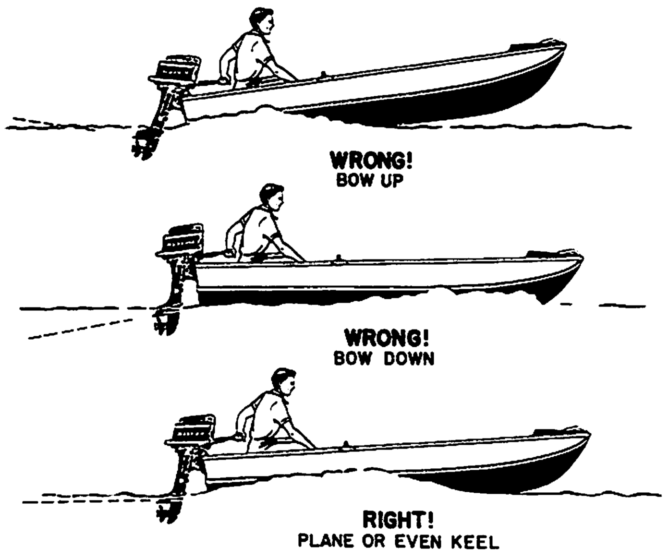
Following are some enlightening facts on boat performance for dealers and customers. Many times the motor itself is blamed for inefficient operation when actually it's the boat or installation of the motor on the boat. If these facts are complied with and practiced, it will result in fewer complaints of poor performance and operating conditions.

BOAT PERFORMANCE

Boat Speed: Consult Boat House Bulletins for similar boat size and loading. These boats and motors are run with the best-suited propellers and with the optimum setup (transom height and tilt angle, usually with aft position of center of gravity).

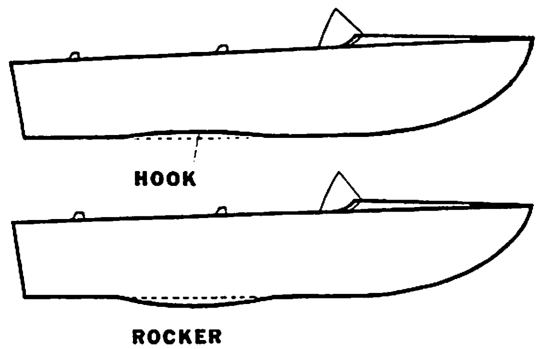
Effect of Center of Gravity Location: For maximum speed, move weight aft until boat porpoises or is about to porpoise. This reduces wetted surface to a minumum, only the rear half of the boat bottom being wet.

Effect of Tilt Angle: The tilt angle should be set so that cavitation is about parallel to bottom of boat. Speed of boats, having center of gravity located forward, may sometimes be improved by tilting engine out one pin hole. (See figure, below.) This will tend to raise bow and reduce wetted surface. If engine is tilted in, the boat will ride with the bow down, wetting more of the bottom and reducing speed. This will generally improve operation in rough water.



Effect of Transom Height: A greater transom height will increase boat speed but makes cavitation more likely. The effect of transom height on speed is slight at low speeds (15-20 MPH) but important at higher speeds (30-35 MPH and above).

Effect of Boat Bottom Condition: For maximum speed, a boat bottom should be nearly a flat plane where it contacts the water. It should be especially straight and smooth in the fore and aft direction. *Hook:* The bottom is said to have a "hook" if it is concave in the fore and aft direction when viewed from below. When the boat is planing, this causes more lift on the bottom near the transom and allows the bow to drop. This greatly increases the wetted surface and reduces boat speed. A hook is frequently caused by supporting the boat too far forward to the transom while hauling on a trailer or during storage. *Rocker:* A "rocker" is the reverse of a "hook" and much less common. The boat has a rocker if the bottom is convex in the fore and aft direction when viewed from below. A boat with a rocker has a strong tendency to porpoise. *Surface Roughness:* Moss, barnacles or other surface irregularities that increase skin friction of the boat bottom will cause considerable loss of boat speed.



"Hook" and "Rocker"

Effect of Gear Case Exterior: Surface roughness of the gear case, caused by barnacles or corrosion, can easily cause a speed loss of 1 or 2 MPH on boats in the 30 to 35 MPH and higher class.

PROPELLER SELECTION

Propeller selection can best be made if approximate boat speed is known or can be estimated. A propeller should allow the engine to turn at the maximum recommended RPM at the highest speed the boat will travel.

For light, fast boats, use the higher values. For cruisers - - where the engine will operate for longer periods near full throttle - - use the lower values. (See Propeller Recommendation Chart, Section III.)

QUICKSILVER PROPELLER PROTECTION

Flo-Torq Propeller Drive, exclusive with Kiekhaefer Mercury Outboard Motors, means safe, sure propeller protection that adds to Mercury's reputation for getting you there -- and back! Compressed live rubber bushing cushions normal loads... slips on impact to guard propeller... eliminates the necessity for shear pins. Flo-Torq Propeller Drive is an important safety feature... the first unbonded rubber bushing propeller drive!

FUEL CONSUMPTION, MILES PER GALLON

For a planing boat the maximum miles/gallon is obtained with an engine that will just plane the boat (15-17 MPH) at full throttle. Larger engines or dual engines, that will drive the boat faster, will give less miles gallon (same as with automobiles).

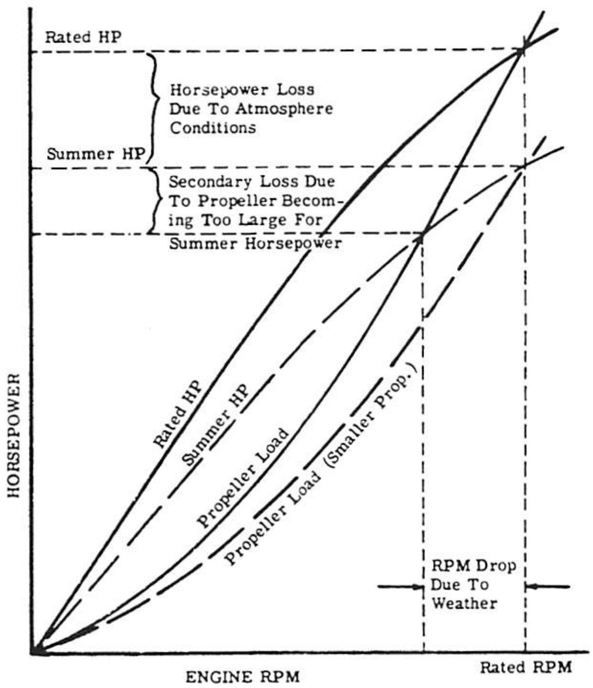
A given boat and motor usually will get the most miles/gallon at or near full throttle. Improper carburetor setting can reduce the miles/gallon by 10 or 15 percent.

WEATHER AFFECTS ENGINE PERFORMANCE

As explained in "Boat Performance and Propeller Selection", this section, a combination of facts will detract from boat performance and speed. There is another factor which enters into this on a highly technical point.

Engineers have long known that weather exerts a profound effect on internal combustion engines, therefore, all horsepower ratings refer to the power which the engine would produce at its rated speed under a specified set of weather conditions.

The Engine Test Code of the Society of Automotive Engineers (SAE) standardizes the computation of horsepower from data obtained on the dynamometer, correcting all values to the power which the engine would produce at sea level altitude in dry air at 60 degree temperature and a barometric pressure of 29.92 inches of mercury.



Summer conditions of high temperature, low barometric pressure and high humidity all combine to reduce the engine power. This, in turn, is reflected in decreased boat speeds--as much as two or three miles per hour in some cases. Nothing will regain this speed for the boatman, but the coming of cool, dry weather.

In pointing out the practical consequences of weather effects, an engine, running on a hot, humid summer day may encounter a loss of as much as 14 per cent of the horsepower it will exert on a dry, brisk spring or fall day. The horsepower which any internal combustion engine will produce depends on the density of the air which it is consuming; this density, in turn, depends on the temperature of the air, its barometric pressure and water vapor or humidity in the air.

Accompanying this weather-inspired loss of power is a second and more subtle loss. At fitting-out time in early spring, the engine was equipped with a propeller which allowed the engine to turn at its rated r.p.m. at full throttle. With the coming of the summer weather and the consequent drop in available horsepower, this propeller will, in effect, become too large. Hence, the engine will operate at less than its rated r.p.m.

Due to the horsepower-speed characteristics of an engine, this will result in further loss of horsepower at the propeller with another decrease in boat speed. This secondary loss can be regained by switching to a smaller pitch propeller which allows the engine to again run at rated r.p.m.

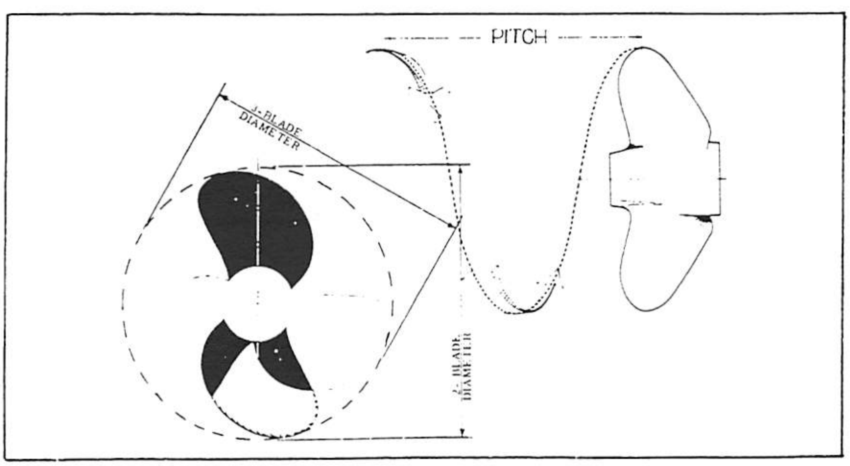
So outboarders can get the most out of their motors under all type weather conditions, see the "Propeller Recommendation Chart", Section III for scientifically selected propeller sizes to accommodate any and all conditions.

This selection table is designed to enable the dealer to choose the correct propeller for each case with a minimum of trial and error.

THEORY OF PROPELLER PROPULSION

There are only two dimensions of a propeller which concern the boat and motor owner:

1. *Propeller Pitch* - The theoretical distance a propeller advances through the water in one revolution with no slip. (See figure right.) The percentage of slip varies considerably, depending on the boat and load characteristics.
2. *Propeller Diameter* - The propeller blade distance, tip of one blade to tip of an opposite blade. (See figure right.)



HIGH-PERFORMANCE PROPELLER SELECTION

A boat-and-motor combination -- capable of 45 MPH or greater with a standard propeller at an engine speed of 5200 RPM and standard transom height -- can be increased 1-to-2 MPH by switching to a High-Performance Propeller that is 1" lower in pitch. This is necessary, because High-Performance Propellers operate with less slippage.

Most boats will gain an additional 1-to-2 MPH with High-Performance Propellers for each additional inch in transom height, not to exceed 20½" with a short shaft engine or 25" with a long shaft engine. High-Performance Propellers are designed to provide maximum speed at maximum transom height allowable.

All 6-cylinder gear shift and 4-cylinder Merc 800 and Merc 650 models should use the Heavy-Duty Propeller Shaft with High-Performance Propellers when operating at transom heights that exceed standard recommendations by more than 1" or in rough water. The Heavy-Duty Propeller Shaft Assembly (A-44-46966A1) includes a new thrust hub (A-46961A1) which also is available separately. This propeller shaft is not plated, therefore, it requires a periodic coating of Anti-Corrosion Grease (C-92-45134A1) on the splines to prevent rusting.

High-Performance Quicksilver Propellers will not clear the standard trim tab. If a trim tab is desired, No. A-46399A1 must be used.

With a High-Performance Propeller, maximum speed normally will occur with the engine propped for 5300 RPM. This setup is recommended for long, straightway endurance marathons. By propping at a higher RPM, acceleration will improve, but at a slight cost in top speed.

For short course racing, or where greater acceleration is required, it is suggested that the next lower pitch propeller be used to increase engine speed to approximately 5600 RPM.

Still another pitch should be dropped when drag racing to allow the engine to turn up to approximately 6000 RPM. It is recommended that the engine not be operated at this speed beyond the duration of the drag.

The following information may be used as a guide for initial propeller selection:

1. Most 6-cylinder, single engine, conventional-bottom boats (I and J class) use either a 22" or 24" pitch propeller and run between 55 and 60 MPH.
2. Most dual engine, conventional-bottom boats (JJ class) use 24" or 26" pitch and run between 60 and 65 MPH.
3. Special high performance (tunnel bottom) boats, either single or dual engine installation, normally will use a 26" or 28" pitch propeller and run 65 to 70 MPH.

NOTE: When operating engine above maximum recommended RPM, or when used for racing, the warranty is void.

The 14" diameter High-Performance Quicksilver Propellers are designed for the standard lower unit gear housing of 6-cylinder Mercury models built after 1962. The 13" diameter series is designed primarily for 4-cylinder Merc 650's, however, they also have been used successfully on 6-cylinder engines in some cases. The 4-cylinder Merc 800 can effectively utilize either the 13" or 14" diameter series, depending upon the particular application.

Refer to Parts or Service Manual for available propellers.

CUPPING PROPELLERS

"Cupping" refers to altering a propeller by rolling or turning the trailing edge of the blade. The cup causes the propeller to do more work on the water before it slides off the trailing edge of the blade.

When a propeller is cupped, its effective pitch is increased 1" to 2".

There are two basic reasons for using a cupped propeller.

1 - If a standard propeller cavitates (thus allowing the propeller to spin, as if in air, and providing little thrust) when accelerating in a tight turn or above certain speeds on a straight course, this effect may be greatly reduced or eliminated by selecting the next lower pitched cupped propeller. This problem usually exists with a boat bottom which has either a poor design, a large keel or an appendage that causes surface air to feed into the propeller. The cup enables a propeller to still produce thrust.
Cupping probably will not improve top speed, unless the boat suffers from wide-open throttle cavitation.

2 - Finally, the engine or drive may have been installed too high on the transom in an effort to obtain higher top speed. The propeller, then, draws down surface air around the anti-cavitation plate, thereby impeding planing the boat. Here, again, a cupped propeller is required for good performance in a water-air mixture. Top speed should be improved by going up on the transom for less lower unit drag and installing a cupped propeller.

A propeller may cavitate if boat reaches a relatively severe angle of attack to the water when attempting to plane. This may require a cupped propeller to achieve planing. It may be necessary to go to the next lower pitch cupped propeller for better acceleration without loss of top speed.

Cupped propellers are listed in the charts in the Mercury Parts Manual.

PREVENTIVE MAINTENANCE

LOWER DRIVE UNIT LUBRICATION

Periodically lubricate the lower drive unit with Quicksilver outboard gear lubricant.

> *NOTE: All 6-cylinder engines, plus the Merc 500 and all 1962 and newer models use only Quicksilver SUPER-DUTY Gear Lubricant (C-92-52650) in the lower unit. Other (older) models use Quicksilver Special Outboard Gear Lubricant (C-92-29409, 9 oz., or C-92-29415, 15 oz.). In an emergency, when these lubricants are not immediately available, use extreme pressure marine gear lubricant. Do not use regular automotive grease in the lower drive unit.*

1. Remove lubricant filler plug, located on right side of gear housing just above skeg, then remove air vent screw above anti-cavitation plate (Figure 1), being careful not to lose the accompanying washers.

   IMPORTANT: Never apply lubricant to the lower unit without first removing the air vent screw, as the injected lubricant displaces air which must be allowed to escape, otherwise the gear housing cannot be completely filled as required.
2. Insert lubricant tube into filler plug hole and inject lubricant until excess fluid starts to flow out of air vent screw hole, indicating that the housing is filled.
3. Replace air vent screw first, then filler plug, taking special care that the washer is in place under the head of each so that water will not leak past the threads into the gear housing.

   IMPORTANT: Do not use regular automotive grease in the lower drive unit. Use only Kiekhaefer Quicksilver Gear Lubricant.

Figure 1. Lower Drive Unit Lube

LUBRICATION CHART - See Section VIII

25-HOUR CHECKUP

1. Remove cowling.
2. Clean entire unit thoroughly, including all accessible powerhead parts.
3. Lubricate lower drive unit as instructed in paragraph preceding.
4. Lubricate other points as shown in following illustrations and lubrication chart, Section VIII.
5. Remove propeller and inspect. Trim nicks and burrs with a file, being careful not to remove more metal than absolutely necessary. Inspect for cracks, damaged or bent condition. Before reinstalling propeller, lubricate propeller shaft with graphite grease or with Quicksilver Anti-Corrosion Grease (C-92-45134A1).
6. Service spark plugs as instructed in Ignition Section IV, "Spark Plug Electrode Burning".
7. Inspect spark plug leads and electrical leads for damage or deterioration, particularly where insulation comes in contact with metal parts. Be sure to reconnect each lead to its respective post.
8. Inspect fuel lines for damage or deterioration.
9. Inspect surfaces for damage or corrosion. Thoroughly clean damaged or corroded areas and apply matching paint. See Paint Chart in Tool Section IX.

Figure 2. Swivel Pin Lubrication

10. Check entire unit for loose, damaged or missing parts. Tighten or replace as required.
11. Service fuel filter on remote tank after every 100 hours of operation or whenever performance indicates that this attention is needed, at least once a season.
12. Check controls. Be sure all connections and fittings are in good condition, properly secured and correctly adjusted. If equipped with steering handle, adjust copilot if necessary.

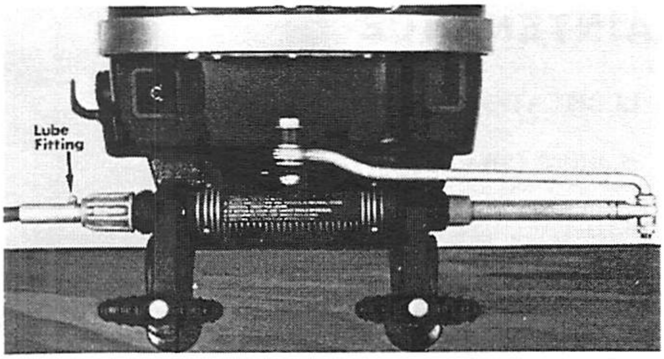


Figure 3. Ride-Guide Tube

13. On other than Thunderbolt Ignition models, ignition breaker points should not be disturbed as long as engine is operating satisfactorily. Servicing of distributor contact points should be done by Certified Kiekhaefer Mercury Service facilities. If the points are cleaned and adjusted at the time of the interseason checkover, they will normally require no further attention for at least 100 hours of operation.

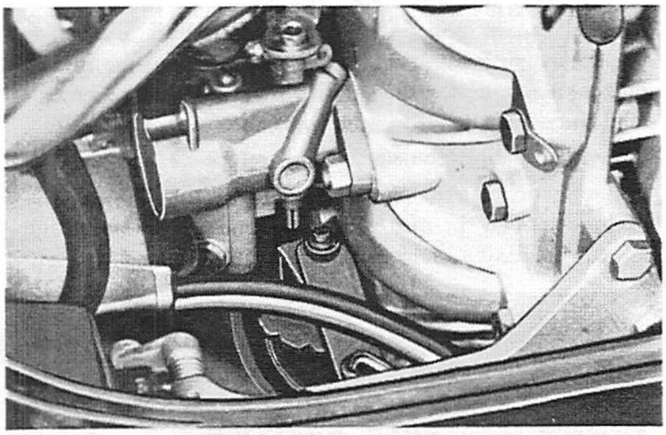


Figure 4. Throttle-Shift Linkage and Upper Shift Shaft

14. Check condition of starter cable.
15. Replace cowling.
16. Battery maintenance and storage -- See Starter Section VII, "Electric Starter".

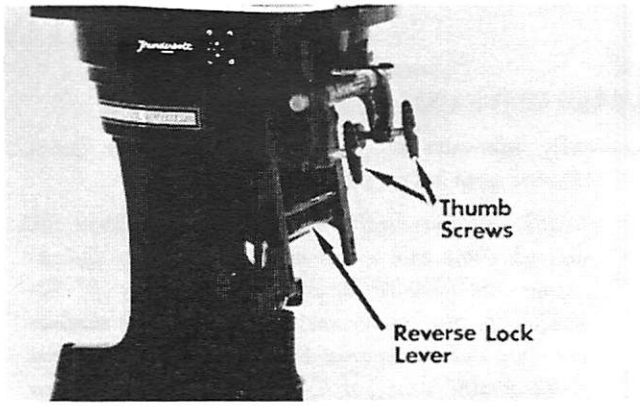


Figure 5. Reverse Lock Lever Lubrication

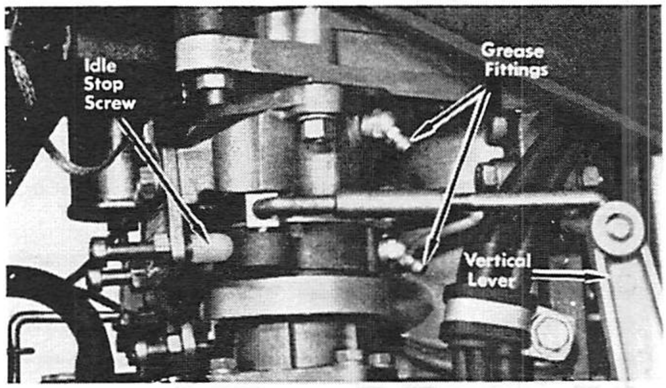


Figure 6. Distributor Adaptor Fittings

Figure 7. Control Handle Lubrication

SPECIAL CARE REQUIRED

RUST PREVENTION

Prior to packing at the factory, new engines are "fogged out" at the final test by injecting approximately 2 oz. of rust preventive oil through the carburetor air intake. This practice also is encouraged at times when engines are not stored in a dry place or stand idle for a long period of time. Use Quicksilver Storage Seal (C-92-28143).

When a motor is started after a length of time, following fogging, it is recommended that the spark plugs be checked and replaced, if necessary, as they may have become fouled from the rust preventive oil.

PREPARATION FOR STORAGE OR SHIPMENT

In preparing the motor for storage or shipment, two precautions must be taken into consideration:
1. The unit must be protected against physical damage.
2. The unit must be protected from rust and dirt.

Original shipping carton is ideal for storage or shipment, but if it is no longer available and a new container must be made, it should be so constructed that weight of the unit is supported by the clamp bracket. Also, suitable blocking and bracing should be provided to hold the motor securely in place regardless of position in which container might be set. Opening should be sealed against entry of dirt, but air vent should be provided to prevent moisture accumulation through condensation. Before placing motor in container, the following preventive measures should be applied to protect external and internal parts from rust and corrosion:

1. Operate motor in water. Disconnect fuel line from motor or turn off fuel shut-off valve and allow motor to run at idling speed until it stops of its own accord, indicating that carburetor or carburetors have run dry.
2. Drain fuel tank and fuel lines.
3. Remove cowling.
4. Service fuel filters as instructed in Fuel System, Section VI, "Fuel Filters".
5. Lubricate lower drive unit as instructed in "Preventive Maintenance", this section.
6. Lubricate control linkage as instructed in Section VIII.
7. Remove spark plugs as instructed in Ignition Section IV, "Spark Plug Electrode Burning".
8. Rotate crankshaft to position where number one (top) piston is at bottom dead center position. This can be determined by inserting a pencil or stick into the spark plug hole. Apply about 2 oz. of Kiekhaefer Quicksilver Storage Seal (C-92-28143) into the spark plug hole of the No. 1 cylinder, allowing time for some of the lubricant to drain into the crankcase via transfer ports. Repeat this operation on remainder of the cylinders, then install spark plugs and operate the starter vigorously to distribute Storage Seal around the inside of the crankcase and cylinders.
9. Again remove spark plugs, clean and reinstall.
10. Connect spark plug cables. Be sure each cable is connected to its respective spark plug.
11. Lubricate magneto or distributor adaptor and pilot. (Figure 6 on Page 12)
12. Lubricate tilt lock lever.
13. Lubricate reverse locking cam on 4-cylinder engines thru grease hole above anti-cavitation plate.
14. Clean the motor thoroughly, including all accessible powerhead parts. Install the cowling and apply a thin film of clean, fresh engine oil to all painted surfaces.
15. Remove propeller, apply graphite grease or Quicksilver Anti-Corrosion Grease (C-92-45134A1) to the propeller shaft and reinstall propeller.
16. Lubricate swivel bracket. (Figure 2 on Page 11)
17. Store and maintain battery. (Section VII, "Starters")

IMPORTANT: When storing outboard motors for the winter, be sure that all water drain holes in the gear housing are open and free (and that flushing plug is removed so that all water will drain out. Trapped water may freeze and expand, thus cracking gear housing and/or water pump housing. Check and refill lower unit with Kiekhaefer Quicksilver SUPER-DUTY Gear Lubricant (C-92-52650 for all 6-cylinder engines, Merc 500's and all 1962 and newer models. [C-92-29409 for earlier models]) before storage to protect against possible water leakage into gear housing, caused by loose air vent plug or loose grease filler plug. Be sure to reinstall gaskets under screws, replacing damaged gaskets.

ATTENTION REQUIRED FOLLOWING OPERATION IN SALT WATER OR SILT

Operation in salt water or silt results in the accumulation of salt or mineral deposits in cooling system water passages and around cylinder water jackets. Unless removed regularly, these deposits will build up to the extent that circulation of cooling water becomes restricted or cut off entirely. Also, the deposits act as head insulators which reduce transfer of heat from cylinders to cooling water. This condition will cause overheating, loss of performance and perhaps serious engine damage.
Even though the interior surfaces of Kiekhaefer Mercury Outboards are treated to resist corrosion, there remains a possibility of a mechanical buildup of salt and silt deposits which no form of protective coating can prevent and which can be eliminated only by occasional flushing with fresh water. While there is no complete protection known for exterior surfaces, there are ways by which electrolysis and corrosion damage can be minimized. By following the simple steps, 1-thru-5, following, the life of all exposed parts and decorative finishes should be materially increased:

1. When outboard is left on boat, it is recommended that those models, equipped with anodic trim tabs or plates, be left in operating position when moored. If partially tilted out of water, the trim tab or anodic plate cannot act as a galvanic corrosion inhibitor. Merc 100-75-40 models should be fully tilted out of water or removed from boat.
2. Lubricate thumb screws (Figure 1) with Anti-Corrosion Grease (C-92-45134A1) to ensure smooth operation.
3. Lubricate propeller shaft splines occasionally with a

waterproof-type lubricant (Anti-Corrosion Grease), thus enabling the propeller to be removed easily.
4. Entire powerhead can be sprayed with a coating of rust preventive oil (C-92-29152) to protect the finish of all parts beneath the cowl. The exterior also can be sprayed or wiped to prevent salt corrosion from dulling the finish.
5. Flushing motor
   a. Remove flushing plug (marked "FLUSH") and washer from flushing hole.
   b. Connect flushing device (chart, following) and attach garden hose coupling (Figure 1 page 14) with hose.
   c. Turn on water but DO NOT OPERATE the outboard while flushing. Water flow is strong enough that flushing can be done with water pressure provided from the city water tap. DO NOT USE full water pressure.

Model	Kit Part No.
Merc 200 (2432536 & above) and All 1969 & Newer 4 and 6-Cylinder	C-48755A1
All 2-4-6 Cyl. Engines Except Those Listed Above	C-24789A1
Mark 5, KF5	A-21030A2

CAUTION: If outboard must be operated while flushing, in order to prevent damage to the water pump impeller it will be necessary to use a Flush-Test Device which attaches directly over the intake holes in the gear housing strut and provides cooling water at this point. DO NOT OPERATE outboard above idle speed while flushing with Flush-Test Device, or RPM cannot be controlled. See your local Mercury Outboard dealer for this device.

WARNING: When flushing, be certain that area in vicinity of propeller is clear and that no person is standing nearby, to avoid possible injury. It is advisable to remove propeller as a precautionary measure.

   d. While and after flushing, keep motor in upright position, resting on skeg, until all water has drained from drive shaft housing to prevent water from entering the powerhead via drive shaft housing and exhaust ports.

By following the preceding simple preventive maintenance operations at regular intervals, longer life will be added to your motor when used in salt water.

ATTENTION REQUIRED FOLLOWING COMPLETE SUBMERSION

Motor, which has been submerged, must be completely disassembled for cleaning and inspection. This requires the facilities and experience of Authorized Mercury Service facilities and should be accomplished as soon as possible after recovery. Delayed action will encourage rust and corrosion of internal parts. Emergency treatment may be completed by following instructions under "Preventive Maintenance", this section. This will temporarily retard rust and corrosion. Basically, the points to remember are these:

1. Recover motor as quickly as possible.
2. Wash entire motor with fresh, clean water to remove mud, weeds, etc.
3. Get as much water as possible out of powerhead. Most of the water can be eliminated by removing spark plugs and operating manual starter with spark plug holes facing downward.

CAUTION: If motor does not turn over freely when starter is operated, do not force. This may be an indication of internal damage such as a bent connecting rod or a broken piston.

4. Pour alcohol in cylinders first, as alcohol will dissolve water—or use Quicksilver Engine Cleaner (C-92-26845)--then lubricate all internal parts which can be reached with engine oil. This is best accomplished by injecting oil into spark plug holes, installing spark plugs and operating manual starter to distribute oil. If alcohol and oil are not available, insert a rod into fuel check unit to open check valve and actuate primer bulb, thus directing fuel flow into cylinders.
5. Disassemble and clean engine as soon as possible.

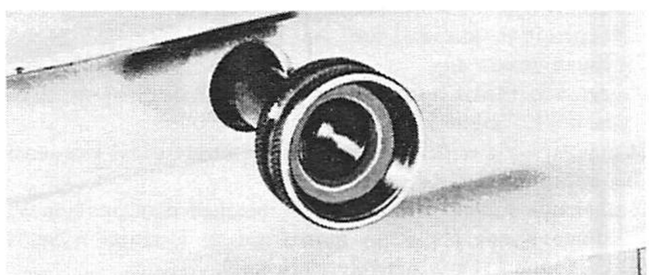


Figure 1. Flushing Attachment (C-24789A1)

MOTOR TROUBLES CAUSE AND EFFECT

If the cause cannot be determined, after checking out a motor for erratic or faulty operation according to the simple trouble-shooting procedure and Engine Trouble Chart, this section, it is apparent that a major reconditioning of the motor is in order. On disassembly of the motor, inspect each part carefully. (Refer to specific sections in this manual for repair.)

Causes of erratic or complete breakdown of a motor, due to faulty or careless operation, follow:

TROUBLE CHART

STARTING TROUBLE

Engine Won't Start but Spark OK:

A. If there is no fuel at carburetor, check for --

Empty gas tank
Clogged fuel filter
Restricted vent in gas tank
Defective fuel pump
Air leak in line from tank
Main adjusting screw closed
Clogged carburetor screen
Clogged or broken fuel line

B. If there is fuel at carburetor, check --

Flooding at carburetor
Choke not operating
Water in gasoline
Restricted carburetor jets

C. If there is flooding at carburetor, check for --

Choke out of adjustment
High float level
Float stuck
Excessive fuel pump pressure
Float saturated beyond buoyancy
High speed adjustment needle not seated properly

D. Fuel and spark OK, check for --

Defective spark plugs
Spark plug gap set too wide
Improper spark timing
Water in cylinders
Poor fuel

ROUGH OPERATION

1. Engine Misfires at Idle:

A. Trouble may be in ignition, check --

Incorrect spark plug gap
Defective or loose spark plugs
Spark plugs of incorrect heat range
Sticking breaker arm
Incorrect breaker point gap
Breaker points not synchronized
Loose wire in primary circuit
Defective distributor rotor
Corroded or pitted breaker points
Cracked distributor cap
Leaking or broken high tension wires
Weak armature magnets
Worn cam lobes on distributor or magneto shaft
Worn distributor or magneto shaft bushings
Defective coil or condenser
Defective ignition switch
Spark timing out of adjustment

B. Trouble may be in carburetion, check --

Dirt or water in fuel
Reed valve open or broken
Incorrect fuel level
Carburetor loose at flange
Throttle shutter not closing completely
Throttle shutter valve turned to one side or placed wrong

C. Crankcase

Magneto adaptor flange worn out-of-round

2. Engine Misfires at High Speeds

A. Check for conditions under No. 1

Float loose or spinning on stem

B. Check spark for --

Weak breaker arm spring
Coil breaks down
Coil shorts through insulation
Breaker points improperly adjusted
Poor breaker point contact
Spark plug gap set too wide
Too much spark advance
Wrong type spark plugs
Excessive carbon in cylinders
Poor compression
Dirty carburetor
Lean carburetor adjustment
Crankcase magneto adaptor flange worn out-of-round

3. Engine Backfires:

A. Through exhaust; check for --

Cracked spark plug porcelain
Carbon path in distributor cap
Crossed spark plug wires
Air leak at intake deflector
Improper timing

B. Through carburetor; check for --

Poor quality fuel
Air-fuel mixture too lean
Excessive lean or too rich mixture
Improper ignition timing
Engine pre-ignition
Improperly seated or broken reed valves
Improperly adjusted carburetor

4. Engine Pre-Ignition:

A. Check for ignition causes --

Spark advanced too far
Incorrect type spark plugs
Burned spark plug electrodes
Incorrect breaker setting

B. Check for fuel causes --

Excessive oil in fuel
Poor grade of fuel
Lean carburetor mixture

C. Check for other causes, such as --

Excessive engine temperature
Carbon deposits in combustion chamber

ENGINE NOISES

1. Knocking in Powerhead:

Loose flywheel
Excessive bearing clearance
Spark advanced too far -- pre-ignition
Excessive end play
Out-of-round bearing journals
Bent or twisted crankshaft
Crankshaft broken

2. Knocking at the Connecting Rods; Check for --

Excessive bearing clearance
Worn connecting rod
Misaligned connecting rods and cap
Bent or twisted connecting rod
Worn crankshaft journals

3. Piston Noises; Check for --

Excessive piston-to-cylinder bore clearance (worn)
Out-of-round cylinder
Loose piston pin
Carbon in top of cylinder
Piston pin bent
Excessive clearance at ring groove
Broken piston ring

4. Centermain Bearing; Check for --

Improperly installed (too high or too low)
Crankshaft striking reed stops

5. Gear Housing Noisy; Check for --

Propeller shaft worn or sprung
Bearing worn
Broken gears
Propeller hub rubbing gearcase cover

6. Gears; Check for --

Improperly fitted (too tight or loose)
Worn
Wrong conical angle
Incorrect back lash
Oil seal leakage (water in gear housing or no grease in gear housing)

COMPRESSION LOSSES

1. Check for Compression Failures:

A. Engine performance shows up in --

Loss of power
Poor acceleration
Poor idle or no idle

B. Engine sounds indicate --

Clicking -- broken piston ring or crankshaft strikes reed stops
Knocking -- piston slap, broken piston or bad bearing
Backfiring through carburetor -- reed valve
Engine miss at all speeds
Engine drops on one or more cylinders

C. A compression gauge shows --

Low compression reading, all cylinders
Low reading, one cylinder

2. Check Piston Ring Condition:

A. If rings are broken, cause may be --

Top ring striking ridge in cylinder
Worn ring grooves
Rings sticking in ring groove (gum-carbon-varnish)
Insufficient ring tension
Insufficient gap clearance
Excessive slide clearance in ring groove
Undersize pistons
Scored, wavy cylinder walls
Overheating

B. If there is ring sticking, check --

Compression blow-by
Incomplete combustion
Engine detonation
Improper engine cooling
Insufficient ring land side clearance
Poor grade of oil or fuel
Carbon-gum-varnish

3. Check for Piston Failures:

A. If there are piston noises, check --

Carbon accumulations in head
Broken piston, skirt or ring land
Insufficient clearance at top of ring land
Out-of-round, tapered or worn cylinders
Excessive piston-to-bore clearance (worn)

B. If there is piston breakage, check --

Inadequate lubrication
Overspeeding -- wrong propeller, excessive RPM
Water taken in thru carburetor or submerged
Pre-ignition
Engine overheating
Worn pistons
Eccentric or tapered cylinders
Warped cylinder sleeves

4. Check for Cylinder Failures:

A. If there is excessive wear (scoring), check for --

Inadequate lubrication
Contaminated or poor oil

Exhaust ports clogged with carbon (no power)
Incomplete combustion
Incorrect type rings
Improper cylinder finish
Hole in cylinder
Incufficient ring gap clearance
Distorted block and crankshaft

5. Check on Valve Seating for:

Incorrect reed valve setting
Broken or weak reed valve

ELECTRICAL FAILURES

1. Battery:

A. If frequent charge is necessary, check for --

Corroded battery terminals
Alternator grounded or shorted
Worn out, inefficient battery
Rectifier defective
Short circuit in charging circuit
Excessive use of electrical units
Short circuit in ignition switch

B. If there is high battery water loss, check for--

Too high charging rate
Old, inefficient battery
Leaking battery cell
Worn out battery
Cracked case
Defective current regulation

C. If battery will not take full charge, check for--

Low water level
Worn out battery
Cracked case
Spilled electrolyte
Internal short circuit
Impure electrolyte

2. Starter Motor:

A. If there is excessive current draw, check for--

Broken, jammed starter drive
Dirty, gummed armature
Shorted armature
Grounded armature or field
Resistance from engine
Misaligned starting motor
Worn armature shaft bearings
Misaligned armature shaft
Loose field pole pieces

B. If starter fails to operate, check for --

Poor battery ground
Jammed drive
Broken teeth on flywheel
Direct ground in switch
Solenoid dead or shorted
Burned contact points in switch
Improper seating brushes
High mica between commutator segments
Shorted armature
Shorted field or brushes

C. If there is excessive noise at starter, check for --

Defective starter drive
Chipped or broken flywheel teeth
Insufficient lubrication
Worn armature shaft bearings
Misaligned starting motor
Loose starter mounting
Sprung armature shaft

D. If there are burned commutator bars, check for --

Excessive arcing at brushes
Excessive battery voltage
Improperly seated brushes
Open circuited armature coils
Open field circuit

3. With Lights as Guide, If There Is Excessive Voltage Drop, Check for --

Corroded, rusty grounds
Loose or corroded connections
Cracked, leaking wire insulation
Frayed, broken cable strands

4. With Generator as Guide, If Generator Fails to Charge, Check --

Open circuit
Grounded wire in charging circuit
Grounded field coil
Short circuit in field

5. With Rectifier as Guide, If Rectifier Fails to Put Out, Check for --

Defective rectifier
Broken wire
Generator -- no output (see above)
Burned, crossed battery leads

DISTRIBUTOR SYSTEM

With Ignition System as Guide:

A. If there is breaker point oxidation, check for--

High battery voltage
Resistor of incorrect capacity
High resistance in condenser circuit
Incorrect type ignition coil

B. If there is ignition coil failures, check for --

Extremely high voltage
Moisture formation
Excessive heat from engine

C. If spark plugs burn and foul, check for --

Incorrect type plug
Too rich fuel mixture
Engine pumping oil
Inferior grade of gasoline
Overheated engine
Too much carbon in combustion chamber

HIGH GAS CONSUMPTION

1. When Trouble Is in Carburetor, Check for:

A. Flooding or leaking caused by --

Cracked carburetor casting
Leaking line connections
Defective carburetor bowl gasket
High float level
Plugged vent hole in cover
Loose float needle seat
Defective needle valve seat gasket
Worn needle valve and seat
Foreign matter clogging needle valve
Ridge worn in lip of float
Worn float pin or bracket
Float binding in bowl
High fuel pump pressure

B. An over-rich mixture caused by --

Choke level stuck
High float level
Warped or bent bowl cover
High fuel pump pressure

2. When Trouble Is in Fuel Pump, Check for:

Leaking around diaphragm cover
Leaking fuel pump diaphragm
Warped check valves
Dirt, sediment in valves
Corroded valve seats
High fuel pump pressure

3. When There Is Fuel Loss, Check for:

Leakage at lines and connections
Leaking gas tank
Leakage at filler cap

4. When Trouble is Caused by Ignition Conditions, Check for:

Incorrect spark timing
Leaking high tension wires
Incorrect spark plug gap
Fouled spark plugs
Worn breaker points
Faulty spark advance
Defective condenser
Weak ignition coil
Pre-ignition

5. When Trouble Is Caused by Poor Compression, Check for:

Worn or broken piston rings
Worn pistons or cylinders
Sticking reed valves
Poorly seated reed valves

6. Check for Other Factors Such as:

Loose carburetor flange
Improperly adjusted or worn throttle linkage
Restricted exhaust system
Carbon in manifold
Overheating engine
Use of poor grade of gasoline

VALVE FAILURES

When Reed Valve Breaks, Check for:

Improper valve opening
Corrosion of reed valve
Poor valve seat

BEARING FAILURES

Check for Premature Wear:

A. Caused by dirt from --

Careless service methods
Contaminated oil

B. Caused by improper fitting due to --

Distorted connecting rods
Mixed connecting rod caps
Dirt between bearing and connecting rod bore
Out-of-round, tapered or worn journals
Warped crankshaft or block
Excessive crankshaft end play
Scored bearing surface
Improper clearance
Use of wrong service tools

C. Caused by corrosion from --

Overheating
Storage in damp place
Water entering powerhead

D. Caused by improper operation, such as --

Overspeeding
Spark detonation
Improper engine break-in
Racing cold engine
Use of wrong type, grade oil
Use of improper fuel
Improper spark timing

E. Caused by lubrication failures resulting from --

Excessive engine temperature
Insufficient engine warm up
Insufficient quantity of oil

COOLING SYSTEM TROUBLES

1. When There Is Internal Leakage, Check for:

Loose cylinder cover bolts
Damaged cylinder cover gasket
Warped cylinder cover or block
Cracked cylinder wall
Porosity of cylinder head

2. When There Is Restricted Overheating and Circulation, Check for:

- Pump impeller loose on shaft
- Water inlet pipe rubber ring not in place
- Pump blades broken or worn
- Waterpump cartridge worn
- Clogged water jacket passages
- Water tube mislocated
- Water tube cracked or corroded
- Cover not securely tightened

3. Spark Conditions Caused by:

- Incorrect ignition timing
- Improper fuel mixture
- Low oil level
- Defective spark advance linkage
- Pre-ignition

ABNORMAL SPEEDS

1. Motor Speed Faster Than Normal:

- Cavitation
- Transom too high
- Propeller clutch slipping

2. Motor Speed Slower Than Normal:

- Carburetor out-of-adjustment
- Too much oil in fuel mixture
- Wrong oil in fuel
- Wrong type gasoline
- Spark plugs fouled
- Wrong spark plugs
- Propeller damaged
- Tilt angle not correctly adjusted
- Transom too high
- Transom too low
- Cavitation
- Weeds tangled on gear housing

OUTBOARD TUNEUP

Description

1. An engine tuneup is a service to put the maximum capability of economy, power and performance back into the engine and, at the same time, assure the operator of a complete check and more lasting results in efficiency and trouble-free operation.
2. Each year tuneup of the modern outboard engine has become increasingly important with improved power and performance. Today, this increase in power and performance has meant higher compression ratios and new and improved electrical systems among other advances in design.
3. It is advisable that the service technician follow a definite and thorough procedure of analysis and correction of all items which affect power, performance and economy to assure lasting results.
4. The extent of engine tuneup usually is determined by the amount of time since the last servicing of the engine; however, specific servicing of items on the engine should be performed at regular intervals, depending upon conditions under which the engine operates.

Tuneup Sequence

1. Compression
2. Spark Plug
3. Carburetors
4. Fuel System
5. Ignition System
6. Starter Motor and Solenoid
7. Alternator and Rectifier
8. Internal Wiring Harness
9. Lower Unit and Water Pump
10. Adjustments Prior to Testing
11. Test Tank Procedure
12. Boat Test
13. Additional Checks and Adjustment

TUNEUP SEQUENCE SERVICING

1. Complete tuneup should follow checks and adjustments shown in "Tuneup Sequence" immediately preceding.
2. Changes to sequence of service outlined should be minimized whenever possible.
3. Tuneup is performed in 2 parts:
   a. Maintenance and adjustments
   b. Additional checks and adjustments
      (1) Includes added instrument checkouts performed with any of the modern compact units of service equipment available for this purpose.
      (2) Many checks and adjustments are included to isolate and correct trouble located during tuneup.
      (3) Always follow instructions for use of equipment as provided by manufacturer.
4. When conditions are uncovered which require major corrective action, refer to appropriate sections of this manual for detailed service information.
5. The following item numbers correspond with item numbers in "Tuneup Sequence" preceding.

"1" Compression

1. Remove spark plugs.
2. Install compression gauge in spark plug hole.
3. Crank engine thru at least 4 compression strokes to obtain highest possible reading.
4. Check and record compression of each cylinder. Variation of more than 15 lbs. per sq. in. between cylinders indicates that lower compression cylinders are in some way defective, such as worn or sticking piston rings and/or scored pistons and cylinders.
5. Compression check is important because an engine with low or uneven compression cannot be tuned successfully to give peak performance. It is essential, therefore, that improper compression be corrected before proceeding with an engine tuneup.
6. Cylinder scoring: If powerhead shows any indication of overheating, such as discolored or scorched paint, inspect cylinders visually thru transfer ports for possible scoring. It is possible for a cylinder to be scored slightly and still have comparatively good compression.

"QUICKSILVER ENGINE CLEANER"

a. After determining that all cylinders are in good condition, remove engine components for checking and servicing.
b. Place engine in horizontal position and soak combustion chambers for not more than 6-8 hours with Quicksilver Engine Cleaner (C-92-26845) to remove carbon deposits.
c. Considerable time will be saved by servicing engine components while powerhead is being soaked.

"2" Spark Plugs

CONVENTIONAL SPARK PLUGS

1. Inspect each plug individually for badly worn electrodes, glazed, broken, blistered or lead fouled porcelains and replace plugs where necessary. (Figure 1)

   NOTE: Refer to spark plug diagnosis information in "Ignition System" Section IV for an analysis of plug conditions.

2. Inspect each spark plug for make and heat range. All plugs must be of the same make and number or heat range.
3. Adjust spark plug gaps to Specification Chart (Sect. VIII) with a round feeler gauge.

CAUTION: Never bend center electrode to adjust gap. Always adjust by bending ground or side electrode.

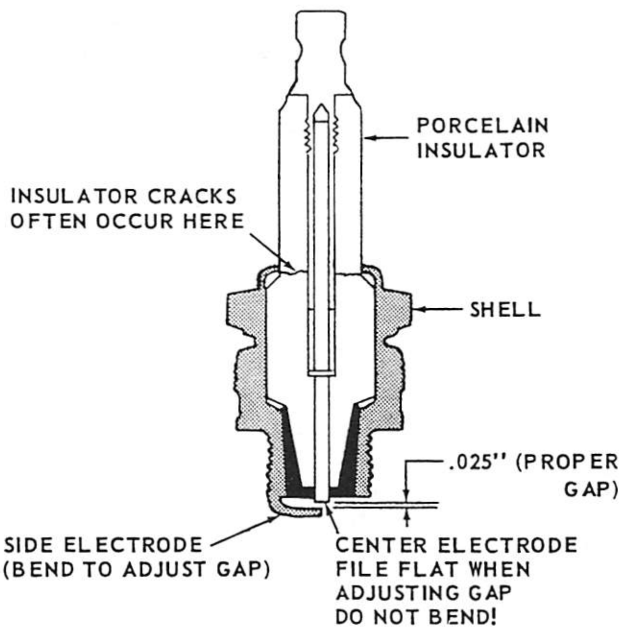
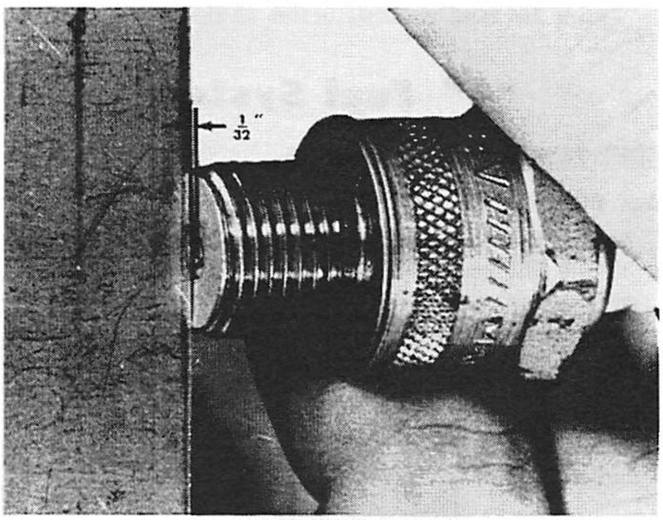


Figure 1. Spark Plugs - Conventional (Top) and Polar Gap (Below)



POLAR GAP SPARK PLUGS

1. If spark plug center electrode is not burned back 1/32" (.8mm) below insulator, it will function properly. (Figure 1, bottom) Do not replace for other than this reason.
2. Be sure plugs being replaced are definitely misfiring; deposit accumulation can be deceiving.

SPARK PLUG INSTALLATION

1. Inspect spark plug hole threads and clean before installing plugs.

> CAUTION: Crank engine several times to blow out any material which might become dislodged during cleaning operation.

2. Install spark plugs in engine with new gaskets and tighten to 20 ft. lbs. torque. Improper installation is one of the greatest single causes of unsatisfactory spark plug performance. Improper installation is the result of one or more of the following practices:

CAUSE	RESULT
Insufficient Torque (to fully seat gasket)	*Compression loss. Early plug failure.*
Excessive Torque	*Reduced operating life. Complete destruction from inability to dissipate heat rapidly.*
Dirty Gasket Seal	*High temperatures. Early plug failure. Compression loss.*
Corroded Spark Plug Hole Threads	*Excessive high temperatures. Early failure from overheating.*

3. Always use a new gasket and wipe seats in head clean. Gasket must be fully compressed on clean seats to complete heat transfer and provide a gas tight seal in the cylinder. For this reason, as well as the necessity of maintaining correct plug gap, the use of correct torque is extremely important during installation.

RADIO INTERFERENCE SUPPRESSION

1. Radio and ship-to-shore telephone interference can be partially eliminated on 6-cylinder models (without Thunderbolt Ignition) by using resistor type spark plugs. DO NOT use resistor type spark plugs on 2 and 4-cylinder models with magneto ignition.
2. A Resistor Cable Kit, which will eliminate the majority of interference originating in the engine's ignition system, also is available for 6-cylinder models which do not have Thunderbolt Ignition.
3. Interference can be partially eliminated on 4 and 6-cylinder models with Thunderbolt Ignition by installing Bonding Kit, Radio Noise Suppression (A-47171A1).
4. It should be noted that the quality of the receiver, antenna location and radio frequency used determines the effectiveness of any suppression equipment.

"3" Carburetors

FLOAT LEVEL AND DROP ADJUSTMENTS

1. Remove cowl.
2. Remove filter cover(s) and fuel filter(s).
3. Remove float bowl cover(s) and float(s).

NOTE: On electric models, it may be necessary to remove starter motor.

4. Inspect carburetor bowl(s) for sediment, gum or varnish deposits. If dirt, gum or varnish is present, it will be necessary to remove carburetor(s) and clean, as outlined in Section V of this manual.

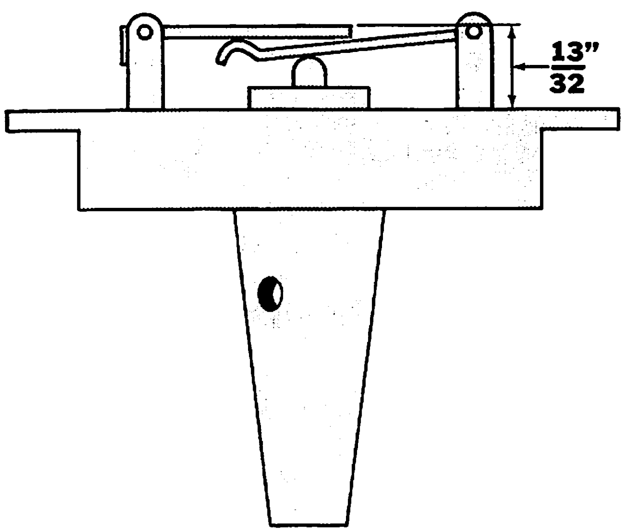


Figure 2. Gauging Primary Lever

5. Invert float bowl cover. Distance from face of shoulder to primary lever is 13/32", plus or minus 1/64". (Figure 2) Bend secondary lever as required.
6. Be sure needle does not stick in seat. Tip unit upright, and needle should move freely on actuating primary lever.
7. Hold float bowl cover upright. (Figure 3) Distance between levers is ¼". Bend tab on secondary lever as required.

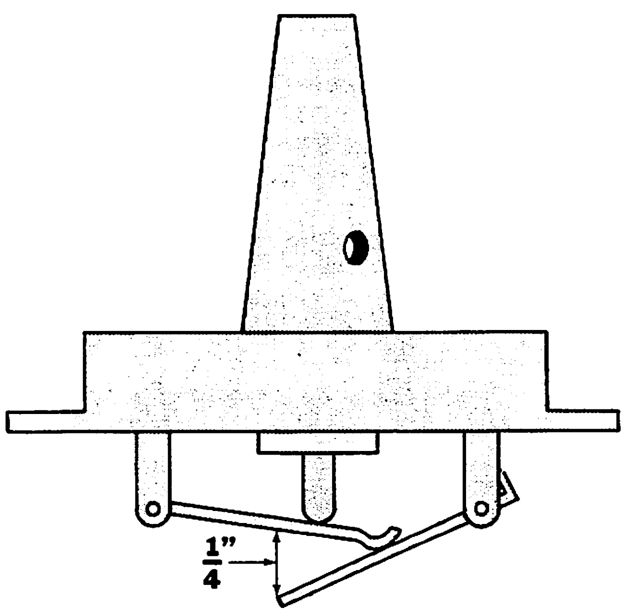


Figure 3. Clearance between Levers

8. Check float(s) for deterioration and/or saturation.
9. Check that float spring measures approximately 3/32" from top of float (not insert) to end of exposed spring. (Figure 4)
10. Place float in bowl on float needle.
11. Float should spin freely in bowl. If anything restricts float movement, correction should be made, or flooding will occur.
12. Install new gasket(s) and replace float bowl cover(s).

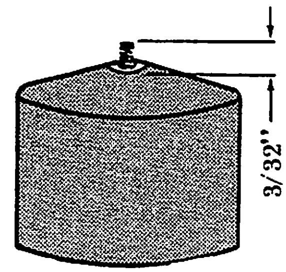


Figure 4. Carburetor Float Assembly

2-CYLINDER MODELS

1. Clearance between choke shutter and carburetor must not exceed .015" (.38mm) when choke is closed, or engine will start hard.
2. It may be necessary to readjust the carburetor idle mixture screw up to 1¼ turn with each change in brand of gasoline to compensate for varying volatility and differences in refining process.

4 & 6-CYLINDER MODELS

Hard starting is often traced to improper choke shutter operation. Adjust choke linkage and choke return spring for fast, positive action of the choke shutters.

"4" Fuel System

FUEL PUMPS - VACUUM TYPES

Merc 60-110 (Up to 1969 Models) (Figure 5)

1. Wash all parts carefully and inspect for wear or damage.
2. If old diaphragm shows any sign of deterioration, replace with new.

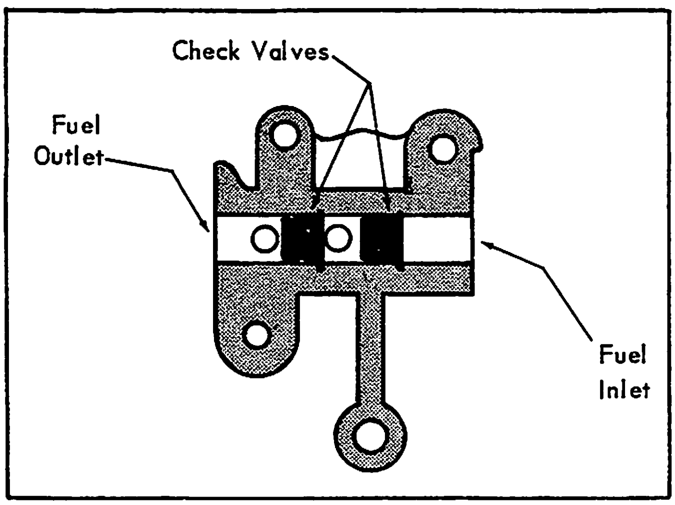


Figure 5. Merc 110-60 Fuel Pump

3. Test check valves by blowing thru outlet hole. Air should be drawn thru valve but should close immediately when attempting to blow thru it.
4. Test inlet valve by reverse procedure. If leakage is encounted, replace check valves. See Section VI of this manual.
5. Reassemble, using new gaskets.

All Other Models (Figure 6)

1. Wash all parts thoroughly and use compressed air to dry.
2. Inspect each part carefully for wear or damage.
3. Replace pulsator diaphragm with new, if old diaphragm shows the least sign of deterioration.
4. Be sure that valve seats provide flat contact area for valve disc.
5. Tighten elbows and check valve connections firmly when replacing.
6. Do not use Permatex on valve retainer gasket.
7. Check valves after reassembling fuel pump cover by blowing thru outlet hole. Air should be drawn thru valve but should close immediately when attempting to blow thru it.

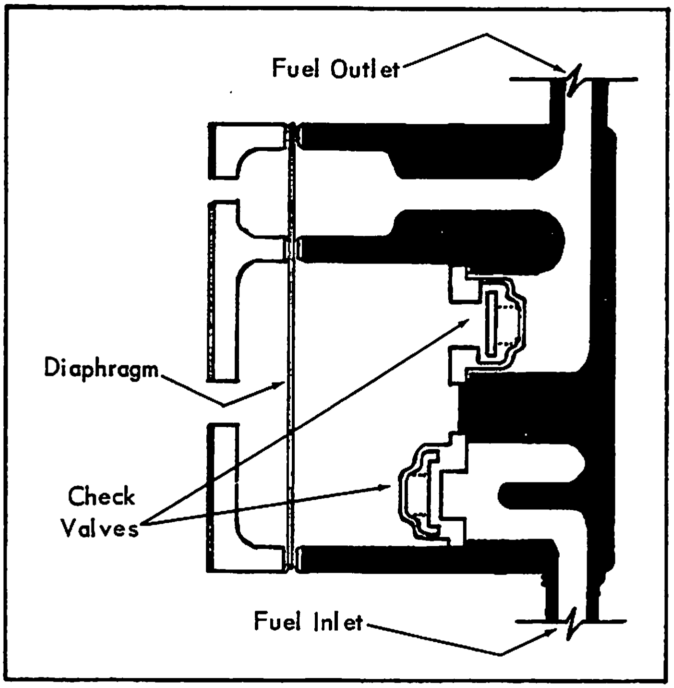


Figure 6. Fuel Pump for Most Models

8. Check inlet valve by reverse procedure. If leakage is encountered, check for free operation and accurate setting of valves.
9. Worn or slightly warped valve will cause leakage. Replace with new valves for more accurate setting.
10. When installing fuel line fittings, we recommend aviation Permatex for sealing. Apply sparingly to avoid clogging of fuel lines.

CAUTION: Do not use Liquid Neoprene on fuel line fittings. Neoprene is recommended only for exposed electrical connections. Permatex is available thru all local hardware stores.

11. Reassemble fuel pump(s), using new gasket(s).

FUEL PUMP DIAPHRAGM

A defective fuel pump diaphragm is often mistakingly diagnosed as ignition trouble. A tiny pin-hole in diaphragm will permit gas to enter crankcase causing that particular cylinder to wet foul the spark plug at idle speed. At higher speeds, quantity of gas is limited and spark plug will fire normally.

FUEL LINES AND FILTERS

1. Inspect fuel lines for kinks, leaks and restrictions and correct any defects found. If necessary, remove fuel lines and blow out with compressed air to remove any foreign material. When reinstalling lines, be sure that they are not twisted or kinked, thereby causing restrictions.
2. Clean or replace fuel line filter element(s) as follows:
   a. Remove filter cover(s) and element(s).
   b. Wash parts in solvent and dry with compressed air.
3. Reinstall element(s)

   NOTE: If a complaint of poor high speed performance exists, fuel pump pressure test, described under "Additional Checks and Adjustments" in this section, should be performed.

4. Brass fuel line fittings are available for replacing damaged fittings or for shortening ½" diameter type fuel lines. No special tools are required. Order from following list:
   A-22-33078 Brass Fuel Line Fitting, 1/4"-18 thread
   A-22-33074 Brass Fuel Line Fitting, 1/8"-27 thread
   C-54-20386 Circle Clamp

   One circle clamp is required for each brass fitting used.

"5" Ignition System

1. Use equipment as directed by manufacturer. All ignition components must be checked.
   a. Coil(s)
      (1) Maximum Operating Amperage Test
      (2) High Speed Test
      (3) Secondary Continuity Test
      (4) Surface Insulation Test
      (5) Ground Test
   b. Spark Plug Wires, Rotor, Distributor Cap
      (1) High Voltage Leakage Test
      (2) Continuity and/or Resistance Test
   c. Condenser
      (1) Capacity Test
      (2) Leakage and Short Test
2. Breaker Points
   a. Examine breaker points and clean or replace if necessary. Contact points, with an overall gray color and only slight roughness or pitting, need not be replaced. Replace points which are burned, badly pitted or have high resistance.
   b. Where burned or badly pitted points are encountered, ignition system and engine should be checked to determine cause of trouble so that it can be eliminated. Unless condition which causes point burning or pitting is corrected, new points will provide no better service than the old points. See "Ignition System", Section IV, for an analysis of point burning or pitting.
   c. Adjust points on 2-4 & 6-cyl. outboards with the recommended synchronizing (degree) plate. Refer to Ignition Sect. IV.
3. Resistors must be checked when 6-cylinder ignition system is serviced. Engines, which have the ignition by-pass, will start and run on all six cylinders, even if one resistor is burned out; however, voltage to ignition

coil is only ½ normal voltage and engine may "miss" under load.

"6" Starter Motor & Solenoid

STARTER MOTOR

Cleaning and Inspection

1. Be sure that battery is fully charged and at least 70 ampere hour capacity before testing starter motor. Many starter motors are needlessly disassembled when battery actually is at fault.
2. With a fully charged battery, connect a negative jumper cable to upper ground terminal on side of starter motor and a positive jumper cable to positive terminal of starter motor. If starter still does not operate, remove for overhaul or replacement.
3. Remove starter motor and disassemble.
4. With starter motor completely disassembled, except for removal of field coils, component parts should be cleaned and inspected. DO NOT use grease dissolving solvent for cleaning armature or field coils, as insulation will be damaged.
5. Test pinion gear and screw shaft. Pinion gear must move freely on screw. Check pinion gear(s) to see that it is not chipped or worn excessively.
6 Check that brush holders are not deformed or bent, and will properly hold brushes against commutator.
7. Check brush springs. If tension is insufficient, the brushes will arc and wear very rapidly.
8. Check condition of brushes. If pitted or worn to one half their original length, they should be replaced.
9. Check fit of armature shaft in bushing of drive end plate. Shaft should fit snugly in bushing. If bushing is worn, it should be replaced. Apply No. 20 oil to this bushing before reassembly. *Avoid excessive lubrication.*
10. Check fit of bushing in commutator end plate. If this bushing is damaged or worn excessively, end plate assembly should be replaced. Apply No. 20 oil to this bushing before reassembly. Avoid excessive lubrication. Lubricant forced onto commutator would gum and cause poor commutation, with resulting decrease in starter motor performance.
11. Inspect armature commutator. If commutator is rough or out-of-round, it should be turned down and undercut. Inspect points, where armature conductors join commutator bars, to make sure that it is a good firm connection. Burned commutator bar usually is evidence of a poor connection.
12. If any of the following conditions are found, starter motor should be repaired as described in Section VII of this manual.
13. Reassemble starter motor and lubricate pinion gear and screw shaft with No. 30 oil.
14. Check return spring for normal tension. Pinion must return from engaged position smoothly and rapidly.
15. For more extensive starter repairs, see Starter Section VII.

STARTER SOLENOID

Identification: Two types of starter solenoids are used on Mercury Outboard Motors, the standard type and the switch type. Although they have the same general external appearance, the internal construction is different and they are not interchangeable.

For identification and test procedure on the starter solenoids, refer to Starter Section VII.

SOLENOIDS - SWITCH TYPE

A defective solenoid can be hard to detect if symptoms are not known. Some of the symptoms are:

1. Engine will continue to run after ignition key has been turned off.
2. Starter continues to run after engine has been started.
3. Rough engine operation may be noted because current travels from solenoid and resistor at same time.
4. Ignition coil overheats.

"7" Alternator & Rectifier

TESTING ALTERNATOR

Three types of rectifiers are used in Mercury Outboard Motors: 1) Plate type, 2) diode type and 3) solid state type. For identification of rectifiers and test procedure for alternator and rectifiers, see Starter Section VII.

"8" Internal Wiring Harness

If trouble has been experienced with any of the electrical components, the internal wiring harness should be checked carefully. Check for frayed or chafed insulation and/or loose connections between wires and terminal ends.

The harness connector should also be checked for possible corrosion and/or bent or broken electrical "prongs". If any of these conditions exist, they must be corrected before proceeding with the following tests:

SHORT TEST (See Wiring Diagrams, Section VII.)

1. Disconnect internal wiring harness from electrical components.
2. Using Magneto Analyzer, Scale No. 3, check for continuity between any of the wires in the harness. If continuity exists, harness will have to be repaired or replaced.

RESISTANCE TEST (See Wiring Diagrams, Section VII.)

1. Turn selector switch of Magneto Analyzer to position No. 2 (Distributor Resistance) and clip small red and black leads together.
2. Turn meter adjustment knob for Scale No. 2 until meter pointer lines up with set position on left side of "OK" block on Scale No. 2.
3. Unclip small red and black leads.
4. Using wiring diagram as a guide, check each wire for resistance between harness connection and terminal ends.
5. If resistance exists, harness will have to be repaired or replaced.

"9" Lower Unit & Water Pump

WATER PUMP

1. Remove lower unit and disassemble water pump.
2. Inspect impeller, insert, face plates and oil seals for excessive wear or damage.
3. Component parts of water pump are relatively inexpensive. If in doubt, it is better to replace than risk serious damage to powerhead from overheating.

LOWER UNIT

1. Remove propeller and propeller shaft.
2. Clean propeller shaft and interior of gear housing.
3. Check propeller shaft for bent condition. If bent more than .010" (.254mm), it should be replaced.
4. Check propeller shaft oil seal. Seal must be in good condition to prevent water from entering gear housing.
5. Check gears and bearings carefully for roughness and/or excessive wear. If condition is questionable, see Section III for complete disassembly and repair of lower unit.
6. Inspect propeller. Minor nicks can be removed with a file. If propeller requires repair, return to factory or one of the Mercury-authorized factory-equipped Quicksilver Propeller Service Repair Stations.
7. Reassemble lower unit and install on motor.
8. Refill with specified lubricant.

6-CYLINDER DIRECT REVERSING MODELS

Always inspect the 2 water valves (A-21-26491) in the gear housing. Water valve end should be closed. If open, deteriorated, torn or out-of-shape, replace.

"10" Adjustments Prior to Testing

Refer to Section IV, "Ignition", for timing, testing and adjusting procedures required for any particular model. Importance of correct timing and synchronization cannot be over-emphasized, as a motor, even in excellent mechanical condition, will not perform satisfactorily unless timing and synchronization are correct.

"11" Test Tank Procedure

The following procedure should be followed when testing motor in test tank.

1. Keep test tank clean to prevent clogging of water intake on engines being tested.
2. When testing any outboard motor in a test tank, it is absolutely necessary that all exhaust gases are drawn out of the tank. This is important, since the gases will rise and enter carburetor, causing engine to run erratically or, if severe, to actually stop engine. Exhaust fan must be capable of removing at least 1,100 cubic feet per minute for larger horsepower engines.
3. When testing Merc 200, Merc 110 or Merc 60 motors in a test tank, a slight leanout may be noted. This condition exists because carburetion has been calibrated for best boat operation and not for test tank operation. A slight choking action will correct this test tank leanout.
4. Before installing in test tank, check and lubricate swivel pin and linkage.
5. Install correct propeller and place motor in test tank.
6. If available, use customer's remote fuel tank for testing.
7. Start engine and check tell-tale water discharge hole.
8. Run at reduced speed until engine reaches normal operating temperature.
9. Make necessary adjustments (refer to Section IV for particular model).
10. After adjustments have been completed, check for any gas, oil or water leaks and correct if necessary.
11. Electric Models:
    a. Check starter motor amperage while cranking motor.
    b. Check alternator output at the battery.
12. Disconnect fuel line and run carburetors dry.
13. Remove engine and hold in upright position until water has drained from drive shaft housing. Be sure that all water drain holes in gear housing are open so that water will drain completely.

"12" Boat Test

Check boat bottom carefully before testing. Any marine growth, or a "hook" or a "rocker" in boat bottom, can greatly reduce performance.

1. Mount motor on boat. (See Section VIII.)
2. Install remote control cables and check for proper adjustment.
3. Electric Models:
    a. Inspect battery and cables and perform necessary service on these components.
    b. Inspect for signs of corrosion on battery, cables and surrounding area, loose or broken carriers, cracked or bulged cases, dirt and acid, electrolyte leakage and low electrolyte level.
    c. Fill cells to proper level with distilled water or water passed thru a "demineralizer".
    d. Top of battery should be clean and battery fastened securely in position. Particular care should be taken so that tops of 12-volt batteries are kept clean of acid film and dirt because of high voltage between battery terminals.
    e. For best results, when cleaning batteries, wash first with a dilute ammonia or soda solution to neutralize any acid present, then flush off with clean water.
    f. Keep vent plugs tight so that neutralizing solution does not enter cell.
    g. Hold-down device should be kept tight enough to prevent battery from shaking around in its holder, but it should not be tightened to point where battery case will be placed under a severe strain.
    h. To insure good contact, battery cables should be tight on battery posts. If battery posts or cable terminals are corroded, cables should be cleaned separately with a soda solution and wire brush. After cleaning and before installing clamps, apply a thin coating of New Multipurpose Lubricant (C-92-52650) to posts and cable clamps to help retard corrosion.
    i. If battery has remained under-charged, check for high resistance in charging circuit.

j. If battery has been using too much water, battery may be defective or undersize. (See Section VII - Starters.)
4. Check fuel tank(s) for dirt, water and/or "stale" fuel.

NOTE: If any doubt exists, clean fuel tanks and refill with fresh fuel before continuing test.
If other than Kiekhaefer Mercury fuel tanks are used see "13" Additional Checks and Adjustments.

5. If possible, boat should be tested with average gross load.
6. Check motor tilt pin adjustment. Boat should ride on even keel.
7. If motor is equipped with adjustable trim tab, tab should be adjusted so that boat steers with equal ease in either direction.
8. Check engine RPM at full throttle. RPM should be within specified range (Section VIII, "Master Specifications"). If RPM is not within specified range, check propeller pitch.
Higher pitch propeller will decrease RPM, lower pitch propeller will increase RPM.

"13" Additional Checks and Adjustments

Following tests are described herein for use as required where either an abnormal condition, requiring further checking, has been detected during Tuneup, or a specific customer complaint exists:

Water Pressure (Use Water Pressure Gauge 91-3337A1)
Fuel Pressure (Use Fuel Pressure Gauge 91-30692)

WATER PRESSURE TEST (C-91-3337A2)

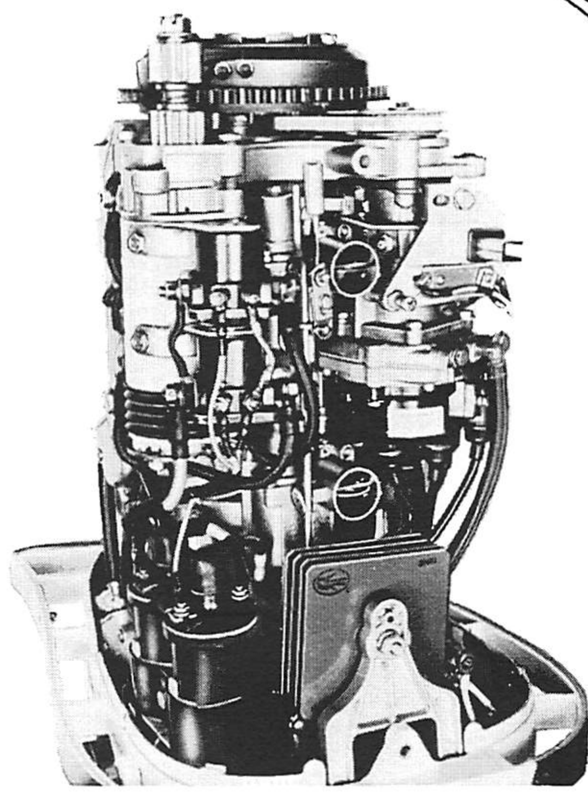
1. Water pressure in the cylinder block should be checked whenever an overheating condition is detected or suspected.
2. A large keel or other accessories located on the boat bottom forward of the motor can cause what is mistakenly diagnosed as water pump failure.
3. A motor mounted unusually high on the transom can also cause overheating. A solid, unrestricted water flow must be delivered to the gear housing for maximum cooling and engine efficiency.
4. Install necessary fitting and water pressure hose on the cylinder block and place water pressure gauge in convenient position for viewing while operating boat. Water pressure at full throttle under any running conditions, i.e. turning, maneuvering, etc, must be 5 psi (lbs. per sq. in.) (.35kg/cm^2) or more.

FUEL PRESSURE CHECK (C-91-30692)

1. Fuel pressure at the top carburetor should be checked whenever insufficient fuel is suspected, or if other than Kiekhaefer Mercury fuel tank is used.
Check "foreign" fuel tanks for the following:
   a. Adequate air vent in fuel cap.
   b. Fuel line large enough (5/16-to-3/8") (8-to-9.5mm).
   c. Filter on end of pickup too small or clogged, or fuel pickup tube too small. Use 32-33909A4 Fuel Pickup Assembly as a comparison.
2. Insufficient fuel supply will cause engine to run lean, lose RPM or cause piston scoring.
3. The fuel pressure gauge should be installed at the end of the fuel line that leads to the upper carburetor. Fuel pressure must be 2 psi (lbs. per sq. in.) (.14kg/cm^2) or more at full throttle.

section II

powerhead



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POWERHEADS ARE DIVIDED INTO SIX MAIN TYPES

1 & 2 Cyl. Mark 7 Type

- Single: 5.5 cu. in. piston displacement
  Bore and Stroke: 2" X 1-3/4"
  Models: KF3, KE3, KD3S, KD3, KB3, KB2, KB1A, KB1, K3, K2 and K1
- Twin: 11 cu. in. piston displacement
  Bore and Stroke: 2" X 1-3/4"
  Models: Mark 7, KE4A, KE4, KD4S, KD4, KB5, KB4, KB4-1, K5 and K4

1 & 2 Cyl. Split Crank-Case Type

- Single: 5.5 cu. in. piston displacement
  Bore and Stroke: 2" X 1-3/4"
  Model: Merc 39
- Twin: 30 cu. in. piston displacement
  Bore and Stroke: 2-7/8" X 2.3"
  Model: Merc 350
- Twin: 32.5 cu. in piston displacement
  Bore and Stroke: 3" x 2.3"
  Model: Merc 350 (1966)
- Twin: 22 cu. in. piston displacement
  Bore and Stroke: 2-9/16" X 2-1/8"
  Models: Merc 250-200 & Mark 28-28A
- Twin: 18.5 cu. in. piston displacement
  Bore and Stroke: 2-11/32" X 2-1/8"
  Models: Merc 150-100 & Mark 15A-10-10A
- Twin: 11 cu. in. piston displacement
  Bore and Stroke: 2" X 1-3/4"
  Model: Merc 110
- Twin: 7.2 cu. in. piston displacement
  Bore and Stroke: 1-3/4" X 1-1/2"
  Model: Merc 60

2 Cyl. Mark 6 Type

- Twin: 7.2 cu. in. piston displacement
  Bore and Stroke: 1-3/4" X 1-1/2"
  Models: Mark 6-6A, Mark 5 & KF5

2 Cyl. Mark 25 Type

- Twin: 19.8 cu. in. piston displacement
  Bore and Stroke: 2-7/16" X 2-1/8"
  Models: Mark 25-20, KH7, KG7, KF7 & KE7

4 Cyl. Models

- Four: 60 cu. in. piston displacement
  Bore and Stroke: 2-7/8" X 2.3"
  Model: Merc 650
- Four: 44 cu. in. piston displacement
  Bore and Stroke: 2-9/16" X 2-1/8"
  Models: Merc 500-450-400 & Mark 58-58A-55A
- Four: 39.6 cu. in. piston displacement
  Bore and Stroke: 2-7/16" X 2-1/8"
  Models: Merc 350-300, Mark 55-50-40-35A, KG9 & KF9
- Four: 29.78 cu. in. piston displacement
  Bore and Stroke: 2-7/64" X 2-1/8"
  Model: Mark 30

6 Cyl. Models

- Six: 93.5 cu. in. piston displacement
  Bore and Stroke: 2-15/16" x 2.3"
  Model: Merc 1100
- Six: 90 cu. in. piston displacement
  Bore and Stroke: 2-7/8" x 2.3"
  Models: Merc 1000-950-900-850
- Six: 76 cu. in. piston displacement
  Bore and Stroke: 2-3/4" X 2-1/8"
  Models: Merc 850-800
- Six: 66 cu. in. piston displacement
  Bore and Stroke: 2-9/16" X 2-1/8"
  Models: Merc 700-600 & Mark 78-78A-75A
- Six: 59.4 cu. in. piston displacement
  Bore and Stroke: 2-7/16" X 2-1/8"
  Model: Mark 75

GENERAL DESCRIPTION

The powerhead consists of:

1. Cylinder block and crankcase assembly.
2. Crankshaft and center main bearing assembly.
3. Connecting rod and piston assembly.
4. Crankcase end caps.
5. Manifold covers.
   a. Intake and exhaust manifolds.
   b. Cylinder block covers.

SPECIAL TOOLS

Refer to Section IX, Tools and Equipment, for special tools and their applications.

POWERHEAD COMPONENTS

Components of the powerhead, such as carburetors, magnetos, fuel pumps, filters, etc, are found in their respective sections.

DISASSEMBLIES & REASSEMBLIES

For purposes of continuity, disassemblies and reassemblies of the powerhead, given on the following pages, will exclude magnetos, carburetors, fuel filters and starters as discussed in other sections.

PART'S INSPECTION - HOW TO CHECK

Crankshaft

A. Check All Bearing Surfaces for Rust and Pit Marks

Clean rust off surfaces with a very fine emery cloth (320 grit). Rust may leave only stain marks on the surfaces, but these may be easily removed.

If fingernail catches on rust pits when it is scraped over surface, pits are too deep and part should be discarded. Check also can be made with magnifying glass. Crankshaft with deep pits must be replaced.

B. Check Shaft for Alignment

Place shaft on "V" blocks with top and bottom bearing journals resting in V. Ends of crankshaft in V must be of equal diameter. (See Figure 1.)

Place dial indicator on flywheel taper.

Turn crankshaft slowly. Dial indicator will show if shaft is bent. Also check on center main bearing journal.

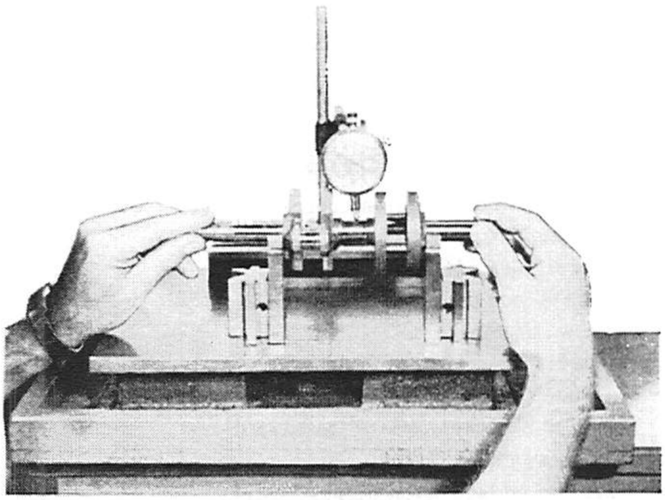


Figure 1. Checking Crankshaft

C. Check Throws for Alignment

Place dial indicator on center main journal. Adjust to zero.

Move indicator to heavy surfaces of one of the throws without upsetting first dial setting.

Adjust crankshaft so dial indicator reads "O" (zero).

Without changing setting on dial indicator, move it to other throw. Dial reading should be the same. Any difference indicates number of thousandths shaft is twisted. This is for shafts having same diameter center journal as connecting rod journal; i.e. Mark 20, KG7, etc.

Note: To check sizes of bearing journals or cylinder bores, always check against a new part.

(See Figure 2.)

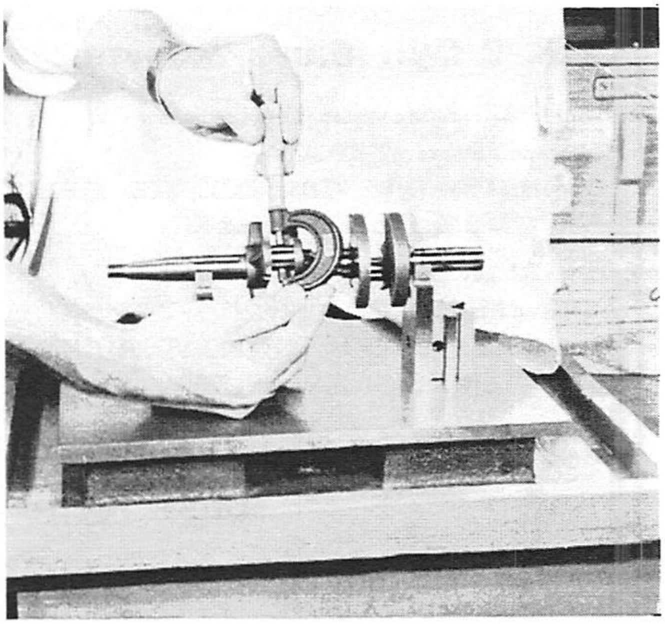


Figure 2. Checking Diameter, Crankshaft Bearing Surfaces

Chatter marks on crankshaft bearing surfaces can be seen with a good magnifying glass. These marks will cause a sound like gear noise when engine is in operation. They resemble a very tiny washboard. This surface condition can be repaired if a total of not over .001" is removed while eliminating marks. If both connecting rod and crankshaft have chatter marks, a total of not over .002" on both parts can be removed. Use 320 grit Carborundum cloth, 1 inch wide strips.

Caution: Always use "jacks" or "blocks" between counterweights to prevent springing or breaking crankshaft when pressing shafts in or out of crankcases. These can be made up from cap screws and nuts. Cut to required length.

Connecting Rods

A. Rust Checks Explained for Crankshafts in Column 1 Will Hold True for Connecting Rods

B. Check Rods for Alignment

Lay rods flat on surface plate. If any light can be seen under any portion of machined surfaces, or it has a slight wobble on plate, rod is bent and should be discarded. A special fixture (91-28441A1) checks rod straightness for all models. (See Figure 3.)

Note: Always count bearings when removing rods to be sure that all bearings have been removed. Also count bearings when assembling so that full complement has been installed. Always rotate after installation, checking that there is no binding.

In reassembly of pistons and connecting rods, check that all parts, bearings, retainer, pins, etc, are thoroughly cleaned before reassembly.

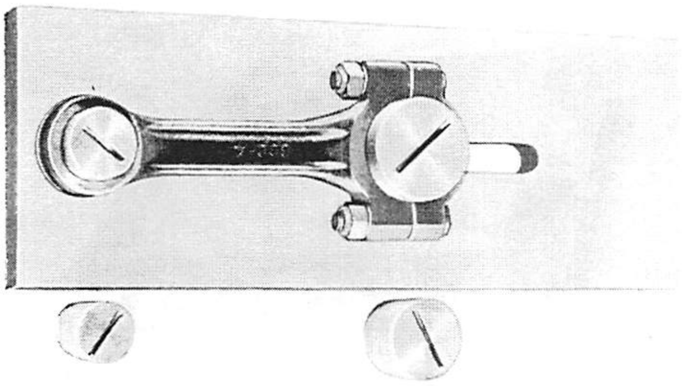


Figure 3. Checking Connecting Rod

Gears

If teeth are worn, pitted, chipped or broken, or if corners are rounded, chipped or otherwise damaged, replace gear.

Bearings

Needle bearings always should be replaced at overhaul and when rust conditions are present. Caged needle bearings also should be replaced at overhaul, or if they have become wet and rusty. Bearings are relatively inexpensive.

Ball bearings should be cleaned and dried before checking.

With one hand, grasp the outer race firmly and, with the other hand, attempt to work inner race in and out. There should not be excessive play. Spin outer race after lubricating with oil. Discard if bearing sounds or feels rough or has "catches". Bearing should have smooth action, no rust stains. Compare with new bearing.

IMPORTANT: Always press cartridge type needle bearings into part with the "lettered" side up, as opposite side has a greater radius for better installation. Check bearings after installation to see that they are free and not frozen or stuck because of improper installation or tight fit. Inspect roller bearings in particular and check that they are not worn. It is recommended, when repairing motors, that they be replaced, as they are relatively inexpensive.

Seals

Always replace oil seals when repairing, as they are relatively inexpensive and can eliminate trouble at a later date. Always lubricate oil seal inner lip before placing over shaft to prevent seal lips from wearing off on dry surface.

Gaskets

Always replace gaskets; never re-use, except in extreme emergency. To clean smooth surface for new gasket, use a wire hand brush, wire wheel on grinder or sharp pocket or putty knife.

Pistons

A. CHECK PISTONS: SCORING, CRACKS, CARBON, ETC.

If pistons have been scored or metal has been damaged, they must be replaced.

Check piston pin bosses for cracks. Replace if cracked or if piston pins are loose.

Inspect piston ring grooves for wear, burn and distortion. It is recommended that new piston rings be installed unless old ones prove to be absolutely free from cracks, burn, carbon or other abnormal wear. Rings are inexpensive and replacement will insure good repair and future operation. Pins, located in ring grooves, prevent rings from rotating.

NOTE: Before replacing piston rings, clean out grooves thoroughly, using recessed end of broken ring. Also clean carbon and varnish deposits from top sides of piston with soft wire brush or carbon remover solution. When wire brushing top of piston, do not burr or round machined edges.

Gum, varnish and softer carbon deposits can be removed by soaking in a carbon remover solution (Gunk), Bendix parts cleaner or others.

Piston skirt can be polished with crocus cloth to remove burrs.

Piston Pins are not sold separately because of slight variation in sizes and correct "fit" into piston. Check pin and pin boss, especially if engine has been submerged. If pin is bent, it elongates piston pin boss when removed. A new pin, thus, would fit loosely.

B. .015" OVERSIZE PISTONS & PISTON RINGS

The major purpose for oversize pistons and rings is for salvaging scored cylinder blocks. Cost of reboring scored cylinder walls is $5.00 per sleeve. If the score is over .0075" deep, it cannot be effectively rebored for future use.

The Service Department has oversize replacement pistons and rings available for all larger bore engines. Refer to Parts Manual under particular model.

The .015" oversized replacement parts have been accepted by the American Power Boat Association (APBA) and are permitted, when used as part of Mercury Outboard Motors, for use in stock utility or hydroplane racing events.

Cylinders

Check cylinders for wear, using an inside telescopic gauge and micrometer. (Figure 4)

On engines that show evidence of over-heating, bore should be checked for out-of-round, .005"-.006" maximum.

If sleeves have been scored, but not out-of-round, or for some other reason sleeve is rough, it can be

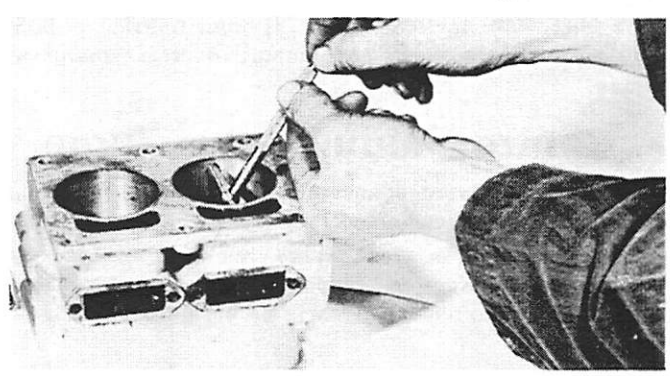


Figure 4. Checking Cylinders

polished with a cylinder hone. Polishing should be done with finishing hone.

Carbon can be removed from top of cylinder with closed cup brush.

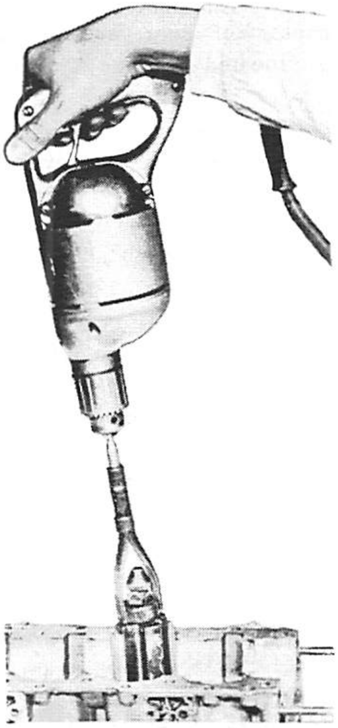


Figure 5. Honing Cylinders

NOTE: When sending block in to Service Repair Department for reboring .015" oversized, tag properly as to which cylinder is to be rebored.

Die cast cylinder blocks cannot be resleeved, as sleeves are cast integrally and cannot be removed. These can be bored .015" oversize, unless scored too deep.

Reboring charge is $5.00 net per cylinder. All studs and covers must be removed or extra charges will be made. Oversize replacement parts are permitted and accepted by the American Power Boat Association.

Exhaust Manifold Plate

If an engine overheats, inspect exhaust manifold plate for presence of foreign material restrictions in cooling system and check water pump for failure.

Overheating conditions can cause . . .

1. Aluminum exhaust manifold plate to "burn" through with subsequent water leak.
2. Stainless steel exhaust manifold plate to warp.
3. Manifold plate gaskets to burn.

Any of the above three conditions, if not corrected, would adversely affect the water cooling system and cause future trouble.

Cylinder Blocks

Inspect cylinder block thoroughly for cracks and condition of cylinder bore. Remove carbon and varnish with fine wire wheel on shaft in electric drill. Roughen walls slightly to seat rings better. If grooved or scored, hone bore with cylinder hone. If worn (maximum .005"-.006"), rebore to .015" and install oversize piston and rings.

Center Main Valve Type

Check that inside diameter is not sprung (especially if the motor has been submerged).

Check wear from reed valves on face of block (indentations). Reface on lapping plate after removing locating pins to remove all mars on surface.

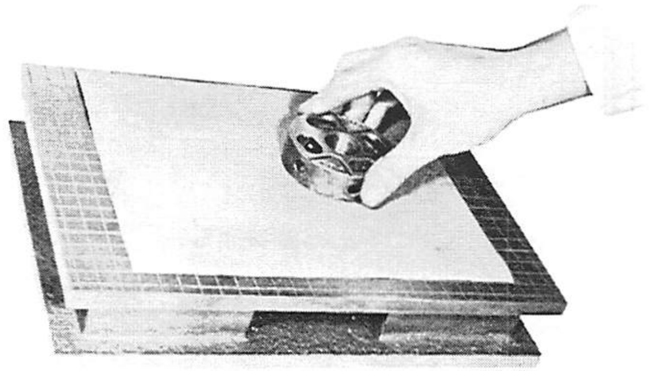


Figure 6. Lapping Surface of Valve-Type Center Main Bearing

Reed Valves

A. CHECKING

Check for chipped, bent or damaged reed valves.

NOTE: Never bend a reed valve to obtain a setting, as bending will cause leakage.

B. ADJUSTING

Adjust reed valves on valve type center main bearing by setting reed valves squarely over their respective openings and at "no preload". (This means that reed valves do not adher tightly to seat but have a slight opening, never more than .007".) Place reed valve stops in position evenly over reed valves. Tighten reed stop screws. Check all 8 reed valves for proper setting. Set reed valve stops (rockers) correct distance from top of closed reed valve to bottom of reed valve stop as shown in Torque Specification Chart on Page 2C of Section VIII. One half of reed valves are left hand, other half right. Left reed valves have extra radius cut into reed valve at fastening end.

Reed Valve Settings

(Refer to "Reed Valve Opening" column in Torque Specification Chart on Page 2C of Section VIII.)

CAUTION: When replacing reed valves on bearing, be careful to set left reed valve on left side of bearing. In some cases, right reed valve can be set on left side to obtain a "no preload" condition. This is passable as long as valves have equal tension and flutter. Right and left are determined by viewing from point (three holes) end of valve stop.

IMPORTANT: Always check for proper opening. Larger opening can cause breakage; smaller opening will not allow sufficient fuel to enter at high RPM.

Test compression with Compression Gauge (91-29287) If compression varies greatly from one cylinder to another, it indicates cylinder is troublesome and engine should be disassembled and checked. A variation of more than 15 lbs. per sq. in. between cylinders indicates the lower compression cylinders are in some way defective, such as worn or sticking piston rings and/or scored pistons and cylinders.

MARK 7 TYPE POWERHEAD
Disassembly

A. MODELS

1. Twins: Mark 7, KE4, KD4S, KD4, KB5, KB4, K5 & K4.
2. Singles: KF3, KE3, KD3S, KD3, KB3, KB2, KB1A, KB1, K3, K2 & K1.

B. CRANKCASE & CYLINDER BLOCK

1. Remove bottom cowl, protector rim, fuel tank, fuel line and starter assemblies.
2. Remove 2 compression nuts on copper tubing from exhaust manifold to cylinder water jacket.
3. Remove exhaust manifold from block.
NOTE: Newer style Mark 7 manifold can be separated into 2 distinct parts if necessary, manifold outer half and engine half, by removing 3 screws.
4. Remove steering handle bracket by unscrewing 4 Phillips head screws from underside of co-pilot disc.
5. To remove powerhead from drive shaft housing, remove 4 Phillips head screws and 2 nuts to disengage entire head.

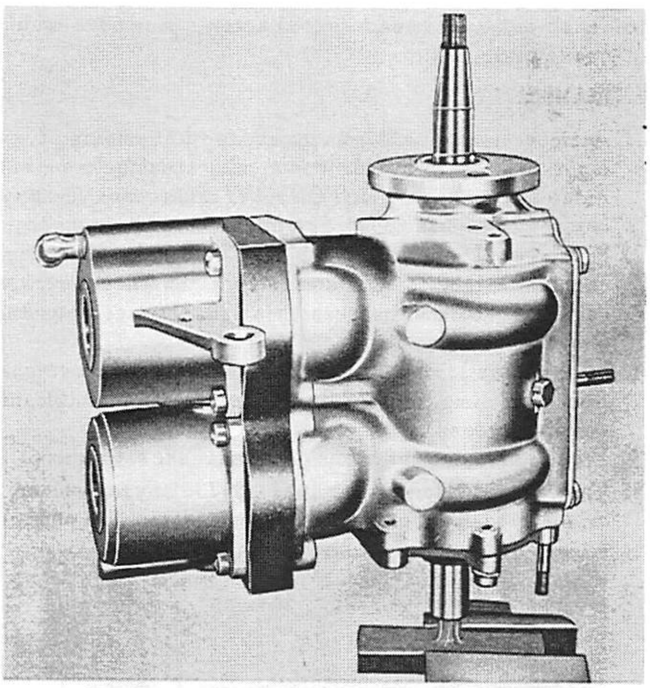


Figure 1. Powerhead on Powerhead Stand

6. Clamp Universal Powerhead Stand (91-24259) in vise with small arbor protruding above jaws for clearance.
7. Set crankshaft spline on protruding splines of Powerhead Stand. (Figure 1)
8. Remove cylinder water jackets by removing 8 Phillips head screws which secure jackets to cylinders. *Be careful of center water jacket rubber seal between the 2 jackets.*
9. At same time that water jackets are being pulled free of block, lower and upper cylinders are free to be removed from crankcase.

NOTE: When removing cylinders, take note of upper and lower cylinders. Bottom cylinder always has 2 additional screw holes on bottom of flange. Observe that exhaust ports of cylinders are always to left side of engine.

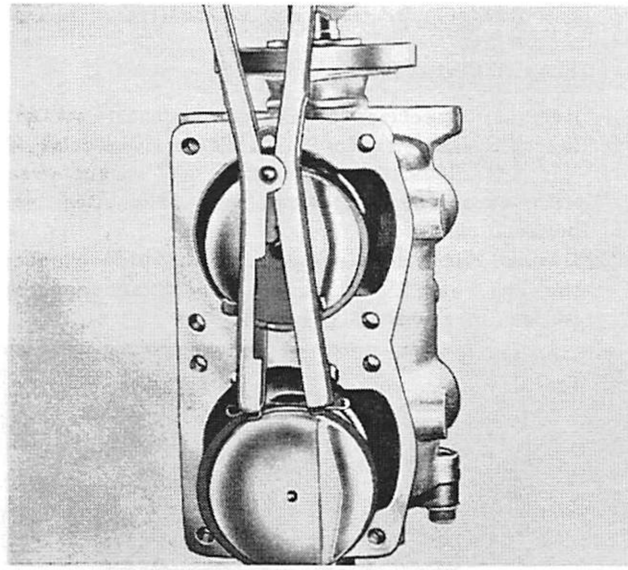


Figure 2. Removing Piston Rings

C. PISTONS

1. Pistons are exposed and piston rings now can be removed. Note their position in piston ring grooves. Rings are held by 3 stops on top, in piston grooves. Because of their low cost, always install new rings.
2. Remove piston rings with Piston Ring Expander (91-24697). (Figure 2)
3. Remove lock rings with needle nose pliers.
4. With lock rings removed, piston pin can be pressed out. Place Piston Pin Tool (91-30425A1) over piston and tighten "T" handle screw on open end of piston pin. Check that tool bar is in upper groove and that "C's" are lined up when removing piston pin and that bar is in lower groove (nearest open end) to install. Continue to turn down on handle of screw until pin emerges on opposite side of piston (Figure 3)

IMPORTANT: Be careful to catch all roller bearings and retaining washers in hand when pin begins to

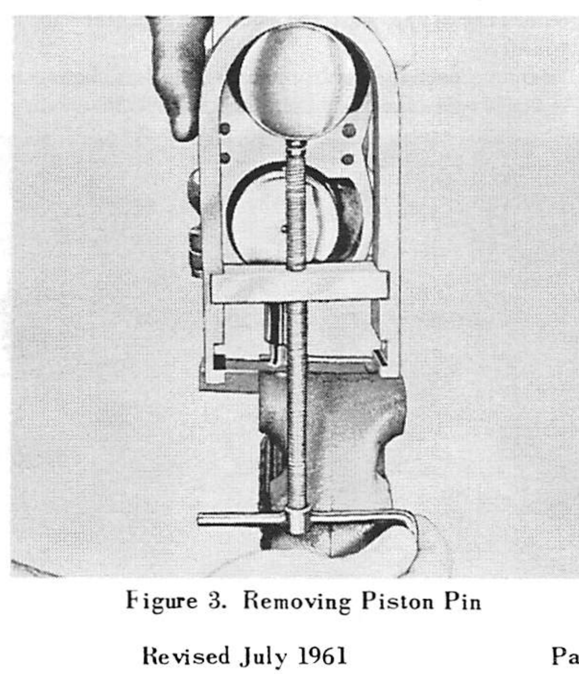


Figure 3. Removing Piston Pin

emerge from piston. Keep clean and free of abrasives when replacing. Each piston pin journal has 20 roller bearings.

NOTE: On KE4 and older models, piston pin bearing is cartridge type, retaining all individual rollers in a cartridge.

D. CONNECTING RODS

1. Remove connecting rod from crankshaft with Allen Insert Socket Wrench (91-24112) or Connecting Rod "T" (91-22409). A standard 7/16" socket wrench with extension is required with the Allen Insert Socket.
2. Remove both Allen screws, which hold connecting rod cap, with Allen Socket Wrench, and connecting rod can be removed. (Figure 4)

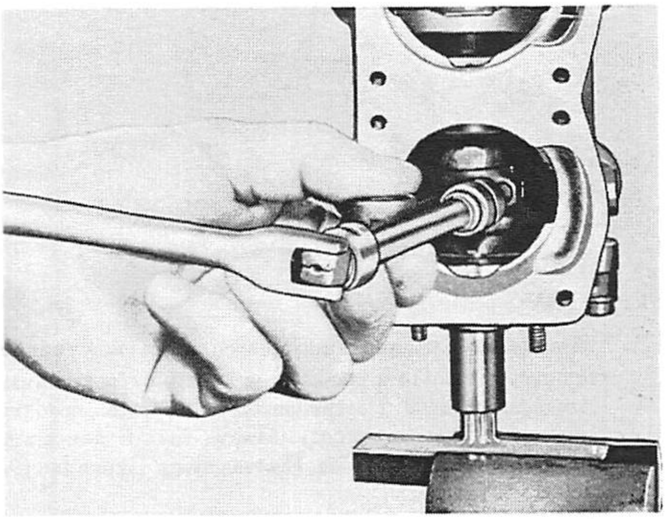


Figure 4. Removing Connecting Rods

IMPORTANT: Be careful not to lose roller bearings disengaging connecting rod from crankshaft. Each connecting rod on crankshaft end has 28 roller bearings. Be sure that each rod and cap are kept together and marks on sides of rod and cap are matched!

3. After both connecting rods are free of crankshaft, crankcase bottom can be removed by taking out 2 screws which hold it to crankcase.
4. Crankcase bottom contains lower main roller bearing (cartridge type), oil seal and seal retainer for crankshaft.
5. Remove cartridge roller bearing from crankcase bottom with Needle Bearing Drift (91-24739). Insert large end

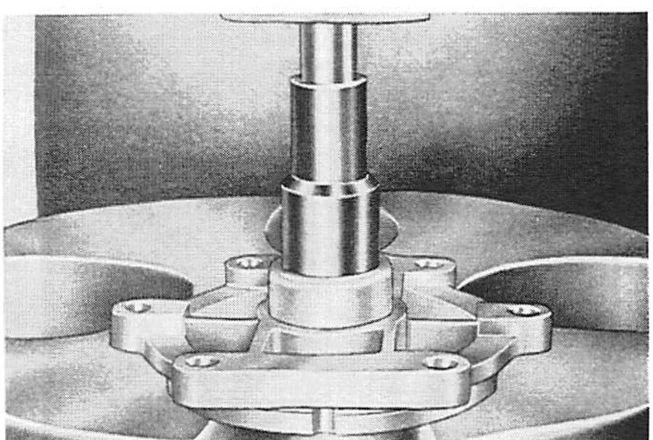


Figure 5. Removing Roller Bearing from Crankcase Bottom

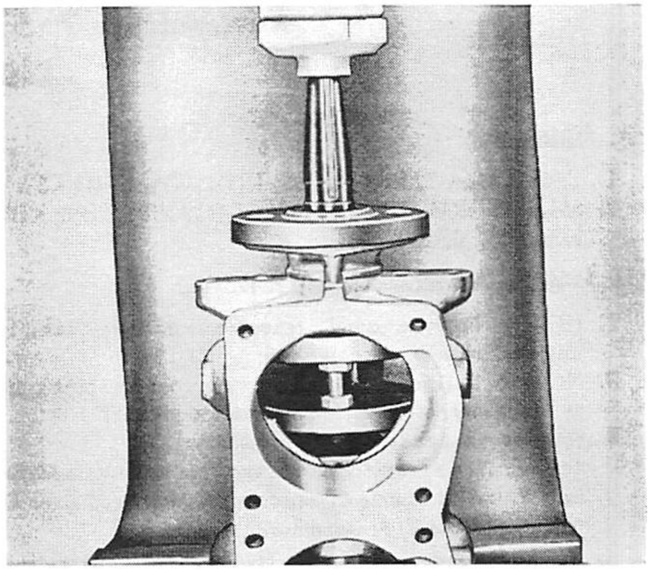


Figure 6. Removing Crankshaft

of tool from bottom side of housing, since bearing is pressed in from top and has a shoulder on which it seats. (Figure 5)

6. Take out 4 oval head slotted screws to remove crankcase plate.

E. CRANKSHAFT

1. Remove crankshaft from crankcase by removing locking screw which holds center main bearing from outside of crankcase. *(IMPORTANT: This must be done before attempting to force crankshaft out of crankcase.*
2. Place small reinforcing "blocks" or "jacks" between counterweights of crankshaft. This can be done with small ¼" bolt and nut which will fit between counterweights. (Figure 6)
3. Loosen nut to make tight fit to keep counterweights from springing out-of-line when pressing shaft out on arbor press.
4. Press shaft out of bottom of crankcase. (Figure 6)
5. Use Needle Bearing Drift (91-24739) to remove cartridge-type roller bearings from piston pin end of

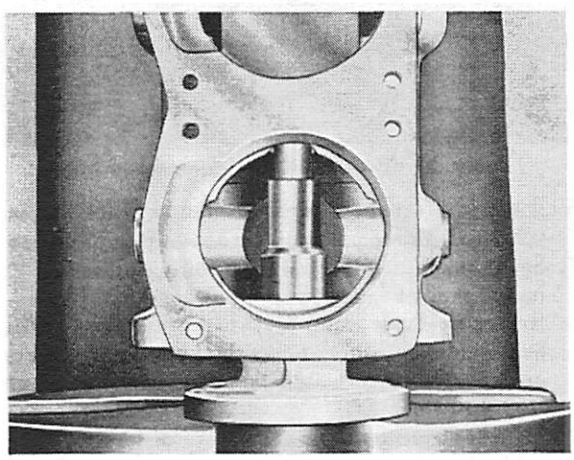


Figure 7. Removing Roller Bearing Cartridge

connecting rod with needle bearing over sleeve. Insert small end of drift into cartridge bearing and press out.

6. Crankcase contains 2 cartridge-type roller bearings and one oil seal. Remove bearings with Needle Bearing Drift (91-24739). Press out either from outside

or inside on arbor press, and be sure that crankcase base is level and not on rear shoulder. (Figure 7)

NOTE: On KD4 and KB4 models, a spacer is located between the 2 bearings. Spacer is removed with bearings.

7. After crankshaft is free of crankcase, center main bearing can be removed from crankshaft by removing 2 Phillips screws which hold 2 halves which make up bearing assembly. (Figure 8)
8. Reeds of center main can be separated and removed easily by loosening 4 reed stop screws. *(Note: On KD4 and older models, there are only 2 reed valves, one top and one bottom.)*

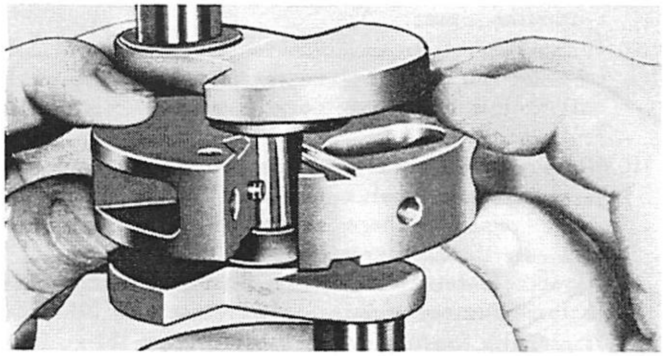


Figure 8. Removing Center Main Bearing

Reassembly

NOTE: See "Parts Inspection - How to Check" at beginning of Powerhead Section before reassembling.

A. CRANKSHAFT

1. Place center main bearing on center journal of crankshaft, being careful to place opening for outer lock set screw on proper side of crankshaft.
2. Look at crankcase front, closed end up with screw hole on left side, hold crankshaft with tapered and threaded end up, then place bearing on shaft with hole for lock screw on left side.
3. Adjust reeds on center main bearing by setting reeds squarely over their respective openings and tighten each individual reed screw.
4. Check all 4 reeds for proper setting, setting reed rocker 5/32" from top of closed reed to bottom of rocker. (Figure 9)

IMPORTANT: Always check for 5/32" opening. Larger opening can cause breakage; smaller opening will not allow sufficient fuel to enter at high RPM.

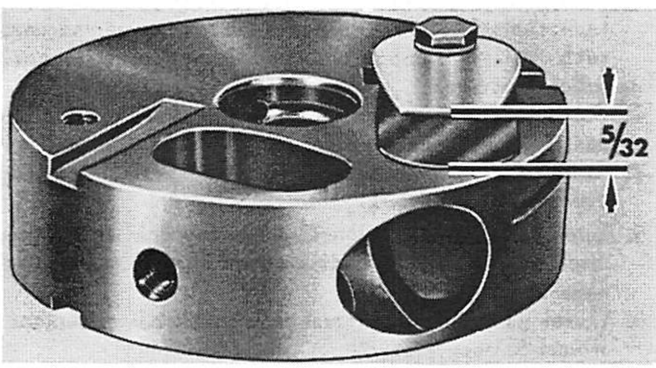


Figure 9. Adjusting Reeds

5. Replace 2 cartridge roller bearings in top of crankcase with Bearing Drift (91-24143). Place one of cartridge bearings into top of crankcase with crankcase setting on opposite (bottom) end on bed of arbor press. (Figure 10)
6. Insert tool with end marked "A" (longer end) on top of bearing and seat into place with press.
7. Repeat same process with 2nd cartridge bearing, using shorter end of tool marked "B". *(Note: On KD4 and older models, replace spacer after lower bearing is pressed in.)*

IMPORTANT: Always insert cartridge bearings with stamp markings up, since opposite side has more of a chamfer. Check bearings after installation to see that they are free and not frozen or stuck from improper installation.

8. To replace crankshaft assembly, again use bolt spacer between crankshaft counterweights, as shown in

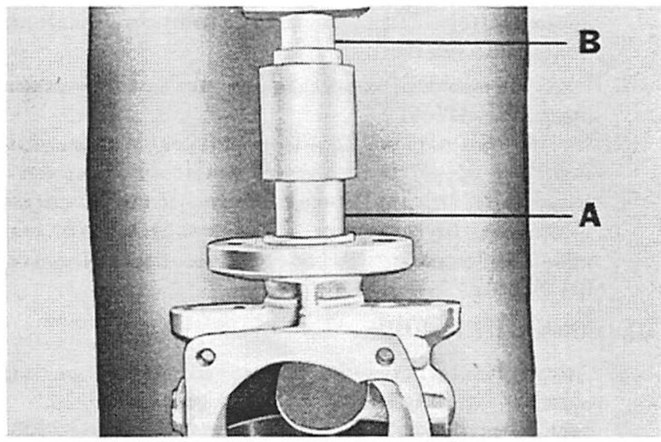


Figure 10. Replacing Roller Bearings (Top)

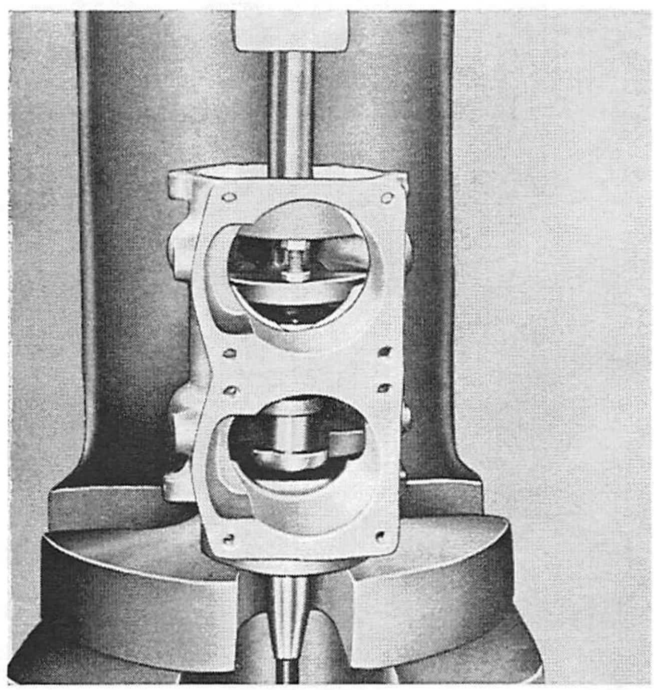


Figure 11. Installing Crankshaft

Figure 11, in order to press crankshaft into housing with arbor press.

9. Place shaft into crankcase with tapered end down (Figure 12), aligning center main bearing directly with hole in crankcase block. Use steel rule to align holes.
10. Press in until equal space is attained on each side of center main bearing opening. ("A" in Figure 12)
11. Space equally. There should be perfect alignment to center threaded screw hole. ("B" in Figure 12)
12. Replace bottom roller cartridge bearing in crankcase bottom (stamped side up) with same tool (91-24143) to press in bearing until seated. (Figure 13)
13. Place neoprene seal in cap retainer for installation on crankcase bottom. *Always check that seal is placed with lip towards drive shaft housing.*
14. Place crankcase bottom on crankshaft and tap lightly with mallet to seat.
15. Tighten 2 Phillips head screws with screwdriver to hold bottom to crankcase.
16. Replace lock screw and external tab washer into crankcase lock hole to center main bearing and tighten with wrench.
17. Check end play of crankshaft. End play should be approximately .012" to .014" between shaft and center main bearing.
18. Place assembled powerhead on splined Powerhead Stand (91-24259).
19. Use oil seal sleeve (22403) to prevent damage while installing upper crankcase oil seal over shoulder on crankshaft. It should seat firmly around shaft and into recess of crankcase. Lip of seal is toward crankcase. Tap in place with body of Rotor Installing Tool (91-24740).

B. CONNECTING RODS

1. Always install new connecting rod piston pin cartridge needle bearings on KE4 and older models.
2. Install bearing with Needle Bearing Jig (91-22408), placing end with shaft upright.

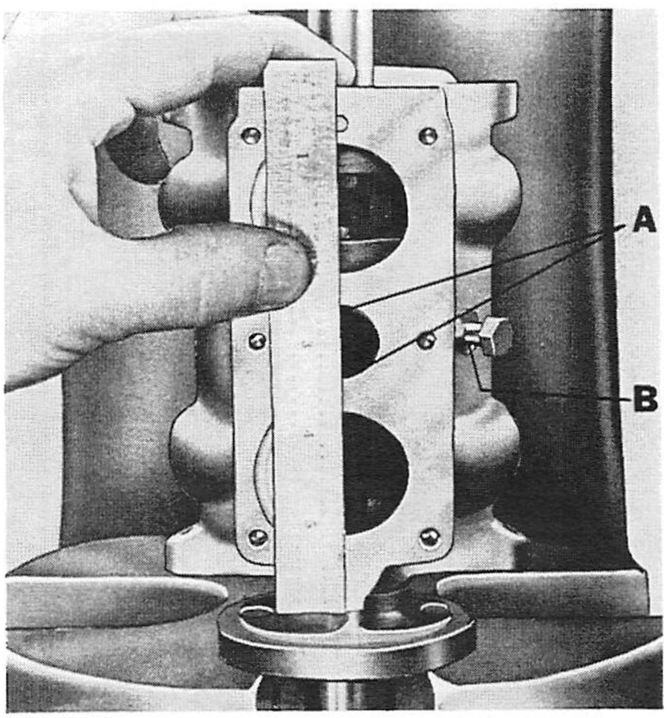


Figure 12. Aligning Center Main Bearing

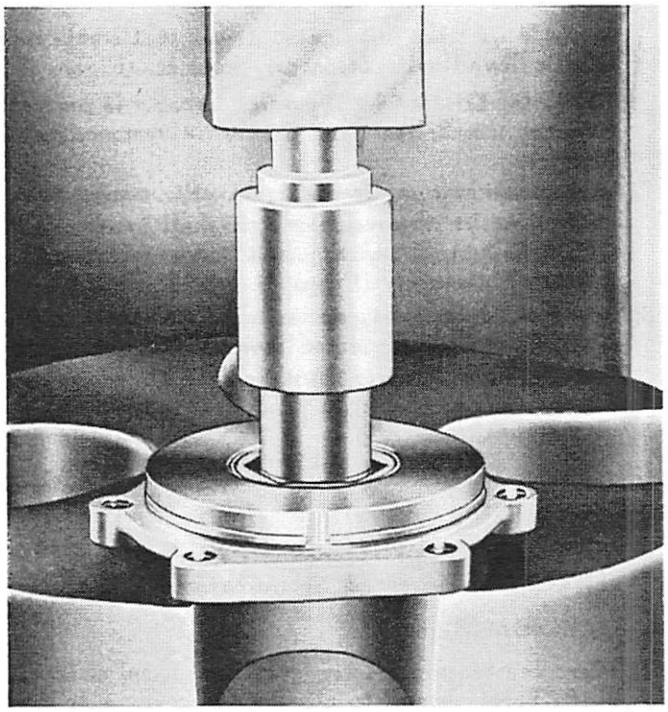


Figure 13. Replacing Bearing (Crankcase Bottom)

3. Place connecting rod piston pin bore on shaft, inserting bearing on tool shaft over connecting rod.
4. Set other end of tool, recessed end to bearing, and press together. (Figure 13)
5. Separate connecting rod cap from connecting rod by removing 2 Allen screws.

NOTE: Watch knob markings on cap and rod for reassembly. Take one rod at a time so that rods and caps will not become mismatched.

6. Place small amount of MULTIPURPOSE Quicksilver Lubricant (92-30239) on end of index finger and coat each half of connecting rod bearing race to hold roller bearings.
7. Place roller bearings in greased race to hold 28 bearings, 14 in each half.
8. Assemble rod to crankshaft with Connecting Rod Cap Holder (91-24254). (Figure 14)
9. Insert holder thru connecting rod top half and screw into lower cap half, holding entire assembly with cap separated from top half.
10. Lower assembly into crankcase and work crankshaft around to one side.
11. Slip separated connecting rod over crankshaft journal bearing surface, bringing cap up tight to fit and sliding rod down to match cap.
12. Insert Allen screw in opposite side and use Allen Insert Socket (91-24112) and extension to tighten.
13. Tighten each screw evenly, then torque to 90 in. lbs, with Torque Wrench (91-25666) for perfect fit. (Refer to Torque Specification Chart in Miscellaneous Section VIII.)
14. Duplicate preceding procedure for other rod.

NOTE: Old style aluminum connecting rods on old "K" models, are no longer available and are replaced by 604-338A1 rod assembly. On single cylinder models, crankshaft must also be replaced. On twin *cylinder models, crankshaft must be cleaned and gauged to be sure it is not undersize.*

C. REPLACING PISTONS

1. Replace loose piston pin bearings with Piston Pin Bearing Tool (91-24118). (Figure 15)
2. Slip bearing retainer washer onto tool sleeve.
3. Coat sleeve with small amount of grease to hold roller bearings, 20 for each piston pin bearing race.
4. Place bearings around sleeve, insert assembly into rod and place other bearing retaining washer on opposite side of rod.
5. Place piston over bearings (watch intake side of piston), grooved side (sharp profiled side) to right, facing open end of crankcase.
6. Push out sleeve with punch part of tool from bottom and set open end of piston pin on small end of piston pin tool. (Figure 16)

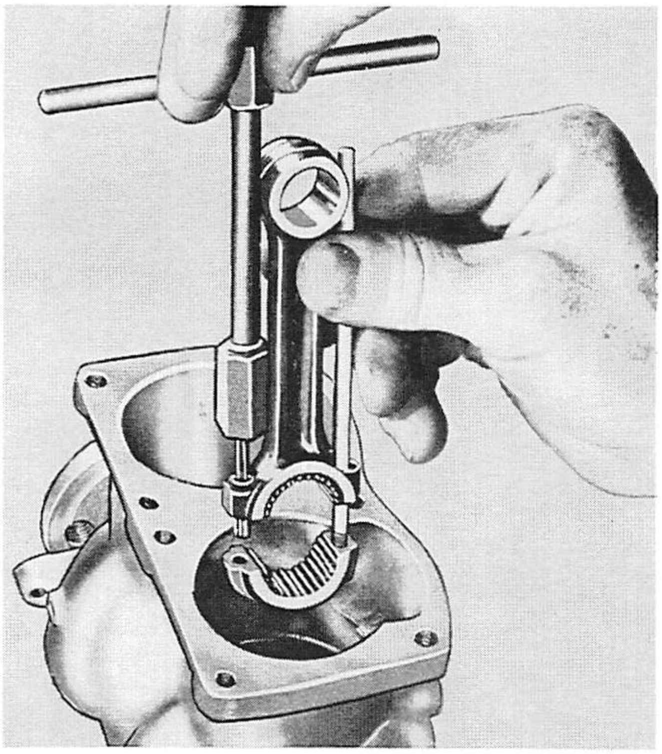


Figure 14. Installing Connecting Rods

7. Lubricate piston pin with MULTIPURPOSE Quicksilver Lubricant (92-30239).
8. Press piston pin with palm of hand--if tight, tap with mallet, being sure to support piston and rod assembly so that rod is not bent while tapping--or use Piston Pin Tool (91-24263).
9. Repeat preceding procedure for other piston.
10. Center piston pin so that piston pin lock rings fit into piston pin grooves to hold pin in place.
11. Install piston rings with Piston Ring Expander (91-24697). (Refer to Figure 2.)

NOTE: On "K" models, certain type pistons are no longer available. If a replacement is required on a twin cylinder model, replace both pistons with newer style to keep a perfect balance for smoothness and efficiency on intake and exhaust.

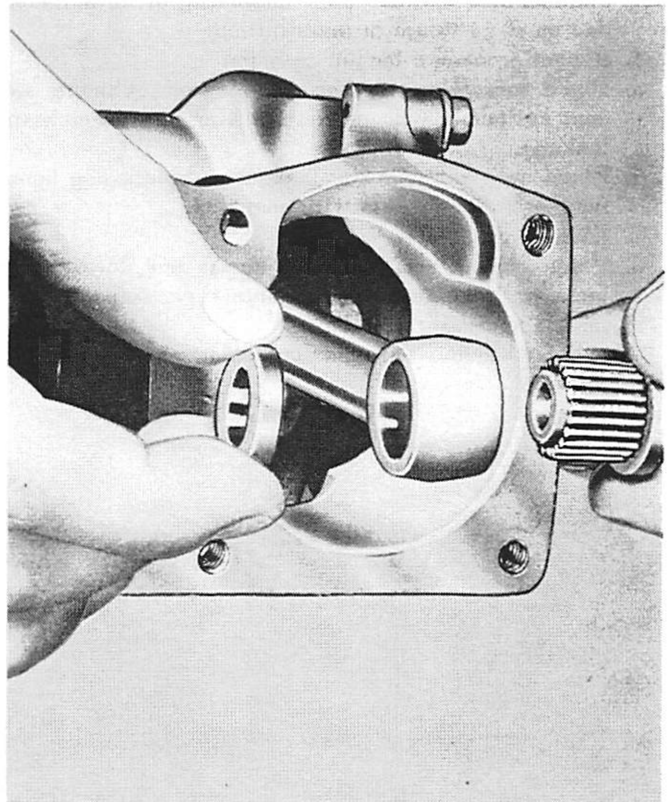


Figure 15. Replacing Piston Pin Bearings

D. REPLACING CYLINDERS AND WATER JACKETS

1. Place a new cylinder gasket on face of crankcase.
2. Set bottom cylinder with 2 drilled and tapped holes to bottom and exhaust ports to left over piston.
3. Compress piston rings with fingers when sliding

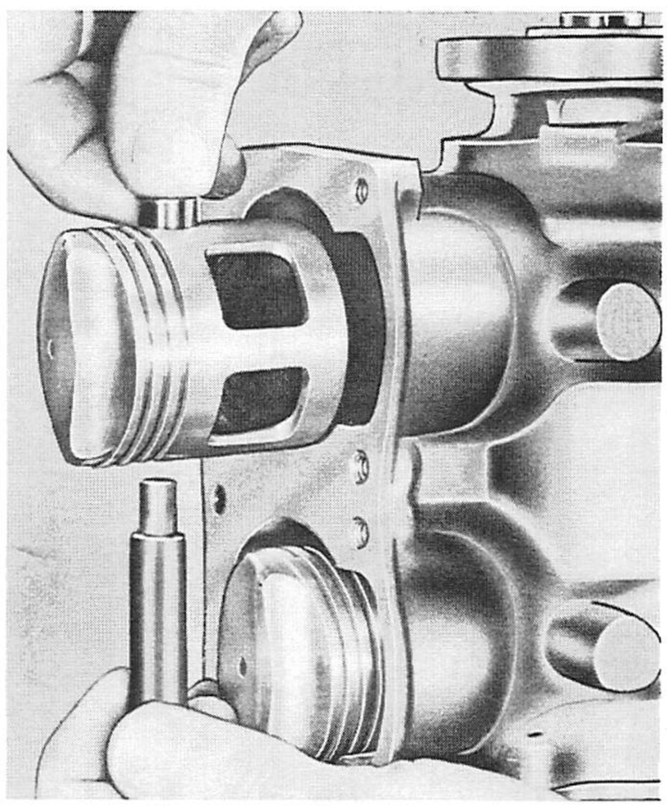


Figure 16. Replacing Piston Pin

cylinder over piston. Place lubricating oil in cylinders and on rings to aid in installation.

4. Repeat procedure for top cylinder.
5. Place new water jacket gaskets on cylinders and coat cylinders with permatex sealer to prevent water leakage.
6. Place new water jacket gaskets on spark plug openings and coat gaskets with permatex.
7. Install lower water jacket.
8. Place rubber seal between upper and lower water jackets, being sure to have water-tight seal.
9. Install upper water jacket.
10. Align cylinders on exhaust side to prevent exhaust leakage.
11. Insert and tighten 8 Phillips head screws to hold both water jackets and cylinders to crankcase.

NOTE: On single cylinder powerheads, follow same procedure as for Mark 7 type, preceding, with the following exceptions. Crankshaft is pressed into crankcase, but is placed in crankcase by hand. Crankshaft is held in place by crankcase bottom. An upper and lower thrust washer take care of crankshaft thrust. These also are set in place. Cylinder and piston are placed so intake side is on top and exhaust is down. All other disassembly and reassembly is same as 2-cylinder Mark 7 type.

MARK 6 TYPE POWERHEAD

Disassembly

A. CYLINDER BLOCK

1. After removing top cowl, flywheel and magneto, remove magneto bearing housing cap and dished thrust washer retaining bearing below housing cap.
2. Remove key on crankshaft and loosen lock nut which holds sealed ball bearing (left hand thread). (Figure 1)

   NOTE: Do not strike crankshaft nut with hammer to loosen or tighten.

3. Remove 4 counter-sunk Phillips head screws from top bearing housing assembly and pull assembly from crankcase. (Figure 2)

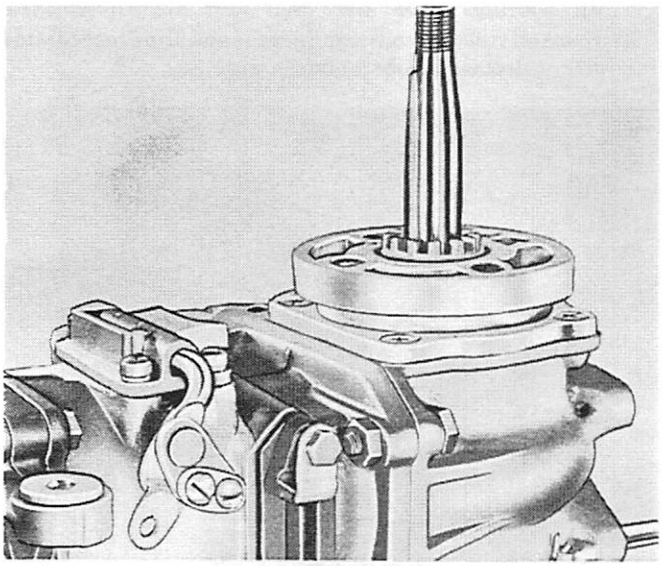


Figure 1. Key on Crankshaft

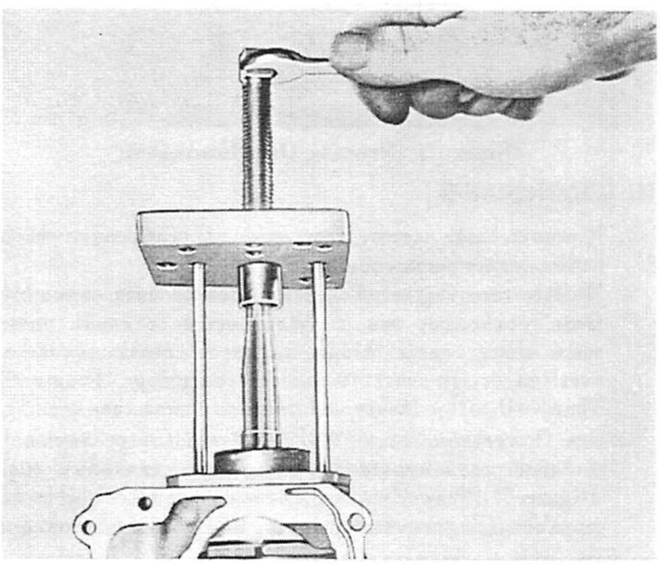


Figure 2. Removing Upper Bearing Housing Assembly

4. Remove roller and sealed ball bearing in upper bearing housing with Needle Bearing Drift (91-24739), large end. (Figure 3) Press out from needle bearing side, as this will press out sealed ball bearing.
5. Press out roller bearing and oil seal from crankcase lower end with Needle Bearing Tool (91-24715A1). Use Arbor Press when pressing out bearings. (Figure 4)

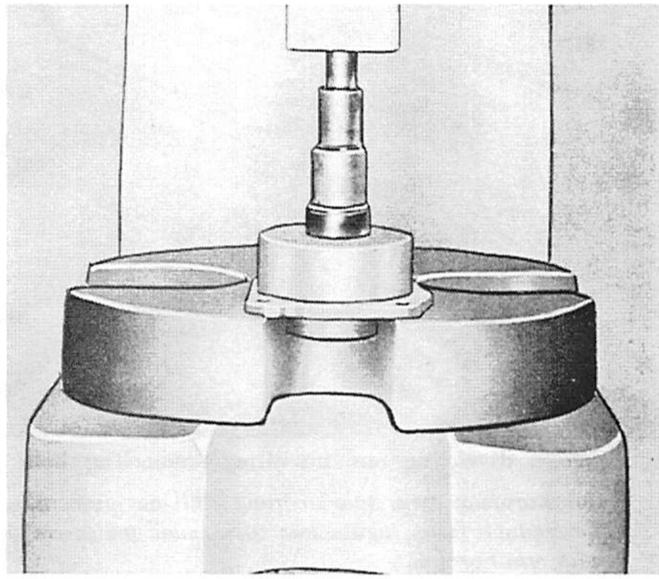


Figure 3. Pressing Out End Cap Bearing

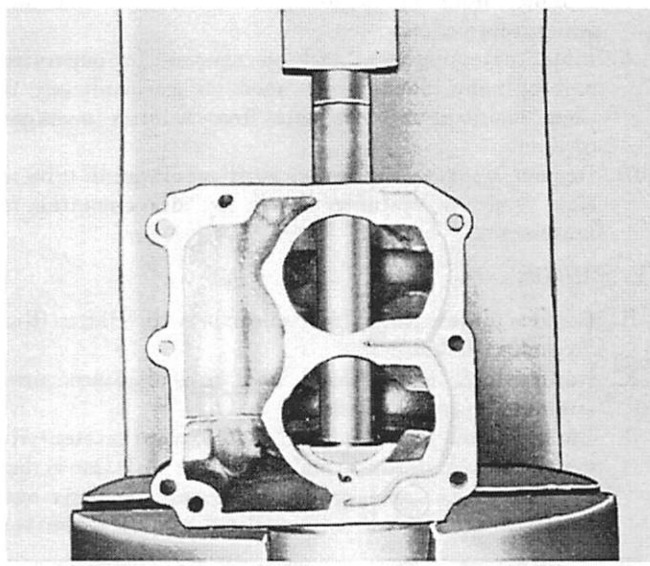


Figure 4. Pressing Out Lower Crankcase Bearing

IMPORTANT: Be sure 2 screws from water inlet cap inside pivot tube, attached to crankcase bottom, are removed before pressing out crankshaft roller bearing.

NOTE: On Mark 6A, new crankcase roller bearing (31-28631) in crankcase must be pressed out of crankcase because of presence of shoulder for bearing to seat. Use Bearing Tool 91-24715A1.

6. To remove water inlet cap installed in upper center of pivot tube, remove 2 Phillips screws with Water Inlet Cap Screw Driver (91-24279) while holding cap to bottom of powerhead.
7. Remove seal and water tube seal, same as in pilot cap. *(Note: Be sure to renew drive shaft seal in this inlet cap on reassembly.)*

   NOTE: In emergency, if screwheads break off in inlet cap, remove pivot tube by driving out 2 groove pins (one each side) and heating crankcase with

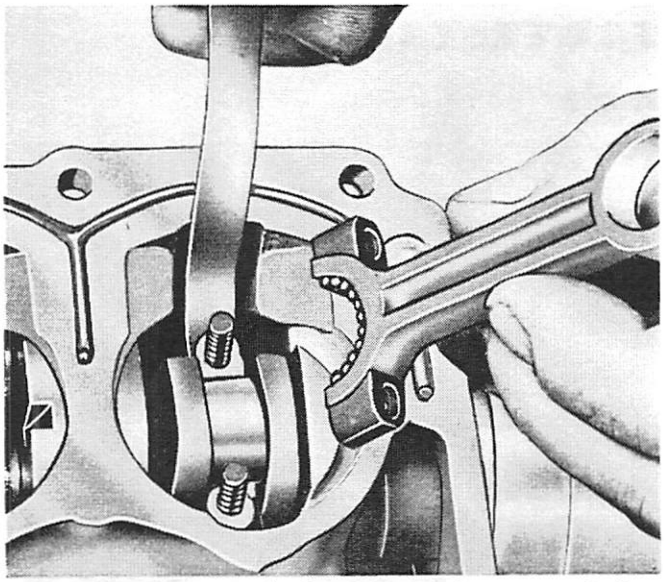


Figure 5. Removing (and Installing) Connecting Rods

torch around pivot tube to free. Pull out pivot tube. To replace tube, again heat to expand and press in with arbor press.

8. Remove cylinder block cover, intake port cover and cylinder block by removing screws, bolts and nuts which retain them.
9. Intake port cover need only be removed for inspection and cylinder block cover need be removed only to clean sand or salt deposits from cooling passages of block.
10. Remove upper end of brass shift cable guide tube at right side of cylinder block by disconnecting at bottom nut.

B. PISTONS

1. Remove piston rings from pistons with Piston Ring Expander (91-24697).
2. Remove lock rings, which hold ends of piston pins, with needle-nosed pliers.
3. Place Piston Pin Tool (91-24263) over piston with screw end set in lower end of piston pin. Check that tool bar is in upper groove when removing pin and in lower groove when installing pin. Tighten tee handle of screw until pin emerges on opposite side of piston.

NOTE: Be careful when pin emerges from piston. Roller bearings and retaining washers should be caught in hand (17 roller bearings in each upper piston pin race).

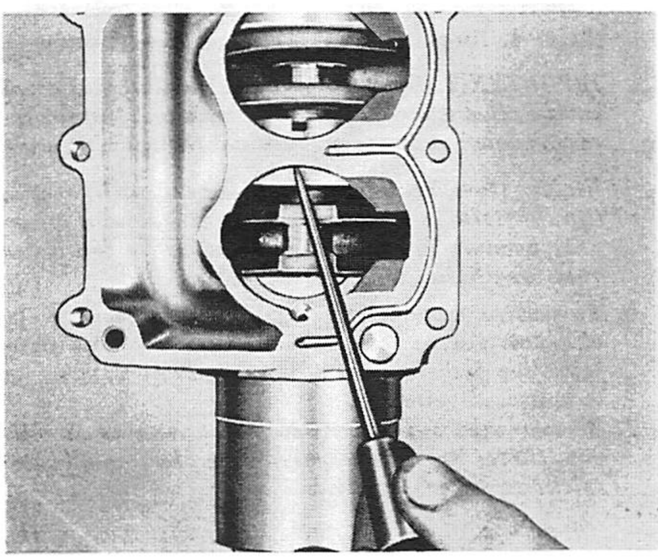


Figure 6. Scribing Center Main Bearing

C. CONNECTING RODS

1. Remove hexagon head nuts, which hold connecting rod bearing race together, with 5/16" 6-point socket, 1/4" drive. Hold bottom cap with Connecting Rod Cap Holder (91-24281). Pull upper half of connecting rod free, being careful of roller bearings. (Figure 5)
2. Turn crankshaft slightly to clear and remove connecting rod cap with roller bearings. Roller bearings in crankshaft race total 46 for 2 connecting rods. Count all bearings to be sure that they are all removed.
3. Rematch rod and rod cap by reassembling immediately with matching knobs.on same side.

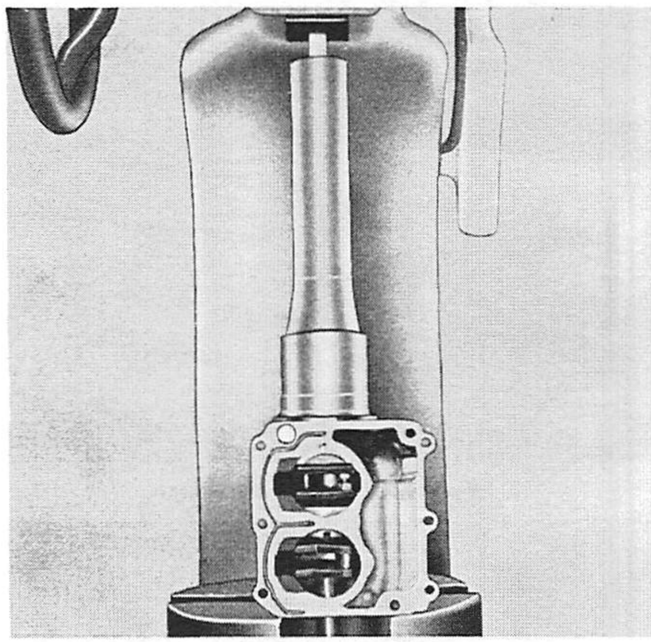


Figure 7. Pressing Out Crankshaft

D. CRANKSHAFT

1. Remove lock screw from side of crankcase which holds center main bearing.
2. Before removing crankshaft and center main assembly from crankcase, use a sharp scribe to mark center main along center bridge radius of crankcase and a vertical scribe mark to aid in realigning. (Figure 6) This will allow faster and more accurate reassembly.
3. Use Powerhead Stand (91-24282) and place assembly in arbor press upside down to force crankshaft out. (Figure 7) Place "jacks" between counterweights of crankshaft to prevent springing and possible breakage.

E. CENTER MAIN BEARING

1. Remove center main bearing from crankshaft by removing 2 clamping screws.
2. Loosen reed locating screws. Tap back of center main bearing lightly with mallet to separate.

NOTE: See "Parts Inspection - How to Check" at beginning of Powerhead Section II before reassembling.

Reassembly

A. CENTER MAIN BEARING

1. Replace roller bearing cartridge in bottom of crankcase journal with Needle Bearing Mandrel (91-29293) on end of Bearing Installation Tool (91-24715A1).
2. Insert bearing in crankcase bottom seat and press against numbered side of bearing with arbor press from inside of crankcase until seated on crankcase shoulder. (Figure 8) Bearing should be about 3/32" below face of crankcase.
3. Replace seal in same manner as originally installed. Lip of seal should be placed down toward pivot tube end.
4. Press oil seal in place from bottom of pivot tube flush with end of crankcase with Center Main Bearing and Lower Seal Tool (91-24282), cap on end of tool. (Figure 9)
5. Install water inlet cap (gasket, oil seal and rubber water tube seal) on bottom of crankcase and inside

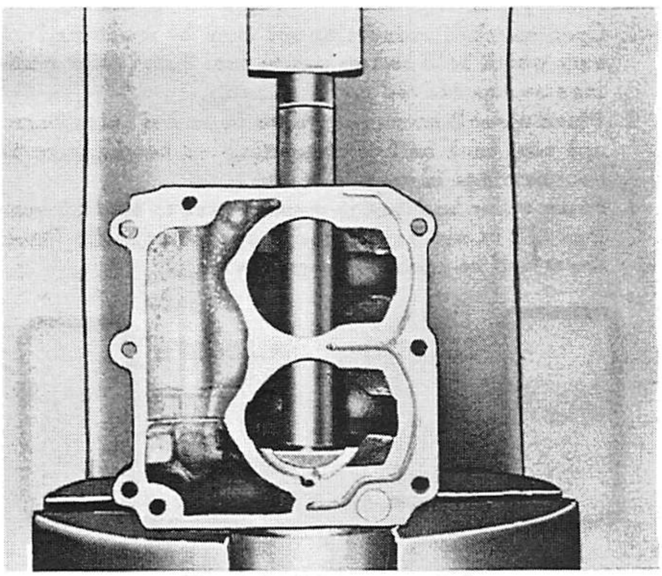


Figure 8. Installing Bearing in Crankcase Bottom

of pivot tube with long handled Water Inlet Cap Screw Driver (91-24279)
6. Secure water inlet cap with 2 lockwashers and Phillips screws.
7. Place Center Main Bearing and Lower Seal Tool (91-24282) in vise and mount crankshaft on splined end, employing it as a powerhead stand.
8. Ready center main bearing to replace on crankshaft. Separate 2 sections of bearing by removing 2 Phillips head screws which hold bearing together. Loosen 4 hexagon head cap screws which hold reeds.
9. Place bearing on center of crankshaft. Check that center main bearing lock screw hole lines up with hole in same side of crankcase.
10. Center and tighten 2 Phillips head screws which hold bearing together.
11. Center reeds over openings and tighten screws on reeds. Spacing on reed stop should be as recommended, 7/64" from top of closed reed to bottom of reed valve stop. *(Important: Always check, as larger opening can cause breakage, and smaller opening will not allow sufficient fuel to enter.)* Reed valve should

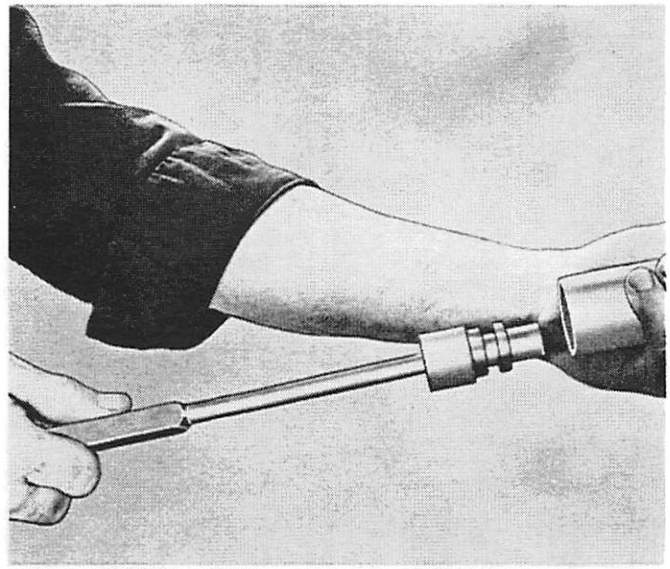


Figure 9. Installing Crankshaft Oil Seal

be set at no pre-load, valves not tight against center main seat, slight flutter and equal tension.

B. CRANKSHAFT

1. Again use "blocks" or "jacks" between crankshaft counterweights when replacing crankshaft assembly.
2. Place shaft into crankcase with tapered end up and align bleed hole in center main bearing directly in line with bleed hole in crankcase and vertical scribe mark which was scored in when disassembled. Use a steel machinist's rule. (Figure 10)
   NOTE: The preceding alignment is very important in order to secure prefect alignment for lock screw. Watch alignment of tapped hole in center main bearing with drilled hole in crankcase.
3. Press crankshaft in until line scribed on center main bearing (when removed) lines up with radius of center bridge of crankcase. (Refer to Figure 10.)
4. Replace roller cartridge bearing in crankcase bearing housing with Needle Bearing Drift (91-24143).

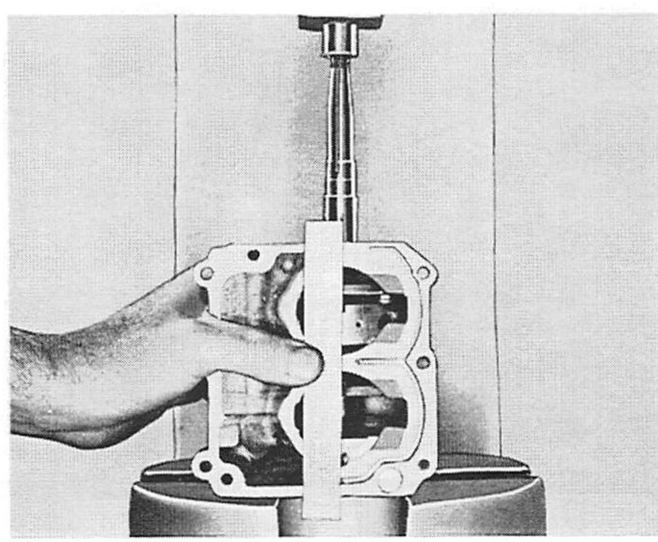


Figure 10. Pressing in Crankshaft

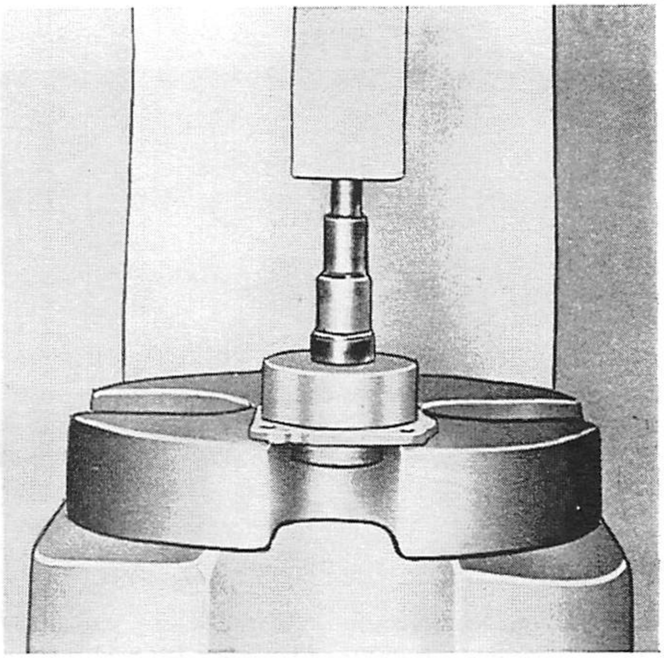


Figure 11. Installing Needle Bearing in Bottom of End Cap

Press in with arbor press and seat flush with bottom of end plate. (Figure 11)

5. Replace sealed ball bearing in crankcase bearing housing with large end of Needle Bearing Drift (91-24739), pressing down with arbor press to seat. (Figure 12)

NOTE: Top main needle cartridge bearing on KF5 engines below Serial No. 354021 use a 31-21711 needle bearing. This is a ground cartridge bearing with .005" smaller outside diameter. (Figure 13)

6. Install new white nylon sealed ball bearing which eliminates the top oil seal. *(Note: Old bearing has black synthetic rubber seal.)*

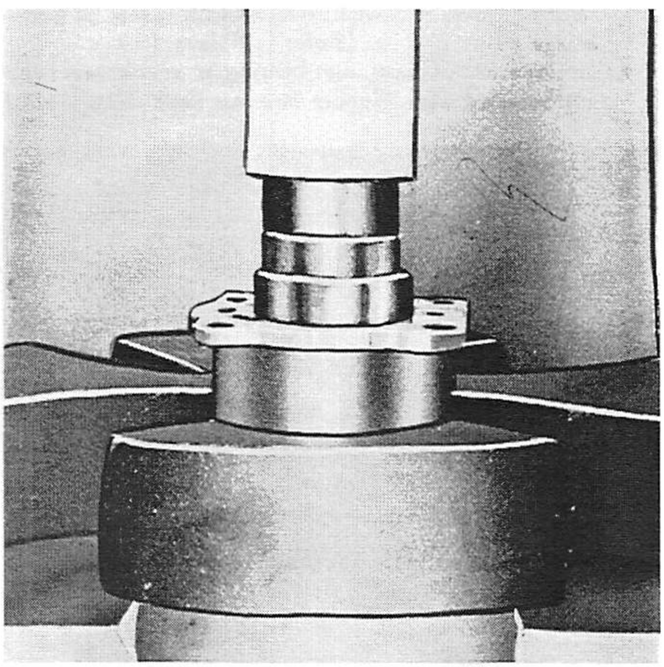


Figure 12. Installing Sealed Ball Bearing in Top of End Cap

7. Install new bearing housing gasket.
8. Replace crankcase bearing housing on crankcase and fasten with 4 Phillips counter-sunk head screws.
9. Place hexagon castellated nut on crankshaft, line up notch of nut with key way in shaft so that key will fit and tighten nut (left hand thread). (Figure 14)
10. Place dished thrust washer on top of sealed bearing with dished side down and install bearing housing cap on crankcase bearing housing. Tap down with mallet and secure with 4 Phillips head screws.
11. Check clearance between center main bearing and crankshaft with feeler gauge. Should be at least .010" to .015" clearance or an equal distance on both sides. If this clearance is not sufficient, remove end cap and loosen castellated nut and adjust shaft in arbor press to attain proper clearance. *(Note: This crankshaft has no end play.)*
12. Set and tighten center main bearing lock screw and lockwasher in crankcase to hold center main bearing. Bend down tabs on washer to secure.

C. CONNECTING RODS

1. Open matched connecting rod race by removing lock nuts which hold bottom cap to rod. *Watch knob markings on cap and rod for reassembly.*
2. Place a small amount of grease on end of index finger and coat each half of connecting rod bearing race to hold bearings in race.
3. Place roller bearings in greased race to hold 23 bearings (11 in one half of rod, 12 in other half). Place lower half so knob markings now match.

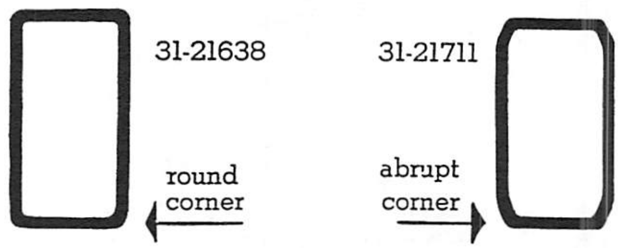


Figure 13. Bearing Types

4. Use connecting rod Cap Holder (91-24281) to hold connecting rod cap while assembling rod to crankshaft.
5. Insert connecting rod bolts thru rod cap and place rod cap in tool holder. Assembly is let down into crankcase while working crankshaft around to one side. Slip rod cap around crankshaft bearing surface and insert connecting rod over connecting rod bolts.
6. Secure with nuts, torquing to 80 in. lbs. with Torque Wrench (91-25666) and extension. (Figure 15) *(Refer to Torque Specification Chart in Miscellaneous Section VIII.)*

D. PISTON ASSEMBLY

1. Slip bearing retainer washer onto tool sleeve with Piston Pin Bearing Tool (91-24144).
2. Coat sleeve with small amount of grease to hold roller bearings, 17 for each upper connecting rod piston pin race.
3. Place bearings around sleeve and insert assembly into rod race. Place other bearing washer retainer on opposite side of rod.
4. Place piston on connecting rod, observing intake

side of piston so that deep grooved top side of piston is right, facing open end of crankcase.
5. Push sleeve out with other part of tool and set piston pin thru side of piston on top of tool.
6. Press in Piston Pin Tool (91-24263). Use Lower groove of tool when installing piston pins. Center the piston pin so that piston pin lock rings fit into piston pin grooves to hold pin in place.
7. Install rings with Ring Expander (91-24697).
8. After rings are in groove, they should rotate freely. Lubricate rings, rotate and line with lock pins in ring grooves. *Repeat this process for 2nd piston.*

E. CYLINDER BLOCK

1. Wipe lubricating oil on cylinder walls and on piston rings with your fingers before installing cylinder block on pistons.

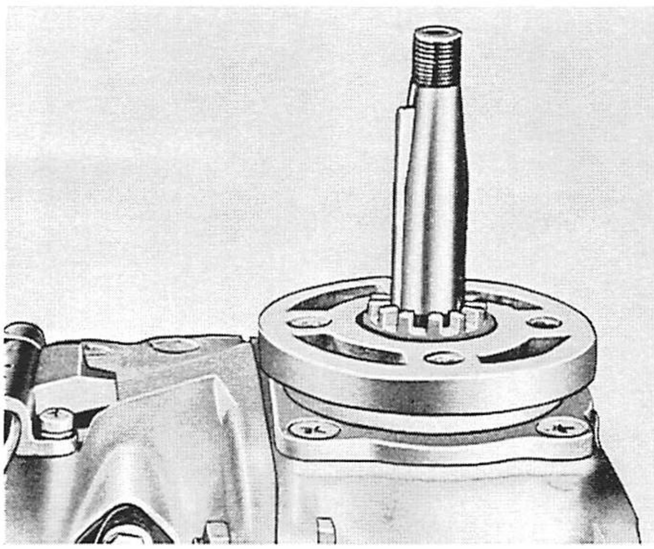


Figure 14. Flywheel Key Position in Lock Nut

2. Place gasket on crankcase, holding in place with light coat of grease.
3. Place Piston Ring Compressor (91-24280) over piston rings, bottom cylinder. (Figure 16)
4. Insert bottom piston and rings into cylinder block. Repeat on top cylinder assembly.
5. Fasten cylinder block to crankcase block with 6 hexagon head cap screws, flat steel washers and nuts. *Leave assembly loose until block is aligned properly.*
6. Set entire assembly horizontally on Powerhead Stand (91-24282) in vise, rotating slowly.
7. When piston finds its own free way to cylinder, tighten 6 connecting bolts for proper cylinder alignment, thus completing reassembly of basic powerhead.

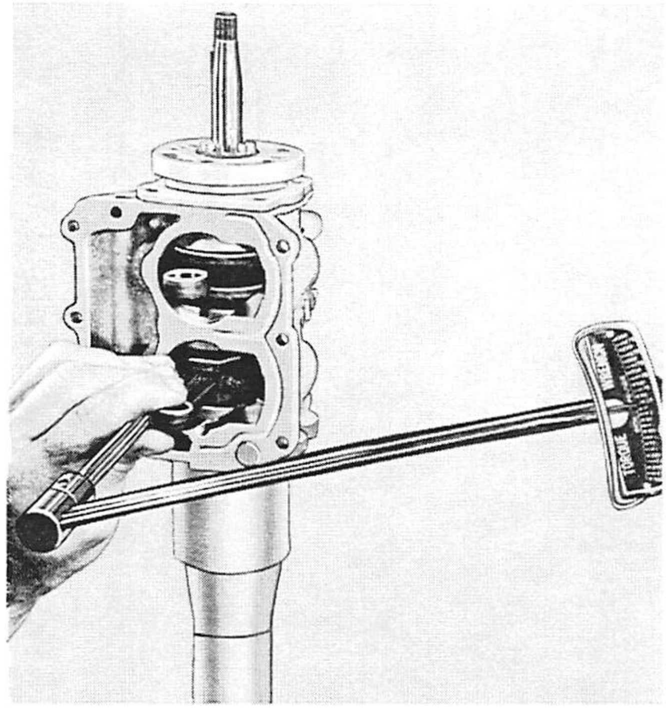


Figure 15. Torquing Connecting Rod Cap Screw

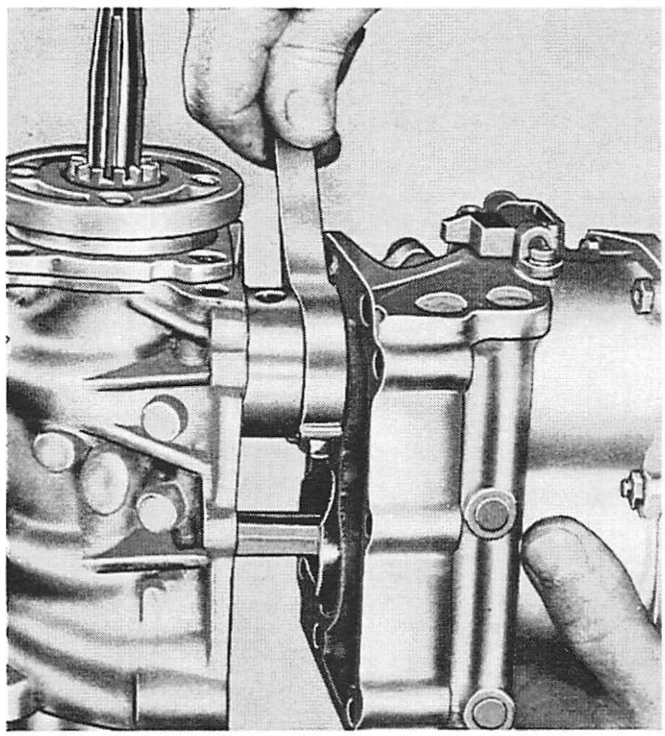


Figure 16. Compressing Piston Rings

MARK 25 TYPE POWERHEAD

Disassembly

A. MODELS

1. 19.8 Cu. In. Displacement: Mark 25-20 and KH7, KG7, KF7, KE7.
2. 14.89 Cu. In. Displacement : Mark 15 and KG4.

B. REMOVING POWERHEAD

1. Remove six 7/16" nuts which hold powerhead to drive shaft housing.
2. Remove two 7/16" cap screws and washers which hold vertical shaft bracket and throttle linkage to crankcase.
3. Pry powerhead loose from drive shaft housing.
4. Place powerhead on splined Powerhead Stand (91-24259) held in a vise. (Figure 1)

C. CRANKCASE AND CYLINDER BLOCK

1. After removing magneto and carburetor, separate crankcase from cylinder block by loosening six 7/16" nuts from assemblies. *(Note: Do not strike crankshaft nut with hammer to loosen or tighten.*
2. Separate assemblies with putty knife between faces if gasket forms a tight seal.

IMPORTANT: Do not damage facing of either crankcase or cylinder block.

3. Remove piston rings with Piston Ring Expander (91-24697). (Figure 2)
4. Remove pistons from connecting rods.
5. Remove piston pin lock rings with needle nose pliers.
6. Press piston pin out of piston with Piston Pin Tool (91-24263), placing round end of tool over piston and centering opening over piston pin. (Figure 3)
7. Tighten "T" handle screw against open end (lower) of piston pin.

NOTE: Be sure that tool bar is in upper groove of tool when removing pin and in lower groove when installing pin.

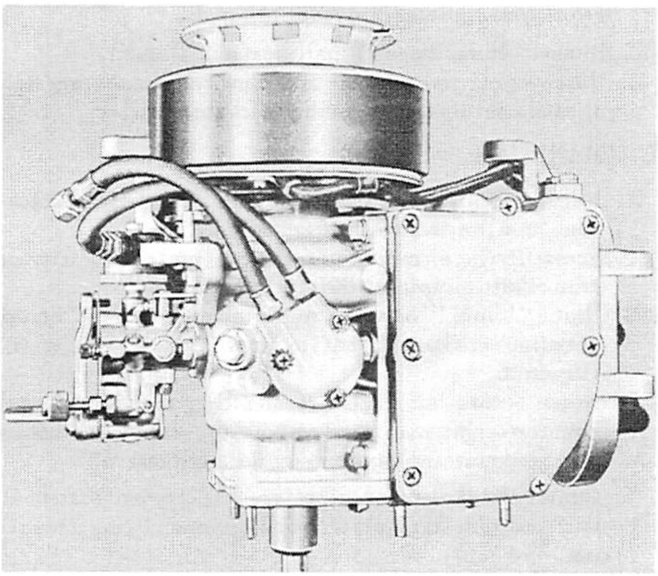


Figure 1. Powerhead on Stand

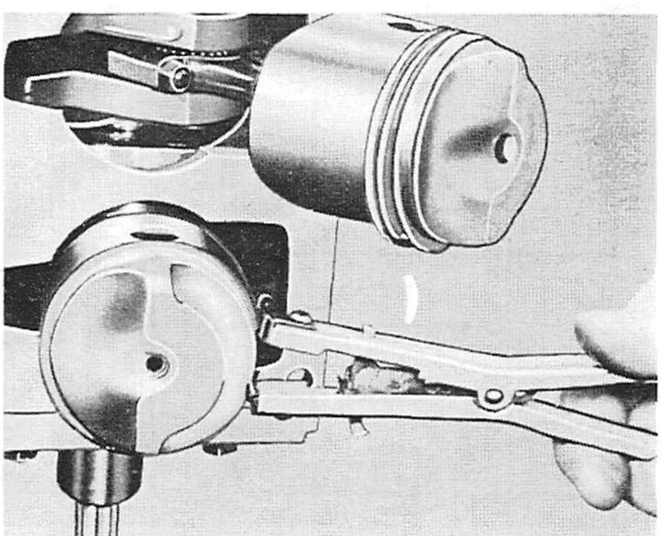


Figure 2. Removing (and Installing) Piston Rings

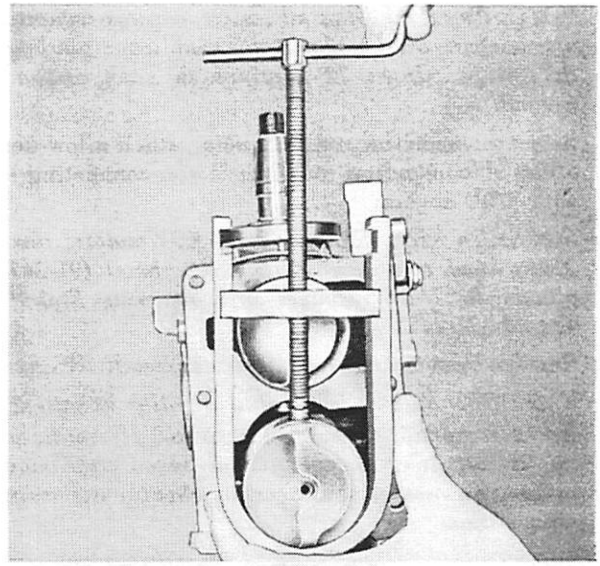


Figure 3. Removing (and Installing) Piston Pin

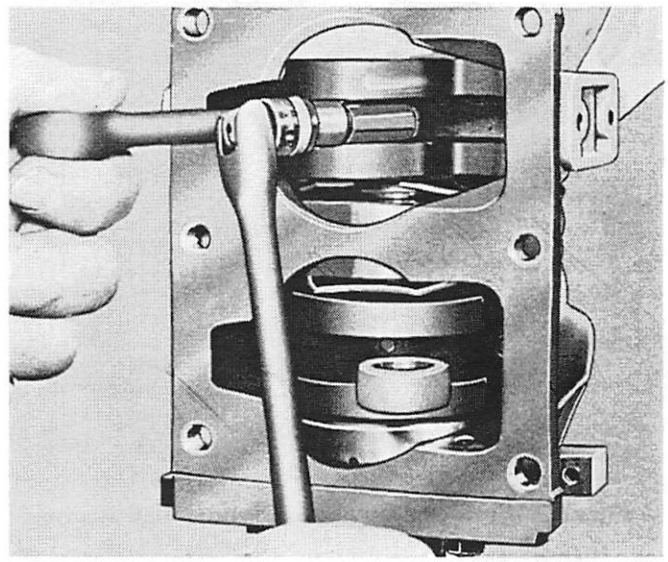


Figure 4. Removing Connecting Rods

8. Continue to turn handle of screw until piston pin emerges on opposite side of piston thru tool opening. (Figure 3)
9. Repeat procedure for other piston.

   NOTE: Be careful that all roller bearings and retaining washers are caught in the hand when pin begins to emerge. Count 22 bearings in each piston pin journal.

10. Remove connecting rod lock nuts, which allow separation of connecting rod from lower connecting cap, with 3/8" socket.

   NOTE: On KE7, KF7 and early KG7 motors, remove Allen head set screw with Allen Insert (91-24745) placed in 7/16" socket or Connecting Rod "T" Wrench (91-24724).

11. Remove connecting rods from crankshaft. (Figure 4)

   CAUTION: Again, be careful of roller bearings, 28 for each rod (25 for each Mark 25 rod).If needle bearing is left in crankcase, it may score crankcase or valve-type center main bearing when center main is pressed out.

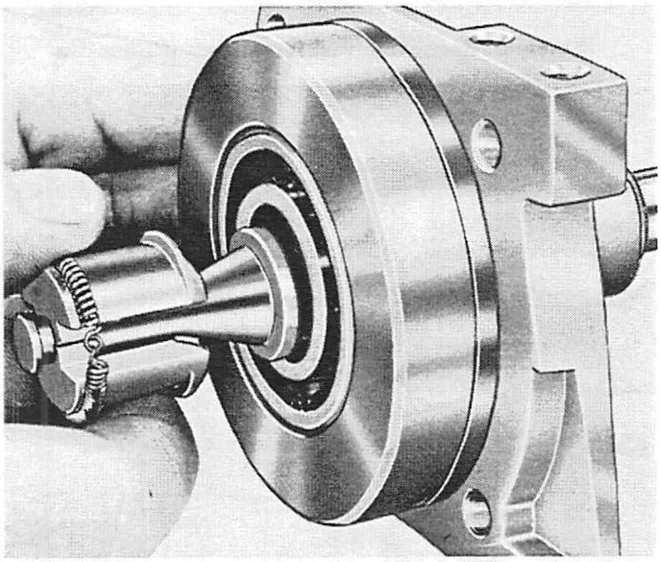


Figure 5. Removing Crankcase Bottom Ball Bearing

IMPORTANT: Immediately after disassembling rod from crankshaft, rematch cap and rod to be certain that they are not separated or mismatched on reassembly. Rematch with nub markings on side of cap and rod.

12. Use Needle Bearing Drift (91-24726) to remove cartridge-type roller bearings from piston pin end of connecting rod. Place sleeve of tool upright, leaving connecting rod with needle bearing over sleeve.
13. Insert small end of drift into cartridge bearing and press out.

D. CRANKCASE BOTTOM

1. Remove two 7/16" nuts and tap on edges of crankcase bottom with mallet to separate from crankcase.
2. Insert handle end of Ball Bearing Puller (91-24722) thru top of crankcase bottom, compressing tool caps so that tool will enter bearing, and remove ball bearing from crankcase bottom. (Figure 5)

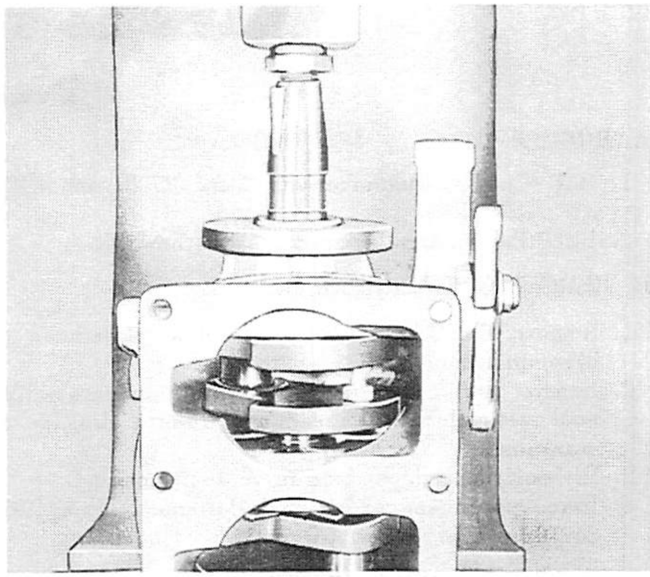


Figure 6. Removing Crankshaft

NOTE: After tool is in, tool caps expand and catch bottom of inner race of bearing. Caps expand and grip when applying pressure to handle.

3. Remove shims beneath ball bearing, if used.
4. Place crankcase bottom face down on bench and tap oil seal out of large opening with screwdriver.

E. CRANKCASE

1. Remove center main bearing locking screw from crankcase to allow removal of crankshaft.
2. Screw flywheel ratchet nut or lock nut temporarily on crankshaft to protect threads. (Figure 6)
3. Place "block" between upper counterweights before pressing crankshaft out to prevent springing shaft. (Figure 6)
4. Place crankshaft upper connecting rod journal and counterweight over reed valve stop screws to obtain even pressure when pressing out. (Figure 6)
5. Center crankcase on arbor press plate so that shaft will protrude thru plate opening when being pressed out.

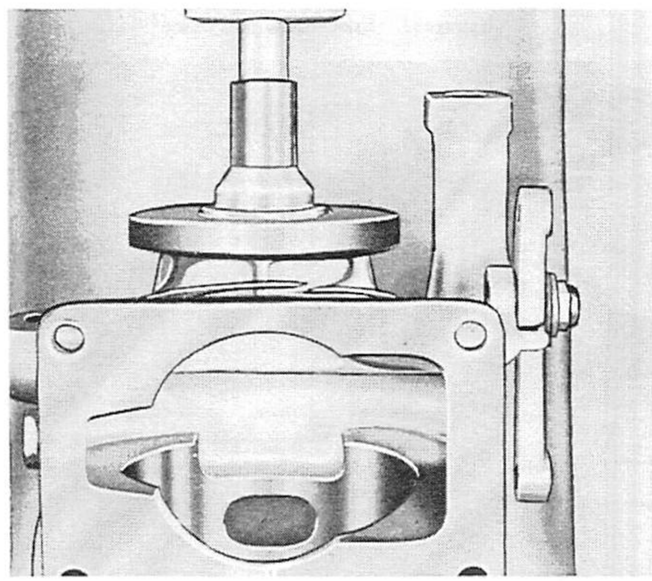


Figure 7. Removing Upper Roller Bearing - Crankshaft

6. Pry out top oil seal from top of crankcase with screwdriver.
7. Remove upper ball bearing from crankcase with Ball Bearing Puller (91-24722).
8. Press down on large end of Needle Bearing Drift (91-24726) from top of crankcase to remove upper roller bearing. (Figure 7)

   IMPORTANT: Upper roller bearing can be pressed out only one way -- top into crankcase.

9. Place crankshaft on Powerhead Stand (91-24259).
10. Remove center main bearing by removing 2 Phillips head screws in bearing with Screwdriver (91-24279). (Figure 8)
11. Tap side (solid section) with mallet to separate halves of reed valve cage.

    NOTE: On Mark 20H, center main bearing can be separated from crankshaft by removing 2 screws which hold bearing halves together. Rear half has a large stepped dowel which holds ½ of split race of bearing. Tap lightly to remove. Place entire assembly on horizontal in vise when removing bearings. Remove locking ring from split races. Separate and be careful of roller bearings in center.

    First Mark 25's had 22 roller bearings in center main, This centermain is a piece of special hardened steel ground as a bearing race. Bearings rotate on this inner diameter surface with reed valves attached as on other valve cages. On later Mark 25's, a split Quicksilver bearing insert replaces roller bearings.

12. Remove reed valves and reed valve stops on center main bearing by removing 5/16" cap screws.

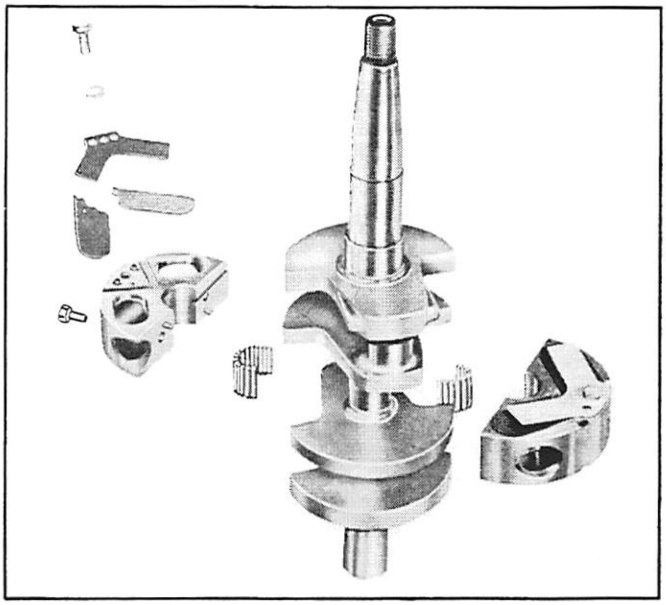


Figure 8. Crankshaft and Center Main Bearing Assembly

Reassembly

NOTE: See "Parts Inspection -- How to Check" at beginning of Powerhead Section II before reassembling.

A. CRANKSHAFT

1. Assemble center main bearing by installing reed valves and stops on valve type center main. On valve cages with 8 reed valves (Figure 9), one half of reed valves are left hand, the others right. Left hand reed valves have extra radius cut in reed at fastening end for identification.

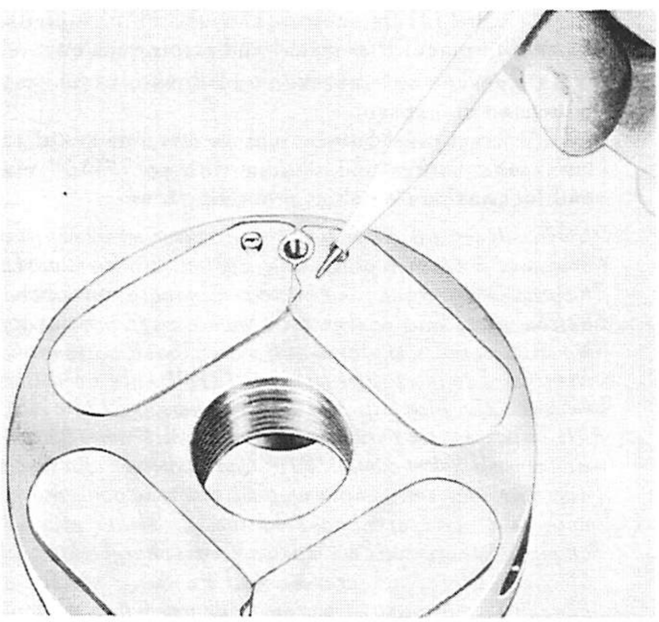


Figure 9. Center Main Bearing, Left and Right Reed

   IMPORTANT: When replacing reed valve on bearing. be careful to set reed valve on left side of center main bearing. Set valves at 5/32" top face of reed valve to underside of reed stop. Set all valves at "no preload" (valves not tight against seat) with maximum opening not to exceed .007". In some cases, a right reed can be set on left side to obtain a "no preload" condition. This is approved, as long as all valves have equal tension and flutter. Right and left are determined by observing "V" groove (3 holes) at end of reed valve stop.

   NOTE: On valve cages of KE7 and KF7, there are only 4 reed valves, 2 on each side. The same settings apply, with no left or right designation.

2. Assemble center main bearing halves on crankshaft and tighten 2 Phillips head screws with Screwdriver (91-24279). (Figure 10)

   NOTE: On Mark 25, grease races of center main bearing sufficiently on both sides to hold the 22 roller bearings. Space bearings equally, 11 in each half. On later models, place Quicksilver split bearing in place.

   On Mark 20H, grease center main bearing inner race shell halves to hold 28 bearings, 14 in each half. Fit snuggly on crankshaft and insert snap ring around races. Place stepped locating dowel in position. Place centermain halves to fit. Secure with 2 Phillips head screws and rotate several times to be sure no binding will occur.

   IMPORTANT: Center main locking screw hole in reed valve block should always be to same side of *crankshaft as locking hole in crankcase so that hole in crankcase will line up when installed.*

3. Install crankcase ball and roller bearings with Bearing Mandrel Tool (91-25045). (Figure 11) End of mandrel with larger diameter and larger of 2 collars is for installation of larger upper roller bearing in Mark 25 and Mark 20H models. Opposite end, with smaller collar, is for smaller roller bearings in KE7, KF7, KG7, KH7 and KG4. Small end is adapted with large collar for pressing upper roller bearing in Mark 20-15. Largest ring is guide, fitting into open end of crankcase. Small flat collar (C) seats on either shoulder of mandrel to press in ball bearing.
4. Replace shims, in any, in disassembly, before pressing in ball bearings (usually requires .005").
5. Coat center main bearing and inside of crankcase with light film of oil.
6. Place center main bearing into Center Main Bearing Tool (from following chart). *Be sure that lugs of tool do not rest on reed valves or reed valve stops. Flat plate of tool slides over crankcase face.*

91-23701	Mark 20-15, KG7, KH7 and KG4
91-24744	KE7 and KF7
91-25061	Mark 25

7. Place crankshaft, center main and installing tool into crankcase.
8. Invert assembly and place on arbor press plate, then press in until tool bottoms on crankcase. (Figure 12)

   IMPORTANT: Check that center main locking screw will fit thru hole in crankcase and screw into center main bearing. Place crankshaft on Powerhead Stand (91-24259). Place oil seal over tapered end of shaft onto crankcase (lips of seal toward crankcase). Tap in place with mallet (Figure 13), using body of Magnet

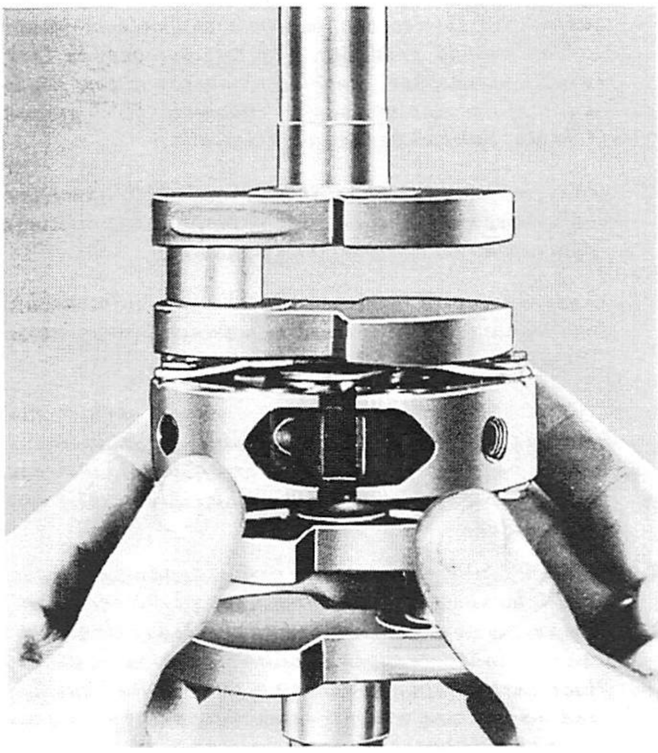


Figure 10. Installing Valve-Type Center Main on Crankshaft

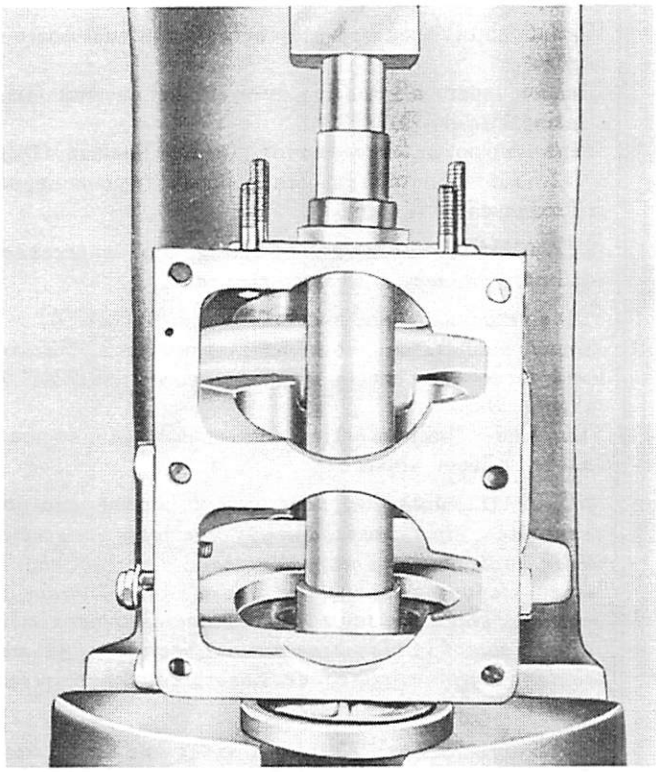


Figure 11. Installing Roller Bearing in Crankcase

Rotor Installing Tool (91-24740). This tool will not fit Mark 25-20H models. Make sleeve from piece of tubing.

B. CRANKCASE BOTTOM

1. Install oil seal in crankcase bottom (lips of seal down).

   IMPORTANT: Line hole in oil seal with drilled passageway in crankcase bottom. This bleeds excess oil from crankcase at slow speeds to prevent "overloading" of lower cylinder.
2. Install shims, as required, and press ball bearing and oil seal in with Arbor Press and Bearing Mandrel (91-25045), long, thin end with ball bearing adaptor ring. (Figure 14) Use narrow end with collar to press oil seal in place. Press seal and bearing until seated.
3. Install gasket on crankcase and reinstall crankcase bottom on crankcase.
4. Install crankcase bottom plate gasket and plate to crankcase bottom and tighten with two 7/16" nuts and lockwashers on short protruding studs.

   NOTE: On Mark 25 engines built after mid-1954, the crankcase bottom plate and gasket are eliminated. Replacement crankcase bottom eliminates crankcase bottom plate and gasket which were used previously. No water enters the new-style crankcase bottom and, therefore, it is required that a 3/16" hole be drilled in cylinder block for water discharge. (Figure 15) All replacement cylinder blocks for all Mark 25 type models will have the 3/16" hole drilled for water discharge at this point and will not allow water to enter old style crankcase bottom. If either piece is changed, there will be no water discharged at base of swivel pin, as previously. Pumping should be checked by amount of water discharged from exhaust relief holes.

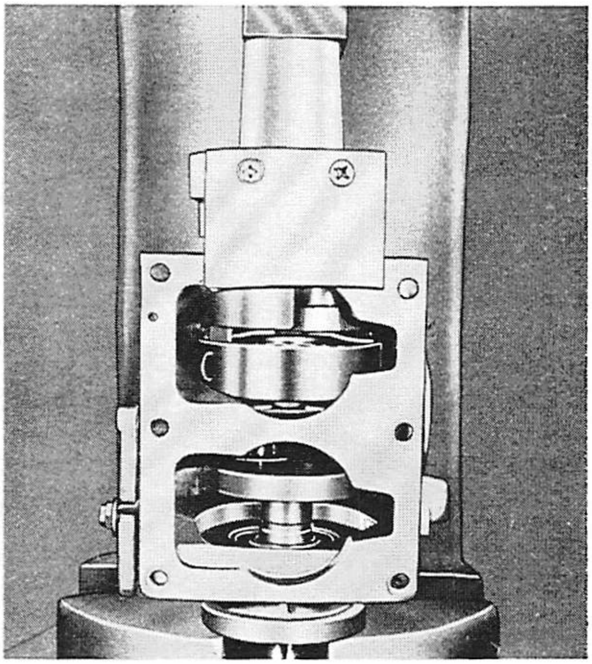


Figure 12. Installing Center Main and Crankshaft into Crankcase.

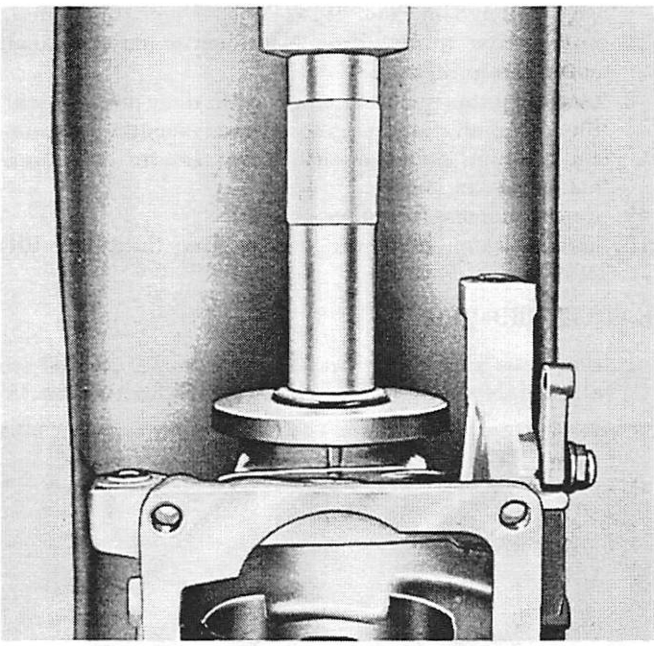


Figure 13. Placing Upper Oil Seal in Crankcase (Not on Mark 25-20H Models)

5. Check end play of crankshaft for minimum of approximately .008", maximum of .012". If not correct, remove crankcase bottom and ball bearing, as assembled, and either add or reduce shims as required to conform to tolerance shown.

IMPORTANT: Shimming must be equal beneath top and bottom ball bearings. Check end play between ball bearing inner race and end of crankshaft bearing thrust face. Tap tapered end of shaft with mallet to check that shaft moves, if unable to move with hand. Be sure that shaft rotates freely after obtaining correct end play. It should not bind at any point.

C. CONNECTING RODS

1. Open connecting rod race by removing 2 nuts and bolts which hold bottom cap to rod. *Watch knob markings on cap and rod for reassembly. Handle one rod at a time so that matched rods and caps are not mixed.*
2. Take small amount of heavy grease on end of finger and coat each half of connecting rod bearing race to hold roller bearings.
3. Place roller bearings in greased race to hold 28 bearings (roller crankpin), 14 in each half of race, for reassembly. *Number of bearings varies according to model.*

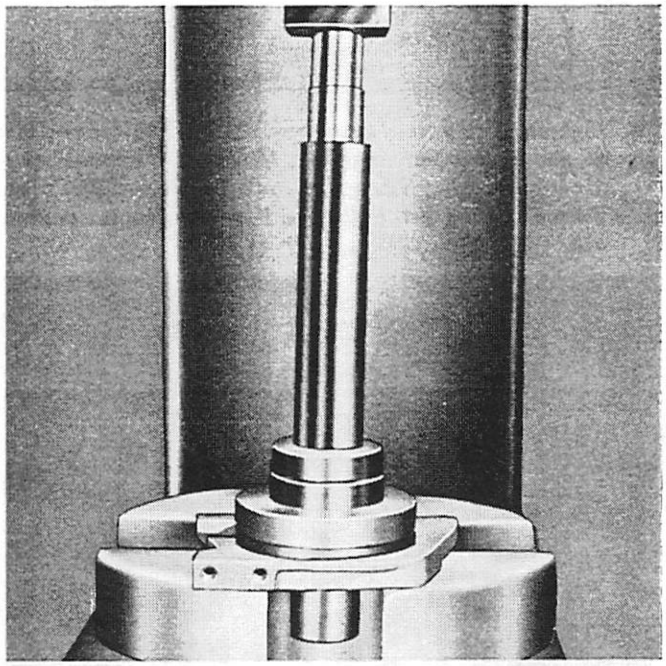


Figure 14. Installing Bearing in Crankcase Bottom

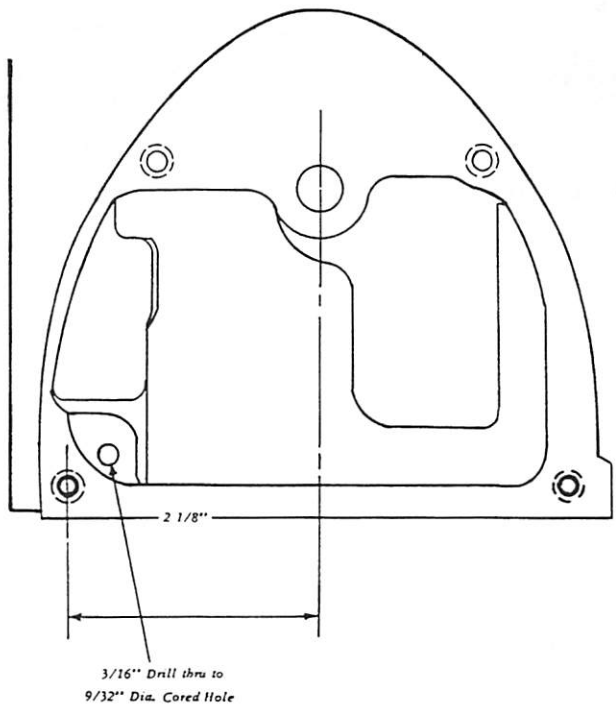


Figure 15. Water Discharge Hole Drilling

4. Place connecting rod bolts in cap, flat side against cap recess. All models in this catagory have 28 roller bearings, except Mark 25-20H, which have 25 and a different connecting rod.
5. Place lower half so that knob markings now match.
6. With Rod Cap Holder Tool (from chart following), hold connecting rod cap with bolts while assembling rod to crankshaft. (Figure 16)
7. Bring lower cap around crankshaft journal bearing surface tight to fit.
8. Slide rod down on journal to match lower cap on Allen type screw rods. *This, too, varies with model.*

91-24119	Mark 20-15, KG7, KH7 and KG4
91-22802	Mark 25-20H
91-24255	KE7, KF7 and KG7

9. Tighten each screw evenly to 180 in. lbs. for perfect fit and repeat for other rod. *(Refer to Torque Specification Chart, Miscellaneous Section VIII.)* Use Torque Wrench (91-24268) with 3/8" sixpoint socket with 1/4" drive. (Figure 17)

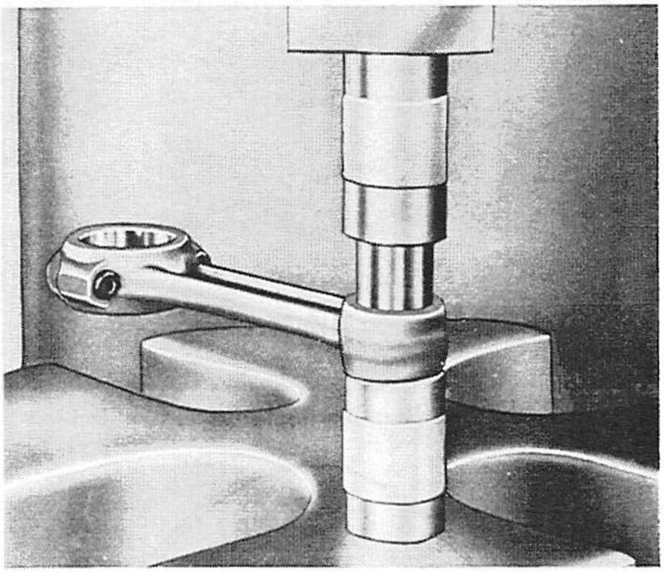


Figure 16. Installing Connecting Rod Bearings

D. PISTONS (CARTRIDGE TYPE)

1. Replace piston pin bearings with Piston Pin Bearing Tool, selecting tool from chart following.

91-24103	Mark 20-15, KG7, KH7 and KG4
91-22803	Mark 25-20H

2. Slip bearing retainer washer onto tool sleeve and coat sleeve with small amount of grease to hold roller bearings, 22 to each piston pin bearing race.
3. Place bearings around sleeve and insert assembly into rod.
4. Place other bearing retaining washer on opposite side of rod.
5. Place piston over bearing assembly (watch intake side of piston), grooved side to right (sharp, milled profile).
6. Push out sleeve with punch part of tool from bottom and set open end of piston pin on small end of piston pin tool.

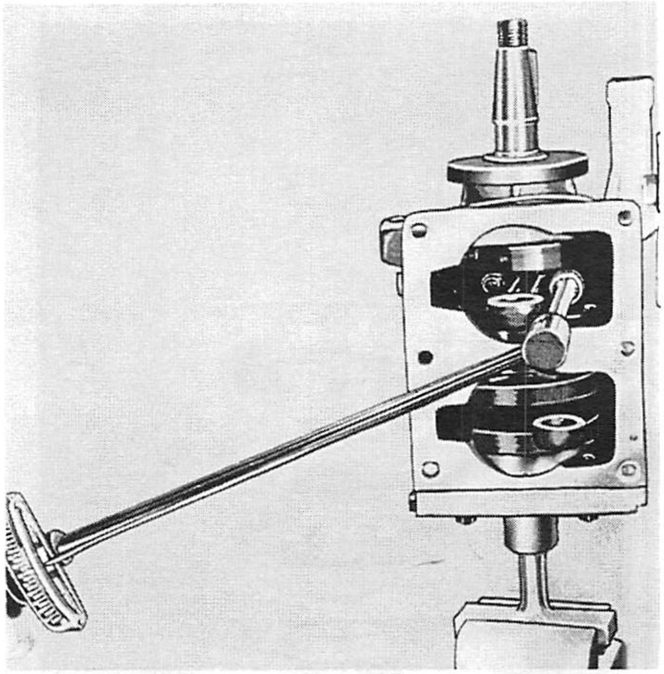


Figure 17. Torquing Connecting Rods

7. Press piston pin in with palm of hand but, if tight, use Piston Pin Tool (91-24263). Place tool bar in lower groove to install pin. Turn center screw against piston pin to install.
8. Install piston pin lock rings with long nose pliers. Place tip of ring in groove, turn counterclockwise and push in place at same time. Rotate to be sure that locks are secure.
9. Repeat process for other piston.
10. Install piston rings with Piston Ring Expander (91-24697).

E. CYLINDER BLOCK

1. Compress rings with Ring Compressor (91-24104 on all models with 2-7/16" bore, 91-24123 with Mark 15

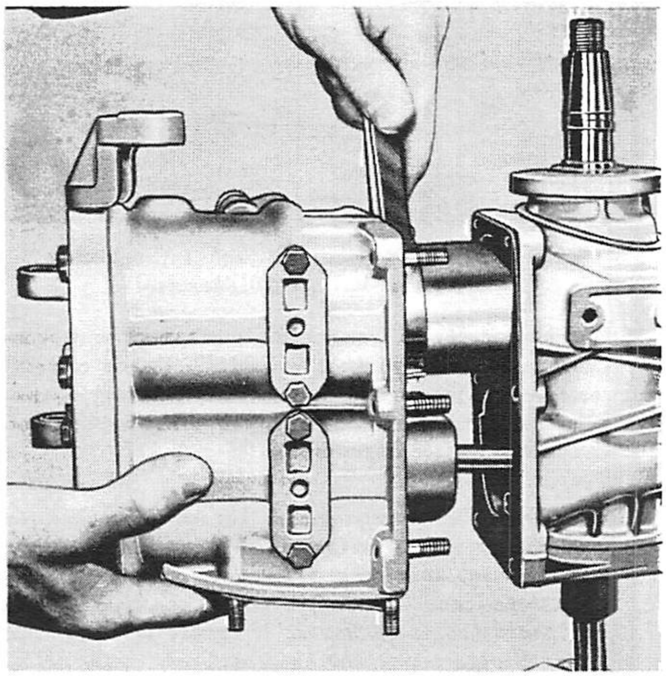


Figure 18. Replacing Cylinder Block

and KG4) and insert pistons into block, first lower, then upper piston.

2. Lubricate rings and cylinder walls before installing.
3. Check that new gasket is installed before replacing cylinder block on crankcase. (Figure 18)

NOTE: Install "O" ring between cylinder block and crankcase gasket in recess before installing piston in cylinder head on models with old block. On models with new block, no water enters crankcase bottom. (Figure 15)

4. Replace six 7/16" nuts on crankcase and cylinder block to hold 2 assemblies securely. Rotate powerhead on stand before tightening 6 nuts so that cylinder block will align itself properly in relation to crankcase.
5. Test piston rings with screwdriver for proper spring tension. Insert screwdriver thru exhaust ports on cylinder block, depressing ring. If ring is broken, it will remain in fixed position. Be careful not to burr rings.

NOTE: On Mark 20-15 models, replace pressure reed and reed stop and secure with 2 common head screws. Replace pressure valve gasket under pressure valve cover and secure to crankcase with three 5/16" cap screws. Replace pressure relief hose from center main bearing locking and pressure relief screw to check valve on pressure cover.

POWERHEAD ·· 4-CYLINDER MODELS

NOTE: For removal and disassembly of ignition, carburetors, fuel filters, fuel pumps, electrical starter parts and starter, see appropriate sections of this manual.

Disassembly

Type IV: 4-Cylinder Models

(Observe Cylinder Bore Specs., Page 2 Section VIII)

For older Models (Mark 50-40, Early Mark 30 and KG9, KF9), See Reference Notes, PP 35-36 This Section.

A. Removing Powerhead

Detach powerhead from drive shaft housing by removeing 8 hex head nuts from crankcase and cylinder block which secures it. Remove vent and fuel lines and disconnect electrical wiring as prescribed under Starter Section VII. Jar powerhead with heel of hand on exhaust side to loosen while holding lower cowling with other hand. Gasket between powerhead and drive shaft housing adheres tightly. *(See Note A-1 on P. 35 for Mark 40, KF9 & KG9; Note A-2 on P. 35 for Mark 30.)*

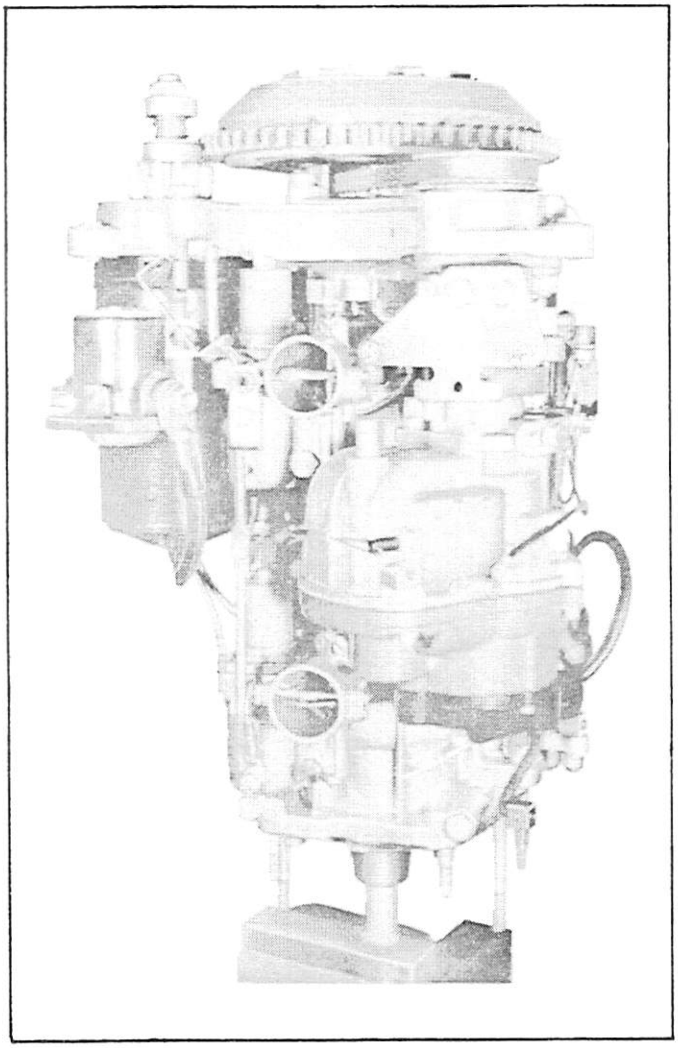


Figure 1. Mark 58E Powerhead

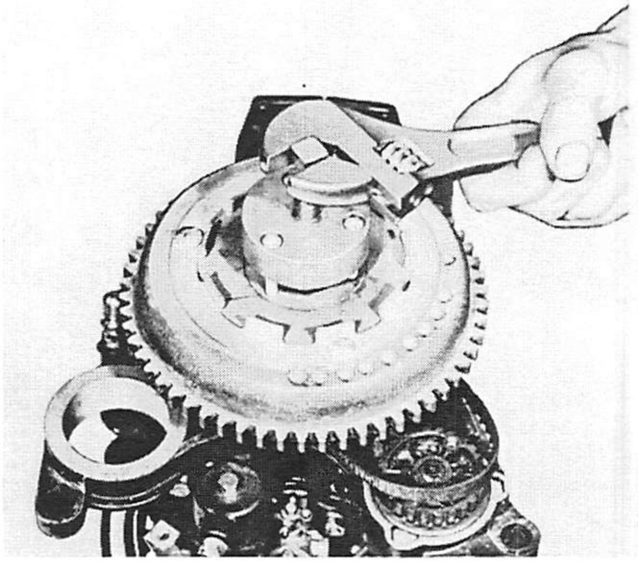


Figure 2. Removing Flywheel

Lift powerhead from lower cowling and drive shaft housing and mount powerhead on Powerhead Stand (91-25821) clamped in vise. (Figure 1) Remove 3 hex head cap screws and lockwashers from auxiliary starter plate and lift plate off. Remove 15/16" elastic stop nut and washer holding flywheel to crankshaft. Do not strike crankshaft nut with hammer to loosen or tighten. *(See Note A-3 on P. 35 for Mark 50-40.)*

Before pulling flywheel, remove magneto driven pulley by removing 5/16" cap screw, flat washer and lockwasher. Detach timing belt from driven pulley. To remove flywheel, use Flywheel Puller (91-24695). (Figure 2) Place protector cap (91-24161) on threaded end of crankshaft to prevent damage to threads. Attach puller to flywheel evenly by securing with 3 screws into top of flywheel. Tighten center screw with wrench until pressure is exerted on end of shaft to loosen. Tap on center screw with hammer to free flywheel from shaft, if exceptionally tight. Detach drive pulley from flywheel, if damaged, by cracking with chisel at keyway. Do not lose locating dowel pin. *(See Note A-4 on P. 35 for Mark 50-*

40.) Remove flywheel key from crankshaft with a pair of end cutting pliers. Remove hex head cap screws in exhaust manifold cover plate on left (port) side of motor. *(See Note A-5 on P. 35 for Mark 40, KF9, KG9.)* Separate baffle plate and gaskets when removing. Remove cylinder block cover and 4 intake deflectors (2 double deflectors on Mark 58 and later Mark 55-30) and gaskets by removing the cap screws. These covers need not be removed unless required for cleaning exhaust chamber and water cooling chamber.

B. Removing Upper End Cap

Remove 4 hex head nuts holding upper end cap to crankcase and cylinder block. Attach Universal End Cap Puller (91-25733A1) with 4 screws evenly and securely attached to upper end cap. (Figure 3) Tighten center screw to pull off end cap. *(For other 4-cylinder models, use two, three or four screws of same puller.)*

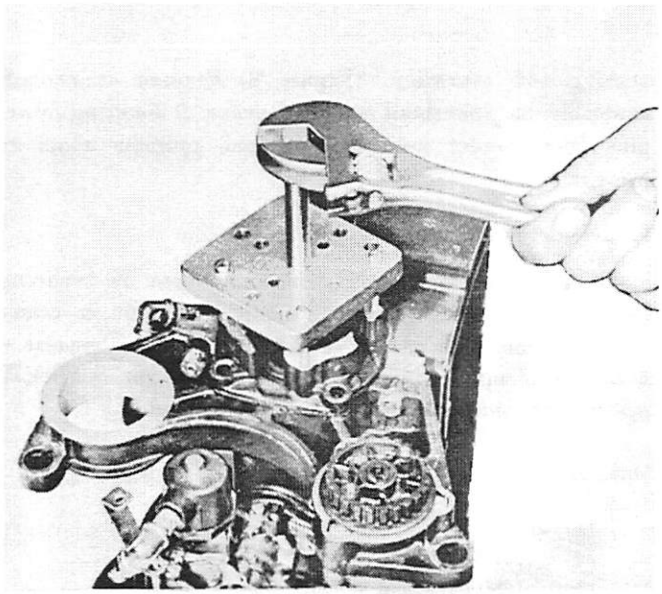


Figure 3. Removing Upper End Cap

Remove ball bearing in upper end cap with Ball Bearing Puller (91-24100). Insert puller from inside of end cap, handle end first. (Figure 4) Compress tool caps so tool will enter bearing. After tool is in, caps expand and catch lower end of inner bearing race. By applying pressure to handle, caps expand and a firm grip is obtained. Tap or press out. (Figure 5) Tap oil seal out with screwdriver. Remove "0" ring and shims and be sure to gauge shims with micrometer for replacement, if necessary.

C. Separating Crankcase and Cylinder Block

Remove all nuts and bolts securing crankcase to cylinder block. (See Note C-1 on P. 36 for Mark 55-50.)

(IMPORTANT: Crankcase and cylinder block are matched

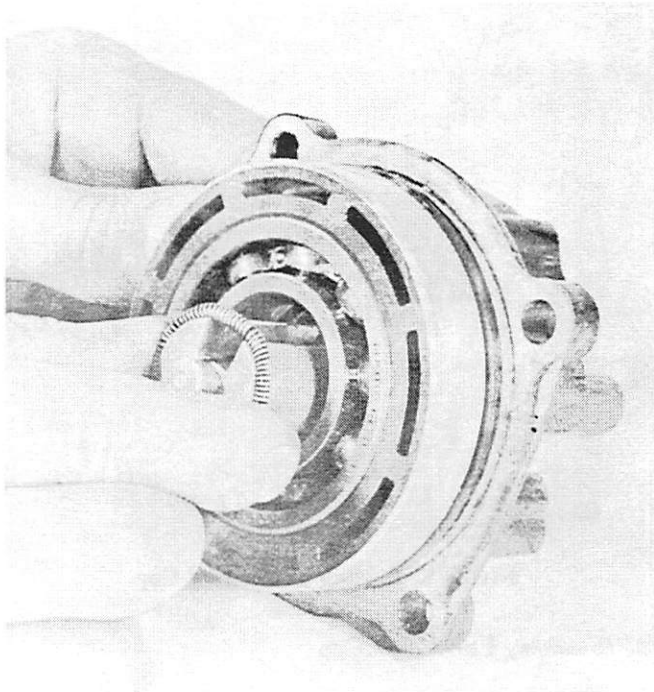


Figure 4. Inserting Ball Bearing Puller into End Cap Ball Bearing

assemblies, line bored and never should be mismatched by using different crankcase or cylinder block. Never place machined surface on concrete or in any place where surfaces may become marred, as this will result in leaking surfaces since no gasket is used at this point.) Remove three 9/16" center main bearing lock screws on outside of crankcase by first bending down lock tabs, below, with screwdriver. Remove screws entirely from crankcase.

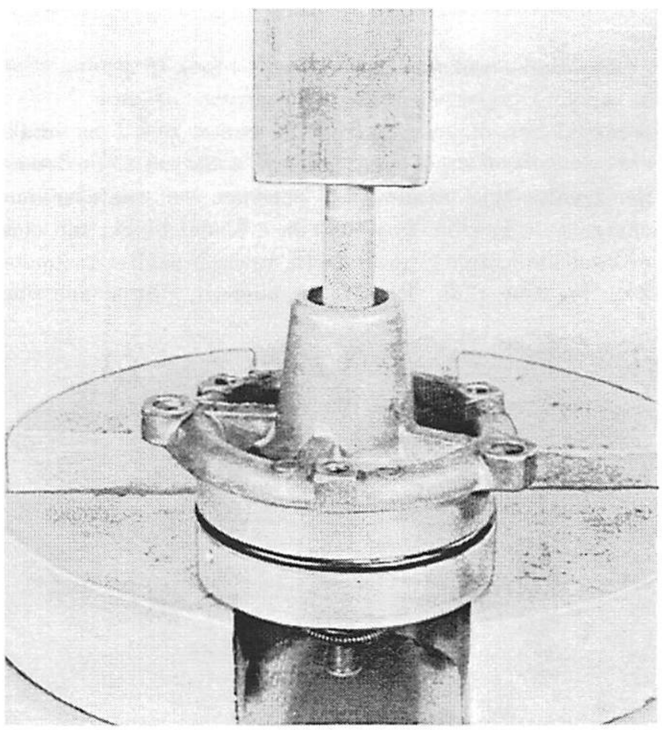


Figure 5. Pressing Ball Bearing Out of End Cap

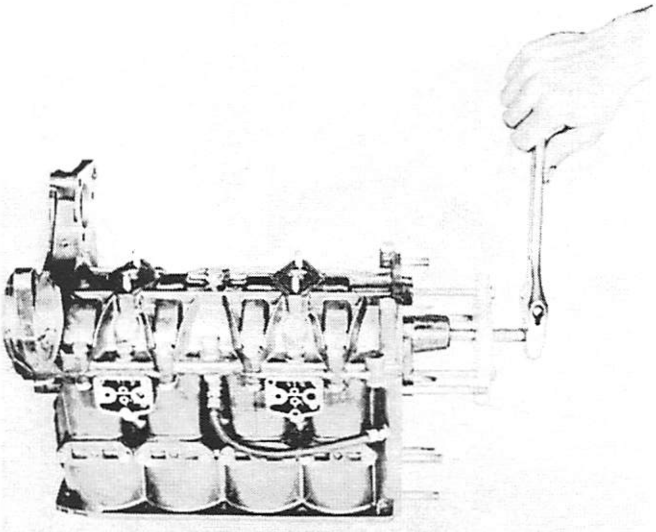


Figure 6. Pulling Lower End Cap

D. Removing Lower End Cap

Lift powerhead off stand to remove lower end cap. Remove 3 nuts holding lower end cap to crankcase and cylinder block. To pull lower end cap, follow procedure in Paragraph "B" ("Remove Upper End Cap"), preceding, with the exception of setting center plug of tool into crankshaft spline opening to accommodate center screw of Universal End Cap Puller (91-25733A1). (Figure 6) There are 2 seals (one seal on earlier Mark 55-30 and Mark 50 models) in the lower housing spaced to provide excellent sealing qualities. Remove ball bearing and seals, employing same procedure as under "Upper End Cap", and refer to Figures 4 and 5.

Separate crankcase from cylinder block by prying apart at special recesses with screwdriver. (Figure 7) Two recesses are on exhaust side in center and 2 on intake side at ends of crankcase. Remove crankcase. To loosen the 2 valve-type center main bearings and one aluminum center main bearing from seat in cylinder block, tap ends of crankshaft lightly upward with rawhide mallet to loosen from locating pins. Remove crankshaft, piston and con-

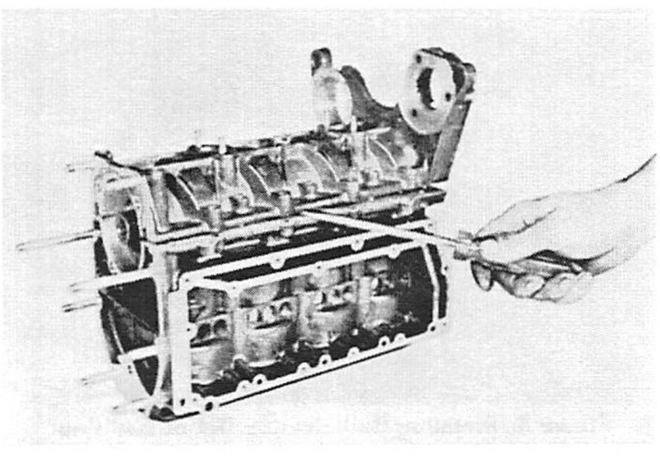


Figure 7. Separating Crankcase and Cylinder Block

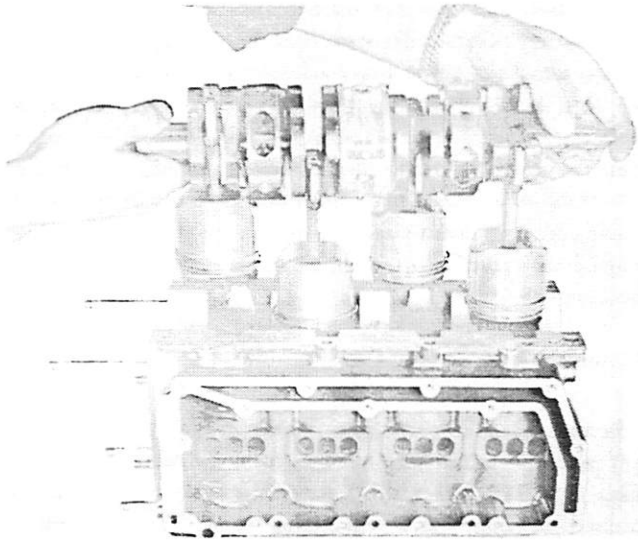


Figure 8. Removing (and Installing) Crankshaft Assembly from Cylinder Block

necting rod assembly. (Figure 8) Replace crankshaft assembly on powerhead stand. Remove 3 locating dowel pins from center main bearing and cylinder block to prevent losing.

E. Removing Magneto Adaptor

Detach magneto adaptor from crankcase by removing three 7/16" nuts. If magneto adaptor is tight in crankcase, tap out with mallet -- if necessary, for repairs -- with tool of equal diameter. *(Refer to Ignition Section IV information and photos for repair of distributor.)*

Mark 50-40, KF9, KG9: See Notes E-1 on / E-2 on Page 35

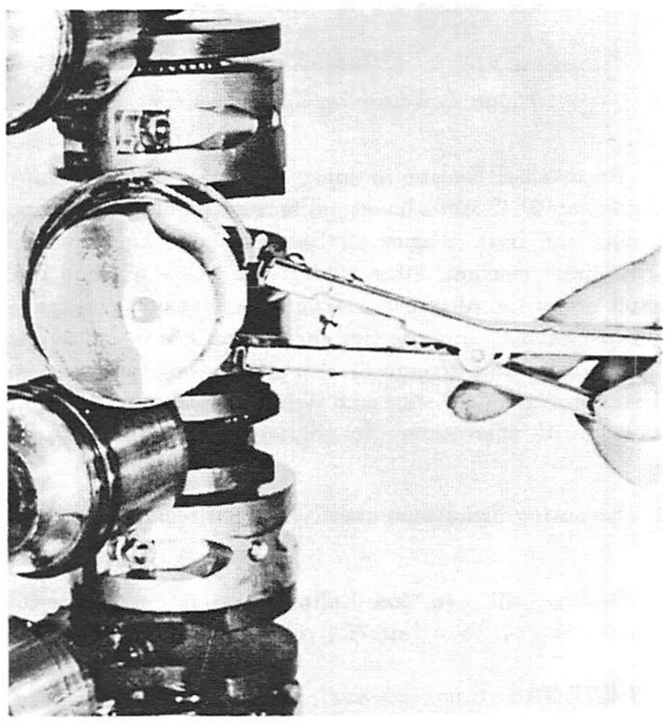


Figure 9. Removing (and Installing) Piston Rings

F. Disassembling Crankshaft and Piston Assembly

With Piston Ring Expander (91-24697), expand and remove piston rings from piston. (Figure 9) Remove piston pin lock rings on both ends of piston pin with long nose pliers. Turn counterclockwise and pull. With Piston Pin Bearing Tool (91-28734), place tool around piston, set bar of tool in center groove and turn screw in until piston pin emerges from piston. (Figure 10) Be careful of roller bearings, 22 in each piston pin race.

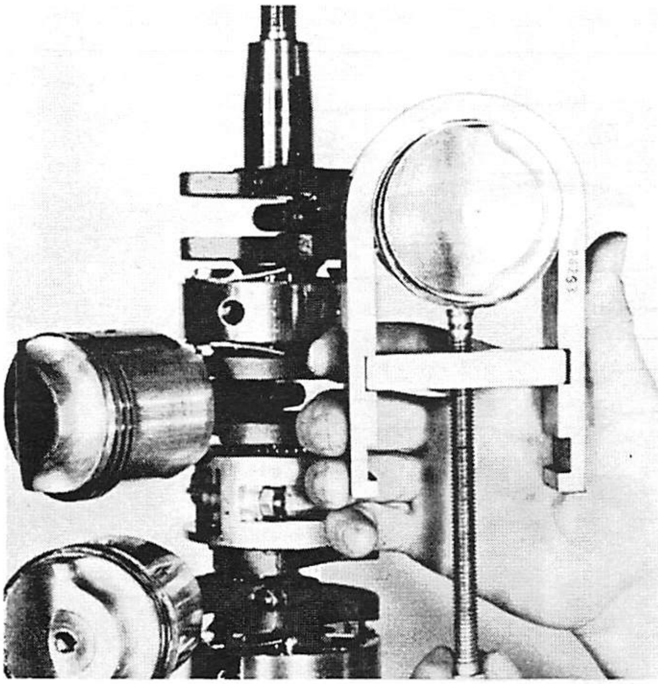
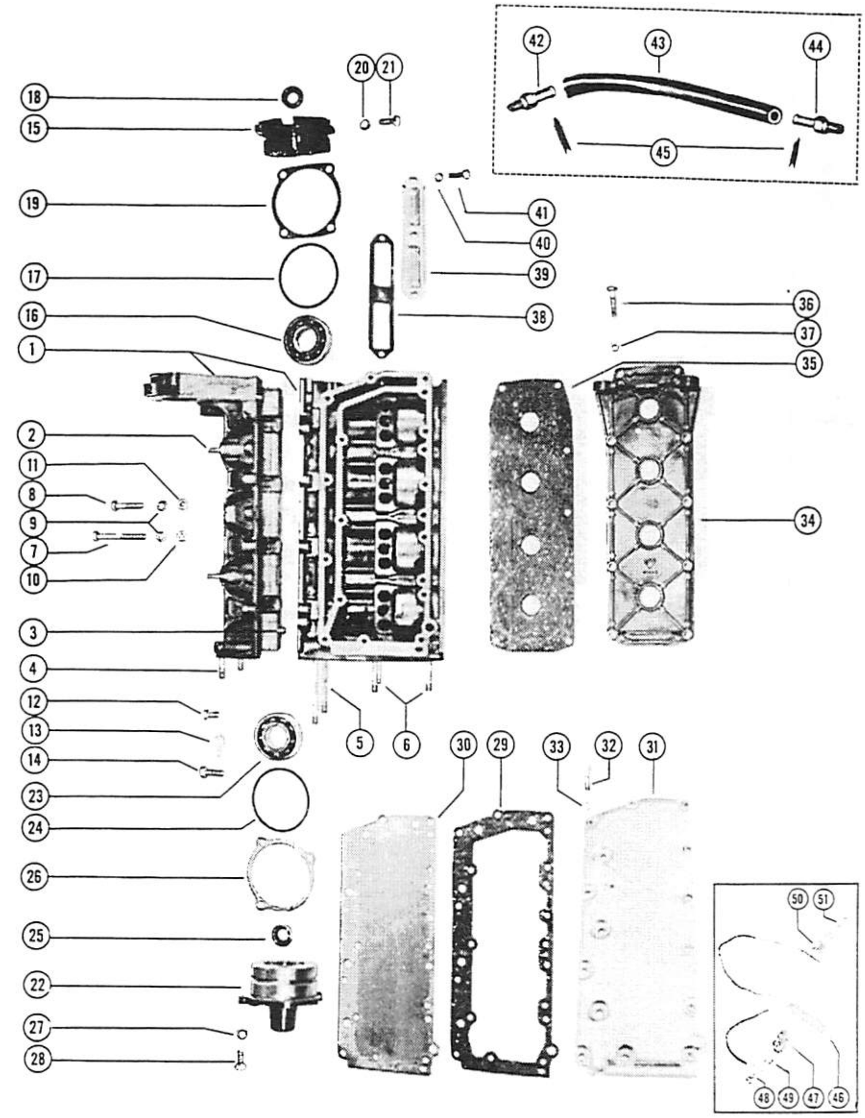


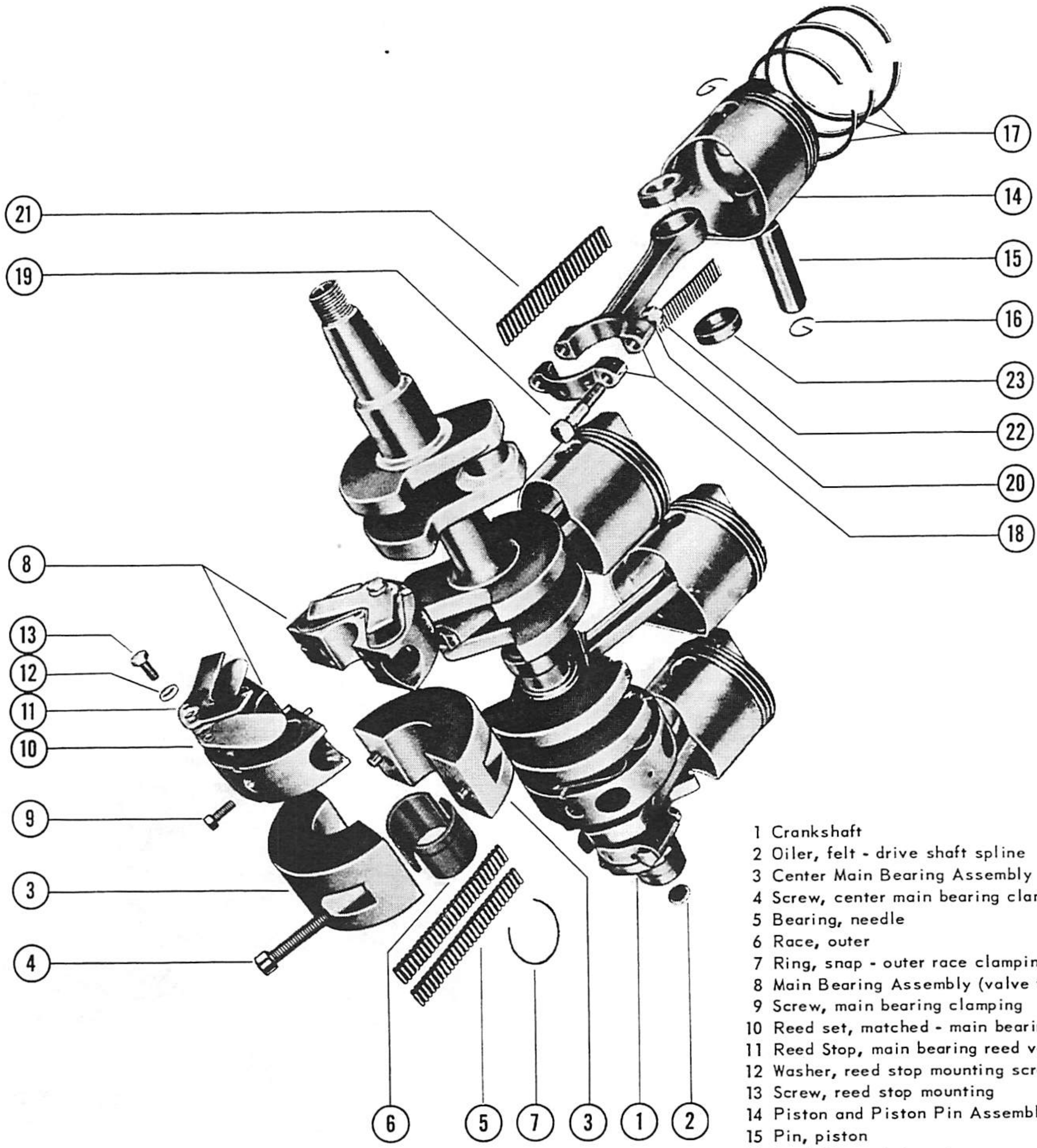
Figure 10. Removing (and Installing) Piston Pins

Connecting rods can be detached by removing 3/8" elastic stop nuts on connecting rod shoulder with 3/8" 6-point socket on ¼" drive. Center main bearing can be separated from crankshaft by removing 2 screws holding bearing halves together. Place entire assembly on horizontal in vise when removing bearings. Rear halves have a large, stepped dowel holding one-half of split race of bearing. Tap lightly to remove. Remove locking ring from split races. Separate and be careful not to drop the 56 roller bearings in center. Reed valve type center main bearings can be removed by removing 2 Phillips head screws. Be careful not to bend or distort reed valves and reed valve stops on bearings. Rematch each bearing on removal to be sure of proper matching on reassembly. Detach reed inlet valves and reed valve stops by removing 5/16" screw with socket wrench. *(Distinguish between right reeds and left reeds. Mark reed valves "L" (left) or "R" (right) for easier replacement if in condition to reuse.)*



1 Cylinder Block and Crankcase Assembly
2 Stud, carburetor mounting
3 Dowel Pin, crankcase to block
4 Stud, crankcase to housing
5 Stud, block to housing
6 Stud, block to housing
7 Screw, crankcase to cylinder block
8 Screw, crankcase to cylinder block
9 Washer, crankcase screw
10 Nut, crankcase screw
11 Nut, crankcase screw
12 Screw, main bearing locking
13 Tab Washer, bearing locking screw
14 Screw, center main bearing locking
15 End Cap Assembly, upper
16 Bearing, ball - upper end cap
17 "O" Ring, upper end cap
18 Oil Seal
19 Shim, upper end cap to crankcase
20 Lockwasher, upper end cap screw
21 Screw, upper end cap mounting
22 End Cap Assembly, lower
23 Bearing, ball - lower end cap
24 "O" Ring, lower end cap
25 Oil Seal
26 Shim, lower end cap to crankcase
27 Washer, lower end cap screw
28 Screw, lower end cap mounting
29 Gasket, cylinder block to man plate
30 Plate, exhaust manifold
29 Gasket, manifold plate to cover
31 Cover, exhaust manifold
32 Screw, manifold cover mounting
32 Screw, cover and high tension lead clip
33 Washer, cover & high ten lead clip screws
34 Cylinder Block Cover Assembly
35 Gasket, cylinder block cover
36 Screw, cylinder block cover mounting
37 Nut, cover mounting screw
38 Gasket, transfer port cover
39 Cover, transfer port
40 Washer, transfer port cover screw
41 Screw, transfer port cover mounting
42 Check Valve Assembly, bleed hose
43 Hose, cylinder bleed
44 Connector, cylinder bleed hose
45 Clamp, bleed hose to check valve & connector
46 Switch, mercury - exhaust manifold cover
47 Clamp, mercury switch to cover
48 Screw, mercury switch clamp fastening
49 "D" Washer, clamp and clip fast screw
50 Clip, mercury switch lead wire
51 Screw, lead wire clip fastening

Figure 11. Cylinder Block and Crankcase Assembly



1 Crankshaft
2 Oiler, felt - drive shaft spline
3 Center Main Bearing Assembly
4 Screw, center main bearing clamping
5 Bearing, needle
6 Race, outer
7 Ring, snap - outer race clamping
8 Main Bearing Assembly (valve type)
9 Screw, main bearing clamping
10 Reed set, matched - main bearing
11 Reed Stop, main bearing reed valves
12 Washer, reed stop mounting screw
13 Screw, reed stop mounting
14 Piston and Piston Pin Assembly
15 Pin, piston
16 Lock Ring, piston pin
17 Ring, piston
18 Connecting Rod and Cap Assembly
19 Screw, connecting rod
20 Nut, connecting rod screw
21 Bearing, needle - crankpin
22 Bearing, needle - piston pin
23 Washer, needle locating

Figure 12. Crankshaft, Pistons and Connecting Rods, Mark 58

NOTE: See "Parts Inspection -- How to Check", Page 2-4 of Powerhead Section, before reassembling. (Re: Earlier Mark 55-30 Models, refer to Note E-3, P. 35, prior to reassembly.)

A. Installation, Center Main Bearing to Crankshaft

Place crankshaft in vertical position on Powerhead Stand (91-25821) held in a vise. Be sure to replace felt oiler in splines of crankshaft. Grease races of center main bearing sufficiently on both sides to hold the 56 roller bearings. Use heavy grease. Space bearings equally around top and bottom halves of outer race, 28 in each complete row. **On later models only one row of rollers (28) is used on the crankshaft. Bearings and outer race are the same.** Fit snugly on crankshaft and insert snap

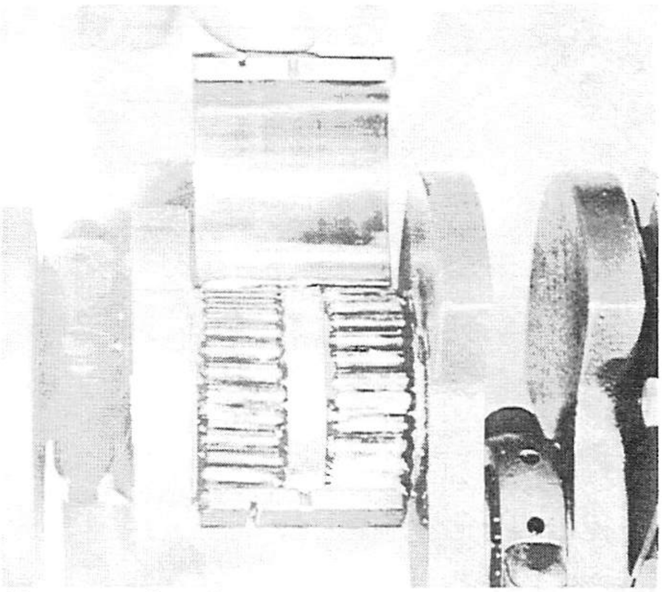


Figure 13. Installing Center Main Roller Bearings and Outer Race

ring around races. (Figure 13) Rotate several times to be sure that no binding will occur. Place stepped dowel in position and fit aluminum halves of center main bearing around it. The center main bearing must be installed with the mark, "TOP", to the top so that the bleed system will function properly. Tighten each half securely with 2 integral Phillips head screws. Either side can be placed up, as locking screw is located in center. Be sure that halves match perfectly. Always recheck for perfect match. *(NOTE: Check that bearings are not cocked when reassembling and that parts turn freely after installation.)*

Adjust reed valves on valve type center main bearing by setting reed valves squarely over their respective openings and at "no preload". *(This means that reed valves do not adhere tightly to seat but have a slight opening, never more than .007".)* (Figure 14) Place reed valve stops in position evenly over reed valves. Tighten

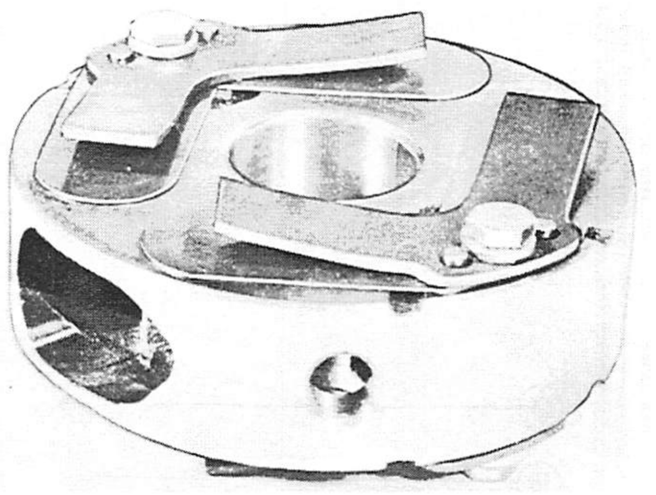


Figure 14. Reed Valve and Stop Settings

reed stop screws. Check all 8 reed valves for proper setting. Set reed valve stops according to Torque Specification Chart on P. 2A of Section VIII, from top of closed reed valve to bottom of reed valve stop. One half of reed valves are left hand, other half are right hand. Left reed valves have extra radius cut into reed valve at fastening end for identification. *(IMPORTANT: Always check reed stop opening dimension carefully, as larger opening can cause breakage and smaller opening will not allow sufficient fuel to enter at high RPM.)*

NOTE: When replacing reed valves on center main valve type bearing, be careful to set left reed valve on left side of bearing. In some cases, right reed valve can be set on left side to obtain a "no preload" condition. This is permissable as long as

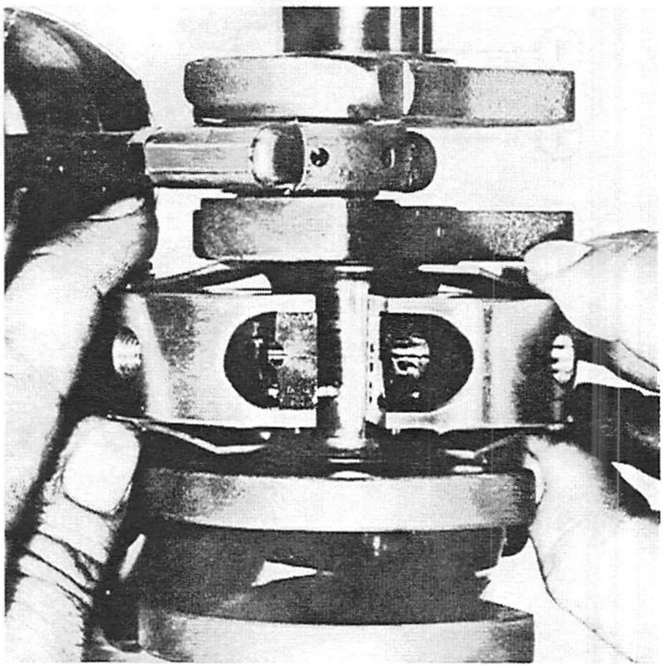


Figure 15. Installing Valve Type Center Main Bearing

valves have equal tension and flutter. Right and left is determined by viewing from point "V" (three holes) end of valve stop.

After resetting reed valves and valve stops on the 3 valve type center main bearings, replace them on crankshaft. (Figure 15) Tighten 2 integral screws securely on each center main to assure safe fit. Recheck reed valve spacing over openings and clearance between reed valve and stop.

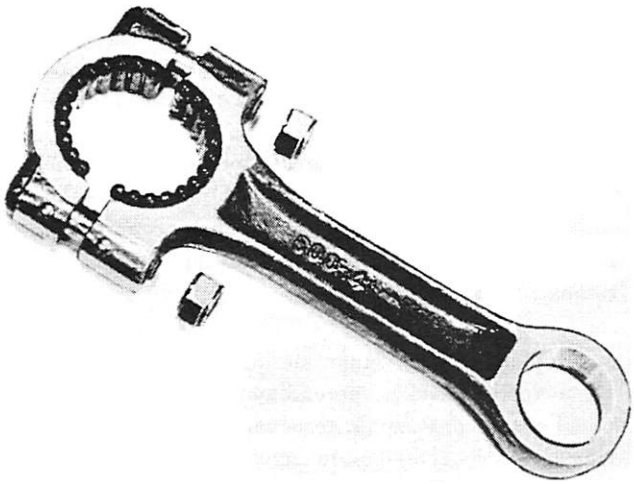


Figure 16. Connecting Rod Assembly Ready to Install

B. Assembling Connecting Rods

Prepare 4 connecting rods, opening matched assemblies (one at a time) by removing cap screws and lock nuts. Watch knob markings on cap and rod for reassembly. Take small amount of heavy lubricating grease on end of index finger and coat each half of connecting rod bearing race to hold roller bearings in place. Place roller bearings in greased race and space 25 roller bearings around both sides for reassembly -- 13 on one half, 12 on other. (Figure 16)

Place connecting rod cap so knob markings match connecting rod. Slip separated rod with bearings over crankshaft journal bearing surface, bringing cap up tight to fit and placing rod down to match cap. Insert cap screws and lock nut and tighten each nut evenly with torque wrench for perfect fit. Refer to Torque Specification Chart on P. 2A of Miscellaneous Section VIII for correct torque value. Rotate connecting rod after torquing, checking that it rotates freely. If rough, remove and check race and rollers. Repeat above procedure for other three connecting rods. Always recheck knob markings on reassembled rods for correct and perfect match. *(See Note B-1 on P. 35 for Mark 50-40, KF9, KG9.)*

C. Replacing Pistons

Replace piston pin bearings with Piston Pin Bearing Tool (91-22803) and slip bearing retainer washer onto tool sleeve. Coat sleeve with small amount of grease to

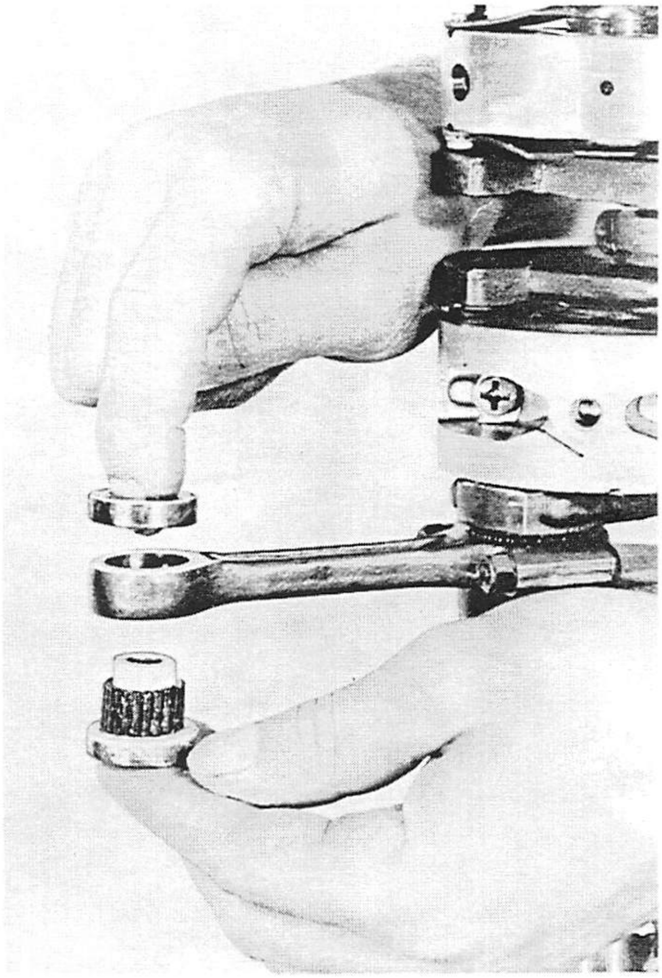


Figure 17. Inserting Piston Pin Bearings and Sleeve into Connecting Rod

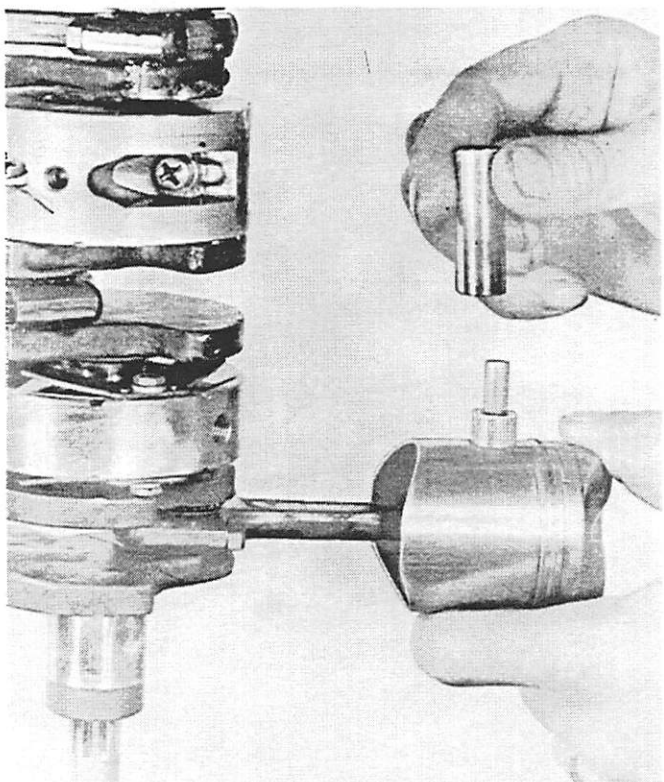


Figure 18. Inserting Piston Pin on Piston Pin Tool

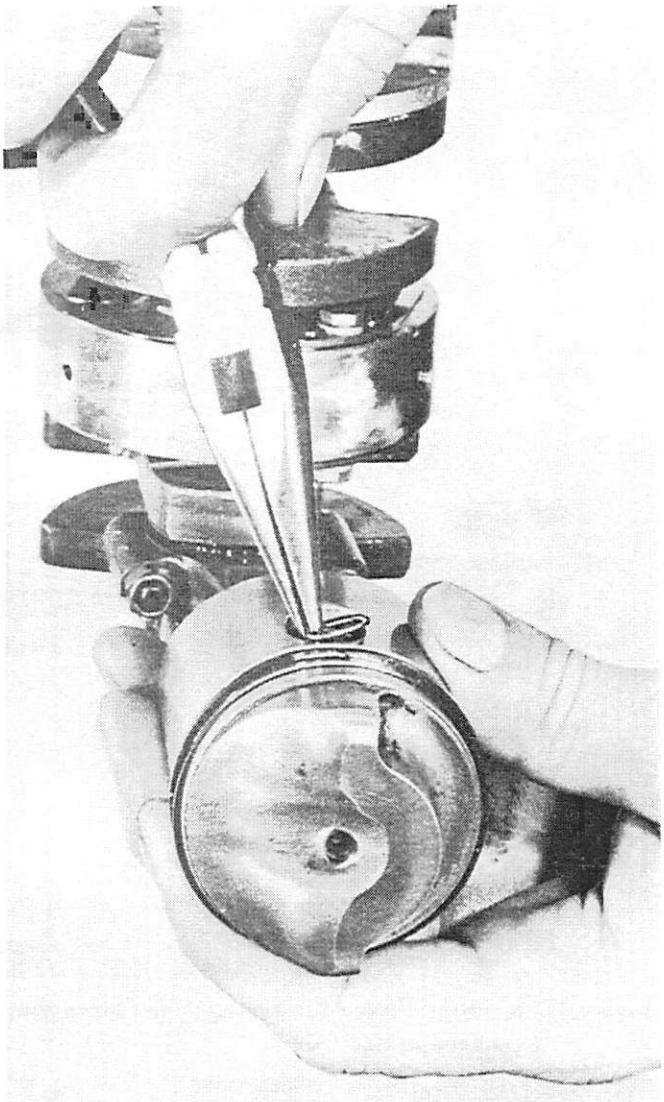


Figure 19. Removing and Installing Piston Pin Lock Ring

hold 22 roller bearings for each piston pin bearing race. Place bearings around sleeve of tool and then insert assembly into race of connecting rod. (Figure 17) Place other bearing retainer washer on opposite side of rod. Place piston over bearings (watch intake side of piston), grooved (sharp profile milled part of piston) to right looking at dome of piston. (Figure 18) Sloping top of piston is exhaust side. Push out sleeve with punch part of tool from bottom and set open end of piston pin on small end of piston pin tool. Press piston pin in with palm of hand and, if tight, tap with mallet, being sure to support piston and rod assembly so that rod is not bent. Piston Pin Tool (91-24263) may be used. (Figure 10) Check assemblies for binding after installing.

Repeat preceding process for other pistons, being certain to replace 2 piston pin lock rings in each piston to secure piston pin. Set tip of lock in groove and, with long nose pliers, push lock in and turn counterclockwise to seat. (Figure 19)

Replace piston rings on pistons with Piston Ring Expander (91-24697), spreading rings over end of piston and seating properly in grooves. (Figure 9) Check that rings float freely in piston groove after lubricating with oil. Align properly with ring openings over pins in piston ring grooves.

D. Replacing Crankshaft, Connecting Rod and Piston Assembly *(Refer to Note E-3, Page 35, before Reassembling)*

Set 3 dowel pins for center main bearings in respective place in cylinder block. Install completed piston and crankshaft assembly -- after removal from powerhead stand -- with piston Nos. 2 and 3 inserted into cylinder

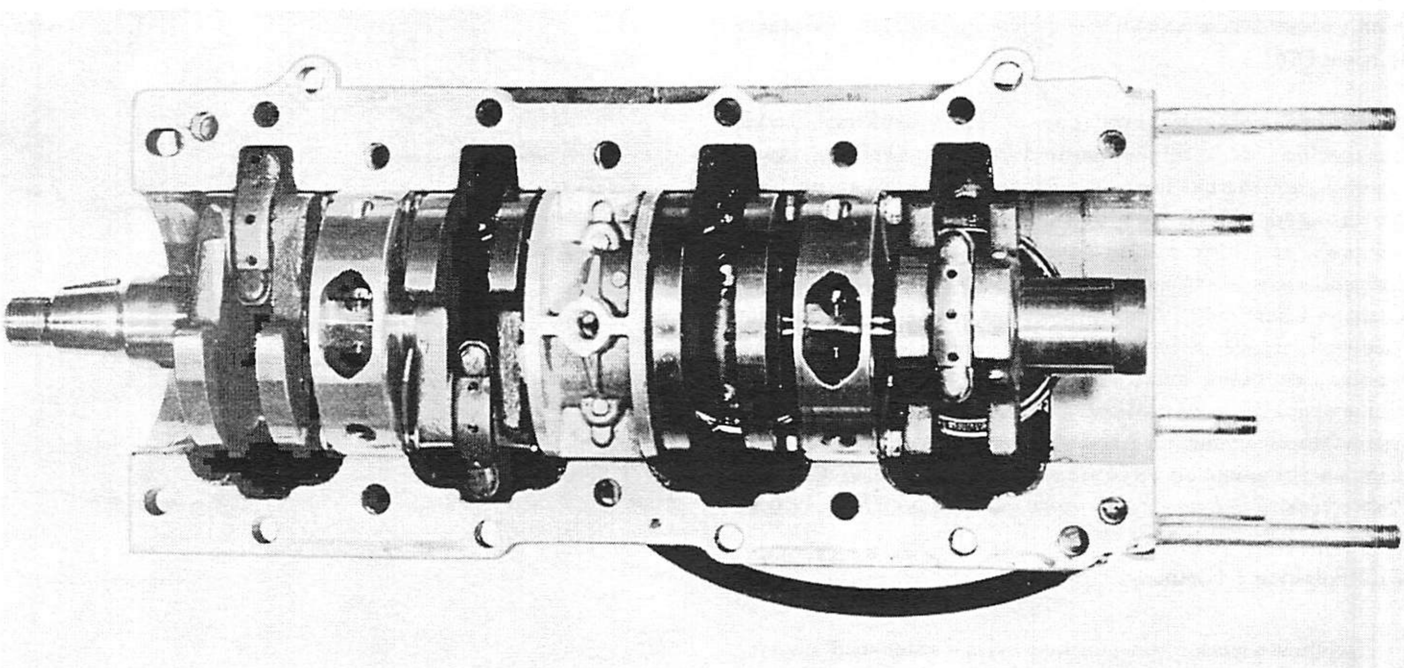


Figure 20. Center Main Bearings Correctly Aligned

head first. (Figure 8) While installing, check that crankshaft tapered end is to top of cylinder block and intake sides of pistons are in correct positions. Work pistons into cylinders. Use Piston Ring Compressors (91-28891-A2) or, with index finger, compress rings and ease pistons down into cylinder bores. Do not use undue force or rings will break. After piston Nos. 2 and 3 are inserted, set in piston Nos. 1 and 4 and work rings in same manner.

Align center main bearing and 2 valve type center main valve bearings on 3 locating pins in cylinder block and push in until seated. (Figure 20) Check each of 12 piston rings thru the exhaust or intake ports by pressing with screwdriver for spring tension. If no spring action occurs, or ring does not return to position, it is likely that ring has been broken in reassembly. Be careful not to burr piston rings.

E. Replacing End Caps, Cylinder Block & Crankcase

Replace oil seals in upper and lower end caps, using a tool of equal diameter and pressing in with arbor press. *(Note: When installing replacement oil seals 26-25837 in crankcase upper end cap only, the oil seal should be pressed in from inside of end cap and flush with inner surface, both lips face down. The 26-25837 oil seals are thicker and, if pressed in from the top, will cause center race of bearing to wear on seal. Particles may enter ball bearing race, thereby causing bearing to squeal and score.)* Replace ball bearings, pressing in with arbor press while using Propeller Shaft Gear Tool (91-23663). (Figure 21) Place "O" ring around end cap. Install upper and lower end caps temporarily on crankcase with same original shims. Tighten nuts on top and bottom. Check for end play between crankshaft ball bearing journal thrust face and inner race of ball bearings. (Figure 22) Tap crankshaft either way with mallet to be sure of attaining a true seat. Tolerance of end play on units should be .008" to .012". If too much end play, remove shims. If not enough, add shims in .002", .003", .005" or .010" thicknesses, as required. After end play check, remove end caps and place on "O" ring seals, spreading light film of white lead around for seal. It is very important that the shimming be equally spaced on the upper and lower caps to keep rod journal centerlines in centerline of cylinder bore.

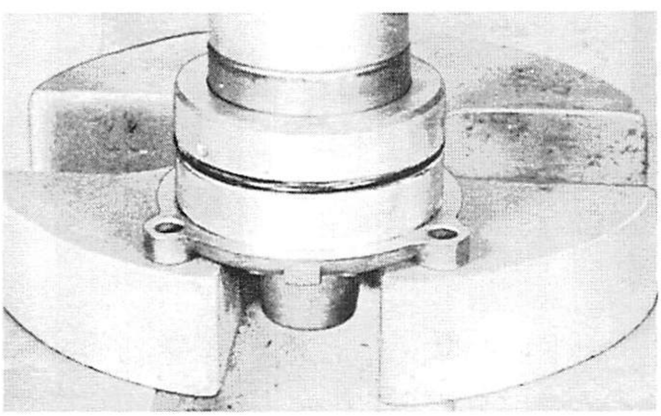


Figure 21. Installing End Cap Ball Bearings

Coat joint face of crankcase with Gasket Sealer 92-28804 for metal-to-metal seal. Set crankcase over cylinder block, insert bolts and attach nuts and washers. Do not tighten until end caps are permanently installed. Place 3 center main bearing locking screws with lock tab washers thru respective holes in crankcase to hold main bearings. Align opening of valve type center main with that of crankcase fuel intake opening so that they are evenly centered. Start tightening with "A" and follow with "B" roller bearing type center main. (Figure 23) Crimp lock tab washers after tightening screws to recommended torque. Refer to correct torque value in Torque Specification Chart, PP 2A-2B, Section VIII. Install end caps, being careful not to damage oil seal. Coat "O" ring face with white lead to form seal. Place proper screws in end cap. Do not tighten. Tighten crankcase bolts, starting with center bolts and work to top, then from center to bottom, etc, to prevent distortion of covers and possible leakage. (Refer to Figure 24.) Use torque values listed on Torque Specification Chart, PP 2A-2B, Section VIII. Tighten end cap screws securely.

Mount completed powerhead on Powerhead Stand (91-25821) in vise and rotate several times to be sure entire powerhead assembly is free. Reinstall intake port covers, cylinder block cover, renewing gaskets before installing. (Figure 11.) *(Use Permatex sealer on older motors if in doubt about seal on cylinder block cover.)* Intake port covers have beveled face to front of intake passage toward crankcase. Reinstall gasket on manifold and baffle plate and gasket for outside cover.

For easy installation, locate 4 studs in cylinder block exhaust side to aid in aligning plates and gaskets. Remove after several screws have been placed. Tighten cylinder block covers and exhaust manifold screws in proper sequence shown in Figure 24, thus preventing warpage and leakage. See sequence in Torque Specification Chart on P. 2B.

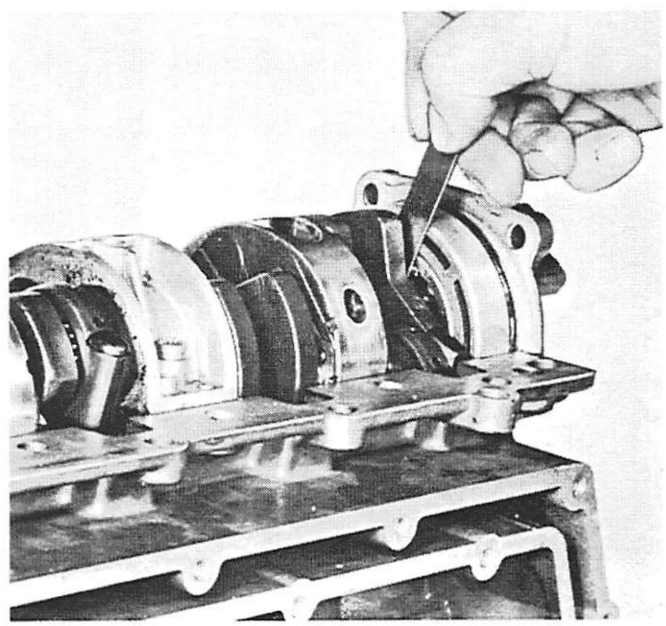


Figure 22. Gauging Crankshaft End Play

F. Installing Magneto Adaptor

A ball bearing is held in place by crimped tabs which cannot be removed. *(IMPORTANT: Magneto pilot must turn freely after assembling in adaptor on Mark 55 and should have .006" end play. Lubricate pilot with high temperature grease through grease fitting.)*

Press or tap magneto adaptor housing into crankcase, if removed, so 3 holes in adaptor align with 3 holes in crankcase flange. Secure with three 7/16" nuts and screws.

Mark 50-40, KF9, KG9: See Notes F-1 on Page 36

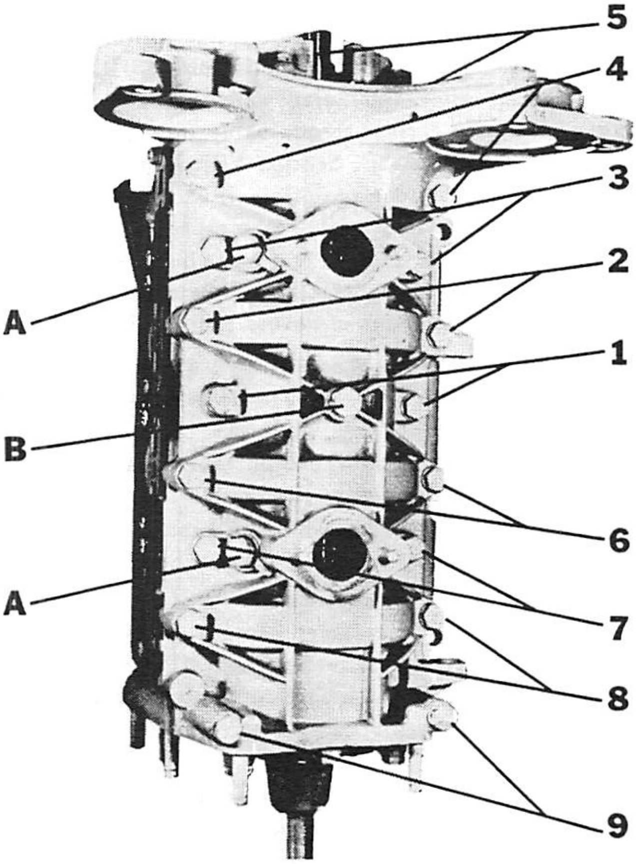


Figure 23. Correct Tightening and Torquing Sequence

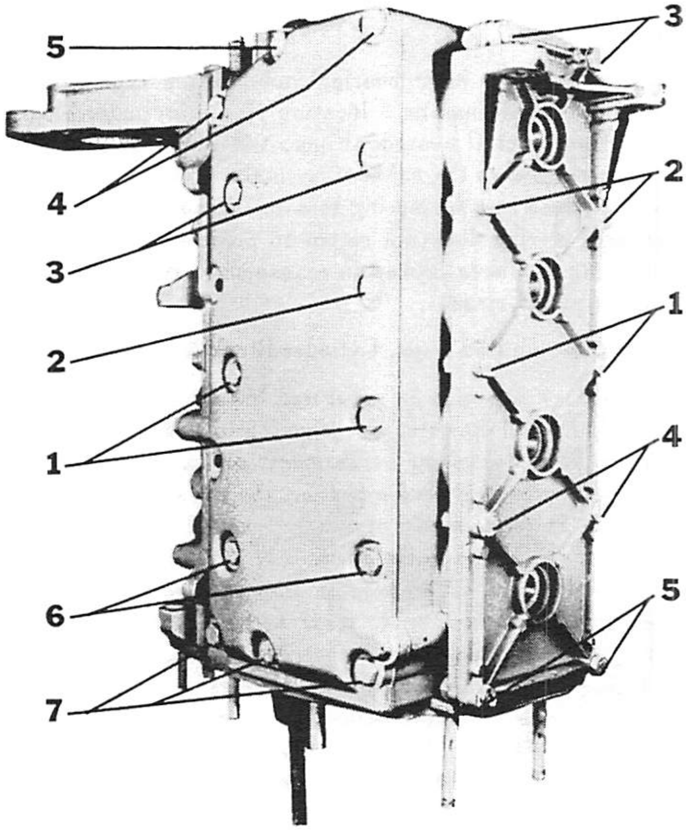


Figure 24. Correct Tightening and Torquing Sequence

NOTES

Powerhead .. 4- Cylinder Models

A-1:

Mark 40, KF9, KG9 - There is no gasket between power-head and drive shaft housing on these models. Use Gasket sealer 92-28804 or White lead as a seal.

A-2:

Mark 30 - Powerhead is mounted to lower cowl with 8 self-locking stop nuts. The cowl acts as an adaptor or mounting flange, as it is attached to the cowl via 6 self-locking stop nuts. See Torque Chart, P. 2A, Section VIII, for torquing values. Newer model Mark 30's no longer have the bottom cowl to drive shaft housing gasket. Use adhesive cement (92-25234) on this surface to form a good seal in place of the gasket.

A-3:

Mark 50-40 - Remove 3 hex head cap screws and lock-washers from auxiliary starter plate. Lift plate off, along with 3 heavy spacers and flywheel nut locking plate. Remove flywheel locking nut and flat washer.

A-4:

Mark 50-40 - Remove magneto drive pulley, if damaged, from disc type flywheel by driving off evenly with drift through 3 puller screw holes.

A-5:

Mark 40, KF9, KG9 - Remove Allen head screws, rather than cap screws, in exhaust manifold cover plate on left side of motor. These can be replaced with cap screws by removing studs.

B-1:

Mark 50-40, KF9, KG9 - When installing the new connecting rods (600-7A1), the connecting rod cap and screw ends must be ground down slightly so that connecting rods do not strike crankcase passages on the sandcast crankcases. (Figure 27) Be sure to check for clearance before tightening crankcase.

C-1:

Mark 50 - Be sure to remove 2 nuts on studs, one at electric starter flange adaptor, other at top, back of crankcase.

Mark 55 *(with die cast crankcase and cylinder block)* - Hex head bolts replace studs. Remove hex head bolts same as studs, mentioned above. Refer to stud location in Figure 23.

E-1:

Mark 50 - Remove magneto adaptor from crankcase by removing three 7/16" nuts, at the same time holding slotted screws with screw driver to keep from turning. Press entire unit out -- if necessary, for repairs -- with tool of equal diameter or drive out with mallet. To remove magneto shaft needle bearing and magneto shaft ball bearing, first pry upper and lower oil seal from adaptor with screwdriver. Remove snap lock ring with Snap Ring Pliers (91-24283). Insert Magneto Drive Bearing Tool (91-24096) in needle bearing. Place magneto adaptor up-side down and press out with arbor press. (Figure 25) This will push out upper ball bearing. Note depth of needle bearing in housing so that it can be installed at same depth later.

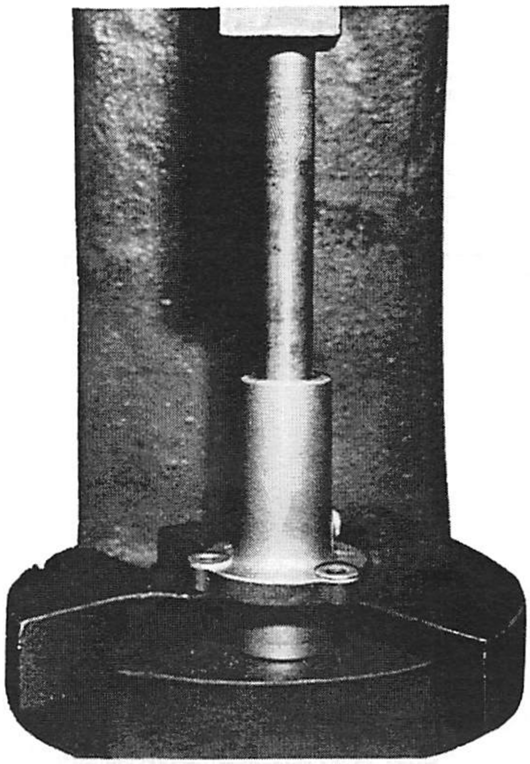


Figure 25. Removing Magneto Drive Bearing from Magneto Adaptor

E-2:

Mark 40, KF9, KG9 - Invert crankcase to press out needle bearings, as magneto adaptor is an integral part of crank-case. Use Magneto Drive Bearing Tool (91-24096).

E-3:

Later Mark 55-30 - These models have the water discharge outlet in the cylinder block relocated to provide water discharge at a more convenient location. (Refer to Fig.

26, below.) This requires the use of new exhaust manifold covers, baffle plates and gaskets. These parts are installed on replacement cylinder block and crankcase assemblies when ordered from the Mercury Parts Manual. *(IMPORTANT: The old exhaust manifold covers, baffle plates and gaskets cannot be used on the new cylinder blocks. The new covers, plates and gaskets can be used on old cylinder block assemblies.)*

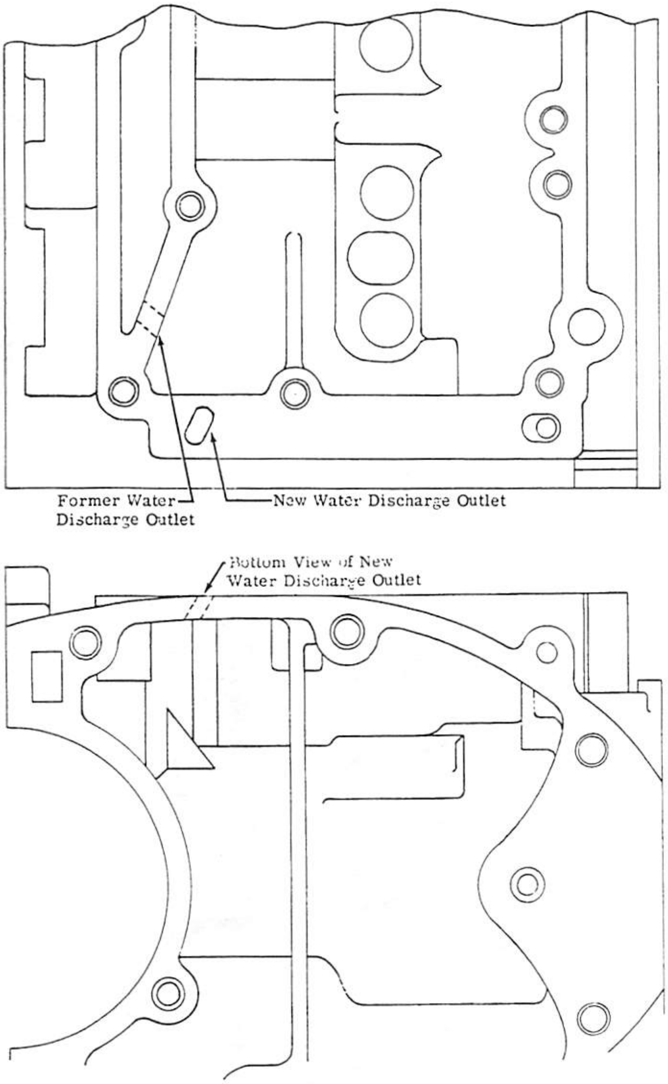


Figure 26. Water Discharge Outlet Relocated

F-1:

Mark 50 - Install new magneto shaft needle bearing in magneto adaptor assembly with Magneto Drive Bearing Tool (91-24096). (Figure 28) Press in ¼" beyond oil seal shoulder or to depth checked before removal. Use arbor press. Install lower oil seal (lips toward inside of housing as shown in Figure 29) and press toward inside

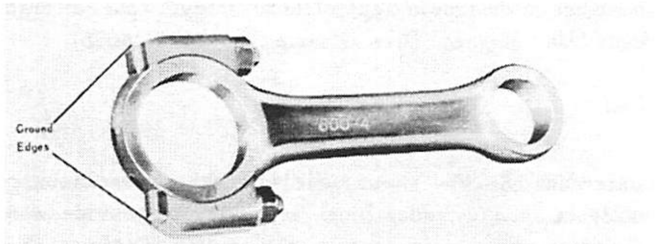


Figure 27. Rod Edges Ground Down

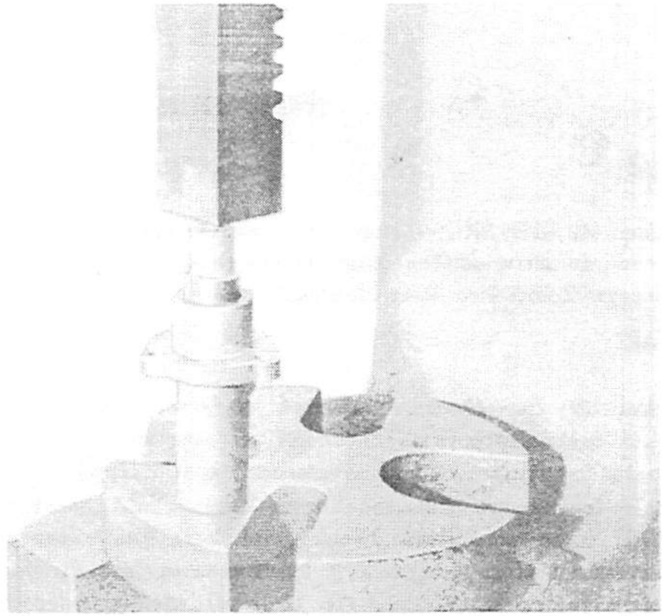


Figure 28. Installing Magneto Shaft Ball Bearing

of housing 'til seated on shoulder. Tap in place until it seats. With same tool, place magneto upper ball bearing in place, tapping it in until it seats. Replace snap ring with Snap Ring Pliers (91-24283).

Mark 40, KF9, KG9 - Install magneto shaft needle bearing in magneto adaptor, integral in crankcase. Follow Mark 50 procedure, above.

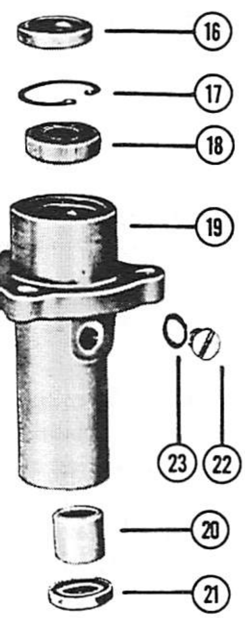


Figure 29. Magneto Adaptor Assembly

16 Oil Seal, magneto shaft bearing
17 Snap Ring, magneto shaft bearing
18 Ball Bearing, magneto shaft
19 Adaptor, magneto
20 Needle Bearing, magneto shaft lower
21 Oil Seal, magneto shaft needle bearing
22 Screw, grease filler hole
23 Fibre Washer, grease filler hole

POWERHEAD -- 6-CYLINDER MODELS

NOTE: For removal and disassembly of ignition, carburetors, fuel filters, fuel pumps, electrical starter parts and starter, see appropriate sections.

Disassembly

A. Removing Powerhead

Detach powerhead from drive shaft housing by removing 8 hex head nuts from crankcase and cylinder block which secures it. Remove vent and fuel lines and disconnect electrical wiring as prescribed under Starter Section VII.

Jar powerhead with heel of hand on exhaust side to loosen while holding lower cowling with other hand. Gasket between powerhead and drive shaft housing adheres tightly. Lift powerhead from lower cowling and drive shaft housing and mount powerhead on Powerhead Stand (91-25821, or 91-30591 for Merc 800) clamped in vise. (Figure 1)

Remove 15/16" elastic stop nut and washer holding flywheel to crankshaft. When removing flywheel to crankshaft nut, do not strike wrench with hammer to loosen nut. *(Note: Before pulling flywheel, remove distributor driven pulley flange by removing 5/16" cap screw, flat washer and lockwasher. Detach timing belt from driven pulley.)* To remove flywheel, use Flywheel Puller (91-24695). (Figure 2) *(Note: Later models have 5/16"-24 thread puller screw holes in flywheel. Modify Flywheel Puller 91-24695 by drilling out the 3 puller screw holes to 11/32" diameter, then use three 10-21449 screws, 5/16"-24 thread x 2" long.)* Place Protector Cap (91-24161) on threaded end of crankshaft to prevent damage to threads. Attach puller to flywheel evenly by securing with 3 screws into top of flywheel. Tighten center screw with wrench until pressure is exerted on end of shaft to loosen. Tap on center screw with hammer to free flywheel from shaft, if exceptionally tight. Detach drive pulley from flywheel, if damaged, by cracking with chisel at keyway. Do not lose locating dowel pin. Remove flywheel key from crankshaft with a pair of end cutting pliers.

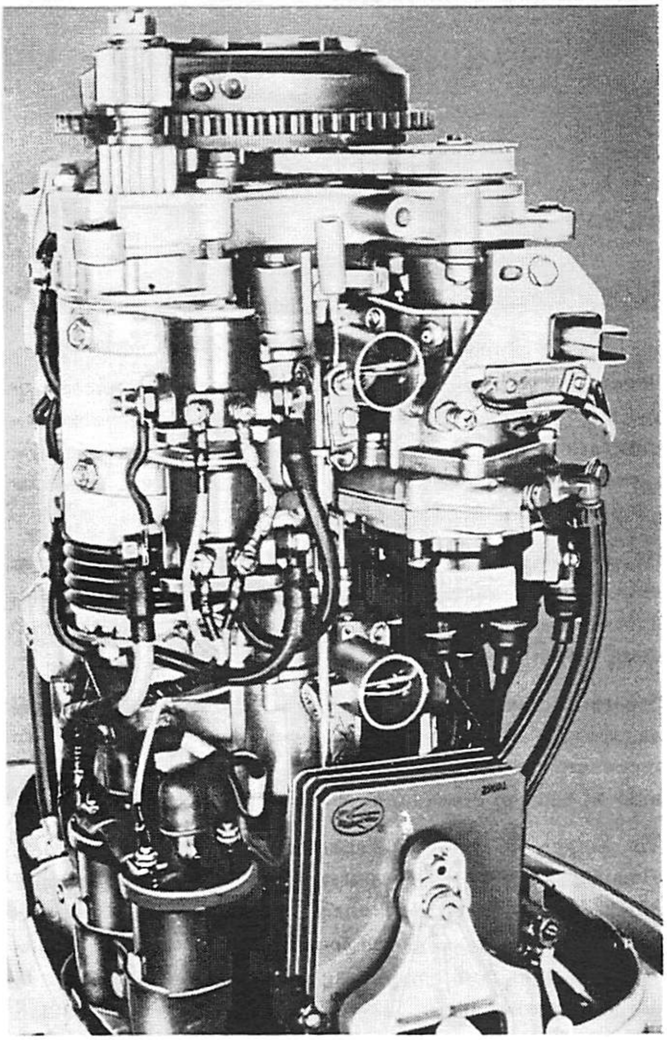


Figure 1. 6-Cylinder Powerhead

Remove 4 screws and lockwashers from stator alternator, then timing belt and stator alternator leads.

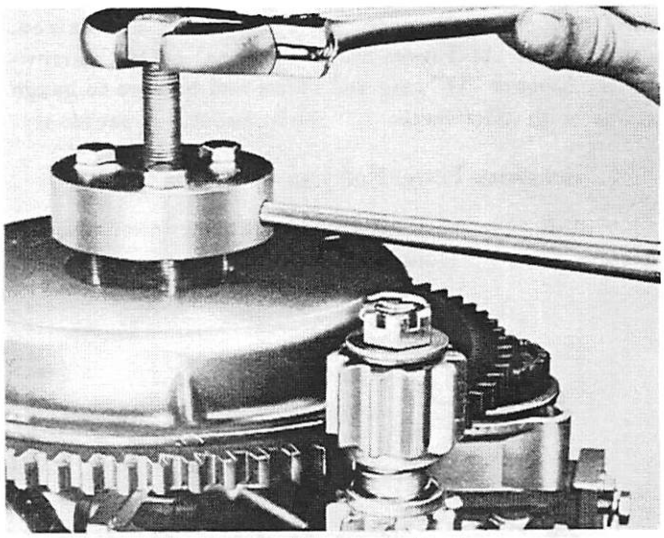


Figure 2. Removing Flywheel

Remove hex head cap screws in exhaust manifold cover plate on left (port) side of motor. Separate baffle plate and gaskets when removing. Remove cylinder block cover and 6 intake deflectors and gaskets by removing the cap screws. These covers need not be removed unless required for cleaning exhaust chamber and water cooling chamber.

B. Remove Upper End Cap

Remove 4 hex head nuts which hold upper end cap to crankcase and cylinder block. Attach Universal End Cap Puller (91-25733A1) with 4 screws evenly secured to upper end cap. Tighten center screw to pull end cap. (Figure 3)

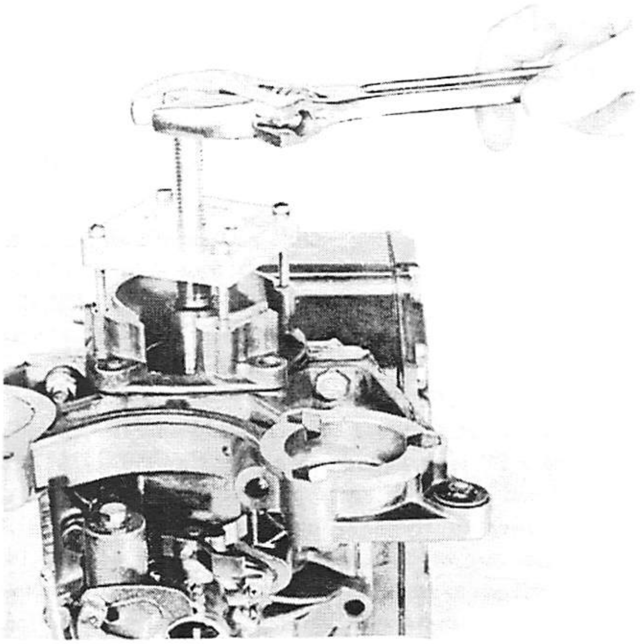


Figure 3. Removing Upper End Cap

Remove ball bearing in upper end cap with Ball Bearing Puller (91-24100). Insert puller from inside of end cap, handle end first.(Figure 4) Compress tool caps so tool will enter bearing. After tool is in, caps expand and catch lower end of inner bearing race. By applying pressure to handle, caps expand and a firm grip is obtained. Tap or press out (Figure 5). Tap oil seal out with screwdriver. Remove "O" ring and shims and be sure to gauge shims with micrometer for replacement, if necessary.

C. Removing Lower End Cap

Lift powerhead off stand to remove lower end cap. Remove 3 nuts holding lower end cap to crankcase and

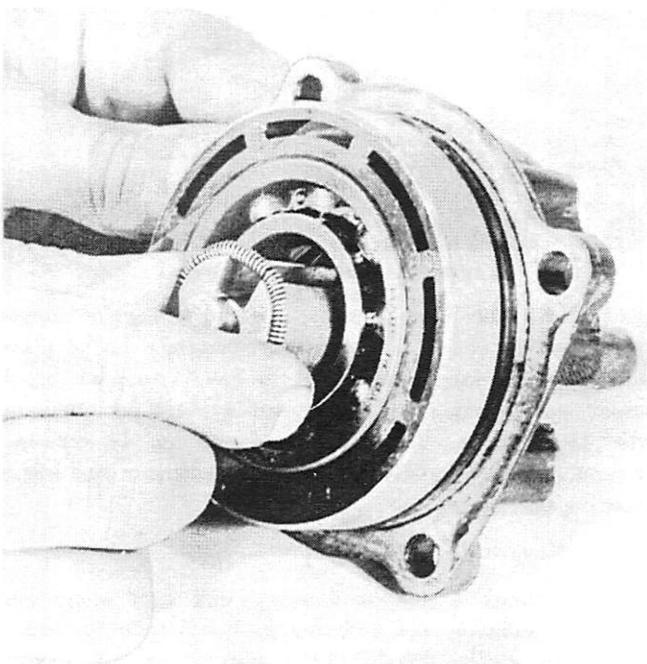


Figure 4. Inserting Ball Bearing Puller into End Cap Ball Bearing

cylinder block.

To pull lower end cap, follow procedure in Para. B ("Remove Upper End Cap"), preceding, with the exception of setting center plug of tool into crankshaft spline opening to accommodate center screw of Universal End Cap Puller (91-25733A1). (Figure 6) There are 2 seals in the lower housing spaced to provide excellent sealing qualities. Remove ball bearing and seals, employing same procedure as under Upper End Cap and see Figures 4 and 5.

D. Separating Crankcase and Cylinder Block

Remove all nuts and screws which secure crankcase to cylinder block. *(NOTE: Crankcase and cylinder block are matched assemblies, line bored, and should*

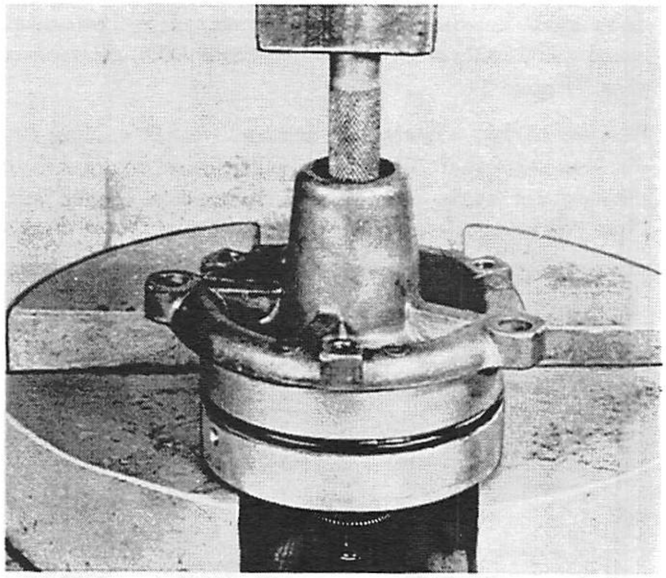


Figure 5. Pressing Ball Bearing Out of End Cap

never be mismatched by using different crankcase or cylinder block. Never place machined surfaces on concrete or in any place where surfaces may become marred, as this will result in leaking surfaces, since no gasket is used at this point.)

Remove five 9/16" center main bearing lock screws on outside of crankcase by first bending down lock tabs, below, with screwdriver. Remove screws entirely from crankcase.

Separate crankcase from cylinder block by prying apart at special recesses with screwdriver. (Figure 7) Two recesses are on exhaust side in center and 2 on intake side at ends of crankcase. Remove crankcase.

To loosen 3 valve-type center main bearings and 2 aluminum center main bearings from seats in cylinder block, tap ends of crankshaft lightly upward with rawhide mallet to loosen from locating pins. Remove crankshaft, piston and connecting rod assembly. (Figure 8) Replace crankshaft assembly on powerhead stand. Remove 5 locating dowel pins from center main bearing and cylinder block to prevent losing.

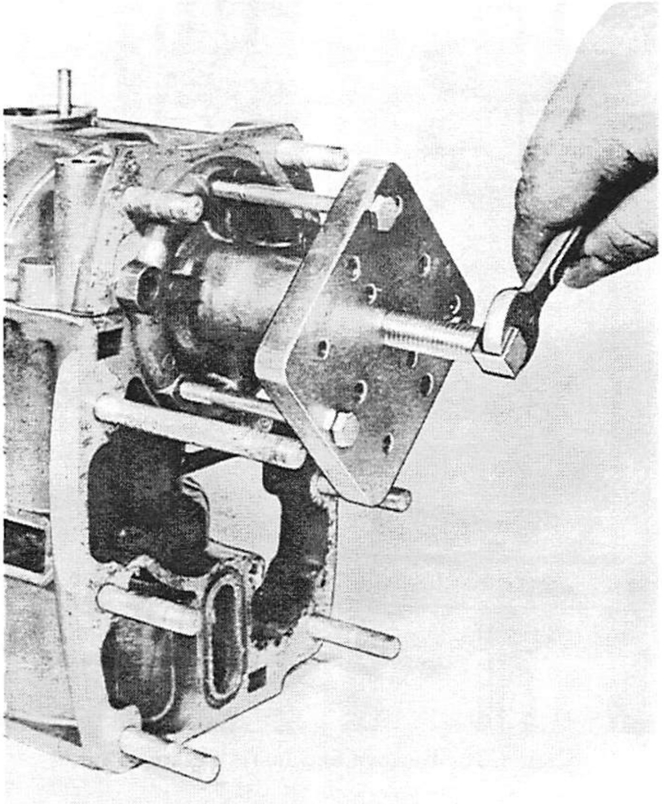


Figure 6. Pulling Lower End Cap

Detach distributor adaptor from crankcase by removing three 7/16" nuts. If distributor cap is tight in crankcase, tap out with mallet -- if necessary, for repairs -- with tool of equal diameter. See Ignition Section IV for repair of distributor.

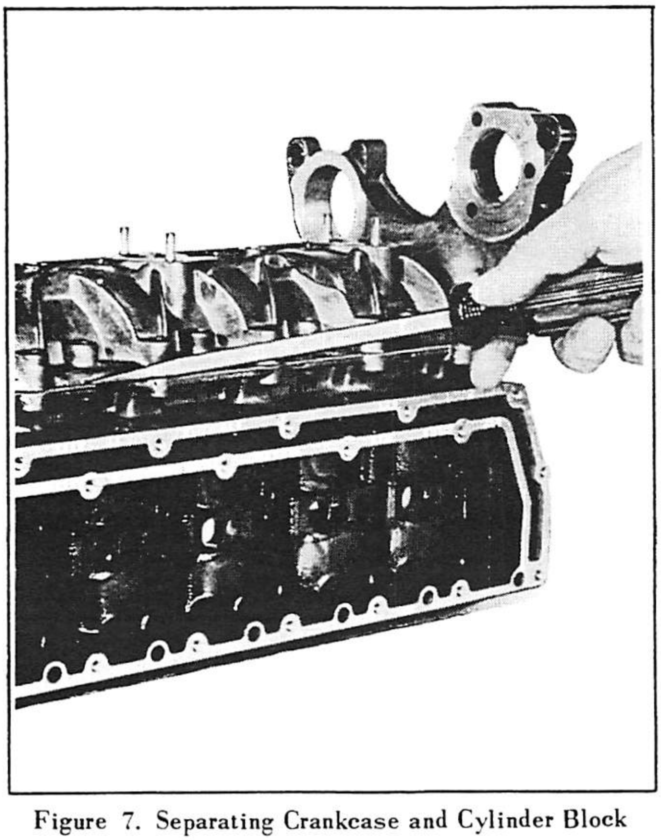


Figure 7. Separating Crankcase and Cylinder Block

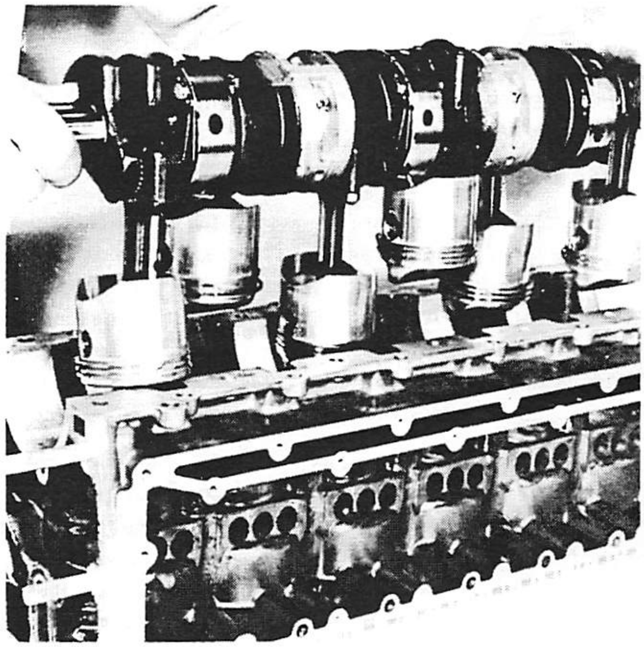


Figure 8. Removing (and Installing) Crankshaft Ass'y from Cylinder Block

E. Disassembling Crankshaft and Piston Assembly

With Piston Ring Expander (91-24697), expand and remove piston rings from pistons. (Figure 9) Remove piston pin lock rings on both ends of piston pin with long nose pliers. Turn counterclockwise and pull. Place Piston Pin Bearing Tool (91-30425A1) around piston, set bar of tool in center groove and turn screw in until piston pin emerges from piston. *(Note: Line up "C" and "C" on tool for centered piston pins, "O" and "C" for off-center pins, as shown in Figure 10.)* Be careful of roller bearings, 22 in each piston pin race of Merc 700-600 and Mark 78-78A-75-75A, 25 in higher (80+) horsepower Mercs.

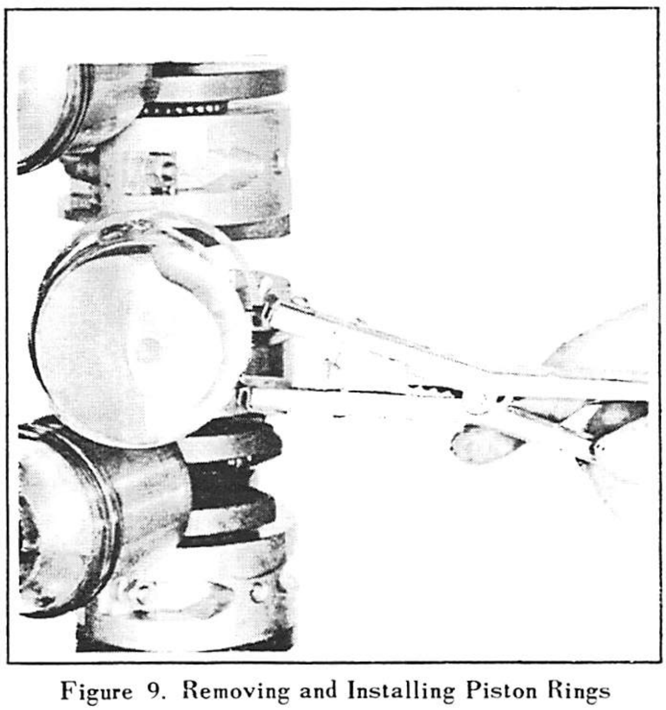


Figure 9. Removing and Installing Piston Rings

Connecting rods can be detached by removing 3/8" elastic stop nuts on connecting rod shoulder with 3/8" 6-point socket on ¼" drive.

NOTE: Be careful of roller bearings, 25 in each race of Merc 700-600 and Mark 78-78A-75-75A, 30 in 70 and higher horsepower Full Gear Shift models.

Center main bearing can be separated from crankshaft by removing 2 screws holding bearing halves together. Place entire assembly on horizontal in vise when removing bearings. Rear halves have a large stepped dowel holding ½ of split race of bearing. Tap lightly to remove. Remove locking ring from split races. Separate and be careful not to drop the 56 roller bearings in center.

Repeat for second bearing-type center main. Reed valve type center main bearings can be removed by removing 2 Phillips head screws. Be careful not to bend or distort reed valves and reed valve stops on bearings. Rematch each bearing on removal to be sure of proper matching on reassembly. Detach reed inlet valves and reed valve stops by removing 5/16" screw with socket wrench.

Note right reeds and left reeds. Mark reed valves "L" (left) or "R" (right) for easier replacement if in condition to reuse.

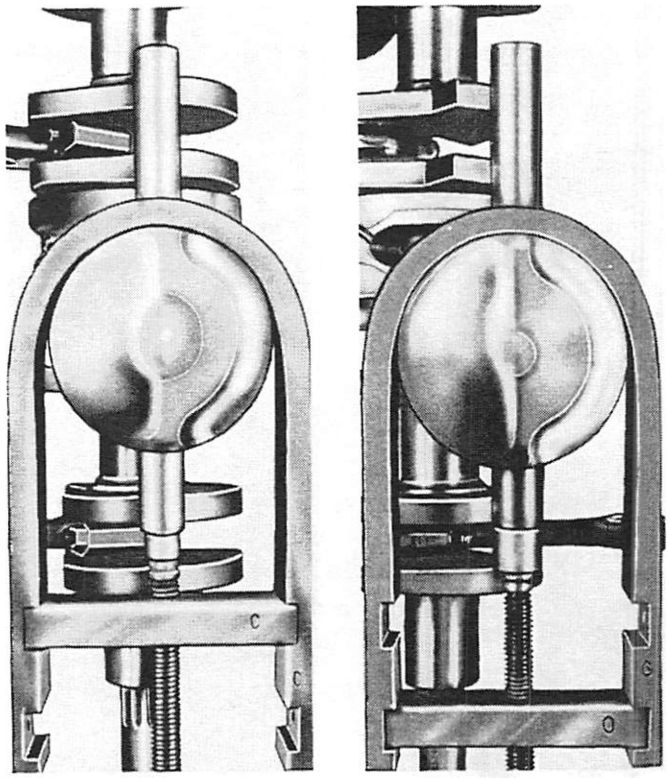
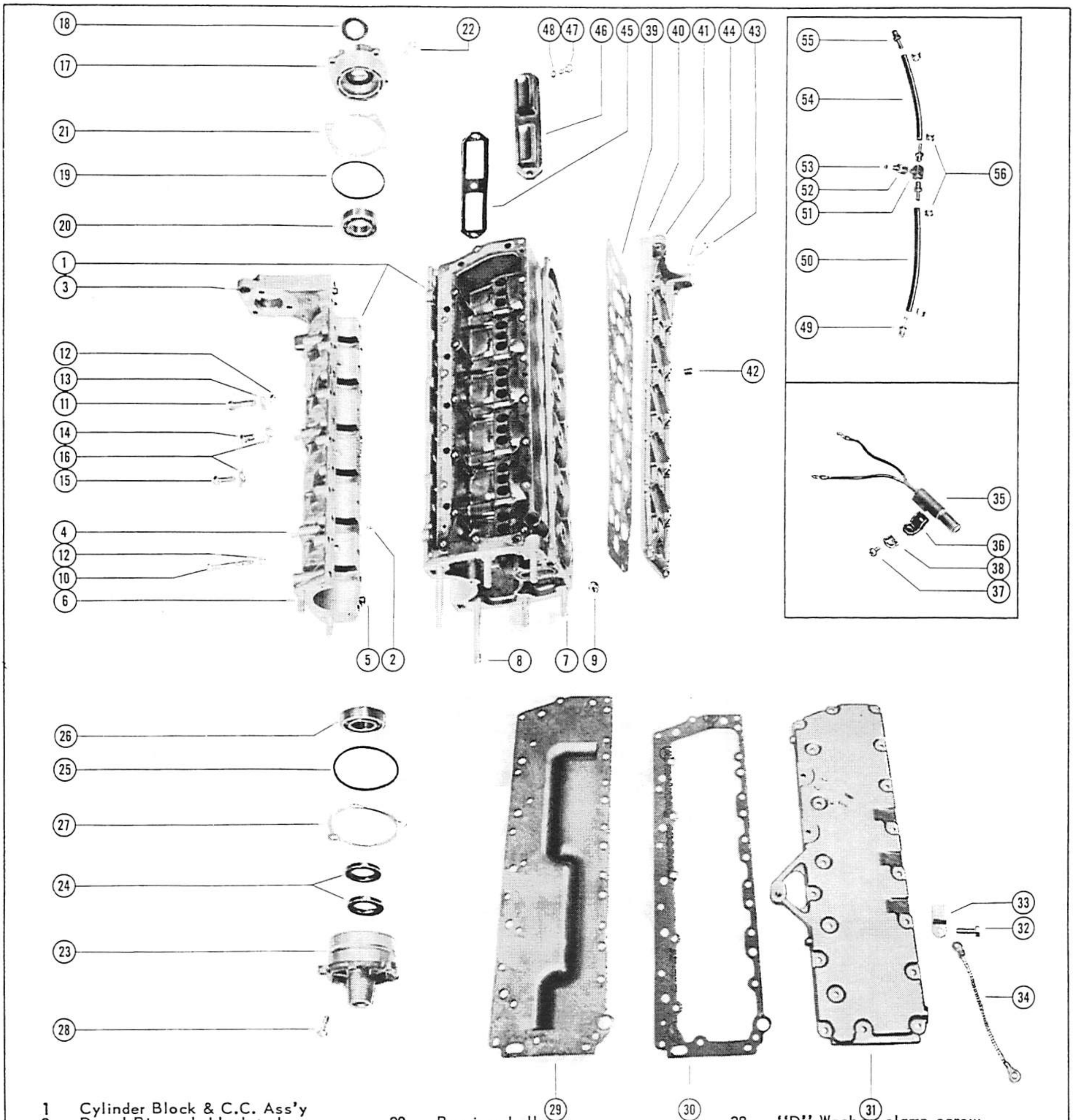


Figure 10. Remove and Install Piston Pins



1 Cylinder Block & C.C. Ass'y
2 Dowel Pin, cyl. block to bear.
3 Bushing, c.c. - cowl mtg. stud
4 Stud, carburetor mounting
5 Dowel Pin, c.c. to cyl. block
6 Stud, c.c. to d. s. housing
7 Stud, cyl. block to d. s. hsg.
8 Stud, cyl. block to d. s. hsg.
9 Plug, pipe - bleed hole
10 Screw, c.c. to cyl. block
11 Screw, c.c. to cyl. block
12 Nut, c.c. fastening screw
13 Bracket, clamp exten.
14 Screw, main bear. lock.
15 Screw, center main bear. lock.
16 Tab Washer, bear. lock. screw
17 End Cap Ass'y, upper
18 Oil Seal
19 "O" Ring
20 Bearing, ball
21 Shim, end cap to c.c.
22 Screw, end cap mtg.
23 End Cap Ass'y, lower
24 Oil Seal
25 "O" Ring
26 Bearing, ball
27 Shim, end cap to c.c.
28 Screw, end cap mtg.
29 Plate, exhaust manifold
30 Gasket, man. plate to cover
31 Cover, exhaust manifold
32 Screw, manifold cover mtg.
33 Clamp
34 Ground Strap Assembly
35 Switch, mercury
36 Clamp, mercury switch hold.
37 Screw, clamp to exht. cover
38 "D" Washer, clamp screw
39 Gasket, cylinder block
40 Cylinder Block Cover Ass'y
41 Bushing, cover - cowl mtg. stud
42 Screw, cyl. block cover mtg.
43 Nut, cover mounting screw
44 Gasket, transfer port cover
45 Cover, transfer port
46 Screw, trans. port cover mtg.
47 Lockwasher
48 Connector, cyl. bleed hose
49 Hose, cylinder bleed
50 Tee, check valve & adaptor
51 Adaptor & Check Valve Ass'y
52 Check Valve Ass'y, adaptor
53 Hose, cylinder bleed
54 Check Valve Ass'y, upper
55 Clamp, bleed hose to conn.

Figure 11. Cylinder Block & Crankcase Assembly, Merc 700-600 & Mark 78-78A-75A

1 Crankshaft
2 Oiler, felt - driveshaft spline
3 Key, flywheel drive
4 Centermain Bearing Assembly
5 Dowel Pin, centermain bearing
6 Bearing, needle - outer race
7 Race, outer (pair)
8 Ring, snap - outer race
9 Dowel Pin, stepped
10 Screw, centermain bearing clamping
11 Nut, bearing clamping screw
12 Main Bearing Assembly, valve type
13 Dowel Pin, main bearing
14 Screw, main bearing clamping
15 Reed Set, matched - main bearing
16 Reed Stop, main bearing reed valves
17 Washer, reed stop mounting screw
18 Screw, reed stop mounting
19 Piston and Piston Pin Assembly
20 Lock Ring, piston pin
21 Ring, piston
22 Connecting Rod and Cap Assembly
23 Screw, connecting rod
24 Nut, connecting rod screw
25 Bearing, needle - crankpin
26 Bearing, needle - piston pin
27 Washer, needle locating

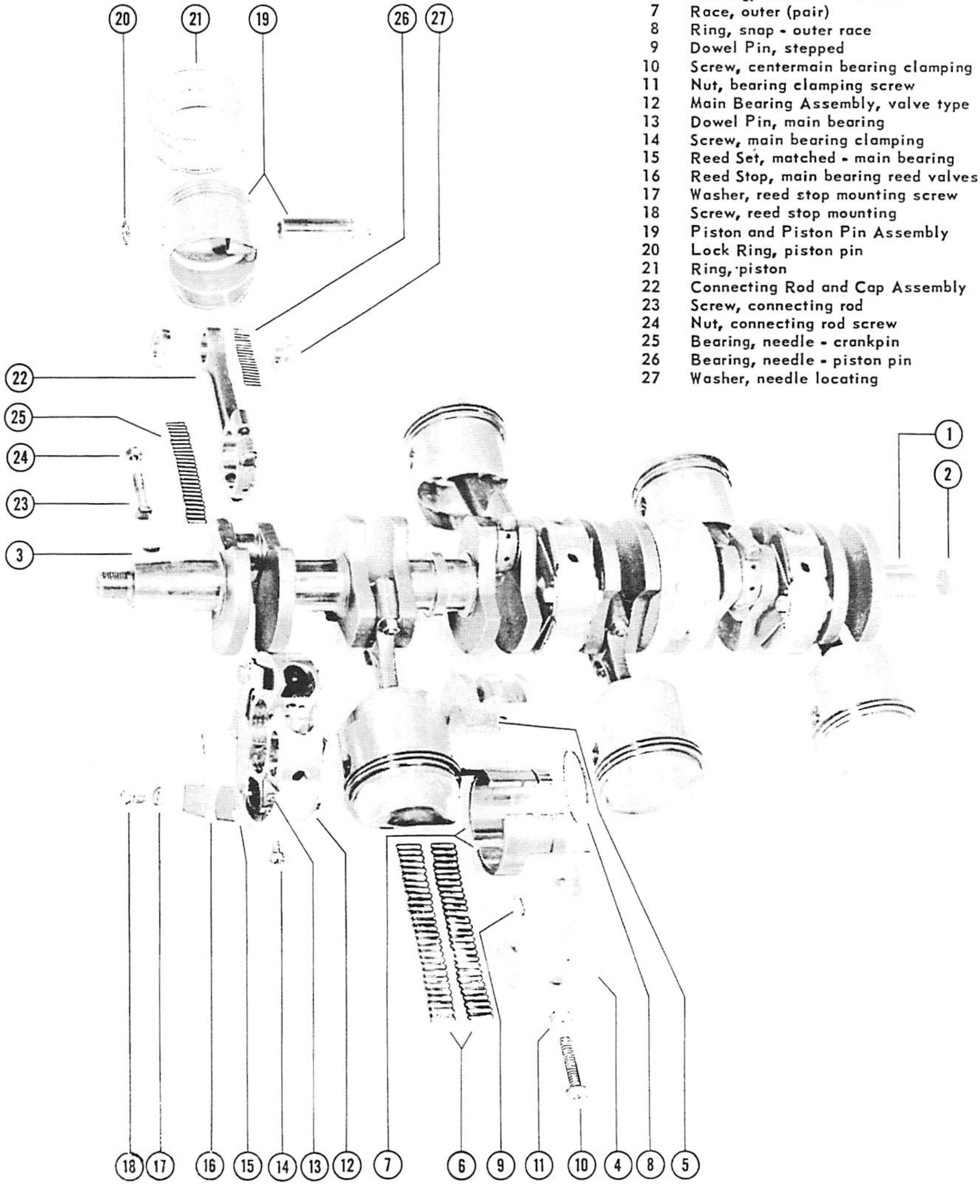


Figure 12. Crankshaft, Pistons & Connecting Rods, 6-Cylinder Models

Reassembly

NOTE: See "Parts Inspection -- How to Check", Page 2-4 of Powerhead Section, before reassembling.

A. Installation, Center Main Bearing to Crankshaft

Place crankshaft in vertical position on Powerhead Stand (91-25821) held in a vise. Be sure to replace felt oiler in splines of crankshaft.

Grease races of center main bearing sufficiently on both sides to hold the 56 roller bearings. Use heavy grease. Space bearings equally around top and bottom halves of outer shell race, 28 in each complete row. **On later models, only one row of rollers (28) is used on the crankshaft. Bearings and outer race are the same.** Fit snugly on crankshaft and insert snap ring around races. (See Figure 13.) Rotate several times to be sure that no binding will occur. Place stepped dowel in position and fit aluminum halves of center main bearing around it. Tighten each securely with 2 integral Phillips head screws. Either side can be placed up, as locking screw is located in center. Be sure that halves match perfectly. Always recheck for perfect match.

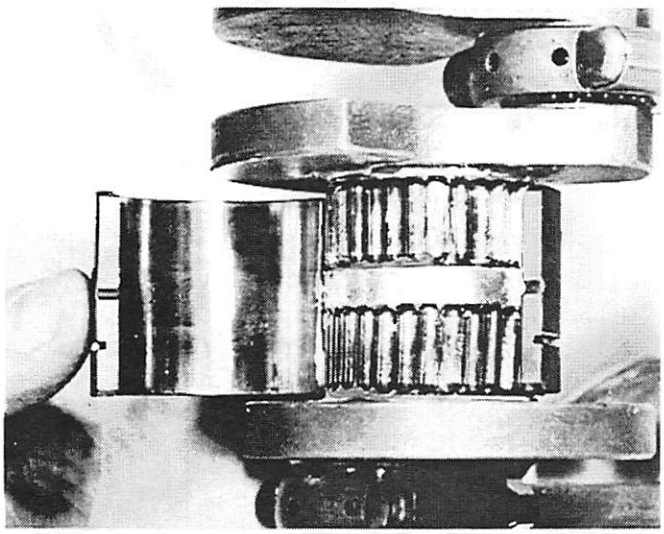


Figure 13. Installing Center Main Roller Bearings and Outer Race

NOTE: Check that bearings are not cocked when reassembling and that parts turn freely after installation.

Adjust reed valves on valve type center main bearing by setting reed valves squarely over their respective openings and at "no preload". *(This means that reed valves do not adhere tightly to seat but have a slight opening, never more than .007".)* (See Figure 14.) Place reed valve stops in position evenly over reed valves. Tighten reed stop screws. Check all 8 reed valves for proper setting. Set reed valve stops according to Specification Chart in Miscellaneous Section, from top of closed reed valve to bottom of reed valve stop. One half of reed valves are left hand, other half are right. Left reed valves have extra radius cut into reed valve at fastening end for identification.

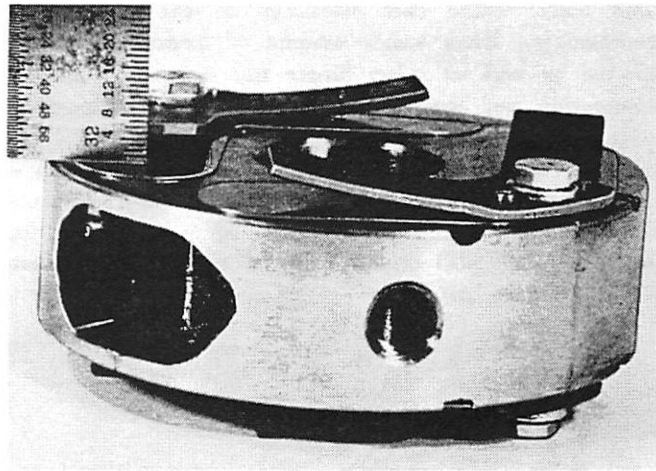


Figure 14. Reed Valve and Stop Settings

IMPORTANT! Always check reed stop opening dimension carefully, as larger opening can cause breakage and smaller opening will not allow sufficient fuel to enter at high RPM.

NOTE: When replacing reed valves on center main valve type bearing, be careful to set left reed valve on left side of bearing. In some cases, right reed valve can be set on left side in order to obtain a "no preload" condition. This is permissable as long as valves have equal tension and flutter. Right and left is determined by viewing from point "V" (three holes) end of valve stop.

After resetting reed valves and valve stops on the 3 valve type center main bearings, replace them on crankshaft. (Figure 15) Tighten 2 integral screws securely on each center main to assure safe fit. Recheck reed valve spacing over openings and clearance between reed valve and stop.

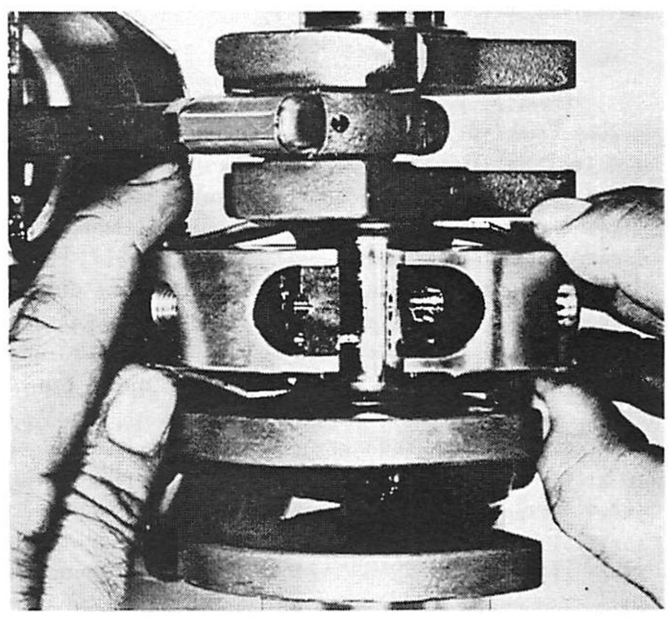


Figure 15. Installing Valve Type Center Main Bearing

B. Assembling Connecting Rods

Prepare 6 connecting rods, opening matched assemblies (one at a time) by removing cap screws and lock nuts. Watch knob markings on cap and rod for reassembly. Take small amount of heavy lubricating grease on end of index finger and coat each half of connecting rod bearing race to hold roller bearings in place. Place roller bearings in greased race and space 25 roller bearings around both sides for reassembly -- (13 on one half, 12 on other for Mark 78-78A-75-75A and Merc 700-600; space 30 bearings, 15 in each half, for Merc 800-700 shift and 32, 16 in each half, for Merc 1000). (Figure 16)

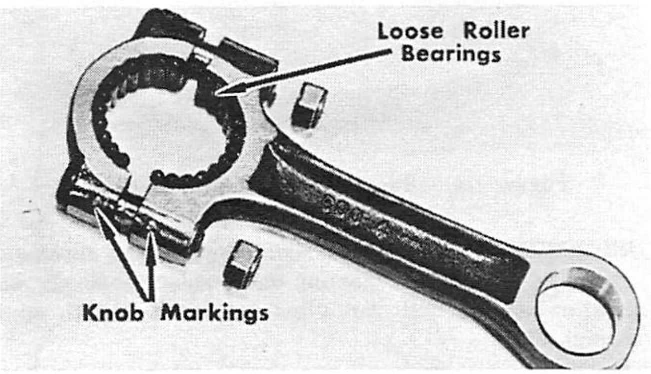


Figure 16. Connecting Rod Ass'y Ready to Install

Place connecting rod cap so knob markings (or etched mark inscribed on side of cap) match connecting rod. Slip separated rod with bearings over crankshaft journal bearing surface, bringing cap up tight to fit and placing rod down to match cap. Insert cap screws and lock nut and tighten each nut evenly with torque wrench for perfect fit. Refer to Torque Specification Chart in Miscellaneous Section for correct torque value. Rotate connecting rod after torquing, checking that it rotates freely. If rough, remove and check race and rollers. Repeat above procedure for other five connecting rods. (Always recheck knob markings on reassembled rods for correct and perfect match.)

C. Replacing Pistons

Replace piston pin bearings with Piston Pin Bearing Tool (91-22803) and slip bearing retainer washer onto tool sleeve. Coat sleeve with small amount of grease to hold roller bearings in piston pin bearing race. Place bearings around sleeve of tool and then insert assembly into race of connecting rod. (Figure 17) Place other bearing retainer washer on opposite side of rod. Place piston over bearings (watch intake side of piston), grooved (sharp profile milled part of piston) to right looking at dome of piston. (Figure 18) Sloping top of piston is exhaust side. Push out sleeve with punch part of tool from bottom and set open end of piston pin on small end of piston pin tool. Press piston pin in with palm of hand and, if tight, tap with mallet, being sure to support piston and rod assembly so rod is not bent. Piston Pin Tool (91-30425A1) may be used. (Figure 10) Check assemblies for binding after installing.

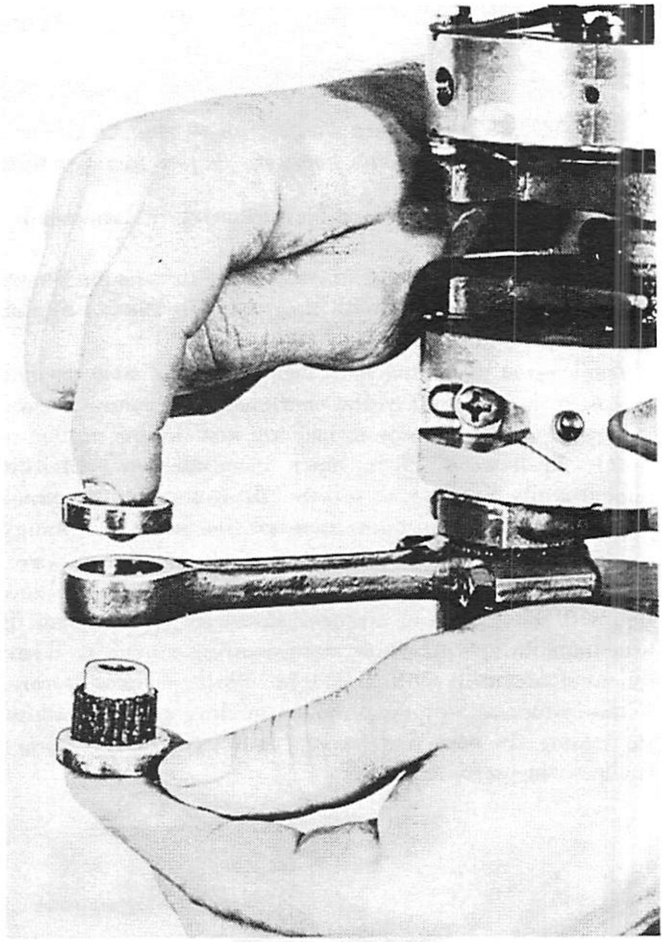


Figure 17. Inserting Piston Pin Bearings and Sleeve into Connecting Rod

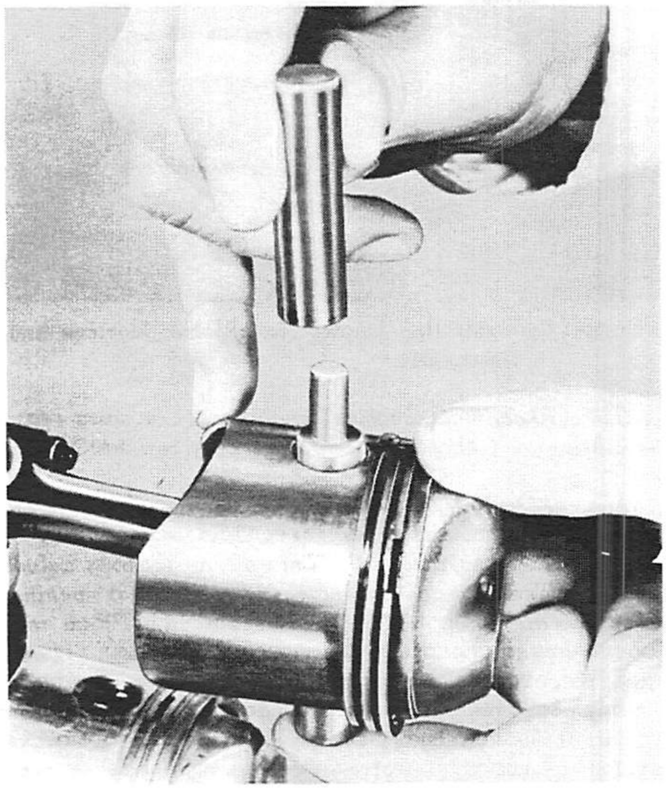


Figure 18. Inserting Piston Pin on Piston Pin Tool

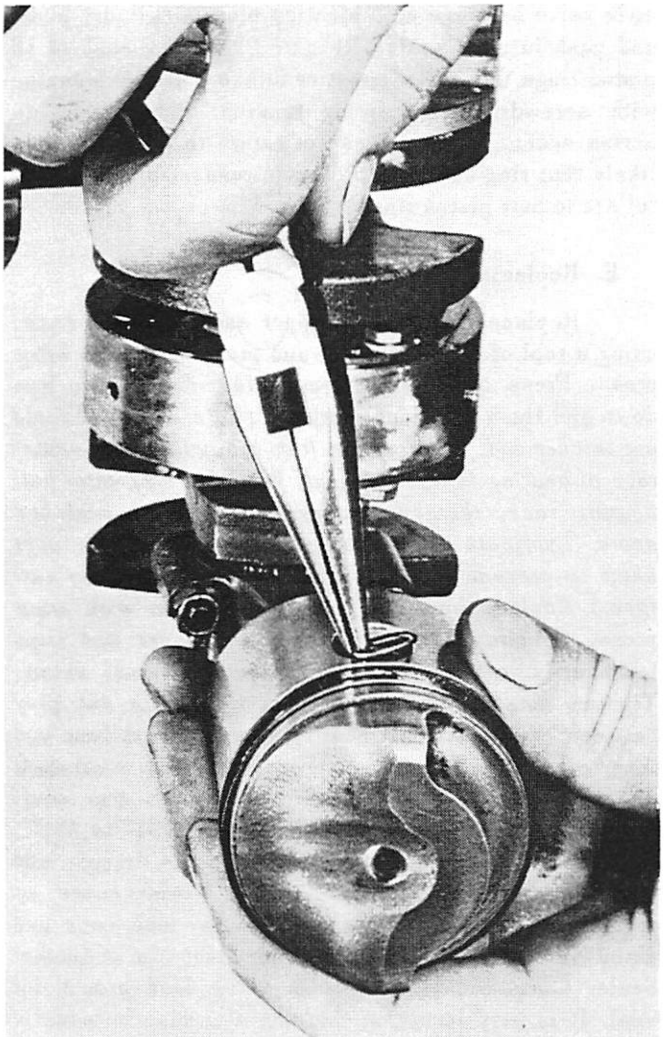


Figure 19. Removing and Installing Piston Pin Lock Ring

Repeat preceding process for other pistons, being certain to replace 2 piston pin lock rings in each piston to secure piston pin. Set tip of lock in groove and, with long nose pliers, push lock in and turn counterclockwise to seat. (Figure 19)

Replace piston rings on pistons with Piston Ring Expander (91-24697), spreading rings over end of piston and seating properly in grooves. (Figure 9) Check that rings float freely in piston groove after lubricating with oil. Align properly with ring openings over pins in piston ring grooves.

D. Replacing Crankshaft, Connecting Rod and Piston Assembly

Set 5 dowel pins for center main bearings in respective place in cylinder block. Lubricate cylinder walls lightly with oil to allow pistons to slide easily into cylinders. Install completed piston and crankshaft assembly -- after removal from powerhead stand -- with piston Nos. 2 and 4 inserted into cylinder head first. (Figure 8) While installing, check that crankshaft tapered end is to top of cylinder block and intake sides of pistons are in correct positions. Work pistons into cylinders. With index finger, compress rings and ease pistons down into cylinder bores. Do not use undue force or rings will break. After piston Nos. 2 and 4 are inserted, set in piston Nos. 1 and 3 and work rings in same manner, repeating for piston Nos. 5 and 6.

NOTE: When using ring compressors to insert pistons into cylinders, place straight compressor on No. 2 piston and two angle compressors on Nos. 4 and 5 pistons. Open ring compressor by turning knurled wheel and place over piston rings from lower end of piston. (Figure 21) Brass shoes on ring compressor

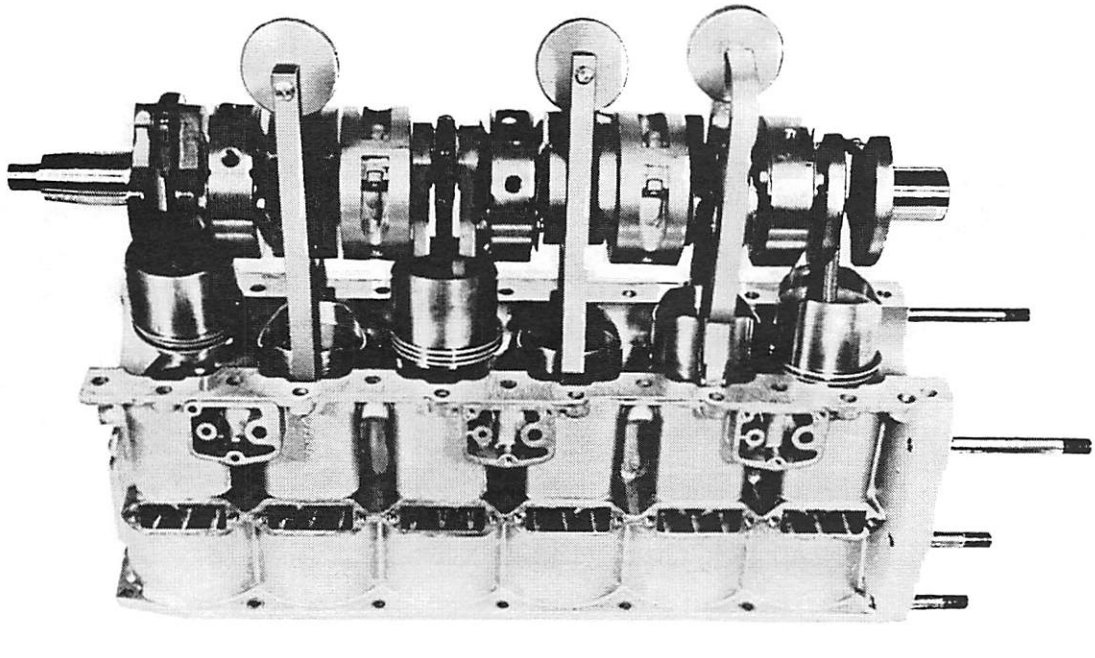


Figure 20. Placing Crankshaft Assembly and Compressors in Cylinder Block

are for the 2-7/16" and 2-9/16" pistons. Place lubricating oil on piston rings and on face of ring compressor shoes and check that they are free and properly aligned over the locating pins in the ring grooves. Insert from crankshaft end, aligning ring compressor shoes over piston rings. When evenly aligned and centered, turn knurled wheel on end of compressor lightly to compress rings. Do not turn wheel too tight or ring compressors cannot slide off piston when placing in cylinder. If too tight, it also may score the piston when removing. After placing ring compressors on pistons, set crankshaft assembly over cylinder block and place No. 2 piston into cylinder. (Figure 20) Compressor will slide off ring and piston as piston slides into cylinder bore with ease. After pistons are placed in cylinder bore, remove compressors. Be sure, when turning crankshaft, that pistons do not come out of cylinders. Repeat procedure for next 3 pistons, using straight compressor on No. 1 piston, angled compressors on Nos. 3 and 6 pistons.

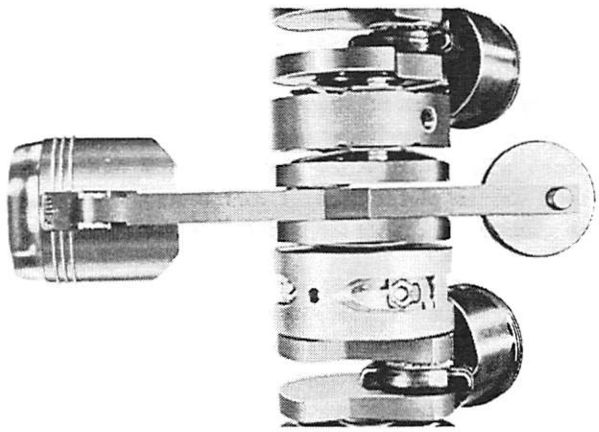


Figure 21. Ring Compressor on Piston

Align 2 center main bearings and 3 valve type center main valve bearings on 5 locating pins in cylinder block and push in until seated. (Figure 22) Check each of 18 piston rings thru the exhaust or intake ports by pressing with screwdriver for spring tension. If no springing action occurs, or ring does not return to position, it is likely that ring has been broken in reassembly. Be careful not to burr piston rings.

E. Replacing End Caps

Replace oil seals in upper and lower end caps, using a tool of equal diameter and pressing in with arbor press. Press oil seal in from inside of end cap, lips down and flush with inner surface. *(Note: New oil seals are thicker and, if pressed in from top, will cause center race of bearing to wear on seal. Particles may enter ball bearing race, thereby causing bearing to squeal and score. Lubricate oil seal inner lip before placing over shaft to prevent seal lips from wearing off on dry surface.)* Replace ball bearings, pressing in with arbor press. (Figure 23) Install upper and lower end caps temporarily on crankcase with same original shims. Tighten nuts on top and bottom. Check for end play between crankshaft ball bearing journal thrust face and inner race of ball bearings. (Figure 24) Tap crankshaft either way with mallet to be sure to get true seat. Tolerance of end play on units should be .008" to .012". If too much end play, remove shims. If not enough, add shims in .002", .003", .005" or .010" thicknesses, as required. After end play check, remove end caps and place on "O" ring seals, spreading light film of Gasket Sealer Compound (92-28804) or white lead around for seal. It is very important that the shimming be equally spaced on the upper and lower caps to keep rod journal centerlines in centerline of cylinder bore.

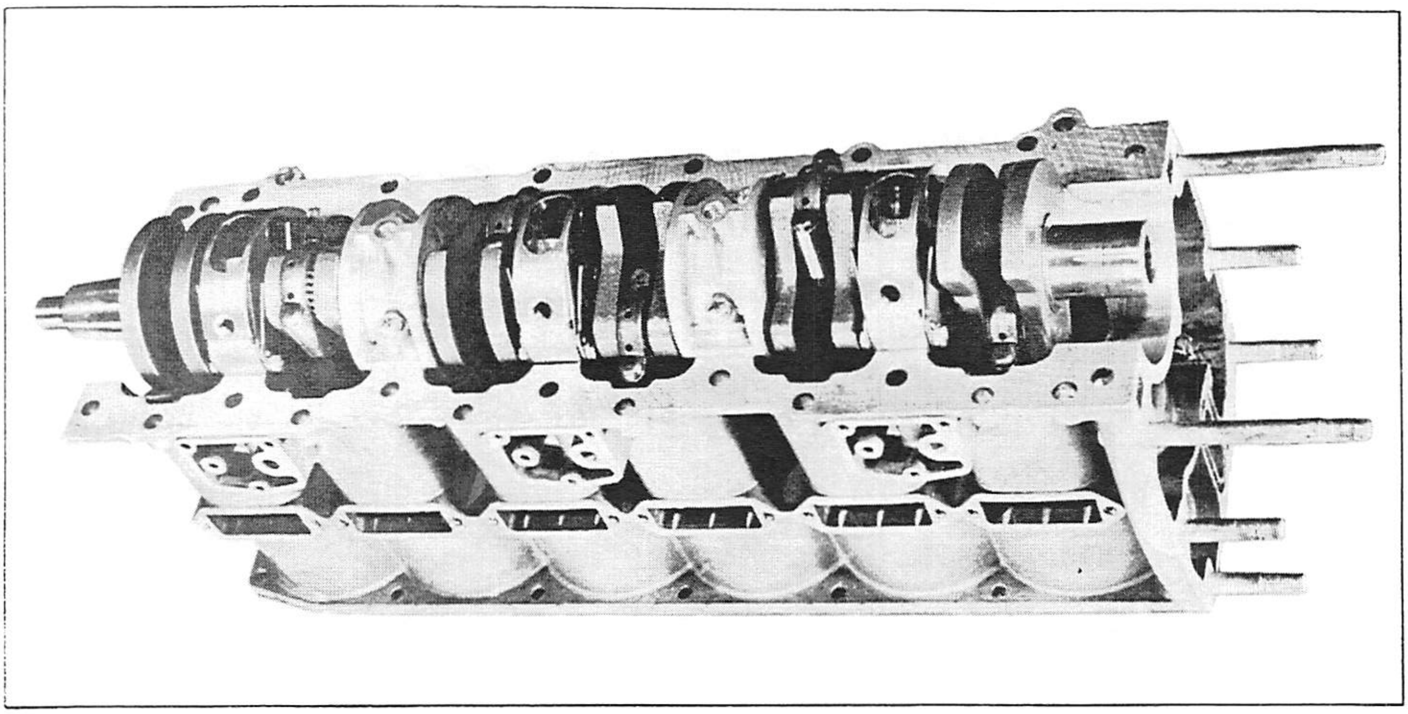


Figure 22. Center Main Bearing Correctly Aligned

Coat joint face of crankcase with thin layer of Gasket Sealer Compound (92-28804) or white lead for metal-to-metal seal. Set crankcase over cylinder block, insert bolts and attach nuts and washers. (Do not tighten until end caps are permanently installed.) Place 5 center main bearing locking screws with lock tab washers thru respective holes in crankcase to hold main bearings. Align opening of valve type center main with that of crankcase fuel intake opening so that they are evenly centered. Start tightening with "A" and follow with "B" roller bearing type center main. (Figure 25) Crimp lock tab washers after tightening screws to recommended torque. Refer to correct torque value in Torque Specification Chart, Page 2C, Section VIII.

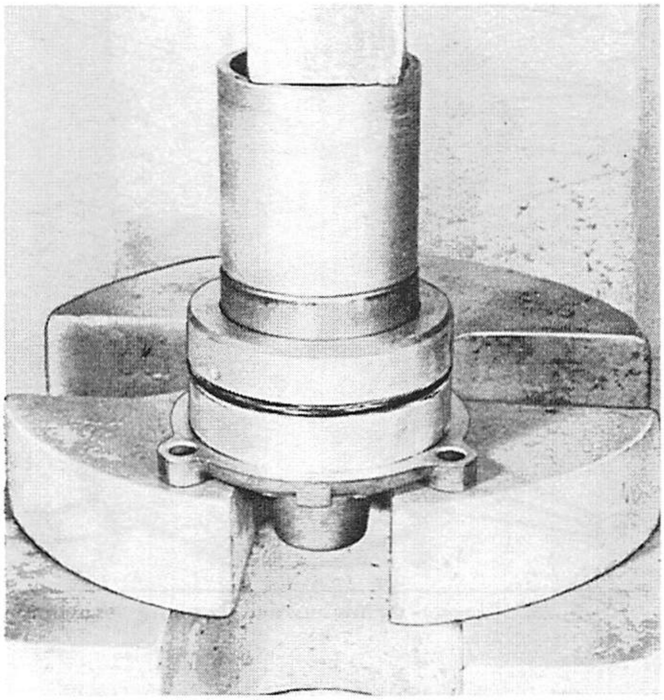


Figure 23. Installing End Cap Ball Bearings

Install end caps, being careful not to damage oil seal. Coat "O" ring face with white lead to form seal. Place proper screws in end cap. Do not tighten. Tighten crankcase bolts, starting with center bolts (No. 1) (Figure 25) and work to top (No. 6) then from center (No. 7) to bottom (No. 12) etc, to prevent distortion of covers and possible leakage. (Figure 25) Use torque values listed on Torque Specification Chart, Page 2C, Section VIII.

(NOTE: The preceding sequence also applies to 4-cylinder engines.) Tighten end cap screws securely. Mount completed powerhead on Powerhead Stand (91-25821) in vise and rotate several times to be sure entire powerhead assembly is free.

F. Installing Cylinder Block and Exhaust Manifold Covers

Reinstall intake port covers and cylinder block cover, renewing gaskets before installing. (Figure 26) *(Use Permatex sealer on older motors if in doubt about seal on cylinder block cover.)* Intake port covers have beveled face to front of intake passage toward crankcase.

NOTE: At this time, check that new exhaust manifold plate (30065) is installed on all 6-cylinder models, with exception of early Mark 75's (below Serial No. 1077746) which had different location for water discharge in cylinder block.

When installing exhaust manifold plate and cover, be sure to remove all used gasket material from cylinder block face (exhaust side) to prevent water and exhaust leakage. For easy installation, locate 4 studs tem-

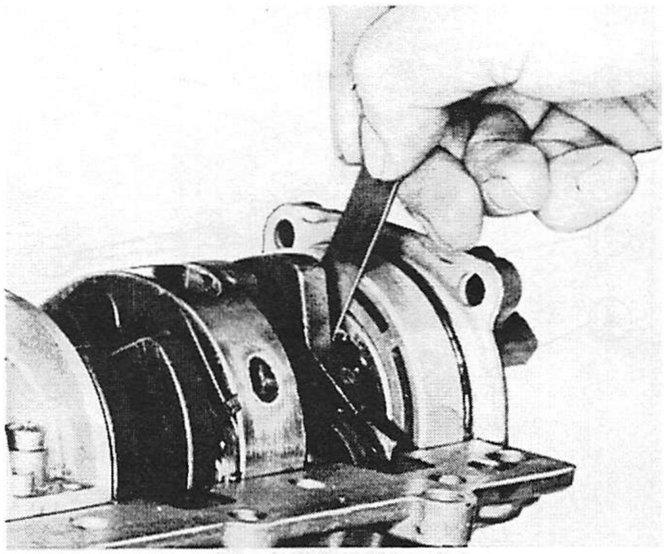


Figure 24. Gauging Crankshaft End Play

porarily in cylinder block exhaust side to aid in aligning gaskets, plate and cover. Place one gasket against cylinder block, then place exhaust manifold plate in position with divider toward exhaust ports. Next, place second gasket in position and then exhaust manifold cover. Remove 4 locating studs after several screws have been placed. After installing all exhaust cover screws, tighten in proper sequence to prevent warping and leakage, as shown in Figure 26. (Refer to Torque Specifications on Page 2C of Section VIII.)

Replace stator alternator and leads, pulley, timing belt, pulley flange and flywheel and flywheel key. Reinstall powerhead on drive shaft housing and replace vent and fuel lines and electrical leads.

This completes powerhead assembly. For installation of components of carburetion, ignition, fuel system, etc, see respective sections in Master Service Manual.

Notes

A. Replacement Vertical Lever - Mark 75

When installing new cylinder block and crankcase assembly (822-1330A2) on Mark 75 engines (Serial No. 1073954 and below), it will be necessary to replace vertical lever (26910) with new vertical lever (26598), as pivot location on exhaust manifold cover (included with 822-1330A2) has been moved down 3/8". Old vertical lever will not give proper distributor travel if used with new exhaust cover (26077). New vertical lever has pivot location also moved down 3/8".

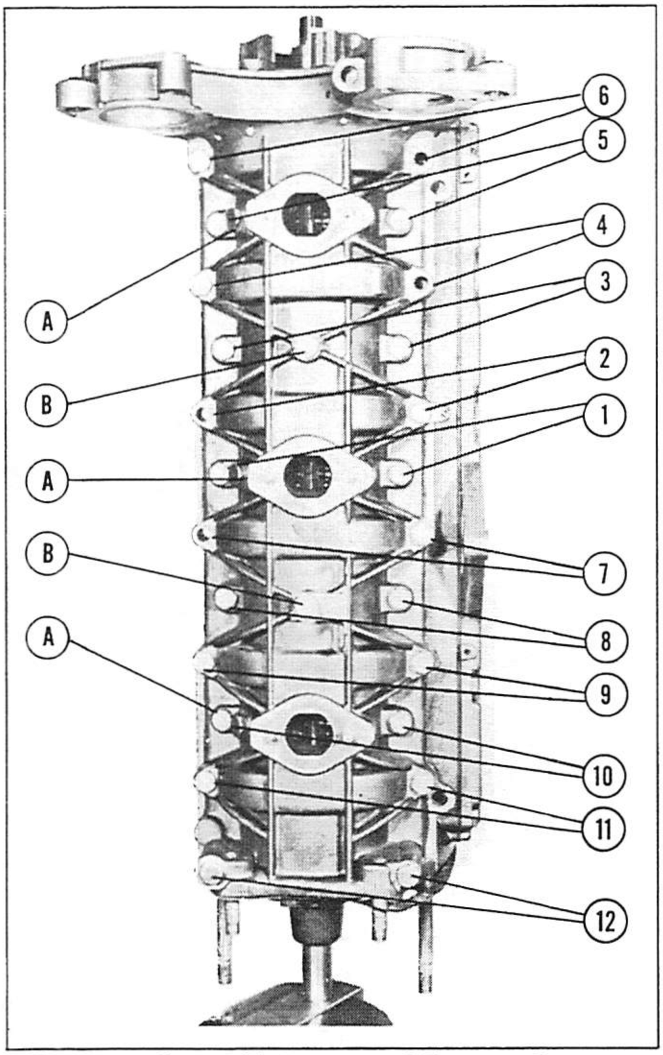


Figure 25. Correct Tightening and Torquing Sequence

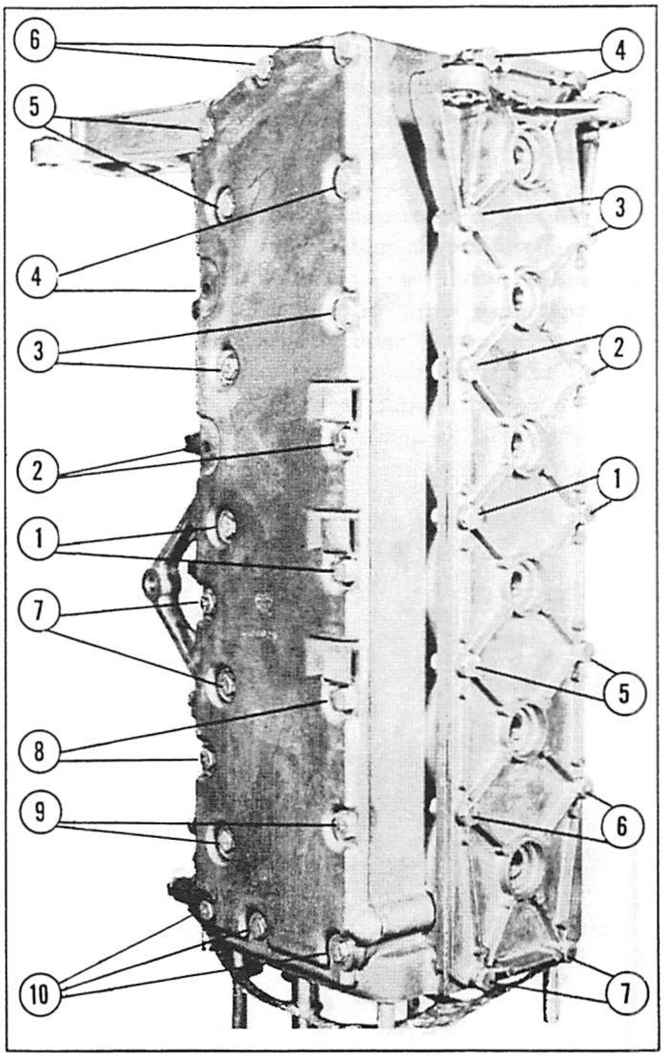


Figure 26. Correct Tightening and Torquing Sequence

NOTE B. Replacement Cyl. Block & C'case - Mark 75

If replacement cylinder block and crankcase 822-1330A2 is installed on Mark 75 engine, Serial No. 1077746 and up, new exhaust manifold cover, baffle plates and gaskets are included with the 822-1330A2 assembly. Reason is that water discharge outlet in cylinder block is relocated to provide water discharge at a more convenient location. (Figure 27) (IMPORTANT: Old exhaust manifold covers, baffle plates and gaskets cannot be used on new cylinder blocks. New covers, plates and gaskets can be used on old cylinder block assemblies.)

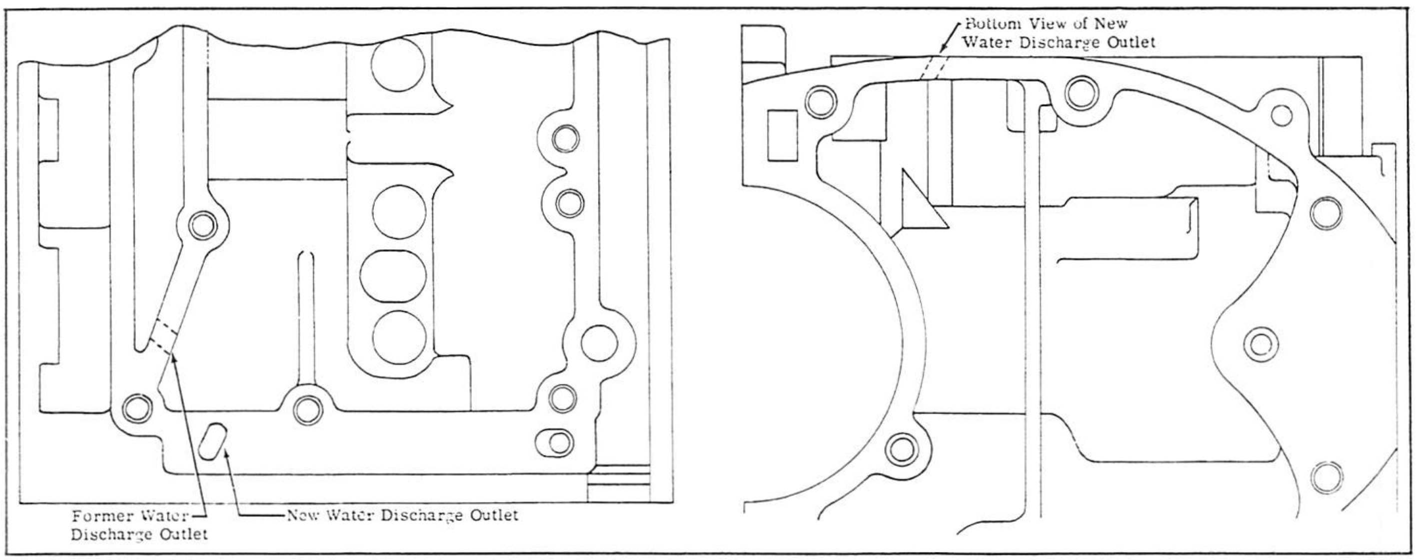


Figure 27. Water Discharge Outlet Relocated

POWERHEAD · · 2 - CYLINDER SPLIT CRANKCASE

NOTE: For removal and disassembly of ignition, carburetors, fuel filters, fuel pumps, electrical starter parts and starter, see appropriate sections.

Disassembly

I. REMOVING POWERHEAD

A. Mark 10-10A-15A Only
(See Para. B for later models)

Remove sound blanket (not on Mark 10) by pulling retainers from fasteners. Remove carburetor by unfastening 2 nuts which secure it to crankcase. Remove fuel line from fuel pump and from fuel filter. (Figure 1) Detach magneto drag link by pulling out the cotter pin securing drag link to drag link nut.

Remove control handle from handle bracket by unscrewing the 2 screws and nuts which hold control handle to bracket and unscrew the small screw in bracket holding bushing in bracket.

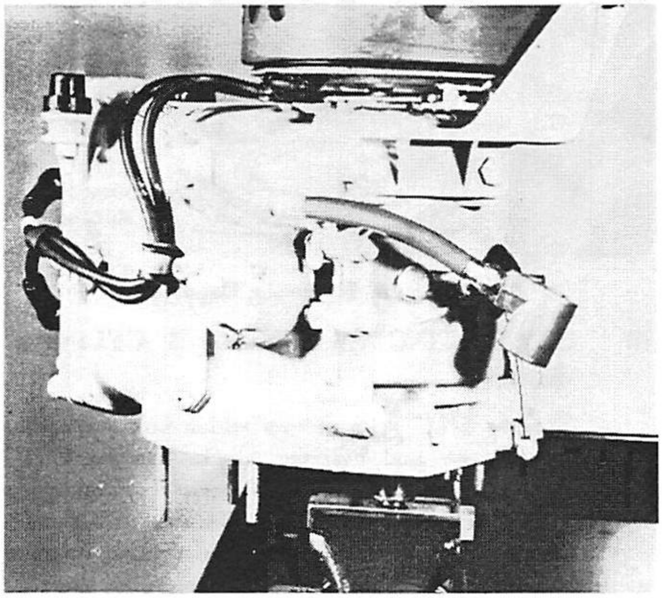


Figure 1. Powerhead on Stand in Vise

Remove the 3 screws which hold the control lever bracket assembly to the lower cowl portion of the drive shaft housing and the small square head set screw holding drag link to troll lever arm. (Figure 2) Control lever bracket assembly now can be removed by pulling ball and sleeve assembly out of crankcase recess.

The transmission cover plate is secured to the front edge of the drive shaft by 3 cap screws which must be removed. Care should be exercised when removing the cover plate, as the neutral and reverse pawl springs, retaining pin and spacer will be pushed out. Remove the cotter pin and wave washer from the lower control shift rod and pull rod out of transmission shaft lever. (Figure 3)

B. Later 2-Cylinder Models

Remove sound blanket by pulling retainers from

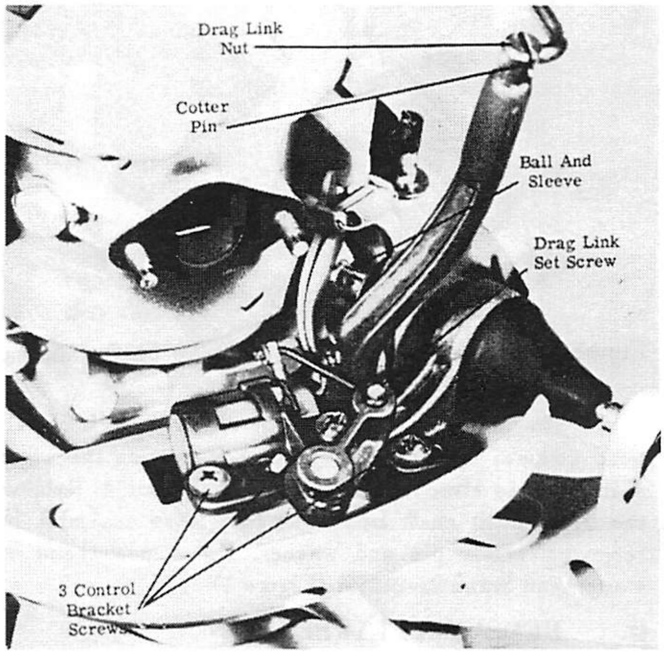


Figure 2. Control Bracket & Linkage

fasteners. Detach fuel line from fuel pump and from fuel filter. Remove cotter pin from link adjustment.

C. Lifting Powerhead

Loosen the powerhead from drive shaft housing by removing the 6 hex head nuts which secure it to the drive shaft housing. Jar powerhead with heel of hand on exhaust side to loosen while holding cowl portion of drive shaft housing with other hand. Gasket between powerhead and drive shaft housing adheres tightly.

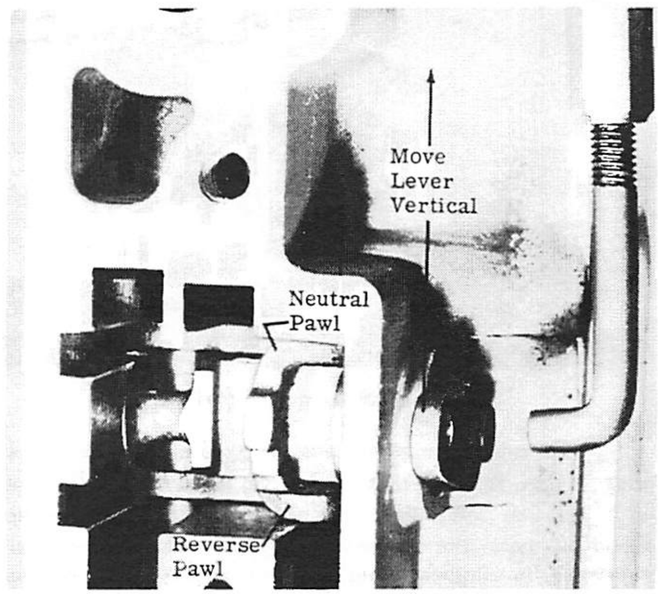


Figure 3. Mark 10-10A-15A Transmission

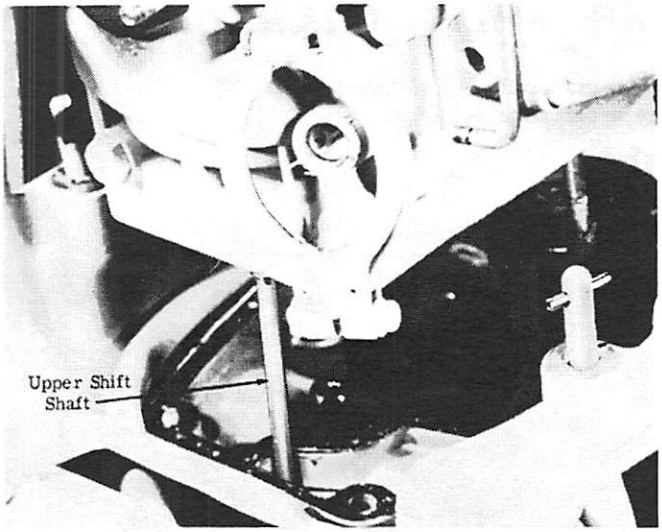


Figure 4. **Lifting Powerhead from Drive Shaft Housing on Mark 10-10A-15A**

The powerhead now can be removed. Lift powerhead straight up from drive shaft housing, as the upper shift shaft is attached to powerhead. (Figure 4) Remove the upper shift shaft from shift cam lever assembly by removing cotter pin and washer. Place powerhead on Powerhead Stand 91-24259. (Figure 1)

II. REMOVING FLYWHEEL

To remove flywheel, use Flywheel Puller (91-24695A1). (Figure 5) Place Protector Cap (91-24161) on threaded end of crankshaft to prevent damage to threads. Attach puller to flywheel evenly by securing with 3 screws into top of flywheel. Tighten center screw with wrench until pressure is exerted on end of shaft to loosen. Tap on center screw with hammer to free flywheel from shaft, if exceptionally tight. Remove flywheel key from crankshaft with a pair of end cutting pliers if tight.

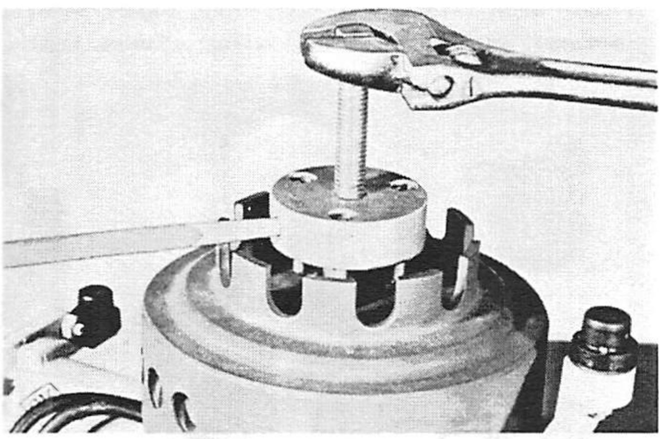


Figure 5. Removing Flywheel

To remove magneto assembly, first remove spark plug leads, then detach screw on hold down clip for high tension leads and turn stator plate in clockwise direction until the magneto hold down clips align with recesses in magneto hold down ring. Magneto now can be lifted off. (Figure 6)

Remove hex head cap screws in exhaust manifold cover plate on left side of motor. Separate baffle plate and gaskets when removing. Remove cylinder block cover and transfer port cover and gaskets by removing the cap screws. These covers need not be removed unless required for cleaning exhaust chamber and water cooling chamber.

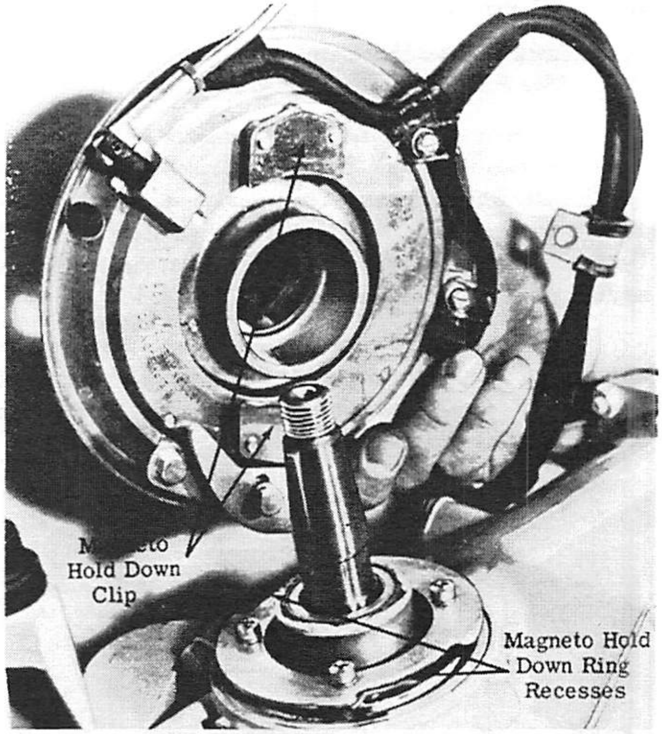


Figure 6. Removing Magneto

III. SEPARATING CRANKCASE & CYLINDER BLOCK

Remove 5/16" cap screws which hold upper end cap to crankcase and cylinder block. Remove 9/16" center main bearing lock screw on outside of crankcase by first bending down lock tabs, below, with screwdriver. Remove screw entirely from crankcase. Remove all nuts and bolts which secure crankcase to cylinder block. *(Note: Crankcase and cylinder block are matched assemblies, line bored, and never should be mismatched by using different crankcase or cylinder block. Never place machined surfaces on concrete or in any place where surfaces may become marred, as this will result in leaking surfaces, since no gasket is used at this point.)*

Separate crankcase from cylinder block by prying apart at special recesses with screwdriver. (Figure 7) One recess is located on each side in center. After crankcase is removed, lift small rubber "O" ring from recess in cylinder block.

Remove crankcase. Loosen valve-type center main bearing from seat in cylinder block by tapping ends of crankshaft lightly upward with rawhide mallet to loosen from locating pin. Remove crankshaft, piston and connecting rod assemblies. (Figure 8) Place crankshaft assembly on powerhead stand.

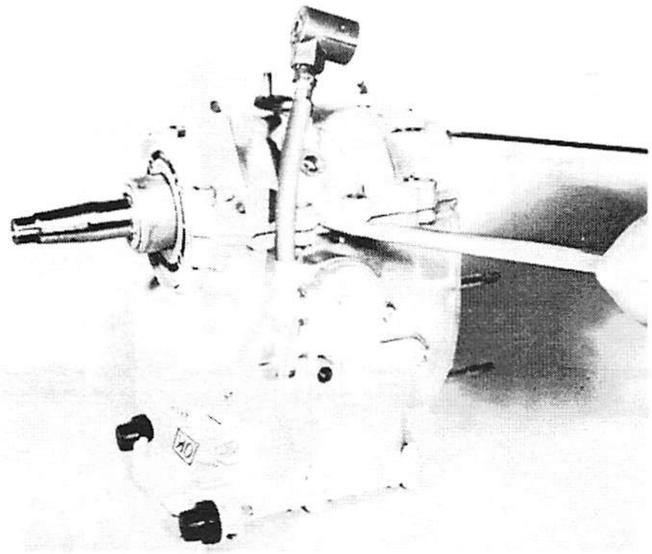


Figure 7. Separating Crankcase and Cylinder Block

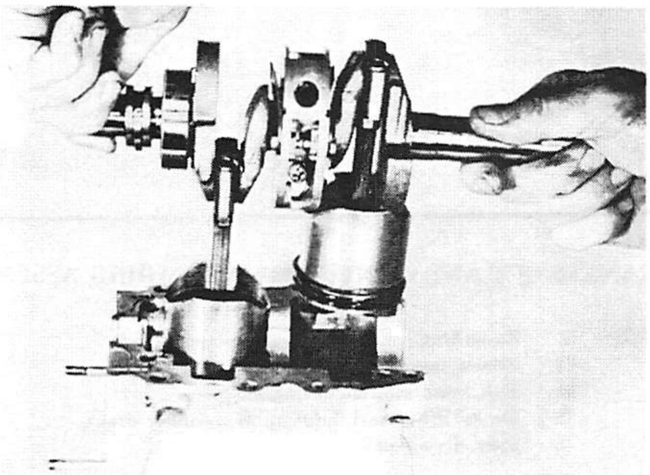


Figure 8. Removing and Installing Crankshaft Assembly from Cylinder Block

IV. REMOVING BEARINGS FROM END CAP

Remove ball bearing in upper end cap with Ball Bearing Puller (91-24722). Insert puller from inside of end cap, handle end first (Figure 9). Compress tool caps so tool will enter bearing. After tool is in, pins expand and catch lower end of inner bearing race. By applying pressure to handle, caps expand and a firm grip is obtained. Tap or press out. After ball bearing is removed, check for ball bearing shims and remove. Gauge shims with micrometer for replacement, if necessary. Press out roller bearing with Needle Bearing Drift (91-24726) from top down. Tap oil seal out with screwdriver.

V. REMOVE AND DISASSEMBLE CRANKSHAFT AND PISTON ASSEMBLY

Remove crankshaft by lifting straight up. Remove locating dowel pin from center main bearing or cylinder block to prevent losing. Remove lower oil seal (lip facing down), lower oil seal spacer, 2nd lower oil seal (facing down), shims (if any) and lower ball bearing from crankshaft. Place crankshaft with piston on Powerhead Stand (91-24259). Remove piston rings from pistons with Piston Ring Expander. (Figure 10) Remove piston pin lock rings on both ends of piston pin with long nose pliers. Turn counterclockwise and pull. (Figure 17) Place Piston Pin Bearing Tool (91-24263) around piston, set bar of tool in center groove and turn screw in until piston pin emerges from piston. (Figure 11) Be careful of roller bearings, 22 in each piston pin race.

Connecting rods can be detached by removing 3/8" elastic stop nuts on connecting rod shoulder with 3/8" 6-point socket on ¼" drive.

Reed valve type center main bearing can be removed by removing 2 Phillips head screws. Be careful not to bend or distort reed valves and reed valve stops on bearings. Rematch bearing halves on removal to be sure of proper matching on reassembly. Detach reed inlet valves and reed valve stops by removing 5/16" screw · ith socket wrench.

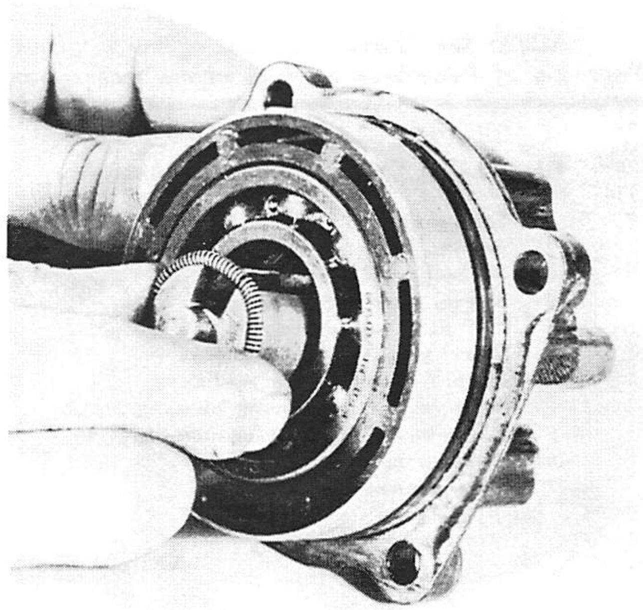


Figure 9. Inserting Ball Bearing Puller into End Cap Ball Bearing

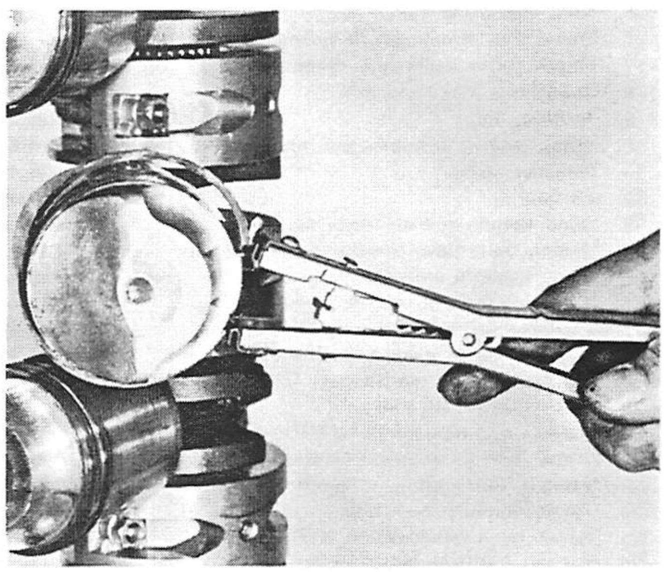


Figure 10. Remove and Install Piston Rings

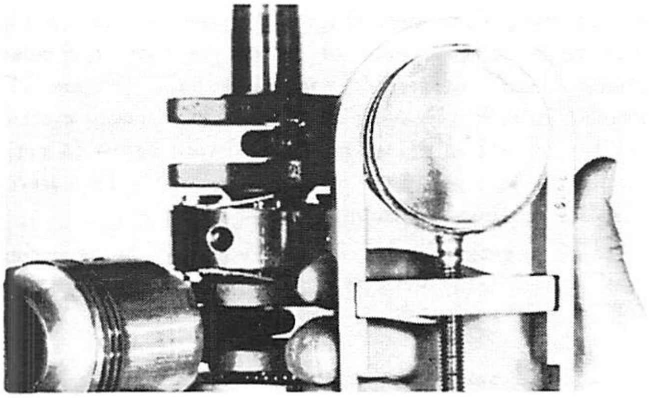
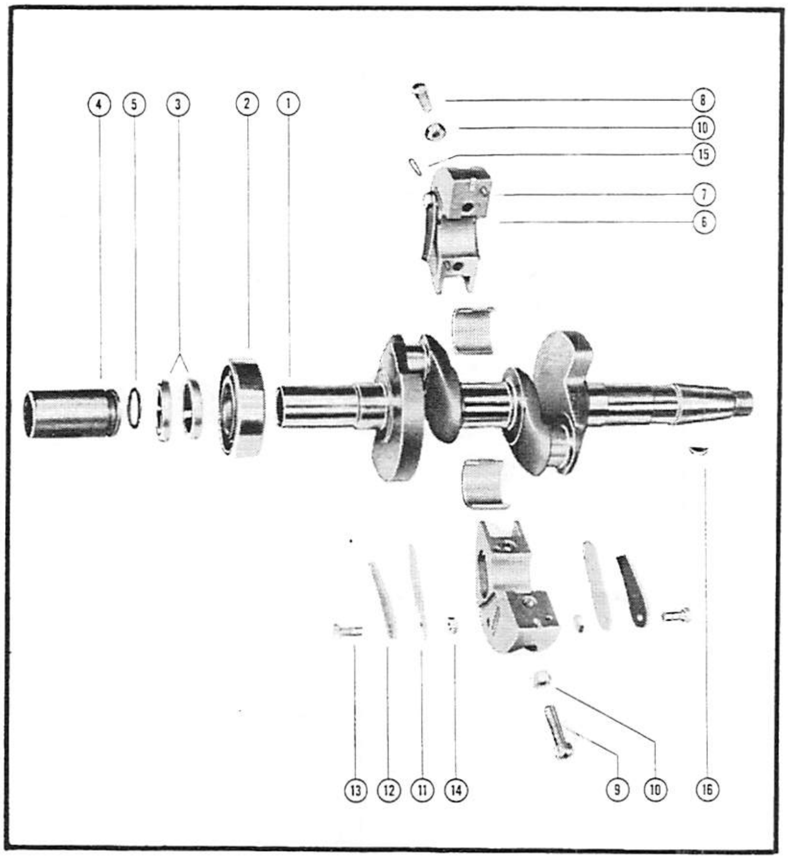


Figure 11. Remove and Install Piston Pins

NOTE: Right reeds and left reeds. Mark reed valves "L" (Left) or "R" (Right) for easier replacement if in condition to reuse.

NOTE: See "Parts Inspection -- How to Check", Page 2-4 of Powerhead Section, before reassembling.



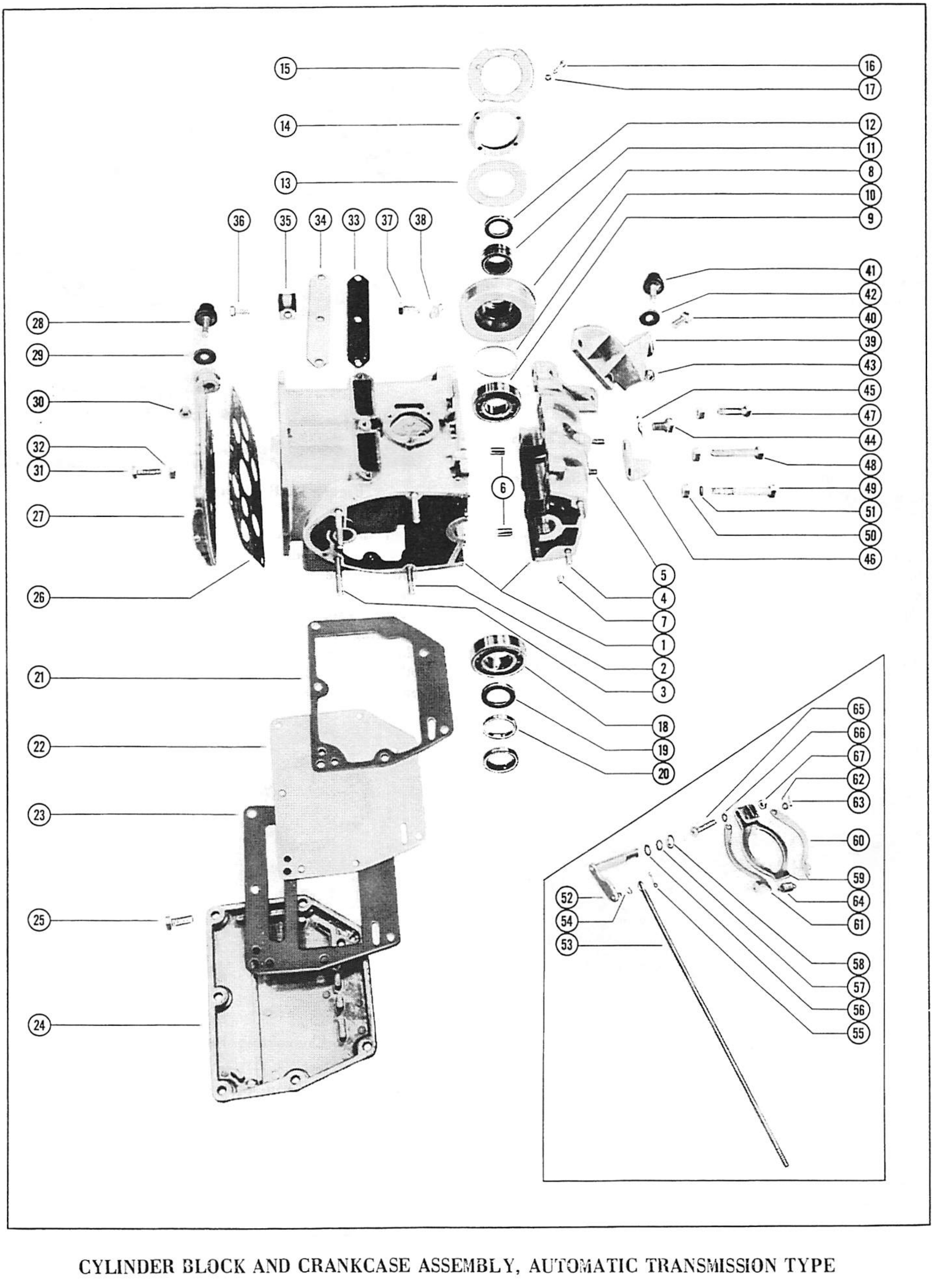
CRANKSHAFT AND CENTER MAIN BEARING ASSEMBLY

Crankshaft & Center Main Bearing Assembly

1 Crankshaft
2 Bearing, ball - crankcase (lower)
3 Oil Seal, crankcase (lower)
4 Sleeve, protector - crankshaft
5 "O" Ring, protector sleeve
6 Center Main Bearing Assembly
7 Dowel Pin, center main bearing
8 Screw, center main bearing clamping (9/16)
9 Screw, center main bearing clamping (7/8)
10 Nut, bearing clamping screw
11 Reed, center main bearing
12 Reed Stop, main bearing reed valves
13 Screw, reed stop mounting
14 Nut, reed stop mounting screw
15 Dowel Pin, main bearing to cylinder block
16 Key, flywheel

Cylinder Block and Crankcase Assembly -- Figure on Page 51

1 Cylinder Block and Crankcase Assembly
2 Stud, cylinder block to drive shaft housing
3 Stud, cylinder block to drive shaft housing
4 Stud, crankcase to drive shaft housing
5 Stud, carburetor mounting
6 Dowel Pin, crankcase to cylinder block
7 Check Valve Assembly, crankcase
8 Crankcase Top Assembly
9 Bearing, ball
10 Shim, bearing to crankcase top
11 Bearing, roller
12 Oil Seal
13 Shim, spacer to crankcase top (.015)
14 Spacer, hold down ring to crankcase top
15 Ring, magneto hold down
16 Screw, hold down ring to crankcase top
17 Lockwasher, hold down ring screw
18 Bearing, ball - crankcase (lower)
19 Oil Seal, crankcase (lower)
20 Spacer, lower oil seal
21 Gasket, cylinder block to baffle plate
22 Plate, baffle - exhaust manifold
23 Gasket, baffle plate to manifold cover
24 Cover, exhaust manifold
25 Screw, manifold cover to cylinder block
26 Gasket, cylinder block cover
27 Cylinder Block Cover Assembly
28 Mount, rubber - top cowl
29 Washer, rubber mount stud
30 Nut, rubber mount to cover
31 Screw, cover to cylinder block
32 Nut, cylinder block cover screw
33 Gasket, transfer port cover
34 Cover, transfer port
35 Clamp, harness - ignition wires
36 Screw, port cover to cylinder block
37 Screw, crankcase top fastening
38 Tab Washer, top fastening screw
39 Bracket, top cowl mounting
40 Screw, cowl mounting bracket to crankc
41 Mount, rubber - top cowl
42 Washer, rubber mount stud
43 Nut, rubber mount to bracket
44 Screw, center main bearing locking
45 Tab Washer, locking screw
46 Stop, centering arms
47 Screw, crankcase to cylinder block
48 Screw, crankcase to cylinder block
49 Screw, crankcase to cylinder block
50 Nut, crankcase screw
51 "O" Ring, crankcase fastening screw
52 Shift Cam Lever Assembly
53 Shaft, upper shift
54 Washer, wave - shift cam lever pin
55 Cotter Pin, upper shift shaft to cam lever
56 Washer, wave - cam lever to crankcase
57 "O" Ring, shift cam lever
58 Spacer, shift cam lever to crankcase
59 Cam, shifting
60 Arm, centering (starboard)
61 Arm, centering (port)
62 Washer, centering arm roll pin
63 Roll Pin, centering arm to shifting cam
64 Spring, centering arm tension
65 Screw, cam lever to shifting cam
66 Washer, cam lever screw
67 Nut, cam lever screw



CYLINDER BLOCK AND CRANKCASE ASSEMBLY, AUTOMATIC TRANSMISSION TYPE

Reassembly

I. INSTALLATION, CENTER MAIN BEARING TO CRANKSHAFT

Place crankshaft in vertical position on Powerhead Stand (91-24259) held in a vise. Adjust reed valves on valve type center main bearing by setting reed valves squarely over their respective openings and at "no preload". *(This means that reed valves do not adhere tightly to seat but have a slight opening, never more than .007".)* (Figure 12) Place reed valve stops in position evenly over reed valves. Tighten reed stop screws. Check all reed valves for proper setting. Set reed valve stops according to Specification Chart in Miscellaneous Section, from top of closed reed valve to bottom of reed valve stop. *(Note: Mark 10-10A-15A have 4-reed center main; later models have 8-reed.)*

IMPORTANT! Always check reed stop opening dimension carefully, as larger opening can cause breakage and smaller opening will not allow sufficient fuel to enter at high RPM.

Note: When replacing reed valves on center main valve type bearing, be careful to set reed valve in order to obtain a "no preload" condition. Reed valves should have equal tension and flutter. (See Reed Valves, Page 4 this Section.)

After resetting reed valves and valve stops on the valve type center main bearing, set insert halves in place in center main and lubricate with heavy grease. Replace on crankshaft. (Figure 13) Tighten 2 integral screws securely on each center main to assure tight fit. Recheck reed valve spacing over openings and clearance between reed valve and stop.

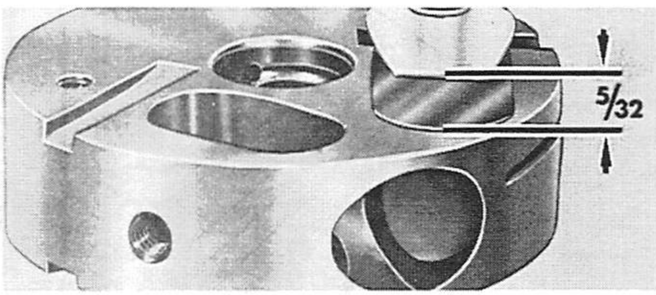


Figure 12. Adjusting Reeds

II. ASSEMBLING CONNECTING RODS

Prepare the connecting rods, opening matched assemblies (one at a time) by removing cap screws and lock nuts. Watch knob markings on cap and rod for reassembly. Take small amount of heavy lubricating grease on end of index finger and coat each half of connecting rod bearing race to hold roller bearings in place. Place roller bearings around both sides for reassembly -- 13 on one half, 12 on other. (Figure 14)

Place connecting rod cap so knob markings match connecting rod. Slip separated rod with bearings over crankshaft journal bearing surface, bringing cap up tight to fit and placing rod down to match cap. Insert cap screws and lock nut and tighten each nut evenly with torque wrench for perfect fit. Refer to Torque Specification Chart in Miscellaneous Section for correct torque value. Rotate connecting rod after torquing, checking that it rotates freely. If rough, remove and check race and rollers. Repeat above procedure for other connecting rod. Always recheck knob markings on reassembled rods for correct and perfect match.

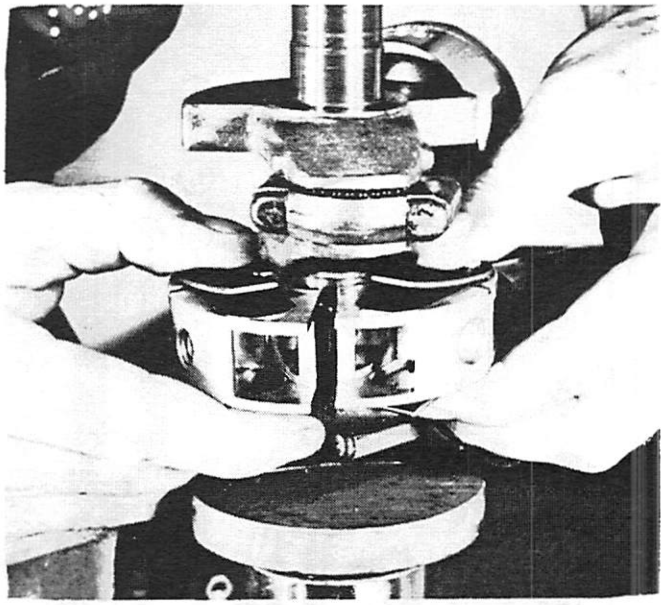


Figure 13. Replacing Center Main Bearing

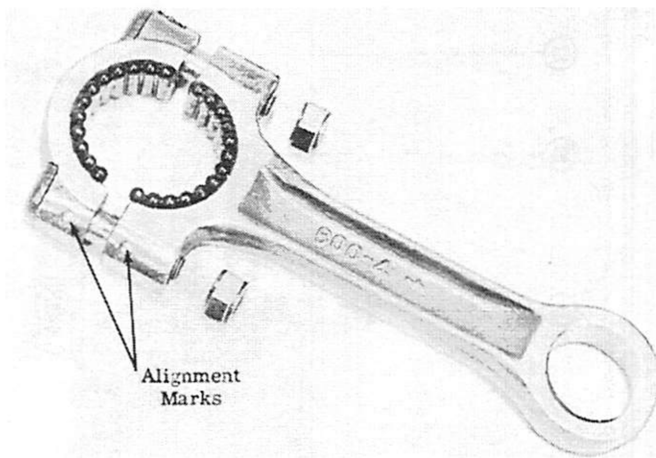


Figure 14. Connecting Rod Assembly Ready to Install

III. REPLACING PISTONS

Replace piston pin bearings with Piston Pin Bearing Tool (91-22803A1) and slip bearing retainer washer onto tool sleeve. Coat sleeve with small amount of grease to hold 22 roller bearings for each piston pin bearing race. Place bearings around sleeve of tool and then insert assembly into race of connecting rod. (Figure 15) Place other bearing retainer washer on opposite side of rod. Place piston over bearings (watch intake side of piston), grooved (sharp profile milled part of piston) to right looking at dome of piston. Sloping top of piston is exhaust side. Push out sleeve with punch part of tool from bottom and set open end of piston pin on small end of piston pin tool. (Figure 16) Press piston pin in with palm of hand and, if tight, tap with mallet, being sure to support piston and rod assembly so rod is not bent. Piston Pin Tool (91-28734) may be used. Check assemblies for binding after installing.

Repeat above proeess for other piston, being certain to replace 2 piston pin lock rings in each piston to secure piston pin. Set tip of lock in groove and, with long nose pliers, push lock in and turn counterclockwise to seat. (Figure 17)

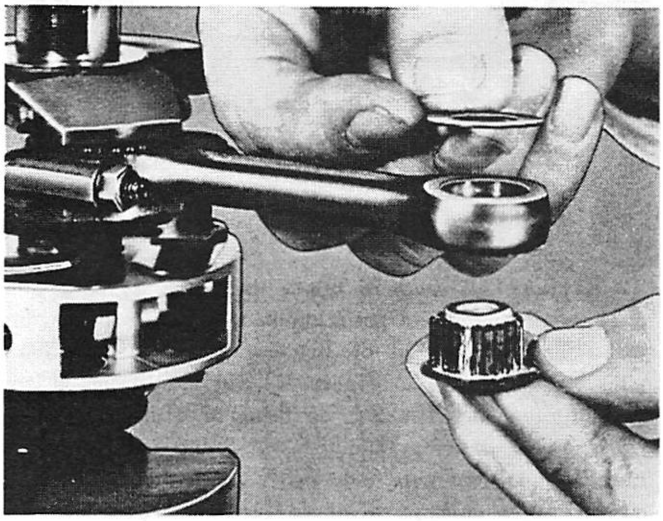


Figure 15. Inserting Piston Pin Bearings & Sleeve into Connecting Rod

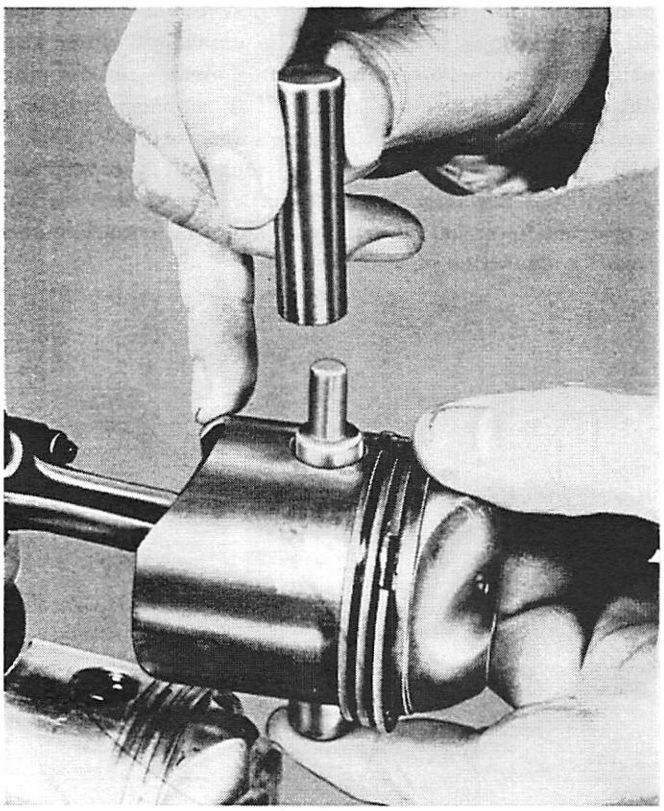


Figure 16. Inserting Piston Pin on Piston Pin Tool

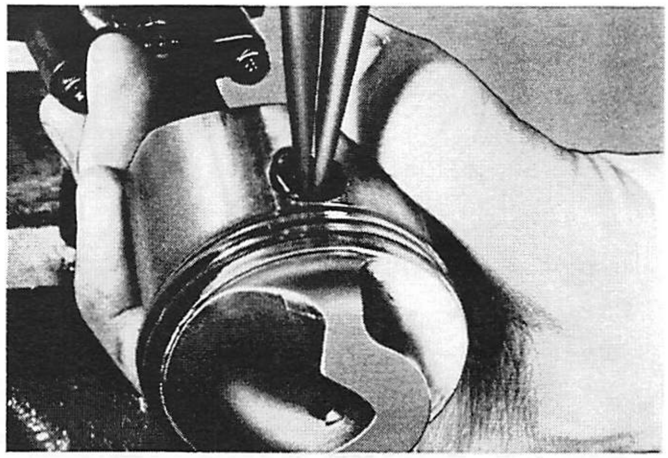


Figure 17. Removing & Installing Piston Pin Lock Ring

Replace piston rings on pistons with Piston Ring Expander (91-24697), spreading rings over end of piston and seating properly in grooves. (Figure 10) Check that rings float freely in piston groove after lubricating with oil. Align properly with ring openings over pins in piston ring grooves.

IV. REPLACING CRANKSHAFT, CONNECTING ROD AND PISTON ASSEMBLY

Slip bottom ball bearing on crankshaft and seat in place against shoulder of lower crankcheek. Replace shims, if any removed. Set upper oil seal on crankshaft with lips facing down and place spacer and second (lower) oil seal on lip also facing down. *(Note: On later models with protector tube, place both seals with lips down and set protector tube recess in shoulder on cylinder block.) (Figure 18)* Set dowel pin for center main bearing in place in cylinder block.

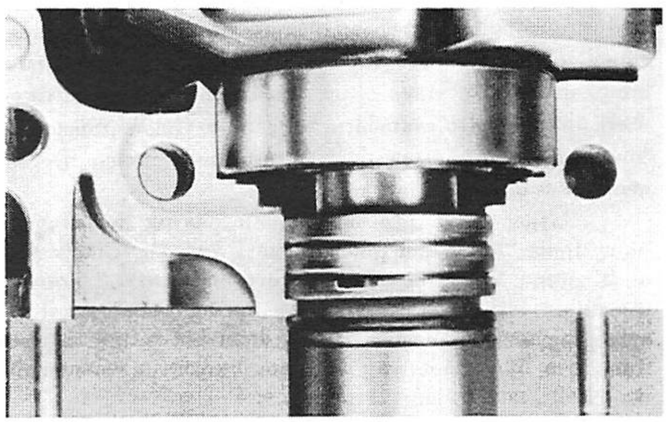


Figure 18. Protector Tube and Seals

NOTE: Use 2 angle ring compressors to insert pistons into cylinders. (Figure 19) (Replace the 4 shoes with the smaller radius shoes in kit for Merc 100-150 and Mark 10-10A-15A models.) Open compressor by turning knurled wheel and place over piston rings from lower end of piston. Place lubricating oil on piston rings and on face of ring compressor shoes and check that they are free and properly aligned over the locating pins in the ring grooves. Insert from crankshaft end, aligning ring compressor shoes over piston rings. When

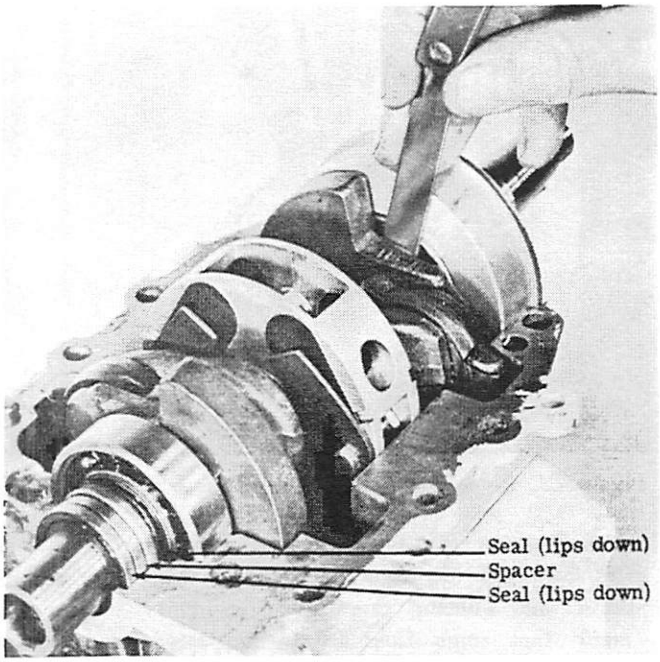


Figure 19. Gauging Crankshaft End Play

evenly aligned and centered, turn knurled wheel on end of compressor lightly to compress rings. Do not turn wheel too tight or compressors cannot slide off piston when placing in cylinder. If too tight, it also may score the piston when removing. After placing compressors on pistons, set crankshaft assembly over cylinder block and insert one piston, then the other. As pistons enter cylinders, loosen ring compressor slightly and piston will slide in with ease. After pistons are placed in cylinder bores, remove compressors. Be sure, when turning crankshaft, that pistons do not come out of cylinders.

If tool is not available, install completed piston and crankshaft assembly. (Figure 8) While installing, check that crankshaft tapered end is to top of cylinder block and intake sides of pistons are in correct position. Work pistons into cylinders. With index finger, compress rings and ease pistons down into cylinder bores. Do not use undue force or rings will break.

Align valve type center main bearing locating pin in cylinder block and push in until seated. Check each of 6 piston rings thru the exhaust or intake 6 ports by pressing with screwdriver for spring tension. If no springing action occurs, or ring does not return to position, it is likely that ring has been broken in reassembly. Be careful not to burr piston rings.

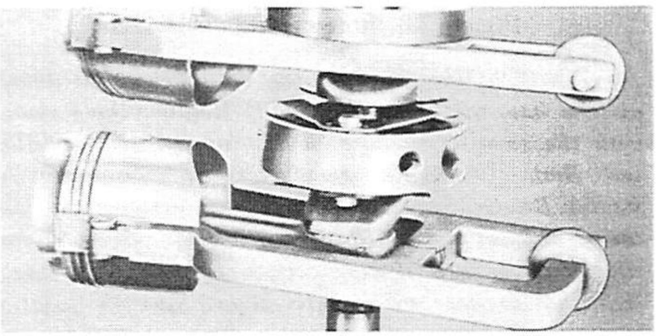


Figure 20. Ring Compressor Installed

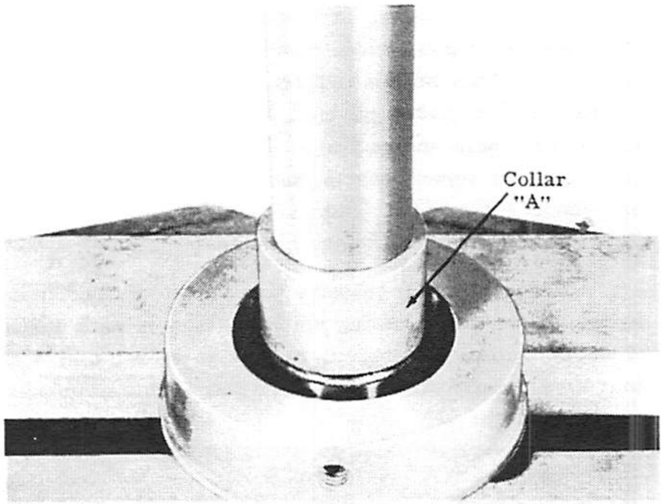


Figure 21. Installing End Cap Roller Bearing

V. REPLACING END CAP

Replace oil seal in upper end cap, using a tool of equal diameter and pressing in with arbor press. Set roller bearing on end of Bearing Mandrell (91-25045) with tool collar "A". (Figure 21) Replace shims in end cap. Replace ball bearing, pressing in with arbor press while using Bearing Mandrell (91-25045). (Figure 22) Install upper end cap temporarily on crankshaft, being careful not to damage oil seal. Tap end cap down so it seats against cylinder block. Install cylinder block to end cap screws, tighten and check for end play between crankshaft ball bearing journal thrust face and inner race of ball bearings. (Figure 19) Tap crankshaft either way with mallet to be sure of true seat. Tolerance of end play on units should be .008" to .012". If too much end play, add shims. If not enough, remove shims in .002", .003", .005" or .010" thicknesses, as required. It is very important that the shimming be equally spaced between the upper and lower ball bearings to keep rod journal centerlines in centerline of cylinder bore.

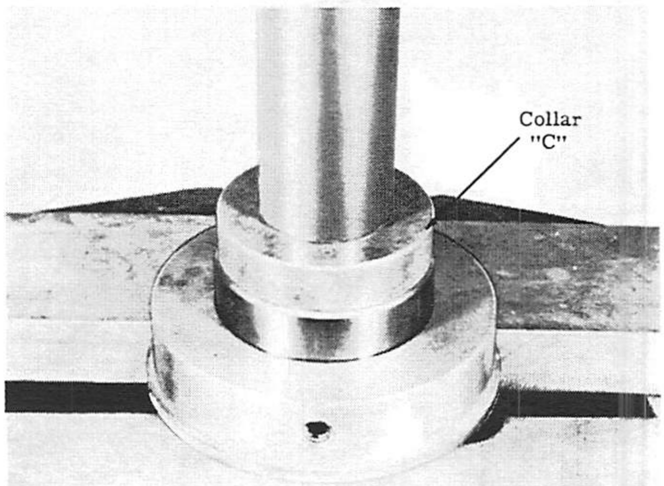


Figure 22. Installing End Cap Ball Bearing

Pull upper end cap back a little from seat on cylinder block and coat seating surface of end cap with Sealer Compound (C-92-28804). Coat joint face of crankcase with thin layer of sealer (C-92-28804) for metal-to-metal seal. Seat "O" ring in cylinder block and set crankcase over cylinder block, insert bolts and attach nuts and washers. Place center main bearing locking screw with lock tab washer thru hole in crankcase to hold main bearing. Align opening of valve type center main with that of crankcase fuel intake opening so that they are evenly centered. Crimp lock tab washers after tightening screws to recommended torque. Refer to correct torque value in Torque Specification Chart, Section VIII. Tap upper end cap into place to seat firmly and install tab locks and screws.

Tighten crankcase cap screws, starting with center cap screws and work to top, then from center to bottom, etc, to prevent distortion of covers and possible leakage. (Figure 25, Page 46, this section for reference) Use torque values listed on Torque Specification Chart, Section VIII. Tighten upper end cap screws securely and bend tab locks.

Mount completed powerhead on Powerhead Stand (C-91-24259) in vise and rotate several times to be sure entire powerhead assembly is free. Reinstall intake port covers, cylinder block cover, renewing gaskets before installing. *(Use Permatex sealer on older motors if in doubt about seal on cylinder block cover.)* Intake port covers have beveled face to front of intake passage toward crankcase.

Reinstall gasket on manifold and baffle plate and gasket for outside cover. For easy installation, locate 2 studs in cylinder block exhaust side to aid in aligning plates and gaskets. Remove after several screws have been placed. Tighten cylinder block covers and exhaust manifold screws in proper sequence shown in Figure 26 Page 46 this section, thus preventing warpage and leakage. See sequence in Torque Specification Chart, Section VIII.

This completes powerhead assembly. For installation of components of carburetion, ignition, fuel system, etc, see respective sections in manual.

VI. REPLACING POWERHEAD

(NOTE: On Mark 10-10A-15A, place wave washer on the shift cam lever and insert upper shift shaft into shift cam lever assembly, securing with cotter pin.)

Place new gasket on drive shaft housing and set powerhead into position on lower cowl portion of drive shaft housing. Be sure that shift shaft extends through opening in drive shaft housing. (Figure 3) Secure powerhead to drive shaft housing with 6 hex head nuts.

(NOTE: On Mark 10-10A-15A, set lower shift control rod into transmission shaft lever. Set wave washer on end of shift control rod and secure with cotter pin. For replacement of springs and cover, see Page 46A, Section III. Place throttle control bracket assembly complete in position on lower cowl, with ball and sleeve placed into recess of crankcase. (Figure 2) Lubricate ball and sleeve with grease before installing. Thread 3 screws through control bracket to cowl but do not tighten. Place drag link into hole of troll lever. (Figure 2) Set steering handle tube nylon bushing in bracket recess and secure with screw and washer. Insert control shaft assembly and lubricate. Replace the handle-to-handle bracket, being sure yoke on steering handle fits over tongue of control shaft assembly. Secure hand to bracket with 2 screws, lockwashers, flat washer and nuts. Align the control bracket so the shift arm assembly and control shaft are engaged and aligned and fasten control bracket to drive shaft housing with the 3 screws previously inserted. Set drag link in troll lever to previous setting and secure with square head set screw. This will be readjusted later to get desired troll qualities.)

To install magneto, align stator hold-down clips on magneto with recesses in magneto hold down ring. Turn stator counterclockwise and magneto is installed. (Figure 6) Install flywheel - and torque. See Torque Specifications, Section VIII.

ONE-CYL. FULL GEAR SHIFT (MERC 39) POWERHEAD

Repair Procedure - Disassembly

REMOVAL OF REED BLOCK

1. Reed block can be removed without removing powerhead.
2. Remove strainer cover from carburetor so that carburetor mounting nuts can be removed. Nut on starboard (right) side need not be removed completely, since carburetor mounting flange is slotted on that side.
3. Disengage choke lever from choke shutter by pulling choke lever forward.
4. Remove carburetor by tilting toward port side of engine and pulling forward.
5. With carburetor removed, reed block can be removed by pulling forward off carburetor mounting studs.
6. Refer to Figure 1 for proper assembly of reeds and reed block. When assembling reeds to reed block, care must be taken so that reeds are centered and square with reed block.
   a. Reeds have an identification notch. Install reed with notch positioned as shown in Figure 1. Install reed retainer with rounded edge toward reed to prevent reed breakage.
   b. Late Merc 39 engines have both the reed and reed retainer notched for identification. Install reeds and reed retainers with notch positioned as shown in Figure 1.

NOTE: For repair procedure on remainder of Merc 39 powerhead, refer to disassembly of 2-cylinder full gear shift powerheads on Page 57.

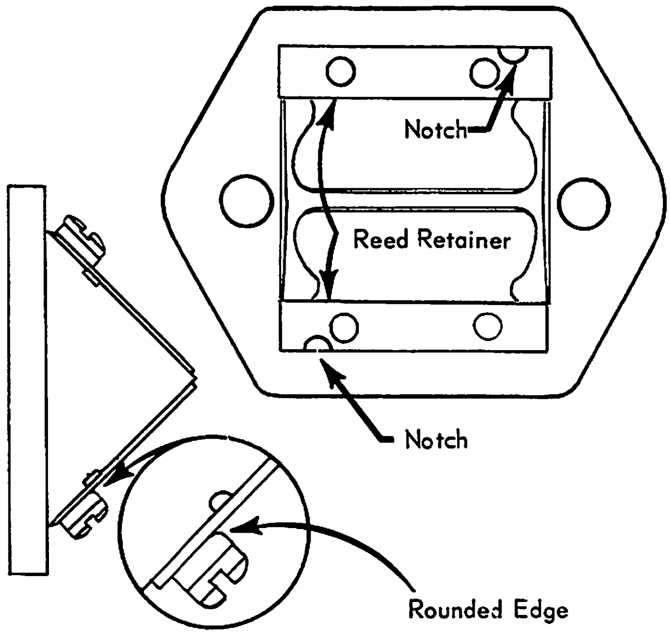


Figure 1. Reeds Centered and Square with Reed Block

Reassembly

REASSEMBLING REED BLOCK AND CARBURETOR TO POWERHEAD

1. Install reed block gasket and reed block to carburetor mounting studs.
2. Install carburetor gasket.
3. Tilt carburetor to port (left) side and engage mounting flange onto port stud.
4. Tilt carburetor downward so that slotted mounting hole is completely down on stud.

NOTE: If carburetor is not down in slot completely, difficulty will be experienced when setting up synchronization on engine.

5. Install and tighten carburetor mounting nuts.
6. Pull choke lever forward and engage it into choke shutter.
7. Install strainer and strainer cover on carburetor and tighten screw.

2-CYL. FULL GEAR SHIFT POWERHEAD

Disassembly

A. REMOVING POWERHEAD

1. Remove 2 screws which hold fuel line check unit adaptor to bottom cowl.
2. Remove 3 screws which connect shut-off switch wires to terminal block.
3. Remove cotter pin, magneto actuator linkage.
4. Remove choke shutter spring.
5. Remove 6 nuts which hold powerhead to drive shaft housing.
6. Jar powerhead on exhaust side with heel of hand to loosen gasket between powerhead and bottom cowl.
7. Remove powerhead and place in Powerhead Stand (91-24282). (Figure 1)
8. Remove fuel pump and carburetor.

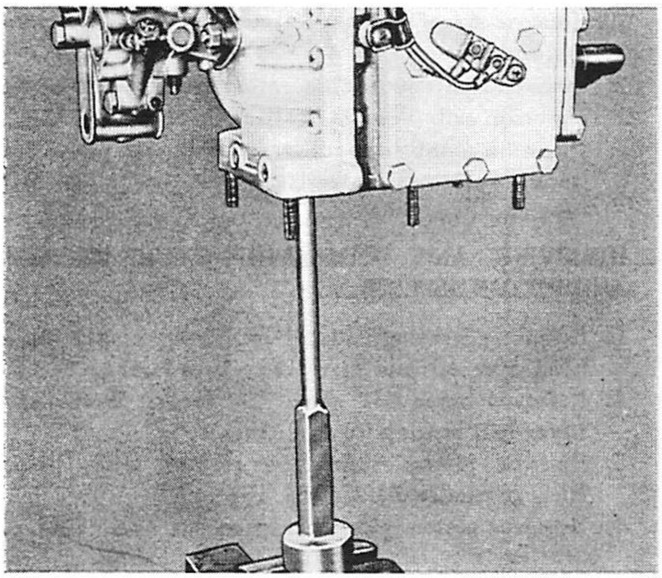


Figure 1. Powerhead on Stand in Vise

B. REMOVING FLYWHEEL

1. To remove flywheel, use Flywheel Puller (91-24695A1). (Figure 2)
2. Place Protector Cap (91-24161) on threaded end of crankshaft to prevent damage to threads.
3. Attach puller to flywheel evenly by securing with 3 screws into top of flywheel.
4. Tighten center screw with wrench until pressure is exerted on end of shaft to loosen. (Figure 2)
5. Tap on center screw with hammer to free flywheel from shaft, if exceptionally tight.
6. Remove flywheel key from crankshaft with pair of end cutting pliers if tight.
7. To remove magneto assembly, first remove spark plug leads.
8. Pull 2 magneto friction clamps outward until they are free from crankcase flange.

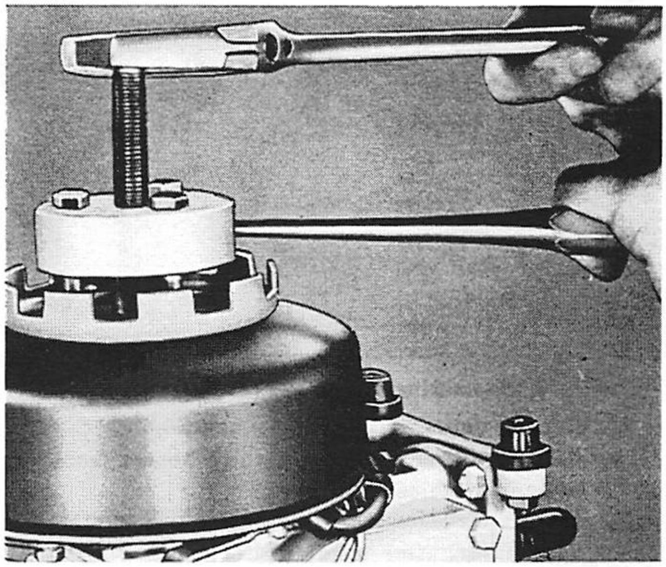


Figure 2. Removing Flywheel

9. Magneto now can be lifted off. (Figure 3)
10. Remove hex head cap screws in exhaust manifold cover plate on left side of motor.
11. Separate baffle plate and gaskets when removing.
12. Remove cylinder block cover and transfer port cover and gaskets by removing cap screws. These covers need not be removed unless required for cleaning exhaust chamber and water cooling chamber.

C. SEPARATING CRANKCASE & CYLINDER BLOCK

1. Remove cap screws which hold upper end cap to crankcase and cylinder block.
2. Remove center main bearing lock screw on outside of crankcase by first bending down lock tabs with screwdriver.

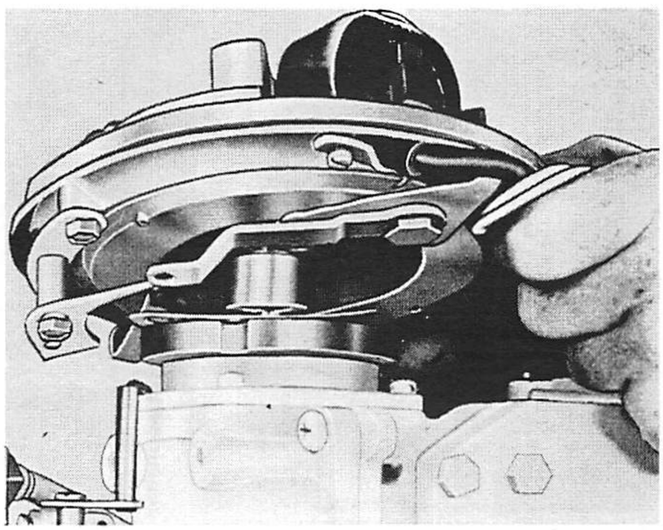


Figure 3. Removing Magneto from Powerhead

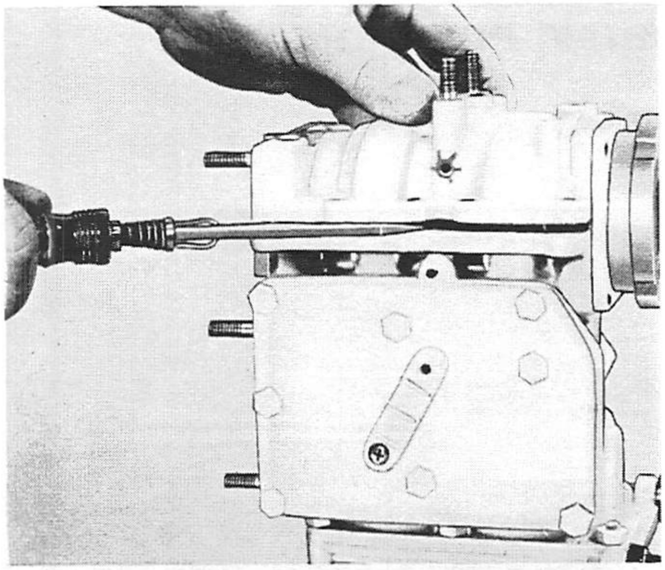


Figure 4. Separating Crankcase and Cylinder Block

3. Remove screw entirely from crankcase.
4. Remove all nuts and bolts which secure crankcase to cylinder block.
   NOTE: Crankcase and cylinder block are matched assemblies, line bored, and never should be mismatched by using different crankcase or cylinder block. Never place machined surfaces on concrete or in any place where surfaces may become marred, as this will result in leaking surfaces, since no gasket is used at this point.
5. Separate crankcase from cylinder block by prying apart at special recesses with screwdriver. (Figure 4) One recess is located on each side in center.
6. Remove crankcase.
7. Loosen valve-type center main bearing from seat in cylinder block by tapping ends of crankshaft lightly upward with rawhide mallet to loosen from locating pin.
8. Remove crankshaft, piston and connecting rod assemblies. (Figure 5)
9. Place crankshaft assembly on Powerhead Stand (91-24283).

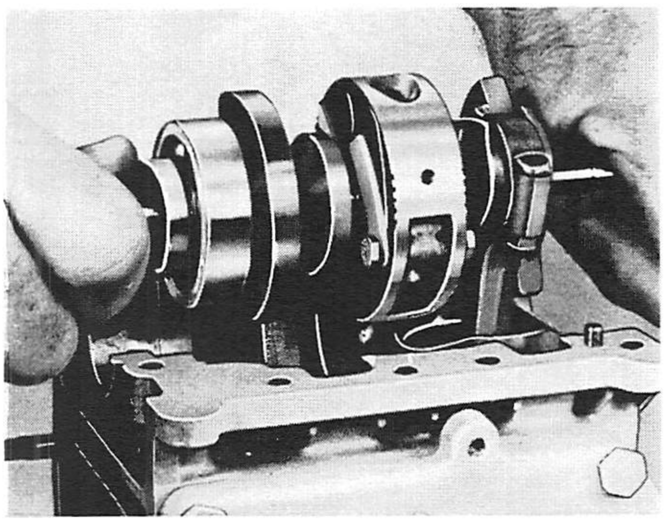


Figure 5. Removing (and Installing) Crankshaft Assembly from Cylinder Block

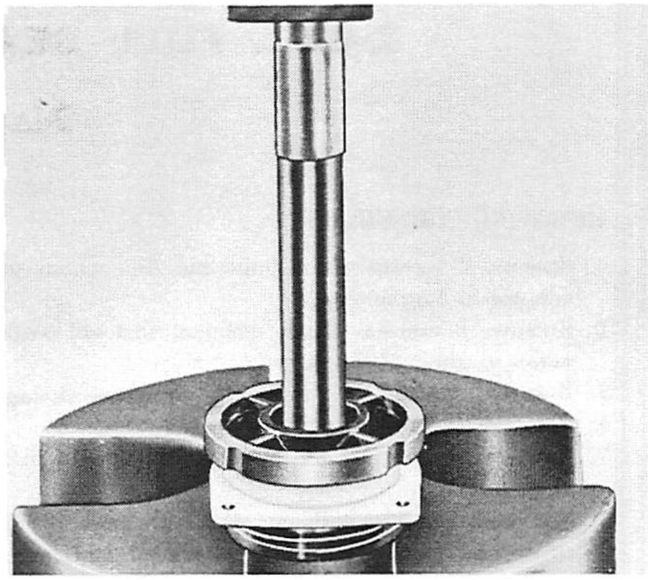


Figure 6. Removing Ball Bearing and Roller Bearing from End Cap

D. REMOVING BEARING FROM END CAP

1. Remove upper end cap oil seal by prying out with screwdriver.
2. Remove ball bearing and roller bearing from upper end cap with Needle Bearing Drive (91-24715A2). Place mandrel into roller bearing and press out toward ball bearing end to remove roller and ball bearing. (Figure 6)

E. REMOVING AND DISASSEMBLING CRANKSHAFT AND PISTON ASSEMBLY

1. Remove locating dowel pin from center main bearing or cylinder block to prevent losing.
2. Remove lower oil seal (lip facing down) and lower ball bearing from crankshaft.
3. Remove piston rings from pistons with Piston Ring Expander (91-24697). (Figure 7)
4. Remove piston pin lock rings on both ends of bearing or cylinder block to prevent losing.

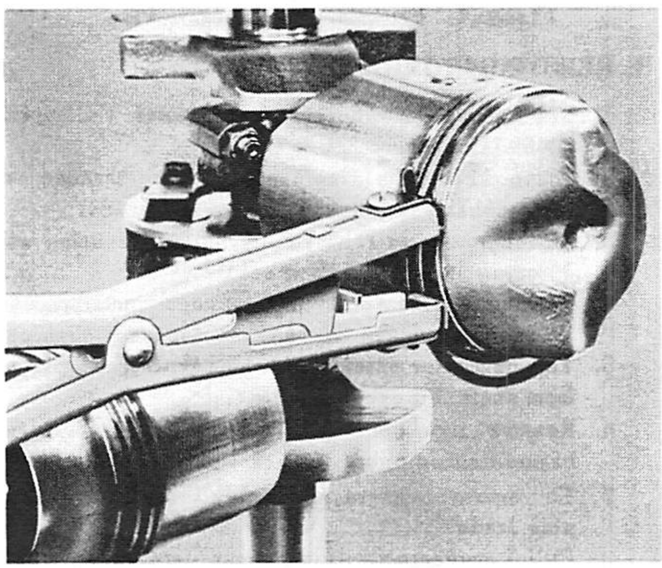


Figure 7. Removing (and Installing) Piston Rings

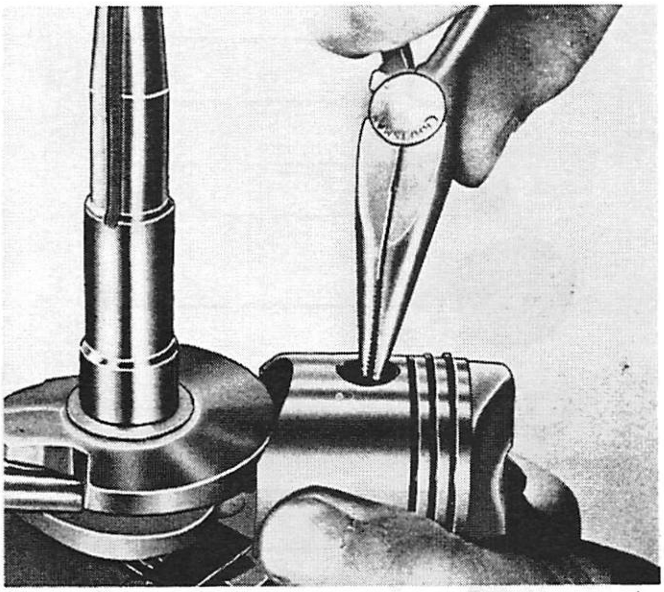


Figure 8. Removing (and Installing) Piston Pin Lock Ring

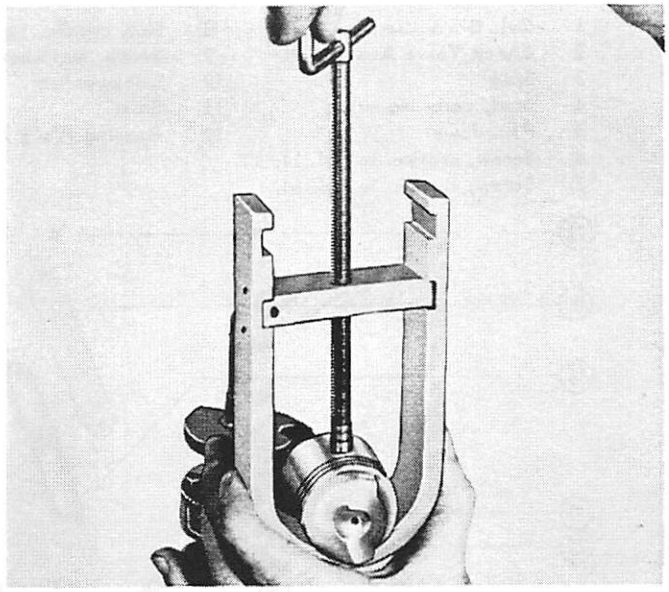
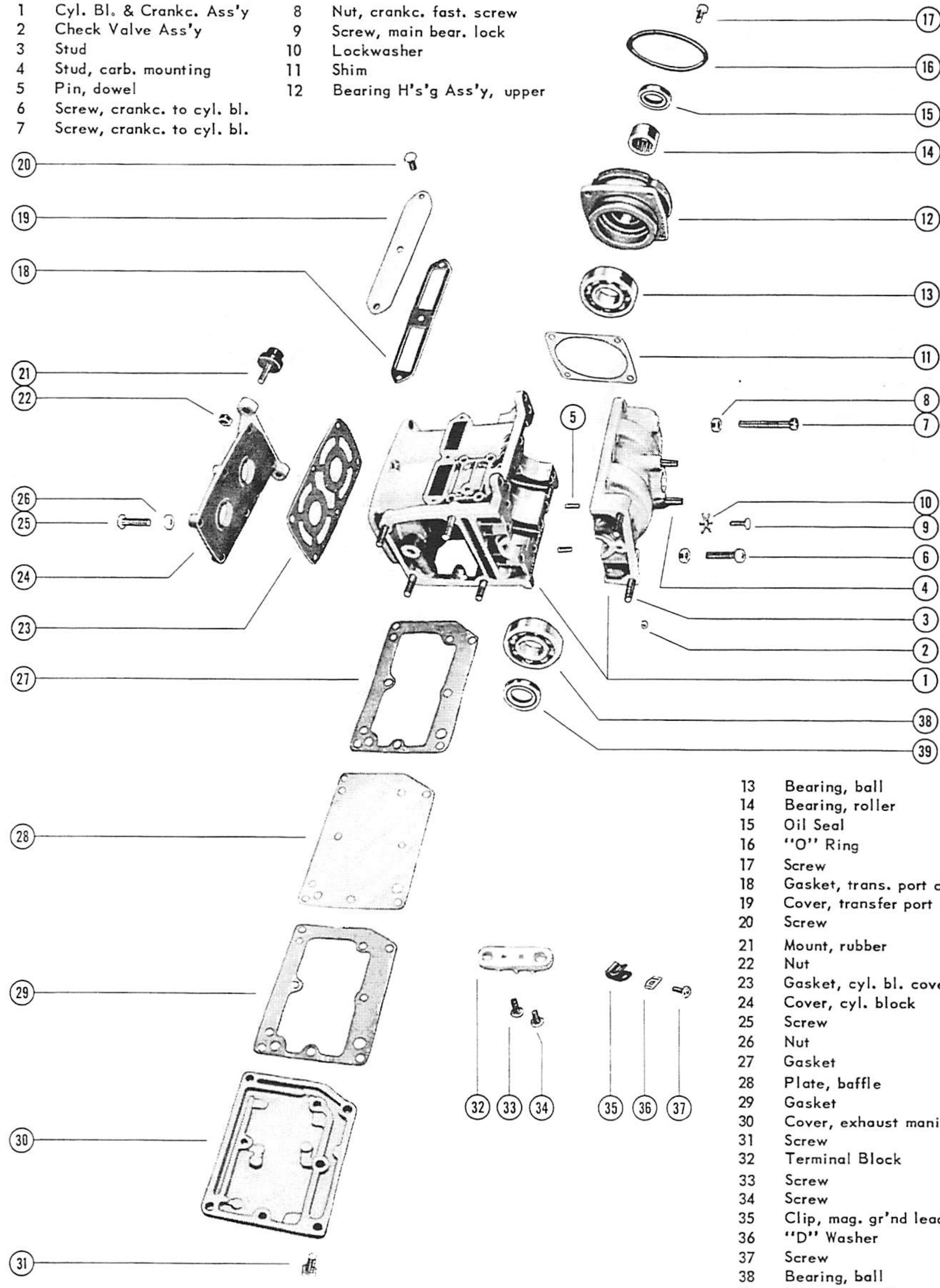


Figure 9. Removing (and Installing) Piston Pin

piston pin with long nose pliers. Turn counter-clockwise and pull. (Figure 8)

5. Place Piston Pin Bearing Tool (91-30425A1) around piston, set bar of tool in center groove and turn screw in until piston pin emerges from piston. (Figure 9) Be careful of roller bearings, 17 in each piston pin race.
6. Connecting rods can be detached by removing 5/16" elastic stop nuts on connecting rod shoulder with 5/16" 6-point socket on ¼" drive.
7. Reed valve type center main bearing can be removed by removing 2 Phillips head screws. Be careful not to bend or distort reed valves and reed valve stops on bearings.
8. Rematch bearing halves on removal to be sure of proper matching on reassembly.
9. Detach reed inlet valves and reed valve stops by removing 5/16" screw with socket wrench.

1 Cyl. Bl. & Crankc. Ass'y
2 Check Valve Ass'y
3 Stud
4 Stud, carb. mounting
5 Pin, dowel
6 Screw, crankc. to cyl. bl.
7 Screw, crankc. to cyl. bl.
8 Nut, crankc. fast. screw
9 Screw, main bear. lock
10 Lockwasher
11 Shim
12 Bearing H's'g Ass'y, upper



13 Bearing, ball
14 Bearing, roller
15 Oil Seal
16 "O" Ring
17 Screw
18 Gasket, trans. port cover
19 Cover, transfer port
20 Screw
21 Mount, rubber
22 Nut
23 Gasket, cyl. bl. cover
24 Cover, cyl. block
25 Screw
26 Nut
27 Gasket
28 Plate, baffle
29 Gasket
30 Cover, exhaust manifold
31 Screw
32 Terminal Block
33 Screw
34 Screw
35 Clip, mag. gr'nd lead
36 "D" Washer
37 Screw
38 Bearing, ball
39 Oil Seal, crankcase

Figure 10. Cylinder Block and Crankcase Assembly, Merc 60

A. INSTALLING CENTER MAIN BEARING TO CRANKSHAFT

1. Place crankshaft in vertical position on Powerhead Stand (91-24282) held in a vise.
2. Adjust reed valves on valve type center main bearing by setting reed valves squarely over their respective openings and at "no preload". (Figure 11) *This means that reed valves do not adhere tightly to seat but have a slight opening, never more than .007".*
3. Place reed valve stops in position evenly over reed valves.
4. Tighten reed stop screws. *(See P. 2B, Sec. VIII.)*
5. Check reed valves for proper setting.
6. Set reed valve stops according to Specification Chart in Miscellaneous Section (VIII), from top of closed reed valve to bottom of reed valve stop.

   IMPORTANT: Always check reed stop opening dimension carefully, as larger opening can cause breakage and smaller opening will not allow sufficient fuel to enter at high RPM.

   NOTE: When replacing reed valves on center main valve type bearing, be careful to set reed valve in order to obtain a "no preload" condition. Reed valves should have equal tension and flutter. (See "Reed Valves", Page 4 this section.)

Figure 11. Adjusting Reeds

7. After resetting reed valves and valve stops on valve type center main bearing, lubricate with MULTIPURPOSE Lubricant (92-30239).

   NOTE: When installing center main valve type bearing, install with locking screw hole on right side of crankshaft, when viewed from intake opening.

8. Replace on crankshaft. (Figure 12)
9. Tighten 2 integral screws securely on each center main to assure tight fit.
10. Recheck reed valve spacing over openings and clearance between reed valve and stop.

B. ASSEMBLING CONNECTING RODS

1. Prepare connecting rods, opening matched assemblies (one at a time) by removing cap screws and lock nuts. Watch knob markings on cap and rod for reassembly.
2. Take small amount of MULTIPURPOSE Lubricant (92-30239) on end of index finger and coat each half of connecting rod bearing race to hold bearings in place.

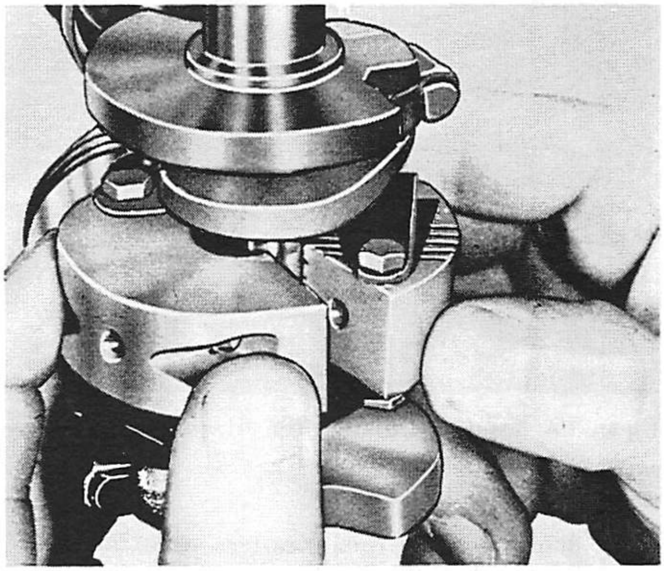


Figure 12. Replacing Center Main Bearing

3. Place roller bearings around both sides for reassembly -- 13 on one half, 12 on other. (Figure 13)
4. Place connecting rod cap so knob markings match connecting rod.
5. Slip separated rod with bearings over crankshaft journal bearing surface, bringing cap up tight to fit and placing rod to match cap.
6. Insert cap screws and lock nuts and tighten each nut evenly with torque wrench for perfect fit. *Refer to Torque Specification Chart in Miscellaneous Section (VIII) for correct torque value.*
7. Rotate connecting rod after torquing, checking that it rotates freely. If rough, remove and check race and rollers.
8. Repeat preceding procedure for other connecting rod.
9. Always recheck knob markings on reassembled rods for correct and perfect match.

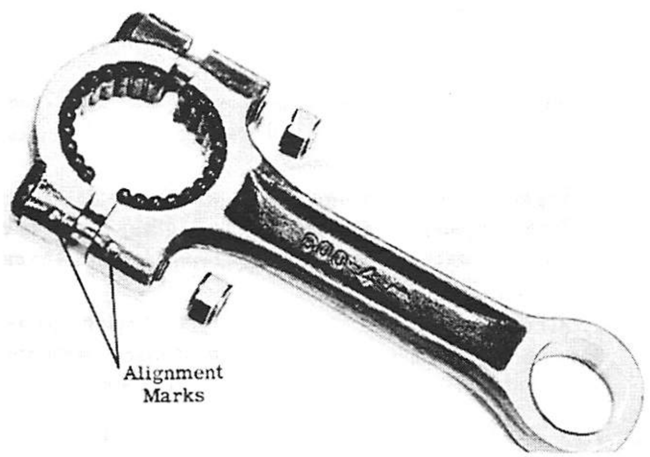


Figure 13. Connecting Rod Assembly Ready to Install

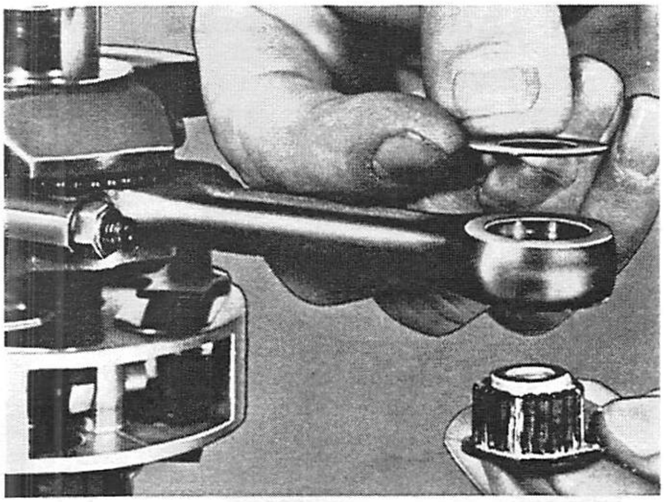


Figure 14. Inserting Piston Pin Bearings and Sleeve into Connecting Rod

C. REPLACING PISTONS

1. Replace piston pin bearings with Piston Pin Bearing Tool (91-24144) and slide bearing retainer washer onto tool sleeve.
2. Coat sleeve with small amount of MULTIPURPOSE Lubricant (92-30239) to hold 17 roller bearings for each piston pin bearing race.
3. Place bearings around sleeve of tool and then insert assembly into race of connecting rod. (Figure 14)
4. Place other bearing retainer washer on opposite side of rod.
5. Place piston over bearings (watch intake side of piston), grooved (sharp profile milled part of piston) to right while looking at dome of piston. *Sloping top of piston is exhaust side.*
6. Push out sleeve with punch part of tool from bottom and set open end of piston pin on small end of piston pin tool. (Figure 15)
7. Press piston pin in with palm of hand and, if tight, tap with mallet, being sure to support piston and rod assembly so that rod is not bent. Piston Pin Tool (91-30425A1) may be used. Check assemblies for binding after installing.
8. Repeat preceding process for other piston, being certain to replace 2 piston pin lock rings in each piston to secure piston pin.
9. Set tip of lock in groove and, with long nose pliers, push lock in and turn counterclockwise (to left) to seat. (Figure 8)
10. Replace piston rings on pistons with Piston Ring Expander (91-24697), spreading rings over end of piston and seating properly in grooves. (Figure 7)
11. Check that rings float freely in piston groove after lubricating with oil. Align properly with ring openings over pins in piston ring grooves.

D. REPLACING CRANKSHAFT, CONNECTING ROD AND PISTON ASSEMBLY

1. Slip bottom ball bearing on crankshaft and seat in place against shoulder of lower crankcheek.
2. Set lower two oil seals on crankshaft with lips facing down.
3. Set dowel pin for center main bearing in place in cylinder block.

NOTE: Use 2 angle ring compressors to insert pistons into cylinders. (Figure 16) Open compressor by turning knurled wheel and place over piston rings from lower end of piston. Place lubricating oil on piston rings and on face of ring compressor shoes and check that they are free and properly aligned over the locating pins in the ring grooves. Insert from crankshaft end, aligning ring compressor shoes over piston rings. When evenly aligned and centered, turn knurled wheel on end of compressor lightly to compress rings. Do not turn wheel too tight or compressors cannot slide off piston when placing in cylinder. If too tight, it also may score the piston when removing. After placing compressors on pistons, set crankshaft assembly over cylinder block and insert one piston, then the other. As pistons enter cylinders, loosen ring compressor slightly and piston will slide in with ease. After pistons are placed in cylinder bores, remove compressors. Be sure, when turning crankshaft, that pistons do not come out of cylinders.

4. If tool is not available, install completed piston and crankshaft assembly. (Figure 5) While installing, check that crankshaft tapered end is to top of cylinder block and intake sides of pistons are in correct position.

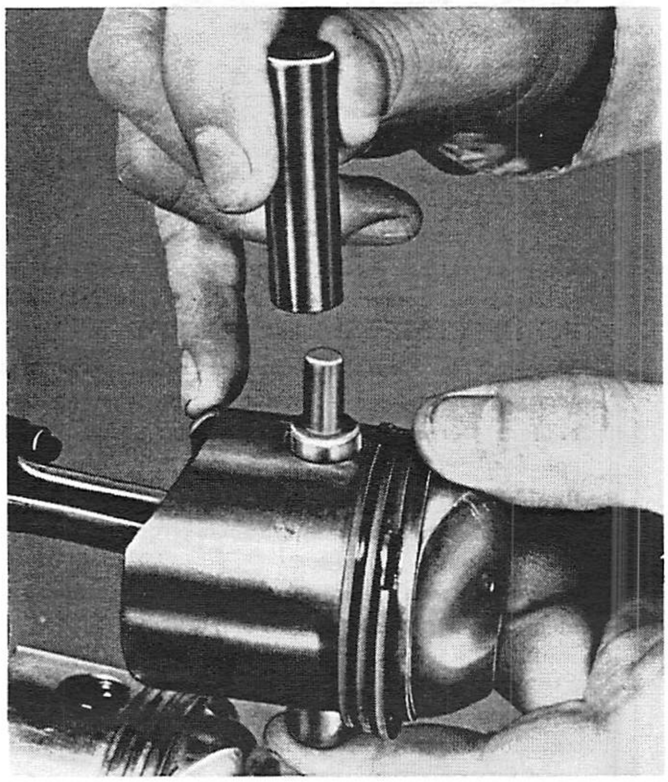


Figure 15. Inserting Piston Pin on Piston Pin Tool

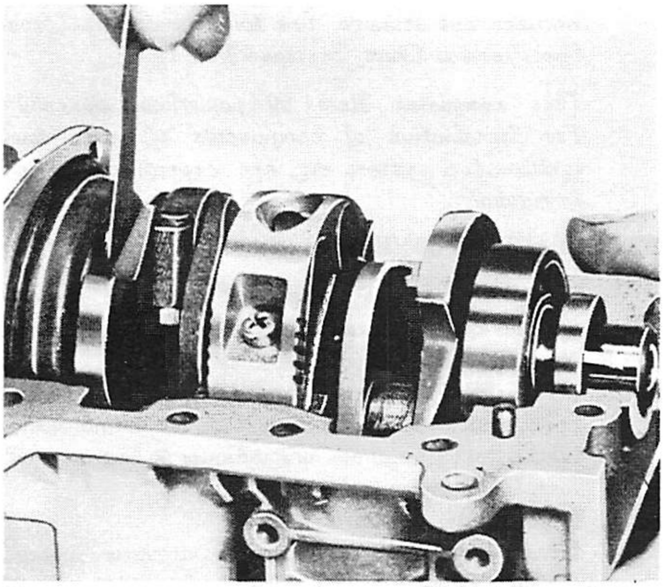


Figure 16. Inserting Pistons into Cylinders with Ring Compressors

5. Work pistons into cylinders. With index finger, compress rings and ease pistons down into cylinder bores. Do not use undue force, or rings will break.
6. Align valve type center main bearing locating pin in cylinder block and push in until seated.
7. Check each of 6 piston rings thru the exhaust or intake 6 ports by pressing with screwdriver for spring tension. If no springing action occurs, or ring does not return to position, it is likely that ring has been broken in reassembly. *Be careful not to burr piston rings.*

E. REPLACING END CAP

1. Set roller bearing on end of Bearing Mandrel (91-24715A2) and press into upper end cap evenly between upper and lower openings. (Figure 17)
2. Replace shims in end cap.
3. Replace ball bearing, pressing in with arbor press until seated evenly.

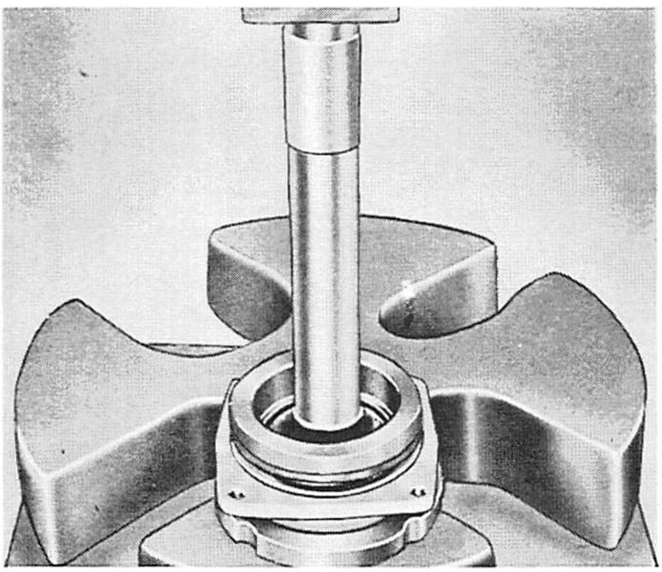


Figure 17. Installing End Cap Roller Bearing

4. Replace oil seal in upper end cap, using a tool of equal diameter and pressing in with arbor press.
5. Install upper end cap temporarily on crankshaft, being careful not to damage oil seal.
6. Tap end cap down so that it seats against cylinder block.
7. Install cylinder block to end cap screws, tighten and check for end play between crankshaft ball bearing journal thrust face and inner race of ball bearings. (Figure 18)
8. Tap crankshaft either way with mallet to be sure of true seat. Tolerence of end play on units should be .008" to .012". If too much end play, remove shims between crankcase and cylinder block and upper end cap; if not enough, add shims in .002", .003", .005" or .010" thicknesses, as required.

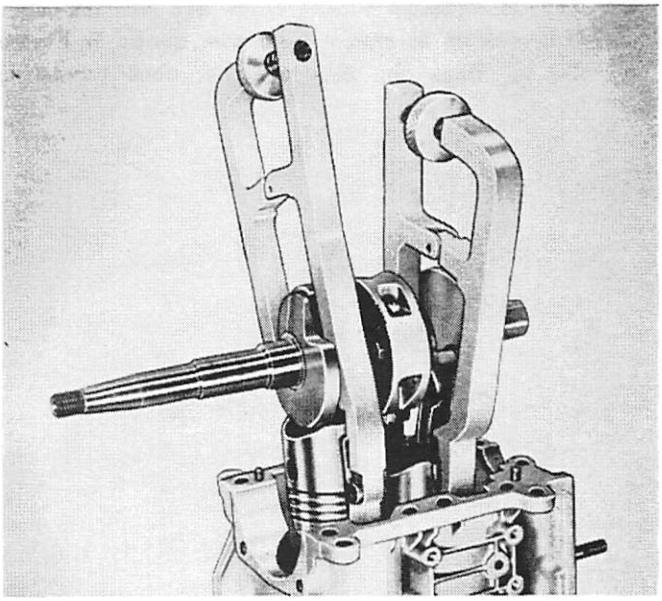


Figure 18. Gauging Crankshaft End Play

9. Pull upper end cap back a little from seat on cylinder block and coat seating surface of end cap with Sealer Compound (92-28804).
10. Coat joint face of crankcase with thin layer of sealer (92-28804) for metal-to-metal seal.
11. Set crankcase over cylinder block, insert bolts and attach nuts and washers.
12. Place center main bearing locking screw with lock tab washer thru hole in crankcase to hold main bearing.
13. Align opening of valve type center main with that of crankcase fuel intake opening so that they are evenly centered.
14. Tighten crankcase cap screws, starting with center cap screws and work to top, then from center to bottom, etc, to prevent distortion of covers and possible leakage. *(See Figure 25, Page 46 of this section for reference.)* Use torque values listed on Torque Specification Chart, Section VIII.
15. Tap upper end cap into place to seat firmly and install screws.
16. Install center main locking screw and crimp lock tab washer after tightening screw to recommended

torque. Refer to correct torque value in Torque Specification Cart, Page 2C, Section VIII.

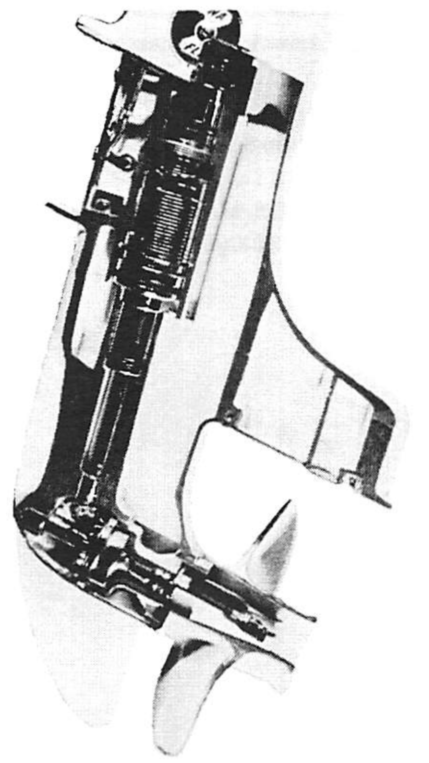
17. Tighten upper end cap screws securely.
18. Mount completed powerhead on Powerhead Stand (91-24282) in vise and rotate several times to be sure that entire powerhead assembly is free.
19. Reinstall intake port covers and cylinder block cover, renewing gaskets before installing.
20. Reinstall gasket on manifold and baffle plate and gasket for outside cover.
21. For easy installation, locate 2 studs in cylinder block exhaust side to aid in aligning plates and gaskets. Remove after several screws have been placed.
22. Tighten cylinder block covers and exhaust manifold screws in proper sequence shown in Figure 26 on Page 46, this section, thus preventing warpage and leakage. *See torque value in Torque Specification Chart, Section VIII.*

This completes Merc 60 powerhead assembly. For installation of components of carburetion, ignition, fuel system, etc, see respective sections in manual.

F. REPLACING POWERHEAD

1. Place magneto on powerhead and push magneto friction clamps inward until they are secure under crankcase flange.
2. Install flywheel and torque. Refer to Torque Specification Chart, Section VIII, for torque value.
3. Install fuel line check unit adaptor in bottom cowl.
4. Install fuel pump and carburetor.
5. Install choke shutter spring.
6. Install cotter pin in magneto actuator linkage.
7. Connect shut-off switch wires and magneto ground wires to terminal block.

section III lower unit



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LOWER UNITS DIVIDED INTO 6 MAIN TYPES

Type I - Neutral Clutch

Models: Mark 6-6A-5

Type II - Full Gear Shift

Models: Merc 1100-1100SS-1000-950-950SS-900-850-800-700-650-500-450-400-350-300-200-110-60-39, Mark 58-58A-55-55A-50-35A-30-25-20-15 & KH7

Type III - Automatic Transmission

Models: Merc 250-200-150-100 & Mark 28-28A-15A-10-10A

Type IV - Standard Non-Shift

(Unicast Unit)

Models: Mark 40-7, KG9, KF9, KG7, KF7, KE7, KF5, KG4, KE4, KF3 and Quicksilver Lower Units

(Two-Piece Unit, Old Models)

Models: KD4, KE3 and Models Prior to 1947

Type V - Direct Reversing

Models: Merc 800-700-600 & Mark 78-78A-75-75A

Type VI - Quicksilver

Models: Mark 55H-40H-30H-20H & KG9H, KG7H, KF7HD, KG4H

DRIVE SHAFT HOUSINGS DIVIDED INTO 4 MAIN TYPES

Type I - Spring Loaded

Models: K to KD4 & KE3

Type II - Spring Loaded and Rubber Mounted

Models: Mark 40-20-15-7, KH7, KG7, KF7, KE7, KG4 & KE4

Type III - Rubber Mounted

Models: Mark 6-6A-5, KF5 & KF3

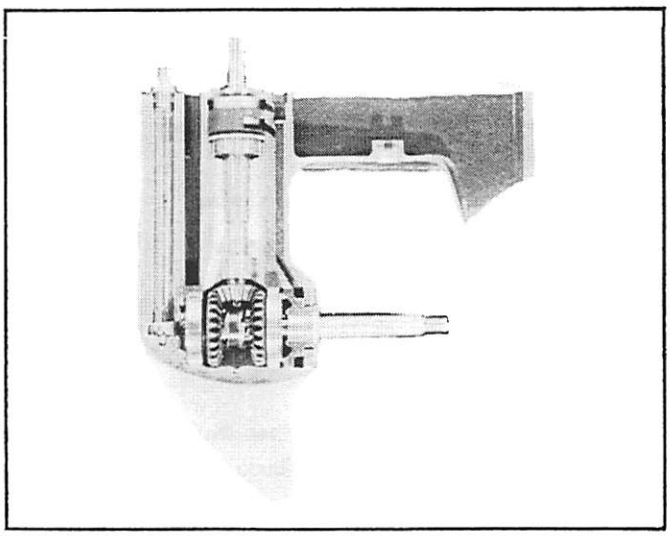
Type IV - Dyna-Float Shear Mounted

Models: Merc 1100-1100SS-1000-950-950SS-900-850-800-700-650-600-500-450-400-350-300-250-200-150-110-100-60-39, Mark 78-78A-75-75A-58-58A-55-55A-50-35A-30-28-28A-25-15A-10-10A

General Description

The lower unit is composed of 3 main sections:

1. Gear housing assembly (including propeller).
2. Drive shaft housing assembly.
3. Clamp and swivel bracket assembly.



Gear Housing, Cutaway

PART'S INSPECTION - HOW TO CHECK

Before reassembling, check all parts thoroughly. Check that the housing and all internal parts are perfectly clean.

Bearings

Cartridge needle bearings should always be replaced at overhaul and when rust conditions are present. Bearings are relatively inexpensive.

Ball bearings should be cleaned first and dried in the following manner:

a. With one hand, grasp the outer race firmly, and with the other attempt to work inner race in and out. There should not be excess play.

b. Spin outer race. If bearing sounds rough or has catches in it, discard it. Bearings should have smooth action, no rust stains. Compare with new bearing.

Note: Always press cartridge type needle bearings into part with the "lettered" side up. Opposite side has a greater radius for better installation. Check bearings after installation to see that they are free and not frozen or stuck due to improper installation or tight fit.

Inspect roller bearings, in particular, and check that they are not worn. It is recommended when repairing motors that they be replaced, as they are relatively inexpensive.

Seals

Always replace oil seals when repairing, as they are relatively inexpensive and can save trouble at a later date.

Drive Shaft and Propeller Shaft

Check for worn, twisted or bent shafts.

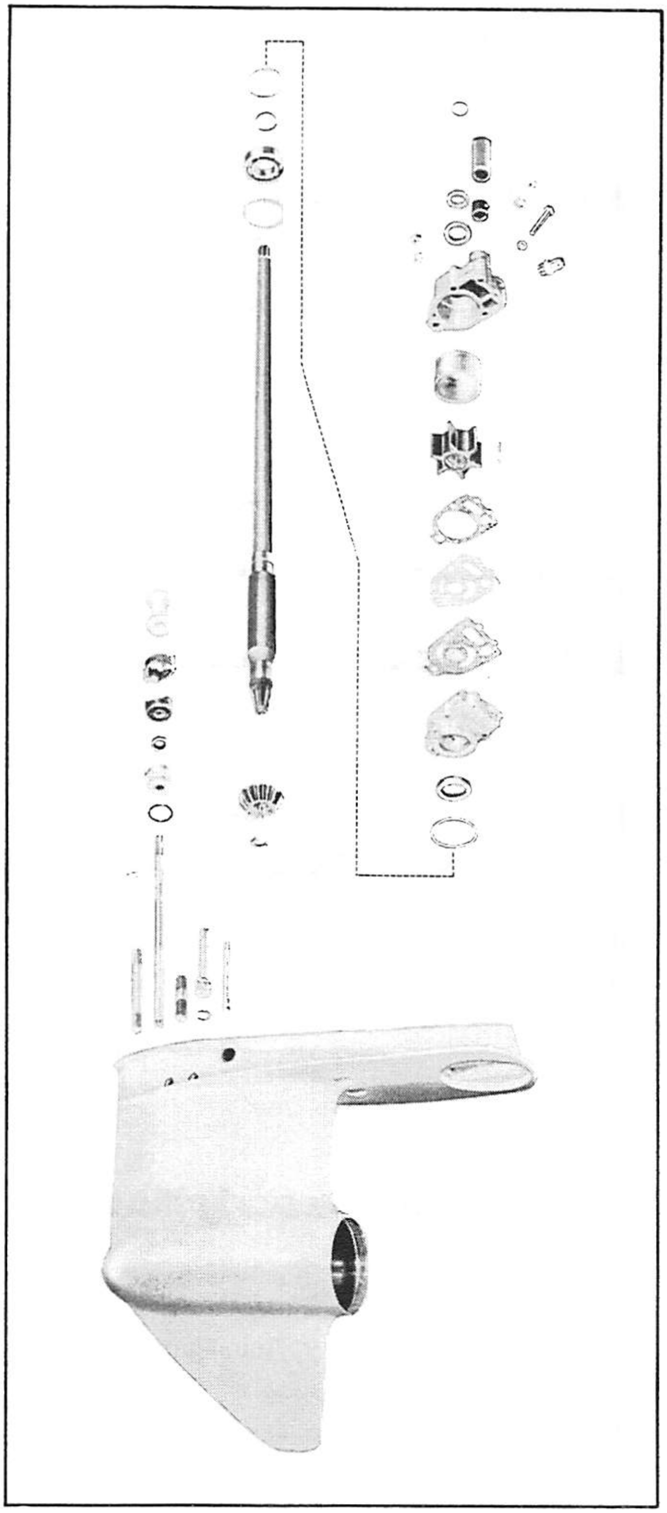
Gears

If teeth are worn, pitted, chipped or broken, or if corners are rounded, chipped or otherwise damaged, replace gear.

Check for wear, improper fit (too tight or too loose), wrong conical angle or too much back lash.

Water Pump Assembly

Check for worn, broken or corroded water pump housing. Check impeller for wear or broken vanes.



Merc 800-700 Full Gear Shift Drive Shaft Components

MARK 6 TYPE LOWER UNIT

(Neutral Clutch with Rubber Mounted Drive Shaft Housing)

Disassembly

A. MODELS

Mark 6-6A and Mark 5

B. LOWER DRIVE SHAFT ASSEMBLY

1. Loosen 2 small round head screws in holding clamp for shift cable at right side of powerhead.
2. Remove large slotted special screw in front top of drive shaft housing which holds drive shaft housing in inner pivot tube.
3. Loosen stress bolt and nut on top side of drive shaft housing and pull down to disengage, then remove entire lower unit from powerhead.
4. Remove shift cable tube by removing brass nut connection and compression fitting at side of block. (Figure 1)
5. Pull out entire tube.

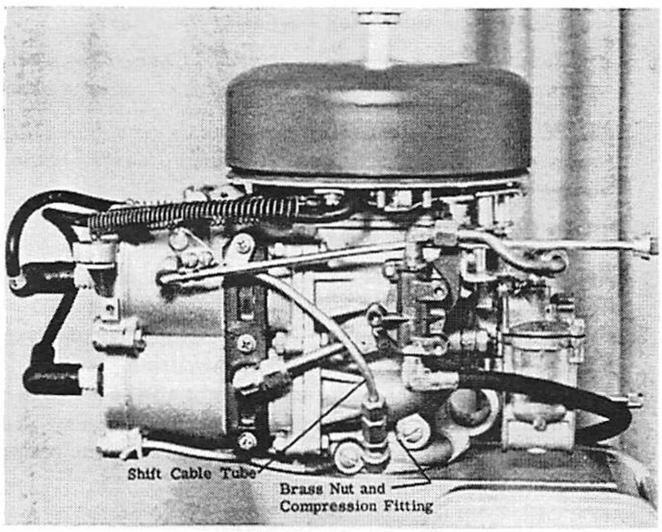


Figure 1. Removing Shift Cable Tube

6. Remove copper water tube from inside of inner pivot tube by pulling down.
7. Loosen screw in co-pilot locking ring to release powerhead and inner pivot tube assembly from clamp and swivel bracket assemblies.
8. Remove co-pilot clamp ring by pulling out. *(Note: Ring has a 5/8" spindle extension extending into bushing inside of swivel bracket.)*

C. DRIVE SHAFT HOUSING

1. Place unit in vise with 2 blocks of soft wood to protect against marring by vise jaws.
2. Remove hexagon nut and tab lockwasher, which holds 3 sections together, from stud on leading edge of housing.
3. Remove Phillips head screw from inside exhaust outlet which holds gear and clutch housing assembly together.
4. Remove hexagon nut and lockwasher from trailing edge stud, below anti-cavitation plate, which holds 3-piece assembly together.

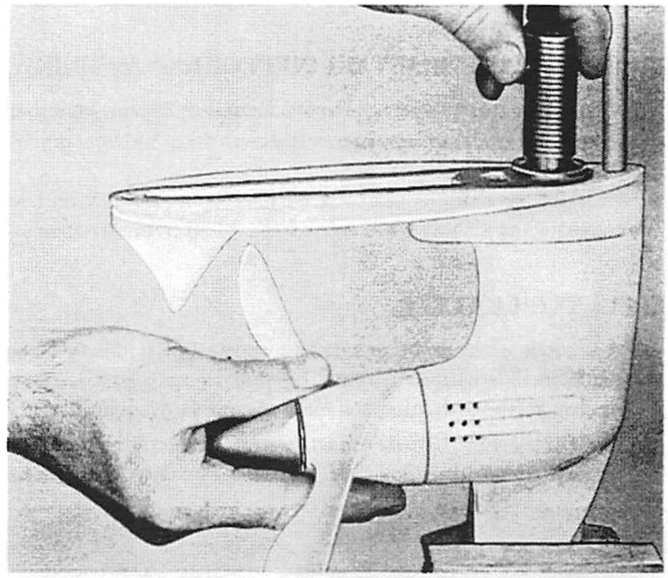
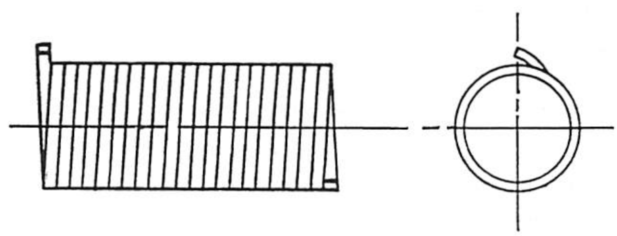


Figure 2. Turning Clutch Spring

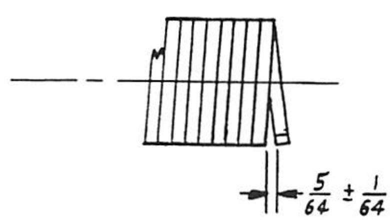
5. Separate top of drive shaft housing from bottom part of assembly.
6. Turn propeller slowly counterclockwise, at same time pulling lower drive shaft housing assembly away from gear housing. *(Note: By turning propeller slowly counterclockwise, the engaging spring from drive shaft unwinds, thus allowing separation of lower drive shaft from gear housing.)*

D. WATER PUMP

1. Remove rubber seal ring from drive shaft spline top end.
2. Remove water pump cover assembly, stainless steel washer, impeller, impeller key and stainless steel



Before Spreading



Spread Bottom 1/2 Coil As Shown

Figure 3. Spreading Coil

water pump housing from middle section of 3-piece assembly in this order.

NOTE: If required, remove water line rubber seal in pilot cap by pressing in 2 side knobs which hold it in cover.

3. To remove drive shaft seal in pilot cap, pry out with screwdriver.

E. LOWER DRIVE SHAFT & PINION GEAR ASSEMBLY

1. Remove clutch spring from knurled clutch drum by turning propeller counterclockwise to unwrap spring from drum. (Figure 2)
2. Pull upper drive shaft out of middle section and remove brass thrust washer at top of upper clutch drum.

F. CLUTCH CHATTER

1. A clutch chatter or grinding noise, which may occur on Mark 5 when in neutral gear, is caused by clutch spring without initial tension wound into spring.

   IMPORTANT: Clutch chatter will have no effect on engine operation, nor will it result in harm to engine.

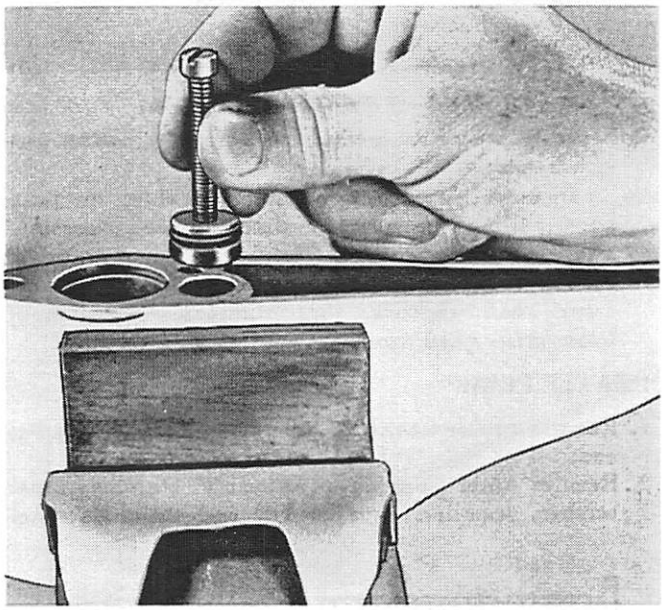


Figure 4. Removing Plug on Shift Linkage Cartridge

2. To eliminate clutch chatter in Mark 5, remove clutch spring and clamp bottom half coil of spring in vise. (Figure 3)
3. With screwdriver, bend bottom half coil 5/64" away from spring (plus-or-minus 1/64"). This will pretension clutch spring when reinstalled.

G. CABLE LINKAGE ON NEUTRAL SHIFT

1. Entire cable shift mechanism is contained in a separate cavity of middle assembly.
2. Remove seal in bottom of housing (middle assembly) by using ¼"-20 screw, turned into seal plug to withdraw assembly. (Figure 4)

   NOTE: This assembly should not be separated from its original sequence on cable when disassembling. Try to keep assembly strung on cable for easy replacement. Anchor on end of cable is soldered to cable, followed by brass trip finger, slotted bushing, spring

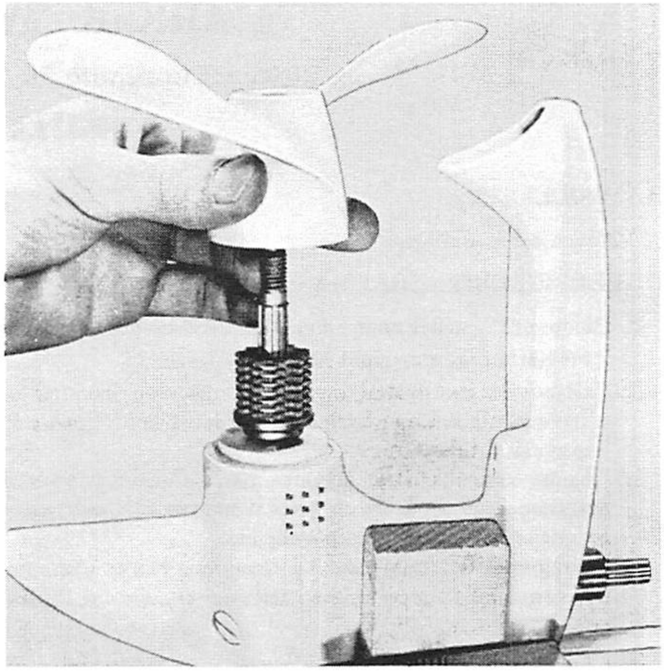


Figure 5. Removing Propeller from Shaft.

and double tapered rubber seal. Check for proper reassembly of seal. Long, tapered end faces down.

IMPORTANT: If excessive grease is found in cable tube, inside diameter of seal leaks. If water is found in gear case, outside diameter leaks.

H. PROPELLER AND DRIVE SHAFT

1. Remove propeller nut by straightening tabs of lockwasher which are bent over flats of propeller nut.
2. Remove propeller clutch spring, steel washer and fibre which fit into back hub of propeller.
3. Remove propeller, being careful not to lose 14 discs (7 fibre and 7 metal) lined up on propeller shaft. (Figure 5) These are followed by clutch thrust plate and gear case cover.

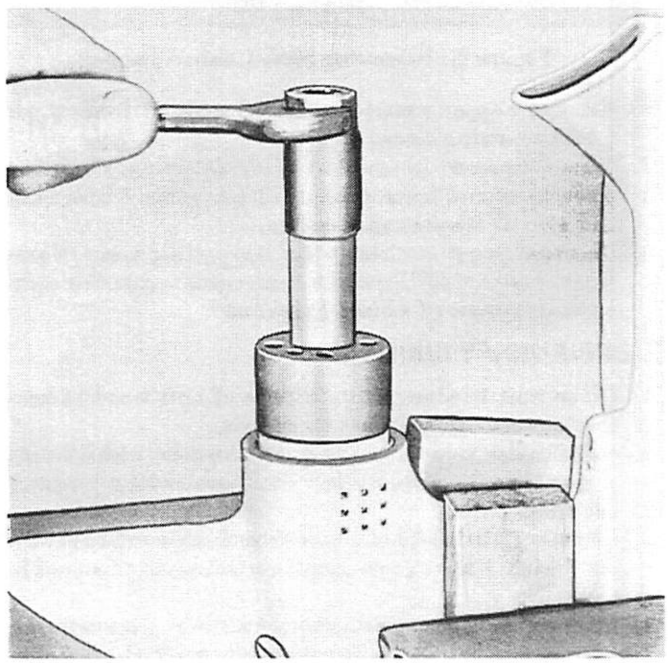


Figure 6. Removing Gear Case Cover

4. Remove gear case cover (left hand thread) with Water Pump Tool (91-24267). Set dowels in cover holes, apply wrench to flats of tool and turn. (Figure 6)
5. Pull propeller shaft drive assembly, including water intake housing, rubber sealing ring, metal retainer and propeller shaft assembly which includes snap ring, shim, ball bearing, bevel drive gear, key and metal bearing ring. (Figure 7)
6. Remove shims, if any, from shoulder in housing beneath propeller shaft ball bearing.
7. To remove propeller shaft ball bearing and gear with Propeller Shaft Gear Tool (91-26376A1), use open end of cup to remove ball bearing and other end to remove gear on shaft (Figure 8).

I. LOWER DRIVE SHAFT ASSEMBLY & GEAR HOUSING

1. Bend down tab washer on pinion gear and remove hex head bolt which holds pinion gear to shaft.
2. Remove pinion gear.

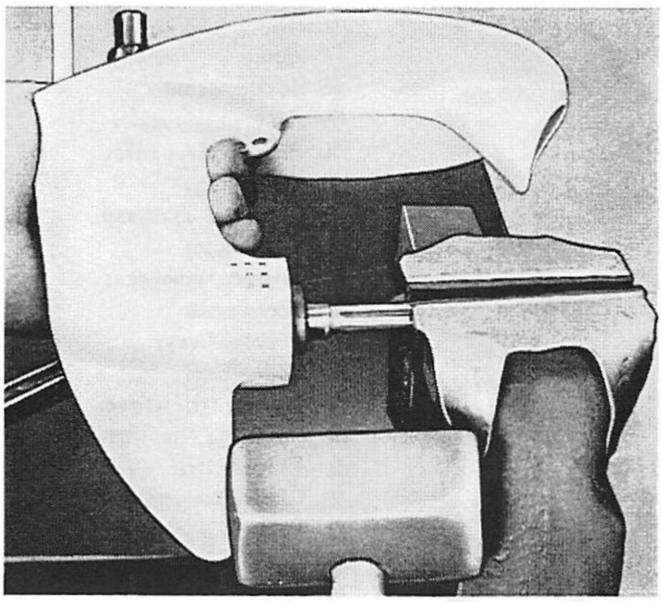


Figure 7. Pulling Propeller Shaft Assembly

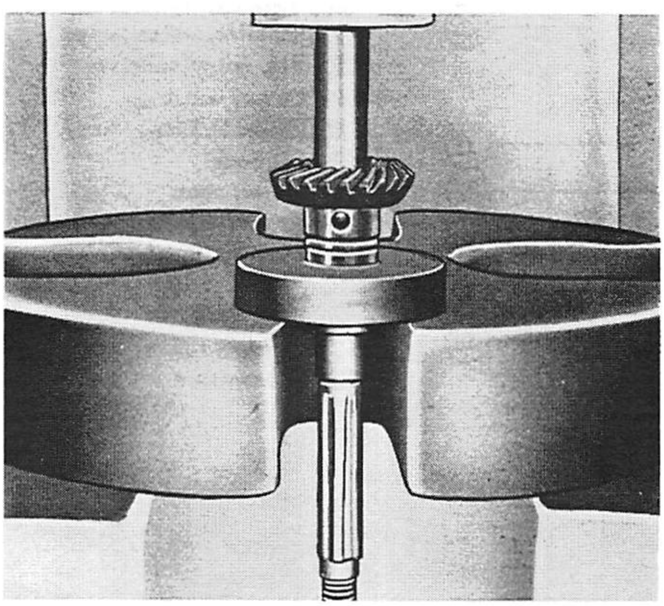


Figure 8. Pressing Off Propeller Shaft Gear

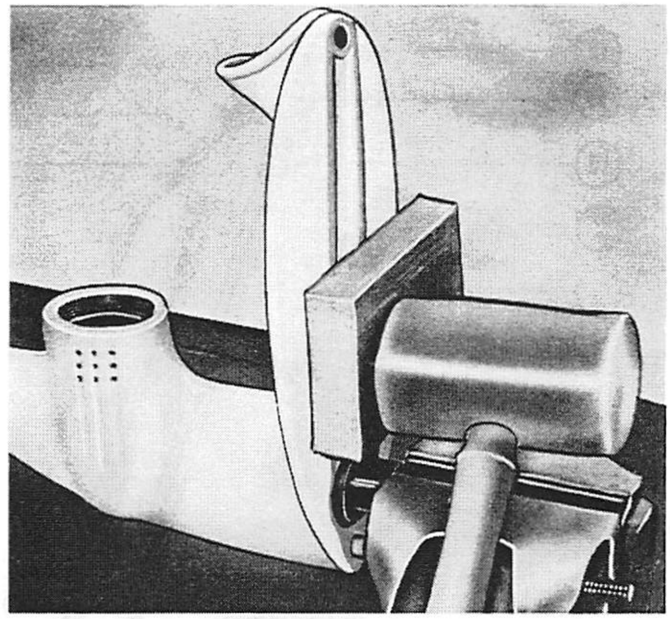


Figure 9. Removing Lower Drive Shaft

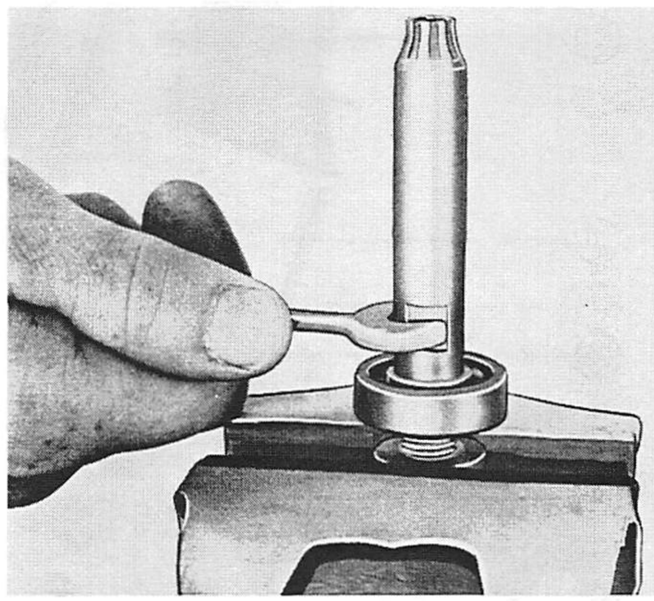


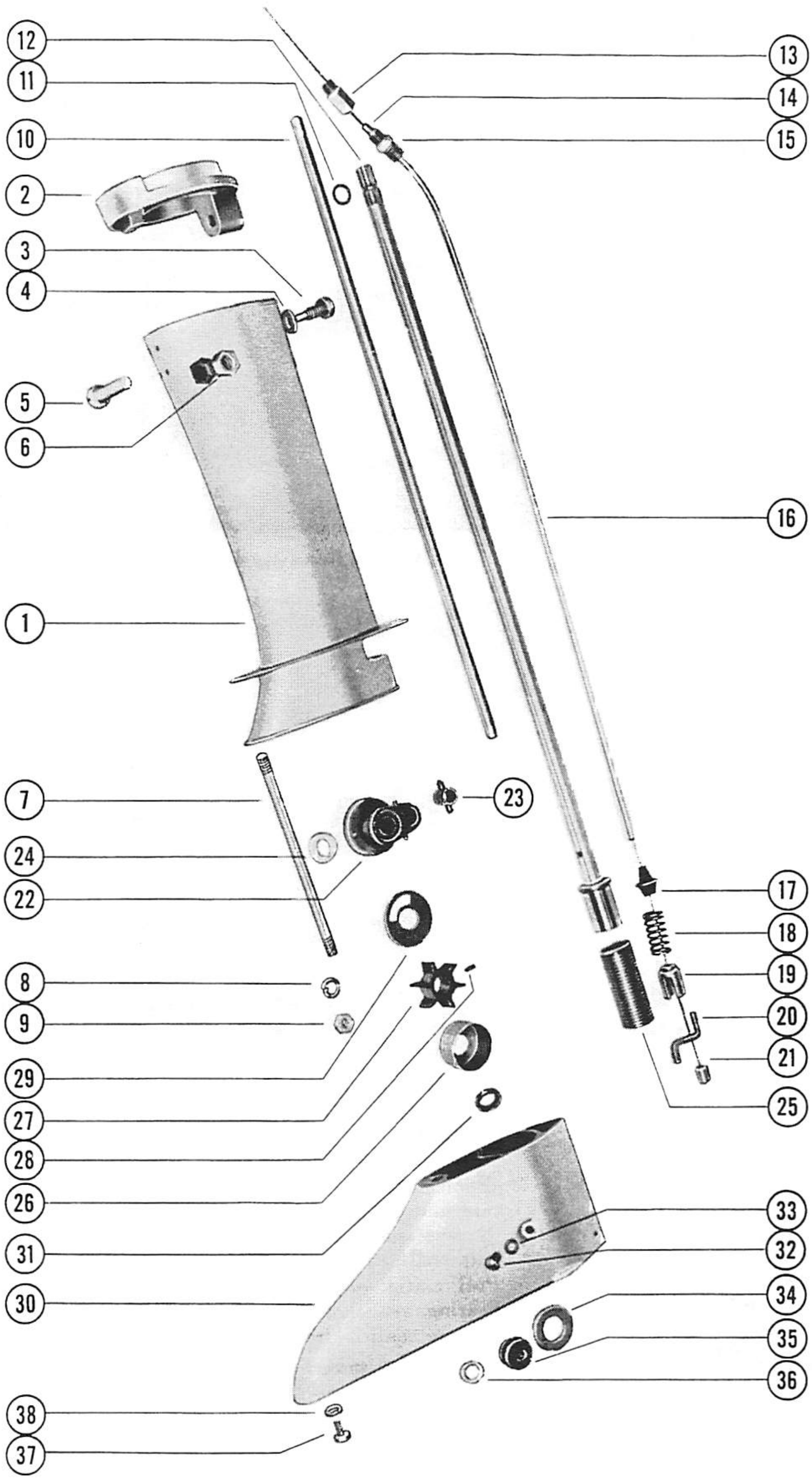
Figure 10. Removing Lower Drive Shaft from Clutch Drum & Bearing

3. Place short lower drive shaft in vise between 2 pieces of wood or soft metal protectors.
4. Remove short lower drive shaft by tapping on casing with mallet. (Figure 9)
5. Pull entire assembly -- including grease seal and bearing spacer, lower knurled clutch drum, ball bearing and shaft -- free from lower gear housing.

NOTE: For proper placement when reassembling, watch position of bearing spacer when removing. Wide part is placed UP in lower gear housing.

J. DRIVE SHAFT BEARING & LOWER DRIVE SHAFT

1. Place clutch drum in protected vise jaws. Note that there are two flat sides on drum.
2. Unscrew drive shaft from clutch drum with wrench and slide bearing off shaft. (Figure 10)
3. Remove drive shaft and propeller shaft needle bearings from gear housing with Gear Housing Needle Bearing Tool (91-24273).



1 Drive Shaft Hsg., up.
2 Top, d. s. hsg.
3 Screw
4 Lockwasher
5 Screw, clamping
6 Nut
7 Stud
8 Lockwasher
9 Nut
10 Pipe, water inlet
11 "O" Ring
12 Upper D. S. Assy.
13 Connector
14 Sleeve, compress.
15 Connector
16 Tubing Assy.
17 Cone Seal
18 Spring, trip finger
19 Housing, trip fing.
20 Finger, trip
21 Cable, control
22 Pilot Cap Assy.
23 Bushing, pilot cap
24 Oil Seal, pilot cap
25 Spring, clutch
26 Housing, water pump
27 Impeller, water pump
28 Pin, impeller drive
29 Cover, w.p. hsg.
30 Lower D.S.Hsg. Assy.
31 Oil Seal
32 Screw, vent
33 Washer
34 Washer, thrust
35 Plug
36 "O" Ring
37 Screw
38 Lockwasher

Figure 11. Neutral Clutch Lower Unit, Mark 6-6A

1 Gear Housing Assy.
2 Drive Shaft
3 Bearing, ball
4 Drum, clutch
5 Shim,(.002-3-5)
6 Spacer
7 "O" Ring
8 Gear, pinion
9 Lockwasher
10 Screw
11 Shaft, propeller
12 Gear, propeller
13 Pin
14 Shim, bearing to prop. gear
15 Shim (.002-3-5-10)
16 Bearing, ball
17 Snap Ring
18 Washer, sealing
19 Water Intake Hsg. Assy.
20 Oil Seal
21 Washer
22 Cover, gear housing
23 Screw
24 Washer
25 Stud
26 Tabwasher
27 Nut
28 Propeller
29 Plate, clutch thrust
30 Disc, friction
31 Disc, friction
32 Spring, compression
33 Tab Washer
34 Nut, propeller

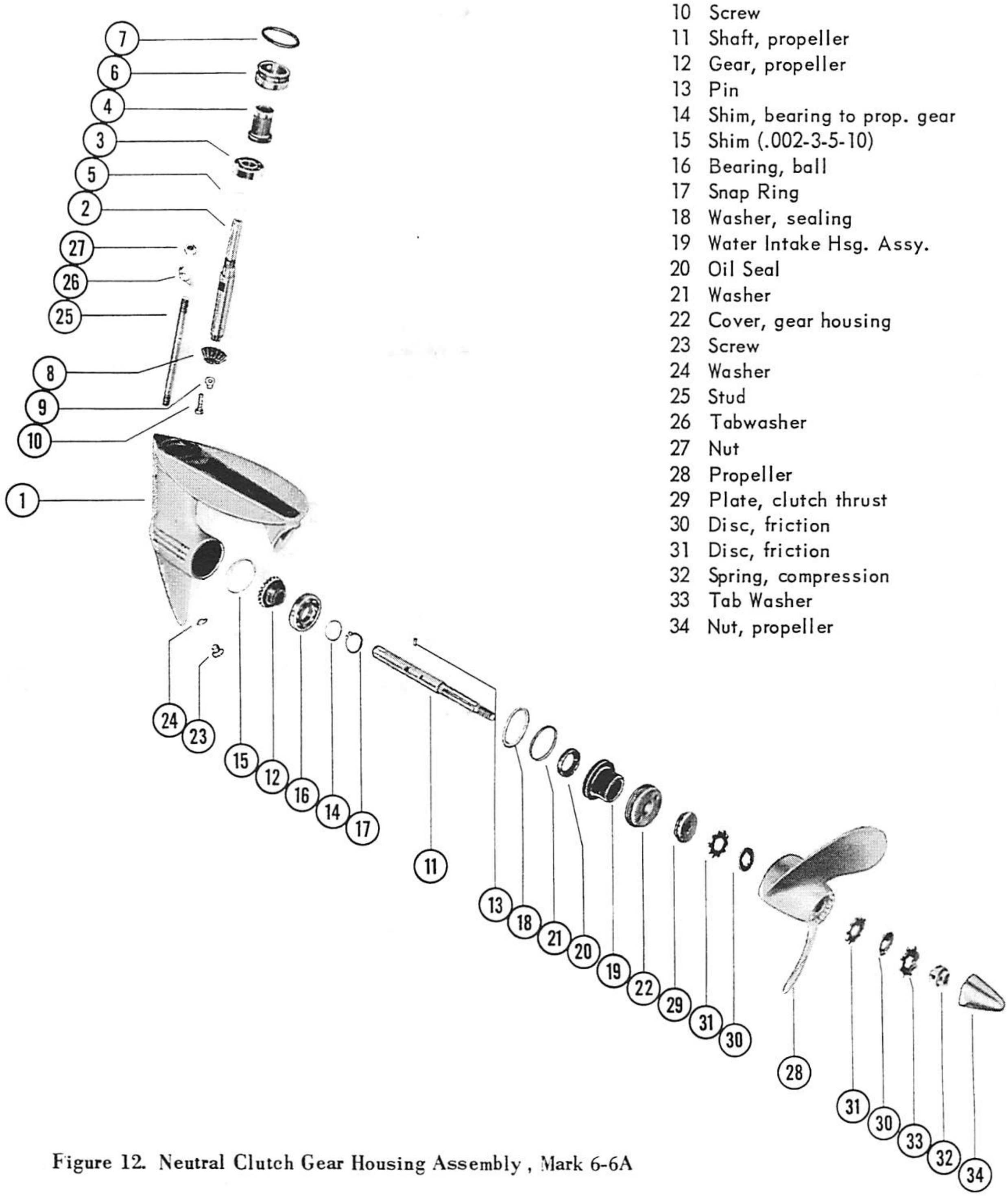


Figure 12. Neutral Clutch Gear Housing Assembly , Mark 6-6A

Reassembly

NOTE: Refer to Page 2, this section, prior to reassembly.

A. LOWER GEAR CASE HOUSING

1. Install needle bearings in gear housing for drive shaft and propeller shaft with Gear Housing Needle Bearing Tool (91-24273).
2. Fit ball bearing race to lower drive shaft extension by pressing down to offset shoulder on shaft.
3. Screw lower half knurled clutch drum on shaft and tighten with wrench.
4. Place brass shims, as necessary, in cavity of gear housing for drive shaft bearing seat.
5. Insert assembly into drive shaft chamber in gear housing.
6. Place bearing spacer ring in journal with wider collar end up and seat grease retainer seal on collar.
7. Insert pinion gear into bottom gear housing and attach to splined end of drive shaft extension. Use new lock tab washer and hexagon head cap screw to hold. Place shaft in vise to tighten. Be sure to use jaw protectors in vise to prevent damage to knurled clutch drum. Tighten screw with a box wrench and bend tab on washer.
8. Ready the propeller shaft and gear by placing gear on closed end of Propeller Shaft Gear Tool Cup (91-26376A1). Place blank end of shaft into gear shoulder and line up drilled key hole in shaft with one in shoulder of gear.
9. Spread lubricant on shaft and press in with arbor press.
10. Insert drive pin to lock in place on shaft. (Refer to Figure 8.)
11. Install propeller shaft ball bearing on shoulder of gear -- shimming if necessary -- with same tool (91-26276A1). (Refer to Figure 8.) Place collar of tool on top of cup to replace ball bearing when pressing on with arbor press.
12. Place brass shim and snap ring to hold ball bearing on shoulder of gear.
13. Place large steel ring on shoulder within housing. (See "NOTE", following) Replace any brass shims which were removed in disassembly.
14. Drive gear and shaft assembly into housing with mallet, with care that entire assembly is entered straight into housing and that 2 gears are meshed properly.

   NOTE: When damaged lower gear housing is replaced with A-1607-400A2 gear housing assembly, it can be used on all Mark 5 and Mark 6 engines. When using this gear housing with propeller ball bearing A-30-21776 (5/16" wide), use spacer A-23-23756 furnished. Place spacer on seat in gear housing before installing propeller shaft assembly. When using propeller shaft ball bearing A-30-22351 (3/8" wide), the spacer is not required. Normal gear back lash should be between .003"-to-.005". Shims of various thicknesses (.003",.005",.007") may be required to attain a correct tolerance for proper gear lash. Only difference between Mark 5 and Mark 6 lower units is the gears, and Mark 5 has smaller propeller.

   Metric Conversion: 1" = 25.4mm

   Mark 5 - Straight Cut Bevel Gear 16:21
   Propeller 6-¾" dia. by 6-¼" pitch

   Mark 6-6A - Spiral Bevel Gears 14:23
   Propeller 7-¼" dia. by 7" pitch

   IMPORTANT: Check play of entire assembly after gears are meshed by working drive shaft and propeller shaft back and forth to find amount of backlash -- not less than .003" nor more than .005". If too much backlash, remove shims; if too tight and no backlash, add shims for correct play and conical angle of gears. Shims must be removed or added only between ball bearing and steel washer on shoulder of gear housing.

15. Insert steel "L" washer with shoulder up, rubber washer of same dimension and housing water intake spacer which contains oil seal.
16. Position water intake housing properly to seal gear.
17. Turn gear case cover in and tighten with Water Pump Cartridge and Cover Puller (C-91-24267) by placing dowels of tool in cover holes (left hand thread).
18. Lubricate threads with MULTIPURPOSE Lubricant (C-92-35226) before installing. (Figure 6 in Disassembly)
19. After installing gear case cover, set clutch thrust plate on splined shaft with small side down. Follow alternately with 7 fibre and 7 steel friction discs, starting with a steel disc. DO NOT lubricate these clutch discs.

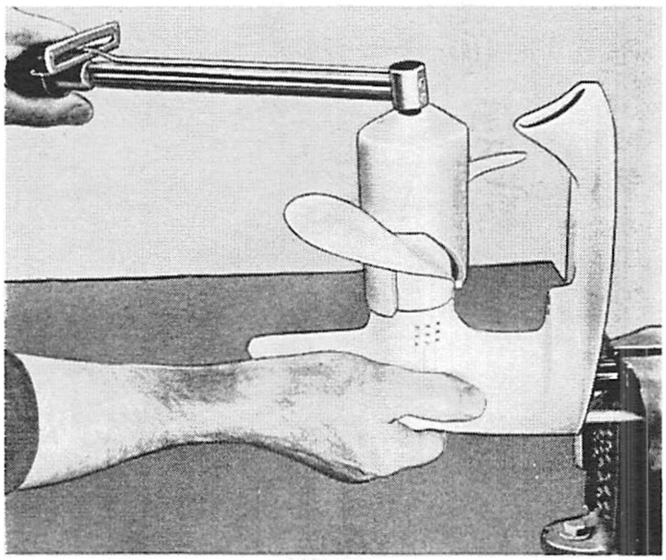


Figure 13. Torquing Propeller and Nut

20. Place propeller over friction discs on shaft, rotate lightly and propeller will drop in place. (Figure 5 in Disassembly)
21. Set one fibre disc to fit in recess of propeller hub and one steel disc, tab washer, compression spring and propeller nut.
22. Tighten nut securely with wrench and torque with Torque Tool (C-91-25666) to 170-to-240 in. lbs. (31.2-to-42.6kg/cm). *(Refer to Torque Specification Chart in Miscellaneous Section VIII.)* When checking propeller torque, hold clutch drum tight in vise. Use jaw shields or blocks of soft wood in vise so that shaft is not scored. (Figure 13)
23. Adjust clutch beneath propeller. If too tight, loosen nut. If too loose, add .010" shim beneath clutch spring.
24. Bend tabs on lock washer to flats on propeller nut.
25. Thread holding stud into top leading edge of gear housing.

B. LOWER DRIVE SHAFT ASSEMBLY (CENTER SECTION)

1. Replace water pump housing. Tab in bottom of housing should fit slot in chamber.
2. Set brass thrust washer in bottom of drive shaft chamber.
3. Slip upper drive shaft assembly thru brass thrust washer in chamber and water pump housing so that collar on upper clutch drum seats on thrust washer.
4. Insert impeller drive pin into drive shaft and slip pump impeller with keyway over pin.
5. Rotate so that impeller is locked on shaft.
6. Replace water pump cover with tab on slot to lock in place.
7. If oil seal in pilot cap assembly is to be removed, place with lip up.
8. If rubber bushing is renewed, squeeze in so that knobs seat in side holes.
9. Set pilot cap assembly on drive shaft and replace "O" ring in groove on upper drive shaft.

C. SHIFT LINKAGE CABLE CONTROL

1. String the following parts on control cable in order: Trip finger *(check that wide offset of finger is up to fit in slot in housing)*, brass slotted trip finger housing, spring and rubber cone seal. Be sure that cone seal is placed on cable with longer counter end in spring. (Figure 14)

   IMPORTANT: Do not invert, or grease leak will result.
2. Thread free end of control cable up thru housing and pull assembly into chamber. Be careful to slip trip finger into slot so that it may properly engage clutch spring.
3. Close up chamber by inserting brass plug with "O" ring to seal. Check that tapped hole is out for easy removal. (Refer to Figure 5 in Disassembly.)
4. Reassembly of lower drive shaft housing assembly now is completed.

D. UPPER DRIVE SHAFT HOUSING, LOWER DRIVE SHAFT HOUSING AND GEAR CASE HOUSING

1. Place clamp and swivel bracket assembly on motor stand to receive powerhead and pivot tube.
2. Check that co-pilot ring is inserted into swivel bracket before installing pivot tube of powerhead into swivel bracket.
3. Also make certain that upper and lower rubber and brass co-pilot bushings are in their proper place in swivel bracket and that they are lubricated properly with MULTIPURPOSE Lubricant (92-30239).

   NOTE: On Mark 6-6A, be sure to install bottom cowl on powerhead BEFORE placing powerhead into swivel bracket.
4. Grease top of pivot tube and slip drive shaft housing top onto pivot tube with drilled lug to front to receive upper drive shaft housing.
5. Use drift pin to line up hole in housing and housing top and secure with snub-nosed screw and washer.
6. Replace clamping screw and nut and tighten.
7. Replace stud in trailing edge of upper drive shaft housing to hold upper housing to gear case.
8. Insert cable control guide tubing down into left side of powerhead and tighten with compression nut and connector for extension.
9. Straighten guide tube, placing it against left inside of upper drive shaft housing. *If not straight, drive shaft splines will not mesh with splines of crankshaft and tubing will push it to the side.*
10. Insert copper water tube up into pivot tube to seat inside water inlet cap. Check that drilled bleeder hole in tube is at bottom.
11. Attach center assembly (lower drive shaft housing) to upper drive shaft housing as follows: (Refer to Figures 11 and 12.)
    a. Insert short piece of tubing (control cable guide tube extension) into bottom of pilot cap to guide end of water tube into top seal of cap.
    b. Push up on pilot cap to seat in chamber of upper drive shaft housing and move entire center assembly towards upper housing, at the same time watching that end of cable guide tube seats into top of shift assembly chamber.

    NOTE: Be sure that water pump cover plate does not move out-of-place. It can be held by thin piece of metal or screwdriver.
12. Place clutch spring on lower drive shaft clutch drum by turning spring onto drum in counterclockwise rotation so that spring opens and inserts freely. End for trip lever is up.
13. Place lower gear assembly with clutch spring into center assembly by engaging spring onto upper half of clutch drum.
14. Turn propeller slowly counterclockwise to wind spring onto upper drum, at same time pushing up on entire assembly to fit all 3 assemblies together securely.

    NOTE: Rotation must be kept up until the 2 housings are together tightly, or it will result in damaged clutch spring. Place tab washer and hexagon head nut on stud and tighten with open end wrench at leading edge. Place nut and washer on bottom stud which holds gear case. Screw in and tighten bolt and washer at exhaust outlet below anti-cavitation plate to hold entire assembly together.
15. Insert control cable into guide tube extension and replace extension by fastening with clamp on side and connecting compression nut on adaptor fitting.
16. Replace all allied components.

    NOTE: For Neutral Clutch Adjustment of Mark 6-6A-5 Models, Turn to Miscellaneous Section VIII.

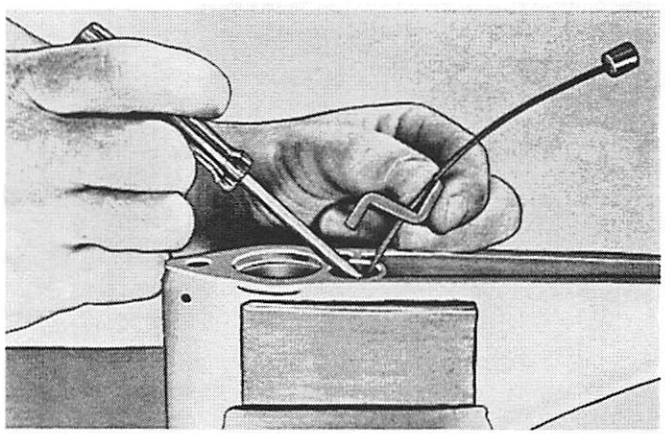


Figure 14. Installing Shift Linkage Assembly in Trip Finger Chamber

LOWER UNIT - - GEAR SHIFT TYPE

All 4-Cyl. Models (Without Jet Prop Exhaust) *

and 2-Cyl. Mark 25-20-15, & KH7

Disassembly

** Does Not Include Mark 40 and KF9, KG9 (See Page 21).*

A. Disassembly of Lower Unit

Remove 2 hexagon head lock nuts holding gear housing assembly to drive shaft housing (on leading edge), one hexagon lock nut located in center of anti-cavitation plate on the underside and one 5/16" socket allen head screw located on the rear, inside exhaust outlet. After the above nuts and screw are removed, the lower gear housing assembly can be pulled off the drive shaft housing.

B. Disassembly of Gear Housing

Mount gear housing assembly in vise between 2 blocks of soft wood to prevent marring of gear housing. Remove propeller by driving tabs on tab washer flat against propeller hub and remove propeller nut. A long piece of round steel can be inserted in hole of propeller nut to remove. (Figure 1) Check gear back lash by pulling on drive shaft with one hand and pushing propeller shaft with other. Refer to lash when shimming in "Reassembly" Remove gear case cover with Gear Case Cover Tool from following chart:

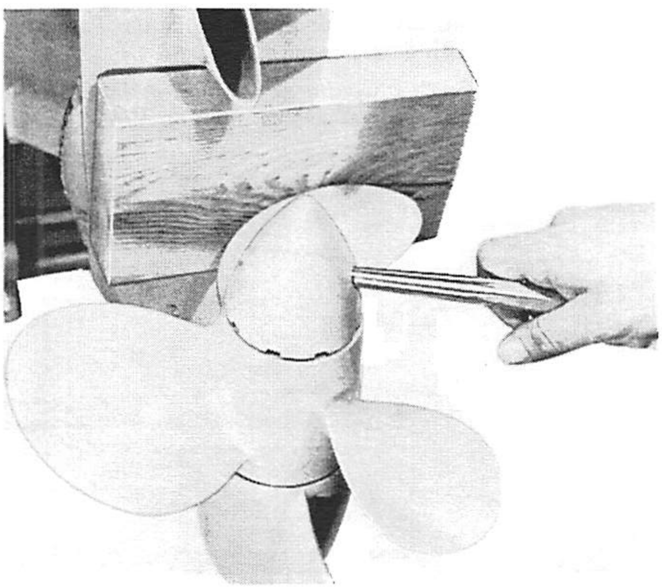


Figure 1. Removing & Installing Propeller Nut

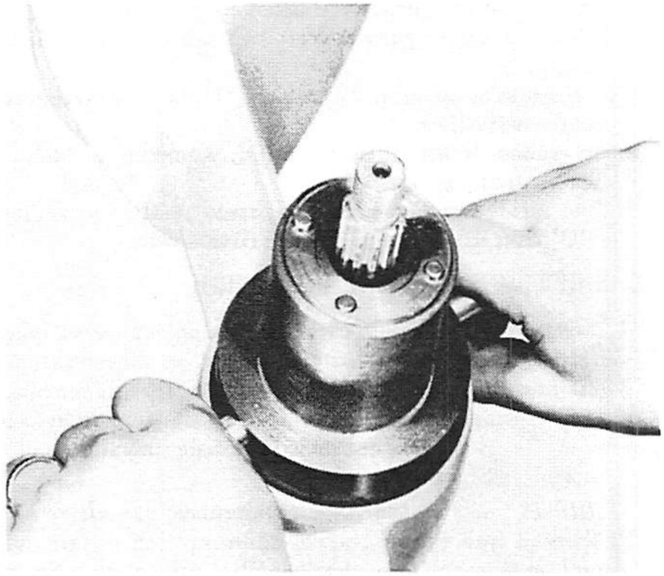


Figure 2. Removing & Installing Gear Housing Cover

C-91-22119	*4-Cyl. 35-Plus HP Models*
C-91-29950	*Mark 30-25-20-15 & KH7*

Place tool over end of propeller shaft and set dowels of tool into gear case cover, turning counterclockwise to loosen (right hand thread). (Figure 2) If tight, strike handles of tool with mallet to loosen.

Bearing housing and oil seal can be removed when removing propeller shaft assembly. To remove the propeller shaft assembly, reverse gear bearing assembly and cam follower pin, remove gear housing from vise and place propeller shaft in vise between 2 pieces of soft wood and tap lightly on skeg of gear housing with mallet until the propeller shaft assembly is removed. (Figure 3) Remove shims as required from gear housing bearing seat. Wash gear housing and parts to remove grease. Roller bearing and oil seal are removable from bearing housing by using Needle Bearing Mandrel:

C-91-24143	*- 4-Cyl. 35-Plus HP Models*
C-91-24096	*- Other Shift Models*

Place bearing housing, small end down, in cup of Propeller Shaft Tool (C-91-26376A1). Press out on arbor press. Detach ball bearing and adaptor ring from gear with Puller

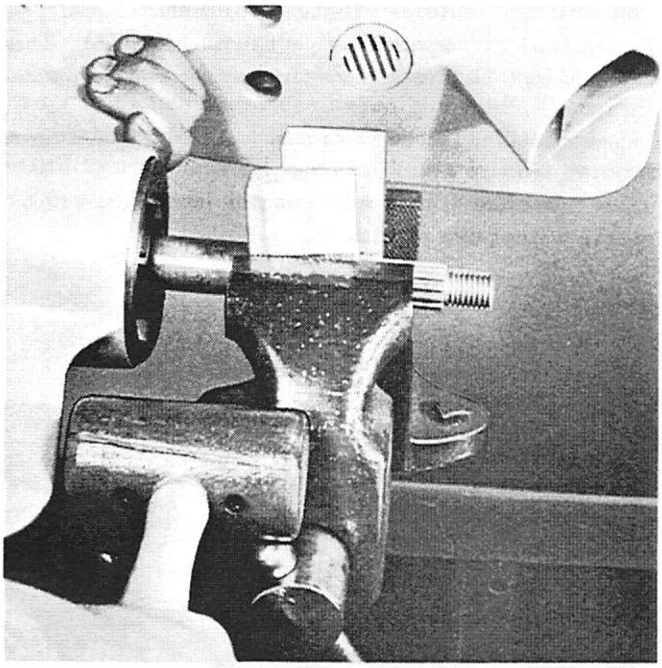


Figure 3. Removing Propeller Shaft

Plate (91-22115). (Figure 4) Place halves of plate between ball bearing and gear with gear teeth facing down and tap halves together with mallet. Insert cap screws and tighten. Press against rear shoulder of gear with arbor press to remove. Use small screwdriver to detach retaining ring from sliding clutch. Do not over-stretch, or ring will be pulled out of shape. Remove sliding clutch from propeller shaft by setting cam follower pin in place on

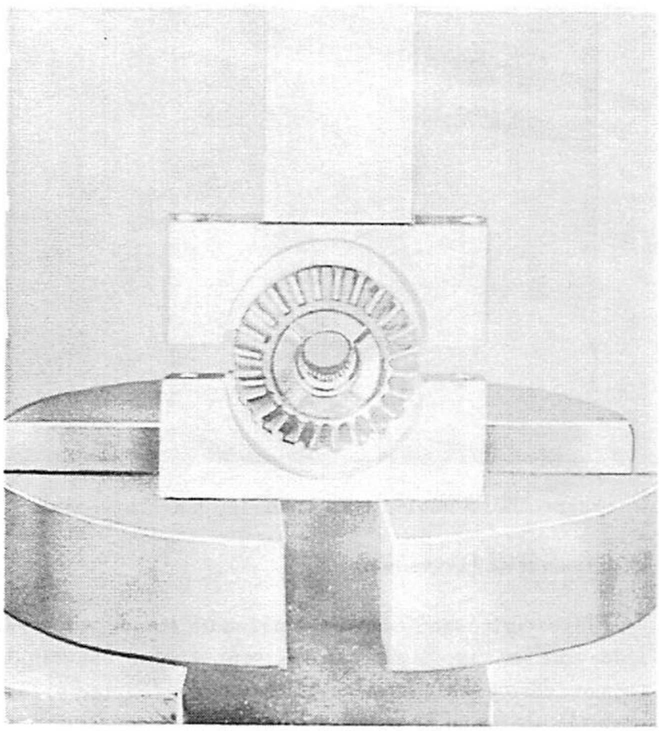


Figure 4. Separating Ball Bearing From Gear

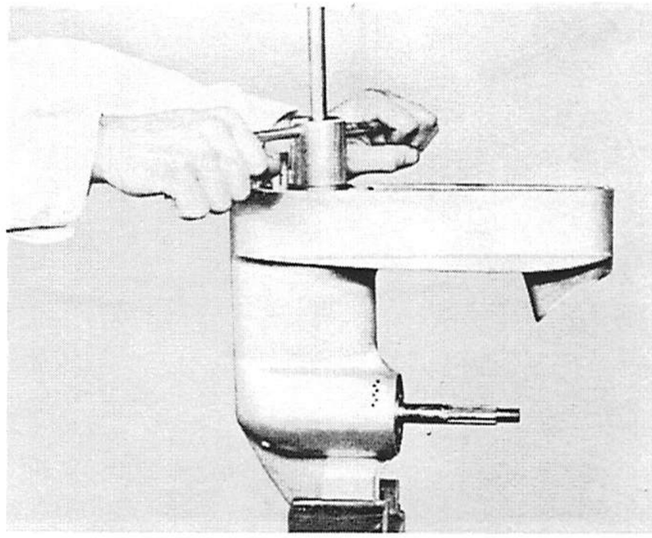


Figure 5. Removing Water Pump Cover

end of propeller shaft. Press against cam follower and, with small punch, push cross pin out of sliding clutch. Sliding clutch now is free to be removed from propeller shaft. Cross pin slide and spring will drop free of inside of propeller shaft.

C. Removal of Pinion Gear

Place drive shaft in vise as close to gear housing as possible and, with a screwdriver, lift tab washer away from pinion gear screw in gear case. With box end wrench, remove pinion gear screw from end of drive shaft. Pinion gear now is loose. Replace gear case skeg in vise between blocks of wood.

(Mark 25-30: Remove centrifugal slinger from drive shaft.)

Detach water pump cover with Gear Case and Water Pump Cover Tool (right hand thread) (Figure 5):

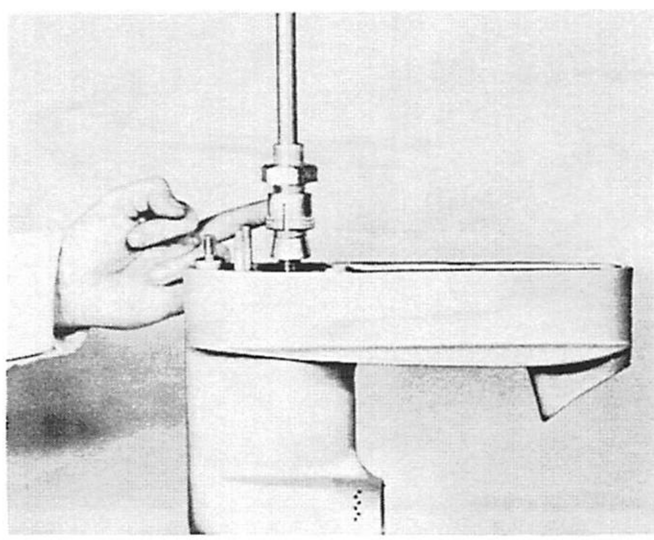


Figure 6. Pulling Jaw and Water Pump Cartridge

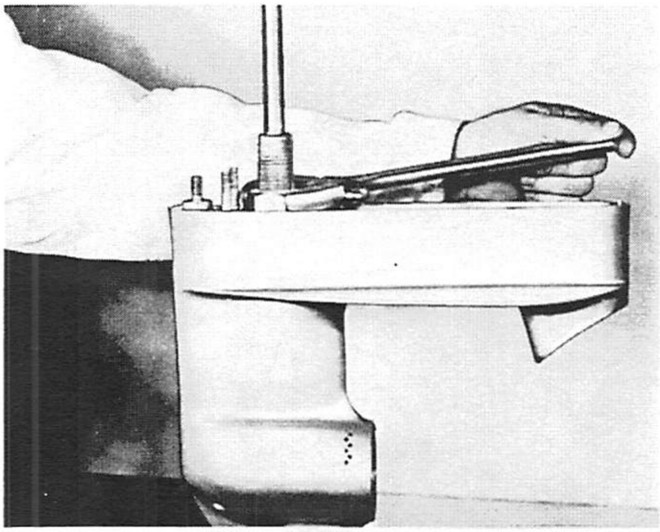


Figure 7. Setting Up Tool, Water Pump Cartridge

91-22119 - 4-Cyl. 35-Plus HP Models *91-24151 - Other Shift Models*

Lift out outlet plate and remove impeller and impeller pin. Use 2 screwdrivers to pry impeller out. Care should be exercised not to damage impeller. Lift out impeller drive pin.

D. Removal of Water Pump Cartridge

4-Cyl. 35-Plus HP Models — Remove water pump cartridge with Water Pump Cartridge Removal Tool (91-22118A1). Place puller jaws in water pump cartridge inlet and outlet slots, lip outward. Place threaded body over drive shaft into cartridge and locate screws into respective jaw and secure. Place cup over drive shaft. Screw large nut onto threaded tool body and tighten to remove cartridge. (Figure 8)

Mark 30-25-20-15, KH7 - Remove water pump cartridge with Water Pump Cartridge Removal Tool (91-24162). Insert shaft of tool over drive shaft, resting tapered end

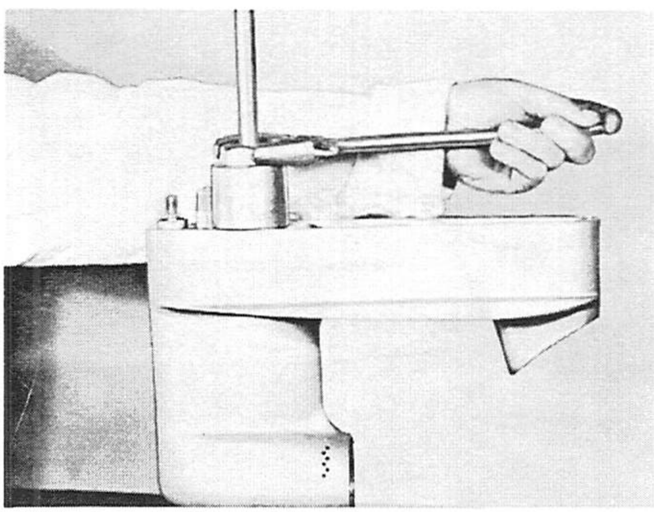


Figure 8. Pulling Water Pump Cartridge

on bottom of cartridge. Place small diameter puller jaws (91-23664) with serrated ratchet down. (Figure 6) Thread nut on shaft and secure tightly against jaw to spread. (Figure 7) Place cup open end over shaft to rest on top of gear housing. Thread on second nut, tightening down to remove cartridge stainless steel liner. (Figure 8) Repeat same procedure with large diameter jaws (91-24006) to remove water pump cartridge.

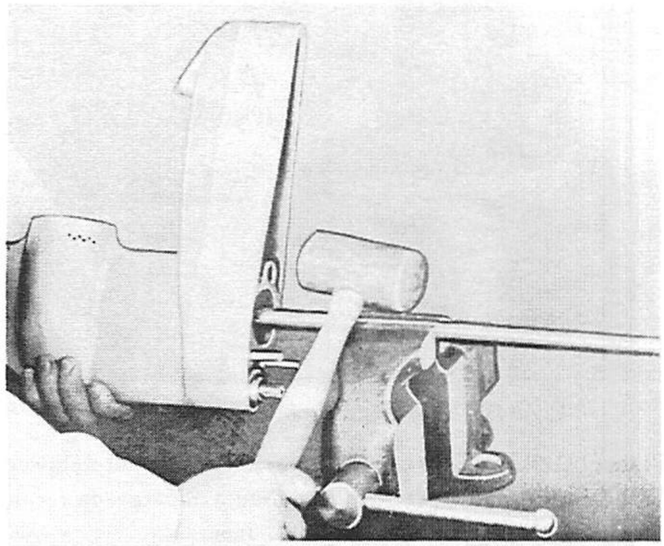


Figure 9. Removing Drive Shaft from Gear Housing

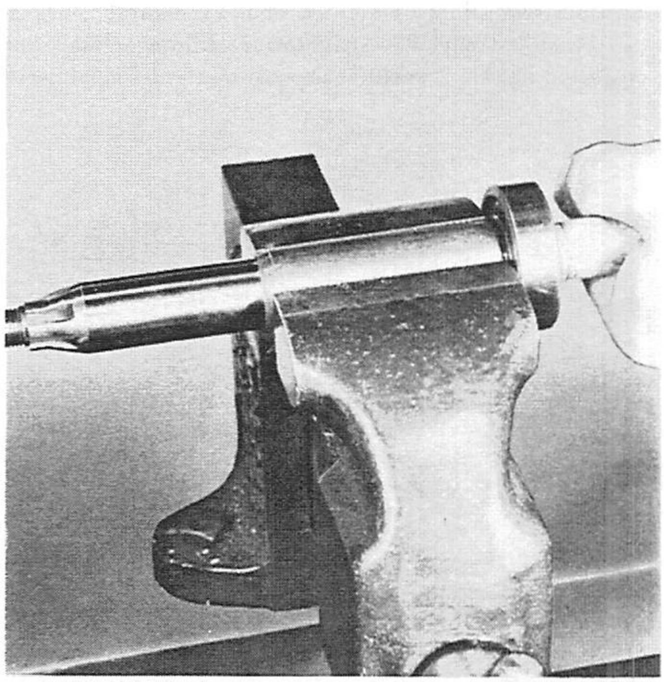


Figure 10. Removing Ball Bearing from Drive Shaft

E. Removal of Drive Shaft

Place drive shaft in vise horizontally and, with rawhide mallet, tap firmly against top of gear housing to remove drive shaft from gear housing. (Figure 9) Ball bearing, shim and bearing retainer will be removed along with the drive shaft housing. The pinion now is free of drive shaft. Remove ball bearing from drive shaft by replacing against open vise jaws, tapping on end of drive shaft to detach. (Figure 10)

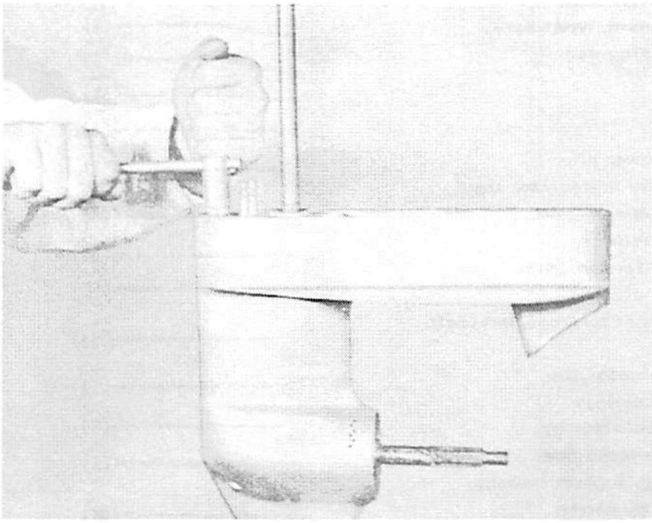


Figure 11. Removing Shift Shaft Bushing

4-Cyl. Models and Mark 25-20: If difficulty is involved in removing water pump cartridge and drive shaft from gear housing of these models, use the following procedure: 1) Remove propeller shaft and gear assembly and drive shaft pinion gear screw; 2) assemble Water Pump Puller (91-22118A1), as shown in Figure 11A, and note that large nut is threaded fully on tool shaft and that puller lugs are not used; 3) place tool assembly over drive shaft with large open end of cup against gear housing and secure drive shaft in vise jaws so that tool assembly is tight against housing, as shown in Figure 11B; and 4) remove drive shaft and water pump cartridge by holding threaded tool shaft with wrench on flat surfaces of tool and, with another wrench, turn large nut clockwise until drive shaft and water pump cartridge are loose.

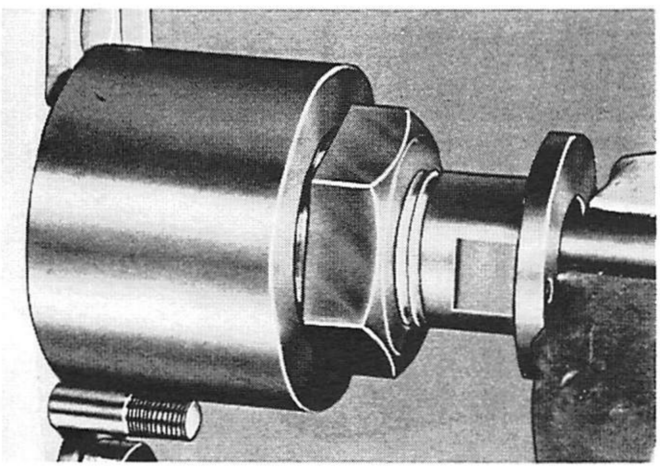


Figure 11A. Water Pump Puller in Position

F. Removing Gear Assembly

Remove forward gear assembly by holding gear housing firmly and tapping open end of gear housing against block of soft wood. Detach ball bearing from gear with Gear Puller Plate (91-22115). Place halves between ball bearing and gear and tap halves together with mallet. Press against gear with arbor press to remove. (Figure 4) Remove shift shaft bushing with Shift Shaft Tool (91-23033) (Figure 11) and pull shift shaft out of gear housing. Cam follower will fall out of gear housing. Remove drive shaft roller bearing from gear housing with Drive Shaft Roller Bearing Tool (Figure 12) from the following chart:

91-24288A3	*- 4 Cyl. 35-Plus HP Models*
91-24147	*- Other Shift Models*

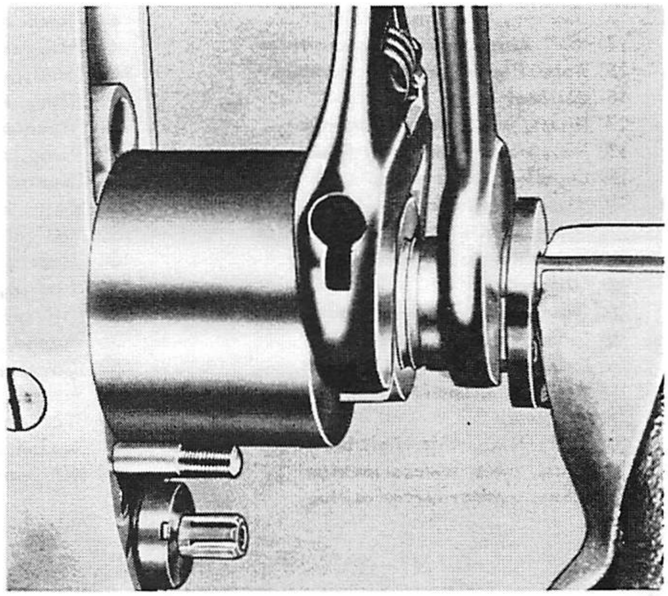


Figure 11B. Removing Drive Shaft and Water Pump Cartridge

Place tool in from top of gear case with guide ring and press out bearing with utility press. (Figure 12) *NOTE: If tool (91-24288) has knurled end, remove .005" on outside diameter before using. Later service tool has knurling already removed.*

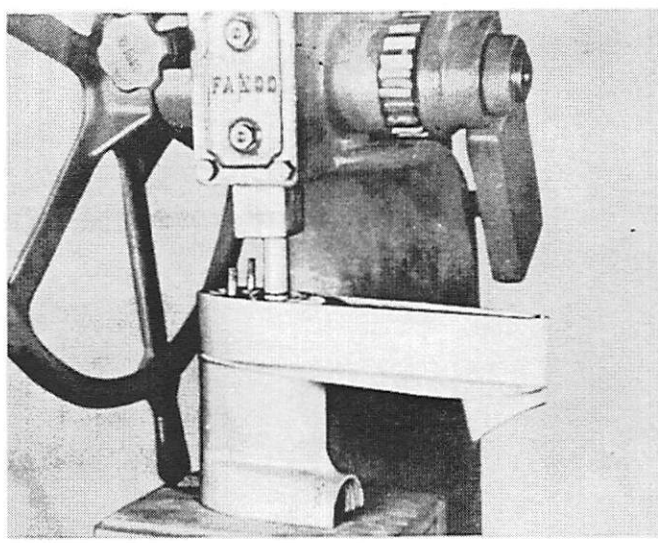
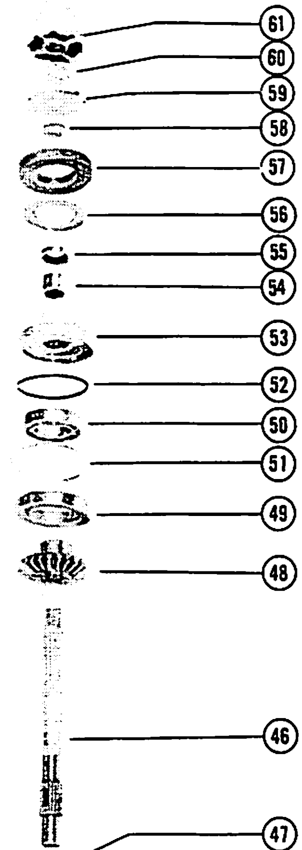


Figure 12. Removing (and Installing) Drive Shaft Roller Bearing

1 Gear Housing Assembly
2 Stud, gear housing to drive shaft housing
3 Bearing, roller - drive shaft
4 Tube, water inlet - lower
5 Sleeve, water inlet tube
6 Seal, water tube
7 Screen, water intake
8 Drive Shaft·
9 Gear, pinion
10 Tab Washer, pinion gear screw
11 Screw, pinion gear retaining
12 Shim, ball bearing to drive shaft
13 Bearing, ball - drive shaft
14 "O" Ring, water pump cartridge
15 Water Pump Cartridge Assembly
16 Oil Seal
17 Insert, water pump cartridge
18 Key, water pump cartridge
19 Impeller, water pump
20 Pin, impeller drive
21 Plate, outlet - water pump cover
22 Water Pump Cover Assembly
23 Oil Seal
24 Ring, rubber - centrifugal slinger
25 Shaft, shift - lower
26 Clip, retaining - shift shaft
27 Bushing Assembly, shift shaft
28 Oil Seal
29 "O" Ring, shift shaft bushing
30 Cam, lower reverse locking
31 Cam, upper reverse locking
32 Washer, grease filler hole screw
33 Screw, grease filler hole
34 Washer, gear housing vent screw
35 Screw, gear housing vent
36 Cam, shift
37 Follower, cam
38 Slide, cross pin
39 Spring, cam follower pin
40 Shim, ball bearing to gear housing
41 Bearing, ball - forward gear
42 Forward Gear Assembly
43 Bearing, roller - forward gear
44 Ratchet, sliding clutch
45 Pin, cross - ratchet to propeller shaft
46 Shaft, propeller
47 Ring, retaining - cross pin
48 Reverse Gear Assembly
49 Ring, adaptor - ball bearing
50 Bearing, ball - reverse gear
51 Shim, adaptor ring to gear housing
52 "O" Ring, bearing carrier
53 Bearing Carrier Assembly
54 Bearing, roller
55 Oil Seal
56 Washer, gear housing cover
57 Cover, gear housing
58 Washer, backing (1/32)
59 Tab Washer, propeller nut
60 Washer, backing (1/8)
61 Nut, propeller



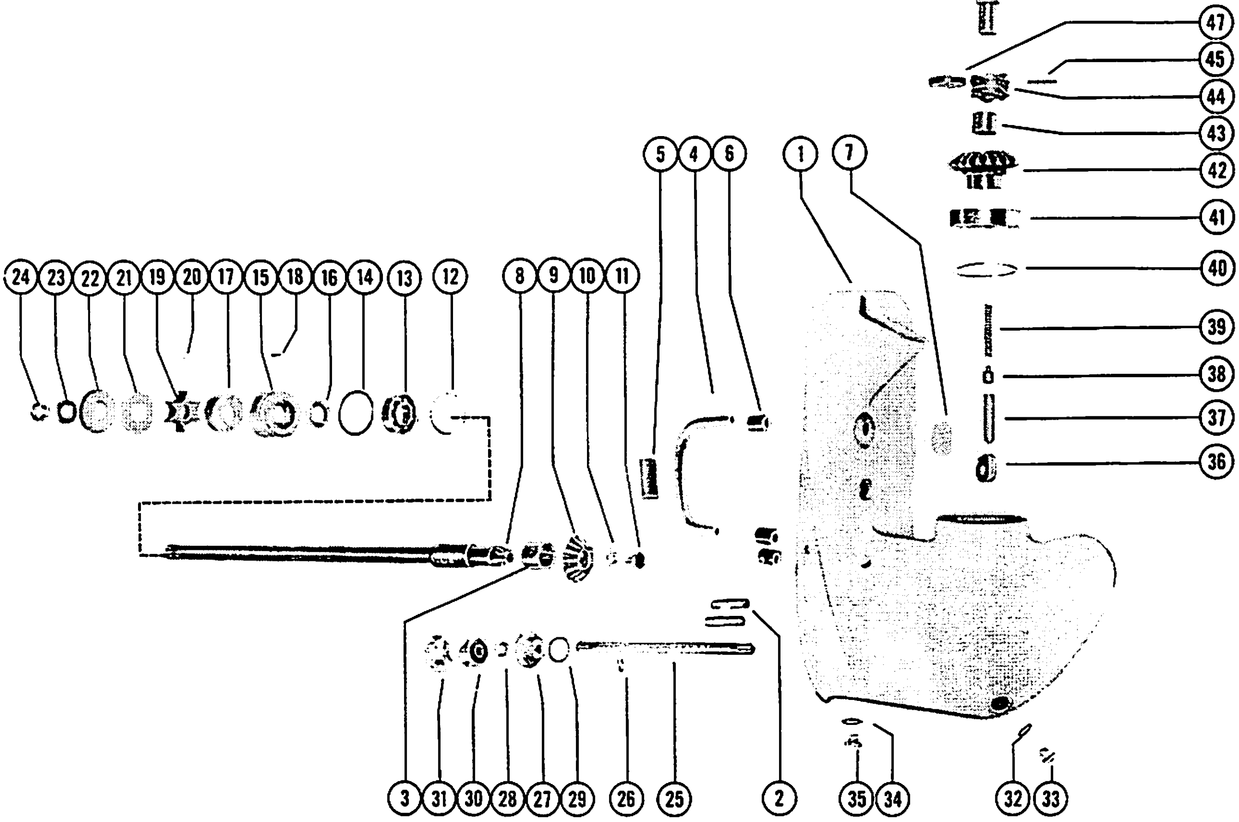


Figure 13. Gear Housing Assembly, Mark 58

Reassembly - 4-Cyl. Gear Shift Type (Non Jet Prop)

NOTE: Refer to Page 2, This Section, Prior to Reassembly

A. Reassembling Gear Housing

(For KH7, See Note A-1, Page 18.)
(For Late Model 4-Cyl., See Note A-3, Page 18A.)

Install shifting cam with notches up and to left when viewing in from skeg end. Cam operates to right. Insert shift shaft lower half so splines engage shifting cam splines inside housing. Replace oil seal in shift shaft bushing. *(NOTE: The larger diameter shift shaft bushing accommodates a new spring loaded oil seal, installed with the lips [spring side] down. On all other engines with oil seals which are not spring loaded, lips of seal face outward. Care must be exercised so that lips of seal will not be cut on shift shaft when installing the bushing. See Note A-2 on Page* 18.) Install shift shaft bushing and tighten securely with Shift Shaft Tool (C-91-23033). (Figure 11) Install drive shaft roller bearing in gear housing with Drive Shaft Roller Bearing Tool from following chart:

C-91-24288A3	*- 4-Cyl. 35-Plus HP Models*
C-91-24147	*- Other Shift Models*

Place guide in recess and bearing on tool. Always press against number side of needle cartridge bearing, as other end has greater radius for easier installation. Press in until recessed evenly on shoulder between upper and lower cavities. Replace ball bearing to gear housing shims, as removed, for forward gear assembly in gear housing. Replace needle bearing in forward gear with long end of Needle Bearing Mandrel:

C-91-24143	*- 4-Cyl. 35-Plus HP Models*
C-91-24096	*- Other Shift Models*

Press ball bearing on forward gear. Set forward gear into place and seat by tapping mallet against hard wood block on face of gear. Check for freedom of rotation on gear and bearing. Place ball bearing on drive shaft and tap in place on shoulder of shaft. Place ball bearing on shoulder of drive shaft and tap bearing to seat. Replace shims on drive shaft ball bearing shoulder and install drive shaft and ball bearing into housing. Be careful not to hit needle bearings as shaft is being installed. Lay pinion gear for drive shaft in position with tab washer installed. Seat drive shaft ball bearing on shoulder. *(NOTE: Pinion gear cannot be installed if drive shaft is seated first.)* Thread pinion gear screw into drive shaft and tighten with box wrench. Bend tab washer down over side of screw head to secure.

B. Install Water Pump Cartridge Assembly

On 4-cylinder 35-plus HP models, place "O" ring for water pump cartridge into position around bottom of water pump cartridge. On other shift models, place the "L" washer and neoprene sealing ring in position. Coat thin film of lubriplate on seal and cartridge. Place oil seal in position in cartridge with lips of seal to inside of cartridge. Place water pump cartridge in position so pin groove in cartridge and gear housing match. (See Note B-1 on Page 18.) Tap cartridge down into gear housing. Use piece of pipe as sliding hammer over drive shaft to drive into place. (Figure 14) Place a heavy washer on cartridge to prevent damage. Install locating pin by tapping into position with punch and hammer.

C. Check Back Lash

Check back lash (at least .003" [0.076mm] to .005" [0.127mm]) between forward gear and pinion gear. If too tight, remove forward shim until correct back lash is obtained . If too much, add shims 'til correct. Be sure conical angle of gears is true. Gears should fully engage each other on length of tooth. Shimming of drive shaft ball bearing may be necessary to obtain correct back lash (.003" [0.076mm] - .005" [0.127mm]), if unable to do so with forward gear shims.

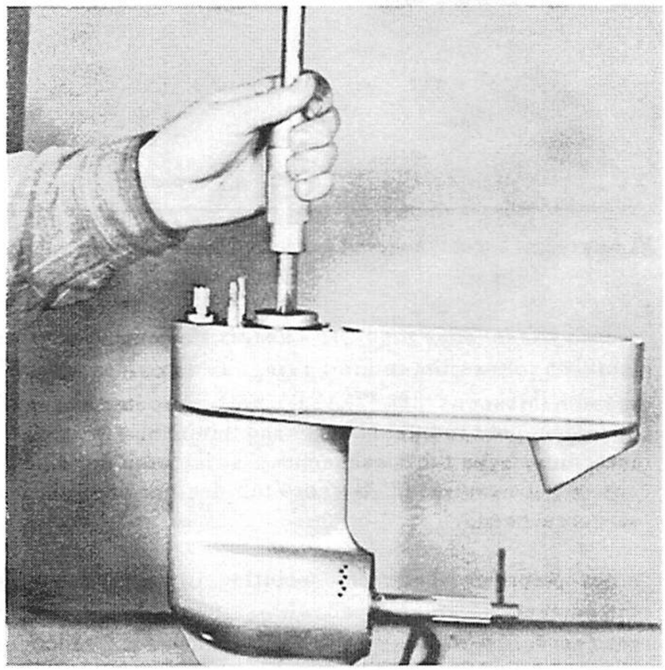


Figure 14. Replacing Water Pump Cartridge

D. Reassembling Propeller Shaft

Install cam follower guide spring and cam follower slide inside hollow end of propeller shaft so that holes in cam follower slide match hole in propeller shaft. Slide the sliding clutch onto propeller shaft and install cam follower on end of propeller shaft. Compress spring inside propeller shaft by pressing on cam follower until holes in sliding clutch, propeller shaft and cross pin slide all line up. Place cross pin through sliding clutch, propeller shaft and slide. Install cross pin retaining ring around sliding clutch. Do not overstress when installing.

Mark 30-25-20-15 & KH7: Place one thrust washer on both ends of propeller shaft, being careful that the small shoulder of thrust washer faces sliding clutch spline on propeller shaft. (Figure 15) Thrust washers are of 3 different thicknesses, .170" (4.318mm), .175" (4.345mm) and .180" (4.572mm). If the propeller shaft end play exceeds recommended .015" (0.381mm), replace thrust washers with 2 thicker washers, .175" (4.345mm) or .180" (4.572mm). Adding 2 washers (.005" [0.127mm] thicker) decreases end play .010" (0.254mm).

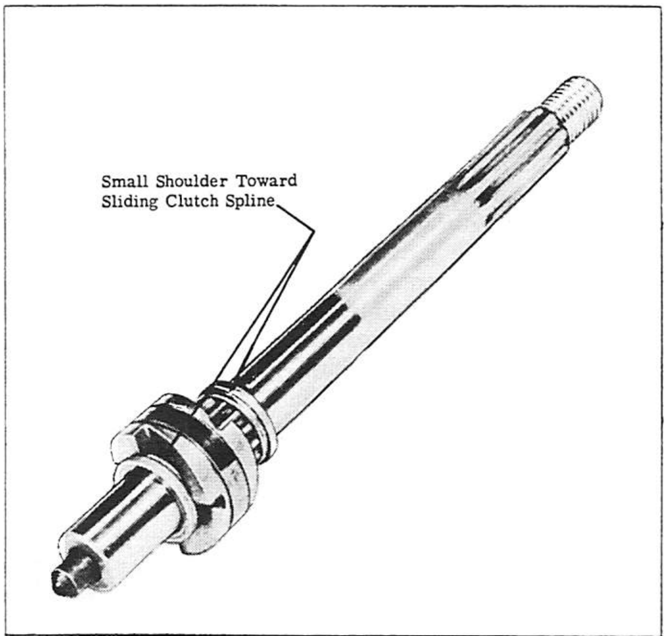


Figure 15. Thrust Washers Correctly Installed on Propeller Shaft

4-Cylinder 35-Plus HP Models: Be cautious when installing cross pin retaining ring, as later rings are of a greater thickness (.042") (1.067mm) for greater strength. Clearance between this ring and pinion screw is such that pinion gear tab washer may strike retaining ring if care is not exercised. Be sure tab does not protrude below screw head.

Set propeller shaft into position in gear housing so that contact is established with shift cam, being careful that cam follower does not fall off. Check for freedom of rotation of entire assembly.

E. Install Reverse Gear Assembly

Place ball bearing into bearing adaptor ring and press both onto reverse gear. *(NOTE: There is no roller bearing in reverse gear as in forward gear.)* Replace shims as required. Place reverse gear assembly, gear teeth down, into gear housing and tap into position with service tool open cup end. Be certain that reverse gear assembly makes contact with pinion gear and turns freely. (Figure 16) Check for back lash, .003" (0.076mm) to .005" (0.127mm). Install "O" ring seal in gear housing above reverse gear assembly. Replace needle bearing and oil seal into bearing housing with long end of Needle Bearing Mandrel from chart below and press in with utility press:

C-91-24143 - 4-Cyl. 35-Plus HP Models
C-91-24096 - Other Shift Models

Place bearing and oil seal housing assembly into position above reverse gear assembly.

4-Cylinder 35-Plus HP Models and Later Models of Mark 30-25: When replacing oil seals (spring-loaded), install with lips of seal toward grease chamber to prevent loss of grease and to eliminate possibility of water entering lower gear housing. On all other engines, with oil seals which are not spring-loaded, lips of seal face outward. Install stainless steel washer between gear case cover and bearing housing, thus preventing binding when gear case cover is tightened.

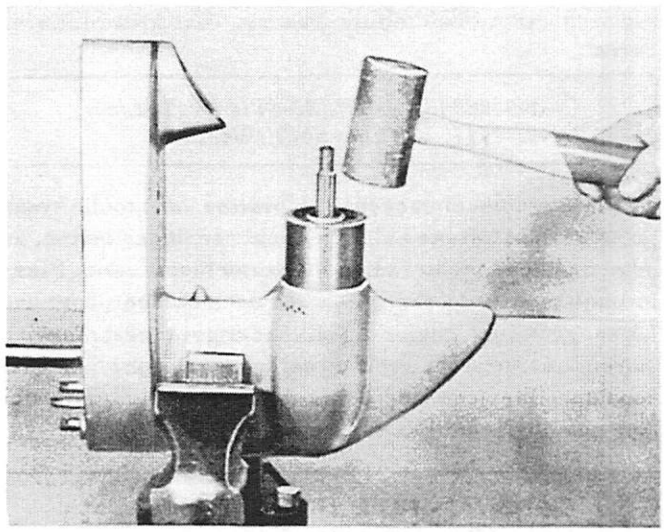


Figure 16. Installing Reverse Gear Assembly

F. Installing Impeller and Covers

Thread gear housing cover into gear housing and tighten housing cover in place (clockwise) with Gear Housing Cover Tool:

C-91-22119 - 4-Cyl. 35-Plus HP Models
C-91-24287 - Other Shift Models

Dowels of tool fit holes in cover. Coat threads of cover with fine coat of MULTIPURPOSE Quicksilver Lubricant (C-91-35226) to facilitate easy removal. Check end play of propeller shaft by pressing on end of propeller shaft. There should be approximately .015" (0.381mm) end play between .003" (0.076mm) and .005" (0.127mm) gear lash. If incorrect, disassemble unit and add or take out shims to make up for proper tolerance. Place gear housing vertical in vise between blocks of soft wood and place impeller drive pin on flat of shaft and parallel to drive shaft with grease to hold upright so slot in impeller will slide over key and be held to shaft. Install water pump impeller by inserting over top of drive shaft and press into cartridge over impeller drive pin with thumbs, making certain that water pump impeller is secured to drive shaft with drive pin. Replace oil seal in water pump cover and coat with MULTIPURPOSE Quicksilver Lubricant (92-30239-1) on cover threads. Replace outlet plate and water pump cover. Use Water Pump Cover Tool to reinstall cover:

91-22119 - 4-Cyl. 35-Plus HP Models
91-24151 - Other Shift Models

Slide centrifugal slinger over drive shaft until it seats against water pump cover on Mark 30-25-20-15 and KH7. *(NOTE: 4-Cylinder 35-Plus HP Models — Water intake screen louvers are at angle slanting toward gear housing to pick up maximum water flow.)* Water pickup tube extends from intake hole to intake water pump cartridge. Circulation is from pump to powerhead.

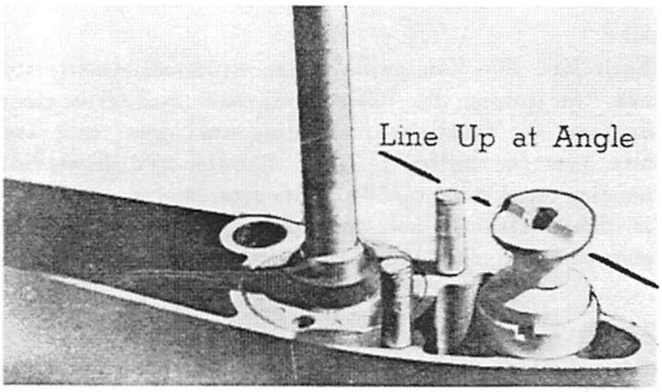


Figure 17. Installing Shift Shaft Coupling

G. Gear Housing Lubrication

Remove grease filler hole screw and washer and vent screw and washer and refill unit with Kiekhaefer Quicksilver Lubricant (92-29415-1 or 92-29409-1) until grease starts to flow from vent. Replace screws and washers and tighten after filling.

H. Installing Shift Shaft

Install shift shaft coupling on lower shift shaft, positioning cam part of coupling so tapered part is in line with stud. (Figure 17) Lubricate splines with MULTIPURPOSE Quicksilver Lubricant (92-30239-1). The new double cam on the shift is an easily-actuated unit. Place the brass splined lower reverse locking cam on the shift shaft (shift shaft must be in forward gear) at a 45^{o} angle to the center line of housing (parallel to the 2 studs). (Figure 18) Place the upper reverse locking cam in the groove in drive shaft housing with the cam surface down (Figure 19) so that it will actuate the reverse lock mechanism. Lubricate cam faces with MULTIPURPOSE Quicksilver Lubricant.

Early Mark 55 Engines: See Note J-1.

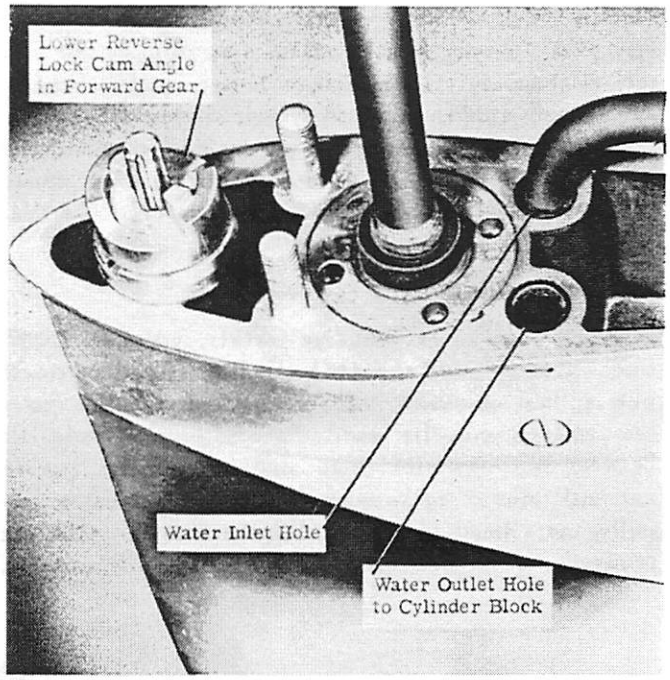


Figure 18. Assembly, Upper and Lower Reverse Locking Cams, 4-Cylinder 35-Plus HP Engines

Check that water intake screen (item 7 in Figure 13) is secure. Tighten prong or replace screen if required.

I. Joining Gear Housing and Drive Shaft Housings

Be sure that rubber washer on 4-cylinder 35-plus HP engines is installed before placing gear housing on drive shaft housing. On the other shift models, steel washer and rubber washer are in the water inlet line recess. Check that shift arm and shifting cam are in forward position; also so that unit can be shifted through entire range, forward to reverse, before installing lower gear case.

Join the 2 assemblies (lower gear housing and drive shaft housing) together by inserting drive shaft up into drive shaft housing. Grease splines heavily with MULTIPURPOSE Lubricant. Elastic lock nuts are recommended as replacement nuts for the former nut and lock tab com-

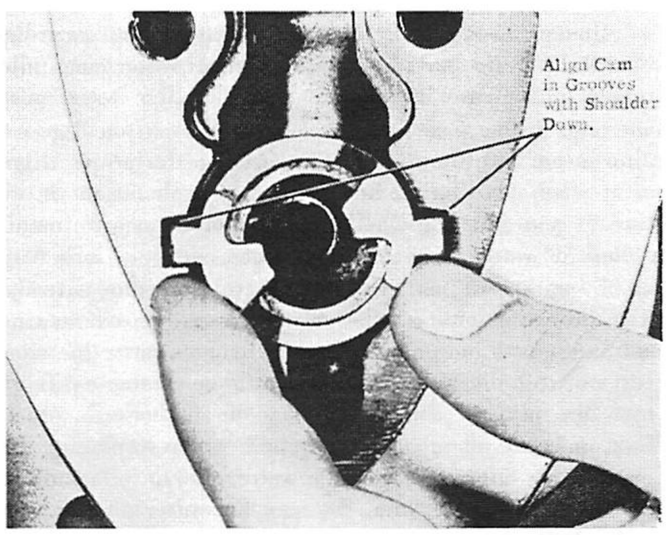


Figure 19. Installing Upper Reverse Locking Cam

bination which secures the gear housing assembly to the drive shaft housing on all models using this nut and lock tab combination, thus making a better installation and more secure attachment. On 4-cylinder 35-plus HP engines, install Allen set screw from rear inside exhaust outlet with 5/16" diameter Allen wrench. Extra stud is located in center of anti-cavitation plate. Replace nut. (For Mark 50 and KH7, See Note I-1 below.)

J. Installing Propeller

Place 1/8" thick backing washer, propeller, 1/32" thick backing washer, tab lockwasher (fitted correctly over splines, as shown in Figure 20) and propeller nut in this order on propeller shaft. Place a block of wood flat between anti-cavitation plate and propeller and tighten nut until tabs of lockwasher line up with recess in propeller nut. Bend tabs of lockwasher into propeller nut recesses, or propeller nut and propeller will back off.

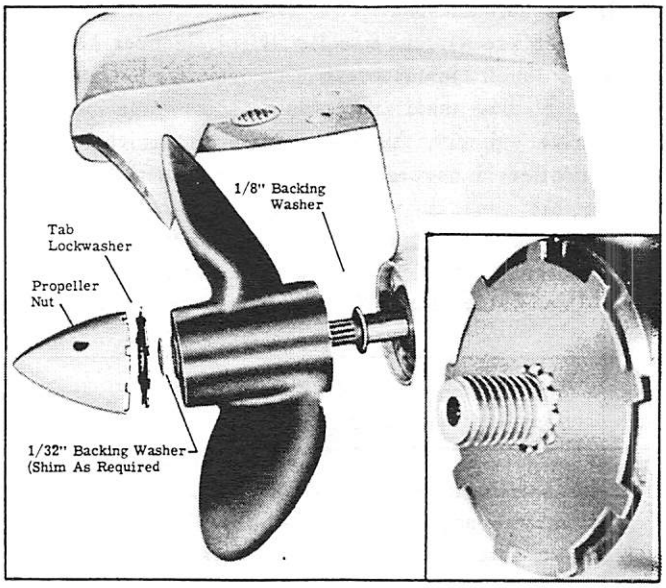


Figure 20. Replacing Propeller on Propeller Shaft

NOTES

A-1
The 1602-1439A1 gear housing assembly is a replacement for the 1605-808A1 gear housing assembly. Installation of the new assembly requires a new forward gear assembly (43-20976A1) in place of the old gear assembly. New bearing is heavier and has a greater load capacity, installation of the new ball bearing is desireable for longer life.

A-2
Early Mark 25's and All Mark 20-15 and KH7: When using the 1602-1439A3 gear housing, substitute the small diameter shift shaft bushing (23-20796A1) for the large diameter shift shaft bushing (to be interchangeable). The small diameter bushing (23-20796A1) must be used with early Mark 25 and Mark 20-15 and KH7 drive shaft housings; the larger diameter bushing (23-25775A1) with other later drive shaft housings. Refer to Mercury Parts Manual.

B-1
4-Cylinder 35-Plus HP Models – Water pump cartridge (46-29117A1) for Mark 58-55 has a longer water pump inlet recess and square keyway to properly align water pump cartridge in the gear housing. A small, semi-round groove also is cut into the side of the cartridge for proper alignment when installation is made as a replacement in the Mark 50 gear housing. CAUTION: Do not attempt to install a Mark 50 water pump cartridge (same part no.) in a Mark 58-55, as it will not allow water to enter the cartridge from the water pickup tube and will result in overheating and damage to powerhead. Both cartridges carry the same part no., the old style cartridge no longer being available from the factory, although it may be in dealer's stock. Caution also should be exercised when replacing the lower water inlet tube from the water pickup inlet hole to the water pump inlet hole. Be sure the water tube extends to the hole on the right side (right side when viewing from rear). (Refer to Figure 19.)

I-1
Early Mark 50 – Use newer, longer studs and elastic stop nuts for joining the lower gear case and drive shaft housing. To install rear mounting stud, gear case stud hole must be drilled to 3/8" diameter and drive shaft housing stud hole to 5/16" diameter and tapped 3/8"-16 thread. To drill hole true, place new hollow dowel in gear case, aligning hole while drilling.

J-1
Early Mark 55 Engines – If reverse lock push rod occasionally comes out of the reverse lock lever socket, replace with reverse lock lever (25188) and push rod (25190), as this later push rod is fastened securely to the reverse lock lever and will not fall out. Also, 2-piece flexible shift shaft is replaced by a 1-piece shift shaft (25171) if difficulty is experienced.

When replacing old style drive shaft housing (1522-893) with new style drive shaft housing (1522-1567), the shift shaft bushing must be replaced to fit the drive shaft housing pilot hole. The new, larger diameter bushing assembly (23-25438A1) in the gear housing has a larger oil seal and a 45° counterbored hole for an "O" ring (25-25439) which seats beneath the bushing to give better sealing qualities. Note the following: On gear housings without the 45° counterbored shift shaft hole (old machining), either larger diameter bushing or small diameter bushing may be used without the "O" ring seal; for the new gear case machining, with the 45° counterbored shift shaft hole, either bushing may be used with the "O" ring seal; with the old drive shaft housing machining, small diameter bushing must be used; and with new drive shaft housing machining, large diameter bushing must be used; therefore, by changing from one bushing to another, any combination can be had to use gear housing and drive shaft housing assemblies available.

NOTES

NOTE A-3: Assembly of A-1603-1868A4 Gear Housing Assembly

New gear housing assembly A-1603-1868A4, which replaces A-1603-1568A3 gear housing assembly, consists of the following parts:

Quan.	Part No.	Description
1	A-1603-1868A4	Gear Housing Assembly
1	A-31-31215A1	Tapered Roller Bearing Assembly
2	A-16-29471	Step Stud
1	A-15-31154 (.003") *	Shim
1	A-15-31154 (.005") *	Shim
1	A-15-31154 (.010") *	Shim

* *Metric Conversion - .003" (0.076mm), .005" (0.127mm), .010" (0.254mm).*

1. Remove ball bearing from forward gear and press tapered roller bearing onto forward gear (taper of rollers to face away from gear).
2. Install new shims and press forward gear roller bearing cup into gear housing.

   NOTE: Gear lash between pinion gear and forward gear must be .003" (0.076mm) to .005" (0.127mm).

3. If too tight, remove forward shims until correct gear lash is obtained.
4. If too loose, add shims until correct.
5. Remainder of the gear housing is reassembled the same as previously.
6. If the 2 front mounting holes in the drive shaft housing are 3/8" (9.525mm), it will be necessary to install step studs in gear housing.

NON-SHIFT TYPE LOWER UNIT

Disassembly

TYPE III - MARK 40 TYPE

Standard Non-Shift Type (Unicast Unit)

Models: Mark 40, Mark 7, KG9, KF9, KG7, KF7, KE7, KF5, KG4, KE4, KF3 and Quicksilver (High Speed Lower Unit).

A. Lower Unit

Remove two 9/16" hexagon nuts holding drive shaft housing to gear housing. Bend down lock tabs before removing nuts (one on leading edge, other on trailing edge). Separate housings.

Place exposed drive shaft in vise. Remove propeller nut and collar and punch out shear pin and remove propeller from shaft. (Figure 33) (KF7, KG7, KF5 and KF3 have multiple disc clutch.) Bend lock tabs down and remove nut. (See Mark 6 gear housing.)

At this time, lash between gears should be checked for future reference. Pull on drive shaft and push on propeller shaft. Refer to back lash later, on Page 25 of Reassembly.

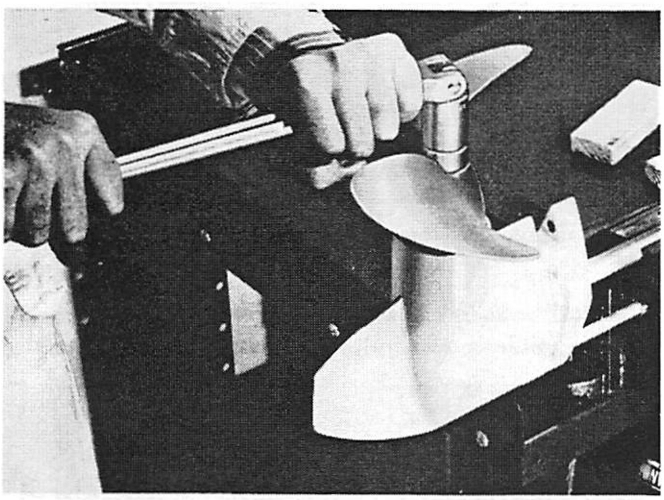


Figure 33. Removing and Installing Propeller and Nut

Use Water Pump Cartridge Tool, from following chart, to remove water pump housing from gear housing. Place housing in vise between 2 pieces of soft wood.

91-24287	- Mark 40, KF9 and KG9
91-24714	- Mark 7, KE7, KF7, KG7, KE4 and KG4.
91-24267	- KF5 and KF3.

Set dowels of water pump tool in holes of cover plate. Apply wrench to flats of tool end and turn (left hand thread) clockwise to loosen. (Figure 34) Remove impeller by prying up with pair of screwdrivers, being careful not to mar threads of gear case cover. Do not lose impeller key.

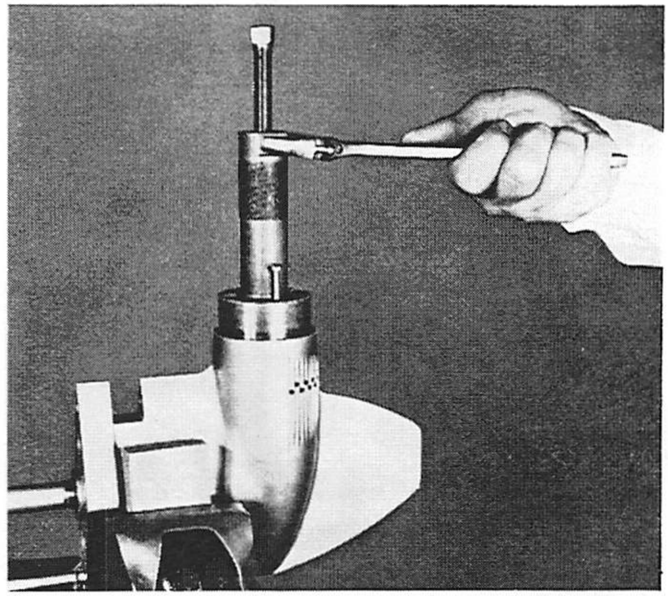


Figure 34. Removing and Installing Water Pump Cover

To remove cartridge, thread 2 screws of tool into cartridge. Apply pressure to center screw of tool against propeller shaft by turning down with wrench. (Figure 35) When loose, remove water pump cartridge, neoprene seal and sealing ring. Remove seal from cartridge by tapping out with screwdriver from inside of impeller housing.

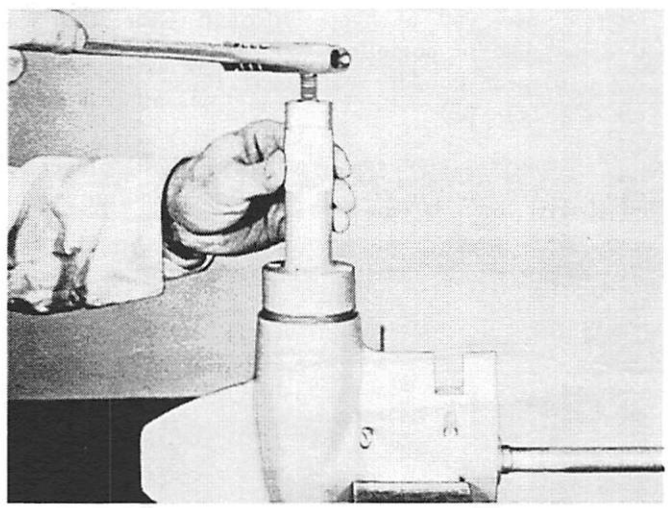


Figure 35. Removing Water Pump Cartridge

To remove propeller shaft assembly, place shaft in vise between 2 pieces of soft wood and tap lightly on skeg of gear housing case with mallet 'til removed. Remove brass shims (as required) from gear housing bearing seat.

Disassemble propeller shaft assembly by first removing snap ring with Snap Ring Pliers (91-24283), then shims (as required) and thrust washer. (Figure 36) Remove ball bearing with Propeller Shaft Gear Tool taken from following chart:

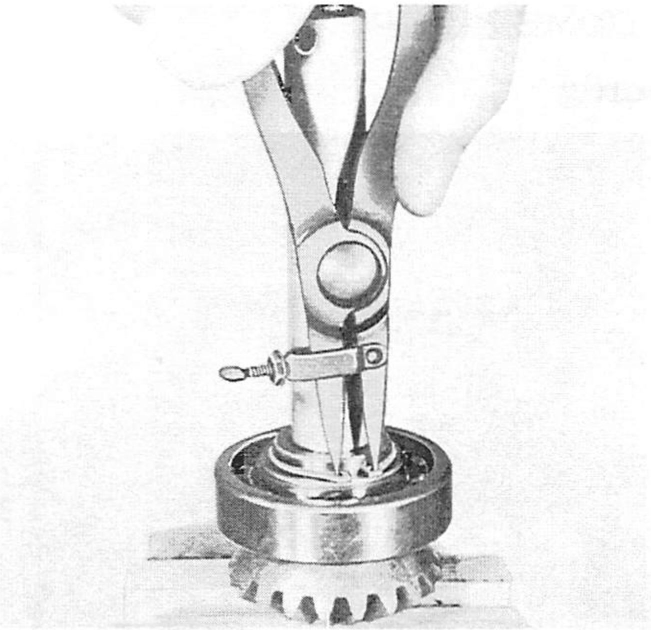


Figure 36. Removing Snap Ring

91-23663	- Mark 40, KF9 and KG9.
91-24716	- Mark 7, KE7, KF7, KG7, KE4 and KG4.
91-24274	- KF5 and KF3.

Set cup with open end up and place shaft assembly gear end-first into cup so ball bearing rests on outside diameter of cup. Press off bearing with arbor press. (Figure 37) Gear drive pin will drop out. Remove gear with closed end of Propeller Shaft Gear Tool. Set threaded end of propeller shaft through small bore of cup until gear shoulder rests on it. Press off with arbor press. (Figure 38)

To remove pinion gear from drive shaft, place free end of drive shaft in vise to hold firm. Bend tab washer up to turn screw loose with wrench and remove both. Tap end of gear housing with mallet and remove shaft and ball bearing from pinion gear. (Figure 39)

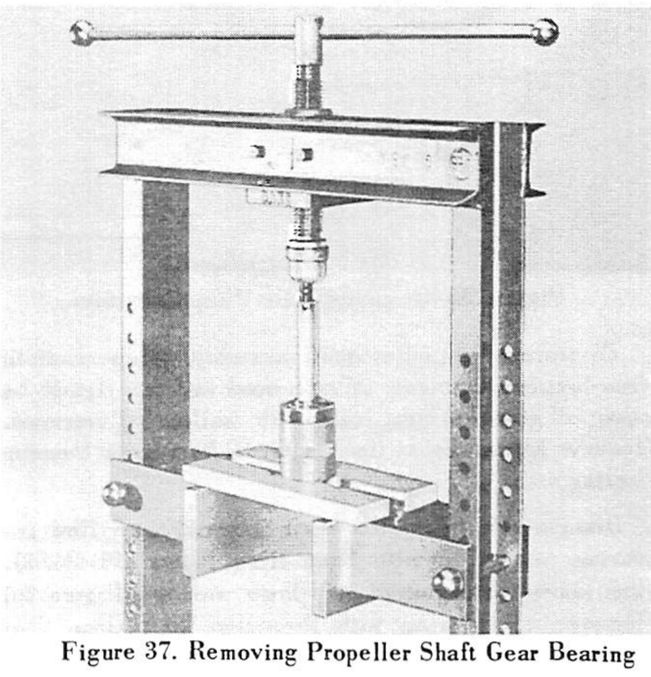


Figure 37. Removing Propeller Shaft Gear Bearing

To remove drive shaft ball bearing, place bearing against open vise jaws so shaft and bearing retainer can be driven off with mallet. (On Mark 40 and KF9 and KG9 only, bearing is held on shaft with bearing retainer.) Remove brass shim below bearing and pilot seal on top.

Note: Gear housing contains needle bearings for propeller shaft and drive shaft. To remove drive shaft needle bearing, use Needle Bearing Mandrel:

91-24288	- Mark 40, KF9 and KG9.
91-24715A1	- Mark 7, KE7 and back thru KE4, KG4.
91-24273	- KF5 and KF3.

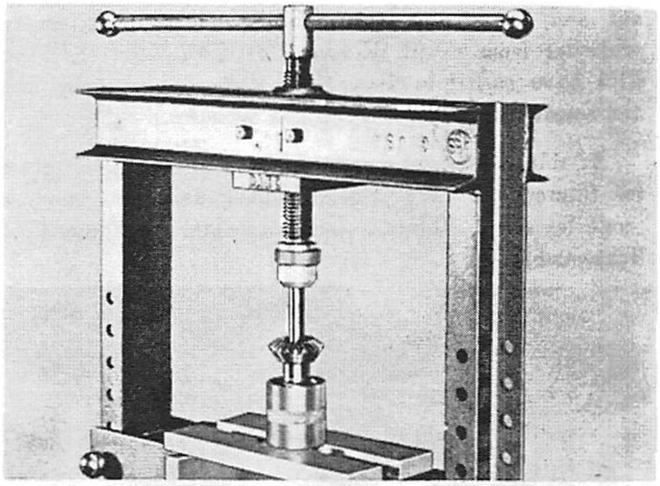


Figure 38. Removing Propeller Shaft Gear

Install mandrel in drive shaft end of gear housing, placing guide on mandrel before installing. Press bearing

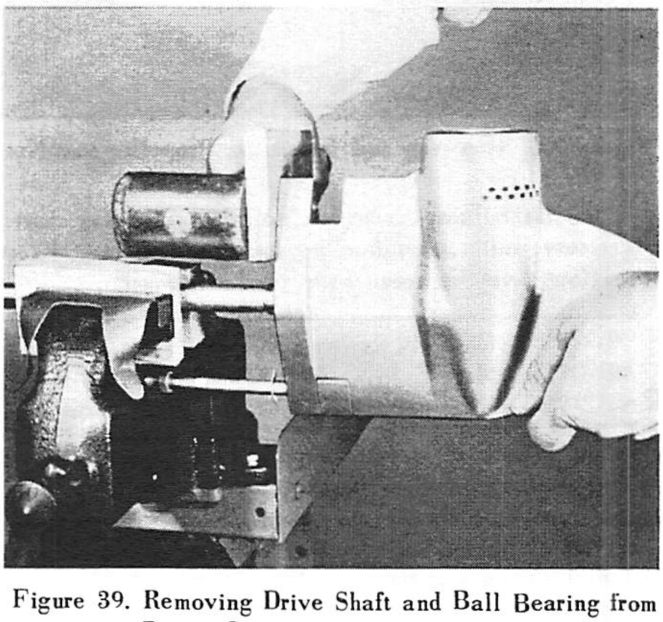


Figure 39. Removing Drive Shaft and Ball Bearing from Pinion Gear

out with arbor press. (Figure 40) To remove propeller shaft needle bearing, pack bearing with heavy cup grease. Place small end of mandrel in bearing. Strike mandrel sharply with mallet several times, as this will force bearing out. If bearing is extremely tight, and above process does not work, heat gear housing around bearing seat 'til bearing falls out. CAUTION: Do not overheat gear housing, or it may be damaged.

B. Quicksilver Lower Units

(See Pages 47-thru-50, this section.)

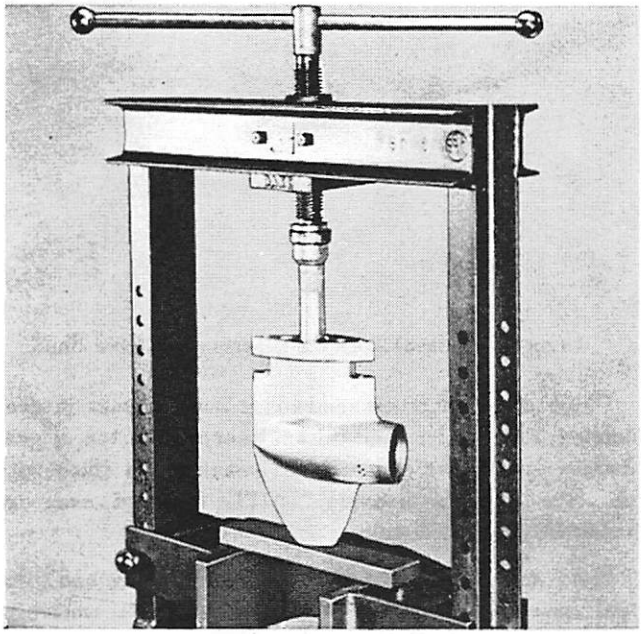


Figure 40. Removing Drive Shaft Needle Bearing

1 Housing, gear
2 Needle bearing, drive shaft
3 Needle bearing, prop shaft
4 Drive shaft
5 Ball bearing, drive shaft
6 Shim, drive shaft ball bearing
7 Assembly, pilot & oil seal
8 Retainer, drive shaft bearing
9 Pinion, drive shaft
10 Tab washer, drive shaft pinion screw
11 Screw, drive shaft pinion
12 Shaft, propeller
13 Gear, propeller shaft
14 Pin, propeller gear driving
15 Ball bearing, propeller shaft
16 Shim, propeller shaft bearing
17 Thrust washer, propeller shaft
18 Snap ring, propeller shaft
19 Shim, propeller shaft bearing
20 Shim, propeller shaft bearing
21 Washer, water pump housing
22 Sealing ring, pump housing
23 Housing, water pump
24 Seal, propeller shaft
25 Impeller
26 Key, drive for impeller
27 Cover, water pump
28 Screw, gear case vent
29 Fibre washer, gear case vent screw
30 Screw, grease filler hole
31 Fibre washer, grease filler screw
32 Stud, drive shaft housing to gear case
33 Special nut, gear case stud
34 Nut, gear case stud
35 Tab washer, gear case stud nut
36 Propeller, 2 blade
37 Pin, propeller to shaft shear
38 Nut, propeller
39 Collar, propeller

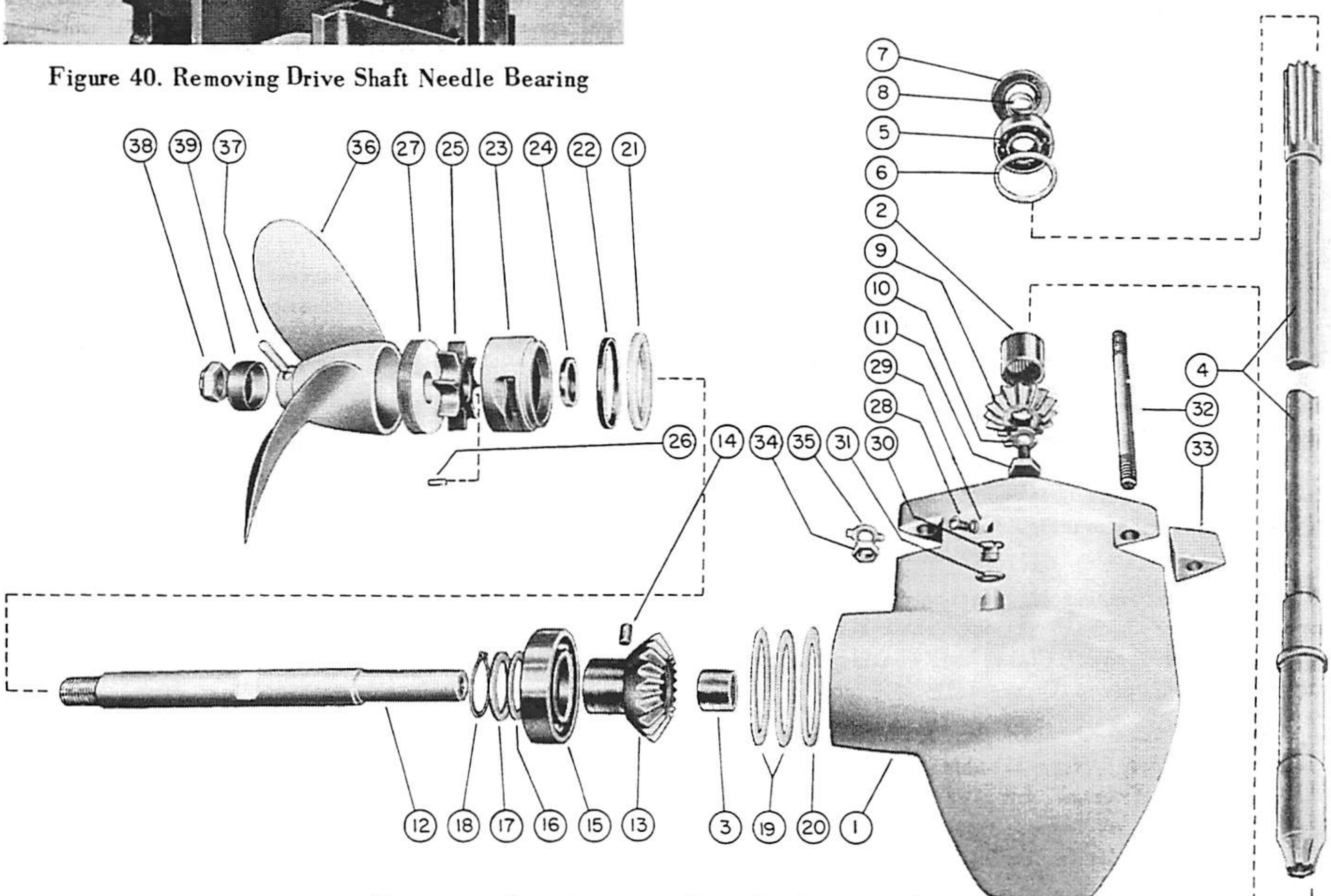


Figure 41. Gear Housing – Drive Shaft – Propeller

Reassembly - Non-Shift Type Lower Unit

Note: Refer to Page 2, this section, prior to reassembly.

A. Gear Housing

Install propeller and drive shaft roller bearing cartridges in gear housing with Mandrel Tool:

91-24288	- Mark 40, KF9 and KG9.
91-24715A1	- Mark 7, KG7 and back thru KE4, KG4.
91-24273	- KF5 and KF3.

Install drive shaft. bearing from top of gear housing with bearing on end of mandrel. Place collar on as guide. Press in 'til bearing seats evenly spaced between drive shaft and gear housing cavity on shoulder. (See Figure 40 in Disassembly.) Use same mandrel to install propeller shaft needle bearing with small cap placed on mandrel, small diameter first. (Figure 42)

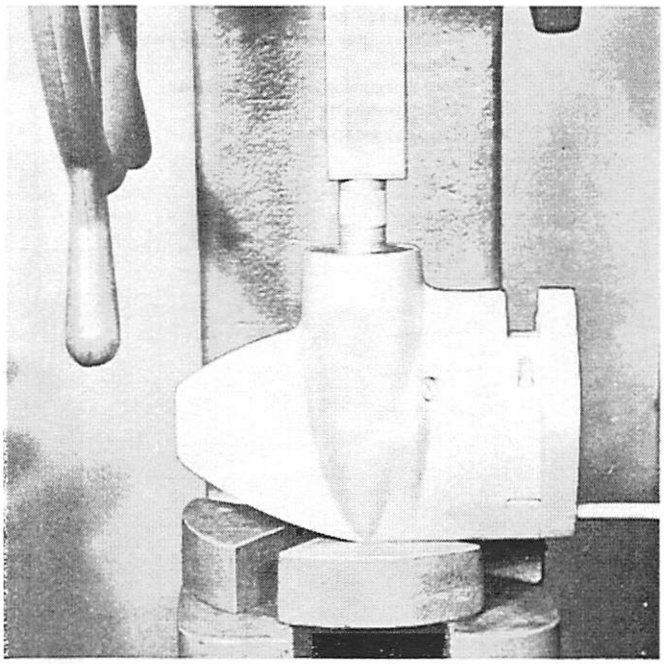


Figure 42. Installing Propeller Shaft Needle Bearing

Place housing in vise between 2 blocks of soft wood at thin section of gear housing.

Oil inner roller bearing in gear housing and replace shims which were originally removed or insert .005" on drive shaft bearing seat. Place ball bearing on drive shaft by tapping in place. (Figure 43)

Note: On Mark 7, place fine brass shim on drive shaft first offset shoulder. (On Mark 40, KF9 and KG9, install drive shaft bearing retainer on shaft and tap against bearing.) Place drive shaft assembly in bearing seat.

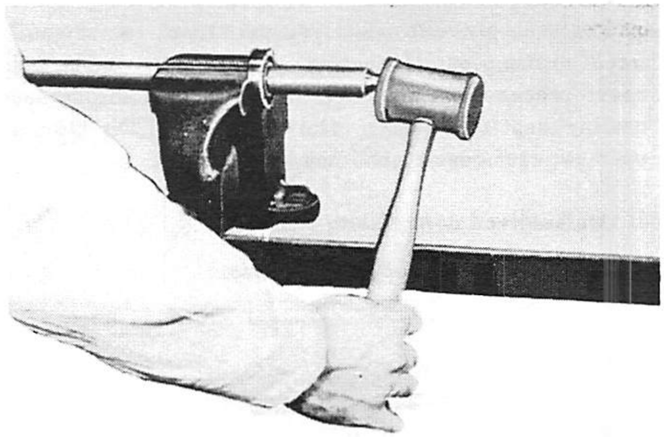


Figure 43. Installing Ball Bearing on Drive Shaft

Place drive shaft assembly into bearing seat in gear housing. Place pilot and oil seal assembly in top of gear housing until pilot and oil seal assembly is flush with top face of gear housing. NOTE: Lips of seal are toward drive shaft housing.

Shim may be required between ball bearing and pilot seal assembly in order to bring flush. Use mallet to drive bearing and pilot assembly down.

While holding entire assembly upside down, place pinion gear on splined end of drive shaft in gear housing and set lock tab washer on top of gear. Check that washer is set in inner splined area of gear so that it is properly locked.

Guide retaining cap screw into end of shaft with needle nose pliers and thread screw into shaft by turning drive shaft by hand while holding. Place drive shaft in vise and tighten cap screw securely with wrench. Bend up lock tab.

Ready the propeller shaft and bevel gear by placing blank end of shaft into rear shoulder of gear. Be careful to place gear on shaft properly so that conical angle will mesh with companion pinion gear. Line up hole in shaft and gear with steel rule. Place gear teeth down on Propeller Shaft Gear Tool, taken from chart following, and use opposite of tool's open end to install gear. Lubricate shaft and press in with arbor press.

91-23663	- Mark 40, KF9 and KG9.
91-24716	- Mark 7, KE7, KF7, KG7, KE4 and KG4.
91-24274	- KF5 and KF3.

Place gear pin in hole of propeller shaft and gear to lock to shaft.

With same tool (Propeller Shaft and Gear Tool), place ball bearing on gear, shoulder of tool collar up on closed end of cup. Insert threaded end of shaft through small hole in cup and press down with arbor press until ball bearing is tight against gear.

Place shim spacer, if required, and thrust washer against bearing and follow with snap ring, using Snap Ring Pliers (91-24283) to spread snap ring onto gear lock ring.

Replace shims as removed or required on shoulder within gear housing. (On Mark 40, KF9 and KG9, place 2 large diameter shims on shoulder.) Install gear and propeller shaft assembly into housing. Use mallet to tap in the shaft. If tight, be careful that entire assembly is centered, straight in housing.

Note: At this point it is very important to check gear back lash of assembly. After drive shaft pinion gear and propeller shaft bevel gears have meshed, try back lash of assembly by pulling drive shaft outward and by applying pressure on propeller shaft assembly. Turn drive shaft in a clockwise and counterclockwise motion very lightly to feel gear lash. No more than .003" to .005" play should be allowed for proper operation. If more than recommended back lash is present, remove shims beneath propeller shaft assembly to mesh gears properly. If too tight and no back lash is present, add a proper amount of shims for correct play and conical angle of gears. Recheck above for back lash after installing water pump and cover assembly as this may cause an undesireable pressure on gears.

B. Assembling Water Pump

Insert "L" washer into housing over propeller shaft ball bearing, shoulder up.

Place neoprene sealing ring on pump cartridge and new internal oil seal in cartridge. *NOTE: Lip of seal must be toward impeller housing.*

Place water pump cartridge into housing by slipping over shaft, being careful to line up intake side (straight slotted) with water intake holes in bottom side of housing. Curved slot in cartridge is outlet of pump. Cartridge remains in fixed position.

Lubricate walls of cartridge and, with Water Pump Cartridge Tool (see chart after Figure 33) centered over shaft, drive cartridge down with mallet. (See Figure 35, this section.)

Coat flat surface of propeller shaft with grease and set impeller key on flat (in hole on KF5 and KF3), parallel to shaft, so slot in impeller will slide over key and be held to shaft. Press down on impeller blades with thumbs to seat impeller on bottom surface of cartridge. Rotate drive shaft so that key is in proper position to drive impeller.

Cover threads of water pump cover with a little grease and then turn cover into housing by hand. With Water Pump Cartridge Tool, set dowels of tool into cover holes and tighten counterclockwise (left hand thread). (See Figure 34, this section.)

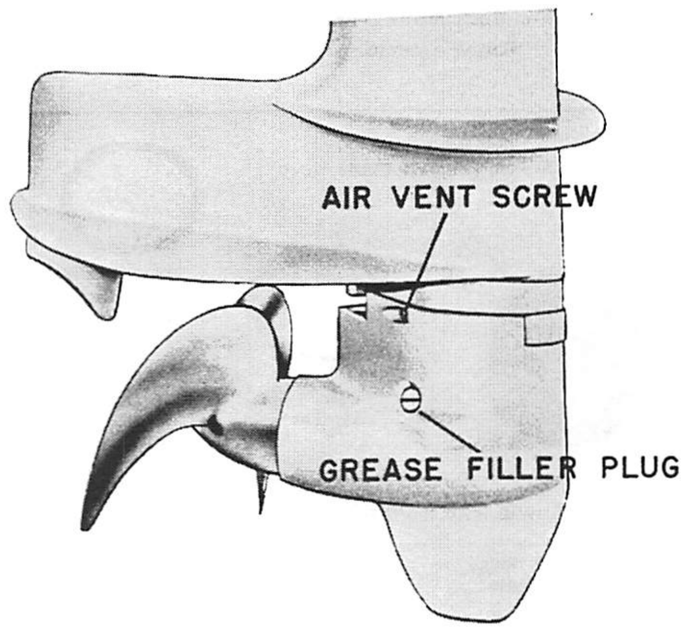
C. Adjustment and Reassembly of Clutch

(See 3 types of clutches listed on Page 27.)

D. Replacing Propeller

Replace propeller on shaft, insert shear pin, and follow with collar and propeller nut to hold secure to shaft. (See Figure 33, this section.)

Remove screw and washer in grease filler hole and also air vent screw and washer. (See figure following.) Lubricate lower unit by inserting grease tube or nozzle into lower grease filler hole in gear housing. Fill until grease is released at top air vent opening. Be careful when replacing 2 screws for these openings that 2 fibre washers are also replaced. Use only recommended Kiekhaefer Special Gear Lubricant (91-24734-1).



Lubricating Lower Unit

E. New Crankshaft and Drive Shaft (KE4, KF5 and Early Mark 7 Models)

If corrosive wear in salt water is observed on splined crankshaft-drive shaft ends of above models, crankshaft and drive shaft should be replaced with new units which have splined ends sealed off from salt water.

Note: New drive shaft for Mark 7 motors below Serial No. 756113 and for all KE4 motors is 1/16" longer which is compensated for by *crankshaft spline depth. This drive shaft cannot be used on Mark 7 and KE4 motors without changing crankshaft.*

Drive shaft has neoprene "O" ring placed in groove at base of splines, and crankshaft splined end is counterbored to accept "O" ring to provide seal for splined drive shaft-crankshaft connection.

New pilot and seal assembly is necessary for proper clearance of snap ring on drive shaft. Snap ring recesses in slot above drive shaft ball bearing to hold it in place, thus preventing drive shaft from pushing upward. *Following are part numbers for new crankshaft and new drive shaft assembly (latter includes new drive shaft, pilot and seal, "O" ring and snap ring).*

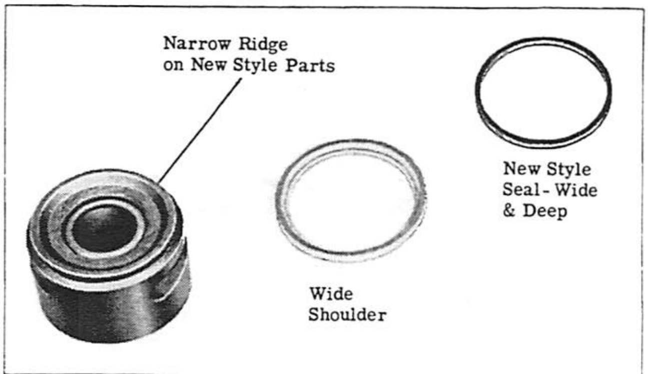
For Mark 7 motors below Serial No. 756113 and all KE4 motors: Crankshaft (403-69) and drive shaft assembly (45-20561A1).

For all KF5 motors: Crankshaft (409-388) and drive shaft assembly (45-21045A1).

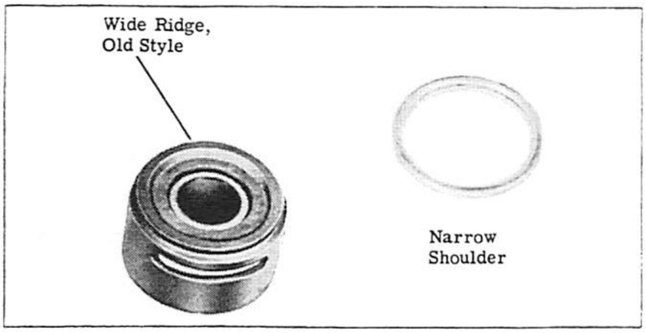
If only crankshaft or drive shaft is damaged (not by salt water) and only one part must be replaced, following parts' numbers apply:

For Mark 7 motors below Serial No. 756113 and all KE4 motors: Crankshaft (403-69) and for drive shaft (45-24475).

For KF5 motors below Serial No. 528404: Drive shaft (45-24451). Above Serial No. 528403: Drive shaft (45-24470).



New & Old Style Cartridge Seal & Ring



For KF5 motors: Crankshaft (409-388).

Note: In the 3 paragraphs just above, the parts do not afford protection to splined areas of crankshaft-drive shaft since they do not incorporate "O" ring seal.

IMPORTANT: Before inserting drive shaft into crankshaft, always coat splines with DC4 Compound (92-24108). This will aid in preventing corrosion and lengthen life of splines.

Water Pump Cartridge (KF5, KF3)

When replacing water pump cartridges (46-22945A1) on KF5's up to Serial No. 344700 and KF3's up to Serial No. 360135, it is important that the new style cartridge use the latest style outside rubber seal (12-22770) and steel sealing ring (12-22768). Improper sealing will result if this procedure is not followed. KF5 and KF3 motors above the aforementioned serial numbers have the new style cartridge.

(See the sketch preceding for proper identification of old and new style parts.)

F. Quicksilver Reassembly

(See Pages 47-thru-50, this section)

CLUTCH REASSEMBLY

MULTIPLE DISC CLUTCH (KF7 and KG7)

Proper torque pressure on clutch plates of KF7 and KG7 models is set at the factory at 22-28 ft. lbs. This can be checked by using Propeller Adaptor Tool (C-91-24272) with Torque Wrench (C-91-25667).

If pressure required to slip clutch is greater than 28 ft. lbs., it will be necessary to remove propeller nut and add additional steel shims located on propeller shaft spline shoulder. Reverse procedure is necessary if torque pressures are less than 22 ft. lbs. (3.036mkg); that is, removing several steel shims.

Lock propeller nut in position with locking tab washer when adjustment is correct.

Replace all graphite grease lost due to disassembly of clutch. Use Dixon Graphite Lubricant or its equivalent.

Note: Clutch on KF7 engines with serial numbers beginning with 368274 have 14 thin fibre discs and 13 thin steel plates. Engines below Serial No. 268274 have 8 fibre and 7 steel plates which were of greater thickness. Starting with a fibre disc, alternate steel and fibre disc, one thick fibre and steel washer seat on top of propeller in recess.

MULTIPLE DISC CLUTCH (KF5 and KF3)

Begin reassembly of clutch discs with thrust plate on splined propeller shaft with small side down. Follow alternately with 7 fibre and 7 steel friction discs, starting with a steel disc. *IMPORTANT: Do not lubricate these discs.*

Set propeller over assembled discs on shaft and rotate lightly as propeller drops in place over disc.

Set one fibre and one steel disc in recess of propeller hub. Place tab washer, compression spring and propeller nut on shaft. Tighten propeller nut securely with wrench and check torque with Propeller Torque Adaptor Tool (C-91-24106). *(See Torque Chart, Section VIII, Page 2D.)* Torque between 170-240 in. lbs. (30.175-42.6kg/cm). Bend tabs on lockwasher into slots on propeller nut.

Adjust clutch beneath propeller. If too tight, loosen nut; if too loose, add .010" (.254mm) shim beneath clutch spring.

DUO-FLEX CLUTCH (MARK 7 and KE4)

Replace clutch drive pin in lower hole of propeller shaft only and then slip drive clutch member on shaft, seating slot over pin to hold. Follow with matching driven member (metal) and propeller, shock absorber retaining washer, propeller nut and cotter pin. Tighten nut with 3/4" box end wrench; then back off ½ turn before placing cotter pin into nut and shaft for secure lock.

GEAR RATIO CHART

Models	Pinion	Propeller
Speedmaster	14	14
Sportmaster	14	21
Merc 1100-1100SS-950-950SS	14	28
Merc 1000-900-850-800 (GS)-700 (GS)-650	14	28
Merc 800 (DR)-700 (DR)-600(DR)	14	28
Merc 500-450-400-350-300	14	23
Merc 350 (2-Cyl.)	13	24
Merc 250-200 (Auto. Trans.)	13	24
Merc 200 (GS) (Forward)	13	24
Merc 200 (GS) (Reverse)	13	28
Merc 150-100	14	23
Merc 110-60 (Forward)	13	26
Merc 110-60 (Reverse)	13	30
Merc 39 (Forward)	13	26
Merc 39 (Reverse)	13	30
Mark 78*-78A-75A	14	28
Mark 75	14	27
Mark 58-58A-55-55A-35A-15A-10-10A	14	23
Mark 40, KF9, KG9	15	20
Mark 30-28-28A-25-20-15, KH7	13	24
Mark 7-5, KE7, KF7, KG7	16	21
Mark 6-6A	14§	23
KF5, KE4, KG4, KF3	16	21
K & KD Twins	14	19**
K & KD Singles	12	22
D Quicksilver	14	14
A-B-C Quicksilver	15	15
Mark 20H Conversion	16	21

*** Bronze spacer & steel shim required*

** Some had 14:27 ratio.* *GS = Gear shift model*

§ Spiral bevel *DR = Direct reversing model*

TYPE IV – "K" MODEL TYPE

Two-Piece Unit, Old Models

Models: KD4, KE3 and models prior to 1947

Disassembly

A. Remove Propeller and Duo-Flex Clutch

Remove cotter pin, propeller nut, washer, propeller and Duo-Flex clutch and/or drive pin.

B. Disassemble Water Pump Housing Assembly.

Remove retainer ring with pliers by compressing ring ends together. Pry up with punch placed in impeller drive pin hole to remove cover and drive hub from water pump housing. Pry out impeller with 2 screwdrivers placed underneath. Remove 2 Phillips head screws securing water pump to gear housing. Water pump housing can now be removed. Propeller shaft and gear will pull out. NOTE: Two shims seat between propeller shaft bushing in gear housing and gear on twin cylinder models. Singles do not have these shims. Remove propeller shaft gear with Propeller Shaft Gear Tool (91-24274).

C. Disassemble Gear Housing Assembly

Remove screw holding gear housing to drive shaft housing and nut located at front end of long stud behind swivel pin. Pull off gear housing assembly. Remove drive shaft, allowing pinion gear, thrust washer and shim to be free. (NOTE: Single cylinder models do not have a thrust washer or shim.) Remove oil seal set in drive shaft cavity of gear housing above bushing. Seal is held in place with spring and spring retainer bushing.

Reassembly

Note: Refer to Page 2, this section, prior to reassembly.

A. Assemble Gear Case

Gear housing is die cast with bronze bushings. Bushings cannot be replaced; thus, if worn, unit must be replaced. Bushings are worn if shaft tends to have excessive side play. Thread long stud into gear case. Insert oil seal into gear case at drive shaft opening (tips of seal face upward). Place tension spring against seal. Insert undercut end of drive shaft into gear housing, allowing shaft to protrude below lower bearing. Insert steel thrust washer, followed by bronze washer and pinion gear into housing. On *single cylinder models*, the bronze washer and steel washer are not used. Push drive shaft into housing, engaging gear. Tap sleeve into place at drive shaft opening at base of drive shaft housing.

Assemble gear case to drive shaft housing by inserting drive shaft into housing through sleeve. (Check that water pipe is in proper place, toward exhaust outlet.) Insert stud into housing. Fasten gear case flange screw securely. Install lockwasher and nut on top end of stud. Tighten nut and bend up one tab of lockwasher.

B. Assemble Water Pump and Install

Ready the propeller shaft and bevel gear by placing blank end of shaft into rear shoulder gear. Be careful to place gear on shaft properly so that conical angle will mesh with companion pinion gear. Line up hole in shaft and gear with steel rule. Place gear teeth down on Propeller Shaft Gear Tool (91-24274), using opposite of open end to install gear. Lubricate shaft and press in with arbor press. Drive gear pin in hole of propeller shaft and gear to lock to shaft. Place propeller shaft, with gear attached, into pump housing.

Insert impeller over propeller shaft with keyway toward outside. Insert drive hub and engage lugs in impeller keyway. Place cover over impeller and be sure locating pin in housing fits into notch on rim of cover. Tap cover into place to seat and install retainer ring. Install drive pin through impeller hub and propeller shaft.

Note: On all models equipped with oscillator-type water pump (K and KB models), slide 2 packings over propeller shaft threads. Packings are installed with plain surfaces together. Slide cup into place over shaft. Install oscillator cam and oscillator pump.

Cement gasket surfaces on pump housing and gear case. Install one or 2 shim washers, as necessary, on propeller shaft between thrust bearing and gear on twin models. Set gasket in place and attach pump housing to gear case housing by installing 2 screws. Draw screws up tightly. Rotate propeller shaft to insure proper gear mesh and check back lash for approximate .005". Remove grease plug and vent plug and insert grease into pump housing until it flows from vent hole. Replace plugs and gasket on vent screw.

C. Assemble Duo-Flex Clutch and Propeller

To complete reassembly, replace clutch drive pin in lower hole of propeller shaft only and then slip drive clutch member on shaft, seating slot over pin to hold. Follow with matching driven member (metal) and propeller, shock absorber retaining washer, propeller, nut and cotter pin. Tighten nut with ¾" box end wrench; then back off ½ turn before placing cotter pin into nut and shaft for secure lock.

PROPELLER REPAIR AND PROPELLERS

Occasional lubrication of the propeller shaft will prevent corrosion. Remove propeller and apply lubricant MULTIPURPOSE Quicksilver Lubricant (92-30239).

For propeller repair, balancing, repitching or straightening, ship propellers to closest Mercury Propeller Repair Station.

Propeller Chart -- All Models (See Page 19 -19A).

1 Gear Housing
2 Gear, propeller shaft
3 Propeller Shaft
4 Gasket, water pump to gear hsg.
5 Water Pump Housing
6 Impeller
7 Hub, impeller drive
8 Cover, water pump
9 Snap Ring, water pump cover
10 Member, clutch drive
11 Member, clutch driven
12 Propeller
13 Shock Absorber, rubber washer
14 Washer, shock absorber retaining
15 Nut, propeller
16 Pin, propeller nut cotter
17 Pin, propeller shaft shear
18 Screw, water pump to gear housing
19 Gear, drive shaft pinion
20 Seal, oil
21 Spacer, oil seal
22 Spring, oil seal tension
23 Stud, drive shaft housing

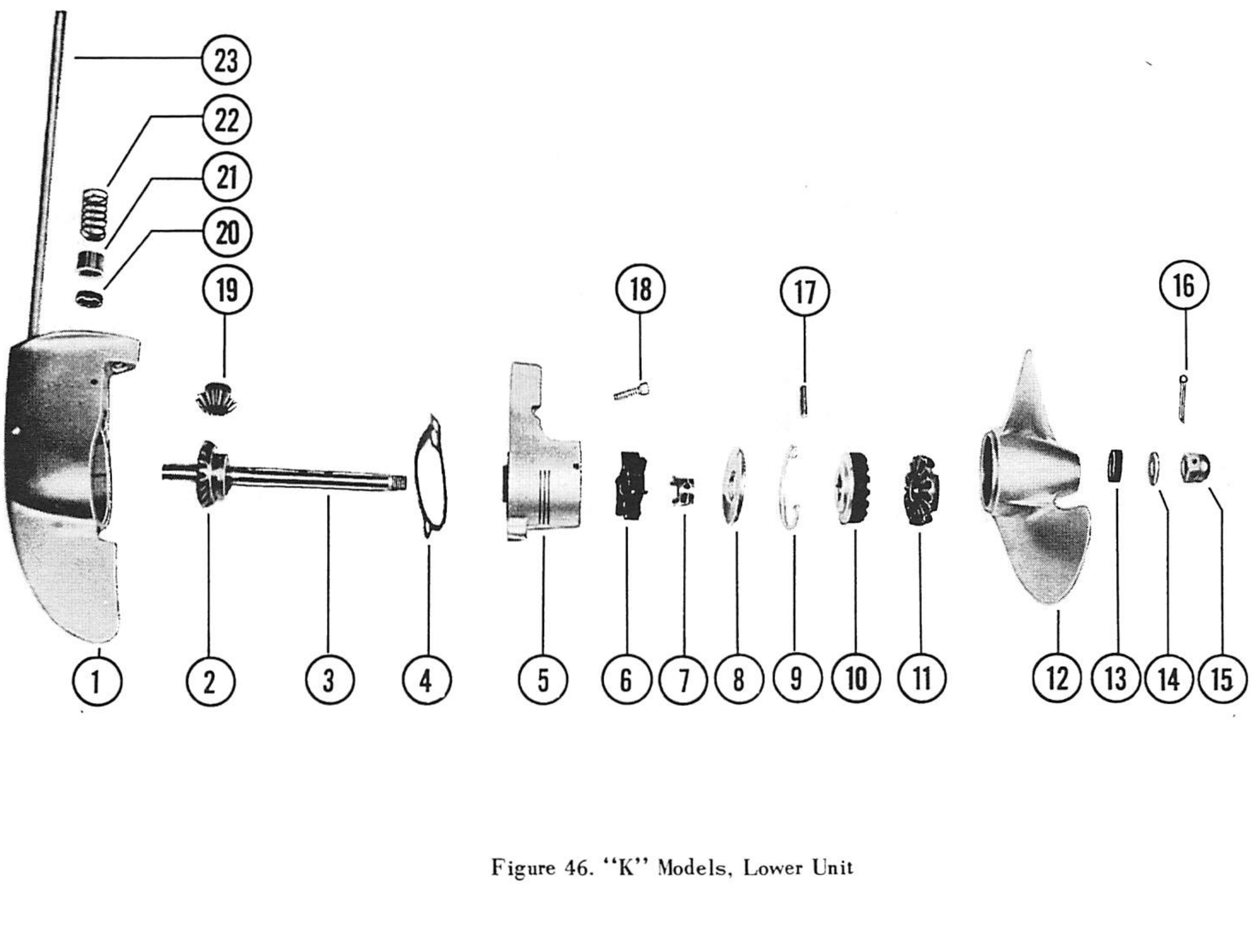


Figure 46. "K" Models, Lower Unit

DRIVE SHAFT HOUSING & CLAMP & SWIVEL BRACKET
Disassembly

Spring Loaded Mounting Type

Models: Mark 50-40-20-15-7, Mark 55H-30H-20H, KF9, KG9, KH7, KG7, KF7, KE7, KG4, KE4 and KD Models

Remove swivel pin from swivel bracket of unit with Swivel Pin Puller (C-91-24047A2). (Fig. 46A) Turn long threaded center pin (5/8"-18 on Mark 50, Mark 40, KF9 and KG9; 1/2"-20 on other swivel pin models) with thread end into top of swivel pin far enough to engage pin firmly. Slide hollow tube over threaded shaft so larger end rests on drive shaft housing. Thread hex head nut on shaft and turn down with wrench until pin emerges from assembly.

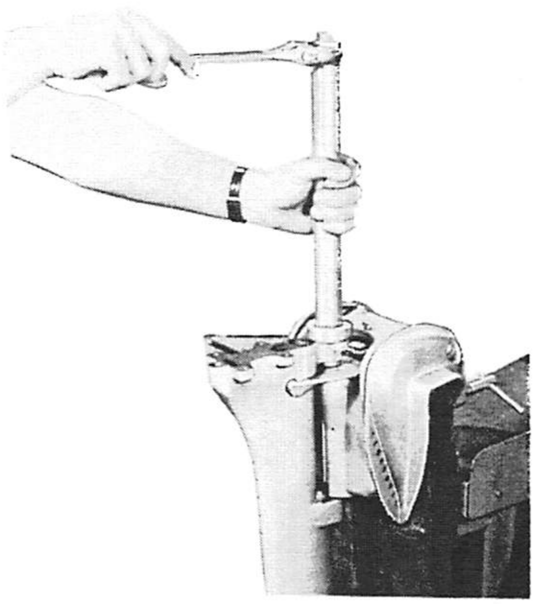


Figure 46A. Removing Swivel Pin

Note on Swivel Pins: It has been evident during operation in salt water areas that swivel pins are sometimes corroded in the swivel bracket, thereby impeding turning. It is recommended that new type swivel pins be used in salt water areas. The new swivel pins are .002"-.003" smaller in diameter and have been given a special corrosion resistant treatment. (Later engines, like Merc models and Mark 78-75-58-55-25, have alemite fittings incorporated in the swivel bracket on the underside.)

Metric Conversion: 1" = 25.4mm

Drive shaft housing is now loose from co-pilot. Be careful not to lose co-pilot springs as they are set loose inside inserts of drive shaft housing and will drop out when drive shaft housing is removed. Remove swivel pin mounting bushings in drive shaft housing. Upper bushing can be pushed or tapped out from top with wrench socket of same outside diameter. Lower bushing can be removed with cape chisel. Co-pilot adjusting screw and screws holding clamp plate assembly and co-pilot friction discs can now be removed. Remove co-pilot by lifting off swivel bracket.

To remove swivel bracket, loosen nut at one end of stud and pull stud free. Watch for 2 fine steel shims, one on each end of stud between swivel bracket and clamp bracket. Remove tilt lock stop lever screws by removing nuts, one on each bracket. Remove nut on clamp stud and pull stud free. Spacer tube also will be free. Tilt lock pin in bracket may be removed. Further disassembly of clamp bracket, if required, can be accomplished by referring to exploded views accompanying Mercury Outboard Motors Parts' Lists.

On models with rubber mounting, to remove reverse lock assembly, remove cotter pin from pivot shaft. Drive pivot shaft either way with drift pin. Reverse lock push rod now can be removed, if necessary, by driving out dowel pin.

Reassembly

A. REASSEMBLING CLAMP BRACKET ASSEMBLY (Figure 48)

1. Place clamp bracket on stand similar to transom of boat. Tighten clamp screws to hold.
2. Insert 2 co-pilot springs into side wells of housing by using 2 putty knives to hold springs in place while co-pilot assembly can be guided between knives and over springs.
3. Release the 2 knives.

   NOTE: On Quicksilver units, springs are replaced by bolts inserted thru holes drilled in co-pilot assembly. Place nut on bolt to hold co-pilot and thread screw into drive shaft housing.

4. With bushings inserted into housing (upper & lower), swivel pin which holds drive shaft housing to swivel bracket can be inserted. Be sure to insert "bottom" friction discs into swivel bracket before driving pin down tight.
5. Place MULTIPURPOSE Quicksilver Lubricant (92-30239) on pin before inserting.

   NOTE: On all older 10 and 16 HP models, replace old brass enclosed neoprene bushing (lower, 23-22054) with new style nylon bushing.
   IMPORTANT: To hold swivel pin in place and to stop possibility of its floating up, take a drift and hammer and punch sides of swivel pin inner shell to form wedge.

6. If copper water line has been removed, insert tube from bottom of drive shaft housing into hole for same at top of housing and flare end with flaring tool. (Figure 47) Use ¼" punch inserted in end of tube. Follow a circular motion to start flare, then finish to match counter-sink in top of housing with a flaring tool (of same contour) which can be purchased locally.
7. Insert friction disc into co-pilot clamp.
8. Insert clamp into recess in swivel bracket and screw clamp into place.

B. JOINING DRIVE SHAFT HOUSING AND GEAR HOUSING

1. Join 2 assemblies (drive shaft housing and lower gear case) by inserting drive shaft up into drive shaft housing. Check that water inlet tube is installed

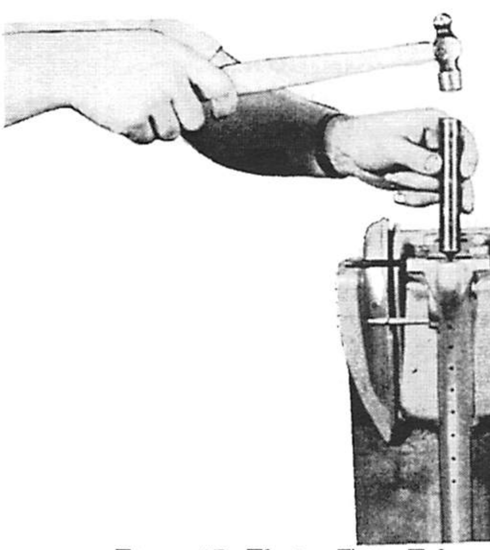


Figure 47. Flaring Water Tube

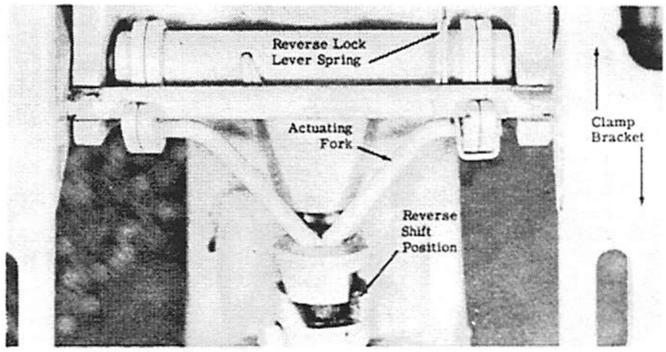


Figure 47A. New Reverse Lock Mechanism

with "0" ring on top and lower water tube seal and special washer installed on lower end before tightening 2 assemblies. Steel washer is placed on water line first, then neoprene seal.

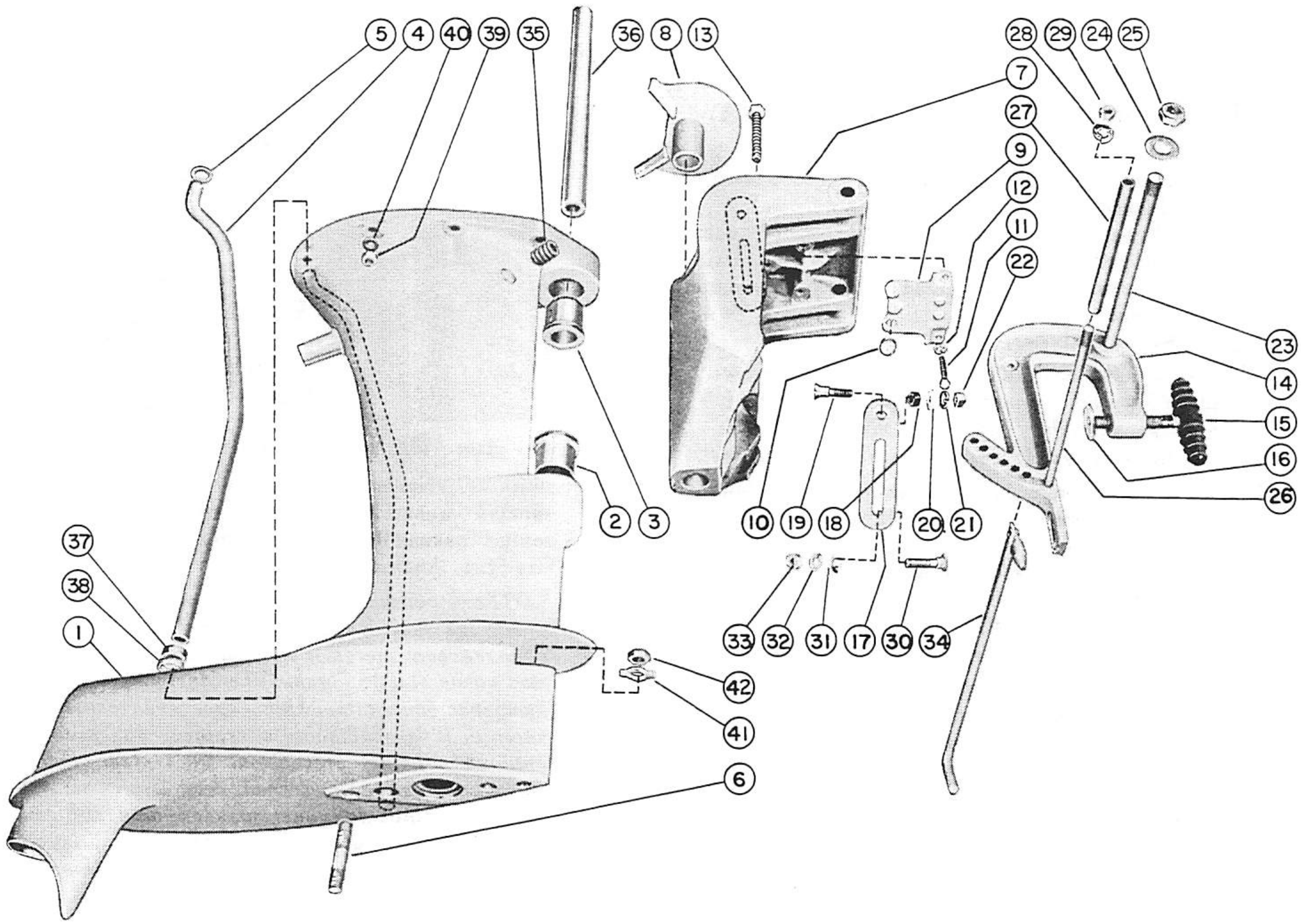
   NOTE: A vibration dampener is placed on the long gear case stud on KE7, KF7, KG7 and KG4 to prevent resonant vibration of stud. Continual vibration may cause stud to break. When installing a vibration dampener on motors which have seen considerable service, it is advisable to replace long gear case stud as a safety precaution. To install vibration dampener, remove powerhead, drop lower unit a few inches and place dampener over long stud with small end down. Tap dampener in place so that it seats approx. 9½" from top of drive shaft housing, then reassemble motor.

2. Install 2 studs properly so that 2 assemblies are held secure by washer and nuts when joined. *(Note: Stud in leading edge, on Mark 40, KF9 and KG9 models, is held by special wedge nut.)*

C. REPLACING POWERHEAD

1. Be careful before setting powerhead on lower unit that "0" ring is replaced in recess of bottom of cylinder block. Lubricate splines of drive shaft heavily with MULTIPURPOSE Quicksilver Lubricant (92-30239) to aid in prevention of spline wear.
2. Replace complete powerhead on lower unit by engaging splines of drive shaft in grooved end of crankshaft and insert studs of powerhead into top of drive shaft housing.
3. Secure 2 assemblies by tightening 8 hexagon head nuts. Replace thumb screw washer on clamp bracket with Clamp Screw Flaring Tool (91-24735). Apply small amount of MULTIPURPOSE Lubricant to bearings.
4. Turn thumb screw against thumb screw disc, applying pressure against tool. Rotate tool counterclockwise with wrench.

   NOTE: On Mark 30, to assemble new actuating fork with new reverse lock lever assembly, place one leg of fork in catch part of lever and insert other leg into hole on opposite side. (Figure 47A) Slide leg extension inward as far as possible, and other leg then can be inserted into its respective hole. Holes are bored oversize, enough to take angularity when reassembling fork into levers. Be sure not to spring fork to assembly! Final positioning is completed by shift shaft.



1 Drive shaft housing
2 Bushing, swivel pin lower
3 Bushing, swivel pin upper
4 Water inlet tube
5 "O" ring, water inlet tube seal
6 Stud housing to gear case
7 Swivel bracket
8 Co-pilot disc
9 Clamp plate
10 Disc, clamp plate friction
11 Screw, clamp plate mounting
12 Lockwasher, clamp plate mounting screw
13 Screw, co-pilot tension adjusting
14 Clamp bracket
15 Assembly, thumb screw
16 Washer, thumb screw
17 Lever, tilt stop
18 Spacer, tilt stop lever
19 Screw, tilt stop lever anchor
20 Washer, lever anchor screw
21 Lockwasher, lever anchor screw
22 Nut, lever anchor screw
23 Stud, clamp bracket to swivel bracket
24 Shim, clamp bracket to swivel bracket
25 Nut, clamp bracket to swivel bracket stud
26 Stud, clamp brackets
27 Spacer, clamp brackets stud
28 Lockwasher, clamp brackets stud
29 Nut, clamp brackets stud
30 Screw, tilt stop lever retaining
31 Washer, lever retaining screw
32 Lockwasher, lever retaining screw
33 Nut, lever retaining screw
34 Assembly, tilt lock pin
35 Spring, co-pilot
36 Swivel pin
37 Seal, water tube lower
38 Special washer, water tube lower
39 Nut, drive shaft housing to power head stud
40 Washer, drive shaft stud nut
41 Tab washer, housing to housing stud nut
42 Nut, gear housing to drive shaft housing stud

Figure 48. Spring Loaded Drive Shaft Housing and Clamp & Swivel Bracket

DYNA-FLOAT SUSPENSION
2-Cylinder Models and Mark 30

A. Description

Kiekhaefer engineered Dyna-Float suspension employs rubber shear mounts, the same vibration dampeners used to cushion powerful aircraft engines. These mounts are found on the drive shaft housing. (Figures 49 and 52) Dyna-Float Suspension keeps engine vibration away from the boat without sacrificing horsepower or other performance.

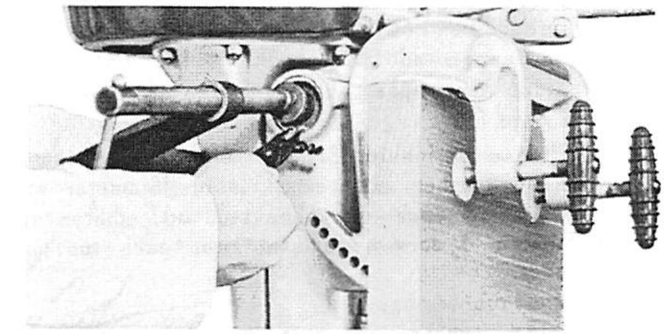


Figure 49. Compressing Mount & Removing Retainer Ring

B. Removing Drive Shaft Housing from Saddle Mount

Remove screws from cover plates. Using "C" clamp, tighten clamp on lower rubber mounts to compress rubber mounts for removal of retaining rings. (Figure 49) Remove retaining ring from each mounting recess with Snap Ring Pliers (C-91-25081). Compress ring to remove. (Figure 49)

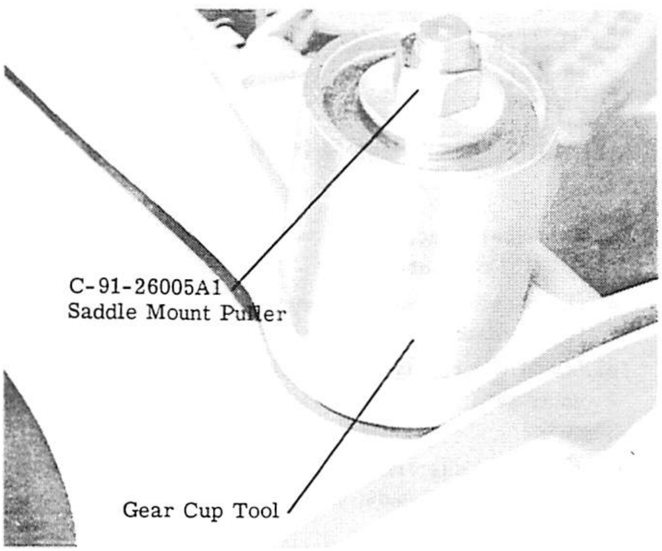


Figure 50. Pulling Dyna-Float Mount

Remove "C" clamp, and rubber mounting bushing can be pulled out. To remove the Dyna-Float mounting bushings, thread small end of Saddle Mount Puller (C-91-26005A1) screw securely into rubber mount threads. Place Propeller Shaft Gear Tool (C-91-23663A1) cover over screw and place large washer and nut of puller tool on screw, then tighten nut to pull out rubber mounts.

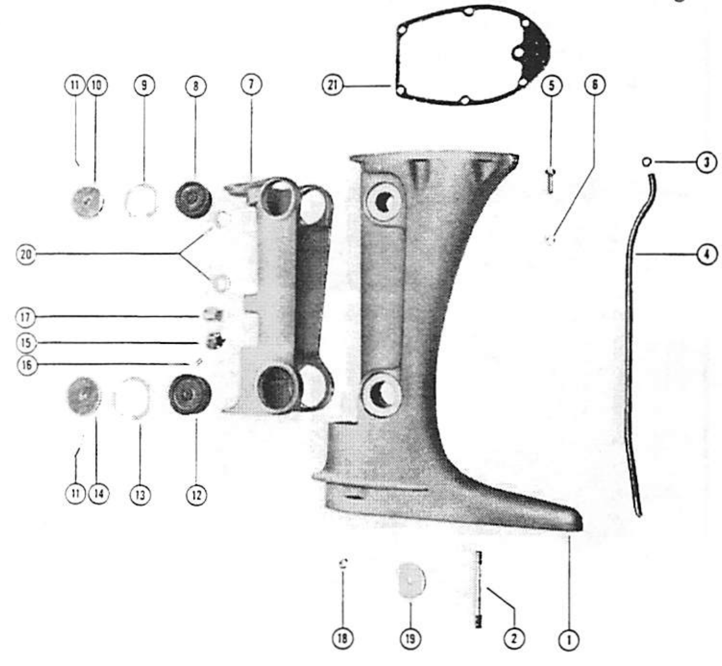
Important: Gaskets are no longer used below rubber mounts. Repeat above procedure for upper rubber mounts.

Note: Flexible shift shaft connector can be pulled off upper and lower shift shaft in saddle mount when gear housing assembly is removed.

C. Reassembly of Drive Shaft Housing to Dyna-Float Saddle Mount (Figure 51)

Locate drive shaft housing in saddle mounting. Set upper rubber mounts in drive shaft housing recess through saddle mount. Be sure screw hole faces out. Place "C" clamp on mounts and tighten to compress. Insert retainer ring in grooves in saddle mounting. Be sure retainer rings are seated properly. Remove "C" clamps. Replace covers and secure in place with screws. Be sure small slot in cover is to bottom to drain out water. Repeat above process for lower rubber mounts.

Place flexible shift shaft connector in position on gear housing shift shaft spline. Set in forward gear and insert unit into drive shaft housing, locating flexible connector on upper shift shaft splines (also in forward gear). Be sure to coat splines with MULTIPURPOSE Quicksilver Lubricant (C-92-30239-1) before installing.



1 Housing, drive shaft
2 Stud, drive shaft housing to gear
3 "O" ring
4 Tube, water inlet
5 Screw, drive shaft housing to powerhead
6 Nut, drive shaft housing to powerhead
7 Saddle
8 Rubber mount (upper)
9 Ring, retaining – upper mount
10 Cover, upper mount
11 Screw, cover fastening
12 Rubber mount (lower)
13 Ring, retaining – lower mount
14 Cover, lower mount
15 Cam, lower – reverse lock
16 Screw, set – reverse cam lock
17 Cam, upper – reverse lock
18 Nut, gear housing to drive shaft housing stud
19 Plate, water tube
20 Washer, thrust – swivel pin (swivel bracket to saddle)
21 Gasket, drive shaft housing to powerhead

Figure 51. Drive Shaft Housing and Saddle

DYNA-FLOAT SUSPENSION
4 and 6 Cylinder Models

DISASSEMBLY OF DRIVE SHAFT HOUSING AND DYNA-FLOAT MOUNTS

1. Remove cross pin which holds reverse lock lever in drive shaft housing.
   a. On current models, the lower mount covers must be removed.
   b. On 1965 models, a cam is used in place of the reverse lock lever. Remove spring from cam.
   c. On direct reversing models, the lever is not used. Remove stop strap.
2. Remove Dyna-Float mount covers (if not already removed in previous step) .
3. Pull rubber bumpers from heads of mounting bolts.
4. Remove nuts from lower mounting bolts.

NOTE: On 1964 and older models, it is first necessary to remove clamp from lower mounts.

5. Remove rubber caps from upper mounts (not used on 1965 models) .
6. Remove nuts from upper yoke studs.
7. Remove drive shaft housing by pulling from top and bottom yokes. (Figure 52)
8. Remove top mounts by removing 4 screws.
   a. Remove "U" cup packing seal.
   b. Separate inner and outer halves.

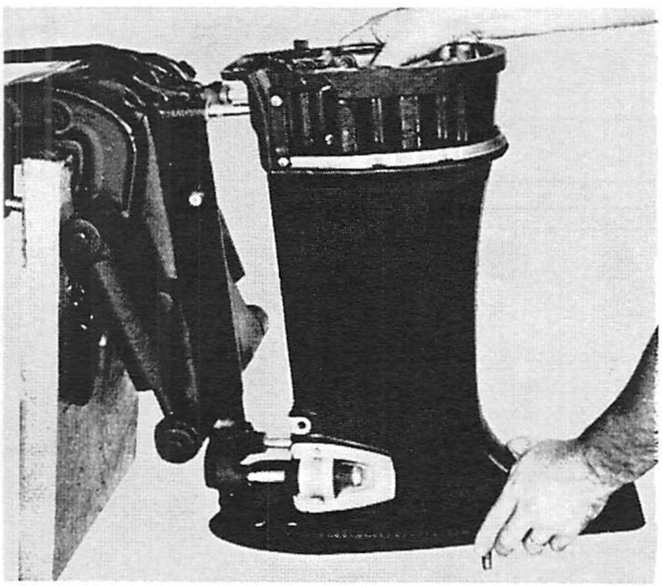


Figure 52. Removing Drive Shaft Housing

REASSEMBLY OF DRIVE SHAFT HOUSING AND DYNA-FLOAT MOUNTS

1. Place top mounts into inside and outside covers and install "U" cup seal.
2. Install upper mount assemblies into drive shaft housing. Do not tighten screws at this time.
3. Place lower mounts on bolts and position in recesses in drive shaft housing. Place washers on threaded end of bolt.
4. With upper and lower yoke bracket in position, place drive shaft housing onto yoke brackets. (Figure 52)
5. Place large inside diameter steel washer, spacer, rubber washer and small inside diameter steel washer on each top yoke stud and tighten nuts.
6. Tighten 4 screws and nuts on each top mount cover.
7. Insert rubber cap.
8. Install washers and nuts on lower mounts and tighten.
9. Install rubber bumper caps and mount covers.

REMOVAL OF UPPER AND LOWER MOUNTING YOKE

1. Remove self-locking nut from bottom of swivel pin. Earlier models had a snap ring in place of lock nut.
2. Tap lower yoke from swivel pin with a mallet.
3. Pull or tap swivel pin from swivel bracket. On earlier engines, the co-pilot assembly first must be removed.

REASSEMBLY OF UPPER AND LOWER YOKE BRACKETS

1. Lubricate swivel pin with Quicksilver MULTI-PURPOSE Lubricant (C-92-35226) .
2. Drive swivel pin into swivel bracket. Replace co-pilot assembly on earlier models.
3. Insert lower yoke on splines of swivel pin. Be sure that lower yoke aligns squarely with top yoke.
4. Replace snap ring or nut. Do not over-tighten nut, as swivel pin must turn freely.

DRIVE SHAFT HOUSING ASSEMBLY

Standard (A-1545-1971) and long (A-1546-1973) drive shaft housings have been superseded by A-1545-2337A4 (standard) and A-1546-2338A2 (long) drive shaft housings and the following parts:

QUANTITY	PART NUMBER	DESCRIPTION
2	A-35473	Clamp - Lower Mount
2	A-35474	Cover - Lower Mount
4	C-24-35522	Spring
4	C-10-29256	Screw
2	C-11-35521	Plastic Grommet
2	C-10-29722	Screw

INSTALLATION

1. Assemble upper mounts as before.
2. Assemble lower mount as follows:
   a. Place lower rubber mount on bolt and position in recess of drive shaft housing.
   b. Install plastic grommet in mount clamp and place springs in front holes of mount clamp. Align ends of springs with recesses of mount clamp. (Figure 52A)

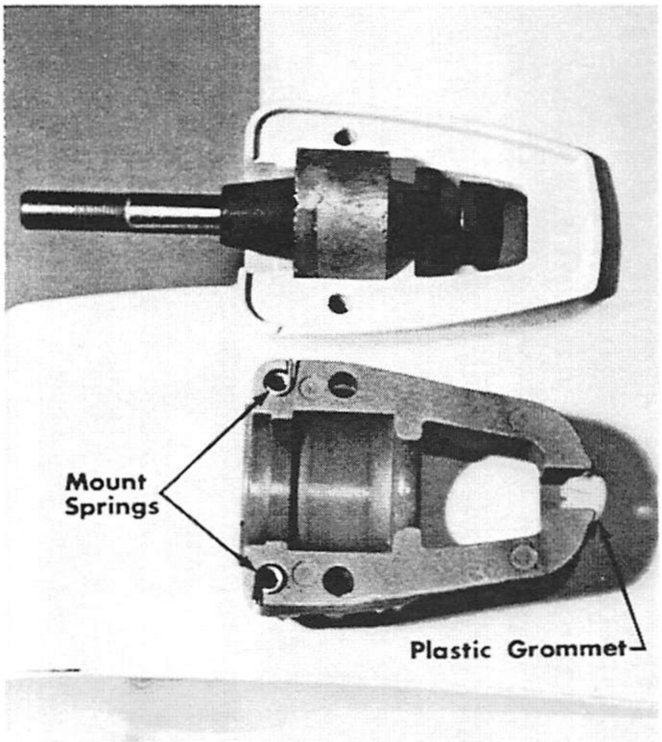


Figure 52A

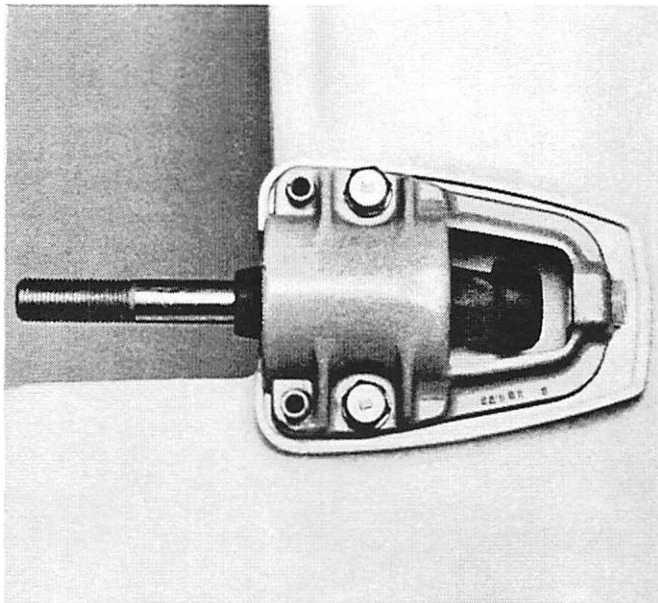


Figure 52B

   c. Position mount clamp over rubber mount. Install screws and tighten securely. (Figure 52B)
   d. Assemble other lower mount in same manner.
   e. Drive shaft housing now can be assembled to swivel pin and yoke.
   f. After drive shaft housing has been installed and mount bolts tightened securely, mount covers may be installed.
   g. Slip forward edge of mount cover over leading edge of mount clamp and press cover tight against drive shaft housing. Install cover screw and tighten securely. (Figure 52C)

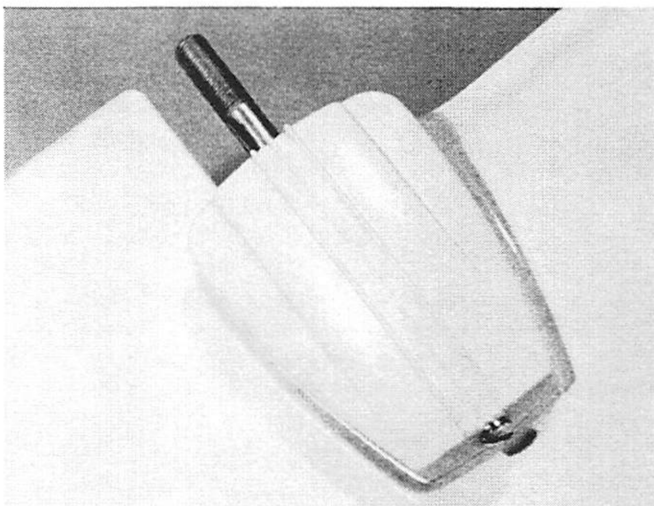
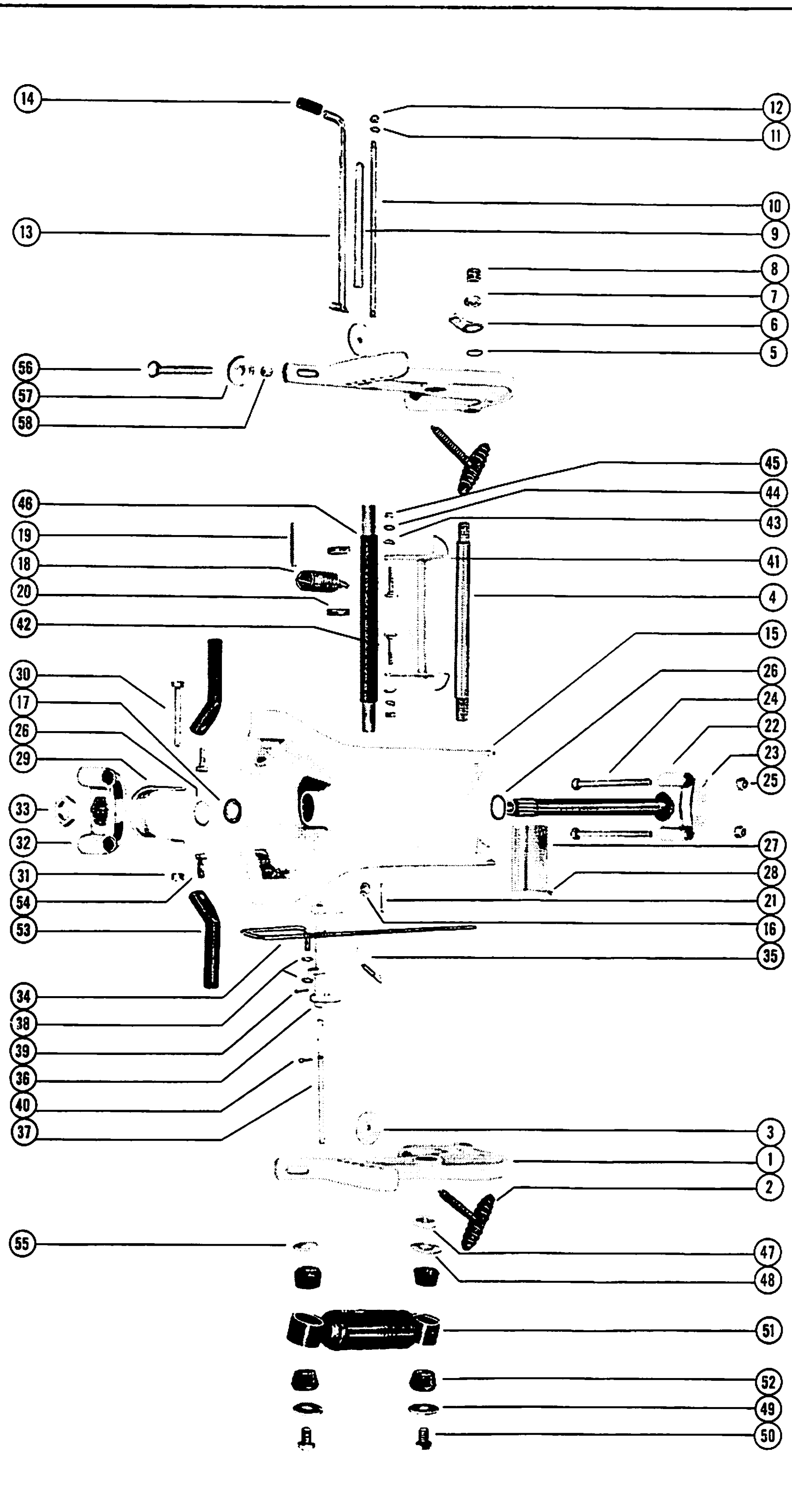


Figure 52C

NOTES



1	Clamp Bracket
2	Thumb Screw Assembly
3	Washer, thumb screw
4	Tube, tilt
5	Shim, clamp bracket tilt tube
6	Clip, safety chain
7	Nut, tilt tube fastening
8	Cap, plastic - tilt tube
9	Spacer, clamp bracket stud
10	Stud, clamp bracket
11	Lockwasher
12	Nut, clamp bracket stud
13	Tilt Lock Pin Assembly
14	Sleeve, rubber
15	Swivel Bracket
16	Fitting, grease
17	Oil Seal
18	Spring, coil - swivel bracket
19	Pin, coil spring mounting
20	Spacer, rubber
21	Pin, rev. lock spring attach.
22	Swivel Pin & Top Yoke Ass'y
23	Bumper, top yoke
24	Bolt, top yoke to up. mount
25	Nut, top yoke bolt fastening
26	Washer, swivel pin
27	Serial Plate
28	Screw, drive
29	Strap Stop
30	Screw, strap stop to d. s. h.
31	Nut, strap stop fast. screw
32	Yoke, bottom
33	Nut, swivel pin retaining
34	Rod, push - reverse lock
35	Spring, reverse lock tension
36	Reverse Lock Assembly
37	Shaft, reverse lock pivot
38	Washer, push rod
39	Cotter Pin
40	Cotter Pin
41	Tilt Stop Lever Assembly
42	Screw, tilt stop lever anchor
43	Washer, wave
44	Lockwasher
45	Nut, lever anchor screw
46	Pin, upper shock mounting
47	Spacer
48	Washer
49	Washer
50	Screw, nylock
51	Shock Absorber
52	Bushing, rubber
53	Pin, lower shock mounting
54	Screw
55	Washer
56	Bolt
57	Washer, clamp bracket bolt
58	Nut, clamp bracket bolt

Figure 53. Clamp and Swivel Bracket Assembly, Mark 78A

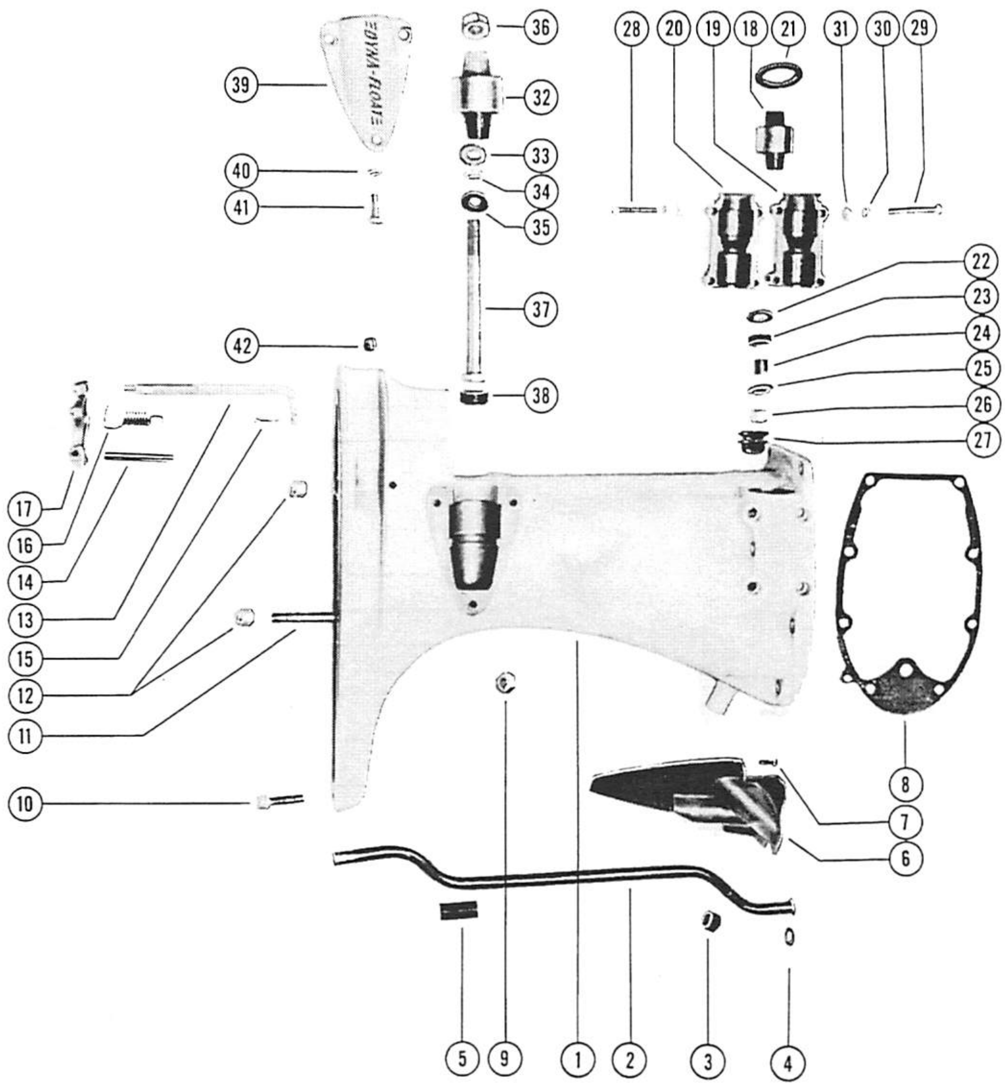


Figure 54. Drive Shaft Housing and Dyna-Float Mounts

1 Drive Shaft Housing
2 Tube, water inlet
3 Ring, rubber - water inlet tube
4 Seal, water inlet tube
5 Sleeve, water inlet tube
6 Baffle, exhaust relief
7 Screw, baffle to drive shaft housing
8 Gasket, drive shaft housing to bottom cowl
9 Nut, powerhead studs
10 Screw, gear housing to drive shaft housing
11 Stud, drive shaft housing to gear housing
12 Nut, gear housing and drive shaft housing studs
13 Rod, push - reverse lock
14 Pin, reverse lock lever
15 Cotter Pin, push rod
16 Spring, tension - push rod
17 Lever, reverse lock
18 Mount, rubber - upper
19 Cover, upper mount - outside half
20 Cover, upper mount - inside half
21 Packing, "U" cup
22 Washer, upper mount stud (17/32 ID)
23 Washer, rubber - upper mount stud
24 Spacer, upper mount stud
25 Washer, upper mount stud (13/32 ID)
26 Nut, upper mount stud
27 Cap, rubber - upper mount
28 Screw, upper mount cover (1 ½")
29 Screw, upper mount cover (2")
30 Washer, mounting cover screw
31 Nut, mounting cover screw
32 Mount, rubber - lower
33 Washer, rubber - lower mount
34 Washer, lower mount
35 Washer, mounting screw
36 Nut, mounting screw
37 Screw, lower mount (5 1/2")
38 Bumper, rubber - mounting screw
39 Cover, lower mount
40 Washer, lower mount cover screw
41 Screw, lower mount cover fastening
42 Plug, grease - reverse lock hole

| 6-CYL. DIRECT REVERSING LEFT HAND ROTATION

NOTE: For removal and disassembly of ignition, carburetors, fuel filters, fuel pumps, electrical starter parts and starter, see appropriate sections.

Disassembly

Models - Merc 600 & Mark 78-78A-75-75A Non-gearshift type for forward and reverse operation

A. Disassembly of Lower Unit

Remove 2 hexagon head lock nuts holding gear housing assembly to drive shaft housing (on leading edge), two ¾" cap screws located in center of anti-cavitation plate and ¾" cap screw located on the rear, inside exhaust outlet. After the above nuts and cap screws are removed, the lower gear housing assembly can be pulled off the drive shaft housing.

At this time lash between gears should be checked for future reference. Pull on drive shaft and push on propeller shaft. Refer to back lash later, in Para. "A" of Reassembly.

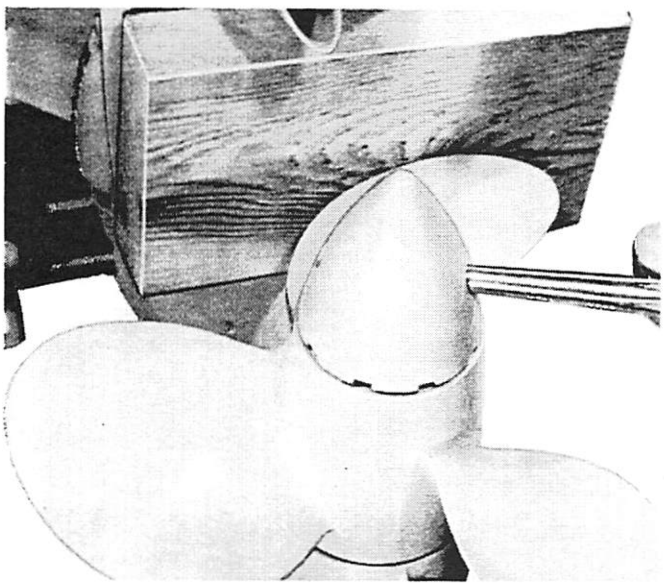


Figure 1. Removing & Installing Propeller Nut

B. Disassembly of Gear Case

Mount gear housing assembly in vise between two blocks of soft wood to prevent marring of gear housing. Remove propeller by driving tabs on tab washer flat against propeller hub and remove propeller nut. A long piece of round steel can be inserted in hole of propeller nut to remove. (Figure 1) *(Note: Check gear back lash by pushing on drive shaft with one hand and pulling on propeller shaft with other. Refer to lash when shimming in "Reassembly" under "NOTE" on bottom of Page 41.)* Remove gear case cover with Gear Case Cover Tool C-91-26374A1. Place tool over end of propeller shaft and set dowels of tool into gear case cover, turning clockwise to loosen (left hand thread). (Figure 2) If tight, strike handles of tool with mallet to loosen.

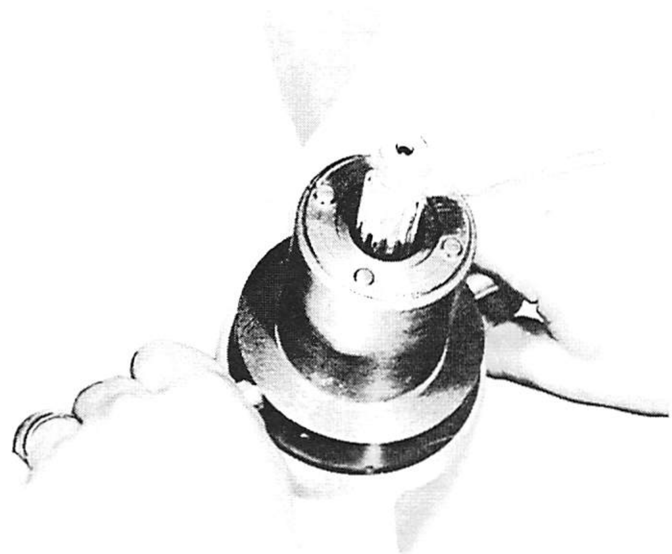


Figure 2. Removing & Installing Gear Housing Cover

Oil seal bearing housing can be removed when removing propeller shaft assembly. To remove the propeller shaft assembly, remove gear housing from vise and place propeller shaft in vise between two pieces of soft wood and tap lightly on skeg of gear housing with mallet until the propeller shaft assembly is removed. (Figure 3) Remove shims as required from gear housing bearing seat. Wash gear housing and parts to remove grease.

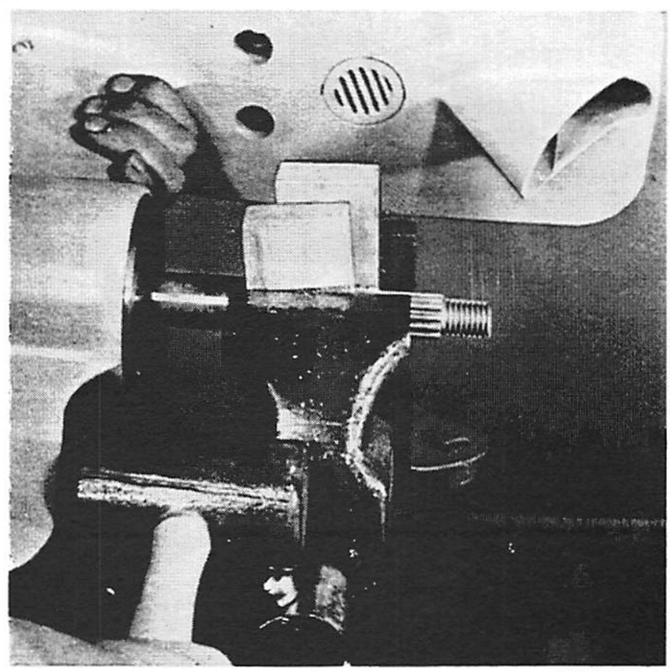
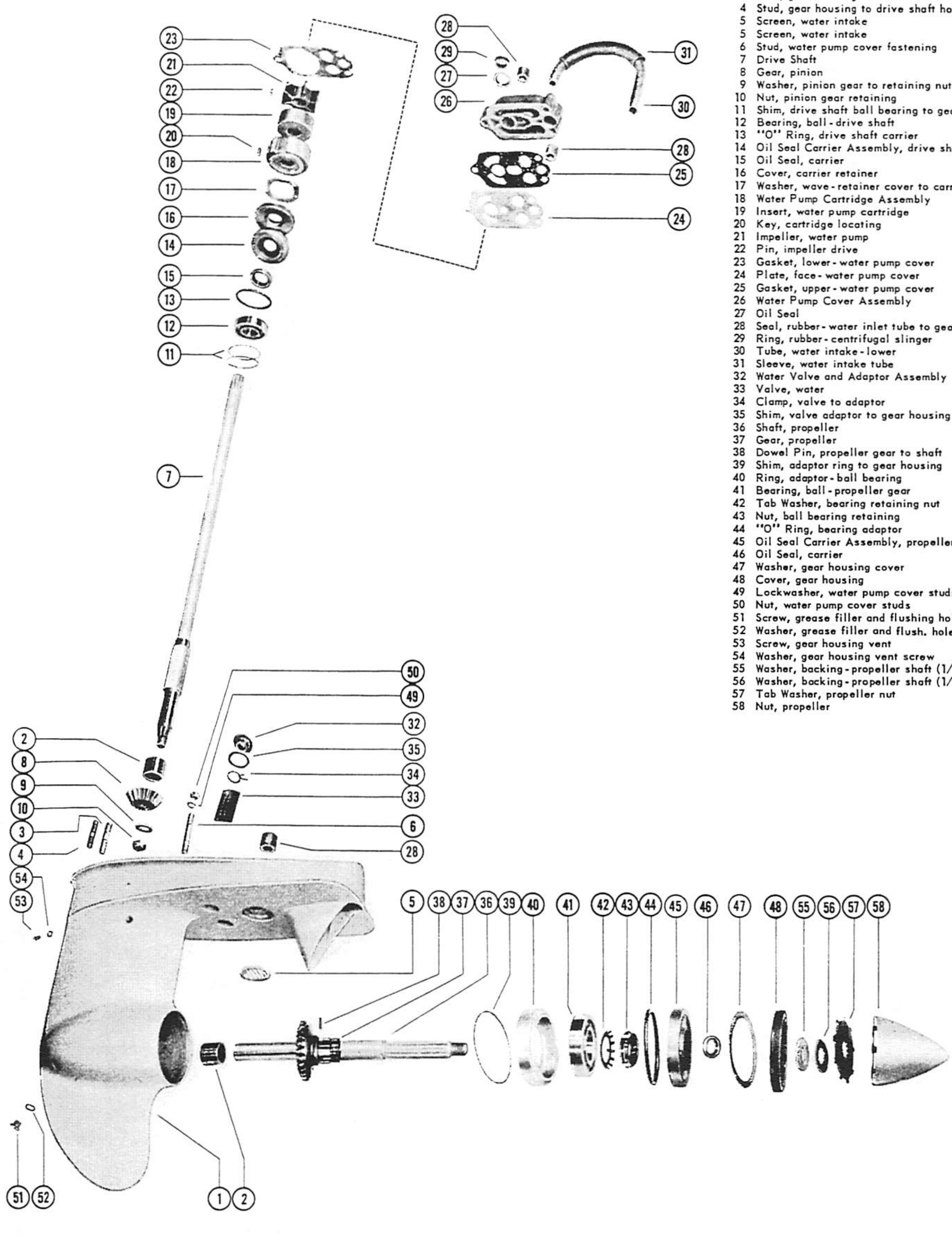


Figure 3. Removing Propeller Shaft Assembly



1 Gear Housing
2 Bearing, roller - propeller and drive shaft
3 Stud, gear housing to drive shaft housing
4 Stud, gear housing to drive shaft housing
5 Screen, water intake
5 Screen, water intake
6 Stud, water pump cover fastening
7 Drive Shaft
8 Gear, pinion
9 Washer, pinion gear to retaining nut
10 Nut, pinion gear retaining
11 Shim, drive shaft ball bearing to gear hsg.
12 Bearing, ball - drive shaft
13 "O" Ring, drive shaft carrier
14 Oil Seal Carrier Assembly, drive shaft
15 Oil Seal, carrier
16 Cover, carrier retainer
17 Washer, wave - retainer cover to carrier
18 Water Pump Cartridge Assembly
19 Insert, water pump cartridge
20 Key, cartridge locating
21 Impeller, water pump
22 Pin, impeller drive
23 Gasket, lower - water pump cover
24 Plate, face - water pump cover
25 Gasket, upper - water pump cover
26 Water Pump Cover Assembly
27 Oil Seal
28 Seal, rubber - water inlet tube to gear hsg.
29 Ring, rubber - centrifugal slinger
30 Tube, water intake - lower
31 Sleeve, water intake tube
32 Water Valve and Adaptor Assembly
33 Valve, water
34 Clamp, valve to adaptor
35 Shim, valve adaptor to gear housing
36 Shaft, propeller
37 Gear, propeller
38 Dowel Pin, propeller gear to shaft
39 Shim, adaptor ring to gear housing
40 Ring, adaptor - ball bearing
41 Bearing, ball - propeller gear
42 Tab Washer, bearing retaining nut
43 Nut, ball bearing retaining
44 "O" Ring, bearing adaptor
45 Oil Seal Carrier Assembly, propeller shaft
46 Oil Seal, carrier
47 Washer, gear housing cover
48 Cover, gear housing
49 Lockwasher, water pump cover studs
50 Nut, water pump cover studs
51 Screw, grease filler and flushing hole
52 Washer, grease filler and flush. hole screw
53 Screw, gear housing vent
54 Washer, gear housing vent screw
55 Washer, backing - propeller shaft (1/8)
56 Washer, backing - propeller shaft (1/32)
57 Tab Washer, propeller nut
58 Nut, propeller

Mark 78A Gear Housing and Drive Shaft

Disassemble propeller shaft assembly by first removing snap ring with Snap Ring Pliers (91-24283) and then shims as required.

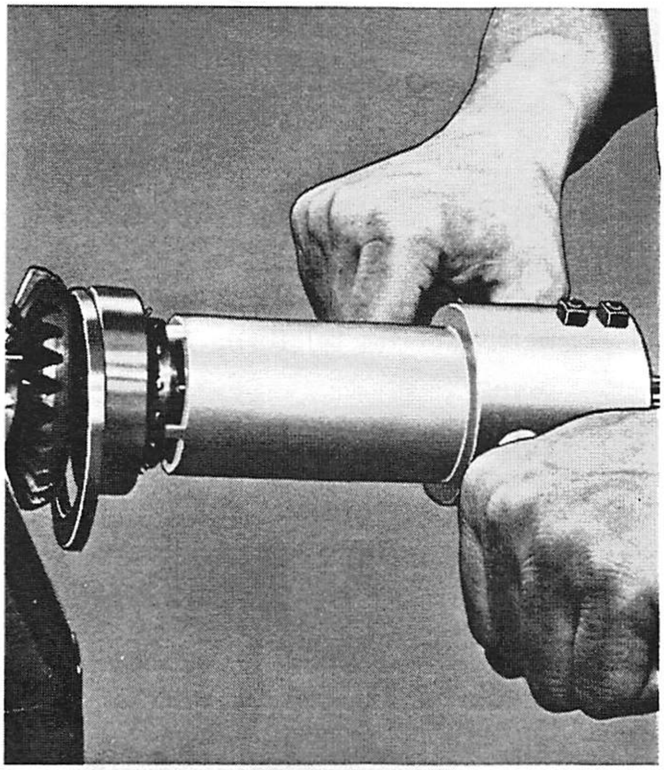


Figure 3A. Removing & Installing Gear Lock Nut

NOTE: On later models, the ball bearing is held securely in position by a special nut threaded on the gear. To remove, bend down lock tabs in gear lock nut recess. Place Propeller Gear Lock Nut Tool (91-29925A1) over propeller shaft, setting tangs of tool into recesses of nut and remove (right hand thread; left hand on those stamped "LH"). (Figure 3A) Lift locking tab off.

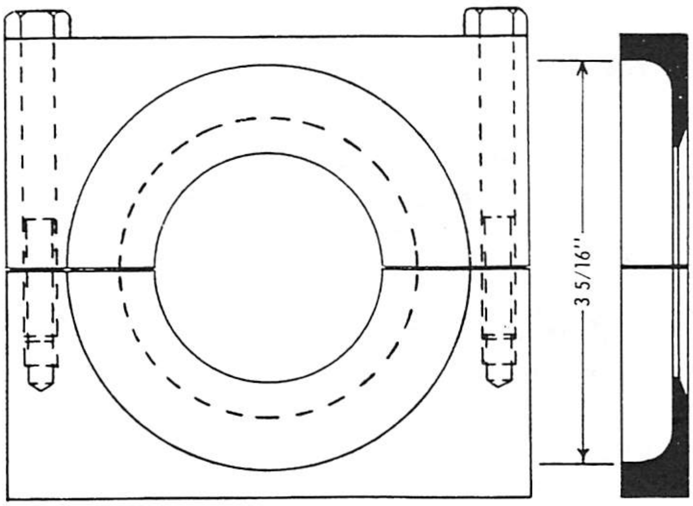


Figure 4. Puller Plate, 3-5/16" Diameter Recess

Puller plate (91-22115) has been reworked to increase inside diameter of recess from 3-1/16" to 3-5/16". (See Figure 4 for rework.)

Gear drive pin in propeller shaft will drop out, as it is held in place by ball bearing. If, for any reason this pin is tight, it may be necessary to drill it out. On later models, the gear has 2 holes for the drive pin, one on each side. Remove drive pin from the gear and propeller shaft from opposite side with a 1/8" drift punch. Remove ball bearing from retainer. Remove propeller shaft gear with closed end of Universal Propeller Shaft Gear Tool (91-26376A1). Use the correct tool collar with the small recess set on top of the gear tool cup (closed end up) when removing the gear. Set threaded end of propeller shaft into small bore of tool cup until gear shoulder rests on it and press off with arbor press. (Figure 5)

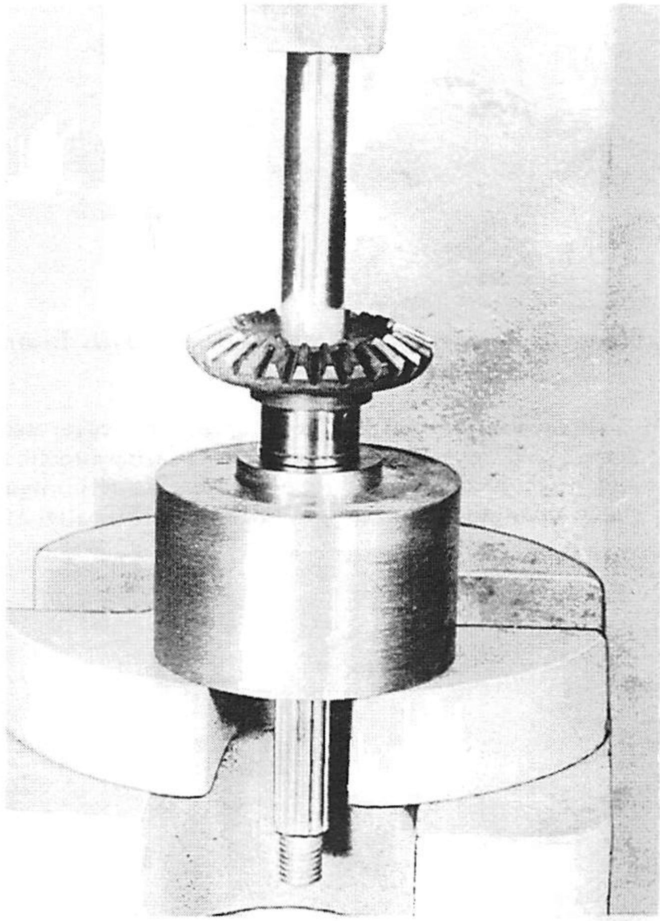


Figure 5. Removing Propeller Shaft Gear

C. Remove Water Pump Housing and Cartridge

Replace gear housing in vise in upright position with skeg held between blocks of wood. Remove inlet water tube and outlet water tube from water pump housing and centrifugal slinger from drive shaft. Remove water pump housing cover assembly by removing the 3 elastic stop nuts which secure it to the gear housing. Lift off water pump housing, gasket, steel outlet plate and another gasket. Lift check valves and shims from recess in gear housing. Remove water pump impeller and impeller pin by prying impeller out with 2 screw drivers. Water pump cartridge has a loose fit and can be removed by prying out. Remove water pump cartridge sealing ring and wave washer from gear housing shoulder.

D. Removal of Drive Shaft

Place drive shaft in vise as close to gear housing as possible and, with box end wrench, remove 3/4" elastic stop nut from drive shaft to free pinion gear from end of drive shaft. Pinion gear is now loose. Replace gear case skeg in vise between blocks of wood in upright position.

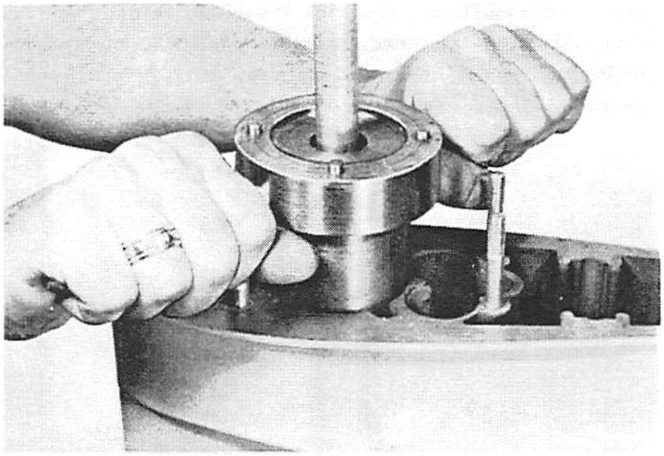


Figure 6. Removing and Installing Drive Shaft Bearing Retainer Cover

Remove drive shaft ball bearing retainer cover using Gear Case Cover Tool 91-26374A1. Turn counterclockwise (right hand thread) to remove. (See Figure 6.) Again place drive shaft in vise and, with rawhide mallet, tap

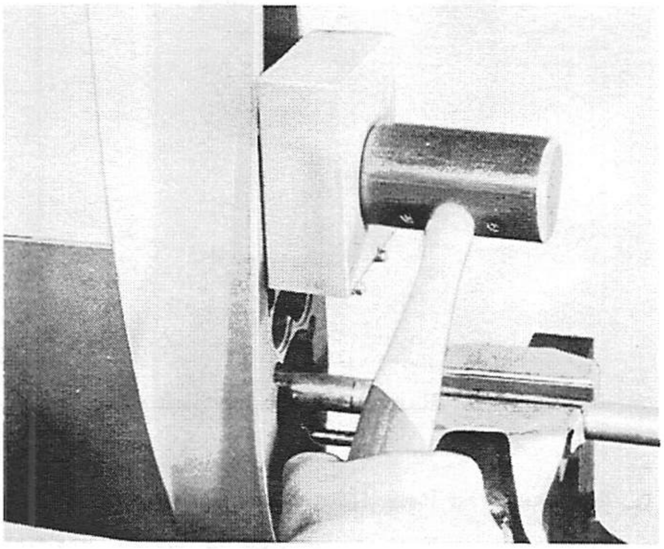


Figure 7. Removing Drive Shaft from Gear Housing

firmly against top of gear housing in order to remove drive shaft from gear housing. (See Figure 7.) The ball bearing, shim and bearing retainer will be removed along with the shaft from housing. The pinion is now free of drive shaft. Remove ball bearing from drive shaft by replacing against open vise jaws, tapping on end of drive shaft to remove. (See Figure 8.)

NOTE: Gear housing contains needle bearings for the propeller shaft and drive shaft. To remove drive shaft needle bearings, use Needle Bearing Tool 91-24288A1 with long tool sleeve 91-26377.

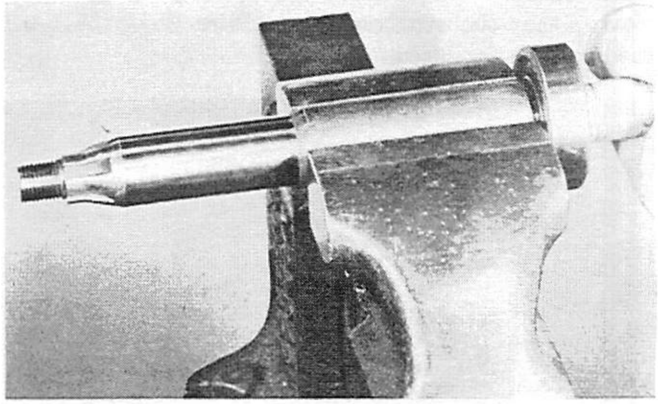


Figure 8. Removing Ball Bearing from Drive Shaft

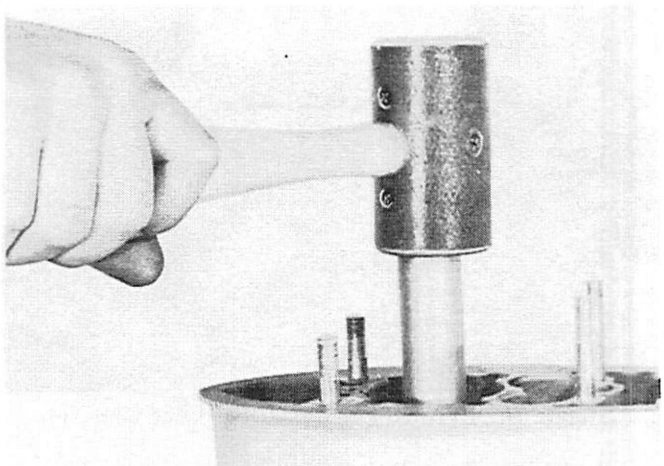


Figure 9. Removing and Installing Drive Shaft Needle Bearing in Gear Housing

Place mandrel in drive shaft end cavity of gear housing, placing guide and sleeve on mandrel before installing. Press bearing out with arbor press or tap against tool with heavy mallet to remove bearing. (See Figure 9.)

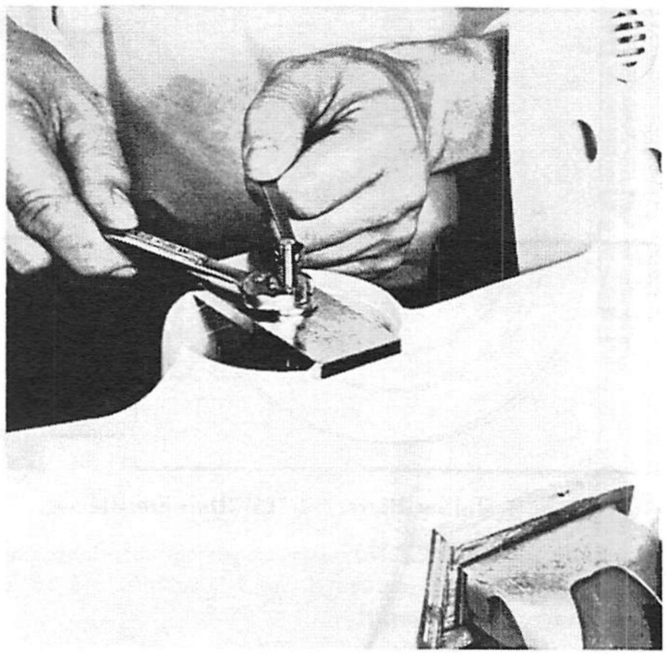


Figure 10. Removing Propeller Shaft Roller Bearing

To remove propeller shaft needle bearing, insert puller caps of Roller Bearing Puller (C-91-29312A1) inside roller bearing. After tool is in bearing, pull shaft up and tool caps expand and catch bottom of bearing case. Place puller bar on shaft against gear housing and thread nut on shaft. Continue to tighten nut to pull bearing out. (Figure 10)

NOTE: If Roller Bearing Puller is not available, pack bearing with heavy cup grease, place bearing Mandrel (C-91-24288) with sleeve (C-91-26377) in bearing and strike mandrel sharply with heavy mallet several times to force bearing out.

This completes disassembly of gear housing. All parts now should be washed in cleaning solvent and inspected for wear.

Reassembly - 6-Cyl. Direct Reversing L.H. Rotation

NOTE: Refer to Page 2, this Section, prior to reassembly

A. Reassemble Lower Gear Housing

Install propeller and drive shaft roller bearing cartridges into gear housing with mandrel tool (needle bearing) C-91-24288A3 and tool sleeve C-91-26377. For easy installation, always press against numbered side of a cartridge type bearing, as opposite end has a greater radius. Press drive shaft needle cartridge bearing in until bearing is recessed evenly on shoulder between upper drive shaft cavity and gear cavity. Press propeller shaft cartridge bearing in until it bottoms. Place gear housing in vise between 2 blocks of soft wood at thin section of gear housing so that gear cover end is up. Lubricate needle bearings in gear housing and replace shims which were originally removed or insert .005" (.127mm) shim on drive shaft bearing seatl Install ball bearing on drive shaft by sliding bearing over drive shaft to seat on shoulderl Tap ball bearing onto drive shaft bearing shoulder by placing shaft in vise loosely.

Insert drive shaft assembly into gear housing and drive ball bearing down into the seat in the gear housing. Replace oil seal in bearing retainer and insert neoprene sealing ring on shoulder of retainer. Install ball bearing retainer and bearing retainer cover. Shims may be required between ball bearing and gear housing shoulder to take up any end play. Tighten retainer cover securely with Gearcase Cover Tool C-91-26374A1.

Place pinion gear on end of drive shaft in gear housing and guide elastic stop nut onto threads on end of drive shaft by turning drive shaft with one hand while holding nut with other hand. Place drive shaft in vise and tighten elastic stop nut securely with 3/4" wrench.

Ready the propeller shaft and bevel gear by placing blank end of propeller shaft into shoulder end of gear. Be careful to place gear on shaft so that the gear teeth will mesh properly with companion pinion gear. Align hole in propeller shaft and gear with steel rule. Place teeth down on Universal Propeller Shaft Gear Tool C-91-26376A1 (use opposite of tool's open end to install gear). Place correct tool collar on top of gear tool in recess. Lubricate shaft and press in with arbor press until hole in gear aligns with hole in propeller shaft.

Place gear drive pin in aligned holes of propeller shaft and gear to lock to shaft.

Set shims as required on shoulder of gear. Press ball bearing into ball bearing retainer. Place recessed end of correct tool collar up on closed end of Universal Propeller Shaft Gear Tool C-91-26376A1. Place ball bearing and retainer in position on end of propeller shaft gear, installing threaded end of propeller shaft through small hole in cup so gear shoulder will set in recess of collar. Press down with arbor press until ball bearing is tight against gear. (Figure 11)

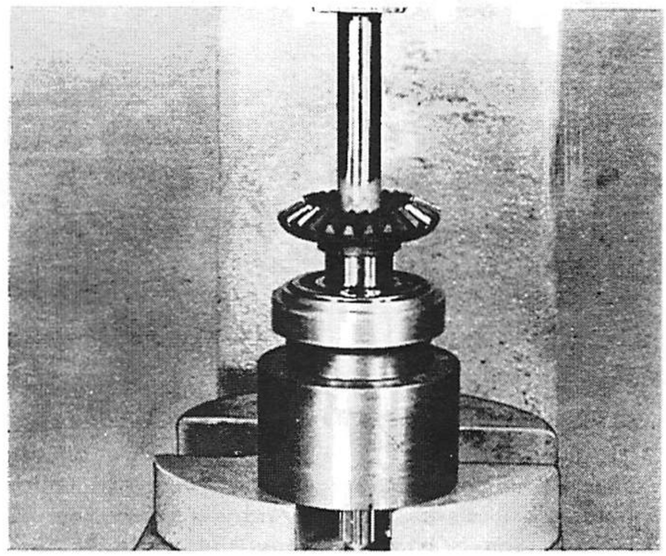


Figure 11. Installing Propeller Shaft Gear Ball Bearing and Retainer

Place shim, if required, against bearing and follow with snap ring, using Snap Ring Pliers C-91-24283 to spread snap ring onto gear lock ring. Be sure snap ring seats securely in groove on gear.

NOTE: On later models, place locking tab in position over gear with inner tab aligning in keyway on gear. Thread gear lock nut into position and secure with Gear Lock Nut Tool (C-91-29925A1). Tighten gear lock nut securely (do not strike tool to tighten) and bend 4 lock tabs into recesses on gear lock nut.

Replace shims as removed or required on shoulder within gear housing. Install completed propeller shaft and gear assembly into housing. Use mallet to tap the propeller shaft assembly in place. If tight, be careful that the entire assembly is centered, straight into the housing.

NOTE: At this point it is very important to check gear back lash of assembly. After drive shaft pinion gear and propeller shaft bevel gears have meshed, check back lash of assembly by pulling drive shaft outward and by applying pressure downward on propeller shaft assembly. Rotate drive shaft in a clockwise and *counterclockwise motion very lightly to feel gear lash. No more than .003" to .005" play should be allowed for proper operation. If more than the recommended back lash is present, remove shims beneath propeller shaft assembly to mesh gears properly. If too tight and no back lash is present, add a sufficient amount of shims for correct play and conical angle of gears.*

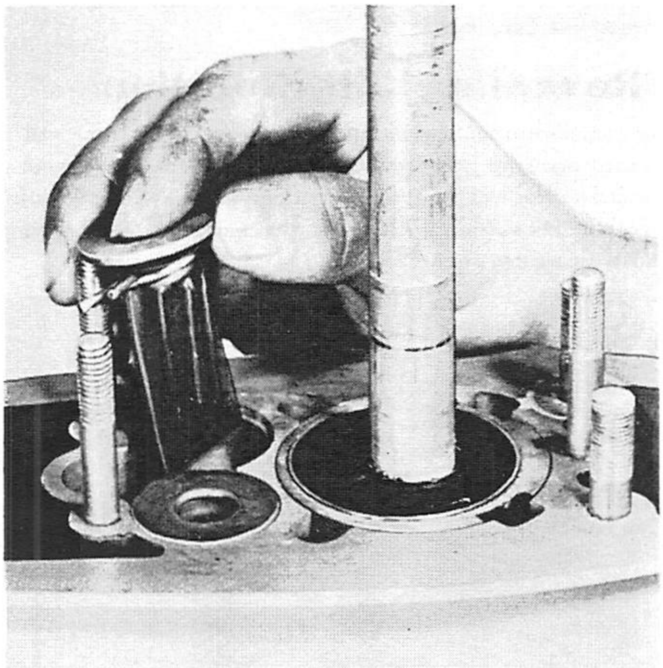


Figure 12. Installing Water Pump Check Valves

Install propeller shaft gearcase cover and tighten in place, (clockwise rotation) with Gearcase Tool 91-26374A1. (See Figure 2.) Dowels of tool fit holes in cover. Coat threads of cover with fine coat of DC4 Compound (92-24108) to facilitate easy removal. Check that there is no end play in propeller shaft by pressing on end of propeller shaft. Again check for correct back lash (.003" and .005"). If incorrect, the propeller shaft assembly must again be removed and the correct amount of shims either removed or added to make up for proper tolerence.

Assembling Water Pump Cartridge: Place wave washer and water pump cartridge sealing ring in gear housing on drive shaft ball bearing retainer. Before placing water pump cartridge into housing, place coat of lubricant on outer surface of water pump cartridge for easier possible future removal. Slip cartridge over shaft, being careful to align square keyway with keyway inside gear housing. Insert key into keyway after cartridge has been set into place. Coat flat surface of drive shaft with grease and set impeller key on flat parallel to shaft so groove in impeller will slide over key and be held to drive shaft. Press down on impeller blades with thumbs to seat impeller on bottom surface of cartridge. Rotate drive shaft in both directions to be sure key is in proper position driving impeller.

B. Replace Water Pump Housing

Be sure to inspect the neoprene water valves and adaptors for damage, replacing if necessary. The water valve adaptors must be installed so that flat sides are together. (Figure 12) Use shims beneath adaptors to bring flush with top surface to form good seal.

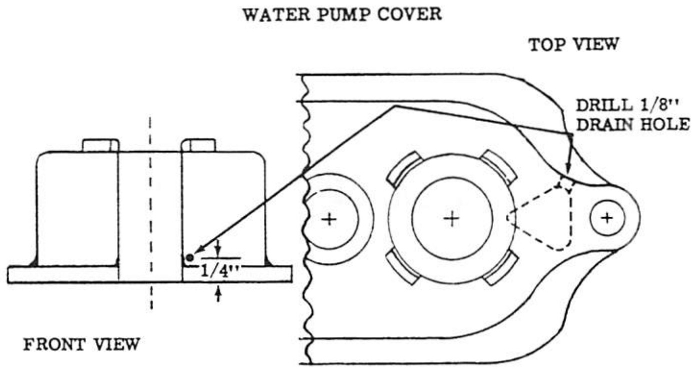


Figure 13. Drill Hole in Water Pump Cover

Water pump covers for Mark 78-78A-75-75A engines should be checked at this time for new 1/8" drain hole (Figure 13), and gear housing should be inspected for enlargement of drain holes (Figure 14). If not completed, drill holes, as shown, to prevent water from freezing in the chamber, which possibly could force the water pump cover gasket out of place and distort the water pump cover face plate. Either could cause loss of pumping pressure and result in engine overheating. In addition, enlargement of gear housing drain holes will prevent possible clogging from sediment.

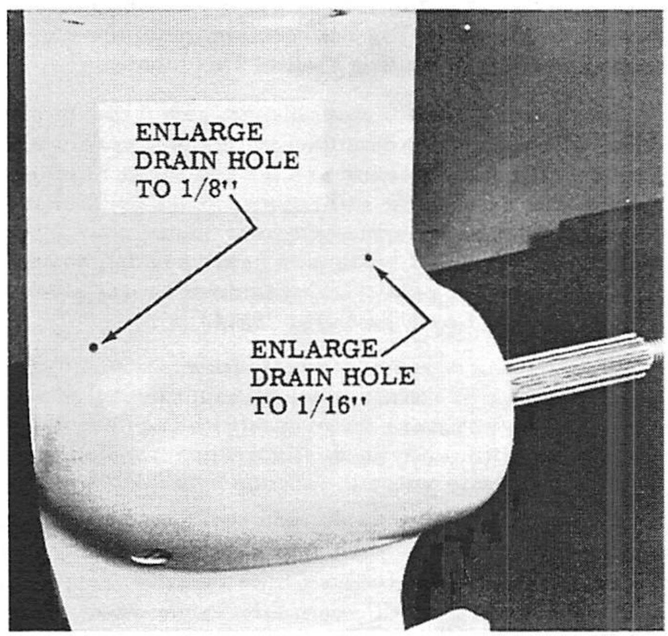


Figure 14. Enlarging Holes in Gear Housing

Replace water pump housing gasket, stainless steel plate, second gasket and water pump housing, securing with 3 cap screws. (Figure 15) Slide centrifugal slinger over drive shaft until seats against water pump housing. Check water pump intake screen louvers in gear housing so that they are at the right angle, slanting in toward gear housing, to pick up water flow. Water is picked up in the tube extending from intake hole to intake of water pump housing hole nearest drive shaft. Outlet line extends from hole at rear lip to powerhead. (Figure 15)

C. Joining Gear Housing and Drive Shaft Housing

1. Before joining housings, coat water inlet tube upper end with MULTIPURPOSE Lubricant (92-30239) so that it will slip easily into rubber seal in bottom cowl and insert into bottom cowl.

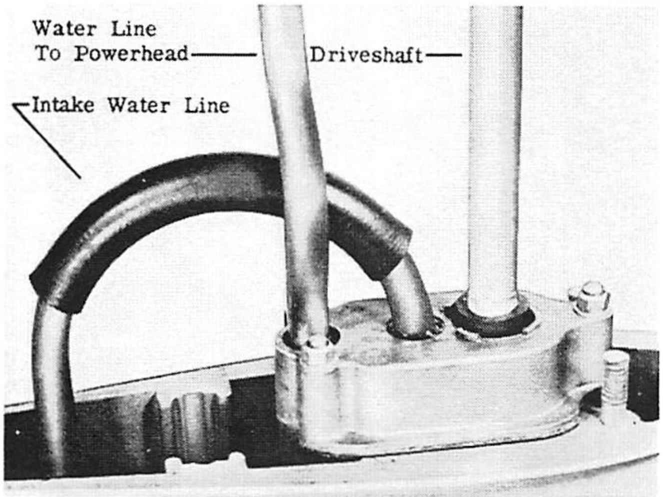


Figure 15. Water Pump Cover Assembly Mounted with Waterlines Installed

2. Place light coat of MULTIPURPOSE Lubricant on bottom end of water tube.
3. Place heavy coat of lubricant on drive shaft spline, then join gear housing and drive shaft housing by inserting drive shaft into drive shaft housing and drive shaft spline into crankshaft. Be careful that water inlet tube enters rubber seal in water pump cover in gear housing.
4. Rotate propeller shaft in either direction until drive shaft spline enters crankshaft spline.
5. With 2 housings joined, install and tighten 5 elastic stop nuts and one cap screw which hold assemblies together.

D. Lower Drive Unit Lubrication

1. Remove air vent screw, located on left side of gear housing, just underneath anti-cavitation plate. Never apply lubricant to lower unit without first removing this air vent screw, as the injected lubricant displaces air which must be allowed to escape, otherwise gear housing cannot be completely filled as required.

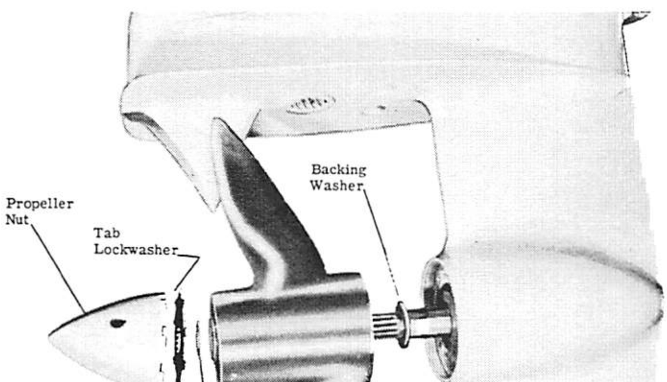


Figure 16. Installation of Propeller

2. Remove filler plug, located in lower left side of gear housing.
3. Insert lubricant tube into filler plug hole and inject lubricant until excess lubricant starts to flow out of air vent screw hole, indicating that housing is filled.
4. Replace air vent screw and filler plug, taking special care that gasket is in place under head of each so that water will not leak past threads into gear housing.

   IMPORTANT: Do not use regular automotive grease in lower drive unit. In an emergency, when Kiekhaefer EXTRA-DUTY Quicksilver Outboard Gear Lubricant (92-30295) is not immediately available, use best quality non-channeling waterproof marine gear lubricant.

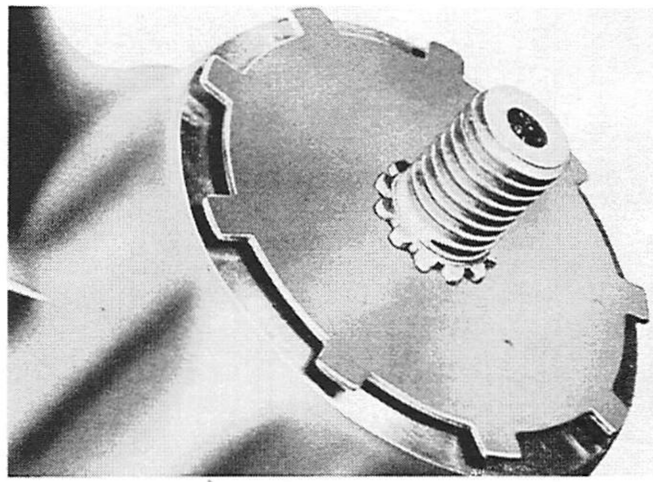


Figure 17. Splines of Tab Lockwasher over Splines of Propeller Shaft

E. Test Propeller

1. Use 48-28369 test wheel (48-26575 for Mark 75) while checking engine in test tank.
2. Before installing test wheel, first remove water pickup housing and gasket from under anti-cavitation plate.
3. When replacing water pickup housing, be sure to install a new gasket if old gasket is damaged.

   NOTE: Always be sure that test tank is kept clean to prevent clogging of engine's water intake.

F. Installing Propeller

1. Apply thin coat of MULTIPURPOSE Quicksilver Lubricant (92-30239) or waterproof grease on splines of propeller shaft, especially if operated in salt water to aid in removing at any future time.
2. Install 1/8" thick backing washer on propeller shaft. (Figure 16)
3. Install propeller, 1/32" thick backing washer, tab lockwasher (making sure that it fits correctly over splines, as shown in Figure 17) and install propeller nut in this order.
4. Place block of wood flat between propeller and anti-cavitation plate and tighten nut securely with large bar or punch. (Figure 1)
5. Bend tabs of lockwasher into propeller nut recesses, or propeller nut and propeller will back off.

TRANSMISSION REPAIR - - 2 CYL. MODELS

(Includes Water Pump, Drive Shaft, Trunnion Carrier & Input Drum Assembly)

Disassembly

I. REMOVING GEAR HOUSING ASSEMBLY AND PAWL CONTROL ASSEMBLY

To remove transmission assembly from drive shaft housing, first remove gear housing assembly. Remove transmission cover plate, which is secured to front edge of drive shaft housing by 3 cap screws. When removing cover, care should be exercised, as neutral and reverse pawl spring retaining pin, control pawl spring spacer and neutral and reverse pawl springs will be pushed out. (Figure 1) Assembly sets in this recess and is held in place by cover. Its purpose is to place a tension on reverse and neutral pawls. Remove elastic stop nut on drive shaft housing recess, as this nut secures forward gear housing stud.

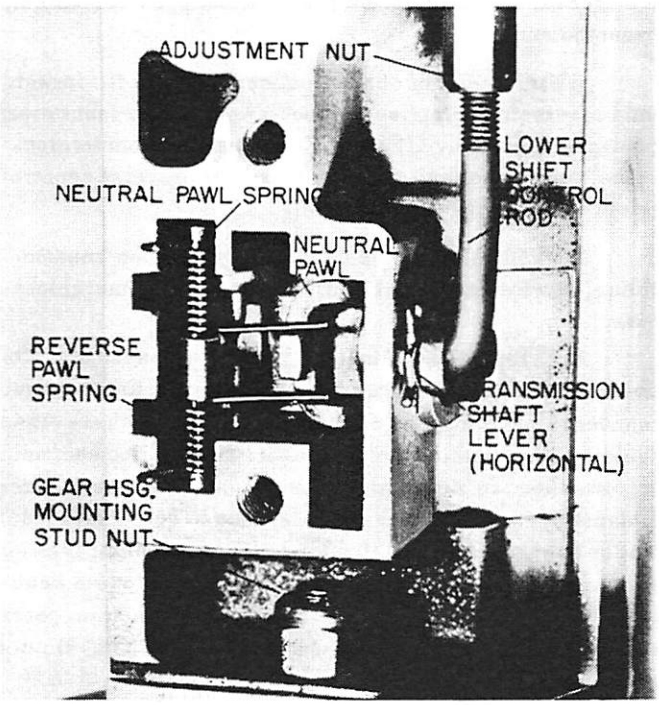


Figure 1. Transmission Cover Plate Removed

Remove 2 elastic stop nuts from underside of anti-cavitation plate of gear housing; one at radius of gear housing and anti-cavitation plate and one at rear of anti-cavitation plate.

Gear housing assembly now is loose from drive shaft housing and can be removed by tapping lightly against gear housing and pulling downward. Tension holding gear housing in drive shaft housing is caused by rubber "O" ring seal on gear housing pilot assembly which protrudes into drive shaft housing. (Figure 2)

II. REMOVING TRANSMISSION ASSEMBLY

Transmission assembly can be removed as one unit. Remove cotter pin and wave washer from lower control shift rod and turn transmission shaft lever up

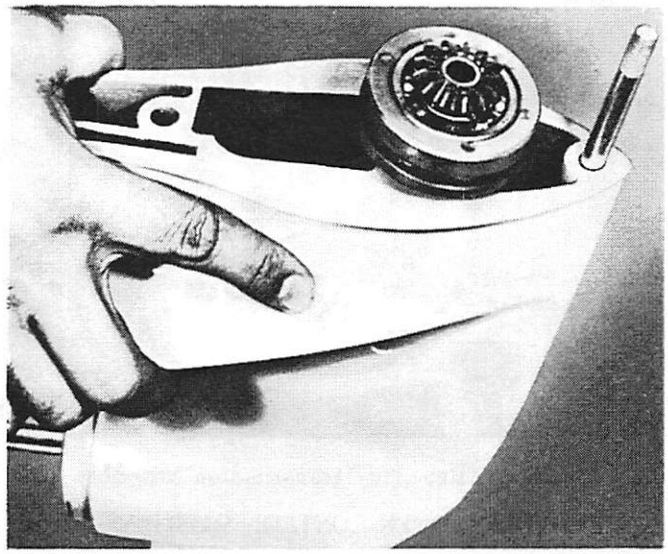


Figure 2. Gear Housing Removed

(vertical). This allows neutral and reverse pawls to be moved away from neutral spring and forward spring. (Figure 3)

If powerhead is removed, entire assembly can be removed by pushing down on drive shaft from the top. If powerhead is not removed, thread a long 10-32 screw into threads provided in trunnion carrier pilot shaft. With screw in position, place screwdriver in one of recesses on either side of trunnion carrier sleeve (Figure 4), holding both screwdriver and screw in one hand and pulling out lightly on assembly while turning flywheel or drive shaft in counterclockwise direction. This rotation allows neutral spring to unwrap itself from upper drive shaft assembly. Complete transmission assembly then is free from drive shaft and can be pulled out of drive shaft housing chamber. (Figure 4)

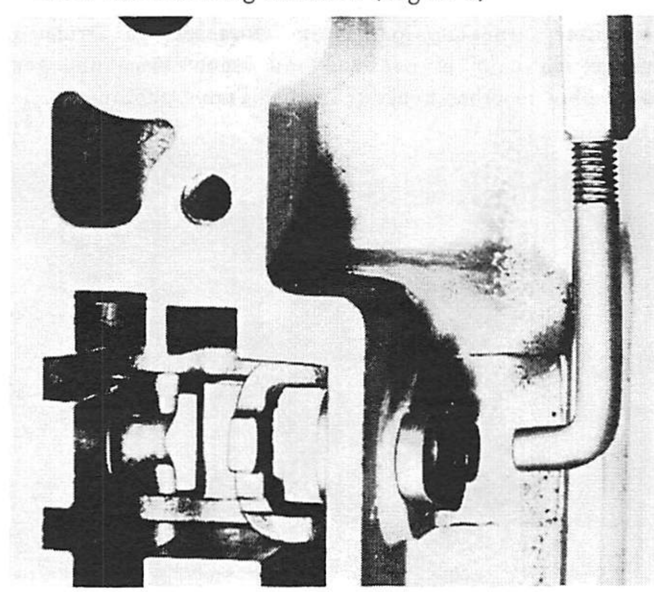


Figure 3. Transmission Control Shaft and Pawls

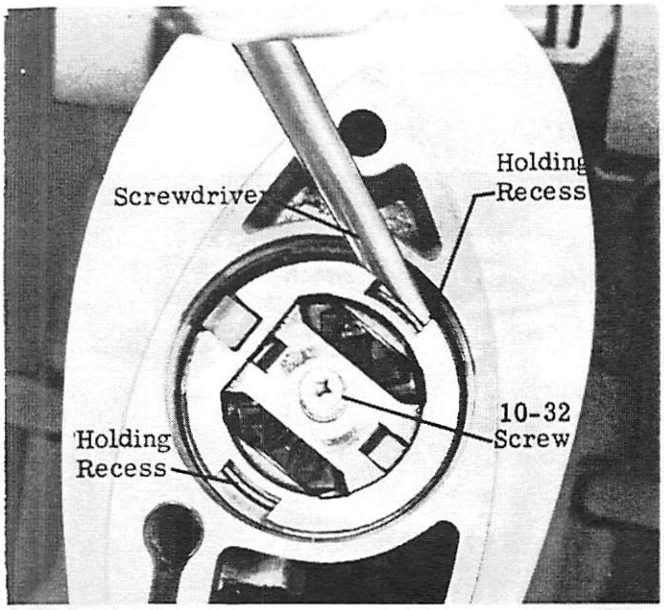


Figure 4. Removing Transmission Assembly

III. REMOVING LOWER CONTROL SHAFT ASSEMBLY

To remove transmission control shaft and pawls, make sure lever is still up. Pry out with screwdriver between lever and drive shaft housing in order to loosen transmission control shaft, as there is an "O" ring placed on end of shaft which is a grease seal. After control shaft has been moved out to where the "O" ring is visible, pull control shaft out completely by hand to allow neutral and reverse pawls to be free. Lift neutral and reverse pawls and pawl control shaft out of chamber.

IV. DISASSEMBLY OF TRANSMISSION

A. **Neutral Spring:** To remove neutral spring from input drum and gear assembly, turn neutral spring in counterclockwise direction and pull apart at same time. Do not stretch neutral spring excessively. (Figure 5)

B. **Reverse-Forward Spring:** To disassemble complete transmission, grasp shoulder of trunnion carrier in palm of one hand and input drum and gear assembly in other hand. (Figure 6) Turn trunnion carrier

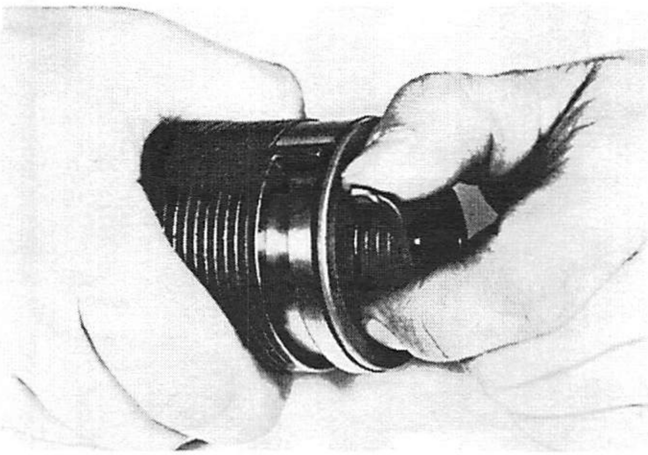


Figure 5. Removing and Installing Neutral Spring

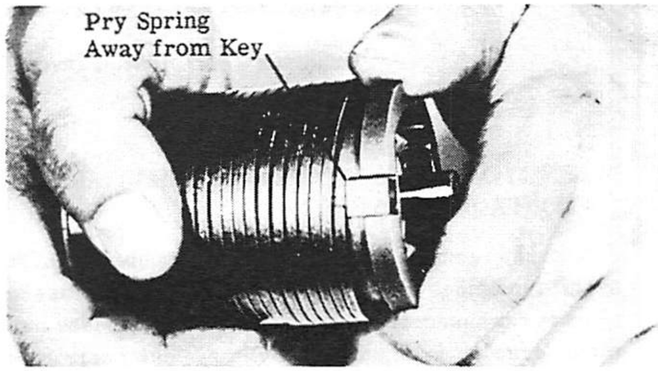


Figure 6. Removing and Installing Forward-Reverse Spring on Trunnion Carrier

in counterclockwise direction and pull apart at same time. This will loosen spring.

After initial loosening is noted, place screwdriver between shoulder of trunnion carrier spring catch key and pry up on end of spring to remove it from catch key recess, allowing spring to be unwrapped easier from trunnion carrier.

After trunnion carrier assembly is off, forward and reverse drive spring can be unwound from input drum and gear assembly. (Figure 7) By turning counterclockwise while holding spring securely, reverse control sleeve and spring will slide off.

IMPORTANT! When disassembling or reassembling, always turn parts of transmission counterclockwise.

C. **Trunnion Carrier:** Further disassembly of trunnion carrier can be accomplished by pulling trunnion carrier sleeve off and removing spring catch key and holding pin. Both have a loose fit. Press pilot shaft out of trunnion carrier with arbor press. To remove idler (planetary) gears, place Pin Bearing Tool (91-24144) in hollow trunnion shaft while placing trunnion carrier on surface to protect it. Press out 2 shafts (one on each gear) with arbor press. Idler gears and thrust washers are now loose and can be removed. (CAUTION! Do not tap out; use press only.)

NOTE: Bronze bearing will not be sold separately but will be part of trunnion carrier housing. If bearings are worn, replace trunnion carrier housing.

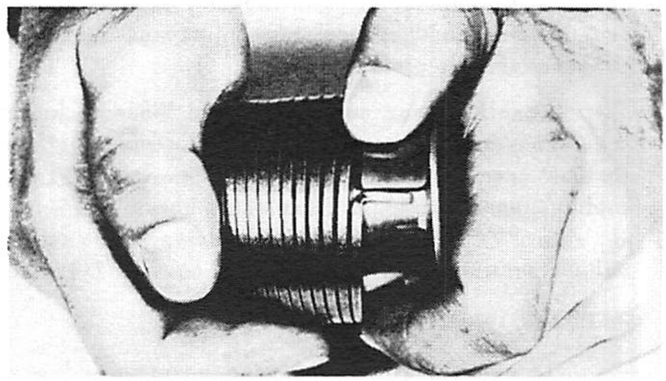


Figure 7. Removing and Installing Forward-Reverse Spring on Input Drum and Gear

V. DISASSEMBLY OF DRIVE SHAFT & WATER PUMP CARTRIDGE ASSEMBLY

A. **Drive Shaft Assembly:** Drive shaft can be removed without detaching water pump impeller and cartridge assembly by simply pushing drive shaft down from inside drive shaft housing. *(Note: Merc 200-150-100 drive shafts have a 10-32 tapped hole in lower end to faciliate removal of drive shaft without damage to either bushing or clutch drum surface. Any length of rod with 10-32 thread on one end will serve as a puller.)* Ball bearing ring lock need not be removed. Impeller pin is a special key pressed into drive shaft so that drive shaft can be replaced easily into impeller drive groove without disassembly or removal of water pump. Remove shims from shoulder of drive shaft to prevent losing.

B. **Water Pump Cartridge:** Water pump cartridge and drive shaft ball bearing are held in drive shaft housing by ball bearing lock ring. Remove lock ring with service tool 91-27532A1 by inserting drive end into recesses of lock ring and turning clockwise (left hand thread). (Figure 9)

Once lock ring is removed, water pump cartridge and impeller can be pulled down with Water Pump Puller (91-27780). *(Note: On later model Mark 28A-15A-10A and 2-cylinder Merc models, water pump cartridge is installed upside down. Impeller can be removed without removing water pump cartridge.)* Grasp puller tool so that, when squeezed together, tips of rods overlap and are at narrowest point. (Figure 10) Insert tool in side of drive shaft housing and into water pump cartridge until it bottoms. Release grip and tool ends will expand above cover plate. Pull down slightly and again squeeze together. Set tool lips below cover plate and allow to expand. Cover plate cannot be removed with cartridge and impeller, as it must be tilted to clear cartridge locating pin. Cartridge and impeller now can be pulled completely out of drive shaft housing. (Figure 11)

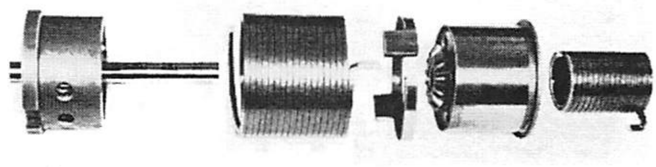


Figure 8. Automatic Transmission Disassembled

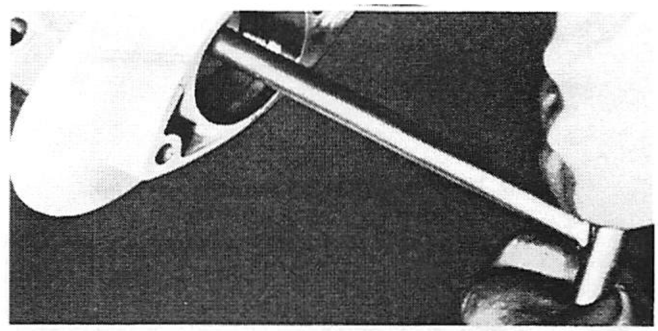


Figure 9. Removing & Installing Ball Bearing Lock Ring

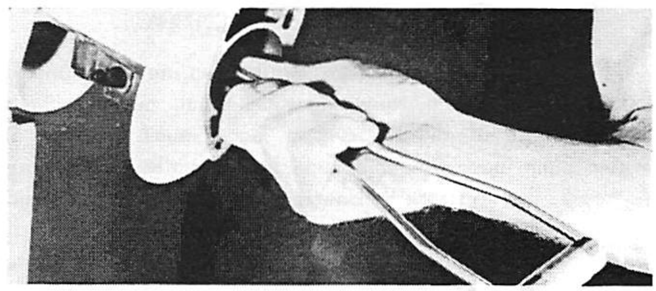


Figure 10. Inserting Tool

Figure 11. Pulling Cartridge and Impeller

Reassembly

I. DRIVE SHAFT & WATER PUMP CARTRIDGE ASS'Y

(Mark 28-28A Engines below Serial No. 1236090 and all Mark 10-10A-15A) (Merc Models and Later Mark 28A's, See Next Column.)

If water pump cartridge and impeller cover have been removed from drive shaft housing, reassemble water pump assembly by placing ball bearing, sealing ring "L" washer (shoulder up), rubber sealing ring (place on water pump cartridge shoulder), water pump cartridge and impeller on Water Pump Assembler Shaft Tool (91-28742A1). *(Note: Apply MULTIPURPOSE Quicksilver Lubricant [92-30239-1] on water pump cartridge and sealing ring so that it will not be damaged during installation and will provide easier removal.)* Attach end of Ball Bearing Ring Installation Tool (91-27532A1) on dowel of Water Pump Assembler Shaft Tool (Figure 12), tilt drive shaft housing and place impeller plate above locating pin in drive shaft housing. **(Water pump cartridge assembly is installed upside down in drive shaft housing on Merc models and Mark 28A engines, Serial No. 1236090 and up.)**

Place following parts, in order, on Water Pump Assembler Shaft Tool (91-28742A1):

1. Ball bearing, numbered side down
2. "L" washer, with flat surface against bearing
3. Sealing cover, with neoprene sealing ring and oil seal installed (lip faces impeller). Shoulder of cover faces bearing.
4. Impeller plate

Complete following steps before installing assembly:

1. Place impeller into water pump cartridge.
2. Place "O" ring on cartridge shoulder.
3. Apply MULTIPURPOSE Quicksilver Lubricant (92-30239-1) on "O" ring and outside of cartridge.
4. Set assembly over assembler shaft with open

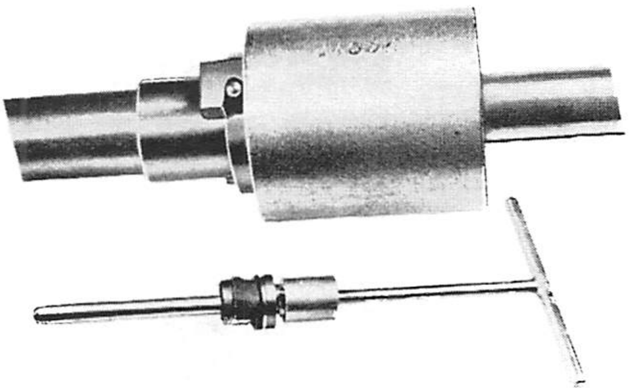


Figure 12. Water Pump Assembly on Tool

end of cartridge facing impeller plate. Note that new tool has 1/8" notch cut in to attach to Assembler Shaft, as shown in Figure 12. Older 91-27532A1 tools can be reworked.

5. Install Assembler Shaft Tool on Ball Bearing Ring Installation Tool (91-27532A1).

Install unit into drive shaft housing (Figure 13), being sure to align groove in water pump cartridge with locating pin at inside front of drive shaft housing in water pump cartridge chamber, then complete following:

1. Remove Ball Bearing Ring Installation Tool by turning away from dowel in Assembler Shaft Tool and leave Assembler Shaft Tool in place in housing.
2. With assembly in position, place ball bearing retainer lock ring cover on Ball Bearing Ring Installation Tool (91-27532A1) and secure in place (left hand thread; turn counterclockwise).
3. Tap impeller drive key in place in drive shaft recess.
4. Install shims (.002, .003, .010, .020, .030, .040), as removed on upper drive shaft.
5. Install drive shaft into drive shaft housing and water pump assembly, turning drive shaft lightly to locate keyway in water pump impeller, then push drive shaft in to seat.

II. TRANSMISSION

A. Trunnion Carrier: Set one thrust washer (ends recess in holes in housing) and idler gear (tooth angle end in to match companion gear) in place and press trunnion shaft in with Piston Pin Bearing Tool (91-24144). End of trunnion shaft must be flush with bronze bearing.

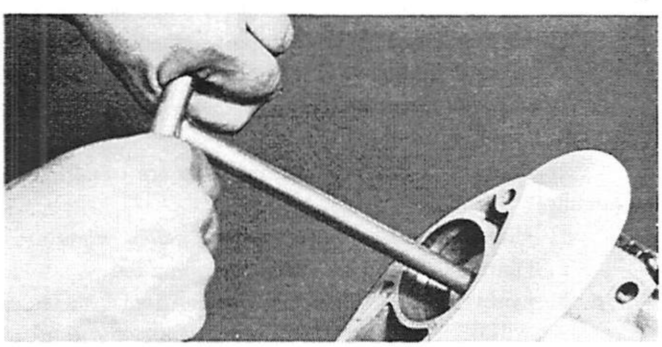


Figure 13. Inserting Assembler Shaft & Water Pump Assembly

Repeat procedure for opposite thrust washer and gear. Set pilot shaft into upper end of trunnion carrier (end opposite shoulder) with threaded hole end down. Align hole in side of pilot shaft with hole for spring catch key pin in carrier housing and push shaft until pin holes align. Use arbor press if necessary. Insert pin and catch key. Insert trunnion carrier sleeve over trunnion carrier and press down until seated with recess in sleeve over spring catch key.

B. Replacing Forward and Reverse Spring: Place forward and reverse spring on trunnion carrier assembly, inserting end opposite of trip finger. Turn in counterclockwise rotation (Figure 6) so spring unwraps itself and slides on easily. Turn down until spring end contacts spring catch key and is seated.

NOTE: Bottom ½ coil is spread apart to give spring a preload condition. Do not bend.

Next, place reverse control sleeve on input drum and gear assembly with lip down, away from shoulder. Set assembly on pilot shaft of trunnion carrier. Be sure

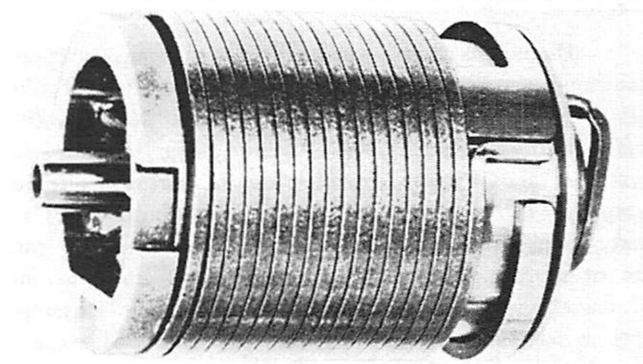


Figure 14. Transmission Assembly Ready to Install

thrust plate is in place. Turn input drum counterclockwise to install. Trip finger end of forward and reverse spring recesses (Figure 7) in slot provided in reverse control sleeve. Turn counterclockwise until unit is together. Now turn neutral spring in counterclockwise direction into input drum and transmission assembly is complete. (Figure 5)

III. SETTING END PLAY

Recommended transmission end play is .008" +.002"-.002". *(Note: When using Transmission Gauge 91-28987A1, this end play is obtained automatically!)* Since it is much easier and more accurate to measure a gap between slide and output gear, it is suggested that trial assembly be made with fewer shims than will ultimately be required. Shimming under pinion shaft ball bearing is determined by proper meshing of final drive gears and should not be altered in process of establishing correct transmission end play.

Assemble transmission into drive shaft housing. DO NOT include the two clutch springs, but DO include lower thrust washer. Remove forward stud from gear housing and center stud from drive shaft housing. After making sure that transmission is firmly seated, fit gauging tool into position with edge of gauge seated against lower face of drive shaft housing and open end of slide seated against transmission lower thrust washer. Tighten thumb screw in this position and recheck to be sure slide did not change position when screw was tightened.

After making certain that pinion shaft and gear housing pilot are firmly seated downward, place gauging tool on top of gear housing.

1. If a gap is measured between solid end of slide and top side of output gear (Figure 15), shims must be added between drive shaft and ball bearing equal to amount of gap.

2. If gap is measured between lower edge of template and upper face of gear housing, this amount of shims must be subtracted from drive shaft. (Figure 16) Be sure to equalize gap at each end of template.

3. If no gap appears at either point, transmission shimming is correct and should not be altered. (Figure 16)

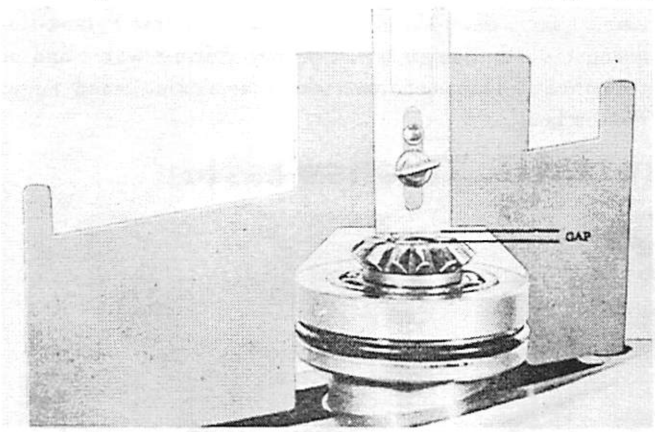


Figure 15. Shims Required

IV. INSTALLATION OF TRANSMISSION

Set large clutch retaining washer on shoulder of drive shaft to provide retainer for neutral spring. Set small bronze thrust washer in recess of input drum for thrust face to drive shaft. A thrust plate also must be placed on planetary gear end. *(Note: Engines with 27987A2 trunnion carrier assembly have 2 different size pilot shaft thrust washers. Upper thrust washer [12-29446] is .031" thick, while lower thrust washer [12-26661] is .020" thick. When reassembling transmission, be sure to replace shims, according to thickness, in correct location. [Figure 17] Mark 28 and Mark 10 models with 27009A2 trunnion carrier assembly have .020"*

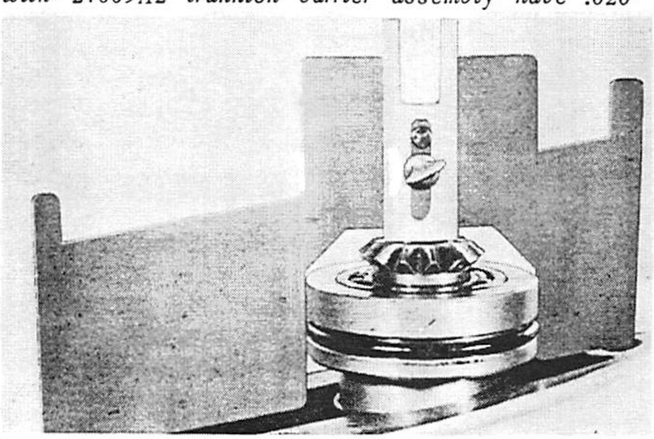


Figure 16. Correct Shimming

12-26661 thrust washer on both top and bottom of trunnion assembly.)

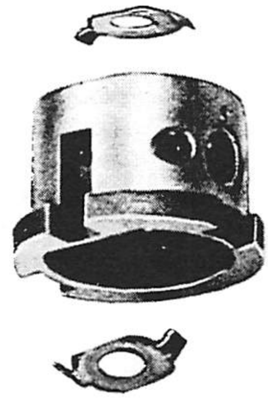


Figure 17. Location of Thrust Washer

Set complete transmission assembly, neutral spring end first, into drive shaft housing and push up against upper drive shaft. (Figure 8) Turn drive shaft or flywheel in counterclockwise rotation so that neutral spring will insert itself onto drive shaft drum. Again, complete transmission trunnion carrier assembly must be held with screwdriver in one of recesses on side and at same time push assembly up into place to seat. (Figure 4)

V. INSTALLATION OF LOWER CONTROL SHAFT ASSEMBLY

Replace neutral and reverse pawls on pawl control shaft in same sequence as when removed. (Figure 18) With control shaft in left hand, larger of 2 pawls is neutral pawl and is set on pawl shaft with arm facing toward assembly and with lever down. Reverse control pawl is placed on shaft below neutral pawl and lever is up toward neutral pawl. Place in recess in drive shaft housing so reverse pawl is held under neutral pawl.

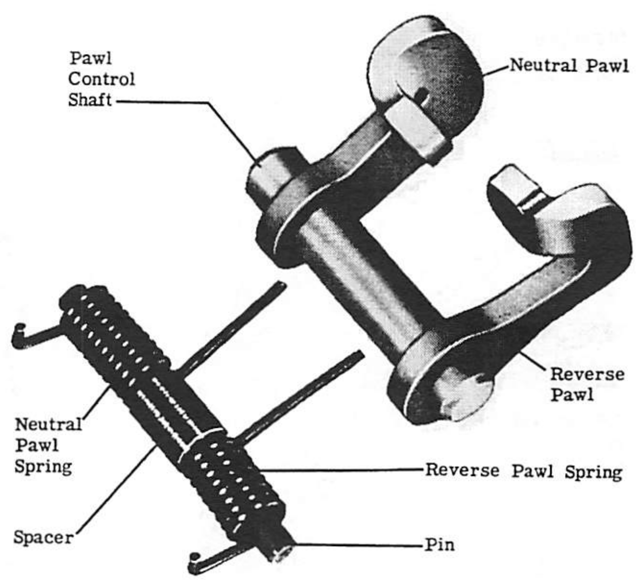


Figure 18. Neutral Pawl and Spring

Install transmission control shaft through drive shaft housing and note that lever of control shaft must be up in order for it to pass through between reverse and neutral pawls. "O" ring on shaft must seat inside drive shaft housing for seal. (Figure 3)

VI. INSTALLATION OF GEAR HOUSING ASSEMBLY COMPLETE

Place hollow dowel on rear drive shaft housing stud, insert gear housing assembly complete into drive shaft housing and fasten elastic stop nut onto forward stud which recesses on shoulder underneath transmission cover plate. (Figure 2) Place other 2 elastic stop nuts beneath anti-cavitation plate. Secure all 3 nuts. Replace pawl spring retaining pin, spacer and neutral and reverse pawl springs, longer of spring arms to bottom (reverse pawl). (Figures 1 and 18)

Set spacer on pawl spring retaining pin and set spring on shaft. While holding shaft in left hand, reverse pawl spring with long arm is set on shaft so spring arm end slides on first, facing right. (Figure 1) Neutral pawl spring arm slides on shaft first from other end of shaft. Set in recess in drive shaft housing, being certain that long spring arms are set in pawl notches. (Figure 1) Replace transmission cover with 3 screws and new gasket. Remove "vent" plug from transmission cover and grease plug from gear housing and refill with Kiekhaefer Quicksilver Outboard Gear Lubricant until lubricant flows out vent.

IMPORTANT: Be sure gasket is replaced and screws are tightened securely.

VII. ADJUSTMENT OF REVERSE & NEUTRAL PAWLS

While pressing against reverse and neutral pawls, locate center of neutral position of pawls. This should be with lever approximately straight out (horizontal). Set twist grip throttle in neutral position and adjust lower control shift rod in or out of adjustment sleeve (hex head) so that control shift rod will slide right in to transmission control shaft lever without moving it. (Figure 1) Place small wave washer on rod and insert lock pin from top of hole.

VIII. OPERATING IN TEST TANK

When testing or demonstrating in test tank, it is necessary that water level be up to lower dyna-float mount so that engine will properly prime water and not overheat. This condition does not exist when engine is on boat.

Cutaway Views of Automatic Transmission

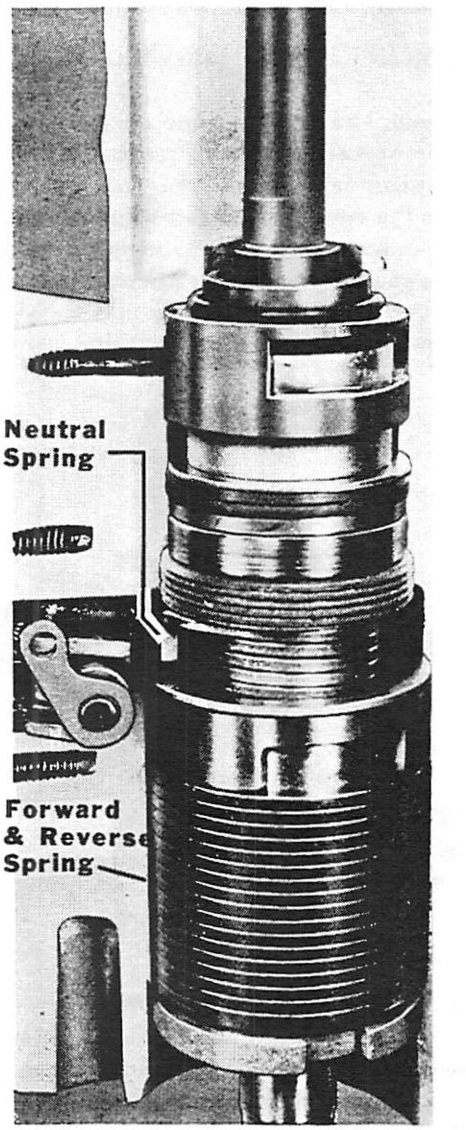


Figure 19. Forward Shift Position

Figure 20. Neutral Shift Position

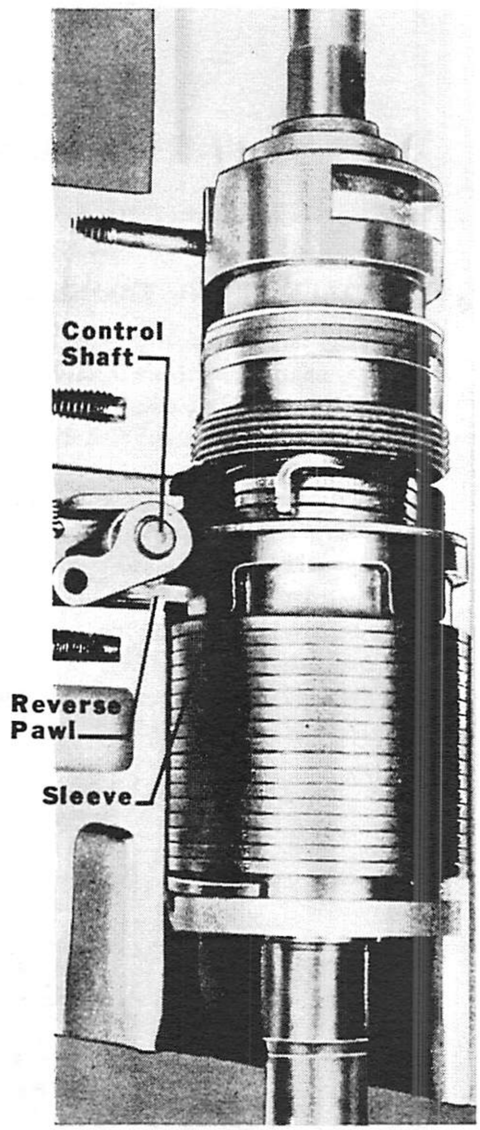


Figure 21. Reverse Shift Position

QUICKSILVER GEAR HOUSINGS
Mark 55H-40H-30H-20H & KG9H, KG7H, KF7HD, KG4H
Disassembly

A. Water Pump Assembly

1. Remove drive shaft housing cover plate and 2 hexagon nuts which hold gear housing to drive shaft housing.
2. Bend down lock tabs before removing nuts (one on leading edge, other on trailing edge) and separate housings.
3. At this time, lash between gears should be checked for future reference. Pull on drive shaft with one hand and push on propeller shaft with other. Refer to backlash later under "Note" on Page 48.
4. Place housing in vise between vise jaw protectors or 2 pieces of soft wood.
5. Remove gear housing cover cone with Quicksilver Water Pump Cover Tool (91-24117).
6. Place sleeve of tool over propeller shaft on A, B and C units.
7. Insert 2 tool pins into holes in cover.
8. Place body of tool over shaft so that notches rest over 2 tool pins. Use ½" drive sliding "T" wrench and turn clockwise (left hand thread) to remove.
9. Remove gear housing water pump cover cone by lifting out. Unit contains 2 needle cartridge bearings and 2 oil seals.
10. Remove top seal with screwdriver.
11. Press bearings and lower seal out with arbor press and following Bearing Mandrel Tool:

91-24273	*A, B and C Units*
91-24147	*D Units*

12. Remove impeller by prying up with pair of screwdrivers, being careful not to mar threads of gear housing cover nor damage impeller. Do not lose impeller key.
13. Thread 2 screws of Water Pump Cartridge Removing Tool (91-24120) evenly into cartridge.
14. Apply pressure to center screw of tool against propeller shaft by turning down with wrench. (Figure 1) When loose, remove water pump cartridge, neoprene seal and sealing ring.
15. Detach seal from cartridge by tapping out with screwdriver from inside of impeller housing.

B. Propeller Shaft Assembly

1. Remove propeller nut, tap out shear pin, turn gear housing cover off and remove propeller.
2. Place propeller shaft in vise between vise jaw protectors or 2 pieces of soft wood and tap lightly on skeg of gear housing with mallet or soft lead hammer until removed.
3. Remove shims, as required, from gear housing bearing seat.
4. Disassemble propeller shaft assembly by first removing snap ring with Snap Ring Pliers (91-24283), then shims, as required, and thrust washer, if required. (Figure 36 on Page 21)
5. Remove ball bearing from propeller shaft gear with Propeller Shaft Gear Tool from following chart. (Figure 37 on Page 21) After ball bearing is removed, gear drive pin will fall out of gear.
6. Remove gear from propeller shaft with closed end of Propeller Shaft Gear Tool, listed in chart following.

91-23663	*Mark 55H-40H & KG9H*
91-24716	*Mark 30H-20H & KG7H, KG4H*

7. Set threaded end of propeller shaft thru small bore of tool cup until gear shoulder rests on cup. It may be necessary to place a tool collar on cup to obtain desired support of gear.
8. Press off with arbor press. (Figure 38 on Page 21)

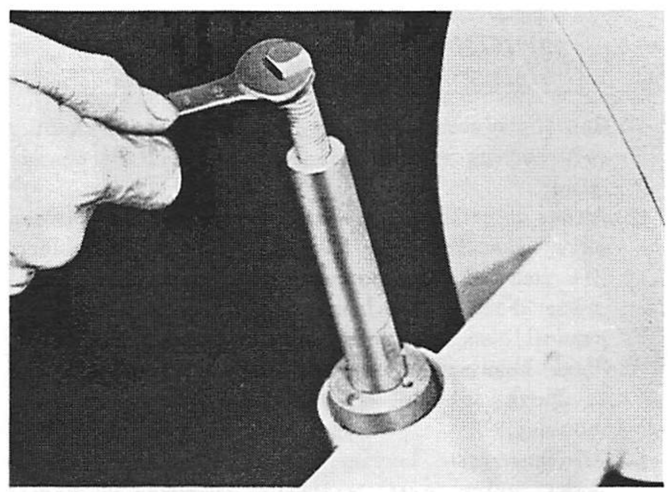


Figure 1. Removing Water Pump Cartridge

C. Drive Shaft Assembly

1. To remove pinion gear from drive shaft, place free end of drive shaft in vise to hold firm.
2. Bend tab washer up and turn screw or nut loose with wrench to remove both.
3. Tap end of gear housing with mallet and remove pinion gear from drive shaft and ball bearing. (Figure 39 on Page 21)
4. For removal of drive shaft ball bearing, place bearing against open vise jaws so that bearing can be driven off drive shaft with mallet.
5. Remove shim below bearing and pilot seal on top.
6. Gear housing contains needle bearings for propeller shaft and drive shaft. To remove drive shaft needle bearing, use the following Needle Bearing Mandrels:

91-24147	*Mark 55H-40H & KG9H*
91-24273	*Mark 30H-20H & KG7H, KG4H*

7. Install mandrel in drive shaft end of gear housing, placing guide on mandrel before installing.
8. Press bearing out with arbor press. (Figure 40 on Page 22)
9. To remove propeller shaft needle bearing, pack inside of bearing with heavy cup grease and use the following Needle Bearing Mandrels:

91-24147	*Mark 55H-40H & KG9H*
91-24715A1	*Mark 30H-20H & KG7H, KG4H*

10. Place small end of mandrel into bearing and strike mandrel sharply with mallet several times to force bearing out. If bearing is extremely tight, and above procedure is not effective, heat gear housing around bearing seat until bearing falls out.

(IMPORTANT: Do not overheat gear housing or it may be damaged.)

Reassembly

NOTE: Refer to Page 2, this section, "Part's Inspection - How to Check", prior to reassembly.

A. Drive Shaft Assembly

1. Install propeller shaft and drive shaft needle bearing cartridges in gear housing with following tools:

Propeller Shaft Needle Bearing Mandrels

91-24147	*Mark 55H-40H & KG9H*
91-24715A1	*Mark 30H-20H & KG7H, KG4H*

Drive Shaft Needle Bearing Mandrels

91-24147	*Mark 55H-40H & KG9H*
91-24273	*Mark 30H-20H & KG7H, KG4H*

2. Install drive shaft bearing from top of gear housing with bearing end of mandrel. Place collar on as guide.
3. Press in until bearing seats evenly spaced between drive shaft and gear housing cavity on shoulder.
4. Use mandrel from preceding chart to install propeller shaft needle bearing, placing small cup on mandrel, small diameter first. (Figure 42 on P. 24)
5. Place housing in vise between vise protectors or 2 blocks of soft wood at thin section of gear housing.
6. Oil inner roller bearing in gear housing and replace shims which were originally removed or insert .005" shim on drive shaft bearing seat.
7. Place ball bearing on drive shaft by tapping in place.
8. Set drive shaft assembly into drive shaft opening of gear housing.
9. Place pilot and oil seal assembly in top of gear housing until pilot and oil seal assembly is flush with top face of gear housing. *(Note: Lips of seal are toward drive shaft housing.)* Shim may be required between ball bearing and pilot seal assembly in order to bring flush with top of gear housing.
10. Use mallet to drive bearing and pilot assembly down. Pilot must fit tight, or it may leak.
11. Set lock tab washer on top of pinion gear and check that washer is set in inner splined area of gear so that it is properly locked.
12. While holding entire assembly upside down, place pinion gear on splined end of drive shaft in gear housing.
13. Guide retaining cap screw or nut onto end of shaft with needle-nose pliers and thread screw or nut on shaft by turning drive shaft by hand while holding.
14. Place drive shaft in vise and tighten cap screw securely with wrench.
15. Bend up lock tab.

B. Propeller Shaft Assembly

1. Ready the propeller shaft and bevel gear by placing blank end of shaft into rear shoulder of gear. *Be careful that gear is placed on shaft properly so that conical angle will mesh with companion pinion gear.*
2. Line up hole in shaft and gear with steel rule.
3. Place gear teeth down on Propeller Shaft Gear Tool taken from following chart, and use opposite of tool open end to install gear:

91-23663	*Mark 55H-40H & KG9H*
91-24716	*Mark 30H-20H & KG7H, KG4H*

4. Lubricate shaft and press in with arbor press.
5. Place gear pin in hole of propeller shaft and gear to lock to shaft.
6. Place ball bearing on gear shoulder and press down with arbor press until ball bearing is tight against gear.
7. Place shim spacer, if required, and thrust washer against bearing and follow with snap ring, using Snap Ring Pliers (91-24283) to spread snap ring onto gear lock ring.
8. Replace shims, as removed or required, on shoulder within gear housing. *(Refer to "NOTE" at end of Reassembly.)*
9. Install gear and propeller shaft assembly into housing. Use mallet to tap assembly in. *If tight, be careful that entire assembly is centered, straight in housing.* Tap unit until seated.
10. At this point it is very important to check gear backlash of assembly.
    a. After drive shaft pinion gear and propeller shaft bevel gears have meshed, try backlash of assembly by pulling drive shaft outward and by applying downward pressure on propeller shaft assembly.
    b. Turn drive shaft in a clockwise and counterclockwise motion very lightly to feel gear lash. No more than .003" to .005" play should be allowed for proper operation.
    c. If more than recommended backlash is present, remove shims beneath propeller shaft assembly to mesh gears properly.

d. If too tight and no backlash is present, add a proper amount of shims for correct play and conical angle of gears.
e. Recheck preceding for backlash after installing water pump and cover assembly as this may cause an undesireable pressure on gears.

C. Water Pump Assembly

1. Insert "L" washer into gear housing, resting on propeller shaft ball bearing, shoulder up.
2. Place neoprene sealing ring on pump cartridge and new internal oil seal in cartridge. *(Note: Lip of seal must be toward impeller housing.)*
3. Place water pump cartridge into housing by slipping over shaft, being careful to line up intake side (straight slotted) with water intake holes in bottom side of housing. *Curved slot in cartridge is outlet of pump. Cartridge remains in fixed position.*
4. Lubricate walls of cartridge and, with Water Pump Cartridge Tool (91-24102) centered over shaft, drive cartridge down with mallet until seated.
5. Coat flat surface of propeller shaft with grease and set impeller key on flat parallel to shaft so slot in impeller will slide over key and be held to shaft.
6. Press down on impeller blades with thumbs to seat impeller on bottom surface of cartridge. Rotate drive shaft so that key is in proper position to drive impeller.
7. Install new propeller shaft needle bearings in water pump cover cone with Propeller Shaft and Needle Bearing Tool, following:

91-24273	*A, B & C Units*
91-24147	*D Units*

8. Press oil seals in with lips of seals facing out at both ends.
9. Place water pump cover plate (stainless steel) in place on locating pin and insert cover cone over shaft to seal.
10. Apply 4 drops of Loc-Tite Sealer (92-32609) equally spaced on threads of gear housing cover and turn cover into housing by hand. (See "NOTE" following.)
11. Set pins of Water Pump Cover Tool (91-24117) into cover holes and tighten counterclockwise (left hand thread). (Figure 2) Torque cover to correct value. Refer to "Torque Specifications", Page 2B of Miscellaneous Section VIII.

NOTES 1. When ordering replacement old style "D" Quicksilver lower unit gear housing for Mark 40H or KG9H, also order 46-21587A1 water pump housing assembly which has more thread body to match new gear housing, thus affording better propeller shaft support and better gear housing cover engagement.

2. When replacing old-style bronze bushing water pump cover in old style "D" Quicksilver lower unit gear housing, order new water pump cover assembly 46-21894A1 which includes a new cover plate and has 1/32" taken off face to adapt new gear housing cover to old gear housing.

3. When repairing "D" Quicksilver lower unit which has 1603-233A1 gear housing assembly, use two 1/32" spacer washers (15-21884-2) at .031" in addition to regular shims.

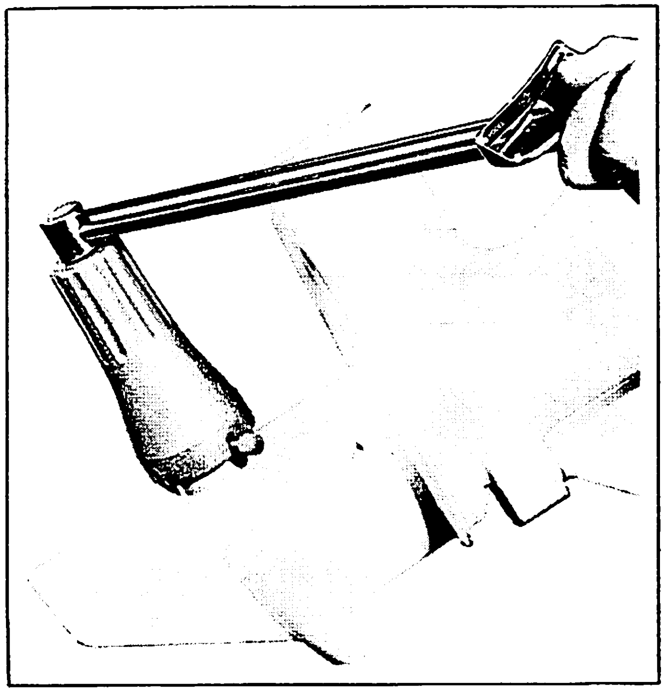


Figure 2. Tightening Water Pump Cover

D. Lubrication

1. Remove lubricant filler hole screw and washer and also air vent hole screw and washer. (Figure on Page 25)
2. Lubricate lower unit with Quicksilver Special Outboard Gear Lubricant (92-29415 or 92-29409). Fill until grease is released at top air vent opening.
3. Be careful when replacing filler and air vent screws that 2 fibre washers also are replaced, then tighten.

E. Installing Propeller

1. Slide propeller on propeller shaft.
2. Line up shear pin hole in propeller hub with shear pin hole in propeller shaft and insert shear pin thru hub into shaft.
3. Place washer and propeller nut on end of propeller shaft.
4. With protector on hand, hold propeller and tighten propeller nut securely, but not so tight that pin is sheared.

1 Gear Housing Assembly
2 Drive Shaft
3 Bearing, ball - drive shaft
4 Pilot and Oil Seal Assembly
5 Oil Seal
6 Shim, drive shaft bearing
7 Gear, pinion
8 Lockwasher, pinion gear locking nut
9 Nut, pinion gear locking
10 Shaft, propeller
11 Gear, propeller
12 Pin, propeller gear to shaft
13 Bearing, ball - propeller shaft
14 Shim, propeller shaft bearing (.003-5-10)
15 Ring, snap
16 Shim, propeller shaft gear (.002-3-5-10)
17 Washer, sealing - water pump cartridge
18 Seal, rubber - water pump cartridge
19 Water Pump Cartridge Assembly
20 Impeller, water pump
21 Key, impeller drive
22 Water Pump Cover Assembly
23 Bearing, roller
24 Oil Seal
25 Plate, water pump cover
26 Cover, gear housing
27 Washer, gear housing vent screw
28 Screw, gear housing vent
29 Washer, grease filler hole screw
30 Screw, grease filler hole
31 Stud, gear housing to d. s. hsg. (long)
32 Stud, gedr housing to d. s. hsg. (short)
33 Washer, gear housing studs
34 Nut, gear housing studs
35 Pin, shear
36 Washer, propeller nut
37 Nut, propeller

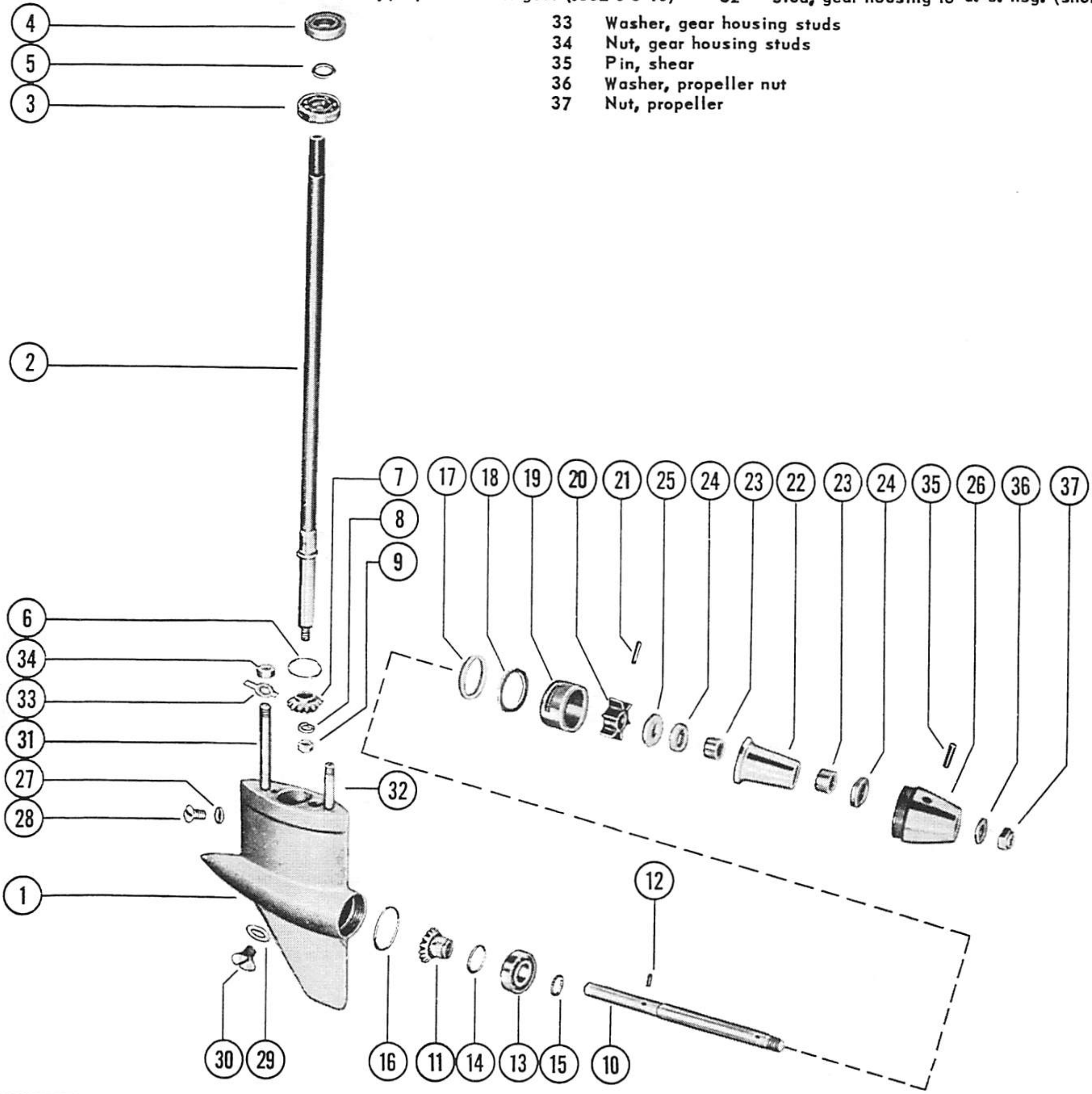


Figure 3. Quicksilver Lower Unit

LOWER UNIT - 2 CYL. TRANSMISSION TYPE

Disassembly

I. Removing Gear Housing Assembly and Pawl Control Assembly

First remove the gear housing assembly by detaching the transmission cover plate which is secured to the front edge of the drive shaft housing by 3 cap screws. When removing the cover plate, care should be exercised, as the neutral and reverse pawl spring retaining pin, control pawl spring spacer and the neutral and reverse pawl springs will be pushed out. The assembly sets in this recess and is held in place by the cover. Its purpose is to place a tension on the reverse and neutral pawls. Remove the elastic stop nut on the drive shaft housing recess, as this nut secures the forward gear housing stud.

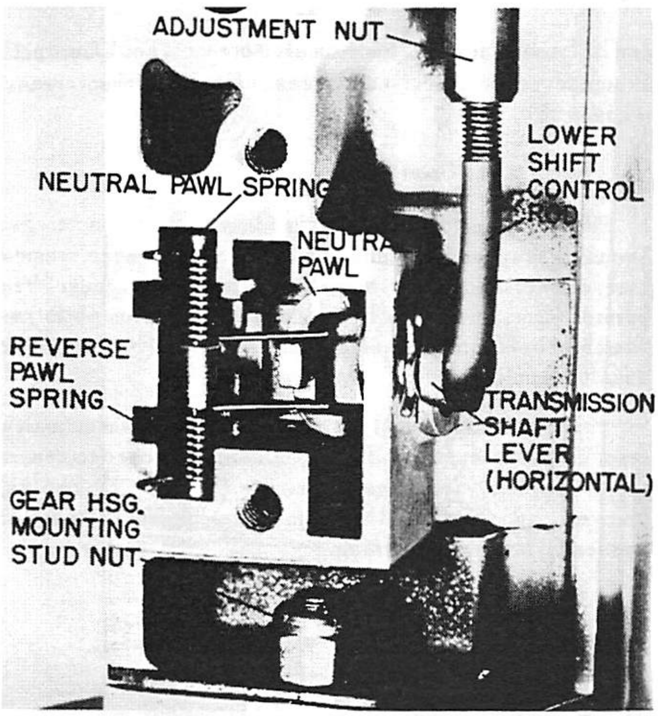


Figure 1. 2-Cylinder Automatic Transmission

Remove the 2 elastic stop nuts from the underside of the anti-cavitation plate of the gear housing; one at the radius of the gear housing and anti-cavitation plate and one at the rear of the anti-cavitation plate.

The gear housing assembly now is loose from the drive shaft housing and can be removed by tapping lightly against the gear housing and pulling downward. Tension holding the gear housing in the drive shaft housing is caused by the rubber "O" ring seal on the gear housing pilot assembly which protrudes into the drive shaft housing.

II. Disassembly of Gear Case

Mount gear housing assembly in vise between two blocks of soft wood to prevent marring of gear housing. Remove propeller by unfastening 5/8" elastic stop nut on propeller shaft. (Figure 3) At this time, lash between

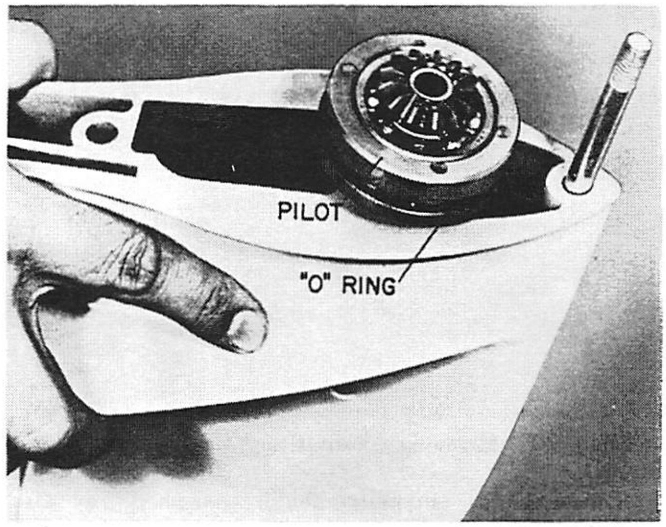


Figure 2. Removing & Installing Gear Housing Assembly

gears should be checked. Push on drive shaft and push on propeller shaft. *(Refer to gear lash later, in reassembly.)* Remove gear case cover with Gear Case Cover Tool 91-27534A1. Place tool over end of propeller shaft and set dowels of tool into gear case cover, turning clockwise to loosen (left hand thread). (Figure 4) If tight, strike handles of tool with mallet to loosen.

Oil seal and bearing carrier can be removed when removing propeller shaft assembly, or it can be pulled out with Puller Tool (91-27780). Spread tongs so lips of tool grasp beneath shoulder of bearing carrier. To remove needle cartridge bearing and seals, press bearing out with Mandrel 91-24147. To remove the propeller shaft assembly, remove gear housing from vise and place propeller shaft in vise between 2 pieces of soft wood and tap lightly on skeg of gear housing with mallet until the propeller shaft assembly is removed. (Figure 5) Remove shims as required from gear housing bearing seat. Wash gear housing and parts to remove grease.

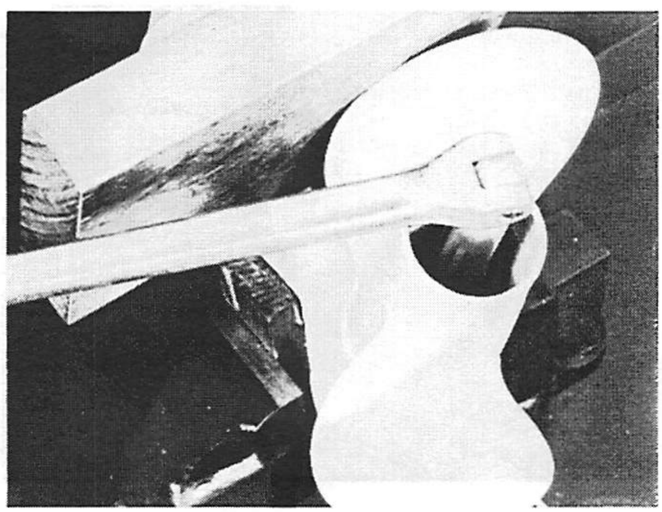


Figure 3. Removing & Installing Propeller Nut

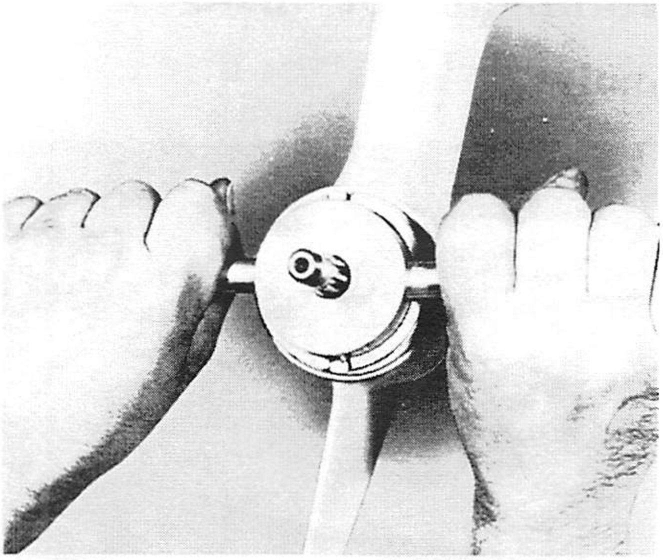


Figure 4. Removing & Installing Gear Case Cover

Disassemble propeller shaft assembly by first removing snap ring with Snap Ring Pliers (91-24283) and then shims as required. Remove ball bearing and bearing retainer ring from propeller shaft assembly by placing the 2 halves of 91-22115 Gear Puller Plate between the propeller shaft gear and bearing retainer ring. Recessed surface is for propeller shaft gear. Tap halves together and secure with tool cap screws. Place puller plate and propeller shaft assembly, splined end up, on arbor press and push bearing and retainer off. Hold propeller shaft so that it will not drop.

Gear drive pin will drop out, as it is held in place by ball bearing. If for any reason this pin is tight, it will be necessary to drill it out. *(Note: On later models, gear has 2 holes for drive pin, one on each side. Remove drive pin from gear and propeller shaft from opposite side with a small drift punch.)* Remove ball bearing from retainer. Remove propeller shaft gear with closed end of Propeller Shaft Gear Tool (91-26376A1). Set threaded

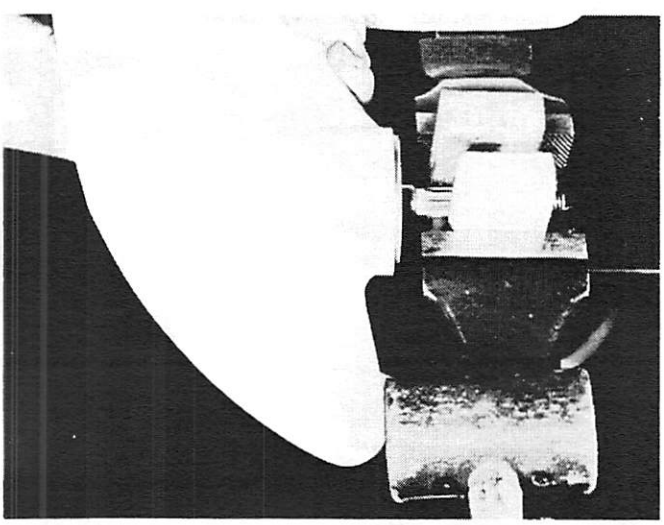


Figure 5. Removing Propeller Shaft Assembly

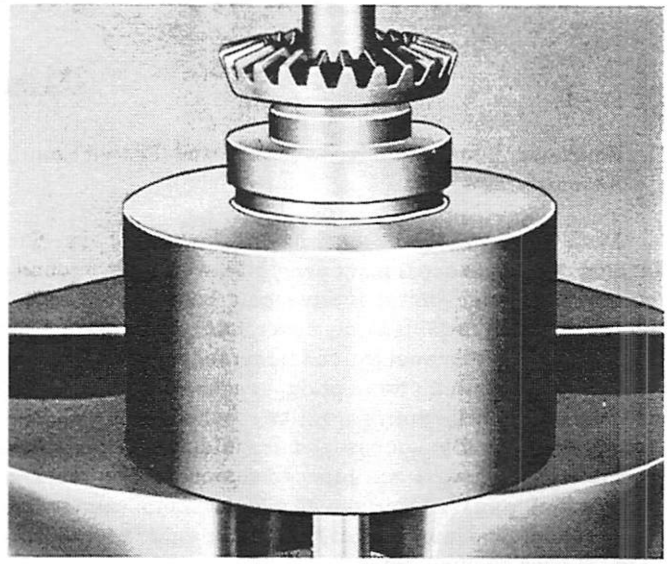


Figure 6. Removing & Installing Gear on Propeller Shaft

end of propeller shaft into small bore of Tool Cup until shoulder rests on it and press off with arbor press. (Figure 6)

III. Removal of Drive Shaft

Place lower drive shaft gear in vise as close to gear housing as possible and, with box end wrench, remove tab washer and screw from drive shaft pinion gear. Free pinion from drive shaft and drive shaft from pilot assembly by tapping against gear housing. Remove drive shaft by pulling out.

Place pilot assembly in vise and, with rawhide mallet, tap firmly against top of gear housing in order to remove pilot assembly from gear housing. (Figure 7) The ball bearing and shim will be removed along with the pilot assembly from the housing.

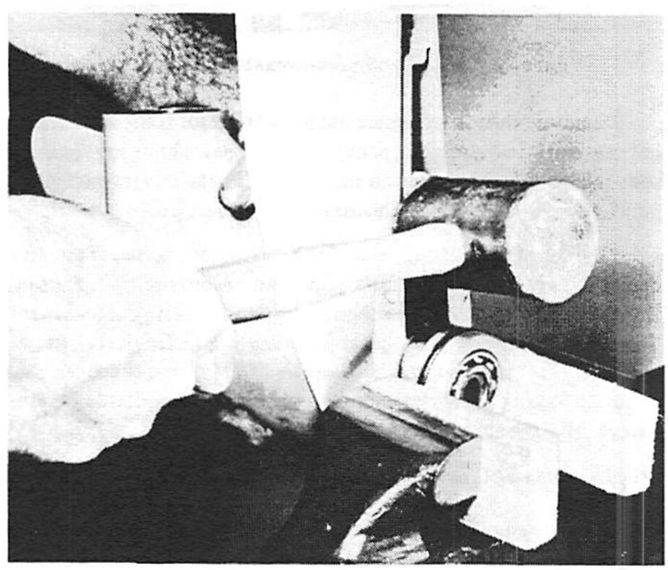


Figure 7. Removing Pilot Assembly

Place Mandrel Bearing Tool (91-24147) in drive shaft end cavity of gear housing, placing guide and sleeve on mandrel before installing. Press bearing out with arbor press or tap against tool with heavy mallet to remove bearing.

To remove propeller shaft needle bearing, pack bearing with heavy cup grease. Place small end of mandrel 91-24147 in bearing and strike mandrel sharply with heavy mallet several times to force bearing out. (See Figure 8.) If bearing is extremely tight, and the above process is not effective, heat gear housing around bearing seat until bearing falls out. *CAUTION: Do not overheat gear housing or it may be damaged.*

This completes disassembly of the gear housing. All parts now should be washed in cleaning solvent and inspected for wear or damage.

(Refer to Pages 43-thru-46 for Data on Disassembly and Reassembly of Transmission.)

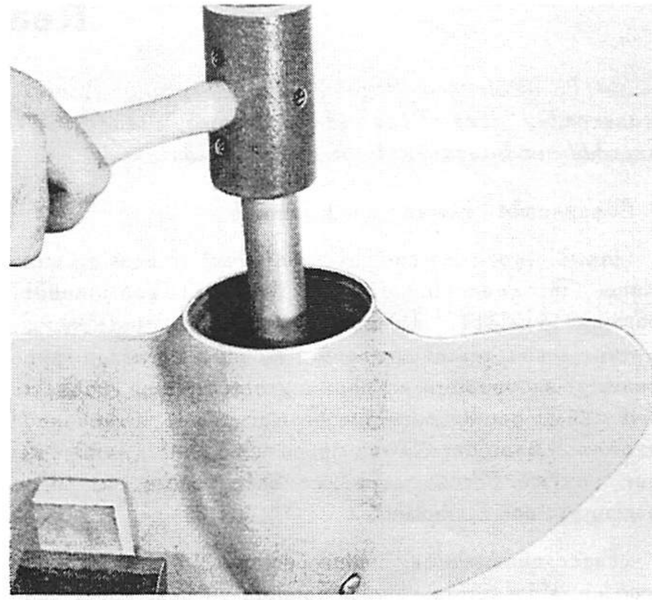


Figure 8. Removing and Installing Propeller Shaft Needle Bearing

Reassembly

NOTE: Refer to Page 2, This Section, Prior to Reassembly. See Page 43-thru-46 for Data on Disassembly and Reassembly of Transmission.

A. Reassembly Lower Gear Housing

Install propeller and drive shaft roller bearing cartridges into gear housing with Mandrel Tool (needle bearing) 91-24147. (Figure 8) For easy installation, always press against numbered side of a cartridge type bearing, as opposite end has a greater radius. Press in drive shaft needle cartridge bearing until it is recessed evenly on shoulder between upper drive shaft cavity and gear cavity. Press propeller shaft needle cartridge bearing in until it bottoms.

Place gear housing in vise between 2 blocks of soft wood at thin section of gear housing so gear cover end is up. Lubricate needle bearings in gear housing. Reassemble gear housing pilot. Replace shims in large recessed end and install ball bearing in pilot assembly by pressing bearing in housing to seat on shoulder until seated. Place "O" rings in upper and lower grooves in pilot. Insert pilot assembly in gear housing and press or tap until it seats on pilot shoulder. Insert lower drive shaft splined end into pilot and gear housing. Tap end to seat in ball bearing. (Figure 9)

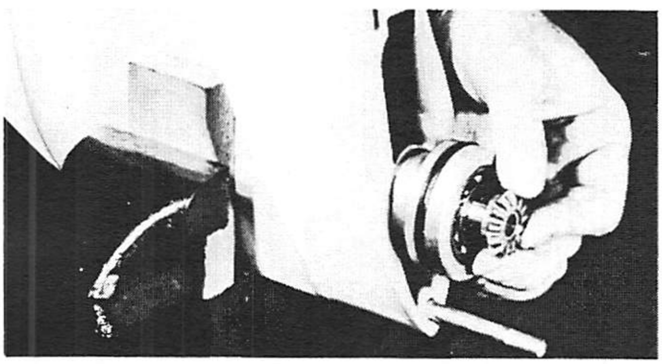


Figure 9. Removing and Installing Lower Drive Shaft

Place pinion gear on end of drive shaft in gear housing and guide tab washer and screw onto threads on end of drive shaft by turning drive shaft with one hand while holding nut with other hand. Place drive shaft in vise and tighten screw and tab washer securely with wrench.

B. Reassemble Propeller Shaft

Ready the propeller shaft and bevel gear by placing blank end of propeller shaft into shoulder end of gear. Be careful to place gear on shaft properly so that the conical angle will mesh with companion pinion gear. Align hole in propeller shaft and gear with steel rule. Place tool collar on Propeller Shaft Gear Tool (91-24716). Use opposite of tool's open end to install gear, shoulder up. (Figure 10) Place propeller shaft gear with teeth down on top of gear tool collar. Lubricate shaft and press in with arbor press until hole in gear aligns with hole in propeller shaft. Place gear drive pin in aligned holes of propeller shaft and gear to lock to shaft. Place recessed end of tool collar up on closed end of Propeller Shaft Gear Tool (91-26376A1). Place ball bearing in bearing retainer and set on propeller shaft so that retainer is toward gear on end of propeller shaft gear, installing threaded end of propeller shaft through small hole in cup so gear shoulder will set in recess of collar. Press down with arbor press until ball bearing is tight against gear. (Figure 11)

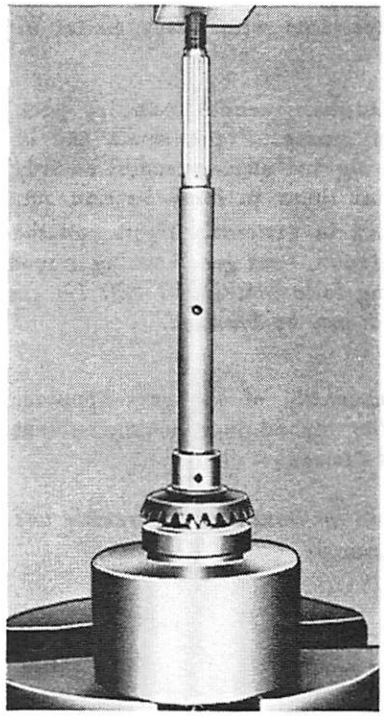


Figure 10. Installing Propeller Shaft Gear

Place shim, as required, against bearing and follow with snap ring, using Snap Ring Pliers (91-24283) to spread snap ring onto gear groove. Be sure snap ring seats securely in groove on gear. Check by tapping on snap ring with screwdriver. Replace shims, as removed or required, on shoulder within gear housing. Install completed propeller shaft and gear assembly into housing. Use mallet to tap the propeller shaft assembly in place. If tight, be careful that the entire assembly is centered, straight into the housing.

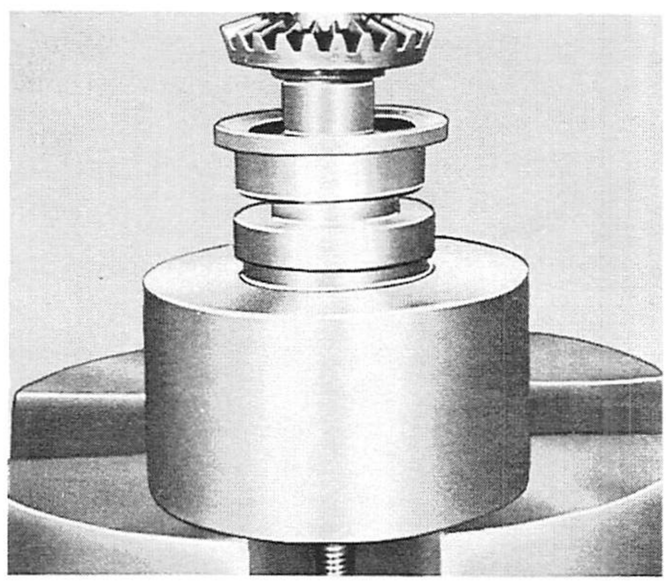


Figure 11. Installing Propeller Shaft Gear Ball Bearing and Retainer

NOTE: At this point it is very important to check gear back lash of assembly. After drive shaft pinion gear and propeller shaft bevel gears have meshed, check back lash of assembly by pressing drive shaft downward and by applying pressure downward on propeller shaft assembly. Rotate drive shaft in a clockwise and counterclockwise motion very lightly to feel gear lash. No more than .003" to .005" play between gear teeth should be allowed for proper operation. If more than the recommended gear back lash is present, after reassembly, remove shims beneath propeller shaft assembly. It may be necessary to add shims under drive shaft ball bearing. If too tight and no back lash is present, add a sufficient amount of shims for correct play and conical angle of gears.

Replace needle cartridge bearing in bearing carrier with Mandrel 91-24147. Press first oil seal in carrier with spring clip, side facing inward. Second seal faces outward. *(NOTE: Mark 10 engines below Serial No. 1061480 have one oil seal in bearing carrier assembly.)*

Install "O" ring on bearing carrier and insert assembly over propeller shaft into gear housing. Replace propeller shaft gear case cover and tighten (clockwise rotation) with Gear Case Tool 91-27534A1. (See Figure 4.) Dowels of tool fit holes in side of cover. Coat threads of cover with fine coat of MULTIPURPOSE Quicksilver Lubricant (92-30239) to facilitate easy removal. Check that there is no end play in propeller shaft by pressing on end of propeller shaft. Again check for correct back lash (.003" and .005"). If incorrect, the propeller shaft assembly again must be removed and the correct amount of shims either removed or added to make up for proper tolerence.

Check that water intake screen (item 15 in Figure on P. 56) is secure. Tighten prong or replace screen if required.

This completes the assembly of the complete gear housing and unit is ready for attaching to drive shaft housing.

NOTE: Transmission end play now must be set. Refer to Page 46, Paragraph III, "Setting End Play".

C. Installation of Gear Housing Assembly Complete

Place hollow dowel on rear stud recess of gear housing and insert the gear housing assembly complete into the drive shaft housing and fasten the elastic stop nut onto the forward stud which recesses on the shoulder underneath the transmission cover plate. (See Figure 2.) Place the other 2 elastic stop nuts on studs beneath the anti-cavitation plate. Secure all 3 nuts. Replace pawl spring retaining pin, spacer and neutral and reverse pawl retaining pin, spacer and neutral and reverse pawl springs, the longer of the spring arms to the bottom (reverse pawl). (See Figures 1 and 12.)

Set spacer on pawl spring retaining pin and set spring on shaft. While holding shaft in left hand, reverse pawl spring with long arm is set on shaft so spring arm end slides on first, facing right. (See Figure 12.) Neutral pawl spring arm slides on shaft first from other end of shaft. Set in recess in drive shaft housing, being certain that the long spring arms are set in pawl notches. (See Figure 1.) Replace transmission cover with 3 screws and new gasket. Remove "vent" plug from transmission cover and grease plug from gear housing and refill with Kiekhaefer Quicksilver Outboard Gear Lubricant until grease flows out vent.

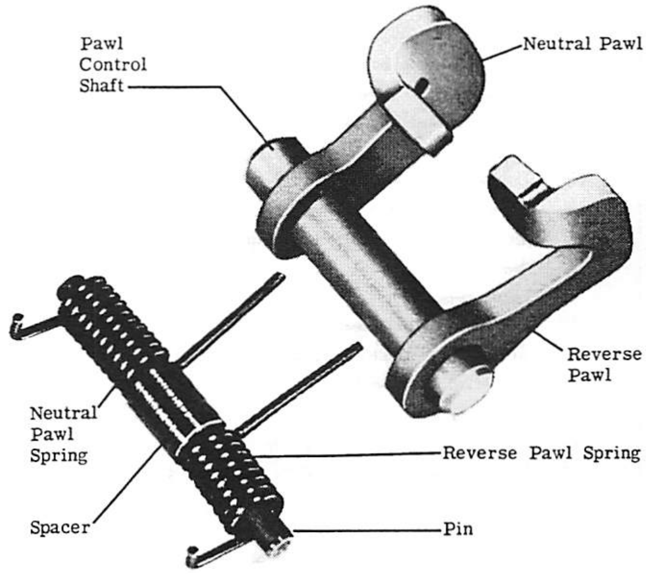


Figure 12. Neutral Pawl and Spring

D. Replace Propeller

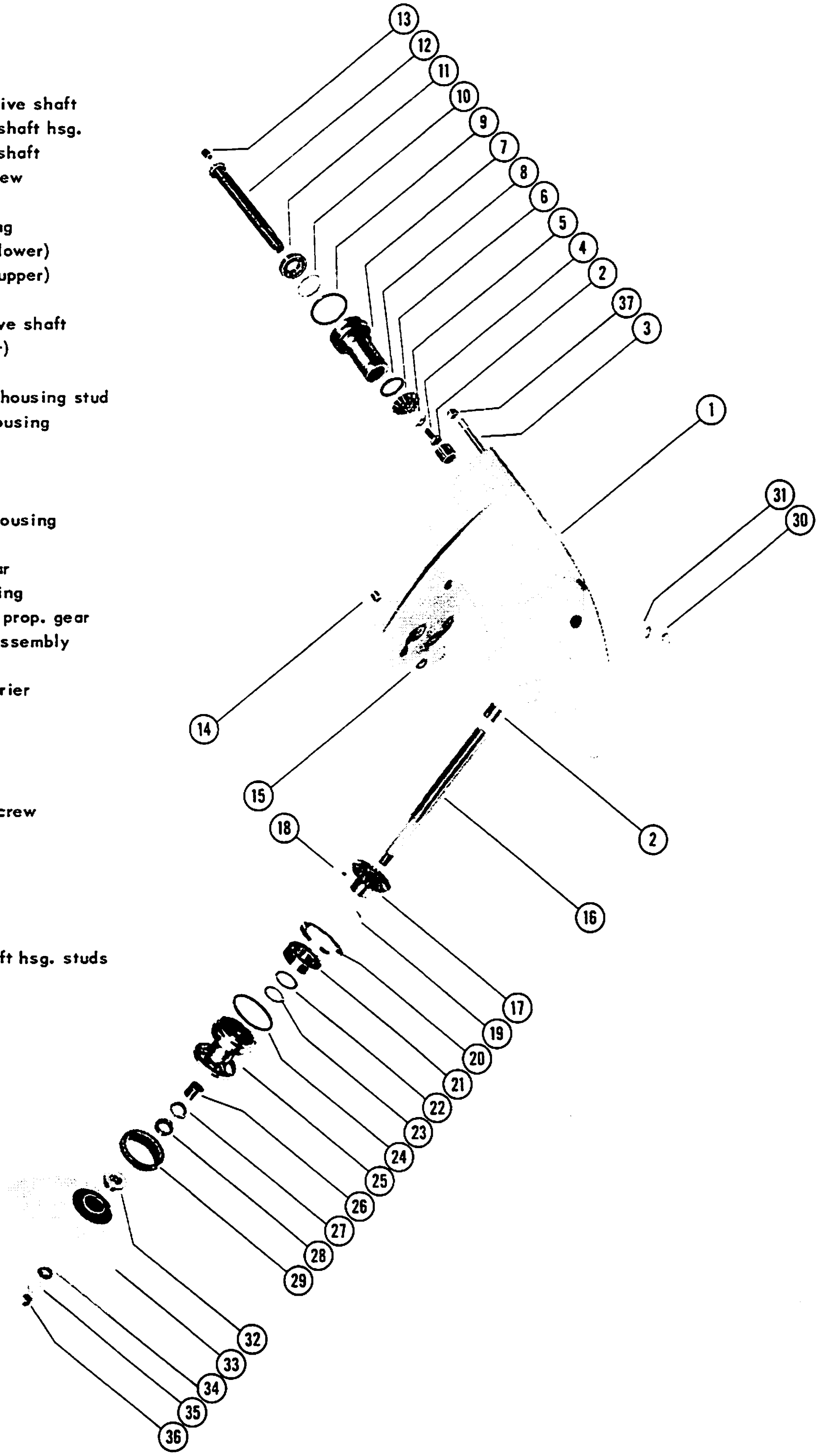
It is very important that the installation of the propeller should be made with care. Place large collar washer with counterbored end over propeller shaft recesses against propeller shaft shoulder. This is guide for end of propeller hub. Install propeller on shaft over splines and place splined spacer over propeller shaft to align propeller hub. Set washer on shaft and tighten propeller nut. (See Figure 3.)

NOTE: When replacing either propeller (48-26608A1) or gear housing cover (26310) on Mark 10 engines (Serial No. 1059111 or below), both parts must be changed. Reason is addition of labyrinth to cover to help seal between cover and propeller. Propeller diameter was also bored deeper to correspond with labyrinth seal added to cover.

IMPORTANT: For correct propeller load conditions, see Propeller Chart, Page 19A, Section III.

NOTE: During tuneup, check transmission cover gasket to be sure that it is in place. If all the water was not completely drained from engine before winter storage, water could freeze, and transmission cover gasket (27-26818) could possibly be forced out. This will result in a loss of cooling water pump pressure which could cause engine to overheat if damaged gasket were not replaced.

1 Gear Housing Assembly
2 Bearing, roller - prop and drive shaft
3 Stud, gear housing to drive shaft hsg.
4 Screw, pinion gear to drive shaft
5 Tab Washer, pinion gear screw
6 Gear, pinion
7 Pilot Assembly, gear housing
8 "O" Ring, pilot assembly (lower)
9 "O" Ring, pilot assembly (upper)
10 Shim, ball bearing to pilot
11 Bearing, ball - pilot and drive shaft
12 Drive Shaft Assembly (lower)
13 Bushing, drive shaft
14 Dowel, hollow - drive shaft housing stud
15 Screen, water inlet - gear housing
16 Shaft, propeller
17 Gear, propeller
18 Pin, propeller gear to shaft
19 Shim, "L" Washer to gear housing
20 "L" Washer, ball bearing
21 Bearing, ball - propeller gear
22 Shim, ball bearing to snap ring
23 Ring, snap - ball bearing to prop. gear
24 "O" Ring, bearing carrier assembly
25 Bearing Carrier Assembly
26 Bearing, roller - bearing carrier
27 Oil Seal, bearing carrier
28 Oil Seal, bearing carrier
29 Cover, gear housing
30 Screw, grease filler hole
31 Washer, grease filler hole screw
32 Collar, propeller shaft
33 Propeller Assembly
34 Spacer, propeller (splined)
35 Washer, propeller nut
36 Nut, propeller
37 Nut, gear housing to dr. shaft hsg. studs



Gear Housing Assembly -- 2-Cylinder Automatic Transmission Type

|DIRECT REVERSING RIGHT HAND ROTATION
Merc 600 & Mark 78-78A-75-75A Disassembly

Remove 5 hexagon head lock nuts which hold gear housing assembly to drive shaft housing and the ¾" cap screw located on the rear, inside exhaust outlet.

After the above nuts and cap screws are removed, the lower gear housing assembly can be pulled off the drive shaft housing.

Mount gear housing assembly in vise between 2 blocks of soft wood to prevent marring of gear housing. Remove propeller by driving tabs on tab washer flat against propeller hub and remove propeller nut. A long piece of round steel can be inserted in hole of propeller nut to remove. (Figure 1) Check gear back lash by pulling on drive shaft with one hand and pushing on propeller shaft with other. Refer to lash when shimming in "Reassembly" under "Note" on Page 62. Remove gear housing cover with Gear Housing Cover Tool (C-91-26374A1). Place tool over end of propeller shaft and set dowels of tool into gear housing cover, turning clockwise to loosen (left hand thread). (Figure 2) If tight, strike handles of tool with mallet to loosen.

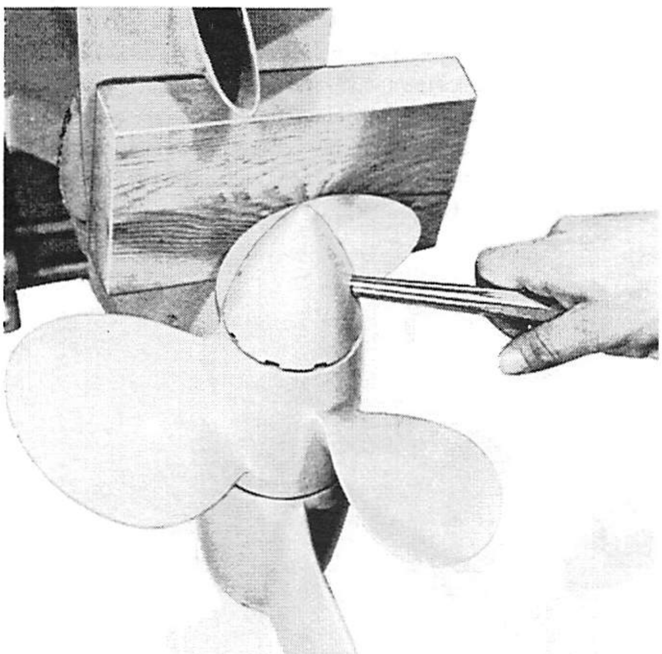


Figure 1. Removing and Installing Propeller Nut

After gear housing cover is removed, lift out washer (gear housing to gear housing cover). Slide Counter-Rotating Puller Tool (C-91-29456A3) down over propeller shaft (Figure 3) and thread three ¼-20 screws into holes of oil seal carrier assembly. Make sure that all screws are inserted equally. Slowly turn center screw of puller clockwise to remove oil seal carrier. Remove oil seal carrier from tool. Remove "O" ring. Bend down lockwasher tabs on bearing retaining n ut.

Clamp drive shaft in vise with jaw protectors, then remove ball bearing retaining nut *(left hand thread with "LH" embossed in special nut; earlier units had right hand thread)* with Propeller Gear Lock Nut Tool (C-91-28953). Remove tab washer and slip Puller Tool (C-91-29456A3) onto propeller shaft. Insert 3 small screws thru puller into ball bearing ring adaptor, tightening equally. Slowly turn center screw of tool clockwise to remove ball bearing and ball bearing ring adaptor. (Figure 3) Check for shims (adaptor ring to gear housing). Remove drive shaft nut and washer from below pinion gear.

NOTE: Drive shaft on counter rotating lower unit must be removed before propeller shaft, as seen in Fig. 4.

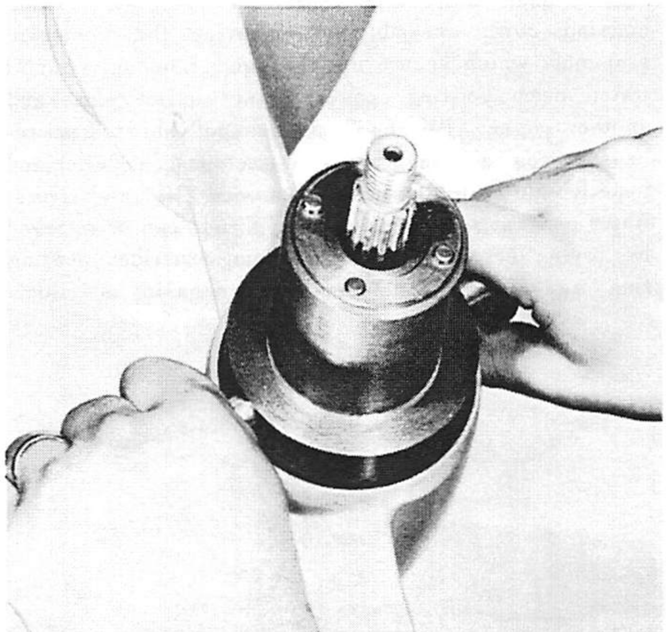


Figure 2. Removing and Installing Gear Housing Cover

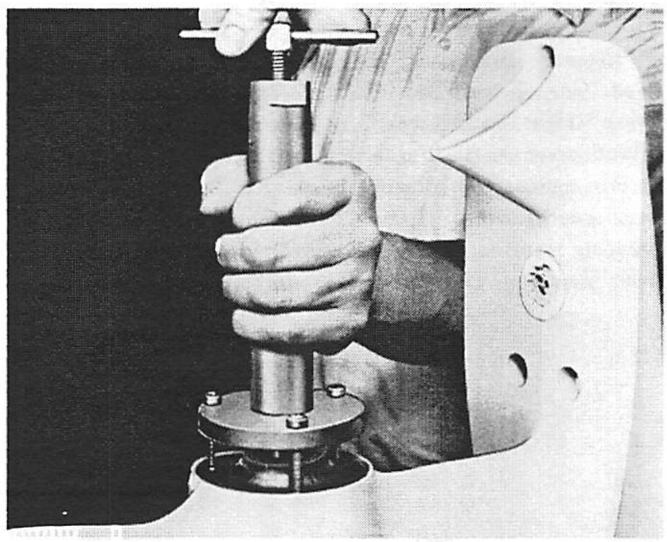


Figure 3. Removing Oil Seal Carrier Assembly

Remove drive shaft from vise and install gear housing in vise in upright position with skeg held between blocks of wood. Remove inlet water tube and

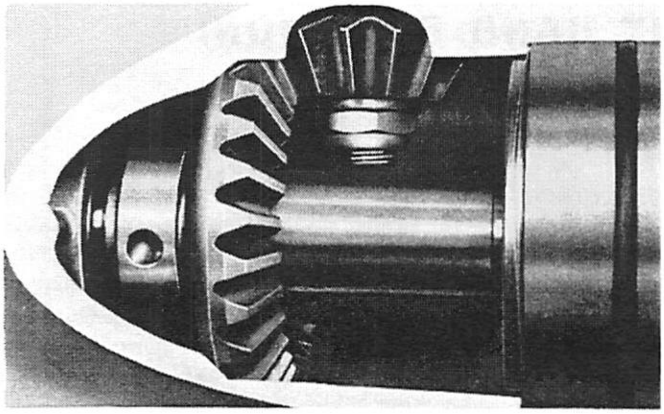


Figure 4. Cutaway of Propeller and Pinion Gears

outlet water tube from water pump housing and centrifugal slinger from drive shaft. Remove water pump housing cover assembly by removing the 3 elastic stop nuts which secure it to the gear housing. Lift off water pump housing, gasket, steel outlet plate and another gasket. Lift check valves and shims from recess in gear housing. Remove water pump impeller and impeller pin by prying impeller out with 2 screw drivers. Water pump cartridge has a loose fit and can be removed by prying out. Remove water pump cartridge sealing ring and wave washer from gear housing shoulder.

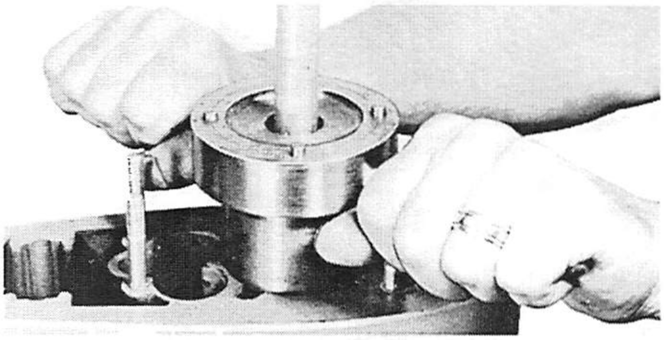


Figure 5. Removing and Installing Drive Shaft Bearing Retainer Cover

Remove drive shaft ball bearing retainer cover with Gear Case Cover Tool (91-26374A1). Turn counterclockwise (right hand thread) to remove. (Figure 5) Again place drive shaft in vise and, with rawhide mallet, tap firmly against top of gear housing to remove drive shaft from gear housing. (Figure 6) The ball bearing, shim and bearing retainer will be removed along with the shaft from housing. The pinion is now free of drive shaft.

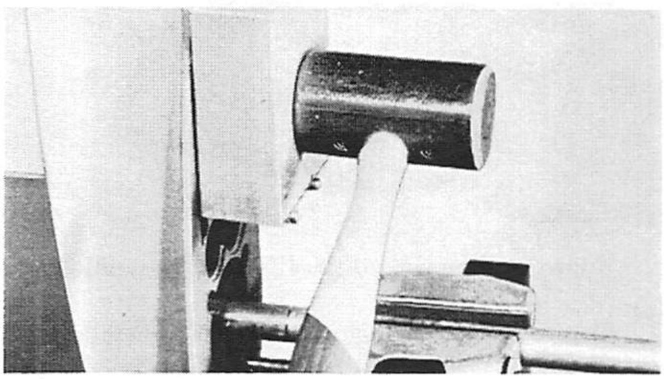


Figure 6. Removing Drive Shaft from Gear Housing

Remove ball bearing from drive shaft by replacing against open vise jaws, tapping on end of drive shaft to remove. (Figure 7) Lift propeller shaft assembly and propeller gear from gear housing.

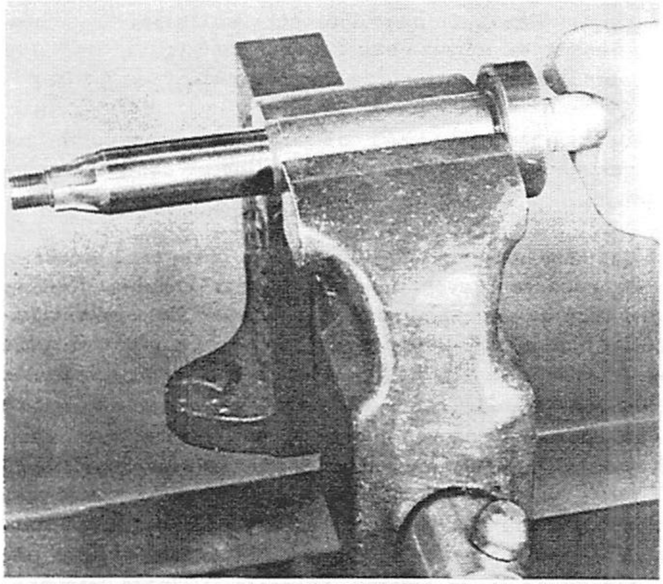


Figure 7. Removing Ball Bearing from Drive Shaft

Gear housing contains needle bearings for the propeller shaft and drive shaft. To remove drive shaft needle bearings, use Needle Bearing Tool (91-24288A2) with long tool sleeve (91-26377). Install guide and sleeve on Needle Bearing Tool and place in drive shaft end cavity of gear housing. Press bearing out with arbor press or tap against tool with heavy mallet to remove bearing. (Figure 8)

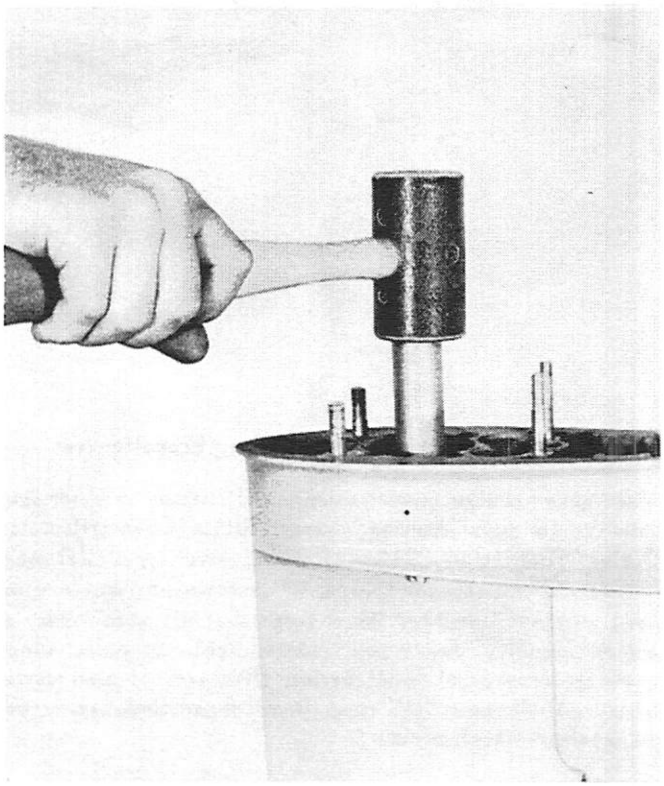


Figure 8. Removing Drive Shaft Needle Bearing in Gear Housing

To remove propeller shaft roller bearing from gear housing, place jaws of Roller Bearing Puller (91-29312-A1) inside roller bearing, pull shaft of tool up and tool jaws expand and catch bottom of bearing race. Place puller plate on shaft of tool against gear housing and thread nut on shaft. Continue to tighten nut to pull bearing out. (Figure 9)

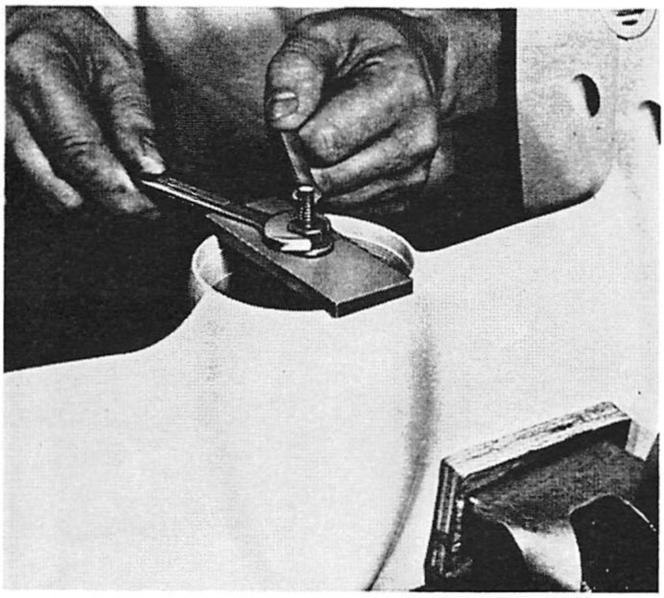


Figure 9. Removing Propeller Shaft Roller Bearing

To remove propeller shaft gear from propeller shaft, first remove snap ring from propeller gear and remove propeller gear to shaft dowel pin. Place propeller shaft and gear assembly into Universal Propeller Shaft Gear Tool (91-26374A1). Press gear off toward threaded end. (Figure 10) *(Note: Sleeve also must be removed.)*

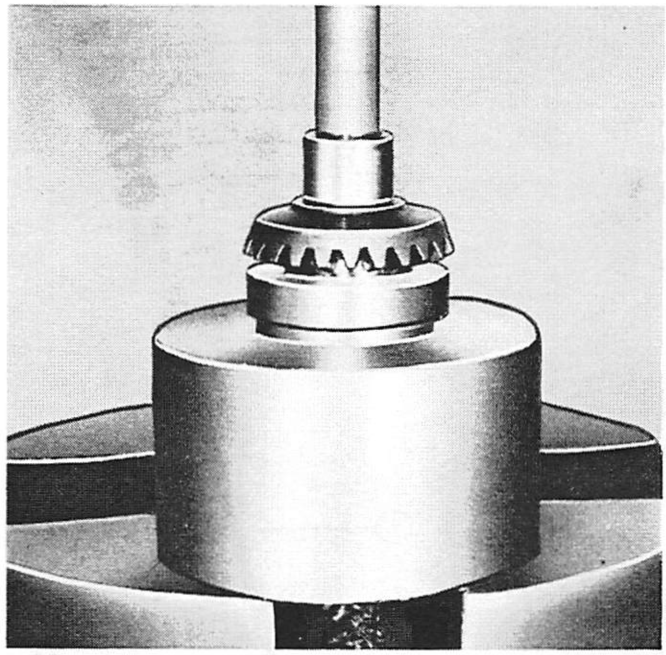
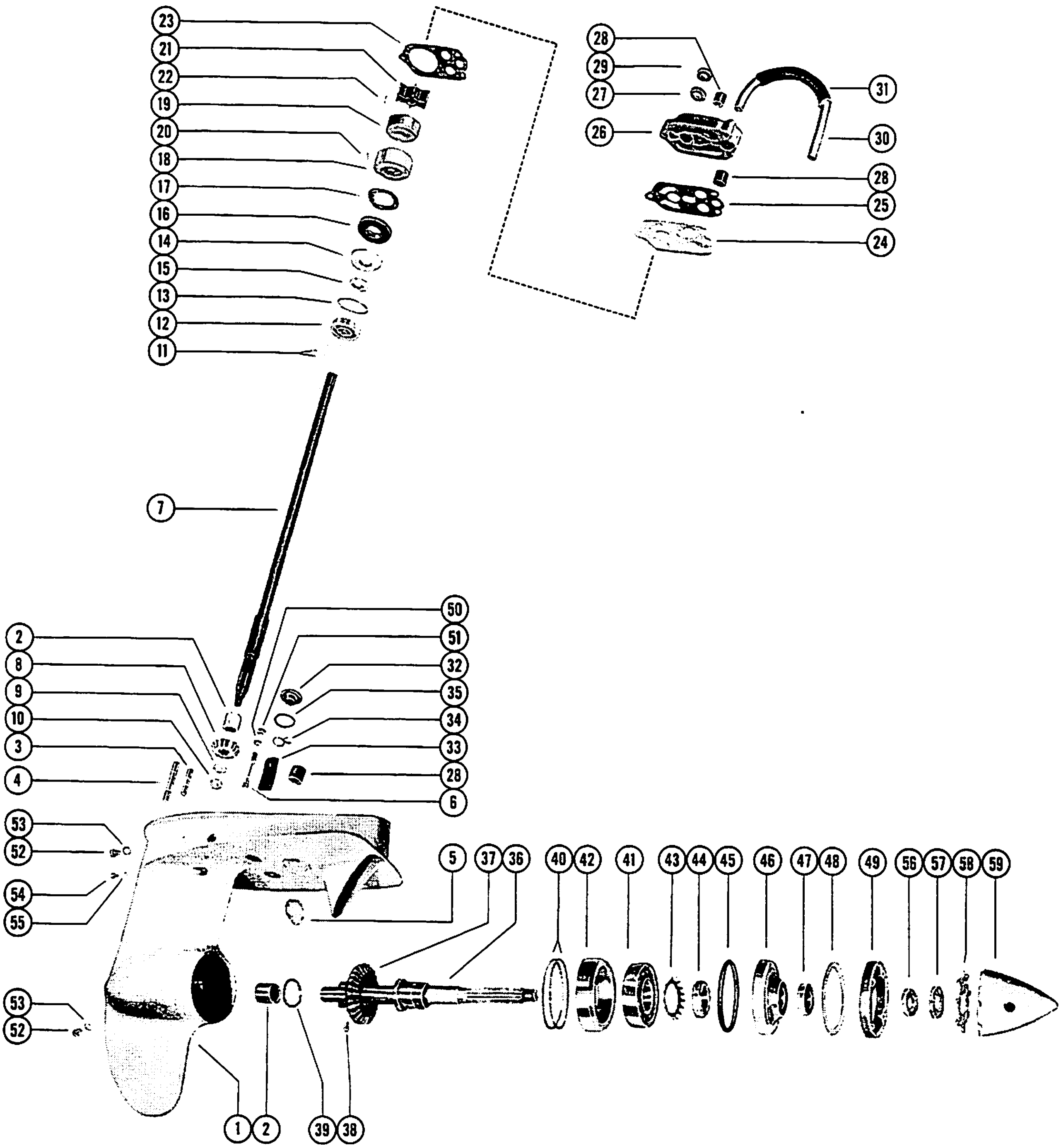


Figure 10. Removing Propeller Shaft Gear

This completes disassembly of gear housing. All parts now should be washed in cleaning solvent and inspected for wear.



1 Gear Housing Assembly
2 Bearing, roller
3 Stud
4 Stud
5 Screen, water intake
6 Stud
7 Drive Shaft
8 Gear, pinion
9 Washer
10 Nut
11 Shim
12 Bearing, ball
13 "O" Ring
14 Oil Seal Carrier Assy.
15 Oil Seal, carrier
16 Cover, carrier retainer
17 Washer, wave
18 Water Pump Cart. Assy.
19 Insert
20 Key, cartridge locating
21 Impeller, water pump
22 Pin, impeller drive
23 Gasket, lower
24 Plate, face
25 Gasket, upper
26 Water Pump Cover Assy.
27 Oil Seal
28 Seal, rubber
29 Ring, rubber
30 Tube, water intake
31 Sleeve
32 Water Valve & Adaptor Assy.
33 Valve, water
34 Clamp, valve to adap.
35 Shim
36 Propeller Shaft Assy.
37 Gear, propeller
38 Dowel Pin
39 Ring, snap
40 Shim
41 Bearing, ball
42 Ring, adaptor
43 Tab Washer
44 Nut
45 "O" Ring
46 Oil Seal Carrier Assy.
47 Oil Seal, carrier
48 Washer
49 Cover, gear housing
50 Lockwasher
51 Nut
52 Screw
53 Washer
54 Screw
55 Washer
56 Washer, backing
57 Washer, backing
58 Tab Washer
59 Nut, propeller

Figure 11. Gear Housing Assembly, Right Hand Rotation -- Merc 600 and Mark 78-78A-75-75A

(Prior to reassembly, check all parts for wear or damage and replace if necessary.)

To install drive shaft needle bearing in gear housing, use Needle Bearing Tool (91-24288A2) with long tool sleeve (91-26377). Install guide and sleeve on Needle Bearing Tool, place a light coat of MULTIPURPOSE Quicksilver Lubricant (92-30239) on outer race of needle bearing and insert needle bearing in gear housing with numbered side of bearing facing up. Place gear housing in arbor press and press drive shaft needle bearing into gear housing. (Figure 12) If arbor press is not available, place gear housing in vise, with wood jaw protectors holding skeg, and tap against Needle Bearing Tool with heavy mallet to install drive shaft needle bearing in gear housing.

To install propeller shaft needle bearing in gear housing, use same procedure and same tool as preceding paragraph.

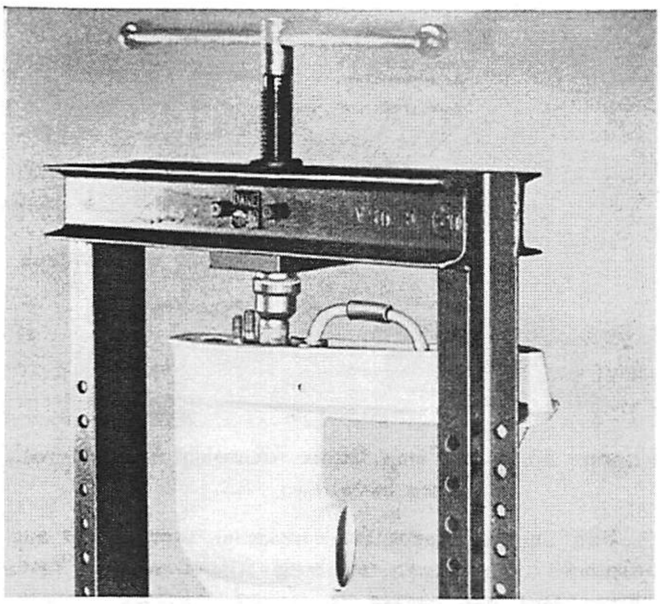


Figure 12. Installing Drive Shaft Needle Bearing

Place light coat of MULTIPURPOSE Quicksilver Lubricant (92-30239) on propeller shaft. Set propeller shaft gear onto Universal Propeller Shaft Gear Tool (91-26376A1) and place propeller shaft into propeller shaft gear (teeth facing up). Be sure that dowel pin depression in propeller gear and in propeller shaft are lined up. Insert, but do not force, dowel pin in depression. Reinstall snap ring in groove over dowel pin.

Place light coat of MULTIPURPOSE Quicksilver Lubricant on inside surface of drive shaft and propeller shaft needle bearings in gear housing. Place gear housing in vise with jaw protectors (propeller shaft opening facing up) and place propeller shaft and gear assembly in gear housing. Place drive shaft horizontally into gear housing. Install pinion gear on drive shaft, being certain that splines of gear and drive shaft are aligned. Install lockwasher and lock nut on shaft and turn shaft by hand while holding nut with wrench to thread nut easily onto shaft. Remove gear housing from vise, clamp drive shaft in vise horizontally and tighten nut securely.

Remove drive shaft from vise and place gear housing (with drive shaft vertical) in vise in jaw protectors. Place drive shaft ball bearing to gear housing shims, as removed or required, into gear housing. Install drive shaft ball bearing (with light coat of MULTIPURPOSE Quicksilver Lubricant (92-30239) on outer race) over drive shaft and into gear housing with numbered side of bearing facing up. Tap drive shaft ball bearing into position lightly on either side of outer race so that bearing goes in straight and is seated against shims. Install "O" ring on oil seal carrier assembly and install assembly over drive shaft into gear housing until seated, "O" ring facing ball bearing. Install gear case cover, applying a light coat of MULTIPURPOSE Quicksilver Lubricant (92-30239) on cover, and place cover over drive shaft into gear housing. Tighten cover with Gear Case Tool (91-26374A1), right hand thread (clockwise).

Reinstall gear housing in vise with propeller shaft in vertical position. Insert propeller shaft ball bearing retaining ring to gear housing shims, as removed or required, into gear housing and against gear housing shoulder. Press or tap propeller shaft ball bearing into ring adaptor and place a light coat of MULTIPURPOSE Quicksilver Lubricant (92-30239) on outer surface of ring adaptor. Install bearing and adaptor over propeller shaft and tap in place until it seats on top of shims. Install bearing retaining nut tab washer and ball bearing retaining nut on propeller shaft and tighten down (left hand thread, "LH" embossed on nut) with Propeller Gear Lock Nut Tool (91-29925A1) to secure propeller shaft ball bearing. *(Note: Retaining nuts with no "LH" embossed on nut have right hand threads.)* Bend tab on lock nut.

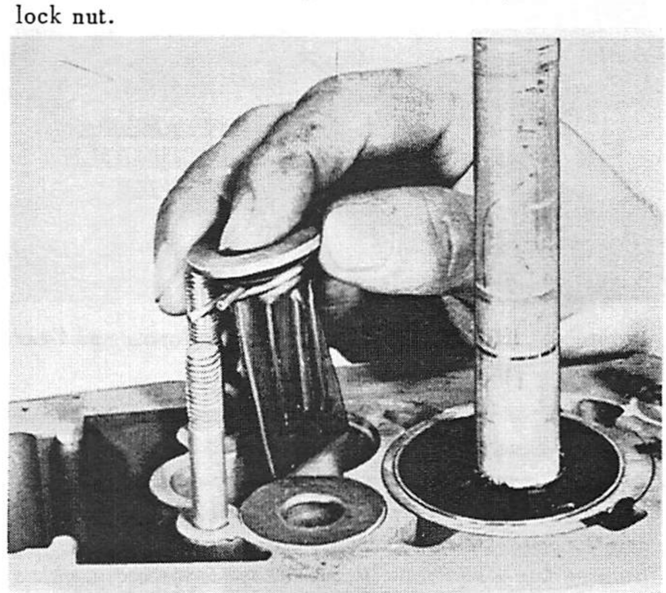


Figure 13. Installing Water Pump Check Valves

Install "O" ring into gear housing on top of propeller shaft ball bearing. Press oil seal into oil seal carrier (large lip of seal down). Place light coat of MULTIPURPOSE Quicksilver Lubricant (92-30239) on inside of oil seal and outside of carrier and tap into place, being careful not to damage lips of seal.

Place light coat of MULTIPURPOSE Quicksilver Lubricant (92-30239) on both sides of gear housing to cover washer and place washer in gear housing on top of oil seal carrier. Place light coat of MULTIPURPOSE Quicksilver Lubricant (92-30239) on threads of gear case cover and install over propeller shaft and thread into gear housing (right hand thread) with Gear Case Cover Tool (91-26374A1). Rotate drive shaft several times in both directions to be sure everything is "free".

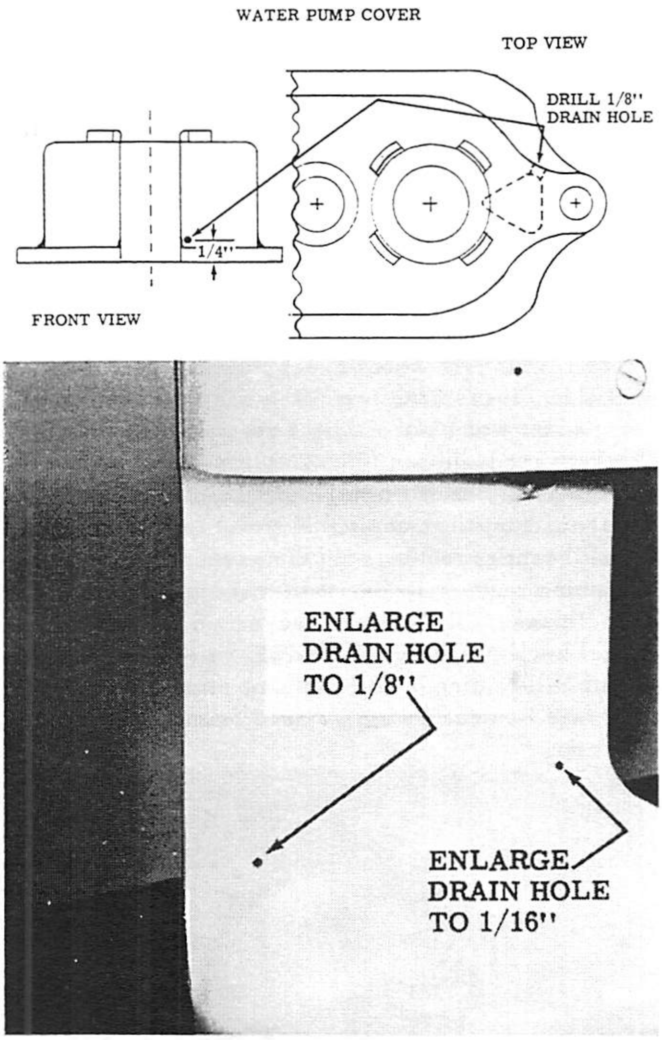


Figure 14. Drill Holes for Water Pump Housing and Gear Housing

NOTE: At this time it is very important to check gear back lash of assembly. After drive shaft pinion gear and propeller shaft bevel gears have meshed, check back lash of assembly by pulling drive shaft outward and by applying pressure downward on propeller shaft assembly. Rotate drive shaft in clockwise and counterclockwise motion very lightly to feel gear lash. No more than .003" to .005" play should be allowed for proper operation. If more than the recommended back lash is present, remove shims beneath propeller shaft assembly to mesh gears properly. If too tight and no back lash is present, add a sufficient amount of shims for correct play and conical angle of gears.

After correct gear lash is obtained, place skeg in vise in jaw protectors. Place wave washer in gear housing on drive shaft ball bearing retainer. Before placing water pump cartridge into housing, place coat of MULTIPURPOSE Quicksilver Lubricant (92-30239) on outer surface of water pump cartridge for easier possible future removal. Slip water pump cartridge over drive shaft into gear housing, being careful to align square keyway with keyway inside of gear housing. Insert key into keyway after cartridge has been set into place. Coat flat surface of drive shaft with grease and set impeller key on flat, parallel to shaft, so groove in impeller will slide over key and be held to drive shaft. Press down on impeller blades with thumbs to seat impeller on bottom surface of cartridge. Rotate drive shaft in both directions to be sure key is in proper position driving impeller.

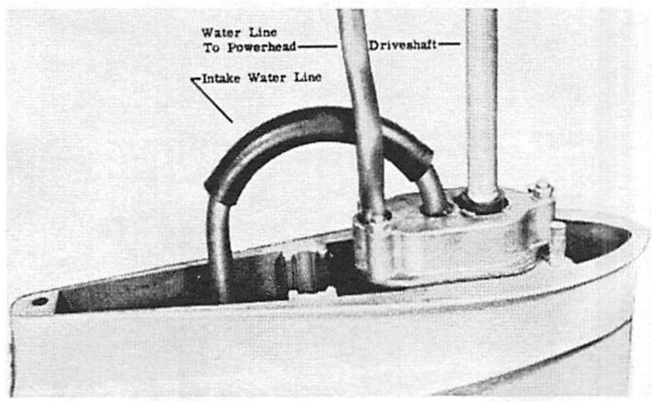


Figure 15. Water Pump Cover Assembly Mounted with Waterlines Installed

Be sure to inspect the neoprene water valves and adaptors for damage, replacing if necessary. *(Note: Water valve end should be closed. Replace if open, deteriorated, torn or out of shape.)* (Figure 13) The water valve adaptors must be installed so that flat sides are together. (Figure 13) Use shims beneath adaptors to bring flush with top surface to form good seal. Replace water pump housing gasket, stainless steel plate, (be sure sharp lips on plate are facing upward), second gasket and water pump housing, securing with 3 cap screws.

NOTE: The water pump housing and gear housing must be drilled for larger water outlet. (Figure 14)

Slide centrifugal slinger over drive shaft until it seats against water pump housing. Check water pump intake screen louvers in gear housing so that they are at the right angle, slanting in toward gear housing, to pick up water flow. Water is picked up in the tube extending from intake hole to intake of water pump housing hole nearest drive shaft. (Figure 15) Outlet line extends from hole at rear lip to powerhead.

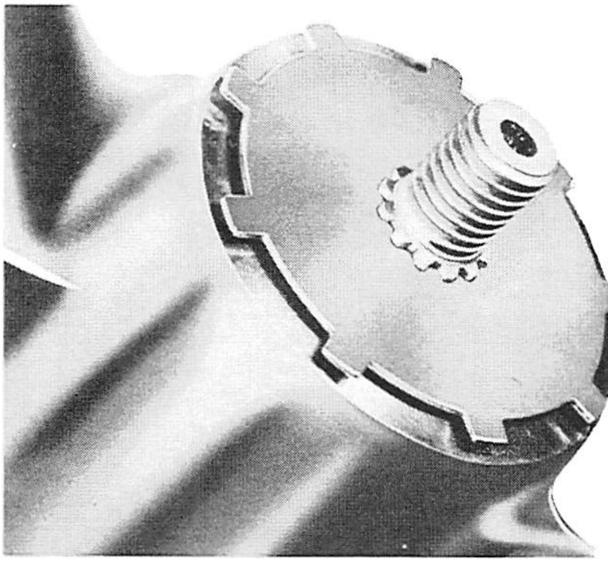


Figure 16. Splines of Tab Lockwasher Over Splines of Propeller Shaft

Check that water intake screen (item 5 in Figure 11) is secure. Tighten prong or replace screen if required.

Before joining gear housing and drive shaft housing, coat water inlet tube upper end with MULTIPURPOSE Quicksilver Lubricant (C-92-35226), so that it will slip easily into rubber seal in bottom cowl, and insert in bottom cowl. Place light coat of MULTIPURPOSE Quicksilver Lubricant on bottom end of water tube. Apply a heavy coat of MULTIPURPOSE Quicksilver Lubricant (C-92-35226) on drive shaft spline, then join gear housing and drive shaft housing by inserting drive shaft into drive shaft housing and drive shaft spline into crankshaft. Be careful that water inlet tube enters rubber seal in water pump cover in gear housing. Rotate propeller shaft in either direction until drive shaft spline enters crankshaft spline. With 2 housings joined, install and tighten 5 elastic stop nuts and one cap screw which hold assemblies together.

Install 1/8"-thick (3.175mm) backing washer on propeller shaft. Before replacing propeller, apply heavy coat of MULTIPURPOSE Quicksilver Lubricant on propeller shaft splines. Install propeller, 1/32"-thick (0.794mm) backing washer, tab lockwasher (making sure that it fits correctly over splines) and install propeller nut in this order. Place block of wood flat between propeller and anti-cavitation plate and tighten nut securely with larger bar or punch. (Figure 1) Bend all tab locks into propeller nut.

Drive Shaft and/or Impeller Drive Pin Wear

In some cases the impeller drive pin and the impeller hub have worn excessively on the drive shaft because of abrasion caused by silt and sand. If the condition exists in your area, we recommend that the new impeller drive pin be bonded to the replacement drive shaft with Type HV Loctite (C-92-36088) . Do not attempt to reuse a drive shaft which has worn down at this location. To install replacement parts with Loctite,

Proceed as Follows:

1. Reassemble gear housing with replacement parts up to point of installing impeller.
2. Assemble water pump base, face plate and gaskets.
3. Place gear housing in a vise so that drive shaft is horizontal.
4. Using FRESH solvent (lacquer thinner is excellent) and a clean cloth, clean the drive shaft from the face plate up to the end of the spline. Also, clean the impeller insert and drive pin. Do not allow solvent to contact pump base oil seal. Wipe all cleaned surfaces dry.
5. Snip off one end of Type HV Loctite tube. Rotate drive shaft so that the flat is up. Squeeze about half the contents of the tube on the flat. Smear this Loctite evenly on the rest at the shaft section on which the impeller will ride. With the flat on the shaft up, squeeze the balance of the Loctite onto the flat.
6. Roll the drive pin in this puddle on the flat and leave it centered in the flat.
7. Slip the impeller onto the shaft with the keyway up so that it will align with drive pin. Slowly push impeller down to the face plate.
8. Rotate the impeller back and forth several times, as far as the drive pin will allow, to thoroughly wet the impeller insert with the Loctite.
9. Wipe off any excess Loctite which appears above the impeller.
10. Install pump body and fastening nuts and screw.
11. Looking down the drive shaft from the spline end, rotate the shaft clockwise at least one turn to seat the drive pin in the driving direction.
12. Allow gear housing to remain in a horizontal position at room temperature or warmer (not to exceed 120° F [48.9°C]) for 12 hours. Gear housing assembly now can be reinstalled.

LEFT HAND ROTATION LOWER UNIT
MERC 800 - 700 DIRECT REVERSING MODELS

NOTE: For removal and disassembly of ignition, carburetors, fuel filters, fuel pumps, electrical starter parts and starter, see appropriate sections of this book.

Disassembly

A. Removing Gear Housing from Drive Shaft Housing

Remove three 5/8" hexagon head lock nuts which hold gear housing assembly to drive shaft housing (leading edge), also two 5/8" hexagon head lock nuts located in center bottom side of cavitation plate. *(Note: If engine is equipped with trim tab, it need not be loosened or removed.)* Remove water pickup under trailing edge of anti-cavitation plate (on engines not equipped with trim tab) by removing 2 screws at front end of water pickup housing, 5/16" allen head screw beneath plastic plug at rear top of drive shaft housing and 5/16" allen head screw beneath pickup housing.

At this time, lash between gears should be checked for future reference. Pull up on drive shaft and in on propeller shaft. Refer to back lash later, in Paragraph "D" of Reassembly.

B. Removing Propeller Shaft and Components

Mount gear housing assembly in vise between 2 blocks of soft wood to prevent marring of surface. Remove propeller by removing propeller nut cap, propeller nut, cup washer and cupped thrust washer. Also remove thrust hub and washer assembly. Remove gear case cover with Gear Case Cover Tool (91-29925A1 for Merc 700 and 91-30291A1 on Merc 800). Place tool over end of propeller shaft and set tool into cover, turning clockwise to loosen (left hand thread). (Figures 1 or 1A) If tight, strike handle of tool with mallet to loosen.

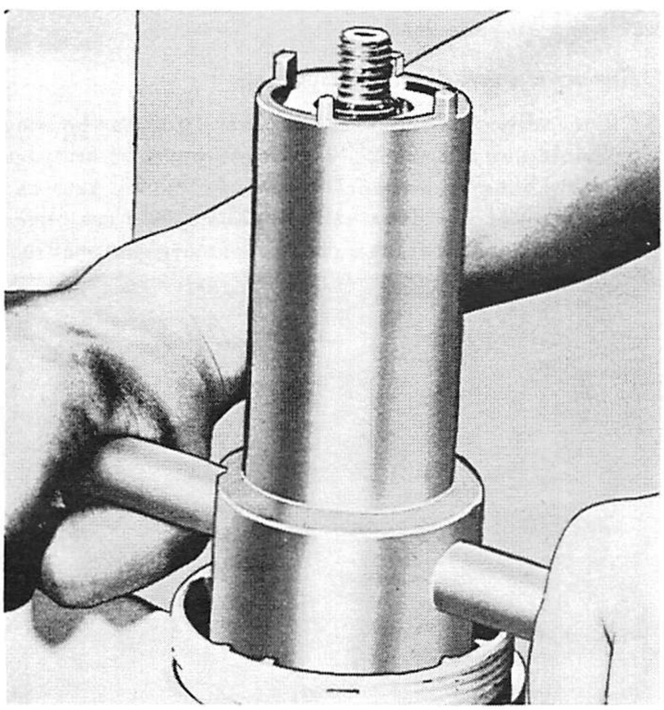


Figure 1. Removing Gear Case Cover, Merc 700

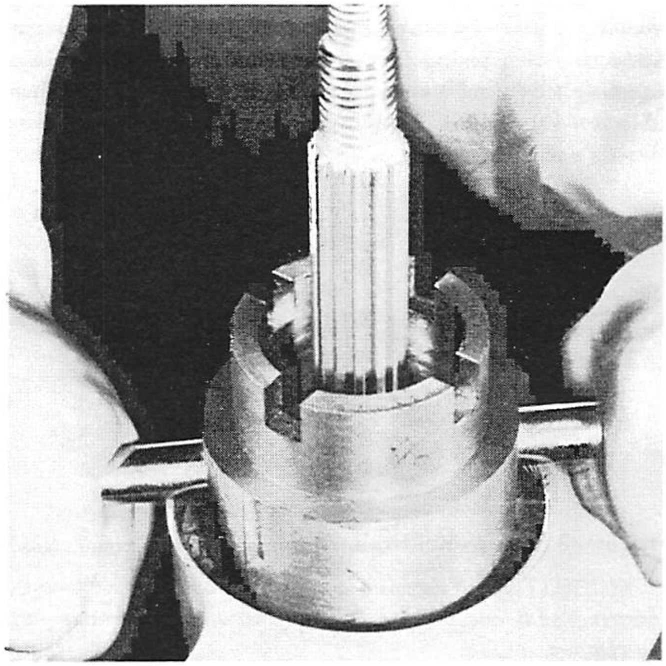


Figure 1A. Removing Gear Case Cover, Merc 800

Bearing carrier assembly can be removed while removing propeller shaft. To remove propeller shaft assembly, remove gear housing from vise and place propeller shaft in vise between 2 soft pieces of wood. The shaft assembly can be removed by tapping lightly and evenly on skeg and gear housing with a mallet. (Figure 2)

NOTE: On Merc 800, propeller shaft carrier can only be pulled out partially. It then is necessary to remove dowel locating pin from inside top of gear housing. Propeller shaft assembly now can be removed completely.

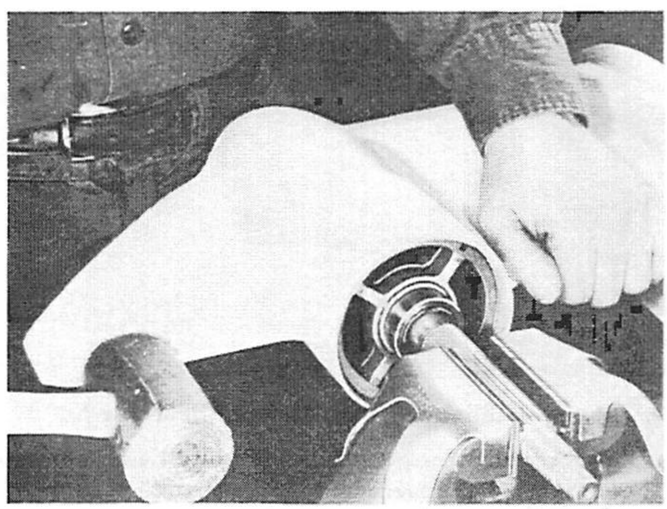


Figure 2. Removing Propeller Shaft Assembly from Gear Housing

After propeller shaft assembly has been removed, check for any shims which may be sticking to thrust ring. To remove bearing carrier from propeller shaft, hold carrier and tap on propeller shaft with mallet. Remove sealing sleeve from bearing carrier by pulling sleeve out of oil seal in carrier assembly. Also remove inner race and inner spacer. Drive oil seal from bearing carrier by tapping inside of oil seal with a small punch or screwdriver and a mallet. *(Note: Merc 800 has two seals.)* Roller bearing can be removed from carrier assembly by placing carrier assembly in arbor press, inserting Bearing Mandrel Tool (91-24288A1) and Bearing Adaptor (91-30406) into bearing and pressing roller bearing out. (Figure 3)

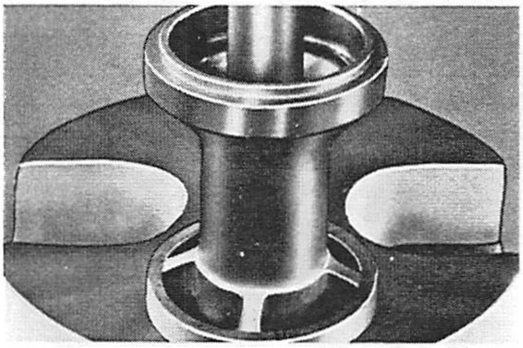


Figure 3. Removing Roller Bearing from Carrier Ass'y

IMPORTANT: Remove shims from gear housing bearing seat and wash gear housing and component parts to remove grease.

Remove ball bearing which is held in position by the special lock nut threaded on gear, and gear from propeller shaft by bending lock tabs down in gear lock nut recess. Set propeller gear lock nut end of 91-29925A1 tool over propeller shaft, with tongs of tool set into recesses of nut, and unscrew (right hand thread). (Figure 4) Lift lock tab off. Place Gear Puller Plate (91-22115) between gear and bearing, set assembly on arbor press and press bearing off. Gear drive pin in propeller shaft will drop out, as it is held in place by ball bearing. If gear drive pin is tight, use a 1/8" drive punch to drive pin from opposite side (small hole).

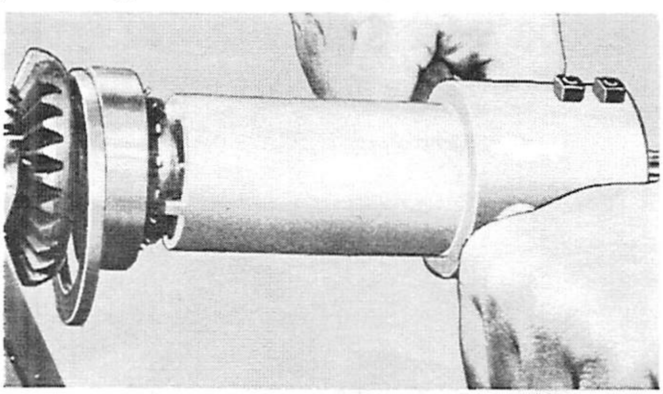


Figure 4. Removing Ball Bearing Retaining Nut

Remove propeller gear from shaft with Gear Tool Cup (91-26376A1). Set threaded end of propeller shaft into small hole of tool cup until gear shoulder rests on tool and press off with arbor press. (Figure 5) Care should

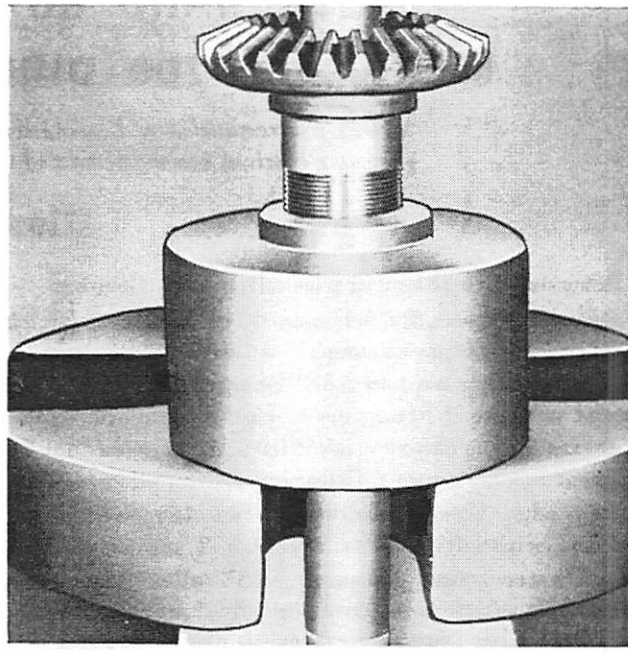


Figure 5. Pressing Propeller Gear from Propeller Shaft

be taken here to avoid marring propeller shaft

C. Removing Water Pump

Set gear housing in vise in upright position with skeg held between blocks of wood. Remove inlet water tube and outlet water tube from water pump housing and centrifugal slinger from drive shaft. Remove water pump body assembly by removing three ½" nuts and lock-washers and two 7/16" nuts and lockwashers. The impeller and impeller pin now can be removed along with water pump body, gasket, water pump face plate and gasket face plate to gear housing. (Figure 6) Remove flushing screw, seal and gasket to allow water pump base assembly to be lifted out. Watch for any shims under water pump base assembly.

D. Removing Drive Shaft Components

Place drive shaft in vise as close to gear housing as possible and remove ¾" elastic stop nut from drive shaft with box end wrench to loosen pinion gear and washer from end of drive shaft. Replace gear case skeg in vise between wooden blocks in upright position.

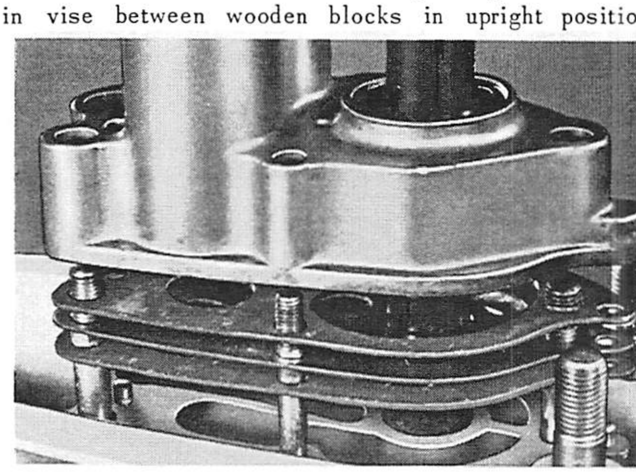


Figure 6. Merc 700-800 Water Pump Gaskets

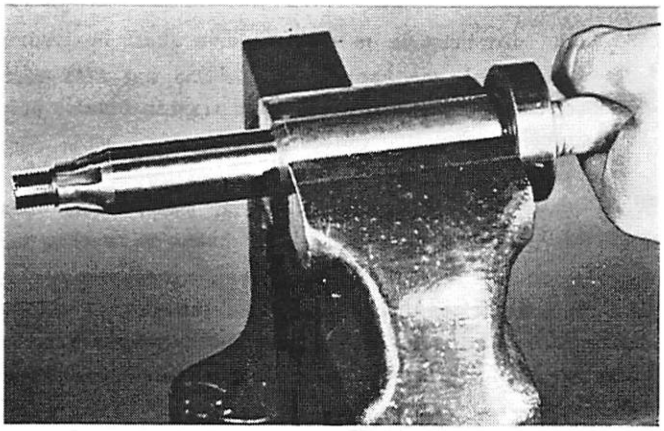


Figure 7. Removing Ball Bearing from Drive Shaft

Remove ball bearing retaining ring with Snap Ring Pliers. Again place drive shaft in vise with wooden blocks and tap firmly against top of gear housing with rawhide mallet to remove drive shaft from gear housing. Remove shims from under bearing and on shoulder of gear housing. Remove ball bearing from drive shaft by replacing against open vise jaws and tapping on end of drive shaft with mallet. (Figure 7)

E. Removing Needle Bearings from Gear Housing

Use Bearing Mandrel (91-24288) with 91-26377 sleeve on Merc 700, 91-30490 sleeve on Merc 800 to remove drive shaft needle bearings from gear housing. *(Note: Use Guide Collar of correct diameter in bearing seat.)* Place mandrel in drive shaft end of gear housing cavity, then press bearing out with arbor press or tap against tool with heavy mallet to remove bearing. (Figure 8)

To remove propeller shaft needle bearings from gear housing, insert puller jaws of Roller Bearing Puller (91-29312A1) inside of roller bearing. After tool is in bearing, pull shaft up and tool jaws will expand and catch bottom of bearing case. Place puller bar on shaft of tool and against gear housing and thread nut on shaft. Continue to tighten nut to remove bearing. (Figure 9)

NOTE: If Roller Bearing Puller is not available, pack bearing with heavy cup grease, place Bearing Mandrel (91-24288) with sleeve (91-26377) in bearing and strike mandrel sharply with heavy mallet several times to force bearing out.

This completes disassembly of the gear housing. All parts now should be washed in cleaning solvent and inspected for wear, replacing those which are worn, not useable or damaged.

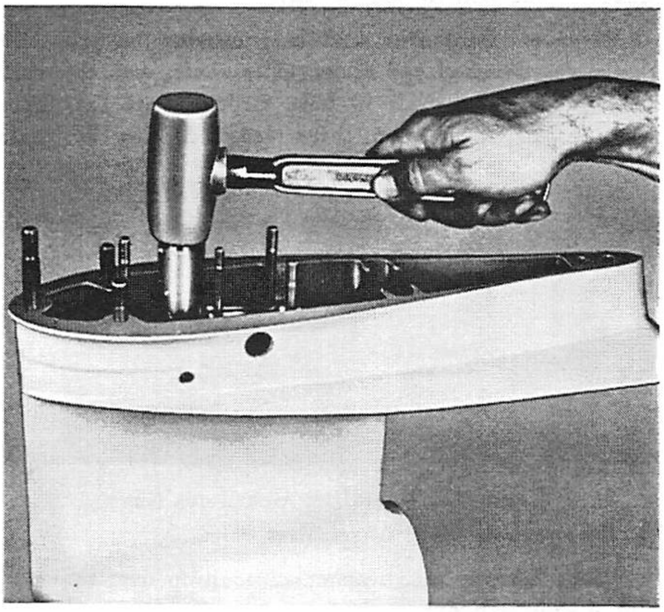


Figure 8. Removing Drive Shaft Needle Bearing from Gear Housing

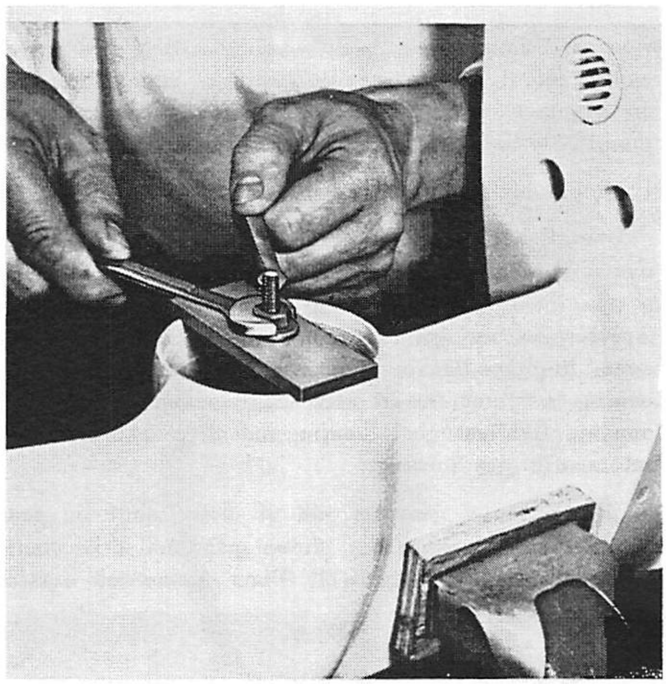
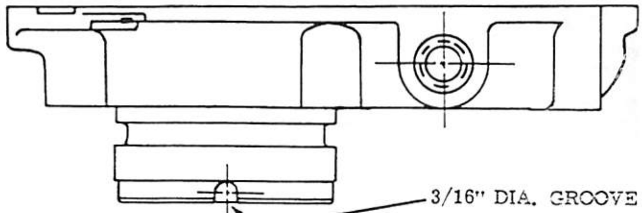


Figure 9. Removing Propeller Shaft Roller Bearing

Reassembly - L. H. Lower Unit - Merc 800-700 Dir. Rev.

NOTE: When installing replacement gear housing on early Merc 700 Direct Reversing engine, where small vent hole was below anti-cavitation plate, it will be necessary to either replace water pump base assembly (46-29972A1) or file a 3/16" diameter groove in water pump base assembly, as shown in drawing following. If groove is not in water pump base assembly, air in gear housing cannot excape when filling with EXTRA-DUTY Lubricant, in which case gear housing cannot be completely filled.



A. Replacing Needle Bearings in Gear Housing

Install propeller shaft and drive shaft bearing cartridges into gear housing with Bearing Mandrel Tool (91-24288) and sleeve (91-26377 on Merc 700, 91-30490 on Merc 800). *(Note: Use Guide Collar of correct diameter to set in ball bearing recess.)* Press drive shaft needle cartridge bearing in until bearing is recessed evenly on shoulder between upper drive shaft cavity and gear cavity. *(For ease of installation, always press against the numbered side of cartridge type bearing, as opposite end has a greater radius.)* Press propeller shaft cartridge bearing in until it bottoms. (Figure 10)

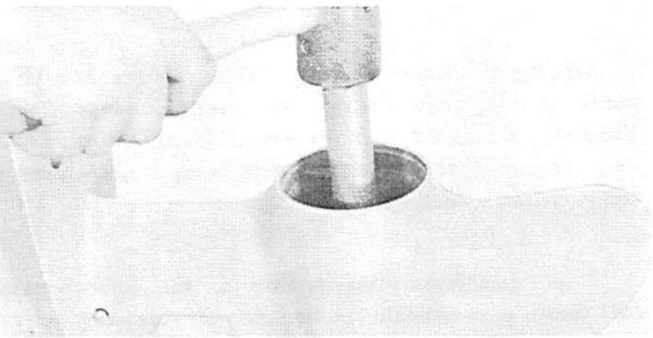


Figure 10. Installing Propeller Shaft Needle Bearings

Place gear housing in vise between 2 blocks of soft wood at thin section of gear housing so that gear cover end is up. Lubricate needle bearings in gear housing and replace shims which were removed originally or insert .005" shim on drive shaft bearing seat.

B. Replacing Drive Shaft Components

Install ball bearing on drive shaft by sliding bearing over drive shaft and seat on shoulder. Place drive shaft in vise loosely, set ball bearing on drive shaft bearing shoulder and tap against pinion splined end until bearing seats. Replace locking ring on drive shaft which holds bearing in place. Insert drive shaft assembly into gear housing, lubricate ball bearing and drive bearing down into seat in gear housing.

Place pinion gear on end of drive shaft in gear housing, making sure that pinion gear and drive shaft spline are aligned. (Figure 11) Place washer and elastic

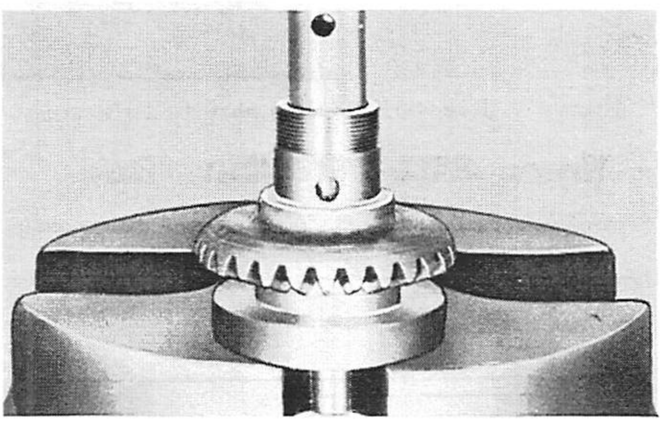


Figure 11. Reinstalling Propeller Gear on Propeller Shaft

stop nut onto threads on end of drive shaft by turning drive shaft with one hand while holding nut with other hand. Place drive shaft in vise and tighten elastic stop nut securely with ¾" wrench.

At this time replace shims, as required, on top of drive shaft bearing before replacing water pump base assembly. There should be no play between bearing and water pump base assembly when water pump base assembly is depressed. If base is too low, add shims; if too high, remove shims. No play may be obtained by over-shimming. Place a feeler gauge between gear housing and water pump body. If gap measured between gear housing and water pump body is .010", remove .010" shim; if .005", remove .005" shim. This will give a zero gap which is correct and should not be altered.

C. Replacing Propeller Shaft Components

Ready propeller shaft and bevel gear by placing blank end of propeller shaft into shoulder of gear. Be careful to place gear on shaft properly, aligning gear drive pin hole in propeller shaft and gear with steel rule. Place teeth down on Propeller Shaft Gear Tool (91-26376A1). Lubricate shaft and press in with arbor press until gear drive pin hole in gear aligns with hole in propeller shaft. (Figure 11) Place gear drive pin in aligned holes of propeller and gear to lock to shaft.

Replace thrust ring and ball bearing on propeller shaft over threaded end of propeller shaft, with threaded end of propeller shaft in hole through cap. Lubricate bearing and gear, then press into position on gear.

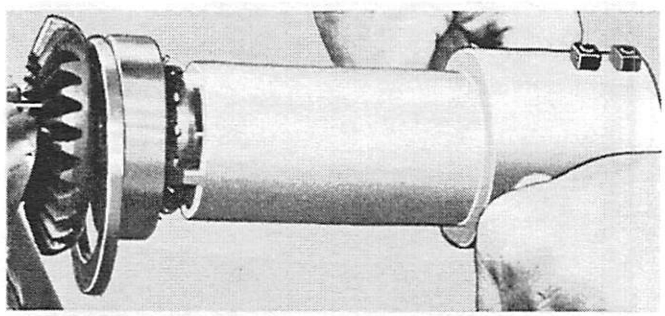


Figure 12. Installing Gear Lock Nut

D. Reinstalling Shaft Assemblies

Place locking tab washer in position over threaded end of gear, aligning in key way on gear. *(Note: Always use new tab washer.)* Thread gear lock nut into position and secure with Gear Housing Cover and Prop Gear Locknut Tool (91-29925A1). (Figure 12) Tighten gear lock nut securely *(do not strike tool to tighten)* and bend 4 lock tabs into recesses of gear lock nut. *(Note: If recesses do not align with lock tabs, loosen or tighten lock nut to align.)* Replace shims, as removed or required, on shoulder within gear housing and install complete propeller shaft and gear assembly into housing. Use mallet to tap propeller shaft assembly into place, being careful not to get any chips or dirt into gears or bearings. If assembly fits tight, check and make sure entire assembly is centered, straight into housing.

NOTE: At this point it is very important to check gear back lash of assembly. After drive shaft pinion gear and propeller shaft bevel gear have meshed, check back lash of assembly by pulling out on drive shaft and in on propeller shaft assembly. Rotate drive shaft in a clockwise and counterclockwise direction very lightly to feel gear lash. No more than .006" to .008" play should be allowed for proper operation. If more than recommended back lash is present, remove shims beneath propeller shaft assembly to mesh gears properly. If too tight and no back lash is present, add a sufficient amount of shims for correct end play and conical angle of gears. The shims under bearings on drive shaft and propeller shaft must be closely watched so as not to shim too much in either direction, but keep proper mesh.

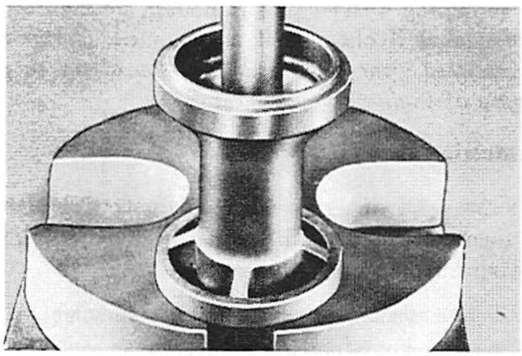


Figure 13. Installing Roller Bearing to Carrier Ass'y

E. Installation of Bearing Carrier

Press roller bearing into bearing carrier from rear of housing with Bearing Mandrel (91-24288A1) and sleeve adaptor (91-30406). (Figure 13) Press until bearing is flush with start of shoulder at front of housing. Press oil seal (lips inward) to seat on shoulder in front of roller bearing. *(Note: On Merc 800, there are two seals, first one with lip inward, second with lip of seal out.)* Replace bearing carrier "O" ring. Place inner spacer and inner race on propeller shaft. Install bearing carrier into gear housing, pushing in until it seats against ball bearing thrust ring. *(Note: On Merc 800, dowel locating pin must be replaced before carrier is pushed into place.)* Install small "O" ring in sealing sleeve and slide small end of sealing sleeve over propeller shaft and push into oil

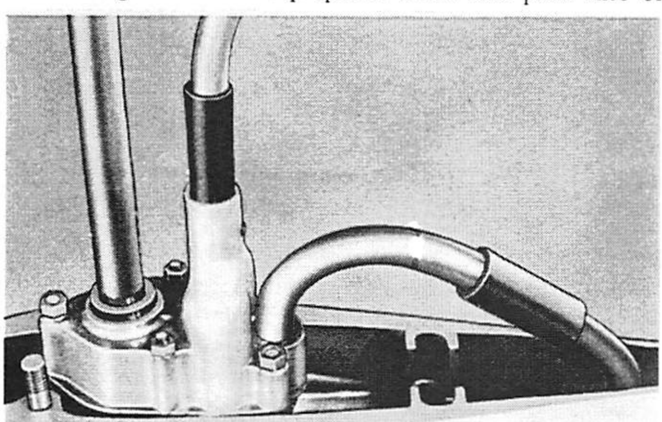


Figure 14. Water Pump Cover Assembly Mounted with Water Lines Installed

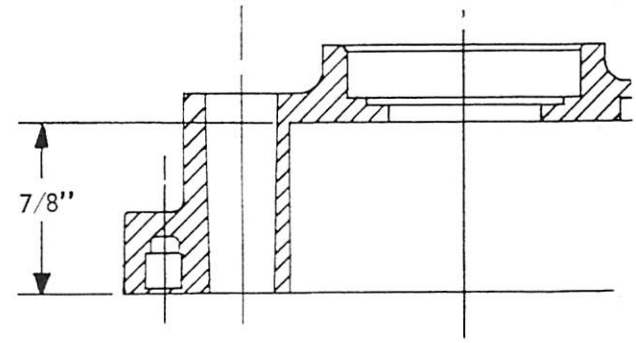


Figure 15. Water Pump Cover Cartridge Recess

seal of bearing carrier until it bottoms. Slide second small "O" ring over propeller shaft to seat in recess on large diameter end of sealing sleeve. Place gear case cover washer on bearing carrier. Coat threads of gear housing cover with a coat of MULTIPURPOSE Quicksilver Lubricant (92-30239) to facilitate easy removal. Tighten gear housing cover in clockwise direction with Gear Housing Cover and Propeller Gear Locknut Tool (91-29925A1 on Merc 700, 91-30291A1 on Merc 800). Check that there is no end play in propeller shaft by pressing on end of propeller shaft. Also check to be sure that correct back lash of gears is maintained.

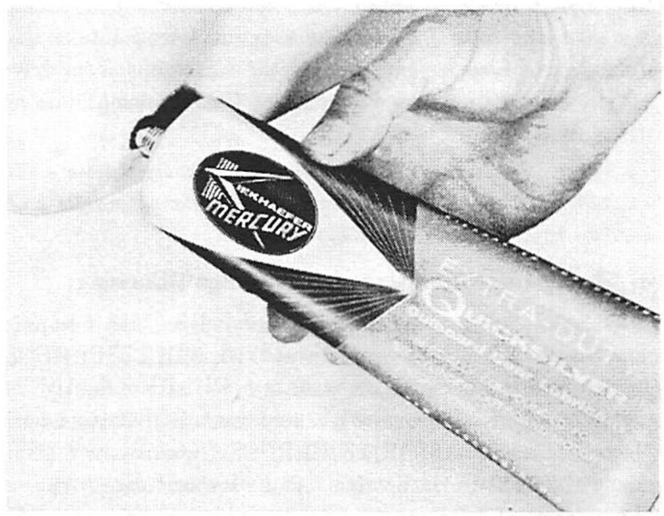


Figure 16. Lubrication of Lower Drive Unit

F. Installation of Water Pump Body Assembly

Place water pump gasket, face plate and body to gear housing gasket on top of water pump base assembly. (Figure 6) Place impeller pin in flat side of drive shaft and press impeller into place. Impeller should have lubricant. *(Important: Impeller should be checked closely for cracks or dried condition before installation.)* Replace water check valves and adaptor assemblies. *(Important: Be sure that 2 water check valves are in good condition, not deteriorated, torn or set out of shape. Water valve end should be closed.)* Check for proper amount of shims. Place 2 water pump plate gaskets on each side of water pump cover plate between water pump cover, cover plate and gear housing face. (Figure 14) *(Important: When servicing Merc 700 engines, below Serial No. 1298978 with 46-29611A1 water pump housing, do not place water pump cover plate gaskets beneath water pump housing, or it will result in reduced water* *pump pressure and may cause engine to overheat and score pistons. Instead, use Gasket Sealer [92-28804] between water pump cover, cover plate and gear housing face. Former water pump cover cartridge recess was 29/32" deep [.906"] while Merc 700's, Serial No. 1298978 and up, have a 7/8" deep [.875"] recess. [Figure 15].)* Replace water pump body assembly; check by rotating drive shaft in either direction to be sure impeller and impeller pin are in proper position and are being driven by shaft. At this time replace and tighten three ½" and two 7/16" nuts and lockwashers. Replace flushing hole screw and gasket in flushing hole seal into water pump base assembly. At this time, again check for correct back lash between pinion and propeller shaft gear (.003" to .005"). If incorrect, propeller shaft again must be removed and correct amount of shims either removed or added to make up for proper tolerance.

Replace water inlet tube sleeve and water intake tube in position (Figure 12), being sure that rubber seals are in place, then replace centrifugal slinger over drive shaft just above oil seal. The slinger throws off any sand or silt from oil seal as an added protection.

(Note: On early Merc 700 engines, check water pump intake screen louvers in gear housing so that they are at the correct angle [slanted in, toward gear housing] to pick up water flow.) Water tube extends from intake hole to intake of water pump body hole farthest from drive shaft. Outlet line sets into outlet of water pump housing. (Figure 12)

(Note: If flushing hole screw is not new type (10-31498) with 1/16" hole drilled thru center, drill the hole or replace with 10-31498 screw.)

G. Joining Gear Housing and Drive Shaft Housing

Before joining gear housing and drive shaft housing coat water inlet tube upper end with MULTIPURPOSE Quicksilver Lubricant, so that it will slip easily into rubber seal in bottom cowl, and insert in bottom cowl. Place light coat of MULTIPURPOSE Quicksilver Lubricant (92-30239-1) on bottom end of water tube. Apply a heavy coat of lubricant on drive shaft spline end, then join gear housing and drive shaft housing with drive shaft splined end into crankshaft. Be careful that water inlet tube enters rubber seal in water pump cover in gear housing. Rotate propeller shaft in either direction until drive shaft spline enters crankshaft spline. With 2 housings joined, install and tighten 5 elastic stop nuts and one 5/16" allen head screw. Place new gasket on water pickup housing and thread 2 screws into front end of water pickup housing. Thread 7/32" allen head screw from top side of drive shaft housing, tighten and replace plastic plug in drive shaft housing.

H. Lower Drive Unit Lubrication

Remove filler hole screw from gear case, being careful not to lose accompanying washer. Place lubricant tube end in filler hole. Remove air vent screw from air vent hole just above anti-cavitation plate, being careful not to lose accompanying washer. Inject EXTRA-DUTY Quicksilver Outboard Gear Lubricant (92-30295-1) into gear case until excess lubricant starts to flow out of air vent screw hole. Replace air vent screw and washer into air vent hole and tighten before removing tube from filler hole. This will create an airlock and hold oil in gear case until filler hole screw is replaced. Remove tube end from filler hole, replace screw and washer into filler hole and tighten. (Figures 16 and 17)

I. Installation of Test Wheel

Use Merc 800-700 Test Wheel (91-30589) while checking engine in test tank. Before installing Test Wheel, first remove water pickup housing and gasket from under anti-cavitation plate. *(Note: Install specially treated water pickup housing 30427A1 on early 800-700 engines to aid in reducing corrosion and pitting action.)* When replacing water pickup housing, be sure to install a new gasket if old gasket is damaged. *(Note: Always be sure that your test tank is kept clean to prevent clogging of engine's water intake.)*

J. Installing Propeller

Use the following procedure for installing Merc 800-700 propellers, thus eliminating the possibility that propeller hub may rub on gear case:

1. Place thrust hub and washer assembly into propeller hub (shoulder into recess of propeller).
2. Apply thin coat of MULTIPURPOSE Quicksilver Lubricant (92-30239) on splines of propeller shaft.
3. Align propeller hub splines with splines of propeller shaft and slide propeller on shaft. Tap into position if necessary.
4. Place propeller shaft cup washer on shaft with shoulder into recess of propeller hub.
5. Thread propeller elastic stop nut on propeller shaft.
6. Tighten elastic stop nut with 1-1/16" or adjustable wrench.
7. Place propeller nut cap on end of propeller shaft.
8. Tighten propeller nut cap securely with 15/16" or adjustable wrench.

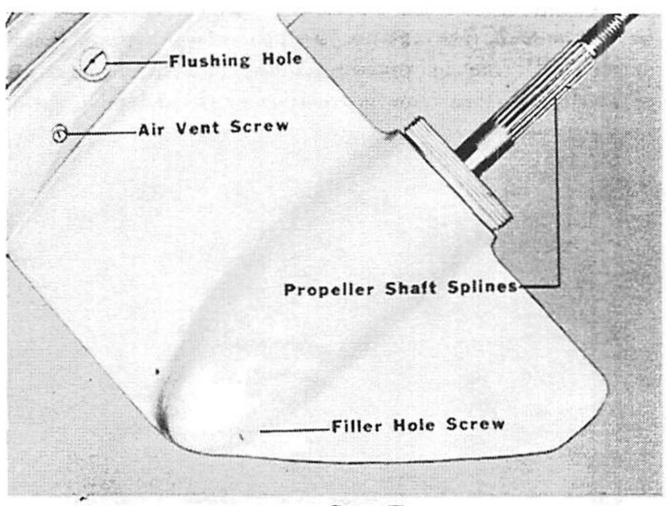
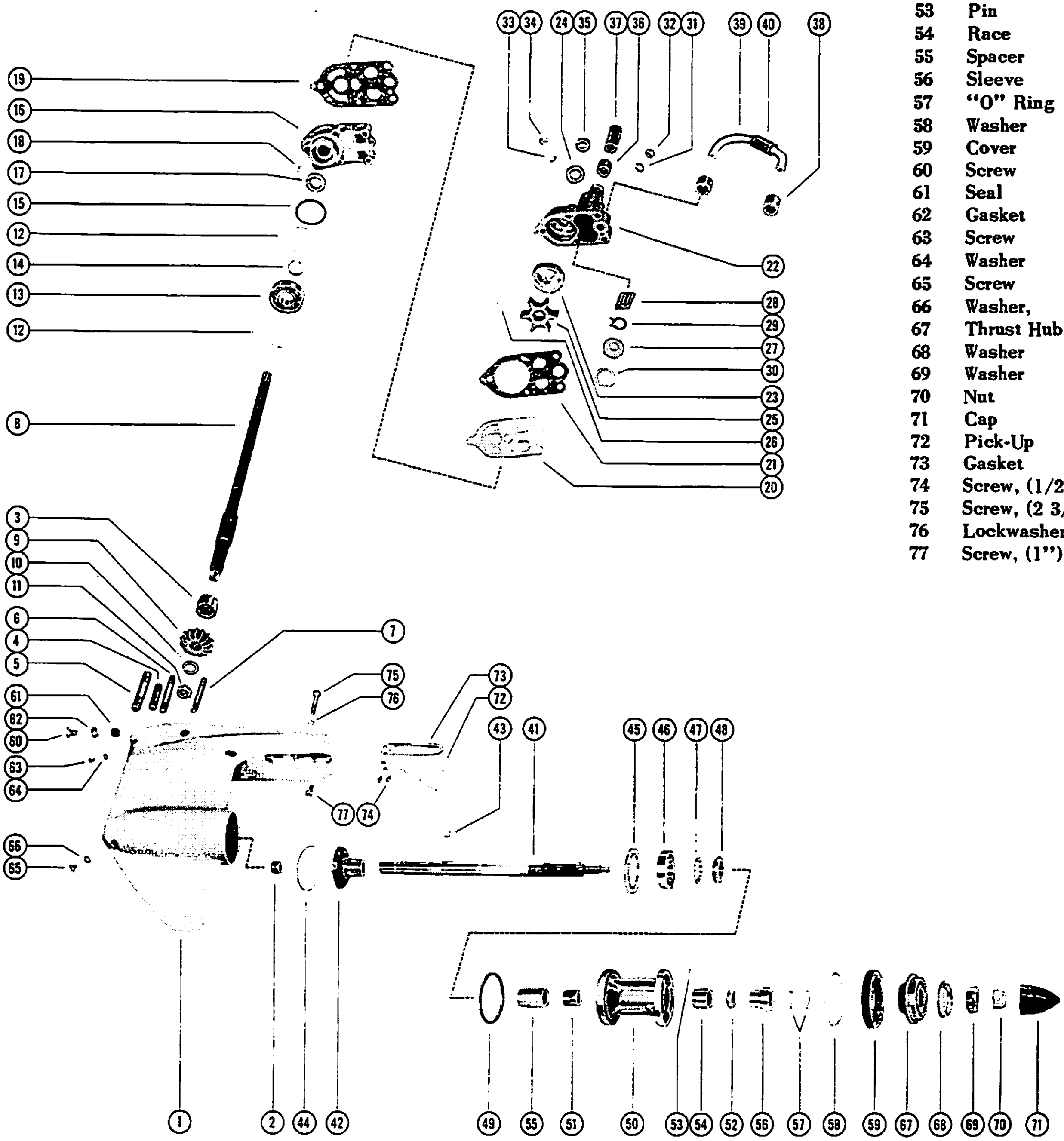


Figure 17. Gear Housing

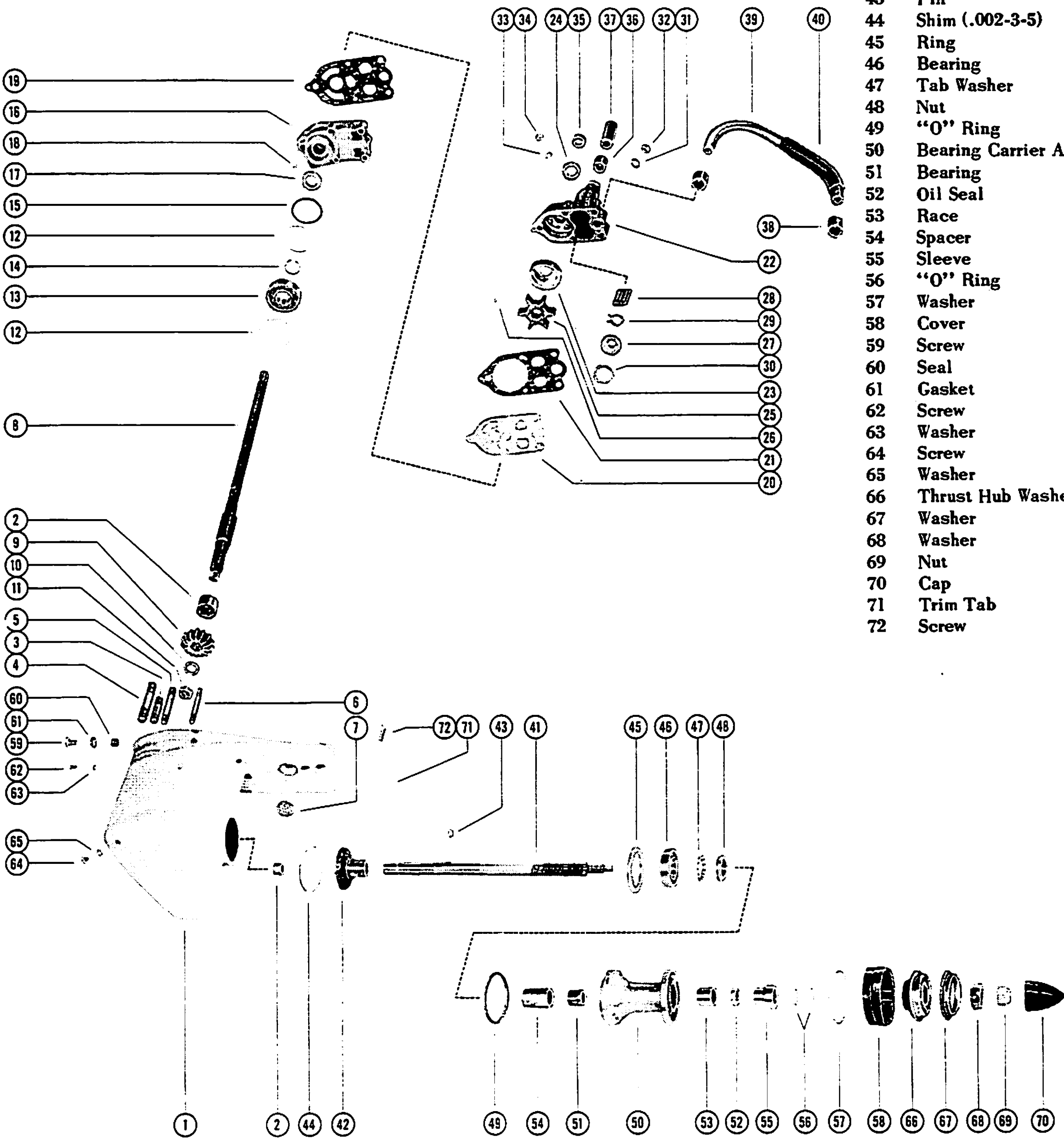
PROPELLER WARNING: Use of Merc 700 propellers on Merc 800 engines will result in gear housing damage and void engine warranty!

1 Gear Housing Assembly
2 Bearing, roller
3 Bearing, roller
4 Stud, (2")
5 Stud, (3")
6 Stud, (3")
7 Stud, (3 5/16")
8 Drive Shaft (standard) & (long)
9 Gear
10 Washer
11 Nut
12 Shim, (.002-3-5-10)
13 Bearing
14 Ring
15 "O" Ring
16 Water Pump Base Assembly
17 Oil Seal
18 Pin
19 Gasket
20 Plate
21 Gasket
22 Water Pump Body Assembly
23 Insert
24 Oil Seal
25 Impeller
26 Pin
27 Water Valve and Adaptor Assembly
28 Valve
29 Clamp
30 Shim, (.003-5-10)
31 Lockwasher, (5/16)
32 Nut, (5/16)
33 Lockwasher, (1/4)
34 Nut, (1/4)
35 Ring, rubber
36 Seal, rubber
37 Sleeve
38 Seal, rubber
39 Water Intake Tube Assembly
40 Sleeve
41 Shaft
42 Gear
43 Pin
44 Shim, (.002-3-5-10)
45 Ring
46 Bearing, ball
47 Tab washer
48 Nut
49 "O" Ring
50 Bearing Carrier Assembly
51 Bearing
52 Oil Seal
53 Pin
54 Race
55 Spacer
56 Sleeve
57 "O" Ring
58 Washer
59 Cover
60 Screw
61 Seal
62 Gasket
63 Screw
64 Washer
65 Screw
66 Washer,
67 Thrust Hub and Washer Assy
68 Washer
69 Washer
70 Nut
71 Cap
72 Pick-Up
73 Gasket
74 Screw, (1/2")
75 Screw, (2 3/4")
76 Lockwasher
77 Screw, (1")



Gear Housing Assembly Complete (Standard Left Hand Rotation), Merc 800

1	Gear Housing Assembly
2	Bearing, roller
3	Stud, gear housing (2")
4	Stud, gear housing (3")
5	Stud, water pump cover (3")
6	Stud, water pump cover (2-7/8")
7	Screen
8	Drive Shaft (standard & long)
9	Gear, pinion
10	Washer
11	Nut
12	Shim, (.002-3-5-10)
13	Bearing
14	Ring
15	"O" Ring,
16	Water Pump Base Ass'y
17	Oil Seal
18	Pin
19	Gasket
20	Plate
21	Gasket
22	Water Pump Body Ass'y
23	Insert
24	Oil Seal
25	Impeller
26	Pin
27	Water Valve Adaptor Ass'y
28	Valve
29	Clamp,
30	Shim (.003-5-10)
31	Lockwasher (5/16)
32	Nut (5/16)
33	Lockwasher (1/4)
34	Nut (1/4)
35	Ring, rubber
36	Seal, rubber
37	Sleeve
38	Seal, rubber
39	Tube
40	Sleeve
41	Shaft
42	Gear
43	Pin
44	Shim (.002-3-5)
45	Ring
46	Bearing
47	Tab Washer
48	Nut
49	"O" Ring
50	Bearing Carrier Ass'y
51	Bearing
52	Oil Seal
53	Race
54	Spacer
55	Sleeve
56	"O" Ring
57	Washer
58	Cover
59	Screw
60	Seal
61	Gasket
62	Screw
63	Washer
64	Screw
65	Washer
66	Thrust Hub Washer Ass'y
67	Washer
68	Washer
69	Nut
70	Cap
71	Trim Tab
72	Screw



Gear Housing Assembly Complete (Standard Left Hand Rotation), Merc 700

RIGHT HAND ROTATION LOWER UNIT

MERC 800-700 DIRECT REVERSING MODELS

Disassembly

(Refer to assembly sequence of counterclockwise lower unit parts on PP 71-72.)

A. Removing Gear Housing from Drive Shaft Housing

1. Remove three 5/8" hexagon head lock nuts which hold gear housing assembly to drive shaft housing (leading edge).
2. Remove two 5/8" hexagon head locknuts located in center bottom side of anti-cavitation plate. *NOTE: If engine is equipped with a trim tab, it need not be loosened or removed.*
3. Remove water pickup under trailing edge of anti-cavitation plate by removing 2 screws at front end of water pickup housing, plastic plug and 7/32" allen head screw and 5/16" allen head screw from rear bottom of drive shaft housing.
4. Separate gear housing from drive shaft housing.

B. Removing Propeller Shaft and Components

1. Place gear housing assembly in vise between 2 blocks of soft wood to prevent marring surface.
2. Drain EXTRA-DUTY Lubricant from gear housing by removing filler hole screw and vent screw. (Figure 16) Do not lose washers. Replace washers and screws after draining.
3. Place a piece of wood flat between propeller and anti-cavitation plate to prevent engine from accidentally starting while removing propeller.
4. Remove brown cap from end of propeller shaft (left hand thread).
5. Remove propeller by removing propeller nut (right hand thread), cupped thrust washer, propeller and thrust hub and washer assembly.
6. At this time, lash between gears should be checked for future reference. Pull on drive shaft with one hand and push on propeller shaft with other. Refer to backlash later in Paragraph E-11 of Reassembly.
7. Loosen small square head set screw in gear case cover.
8. Remove gear case cover and washer with Gear Case Cover Tool (91-30291A1). Place tool over end of propeller shaft and set tool into cover, turning clockwise to loosen (left hand thread). (Figure 1) If tight, strike handle of tool with mallet to loosen.
9. Remove bearing carrier assembly and sealing sleeve with 91-27780 tool. (Figure 2)
10. Press roller bearing and seal from carrier assembly on arbor press with Bearing Mandrel (91-24288A1) and Bearing Adaptor (91-30406). (Figure 3)
11. Remove "O" ring from carrier and 2 "O" rings from sealing sleeve.
12. Bend tab out of ball bearing retaining nut with a drift or punch.
13. Position drive shaft in vise as close to housing as possible.
14. Place tool (91-29925A1) over propeller shaft (small end down) and loosen retaining nut (left hand thread). (Figure 14) *(Note: On some 91-29925A1 tools, center hole is too small, 1-1/32". Redrill to 1-3/8".)*

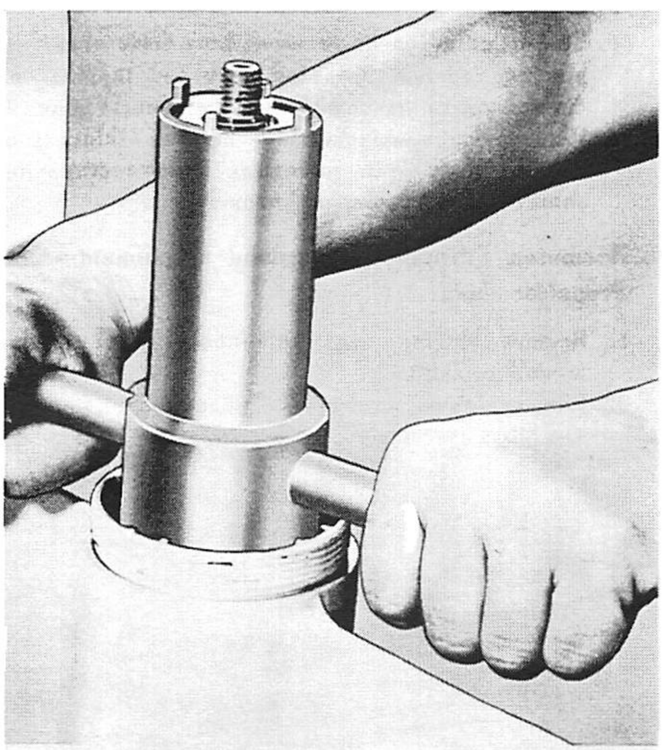


Figure 1. Removing Gear Case Cover

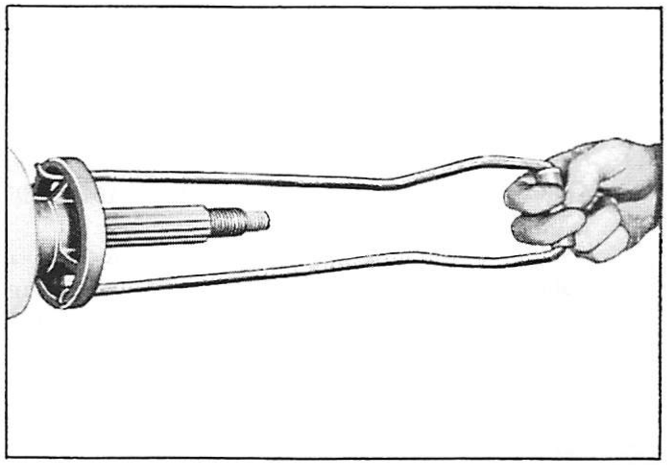


Figure 2. Removing Bearing Carrier Assembly

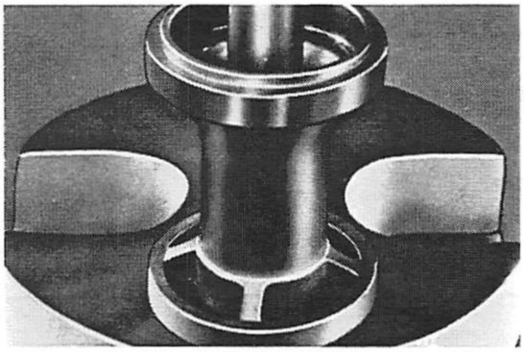


Figure 3. Pressing Roller Bearing from Carrier Ass'y

15. Remove nut and tab washer.
16. Remove ball bearing and bearing adaptor with puller tool (91-29456A3) with 3 studs (16-30691, 6/32 thread size). (Figure 4)
    NOTE: Later Merc 800's have a thrust ring in place of ball bearing adaptor. Remove thrust ring in same manner as adaptor. First thrust rings did not have 3 screw holes for removal. To remove thrust ring without holes, place heavy block of wood on bench or floor, lift gear housing in two hands and strike wood block with end of propeller shaft. Ball bearing and thrust ring then will drop out of gear housing. Drill 3 holes in thrust ring with #36 drill and tap with 6-32 tap. (Figure 5)

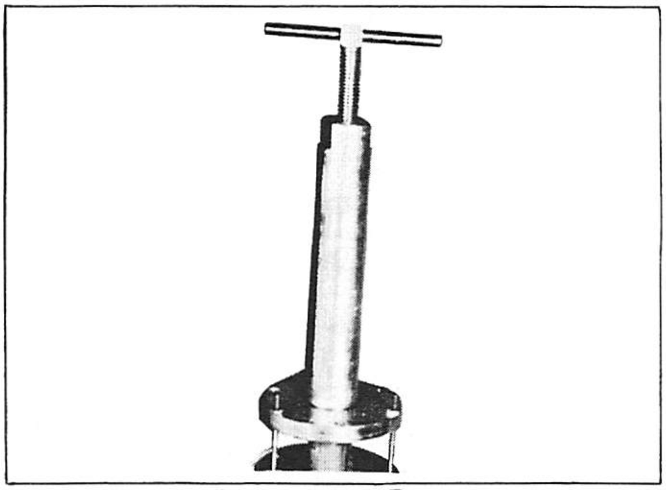


Figure 4. Removing Ball Bearing Adaptor

17. Tighten studs into bearing adaptor evenly.
18. Tighten tool handle and remove adaptor and bearing. Observe and remove shims under ball bearing adaptor.

C. Remove Water Pump

1. Set gear housing in vise in upright position with skeg held between blocks of wood.
2. Remove inlet and outlet water tubes from water pump housing.
3. Remove centrifugal slinger from drive shaft.
4. Remove water pump body assembly by removing three ½" nuts and lockwashers, plus two 7/16" nuts and lockwashers.
5. Remove water valve adaptor assembly, water pump insert, impeller and impeller pin along with water pump body, gasket, water pump face plate and gasket face plate to gear housing and oil seal. (Figure 6) Check impeller and impeller pin closely for wear or damage.
6. Remove flushing screw, seal and gasket to allow water pump base assembly to be lifted out.
7. Remove "O" ring and oil seal from base plate assembly and watch for shims under base assembly.

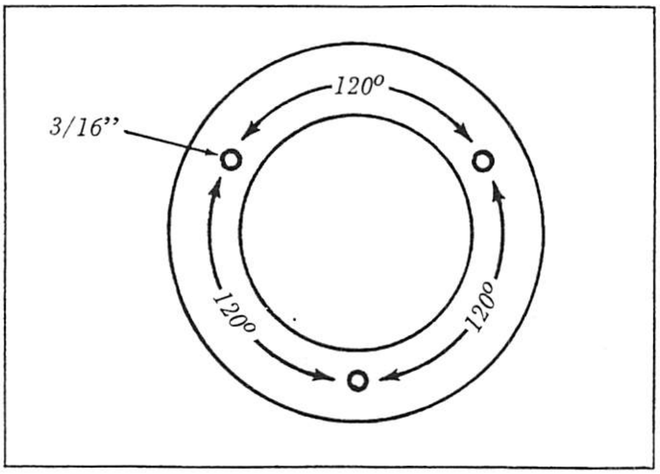


Figure 5. Thrust Ring Holes

D. Removing Drive Shaft and Components

1. Place drive shaft in vise as close to gear housing as possible.
2. Remove ¾" elastic stop nut from drive shaft pinion gear with a thin ¾" open-end wrench (right hand thread).
3. To loosen drive shaft, hold gear housing in one hand and tap lightly on gear housing with rawhide mallet.
4. Observe any shims under drive shaft ball bearing.
5. Remove ball bearing retaining ring with snap ring pliers.
6. Ball bearing can be removed from drive shaft by placing against open vise jaws and tapping on splined end of drive shaft with a mallet. (Figure 7)
7. Place gear housing in vise between 2 blocks of soft wood or jaw protectors. Remove propeller shaft assembly from gear housing.

E. Removing Propeller Gear and Components from Propeller Shaft

1. Remove locking ring which holds dowel pin in propeller shaft.
2. Remove dowel pin with 1/8" punch.

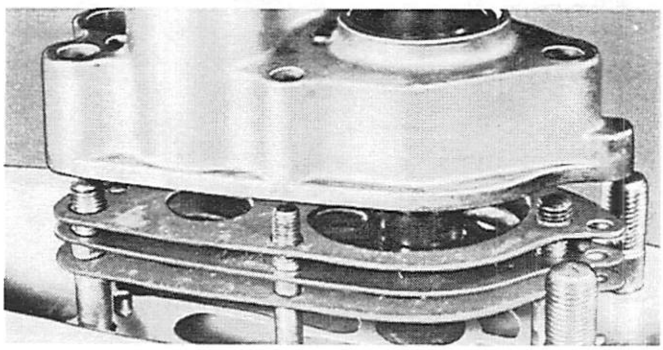


Figure 6. Water Pump Gaskets and Face Plate

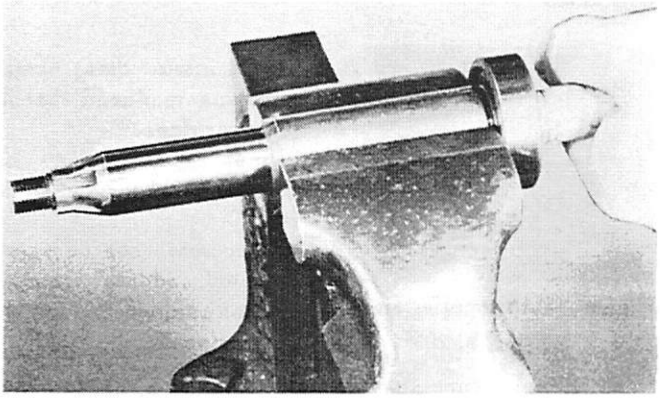


Figure 7. Removing Ball Bearing from Drive Shaft

3. Place propeller shaft assembly in Gear Cup Tool (91-26376A1) on Arbor Press or Utility Press.
4. Press on threaded end of propeller shaft and press off the sleeve, spacer and gear. (Figure 8) Care should be taken not to mar shaft. *(Note: Some propeller shafts do not have shoulder on bearing end. Press out propeller shaft through rear end of gear, on smooth end of shaft, using 2 blocks of metal with press.)*

F. Removing Needle Bearings from Gear Housing

1. Remove drive shaft needle bearings from gear housing with Bearing Mandrel (91-24288) and 91-26377 sleeve for Merc 700, 91-30490 sleeve for Merc 800. Use Guide Collar of correct diameter in bearing seat.
2. Place mandrel in drive shaft end of gear housing cavity.
3. Press bearing out with arbor press or tap on tool with heavy mallet to remove bearing. (Figure 9)
4. To remove propeller shaft needle bearing from gear housing, insert puller jaws of Roller Bearing Puller (91-29312A1) inside of roller bearing.

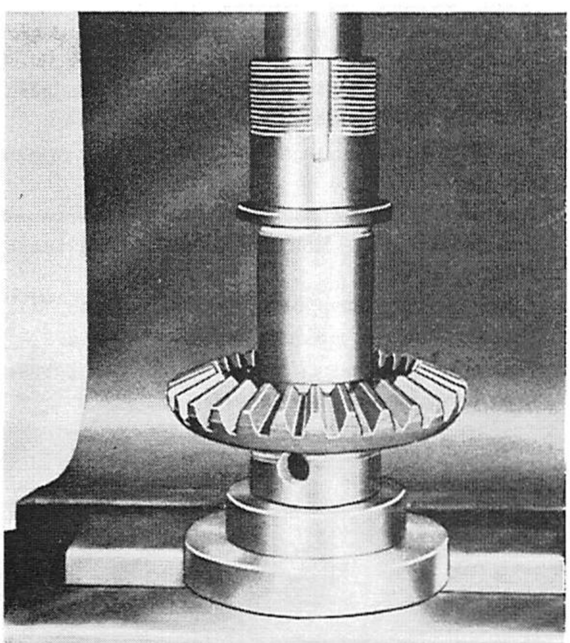


Figure 8. Pressing Propeller Gear from Propeller Shaft

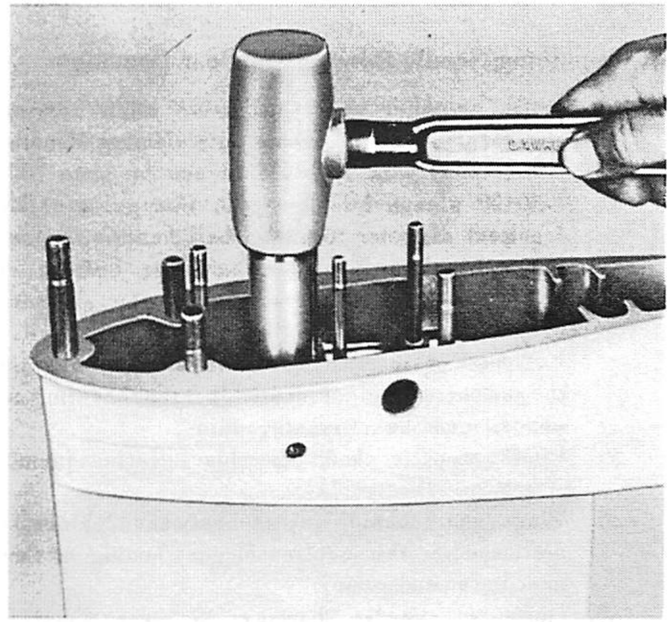


Figure 9. Removing Drive Shaft Needle Bearing from Gear Housing

5. After tool is in bearing, pull shaft up and tool jaws will expand and catch bottom of bearing case.
6. Place puller bar on shaft of tool and against gear housing and thread nut on shaft.
7. Tighten nut to remove bearing. (Figure 10)

NOTE: If Roller Bearing Puller (91-29312A1) is not available, pack bearing with heavy cup grease, place Bearing Mandrel (91-24288) with sleeve (91-26377) in bearing and strike mandrel sharply with heavy mallet several times to force bearing out.

This completes disassembly of gear housing. All parts now should be washed in cleaning solvent and inspected for wear, replacing those which are worn, not useable or damaged.

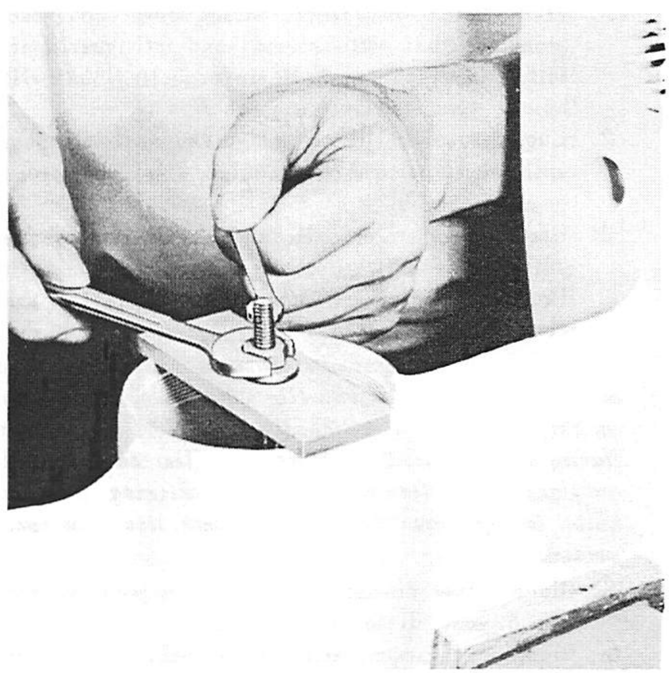


Figure 10. Removing Propeller Shaft Roller Bearing

Reassembly

A. Replacing Needle Bearings in Gear Housing

1. Install propeller shaft and drive shaft bearing cartridges into gear housing with Bearing Mandrel (91-24288A1) with 91-26377 sleeve for Merc 700, 91-30490 sleeve for Merc 800. Use guide collar of correct diameter to set in ball bearing recess.
2. Press drive shaft needle cartridge bearing in until bearing is recessed evenly on shoulder between upper drive shaft cavity and gear cavity. For ease of installation, always press against the numbered side of cartridge type bearing, as opposite end has a greater radius.
3. Press propeller shaft cartridge bearing in until it bottoms. (Figure 11)
4. Place gear housing in vise between 2 blocks of soft wood at thin section of gear housing so that gear cover end is up.
5. Lubricate needle bearings in gear housing.
6. Replace shims which were removed originally or insert .005" shim on drive shaft bearing shoulder of gear housing.

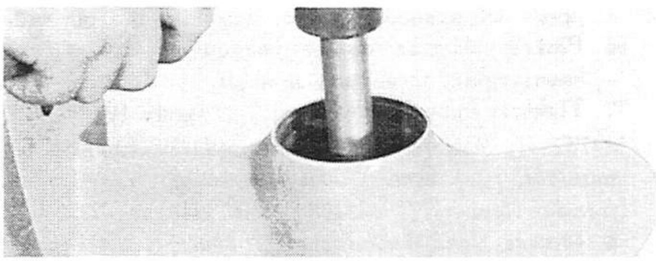


Figure 11. Installing Propeller Shaft Cartridge Bearing

B. Replacing Propeller Shaft and Drive Shaft Components

1. Place propeller gear on Propeller Shaft Gear Tool (91-26376A1) with teeth facing down and insert propeller shaft with splined end into gear. Carefully align gear pin hole in propeller shaft with hole in gear for drive pin.
2. Lubricate shaft lightly and press shaft into gear until shaft bottoms on shoulder. Use arbor press or utility press.
3. Place spacer on propeller shaft and insert threaded collar on shaft, shoulder end first. Place in Propeller Shaft Gear Tool (91-26376A1) cup and press on until seated.

NOTE: On propeller shafts without shoulder on gear end, place spacer on propeller shaft gear. Place gear on Propeller Shaft Gear Tool (91-26376A1) with teeth facing up (Figure 12) and set propeller shaft (smooth end) and spacer into propeller gear, aligning drive pin holes in gear and shaft. Press shaft into gear until seated.

4. Place drive pin and spring clip in position over end of gear. (Refer to Figure 12.)
5. Replace 2 spacers, ball bearing locking collar and bearing race on propeller shaft.
6. Place propeller shaft assembly in gear housing, being sure that shaft recesses in needle bearing cartridge.

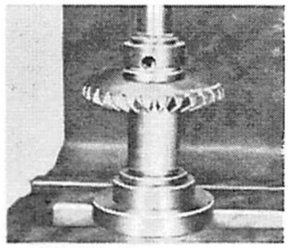


Figure 12. Propeller Gear on Shaft

7. Place ball bearing on drive shaft bearing shoulder.
8. Place drive shaft in vise loosely, and tap against pinion splined end until bearing seats.
9. Replace locking ring on drive shaft to hold bearing in place. Use lock ring pliers.
10. Place shims as required, or as previously removed into gear housing on shoulder of housing.
11. Insert drive shaft assembly into gear housing.
12. Before seating drive shaft and bearing, place pinion gear on spline end, aligning with splines in gear.
13. Replace washer and ¾" elastic stop nut on end of drive shaft.
14. Place drive shaft in vise, as close to housing as possible and tighten elastic stop nut with ¾" open end thin ¾" wrench.
15. Lubricate ball bearing and tap drive shaft assembly onto seat in gear housing.
16. Remove drive shaft from vise and install skeg of gear housing in vise between 2 blocks of soft wood or jaw protectors with drive shaft facing up.
17. At this time replace shims, as required, on top of drive shaft bearing before replacing water pump base assembly. There should be no play between bearing and water pump base assembly when water pump base assembly is depressed. If base is too low, add shims; if too high, remove shims. No play may be obtained by over-shimming. Place a feeler gauge between gear housing and water pump body. If gap measured between gear housing and water pump body is .010", remove .010" shim; if .005" remove .005" shim. This will give a zero gap which is correct and should not be altered.
18. Press oil seal in water pump base assembly, lip up.
19. Install "O" ring on water pump base assembly and coat with MULTIPURPOSE Lubricant (92-30239).
20. Place water pump base assembly, with "O" ring facing down, in position in gear housing.
21. Replace flushing hole screw and gasket seal in gear housing and tighten screw.

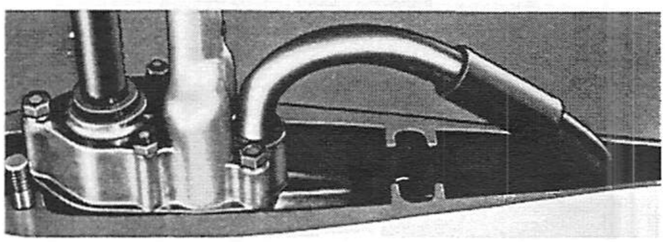


Figure 13. Water Pump Assembly Mounted with Water Lines Installed

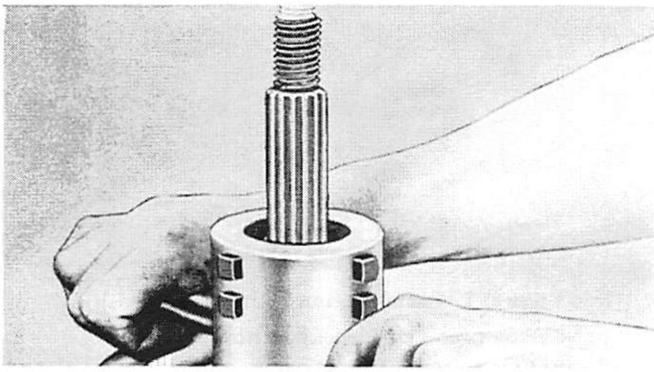


Figure 14. Installing (Removing) Gear Lock Nut

C. Installation of Water Pump Body Assembly

1. Install water pump base-to-face-plate gasket and replace stainless face plate.
2. Install drive pin on drive shaft.
3. Check condition of impeller closely, and set in place over drive shaft.
4. Set water valves and adaptor assemblies, with shims if any, in water pump body and place water pump body-to-face-plate gasket on water pump body.
5. Slide water pump body assembly over drive shaft.
6. Turn drive shaft clockwise and press water pump body assembly into place at same time.
7. Tighten nuts and replace lower water intake copper tube and drive shaft slinger.
8. Place plastic water tube guide in water pump body recess.

NOTE: Observe that water tube extends from intake of water pump body hole farthest from drive shaft. Outlet line sets into outlet of water pump housing. (Figure 13)

D. Installing Gear Lock Nut

1. Place locking tab washer in position over threaded end of propeller shaft aligning in keyway on gear. *(Note: Always use new tab washer, if available.)*
2. Thread gear lock nut into position (left hand thread) with Propeller Gear Lock Nut Tool (91-29925A1). (Figure 14)
3. Tighten gear lock nut securely. Do not strike tool to tighten.
4. Bend tab into recess of gear lock nut. *(Note: If recess does not align with lock tab, loosen or tighten lock nut slightly to align.)*
5. Replace shims which were removed originally or insert .005" shim on shoulder of propeller shaft cavity.

E. Installation of Bearing Carrier

1. Press roller bearing into bearing carrier from rear of housing with Bearing Mandrel (91-24288A1) and sleeve adaptor (91-30406). (Figure 15) Press until bearing is flush with start of shoulder at front of housing.
2. Press oil seal (lips inward) to seat on shoulder in front of roller bearing. *(Note: Merc 800 has 2 seals, first one with lip inward and second with lip of seal out.)*
3. Replace "O" ring on bearing carrier.
4. Push bearing carrier into gear housing until it seats against ball bearing thrust ring. *(Note: On Merc 800, dowel locating pin must be replaced before carrier is pushed into place.)*
5. Install small "O" ring in sealing sleeve, slide small end of sealing sleeve over propeller shaft and push into oil seal of bearing carrier until it bottoms.
6. Slide second small "O" ring over propeller shaft to seat in recess on large diameter end of sealing sleeve.
7. Place gear case cover washer on bearing carrier.
8. Coat threads of gear housing with MULTIPURPOSE Quicksilver Lubricant (92-30239) to facilitate easy future removal of gear housing cover.
9. Tighten gear housing cover in clockwise direction with Gear Housing Cover and Propeller Gear Lock Nut Tool (91-29925A1 for Merc 700, 91-30291A1 for Merc 800).
10. After gear housing cover has been replaced, tighten small locking screw on gear housing.
11. Check gear lash of assembly in the following manner: With pinion gear and propeller shaft beveled gear meshed, check back lash by pulling out on drive shaft and pushing in on propeller shaft. Rotate drive shaft very lightly in both directions to feel gear lash. No more than .006" to .008" play should be allowed for proper operation. If more than recommended back lash is present, add shims beneath propeller shaft assembly to mesh gears properly. If too tight, and no back lash is present, remove a sufficient amount of shims for correct end play and conical angle of gears. Shims under bearings on drive shaft and propeller shaft must be watched closely so as not to shim too much in either direction while establishing proper mesh.

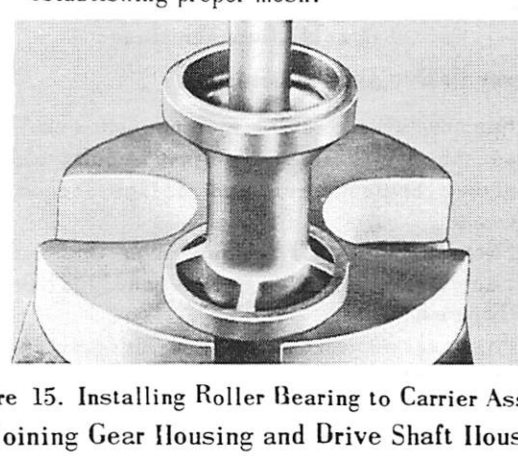


Figure 15. Installing Roller Bearing to Carrier Assembly

F. Joining Gear Housing and Drive Shaft Housing

1. Place water tube rubber over drive shaft housing water tube, approximately 1 inch from bottom to prevent plastic water tube guide from sliding upon water line when gear housing assembly is installed.
2. If water inlet tube-to-powerhead is pulled out when gear housing was removed, coat tube upper

end with MULTIPURPOSE Quicksilver Lubricant (92-30239) so that it will slip easily into rubber seal in bottom cowl and insert into recess in powerhead.

3. Place light coat of MULTIPURPOSE Lubricant on bottom end of water tube.
4. Apply a heavy coat of MULTIPURPOSE Lubricant on drive shaft splines.
5. Insert drive shaft into drive shaft housing, aligning water tube with water pump body outlet and drive shaft splines with crankshaft, and slide into place, joining housings. *(Note: Be careful that water inlet tube enters plastic water tube guide in water pump body recess and rubber seal in water pump cover.)*
6. Rotate propeller shaft in either direction until drive shaft spline enters crankshaft spline.
7. With 2 housings joined, install and tighten 5 elastic stop nuts and one 5/16" allen head screw.
8. Remove backing from water pickup gasket, place new gasket on water pickup housing and install water pickup by threading 2 screws into front end of water pickup housing. Thread 7/32" allen head screw from top side of drive shaft housing and tighten all 3 screws.
9. Replace plastic plug in drive shaft housing.

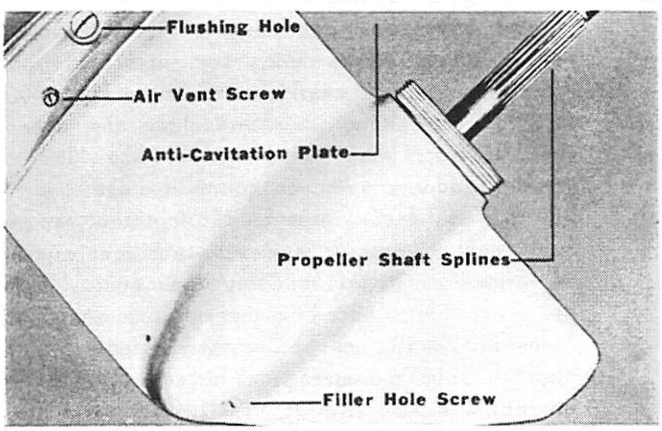


Figure 16. Gear Housing

G. Lower Drive Unit Lubrication

1. Remove filler hole screw from gear case, located as shown in Figure 16 or just to left of air vent screw, being careful not to lose accompanying washer.
2. Place EXTRA-DUTY Quicksilver Outboard Gear Lubricant (92-30295) tube end in filler hole. (Figure 17)
3. Remove air vent screw from air vent hole just above anti-cavitation plate, being careful not to lose accompanying washer. (Figure 16)
4. Inject EXTRA-DUTY Lubricant into gear case until excess lubricant starts to flow out of air vent screw hole.
5. Replace air vent screw and washer into air vent hole and tighten before removing tube from filler hole when hole is in position as shown in Figure 16. This will create an airlock and hold oil in gear case until filler hole screw is replaced.

Figure 17. Lubrication of Lower Drive Unit

6. Remove tube end from filler hole.
7. Replace screw and washer into filler hole and tighten.

H. Replacing Flushing Hole Screw

1. Replace flushing hole screw (Figure 16) with new flushing hole screw (10-31498), which has 1/16" hole drilled thru center, or drill 1/16" hole in center of screw.
2. Above will prevent water from freezing in chamber of water pump housing or base assembly, which possibly could force water pump cover gasket out-of-place, distort water pump cover plate or even break water pump housing. Any damage could cause loss of water pressure and result in an overheated motor.

I. Installation of Test Wheel

(Use Merc 800-700 Test Wheel (48-30724A2) while checking engine in test tank.)

1. Before installing Test Wheel, first remove water pickup housing and gasket from under anti-cavitation plate.
2. When replacing water pickup housing, be sure to install a new gasket if old gasket is damaged. *NOTE: Always be sure that your test tank is kept clean to prevent clogging of engine's water intake.*

J. Installing Propeller

IMPORTANT: Be sure that correct propeller is being installed.

1. Place thrust hub and washer assembly into propeller hub (shoulder into recess of propeller).
2. Apply thin coat of MULTIPURPOSE Quicksilver Lubricant (92-30239) on splines of propeller shaft. (Figure 16)
3. Align propeller hub splines with splines of propeller shaft and slide propeller on shaft. Tap into position if necessary.
4. Place propeller shaft cup washer on shaft with shoulder into recess of propeller hub.
5. Thread propeller elastic stop nut on propeller shaft.
6. Tighten elastic stop nut with 1-1/16" socket wrench or adjustable wrench.
7. Place propeller nut cap on end of propeller shaft.
8. Tighten propeller nut securely with 15/16" or adjustable wrench.

PROPELLER WARNING: Use of Merc 700 propellers on Merc 800 engines will result in gear housing damage and jeopardize engine warranty!

FULL GEAR SHIFT DISASSEMBLY

A. Removing Gear Housing from Drive Shaft Housing

1. Remove three 5/8" hexagon head locknuts which hold gear housing assembly to drive shaft housing (leading edge).
2. Remove two 5/8" hexagon head locknuts located in center bottom side of anti-cavitation plate.
3. Remove water pickup under trailing edge of anti-cavitation plate by removing plastic plug and 7/32" allen head screw from rear bottom of drive shaft housing.
4. Remove 5/16" allen head screw from rear bottom of drive shaft housing.
5. Separate gear housing from drive shaft housing.
6. Remove upper reverse locking cam and nylon spool sleeve from upper shift shaft.

B. Removing Propeller Shaft and Components.

1. Drain EXTRA-DUTY Lubricant from gear housing by removing filler hole screw and vent screw. (Figure 1 or 15) Do not lose washers. Replace washers and screws after draining.

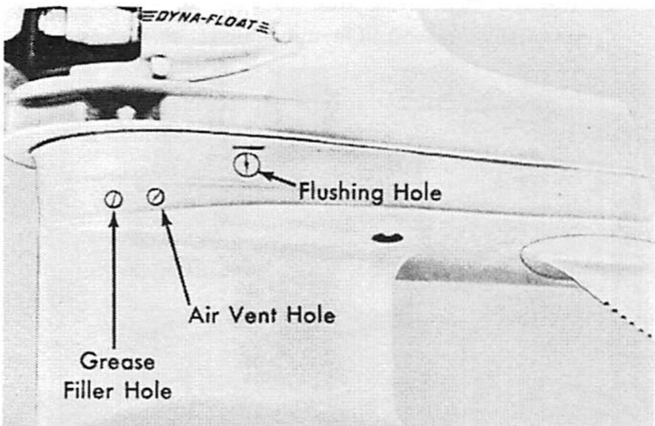


Figure 1. Filler Hole and Vent Screw

2. Place gear housing assembly in vise between 2 blocks of soft wood to prevent marring surface.
3. Place a piece of wood flat between propeller and anti-cavitation plate to prevent propeller from turning while removing the propeller nut.
4. Remove propeller by bending tabs on tab washer and removing propeller nut (right hand thread), tab washer, cupped thrust washer, propeller and thrust hub and washer assembly.
5. At this time, lash between gears should be checked for future reference. Pull on drive shaft with one hand and push on propeller shaft with other. Refer to backlash later in Paragraph E-12 of Reassembly.
6. Remove gear housing cover and washer with Gear Housing Cover Tool (91-30291A1). Place tool over end of propeller shaft and set tool into cover, turning counterclockwise (right hand thread) to loosen. (Figure 2) If tight, strike handle of tool with mallet to loosen.

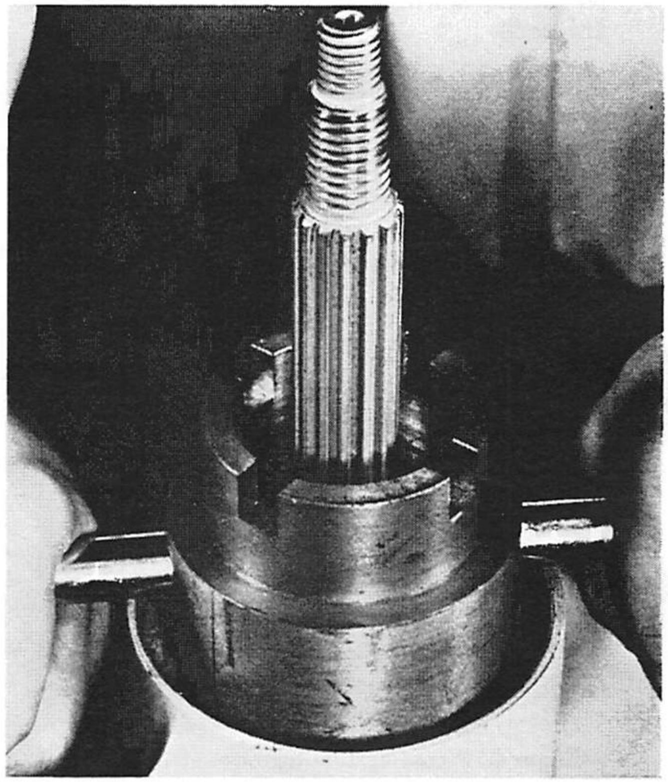


Figure 2. Removing Gear Case Cover

7. Bearing carrier assembly can be removed while removing propeller shaft. Place propeller shaft in vise between 2 pieces of soft wood. Shaft assembly then can be removed by tapping lightly and evenly on skeg of gear housing with a mallet. Remove key from keyway from inside bottom of gear housing.
8. Remove propeller shaft from bearing carrier.
9. Remove reverse gear from bearing carrier with 91-27780 tool, as shown in Figure 3.

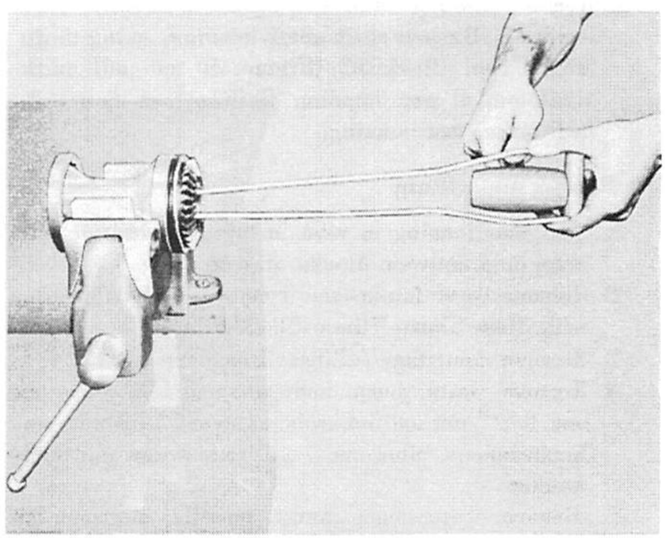


Figure 3. Pulling Reverse Gear From Bearing Carrier

10. Remove "O" ring from carrier.
11. Press roller bearing and seal from carrier assembly on arbor press with Bearing Mandrel (91-24288A3) and Bearing Adaptor (91-30406). Adaptor must be put on mandrel with large shoulder facing bearing. (Figure 4)

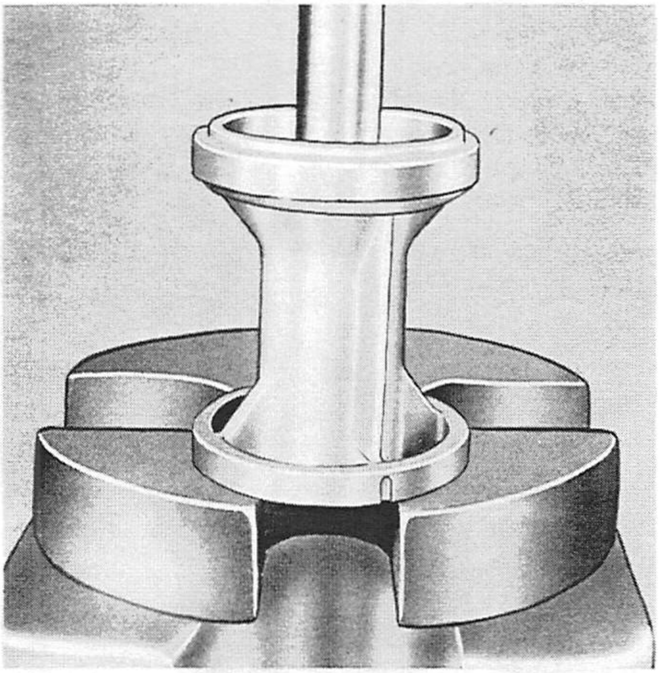


Figure 4. Pressing Bearings out of Carrier

C. Dissassembly Of Propeller Shaft And Gear Assembly

1. Use screwdriver to detach retaining ring from sliding clutch. Do not over-stretch or ring will lose its shape and tension.
2. Remove sliding clutch from propeller shaft by setting cam follower in place in end of propeller shaft. Press against cam follower and, with small punch, push cross pin out of sliding clutch.
3. Sliding clutch now is free to be removed from propeller shaft, with cross pin slide and spring dropping free from inside of propeller shaft.
4. Remove lower reverse locking cam from shift shaft bushing. Remove shift shaft bushing, using Shift Shaft Tool (91-31107) (Figure 5) and pull shift shaft out of gear housing. Shifting cam then will fall out of gear housing.

D. Remove Water Pump

1. Set gear housing in vise in upright position with skeg held between blocks of wood.
2. Remove water intake hose from water pump housing with Hose Clamp Pliers (91-23007).
3. Remove centrifugal slinger from drive shaft.
4. Remove water pump body assembly by removing one 1/2" nut and lockwasher, two 7/16" nuts and lockwashers, plus one 7/16" cap screw and lockwasher.
5. Remove water pump insert, impeller and impeller pin along with water pump body, gasket, water

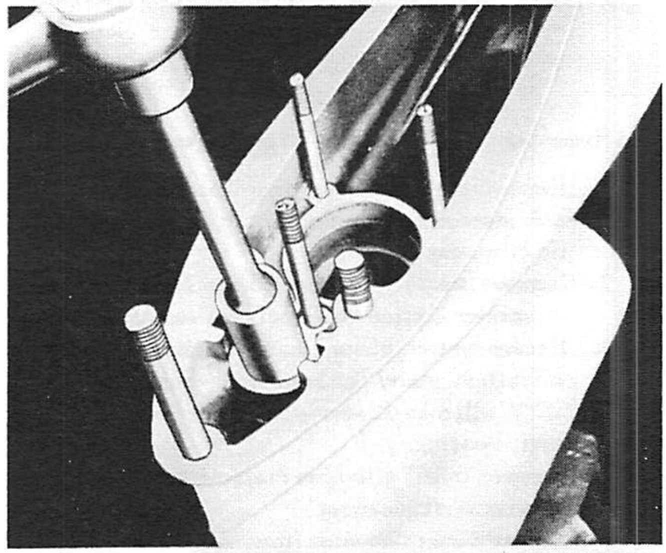


Figure 5. Removing Shift Shaft Bushing

pump face plate and gasket face plate to gear housing and oil seal (Figure 6).

6. Check impeller and water pump insert closely for wear or damage.
7. Remove flushing screw, seal and gasket to allow water pump base assembly to be lifted out.
8. Remove "O" ring and oil seal from base plate assembly and watch for shims under base assembly.

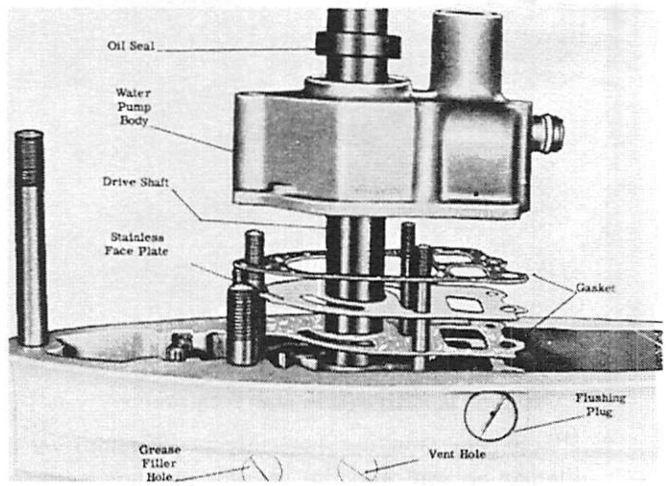


Figure 6. Removing Water Pump Assembly

E. Removing Drive Shaft and Components

1. Place drive shaft in vise as close to gear housing as possible.
2. Remove 3/4" nut from drive shaft pinion gear with a thin 3/4" box-end wrench (right hand thread).
3. To loosen drive shaft, hold gear housing in one hand and tap lightly on gear housing with rawhide mallet.
4. Observe any shims under drive shaft ball bearing.
5. Remove ball bearing retaining ring with snap ring pliers.
6. Ball bearing can be removed from drive shaft by placing against open vise jaws and tapping on splined end of drive shaft with a mallet. (Figure 7)

7. Remove forward gear and bearing assembly from gear housing.

8. Remove bearing cup from gear housing with service tool C-91-31228A1. (Figure 8)

F. REMOVING NEEDLE BEARINGS FROM GEAR HOUSING

1. Remove drive shaft needle bearings from gear housing with Bearing Mandrel (C-91-24288A3) and C-91-30490 sleeve for Merc 800, C-91-26377 sleeve for Merc 700. Use Guide Collar of correct diameter in bearing seat.

2. Place mandrel in drive shaft end of gear housing cavity.

3. Press bearing out with arbor press or tap on tool with heavy mallet to remove bearing. (Figure 9)

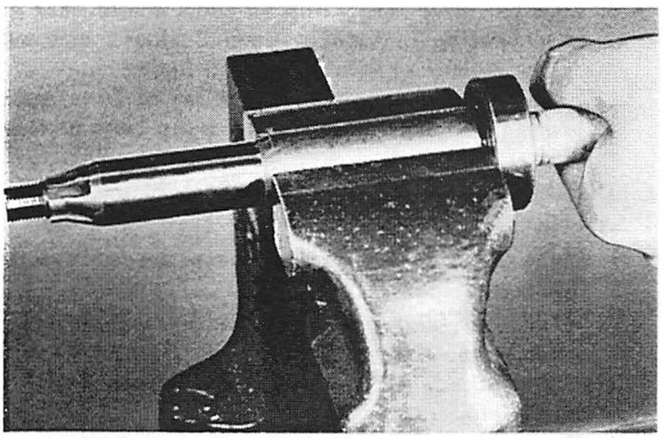


Figure 7. Removing Ball Bearing From Drive Shaft

This completes disassembly of gear housing. All parts now should be washed in cleaning solvent and inspected for wear, replacing those which are worn, not useable or damaged.

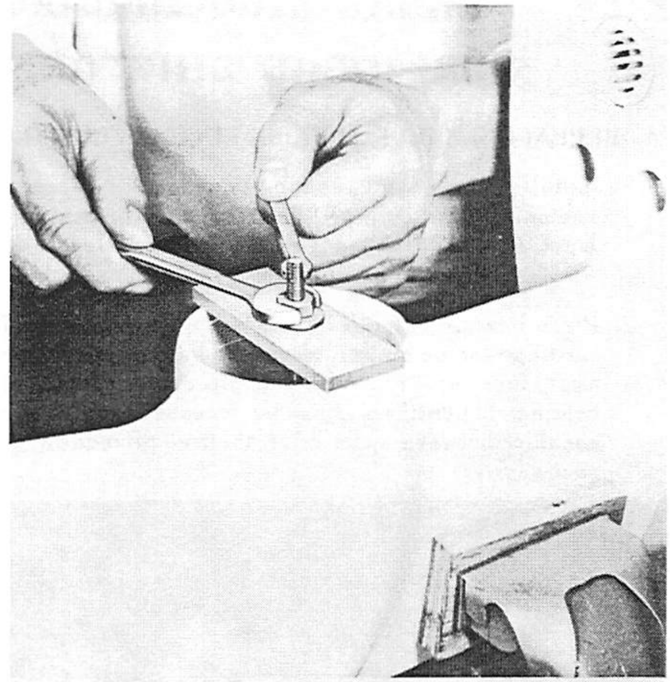


Figure 8. Removing Cup from Gear Housing

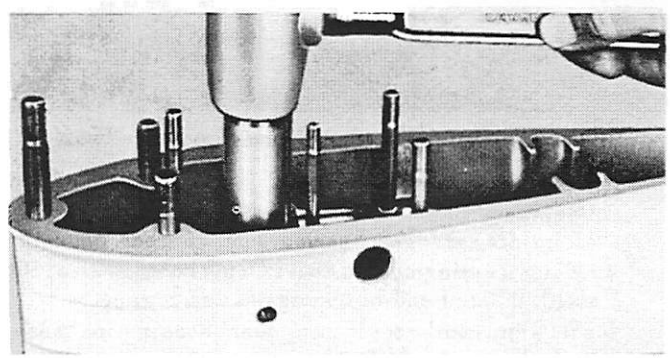


Figure 9. Removing Drive Shaft Needle Bearing From Gear Housing

FULL GEAR SHIFT GEAR HOUSING - REASSEMBLY

A. REPLACING NEEDLE BEARING IN GEAR HOUSING

1. Install drive shaft bearing cartridge into gear housing with Bearing Removing and Installing Kit, C-91-31229A1 and Bearing Puller Head, C-91-36569, which is part of C-91-31229A2 assembly.

2. Place bearing on puller head with numbered side of cartridge facing outward. Numbered side of cartridge must face up. Pull drive shaft needle cartridge bearing in until bearing is recessed evenly on shoulder between upper drive shaft cavity and lower gear cavity.

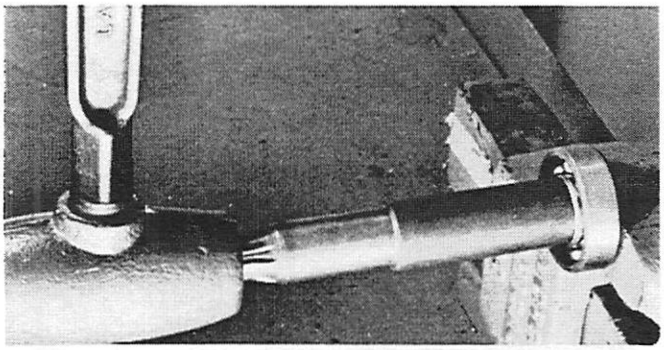


Figure 10. Installing Ball Bearing on Drive Shaft

3. Replace shims which were removed originally from forward gear bearing cup of gear housing.
4. Place bearing cup on Driver Cup Tool (C-91-31106) with tapered end of cup against driver cup.
5. Set cup with tool into gear housing on bearing shoulder and place propeller shaft (ratchet end) into center hole of driver cup.
6. Place bearing carrier assembly into housing to act as a guide to hold shaft straight when pressing cup into position.
7. Press forward gear roller bearing outer cup into gear housing.
8. Lubricate needle and roller bearings in gear housing with oil.
9. Place gear housing in vise between jaw protectors at thin section of gear housing so that gear cover end is up.
10. Insert shifting cam into gear housing with notches up and to left when viewing in from skeg. Cam operates to right.
11. Insert shift shaft lower half so that splines engage shifting cam splines inside housing.
12. Install shift shaft bushing and tighten securely with Shift Shaft Tool (C-91-31107).
13. Press roller bearing onto forward gear (taper of bearings to face away from gear).
14. Place gear and bearing assembly into bearing outer cup.

B. INSTALLING DRIVE SHAFT

1. Place ball bearing on drive shaft.
2. Place drive shaft in vise loosely, tapping against pinioned spline end until bearing seats. (Figure 10)
3. Replace locking ring on drive shaft to hold ball bearing in place.
4. Place shims as required, or as previously removed, into drive shaft ball bearing recess in gear housing.
5. Before seating drive shaft and bearing, place pinion gear on splined end of shaft, aligning with splines in gear.
6. Lubricate ball bearing and tap drive shaft assembly to seat in gear housing.
7. Place drive shaft in vise close to housing and tighten ¾" nut at pinion. Torque to 60 ft. lbs. (8.295mkg). Chamfer on nut must be toward pinion.
8. Remove drive shaft from vise and install skeg of gear housing in vise between 2 blocks of wood or jaw protectors with drive shaft facing up.
9. Replace shims, as required, on top of drive shaft bearing before replacing water pump base assembly.

C. INSTALLATION OF WATER PUMP BASE AND BODY ASSEMBLIES

1. Place seal in water pump base assembly with lips facing down.

   NOTE: On later model 6-cylinder gear housing, water pump base has 2 oil seals. Upper oil seal is installed with lips facing up. Lower seal is installed with lips down.
2. Place water pump base assembly in position in gear housing, using Water Pump Base Assembly Tool, C-91-38461, on drive shaft. Place grease on seals.
3. There should be no play between bearing and water pump base assembly when water pump base assembly is depressed. Add or remove shims as required. No play may be obtained by over-shimming. With a new gasket installed, place a feeler gauge between gear housing and water pump body. If gap measured between gear housing and water pump body is .010" (0.254mm), remove .012" (.305mm) shim; if .005" (0.127mm), remove .007" (.178mm) shim. This will allow for .002"-.003" (.051mm-.076mm) compression of gasket and give a zero gap which is correct and should not be altered.

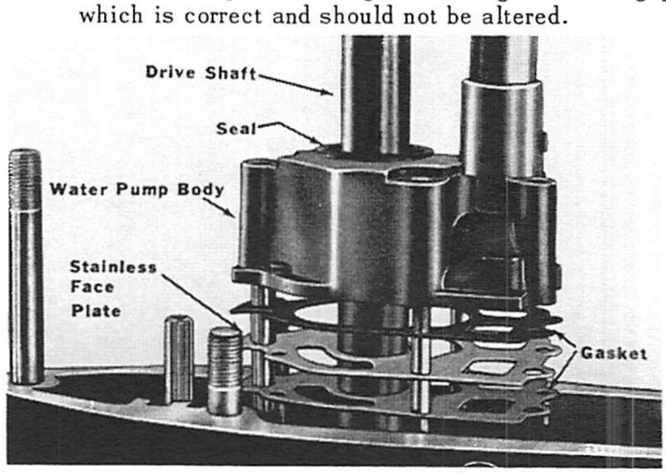


Figure 11. Installing Water Pump Assembly (New Style)

4. Install water pump base-to-face-plate gasket and replace stainless face plate. (Figure 11)
5. Place drive pin on drive shaft, holding in position with dab of MULTIPURPOSE Lubricant (C-92-35226).
6. Check condition of impeller closely and set in place over drive shaft.
7. Insert stainless water pump cartridge in water pump body and place water pump body-to-face-plate gasket on water pump body. (Figure 11)
8. Slide water pump body assembly over drive shaft and impeller. (Figure 11)
9. Turn drive shaft clockwise and press water pump body assembly into place, at same time seating impeller. Be sure that impeller drive pin is in position in drive pin groove of impeller.
10. Replace lock washers and tighten nuts and cap screw.
11. Place plastic water tube guide in water pump body recess.

    NOTE: On earlier models, replace water intake hose with hose clamps; use Hose Clamp Pliers (C-91-23007), and replace lower water intake rubber tube and drive shaft slinger.
12. Place gear housing in vise so that gear housing cover is facing up. Use jaw protectors or wood blocks so as not to mar gear housing.
13. Check forward gear lash (at least .006" to .008") between forward gear and pinion gear at this time. If too tight, remove forward shim until correct back lash is obtained. If too much, add shims 'til correct. Be sure that conical angle of gears is true. Gears should fully engage each other on length of tooth. Shimming of drive shaft ball bearing may be necessary to obtain correct back lash (.006" - .008"), if unable to do so with forward gear shims.

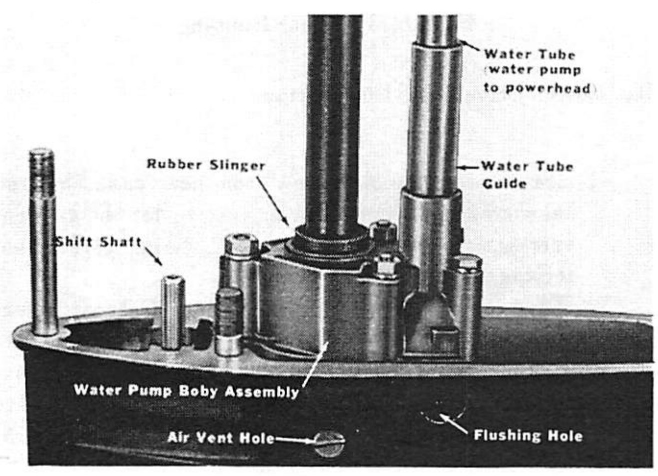


Figure 12. Water Pump Assembly Installed (New Style)

D. Reassembling Propeller Shaft Components

1. Install cam follower spring and cam follower slide inside hollow end of propeller shaft so that holes in cam follower slide match hole in propeller shaft.
2. Place sliding clutch onto propeller shaft and install cam follower in end of propeller shaft.
3. Compress spring inside propeller shaft by pressing on cam follower until holes in sliding clutch, propeller shaft and cross pin, slide all line up.
4. Place cross pin thru sliding clutch, propeller shaft and slide.
5. Install cross pin retaining ring around sliding clutch. Do not over-stretch spring when installing.
6. Place propeller shaft assembly into forward gear assembly in gear housing.

E. Installation of Bearing Carrier

1. Press roller bearings into bearing carrier from rear of housing with Needle Bearing Driver (C-91-31109). (Figure 13) Press first bearing in with long end of Needle Bearing Driver, second bearing with short end of tool.

NOTE: Later production engines have only one roller bearing. Press bearing into bearing carrier with bearing part numbers facing outward (aft).

2. Press oil seals in with Oil Seal Driver (C-91-31108) to seat on shoulder in front of roller bearing. (Figure 14) Seat first one with lip inward, using deep shouldered end of Oil Seal Driver, and second with lip of seal out, using opposite end of tool.

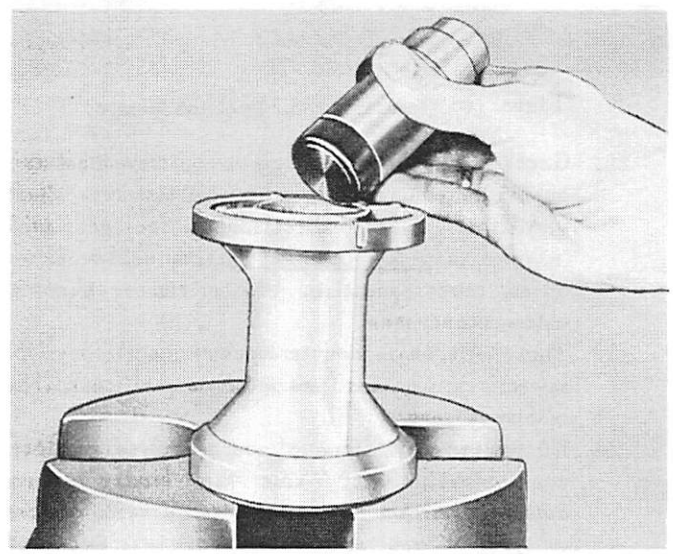


Figure 13. Installing Roller Bearings in Carrier

3. Press large ball bearing into bearing carrier.
4. Replace large "O" ring on outside diameter bearing carrier and ball bearing thrust washer on bearing carrier.
5. Press reverse gear into large ball bearing in bearing carrier.
6. Install shims in gear housing.
7. Push bearing carrier into gear housing until it seats against ball bearing thrust ring.
8. Place key in keyway in bearing carrier and bottom of gear housing.
9. Coat threads of gear housing with Gasket Sealer (C-92-28804) or Liquid Neoprene (C-92-25711) to facilitate easy future removal of gear housing cover.
10. Place gear housing cover washer on bearing carrier shoulder.
11. Thread gear housing cover onto gear housing and tighten in clockwise direction with Gear Housing Cover and Propeller Gear Lock Nut Tool (C-91-30291A1).

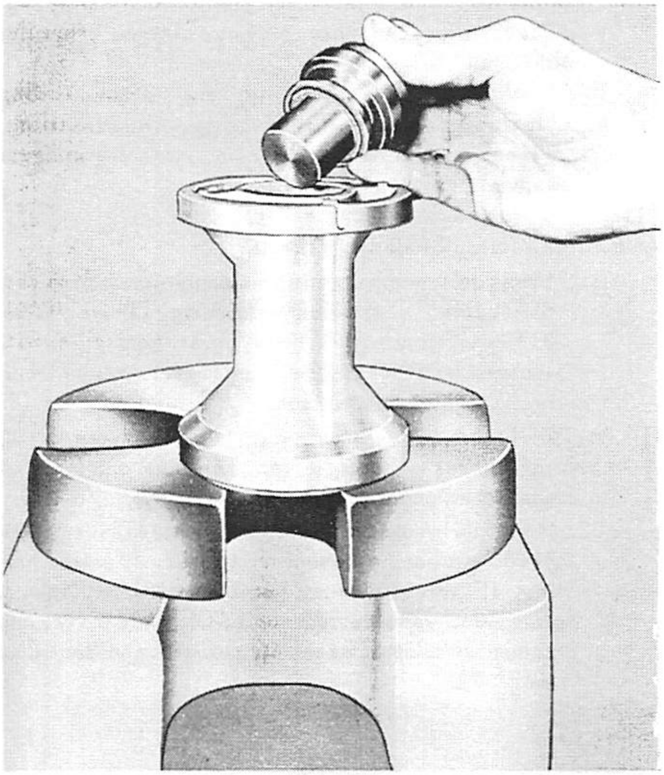


Figure 14 Installing Oil Seals in Carrier

12. Check gear lash by pulling out on drive shaft and pushing in on propeller shaft. Rotate drive shaft very lightly in both directions to feel gear lash. No more than .006" to .008" play should be allowed for proper operation. Add or remove shims to obtain proper mesh.
13. Turn shift shaft counterclockwise until cam follower is felt against first notch on shift cam. This is forward gear.
14. With lower unit in forward gear, place reverse lock cams of shift shaft. *(Note: Place bronze cam on bottom, aluminum cam in middle and nylon spacer on top. It is important that lower unit is in forward gear and reverse lock cams are installed in proper sequence, or motor will not shift properly.*
15. After replacing shift cams and nylon spacer cam, lubricate parts heavily with MULTIPURPOSE Lubricant (92-30239).

F. Joining Gear Housing and Drive Shaft Housing

1. If water inlet tube-to-powerhead is pulled out when gear housing was removed, coat tube upper end with MULTIPURPOSE Quicksilver Lubricant so that it will slip easily into rubber seal in bottom cowl and insert into recess in powerhead.
2. Place light coat of MULTIPURPOSE Lubricant on bottom end of water tube.
3. Apply heavy coat of MULTIPURPOSE Lubricant on drive shaft splines.
4. Insert 7/32" allen head water pickup screw in place on top of gear housing.
5. Check that shift control lever and lower unit are in forward gear before installing gear housing.
6. Insert drive shaft into drive shaft housing, aligning water tube with water pump body outlet and drive shaft splines with crankshaft, then sliding into place while joining housings. *(Note: Be careful that water inlet tube enters plastic water tube guide in water pump body recess and rubber seal in water pump cover.)*
7. Place shift control lever in neutral, then in forward to check that upper and lower shift shaft splines are properly aligned.
8. Rotate propeller shaft by pulling lightly on starter rope to cause drive shaft splines to enter crankshaft splines. Upper and lower shift shaft splines also must be aligned.
9. With 2 housings joined, install and tighten 5 elastic stop nuts and one 5/16" allen head screw.
10. Install water pickup and trim tab and torque 7/32" allen head screw to 180 in. lbs. thru plastic plug hole in drive shaft housing, then replace plastic plug.

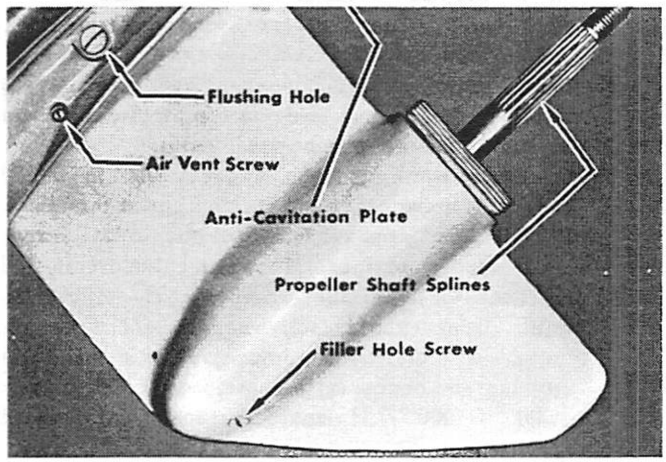


Figure 15. Gear Housing

G. Lower Drive Unit Lubrication

1. Remove filler hole screw from gear case, located as shown in Figure 15, or just to left of air vent screw, as shown in Figure 12, being careful not to lose accompanying washer.
2. Place EXTRA-DUTY Quicksilver Outboard Gear Lubricant (92-30295) tube end in filler hole.
3. Remove air vent screw from air vent hole just above anti-cavitation plate, being careful not to lose accompanying washer. (Figure 12 or 15)
4. Inject EXTRA-DUTY Lubricant into gear case (Figure 16) until excess lubricant starts to flow out of air vent screw hole.
5. Replace air vent screw and washer into air vent hole and tighten before removing tube from filler hole, when hole is in position as shown in Figure 15. This will create an airlock and hold oil in gear case until filler hole screw is replaced.
6. Remove tube end from filler hole.
7. Replace screw and washer into filler hole and tighten.

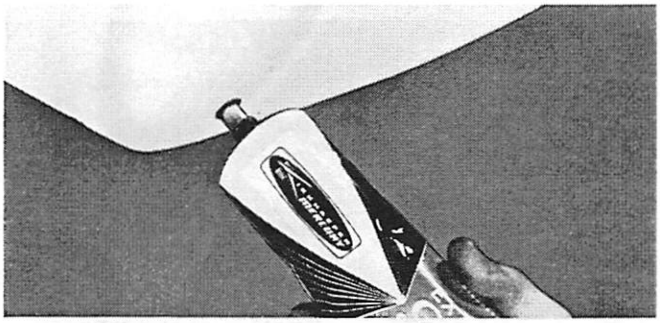


Figure 16. Gear Case Lubrication

H. Installation of Test Wheel

1. Before installing Test Wheel (A-48-30724A2), first remove water pickup housing from under anti-cavitation plate.
2. When replacing water pickup housing, be sure to install a new gasket if old gasket is damaged.

NOTE: Always be sure that your test tank is kept clean to prevent clogging of engine's water intake.

I. Installing Propeller (Figure 17)

1. Replace split washer, then place thrust hub and washer assembly into propeller hub (shoulder into recess of propeller).
2. Apply thin coat of MULTIPURPOSE Quicksilver Lubricant (C-92-35226) on splines of propeller shaft. (Figure 17)
3. Align propeller hub splines with splines of propeller shaft and slide propeller on shaft. Tap into position if necessary.
4. Replace cupped thrust washer and tab washer.
5. Replace propeller nut and tighten with adjustable wrench.
6. Bend all tabs on tab washer to lock.

WARNING: Use of other than recommended Quicksilver Propellers will void the motor warranty.

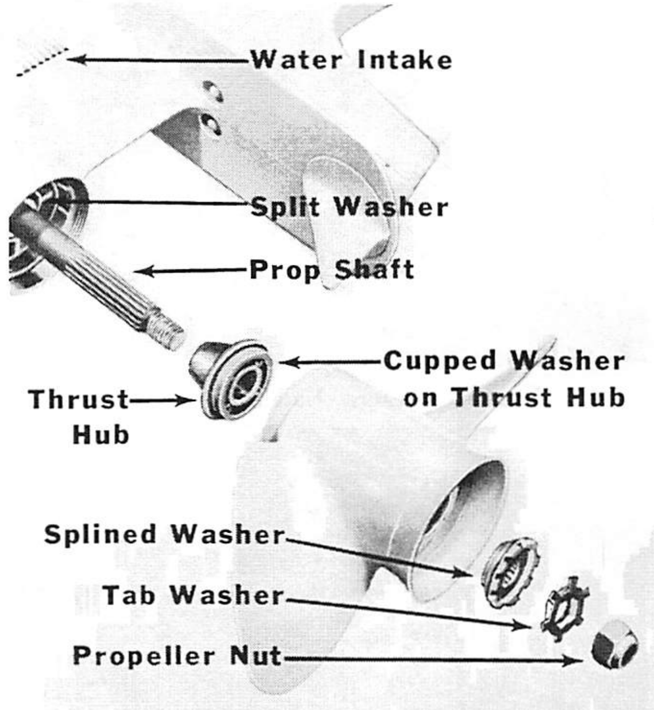


Figure 17. Propeller Installation

REVERSE HOOK INSTALLATION • Merc 1100-1000-950-900-650

DISASSEMBLY

1. Remove gear housing.
2. Remove 3 nylon cams.
3. Remove reverse latch and push rod assembly.

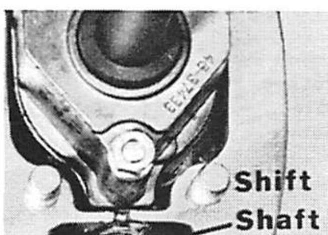


Figure 1. Spacer Installed

REASSEMBLY

1. Install spacer over gear housing shift shaft with groove down. (Figure 1)
2. Install cam over gear housing shift shaft while unit is in reverse. Note that cam must be positioned so that upper flat of cam is facing front of gear housing when in reverse shift position. (Figure 2) To check cam for correct positioning on shiftshaft, shift lower unit into neutral. Cam then should be positioned as shown in Figure 3.

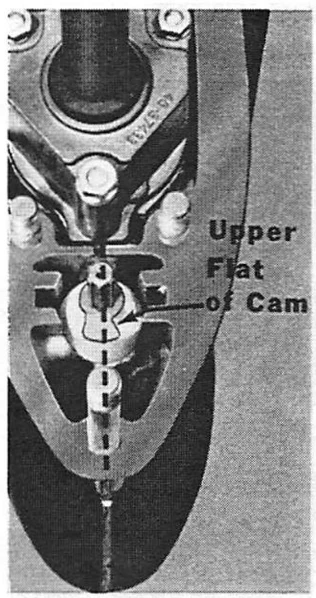


Figure 2. Cam in Reverse

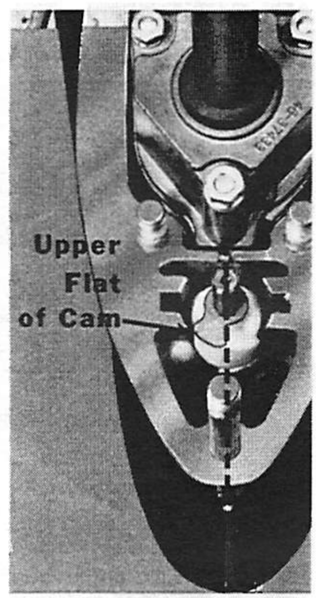


Figure 3. Cam in Neutral

3. Install new reverse lock and shaft assembly and connect tension spring to reverse lock. (Figure 4)
4. Install push rod guide into drive shaft housing, sliding over upper shift shaft coupling and push rod. (Figure 5)

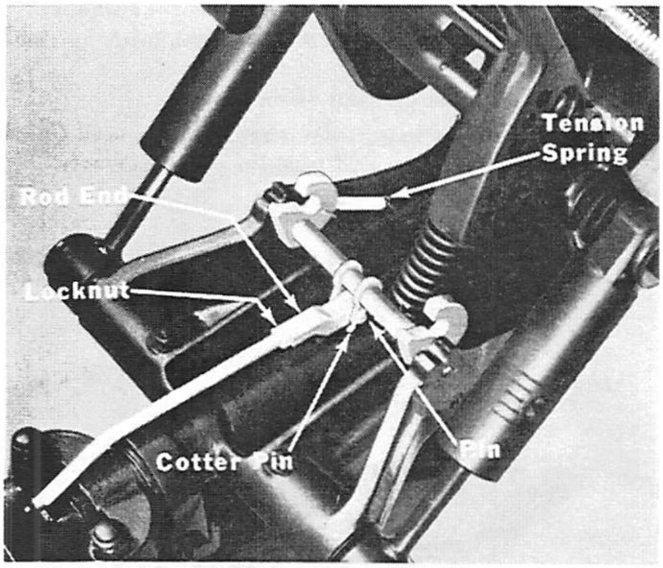


Figure 4. Reverse Latch Hook Assembly

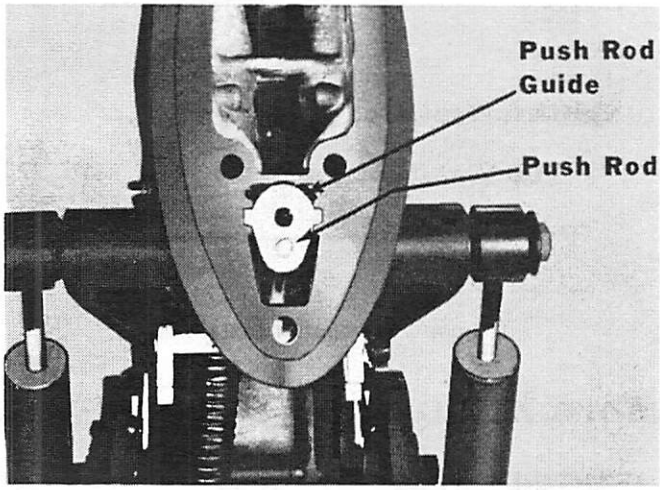


Figure 5. Push Rod Guide Installed

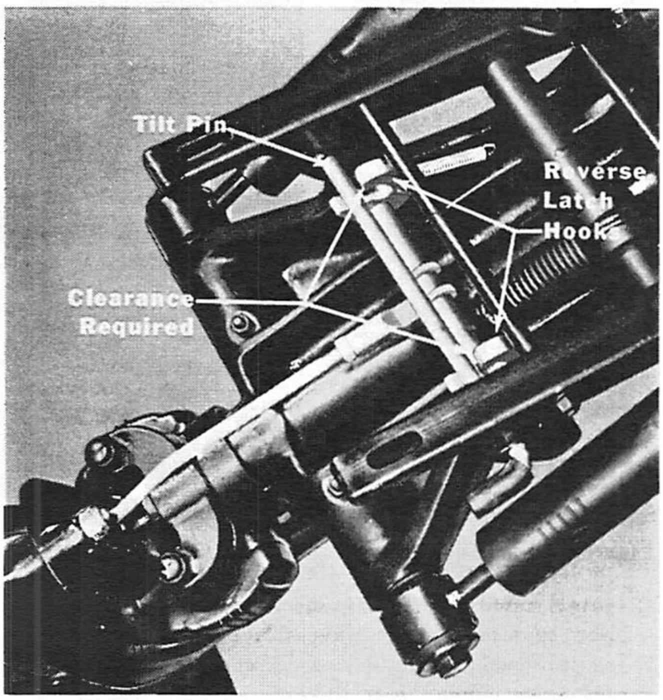


Figure 6. Latch Hooks Position in Forward Gear

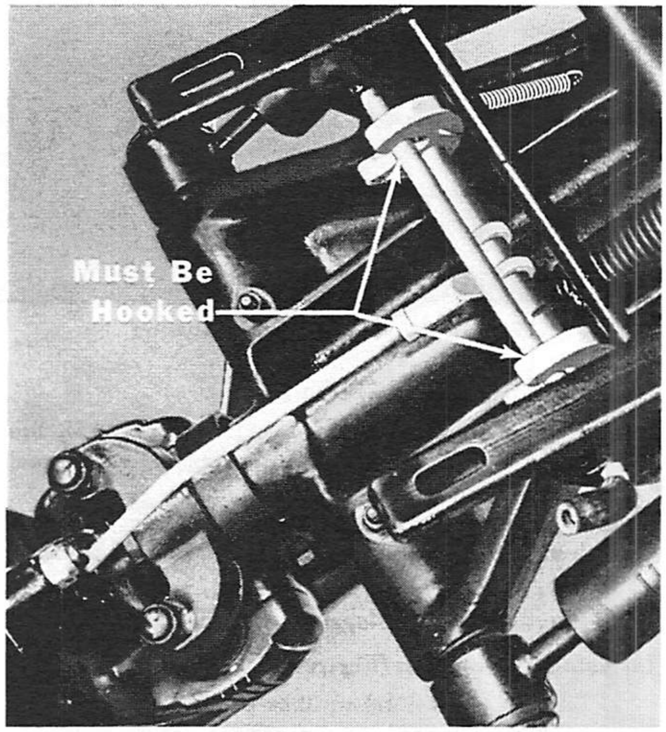


Figure 7. Latch Hooks Position in Reverse Gear

5. Check that both shift control lever and lower unit are in neutral gear, then install gear housing to drive shaft housing.
6. Place engine in forward gear and check reverse latch. Be certain that reverse latch hooks clear tilt pin when tilting. (Figure 6)
7. Check in neutral and reverse gear positions and make sure that reverse latch is hooked in both positions when tilting. (Figure 7) To check, pull back on lower unit, and reverse latch hook must be positioned against tilt pin as shown in Figures 7 & 8.

NOTE: If adjustment is necessary, remove cotter key and pin from rod end and adjust in or out until latch operates as described in Steps 6 and 7 preceding.

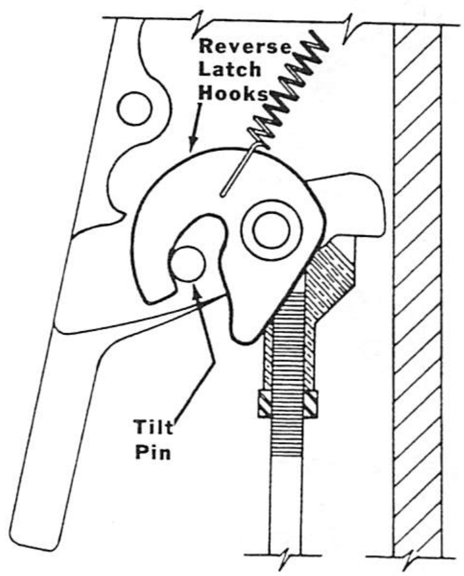


Figure 8.

MERC 200-110-60-39 FULL GEAR SHIFT

DISASSEMBLY

A. REMOVING GEAR HOUSING FROM DRIVE SHAFT HOUSING

1. Remove one 9/16" hexagon head lock nut which holds gear housing assembly to drive shaft housing (leading edge).
2. Remove one ½" hexagon head locknut located in center bottom side of anti-cavitation plate.
3. Separate gear housing from drive shaft housing.

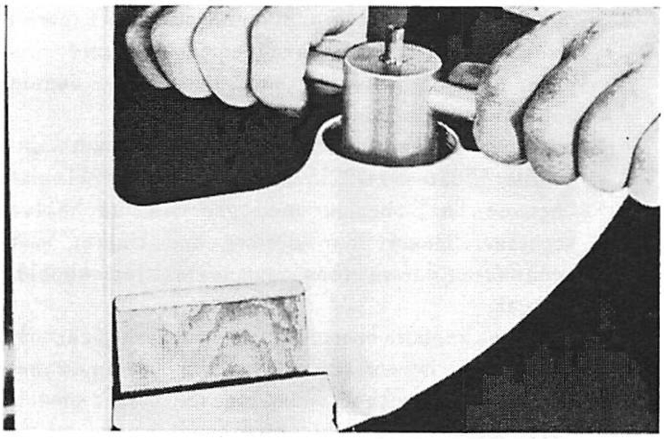


Figure 1. Removing Gear Case Cover

B. REMOVING PROPELLER SHAFT AND COMPONENTS

1. Place gear housing assembly in vise between 2 blocks of soft wood to prevent marring surface.
2. Place a piece of wood flat between propeller and anti-cavitation plate to prevent propeller from turning while removing propeller nut.
3. Remove propeller by removing propeller nut (right hand thread), thrust washer, propeller and thrust hub and washer assembly.
4. At this time, lash between gears should be checked for future reference. Pull on drive shaft with one hand and push on propeller shaft with other. *Refer to backlash later in Paragraph E-11 of "Reassembly".*

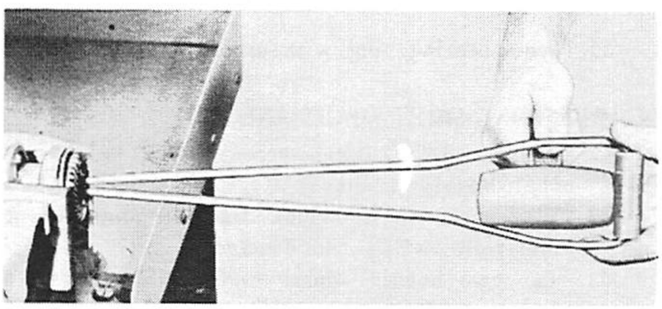


Figure 2. Pulling Reverse Gear from Bearing Carrier

5. Remove gear housing cover and washer with Gear Housing Cover Tool (C-91-30798). Place tool over end of propeller shaft and set tool into cover, turning clockwise (left hand thread) to loosen. (Figure 1) If tight, strike handle of tool with mallet to loosen.
6. Bearing carrier assembly can be removed while removing propeller shaft. Place propeller shaft in vise between 2 pieces of soft wood. Shaft assembly then can be removed by tapping lightly and evenly on skeg of gear housing with a mallet.
7. Remove propeller shaft from bearing carrier.
8. Remove reverse gear from bearing carrier with C-91-27780 tool, as shown in Figure 2.

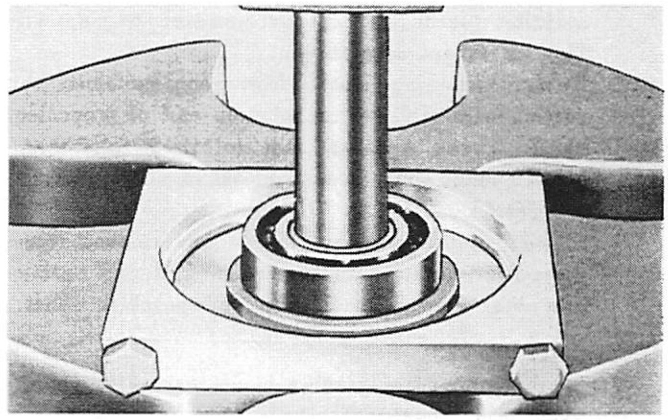


Figure 3. Removing Ball Bearing from Reverse Gear

9. Remove "O" ring from carrier.
10. Remove ball bearing from reverse gear with Gear Puller Plate (C-91-22115). (Figure 3) Place halves of plate between ball bearing and gear and tap halves together. Insert cap screws and tighten. With gear facing down, press out against rear shoulder of gear.
11. Press roller bearing and seal from carrier assembly on arbor press with Bearing Mandrel (C-91-24273). (Figure 4)

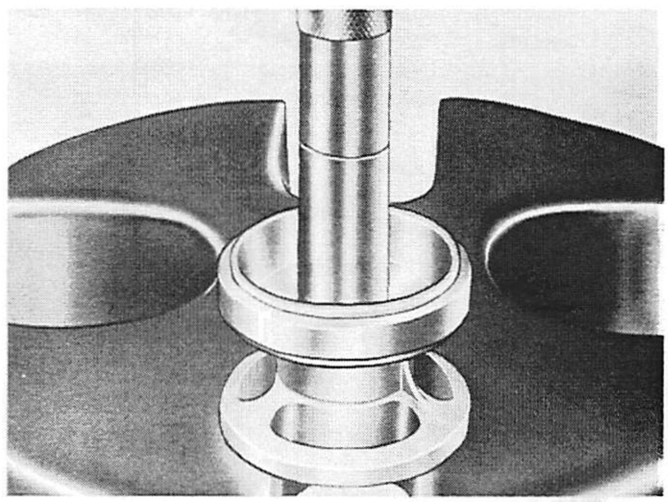


Figure 4. Pressing Bearings Out of Carrier

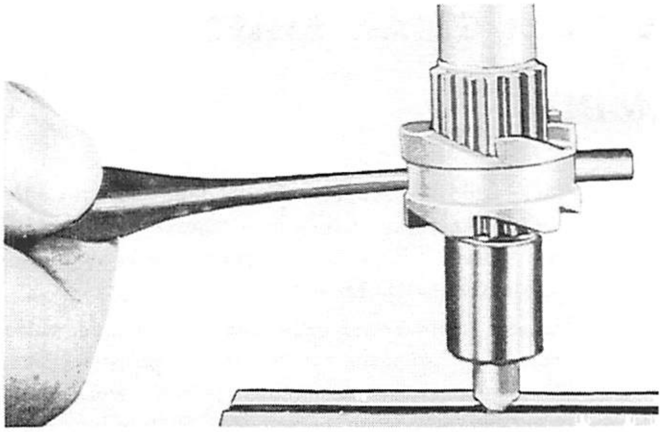


Figure 5. Removing Cross Pin from Sliding Clutch

C. DISASSEMBLY OF PROPELLER SHAFT AND GEAR ASSEMBLY

1. Use screwdriver to detach retaining ring from sliding clutch. Do not over-stretch, or ring will lose its shape and tension.
2. Remove sliding clutch from propeller shaft by setting cam follower in place in end of propeller shaft. Press against cam follower and, with small punch, push cross pin out of sliding clutch. (Figure 5)
3. Sliding clutch now is free to be removed from propeller shaft, with cross pin slide and spring dropping free from inside of propeller shaft.

D. REMOVE WATER PUMP

1. Set gear housing in vise in upright position with skeg held between blocks of wood.
2. Remove centrifugal slinger from drive shaft.
3. Remove water pump body assembly by removing two 7/16" nuts.
4. Remove water pump cover, wave washer and water pump face plate. (Figure 6)
5. Remove impeller and impeller drive pin.
6. Check impeller and water pump insert closely for wear or damage.
7. Remove water pump base assembly and water inlet tube.
8. Remove "O" ring and oil seal from base plate assembly and watch for shims under base assembly.

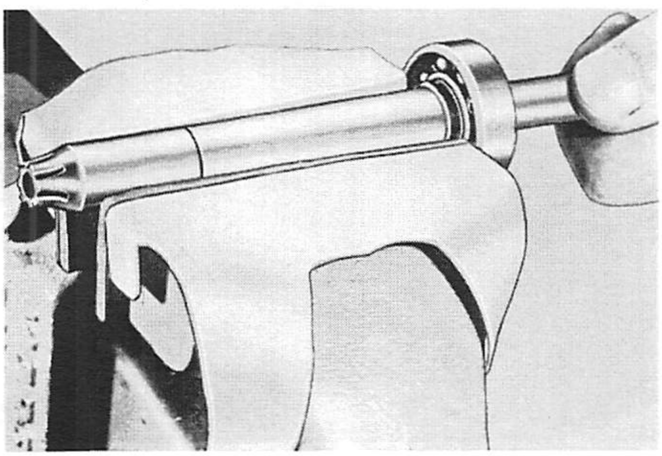


Figure 6. Removing Drive Shaft Ball Bearing

E. REMOVING DRIVE SHAFT AND COMPONENTS

1. Place drive shaft in vise as close to gear housing as possible.
2. Bend back tab washer and remove 3/8" screw from drive shaft pinion gear with a thin 3/8" box-end wrench (right hand thread).
3. To loosen drive shaft, hold gear housing in one hand and tap lightly on gear housing with rawhide mallet.
4. Observe any shims under drive shaft ball bearing.
5. Remove ball bearing retaining ring with snap ring pliers.
6. Ball bearing can be removed from drive shaft by placing against open vise jaws and tapping on splined end of drive shaft with mallet. (Figure 6)
7. Remove forward gear and bearing assembly from gear housing by tapping open end of gear housing against block of soft wood.
8. Remove ball bearing from forward gear with Gear Puller Plate (91-22115). Place halves of plate between ball bearing and gear and tap halves together. Insert cap screws and tighten. With gear facing down, press out against rear shoulder of gear.
9. Remove needle bearing from forward gear only if bearing is worn or rough. This bearing cannot be removed without damaging it. Place gear in vise between jaw protectors and remove bearing with a pin punch.

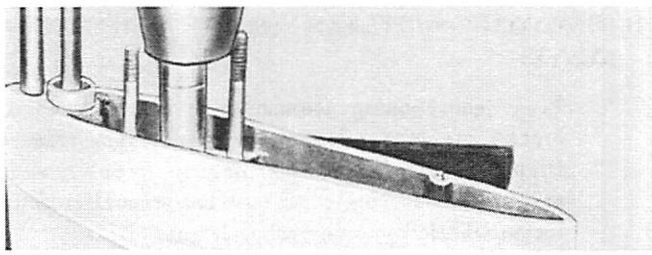


Figure 7. Removing Drive Shaft Needle Bearing from Gear Housing

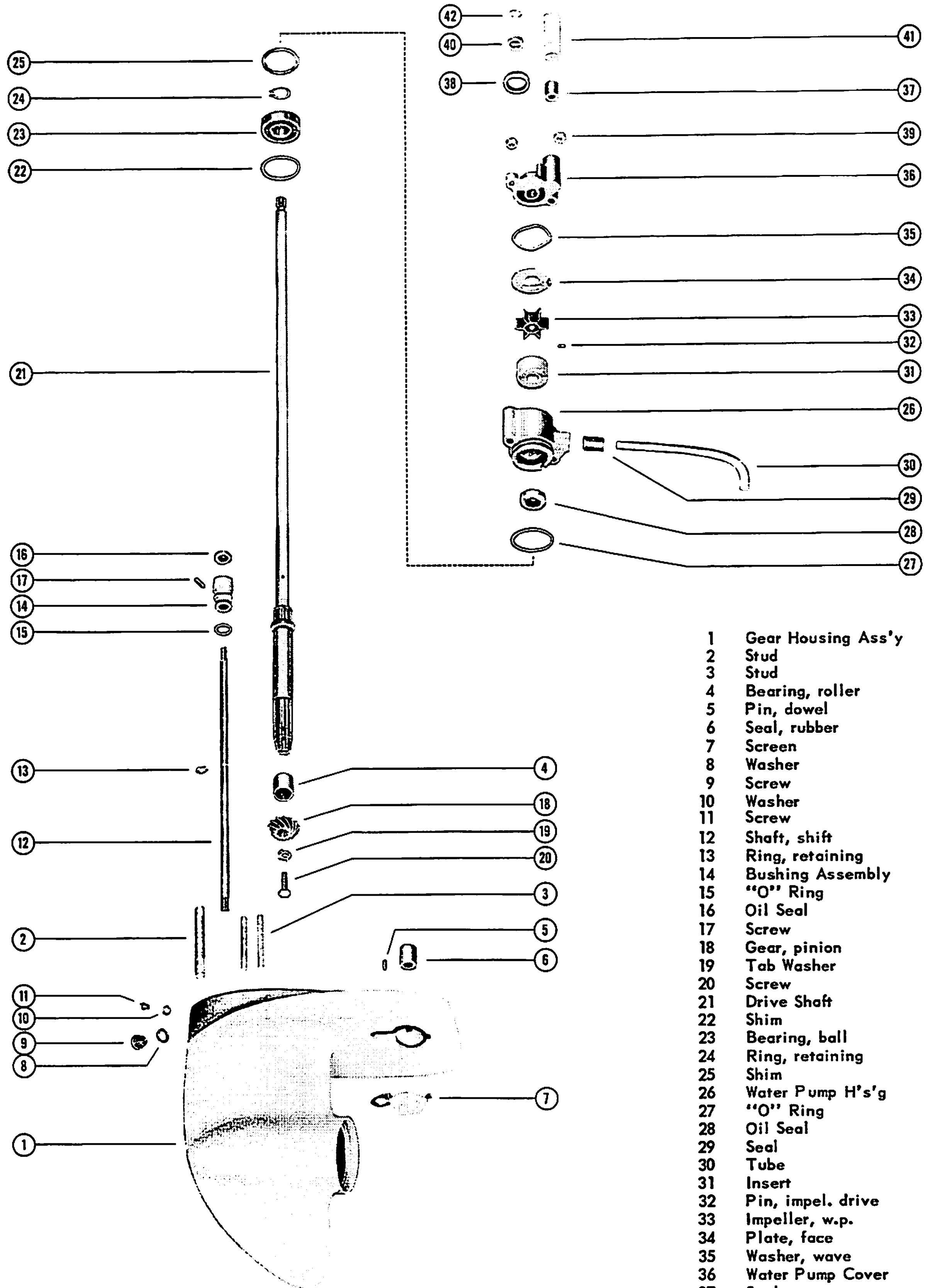
F. REMOVING NEEDLE BEARINGS FROM GEAR HOUSING

1. Remove drive shaft needle bearings from gear housing with Bearing Mandrel (91-24273).
2. Place mandrel in drive shaft end of gear housing cavity.
3. Press bearing out with arbor press. (Figure 7)

G. REMOVING SHIFT SHAFT AND CAM

1. Remove 3/32" allen screw which holds shift shaft bushing in place.
2. Place shift shaft in vise. Use jaw protectors so that spline will not be damaged.
3. Tap gear housing lightly with rawhide mallet to remove shift shaft, shift shaft bushing and shift cam.

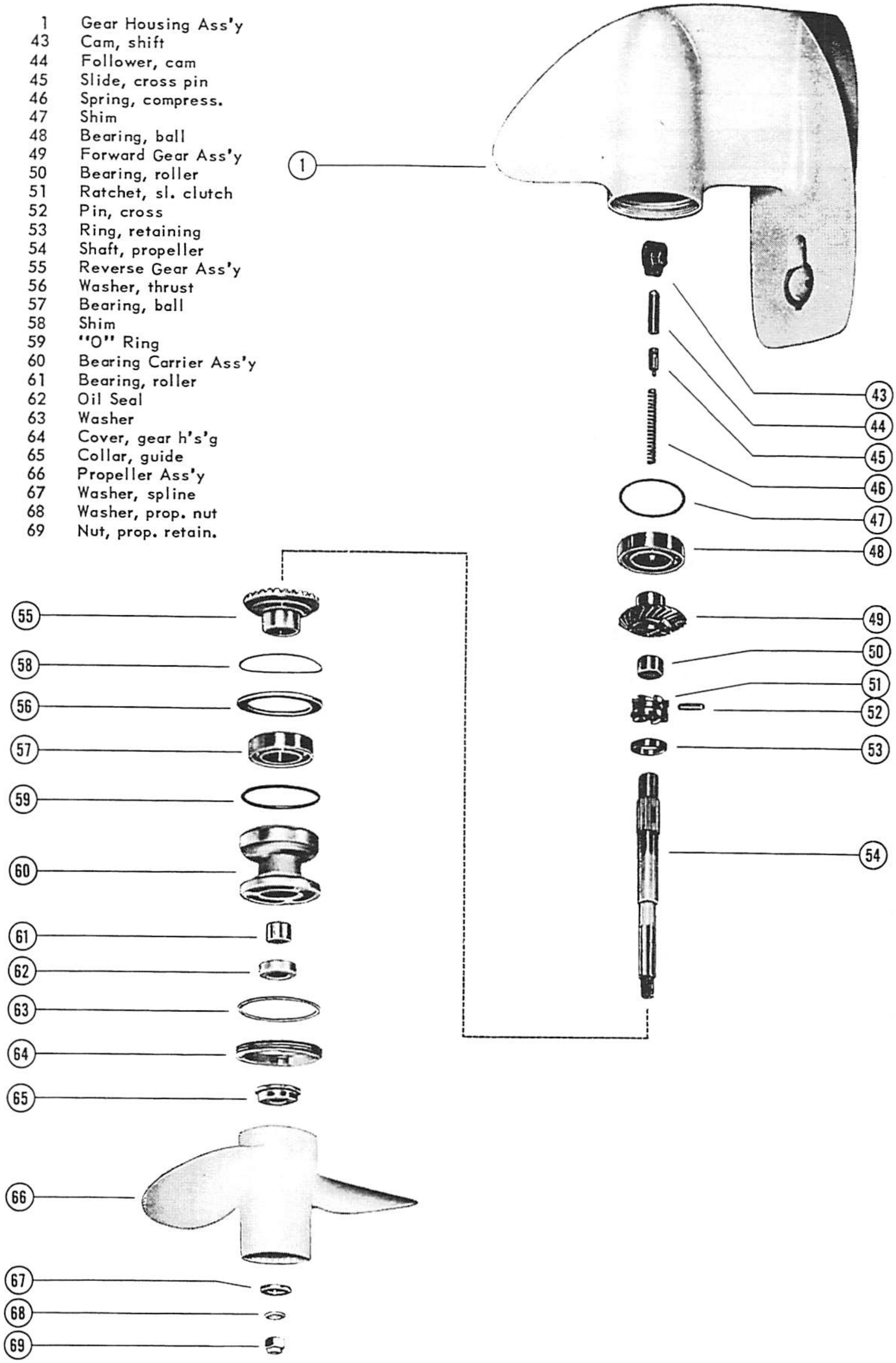
All parts now should be washed in cleaning solvent and inspected for wear, replacing those which are worn, not useable or damaged.



Merc 60 Gear Housing Assembly Complete

1	Gear Housing Ass'y
2	Stud
3	Stud
4	Bearing, roller
5	Pin, dowel
6	Seal, rubber
7	Screen
8	Washer
9	Screw
10	Washer
11	Screw
12	Shaft, shift
13	Ring, retaining
14	Bushing Assembly
15	"O" Ring
16	Oil Seal
17	Screw
18	Gear, pinion
19	Tab Washer
20	Screw
21	Drive Shaft
22	Shim
23	Bearing, ball
24	Ring, retaining
25	Shim
26	Water Pump H's'g
27	"O" Ring
28	Oil Seal
29	Seal
30	Tube
31	Insert
32	Pin, impel. drive
33	Impeller, w.p.
34	Plate, face
35	Washer, wave
36	Water Pump Cover
37	Seal
38	Oil Seal
39	Nut
40	Ring, rubber
41	Sleeve, guide
42	"O" Ring, upper

1 Gear Housing Ass'y
43 Cam, shift
44 Follower, cam
45 Slide, cross pin
46 Spring, compress.
47 Shim
48 Bearing, ball
49 Forward Gear Ass'y
50 Bearing, roller
51 Ratchet, sl. clutch
52 Pin, cross
53 Ring, retaining
54 Shaft, propeller
55 Reverse Gear Ass'y
56 Washer, thrust
57 Bearing, ball
58 Shim
59 "O" Ring
60 Bearing Carrier Ass'y
61 Bearing, roller
62 Oil Seal
63 Washer
64 Cover, gear h's'g
65 Collar, guide
66 Propeller Ass'y
67 Washer, spline
68 Washer, prop. nut
69 Nut, prop. retain.



Merc 60 Gear Housing Assembly Complete (Continued)

MERC 200-110-60-39 FULL GEAR SHIFT

REASSEMBLY

A. REPLACING NEEDLE BEARING IN GEAR HOUSING

1. Install drive shaft bearing cartridge into gear housing with Bearing Mandrel (C-91-24273). (Figure 7)
2. Press drive shaft needle cartridge bearing in until bearing is recessed evenly on shoulder between upper drive shaft cavity and lower gear cavity. Always press against the numbered side of cartridge type bearing. Numbered side of cartridge must face up.
3. Place gear housing in vise between 2 blocks of soft wood at thin section of gear housing so that gear cover end is up.
4. Insert shifting cam into gear housing with notches up and to right when viewing in from skeg. Cam operates to left.
5. Insert shift shaft lower half so that splines engage shifting cam splines inside housing. Short spline on shift shaft engages with shift cam, and long spline on shift shaft engages with upper shift shaft.
6. Install shift shaft bushing and tighten securely with 3/32" allen screw.
7. Replace shims which were removed originally from under forward gear ass'y.
8. Install new needle bearing in forward gear (if previously removed) with Mandrel (C-91-24273).
9. Press ball bearing onto forward gear.
10. Place gear and bearing assembly into gear housing
11. Place propeller shaft (ratchet end) into center of forward gear assembly.
12. Place forward gear assembly into gear housing, using bearing carrier as a guide.
13. Lubricate needle and ball bearings in gear housing with oil.

B. INSTALLING DRIVE SHAFT

1. Place ball bearing on drive shaft. (Figure 8)
2. Place drive shaft in vise loosely, tapping against pinioned spline end until bearing seats.

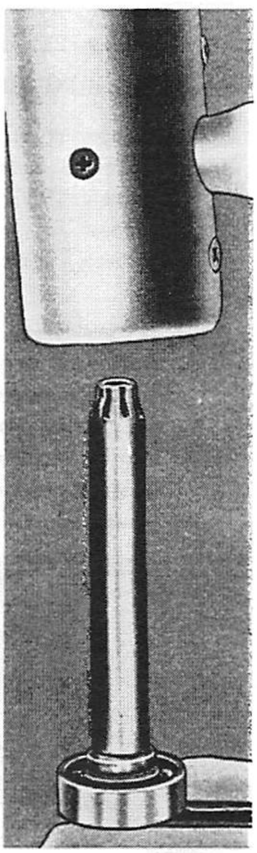


Figure 8. Installing Drive Shaft Ball Bearing

3. Replace locking ring on drive shaft to hold ball bearing in place.
4. Place shims as required, or as previously removed, into drive shaft ball bearing recess in gear housing.
5. Before seating drive shaft and bearing, place pinion gear on splined end of shaft, aligning with splines in gear.
6. Lubricate ball bearing and tap drive shaft assembly to seat in gear housing.
7. Place drive shaft in vise close to housing and tighten screw at pinion with box end 3/8" wrench. Bend tab washer down over side of screw head to secure.
8. Remove drive shaft from vise and install skeg of gear housing in vise between jaw protectors or 2 blocks of soft wood with drive shaft facing up.
9. Replace shims, as required, on top of drive shaft bearing before replacing water pump base assembly.

C. INSTALLING WATER PUMP BASE AND BODY ASSEMBLIES

1. Place water pump base assembly in position in gear housing.
2. There should be no play between bearing and water pump base assembly when water pump base assembly is depressed. Add or remove shim as required. No play may be obtained by over-shimming. Place a feeler gauge between gear housing and water pump body. If gap measured between gear housing and water pump body is .010" (.254mm), remove .010" shim; if .005" (.127mm), remove .005" shim. This will give a zero gap which is correct and should not be altered.
3. Insert stainless water pump cartridge in water pump body.
4. Place drive pin in drive shaft, holding in position with dab of MULTIPURPOSE Lubricant (C-92-35226).
5. Check condition of impeller closely and set in place in water pump cartridge.
6. Turn drive shaft clockwise, at same time seating impeller. Be sure that impeller drive pin is in position in drive pin groove of impeller.
7. Replace stainless steel face plate, wave washer, water pump cover assembly and water inlet tube. (Figure 9)
8. Replace two 7/16" locknuts and tighten evenly.
9. Place plastic water tube guide in water pump body recess.
10. Replace drive shaft slinger and drive shaft "O" ring.

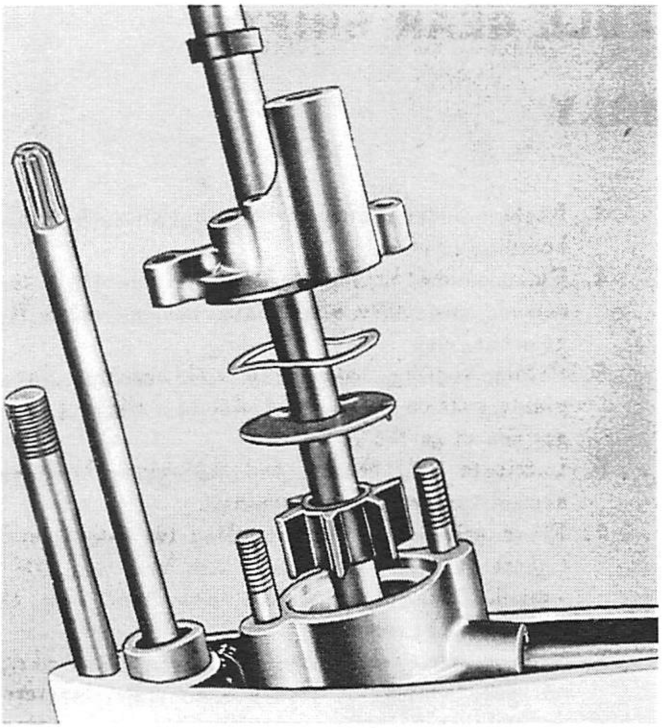


Figure 9. Installing Water Pump Body Assembly

11. Place gear housing in vise so that gear housing cover is facing up. Use jaw protectors or wood blocks so gear housing will not be marred.
12. Check forward gear lash (at least .003" to .005") between forward gear and pinion gear at this time. If too tight, remove forward shim until correct back lash is obtained. If too much, add shims 'til correct. Be sure that conical angle of gears is true. Gears should fully engage each other on length of tooth. Shimming of drive shaft ball bearing may be necessary to obtain correct back lash (.003" to .005"), if unable to do so with forward gear shims.

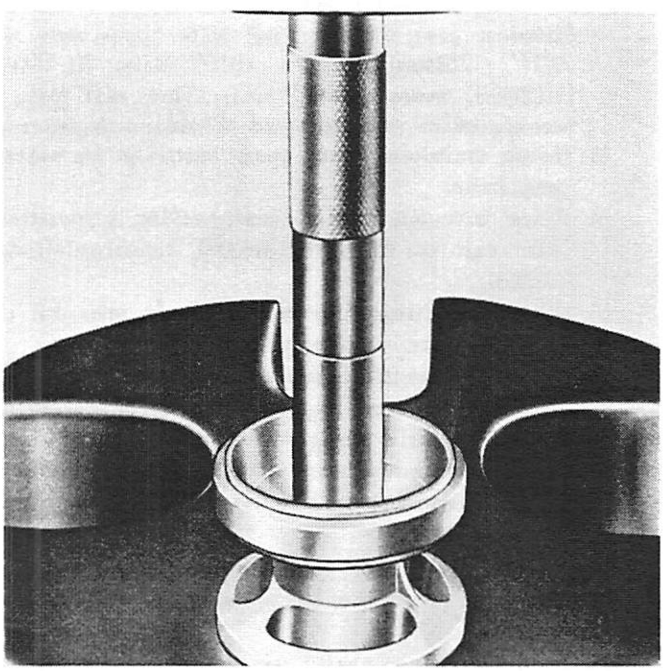


Figure 10. Installing Roller Bearings in Carrier

D. REASSEMBLING PROPELLER SHAFT COMPONENTS

1. Install cam follower spring and cam follower slide inside hollow end of propeller shaft so that holes in cam follower slide match hole in propeller shaft.
2. Place sliding clutch onto propeller shaft and install cam follower in end of propeller shaft.
3. Compress spring inside propeller shaft by pressing on cam follower until holes in sliding clutch, propeller shaft and cross pin slide all line up.
4. Place cross pin thru sliding clutch, propeller shaft and slide.
5. Install cross pin retaining ring around sliding clutch. Do not over-stretch spring when installing.
6. Place propeller shaft assembly into forward gear assembly in gear housing.

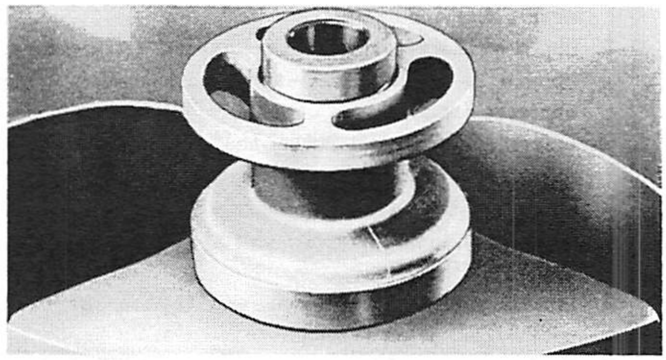


Figure 11. Installing Oil Seals in Carrier

E. INSTALLING BEARING CARRIER

1. Press roller bearing into bearing carrier from rear of housing with Bearing Mandrel (91-24273). (Figure 10)
2. Press oil seal into bearing carrier flush with face of carrier, seal lips facing inward. (Figure 11)
3. Press large ball bearing into bearing carrier.
4. Replace large "O" ring on outside diameter bearing carrier and ball bearing thrust washer on bearing carrier.
5. Press reverse gear into large ball bearing in bearing carrier.
6. Install shims in gear housing.

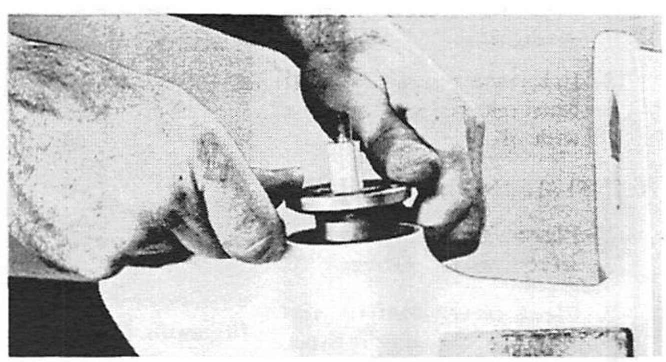


Figure 12. Installing Bearing Carrier

7. Install plastic guide tube (23-30960) over propeller shaft to protect oil seals. Push bearing carrier into gear housing until it seats against ball bearing thrust ring. (Figure 12) Plastic guide tube may be removed from propeller shaft.

   NOTE: It is a good idea to keep one of these plastic sleeves on hand to use as an oil seal sleeve.

8. Coat threads of gear housing with Gasket Sealer (92-28804) or Liquid Neoprene (92-25711) to facilitate easy future removal of gear housing cover.
9. Place gear housing cover washer on bearing carrier shoulder.
10. Thread gear housing cover onto gear housing and tighten in counterclockwise direction with Gear Housing Cover Tool (91-30798).
11. Check gear lash by pulling out on drive shaft and pushing in on propeller shaft. Rotate drive shaft very lightly in both directions to feel gear lash. No more than .003" to .005" play should be allowed for proper operation. Add or remove shims to obtain proper mesh.
12. Turn shift shaft clockwise until cam follower is felt against first notch on shift cam. This is forward gear.

F. JOINING GEAR HOUSING AND DRIVE SHAFT HOUSING

(See Paragraph "G" for Long Shaft Models.)

1. If water inlet tube-to-powerhead is pulled out when gear housing was removed, coat tube upper end with MULTIPURPOSE Quicksilver Lubricant so that it will slip easily into rubber seal in bottom cowl and insert into recess in powerhead.
2. Place light coat of MULTIPURPOSE Lubricant on bottom end of water tube.
3. Apply heavy coat of MULTIPURPOSE Lubricant on drive shaft splines.
4. Check that shift control lever and lower unit are in forward gear before installing gear housing.
5. Insert drive shaft into drive shaft housing, aligning water tube with water pump body outlet and drive shaft splines with crankshaft, then sliding into place while joining housings. *(Note: Be careful that water inlet tube enters plastic water tube guide in water pump body recess and rubber seal in water pump cover.)*
6. Place shift control lever in neutral, then in forward to check that upper and lower shift shaft splines are properly aligned.
7. Rotate propeller shaft by pulling lightly on starter rope to cause drive shaft splines to enter crankshaft splines. Upper and lower shift shaft splines also must be aligned.
8. With 2 housings joined, install and tighten 2 elastic stop nuts.

G. JOINING GEAR HOUSING AND DRIVE SHAFT HOUSING "Long Shaft Models"

NOTE: If nylon block (31455) was dislodged when removing lower unit, powerhead must be removed to reinstall nylon block on drive shaft of long shaft models.

1. Remove powerhead.
2. If water inlet tube-to-powerhead was pulled out when gear housing was removed, coat tube upper end with MULTIPURPOSE Quicksilver Lubricant, so that it will slip easily into rubber seal in bottom cowl, and insert into recess.
3. Place light coat of MULTIPURPOSE Lubricant (92-30239) on bottom end of water tube.
4. Insert drive shaft part way into drive shaft housing.
5. Reach through exhaust opening of bottom cowl and install nylon block on drive shaft.
6. Join gear housing and drive shaft housing.

   NOTE: Be careful that water inlet tube enters plastic water tube guide in water pump body recess and rubber seal in water pump cover.

7. Place shift control lever in neutral, then in forward to check that upper and lower shift shaft splines are properly aligned.
8. With 2 housings joined, install and tighten 2 elastic stop nuts.
9. Before installing powerhead, check that nylon block is in proper position. Nylon block should be wedged lightly between drive shaft housing and drive shaft. The radius side of the nylon block should face toward rear of engine.
10. Apply heavy coat of MULTIPURPOSE Lubricant on drive shaft splines.
11. Install powerhead.
12. Turn flywheel to align crankshaft splines and drive shaft splines.

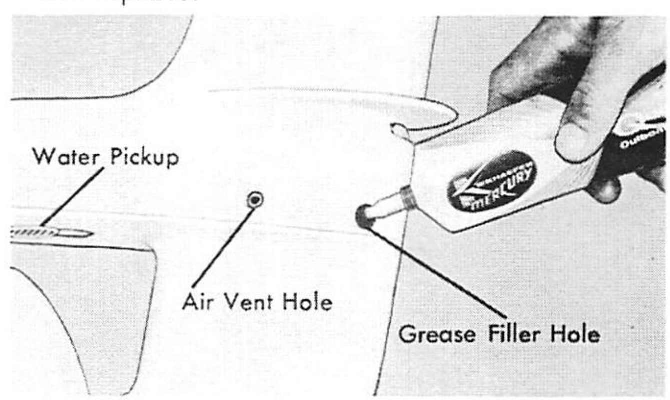


Figure 13. Gear Case Lubrication

H. LOWER DRIVE UNIT LUBRICATION

1. Remove air vent screw and lubricant filler plug which are located on starboard side of gear housing, the vent screw just above anti-cavitation plate, the filler plug either above or below anti-cavitation plate.
2. Insert Quicksilver Special Outboard Gear Lubricant (92-29415 or 92-29409) tube into filler plug hole and inject lubricant until excess lubricant

starts to flow out of air vent screw hole, indicating that housing is filled. (Figure 13)

3. Replace air vent screw and filler plug, taking special care that washer is in place under head of each so that water will not leak past threads and into gear housing.

I. INSTALLING PROPELLER (Figure 14)

1. Place collar guide into propeller hub (shoulder into recess of propeller).
2. Apply thin coat of MULTIPURPOSE Quicksilver Lubricant (92-30239) on splines of propeller shaft.
3. Align propeller hub splines with splines of propeller shaft and slide propeller on shaft. Tap into position if necessary.
4. Replace splined washer and plain washer.
5. Replace propeller nut and tighten with ½" socket wrench.

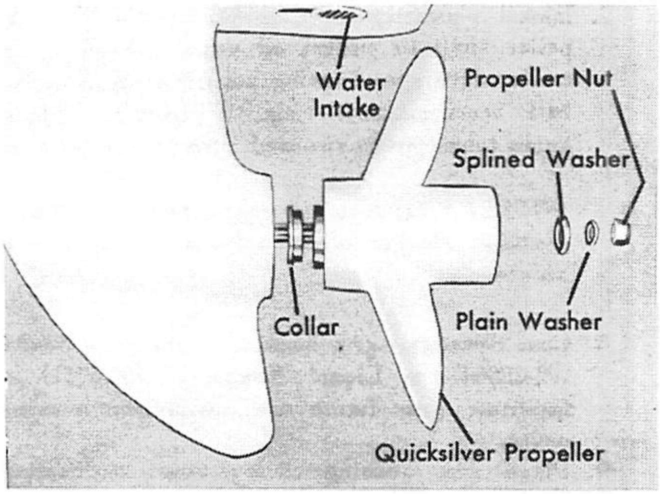


Figure 14. Propeller Installation

WARNING: Use of other than recommended Quicksilver Propellers will void warranty.

MERC 500-450-350(2-CYL.) FULL GEAR SHIFT

Jet Prop Exhaust Type Lower Unit

DISASSEMBLY

NOTE: Repair procedure, for gear housings with water pickup in trim tab and gear housings with water pickup in the gear housing strut, are parallel, except where indicated.

REMOVING GEAR HOUSING FROM DRIVE SHAFT HOUSING

1. Remove 2 hexagon head lock nuts which hold gear housing assembly to drive shaft housing (leading edge) .
2. Remove hexagon head lock nut located in center bottom side of anti-cavitation plate.
3. Remove water pickup or trim tab under trailing edge of anti-cavitation plate by removing plastic plug and allen head screw from rear of drive shaft housing.
4. Remove hexagon head lock nut from inside trim tab cavity.
5. Separate gear housing from drive shaft housing.

REMOVING PROPELLER SHAFT AND COMPONENTS

1. Drain EXTRA-DUTY Lubricant from gear housing by removing filler hole screw and vent screw. (Figure 1) Do not lose washers. Replace washers and screws after draining.

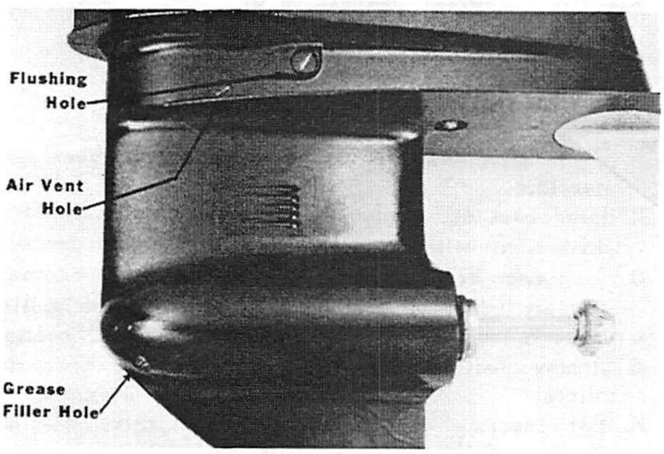


Figure 1. Filler Hole and Vent Screw

2. Place gear housing assembly in vise between 2 blocks of soft wood to prevent marring surface.
3. Place a piece of wood flat between propeller and anti-cavitation plate to prevent propeller from turning while removing the propeller nut.
4. Remove propeller by removing propeller nut (right hand thread) , splined washer, propeller and thrust hub and backing washer.
5. At this time, lash between gears should be checked for future reference. Pull on drive shaft with one hand and push on propeller shaft with other. Refer to backlash later in Paragraph 12, Column 2, Page 99.
6. Remove gear housing cover and washer with Gear Housing Cover Tool (91-30291A2) . Place tool over

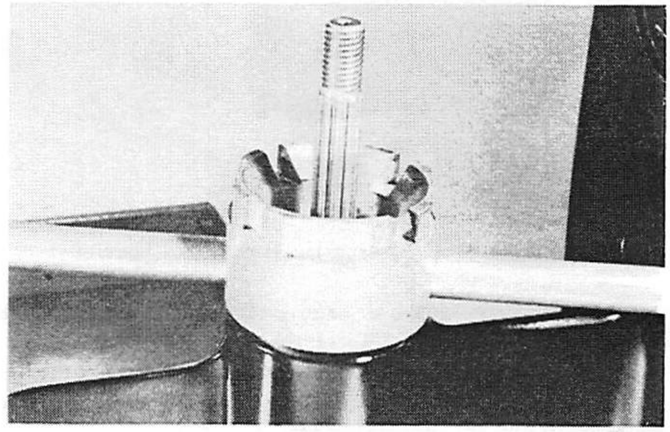


Figure 2. Removing Gear Case Cover

end of propeller shaft and set tool into cover, turning counterclockwise (right hand thread) to loosen. (Figure 2) If tight, strike handle of tool with mallet to loosen.

7. Bearing carrier assembly can be removed while removing propeller shaft. Place propeller shaft in vise between 2 pieces of soft wood. Shaft assembly then can be removed by tapping lightly and evenly on skeg of gear housing with a mallet. Remove key from keyway from inside bottom of gear housing.
8. Remove propeller shaft from bearing carrier.
9. Remove reverse gear and ball bearing from bearing carrier with 91-27780 tool, as shown in Figure 3.

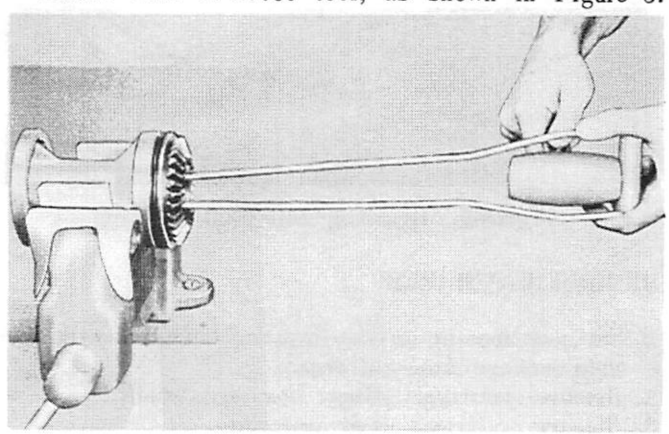


Figure 3. Pulling Reverse Gear from Bearing Carrier

10. Remove "O" ring from carrier.
11. Press or tap roller bearing and seal from carrier with Driver Head (91-37311) . (Figure 4)

DISASSEMBLY OF PROPELLER SHAFT AND GEAR ASSEMBLY

1. Use screwdriver to detach retaining ring from sliding clutch. Do not over-stretch, or ring will lose its shape and tension.
2. Remove sliding clutch from propeller shaft by setting cam follower in place in end of propeller shaft. Press

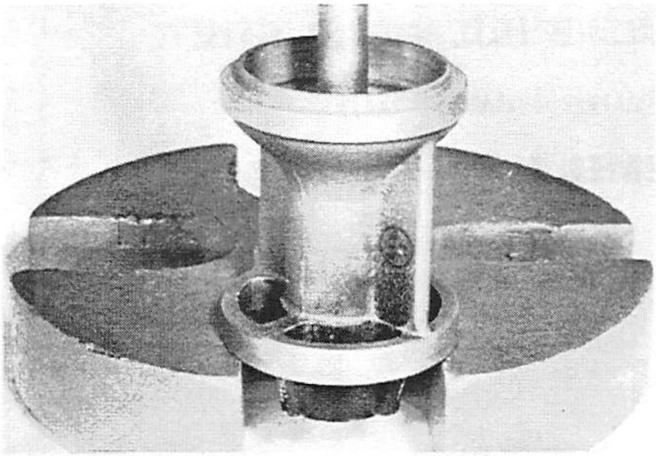


Figure 4. Pressing Bearing out of Carrier

against cam follower and, with small punch, push cross pin out of sliding clutch.

3. Sliding clutch now is free to be removed from propeller shaft, with cross pin slide and spring dropping free from inside of propeller shaft.
4. Remove lower reverse locking cam from shift shaft bushing. Remove shift shaft bushing, using Shift Shaft Tool (91-23033) (Figure 5), and pull shift shaft out of gear housing. Shifting cam then will fall out of gear housing.

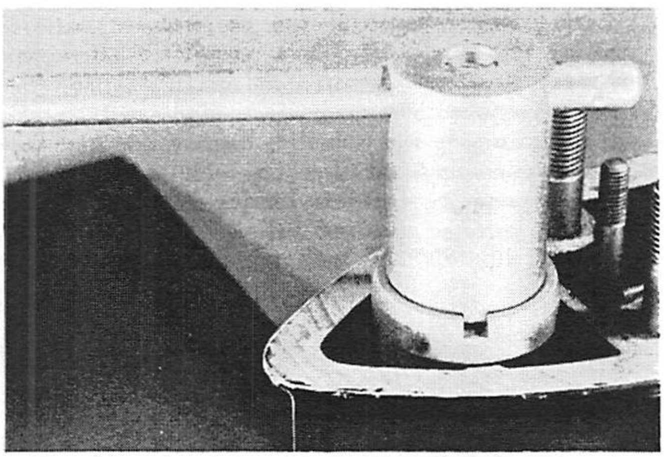


Figure 5. Removing Shift Shaft Bushing

REMOVE WATER PUMP

1. Set gear housing in vise in upright position with skeg held between blocks of wood.
2. Remove centrifugal slinger from drive shaft.
3. Remove water pump body assembly.
4. Remove water pump insert, impeller and impeller pin along with water pump body, gasket, water pump face plate and gasket face plate to gear housing and oil seal.(Figure 6)
5. Check impeller and water pump insert closely for wear or damage.
6. Remove flushing screw, seal and gasket to allow water pump base assembly to be lifted out.

NOTE: Water pump base in late style gear housing has a threaded hole, located next to forward stud, to aid removal. Install a 10-24 screw and turn in until water pump base is forced away from gear housing.

7. Remove "O" ring and oil seal from base plate assembly and watch for shims under base assembly.

NOTE: Gear housing with water intake in strut has an additional gasket located between water pump base and gear housing.

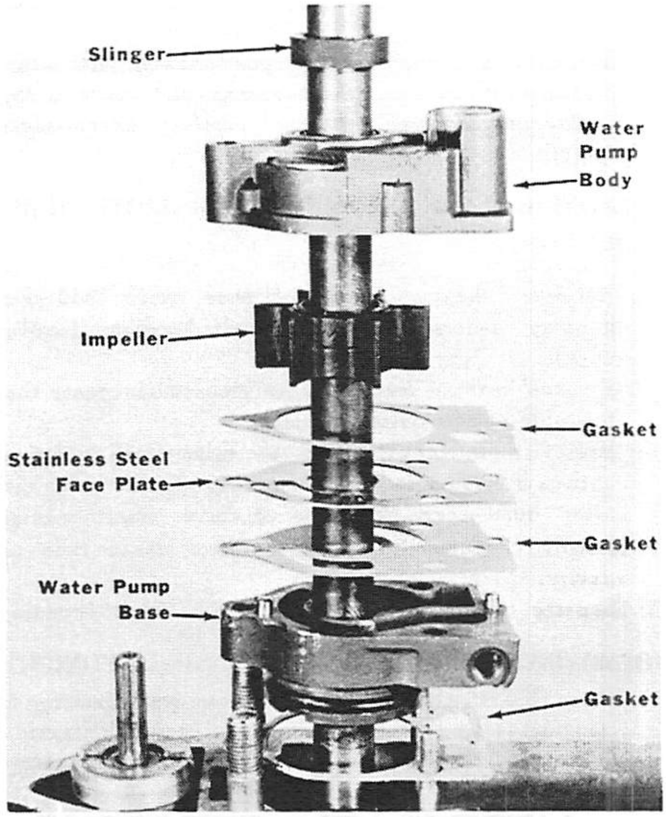


Figure 6. Removing Water Pump Assembly

REMOVING DRIVE SHAFT AND COMPONENTS

1. Place drive shaft in vise as close to gear housing as possible.
2. Bend back tab washer and remove pinion screw from drive shaft with box-end wrench (right hand thread) .
3. To loosen drive shaft, hold gear housing in one hand and tap lightly on gear housing with rawhide mallet.
4. Observe any shims under drive shaft ball bearing.
5. Remove ball bearing retaining ring with snap ring pliers.
6. Ball bearing can be removed from drive shaft by placing against open vise jaws and tapping on splined end of drive shaft with a mallet. (Figure 7)

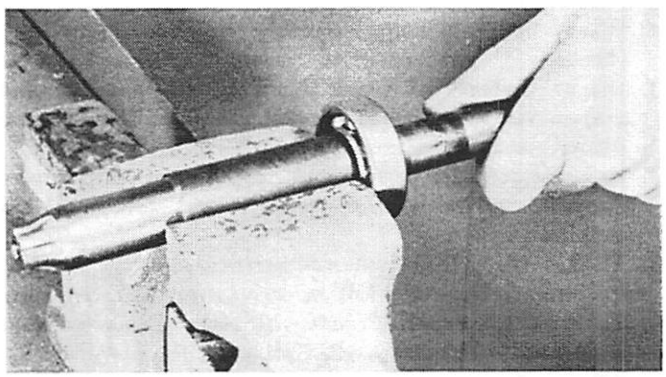


Figure 7. Removing Ball Bearing from Drive Shaft

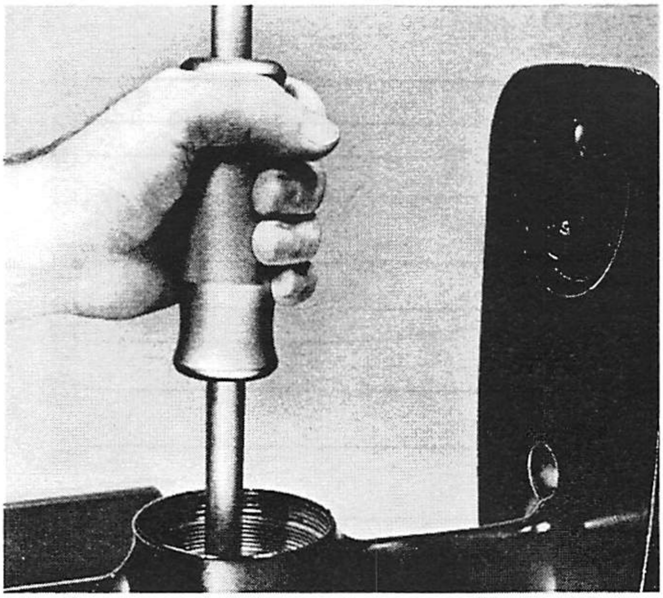


Figure 8. Removing Cup from Gear Housing

7. Remove forward gear and bearing assembly from gear housing.
8. Remove bearing cup from gear housing with Slide Hammer Puller (91-34569A1). (Figure 8)

REMOVING NEEDLE BEARINGS FROM GEAR HOUSING

1. Remove drive shaft needle bearings from gear housing with Driver Head (91-37312).
2. Place tool in drive shaft end of gear housing cavity.
3. Press bearing out with arbor press or tap on tool with heavy mallet to remove bearing. (Figure 9)

This completes disassembly of gear housing. All parts now should be washed in cleaning solvent and inspected for wear, replacing those which are worn, not useable or damaged.

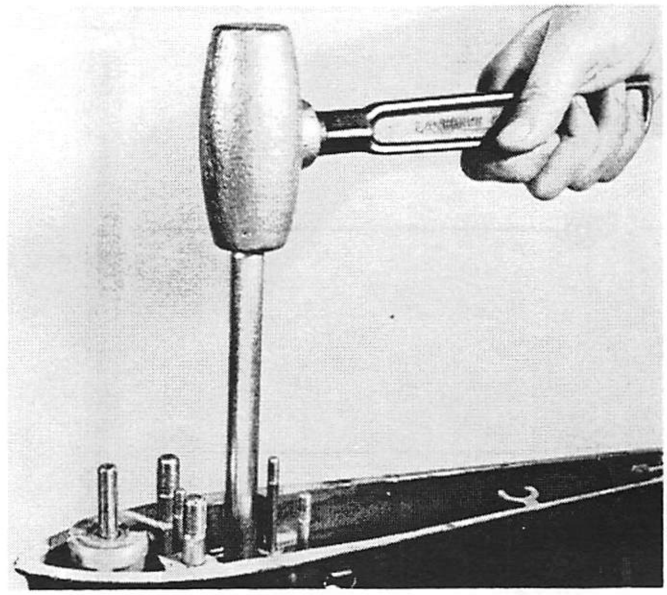
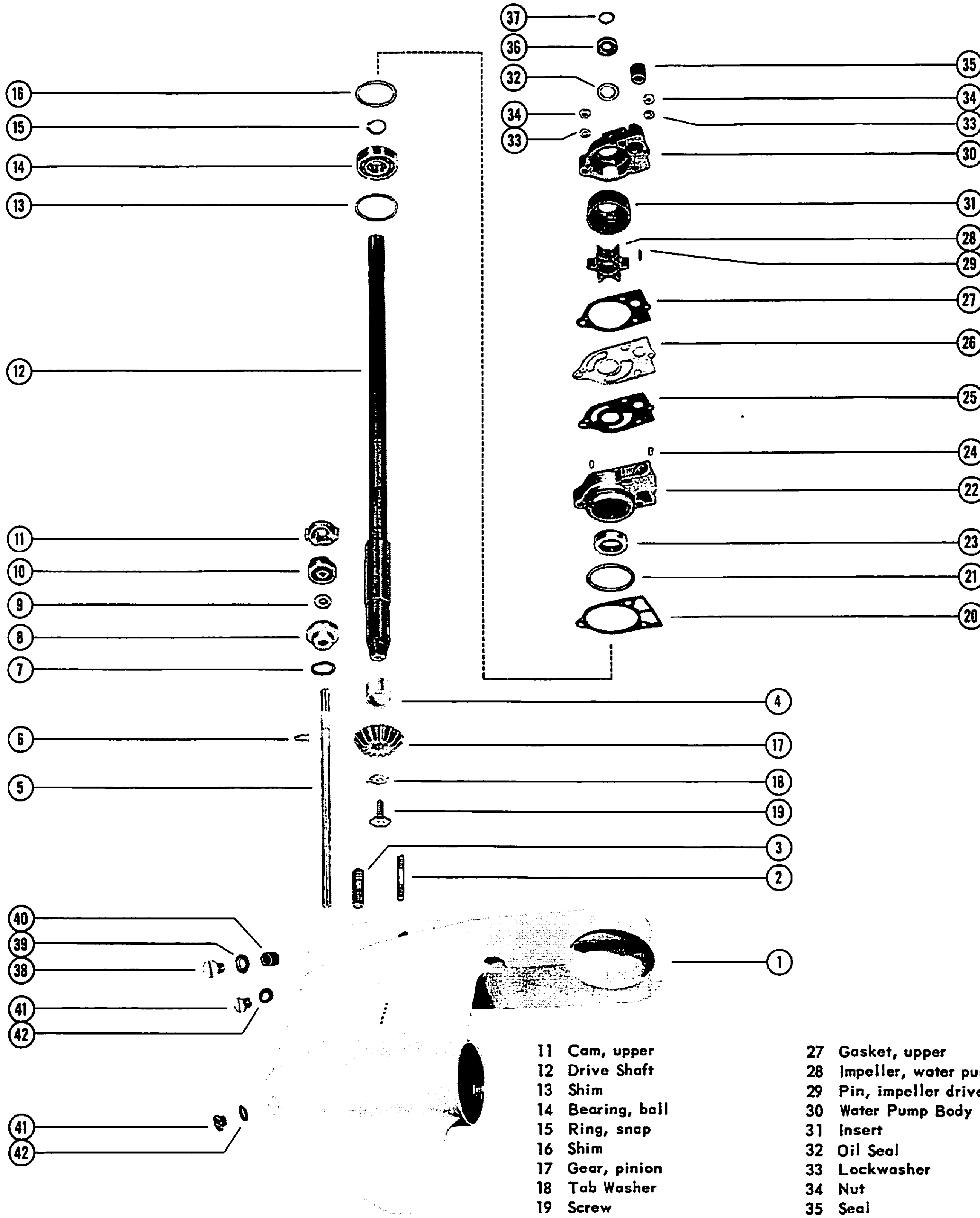


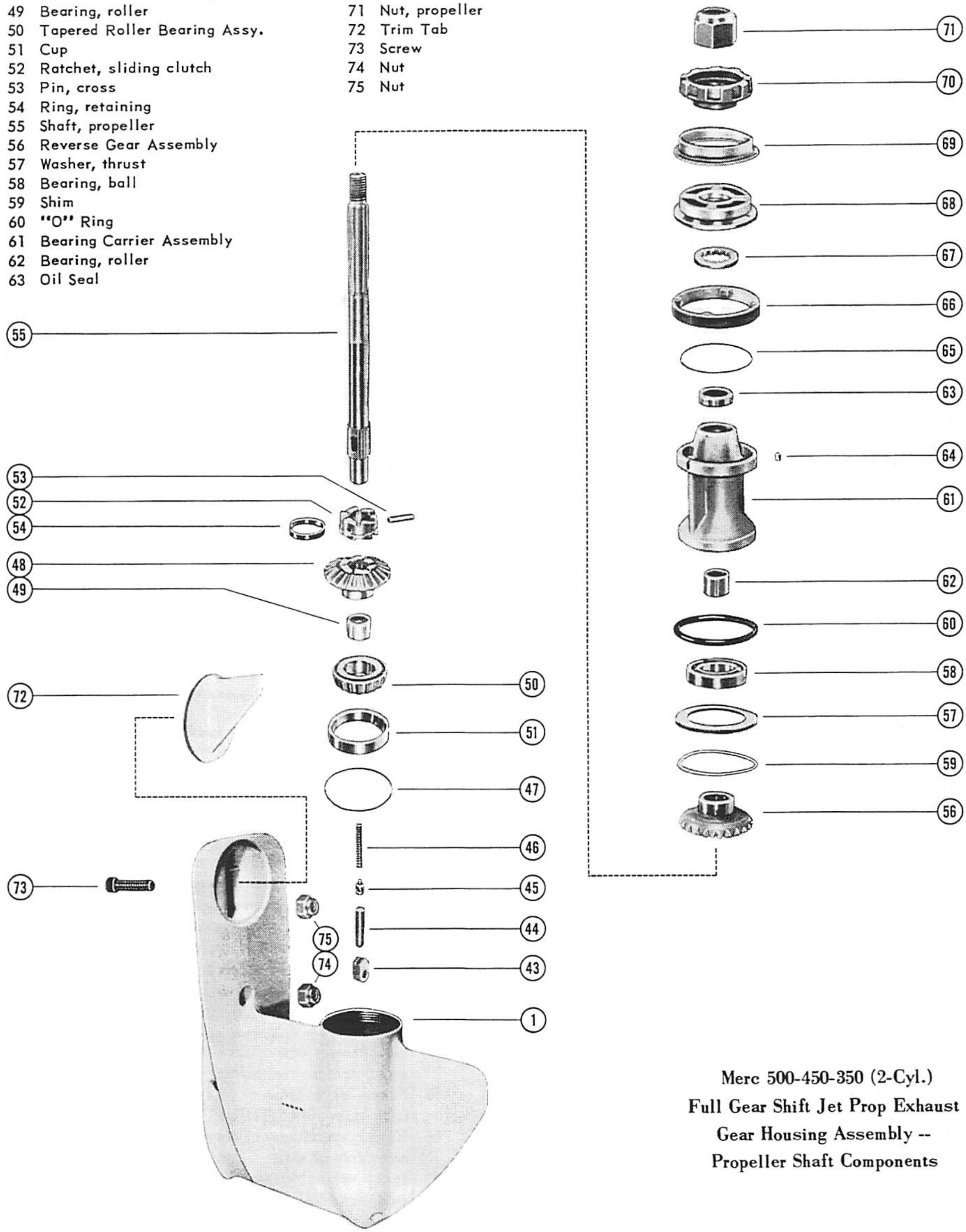
Figure 9. Removing Drive Shaft Needle Bearing from Gear Housing



1 Gear Housing Assembly
2 Stud
3 Stud
4 Bearing, roller
5 Shaft, shift - lower
6 Clip, retaining
7 "O" Ring
8 Bushing Assembly
9 Oil Seal
10 Cam, lower
11 Cam, upper
12 Drive Shaft
13 Shim
14 Bearing, ball
15 Ring, snap
16 Shim
17 Gear, pinion
18 Tab Washer
19 Screw
20 Gasket
21 "O" Ring
22 Water Pump Base Assy.
23 Oil Seal
24 Dowel Pin
25 Gasket, lower
26 Plate, face
27 Gasket, upper
28 Impeller, water pump
29 Pin, impeller drive
30 Water Pump Body Assy.
31 Insert
32 Oil Seal
33 Lockwasher
34 Nut
35 Seal
36 Ring, rubber
37 "O" Ring, upper
38 Screw
39 Gasket
40 Seal
41 Screw
42 Washer

Merc 500-450-350 (2-Cyl.) Full Gear Shift Jet Prop Exhaust
Gear Housing Assembly – Drive Shaft Components

1 Gear Housing Assembly
43 Cam, shift
44 Follower, cam
45 Slide, cross pin
46 Spring, compression
47 Shim
48 Forward Gear Assembly
49 Bearing, roller
50 Tapered Roller Bearing Assy.
51 Cup
52 Ratchet, sliding clutch
53 Pin, cross
54 Ring, retaining
55 Shaft, propeller
56 Reverse Gear Assembly
57 Washer, thrust
58 Bearing, ball
59 Shim
60 "O" Ring
61 Bearing Carrier Assembly
62 Bearing, roller
63 Oil Seal
64 Key, locating
65 Washer
66 Cover
67 Washer, backing
68 Thrust Hub & Washer Assy.
69 Washer, cupped
70 Washer, splined
71 Nut, propeller
72 Trim Tab
73 Screw
74 Nut
75 Nut



Merc 500-450-350 (2-Cyl.)
Full Gear Shift Jet Prop Exhaust
Gear Housing Assembly --
Propeller Shaft Components

MERC 500-450-350(2-CYL.) FULL GEAR SHIFT

Jet Prop Exhaust Type Lower Unit

REASSEMBLY

NOTE: Repair procedure, for gear housings with water pickup in trim tab and gear housings with water pickup in the gear housing strut, are parallel, except where indicated.

REPLACING NEEDLE BEARING IN GEAR HOUSING

1. Install drive shaft bearing cartridge into gear housing with Driver Head (C-91-37312). (Figure 9)
2. Press drive shaft needle cartridge bearing in until bearing is recessed evenly on shoulder between upper drive shaft cavity and lower gear cavity. Always press against the numbered side of cartridge type bearing. Numbered side of cartridge must face up.
3. Replace shims, which were removed originally, from forward gear bearing cup of gear housing.
4. Place bearing cup on Driver Cup Tool (C-91-31361) with tapered end of cup against driver cup.
5. Set cup with tool into gear housing bearing shoulder and place propeller shaft (ratchet end) into center hole of driver cup.
6. Place bearing carrier assembly into housing to act as a guide to hold shaft straight when pressing cup into position.
7. Press forward gear roller bearing outer cup into gear housing.
8. Lubricate needle and roller bearings in gear housing with oil.
9. Place gear housing in vise between jaw protectors at thin section of gear housing so that gear cover end is up.
10. Insert shifting cam into gear housing with notches up and to left when viewing in from skeg. Cam operates to right.
11. Insert shift shaft lower half so that splines engage shifting cam splines inside housing.
12. Install shift shaft bushing and tighten securely with Shift Shaft Tool (C-91-23033).
13. Press roller bearing onto forward gear (taper of bearings to face away from gear) .
14. Place gear and bearing assembly into bearing outer cup.

INSTALLING DRIVE SHAFT

1. Place ball bearing on drive shaft.
2. Place drive shaft in vise loosely, tapping against pinioned spline end until bearing seats. (Figure 10)
3. Replace locking ring on drive shaft to hold ball bearing in place.
4. Place shims as required, or as previously removed, into drive shaft ball bearing recess in gear housing.
5. Before seating drive shaft and bearing, place pinion gear on splined end of shaft, aligning with splines in gear.
6. Lubricate ball bearing and tap drive shaft assembly to seat in gear housing.
7. Place drive shaft in vise close to housing and install tab washer and pinion screw.
8. Tighten pinion screw securely and bend tab washer to secure pinion screw.
9. Remove drive shaft from vise and install skeg of gear housing in vise between 2 blocks of wood or jaw protectors, with drive shaft facing up.
10. Replace shims, as required, on top of drive shaft bearing before replacing water pump base assembly.

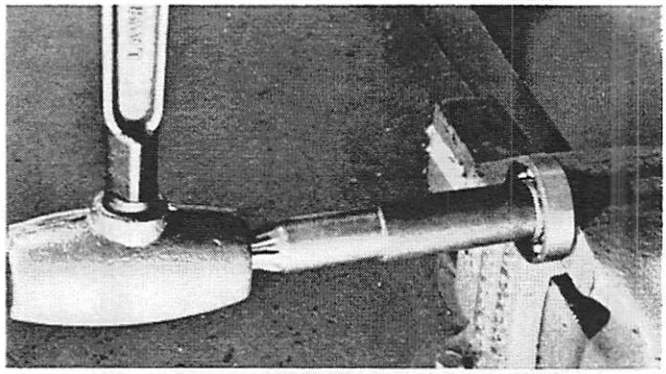


Figure 10. Installing Ball Bearing on Drive Shaft

INSTALLATION OF WATER PUMP BASE AND BODY ASSEMBLIES

1. Place seal in water pump base assembly with lips facing down.
   NOTE: On later model 4-cylinder gear housing, water pump base has 2 oil seals. Upper oil seal is installed with lips facing up. Lower seal is installed with lips down.
2. Place water pump base assembly in position in gear housing.
   NOTE: Gear housing with water intake in strut requires a gasket between water pump base and gear housing.
3. There should be no play between bearing and water pump base assembly when water pump base assembly is depressed. Add or remove shims as required. No play may be obtained by over-shimming. Place a feeler gauge between gear housing and water pump body. If gap measured between gear housing and water pump body is .010", remove .010" shim; if .005", remove .005" shim. This will give a zero gap which is correct and should not be altered.
4. Install water pump base-to-face-plate gasket and replace stainless face plate. (Figure 11)
   NOTE: Gear housing with water intake in trim tab must have water intake tube installed in water pump base before installing stainless steel face plate.
5. Place drive pin on drive shaft, holding in position with dab of MULTIPURPOSE Lubricant (C-92-35226).
6. Check condition of impeller closely and set in place over drive shaft.
7. Insert stainless water pump cartridge in water pump body and place water pump body-to-face-plate gasket on water pump body. (Figure 11)

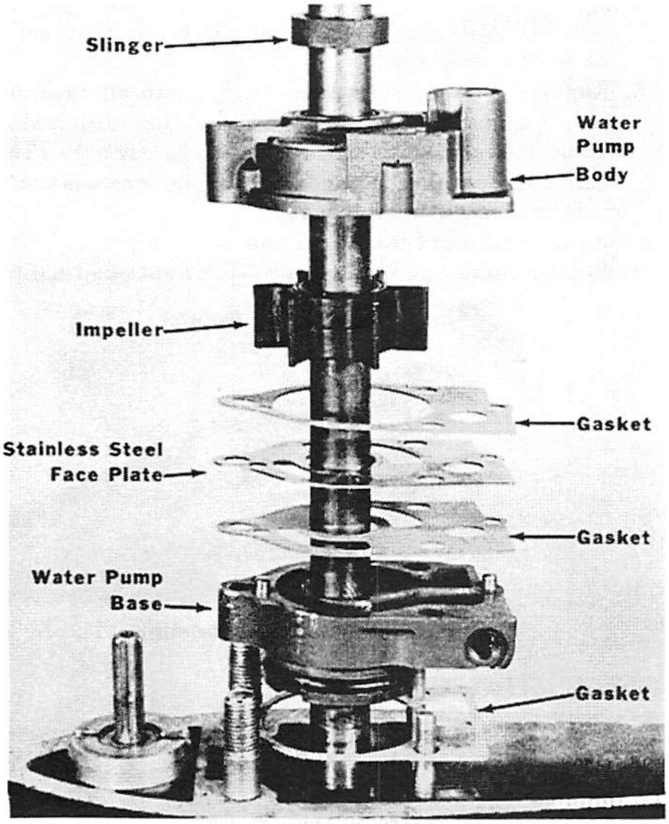


Figure 11. Installing Water Pump Assembly

8. Slide water pump body assembly over drive shaft and impeller. (Figure 11)
9. Turn drive shaft clockwise and press water pump body assembly into place, at same time seating impeller. Be sure that impeller drive pin is in position in drive pin groove of impeller.
10. Replace lock washers and tighten nuts.
11. Replace drive shaft slinger.
12. Place gear housing in vise so that gear housing cover is facing up. Use jaw protectors or wood blocks so as not to mar gear housing.
13. Check forward gear lash (at least .003" to .005") between forward gear and pinion gear at this time. If too tight, remove forward shim until correct back lash is obtained. If too much, add shims 'til correct. Be sure that conical angle of gears is true. Gears should fully engage each other on length of tooth. Shimming of drive shaft ball bearing may be necessary to obtain correct back lash (.003"-.005"), if unable to do so with forward gear shims.

REASSEMBLING PROPELLER SHAFT COMPONENTS

1. Install cam follower spring and cam follower slide inside hollow end of propeller shaft so that holes in cam follower slide match hole in propeller shaft.
2. Place sliding clutch onto propeller shaft and install cam follower in end of propeller shaft.
3. Compress spring inside propeller shaft by pressing on cam follower until holes in sliding clutch, propeller shaft and cross pin slide all line up.
4. Place cross pin thru sliding clutch, propeller shaft and slide.
5. Install cross pin retaining ring around sliding clutch. Do not over-stretch spring when installing.
6. Place propeller shaft assembly into forward gear assembly in gear housing.

INSTALLATION OF BEARING CARRIER

1. Press or tap roller bearing into bearing carrier from rear of housing with Driver Head (91-37311). (Figure 12)
2. Press oil seal in to seat on shoulder in front of roller bearing with lip of seal facing in.
3. Press large ball bearing into bearing carrier.
4. Replace large "O" ring on outside diameter bearing carrier and ball bearing thrust washer on bearing carrier.
5. Press reverse gear into large ball bearing in bearing carrier.
6. Install shims in gear housing.
7. Push bearing carrier into gear housing until it seats against ball bearing thrust ring.
8. Place key in keyway in bearing carrier and bottom of gear housing.
9. Coat threads of gear housing with Gasket Sealer (92-28804) or Liquid Neoprene (92-25711) to facilitate easy future removal of gear housing cover.
10. Place gear housing cover washer on bearing carrier shoulder.
11. Thread gear housing cover onto gear housing and tighten in clockwise direction with Gear Housing Cover Tool (91-30291A2).
12. Check gear lash by pulling out on drive shaft and pushing in on propeller shaft. Rotate drive shaft very lightly in both directions to feel gear lash. No more than .003" to .005" play should be allowed for proper operation. Add or remove shims to obtain proper mesh.

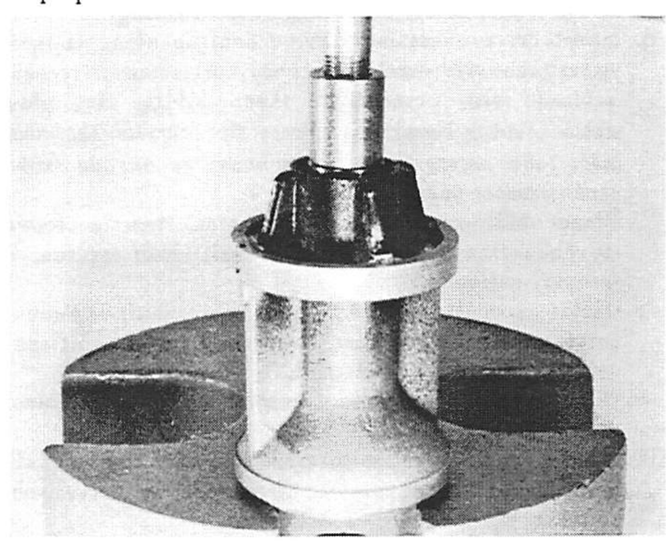


Figure 12. Installing Roller Bearings in Carrier

13. Turn shift shaft counterclockwise until cam follower is felt against first notch on shift cam. This is forward gear.
14. With lower unit in forward gear, place reverse lock cam on shift shaft.
NOTE: Shift shaft must be in forward gear position, and the lower reverse lock cam installed with the 2 tabs aligned with left front stud. (Figure 13)
15. After replacing shift cam, lubricate heavily with MULTIPURPOSE Lubricant (92-35226).

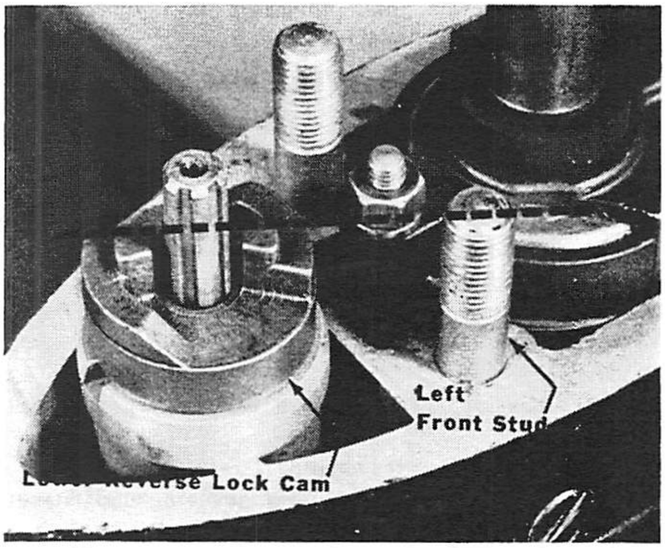


Figure 13. Installing Lower Reverse Lock Cam

JOINING GEAR HOUSING AND DRIVE SHAFT HOUSING

1. If water inlet tube-to-powerhead is pulled out when gear housing was removed, coat tube upper end with MULTIPURPOSE Quicksilver Lubricant so that it will slip easily into rubber seal in bottom cowl and insert into recess in powerhead.
2. Place light coat of MULTIPURPOSE Lubricant on bottom end of water tube.
3. Apply heavy coat of MULTIPURPOSE Lubricant on drive shaft splines.
4. Insert allen head water pickup or trim tab screw in place on top of gear housing.
5. Check that shift control lever and lower unit are in forward gear before installing gear housing.
6. Insert drive shaft into drive shaft housing, aligning water tube with water pump body outlet and drive shaft splines with crankshaft, then sliding into place while joining housings. *(Note: Be careful that water inlet tube enters water pump body recess and rubber seal in water pump cover.)*
7. Place shift control lever in neutral, then in forward to check that upper and lower shift shaft splines are properly aligned.
8. Rotate propeller shaft to permit drive shaft splines to enter crankcase splines. Upper and lower shift shaft splines also must be aligned.
9. With 2 housings joined, install and tighten elastic stop nuts.
10. Install water pickup or trim tab and tighten allen head screw thru plastic plug hole in drive shaft housing, then replace plastic plug.

LOWER DRIVE UNIT LUBRICATION

1. Remove filler hole screw from gear case, located as shown in Figure 1. Be careful not to lose accompanying washer.
2. Place EXTRA-DUTY Quicksilver Outboard Gear Lubricant (92-30295) tube end in filler hole.
3. Remove air vent screw from air vent hole just above anti-cavitation plate, being careful not to lose accompanying washer. (Figure 1)
4. Inject EXTRA-DUTY Lubricant into gear case (Figure 14) until excess lubricant starts to flow out of air vent screw hole.
5. Replace air vent screw and washer into air vent hole and tighten before removing tube from filler hole, when hole is in position as shown in Figure 1. This will create an airlock and hold oil in gear case until filler hole screw is replaced.
6. Remove tube end from filler hole.
7. Replace screw and washer into filler hole and tighten.

Figure 14. Gear Case Lubrication

INSTALLATION OF TEST WHEEL

1. Before installing Test Wheel (48-32618A1) , first remove water pickup or trim tab from under anti-cavitation plate.
2. When replacing water pickup, be sure to install a new gasket if old gasket is damaged.
NOTE: Always be sure that your test tank is kept clean to prevent clogging of engine's water intake.

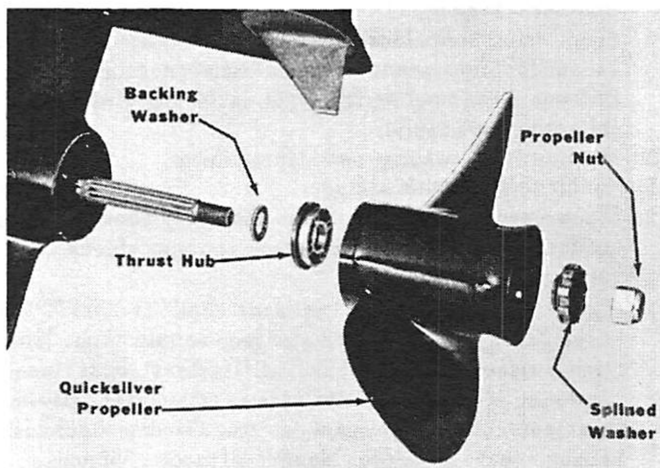


Figure 15. Propeller Installation

INSTALLING PROPELLER (Figure 15)

1. Replace backing washer, then place thrust hub and washer assembly into propeller hub (shoulder into recess of propeller) .
2. Apply thin coat of MULTIPURPOSE Quicksilver Lubricant (92-35226) on splines of propeller shaft. (Figure 15)
3. Align propeller hub splines with splines of propeller shaft and slide propeller on shaft. Tap into position if necessary.
4. Replace splined washer.
5. Replace propeller nut and tighten with adjustable wrench.
WARNING: Use of other than recommended Quicksilver Propellers will void warranty.

HEAVY DUTY WATER PUMP KIT

Installation

REMOVAL

1. Remove water pump body assembly, impeller, impeller drive pin, face plate and water pump base assembly*, and discard.
2. Carefully clean gasket surface of gear housing.

INSTALLATION

1. Install pump base to gear housing gasket*, water pump base assembly*, base to plate gasket, face plate and plate to body gasket. Be sure that pump base is down, fully seated in gear housing. *(NOTE: Loosen oil vent screw if air lock makes this difficult.)* Squirt a little oil on the pump base oil seal after installation.
2. Place gear housing in a vise so that drive shaft is horizontal.
3. Using FRESH solvent (lacquer thinner is excellent) and a clean cloth, clean the drive shaft from the face plate up to the end of the spline. Also, clean the impeller insert and drive pin. Avoid getting solvent on the pump base oil seal. Wipe all cleaned surfaces dry.

**Change required only on those kits which include a new water pump base. On those kits which do not include a new water pump base it will be necessary to install the new longer dowel pins in the old water pump base.*

4. Snip off one end of Type HV Loctite (C-92-36088) tube. Rotate drive shaft so that the flat is up. Squeeze about half the contents of the tube on the flat. Smear this Loctite evenly on the rest at the shaft section on which the impeller will ride. With the flat on the shaft up, squeeze the balance of the Loctite onto the flat.
5. Roll the drive pin in this puddle on the flat and leave it centered in the flat.
6. Slip the impeller onto the shaft with the keyway up so that it will align with drive pin. Slowly push impeller down to the face plate.
7. Rotate the impeller back and forth several times, as far as the drive pin will allow, to thoroughly wet the impeller insert with the Loctite.
8. Wipe off any excess Loctite which appears above the impeller.
9. Install pump body and fastening nuts and screw.
10. Looking down the drive shaft from the spline end, rotate the shaft clockwise at least one turn to seat the drive pin in the driving direction.
11. Allow gear housing to remain in a horizontal position at room temperature or warmer (not to exceed 120° F [49° C]) for 12 hours.
12. Gear housing assembly now can be reinstalled.

TRIM TAB INSTALLATION

1. Remove plug located in drive shaft housing directly above trim tab.
2. Loosen socket head screw, located in drive shaft housing, with an allen wrench until trim tab can be removed.
3. Scrape small area of gear housing surface, that touches trim tab, down to bare metal.

   IMPORTANT: In order to be effective, new trim tab must make good contact with surface to which it is being fastened.

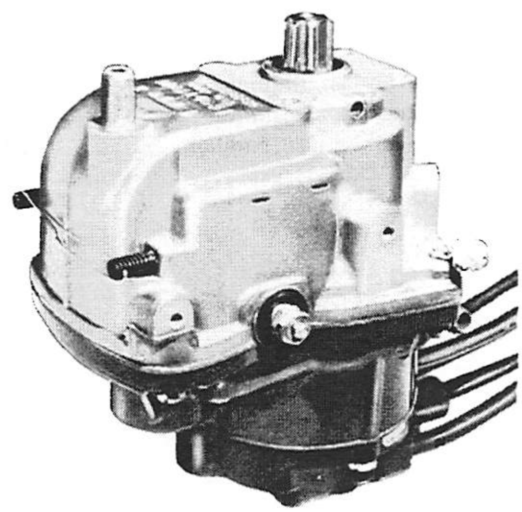
4. Place new trim tab in position and thread socket head screw into it. Before tightening screw, place trim tab in position that old tab was in before removal.

   NOTE: Trim tab should be positioned so that steering wheel will turn with equal ease in each direction at cruising speed. If boat turns more easily to right than to left, loosen socket head screw and move trim tab trailing edge to the right. Reverse procedure if boat turns more easily to left than right.

5. Tighten socket head screw securely and replace plug.

section IV

ignition



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IGNITION - GENERAL INFORMATION

I. GENERAL DESCRIPTION

The ignition system on Mercury motors is comprised of the following:

A. A self-contained electrical generating unit called 1) magneto, or 2) distributor.

B. Spark plugs.

II. MAGNETO

A. Parts

The magneto, itself, is made up chiefly of an armature base, often called the stator plate, with the coils, condensers and breaker point assemblies mounted on the base. A permanent magnet mounted inside the flywheel or a magnet rotor complete the assembly. (See Figure 1.)

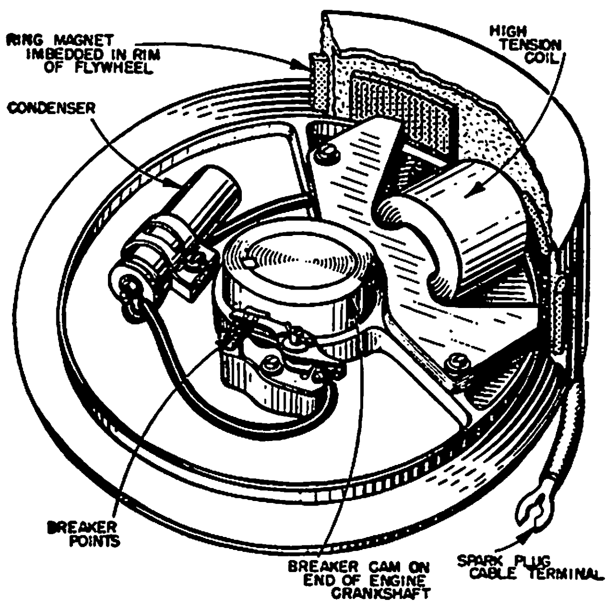


FIGURE 1
Flywheel Type Magneto (Phelon)

B. Function

The magneto requires no assistance from any outside source of eletricity, such as a dry cell or storage battery to produce essential starting energy. The electrical energy produced by the rotation of the flywheel on the magneto is imparted to the spark plugs to complete combustion in the cylinders for continuous motor operation.

C. Operation

In actual operation, the magneto functions very simply. In rotating, the flywheel's permanent magnet pole pieces pass over the pole shoes of the coil laminations, thus setting up a magnetic field of induced current to flow through the coil. (See Figure 2.) The coil actually consists of 2 coils, one inside the other. The inner coil, called the primary coil, has comparatively few turns of wire. The outer coil (secondary) has a great many more turns of very fine wire. A simplified diagram of the coils is shown below (Figure 3).

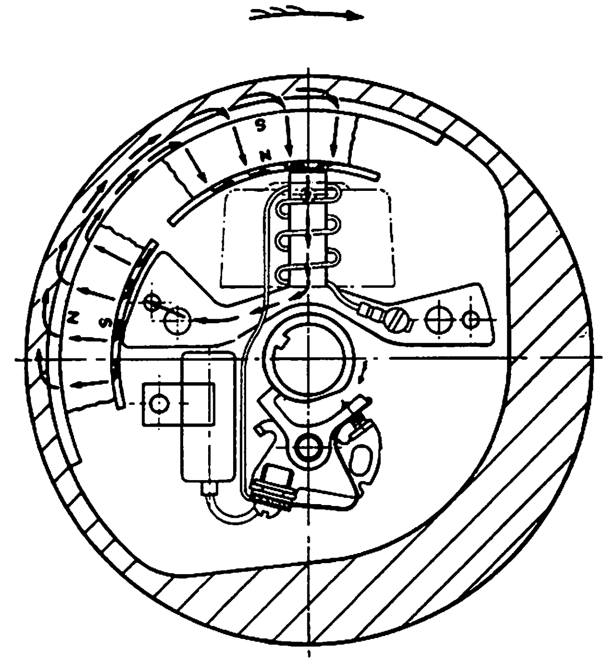


FIGURE 2
Magnetism Is Established Through Coil

When the induced current flowing through the primary coil is suddenly interrupted, the lines of magnetic force produced by the current collapse abruptly, cutting across turns of the secondary coil. This induces a current in the secondary coil or winding that has a much higher voltage than the current in the primary, because the secondary coil has so many more turns of wire.

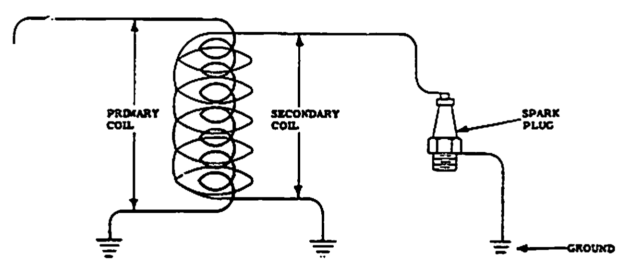


FIGURE 3
Diagram of Coils

In order to produce this interruption of current in the primary coil at just the right time, a set of breaker points is used. These 2 points are connected into the primary circuit and are held together by a spring. As long as the points are touching, current can flow through the primary circuit. At the precise time that current in the primary coil reaches its peak a cam or high spot on the crankshaft forces the points apart, suddenly interrupting the primary current. This sudden interruption collapses the magnetic field and produces a current in the secondary coil of very high voltage, allowing it to break down the

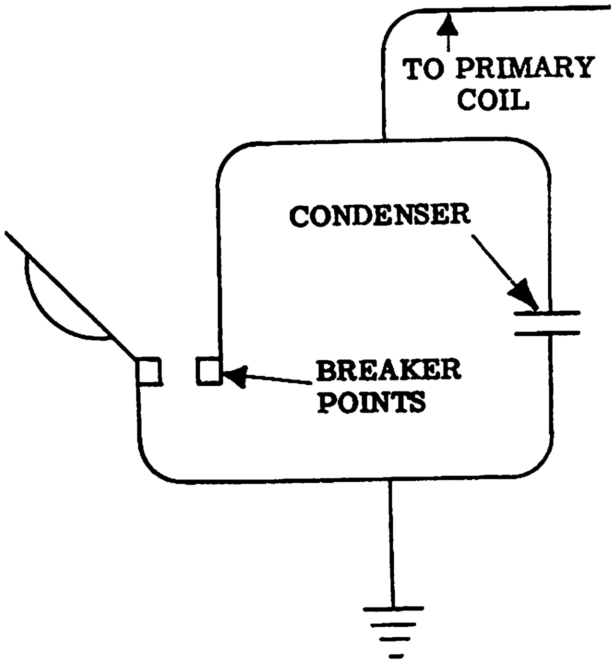


FIGURE 4
Interruption of Current

air resistance of the spark plug and to pass a spark across the spark plug gap.

At the same instant the breaker points open, the condenser comes into action. Its function is to act as a momentary reservoir for the surge of current in the primary, which, if it had nowhere to go, would continue to arc across the breaker points as they moved apart. Not only would this pit the points, but the spark across the spark plug terminals would be weakened because the current in the primary would die down gradually instead of being cut off suddenly. With the condenser available, the current surges into it momentarily and then surges out again, which action further contributes to the change of magnetic field in the coil core and, thus, contributes to the higher voltage in the secondary output. A faulty condenser will permit a spark to jump across the breaker points, pitting them and reducing the power of the spark.

The rapidity of action, which takes place as explained above, can be figured from the fact that an engine turning up to 6000 RPM repeats the entire cycle 60 or more times a second. Therefore, it is logical to assume that any maintenance or repair on the magneto, especially the setting of breaker point gap, should be done carefully and exactly as recommended.

D. Components

1. **Magneto Coil.** A magneto coil is made up of 2 individual sets of wire windings, namely the primary and secondary coils. The inner winding is the primary coil and contains approximately 175 turns of heavy wire. (See Figure 6.) One end of this primary coil is connected to the frame of the magneto as a ground, and the other end is connected to the live insulated breaker point. The secondary coil is wound around the outside of the primary and usually has about 10,000 turns of very fine wire. (See Figure 6.) The inside end of the secondary is

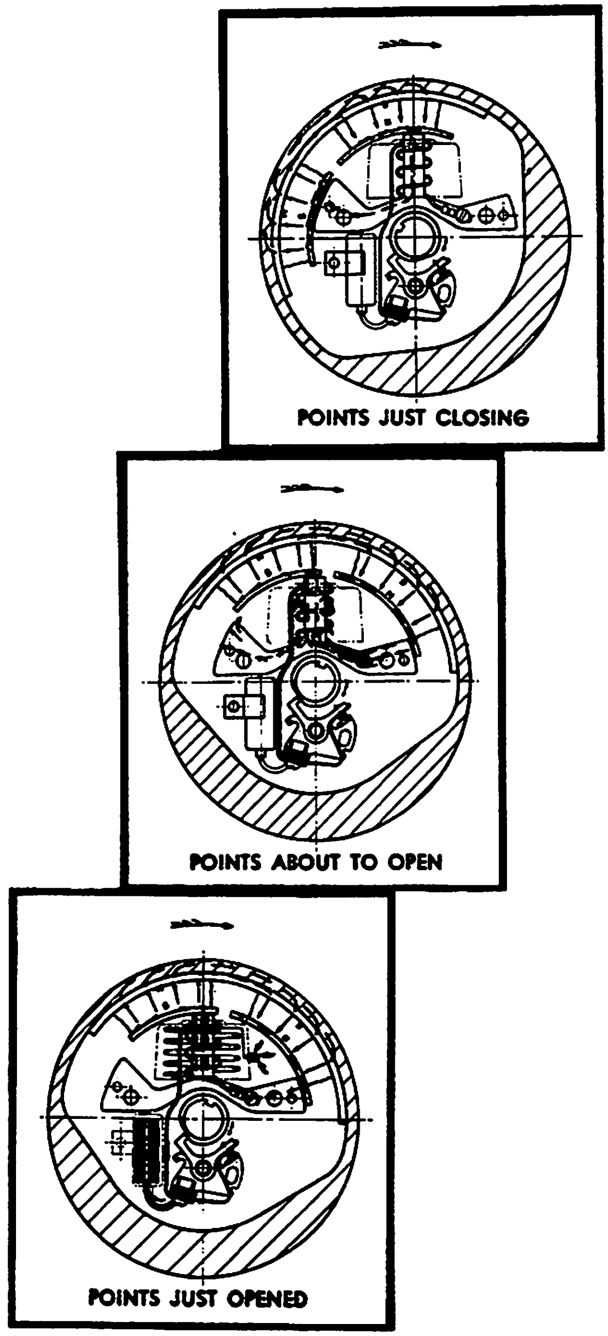


FIGURE 5
Breaker Points

grounded with the end of the primary ground wire. The outside lead wire is connected to the spark plug wire. The entire coil is insulated for protection. Do not attempt to rewind a defective coil. Replace with new coil if test proves old coil is defective.

2. **Condenser.** The condenser is a storage reservoir for electricity. It consists basically of strips of foil with paper insulation between them, wound together in a roll and inserted into a metal case for protection and easy assembly. (See Figure 7.) The strips of foil and insulation are wound together so that one of the strips of foil can be grounded and the other strip of foil can be connected to the live breaker point. At the instant of breaker point opening, the insulating paper between the 2 strips

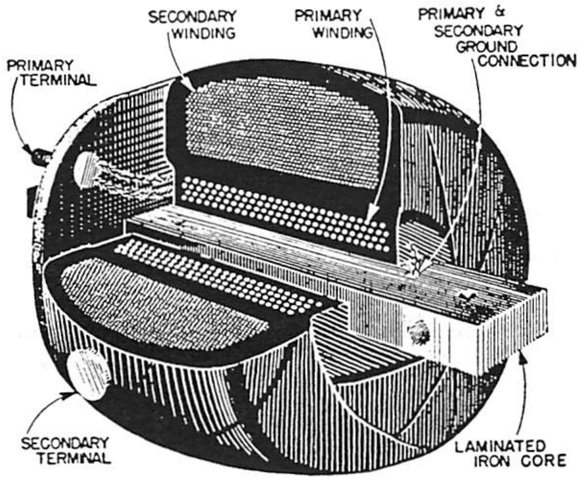


FIGURE 6
Construction of High Tension Coil (Fairbanks-Morse)

of foil acts as a storage reservoir for electricity during an extremely small fraction of a second before the arc across the breaker points is extinguished. The condenser case has an integral mounting strap for attaching to the armature base with a single screw. The condenser cannot be repaired and must be replaced if weak or defective.

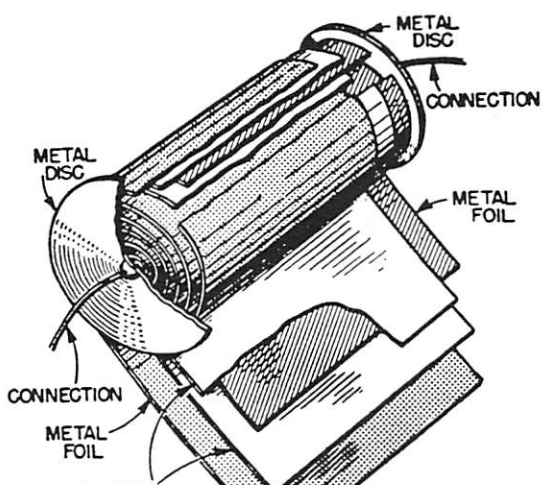


FIGURE 7
Paper-Wound Condenser

3. **Laminated Core.** The complete coil assembly contains the coil and laminated core. (See Figure 8.) The core has magnetism concentrated in it, first in one direction, then rapidly reversed. Because iron itself is an electrical conductor, large "eddy" currents would be set up in a solid piece of iron. These eddy currents would in themselves act as electro-magnets and oppose the change of direction of the magnetic field in the iron, thus slowing it down. By splitting the iron core up into a number of thin laminations, the build-up of any one large electrical path for an eddy current is prevented. The slight amount of oxide between each lamination acts as enough insulation to prevent the eddy currents from traveling across between one lamination and the next.

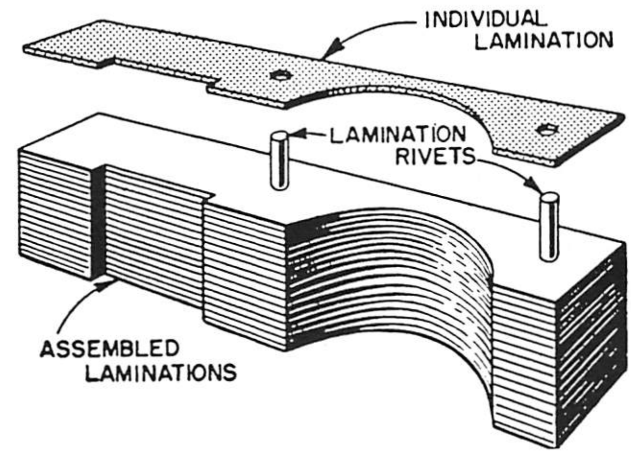


FIGURE 8
Laminated Field Assembly

The shape and style of the core-lamination may vary on different types of magnetos, but basically it is the same on models made by certain manufacturers.

Note: Do not attempt to disassemble or repair a core lamination. Replace it as a complete unit

4. **Breaker Assembly.** The breaker assembly consists of a pair of tungsten points mounted on brackets. (See Figure 9.) One of the brackets is stationary and the other a movable breaker spring assembly.

A cam on the crankshaft, which in turning separates the points, and the spring, which closes the points, regulate the working of the breaker points.

To adjust the breaker point gap, which is the most important and only adjustment required in the magneto assembly, loosen the screw on the stationary bracket and move either one way or the other after checking with a feeler gauge for proper gap setting.

Breaker assemblies must be replaced complete when points are no longer serviceable.

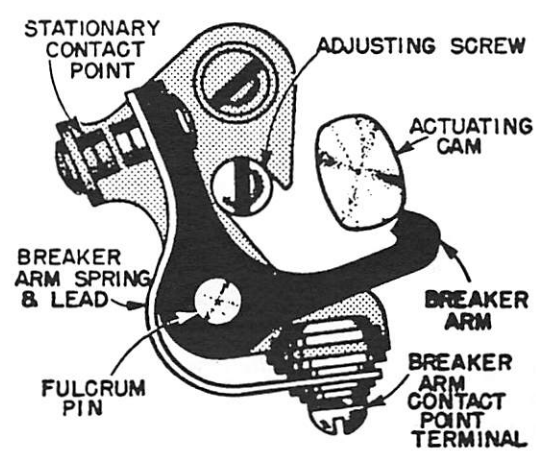


FIGURE 9
Breaker Assembly

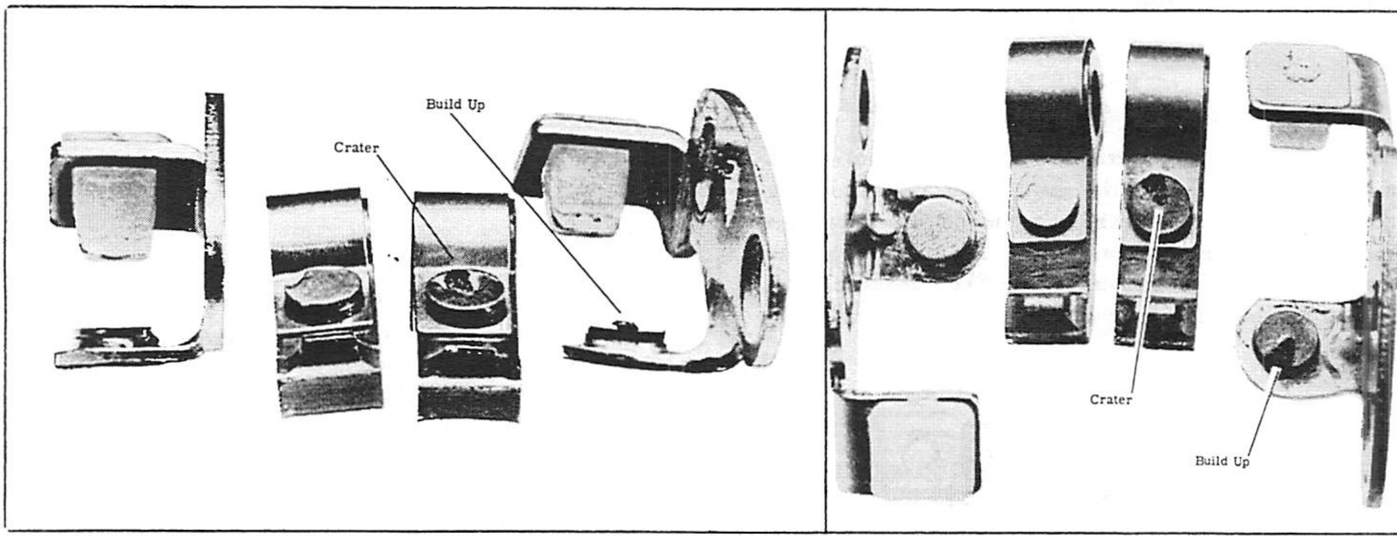
Unnecessary replacement of magneto and distributor points warrants a guide to judging the condition of points, as shown in the photographs of two sets of points, below. The set on the left in each illustration shows only discoloration and some shallow pitting. This set has been run 30 minutes and is in excellent condition. On the other hand, the set of points on the right hand side exhibits considerable build-up and deep crater formation. Running time on this set was 460 hrs. & replacement was well justified. Always use Degree Plate when resetting 2 and 6-cyl. breaker points.

E. **Lubrication (Phelon and Scintilla Magnetos)**

On breaker assemblies incorporating a cam follower felt, apply one (1) drop of S.A.E. No. 60 oil to the cam follower felt when the magneto is installed and, after each 100 hours of operation, apply two (2) drops of S.A.E. No. 60 oil with a clean cloth. Blot off any excess oil with a clean cloth. Clean any excess grease from the cam. Inspect the cam surface for rusting, pitting or scoring. All damaged cams should be replaced to reduce cam follower wear. Keep oil and grease away from the contact point surfaces.

F. **Lubrication (Kiekhaefer Mercury Magnetos)**

The cam wick is specially lubricated and requires no further lubrication. Any further lubrication would be detrimental to breaker point life. A new cam wick should be installed every 100 hours of engine operation and each time a breaker assembly is installed.



MAGNETO SERVICE INSTRUCTIONS

A. **General Description.**

Ordinarily the magnetos employed in the assembly of Mercury motors will operate over extremely long periods of time without the need for adjustment or repair. However, if engine operating difficulties, which appear to be caused by the ignition system, are experienced, the magneto output should be checked to determine if the unit is functioning properly.

Overhaul procedure differs somewhat on various models; however, the general basic procedures will apply to high speed flywheel type magnetos. They combine dependability with light weight and simplicity.

Instructions set forth on the following pages of this section cover all type magnetos employed on Kiekhaefer Mercury motors.

To remove magnetos which are secured to the engine with clamping springs, loosen the clamp screws and disengage the springs from the engine pilot groove. Other magnetos are installed on the engine with securing screws which are easily removed.

B. **Magneto Service.**

When should you suspect the magneto is not operating properly?

1. When the engine refuses to start or is hard to start and after gas supply, carburetion and other features of engine have been checked.
2. Occasionally but rarely, when the engine misses at high speed or will not get up to full speed.

How should you check for magneto trouble?

1. Remove spark plug wire. Hold it 3/16" away from sharp part of engine block, and a spark should jump this gap when engine is cranked over in normal way.
2. While engine is running, hold lead wire 3/16" away from spark plug terminal. Spark should jump this extra gap. *Caution: Do not hold wire farther away from plug and only make this test for a brief instant. It puts a strain on coil and might break down a perfectly good coil if overdone.*
3. Remove and inspect spark plug for fouling and for proper gap. A badly fouled plug will not even fire across the electrodes when rested on cylinder block and not under compression. A plug can be fouled badly enough so that it will not fire under compression in the engine, but not enough to prevent it from firing in the air. It is best to replace a fouled plug—cleaning usually doesn't last long.

SPARK PLUGS

A. General Description

Spark plugs are a small but vitally important component of modern gasoline engines. Without proper spark plug operation, satisfactory engine performance cannot be obtained. Outboard motors are equipped with plugs of special electrode gap design. (Figure 10)

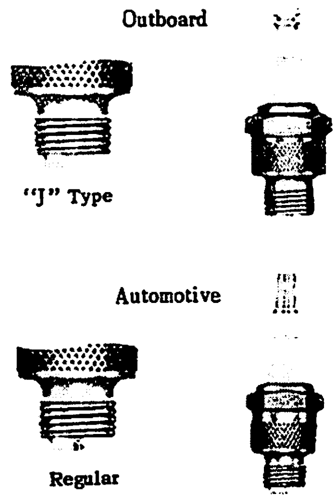


Figure 10. Champion Spark Plug Types

It is positively recommended that burned, fouled or damaged spark plugs be replaced with the same type originally installed in the motor by the manufacturer, unless operating under some conditions as explained below.

B. Spark Plug Inspection

Casual inspection of a normal operating plug in an outboard motor discloses that the porcelain, after a period of operation, will become coffee-colored. If the porcelain remains its natural white color, under the conditions of the motor's use, it should be replaced with a colder temperature plug. If black, replace with hotter plug.

C. Requirements

Spark plugs are made in a number of "heat ranges" to satisfy a variety of possible operating conditions. Those types having a long insulator firing end transfer heat slowly and are used where combustion chamber temperatures are relatively low. Sustained idling, stop and start and "light load" operation produce this condition. (Figure 11)

Thus, the ultimate requirement of the plug, under the conditions stated above, is its ability to maintain proper temperature for the type of service to which the motor is subjected. They are: 1) The long insulator type or "Hot Plug" to sustain its temperature in order to burn off normal combustion deposits and avoid fouling, and 2) The short insulator or "Cold Plug" to remain cool enough to avoid pre-ignition and excessive gap erosion.

The appearance of spark plugs removed from the block will indicate whether it is too hot or too cold for the motor. The end of the plug is subjected to intense heat from the explosions of the fuel mixture, and this heat is dissipated by conduction along the porcelain end of the plug and thus to the cylinder jacket. If the porcelain part of the plug which extends into cylinder is comparatively long, the heat cannot be dissipated rapidly, and the plug will run hot. If the plug is short, the heat can pass through it more quickly, and the plug will run cold.

The plug which is installed originally in the motor, for standard or normal use, is the one that will give best service under normal operating conditions; however, if the RPM is increased by placing the motor on a lighter hull, it may be necessary to substitute a colder plug. If the motor is placed on a heavier boat, and the RPM is decreased, a hotter plug may be required. If trouble arises with plugs fouling while trolling, a switch to a hotter type of plug may help.

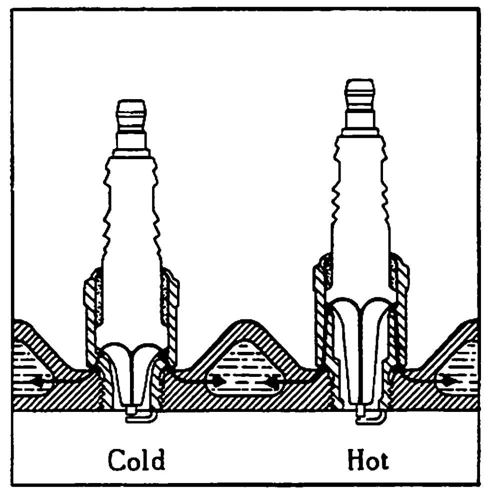


Figure 11. Heat Flow Paths in Hot and Cold Type Plugs

If the plug is operating at its most efficient temperature, the porcelain part which projects inside the cylinder will be dark brown, chestnut or coffee colored. If the porcelain is chalky white, or has flaky blisters, the plug is too hot. When a motor is operating at high speed with a plug that is too hot, the motor will run along evenly for a while – then will slow down, pick up again and will repeat this sort of balking over and over. If a smutty or oily coating appears on the plug, it shows that there is incomplete fuel combustion because the plug is too cold. Hard starting frequently is caused by too cold a plug.

D. Fire and Misfire

To "fire the charge", a combustible mixture first must be present in the cylinder. Secondly, a spark of sufficient intensity must be supplied to ignite the fuel or, literally, get the fire started. The spark plug's main job, therefore, is to transfer the ignition system's energy into the cylinder in the form of an adequate spark. If a normal fuel charge fails to ignite, the spark plug itself then can be considered misfiring. What are the possible causes of misfiring? (Figure 12)

1. The plug gap may be so small that there is sufficient burnable mixture between the electrodes.

2. The plug gap may be so wide that the ignition system is unable to furnish enough voltage to jump the gap.
3. The spark gap can be bridged by some conductible deposit which prevents a normal spark discharge.
4. The high voltage can short over the top of the plug, termed "flash-over". ("B" in Figure 12)
5. The high voltage can leak to ground through a direct mechanical break in the insulator. ("C" in Figure 12)
6. The high voltage can lead to ground through conducting deposits on the firing surface of the insulator. In this case, energy is drained away and the ignition system cannot build up sufficient voltage to jump the gap. ("D" in Figure 12)

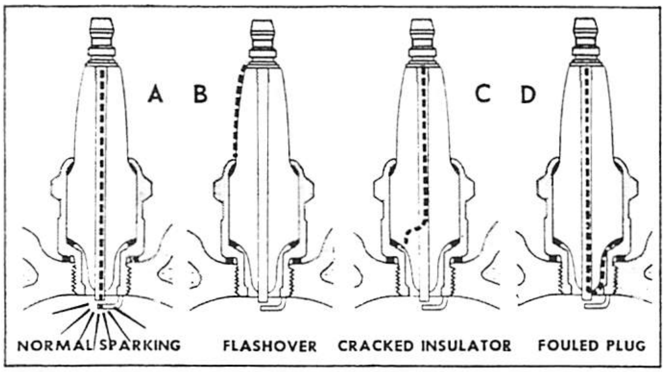


Figure 12. Fire and Misfire

Most misfires result from the shorting through deposits on the insulator nose surface. When these are removed (either by cleaning or in some cases by burning them off at higher speeds) the spark plug's firing ability is largely restored. This type of shorting is troublesome, too, in that it can occur long before it is noticed. In other words, one would be aware only of a slow decrease in performance and economy while one or more cylinders is misfiring, usually due to dirty or burned spark plugs.

Figure 13. Spark Plug Gaskets

E. Analyzing Plugs Under Service Conditions

It is an established fact that so-called spark plug troubles are seldom traced to faulty spark plugs. Instead, difficulties usually result from (a) poor spark plug installation, (b) abnormal operating conditions which necessitate hotter or colder spark plugs, and (c) engine's in need of overhaul or adjustment.

Used spark plugs, together with their gaskets, are usually the best guide to the type and source of trouble. Therefore, it is good practice to inspect each plug and its gasket as they are removed from an engine. A gasket which is compressed to about ¾ original thickness, with smooth parallel surfaces, indicates that the spark plug was properly installed and tightened. (Figure 13) Gaskets which are compressed too much or too little reveal improper tightening during installation. Rough, corroded surfaces also indicate gasket seats were not cleaned before installation. In any case, resulting compression leakage may have overheated the spark plugs, causing excessive electrode erosion.

Spark plugs which are not tightened securely in the cylinder block will also cause fast electrode burning and may burn the piston, due to detonation. Torque spark plugs to 20 ft. lbs. (2.77mkg) for good seat.

Proper spark plug heat range and normal engine conditions will produce rusty brown to grayish tan powdery deposits on the insulator firing end and a minor degree of electrode wear. (Figure 14) This spark plug also has been properly installed.

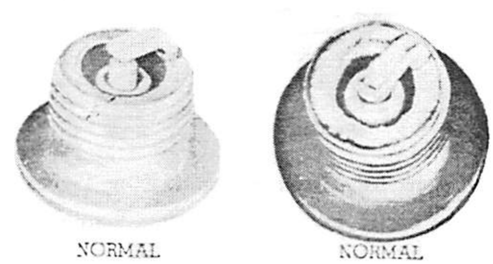


Figure 14. Normal Plugs

F. Ignition Timing

In general, ignition timing advanced beyond specifications will encourage overheating, thus leading to shorter spark plug life and burned pistons.

G. Service Procedure

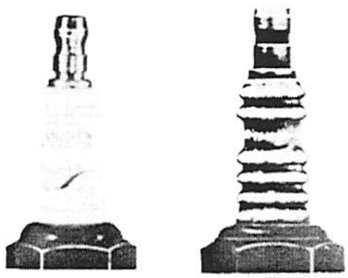
Clean and re-gap spark plugs according to the recommended procedure. Use new gaskets and reinstall to the proper torque tightness 240 inch pounds or 20 ft. lbs. (2.77mkg).

Fuel fouling usually is identified by wet, black deposits covering the entire firing end of the spark plug. These deposits result from incomplete combustion traceable to over-rich air-fuel mixture.

Burned, pitted or improperly set breaker points and frayed ignition cable are also sources of spark plug trouble. (See Ignition Trouble Shooting, P. 28 in Section I.)

All spark plugs should be replaced periodically to assure maximum economy and peak performance. Spark plugs which test below the "Fair" zone on the "Sparking Comparator" usually should be replaced. Also, if electrodes are eroded enough to make accurate gap setting impossible or, if excessive compression leakage is noted, new spark plugs should be installed.

Any crack in the insulator is sufficient cause for discarding the spark plug. (Figure 15) Cracks in the upper portion of the insulator are caused by dropping the plug or by hitting the insulator with a wrench. For this reason, always use a proper size deep socket wrench when removing or installing spark plugs.



CRACKED INSULATOR   DIRTY INSULATOR

Figure 15. Cracked, Dirty Insulators

Cracked or broken insulator firing ends result from bending the center electrode while setting the spark gap. (Figure 16) To avoid damaging the insulator, bend only the side electrode.

H. Save Those Plugs!

Plier-type spark plug gap tools, if incorrectly used, will ruin quantities of perfectly good spark plugs. By exerting enormous unit pressure on the center electrode of a plug, the interior pressure seal is likely to be damaged, resulting in severe leakage, burning and shortened plug life. Be certain to exert pressure on the ground electrode only when setting gaps.

I. Installation

After thorough check of spark plugs, reinstall in cylinder. Set spark gap according to "M" and torque to 20 ft. lbs. (2.77mkg) with Torque Wrench (C-91-25667). Replace ignition lead twist-on connectors on plugs in correct sequence. Push on and turn clockwise.

J. Spark Plug Protectors

When installing a new set of spark plugs, inspect the spark plug protector carefully for possible need of replacement.

No rubber made will withstand indefinitely the heat of a spark plug operating under modern conditions, particularly with the high temperature fuels now being used.

When this rubber is stretched tight around the hot porcelain the effect of this will cause the rubber to dry out and crack. Once this has happened, the effectiveness of the spark plug protector as a waterproof seal is seriously impaired. Avoid this condition, always . . .

"CHECK THE SPARK PLUG PROTECTOR WHEN REPLACING THE SPARK PLUG"

As the ignition cable itself does not get as hot and is not stretched, its life is much longer.

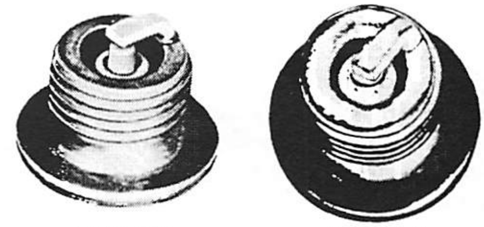
The sensitive area--where heat and stretch are greatest--is the inside bottom rim of the spark plug protector where it touches the porcelain. When this edge becomes hard, it loses its stretch. The next phase is a series of fine cracks in the surface of the rubber along this same edge. It is safest to replace the spark plug protector when this edge gets hard, before it has a chance to start cracking.

The spark plug protector is not meant to be taken apart - doing so will usually bend the prong in the spring making it all but impossible to reassemble correctly. Don't pull the cable out of the spark plug protector except when the spark plug protector and spring are to be replaced.

NOTE: When assembling spark plug protectors to cables, make sure that the prong of the spring goes through the center of the cable to make solid contact with the ignition wire. If this is not a good electrical contact, a weak spark may result. Also, the point on this prong should always face down toward the spark plug. If it is assembled upside down, the spark plug protector may have a tendency to shake loose.

K. Service after Installation

It is important to keep the upper portion of insulator free from moisture, grease, dirt, paint, etc. Such deposits on outside of spark plug can cause surface shorting or flashover from terminal to shell with resulting misfire and hard starting. Spark plug insulators should be wiped off with a clean rag.



NORMAL   NORMAL

Figure 16. Insulator Firing Ends

L. Spark Plug Life vs. Gasoline

M.

SPARK PLUG HEAT RANGE (CHAMPION AND AC SPARK PLUGS) (ALL ARE 14MM)

1/2" REACH			3/8" REACH	
TYPE	MANUFACTURER MODEL NO.	KIEKHAEFER MODEL NO.	MANUFACTURER MODEL NO.	KIEKHAEFER MODEL NO.
HOT	L-9J	A-33-46082	J-8J	A-33-31375
	L-7J	A-33-46028	J-7J AC-M45	A-33-22805 A-33-28916
			J-6J XJ-6J (Resistor) AC-N44C	A-33-20127 A-33-22265 A-33-28915
	L-4J	A-33-39638	J-4J XJ-4J (Resistor) UJ-4J (Series Gap) AC-K421	A-33-30578 A-33-30739 A-33-39564 A-33-31390
	L-62R		J-62R (Was J3-2, K3, J63T)	A-33-20982
			J-2J	A-33-32443
COLD	L-57R		J-57R (Was J2-3, K2, J58T)	A-33-20595
*	L-19V (Polar Gap)	A-33-45191		

** Thunderbolt Ignition System Spark Plug - has no "Heat-Range" as such.*

Spark Gap Specification (For Conventional Side Ground Electrode Plugs):

.030 for 1/2" Reach L Types
.025 for 3/8" Reach J Types

½" = 12.7mm   3/8" = 9.5mm

NOTE: Torque value for spark plug tightening is 20 ft. lbs. (2.77mkg) on all aluminum heads.

N. Resistor Type Spark Plugs for 6-Cyl. Engines

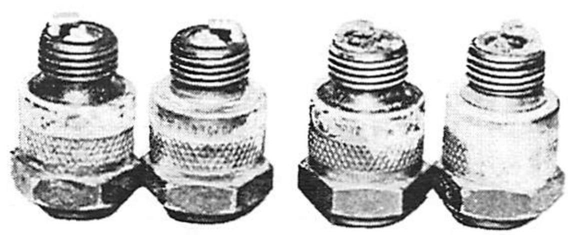
Radio and ship-to-shore telephone interference can be eliminated partially on 6-cylinder engines by using resistor type spark plugs. Do not use resistor type plugs on 2-and-4-cylinder engines with magneto ignition nor on 6-cylinder engines with Thunderbolt ignition.

SPARK PLUG ELECTRODE BURNING

A. Explanation

Exhaustive tests in our laboratories, at our proving grounds and in the field have definitely shown that spark plug life difficulties are directly related to the gasoline used in the engine. Tests were conducted on our own and upon competitive brands of outboard motors with almost identical results. These tests, as well as discussions with representatives of all major gasoline refiners and spark plug manufacturers, brought the following information to light:

1. Much of the plug trouble is simply lead fouling, resulting from the presence of much tetraethyl lead in automotive gasolines. The octane rating of automotive fuels is constantly being increased to suit the high compression ratios resulting from the automobile "horsepower race", and the quantity of tetraethyl lead required has reached 3.04 cubic centimeters per gallon in some cases. Generally speaking, there is little to choose between regular and premium grades of fuel in this respect. It should also be noted that the lead content of a given brand of fuel can vary considerably with location, being for one make of regular gasoline 0.58 c.c. in Wichita, Kansas, and 2.95 c.c. in Dallas, Texas – an increase of over 400 percent. There is no practical way of removing this lead from the fuel in the field. Lead fouling may be identified by the presence of small yellow or brown globules on the plug. (See Figure 17.)



Normal Burning
Quicksilver Oil

Fouled Plugs
Regular Oil

FIGURE 17. Fouled Plugs

2. Some of the plug trouble is caused by excessive carbon formation in the combustion chamber with eventual fouling of the plug by carbon particles. It is natural for all internal combustion engines to form some amount of carbon during operation, but excessive amounts are engendered by use of fuels which burn to a gummy residue rather than a fluffy carbon which can pass out with the exhaust. It has been suggested that extensive "cracking", now used to obtain more gasoline from a given amount of crude oil, results in fuels which give gummy deposits that remain in the combustion chamber while "straight-run" gasolines are cleaner in this respect.

3. A less common plug problem, termed "intergranular corrosion", is indicated by a deterioration or decay of the center electrode in a short period of time. This is an actual corrosion of the electrode metal by chemical compounds found in the combustion products of some gasolines, oils and additives. Spark plug manufacturers are trying to combat this through the use of corrosion resistant alloys for their electrodes.

FIGURE 18. Pistons Removed from Motor Using Quicksilver Oil (Left), Regular Grade Oil (Right)

It is impossible for the factory to test and recommend or disapprove a given brand of gasoline, as any given brand will vary greatly from one section of the country to another, depending upon which refinery it comes from and from which base stock it is made. It is known, however, that the use of a "marine white" gasoline will virtually eliminate the plug and carbon or varnish problem. "Marine white" gasolines are straight-run fuels which contain no tetraethyl lead or other metallic additives and are excellent from the standpoint of engine cleanliness. They generally have an octane rating of 75 to 80 and should not be confused with the nonmarine "whites" sold for use in gasoline lamps and cook stoves. Although intended for marine use, some truck fleets use the marine whites to obtain longer periods between plug and engine overhaul. Consequently, these fuels can be found far from coastal areas.

A partial list of companies manufacturing marine white gasolines follows:

Gulf	*Standard of Kentucky*	*Texaco*
Socony	*Standard of Ohio*	*Sinclair*
Esso	*Standard of Indiana*	*Magnolia*
Amoco		*Humbolt*

In addition, Amoco Premium automotive gasoline, sold throughout the East, contains no lead. Union Oil of California produces a 76 octane white gas which is also suitable for outboard use. The 80 octane aviation gasolines, as used in light aircraft, are limited to 0.5 c.c. of lead and are suitable for outboard use.

In cases where spark plug or carbon difficulties are being encountered, it is suggested that a change be made to one of the above fuels. If excessive carbon has already been formed in the engine, it should be removed by disassembly or with Quicksilver Engine Cleaner, described below.

The principal advantages of "Marine White Gasolines", in 2-cycle engines, over leaded gasoline is the fact that it contains no lead to contribute to spark plug fouling. Its distillation range allows complete burning, and it is free from deposit-forming gum and is very stable. "Marine White Gasoline" is manufactured to specifications closely approaching aviation gasoline specifications; therefore, the higher temperature automobile gasoline components are not used. These components contribute to gum, varnish and smoke in 2-cycle engines.

Two-cycle engines do not have fuel octane number requirements as high as 4-cycle engines. "Marine White Gasoline" is used in all types of 4-cycle inboard marine engines so no 2-cycle engines are encountering octane requirement difficulty on this type fuel. Care should be taken to discriminate between "Marine White Gasoline", which has the above-described characteristics, and ordinary stove and lamp gasoline which may have none of the above characteristics and is not recommended for use as engine fuel.

QUICKSILVER ENGINE CLEANER

Description

Kiekhaefer Quicksilver Engine Cleaner (C-92-26845 in 16 U.S. fluid oz. can [.473 liter or 454.56cm^3]; C-92-30140 in one (1) U.S. gal. can [3.785 liters or .832 Imperial gallon]) is a laboratory and field tested blend of chemicals designed to purge power-robbing deposits that accumulate in gasoline engines. It eliminates costly dismantling of the engine to remove carbon deposits caused by certain types of gasolines. Heavy carbon deposits in combustion chambers result in spark plug burning, pre-ignition and reduction of RPM.

In addition to outboards, Quicksilver Engine Cleaner also is effective in removing gum, varnish and carbon from chain saws, power lawn mowers, garden tractors and other 2 and 4-cycle engines.

HOW TO USE QUICKSILVER ENGINE CLEANER

Run engine to normal operating temperature, as it is most effective when engine is warm.

One and 2-Cylinder Models

Slowly run about 10 U.S. oz. (.296 liter or 284.10cm^3) cleaner through carburetor throat at fast idle (1200 RPM), using pump-type oil can or pressure sprayer. Increase speed and stall engine with balance of material. Let stand for 30 minutes or longer. Start engine and run at full throttle for 5 minutes.

Four and 6-Cylinder Models

With engine operating at lowest RPM above stalling, feed sufficient quantity of Engine Cleaner into throat of one carburetor. Leave engine run until it is again firing on all cylinders and repeat process for other sets of carburetors. Next, flood entire engine through carburetors and allow to stand for ½ hour.

Additional Cleaning Benefits

Mix 16 U.S. fluid oz. can (.473 liter or 454.56cm) of Quicksilver Engine Cleaner to one (1) U.S. gal. (3.785 liter or .832 Imperial gal.) of fuel mixture. Run this special mixture until depleted, then follow normal application as outlined above.

Severely Carboned Engines

Tilt engine in horizontal position and close as many intake and exhaust ports as possible by turning flywheel so pistons cover ports. Pour Engine Cleaner through spark plug holes. Leave set over night or for 6-to-8 hour period. After setting, place vertically and pull starter over several times to remove excess accumulation. Ready engine to run and repeat the regular cleaning process as previously explained.

WARNING: Use of lacquer thinner to remove carbon, gum and/or varnish accumulation will cause serious damage to the powerhead besides deteriorating the oil seals. Use of lacquer thinner in the engine will void the engine warranty.

OTHER SUGGESTED USES OF QUICKSILVER ENGINE CLEANER

Penetrating Oil

Quicksilver Engine Cleaner has a tremendous penetrating and soaking action. Frees engines which are tight from rust and corrosion due to submersion.

Protection for Submerged Engines

Emulsifies with water and gives protective coat to parts. Remove water from engine and pour Engine Cleaner through spark plug holes. Turn engine over several times, allowing it to drain thru crankcase and out exhaust ports.

External Cleaner

Cleans and removes external marine growth, grease, oil and dirt deposits from engines. Brush on and leave set for ½ hour.

Winterizing

It is a good policy to clean the combustion chamber of engines with Quicksilver Engine Cleaner at time of winterizing, tuneup or before delivery in spring, if engine has been in dealer storage.

COIL TEST DATA

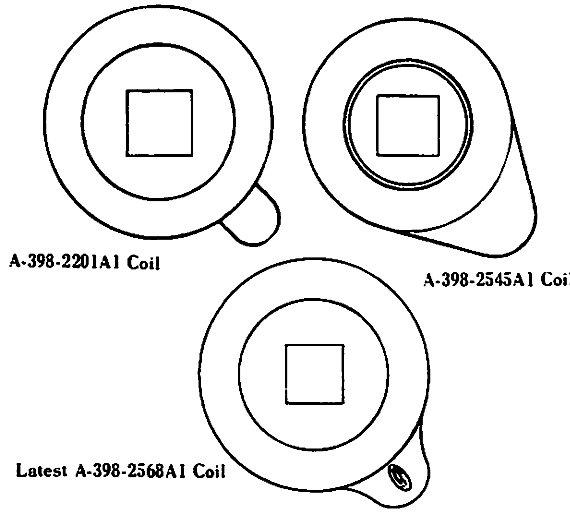
Kiekhaefer Part No.	Manufacturer	Mfg. No.	Max. Amps.	Secondary Continuity		Primary Resist. (Ohms)	
				Min.	Max.	Min.	Max.
A-30-204	Scintilla	10-38222Y	2.3		60		
A-399-125	Scintilla	10-70132	2.1		50		
A-399-756	Scintilla	10-70100	2.1		50		
A-398-716	Phelon	F-608	2.5	42	65		
A-398-173	Phelon	F-1835	2.5	42	65		
A-398-2201	Phelon	FG-6446	2.0	45	60	.45	.60
A-398-2545	Phelon	FG-7168	2.0	35	50	.50	.65
A-398-2568	Phelon	FG-7202	1.8	40	60	.50	.65
A-397-361	Fair.-Morse	H-2477	2	40	60		
A-397-361	Fair.-Morse	T-2477	2	40	60		
A-397-361	Fair.-Morse	E-2477C	2	40	60		
A-397-430	Fair.-Morse	QY-2477C	2	45	60		
A-396-648	Eiseman	27894	1.60	40	60		
A-395-679	Wico	X-2156	1.90	40	60		
A-394-1128A1	Kiekhaefer	A-394-1128	1.80*	55	65		
A-26433	Delco-Remy	1115106	0.9	55	65	.9	1.2
A-32193	Auto-Lite	200673	1.1	60	70	1.1	1.5

* *Off Plate*

NOTES:

1. Test on complete magneto with points open. In some cases the FM coils reverse red and black primary test leads to get better reading.

IDENTIFICATION OF LATE STYLE PHELON COILS



2. The coil tester must check the primary and secondary windings for open circuits, shorts or high resistance. In addition, the coil lead wire, its terminal and insulation, also should be checked during this portion of test.

CONDENSER TEST DATA

Kiekhaefer Part No.	Manufacturer	Mfgr. No.	Mfd. Cap.
A-399-759	Scintilla	10-70141	.17-.21
A-399-123	Scintilla	10-82238	.17-.21
A-398-713	Phelon	FG-607	.15-.19
A-398-176	Phelon	FG-1807	.22-.27
A-398-693	Phelon	FG-1770	.14-.18
A-398-2203	Phelon	FG-6453	.14-.20
A-396-650	Eiseman	24235	.19-.23
A-395-684	Wico	X-2186	.16-.20
A-397-741	Fairbanks-Morse	"S"-2433	.28-.32
A-397-359	Fairbanks-Morse	M-2433	.18-.22
A-397-874	Fairbanks-Morse	KX-2433	.28-.35
A-394-1130	Kiekhaefer		.28-.35
A-393-1283	Delco-Remy		.18-.23

NOTES:

1. Leakage and series resistance values should be within proper limits set by manufacturer of the particular condenser checker.
2. Condensers should be tested for breakdown, leakage capacitance and series resistance.
3. Do not heat condenser prior to testing in attempt to duplicate engine operating conditions.
4. A condenser should be tapped while being tested to make sure there is no loose element or connection which will not show up if condenser is not tapped.

RECTIFIER TEST PROCEDURE

Measure Direct Current Resistance on Magneto Analyzer or Ohm Meter

Refer to "Test with Magneto Analyzer", this section.

To test rectifier and find cause of rectifier failure, refer to "MercElectric Testing & Trouble Chart", Outboard Master Service Manual, Section VII.

IGNITION COIL BALLAST AND RESISTOR TEST DATA

1. MERC-O-TRONIC 6-VOLT TESTER *

Part No.	Min.	Max.
A-393-1286	2.6	3.5
A-393-1482	3.4	3.6
A-393-1572	3.8	4.0

2. MERC-O-TRONIC DIRECT OHM SCALE READINGS

Part No.	Min.	Max.
A-393-1286	1.3	1.7
A-393-1482	2.0	2.4
A-393-1572	3.0	3.4
A-32227	.41	.52

* *Conversion Scale - Not direct ohm readings*

1. Scale No. 2 is used for checking lower ohm resistance values on Magneto Analyzer (C-91-25213). Place selector switch on No. 2 Distributor Resistance position. Do not clip leads together.

2. Turn No. 2 scale meter adjustment knob to adjust meter needle evenly with Figure 5 on right-hand side of scale No. 1. Analyzer is now ready to test low ohm resistance values.

3. Ignition coil ballast and resistor should be removed from engine for testing. After completing above Analyzer settings, fasten small red and black test leads to terminals of resistor. Resistor test value can be read on Scale No. 1. Readings are shown in chart above. Replace ballasts and resistors not meeting these specifications.
   Refer to "Test with Magneto Analyzer", this section.

4. Place selector switch on Scale No. 3 (Coil Continuity). Connect small red test lead to either terminal of ballast and connect small black test lead to metal case. If continuity exists, ballast is grounded and must be replaced.

PHELON MAGNETO - 2-CYLINDER ENGINES

FLYWHEEL

Powerhead Removal

To work on the Phelon magneto the flywheel must be removed. The recommended and safest method is described below:

After cowl or cover is removed on motor, the flywheel is accessible. If powerhead is removed from lower unit. place powerhead on service stand (C-91-24282 or C-91-24259) after clamping stand in vise with splined end up to receive powerhead. If powerhead is not removed, use Universal Flywheel Holder (C-91-24937A1) to hold flywheel while removing flywheel nut with wrench.

Flywheel Removal

1. Remove nut which fastens flywheel to crankshaft. (Figure 19)

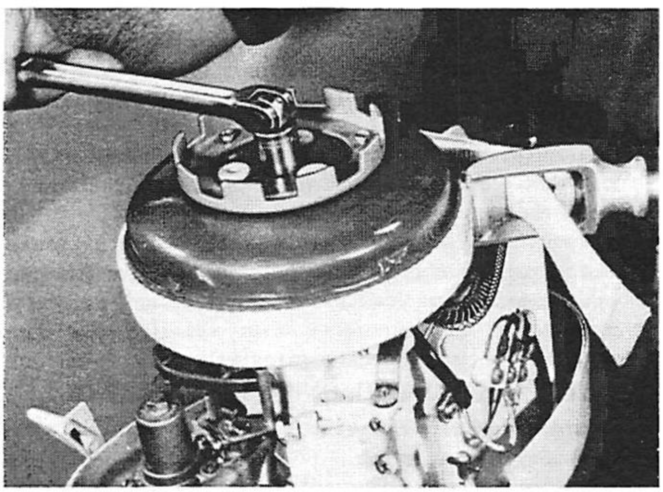


Figure 19. Removing Flywheel Nut

2. Using Flywheel Puller (C-91-24695A2), place plug of tool over end of crankshaft.
3. Turn 3 screws into tapped holes in top of flywheel, so that it sets evenly above flywheel, and draw down on center screw. Tap screw with hammer, if flywheel is exceptionally tight. (Figure 20)
4. Remove washer, spring and/or flywheel key, whichever is part of the assembly.
5. Magneto is now ready for inspection. (See correct test procedure of ignition parts, this section.)

MAGNETO

Entire magneto may be removed from the motor by completing the following:

1. Remove both high tension leads from spark plug terminals.
2. Remove clamp screws which hold high tension leads to cylinder block on some models.
3. Loosen magneto.
   a. Loosen the 2 screws below magneto stator plate and slide friction clamps which hold magneto on crankcase to allow removal of stator, or
   b. Loosen 4 screws below magneto stator plate, bring friction hold-down clamp back and remove stator plate, or
   c. On automatic transmission models, turn stator plate in clockwise direction and lift stator plate off.
4. Lift off magneto.

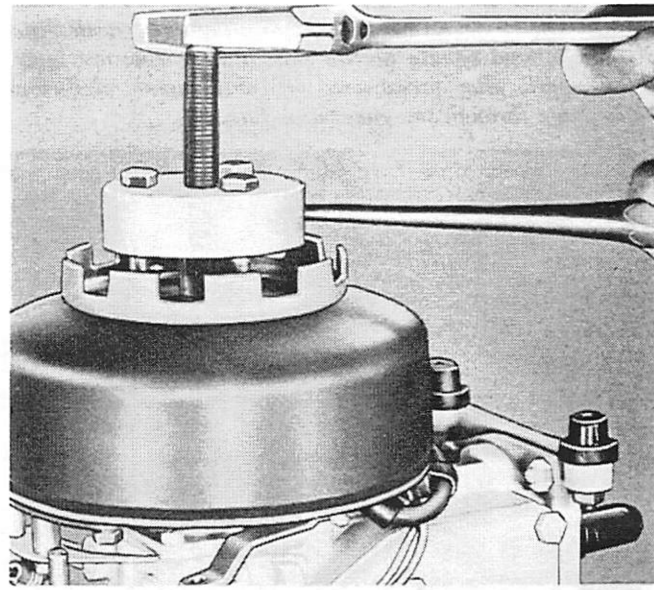


Figure 20. Pulling Flywheel

IMPORTANT: Eiseman magnetos, used on a number of older models, are very similar to the Phelon magneto in construction. Refer to Phelon magneto for repair of Eiseman magnetos, Figure 21.

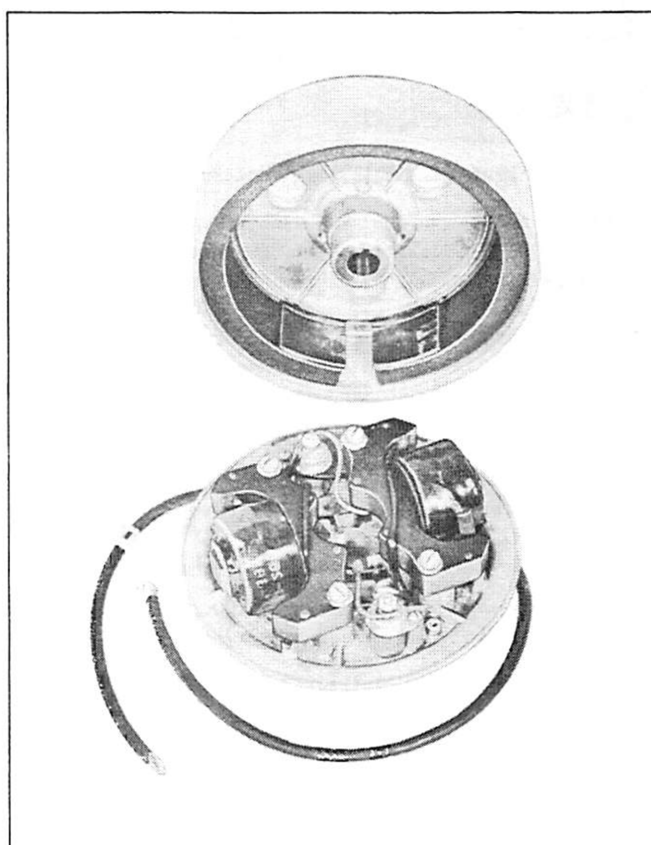


Figure 21. Eiseman Magneto Assembly

SPARK LEAKAGE--WHAT SHOULD BE INVESTIGATED

1. Check lead wire to see if spark is leaking through insulation at some point.

   CAUTION: Avoid using a spark plug tester with hypodermic type needle on the end. It will puncture leads or spark plug protectors and will cause electrical leakage through the punctured hole.

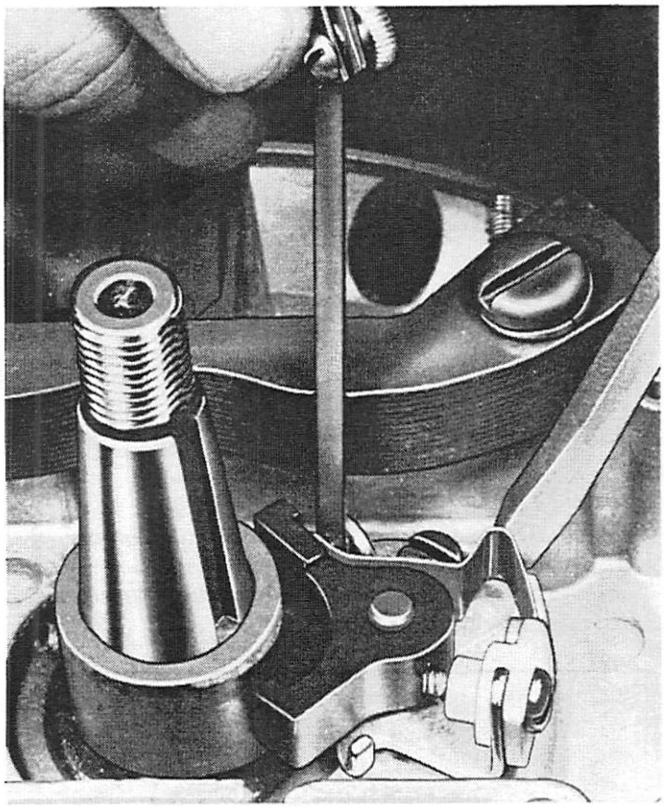


Figure 22. Adjusting Points on Phelon

2. Check breaker points. Be sure they are set to proper gap (.018" [0.457mm]). On late model Phelon Magneto, set gap .020" (0.5080mm). Use a Feeler Gauge (C-91-24262). (See Figure 22.) (Refer to "degree plate setting" on P. 13) Be sure breaker rubbing surface is on highest part of cam when checking points. This is the part of cam which follows directly after points have opened. Be sure they are clean. Clean with a lint-free cloth.
3. Care must be taken when adjusting breaker point gap on the late model Phelon Magneto for 2-cylinder Merc 350-200-110-60-39 models.
4. Heel of the breaker arm must be on high point of cam.

   NOTE: High point of cam is not at the keyway, but located as shown in Figure 24A, Page 14.

5. If the points are pitted, replace them. *(Refer to illustration on P. 4.)* Check the condenser, as a defective condenser may be the cause of badly pitted points.
6. If points require replacement, they can be replaced only as an assembly.
7. Set magneto lever (in cases of models with twist grip control, the centerline of magneto) in centerline of engine. Rotate crankshaft until breaker points are fully open. Be sure breaker gaps are equally set for smoothest performance when using Feeler Gauge.
8. For proper settings, see information on "degree plate", on Page 13.
9. If replacement points are not available, they can be stoned, using care to keep surfaces flat and parallel. They should be removed separately and rubbed against the stone. Do not use a file, as this may contaminate points with iron particles.

   CAUTION: Never use a plated gauge in checking point gap, as plating may come off.
10. After resetting breaker points, recheck magneto at cranking speed as outlined previously. This check may eliminate the necessity for removing coil and condenser and is the most positive method of determining if magneto is operating satisfactorily.
11. If magneto does not function properly, check coil with Magneto Analyzer. Settings and value data are compiled in Coil Test Chart, following in this section.
12. Check condenser on a condenser tester. For capacities, see Condenser Test Chart, following in this section.

    CAUTION: Do not substitute another condenser of a different capacity. Check leakage, series resistance and breakdown.
13. Inspect coil for insulation leakage or for evidence that spark has been leaking to ground from terminal where spark plug lead is connected. Check coil on a coil tester in accordance with specifications (see chart) given by coil tester manufacturer.

HOW TO REPLACE COIL ON PHELON MAGNETO

1. Remove primary connection and spark plug wire. Ground the connection.
2. Bend down clip holding coil down on core, taking care not to break off this clip.
3. Remove core screw which free coil and core. Place coil assembly across open jaws of a vise with bottom of coil resting on tops of vise jaws and tap center leg of core gently until coil comes off.
4. In replacing coil on core, great care must be taken not to bend core which, being laminated, is quite easily distorted.
   a. Core must be supported under center leg while new coil is being pressed on.
   b. Be sure that coil is "bottomed" before bending tab.
   c. New coil now can be placed in position on stator plate, being careful that primary leads are in proper position. Use same or new self tapping screws to replace core. They will act as dowels. Align core with bosses on stator plate carefully, or flywheel magneto will strike and cause damage to flywheel or magneto assembly.
5. Check ground connection to be sure it is making a good contact both under screw and at crimped part of terminal. Check for good contact at live terminal ends.
6. Check insulation at breaker point connection to be sure the lead does not ground against spring or fixed contact.
7. If cam wick becomes dry, it should be replaced. (Do not oil wick.) If breaker arm pivot is dry, lubricate lightly with MULTIPURPOSE Lubricant (C-92-35226). Do not use any oil and avoid excess lubrication which might get on points.

SERVICING: WHAT SERVICING SHOULD BE DONE TO THE MAGNET UNIT IN THE FLYWHEEL?

Absolutely none. The magnet unit is an integral part of the flywheel, assembled permanently and machined with the flywheel. It should never be removed. This magnet unit should not require recharging. Any attempt to recharge the magnet unit by ordinary means will only result in discharging it, which requires replacing.

REASSEMBLY - PHELON MAGNETO

REINSTALLING PHELON MAGNETO

After magneto assembly has been thoroughly checked and repaired, as instructed previously, reinstall in the following manner:

1. Replace cam breaker (on engines equipped with cam) on crankshaft with arrow marking down and in direction of rotation of engine. See that nub in cam is on top for point setting. Insert key into slotted keyway on crankshaft.
2. Replace thrust washer, spring or wave washer and flywheel key, whichever is used on this particular model motor.
3. Seat magneto, install clamps and lock snugly with knurled head screws. Tension on screws tightens magneto rotation accordingly.

SYNCHRONIZING BREAKER POINTS - 2-CYL. ENGINES WITH EARLY OR LATE TYPE PHELON MAGNETO

With flywheel removed from engine, and stator assembly, coils, condensers and breaker points tested on Magneto Analyzer C-91-25213, defective parts or parts not up to standard have been replaced.

INSTALLING SYNCHRONIZING PLATE

1. Place correct Synchronizing Plate on rim of stator plate. *Use C-91-28619A1 plate on early type Phelon magneto (Figure 23) and C-91-36454A1 plate on late type Phelon magneto (Figure 23A).* Move stator to position where magneto cam touches carburetor pickup lever. (Figure 24) Leave stator set at this position throughout rest of settings.
2. Thread proper size indicator arm (included with tool) onto threaded end of crankshaft until it seats on shoulder.

EARLY TYPE PHELON MAGNETO

Model Adaptable	Thread Size
Merc 110-60 & Mark 6-6A-7	7/16"-20
Mark 15 & KG4	1/2"-20
Mark 10-10A-15A-28-28A-25	5/8"-18
Merc 100-150-200	5/8"-18

LATE TYPE PHELON MAGNETO

Model	Thread Size
Merc 110-60	7/16"-20
Merc 200-350	5/8"-18

3. Thread flywheel nut against indicator arm to hold arm securely in position. (Nut acts as a jam nut.) Remove spark plugs to relieve compression when turning crankshaft. Turn crankshaft -- not indicator arm -- to prevent bending indicator arm.

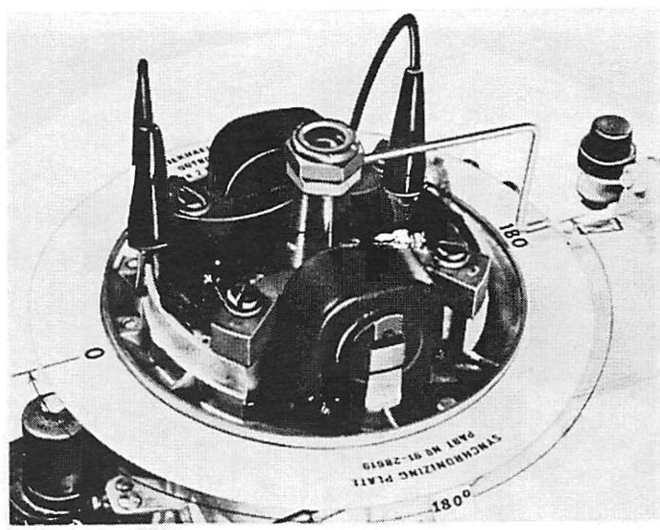


Figure 23. Degree Plate C-91-28619A1 on Stator

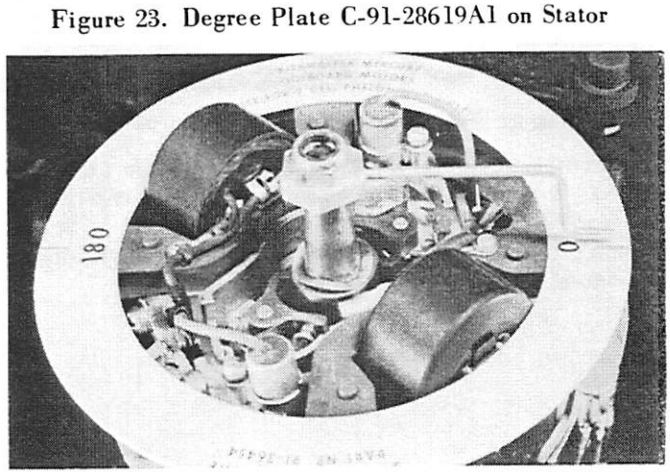


Figure 23A. Degree Plate C-91-36454A1 on Stator

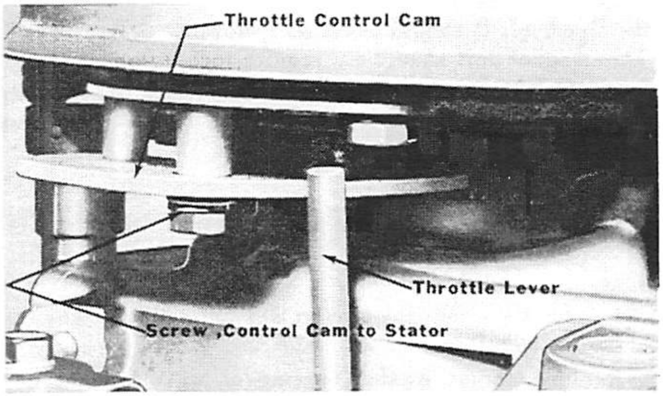


Figure 24. Cam Touches Pickup Lever

ADJUSTING BREAKER POINTS

1. Adjust breaker points so that breaker cam follower arm is at high point on cam (about ¼" rotation after points open).
2. Set first breaker assembly clearance with a feeler gauge.

Early type Phelon magneto	.018" (0.4572mm)
Late type Phelon magneto	.020" (0.5080mm)

Care must be taken when adjusting breaker point gap on the late model Phelon magneto. High point of cam is not at the keyway, but located as shown in Figure 24A.

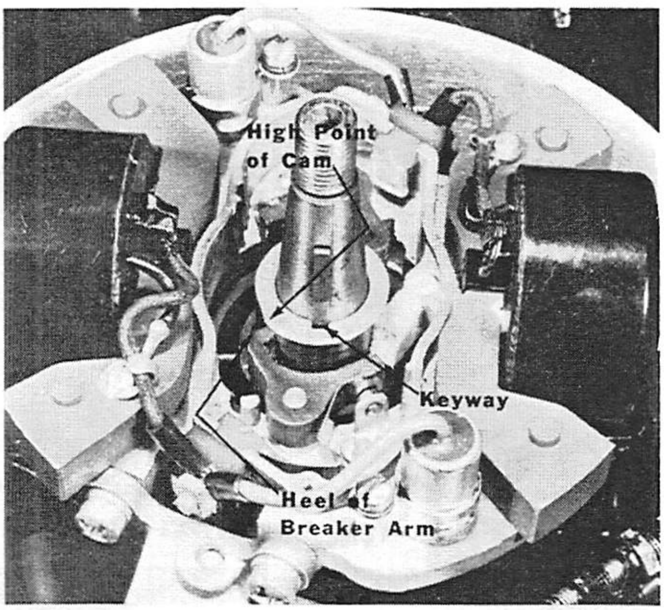


Figure 24A. Location of High Point of Cam

3. Set Magneto Analyzer (C-91-25213) selector switch on No. 2 (resistance) or, employing Continuity Meter (C-91-22966), attach one small test lead to stator plate (ground) and second small test lead to spring arm of breaker point.
4. Rotate indicator arm clockwise to allow breaker to close. Continue to rotate crankshaft and indicator arm (turn crankshaft, not indicator arm, to prevent bending indicator arm) clockwise until meter hand moves (breaker points open). This will be indicated by sudden movement of meter pointer hand.
5. Move degree plate in either direction required to place 0° mark directly under indicator arm.
6. Move small test lead from first breaker point spring to second point spring and attach.
7. Rotate indicator arm clockwise toward second breaker assembly until indicator arm is directly over 180° mark. Second breaker must open exactly at this time. If not, readjust breaker points until they just begin to open, as indicated by the meter pointer hand movement.
8. Recheck settings on No. 1 and No. 2 breaker points to assure that settings have not changed, due to possible movement of degree plate.

NOTE: If degree plate is not available, set breaker arms at highest point on lobe of cam. Using Feeler Gauge (C-91-24262) between open faces of points, set gap at specified clearance. To set other breaker point opening, rotate crankshaft 180° and set gap the same.

NOTE: The breaker cam should be checked for looseness. Install with arrow in direction of rotation. It should be tight on the crankshaft. If loose, it may cause misfire at idling speed. (Some models have cam cut on shaft.)

SYNCHRONIZATION

Synchronization between magneto cam and carburetor throttle shaft is important. Magneto cam should pick up throttle lever just as centerline of magneto is in approximate center line of crankshaft or at approximately 1000 RPM with engine in forward gear. If throttle pickup occurs too soon or too late, it can cause erratic mid-range operation. Improper synchronization also will cause a "flat spot" or four-cycling in engine operation.

NOTE: Refer to "Timing, Adjusting and Synchronizing" of 2-cylinder engines, this section.

REINSTALLING FLYWHEEL

After points have been set, flywheel can be installed:

1. Place flywheel on shaft over key. Place flat washer on top of flywheel (optional on some models).
2. Place ratchet or nut on crankshaft on top of washer and tighten with starter ratchet or socket wrench, using Torque Wrench (C-91-32610) to tighten to required number of foot pounds. (See Torque Chart Specifications, Section VIII.)

1 Flywheel
2 Stator and Core
3 Screw, core fastening
4 Lockwasher, core fastening screw
5 Coil, ignition
6 Screw, ground terminal
7 Cover, breaker compartment sealing
8 Screw, sealing cover fastening
9 Breaker Assembly
10 Screw, breaker fastening
11 Washer, breaker fastening screw
12 Lockwasher, breaker fastening screw
13 Screw, breaker connection
14 Condenser
15 Screw, condenser fastening
16 Lockwasher, condenser fastening screw
17 Wick, felt
18 Lead Wire (short)
19 Lead Wire (long)
20 Marker, "top" - lead wire
21 Tube, lead wire (port side)
22 Clamp, plastic - lead wire to stator
23 Screw, lead wire clamp (short)
24 Screw, lead wire clamp (long)
25 Washer, lead wire clamp screw
26 Lockwasher, lead wire clamp screw
27 Bushing, lead wires (upper)
28 Protector, spark plug
29 Spark Plug
30 Throttle Control Cam Assembly
31 Spacer, throttle cam
32 Screw, throttle cam to stator plate (short)
33 Screw, throttle cam to stator plate (long)
34 Washer, cam mounting screw (long)
35 Lockwasher, cam mounting screw
36 Clip, magneto hold down
37 Screw, hold down clip to magneto
38 Spring, hold down clip screw
39 Key, flywheel
40 Nut, flywheel

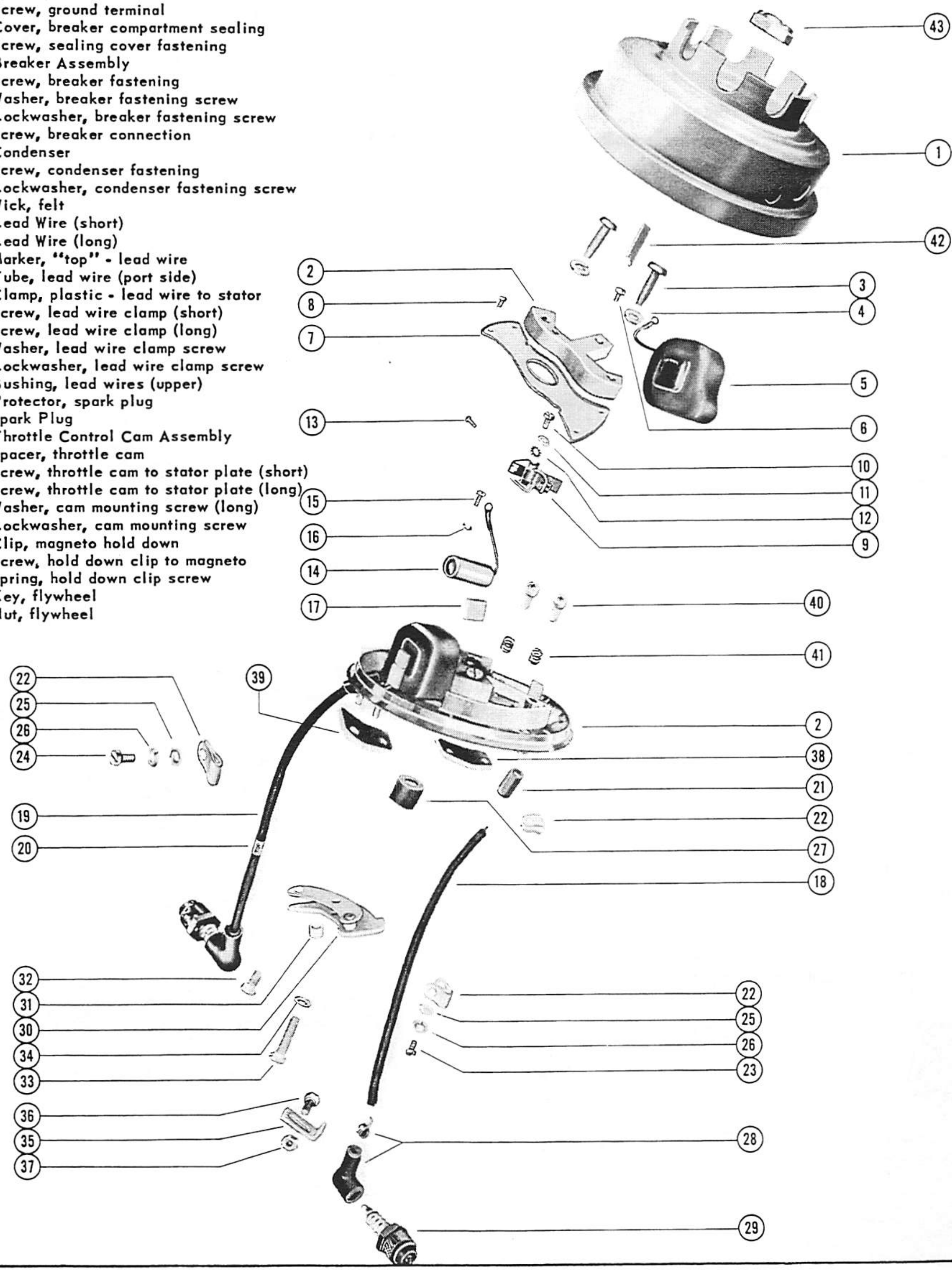


FIGURE 25. Phelon Magneto Parts Identification (Mark 10-10A)

TESTING WITH MAGNETO ANALYZER

The Magneto Analyzer (91-25213) is not just a coil and condenser tester but is designed to meet the growing need for a completely accurate magneto analyzer at a price within reach of all Mercury service shops.

The Magneto Analyzer completes the following tests (instructions are included with tester):

High and Low Speed Coil Test

Tests coil under actual working conditions while coil is being fired.

Coil Dampness (Continuity) Test

Accurately tests coil secondary for high resistance, open or shorted windings and dampness (continuity).

Coil Primary Test

Tests primary circuit for open windings or shorted windings.

Insulation Test

Completely checks insulation of system, including caps, rotors, coils and high tension leads under actual working conditions.

Distributor Resistance Test

Tests for high resistance between breaker points, all connections in primary circuit, high tension leads, alternators and internal and external wiring harnesses.

Condenser Capacity Test

Accurately checks capacity of all condensers to manufacturer's specifications.

Condenser Leakage and Short Test

Checks condenser for leakage of insulation or shorts. Test made with only one hookup. Condenser should be tapped lightly while button is depressed.

Timing of Motor

Accurately sets timing of all engines.

Continuity Test

Checks all electrical parts for internal broken wire or current.

Resistor Test

Tests resistors on 6-cylinder engines.

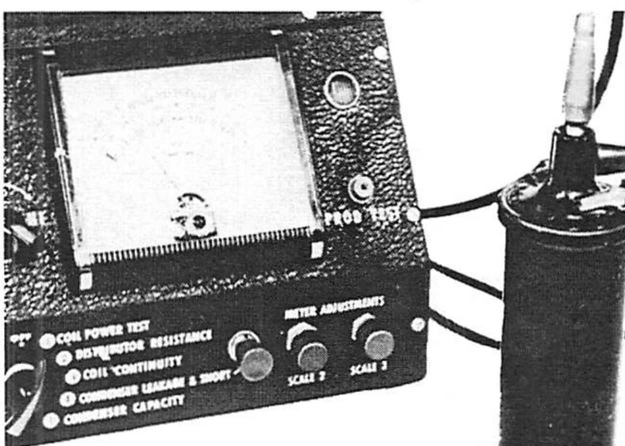


FIGURE 26. Testing Battery Ignition Coil, 6-Cyl. Engines
Selector Switch on No. 1

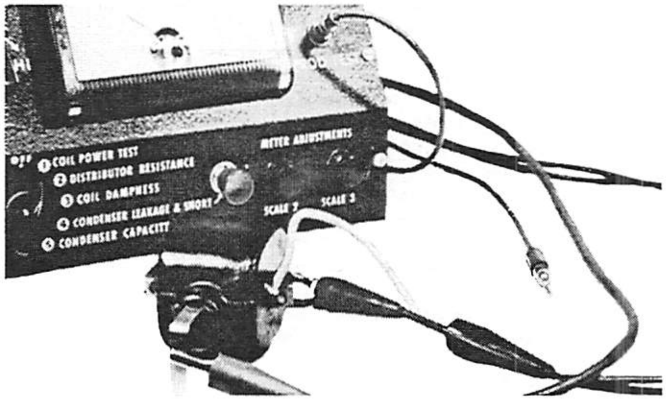


FIGURE 27. Testing Magneto Coil
Selector Switch on No. 1

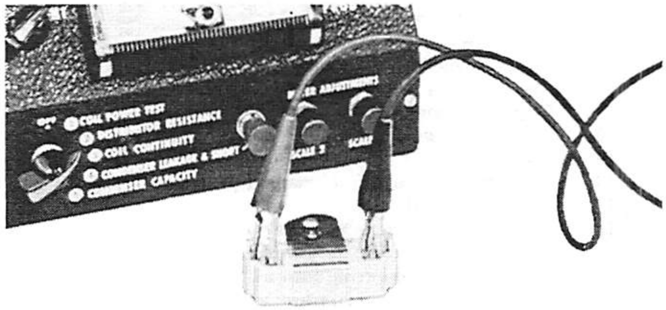


FIGURE 28. Testing Resistor, 6-Cylinder Engines
Selector Switch on No. 2


FIGURE 29. Testing Rectifier
Selector Switch on No. 3

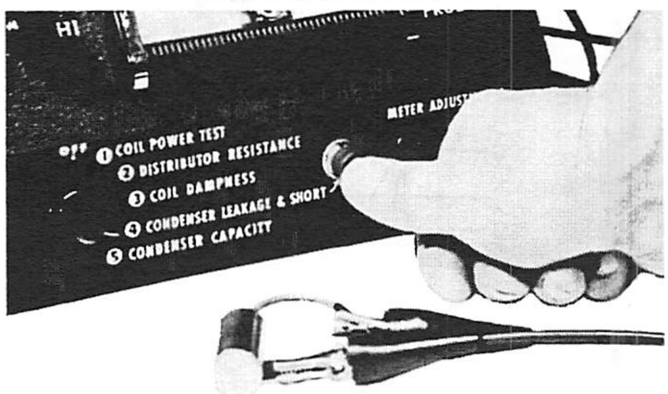


FIGURE 30. Testing Condenser Leakage & Short
Selector Switch on No. 4

SCINTILLA MAGNETO PARTS

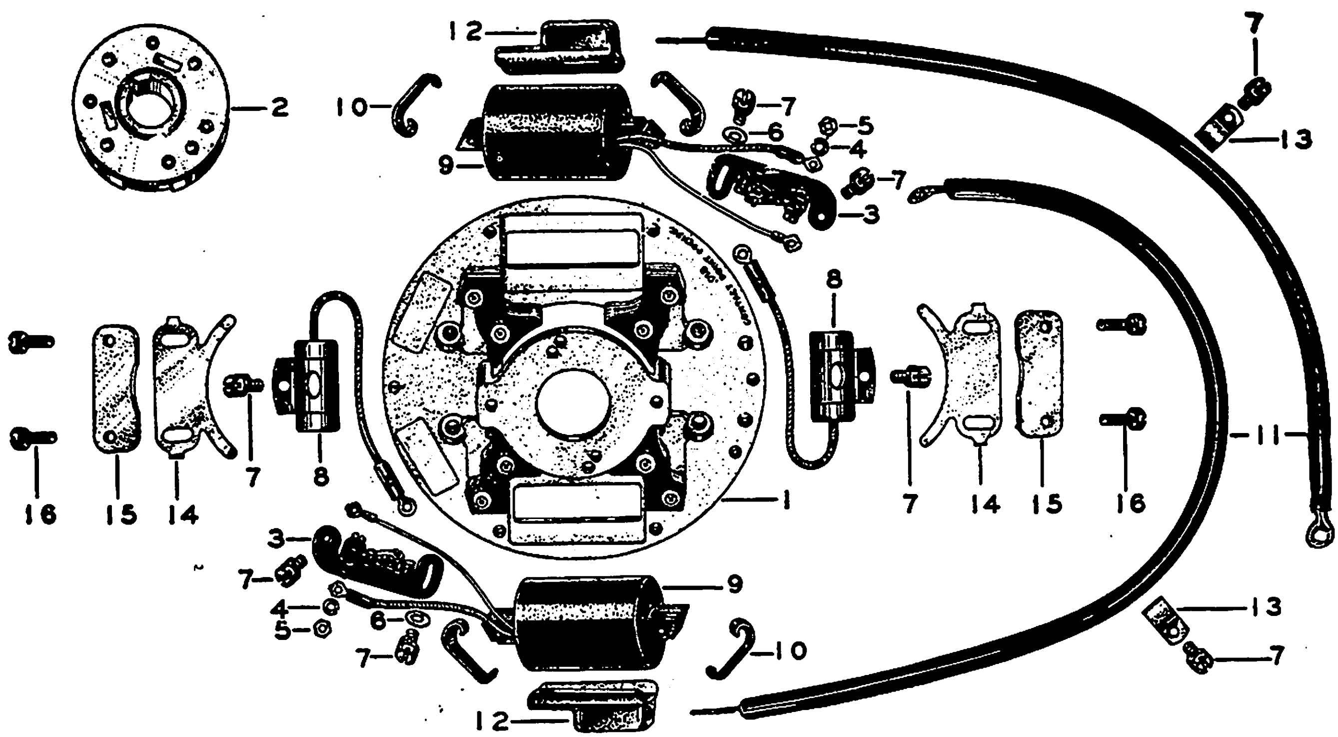


FIGURE 31. Scintilla (Type K2A-5) Magneto Parts

1 Plate, stator
2 Magnet, rotating
3 Breaker assembly
4 Washer, primary connector to breaker nut
5 Nut, primary connector to breaker
6 Washer, breaker adjusting screw (plain)
7 Screw
8 Condenser
9 Coil, ignition
10 Clamp, Coil fastening
11 Lead, high tension (short) (long)
12 Insulator, high tension lead
13 Clamp, high tension lead
14 Spring, stator plate tension
15 Plate, stator plate tension spring
16 Screw, stator plate tension spring

Type	Motor Model No.	Year
K1-6	KD3	1946
K1-6	KE3	1947
K1-6	KF3	1949-50
K2A-3	KD4	1946
K2A-3	KE4	1947-50
K2A-3	KF5	1949-52
K2A-5	KE7 (Up to Serial No. 340835)	1947-49
K2A-5	KF7 (Up to Serial No. 361363)	1949-50

BREAKER POINT SETTING

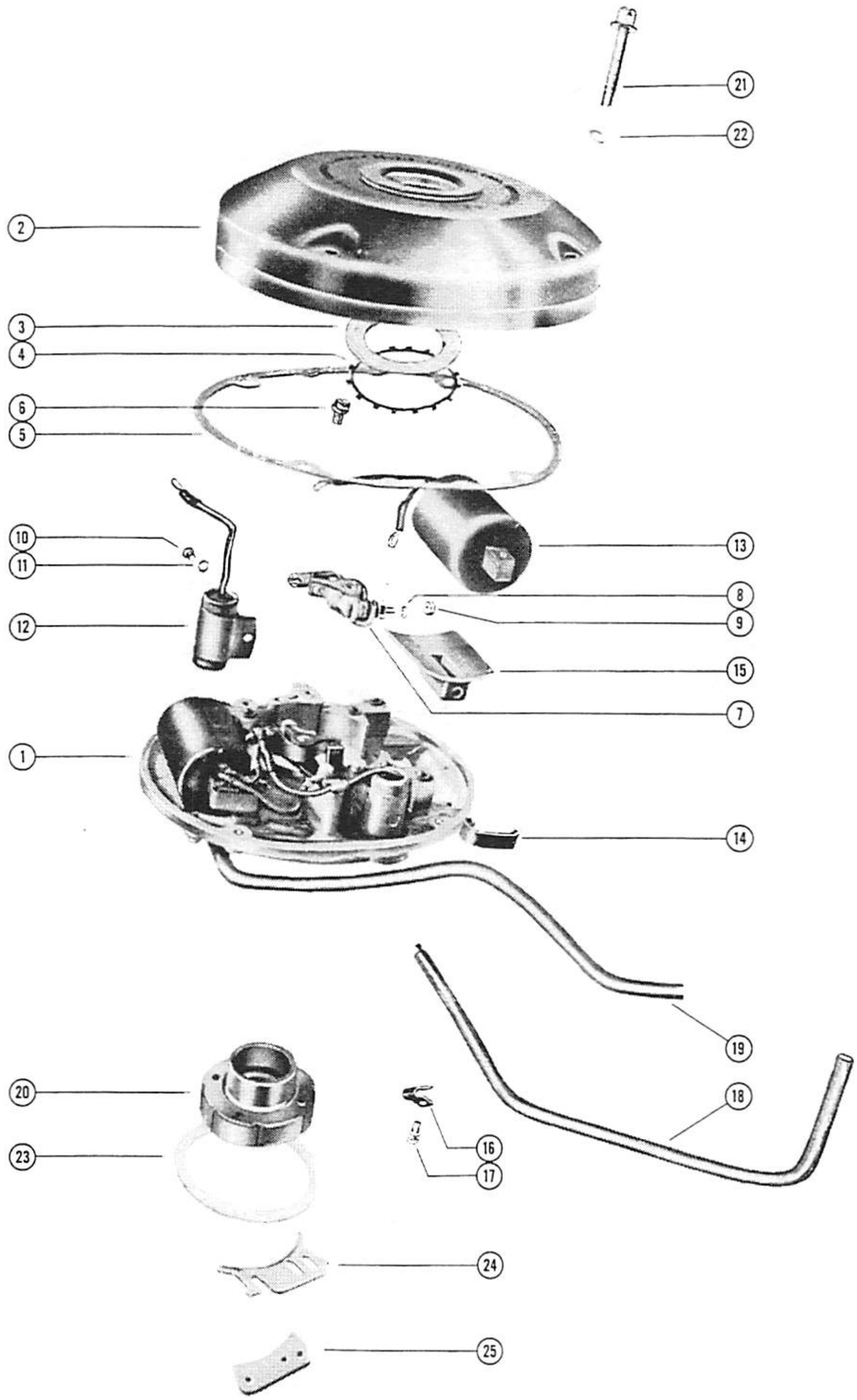
Model	Magneto Type	Setting
2-Cyl.	Eisemann	.018"
2-Cyl.	Scintilla	.018"
2-Cyl.	Phelon	.020" (.508mm)**
KB3	Wico	.018"
4-Cyl.	Kiekhaefer	.008" + .000 – . 002 or 48° Dwell*
4-Cyl.	Fairbanks-Morse	.010" + .000 – .002 or 54° Dwell*
6-Cyl.	Kiekhaefer Distributor	90° Dwell§
6-Cyl.	Kiekhaefer Distributor w/Thunderbolt Ignition	45° Dwell£

** Use Degree Plate C-91-31484A2*　*§ Plate C-91-30356A1*

.018" = .457mm　.010" = 254mm　*£ Plate C-91-45510A1*

.008" = .203mm　.002" = .051mm　*** .018" for 1962 and Earlier Models*

SCINTILLA MAGNETO PARTS



1 Plate, stator
2 Cover, magneto
3 Washer, felt - magneto cover
4 Ring, lock - magneto cover
5 Gasket, magneto cover
6 Screw & Lockwasher, breaker assembly mounting
7 Breaker Assembly
8 Lockwasher, terminal nut
9 Nut, terminal
10 Screw, condenser mounting
11 Lockwasher, condenser mounting screw
12 Condenser
13 Coil, ignition
14 Clip, coil
15 Insulator, high tension lead
16 Clamp, high tension lead
17 Screw & Lockwasher, high tension lead clamp
18 Lead, high tension - short
19 Lead, high tension - long
20 Magnet, rotating
21 Screw & Lockwasher, cover fastening
22 Washer, cover fastening screw
23 Shim, magneto pilot
24 Spring, magneto hold down
25 Plate, magneto flange

FIGURE 32. Scintilla Magneto, Mark 6

Type	Motor Model No.	Year
K2A-201	KF5 (Serial Nos. 340836-425562)	1949-52
K2A-202	KF7 (Serial No. 361364 and Up)	1949-50
K2A-202	KG7 (Serial Nos. Under 471987)	1950-52
K2A-205	KG7 (Serial Nos. Over 471986)	1950-52
K2A-205	KH7 and KG7H	1952
K2A-208	Mark 20	1953-54

SCINTILLA MAGNETO - 2-CYLINDER ENGINES
Servicing and Disassembly

SCINTILLA MAGNETO SERVICE INSTRUCTIONS

A. Testing Scintilla Coils

If the Scintilla magneto does not function properly, check the coil with the Magneto Analyzer (91-25213). (See data on charts immediately preceding.)

Recommended testing equipment, procedures and values:

All 399-756 coil readings on the Magneto Analyzer (91-25213) are recommended for the most positive test.

The new, high-output coil 399-125 has a green plastic sleeve on the primary lead. The primary lead has but one wire on this coil, while the ground wire is composed of 2 wires. These leads both come out of the same end of the coil. The 399-756 coil primary lead has 2 wires, while the ground wire has but one. There are 2 types of this coil, one with both leads leading out of one end, the other with one lead out of each of the ends. (The latter is the obsolete type.)

The readings of the 399-125 coil are listed on the Test Data Chart, preceding. This coil has a different interior winding resulting in a much higher amperage or primary index reading. Some of the high output is derived from the new high output rotor (20599), a 2 pole rotor.

The Magneto Analyzer may be used to indicate the general condition of the coils, providing the manufacturer's instructions are carefully followed and calibration of the analyzer is maintained to its original accuracy. (While most instruments indicate the general condition of a coil, our experience has shown that they are not infallible.)

TO REMOVE SCINTILLA COIL

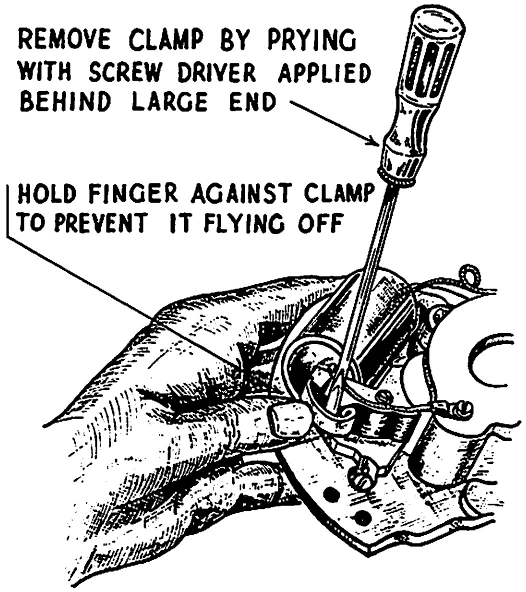


FIGURE 33. Removing Scintilla Coil

B. Removing Coil

To replace the coil on a Scintilla magneto, remove nut from breaker point terminal and remove coil primary wire and condenser lead. Remove coil ground wire from stator plate by removing screw.

With a screwdriver placed between clip and core, pry clip away from core. (Figure 33) *Caution: Hold hand over clip as clip will spring off with force. Repeat procedure on other clips.*

Loosen lead wire clamp and pull coil out of recess with lead wire. Remove lead from coil.

Installing Coil: When installing the coil, check high tension cable connection to coil terminal. Heretofore on magnetos incorporating a high tension connection insulator, the cavity of the insulator was filled with Bendix No. 47 Compound. Now a more secure connection between high tension cable and coil high tension terminal has been devised. The following procedure is recommended to effect this change:

Slide high tension cable through hole in end of high tension insulator and out through elongated slot. Strip insulation ¾" from high tension cable. Clean the coil high tension terminal and end of wire to be soldered thoroughly to remove any dirt, grease or oxide.

Pass the stripped end of cable down through the hole in the coil high tension terminal and twist the remaining wire as shown in Figure 34. Apply a thin coat of rosin or rosin alcohol flux to areas to be soldered. If using rosin-core solder, no additional fluxing will be required.

Using 50-50 tin-lead solder, join coil terminal and cable together, using enough heat to melt and flow the solder, yet only enough solder to make a satisfactory joint.

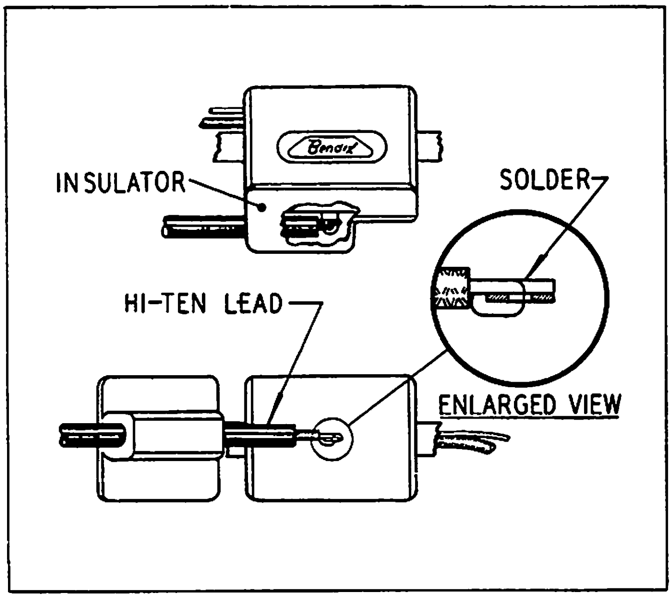


FIGURE 34. Cable Position for Soldering to Coil High Tension Terminal

Parts to be joined should be held in such a manner that they will not move in relation to one another during soldering operation. After soldering, the joint shall not be disturbed until the solder has completely solidified. If a satisfactory joint is not initially obtained, the joints shall be taken apart, parts thoroughly cleaned and the entire soldering procedure repeated. If excessive flux residues are in evidence around the soldered joint, they may be removed by wiping with a cloth moistened with denatured alcohol, thinner or acetone.

Slide insulator up over soldered area of high tension cable. To install coil clamps, push them into place by applying pressure on the curved portion. CAUTION: Do not hammer into position!

C. Testing Condenser

When testing the condenser, use the Magneto Analyzer (91-25213) or its equivalent. This test may be accomplished without removing the condenser, providing condenser lead is disconnected from coil and breaker. Tap condenser lightly with screwdriver handle. (See Test Data Chart, preceding, for condenser capacity.)

D. Checking Rotors

All magneto rotors (rotating magnets) must be handled with a reasonable amount of care. These magnets are made of the best composition of metals, having excellent properties for retaining their magnetism. When handled with a reasonable amount of care, they will function satisfactorily for long periods of time.

After removal of rotating magnet, it should be cleaned, dried, wrapped in clean cloth or paper and stored away from any metallic object until ready for use.

Here are some of the important "DON'TS":

1. Don't drop or strike with hammer.
2. Don't place rotor on metal bench.
3. Don't leave rotor lie around without a metal keeper.
4. Don't expose rotor to metal filings, etc , where they might be picked up and later deposited inside magneto assembly.
5. Don't attempt to remove rotor from crankshaft without proper tool.
6. Keep rotating magnets at least 1" away from each other.

SPECIAL RECOMMENDATIONS

E. Use of Starter Ratchet Lockwasher

The Service Department recommends the use of an external tooth lockwasher under the starter ratchet on all engines listed below:

Mark 20	KF7	KF7HD	KH7
Mark 15	KG7	KG7H	KG4H

NOTE: On KG7, KG4 and KG4H models with Phelon magnetos, the flat washer is removed and replaced with Part No. 13-20632, external tooth lockwasher. The starter ratchet is not cut down. Use same ratchet part number, 24177. On Mark 20H, use Part No. 13-20897.

The use of this lockwasher necessitates a new starter ratchet (20631) which is 1/16" thinner to prevent ratchet from coming in contact with starter pawl retainer (on Scintilla Magnetos).

When removing starter ratchet from engine already equipped with external tooth lockwasher, it is recommended that a new lockwasher be installed each time.

The old ratchet can be cut down for use with the lockwasher by the following method:

Mount ratchet on an old crankshaft, if available, or on a suitable bolt and secure in a lathe check. Turn off 1/16" from bottom of ratchet (flywheel side). *Caution: It is of the utmost importance that this surface be absolutely perpendicular to crankshaft threads.*

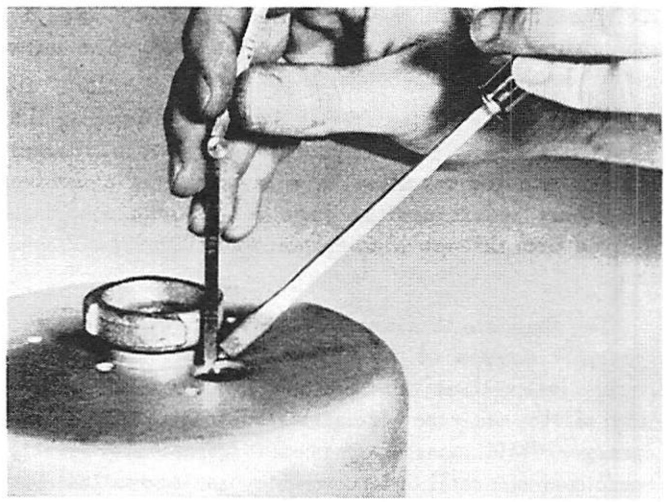


FIGURE 35. Setting Breaker Points on KD and KE Models

F. Scintilla Magnetos on KD4, KD4S, KE4, KE7, KE3, KD3 and KD3S

To properly set breaker points on models with Scintilla Magnetos and flywheel -- with the breaker cam on flywheel hub -- use the following procedure:

Secure flywheel to crankshaft with ratchet or nut. Rotate flywheel until hole in top of flywheel, marked "I" or "T" for ignition or timing, is over breaker assembly. Recheck for correct opening. Points should open when observed through this opening while rotating slightly. With Feeler Gauge (91-24262), set points at .018". (Figure 35) Loosen breaker point attaching screw at both ends of points. Adjust points so that they can be set at .018" with Feeler Gauge (91-24262). Tighten screws and recheck gap, as points may have moved while tightening. Rotate flywheel to 2nd set and repeat procedure.

DISASSEMBLING SCINTILLA MAGNETO

1. To remove flywheel ratchet nut, use Starter Ratchet Wrench (C-91-24710 or C-91-24719) to engage starter ratchet nut which fastens flywheel to crankshaft. Turn loose right hand thread with sliding "T" wrench (½" drive). (Figure 36) If flywheel is to be removed for tuneup, use Universal Flywheel Holder (C-91-24973A1).

   NOTE: On later models, the starter ratchet is not used. A 13/16" hex nut is employed with a different type starter.

2. To remove flywheel, attach Flywheel Puller Tool (C-91-24695A2) to flywheel evenly and secure with 3 screws into top of flywheel. Center the Puller Plug (C-91-24161) over crankshaft thread end to protect threads and turn down on flywheel puller with wrench until pressure is exerted on flywheel. (Figure 37) Hold center part of tool rigid with screwdriver inserted in hole on side of tool body while turning down on center screw. Tap top of center screw with hammer to break flywheel loose, if exceptionally tight.

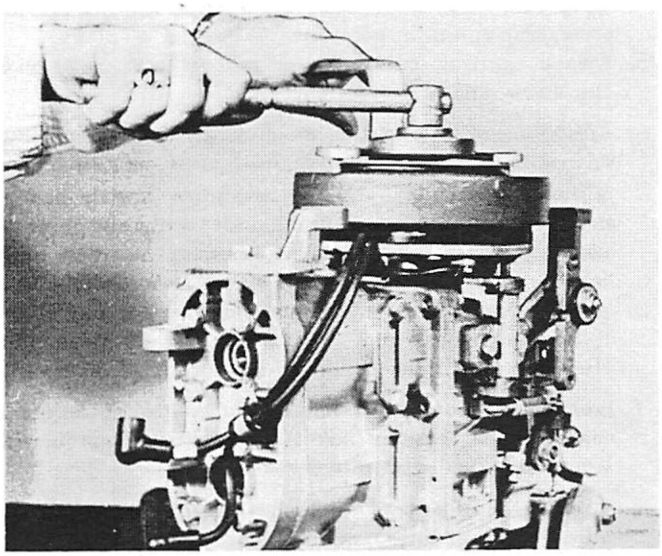


Figure 36. Removing Ratchet Nut

3. Remove 4 round head screws and washers to remove magneto cover. Loosen the 4 gear mounting screws which hold tension springs and driven sector gear tight to crankcase adaptor. Push tension springs outward to release magneto stator assembly from crankcase. Loosen the 2 tension adjusting spring screws on bottom rear of magneto stator plate, enough to allow removal of magneto assembly.

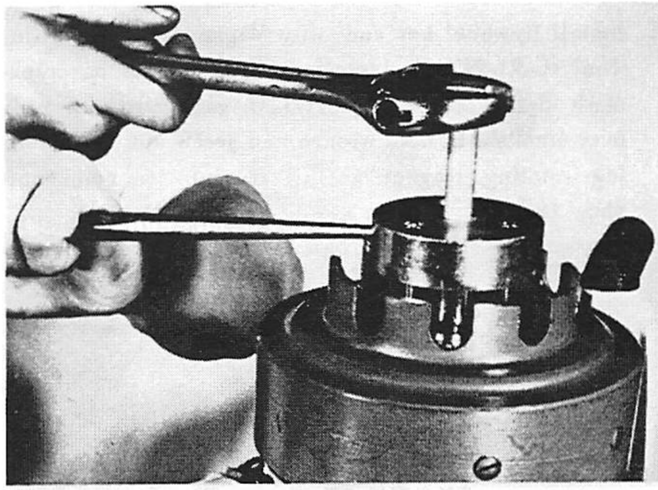


Figure 37. Removing Flywheel

4. Remove cap screw on cylinder block cover in order to free ignition cables held by high tension lead clip. Lift magneto up from powerhead. Remove flywheel key. Remove magneto stator plate to crankcase shim and clamp spring shim (split shim).

5. Remove magnet rotor from crankshaft with Rotating Magnet Puller (C-91-30867A1) in conjunction with Universal End Cap Puller (C-91-25733A2). (Figure 38) Insert the halves of tool plate under rotor and fasten together with plate screw. Position frame and center screw over crankshaft. Turn center screw against end of crankshaft, pulling off rotor. After removal, place magnet rotor in position in stator assembly for protection.

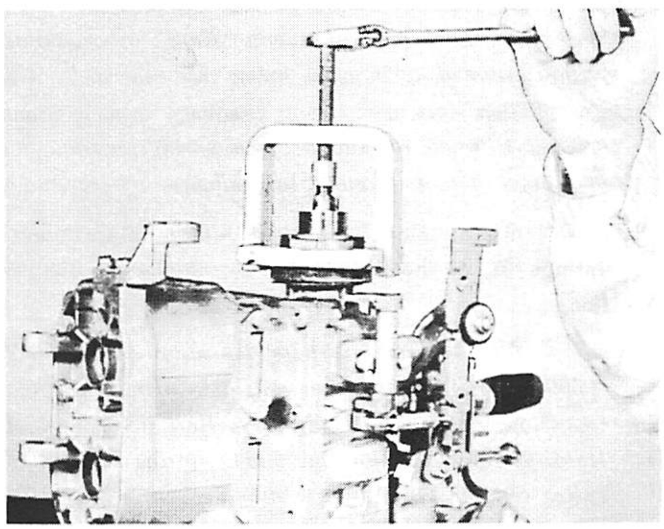


Figure 38. Removing Magneto Rotor

REINSTALLING SCINTILLA MAGNETO

1. Install flywheel key and, with Magnet Rotor Installing Tool (C-91-24740), install rotating magnet on crankshaft (Scintilla magneto only). (Figure 39) Place body over crankshaft, hold wrench and screw nut down, forcing rotating magnet on 'til it seats on crankshaft shoulder.

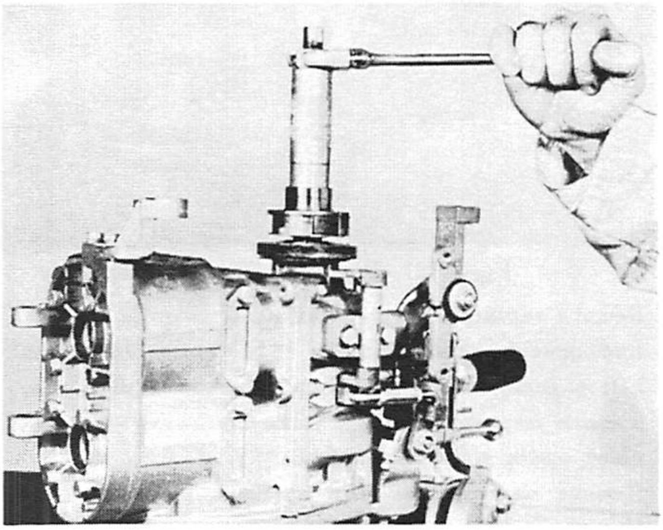


Figure 39. Installing Magnetic Rotor

2. Coat magneto adaptor flange on crankcase with Lubriplate 130A, top, bottom and sides. Install magneto stator plate shims on top and bottom (split shim).

   NOTE: When repairing old 10 and 16 HP motors, (pre-1956), it is recommended that a split shim (A-15-20627) be placed beneath adaptor flange on crankcase so that stator plate tension spring will ride on it. Use of crankcase shim will lessen tendency to wear crankcase out of round or indent it from spring tension, thus add longer life to stator plate adaptor of crankcase.

3. Install stator plate and push stator plate tension springs in to hold magneto to crankcase adapting flange.

   NOTE: The tension springs on stator plate (A-24-20569) should be used on all Scintilla and Phelon magnetos. On the first KH7 and Mark 15 models, the stator springs were flat and had no spring tension. The spring tension type stator plates prevent magneto from loosening and vibrating, causing wear and misfire.

   Tighten tension screws securely to sector gear. Also

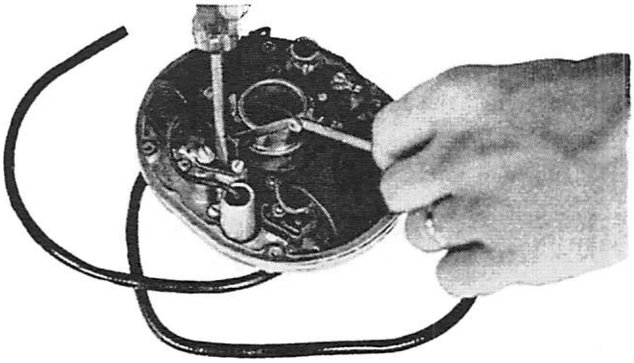


Figure 40. Adjusting Breaker Points

tighten tension screw assembly in stator plate to get correct tension on magneto.

4. Gauge clearance between stator field and magnetic rotor poles with Feeler Gauge. A .006" (.1524mm) to .008" (.2032mm) air gap is required. If gap exceeds .008" (.2032mm), the magnetic influence is lessened. If gap is closer than .006" (.1524mm), the poles of magnetic rotor may strike stator laminated core, causing severe damage to magnetic rotor and core. To move core away from rotor, use a drift, driving against protruding rivets in core.
5. Attach ignition cables to cylinder block cover with cap screw and high tension lead clip.
6. Adjust breaker points in magneto by setting magneto so one breaker arm is at highest point on cam (about ¼" after breaking open). Set stator or throttle handle at half throttle and turn crankshaft to highest point on cam. Set .018" (.4572mm) clearance between open faces of points with Feeler Gauge (C-91-24262) or a good automotive type. (Figure 40) To set the other, rotate crankshaft and cam 180° and set same gap. (Refer to 2-cylinder "degree plate setting" on P. 13.)
7. Install cover gasket on stator plate of Scintilla magneto and replace bakelite cover on magneto with 4 common head screws and washers.
8. Replace flywheel on crankshaft and tighten with flywheel ratchet nut. Torque flywheel nut with Torque Wrench according to specifications on Torque Chart in Section VIII. Remove nut and install external locking washer. Again Tighten nut to recommended torque pounds for secure fit to prevent any false torque reading.

NOTE: Flywheel replacement, KF7, KG7 and KH7 models - When replacement of old flywheel is necessary on KF7, KG7 and KH7 motors, the new, improved flywheel (A-201-77A1) is recommended. This new flywheel is heavier, idles better, and performs smoother over entire speed range of engine.

MAGNETOS FOR 4-CYLINDER ENGINES
General Service Procedure

("Timing, Adjusting and Testing" for various models follows in this section.)

I. DESCRIPTION

Kiekhaefer and Fairbanks-Morse magnetos are special type units for use on 4-cylinder Mercury Outboard Motors. (Figure 42.) These motors, containing 4 cylinders in line, are of the 2-stroke cycle design and require an

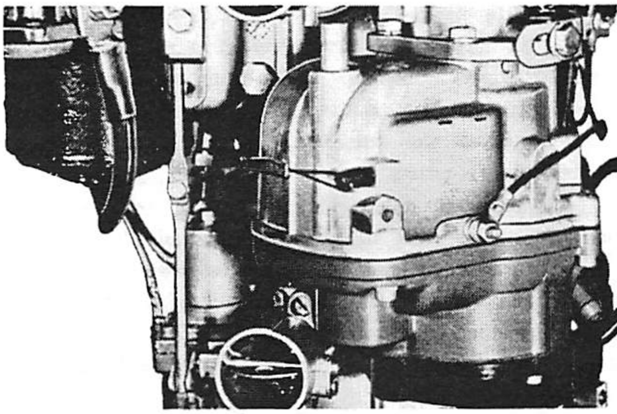


Figure 42. Four-Cylinder Kiekhaefer Magneto

ignition spark every 90 degrees of crankshaft rotation. These magnetos, each having a 4-pole rotor and 4-lobe cam, meet this requirement by producing 4 sparks per revolution of the rotor, which runs at crankshaft speed.

Mfgr. No.	Motor	Ball Bearings
XV4B70	KF9	Separable
XV4B70A	KF9, KG9	Separable
XV4B70B	KG9	Separable
XV4B70C	Mark 50-50E	Separable
Converted to		
XV4B70D	Mark 50-50E	Sealed
XV4B70E	Mark 55-55E	Sealed

Modern ignition systems are carefully designed to provide quick, easy starting and maximum dependability of operation with minimum adjustment or service. Field adjustments are rarely necessary and, although very simple, should be made only in accordance with the following instructions:

Improper functioning of magneto is often believed to be the cause of much engine trouble arising from other sources, such as a flooded carburetor, obstructed fuel lines, loose connections or fouled spark plug electrodes. Since a brief engine inspection will often locate the trouble before the magneto is reached, it prevents mal-adjustment of magneto parts in good condition.

It is suggested that the magneto be opened only when it is certain that the ignition spark produced is unsatisfactory. This condition may be determined by simple tests which are easily made in the field.

II. ESSENTIAL SHOP EQUIPMENT

Shop service for magnetos requires a combination of skilled personnel and suitable equipment. The recommended service tools are the Magneto Analyzer (91-25213) and a drill press for driving the magneto -- for low, medium and high speed running -- so that the ignition spark produced can be tested for a standard spark gap at all speeds.

III. CLEANING AND TESTING

The first step in servicing the magneto is to completely and thoroughly clean the exterior magneto frame. Use compressed air, a wire brush or solvent, if necessary, to remove any accumulated foreign matter. *Do not submerge unit in liquid.*

After exterior cleaning has been completed, magneto should be mounted on test block and rotor turned over slowly by hand. If there is a noticeable binding or rubbing action, no further rotative testing should be undertaken before dismantling, since such a condition indicates badly worn or rough bearings. The pull, due to the magnetic break which occurs during rotation, should not be confused with binding or rubbing action.

IV. TESTING IGNITION SPARK, GENERAL

Ignition spark can be tested in several ways, but it should be remembered that a spark produced within an engine cylinder, where a compressed fuel mixture is present, is not identical to a spark produced by the same equipment in the open air. With properly adjusted spark plugs in good condition, the ignition spark should be strong enough to bridge a short gap in addition to actual spark plug discharge. This test must be made while motor is operating, by holding end of high tension lead wire of each spark plug 3/16" away from its terminal.

If spark plug continues to fire in cylinder, strength of ignition spark can be assumed sufficient. Ignition tests made, while any part of system is wet, are useless. If no spark occurs, the shorting assembly should be examined to make certain it has not accidentally become shorted. If tests prove that shorting does not occur, the following service can be completed.

V. REMOVING MAJOR PARTS, GENERAL

Remove end cap from unit by removing the 2 screws in the cover. (See "Corrosion Caused by Oxidation", Page 26.) Remove magneto rotor and spring by pulling out. Remove end cap by removing 4 screws. To remove breaker points, remove contact support screw and contact support locking screw. Remove breaker terminal screw. Detach primary ground lead condenser wire and coil primary lead. Remove condenser by removing condenser mounting screw. Cam wick and holder also are now loose. Remove coil by loosening coil bridge set screws.

Pull coil out. (See "Leakage Paths", Page 26.)

To service or repair breaker points or other components, see PP. 25-26-27.

VI. PARTS

Use the chart, right, to determine which parts to order for the Fairbanks-Morse magneto being repaired.

	XV4B70"C" Reworked to "D"	XV4B70"D" New F-Morse Magneto
Ball Bearing Drive End	30-22978	30-24998
Ball Bearing Opposite Drive End	30-22979	30-24997
Bearing Support Plate	22980	397-918
Magneto Rotor and Shaft	397-381	397-906

Removing Magneto From Engine

I. MARK 58-58A-55-55A-35A-30

Remove screws from 2 hold-down clips on exhaust side of engine to release high tension leads from engine. Disconnect braided ground strap by detaching crankcase screw, leaving strap attached to magneto. Remove lockwasher and nut from primary ground screw which holds lead to magneto. *(Note: Models with mercury cut-off switch also have switch lead held by this screw.)* Disconnect screw, "D" washer and clip which holds ground wire to front of magneto. *(Note: On models with mercury switch, also remove screw, "D" washer and clip holding switch lead to back of magneto.)* Disconnect air vent lines. Remove magneto actuating bracket on Mark 55-30 Remove 4 cap screws which hold magneto to magneto adaptor and pull magneto downward about one inch to remove magneto from adaptor.

II. MARK 50

Remove top cowl. Remove screws from 2 hold-down clips on intake side of engine to release high tension leads from engine. Remove braided ground strap by detaching crankcase screw, leaving strap attached to magneto. Remove lockwasher and nut from primary ground screw which holds lead to magneto. Disconnect screw and clip which holds ground wire to front of magneto. Disconnect air vent lines. (See "Magneto Ventilation" for Mark 50 on Page 30.) Remove magneto actuating bracket. Remove screw and washer which hold magneto torsion spring to magneto. Disconnect timing driven pulley with End Cap Puller (91-25733A1) on top of magneto shaft by attaching tool to pulley with 2 small 12-24 thread middle screws. Insert center cap screw in pulley several threads so center screw of tool contacts it when turned down. (Figure 43) Apply pressure to center screw of tool to free pulley from shaft. After pulley is removed, take out magneto driving key and spacer to remove magneto and shaft assembly from housing. Tap shaft lightly with mallet if tight.

III. MARK 40, KF9 and KG9

Detach 3 screws and washers on starter assembly; remove flywheel nut and washer with Flywheel Puller (91-24695A1) and plug to protect crankshaft; and remove flywheel. Remove front cowl, held by 4 nuts and washers. Disconnect fuel lines from fuel pump and detach pump. Remove instrument panel bracket assembly, held by 3 nuts and washers. Detach screws and washers from timing case cover and remove cover (KF9 and KG9 magneto is gear driven and have grease in gear tray; Mark 40 is belt driven.) Remove spark plug cover assembly, held by 2 screws and washers, and intake cover assembly, held by 4 screws and washers. Disconnect high tension leads from spark plugs and remove spark plug protectors from high tension leads. (Pull 4 high tension leads through holes on side of KF9 and KG9 block.) Remove 7/16" cap screw on magneto which releases tension on return torsion spring. Disconnect lock wire on magneto actuating bracket and remove bracket. (On Mark 40, remove timing driven pulley with End Cap Puller 91-25733A1 on top of magneto shaft by attaching tool to pulley with 2 small 12-24 thread middle screws. Insert center cap screw in pulley several threads so center screw of tool contacts it when turned down, as shown in Figure 43. Apply pressure to center screw of tool to free pulley from shaft.) (KF9 and KG9 have crankshaft magneto and tachometer drive gear. To remove, use Timing Gear Puller 91-23662.) After pulley or gear is removed, take out magneto driving key and spacer and remove magneto and shaft assembly from housing. Tap shaft lightly with mallet if tight. *(Note: See "Magneto Ventilation" on Page 30.)*

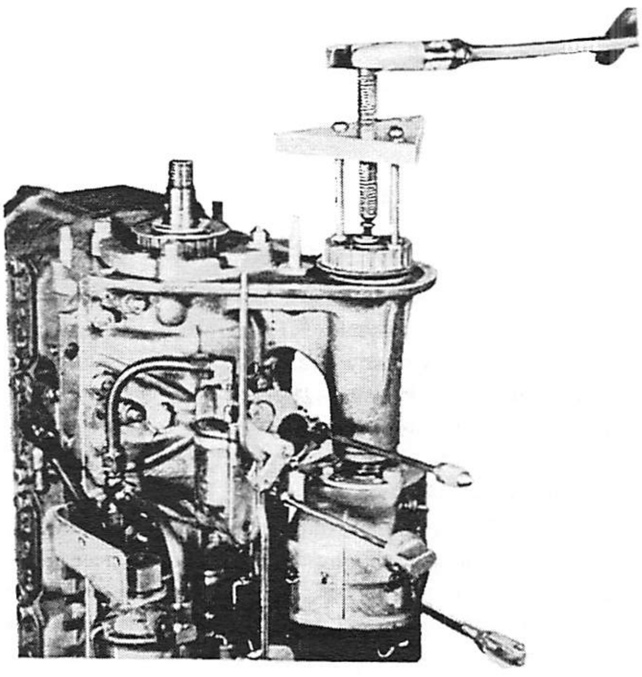


Figure 43. Removing Timing Pulley

Servicing Magneto Parts

END CAP COVER REMOVAL

If it is certain that 4-cylinder magneto is not operating properly, remove end cap, rotor and cover, being careful not to damage. Remove breaker assemblies by detaching breaker terminal screw which holds primary ground lead wire, condenser lead and primary coil lead. Remove condenser hold-down screw, condenser and cam wick assembly. Detach movable breaker assembly from pivot post by removing cotter pin and washer. Remove stationary breaker assembly by detaching 2 hold-down screws. Remove coil after disconnecting lock wire and 2 lock wire coil bridge set screws. Remove 4 screws and lock washers which hold bearing support plate to magneto frame. Press out magnetic rotor and shaft, and bearing support plate also will come out. Be careful not to damage magnetic rotor or support plate.

REMOVE AND CHECK BALL BEARINGS

1. To remove bearing support plate from rotating magnet, place in vise with vise jaw protectors, hold magnetic rotor and tap on shaft opposite of driven end.
   NOTE: On older 4-cylinder models, remove ball bearing outer races from frame and plate with special tool.
2. If bearings are worn, replace with new bearing assemblies. If not worn (non-sealed bearings), lubricate before reassembly with Cam Lubricant (C-92-36203).

   NOTE: On early Mark 50-50E engines (below Serial No. 795826), the XV4B70-D magneto (Part No. A-300-35) replaces the XV4B70-C magneto. New XV-4B70-D magneto has sealed ball bearings in place of the older type separable bearings. (Chart on Page 23.) This eliminates the use of oil seals, insulators and washers formerly required with older-style magnetos. The elimination of the seals allows cooler operation and longer magneto and bearing life. The new magneto also has a new coil (A-397-430), end cap (A-397-429) and carbon brush (A-394-1065A1). With the new magneto, there should be no trouble with starting when motor is warm.

   Caution: Wipe off -- do not wash -- sealed bearings!
3. Important to Service Personnel: Lubrication of newer model magnetos with sealed ball bearings is not necessary, as they are grease-packed when manufactured and require no further lubrication.
4. After cleaning bearings, they should be immersed in a clean, light oil and spun until solvent has been removed. Grease-lubricated bearings should then be repacked. Quantity of grease used should not exceed 1/3 to 1/2 of total capacity of bearing.

CHECK MAGNETO FRAME

Check magneto frame housing for dirt, rust or corrosion. Any rust should be cleaned out with No. 320 Carburundum Paper and wiped out clean. Check primary ground lead in frame to be sure wire is in good condition and that bushing insulation is not broken so that primary ground screw does not short to the frame. Check rotating magnet and shaft for rust or corrosion, cleaning thoroughly with No. 320 Carburundum Paper (not a wire brush) and wiped off. Check lobes of magnet for wear or damage.

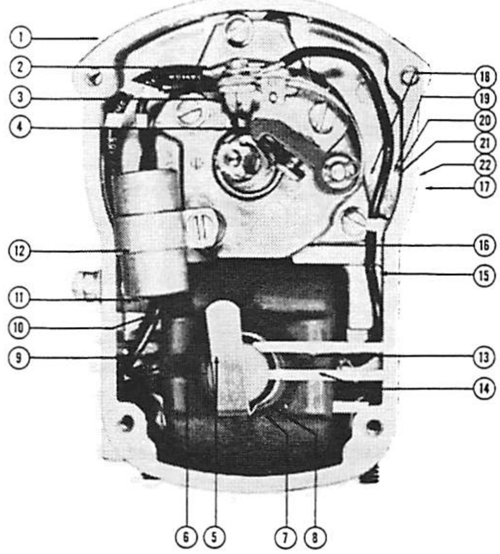


Figure 44. Four-Cylinder Magneto

1 Frame
2 Coil
3 Knob, high tension coil
4 Clip, high tension
5 Breaker Arm Assembly
6 Breaker Assembly Complete
7 Screw, 6-32 self-tapping
8 Washer
9 Screw, bracket support
10 Washer, breaker arm
11 Hair Pin
12 Screw and Lockwasher
13 Screw, fastening
14 Washer
15 Condenser
16 Screw and Lockwasher
17 Screw, primary ground
18 Insulator Ground Switch
19 Washer, grnd. screw insul.
20 Washer, ground screw
21 Lockwasher, lock screw
22 Nut, ground screw

CHECK OF OTHER MAGNETO PARTS

Check all other parts now disassembled for wear or damage. Test coil (see "Coil Test Data", Page 10), condenser, rotor, end caps, high tension leads and breaker assemblies. Make resistance test on high tension leads (refer to Magneto Analyzer Instruction Book). If lead requires replacement, refer to the following chart for removal:

Mark 50-40 and KG9	Unscrew
KF9 and Some KG9	Pull Out
All Other 4 Cyl. Models	Remove 4 Screws*

* *Special terminal screws inside magneto cap adjacent to contact posts.*

MAGNETIC ROTOR, 4-CYLINDER MAGNETOS

1. Occasionally a vertical crack appears in the magnetic rotor of the 4-cylinder magneto. The magnet steel in the rotor is a very hard, brittle material with a low tensile strength which will crack periodically despite all practical measures taken to prevent such a condition. This matter has been checked in the manufacturer's product engineering department, process engineering and with the magnet steel suppliers. This condition is controlled as closely as possible, with the realization that some cracking still will be encountered.
2. The cracks which appear in the magnet of this rotor all lie in a plane coinciding with the direction of magnet flux. This, therefore, eliminates the possibility of the cracks introducing additional air gaps across the flux path which would cut down the available flux at the ignition coil.
3. The above theory has been confirmed repeatly by actual tests which have shown, without question, that the cracks in no way affect the performance either magnetically or physically.

LEAKAGE PATHS

1. The high voltage surge of the secondary circuit occasionally establishes a path to ground by a different route than across the spark plug gap. Once such

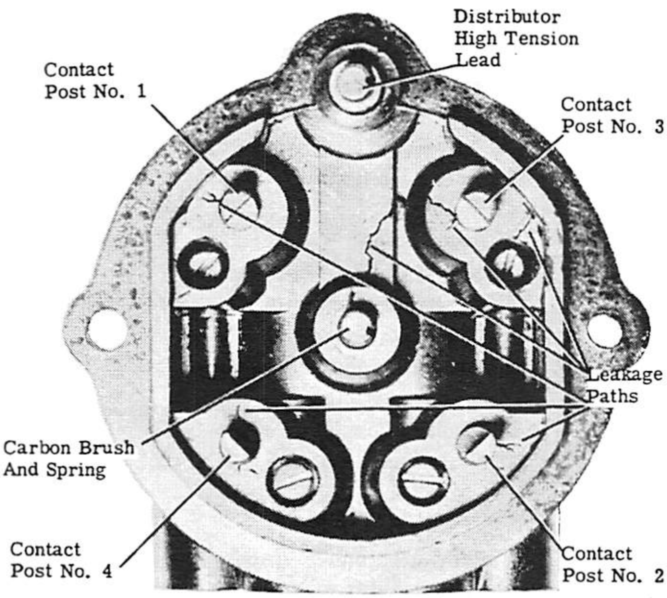


Figure 45. Magneto Cap Leakage Paths

a path is established, the ignition spark is likely to continue to spark across to ground.
2. Among the various causes of leakage paths are the following:
   a. Broken leads or poor lead connections.
   b. Spark plug point gap too wide.
   c. Moisture, dirt, carbon or corrosion within the magneto.
3. A surface leakage path can usually be located because of the burning effect the high voltage spark has on plastic or other insulating materials. (Figure 45)
4. The first step in servicing units having one or more leakage paths is to remedy the condition which causes the high voltage spark to stray from its established circuit. Actual repair of unit should be made very carefully, usually discarding any insulating parts which give evidence of high voltage flashover.
5. If leakage path is heavy -- or more than one path occurs (Figure 45) -- it is recommended that the part be discarded. When making leakage test, be sure high tension clips are removed from high tension leads to assure an accurate check.
6. A new 4-cylinder magneto rotor and end cap cover, which limit arcing and electrical leakage paths, are available as replacement parts. The rotors and end cap covers are manufactured from a new material which has high dielectric characteristics that make them exceedingly resistant to moisture. (Figure 45A)

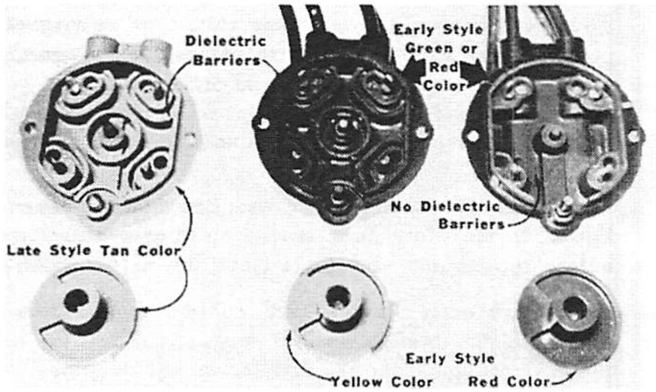


Figure 45A. Rotor and End Cap Identification

7. If there are 4-cylinder model motors in your area which are experiencing an arcing or leakage condition in the magneto end cap cover, we recommend that a new rotor and cap be installed. (Figure 45A)
8. Because of a 1/16" (1.588mm) difference in height, this new rotor can be used only with magneto end cap covers which have the built-in dielectric barriers. The new rotor may be identified by the tan color and the model number (A-394-1560) on the bottom.
9. On earlier (pre-1959) magneto end cap covers, which do not have the built-in dielectric barriers, the red magneto rotor (A-394-1560A1) must be used, unless both cap and rotor are changed to take advantage of the characteristics of the new cap and rotor.

CORROSION CAUSED BY OXIDATION

1. Continued high voltage arcing within a magneto housing results in oxidation, a likely cause of complete failure. Interior corrosion is readily apparent once the unit is opened, since it causes a green discoloration of copper and brass parts (the ozone formed by the high voltage arc reacts with copper to form an oxide). A brown deposit is usually also found throughout the unit, and there is sometimes some evidence of moisture condensation.
2. To eliminate oxidation, if the condition of unit is noticed in time, the cause must first be located. There are several common causes:

1. A spark gap across a loose connection in secondary (high voltage) circuit within the magneto.
2. Carbon paths within magneto.
3. Broken or sticking brush leads.

VIII. OVERHAUL OF OXIDIZED UNITS

In most cases, magnetos subjected to interior oxidation can be cleaned and put into satisfactory shape for re-use. The situation first must be very carefully analyzed so that the cause of the difficulty will not reoccur and continue the trouble.

First examine rubbing block for wear. Excessive wear often is indicated when contour of rubbing block matches that of cam. Replacement of assembly is necessary if breaker arm pivot is too tight or too loose in hole.

Breaker points then should be inspected for evidence of pitting or pyramiding. (Figure 46) The sets on the left hand sides in Figure 46 show only discoloration and some shallow pitting. These sets have been run 30 minutes and are in excellent condition. On the other hand, the sets of points on the right hand sides exhibit considerable build-up and deep crater formation. The running time on these were 460 hours and replacement was well justified.

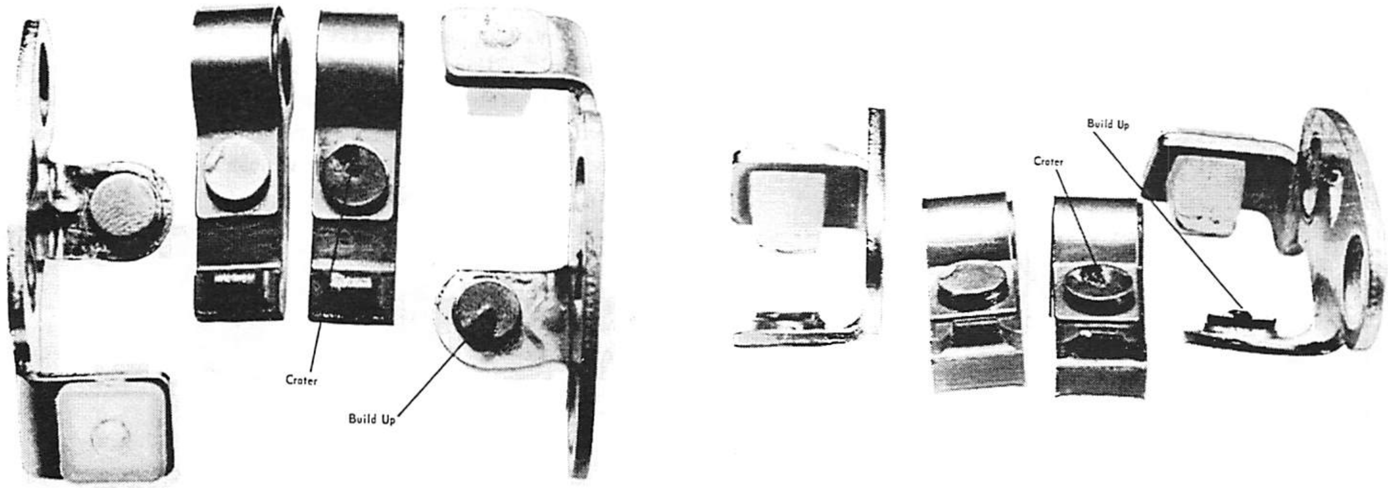


Figure 46. Good and Bad Breaker Points

Reassembly - 4-Cylinder Magnetos

I. INSTALLING ROTATING MAGNET

Press ball bearing drive end into magneto frame housing with care. Press ball bearing opposite drive end into bearing support. Bearing support should be tapped with a mallet or pressed into housing, being careful that it is lined up and will not damage plate. Install 4 screws and lock washers to support frame, tightening evenly. (Make sure that they are tight.) Turn rotating magnet assembly, checking that there is no binding on shaft. Place frame in vise (with jaw protectors) but do not overtighten.

II. INSTALLING BREAKER ASSEMBLY

If points are not replaced, they should be cleaned with carbon tetrachloride, using a small brush, such as an old toothbrush. If points are replaced, install new assembly. Install 2 hold-down screws and washers but do not tighten.

Before installing movable point on pivot post, clean post and apply a very light film of MULTIPURPOSE Lubricant (C-92-36226) on post. Oil and grease should be kept clear of breaker assembly. Then install washer and cotter pin (fulcrum pin). Install coil -- after thorough check -- in magneto housing, being sure that bridge set screws are in place and tightened. Insert lock wire into coil bridge set screws to secure. Install holder and cam wick assembly and condenser on top of holder and condenser hold-down screw through condenser and holder.

III. CAM WICK SETTING

Install a new cam wick, enclosed with each new breaker assembly, if a new breaker assembly is required. The cam wick holder must be set so that the wick has a 1/64" (1.6mm) clearance to the flat of the cam shaft (between lobes). Use .015" (.38mm) feeler gauge. Tighten hold-down screw. (Figure 47) If cam wick is set too tight against the flat of the cam shaft, it may result in loosened fibre wick particles and/or excessive grease throw-out from the wick. If set too lightly, the cam wick will not lubricate the cam shaft, and it will result in rapid wear of the cam follower portion of breaker assembly, thus allowing point gap to close. Any one of these could cause possible ignition failure and also will result in rapid breaker point burning and pitting. The cam wick is specially lubricated and requires no further lubrication. Any additional lubrication would be detrimental to breaker point life. A new cam wick should be installed every 100 hours of engine operation and each time a breaker assembly is installed. Breaker point gap is .008" (.203mm).

IV. SETTING AND ALIGNING POINTS

Place washer on terminal screw and insert screw in primary lead of coil. Place condenser lead on terminal screw, then ground lead on screw. Hold all 3 leads to-

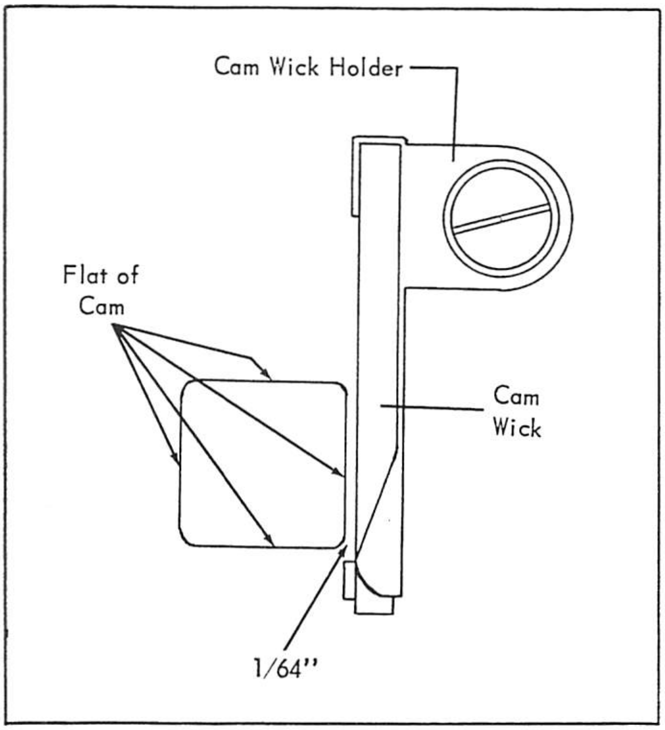


Figure 47. Cam Wick and Holder

gether and in line -- so that they will not short out on support plate -- and insert screw in movable and stationary points and tighten.

Ignition breaker points should be aligned accurately to provide the best contact surface for maximum contact area between point surfaces and to assure normal point life. (Figure 48) Any misalignment of breaker point surfaces will result in premature wear or pitting and may change the cam angle with the breaker point opening, although the actual distance of movement between the points is the same.

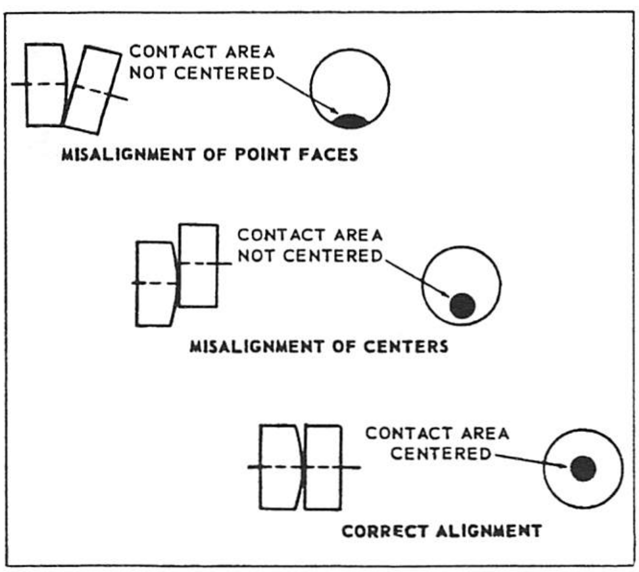


Figure 48. Point Alignment

Breaker points in magneto should be aligned correctly by bending or twisting the fixed contact point only. Correct alignment and misalignment are shown in Figure 48.

When new breaker points are installed in magneto, be sure to follow the above procedure and use breaker point alignment tool.

V. BREAKER POINT SPRING TENSION

Breaker point life can be maintained on all 4-cylinder engine magnetos (and 6-cylinder distributor) by adjusting the spring tension of the movable breaker point to a 33-to-37 ounce tension. If spring tension is in excess of 37 ounces, the breaker point cam follower (rubbing block) will wear rapidly and result in breaker points closing after 4-to-6 hours or less operation. If spring tension is below the recommended 33 ounces, the breaker arm will flutter at high speed and result in engine miss at high RPM.

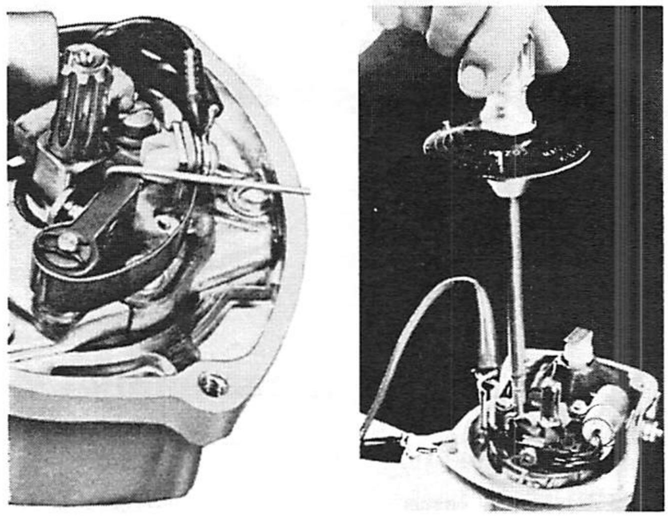


Figure 49. Gauging Spring Tension

IMPORTANT: Do not use pliers to bend point springs. Do not make a sharp bend! Bend with fingers.

NOTE: Remove and discard any backing plates from older breaker assemblies.

Breaker point spring tension is measured with a Breaker Spring Tension Scale (91-28993 or 91-29406). Attach small test lead of Continuity Meter (91-22966) or Magneto Analyzer (91-25213, Scale 3) to primary lead wire of magneto and second small lead to frame of magneto.

If checking spring tension with 91-28993 tool, place hook end in crook of fibre cam follower (Figure 49, left) and pull the tension scale at a right angle (90°) and horizontal to the movable arm (Figure 46) until the breaker point just begins to open, as indicated by a sudden movement of the Magneto Analyzer or Continuity Meter pointer hand. If tension gauge is located at any other position on cam follower, or not pulled at a right angle to the cam follower, the scale reading will be false.

When checking spring tension with Spring Tension Torque Tool (C-91-29406), as shown in Figure 49, place hook on end of tool over breaker assembly and turn toward breaker point spring. Read tension on scale of tool.

There are some breaker point tension scales presently on market which attach around the point contact face. Do not use this type scale, as tension will change completely since the point contact face is closer to the fulcrum point.

If spring tension is too great, bend breaker point spring inward to fibre cam follower. If spring tension is too low, bend breaker point spring outward (away) from cam follower. Do not use pliers to bend point springs and do not make a sharp bend! Bend with fingers.

SETTING BREAKER POINTS ON 4-CYL. MAGNETOS

Description

1. The 4-cyl. Magneto Breaker Point Dwell plate (C-91-31484A2) is designed to adjust breaker point gap more accurately than is possible with a feeler gauge.
2. Points must be closed for 48° of rotation to allow sufficient current buildup in coil. This is reason proper dwell is so important.

NOTE: A breaker point dwell setting of 48° is recommended for Mark 58 and later model 4-cylinder engines. Mark 55 and earlier model 4-cylinder engines use a 54° breaker point dwell setting. For optimum performance these recommendations must be followed.

Prelimary Instructions

1. Prior to synchronization, clean face of points with piece of paper to remove oil and dirt film.
2. Check breaker point resistance with Magneto Analyzer (C-91-25213, scale No. 2) to be sure that points are in good condition. If they do not conform to tests, replace with new points.
3. Check point contact faces for proper alignment.

   NOTE: Breaker points will pit slightly after a few minutes of running. This does not mean that points are bad. They should be checked with the Analyzer to determine if they are bad before replacing.
4. Check breaker point spring tension (33-to-37 oz. in.) with Breaker Point Spring Torque Scale (C-91-29406).

Installation

1. With Magneto Dwell Plate face up, set magneto housing drive end collar into center opening of Dwell Plate with air intake nozzle extended into slot on side of Dwell Plate.
2. Install the 2 flat-headed ¼-20 screws from underneath thru slots of dwell plate into magneto mounting screw holes. Do not tighten, as travel must be allowed for the mounting slots in Degree Plate.

   NOTE: Set screw in base of indicator arm must be aligned with blank spline of drive coupling.
3. Install base of indicator arm on large splined drive coupling of magneto.
4. Tighten set screw in base of indicator arm.
5. Clamp large square end of indicator arm in vise (with vise jaw protectors) to allow use of both hands for adjusting. Do not over-tighten.

Dwell Adjustment

1. Set breaker point gap to .008" (0.203mm) for an approximate setting of 48° dwell.

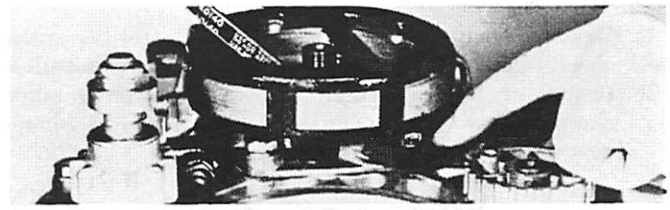


Figure 50. Magneto Timing Belt, 4-Cyl. Models

2. With Magneto Analyzer Selector switch on scale No. 2 (Resistance) or employing Continuity Meter (C-91-22966), attach one small lead to housing of magneto (ground) and 2nd small lead to primary ground screw.
3. With breaker points open, rotate magneto slowly in a clockwise direction until meter hand moves, indicating points closed.
4. Holding magneto housing in this position, rotate dwell plate in either direction so that "points close" mark is in line with indicator arm.
5. Holding dwell plate and magneto housing together rotate assembly in clockwise direction, observing meter hand movement indicating "points close" which must fall on 0° and remain closed until pointer indicates 48° "points open" position.
6. If rotation is less than 48° breaker points open too soon, and point gap must be closed slightly. If rotation is more than 48° breaker points open to late, and gap must be increased slightly.
7. After each point gap adjustment, repeat Paragraphs 3,4 and 5.

   NOTE: If a dwell plate is not available, set breaker point gap at .008" +.000" −.002" (0.203mm +.000 - 0.051mm) when cam follower fibre arm is on highest part of cam lobe.

INSTALLING MAGNETO END CAP

1. Place 4 cover screws through new gasket and cover. Start screws but do not tighten.
2. Insert Magneto Cap Aligning Tool C-91-26351 for Kiekhaefer magneto.
3. Install gasket and magneto end cap over cover with 2 screws and tighten screws.
4. Tighten 4 screws on cover, thus properly aligning magneto cap and end cap to magneto frame to obtain an equal air gap between contact post of magneto cap and magneto rotor contact point, thereby resulting in better and equal spark at magneto cap.
5. Remove 2 screws from magneto end cap, end cap and aligning tool.
6. Install rotor, being sure that it lines up with spline (with flat spot on shaft on Fairbanks-Morse).
7. Reinstall gasket, end cap and 2 screws -- with ground strap on one end cap screw -- and tighten.

   NOTE: Ground strap on 4-cyl. models is made of braided wire -- similar to U.S. Government standards -- as an added safety precaution. This will eliminate static spark.
8. Other end of ground strap is attached in crankcase screw after magneto is test run on drill press and, if satisfactory, installed on engine.
9. To test run, place in drill press and run at low, medium and high speeds so that ignition spark produced can be tested on a standard spark gap at each speed for a short length of time. If no misfire, and magneto operates satisfactorily, it is ready to be installed on engine.

MAGNETO TIMING BELT CARE

1. Magneto timing belt (Figure 50) should be given careful consideration when being removed or installed.
2. Do not pry timing belt off with screwdriver or other sharp-pointed tool, as this may cut the edge of the belt and eventually cause failure.
3. Care should be exercised that timing belt is not bent, folded, pinched or flattened out, as this will break or weaken strands of wire molded inside belt and greatly reduce belt's operational hours.
4. Keep in full shape, as shown in Figure 50, or in box which allows large bend.

REPLACING MAGNETO - 4-Cylinder Engines

INSTALLATION ON ENGINE

1. Completely assemble magneto, including magneto cap, with lead wires.
2. Magneto rotor shaft and shaft extension are splined with one spline blanked on each shaft for easy replacement of magneto after repair. Rotate timing pulley until shaft sets in place.
3. Replace 4 cap screws and secure magneto to adaptor.

Replacement on Mark 50-40, KF9, KG9

(See Coil Replacement, Magneto Ventilation and Reconditioned "C", following.)

1. Place tip of magneto return torsion spring in bottom of crankcase magneto drive housing in small hole. Lubricate magneto drive shaft housing with sufficient quantity of Kiekhaefer Quicksilver Special Gear Lubricant (C-92-29415). Be careful not to get any grease in the timing case, as this unit is run "dry".
2. Reinstall magneto by inserting rotor shaft up into housing, See that torsion return spring is in proper place. Replace spacer in upper end of magneto drive shaft housing by pressing down into seal. Place drive key in rotor shaft keyway.
3. Replace timing driven pulley on end of shaft as marked with stamped note, "This Side Down". Tap lightly to seat. Replace carburetor actuating magneto bracket and magneto actuating bracket with 4 cap screws.
4. Secure end of tension return spring around cap screw in magneto so enough tension is on spring to return magneto to idle position after accelerated to the left. If tension is not great enough, move end of spring to next screw hole provided in magneto, providing spring has been wound sufficiently the first time.

Coil Replacement

Superior performance of the high output magneto coil (A-397-430) on the Mark 50 warrants its recommendation as a replacement coil in magnetos on all Mark 40, KF9 and KG9 motors. A coil replacement kit (A-324-899), complete with installation instructions, therefore, is stocked for these 3 motors.

Magneto Ventilation

To retard condensation in enclosed magnetos of the type employed on 4-cylinder motors, ample ventilation is recommended. Ventilation has been provided in Mark 50 magnetos and subsequent 4-cylinder models manufactured after 1954. Ventilation of Mark 40, KF9 and KG9 magnetos can be done at the time of coil replacement from instructions contained in the coil replacement kit (A-324-899).

Caution: At the time the new coil is installed, the ground safety strap should be installed to ground the magneto end to the motor as a safety precaution.

Reconditioned "C" Series Magnetos

1. The factory has reworked the A-300-35 (XV4B70 "C") series magnetos to a "D" series which includes installation of sealed ball bearings. Identification of these magnetos can be made by the letter on the magneto frame after the manufacturer's number, XV4B70"C" or "D". The reworked magnetos had the letter "D" stamped over the "C".
2. The reworked "C" series magnetos require use of a larger inside diameter sealed ball bearing for the magneto rotor and shaft and a remachined bearing support plate.

REPLACING FLYWHEEL

1. To replace flywheel, if removed, insert flywheel key into keyway in crankshaft. Tap to seat. Timing belt driven pulley is pressed onto flywheel and need not be removed unless necessary for replacement due to breakage or wear. If removed, place locating dowel in recess and locate keyway of pulley over dowel. Press on with arbor press.
2. Place timing belt on driving pulley on flywheel and place flywheel on crankshaft over key.

   NOTE: On Mark 40 motors, reinstall pulley drive key, drive pulley flange plate and pulley on end of crankshaft so that keyway lines up in direct line with key in crankshaft and as marked "This Side Up". Seat pulley securely by tapping with mallet on any tool that will fit over shaft and on pulley. Make sure drive pulley flange plate is seated properly.

FIELD LUBRICATION

Magnetos are lubricated independent of engine and, as a result, often have been neglected in the field. This condition has led to the development of permanently lubricated designs in which sufficient lubricant for the life of the unit is placed in bearings during original assembly at the factory. Lubricants used in such cases usually are special greases of a consistancy suitable for operation through a wide temperature range. Special care should be exercised not to over-lubricate the unit The cam felt wick, if dry or hard, should be replaced by a new factory-impregnated wick. Other than this, 4-cylinder magnetos do not require regular field lubrication. Lubricants should be renewed only during a complete overhaul of magneto.

ADVANCING SPARK

1. Advancing spark beyond recommended degrees will cause pre-ignition, and RPM will decrease noticeably after running several minutes. Continued operation under this condition may cause pistons to score.
2. To advance spark when using a remote throttle control, adjustments can be made by adjusting set screws on magneto control lever. Back screw out to allow further spark advance. When optimum spark is reached, tighten jam nut securely. Adjust second set screw for desired idle.

TIMING, SYNCHRONIZING - 4-CYL. ENGINES

TIMING MAGNETO TO ENGINE

If magneto has been removed from motor, it must be accurately retimed to the motor upon reassembly. Proper timing of magneto to the engine produces an ignition spark in each cylinder at the exact instant that fuel mixture should be ignited for best engine performance. This instant, which is accurately determined by the engine designers, is usually designated as a given number of degrees of angular travel of crankshaft before piston reaches its uppermost position in cylinder.

NOTE: See following pages for Timing and Synchronization of late 4-cylinder models.

Mark 40

Line up arrow markings on pulleys facing each other. (Figure 51) Use scale to align, then slip timing belt over the 2 pulleys. Install on drive pulley on crankshaft first. This will time the motor and magneto.

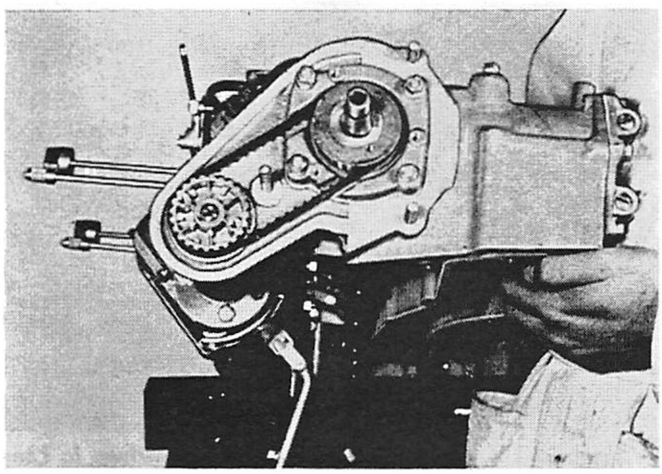


Figure 51. Aligning Timing Belt Pulleys, Mark 40

Setting Maximum Spark Advance

1. Thread Timing Gauge (C-91-26916A1) into No. 1 spark plug hole.
2. Turn flywheel until No. 1 piston strikes Timing Gauge.
3. While turning flywheel, thread Timing Gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center (TDC) position.
4. Rotate flywheel clockwise ¼ turn.
5. Depress center shaft of Timing Gauge.
6. Rotate gauge shaft ¼ turn to seat on tool body shoulder (.235" [5.969mm] BTDC position). Be careful that tool body does not move, or preceding procedure will have to be repeated.
7. Rotate flywheel clockwise by hand until No. 1 piston strikes Timing Gauge center shaft. This is .235" (5.969mm) BTDC.
8. Attach one test lead of Timing Meter (C-91-22966) or Magneto Analyzer (C-91-25213) (on No. 2, Resistance) to magneto frame.
9. Attach second lead of tester to primary ground terminal of magneto.

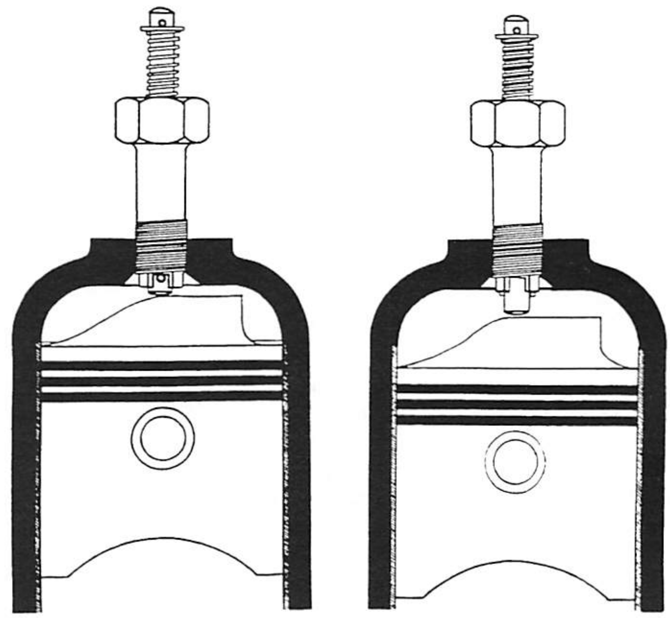


Figure 52. Piston At .235" (5.969mm) BTDC

10. With magneto stop bracket loose, slowly advance magneto until points break, as indicated by tester used.
11. Hold magneto at this position.
12. Adjust and lock magneto stop bracket.
13. Recheck setting by actuating magneto with throttle control lever.
14. Replace plate over belt on driven pulley at end of magneto shaft. Fastern with 5/16" (7.938mm) cap screw, washer and lockwasher.
15. Install tension spacer and washer on end of crankshaft and flywheel key in slot. Tap to seat.
16. Replace timing pulley cover and secure with three 7/16" (11.112mm) nuts and washers.

KF9 and KG 9

1. When timing gear setting on KF9 and KG9, it should be noted that crankshaft drive gear and magneto driven gear have a timing mark etched to the top side. (Refer to (Figure 53)
2. Align timing marks by placing No. 1 piston on top dead center (TDC). Drive gear on crankshaft is then in correct position. Position magneto gear so timing mark is in a straight line with drive gear timing mark. Place scale at edge of mark. This should be in line with centerline of idle gear ball bearing.
3. Place idler gear in position. One full tooth of crankshaft gear and magneto gear engage into idler gear tooth root. Recheck alignment, as idler gear may have moved it off one tooth either way. Lay scale over centerline of idler gear cam shaft.

NOTE: KF9's up to Serial No. 377322 use straight cut spur gears. KF9's above 377321 employ helical cut gears. All KG9's have helical gears.

Synchronizing Magneto To Carburetor

NOTE: Refer to "Timing, Adjusting and Testing" of various Models, Following.

1. To synchronize magneto to carburetors, set No. 1 piston at top dead center. Advance magneto so magneto is in firing position for No. 1 piston (points beginning to break); then set magneto bracket so bracket pin just contacts throttle cam. This should be approximately 1,100 RPM, if checked in test tank.

NOTE: On KF9 and KG9, adjust linkage beneath handle bracket assembly by loosening stud nut and adjusting ball joint stud.

2. KF9 and KG9 models have timing gears. (Figure 53) Set KF9 motor timing at .210" (5.334mm) (32½°) BTDC.

CAUTION: Do not advance KF9 models more than .210" (5.334mm) BTDC.

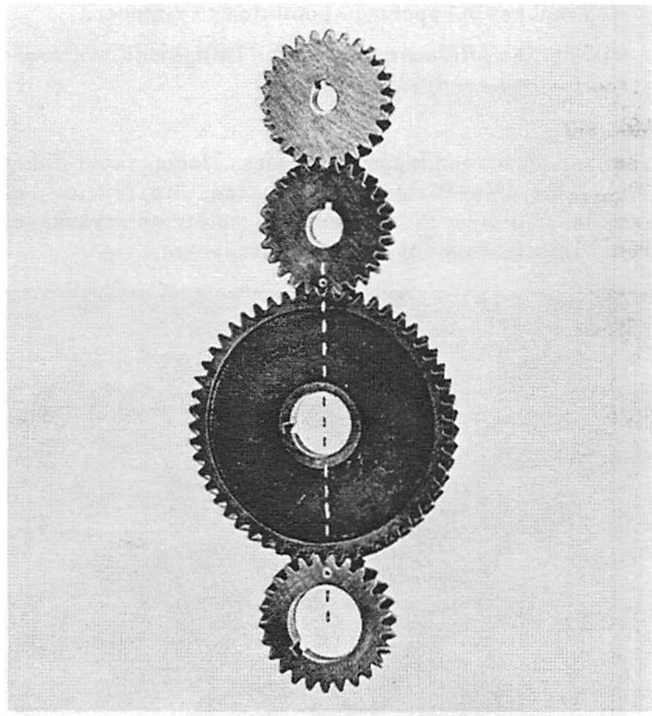
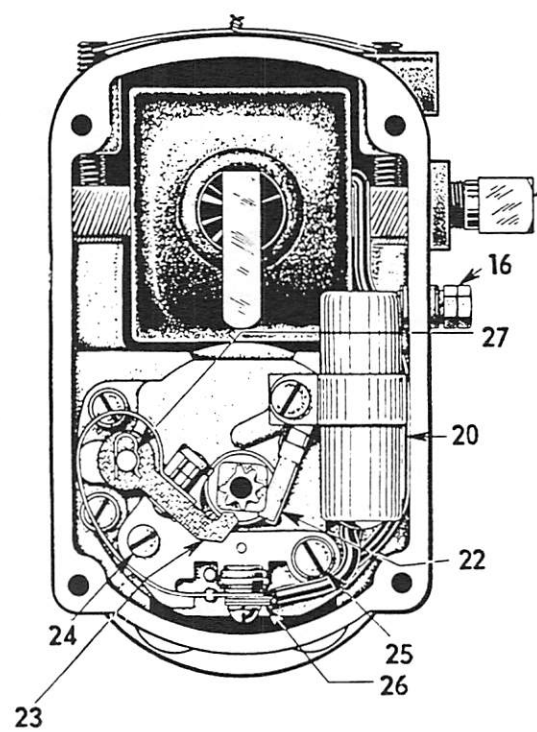
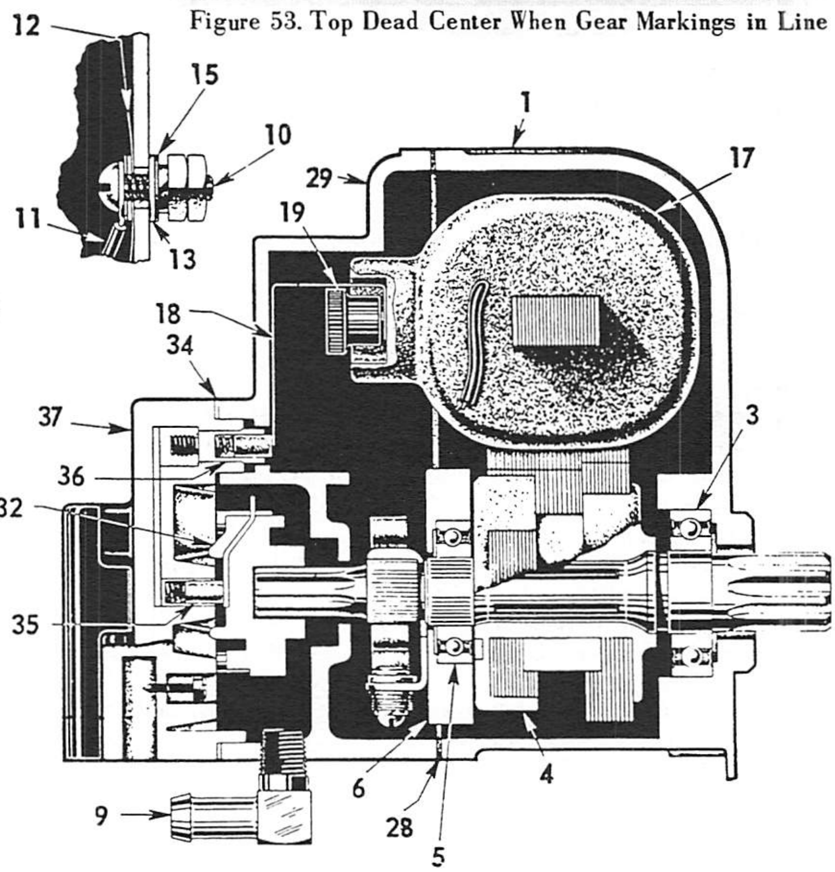


Figure 53. Top Dead Center When Gear Markings in Line

Figure 55. Magneto for 4-Cylinder Models

1 Frame
3 Bearing, ball—rotor (drive end)
4 Magnetic rotor & shaft
5 Bearing, ball—rotor (opp. drive end)
6 Support, bearing plate
9 Elbow, magneto vent line
10 Screw, primary ground
11 Wire, primary ground
12 Insulator, primary ground terminal
13 Washer, insulating—ground terminal
15 Lockwasher, primary ground screw
16 Nut, primary ground terminal
17 Coil, ignition
18 Clip, coil
19 Nut, coil clip
20 Condenser
22 Cam wick & holder
23 Breaker arm assembly
24 Screw, contact support locking
25 Screw, contact support
26 Screw, breaker terminal
27 Pin, fulcrum (snap ring)
28 Gasket, end cap
29 End cap
32 Rotor, distributor
34 Gasket, end cap cover
35 Brush & spring, coil lead
36 Lead, high tension (distributor)
37 Cover, end cap





IGNITION DISTRIBUTOR REPAIR -- 6-CYL. ENGINES

Disassembly

(Includes Ignition, Coils and Resistors)

A. REMOVING DISTRIBUTOR ASSEMBLY FROM ENGINE

1. Unscrew 4 hex head cap screws which secure distributor assembly to distributor adaptor.
2. Remove ground strap from distributor frame and spark plug leads from spark plugs and loosen screws which hold high tension lead to exhaust plate.
3. Pull air vent tubes from nylon elbows and pull secondary leads out of coils.
4. Disconnect primary leads from terminal block or, on earlier models, from resistors or from coil primary lead, thus freeing all distributor lead wires.
5. Remove distributor assembly (Figure 1) from engine.

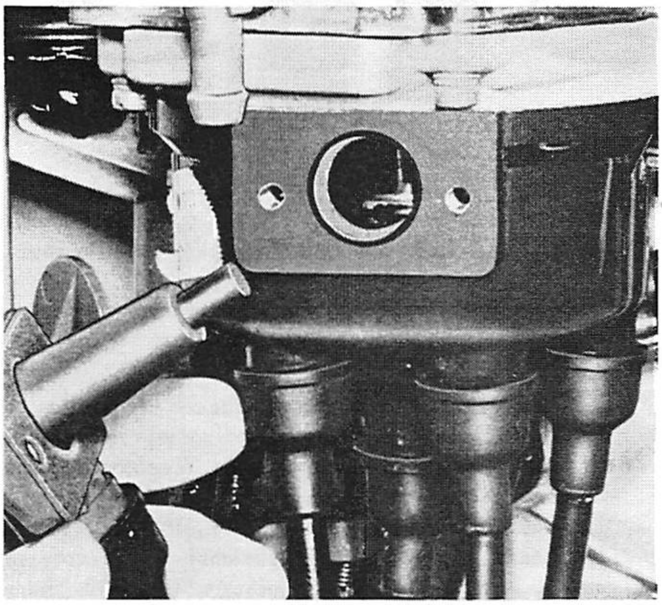


Figure 1. Removing Side Inlet

B. DISASSEMBLING DISTRIBUTOR ASSEMBLY

1. Remove 2 screws which secure side inlet assembly to distributor cap and pull off side inlet assembly. (Figure 1)

   IMPORTANT: Side inlet cap must be removed before distributor cap is removed, as carbon brush on side inlet extends in side of distributor rotor and can be broken off.

2. Remove secondary lead wires, which are threaded into distributor housing and side inlet, by pulling neoprene caps down and unscrewing leads.
3. Detach distributor cap and gasket from distributor cap-to-housing fibre glass adaptor by removing 2 screws which secure it.
4. Pull distributor rotor off distributor shaft. (Figure 2) If rotor is secured tightly on shaft with Loc-Tite, remove with Rotor Pulling Pliers (91-32477A1).
5. Remove 4 screws which secure housing adaptor to distributor frame.
6. Separate housing adaptor from distributor frame and all working parts are accessible for checking or removal. (Figure 3)

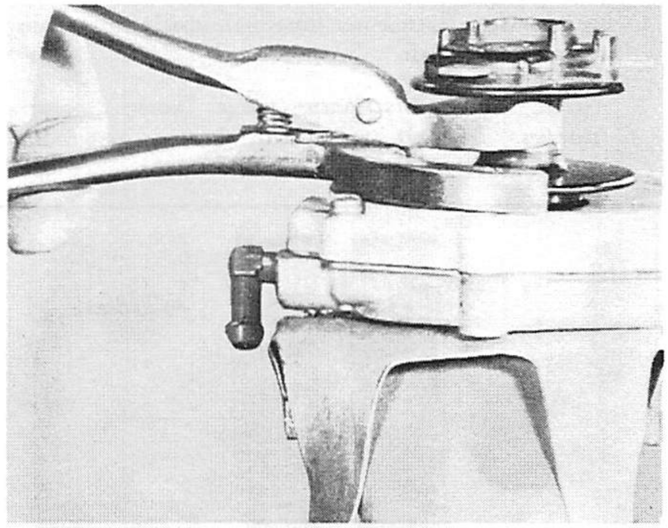


Figure 2. Removing Rotor

C. CONDENSERS AND BREAKER ASSEMBLIES

1. Remove screw (or nut on new breaker assemblies) which secures leads to breaker assemblies.

   NOTE: One condenser has cam wick and holder bracket which also holds one primary lead wire in place. (Figure 3)

2. Remove hold-down screw which secures condenser and cam wick holders to frame.
3. Remove cotter pins and fibre washers from pivot pins. (Figure 3)
4. Remove mounting screws which hold breaker assemblies to frame.
5. Lift breaker assemblies off pivot pins.

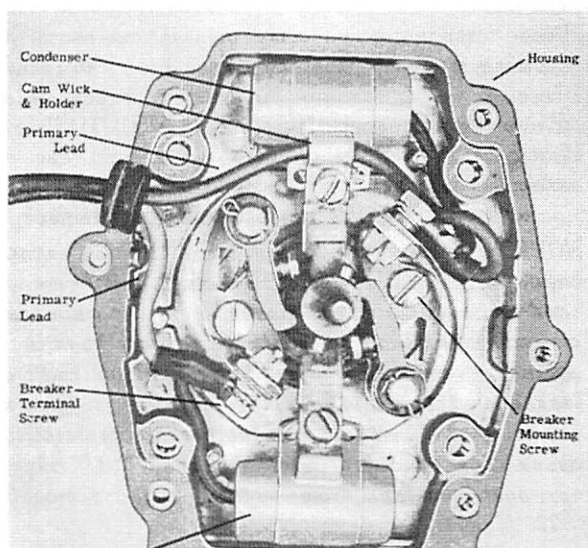


Figure 3. Distributor Open for Checking

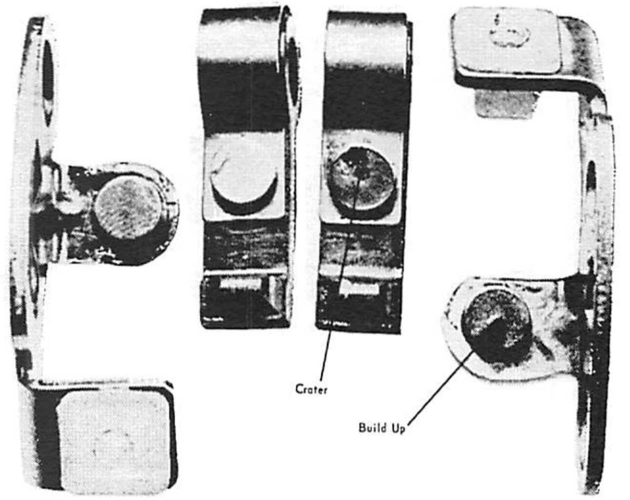
D. DISTRIBUTOR ROTOR SHAFT AND FRAME

1. After removing breaker points and condensers, tap distributor cam shaft assembly and 2 sealed ball bearings from distributor frame with mallet by tapping against rotor shaft.

   NOTE: Later distributor frames have 2 wave washers between upper ball bearing and ball bearing seat in frame. Early distributors did not have these wave washers. See note under Para. A in "Reassembly", following.

2. Because distributor rotor drive pin is a tight fit in rotor shaft, be sure to support cam shaft assembly when driving pin out, for replacement of ball bearings, to prevent bending rotor shaft.
3. Remove ball bearings from rotor shaft by tapping or pressing off, if necessary to remove.

E. SERVICING *(Refer to PP 23-thru-28, Section IV.)*



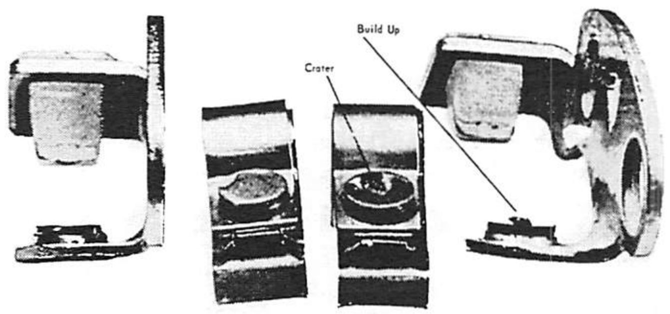


Figure 4. Good (Left) and Bad (Right) Breaker Points

Reassembly

A. ROTOR SHAFT AND FRAME

1. Inspect cam shaft and ball bearings for wear or damage and replace if defective.
2. Press sealed ball bearings onto shaft, applying pressure against inner ball race to prevent damage to ball bearing. One bearing is pressed on from each end of cam shaft, as they seat against shoulder of cam shaft.
3. Press distributor cam drive pin in cam shaft hole, centering it evenly. Replace if damaged when removed.
4. Place 2 wave washers in bearing recess of distributor frame, apply light film of MULTIPURPOSE Lubricant (92-30239) in bore and insert cam shaft assembly. Bearings slip freely into housing.
5. Thread plastic vent elbow into frame, if removed.

   NOTE: On early Mark 75 engines, "O" ring expander between the 2 ball bearings on cam shaft frame were used on new distributor assemblies. Two wave washers now are incorporated between ball bearing and against frame. This places a preload on ball bearings and prevents excessive side play in cam shaft assembly. This cannot be incorporated in distributor assemblies which formerly had used "O" ring and expander, unless frame bearing seat is machined .020" deeper.

B. INSTALLING POINTS

1. Although replacement 6-cylinder distributor breaker assemblies are one-piece units, pre-tensioned and pre-aligned, they should be rechecked.
2. Check breaker points for evidence of pitting or pyramiding, as shown in sets of points on right in Figure 4. Sets on left show only discoloration and are in excellent condition.
3. Lubricate both pivot pins with MULTIPURPOSE Lubricant. Place breaker assembly on pivot pin, making sure that stationary point is flush with frame of housing. To be sure that breaker assembly is flush with frame, depress cam shaft. Place hold-down screw into position but do not tighten. Place fibre washer on pivot pin and install cotter pin in pivot pin. Replace other breaker assembly in same fashion.

   NOTE: Do not use backing plate on breaker assemblies.

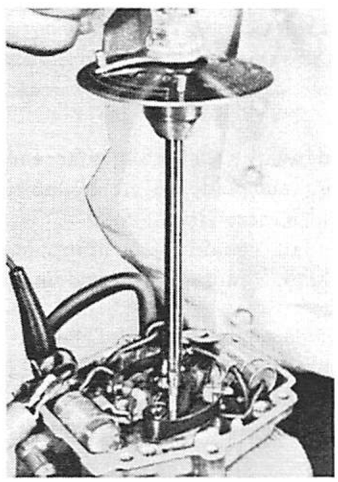


Figure 5. Gauging Spring Tension

4. Set breaker assemblies with Feeler Gauge to approx. .006".
5. Check spring tension setting with Spring Tension Gauge (91-29406). Place end of tool over breaker assembly and turn toward breaker point spring to 33-37 oz. tension. (Figure 5)
6. With Magneto Analyzer (91-25213) selector switch set on Scale No. 2 (low ohm re-

sistance), clip small red and black lead together.
7. Turn meter adjustment knob for Scale No. 2 until meter pointer lines up with set position on left side of "OK" block on Scale No. 2. Unclip small red and black leads.
8. Connect small red test lead to one end of primary lead and connect small black test lead to other end of primary lead.
9. Meter pointer hand must move into the "OK" block, or primary lead is defective and must be replaced. Refer to "Resistance Check", this section.

   NOTE: Repeat above procedure for opposite primary lead.

10. Refer to "Condenser Test Data", this section.
11. Place primary leads and condenser leads on primary terminals of breaker assemblies and tighten with nut.
12. Place condensers into position in frames.
13. Place cam and cam wick holders and one primary lead into position and tighten down holders and condensers with screw. New cam wick should be installed every 100 hours of engine operation and each time a breaker assembly is installed. Cam wick is specially lubricated and requires no further lubrication. Any additional lubrication would be detrimental to breaker point life.

    NOTE: New breaker assembly contains new cam wick for installation.

14. Set cam wick holder so that wick has 1/64" (0.397mm) clearance to flat of cam shaft (between lobes). (Figure 6) Use .015" (0.381mm) feeler gauge.
15. Tighten hold-down screw. If cam wick is set too tight against flat of cam shaft, it may result in loosened fibre wick particles and/or excessive grease throwout from wick. If set too lightly, cam wick will result in rapid wear of cam follower portion of breaker assembly, thus allowing point gap to close. Any one of these could cause possible ignition failure and also will result in rapid cam wear or breaker point burning and pitting.

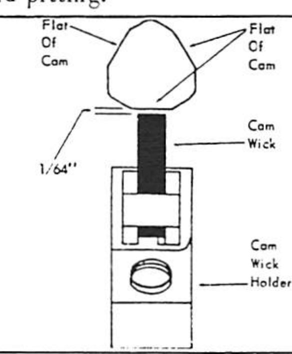


Figure 6. Cam Wick and Holder

SETTING AND ADJUSTING BREAKER POINTS

1. Check breaker point alignment. Breaker assemblies are prealigned at the factory; however, if points are not properly aligned, as shown in Figure 7, bend or twist FIXED CONTACT POINT ONLY with Breaker Point Alignment Tool (C-91-28883).

   NOTE: Correct alignment will provide best contact surface for maximum contact area between point surfaces and to assure normal point life. Misalignment of breaker point surfaces will result in premature wear, pitting and may change cam angle with breaker point opening, although actual distance of movement between points is the same.

2. It is essential that both distributor breaker point gaps are of equal opening, or it will result in erratic engine operation, as 3 cylinders being fired by one set of points will be out-of-time (out-of-synchronization) with second set. (Use Degree Plate, "6-Cyl. Distributor Breaker Point Setting & Synchronizing", this section) If available, use of an automotive-type distributor synchroscope (or syncrograph) will allow breakers to be equally adjusted and synchronized. The dwell is 90°.
3. When adjusting with synchrograph, breakers are set at 45° cam angle Breaker points fire at 120° intervals, but second breaker point fires at 60° intervals from the first. One fires 0°-120°-240°; the second fires 60°-180°-300°.

REASSEMBLING DISTRIBUTOR

1. Replace fibre glass adaptor and place new gasket on frame, securing with 4 screws and lockwashers. Adaptor has recess to fit over rubber grommet on primary lead wire.
2. Test distributor rotor for possible leakage or cracks. Replace if defective.
3. Place new "O" ring in cam shaft recess. *(Place nylon sleeve on end of rotor shaft on later models.)*
4. Apply 4 drops of Loc-Tite "A" (C-92-32609) in rotor shaft bore and install rotor on shaft.
5. Press on rotor until it is seated on drive pin. Note that pin is located off center and rotor will fit only one way.

6-CYLINDER DISTRIBUTOR COMPONENTS

Although there have been several design changes on the distributor cap, adaptor and primary housing for 6-cylinder models, any combination of parts is satisfactory. Figures 6A, 6B and 6C illustrate the various combinations.

CAUTION: When matching the late style distributor cap with the early style adaptor, secure the distributor cap with 2 screws only, or the cap may break.

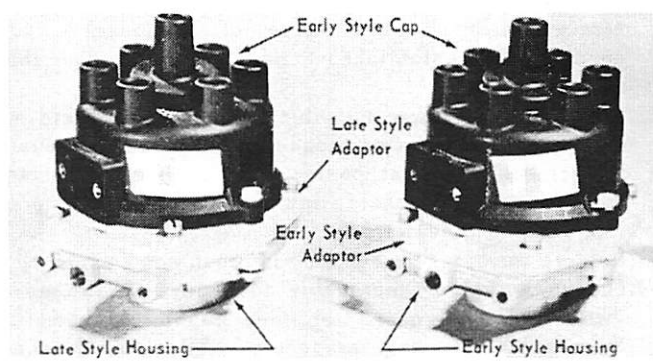


Figure 6A

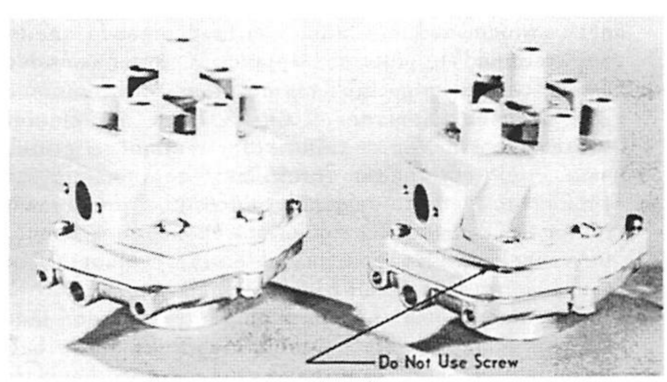


Figure 6B

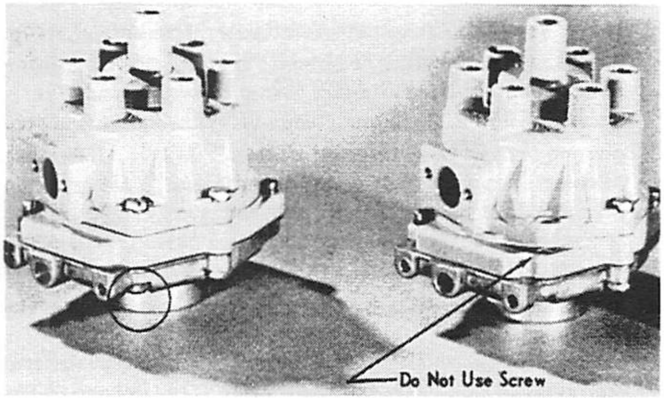


Figure 6C

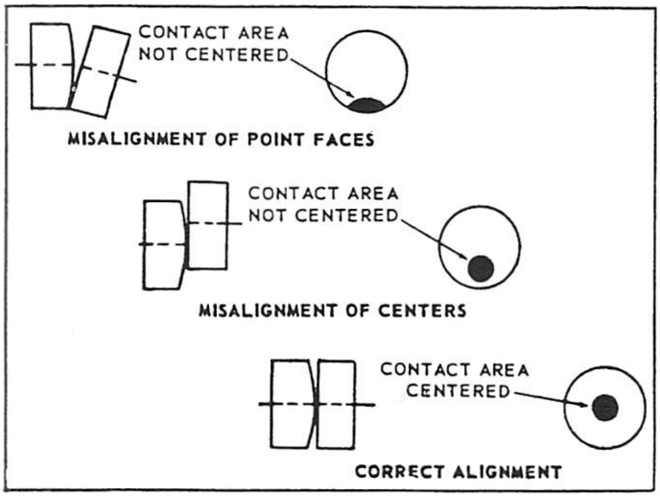


Figure 7. Point Alignment

DISTRIBUTOR CAP AND LEAKAGE PATHS

1. Inspect distributor cap closely for carbon paths or cracks. High voltage surge of secondary circuit occasionally establishes a path to ground other than normal spark gap.
2. Corrosion, moisture and dirt formations on inside of distributor cap can be cleaned and cap can be reused by cleaning contact posts with fine steel wool and then thoroughly washing inside of cap with any good liquid household detergent.
3. Before washing, remove carbon brush and spring.
4. Clean and rinse thoroughly to remove all traces of water and detergent. Cap then can be checked out thoroughly via test procedure outlined in Magneto Analyzer operator's manual.
5. Be sure that carbon brush is not worn and spring is not corroded and that brush can be depressed easily and returned to position. Replace if worn or corroded.
6. Check 6 spark plug high tension leads for resistance with Magneto Analyzer (C-91-25213). Turn selector switch to Scale No. 2 (distributor resistance), attach small red test lead to distributor cap terminal and small black lead to spark plug protector. Needle must return to OK band. If it does not, connections should be rechecked. If a part is defective, replace. This test also includes 2 coil high tension leads.
   a. If replacing one of 6 spark plug high tension leads (3 long and 3 short), thread lead into distributor housing. Be sure of correct sequence so that wires will be long enough. (Figure 8)
   b. Hi-tension lead for coil No. 1 threads into center terminal of distributor housing and hi-tension lead coil No. 2 to side inlet assembly. (Figure 8)
7. Set new gasket on distributor housing and place distributor housing on frame and adaptor. Note that notch in housing and adaptor must match for correct alignment. Fasten with 2 screws and tab washers. Tighten screws down equally to prevent cap from cracking.
8. Check side inlet for cracks or leakage and replace if defective.
9. Check carbon brush and spring of inlet for wear and corrosion and be sure that brush and spring can be depressed easily and will return to position.
10. Set new gasket on inlet and place inlet into distributor cap, making sure that brush is in position on rotor.
11. Secure inlet to distributor housing with 2 screws and tighten equally to prevent inlet from cracking.

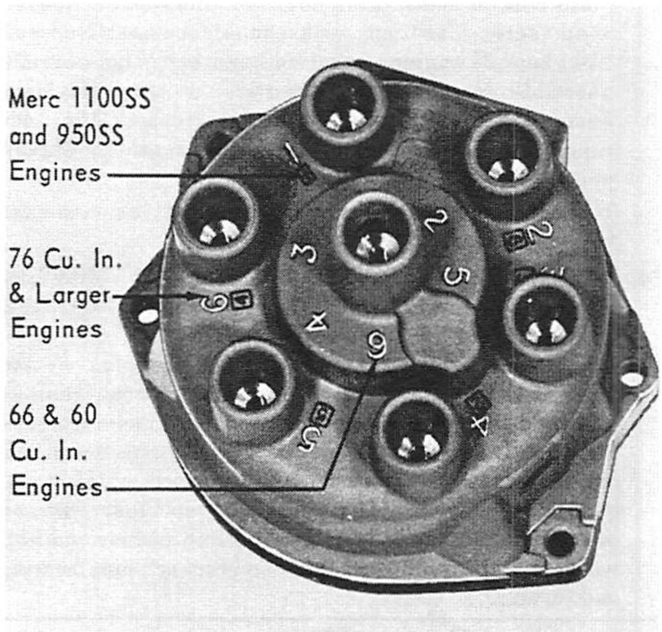


Figure 8. Distributor Cap for 6-Cylinder Engines

INSTALLING DISTRIBUTOR ASSEMBLY ON ENGINE

1. Secure with 4 hex head cap screws and attach ground straps from crankcase to distributor frame.
2. Replace vent tubes to air vent elbow on distributor frame and distributor cap and attach primary wires to correct location. See Wiring Diagrams in Starter Section VII.
3. Place high tension leads so that 2 leads will be positioned in each clamp on rear side of manifold cover.
4. Attach high tension leads to respective spark plug terminals.

RESISTORS AND IGNITION COILS

1. Purpose of resistors in primary ignition circuit is to limit primary current flow of breaker points to prevent breaker points from burning when engine is operated at slow speeds.
2. For Resistor Test Values, see Test Data Chart on Page 10.
3. Ignition coils are mounted in bottom cowl and are

held in place with coil fastening bracket and retainer band. To remove, loosen coil retainer band screw Remove primary coil leads and jumper coils can be lifted out.

NOTE: For firing order and coil firing sequence, see "Timing, Testing and Adjusting" for individual model.

4. Coil Test Values: See Test Data Chart on Page 10.

IGNITION COIL REPLACEMENT, 6-CYL. MODELS

1. Do not install a A-26433 Delco ignition coil on Merc models which use A-32193 Autolite coils, because ignition wiring system differs in that it uses ignition coil ballasts rather than resistors. Coils are not connected as on earlier 6-cylinder models.
2. Six-cylinder models, which use A-32193 (Autolite) coil, employ starter solenoid A-32082 or A-28062 which are not interchangeable with "switch" type starter solenoids used on some other 6-cylinder models.
3. Replace vent tubes to air vent elbow on distributor frame and distributor cap and attach primary wires to resistors.
4. Guide lead wires through opening in exhaust manifold cover and separate so that 2 leads will be placed in each clamp on rear side on manifold cover. Attach lead wires to respective spark plug terminals.

Resistors and Ignition Coils

The purpose of the resistors in the primary ignition circuit is to limit the primary current flow to the breaker points to prevent them from burning when engine is operating at slow speeds.

Resistor Test Values: See Test Data Chart, Page 10.

Ignition Coils

The ignition coils are mounted in the bottom cowl and are held in place with the coil fastening bracket and retainer band. To remove coils, loosen the coil retainer band screw. Remove the primary coil leads and jumper and coils can be lifted out.

66 Cubic Inch Engines (1081.553cm^3):
Coil No. 1 fires cylinders 1-4-5
Coil No. 2 fires cylinders 6-2-3
Engine firing order is 1-6-4-2-5-3
(Use inner numbers on distributor cap)

76 Cubic Inch and Larger Engines (1245.424cm^3):
Coil No. 1 fires cylinders 1-5-3
Coil No. 2 fires cylinders 4-2-6
Engine firing order is 1-4-5-2-3-6
(Use outer numbers on distributor cap)

Coil Test Values: See Test Data Chart, Page 10.

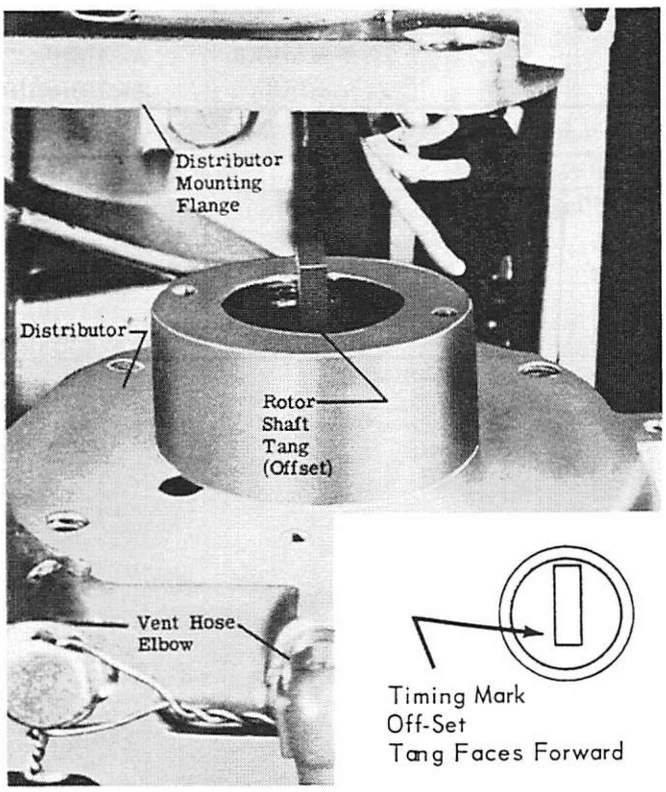


Figure 9. Distributor Rotor Shaft

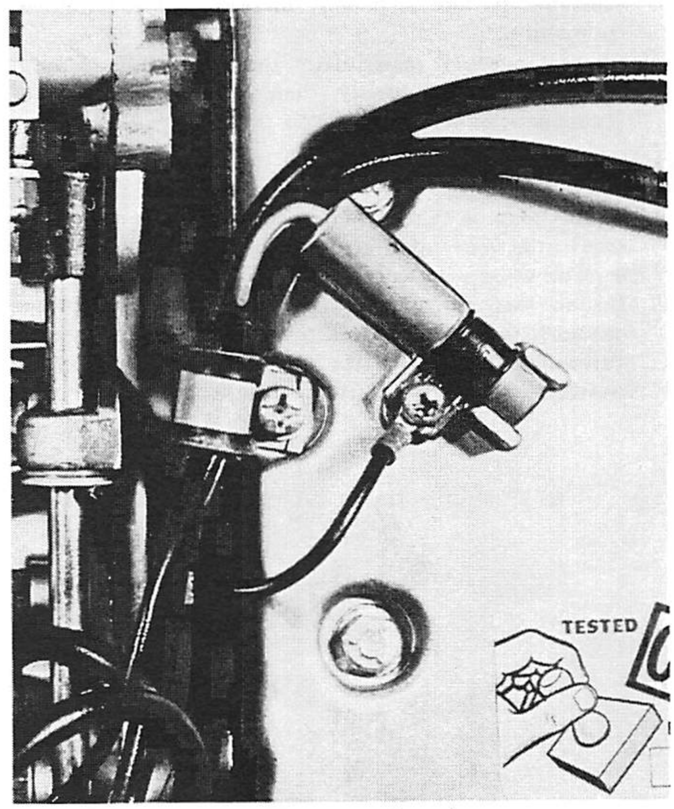


Figure 10. Mercury Switch

SUPPRESSION OF RADIO INTERFERENCE

RESISTOR CABLE KIT FOR 6-CYL. MERCURY ENGINES

1. Resistor cable kit will eliminate the majority of interference originating in the engine's ignition system. New resistor-type ignition cables, which meet our rigid requirements for reliability in outboard service, are used in this kit. In the past, the cable for this type application has been prone to open-circiut failure after a few hours of operation.
2. Order your suppressor cable sets installed in a distributor cap, as shown below, for 6-cylinder engines from the following accessory kit list:

A-393-1927A2 Resistor Cable Kit, Merc 700-600 & Mark 78-78A-75-75A

A-393-1927A3 Resistor Cable Kit, Merc 1000-850-800

NOTE: Difference between 2 kits is firing order and lead lengths.

3. It should be noted that resistor cables are more effective in reducing interference in some installations than in others. Quality of the receiver, antenna location and radio frequency used determine the effectiveness of any suppression equipment.
4. The following suggestions, regarding installation of radio receivers and other electronic equipment, may be helpful.

   a. Any removable covers on devise should be well grounded at close intervals, preferable with "finger" strips.
   b. Negative ground must be used even though a separate battery is connected to electronic equipment in order to avoid serious electrolysis problems.
   c. Antenna lead should be shielded and shield should be grounded.
   d. All grounds should terminate at one point in order to avoid forming a ground loop circuit.
   e. Install antenna as far as practicable from engine and remote control cables. Also, select an antenna suitable for the frequency on which it is intended to operate.
   f. Do not overlook possibility that a competent radio technician can greatly improve performance of equipment by adjusting it "as installed".

PRECAUTIONS TO OBSERVE

1. Avoid tension and bending loads, such as might result from carrying distributor by the leads or pulling on lead when removing it from spark plug insulator.
2. Do not attempt to shorten these leads or replace damaged terminals. A field repair may appear to work satisfactorily, but it is very likely to fail after customer has been underway a few hours.
3. These cable sets are designed specifically for 6-cylinder Mercury outboard engines and are not recommended for use on other devices.
4. Sparks observed in a test gap will not appear as "hot" as with standard cable, but this is of no consequence as long as there is no missing.
5. Some secondary-type tachometers will not function properly on resistor type ignition cables and give incorrect RPM reading.

RADIO SUPPRESSOR KIT LEAD TEST, 6-CYLINDER OUTBOARDS

1. The acceptable limit of resistance for individual leads -- to determine when a lead is no longer useful – has been set at a maximum of 100,000 ohms on distributor leads and 50,000 ohms for coil leads.
2. Lead wires which have greater resistance should be replaced. Refer to charts below for replacement part numbers.
3. Lead wires may be tested with Magneto Analyzer (C-91-25213). Use Scale No. 3, lower band. This is a true ohm scale (0-to-200,000 ohms) and also can be used to test ohm resistance of other electrical components.

Lead No.		Part No.	
Coil	Sp. Plug	Merc 700*	Merc 1000§
1		A-393-1926A1	A-393-1926A1
2		A-393-1926A2	A-393-1926A2
	1	A-31518A4	A-31518A12
	2	A-31518A5	A-31518A10

* *Includes Merc 600 & Mark 78-78A-75-75A*

Lead No.	Part No.	
Sp. Plug	Merc 700*	Merc 1000§
3	A-31518A1	A-31518A7
4	A-31518A2	A-31518A8
5	A-31518A3	A-31518A9
6	A-31518A6	A-31518A11

§ *Includes Merc 900-850-800*

TIMING - ADJUSTING - TESTING

MARK 78-78A-75-75A MODELS

I. TIMING AND LINKAGE ADJUSTMENT

A. Flywheel and Distributor Pulley Timing

Rotate flywheel until "N" or timing mark (arrow) stamped on rim is on line between crankshaft and distributor pulley center. (No. 1 piston then is 20° after top dead center in forward direction.) Arrow on distributor pulley should be pointed toward "N" or timing mark (arrow) on flywheel. (Figure 1) If it is not, remove timing belt and turn pulley to correct position.

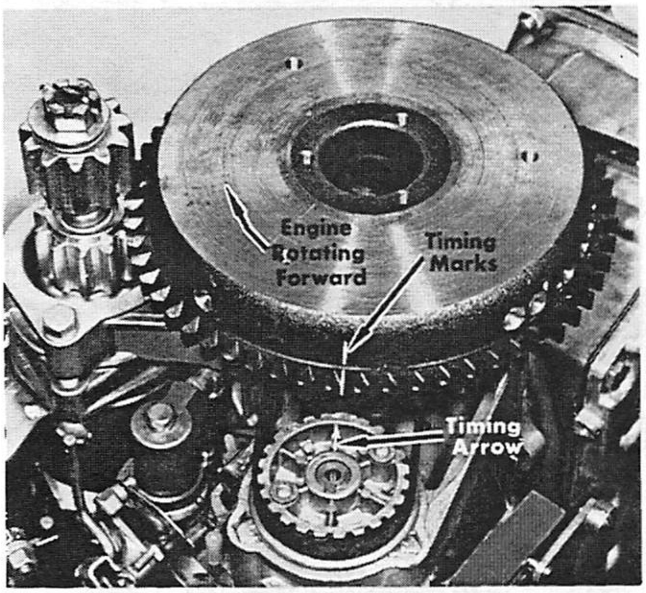
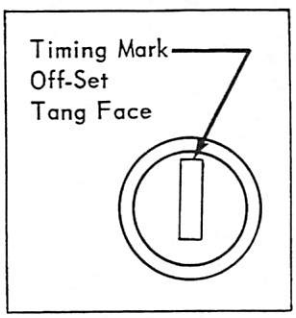


Figure 1

B. Distributor Drive Coupling

When distributor is reassembled to engine, flywheel and distributor pulley should be aligned as above. The 2 punch marks or a small circle "O" on tongue of distributor shaft should point forward (direction engine will travel when distributor is bolted in place). (Figure 2) Secure distributor adaptor with 4 hex head cap screws.



Later distributor shafts have an off-set face tang at the drive end. (See drawing at left.) The off-set face of the tang is considered the timing side, the same as if it were marked with the "O" or two small punch marks (:) as previous distributor cam shafts were marked.

C. Lever Cluster to Carburetor Shaft

With carburetor throttle shutter closed, adjust lever cluster so that foot of No. 2 lever is 3/32" from No. 1 nylon pickup pin. (Figure 3) Insert 3/32" drill between lever and pin to get proper clearance and tighten set screw against butterfly shaft. (Mark 78 has a self-aligning set screw which automatically positions the lever cluster at 1/32" and is not adjustable.)

D. Maximum Spark Advance -- Forward

Position distributor with side high tension lead facing approximately forward. Place No. 1 piston (or No. 2) at .235" BTDC (before top dead center) by rotating flywheel in a clockwise (forward) direction from BDC (bottom dead center). Thread Timing Gauge 91-26916A1 into the No. 1 spark plug hole. Turn flywheel until No. 1 piston strikes the Timing Gauge. While turning the flywheel, thread the Timing Gauge in or out so that the piston can "rock" over the center shaft of the gauge, indicating that the Timing Gauge is set at the top dead center position. Rotate flywheel clockwise ¼ turn. Depress the center shaft of the Timing Gauge and rotate ¼ turn to seat on tool body shoulder (.235" BTDC position). Be careful that tool body does not move or above procedure will have to be repeated. Rotate the flywheel clockwise by hand until No. 1 piston strikes the Timing Gauge center shaft. This is .235" BTDC.

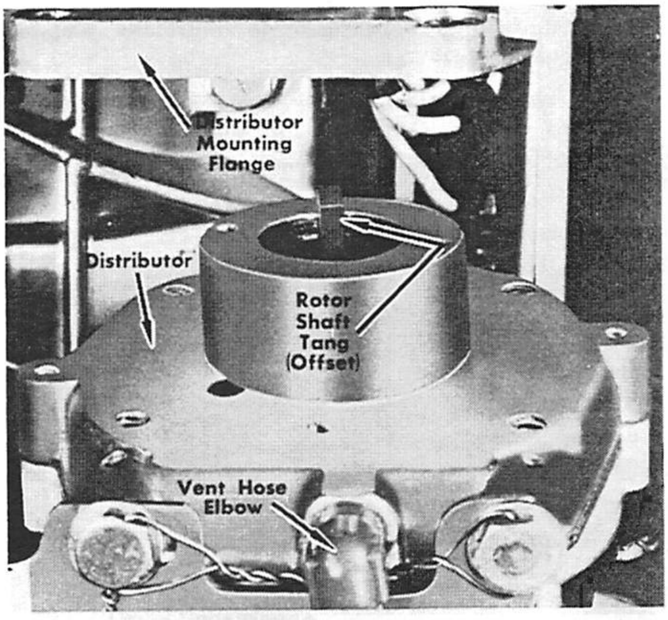


Figure 2

With one test lead of Timing Meter 91-22966 or Magneto Analyzer 91-25213 (scale No. 2) connected to either terminal of No. 1 resistor (or resistor No. 2 if using No. 2 piston), with second lead attached to distributor frame and with distributor stop bracket loose, slowly advance distributor until points break, as indicated by meter used. Hold distributor at this position and set distributor stop bracket to contact crankcase at this point. (Figure 4)

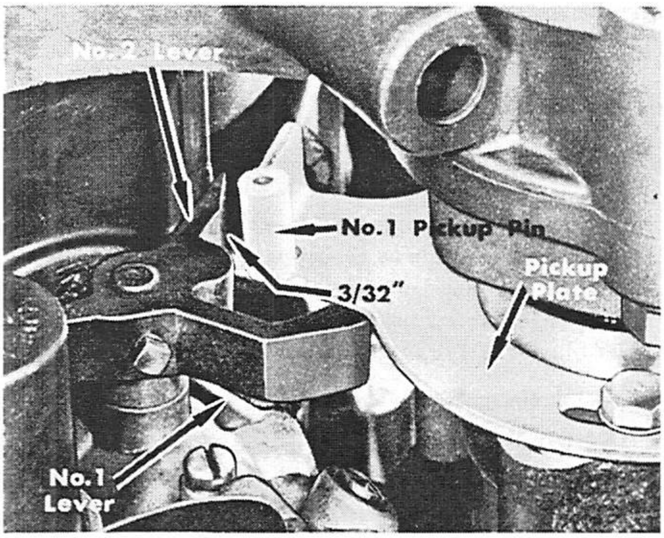


Figure 3

E. Forward Throttle Pickup Adjustment

Rotate distributor counterclockwise until distributor stop bracket touches crankcase. While holding distributor in this position, rotate throttle pickup plate counterclockwise until No. 2 pickup pin is 1/16" from backside of No. 2 lever on lever cluster and tighten cap screws to hold pickup plate in place. (See Figure 5.)

F. Latch Spring Clearance and Latch Spring Screw

Check for 1/64" clearance or less between latch spring and gear sector pin when sector is held and torque is applied to distributor in advance (counterclockwise) direction. Adjust latch spring, if necessary, by loosening the 2 cap screws securing it to distributor adaptor. (See Figure 6.)

The latch spring and latch spring adjustment screw have been eliminated on Mark 78E engines above Serial No. 1166569. It cannot be removed from older models

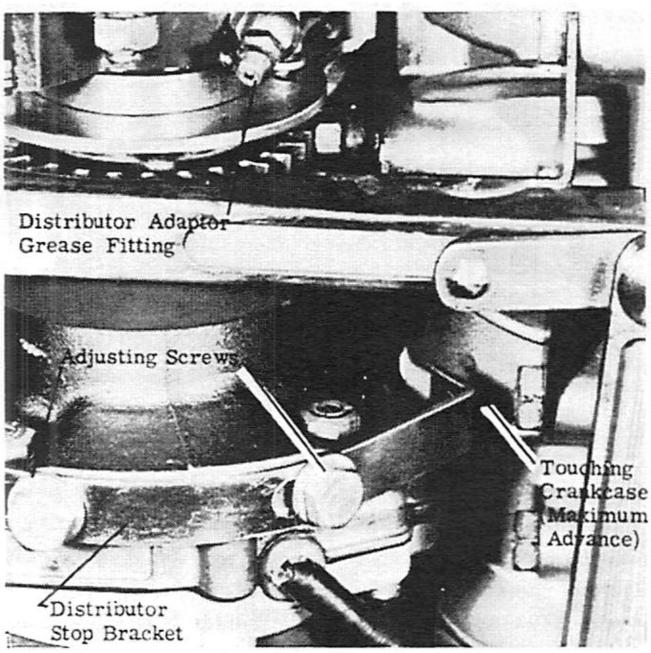


Figure 4

unless new pilot assembly 28512A1 and components are used.

Adjust latch spring screw so that latch spring is just unlatched when distributor stop bracket strikes crankcase (full advance). (See Figure 7.) *(NOTE: This has been eleminated on later Mark 78 Models.)*

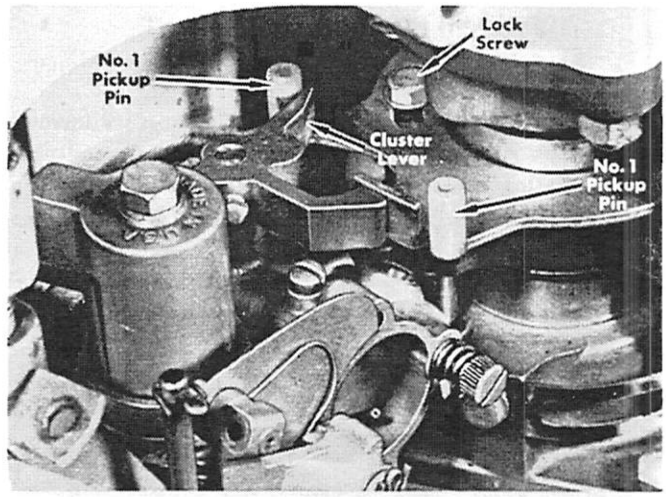


Figure 5

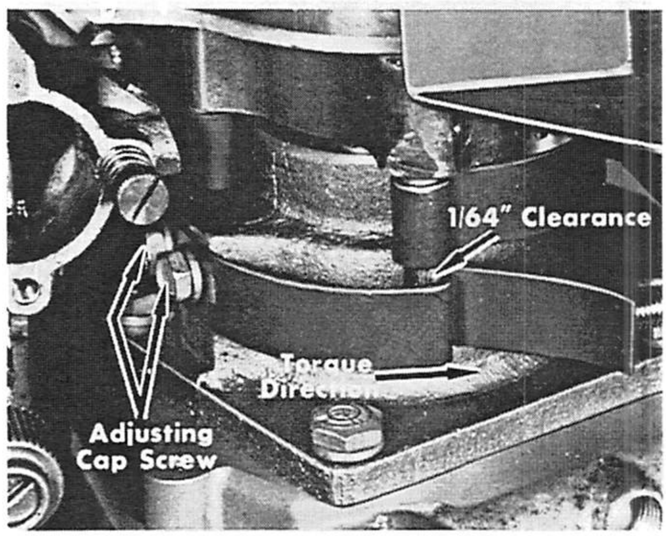


Figure 6

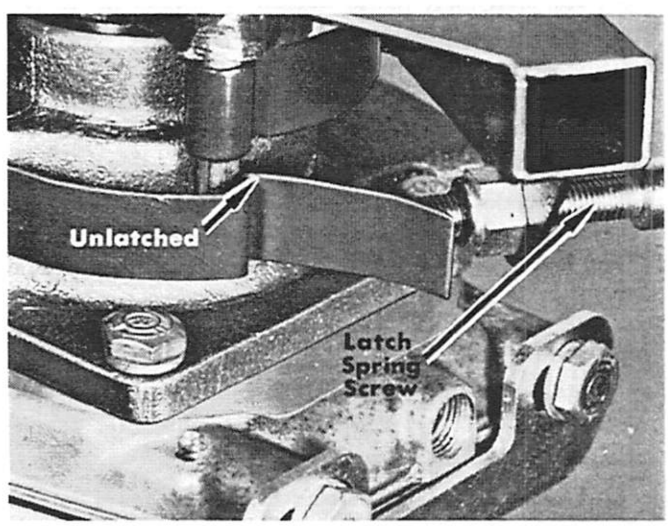


Figure 7

G. Reverse Cam Adjustment

Before placing engine in test tank, adjust reverse cam by actuating self-locking nut on inside bottom cowl underneath lower carburetor. Adjustment of this nut secures reverse locking assembly over the tilt pin. Care should be taken not to tighten nut down too far so that reverse locking assembly will not be too tight on tilt pin, thus imparing reverse throttling.

H. Forward Stop Block

With engine shut off, loosen forward stop block and move bottom cowl lever to give full carburetor throttle shutter opening (not merely full distributor advance.) Tighten stop block in bottom cowl so that any forcing of lever will not spring carburetor linkage. (See Figure 10.)

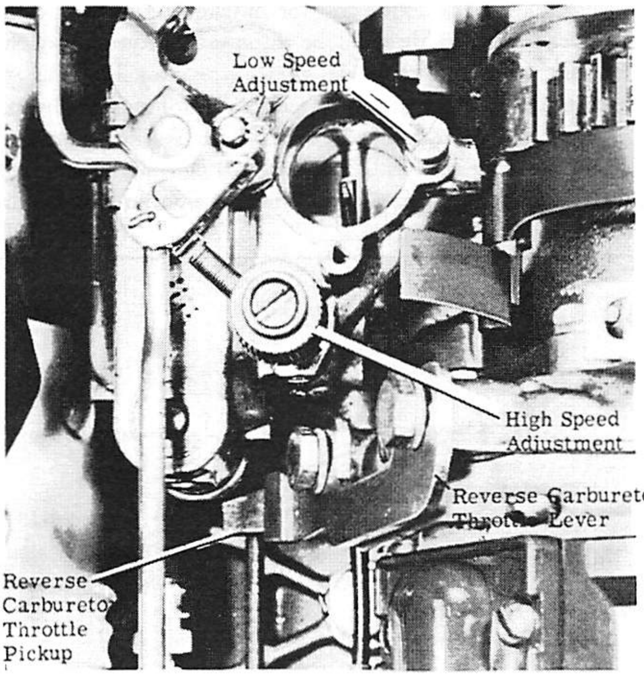


Figure 8

NOTE: All adjustments given here are made with carburetor adjustment propeller.

I. Reverse Lock Link

Adjust reverse lock link so that top cam has risen completely, and link has a minimum 1/32" clearance or free movement at full reverse RPM. (Bottom cowl lever is positioned to give 600-to-800 RPM in reverse.) (See Figure 9.) This will prevent engine from kicking up in case of improper initial adjustment.

J. Reverse Throttle Pickup

With reverse throttle pickup bracket loose, move bottom cowl lever to near back of slot and start engine in reverse direction. Advance distributor (reverse direction) to get 1000 RPM. Set bracket to pick up reverse throttle lever and tighten in place. (See Figure 8.)

K. Maximum Reverse RPM

With stop lock loose and engine running in reverse, move bottom cowl lever to get desired maximum reverse RPM (about 4000) and tighten stop block against lever in bottom cowl to limit further movement of lever. (See Figure 10.) *NOTE: The reverse RPM should be decreased on lighter boats.*

II. CARBURETOR ADJUSTMENT

A. High Speed Adjustment -- Mark 75

The high speed needles of the Mark 75 carburetors have been adjusted carefully at the factory and should not require readjustment if engine will be operated at an altitude of less than 2500 ft. If engine is operated at altitudes above 2500 ft. or. if for some reason, the high speed needles must be adjusted, it is recommended that the propeller be removed and the carburetor adjusting propeller (48-26575) be installed. Engine will then turn about 5200-5400 RPM at full throttle in the test tank or 5000 RPM on the back of a boat. This will permit the accurate adjustment of carburetors for maximum engine RPM. (Use Tachometer 91-28014.) *Note: When using carburetor adjusting propeller in test tank, it will be necessary to install a spray deflector plate.*

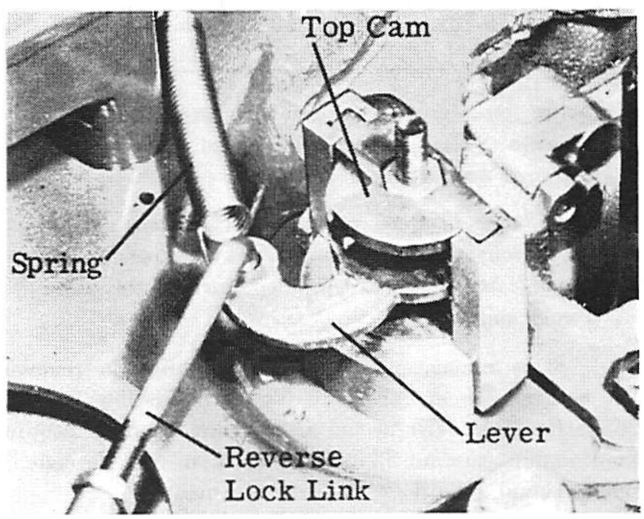


Figure 9

For high speed adjustment of the Mark 75, warm motor up thoroughly and set choke in open position (down). While operating motor at wide open throttle, slowly turn high speed mixture adjusting needle counterclockwise until corresponding bank of cylinders starts to "four-cycle", and motor begins to slow down. (See Figure 8.) Then turn high speed mixture adjusting needle clockwise through range where cylinders fire normally to the point where motor again slows down, indicating that mixture is becoming too lean. Determine this critical "leaning out" point as accurately as possible and back adjusting needle out one-half turn from that point. When in doubt, it is better to set mixture slightly rich rather than too lean, because an excessively lean mixture will cause overheating and loss of power. Sustained full throttle operation with an excessively-lean mixture may cause severe engine damage.

NOTE: "Four-cycling" refers to a condition of operation under which cylinders fire every other revolution rather than once every revolution. It is indicated by the loss of power and a characteristic low-frequency exhaust note. If, in making high speed mixture adjustment, it is found that four-cycling cannot be induced, even though high speed mixture adjusting needle is turned to full rich position, it is possible that a restriction in fuel flow exists between fuel tank and carburetors. Operation of engine under condition of reduced fuel flow may cause damage due to lean fuel mixture and resultant overheating.

B. High Speed Adjustment -- Mark 78-78A-75A

Mark 78-78A-75A models have high speed fixed jet carburetors. The standard jet, installed at the factory, is recommended for operation from sea level to 2500 ft. elevation. If engine is operated above 2500 ft., select and install correct jets from chart below. Note that aperature decreases .002" as elevation increases each 2500 ft. Before changing jets, check engine out, unless previous tests indicate exact jet size.

Model	Up to 2500′	2500–5000′	5000–7500′	7500–10000′
Mark 78-78A	.063"	.061"	.059"	.057"
Mark 75A	.055"	.053"	.051"	.049"

Note: Jet size recommendations are intended as a guide, like a propeller chart. Try a size larger or smaller if in doubt.

No change in spark advance is recommended for elevation operation. Propellers of lower pitch should be used at high elevations to allow proper engine RPM.

It is recommended that the propeller be removed and a Test Wheel (48-28369 for Mark 78-78A-75A; 48-26575 for Mark 75) be installed when testing. Engine then should turn at 5200-5400 RPM at full throttle in test tank and 5000 RPM on back of a boat.

C. Idle Adjustment Screws

The idle adjustment screws also have been adjusted at the factory. If readjustment is necessary, it can be done with the Test Wheel (48-28369 for Mark 78-78A-75A; 48-26575 for Mark 75) or a regular propeller in the test tank or on the boat. Start with all idle needles 7/8 turn open and adjust for maximum RPM with distributor retarded to give about 600-to-700 RPM. Warm engine before attempting adjustment.

With the motor running at idling speed while in forward gear, turn the low speed mixture adjusting needle counterclockwise until affected cylinders start to "load up" or fire unevenly due to over-rich mixture. (Figure 8) Then slowly turn the needle clockwise until cylinders fire evenly and motor picks up speed. Continue turning clockwise until too-lean a mixture is obtained and engine slows down and misfires. Set adjustment screw half way between rich and lean (approx. ½ turn on Mark 78-78A-75A). If a Mark 75 tends to start hard after engine is warm, turn idle adjustment screw 1/16-to-1/8 turn slightly richer. Do not adjust leaner than necessary to attain reasonably smooth idling. When in doubt, it is preferable to have the mixture set slightly rich rather than too lean.

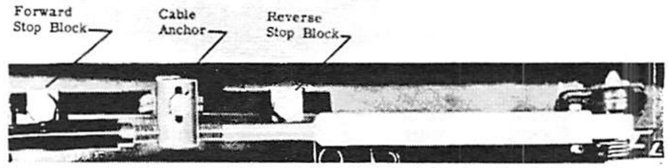


Figure 10

III. REMOTE CONTROL ADJUSTMENT

A. Cable Anchor

The brass cable anchor on the engine end of the remote control cable must be adjusted by turning so that the bottom cowl lever will strike the stop block in the bottom cowl in both forward and reverse before the stroke is used up in the remote control box. If this adjustment is not made, either full forward throttle operation or full reverse throttle operation will not be obtainable. (Figure 10)

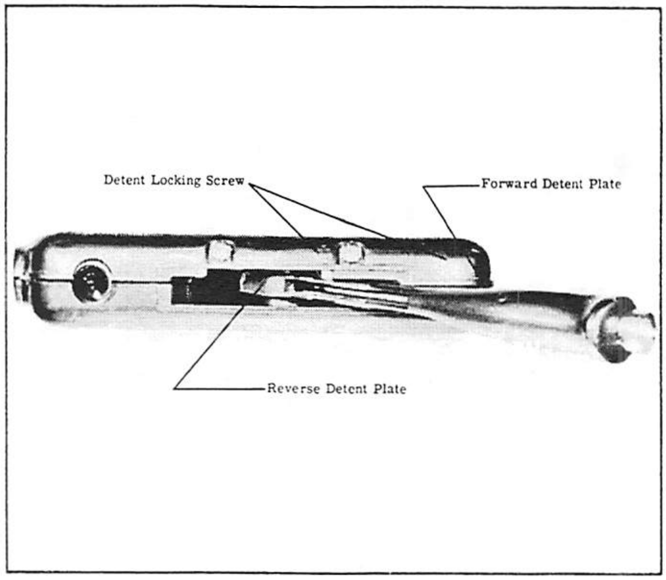


Figure 11

B. Forward Start Position

Remove front cover from engine. Move remote control lever forward until carburetor butterfly starts to open. Move detent plate in control box up against front side of control lever and lock in place with screw provided, as shown in Figure 11 (top), or adjust detent screw as shown in Figure 11 (bottom).

C. Reverse Start Position

Move remote control lever backwards (reverse) until carburetor butterfly starts to open. Move detent plate in control box up against back side of control lever and lock in place with screw provided, as shown in Figure 11 (top), or adjust detent screw as shown in Figure 11 (bottom).

6-CYLINDER DISTRIBUTOR BREAKER POINT

SETTING and SYNCHRONIZING

DESCRIPTION

The Distributor Breaker Point Dwell and Synchronizing Plate C-91-45510A1 can be used for all 6-cylinder outboards and simplifies 6-cylinder breaker point setting.

Six-cylinder distributor breaker points must be properly adjusted and set so that the 2nd set of points fires exactly 60° after the first. Each set must be closed for 90° (45° on Thunderbolt ignition system) of rotation to allow sufficient current build-up in the coil.

Incorrect dwell and synchronizing will result in less efficient engine operation, as one set of points fires 3 cylinders.

PRELIMINARY INFORMATION AND INSTRUCTIONS

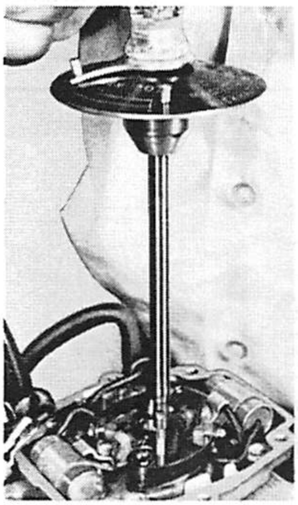


Figure 1.
Gauging Spring Tension

1. Preliminary to synchronizing the points, clean the face of the points with a piece of paper to remove oil and dirt film.
2. Check spring tension setting with Spring Tension Gauge (C-91-29406). Place end of tool over breaker assembly and turn toward breaker point spring to 33-37 oz. tension. (Fig. 1)
3. Check breaker point resistance with Magneto Analyzer (C-91-25213) (scale No. 2) to be sure that points are in good condition. On Thunderbolt ignition system, high point resistance is permissable.
4. Check breaker point contact faces to be certain that they are properly aligned, since setting and synchronizing will be accurate only with clean and correctly aligned points.

INSTALLATION

1. With distributor dwell plate face up, set distributor assembly frame collar into center opening of dwell plate with primary lead extending into slot on side of plate.
2. Thread 2 slotted flat head ¼-20 screws into slots thru degree plate into two ¼-20 threaded distributor mounting holes. Do not tighten.
3. Mount frame collar in vise (with vise jaw protectors) to allow freedom of both hands for adjusting. Do not overtighten in vise.

SYNCHRONIZATION INSTRUCTIONS

1. Place rubbing block of No. 1 set of points (white lead; brown lead for Thunderbolt ignition; red lead on Mark 78-75 models) on high lobe of distributor cam and set points at .007" (.178mm). This is a primary setting required to obtain the appropriate dwell.
2. Set indicator arm over rotor shaft. Note that indicator arm groove is off center: therefore, it will be set over rotor shaft cross pin only one way.
3. With Magneto Analyzer selector switch on No. 3 (continuity), or employing a Continuity Meter (C-91-22966), attach the small red test lead to the white primary lead wire (brown lead on Thunderbolt; red on Mark 78-75) of the distributor and small black test lead to the frame of the distributor.
4. With breaker points open, rotate the indicator arm counterclockwise until hand moves (breaker points close). This will be indicated by the sudden movement of the Magneto Analyzer or Continuity Meter pointer hand.

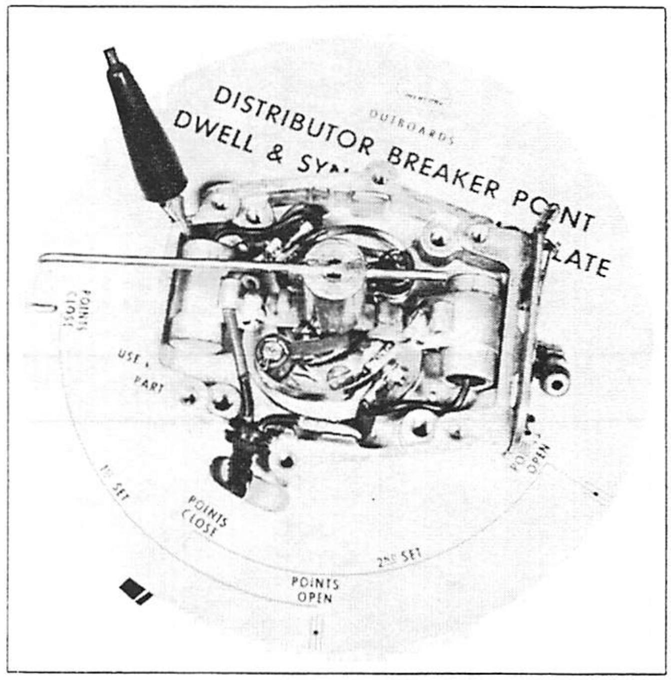


Figure 2. Dwell Plate C-91-30356A1

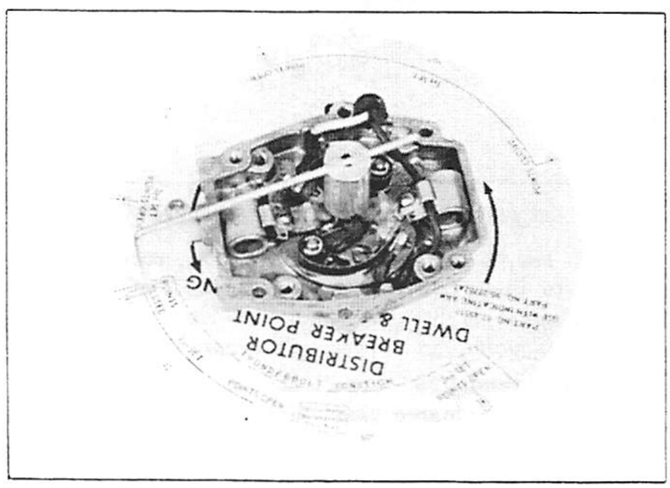


Figure 3. Dwell Plate C-91-45510A1

5. Move degree plate in either direction which is required to place "Points Close" mark directly under indicator arm. (Figure 2 or 3)
6. Rotate indicator arm counterclockwise until breaker points open, which will be indicated by the sudden movement in opposite direction of meter pointer hand. Indicator hand must be exactly on centerline marked "Points Open". (Figure 4 or 5)
   a. If breakers open too soon (before mark), move indicator hand counterclockwise half way to mark. At this time, readjust breaker points until they just begin to close and reopen, as indicated on meter.
   b. If points open too late (after mark), move indicator hand back halfway (clockwise) to mark. At this point, readjust points until they just begin to open. Above divides distance between starting point and breaking point to get correct setting.

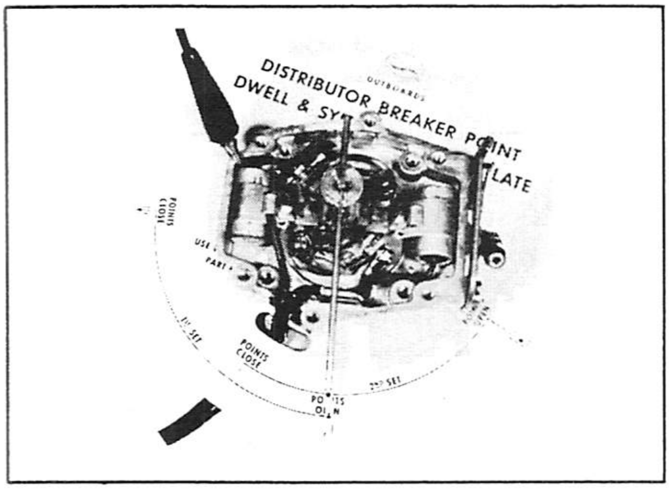


Figure 4. Dwell Plate C-91-30356A1

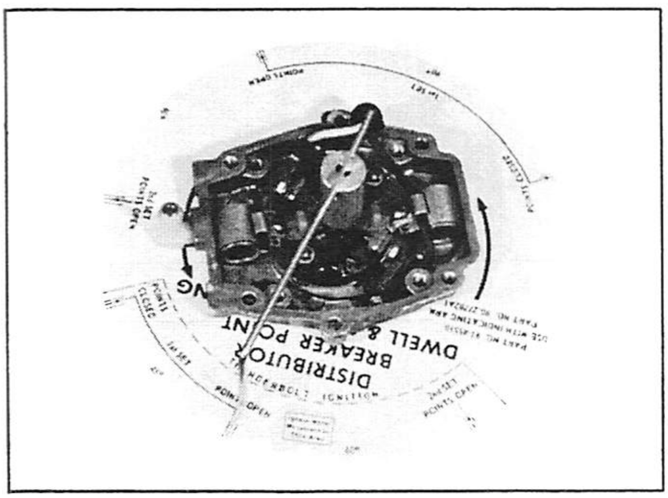


Figure 5. Dwell Plate C-91-45510A1

7. After making adjustment "a" or "b", preceding, return to instruction No. 3 and proceed as before, as adjustment of breakers under "a" or "b" changes starting point, and degree plate must be readjusted.
8. After obtaining 90° dwell (45° on Thunderbolt ignition), tighten degree plate with two ¼-20 screws and recheck that dwell was not changed while tightening screws.
9. This completes No. 1 breaker assembly settings. No further adjustment of this breaker is required, but do not remove degree plate under any circumstances.
10. Brown lead, No. 2 breaker point setting (black on Mark 78-75 models; white lead on Thunderbolt ignition).
    a. Remove test lead from No. 1 lead and attach to No. 2 lead terminal.
    b. Move indicator arm to align "Points Open" and adjust brown (black on Mark 78-75; white on Thunderbolt ignition) lead breaker points until meter pointer hand indicates points just begin to open. (Figure 6 or 7) If points open too soon, point gap must be closed slightly. If breaker points open too late, gap must be opened slightly.
    c. Always recheck after tightening breaker assembly to plate so that point setting does not change. This completes breaker point settings.

NOTICE: OBSERVE "Ignore Meter Movement in This Area" on C-91-45510A1 DWELL PLATE.

The second set of breaker points will close in this area. This is unimportant. For more efficient engine performance, the 60° phasing between No. 1 set of points opening and No. 2 set of points opening must be accurate.

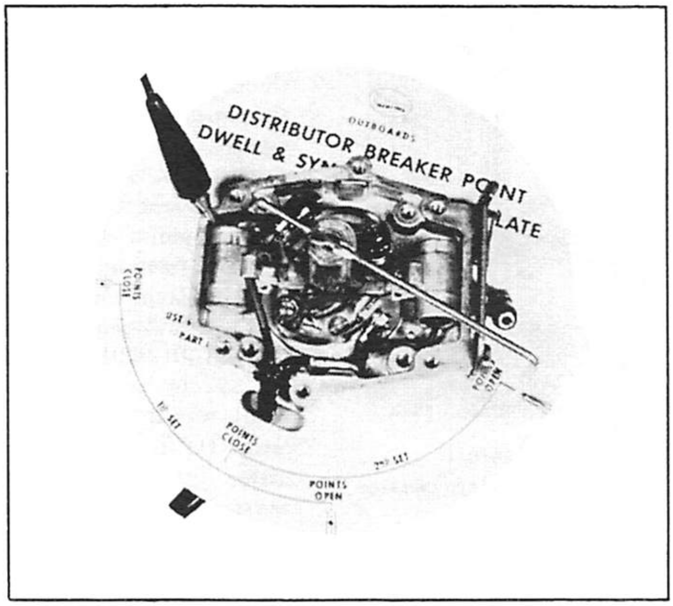


Figure 6. Dwell Plate C-91-30356A1

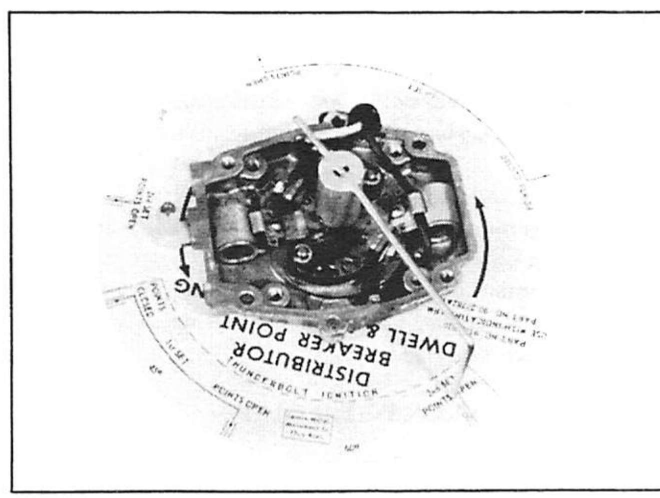


Figure 7. Dwell Plate C-91-45510A1

TIMING, ADJUSTING, TESTING

Merc 500-450-400-350-300 & Mark 58-58A-55A-35A

I. Timing and Linkage Adjustment

A. Upper Shift Shaft Adjustment (Figure 1)

When shift control lever is in forward gear, detent spring should be in the first notch of the shift control lever. If it is not, adjust upper shift shaft in the following manner:

1. Remove cotter pin from link rod.
2. Turn link rod to allow detent spring to catch in first notch.
3. Tighten lock nut on link rod.
4. Replace cotter pin.

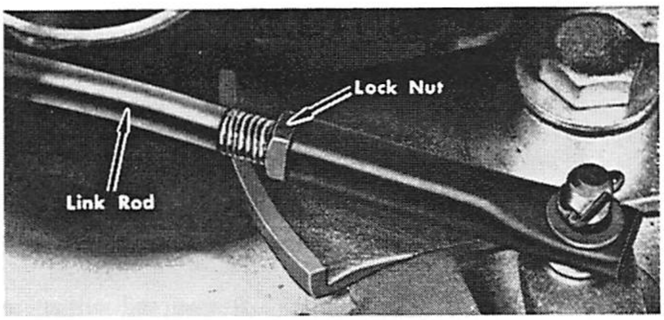


Figure 1. Reverse Lock Adjustment

B. Timing Flywheel and Magneto Pulley

Flywheel has 2 markings. One is a straight line which times the motor to top dead center (TDC) when positioned with arrow on magneto driven pulley. Second is a straight line with an "O" stamped over it. (Figure 2) This is .235" BTDC (before top dead center).

1. Rotate flywheel until timing mark (straight line stamped on rim) is in a straight line with center of crankshaft and distributor pulley center.

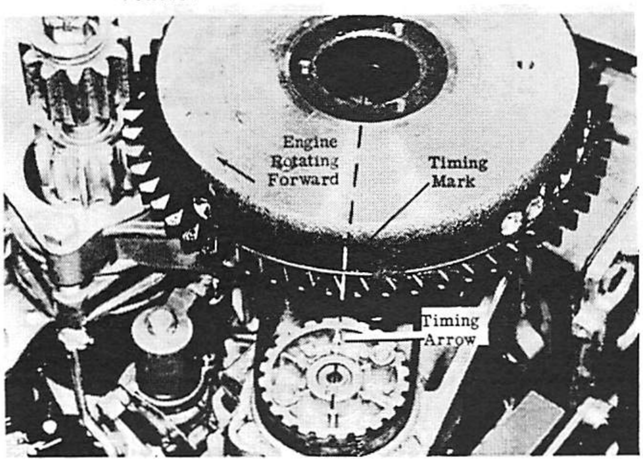


Figure 2. Flywheel and Magneto Pulley Timing

2. Position arrow on pulley to point at timing mark.
3. Replace timing belt, plate, cap screw and washers.

C. Installing Magneto

Magneto rotor shaft and shaft extension are splined with one blanketed spline on each shaft for easy installation.

1. With flywheel and pulley in position described in "B" preceding, install magneto on engine.
2. Rotate timing pulley until shaft sets in place. A 1/16" groove is located at end of shaft coupling in centerline of blanketed shaft to locate for easy installation.
3. Secure magneto to magneto adaptor with 4 hex head cap screws.

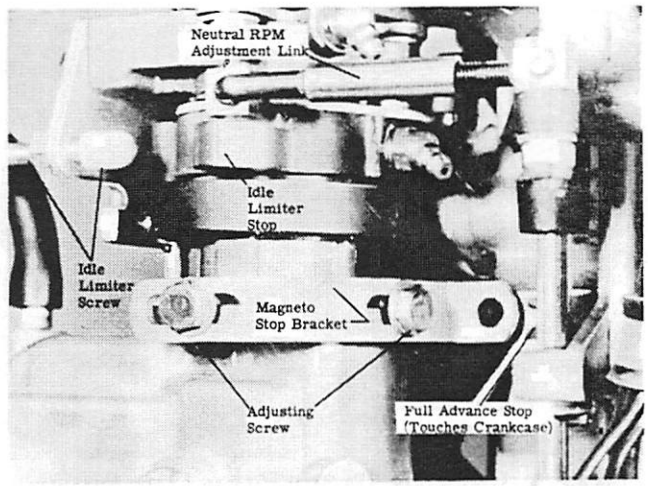


Figure 3. Magneto Stop Bracket Adjustment

D. Setting Maximum Spark Advance

1. Thread Timing Gauge (91-26916A1) into No. 1 spark plug hole.
2. Turn flywheel until No. 1 piston strikes Timing Gauge.
3. While turning flywheel, thread Timing Gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center (TDC) position.
4. Rotate flywheel clockwise ¼ turn.
5. Depress center shaft of Timing Gauge.
6. Rotate gauge shaft ¼ turn to seat on tool body shoulder (.235" BTDC position). Be careful that tool body does not move, or preceding procedure will have to be repeated.
7. Rotate flywheel clockwise by hand until No. 1 piston strikes Timing Gauge center shaft. This is .235" BTDC.
8. Attach one test lead of Timing Meter (91-22966) or Magneto Analyzer (91-25213) (on

No. 2, Resistance) to magneto frame.

9. Attach second lead of tester to primary ground terminal of magneto.
10. With magneto stop bracket loose, slowly advance magneto until points break, as indicated by tester used.
11. Hold magneto at this position.
12. Adjust and lock magneto stop bracket to contact crankcase at this point. (Figure 3)
13. Recheck setting by actuating magneto with throttle control lever on side of bottom cowl.

E. Adjusting Carburetor Throttle Pickup Plate

Adjust carburetor throttle pickup plate position with .015" feeler gauge to obtain 1/64" clearance between second pickup pin and No. 2 lever or carburetor cluster when magneto is against the the stop in full advance position. (Figure 4) *(Note: Be sure that throttle moves freely throughout range and both throttle shutters close fully at idle position.)*

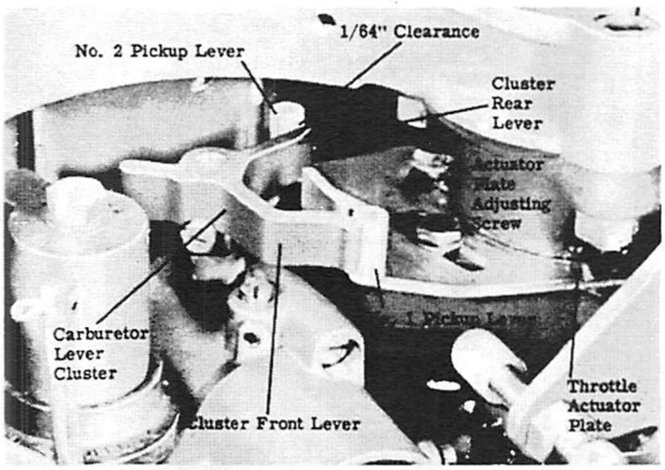


Figure 4. Carburetor Throttle Pickup Plate Adjustment

F. Full Throttle Stop Adjustment Screw

Set full throttle stop adjustment screw to allow 1/64" free movement of cluster lever in clockwise direction when throttle is held against its full throttle stop. (Figure 5) Push cluster lever with finger. *(Note: If timing stop is readjusted, Paragraph D, preceding, must be repeated.)*

II. Carburetor Adjustment

Before starting engine, turn low speed needles of each carburetor in until they seat lightly; then back out 7/8 turn. This will allow engine to start, and you then can make final adjustments, following.

A. High Speed Adjustment

All Merc 400-300, Mark 58-58A and later 55A-35A carburetors have fixed high speed jets. The standard jet, installed at the factory, is recommended for operation from sea level to 2500 or 4000 ft. elevation. If engine is operated above 2500 or 4000 ft., select and install correct jets from chart below. *(Note that jet aperature decreases .002" as elevation increases.)* Use Jet Installation Tool (91-29795).

It is recommended that propeller be removed, and test propeller (48-26976) be installed. Engine then should turn at 5500-5600 RPM at full throttle in test tank or on back of boat. *(Note: For high speed adjustment of early Mark 55A-35A, see* *Page 49, Paragraph II, Item A.)*

Engine Model	Jet Sizes for Elevations						
	Up to 4000'	4000-7000'	7000-10000'	Up to 2500'	2500-5000'	5000-7500'	7500-10000'
Merc 500-450	.059"	.057"	.055"				
Merc 400	.061"	.059"	.057"				
Merc 350-300	.055"	.053"	.051"				
Mark 58-58A				.063"	.061"	.059"	.057"
Mark 55A-35A				.063"	.061"	.059"	.057"

Note: **Jet size recommendations are intended as a guide (like a propeller chart). Try size larger or smaller if in doubt.**

No change in spark advance is recommended for elevation operation. Propellers of lower pitch should be used at high elevations to allow proper engine RPM.

B. Low Speed (Idle) Adjustment

Make idle adjustment after high speed adjustment is completed.

1. Turn all idle needles 7/8 open and adjust for maximum RPM with distributor retarded to give about 600 RPM.
2. Run engine at idle speed while in forward gear.
3. Turn low speed mixture adjusting needle counterclockwise until engine starts to "load up" or fire unevenly due to over-rich mixture.
4. Slowly turn needle clockwise until cylinders fire evenly and engine picks up speed. Do not adjust leaner than necessary to obtain reasonably smooth idling.

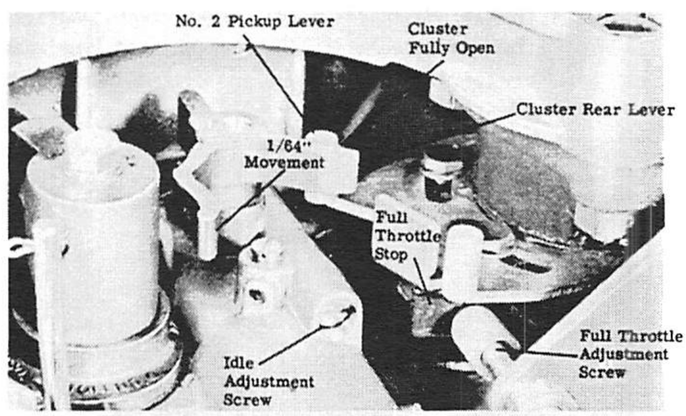


Figure 5. Full Throttle Stop Adjustment

(Note: When in doubt, it is preferable to have mixture set slightly rich rather than too lean. Idle cannot be adjusted while in "Neutral" or engine will sputter and stop when shifted in "Forward" because of "no load" condition while adjusting.)

C. Idle Limit Adjustment

1. Warm up engine.
2. Set carburetor idle mixture screw for proper operation, as explained in Paragraph B, preceding.
3. Set minimum idle limit screw (Phillips head screw on magneto adaptor toward outside) to obtain 525 RPM idle. (Figure 3) Set "in" for increased RPM, "out" for decreased RPM.

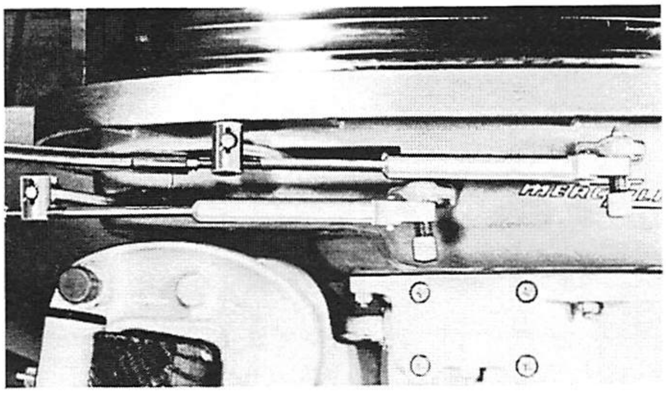


Figure 6. Cable Anchor Adjustment

D. Neutral RPM Adjustment

1. Shift into neutral.
2. Adjust length of link between vertical shaft and magneto actuator to obtain a speed of 2400 to 3000 RPM. (Figure 3)

III. Remote Control Adjustment

A. Cable Anchor

Adjust brass cable anchor on engine end of remote throttle control cable (Figure 6) by turning so that bottom cowl lever will allow full traverse in both forward and reverse directions before the stroke is used up in remote control box. If this adjustment is not made, either full forward throttle operation or full reverse throttle operation will not be obtainable.

B. Shift Control

1. Set remote control lever in "Neutral" position in control box.
2. Set shift lever on engine in neutral position.
3. Anchor cable to anchor block on rear side of engine with knurled pin.
4. Adjust brass cable anchor block on cable to align with clevis yoke on shift lever on engine.
5. Remove cable from anchor block at rear side of engine.
6. Attach brass cable anchor block on clevis arm.
7. Attach end of control lever to anchor block.

TIMING, ADJUSTING & SYNCHRONIZING
MARK 10-10A-15A

I. CARBURETOR ADJUSTMENTS

A. High Speed Adjustment

1. Engines Not Having High Speed Fixed Jet for Mark 10-10A-15A§ (Figure 1)

Warm up engine thoroughly. Operate engine at full throttle in forward gear. Slowly turn high speed adjusting needle counterclockwise. Engine will "four-cycle". Turn high speed needles clockwise to a point where engine slows down, indicating too lean a mixture. Determine this point as accurately as possible. Turn needle counterclockwise one-half turn from that point. When in doubt, set mixture slightly rich rather than too lean. A lean mixture will cause overheating and a loss of power or could cause severe engine damage.

§ *Early Mark 15A Engines*

2. Engines With High Speed Fixed Jet (Mark 15A)

The standard jet, installed at the factory, is recommended for operation from sea level to 2500 ft. altitude. If the engine is operated above 2500 ft., select and install correct jets from chart below.

Motor Model	Start with Serial No.	Fixed Jet Part No.	Jet Size	Elevation
Mark 15A	1238590	1399-1457	.057*	Sea Level - 2500
Mark 15A	1238590	1399-1455	.055	2500 - 5000
Mark 15A	1238590	1399-1453	.053	5000 - 10000

* *Standard Jet Equipped on New Engines*

Jet size recommendations are intended as a guide (like a propeller chart). Try size larger or smaller if in doubt.

No change in spark advance is recommended for elevation operation. Propellers of lower pitch should be used at high elevations to allow proper engine RPM.

Troll lever should be toward "Troll" position (indicated on instruction plate).

B. Low Speed (Idle) Adjustment

With engine running in forward gear and troll lever in troll position, turn low speed adjusting needle clockwise until engine slows down from this point. Turn low speed needle counterclockwise about one-half turn. Do not adjust leaner than necessary to attain reasonably smooth idling. When in doubt, set mixture slightly rich rather than too lean. Engine should idle at about 500 RPM.

NOTE: Idle cannot be adjusted while in "Neutral" or engine will sputter and stop when shifted to "Forward" because of "no load" condition while adjusting.

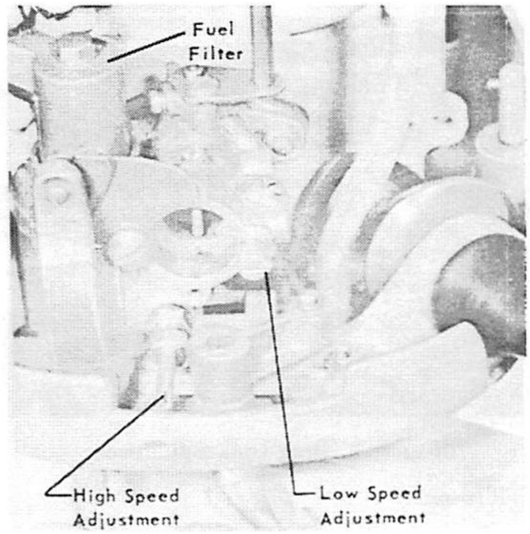


Figure 1, Carburetor Adjustments

II. ADJUSTING AND TIMING

A. Pickup Adjustment

With engine running, set troll lever in "RUN" position and turn twist grip throttle to just engage in forward gear to obtain 1000 RPM. At this point, the throttle pickup cam on magneto should just touch the carburetor throttle lever on carburetor. If recommended RPM is not obtained, loosen the long hex-head screw (Figure 2) which secures the throttle control cam assembly to the magneto stator plate and move cam portion "in" (away from carburetor throttle lever) to decrease pickup RPM and "out" (toward carburetor throttle lever) to increase pickup RPM. After obtaining the desired 1000 RPM, tighten screw to secure cam.

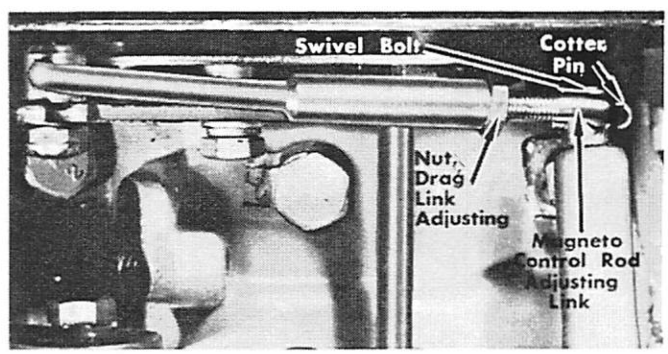


Figure 2. Pickup Adjustment

B. Neutral RPM

With engine running, turn twist grip throttle handle in "NEUTRAL" position and troll lever in "START" position. Engine should operate at 2200 to 2400 RPM. To adjust RPM, remove cotter pin from drag link and swivel of vertical shaft (Figure 3) and loosen drag link adjusting nut, turning drag link "out" to increase RPM and "in" to decrease RPM in neutral. After obtaining desired RPM, fasten drag link adjusting nut and replace drag link into opening in swivel. Place cotter pin in drag link to complete adjustment.

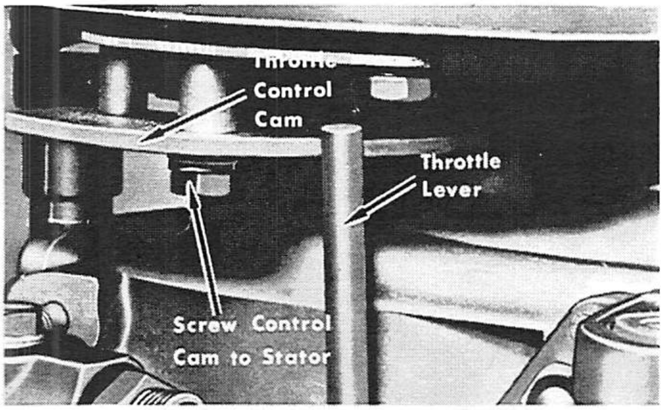


Figure 3. Drag Link Adjustment

C. Timing

No timing adjustment is required on this engine, as magneto holddown ring has a stop on ring which controls maximum advance. (Mark 15A has adjustable idle stop bracket to control slow speed magneto retard.)

D. Stopping

Because of fine idling characteristics, the engine must be "choked" to stop.

III. TROLL LEVER SETTING

The troll lever should be set in the "Run" position for general engine operation in running and shifting. The troll lever is a secondary control to advance or retard the spark and is used for obtaining slower idle RPM than can be had with the throttle handle or remote control while in gear. If the troll lever is in maximum retard (slow idle) position, the engine will idle too slowly to permit shifting from "Forward" to "Neutral" or "Reverse" without stopping. The troll lever should be in "Run" position when engine is to be shifted or when throttle handle is turned for more speed. Because of the extreme spark retard which can be obtained, the engine will idle extremely slow and the very slow firing impulses may result in some boat vibration. Idle RPM then should be increased by moving troll lever slightly toward "Run" position.

TIMING, ADJUSTING, SYNCHRONIZING
Merc 100-150-200-250 and Mark 28-28A

I. Check and Adjust Reverse Lock Mechanism

Reverse lock must be set so that it is engaged in reverse and neutral only and clears tilt pin when twist grip throttle is turned into forward. Adjustment must be made before testing engine. With engine stopped, turn twist grip throttle to full throttle position (forward), being certain that reverse lock clears tilt pin. Next, turn twist grip throttle to neutral position. Reverse lock lever should be fully engaged over tilt pin.

To adjust, turn elastic stop adjusting nut on upper shift shaft counterclockwise to have reverse lock lever engage earlier. Turn adjusting nut clockwise to engage reverse lock later.

II. Setting and Synchronizing Breaker Points

(See information on Page 13-14 of Ignition Section IV.)

III. Carburetor Adjustment

A. High Speed

Carburetors have fixed high speed jets. The standard jet, installed at the factory, is recommended for operation from sea level to 2500 ft. elevation. If the engine is operated above 2500 ft., select and install correct jets from chart below (note that jet aperature decreases .002" as elevation increases each 2500 ft.):

Engine Model	Jet Sizes for Elevations			
	*Up to 2500'	2500-5000'	5000-7500'	7500-10000'
Merc 250-200	.063"	.061"	.059"	.057"
Merc 150 *(1346448 & Up)*	.051"	.049"	.047"	.045"
Merc 150 *(Below 1346448)*	.057"	.055"	.053"	.051"
Merc 100 *(1349698 & Up)*	.051"	.049"	.047"	.045"
Merc 100 *(Below 1349698)*	.055"	.053"	.051"	
Mark 28-28A	.063"	.061"	.059"	.057"

* *Standard jet -- factory equipped.*

Jet size recommendations are intended as a guide (like a propeller chart). Try size larger or smaller if in doubt.

No change in spark advance is recommended for elevation operation. Propellers of lower pitch should be used at high elevations to allow proper engine RPM.

Troll lever should be toward "Troll" position (indicated on instruction plate).

B. Low Speed (Idle)

With the motor running at idling speed (approx. 500 RPM) while in forward gear, turn low speed needle slowly counterclockwise until engine starts to "load up" or fire unevenly due to over-rich mixture. Then slowly turn clockwise until cylinders fire evenly and engine picks up speed. Do not lean out the idle more than necessary to obtain smooth idling. When in doubt, it is preferable to leave mixture set slightly rich than too lean. (Figure 1)

When desired idle is obtained, loosen idle stop cap screw and nut, located on top cowl bracket (Figure 2) and move adjustable idle stop to just touch throttle cam assembly.

Note: Idle cannot be adjusted while in "Neutral" or engine will sputter and stop when shifted to "Forward" because of "no load" condition while adjusting.

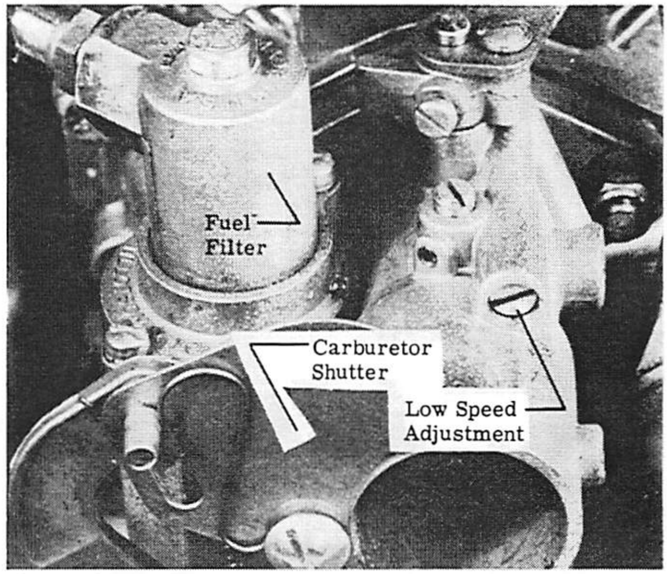


Figure 1. Low Speed (Idle) Adjustment

IV. Adjusting and Timing

A. Pickup Adjustment

With engine running, set troll control lever in "RUN" position and turn twist grip throttle to just engage in forward gear to obtain 1000 RPM. At this point, the throttle pickup cam on the magneto should just touch the carburetor throttle lever on the carburetor. If recommended RPM is not obtained, loosen the long hex head screw (Figure 2) which secures the throttle control cam assembly to the magneto stator plate and move cam portion "in" (away from carburetor throttle lever) to decrease pickup RPM and "out" (toward carburetor throttle lever) to increase pickup RPM. After obtaining the desired 1000 RPM, tighten screw to secure cam.

B. Neutral RPM

With engine running, turn twist grip throttle handle in "NEUTRAL" position and troll control lever in "START" position. Engine should operate at 2200-to-2400 RPM. To adjust RPM, remove cotter pin from drag link and swivel of vertical shaft (Figure 3) and loosen drag link adjusting nut. Turn magneto control rod adjusting link "in" to increase RPM and "out" to decrease RPM in neutral. After obtaining desired RPM, fasten drag link adjusting nut and replace drag link into opening in swivel. Place cotter pin in drag link to complete adjustment.

C. Timing – Maximum Spark Advance

Timing adjustment is required. Magneto advance is controlled by adjusting magneto advance stop screw and nut at .275" BTDC for Merc 200-150 and Mark 28-28A and at .235" BTDC for Merc 100. (Figure 4)

To check timing, if in doubt, thread Timing

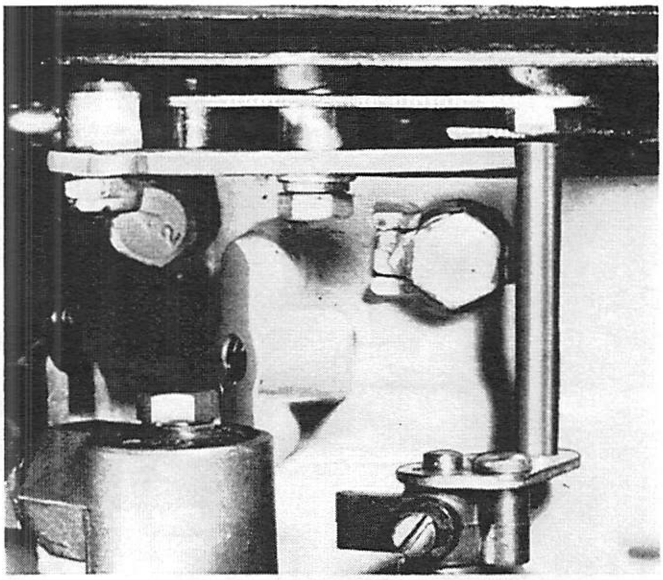


Figure 2. Throttle Control Cam Assembly

Gauge (91-26916A1 for .235" BTDC advance on Merc 100 or 91-30292A1 for .275" BTDC advance on Merc 200-150 and Mark 28-28A) into No. 1 spark plug hole. Turn flywheel until No. 1 piston strikes Timing Gauge. While turning flywheel, thread gauge in or out so that piston can "rock" over center shaft of gauge, indicating that gauge is set at top dead center position. (Figure 5)

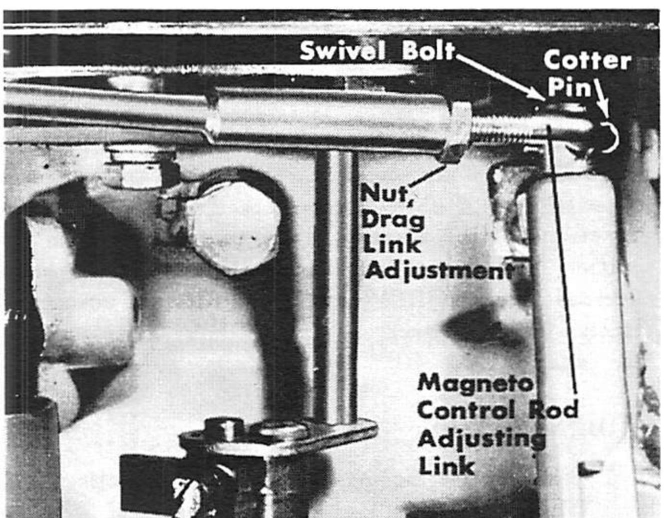


Figure 3. Magneto Control Rod Adjusting Link

Rotate flywheel clockwise ¼-turn, depress center shaft of gauge and rotate ¼-turn to seat on tool body shoulder (.235" or .275" BTDC position, depending upon gauge used). Be careful that tool body does not move, or above procedure must be repeated. Rotate flywheel clockwise until No. 1 piston strikes timing gauge center shaft. This is .235" or .275" BTDC.

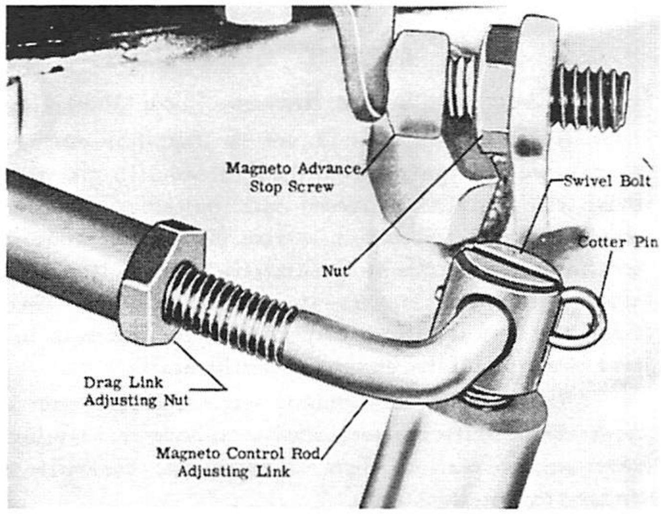


Figure 4. Magneto Advance Stop Screw Adjustment

Now attach one test lead of Timing Meter (91-22966) or Magneto Analyzer (91-25213; selector switch on No. 2, resistance) to magneto frame and second lead of tester to primary terminal No. 1 breaker assembly. With the advance stop screw and nut loose, slowly advance magneto until points break, as indicated by tester used. Hold magneto at this position, adjust stop screw to contact magneto bracket and tighten stop screw locking nut. (Figure 4)

D. Stopping

Engine must be choked to stop, because of fine idling characteristics.

V. Tension Adjustment of Troll Control Lever

The desired tension, or friction, on the troll control lever can be obtained by adjusting the 2 hex head nuts shown in Figure 6. These nuts serve as a tension and are threaded "in" to increase friction, threaded "out" to decrease friction. Both nuts must be adjusted equally to give a flat bearing surface to the internal friction disc.

VI. Troll Lever Setting

The troll lever should be set in the "Run" position for general engine operation in running and shifting. The troll lever is a secondary control to advance or retard the spark and is used for obtaining slower idle RPM than can be had with the throttle handle or remote

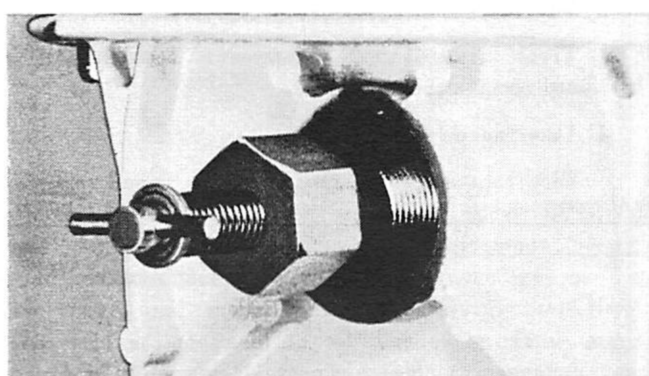


Figure 5. Timing Gauge Installed

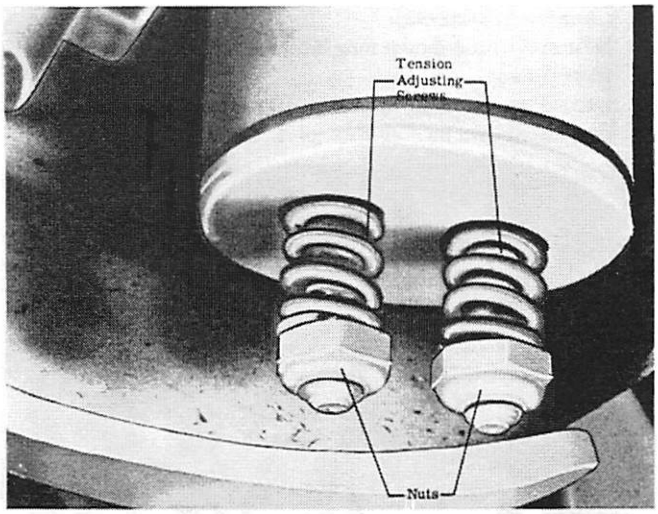


Figure 6. Tension Adjustment

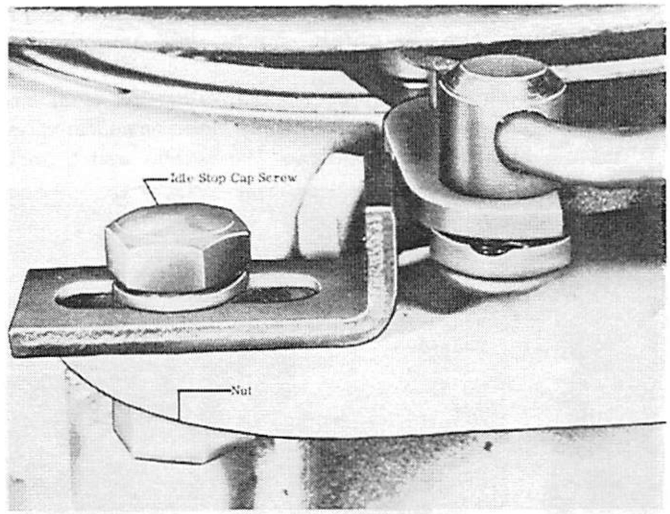


Figure 7. Idle Stop Adjustment

control while in gear. If the troll lever is in maximum retard (slow idle) position, the engine will idle too slowly to permit shifting from "Forward" to "Neutral" or "Reverse" without stopping. The troll lever should be in "Run" position when engine is to be shifted or when throttle handle is turned for more speed. Because of the extreme spark retard which can be obtained, the engine will idle extremely slow and the very slow firing impulses may result in some boat vibration. Idle RPM then should be increased by moving troll lever slightly toward "Run" position. When desired idle RPM is obtained, loosen idle stop cap screw and nut and move idle stop bracket against drag link swivel. (Figure 7)

LEAD WIRE SHIELD - MERC 200 - 110 - 60

Production is now installing a lead wire shield on the magneto stator plate of all Merc 200-110 & 60 motors. This shield prevents the flywheel from rubbing or chafing, with subsequent shorting of spark plug leads which may have been improperly positioned.

NOTE: Merc 200 requires lead wire shield 34674A1. (Figure 8)Merc 110 & 60 require lead wire shield 35599A1 which is offset to provide necessary clearance for the flywheel. (Figure8)

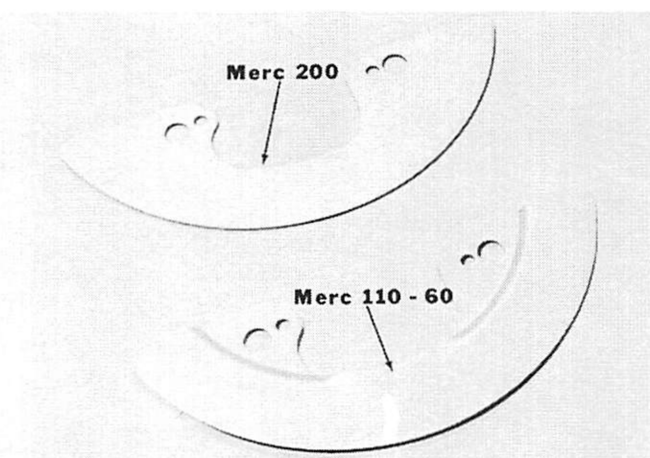


Figure 8. Merc 200 Wire Shield (34674A1) - Merc 110 & 60 Wire Shield (35599A1)

These new shields can be easily installed on earlier models which have the late style magneto.

INSTALLATION

1. Remove magneto stator and stator hold-down ring.
2. Use lead wire shield as a template. Place shield in position, as shown in Figures 9 & 10, and center punch screw holes.

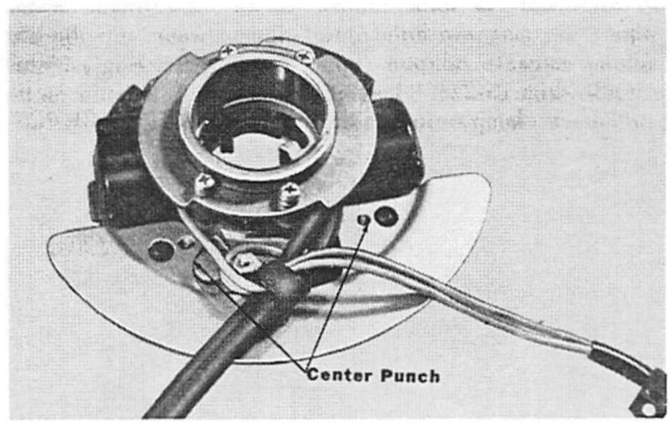


Figure 9. Wire Shield (35599A1) in Position

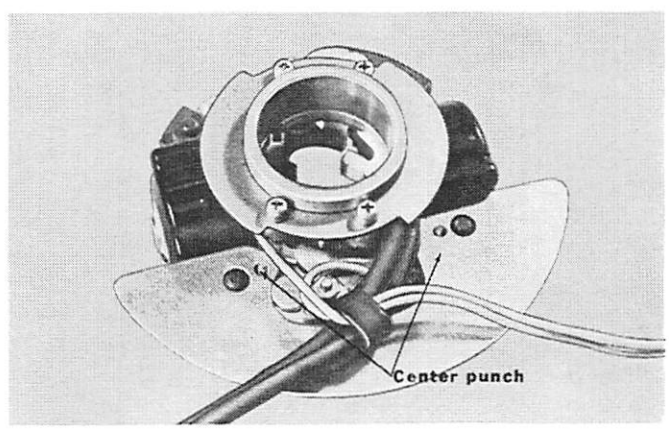


Figure 10. Wire Shield (34674A1) in Position

3. Drill and tap stator plate with a No. 21 drill and a 10-32 N.F. tap. Be careful not to drill into the coil core.
4. Blow out chips and inspect magneto carefully, as any loose metal particles could cause ignition malfunction.
5. Install shield with 2 screws (10-34695) and 2 lockwashers (13-26996).

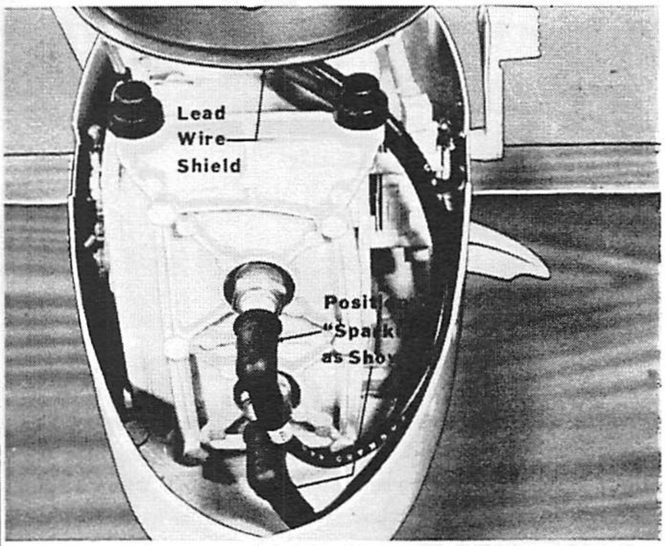


Figure 11. Spark Plug Leads Installed

34674A1 Lead Wire Shield Assembly for Merc 200 *(Includes One 34674 Shield, Two 10-34695 Screws & Two 13-26996 Lockwashers)*

6. Reinstall hold-down ring and install magneto stator on powerhead.
7. Install spark plug leads on the spark plugs and position as shown in Figures 11 & 12.

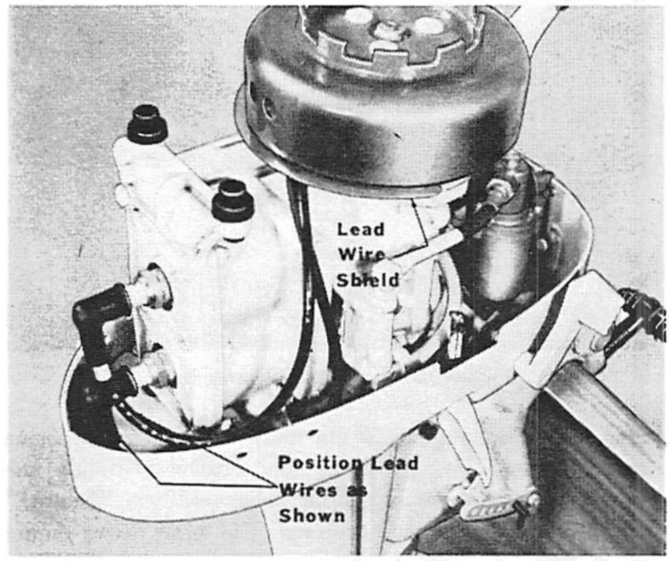


Figure 12. Spark Plug Leads Installed

35599A1 Lead Wire Shield Assembly for Merc 110-60 *(Includes One 35599 Shield, Two 10-34695 Screws & Two 13-26996 Lockwashers)*

MAGNETO MOUNTING MODIFICATION - 2 - CYL. MODELS

If difficulty is experienced on any 2-cylinder model, where the magneto hold down clamps wear into the aluminum magneto adaptor (upper bearing housing), install a split shim 15-22371 beneath the magneto adaptor on the hold down clamp surface. Lubricate with MULTIPURPOSE Lubricant.

If wear occurs, the stator plate becomes loose and has excessive play which may permit the stator coil cores to strike the flywheel magnets, or it also may cause misfiring.

TIMING, ADJUSTING, TESTING --- MARK 55-55E

I. Timing and Adjusting

A. Upper Shift Shaft Adjustment (Figure 1)

When shift control lever is in forward gear, detent spring should be in the first notch of the shift control lever. If it is not, adjust upper shift shaft in the following manner:

1. Remove cotter pin from link rod.
2. Turn link rod to allow detent spring to catch in first notch.
3. Tighten lock nut on link rod. (Figure 1)
4. Replace cotter pin.

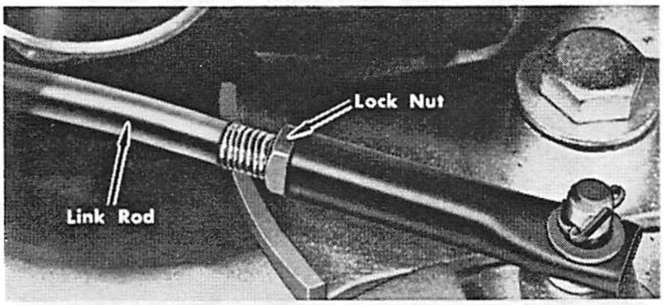


Figure 1. Upper Shift Shaft Adjustment

B. Flywheel and Magneto Pulley Timing

Rotate flywheel until timing mark (stamped on rim) is in a straight line with center of crankshaft and distributor pulley center. Position arrow on pulley to point at timing mark and replace timing belt, plate, cap screws and washers. (Figure 1A)

NOTE: Flywheel has 2 markings. One is a straight line which times the motor to top dead center (TDC) when positioned with arrow on magneto driven pulley. Second is a straight line with an "O" stamped over it. (Figure 1A) This is .235 BTDC (before top dead center). When this marking is in a direct line with center line of crankshaft and centerline of magneto shaft, the key way of magneto shaft should be on centerline of starter mounting hole bushing.

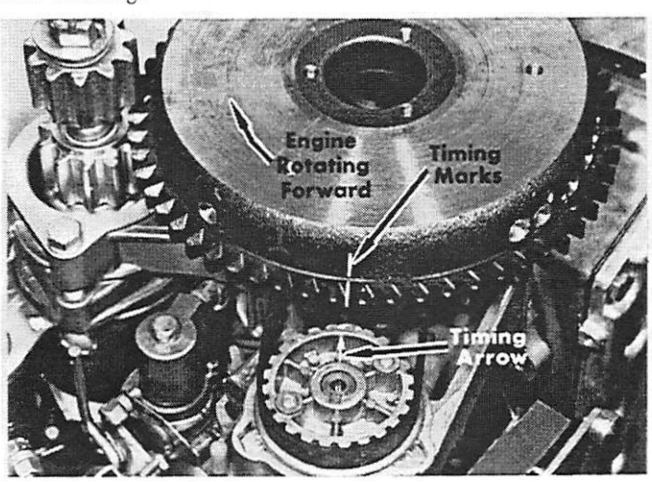


Figure 1A. Flywheel and Magneto Pulley Timing

C. Magneto Drive Coupling

With flywheel and pulley in above position, install magneto on engine. Magneto rotor shaft and shaft extension are splined with one blanked spline on each shaft for easy installation. (Figure 2) Rotate timing pulley until shaft sets in place. A 1/16" groove is located at end of shaft coupling in centerline of blanked shaft to locate for easy installation. Secure to magneto adaptor with 4 cap screws.

Attach grounding wire to magneto frame with self-tapping screw and nylon clamp and terminal of grounding wire to primary ground terminal of magneto with 3/8" nut. Secure ground strap to crankcase bolt which was removed and replace magneto air ventilation hoses.

II. Carburetor Adjustment

When adjusting carburetor high speed needles, it is recommended that the propeller be removed and the Test Wheel (48-26976) be installed. Engine will then turn about 5200-5300 RPM at full throttle in the test tank or 5000 RPM on the back of a boat. This will permit the accurate adjustment of carburetors for maximum engine RPM. (Use Tachometer 91-28014.)

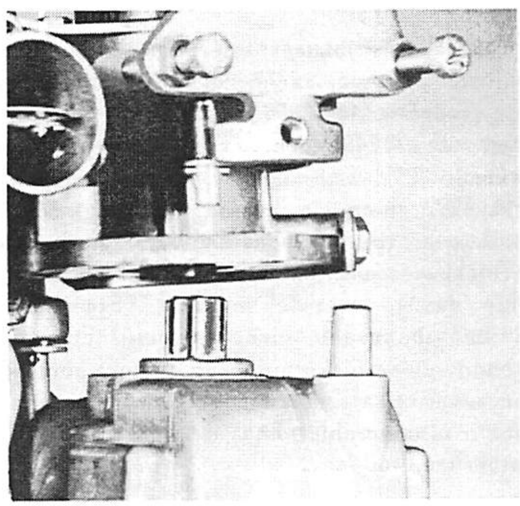


Figure 2. Installing Magneto on Engine

A. High Speed Adjustment

First warm up engine thoroughly. Operate engine at wide open throttle and slowly turn high speed mixture adjusting needle counterclockwise until engine starts to "four cycle", and motor begins to slow down. Then turn high speed mixture adjusting needle clockwise through range where cylinders fire normally to the point where engine again slows down, indicating that mixture is becoming too lean. Determine this critical "leaning out" point as accurately as possible and back adjusting needle out one-half turn from that point. (Figure 3) When in doubt, it is better to set mixture slightly rich rather than too lean, because an excessively lean mixture will cause overheating and loss of power. Sustained full throttle operation with an excessively-lean mixture may cause severe engine damage.

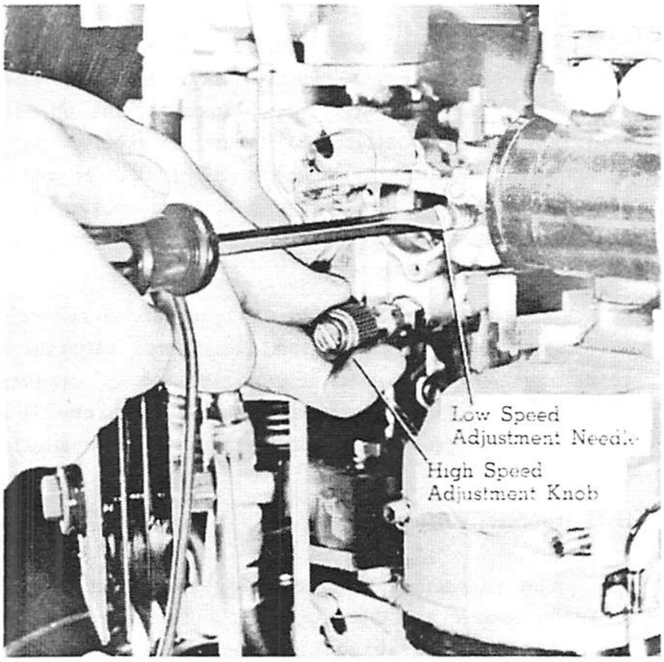


Figure 3. Carburetor Adjustments

B. Idle Adjustment

Make idle adjustment after high speed adjustment is completed. It, too, can be done with the carburetor adjusting propeller (48-26976) in the test tank or on the boat. Start with all idle needles 7/8 turn open and adjust for maximum RPM with magneto retarded to give about 600 RPM. With the engine running at idling speed while in forward gear, turn low speed mixture adjusting needle counterclockwise until engine starts to "load up" or fire unevenly due to over-rich mixture. (Figure 3) Then slowly turn the needle clockwise until cylinders fire evenly and engine picks up speed. Do not adjust leaner than necessary to attain reasonably smooth idling. When in doubt, it is preferable to have the mixture set slightly rich rather than too lean.

NOTE: Idle cannot be adjusted while in "Neutral" or engine will sputter and stop when shifted to "Forward" because of "no load" condition while adjusting.

III. Linkage Adjustment

A. Pickup Adjustment

With engine running in forward gear, loosen 2 hex head cap screws which hold carburetor actuating bracket on magneto. Advance throttle (magneto) to obtain 1100-to-1200 RPM. Rotate carburetor actuating bracket so that it just touches back of throttle pickup bracket. (Figure 4) At this RPM, secure carburetor actuating bracket in position by tightening the 2 cap screws.

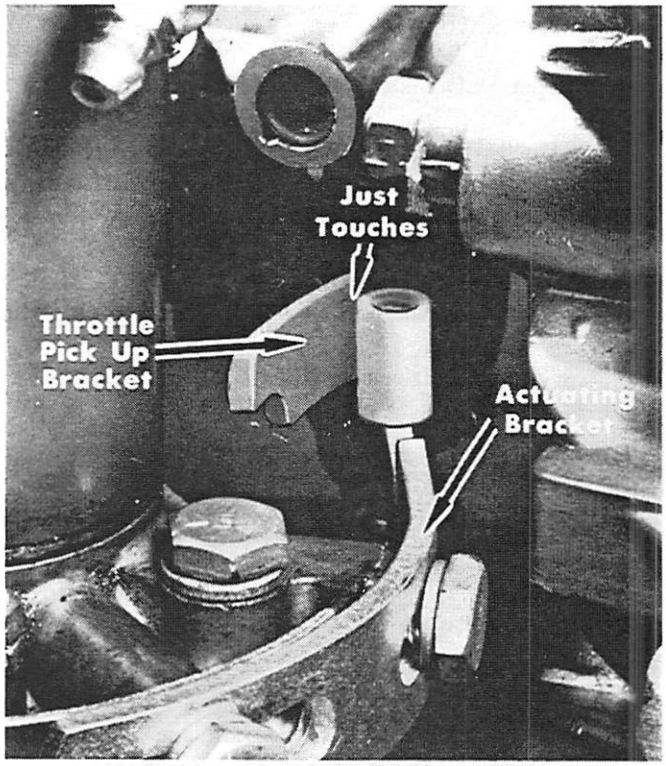


Figure 4. Pickup Adjustment

B. Neutral RPM

Shift into neutral gear with engine running and advance magneto control lever until control lever is stopped by shift lock bracket recess at 2400-to-2500 RPM. *(IMPORTANT: This procedure also is used for maximum shift and reverse RPM.)* To adjust, loosen vertical magneto actuating bracket to increase or decrease RPM. (Figure 5) While holding magneto, move vertical bracket to forward to increase neutral RPM, back to decrease neutral RPM. After proper neutral RPM has been obtained, tighten vertical actuating bracket screws. Shift into reverse and back to forward several times. Check position of detent spring and adjust if necessary.

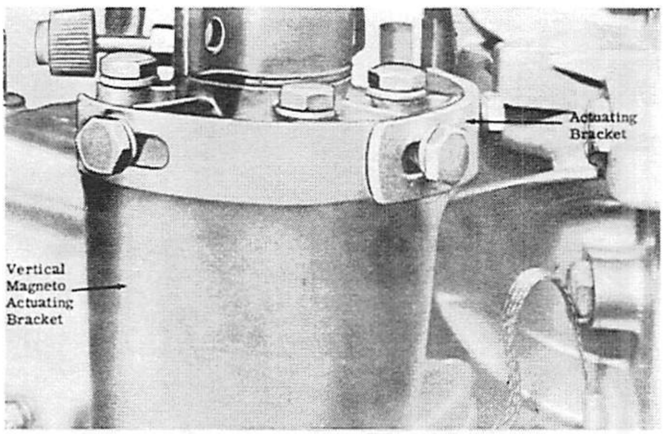


Figure 5. Adjusting Magneto Actuating Bracket

IV. Timing -- Maximum Spark Advance

Thread Timing Gauge (91-26916A1) into No. 1 spark plug hole. Turn flywheel until No. 1 piston strikes the timing gauge. While turning flywheel, thread timing gauge in or out so that piston can "rock" over center shaft of gauge, indicating that timing gauge is set at top dead center position. (Figure 6) Rotate flywheel clockwise ¼ turn, depress center shaft of timing gauge and rotate ¼ turn to seat on tool body shoulder (.235" BTDC position). Be careful that tool body does not move, or above procedure will have to be repeated. Rotate flywheel clockwise until No. 1 piston strikes timing gauge center shaft. This is .235" BTDC.

Attach one test lead of Timing Meter (91-22966) or Magneto Analyzer (91-25213, No. 2 scale), "Resistance") second lead of tester to primary ground terminal of magneto. With the cowl rear stop block loose, slowly advance magneto until points break as indicated by tester used. Hold magneto at this position and adjust cowl rear stop block to contact magneto actuating bracket and tighten stop block screw.

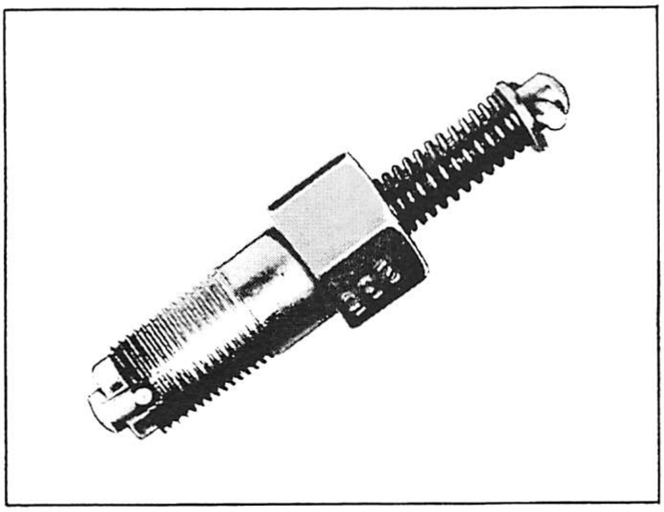


Figure 6. Timing Gauge (91-26916A1)

V. Remote Control Adjustment

A. Throttle Control

Brass cable anchor on engine end of remote control throttle cable must be adjusted by turning so that bottom cowl lever will strike the stop blocks in both forward and reverse before the stroke is used up in remote control box. *(Note: On Mark 58-58A-55A-35A, the travel is set on the magneto adaptor limiter stop.)* If this adjustment is not made, either full forward throttle operation or full reverse throttle operation will not be obtainable. (Figure 7)

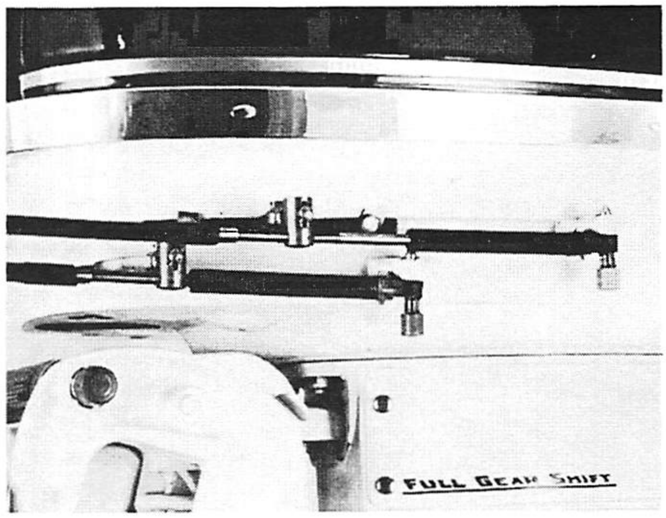


Figure 7. Cable Anchor Adjustment

B. Shift Control

Set remote control lever in "Neutral" position in control station. Set shift lever on engine in neutral position, anchor cable to anchor block on rear side of engine with knurled pin and adjust brass cable anchor block on cable to align with clevis yoke on shift lever on engine. Remove cable from anchor block at rear side of engine and attach brass cable anchor block on clevis arm. Re-attach end of control lever to anchor block.

(Also Applies to Mark 20, Mark 15 and KH-7)

I. Linkage Adjustment - Timing

A. Check and Adjust Reverse Lock Mechanism

Reverse lock lever must fully engage tilt pin in neutral and reverse gear. To adjust, bend actuating fork on reverse lock lever assembly to engage when shifted in neutral or reverse. (Figure 1)

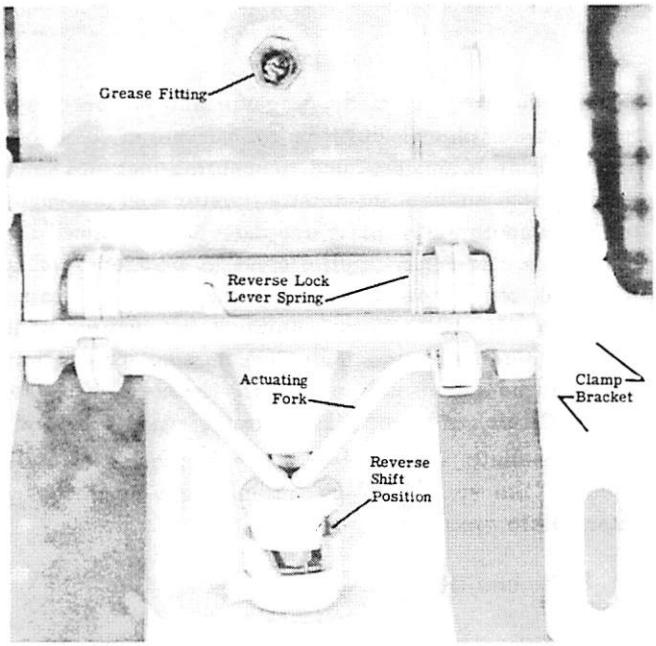


Figure 1.

B. Sector Gear (Figure 2)

A correct relative position of drive sector gear with magneto sector gear is necessary to assure full range of advance-retard movement. To check, turn magneto stator plate to full retard position and note relation of drive gear to driven gear. When properly engaged, last tooth on driven gear registers <u>between</u> last 2 full teeth on drive gear so that last (partial) tooth on drive gear acts as a stop. If necessary to reset, merely loosen vertical shaft bracket screws so that drive gear can be pulled out of engagement with driven gear. After correct relative position has been attained, retighten screws securely.

Sufficient gear lash must be allowed between drive gear and driven gear. Lash can be adjusted by means of .005" or .010" shims fitted between vertical shaft bracket and crankcase. Lash should not be more than is necessary to prevent binding or interference between gear teeth, but it must be sufficient to be noticeable. Vertical shaft and lever assembly must have sufficient end play in bracket to operate freely, but end play must be held to a minimum. If necessary, fit shims between lower face of bracket and vertical shaft lever. (These shims are available in thicknesses of .005" and .010".)

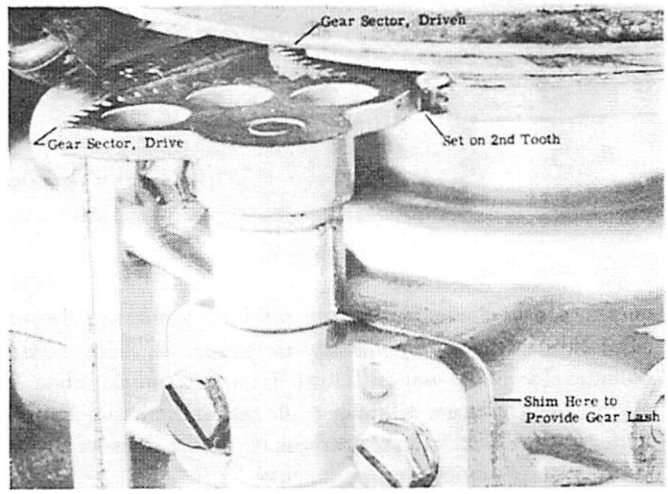


Figure 2.

C. Throttle Control Linkage Setting (Figure 3)

The throttle control linkage rod on later Mark 25 models is non-adjustable. On earlier models with the adjustable swivel and linkage rod, set the throttle control linkage rod to measure 2 9/16" from centerline to centerline of rod.

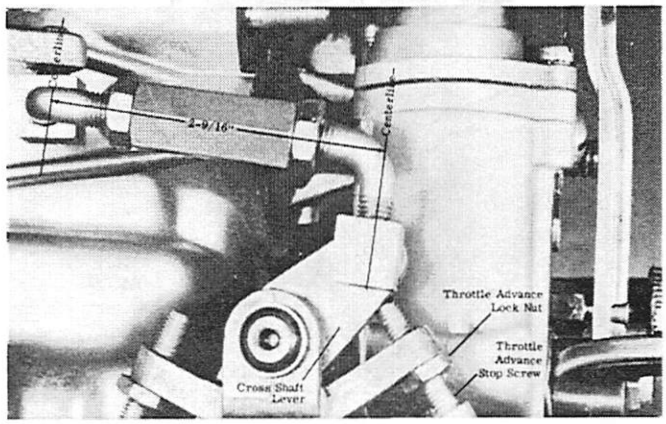


Figure 3.

D. Spark Advance (Figure 3)

Turn twist grip throttle so throttle arm of carburetor is approximately 3/4" from end of magneto cam travel. Adjust set screw in throttle and shift lock bracket to just touch control lever at this point. (Figure 4.) To retard spark, turn forward adjusting set screw in throttle and shift lock bracket inward to desired setting. This will retard magneto travel. To increase magneto travel for more spark advance, turn adjusting set screw outward.

II. Carburetor Adjustment

A. High Speed Adjustment

Warm up engine thoroughly. Operate engine at full throttle in forward gear. Slowly turn high speed adjusting needle counterclockwise. Engine will "four-cycle". Turn high speed needles clockwise to a point where

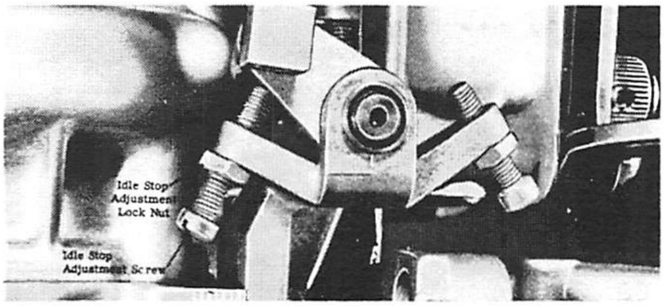


Figure 4

engine slows down, indicating too lean a mixture. Determine this point as accurately as possible. Turn needle counterclockwise one-half turn from that point. When in doubt, set mixture slightly rich rather than too lean. A lean mixture will cause overheating and a loss of power could cause severe engine damage.

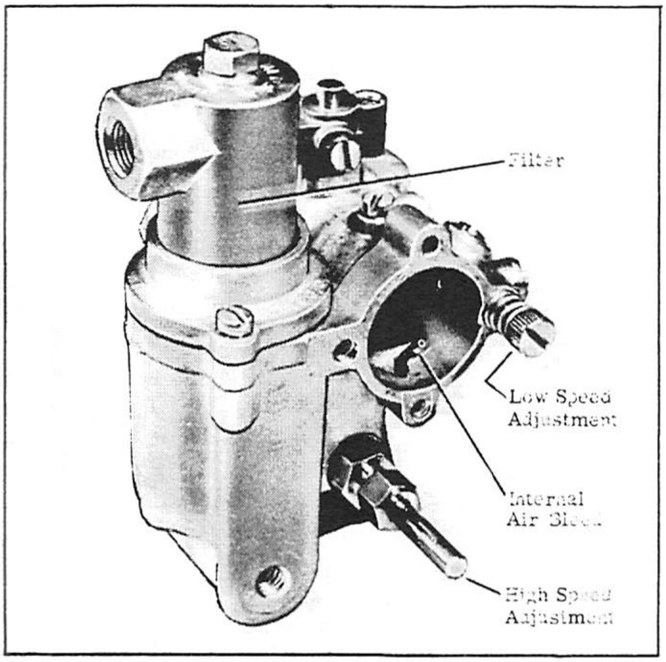


Figure 5

B. Low Speed Adjustment (Figure 5)

With engine running in forward gear, turn low speed adjusting needle clockwise until engine slows down from this point. Turn low speed needle counterclockwise about one-half turn. Do not adjust leaner than necessary to attain reasonably smooth idling. When in doubt, set mixture slightly rich rather than too lean. Engine should idle at about 500 RPM.

Note: Idle cannot be adjusted while in "Neutral" or engine will sputter and stop when shifted to "Forward" because of "no load" condition while adjusting.

III. Adjusting and Testing

A. Pickup Adjustment (Figure 6)

With engine running in forward gear, turn twist grip throttle to obtain 1000 RPM. At this point, the

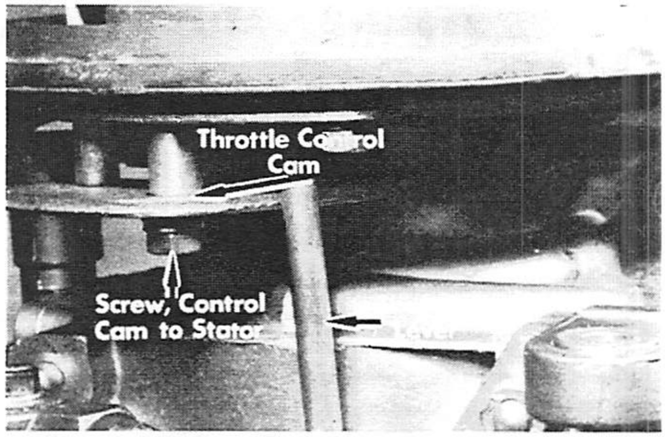


Figure 6.

throttle pickup cam on the magneto should just touch the carburetor throttle lever on the carburetor. If recommended RPM is not obtained, loosen the long hex head screw which secures the throttle control cam assembly to the magneto stator plate and move cam portion "in" (away from carburetor throttle lever) to decrease pickup RPM and "out" (toward carburetor throttle lever) to increase pickup RPM. After obtaining the desired 1000 RPM, tighten screw to secure cam. In some cases, this lever may be set to pick up slightly before or after the 1000 RPM pickup to eliminate erratic engine operation at intermediate speed. Improper synchronization will cause a "flat spot" or 4-cycling in engine operation at intermediate speeds.

B. Neutral RPM

With engine running, turn twist grip throttle to neutral. Engine should operate at 2400 RPM. To adjust RPM, adjust position of lock drum on cross shaft by setting shift lever in forward position and sliding lock drum to position where stop pin just clears end face of drum. Move shift lever to neutral position and turn twist grip throttle to advance magneto to obtain 2400 RPM. With magneto remaining in this position, turn lock drum to position where flat surface contacts end of stop pin. Secure lock drum in this position by tightening set screw. Repeat shifting procedure to check engine shift range--forward, neutral and reverse.

C. Readjust Interlock-Remote Control

It has been noted that Mark 25 motors, with remote control attached, have excessive high RPM in neutral gear and shifting range because of lost motion between vertical connection and throttle-shift interlock control. Readjust interlock drum to get correct RPM after installing remote control. To readjust interlock, decrease RPM by resetting throttle and shift lock drum. Loosen 1/4" square head set screw and rotate drum slightly forward to obtain 2400 RPM in neutral gear. Do not allow engine to race when shifting or while in neutral gear. Decrease RPM by retarding throttle.

TIMING, ADJUSTING AND TESTING - MARK 30-30E

I. TIMING AND ADJUSTMENT

A. Check and Adjust Reverse Lock

Reverse lock lever must fully engage tilt pin in neutral and reverse gear. To adjust, bend actuating fork on reverse lock lever assembly to engage when shifted in neutral or reverse. (Figure 8)

B. Flywheel and Magneto Pulley Timing

Rotate flywheel until timing mark (stamped on rim) is in a straight line with center of crankshaft and distributor pulley center. Position arrow on pulley to point at timing mark and replace timing belt, plate, cap screw and washers.

(NOTE: Flywheel has 2 markings. One is a straight line which times the motor to top dead center (TDC) when positioned with arrow on magneto driven pulley. Second is a straight line with an "O" stamped over it. This is .235" BTDC (before top dead center). When this marking is in direct line with the center line of crankshaft and centerline of magneto shaft, the keyway of the magneto shaft should be on centerline of starter mounting hole bushing.

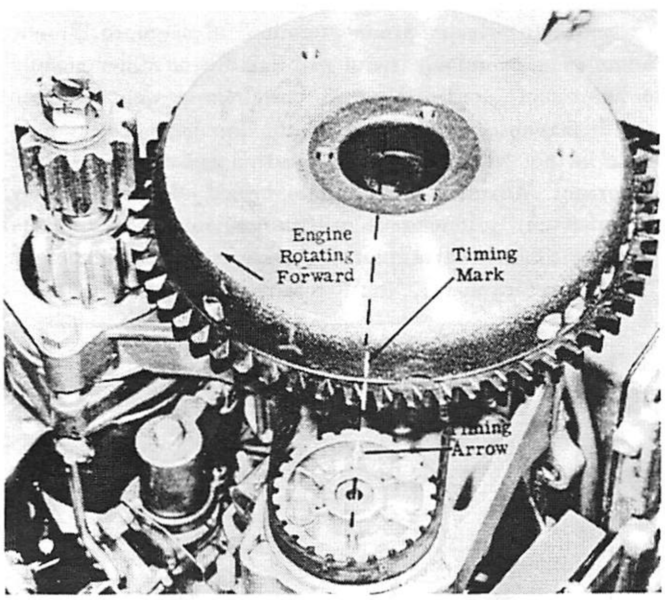


Figure 1. Timing Marks

C. Magneto Installation

1. Early Model Mark 30

To replace magneto, first place bell crank, pivot lever and attached parts in relative position with side of pivot lever marked "Top" to the top. After completing repairs to magneto, replace distributor cap and lead wires. Insert splined shaft of magneto into splined drive shaft in magneto adaptor with blanked spline on magneto shaft in alignment with blanked spline of magneto drive shaft. Secure with 4 cap screws. It may be necessary to move linkage to get magneto shaft into adaptor housing. Set intermediate pivot lever post in recess at front of bottom cowl and secure with elastic stop nut. Place pivot lever with side marked "Top" on seat of bottom cowl and secure in place with 2 screws and lockwashers. Use open end wrench to replace front screw through opening above elbow in bottom cowl and socket wrench for rear screw.

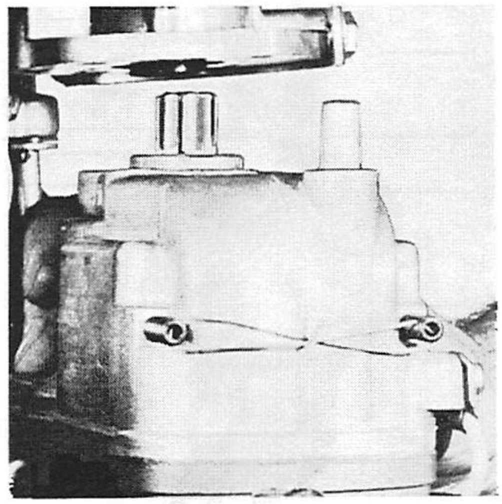


Figure 2. Installing Magneto On Engine

Linkage reassembly now is completed. Place magneto actuating bracket pivot post in nylon bushing of bell crand and secure bracket to magneto frame with 2 small screws and lockwashers. Attach grounding wire to magneto frame with self-tapping screw and nylon clamp, and terminal of grounding wire to primary ground terminal of magneto with 3/8" nut. Secure ground strap to crankcase bolt which was removed and replace magneto air ventilation hoses.

2. Mark 30 1-2-3-4 Models

To replace magneto after completing repairs, first replace distributor cap and lead wires. Insert splined shaft of magneto into splined shaft coupling in magneto adaptor with blanked spline on magneto shaft in alignment with missing spline of magneto shaft coupling. A 1/16" groove is located at end of shaft coupling in centerline of missing spline to locate for easy installation. Set mounting plate and link plate in position and secure to adaptor with 4 cap screws. Attach grounding wire to magneto frame with self-tapping screw and nylon clamp and terminal of grounding wire to primary ground terminal of magneto with 3/8" nut. Secure ground strap to crankcase bolt which was removed and replace magneto air ventilation hoses. Replace magneto limiter bumper and throttle actuator assembly on magneto adaptor and secure with 3 cap screws.

(NOTE: Use alignment marks made when brackets were removed to help locate relatively correct position. The screw and nut on magneto travel limiter are for adjusting magneto travel and to set idle revolutions.) The magneto vertical shaft can be removed from the crank--case by driving the 2 roll pins from the shaft and loosening the 2 set screws in upper and lower linkage levers.

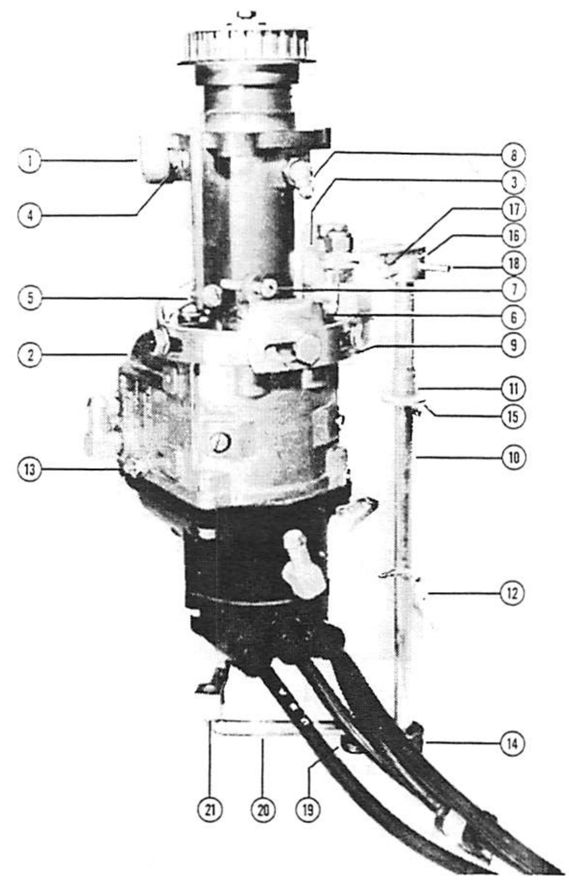


Figure 3. Magneto and Bracket

1	Magneto Adaptor and Pilot Assembly
2	Magneto Assembly
3	Mounting Link Plate Assembly
4	Screw, tension adjusting
5	Bumper, magneto limiter
6	Limiter, magneto travel
7	Screw, limiter adjusting
8	Fitting, grease
9	Throttle Adjustment Assembly
10	Vertical Shaft
11	Bushing, nylon - vertical shaft
12	Ground Strap Assembly
13	Primary Ground Terminal
14	Lever, linkage
15	Washer, vertical shaft
16	Magneto Actuating Lever Assembly
17	Screw, set - actuating lever
18	Roll Pin, vertical shaft to lever
19	Swivel, vertical shaft to link rod
20	Rod, link
21	Swivel, link rod to cross shaft lever

II. TIMING - MAXIMUM SPARK ADVANCE

Thread Timing Gauge (91-26916A1) into No. 1 spark plug hole. Turn flywheel until No. 1 piston strikes the timing gauge. While turning flywheel, thread timing gauge in or out so that piston can "rock" over center shaft of gauge, indicating that gauge is set at top dead center position. Rotate flywheel ¼ turn clockwise, depress center shaft of timing gauge and rotate ¼ turn to seat on tool body shoulder (.235" BTDC position). Be careful that tool body does not move, or above procedure must be repeated. Rotate flywheel clockwise

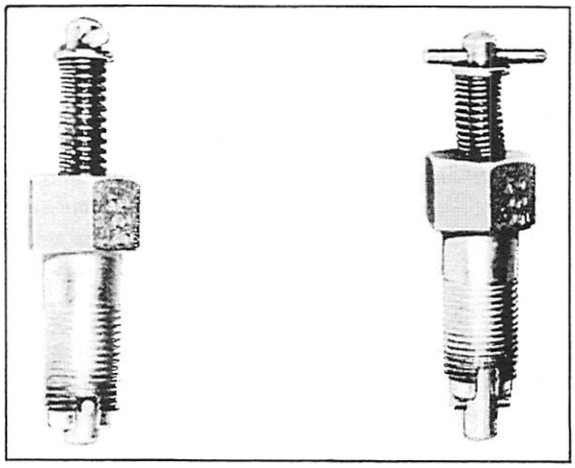


Figure 4. Timing Gauge 91-26916A1

until No. 1 piston strikes timing gauge center shaft. This is .235" BTDC. Attach one test lead of Timing Meter (91-22966) or Magneto Analyzer (91-25213; No. 2 scale, "Resistance") to magneto frame and second lead of tester to primary ground terminal of magneto. Slowly advance magneto via twist grip handle on older models or via remote control lever so that linkage wear is taken up. If magneto is advanced by moving magneto linkage, wear is not taken into consideration and timing will be incorrect. Advance until points break, as indicated by tester used. Hold magneto at this position and adjust as follows: Turn front adjusting screw on lower right cowl "in" to retard spark, "out" to advance spark.

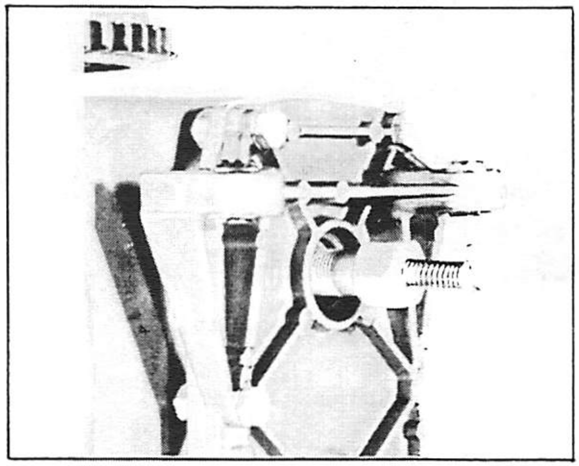


Figure 5. Timing Gauge in Spark Plug Hole

III. CARBURETOR ADJUSTMENTS

(It is recommended that the propeller be removed and carburetor adjusting propeller 48-26975 be installed. Engine then will turn about 5000 RPM at full throttle in test tank, 600 RPM at idle. Use tachometer 91-28014.)

A. High Speed Adjustment (Figure 6)

Warm up engine thoroughly, then operate at wide open throttle, slowly turning high speed mixture adjusting needle counterclockwise until engine starts to "four-cycle" and begins to slow down. Then turn high speed mixture adjusting needle clockwise through range where cylinders fire normally to the point where motor again slows down, indicating that mixture is becoming too lean. Determine this critical "leaning out" point as accurately as possible and back adjusting needle out one-half turn from that point. When in doubt, it is better to set mixture slightly rich rather than too lean, because an excessively lean mixture will cause overheating and loss of power. Sustained full throttle operation with an excessively-lean mixture may cause severe engine damage.

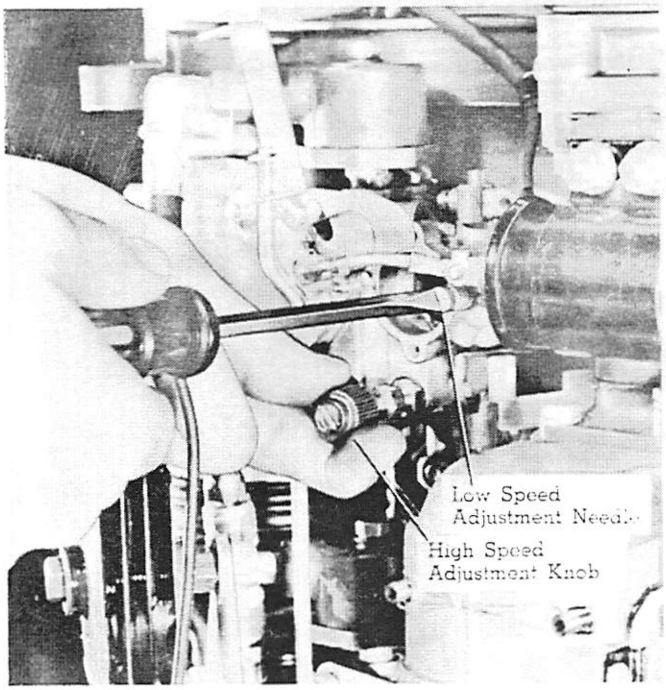


Figure 6. Carburetor Adjustments

B. Idle Adjustment (Figure 6)

Make idle adjustment after completing high speed adjustment. Start with all idle needles 7/8ths turn open and adjust for maximum RPM with magneto retarded to give about 600 RPM. With the motor running at idling speed while in forward gear, turn the low speed mixture adjusting needle counterclockwise until affected cylinders start to "load up" or fire unevenly due to over-rich mixture. Then slowly turn the needle clockwise until cylinders fire evenly and motor picks up speed. Do not adjust leaner than necessary to attain reasonably smooth idling. When in doubt, it is preferable to have the mixture set slightly rich rather than too lean.

IV. LINKAGE ADJUSTMENTS

A. Idle Stop Setting

Readjust carburetor to get proper idle at 600 RPM. Allow magneto to travel back far enough by adjusting set screws on right side of bottom cowl on early Mark 30 models. Rear adjusting set screw turns "in" for less retard and "out" for more retard. On later models, adjust idle set screw on magneto adaptor. *(IMPORTANT: Engine must idle for 3 minutes at 600 RPM or lower without misfiring.)* Engine is stopped with shorting switch.

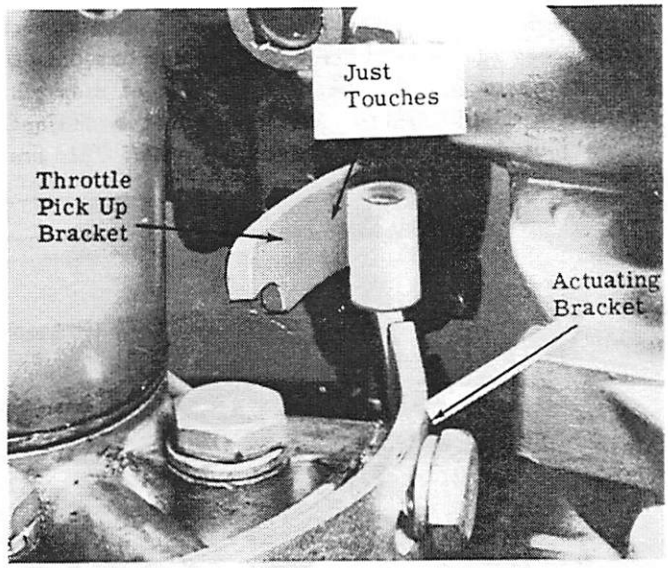


Figure 7. Pickup Adjustment

B. Pickup and Synchronization Adjustment (Figure 7)

With engine running in forward gear, loosen 3 hex head cap screws holding carburetor actuating bracket on magneto. Advance magneto throttle to obtain 1000 to 1100 RPM. Rotate carburetor actuating bracket to just touch back of throttle pickup bracket. At this RPM.

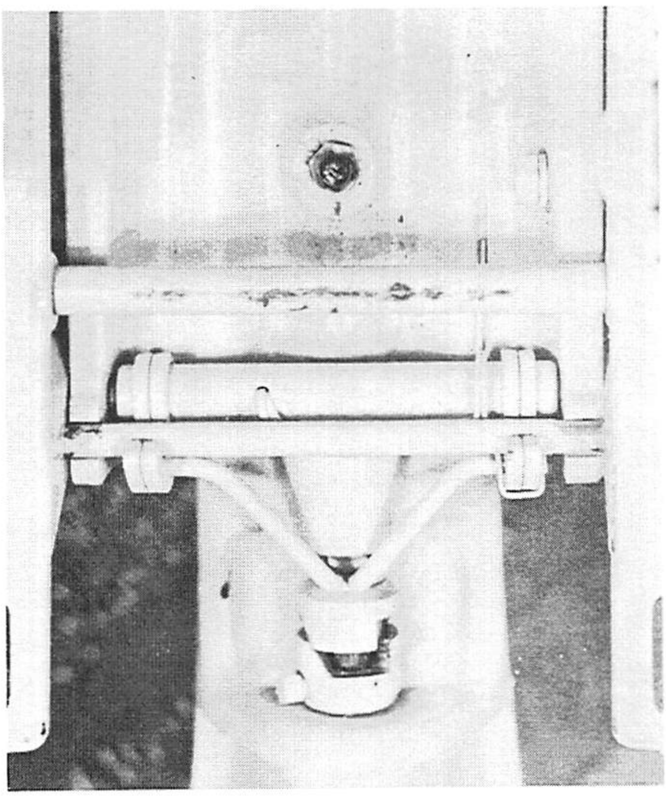


Figure 8 Engaging Reverse Lock Lever

secure carburetor actuating bracket in this position by tightening the 3 cap screws.

C. Neutral RPM and Shifting Range

Shift into neutral gear and advance magneto until throttle and shift lock drum is contacted by the stop pin on the shift lever at 1800-2200 RPM. To obtain correct RPM, loosen square head screw in drum and turn drum to position where flat surface contacts end of stop pin. Advance or retard magneto until desired RPM is obtained. Secure lock drum with set screw. *(Important: This procedure also is used for maximum shift and reverse RPM. Shift into the various gears to check indexing of drum.)*

V. REMOTE CONTROL ADJUSTMENT

Cable Anchor: Brass cable anchor on engine end of remote control cable must be adjusted by turning so that the throttle lever will allow full traverse in both forward and reverse directions before the stroke is used up in remote control box. If this adjustment is not made, either full forward throttle operation or full reverse throttle operation will not be obtainable. (Figure 9.)

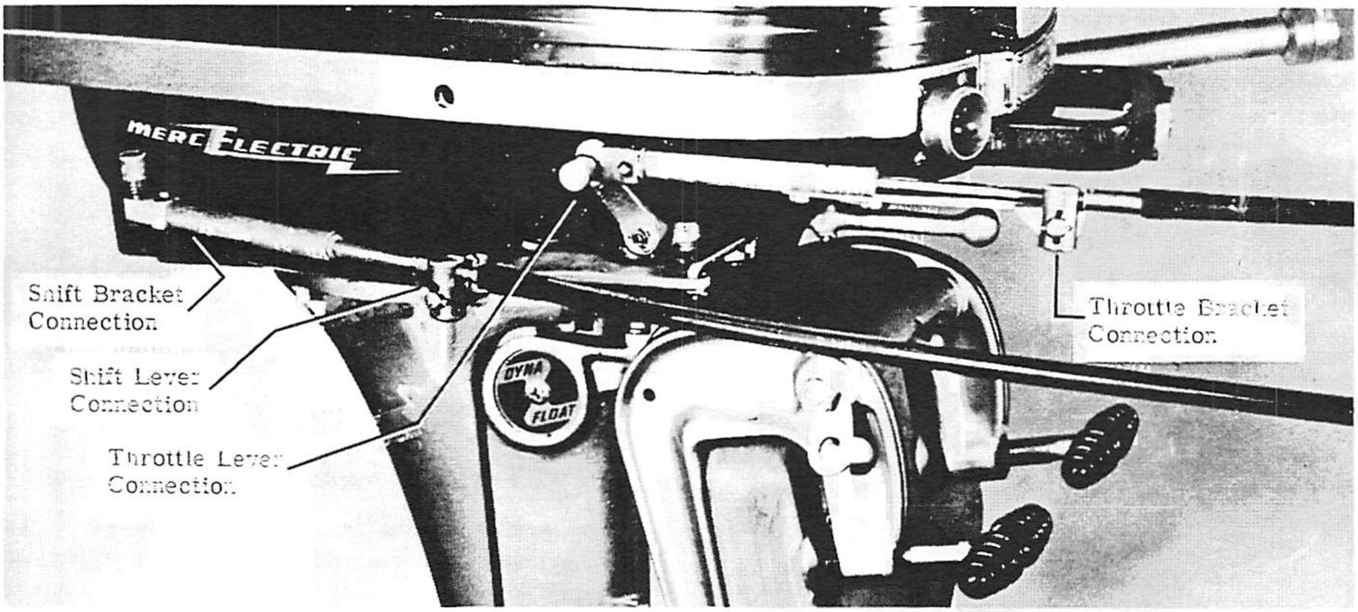


Figure 9. Brass Cable Anchor Adjustment

TIMING, ADJUSTING, TESTING --- MARK 55H - 30H

TIMING AND ADJUSTING

Flywheel and Magneto Pulley Timing

Rotate flywheel until timing mark ("TDC" stamped on rim) is in a straight line with center of crankshaft and distributor pulley center. Position arrow on pulley to point at timing mark and replace timing belt, plate, cap screws and washers. (Figure 1)

Timing Magneto to Motor

The flywheel has 2 markings: One is a line marked TDC (top dead center) and the other marked "40". (Figure 1) This is 40½° or .320" (8.128mm) BTDC (before top dead center). When the "40" marking is in line with the short line marked on the pulley flange, the piston is 40½° or .320" (8.128mm) BTDC. Use Timing Gauge (C-91-24111) to check timing.

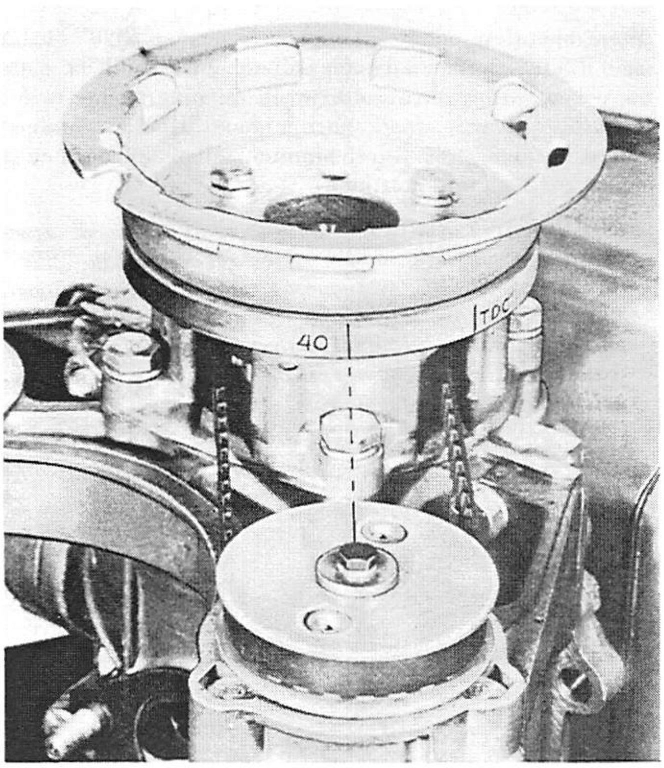


Figure 1. Timing .320" BTDC

Magneto Drive Coupling

With flywheel and pulley in above position, install magneto on engine. Magneto rotor shaft and shaft extension are splined with one blanked spline on each shaft for easy installation. (Figure 2) Rotate timing pulley until shaft sets in place. A 1/16" (1.588mm) groove is located at end of shaft coupling in centerline of blanked shaft to locate for easy installation. Secure to magneto adaptor with 4 cap screws.

Attach grounding wire to magneto frame with self-tapping screw and nylon clamp and terminal of grounding wire to primary ground terminal of magneto with 3/8" nut. Secure ground strap to crankcase bolt which was removed and replace magneto air ventilation hoses.

PICKUP ADJUSTMENT

With engine running, loosen 2 hex head cap screws

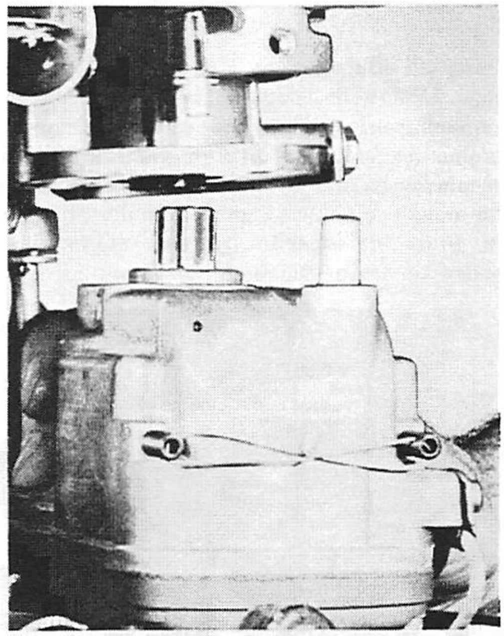


Figure 2. Installing Magneto on Engine

which hold carburetor actuating bracket on magneto. Advance throttle (magneto) to obtain 1000-to-1100 RPM on Mark 30H and Mark 55H with Tillotson carburetors, 2000-to2400 RPM on Mark 55H with Carter carburetors. Rotate carburetor actuating bracket so that it just touches back of throttle pickup bracket. (Figure 3) At this RPM, secure carburetor actuating bracket in position by tightening the 2 cap screws.

CARBURETOR ADJUSTMENTS

When adjusting carburetor high speed needles, it is recommended that the propeller be removed and the carburetor adjusting propeller (A-48-26003-D for Mark 55H; A-48-26003-C for Mark 30H) be installed. Engine will then turn about 6000-to-7000 RPM at full throttle. This will permit the accurate adjustment of carburetors for maximum engine RPM. (Use service tachometer.)

High Speed Adjustment

First warm up engine thoroughly. Operate engine at wide open throttle and slowly turn high speed mixture adjusting needle counterclockwise until engine starts to "four-cycle" and begins to slow down. Then turn high speed mixture adjusting needle clockwise through range where cylinders fire normally to the point where engine again slows down, indicating that mixture is becoming too lean. Determine this critical "leaning out" point as accurately as possible and back adjusting needle out one-half turn from that point. When in doubt, it is better to set mixture slightly rich rather than too lean, because an excessively lean mixture will cause overheating and loss of power. Sustained full throttle operation with an excessively-lean mixture may cause severe engine damage.

Slow Speed Adjustment

Make slow speed adjustment after high speed adjustment is completed. It, too, can be done with the carburetor adjusting propeller in the test tank or on the boat.

NOTE: Test tank should be equipped so that exhaust fumes are channeled out of a building.

Start with all idle needles 7/8 turn open and adjust for maximum RPM with magneto retarded to give desired slow speed range. Turn low speed mixture adjusting needle counterclockwise until engine starts to "load up" or fire unevenly due to over-rich mixture. Then slowly turn the needle clockwise until cylinders fire evenly and engine picks up speed. Do not adjust leaner than necessary to attain reasonably smooth idling. When in

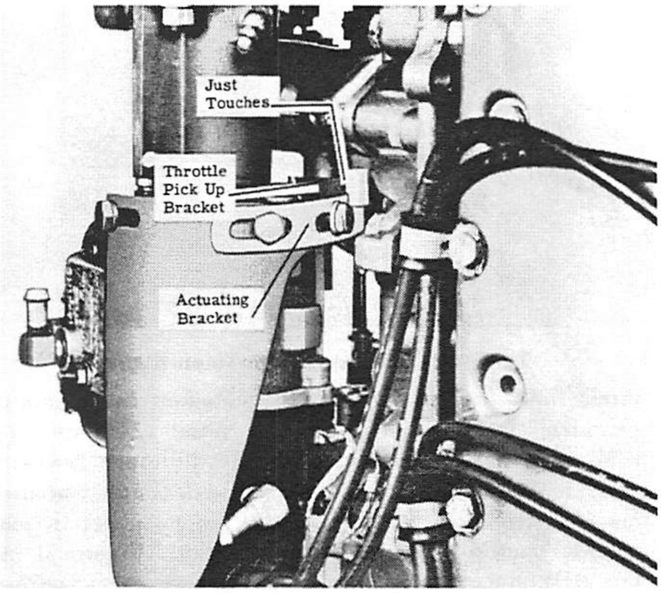


Figure 3. Pickup Adjustment

doubt, it is preferable to have the mixture set slightly rich rather than too lean.

TIMING - MAXIMUM SPARK ADVANCE

The flywheel has 2 markings: One is a line marked TDC (top dead center) and the other marked "40" (Figure 1) This is 40½° or .320" (8.128mm) BTDC (before top dead center). When the "40" marking is in line with the short line marked on the pulley flange, the piston is 40½° or .320" (8.128mm) BTDC.

Attach one test lead or Timing Meter (C-91-22966) or Magneto Analyzer (C-91-25213) to magneto frame and second lead of tester to primary ground terminal of magneto. With the cowl rear stop block loose, slowly advance magneto until points break, as indicated by tester used. Hold magneto at this position and adjust cowl rear stop block to contact magneto actuating bracket and tighten stop block screw.

When operating engine above recommended .320" (8.128 mm) BTDC, further advance adjustment should be made on a boat with a tachometer while running engine at full throttle. Advance spark until highest RPM is obtained and maintained from 3-to-5 minutes. Advance can then be measured for future settings.

IMPORTANT: Extreme caution must be used when operating engine above the recommended .320" (8.128mm) BTDC. Advancing spark beyond recommended degrees will cause pre-ignition, and RPM will decrease noticeably after running for several minutes. Continued operation under this condition will result in scored pistons.

TIMING, ADJUSTING, TESTING
MERC 700-600 DIRECT REVERSING

I. IGNITION DATA

Cylinder Firing Order: 1-6-4-2-5-3
Coil No. 1 fires 1-4-5
Coil No. 2 fires 6-2-3
Spark Plugs: J6J - Standard Installation
XJ6J - Resistor Type*
Spark Plug Gap: .025"
Timing : .235" BTDC (Before Top Dead Center)
RPM : 5500 - Maximum Operating
* *For static elimination on radio or radio -telephone equipped boats.*

II. TIMING AND LINKAGE ADJUSTMENT

A. Flywheel and Distributor Pulley Timing

1. Rotate flywheel until timing mark (arrow) stamped on rim is on line between crankshaft and distributor pulley center. *(No. 1 piston then is 20° after top dead center in forward direction.)*
2. Arrow on distributor pulley should be pointed toward timing mark (arrow) on flywheel. (Figure 1) If it is not, remove timing belt and turn pulley to correct position.

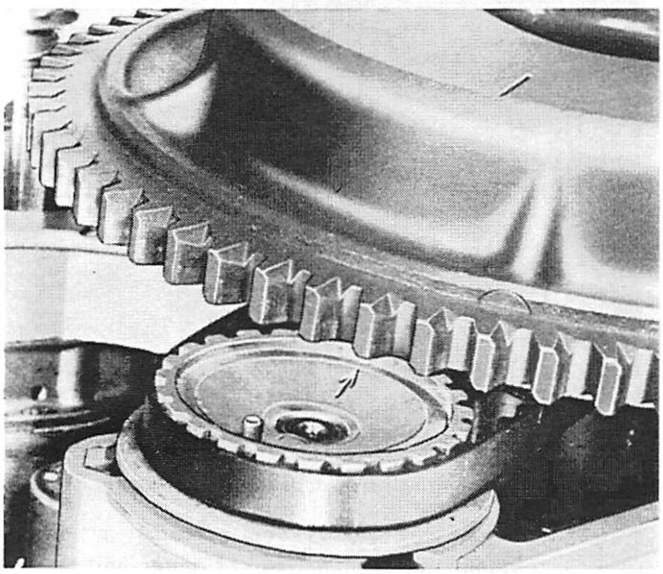
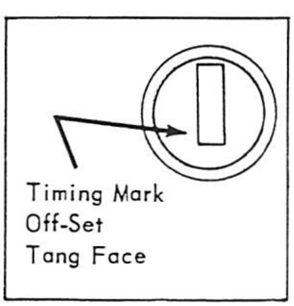


Figure 1. Timing Marks on Flywheel and Pulley

B. Distributor Drive Coupling

1. When distributor is reassembled to engine, flywheel and distributor pulley should be aligned as above. The offset face tang at drive end of distributor shaft should point forward (direction engine will travel when distributor is bolted in place). (See drawing at left.)



2. The offset face of the tang is considered the timing mark. (Figure 2) Drive shaft spring is located in ground out portion which is closest in line with timing belt pulley keyway. This spring has to line up with ground off portion of distributor drive tab before assembling distributor to distributor pilot assembly.
3. Secure distributor adaptor with 4 hex head cap screws.

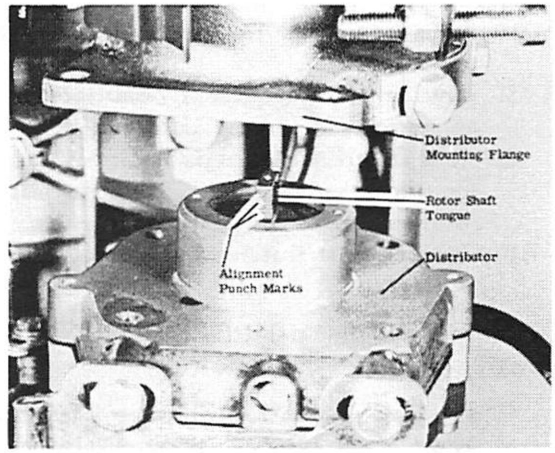


Figure 2. Timing Mark on Offset Tang Face

C. Maximum Spark Advance -- Forward

1. Position distributor with side high tension lead facing approximately forward.
2. Place No. 4 piston at .235" BTDC (before top dead center) by rotating flywheel in a clockwise (forward) direction from BDC (bottom dead center).
3. Thread Timing Gauge (91-26916A1) into No. 4 spark plug hole. (Figure 3)
4. Turn flywheel until No. 4 piston strikes Timing Gauge.
5. While turning flywheel, thread Timing Gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center position.
6. Rotate flywheel clockwise ¼ turn.
7. Depress center shaft of Timing Gauge and rotate ¼ turn to seat on tool body shoulder (.235" BTDC position). Be careful that tool body does not move, or preceding procedure will have to be repeated.
8. Rotate flywheel clockwise until No. 4 piston strikes Timing Gauge center shaft. This is .235" BTDC.
9. Connect one test lead of Timing Meter (91-22966) or Magneto Analyzer 91-25213 (selector switch, on No. 2, Distributor Resistance) to white lead (No. 1 coil primary) at terminal block.

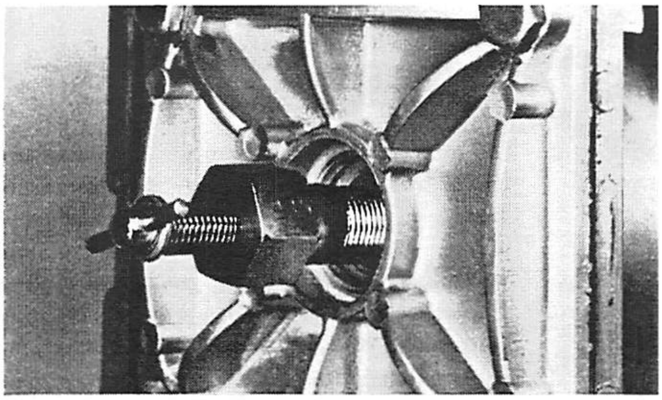


Figure 3. Timing Gauge in Spark Plug Hole

10. Connect second lead of timing unit to distributor frame.
11. Advance distributor slowly until point breaks, as indicated by timing unit used.
12. Hold distributor at this position and adjust distributor advance stop screw to just touch pilot assembly and tighten lock nut.
13. Recheck distributor advance to insure correct setting.

III. CARBURETOR SHAFT REVERSE PICKUP BRACKET

1. Position distributor with side inlet high tension lead facing approximately forward.
2. Move throttle pickup away from the float bowl.
3. Use a ruler and set throttle pickup 7/8" from the front of the float bowl.
4. Make sure throttle shutters are closed.
5. Tighten pickup screw. (Figure 4)

IV. REVERSE PICKUP ADJUSTMENT

1. Position distributor with side high tension lead facing approximately forward.
2. Place No. 4 piston at .030" BTDC (before top dead center in reverse direction) by rotating flywheel in a counterclockwise direction from BDC (bottom dead center).

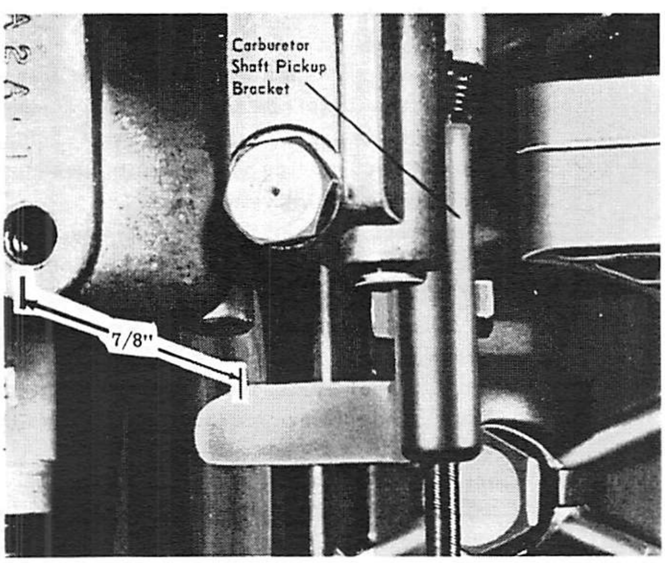


Figure 4. Carburetor Shaft Reverse Pickup Bracket Adjustment

3. Thread .030" Timing Gauge (91-30290A1) into No. 4 spark plug hole.
4. Turn flywheel until No. 4 piston strikes Timing Gauge.
5. While turning flywheel, thread Timing Gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center position.
6. Rotate flywheel counterclockwise ¼ turn.
7. Depress center shaft of Timing Gauge and rotate ¼ turn to seat on tool body shoulder (.030" BTDC position in reverse rotation).
8. Be careful that tool body does not move, or preceding procedure will have to be repeated.
9. Rotate flywheel counterclockwise until No. 4 piston strikes Timing Gauge center shaft. This is .030" BTDC in reverse rotation.
10. Connect one test lead of Timing Meter (91-22966) on Magneto Analyzer 91-25213 (selector switch, on No. 2, Distributor Resistance) to

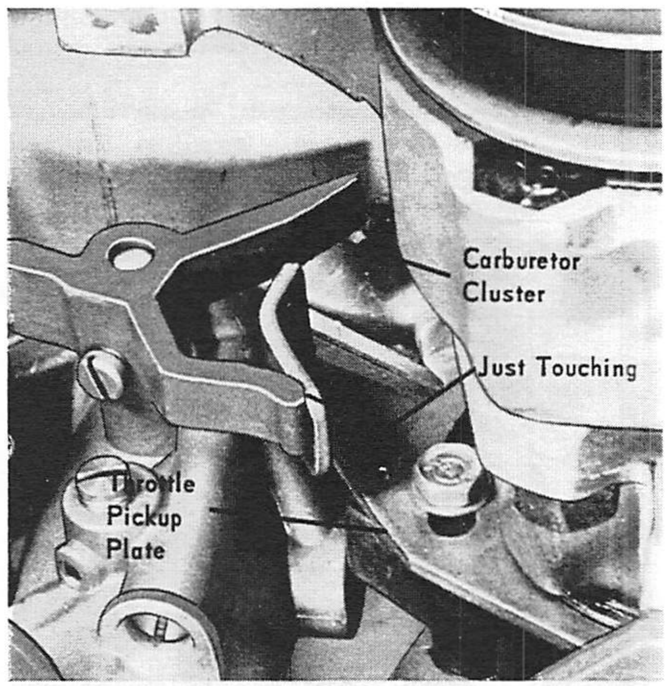


Figure 5. Forward Pickup Adjustment

white lead (No. 1 coil primary) at terminal block with second lead of timing unit attached to distributor frame.

11. Advance distributor slowly in reverse until point breaks, as indicated by timing unit used.
12. Slide reverse throttle pickup lever until it touches reverse throttle pickup.
13. Tighten 2 throttle pickup screws on distributor.
14. Secure lock wire.

V. FORWARD PICKUP ADJUSTMENT

1. Position distributor with side high tension lead facing approximately forward.
2. Place No. 4 piston at .030" BTDC (before top dead center) by rotating flywheel in a clockwise (forward) direction from BDC (bottom dead center).

3. Thread Timing Gauge (91-30290A1) into No. 4 spark plug hole.
4. Turn flywheel until No. 4 piston strikes Timing Gauge.
5. While turning flywheel, thread Timing Gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center position.
6. Rotate flywheel clockwise ¼ turn.
7. Depress center shaft of Timing Gauge and rotate ¼ turn to seat on tool body shoulder (.030" BTDC position). Be careful that tool body does not move, or preceding procedure will have to be repeated.
8. Rotate flywheel clockwise until No. 4 piston strikes Timing Gauge center shaft. This is .030" BTDC. (Figure 5)
9. Connect one test lead of Timing Meter (91-22966) or Magneto Analyzer 91-25213 (selector switch, on No. 2, Distributor Resistance) to white lead (No. 1 coil primary) at terminal block with second lead of timing unit attached to distributor frame.
10. Advance distributor slowly until point breaks, as indicated by timing unit used.
11. Slide throttle pickup plate so that first throttle pickup tab (without nylon sleeve) just touches carburetor cluster. (Figure 5)
12. Tighten throttle pickup plate screws.
13. Turn distributor against .235" stop.
14. Bend second throttle pickup pin (with nylon sleeve) against carburetor cluster (.000" to .015" gap).
15. Lubricate cam's travel surface and nylon pin with MULTIPURPOSE Lubricant.

VI. STARTING SWITCH ADJUSTMENT

A. Merc 700 (below Serial No. 1303410) and Merc 600 (below 1305193)

1. Forward Interlock Starting Switch Adjustment
   a. After engine has been properly timed for .235" BTDC, turn distributor against dis-

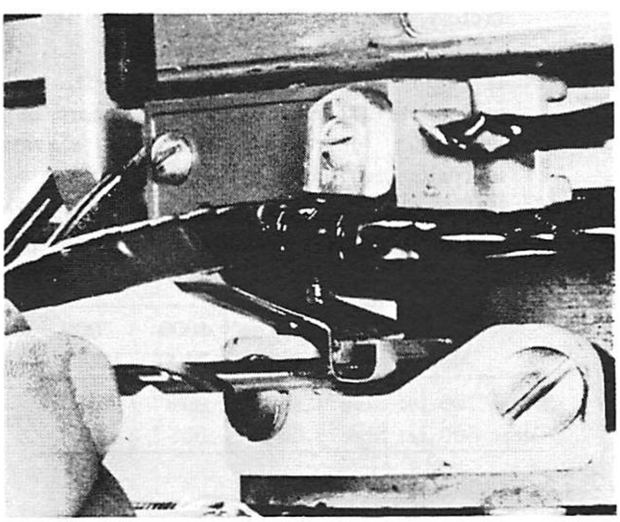


Figure 6. Forward Starting Switch Adjustment, Early Merc 700-600 Engines

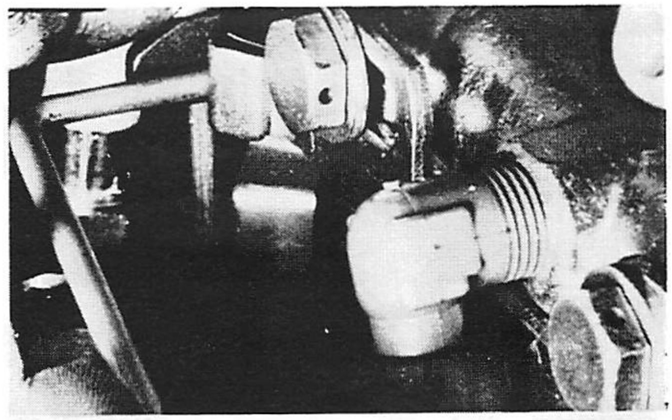


Figure 7. Reverse Starting Switch Adjustment, Early Merc 700-600 Engines

tributor forward stop screw.
   b. Insert a 5/32" drill or rod into interlock actuator cam between switch leaf and reverse cam lobe. (Figure 6)
   c. Slide interlock switch against 5/32" diameter drill or rod and tighten screws on switch.

2. Reverse Interlock Starting Switch Adjustment
   a. Attach one lead of Magneto Analyzer (91-25213) or Continuity Meter (91-22966) to green terminal on top starter solenoid and connect second lead to center small pin ("B" orange) of internal harness.
   b. Insert 3/32" diameter drill against reverse throttle pickup lever and reverse pickup.
   c. Turn distributor in reverse direction until throttle pickup lever just touches drill or rod. (Figure 7)
   d. Slide switch until meter needle hand moves to show contact and tighten reverse switch screws.
   e. Lubricate nylon cam lightly with MULTIPURPOSE Lubricant.

B. Merc 700 (Serial No. 1303410 and above)

3. Forward Starting Switch Adjustment
   a. After engine has been properly timed for .235" BTDC, turn distributor against forward stop screw.
   b. Adjust forward switch so that the rubbing portion of the spring leaf is in the bottom center of the nylon cam. Cam has mark for lineup, as shown in Figure 8.
4. Reverse Starting Switch Adjustment
   a. Turn distributor in reverse direction until it touches carburetor throttle shaft (do not confuse this with throttle pickup bracket clamp).
   b. Adjust reverse switch so that the rubbing portion of the spring leaf has started down the cam. (Figure 9) Nylon cam has mark for lineup, as shown in Figure 9.
   c. Lubricate cam's travel surface lightly with MULTIPURPOSE Lubricant.

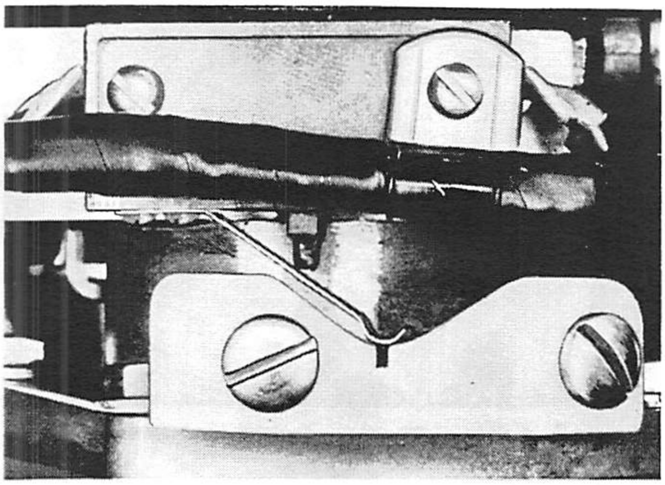


Figure 8. Forward Starting Switch Adjustment, Late Merc 700

VII. REVERSE CAM ADJUSTMENT

1. Before placing engine in test tank, adjust reverse cam (if necessary) by actuating self-locking nut on inside bottom cowl underneath lower carburetor. (Figure 10) Adjustment of this nut secures reverse locking assembly over the tilt pin.
2. Care should be taken not to tighten nut down too far so that reverse locking assembly will not be too tight on tilt pin, thus imparing reverse throttling.

VIII. REVERSE LOCK LINK

1. Adjust reverse lock link so that top cam has risen completely, and link has a minimum 1/32" clearance or free movement at full reverse RPM.
2. (Bottom cowl lever is positioned to give 600-to-800 RPM in reverse.) (Figure 10) This will prevent engine from kicking up in case of improper initial adjustment.

IX. THROTTLE STOP ADJUSTMENTS ON BOTTOM COWL

A. Forward Stop Adjustment

1. With engine running, loosen forward stop block

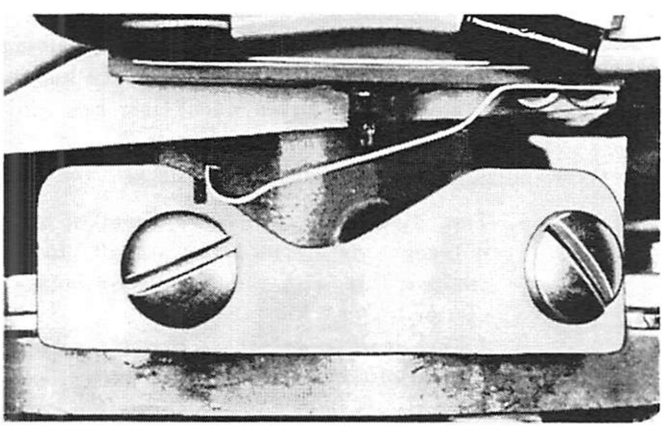


Figure 9. Reverse Starting Switch Adjustment, Late Merc 700

and move bottom cowl lever to allow full carburetor throttle shutter opening (not merely full distributor advance).
2. Do not allow throttle shutters to act as a stop or the carburetor cluster to hit carburetor filter bowl.
3. Tighten stop block in bottom cowl so that any forcing of lever will not spring carburetor linkage. (Figure 11)

B. Reverse Stop Adjustment

1. With stop block in bottom cowl loose and engine running in reverse, move bottom cowl lever to obtain 3000 RPM.
2. Then tighten stop block against lever in bottom cowl to limit further movement of lever. (Figure 11) *(Note: Reverse RPM can be decreased on lighter boats.)*

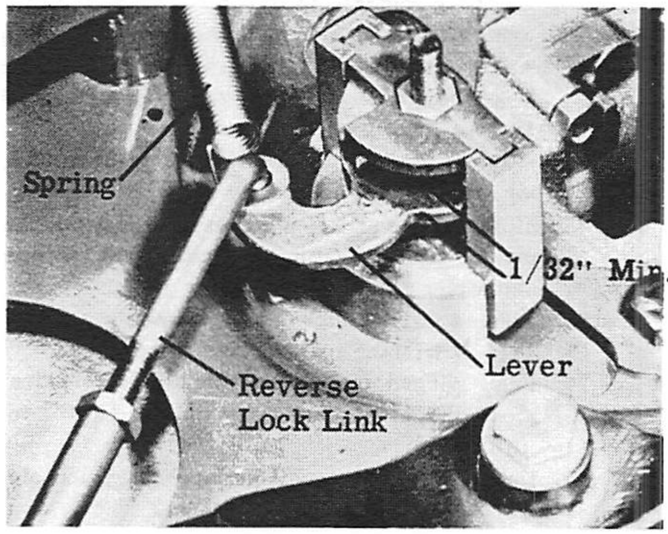


Figure 10. Reverse Cam Adjustment

X. CARBURETOR ADJUSTMENT

A. High Speed Adjustment

1. Merc 700-600 carburetors have fixed high speed jets. The standard jet, installed at the factory, is recommended for operation from sea level to 4000 ft. elevation.
2. If engine is operated above 4000 ft., select and install correct jets from chart below (aperature decreases .002" as elevation increases each 3000 ft.).
3. Before changing jets, check engine out unless previous tests indicate exact jet size.

Model	*Up to 4000'	4000-7000'	7000-10000'
Merc 700 Jet Size	.061"	.059"	.057"
Merc 600 Jet Size	.057"	.055"	.053"

* *Standard jet -- factory equipped.*

Jet size recommendations are intended as a guide (like a propeller chart). Try size larger or smaller if in doubt.

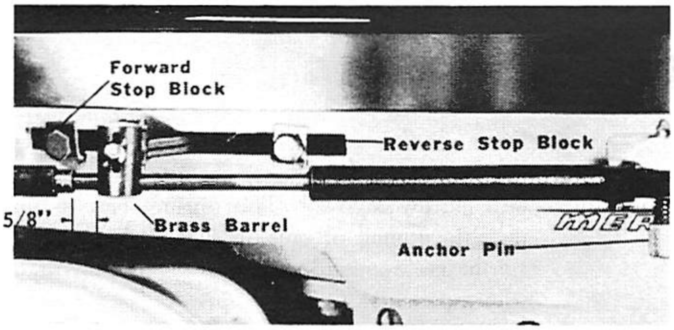


Figure 11. Throttle Stop Adjustments

4. *No change in spark advance is recommended for elevation operation.*
5. *Propellers of lower pitch should be used at high elevations to allow proper engine RPM.*
6. The engine can be tested in the test tank with the propeller or carburetor adjusting propeller.

B. Idle Adjustment Screws

1. Idle adjustment screws also have been adjusted at the factory.
2. If readjustment is necessary, it can be done with a test wheel or a regular propeller in the test tank or on the boat.
3. Start with all idle needles 1 turn open and adjust for maximum RPM with distributor retarded to give about 600-to-700 RPM.
4. Warm engine before attempting adjustment.
5. With engine running at idling speed while in forward gear, turn low speed mixture adjusting needle counterclockwise until affected cylinders start to "load up" or fire unevenly due to over-rich mixture. (Figure 12)
6. Then slowly turn needle clockwise until cylinders fire evenly and engine picks up speed.
7. Continue turning clockwise until too-lean a mixture is obtained and engine slows down and misfires.
8. Set adjustment screw half way between rich and lean (approx. ½ turn).
9. Do not adjust leaner than necessary to attain reasonably smooth idling.

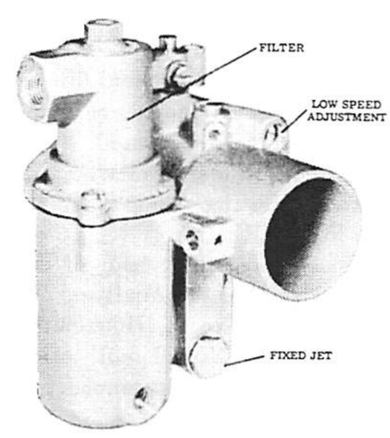


Figure 12. Idle Adjustment Screw

10. When in doubt, it is preferable to have mixture set slightly rich rather than too lean.

XI. REMOTE CONTROL ADJUSTMENTS

A. Cable Anchor on Engine

1. Adjust brass barrel so that it is 5/8" from end of brass sleeve on engine end of control cable. (Figure 11)
2. Install cable to engine with barrel in this position.
3. Adjust forward limit screw in control station until engine throttle lever touches front throttle stop on bottom cowl. *(The purpose of the forward limit in control box is to provide a positive stop for handle to prevent overloading cable and attaching fittings.)*

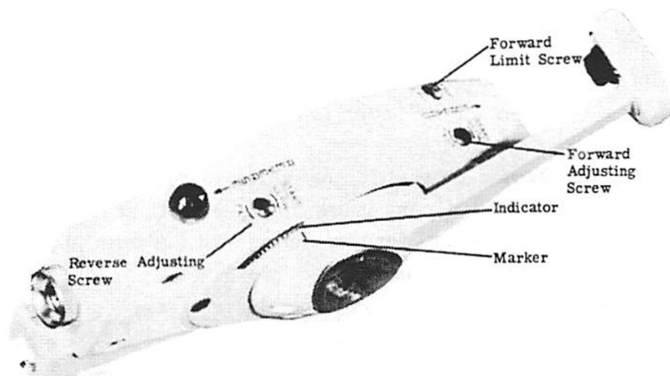


Figure 13. Forward and Reverse Detents

B. Forward Start Position

1. Insert harness connector in engine receptacle.
2. With control handle in vertical position, and with ignition switch on, depress starting button on underside of handle and slowly move forward (while holding switch depressed) until starter motor cranks engine.
3. With handle in this position, turn adjusting screw in "slow" direction until handle moves.
4. Now turn adjusting screw in "fast" direction 6 full turns. (Figure 13)

C. Reverse Start Position

1. Adjust in same manner as "Forward Start Position" in Paragraph "B" preceding.
2. Handle mechanism of this control is side-loaded and must be moved toward operator to move past starting detents for either full forward or full reverse operation.

TIMING, ADJUSTING, TESTING
MERC 800 DIRECT REVERSING

I. IGNITION DATA

Cylinder Firing Order: 1-4-5-2-3-6
Coil No. 1 fires cylinders 1-5-3
Coil No. 2 fires cylinders 4-2-6
Spark Plug Type: J4J - - Standard Installation*
XJ4J - Resistor Type §
Spark Plug Gap : .025"
Timing : .235" BTDC (Before Top Dead Center)
RPM : 5200 Maximum Operating

** See Note No. 1 on P. 70* § *For static elimination on radio or radio-telephone equipped boats.*

II. TIMING AND LINKAGE ADJUSTMENT

A. Flywheel and Distributor Pulley Timing

1. Rotate flywheel until timing mark (arrow) stamped on rim is on line between crankshaft and distributor pulley center. *(No. 1 piston then is 20° after top dead center in forward direction.)*
2. Arrow on distributor pulley should be pointed toward timing mark on flywheel. (Figure 1) If it is not, remove timing belt and turn pulley to correct position.

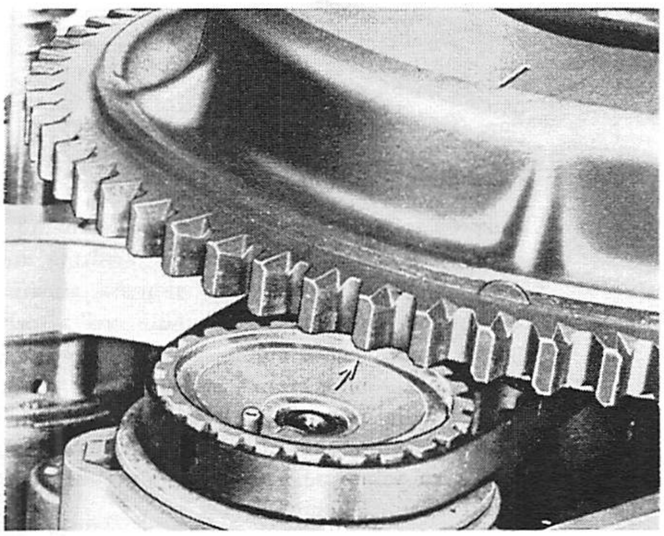
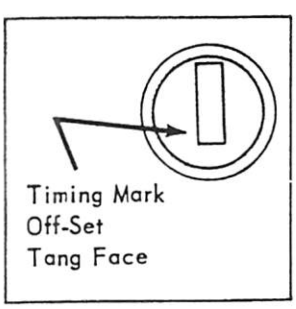


Figure 1. Timing Marks on Flywheel and Pulley

B. Distributor Drive Coupling

1. When distributor is reassembled to engine, wheel and distributor pulley should be aligned as above.



2. The offset face tang at drive end of distributor shaft should point forward (direction engine will travel when distributor is bolted in place). (See drawing at left.)
3. The offset face of the tang is considered the timing mark. (Figure 2)
4. Drive shaft spring is located in ground out portion which is closest in line with timing belt pulley keyway. This spring has to line up with ground off portion of distributor drive tab before assembling distributor to distributor pilot assembly.
5. Secure distributor adaptor with 4 hex head cap screws.

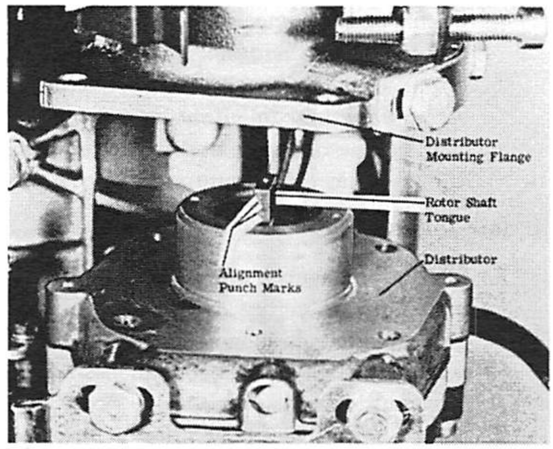


Figure 2. Timing Mark on Offset Tang Face

C. Maximum Spark Advance -- Forward

1. Position distributor with side high tension lead facing approximately forward.
2. Place No. 3 piston at .235" BTDC (before top dead center) by rotating flywheel in a clockwise (forward) direction from BDC (bottom dead center).
3. Thread Timing Gauge (91-26916A1) into No. 3 spark plug hole. (Figure 3)
4. Turn flywheel until No. 3 piston strikes Timing Gauge.
5. While turning flywheel, thread Timing Gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center position.
6. Rotate flywheel clockwise ¼ turn.
7. Depress center shaft of Timing Gauge and rotate ¼ turn to seat on tool body shoulder (.235" BTDC position). Be careful that tool body does not move, or preceding procedure will have to be repeated.
8. Rotate flywheel clockwise until No. 3 piston strikes Timing Gauge center shaft. This is .235" BTDC.
9. Connect one test lead of Timing Meter (91-22966) or Magneto Analyzer 91-25213 (selector switch, on No. 2, Distributor Resistance) to white lead (No. 1 coil primary) at terminal block and connect second lead of timing unit to distributor frame.
10. Advance distributor slowly until point breaks, as indicated by timing unit used.

11. Hold distributor at this position and adjust distributor advance stop screw to just touch pilot assembly and tighten lock nut.
12. Recheck distributor advance to insure correct setting.

III. REVERSE PICKUP ADJUSTMENT

NOTE: Nylon rack first full tooth fits into second full tooth of distributor sector gear when distributor is in full advance in reverse direction. (Figure 4)

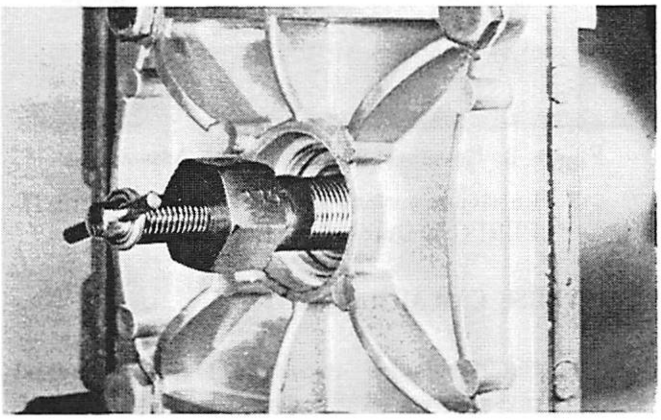


Figure 3. Timing Gauge in Spark Plug Hole

1. Reverse throttle pickup lever is set to end of slot travel which gives most spark advance in reverse. This means that the plate will be moved as far to right of distributor (when viewed from front of engine) as slots allow.
2. Secure with lock wire.
3. Insert No. 40 size drill, or equivalent, 3'' into top carburetor throttle shutter opening. (Figure 5) Drill must be in vertical center on port side of throttle shutter between shutter and carburetor body. (Figure 5)
4. Advance distributor in extreme reverse advance position until it stops.
5. Adjust carburetor shaft reverse pickup bracket until it just touches reverse throttle pickup lever. (Figure 5)

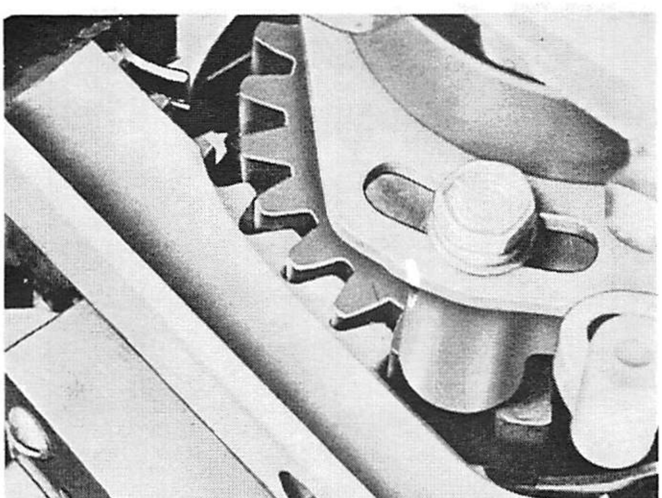


Figure 4. Nylon Rack and Distributor Sector Gear in Full Reverse Position

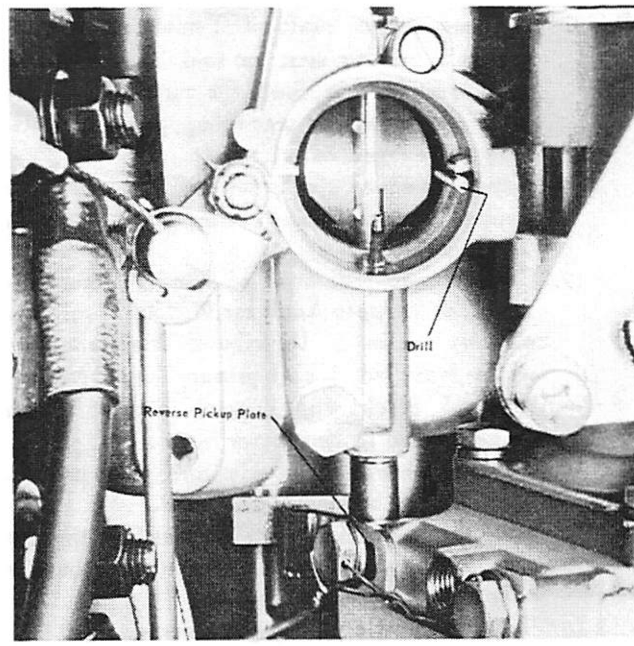


Figure 5. Reverse Pickup Bracket Adjustment

IV. FORWARD PICKUP ADJUSTMENT

1. Position distributor with side high tension lead facing approximately forward.
2. Place No. 3 piston at .030'' BTDC (before top dead center) by rotating flywheel in a clockwise (forward) direction from BDC (bottom dead center).

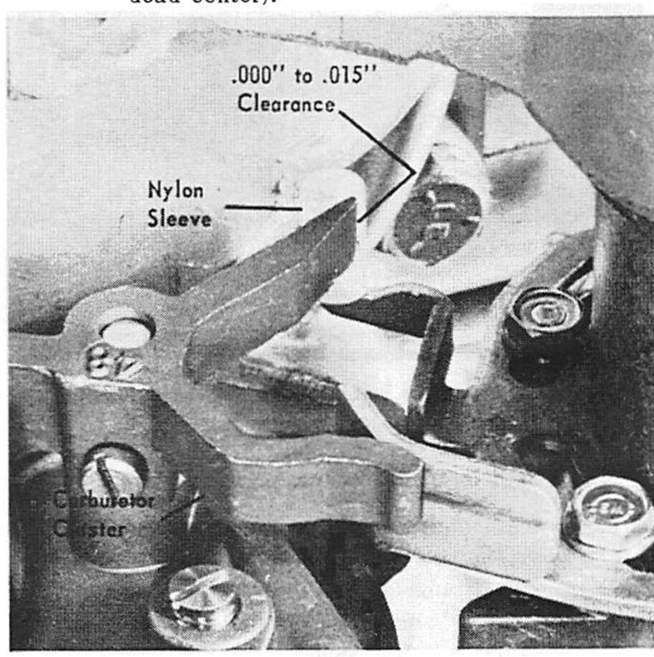


Figure 6. Forward Pickup Adjustment

3. Thread Timing Gauge (91-30290A1) into No. 3 spark plug hole.
4. Turn flywheel until No. 3 piston strikes Timing Gauge.
5. While turning flywheel, thread Timing Gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center position.
6. Rotate flywheel clockwise ¼ turn.

7. Depress center shaft of Timing Gauge and rotate ¼ turn to seat on tool body shoulder (.030" BTDC position). Be careful that tool does not move, or preceding procedure will have to be repeated.
8. Rotate flywheel clockwise until No. 3 piston strikes Timing Gauge center shaft. This is .030" BTDC.
9. Connect one test lead of Timing Meter (91-22966) or Magneto Analyzer 91-25213 (selector switch, on No. 2, Distributor Resistance) to white lead (No. 1 coil primary) removed from terminal block with second lead of timing unit attached to distributor frame.
10. Advance distributor slowly until point breaks, as indicated by timing unit used.
11. Slide throttle pickup plate so that first throttle pickup tab (without nylon sleeve) just touches carburetor cluster. (Figure 6)
12. Tighten throttle pickup plate screws.
13. Turn distributor against .235" stop.
14. Bend second throttle pickup pin (with nylon sleeve) against carburetor cluster (.000" to .015" gap).
15. Lubricate cam and nylon pin with MULTI-PURPOSE Quicksilver Lubricant (92-30239-1).

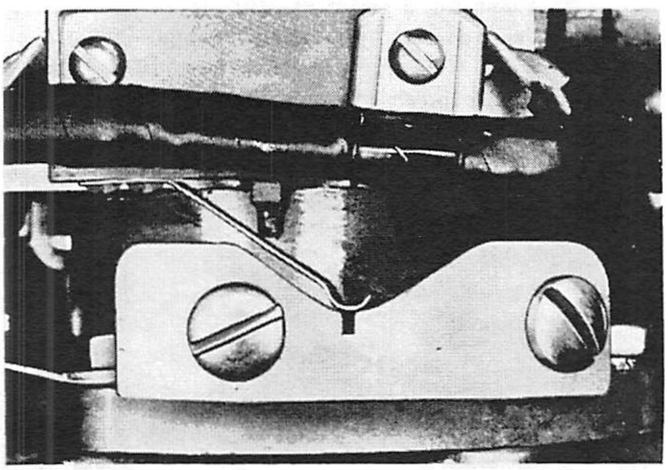


Figure 7. Forward Interlock Switch Adjustment

V. STARTING SWITCH ADJUSTMENTS

A. Forward Interlock Switch Adjustment

1. After engine has been properly timed for .235" BTDC, turn distributor against forward stop screw and adjust forward switch so that rubbing portion of spring leaf is in bottom center of nylon cam.
2. Cam has mark for lineup, as shown in Figure 7.
3. Lubricate surface of cam lightly with MULTI-PURPOSE Quicksilver Lubricant.

B. Reverse Interlock Switch Adjustment

1. Turn distributor in reverse direction until it touches carburetor throttle shaft (do not confuse this with throttle pickup bracket clamp).
2. Adjust reverse switch so that rubbing portion of spring leaf is 1/8" below top of cam. (Figure 8)

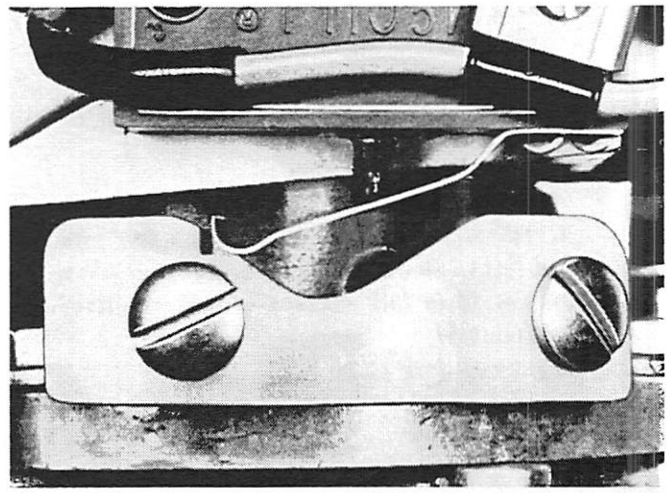


Figure 8. Reverse Interlock Switch Adjustment

3. Lubricate surface of cam lightly with MULTI-PURPOSE Quicksilver Lubricant.

VI. REVERSE CAM ADJUSTMENT

1. Before placing engine in test tank, adjust reverse cam (if necessary) by actuating self-locking nut on inside bottom cowl underneath lower carburetor. (Figure 9)
2. Adjustment of this nut secures reverse locking assembly over the tilt pin. Be sure this is unlocked in forward.

VII. REVERSE LOCK LINK

1. Adjust reverse lock link so that top cam has risen completely, and link has a minimum 1/32" clearance for free movement at full reverse RPM.
2. Bottom cowl lever is positioned to give 600-to-800 RPM in reverse. (Figure 9) This will prevent engine from kicking up in case of improper initial adjustment.

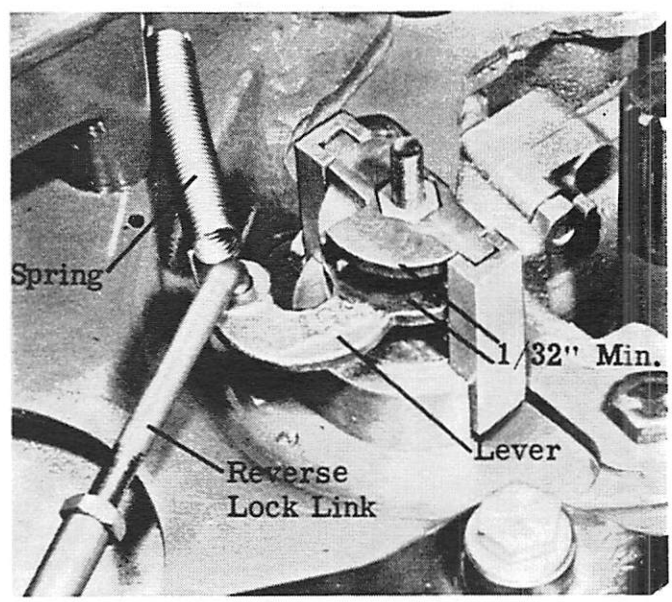


Figure 9. Reverse Cam Adjustment

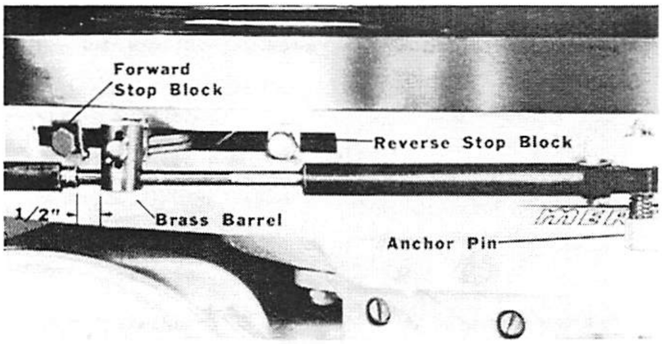


Figure 10. Throttle Stop Adjustments

VIII. THROTTLE STOP ADJUSTMENTS ON BOTTOM COWL

A. Forward Stop Adjustment

1. With engine running at full throttle, loosen forward stop block and move bottom cowl lever to allow full carburetor throttle shutter opening (not merely full distributor advance).
2. Do not allow throttle shutters to act as a stop or the carburetor cluster to hit carburetor filter bowl.
3. Tighten stop block in bottom cowl so that any forcing of lever will not spring carburetor linkage. (Figure 10)

B. Reverse Stop Adjustment

1. With stop block in bottom cowl loose and engine running in reverse, move bottom cowl lever to obtain 3000 RPM.
2. Then tighten stop block against lever in bottom cowl to limit further movement of lever. (Figure 10) *(Note: Reverse RPM can be decreased on lighter boats.)*

IX. CARBURETOR ADJUSTMENTS

A. High Speed Adjustment

1. Merc 800 carburetors have fixed high speed jets. The standard jet, installed at the factory, is recommended for operation from sea level to 4000 ft. elevation.
2. If engine is operated above 4000 ft., select and install correct jets from chart below (aperature decreases .002" as elevation increases each 3000 ft.).
3. Before changing jets, check engine out unless previous tests indicate exact jet size.

Model	*Up to 4000'	4000-7000'	7000-10000'
Merc 800 Jet Size	.065"	.063"	.061"

* *Standard Jet -- factory equipped.*

Jet size recommendations are intended as a guide (like a propeller chart). Try size larger or smaller if in doubt.

4. *No change in spark advance is recommended for elevation operation.*
5. *Propellers of lower pitch should be used at high elevations to allow proper engine RPM.*
6. The engine can be tested in a test tank with the propeller or the Test Wheel (48-30589).

B. Idle Adjustment Screws

1. Idle adjustment screws also have been adjusted at the factory.
2. If readjustment is necessary, it can be done with the Test Wheel or a regular propeller in the test tank or on the boat.
3. Start with all idle needles 1 turn open and adjust for maximum RPM with distributor retarded to give about 600-to-700 RPM.
4. Warm engine before attempting adjustment.
5. With engine running at idling speed while in forward gear, turn low speed mixture adjusting needle counterclockwise until affected cylinders start to "load up" or fire unevenly due to over-rich mixture. (Figure 11)
6. Then slowly turn needle clockwise until cylinders fire evenly and engine picks up speed.
7. Continue turning clockwise until too lean a mixture is obtained and engine slows down and misfires.
8. Set adjustment screw half way between rich and lean (approx. 1 turn). Do not adjust leaner than necessary to attain reasonable smooth idling. When in doubt, it is preferable to have mixture set slightly rich rather than too lean.

X. REMOTE CONTROL ADJUSTMENTS

A. Attaching Cables to Engine

1. Adjust brass barrel so that it is 3/8" to ½" from end of brass sleeve on engine end of control cable. (Figure 10)
2. Install cable to engine with barrel in this position.
3. Adjust forward limit screw in control station (Figure 12) until engine throttle lever touches front throttle stop on bottom cowl. *Note: Purpose of forward limit in control box is to provide a positive stop for handle to prevent overloading cable and attaching fittings.*

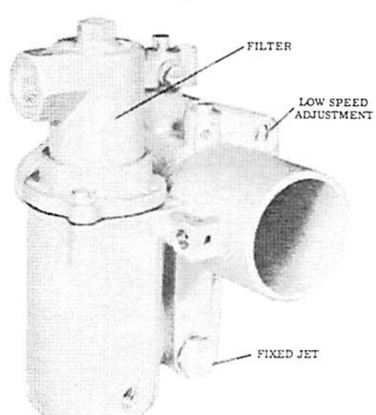


Figure 11. Idle Adjustment Screw

B. Adjusting Detents

1. Forward Detent

a. Insert harness connector into connector.
b. With control handle in vertical position, and with ignition switch on, depress starting button on underside of handle and slowly move handle forward (while holding switch depressed) until starter motor cranks engine.
c. With handle in this position, turn adjusting screw in "slow" direction until handle moves.
d. Now turn adjusting screw in "fast" direction 6 full turns. (Figure 12)

2. Reverse Detent

a. Adjust in same manner as "Forward Detent", preceding.
b. Handle mechanism of this control is side-loaded and must be moved toward operator to move past starting detents for either full forward or full reverse operation. (Refer to Section I for operation.)

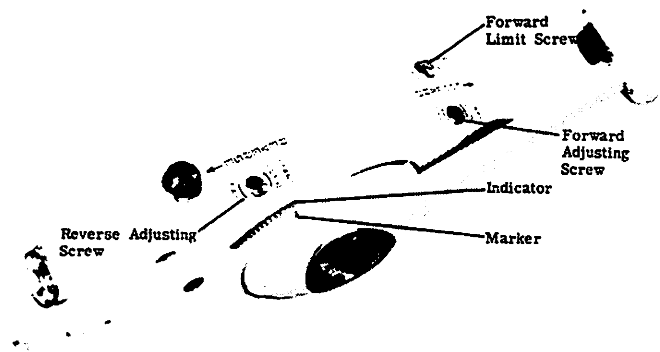


Figure 12. Forward Limit Adjustment

1. If spark plug burning or pre-ignition is experienced, it is recommended that J2J (33-32433) spark plugs be installed.

TIMING, ADJUSTING, TESTING
MERC 850 (76 Cu. In.)-800-700 FULL GEAR SHIFT

I. IGNITION DATA

Description	Merc 850-800	Merc 700
Cyl. Firing Order (Figure 1)	1-4-5-2-3-6	1-6-4-2-5-3
Coil No. 1 Fires Cyls.	1-5-3	1-4-5
Coil No. 2 Fires Cyls.	4-2-6	6-2-3
Spark Plug, Std. Install.	J4J §	J6J
Spark Plug, Resistor Type*	XJ4J	XJ6J
Spark Plug Gap	.025" (.635mm)	
Timing	.235" (5.969mm) BTDC	
Full Throttle RPM Range	4800-5200	5100-5500

* *For static elimination on radio or radio-telephone equipped boats.*

§ *See Note No. 1 on Page 75.*

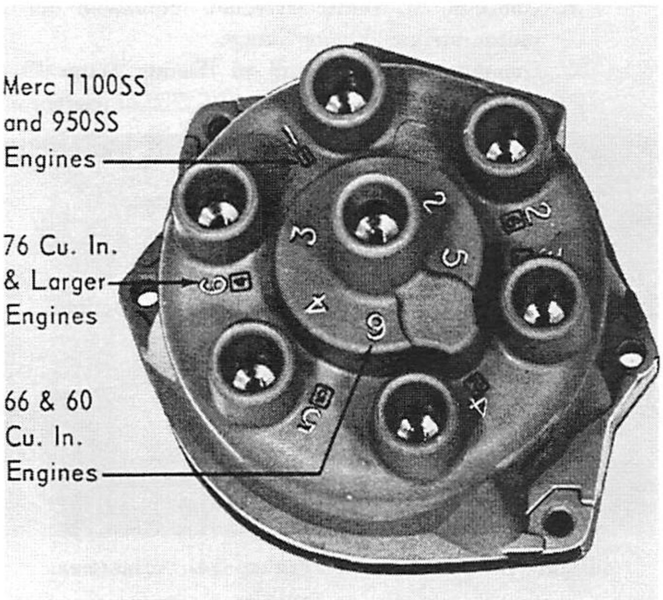


Figure 1. Distributor, Merc 850-800 Outside Ring, Merc 700 Inside Ring

II. TIMING AND LINKAGE ADJUSTMENT

A. Flywheel, Distributor Pulley and Belt Assembly

1. Rotate flywheel until timing mark (a straight line stamped on upper surface) is in a straight line with center of crankshaft and distributor pulley center. (Figure 2)
2. Position arrow on pulley (not plate) to point at timing mark on flywheel.
3. Install timing belt, plate, cap, washers and screw and tighten to 60 in. lbs. (10.65kg/cm).

B. Distributor Drive Coupling

1. When reassembling distributor, leave distributor cap off to aid in timing engine as described in following instructions.

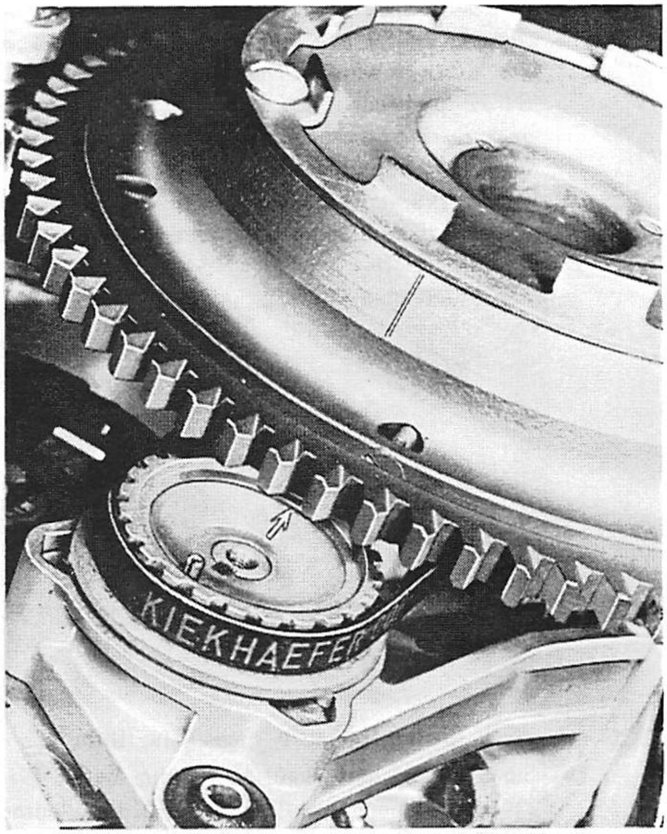


Figure 2. Timing Marks on Flywheel and Pulley

2. When distributor is reassembled to engine, flywheel and distributor pulley should be aligned as explained in Para. "A", preceding. The radius of the tang at drive end of distributor shaft should point forward (direction engine will travel when distributor is bolted in place). (See drawing on left.)

3. Secure distributor adaptor with 4 hex head cap screws.

C. Spark Advance Stop Adjustment

1. Position distributor with air vent elbow facing approximately forward.
2. Place No. 3 piston of Merc 850-800 (No. 4 piston on Merc 700) at .235" (5.969mm) BTDC (before top dead center) by rotating flywheel in a clockwise (forward) direction from BDC.
3. Thread Timing Gauge (C-91-26916A1) into No. 3 (or No. 4) spark plug hole. (Figure 3)
4. Turn flywheel until No. 3 (or No. 4) piston strikes Timing Gauge.

5. While turning flywheel, thread Timing Gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center position.
6. Rotate flywheel clockwise ¼ turn.
7. Depress center shaft of Timing Gauge and rotate ¼ turn to seat on tool body shoulder (.235" BTDC position). *NOTE: Be careful that tool body does not move, or preceding procedure will have to be repeated.*
8. Rotate flywheel clockwise until No. 3 (or No. 4) piston strikes Timing Gauge center shaft. This is .235" BTDC.

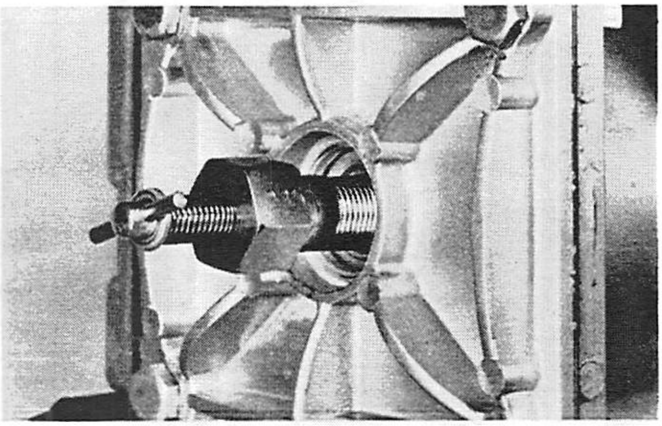


Figure 3. Timing Gauge in Spark Plug Hole

9. Connect one test lead of Timing Meter (91-22966) or Magneto Analyzer (91-25213) (selector switch on No. 2, Distributor Resistance) to white lead (No. 1 coil primary) at terminal block.
10. Attach second lead of tester to distributor frame.
11. Retard distributor against "idle speed" stop screw. (Figure 4)
12. Turn distributor rotor slowly counterclockwise to touch drive coupling.
13. Turn distributor (holding rotor) slowly counterclockwise until points break, as indicated by timing unit used.

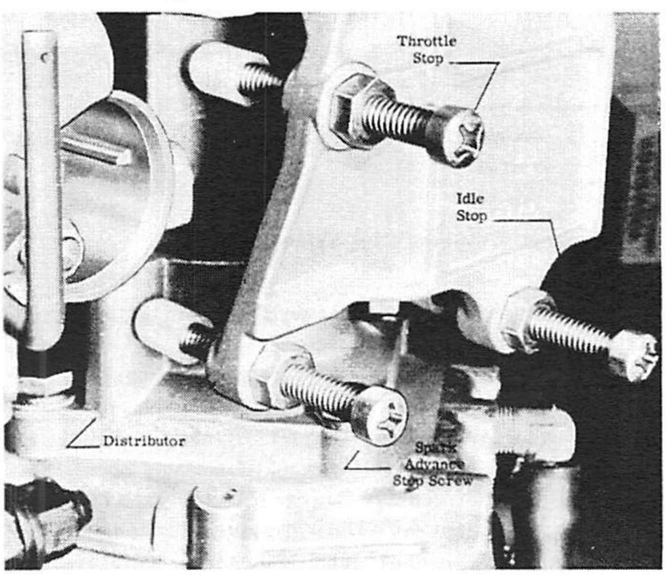


Figure 4. Spark Advance Adjustment

14. Hold distributor in this position and adjust spark advance stop screw to just touch pilot assembly and tighten lock nut.
15. Recheck steps 11, 12 and 13 to be sure adjustment is correct.

D. Pickup Plate Adjustment

1. Thread .015" Timing Gauge (91-31161A1) into No. 3 spark plug hole of Merc 850-800, No. 4 spark plug hole for Merc 700. (Figure 3)
2. Turn flywheel until piston strikes Timing Gauge.
3. While turning flywheel, thread timing gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center (TDC) position.
4. Rotate flywheel clockwise ¼ turn.
5. Depress center shaft of Timing Gauge and rotate ¼ turn to seat on tool body shoulder (.015" BTDC). *(Note: Be careful that tool body does not move or preceding steps will have to be repeated.)*
6. Continue to rotate flywheel clockwise until piston strikes Timing Gauge.
7. Connect one test lead of Timing Meter (91-22966) or Magneto Analyzer (91-25213) (selector

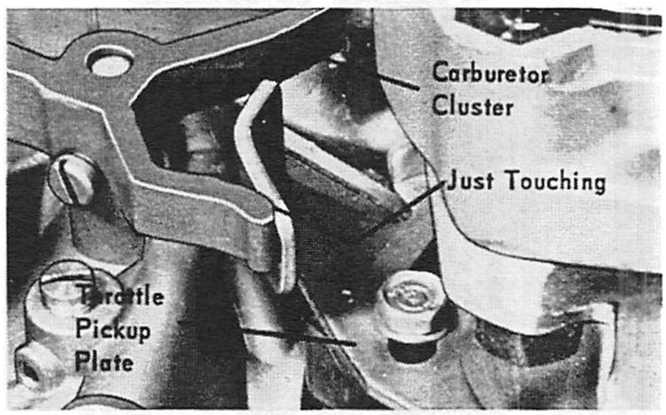


Figure 5. First Throttle Pickup Tab Adjustment

switch on No. 2, Distributor Resistance) to white lead (No. 1 coil primary) at terminal block.

8. Attach second lead of tester to distributor frame.
9. Retard distributor against idle stop screw.
10. Turn distributor rotor slowly counterclockwise to touch drive coupling.
11. While holding rotor in this position, rotate distributor slowly counterclockwise until points break, as indicated by timing unit used.
12. Loosen throttle pickup plate screws. (Figure 5)
13. Slide throttle pickup plate so that first throttle tab (without nylon sleeve) just touches carburetor cluster. (Figure 5)
14. Tighten throttle pickup plate screws.
15. Turn distributor against .235" ("spark advance") stop.
16. Bend second throttle pickup pin (with nylon sleeve) against carburetor cluster (.000"-to-.015" gap). (Figure 6)

17. Lubricate cam and nylon pin with MULTI-PURPOSE Quicksilver Lubricant (92-30239).
18. Replace distributor cap.

E. Check and Adjust Neutral Interlock

1. Place shift lever in neutral position, being sure that detent spring is in neutral notch (detent).
2. Loosen shift shaft adjusting nut on shift control linkage in bottom cowl. (Figure 7)
3. Remove link rod retaining clip.
4. Adjust linkage so that mating mark on shift lever is to left of alignment mark on throttle control lever. (Figure 8)
5. Replace link rod retaining clip and tighten shift shaft adjusting nut on shift control linkage in bottom cowl.

III. THROTTLE STOP ADJUSTMENTS

A. Throttle Stop Adjustment

1. Rotate Economizer collar to wide open throttle position.

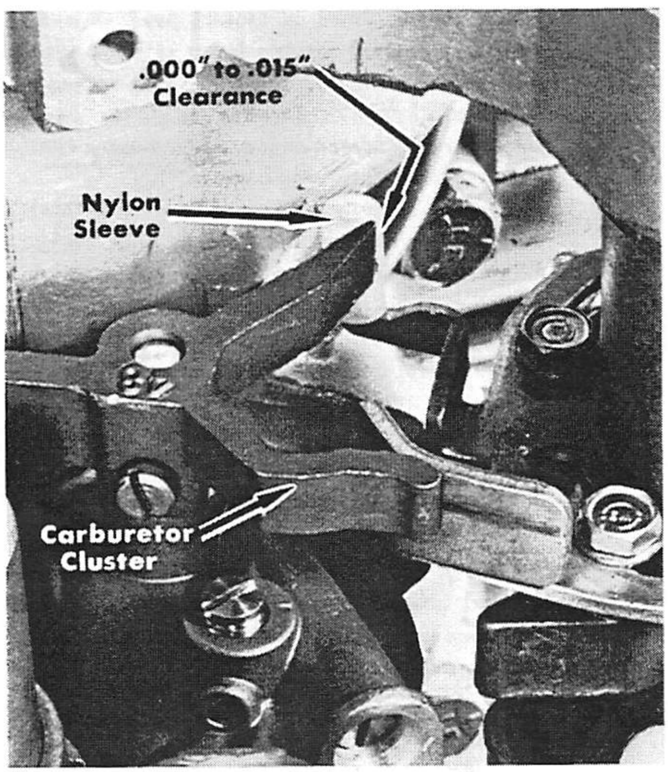


Figure 6. Second Throttle Pickup Tab Adjustment

2. Adjust "throttle stop" screw on stop bracket (Figure 4) to allow full throttle shutter opening but not to allow throttle shutters to act as a stop or the carburetor cluster to hit carburetor filter bowl.

B. Idle Speed Adjustment and Checks

1. Start engine and run until warm.
2. Idle engine and adjust "idle speed" screw on stop bracket (Figure 4) so that engine idles at 500 RPM in forward gear.

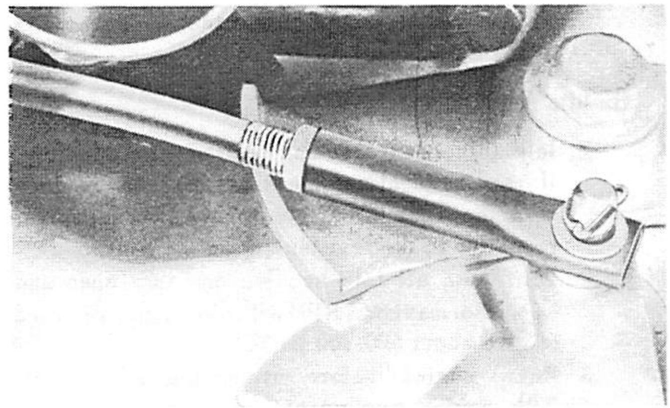


Figure 7. Shift Shaft Adjusting Nut

IV. CARBURETOR ADJUSTMENTS

A. High Speed Adjustment

Merc 850-800-700 carburetors have fixed high speed jets. The standard jet, installed at the factory, is recommended for operation from sea level to 4000 ft. elevation.

1. If engine is operated above 4000 ft., select and install correct jets from chart following (aperature decreases .002" as elevation increases each 3000 ft.).
2. Before changing jets, check engine out unless previous tests indicate exact jet size.

Model	*Up to 4000'	4000-7000'	7000-10000'
Merc 850§	.069"	.067"	.065"
Merc 800 Jet	.065"	.063"	.061"
Merc 700 Jet Size	.061"	.059"	.057"

* *Standard jet -- factory equipped*
§ *See Note No. 2 on Page 75.*

3. Jet size recommendations are intended as a guide (like a propeller chart). Try size larger or smaller if in doubt.
4. No change in spark advance is recommended for elevation operation. Propellers of lower pitch should be used at high elevations to allow proper engine RPM.

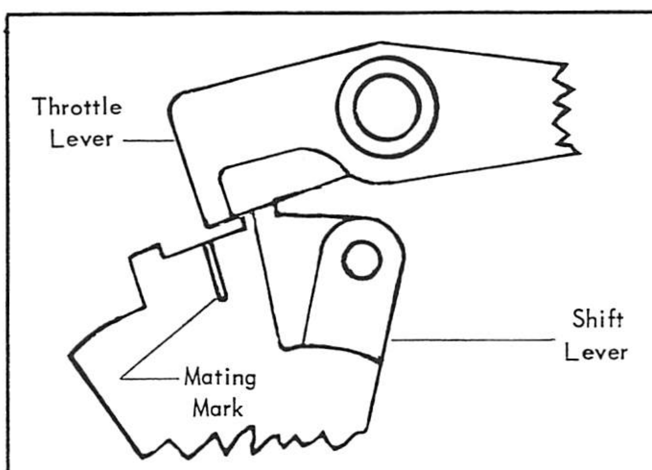


Figure 8. Linkage Adjustment

5. Engine can be tested in test tank with propeller or the Test Wheel (48-30724A2).

B. Idle Adjustment

1. Idle adjustment also has been set at the factory. If readjustment is necessary, it can be done with the Test Wheel (48-30724A2) or a regular propeller in the test tank or on the boat.
2. Start with all idle needles one turn open and adjust for maximum RPM with distributor retarded to give about 600-700 RPM.
3. Warm engine before attempting adjustment.
4. With engine running at idling speed while in forward gear, turn low speed mixture adjusting needle counterclockwise until affected cylinders start to "load up" or fire unevenly due to over-rich mixture. (Figure 9)

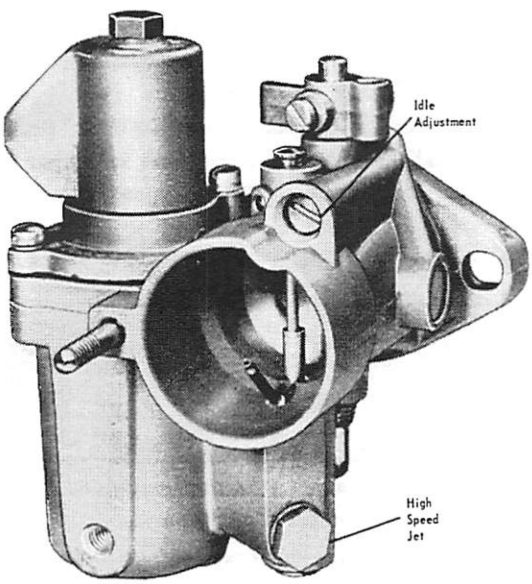


Figure 9. Idle Adjustment

5. Slowly turn needle clockwise until cylinders fire evenly and engine picks up speed.
6. Continue turning clockwise until too-lean a mixture is obtained and engine slows down and misfires.
7. Set adjustment screw one turn counterclockwise from lean-out position for Merc 800, one-half turn from lean-out position for Merc 700 to gain approximate true setting.
8. Do not adjust leaner than necessary to attain reasonably smooth idling.
9. When in doubt, it is preferable to have mixture set slightly rich rather than too lean.

C. Neutral RPM Adjustment

1. Shift into neutral.
2. Adjust length of link between vertical shaft and distributor actuator to obtain a speed of 2400-to-3000 RPM. (Figure 10)

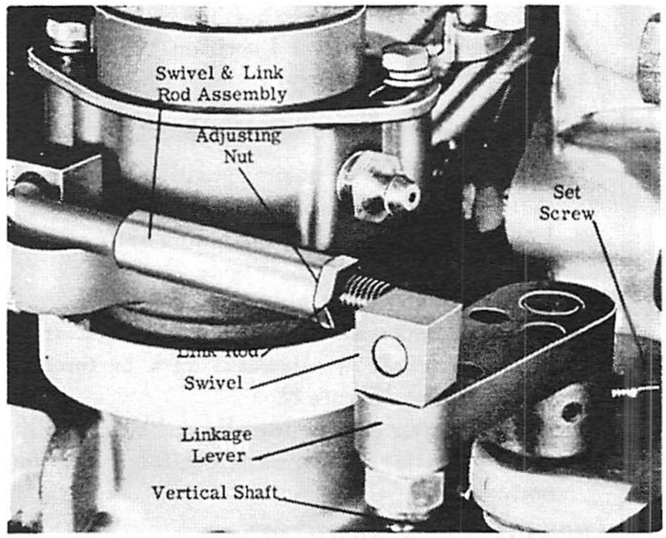


Figure 10. Vertical Shaft Adjustment

V. REMOTE CONTROL ADJUSTMENTS

A. Throttle Control Cable

1. Place control lever in neutral position and be sure that neutral throttle lever is down all the way before attaching throttle cable to engine. (Figure 11) *NOTE: Throttle cable is one on which nylon end moves last when moving control handle from neutral position.*
2. Move throttle lever on engine forward to throttle stop (idle position) and hold in this position.
3. Align brass barrel on throttle cable so that distributor is held lightly against idle stop screw with cable installed. (Figure 12)
4. Move control handle to full forward, full reverse and return to neutral.
5. Check to see that distributor has returned to idle stop.
6. If necessary, readjust brass barrel on cable to accomplish correct final adjustment. (Figure 12)

NOTE: If distributor is forced too tightly against idle stop, neutral throttle lever will not open carburetor throttle shutters, and hard starting will result.

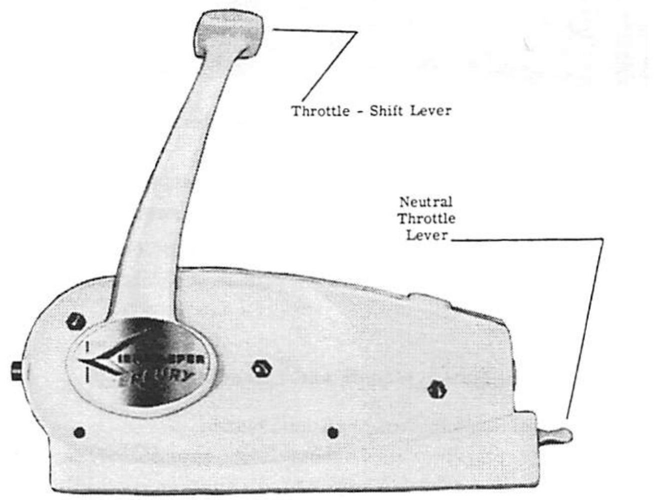


Figure 11. Remote Control Station

B. Gear Shift Cable

1. Place control handle in neutral (detent) position and shift lever on engine in neutral position. *NOTE: Gear shift cable is one on which nylon end moves first when moving control handle from neutral (detent) position.*
2. Adjust brass barrel so that cable is connected without disturbing either lever or handle.
3. Move control handle to forward position and be sure that detent spring is in forward notch (detent) of shift control lever plate in bottom cowl.

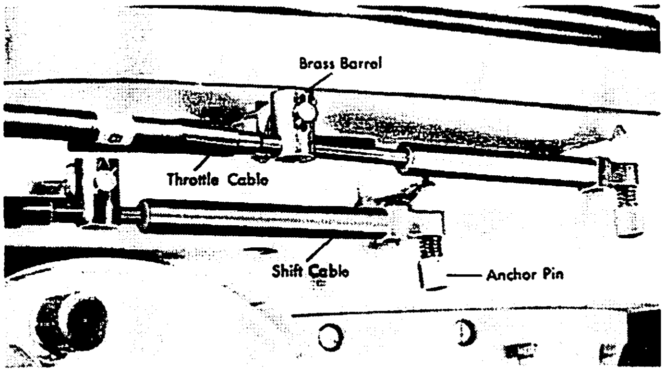


Figure 12. Cable Adjustments

4. Shift back into neutral and check to see that throttle lever and shift lever are in position as shown in Figure 13. Disengage cable end and readjust brass barrel of throttle cable, if necessary, to be sure that mating mark on shift lever is to the right of indicating portion of throttle control lever, as shown in Figure 14. This will assure that engine is in neutral when control handle of remote control is in its detent position (neutral).

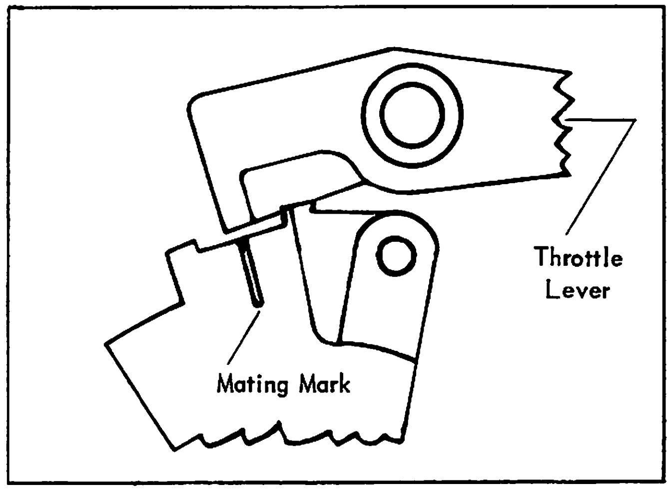


Figure 13. Lever Positions

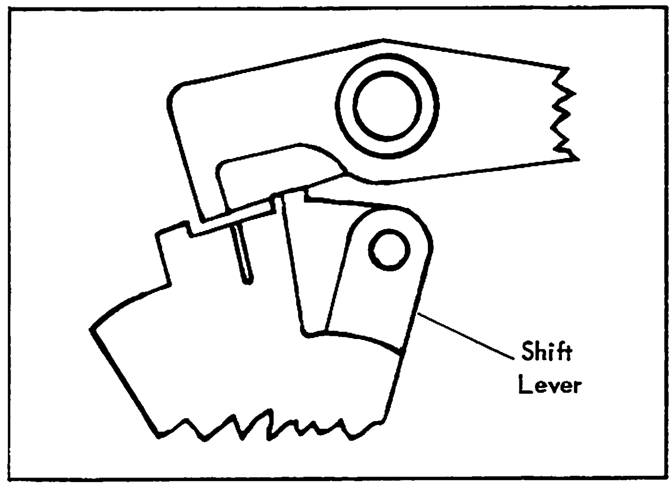


Figure 14. Lever Positions

NOTE: If control cables are not properly adjusted, engine cannot operate satisfactorily.

NOTES

1. All Merc 1000-850 motors and some Merc 800 Full Gear Shift motors are constructed with the new "Power Dome" combustion chamber which allows the spark plugs to run cooler for protection against pre-ignition in leaded-up motors.

   If a great deal of slow speed operation with a clean motor results in wet fouling of the spark plugs, we recommend installation of Champion J6J spark plugs for that particular motor.
2. "Power Dome" motors also are very tolerant to carburetor fixed jet size. On the Merc 850 (76 cu. in.)-800, if the standard .069" fixed jet (A-1399-1962) is too rich when operated in a very hot climate, it is permissable to install a jet of a smaller size opening from the chart on right. On Merc 850 (90 cu. in), if standard fixed jet of .055" (A-1399-1655) is too rich, in very hot climate, install the .053" (A-1399-1653).

   On the Merc 1000, if the standard fixed jet (A-1399-1962) of .069" is too rich in very hot climate areas, install the .067" (A-1399-1467) jet.

Engine Model (Power Dome Only)	Jet Sizes for Elevations		
	Up to 4000'	4000-7000'	7000-10000'
Merc 1000	.069"	.067"	.065"
Merc 850 (90 Cu. In.)	.055"	.053"	.051"
Merc 850 (76 Cu. In.)	.069"	.067"	.065"
Merc 800-1	.069"	.067"	.065"

.069" = 1.753mm .055" = 1.397mm
.067" = 1.702mm .053" = 1.346mm
.065" = 1.651mm .051" = 1.295mm

TIMING, ADJUSTING, TESTING
MERC 1000-850 (90 Cu. In.)

I. IGNITION DATA

Description	1000-850 (90 Cu. In.)
Cylinder Firing Order (Figure 1)	1-4-5-2-3-6
Coil No. 1 Fires Cylinders	1-5-3
Coil No. 2 Fires Cylinders	2-4-6
Firing Sequence	60° Consecutive
Spark Plug, Standard Installation	J4J or AC-K421 §
Spark Plug, Resistor Type *	XJ4J
Spark Plug Gap	.025" (.635mm)
Timing	.222" (32½°) BTDC
Breaker Setting	90° Dwell
Full Throttle RPM Range	4800-5200

§ *See Note No. 1 on Page 75.* *.222" = 5.639mm*

* *For static elimination on radio or radio-telephone equipped boats.*

II. TIMING AND LINKAGE ADJUSTMENT

A. Flywheel, Distributor Pulley and Belt Assembly

1. Rotate flywheel until timing mark (a straight line stamped on upper surface) is in a straight line with center of crankshaft and distributor pulley center. (Figure 2)
2. Position arrow on pulley (not plate) to point at timing mark on flywheel.
3. Install timing belt, plate, cap, washers and screw and tighten to 60 in. lbs. (10.65kg/cm).

B. Distributor Drive Coupling

1. When reassembling distributor, leave distributor cap off to aid in timing engine as described in following instructions.

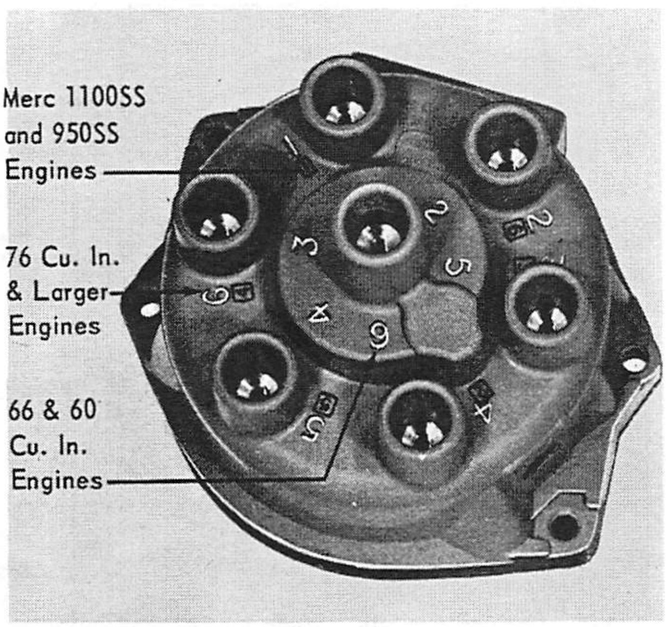


Figure 1. Distributor (Outside Ring of Numbers for 76 Cu. In. [1245.424cm^3] and Larger Engines)

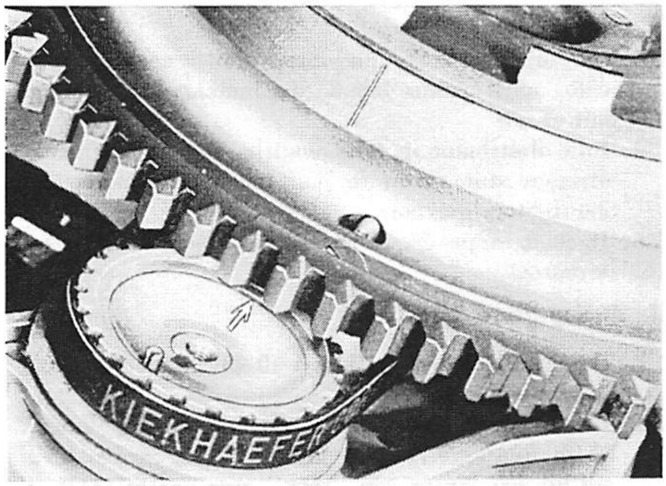
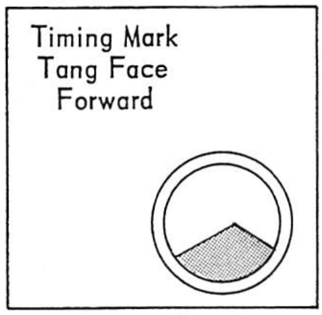


Figure 2. Timing Marks on Flywheel and Pulley

2. When distributor is reassembled to engine, flywheel and distributor pulley should be aligned as explained in Para. "A", preceding. The radius of the tang at drive end of distributor shaft should point forward (direction engine will travel when distributor is bolted in place). (See drawing on left.)



3. Secure distributor adaptor with 4 hex head cap screws.

C. Spark Advance Stop Adjustment

1. Position distributor with air vent elbow facing approximately forward.
2. Place No. 3 piston at .222" (5.639mm) (32½°) BTDC (before top dead center) by rotating flywheel in a clockwise (forward) direction from BDC (bottom dead center).
3. Thread Timing Gauge (C-91-32253A1) into No. 3 spark plug hole.
4. Turn flywheel until No. 3 piston strikes Timing Gauge.
5. While turning flywheel, thread Timing Gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center position.
6. Rotate flywheel clockwise ¼ turn.
7. Depress center shaft of Timing Gauge and rotate ¼-turn to seat on tool body shoulder (.222" [5.639mm] BTDC position). *NOTE: Be careful that tool body does not move, or preceding procedure will have to be repeated.*
8. Rotate flywheel clockwise until No. 3 piston strikes Timing Gauge center shaft. This is .222" BTDC.
9. Connect one test lead of Timing Meter (C-91-22966) or Magneto Analyzer (C-91-25213) (selector switch

on No. 2, Distributor Resistance) to white lead (No. 1 coil primary) at terminal block.
10. Attach second lead of tester to distributor frame.
11. Retard distributor against "idle speed" stop screw. (Figure 3)
12. Turn distributor rotor slowly counterclockwise to touch drive coupling.
13. Turn distributor (holding rotor) slowly counterclockwise until points break, as indicated by timing unit used.
14. Hold distributor in this position and adjust spark advance stop screw to just touch pilot assembly and tighten lock nut.
15. Recheck steps 11, 12 and 13 to be sure adjustment is correct.

D. Pickup Plate Adjustment

1. Thread .015" Timing Gauge (91-31161A1) into No. 3 spark plug hole.
2. Turn flywheel until piston strikes Timing Gauge.
3. While turning flywheel, thread timing gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center (TDC) position.
4. Rotate flywheel clockwise ¼ turn.

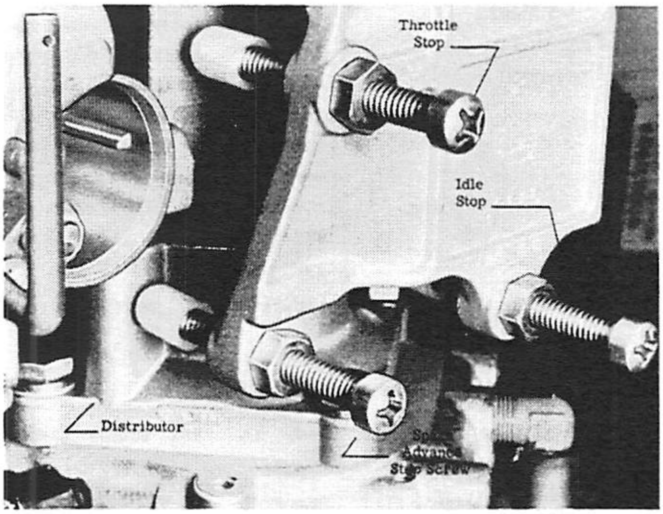


Figure 3. Spark Advance Adjustment

5. Depress center shaft of Timing Gauge and rotate ¼ turn to seat on tool body shoulder (.015" BTDC). *NOTE: Be careful that tool body does not move or preceding steps will have to be repeated.*
6. Continue to rotate flywheel clockwise until piston strikes Timing Gauge.
7. Connect one test lead of Timing Meter (91-22966) or Magneto Analyzer (91-25213) (selector switch on No. 2, Distributor Resistance) to white lead (No. 1 coil primary) at terminal block.
8. Attach second lead of tester to distributor frame.
9. Retard distributor against idle stop screw.
10. Turn distributor rotor slowly counterclockwise to touch drive coupling.
11. While holding rotor in this position, rotate distributor slowly counterclockwise until points break, as indicated by timing unit used.
12. Loosen throttle pickup plate screws. (Figure 4)
13. Slide throttle pickup plate so that first throttle

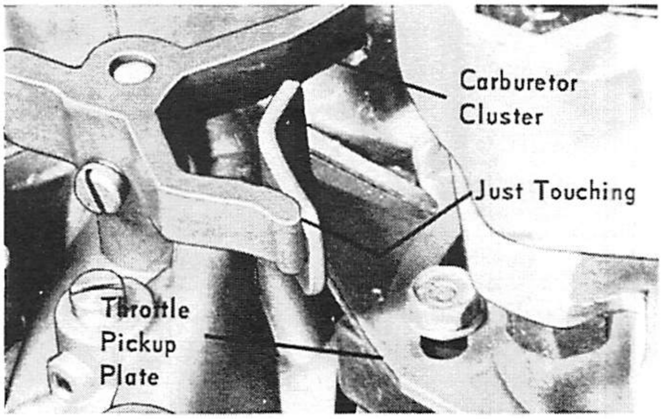


Figure 4. First Throttle Pickup Tab Adjustment

tab (without nylon sleeve) just touches carburetor cluster. (Figure 4)
14. Tighten throttle pickup plate screws.
15. Turn distributor against .222" ("spark advance") stop.
16. Bend second throttle pickup pin (with nylon sleeve) against carburetor cluster (.000"-to-.015" gap). (Figure 5)
17. Lubricate cam and nylon pin with MULTIPURPOSE Quicksilver Lubricant (92-30239).
18. Replace distributor cap.

E. Check and Adjust Neutral Interlock

1. Place shift lever in neutral position, being sure that detent spring is in neutral notch (detent).
2. Loosen shift shaft adjusting nut on shift control linkage in bottom cowl. (Figure 6)
3. Remove link rod retaining clip.
4. Adjust linkage so that mating mark on shift lever is to left of alignment mark on throttle control lever. (Figure 7)
5. Replace link rod retaining clip and tighten shift shaft adjusting nut on shift control linkage in bottom cowl.

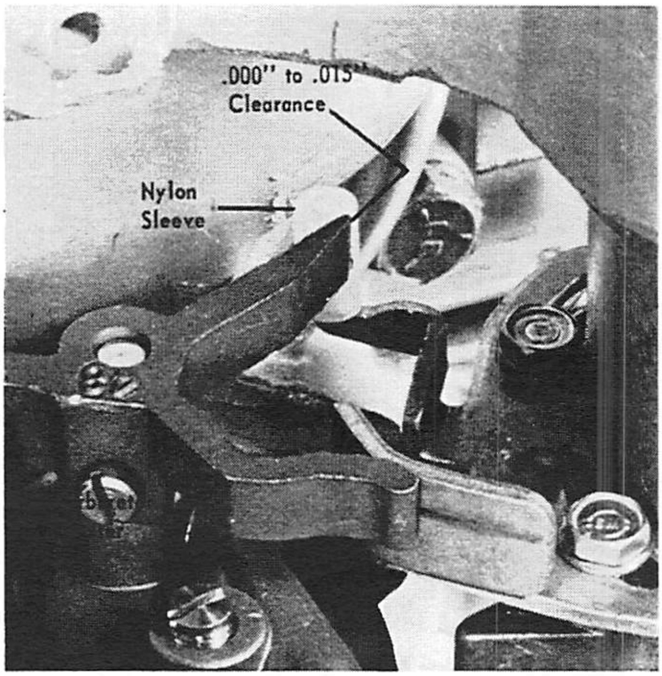


Figure 5. Second Throttle Pickup Tab Adjustment

III. THROTTLE STOP ADJUSTMENTS

A. Throttle Stop Adjustment

1. Rotate Economizer collar to wide open throttle position.
2. Adjust "throttle stop" screw on stop bracket (Figure 3) to allow full throttle shutter opening but not to allow throttle shutters to act as a stop or the carburetor cluster to hit carburetor filter bowl.

B. Idle Speed Adjustment and Checks

1. Start engine and run until warm.

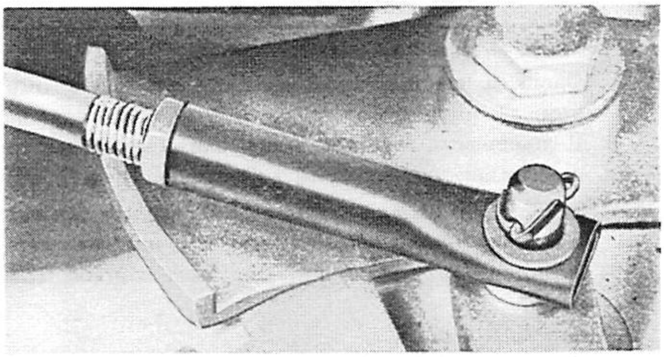


Figure 6. Shift Shaft Adjusting Nut

2. Idle engine and adjust "idle speed" screw on stop bracket (Figure 3) so that engine idles at 500 RPM in forward gear.
3. Run engine between 4500-5000 RPM.

IV. CARBURETOR ADJUSTMENTS

A. High Speed Adjustment

Carburetors have fixed high speed jets. Standard jet, installed at factory, is recommended for operation from sea level to 4000 ft. elevation.

1. If engine is operated above 4000 ft. (1219m), select and install correct jets from chart following (aperture decreases .002" [.051mm] as elevation increases each 3000 ft. [914m]).
2. Before changing jets, check engine out unless previous tests indicate exact jet size.
3. Jet size recommendations are intended as a guide (like a propeller chart). Try size larger or smaller if in doubt.

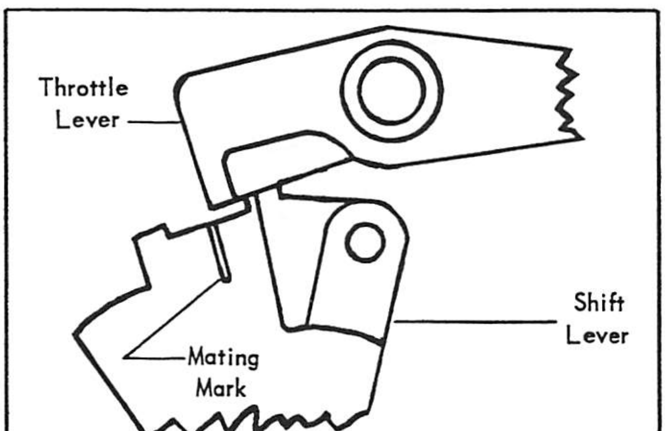


Figure 7. Linkage Adjustment

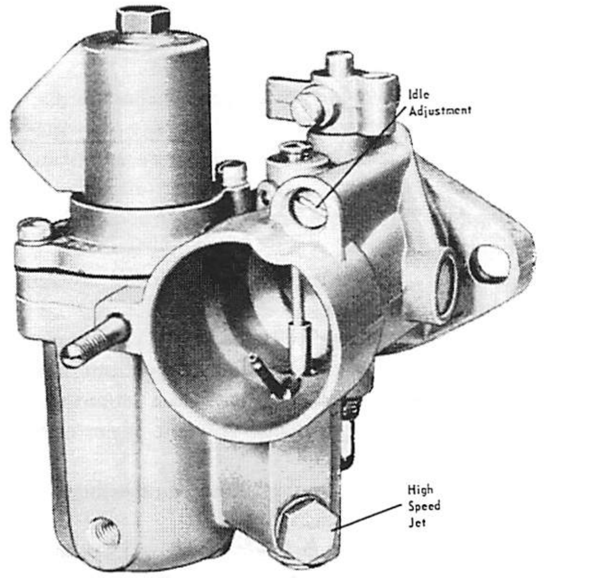


Figure 8. Idle Adjustment

Model	*Up to 4000'	4000-7000'	7000-10000'
Model 1000 Jet Size	.069" (1.753mm)	.067" (1.702mm)	.065" (1.651mm)
Merc 850 (90 Cu. In.)	.055" (1.397mm)	.053" (1.346mm)	.051" (1.295mm)

** Standard jet -- factory equipped*

4. No change in spark advance is recommended for elevation operation. Propellers of lower pitch should be used at high elevations to allow proper engine RPM.
5. Engine can be tested in test tank with propeller or Test Wheel.

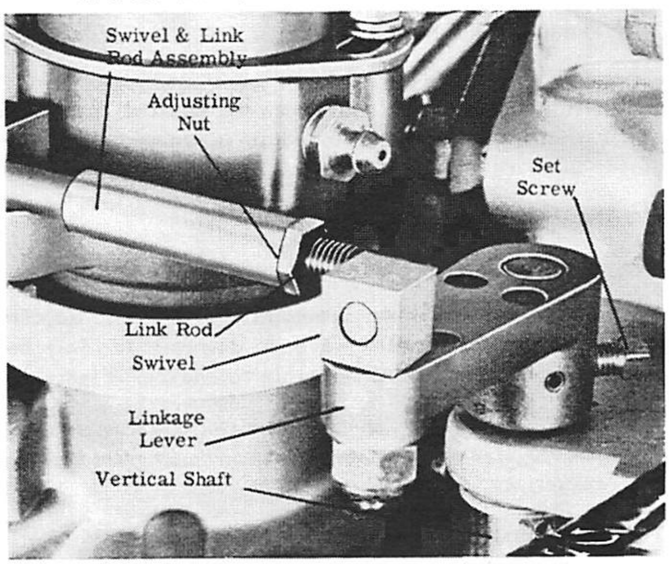


Figure 9. Vertical Shaft Adjustment

B. Idle Adjustment

1. Idle adjustment also has been set at factory. If readjustment is necessary, it can be done with Test Wheel or a regular propeller in the test tank or on the boat.

2. Start with all idle needles one turn open and adjust for maximum RPM with distributor retarded to give about 600-700 RPM. (Figure 8)
3. Warm engine before attempting adjustment.
4. With engine running at idling speed while in forward gear, turn low speed mixture adjusting needle counterclockwise until affected cylinders start to "load up" or fire unevenly due to overrich mixture. (Figure 8)
5. Slowly turn needle clockwise until cylinders fire evenly and engine picks up speed.
6. Continue turning clockwise until too-lean a mixture is obtained and engine slows down and misfires.
7. Set adjustment screw one turn counterclockwise from lean-out position to gain approximate true setting.
8. Do not adjust leaner than necessary to attain reasonably smooth idling.
9. When in doubt, it is preferable to have mixture set slightly rich rather than too lean.

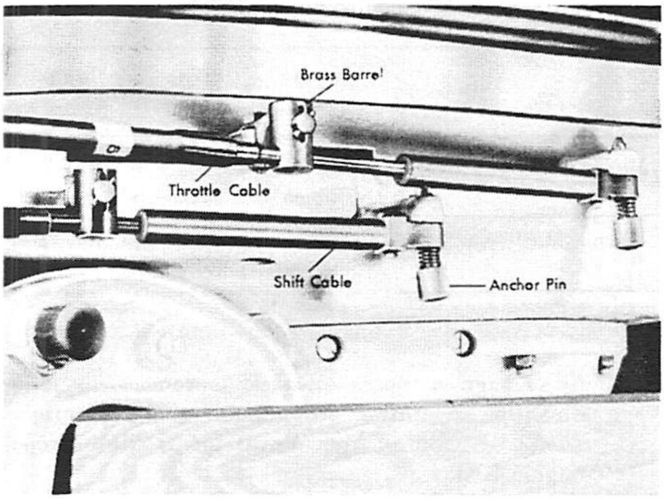


Figure 10. Cable Adjustments

C. Neutral RPM Adjustment

1. Shift into neutral.
2. Adjust length of link between vertical shaft and distributor actuator to obtain a speed of 2400-to-3000 RPM. (Figure 9)

V. REMOTE CONTROL ADJUSTMENTS

A. Throttle Control Cable

1. Place control lever in neutral position and be sure that neutral throttle lever is down all the way before attaching throttle cable to engine. (Figure 11)

NOTE: Throttle cable is one on which nylon end moves last when moving control handle from neutral position.

2. Move throttle lever on engine forward to throttle stop (idle position) and hold in this position.
3. Align brass barrel on throttle cable so that distributor is held lightly against idle stop screw with cable installed. (Figure 10)
4. Move control handle to full forward, full reverse and return to neutral.

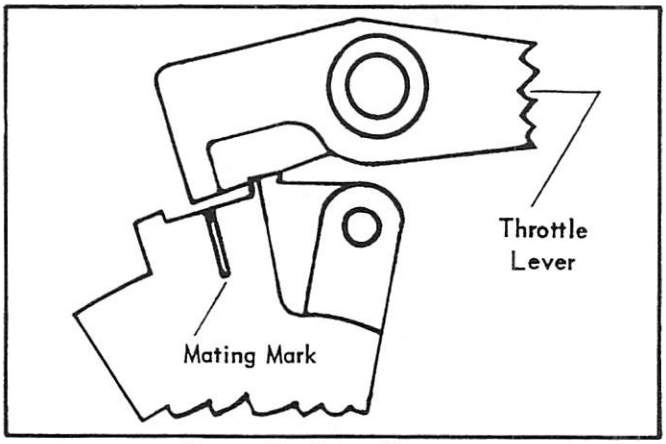


Figure 11. Lever Positions

5. Check to see that distributor has returned to idle stop.
6. If necessary, readjust brass barrel on cable to accomplish correct final adjustment. (Figure 10)

NOTE: If distributor is forced too tightly against idle stop, neutral throttle lever will not open carburetor throttle shutters, and hard starting will result.

B. Gear Shift Cable

1. Place control handle in neutral (detent) position and shift lever on engine in neutral position.

NOTE: Gear shift cable is one on which nylon end moves first when moving control handle from neutral (detent) position.

2. Adjust brass barrel so that cable is connected without disturbing either lever or handle.
3. Move control handle to forward position and be sure that detent spring is in forward notch (detent) of shift control lever plate in bottom cowl.
4. Shift back into neutral and check to see that throttle lever and shift lever are in position as shown in Figure 11. Disengage cable end and readjust brass barrel of throttle cable, if necessary, to be sure that mating mark on shift lever is to the right of indicating portion of throttle control lever, as shown in Figure 12. This will assure that engine is in neutral when control handle of remote control is in its detent position (neutral).

NOTE: If control cables are not properly adjusted, engine cannot operate satisfactorily.

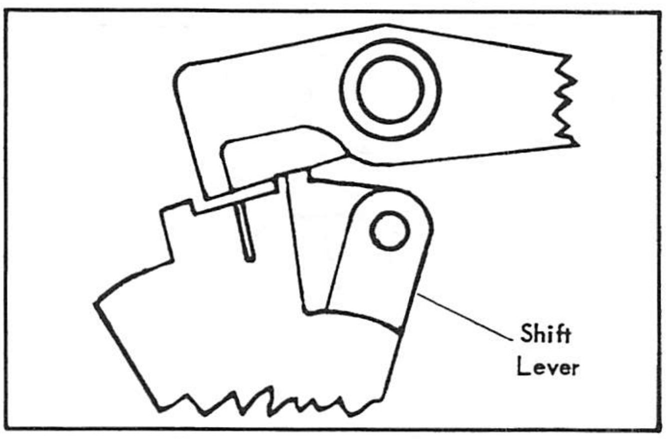


Figure 12. Lever Positions

TIMING, ADJUSTING, TESTING
MERC 650

Description	Merc 650
Cylinder Firing Order	1-3-2-4
Firing Sequence	90° Consecutive
Spark Plug, Standard Installation	J4J
Spark Plug Gap	.025" (.635mm)
Timing	.222" (5.64mm) (32½°) BTDC
Breaker Setting	48° Dwell (.008" [.203mm] +.000" -.002" [.051mm])
Full Throttle RPM Range	4800-5200

I. TIMING AND LINKAGE ADJUSTMENT

A. Flywheel, Magneto Pulley and Belt Assembly

1. Rotate flywheel until timing mark (a straight line stamped on upper surface) is in a straight line with center of crankshaft and magneto pulley center. (Figure 1)
2. Position arrow on pulley (not plate) to point at timing mark on flywheel.
3. Install timing belt, plate, cap, washers and screw and tighten to 60 in .lbs .(10.65kg/cm).

B. Installing Magneto

Magneto rotor shaft and shaft extension are splined with one blanketed spline on each shaft for easy installation.

1. With flywheel and pulley in position described in "A" preceding, install magneto on engine.
2. Rotate timing pulley until shaft sets in place. A 1/16" (1.6mm) groove is located at end of shaft coupling in centerline of blanketed shaft to locate for easy installation.
3. Secure magneto to magneto adaptor with 4 hex head cap screws.

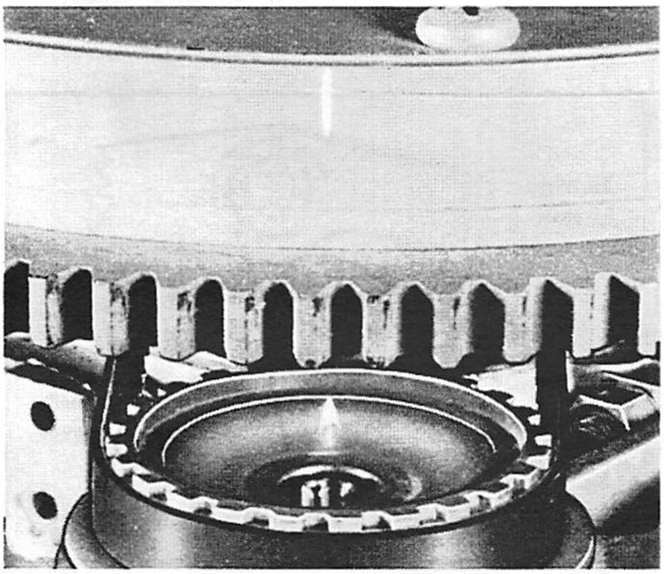


Figure 1. Timing Marks on Flywheel and Pulley

C. Setting Maximum Spark Advance

1. Thread Timing Gauge (C-91-32253A1) into No. 1 spark plug hole.
2. Turn flywheel until No. 1 piston strikes Timing Gauge.
3. While turning flywheel, thread Timing Gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center (TDC) position.
4. Rotate flywheel clockwise ¼ turn.
5. Depress center shaft of Timing Gauge.
6. Rotate gauge shaft ¼ turn to seat on tool body shoulder (.222" [5.639mm] BTDC position). Be careful that tool body does not move, or preceding procedure will have to be repeated.
7. Rotate flywheel clockwise by hand until No. 1 piston strikes Timing Gauge center shaft. This is .222" (5.639mm) BTDC.
8. Attach one test lead of Timing Meter (C-91-22966) or Magneto Analyzer (C-91-25213) (on No. 2 Resistance) to magneto frame.
9. Attach second lead of tester to primary ground terminal of magneto.
10. Slowly advance magneto until points break, as indicated by tester used.
11. Hold magneto in this position and adjust spark advance stop screw to just touch pilot assembly and tighten lock nut. (Figure 2)
12. Recheck setting by actuating magneto with throttle control lever on side of bottom cowl.

D. Pickup Plate Adjustment

1. Thread .015" (.381mm) Timing Gauge (C-91-31161A1) into No. 1 spark plug hole.
2. Turn flywheel until piston strikes Timing Gauge.
3. While turning flywheel, thread timing gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center (TDC) position.
4. Rotate flywheel clockwise ¼ turn.
5. Depress center shaft of Timing Gauge and rotate ¼-turn to seat on tool body shoulder (.015" [.381mm] BTDC). *NOTE: Be careful that tool body does not move or preceding steps will have to be repeated.*
6. Continue to rotate flywheel clockwise until piston strikes Timing Gauge.
7. Connect one test lead of Timing Meter (C-91-22966) or Magneto Analyzer (C-91-25213) (selector switch on No. 2, Distributor Resistance) to magneto frame.
8. Attach second lead of tester to primary ground terminal of magneto.
9. Retard magneto against idle stop screw. (Figure 2)
10. Rotate magneto slowly counterclockwise until points break, as indicated by timing unit used.
11. Loosen throttle pickup plate screws. (Figure 3)
12. Slide throttle pickup plate so that tab (without nylon sleeve) just touches carburetor cluster. (Figure 3)
13. Tighten throttle pickup plate screws.
14. Turn magneto against .222" (" spark advance") stop.

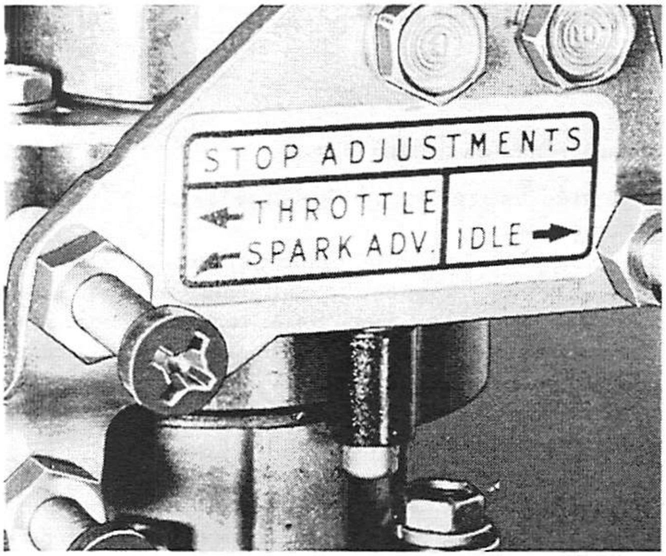


Figure 2. Spark Advance Adjustment

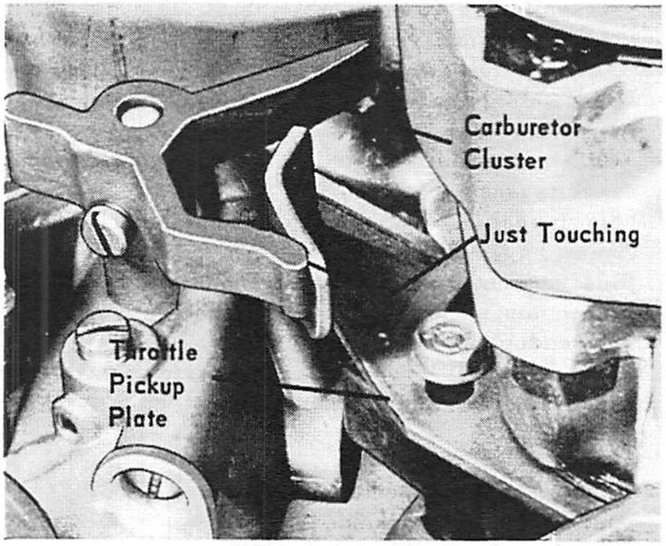


Figure 3. First Throttle Pickup Tab Adjustment

15. Bend second throttle pickup pin (with nylon sleeve) against carburetor cluster (.000"-to-.015" gap). (Figure 4)
16. Lubricate cam and nylon pin with MULTIPURPOSE Quicksilver Lubricant (92-30239).

E. Check and Adjust Neutral Interlock

1. Place shift lever in neutral position, being sure that detent spring is in neutral notch (detent).
2. Loosen shift shaft adjusting nut on shift control linkage in bottom cowl. (Figure 5)
3. Remove link rod retaining clip.
4. Adjust linkage so that mating mark on shift lever is to left of alignment mark on throttle control lever. (Figure 6)
5. Replace link rod retaining clip and tighten shift shaft adjusting nut on shift control linkage in bottom cowl.

II. THROTTLE STOP ADJUSTMENTS

A. Throttle Stop Adjustment

1. Rotate Economizer collar to wide open throttle position.
2. Adjust "throttle stop" screw on stop bracket (Figure 2) to allow full throttle shutter opening but not to allow throttle shutters to act as a stop or the carburetor cluster to strike carburetor filter bowl.

B. Idle Speed Adjustment and Checks

1. Start engine and run until warm.
2. Idle engine and adjust "idle speed" screw on stop bracket (Figure 2) so that engine idles at 500 RPM in forward gear.
3. Run engine between 4500-5000 RPM.

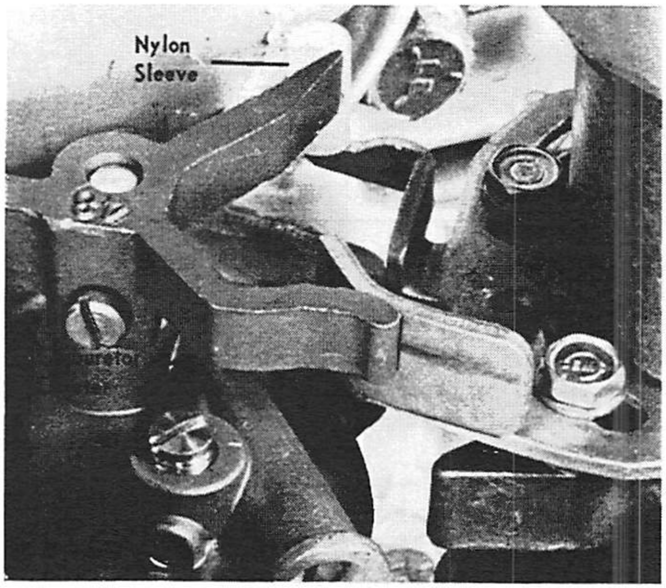


Figure 4. Second Throttle Pickup Pin Adjustment

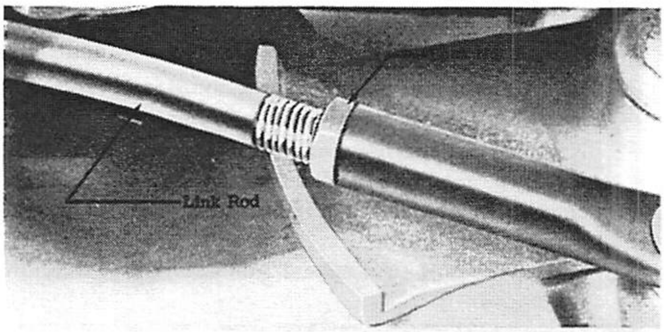


Figure 5. Shift Shaft Adjusting Nut

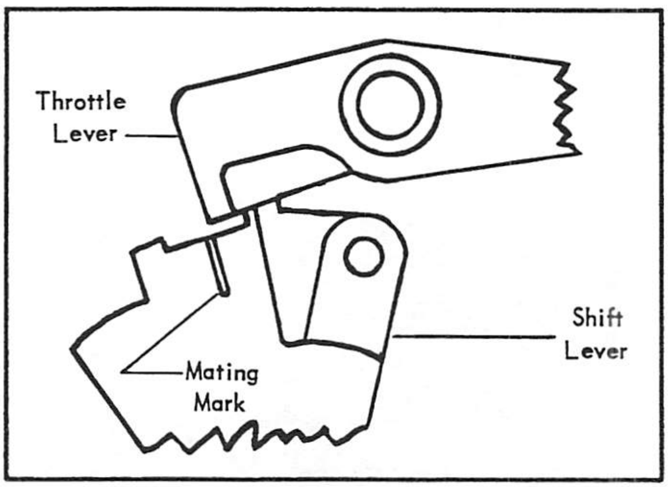


Figure 6. Linkage Adjustment

CARBURETOR ADJUSTMENTS

High Speed Adjustment

Carburetors have fixed highspeed jets. Standard jet, installed at factory, is recommended for operation from sea level to 4000 ft. (1219.200m) elevation.

1. If engine is operated above 4000 ft. (1219.200m), select and install correct jets from chart following (aperature decreases .002" (.0508mm) as elevation increases each 3000 ft. [914.400m]).
2. Before changing jets, check engine out unless previous tests indicate exact jet size.
3. Jet size recommendations are intended as a guide (like a propeller chart). Try size larger or smaller if in doubt.
4. No change in spark advance is recommended for elevation operation. Propellers of lower pitch should be used at high elevations to allow proper engine RPM.
5. Engine can be tested in test tank with propeller or Test Wheel.

NOTE: See Carburetor Chart, Section V, Page 21 to determine correct jet size for altitude.

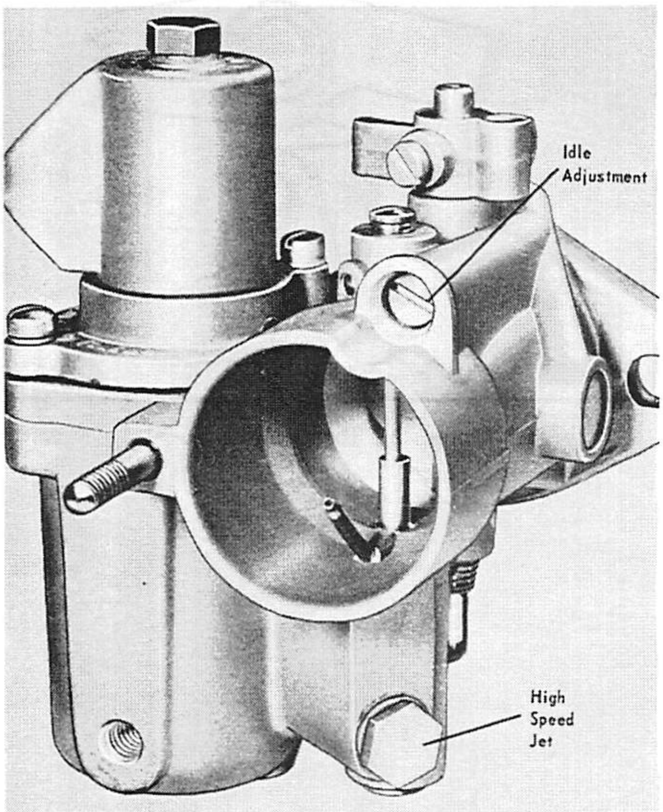


Figure 7. Idle Adjustment

Idle Adjustment

1. Idle adjustment also has been set at factory. If readjustment is necessary, it can be done with Test Wheel or a regular propeller in the test tank or on the boat.
2. Start with all idle needles one turn open and adjust for maximum RPM with magneto retarded to give about 600-700 RPM. (Figure 7)
3. Warm engine before attempting adjustment.
4. With engine running at idling speed while in forward gear, turn low speed mixture adjusting needle counterclockwise until affected cylinders start to "load up" or fire unevenly due to overrich mixture. (Figure 7)
5. Slowly turn needle clockwise until cylinders fire evenly and engine picks up speed.
6. Continue turning clockwise until too-lean a mixture is obtained and engine slows down and misfires.
7. Set adjustment screw one turn counterclockwise from lean-out position to gain approximate true setting.
8. Do not adjust leaner than necessary to attain reasonably smooth idling.
9. When in doubt, it is preferable to have mixture set slightly rich rather than too lean.

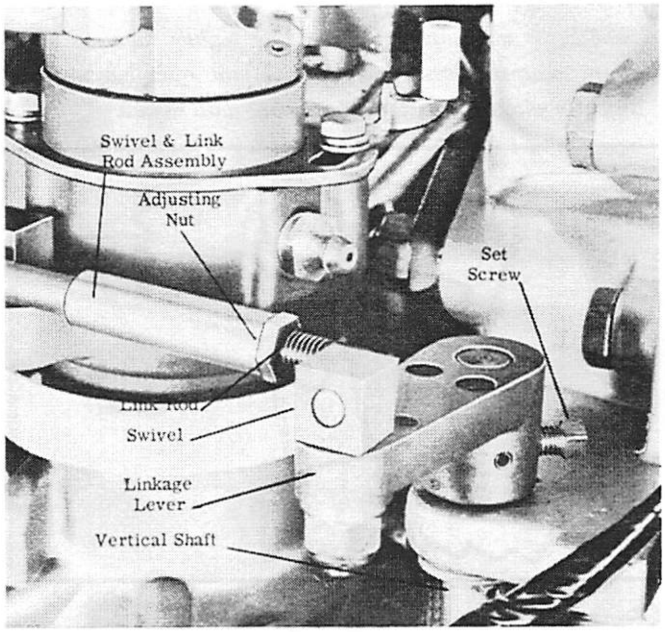


Figure 8. Vertical Shaft Adjustment

Neutral RPM Adjustment

1. Shift into neutral.
2. Adjust length of link between vertical shaft and magneto actuator to obtain a speed of 2400-to-3000 RPM. (Figure 8)

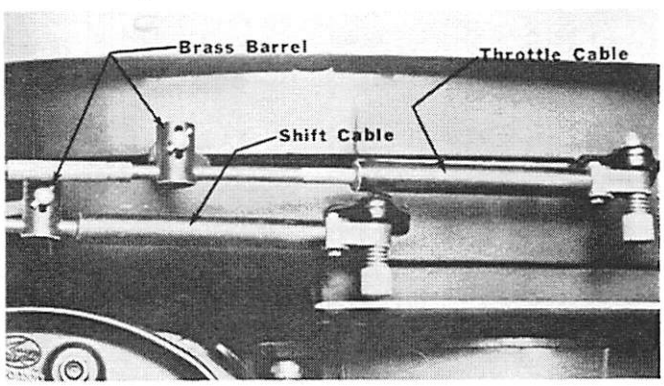


Figure 9. Cable Adjustments

REMOTE CONTROL ADJUSTMENTS

Throttle Control Cable

1. Place control lever in neutral position and be sure

that neutral throttle lever is down all the way before attaching throttle cable to engine.

NOTE: Throttle cable is one on which nylon end moves last when moving control handle from neutral position.

2. Move throttle lever on engine forward to throttle stop (idle position) and hold in this position.
3. Align brass barrel on throttle cable so that distributor is held lightly against idle stop screw with cable installed. (Figure 9)
4. Move control handle to full forward, full reverse and return to neutral.
5. Check to see that magneto has returned to idle stop.
6. If necessary, readjust brass barrel on cable to accomplish correct final adjustment. (Figure 9)

NOTE: If magneto is forced too tightly against idle stop, neutral throttle lever will not open carburetor throttle shutters, and hard starting will result.

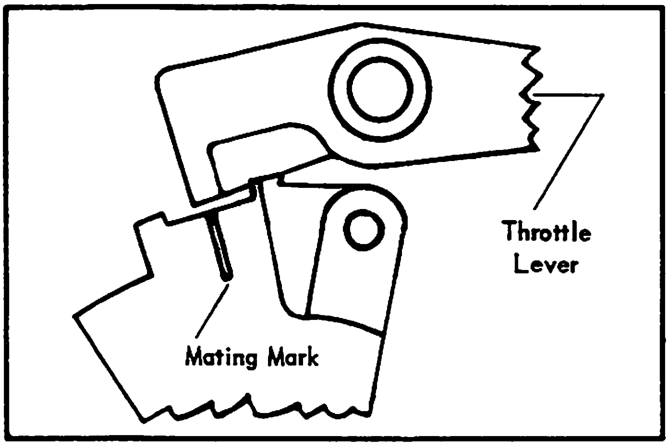


Figure 10. Lever Positions

Gear Shift Cable

1. Place control handle in neutral (detent) position and shift lever on engine in neutral position.

NOTE: Gear shift cable is one on which nylon end moves first when moving control handle from neutral (detent) position.

2. Adjust brass barrel so that cable is connected without disturbing either lever or handle.
3. Move control handle to forward position and be sure that detent spring is in forward notch (detent) of shift control lever plate in bottom cowl.
4. Shift back into neutral and check to see that throttle lever and shift lever are in position as shown in Figure 10. Disengage cable end and readjust brass barrel of throttle cable, if necessary, to be sure that mating mark on shift lever is to the right of indicating portion of throttle control lever, as shown in Figure 11. This will assure that engine is in neutral when control handle of remote control is in its detent position (neutral).

NOTE: If control cables are not properly adjusted, engine cannot operate satisfactorily.

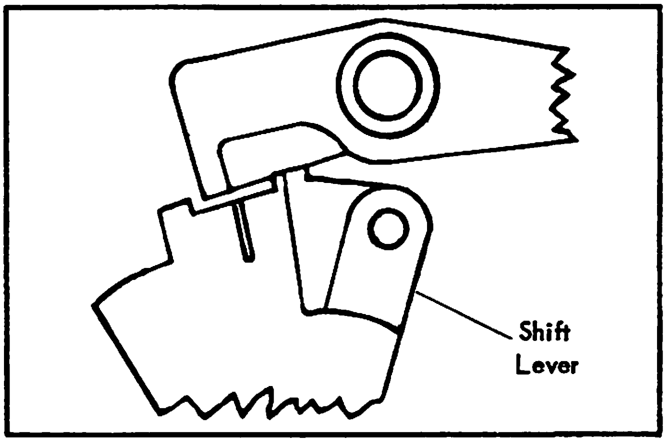


Figure 11. Lever Positions

TIMING, ADJUSTING, TESTING

MERC 350 (2-CYL.)

MERC 350 1964		MERC 350 1965	
Merc Model	Serial No.	Merc Model	Serial No.
350	1571114 thru 1812753	350	1812754 and up

I. IGNITION DATA

DESCRIPTION	MERC 350
Firing Order	Alternate Firing
Spark Plug, Standard Installation	J6J
Spark Plug Gap	.025" (0.6350mm)
Timing	.222" (5.6388mm) (32°) B.T.D.C.
Breaker Point Setting	.020" (0.5080mm)
RPM, Maximum Recommended	5200

II. TIMING AND SYNCHRONIZING BREAKER POINTS

1. Remove flywheel.
2. Set No. 1 breaker assembly at .020" (0.5080mm).
3. Install .222" (5.6388mm) Timing Gauge (C-91-32253A1) in No. 1 spark plug hole.
4. Turn crankshaft until No. 1 piston lightly touches timing gauge.

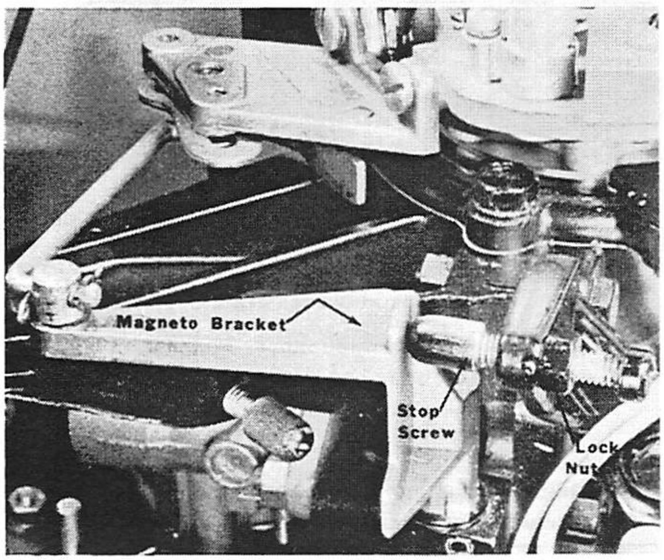


Figure 1. Stop Screw against Magneto Bracket

5. While turning crankshaft, thread timing gauge in or out so that piston can "rock" over center shaft of gauge, indicating that timing gauge is set at top dead center position.
6. Rotate crankshaft clockwise ¼ turn.
7. Depress center shaft of timing gauge and rotate ¼ turn to seat on tool body shoulder (.222" [5.6388 mm] BTDC position). *Note: Be careful that tool body does not move, or preceding procedure will have to be repeated.*
8. Rotate crankshaft clockwise until No. 1 piston strikes timing gauge center shaft. This is .222" (5.6388mm) BTDC.
9. Set Magneto Analyzer (C-91-25213) selector switch on No. 2 (resistance) or, employing Continuity Meter (C-91-22966), attach one small test lead to stator plate (ground) and second small test lead to terminal of breaker point.
10. Advance magneto until breaker points open, as indicated by tester used.
11. Hold magneto at this position, adjust stop screw to contact magneto bracket and tighten stop screw lock nut. (Figure 1)
12. Move small test lead from first breaker point and attach to No. 2 breaker point terminal.
13. Install .222" (5.6388mm) Timing Gauge (C-91-32253A1) into No. 2 spark plug hole.
14. Set No. 2 piston at .222" (5.6388mm) BTDC.
15. With magneto in full advance position, adjust No. 2 breaker point assembly until it just starts to open, as indicated by tester used.
16. Recheck settings on No. 1 and No. 2 breaker points to be sure adjustments are correct.
17. Reinstall flywheel and torque flywheel nut to 65 ft. lb. (8.97 mkg)
18. Reinstall two (2) screws which were removed previously from flywheel ratchet and torque to 150 in. lbs. (26.625 kg/cm)
19. Adjust stop block in bottom cowl to permit magneto stop to just touch maximum spark advance screw. This prevents overloading of magneto and throttle linkage. (Fig. 2)

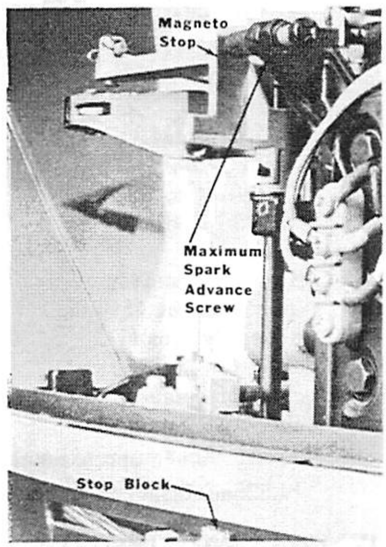


Figure 2. Stop Block Adjusted in Bottom Cowl

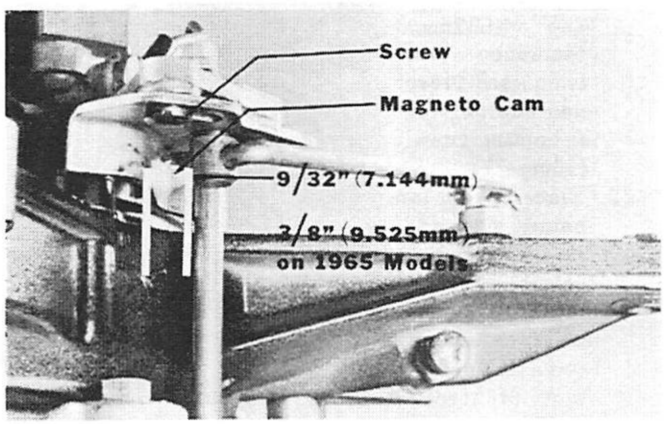


Figure 3. Magneto Cam Adjustment

III. MAGNETO CAM ADJUSTMENT

NOTE: Magneto cam and throttle lever have been adjusted at the factory. No adjustments are necessary, unless magneto cam or throttle lever are replaced. These adjustments are:

1. Clearance between magneto cam and swivel link should be 9/32" (7.144mm). (Clearance is 3/8" [9.525mm] on 1965 model.) Readjust, if necessary, by loosening 2 screws and moving magneto cam in slots. Tighten screws securely. (Figure 3)
2. With magneto in full advance position, loosen screw which secures throttle lever to carburetor and adjust throttle shutter to wide open position. Tighten screw securely. (Fig. 4)
3. Retard magneto so that throttle lever is on cam plateau (economy position). Bend throttle lever, if necessary, to obtain .089" (2.2606mm) throttle shutter opening. (Opening is .045" [1.1430 mm] to .070" [1.7780mm] on 1965 model.) Check with No. 43 drill (No. 52 on 1965 model). (Figure 5)
4. Retard magneto to idle position. If necessary, bend end of leading edge of magneto cam to touch throttle lever approximately 1/4" (6.350mm) to 3/8" (9.525mm) from end of cam. (Figure 6)

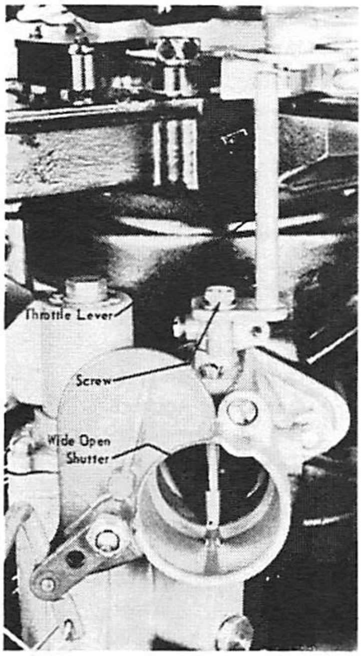


Figure 4. Throttle Shutter Adjustment

IV. SHIFT AND THROTTLE LINKAGE ADJUSTMENT

1. Place motor in forward gear and adjust shift control rod to obtain 3/8" (9.525mm) clearance between shift lever and rear of slot in bottom cowl. (Figure 7)
2. Place motor in neutral gear; adjust throttle stop control rod so that throttle control lever is centered in neutral slot of throttle stop lever. (Figure 8)

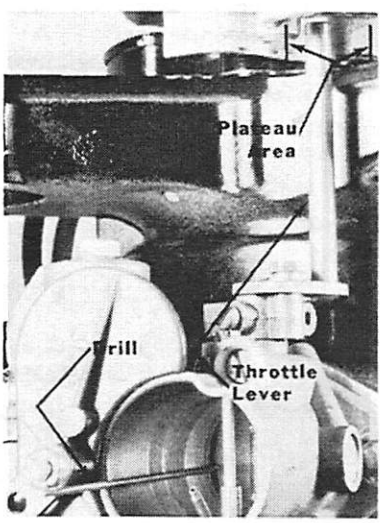


Figure 5. Checking Throttle Shutter Opening

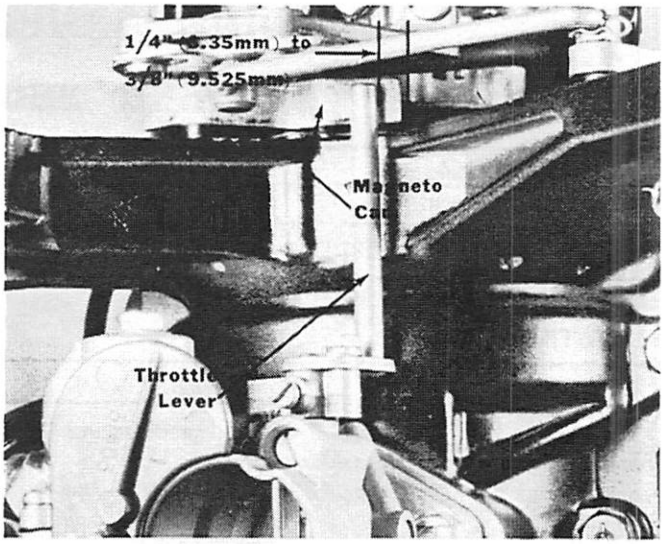


Figure 6. Magneto Cam Touching Throttle Lever

V. ADJUSTMENTS IN TEST TANK, CARBURETOR ADJUSTMENTS

A. High Speed Adjustment

1. The standard jet, installed at the factory, is recommended for operation from sea level to 4000 ft. (1219.2 m) elevation.

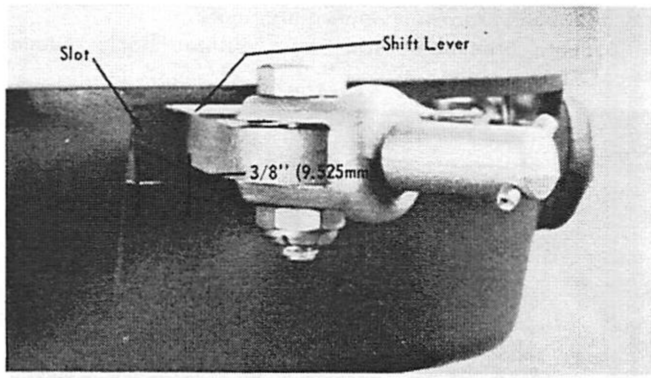


Figure 7. Clearance between Shift Lever and Cowl

a. If engine is operated above 4000 ft. (1219.2 m) elevation, select and install correct jets from chart following (aperature decreases .002" [0.0508 mm] as elevation increases each 3000 ft. (914.40 m).
b. Before changing jets, check engine out, unless previous tests indicate exact jet size.

Model Merc 350 Jet Size		
*Up to 4000' (1219.2m)	4000'-7000' (1219.2m-2133.6m)	7000'-10,000' (2133.6m-3048.0m)
.069" (1.7526mm)	.067" (1.7018mm)	.065" (1.6510mm)

* Standard Jet - Factory Equipped

c. No change in spark advance is recommended for elevation operation. Propellers of lower pitch should be used at high elevations to allow proper engine RPM.
d. Engine can be tested in test tank with propeller or test wheel.

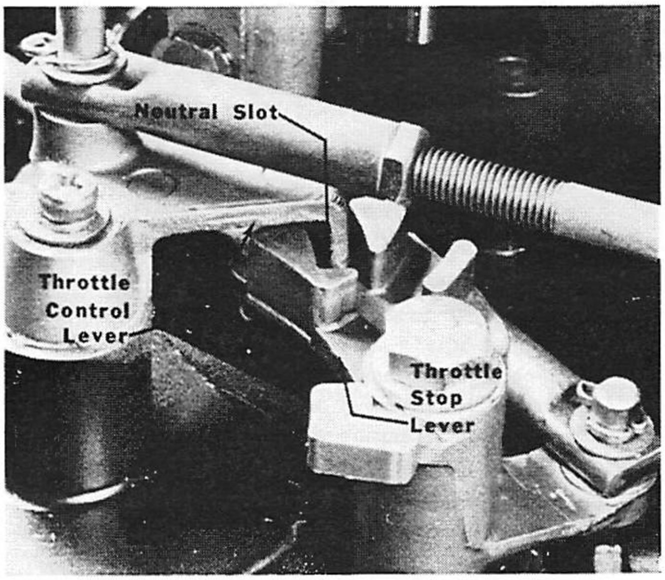


Figure 8. Throttle Control Lever Centered

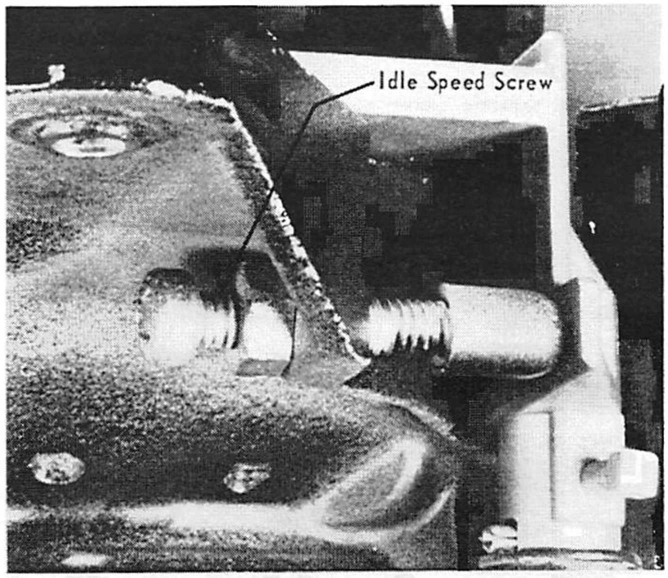


Figure 10. Idle Speed Screw

B. IDLE ADJUSTMENTS

1. Idle adjustment also had been set at factory. If readjustment is necessary, it can be done with Test Wheel or a regular propeller in the test tank or on the boat.
2. Start with idle needle one turn open and adjust for maximum RPM with magneto retarded to give about 600-700 RPM.
3. Warm engine before attempting adjustment.
4. With engine running at idling speed while in forward gear, turn low speed mixture adjusting needle counterclockwise until affected cylinders start to "load up" or fire unevenly due to overrich mixture.
5. Slowly turn needle clockwise until cylinders fire evenly and engine picks up speed. (Figure 9)
6. Continue turning clockwise until too-lean-a-mixture is obtained and engine slows down and misfires.
7. Set adjustment screw ¾-turn counterclockwise from lean-out position to gain approximate true setting.
8. Do not adjust leaner than necessary to attain reasonable smooth idling.
9. When in doubt, it is preferable to have mixture set slightly rich rather than too lean.
10. Adjust idle speed screw so that motor idles at approximately 500 RPM in forward gear. (Figure 10)

VI. NEUTRAL RPM ADJUSTMENT

1. Shift into neutral.
2. Adjust throttle control rod to obtain a maximum RPM in neutral of 2500-to-2700. (Figure 11)

VII. REMOTE CONTROL ADJUSTMENTS

A. Throttle Control Cable Installation on Engine

1. Remove front cover and wrap-around cowl from engine.
2. Place control lever in neutral position and be sure that neutral throttle lever is down all the way before attaching throttle cable to engine. *(Note: The*

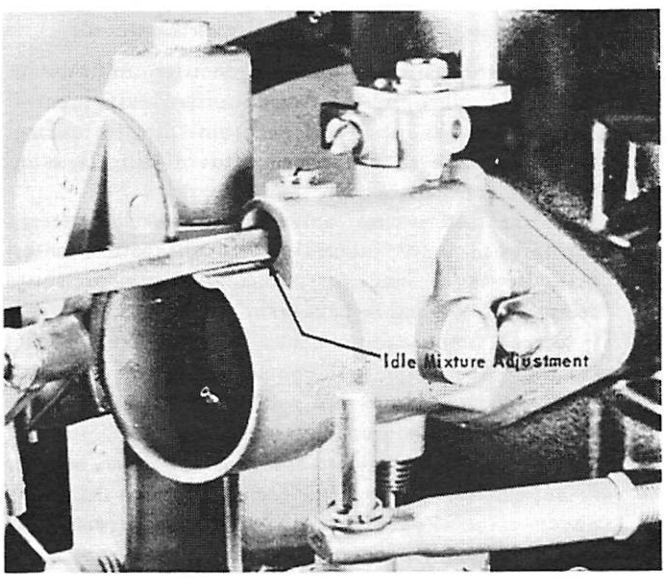


Figure 9. Carburetor Idle Adjustment

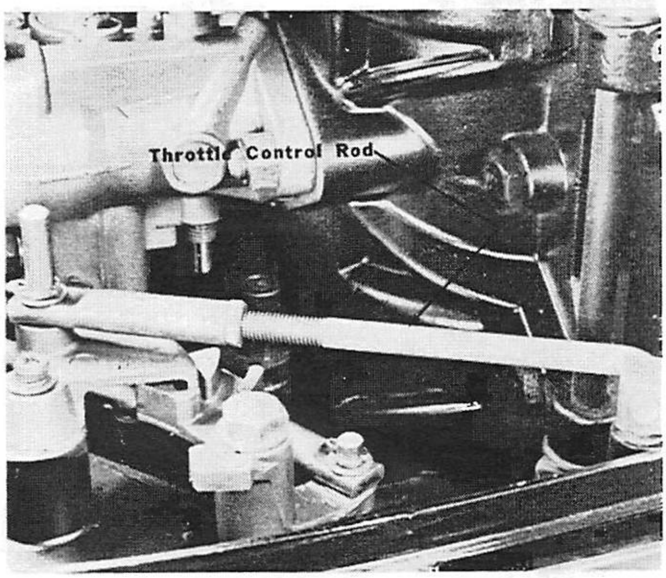


Figure 11. Neutral RPM Adjustment

throttle cable is the one on which nylon end moves last when moving control handle from neutral position.)

3. Move throttle lever on engine forward until throttle stop lever touches idle stop screw lightly and hold lever in this position. (Figure 12)

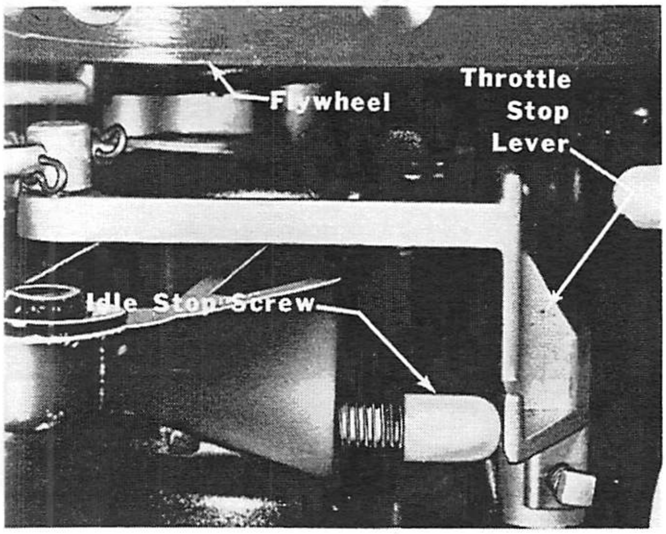


Figure 12. Throttle Stop Lever Touching Idle Stop Screw

4. Fasten throttle cable end guide to bottom of anchor point on bottom cowl. (Figure 13)
5. Align brass barrel so that hole in barrel is in line with clevis yoke on throttle lever.
6. Remove knurled pin from anchor point and place brass barrel on clevis yoke with cable on bottom. (Figure 13)
7. Re-insert knurled pin in anchor point. (Figure 13)
8. Move control handle to full forward, full reverse and return to neutral.
9. Check to see that throttle stop lever is touching stop screw lightly. (Figure 12) If necessary, readjust brass barrel on cable to accomplish correct adjustment. If throttle stop lever is forced too tightly against idle stop screw, neutral throttle lever will not open carburetor throttle shutters, and hard starting will result. If stop lever is not touching idle stop screw, engine will not idle down.

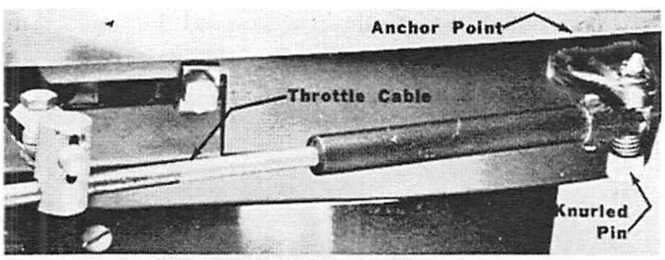


Figure 13. Throttle Cable Adjustment

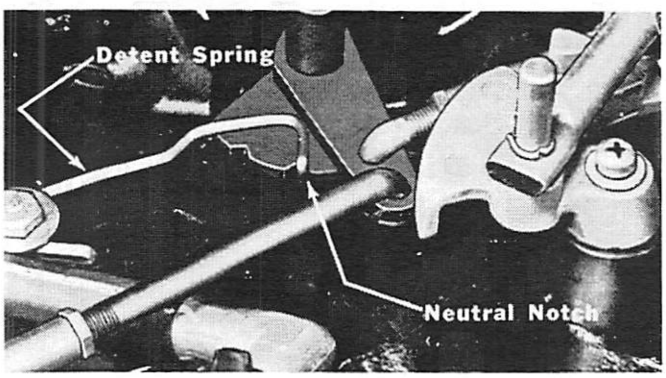


Figure 14. Detent Spring and Shift Control Lever Plate

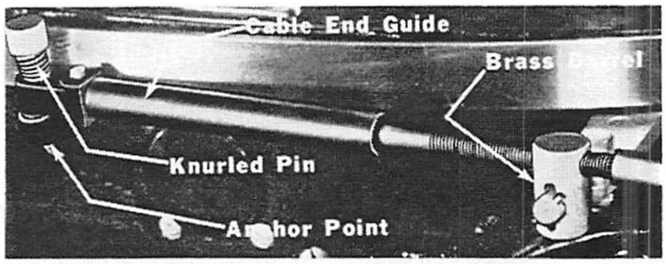


Figure 15. Shift Cable Installed

B. Gear Shift Control Cable Installation on Engine

1. Gear shift cable is one on which nylon end moves first when moving control handle from neutral (detent) position.
2. Place control in neutral position (detent) and shift lever on engine in neutral position. When shift lever on engine is in neutral position, detent spring will be in center notch of shift control lever. (Figure 14)
3. Fasten shift cable end guide to top of anchor point on bottom cowl. (Figure 15)
4. Align brass barrel so that hole in barrel is in line with clevis yoke on shift lever.
5. Remove knurled pin from anchor point and place brass barrel on clevis yoke with cable on top. (Figure 15)
6. Re-insert knurled pin in anchor point. (Figure 15)

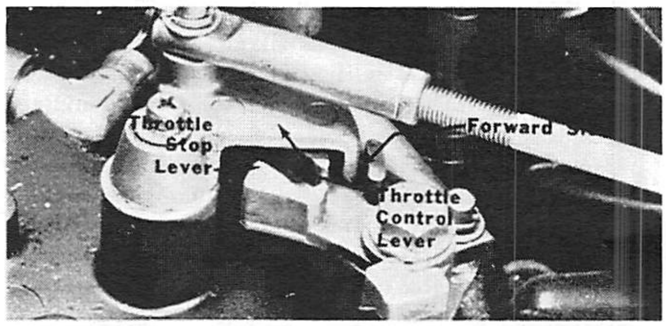


Figure 16. Throttle Control Lever Centered

7. Move control handle to forward position and be sure that detent spring is in forward notch of shift control lever plate in bottom cowl and that throttle control lever is centered in forward slot of throttle stop lever. (Figure 16)
8. Shift back into neutral and check to see that detent spring is in center (neutral) notch of throttle control plate. It may be necessary to adjust brass barrel to compensate for cable backlash.
9. If correct cable adjustments have not been made, shifting mechanism will not function properly and throttle control lever will not enter slot of throttle stop lever, as shown in Figure 8 on Page 87.

CAUTION: Do not shift into reverse while engine is not running, as reverse gear clutch may not be in exact relative position to permit engagement of shifter clutch. Forcing lever under this condition will result in bent or damaged shifting mechanism on engine and control.

TIMING, ADJUSTING, TESTING
MERC 200 FULL GEAR SHIFT

I. IGNITION DATA

Description	Merc 200 Gear Shift
Firing Sequence	Alternate Firing
Spark plug, Standard installation	J6J
Spark Plug Gap	.025"
Timing	.275" BTDC
Breaker Setting	.018"
RPM Maximum	5400

II. TIMING AND SYNCHRONIZING

A. Synchronize Breaker Points

(See information on P. 13 of Ignition System Section V)

B. Maximum Spark Advance

NOTE: Before installing flywheel, maximum spark advance must be set.

1. Place No. 1 piston at .275" BTDC (before top dead center) by rotating crankshaft in a clockwise (forward) direction from BDC (bottom dead center).
2. Thread Timing Gauge (91-30292A1) into No. 1 spark plug hole. (Figure 1)
3. Turn crankshaft until No. 1 piston strikes Timing Gauge.
4. While turning crankshaft, thread Timing Gauge in or out so that piston can "rock" over center shaft of gauge, which indicates that Timing Gauge is set at top dead center position.
5. Rotate crankshaft clockwise 1/4 turn.
6. Depress center shaft of Timing Gauge and rotate 1/4 turn to seat on tool body shoulder (.275" BTDC position). Be careful that tool body does not move, or preceding procedure must be repeated.
7. Rotate crankshaft clockwise until No. 1 piston strikes Timing Gauge center shaft. This is .275" BTDC.
8. Connect one test lead of Timing Meter (91-22966) or Magneto Analyzer 91-25213 (selector switch, on No. 2 Distributor Resistance) to No. 1 breaker point.

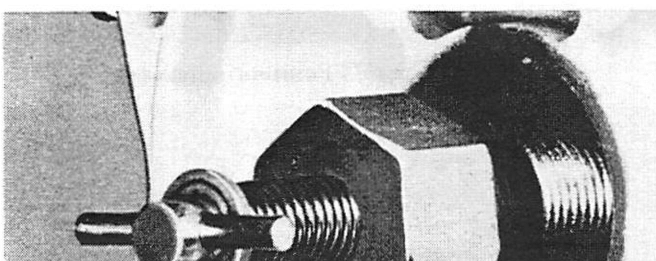


Figure 1. Timing Gauge in No. 1 Spark Plug Hole

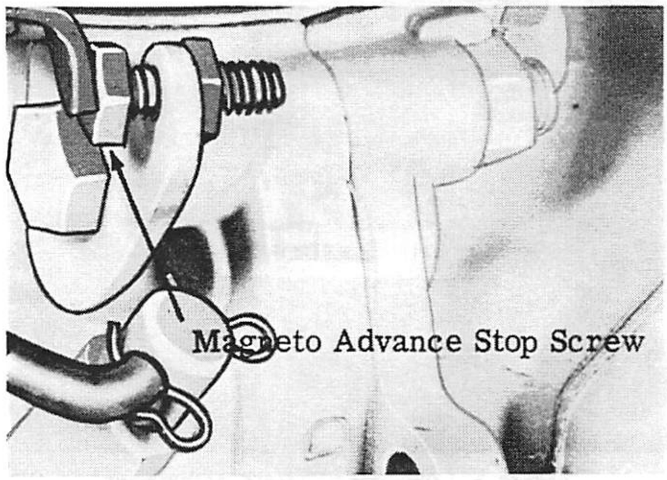


Figure 2. Magneto Advance Stop Screw Adjusted

9. Connect second lead of timing unit to stator plate (ground).
10. Advance magneto slowly until point breaks, as indicated by timing unit used.
11. Hold magneto at this position and adjust magneto advance stop screw to just touch magneto stop and tighten lock nut. (Figure 2).
12. Recheck magneto advance to insure correct setting.

III. CARBURETOR ADJUSTMENTS

A. High Speed Adjustment

1. The carburetor has a fixed high speed jet. The standard jet, installed at the factory, is recommended for operation from sea level to 4000 ft. elevation.
2. If engine is operated above 4000 ft., select and install correct jets from chart below (aperture decreases .002" as elevation increases each 3000 ft.).
3. Before changing jets, check engine out, unless previous tests indicate exact jet size.

Full Gear Shift Model	*Up to 4000'	4000-7000'	7000-10000'
Merc 200 Jet Size	.061"	.059"	.057"

* *Standard Jet - Factory Equipped*

Jet size recommendations are intended as a guide (like a propeller chart). Try size larger or smaller if in doubt.

4. No change in spark advance is recommended for elevation operation.
5. Propellers of lower pitch should be used at high elevations to allow proper engine RPM.
6. Engine can be tested in a test tank with propeller.

B. Idle Adjustment Screws

1. Idle adjustment screw also has been adjusted at the factory.
2. If readjustment is necessary, it can be done with a regular propeller in test tank or on boat.

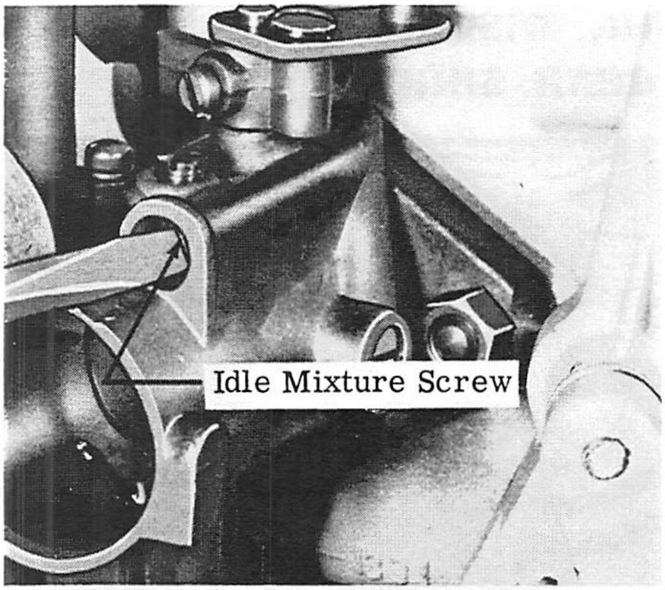


Figure 3. Low Speed Mixture Adjustment

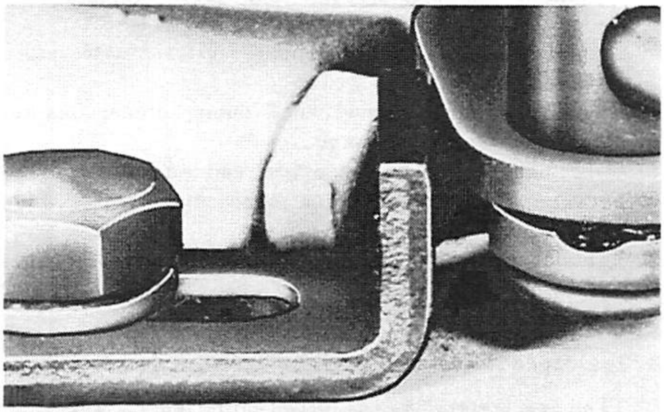


Figure 4. Idle Stop Bracket

3. Start with idle needle one turn open and adjust for maximum RPM with magneto retarded to give about 600 to 700 RPM.
4. Warm-up engine before attempting adjustment.
5. With engine running at idling speed while in forward gear, turn low speed mixture adjusting needle counter-clockwise until engine starts to "load up" or fires unevenly due to over-rich mixture. (Figure 3)
6. Slowly turn needle clockwise until cylinders fire evenly and engine picks up speed.
7. Continue turning clockwise until too lean a mixture is obtained and engine slows down and misfires.
8. Set adjustment screw half way between rich and lean (approx. 1 turn). Do not adjust leaner than necessary to attain reasonable smooth idling. When in doubt, it is preferable to have mixture set slightly rich rather than too lean.

NOTE: Idle cannot be adjusted while in "neutral" or engine will sputter and stop when shifted to "Forward" because of "no load" condition while adjusting.

C. Idle Speed Adjustment and Checks

1. Start engine and run until warm.
2. Idle engine and adjust "idle stop bracket" (Figure 4) so that engine idles at 500 RPM in forward gear.

IV. PICKUP ADJUSTMENT

NOTE: No pickup adjustment is necessary on this model.

V. MAXIMUM NEUTRAL ADJUSTMENT

1. Shift into neutral gear.
2. Adjust magneto control rod to obtain a maximum speed of 2200 to 2400 RPM. (Figure 5)

VI. TILLER HANDLE ADJUSTMENT

1. With engine running in neutral gear, turn twist grip to obtain 2200 to 2400 RPM. At this point, "Start" position on twist grip should align with indicator arrow on tiller handle. (Figure 6)
2. If twist grip is not properly aligned, loosen allen screw at bottom of twist grip and realign. (Figure 7)
3. Recheck adjustment by returning to idle and advancing throttle to "Start" position. This will eliminate any possible error caused by "play" in throttle linkage.

NOTE: This adjustment must be accurate to insure easy starting with a cold motor.

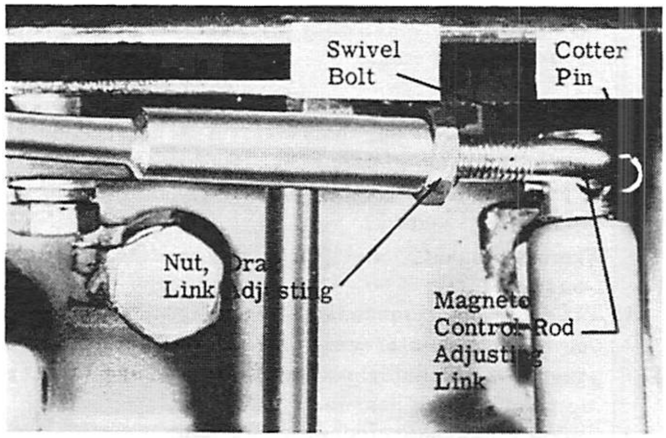


Figure 5. Maximum Neutral Adjustment

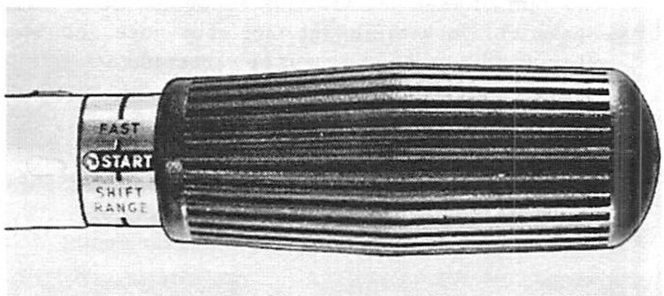


Figure 6. "Start" Position Adjustment

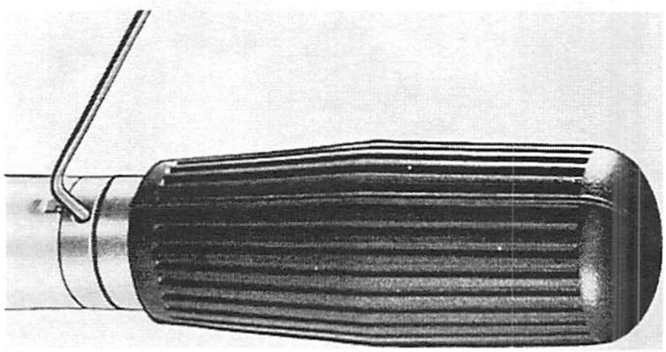


Figure 7. Twist Grip Alignment

I. IGNITION DATA

Description	Merc 39-40	Merc 60-75	Merc 110
Firing Sequence	Single Cylinder	Alternate Firing	Alternate Firing
Spark Plug Standard Installation	J8J (1964-66) L9J or AC-M45FF (1967 & Newer)	J7J (1960-66) L7J orAC-M43FF (1967 & Newer)	J7J (1961-66) L4JorAC-M42FF (1967 & Newer)
Spark Plug Gap	J8J - .025(.635mm) L9J - .030(.762mm)	J7J - .025 L7J - .030	J7J - .025 L4J - .030
Timing	Not Adjustable	Not Adjustable	Not Adjustable
Breaker Setting	.020" (.508mm)	*.020"	*.020"
Recomm. RPM Range	5000-5400	5000-5400	5000-5400

**Point setting is .018" (.457mm) on Merc 110 and 60 equipped with early style Phelon magneto.*

II. ADJUSTING AND SYNCHRONIZING POINTS
(See information on Page 13, Ignition Section IV.)

III. CARBURETOR ADJUSTMENTS

A. High Speed Adjustment

1. Carburetors have fixed high speed jets. The standard jet, installed at the factory, is recommended for operation from sea level to 2500 ft. elevation.
2. If engine is operated above 2500 ft., select and install correct jets from chart below (aperature decreases .002" as elevation increases each 2500 ft.).
3. Before changing jets, check engine out, unless previous tests indicate exact jet size.

Merc Model	Jet Size *Up to 2500'	Jet Size 2500'-5000'	Jet Size 5000'-Above
110	.049"(1.24mm)	.047"(1.19mm)	.045"(1.14mm)
75	.039" (0.99mm)	.037" (0.94mm)	.035" (0.89mm)
60	.045"(1.14mm)	.043"(1.09mm)	.041"(1.04mm)
40	.036" (0.91mm)	.034" (0.86mm)	.032" (0.81mm)
39(KB7A) 39(KB7B)	.043"(1.09mm) .036"(0.91mm)	.041"(1.04mm) .034"(0.86mm)	.039"(0.99mm) .032"(0.81mm)

* *Standard Jet - Factory Equipped*

Jet size recommendations are intended as a guide (like a propeller chart). Try size larger or smaller if in doubt.

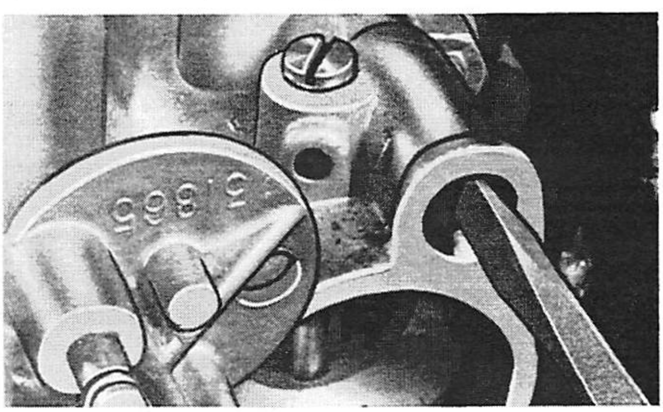


Figure 1. Adjusting Idle Mixture

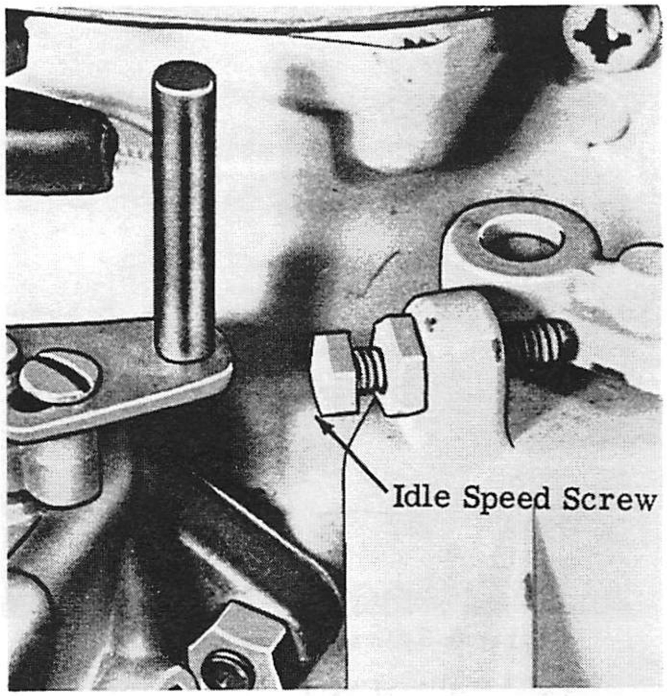


Figure 2. Adjusting Idle Speed

4. Propellers of lower pitch should be used at high elevations to allow proper engine RPM.
5. Engine can be tested in a test tank with propeller.

B. Idle Adjustment

1. Idle adjustment also has been adjusted at factory.
2. If readjustment is necessary, it can be done with a regular propeller in test tank or on boat.
3. Start with idle needle one turn open and adjust for maximum RPM with magneto retarded to give about 600-700 RPM.
4. Warm engine before attempting adjustment.
5. With engine running at idling speed while in forward gear, turn low speed mixture adjusting needle clockwise (counterclockwise on 1969 models) until affected cylinders start to "load up" or fire unevenly due to over-rich mixture. (Figure 1)
6. Slowly turn needle counterclockwise (clockwise on 1969 models) until cylinders fire evenly and engine picks up speed.
7. Continue turning counterclockwise (clockwise on 1969 models) until too-lean a mixture is obtained and engine slows down and misfires.
8. Set adjustment screw half way between rich and lean (approx. one turn). Do not adjust leaner than necessary to attain reasonable smooth idling. When in doubt, it is perferable to have mixture set slightly rich rather than too lean.

NOTE: Idle cannot be adjusted while in "neutral", or engine will sputter and stop when shifted to "Forward" because of "no load" condition while adjusting.

C. Idle Speed Adjustment

1. Start engine and run until warm.
2. Idle engine and adjust "idle speed" screw on stop bracket (Figure 2) so that engine idles at approximately 500 RPM in forward gear.

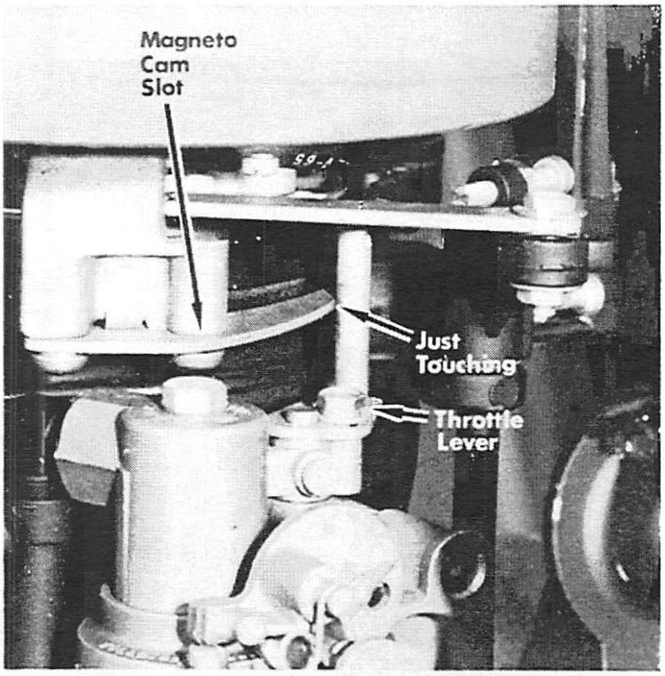


Figure 3. Throttle Pick-up Adjustment

IV. PICKUP ADJUSTMENT

1. With engine running in "Forward" gear, turn twist grip throttle to obtain 1000 to 1100 RPM. At this point, magneto cam should just touch throttle lever on carburetor. (Figure 3)
2. If recommended RPM is not obtained, loosen screw, which secures throttle lever to carburetor, and adjust. Throttle lever is slotted for this purpose.

   NOTE: On later model 1968 engines, the magneto cam (Figure 3) also is slotted for a finer adjustment of pickup point.

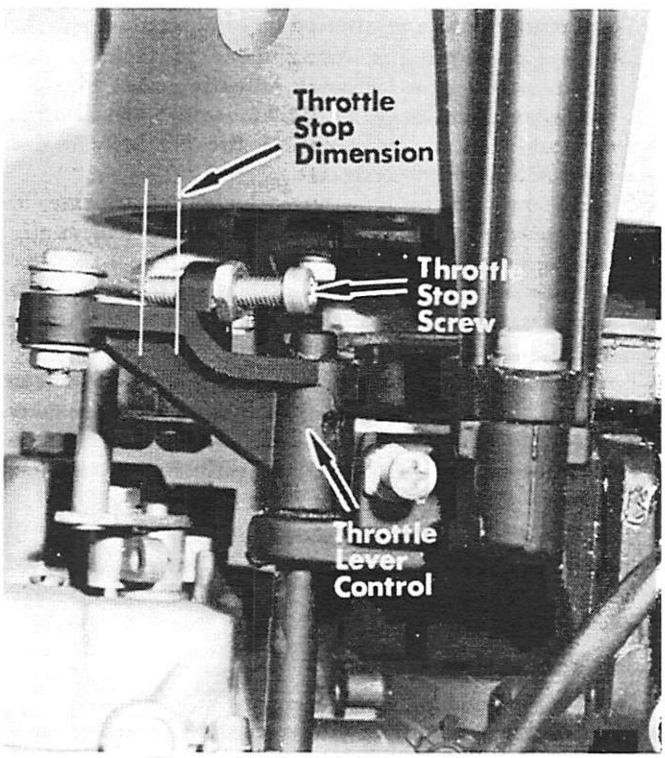


Figure 4. Throttle Stop Adjustment

V. THROTTLE STOP ADJUSTMENT

(Merc 110, Serial No. 1580203 and Above)

Adjust throttle stop screw so that threaded end of screw extends ¼" (6.35mm) through throttle lever control. (Figure 4)

(Merc 60, Serial No. 1610265 and Above)

Adjust throttle stop screw so that threaded end of screw extends 5/16" (8mm) through throttle lever control. (Figure 4)

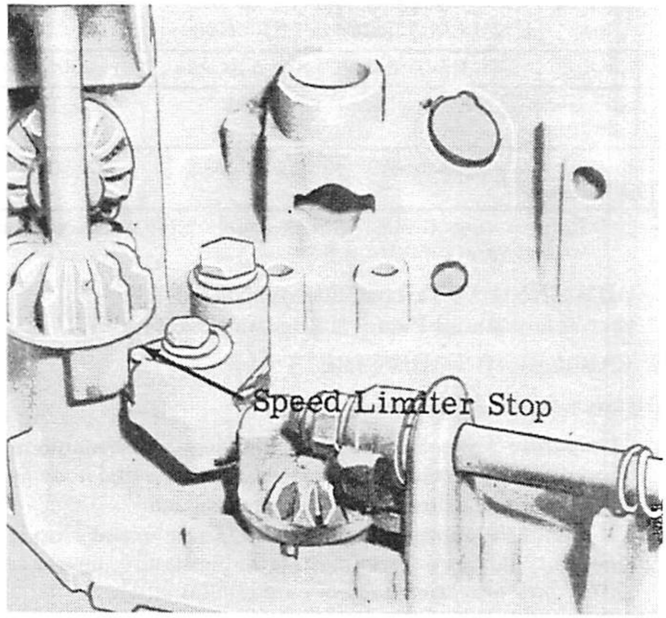


Figure 5. Neutral RPM Adjustment

VI. MAXIMUM NEUTRAL RPM

(Merc 110, Serial No. 1492282 & Up)

1. Shift into neutral gear.
2. Adjust neutral speed limiter stop to obtain a maximum speed of 2400-2700 RPM. (Figure 5)

VII. TILLER HANDLE ADJUSTMENT

1. With engine running in neutral gear, turn twist grip to obtain 2400 to 2700 RPM. At this point, "Start" position on twist grip should align with indicator arrow on tiller handle. (Figure 6)
2. If twist grip is not properly aligned, loosen allen screw at bottom of twist grip and realign.
3. Recheck adjustment by returning to idle and advancing throttle to "Start" position. This will eliminate any possible error caused by "play" in throttle linkage.

   NOTE: This adjustment must be accurate to insure easy starting with a cold motor.

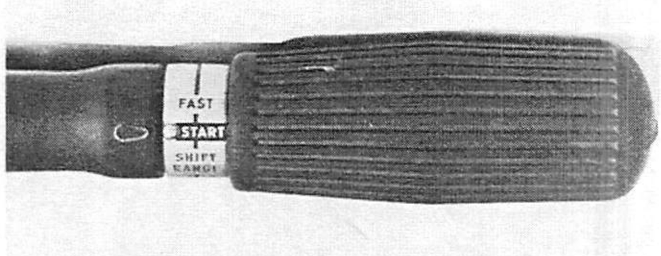


Figure 6. "Start" Position Adjustment

TIMING, ADJUSTING, TESTING
MERC 1000-900, STARTING WITH 1965

IGNITION DATA

Description	Merc 1000-900
Cylinder Firing Order (Figure 1)	1-4-5-2-3-6
Coil No. 1 Fires Cylinders	1-5-3
Coil No. 2 Fires Cylinders	2-4-6
Firing Sequence	60° Consecutive
Spark Plug, Standard Installation §	J4J
Spark Plug, Resistor Type *	XJ4J
Spark Plug Gap	.025" (.6350mm)
Timing	.222" (5.6388mm) (32½°) BTDC
Breaker Setting	90° Dwell
RPM, Maximum	5200

§ *See Note No. 1 on Page 75.*
* *For static elimination on radio or radio-telephone equipped boats.*

TIMING AND LINKAGE ADJUSTMENT

A. Flywheel, Distributor Pulley and Belt Assembly

1. Rotate flywheel until timing mark (a straight line stamped on upper surface) is in a straight line with center of crankshaft and distributor pulley center. (Figure 2)
2. Position arrow on pulley (not plate) to point at timing mark on flywheel.
3. Install timing belt, plate, cap, washers and screw and tighten to 60 in. lbs. (10.65 kg/cm)

B. Distributor Drive Coupling

1. When reassembling distributor, leave distributor cap off to aid in timing engine as described in following instructions.

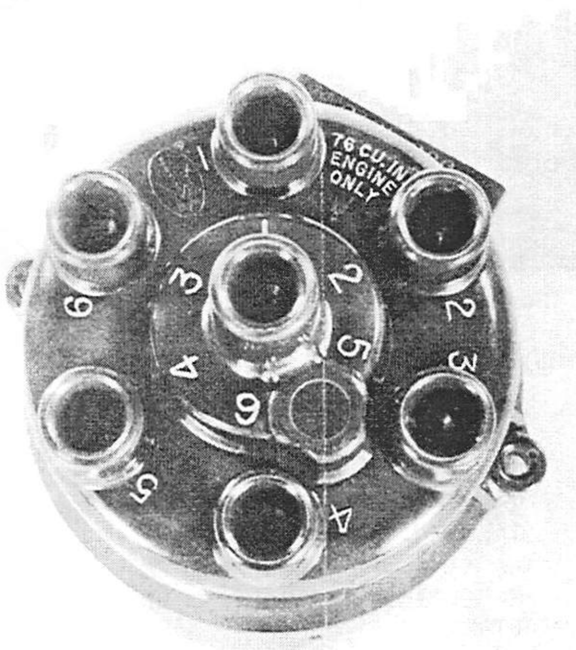


Figure 1. Distributor (Outside Ring of Numbers for 76 Cu. In.[1245.424 cm^3] and Larger Engines)

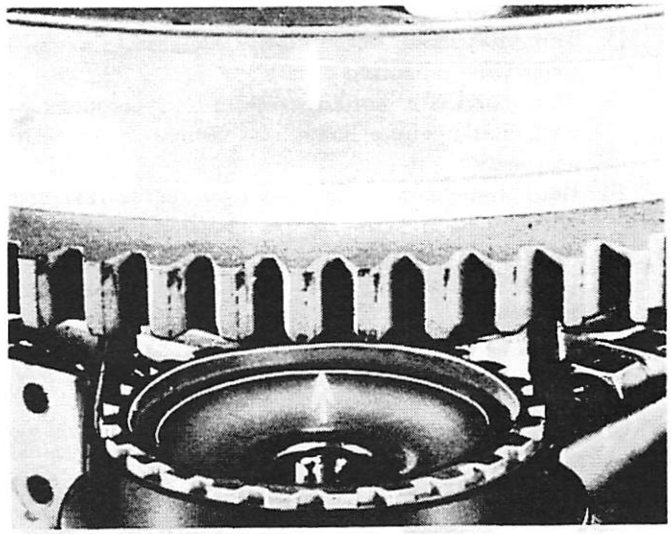


Figure 2. Timing Marks on Flywheel and Pulley

2. When distributor is reassembled to engine, flywheel and distributor pulley should be aligned as explained in Para. "A", preceding. The radius of the tang at drive end of distributor shaft should point forward (direction engine will travel when distributor is bolted in place). (See drawing on left.)

3. Secure distributor adaptor with 4 hex head cap screws.

C. Spark Advance Stop Adjustment

1. Position distributor with air vent elbow facing approximately forward.
2. Place No. 3 piston at .222" (5.6388mm) (32½°) BTDC (before top dead center) by rotating flywheel in a clockwise (forward) direction from BDC (bottom dead center).
3. Thread Timing Gauge (C-91-32253A1) into No. 3 spark plug hole.
4. Turn flywheel until No. 3 piston strikes Timing Gauge.
5. While turning flywheel, thread Timing Gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center position.
6. Rotate flywheel clockwise ¼ turn.
7. Depress center shaft of Timing Gauge and rotate ¼ turn to seat on tool body shoulder (.222" [5.6388mm] position). *NOTE: Be careful that tool body does not move, or preceding procedure will have to be repeated.*
8. Rotate flywheel clockwise until No. 3 piston strikes Timing Gauge center shaft. This is .222" (5.6388mm) BTDC.
9. Connect one test lead of Timing Meter (C-91-22966) or Magneto Analyzer (C-91-25213) (selector

switch on No. 2, Distributor Resistance) to white lead (No. 1 coil primary) at terminal block.

10. Attach second lead of tester to distributor frame.
11. Retard distributor against "idle speed" stop screw. (Figure 3)
12. Turn distributor rotor slowly counterclockwise to touch drive coupling.
13. Turn distributor (holding rotor) slowly counterclockwise until points break, as indicated by timing unit used.
14. Hold distributor in this position and adjust spark advance stop screw to just touch pilot assembly and tighten lock nut.
15. Recheck steps 11, 12 and 13 to be sure adjustment is correct.

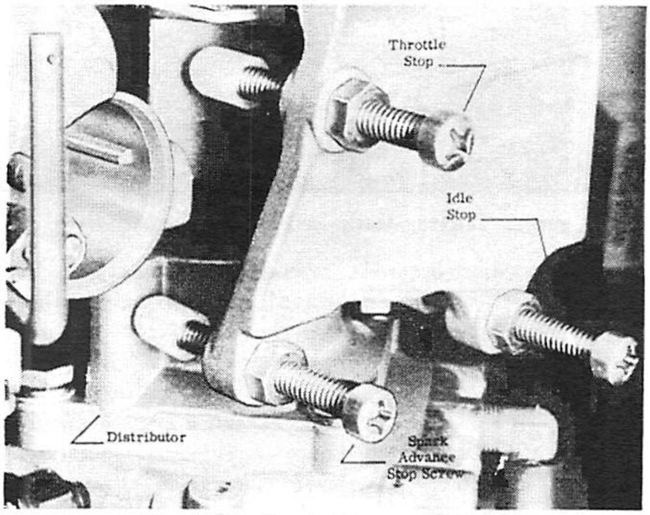


Figure 3. Spark Advance Adjustment

D. Pickup Plate Adjustment

1. Thread .015" (0.3810mm) Timing Gauge (C-91-31161A1) into No. 3 spark plug hole.
2. Turn flywheel until piston strikes Timing Gauge.
3. While turning flywheel, thread timing gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center (TDC) position.
4. Rotate flywheel clockwise ¼ turn.
5. Depress center shaft of Timing Gauge & rotate ¼ turn to seat on tool body shoulder (.015"[0.3810mm] BTDC). *NOTE: Be careful that tool body does not move or preceding steps will have to be repeated.*
6. Continue to rotate flywheel clockwise until piston strikes Timing Gauge.
7. Connect one test lead of Timing Meter(C-91-22966) or Magneto Analyzer (C-91-25213)(selector switch on No. 2, Distributor Resistance) to white lead (No. 1 coil primary) at terminal block.
8. Attach second lead of tester to distributor frame.
9. Retard distributor against idle stop screw.
10. Turn distributor rotor slowly counterclockwise to touch drive coupling.
11. While holding rotor in this position, rotate distributor slowly counterclockwise until points break, as indicated by timing unit used.
12. Loosen throttle pickup plate screws. (Figure 4)
13. Slide throttle pickup plate so that first throttle

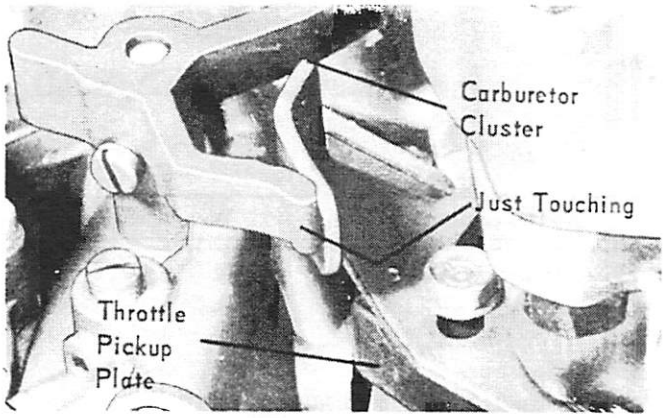


Figure 4. First Throttle Pickup Tab Adjustment

tab (without nylon sleeve) just touches carburetor cluster. (Figure 4)

14. Tighten throttle pickup plate screws.
15. Turn distributor against .222" (5.6388mm) ("spark advance") stop.
16. Bend second throttle pickup pin (with nylon sleeve) against carburetor cluster (.000"-to-.015" [0.3810mm] gap) . (Figure 5)
17. Lubricate cam and nylon pin with MULTIPURPOSE Quicksilver Lubricant (C-92-35226).
18. Replace distributor cap.

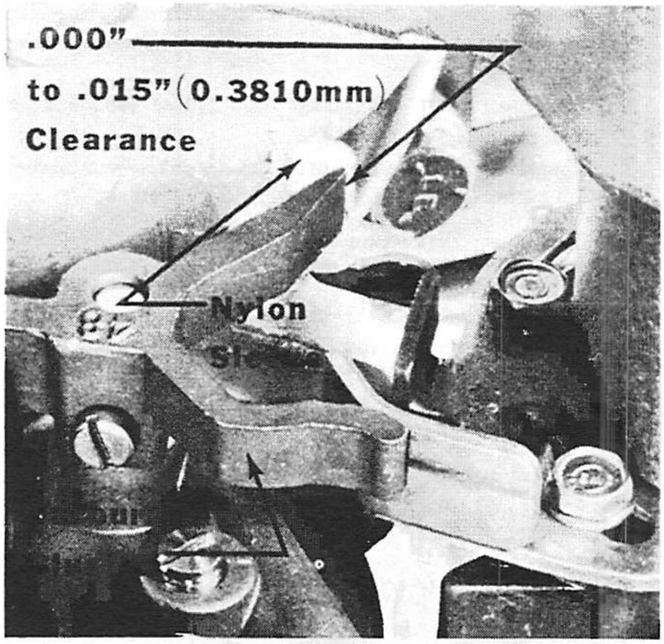


Figure 5. Second Throttle Pickup Tab Adjustment

THROTTLE STOP ADJUSTMENTS

A. Throttle Stop Adjustment

1. Rotate Economizer collar to wide open throttle position.
2. Adjust "throttle stop" screw on stop bracket (Figure 3) to allow full throttle shutter opening but not to allow throttle shutters to act as a stop or the carburetor cluster to hit carburetor filter bowl.

B. Idle Speed Adjustment and Checks

1. Start engine and run until warm.

2. Idle engine and adjust "idle speed" screw on stop bracket (Figure 3) so that engine idles at 500 RPM in forward gear.
3. Run engine between 4500-5000 RPM.

CARBURETOR ADJUSTMENTS

A. High Speed Adjustment (Figure 6)

Carburetors have fixed high speed jets. Standard jet, installed at factory, is recommended for operation from sea level to 4000 ft. (1219.2m) elevation.

1. If engine is operated above 4000 ft. (1219.2m), select and install correct jets from chart following (aperature decreases .002" [.0508mm] as elevation increases each 3000 ft. [914.4m]).
2. Before changing jets, check engine out unless previous tests indicate exact jet size.
3. Jet size recommendations are intended as a guide (like a propeller chart). Try size larger or smaller if in doubt. See jet sizes in chart below.

Model	*Up to 4000' (1219.2m)	4000 (1219.2m) 7000' (2133.6m)	7000 (2133.6m) 10000' (3048.0m)
1000	.065" (1.6510mm)	.063" (1.6002mm)	.061" (1.5494mm)
900	.049" (1.2446mm)	.047" (1.1938mm)	.045" (1.1430mm)

* *Standard jet -- factory equipped*

4. No change in spark advance is recommended for elevation operation. Propellers of lower pitch should be used at high elevations to allow proper engine RPM.
5. Engine can be tested in test tank with propeller or Test Wheel.

B. Idle Adjustment (Figure 6)

1. Idle adjustment also has been set at factory. If readjustment is necessary, it can be done with Test Wheel or a regular propeller in the test tank or on the boat.
2. Start with all idle needles one turn open and adjust for maximum RPM with distributor retarded to give about 600-700 RPM. (Figure 6)
3. Warm engine before attempting adjustment.
4. With engine running at idling speed while in forward gear, turn low speed mixture adjusting needle counterclockwise until affected cylinders start to "load up" or fire unevenly due to overrich mixture. (Figure 6)
5. Slowly turn needle clockwise until cylinders fire evenly and engine picks up speed.
6. Continue turning clockwise until too-lean a mixture is obtained and engine slows down and misfires.
7. Set adjustment screw one turn counterclockwise from lean-out position to gain approximate true setting.
8. Do not adjust leaner than necessary to attain reasonably smooth idling.
9. When in doubt, it is preferable to have mixture set slightly rich rather than too lean.
10. If engine hesitates during acceleration after adjusting idle mixture it is too lean and idle mixture should be richened slightly until engine will accelerate correctly.

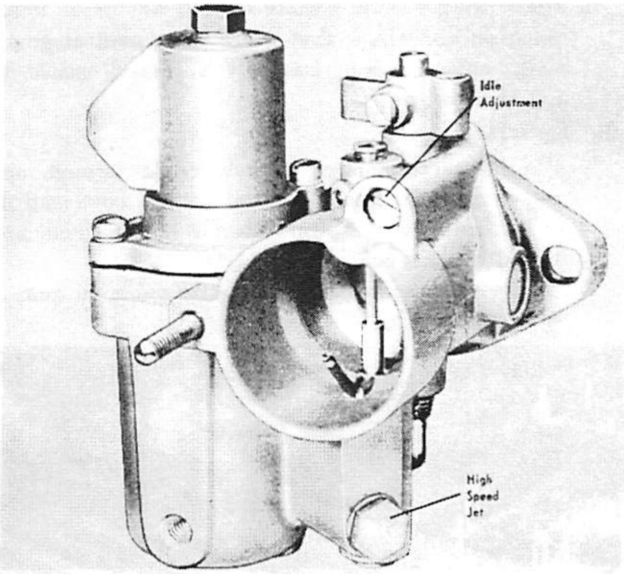


Figure 6. Idle Adjustment

REMOTE CONTROL ADJUSTMENTS

A. Gear Shift Control Cable

1. Remove front cowl and wrap-around cowl.
2. Place single lever remote control handle in forward position and smaller neutral warmup lever (on side of box) down all the way.
3. Place remote control shift cable through opening in front left hand side of bottom cowl.
4. With motor in forward gear, place brass barrel (on shift cable) in recess in bottom cowl and cable end guide over peg without disturbing setting as shown in Figure 7. If necessary, readjust brass barrel for correct position and to compensate for backlash.
5. Press down on rear of clamp lever and position lever over cable end guide as shown in Figure 8.

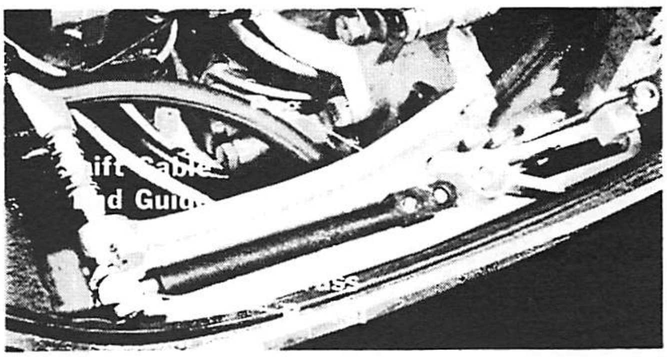


Figure 7. Positioning Brass Barrel and Cable End Guide

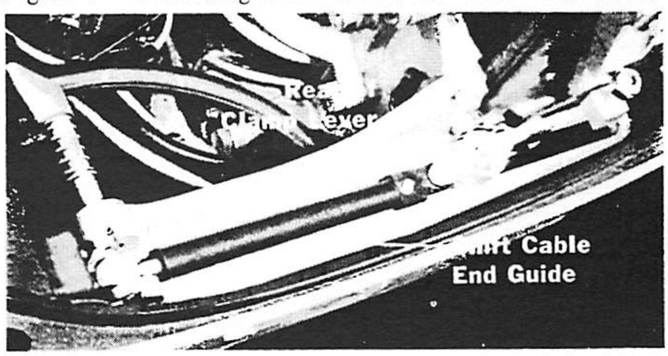


Figure 8. Positioning Lever over Cable End Guide

6. Place single lever remote control handle in neutral position and check that motor is in neutral gear. If shift cable is not correctly adjusted, motor will not shift properly.

B. Throttle Cable

1. Place remote control throttle cable through opening in front left hand side of bottom cowl and position brass barrel (on throttle cable) over brass barrel of shift cable.
2. Secure brass barrel (on throttle cable) in position with anchor pin. (Figure 9)

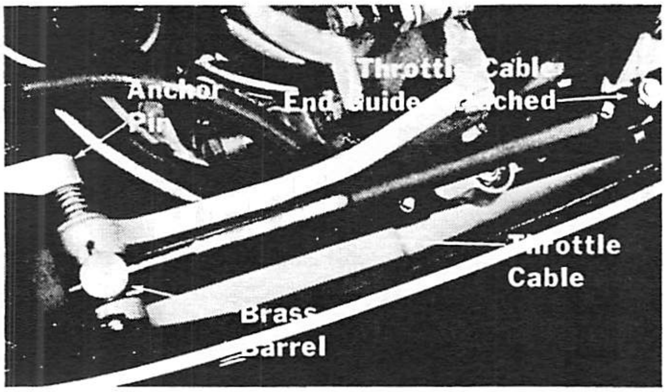


Figure 9. Securing Brass Barrel with Anchor Pin

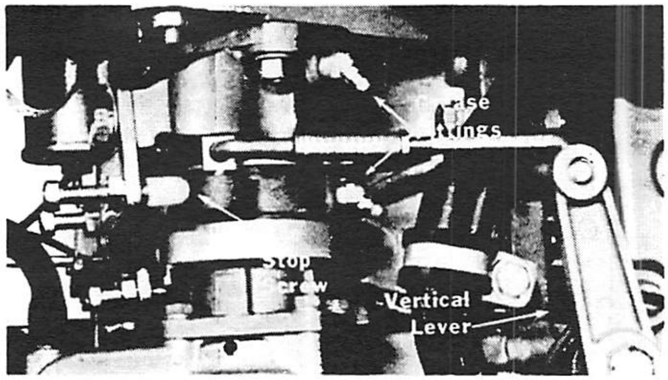


Figure 10. Vertical Lever and Idle Stop Screw

3. Position vertical lever so that distributor is held lightly against idle stop screw. (Figure 10) Attach cable end guide to vertical lever swivel without disturbing setting. (Figure 9) If necessary, readjust brass barrel for correct position and to compensate for cable backlash.
4. Move single lever remote control handle to forward position and then back to neutral position. Check that distributor is held lightly against idle stop screw (Figure 10) when control handle is in neutral position.

TIMING, ADJUSTING, TESTING
MERC 650, STARTING WITH 1965

Description	Merc 650
Cylinder Firing Order	1-3-2-4
Firing Sequence	90° Consecutive
Spark Plug, Standard Instal	J4J
Spark Plug Gap	.025" (.6350mm)
Timing	.222" (5.6388mm) (32½°) BTDC
Breaker Setting	48° Dwell(.010"[0.2540mm] + .000" [.000mm] - .002" [.0508mm])
RPM, Maximum	5200

TIMING AND LINKAGE ADJUSTMENT

A. Flywheel, Magneto Pulley and Belt Assembly

1. Rotate flywheel until timing mark (a straight line stamped on upper surface) is in a straight line with center of crankshaft and magneto pulley center. (Figure 1)
2. Position arrow on pulley (not plate) to point at timing mark on flywheel.
3. Install timing belt, plate, cap, washers and screw and tighten to 60 in. lbs. (10.65 kg/cm)

B. Installing Magneto

Magneto rotor shaft and shaft extension are splined with one blanketed spline on each shaft for easy installation.

1. With flywheel and pulley in position described in "A" preceding, install magneto on engine.
2. Rotate timing pulley until shaft sets in place. A 1/16" (1.588mm) groove is located at end of shaft coupling in centerline of blanketed shaft to locate for easy installation.
3. Secure magneto to magneto adaptor with 4 hex head cap screws.

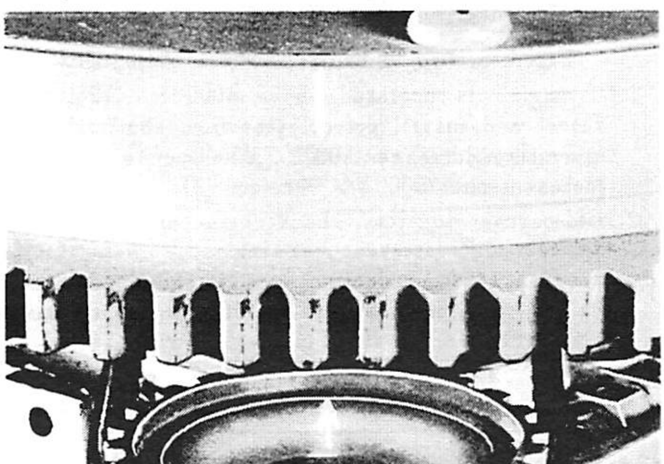


Figure 1. Timing Marks on Flywheel and Pulley

C. Setting Maximum Spark Advance

1. Thread Timing Gauge (C-91-32253A1) into No. 1 spark plug hole.
2. Turn flywheel until No. 1 piston strikes Timing Gauge.
3. While turning flywheel, thread Timing Gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center (TDC) position.
4. Rotate flywheel clockwise ¼ turn.
5. Depress center shaft of Timing Gauge.
6. Rotate gauge shaft ¼ turn to seat on tool body shoulder (.222" [5.6388mm]BTDC position) . Be careful that tool body does not move, or preceding procedure will have to be repeated.
7. Rotate flywheel clockwise by hand until No. 1 piston strikes Timing Gauge center shaft. This is .222" (5.6388mm) BTDC.
8. Attach one test lead of Timing Meter (C-91-22966) or Magneto Analyzer (C-91-25213) (on No. 2, Resistance) to magneto frame.
9. Attach second lead of tester to primary ground terminal of magneto.
10. Slowly advance magneto until points break, as indicated by tester used.
11. Hold magneto in this position and adjust spark advance stop screw to just touch pilot assembly and tighten lock nut. (Figure 2)
12. Recheck setting by actuating magneto with throttle control lever on side of bottom cowl.

D. Pickup Plate Adjustment

1. Thread .015" (0.3810mm) Timing Gauge (C-91-31161-A1) into No. 1 spark plug hole.
2. Turn flywheel until piston strikes Timing Gauge.
3. While turning flywheel, thread timing gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center (TDC) position.
4. Rotate flywheel clockwise ¼ turn.
5. Depress center shaft of Timing Gauge and rotate ¼ turn to seat on tool body shoulder (.015 [0.3810mm] BTDC) . *NOTE: Be careful that tool body does not move or preceding steps will have to be repeated.*
6. Continue to rotate flywheel clockwise until piston strikes Timing Gauge.
7. Connect one test lead of Timing Meter (C-91-22966) or Magneto Analyzer (C-91-25213) (selector switch on No. 2, Distributor Resistance) to magneto frame.
8. Attach second lead of tester to primary ground terminal of magneto.
9. Retard magneto against idle stop screw. (Figure 2)
10. Rotate magneto slowly counterclockwise until points break, as indicated by timing unit used.
11. Loosen throttle pickup plate screws. (Figure 3)
12. Slide throttle pickup plate so that tab (without nylon sleeve) just touches carburetor cluster. (Figure 3)
13. Tighten throttle pickup plate screws.
14. Turn magneto against .222" (5.6388mm) ("spark advance") stop.

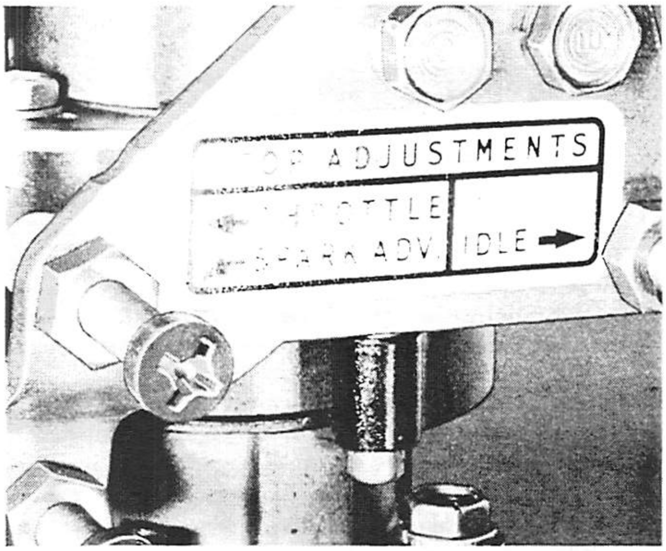


Figure 2. Spark Advance Adjustment

15. Bend second throttle pickup pin (with nylon sleeve) against carburetor cluster (.000" [.000mm]-to- .015" [0.3810mm] gap). (Figure 4)
16. Lubricate cam and nylon pin with MULTIPURPOSE Quicksilver Lubricant (C-92-35226).

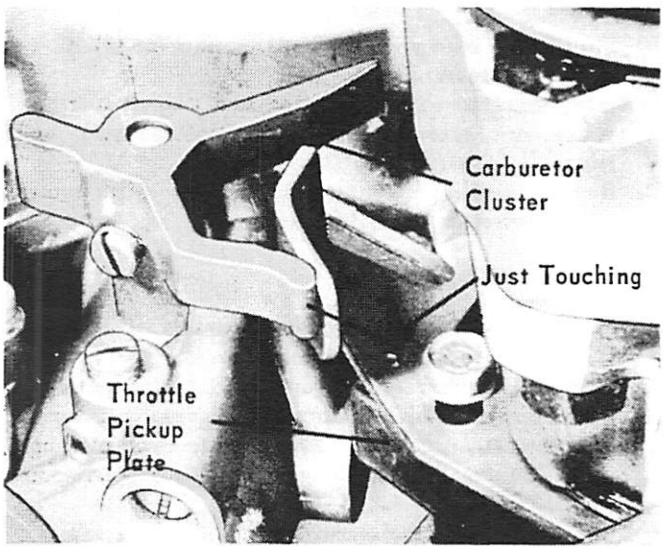


Figure 3. First Throttle Pickup Tab Adjustment

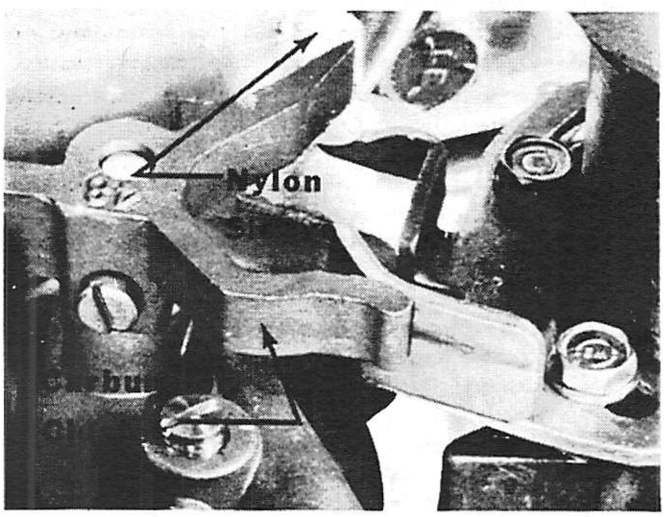


Figure 4. Second Throttle Pickup Pin Adjustment

THROTTLE STOP ADJUSTMENTS

A. Throttle Stop Adjustment

1. Rotate Economizer collar to wide open throttle position.
2. Adjust "throttle stop" screw on stop bracket (Figure 2) to allow full throttle shutter opening but not to allow throttle shutters to act as a stop or the carburetor cluster to strike carburetor filter bowl.

B. Idle Speed Adjustment and Checks

1. Start engine and run until warm.
2. Idle engine and adjust "idle speed" screw on stop bracket (Figure 2) so that engine idles at 500 RPM in forward gear.
3. Run engine between 4500-5000 RPM.

CARBURETOR ADJUSTMENTS

A. High Speed Adjustment

Carburetors have fixed high speed jets. Standard jet, installed at factory, is recommended for operation from sea level to 4000 ft. (1219.2m) elevation. (Figure 5)

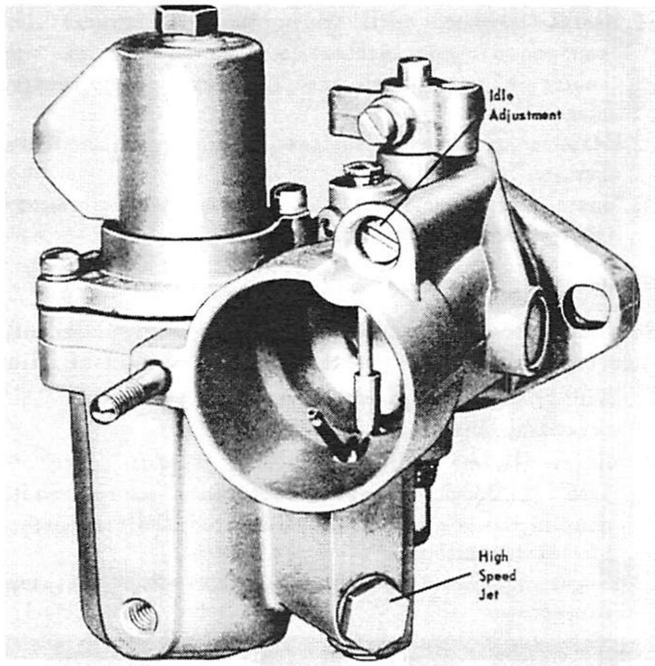


Figure 5. High Speed Jet and Idle Adjustment

1. If engine is operated above 4000 ft. (1219.2m), select and install correct jets from chart following (aperature decreases .002" [.0508mm] as elevation increases each 3000 ft. [914.4m]).
2. Before changing jets, check engine out unless previous tests indicate exact jet size.
3. Jet size recommendations are intended as a guide (like a propeller chart). Try size larger or smaller if in doubt. See jet sizes in chart below.

Model	*Up to 4000' (1219.2m)	4000 (1219.2m) 7000' (2133.6m)	7000 (2133.6m) 10000' (3048.00m)
650	.069" (1.7526mm)	.067" (1.7018mm)	.065" (1.6510mm)

* *Standard jet - - factory equipped*

4. No change in spark advance is recommended for elevation operation. Propellers of lower pitch should

be used at high elevations to allow proper engine RPM.

5. Engine can be tested in test tank with propeller or Test Wheel.

B. Idle Adjustment

1. Idle adjustment also has been set at factory. If re-adjustment is necessary, it can be done with Test Wheel or a regular propeller in the test tank or on the boat.
2. Start with all idle needles one turn open and adjust for maximum RPM with magneto retarded to give about 600-700 RPM. (Figure 5)
3. Warm engine before attempting adjustment.
4. With engine running at idling speed while in forward gear, turn low speed mixture adjusting needle counter-clockwise until affected cylinders start to "load up" or fire unevenly due to overrich mixture. (Figure 5)
5. Slowly turn needle clockwise until cylinders fire evenly and engine picks up speed.
6. Continue turning clockwise until too-lean a mixture is obtained and engine slows down and misfires.
7. Set adjustment screw one turn counterclockwise from lean-out position to gain approximate true setting.
8. Do not adjust leaner than necessary to attain reasonably smooth idling.
9. When in doubt, it is preferable to have mixture set slightly rich rather than too lean.
10. If engine hesitates during acceleration after adjusting idle mixture it is too lean and idle mixture should be richened slightly until engine will accelerate correctly.

REMOTE CONTROL ADJUSTMENTS

A. Gear Shift Control Cable

1. Remove front cowl and wrap-around cowl.
2. Place single lever remote control handle in forward position and small neutral warmup lever (on side of control box) down all the way.
3. Place remote control shift cable through opening in front left hand side of bottom cowl.
4. With motor in forward gear, place barrel (on shift cable) in recess in bottom cowl and cable end guide over peg without disturbing setting as shown in Figure 6. If necessary, readjust brass barrel for correct position and to compensate for cable backlash.

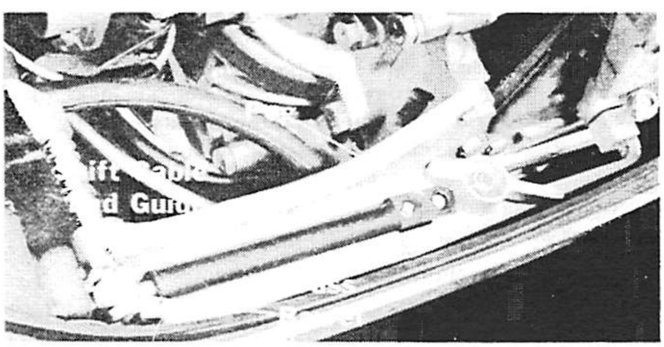


Figure 6. Positioning Brass Barrel and Cable End Guide

5. Press down on rear of clamp lever and position lever over cable end guide as shown in Figure 7.
6. Place single lever remote control handle in neutral position and check that motor is in neutral gear. *NOTE: If shift cable is not correctly adjusted, motor will not shift properly.*

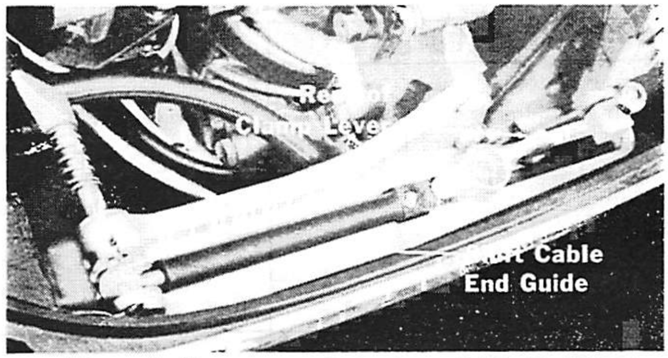


Figure 7. Positioning Lever over Cable End Guide

B. Throttle Cable

1. Place remote control throttle cable through opening in front left hand side of bottom cowl and position barrel (on throttle cable) over barrel of shift cable.
2. Secure barrel in position with anchor pin. (Figure 8)

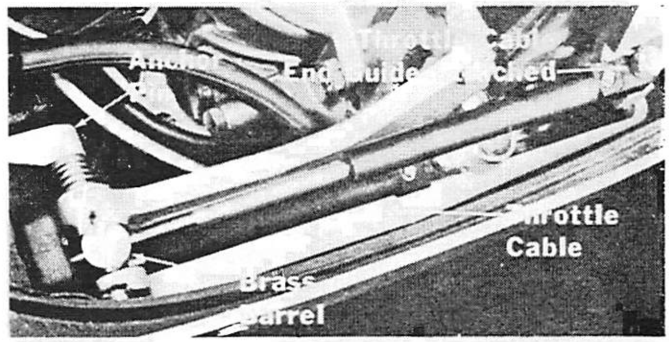


Figure 8. Securing Brass Barrel with Anchor Pin

3. Position vertical lever so that magneto is held lightly against idle stop screw. (Figure 9) Attach cable end guide to vertical lever swivel without disturbing setting. (Figure 9) If necessary, readjust barrel for correct position and to compensate for cable backlash.
4. Move single lever remote control handle to forward position and then back to neutral position. Check that magneto is held lightly against idle stop screw (Figure 9) when handle is in neutral position.

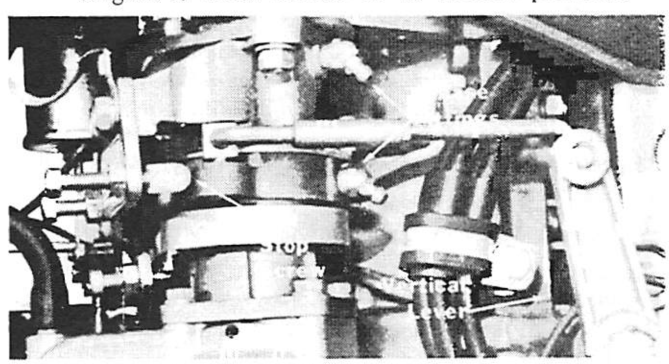


Figure 9. Vertical Lever and Idle Stop Screw

TIMING, ADJUSTING, TESTING
MERC 500 STARTING WITH 1965

DESCRIPTION	MERC 500
Firing Order	1-3-2-4
Firing Sequence	90° Consecutive
Spark Plug-Standard Installation	J4J
Spark Plug Gap	.025" (.6350mm)
Timing	.235" (5.9690mm) BTDC (34½°)
Breaker Point Setting	48° Dwell (.010"[.2540mm] + .000"-.002" [.0508mm])
RPM, Maximum Recommended	5500-5800

I. TIMING AND LINKAGE ADJUSTMENT

A. Timing Flywheel and Magneto Pulley

1. Flywheel has one mark, a straight line, which times the motor to top dead center (TDC) when positioned with arrow on magneto driven pulley.
2. Rotate flywheel until timing mark (straight line stamped on rim) is in a straight line with center of crankshaft and distributor pulley center. (Figure 1)

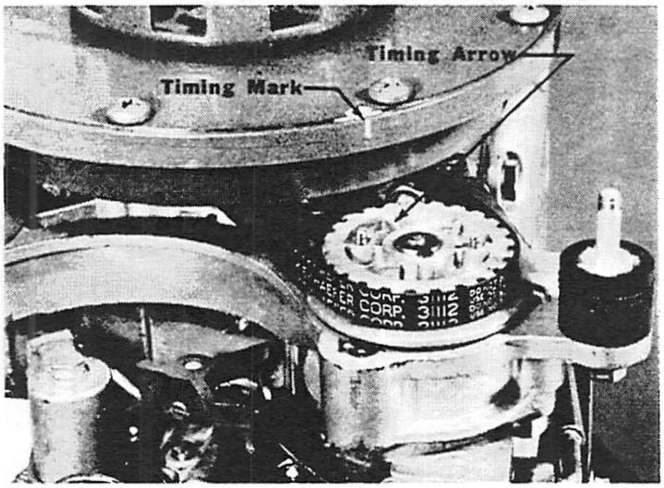


Figure 1. Flywheel and Magneto Pulley Timing

3. Position arrow on pulley to point at timing mark.
4. Replace timing belt, plate, cap screw and washers.

B. Installing Magneto

1. Magneto rotor shaft and shaft extension are splined with one blanketed spline on each shaft for easy installation.
2. With flywheel and pulley in position described in "A" preceding, install magneto on engine.
3. Rotate timing pulley until shaft sets in place. A 1/16" (1.588mm) groove is located at end of shaft coupling in centerline of blanketed shaft to locate for easy installation.
4. Secure magneto to magneto adaptor with 4 hex head cap screws.

C. Setting Maximum Spark Advance

1. Thread Timing Gauge (C-91-26916A1) into No. 1 spark plug hole.
2. Turn flywheel until No. 1 piston strikes Timing Gauge.
3. While turning flywheel, thread Timing Gauge in or out so that piston can "rock" over center shaft of gauge, indicating that Timing Gauge is set at top dead center (TDC) position.
4. Rotate flywheel clockwise ¼ turn.
5. Depress center shaft of Timing Gauge.
6. Rotate gauge shaft ¼ turn to seat on tool body shoulder (.235" [5.9690mm] BTDC position). Be careful that tool body does not move, or preceding procedure will have to be repeated.
7. Rotate flywheel clockwise by hand until No. 1 piston strikes Timing Gauge center shaft. This is .235" (5.9690mm) BTDC.
8. Attach one test lead of Timing Meter (C-91-22966) or Magneto Analyzer (C-91-25213) (on No. 2. Resistance) to magneto frame.
9. Attach second lead of tester to primary ground terminal of magneto.
10. Slowly advance magneto until points break, as indicated by tester used.
11. Hold magneto in this position and adjust spark advance screw to just touch pilot assembly and tighten lock nut.(Figure 2)
12. Recheck setting by actuating magneto with throttle control lever.

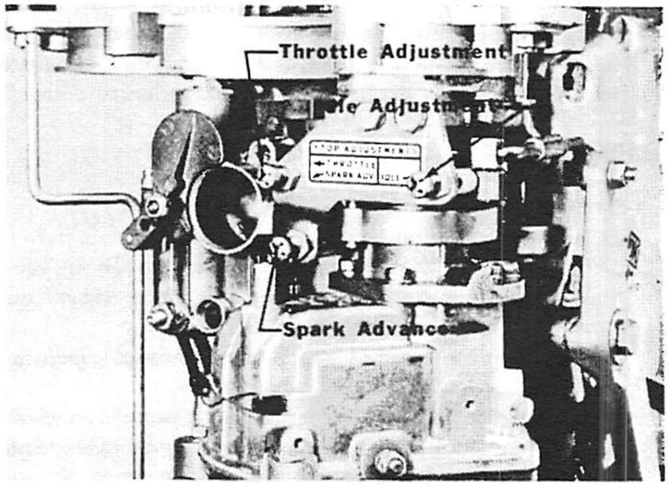


Figure 2. Magneto Stop Bracket Adjustment

D. Adjusting Carburetor Throttle Pickup Plate

Adjust carburetor throttle pickup plate position with .015" (.3810mm) feeler gauge to obtain 1/64" (0.397 mm) clearance between second pickup pin and No. 2 lever or carburetor cluster when magneto is against the stop in full advance position. (Figure 3)
(Note: Be sure that throttle moves freely throughout range and both throttle shutters close fully at idle position.)

E. Full Throttle Stop Adjustment Screw

Set full throttle stop adjustment screw to allow 1/64" (0.397mm) free movement of cluster lever in clockwise direction when throttle is held against its full throttle stop. (Figure 4) Push cluster lever with finger.
(Note: If timing stop is readjusted, Paragraph C, preceding, must be repeated.)

II. CARBURETOR ADJUSTMENT

Before starting engine, turn low speed needles of each carburetor in until they seal lightly; then back out 7/8 turn. This will allow engine to start, and you then can make final adjustments, following.

A. High Speed Adjustment

Merc 500 carburetors have fixed high speed jets. The standard jet, installed at the factory, is recommended for operation from sea level to 4000 ft. (1219.2m) elevation. If engine is operated above 4000 ft. (1219.2m) select and install correct jets from chart below. *(Note that jet aperature decreases .002" [.0508mm] as elevation increases.)* Use Jet Installation Tool (C-91-29795) .

It is recommended that propeller be removed, and test propeller (A-48-32618A1) be installed. Engine then should turn at 5500-5600 RPM at full throttle in test tank or on back of boat.

Jet Sizes for Elevations			
Engine Model	Up to 4000' (1219.2m)	4,000' (1219.2m) 7,000' (2133.6m)	7,000' (2133.6m) 10,000' (3048.0m)
500	.057" (1.4478mm)	.055" (1.3970mm)	.053" (1.3462mm)

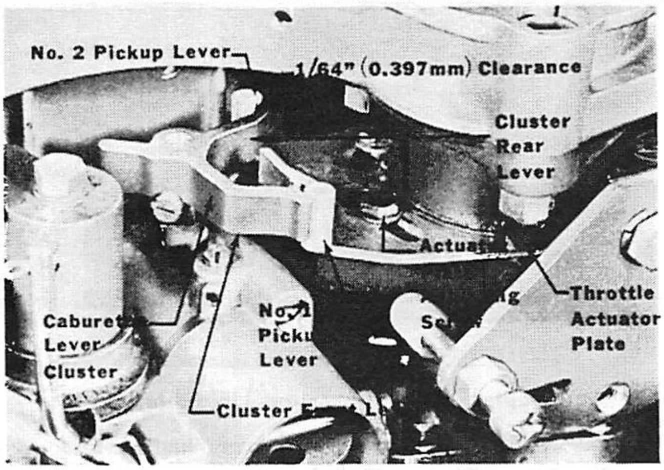


Figure 3. Carburetor Throttle Pickup Plate Adj ustment

Note: Jet size recommendations are intended as a guide (like a propeller chart). Try size larger or smaller if in doubt.

No change in spark advance is recommended for elevation operation. Propellers of lower pitch should be used at high elevations to allow proper engine RPM.

B. Low Speed (Idle) Adjustment

Make idle adjustment after high speed adjustment is completed.

1. Turn all idle needles 7/8 open and adjust for maximum RPM with distributor retarded to give about 600 RPM.
2. Run engine at idle speed while in forward gear.
3. Turn low speed mixture adjusting needle counterclockwise until engine starts to "load up" or fire unevenly due to over-rich mixture.
4. Slowly turn needle clockwise until cylinders fire evenly and engine picks up speed. Do not adjust leaner than necessary to obtain reasonably smooth idling.
5. If engine hesitates during acceleration after adjusting idle mixture, it is too lean and should be richened slightly until engine will accelerate correctly.

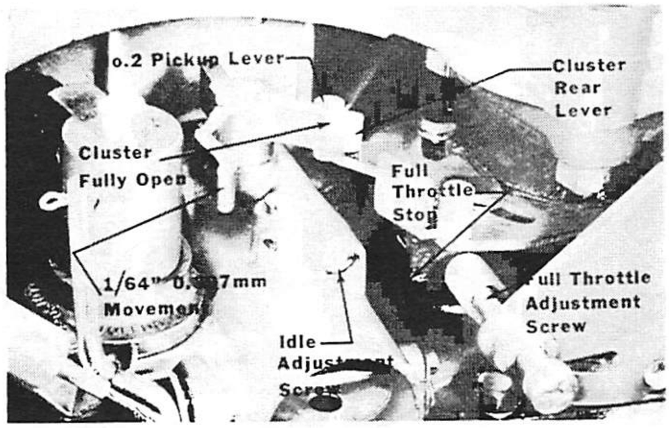


Figure 4. Full Throttle Stop Adjustment

(Note: When in doubt, it is preferable to have mixture set slightly rich rather than too lean. Idle cannot be adjusted while in "Neutral" or engine will sputter and stop when shifted in "Forward" because of "no load" condition while adjusting.)

C. Idle Limit Adjustment

1. Warm up engine.
2. Set carburetor idle mixture screw for proper operation, as explained in Paragraph B, preceding.
3. Set minimum idle limit screw (Phillips head screw on magneto adaptor toward outside) to obtain 525 RPM idle. (Figure 2) Set "in" for increased RPM, "out" for decreased RPM.

III. REMOTE CONTROL ADJUSTMENT

1. Remove front cowl and wrap around cowl.
2. Place single lever remote control handle in forward position and smaller neutral warmup lever (on side of box) down all the way.
3. Place remote control shift cable through opening in front left hand side of bottom cowl.
4. With motor in forward gear, position cable end guide over shift actuator peg without disturbing setting. (Figure 5)

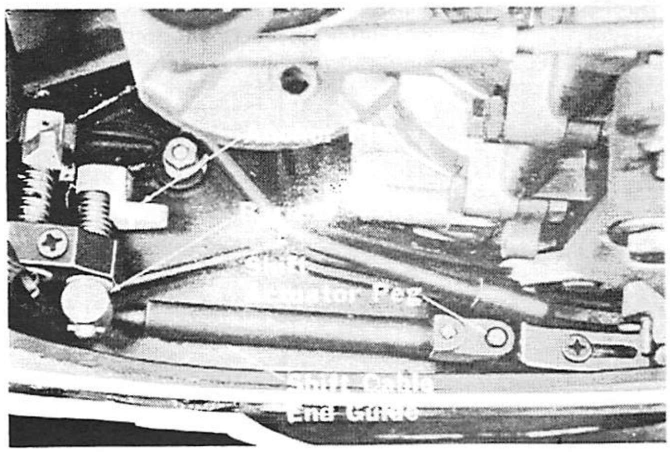


Figure 5. Installing Shift Cable

5. Secure cable end guide by sliding spring retainer clip over cable end guide. Be sure that hole in spring retainer clip is centered over peg. (Figure 6)
6. Secure brass barrel with anchor pin. If necessary, readjust brass barrel for correct position and to compensate for cable backlash. (Figure 6)
7. Place single lever remote control handle in neutral

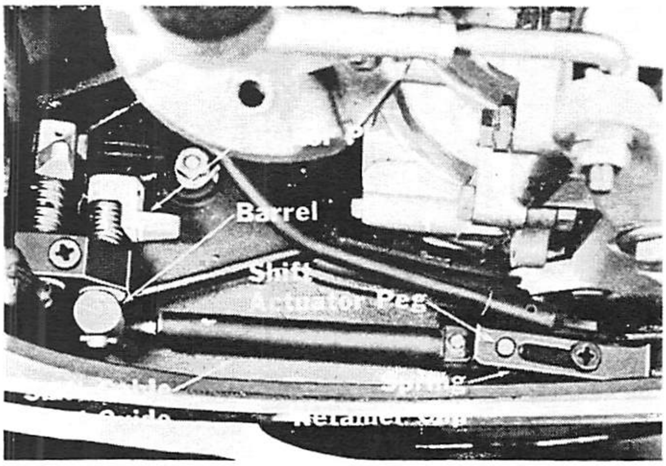


Figure 6. Secure Brass Barrel with Anchor Pin

position and check that motor is in neutral gear. If shift cable is not correctly adjusted, motor will not shift properly.

8. Place remote control throttle cable through opening in front left hand side of bottom cowl and position cable end guide over peg on vertical lever. (Figure 7)

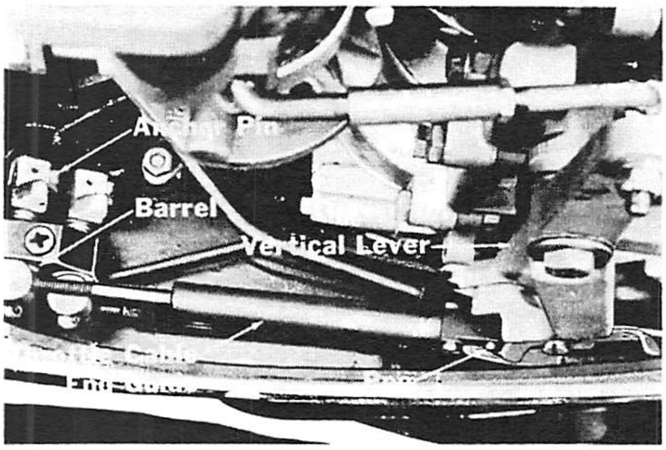


Figure 7. Cable End Guide Over Peg on Vertical Lever

9. Secure cable end guide by sliding spring retainer clip over cable end guide. Be sure that hole in spring retainer clip is centered over peg. (Figure 8)

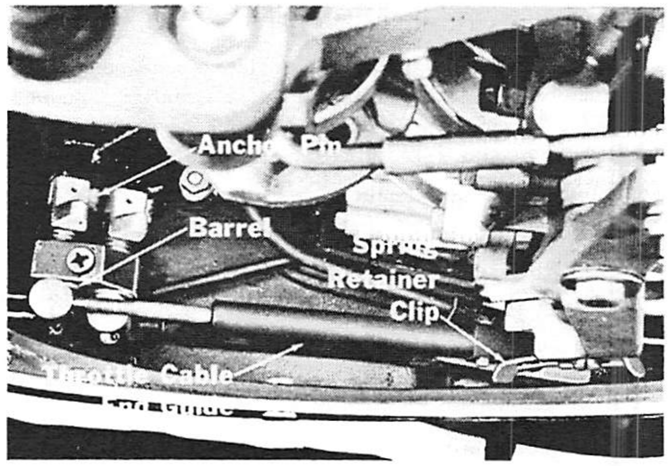


Figure 8. Sliding Spring Retainer on Cable End Guide

10. Position vertical lever so that magneto is held lightly against idle stop screw. (Figure 9) Secure brass barrel with anchor pin. If necessary, readjust brass barrel for correct position and to compensate for cable backlash.

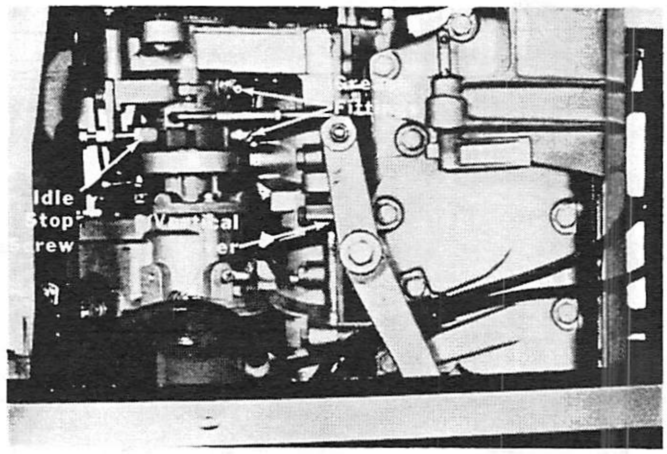
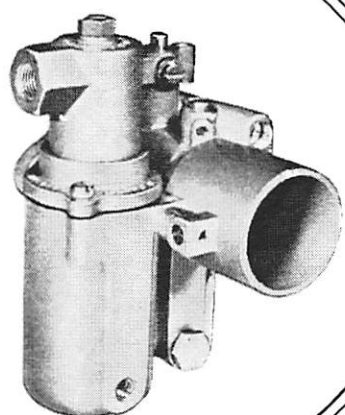


Figure 9. Magneto Against Idle Stop Screw

11. Move single lever remote control handle to forward position and then back to neutral position. Check that magneto is held lightly against idle stop screw (Figure 9) when control handle is in neutral position.



section V
carburetion

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GENERAL INFORMATION

A. Fuel

Fuel used in gasoline engines is a compound of hydrogen and carbon in liquid form. To burn it as efficiently as possible in the cylinders of an internal combustion engine, the liquid fuel must be broken up into fine particles and thoroughly mixed with the oxygen in the air. Fifteen to 18 pounds of air burned to each pound of gasoline used is the approximate ratio to efficient combustion. In practice, however, this is somewhat modified.

Mercury Outboard Motors use a fuel mixture of gasoline and engine oil. As explained in the forepart of the manual on 2-cycle engines, oil is used to lubricate the internals of the motor and most of it is dissipated along with the gasoline in the combustion process.

B. Combustion

Liquid fuels will not burn while it remains liquid. Before liquid fuel can be burned in an engine, it must be changed to a vapor or a gas, and then mixed with air in the proper proportion to form a combustible mixture. Air enriched by the addition of gasoline vapor is called carburetion of the air, and the device used for carbureting the air is called a *carburetor.*

C. Ignition

The operation of igniting the gaseous mixture in the engine cylinder by means of a suitable device such as a spark plug is known as ignition. In order to complete combustion of the fuel mixture, heat is required, and this, although very small, is derived from the electric spark provided by the spark plug.

D. Mixture

As explained above (combustible mixture), any given volume of air will absorb only a certain amount of gasoline vapor, just as water can dissolve no more than a certain amount of salt. *The air is then said to be saturated with gasoline vapor.* A mixture containing less than the full amount of vapor which it can absorb is neither a saturated nor a perfectly proportioned mixture. The less vapor it possesses, the leaner it is said to be. A mixture containing more than the amount of vapor which it can absorb also is not perfectly proportioned. The more vapor which it has, the richer it is said to be.

The proper mixture of gasoline vapor and air, for explosive purposes in a gasoline engine cylinder, burns at atmospheric pressure when employing a carburetor and should burn with a blue flame. It should leave little or no soot or carbon deposit on the internals of the cylinder or piston. However, in an outboard motor using a gasoline-oil mixture, there is a natural tendency for the cylinder internals to carbon easier than engines utilizing only gasoline as fuel. This point is brought out here to show the importance of mixing gasoline and proper type of oil exactly as recommended by the manufacturer to avoid as much as possible the over-carbonizing of the cylinders or building up a carbon deposit in a short period of time.

A lean mixture behaves somewhat in the same way, except that in burning in a confined space, such as a cylinder, less pressure than that of a perfect mixture is produced. The surplus air does not burn. It is heated, however, and expands some, but with less power.

E. Choking

When a cold motor is being started, the fuel vapor must be extra rich. This richer mixture is provided by choking the carburetor. At the carburetor's air intake, ahead of the jet, is a flat metal disc called a choke shutter, controlled by means of the choke lever. When the shutter is closed, blocking the air intake, the fuel vapor delivered to the crankcase naturally contains less air and a higher proportion of gasoline, and is therefore richer. When the motor starts, the shutter is opened, and the carburetor provides the leaner mixture for ordinary running.

F. Throttle

A similar butterfly valve, ahead of the jet and the crankcase, serves as the throttle. A turn of the throttle to the left partly closes this valve, less fuel vapor can enter the crankcase and the motor runs slower. Turning it to the right opens the throttle "wide" and provides a greater amount of fuel vapor for maximum speed.

G. Types of Carburetors

Most of the modern carburetors are of the "spray type", which has one or more nozzles or jets, each having one or more small, almost minute openings or orifices.

The carburetor employed on the Mercury Outboard Motor is of this type, with 2 orifices, namely the "idle tube fuel outlet orifice" for slow speed adjustment and the "main fuel adjustment orifice" or "fixed jet" for high speed.

H. Adjustment Instructions

Before starting engine, check for proper fuel supply in tank, open fuel line shut-off valve or attach connector and be certain air valve on fuel tank cap is open (if not a pressurized tank).

Separate manual carburetor adjustments are provided. The main adjustment screw controls the power range mixture and the idle adjustment screw governs the idle mixture at closed throttle.

CARBURETION -- PRELIMINARY CHECK

A. Make sure there's gasoline in the fuel tank. This seems almost too obvious to mention, but sometimes the fuel supply burns up faster than the operator realizes. Many an outboarder, confident he has plenty of gas, has spent half an hour hunting for trouble elsewhere before finally checking the tank and finding it empty.

B. Make sure air vent in filler cap is open, as well as the gasoline shut-off valve leading from tank to carburetor on engines with integral fuel tanks on top. This is another of the "obvious" checks.

C. Follow the procedure for "starting a flooded motor"; that is, close the needle valve (or valves, if there are two of them) completely and spin the flywheel several times. This will clean out excess fuel from cylinders. Then, open needle valves to correct starting position and try again.

D. Check the Carburetor

The presence of water in the fuel can be ascertained by catching a little of the spilled gasoline in the palm of your hand. Gasoline and water, not mixing, will remain in separate beads or bubbles. If you blow on the mixture, gasoline will evaporate rapidly, leaving the water on your hand.

If float bowl is dry, look for some obstruction between fuel tank and carburetor. (Usually you'll find that the fuel strainer has been stopped up by dirt or moisture in the fuel mixture.) The only way of checking is to loosen the high speed packing gland screw or body channel screw plug on the bottom of the carburetor to see whether gas is entering the carburetor.

Before disconnecting gas line at the carburetor, open the shut-off valve (if so equipped) and check that gas flows freely through the line. If not, gas is stopped up. Disconnect other end from fuel tank and blow line clean. Also, clean out connections at the tank and at the carburetor.

Fuel lines are disconnected merely by unscrewing the nuts. Always use wrenches on these nuts; never pliers. When replacing gas line, do not tighten the nuts too severely, as the threads can be stripped rather easily if a little care is not exercised.

If carburetor seems okay, or if it is difficult to reach the carburetor, remove a spark plug and look at it. *A dry plug means that fuel is not entering cylinder.*

If carburetor float bowl is full, there must be some obstruction between float bowl and cylinder -- most likely in the jets. If the carburetor has not been checked up to this time, the dry plug tells you that the trouble is somewhere in the fuel line or carburetor.

Attempting to remedy any of the above causes by complete disassembly of the carburetor on a rough sea would be a bit difficult with almost any type carburetor. The only suggestion or recommendation which can be made, as stated previously, is to make certain that any obstruction in the passages of the fuel line to the carburetor, and from the carburetor, are not restricted by some foreign object.

NOTES

GENERAL SERVICE HINTS

A. Clean Fuel

Always strain fuel through a suitable medium when filling tank. When deposits of dirt and water are observed, after removing cover, clean bowl and channels with compressed air.

Before storing motors for the winter, thoroughly clean the carburetor of gasoline, water and dirt. This will insure free flow of gasoline through it when ready to use.

B. Testing Equipment

To eliminate carburetor complaints of all nature, tune up service should be performed with modern testing apparatus, such as the recommended Magneto Analyzer (91-25213). Spark plugs, complete magneto mechanism, ignition, valve setting, compression and the carburetor all are important in controlling good engine performance. They should be checked in the above sequence and serviced to specifications.

C. Adjustments

To correctly service the carburetor, check the adjustments, gasoline level and other factors outlined previously. Clean as mentioned above, using a wire or drill in cleaning the orifices.

Note: Drill reference in carburetor means to use small drill held in pin vise actuated with fingers.

All plugs, screws and nozzles must be tight. All gaskets must be in their proper place, and it is recommended that new gaskets be used.

Re-adjust carburetor in accordance with instructions for high speed and idle adjustment, following, bearing in mind that either too rich or too lean a mixture causes flatness. Also, check the gasoline level in the bowl and see that no dirt or lint is restricting the orifices. Check action of throttle and choke. Any gum residue left in carburetor or copper lines can be removed with alcohol or lacquer thinner. Caution must be exercised when using lacquer thinner.

Caution: Do not use lacquer thinner on neoprene or flexible lines.

NOTE: For motors operated in higher elevations, carburetors may possibly need slightly different adjustments than when operating at sea level. Normal carburetor operation is based on operating at atmospheric pressure which is 14.7 pounds (P.S.I.) at sea level. At high elevations, because of less dense (rarified) air, the main fuel adjustment of the carburetor must be set to a leaner position by adjusting high speed screw or replacing fixed jet.

D. Probable Restrictions

Constant difficulty in getting proper idle adjustment may be caused by a restriction in idle jet. This can be cleaned by using proper size drill (See Carburetor Drill Chart, following in this section) and compressed air. A restriction in the idle bypass chamber (beneath welch plug) will also cause this trouble. Drill holes with proper size drills and blow off with compressed air.

If unable to get sufficient fuel (rich mixture) while running above ½ throttle, after having tried to adjust according to instructions, and it is necessary to constantly "choke" engine to maintain running, then main fuel discharge tube is partially clogged and should be cleaned with proper drill size (see chart). Blow clear with compressed air.

Note: When carburetor constantly floods, it may be caused by a float that is saturated with fuel to a point beyond buoyancy. Install new float. It may also be caused by 1) Float sticking or out of position, 2) Worn inlet needle and seat or 3) Incorrect float lever dimensions.

NOTES

TYPES OF CARBURETORS - ADJUSTMENT

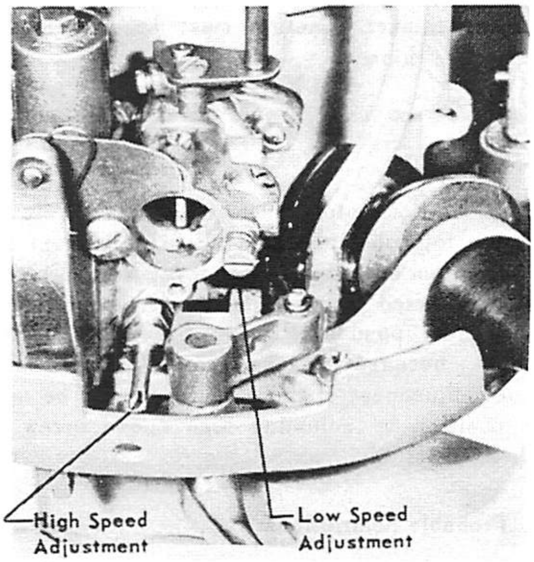


Figure 1. High Speed Adjustment

A. General Description

Mercury carburetors are of two types, 1) Gravity feed, and 2) Pressure feed. The major difference is that fuel enters at the bottom of the carburetor bowl on the gravity feed carburetor, and it enters the top of the carburetor float bowl cover on the pressure feed type.

B. Carburetor Adjustments

All high speed and slow (idle) speed valve adjustments are made on all carburetors at the factory. It will, however, require resetting for best operation depending upon the temperature, elevation, fuel characteristics and the gasoline-oil ratio in the fuel mixture. High speed fixed jet is selected for sea level application. Operation above sea level, see chart on Page 21.

C. Initial Adjustment

Before starting engine, complete the initial adjustment by closing the idle adjustment screw by turning in clockwise until seated. *Do not force.* Then turn back in opposite direction one full turn. Proceed in like manner with high speed adjustment screw, except to open it about 1½ turns after first being closed. *(Adjustment not required with fixed jet.)* Now choke and start engine in usual manner and run until thoroughly warm.

D. High Speed Adjustment (not with Fixed Jet)

After motor has warmed up, set throttle in FAST position on all motors and in FORWARD gear on those motors with shifting. Then complete the following high speed adjustment for all Mercury Motors:

1. Slowly turn high speed adjustment screw inward (clockwise) until motor starts to slow down (mixture becoming too lean). (Figure 1)

2. Determine this critical lean point as closely as possible, then back needle out ½ to ¾ turn.

3. It is better to set mixture slightly rich (¾ turn), when in doubt, rather than too lean. An excessive lean mixture will cause overheating and loss of power. Sustained full throttle with this setting may cause motor damage and will burn spark plugs rapidly.

NOTE: If engine can be four-cycled and leaned out at fuel throttle by carburetor adjustment screw, this indicates that carburetor is satisfactory at high speed, and it can be eliminated as a possible cause of trouble at high speed.

E. Slow Speed Adjustment

After motor has been warmed up and high speed adjustment completed:

1. Place throttle in SHIFTING RANGE or SLOW position and gear shift, if so equipped, in FORWARD gear. Turn idle adjustment screw inward (clockwise) until motor starts to "load up" or slow down or fire unevenly due to mixture becoming too rich because of lack of air. Idle screw adjusts air volume only. (Figure 2) NOTE: On 1956 and newer Mark 25 and Mark 55 only, turn screw outward (counterclockwise), adjustment opposite of previous models because of volumetric (air and fuel) control rather than air adjustment only.

2. Turn adjustment screw out (counterclockwise) until motor picks up speed and fires evenly. Turn in (clockwise) on Mark 25 and 55.

3. Do not adjust leaner than necessary to attain reasonably smooth idling. Again, it is preferable to set mixture a little rich than too lean. When adjusting idle needle, turn approximately 1/8 turn at a time; then wait sufficient time for engine to respond to this adjustment.

Note: It may be necessary to readjust carburetor idle screw on 2-cylinder engines up to 1¼ turn with each change in brand of gasoline to compensate for varying volatility and differences in refining processes.

Note: When adjusting idle needle on Mark 20H, set spark lever in ¾ retard position.

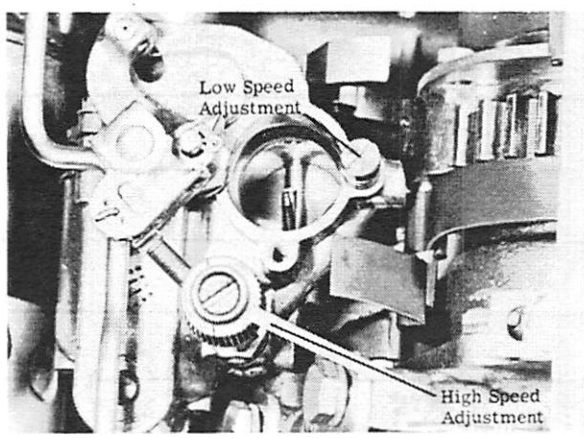


Figure 2. Slow (Idle) Speed Adjustment

F. **Final Adjustment**

Alternately open and close throttle a few times for adjustment test. If acceleration hesitancy or stalling at idle speed occurs, entire adjustment procedure, outlined in "E" preceding, should be repeated. Warm motor only requires opening of throttle and one or two vigorous pulls on starter rope. (Choking is not required, unless previous experience indicates otherwise.) Regardless of elevation or climate conditions, a proper carburetor adjustment can be made by following the above rules.

G. **Synchronization**

Synchronization between magneto cam and carburetor throttle shaft is important. Magneto cam should pick up throttle lever at centerline of engine. It may vary slightly and pick up sooner or later in order to maintain smooth intermediate operation. Improper synchronization will cause a "flat spot" or "4-cycling" in engine operation.

Note: On the Mark 20 and Mark 25-25E, set so throttle arm of carburetor is 1" to 1½" from end of magneto cam travel. This is maximum spark advance. (For 4-and-6-Cylinder Models, see Ignition Section, "Synchronization.")

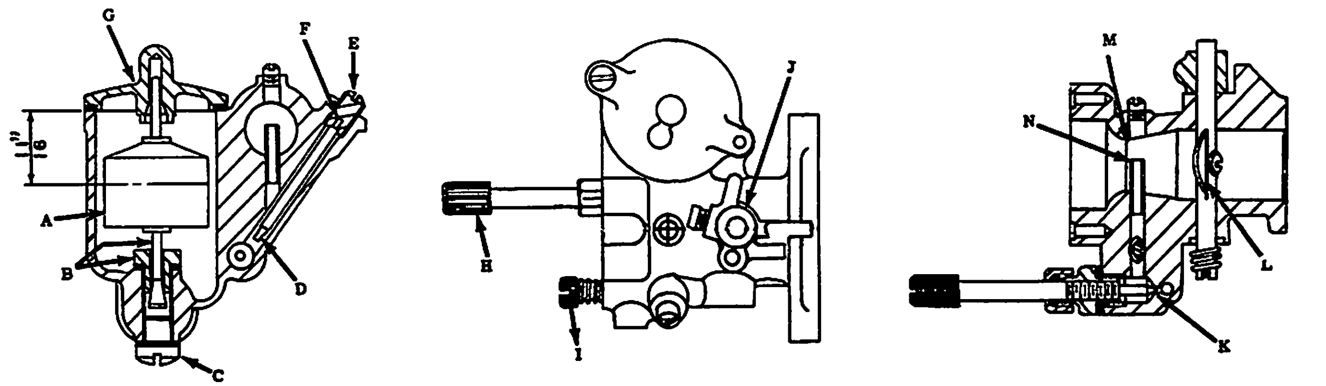
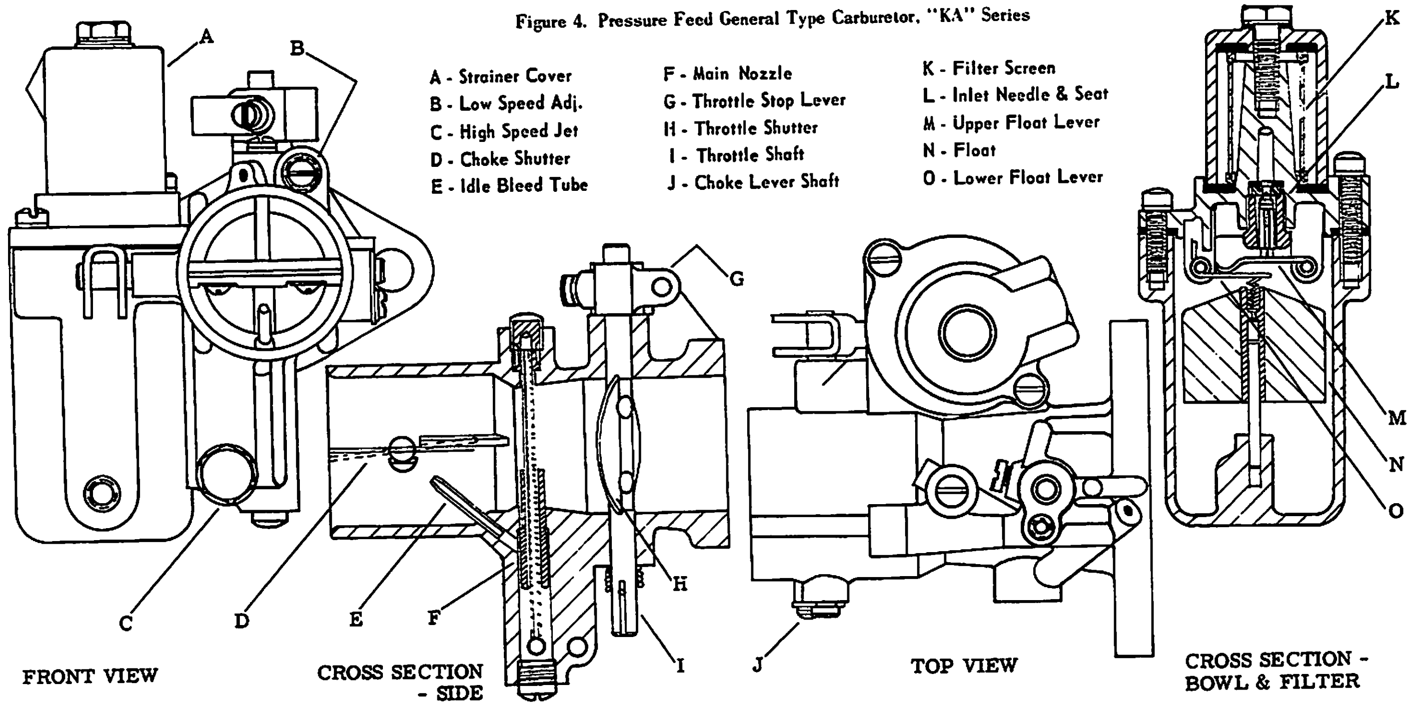


Figure 3. Gravity Feed General Type Carburetor, "AJ" Series

A. Float
B. Inlet Needles and Seat
C. Inlet Plug Screw
D. Idle Jet Seat
E. Idle Jet
F. Idle Jet Gasket
G. Cover
H. High Speed Adj.
I. Idle Adjustment
J. Throttle Stop Lever
K. High Speed Adj. Seat
L. Throttle Shutter
M. Channel Plug Screen
N. Main Discharge Nozzle

Figure 4. Pressure Feed General Type Carburetor, "KA" Series



PRESSURE FEED CARBURETOR (TILLOTSON TYPE)

A. General Description

Fuel is pumped into the float bowlunder pressure. Fuel enters at the top of the carburetor float bowl. The primary lever should be 13/32" ± 1/64" from top of float bowl cover shoulder. Measure by inverting cover.

B. Fuel Level

Fuel level is approximately correct when 11/16" below bowl rim. Float is positioned on valve stem. A level, constantly higher than normal, requires careful valve and seat cleaning or replacement. To replace inlet valve and seat assembly, see "Disassembly", following.

Before starting engine, check for proper fuel supply in tank and make preliminary high and slow speed mixture adjustments.

Disassembly, Pressure Feed

If carburetor foams through air vent in float bowl cover, it is due to an air leak. If engine runs lean after proper adjustment of main adjustment screws, it may be due to clogged screen in top of carburetor float bowl cover beneath elbow. Complete the following for disassembly:

1. Remove float bowl cover, lower (primary) float lever pin and lever, allowing upper (secondary) lever to be pivoted back.
2. Remove inlet needle (loose) and seat (right hand thread) with screwdriver or 3/8" socket wrench, depending upon motor model.

   NOTE: A leaking needle and seat would cause hard starting after engine was stopped.
3. Remove float by tipping carburetor upside down.
4. Remove idle restriction tube. Motors with volumetric controlled idle adjustment (adjusts both air and fuel) have a plug over top which must first be removed with screwdriver.
5. Remove welch plug over idle by-pass chamber with sharp center punch, driving welch plug through, and pry off.
6. Remove shutter by removing screw and lockwasher which hold shutter to throttle shaft. Pull shaft out from top, then remove return spring and throttle shaft.
7. Remove lead plugs with sharp center punch.

Cleaning Carburetor

1. Insert proper size drill, held in a pin vise (tool to hold extremely small drills, in passages). (Refer to Carburetor Drill Chart, following.) Be sure that passages are clean and free of restrictions which impair operation.
2. Place carburetor body in a carburetor cleaning solution for a short period of time to remove all dirt, gum and varnish which may have accumulated. Carburetor cleaners are available through automotive supply stores.
3. After removing carburetor from cleaning solution, rinse thoroughly in clean solvent and blow off with compressed air. Be sure to blow through all passages, orifices and nozzles.

Reassembly, Pressure Feed

1. Check float for deterioration, saturation and loss of sealer.
2. Place float in float bowl on top of float needle.
3. Screw needle seat (nylon or neoprene) in place. Set needle in seat with upper (secondary) float lever over pin.
4. Replace lower (primary) lever and pin.

   (Note in reference to inverted assembled float bowl cover: Primary lever should gauge 13-32" [plus or minus 1/64"] from face of shoulder. Bend primary lever to get correct dimension, as shown in Figure 6. Be sure needle does not stick in seat. Tip until upright, and needle should move freely on actuating lower [primary] lever.)
5. Install new gasket and fasten cover to bowl. Replace idle restriction tube. Check for correct size and full passage on volumetric control carburetors.
6. Replace cover plug.
7. Replace throttle shaft in the following manner:
   a. Insert shaft in body (slot in bottom).
   b. Place shutter in position and secure with screw and lockwasher.
   c. Replace throttle return stop lever and screw.
   d. Place return spring in position so that throttle shutter will close from spring tension.
   e. Replace discharge nozzle cleanout hole screw (or lead shot).
   f. Replace lead shot removed from passages and welch plug over idle by-pass.
   g. Replace idle adjustment screw and spring.
8. Replace packing in packing gland, packing gland nut and high speed adjustment screw.

A - Float
B - Upper Float Lever
C - Needle & Seat, Inlet
D - Screen, Inlet
E - Lower Float Lever

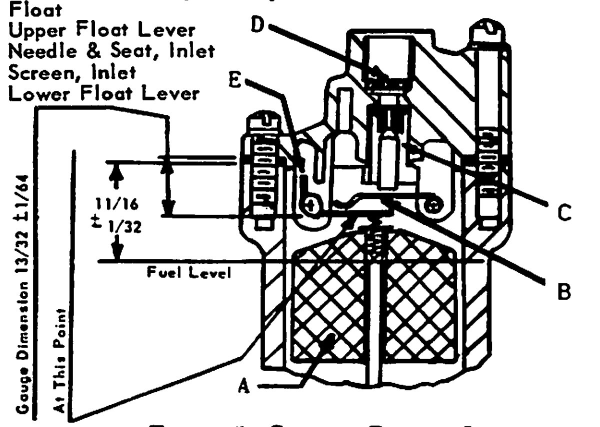


Figure 5. Gauging Primary Lever

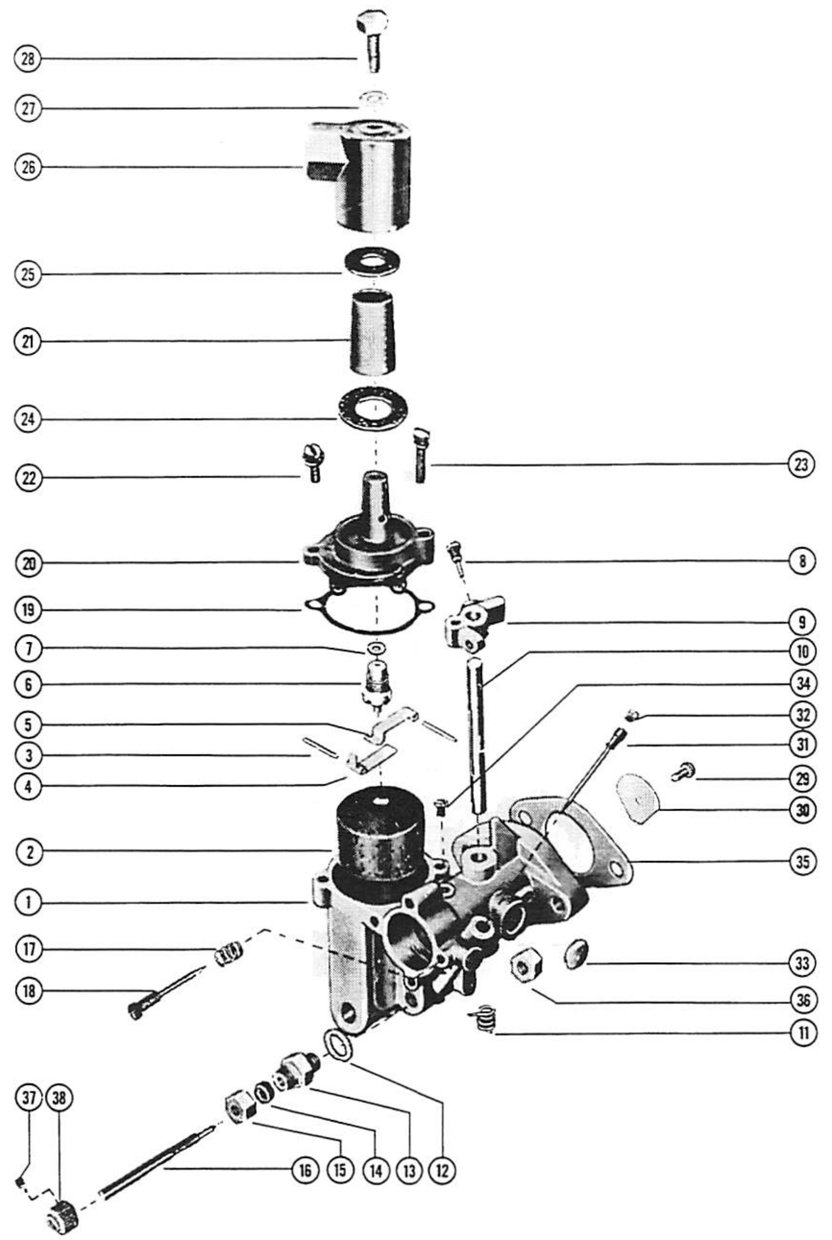


Figure 6. Pressure Feed Carburetor

1	Carburetor Assembly	20	Cover, float bowl
2	Float Assembly	21	Element, filter
3	Pin, float lever pinion	22	Screw, float bowl cover (short)
4	Lever, float (lower)	23	Screw, float bowl cover (long)
5	Lever, float (upper)	24	Gasket, strainer cover (large)
6	Inlet Needle, seat & gasket	25	Gasket, strainer cover (small)
7	Gasket, inlet seat	26	Cover, strainer
8	Screw, throttle stop lever	27	Gasket, strainer cover screw
9	Lever, throttle stop	28	Screw, strainer cover fastening
10	Shaft, throttle	29	Screw & Lockwasher, throttle shutter
11	Spring, throttle shaft return	30	Shutter, throttle
12	Gasket, main adjustment screw gland	31	Tube, by-pass
13	Gland, main adjustment screw	32	Screw, plug - by-pass tube
14	Packing, main adjustment screw	33	Welch Plug, body channel
15	Nut, main adjustment screw	34	Screw, plug - body channel
16	Screw, main adjustment	35	Gasket, carburetor flange
17	Spring, idle adjustment screw	36	Nut, carburetor mounting stud
18	Screw, idle adjustment	37	Screw, knob fastening (#10)
19	Gasket, float bowl cover	38	Knob Assembly, main adjustment screw

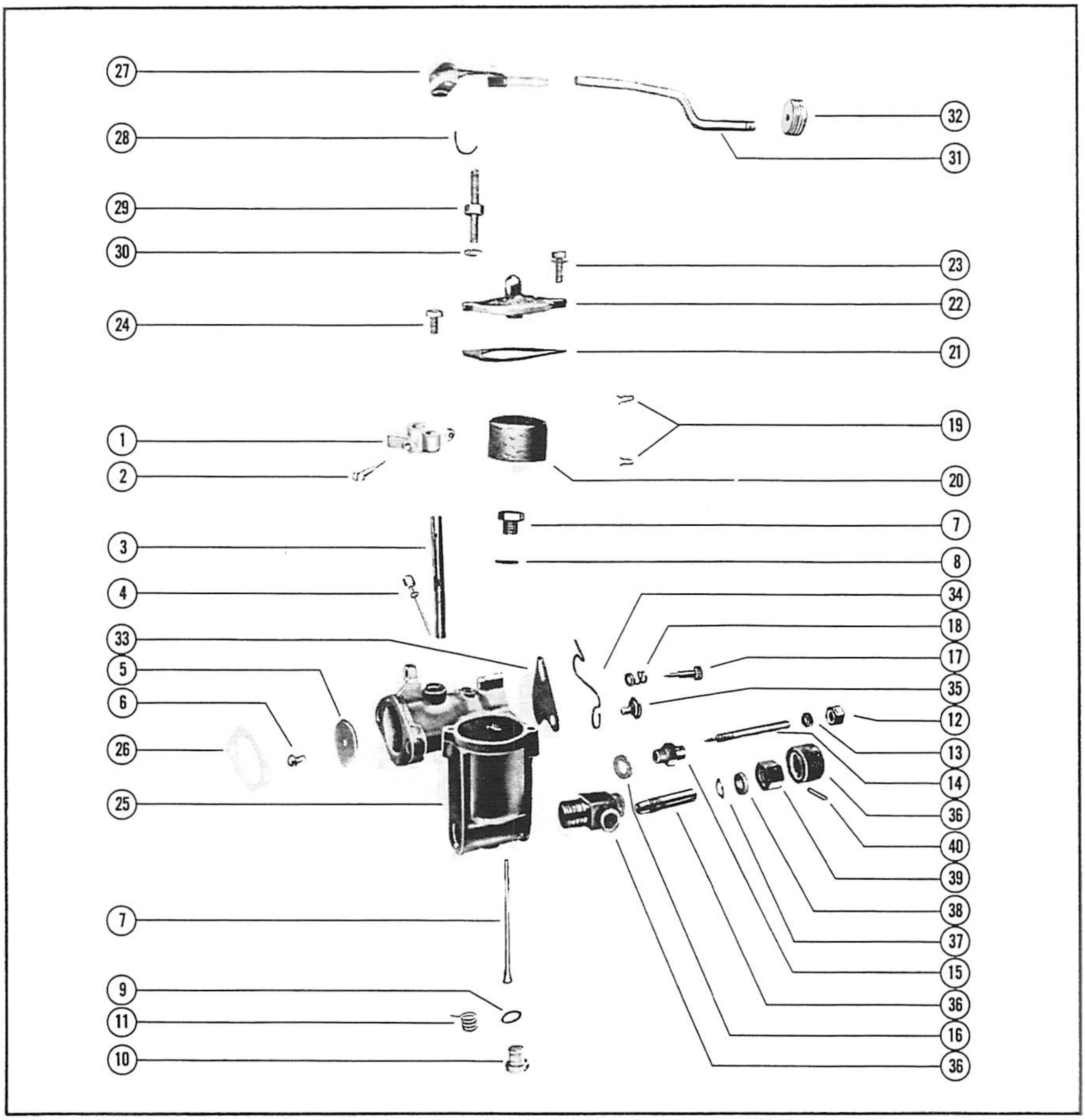


Figure 7. Gravity Feed Carburetor, Shut-Off Valve and Choke

1. Lever, throttle stop
2. Screw, throttle stop lever
3. Shaft, throttle stop lever
4. Jet, idle
5. Shutter, throttle
6. Screw, throttle shutter
7. Inlet Needle & Seat Assembly
8. Gasket, carburetor inlet seat
9. Gasket, inlet valve channel plug screw
10. Screw, inlet valve channel plug
11. Spring, throttle shaft return
12. Nut, main adjusting screw packing
13. Packing, main adjusting screw
14. Screw, main adjusting
15. Gland, main adjusting screw
16. Gasket, main adjusting screw gland
17. Screw, idle adjusting
18. Spring, idle adjusting screw
19. Cotter Pin, float retaining
20. Float, carburetor
21. Gasket, float bowl cover
22. Cover, float bowl
23. Screw & Lockwasher, float bowl cover
24. Screw
25. Nut, carburetor mounting stud
26. Gasket, carburetor flange
27. Choke Lever Assembly
28. Pin, choke rod swivel
29. Stud, choke lever
30. Lockwasher, choke lever stud
31. Rod, choke
33. Shutter, choke
34. Spring, choke shutter
35. Screw, choke shutter
36. Fuel Shut-Off Valve Assembly
37. Washer, packing gland
38. Packing, gland nut
39. Nut, gland
40. Pin, groove - knob retaining

GRAVITY FEED

Disassembly

Principle of Gravity Feed Type Carburetor: Fuel, supplied from a tank located above carburetor, flows downward without pressure and enters float bowl at bottom. Disassembly and repair of gravity type Tillotson carburetors is similar to pressure type on P. 6. (Figure 7)

Follow disassembly of pressure type, preceding, except for the following:

1. Float bowl cover contains no levers or seat.
2. Remove inlet valve channel plug and gasket from bottom of carburetor.
3. Remove float retainer clip above float (second retainer clip in needle groove below float which holds it in position). To remove, thumb pressure on needle will force needle through plug hole at bottom, then –
   a. Pull float needle through plug hole at bottom.
   b. Pull float needle out, leaving float and clip free.
   c. Remove seat with 3/8" hex head socket. Gasket is beneath.

(Use same procedure as in "Cleaning Carburetor" on Page 6.)

Reassembly

Follow instructions for pressure type, on Page 6, with the following exceptions:

1. Replace float needle seat and gasket, with 3/8" socket wrench.
2. Insert needle into seat and replace screw plug and gasket.
3. Place float retainer clip in lower float needle groove.
4. Place float on needle and press float until it touches lower float retainer clip.
5. Place top float retainer clip in position.
6. Replace float bowl cover and new gasket.
7. After mounting carburetor on powerhead, time engine and synchronize opening of carburetors and points on magneto for maximum efficiency. This also can be done after powerhead is mounted onto drive shaft housing and bottom cowl. (Refer to Ignition Section IV.)

CARBURETOR DRILL CHART - MARK & "K" MODELS

(Figures shown are number drill sizes.)

Motor Model	MK 78 MK 78A MK 58 MK 58A	MK 75 MK 75A§	MK 75A§	MK 55 MK 35 MK 55A§ MK 35A§	MK 55A§ MK 35A§	MK 55H	MK 55H MK 20H	MK 50	MK 30 MK 30H	MK 30 MK 30H	MK 28 MK 28A	MK 10 MK 15A§ MK 10A	MK 15A§	MK 6 MK 6A
Carburetor Mfg. Number	KA2A	AJ53A	AJ55A	AJ50A AJ47A	AJ54A	N2537S	KA7A	AJ44A	AJ51A	AJ49A	KA5A	AJ52A	AJ56A	AJ46A
Main Discharge Nozzle	29	50	50	50	50	44	29	50	52	52	29	52	52	58
Main Discharge Nozzle-2 Cross Holes	60						60				60			
Internal Air Bleed Tube	55	70	70	70	70		50	70	70	70	60	70	55	70
1st Idle Hole By-Pass Under Welch Plug	56	55	55	55	55		56	58	65	60	56	55	55	65
2nd Idle Hole By-Pass Under Welch Plug	56*	65	65	65	65		56	72	60	65	56*	62	58	72
3rd Idle Hole By-Pass Under Welch Plug	56						56			56	56			
Idle By-Pass Large Hole, Rear under Welch Plug	50						50			47	47			
Idle Fuel Restriction Tube	50	65	65	65	65	68	60	70	65	65	50	65	65	74
Idle Air Supply Hole	65	54	54	54	54	50	65	42		54	69	54	55	
High Speed Adjusting Orifice	Jet .063	46	Jet .055	46	Jet .055	50	46	46	46	46	Jet .063	48	Jet .057	52
Idle Air Adjusting Orifice	50	52	52	52	52	44	50	40	52	52	50	52	48	45
Fuel Inlet Seat Orifice	42	52	52	52	52	48	42	54	52	52	42	52	52	54
By-Pass Hole Top of Bore	68	70	70		70		68		62	62	65	72	72	

§ Check carburetor manufacturing number

* Two Holes Side-by-Side   Supersedes Previous Carb. Drill Charts   NOTE: Absence of figure in square indicates no drill hole provided.

Motor Model	Mark 40 KG9	Mark 20	Mark 20H	Mark 15	Mark 7 KE4	Mark 5	KF9	KF9HD KF7HD	KG7 KH7	KF7 KE4HD	KE7	KG4	KF5	KD3 KF3	KD and Older
Carburetor Mfg. Number	AJ33A	AJ41A	N2150S	AJ40A	AJ23A	AJ30B	AJ31A	AJ29AB	AJ32A	AJ29A	AJ19A	AJ36A	AJ30A	AJ10B	AJ8A, 8B 10A, 3A
Main Discharge Nozzle	52	52	44	52	56	58	52	52	52	52	56	52	58	58	58
Internal Air Bleed Tube	54	68		65	62	72	56	55	68	55	62	54	72	54	54
1st Idle Hole By-Pass Under Welch Plug	56	56		56	56	65	56	56	56	56	56	56	66	70	70
2nd Idle Hole By-Pass Under Welch Plug		72		72	68	72	68	68	65	68	68	68	72	70	70
Idle Fuel Restriction Tube	70	70	68	70	72	74	68	68	68	68	68	70	74	74	74
Idle Air Supply Hole	45	45	50	42		52	45	45	45	48		48	48		
High Speed Adjusting Orifice	47	47	50	47	47	50	47	44	47	47	47	47	50	52	52
Idle Air Adjusting Orifice	42	42	44	42	48	48	42	48	42	42	48	42	48	54	54
Fuel Inlet Seat Orifice			48												

CARBURETOR DRILL CHART - MERC MODELS

MERC MODEL	850 (76 Cu.In	800 Rev	800 Shift	800-1 Shift	700 Rev	700 Shift	600	500	500-1	450	400	400-1
Carburetor Manufacturer Number	KA 16A	KA 10A	KA 11A	KA 14A	KA 8A	KA 12A	KB 3A	KA 13A	KA 18A	KA 17A	KA 2A	KA9A
Main Discharge Nozzle	29	29	29	29	29	31* 29▲	31	28	28	31* 29▲	29	29
Main Discharge Nozzle Cross Holes	54	54	54	54	54●	70■ 56●	60	60■ 54●	60■ 54●	70■ 56●	60	60
Internal Air Bleed Tube	65	65	65	65	65	70	55	65	65	70	55	65
1st Idle Hole By-Pass Under Welch Plug	56	56	56	56	56	50	65	55	55	55	56	55
2nd Idle Hole By-Pass Under Welch Plug; 2 Holes Side-by-Side	56	56	56	56	56	57	65	55	55	55	56	55
Idle By-Pass Large Hole, Rear under Welch Plug	48	48	48	48	50	50	50	48	44	48	50	48
Idle Fuel Restriction Tube	53ID	53ID	55ID	53ID	53ID	53ID	55ID	53ID	53ID	53ID	55ID	53ID
Idle Air Supply; 2 Holes	70	70	72	70	66	70	68	65	65	65	65	65
Idle Mixture Restriction	50	50	50	50	50	50	50	50	50	50	50	50
High Speed Fixed Jet	.069	.065	.065	.069	.061	.061	.057	.059	.059	.059	.063	.061
Idle Air Adjusting Orifice	50	50	50	50	50	50	52	50	50	50	50	50
Fuel Inlet Seat Orifice	42	52	52	52	52	52	52	52	42	42	52	52
By-Pass Hole Top of Bore	68	68	68	68	68	65	70	68	66	66	68	68

MERC MODEL	350 4-Cyl.	300	300-1	250	200 200-1	200-2	150 100	150-1	100	100 100-1-2	60 60-1
Carburetor Manufacturer Number	KB 2A	AJ 54A	KB2A	KA 15A	KA5A	KA5B	AJ 56A	KB1A	AJ 56AB	KB4A	AJ 57A
Main Discharge Nozzle	31	50	31	27	28	28	52	31	52	31	56
Main Discharge Nozzle Cross Holes	60		60	54	60	60		56		56	
Internal Air Bleed Tube	68	70	68	65	60	60	55	55	55	55	68
1st Idle Hole By-Pass Under Welch Plug	60	65	60	56	56	56	58	65	58	58	70
2nd Idle Hole By-Pass Under Welch Plug; 2 Holes Side-by-Side	60	55	60	56	56	56	55	65	55	58	60
Idle By-Pass Large Hole, Rear under Welch Plug	52		52	48	47	47		49		49	
Idle Fuel Restriction Tube	55ID	65	55ID	55ID	55ID	55ID	65	55ID	65	55ID	74‡
Idle Air Supply; 2 Holes	68		68	72	65	65	55	65		65	
Idle Mixture Restriction	50		50	50	50	50		50	55	50	
High Speed Fixed Jet	.055	.055	.055	.063	.063	.063	.057	.051	.055	.051	.045
Idle Air Adjusting Orifice	52	52	52	50	50	50	48	48	48	48	42
Fuel Inlet Seat Orifice	52	52	52	42	52	52	52	52	52	52	52
By-Pass Hole Top of Bore	70	70	70	68	65	65	72		72	65	

* Outlet ▲ Sump ■ 4 Holes, Upper ● Lower

‡ In Plug

NOTE: Absence of Figure in Square Indicates No Drill Hole Provided.

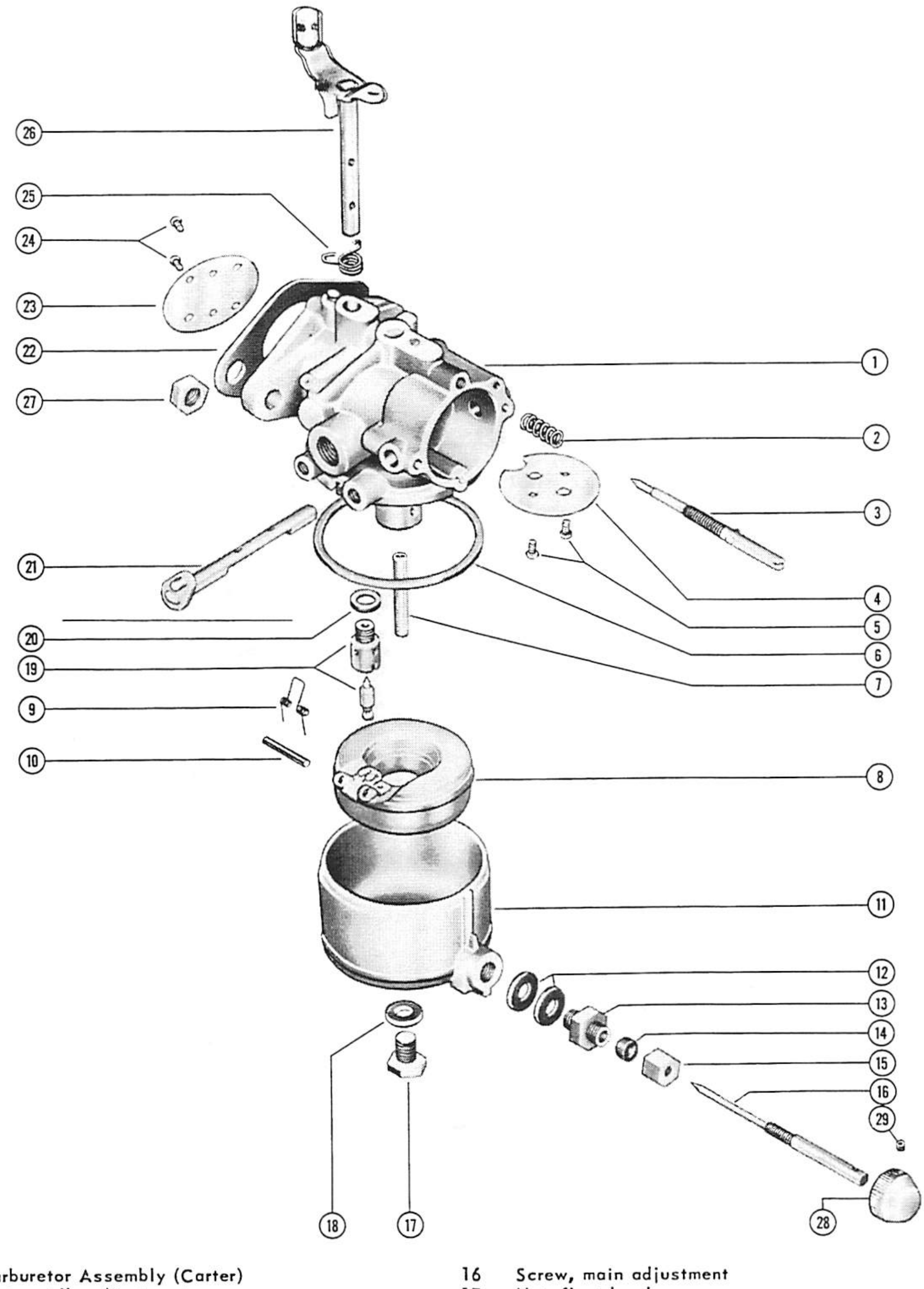
CARBURETOR DRILL CHART - MERC MODELS - Cont'd

MERC MODEL	1250SS-1	1250SS	1250SS	1250BP	1100 1100SS 1100SS-1 1000-2	1000SS-1	1000SS	1000BP	1000 1000-1	950 950SS 950SS-1	900	850 (80 Cu. In.) 850-1	800 (4-Cyl.)	650 650-1	650-2 650-3
Carburetor Mfg. No.	KD2A	KD1A	KD1B	KD1BR1	KC7A	KC14A	KA10A	KC7B1	KC1A	KC6A	KC6A	KC3A	KD4A	KC2A	KC5A
High Speed System Nozzle I.D.	23	28	28	28	22	22	22	22	28	22	22	26	25	26	22
Nozzle Cross Holes	60(6)	60(4)	60(4)	60(4)	55	55(4)	55(4)	55(4)	56	55	55	55	60(6)	55	55
Nozzle Air Bleed	.065	.065	.065	.065	55	.055	.055	55	58	.053	.053	56	.065	58	.057
Fixed Jet	.076	.082	.082	.080	.065	.059	.059	.059	.069	.051	.049	.055	.074	.069	.071
Idle System - Pickup Tube Bottom - I.D. or Restriction	59				.065	.053-.056	.053 .056	.065	52	.065	.065	52	63	52	.065
Top - I.D. or Restriction		65	65	65	50		60(2)	50	50	50	50	50		50	50
Air Bleed - Body or Tube	58	60	60	60	70	62	62	70(2)	70	68	68	68	60	70	70
Idle Adjustment Restriction - Orifice	47	50	50	50	48	48	48	48	48	48	48	48	50	48	48
Discharge Holes - In Tube															
By-Pass Holes 1st under Welch Plug	58(2)	58(2)	58(2)	58(2)	50	60(2)	53(2)	54(2)	55	47	50	55	58(2)	44	44
2nd under Welch Plug	53	54	54	54	56	53	55	55	56	56	56	56	52	1/16	1/16
3rd under Welch Plug					55	55		56(2)	50	55	55	57			
Throttle Bore - Top			68		68			68	68	68	68	68		68	68
Miscellaneous Inlet Seat	3/32	3/32	3/32	3/32	42	3/32	3/32	3/32	42	42	3/32	42	3/32	42	42
Shutter Valve- Hole(Cutoff) Side	By-Pass	By-Pass	By-Pass	By-Pass		By-Pass	By-Pass	By-Pass					By-Pass		

MERC MODEL	650-4 650SS	650-7	650-8	500-2 500-3	500-4	500-5	500-6 500SS	500-7	500-8	350 350-1 (2-Cyl.)	350-2	350-3	350-3	350-4 350-5	350-6
Carburetor Mfg. No.	KC5B	KC5C	KA11A	KA19A	KA21A	KA21B	KA21C	KA21D	KA24A	KC4A	KC8A	KC9A	KC9B	KC9C	KC13A
High Speed System Nozzle I.D.	22	22	22	28	27	27	27	27	27	24	22	22	22	22	22
Nozzle Cross Holes	55(4)	55(4)	55(4)	60* 54*	60* 54*	56	56(2)	56(2)	56(2)	55*	55*	55(4)	55(4)	55(4)	55(4)
Nozzle Air Bleed	.057	.055	.055	65	65	55	55	.052	.052	58	58	58	58	54	54
Fixed Jet	.061	.061	.061	.059	.057	.061	.065	.063	.063	.069	.069	.067	.069	.063	.061
Idle System - Pickup Tube Bottom - I.D. or Restriction	.065	.065	.065	53	60	60	.060	60	.060	52	50	.065	.065	.065	.065
Top - I.D. or Restriction	50	60(2)		50	50	50				50	50	50	50	50	50
Air Bleed - Body or Tube	70(2)	60	60	65	70	70	60	58	58	70	70	70(2)	68(2)	68(2)	68(2)
Idle Adjustment Restriction - Orifice	48	48	48	50	50	50	50	50	50	48	48	48	48	48	48
Discharge Holes - In Tube															
By-Pass Holes 1st under Welch Plug	44	53(2)	60(2)	56	53	53	50(2)	50(2)	50(2)	50	50	47	47	52	52
2nd under Welch Plug	1/16(2)	55	53(2)	56	56	1.15mm	1.15mm(2)	1.15mm	1.15mm(2)	1/16	1/16	1/16(2)	1/16(2)	54	54
3rd under Welch Plug			55	50	46	46	51	51	51		60	60	60		
Throttle Bore - Top				60	60					65	65	65	65		
Miscellaneous Inlet Seat	3/32	3/32	3/32	42	42	42	3/32	3/32	3/32	42	42	3/32	3/32	3/32	3/32
Shutter Valve-Hole (Cutoff) Side	Float	By-Pass	By-Pass				By-Pass	By-Pass	By-Pass			Float		Bottom	Bottom

MERC MODEL	200 200-1 200-2 Shift	200-3	200-4 200-5	200-6	110 110-1 -2-3-4 -5-6-7	110-8	75	60-2 60-3	60-4 60-5 60-6 60-7	60J	40	39 39-1 39-2	39-3 39-4
Carburetor Mfg. No.	KA20A	KA22A	KA22B	KA23A	KB5A	KB8A	KB9A	KB6A	KB6B	KB6B	KB10A	KB7A	KB7B
High Speed System Nozzle I.D.	28	28	28	28	31	1/8	32	32	32	32	30	31	30
Nozzle Cross Holes	60	60	60(2)	60(2)	60	60(4)	58(2)	72* 65*	72* 58*	58(2) Lower 72(4) Upper	65(4)* 55(4)●	60* 60	55(2)
Nozzle Air Bleed	60	60	56	56	.054	60	65	68	.054	.0537	.060	53	.060
Fixed Jet	.061	.059	.063	.063	.049	.049	.034	.045	.045	.045	.036	.043	.036
Idle System - Pickup Tube Bottom - I.D. or Restriction	52	50	.065	.065	55	.053-.056	.053-.056	55	74	74	.053	70	70
Top - I.D. or Restriction	50	50		50	70			74	74			70	
Air Bleed - Body or Tube	68	68	60	60	50§	65	65	50§	43	43	65	50§	43
Idle Adjustment Restriction - Orifice	50	50	50	50	42	52	56	42	42	42	50	40	40
Discharge Holes - In Tube						65(2)	65(2)				60(2)		
By-Pass Holes 1st under Welch Plug	56	56	50	50	70	66(2)	68(2)	74	74	60	62(2)	70	60
2nd under Welch Plug	56	56	68	68	62	56	68	60	60	74	70	60	70
3rd under Welch Plug	47	47	55	55									
Throttle Bore - Top	65	65			72								
Miscellaneous Inlet Seat	42	42	3/32	3/32	52	52	52	52	52	52	52	52	52
Shutter Valve-Hole (Cutoff) Side			By-Pass	By-Pass	Bottom	By-Pass	By-Pass		Bottom	Bottom	By-Pass		Float
Air Relief to Bore								46	46	46			

** 4 Holes, Upper* ● *4 Holes, Lower* § *1 Hole, Front of Venturi*



1	Carburetor Assembly (Carter)	16	Screw, main adjustment
2	Spring, idle adjustment screw	17	Nut, float bowl cover
3	Screw, idle adjustment	18	Gasket, float bowl nut
4	Shutter, choke	19	Inlet Needle & Seat
5	Screw, choke shutter fastening	20	Gasket, inlet needle and seat
6	Gasket, bowl ring	21	Choke Lever & Shaft Assembly (Not as Illustrated)
7	Nozzle, fuel discharge	22	Gasket, carburetor to crankcase
8	Float & Lever Assembly	23	Shutter, throttle
9	Spring, float	24	Screw, throttle shutter fastening
10	Pin, float lever	25	Spring, throttle return
11	Cover, float bowl	26	Throttle Shaft & Lever Assembly (Not as Illustrated)
12	Gasket, main adjustment screw gland	27	Nut, carburetor mounting stud
13	Gland, main adjustment screw	28	Knob Assembly, main adjustment screw
14	Packing, main adjustment screw	29	Screw, knob to main adjustment screw (#10)
15	Nut, main adjustment screw		

Figure 7. Pressure Feed Carburetor and Choke Assembly (Mark 20H-55H)

CARTER CARBURETOR -- MARK 20H AND 55H

Disassembly

1. Remove carburetor from engine.
2. Remove high speed adjusting needle, packing nut and packing.

   NOTE: Scribe a mark on body and bowl for alignment in reassembly.
3. Remove bowl nut, gasket and bowl.
4. Remove float pin, float, spring, needle and needle seat.
5. Check float for dents, leaks and wear on float lip or in float pin holes.
6. Remove bowl ring gasket and idle adjustment screw and spring.
7. Detach high speed discharge nozzle. *(Note: Do not remove low speed jet tube.)*
8. Remove throttle valve screws, valve and shaft and lever assembly.
9. Clean all parts with solvent. Soak in carburetor or carbon remover solution if extremely dirty, being certain that all gum accumulation is removed from bore, especially where throttle valve sets in casting.
10. Blow out all passages with compressed air. Replace all worn or damaged parts. Always use new gaskets.

Reassembly

1. Install throttle shaft and valve. Valve must be installed with trademark "C" on side toward idle port when viewing from flange side. Always use new screws.
2. With valve screws loose and throttle lever setscrew backed out, seat valve by tapping lightly with a small screwdriver. Hold in place while tightening screws.
3. Install nozzle, being sure that it seats in casting.
4. Install needle seat, spring, needle, float and float pin.
5. Set float level with carburetor casting inverted, float resting lightly against needle in its seat. There should be 3/32" clearance on Mark 20H (no clearance on Mark 55H) between outer surface of casting and free end of float (side opposite needle seat). Adjust by bending lip of float. (Figure 8)
6. Attach bowl ring gasket, bowl (line up scribe marks), bowl nut gasket and bowl nut and tighten securely.
7. Install high speed adjusting needle, packing nut and new packing.
8. Turn needle in until it just seats in body, then turn back out 1½ turns.

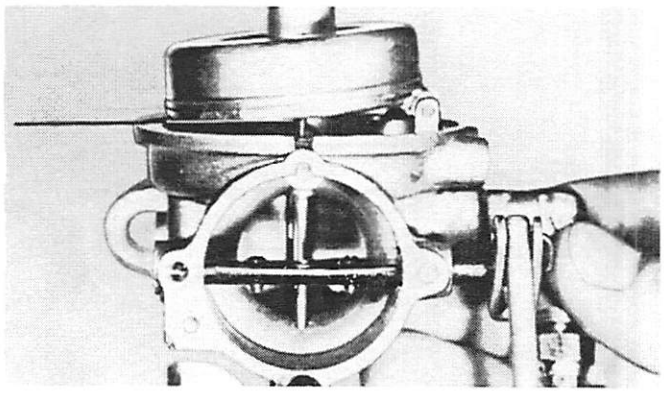


Figure 8. Adjusting Carburetor Float Level, Mark 55H

9. Install idle adjusting screw finger tight, then back out approximately 1¼ turns. Do not use pliers or screwdriver, as it may damage idle screw.
10. Install carburetor on engine and make idle and high speed adjustments as necessary.

Miscellaneous Service

A. Carburetor Return Spring and Clip for Mark 20H

Throttle shutter on Mark 20H carburetor has easier return to closed position, if it is equipped with a throttle return spring, by twisting the idle screw end of the spring same as on the opposite end where it is attached to the throttle shaft lever. (Figure 9) Replace the washer on idle adjustment screw with clip.

A new carburetor inlet needle and seat (1398-1174) is used as a replacement on the Mark 20H carburetor. It gives more satisfactory operation at high speed, thus preventing the foaming condition previously experienced on some motors. (Figure 10)

B. New Style Inlet Needle and Seat, Mark 20H

Installation of the new inlet needle and seat necessitates cutting off a portion of the float tang (Figure 11) or replacement with a new style float (1398-1172). (Figure 10)

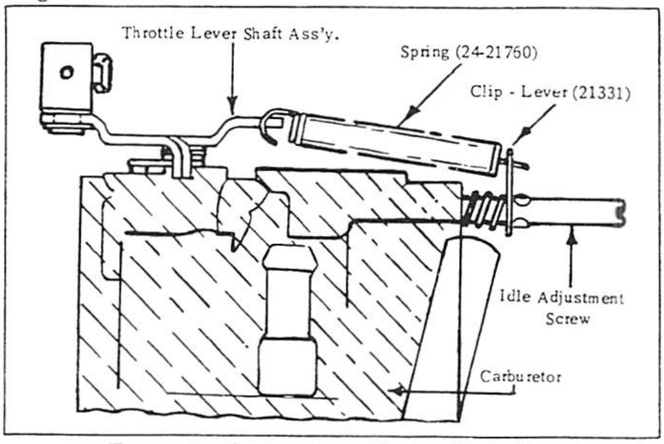


Figure 9. Spring and Clip for Mark 20H

Rework the present float as follows:

1. Cut forked tang off at lower bend, as shown in Figure 11.
2. File smooth with fine-cut file and polish with fine crocus cloth.
3. Reset float level with carburetor casting inverted, float resting lightly against needle in its seat.
4. There should be a 3/32" clearance between outer surface of casting and free end of float (side opposite needle seat). Adjust by bending lip of float. (Figure 12)

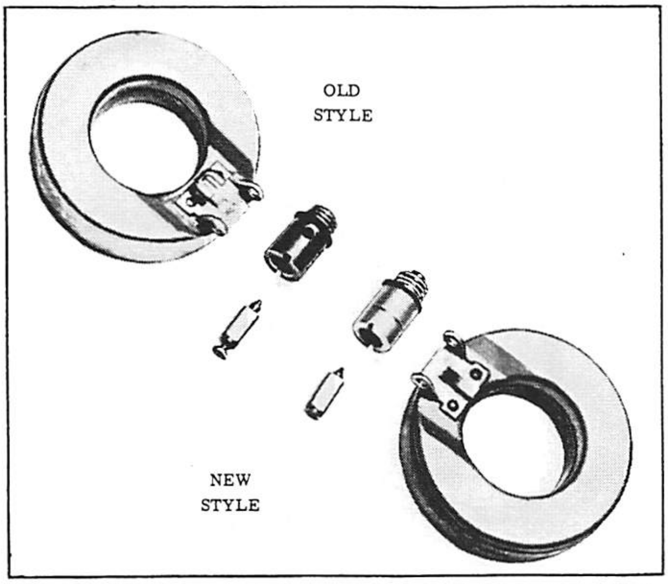


Figure 10. New Style Inlet Needle and Seat, Mark 20H

C. Float Adjustment, Mark 55H

The first production Mark 55H motors have the carburetor float level set at 3/32" clearance between the outer surface of the carburetor casting and free end of float (side opposite needle and seat). In rough water, however, the carburetor functions better with the float set tangent (in line) with the edge of the float bowl cover. Reset float level with carburetor casting inverted and lip of float lever resting lightly against inlet needle. (Figure 8) There should be no clearance between outer surface of float bowl cover and free end of float. Sight across bowl cover for correct setting. Adjust by bending lip.

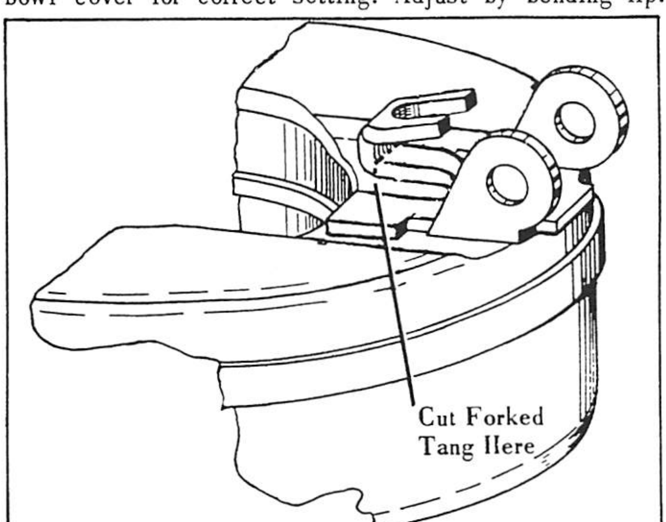


Figure 11. Location of Forked Tang

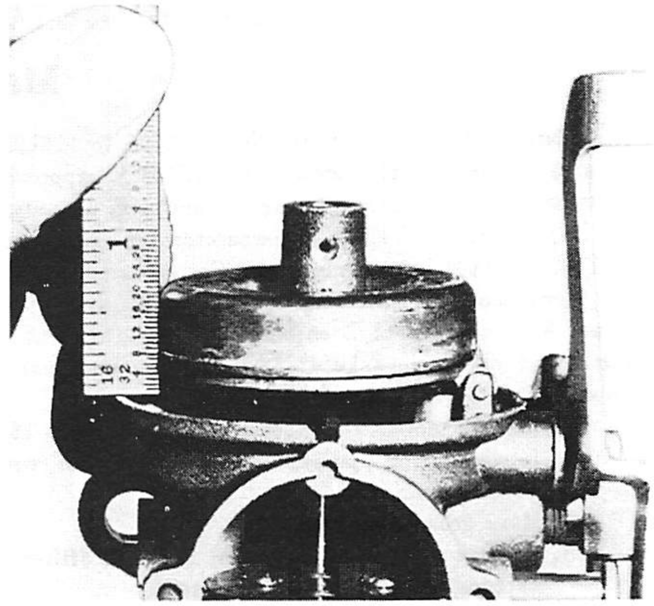


Figure 12. Float Clearance

Note: If a momentary lean-out or "miss" is noticed at high speed, it may be because the float assist spring has too much tension. Bend the spring to decrease tension.

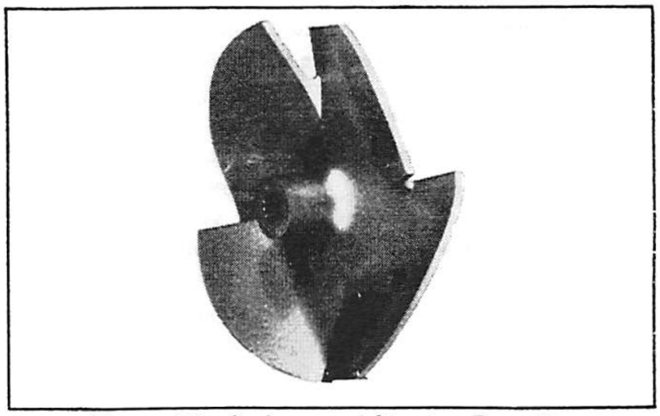


Figure 13. Carburetor Adjusting Propeller

D. Test Wheels (Refer to Chart in Section IX.)

Adjustment of carburetors has been made easier -- while running at full throttle -- with the introduction of Test Wheels. These wheels, which act as a govenor, designed to allow the motor to run up to 5500 RPM (hydros up to 7000 RPM), allow carburetors to be adjusted accurately and easily at the dock without the boat moving. (Figure 13)

After adjustments are made, replace the Test Wheel with the Quicksilver propeller and the unit is ready for operation.

CARBURETOR CONVERSION

Mark 55H

Mark 55H engines, Serial No. 1260725 to 1261024 inclusive, were manufactured with A.P.B.A. approved new large-throat Tillotson carburetors and with new-style "flat top" pistons. Tillotson carburetors in conversion kit (1333-1609A2) -- to replace the Carter carburetors -- have elongated stud mounting holes to adapt directly to engine. Kit consists of 2 carburetors, choke assembly, throttle and bracket, gaskets and mounting nuts. Install by completing the following (Figure 13A):

1. Drill a choke rod hole in top cowl 1-13/16" forward from present choke rod hole with 15/32" drill.
2. Move grommet to new hole.
3. Remove old bowl type filter, fuel line (filter to carburetor) and Carter carburetors.
4. Remove fittings and fuel lines from side of both Carter carburetors.
5. Remove filter from crankcase.
6. Remove flex elbow from street el and street el from tee.
7. Screw flex elbow into tee fitting and screw this assembly into bottom carburetor.
8. Place other flex fitting in top carburetor.
9. Screw short fuel line into tee of bottom carburetor and connect flex fitting of top carburetor.
10. Adjust angles of fittings to suit. Tee on bottom carburetor will be nearly vertical.
11. Place fuel line from pump into bottom carburetor flex fitting.
12. Remove double carburetor pickup from magneto and substitute pickup 23603A1.
13. Set magneto throttle pickup to contact carburetor pickup bracket at approximately 1000 RPM.
14. Reset timing to .320" BTDC or to previous setting.

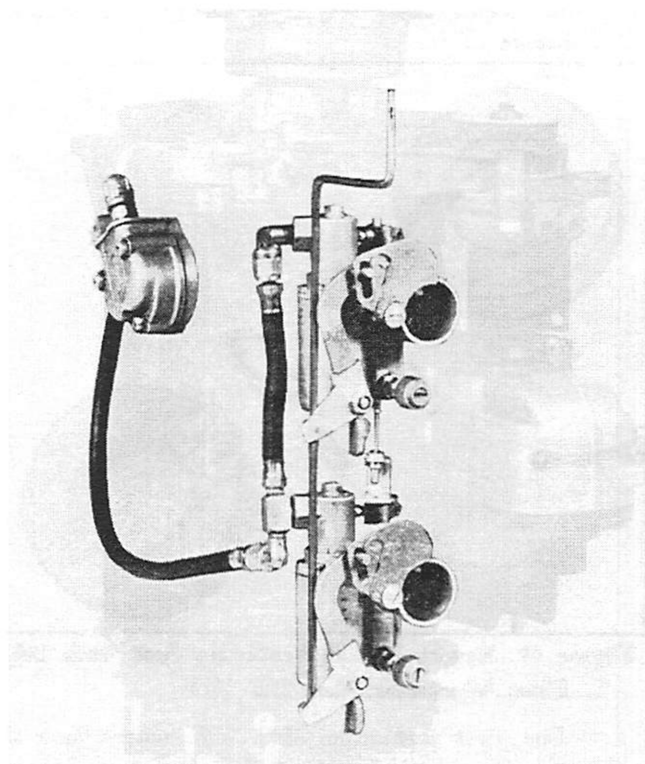


Figure 13A. Mark 55H Conversion Kit

Mark 20H

After removing starboard cowl and starter housing, complete the following:

1. Loosen throttle wire lock screw on carburetor and disconnect throttle wire.
2. Remove port cowl, disconnect fuel lines to pressure valve cover and to carburetor and place aside for time being.
3. Remove carburetor by disconnecting 2 nuts.
4. Remove pressure valve cover by loosening 3 screws and lockwashers.
5. Remove 2 screws from fuel tank pressure stop reed and plate and screws which hold down swivel pin.
6. Install new fuel line check unit adaptor bracket (29498) over swivel pin and secure with 2 new screws (10-29197) in drive shaft housing.
7. If necessary, assemble parts of new fuel pump assembly.
8. Place check valve gaskets in fuel pump seats and set check valve discs in position. Inlet check valve is identified by its protruding tip in casting. Flat side of check valve seats over this tip. Outlet check valve is set in opposite (flat end up) so tension is against valves.
9. Position retainer on check valves in fuel pump housing and secure with 2 screws.
10. Attach new nipple (22-23595) and new regular 90° elbow (22-24690) to fuel pump tapped hole marked "IN".
11. Connect new short fuel line (32-29194) between new reducing elbow (22-25354) in check unit assembly (22831A1) and regular 90° elbow (22-24690) on fuel pump.
12. Install new male-to-male elbow (22-22947) in other tapped hole of fuel pump.

NOTE: Use a light coat of Aviation-Form-A-Gasket No. 3 or equivalent on all brass fitting threads. Be sure that none seeps into assemblies or fuel lines.

13. Place gasket (thin) on fuel pump body, followed by neoprene diaphragm and another gasket, fuel pump cover and cover to crankcase gasket. Be sure that gasket holes align with cover holes.

14. Secure fuel pump assembly to crankcase with 3 screws.
15. Install check unit adaptor to bracket over swivel pin and secure with 2 new screws (10-28714).
16. Install new carburetor with filter (1333-1609A4) on engine, using new gasket (27-20478).
17. Connect new long fuel line (32-23837) to fuel filter, then to fuel pump outlet.

IMPORTANT: Be sure that all fuel line connections are tight!

18. Remove 2 screws and connector retainer on outside of port side cowl.
19. Remove 2 screws, receptacle connector, fuel lines and filter from inside port cowl.
20. Reassemble port cowl and starter housing to powerhead.
21. Connect throttle wire to carburetor.

NOTE: Operate engine without starboard cowl and shield. If a Mark 20H, equipped with carburetor conversion kit, has a tendency to flood or "overload" when running in choppy water, it can be corrected by installing a 1399-1138 inlet needle and seat in carburetor and replacing fuel pump cover (23008, with only one pressure hole). This reduces fuel pump pressure to carburetor. Any tendency to run lean at part throttle in turns can be corrected by enriching low speed needle valve setting to approximately 2½ turns open and by adding a spray shield in front of carburetor.

NOTES

CARBURETOR ASSEMBLIES

2 - Cylinder Engines

1. Removal

   a. Remove hex head nuts from mounting studs.
   b. Pull carburetor free.
   c. Remove choke lever and rod, if necessary.
   d. Remove fuel shut-off valve, choke shutter and spring, if necessary.

2. Replacement

   a. Place new carburetor gasket on crankcase plate.
   b. Install carburetor by slipping over studs and securing with 2 washers and nuts. Tighten with open end wrench.
   c. Replace throttle arm on carburetor with screw to hold in place.
   d. Replace choke rod on carburetor and secure with cotter pin.
   e. Replace choke shutter by inserting slot over choke rod arm linkage and replace screw (round head slotted).
   f. Replace tension spring around screw and then tighten.
   g. Replace fuel shut-off valve (on older models) by inserting assembly (brass "T" and valve) into carburetor and tighten with wrench to secure gas-tight fit. Do not over-tighten, or threads may be stripped.

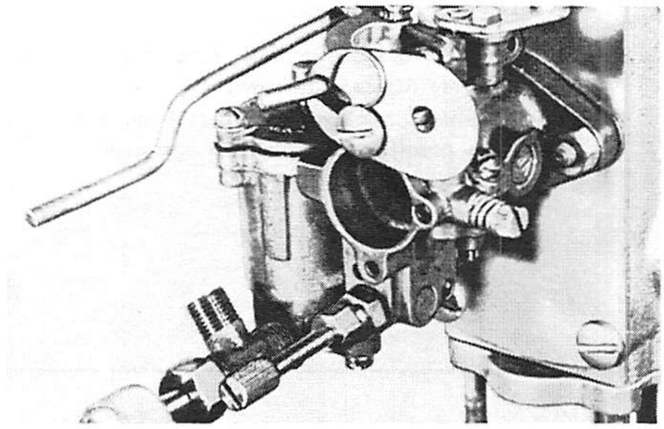


Figure 14. Carburetor Assembly Installed on 2-Cylinder Mark 7 Engine

4-and-6 Cylinder Engines

1. Removal

   a. Remove self-locking nuts (crimped edge) in order to remove carburetors and choke assemblies complete from crankcase.
   b. Remove choke assembly.
   c. Pull cotter pins from choke lever pivot pins.
   d. Remove choke rod retaining spring from high speed adjusting screw.
   e. Remove chode rod and choke levers.
   f. Unscrew choke lever pivot pins with 7/16" wrench.
   g. Remove choke shutters and spring.
   h. Remove throttle pickup brackets and throttle pickup levers complete by removing screws which secure their carburetors.
   i. Pull entire assembly down, and it will slide off throttle shafts.

2. Replacement

Reassemble carburetors as a unit before attaching to engine crankcase.

   a. Install throttle pickup bracket and throttle pickup lever with mounting screw on lower carburetors, sliding throttle pickup lever into top carburetor's throttle shutter shaft slot.
   b. Replace choke shutters and springs by screwing in choke lever pivot pins.
   c. Replace choke levers and choke lever rod to choke lever pivot pins and insert cotter pins to hold to lever pivot. Be sure to insert choke lever pins into choke springs and slot in choke shutter while installing on pivot pin.
   d. Connect choke rod, positioning spring to choke rod pin and secure to carburetor adjustment screw.
   e. Install carburetor flange gaskets.
   f. Attach assembly to crankcase of engine.

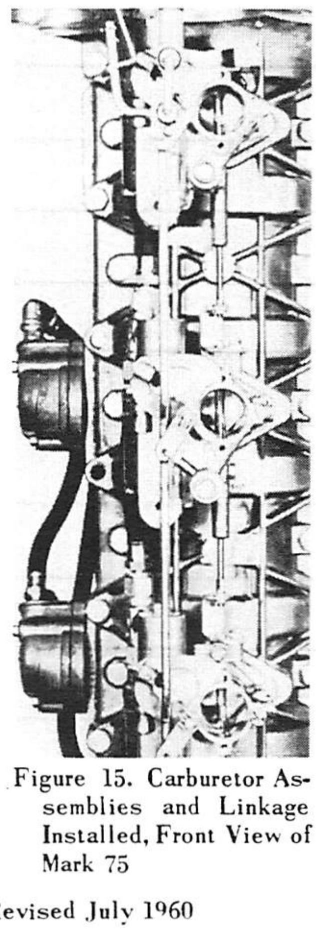


Figure 15. Carburetor Assemblies and Linkage Installed, Front View of Mark 75

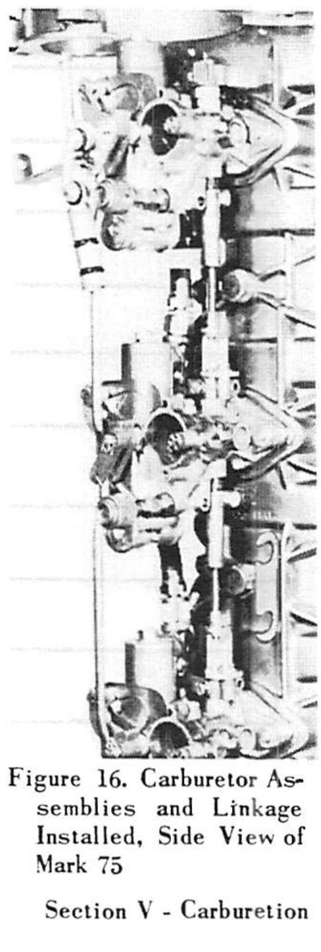


Figure 16. Carburetor Assemblies and Linkage Installed, Side View of Mark 75

MODEL KA CARBURETOR
Pressure Type
Disassembly

FUEL FILTER

1. Remove 3/8" cap screw and gasket from fuel filter cover.
2. Detach filter housing, gasket and filter element and gasket. (Figure 1)

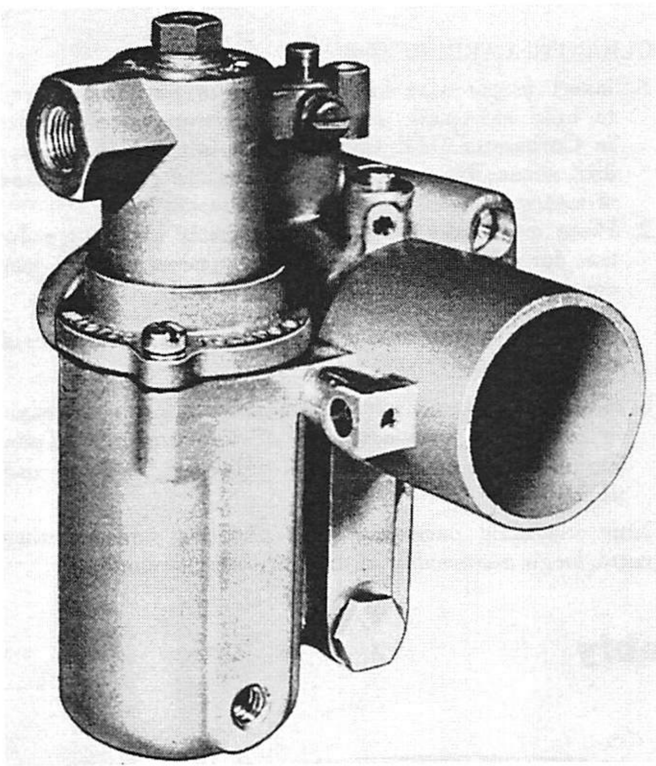


Figure 1. Model KA Carburetor

FLOAT

1. Remove 2 screws which hold float bowl cover and gasket to carburetor body.
2. Lift off cover and gasket.
3. Remove lower (primary) float lever pin and lever, allowing upper (secondary) lever to pivot back, thus freeing inlet needle.
4. Pull out inlet needle.
5. Remove inlet needle seat (right hand thread) with a 3/8" socket wrench. Do not lose small gasket beneath inlet seat.
6. Remove float by tipping carburetor upside down.
7. Remove welch plug, which covers idle by-pass chamber, by tapping with a sharp center punch, then prying off.

IDLE RESTRICTION TUBE

Unscrew idle restriction tube, which extends inside main discharge nozzle, from top carburetor. (Figure 2) Be sure not to lose small restriction tube gasket.

IDLE ADJUSTMENT SCREW

Unscrew idle adjustment screw and remove spring.

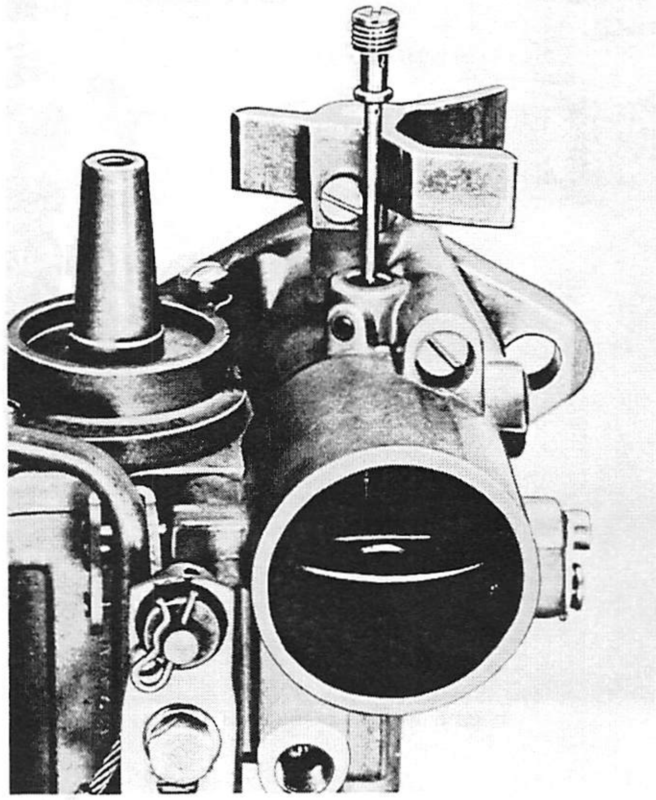


Figure 2. Removing and Installing Idle Restriction Tube

MAIN DISCHARGE NOZZLE

Remove discharge jet plug screw and then, with a screwdriver of exact size, unscrew high speed discharge nozzle.

FIXED HIGH SPEED JET

1. Remove brass hex head plug and gasket from carburetor body with 3/8" wrench. (Figure 3)

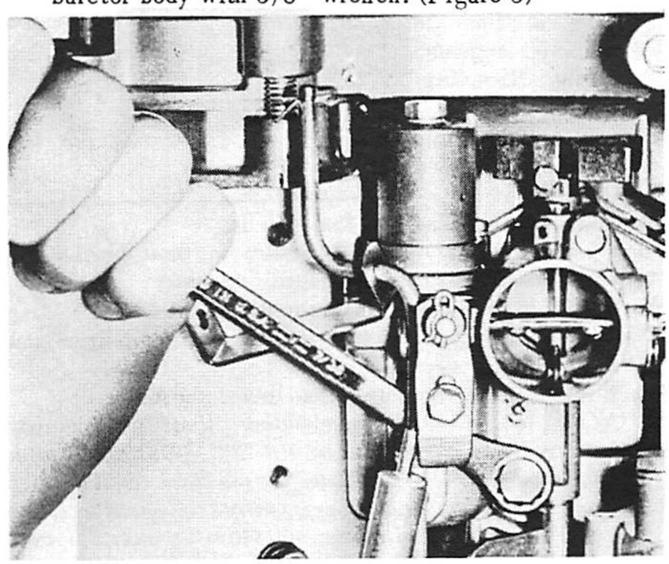


Figure 3. Removing Plug

2. Remove fixed jet and gasket with Fixed Jet Screwdriver (C-91-29795) or standard screwdriver of exact size. (Figure 4)

THROTTLE SHUTTER

1. Remove 2 screws and lockwashers which secure throttle shutter to carburetor throttle shaft.

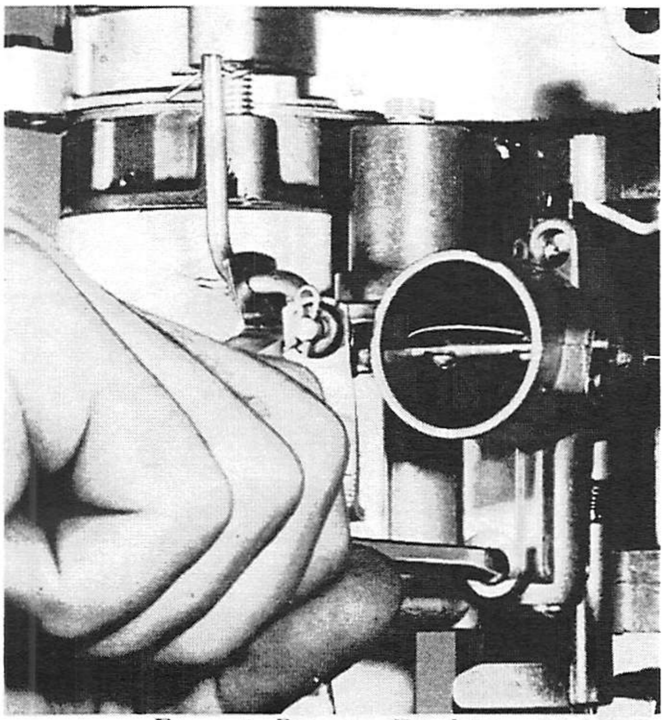


Figure 4. Removing Fixed Jet

2. Pull throttle shaft out from top of carburetor.
3. Pull throttle shutter return spring out of carburetor body.
4. Remove lead plugs (shot) with sharp punch.

CHOKE SHUTTER

1. Remove 2 screws and lockwashers which secure choke shutter to choke shutter shaft.
2. Pull shutter out with long nose pliers.
3. Remove screw and lockwasher which holds choke shutter shaft retaining clip.
4. Pull out choke shaft.

CLEANING CARBURETOR

1. Insert proper size drills, held in a pin vise (a tool to hold extremely small drills), in passages. Refer to Carburetor Drill Chart in this section for correct drill sizes. Be sure that passages are clean and free of restrictions which might impair operation.
2. Place carburetor body in a carburetor cleaning solution for a short period of time to remove all dirt, gum and varnish which may have accumulated.

(Note: Carburetor cleaners are available through local automotive supply stores.)

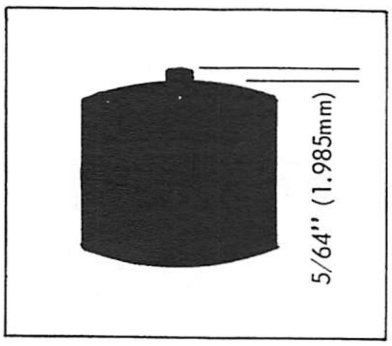
3. After removing carburetor from cleaner, rinse thoroughly in clean solvent and blow off with compressed air. Be sure to blow through all passages, orifices and nozzles.

After cleaning carburetor and checking and cleaning parts, begin reassembly in the following sequence:

Reassembly

FLOAT

1. Check for deterioration, saturation and loss of sealer.
2. Check that float spring measures approximately 5/64" (1.985mm) from center of face of float to end of exposed spring. (See figure, right.)
3. Check that spring has not been stretched.



4. Place float in bowl on float needle.
5. Place inlet needle seat gasket in float bowl cover and thread inlet needle securely in place.
6. Set inlet needle in seat (neoprene).
7. Place upper (secondary) float lever in position and insert float lever pin.
8. Replace lower (primary) float lever and pin.
NOTE: On inverted assembled float bowl cover, primary lever should gauge 13/32" (10.319mm) (plus or minus 1/64" [0.397mm]) from face of shoulder. Bend secondary lever to get correct dimension. (Figure 5) Be sure needle does not stick in seat. Tip unit upright, and needle should move freely on actuating lower (primary) lever.

9. Install new gasket on float bowl cover and replace on carburetor float bowl, securing with 2 screws and lockwashers.

FUEL FILTER

1. Install fuel filter gasket, fuel filter element, another gasket and filter bowl cover.
2. Replace filter bowl cover gasket and secure filter on carburetor with 3/8" cap screw.

METRIC CONVERSION: 1" Is Equal to 25.4mm (Millimeters) or 2.54cm (Centimeters)

Figure 5. Gauging Primary Lever

CHOKE SHUTTER

1. Insert choke shutter shaft into carburetor body from right side.
2. Secure opposite end with choke shaft retaining clip, screw and lockwasher.
3. Insert choke shutter into shaft and secure with 2 screws and lockwashers.
4. Replace all lead plugs with a recessed tool to provide a neat and strong installation.

THROTTLE SHUTTER

1. Insert throttle shaft return spring in recess at lower end of carburetor.
2. Insert throttle shaft into top of carburetor and into return spring slot. Be sure to have one coil of spring turned to allow sufficient return of throttle shutter to closed position from spring tension.
3. Insert throttle shutter, "V" portion to bottom of carburetor throat, and secure with 2 screws and lockwashers.

MAIN DISCHARGE NOZZLE

1. Insert into receptacle at bottom of carburetor and, with proper size screwdriver, thread in securely.
2. Thread discharge plug into carburetor.

NOTE: If a Merc 800 KA-10A carburetor runs lean at high speed, the idle pickup tube--which extends inside the main discharge nozzle--may not be touching the front side of main discharge nozzle. (Figure 6) Check that idle tube is straight by removing and rolling on a flat surface. If it is found to be bent, it can be straightened and used as long as it is not pinched or kinked. Other means which may be used to check tube for proper location are: a) Pull tube forward with hook made from wire. If tube can be felt to move, it must be corrected. b) Remove tube and look for wear pattern caused from touching main nozzle.

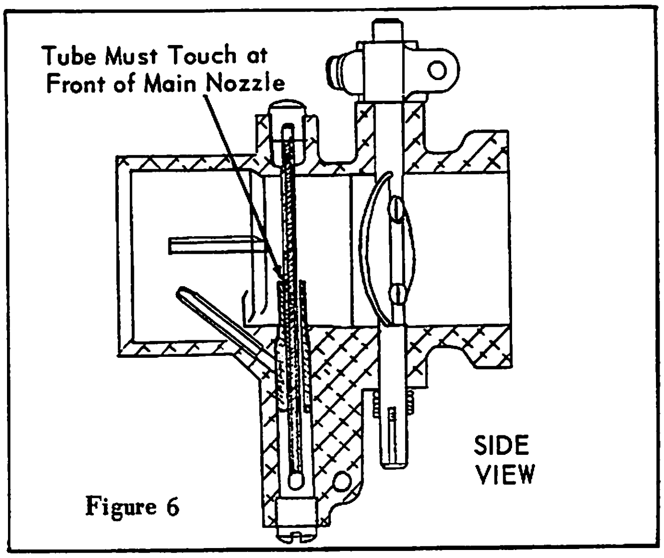


Figure 6

FIXED HIGH SPEED JET

1. Place gasket on correct fixed jet and insert jet (from chart following) into carburetor. Use Jet Installation Tool (C-91-29795) to fit jet exactly.
2. Place gasket on 3/8" brass hex head plug and secure plug with wrench.

IDLE ADJUSTMENT SCREW

Place spring on idle adjustment screw and thread into carburetor.

IDLE RESTRICTION TUBE

1. Place gasket on idle restriction tube and insert into top of carburetor. (Figure 2)
2. Insert new welch plug over idle by-pass chamber and tap center of plug lightly to hold plug in place.
3. Seal with Liquid Neoprene (C-92-25711)

This completes assembly of the Model KA carburetor. Reinstall on engine.

Engine Model	Jet Sizes for Elevations						
	Up to 4000'	4000-7000'	7000-10000'	Up to 2500'	2500-5000'	5000-7500'	7500-10000'
Merc 1250SS	.082"	.080"	.0785"				
Merc 1100SS-1100	.065"	.063"	.061"				
Merc 1000SS(1968)	.059"	.057"	.055"				
Merc 1000 (1965)	.065"	.063"	.061"				
Merc 1000	.069"	.067"	.065"				
Merc 950	.051"	.049"	.047"				
Merc 950SS-900	.049"	.047"	.045"				
Merc 850 (90 Cu. In.)	.055"	.053"	.051"				
Merc 850-800* (Power Dome				.069"	.067"	.065"	.063"
Merc 800*				.065"	.063"	.061"	.059"
Merc 700-400				.061"	.059"	.057"	.055"
Merc 650 (1967-68)	.061"	.059"	.057"				
Merc 650	.069"	.067"	.065"				
Merc 600				.057"	.055"	.053"	.051"
Merc 500 (1966 ● -68)	.063"	.061"	.059"				
Merc 500(1967)	.065"	.063"	.061"				
Merc 500 (1965-66▲)	.057"	.055"	.053"				
Merc 500*-450				.059"	.057"	.055"	.053"
Merc 500*	.059"	.057"	.055"				
Merc 350-200 (1967-68)	.063"	.061"	.059"				
Merc 350 (2-Cyl.)	.069"	.067"	.065"				
Merc 300				.055"	.053"	.051"	.049"
Merc 250-200 (Auto. Trans.)				.063"	.061"	.059"	.057"
Merc 200 (Gear Shift)	.061"	.059"	.057"				
Merc 150-100*				.051"	.049"	.047"	.045"
Merc 110				.049"	.047"	.045"	.043"
Merc 100*	.055"	.053"	.051"				
Merc 60	.045"	.043"	.041"				
Merc 39(1967-68)	.036"	.034"	.032"				
Merc 39	.043"	.041"	.039"				
Mark 78-78A-58-58A-28A				.063"	.061"	.059"	.057"
Mark 75A-55A-35A				.055"	.053"	.051"	.049"
Mark 28				.065"	.063"	.061"	.059"
Mark 15A				.057"	.055"	.053"	.051"

**Where duplicate model numbers are shown, refer to "Carburetor Manufacturer Number" in Carburetor Drill Charts on PP 11-12 for different style carburetors.*

METRIC CONVERSION:

1" (Inch) Is Equal to 25.4mm (Millimeters) or 2.54cm (Centimeters); 1' (Foot) Is Equal to .3048m (Meter); 1 Cu. In. (Cubic Inch) Is Equal to 16.387cm^3 (Cubic Centimeters).

NOTE: Jet size recommendations are intended as a guide (like a propeller chart). Try size larger or smaller if in doubt.
No change in spark advance is recommended for elevation operation. Propellers of lower pitch should be used at high elevations to allow proper engine RPM.

● Serial No. 2010163 and Up
▲ Serial No. 2010162 and Below

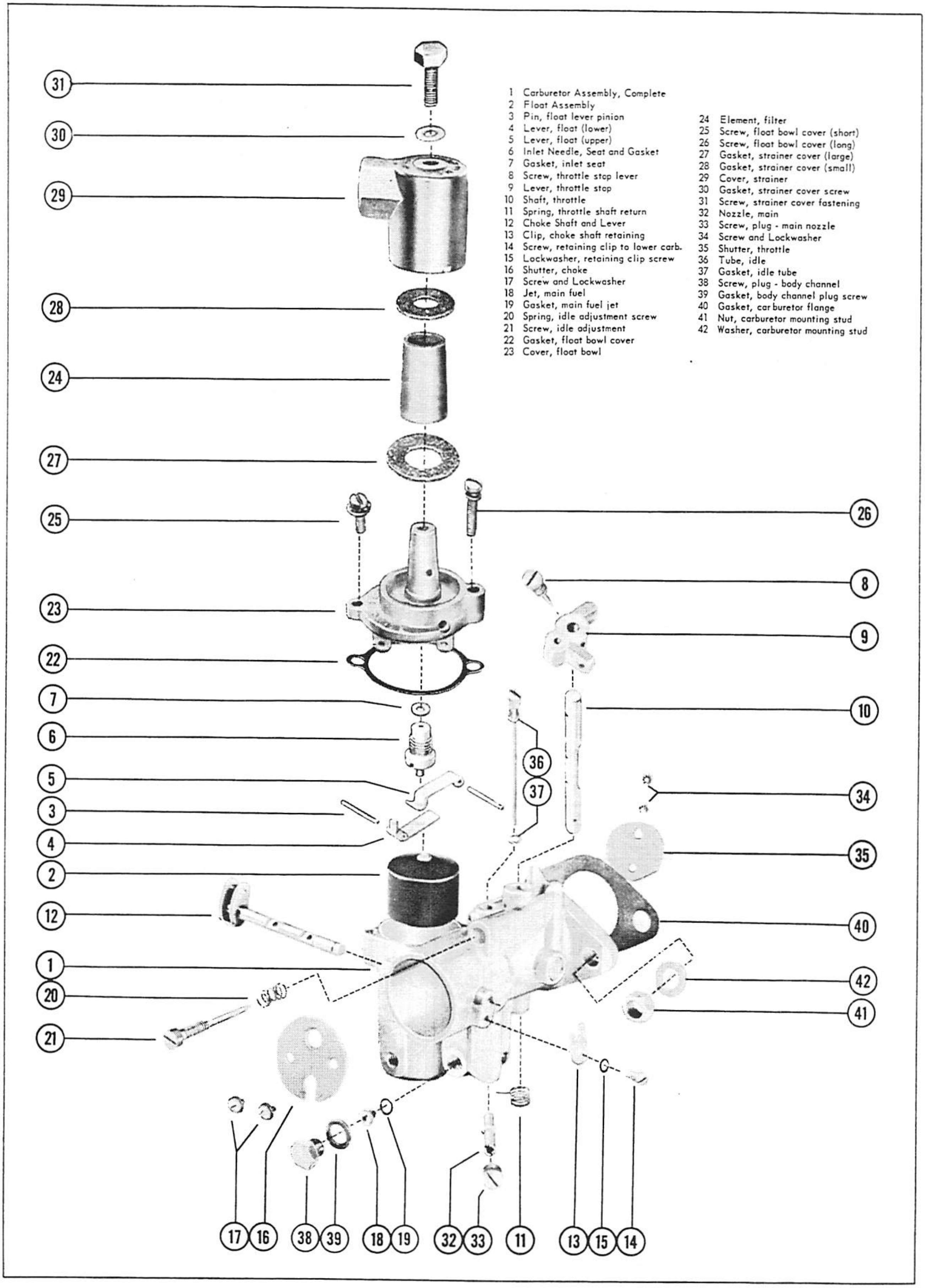
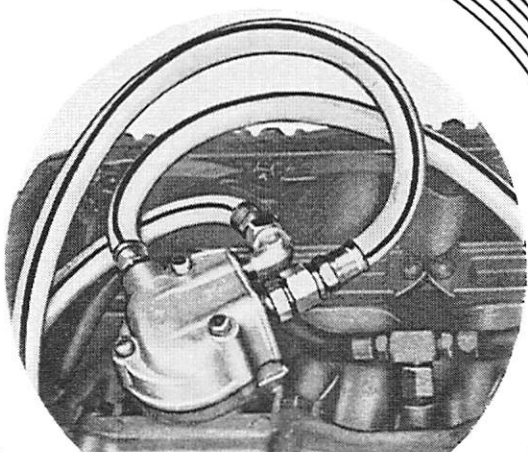


Figure 6. KA (Fixed Jet) Carburetor Assembly

section VI

fuel system



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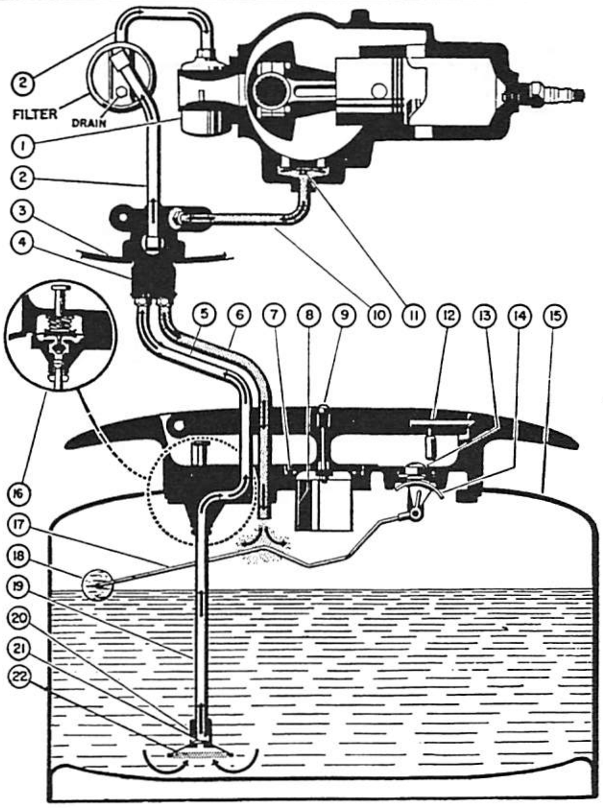
PRESSURIZED FUEL TANK

A. SCHEMATIC FUEL FLOW

1. Schematic flow of fuel is conducted thru component parts of fuel system. (Figure 1)



1 Carburetor
2 Fuel line, filter to carburetor
3 Bottom cowl
4 Twist connector
5 Fuel line, tank to twist connector
6 Air line, tank to twist connector
7 Seal
8 Extension tube, filler opening
9 Pressure relief valve
10 Air line, crankcase to connector
11 Pressurized valve, crankcase
12 Release latch
13 Magnifying lens
14 Graduated sector
15 Remote fuel tank
16 Priming pump
17 Float arm
18 Float
19 Fuel pick-up tube
20 Disc filter
21 Check calve
22 Strainer

Figure 1. Pressure Fuel System

2. Carburetors (1) are connected to fuel tank (15) thru fuel filter by fuel lines (2 & 5).
3. Fuel flow from tank to carburetors is induced by pressure transmitted from crankcase to air space above fuel line level via air line (10), running from pressurized valve (11) to twist connector (4) to top of fuel tank (15).
4. For starting, initial fuel flow to carburetors is induced by hand-operated priming pump (16).
5. Disc filter (20) is incorporated in bottom of fuel pick-up tube (19).
6. Fuel level is indicated by graduated sector (14) actuated by float (18) on arm (17).
7. Pressure relief valve (9) in center of carrying handle permits relieving pressure when necessary.
8. Check valve in twist connector (4) permits disconnecting fuel-air line without loss of tank pressure.
9. Latch (12) releases hinged portion of carrying handle so that it can be raised to uncover filler opening.
10. Seal (7) prevents pressure leakage from filler opening during operation.
11. Filler opening extension tube (8) prevents overfilling.
12. Magnifying lens (13) is provided to make fuel gauge graduations more easily readable.
13. Check valve (21) is essential to operation of priming pump (16).

B. PRIMING PRESSURIZED FUEL TANK

1. On initial priming of 6 gal. (22.7 liters) pressurized fuel tank, and after line is filled with fuel, pressure valve will remain in upstroke position. (Figure 3)

   NOTE: On early models of 6 gal. pressurized tank, priming was done by pressing down on carburetor priming plunger. On all models after this (pressure and early vacuum type), priming is done by pulling up on plunger. (See Para. "D", following, for conversion of old to new type.)

2. Pressure will build up in fuel tank when motor begins to run.
3. Initial fuel consumed and pressure being built up will cause primer regulator valve to drop down and allows fuel to enter thru strainer inlet in tank. (Refer to item 22 in Figure 1.)
4. When fuel pressure reaches 2¾ to 3½ lbs. per sq. in. (psi) (.193 to .245 kgs/sq. cm), pressure against bottom of primer diaghragm assembly causes it to rise.
5. Primer regulator valve with regulator valve "O" ring attached to primer diaphragm causes primer regulator valve to rise and seat in primer cover, thus sealing off flow of fuel.
6. Further flow of fuel to motor is stopped until fuel pressure in line to motor decreases. This allows regulator valve to again reopen fuel flow.

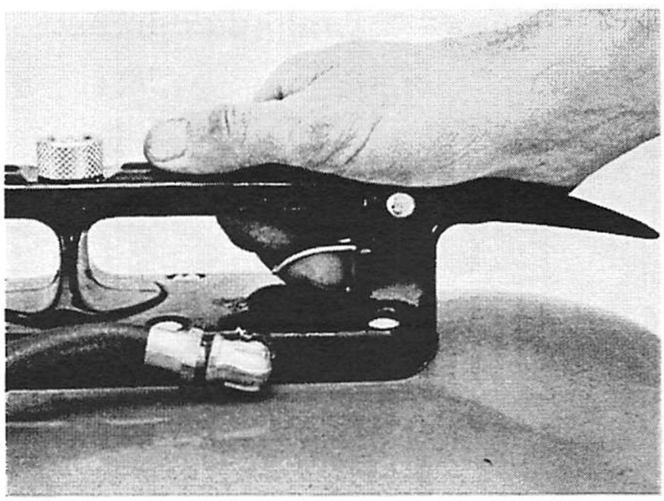
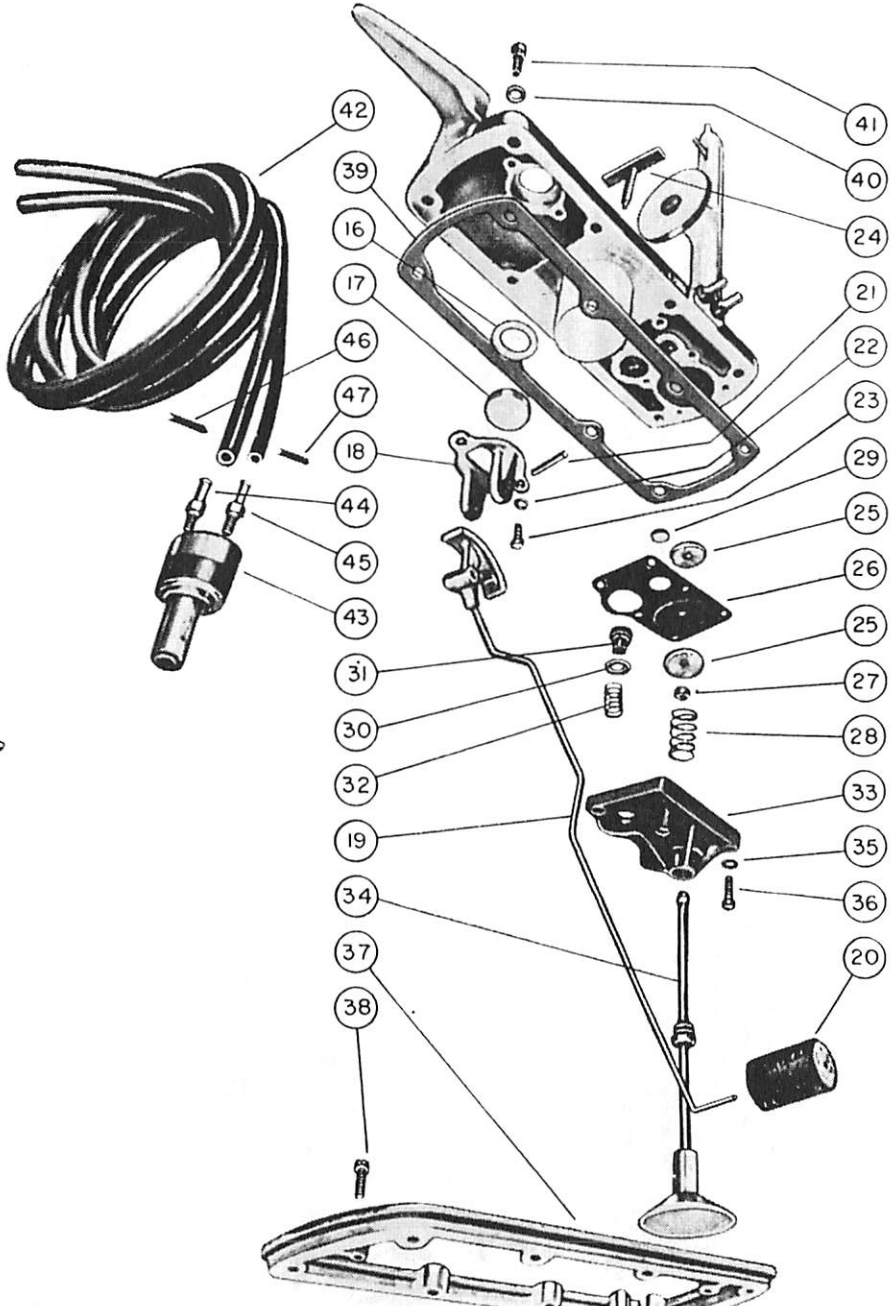


Figure 3. Priming Remote Fuel Tank (Early Model with Up-Stroke to Prime)

1 Cover, fuel tank (base half)
2 Seal, filler tube
3 Connection, air hose
4 Connection, fuel hose
5 Handle
6 Spring, plunger
7 Rod, pressure relief
8 Washer, back-up
9 Washer, valve
10 Washer, return
11 Nut, pressure relief rod
12 Spring, latch pin
13 Pin, latch
14 Pin, trigger
15 Pin, pivot
16 Gasket, lens
17 Lens
18 Bracket, float arm
19 Arm and indicator assembly
20 Float
21 Pin, float arm pivot
22 Washer, lock
23 Screw, float arm bracket
24 Shaft assembly, primer
25 Disc, primer
26 Diaphragm, primer
27 Nut, primer shaft assembly
28 Spring, compression primer
29 Valve, fuel
30 Washer, valve spring
31 Valve, pressure relief
32 Spring, relief valve
33 Cover, primer
34 Filter assembly, fuel
35 Washer, cover screw
36 Screw, primer cover
37 Frame, retaining
38 Screw, retaining frame
39 Gasket, handle assembly
40 Gasket, handle screw
41 Screw, handle assembly
42 Line, fuel-air
43 Connector assembly
44 Connection, fuel hose
45 Connection and check valve assembly
46 Clamp, fuel line
47 Clamp, fuel line



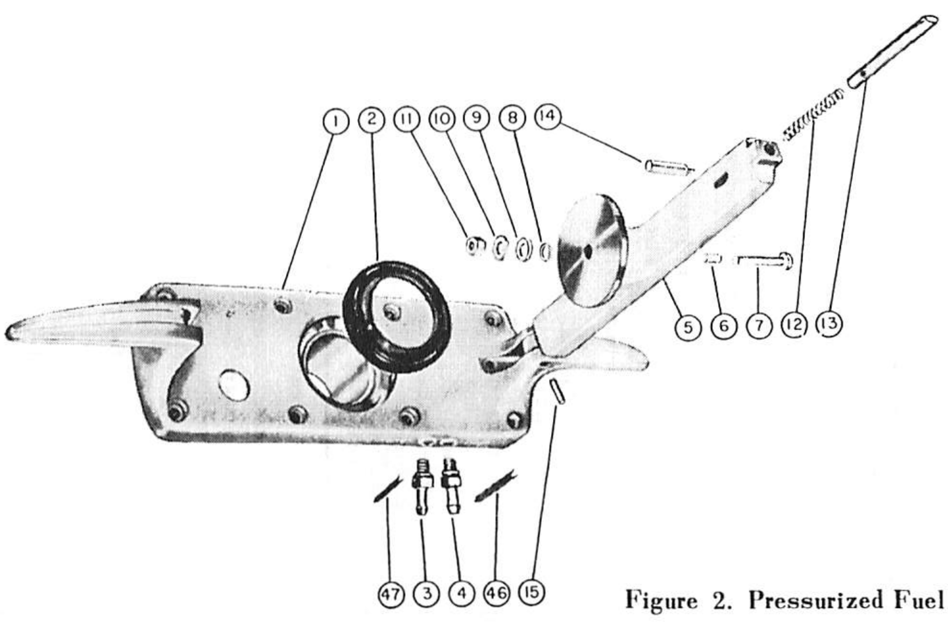


Figure 2. Pressurized Fuel Tank Fittings

NOTE: Priming sequence and starting of engine is a rapid repetitive action with subsequent acceleration of engine. Should the regulator valve "O" ring be cut or worn from rough treatment in initial priming, fuel will continue to by-pass under excessive pressure and result in flooding of carburetor.

C. FUEL TANK PRESSURES

1. A remote fuel tank with a good operating regulator should produce 2¾ to 3½ psi pressure at the carburetor at full engine throttle with tank base approx. 18" (45.7cm) lower than top of boat transom.
2. A 3/4 to 1/8 psi variation between full throttle and idle position is normal.
3. Normal tank pressures for pressurized fuel tanks are:
   a. Mark 50 & Mark 40 - 5-6 psi at full throttle
   b. Mark 20 - 6-7 psi at full throttle
   c. Mark 20H - 8-9 psi at full throttle
   d. Mark 15 - 4-5 psi at full throttle
   (1 psi = .07 (ksg/sq. cm metric)

D. CONVERTING PRESSURIZED FUEL TANK

1. Converting Priming System
   a. Old system (press plunger down) may be converted to new system (pull plunger up) by installing a pressure relief system in handle base assembly of tank. (Figure 4)
   b. Conversion can be made on pressure relief system of Mark 20 motors (under Serial No. 754097) and Mark 40H motors (under Serial No. 713309).
   c. Replace pressure pad on crankcase with new type (20038), or old pressure pad must be blocked off with a plug at check valve outlet.
   d. Seal return line connection to crankcase with a main bearing locking screw (C-10-20089).
   e. To save cost of a new handle base assembly (20448), spot face shoulder 1/16" (1.6mm). (Figure 4) *Shoulder must be relieved to accomodate new primer compression spring.*
   f. To convert tank with new parts, following are necessary:

Part No.	Description	Quan.
A-20448	Handle Base Assembly	1
A-20421A1	Shaft Assembly Primer	1
A-24-20334A1	Valve, spring	1
A-20414	Valve, pressure relief	1
A-20418	Disc, primer	2
A-20417	Diaphragm, primer	1
A-20424A1	Cover, primer assembly	1
C-12-20413	Washer, spring	1
A-20408	Valve, fuel	1
A-24-20335	Spring Compressor, primer	1
A-21-20416A1	Valve Regulator Assembly	1

2. Converting Pressurized Tank to Single Line Vacuum Tank
   a. Remove and discard fuel connector assembly, fuel line and nipples.
   b. Plug air inlet hole with pipe plug (C-22-21290).
   c. Screw 90° street elbow (C-22-23125) into fuel outlet hole and attach fuel line (A-32-28252) and check unit assembly (A-22831A1).
   d. Release handle assembly and remove pressure release rod.
   e. Replace plunger spring with spacer (A-23-25197) and insert rod into handle.

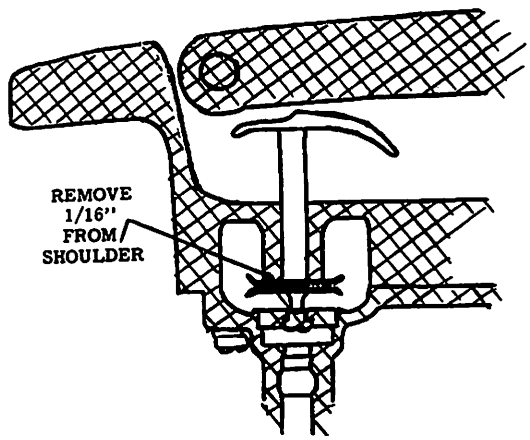


Figure 4. Spot Facing Shoulder

   f. Replace plunger spring on threaded end of pressure release rod.
   g. Install large brass washer and secure in place with elastic stop nut to complete tank conversion.

NOTE: Spacer is manufactured from 5/16" (8mm) outside diameter copper or brass tubing with ¼" (6.35mm) inside diameter, 21/64" (8.4mm) long.

IMPORTANT: When converting fuel tank, check fuel filter assembly at end of pickup tube. A porous metal-type filter tends to restrict pumping capacity and should be replaced with a screen-type filter assembly (A-35-20405A1).

E. TROUBLE CHECKS, PRESSURIZED TANK

1. If lack of fuel pressure is noted at carburetor, check air pressure in tank, dirt or lint in regulator lines or plugged filter.
2. If pulsation of pressure is observed at carburetor, check air leaking into fuel lines. Fluctuation of 1-to-6 lbs. would indicate porosity in fuel connector or tank handle.
3. Carburetor foaming indicates air leak between tank and carburetor.
4. Check fuel tank cover by removing component parts.
5. Always eliminate possibility of a bad tank by using a tank known to be good. *A check for air holes in casting between air inlet (AIR) and fuel outlet (FUEL) should be made first.*
6. Check fuel receptacle on engine also for porous casting. This can be done easily by bypassing connector and attaching a fuel line to carburetor. Worn or cut "O" ring seals in receptacle also may be cause.
7. If fuel leaks at primer shaft, check brass regulator valve for looseness or improper sealing at diaphragm. Holes in diaphragm or diaphragm out of position may also cause leak.
8. If sticking or bad regulator, check assembly for poor alignment on primer shaft rubbing on fuel tank handle. *IMPORTANT: Primer shaft must be free throughout its full range of travel.*
9. If primer is not functioning, check valves for improper sealing. Check for excess diaphragm stretch which may be pulled in between handle and cover during assembly.
10. Flooding may be caused by "O" ring regulator valve being cut or out of place.

F. SERVICE CHECKS, PRESSURIZED TANK

1. Determine if adequate air pressure is present in fuel tank.

2. Check that air line from pressure pad to fuel receptacle is not kinked and that fuel and air lines do not have breaks or holes.
3. Check for proper reed stop setting. Factory setting is 3/32" (2.4mm). Make sure that reed is not adhering to reed stop or face of pad.
NOTE: New cracking methods of distillation in present day fuels present some difficulty in high compression engines. Chemicals left after combustion have a tendency to build up on interior and on reed stop, thereby producing a sort of hard varnish coating. Clean thoroughly with a good solvent and replace with proper setting.
4. Check for proper fuel flow to carburetor and any restrictions from carburetor.

G. DISASSEMBLY OF PRESSURIZED FUEL TANK

1. Description: Pressurized remote fuel tank for models above 6 HP are constructed of 20 gauge steel with bottom protective rim to hold bottom of tank and protect from surface damage.
2. Capacity: Although capacity is 6½ gallons, many users prefer not to fill tank to top for mixing purposes, and, for this reason, tank is referred to as "6 gallon tank".
3. To replace a worn diaphragm, disassemble tank fitting assembly.
4. Remove 8 screws and gaskets and lift entire handle assembly carefully out of tank.
5. In case of severe damage to tank, which would require sealing a leak to prevent loss of fuel, it is suggested that tank be properly ventilated of all traces of fuel vapor before applying any heat to affected section to be repaired. Ventilate by opening top of tank first, then dispel all vapor fumes with a neutralizing agent.
6. Solder all leaks with good grade of solder and flux, file smooth and repaint.
IMPORTANT: All gasoline containers must be painted red by law.

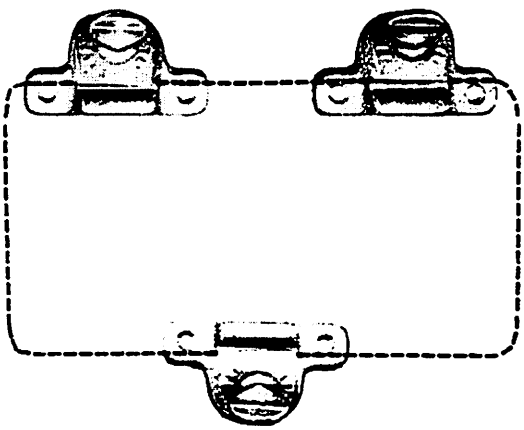


Figure 5. Tank Traps (A-24016)

7. To service fuel tank filter, remove 8 screws and gaskets from handle assembly and lift assembly carefully out of tank.
8. Loosen coupling nut on fuel pickup tube to free filter head. Filter disc is a fine, stainless screen which can be cleaned by rinsing in clean benzol (benzine).
9. If greatly discolored or clogged, replace filter assembly complete.
10. Install filter head on fuel pickup tube. Start coupling nut threads one or two turns with fingers to avoid danger of cross-threading. Do not tighten more than necessary to attain a fuel-tight seal.
CAUTION: When reinstalling handle assembly, bear in mind the importance of maintaining air-tight joints. Be sure gasket is in good condition. Also note condition of fibre washers.
IMPORTANT: "Tank Traps" (A-24016, set of 3) are recommended to hold all remote and auxiliary fuel tanks (with bottom rim) in boat for convenience and safety. (Figure 5)

H. REPAIR OF PRESSURIZED TANK

1. With entire handle assembly removed, as explained in Para. "G", preceding, assemble the following special repair equipment:
   a. Set of welding equipment, aircraft type (acetylene and oxygen).
   b. Pressure regulators and gauges for oxygen and acetylene.
   c. Air hoses and pressure regulators and gauges for air supply.
   d. Manufactured gas supply, oxygen - acetylene.
   e. Aluminum welding rod (Eutector No. 190, 1/8" dia. or equivalent).
   f. Flux (Eutector No. 21x or equivalent).
   g. Repair bench.
   h. Holding fixtures and stand.
2. Small holes or cracks can be welded in the following manner without cutting and patching:
   a. Use good grade aluminum welding rod (Eutector No. 190) which is adaptable to sheet aluminum welding and a flux (Eutector 21x) to fit type rod.
   b. Be sure that all surfaces to be welded are thoroughly cleaned and proceed as recommended by rod manufacturer.
   c. Using small aircraft-type torch with .055" (1.4mm) tip opening, set oxygen regulator at 40 PSI and acetylene at 8-10 PSI.
   d. Use difused flame with medium pressure, preheating section to be aluminum brazed.
   e. With weld rod (Eutector No. 190) and flux (Eutector 21x) swiftly move torch across small area to be welded, applying rod and flux as fast as it melts.
   f. If weld tends to build up without flowing into metal of tank, metal is not sufficiently hot and a hotter flame must be applied.
   g. When part is welded to satisfaction, flux can be removed by placing fuel tank in water (wait 'til cooled by air). Flux will soak off.
   h. Brush off remainder with steel wire brush.
   i. After welding, clean off excess flux by method prescribed.
   j. After tank is repaired and tested preparatory to finish painting, smooth down all rough surfaces either by filing, emery cloth or sanding wheel.
   k. Apply coat of primer (C-92-31292-1) and finish with coat of red paint.

IMPORTANT: If you are confronted with service repair problems involving fuel tanks, which cannot be remedied by any of the preceding procedures, do not hesitate to write to the Service Department of your parts distributor with complete information in reference to the problem along with motor model and serial number.

VACUUM FUEL TANK

A. DESCRIPTION

Because fuel pump on motor pumps fuel from tank to carburetor, following initial priming and starting of motor, only one flexible fuel line is necessary between tank and motor.

B. PRIMING

1. Priming on first vacuum tanks was done by pulling up on plunger on handle assembly.
2. Priming on new vacuum tanks (6 gal. and 3¼ gal.) (22.7 and 12.3 liters) is done by squeezing primer bulb on fuel line. (Figure 6)

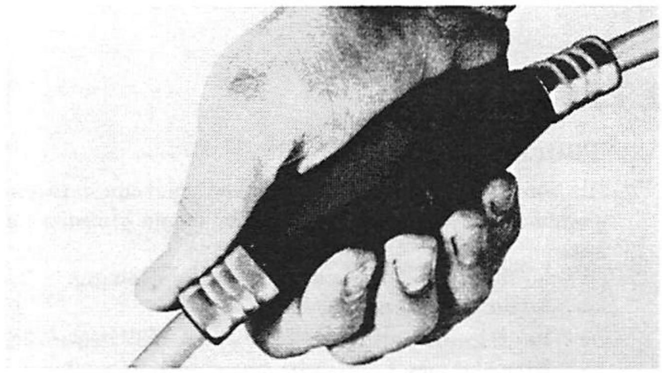


Figure 6. Priming Vacuum Fuel System

3. Carburetor is filled with fuel by slowly actuating primer bulb on fuel line. (Figure 6) When fully primed, pressure will be felt on bulb.

C. REPAIR OF VACUUM TANK

1. Remove filler cap assembly and check wear of parts for possible replacement.
2. Remove 4 fastening screws and washers which secure fuel tank cover.
3. Remove fuel tank cover assembly and disassemble component parts to check for possible wear, filter on end of pickup tube in particular.
4. Replace any worn part.
5. Check fuel line and component parts for wear and replace a worn part.
6. Primer bulb.

   NOTE: Two different fuel lines are used; one with 7/16" (11.2mm) outside diameter, the other with 1/2" (12.7mm). The 7/16" fuel line has a A-25423A1 check valve assembly in engine end of line and a A-25425A1 body and stem assembly in fuel tank end. (Figure 7) The 1/2" fuel line has a A-23-30184 sleeve in engine end of line and A-30183A1 body and stem assembly in fuel tank end. (Figure 8)

   a. Remove damaged or inoperative primer bulb by cutting fuel line as close as possible to bulb.
   b. Inspect check valve assembly and body and stem assembly for free operation. (Figure 8) If corroded, stuck, damaged or otherwise inoperative, replace with new check valve assembly and body and stem assembly.
   c. Apply light coat of adhesive (C-92-27813) to outside of check valve assembly stem only. Care must be exercised not to get adhesive in stem hole or on valve face.
   d. Insert stem into fuel line (fuel tank end). (Figure 8)
   e. Apply light coat of adhesive around outside of fuel line over check valve assembly.
   f. Push fuel line end in about one inch or until check valve end can be felt flush on inside end of primer bulb.
   g. Place circle clamp (A-54-27764) in position over small end of primer bulb and, with a pair of end cutter pliers, clinch sides (recesses) of clamp. Compress until recesses of circle clamp shoulders touch.
   h. Repeat procedure for body and stem assembly on opposite end of primer bulb.

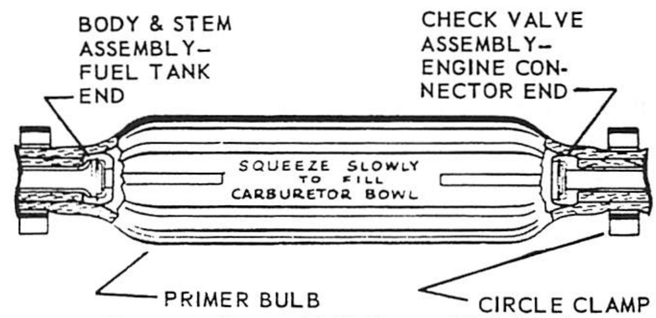


Figure 7. Primer Bulb Repair (Old Style)

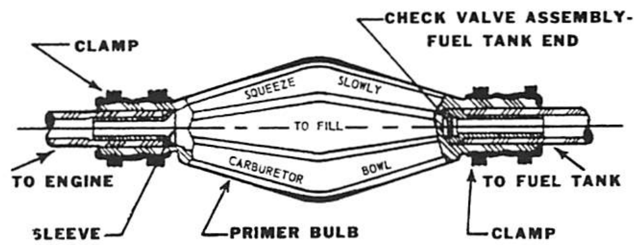


Figure 8. Primer Bulb Repair (New Style)

7. Finding fuel tank leaks
   a. Remove filler cap and fuel tank cover assembly.
   b. If point of leak is known, circle hole with pencil, drain tank thoroughly and flush with hot water or carbon tetrachloride.
   c. If point of leak is not known, drain tank thoroughly and flush with hot water or carbon tetrachloride. Submerge tank in water and observe bubbles rising from hole in tank.
8. Repair leak in sheet metal tank
   a. Use equipment listed in Para. H-1, if available.
   b. Weld according to procedure in Para. H-2, preceding.

D. FUEL TANK CAP MODIFICATION - LOSS OF RPM

If there is a noticeable decrease in RPM after operation for several minutes at high speed, it may be caused by one of the following:

1. Inadequate air vent hole in fuel tank cap with identification of one indentation around vent screw hole. (Caps with 3 indentations [Figure 9] have adequate hole.) To remedy, drill 1/16" (1.6mm) hole as follows: Turn fuel cap upside down and drill 1/16" diameter hole thru inner plate (in bayonet fitting) only. Locate hole 3/16" (4.8mm) from edge of vent screw opening.
2. Wrong fuel tank (refer to correct tank in parts list).
3. Fuel line too small (refer to correct line in parts list).
4. Filter on end of pick-up tube clogged or wrong type (refer to co rect pick-up tube in parts list).

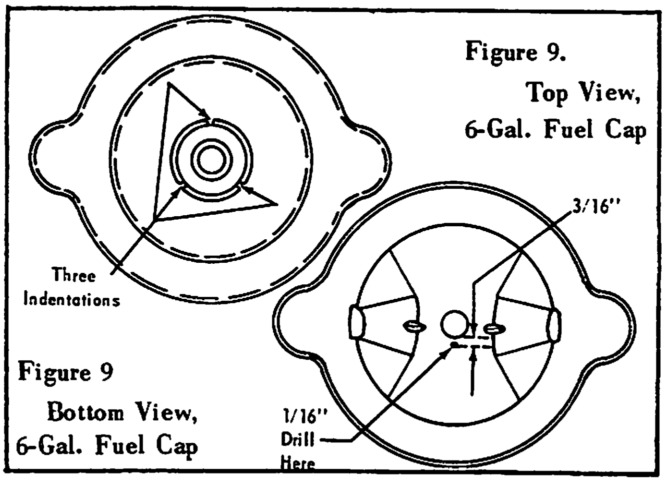


Figure 9. Top View, 6-Gal. Fuel Cap

Figure 9 Bottom View, 6-Gal. Fuel Cap

OTHER FUEL TANKS

A. AUXILIARY FUEL TANKS

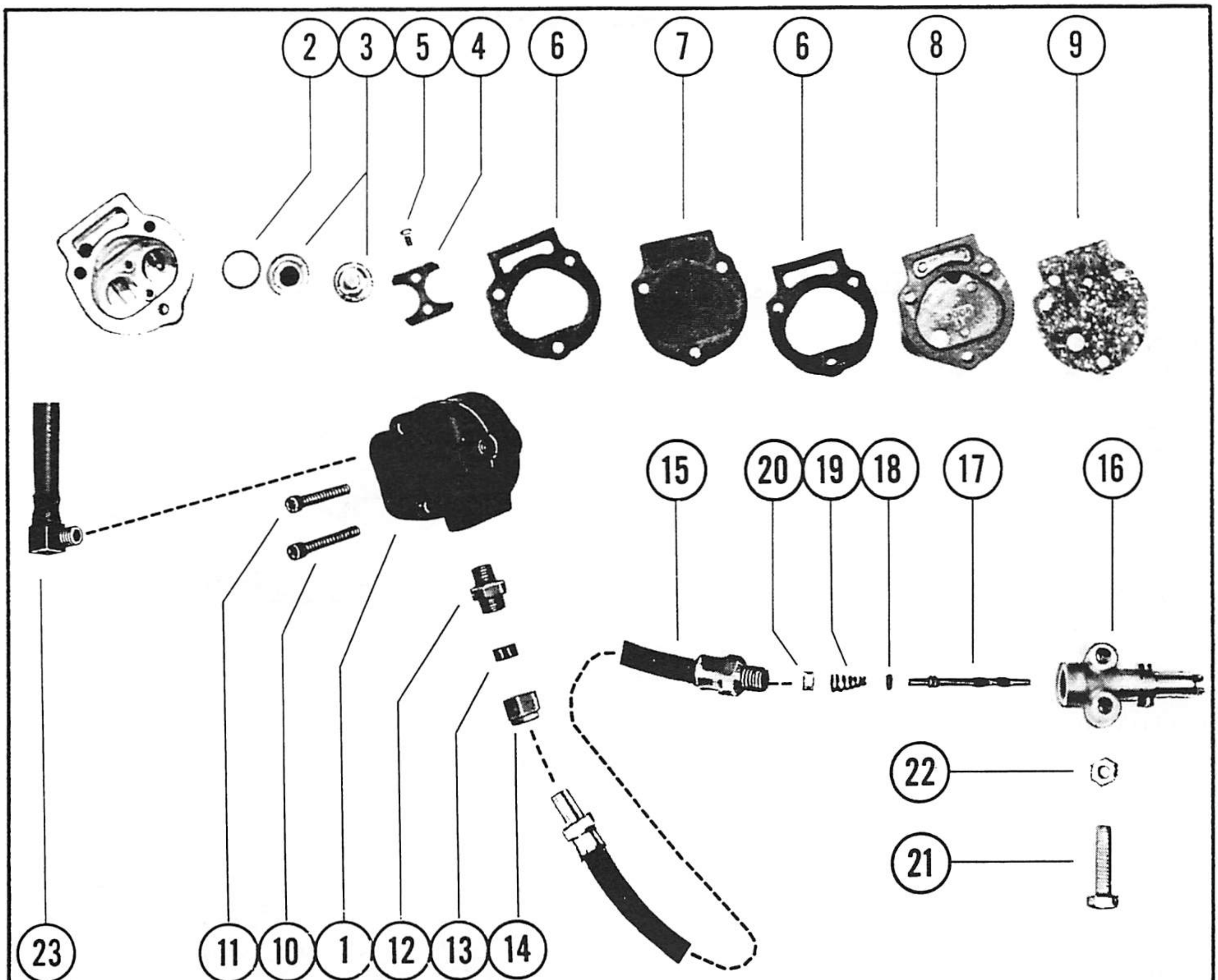
NOTE: New style fuel gauge can be installed on auxiliary tank by removing old gauge with sharp instrument inserted between flange of fuel gauge and tank. Then pry up and set new gauge in place and press in with fingers.

B. CUSTOM-MADE FUEL TANKS

When using vacuum system with these tanks, an air vent is only requirement. A special pickup tube can be made but should have a large pre-filter attached to prevent excessive dirt in carburetor top filter.

C. "FOREIGN" FUEL TANKS

1. If other than Kiekhaefer Mercury fuel tank is used, engine may run lean, lose RPM or cause piston scoring.
2. Check "foreign" fuel tanks for the following:
   a. Adequate air vent in fuel cap.
   b. Fuel line large enough (5/16-to-3/8") (8-to-9.5mm)
   c. Filter on end of pickup too small or clogged, or fuel pickup tube too small.



1 Fuel Pump Assembly
2 Gasket
3 Valve, check
4 Retainer
5 Screw
6 Gasket
7 Diaphragm
8 Cover, fuel pump
9 Gasket
10 Screw (1 3/4")
11 Screw (1 1/2")
12 Connector
13 Sleeve, rubber
14 Nut
15 Fuel Line
16 Adaptor
17 Stem
18 "O" Ring
19 Spring
20 Cup Washer
21 Screw
22 Nut
23 Fuel Line

Figure 10. Vacuum Fuel Pump Exploded View

FUEL PUMPS

A. DESCRIPTION

1. Before attempting to service fuel pump, determine whether pump really is defective.
2. Be sure to have necessary replacement parts required for job. *Without replacement parts, only cleaning can be done.*
3. The following are parts which are usually replaced:
   a. Diaphragm   b. Gaskets   c. Fuel lines

B. SERVICING

1. Wash all parts thoroughly and use compressed air to clean all parts completely.
2. Inspect each part carefully for wear or damage.
3. Replace pulsator diaphragm with new, if old diaphragms show least sign of deterioration.
4. Be sure that valve seats provide flat contact area for valve disc.
5. Tighten elbows and check valve connections firmly when replacing.
6. Do not use Permatex on valve retainer gasket.
7. Check valves after reassembling fuel pump cover by blowing thru outlet hole. Air should be drawn thru valve but should close immediately when attempting to blow thru it.
8. Check inlet valve by reverse procedure. If leakage is encountered, check for free operation and accurate setting of valves.
9. Worn or slightly warped valve will cause leakage. Replace with new valves for more accurate setting.
10. When installing fuel line fittings, we recommend aviation Permatex for sealing. Apply sparingly to avoid clogging of fuel lines.
    CAUTION: Do not use Liquid Neoprene on fuel line fittings. Neoprene is recommended only for exposed electrical connections. Permatex is available thru all local hardware stores.

C. VACUUM FUEL SYSTEM PUMP (Figure 10)
Found on all engines with vacuum fuel system.

1. Disassembly
   a. Remove 2 fuel lines from fuel pump.
   b. Remove 3 screws which hold fuel pump assembly to crankcase.
   c. Remove gaskets, diaphragm, check valve, retainer and screw from under fuel pump cover.
2. Reassembly
   a. First, inspect all parts, making certain that all are usable, clean and ready for reassembly. (Figure 10)
   b. Place new check valve gaskets in seats and set check valve discs in position. Inlet check valve seat is identified by its protruding tip in casting. Flat side of check valve seats over this tip. Outlet check valve is set in opposite (flat end up) so tension is against valves. (Figure 11)
   c. Position retainer on check valves in housing and secure with 2 screws.
   d. Place new gasket on pump body followed by neoprene diaphragm, another gasket, fuel pump cover and cover to crankcase gasket. Be sure that gasket holes align with cover holes.

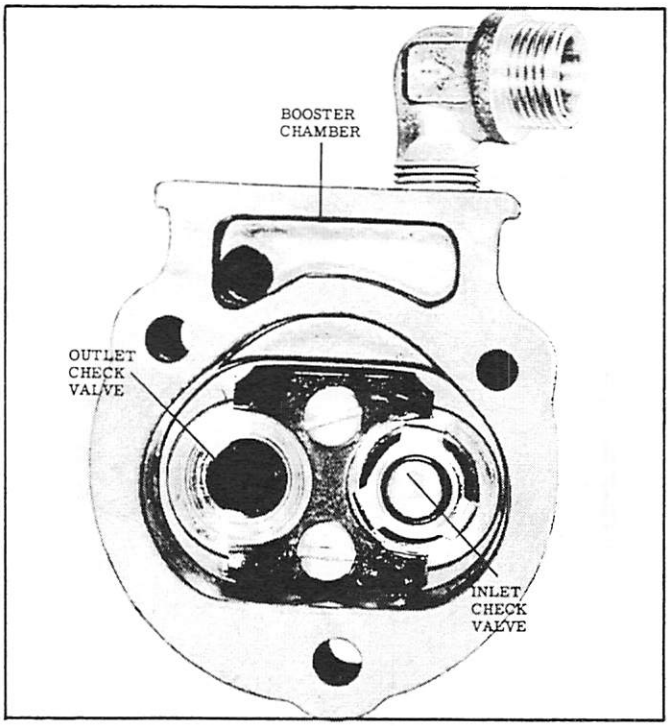


Figure 11. Check Valve Location

   e. Secure to crankcase with 3 screws.
   NOTE: Inlet line from adaptor assembly attaches to fuel inlet hole marked "IN".

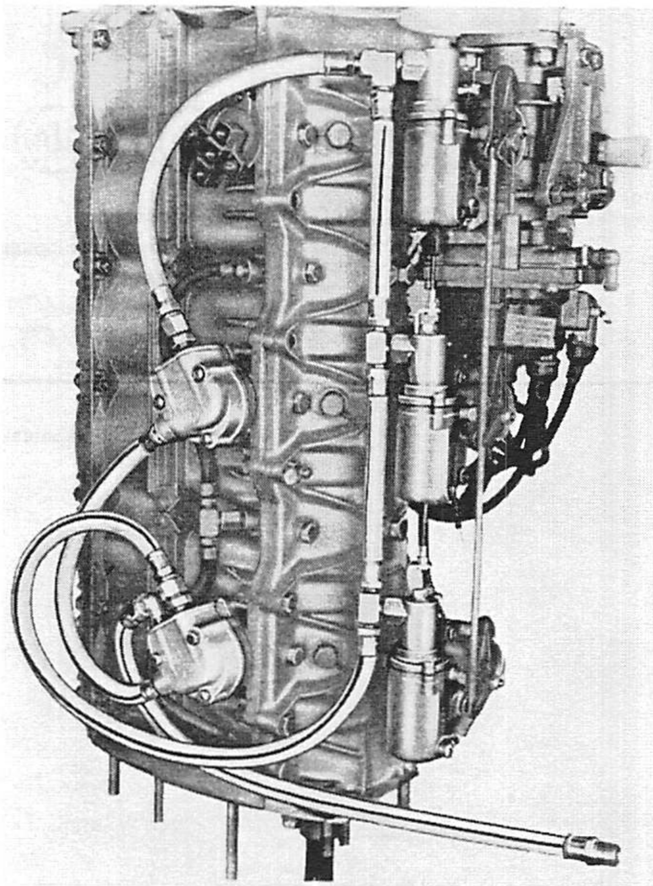
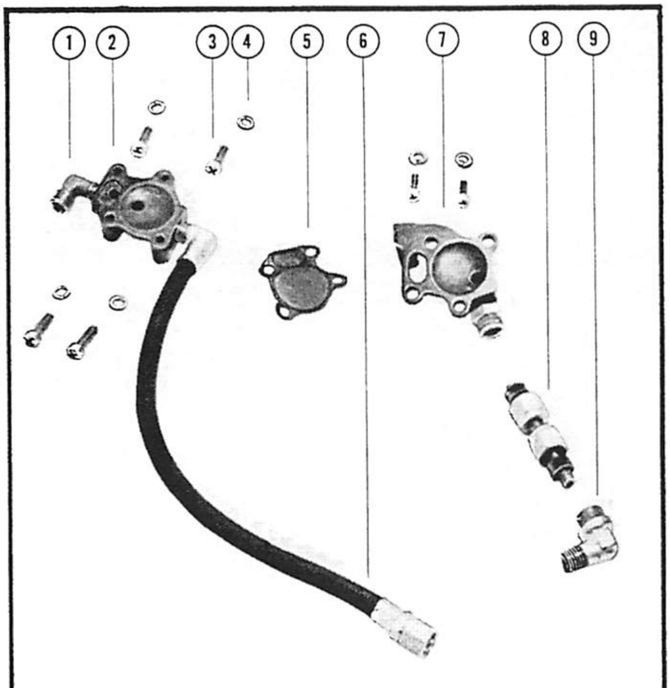


Figure 12. Fuel Pumps in Parallel



1 Elbow
2 Cover, fuel pump
3 Screw
4 Lockwasher
5 Diaphragm
6 Fuel Line
7 Fuel Pump Hsg. Ass'y
8 Pressure Line & Nut
9 Elbow, fuel inlet

Figure 13. Mark 6 Fuel Pump

D. MARK 6 FUEL PUMP

1. Description
   a. Crankcase pulsating pressure is transferred to fuel pump diaphragm via line from fuel transfer cover on cylinder block which in turn draws fuel from fuel tank. (Figure 13)
   b. Prime engine first by actuating priming bulb on fuel line.
2. Disassembly
   a. Remove 2 screws which hold housing in bottom cowl bracket.
   b. Remove pressure line from intake cover.
   c. Remove nut which holds carburetor line to fuel pump.
   d. Remove 4 screws which hold fuel pump together.
   e. Lift off diaphragm and discard.
   f. Test check valves in fuel pump housing assembly.
   g. Remove check valves by pressing out with 9/32" (7.2mm) drift from intake side, thru to outside. *Replace check valves with new valves, if removed.*
3. Reassembly
   a. Inspect and clean parts as outlined in "B. Servicing", preceding.
   b. Press new check valves into fuel pump housing from inlet side of housing. (Figure 14)
   c. Press first check valve in until top of valve housing is 1-1/32" (26.2mm) from face of inlet side.
   d. Press 2nd check valve in 31/64" (12.4mm) from face of inlet side.
   e. Test pump, following instructions in "B. Servicing", preceding.
   f. Place new diaphragm in position between fuel pump housing and fuel pump cover and secure with 4 screws.
   g. Install fuel inlet line to bottom hole of fuel pump, elbow to top outlet.
   h. Install fuel pump assembly on powerhead.

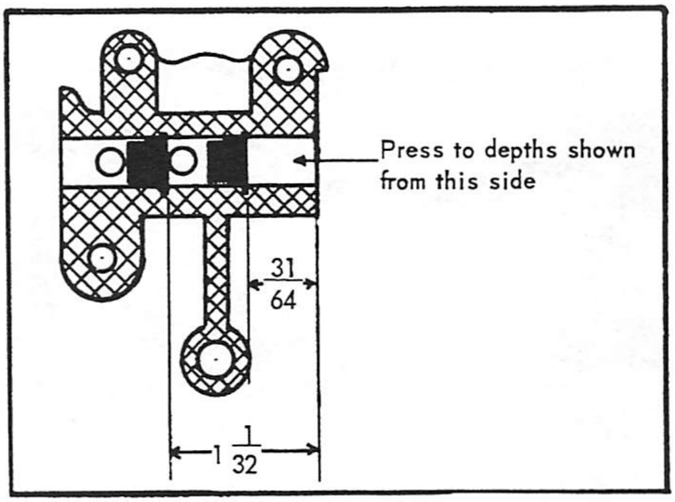


Figure 14. Pressing in Check Valves

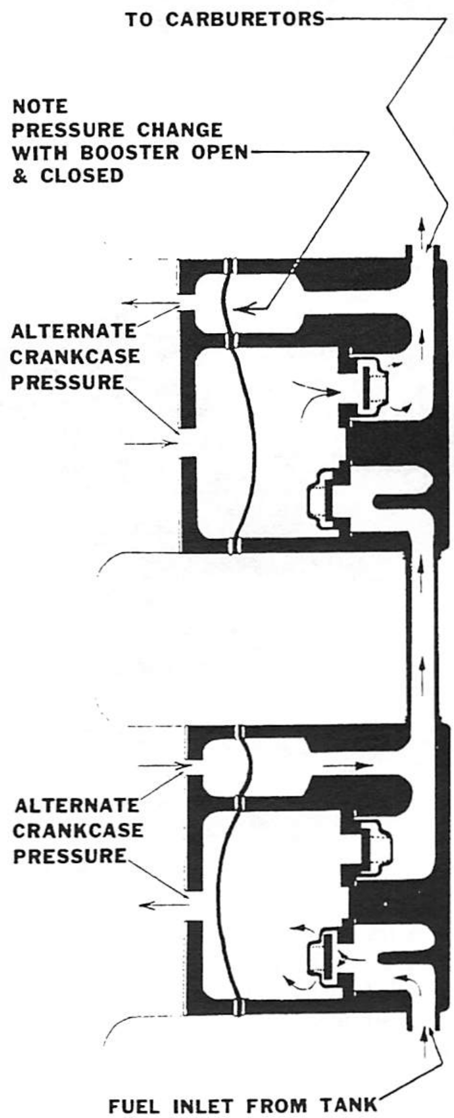


Figure 15. Fuel Pump Operation

E. MERC 60 FUEL PUMP CONVERSION

Installing Late Style Fuel Pump (Figure 16)

1. Install filter cover and check unit adaptor on new fuel pump assembly.
2. Install gasket and new spacer assembly on cylinder block. Tighten screws securely.

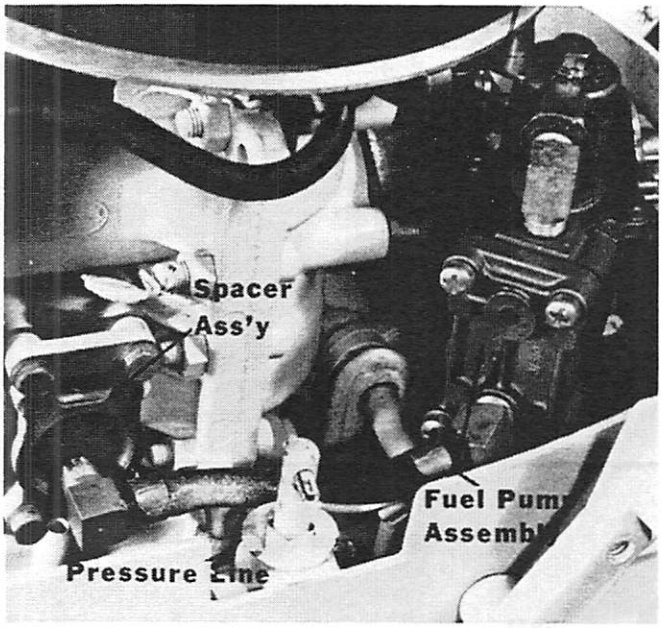


Figure 16. Late Style Fuel Pump Installed

3. Install pressure line on fuel pump assembly and secure with hose clamp.
4. Install opposite end of pressure line on spacer elbow and secure with hose clamp.

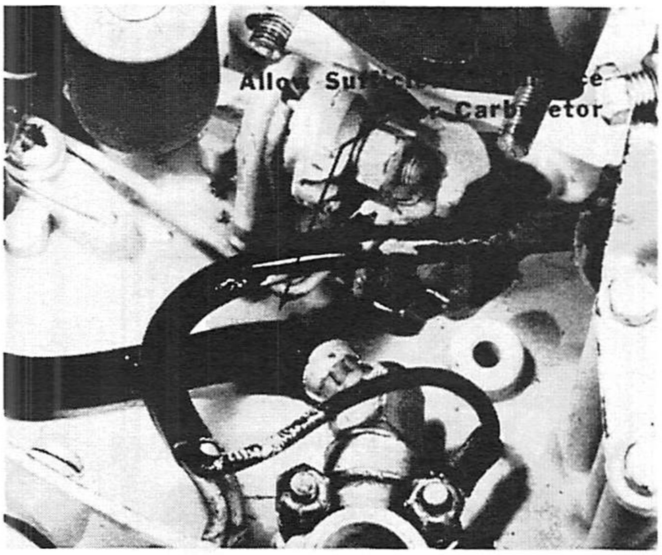


Figure 17. Stop Switch Ground Lead Attached

5. Install check unit adaptor in bottom cowl and secure with 2 screws. Be sure that stop switch ground lead is attached. (Figure 17)
6. Install carburetor.
7. Install filter cover and fuel pump assembly on carburetor.
8. When installation is completed (Figure 18), check for clearance during shifting and for easy installation of fuel tank line connector.

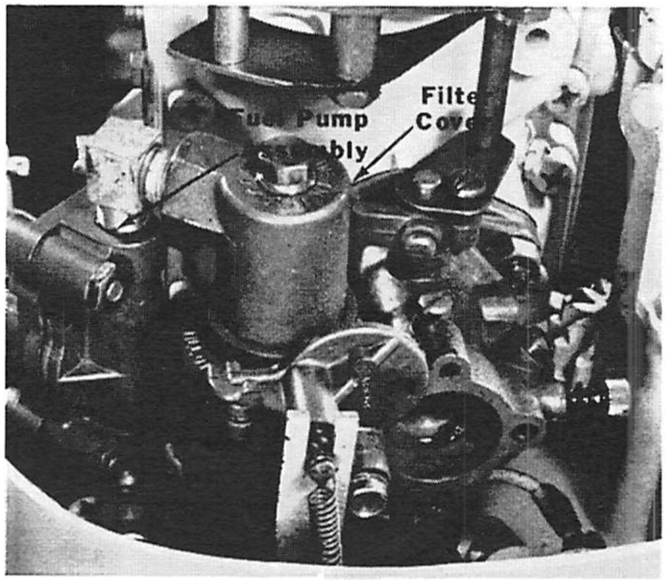


Figure 18. Installation Completed

F. FUEL LINE CHECK UNIT ADAPTOR, MERC 110-60

A new check unit adaptor can be mounted with spring loading to provide flexibility as on latest model motors.

1. Drill out the 2 adaptor to bottom cowl threaded screw holes with 7/32" diameter drill. (Tilt motor up and to right side for access to screw holes.)
2. Counter bore 2 holes from underside of cowl to depth shown in Figure 19. Use 11/32" diameter drill. This is not necessary if bolt heads clear swivel bracket.
3. Place new check unit adaptor (A-32454) in position and insert 2 Phillips head screws (C-10-24233), 1½" (38mm) long.
4. Place coil spring (A-24-28357) on screws and thread on elastic stop nuts (C-11-20110).
5. Elastic stop nuts are to be tightened only far enough to preload coil springs. (Expose approximately 3 threads above nut.)

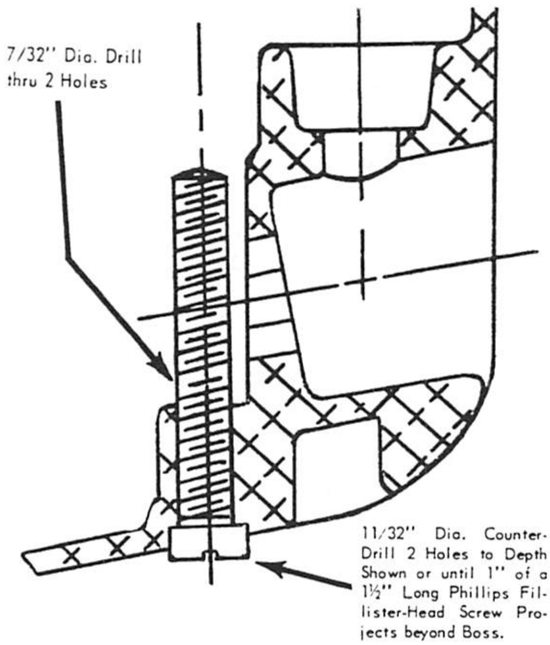
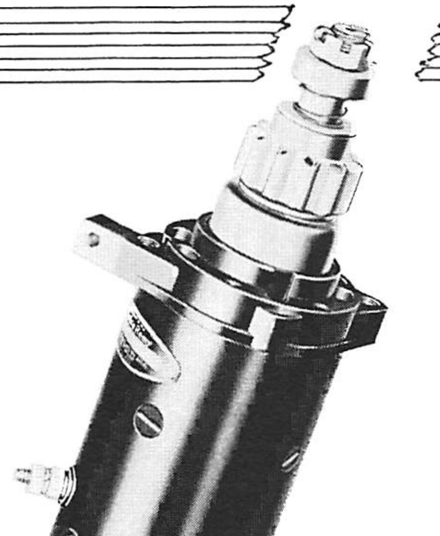


Figure 19. Bottom Cowl
(Side View Cross-Section)

section VII starters



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Description

A. TYPES OF STARTERS

1. Manual
    a. Magna-Pull
    b. Automatic Rewind
2. Electric
    a. With generator
    b. Less generator

B. MANUAL STARTING, PRINCIPLE OF OPERATION

1. Principle of starting both Magna-Pull and Automatic Rewind starters is generally the same.
2. When pulling on starter handle, starter pawls of starter make a positive action with flywheel adaptor, thereby impelling magneto to make a spark at spark plug and causing combustion in cylinder, thus starting motor.
3. After motor has started, pawls disengage automatically.
4. Starter mechanism remains idle after motor has started; thus, there is little wear on any of the parts and very little attention is required.

NOTE: For principle of electric starting, refer to Page 6 of this section.

Magna-Pull Starters

A. DISASSEMBLY

The following procedure is used in disassembly of Magna-Pull starters on Mark 20, Mark 20H, Mark 15, Mark 7, Mark 6, Mark 5, all models with a "K" prefix and all "K" models. (Figure 1)

1. Remove screws on top cover which holds starter to cover.
2. Remove starter cable bushing insert from rubber handle by prying out with screwdriver.
3. Slip rubber handle back on cable and cut cable as close to bushing as possible, releasing cable so that spring unwinds.

    NOTE: If starter is to be removed from a tank and no work performed on the starter, hold cable after cutting off knot. Lift starter from tank and tie knot in cable in screw hole of cover so it will not unwind.
4. Remove screws and washers which hold friction plate to starter housing.
5. Remove friction plate, starter pawls and anti-rattle springs from sheave.
6. Remove flat head screw from sheave shaft in top of starter housing with Allen wrench.
7. Remove sheave assembly, being careful that sheave does not drop out so that spring unwinds with force. (Figure 2) **CAUTION: Be sure to place other hand under sheave, as it is removed, to prevent spring from coming out of recess.**
8. Remove starter spring by placing cloth in hand and grasping spring firmly.
9. Pull spring out and allow to unwind slowly in hand.

    NOTE: End of starter sheave shaft is peened over shaft collar. It will be necessary to grind off end of shaft even with collar. Drive the shaft out of collar with drift to remove pawl retainer washers, starter pawl retainer washers, starter pawl retainer, pawl retainer spacer, sheave shaft shim and starter sheave shaft wave washer.
10. Remove 4 Phillips head screws from sheave to release anchor cable. *(Note: On Mark 6, Mark 5, KF5 and KF3 models, only 2 screws in sheave hold cables. Be sure not to lose 2 thread guards.)*
11. Remove cable from sheave by unwinding and twisting end near anchor ½-turn.
12. Use Needle Bearing Drift (91-24739) to remove bearing or bushing in sheave.
13. Starter now is completely disassembled and parts are available for inspection. Replace any worn or broken part before reassembly.

B. REASSEMBLY

1. Replace bearing or bushing in starter sheave with Needle Bearing Drift (91-24739), pressing into sheave.
2. Lubricate bearing with MULTIPURPOSE Lubricant (92-30239).
3. Replace starter cable in starter sheave by attaching anchor end of cable in slot.
4. Slide in sideways and twist ½-turn after anchor is in hole in sheave in lock.
5. Wind cable on sheave in clockwise rotation.
6. After completing one full revolution, insert 4 Phillips screws to secure cable. *(Note: Two screws have thread guards on small sheave models Mark 6, Mark 5, KF5, KF3 and KE3.)*
7. Complete winding cable on sheave, leaving sufficient length to insert later through cover opening.
8. Place starter sheave shaft wave washer on sheave shaft and insert sheave shaft in sheave, replacing sheave shaft shim, washer, pawl retainer, washer and collar in this order on shaft.
9. Peen end of shaft over shaft collar with ball peen hammer. *Do not peen too tightly, as a moderate amount of tension is required.*

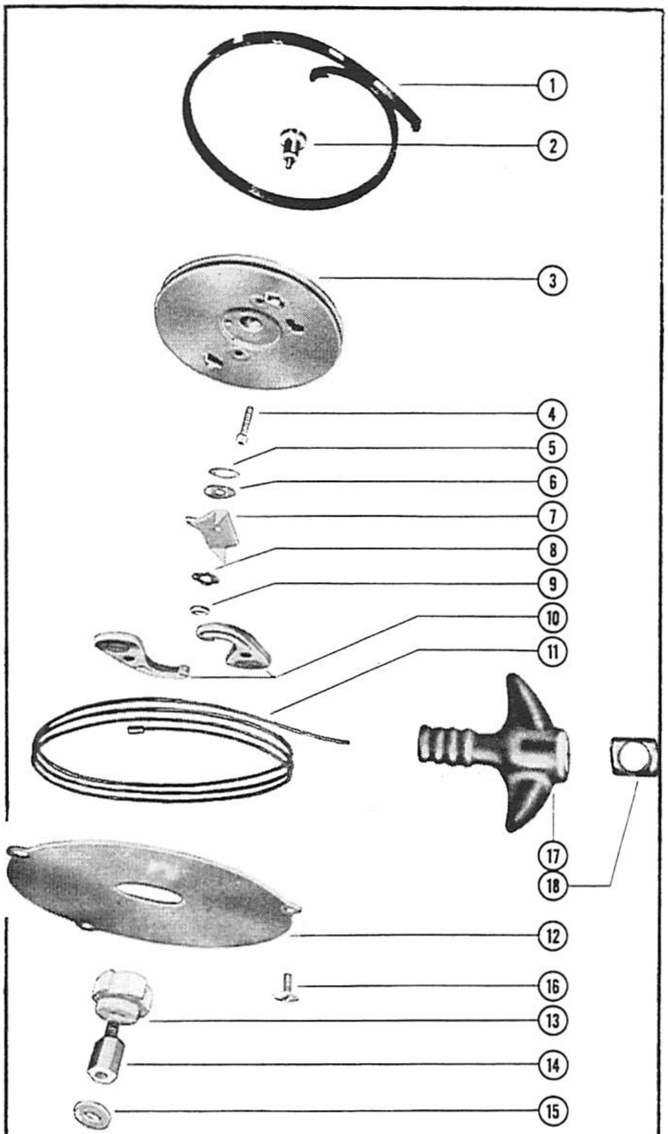


Figure 1. Magna-Pull Starter, Mark 6

1	Spring, starter
2	Shaft, starter sheave
3	Sheave, starter
4	Screw, sheave reinforcing
5	Shim, sheave shaft
6	Washer, sheave shaft
7	Retainer, starter pawl
8	Washer, wave
9	Collar, sheave shaft
10	Starter pawl assembly
11	Starter cable assembly
12	Plate, friction
13	Ratchet, starter
14	Spacer, starter ratchet
15	Washer, starter ratchet
16	Screw, friction plate to top cowl
17	Handle, starter cable
18	End cap, starter handle

10. Check tension by twisting pawl retainer with fingers, holding sheave shaft rigid.
11. If starter and shift handle (Mark 5) was disassembled for servicing, see "NOTE" on Page 3 to reassemble.

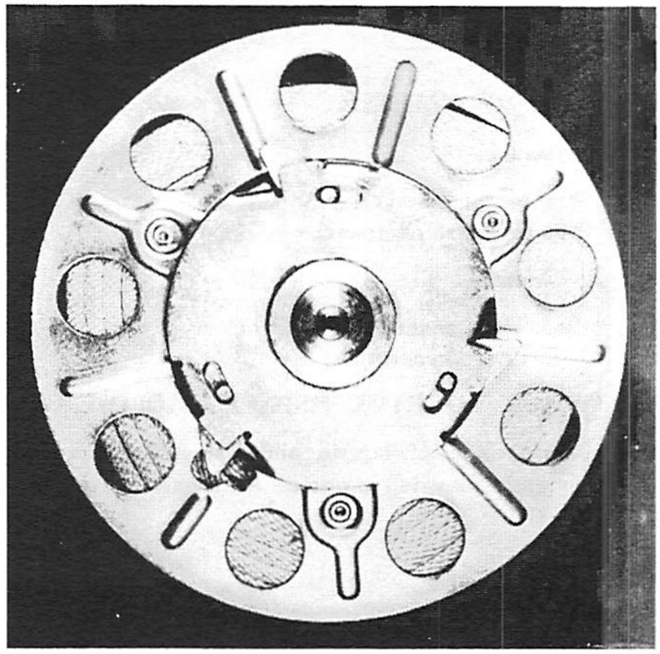


Figure 2. Starter Pawls and Sheave

12. Lubricate spring lightly with MULTIPURPOSE Lubricant (92-30239) and engage inner loop of spring on sheave anchor pin.
13. Insert sheave with shaft head into hub recess of housing and rotate sheave until slot in hub engages pin in hub recess.
14. Install Allen set screw into top of housing to hold assembly.

    NOTE: Without unwinding starter cable from starter sheave, make 3 full revolutions of starter sheave to obtain correct tension for rewind. Place rope in starter cover hole and tie loose temporary knot in starter cable about a foot from end of protruding cable to prevent spring from unwinding.

15. Insert starter cable in starter handle and through end plug.
16. Tie a "figure 8" knot in cable. (Figure 3)
17. Cut excess cable off ½ inch from end of knot and press knot into recess of plug.
18. Pull cable and plug into handle.
19. Lubricate pawl posts on sheave hub and inner face of friction plate with MULTIPURPOSE Lubricant (92-30239) and install pawls.

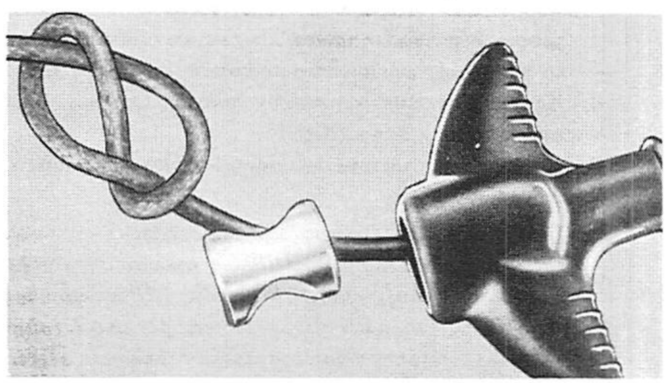


Figure 3. "Figure 8" Knot in Cable (Magna-Pull)

20. Replace friction plate and secure with screws and lockwashers.

C. NOTES

1. Starter & Shift Handle (Mark 5) Reassembly
   a. Set adjusting neutral lever screw in back part of lever.
   b. Place finger release in front part of lever catch and fasten with 2 small counter-sunk-head screws.
   c. Reassemble push button release in handle by inserting first the finger release spring, the finger release which is pinned with a roll pin through handle. Follow with spring for release button and insert push button from front of handle through spring and lock with retaining ring.
   d. Set adjusting lever neutral yoke into notch end of lever, place lever spring under lever into handle and pin lever with roll pin through handle.
   e. Attach lever handle assembly to starter cover with 4 screws through bottom of cover.
2. Sheave Shaft Service
   a. An objectionable rattling noise has been noted in this type starter on some motors. This is caused by excessive looseness of starter pawl retainer.
   b. To eliminate this, simply peen end of starter sheave shaft to tighten pawl retainer. Do not peen too tightly, rendering it inoperative. Strong finger pressure should be able to move it.

Automatic Rewind Starters

A. DISASSEMBLY (Figure 4)

Use following procedure in disassembly of automatic rewind starters, all 6-and-4-cylinder engines and all recent 2-cylinder models (those not mentioned under Magna-Pull starters on Page 1).

1. After starter assembly has been removed from motor proper, entire unit can be disassembled further if in need of repair.
2. Pull starter handle out from housing cover and, with screwdriver, pry end cap out of rubber handle.
3. Cut cable as close to end cap as possible and release cable so that spring unwinds.
4. Remove auxiliary cover by removing auxiliary cover screw.
5. Bend lock tabs down from nut and remove nut which holds internal parts to inside top of cover with aid of sheave shaft. Component parts are removable.
6. Place screwdriver in sheave shaft slot to hold while removing nut (left hand thread).
7. Remove retainer plate, shaft, starter pawls, wave washers, bushing, spring guide, retainer spring, sheave shaft spacer, wave washer and wave washer retainer.
   CAUTION: Be careful when removing these parts that rewind spring does not fly out of sheave and cause injury. Place cloth in hand and grasp spring firmly. Pull out, allowing spring to uncoil slowly in hand.
8. Remove cable from sheave by unwinding & twisting end near anchor ½-turn.

B. REASSEMBLY (Figure 4)

1. Replace starter cable in starter sheave by attaching anchor end of cable in slot. Slide in sideways and twist ½-turn after anchor is in hole in sheave to lock.
2. Wind cable on sheave in clockwise (right hand) direction, working from bottom of sheave and leaving enough free end to insert later through cover opening. *(Note: Wind cable on new sheave as shown in Figure 5.)*
3. Place sheave in vise and engage outer loop of spring into slot of spring recess in sheave. Wind counterclockwise (to left) until spring is in place.
4. Place spring guide bushing on hub of sheave, chamfered end toward sheave.

10 Retainer, starter spring
11 Spring, starter rewind
12 Bushing, spring guide
13 Sheave Assembly
14 Pawl, starter
15 Washer, wave
16 Bushing, nylon
17 Spacer, sheave shaft
18 Retainer, wave washer
19 Washer, washer retain.
20 Washer, wave
21 Plate, ret. starter pawl
22 Shaft, sheave

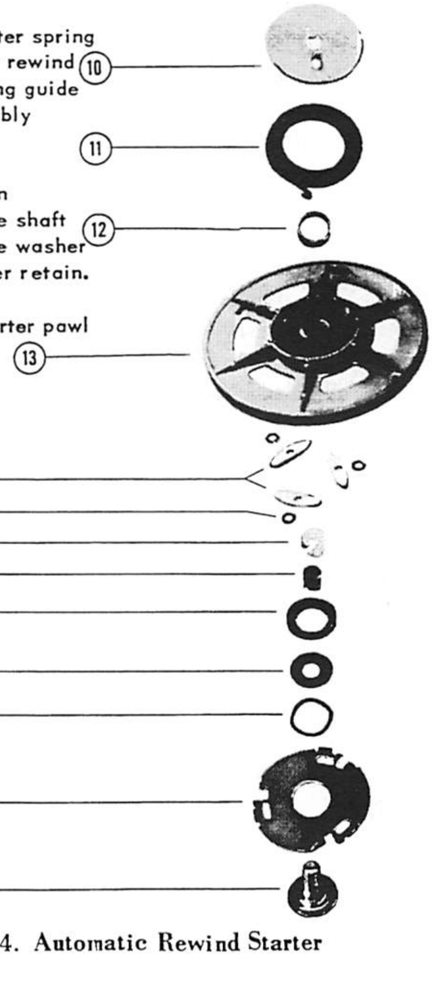


Figure 4. Automatic Rewind Starter

5. Set spring retainer on top of spring, engaging inner loop in anchor pin of spring retainer plate.
6. Lubricate spring and spring guide bushing with MULTIPURPOSE Lubricant (92-30239).
7. Assemble starter pawl to sheave with identification mark side away from sheave and end on which mark appears toward rim of sheaves.
8. Mount the 3 starter pawl wave washers on anchor pins on bottom of sheave and follow with starter pawls on top of pins. Lubricate all parts with MULTIPURPOSE Lubricant as they are being installed.

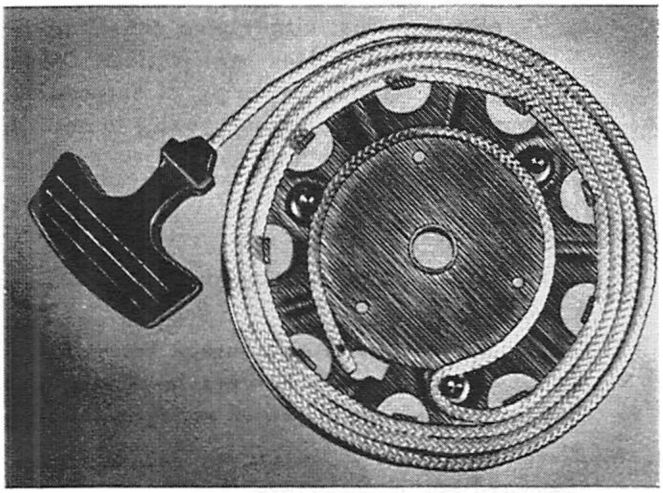


Figure 5. Top Cut-A-Way View of Sheave With Correct Rope Positioning

NOTE: Be careful when replacing these pawls that they are all set the same way. Radii of pawls are to follow radius of pawl retainer plate (flat angle end to inside) which follows to hold pawls in place.

9. Set sheave shaft spacer in place in sheave hub.
10. Set wave washer retainer on with cup end up. Set washer equalizer ring into cup and set wave washer and pawl retainer plate in position. Refer to Figure 4, items 19-20-21-22. *Be sure pawls extend through slots in sides and insert sheave shaft so keyway guides through spring retainer notch.*
11. Insert sheave shaft through pawl retainer plate assembly and sheave.
12. Insert free end of starter cable into cable outlet in starter cover and tie loose, temporary knot about one foot from end of cable to hold.
13. Place sheave assembly, with sheave shaft up, into cover for tightening.
14. Place lock washer for sheave shaft with notch set in keyway and screw nut (left hand thread) on sheave shaft.
15. Untie temporary knot and insert through starter cable handle and end cap.
16. Tie "figure 8" knot in cable, cut off excess ½" from end of knot and press knot into recess of end cap, or install cable into new starter handle as shown in Figure 6.
17. Pull cable and end cap into starter handle to complete assembly.

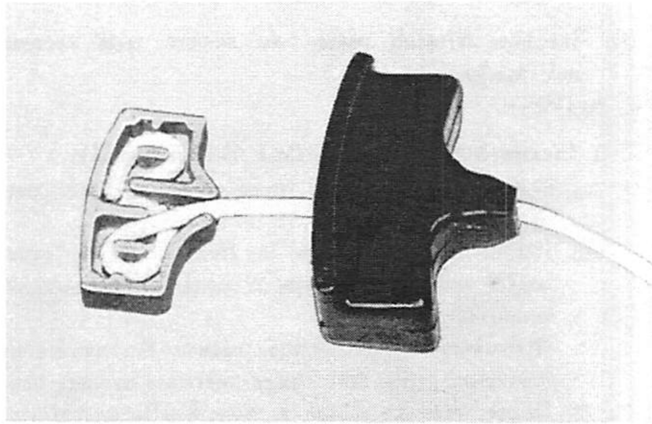


Figure 6. Installing Cable in New Starter Handle

18. Turn sheave shaft counterclockwise with screwdriver until handle is against guide bushing, then turn in additional 1¼ turns counterclockwise to wind spring to correct returning tension. (Figure 7)
19. With a ¾" open end wrench, turn down on sheave shaft nut until tight, while keeping screwdriver in slot in shaft to prevent spring from unwinding.
20. Bend one tab of washer down into hole of cover and one tab up to flat side of nut.
21. Replace auxiliary cover and secure with small screw.
22. Pull starter cord several times to see that pawls actuate correctly and that there is sufficient tension on starter spring.

    NOTE: Cord should be pulled out to full length to be sure that it does not stick when pulled out.
23. Replace entire starter housing assembly on top of unit and tighten.
24. Check that starter pawls engage auxiliary starter plate for proper operation.
25. Replace top cowl on engine and place small washers, large washers and elastic stop nuts on studs. Small washers fit against bushings. Tighten to secure top cowl.

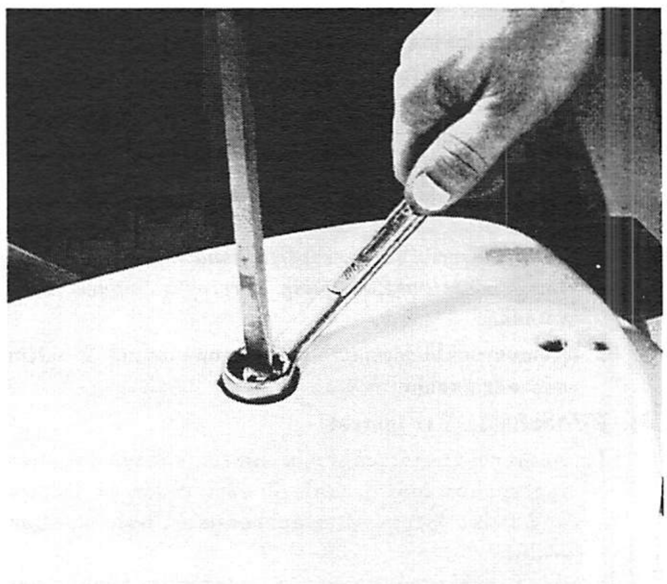


Figure 7. Preloading Starter Spring

MERCELECTRIC STARTING - - Positive Ground Type

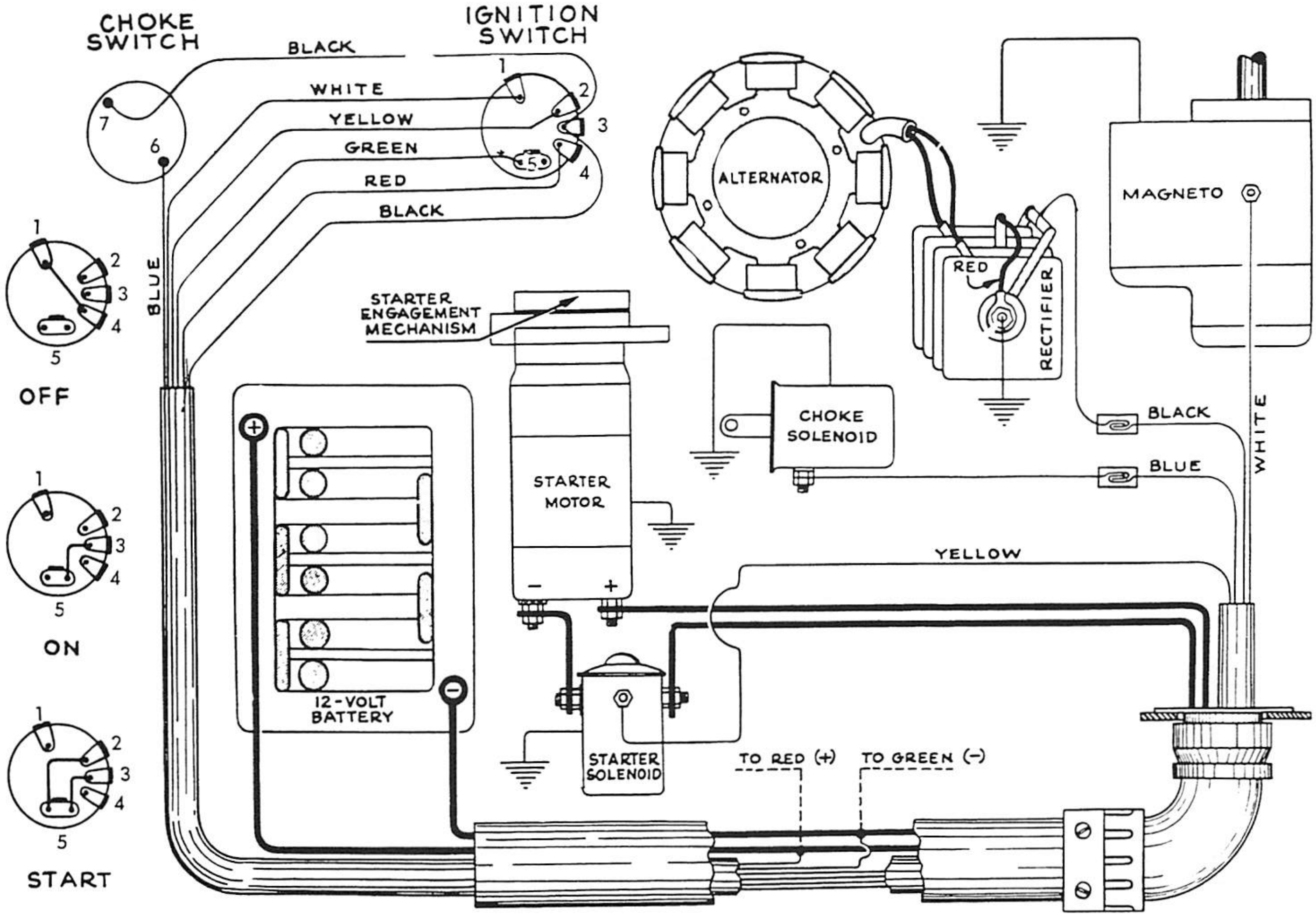


FIGURE 4. Mark 55E and Mark 50E Wiring Diagram (Positive Ground)

1. Terminal, ignition switch, white wire
2. Terminal, ignition switch, yellow wire
3. Terminal, ignition switch, black jumper wire
4. Terminal, ignition switch, red wire
5. Terminal, ignition switch, green wire
6. Terminal, choke switch, blue wire
7. Terminal, choke switch, black jumper wire

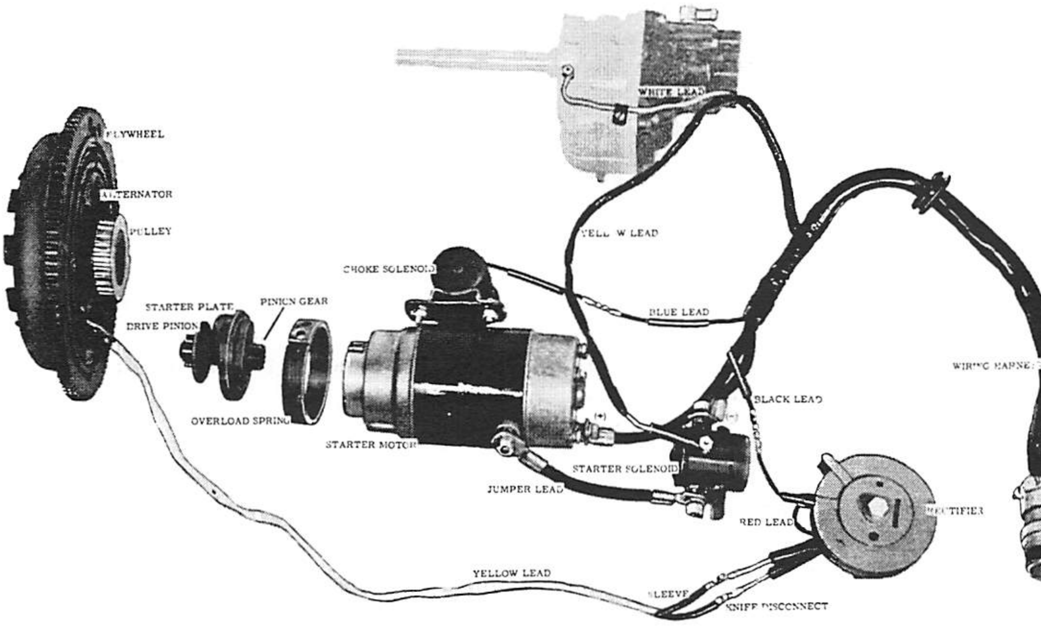


FIGURE 5. Electric Starter Assembly (Positive Ground), Mark 50E and Early Mark 55E

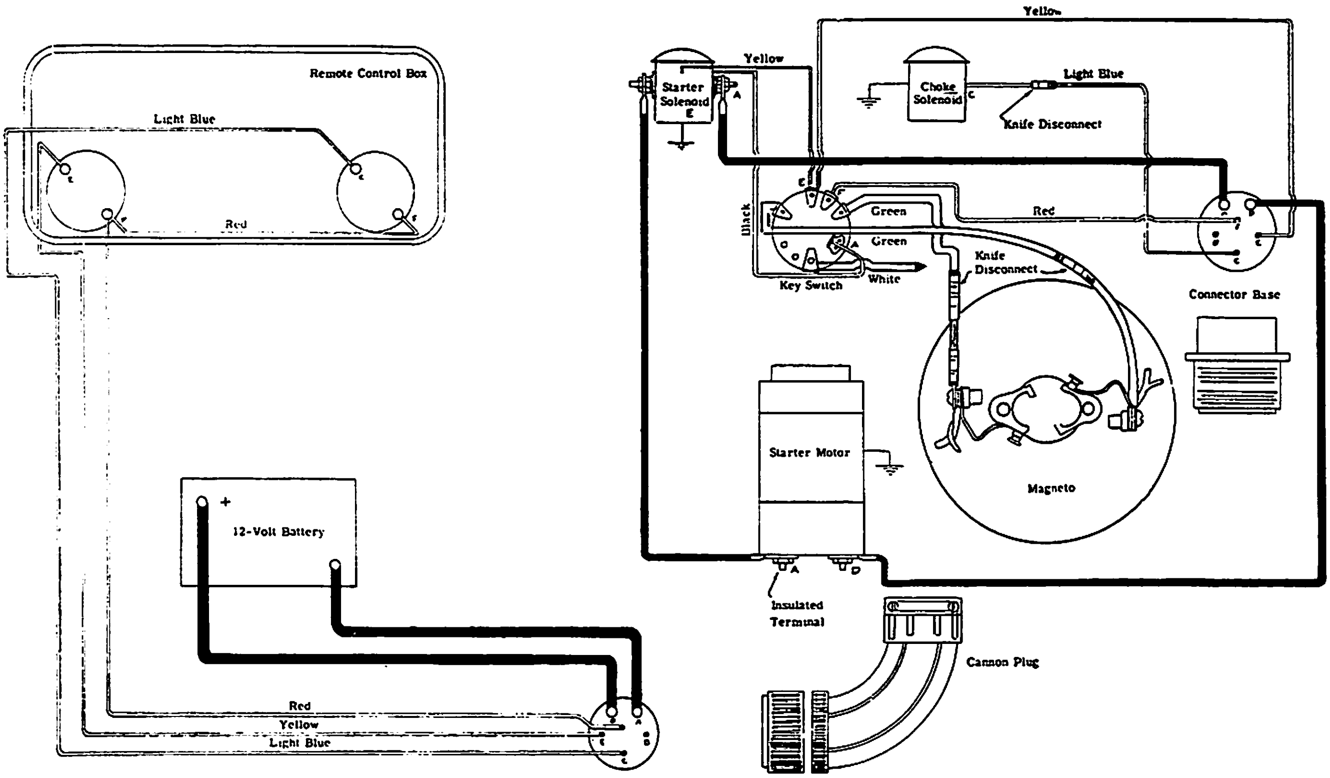


FIGURE 6. Mark 25E Wiring Diagram (Positive Ground)

A: Negative (−) battery cable, battery thru starter solenoid
B: Terminal, open
C: Choke solenoid lead, blue
D: Positive (+) battery cable, battery to starter motor
E: Starter solenoid lead, yellow
F: Ignition switch lead, red
Ground: Green lead to breaker assembly

ELECTRIC STARTING

A. Description

The smooth operating MercElectric starter is optional on late model Mercury outboards of higher horsepower. Motors equipped with MercElectric starting are distinguished by the letter "E" following the model number; e.g. Merc 400E, Mark 58AEL, Mark 75E, Mark 25E.

The electric starter system is a 12 volt type especially designed for outboard use. It is as simple and dependable as the starting system on your automobile. There are no adjustments to make.

B. Circuits

The MercElectric system on 4 and 6 cylinder motors consists of 4 circuits; on 2 cylinder motors, 3 circuits. (Figures 4 and 6) The generator circuit is not present on 2 cylinder models. The four circuits follow:

Generator Circuit (4 and 6 Cylinder Only): Within the flywheel are permanent magnets and a wound stator. The alternating current generated in the stator windings passes to the rectifier. This, in turn, produces direct current (DC) from the alternating current (AC). Negative side of rectifier is grounded; positive side goes to internal harness plug. Through the plug, the current passes on to the ignition switch in the control box and from there to the battery on the negative side. The positive side of the battery is connected through connector to ground of the engine.

Starter Circuit: The starter circuit consists of a 12 volt motor and starter engaging mechanism. A starter solenoid prevents the full starting current from passing through the ignition switch.

Choke Circuit: To operate choke, key must be in the ON (middle) or STARTING (right) position. While using electric choke, manual choke must be in down position; however, manual choke can be operated at all times if necessary.

Magneto Circuit: The engine is stopped by grounding the magneto, not by choking the engine. This is accomplished by turning key to OFF (left) position.

C. Starting and Stopping

For starting and stopping procedure with electric starter, refer to charts in Section I, General Information.

BATTERY AND ELECTRIC ACCESSORIES

A. Maintenance

A strong battery must be maintained. (Figure 7A) If battery shows less than 9½ volts when under starting load, it should be recharged. Check with DC voltmeter. A reading under 9½ volts (measured at the battery terminals under starting load) indicates insufficient voltage and subsequent shortage of power with result that motor will not turn fast enough to start.

Note: When installing a new battery, make it a habit to wire brush the tapered terminals and clamp terminals, then clean and grease them. This will protect against high resistance connections which make it difficult to keep the battery fully charged and may contribute to low available voltage in entire electrical starting system (and ignition system on 6-cylinder models).

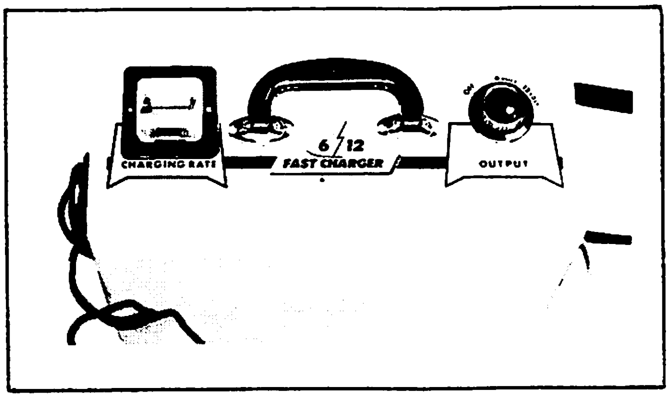


Figure 7. 6-and-12-Volt Battery Charger

A 12-volt full marine type Quicksilver battery of a minimum 70-ampere-hour capacity is recommended for all MercElectrics.

Note: Check can also be made with Hydrometer. (Figure 7A) If reading below 1.230 (specific gravity), recharge or replace present battery. Battery and battery readings in this manual refer to "Quicksilver" 12-volt battery.

WARNING

Lead acid batteries have an inherent, self-discharge characteristic which necessitates recharging when not in use every 30-45 days. Failure to do so will result in plate sulfation which will permanently damage the battery. The company cannot be responsible for battery damage either in winter storage or in dealer stock if the above information is not strictly complied with.

When adding distilled water to the battery, be extremely careful not to fill more than 3/16" above the perforated baffles appearing inside the battery. Battery solution or electrolyte expands from heat caused by charging. Overfilling the battery will cause the electrolyte to overflow if filled beyond 3/16" above the baffles.

If the specific gravity drops below 1.230, check the battery for reason and recharge battery. Battery recharge rate should not be over 4 amperes. When gravity reaches recommended gravity reading (see chart below), discontinue charging. (Figure 7A)

B. Ampere Capacity

New storage batteries, which are not initially fully charged, supply insufficient amperage and voltage capacity to the starting (cranking) motor and results in few engine starts before battery will no longer turn starter motor fast enough to start engine. If you do not have a battery charger in your service shop, have the local automotive garage check and recharge (at slow charge) all batteries in your stock before delivery to a customer so that optimum battery performance may be obtained.

If a dry-charge battery is put into outboard service, the battery should not be filled with an electrolyte until it is sold. After the battery has been filled, wait 15 minutes and check the specific gravity of each cell with a hydrometer. If the specific gravity drops below 1.230 in any cell, the battery should be brought up to full charge before being put into service. Bring battery to full charge with a slow charge for 2-to-3 hours at a 5-6 ampere rate.

C. Table of Gravity Readings

The specific gravity of the electrolyte in a charged battery, which contains approximately 39 percent sulphuric acid, is 1.290, while the specific gravity of a discharged battery, which contains approximately 14 percent acid, is 1.100. Specific gravity readings between these two extremes indicate various states of battery charge. Refer to the following tabulation which translates specific gravity into general terms of battery state of charge. The table is based on the battery's ability to crank the engine at 80° F. It is assumed that no electrolyte has been lost from the battery and that the adjustment at full charge is correct.

Capacity Reading*	Battery Condition
1.260 Sp. Gr.	100% Charged
1.230 Sp. Gr.	75% Charged
1.200 Sp. Gr.	50% Charged
1.170 Sp. Gr.	25% Charged
1.140 Sp. Gr.	Very Little Useful Capacity
1.110 Sp. Gr.	Discharged

* *Based on a temperature of 80° F. for 35190 battery.*

To obtain accurate measurements of the battery's state of charge, it is necessary to consider temperature as well as the specific gravity. The specific gravity of electrolyte varies not only with the amount of sulphuric acid in the solution but also with the temperature of the solution. As electrolyte is cooled, it contracts, becoming more dense and gaining specific gravity. When electrolyte is heated, it expands, becoming less dense and losing in specific gravity.

WINTER STORAGE OF BATTERIES

Battery companies are not responsible for battery damage either in winter storage or in dealer stock if the following instructions are not complied with:

Remove battery from its installation as soon as possible and remove all grease, sulfate and dirt from top surface. This can best be done by turning a hose on the top of the battery. Be sure, however, that vent caps are tight beforehand, and blow off all excess water thoroughly with compressed air. Check water level, making sure that plates are covered.

When adding distilled water to the battery, be extremely careful not to fill more than 3/16" above the perforated baffles appearing inside the battery. Battery solution or electrolyte expands from heat caused by charging. Overfilling the battery will cause the electrolyte to overflow if filled beyond 3/16" above the baffles.

Grease the terminal bolts well with cup grease or DC4 Compound and store battery in a COOL-DRY place. Remove battery from storage every 30-45 days, check water level, and put on charge for 5 or 6 hours at 6 amperes. DO NOT FAST CHARGE.

If the specific gravity drops below 1.230, check the battery for reason and recharge battery. When gravity reaches 1.260, discontinue charging. To check the specific gravity, use a hydrometer which can be purchased locally. (See illustration.)

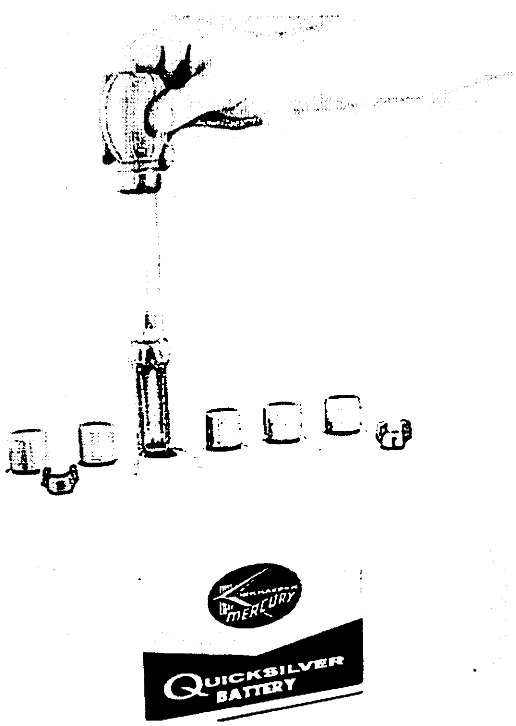


Figure 7A. Testing with Hydrometer

Repeat the preceding charging procedure every 30-45 days as long as battery is in storage. Adhering to this procedure is the best possible method of maintaining the battery during inactive periods and will insure a good serviceable battery in spring. When ready to place the battery back in service, remove excess grease from terminals (a small amount is desireable on the terminals at all times), recharge again as necessary, and reinstall in your equipment.

When charging 2 or more batteries, connect them in series, positive terminal of one to negative terminal of next.

WARNING! Hydrogen and oxygen gases are produced during normal battery operation or charging. Sparks or flame can cause this mixture to ignite and explode if they are brought near the vent openings. Sulphuric acid in the battery can cause serious burns if spilled on the skin or in the eyes. Flush or wash away immediately with clear water.

Batteries in Parallel

To increase the amperage hour capacity of a battery, connect two or more batteries together. The positive terminal of one battery is connected to the like terminal of second battery. Negative terminal is connected to negative terminal of second battery. Two 35 ampere hour capacity batteries in parallel are equal to 70 ampere hours.

Example: 35 + 35 = 70 Ampere Hours

70 + 70 = 140 Ampere Hours

Any electrical accessories, such as horns, running lights, etc, should be installed with electrical connections attached directly to clamps on battery terminals.

NOTE TO CONVERT ELECTRICAL ACCESSORIES:

The following electrical accessories, if manufactured for a 6-volt system, may be converted to a 12-volt system:

- Radio: Usually considerable internal modification. Refer most radios to radio expert only.
- Stove: Change 6-volt elements to 12-volt elements on some; on others, change impossible.
- Running Lights: Change to 12-volt bulbs or connect 2 identical bulbs in series.
- Search Light: Change to 12-volt bulb or 12-volt sealed element.
- Fuel Pump: Change to 12-volt fuel pump or consult manufacturer of pump on possible use of 6-volt pump on 12-volt system.
- Bilge Pump: See fuel pump (above).
- Horns: See fuel pump (above).

Rugged, attractive MercElectric Battery Boxes have been designed for Quicksilver Aircraft Type Batteries. The new battery boxes which can be mounted on the transom of most boats, 1) hold the battery snugly, 2) prevent damage to battery and boat, 3) protect battery cables, and 4) facilitate easy installation and removal of battery from box.

Caution! Operating 4-cylinder Merc-Electrics without battery: If it should be necessary to run without a battery connected to the engine, disconnect alternator leads (yellow) from the rectifier at the "knife" disconnects *provided for this purpose. Then tape the 2 alternator leads and 2 short rectifier leads individually and secure on engine to prevent breakage or short circuiting.*

NOTE: Battery terminal lugs and terminals on Quicksilver batteries incorporate a feature to prevent the possibility of errors in crossed leads. The positive terminal post has a 3/8"-16 stud, while the negative has a 5/16"-18 stud. Remote control electrical harness has 3/8" hole in positive lead, 5/16" hole in negative lead.

E. Twin Installation, 4-Cylinder MercElectrics

When operating two 4-cylinder MercElectrics on the same boat with one battery, it is imperative that only ONE engine's GENERATING UNIT be used to recharge the battery. With both alternators recharging the battery simultaneously, battery life will decrease or result in complete failure. One alternator, therefore, should be disconnected (as described in "CAUTION", above) when twin installation is made on a boat.

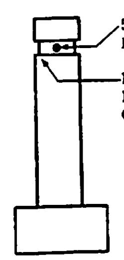
DISASSEMBLY OF STARTER MOTOR

All Mark 50E, Mark 55E below Serial No. 899950, Mark 30E below 950251 and Mark 25E below 956420

1. Remove positive (+) battery lead from starter motor lower end cap.
2. Remove jumper lead between starter motor and starter solenoid.
3. Bend down lock tab of washer and remove 5/16" hex head cap screw on starting mechanism drive pinion assembly.

   NOTE: On Mark 55E and Mark 25E, remove snap ring lock with Snap Ring Pliers (91-24283). Set expander lock in order not to over-stress ring during removal. Later models used washer and cotter pin in place of snap ring.

   IMPORTANT: Servicing Fastening Retaining Ring - Occasionally a retaining ring (53-24810) has become disengaged from the pinion gear and shaft and from the output gear and shaft in the starter motor and starter mechanism. In cases where this occurs, or when performing repair work on some other part of the starter motor, the shaft should be removed and drilled with a 5/64" diameter drill. Locate the hole in the center of the retainer ring groove, as shown on right, and insert cotter pin (18-20180). Replacement shaft and gears are drilled for cotter pin fastening.



4. Lift drive pinion gear off pinion gear shaft.
5. Remove 3 cap screws and lockwashers which hold starter mechanism plate to top of starter motor.

   NOTE: Hold starter motor when removing last of the 3 screws, as motor is loose once screws are removed. Pinion gear and shaft, also loose, may drop out of starter mechanism.
6. Remove upper end cap.
   a. Remove 2 nuts and washers from upper to lower end cap studs at bottom of starter motor.
   b. Tap lightly under end cap assembly with mallet to loosen from body and field, then pull off. Note that 6" studs are threaded into upper end cap and that insulator sleeves pull off bottom of studs and remain loose in lower end cap.
   c. Pull armature out of body and field with fingers or tip unit upside down and armature will fall out. Do not lose thrust washer on commutator end of armature shaft.
   d. Remove reduction gear from reduction gear output shaft by bending down tab washer and removing hex head cap screw.

   NOTE: On Mark 55E and Mark 25E engines, remove snap ring lock with Snap Ring Pliers (91-24283). Set expander lock in order not to over-stress ring during removal. Later models had flat washer and cotter pin. (Refer to "Fastening Retaining Ring" in Paragraph 1, preceding.)

   e. Remove reduction gear, thrust washer and reduction gear output shaft. Thrust washers are located on each side of upper end cap assembly.
   f. Press needle bearing from end cap assembly with body of Tachometer Bearing Tool (91-24101). *(Note: Oilite bearing from armature shaft is not replaceable, as it requires reaming after installation. Wear is negligible.)*
7. Remove lower end cap.
   a. Remove lower end cap assembly from body and field by tapping lightly against end cap to loosen.
   b. Remove field lead wire from lower end cap by removing screw, nut, flat washer, insulator washer and insulator bushing which secures wire to brush lead wire and cap.
8. Remove carbon brush and holder.
   a. Detach brushes from holders by removing screws, lockwashers and washers which hold brushes to brush holders.
   b. Remove screw which holds second brush lead wire to positive (+) terminal.
   c. Remove carbon brushes, holders and springs from brush holder post by pulling up on entire brush holder assembly.
   d. Detach brush holder post and spring holder post by turning cap upside down and, with a 1/8" drift punch and hammer, drive out the 4 posts.
   e. Use ¼" drift to remove 4 insulator bushings. Tap lightly, being careful not to damage bushings.
   f. Remove brush ground post in lower end cap by removing nut, lockwasher and flat washer. Tap post from bottom to remove.
   g. Oilite bearing is not replaceable, as it requires reaming after installation. Normal wear is negligible. If worn, replace end cap assembly.

DISASSEMBLY OF MERCELECTRIC COMPONENTS

All Mark 50E, Mark 25E and Mark 30E Engines and Mark 55E below Serial No. 1090100

1. Remove starter mechanism.
   a. Remove starter mechanism from crankcase flange. Do not lose locating dowel on models equipped with dowel.
   b. Remove overload spring from starter plate by bending back lock tabs on washer and removing 2 cap screws and double tab washer.
   c. Pull out pinion gear and shaft. Do not lose 2 thrust washers, one located on each side of starter arm.
   d. Remove starter arm assembly by driving starter arm roll pin out of starter plate. Pin holds starter arm pin in plate.
   e. Press out starter arm pin with arbor press.
   f. Remove starter arm spring.
2. Remove electrical harness, 4-cylinder MercElectrics (Figure 5).
   a. Remove nylon harness clip by detaching 5/16" cap screw, nut and washer from clip.
   b. Remove 10-32 screw from bottom cowl so that nylon clip which holds small white lead (magneto shorting wire) and clip which holds fuel inlet hose can be removed.
   c. Remove self-tapping screw and hex head nut which hold white lead to magneto body and primary ground terminal of magneto.
   d. Remove ground strap which is connected to rear mounting screw and to bottom screw of No. 3 transfer port.
   e. Remove negative (-) battery lead to starter solenoid.
   f. Remove single yellow lead to starter solenoid from harness.
   g. Remove black lead to rectifier via knife disconnect after sliding back rubber insulator sleeve.
   h. Remove positive (+) battery lead to starter motor.
   i. Remove blue lead to choke solenoid via knife disconnect.
   j. Remove 4 screws which secure wiring harness connector into cowling. *(Note: Rubber grommet on Mark 50E will pull out of 1-1/8" hole with harness.)* If nylon clamp is used in a 1-3/16" hole, clamp may be removed by squeezing with pliers. Be careful that harness leads do not catch on rectifier bracket, thus causing damage to lead wires while harness is being withdrawn.
3. Remove starter solenoid (Figure 5).
   a. Negative (-) battery lead was removed when harness was removed.
   b. Remove jumper lead.
   c. Remove 2 cap screws which hold starter solenoid to bottom cowl.

   NOTE: On Mark 25E, remove starter solenoid from bracket on top cylinder block. Note that solenoid is upside down. Remove ground strap for starter solenoid mounting screw from left rear top cowl bolt.
4. Remove rectifier (Figure 5).
   a. Remove 2 yellow alternator leads from yellow leads on rectifier at knife disconnects under insulator sleeves.
   b. Remove black lead from wiring harness, if not already detached.
   c. Detach rectifier from rectifier bracket by removing ½" hex head nut, lockwasher and steel clamp which hold choke and rectifier leads from wiring harness.
   d. Rectifier mounting bracket is held to fuel connector and bottom cowl by 7/16" hex head cap screws.
5. Remove choke solenoid (Figure 5).
   a. Remove blue lead from harness, if not removed previously.
   b. Remove cap screws which hold choke solenoid to starter motor, magneto adaptor or to top cowl.
   c. Remove connecting link rod from choke lever adaptor by removing link rod clevis clip.
   d. Choke plunger is ejected from solenoid when solenoid is removed and can be taken off link rod by removing second clevis clip.
6. Remove alternator (Figure 5).
   a. Remove elastic stop nut and washer, which hold alternator flywheel to crankshaft, with Universal Flywheel Holder (91-24937A1). Alternator is an integral part of the flywheel.
   b. Remove magneto driven pulley flange by removing 5/16" cap screw, flat washer and lock washer.
   c. Remove timing belt from driven pulley.
   d. Remove alternator flywheel with Flywheel Puller (91-24695A1).
   e. Remove flywheel, being careful not to damage timing belt.
7. Alternator Stator.
   a. Remove 4 screws and lockwashers which hold alternator generator to upper end cap assembly and lift off alternator stator.
   b. Remove self-tapping screw and clip which hold alternator leads to top of cylinder block (if leads are so fastened).

   NOTE: On first Mark 50E models, leads were 20" long and were clamped to rear screw of pressure housing with nylon clip and to right side of bottom cowl with 2 "S" clips to take up slack in leads.

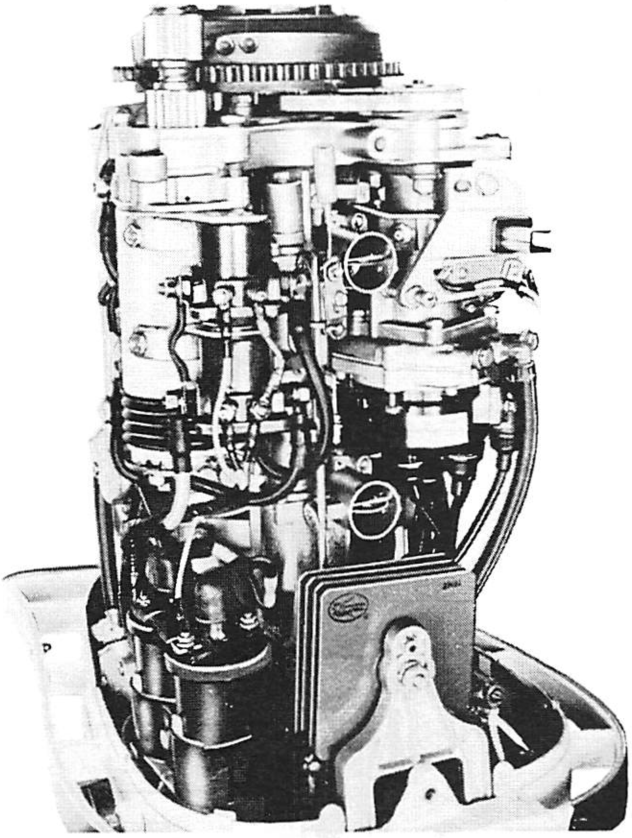


Figure 9A. Merc 700 Direct Reversing Powerhead

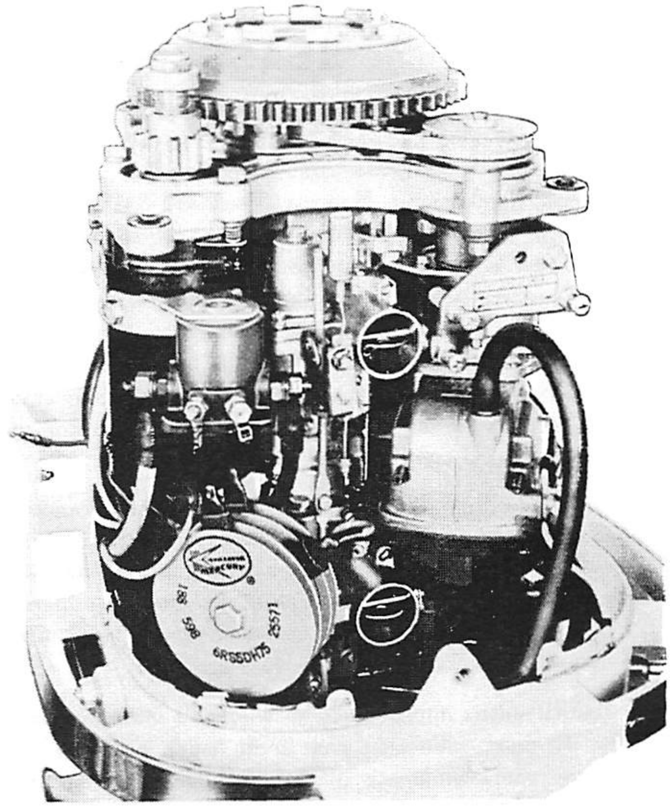


Figure 9B. Merc 400E Powerhead

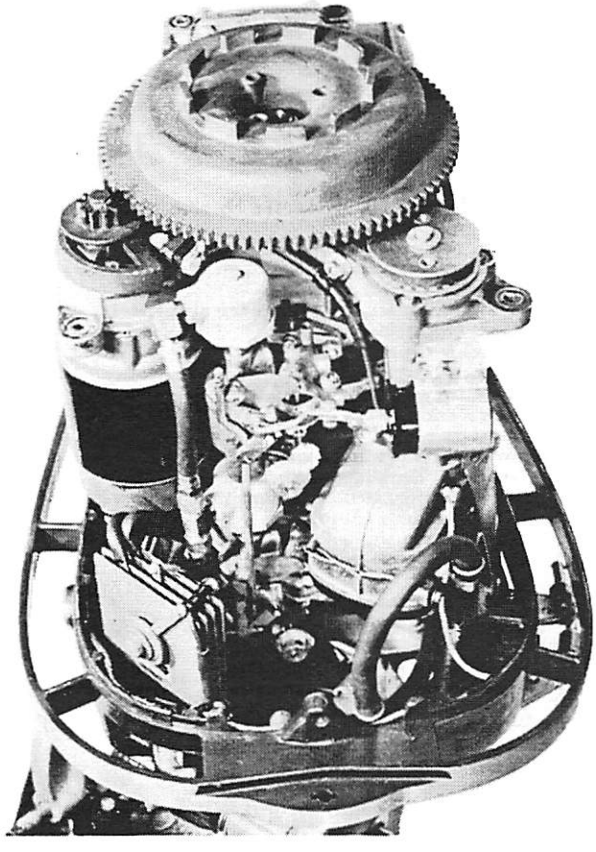


Figure 9C. Mark 50E Powerhead

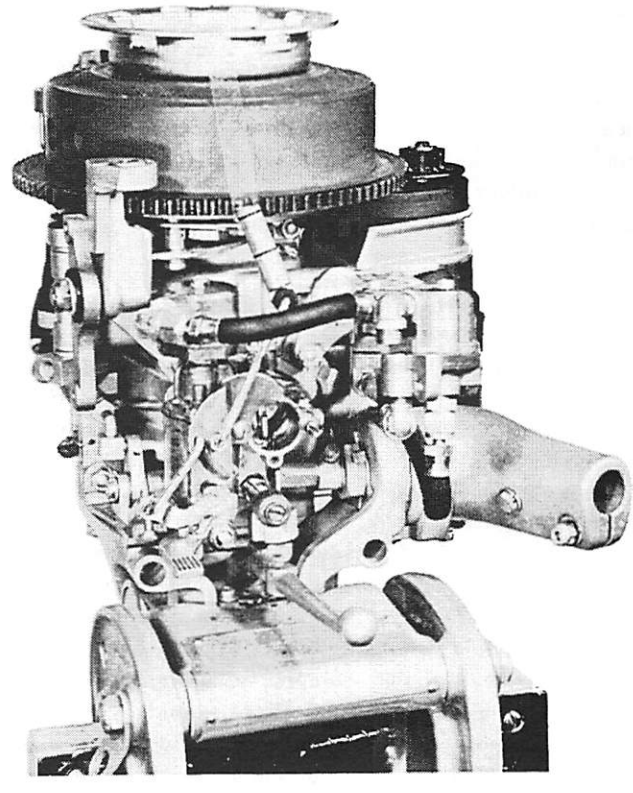


Figure 9D. Mark 25E Powerhead

REASSEMBLY OF STARTER MOTOR

All Mark 50E, Mark 55E Below Serial No. 899950, Mark 30E Below 950251 and Mark 25E Below 956420

Upper End Cap: Press needle bearing into upper end cap with Tachometer Bearing Tool (91-24101) body. Bearing is pressed even on both sides of end cap. Always press against number side of bearing. Lubricate needle bearing with Skelly Multipurpose Grease No. 2 or equivalent. Place thrust washer on reduction gear output shaft. Insert shaft into needle bearing from outside of cap. Place thrust washer and reduction gear on output shaft with small detent hole in gear facing up. Insert screw and tighten. Bend tab.

Note: On Mark 25E and 55E, replace snap ring lock with Snap Ring Pliers (91-24283). Snap ring pliers should be set so not to over-stress ring during installation. Be sure lock ring is seated in groove properly. On later models a cotter pin and washer are used. (See "Fastening Retaining Ring" in F, Page 9.)

Install entire upper end cap assembly onto field and body. Be sure reduction gear teeth mesh with teeth of armature gear. Studs are placed through holes in field and body. Tap cap lightly to seat.

Body and Field: The field winding is an integral part of the body. Inspect carefully for burned out winding, shorting or poor insulation. If insulated covering is burned or removed, or unit is shorted, it can be rewound at an electric motor repair shop, or it must be replaced.

Lower End Cap: Replace 4 insulator bushings and insulator bushing and brush ground post by pressing in from inside of lower end cap.

(Note: Larger insulator bushing is for brush lead and field winding lead attachment. Secure with flat washer, lockwasher and nut.) Press 2 brush holder posts and 2 spring holder posts into 4 insulator bushings. Two spring holder post holes are located in line with tips from oilite bearing recess. Spring holder posts have groove cut around center.

Brush Holders and Brushes: Replace carbon brush on brush holder with screw, lockwasher and flat washer. Place brush and brush holder with brush holder spring on brush holder posts. The brush holder spring fingers are retained in grooves behind carbon brush mounting lip. Opposite end catches in groove on spring holder post, causing brush holder assembly to tension against armature commutator.

Repeat above for second brush holder assembly.

Lead wire from one brush is secured to ground post with 8-32x3/8" screw. Lead wire from second brush and lead from field windings (see Body and Field, above, before proceeding) are secured to lower end cap with screw into insulator bushing. Place insulator washer on screw from outside of cap, following with flat washer, lockwasher and nut and tighten. Cover this connection on outside with Glyptal (General Electric Red Enamel No. 1201) for insulation. Glyptal may be obtained at any local electrical supply house.

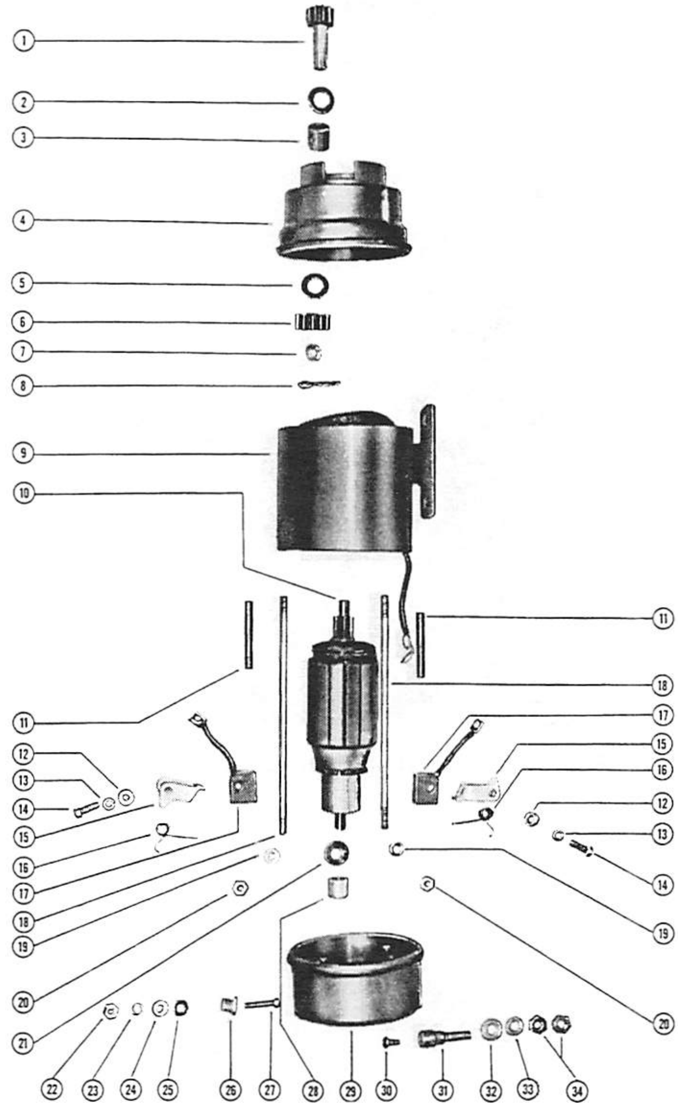


Figure 10. Electric Starter Motor

1 Ring, retaining—reduction gear to output shaft
2 Washer, reduction gear
3 Gear and shaft, output
4 Washer, thrust, output gear and shaft
5 Gear, reduction
6 Bearing, needle
7 End cap, upper
8 Bushing, oilite armature
9 Body and field
10 Armature
11 Sleeve, stud insulating
12 Washer, brush fastening screw
13 Lockwasher, brush fastening screw
14 Screw, brush to holder
15 Holder, brush
16 Spring, brush holder
17 Brush
18 Stud, end cap to body and field
19 Washer, starter stud
20 Nut, starter stud
21 Washer, thrust—armature
22 Nut, starter terminal
23 Lockwasher, starter terminal
24 Washer, starter terminal
25 Washer, insulating—starter terminal
26 Bushing, insulating
27 Screw, terminal
28 Bushing, oilite armature
29 End cap, lower
30 Screw, ground post
31 Post, ground
32 Washer, ground post
33 Lockwasher, ground post
34 Nut, ground post

Armature: Not much of the armature can be repaired. If commutator is worn, due to brush wear, it can be machined evenly and reinstalled with new brushes. This can be accomplished by any dealer having a lathe or regular armature reconditioning tool which can be purchased from a local automotive or tool supply store. The aforementioned armature reconditioning tool turns down the commutator and undercuts the mica. Undercut of mica should be approximately 1/32". After thorough inspection has been completed and armature is found to check out OK, or has been reworked, it can be reinstalled. Armature can be checked out on an armature growler. Any automotive garage can test armatures, or armature can be checked on Magneto Analyzer (91-25213). Check for continuity between commutator and windings. If continuity exists, winding is grounded and armature must be replaced. Place armature in body and field with commutator toward lower end cap and thrust washer on commutator end of armature. Spread brush and holders so that armature commutator will slide into position. Be sure thrust washer does not fall off. A minute spot of grease can be placed on thrust washer to prevent dropping off. Place insulator sleeves on studs. Align lower end cap stud holes with studs of upper end cap. Insert studs through holes in lower end cap and complete reassembly of starter motor by placing washer and nut on stud ends and tightening.

REASSEMBLY OF MERCELECTRIC COMPONENTS

(All Mark 50E and Mark 30E engines and Mark 55E below Serial No. 1090100.

A. Wiring Harness, 4 Cylinder Motors Only (Figure 11)

Install wiring harness through hole in front of cowl. Before positioning rubber grommet or nylon clamp holding harness in hole, run leads of wiring harness, except white lead to magneto, through leg of rectifier bracket. Position rubber grommet of harness in 1-1/8" hole of cowl. *(NOTE: If nylon clamp is used in place of grommet, position it in 1-3/16" hole.)* Install large nylon wiring harness clip on harness at inside end of rubber grommet near end of heavy plastic sleeve. Place 10-32 screw, nut and washer on nylon clip. Tighten screw, as clip does not connect to any part. Pull harness out from cowl until nylon clip touches rubber grommet, thus preventing harness from being pulled out of bottom cowl. Tape end of plastic sleeve with 3 turns of friction tape to prevent worn nylon clips from pulling off, allowing harness to pull out.

Note: On Mark 55E, electric harness assembly is attached to right side of bottom cowl with 4 small screws and nuts. Install 4 screws which secure connector into cowling.

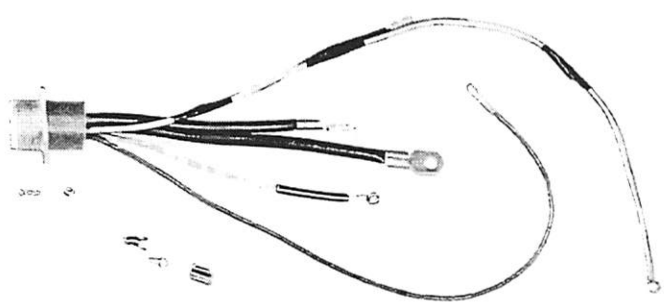


Figure 11. Electrical Wiring Harness, Mark 55E

Place nylon clip on white ground wire leading to magneto and place nylon cable clip on fuel line leading to fuel filter. Hold the 2 clips together with 10-32x½" screw and insert screw through small hole in bottom front cowl, fastening with nut and washer. Attach shorting wire (white lead) to magneto primary ground terminal with 5/16" nut. Fasten magneto shorting wire to magneto body with nylon clip and self tapping screw. *(Note: Be sure white lead has enough play for magneto movement.)*

Note: On Mark 25E, the internal wiring harness is secured to left cowl by 1) key switch bezel, 2) 4 screws securing connector to cowl, and 3) nylon clamp around lead wires fastened with metal screws. Blue (choke) lead is secured to cowl and attaches to choke with knife disconnects covered by sleeve. White lead is a ground. Eyelet is secured to cowl. Green leads to magneto breaker points are shorting wires to stop engine.

B. Starter Solenoid, 4 and 2 Cylinder Motors (Figure 12)

Attach yellow lead from wiring harness to small terminal of starter solenoid. Waterproof connection with Glyptal.

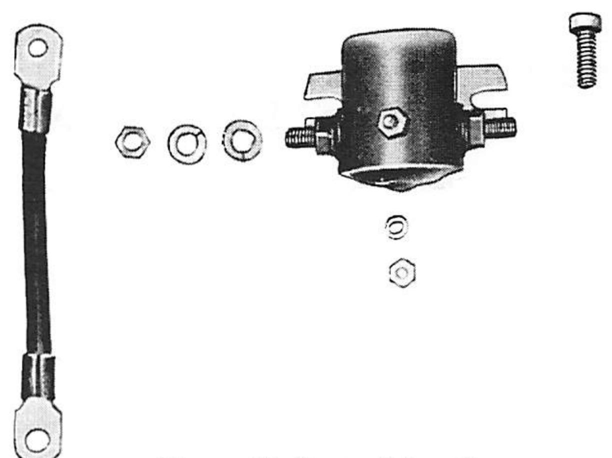


Figure 12. Starter Solenoid

Secure negative (-) battery lead to starter solenoid with nut and lockwasher. NOTE: This terminal is not marked. Positive (+) has plus (+) marked on terminal. Place negative (-) jumper lead on terminal at far end of starter solenoid with nut and lockwasher. Waterproof connections with Glyptal. Mount starter solenoid with 2 cap screws, washers, lockwashers and 2 nuts through 2 holes drilled in cowl. Attach electric grounding strap to rear mounting screw with opposite end of strap to bottom screw of No. 3 transfer port.

Note: On Mark 25E, mount starter solenoid onto bracket on top of cylinder block. Note that solenoid is upside down. Ground strap for starter solenoid attaches from solenoid mounting screw to left rear top cowl bolt.

C. Starter Mechanism, 4 and 2 Cylinder Motors (Figure 13)

Inspect parts for wear. If bushings in starter arm assembly are worn, replace assembly. Place spring in position around starter arm. Tips of spring recess in starter arm and starter plate. After correctly aligning spring, press starter arm pin into place with arbor press.

(Note: Starter arm long end is positioned "up" in order to push against overload spring. Groove of starter arm pin should line up with hole in side of starter plate for roll pin. Press in with arbor press.)

Drive roll pin into position. Place thrust washer on pinion gear and shaft. Insert pinion gear and shaft through starter arm. Lubricate with oil. Place thrust washer on shaft on top of starter plate. Place drive pinion gear assembly on splined shaft on pinion gear and shaft. Set tab washer on gear and insert screw several threads to hold shaft while reworking and installing starter motor. Unit is now ready for installation. Overload spring, screw and tab washer can be installed after starter mechanism has been secured to starter motor.

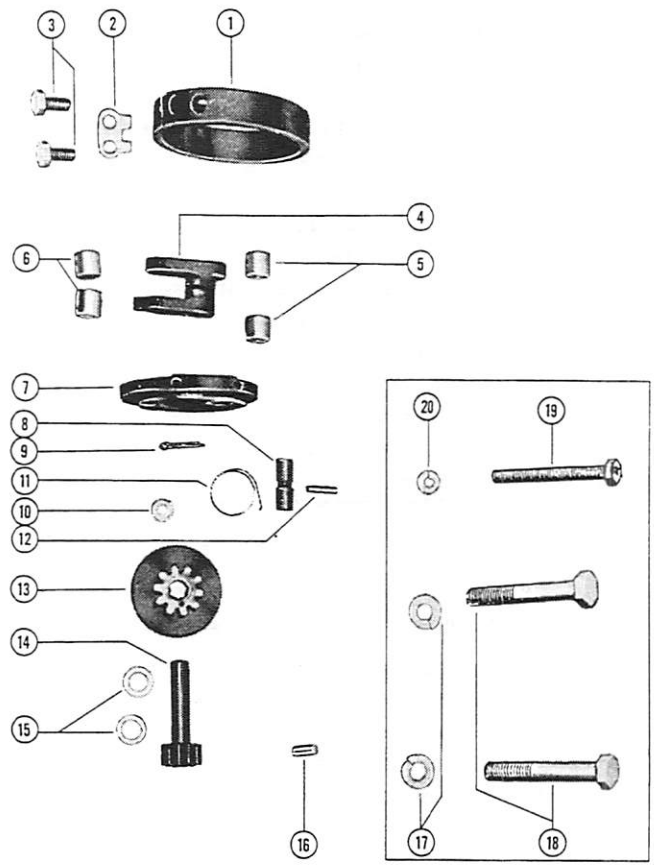


Figure 13. Starter Mechanism

1 Spring, overload	11 Spring, starter arm
2 Tab washer	12 Pin, roll
3 Screw	13 Drive pinion assembly
4 Arm, starter	14 Pinion gear and shaft
5 Bushing	15 Washer, thrust
6 Bushing	16 Pin, dowel
7 Plate, starter	17 Washer, splitlock
8 Pin, starter arm	18 Screw, hex head
9 Screw (or cotter pin or snap ring)	19 Screw, hex head
10 Tab washer	20 Lockwasher

INSTALLATION OF STARTER & COMPONENTS

A. Installing Starter Motor and Starter Mechanism, 4 and 2 Cylinder motors

Install dowel pin in hole at top of crankcase in starter motor mounting flange. Install starter mechanism assembly, engaging dowel pin into hole in starter plate. *(Caution: Plate must seat flat on machined surface of crankcase.)* Insert starter motor assembly through bottom of crankcase mounting flange. Remove screw, tabwasher and pinion gear (set on loose). With choke mounting bracket to the front (on Mark 50E only), hold starter motor assembly in place and secure starter motor and starter mechanism plate with the 3 cap screws and 3 lockwashers. Draw down cap screws securely. Place overload spring over starter mechanism plate, spreading with screwdriver if necessary. Position 2 holes in spring with 2 holes in starter mechanism plate. Insert 2 cap screws in double tab washer and thread into holes in starter mechanism plate. Bend tabs to secure. Insert drive pinion gear assembly and secure with tab washer and screw. Bent end of tab engages small hole in gear. Set tab.

Note: On Mark 25E and 55E, replace snap ring lock using Snap Ring Pliers (91-24283). Snap ring pliers should be set so not to over-stress ring during installation. Be sure lock ring is seated in groove properly. Later models have cotter pin and washer. (See "Fastening Retaining Ring" in F, Page 9.)

Connect positive (+) battery lead from wiring harness to bottom terminal (positive) of starter motor *(Caution: Be careful that terminal does not touch crankcase, causing a short.)* Connect negative (-) jumper lead from starter solenoid to starter motor negative terminal with lockwasher and nut. Coat with Glyptal.

B. Rectifier, 4 Cylinder Motors Only (Figure 14)

Rectifier converts alternating current (AC) supplied by alternator flywheel and alternator stator to direct current (DC) in order to recharge battery.

Important - Rectifier, Loss of Direct Current Output: Failure of rectifier to discharge a direct current (DC) indicates that it, or the alternator, is faulty. Rectifiers are usually rendered useless when battery leads of electrical control harness are connected to wrong battery terminals.

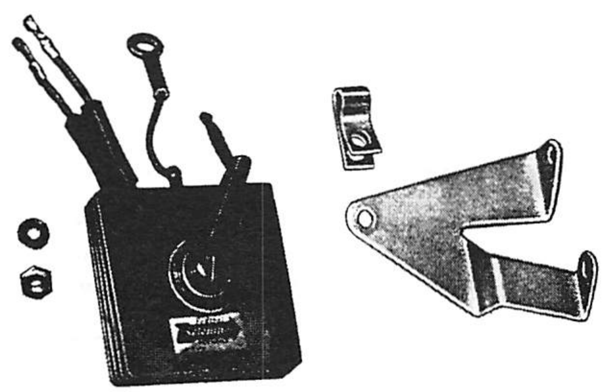


Figure 14. Rectifier

Connect black lead from rectifier to black lead from wiring harness with knife disconnects. Cover with insulator sleeve. Install rectifier to rectifier bracket, placing red ground lead on bolt between rectifier and rectifier bracket. Position rectifier so that red lead is up. Install rectifier to bracket. Place steel clamp around blue and black leads below knife disconnects. Place steel clamp on rectifier bolt and secure with lockwasher, washer and nut

NOTE: Round-shaped and square-shaped rectifiers are interchangeable.

C. Choke Solenoid, 4 and 2 Cylinder Motors (Figure 15)

Connect blue leads from choke solenoid and wiring harness with knife disconnects. Cover with insulator sleeves.

Note: On Mark 50E only, place nylon clip around yellow alternator leads and attach in lower choke solenoid mounting hole on starter motor with cap screw, large flat washer, lockwasher and nut. Set large washer in place on screw before installing. Do not tighten. Install choke solenoid to bracket on starter motor. Remove paint from face of starter mounting bracket to insure good ground. Choke solenoid bracket slides into lower screw, holding nylon clip and yellow alternator leads. Install upper screw, washer, lockwasher and nut and secure both screws.

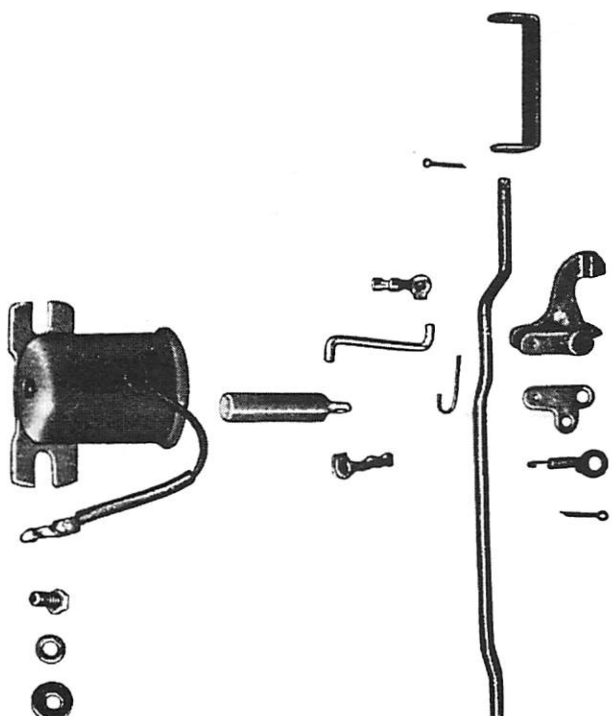


Figure 15. Choke Solenoid

Note: On Mark 55E only, install 2 cap screws to secure choke solenoid bracket to magneto adaptor housing. The opening faces toward carburetor. On Mark 25E only, install 3 screws to secure choke solenoid bracket to starter housing.

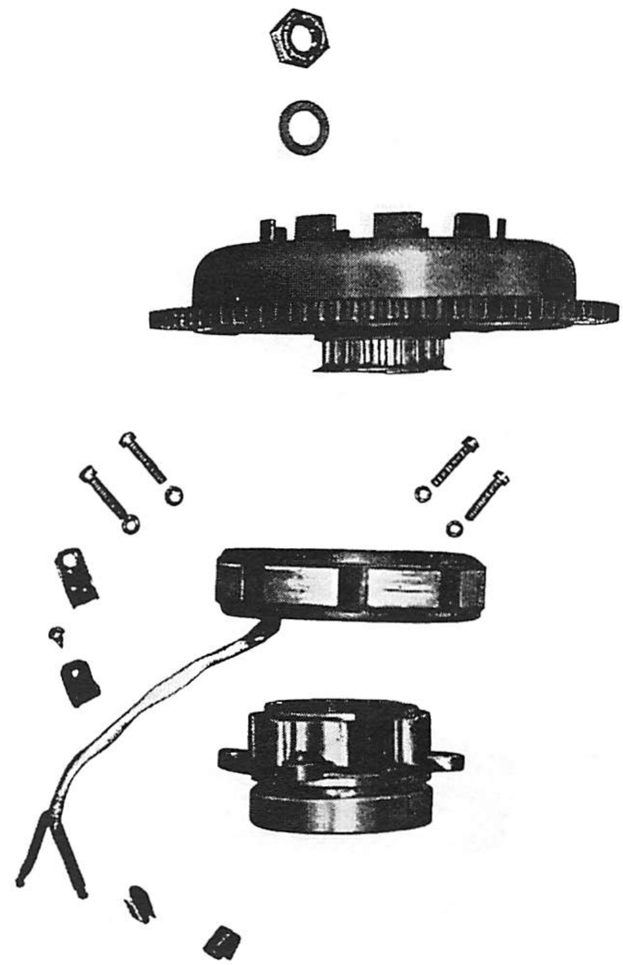


Figure 16. Alternator Stator

Install choke solenoid plunger into solenoid and connect to choke lever adaptor with connecting link rod and 2 link rod clevis clips. *(Important: Free movement of plunger is necessary. Tilt solenoid slightly in order to achieve free movement.)*

D. Alternator Stator, 4 Cylinder Motors (Figure 16)

Lay timing belt in 2 slots in upper end cap assembly. *(Note: It cannot be placed into position after alternator stator is installed.)* Install alternator stator with 4 screws and lockwashers. Lead wires are down, toward right rear side of motor. Place nylon clip on yellow alternator lead and fasten with self tapping screw and washer to hole at top of cylinder block. Connect yellow alternator lead ends to 2 yellow leads on rectifier and cover with insulator sleeves.

Note: For alternators with 20" leads only (first Mark 50E motors), place nylon clip on yellow alternator leads and fasten to rear screw of pressure valve cover. Install 2 "S" clips to right side of bottom cowl lip to take up slack. Place leads in these "S" clips. "S" clips are used only on alternators with 20" leads.

E. Alternator (Flywheel), 4 Cylinder Motors (Figure 16)

Install new drive pulley on flywheel, if removed, by pressing on with arbor press. Be sure locating dowel is installed. Position timing belt on flywheel pulley as flywheel is being placed on crankshaft. (See Figure 50, Section IV.) Pull opposite end of belt in order to maintain tension and to prevent belt from falling off. Place large, flat flywheel washer over crankshaft at top of flywheel and install elastic stop nut on crankshaft. Tighten to 65 ft. pounds with Torque Wrench (91-25667). (See Torque Specification Chart, Miscellaneous Section VIII.)

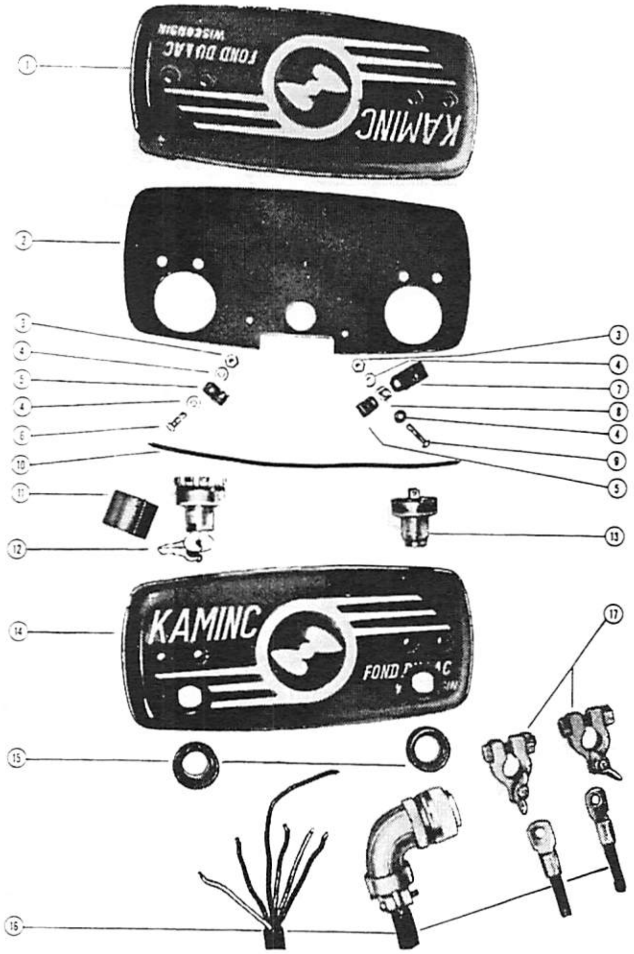


Figure 17. Electric Remote Control Assembly

Electric Remote Control Assembly

1 Housing, rear half
2 Plate, housing divider
3 Nut, cable clip screw
4 Washer, cable clip screw
5 Clip, choke wire to plate
6 Screw, cable clip
7 Clip, harness to plate
8 "D" washer, clip screw
9 Screw, cable clip
10 Wire, choke to starter switch
11 Cap, choke/starter buttons
12 Starter switch
13 Choke switch
14 Housing, front half
15 Bezel, starter button
16 Wiring harness
17 Terminals, battery

F. Remote Control, 4 and 2 Cylinder Motors (Figure 17)

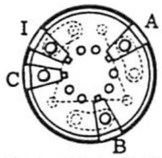
After parts have been thoroughly inspected, wiring and switches tested according to Trouble Chart, following, remote control is now ready for reassembly.

Lead wires from control wiring harness are to be soldered to starting switch.

Note: On Mark 55E and 50E, green lead is soldered to wider terminal on back side of switch. Place this wider terminal at bottom and solder. Installing counterclockwise, lead wires are green - red - black (solder 2 black lead wires together here; one leads to choke control switch) - yellow - white.

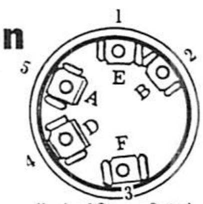
Wiring harness can be checked for broken or shorted wires by using Continuity Tester (91-22966) or Magneto Analyzer (91-25213). Place one lead of meter on plug end and opposite lead of meter on starting switch end of lead. Check to see that current flows through wire. If not, wire is shorted or broken. Check each individual lead the same way. (Refer to wiring diagrams, Figures 4 and 5, for correct leads and terminals and see Back of Starter Switch Diagram, Figure 18, and chart following.)

MercElectric Ignition & Starter Switches

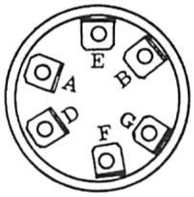


Back of Starter Switch
Switch No. 29060
6-Cyl. Models

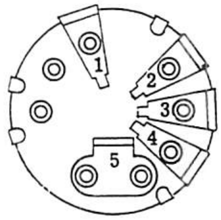
Back of Starter Switch
Switch No. 30163
6-Cyl. Models



Back of Starter Switch
No. 30162 (Letters)
No. 22569 (Numerals)
Embossed "INDAK"
4-Cyl. Models



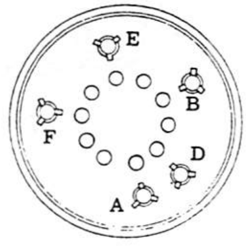
Back of Starter Switch
Switch No. 34198
Merc 350 (2-Cyl.)



Back of Starter Switch
Switch No. 29566
Mark 55E-50E-30E-25E

Position	Connects Terminals	Models
Off	E & D 1 & 4 1-4-6 No Contact E-D-G	All 4-Cyl. 1958 & Newer Mark 55E-50E-30E Mark 25E All 6-Cyl. Models Merc 350 (2-Cyl.)
Run	A & F 3 & 5 B-A-I A-F	All 4-Cyl. 1958 & Newer Mark 55E-50E-30E-25E All 6-Cyl. Models Merc 350 (2-Cyl.)
Choke	B-A-I-C	Merc 800-700-600 Dir. Rev.
Start	A-F-B 2-3-5 2 & 5 B-A-I-C* B-A-I A-F-B	All 4-Cyl. 1958 & Newer Mark 55E-50E-30E Mark 25E All 6-Cyl. but 800-700-600 D.R. Merc 800-700-600 Dir. Rev. Merc 350 (2-Cyl.)

* *Merc 800-700-600 Full Gear Shift in Neutral*



Back of Starter Switch
Plug-In Type, Switch Nos. 29061 and 30590, 4-Cyl. Models

Figure 18. Back of Starter Switches

RECTIFIER CHECK

A. REASONS FOR RECTIFIER FAILURE

1. Reversed battery wires.
2. Stopping engine with ignition switch at RPM's above idle.
3. Open circuit, such as broken wire, loose connection, bad switch or loose harness connector at engine.

B. HOW TO CHECK FOR OPEN CIRCUIT

1. Connect remote control to engine.
2. Disconnect BATTERY terminals from battery.
3. Use Merc-O-Tronic Tester (91-25213) set to scale No. 3. (Figure 1)
4. Connect 2 small test leads together and adjust meter for "ZERO".
5. Connect one test lead to Red (center) wire of rectifier.
6. Connect other test lead to "RED" BATTERY cable.
7. Turn ignition switch of remote control to "ON" position. Meter should move to right to "ZERO". IF WIRING IS GOOD, METER HAND ALWAYS WILL REMAIN AT RIGHT HAND "ZERO", WHILE IGNITION SWITCH IS IN "ON" POSITION, WHEN BELOW TESTS ARE BEING MADE. IF IT DOES NOT, FAULT MUST BE FOUND AND CORRECTED OR NEW RECTIFIER ALSO WILL BE BURNED OUT.
8. Turn ignition switch "ON" and "OFF" several times and make sure that pointer moves to "ZERO" each time that switch is turned "ON". If it does not, high resistance will be present and must be found or a new rectifier also will fail.
9. With ignition switch "ON", move external wiring harness back and forth, up and down, to check for breaks in wiring. Meter should remain at "ZERO" if harness is good.
10. Move red wire on rectifier back and forth, up and down. Meter should remain at "ZERO" if lead is not broken.
11. Remove test lead from "Red" BATTERY cable and connect to "Black" BATTERY cable.
12. Remove other test lead from "Red" (center) wire of rectifier and connect center ground stud of rectifier.
13. Move internal harness back-and-forth, up-and-down to check for breaks in wiring. Meter should remain at "Zero" if harness is good.
14. Move external harness back-and-forth, up-and-down to check for breaks in wiring. Meter should remain at "Zero" if harness is good.
15. Disconnect meter from engine and harness, reconnect battery terminals and engine is ready for use.

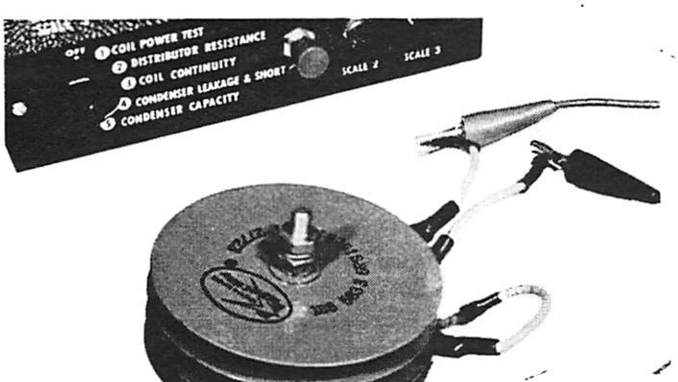


Figure 1. Testing Rectifier

C. RECTIFIER TEST PROCEDURE

Two types of rectifiers are used, the plate type and the diode type. The following methods may be used to test them.

TESTING PLATE TYPE

(By Measuring Direct Current Resistance on Magneto Analyzer) (Figure 1)

1. Set selector switch on Position No. 3 (Continuity).
2. Clip small red and black test leads together and turn meter adjustment knob for Scale No. 3. until meter pointer hand lines up on net position on Scale No. 3, right side.
3. Connect small red and black test leads from analyzer to:
   a. Black wire and red wire on positive ground type rectifiers or
   b. Red wire and ground bolt on negative type rectifier.
4. Note reading of figures on lower band, Scale No. 3.
5. Reverse test leads on rectifier and note readings again.
6. Ratio of two readings should be 10:1 or greater.
7. Remove analyzer test leads and connect to the two alternator leads or lead terminals on rectifier. Note reading of figures on lower band, Scale No. 3.
8. Reverse test leads on rectifier and note readings again.
9. The ratio of the two readings should be no more than 2:1.
10. This is only a preliminary test to determine condition of rectifier. If questionable, as a final test, rectifier should be installed on engine and checked with ammeter while engine is running.

TESTING DIODE RECTIFIER

1. Turn Magneto Analyzer selector switch to position No. 3 (Coil Continuity) and connect small red and black test leads together.
2. Turn meter adjustment knob for Scale No. 3 until meter pointer lines up on right side (set position).
3. Testing positive diodes
   a. Connect small red test lead to either alternator terminal and connect black lead to positive terminal of rectifier. (Figure 2) Meter pointer should move to right of Scale No. 3.
   b. Reverse test leads on rectifier. Meter pointers should remain stationary at left side of Scale No. 3.
   c. Repeat Steps "a" & "b" on the opposite alternator terminal.
   This will determine condition of positive diodes.
4. Testing negative diodes
   a. Connect small red test lead to either alternator terminal and connect black test lead to rectifier

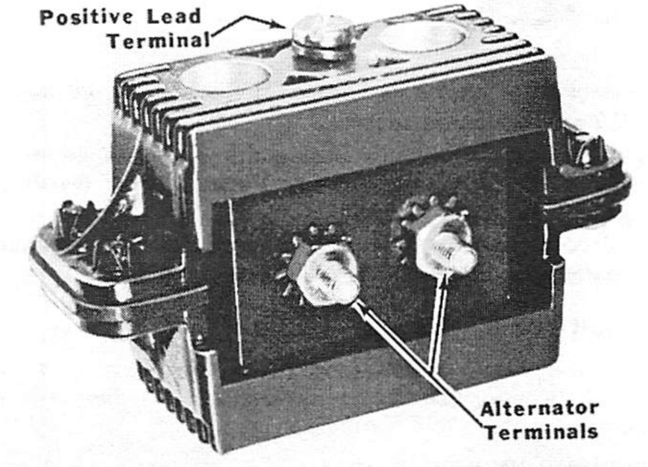


Figure 2. Testing Positive Diodes

ground stud. (Figure 3) Meter pointer should remain stationary at left side of Scale No. 3.

b. Reverse test leads on rectifier. Meter pointer should move to right side of Scale No. 3.

c. Repeat Steps "a" & "b" on opposite alternator terminal. This will determine condition of negative diodes.

NOTE: If any of the diodes do not check good, rectifier is defective and must be replaced.

Caution: Do not attempt to check polarity of battery leads by "sparking" lead terminals against battery terminals. This action may result in a burned-out rectifier.

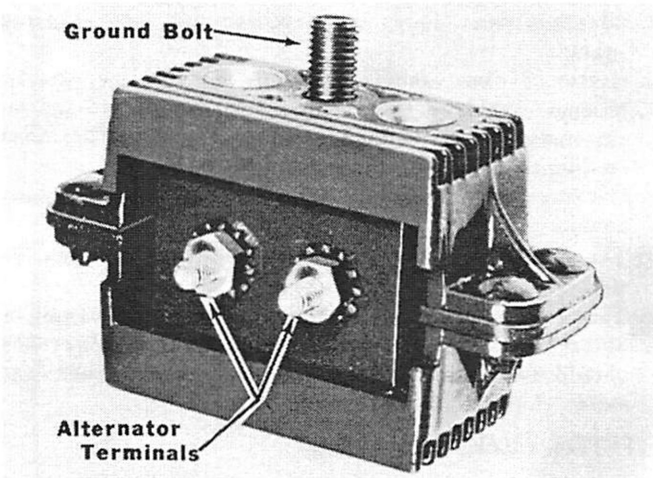


Figure 3. Testing Negative Diodes

FINDING CAUSE OF TROUBLE: Burned-out rectifiers are greatly discolored and/or have a "baked" appearance. Unless condition which caused failure is corrected, new rectifier will provide no better service than old rectifier. See Section VII for analysis of rectifier failure.

Rectifiers usually are rendered useless (burned-out) when battery leads of the electrical control harness are connected to the wrong terminals on the battery, or if battery leads are disconnected from battery terminals during operation of motor. Burned-out rectifiers are greatly discolored and/or have a "baked" appearance.

The Kiekhaefer Corporation will not honor warranty on any rectifiers which are burned out, as described above.

D. REPLACEMENT RECTIFIER AND ASSEMBLY (A-25571A1) NEGATIVE (-) GROUND

The A-22507A1, A-22692A1 and A-25448 positive (+) ground type rectifiers are no longer available and are no longer available and are replaced by a negative (-) ground type rectifier assembly (A-25571A1).

NOTE: Rectifier assembly A-25571A1 has been superceded by rectifier replacement assembly A-32970A1. See paragraph E below.

Replacement of a positive ground rectifier with a negative ground rectifier requires that the battery leads on the A-22631 series remote controls be reversed.

Each A-25571A1 rectifier will have a yellow tag containing the preceding information. This tag should not be removed from the rectifier when installed. A small piece of green tape will accompany the new rectifier to be placed on the negative ground battery lead.

The 2 yellow leads, side-by-side on the rectifier, are for alternator leads attachment. The black lead attaches to the black lead of the internal harness (on motors formerly with positive ground). The ground wire, formerly attached to the thru bolt, is no longer used, as grounding is now accomplisted through the center bolt (internally).

CAUTION! Failure to connect leads properly will result in a burned-out rectifier.

E. RECTIFIER REPLACEMENT ASSEMBLY (A-32970A1)

When replacing early style (large) rectifier (A-25571, A-25571A1 and A-25571A2) with late style (small) rectifier use the accompanying lead wires as follows:

1. Attach red extension lead to rectifier output (red) terminal. Secure with 10-32x¼" screw and nut. Paint terminal and screw with Liquid Neoprene (C-92-25711).
2. Slide rubber sleeve over red extension lead and position over rectifier terminal.
3. Connect red extension lead (knife disconnect end) to internal harness red lead terminal. Position rubber sleeve over knife disconnect.
4. Attach yellow extension leads to rectifier input (yellow) terminals. Secure with 10-32x¼" screws and nuts. Paint terminal and screw with Liquid Neoprene (C-92-25711).
5. Slide rubber sleeves over yellow extension leads and position over rectifier terminals.
6. Connect yellow extension leads(knife disconnect ends) to yellow alternator leads. Position rubber sleeves over knife disconnects.

NOTE: Some models have spade disconnects on yellow alternator leads. Remove spade connectors, install knife disconnects, crimp securely and solder with resin core solder and connect leads as outlined immediately preceding.

ALTERNATOR

TESTING ALTERNATOR

1. Alternator may be tested without removing flywheel.
2. Disconnect 2 yellow alternator leads from rectifier.
3. Turn selector switch of Magneto Analyzer to Position No. 2.
4. DO NOT clip small red and black leads together.
5. Turn No. 2 Scale meter adjustment knob to adjust meter needle with red line on right side of Scale No. 2.
6. Connect small red and black test leads to terminals of yellow alternator leads.
7. Read figures on Scale No. 2. Refer to specification chart, below, for model being tested. If alternator does not meet specifications, it should be replaced.

ALTERNATOR SPECIFICATIONS

Model	Ohms
All 6-Cyl. except Late Merc 1000-850	.4 to .6
Late Merc 1000-850	.35 to .45
All 4-Cyl. except Merc 650	.25 to .35
Merc 650	.35 to .45

IGNITION REPLACEMENT KEY & COIL

IGNITION KEY REPLACEMENT

Ignition key serial numbers for MercElectric motors should be recorded by the user. In event key is lost, a new one may be ordered directly from the Kiekhaefer Corporation, but only if key number is provided. In event correct serial number of key is not provided, it will be necessary to purchase a new key and switchlock assembly. (NOTE: Only the key [not the switch] has the number stamped on it.)

IGNITION COIL REPLACEMENT, 6-CYL. MODELS

1. Do not install a 26433 Delco ignition coil on Merc models which use 32193 Autolite coils, because ignition wiring system differs in that it uses ignition coil ballasts rather than resistors. Coils are not connected as on earlier 6-cylinder models.
2. Six-cylinder models, which use 32193 (Autolite) coils, employ starter solenoid 32082 or 28062 which are not interchangeable with "switch" type starter solenoids used on some other 6-cylinder models.

BATTERY METER INSTALLATION

FOUR (4) CYLINDER MODELS

1. Disconnect red rectifier lead at knife disconnect and discard present rubber sleeve. Place new rubber sleeve over either lead and hook one furnished knife connector to each lead.
2. Connect one wire from battery meter "IGN" terminal to ring terminal furnished and connect all 3 together with nut and screw provided. Slide rubber sleeve over this connection to provide insulation.
3. Connect second wire from battery meter "GROUND" terminal to a clean metal ground.

SIX (6) CYLINDER MODELS

1. Connect one wire from battery meter "IGN" terminal to bottom terminal of terminal block on right side of engine (located on upper fuel pump mounting pad).
2. Connect second wire from battery meter "GROUND" terminal to suitable engine ground (mounting screw for terminal block).

   Battery meter will indicate system voltage only when ignition key is in "RUN" or "START" position. Instrument reaction is slow, requiring approximately one minute warmup period.

3. On earlier models without terminal block, follow "Four Cylinder Model" procedure, which substitutes ring terminals for knife disconnects provided.

STARTER ARM REPAIR

(From Service Bulletin 2, Section VII)

Super oilite bushings, Part Nos. 23-22602 and 23-22530, are available for replacing worn starter arm bushings.

Bushing 23-22602 (¼" long) is pressed into open end of arm. Bushing 23-22530 (5/16" long) is pressed in opposite end.

The bushings must be pressed flush with outside surfaces and then line reamed. A sharp reamer is necessary to clean the hole without plugging the lubricating pores. Use a 3/8" diameter expansion hand reamer and adjust with micrometer. Line ream to .375" - .376" diameter after installing bushings.

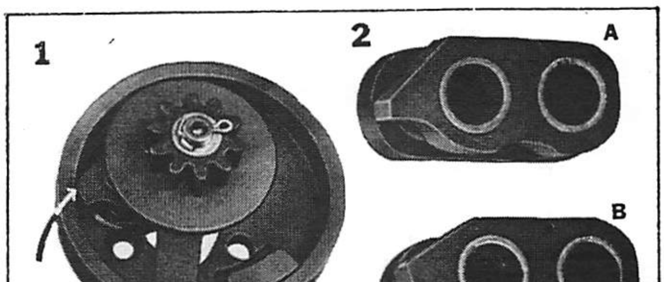


Figure 4. 1) Greasing Point on Overload Spring and 2) 22422A1 Starter Arm, "A", and 23881A1 Starter Arm, "B"

STARTER SOLENOID

Identification: Two types of starter solenoids are used on Mercury Outboard Motors, 1) standard type and 2) switch type. Although they have the same general external appearance, internal construction is different and they are not interchangeable. The following wiring diagrams (Figures 5-6) will illustrate internal construction of each.

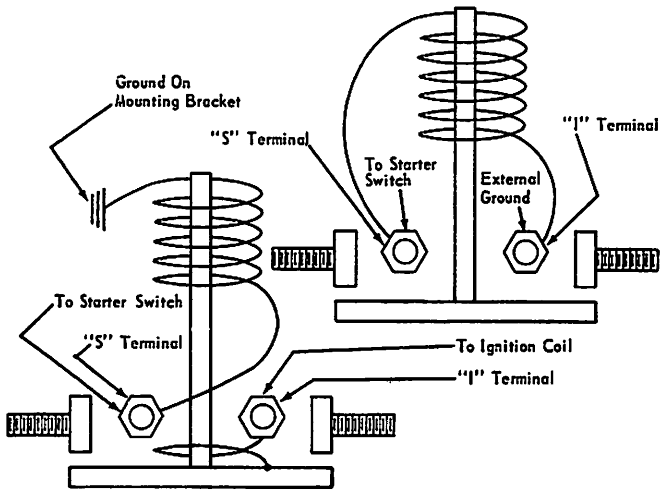


Figure 5 (Top, Rt.). Standard Type Starter Solenoid
Figure 6 (Bottom). Switch Type Starter Solenoid

If, for any reason, solenoid cannot be identified, the following methods may be used for easy identification:

A. Using Magneto Analyzer

1. Turn Magneto Analyzer selector switch to position No. 2 (Distributor Resistance).
2. DO NOT clip small red and black lead together.
3. Turn No. 2 scale meter adjustment knob to adjust meter needle with red line on right side of scale No. 2.
4. Connect small red test lead to "S" terminal and black test lead to "I" terminal.
5. An ohm reading of 3.5 to 5.5 (Scale 2) indicates a standard type solenoid. If meter pointer hand remains stationary, this will indicate that it is a switch type solenoid.

B. Using 12-volt Battery

1. Connect jumper leads to 12-volt battery.
2. Connect positive jumper lead to small "S" terminal.
3. Touch negative jumper lead to "I" terminal. If solenoid engages (a clicking sound), this indicates a Standard Type Solenoid.
4. If solenoid did not engage, touch negative jumper lead to mounting bracket. If solenoid then engages (a clicking sound), this indicates a Switch Type Solenoid.
5. After solenoid has been identified, use the following test procedure to test solenoid.

TESTING STANDARD TYPE SOLENOID

1. Turn selector switch of Magneto Analyzer to Position No. 2 (Distributor Resistance) and clip small red and black lead together.
2. Turn meter adjustment knob for Scale No. 2 until meter pointer lines up with set position on left side of "OK" block on Scale No. 2.
3. Unclip small red and black leads.
4. Connect small red test lead to one large terminal of solenoid and connect small black test lead to other large terminal as shown in Figure 7.
5. Using 12-volt battery and jumper leads, connect positive lead to small "S" terminal of solenoid.
6. Connect negative battery lead to "I" terminal of solenoid.
7. Meter pointer hand must move into the "OK" block, or solenoid is defective and must be replaced.

CAUTION: Do not connect battery leads to large terminals of solenoid, or meter will be damaged.

TESTING SWITCH TYPE SOLENOID

1. Turn selector switch of Magneto Analyzer to Position No. 2 (Distributor Resistance) and clip small red and black lead together.
2. Turn meter adjustment knob for scale No. 2 until meter pointer lines up with "set" position on left side of "OK" block on Scale No. 2.
3. Unclip small red and black leads.
4. Connect small red test lead to one large terminal of solenoid and connect small black test lead to other large terminal, as shown in Figure 7.

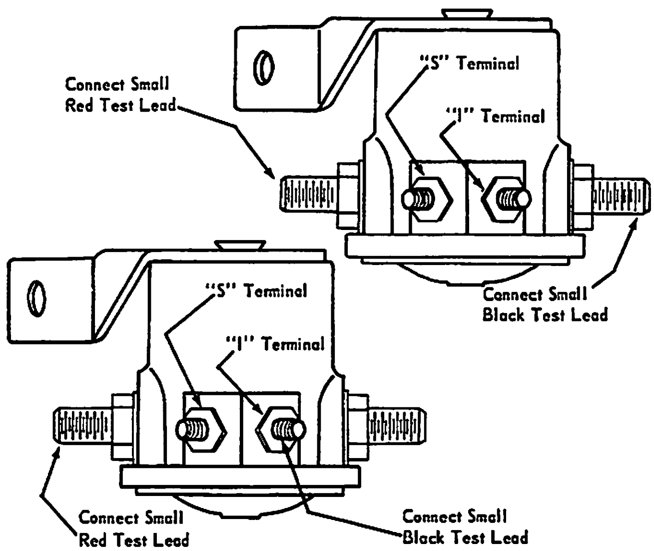


Figure 7 (Top, Rt.). Terminals on Standard Solenoid
Figure 8 (Bottom). "I" Terminal on Switch Solenoid

5. Using 12-volt battery and jumper leads, connect positive lead to small "S" terminal of solenoid.
6. Connect negative battery lead to mounting bracket of solenoid.
7. Meter pointer must move into "OK" block or solenoid is defective and must be replaced.
8. Remove one test lead from large terminal and connect to small "I" terminal of solenoid, as shown in Figure 8.
9. Again, meter pointer must move into "OK" block, or solenoid is defective and must be replaced.

CAUTION: Do not connect battery leads to large terminals of solenoids, or meter will be damaged.

MERCELECTRIC TESTING & TROUBLE CHART

Trouble	Cause	Remedy
Starter does not operate.	Run down battery	(1) Check battery with hydrometer. If reading is below 1.150, recharge or replace battery. Use Battery Charger 91-28997.
	Poor contact at terminals	(2) Remove terminals, scrape clean and tighten bolts securely. Coat with sealer to protect against further corrosion.
	Wiring or key switch	Check for resistance between: a) Positive (+) terminal of battery and large input terminal of starter solenoid; b) Large wire at top of starter motor and negative (-) terminal of battery; and c) Small terminal of starter solenoid and positive battery terminal (key switch must be in "Start" position). Repair all defective parts.
	Starter solenoid	Disconnect wire from starter solenoid to starter motor. With key switch in "Start" position, check resistance between 2 large terminals of starter solenoid. Replace a defective solenoid.
	Starter motor	(3) With a fully charged battery, connect a negative (-) jumper wire to upper terminal on side of starter motor and a positive jumper to large lower terminal of starter motor. If motor still does not operate, dismount for overhaul or replacement.
Starter turns over too slowly.	Low battery	Complete (1) preceding.
	Poor contact at battery terminal	Complete (2) preceding.
	Poor contact at starter solenoid or starter motor	(4) Check all terminals for looseness and tighten all nuts securely.
	Starter mechanism	Disconnect positive (+) battery terminal. Rotate pinion gear in disengage position. Pinion gear and motor should run freely by hand. If motor does not turn over easily, clean starter and replace all defective parts.
	Starter motor	Complete (3) preceding.
Starter spins freely but does not engage engine.	Low battery	Complete (1) preceding.
	Poor contact at battery terminals	Complete (2) preceding.
	Poor contact at starter solenoid or starter motor	Complete (4) preceding.
	Dirty or corroded drive pinion	Clean thoroughly and grease the spline underneath pinion with MULTI-PURPOSE Lubricant (92-30239).
Starter does not engage properly.	Pinion or flywheel gear	Inspect mating gears for excessive wear. Replace all defective parts.
	Small anti-drift spring	If drive pinion interferes with flywheel gear after engine has started, inspect small anti-drift spring located under pinion gear. Replace all defective parts. *(NOTE: If drive pinion tends to stay engaged in flywheel gear when starter motor is in idle position, start motor at ¼ throttle to allow starter pinion gear to release flywheel ring gear instantly.)*
	Starter arm sticks against overload spring	Grease overload spring at point where starter arm contacts overload spring. (Refer to Figure 1 on Page 16.)
Starter keeps spinning after key is turned to "On" position.	Key not fully returned	Check that key has returned to normal "On" position from "Start" position. Replace switch if key constantly stays in "Start" position.
	Starter solenoid	Inspect starter solenoid to see if contacts have become stuck in closed position. If starter does not stop running with small yellow lead disconnected from starter solenoid, starter solenoid should be replaced.
	Wiring or key switch	Inspect all wires for defects. Open remote control box and inspect wiring at switches. Repair or replace all defective parts.
Choke does not open or close sufficiently	Choke linkage	Check for interference between moving parts of choke linkage. Adjust any pins or clips which may interfere. Replace all defective parts.
	Choke solenoid improperly located.	Loosen base bolts on choke solenoid and readjust for improved action.

MERCELECTRIC TESTING, TROUBLE CHART - CONT.

Trouble	Cause	Remedy
Choke does not operate.	Low battery	Complete (1) preceding.
	Poor contact at battery terminals	Complete (2) preceding.
	Wiring or key switch	With key switch turned to "On" position, check for continuity between positive (+) terminal of battery and choke knife disconnect, located under rubber sleeve about 6 inches down blue wire lead from choke solenoid. Repair or replace all defective parts.
	Choke solenoid	With a fully-charged battery, connect a positive (+) jumper to disconnected lead of choke solenoid and a negative (-) jumper to base of solenoid. Replace a defective solenoid. Unit should operate with Analyzer (91-25213), using switch on resistance between lead and ground.
Alternator is not charging battery.	Battery will not retain charge	Complete (1) preceding.
	Wiring between rectifier and battery or key switch	With key in "On" position, check for resistance between: a) Positive (+) terminal of battery and the spade terminal located at the "red" terminal of the rectifier; and b) Negative (-) terminal of battery and mounting bolt at rear of rectifier. Inspect all soldered joints. Repair or replace all defective parts.
	Wiring between rectifier and alternator	Rectifier: With an ohmmeter, measure the DC resistance between: a) Red wire on rectifier and mounting (ground) bolt. Reverse the 2 leads from ohmmeter and measure resistance again. Ratio of the 2 readings should be 10-to-1 or greater; and b) Two yellow leads on rectifier. Reverse the 2 leads from ohmmeter and measure resistance again. Ratio of 2 readings should be no more than 2-to-1. Replace a defective unit. Alternator: With the 2 spade terminals open, check for continuity between 2 yellow leads from alternator. Also, check that there is NO continuity between alternator wire and ground (base of stator or engine block). Repair or replace all defective parts.
Rectifier is over-heating.	Battery terminals improperly connected	Check that negative marking on harness matches that of battery. If battery is connected improperly, severe burning of rectifier will occur.
	Rectifier is damaged	Inspect rectifier for damaged protective coating of plates. Replace a defective unit.
Wires are overheating.	Battery terminals improperly connected.	Check that negative marking on harness matches that of battery. If battery is connected improperly, red wire to rectifier will overheat.
	Short circuit in wiring system	Inspect all connections and wires for looseness or defects. Open remote control box and inspect wiring at switches. Repair or replace all defective parts. Check for high resistance.
	Short circuit in choke solenoid	If blue choke wire heats rapidly when using choke, choke solenoid may have internal short. Replace if defective.
	Short circuit in starter solenoid	If yellow starter solenoid lead overheats, there may be internal short (resistance) in starter solenoid. Replace a defective solenoid.
Circuit tester	Circuits on MercElectric models	To check performance of various components of MercElectric system, use Magneto Analyzer (91-25213), scale No. 2.
Battery voltage	Battery voltage	Battery voltage is checked with Ampere-Volt Tester (91-27883) only when battery is under starting load. Battery must be recharged if it registers under 9½ volts. If battery is below specified Hydrometer readings (1.150), it will not turn engine fast enough to start.

MERCELECTRIC STARTER SYSTEM - COMPONENTS

(Refer to Wiring Diagrams, following in Section.)

A. CIRCUITS

1. **Generator Circuit (On All 6-Cyl. Models and 4-Cyl. MercElectric "E" Models Only)**

Within the flywheel are permanent magnets and a wound stator. The alternating current generated in the stator windings passes to the rectifier which, in turn, produces direct current from the alternating current. Negative side of rectifier is grounded; positive side goes to internal harness. Through the plug, current passes on to the ignition switch in the control box, and from there to the battery on the positive side. Negative side of battery is connected through connector to ground of engine.

2. **Starter Circuit (MercElectric "E" and "S" Models)**

Consists of a 12-volt starter motor and starter engaging mechanism. Starter solenoid (two on 6-cylinder direct reversing models) prevent full starting current from passing through the ignition switch.

3. **Choke Circuit (MercElectric "E" and "S" Models)**

To operate choke, ignition key must be in the ON (middle) or moved past STARTING (right) position. While using electric choke, manual choke must be in down position; however, manual choke can be operated at all times if necessary. *(Note: Early Merc 800 direct reversing model does not have a manual choke.)*

4. **Ignition Circuit (MercElectric "E" and "S" Models)**

The engine is stopped by grounding the magneto (2 and 4-cylinder engines) or distributor (6-cylinder engines), not by choking the engine. This is accomplished by turning key to OFF (left) position. *(Note: This turns off ignition on 6-cylinder models; engine is stopped by moving throttle lever to FORWARD STOP or REVERSE STOP position. DO NOT turn ignition off on 6-cylinder engines before stopping engine with throttle lever!)*

B. STARTING AND STOPPING

For starting and stopping procedure with electric starter, refer to Section I, General Information.

REMOVAL AND INSTALLATION OF COMPONENTS

(Refer to Figure on Page 22.)

A. ELECTRICAL HARNESS - **Removal (Figure 1)**

Remove 4 small screws and nuts which secure connector into bottom cowl, remove the following leads to harness, then lift connector and harness out of bottom cowl:

1. White lead to primary ground terminal.
2. Black positive (+) jumper lead to starter solenoid.
3. Black negative (-) ground lead to starter motor.
4. Yellow lead to starter solenoid.
5. Blue lead to choke solenoid.
6. Red lead to rectifier.

Electrical Harness - Installation

Install connector thru hole in side of bottom cowl with 4 small screws, then attach the 6 leads to harness listed in Paragraph "A" above.

B. RECTIFIER - **Removal**

Rectifier can be detached by removing the following:

1. Two yellow leads to alternator.
2. Red lead to electrical harness.
3. The ½" hex head nut and lockwasher from rectifier bracket.

Rectifier - Installation

Install rectifier on rectifier mounting bracket with ½" hex head nut and lockwasher, then attach the 3 leads removed in Paragraph "B" above.

IMPORTANT: Failure of rectifier to discharge a direct current (DC) indicates that it, or the alternator, is faulty. Rectifiers usually are rendered useless ("baked" or discolored appearance) when battery leads of electrical harness are connected to wrong battery terminals. Function of rectifier is to convert alternating current (AC), supplied by alternator flywheel and alternator stator, to direct current (DC) for recharge of battery.

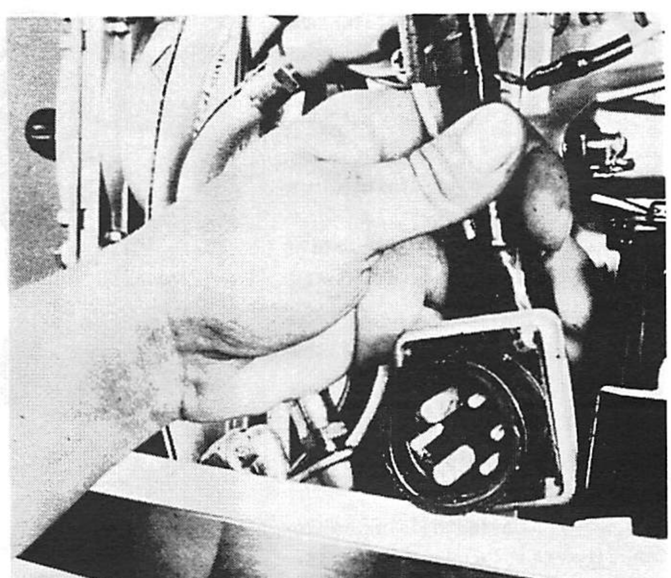


Figure 1. Removing Harness Connector

C. **CHOKE SOLENOID** - Removal

Choke solenoid can be removed by disconnecting blue lead to harness at knife disconnect and removing screws which hold solenoid to top cowl or to magneto adaptor choke solenoid bracket.

Choke Solenoid - Installation

Secure solenoid to inside top cowl or magneto adaptor bracket with screws and connect blue lead between solenoid and wiring harness with knife disconnect.

IMPORTANT: Free movement of plunger is necessary. Plunger should be as close to "bottoming" as possible in full choke position. Tilt solenoid slightly, on models with solenoid secured to magneto adaptor, to achieve free movement.

D. **ALTERNATOR STATOR** - Removal

Alternator stator, which is attached to upper end cap, can be removed by removing the following:

1. Flange from top of driven pulley; then slide timing belt off driven pulley. *(Note: Do not damage timing belt by forcing with screwdriver.)*
2. Flywheel elastic stop nut and washer from crankshaft, while holding flywheel with Universal Flywheel Holder (C-91-24937A1).
3. Flywheel with Flywheel Puller (C-91-24695A2). (Figure 1) While lifting flywheel off crankshaft, slide timing belt off flywheel pulley.
4. Two yellow leads between alternator and rectifier at knife disconnects.
5. Alternator stator via 4 screws which hold it to upper end cap.

Alternator Stator - Installation

Install alternator stator by replacing the following:

1. Alternator stator on top of upper end cap and fasten with 4 screws.
2. Two yellow leads between alternator and rectifier via knife disconnects.
3. Timing belt in position on flywheel pulley first, then driven pulley, while placing flywheel on crankshaft. (Figure 2)

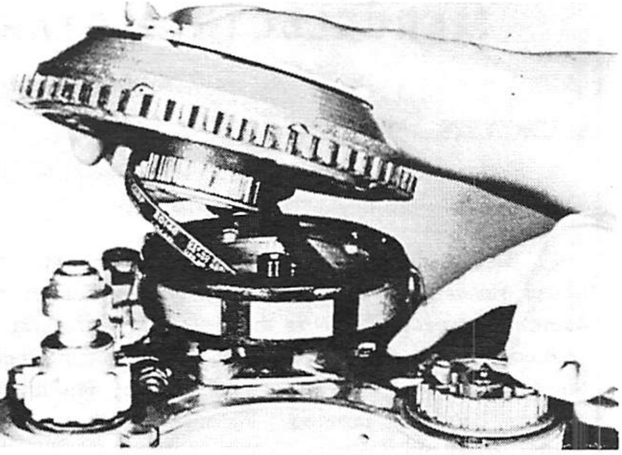


Figure 2. Replacing Timing Belt

4. Flywheel nut on crankshaft and torque to recommended torque (see Master Torque Specifications on Page 2B, Section VIII).
5. Flange on top of driven pulley.

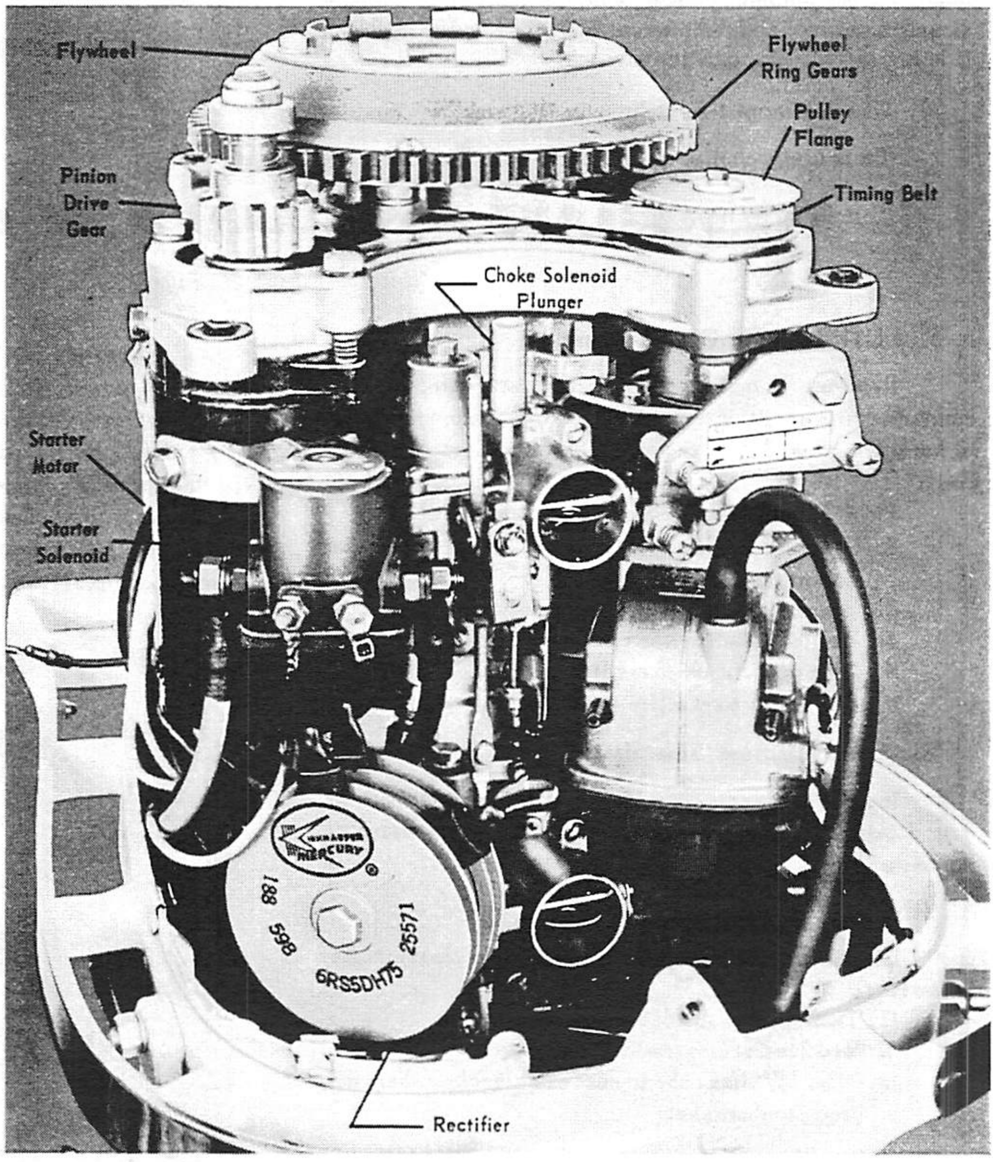
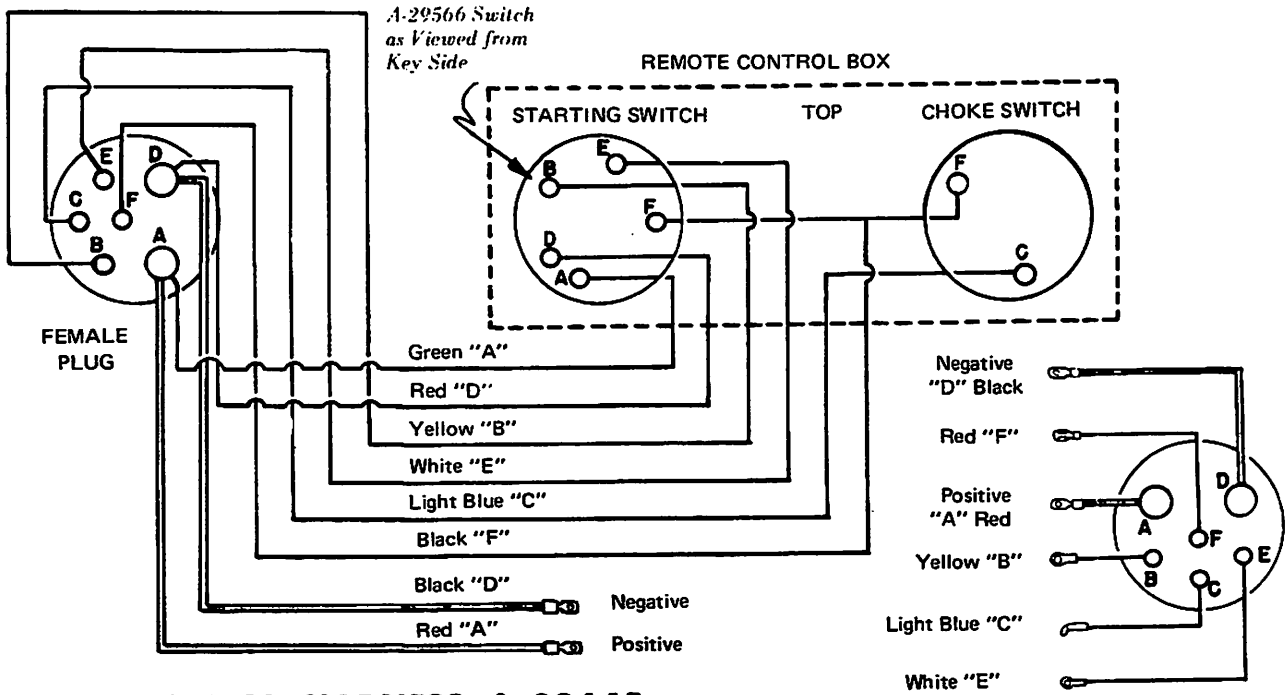


Figure 3. MercElectric Starting Components, 4-Cyl.

HARNESSES - 4-CYL. 2-LEVER ELECTRIC CONTROL

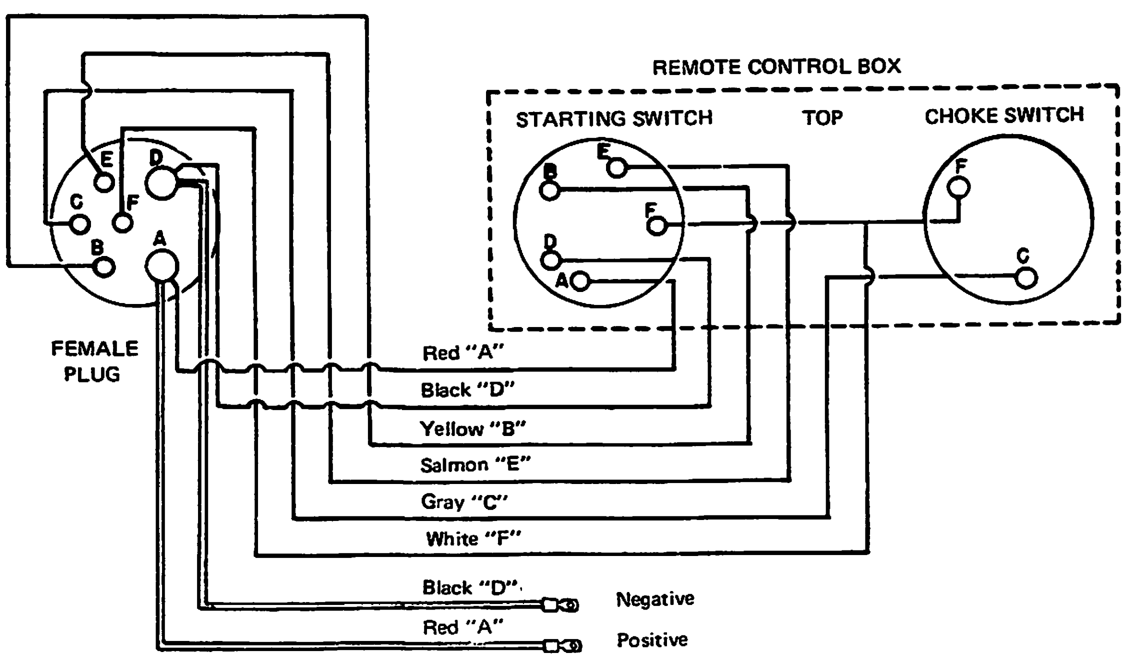


EXTERNAL HARNESS A-29645_

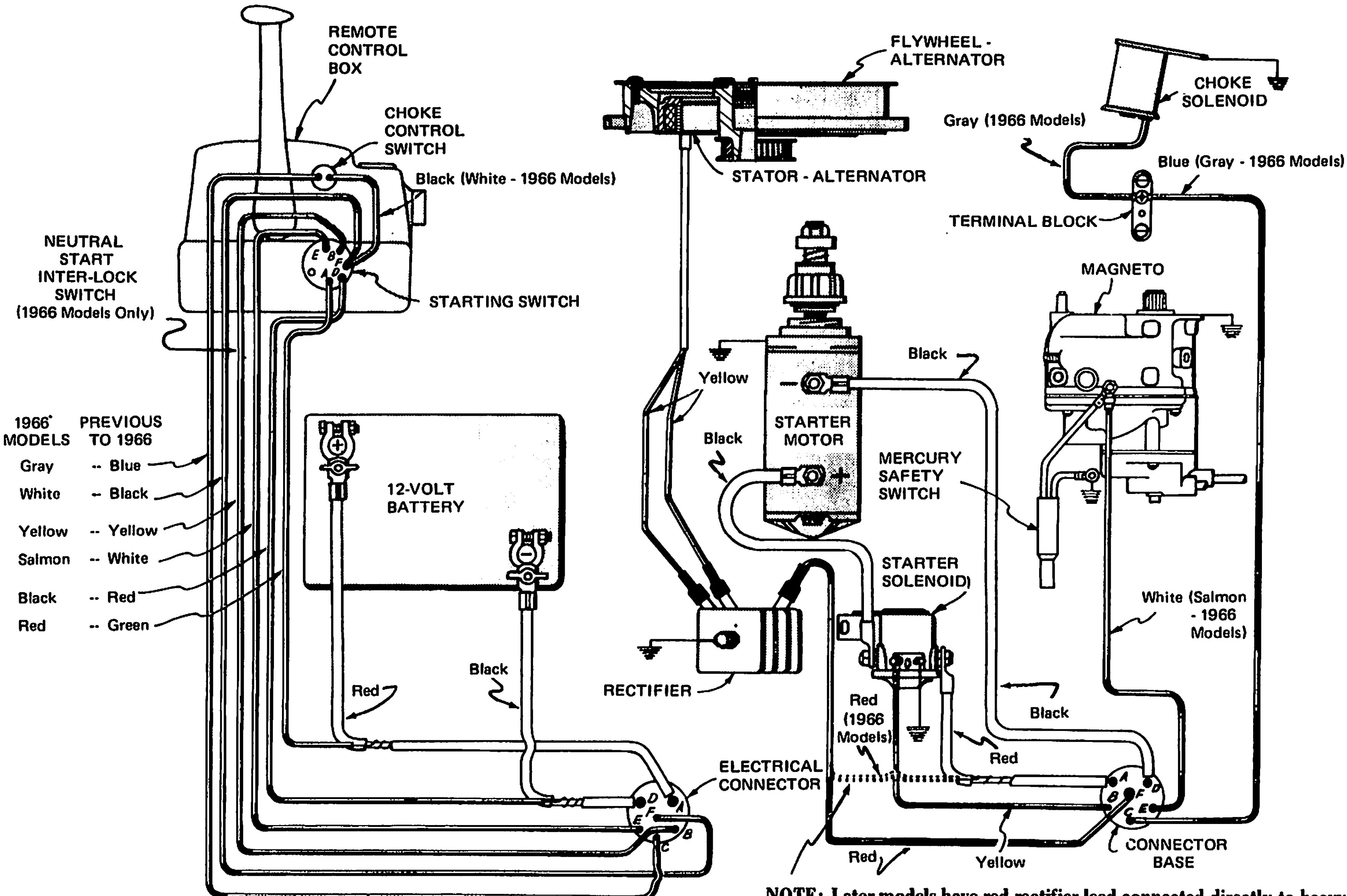
INTERNAL HARNESS

External wiring harness A-29645_ is superseded by external wiring harness A-39125_ (below). When replacing harness A-29645_ with an A-39125_ harness, use the wiring code shown on drawing.

EXTERNAL HARNESS A-39125



ELECTRIC STARTER WIRING DIAGRAM
4-CYL. SINGLE LEVER REMOTE CONTROL



NOTE: Later models have red rectifier lead connected directly to heavy red cable. This will permit ignition switch to be turned to "OFF" position at any engine RPM without damage to rectifier.

Starter Mechanism and Starter Motor American Bosch Disassembly and Reassembly

(Refer to Exploded View, Figure 5.)

A. Starter Mechanism and Starter Motor – Removal

Removal of starter motor and mechanism from the engine can be accomplished by unscrewing the 2 mounting bolts from the mounting flange. Lift flange off, being careful not to allow starter motor and mechanism to drop since starter is loose once bolts are removed. If flange is tight pry off, as it has a locating dowel for alignment to crankcase.

B. Starter Mechanism – Disassembly

Remove cotter pin from armature shaft end, with a wrench, unscrew castellated nut so that the entire starter mechanism can be pulled off in the following sequence: Spacing mechanism collar, anti-drift spring, pinion washer, anti-drift spring sleeve, pinion, screw shaft, neoprene washer, thrust washer, re-entry spring, drive spring support, drive spring, thrust washer and ring spring retainer.

C. Starter Motor – Disassembly

Unscrew and remove the 2 thru-bolts, lockwashers and flat washers at bottom of starter motor. This loosens the drive end mounting bracket. Remove lock spring at "drive end" of armature and slide off the motor end cap and bearing. The entire armature can now be removed by grasping the splined shaft end and pulling out. Be careful not to lose the shim at either end of armature. The commutator end plate assembly can be removed by pulling off. Neoprene end plate cover and insulation strip can be pulled off. Inspection of brushes and commutator end can be made at any time by removing the sealing ring, provided that the edges of the sealing ring are waterproofed with a neoprene sealing compound when replaced.

Lower End Cap

Carbon Brush and Holder: The entire commutator plate, including bearing, 2 brushes and 4 brush springs can be removed by pulling the 2 brush springs from their posts which secure the 2 brushes to the field coil lead wires. Unscrew the brush lead terminal from the end plate mounts by pulling springs off the retainers and pulling brush out. Other parts in the cap are permanent installations. Any damage to these parts will require replacement of entire cap. The carbon brushes attached to the fields can be removed by unsoldering brush lead wire from field contacts. This completes disassembly of the American-Bosch type starter motor.

D. Starter Motor – Reassembly

Brush Holders and Brushes: Solder new carbon brush leads to field leads if old ones were removed for any reason. Be sure to place insulating sleeve on carbon brush lead and clamp on with wire clamp before soldering. Apply a thin film of SAE No. 10 oil on inside surface of bearing prior to assembly of drive end plate to housing. Replace carbon brushes when they are worn - - always in a complete set. Place new carbon brushes into brush holders adjacent to the end cap mounting posts and secure terminals to flange with taper head screws. Place all brush springs on posts with small groove of spring to bottom of post with spring arm to inside of end cap. After spring is on, pull arm of spring in front of brush holder. (See Figure 3)

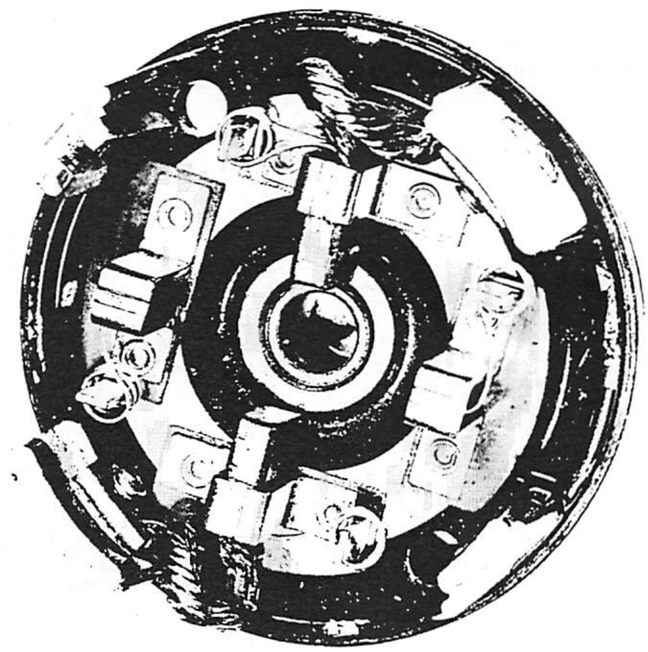


Figure 3. Commutator End Plate Assembly with Springs and Brushes in Place

Body and Field: The field winding is an integral part of the body. Inspect carefully for burned-out winding, shorting or poor insulation. If insulated covering is burned or removed, or unit is shorted, it must be replaced.

Armature: Not much of the armature can be repaired. If commutator is worn, due to brush wear, it can be machined evenly and reinstalled with new brushes. This can be accomplished by any dealer having a lathe or regular armature reconditioning tool which can be purchased from a local automotive or tool supply store. The aforementioned armature reconditioning tool turns down the commutator and undercuts the mica. Undercut of mica should be approximately 1/32". After thorough inspection has been completed and armature is found to check out OK, or has been reworked, it can be reinstalled. Armature can be checked out on an armature growler. Any automotive garage can test armatures, or armature can be checked on Magneto Analyzer (91-25213). Check for continuity exists, winding is grounded and armature must be replaced.

Place carbon brushes into brush holders by pulling brush holder springs back with needle nose pliers and inserting brushes. Reset spring into small groove of carbon brush. (See Figure 4.)

Insert 2 thru-bolts, lockwashers and washers in end cap; set shims on shaft; place drive end plate shoulder down onto armature shaft; and place 2 thru-bolts and lock plate on shaft with locking ring. Check armature end play. Shim as required to obtain 0.010"-0.020" end play. Place adaptor flange on drive end over plate and secure in position by threading the 2 bolts into flange and torque to 60-65 in. lbs. Place insulating band around field housing and commutator end cap. Attach ends with a piece of Scotch Tape. Paint around band with Liquid Neoprene and install neoprene insulator cover, position evenly and seal with Liquid Neoprene.

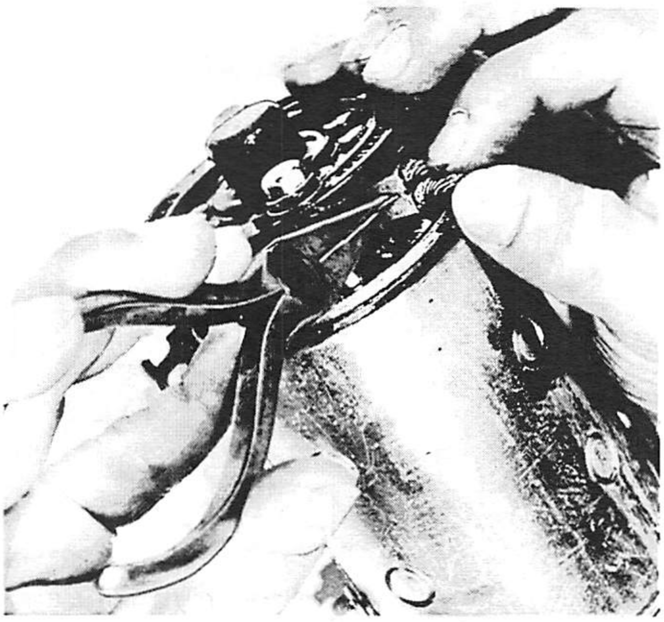


Figure 4. Installing Carbon Brush

E. Starter Mechanism — Reassembly

In sequence, replace ring spring retainer with recessed end down, large flat thrust washer, drive spring, drive spring support closed end down, entry spring, large thrust washer, neoprene washer, shaft anti-drift spring screw (threaded-end up), drive pinion, pinion washer, anti-drift spring sleeve and spacing collar (recessed end down). Secure with castellated fastening nut to a torque of 200 in. lb. minimum. Nut must be spaced so cotter pin can be inserted through hole in armature shaft.

Drive mechanism operation: The drive mechanism is part of the complete starter motor It is located at the top of the starter motor. The starter motor drive pinion gear automatically engages the flywheel ring gear, due to sudden inertia when the starter turns over, and automatically disengages when the engine starts. The teeth on the drive pinion gear are chamfered so as to engage more readily with the flywheel ring gear teeth.

Set armature into field housing assembly, commutator end toward end of housing having brushes secured to field. Place commutator end cap onto armature shaft and align slot in one of the 4 end cap posts with small notch in housing frame. Place carbon brushes into brush holders, being sure brush leads are not touching on metal surfaces.

F. Installing Starter Motor and Starter Mechanism on Engine

Insert starter motor in crankcase adaptor with terminals to rear.

Place upper motor mounting bracket in position. Note that dowel pin hole location for 2-cylinder and 4-cylinder models. Thread two 5/16" bolts to starter motor adaptor flange and torque to 75 in. lbs. Connect negative (-) battery lead from wiring harness to upper terminal, negative (-), of starter motor. Coat with Liquid Neoprene.

G. Starter Solenoid — Installation

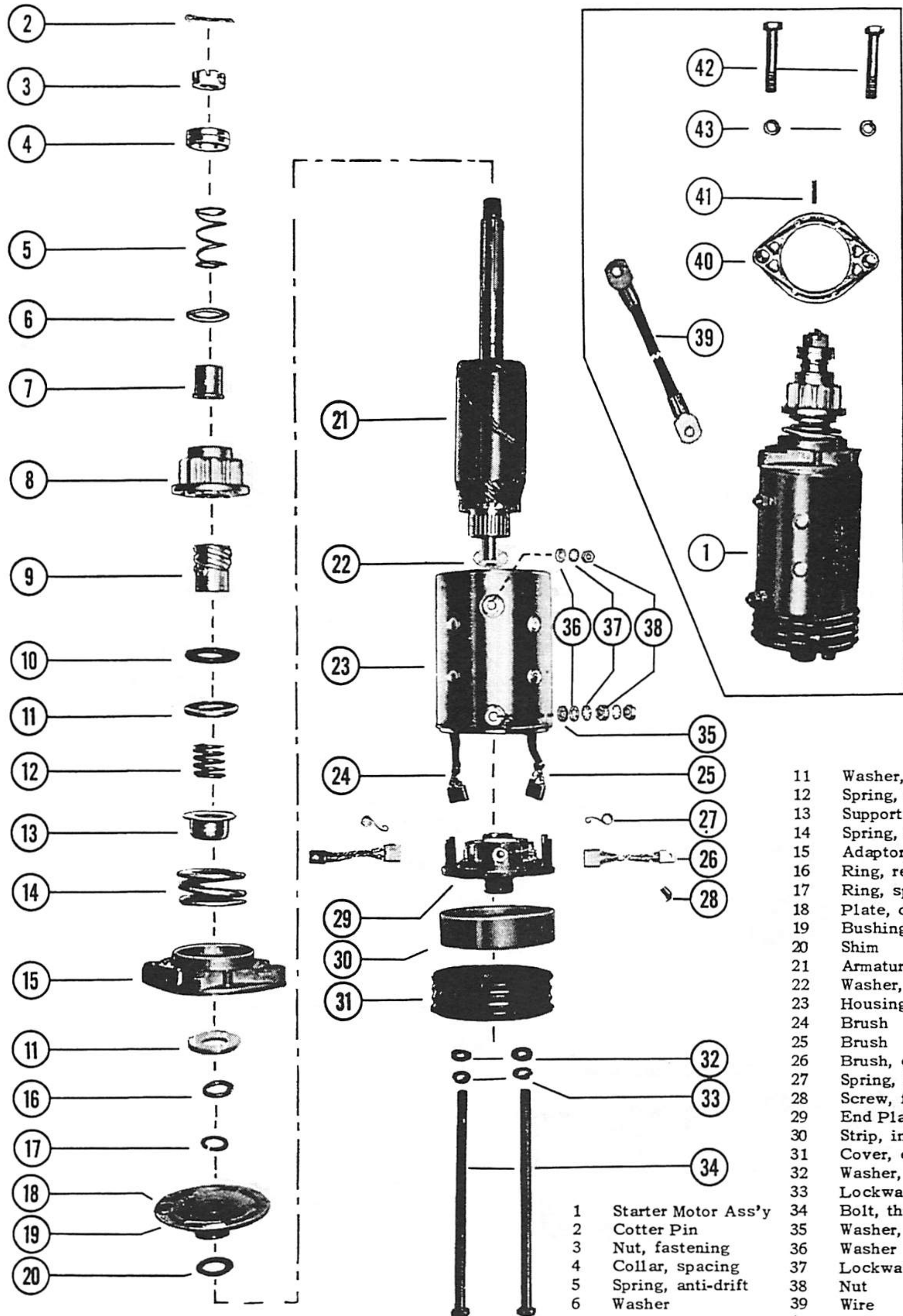
Secure positive (+) battery lead to starter solenoid with nut and lockwasher. The solenoid mounts inverted (top down). Attach leads accordingly. Positive has plus (+) marked on terminal. Place positive (+) jumper lead on terminal at near end of starter solenoid with nut and lockwasher attaching opposite end to lower terminal of starter motor. Waterproof connections with Liquid Neoprene. Mount starter solenoid to starter motor with 2 screws and washers through 2 holes drilled in starter motor.

Attaching leads to the solenoid first simplifies installation of solenoid and leads.

Attach yellow lead from wiring harness to small terminal of starter solenoid. Waterproof connection with Liquid Neoprene (92-25711) and secure lead wires to "S" clips on cowl (no "S" clips on yellow lead).

H. Starter Motor Performance Testing - Merc 800 Full Gear Shift

1. Operation
   a. Use a fully charged 12-volt battery and connect it to starting motor input terminals thru a switch.
   b. Use test leads of No. 10 stranded cable or larger, but leads should not exceed 6 ft. in length.
   CAUTION: These motors should not be operated continuously for more than 15 seconds when testing.
2. Performance Test (No Load)
   a. Applied Voltage: 12 volts, read at input terminal.
   b. Minimum RPM: 6,000 RPM
   c. Maximum Current Draw: 50-55 amperes
3. Performance Test (Under Load)
   Starter Load: 180-240 amperes while cranking, 12 volt



1	Starter Motor Ass'y
2	Cotter Pin
3	Nut, fastening
4	Collar, spacing
5	Spring, anti-drift
6	Washer
7	Sleeve
8	Gear, pinion
9	Shaft, screw
10	Washer, rubber
11	Washer, thrust
12	Spring, re-entry
13	Support
14	Spring, drive
15	Adaptor, top cap
16	Ring, retaining
17	Ring, spring
18	Plate, drive end
19	Bushing
20	Shim
21	Armature
22	Washer, shimming
23	Housing Assembly
24	Brush
25	Brush
26	Brush, end plate
27	Spring, brush
28	Screw, fastening
29	End Plate
30	Strip, insulation
31	Cover, end plate
32	Washer, thru bolt
33	Lockwasher
34	Bolt, thru
35	Washer, insulation
36	Washer
37	Lockwasher
38	Nut
39	Wire
40	Plate, upper
41	Dowel Pin
42	Screw
43	Lockwasher

Figure 5. Starter Motor, American Bosch, Negative Ground

Starter Mechanism and Starter Motor
Delco–Remy
Disassembly and Reassembly

NOTE: The Delco-Remy Starter Motor (Figure 6) replaces the American Bosch Starter Motor (Figure 5) on later MercElectric models and is completely interchangeable as a unit.

A. Removal of Starter Motor and Mechanism from Powerhead Page 23

B. Starter Mechanism, Delco-Remy – Disassembly

Remove the cotter pin from the armature shaft end with a wrench and unscrew castulated nut so entire starter mechanism can be pulled off in the following sequence: Pinion stop, anti-drift spring, pinion washer, anti-drift spring sleeve, pinion gear, screw shaft, thrust washer, cushion cup, cushion, cushion spacer and thrust washer. (See Figure 7.)

C. Starter Motor, Delco-Remy – Disassembly

Unscrew and remove the 2 thru bolts and lockwashers at bottom end of starter motor to loosen drive end mounting bracket. Remove drive end mounting bracket by pulling off armature shaft. The entire armature can now be removed by grasping the splined shaft end and pulling out. Be careful not to lose shims at either end of armature shaft. The lower end cap can be removed by pulling off.

1. Disassembly of frame and field.

If the frame and field assembly is found to be defective, it may be disassembled, if necessary, to locate

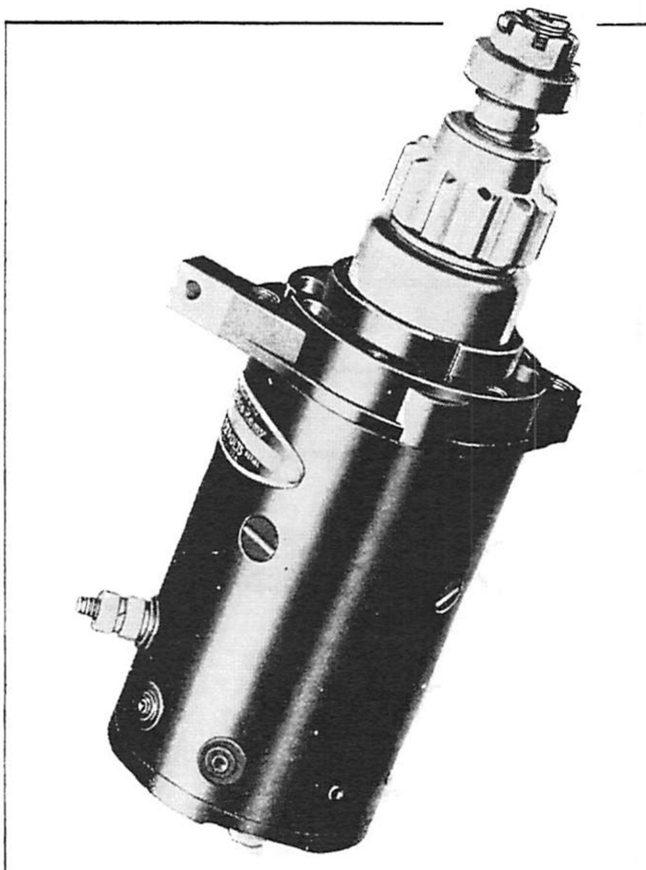


Figure 6. Delco-Remy Starter Motor

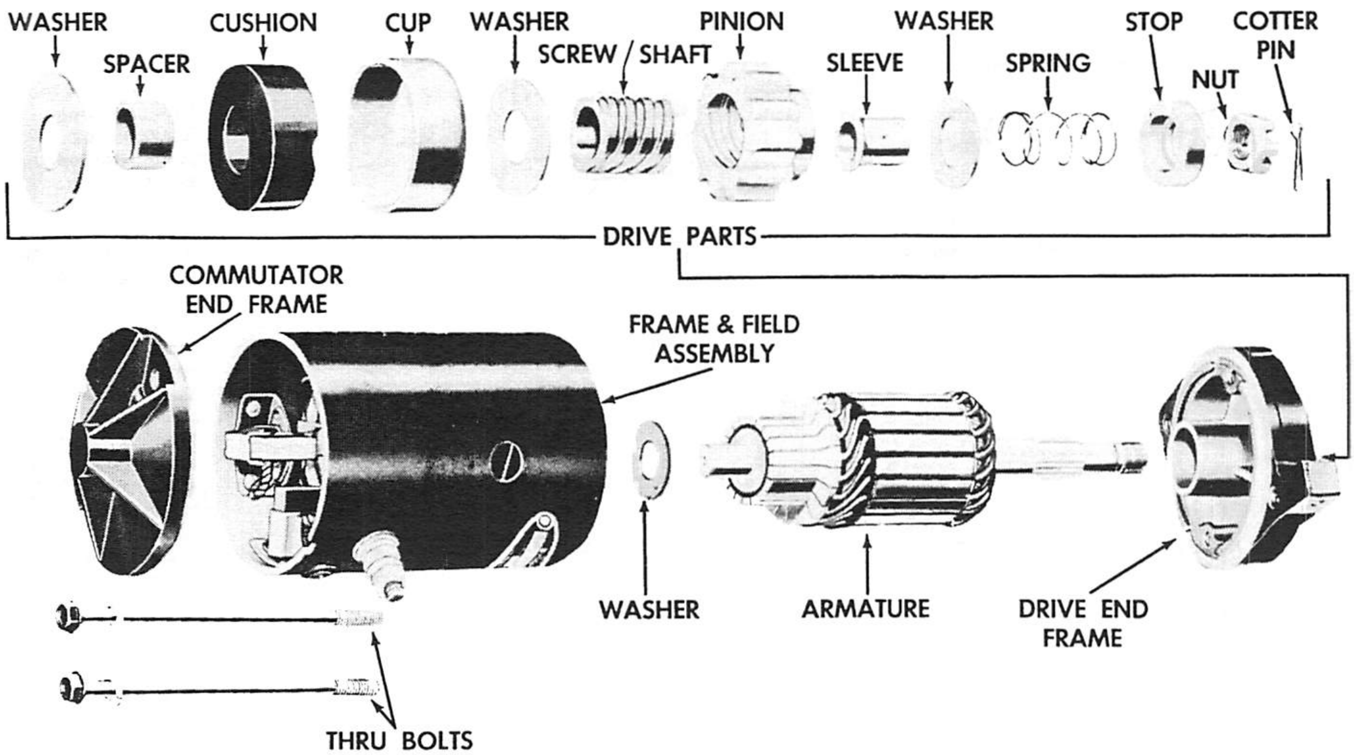


Figure 7. Exploded View of Starter Motor and Mechanism, Delco-Remy

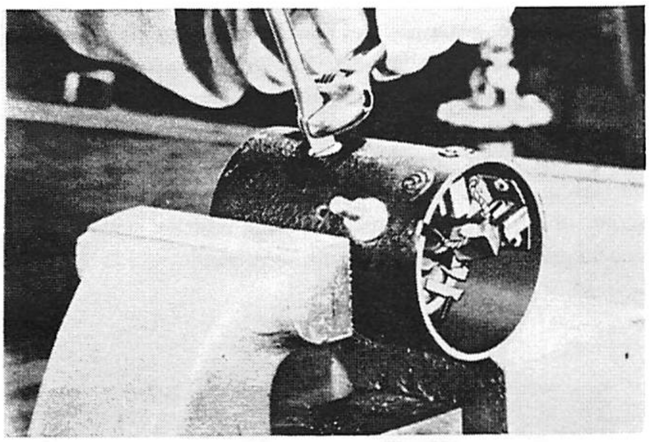


Figure 8. Removing Pole Shoes with Screwdriver and Adjustable Wrench

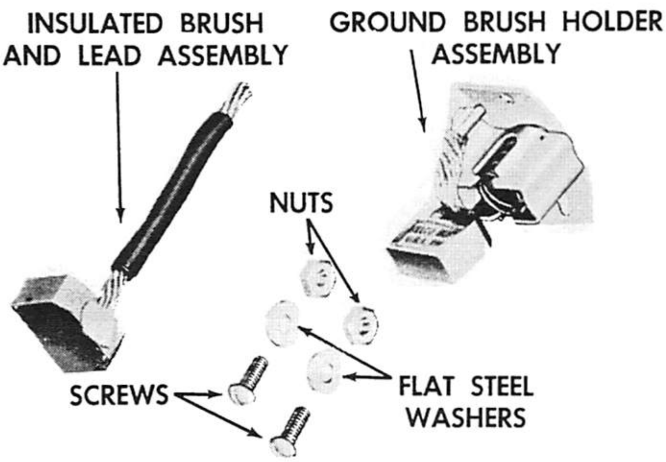


Figure 9. Brush Replacement Kit

the trouble. The first step is to remove the pole shoe screws. This may be accomplished by placing the frame in a vise (being careful not to clamp it tightly enough to distort the frame). The pole shoe screws may then be removed with a large screwdriver, using an adjustable wrench to turn the screwdriver. (See Figure 8) Next remove the terminal nut and insulating washers, and the field coil set is free to be removed. Disassembly is now complete, except for the brush holders. It is unnecessary to remove the brush holders from the frame except when defective or when replacing the ground brushes. Removal is accomplished by cutting off the rivets with a chisel or by drilling them out. Replacement brush holders are available complete with screws, washers and nuts for attaching to the frame. (See Figure 9) Brush springs are also available for replacement. To remove brush spring from holder, first compress one side of the spring with a small screwdriver until the spring flips out of its seat. Then turn the spring clockwise until it comes out of the holder.

2. Removal of brushes.

If it becomes necessary to replace the brushes in the starter motor, the frame and field must be disassembled as described in the preceding section. Replacement brush sets are available and contain the 2 insulated brushes with flexible leads attached and 2 ground brush holders with brushes and leads attached along with the necessary screws, washers and nuts for attaching to the frame. (See Figure 10.)

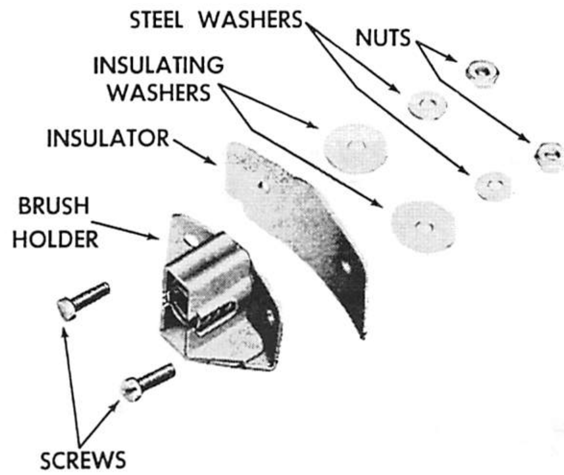


Figure 10. Brush Holder Replacement Kit

D. Starter Motor, Delco-Remy – Reassembly

1. Replacement of brushes.

To replace the insulated brushes, first cut off the old brush leads at the points where they are attached to the field coils. The ends of the coils must then be prepared for soldering on the new brush lead assemblies. It is recommended that the leads be soldered to the back sides of the coils so that excessive solder will not rub the armature. The ends of the coils should be thoroughly cleaned by filing or grinding off the old brush lead connections. Varnish should be removed only as far back as is necessary to make the solder connections. Using rosin flux, the leads may then be soldered to the field coils, making certain that they are in the right position to reach the brush holders. (See Figure 10) Do not overheat leads, as the solder will run on the lead and it will no longer be flexible.

To replace the ground brush assemblies, first remove the old brush holders as described in the preceding section, then attach the new assemblies to the frame with screws, washers and nuts included in the package. After tightening the nuts, the screws should be peened with a hammer so that the nuts cannot vibrate loose during operation of the engine.

When the field coil and brush assembly is reassembled in the frame, the frame and field assembly should be rechecked to make sure that none of the soldered connections is touching the frame, thus grounding the fields.

2. Body and field armature.

The armature should be checked for opens, short circuits or grounds as explained in the following paragraphs. If the armature commutator is worn, dirty, out-of-round or has high mica, the armature should be put in a lathe so the commutator can be turned down or use an armature reconditioning tool. (See Figure 12.) The mica should then be undercut 1/32" deep, and the slots cleaned out to remove any trace of dirt or copper dust. (See Figure 13.) As a final step in this procedure, the commutator should be sanded lightly with No. 00 sandpaper to remove any burrs left as a result of the undercutting procedure.

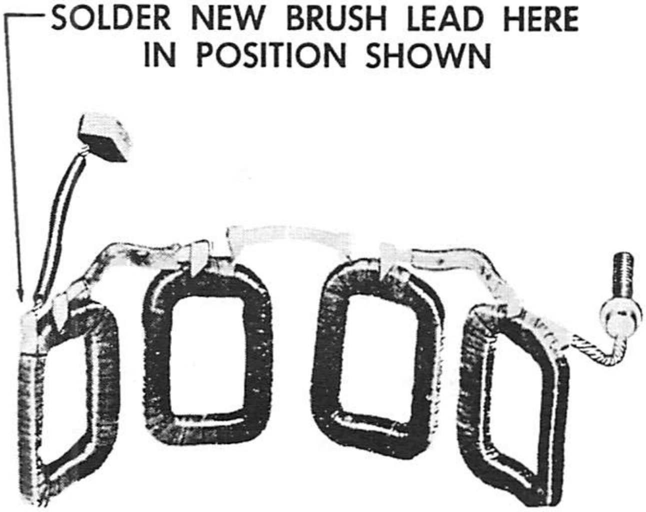


Figure 11. Field Coil and Brush Assembly, Showing Proper Position of Brush lead

Open circuited armatures often can be saved where the open circuit is obvious and repairable. The most likely place for an open circuit to occur is at the commutator bars as a result of excessively long cranking periods. Long cranking periods overheat the starter motor so that the solder in the connections melts and is thrown out. The consequent poor connections then cause arcing and burning of the commutator bars as the starter motor is used. If the bars are not too badly burned, repair can often be affected by resoldering the leads in the bars (using the rosin flux) and turning down the commutator in a lathe to remove the burned material. The mica should then be undercut. (Figure 13)

Short circuits in the armature are located by use of a growler. (See Figure 14.) When the armature is revolved in the growler with a steel strip such as a hack-saw blade held above it, the blade will vibrate above the area of the armature core in which the short circuit is located. Copper or brush dust in the slots between the commutator bars sometimes produces shorts between the bars which can be eliminated by cleaning out the slots.

Grounds in the armature can be detected by the use of the Magneto Analyzer (91-25213), No. 3 continuity test. If the needle moves across the meter when one test point is placed on the commutator with the other point on the core or shaft, the armature is grounded. Grounds often occur as a result of insulation failure which is often brought about by overheating of the starter motor produced by excessively long cranking periods.

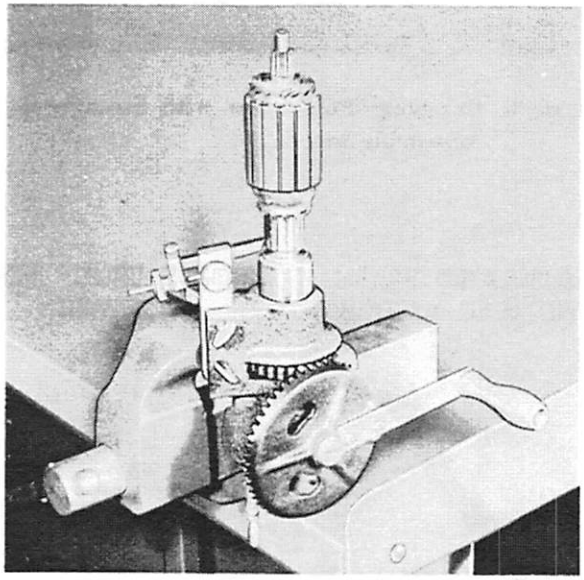


Figure 12. Turning-Down Commutator

Set armature into field and frame assembly, commutator end toward end of frame having brushes secured to frame. Place lower end cap assembly unto armature shaft after having lubricated end cap bearing and thrust washer on armature shaft lightly with multi-purpose lubricant. Align notch in cap with small notch in frame. The bronze bearings of the starting motor are graphite and oil impregnated and ordinarily require no added lubrication. They should be lubricated when the motor is disassembled for some reason, at which time a few drops of light engine oil or multi-purpose lubricant may be added before reassembly. Care should be taken that no oil reaches the commutator.

Insert 2 thru-bolts and lockwashers in end cap, place drive end cover shoulder down on frame over armature shaft, aligning with dowel pin, and secure the 2 thru-bolts to end cover. Torque to 60-65 in. lbs. Note that bushing is not replaceable in upper or lower end caps.

After reassembly has been completed, paint around all screws, seams and terminals with Liquid Neoprene (92-25711) to seal starter motor against water leaks and moisture.

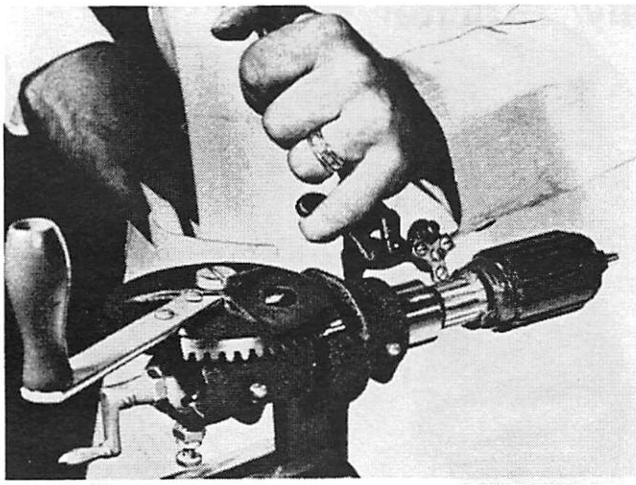


Figure 13. Undercutting Mica

E. Starter Mechanism – Reassembly

In sequence (follow Figure 7), replace thrust washer, cushion spacer, cushion, cushion cup (open end over cushion), cup thrust washer, screw shaft (splined end up; lubricate underside with multi-purpose grease) pinion gear (screw end down), anti-drift spring sleeve (shoulder down), anti-drift spring washer, anti-drift spring and pinion gear stop (recessed end down) and secure with castellated fastening nut to torque of 200 in. lbs. Space so cotter pin can be passed through nut and hole in shaft.

Drive Mechanism Operation: The Bendix drive mechanism should be lubricated with a few drops of light engine oil or DC4 Compound (92-24108) periodically. This can be done easily without removing the motor from its mounting. Grease or heavy oil should never be used, as this will retard the action of the drive mechanism.

F. Installing Starter Motor & Mechanism to Motor

Place starter motor in correct position and secure by threading two 5/16" cap screws through the mounting bracket and tighten to 75 in. lbs. Connect negative (-) battery lead marked negative (-) to upper terminal (ground) of starter motor and positive (+) jumper lead to lower terminal of starter motor. Waterproof all electrical connections with Liquid Neoprene (92-25711).

Performance Test – On Engine

Clockwise rotation

	Amperes	Volts
Starter No Load	45-50	12
Starter Load	160 Cranking	12

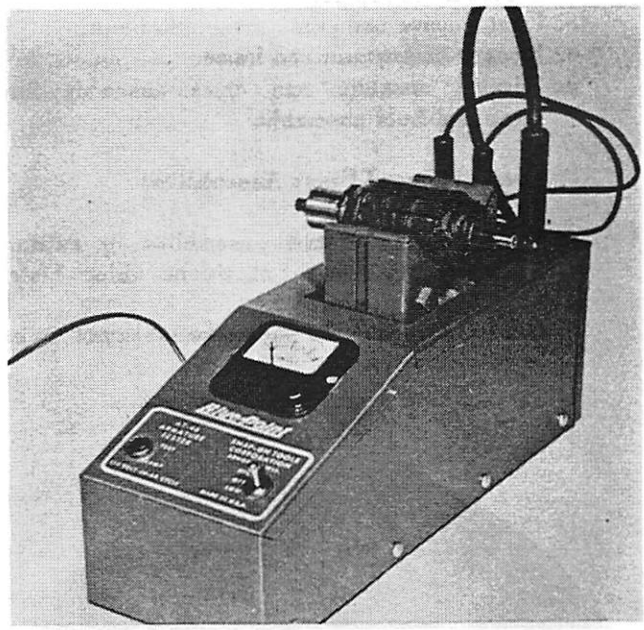


Figure 14. Testing with Growler

New 6-Cyl. Delco-Remy Starter Motor

A. DESCRIPTION

1. Models: For 6-cyl. full gear shift models.
2. These starter motors have field coils and field coil frames (A-31190) specially sealed with an exceptionally hard coating of a clear plastic which has extreme di-electric characteristics.

B. INSTALLATION OF CARBON BRUSHES

1. Disassembly

a. Partial disassembly of cranking motor is necessary to replace brushes.
b. First, loosen and pull out the thru bolts.
c. Remove commutator end frame.
d. Remove armature and drive assembly from frame and field assembly.

2. Removal of Ground Brush Assemblies

a. Remove ground brush assemblies by cutting, drilling or grinding out rivets which fasten holders to field frame.
b. If drill is used, care should be taken not to enlarge hole in frame.

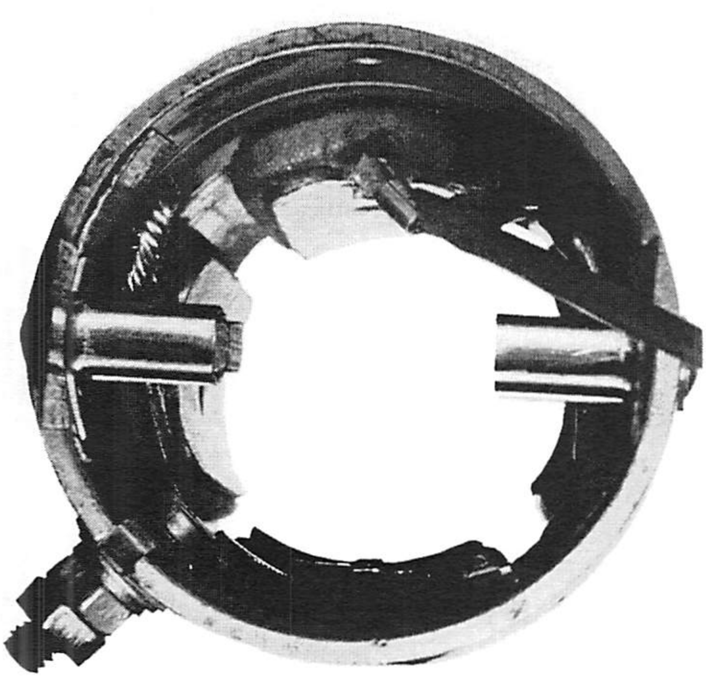


Figure 1. Opening Clip

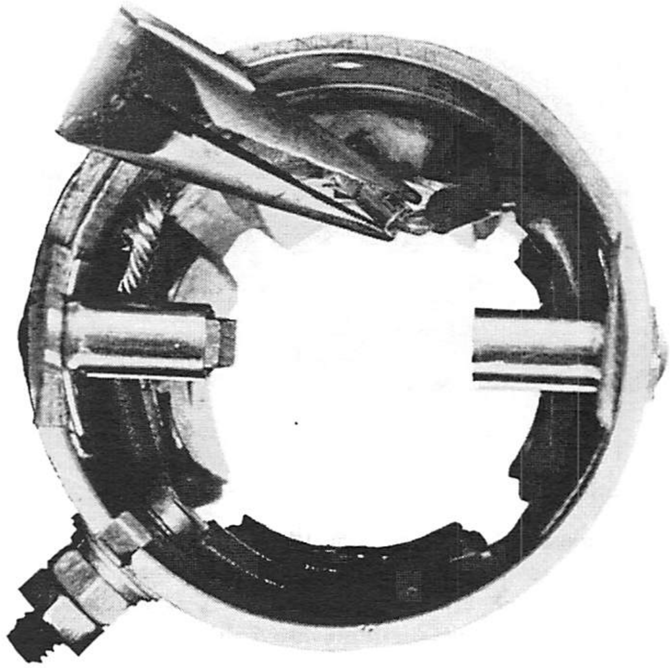


Figure 2. Crimping Clip

3. Removal of Insulated Brushes

a. Bend clip inward to facilitate brush lead removal.
b. Open clip which supports insulated brush leads with pair of sidecutters or similar tool. (Figure 1)
c. Break weld which holds brush lead to clip.
d. Note which brush has longer lead and replace with same length brush lead provided in package.
e. Discard all old parts.

4. New Brush Installation

a. Install new insulated brushes by placing proper brush lead into open clips on field coils.
b. Tin approx. 1/4" of both field coil assembly clip and brush lead with large (heavy duty) soldering iron before placing into field.
c. Place brush lead into clip and crimp clip with lead inside it to form good mechanical connection. (Figure 2)
d. Solder connection with large solder iron to heat quickly so that field coil and brush lead are not overheated. Use only rosin core solder.

CAUTION: Do not allow solder to run up lead, since this will make lead rigid.

Refer to Delco-Remy Starter Motor Disassembly & Reassembly on Pages 26 to 29 for Other Repair Procedures.

DELCO-REMY INERTIA TYPE DRIVE

A. DESCRIPTION

The Delco-Remy inertia type drive assembly is mounted on the armature shaft which has external spiral splines which match the internal splines in the drive assembly.

B. DISASSEMBLY

1. To disassemble Delco-Remy drive from armature, slide a standard half-inch pipe coupling or other metal cylinder onto shaft so end of coupling or cylinder butts against edge of pinion stop collar.
2. Tap end of coupling to drive the stop collar towards armature and off snap ring.
3. Remove snap ring from groove in shaft.
4. Remove drive and spring in order shown in Figure 1.

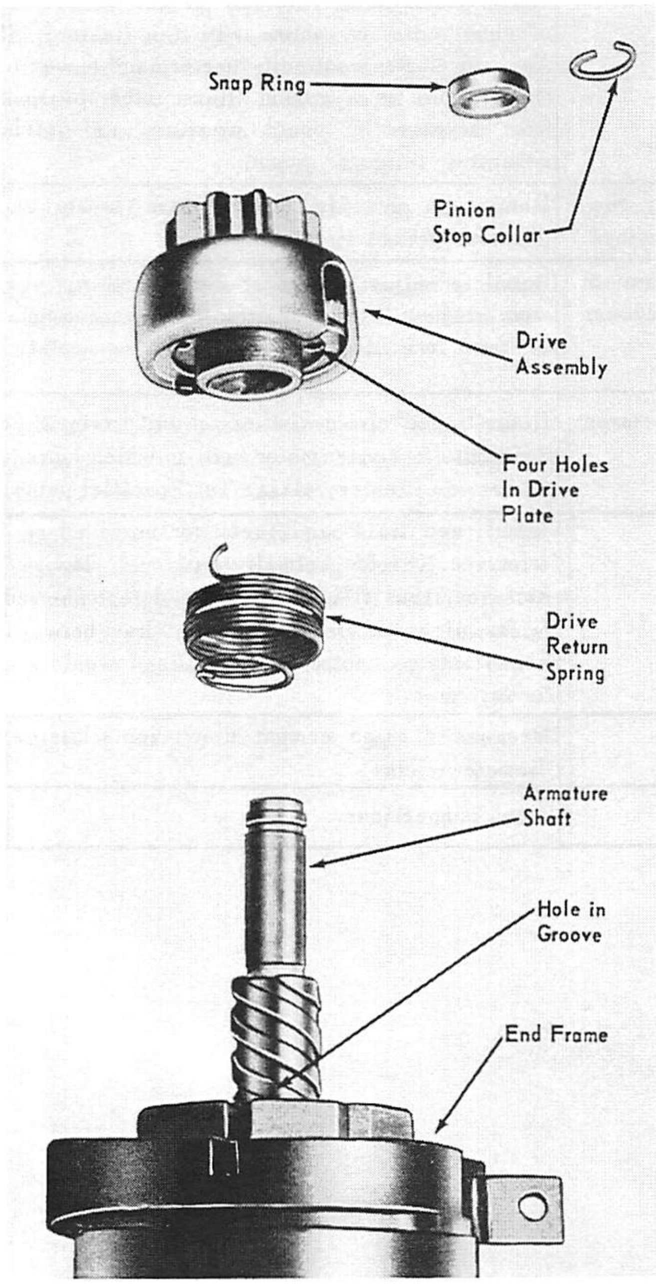


Figure 1. Delco-Remy Inertia Type Drive Assembly

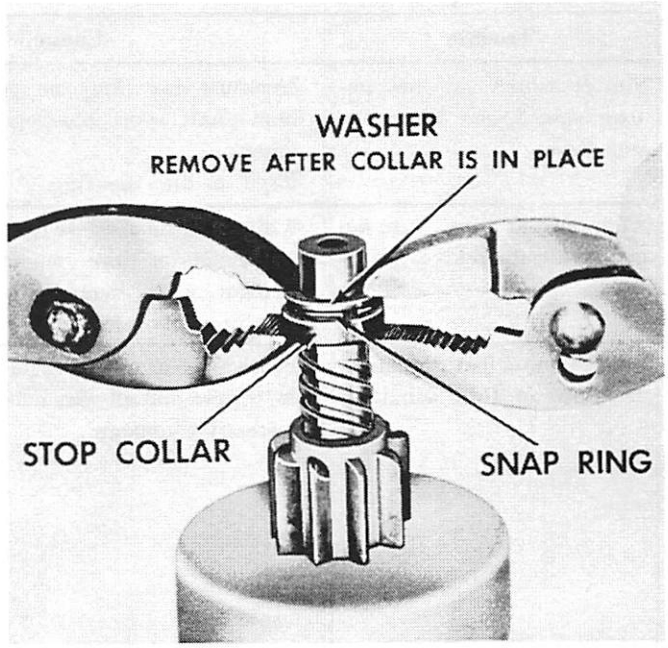


Figure 2. Installing Pinion Stop on Motor with Delco-Remy Inertia Type Drive

5. Remove drive end frame from armature and disassembly is complete.
6. Frame and field assembly may be disassembled for servicing, if required.

C. REASSEMBLY (Figure 1)

1. Lubricate splined portion of armature shaft with SAE 30 or 10W30 oil.
2. Place drive return spring on armature shaft with small diameter of spring towards end frame.
3. Install first turn of small end of spring in groove of shaft next to end frame. Hook tip of end of spring in hole at bottom of groove. *Do not distort spring.*
4. With spring in free position, hold spring out of way while drive is assembled on shaft in full disengaged position.
5. Wind up free end of spring 3/4 turn and hook it into nearest of four holes in drive plate. *Be sure that spring is securely hooked into drive plate.*
6. Slide pinion stop collar onto shaft with cupped surface facing away from drive.
7. Install snap ring in groove at end of shaft. Squeeze snap ring (with pliers) so that it fits well into groove.
8. Position pinion stop collar next to snap ring and assemble a washer (standard automotive cranking motor thrust washer if available) next to other side of snap ring. (Figure 2) *Use 2 pairs of pliers at the same time (one pair on either side of shaft) to grip stop collar and washer.* Stop collar will rotate freely when properly assembled.
9. Rotate drive against pinion stop and relieve any turns which may be overlapping other turns. When spring is properly assembled, drive should return snappily from engaged position.

STARTER MOTOR TESTING and TROUBLE CHART

Trouble	Cause	Remedy
Starter motor has low no-load speed and high current draw.	Armature may drag on pole shoes from bent shaft, worn bearings or loose pole shoes. Tight or dirty bearings.	Remove armature and test on growler for short. Replace shaft or bearings and/or tighten pole shoes. Loosen or clean bearings.
High-current draw with no armature rotation.	A direct ground at switch, at terminal or at brushes or field connections. Frozen shaft bearings which prevent armature from rotating.	Replace defective parts. Loosen, clean or replace bearings.
Starter motor has grounded armature or field winding.	Field and/or armature is burned or lead is thrown out of commutator because of excessive leakage.	Raise grounded brushes from commutator & insulate them with cardboard. Use Magneto Analyzer (Selector #3) & test points to check between insulated terminal of starter motor & starter motor frame. (Remove ground connection of shunt coils on motors with this feature.) If Analyzer shows continuity (meter hand moves to right), there is a ground. Raise other brushes from armature & check armature and fields separately to locate ground.
Starter motor has grounded armature or field winding.	Current passes thru armature first, then goes to ground thru field windings.	Disconnect grounded leads, then locate any abnormal grounds in starter motor.
Starter motor fails to operate & draws no current and/or high resistance condition.	Open circuit in fields or armature, at connections or brushes or between brushes & commutator.	Repair or adjust broken or weak brush springs, worn brushes, high insulation between commutator bars, or a dirty, gummy or oily commutator.
High resistance in starter motor.	Low no-load speed and a low-current draw and low developed torque	Close "open" field winding on unit having 2 or 3 circuits in starter motor (unit in which current divides as it enters, taking 2 or 3 parallel paths)
High free speed and high current draw.	Shorted fields in starter motor.	Install new fields and check for improved performance. (Fields normally have very low resistance, thus it is difficult to detect shorted fields, since difference in current draw between normal starter motor field windings would not be very great.)
Excessive voltage drop.	Cables not adequate size.	Because of high current draw, install larger diameter cables.
High circuit resistance.	Dirty connections.	Clean connections.

MARK 25E STARTER ... NEGATIVE GROUND
Disassembly and Reassembly

A. Electrical Harness - Disassembly

Remove cowling as far as possible. (See Miscellaneous Section VIII, Page 14, Article F, Mark 25E Cowl.)

Remove negative (-) battery lead of wiring harness from upper terminal of starter motor and positive (+) battery lead from starter solenoid, left side. (See figure below.)

Remove positive jumper lead from lower terminal of starter motor and terminal of starter solenoid, right side. Remove single yellow lead from starter solenoid. Disconnect the 2 shorting leads (green) to the magneto and the choke lead (blue) via knife disconnects after pulling back on the neoprene insulating sleeves. Cowl now can be removed from engine.

Remove harness from cowl. Unscrew bezel holding starter switch to front cowl. Remove 2 large nylon harness clips and screws from harness; also screws holding ground wire (white) and choke lead (blue) to cowl. Wiring harness connector is attached to cowl with 4 small screws and nuts. Remove these screws and harness can be completely removed.

Remove starter solenoid from bracket on top of cylinder block. Note that starter solenoid is mounted in an inverted position. Remove ground strap from starter solenoid mounting screw and from left rear top cowl bolt.

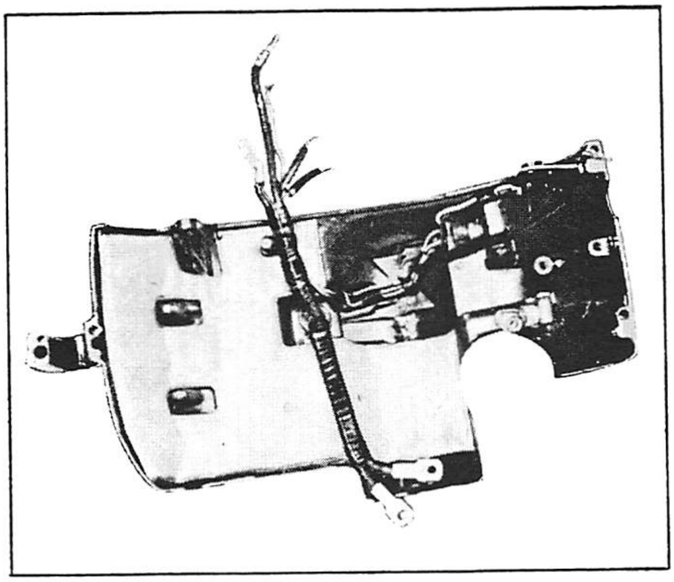


Figure 18. Mark 25E Cowl, Left Side

Electrical Harness - Reassembly

Install wiring harness through hole in side cowl. Two large terminals in connector are located toward the bottom of the cowl in order that lead wires are correctly located and that harness will attach correctly. Secure electrical harness to cowl with 4 small screws and nuts.

Place starter switch through opening in front of cowl and secure in place with bezel.

Attach shorting wire (white lead) terminal to cowl above switch and choke lead (blue) to inside front of cowl with self-tapping screws and nylon clips.

Fasten large harness to cowl with 2 nylon clips and 2 self-tapping screws.

Cowl now is ready for installation.

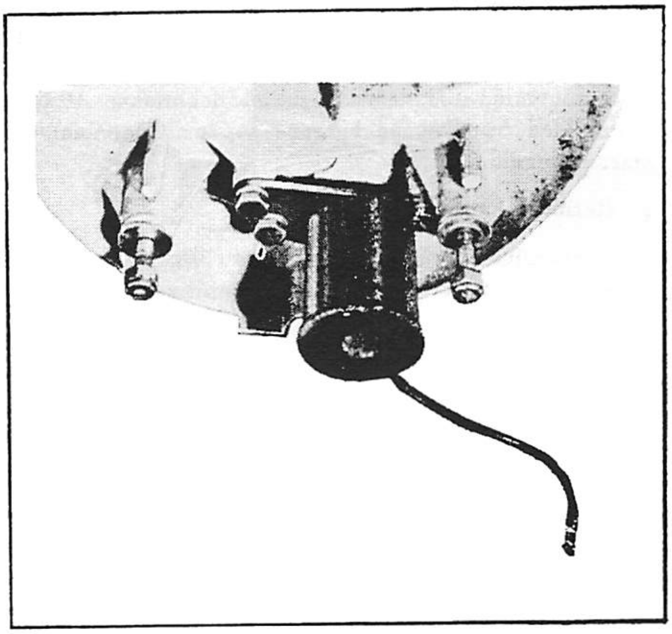


Figure 19. Starter Cover and Choke

B. Choke Solenoid - Disassembly

Choke solenoid is secured to starter cover by 3 screws. (See Figure 19.)

Choke Solenoid - Reassembly

Mount choke solenoid to starter cover with 3 screws.

Connect blue lead from choke solenoid and wiring harness with knife disconnects. Cover with neoprene insulating sleeves.

C. Starter Mechanism and Starter Motor - Bosch Removal Page 23

Starter Mechanism and Starter Motor - Delco-Remy Removal Page 26

Starter Mechanism - Bosch — Disassembly Page 23
Starter Mechanism - Delco-Remy — Disassembly Page 26

Starter Motor - Bosch — Disassembly Page 23
Starter Motor - Delco-Remy — Disassembly Page 26-27

Starter Motor - Bosch — Reassembly Page 23-24
Starter Motor - Delco-Remy — Reassembly Page 27-28

Starter Mechanism - Bosch — Reassembly Page 24
Starter Mechanism - Delco-Remy — Reassembly Page 29

Starter Motor and Mechanism to Motor Bosch — Installation Page 24
Starter Motor and Mechanism to Motor Delco-Remy — Installation Page 29

D. Starter Solenoid - Installation

Secure positive (+) battery lead to starter solenoid (left side) with nut and washer. The solenoid mounts inverted (top down). Attach positive jumper lead to opposite solenoid terminal with nut and lockwasher. Attach yellow lead from wiring harness to small terminal of starter solenoid.

E. Remote Controls - Conversion

Conversion: Positive Ground to Negative Ground (new style); Negative Ground to Positive Ground (old style).

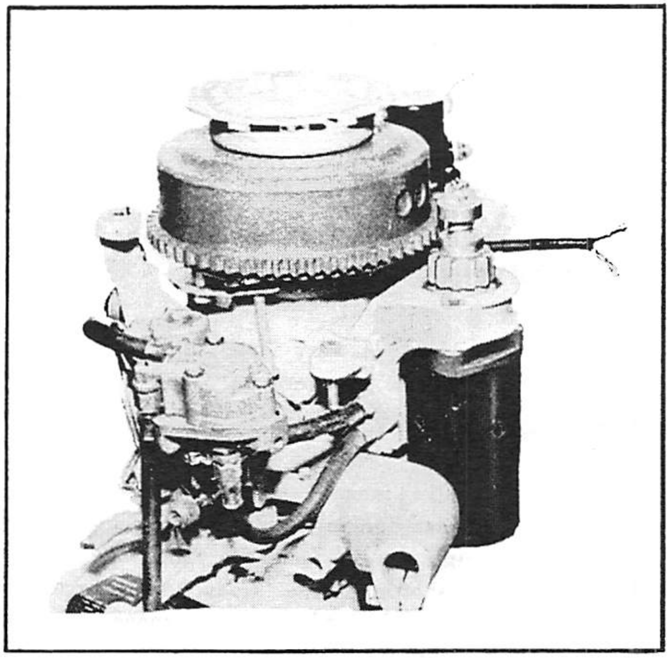
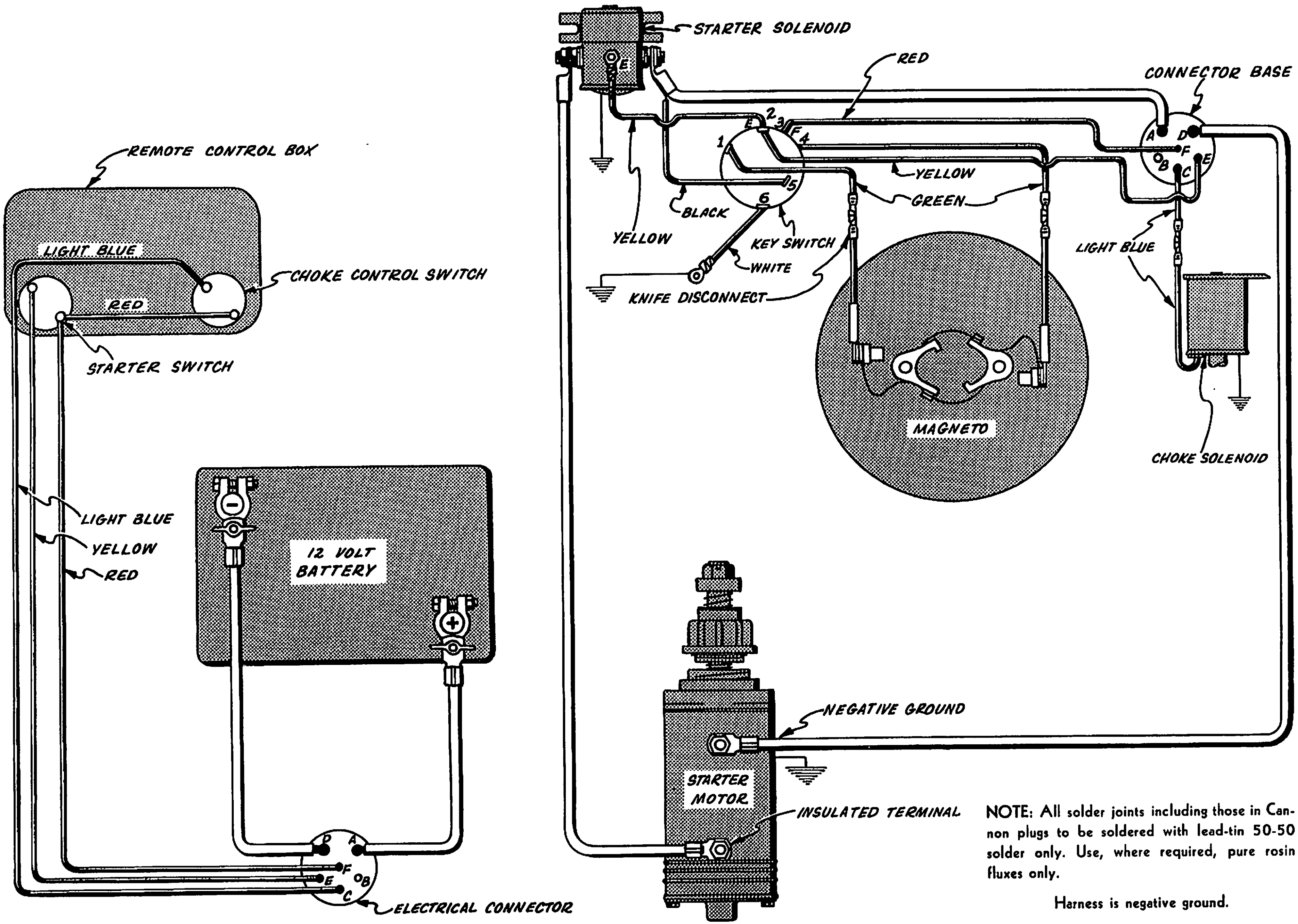


Figure 20. Mark 25E Powerhead, Negative Ground

F. MercElectric Testing - Trouble Chart Page 31-32

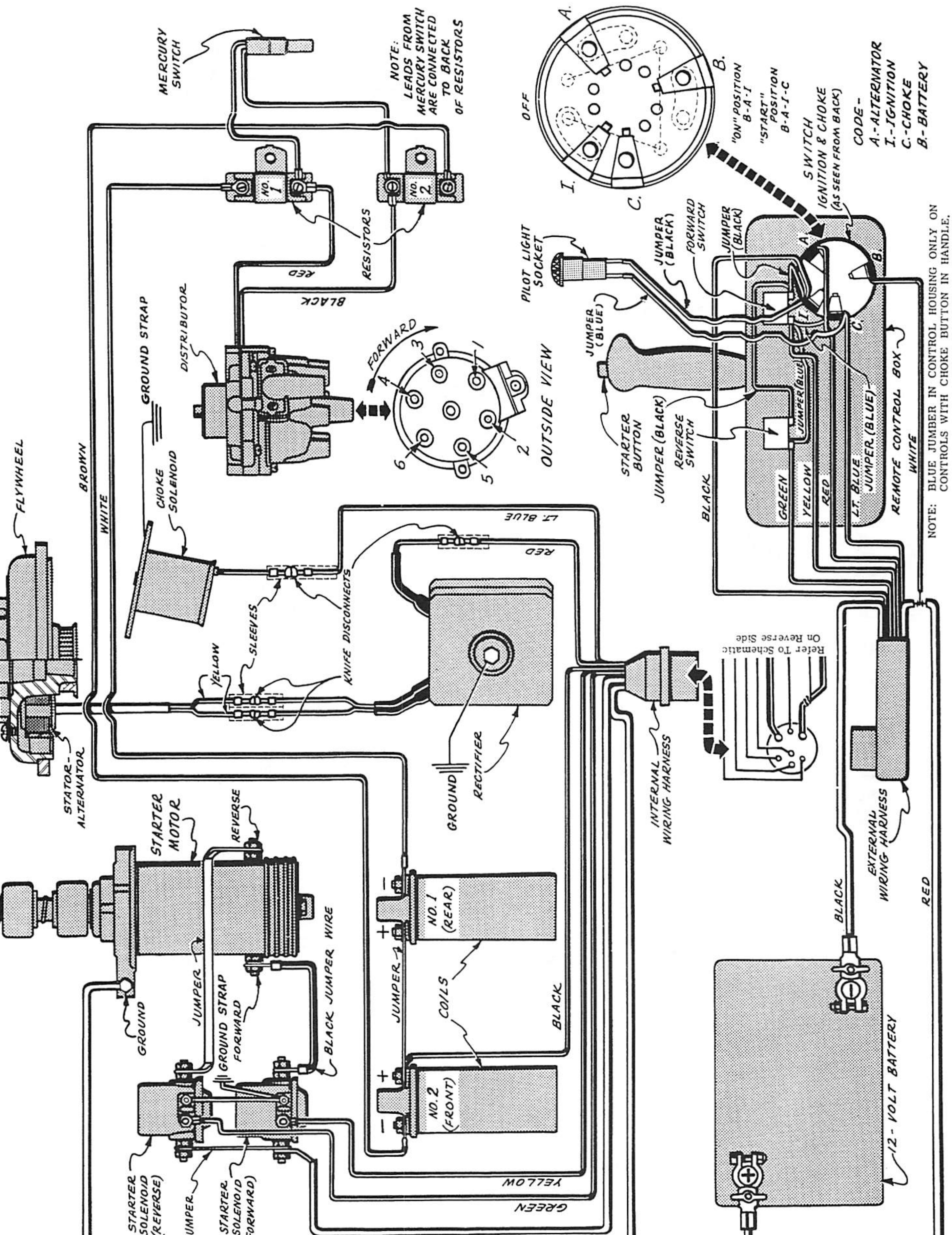
ELECTRIC STARTER WIRING DIAGRAM – MARK 25E

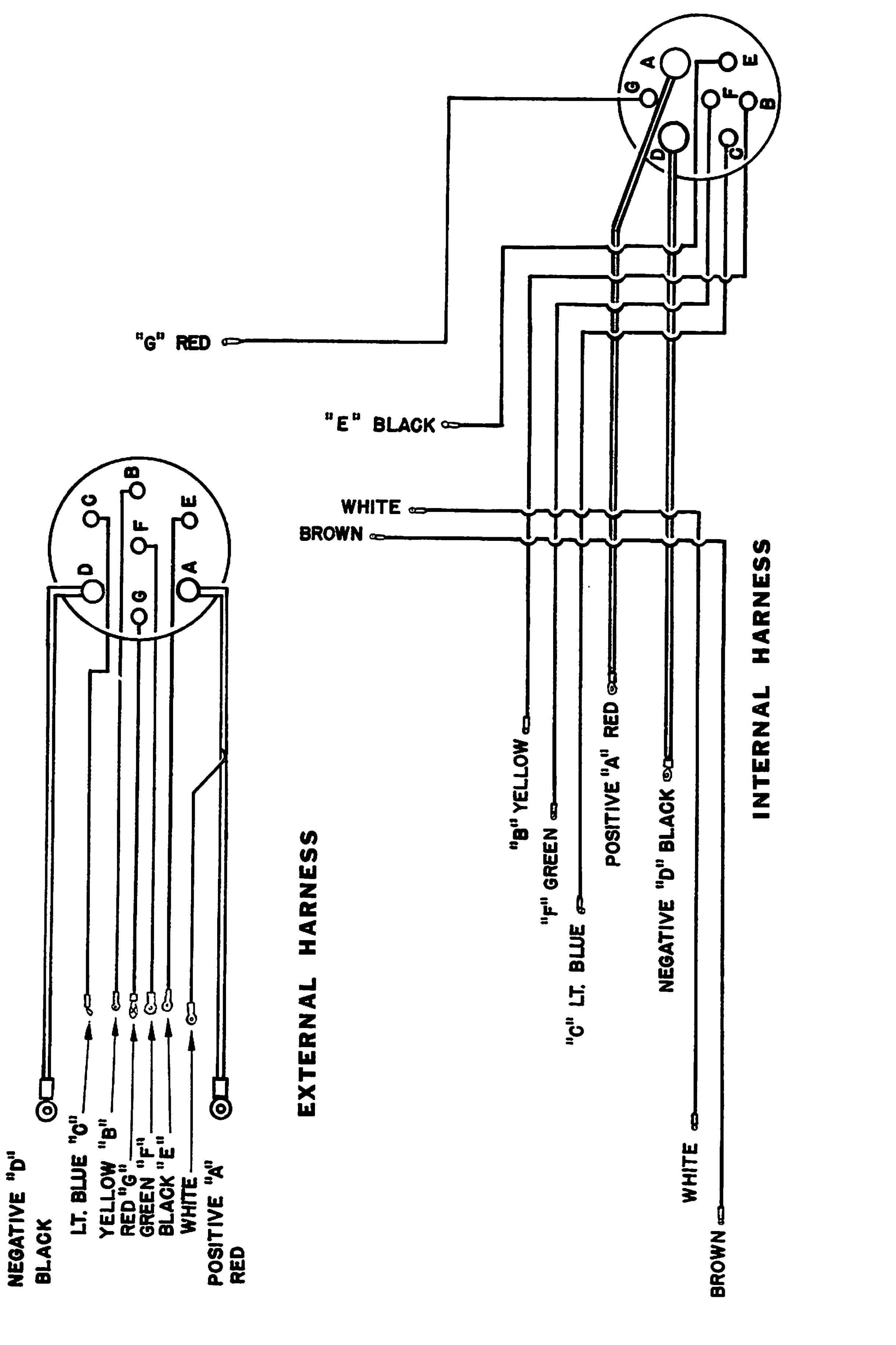


NOTE: All solder joints including those in Cannon plugs to be soldered with lead-tin 50-50 solder only. Use, where required, pure rosin fluxes only.

Harness is negative ground.

ELECTRIC STARTER WIRING DIAGRAM - MARK 78 -75





HARNESSES - MARK 78-75

REVERSING TYPE 4 & 8 BRUSH MERCELECTRIC

STARTER MOTOR - DISASSEMBLY

A. Removing Starter Motor & Mechanism from Engine

Remove starter motor and mechanism from engine by unscrewing the 2 mounting bolts from the mounting flange and the 2 crankcase-to-cylinder block bolts and nuts holding the starter motor support bracket. Be careful not to allow starter motor and mechanism to drop, since unit is loose once the bolts are removed.

B. Starter Mechanism Disassembly

Remove cotter pin from armature shaft end. With a wrench, unscrew castellated nut so that the entire starter mechanism can be pulled off by following sequence 2 through 16 in exploded view on Page 36.

C. Starter Motor Disassembly

Unscrew and remove the 2 thru-bolts, lockwasher and flat washers at bottom of starter motor. This loosens the drive end mounting bracket and support bracket. Slide off the motor end cap and bearing. The entire armature now can be removed by grasping the splined shaft end and pulling out. Be careful not to lose the shim at either end of armature. The commutator end plate assembly, as well as the neoprene end plate cover and insulation strip, can be removed by pulling off. Inspection of brushes and commutator end can be made at any time by removing the sealing ring, provided that the edges of the sealing ring are waterproofed with a neoprene sealing compound when replaced.

D. Lower End Cap (2 or 4 Brush Type)

Carbon Brush & Holder: Entire commutator plate, including bearing, 2 (or 4) brushes and 4 (8) springs, can be removed by pulling the 2 (4) brush springs from their posts which secure the 2 (4) brushes to the field coil lead wires. Unscrew the brush lead terminal from the end plate mounts by pulling springs off the retainers and pulling brush out. Other parts in the cap are permanent installations. Any damage to these parts will require replacement of entire cap. The carbon brushes attached to the fields can be removed by unsoldering brush lead wire from field contacts. This completes disassembly of the American Bosch type starter motor.

REASSEMBLY

A. Starter Motor Reassembly

Brush Holders & Brushes: Solder new carbon brush leads to field leads if old ones were removed for any reason. When replacing brushes, solder must be prevented from flowing up the brush shunt. When soldering, grip the shunt tightly near the end being soldered with a pair of round-nosed pliers. The shunt must remain flexible to allow the brush to move freely in the brush holder. Make sure that the brush shunts are positioned so that they do not restrict brush movement, and so that they will not hang up on brush holders as brush wears. The live brush shunts must clear ground potential. Brush shunts also must clear commutator riser bars. Be sure to place insulating sleeve on carbon brush lead and clamp on with wire clamp before soldering. Apply a thin film of SAE No. 10 oil on inside surface of bearing prior to assembly of drive end plate to housing. Replace carbon brushes when they are worn — always in a complete set. Place new carbon brushes into brush holders adjacent to the end cap mounting posts and secure terminals to flange with taper head screws. Place all brush springs on posts with small groove of spring to bottom of post with spring arm to inside of end cap. After spring is on, pull arm of spring in front of brush holder. (See Figure 21.)

Body and Field: The field winding is an integral part of the body. Inspect carefully for burned-out winding, shorting or poor insulation. If insulated covering is burned or removed or unit is shorted, it must be replaced.

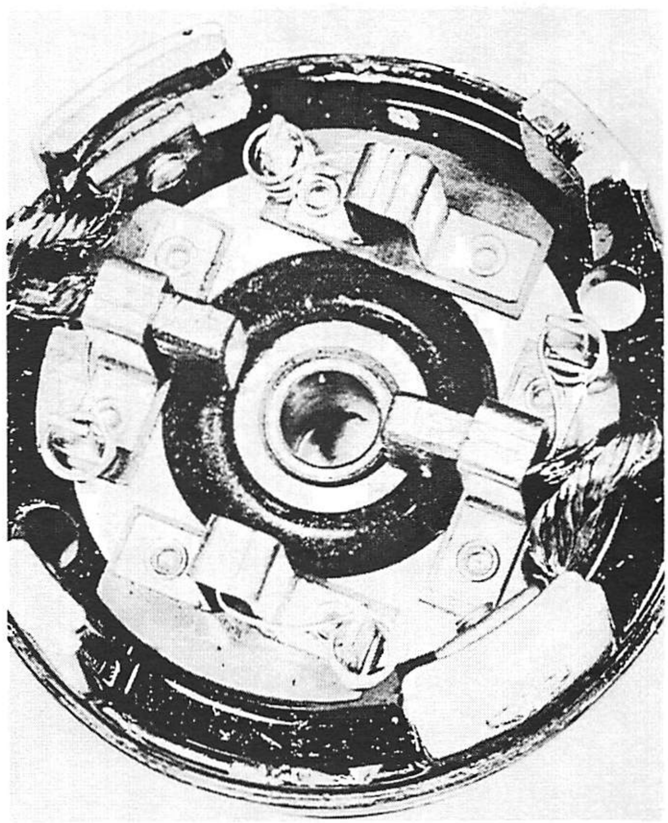


Figure 21. Commutator End Plate Assembly with Springs and Brushes in Place

Cleaning: Field coils, armature & brushes may be wiped with a clean, dry cloth or cleaned with compressed air. Do not immerse bearing-equipped parts in cleaning fluid. These parts should be cleaned with a brush dipped in Varsol, or any other comparable mineral spirits, while exercising caution that none of the cleaning fluid comes in contact with bearings. Thoroughly dry all parts which have come in contact with cleaning fluid.

Armature: Not much of the armature can be repaired. If commutator is worn, due to brush wear, it can be machined evenly and reinstalled with new brushes. This can be accomplished by any dealer having a lathe or regular armature reconditioning tool (See Figure 14 and 15, Page 31 and 32). *(Note: The reconditioning tool can be purchased from a local automotive or tool supply store.)* The aforementioned armature reconditioning tool turns down the commutator and undercuts the mica.

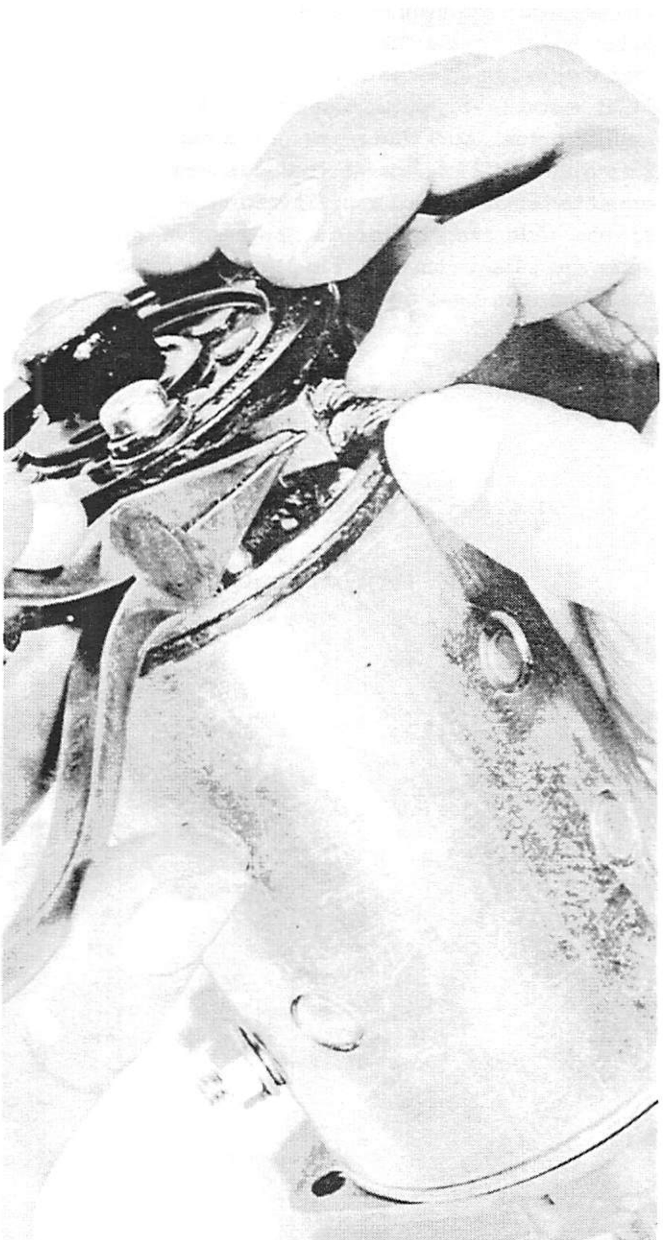


Figure 22. Installing Carbon Brush

Undercut of mica should be approximately 1/32". After thorough inspection has been completed and armature is found to check out OK, or has been reworked, it can be reinstalled. Armature can be checked out on an armature growler. (See Figure 16, Page 32.) Any automotive garage can test armatures, or armature can be checked on Magneto Analyzer (91-25213). Check for continuity between commutator and armature shaft. If continuity exists, winding is grounded and armature must be replaced. Set armature into field housing assembly, commutator end toward end of housing having brushes secured to field. Place commutator end cap onto armature shaft and align slot in one of the 4 end cap posts with small notch in housing frame. Place carbon brushes into brush holders, being sure brush leads are not touching on metal surfaces.

Place carbon brushes into brush holders by pulling brush holder springs back with needle-nose pliers and inserting brushes. Reset spring into small groove of carbon brush. (See Figure 22.)

Apply a light film of SAE #10 oil to bearing portions of armature shaft before reassembling motor and to splines of armature shaft before reassembling drive assembly. Insert field coil windings insulation strip into the housing at the drive end over drive end thru bolt insulation strip. Assemble tab of insulation strip under commutator end thru bolt insulation strip. The notched end of the insulation strip at commutator end of housing is to clear the terminal. Insert, etc. Insert the 2 pieces of thru-bolt insulation strip into commutator end, flush to .062" inside housing over tab of insulation strip (field coil windings) and glue the 2 pieces of insulation strip (thru bolt, commutator end) into place. Exercise care when inserting thru-bolts, as they must be placed between frame and insulator paper or into insulator tube, whichever is provided at each end of fields in frame. Insert 2 thru-bolts, lockwasher and washers through starter motor support bracket (be sure bracket is correctly located) and commutator end plate. Set shims on shaft. Place drive end plate shoulder down onto armature shaft over 2 thru-bolts. Check armature end play. Shim as required to obtain 0.005" to 0.015' armature end play. Place adaptor flange on drive end over plate and secure in position by threading the 2 bolts into flange and tighten. Torque thru-bolts to 60-65 in. lbs. Place insulating band around field housing and commutator end cap, attaching ends with a piece of Scotch Tape. Install neoprene insulator cover, position evenly with ridges facing outward and seal with Liquid Neoprene (92-25711) to provide watertight seal.

B. Starter Mechanism Reassembly

Installation of the starter mechanism parts can be made by using the exploded view on Page 36 and noting the following positioning:

In sequence, replace: Washer, thrust - cushion cup, 16; spacer, cushion, 15; cushion, rubber - recoil, 14; cup, cushion (open end over rubber cushion), 13; washer, thrust - cushion cup, 12; assemble the screw shaft to the pinion so that the splined end of the screw shaft enters the inside diameter of the pinion opposite the counterbore and assemble the screw shaft and pinion as a unit to the armature shaft with the inside diameter counterbore of the pinion facing the motor, 7; gear, pinion - forward drive (chamfered teeth up), 8 (later units have these parts as one assembly); sleeve, anti-drift spring (shoulder down), 9; washer, anti-drift spring (recess up), 10; spring, anti-drift, 11; washer, anti-drift spring (recess down), 10; sleeve, anti-drift spring (shoulder up), 9 (later units have these parts as one assembly); gear, pinion - reverse drive (chamfer teeth down), 8; assemble the screw shaft to the pinion so that the splined end of the screw shaft enters the inside diameter of the pinion opposite the counterbore and assemble the screw shaft and pinion as a unit to the armature shaft with the inside diameter counterbore of the pinion facing the castellated nut, 7; sleeve, 6; wave washers (2), 5; flat washer, 4; castellated nut; tighten nut to 200 in. lbs. minimum torque and, if necessary, continue tightening nut until cotter pin can be assembled to hole in shaft and slot in nut (do not back nut off).

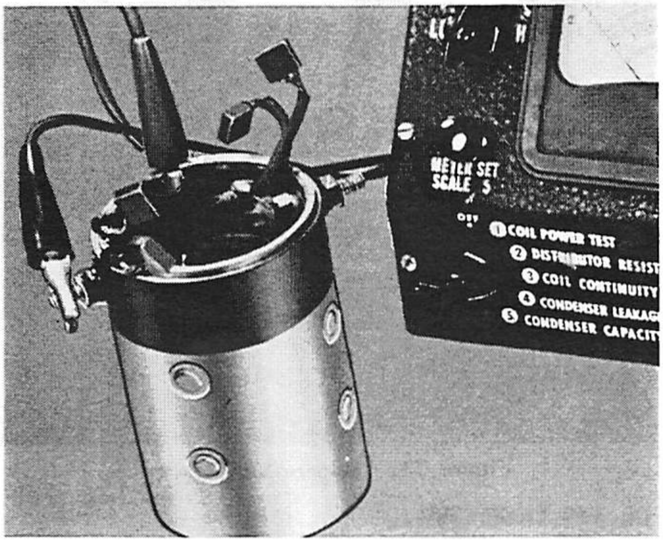


Figure 22A. Checking Starter Motor for Grounded Field Winding

Testing: Use fully charged 12-volt battery for testing and apply power to starting motor input terminal through a switch. Test leads of No. 10 stranded cable or larger must not exceed 6 ft. in length. Check operation of drive assembly by applying rated voltage momentarily. The starting motor should not be run continuously for more than 15 seconds when testing. Before taking each test reading, the motor should be cooled to room temperature (approx. 75° F.), and the reading should be taken as quickly as possible.

NOTE: Refer to Page 43 "Starter Motor Testing and Trouble Chart".

Starter Motor Characteristics – 6-Cylinder Engines

Starter	Volts	Ampere Draw
No load*	12	50-55
Load	12	180-240 while cranking

* *Momentary operation only. Caution: Do not allow to run too long!*

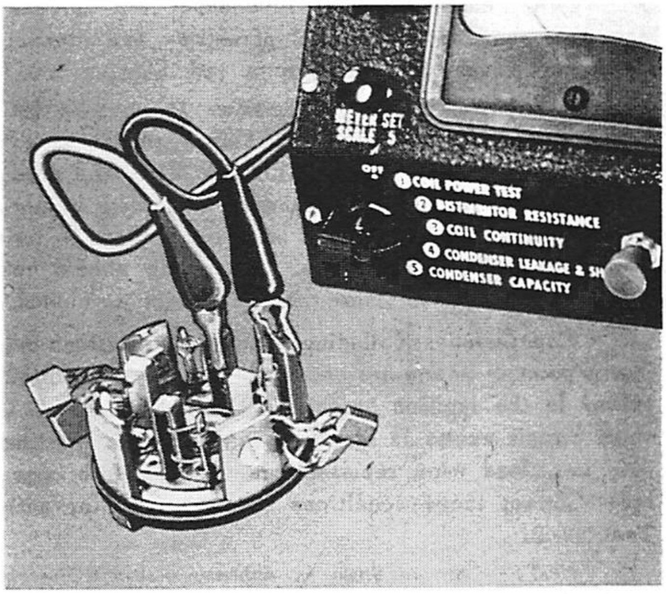


Figure 22B. Checking Starter Motor for Grounded Brushes or Brush Holders

Drive mechanism operation: The drive mechanism is part of the complete starter motor. It is located at the top of the starter motor. The starter motor drive pinion gear automatically engages the flywheel ring gear, due to sudden inertia when the starter turns over, and automatically disengages when the engine starts. The teeth on the drive pinion gear are chamfered so as to engage more readily with the flywheel ring gear teeth.

C. Installing Starter Motor Mechanism on Engine

Place spacer washers as required on top of starter motor to obtain equal clearance between collars of forward and reverse starter pinion gears. *(Note: Insert starter motor assembly into crankcase adaptor flange with terminals to rear.)* Thread two 5/16" bolts into starter motor mounting flange holes. Insert the 2 crankcase-to-cylinder block bolts through the starter motor support bracket holes and thread on nuts. Torque top mounting bolts first and then support bracket bolts. See Page 2B, Section VIII for correct torque specifications.

D. Starter Motor Operation

Warning: Do not operate starter motor continuously for more than 30 seconds without pausing to allow motor to cool off for 2 minutes! Starter motor is not designed for continuous operation, and serious damage may result.

NOTE: Warranty will not apply on starter motor if starter motor and/or armature or field coil assembly is burned or lead thrown out of commutator because of excess cranking.

CHECKING AMPERAGE OUTPUT - - MERCELECTRICS

I. TESTING NET DC AMPERAGE OUTPUT ON ALL 6-CYLINDER ENGINES

(Use 91-27883 Ampere-Volt Tester.)

A. Test No. 1

With engine stopped, disconnect red harness lead from positive (+) terminal of battery and connect negative (-) ammeter terminal to red harness lead. Connect positive (+) side of ammeter to positive (+) terminal of battery. (Figure 23) Turn ignition key to "ON" position (DO NOT START ENGINE) and read ammeter. The proper amperage draw with both points closed should be 5½-to-6½ amperes (6½-to-7½ for Mark 75). If reading is less, the engine should be turned over by hand to insure that both points are closed.

Conclusions: If reading is lower, indications are that a point or points are not closing or an open circuit exists in the ignition system. If reading is higher, a short circuit exists in ignition system (a part shorting out; i.e., lead wire, resistor screw grounded to case, etc). Correct these conditions before proceeding with Test No. 2.

NOTE: Current draw is approx. 4-to-5 amperes during operation; (Mark 75 current draw is approx. 4 amperes during operation).

B. Test No. 2

Disconnect ammeter from electrical circuit and reconnect red harness lead to positive battery terminal. Start engine and run at 1500 RPM or less. *(WARNING ABOUT CONNECTION: Without disconnecting red harness lead from battery, connect the positive clip from ammeter to the positive battery terminal and negative clip to spade lug on red harness lead.)* Remove wing nut and <u>carefully</u> remove spade lug from battery post, being sure that neither of the 2 clips breaks contact with the parts to which they are attached. If accidental loss of contact occurs, rectifier failure may result which might be prevented by immediately reconnecting spade lug of harness to battery terminal.

CAUTION: Should engine stop, do not attempt to start engine with ammeter connected, as ammeter will become damaged instantly. Always reconnect red harness lead to battery post before starting.

With a partially discharged battery, the ammeter should change from discharge to charge at between 800-to-1000 RPM (1100-to-1500 for the Mark 75). With a fully-charged battery, this RPM may be somewhat higher. Increase engine RPM to 5200 to 5500, at which time the reading should be approximately 10-to-12 amperes (5-to-6 amperes for the Mark 75) with partially discharged battery. With a fully-charged battery, a somewhat lower reading will be obtained because of self-regulating characteristics of the generating systems.

Before disconnecting ammeter, reconnect red harness lead to positive terminal of battery and replace wing nut.

II. CHECKING GROSS DC AMPERE OUTPUT OF RECTIFIERS, ALL MERCELECTRICS WITH GENERATORS

(Use 91-27883 Ampere-Volt Tester.)

Connect an ammeter (Figure 23) between red output lead from the rectifier and the electrical internal harness red lead. Disconnect this lead by removing the self-tapping screw from the rectifier bracket and pull the neoprene sleeve back from the knife disconnects. Open the disconnects and connect ammeter, attaching lead from rectifier to one terminal of ammeter and lead from internal harness to second terminal. Start engine and check amperage output. Maximum output with a low battery at full throttle is 14 amperes (Mark 75, 9½ amperes).

The same test procedure can be used on 4-cylinder MercElectrics. Maximum output at full throttle on these models is 7 amperes with a low battery.

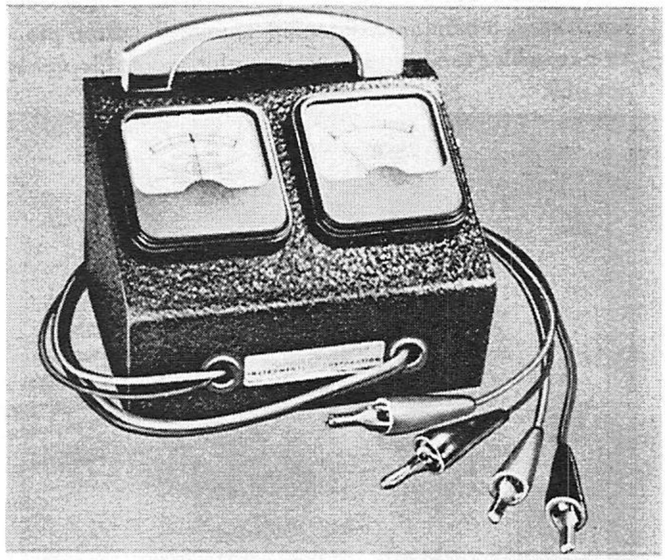


Figure 23. Ampere-Volt Tester

III. VOLTAGE CHECK

(Use Voltmeter Side of Tester.)

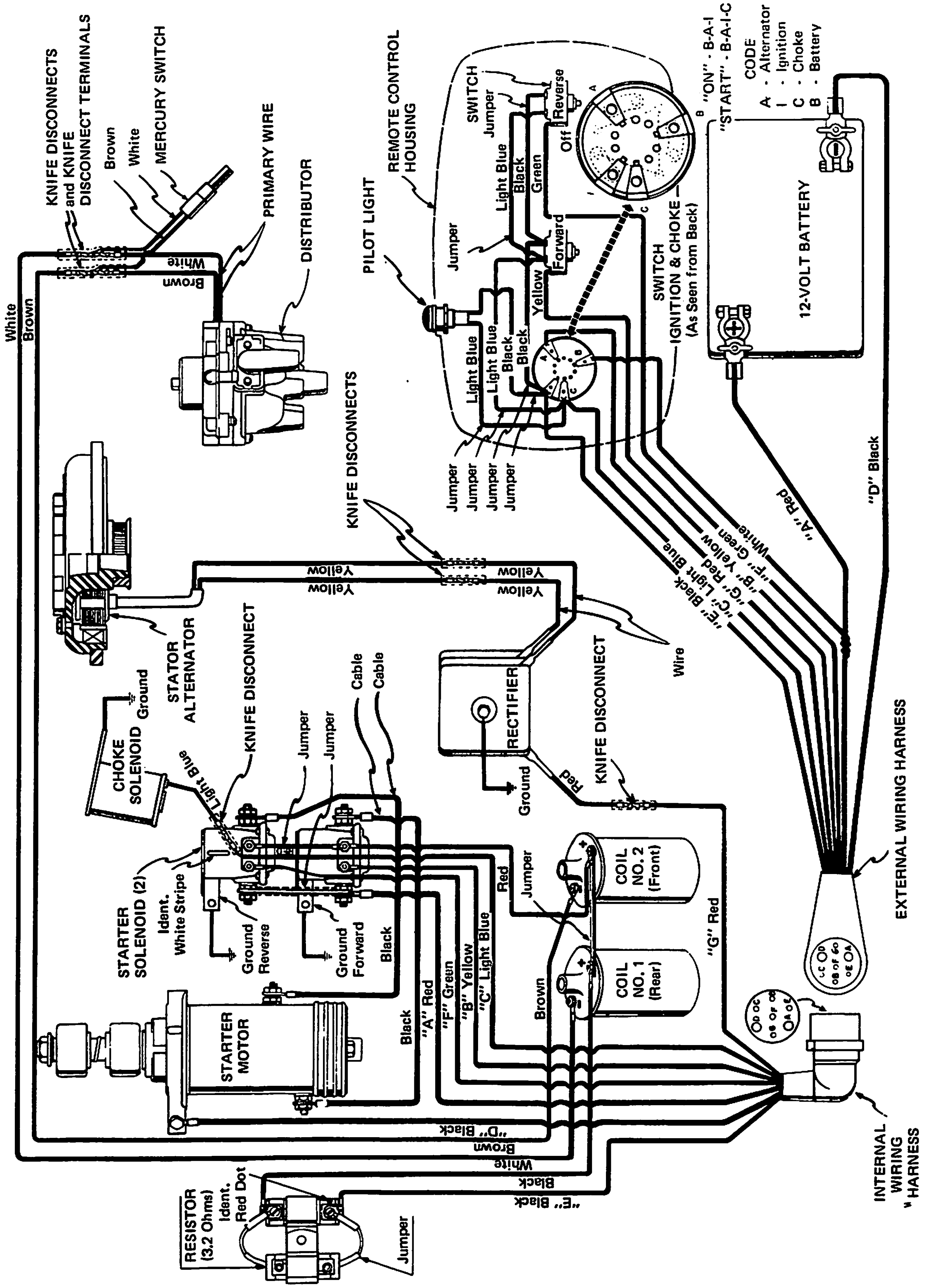
A. Battery Voltage While Cranking Engine

To check battery voltage while cranking engine with electric starting motor, place red (+) lead of tester on positive (+) battery terminal and black (-) lead of tester on negative (-) battery terminal. If the voltage drops below 9½ volts while cranking, the battery is weak and should be recharged or replaced.

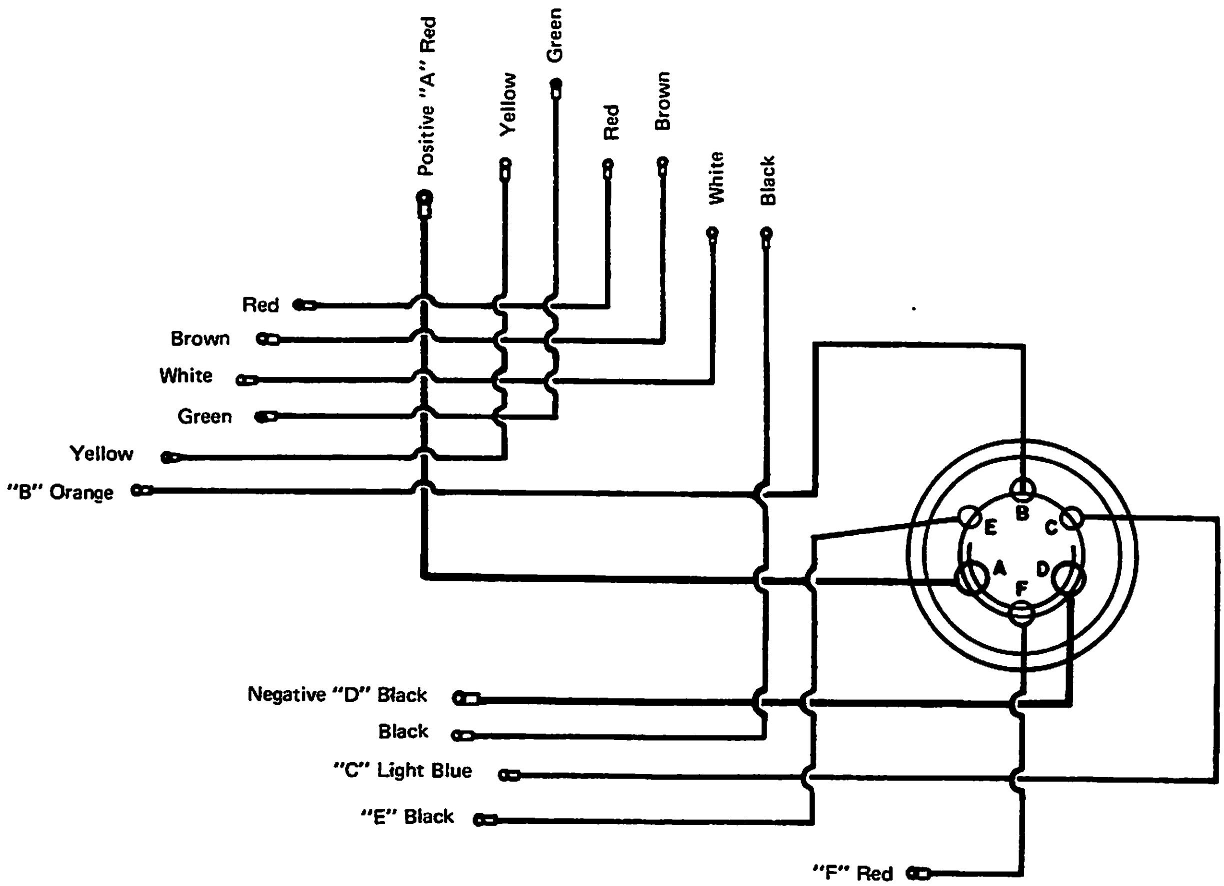
B. Condition of Battery

A quick voltage check to determine condition of the battery can be completed by attaching the leads as stated in "A" above. Meter will indicate voltage. If below 12 volts, it indicates a weak battery. A closer check then can be made with a hydrometer to obtain specific gravity readings.

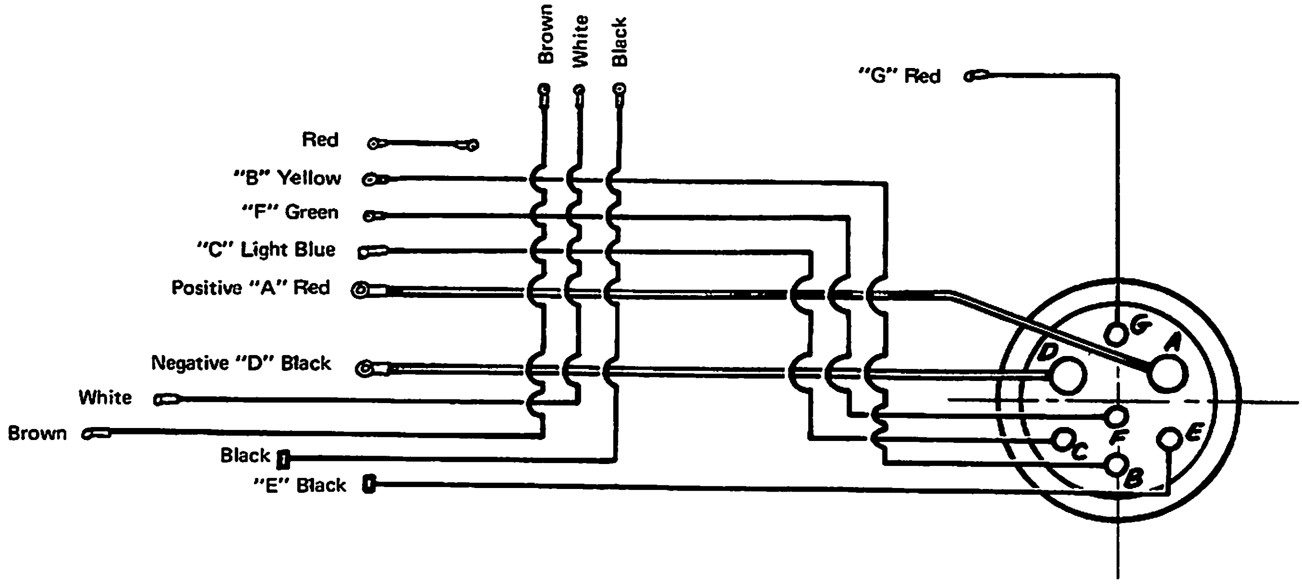
ELECTRIC STARTER WIRING DIAGRAM - MARK 78A-75A



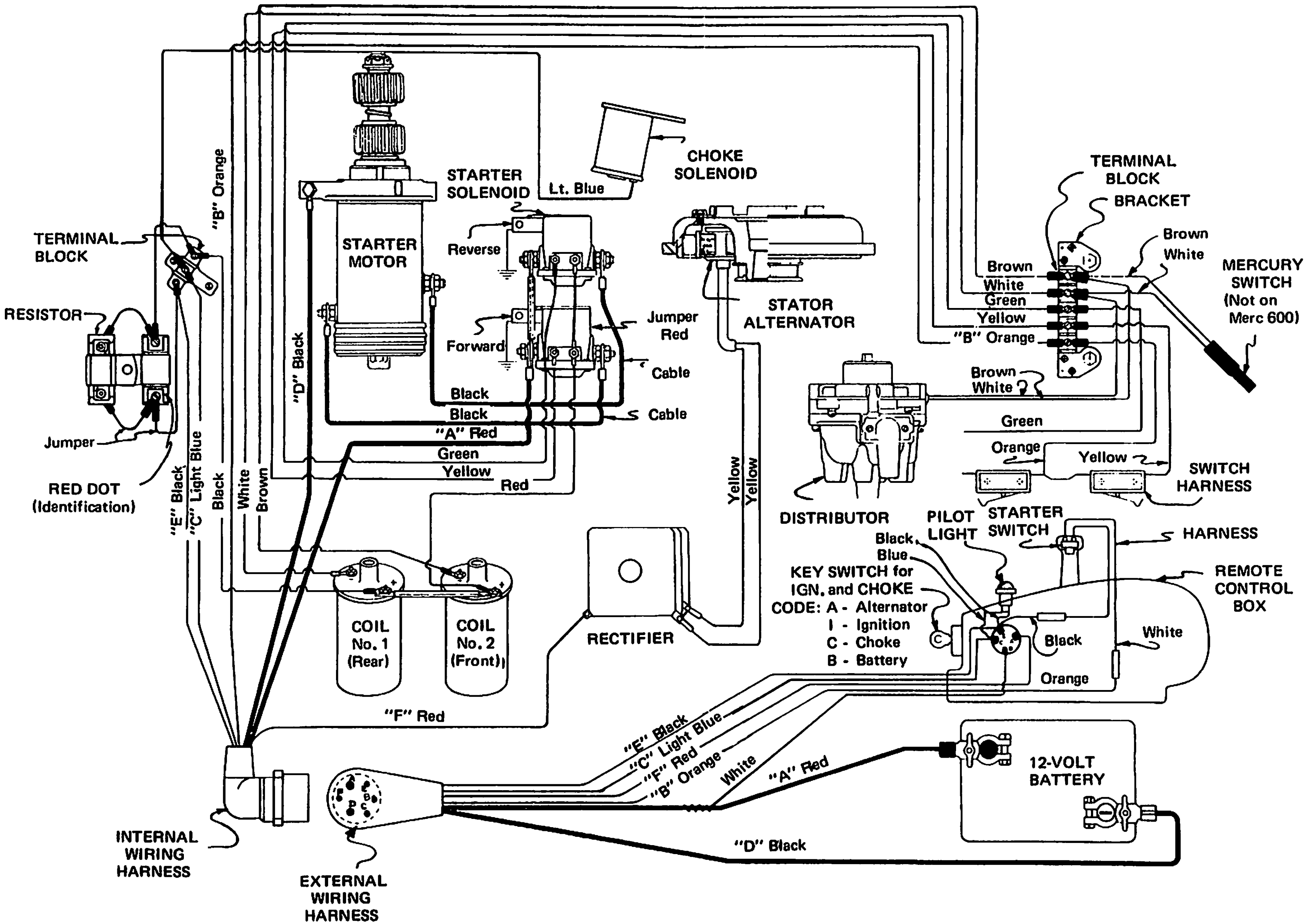
INTERNAL HARNESS - MERC 800-700-600
(DIRECT REVERSING)



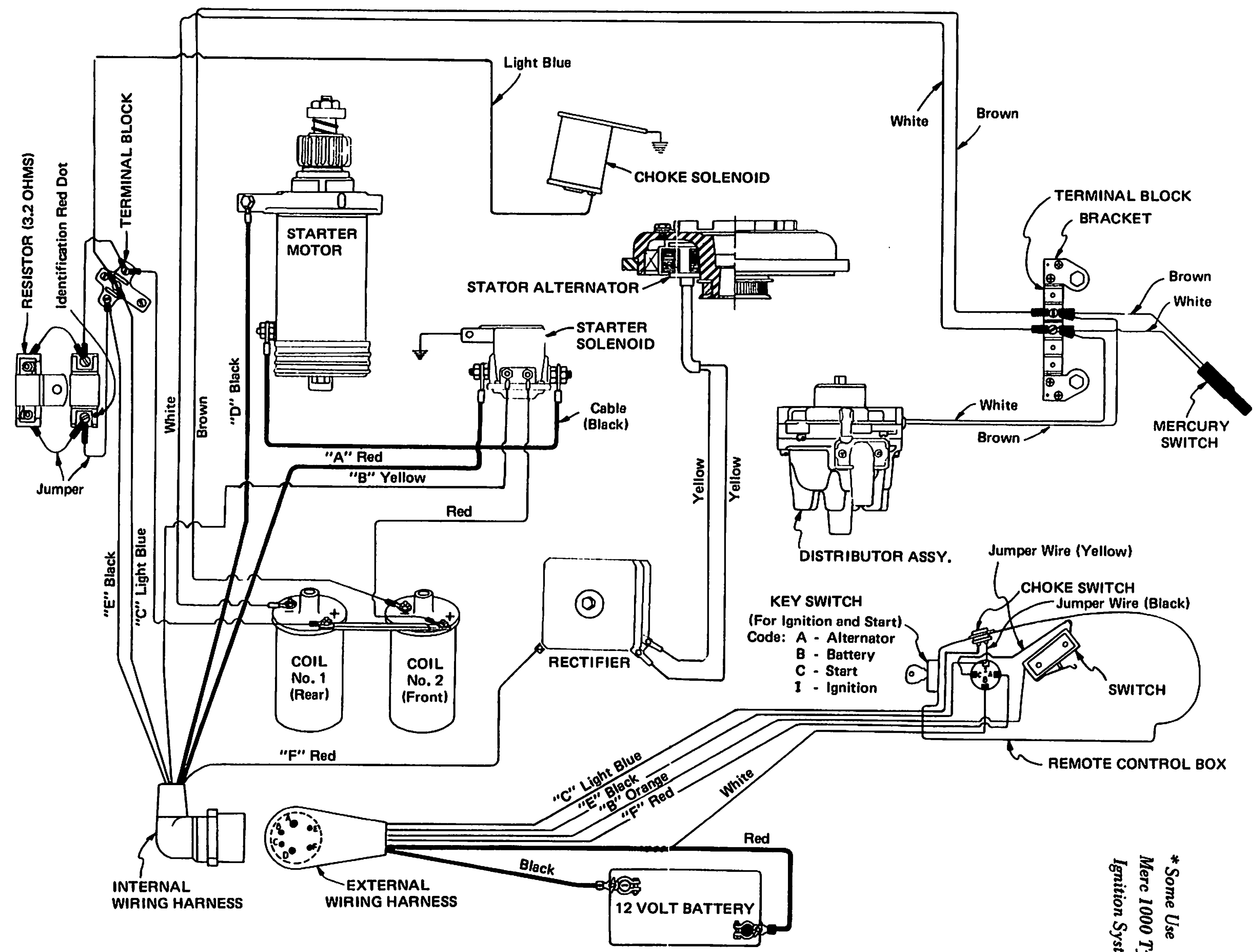
INTERNAL HARNESS - MARK 78A-75A



ELECTRIC STARTER WIRING DIAGRAM
MERC 800-700-600 (DIRECT REVERSING)

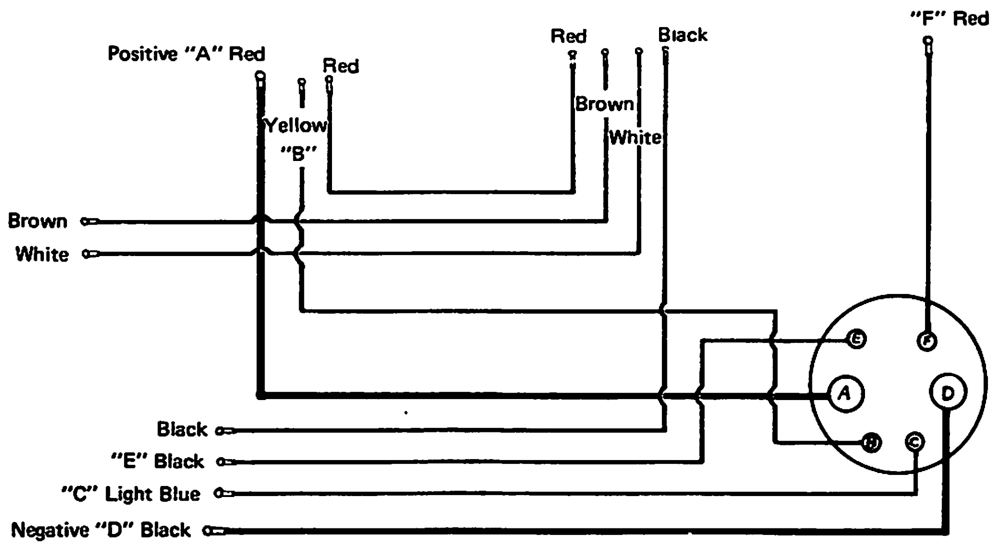


ELECTRIC STARTER WIRING DIAGRAM
MERC 850*-800-700* FULL GEAR SHIFT

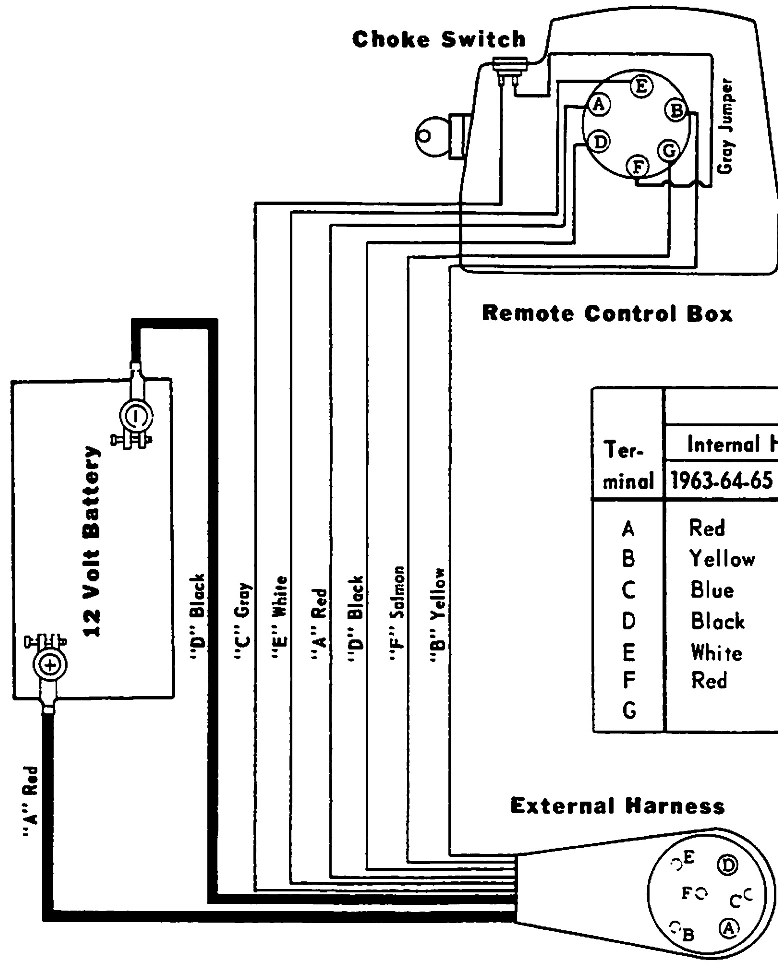


*Some Use Merc 1000 Type Ignition System

INTERNAL HARNESS - MERC 850-800-700
FULL GEAR SHIFT

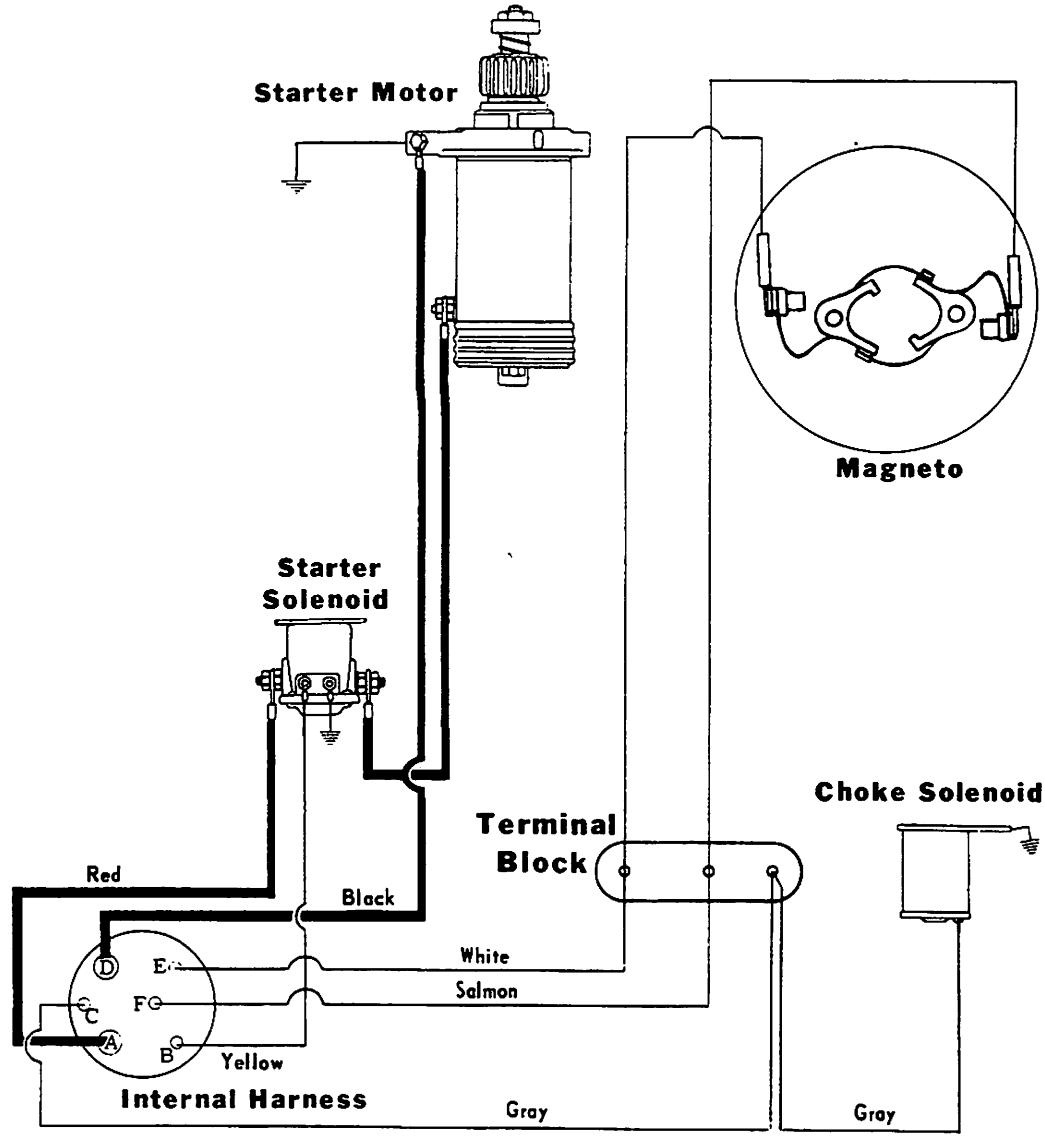


MERC 350 (2-CYL.) MERCELECTRIC HARNESS

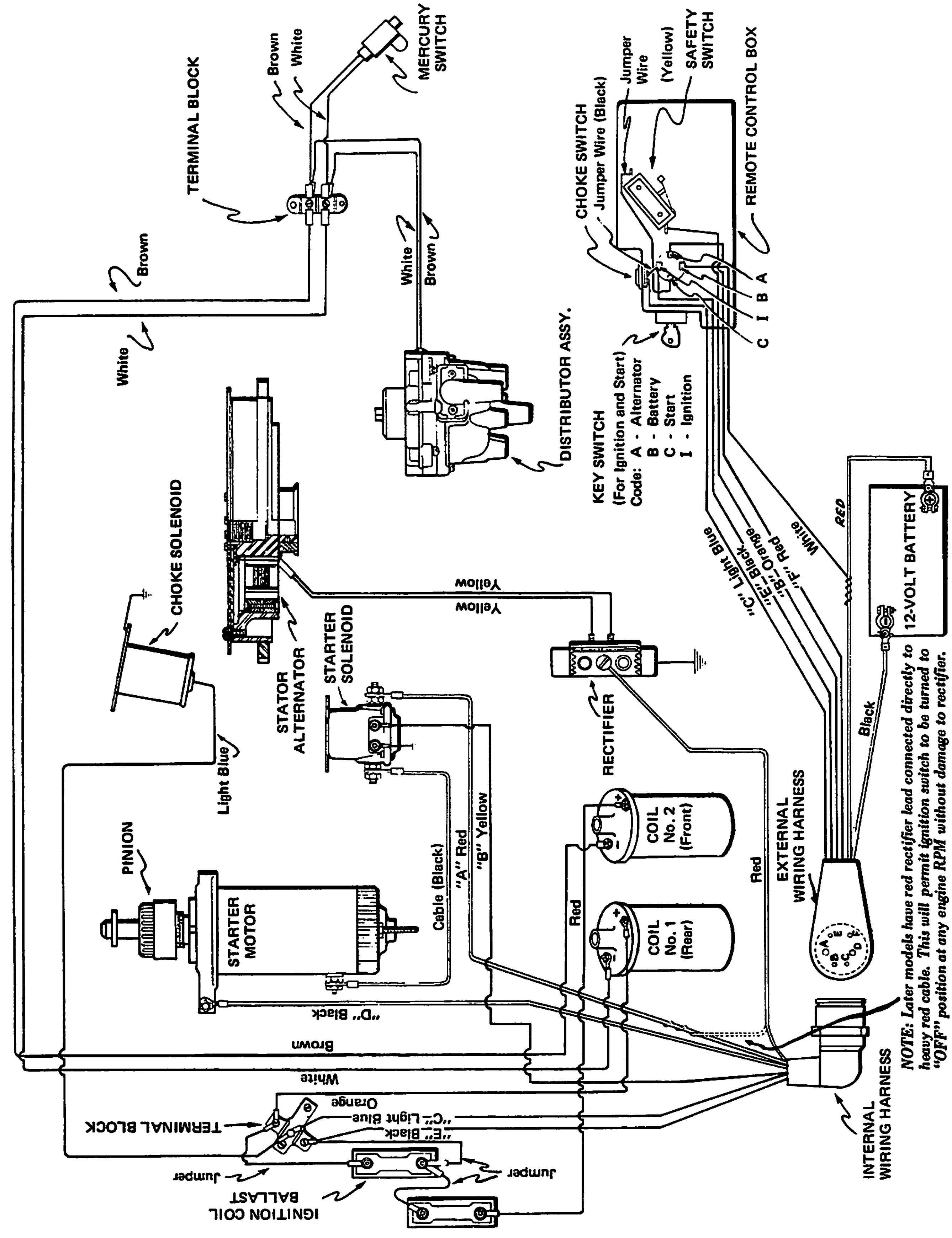


Ter-minal	Terminal Color: Internal Harness 1963-64-65	Internal Harness 1966	External Harness 1963-64-65	External Harness 1966	Key Switch 1963-64-65	Key Switch 1966
A	Red	Red	Green	Red	Green	Red
B	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
C	Blue	Gray	Blue	Gray		
D	Black	Black	Red	Black	Red	Black
E	White	White	White	White	White	White
F	Red	Salmon	Black	Salmon	Black	Gray
G					Black	Salmon

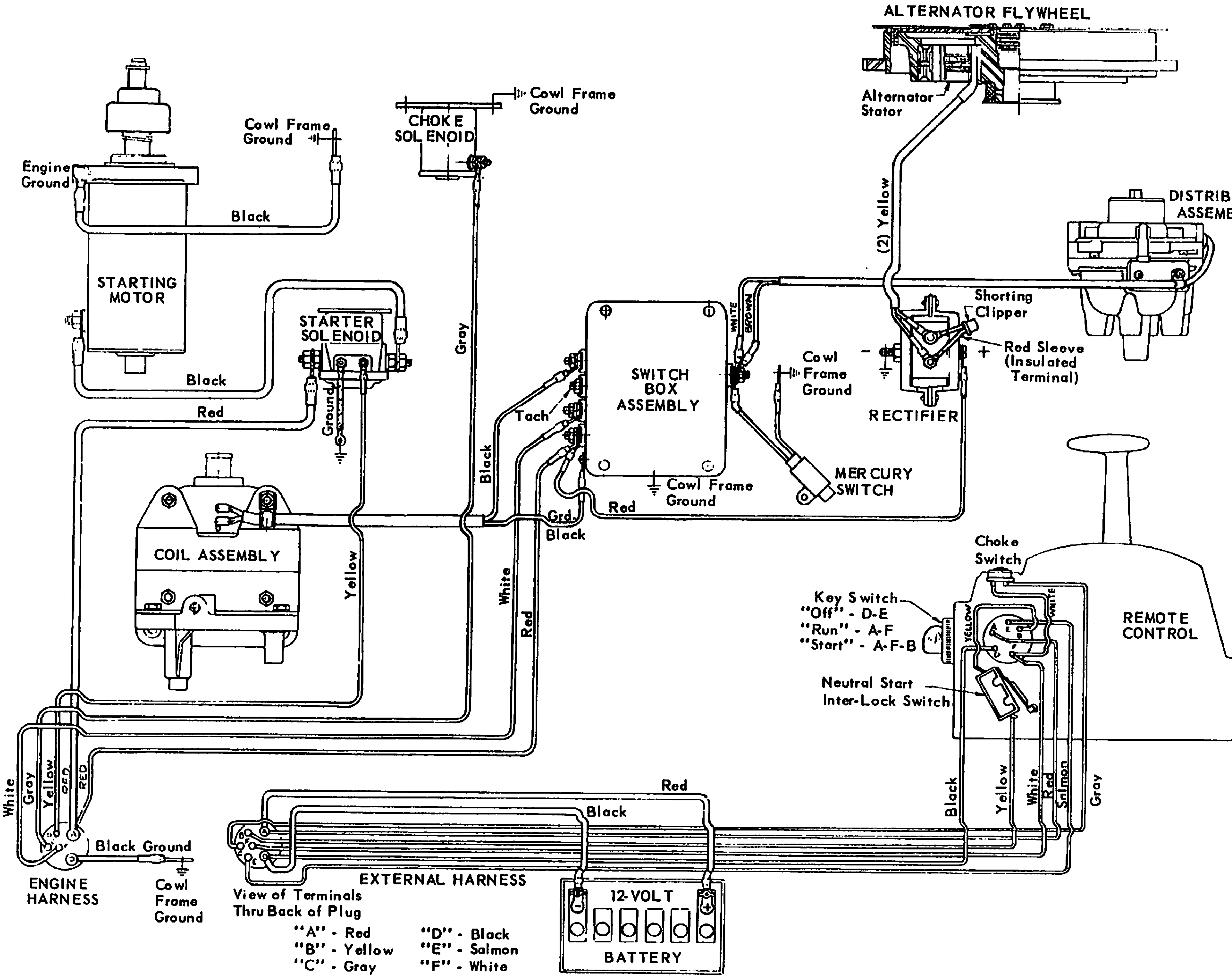
MERC 350 (2-CYL.) MERCELECTRIC WIRING DIAGRAM



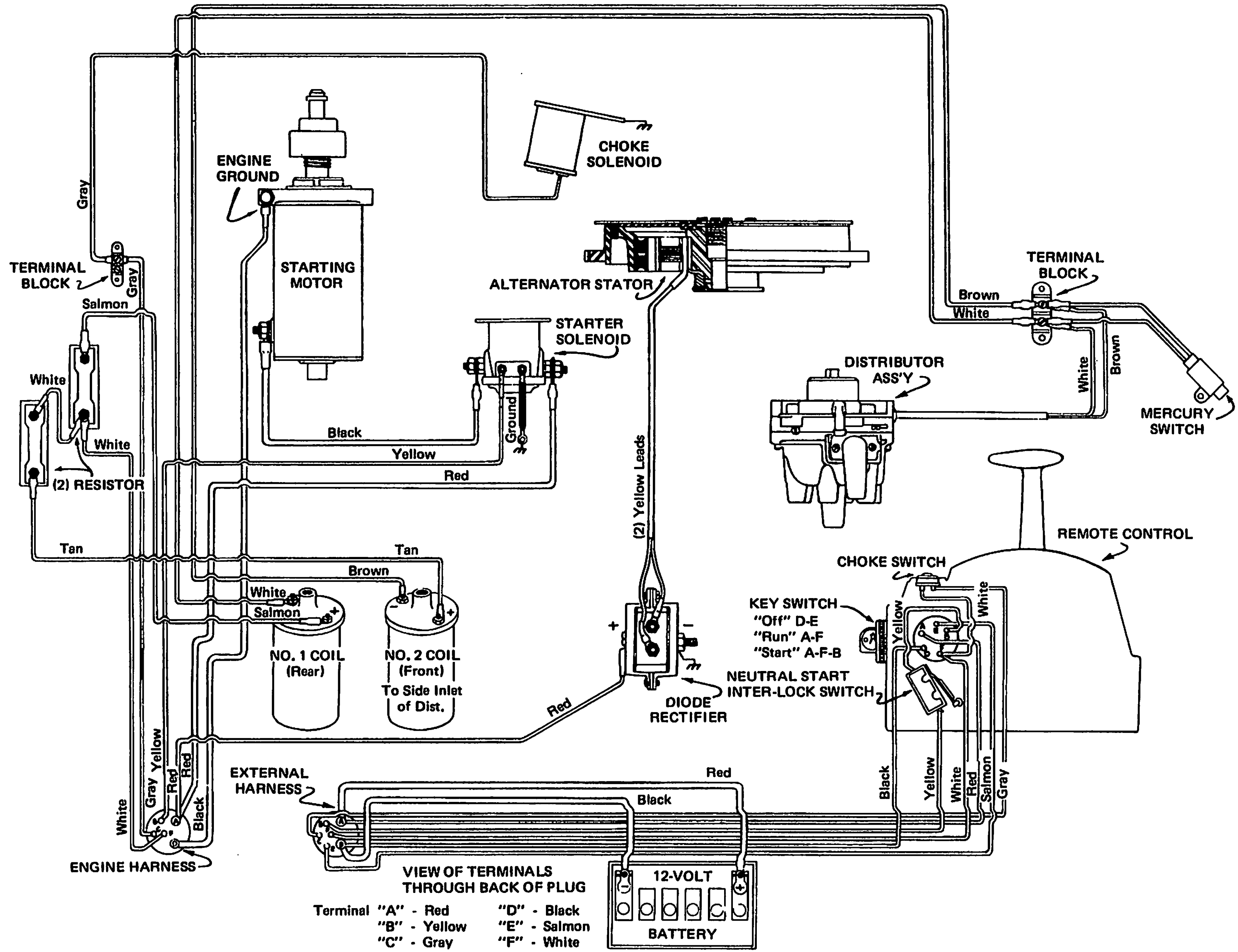
ELECTRIC STARTER WIRING DIAGRAM
MERC 1000-900-850-700 FULL GEAR SHIFT



MERC 1100SS-950SS WIRING DIAGRAM



MERC 1100-950 WIRING DIAGRAM



KIEKHAEFER STARTER MOTOR
FOR 6-CYL. MODELS, STARTING WITH 1965

Disassembly

STARTER MECHANISM - DISASSEMBLY OF INERTIA TYPE DRIVE

Refer to disassembly of Delco-Remy inertia type drive, Section VII, Page 31, Paragraph B.

STARTER MOTOR - DISASSEMBLY AND REPAIR

1. Remove 2 thru bolts, lockwashers and flat washers from bottom of starter.
2. Pull armature and upper end cap from body and field.
3. Remove lower end cap and release brushes from brush holder. Do not lose thrust washers from end cap or armature shaft.
4. Brushes should be replaced if worn to one-half of original length or chipped or worn.
5. Two brushes and terminal can be removed by pushing terminal block toward bottom of field housing.
6. Field brushes are removed by loosening solder connections with a soldering gun.
7. Field winding is an integral part of body, as they are spot welded together, and must be replaced complete if found defective.
8. Set Magneto Analyzer on Scale No. 3 and check between field and body. Needle on analyzer should move completely to the right of Scale No. 3, as field and body are connected.
9. Check armature on a growler, or by placing Magneto Analyzer on Scale No. 3, and check for shorts between commutator bars and core. Any movement of analyzer needle to the right indicates a short. Clean carbon dust from armature, as this may be cause for short.
10. Armature commutator bars can be resurfaced with a reconditioning tool, if worn excessively, or cleaned with No. 00 sandpaper.

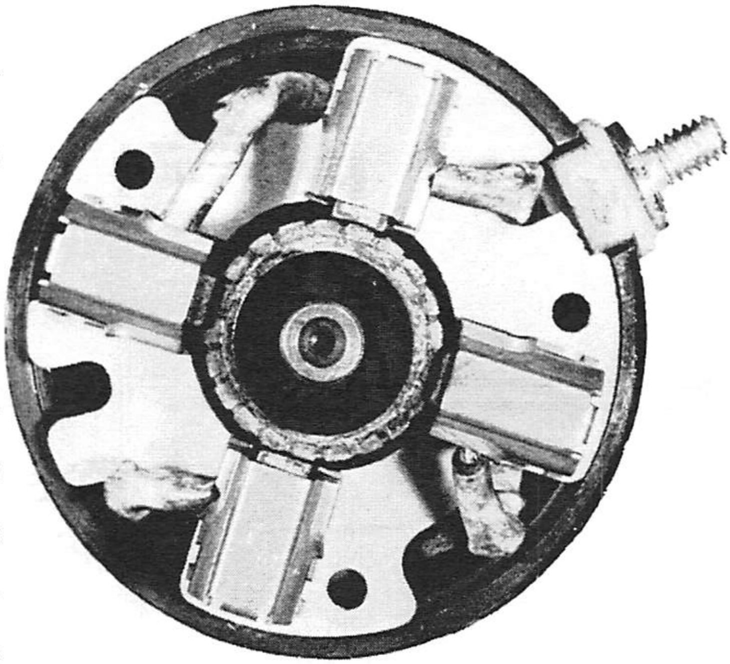


Figure 1. Brush and Brush Holder Aligned

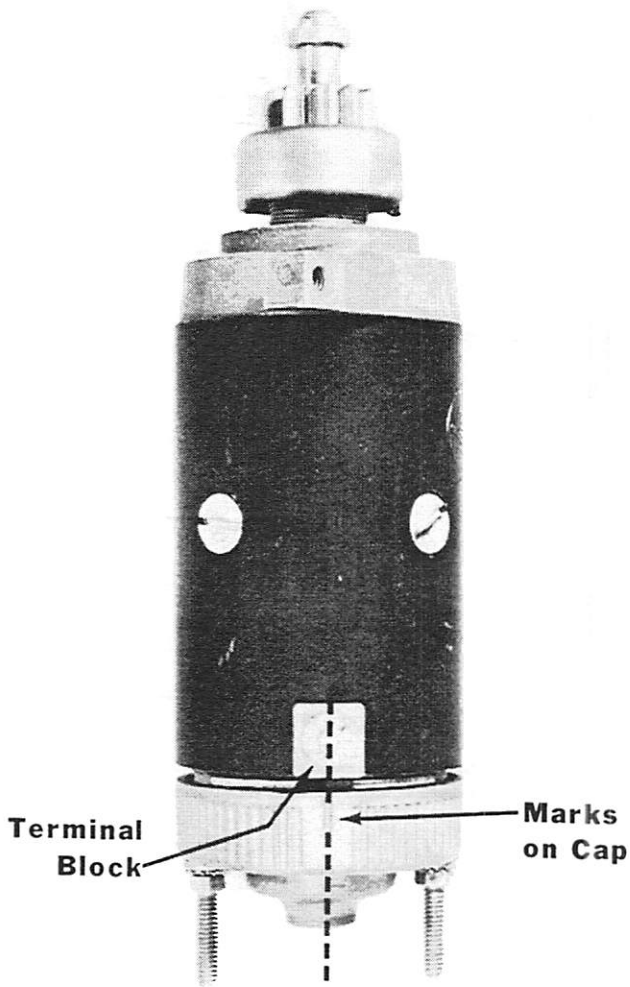


Figure 2. Aligning End Cap with Brush Holder

Reassembly

REASSEMBLY OF STARTER MOTOR

1. Clean connections on field windings and resolder on new brushes with resin flux solder. Do not apply excessive solder on brush lead, as lead must remain flexible.
2. Place shims and upper end cap on armature shaft. Install armature into body and field and line up detents.
3. Install thrust washers on lower end of armature shaft.
4. Install brushes into brush holder and depress brushes and brush springs while sliding over commutator bars. Check for proper alignment of brush and brush holder, as they will only fit onto field body one way. (Fig 1)
5. Align lower end cap with brush holder and install. Two marks on cap line up with terminal block. (Figure 2) Install 2 thru bolts and tighten.

REASSEMBLY OF INERTIA TYPE DRIVE

Refer to reassembly of Delco-Remy inertia type drive, Section VII, Page 31, Paragraph C.

AMERICAN BOSCH STARTER MOTOR
FOR 4-CYL. MODELS, STARTING WITH 1965

Disassembly

STARTER MECHANISM - DISASSEMBLY OF INERTIA TYPE DRIVE

Refer to disassembly of Delco-Remy inertia type drive, Section VII, Page 31, Paragraph B.

STARTER MOTOR - DISASSEMBLY

1. Remove 2 thru bolts and lock washers at bottom of starter.
2. Pull armature and upper end cap from body and field.
3. Remove lower end cap and release field brush by pulling brush spring back with pliers. Do not lose thrust washer from end cap.
4. Brushes
   a. Replace brushes, if worn 1/2 of original length or if chipped or broken.
   b. Ground brush may be replaced by removing screw in lower end cap.
   c. Field brush
      (1) Unwrap tape and slide sleeve from soldered connection.
      (2) Loosen soldered connection with soldering iron.
      (3) Resolder new brush lead to coil connections with rosin flux only. (Figure 1)
      NOTE: Do not use excessive solder on lead of brush, as lead must remain flexible.
      (4) Install sleeve and retape soldered connection.
   d. Brush spring tension: 29-36 oz.

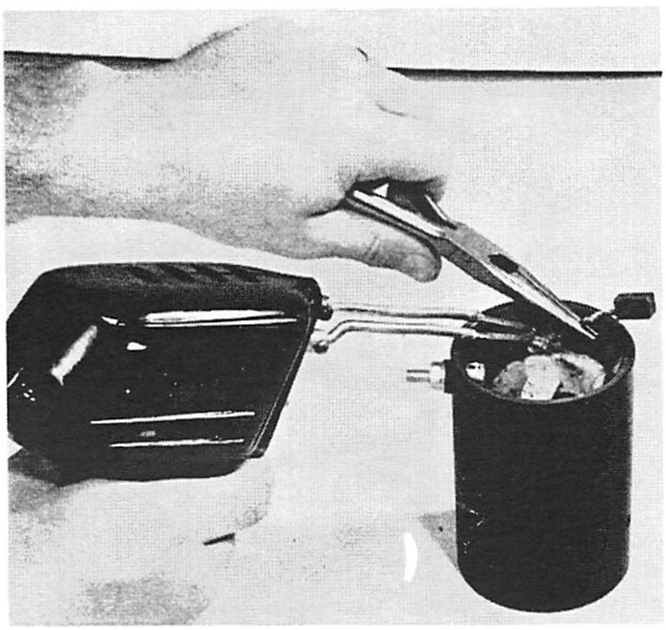


Figure 1. Soldering New Brush Lead

5. Body and field assembly
   a. Field winding is an integral part of the body and must be replaced complete.
   b. Check for shorted field by setting Magneto Analyzer (C-91-25213) on Scale No. 3 and checking between

Figure 2. Check for Shorted Field

field terminal and body. (Figure 2) Any movement of needle to right indicates the field is shorted.
   c. Field coil resistance: .025 ohms
6. Armature
   a. Commutator can be resurfaced with a reconditioning tool, if excessively worn, and mica undercut to 1/32" (.794mm).
   b. If commutator bars are not worn excessively, they can be cleaned with No. 00 sandpaper.
   c. Check armature on a growler or place Magneto Analyzer on Scale No. 3 and check for shorts between commutator bars and core.
      (1) Any movement to right indicates a short.
      (2) Clean off carbon dust, as this may be cause for short.

Reassembly

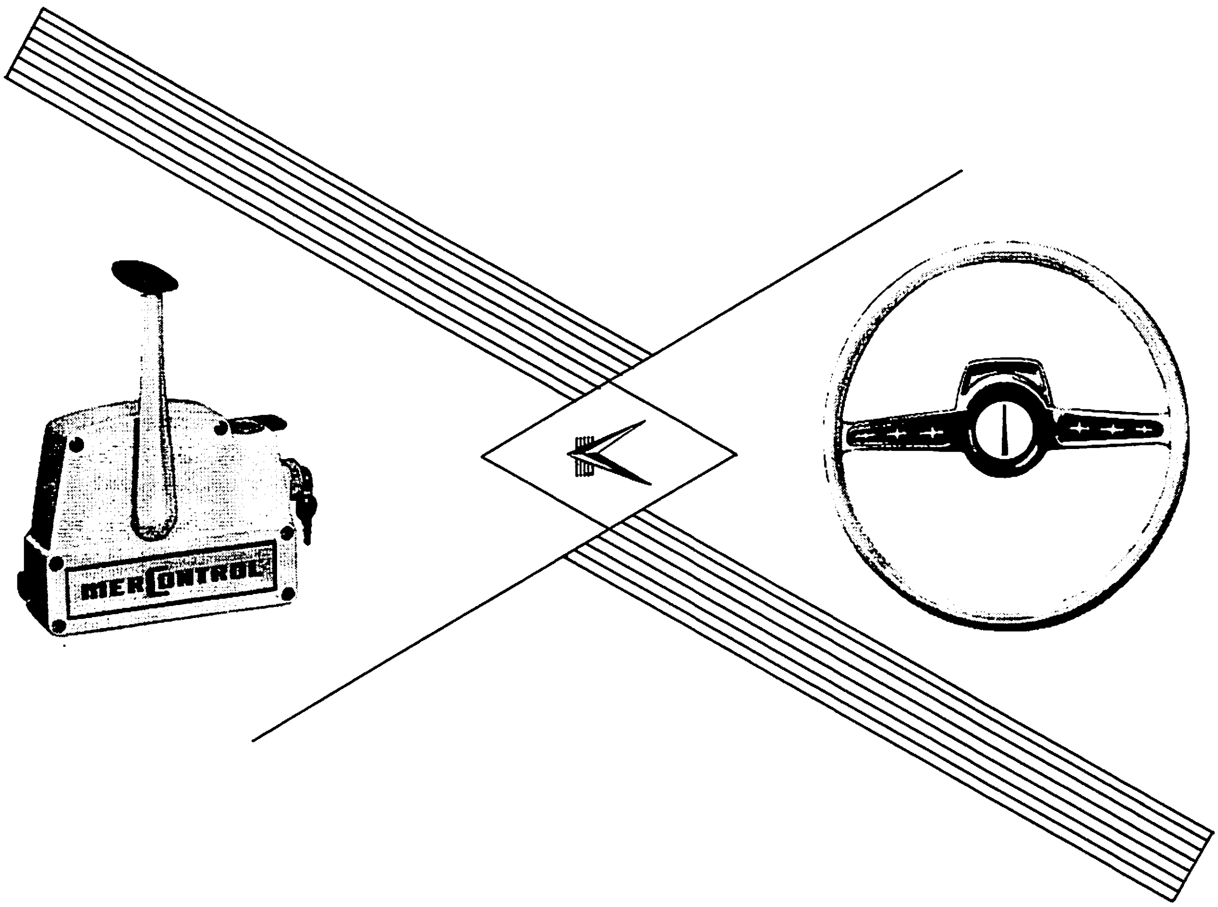
REASSEMBLY OF STARTER MOTOR

1. Place shims and upper end cap on armature shaft. Armature shaft must be shimmed to allow an end play of .005 - .015 (.013 - .038mm).
2. Install armature into body and field and line up detent of upper end cap and body with marking on body and end cap.
3. Install thrust washer over lower end of armature shaft.
4. Pull brush springs back, slide brushes over commutator bars and line up marks on end cap.
5. Install 2 thru bolts and washers and torque to 60 - 65 in. lbs. (10.65 - 11.54 kg/cm) .

REASSEMBLY OF INERTIA TYPE DRIVE

Refer to reassembly of Delco-Remy inertia type drive, Section VII. Page 31, Paragraph C.

section VIII



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SECTION VIII A - MISCELLANEOUS

KIEKHAEFER MERCURY

OUTBOARD ENGINE SPECIFICATIONS

I. KIEKHAEFER MERCURY OUTBOARD MOTORS, 1940-1955

Designation	Model	Year	Spark Plug Model	Spark Plug Setting	Magneto Model	Breaker Setting	Horse Power	RPM	Bore	Stroke	Cu. In. Displ.	Engine Weight
Special	K1	1940	Ch. J8J	.025	Eisemann	.018	2.5	3800	2"	1¾"	5.5	27
Standard	K2	1940	Ch. J8J	.025	Eisemann	.018	3	4250	2"	1¾"	5.5	28
Deluxe	K3	1940	Ch. J8J	.025	Eisemann	.018	3	4250	2"	1¾"	5.5	31
Alternate	K4	1940	Ch. J8J	.025	Eisemann	.018	6	4250	2"	1¾"	11	41
Alternate Deluxe	K5	1940	Ch. J8J	.025	Eisemann	.018	6	4250	2"	1¾"	11	43
Comet	KB1	1941	Ch. J8J	.025	Eisemann	.018	2.9	4000	2"	1¾"	5.5	31
Comet Deluxe	KB1A	1941	Ch. J8J	.025	Eisemann	.018	3.1	4000	2"	1¾"	5.5	32
Streamliner	KB2	1941	Ch. J8J	.025	Eisemann	.018	3.2	4000	2"	1¾"	5.5	32
Torpedo	KB3	1941-42	Ch. J8J	.025	Wico	.018	3.2	4000	2"	1¾"	5.5	36
Rocket	KB4	1941-42	Ch. J8J	.025	Eisemann	.018	5.8	4000	2"	1¾"	11	42
Rocket Deluxe	KB5	1941	Ch. J8J	.025	Eisemann	.018	6	4000	2"	1¾"	11	46
Rocket	KB4-1	1946	Ch. J8J	.025	Eisemann	.018	6	4000	2"	1¾"	11	42
Comet	KD3	1946-47	Ch. J8J	.025	Scin.-Eise.	.018	3.2	4000	2"	1¾"	5.5	32
Rocket	KD4	1946-47	Ch. J7J	.025	Scin.-Eise.	.018	6	4000	2"	1¾"	11	42
Comet	KD3S	1947	Ch. J8J	.025	Scin.-Eise.	.018	3.2	4000	2"	1¾"	5.5	36
Rocket	KD4S	1947	Ch. J7J	.025	Scin.-Eise.	.018	6	4000	2"	1¾"	11	46
Comet Deluxe	KE3	1947-48	Ch. J7J	.025	Scintilla	.018	3.6	4000	2"	1¾"	5.5	36
Rocket Deluxe	KE4	1947-52	Ch. J7J	.025	Phelon	.018	7.5	4000	2"	1¾"	11	54
Rocket Deluxe	KE4A	1947	Ch. J7J	.025	Scintilla	.018	6	4000	2"	1¾"	11	54
Lightning Deluxe	KE7	1947-49	Ch. J7J	.025	Scintilla	.018	10	4000	2 7/16"	2⅛"	19.8	59
Comet	KF3	1949-50	Ch. J7J	.025	Phelon	.018	3.5	4000	2"	1¾"	5.5	38
Comet	KF3	1949-50	Ch. J7J	.025	Scintilla	.018	3.5	4000	2"	1¾"	5.5	38
Super 10	KF7	1949-50	Ch. J7J	.025	Scintilla	.018	10	4000	2 7/16"	2⅛"	19.8	61
Super 5	KF5	1949-52	Ch. J7J	.025	Phelon	.018	5	4200	1¾"	1½"	7.2	41
Super 5	KF5	1949-52	Ch. J7J	.025	Scintilla	.018	5	4200	1¾"	1½"	7.2	41
Rocket Hurricane	KG4	1950-52	Ch. J7J	.025	Phelon	.018	7.5+*	*	2 7/64"	2⅛"	14.89	57
Rocket Hurricane	KG4H	1950-52	Ch. J6J	.025	Phelon	.018	7.5+*	*	2 7/64"	"2⅛	14.89	57
Super 10 Hurricane	KG7	1950-52	Ch. J6J	.025	Scintilla	.018	10+*	*	2 7/16"	2⅛"	19.8	63
Super 10 Hurricane	KG7H	1950-52	Ch. J6J	.025	Phelon	.018	10+*	*	2 7/16"	2⅛"	19.8	63
Super 10 Hurricane Cruiser	KH7	1952	Ch. J6J	.025	Scintilla	.018	10+*	*	2 7/16"	2⅛"	19.8	70
Thunderbolt	KF9	1949-50	Ch. J7J	.025	F.-Morse	.010+.000 −.002	25+*	*	2 7/16"	2⅛"	39.6	122
Thunderbolt	KG9	1950-52	Ch. J6J	.025	F.-Morse	.010+.000 −.002	25+*	*	2 7/16"	2⅛"	39.6	122
Super 5	Mark 5	1953-55	Ch. J7J	.025	Phelon	.018	5	4200	1¾"	1½"	7.2	40
Rocket Deluxe	Mark 7	1953-55	Ch. J7J	.025	Phelon	.018	7.5	4000	2"	1¾"	11	54
Rocket Deluxe	Mark 15	1953	Ch. J7J	.025	Phelon	.018	10	4000	2 7/64"	2⅛"	14.89	57
Rocket Deluxe	Mark 20	1953-55	Ch. J6J	.025	Scintilla	.018	16	4000	2 7/16"	2⅛"	19.8	73
Thunderbolt	Mark 40	1953-54	Ch. J6J	.025	F.-Morse	.010+.000 −.002	25+*	*	2 7/16"	2⅛"	39.6	122
Thunderbolt	Mark 40H	1953-55	Ch. J6J	.025	F.-Morse	.010+.000 −.002	25+*	*	2 7/16"	2⅛"	39.6	95
Thunderbolt	Mark 50	1954	Ch. J6J	.025	F.-Morse	.010+.000 −.002	40	5400	2 7/16"	2⅛"	39.6	118
Thunderbolt MercElectric	Mark 50E	1954	Ch. J6J	.025	F.-Morse	.010+.000 −.002	40	5400	2 7/16"	2⅛"	39.6	120
Hurricane	Mark 20H	1954-55	Ch. J62R	.025	Phelon	.018	16*	*	2 7/16"	2⅛"	19.8	74
Comet (Silent Six)	Mark 6	1955	Ch. J7J	.025	Phelon	.018	5.9	4500	1¾"	1½"	7.2	42
Hurricane	Mark 25	1955	Ch. J6J	.025	Phelon	.018	18	5400	2 7/16"	2⅛"	19.8	75
Hurricane MercElectric	Mark 25E	1955	Ch. J6J	.025	Phelon	.018	18	5400	2 7/16"	2⅛"	19.8	84
Thunderbolt	Mark 55	1955	Ch. J6J	.025	F.-Morse	.010+.000 −.002	40	5400	2 7/16"	2⅛"	39.6	111
Thunderbolt MercElectric	Mark 55E	1955	Ch. J6J	.025	F.-Morse	.010+.000 −.002	40	5400	2 7/16"	2⅛"	39.6	118

* Horsepower Varies with RPM.

Metric conversion: 1" = 2.54cm; 1 cu. in. = 16.387cc.

All Models Use Kiekhaefer Quicksilver 2-Cycle Engine Oil, 3/8 Pt. Mixed with Each Gallon of Gasoline.
Quicksilver Models Require 3/4 Pt. Kiekhaefer Quicksilver 2-Cycle Engine Oil with Each Gallon of Gasoline.
All Models Use Kiekhaefer Quicksilver Gear Lubricant in Lower Unit.

MASTER SPECIFICATIONS -- 1956-57-58-59 MODELS

Designation	Model	Year	Spark Plug Type	Spark Plug Setting	Magneto Type	Breaker Setting	HP	Recom. Oper. RPM	Bore	Stroke	Cu. In. Displ.	Approx. Eng. Wt.
Hurricane Hydro	Mark 20H	1956	J62R	.025"	Phelon	.018	20+*	*	2-7/16"	2-1/8"	19.8	74
Thunderbolt	Mark 55	1956-58	J6J	.025"	Kiekhaefer§ Fair.-Morse	.010+.000 -.002	40	5400	2-7/16"	2-1/8"	39.6	111
MercElectric Thunderbolt	Mark 55E	1956-58	J6J	.025"	Kiekhaefer§ Fair.-Morse	.010+.000 -.002	40	5400	2-7/16"	2-1/8"	39.6	120
Thunderbolt Hydro	Mark 55H	1956-58	J62R	.025"	Fair.-Morse	.010+.000 -.002	40+*	*	2-7/16"	2-1/8"	39.6	100
Turbo-Four	Mark 30	1956-58	J6J	.025"	Kiekhaefer§ Fair.-Morse	.010+.000 -.002	30	5400	2-7/64"	2-1/8"	29.78	110
MercElectric Turbo-Four	Mark 30E	1956-58	J6J	.025"	Kiekhaefer§ Fair.-Morse	.010+.000 -.002	30	5400	2-7/64"	2-1/8"	29.78	118
Turbo-Four Hydro	Mark 30H	1956-58	J62R	.025"	Fair.-Morse	.010+.000 -.002	30+*	*	2-7/64"	2-1/8"	29.78	98
Hurricane	Mark 25	1956-58	J6J	.025"	Phelon	.018	20	5400	2-7/16"	2-1/8"	19.8	75
MercElectric Hurricane	Mark 25E	1956-57	J6J	.025"	Phelon	.018	20	5400	2-7/16"	2-1/8"	19.8	85
Comet Silent Six	Mark 6	1956-58	J7J	.025"	Phelon Scintilla	.018	6	4500	1-3/4"	1-1/2"	7.2	42
Marathon "Six"	Mark 75E	1957-58	J6J	.025"	Kiekhaefer Distributor	90° Dwell▲	60	5400	2-7/16"	2-1/8"	59.4	168
Trol-Twin Rocket	Mark 10	1957-58	J7J	.025"	Phelon	.018	10	4500	2-11/32"	2-1/8"	18.5	66
Super Hurricane	Mark 28	1958	J6J	.025"	Phelon	.018	22	5400	2-9/16"	2-1/8"	22	79
MercElec. Super Thunderbolt	Mark 58E	1958	J6J	.025"	Kiekhaefer	.010+.000 -.002	45	5400	2-9/16"	2-1/8"	44	131
Super Marathon "Six"	Mark 78E	1958	J6J	.025"	Kiekhaefer Distributor	90° Dwell▲	70	5400	2-9/16"	2-1/8"	66	180
Comet Silent Six	Mark 6A	1959	J7J	.025"	Phelon	.018"	6	4500	1-3/4"	1-1/2"	7.2	46
Trol Twin Rocket	Mark 10A	1959	J7J	.025"	Phelon	.018"	10	4500	2-11/32"	2-1/8"	18.5	77
Rocket	Mark 15A	1959	J7J	.025"	Phelon	.018"	15	4500	2-11/32"	2-1/8"	18.5	83
Super Hurricane	Mark 28A	1959	J6J	.025"	Phelon	.018"	22	5400	2-9/16"	2-1/8"	22	88
Thunderbolt	Mark 35A	1959	J6J	.025"	Kiekhaefer	.010+.000 -.002	35	5500-5800	2-7/16"	2-1/8"	40	123
Thunderbolt	Mark 55A	1959	J6J	.025"	Kiekhaefer	.010+.000 -.002	40	5500-5800	2-9/16"	2-1/8"	44	125
Super Thunderbolt	Mark 58A	1959	J6J	.025"	Kiekhaefer	.010+.000 -.002	45	5500-5800	2-9/16"	2-1/8"	44	127
Marathon "Six"	Mark 75A	1959	J6J	.025"	Kiekhaefer Distributor	90° Dwell▲	60	5500	2-9/16"	2-1/8"	66	185
Super Marathon "Six"	Mark 78A	1959	J6J	.025"	Kiekhaefer Distributor	90° Dwell▲	70	5500	2-9/16"	2-1/8"	66	188

§ *Kiekhaefer magneto -- used alternately on 1957 models, exclusive on 1958-59 models.*

▲ *Use Degree Plate C-91-30356A1 or C-91-45510A1* — * *Horsepower varies with RPM*

All 6-cyl. models used Kiekhaefer EXTRA-DUTY Quicksilver Gear Lubricant (C-92-32641) in lower unit.

All models use Kiekhaefer Quicksilver Formula 2 2-Cycle Engine Oil, one 12-oz. can mixed with each 2 gallons of gasoline or one 30 oz. can mixed with each 5 gallons of gasoline (hydro models use 12 oz. to each one gallon).

Metric conversion: 1"=2.54cm; 1 cu.in.=16.39cc; 1 oz.=.03 liter; 1 gal.=3.78 liters.

MASTER SPECIFICATIONS - 1960-61-62-63 MODELS

Model	Year	Spark Plug Type	Spark * Plug Setting	Magneto Type	Breaker ** Setting	HP	Full ● Throttle RPM Range	Bore	Stroke	Cu. In. Displ.
Merc 100	1960-61	J7J	.025"	Phelon	.018"	10	4500	2-11/32"	2-1/8"	18.5
Merc 150	1960-61	J7J	.025"	Phelon	.018"	15	4500	2-11/32"	2-1/8"	18.5
Merc 200	1960-61	J6J	.025"	Phelon	.018"	22	5400	2-9/16"	2-1/8"	22
Merc 300	1960	J6J	.025"	Kiekhaefer	.010" $^{+.000"}_{-.002"}$ 48° Dwell ♦	35	5200-5600	2-7/16"	2-1/8"	40
Merc 400	1960-61	J6J	.025"	Kiekhaefer	.010" $^{+.000"}_{-.002"}$ 48° Dwell ♦	45	5200-5600	2-9/16"	2-1/8"	44
Merc 600	1960	J6J	.025"	Kiekhaefer Distributor	90° Dwell ▲	60	5100-5500	2-9/16"	2-1/8"	66
Merc 700 Dir. Rev.	1960-61	J6J	.025"	Kiekhaefer Distributor	90° Dwell ▲	70	5100-5500	2-9/16"	2-1/8"	66
Merc 800 Dir. Rev.	1960-61	J4J	.025"	Kiekhaefer Distributor	90° Dwell ▲	80	4800-5200	2-3/4"	2-1/8"	76
Merc 800 Gear Shift	1961	J4J	.025"	Kiekhaefer Distributor	90° Dwell ▲	80	4800-5200	2-3/4"	2-1/8"	76
Merc 700 Gear Shift	1961	J6J	.025"	Kiekhaefer Distributor	90° Dwell ▲	70	5100-5500	2-9/16"	2-1/8"	66
Merc 500	1961	J6J	.025"	Kiekhaefer	.010" $^{+.000"}_{-.002"}$ 48° Dwell ♦	50	5200-5600	2-9/16"	2-1/8"	44
Merc 350	1961	J6J	.025"	Kiekhaefer	.010" $^{+.000"}_{-.002"}$ 48° Dwell ♦	40	5200-5600	2-7/16"	2-1/8"	40
Merc 60	1961	J7J	.025"	Phelon	.018"	6	5000-5400	1-3/4"	1-1/2"	7.2
Merc 1000§	1962-63	J4J	.025"	Kiekhaefer Distributor	90° Dwell ▲	100	4800-5200	2-7/8"	2.3"	90
Merc 850§ (90 cu. in.)	1963	J4J	.025"	Kiekhaefer Distributor	90° Dwell ▲	85	4800-5200	2-7/8"	2.3"	90
Merc 850§ (76 cu. in.)	1962	J4J	.025"	Kiekhaefer Distributor	90° Dwell ▲	85	4800-5200	2-3/4"	2-1/8"	76
Merc 700 Gear Shift	1962	J6J	.025"	Kiekhaefer Distributor	90° Dwell ▲	70	5100-5500	2-9/16"	2-1/8"	66
Merc 650§	1963	J4J	.025"	Kiekhaefer	.010" $^{+.000"}_{-.002"}$ 48° Dwell ♦	65	4800-5200	2-7/8"	2.3"	60
Merc 500 Jet Prop	1962-63	J6J	.025"	Kiekhaefer	.010" $^{+.000"}_{-.002"}$ 48° Dwell ♦	50	5200-5600	2-9/16"	2-1/8"	44
Merc 450	1962	J6J	.025"	Kiekhaefer	.010" $^{+.000"}_{-.002"}$ 48° Dwell ♦	45	5200-5600	2-9/16"	2-1/8"	44
Merc 350§ (2-Cyl.)	1963	J6J	.025"	Phelon	.020"	35	4800-5200	2-7/8"	2.3"	30
Merc 250	1962	J6J	.025"	Phelon	.018"	25	5000-5400	2-9/16"	2-1/8"	22
Merc 200 Gear Shift	1963	J6J	.025"	Phelon	.018"	20	5000-5400	2-9/16"	2-1/8"	22
Merc 110	1962-63	J7J	.025"	Phelon	.018"	9.8	5000-5400	2"	1-3/4"	11
Merc 60	1962-63	J7J	.025"	Phelon	.018"	6	5000-5400	1-3/4"	1-1/2"	7.2

▲ *Use Degree Plate C-91-45510A1 or C-91-30356A1* ♦ *Use Degree Plate C-91-31484A2* § *"Power Dome" Combustion Chamber*

* *Millimeter Dimension (.025" [0.6350mm])* ● *For Commercial Application, Use Lower RPM Listed.*

** *Millimeter Dimensions (.018" [0.4572mm], .010" [0.2540mm], .002" [0.0508mm], .020" [0.5080mm])*

NOTES: All Models Use Formula 2 Quicksilver 2-Cycle Engine Oil, 3/8 Pt. (6 Oz.) Mixed with Each Gallon of Gasoline. Use Kiekhaefer Quicksilver Gear Lubricant in Lower Unit of 2-&-4Cyl. Models, prior to 1962, except Merc 500-450. Use Kiekhaefer EXTRA-DUTY Quicksilver Gear Lubricant in All 6-Cyl. Models, Merc 500-450 & All 1962 & Newer Models.

MASTER SPECIFICATIONS - 1964-65-66-67-68-69 MODELS

Models	Year	Spark Plug Type‡	Spark Plug Setting	Distributor or Magneto Type	Breaker Setting	HP	Full Throttle RPM Range*	Bore	Stroke	Cu.In. Displ.
Merc 1100SS	1966	L19V	None	Kiekhaefer Dist.	45° Dwell▲	110	4800-5200	2-15/16"	2.3"	93.5
Merc 1100	1966	L4J	.030"	Kiekhaefer Dist.	90° Dwell▲	110	4800-5200	2-15/16"	2.3"	93.5
Merc 1000	1964-65	J4J	.025"	Kiekhaefer Dist.	90° Dwell▲	100	4800-5200	2-7/8"	2.3"	90
Merc 950SS	1966	L19V	None	Kiekhaefer Dist.	45° Dwell▲	95	4800-5200	2-7/8"	2.3"	90
Merc 950	1966	L4J	.030"	Kiekhaefer Dist.	90° Dwell▲	95	4800-5200	2-7/8"	2.3"	90
Merc 900	1965	J4J	.025"	Kiekhaefer Dist.	90° Dwell▲	90	4800-5200	2-7/8"	2.3"	90
Merc 850 (90 Cu. In.)	1964	J4J	.025"	Kiekhaefer Dist.	90° Dwell▲	85	4800-5200	2-7/8"	2.3"	90
Merc 650	1964-65-66	J4J	.025"	Kiekhaefer Mag.	48° Dwell♦ .010" +.000 -.002	65	4800-5200	2-7/8"	2.3"	60
Merc 500 Jet Prop	1964-65-66	J4J⊕	.025"	Kiekhaefer Mag.	48° Dwell♦ .010" +.000 -.002	50	5200-5600	2-9/16"	2-1/8"	44
Merc 350	1964-65-66	J6J	.025"	Phelon Magneto	.020"●	35	4800-5200	2-7/8"□	2.3"	30†
Merc 200 Gear Shift	1964-65-66	J6J	.025"	Phelon Magneto	.020"●	20	5000-5400	2-9/16"	2-1/8"	22
Merc 110	1964-65-66	J7J	.025"	Phelon Magneto	.020"●	9.8	5000-5400	2"	1¾"	11
Merc 60	1964-65-66	J7J	.025"	Phelon Magneto	.020"●	6	5000-5400	1¾"	1½"	7.2
Merc 39	1964-65-66	J8J	.025"	Phelon Magneto	.020"	3.9	5000-5400	2"	1¾"	5.5
Merc 1100SS	1967	L19V	None	Kiekhaefer Dist.	None	110	4800-5200	2-15/16"	2.3"	93.5
Merc 950SS	1967	L19V	None	Kiekhaefer Dist.	None	95	4800-5200	2-7/8"	2.3"	90
Merc 650SS	1967	L19V	None	Kiekhaefer Dist.	None	65	4800-5200	2-15/16"	2.3"	62.4
Merc 650S	1967	L4J	.030"	Kiekhaefer Mag.	48° Dwell♦ .010" +.000 -.002	65	4800-5200	2-15/16"	2.3"	62.4
Merc 500SS	1967	L19V	None	Kiekhaefer Dist.	None	50	5200-5600	2-9/16"	2-1/8"	44
Merc 500S	1967	L4J	.030"	Kiekhaefer Mag.	48° Dwell♦ .010" +.000 -.002	50	5200-5600	2-9/16"	2-1/8"	44
Merc 500M	1967	L4J	.030"	Kiekhaefer Mag.	48° Dwell♦ .010" +.000 -.002	50	5200-5600	2-9/16"	2-1/8"	44
Merc 350	1967-68-69	L4J	.030"	Phelon Magneto	.020"●	35	4800-5300	3"	2.3"	32.5
Merc 200	1967-68-69	L4J	.030"	Phelon Magneto	.020"●	20	5000-5400	2-9/16"	2-1/8"	22
Merc 110	1967-68-69	L4J	.030"	Phelon Magneto	.020"●	9.8	5000-5400	2"	1¾"	11
Merc 60	1967-68	L7J	.030"	Phelon Magneto	.020"●	6	5000-5400	1¾"	1½"	7.2
Merc 39	1967-68	L9J	.030"	Phelon Magneto	.020"	3.9	5000-5400	2"	1¾"	5.5
Merc 1250SS	1968-69	L19V°	None	Thunderbolt Ign.	None	125	4800-5300	2-7/8"	2-9/16"	99.81
Merc 1000SS	1968-69	L19V°	None	Thunderbolt Ign.	None	100	4800-5300	2-7/8"	2.3"	90
Merc 650SS	1968-69	L19V°	None	Thunderbolt Ign.	None	65	4800-5300	2-15/16"	2.3"	62.4
Merc 500SS	1968-69	L19V°	None	Tunnderbolt Ign.	None	50	5200-5500	2-9/16"	2-1/8"	44
Merc 800 (4-Cyl.)	1969	L19V°	None	Thunderbolt Ign.	None	80	4800-5300	2-7/8"	2-9/16"	66.6
Merc 75	1969	L7J	.030"	Phelon Magneto	.020"	7.5	4500-5500	2"	1¾"	11
Merc 40	1969	L9J	.030"	Phelon Magneto	.020"	4	4500-5500	2"	1¾"	5.5

NOTE: All 1963-64-65-66-67-68-69 Mercury models use new FORMULA 50 Quicksilver 2-Cycle Motor Oil, mixed one 12 oz. can with 5 gallons of gasoline. All Mercury models use Formula 2 Quicksilver 2-Cycle Motor Oil, mixed one 12 oz. can with each 2 gallons of gasoline. In an emergency, when FORMULA 50 or Formula 2 Quicksilver Oil are not available, substitute one of the approved oils, mixed 12 oz. to 2 gallons of gasoline. All models use SUPER-DUTY Quicksilver Outboard Gear Lubricant (C-92-52650) in the gear case.

± *If wet fouling is experienced, 4-and-6-cyl. models (except 1967-68 & SS models) use UJ4J (A-33-39564) spark plugs.*
* *For commercial application, use lower RPM listed.* † *1966 model has 32.5 cu. in. displacement.*
▲ *Use Degree Plate C-91-30356A1 or C-91-45510A1.* ♦ *Degree Plate C-91-31484A1* ● *Degree Plate C-91-36454A1*
⊕ *1964 model uses J6J.* □ *1966 model has 3" bore.* ° *or ACV40FF*

TORQUE SPECIFICATIONS

	Merc 1250-800 (4-Cyl.)	Merc 1250 BP	Merc 1100-1000	Merc 1000 BP	Merc 950-900-850 (90 Cu. In.)	Merc 850-800 GS-800 DR	Merc 700 GS - 700 & 600 DR	Merc 650	Merc 500-450-400-350-300	Merc 350 (2-Cyl.)	Merc 250	Merc 200 GS	Merc 200-150-100
CONNECTING ROD NUTS													
180 In. Lbs.	●	●	●	●	●	●	●	●	●	●	●	●	●
90 In. Lbs.													
80 In. Lbs.													
65 In. Lbs.													
FLYWHEEL TO CRANKSHAFT													
90 Ft. Lbs.													
85 Ft. Lbs.	●	●	●	●	●	●							
65 Ft. Lbs.							●	●	●	●	●	●	●
60 Ft. Lbs. (1)													
40 Ft. Lbs.													
35 Ft. Lbs.													
WATER PUMP COVER													
150 Ft. Lbs.													
100 Ft. Lbs.													
65 Ft. Lbs.													
WATER PUMP (PLASTIC)													
Nuts - 1/4-28 Thread 25-30 In. Lbs.	●		●					●	●	●			
Nuts - 5/16-24 Thread 35-40 In. Lbs.	●		●					●	●	●		●	
Bolts - 1/4-20 Thread 15-20 In. Lbs.	●		●					●					
CLUTCH TORQUE													
170-240 In. Lbs. (2)													
SPARK PLUGS													
20 Ft. Lbs.	●	●	●	●	●	●	●	●	●	●	●	●	●
CENTERMAIN BEARING													
Lock Screw (4)													
3/8-16 Thread 120 In. Lbs.					●	●	●		●		●		●
3/8-24 Thread 150 In. Lbs.	●	●	●	●	●	●	●	●	●	●	●	●	
Reed Stop Screw													
35-40 In. Lbs.	●		●		●	●	●	●	●	●	●	●	●
30 In. Lbs.													
20-25 In. Lbs.													
Reed Valve Opening													
3/16" Valve			●					●		●	●	●	
5/32" Valve (3)	●				●	●	●		●				●
7/64" Valve													
EXHAUST COVER SCREWS													
Inner Water Jacket Cover													
150 In. Lbs. (5/16-18)	●	●											
Outer Cover													
1965 & Up													
150 In. Lbs. (5/16-18)	●	●	●	●	●			●	●	●		●	
All thru 1964													
80 In. Lbs. (1/4-20)					●	●	●	●	●	●	●	●	●
CYLINDER BLOCK COVER													
Cap Screw 50 In. Lbs.													
Bolt & Nut 100 In. Lbs.	●	●	●	●	●	●	●	●	●	●	●	●	●
CRANKCASE TO CYLINDER BLOCK													
5/16" Bolt & Nut 150 In. Lbs.	●	●	●	●	●	●	●	●	●	●			
GEAR HOUSING TO DRIVE SHAFT HOUSING													
200 In. Lbs.	●	●	●	●	●	●	●	●	●	●			
STARTER MOTOR TO CRANKCASE													
85 In. Lbs.						●	●		●				
125 In. Lbs.	●	●	●	●	●			●		●			
POWERHEAD TO DRIVE SHAFT HOUSING													
350 In. Lbs.	●	●	●	●	●	●	●	●					

	Merc 110-75	Merc 60 & Mark 6-6A	Merc 60-J	Merc 40-39	Mark 78-78A-75-75A	Mark 58-58A-55-55A-35A	Mark 55H	Mark 50	Mark 40	Mark 40H	Mark 30	Mark 30H	Mark 28-28A-15-10-10A
CONNECTING ROD NUTS													
180 In. Lbs.	●		●	●	●	●	●	●	●	●	●	●	●
90 In. Lbs.													
80 In. Lbs.		●											
65 In. Lbs.													
FLYWHEEL TO CRANKSHAFT													
90 Ft. Lbs.									●				
85 Ft. Lbs.													
65 Ft. Lbs.					●	●	●	●		●	●	●	●
60 Ft. Lbs. (1)													
40 Ft. Lbs.													
35 Ft. Lbs.	●	●	●	●									
WATER PUMP COVER													
150 Ft. Lbs.							●			●			
100 Ft. Lbs.												●	
65 Ft. Lbs.			●										
WATER PUMP (PLASTIC)													
Nuts - 1/4-28 Thread 25-30 In. Lbs.	●			●									
Nuts - 5/16-24 Thread 35-40 In. Lbs.													
Bolts - 1/4-20 Thread 15-20 In. Lbs.													
CLUTCH TORQUE													
170-240 In. Lbs. (2)		2											
SPARK PLUGS													
20 Ft. Lbs.	●	●	●	●	●	●	●	●	●	●	●	●	●
CENTERMAIN BEARING													
Lock Screw (4)	4	4	4										
3/8-16 Thread 120 In. Lbs.					●	●	●	●					●
3/8-24 Thread 150 In. Lbs.							●		●	●	●	●	
Reed Stop Screw													
35-40 In. Lbs.					●	●	●	●	●	●	●	●	●
30 In. Lbs.													
20-25 In. Lbs.	●	●	●										
Reed Valve Opening													
3/16" Valve													
5/32" Valve (3)	3				●	●	●	●	●	●	●	●	●
7/64" Valve		●	●										
EXHAUST COVER SCREWS													
Inner Water Jacket Cover													
150 In. Lbs. (5/16-18)													
Outer Cover													
1965 & Up													
150 In. Lbs. (5/16-18)													
All thru 1964													
80 In. Lbs. (1/4-20)	●				●	●	●	●	●	●	●	●	●
CYLINDER BLOCK COVER													
Cap Screw 50 In. Lbs.								●	●	●			
Bolt & Nut 100 In. Lbs.	●	●	●	●	●	●	●				●	●	●
CRANKCASE TO CYLINDER BLOCK													
5/16" Bolt & Nut 150 In. Lbs.					●	●	●	●	●	●	●	●	
GEAR HOUSING TO DRIVE SHAFT HOUSING													
200 In. Lbs.					●	●	●	●	●	●	●	●	
STARTER MOTOR TO CRANKCASE													
85 In. Lbs.					●	●		●					
125 In. Lbs.													
POWERHEAD TO DRIVE SHAFT HOUSING													
350 In. Lbs.					●								

	Mark 25	Mark 20-15	Mark 20H	Mark 7	Mark 5	KG 9	KF 9	KH7-KG7-KF7-KE7-KG4	KG7H-KG4H	KF5	KF3	KE4 & All Prior 1 & 2 Cyl.
CONNECTING ROD NUTS												
180 In. Lbs.	●	●	●			●	●	●	●			
90 In. Lbs.				●								●
80 In. Lbs.					●						●	
65 In. Lbs.										●		
FLYWHEEL TO CRANKSHAFT												
90 Ft. Lbs.						●	●					
85 Ft. Lbs.												
65 Ft. Lbs.	●		●									
60 Ft. Lbs. (1)		1						1	1			
40 Ft. Lbs.				●	●							●
35 Ft. Lbs.										●	●	
WATER PUMP COVER												
150 Ft. Lbs.												
100 Ft. Lbs.			●						●			
65 Ft. Lbs.												
WATER PUMP (PLASTIC)												
Nuts - 1/4-28 Thread 25-30 In. Lbs.												
Nuts - 5/16-24 Thread 35-40 In. Lbs.												
Bolts - 1/4-20 Thread 15-20 In. Lbs.												
CLUTCH TORQUE												
170-240 In. Lbs. (2)					2					2	2	
SPARK PLUGS												
20 Ft. Lbs.	●	●	●	●	●	●	●	●	●	●	●	●
CENTERMAIN BEARING												
Lock Screw (4)												
3/8-16 Thread 120 In. Lbs.												
3/8-24 Thread 150 In. Lbs.	●	●	●			●	●					
Reed Stop Screw												
35-40 In. Lbs.	●	●	●	●		●	●	●	●			
30 In. Lbs.					●					●	●	●
20-25 In. Lbs.												
Reed Valve Opening												
3/16" Valve												
5/32" Valve (3)	●	●	●	●		●	●	●	●		●	●
7/64" Valve					●					●		
EXHAUST COVER SCREWS												
Inner Water Jacket Cover												
150 In. Lbs. (5/16-18)												
Outer Cover												
1965 & Up												
150 In. Lbs. (5/16-18)												
All thru 1964												
80 In. Lbs. (1/4-20)	●	●	●			●	●	●	●			
CYLINDER BLOCK COVER												
Cap Screw 50 In. Lbs.	●	●	●			●	●	●	●			
Bolt & Nut 100 In. Lbs.				●	●					●	●	●
CRANKCASE TO CYLINDER BLOCK												
5/16" Bolt & Nut 150 In. Lbs.						●	●					
GEAR HOUSING TO DRIVE SHAFT HOUSING												
200 In. Lbs.						●	●					
STARTER MOTOR TO CRANKCASE												
85 In. Lbs.												
125 In. Lbs.												
POWERHEAD TO DRIVE SHAFT HOUSING												
350 In. Lbs.												

(1) Use external tooth lockwashers beneath ratchet. (2) No grease between discs; start with steel disc and alternate. (3) Merc 75 reed valve opening is .093".

(4) Merc 110-75 is 10-15 in. lbs; Merc 60 and Mark 6-6A is 30-35 in. lbs. *Metric Equivalents: 1 In. Lb. = .18 kg cm; 1 Ft. Lb. = .14 mkg; 1" = 25.4mm*

GEAR RATIOS

Models	Pinion	Propeller
Speedmaster	14	14
Sportmaster	14	21
Merc 1250-1100-1000 (1968-69)-950	14	28
Merc 1000-900-850-800 (GS)-700 (GS)-650	14	28
Merc 800(DR)-700(DR)-600(DR)	14	28
Merc 800(1969)	13	30
Merc 500-450-400-350-300	14	23
Merc 350 (2-Cyl.)	13	24
Merc 250-200 (Auto. Trans.)	13	24
Merc 200 (GS) (Forward)	13	24
Merc 200 (GS) (Reverse)	13	28
Merc 150-100	14	23
Merc 110-75-60 (Forward)	13	26
Merc 110-75-60 (Reverse)	13	30
Merc 40-39 (Forward)	13	26

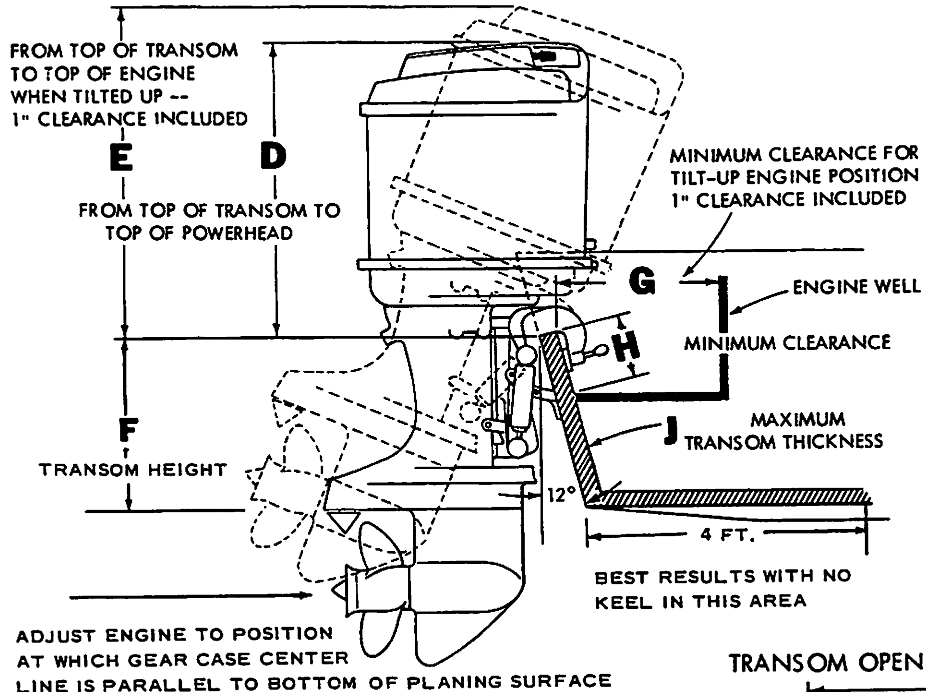
Models	Pinion	Propeller
Merc 40-39 (Reverse)	13	30
Mark 78*-78A-75A	14	28
Mark 75	14	27
Mark 58-58A-55-55A-35A-15A-10-10A	14	23
Mark 40, KF9, KG9	15	20
Mark 30-28-28A-25-20-15, KH7	13	24
Mark 7-5, KE7, KF7, KG7	16	21
Mark 6-6A	14§	23
KF5, KE4, KG4, KF3	16	21
K & KD Twins	14	19**
K & KD Singles	12	22
D Quicksilver	14	14
A-B-C Quicksilver	15	15
Mark 20H Conversion	16	21

* *Some had 14:27 ratio.*
** *Bronze spacer & steel shim required*
§ *Spiral bevel*
GS = Gear shift model
DR = Direct reversing model

CAPACITY OF LUBRICANT IN GEAR HOUSING

Model	Capacity
Merc 1250-1100-1000-950-900-850-800-700-650	17 Fl. Oz.
Merc 500-450-400-350-300	9 Fl. Oz.
Merc 250	7½ Fl. Oz.
Merc 200	6 Fl. Oz.
Merc 110-75-60-40-39	3 Fl. Oz.

Metric conversion: 1 U.S. fl. oz. = .03 liter

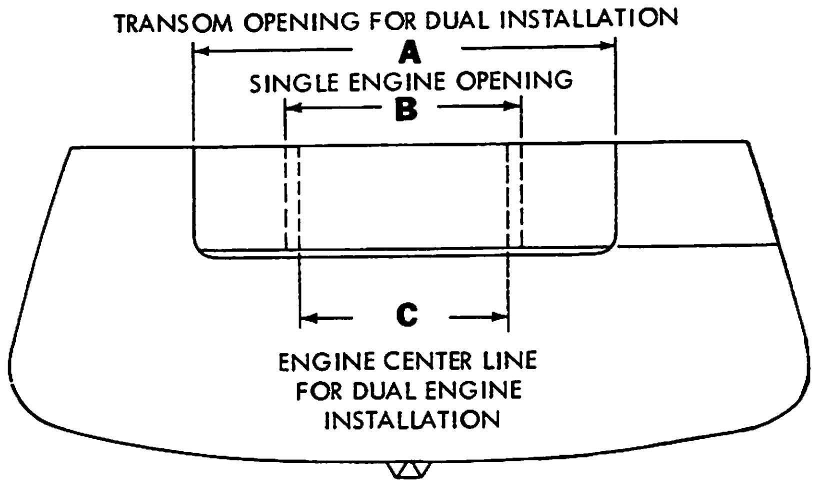


TRANSOM MOUNTING SPECIFICATIONS

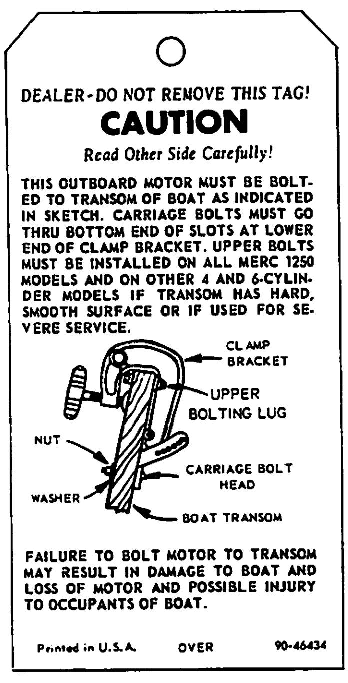
NOTE: Dimensions are ± 1/16" tolerance.

NOTE: Clamp screws should be in horizontal position after tightening.

CAUTION: Before operating, 4 and 6-cylinder motors must be secured to boat with 2 bolts placed thru transom into slots provided at bottom of clamp bracket. Refer to figure, above, and instructions on red "Caution" tag attached to new motor and shown, below. Upper mounting bolts must be installed on all Merc 1250 models and on other 4 and 6-cylinder models which are mounted on a transom, that has an extremely hard, smooth surface, or for severe service. During operation, clamp screws should be checked occasionally for tightness on the transom. Failure to bolt motor to transom may result in damage to boat and/or loss of motor and possible injury to occupants of boat.



* Boats with heavy keels require lower settings to avoid propeller cavitation. Very fast boats may benefit from higher settings.
£ Recommended location for mounting remote throttle-shift & steering controls on boat to balance engine torque caused by direction of propeller rotation.
§ Includes clearance for Power Tilt.
+ End of throttle-shift-steering handle.
● 21½" for 1966 and earlier models.



	Min. A	Min. B	Min. C	Min. D	Min. E	F* Short Shaft	F* Long Shaft	G	H	J	Control On Boat Mount. £
Merc 1250-1100-1000-(68)-950	33"§	17"§	16"	27-3/4"	32"	15½"	20"	30"	4-3/8"	2-3/8"	R. Side
Merc 1000-900-850-800	34 §	17 §	16	27-3/4	32	15½	20	30	4-3/8	2-3/8	R. Side
Merc 800 Dir. Reversing	34 §	17 §	16	28-1/4	31-1/2	16½	20½	29	4-3/8	2-3/8	L. Side
Merc 700 Gear Shift	34 §	17 §	15½	25-3/4	29-1/8	15½	20	26-1/8	4-3/8	2-3/8	R. Side
Merc 700-600 Dir. Rev.	34 §	17 §	15½	25-3/8	29-1/8	16½	20½	26-1/8	4-3/8	2-3/8	L. Side
Merc 650-800 (1969)	33 §	17 §	16	22-1/4	28-1/2	15½	20	24	4-3/8	2-3/8	R. Side
Merc 500 (1966-67-68)	31½	16	15½	20	25-1/2	16½	20 ●	20-1/2	4-3/8	2-3/8	R. Side
Merc 500-450-400	31½	16	15½	20-1/4	26	16½	21½	20-1/2	4-3/8	2-3/8	R. Side
Merc 350-300	31½	16	15½	19-3/8	25	16½	20½	17-5/8	4-3/8	1-7/8	R. Side
Merc 350 (2-Cyl.)	34	16	18	16	24	16½	20 ●	17-3/4	4-3/8	2-1/4	R. Side
Merc 250-200	39¼	21	18¼	16-1/8	22-1/2	15¼-16½		17-1/2	4-3/8	1-7/8	L. Side
Merc 200 Gear Shift	39¼	21	18¼	16-1/8	22½	15½	20½	20-1/2 +	4-3/8	1-7/8	R. Side
Merc 200 (1966-67-68)	39¼	21	18¼	16-3/4	23-3/8	15½	20½	19-5/8 +	4-3/8	1-7/8	R. Side
Merc 150-100	39¼	21	18¼	16-1/8	21-1/4	15½		15-1/4	4-3/8	1-7/8	L. Side
Merc 75 & 110-60 (1966-67-68)	35¼	21¾	13½	14-3/8	20-1/8	15½	20½	19-5/8 +	2-7/8	1-7/8	R. Side
Merc 110-60	35¼	21¾	13½	13-7/8	18-1/2	15½	20½	20-1/2 +	2-7/8	1-7/8	R. Side
Merc 40 & 39 (1966-67-68)	35¼	21¾	13½	12-3/4	18-1/4	15½	20½	18-3/4 +	2-7/8	1-7/8	R. Side
Merc 39	35¼	21¾	13½	12-3/4	18	15½	20½	21 +	2-7/8	1-7/8	R. Side
Mark 78-78A-75A	34 §	17 §	15½	25-3/8	29-1/8	16½	20½	26-1/8	4-3/8	2-3/8	L. Side
Mark 75	34 §	17 §	15½	25-3/8	29-1/8	16½	20½	26-1/8	4-3/8	1-7/8	L. Side
Mark 58-58A	31½	16	15½	19-3/8	25	16½	21½	17-5/8	4-3/8	2-3/8	R. Side
Mark 55-55A-35A	31½	16	15½	19-3/8	25	16½	21½	17-5/8	4-3/8	1-7/8	R. Side
Mark 30	33	19½	13½	20-1/8	24-3/8	15½		19-3/8	4-3/8		R. Side
Mark 28-28A	39¼	21	18¼	16-1/8	22-1/2	16		17-1/2	4-3/8	1-7/8	L. Side
Mark 25	34	22	16	14-1/4	22-1/8	15½		14-3/4	4-3/8		R. Side
Mark 15A-10-10A	39¼	21	18¼	16-1/8	21-1/4	16		15-1/4	4-3/8	1-7/8	L. Side
Mark 6-6A	35¼	21¾	13½	13-3/8	18-7/8	15½		14-1/4	2-7/8		L. Side

LUBRICANT AND SEALER APPLICATION CHART

LUBRICATION POINT	MERC MODEL								
	40-39	75-60	110	200	350	500	800-650	1000	1250
Gear Housing	A	A	A	A	A	A	B	B	B
Drive Shaft Splines	D	D	D	D	D	D	D	D	D
Shift Shaft Coupling	C	C	C	C	C	C	C	C	C
Distributor Pilot Grease Fitting						D	D	D	D
Magneto Bushing	D	D	D	D	D				
Swivel Pin Grease Fitting	C	C	C	C	C	C	C	C	C
Tilt to Swivel Bracket	E	E	E	E	E	E	E	E	E
Tilt Tube Inside Diameter (ID)	E	E	E	E	E	E	E	E	E
Propeller Shaft Splines	E	E	E	E					
Reverse Lock Cams				D	D	E			
Thumb Screws	E	E	E	E	E	E	E	E	E
Tilt Stop Levers	C	C	C	C	C	C			
Reverse Lock Latch in Swivel Bracket	E	E	E						
Throttle Linkage*	E	E	E	E	E	E	E	E	E
Throttle Cluster					E	E	E	E	E
Shift Linkage*	E	E	E	E	E	E	E	E	E
Tiller Handle Knuckle Pivot	E	E	E	E					
Tiller Handle Knuckle Gears	E	E	E	E					
Tiller Handle Universal Joint	E	E	E	E					
Choke Shutter Stud	E	E	E	E	E	E	E	E	E
Choke Shaft in Bottom Cowl				E					
Starter Sheave Pawls	D	D	D	D	D	D			
Distributor or Ign. Driver Shaft Splines						E	E	E	E
Choke Grommets						G	G	G	G
Choke Solenoid Plunger Hole						G	G	G	G
Cylinder Bores						F	F	F	F
Piston Rod and Crank Needles	D	D	D	D	D	D	D	D	D
Centermain Needles						D	D	D	D
Top Cowl Mounts	C	C	C			C	C	C	C
Piston Rings	F	F	F	F	F	F	F	F	F
Bearing Carrier Spool - Gear Housing	D	D	D	D	D	D	D	D	D
Water Pump Base and Housing	D	D	D	D	D	D	D	D	D
Shift Shaft Threaded Bushing - Gear Housing	D	D	D	D	D	D	D	D	D
End Caps - Crankshaft	F	F	F	F	F	F	F	F	F
Impeller Pin and Drive Shaft	D	D	D	D	D	D	D	D	D
Screws - Exhaust Cover	E	E	E	E	E	E	E	E	E
Oil Seals (Outside Diameter) to Spool					J	J	J	J	J
Oil Seals (OD) to Threaded Shift Shaft Bushing					J	J	J	J	J
Oil Seals (OD) to Water Pump Base						J	J	J	J
Crankcase to Block Split Line	K	K	K	K	K	K	K	K	K
Pinion Nut							J	J	J
Apply to Inner Water Jacket Cover Screws							H§		H

**Includes all pivot points and sliding surfaces, unless stated elsewhere.*

§ Merc 800 Model

A - EXTRA-DUTY Quicksilver Lubricant (C-92-32641)
B - SUPER-DUTY Quicksilver Oil (C-92-52645-1)
C - Anti-Corrosion Grease (C-92-45134A1)
D - New Multipurpose Quicksilver Lubricant (C-92-49588-12)
E - Anti-Corrosion Oil (C-92-39928A1)
F - Formula 50 Quicksilver 2-Cycle Motor Oil (C-92-39607-1)
G - DC-4 Compound (C-92-24108-1)
H - Exhaust Tube Sealer (C-92-33749-1)
J - Loctite "A" (C-92-32609-1)
K - Gasket Sealer (C-92-28804-1)

OUTBOARD LUBRICANT and MAINTENANCE CHART

Locations▲	Every 30 Days	Every 60 Days	Once in Season	Twice in Season
Check Lubricant Level in Lower Drive Unit	A*			
Lubricate Propeller Shaft Splines	C - Each Prop Installation			
Lubricate Swivel Pin	§	C		
Lubricate Magneto/Distributor Adaptor*			D	§
Lubricate Ride-Guide Steering Tube	§	D		
Lubricate Ride-Guide Steering Cable	§	D		
Lubricate Ride-Guide Steering Pivot/Ball Joint	§	E		
Lubricate Throttle/Shift Linkage*	§	E		
Lubricate Thumb Screws	§	E		
Lubricate Upper Shift Shaft	§	E		
Lubricate Reverse Lock Lever*	§	E		
Lubricate Reverse Locking Cams	§	C		
Lubricate Tilt Stop Lever	§	E		
Lubricate Starter Motor Pinion Gear		§	E	
Lubricate Tiller Handle Knuckle Pivot/Gears *	§	E		
Lubricate Stator Plate Clamps			E	§
Check Lubricant Level in Power Trim Pump		1		
Check Condition of Battery/Terminals				●
Inspect Spark Plug Leads/ All Electrical Connections			●	
Clean Fuel Filter(s)			●	
Clean Fuel Tank Filter			●	
Inspect All Fuel Lines/Connections				●
Check Entire Unit/Loose, Damaged or Missing Parts			●	
Check Condition of Spark Plugs♦			●	
Inspect Breaker Points♦			●	
Inspect Propeller for Possible Damage				●
Inspect and Clean Entire Unit/Touch-Up Paint			L-M	§

▲ - *Complete List of Maintenance Is Not Applicable to All Models.*
* - *For All 6-Cylinder Engines, Merc 500 and All 1962 and Newer Models (except Merc 250). All Other (Older) Models Use "Special Outboard Gear Lubricant" (C-92-29409 or C-92-29415).*
♦ - *Does Not Apply to "Thunderbolt Ignition". When Performance Indicates Service Is Required.*
§ - *Units Operated in Salt Water.*
* - *Includes All Pivot Points and Sliding Surfaces, unless Stated Elsewhere.*
A - *EXTRA-DUTY Quicksilver Gear Lubricant (C-92-32641)*
C - *Anti-Corrosion Grease (C-92-45134A1)*
D - *New Multipurpose Quicksilver Lubricant (C-92-49588-12)*
E - *Anti-Corrosion Oil (C-92-39928A1)*
L - *Quicksilver Marine Cleaner (C-92-32172-1)*
M - *Quicksilver Spray Paint*
1 - *Quicksilver Formula 4 Oil (C-92-33157-1)*

SECTION VIII B - MISCELLANEOUS

COWLS

TOP AND SIDE COWLS
Disassembly

DESCRIPTION

Later 6-4-2-cylinder Mercs have a suspended cowling which does not make direct contact with the engine. The brackets are suspended by rubber mounts.

Four and 6-cylinder Mercurys have the wrap-around cowling, while the 2-cylinder models (except the Merc 350) have the lift off top cowl. Older models have the side cowl style and the lower cowl apron type.

NOTE: Heavy duty top cowl front support mounts are available as service replacement parts for 1965 and 1966 Merc 1100-1000-950-900-650-500 models which are operated in extremely rough water.

All 4 & 6-Cyl. Example Merc 1100, Mark 55	Wrap-Around Cowl with Snap Hooks
Mark 25-20-20H-15	Side Cowls
Newer 2-Cyl., Example Merc 60, Mark 28	Lift-Off Top Cowl
KE, KF, KG & KH Models	Lower Cowl, Apron Type

Disassembly and reassembly of top and side cowlings are relatively simple, and no special tools are required. Repair can be accomplished by merely referring to exploded views of each particular model and following sequence of parts in the illustrations.

Right (starboard) side (Figure 3)

1. Clamp motor bracket on work bench stand similar to boat transom.
2. Remove two 7/16" cap screws which hold cowling.
3. Remove one screw on rear right cowl handle.
4. Push firmly forward and outward to remove entire right side of cowl.

Starter

1. Remove four 7/16" self-locking nuts below starter assembly with small ratchet wrench.
2. Lift entire assembly off brackets.
   NOTE: On Mark 20-20H models, remove fuel filter by removing front starter nuts.
   REFERENCE: For complete starter disassembly, turn to Starter Section VII.

Left (port) side (Figure 3)

1. Remove spark plugs.
2. Remove three 7/16" screws which hold cowl to brackets with a ratchet and open end wrench.
3. Remove fuel line from carburetor.
   NOTE: When removing left cowl from Mark 20-20H-15, remove end of air line from pressure valve cover at the same time.
4. Remove two ½" cap screws from fuel adaptor in order to release it thru inside of cowl.
5. Remove 2 Phillips head screws and washers from base receptacle so that connector retainer can be taken out.
6. Pry 2 "0" rings out with screwdriver.

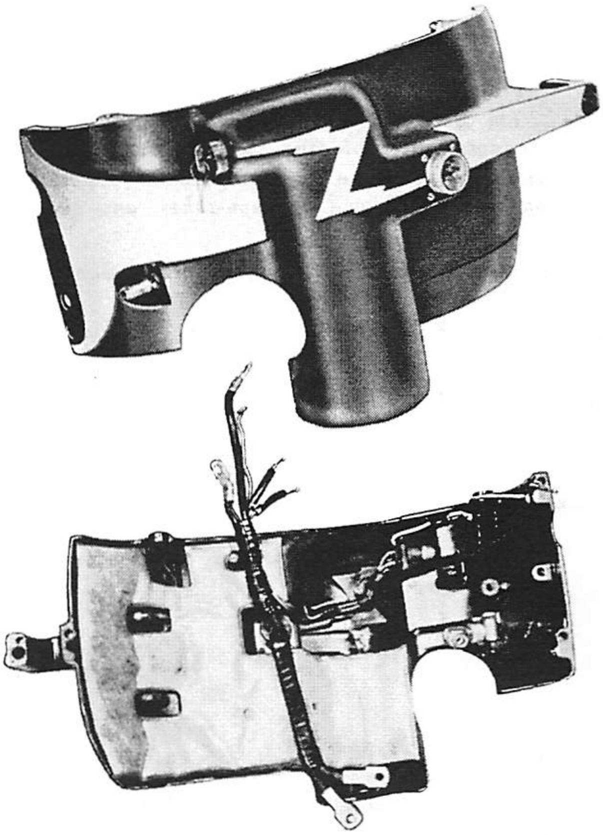


Figure 1. Mark 25E Cowl, Left Side

NOTE: On Mark 25, disassemble adaptor assembly, remove fuel inlet line and pry out cup washer. Other parts fall out. Sound absorbing blankets, to reduce nominal powerhead sound, are attached to right and left cowls of Mark 25 with a special adhesive. (Figure 1) This adhesive (C-92-25234) in 2 oz. tube is also included in a kit (A-25232) of sound absorbing blankets for installation on Mark 20-15 models.

Mark 25E electric starting cowl

1. Port side of cowl contains electric starting switch and wiring harness. (Figure 1) For repair of these components, refer to Starter Section VII.
2. Remove 2 screws which secure fuel pump to front of left cowl.
3. Move fuel pump downward to obtain ready access to upper left front starter mounting nut.
4. Remove fuel lines from fuel filter.
5. Remove 2 screws which secure fuel pump to front of left cowl so that pump may be pushed down and left front nut, which holds top cowl, may be removed.
6. After top cowl is lifted off, remove 3 bolts which hold left cowl.
7. Disconnect lead terminals from starter solenoid and starter motor.

Reassembly

1. Replace fuel line adaptor in cowl with 2 screws.
2. Attach fuel line to carburetor elbow.
   NOTE: On Mark 20-20H-15, air line with spring inserted is attached to pressure pad connector.
3. Replace 2 "0" rings in connector and install connector retainer.
   NOTE: On Mark 25, set fuel line adaptor stem into check adaptor after placing small "0" ring on stem shoulder recess. Place on spring (small tapered end sets on stem), followed by cupwasher, and secure in place with elbow.
4. Install starter assembly. See Starter Section VII for repairs.
5. Replace spark plugs. See Ignition Section IV for repairs.

Wrap-Around Cowl

1. Wrap-around (side) cowls on 4-and-6 cyl. models are fastened together around top and bottom cowling with hook-latch fasteners.

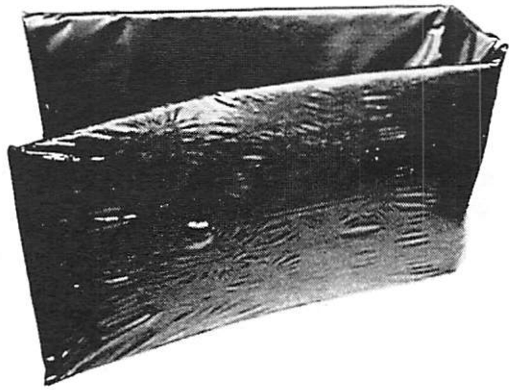


Figure 2. Sound-Absorbing Blanket

2. Sound-absorbing blanket, attached to inside of wrap-around, reduce nominal powerhead sounds. (Figure 2)

NOTE: Blanket kit (A-25233) can be readily installed on Mark 50.

DECALS, APPLICATION

DESCRIPTION

Decals are applied with special decal solution (C-92-25143) and, therefore, are sold only as a decal replacement set. The liquid (C-92-25143) must be purchased separately in its one pint container and may be reused often if poured into a clean container each time used.

INSTALLATION

1. Clean metal surface.
2. Pour decal solution in pan.
3. Emerse decal in solution long enough (30-60 secs.) to loosen decal from backing paper.
4. Place decal in position with backing paper to outside.
5. Peal off backing paper.
6. Wipe over with tips of fingers to smoothen.

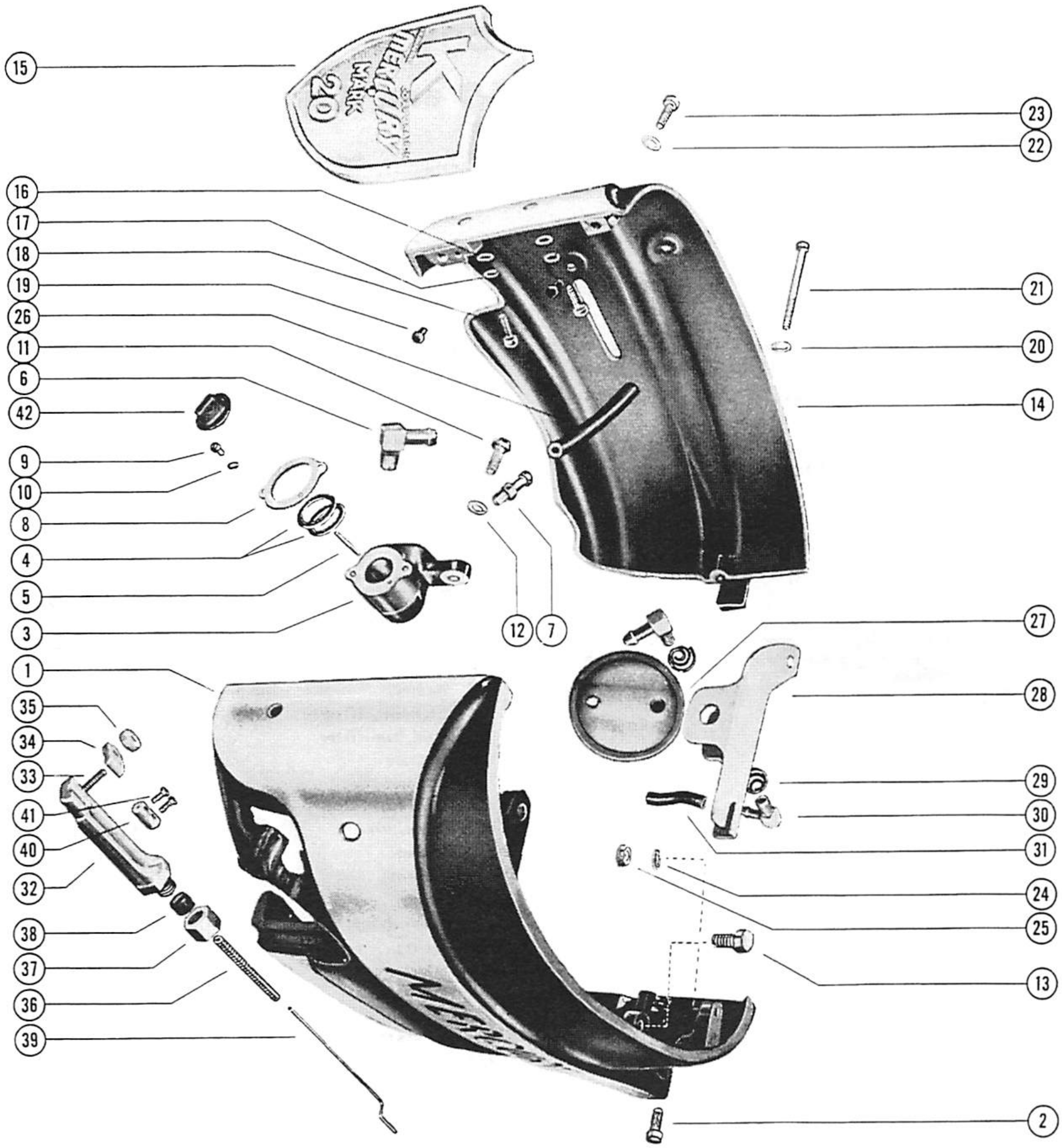


Figure 3. Side Cowl Type, Mark 20

1 Cowl Assembly, port
2 Sleeve
3 Base Connector Ass'y.
4 "O" Ring
5 Pin, groove
6 Elbow
7 Connector
8 Retainer, connector
9 Screw
10 Lockwasher
11 Screw
12 Lockwasher
13 Screw
14 Cowl, starboard
15 Shield, front cover
16 Washer, shield screw
17 Lockwasher
18 Screw
19 Bumper, rubber
20 Washer
21 Screw, handle clamping
22 Washer, cowl screw
23 Screw
24 Washer
25 Nut
26 Fuel Line
27 Filter, fuel
28 Bracket, fuel filter
29 Spring, filter connector
30 Elbow
31 Fuel Line
32 Guide, cable connector
33 Stud
34 Clamp
35 Nut
36 Casing
37 Cap
38 Bushing
39 Wire
40 Block
41 Screw, connector block
42 Plug, connector ass'y.

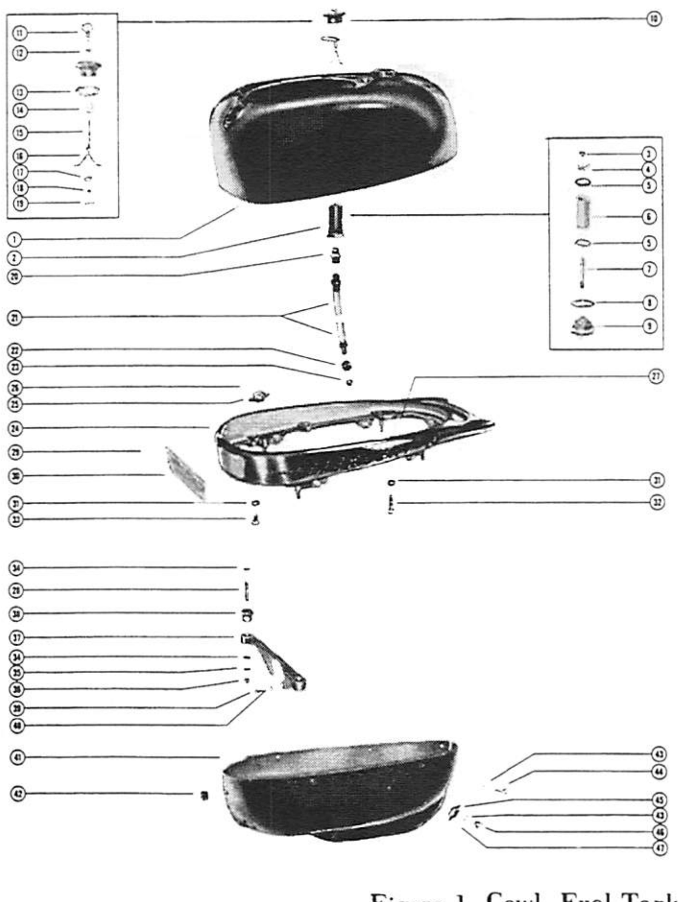
BOTTOM COWL

Apron Type - KE,KF,KG and KH Models

1. Remove screws or fasteners which hold cowl.
2. Remove choke knob which extends thru cowling by unscrewing knob and nut from choke rod.
3. To remove fuel tank, detach screws from bottom of tank to protector rim.
4. Remove fuel line from carburetor by loosening compression nut.
5. To remove starter cable handle, pull out bushing in cable end cap and cut starter cable as close to bushing as possible. Tie knot in end of cable to prevent starter from becoming unwound.
6. Remove fuel filter assembly by unscrewing adaptor nut which holds filter to bottom of fuel tank.
7. Remove fuel tank protector rim by detaching 4 self-locking nuts or screws (depending upon model) from front and rear studs.

   NOTE: To prevent flexible fuel lines (A-32-23439A1) from collapsing at bend (from fuel filter) on KG4, KG7, KH7 and hydro models, we recommend installation of a 45° or 90° elbow. This will eliminate one bend and give 2nd bend a larger radius to prevent possible collapse and fuel supply shutoff.

8. For reassembly, follow sequence of parts in exploded view (Figure 1) and reverse procedure in Paragraphs 1-thru-7 preceding.

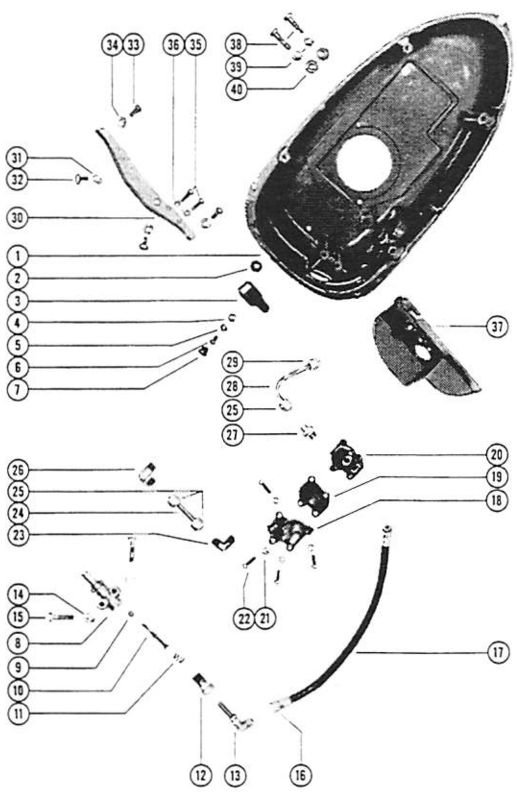


1	Fuel Tank	25	Nut, spring unit
2	Fuel Filter Ass'y	26	Rivet
3	Nut	27	Screw, drive
4	End Cap	28	Stud
5	Washer	29	Screw, drive
6	Element, filter	30	Serial Plate
7	Stud, fuel filter	31	Lockwasher
8	Gasket	32	Screw
9	Nut, adaptor	33	Screw
10	Fuel Tank Cap	34	Washer
11	Screw, vent	35	Washer
12	Gasket	36	Nut
13	Gasket	37	Bracket, fuel tank
14	Spring	38	Bushing
15	Chain & Spring Ass'y	39	Screw
16	Spring	40	Lockwasher
17	Washer	41	Cowl Assembly
18	Washer	42	Grommet, choke rod
19	Cotter Pin	43	Pin, cross
20	Connector	44	Stud, sides
21	Fuel Line Ass'y.	45	Fastener, spring unit
22	Nut, compression	46	Stud, rear
23	Sleeve, compression	47	Rivet
24	Protector Rim Ass'y		

Figure 1. Cowl, Fuel Tank and Protector Rim, KF7, KG7

Mark 6 - 6A

1. Bottom cowl of Mark 6-6A need be removed only in event of a major powerhead overhaul. Carburetor can be cleaned without removing from engine. Follow exploded view. (Figure 2)
2. To remove bottom cowl, remove draw bolt assembly and plug button from bottom cowl.
3. Remove choke body and baffle plate and 2 screws from choke body thru holes in front of cowl.
4. Pull choke body and baffle plate upward and remove choke knob.
5. Remove drive shaft housing and lower unit from power-head pivot tube. (Refer to Lower Unit Section III.)
6. Remove 2 cap screws which hold fuel connector adaptor to lower cowl.
7. Remove 4 screws which hold bottom cowl to cylinder block cover and front cowl bracket,
8. Pull powerhead from swivel bracket, and cowl now can be removed.
9. For reassembly, follow sequence of parts in exploded view (Figure 2) and reverse procedure in Paragraphs 1-thru-8 preceding.



1	Cowl, bottom
2	Grommet, choke rod
3	Draw bolt assembly
4	Nut, draw bolt screw
5	Lockwasher, draw bolt screw
6	Screw, draw bolt to bottom cowl
7	Plug button, bottom cowl
30	Bracket, crankcase to bottom cowl
31	Lockwasher, bracket screw
32	Screw, bracket to crankcase
33	Screw, crankcase bracket to bottom cowl
34	Lockwasher, crankcase bracket screw
35	Screw, fuel pump to crankcase bracket
36	Lockwasher, fuel pump mounting screw
37	Baffle assembly
38	Screw, cylinder cover to bottom cowl
39	Lockwasher, cylinder block cover screw
40	Washer, cylinder block cover screw

Figure 2. Bottom Cowl, Mark 6-6A

4 & 6-Cylinder Models

1. Remove all wires and tubes between bottom cowl and powerhead, then remove powerhead.
2. Remove shift shaft on shift models by gripping tip of link rod spring clip (holding shift shaft and lever) with pliers and pulling forward until spring comes off. On 6-cyl. direct reversing models, remove tension springs.
3. Pivot shift shaft lever to right off detent spring and pull to remove shaft from bottom cowl and drive shaft housing.
4. Remove shift lever control bracket and lower throttle control bracket clevis pins by removing the 3/8" elastic stop nuts, at the same time holding screw with screwdriver.
5. Remove clevis pin screw and wave washer. (Small clevis is for shift arm bracket on gear shift models.)
6. Remove two 9/16" hex head cap screws from control brackets which hold to bottom cowl.
7. Remove throttle and shift control lever assemblies (control lever on 6-cyl. direct reversing models).
8. Nylon bushing on steel bushing can be removed from both assemblies. Watch for small fibre spacer below magneto control bracket on 4-cyl. Mark models. Lubricate with MULTIPURPOSE Lubricant when replacing.
9. Lift up on bottom cowl assembly, including water line, to separate from drive shaft housing.

   NOTE: Take notice of "0" ring on top of water line. Lift water line from bottom cowl to remove.

10. Remove screws which hold 2 cable end anchor brackets.
11. Lift off powerhead to bottom cowl gasket and replace with new gasket.

    NOTE: Refer to Section VI for disassembly of check unit adaptor.

12. If so equipped, and if required, remove external wiring harness support, baffle, lock knob bracket and harness hole cover plug and coil fastening bracket and band (Merc 700-600 direct reversing models).
13. Remove 3 screws which hold check unit adaptor to bottom cowl.
14. Remove 4 screws which hold wiring harness backing plate to bottom cowl.
15. For reassembly, follow sequence of parts in exploded view (Figure 3) and reverse procedure in Paragraphs 1-thru-14 preceding.

1 Bottom Cowl Ass'y
2 Plug Cover
3 Screw
4 Lockwasher
5 Nut
6 Baffle
7 Screw
8 Trim Moulding
9 Decorative Screw
10 Fibre Washer
11 Nylon Cap Nut
12 Lockwasher
13 Brass Nut
14 Gasket
15 Ground Strap
16 Bracket
17 Screw
18 Lever
19 Lever
20 Bushing
21 Washer
22 Screw
23 Pin Assembly
24 Roll Pin
25 Screw
26 Wave Washer
27 Nut
28 Shift Shaft Ass'y
29 Rod (sleeve)
30 Adjusting Nut
31 Link Rod
32 Cotter Pin
33 Washer
34 Detent Spring
35 Screw
36 Washer
37 Nut
38 Vent Tube
39 Elbow
40 Nipple
41 Conn. Base Ass'y
42 Lockwasher
43 Nut
44 Clip
45 Screw
46 Bracket
47 Screw
48 Screw
49 Nut
50 Support
51 Screw
52 Washer
53 Nut

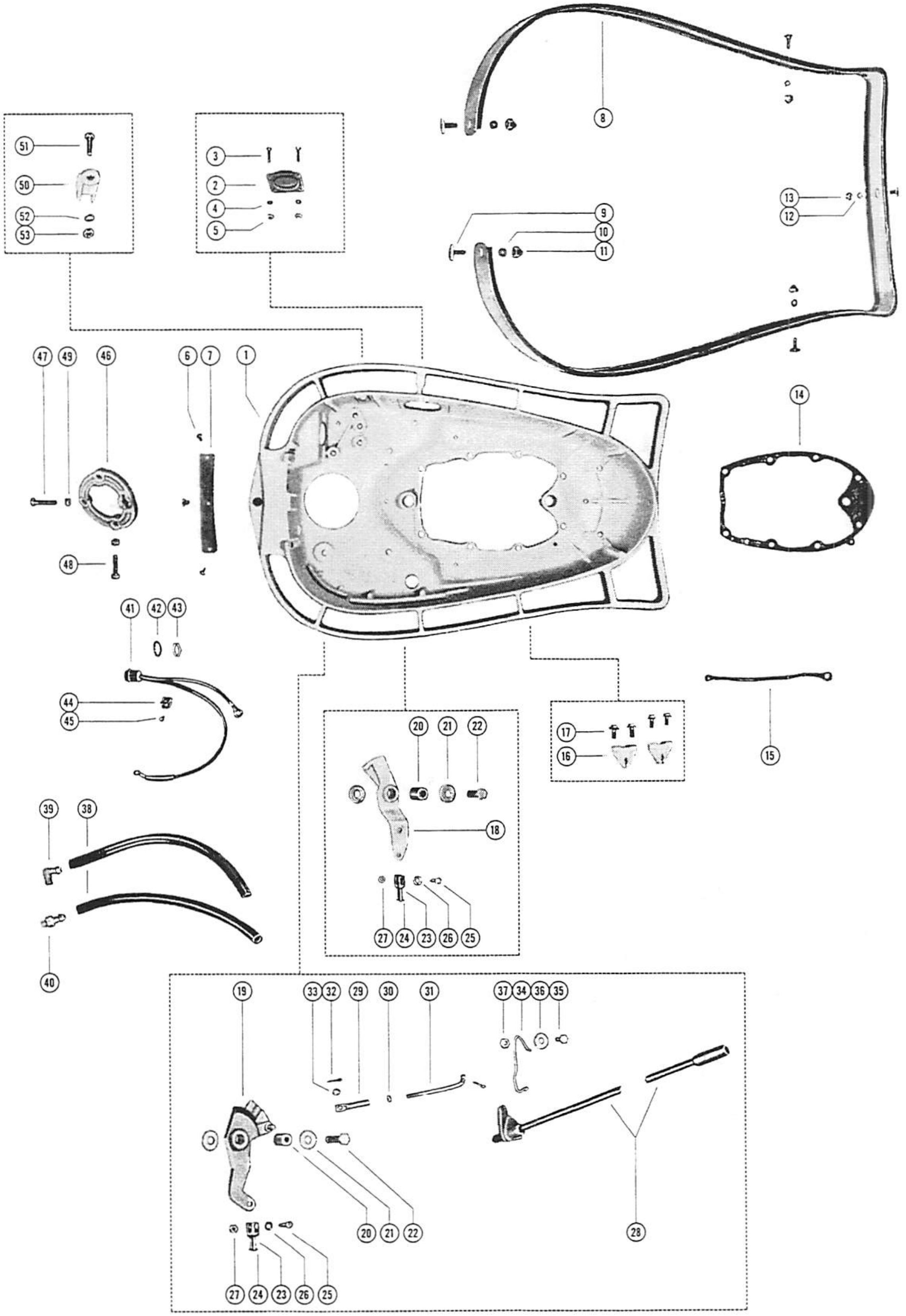


Figure 3. Bottom Cowl, 4-Cyl. Models

SECTION VIII C - MISCELLANEOUS

STEERING HANDLE ASSEMBLIES

THROTTLE AND SHIFT MECHANISM AND STEERING HANDLE

DESCRIPTION

1. Throttle and shift mechanism and steering handle are so closely allied that they may be considered under the same section.
2. Four types of throttles -- remote control, twist grip, cowl lever and squeeze grip -- as shown in chart below, are or have been employed with Mercury Outboard Motors:

Remote Control Throttle Full Gear Shift Models	All 4 & 6-Cyl. Full Gear Shift Models, F-N-R
Remote Control Throttle Direct Reversing Models	6-Cyl. Direct Reversing Models
Remote Control Throttle Optional	2-Cyl. Models
Twist Grip Throttle	2-Cyl. Models
Twist Grip Throttle Accessory	4-Cyl. Gear Shift Models
Throttle Lever on Cowl	Mark 7-5, KE7, KF7, KG7, KF5, KE4, KG4 & Older "K" Models
Squeeze Grip Throttle	KG9, KF9

3. Shifting is done with the shift handle, if remote controls are used, or by the shift lever just above the swivel bracket at the front of the motor.
4. Three types of shifting are used:
   a. FORWARD-NEUTRAL-REVERSE with all Merc and Mark models and KH7 with exception of Mark 7-6-6A-5 and Merc 800-700-600 and Mark 78-78A-75-75A Direct Reversing models.
   b. FORWARD-REVERSE with all Merc 800-700-600 and Mark 78-78A-75-75A Direct Reversing models.
   c. FORWARD-NEUTRAL (360° Pivot) with Mark 6-6A-5.

THROTTLE & SHIFT MECHANISM - DISASSEMBLY

1. To maintain original factory adjustment of linkage in reassembly, measure and record exact distance between ends of ball joints or swivel bodies. *In reassembly, adjust stud or connector necessary to restore this same distance.*
2. Remove nut from end of cross-shaft and cross shaft lever (linkage). (Figure 1)
3. Separate entire throttle and shift linkage from cross-shaft linkage by prying between cross-shaft lever and throttle shift bracket stop (Caution: Undue force may break stops.)
4. Loosen 2 jaw nuts (left and right hand thread) and unscrew control rod connector sleeve (left and right hand thread).

NOTE: Mark 25-20 type is used as an example. (Figure 2). When disassembling and reassembling Merc 200-Mark 28 type throttle and shift control, follow sequence in Figure 5.

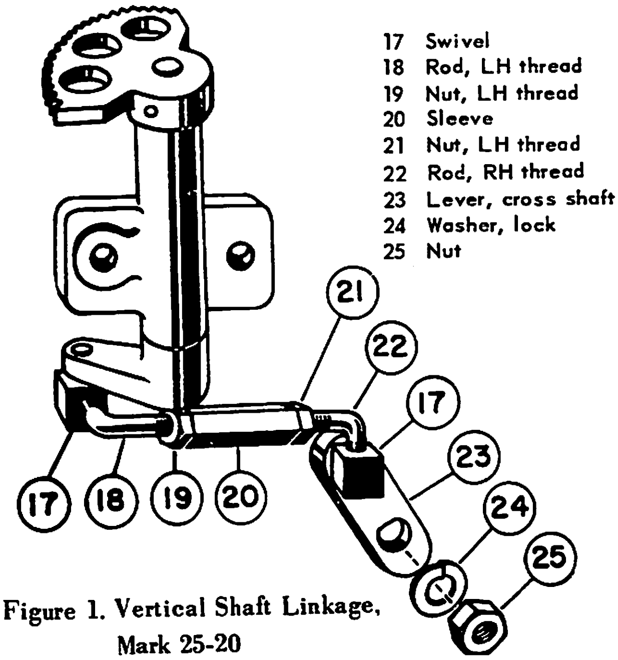


Figure 1. Vertical Shaft Linkage, Mark 25-20

5. Unscrew throttle swivel from vertical shaft assembly and cross-shaft lever.
6. Drive sector gear pin out of sector gear with punch.
7. Disassembly of vertical shaft bracket assembly is now complete.
8. To remove cross-shaft and steering handle elbow, loosen set screw on throttle and shift lock drum.
9. Bend tab washer up on cross-shaft bushing nut and loosen bushing nut.
10. Grasp steering elbow with hand and pull steering handle elbow assembly straight out from throttle and shift lock bracket.
11. To disassemble steering handle elbow, remove 4 common head screws.
12. Separate elbow cover plate from elbow and remove the following parts in order: Cross-shaft bushing, spacer tube and cross-shaft and gear assembly.
13. Remove friction plug screw from elbow and friction plug and spring also can be removed.
14. To remove shift control lever, loosen set screw which holds upper and lower reverse lock cam to shift control lever below swivel bracket.
15. Loosen screws which hold detent spring in bracket.
16. Pull shift shaft control lever straight up for removal.
17. To remove detent plate, unscrew stop pin on Mark 20-15 or inter-lock block on Mark 25 by removing nut. *NOTE: Upper and lower reverse lock cams will fall out of drive shaft housing when shift lever is removed.*
18. Remove bracket from drive shaft housing by unscrewing 2 nuts under bracket of drive shaft housing and remove cap screws to disengage entire bracket assembly.
    NOTE: On Mark 25, remove 3 cap screws which secure bracket to drive shaft housing.
19. To disassemble steering handle, drive groove pin from pinion gear and pull handle grip and shaft from steering handle tube. (Figure 3)

1 Bracket, vertical shaft
2 Bushing, vertical shaft bracket
3 Gear, sector - drive
4 Groove pin, sector gear
5 Vertical shaft assembly
6 Swivel, throttle control linkage
7 Rod, left hand thread
8 Nut, control rod connector sleeve (left hand thread)
9 Sleeve, control rod connector
10 Nut, control rod connector sleeve (right hand thread)
11 Rod, right hand thread
12 Lever, cross shaft
13 Screw, vertical shaft bracket mounting
14 Washer, vertical shaft bracket mounting screw
15 Bracket, throttle shaft bearing
16 Screw, throttle shaft bearing bracket to crankcase
17 Washer, throttle shaft bearing bracket screw
18 Bushing, throttle shaft bearing bracket
19 Screw, throttle adjusting (7/8")
20 Screw, throttle adjusting (1")
21 Nut, throttle adjusting screw
22 Shift control assembly
23 Lug, detent plate hold down
24 Screw, hold down lug to steering bracket
25 Washer, hold down lug screw
26 Shift shaft assembly (flexible)
27 Tab Washer, cross shaft bushing nut
28 Nut, cross shaft bushing
29 Drum, throttle and shift lock
30 Screw, set - throttle and shift lock drum
31 Steering bracket assembly
32 Pin, detent
33 Spring, detent pin
34 Welch plug, detent pin spring holding
35 Screw, steering bracket to housing (1")
36 Screw, steering bracket to housing (¾")
37 Washer, steering handle
38 Elbow, steering handle
39 Screw, steering handle clamp
40 Nut, steering handle clamp screw
41 Screw, steering handle locating
42 Lockwasher, steering handle locating screw
43 Spring, friction plug
44 Screw, friction plug
45 Plug, friction
46 Cross shaft assembly
47 Bushing, cross shaft
48 Tube, spacer
49 Plate, elbow cover
50 Screw, elbow cover plate to elbow

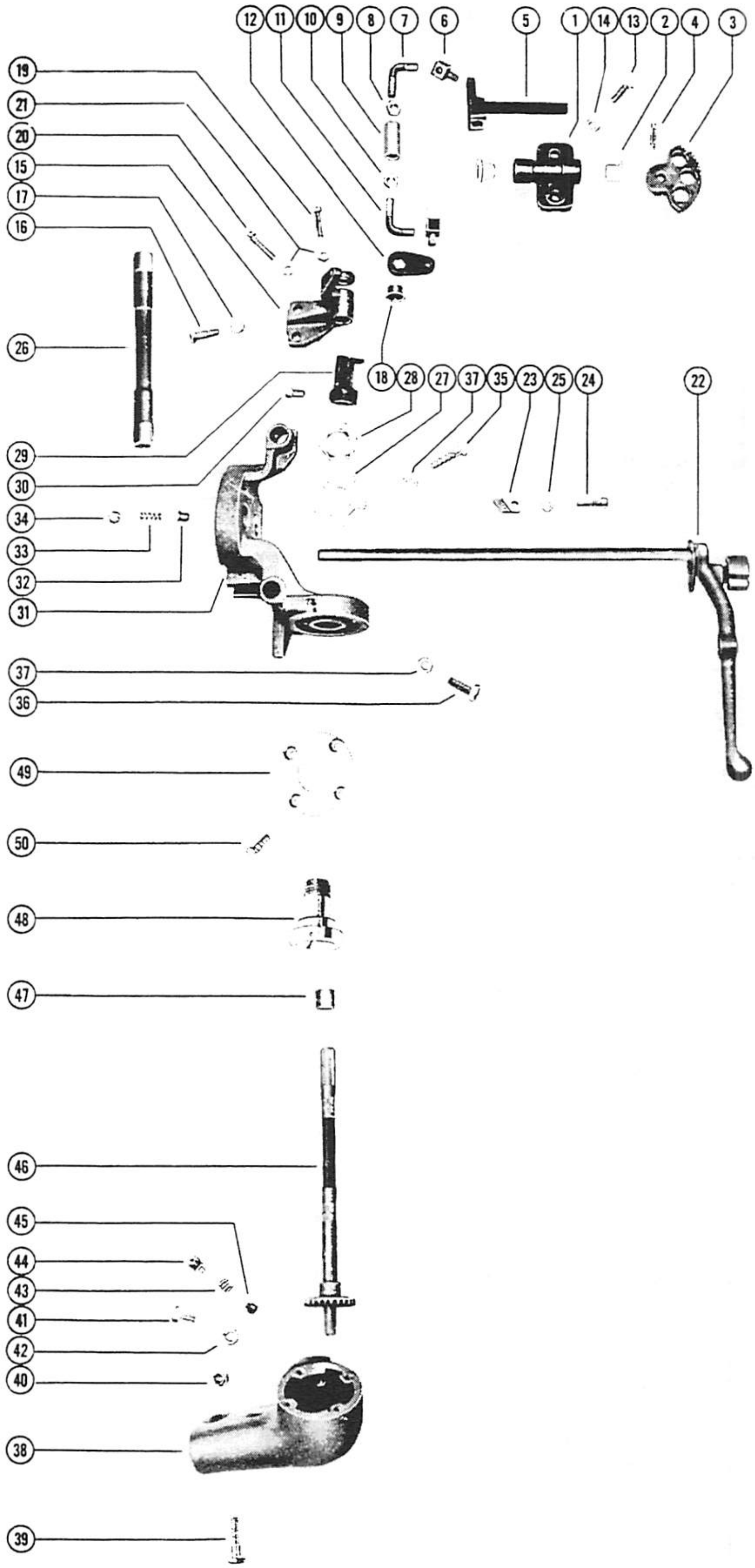
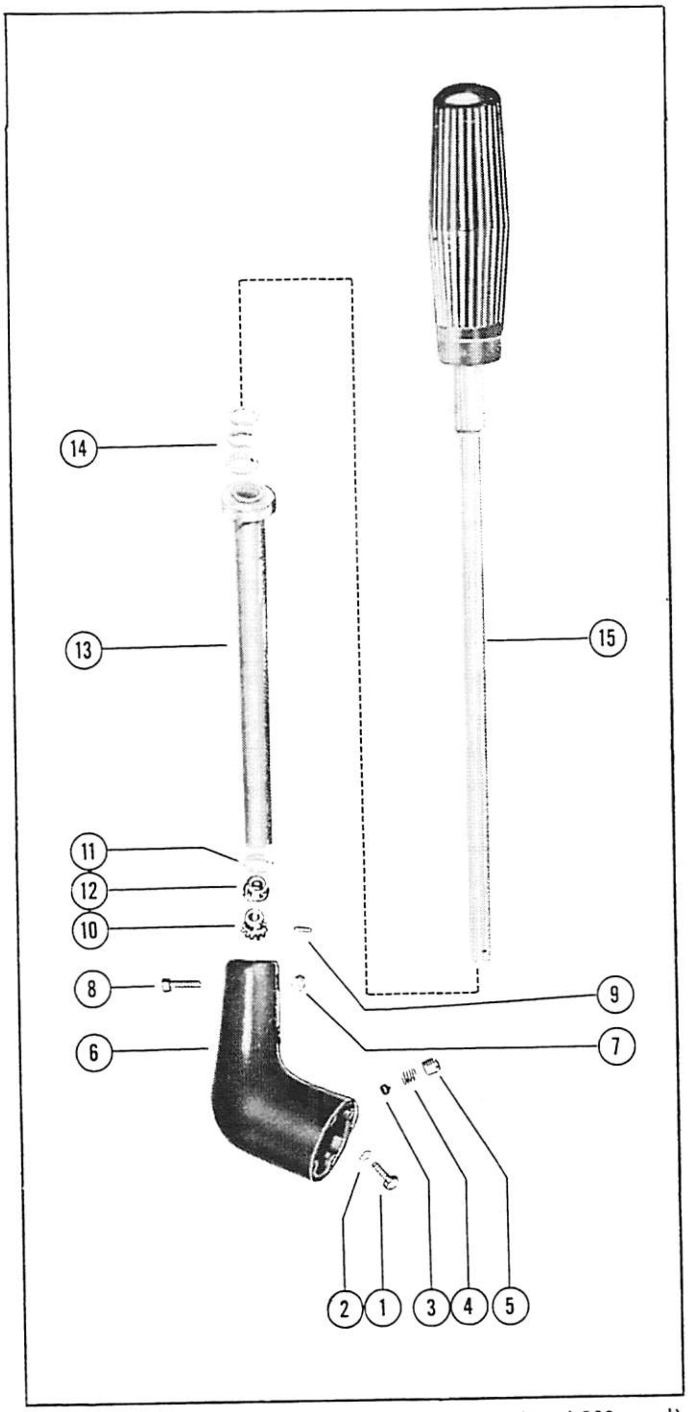


Figure 2. Throttle and Shift Mechanism, Mark 25



1	Screw	6	Elbow	11	Shim (.010 steel)
2	Washer, lock	7	Nut	12	Bushing
3	Plug, friction	8	Bolt	13	Tube
4	Spring	9	Pin	14	Washer
5	Screw	10	Gear, pinion	15	Handle Assembly

Figure 3. Steering Handle, Mark 25-20 Type

THROTTLE & SHIFT MECHANISM-REASSEMBLY

1. Install throttle and shift lock bracket with screws, washers and nuts holding bracket to housing.
2. Insert lever and shaft assembly thru bushing in throttle and shift lock bracket assembly and thru reverse lock cams until it seats.
3. Check that upper reverse lock cam has lip in cam guide slot liner of drive shaft housing.
4. Be sure that reverse lock lever assembly has tongue in place above cams.

   NOTE: Make certain that detent plate and stop pin on Mark 20-15 and KH7 and inter-lock block on Mark 25 and nuts are replaced, if removed previously.

5. Place shift shaft in forward position and tighten set screw in lower reverse lock cam. Check that cams are together at bottom of shaft.
6. Lubricate cam faces and slide with Quicksilver Anti-Corrosion Oil (C-92-39928A1).
7. Secure throttle detent spring in place on throttle and shift bracket.
8. Place cross shaft assembly in elbow, placing on cross-shaft bushing spacer tube and elbow cover plate and secure with 4 screws.
9. Place elbow and shaft assembly thru opening of left hand side of throttle and shift lock bracket.
10. Install tab washer, nut and shift shaft drum and insert cross-shaft all the way thru throttle and shift lock bracket.
11. Tighten nut on threads of cross-shaft bushing and bend one of tabs on washer over nut to prevent nut from turning loose.
12. Install set screw in shift lock drum and tighten. *Shift lock drum must be centered so that it will strike stop pin or inter-lock block in forward and reverse gear positions at correct speed.*
13. Install cross-shaft lever and tighten with 9/16" nut and lockwasher.
14. Install adjusting linkage by screwing swivels into vertical shaft assembly and cross shaft lever.
15. Screw connector sleeve together and tighten jaw nuts on either end (left and right hand threads). Make adjustment.

    NOTE: As explained at start of disassembly procedure, original factory adjustment of linkage can be restored by adjusting ball joints on stud or connector on swivel bodies so that they are same distance apart as in original assembly.

16. Insert vertical shaft lever thru vertical shaft bracket.
17. Place sector gear on vertical shaft and drive sector gear pin in place.
18. To reassemble steering handle, replace handle grip and shaft into steering handle tube, as shown in Figure 3, and replace groove pin in pinion gear.

INSTALLING THROTTLE SHAFT ASSEMBLY

1966 Mérc 39

1. When installing throttle shaft assembly A-39217A1 on 1966 Merc 39 engines below Serial No. 1914878, the shaft must be assembled in a definite position with respect to the throttle control socket (A-31200). This must be done to prevent disengagement of the control linkage while advancing throttle with handle in tilted-up position.

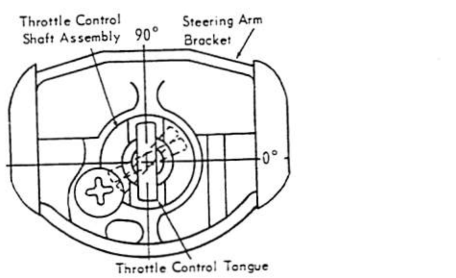


Figure 4. Throttle Shaft Assembly

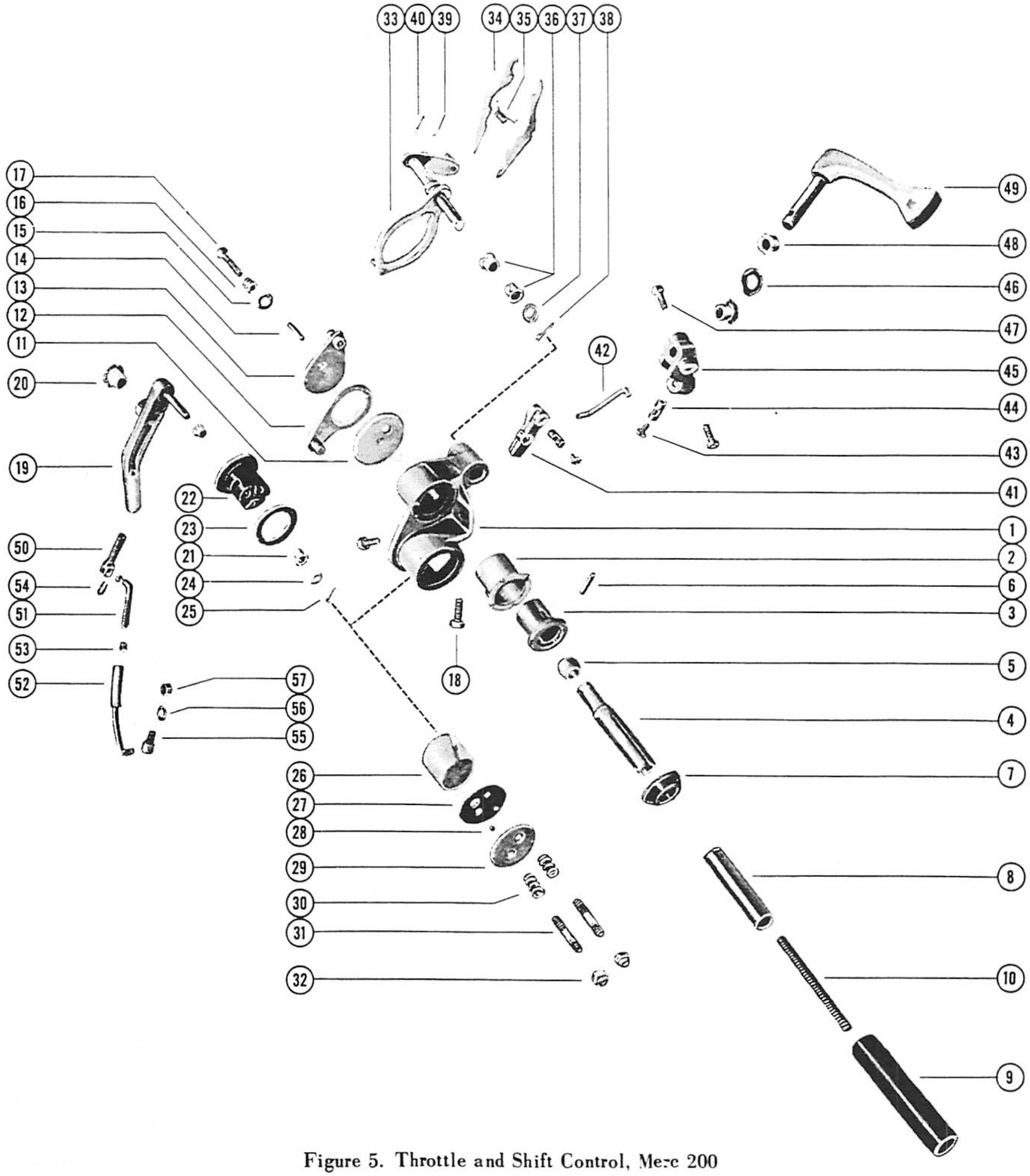


Figure 5. Throttle and Shift Control, Merc 200

1 Body, synchronizer
2 Bushing, nylon
3 Shaft, support
4 Shaft, input
5 Ball Joint, nylon
6 Pin
7 Bushing, rubber
8 Sleeve, inner
9 Tube, outer
10 Spring, input shaft
11 Eccentric
12 Link
13 Actuator Assembly
14 Pin, roller
15 Washer
16 Spacer
17 Screw
18 Screw
19 Lever
20 Bushing, nylon
21 Bushing, nylon
22 Cam, control lever
23 Plate, clutch
24 Washer
25 Cotter Pin, lock
26 Bushing, nylon
27 Plate, clutch
28 Ball, detent
29 Plate
30 Spring
31 Stud
32 Nut
33 Shift Cam Assembly
34 Lever, detent
35 Spring, tension
36 Bushing, nylon
37 Washer
38 Cotter Pin
39 Washer, wave
40 Cotter Pin
41 Lever, cam control
42 Link, drag
43 Screw
44 Pin, anchor
45 Arm
46 Washer, wave
47 Screw, set
48 Bushing, nylon
49 Lever, troll control
50 Bolt, swivel
51 Link, adjusting
52 Rod, magneto control
53 Nut, lock
54 Cotter Pin
55 Bolt, toggle
56 Washer, wave
57 Nut

2. When engaging the throttle shaft into the throttle socket, the magneto must be retarded against the idle stop screw. The assembly then must be installed with the tongue in a position between zero and 90°. (Figure 4)

THROTTLE & STEERING CONTROL - MARK 6-6A-DISASSEMBLY

1. Remove steering handle assembly by loosening clamping screw and nut and removing steering handle to elbow locating screw. (Figure 6)
2. Pull handle assembly out.
3. Drive gear fastening roll pin out of steering handle gear thru groove in handle tube.
4. Handle and grip, anti-rattle spring, steering handle tube and gear now can be removed.
5. Elbow, elbow retaining ring, outer shim, inner wave washer and gear coupling assembly can be removed from lower cowl by removing 2 cap screws, special bolt, stop nuts and washers which secure retainer to cowl.
6. To disassemble vertical shaft and gear, remove cotter pin and washer which hold limit plate link to vertical shaft lever and lift off limit plate link.
7. Remove screws which hold vertical shaft bracket to lower front cowl bracket.
8. Lift bracket and shaft upward to remove.
9. Lower vertical shaft gear is loose and can be removed.
10. Speed control shaft (horizontal) and gear can be taken from cowl by driving roll pin speed control shaft and pushing it thru cowl. A nylon bushing sets in cowl.

THROTTLE & STEERING CONTROL - MARK 6-6A - REASSEMBLY

1. Place nylon bushing in shaft hole in lower cowl from inside.
2. Insert horizontal speed control shaft and gear thru nylon bushing from inside.
3. Insert spring and washer on shaft outside of cowl, securing with roll pin in shaft hole.
4. Set nylon bushing in vertical shaft hole in bottom of cowl, placing gear on bushing with teeth facing up.
5. Assemble vertical shaft, if disassembled, setting vertical shaft support (block) with 2 holes upward and place brass washer, spring, sleeve, washer and "E" retaining ring in groove around vertical shaft to secure parts.
6. Tap roll pin into shaft opposite end.
7. Place magneto limit plate link on vertical shaft lever and secure with washer and cotter pin.
8. Place gear shaft in elbow with brass shim on outside of elbow under elbow retainer flange and wave washer on inner elbow flange toward cowl.
9. Secure in position with 3 bolts (one the special stop bolt), washers and nuts.
10. Install anti-rattle spring, steering handle tube (index ring toward rubber grip) and gear on handle and grip and secure with roll pin thru gear and handle.

INSTRUMENT PANEL & STEERING HANDLE BRACKET MARK 40, KF9, KG9 - DISASSEMBLY

1. Loosen fuel line from elbow connectors with wrench. *(Note: On Mark 40, remove air hose from pressure valve cover.)*
2. Remove cotter pin from magneto control connecting pin and remove connecting pin.
3. Disconnect shorting wire from magneto by removing 5/16" nut on magneto primary ground terminal.
4. Remove instrument panel (or steering handle bracket on KF9 & KG9) from unit by removing the three 9/16" hex nuts.
5. To remove shorting button assembly (items 15 thru 24 in Figure 7), remove shorting button cover by inserting screwdriver beneath end of cap and pulling back.
6. Remove 5/16" hex nut and remaining parts can be readily removed in sequence.

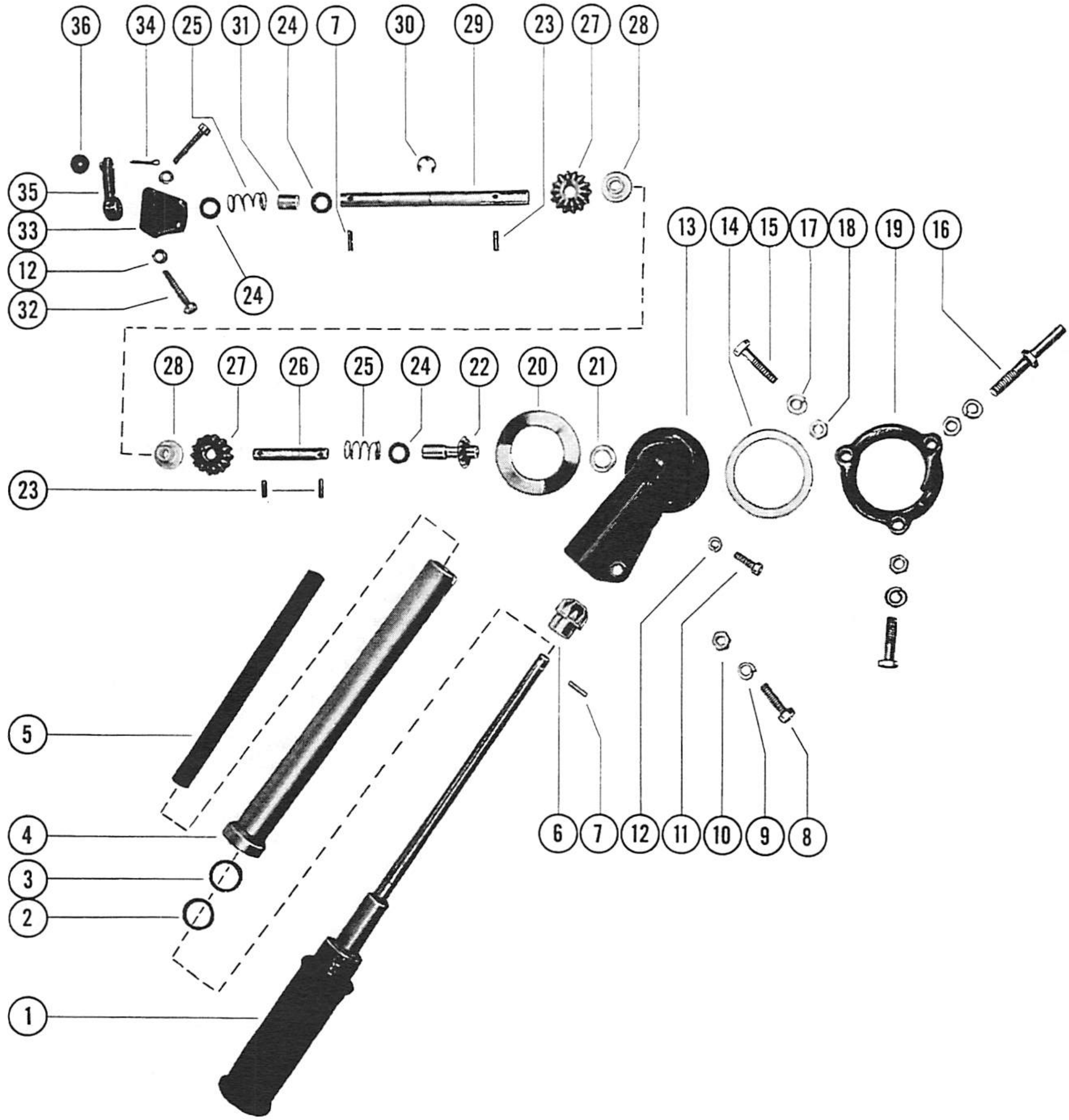
   NOTE: On Mark 40 only, remove male connector pin which screws into control bracket casting with 5/16" wrench. Do not lose fibre washer.

   Remove 2 "O" rings by inserting screwdriver beneath ring and lifting out.

7. Remove magneto control lever nut with 9/16" wrench, holding 2nd nut with another wrench to remove mounting screw. *This screw is threaded into casting on Mark 40's; on KF9 & KG9, it is a long stud with nut on bottom.*
8. Fuel pump on instrument bracket on KF9 and KG9 can be serviced individually when bracket is removed from motor:
   a. Remove Allen insert screw in knob of pump.
   b. Remove 2 screws and washers from rear of assembly which hold spring and plunger tube.
   c. Remove nut on end of spring and bearing to disassemble.
   d. Replace "O" ring, if worn, to prevent leakage of fuel thru pump handle.
   e. Replace any other part of assembly, if worn or damaged, especially neoprene gaskets.
9. Other miscellaneous parts of bracket can be removed by observing exploded view. (Figure 7)

INSTRUMENT PANEL & STEERING HANDLE BRACKET - MARK 40, KF9, KG9 - REASSEMBLY

1. Reassemble bracket before attaching to motor. (Figure 7)
2. Take bracket and attach magneto control lever on top with nut, bolt and washer. Bolt screws into control bracket and it is locked securely by nut.
3. Replace set screws and jam nuts in lever cross arms.
4. Replace throttle and steering coupling control swivels and fasteners in their respective places.
5. Replace magneto rod and yoke assembly on lever with swivel pin and lock in with cotter pin.
6. Reassemble shorting button switch in instrument panel according to sequence shown in Figure 7 as follows: 15, 25, 16, 17, 18, 19, 20, 22, 16, 21, 23, 24.
7. On Mark 40 only, reassemble female twist connector assembly in instrument panel according to sequence shown in Figure 7 as follows: 2, 3, 4, 7, 9, 8.
8. Remount instrument panel (or steering handle bracket on KF9 & KG9) with three 9/16" nuts and washers.
9. Connect magneto grounding wire to magneto primary group with nuts, the fuel inlet line to fuel filter elbow and air pressure line connects to pressure pad lower connector.
10. Reassemble KF9 and KG9 fuel hand pump in sequence reverse that in Paragraph 8, preceding.



1 Handle & Grip Assembly
2 Shim
3 Washer, wave
4 Steer. Handle Tube Ass'y
5 Spring, anti-rattle
6 Gear
7 Roll Pin
8 Screw, elbow clamping
9 Lockwasher
10 Nut
11 Screw
12 Lockwasher
13 Elbow Assembly
14 Shim, outer
15 Screw
16 Bolt, stop
17 Lockwasher
18 Nut
19 Ring, retaining
20 Washer, wave
21 Washer, thrust
22 Gear & Coupling Ass'y
23 Roll Pin
24 Washer
25 Spring
26 Shaft, horizontal
27 Gear
28 Bushing, nylon
29 Shaft, vertical
30 "E" Ring, retaining
31 Sleeve, vertical shaft
32 Screw
33 Support, vertical shaft
34 Cotter Pin
35 Lever, vertical shaft
36 Washer

Figure 6. Throttle & Steering Control, Mark 6-6A

NEUTRAL SHIFT DIMENSIONS AND ADJUSTMENT DATA - MARK 6-6A

1. Reference "A" in Figure 8: Shows normal operating view with motor shift controls in FORWARD operating position.
2. Reference "B" in Figure 8: Shows NEUTRAL push button in IN position and twist grip speed control in SLOW position. High speed acceleration is definitely limited, since the magneto and throttle cannot be advanced beyond this point. The limit plate, attached to underside of magneto, butts up against link lever which acts as a safety to control high speed RPM while clutch spring is disengaged and engine load is removed.
3. Reference "C" in Figure 8: Shows NEUTRAL push button part way into IN position and twist grip speed control in FAST position. The given dimension, 1/16" (1.6mm) to 1/8" (3.2mm), is set by screwing red neutral push button on rod to proper location and locking with neutral cam. In this position, motor should still be in FORWARD operating position. If not, the adjustment under reference "D" will assure proper operation.
4. Reference "D" in Figure 8: Shows NEUTRAL push button further into IN position and twist grip speed control in SLOW position. Critical point is where shift linkage just begins to release clutch on drive shaft, thus allowing engine to shift from FORWARD into NEUTRAL operating position. While motor is operating, push in red neutral button and determine by feel the point of clutch release. This should be 1/4" to 5/16" (6.4mm to 8.0mm), as shown. Shut motor off and make necessary adjustment on cable clamp on right side of powerhead. Re-start motor and check for proper release point.

NEUTRAL SHIFT DIMENSIONS AND ADJUSTMENT DATA MARK 5

Refer to instructions in Figure 9.

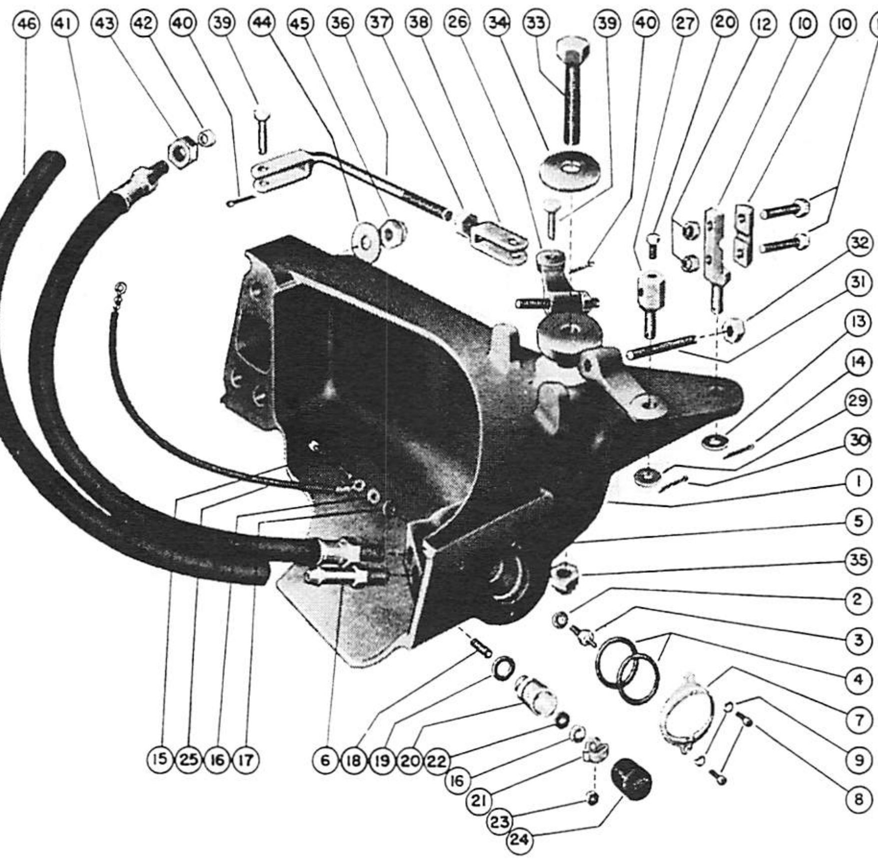
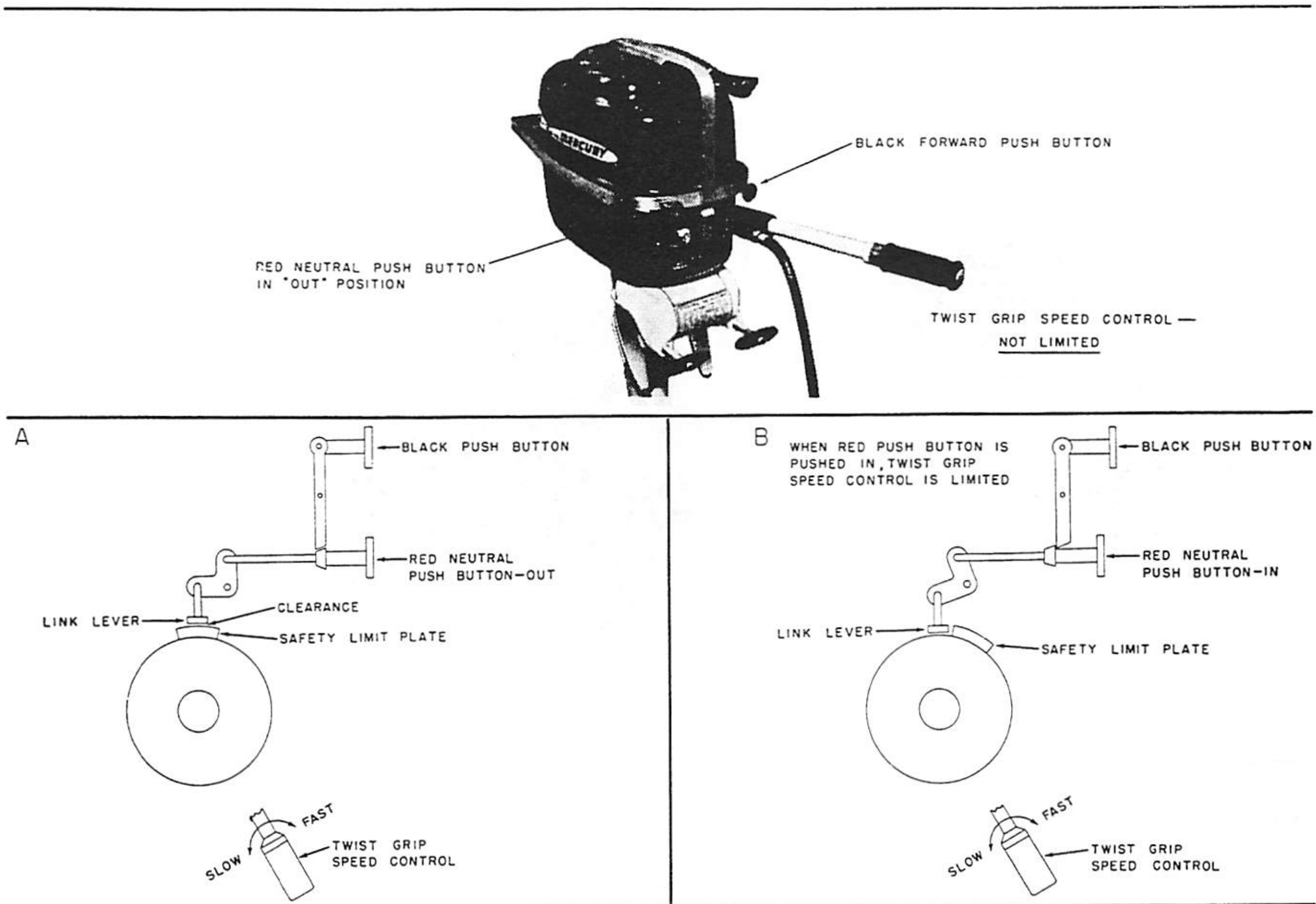
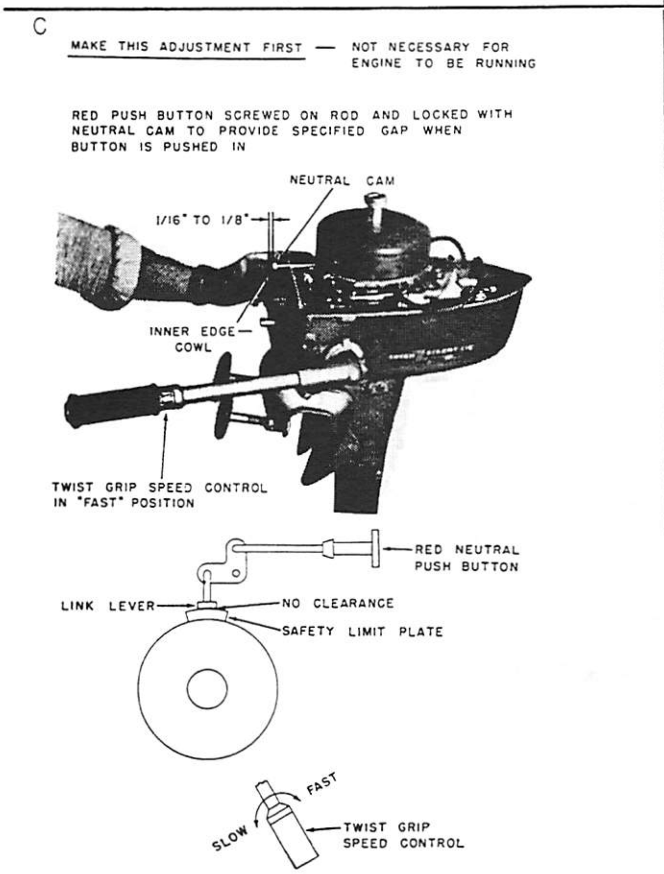
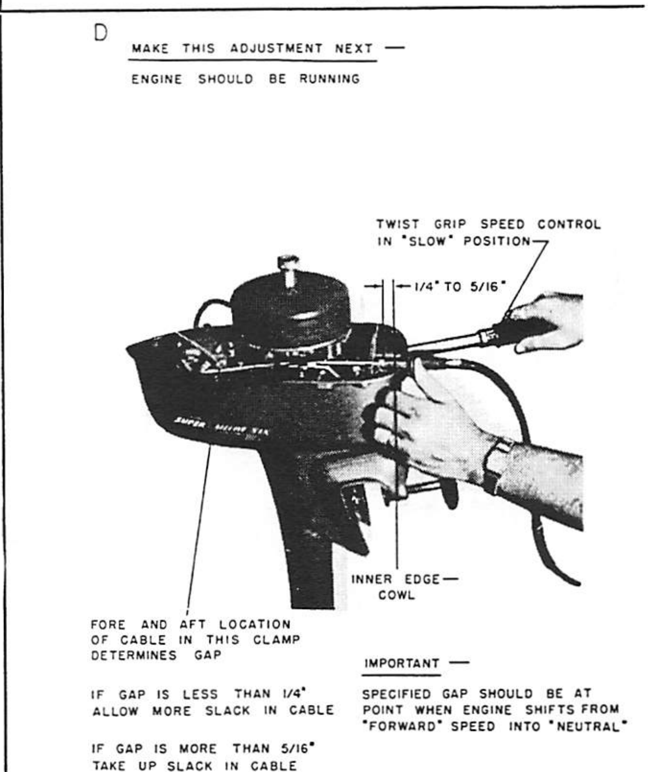


Figure 7. Instrument Panel, Mark 40

1 Bracket, instr. panel
2 Washer
3 Pin
4 "O" Ring
5 Groove Pin
6 Nipple, air hose
7 Retainer
8 Screw
9 Split lockwasher
10 Coupling
11 Screw
12 Nut
13 Washer
14 Cotter Pin
15 Screw
16 Washer
17 Insulating Washer
18 Insulating Bushing
19 Gasket
20 Base
21 Spring
22 Insulating Washer
23 Nut
24 Cover
25 Shorting Wire
26 Mag. Control Lever
27 Coupling
28 Screw
29 Washer
30 Cotter Pin
31 Set Screw
32 Jam Nut
33 Screw
34 Washer
35 Nut
36 Rod and Yoke
37 Nut
38 Yoke, throttle control
39 Pin
40 Cotter Pin
41 Fuel Line
42 Bushing
43 Nut
44 Washer
45 Nut
46 Air Line







NOTE: The dimensions shown are for all Mark 6 Motors and are set correctly at the factory. Recommendations are for resetting when repairing or for cable linkage stretch.

Figure 8. Neutral Shift Dimensions & Adjustment Data, Mark 6-6A

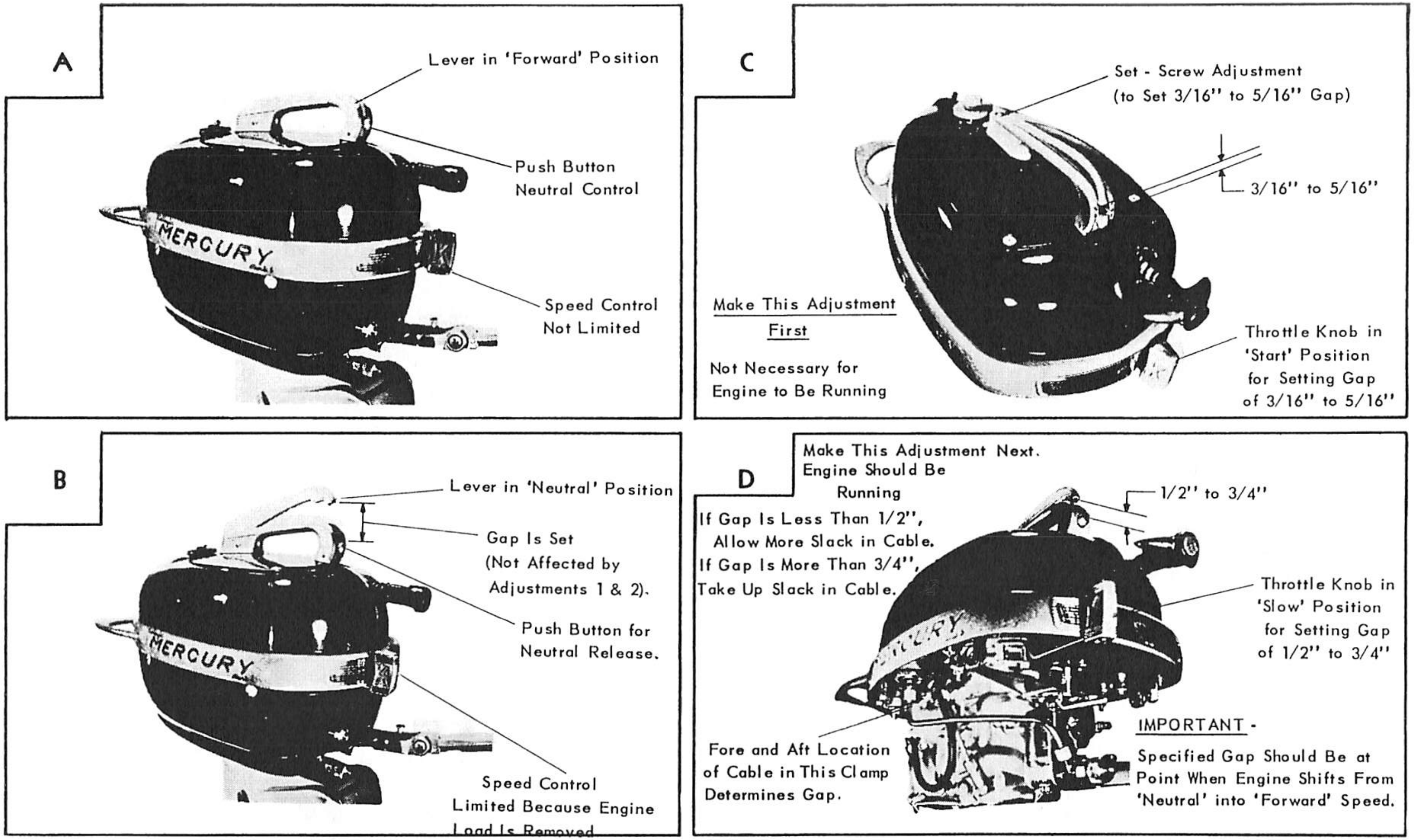


Figure 9. Neutral Shift Dimensions & Adjustment Data, Mark 5

Reference "A": Shows normal operating view, FORWARD operating position.

Reference "B": Shows lever in full open position, NEUTRAL throttle control in slow speed position. High speed acceleration is definitely limited since (magneto) throttle control cannot be advanced beyond this point. Limit plate, attached to underside of magneto, butts up against link lever which acts as a safety to control high speed RPM while clutch spring is disengaged and engine load is removed.

Reference "C": Shows lever in open safety position, throttle control in START position. The given dimension, 3/16" to 5/16" is set by adjusting set screw in back part of handle, as shown. In this position, motor is still in FORWARD drive position, since limit plate holds link lever up. Motor will pass into neutral when throttle is moved to slow position.

Reference "D": Lever in semi-open position (NEUTRAL) and throttle control at SLOW position. This critical point exists when shift linkage just begins to release clutch spring on drive shaft, thus allowing engine to shift from neutral into forward position. While motor is operating, press down on shift lever with left hand and determine by feel the point of spring release. This should be approximately ½" to ¾", as shown. Shut off motor and make necessary adjustment on cable clamp at right side of powerhead.

THROTTLE AND SHIFT CONTROL AND STEERING HANDLE (A-25825A1) FOR MARK 30-1-2-3

DISASSEMBLY

NOTE: Motor comes equipped with remote control attaching parts, since handle on Mark 30-1-2-3 is omitted and sold as accessory A-25825A1. (Figure 1)

THROTTLE & SHIFT MECHANISM

1. Remove elastic stop nut and washer which secure swivel coupling to cross shaft lever.
2. Remove 2 cap screws which hold cross shaft bushing and bracket assembly and shorting switch ground lead.
3. Pull cross shaft assembly out of cross shaft cover bushing, and swivel coupling can be pulled out of cross shaft lever.
4. Remove shorting lead assembly from bottom cowl by removing screw and nut which hold shorting switch lead to magneto.
5. Remove cross shaft assembly from right side of bottom cowl. (Figure 2)
6. Remove large elastic stop nut and washer from cross shaft cover bushing and pull cover assembly out. Do not lose alignment key in brass bushing.
7. Key holds bushing and cover in place in cowl to prevent turning. It may be necessary to remove powerhead to get large nut off.

STEERING HANDLE

See information under Mark 30 "Steering Handle" disassembly, preceding.

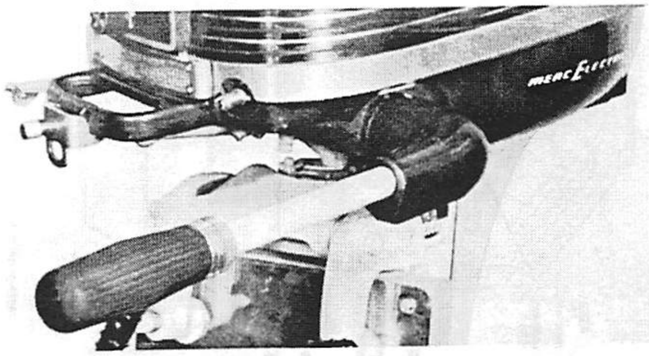


Figure 1. Steering Handle A-25825A1

REASSEMBLY

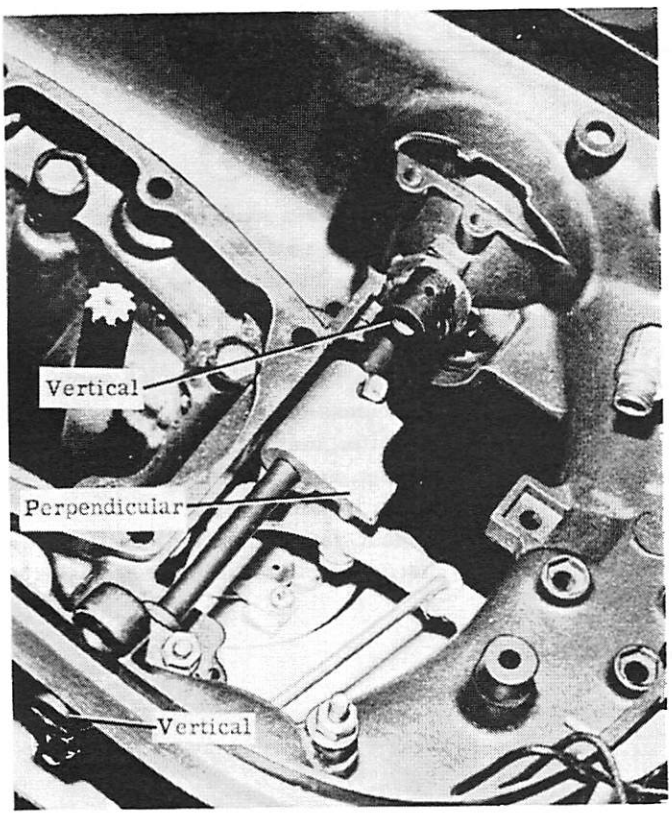


Figure 2. Throttle and Shift Lock Drum and Cross Shaft Lever

THROTTLE MECHANISM

1. Install connector in hole on right front of bottom cowl, from which it was removed, and fasten with lockwasher and nut.
2. Place alignment key in keyway of cross shaft cover bushing and set bushing assembly into lower cowl so that key is to top to align with keyway in cowl.
3. Set washer on bushing and thread large elastic stop nut on bushing and secure.
4. If component parts were removed from cross shaft, replace as follows: Cross shaft lever * (flat surface on shaft first), throttle and shift stop bracket * (small end first) and cross shaft bracket. Insert cross shaft assembly into cross shaft cover bushing and secure opposite end of cross shaft to the lower cowl with cross shaft bracket via the 2 cap screws, washers and nuts.

   * *Later models have throttle and shift lock drum and cross shaft lever combined into one piece.*
5. Attach short ground lead of switch to front cross shaft mounting bracket screw. Flat threaded end of cross shaft must be up and throttle and shift lock drum must be vertical to the flat on shaft as shown in Figure 2.
6. Align throttle and shift lock bracket on shaft (cross) so that neutral recess of bracket will strike stop pin on shift control lever in neutral gear. Secure with square head set screw.

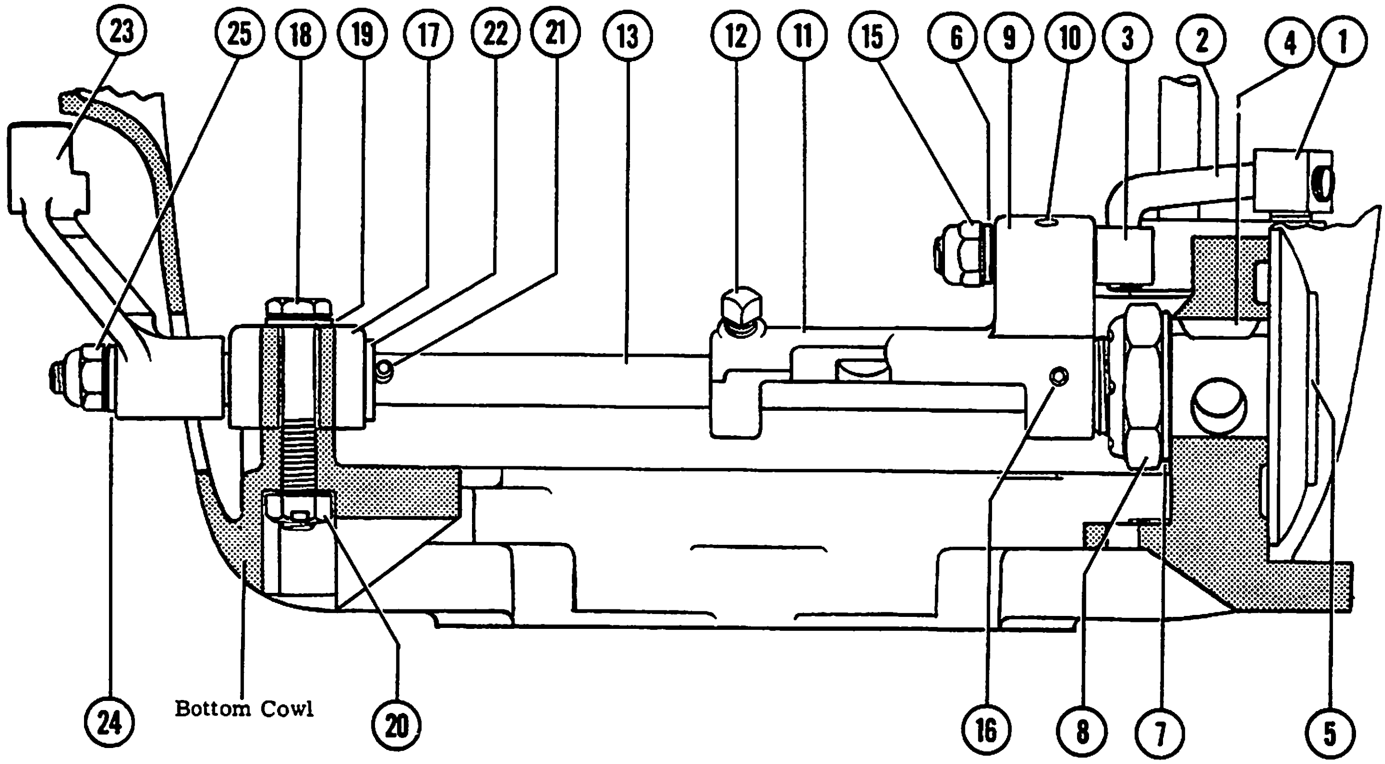
7. Set remote throttle control lever on shaft. Lever arm should be up and out. Secure in place with washer and elastic stop nut.

8. Cross shaft lever is loose on cross shaft. Pull toward throttle and shift lock bracket so that swivel coupling can be inserted into cross shaft lever. Secure with washer and elastic stop nut. Do not tighten nut securely, as shaft pivots in cross shaft lever. Use pin punch to align cross shaft lever with hole in cross shaft. Cross shaft lever must be up in relation to flat on threaded end of cross shaft.

9. Drive roll pin thru bracket and shaft and secure with small square head screw.

STEERING HANDLE

See information under Mark 30 "Steering Handle" reassembly, preceding.



1	Swivel, vertical shaft to link rod
2	Rod, link - swivel to swivel
3	Swivel, link rod to cross shaft lever
4	Key, cross shaft cover
5	Cover, cross shaft (steering handle opening)
6	Washer, cross shaft lever to swivel
7	Washer, cross shaft cover
8	Nut, cross shaft cover
9	Lever, cross shaft
10	Cross Shaft Lever
11	Drum, throttle and shift lock
12	Screw, set - throttle and shift lock drum
13	Shaft, cross
14	Washer, cross shaft lever to swivel
15	Nut, cross shaft lever to swivel
16	Roll Pin, lever to cross shaft
17	Cross Shaft Bracket Assembly
18	Screw, bracket to bottom cowl
19	Washer, cross shaft bracket screw
20	Nut, cross shaft bracket screw
21	Roll Pin, bracket to cross shaft
22	Washer, cross shaft bracket
23	Lever, remote throttle
24	Washer, remote throttle lever fastening
25	Nut, remote throttle lever fastening

Figure 3. Throttle Mechanism

THROTTLE AND SHIFT CONTROL AND STEERING HANDLE - - MARK 30

DISASSEMBLY

THROTTLE MECHANISM

1. To remove cross shaft and steering handle elbow, loosen set screw on throttle and shift lock drum, drive roll pin out of the throttle stop lever on the cross shaft and remove remote control throttle lever.
2. Remove the roll pin which drives the cross shaft lever.
3. Bend tab washer up on cross shaft bushing nut and remove bushing nut.
4. Grasp steering elbow with hand and pull steering handle elbow assembly straight out from throttle and shift lock bracket.

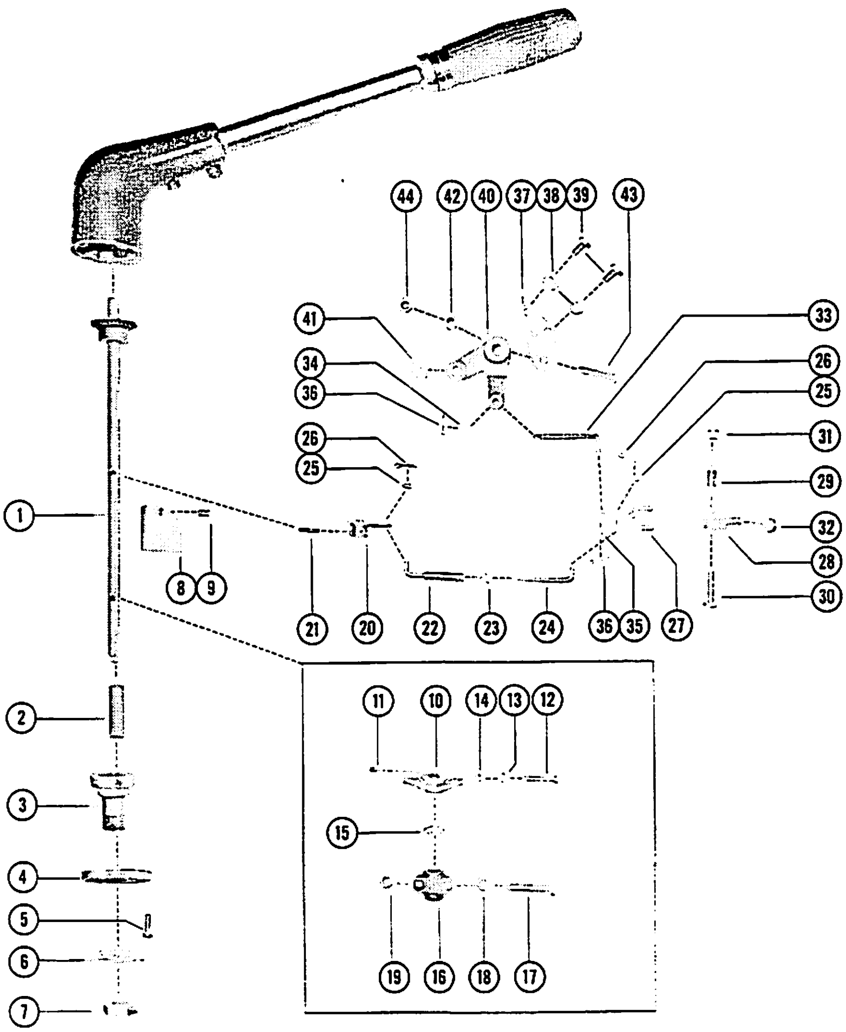


Figure 1. Throttle and Shift Mechanism and Steering Handle

1 Cross Shaft Assembly
2 Tube, spacer
3 Bushing, cross shaft
4 Plate, elbow cover
5 Screw, cover plate to elbow
6 Tab Washer
7 Nut, cross shaft bushing
8 Drum, throttle and shift lock
9 Screw, set
10 Lever, cross shaft
11 Roll Pin
12 Screw, throttle adjusting
13 Nut, throttle adjusting screw
14 Lockwasher
15 Wave Washer
16 Bracket, cross shaft
17 Screw
18 Washer
19 Nut
20 Lever, throttle stop
21 Roll Pin
22 Link Rod Assembly
23 Nut, link rod adjusting
24 End, adjustable link rod
25 Washer
26 Cotter Pin
27 Lever, intermediate
28 Post, pivot
29 Bushing, pivot post
30 Screw
31 Nut, pivot post screw
32 Nut
33 Link Rod
34 Washer, link rod (1/32)
35 Washer, link rod (1/16)
36 Cotter Pin
37 Bracket, pivot
38 Lockwasher
39 Screw
40 Bell Crank Assembly
41 Bushing, nylon
42 Bushing
43 Screw
44 Nut

STEERING HANDLE

1. To disassemble steering handle elbow, remove 4 common head screws.
2. Separate elbow cover plate from elbow and remove the following parts in order: Cross shaft bushing, spacer tube and cross shaft and gear assembly.
3. Removing friction plug screw from elbow will allow friction plug and spring to be removed.

SHIFT MECHANISM

1. Powerhead must be removed before shift control can be removed.
2. To remove shift control lever, loosen square head set screw, which holds upper and lower reverse lock cams to shift control lever below swivel bracket right side, and remove small screw holding detent block on flange cover bracket.
3. Pull shift shaft control lever straight up for removal. Upper and lower reverse lock cams will fall out of drive shaft housing when shift lever is removed.
4. Remove flange cover from drive shaft housing by removing 3 cap screws securing flange cover to drive shaft housing.

Reassembly

SHIFT MECHANISM

1. Install flange cover with screws which hold bracket to drive shaft housing. Insert shift and lever assembly through bushing in flange cover assembly and thru upper and lower reverse lock cams until it seats.
2. Check that upper reverse lock cam has lip in cam guide slot liner of drive shaft housing. Be sure that reverse lock lever assembly has tongue in place above cams.
3. Place shift shaft in forward position and tighten set screw in lower reverse lock cam. Check that cams are together at bottom of shaft.
4. Lubricate cam faces and slide with Anti-Corrosion Oil (C-92-39928A1) for easier actuation.
5. Secure throttle detent block in place on flange cover bracket.
6. Lubricate swivel pin by injecting grease through fitting located in center of swivel bracket on underside.

THROTTLE MECHANISM

1. Insert cross shaft assembly in elbow, placing on cross shaft bushing spacer tube and elbow cover plate, and secure with 4 screws.
2. Place elbow and shaft assembly through opening of left hand side of bottom cowl.
3. Install tabwasher, nut, throttle stop lever and roll pin, throttle and shift lock, drum, cross shaft lever roll pin and cross shaft lever and insert cross shaft thru cross shaft bracket.
4. Tighten nut on threads of cross shaft bushing and bend one of tabs on washer over nut to prevent nut from turning loose.
5. Install set screw in throttle and shift lock drum and tighten. Throttle and shift lock drum must be centered so that it will strike stop pin on shift control lever in neutral and reverse gear positions at correct speeds.
6. Install remote control lever and secure the cotter pin.

INSTALLATION OF ADJUSTING LINKAGE

1. Place bell crank, pivot lever and attached parts in relative position with side of pivot lever marked "top" to the top.
2. Set intermediate pivot lever post in recess at front of bottom cowl and secure with elastic stop nut.
3. Place pivot lever with side marked "top" on seat of bottom cowl and secure it in place with 2 screws and lockwashers.
4. Use open end wrench to replace front screw thru opening above elbow in bottom cowl and socket wrench for rear screw. Linkage reassembly is now completed.
5. Place magneto actuating bracket pivot post in nylon bushing of bell crank and secure bracket to magneto frame with 2 small screws and lockwashers.

STEERING HANDLE

1. To reassemble steering handle, drive groove pin from pinion gear.
2. Pull handle grip and shaft from steering handle tube.
3. To reassemble steering handle, reverse procedure under "Steering Handle" in disassembly, preceding.

THROTTLE-STEERING HANDLE ASS'Y. & CO-PILOT 4-CYL. ENGINES - INSTALLATION

THROTTLE-STEERING HANDLE INSTALLATION

1. Remove clevis yoke pin assembly from shift control lever and magneto control (lower) bracket on side of engine.
2. Remove (from steering handle assembly) 1-3/8" (1.38mm) bracket to bottom cowl screw and nut and 2" (.500mm) to bottom cowl screw, nut, clamp and washer.
3. Place handle assembly on bottom cowl rim and attach front screw with nut.
4. Remove washer and cotter pin from end of shift control link rod, place end of rod thru hole in shift control lever of engine and replace washer and cotter pin. *NOTE: Refer to "Steering Handle Assembly (A-38445A1) for Merc 500 Engines".*

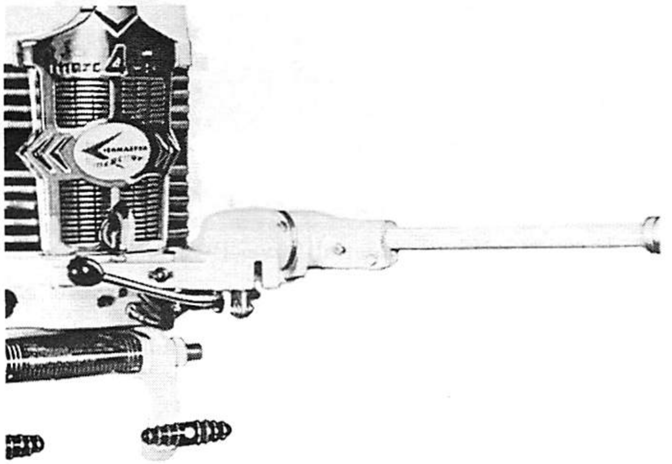


Figure 1. Throttle and Steering Handle Ass'y (A-29822A1)

5. While placing rod on lever, be sure to position link rod tension spring of shift control link rod so as to hook on shift control lever assembly.
6. Remove washer and cotter pin from end of magneto control link rod, place end of rod thru hole in magneto control (lower) bracket and replace washer and cotter pin.
7. While placing rod on bracket, be sure to position link rod tension spring of magneto control link rod so as to hook on magneto control lever assembly.
8. Place clamp into position on bottom cowl and replace 2" (.500mm) bracket to bottom cowl screw, washer and nut to fasten clamp.
9. Attach shorting switch connector to engine connector base assembly.

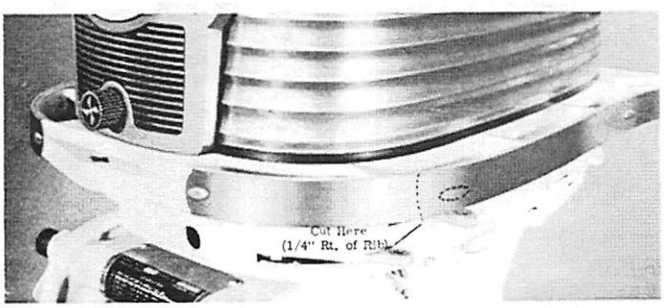


Figure 2. Cut of Chrome Trim Moulding

NOTE: When installing A-25262A1 handle assembly on engines with chrome trim moulding on bottom cowl, cut moulding off in line with first rib in bottom cowl, as handle assembly will not fit over moulding. (Figure 2) (Chrome need not be cut when installing A-29822A1 handle assembly.) Drill hole in moulding and rim back of first rib and insert decorative screw and nut to hold moulding. Handle assembly now can be installed as explained in previous paragraph.

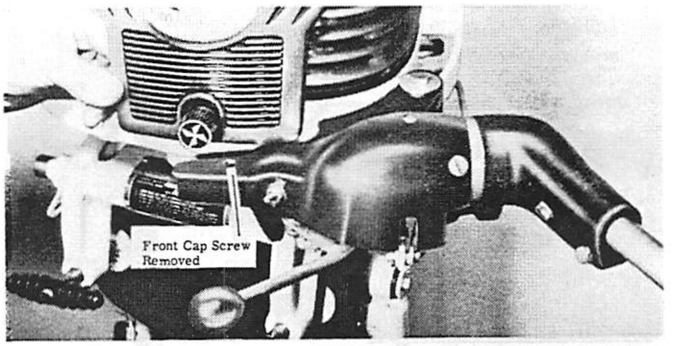


Figure 3. Removing Front Cowl Cover (A-25262A1) Handle)

IMPORTANT: To remove front cowl cover from engines with A-25262A1 handle assembly installed, first remove front cap screw and nut on handle assembly and swing handle out. (Figure 3) (Not required with A-29822A1 handle assembly.)

CO-PILOT REPLACEMENT KIT INSTALLATION (Figure 4)

Co-pilot (A-29738A3 for 3/4" [19mm] dia. tilt tube, A-29738A4 for 7/8" [22.2mm] dia. tilt tube) can be installed on either side of clamp bracket.

1. Remove tilt tube cap on side of installation.
2. Remove pivot pin washer and nut from pivot pin.
3. Place pilot rod into tilt tube of clamp bracket.
4. Attach pivot pin and bracket assembly to bottom cowl with pivot pin washer and nut previously removed.
5. Tighten large hand-fastening coupler nut on tilt tube to obtain desired tension.

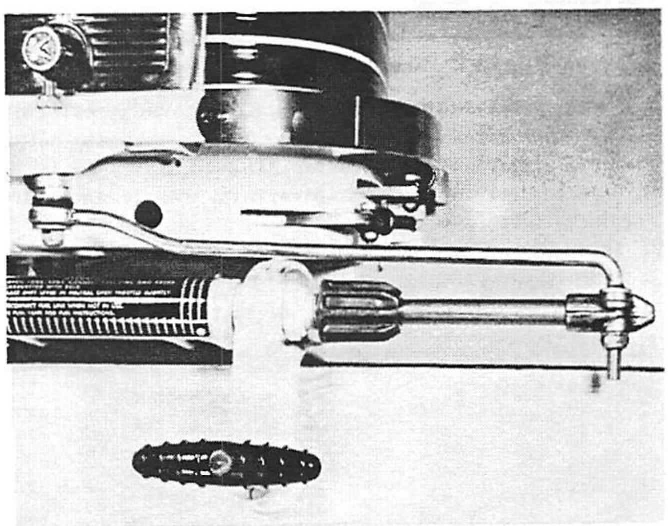


Figure 4. Co-Pilot Installed

THROTTLE-STEERING HANDLE ASSEMBLY
(30 Cu. In. [491.61cm^3]) 2-CYL. ENGINES - INSTALLATION

MANUAL SHIFT LEVER INSTALLATION

1. Remove front cowl cover and wrap-around cowl.
2. Remove screw and nut which fasten clevis yoke to remote control shift lever and remove clevis yoke. (Figure 1)
3. Remove cotter pin and washer which fasten link rod to shift lever. (Figure 1)
4. Remove shift lever pivot screw and remove shift lever, bushing and 2 flat washers from cowl. (Figure 1)

NOTE: If installed on a Merc 350S (electric starter) model, use A-35247 lever in place of A-34135 lever. The A-35247 lever is not supplied with the steering handle and must be ordered separately.

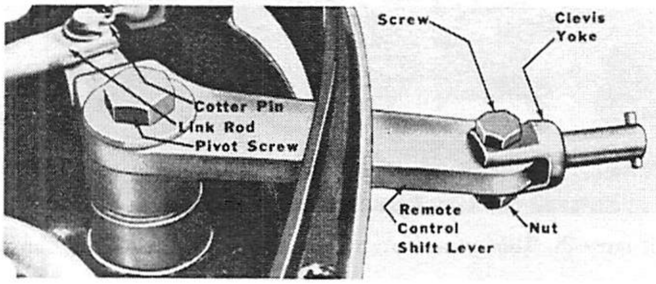


Figure 1. Remote Control Shift Lever

5. Unscrew knob from manual shift lever and place lever in position in cowl. Place link rod on shift lever. (Figure 2)
6. Place bushing, which was removed previously, in hole in shift lever. Place one flat washer, which was removed previously, between lever and bottom cowl and other washer on top of lever. Lubricate bushing and washers with MULTIPURPOSE Lubricant(C-92-35226).

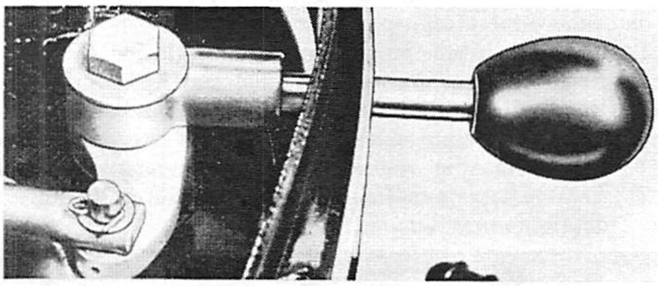


Figure 2. Manual Shift Lever Position

7. Place pivot screw, which was removed previously, thru washers and bushing and thread screw into bottom cowl. Tighten screw securely. (Figure 2)
8. Fasten link rod to shift lever with washer and cotter pin. (Figure 2)
9. Thread knob on lever and tighten securely. (Figure 2)
10. Pull remote control throttle lever forward as far as possible so that engine may be shifted.

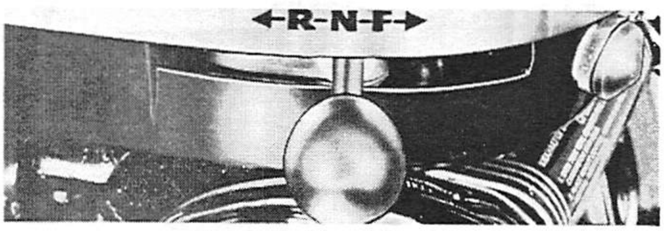


Figure 3. Decal Position

11. Move shift lever to neutral position and place decal on protector rim so that "N" is directly above lever. (Figure 3)

This completes installation of manual shift lever.

STEERING HANDLE AND THROTTLE BRACKET INSTALLATION

1. Remove phillips head screw, washer and spacer from throttle control lever. (Figure 4)

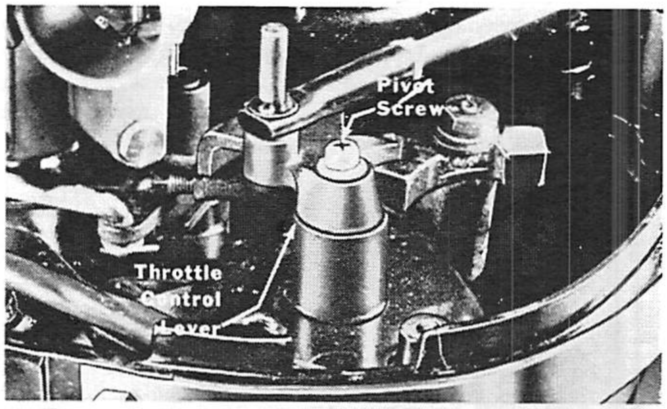
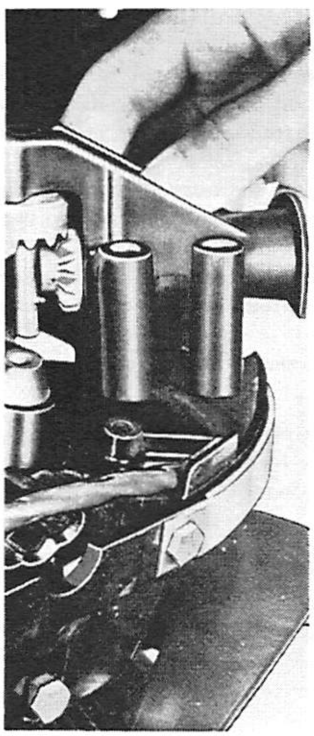


Figure 4. Throttle Control Lever Pivot Screw

2. Lubricate throttle control bracket pivot shafts and gears with MULTIPURPOSE Lubricant (C-92-35226) .
3. Place bracket in position and fasten bracket to bottom cowl with 3 cap screws and lock washers. Tighten screws evenly and securely. (Figures 5 and 6)
4. Remove 2 cap screws, which fasten remote steering bracket to steering arm bracket on engine, and remove remote steering bracket. (Figure 7)
5. Align speed and shift indicator on steering handle



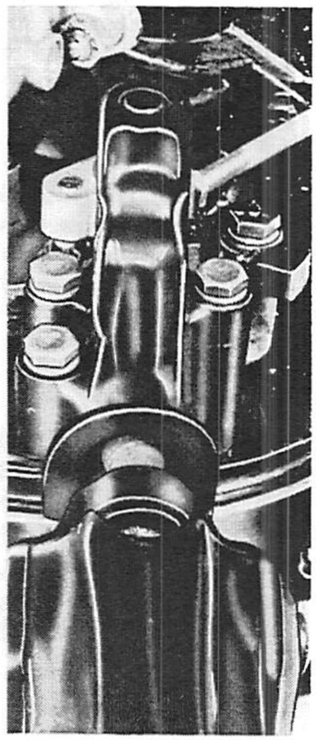


Figure 5. Installing Throttle Control Bracket Figure 6.

grip with mark on steering handle tube, as shown in Figure 8.

6. Pull remote control throttle lever forward as far as possible.
7. Lubricate square coupling end of throttle control shaft in handle with MULTIPURPOSE Lubricant (C-92-35226) and insert coupling into socket in throttle control bracket. (Figure 7)
8. Fasten steering arm to steering arm bracket on engine with 2 cap screws which were removed previously. Tighten screws securely. (Figure 9)
9. Remove screw and nut, which fasten clevis yoke to remote control throttle lever, and remove clevis yoke.

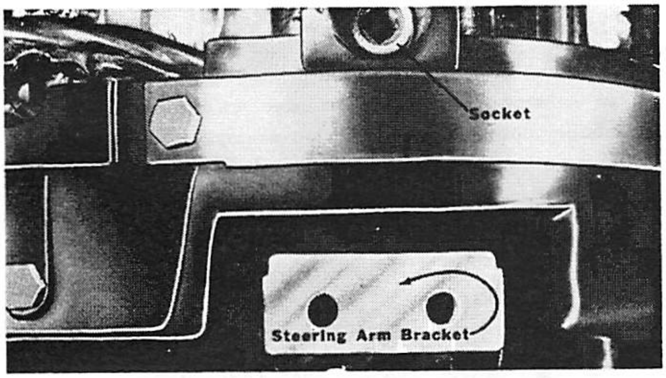


Figure 7. Steering Arm Bracket Removed

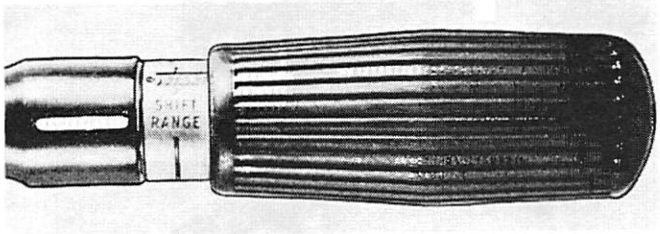


Figure 8. Steering Handle

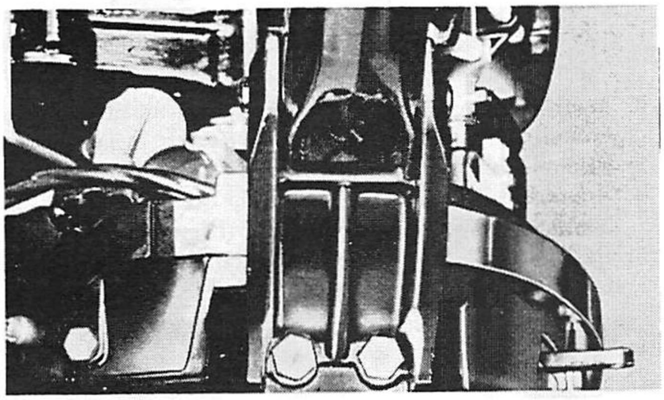


Figure 9. Steering Arm Bracket Attached

WRAP-AROUND COWL MODIFICATION

NOTE: It is necessary that wrap-around cowl has a cut out to fit around throttle bracket.

Proceed as follows:

1. Cut out template on line designated.
2. Place template in position on wrap-around cowl as shown in Figure 10.
3. Cut cowl on line designated on template.
4. Install wrap-around cowl and front cowl cover.

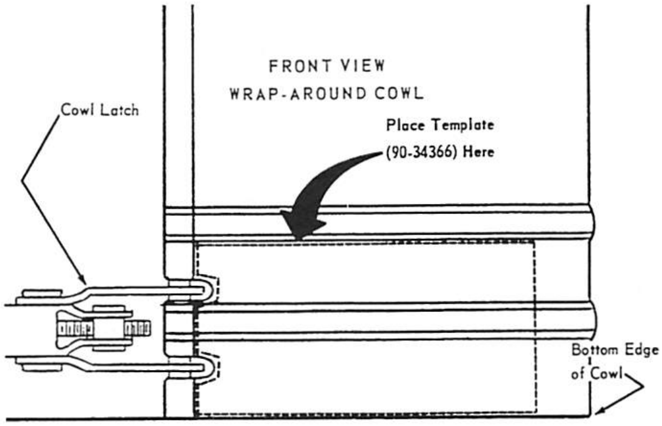


Figure 10. Template Position

CO-PILOT INSTALLATION & ADJUSTMENT

1. If co-pilot is not already installed (Figure 11), slide clamp plate assembly from kit thru slot (friction button side down) in bottom face of swivel bracket. (Figure 12)
2. Fasten clamp plate assembly to swivel bracket with 5/16-24x1" screw and 5/16" internal lockwasher. (Figure 11)
3. Adjust co-pilot so that motor will remain in a fixed course position, without need of manual control, yet will not be too tight to allow free-and-easy steering.
4. Tighten adjusting screw (Figure 12) to increase friction; loosen to decrease friction.

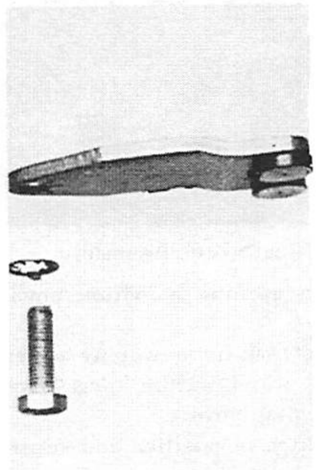


Figure 11. Co-Pilot

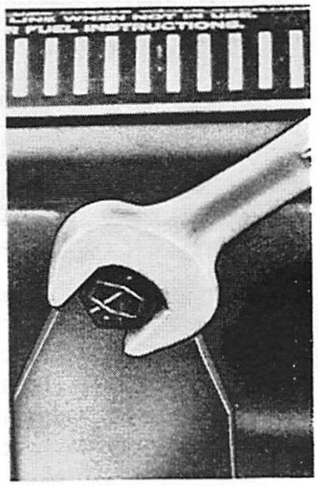


Figure 12. Adjusting Co-Pilot

OPERATING INSTRUCTIONS

CAUTION: Before starting engine, after attaching manual shift control, be sure that fuel line is lying against bottom of cowl and cannot jam control handle in reverse position.

1. Position twist grip throttle so that "Start" is lined up with mark on steering handle tube.
2. Place manual shift lever in "N" (neutral) position.
3. Start engine.
4. Turn twist grip throttle to "Shift Range".
5. Move shift lever to desired gear.

CAUTION: Do not shift gears unless twist grip throttle is in "Shift Range" position. Do not shift into reverse gear when engine is not running, as shifting mechanism will be damaged.

STEERING HANDLE ASSEMBLY [A-39926A1]

For Merc 350 Engines [Serial No. 1976427 & Up]

INSTALLATION INSTRUCTIONS

INSTALLING MAGNETO SHORTING SWITCH ASSEMBLY

1. Remove front cowl and wrap around cowl from engine.
2. Disconnect magneto shorting switch leads from terminal block (Figure 1) and remove switch from bottom cowl.

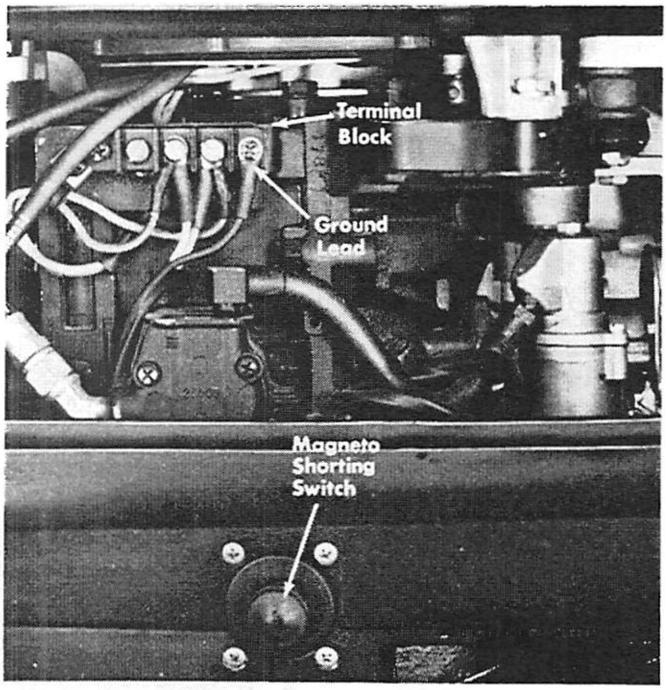


Figure 1. Magneto Shorting Switch Assembly

3. Insert plug and fastener in opening in bottom cowl. (Figure 2)
4. Install magneto shorting switch in new plug cover.
5. Remove 4 screws and nuts, which secure plug cover to bottom cowl, and remove plug cover.
6. Place magneto shorting switch in position and secure with 4 screws. (Figure 1)

   NOTE: Black lead is ground and must be attached under one of 4 screws. Remove paint under lead to ensure a good electrical connection to bottom cowl.

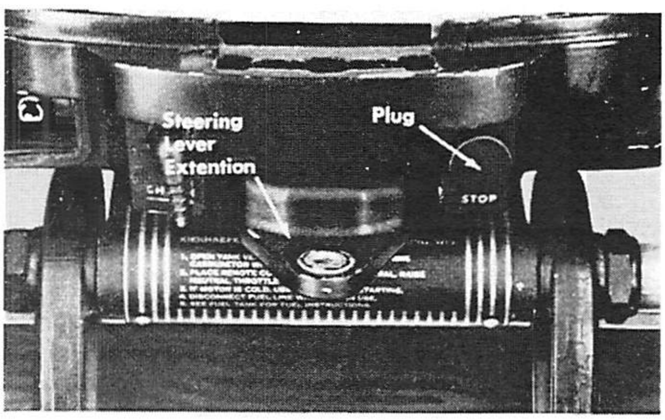


Figure 2. Steering Lever Extension

7. Attach magneto shorting switch leads to terminal block as shown in Figure 1.

   NOTE: Black lead is ground and must be attached as shown in Figure 1.

INSTALLING HANDLE ASSEMBLY

1. Remove nuts, which secure steering lever extension to steering lever, and remove extension. (Figure 2)
2. Place cover in position on steering handle bracket and secure cover to bracket with 2 screws. (Figure 3)

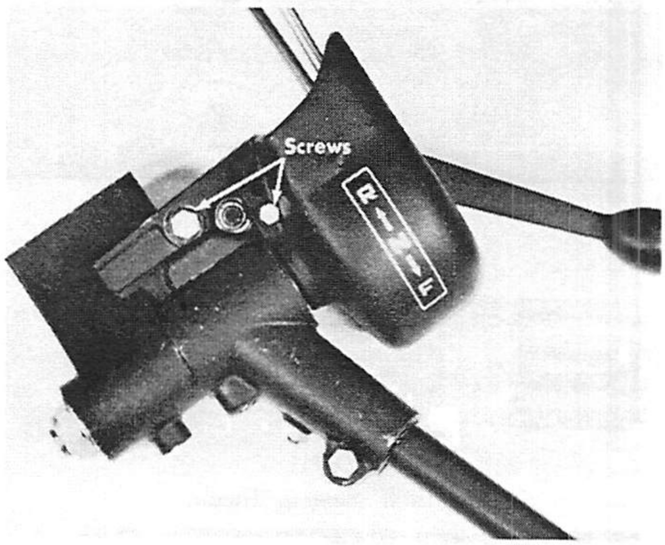


Figure 3. Cover Installed

3. Insert throttle and shift link rods thru opening in left side of cowl and place handle assembly in position on engine steering lever. (Figure 4)
4. Secure handle assembly to engine steering lever with 2 nuts and tighten nuts securely. (Figure 4)
5. Place shift lever, which is located on handle assembly, in forward gear position.

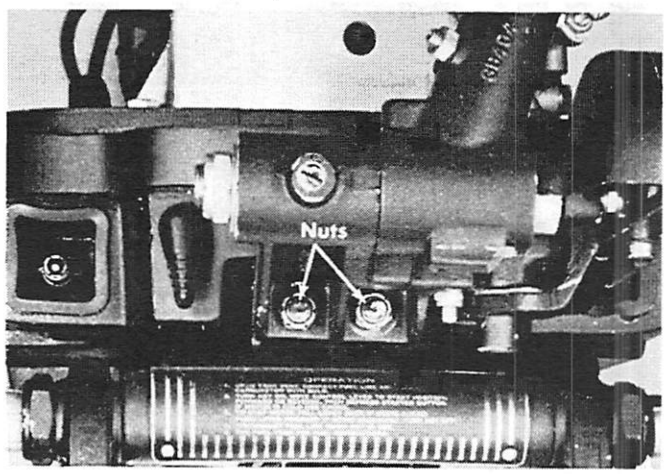


Figure 4. Handle Assembly Installed

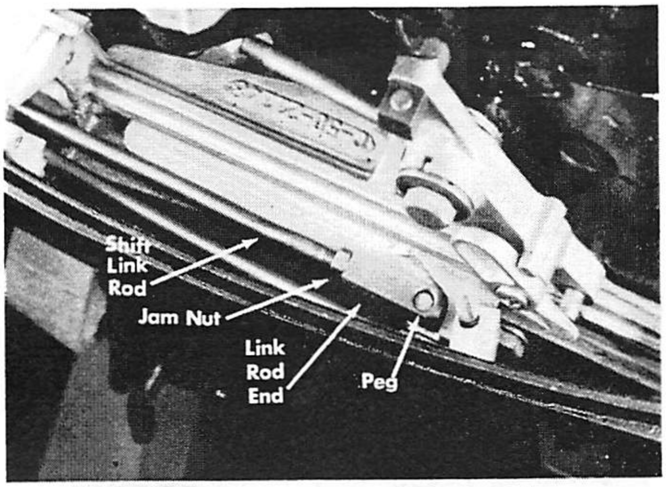


Figure 5. Installing Shift Link Rod

6. With motor in forward gear, place end of shift link rod over shift actuator peg. It may be necessary to loosen jam nut, which is located on link rod, and thread link rod end clockwise or counterclockwise, as required, to line up hole in rod end and shift actuator peg. Tighten jam nut securely. (Figure 5)
7. Position rod end retainer over link rod end. (Figure 6)

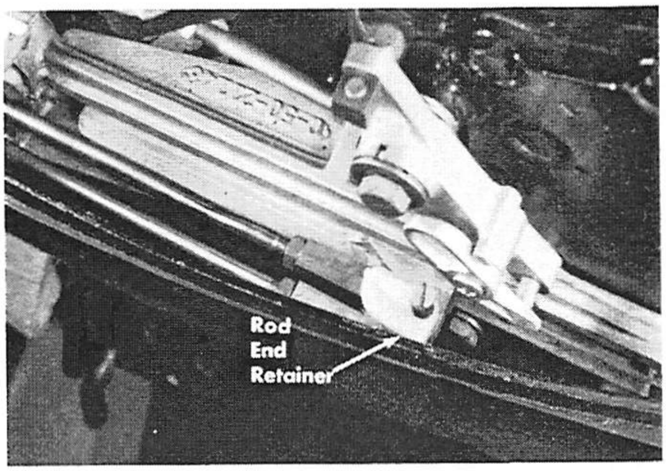


Figure 6. Shift Link Rod Installed

8. Place shift lever in neutral position and check that motor is in neutral gear. If link rod end is not correctly adjusted, motor will not shift properly.
9. Turn handle grip clockwise until grip stops. Markings on grip indicator and mark on tube will be positioned as shown in Figure 7.

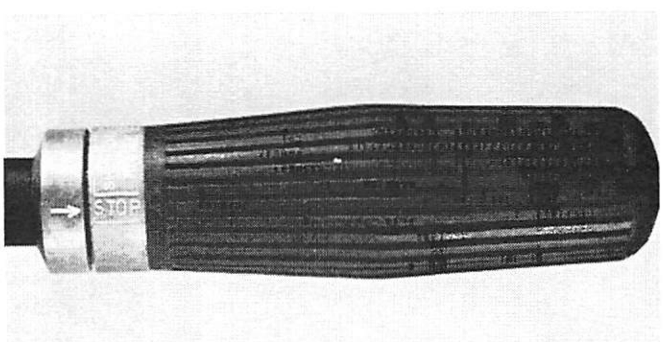


Figure 7. Handle Grip Position

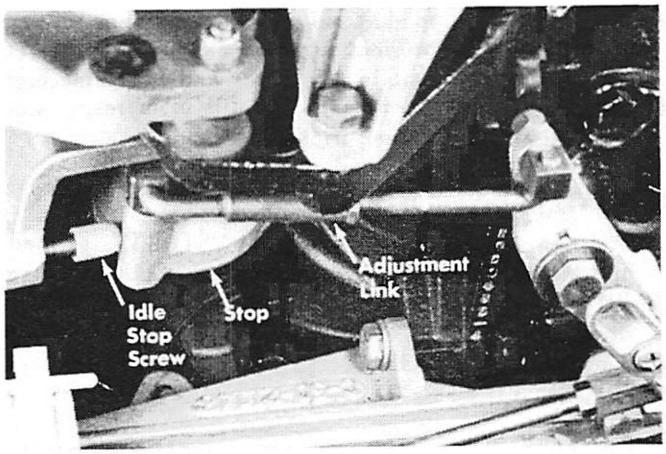


Figure 8. Idle Stop Screw

10. Position vertical lever so that magneto is held lightly against idle stop screw. (Figure 8)
11. With vertical lever in this position and handle grip positioned as outlined in Step No. 9, adjust throttle link rod end, as required, to place rod end over peg on vertical lever. (Figure 9)
12. Position rod end retainer over link rod end. (Figure 9)
13. Turn handle grip to full throttle position and back to idle. Check that magneto is held lightly against idle stop screw. (Figure 8) If more adjustment is required, it can be obtained by adjusting link between throttle lever and throttle control shaft. (Figure 8)

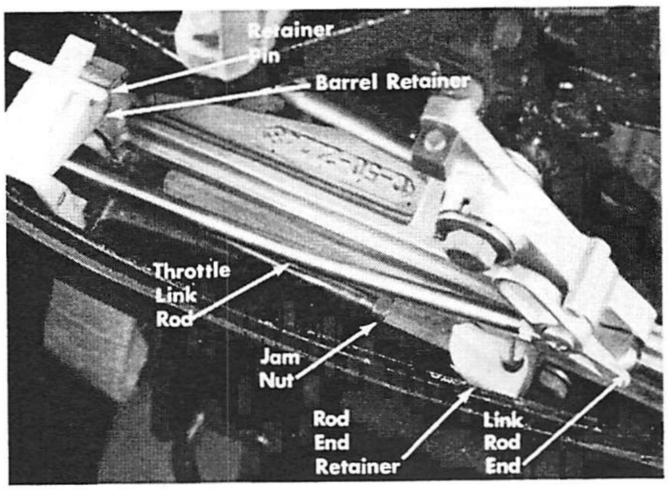


Figure 9. Throttle Link Rod Installed

14. If link rod end is not correctly adjusted, magneto will not return to idle stop and motor will not idle at approximately 500 RPM in forward gear.

NOTE: Barrel retainer (Figure 9) is not required when steering handle is installed. Barrel retainer may be removed by tapping out retainer pin. (Figure 9)

15. Install wrap-around cowl and front cover.

CO-PILOT INSTALLATION & ADJUSTMENT

1. To install co-pilot (Figure 10), slide clamp plate assembly from kit thru slot (friction button side down) in bottom face of swivel bracket. (Figure 10)
2. Fasten clamp plate assembly to swivel bracket with screw and 5/16" internal lockwasher. (Figure 10)

3. Adjust co-pilot so that motor will remain in a fixed course position, without need of manual control, yet will not be too tight to allow free-and-easy steering.
4. Tighten adjusting screw (Figure 10) to increase friction; loosen to decrease friction.

OPERATING INSTRUCTIONS

1. Position twist grip handle so that "START" is lined up with mark on steering handle tube.
2. Place shift lever in "N" (neutral) position.
3. Start engine.
4. Turn twist grip handle to "SHIFT RANGE".
5. Move shift lever to desired gear.

   CAUTION: Do not shift gears unless twist grip handle is in "Shift Range" position. Do not shift into reverse gear when engine is not running, as shifting mechanism will be damaged.

6. To stop motor, return twist grip handle to "STOP" position and depress stop button on bottom cowl.

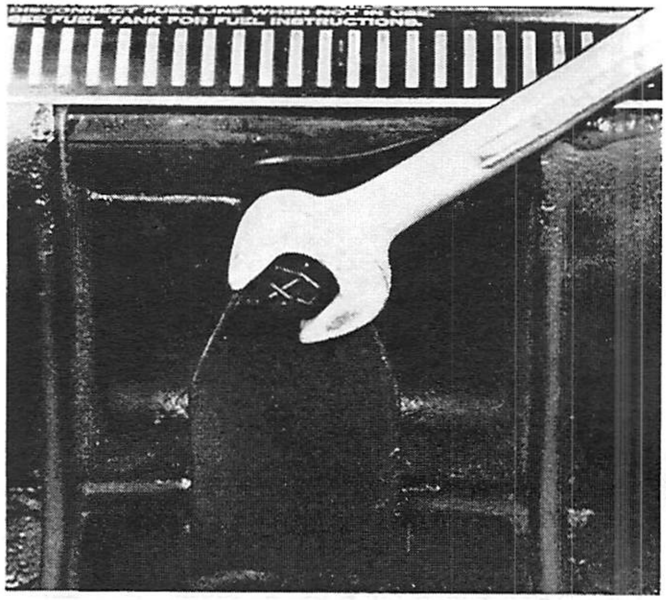


Figure 10. Co-Pilot Adjustment

STEERING HANDLE ASSEMBLY (A-38445A1)

For Merc 500M Engines (Serial No. 1770179 & Up)

INSTALLATION INSTRUCTIONS

INSTALLING MAGNETO SHORTING SWITCH ASSEMBLY

1. Remove 3 screws, which fasten magneto vent tube baffle to bottom cowl, and remove baffle.
2. Fasten new baffle (with shorting switch) in position with 3 screws removed previously in Step No. 1. (Figure 1)
3. Fasten connector, which is located on end of shorting switch lead wire, to connector which is located in bottom cowl. (Figure 1)
4. Remove paper backing from "OFF" - "ON" decal and place decal in position on protector rim directly above shorting switch. (Figure 1)

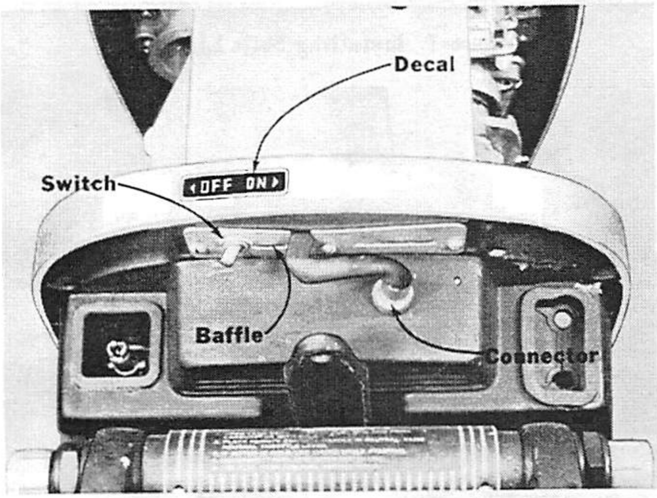


Figure 1. Magneto Shorting Switch Installed

INSTALLING SUPPORT PLATE

1. Remove 2 elastic stop nuts from engine tilt tube.
2. Place a block of wood on one end of tilt tube and drive tilt tube toward clamp bracket until end is flush with clamp bracket.
3. Place one ear of support plate over tilt tube and place support plate in position under steering lever.

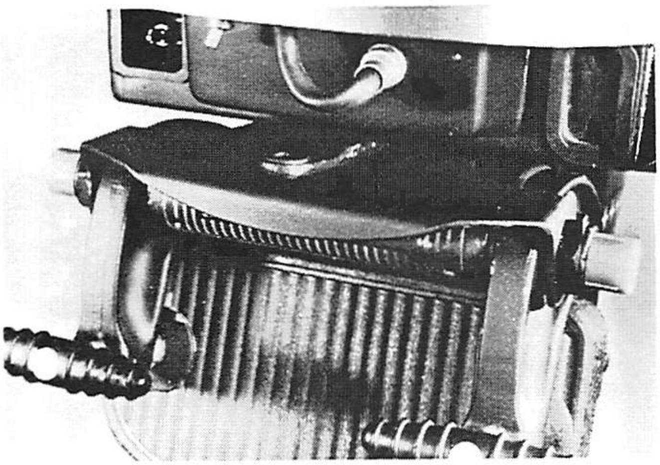


Figure 2. Support Plate Installed

4. Place wood block on exposed end of tilt tube and drive tilt tube back thru support plate until tube is centered.
5. Thread elastic stop nuts on tilt tube and, while holding leading edge of support plate up, tighten nuts securely. (Figure 2)
NOTE: To keep tilt tube centered, tighten one nut until it just touches support plate. Then tighten the other nut securely.

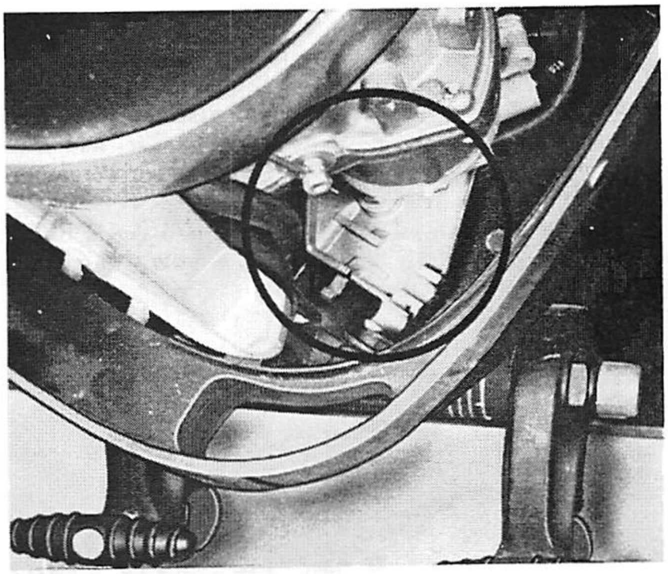


Figure 3. Anchor Pin Assemblies Removed

INSTALLING HANDLE ASSEMBLY

1. Remove front cover and wrap around cowl from engine.
2. Remove screw, which fastens anchor pin assemblies to bracket, & remove anchor pin assemblies. (Fig. 3)
3. Place cover in position on steering handle bracket and fasten cover to bracket with 2 self-tapping screws. (Figure 4)

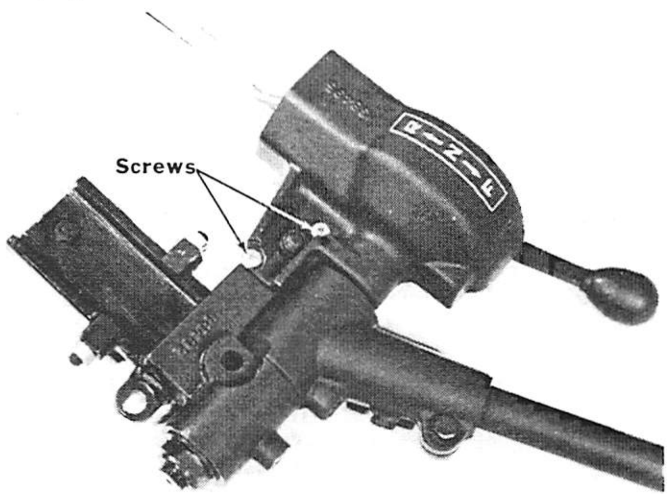


Figure 4. Cover Installed

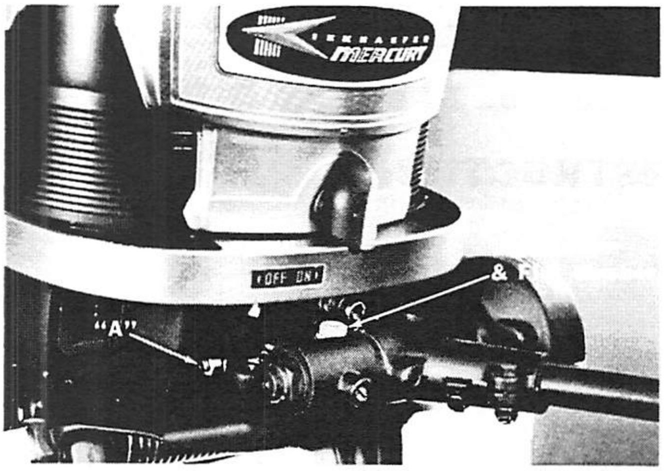


Figure 5. Handle Assembly Installed & Set Screw

4. Insert throttle and shift link rods thru opening in left side of cowl and place handle assembly in position on engine steering lever. (Figure 5)
5. Fasten handle assembly to engine steering lever with 3/8-24x1-1/2" long screw, lockwasher and flat washer which are in plastic bag. Tighten screw securely. (Figure 5)
6. Tighten set screws ("A" in Figure 5 and "B" in Figure 6) securely. Tighten jam nuts, which are threaded on set screws, securely.

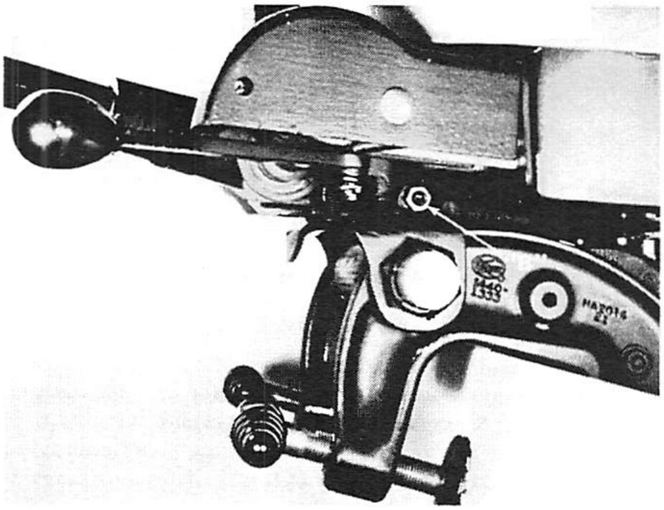


Figure 6. Handle Assembly Installed & Set Screw

7. Place shift lever, which is located on handle assembly, in forward gear position.
8. With motor in forward gear, place end of shift link rod over shift actuator peg. It may be necessary to loosen jam nut, which is located on link rod, and thread link rod end clockwise or counterclockwise, as required, to line up hole in rod end and shift actuator peg. Tighten jam nut securely. (Figure 7)
9. Slide spring retainer clip over link rod end. Be sure that hole in spring retainer clip is centered over peg. (Figure 8)
10. Place shift lever in neutral position and check that motor is in neutral gear. If link rod end is not correctly adjusted, motor will not shift properly.
11. Turn handle grip clockwise until grip stops. Markings on grip indicator and mark on tube will be positioned as shown in Figure 9.

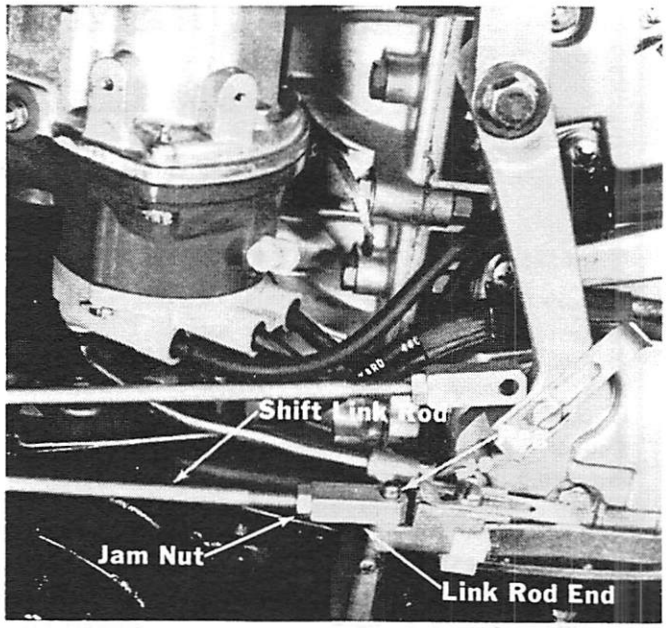


Figure 7. Installing Shift Link Rod

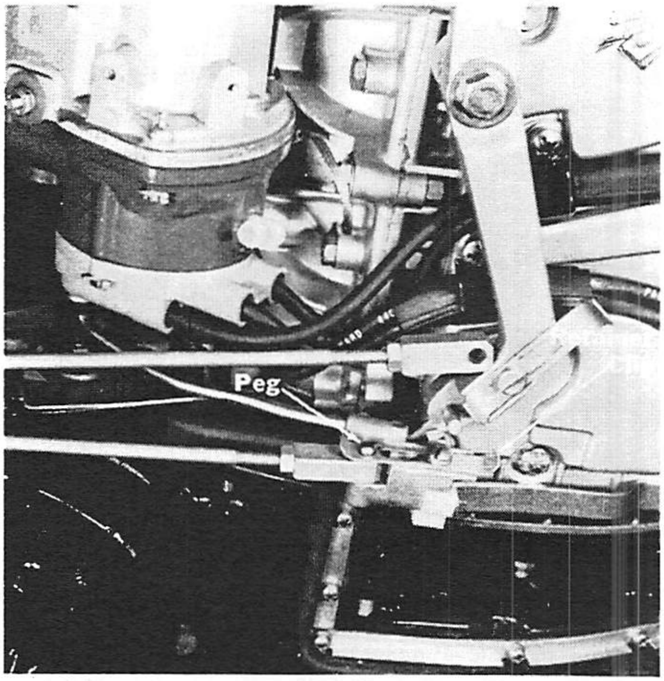


Figure 8. Shift Link Rod Installed

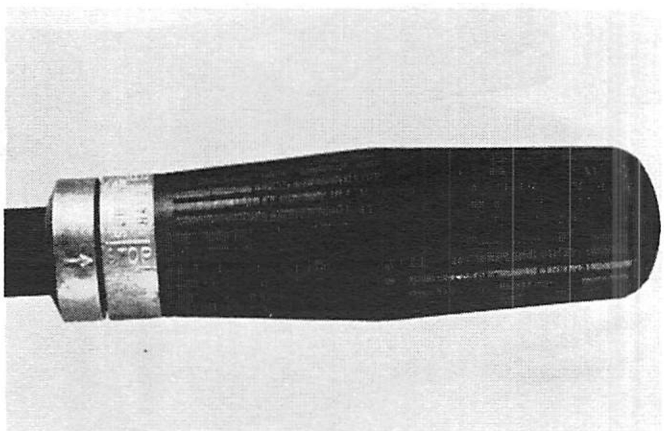


Figure 9. Handle Grip Position

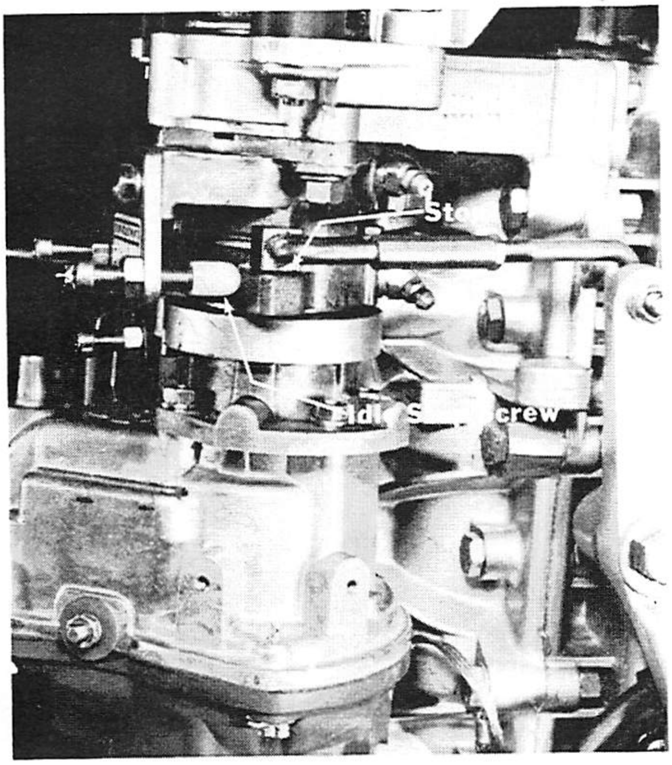


Figure 10. Idle Stop Screw

12. Position vertical lever so that magneto is held lightly against idle stop screw. (Figure 10)
13. With vertical lever in this position and handle grip positioned as outlined in Step No. 11, adjust throttle link rod end as required to place rod end over peg on vertical lever. (Figure 11)
14. Slide spring retainer clip over link rod end. Be sure that hole in spring retainer clip is centered over peg. (Figure 12)
15. Turn handle grip to full throttle position and back to idle. Check that magneto is held lightly against idle stop screw. (Figure 10)
16. If link rod end is not correctly adjusted, magneto will not return to idle stop and motor will not idle at approximately 500 RPM in forward gear.
17. Install wrap-around cowl and front cover.

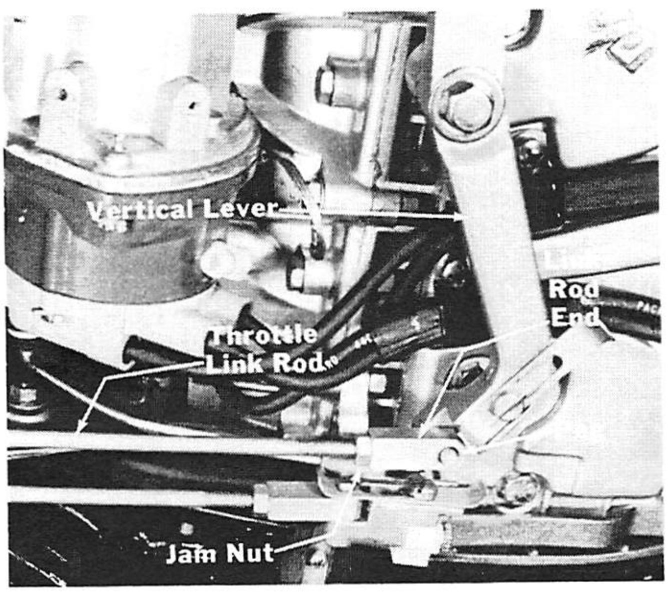


Figure 11. Installing Throttle Link Rod

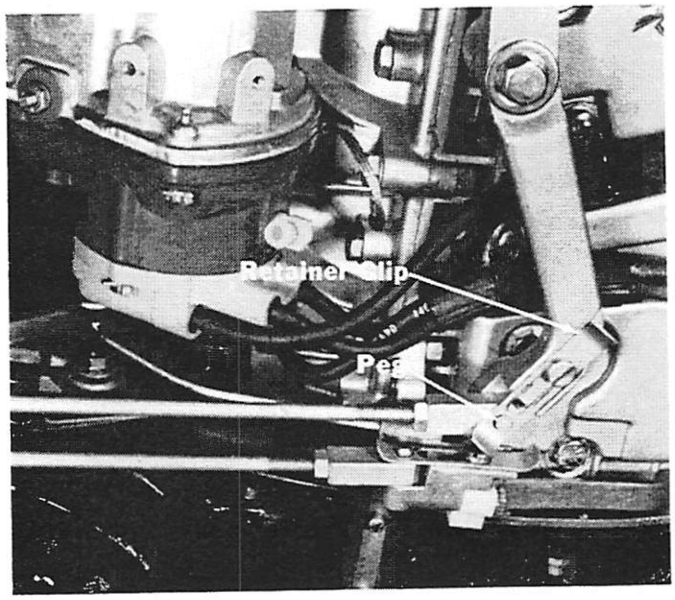


Figure 12. Throttle Link Rod Installed

CO-PILOT INSTALLATION

Co-pilot replacement kit (Part No. A-29738A5) may be used with this steering handle to provide steering tension. Kit is not supplied with handle assembly.

1. Remove red tilt tube cap from starboard end of tilt tube.
2. Place pilot rod into tilt tube. (Figure 13)
3. Fasten end of link rod to handle bracket with 3/8-24 x 1-1/2" long screw and nut which are included in plastic bag. (Figure 13)
4. Tighten large coupler nut on tilt tube, as required, to obtain desired tension. (Figure 13)

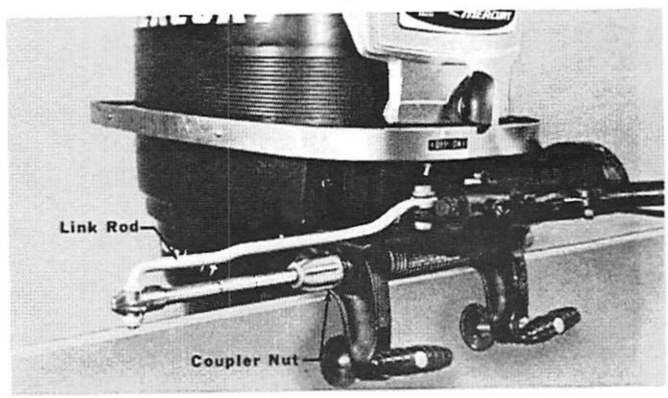


Figure 13. Co-Pilot Kit Installed

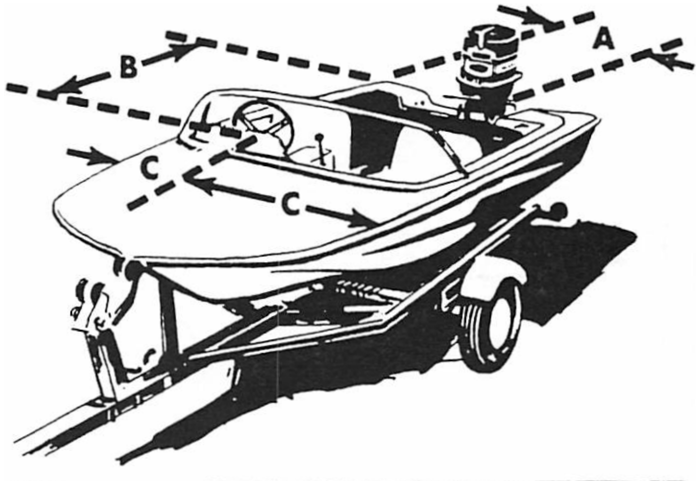
OPERATING INSTRUCTIONS

1. Position twist grip handle so that "START" is lined up with mark on steering handle tube.
2. Place shift lever in "N" (neutral) position.
3. Place magneto shorting switch in "ON" position.
4. Start engine.
5. Turn twist grip handle to "SHIFT RANGE".
6. Move shift lever to desired gear.
   CAUTION: Do not shift gears unless twist grip handle is in "Shift Range" position. Do not shift into reverse gear when engine is not running, as shifting mechanism will be damaged.
7. To stop motor, return twist grip handle to "STOP" position and move magneto shorting switch to "OFF" position.

SECTION VIII D- MISCELLANEOUS

RIDE-GUIDE ASSEMBLIES

STANDARD AND UNIVERSAL
RIDE-GUIDE INSTALLATION DIMENSIONS



Single Engine Installation

1. Add boat measurements A-B-C.

   A = distance from Ride-Guide attachment on engine to side (inside) of boat
   B = distance from inside rear of boat to dashboard
   C = distance from centerline of steering wheel hub to side (inside) of boat (right hand or left hand installation)

2. Subtract 30" for Standard Ride-Guide
   39" for Universal Ride-Guide.
   (This allows for 12" radii at each cable bend.)
3. Divide by 12.
4. Answer is cable assembly suffix number.

Duo l Engine Installation

1. Add boot measurements A-B-C.
2. Subtract 21" for Standard Ride-Guide.
   Universal Ride-Guide measurement depends upon location of mounting bracket, 1) between clamp brackets of first engine or 2) to one side of transom on which coble is attached.
   (This allows for 12" radii at each cable bend.)
3. Divide by 12.
4. Answer is cable assembly suffix number.

Example: A = 29"
B = 106"
C = 39"

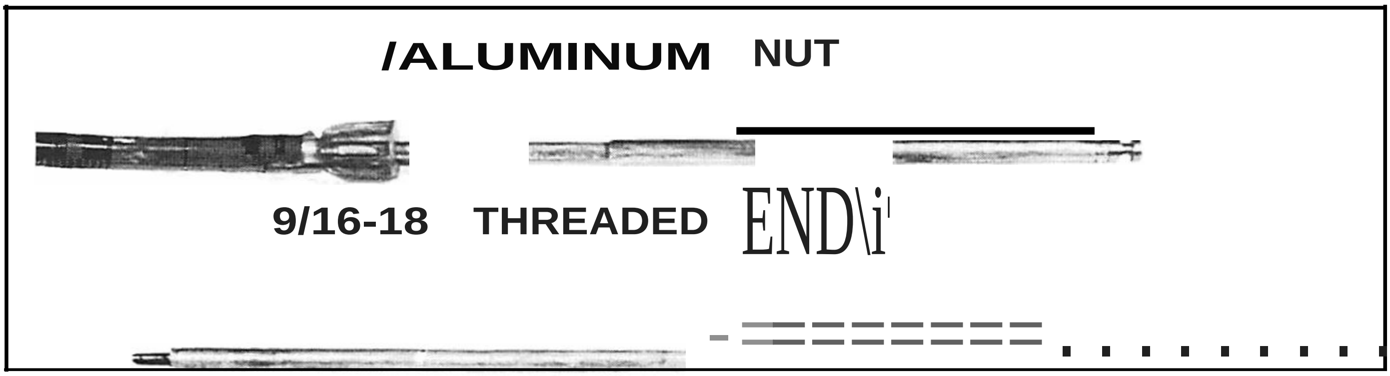
Total 174"
Minus 30" Single Engine
Divided by 12/ 144"
12

Order A-37305A_12 Cable

Ride-Guide Cables Available in Lengths 7 Ft. (2.134m) thru 40 Ft. (12.192m).(Longer Cables Available on Request)

RIDE-GUIDE CABLE MEASUREMENTS

In order to clarify measurement of Ride-Guide cable, cable is measured from large aluminum nut to 9/16-18 threaded end, as shown in figure below.



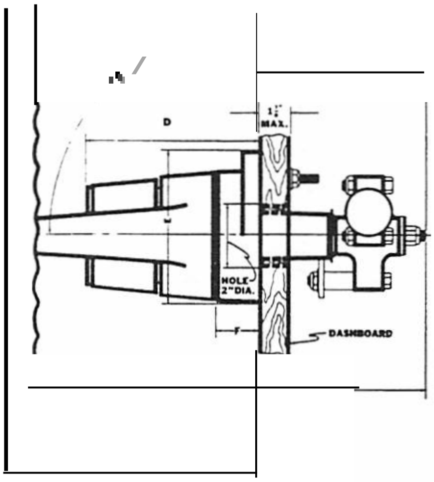
NOTE: On boats with considerable freeboard drop or unusual routing of cables, it may be necessary to add extra length to cables. Ride-Guide Cable is measured from large aluminum nut to 9/16-18 threaded end.

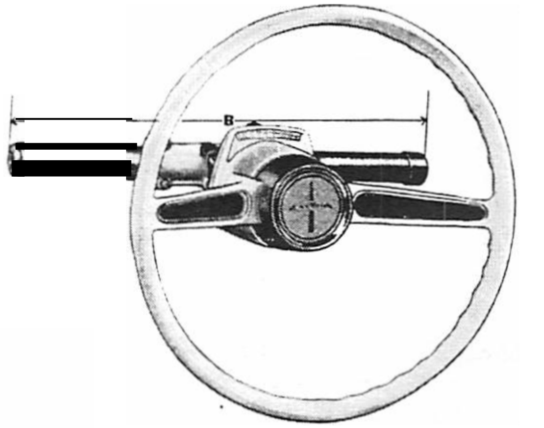
RIDE-GUIDE INDICATOR STEERING WHEEL DIMENSIONS

Indicator Wheel

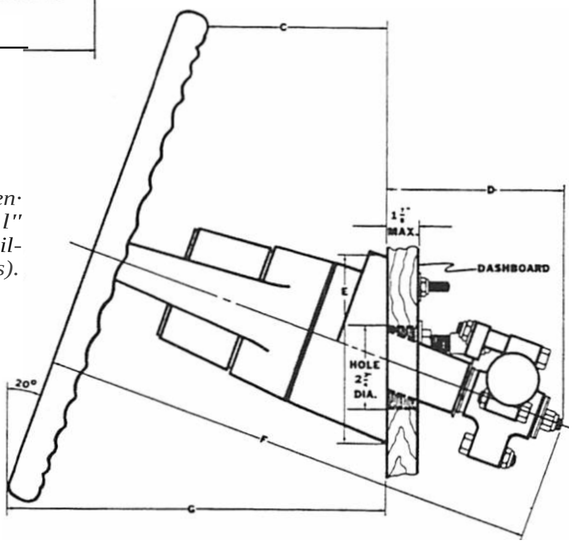
90°

''	16"
B	21)\"
C	S-718"
O	6-3/16"
E	S-318"
F	1-518"
C	1'-7/S"
H	9"





NOTE: When converting dimensions into metric system, 1" (inch) is equal to 25.4mm (millimeters) or 2.54cm (centimeters).



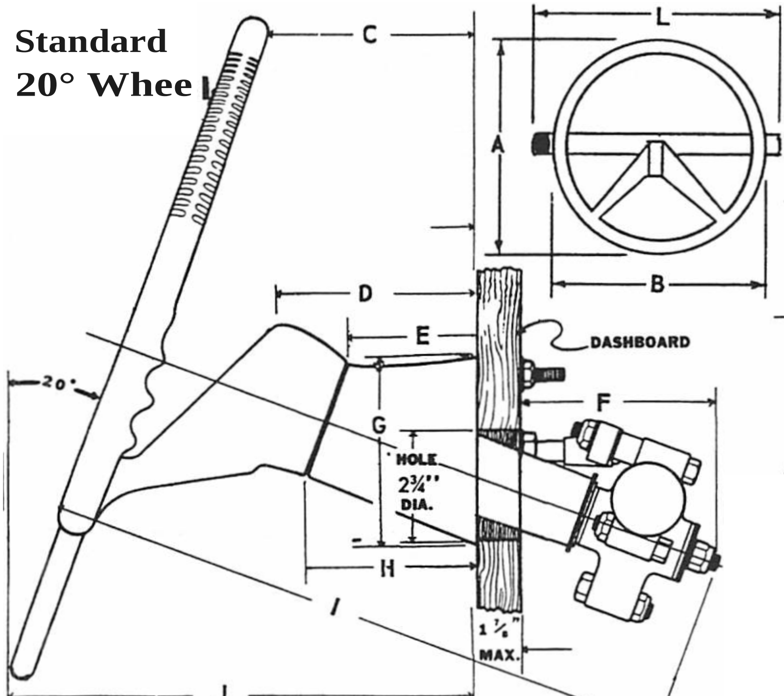
Indicator Wheel

20°

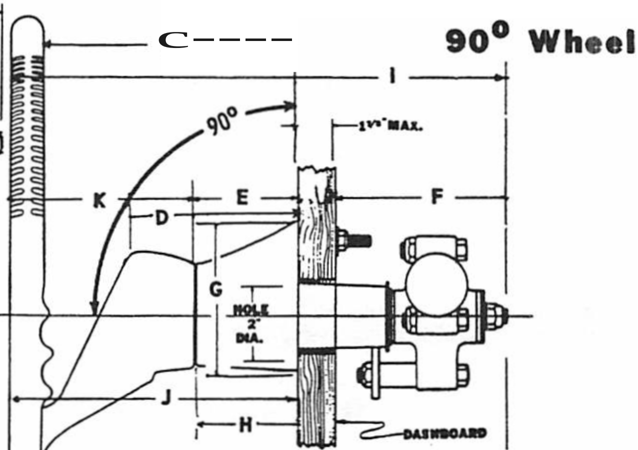
''	16"
8	211 "'
C	S-5/8""
O	S-5/8"'
E	S.ll•'"
F	IS-3/4"
C	12"

RIDE-GUIDE STEERING WHEEL DIMENSIONS

Standard 20° Wheel



90° Wheel



	Deluxe Wheel		Stondord Whffl		Coptaln'a Wheel•	
	20°	90°	200	90°	700	900
A	14-11116"	14-11116'	lS-314"	lS-3/4"	20"	20"
8	16-7/8"	16-7/8"	lS-3/4"	lS-3/4"	20"	20"
C	S-7/8"	7-3/4"	•314"	6-7/8"		
D	4-3/8"	4·1/2"	•112"	•112"		
E	2-7/8"	2-3/4"	3"	2-3/4"	2·7/8"	2-3/4".
F	4-9/16"	•13116'	•9116'	4.3/4"	•9/16"	'"13/16"•
G	4-7/8"	4 5/8"	4-114"	4"	•718"	•SIB" •
H	4-1/16"	23/4"	J.7/8"	2-314"	'"1116"	2-3/4".
I	lS-9/16"	14-5/8"	14-58"	13-1/2"		
J	11-3/4"	8-3/4"	10-3/4"	7·13/16"		
K		6"		5"		
L	21112"	21-l/2"	21-112"	21-1/2"	21-1/2"	21-112"e

• *Dimension applies eo 20•• & 16" diameter Capt.ain'i* **Wlaecl.**

NOTE: When converting dimensions into metric system, 1" (inch) is equal to 25.4mm (millimeters}or 2.54cm (centimeters}.

RIDE-GUIDE STEERING
Steering Wheel Installation

STEERING WHEEL LOCATIO:\

The recommended locations for mounting remote throttle and shift controls and steering controls on boat -- which help to overcome engine torque caused by direction of propeller rotation -- are: Right side for right hand rotation of propeller and left side for left hand rotation of propeller. Refer to last column in "Transom Mounting" specifications chart in Section I.

CUTTING HOLES FOR STEERING WHEEL BRACKET

Set template from kit over boat dash panel at desired location of steering wheel post for (1) Thru-the-Dash Mounting, or (2) Under-the-Dash Mounting.

Thru-the-Dash Mounting

1. Place template from kit on dash panel at desired height and location to allow full center hole (2"@3.5m for standard wheel; 2"@0.8m for 90° wheel) to be cut through panel.
2. Mark center of holes with punch.
3. Drill holes.

Under-the-Dash Mounting

1. Place template so centerline of 2W' (63.5mm) hole (2" @0.8mm] for 90° wheel) is even with bottom edge of dash panel or at desired height. Allow sufficient distance from lower edge of dash to prevent panel from breaking out at mounting holes.
2. Mark center of holes on panel.
3. Drill 9/16" (14.28mm) holes, one 3/8" (9.53mm) hole and cut out the 2W' (63.5mm) hole (2" 0.8mm] for 90° steering wheel) with a 2 " (63.5mm) or 2" (50.8mm) saw.

CABLE INSTALLATION IN GEAR RACK

1. Remove neoprene cap from end of tube. (Figure 2)
2. Place large lock nut on larger threaded end of cable.

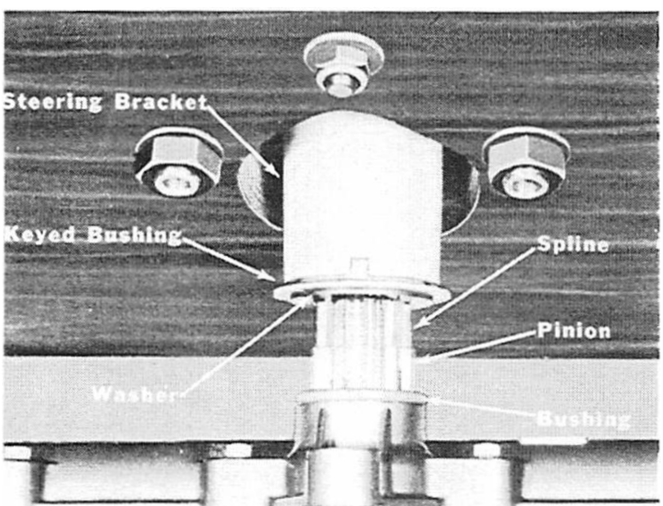


Figure 1. Thru-the-Dash Mounting

3. Thread cable into cable end tube (one with large, tapped hole).
4. Turn lock nut against end of tube to secure cable to tube.
5. Push inner wire to full length inside of end tube.
6. Secure cable to gear rack by threading 2 lock nuts onto threaded end of cable. First nut draws up on cable; second nut is lock nut and secures first nut in place.
7. Replace neoprene cap on end of tube. Walls of end tabes and gear rack teeth have been coated with gear lubricant. Be careful not to over-lubricate! (Figure 3 and 4)

STEERING WHEEL INSTALLATION ON DASH PA.NEL

Indicator Wheel

NOTE: Refer to parts identification numbers in Figure 3.

1. Place steering wheel bracket studs (37 & 41) into holes previously drilled in boat dash panel.
   Note that plastic bushings (13) are already installed in opposite ends of steering wheel bracket (14).
2. Fasten steering wheel bracket in place with 2 nuts (39) and washers (38) and one nut (43) and washer (42) and tighten.
3. Position gear housing bracket (31) on ends of 2 steering wheel post spacers (37) and fasten with 2 cap screws (36).

Standard Wheel

NOTE: Refer to parts identification numbers in Figure 4.

1. Place steering wheel post studs (11 and 7) in holes previously drilled in boat dash panel.
2. Fasten steering wheel post in place with 2 nuts (13) and washers (12) and one nut (9) and washer (8) and tighten.
3. Position gear housing bracket (14) on ends of 2 steering wheel post studs (11) and fasten with 2 cap screws (15) and washers (16).

POSITION OF PINION IN RELATION TO GEAR RACK

Before installing gear rack and pinion assembly on steering wheel mounting bracket behind dash panel, note that pinion is on bottom of rack. Check that boat will turn to right when wheel is turned to right and that boat will turn to left when wheel is turned to left. (Figure 2)

INSTALLING GEAR RACK AND PINION ASSEMBLY

Indicator Wheel

NOTE: Refer to parts identification numbers in Figure 3.

1. Place large washer (17) on gear rack p10 1on (24) and slide steering wheel shaft (16) over splined end of gear rack pinion.

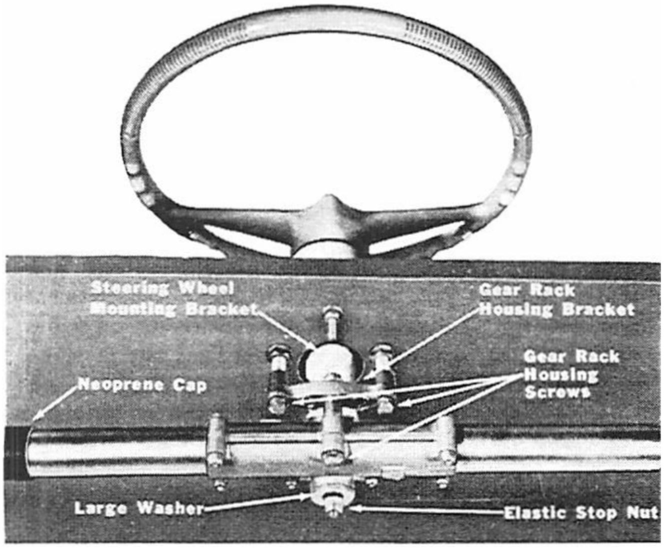


Figure 2. Pinion on Bottom of Gear Rack

2. Slide gear rack and steering wheel shaft into position in steering wh eel bracket.
3. Place gear rack and pinion assembly positi oning screw (32) thru gear rack housing (19), spacer (33), washer (34) and choice of 3 holes in gear rack h ousin g bracket (31) and secure with washer (34) and elastic lock nut (35).
4. Apply a thin coat of MULTIPURPOSE Quicksilver Lubricant on nylon pinion shaft (11) and install in recess of steering wheel. *NOT E: Lett er "F" on end of nylon pinion shaft must face up toward steering wheel.*
5. Position steering wheel over steering wheel shaft, be ing careful to align teeth of ny lon pinion shaft with gear on steering wheel !racket.
6. Slip thru-bolt (12) thru hole in center of steering wheel and steering wheel shaft.
7. Slide large washer (29) and elastic lock nut (30) on thru-bolt and torque to approximately 80 in. lbs. (14.2kg/cm).
8. Place indicator hub (4) in steering wheel and secure with screw (8), washer (10), and lockwasher (9).
9. Center steering wheel and pla ce indicator button (2) with indicat or mark pointing straight ahead, on indicator hub (4) and snap into position.

Standard Wheel

N OTE: Ref er to parts identific ation numb ers in Figure 4.

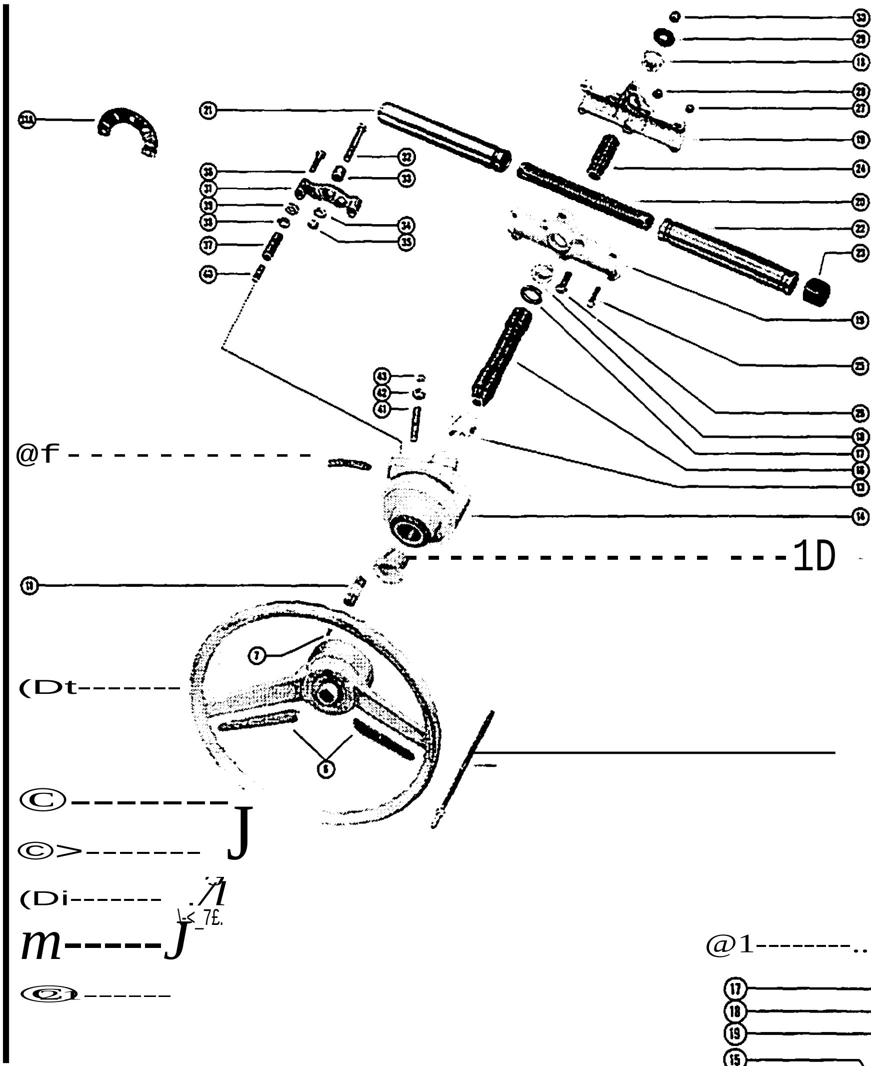
1. Slide gear rack and pinion assembly snugly into splined end of steering wheel shaft (21).
2. Slide large washer (34) and lock washer (35) over thru-bolt (4) and fasten lightly with elastic stop nut (36) to hold in place.
3. Place gear rack and pinion assembly positioning screw (17) thru gear rack housing (25), spacer (18), washer (19) and choice of 3 holes in gear rack housing bracket (14) and secure with washer (19) and elastic stop nut (20).
4. Torqu e elastic stop nut (36), previously placed on thru-bolt (4), to approximately 80 in. lbs. (14.2kg/cm). (Figure 2)

LlBRICATIO N

Sh ould future lubrication of Ride-Guide cable and/or engine end be required, insert Quicksilver MULTIPURPOSE Lubricant (C-92-35226) thru grease fitting located at ends of flexible cable. Use Quicksilver Lube Gun (C-91-30500) . Turn steerin g wheel so that cable is at maximum travel outward . This prevents over-lubrication of Ride-Guid e end.

ATTACHING CABLE TO **BOAT**

At ach cable to upper gunnal of boat with nylon clips. lips should b e spaced at intervals as required . It is 1 p?rtant that the number of bends in cable be kept to a m101mum, as each bend made in the cable increases the am ount of lag in th e steering wheel.



1	Steering Wheel Assy	23	Cap, rubber
2	Button	24	Pinion, gear rack
3	Cap	25	Screw
4	Hub	26	Screw
5	Bushing	27	Nut
6	Decal	28	Nut
7	Screw	29	Washer, lower
8	Screw	30	Nut
9	Lockwasher	31	Bracket (200)
10	Washer	31A	Bracket (900)
11	Shaft, pinion	32	Screw
12	Bolt (200)	33	Spacer (200)
12	Bolt (90°)	33	Spacer (900)
13	Bushing	34	Washer
14	Bracket (200)	35	Nut
14	Bracket (900)	36	Screw (200)
15	Insignia (Quicksilver)	36	Screw (900)
16	Shaft (20°)	37	Spacer
16	Shaft (90°)	38	Washer
17	Washer	39	Nut
18	Bushing	40	Stud
19	Housing	41	Stud
20	Rack, gear	42	Washer
21	Tube (cable end)	43	Nut
22	Tube (open end)		

NOTE: Parts are interchangeable for standard 200 wheel and 900 wheel. except where indicated.

Figure 3.

Indicator Ride-Guide Steering Wheel

1	Steering Wheel	11	Spacer
2	Insignia	12	Washer
3	Plate	13	Nut
4	Bolt	14	Bracket
5	Bracket	14A	Bracket (900)
6	Bushing	15	Screw
7	Stud	16	Lockwasher
8	Washer	17	Screw
9	Nut	18	Spacer
10	Stud	19	Washer

20	Nut
21	Shaft
22	Washer
23	Bushing
24	Rack
25	Housing
26	Tube
27	Tube
28	Cap
29	Pinion
30	Screw
31	Nut
32	Screw
33	Nut
34	Washer
35	Lockwasher
36	Nut

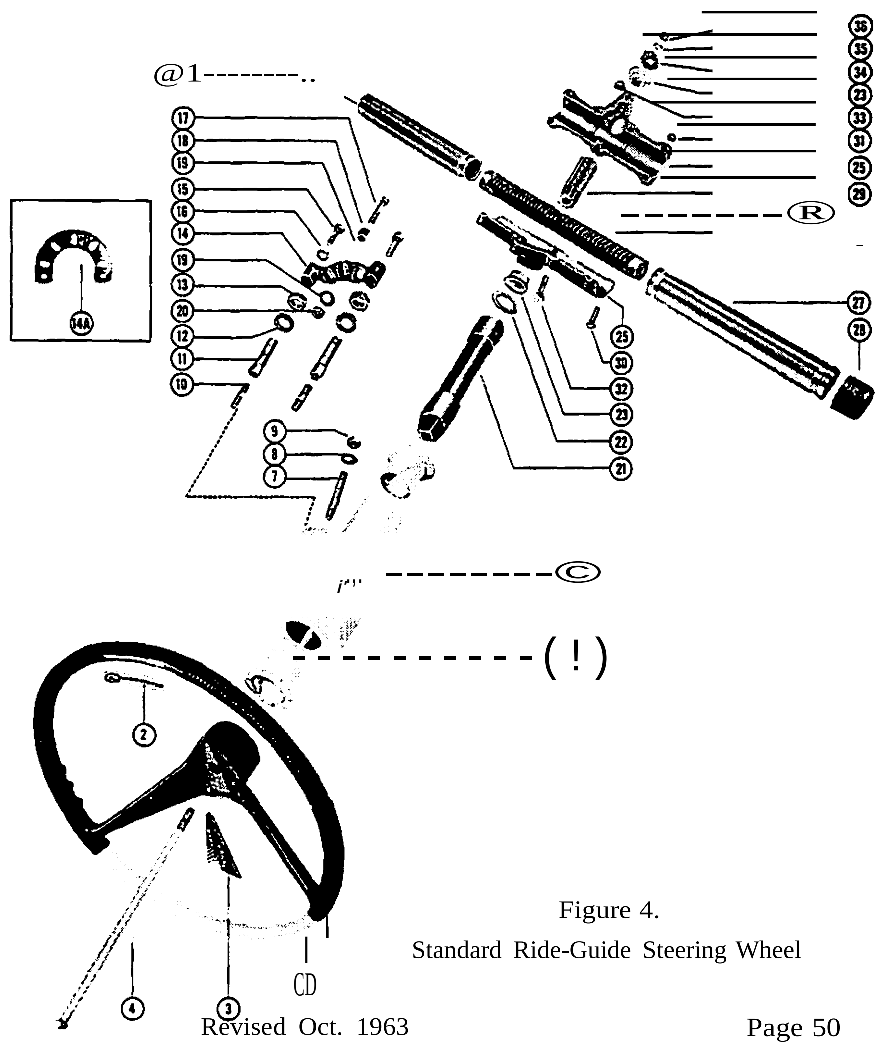


Figure 4.

Standard Ride-Guide Steering Wheel

RIDE-GUIDE ENGINE ATTACHMENT
Standard Ride-Guide for Mercury Models

SINGLE ENGINE ATTACHMENT

4-and-6-Cyl. 1964-and-Earlier Models

1. Place pivot pin thru bracket and cowl from underside. Secure with nut. (Figure 1) Late models are equipped with steering bracket and pivot pin.
2. After coating stainless steel ball with Anti-Corrosion Grease (C-92-45134A1), assemble ball joint parts to protruding pivot pin in this order: Flat washer, spring and rubber sleeve, flat washer, nylon washer, link rod (with large side of hole down), stainless steel ball (with flat side up), flat washer and elastic stop nut.
3. Tighten nut only until rubber sleeve contacts washers on either side of nut. Do not overtighten!

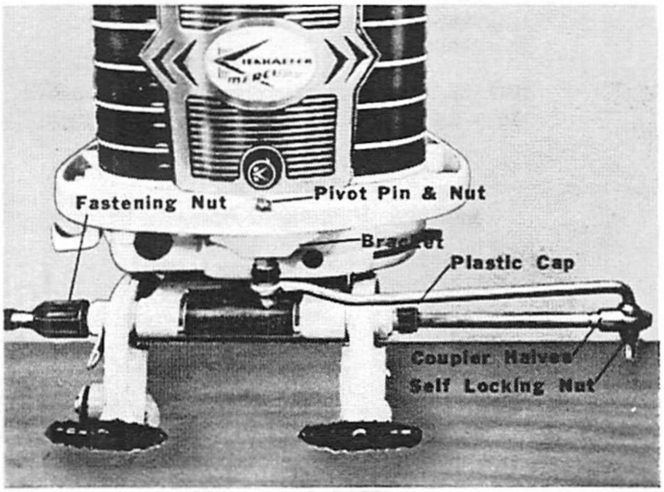


Figure 1. Attaching Kit Installed

4-and-6-Cyl. 1965-and-Newer Models

1. Install attaching kit on steering arm as shown in Figure 2.
   NOTE: 6-cylinder models are attached as shown; 4-cylinder models have the steering link rod beneath the steering arm.
2. Attaching bolt will be found in bag with transom mounting bolts.

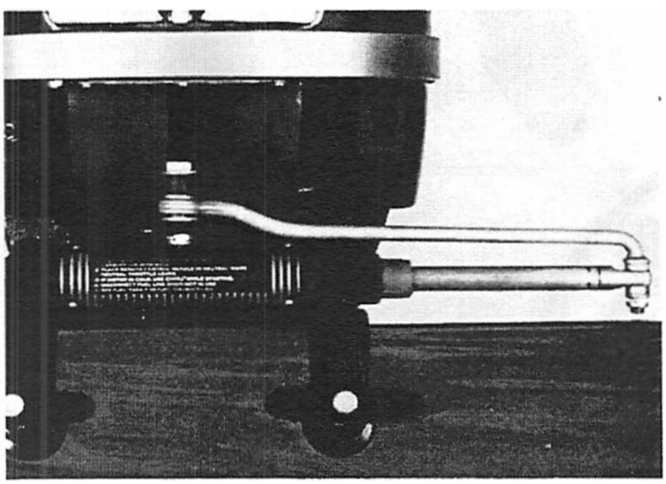


Figure 2. Attaching Kit Installed

2-Cyl. Automatic Transmission Models

1. Remove the 3 steering-bracket-to-saddle cap screws and nuts to allow inside steering bracket to be installed between these 2 assemblies. (Figure 3)
2. Remove 2 screws which hold check unit adaptor to steering bracket.
3. Add one each lockwasher and plain washer (in kit) at head of each screw.

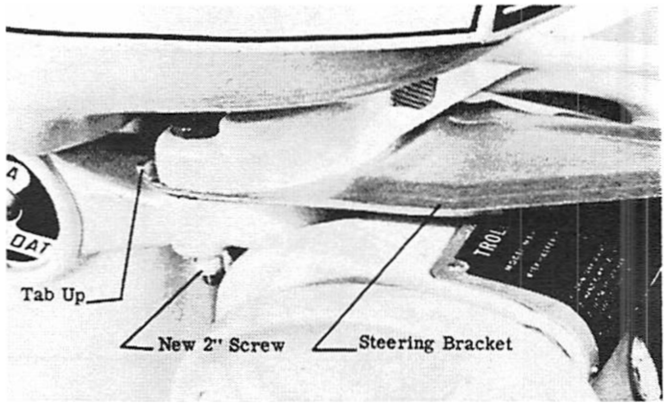


Figure 3. Steering Bracket Installed

4. Reassemble adaptor to steering bracket and fasten with screws, washers and nuts.
5. Install steering bracket (tabs up). (Figure 3)
6. Replace the two 1-3/4" rear cap screws, previously removed, with the 2 new 2" screws in kit and tighten.
7. Replace the other 1-3/4" cap screw and tighten.
8. Replace hollow tilt tube with new, longer tilt tube in kit.
9. Insert shims between swivel bracket and clamp bracket.
10. Place spacers (in kit) on tube and secure with elastic stop nuts.

2-Cylinder Full Gear Shift Models

1. Remove 2 plastic caps and 2 elastic stop nuts on ends of tilt tube.
2. Replace hollow tilt tube with new, longer tilt tube from kit. (Figure 4)

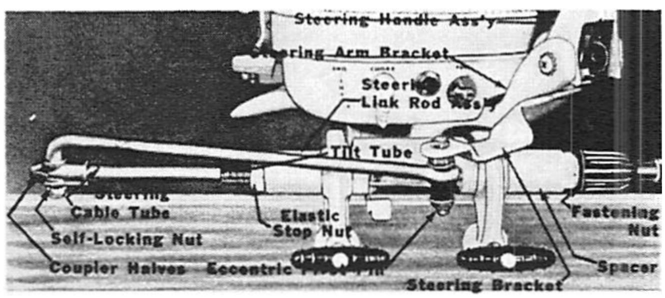


Figure 4. Attaching Kit Installed

3. Place spacers from kit on tilt tube and secure with elastic stop nuts from engine. (Figure 4)
4. Place plastic open end cap from kit on end of tilt tube.
5. Place steering bracket from kit into position on steering arm bracket. (Figure 4) Steering handle assembly need not be removed.

6. Secure steering bracket with 2 slotted screws and 2 lockwashers from kit.
7. Attach steering link rod assembly to steering bracket.

ATTACHING STEERING CABLE

1. Lubricate steering cable tube end with Anti-Corrosion Grease (C-92-45134.'\l), insert cable end thru tilt tube and secure with large handtype fastening nut. (Figures l,2and4)
2. Thread red plastic cap with hole on opposite end of tiIt tube.
3. Turn steering wheel so that cable end is out far enough to attach coupler halves into groove at end of cable.
4. Early Steering Cable: Tighten self-locking nut on steering link below bottom coupler.

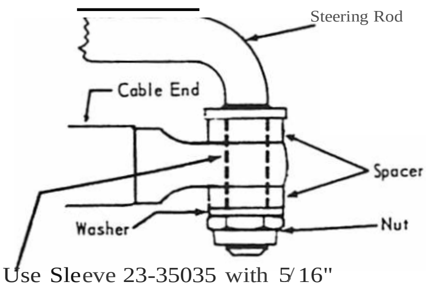


Figure 5. Spacers and Cable Assembled on Steering Link Rod

Late Steering Cable: Assemble spacers and cable on steering link rod as shown in Figure 5. Tighten nut securely, then back off -turn. Spacers are included in plastic bag in cable carton.

CENTERING SfEERING WHEEL

Under normal conditions, steering wheel will be correctly centered with gear rack; however, should the steering wheel be slightly out of correct position, it will be necessary to move gear rack one tooth to the right or left of pinion gear. (Figure 5)

DUAL ENGINE INSfALLATION

4-and-6-Cyl. 1odels

NOTE: On earlier models, the pivot pin on left engine (Figure 6) must be replaced with longer pivot pin from kit to accommodate the 2 link rods.

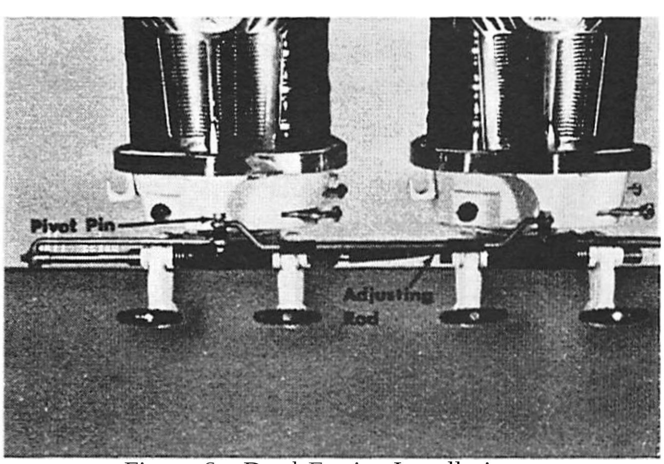


Figure 6. Dual Engine Installation

1. Dual control Ride-Guide attachment kit includes all parts necessary to connect both engines to cable. (Figure 6)
2. Cable attaches to far engine; i.e., right side mounting of Ride-Guide steering wheel, cable attaches to left engine; left mounting to right engine.
3. Assemble parts from kit to protruding pivot pin in the following order: Right hand engine in Figure 6 Flat washer, stainless steel ball (with flat side up), adjusting link, nylon washer, flat washer, springand rubber sleeve, flat washer and elastic stop nut. Left hand engine in Figure 6 - Flat washer, stainless steel ball (with flat side up), adjusting link, nylon washer, flat washer, spring and rubber sleeve, flat washer, nylon washer, link rod, stainless steel ball (with flat side up), flat washer and elastic stop nut.
4. Install rod between adjusting links.
5. For centering second engine with first, turn adjusting rod either way to center. This is important, or engine may run at an angle in relation to the other.

2-Cyl. Models

1. Dual control kits include all parts necessary to connect both engines to Ride-Guide cable. Installation of dual control assembly follows same procedure as single installation with the following additions:
2. Do not replace tilt tube on secondary (right) engine.
3. Mount engines on transom on 18l..'i" (46.4cm) centerlines.
4. Adjust dual steering link to align engines on these centers and attach to steering brackets. Ride-Guide cables will cross in front of first engiQe and be anchored thru tilt tube on second engine.
5. Secure coupler to cable end to complete installation.

RIOE-GUIOE CABLE EXTENSION (Figure 7)

1. Determine pipe length and cut rod 11" (28cm) longer than pipe.
2. Assemble mounting brackets on threaded ends of pipe. Rod must be threaded 51/6-24xl" long.
3. Install rod and mount complete assembly.
4. Install hex jam nut and steering cable end to both ends of rod.

;,. Attach 3/4-14 hex jam nut to cable coupling tubes and install in front and rear brackets.

6. Attach front cable from Ride-Guide steering unit to cable coupling tube at front mounting bracket by inserting cable end thru tube and tightening hand adjusting nut.
7. Install 9/16-18 hex ham nut to forward end of cable, running to engine, and anchor cable to cable coupling tube by screwing cable into threads provided inside cable coupling tube.
8. Link flexible Ride-Guide cable end to rigid part of installation by attaching coupler halves and secure with -28 hex head bolt and -28 elastic stop nut.
9. Attach engine end of cable to engine and check for free and full travel.

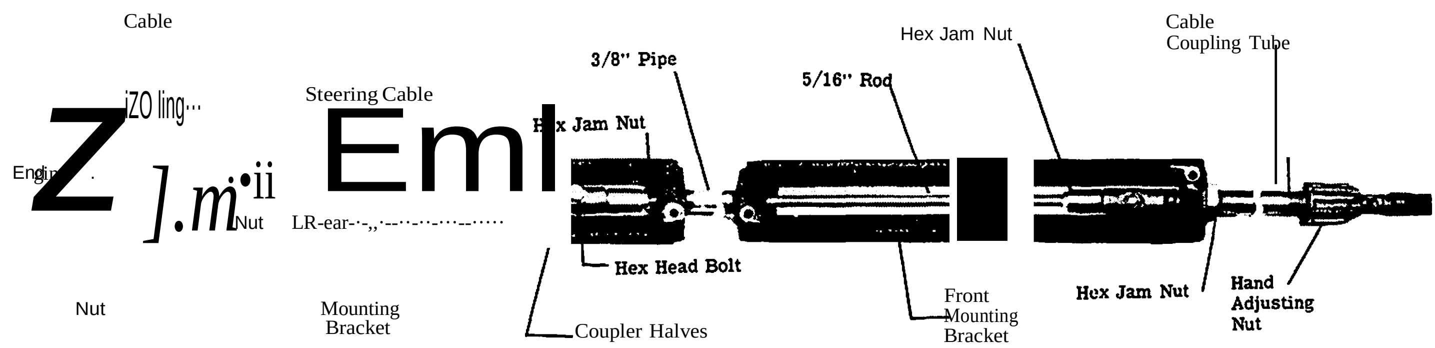


Figure 7. Ride-Guide Cable Extension

SECTION V I ·MISCELLANEOUS

REMOTE CONTROLS

REMOTE THROTTLE - SHIFT CONTROLS
Description

APPLICATION

The use of remote throttle-and-shift controls has moved the outboard motor pilot from a position beside the motor at the rear of the boat to a more comfortable post with a steering wheel at the approximate center of the boat. (Figure 1)

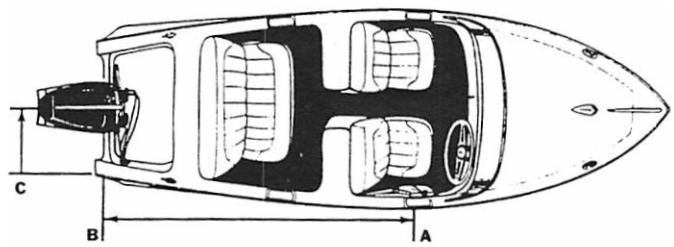


Figure 1. Measuring Boat for Remote Control Cables

QUICKSILVER CONTROLS

1. Superior construction of Quicksilver remote controls provides positive action for both shift and throttle.
2. Quick snap connectors for installing and removing control from motor and simplified installation are incorporated in Quicksilver controls.

Cables

MEASURING

Measure cables from end of one cable to end of other, not to include inner wire. Determine total length of cable required for remote control installation by measuring the boat from centerline of control box "A" to back of transom "8" over to center of transom "C" and add 1X ft. (3.8cm) for all Full Gear Shift Models with right side mounting or X ft. (l.27cm) for all Direct Reversing and 2-Cyl. Automatic Transmission Models. (Figure 2)

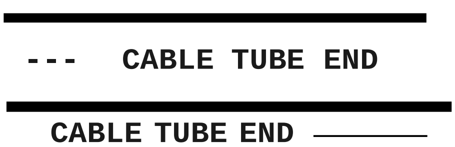


Figure 2. Measuring Remote Control Cables

CABLE LENGTHS

Determine total length of cable for installation by measuring boat from centerline of control box ("A" in Figure 1) to back of transom ("8") to center of transom ("C") and add the following:

One-half ft. (15cm) for:

1. Six cylinder direct reversing engines with left side mounting.
2. Two cylinder engines with left side mounting.

One and one-half ft. (46cm) for:

a. Six cylinder full gear shift models with right side mounting.
b. All 2 and 4 cylinder models with right side mounting.

LENGTHENING CABLES

1. Remove inner stainless steel wire from control cable. ("A" in Figure 3)
2. Remove brass or stainless steel tube from end of new cable. ("A" in Figure 3)
3. Cut tube off cable to be connected 3/16" (4.763mm) from shoulder of cable. ("8" in Figure 3)
4. Cut tube end which has small brass block staked on.
5. File chamfer on threaded end to remove burr. Rethread 1/4-40 NS, if damaged. Use C-91-28487 1/4-40 thread die to rethread tube and C-91-28486 1/4-40 thread tap to rethread cable end.
6. Turn new cable into protruding threaded part until tight. ("C" in Figure 3) Cables should butt together.
7. Stake shoulder of cables with approximately 1/16" (l.588mm) diameter punch at each end to secure. Seal joint with waterproof compound.
8. Pull rubber cable cover equally over joint. The neoprene cover stretches over cable. ("D" in Figure 3)
9. Tape joint to seal completely with Scotch No. 32 Electrical Tape or equivalent.
10. Cut a new piece of inner stainless steel cable of required length available in 100 ft. (30m) rolls (A-25260). Inner wire must be 4-9/16" (ll.6cm) longer on A-20015 cables, 5-9/16" (14cm) longer on A-29564 cables than combined length of connected cables.
11. Feed wire into cable. As new inner stainless wire is inserted, use a clean cloth patch saturated with Anti-Corrosion Oil (C-92-39928Al) and run wire over patch to lubricate.

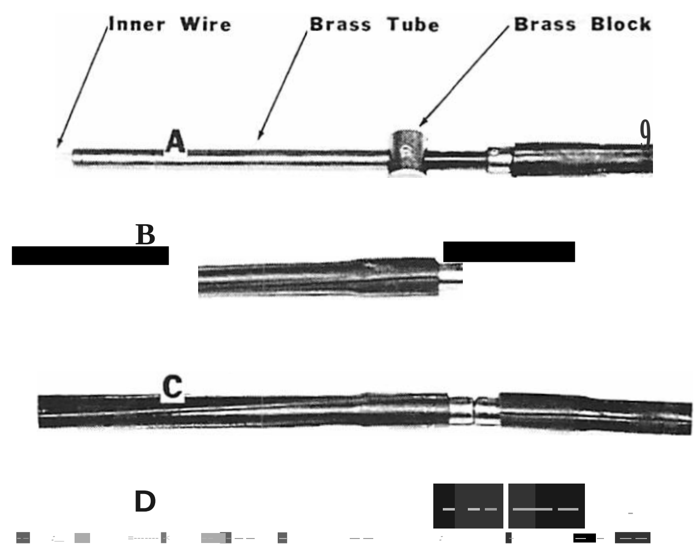


Figure 3. Increasing Length of Cable

REMOTE CONTROL CABLE EXTENSION (Kit No. C-29377Al & C-30707Al)

1. Cut and thread 3/8" (9.5mm) pipe to desired length.
2. Cut 5/16" (7.9mm) rod 8-1/2" (21.6cm) longer than length of pipe. This will give proper length of rod to get full travel.
3. Attach mounting brackets from kit to ends of threaded pipe. Rod must be threaded 5/16-24x l" long. Install rod thru pipe and mount rigid unit to boat. (Figure 4)
4. Attach jam nuts and bronze U-shaped cable anchoring brackets to end of rod.
5. Attach bronze barrel on cable to end of mounting bracket and insert cable end into U-shaped cable anchoring bracket and secure with screw and stop nut supplied.
6. Attach rear cable to engine and front cable to control.

NOTE: The shorter the cables, the better the installation. Cable A-29427A_ must be used for control end cable A-29428A_ for engine end on 1959 and prior model engines using A-20015-S cables. Cable C-30033A_ must be used for control end and cable C-30032A-for engine end on newer models. Cables, rn varying lengths, are not included in kit.

C-29564A-CONTROL CABLE MODIFICATION

To change C-29564A_ control cable to fit old-style 2-lever remote control, precede as follows:

1. Cut lYi" (3.8cm) off inner core wire.
2. Cut 3/4" (19.lmm) off brass cable guide (control housing end).
3. Replace gear rack (C-29577) with old style gear rack (A-25053).

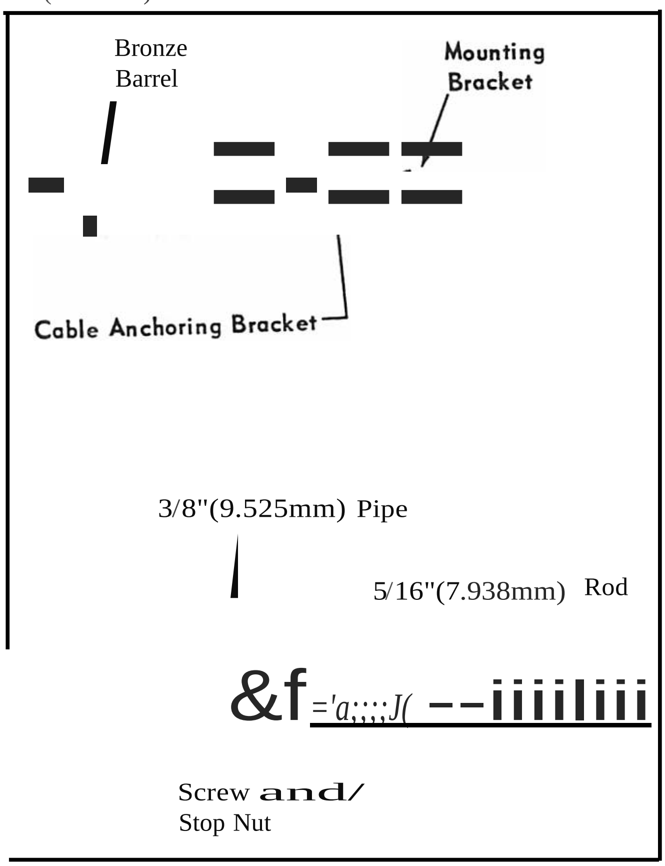


Figure 4. Remote Control Cable Extension

MOUNTING CONTROL CABLES ON BOAT

1. To prevent possible fouling or interference of remote control cables -- which may cause bending of metal cable end tube insert at engine end of remote control-control cable should be anchored in the dry well or to boat with nylon clamp, "D" washer and screw.

2. Preceding provides sufficient slack for proper operation of control and still enables engine to turn fully each way with no interference.

REPLACING NYLON BARREL ON C-34555A_CABLE

If nylon barrel on remote control cable (C-34555A_) becomes loose or damaged, it may be reP,aced as follows:

1. Remove inner core wire.

   NOTE: Remove burrs, made by set screws on core wire, with a file so that inner liner of cable will not be damaged when core wire is removed. Round off end of core wire so that inner lining is not damaged when core wire is reinserte.d.

2. Remove damaged nylon barrel.

3. Install new brass barrel assembly (C-38685Al) Larger diameter of hole in barrel faces cable.

4. Distance from end of cable to center line of brass barrel assembly must measure exactly 1-3/8" (3.5cm). (Figure 4A)

   NOTE: Brass barrel assembly must be staked or locked in place with Loctite Type "A"(C-92-32609).

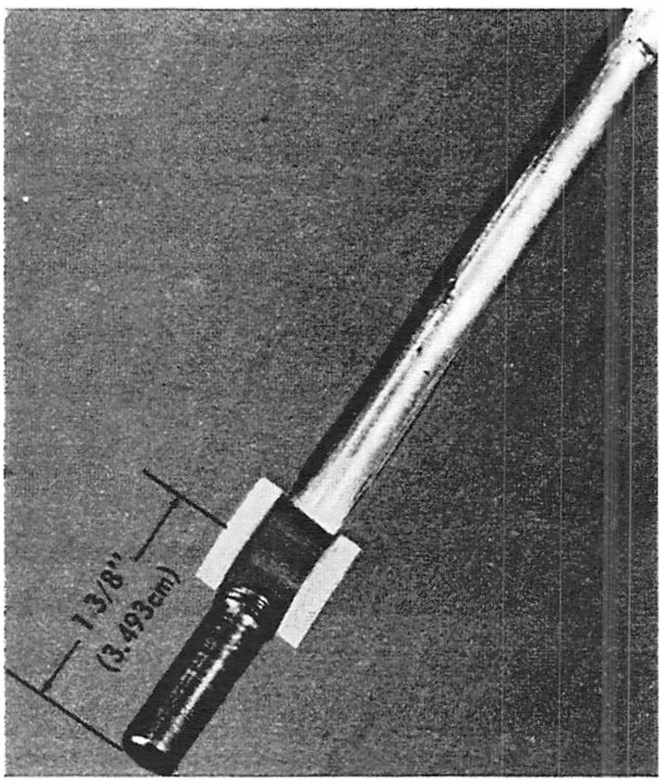


Figure 4A. Distance from Cable End to Center of Brass Barrel

Two-Lever Remote Controls - Installation

2-CYL. \.IANUAL STARTI G \IARK 25-20-15 & KH7

1. Screw vertical connector (A-20020Al) into lever of vertical shaft and adjust locknut on vertical connector so that centerline ofrivet is approximately 2" (.500mm) from centerline of vertical shaft. Make certain that head of rivet, which holds clevis pin, is on top.
2. Tighten lock nut on vertical connector.

NOTE: On all Mark 20's, below Serial No. 754097, replace vertical shaft with new vertical shaft (A-20022AJ). On all KE7, replace vertical shaft with new vertical shaft (A-20998Al) and supporting brackets. Mark 15 requires vertical shaft A-21109Al.

3. Secure bracket A-20557 to outside cowl with two D-32xl/2" hex head cap screws and lockwashers. Holes are already drilled. Be sure that bracket is positioned with groove on top.
4. Install inside steering bar A-23860A2 on Mark 25 and A-20507A3 on Mark 20-15.
5. Attach control to boat and motor by securing control assembly to boat with two 1/4-28 x 3 1/2 oval head machine screws, plain washers and lock nuts. Longer screws, if desired, may be procured from local hardware store.
6. Before attaching shift control cable to motor, set shift lever on motor in FORWARD position.
7. Place shift cable brass block on swivel barrel on inside steering bracket by aligning slot on block with pin through swivel barrel. (Figure 5)

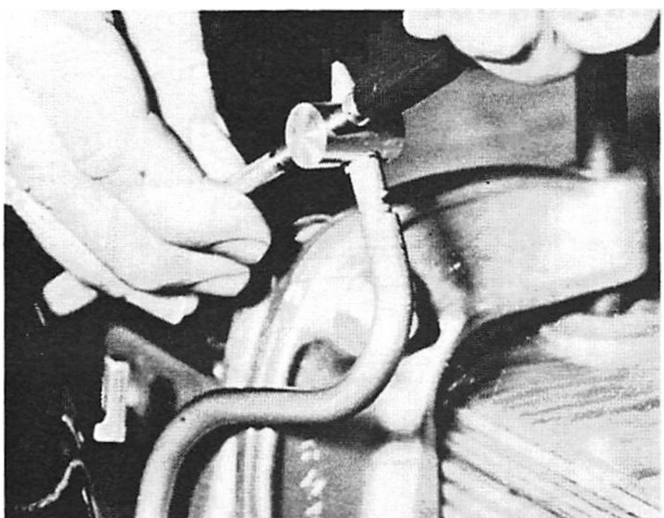


Figure 5. Placing Shift Cable on Holder Bar, Mark 20

8. Turn cable down and move shift pivot lever on inside steering bar to rear so that anchor pin in nyIon end guide will fit into anchor bracket from underneath.
9. Round brass cable anchor on threaded cable guide can be adjusted to position for easy attachment to swivel barrel. Push up and turn knurled pin 1/4 turn after it is thru slot in order to anchor unit. Move shift lever for free forward and reverse traverse to check for proper adjustment.

NOTE: On Mark 20-15 & KH7, set shift lever on motor in reverse position. Place "shift cable" end nylon guide on shift lever by tilting up and hooking onto pin placed at bottom of lever. Cable extends over top of

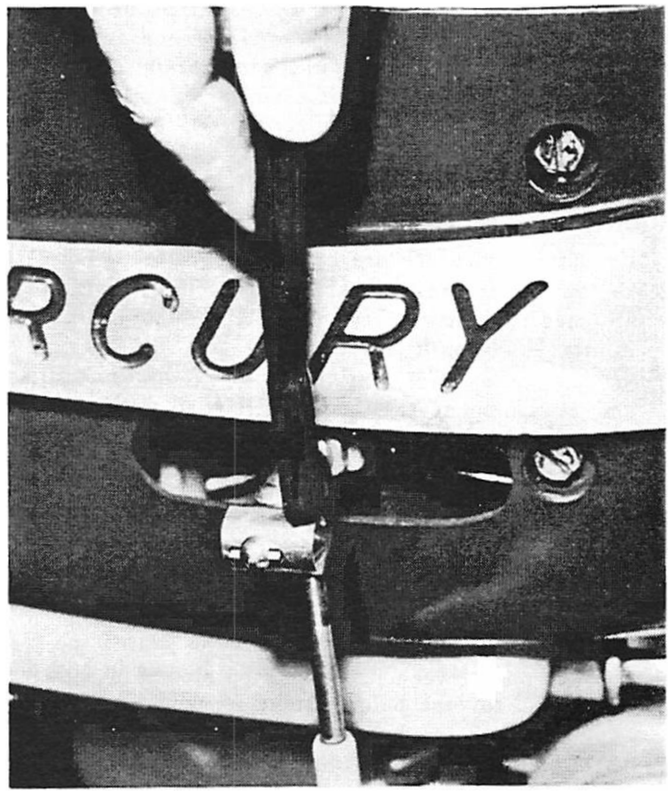


Figure 6. Throttle Cable Connection

bracket. Move shift lever for full forward and reverse traverse to check for proper adjustment.

10. Attach throttle cable to throttle vertical connector by holding cable vertical so that pin will pass thru round brass cable anchor. (Figure 6) Cable should be beneath clevis arm.
11. Turn cable down and move throttle lever so that anchor pin in end of nylon guide will fit into anchor bracket on cowl from underneath.
12. When attaching cables to motor, note correct throttle lever handle. Push up and turn knurled pin 1/4 turn after it is thru slot in order to anchor cable. (Figure 7)
13. Adjust throttle block on cable for proper position.
14. Move throttle lever to full advance and full retard to be sure that it has full traverse and will shut off engine.
15. Tum lock nut and vertical connecter "out" for less magneto travel and "in" for more magneto travel.

NOTE: Readjusting Interlock, ;\lark 25 - If Mark 25 has excessive high RPM in neutral gear and shifting range because of lost motion between vertical con-

-MERCURY

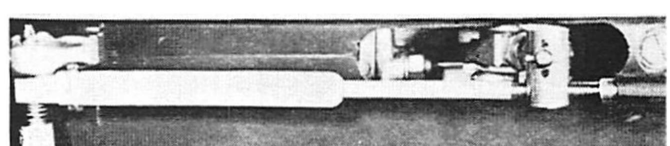


figure 7. Throllle Cable Connected and .-\nchored

nection and throttle-shift interlock control, read just interlock drum to get correct RPM after installing remote coTLtrol. Decrease RPM by resetting throttle and shift lock drum. Loosen 1/4" square head set screw and rotate drum slightly forward to obtain 2700-3000 RPM in neutral gear. Do not allow engine to race when shifting or in neutral gear. Decrease RPM by retarding throttle.

4-CYLINDER MERC AND MARK MANUAL STARTING MODELS

1. Be sure that cables are of correct length. (Figure 1)
2. Be sure that throttle cable from control housing is attached to throttle lever on engine and that shift cable is attached to shift lever.
3. Set remote control shift lever in "Neutral" position and attach connector (brass barrel) of shift cable to clevis yoke pin on shift lever, as shown in Figure 8.
4. Attach connector (brass barrel) of throttle cable to clevis yoke pin on throttle lever. (Figure 8)
5. Tum cable end guide pin of shift cable into cable end anchor bracket and lock.
6. Tum cable end guide pin of throttle cable into cable end anchor bracket and lock.
7. Adjusting throttle cable
   a. Adjust by turning connector (brass barrel) so that bottom cowl lever will strike stop blocks in both forward and reverse before stroke is used up in remote control box.

      NOTE: On Mark 58-58A-55A-35A and Mere models, travel is set on magneto adaptor limiter stop.

   b. If preceding adjustment is not made, either full forward throttle operation or full reverse throttle operation will not be obtainable and will prevent bending of linkage.

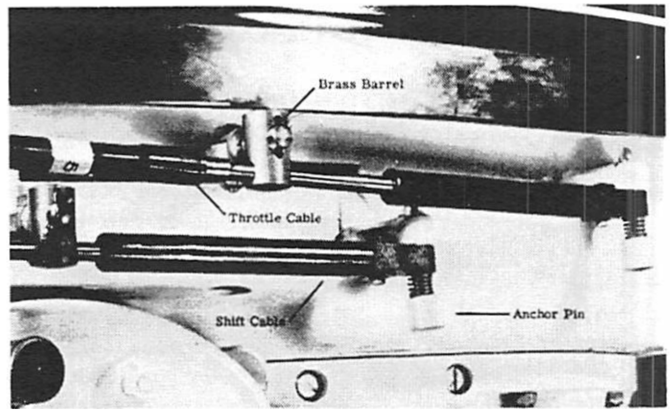


Figure 8. Cable Attachments on Engine

ELECTRIC STARTING 2-LEVER CONTROLS

1. Complete installation according to instructions in "4-Cyl. Mere & Mark Manual Starting-Models", preceding.
2. Insert connector on end of electrical harness from control box to receptacle on side of engine.

   NOTE: Observe that choke button is on side of control housing.

Steering Bar Installation

INSIDE & OUTSIDE STEERING BARS

1. Inside steering bar (Figure 9) fits into holes of steering bracket on Mark 25-20.
2. Outside steering bar bolts onto steering handle bracket on KH7, KG7, KF7, KE7, KG4 and KE4 models.

MAHK 25 INSIDE STEERING BAR

1. Mount shift bracket pivot lever of remote control in inside steering bar (right side). (Figure 9) Assembly has 2 threaded ends which fit into holes on both sides of throttle and shift lock bracket on motor.
2. Attach inside steering bar assembly to motor bracket. (Figure 9)
   a. Place cable anchor bracket on right rear of protruding threaded portion of inside steering bracket. Lip of anchor bracket rests on top of shift and throttle lock bracket.
   b. Secure both sides with elastic stop nuts.
3. Shift lever handle on motor has a drilled hole lo receive connecting link from shift lever bracket (movable). Insert this link in hole from top and insert washer and cotter pin lo secure.
4. Attach opposite end to lever bracket with clevis clip.
5. Make all steering cable connections to removable center swivel lock on steering bar by pressing knurled head pin tum and release.
6. When removing motor, simply disconnect swivel lock from steering bar.

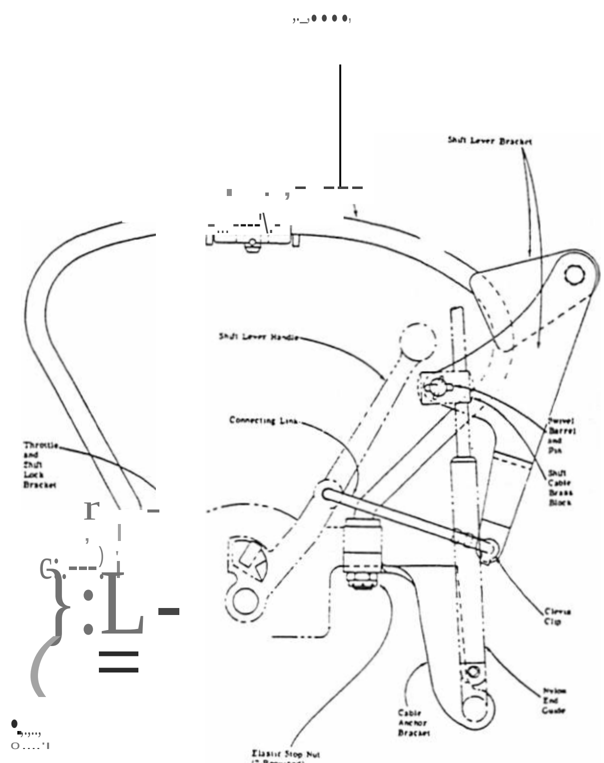


Figure 9. Inside Steering Bar (Marie 25)

Two-Lever Remote Controls - Repair

DISASSEMBLY OF lA.NUAL STARTING 2-LEVER CONIBOLS

1. Follow exploded view of Figure 9.
2. Remove screws which hold 2 control box halves and divider (backing) plate together.

   NOTE: Control box is provided with locations for attaching cables at either end, depending upon boat mounting (left or right).
3. Remove parts as shown in Figure 9.

REASSEMBLY OF MANUAL STARTING 2-LEVER COJ'\TROLS

1. Apply liberal amount of MULTIPURPOSE Lubricant (C-92-35226) to both nylon gear racks, box slides, back of handles, handle gear sectors and nylon pivot bearings before setting in gear box.
2. Place round brass cable anchor (control end of cable) in round recess at end of gear rack slide in control box and check that nylon gear rack is set with teeth in position to engage handle gear sector.
3. Set nylon gear rack at itsfull maximum traverse in box slide (forward).
4. Set throttle handle on nylon pivot bearing in control box "inside half" and engage teeth of handle sector and nylon gear rack so first tooth of each one engages the other while nylon gear rack is at its maximum traverse in slide and handle at forward position. (Figure 10)
5. Repeat same procedure for shift handle with "outside half".
6. Set divider (backing) plate with large center hole over handle pivot.

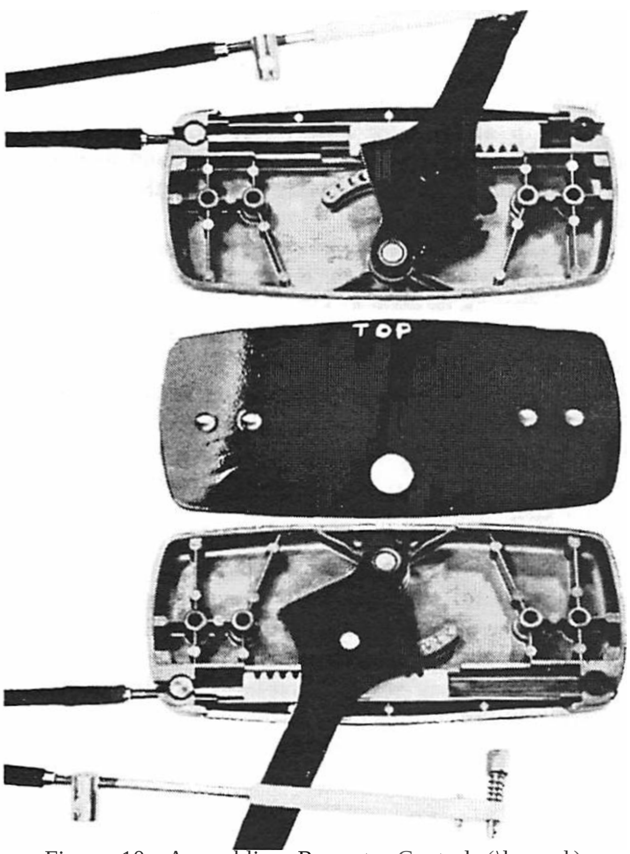


Figure 10. Assembling Remote Control (\lanual)

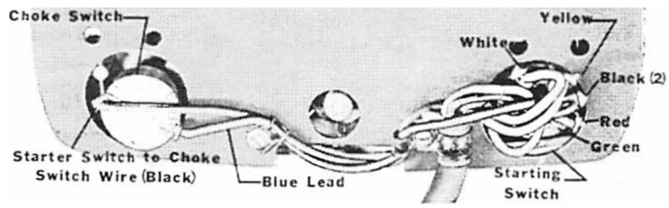


Figure 11. Backing Plate, Electric Control Housing

NOTE: Control can be mounted for left or right side operation.

7. After gear rack cables and control handles are assembled, close control box by bringing 2 halves together and tightening with screws which were removed. tFigure 9)

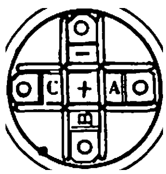
   NOTE: If an inner stainless steel wire pulls out of control box, install an alien head set screw (C-10-20014) on opposite side of square head set screw in gear rack inside housing. Loosen square head set screw and insert alien set screw in anchor and tighten; then tighten square head screw to secure wire inplace.

DISASSEMBLY OF ELECTRIC STARTING 2-LEVER CONTROLS

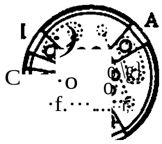
1. Remove 2 Phillips head screws and nuts which hold control box halves together. Rear half housing has only shift arm and remote control shift cable inside.
2. To remove front half of housing, unscrew 2 bezels from starter and choke switches.
3. Remove throttle arm and throttle control cable assemblies from front half by pulling backing plate away from front housing. Backing plate holds choke control switch leads and starter switch leads with 2 small nylon cable clips and one large clip. (Figure 11)
4. Remove screws, washers, "D" washer and nuts from nylon clips to release wires.
5. To remove wiring from choke switch and/or starting switch, rubber insulation sleeve must be removed from starting switch.
6. Remove Glyptal from terminals of both switches with lacquer thinner, using a small paint brush so that inside of switch does not become saturated and dissolve the waterproofing.
7. After Glyptal is removed, use a smail soldering iron and heat soldered connections to separate.

REASSE H3LY OF ELECTRIC STARTI'.'IG 2-LEVER CONTRO LS

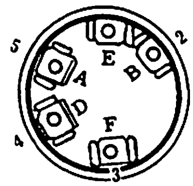
1. Wiring harness leads inside housing can be checked for breaks or shorts with Continuity Tester (C-91-22966) or Magneto Analyzer (C-91-25213).
2. . Place one lead of meter on plug end and opposite lead of meter on starting switch end of lead.
3. Check to see that current flows thru wire. If not, wire is shorted or broken.



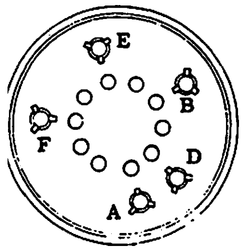
Back of Starter Switch
Switch No. 30163
6-Cy1. Models



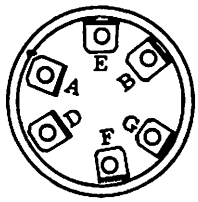
Back of S :;., Switch
Switch No. 29060
6-Cyl. Models



Back of Starter Switch
No. 30162 (Letters)
No. 22569 (Numerals)
Embossed "INDAK"
4-CyI. Models



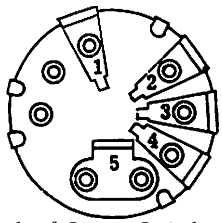
Back of Starter Switch
Plug in Type, Switch No. 29061
4-Cyl. Models



Back of Starter Switch
Switch No. 34198
Mere 350 (2-Cy1.)

Poaition	Connect a Tetmlnols	Model a
Off	E & D	All 4-Cyl. 1958 & Newer
	1&•	Martt SSE-SOE-30E
	1-4-6	Mmk 2SE
	No Contoet	All 6-Cyl. Modela
	E·D·G	Mere 350 (2-Cyl.)
Run	A&F	Al I 4-Cyl. 1958 & Ne-r
	3&S	Mork SSE-SOE-30E·2SE
	l>A-1	All 6-Cyl. Model a
	A·F	M•e 350 (2•Cyl.)
	l>A-l·C	M•e 800-70Q-600 Dir. R.....
Stort	A-f·B	All 4-Cyl. 1958 & Newer
O.Oko	2·3-S	Marie SSE-SOE-JOE
	2&5	Mark 25E
	l>A-l·C•	All 6-Cyl. but 800-700-600 D.R.
	B·A·I	More 800·700-600 Dir. Rov.
	A-F·B	Mere 350 (2-Cyl.)

• Mere 8110-700-600 Fidl Ccar Slai/t i11 Nc11ual



Back of Starter Switch
Switch No. 29566
Mark 55E-50E-30E-25E

Figure 12. Back of Starter Switches

NOTE: If a key switch tends to stick or react slowly, lubricate with Lock Ease, a lubricant mixture which does not harm switch. Occasional use is recommended where sticking is experienced. Lock Ease is available thru local hardware stores.

4. Check each individual lead the same way. Refer to wiring diagrams in Section VIl and in Figure 12 (top switch) chart above.
5. Use resin core solder (lead-tin 50-50) and resin paste to insure a positive connection. Acid core solder will have corrosive action on electrical parts.
6. Be sure that all electrical connections have been covered with protective coat of Glyptal after soldering.

   NOTE: On Mark SSE and SOE, green lead is .soldered to wider terminal on back side of switch. Place this wider terminal at bottom and solder. Installing counter-clockwise, lead wires are green-red-black (solder 2 black lead wires together here; one leads to choke control switch) - yellow-white.

7. If harness connector requires replacement, complete the following:
   a. Using 50-50 lead-tin solder, join connector terminal and cable together with enough heat to melt and flow the solder, yet only enough solder to make a satisfactory joint.
   b. Hold parts to be joined in such a manner that they will not move in relation to one another during soldering operation.
   c. After soldering, joint should not be disturbed until solder has completely solidified..
   d. If a satisfactory joint is not initially obtained, joints must be taken apart, parts thoroughly cleaned and entire soldering procedure repeated.
   e. If excessive flux residue is in evidence around soldered joint, remove by wiping with cloth moist-ened with denatured alcohol, thinner or acetone.
   £. After soldering, fill back area of connector around connections with MULTIPURPOSE Lubricant CC-92-35226) to eliminate electrical leakage.
   g. Install new neoprene sealing washer inside electrical harness connector, on elbow end, to prevent moisture from entering connector and causing a short.
   h. To halt salt corrosion of lead wires of wiring harness, at its point of entry into male and female connectors, it is recommended that this area be packed with a special compound (PC1120 Potting Compound) with an accelerator (EC1131) to speed solidifying while not hardening completely. These 2 materials are 3M (Minnesota Mining & Manufacturing) products available thru local 3M distributors.

   NOTE: Metal clamps must be removed in order to fill back of connectors. Be sure that surfaces are clean before placing compound. Amount of accelerator mixed with compound determines hardening time. Only small amount is required. Mix only enough for one unit at a time, as once mixed, it will remain useable for only a few hours.

8. Place 2 nylon clips on lead wire from choke to starter switches and mount to 2 small holes in backing plate. Nylon clip at starting switch fits over larger nylon clip and "D" washer which holds thick end of control wiring hamess. Unit is held in place with screw, nut and 2 washers.
9. Tape leads from choke to starter switches with No. 33 Scotch electrical tape to insulate and protect wire from rubbing on throttle arm.
10. Place nylon bushing on pivot in front half of control housing.
11. Place choke and starting switches on backing plate in front half of control housing and secure with bezels.
12. Pull backing plate slightly away from front control hoosing and place nylon gear rack and cable in slide. Brass knob fits in round recess.
13. Pull gear rack to opposite end of slide.
14. Place throttle arm (with knob) pivot hole over nylon bushing, in full throttle position and engage gear on arm with gear on nylon rack. Match tooth-for-tooth.
15. Place cable and gear shift arm (with knob) in rear half housing, engaging gears same as throttle arm (full forward position).
16. Place housing halves together and secure with screws and nuts.

SINGLE-LEVER REMOTE CONTROLS
6-Cyl. Electric Starting
Direct Reversing Models - Mark 78-78A-75-7SA
Installation

ATTACHING REMOTE CO TROL HOUSING ON BOAT

1. Use screws and nuts, furnished with control, to attach housing to boat.
2. It is recommended that remote c ntrols and steering be mounted on left side of boat because of rotation of propeller and subsequent torque development.

ATTACHING CONTROL CABLE

1. Attach cable to clevis yoke on left side of bottom cowl.
2. Hold cable vertically so that clevis yoke pin can be placed thru round brass cable anchor slots. Cable should be below clevis. (Figure 1)
3. Turn cable down and move throttle and shift control lever in control housing so that anchor pin in end of nylon guide will fit into anchor bracket on bottom cowl.
4. Push and turn knurled pin turn after it is extended through slot to anchor it. (Figure 1)
5. When attaching brass cable anchor (turns on brass tube), adjust so that bottom cowl lever will strike

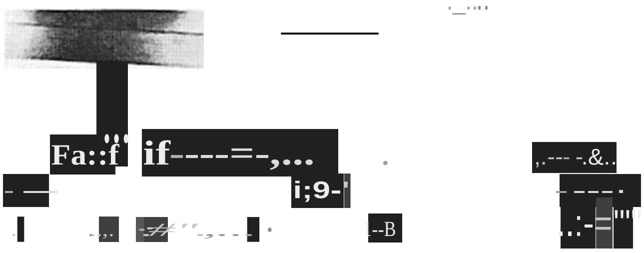


Figure 1. Cable Attachment, Full Throttle

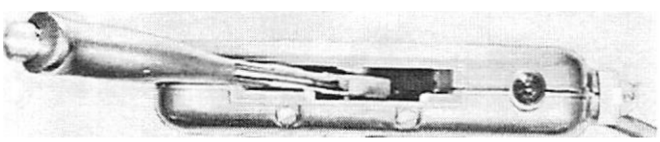


Figure 2. Control Station, Showing Detents

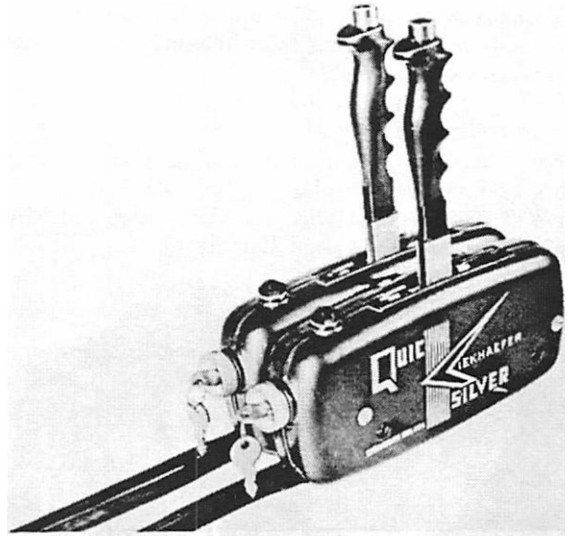


Figure 3. Dual Control Station Installation

stop blocks at each end of slot before control lever reaches limit of its travel in control box. (Figure 1) If this adjustment is not made, either full forward throttle operation or full reverse throttle operation will not be obtainable.

ADJUSfMENTS

Forward Start Position

1. Remove front cover from engine.
2. Move remote control lever forward until carburetor butterfly valve starts to open.
3. Move detent plate in control box up against front side of control lever and lock in place with screw provided (Figure 2).

Reverse Start Position

1. Move remote control lever backwards (reverse) until carburetor butterfly valve starts to open.
2. Move detent plate in control box up against back side of control lever and lock in place with screw provided (Figure 2).

DUAL ENGIE INSfALLATION

1. Place several thick washers between control boxes on thru bolts. (Figure 3)
2. Use 2 batteries, each independent of the other.

SINGLE-LEVER REMOTE CONTROLS
6-Cyl. Electric Starting - Merc 800-700-600 Dir. Rev. Right & Left Hand Installation

INSTALLI!\G CACLE IN CO\TKOL HOCSI G

1. Remove screw from side of control opposite control handle and remove round cover plate. (Figure 1)
2. Remove 4 screws and nuts from housing and separate housing halves. (Figure 2)
   NOTE: Do not remove inner wire between 2 housing halves of right hand control.
3. Remove 2 screws from rack retaining plate on right housing half and remove plate. (Figure 3)
4. Remove 2 screws from wire retaining ring and slide retaining ring out of the way. (Figure 4)

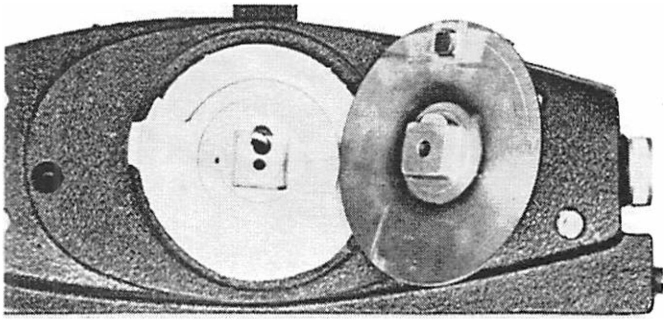


Figure 1. Removing Cover Plate

5. Check mechanical throttle and shift cables before installing into control station to insure that square head set screws on nylon racks and end guides are tight.
6. Install nylon cable rack on rack slide with first full tooth space aligned with first full tooth in gear sector while control handle is in full reverse position. (Figure 4)
7. Replace rack retaining plate and 2 screws which secure it and wire retaining ring and 2 screws which hold it.
8. Check operation of control (move control lever throughout entire throttle range) while halves are separated to be sure that cable has full traverse.
9. Reassemble control halves and replace securing screws.
10. Replace round cover plate and screw on side of housing opposite handle. Control now is ready for mounting

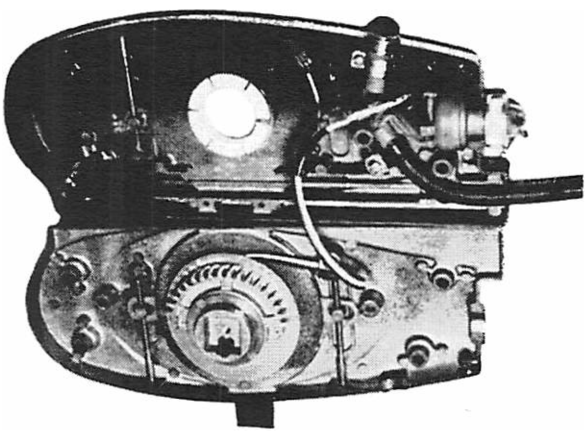


Figure 2. Housing Halves

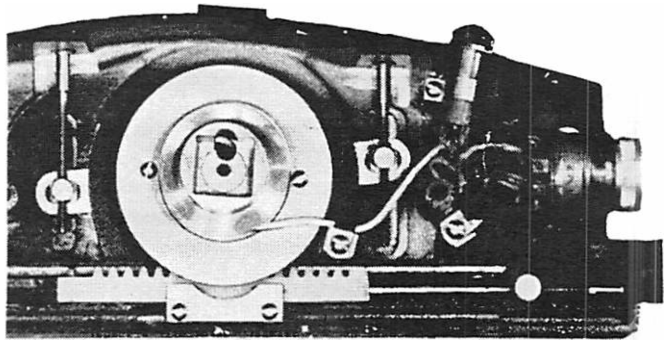


Figure 3. Rack Retaining Plate

MOUNTING CONTROL STATION

1. Mount control on boat with stainless steel mounting screws provided.
2. For dual installation, either right or left, orderdual mounting kit.
   NOTE: Be sure to record key number!

ATTACHING CABLES TO ENGINE

1. Adjust brass barrel so that it is 5/8" (15.9mm) from end of brass sleeve on engine end of control cable for Merc 700-600 engines, 3/8-to-l/2" (9.53mm-to-.500mm) for Merc 800. (Figure 5) Install cable to engine with barrel in this position.
2. Adjust forward limit screw (Figure 6) in control station until engine throttle lever touches front throttle stop on bottom cowl.
   NOTE: Purpose of forward limit in control box is to, provide a positive stop for handle to prevent overloading cable and attaching fittings.

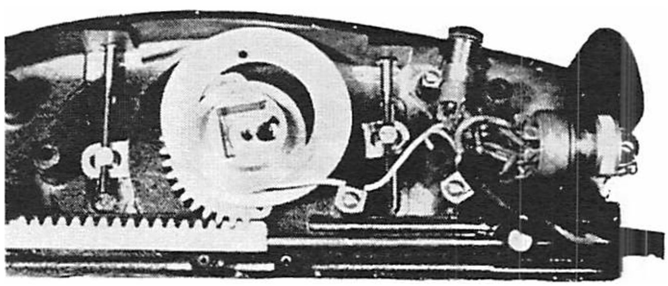


Figure 4. Sliding Retaining Ring Out of Way

ADJUSTING STARTING DETENTS

First apply 3 adjustment decals (stickers) on control housing in position as shown in Figure 6. Adjustment decal position in Figure 6 are opposite on right hand housing.

Forward Detent Adjustment

1. Insert harness connector in receptacle.
2. With control handle in verticle position, and with

ignition switch on, depress starting button on under-side of handle and slowly move handle forward (while holding switch depressed) until starter motor cranks engine.

3. With handle in this position, turn adjusting screw in "slow" direction until handle moves.
4. Now turn adjusting screw in "fast" direction 6 full turns. (Figure 6)

Reverse Detent Adjustment

1. Adjust in same manner as "Forward Detent Adjustment" immediately preceding.
2. Handle mechanism of this control is side-loaded and must be moved toward operator to move past starting detents for either full forward or full reverse operation.

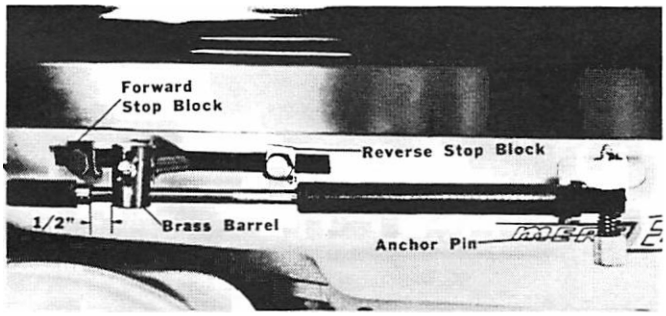


Figure 5. Engine Attachment

APPLYING MERCONOMIZER DECAL

1. With control handle in full forward position, apply "Merconomizer" indicator to box so that edge is in line with marker on handle hub. (Figure 6)

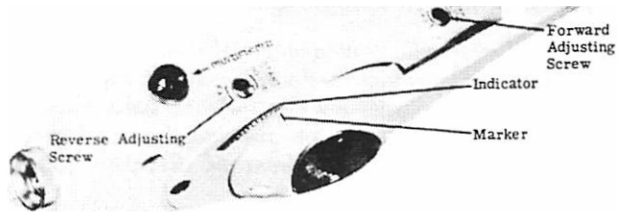


Figure 6. Remote Control Housing

2. . Maximum economy (miles per gallon) can be achieved by throttling back until mark on handle is lined up with high point of indicator.

DUAL INSTALLATION (Figure 7)

1. Set up one control as instructed in preceding information.
2. Leave control cable of 2nd control disconnected from its engine and set forward limit stop so that both control handles match in full forward position.
3. Mount control cable to engine and note whether engine throttle lever touches front stop on engine's bottom cowl. (Figure 5)
4. If throttle lever on engine does not touch cowl stop or control handles do not match at full throttle position, adjust barrel on engine end of 2nd control until throttle lever at engine touches front stop and control handles match.
5. Adjust "Forward and Reverse Start" positions of 2nd control by matching handle position to first control.

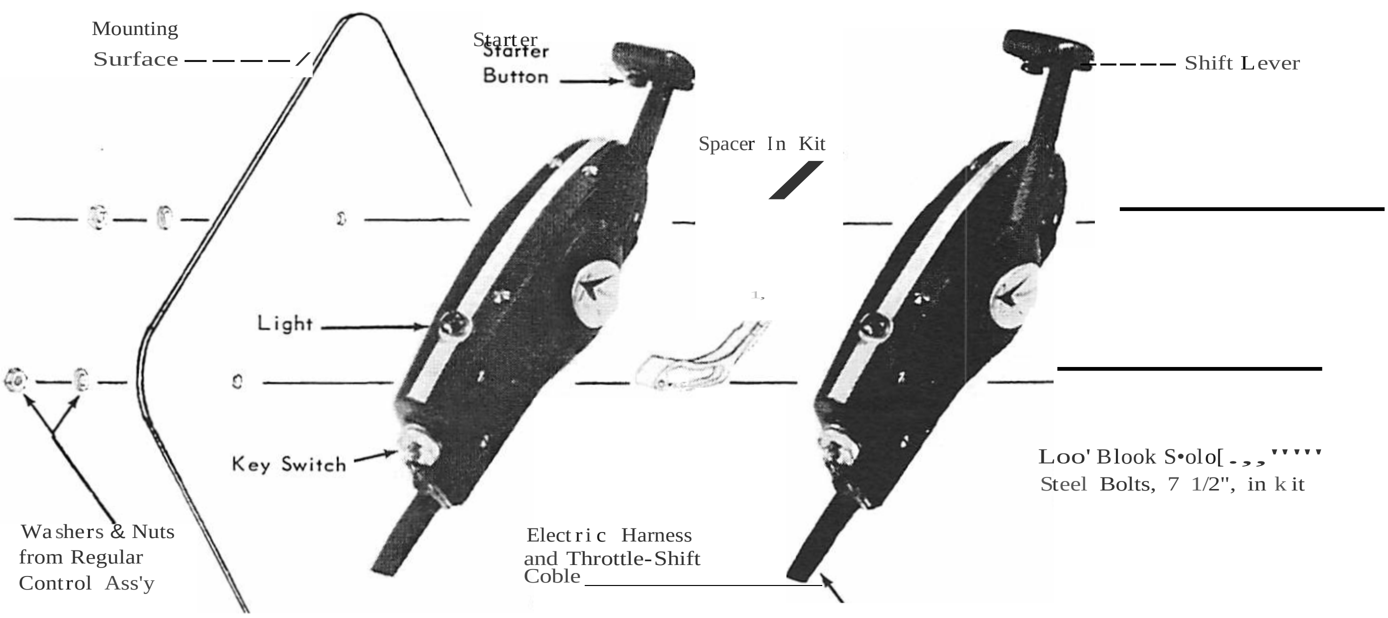


Figure 7. Dual Control Installation

SINGLE-LEVER REMOTE CONTROL
2-4 & 6-Cyl. Full Gear Shift Models

IMPORT ANT: Remote Control Forces Are Greatly Reduced if Twist Grip Throttle Steering Handle ls Remov ed.

NO TE: For 4-cyl. 1959 and earlier engines, magneto rotor m!Lst be changed to Part No. A-394-1671Al . It is not necessary to remov e key switch, limit switch or choke f rom housing when disassembling. For dual installation, use Dual Mounting Bra cket Kit (C-29700Al).

DISASSE BLY OF CONTROL STATION

1. Remove 3 screws which hold control housing halves together and lift left side housing off (housing without neutral throttle lever) to separate halves. In removing left half, insert thumb into splined handle hub to insure that hub stays with right half.
2. Remove screws in 2 ra ck-retaining plates and one cable-retaining pla te and lift plates off. (Figures l-thru-3)
3. Control station now is ready for control cable installation.

CONTROL CADLE INSTALLATION

1. Use control cables C-29564-55 thru C-29564-185 or C-20015-55 thru C-20015-185 with this control. Choose control cable of correct length.

   IMPORT ANT: lflhen using A-20015-_S cables, follow installation instructions for A-20015.,_S cables.

   CAUTION: Do not use A-20015-_S remote control cable on Merc 800-700-600 direct reversing remote controls (A-29699A). Use only C-29564-_S remote control cables--which can be readily identified by the stainless steel tube on engine end of control cable -- for these Merc 800-700-600 direct reversing motors.

2. Check mechanical throttle and shift cables before installing into control station to insure that square head set screws on nylon racks and end guides are tight.

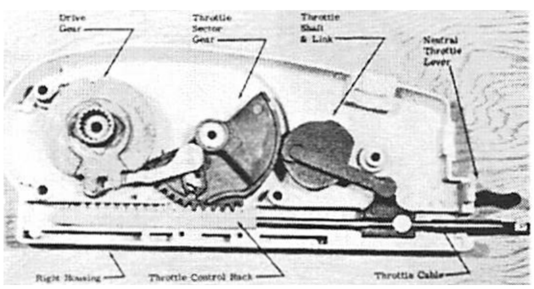


Figure 1. Throttle Sector, C-29564-_S Cables

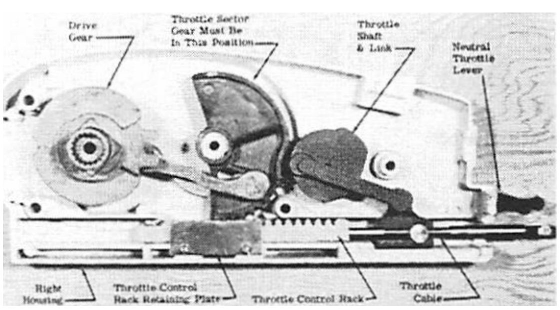


Figure 2. Throttle Sector, C-29564-_S Cables

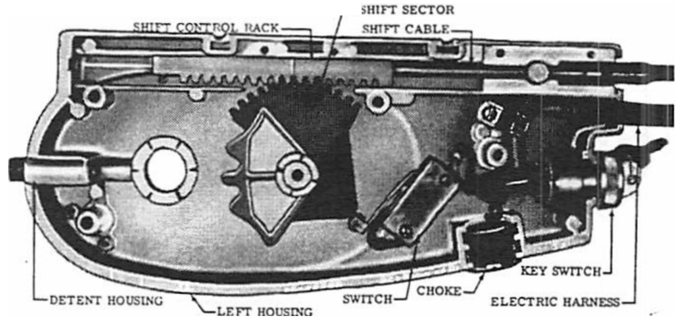


Figure 3. Shift Sector, C-29564-_S Cables

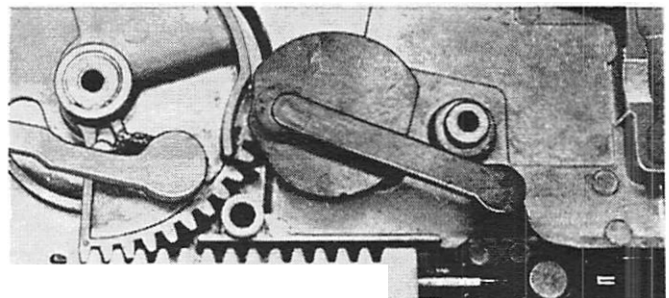


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Figure 4. Throttle Sector, A-20015=-S Cables

f'.'ISTALLATION OF C-29564-_S CONTROL CABLES

Throttle Sector

1. With throttle control rack set in full throttl e pos1t1on, engage last tooth of throttle sector in last tooth space of nylon rack. (Figure 1)
2. Rotate throttle sector gear 90° to position (Figure 2) for assembly of control halves.

Shift Sector

1. Place alignment mark of gear shift rack in line with mark (dot) on tooth of shift sector. (Figure 3)
2. Move shift sector to position (Figure 3) for assembly of control halves.

INSTALLATION OF A-20015=-S CONTROL CABLES

Control cable A-20015:....5 can be used on this single lever remote control installation. Install as follows:

Throttle Cable

1. Relocate brass drum 1/8" (3.18mm) from end of conduit fitting. (Figure 4)
2. Line up first tooth of throttle sector with first tooth of throttle control rack, as shov.-11 in Figure 4.

   NOTE: Number of teeth on throttle sector has been reduced from 15 to 13. If sector has 15 teeth, cut off last 2 teeth. (Figure SA)

Shift Cable

1. Relocate brass drum 5/16" (7.94mm) from end of conduit fitting. (Figure 6)
2. Cut off last tooth of shift sector. (figure 58)

3. Line up last tooth of shift sector with last tooth of shift control rack (Figure 6) or install new shift sector A-43-31802 (available on exchange basis from Mercury parts distributor.

NOTE : On 4-cyl . non-electric models, shorting switch must be installed (Part No. A-29649A10 for 10 ft. cable length, A-29649Al5 for 15 ft. length and A-29649A20 for 20 ft.). Install in left housing half. The electric wire extends thru lower opening next to throttle-shift cable outlet. Shorting switch plug must be attached to receptacle on engine. Be sure that switch is in "OFF" position.

REASSEMBLY OF CONTROL STATION

I. Before placing halves together, be sure that keyed

on drive gear, and that shift sector clears limit switch

plastic bushing is in position in control housing, not spring rolled6-cyl. models only), or it will bend spring when housings are assembled.

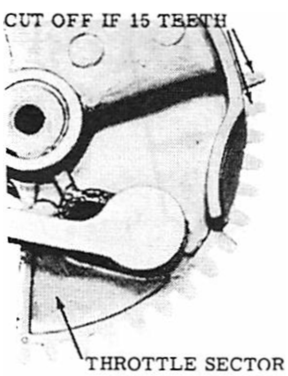


Figure 5A

Figure 5B

2. Place housing halves together. If housing halves do not fit together, sector gears are not meshing. *Note position of sector gears in Figures 2 and 3.* If gears do not mesh, place handle into splined recess and move gear sector slightly until gears mesh.
3. Place screws thru housing halves and tighten evenly (short screw into rear screw hole).
4. Turn detent screw in past nylon pellet to desired control handle tension.
5. Set handle into splined hub on desired side and turn until detent (neutral position) is noted.
6. Reset handle so that emblem is horizontal.
7. Replace handle screw.

NOTE: If control handle of a different angle is required to clear steering wheel, order handle A-30048, which has a different angle, or A-31384Al, which is 2" (50.Bmm} shorter.

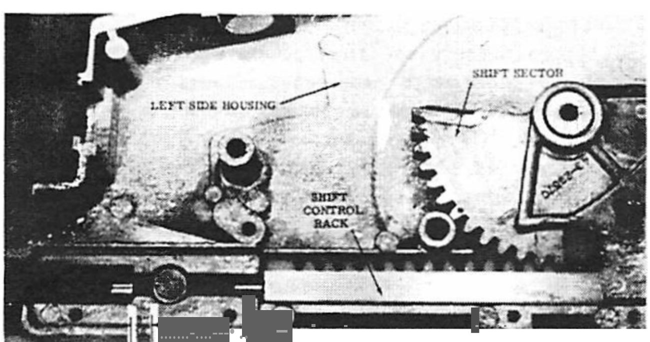


Figure 6. Shift Sector, A-20015- S Cables

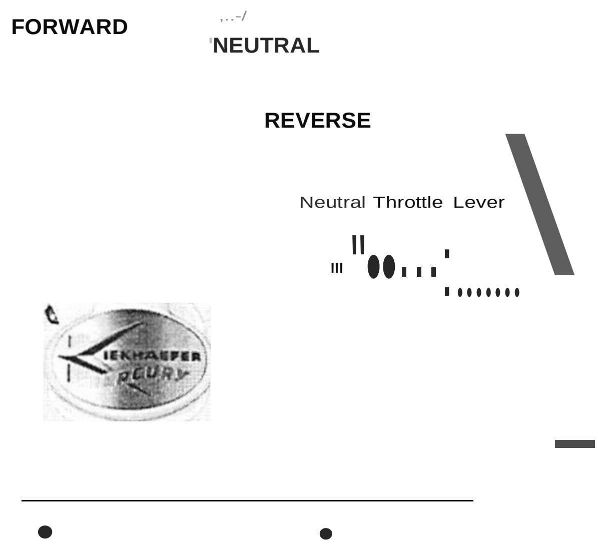


Figure 7. Lever Positions

MOUI\TING CONTKOL STATIO!\ ON OOAT

I. \lount control housing on side or on mounting bracket of boat. Be sure that mounting surface is flat, that sufficient clearance for operation of neutral throttle lever is provided between control housing and side of boat and that there is sufficient clearance between control handle and any part of boat so that operator's hand on control handle will clear comfortably.
2. Right side mounting on boat is recommended to balance torque caused by propeller rotation. If left side mounting in boat is required for any reason, remove handle screw and handle and place handle on opposite side of control housing.

NOTE: In some instances, control mounting bracket in boat is located so that operation of control is inconvenient. If this is the case, mounting control box on seat beside driver may be more desirable.

3. Reinstall screw-and tighten.
4. Meehanical control cables must not be restrained in the fore-aft direction within 3 ft. (.9lm) of control box. If cables must pass thru a bulkhead, sliding clearance should be provided.

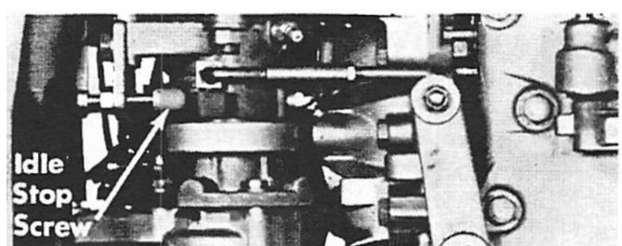


Figure 8. Idle Throttle Stop

CONTROL CABLES TO ENGINE INSTALLATION

1964 and Previous Models

Throttle Control Cable

I. Remove front cover and wrap-around cowl from engine.
2. Place control lever in neutral position and be sure that neutral throttle lever is down all the way before attaching throttle cable to engine.

NOTE: The throttle cable is the one on which nylon end moves last when moving control handle from *neutral position.*

3. Move throttle lever on engine forward to throttle stop (idle position) and bold in this position.
4. Align lrass barrel on throttle cable so that distributor or magneto is held lightly against idle stop screw with cable installed.
5. Move control handle to full forward, full reverse and return to neutral.
6. Check to see that distributor or magneto (Figure 8) has returned to idle stop.
7. If necessary, readjust brass barrel on cable to accomplish correct final adjustment. If distributor or magneto is forced too tightly against idle stop, neutral throttle lever will not open carburetor throttle shutters, and hard starting will result.

Gear Shift Cable

1. Gear shift cable is one on which nylon end moves first when moving control handle from neutral (detent).
2. Place control handle in neutral (detent) position and shift lever on engine in neutral position.
3. Adjust brass barrel so that cable is connected without disturbing either lever or handle.
4. Move control handle to forward position and be sure that detent spring is in forward notch (detent) of shift control lever plate in bottom cowl.
5. Shift back into neutral and check to see that throttle lever and shift lever are in position shown in Figure 9.
6. Disengage cable end and readjust brass barrel so that mating mark on shift lever is to right of indicating portion of throttle control lever. (Figure 10) This will assure that engine is in neutral when control handle of remote control is in its detent position (neutral).
7. Be sure that detent spring is in notch in shift lever plate. It may be necessary to adjust lrass barrel to compensate for cable backlash.

IMPORTANT: Do not shift into reverse while engine is not running, as reverse gear clutch may not be in exact rela.tive position to permit engagement of shifter clutch. Forcing lever under this condition will result in bent or damaged shifting mechanism on engine and control.

Limit Switch - 6-Cyl. Models

Limit switch in control housing allows starting only in "Neutral" gear position on 6-cyl. models only.

Mounting Control Cables on Boat

1. To prevent fouling or interference of remote control cables -- which may cause bending of metal cable end tube insert at engine end of control cable--control cable should be anchored in the dry well or to boat with nylon clamps and screws provided.
2. This gives sufficient slack for proper operation of control and still enables engine to tum fully each way with no interference.

ATTACHING ELECTRICAL HARNESS

1. Turn ignition key to "Off' position (key vertical).
2. Plug electrical harness connector into receptacle on right front side of motor.
3. Connect battery leads.

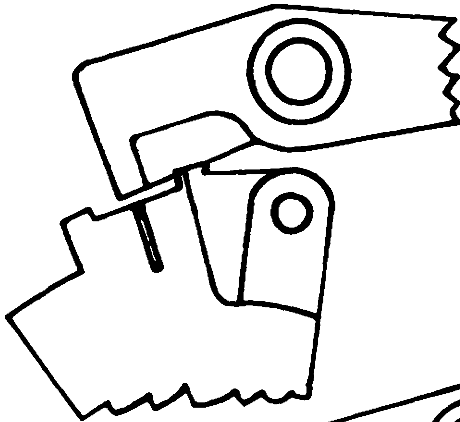


Figure 9.

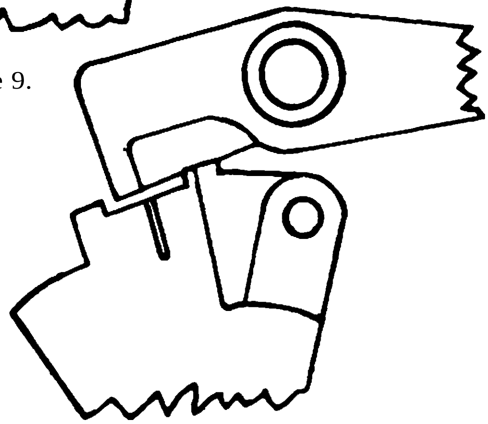


Figure 10.

4. Install battery lugs on end of lead wires and fasten securely to correct terminals on battery. Red lead of harness attaches to positive (+) post of battery and black lead to negative(-} post of battery.
5. Use grease to prevent corrosion of terminals.

NOTE: Positive battery clamp has a 3/8" (9.Smm) stud for battery cable, and negative ba.ttery clamp has a 5/ 16" (7.9mm) stud. Positive (+) battery lead from harness will have a larger hole in spade end.

CONTROL D ENGINE OPERATION

1. Place control handle on neutral (detent) position.
2. Move neutral throttle lever up.
3. Tum key to "start" position and use choke as required.
NOTE: If a key switch tends to stick or react slowly, lubricate with Lock Ease, a lubricant mixture which does not harm the switch. Occasional use is recommended where sticking is experienced. Lock Ease is available thru local hardware stores.
4. Before shifting engine, return neutral throttle lever to closed position (down).
5. Approximately the first 45 degrees of control handle travel – forward and reverse – shifts the engine. Remainder of travel is throttle advance.
IMPORTANT: If engine dies during fast shifting cycle, increase idle RPM by adjusting idle stop screw {turn in) on throttle stop plate inside cowl. Any idle adjustment made on engine must be accompanied by a readjustment of barrel on throttle control cable.

2-Cyl. Manual Starting Engines
Automatic Transmission Type
Disassembly, Reassembly & Installation

CABLE INSTALLATION IN CONTROL HOUSINGS

NOTE: Cables are installed in housings of new style remote controls.

Engine End Disassembly (Figure 1)

1. Remove screw from center of indicator arm and lift arm off.
2. Remove screws which hold housing cover and lift cover and gasket off.
3. Remove 2 clamp screws and clamps from drive pulley. (Figure 2)
4. Remove inner wire, chain, drive pulley and bushing.
5. Remove housing half from steering handle adaptor.

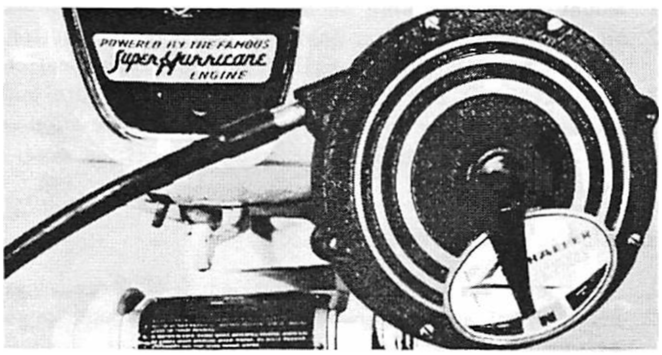


Figure 1. Engine End Housing Installed

Engine End Reassembly

NOTE: If a replacement inner wire is required, cut it 2IW' (546.JOOmm) longer than length of cable.

1. Install housing half on steering handle adaptor.
2. Place bushing in position in housing half.
3. Place chain around pulley and install in housing half.
4. Thread brass end of control cable into housing and thread jam nut against housing to secure cable into position. (Figure 2) Be sure cable is threaded completely in.
5. Push inner wire of cable into housing and drive pulley.
6. As soon as end of wire can be lifted up (use awl or ice pick), pull wire out far enough so that end of wire touches end of pulley groove and can be placed into cable wire groove in pulley. (Figure 3)
7. Place clamp nearest end of groove and tighten securely. (Figure 3)
8. Hold inner wire at opposite end of cable and turn drive pulley so that wire lies in slot in bottom of groove around pulley.
9. Place second clamp in pos1t1on, making sure that groove in clamp retains wire. (Figure 3)
   NOTE: Be sure that both screws are tight before replacing cover.
10. Set gasket in cover and place cover over housing. Recess in cover sets over outlet of housing.
11. Replace indicator hand with pointer toward "F" or "Forward" mark on cover. (Figure 1)

Control End Disassembly

IMPORTANT: Cable must be removed from this end

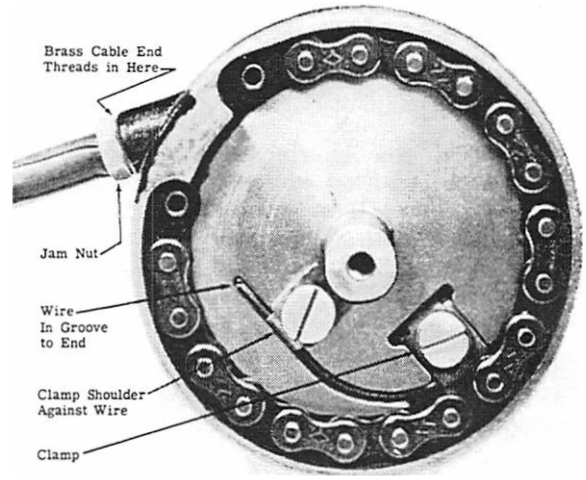


Figure 2. Engine End Housing with Cove- ltff

if it is to be placed thru small hole/holes in bracing of boat.

1. Remove screw which secures handle to control housing and remove handle. (Figure 4)
2. Remove 4 screws and nuts which secure 2 cover halves together and open assembly.
3. Remove pulley, link chain and both clamps and clamp backing plate which hold inner wire on pulley. (Figure 3)
   NOTE: If required, slip inner wire from housing half and place cable thru boat bracing at this time.
4. Insert inner wire of cable into pulley groove and place long clamp in position over wire. (Figure 3) Be sure that inner wire is pushed down fully into pulley groove to seat.
5. Fasten long clamp with screws previously removed.
6. Place small clamping plate in position over inner wire. Set recess of clamp over inner wire and secure tightly with screw. (Figure 3) Be sure that inner wire is recessed in pulley guide. If inner wire is loo high in groove, it will cause binding in control when assembled.
7. Retighten 3 screws to make certain that they are tight.
8. Place nylon bushing with detent in recess in housing halves and lubricate with MULTIPURPOSE Lubricant (C-92-35226).
9. Lubricate link chain and wrap chain around pulley. Place assembly (pulley, chain and cable) into housing half. Remote control cable sets into recess in housing.
   NOTE: Cable with brass block sets into recess in earl1· controls.
10. Place nylon bushing in other housing half and lubricate. Be sure that gasket is in place in housing half.
11. Set housing assembly over pulley shaft.
12. Insert 4 screws into housing so that screws are on handle side. The tri-lock (crimped) face of the nut threads on the screw first to get maximum locking qualities from nut. Do not tighten.
13. Insert handle temporarily and compress cable into each end before tightening housing screws. This is done by winding all slack cable onto remote control end pulley

and, while holding indicator on engine end, turn handle in reverse direction.

14. Now tighten screws securely.
15. Turn indicator on engine end to "N" or "Neutral" position and reset handle in remote control housing in upright (vertical) position on desired side of housing and secure with lockwasher and screw. (Figure 4)

REPLACING TWIST GRIP THROTTLE WITH ENGINE END HOUSING

1. Turn twist grip throttle and shift handle to "F" or "Forward" position so that tongue of control shaft is vertical, thus allowing easy installation of control. Tongue on control fits into yoke on control stem.
2. Remove twist grip throttle and shift handle from engine by releasing lock lever located beneath handle bracket.
3. Replace lever type lock handle bracket with new bracket and 2 cap screws and nuts in carton.

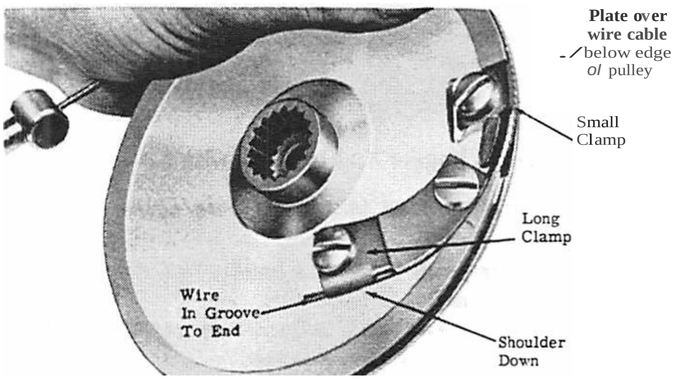


Figure 3. Wire in Pulley and Groove

NOTE: Later models already have new bracket on engine, and it is not necessary to change brackets. Mark 10 and early Mark 10A engines require adaptor bracket A-27759A1 when employing A-28324A2 control.

4. Place thin coat of MULTIPURPOSE Lubricant (C-92-30239) over stem of control shaft on engine control housing before inserting into handle bracket.
5. Move indicator arm to align with first screw in engine end of control housing in "F" or "Forward" position. (Figure 4, Right) This places yoke in correct position to be inserted into tongue on control shaft assembly of engine. Groove on bottom side of stem of housing will align with split in handle bracket
6. Push assembly into position and tighten 2 cap screws and nuts to secure control housing in place. Control cable extends housing at 45° angle.
7. Turn indicator on engine end control to "N" or "Neutral" position.

NOTE: It is suggested that bends in cable be kept to a minimum to allow easier operation of controls.

8. Remove handle from remote control end housing and reset perpendicular to cable entering housing, if it is not already in this position. Be sure handle in on correct side of housing. (Figure 4, left)
9. Tighten screw which secures handle to control housing.

NOTE: Control housing can be set at angle if desired and, if this is the case, control lever can be moved to any desired position in relation to housing.

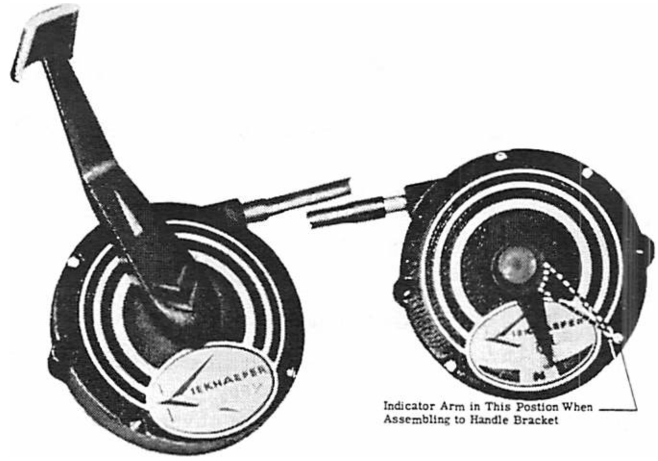


Figure 4. Control End (left) and Engine End (Right)

MOUNTING CONTROL HOUSING ON BOAT

1. Mount control housing on boat, and unit is complete.
2. Mount control cable on boat according to instructions under "Remote Throttle-Shift Controls", this Section.
3. Recheck shift and throttle positions to be sure both are correct and are in synchronization with one another.
4. On new-style control, place neutral decal on control housing.

DUAL INSTALLATION

1. Remove bottom 2 screws from each of 2 housings.
2. Install dual control bracket with washers and longer screws from kit. (Figure 5)
3. Replace handle of outside control with reverse bend handle from kit to allow side-by-side hand grips like multi-engine aircraft throttles. (Figure 5)

OPERATION

Shifting

There is no reverse shift lock button, and care must be exercised when shifting by remote control from forward to neutral and reverse.

Stopping

Operation of remote control lever does not allow engine to be shut off. To stop engine, use choke.

Figure 5. Dual Housing Installation

SPECIAL OUTBOARD SERVICE TOOLS

MERC 200-110-75-60-40-39

1. C-91-24144A2 - PISTON PIN BEARING TOOL
   Merc 60, Mark 6A-6-5, KF5, KF3
   Required for removing and installing piston pins.

2. C-91-24273 - BEARING MANDREL
   Merc 110-60-39
   Removes and installs drive shaft needle bearing.

   Mark 6A-6-5, KF5, KF3
   Removes and installs drive shaft and prop shaft needle bearings.

   A and B Quicksilver Lower Unit
   Removes and installs drive shaft needle bearing.

3. C-91-24282 - POWERHEAD STAND
   Merc 110-75-60-40-39, Mark 6A-6-5, KF5, KF3
   Holds powerhead in vise while servicing.

   Mark 6A-6-5, KF5, KF3
   Also used to install crankshaft and center main bearing and oil seal in lower crankcase.

4. C-91-33450 - GEAR CASE COVER TOOL
   Merc 200 Gear Shift
   For removing and installing gear case cover.

5. C-91-34230 - PISTON PIN BEARING TOOL
   Merc 110-75-40-39
   Removes and installs pistons on connecting rods.

6. C-91-36553A1 - PULLER HEAD, SWIVEL PIN
   Merc 110-75-60-40-39
   Removes swivel pin with aid of Slide Hammer Puller (C-91-34569A1).

7. C-91-48830 - GEAR CASE COVER TOOL *(Similar to C-91-33450)*
   Merc 110-75-60-40-39
   Removes and installs gear case cover.

8. C-91-59096A1 - MAKER POINT PHASING TOOL
   Use on Merc 200-110-75 (starting 1970).
   To properly phase maker points to fire 180° apart.

273R1

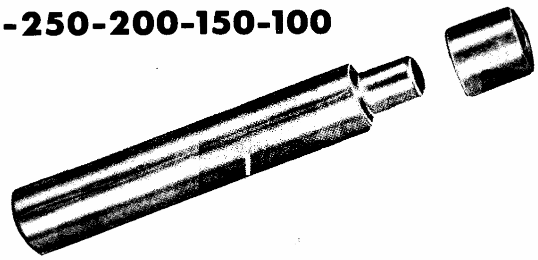
COMMON 2-CYLINDER

Required in Addition to Merc 110-75-60-40-39 and 402-400-350-250-200-150-100

1. C-91-22803A1 - PISTON PIN TOOL

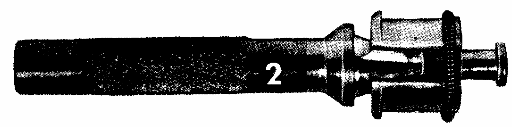
   Removes and installs piston on connecting rod.

   NOTE: All pistons from 2-11/32" (59.533cm) thru 2-9/16" (65.088cm)



2. C-91-24100A1 - BALL BEARING PULLER

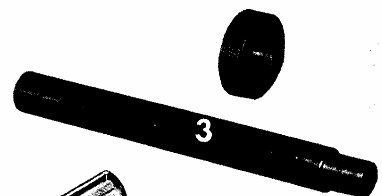
   Removes ball bearing from end cap or crankcase.



3. C-91-24147A1 - BEARING MANDREL

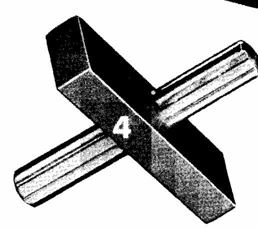
   Merc 200 Gear Shift - All Automatic Transmission Models
   Mark 30-25-20-15, KH7, D Quicksilver

   Removes and installs drive shaft and prop shaft needle bearing.



4. C-91-24259A1 - POWERHEAD STAND

   All 2-cylinder models excepting those using C-91-24282. Holds powerhead in vise while servicing.



5. C-91-24715A2 - NEEDLE BEARING TOOL

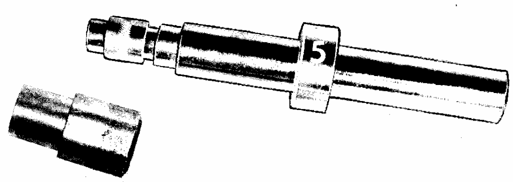
   Mark 6A-6-5 & KF5

   Removes and installs lower crankcase needle bearing.

   Mark 7, KE7, KF7, KE4, KG4

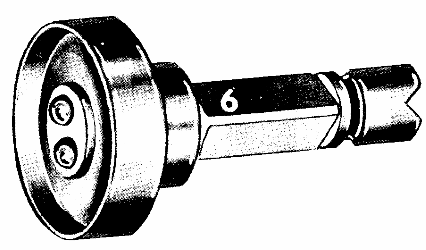
   Removes and installs prop shaft and drive shaft needle bearing. Installs A & B Quicksilver prop shaft roller bearing.

   NOTE: Also used on earlier 2-cylinder models, 10 H.P. or higher.



6. C-91-24735 - CLAMP SCREW FLARING TOOL

   Reflares thumbscrew on thumbscrew washer.



7. C-91-28619A1 - DEGREE PLATE ASSEMBLY

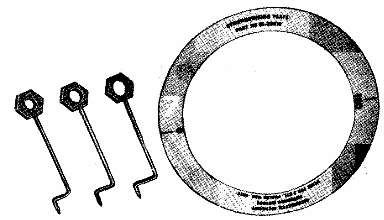
Accurately synchronizes points 180° for maximum performance at all engine speeds.

NOTE: Includes indicator arms for all models with Phelon magneto.

C-91-28623 - INDICATOR ARM (NLA)
Merc 110-60 & Mark 6-6A-7

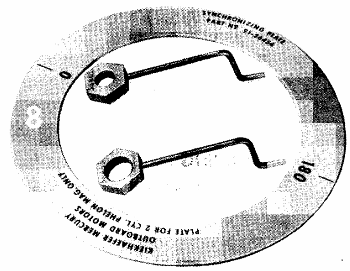
C-91-28885 - INDICATOR ARM
Mark 28-28A-25-15A-10-10A, Merc 200-150-100

C-91-28886 - INDICATOR ARM
Mark 15 & KG4



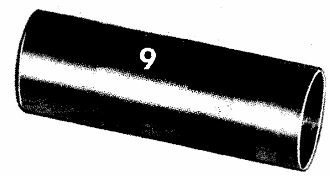
8. C-91-36454A1 - SYNCHRONIZING PLATE

Synchronizing Plate for 2-cyl. Merc 350-200-110 75-60 models which are equipped with the late-type Phelon magneto.



9. C-91-39014 - SEAL PROTECTOR
Merc 350 (2-Cyl.)

Used for installing upper end cap on Merc 350 to prevent damage to oil seal.

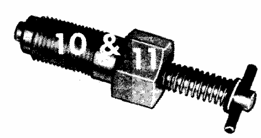


10. C-91-39735A1 - TIMING GAUGE .300 (NLA)
1966 Merc 350 (2-Cyl.)

Positions piston for accurate ignition timing.

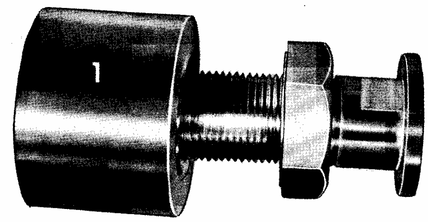
11. C-91-46707A1 - TIMING GAUGE .375 (NLA)
1967-68 Merc 200

Positions pistons for accurate ignition timing.



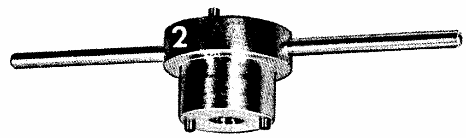
Merc 650-500-450-400-350-350 (2-Cyl.) -300 and Mark 58-58A-55-55A-35A

1. C-91-22118A1 - WATER PUMP CARTRIDGE PULLER
Removes water pump cartridge on all 4-cylinder models except, late Merc 500 and Merc 650.

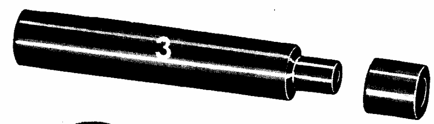


2. C-91-22119 - GEAR CASE & WATER PUMP COVER TOOL
Removes and installs gear housing cover, all models except Merc 650 and late Merc 500 models.

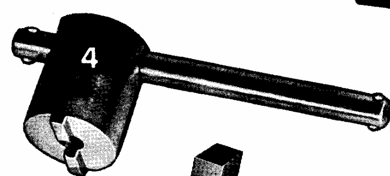
A-17-25104 Replacement Pin



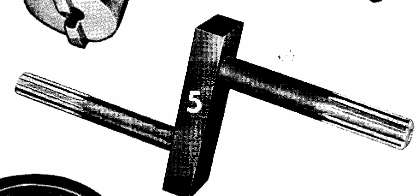
3. C-91-22803A1 - PISTON PIN BEARING TOOL
(Also Listed under "Common 2 Cylinder")
Removes and installs pistons on connecting rod.



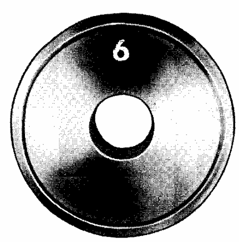
4. C-91-23033 - SHIFT SHAFT BUSHING TOOL
Removes and installs shift shaft bushing in gear housing assembly.



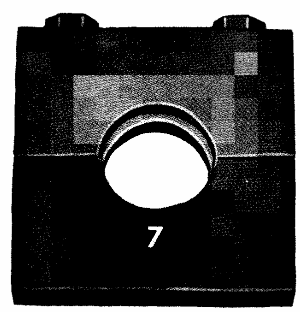
5. C-91-25821A1 - POWERHEAD STAND
Holds powerhead in vise while servicing.



6. C-91-31361 - DRIVER CUP
Merc 500-450
Installs tapered roller bearing cup in gear housing.

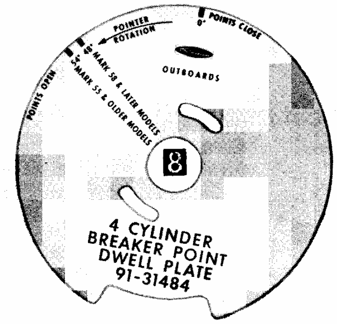


7. C-91-31483 - MAGNETO BEARING PULLER
Removes ball bearing from magnetic rotor.



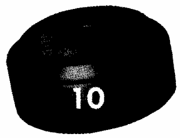
8. C-91-31484A2 - DWELL PLATE, 4-CYLINDER

Adjusts point dwell much more accurately than is possible with a feeler gauge.



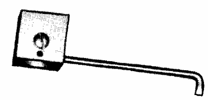
9. A-48-32618A1 - TEST WHEEL (Jet Exhaust)
(Superseded by C-91-32618A1)

For use in test tank to check motor operation.



10. C-91-39818 - TAPERED BEARING RACE TOOL - DRIVE SHAFT

Used on Merc 500-400-350 to install bearing race on drive shaft.

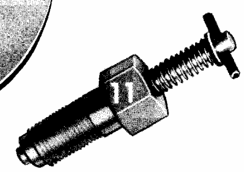


11. C-91-45123A1 - TIMING GAUGE .200 (NLA)
1965 and 1966 Merc 500

Positions piston for accurate ignition timing.

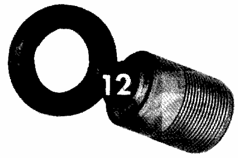
12. C-91-47448A1 - LIFTING EYE TOOL

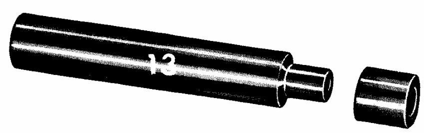
Tool screws into flywheel for lifting outboard motors.



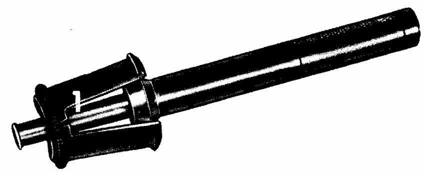
13. C-91-52395A1 - PISTON PIN TOOL
(Similar to C-91-22803A1 Tool)

For use on 1968 and later Merc 500 and Merc 200 to install pistons on connecting rods.



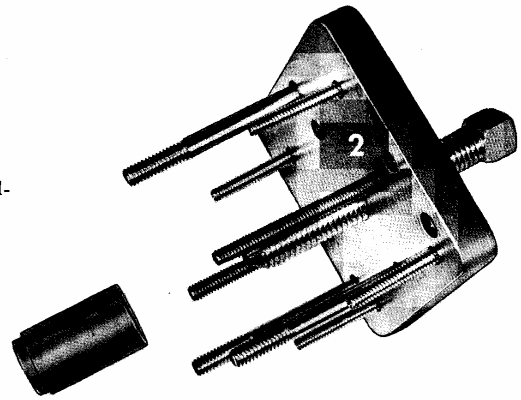


COMMON 4 and 6-CYLINDER TOOLS
Required in Addition to Tools Listed
Under 4-Cylinder and 6-Cylinder Tools

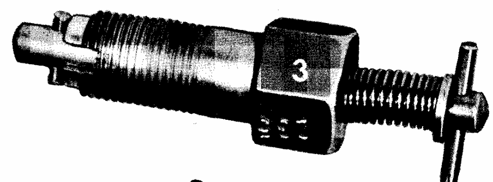


1. C-91-24100A1 - BALL BEARING PULLER
   Removes ball bearing from crankcase end caps. Press out with arbor press.

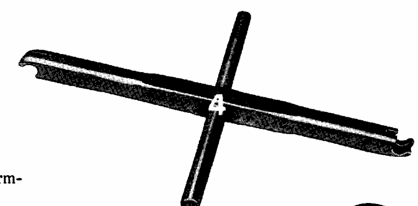
   A-24-24131 - Replacement spring



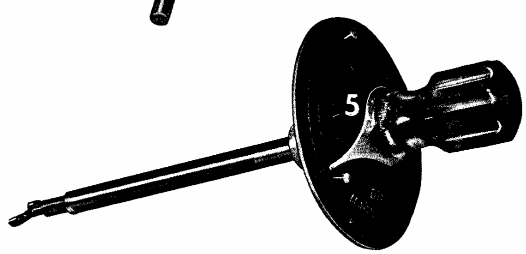
2. C-91-25733A2 - END CAP PULLER - UNIVERSAL
   Removes crankcase end caps without disassembling powerhead.
   C-10-20965 Screw 12-24 x 2¾
   A-10-20967 Screw, center puller
   C-10-20969 Screw ¼-20 x 3
   C-10-26410 Screw 10-24 x 2-1/16
   C-11-20890 Nut ¼-20



3. C-91-26916A1 - TIMING GAUGE .235" (5.969mm) (NLA)
   Positions piston for accurate ignition timing.



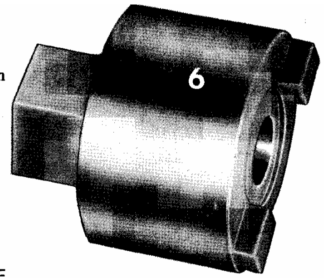
4. C-91-28883 - BREAKER POINT ALIGNING TOOL
   Aligns breaker points to assure maximum performance.



5. C-91-29406 - BREAKER SPRING TORQUE SCALE
   Measures spring tension of moveable breaker arm.

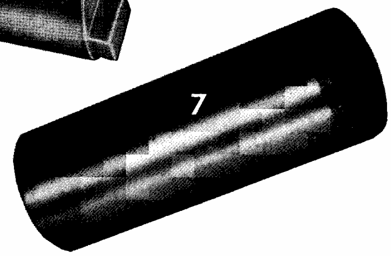
6. C-91-31107 - SHIFT SHAFT TOOL
Merc 1100-1000-950-900-850-800-700-650

Removes and installs shift shaft bushing in gear housing assembly.

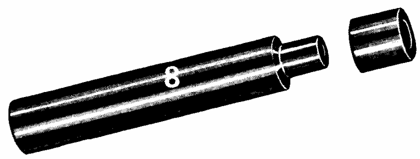


7. C-91-38461 - SLEEVE, OIL SEAL, WATER PUMP BASE

Used to protect oil seal when installing water pump base.

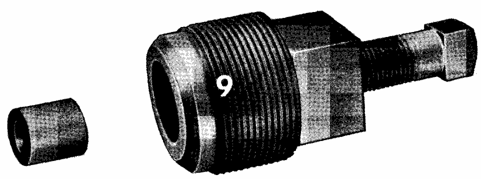


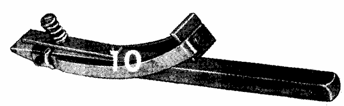
8. C-91-46739A2 - PISTON PIN TOOL
(Similar to C-91-22803A1 Tool)
To install pistons on connecting rods.



9. C-91-48501A1 - FLYWHEEL PULLER

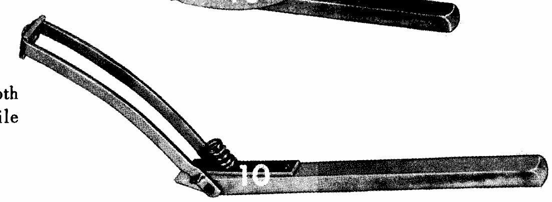
Used to pull flex plate type flywheels.





10. C-91-52344 - FLYWHEEL HOLDING TOOL

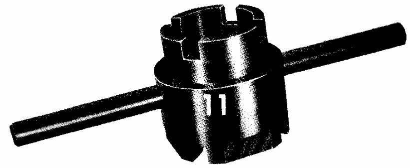
Holds the outboard flywheel (with starter gear tooth ring). Tool is designed to hold the flywheel while removing or torquing.



11. C-91-53126 - GEAR CASE COVER TOOL

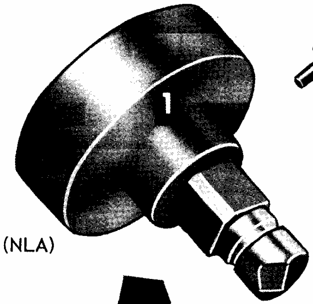
NOTE: Also for MerCruiser 60-80-90-I and II lower unit.

Removes and installs gear case cover.

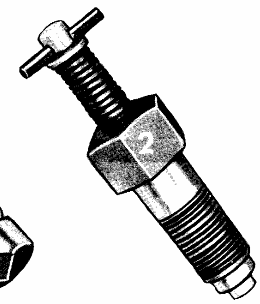


MERC 1500-1400-1350-1250-1150-1100-1000-950-900-850-800-700-650 GEAR SHIFT

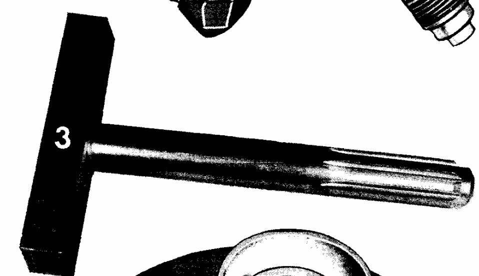
1. C-91-26930 - THUMB SCREW FLARING TOOL
   Reflares thumb screw on thumb screw washer.



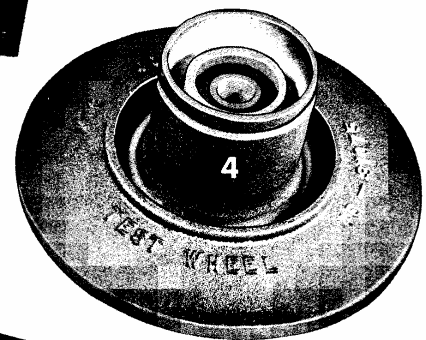
2. C-91-30292A1 - TIMING GAUGE .275" (6.985mm) B.T.D.C. (NLA)
   Merc 1100-950
   Positions pistons for accurate ignition timing.



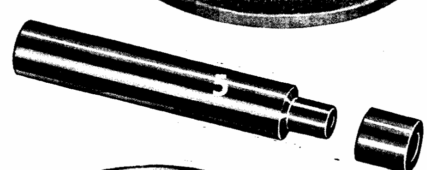
3. C-91-30591A1 - POWERHEAD STAND
   All 6-cylinder models and 650 4-cylinder.



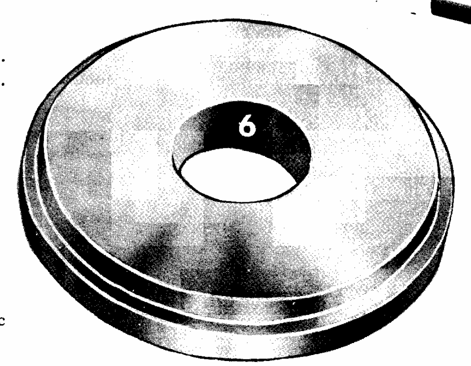
4. A-48-30724A2 - TEST WHEEL
   Merc 850 (76 Cu. In.) 800-700 Full Gear Shift.
   For checking motor operation in test tank.



5. C-91-30766A1 - PISTON PIN TOOL
   All models with 2¾" (69.850mm) piston and larger.
   Removes and installs piston on connecting rod.

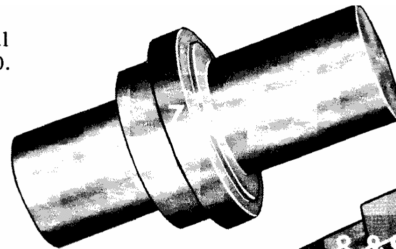


6. C-91-31106 - BEARING DRIVE CUP
   Installs forward gear bearing cup - including Merc 650 4-cylinder.



7. C-91-31108 - OIL SEAL DRIVER

Installs and properly positions prop shaft oil seal in bearing carrier of lower unit. Includes Merc 650.

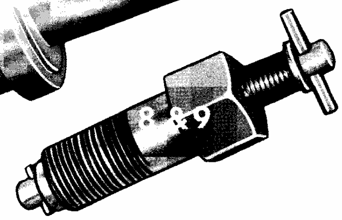


8. C-91-31161A1 - TIMING GAUGE .015" (0.381mm) (NLA)

Accurately gauges forward throttle pickup.

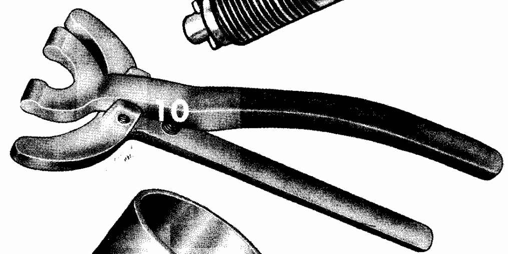
9. C-91-32253A1 - TIMING GAUGE .222" (5.639mm) (NLA)
Merc 1100-1000-950-900-850 (90 Cu. In. [1474.845cc])-650-350

Positions pistons for accurate ignition timing.



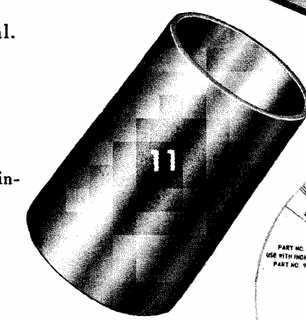
10. C-91-32477A1 - ROTOR PULLER PLIERS

Minimizes the breakage of rotors during removal.



11. C-91-32699 - OIL SEAL SLEEVE

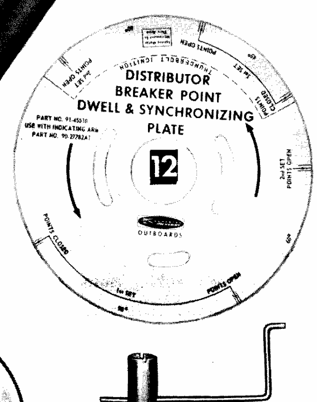
Prevents damage to prop shaft oil seal when installing bearing carrier.



12. C-91-45510A1 - DEGREE PLATE ASSEMBLY

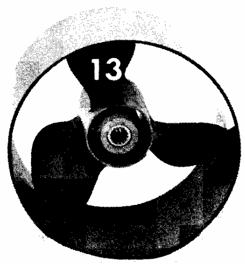
Accurately sets dwell and synchronization of breaker points.

C-10-21562 Replacement Screw
A-91-45510 Degree Plate



13. C-91-52832A2 - LOAD PROPELLER (Superseded by C-91-52831A2) Merc 1250-1000-800

For checking motor operation in test tank.

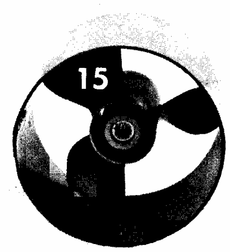


14. C-91-52952A1 - PISTON PIN LOCK RING TOOL

For removing tabless pin retaining rings.

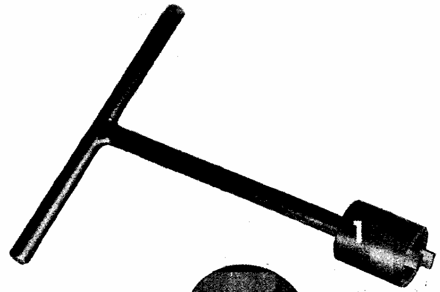
15. C-91-59165A1 - LOAD PROPELLER
Merc 1350-1150

For checking motor operation in test tank.



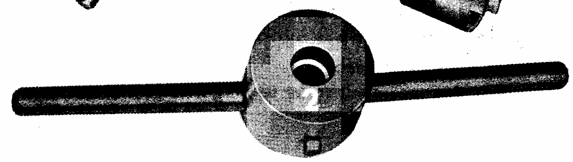
MERC 250-200-150-100 and MARK 28A-28-15A-10A-10
AUTOMATIC TRANSMISSION

1. C-91-27532A1 - BALL BEARING RING TOOL
   Removes and installs ball bearing ring lock holding drive shaft ball bearing and water pump assembly in drive shaft housing.

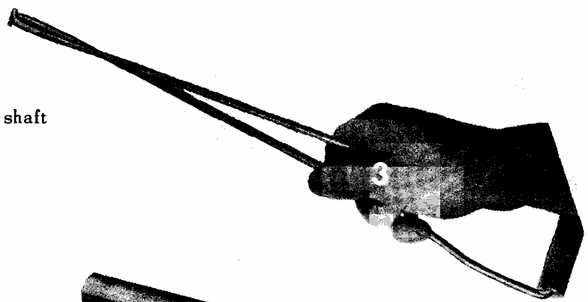


2. C-91-27534A1 - GEAR HOUSING COVER TOOL
   Removes and installs gear housing cover.

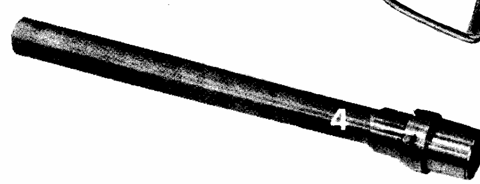
   C-10-20716 Replacement Screw

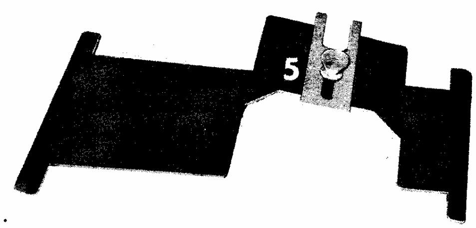


3. C-91-27780 - WATER PUMP CARTRIDGE PULLER
   Removes water pump cartridge from drive shaft housing.

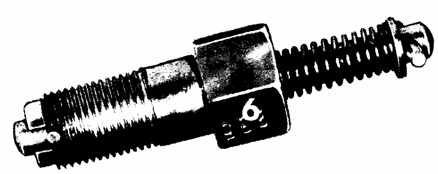


4. C-91-28742A1 - WATER PUMP INSTALLATION SHAFT
   Used in conjunction with Ball Bearing Ring Tool (C-91-27532A1) to aid in installation of water pump cartridge, impeller, ball bearing and retainer ring.





5. C-91-28987A1 - TRANSMISSION GAUGE
   Necessary for accurate shimming of transmission.

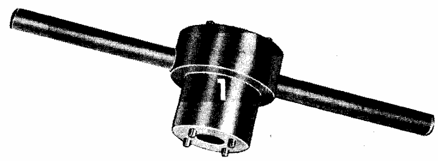


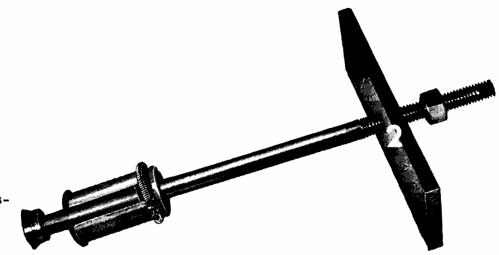
6. C-91-30292A1 - TIMING GAUGE .275" (6.985mm) B.T.D.C. (NLA)
   Positions piston for accurate ignition timing.
   (Plus Common 2-Cylinder Tools)

MERC 800-700-600 DIRECT REVERSING

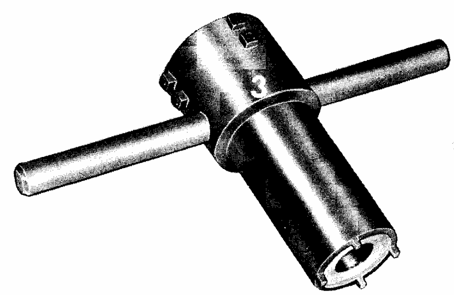
1. C-91-26374A1 - GEAR CASE COVER TOOL
   Merc 600 - Mark 78-78A-75A
   Removes and installs gear case cover.

   A-17-25104 Replacement Pin

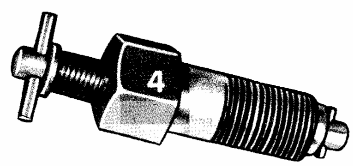




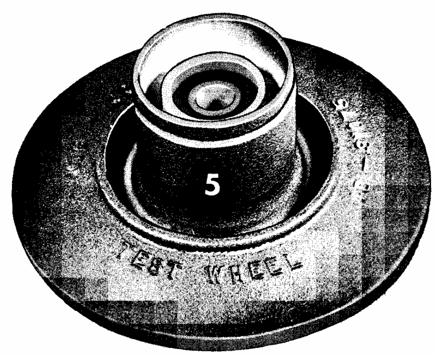
2. C-91-29312A1 - ROLLER BEARING PULLER
   All Direct Reversing Models
   Removes prop shaft roller bearing from gear housing.



3. C-91-29925A1 - GEARHOUSING COVER and PROPELLER GEAR LOCKNUT
   Merc 700
   Removes and installs gear housing cover.
   Merc 800-700-600 - Mark 78-78A-75A
   Removes and installs gear locknut.



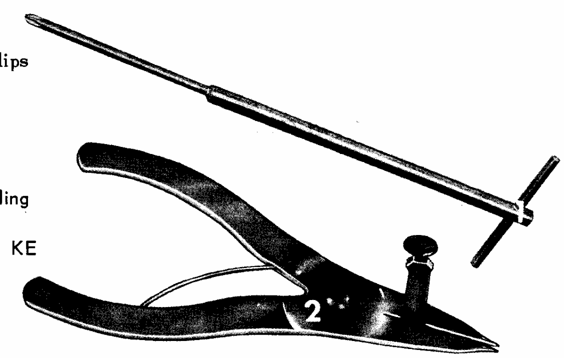
C-91-30290A1 - TIMING GAUGE .030" (0.762mm) (NLA)
Accurately gauges forward throttle pickup.



5. A-48-31075A1 - TEST WHEEL (NLA)
   Merc 800-700 Direct Reversing
   For checking motor operation in test tank.

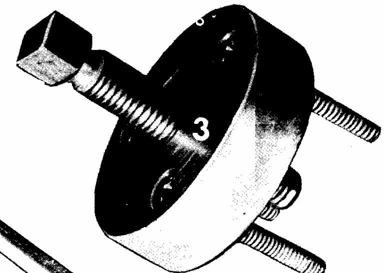
TOOLS - GENERAL

Required in Addition to Tools Specified by Models

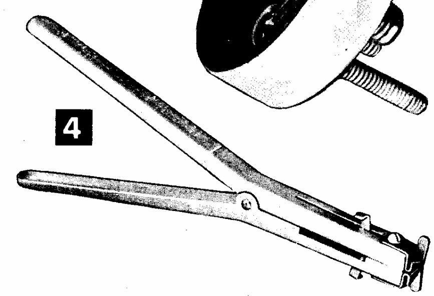


1. C-91-24279 - WATER INLET CAP SCREWDRIVER
   Mark 6, Mark 5, and KF5
   Removes water inlet cap screws with Phillips No. 1 screwdriver tip.

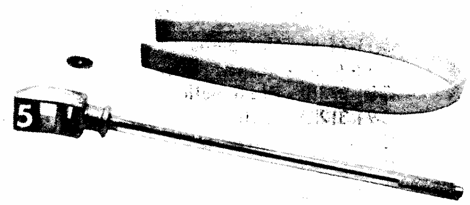
2. C-91-24283 - TRUARC SNAP RING PLIERS (Expanding Type)
   All Direct Reversing Models and Mark 6-5, KG, KF, KE Models
   Removes snap rings in lower units.



3. C-91-24695A2 - FLYWHEEL PULLER
   All Models, except Merc 1500-1400-1350-1250-1150-1100-1000-950-900-850-800 (4-Cyl.) (90 Cu. In.) and 650
   Pulls flywheel. Place plug over end of crankshaft to protect threads and prevent possible break of shaft tip. Attach puller to flywheel evenly and secure with 3 screws. Tighten center screw, tapping with hammer if flywheel is exceptionally tight.
   (a) A-10-20967 - Replacement Center Screw, ½-13
   A-10-27074 - Replacement Center Screw, ½-20
   (b) C-10-26948 - Replacement Screw, ¼-20
   C-10-24624 - Replacement Screw, ¼-28
   C-10-21449 - Replacement Screw, 5/16-24

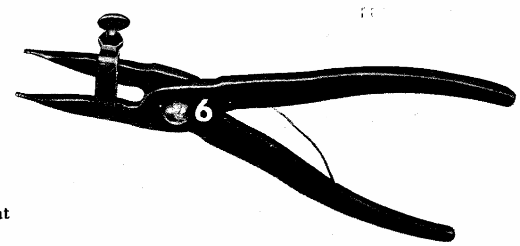


4. C-91-24697 - PISTON RING EXPANDER
   All Models
   Removes and installs piston rings from pistons.



5. C-91-24937A1 - UNIVERSAL FLYWHEEL HOLDER
   All Model Outboards. (See C-91-52344 for Electric Starting Models.)
   Holds flywheel while removing flywheel nut.

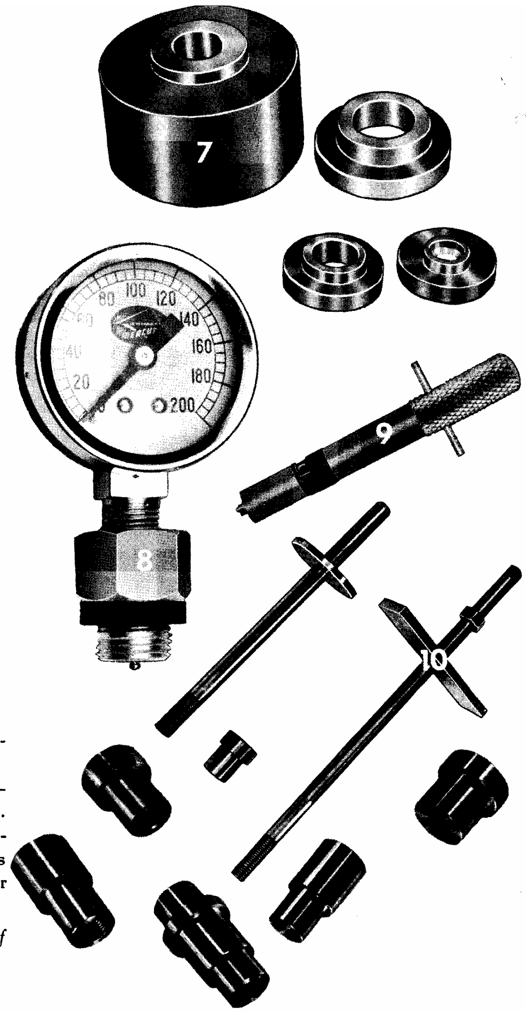
   Replacement Parts:
   A-91-24940 - Web Belt (Special)



6. C-91-25081 - TRUARC SNAP RING PLIERS (Compressing Type)
   All 2-Cylinder Models and Mark 30-25
   Removes and installs snap rings in Dyna-Float mounting.

7. C-91-26376A1 - PROPELLER SHAFT GEAR TOOL
All Models

Removes and installs propeller shaft ball bearings and gears. Open end of cup used to remove ball bearing; other end used to remove and install gear. Place collar on top of cup to replace ball bearing.



8. C-91-29287 - COMPRESSION TESTER
All Models

Tests compression in cylinders. Registers 0-to-200 lbs. per sq. in. (0-to-014.060kg/cm^3). When checking compression, a variation of more than 15 lbs. per sq. in. (1.055kg/cm^3) between cylinders indicates the lower compression cylinders are in some way defective, such as worn or sticking piston rings and/or scored pistons and cylinders.

Valve Cores (No. 1566 T-600) may be purchased from: Schrader
Divison of Scovill Automotive Products
Dickson, Tennessee 37055

9. C-91-29795A1 - FIXED JET REMOVAL TOOL
All Engines with Fixed High Speed Carburetor Jets

Assures easy removal of fixed high speed jets from carburetors.

10. C-91-31229A1 - MERCURY OUTBOARD BEARING REMOVING & INSTALLING KIT *(See Next Page.)*

A bearing removing and installing kit allows addition of various adaptors for Mercury Outboards. This eliminates the purchase of larger, more expensive mandrels for each bearing. It also provides for greater versatility and is adaptable to other products.

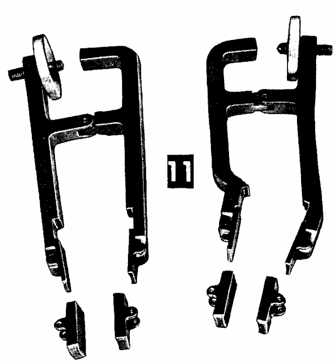
NOTE: DO NOT order individual tools if C-91-31229A1 is ordered.

C-11-24156 - Nut, puller
B-12-34961 - Washer, puller
C-91-29310 - Plate, puller
C-91-31229 - Shaft, puller
C-91-36569 - Driver Head
C-91-37263 - Adaptor, bearing
C-91-37292 - Puller, head
C-91-37311 - Driver Head
C-91-37312 - Driver Head
C-91-37323 - Rod, driver
C-91-37350 - Washer, pilot

11. C-91-31461A2 - RING COMPRESSOR KIT
All Models

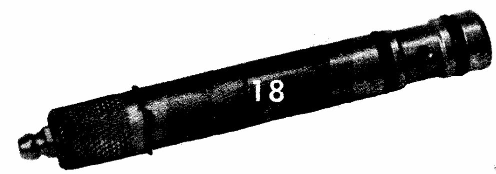
Set of 3 ring compressors to install pistons into cylinder blocks. (For Merc 1500-1400-1350-1250-1150-800-400, use C-91-47844A2.)

Replacement Shoe - C-91-28887

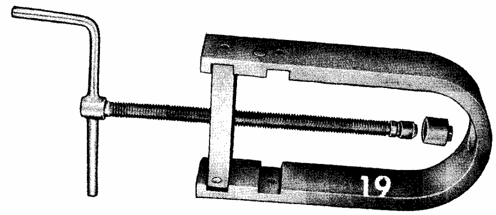


273R1

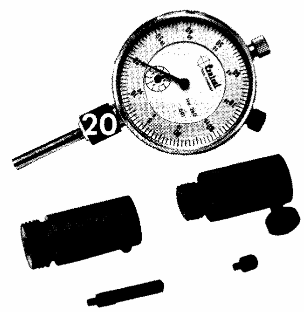
18. C-91-52561A1 - SWIVEL BRACKET LUBRICATING TOOL
Used to lubricate hinge points between swivel bracket and tilt tube; 1967 and newer outboards.



19. C-91-54453A1 - PISTON PIN TOOL
All Models
Remove and install piston pins on all models.



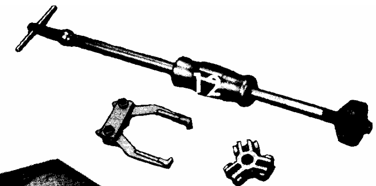
20. C-91-58222 - DIAL INDICATOR TIMING GAUGE
Used to set timing on all models.

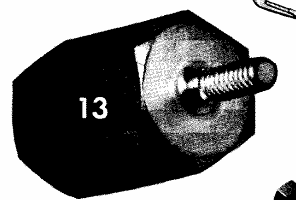


12. C-91-34569A1 - SLIDE HAMMER PULLER

Removing all tapered roller bearing cups from Mercury Outboards. Removing reverse gear assembly from bearing carrier from Mercury Outboards. Will fit other applications as well.

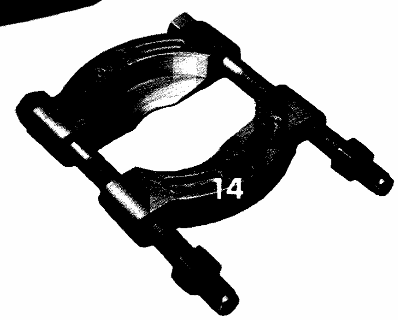
C-91-34570 - Jaws - Replacement, Slide Hammer Puller





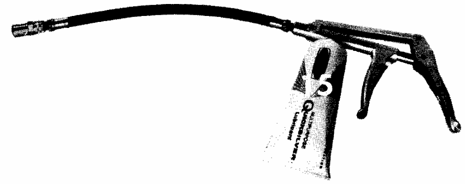
13. C-91-36062 - ADAPTOR, RUBBER MOUNT PULLER

The Rubber Mount Puller Adaptor, ¼-20 is used with Slide Hammer Puller (C-91-34569A1). Adaptor is designed to pull upper and lower rubber mounts from drive shaft housing.



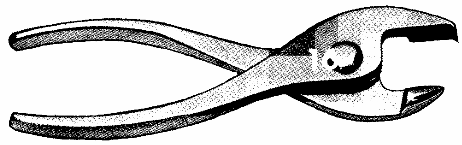
14. C-91-37241 - UNIVERSAL PULLER PLATE

For pulling gears and bearings on all outboards. The "knife-like" edges of puller plates may be forced behind the part. The finest alloy steels and expert heat treating assures unequaled strength. This plate supersedes previous puller plates.



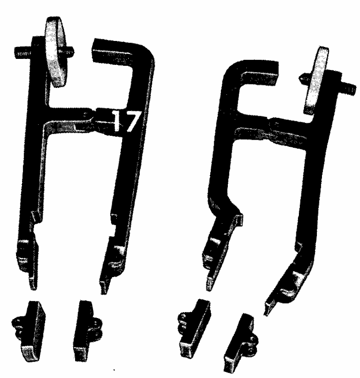
15. C-91-37299 - PISTOLUBER GREASE GUN

Squeeze-grip design permits one hand operation. High pressure 12" flexible hose allows easy access to grease fittings on outboards and stern drive units. Multipurpose Lubricant (C-92-49588) tube screws directly on grease gun to prevent possible contamination of lubricant. Light-weight and easy-to-use, the Pistoluber Grease Gun is ideal for resale to customers.



16. C-91-38277 - PLIERS, PROP NUT TAB WASHER

Bends tab on propeller nut tab washer onto nut.



17. C-91-47844A2 - RING COMPRESSOR SET - 4 & 6-Cyl.

(Similar to C-91-31461A2 Ring Compressor)

Set of three ring compressors to install pistons into cylinder block.

Replacement Shoes - C-91-47842A1 - For above ring compressors (1 set)

MERCURY

KIEKHAEFER CORP.

(General Offices)
Fond du Lac, Wisc.

(Parts and Service Division)
Beaver Dam, Wisc.

CONDENSED SERVICE DATA

Series Year Produced	6 hp
1955	Mark 5 Mark 6
1956	Mark 6
1957	Mark 6
1958	Mark 6
1959	Mark 6A

TUNE-UP

Hp @ rpm	6 @ 4500
Bore — Inches	1¾
Stroke — Inches	1½
Number of cylinders	2
Displacement — Cu. In.	7.2

Spark Plug

Champion	J7J
AC	M45
Electrode gap	0.025

Magneto

Make	Scintilla or Phelon
Point gap	0.018
Timing	See Text

Carburetor

Make	Tillotson
Model	AJ-30B or AJ-46A
Adjustment	See Text
Fuel — Oil Ratio	20:1

SIZES—CLEARANCES POWER HEAD

Piston Rings	Publication Not Authorized by Manufacturer
End Gap	
Side Clearance	
Piston Skirt Clearance	
Crankshaft Bearing Journal Diameter	
Upper main bearing	
Center main bearing	
Lower main bearing	
Crankpin	

Crankshaft Bearing Diametral Clearance

Upper main bearing	Roller Brng.
Center main bearing	
Lower main bearing	Roller Brng.
Crankpin	Roller Brng.
Piston Pin Diameter	
Clearance	Roller Brng.

TIGHTENING TORQUES

(All Values In Inch—Pounds)

Connecting Rod	80
Flywheel Nut	480
Spark Plug	180

LUBRICATION

The power head is lubricated with oil mixed with the fuel. If "Kiekhaefer Quicksilver" 2-cycle engine oil is used, one 12 ounce can should be mixed with each 2 gallons of gasoline. If "Quicksilver" oil is not available a good grade non-detergent SAE 30 motor oil may be substituted by mixing ½ pint with each gallon of fuel. Gasoline and oil should be thoroughly mixed. Marine white, automotive white, or light-aircraft gasoline is recommended. If not available, use a suitable "Regular" gasoline.

The lower unit gears and bearings are lubricated by oil contained in the gear case. Special "Quicksilver Outboard Gear Lubricant" or a non-channeling, waterproof marine gear lubricant should be used. Gearcase is filled through the forward plug hole on starboard side of case, with motor in an upright position. The vent plug (located aft of fill plug) should be removed when filling. Lubricant should be maintained at level of vent plug.

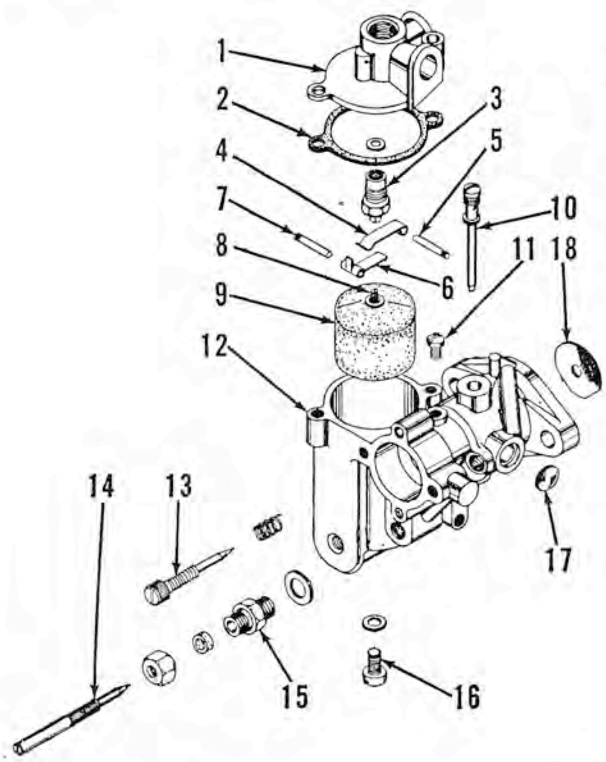


Fig. M1 — Exploded view of Tillotson carburetor of the type used on all models.

1. Bowl cover
2. Gasket
3. Inlet needle & seat
4. Secondary lever
5. Shaft
6. Primary lever
7. Shaft
8. Float spring
9. Float
10. Idle tube
11. Channel plug
12. Body
13. Idle needle
14. High speed needle
15. Gland nut
16. Drain plug
17. Plug
18. Throttle valve

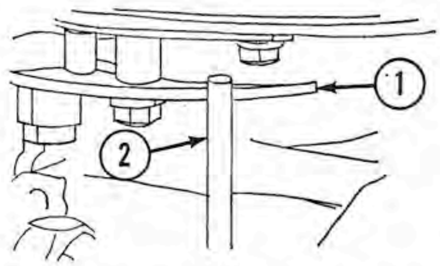


Fig. M3—Schematic view of speed control linkage. Refer to text for details of adjustment.

1. Throttle cam
2. Follower lever

FUEL SYSTEM

CARBURETOR. Tillotson, AJ series, float fed carburetors are used. Refer to Fig. M1. Initial setting is one turn open from closed position for the idle needle (13), and 1½ turns open for the high speed needle (14). Run motor until operating temperature is reached, then shift to forward gear and open the throttle. Slowly turn high speed needle (14) clockwise until motor falters or slows because of a too lean mixture; then back needle out approximately ½-turn. After high speed needle has been properly adjusted, regulate the idle needle until engine runs smoothly under load at slow speed. Turning idle needle clockwise will lean the mixture.

The recommended fuel level is approximately $\frac{11}{16}$-inch below gasket surface of float bowl. To adjust the fuel level, remove bowl cover (1) and refer to Fig M2. Invert the cover, and with inlet needle (6) closed, measure the distance between primary lever (9) and gasket surface of bowl cover as shown at (A). This dimension should be $\frac{13}{32}$-inch, if it is not, bend the curved tang on secondary lever (8) until correct measurement is obtained. After adjusting the flaot height, bend the vertical tang on primary lever (9) to allow a maximum clearance (B) of 0.040 between secondary lever (8) and inlet needle (6).

Model numbers and Tillotson parts lists are as follows:

Model AJ-30B

Repair kit	RK-226
Gasket set	GS-113
Inlet needle & seat	08669
Float	08215
Idle adjustment screw	09019
Idle tube	07113
Main adjusting screw	09441

Model AJ-46A

Repair kit	RK-155
Gasket set	GS-107
Inlet needle & seat	010400
Float	09085
Idle adjustment screw	010155
Idle tube	010232
Main adjusting screw	010327

SPEED CONTROL LINKAGE. The speed control grip or lever moves the magneto stator plate to advance or retard the ignition timing. The throttle valve is synchronized to open as timing is advanced. It is extremely important that ignition timing and throttle valve opening be correctly synchronized to obtain satisfactory operation. To synchronize the linkage, move the speed control grip until the throttle cam (1—Fig. M3), attached to bottom of the magneto stator plate, is at the front centerline of the power head. Loosen the cam attaching screws and move the cam on stator plate until it contacts follower lever (2) and just starts to open the throttle valve.

REED VALVES. The inlet reed valves are located on the crankshaft center main bearing assembly as shown in Fig. M4. Crankshaft must be removed before reed valves can be serviced.

Reed petals (RP) should be perfectly flat and have no more than 0.007 clearance between free end of reed petal and seating surface of center main bearing. The reed stop (RS) must be carefully adjusted to provide 7/64-inch clearance between end of stop and seating surface on bearing housing as shown at (A). Seating surface of bearing must be smooth and flat, and may be refinished on a lapping plate after removing reed valves and dowels. Do not attempt to bend or straighten a reed petal to modify performance, and never install a bent petal. Lubricate the reed valve units with "Quicksilver" Multipurpose lubricant or a light distributor cam grease when reassembling.

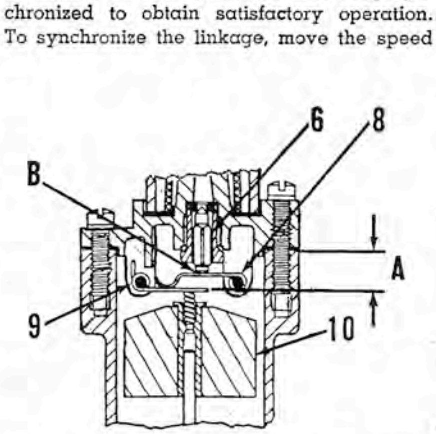


Fig. M2—Schematic view of float mechanism showing method of adjustment. Refer to text.

A. Closing adjustment
B. Open adjustment
6. Inlet needle
8. Secondary lever
9. Primary lever
10. Float

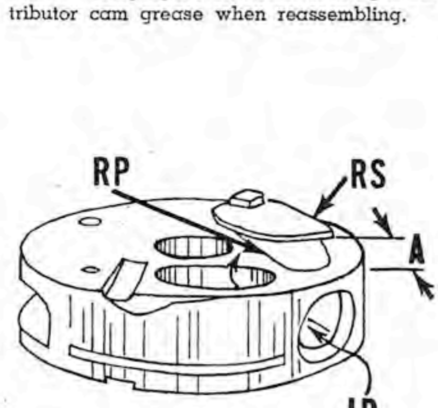


Fig. M4—Center main bearing showing inlet reed valves. Adjustment (A) of reed stop (RS) is 7/64 inch.

A. Adjustment
IP. Inlet port
RP. Reed petal
RS. Reed stop

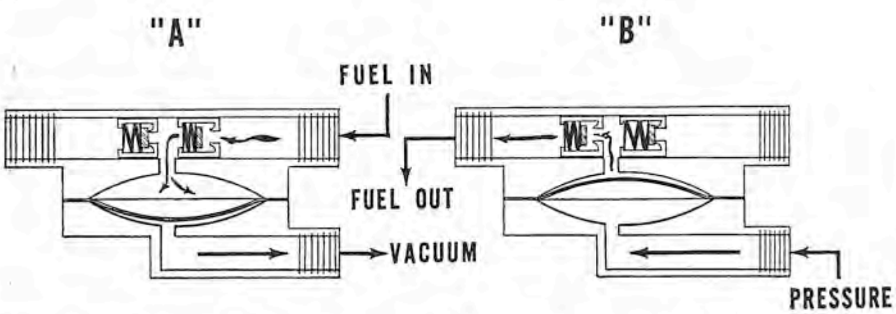


Fig. M5—Schematic view of diaphragm type fuel pump showing method of operation. Vacuum - Pressure line attaches to lower crankcase. When powerhead piston moves upward in cylinder, vacuum in crankcase draws diaphragm out and fuel in as shown in view "A". Crankcase pressure resulting from power stroke forces diaphragm in and fuel out as shown in view "B".

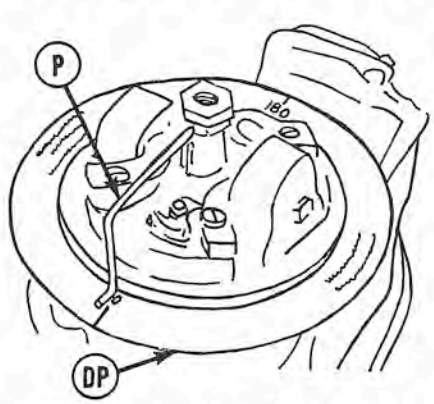


Fig. M8—Synchronizing tool installed for adjusting the magneto points. Refer to text for details.

DP. Degree plate P. Pointer

FUEL PUMP. A diaphragm type fuel pump is used, which is operated by pressure and vacuum pulsations in the lower crankcase as shown in Fig. M5. Vacuum in the crankcase draws the diaphragm down, pulling fuel past the inlet check valve as shown in view "A." Crankcase pressure forces the diaphragm out and the trapped fuel enters the carburetor line past the outlet check valve as shown in view "B."

All defective or questionable parts should be renewed. Check valves must both be pressed out at the same time, working from the OUTLET side of fuel passage. Press valves in from inlet side to the depths shown in Fig. M7.

IGNITION

Breaker point gap should be set at approximately 0.018 on highest lobe of cam. The two sets of points should be set to open at exactly 180 degree intervals. The points may be synchronized by using the Mercury Synchronizing Tool set, part number 91-28619A1 shown in Fig. M8 (or equivalent), plus a timing test light such as that shown in Fig. M9. To adjust the timing, remove the flywheel and install the degree plate (DP—Fig. M8) and pointer (P). Set the contact points for top cylinder at 0.018. Remove the spark plugs and install the test light by attaching one clip to insulated point connection and the other clip to a suitable ground. Turn the crankshaft clockwise slowly until the points just open as indicated by the test light bulb going out. Turn the degree plate until the 0° timing mark is aligned with the pointer as shown. Attach the test light to the other set of points and turn the crankshaft until timing pointer is aligned with the 180° timing mark on degree plate; then adjust the second set of points to barely open. Recheck both sets of points with the degree plate and timing light. If the synchronizing tools are not available, renew the points or dress the contacts to remove any irregularities, then set each set of points to exactly 0.018 working from the same position on the magneto cam.

A quick check of magneto condition can be made without disassembly by removing the spark plugs and holding one spark plug wire about ⅛-inch away from cylinder head. Have someone spin the motor and note the condition of the spark. Although, in bright daylight, the spark may not be visible, a distinct snap will be noted as spark jumps the gap. If spark is weak or erratic, adjust the points as outlined above. Be sure to note point condition. While flywheel is off, carefully examine the wiring and the insulation of the magneto coils. Look for broken or worn insulation or broken wires. Also check for loose or corroded connections. Renew any parts which are damaged or in poor condition. Lubricate the cam wick and breaker arm pivot with a high meling point distributor or magneto grease.

COOLING SYSTEM

WATER PUMP. The rubber impeller type water pump is housed in the lower drive shaft housing. Impeller is mounted on and driven by the lower unit drive shaft. The pump housing is offset with relation to drive shaft as shown in Fig. M10. Flexing of the impeller blades varies displacement volume between the blades which causes water to be drawn through inlet and forced upward into power head. At high speeds, the impeller blades remain partially curved as indicated by the broken lines (HS), and the pump operates partially by centrifugal action.

When cooling system problems are encountered, first check the water inlet for plugging or partial stoppage, then if not corrected, remove and disassemble the lower unit as outlined in the LOWER UNIT section and examine the water pump, water tubes and seals. The water inlet is located on the sides of the lower unit gearcase, the water passing up through a housing which surrounds the propeller shaft.

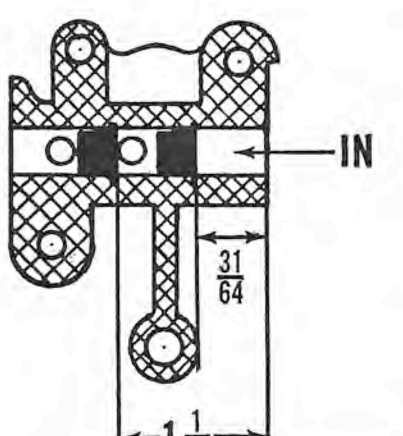


Fig. M7—When renewing the fuel pump check valves, press both valves in from inlet side to the distances shown.

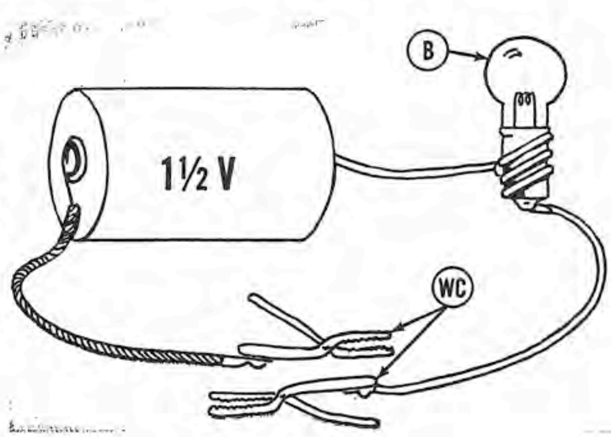


Fig. M9 — A timing test light can be constructed as shown, using a flashlight battery, bulb (B), two wire clips (WC) and short pieces of wire.

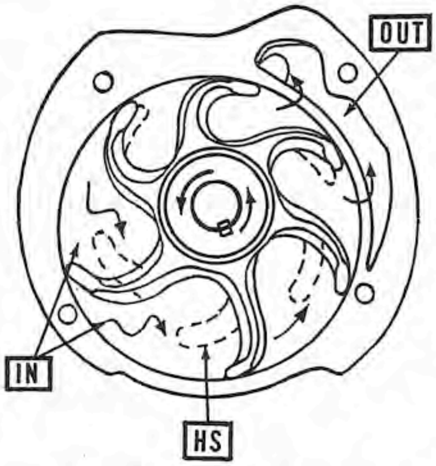


Fig. M10—Schematic view of the rubber impeller type water pump. Flexing of the impeller blades in offset housing causes water to be drawn into pump through inlet ports (IN) and forced into power head through outlet ports (OUT). At high speeds, blades remain partially curved as shown by broken lines (HS) and pump becomes a centrifugal pump.

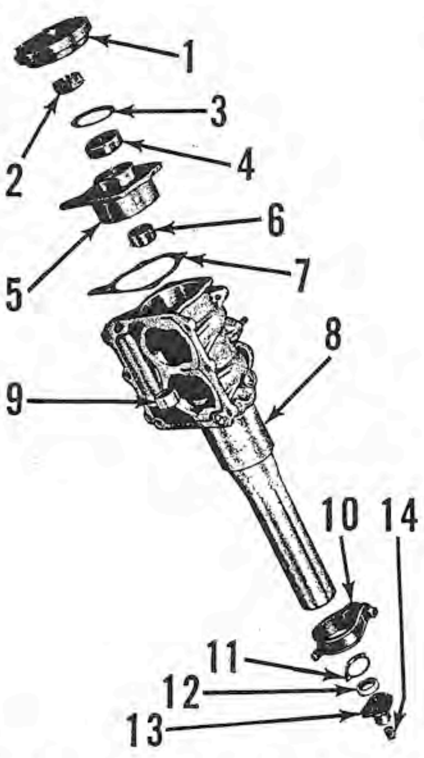


Fig. M11—Exploded view of the one-piece crankcase and associated parts.

1. Housing cap
2. Bearing nut
3. Thrust washer
4. Ball bearing
5. Housing
6. Roller bearing
7. Gasket
8. Crankcase
9. Roller bearing
10. Co-pilot ring
11. Gasket
12. Oil seal
13. Water inlet cap
14. Bushing

POWER HEAD

R&R AND DISASSEMBLE. To remove the power head assembly, first remove the top cowl, then disconnect and remove the shift cable. Remove the slotted special screw in front top of lower unit driveshaft housing, loosen the clamping bolt at top rear of driveshaft housing, then withdraw the lower unit assembly downward out of swivel bracket and power head assembly. Loosen the clamping screw in co-pilot locking ring (10—Fig. M11) and withdraw the power head assembly upward out of swivel bracket and lower cowl.

The powerhead stand, Mercury part number 91-24282, or equivalent is required to disassemble the removed power head. Place the stand in a vise and set the powerhead on the stand; then remove the flywheel, magneto, carburetor and inlet manifold. Remove the housing cap (1) and dished thrust washer (3) from upper bearing housing, remove flywheel key, then unscrew and remove the upper bearing retaining nut (2). NOTE: Nut is secured with LEFT HAND thread.

Remove the screws retaining bearing housing (5), then remove housing using a puller with legs which will screw into threaded holes in housing.

Remove the spark plugs, then unbolt and remove the cylinder assembly from the crankcase, crankshaft and pistons assembly. Cylinder block cover (6—Fig. M12) and inlet port cover (2) should be removed for inspection and cleaning of the block.

Remove the screws retaining water inlet cap (13—Fig. M11) from crankcase pivot tube using Mercury tool number 91-24279, or a No. 1 Phillips screwdriver socket and extension. Remove the water inlet cap (13).

Hold the connecting rod cap with the formed cap holder (Tool Number 91-24281), remove the retaining screws, then remove the connecting rod and piston assemblies. Keep the assemblies together and make sure they are properly marked for reinsertion in the same cylinder. There are 23 loose needle rollers in each connecting rod crankpin bearing. Make sure all bearings are removed from crankcase and kept with the assembly.

Remove the center main bearing locking screw from side of crankcase and scribe a line across center main bearing and center bridge of crankcase to aid in alignment of bearing when reinstalling. Refer to Fig. M13. Place spacers or jacks (J) between counterweights of crankshaft to prevent springing or breakage of shaft. Jacks may be fashioned of brass, hardwood blocks, or a short bolt and nut may be used. Use the Mercury powerhead stand as an arbor, and press the crankshaft and center main bearing out the top of the crankcase assembly. Inspect and overhaul the power head components as outlined in the appropriate following paragraphs.

ASSEMBLY. Because of the two-cycle design, crankcase and inlet manifold must be completely sealed against both vacuum and pressure. Exhaust manifold and water

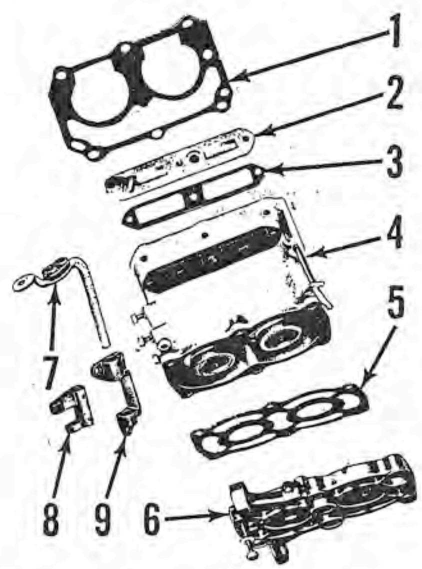


Fig. M12—Exploded view of power head cylinder and component parts.

1. Gasket
2. Transfer port cover
3. Gasket
4. Cylinder
5. Gasket
6. Cylinder cover
7. Pivot lever
8. Link lever
9. Clutch bracket

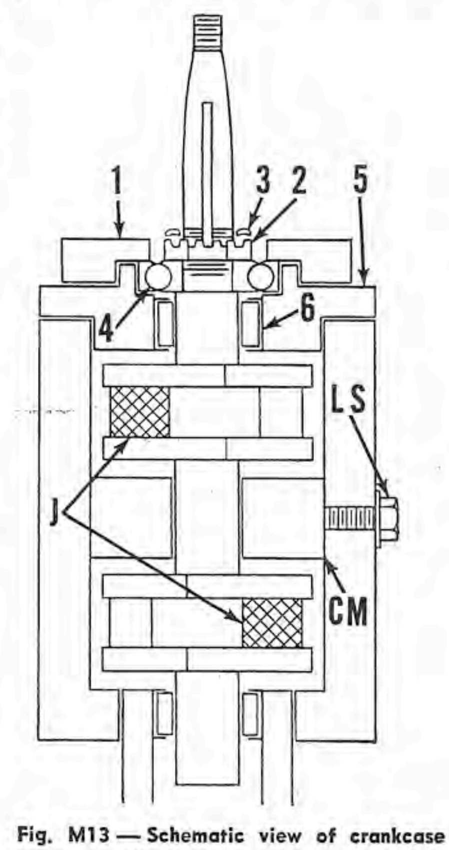


Fig. M13 — Schematic view of crankcase showing method of removing and installing crankshaft. Refer to text.

1. Housing cap
2. Bearing nut
3. Thrust washer
4. Ball bearing
5. Bearing housing
6. Roller bearing
J. Jacks
CM. Center main bearing
LS. Locking screw

passages must be sealed against water leakage. Whenever powerhead is disassembled, it is recommended that all gasket surfaces be carefully checked for nicks and burrs which might interfere with a tight seal. Slight damage can sometimes be remedied by lightly lapping the surfaces on a lapping block using No. 00 emery cloth. Remove only the high spots without lowering the surface.

Coat gasket surfaces lightly and evenly with a non-hardening type gasket cement. Lubricate all friction surfaces with new engine oil before assembly. A light, non-fibrous grease should be used to retain loose needle bearings.

Make sure scribe lines on center main bearing and crankcase are aligned and press the crankshaft assembly in place, using the jacks (J—Fig. M13), until the threaded lockscrew hole in center main bearing is aligned with the hole in crankcase. Install and tighten the locking screw (LS). Reinstall upper bearing housing (5), bearing (4) and the crankshaft nut (2). Tighten nut until the clearance between center main bearing and crankshaft is equal at top and bottom; then align one castellation of nut with the crankshaft key slot, and install key with lower end locking the nut in position as shown.

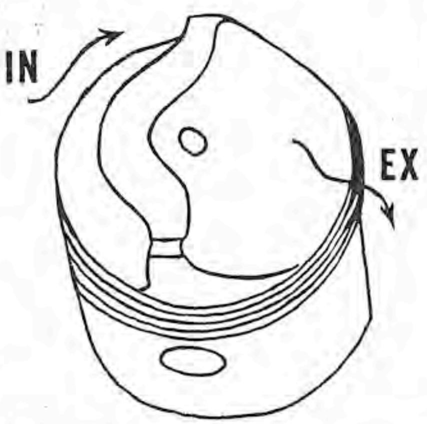


Fig. M14—Piston crown design improves scavenging efficiency. Be sure piston is installed as indicated with relation to inlet and exhaust ports.

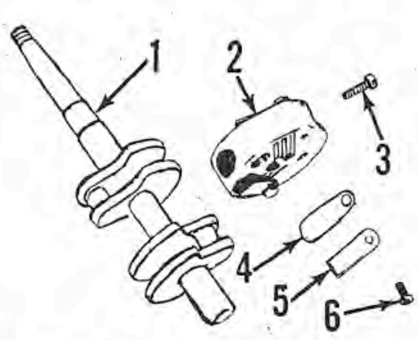


Fig. M15—Exploded view of crankshaft and center main bearing assembly.

1. Crankshaft
2. Center main bearing
3. Locating screw
4. Reed petal
5. Reed stop
6. Retaining screw

Install connecting rods, using the formed holding tool (91-24281), making sure that alignment marks on rod and cap are matched. Piston must be installed with sharp vertical side of deflector to starboard (intake) side of cylinder. See Fig. M14. Tighten the connecting rod screws to a torque of 80 inch pounds. Install the cylinder assembly using a ring compressor, install the retaining screws loosely, then rotate the crankshaft to align the block before tightening the retaining screws.

PISTONS, PINS, RINGS & CYLINDERS. Before detaching connecting rods from crankshaft, make sure that rod and cap are properly identified for correct assembly to each other and in the correct cylinder.

Each piston is fitted with three rings which are interchangeable in the ring grooves and are pinned in place.

Piston pin is pressed in piston bosses and secured with retaining rings. Piston end of connecting rod is fitted with 17 loose needle bearings which use the connecting rod bore and the piston pin as bearing races. Install bearing washers and needle bearings in upper end of connecting rod, then install and center the piston pin using Mercury tool (91-24263). Piston must be installed so that sharp vertical side of deflector will be to starboard (intake) side of cylinder when powerhead is assembled. Thoroughly lubricate all friction surfaces during assembly.

CONNECTING RODS, BEARINGS AND CRANKSHAFT. Upper end of crankshaft is carried by a ball bearing which also controls end thrust, plus a caged needle bearing. The unbushed center main bearing (2—Fig. M15) also contains the inlet reed valves. Lower main bearing is a caged needle roller type which should be pressed into crankcase until upper edge is $\frac{3}{32}$-inch below bottom of crankcase.

Connecting rod rides in 17 loose needle rollers at piston end and 23 loose needle rollers at crankpin end of rod. Check rod for alignment, using Mercury alignment tool (91-28441A1), or by placing rod on a surface plate and checking with a light.

If bearing surface of rod and cap is rough, scored, worn, or shows evidence of over-heating, renew the connecting rod. Inspect crankpin and main bearing journals. If scored, out-of-round, or worn, renew the crankshaft. Check crankshaft for straightness using a dial indicator and Vee-blocks.

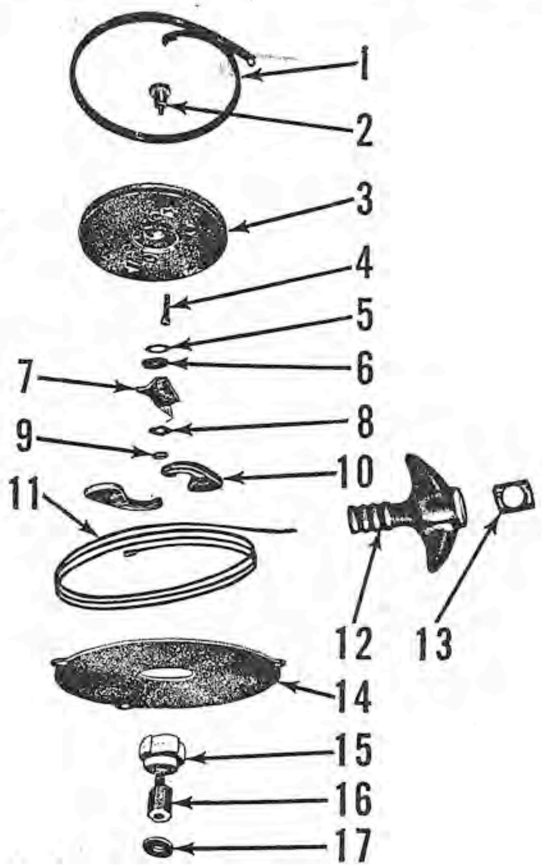
Inspect and adjust the reed valves as outlined in REED VALVE paragraph, and reassemble as outlined in ASSEMBLY paragraph.

MANUAL STARTER

Refer to Fig. M16. To install a new starter cord (cable) or spring, remove and invert the top cowl assembly. Pry the cable bushing insert from handle with a screwdriver, slip handle (12) back on starter cable and cut the retaining knot. Release the cable and allow the recoil spring to unwind. Unbolt and remove the friction plate (14) and the starter pawls (10); then remove the sheave retaining screw (4). Slowly pull the sheave (3) down, working behind sheave to make sure the recoil spring (1) remains

Fig. M16—Exploded view of recoil starter showing component parts.

1. Recoil spring
2. Sheave shaft
3. Sheave
4. Retaining screw
5. Shim
6. Washer
7. Pawl retainer
8. Wave washer
9. Collar
10. Pawl
11. Cable
12. Handle
13. Anchor
14. Friction plate
15. Ratchet
16. Spacer
17. Washer



in recess in housing. Spring can be removed from recess after sheave is removed. NOTE: Wear cotton gloves or protect the hands with a cloth, then grasp and remove the spring, allowing it to unwind slowly after removal.

Unwind the cable (11) from sheave and remove the two anchor screws to release the cable. Install new cable by inserting anchor end in cable slot and twisting ½-turn to lock in place. Wind cable 1 full turn around sheave, then fasten with the 2 locking screws and thread guards. Continue to wind cable in sheave, leaving enough cable free of sheave to insert through cover opening. Lubricate the recoil spring (1) lightly with "Quicksilver" Multipurpose Lubricant and engage inner loop of spring on sheave anchor pin. Position sheave in cover and secure with the locking screw (4); then wind the recoil spring 3 full turns, pull cable through cover and tie a lose knot on outside of housing, leaving sufficient free end to install the handle (12). Complete the assembly by reversing the disassembly procedure.

To renew the sheave (3), shaft (2) or pawl retainer (7), first remove the sheave as previously outlined, grind off the peened end of shaft (2) and drive the shaft out of collar (9) with a punch. Use Fig. M16 as a guide for disassembly and reassembly, and peen the collar (9) to shaft (2), making sure sheave is free to turn.

LOWER UNIT

PROPELLER AND DRIVE CLUTCH. Protection for the motor is provided by the multiple disc clutch located in the propeller hub. To check the clutch torque, first remove the complete lower unit assembly as outlined in the following R&R AND OVERHAUL paragraph, then separate the gearcase housing from drive shaft lower housing. Clamp the neutral clutch drum (upper end of lower drive shaft) in a soft jawed vise and use the special Torque Adapter Tool, 91-24106 (See Fig. M18) and a torque wrench to check the torque. Propeller should turn on shaft at a torque of 170-240 inch-pounds.

If clutch tension must be increased, straighten the tabs on the propeller nut locking washer (26—Fig. M20) and tighten the propeller nut until the proper torque is applied. If propeller nut bottoms on shaft, remove the nut and place a shim behind the compression spring (27). Shims are available in thicknesses of 0.015 and 0.031. An inoperative clutch can be cleaned or the parts renewed by removing the propeller after tension nut is off. Clutch contains 8 externally splined friction discs (23) and 8 internally splined discs (24) which must be alternated on shaft. Motors are equipped with a 6¾ inch diameter, 7 inch pitch, 2 blade aluminum propeller.

R&R AND OVERHAUL. To remove the complete lower unit, first remove the top cowl and disconnect and remove the shift cable. Remove the slotted special screw in front top of lower unit driveshaft housing, loosen the clamping screw at top rear of housing; then pull the complete lower unit downward out of power head.

Clamp the gearcase housing in a vise (above the propeller shaft) using formed wood blocks to protect the housing. Remove the stud nuts (1 & 3—Fig. M19) and the Phillips head screw (2).

Hold the upper driveshaft, if necessary, and turn the propeller counter-clockwise while pulling the housings apart, to allow the neutral clutch to separate.

To disassemble the gearcase, remove the propeller and drive clutch as outlined previously, then remove the gearcase cover (21—Fig. M20) using Mercury tool 91-24267 or a suitable spanner wrench. NOTE: Gearcase cover is secured with left-hand thread.

Withdraw the propeller shaft assembly and remove the shims (10) from gearcase housing, if used. Bend down the tab washer retaining the drive pinion cap screw (8) and remove the cap screw and pinion (7). Clamp upper end of shaft (6) in a soft jawed vise and tap the gearcase housing from shaft assembly using a soft hammer. Remove and save the shims (5).

To disassemble the propeller shaft assembly, remove snap ring (14) and shims (13); then press bearing (12) from gear. Gear can be pressed from shaft after removing the loose locating pin (15). When reassembling, adjust gear backlash to 0.003-0.005 by means of shims (10). Adjust propeller shaft end play to a minimum by means of shims (13).

When reassembling, hold the upper drive shaft if necessary, and turn the propeller shaft counter-clockwise while moving the housings together, to allow the neutral spring to feed into place.

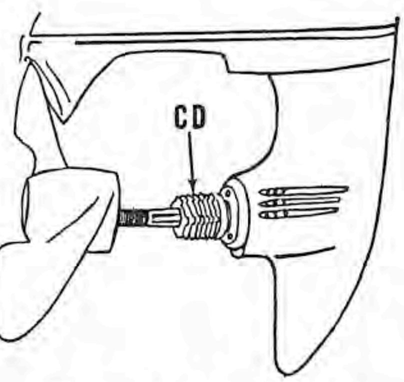


Fig. M17—Lower unit gearcase with propeller removed showing the multiple disc drive clutch. Refer to text for details.

CD. Clutch discs

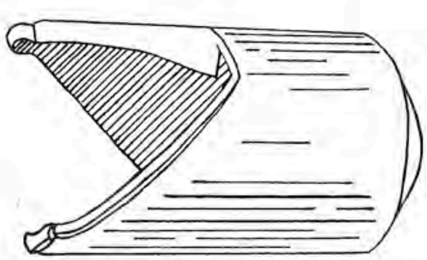


Fig. M18—Checking and adjusting the drive clutch torque requires the use of the special pronged tool. Refer to text.

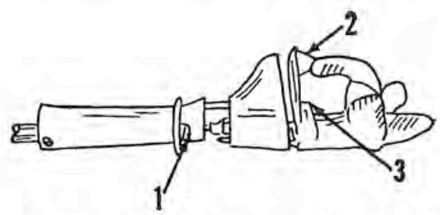


Fig. M19—Partially disassembled view of the three-piece lower unit showing location of the two stud nuts (1 & 3) and the retaining screw (2) which hold lower unit together. Refer to text for disassembly procedure.

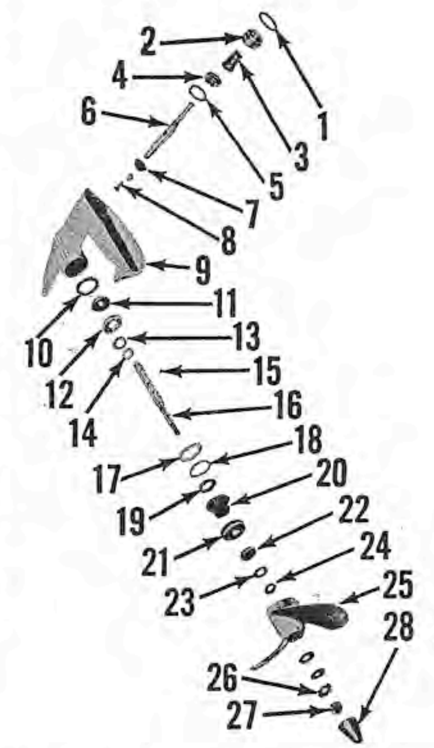


Fig. M20 — Exploded view of lower unit gearcase and associated parts.

1. "O" ring
2. Spacer
3. Clutch drum
4. Ball bearing
5. Shim
6. Lower drive shaft
7. Drive pinion
8. Screw
9. Gearcase
10. Shim
11. Driven gear
12. Ball bearing
13. Shim
14. Snap ring
15. Locating pin
16. Propeller shaft
17. Sealing washer
18. Sealing washer
19. Oil seal
20. Water intake housing
21. Gearcase cover
22. Thrust plate
23. Clutch disc
24. Clutch disc
25. Propeller
26. Tab washer
27. Clutch spring
28. Propeller nut

MERCURY

KIEKHAEFER CORP.

(General Offices)
Fond Du Lac, Wisc.

(Parts and Service Division)
Beaver Dam, Wisc.

CONDENSED SERVICE DATA

Series / Year Produced	6 hp	9.8 hp
1960	Merc 60	....
1961	Merc 60	....
1962	Merc 60	Merc 110
1963	Merc 60	Merc 110

TUNE-UP		
Rated Horsepower	6	9.8
Rated rpm	4500	4500
Bore — Inches	1¾	2
Stroke — Inches	1½	1¾
Number of cylinders	2	2
Displacement — Cu. In.	7.2	11
Compression @ Cranking Speed	*	*
Spark Plug		
Champion	J7J	J7J
AC	45M	
Electrode gap	0.025	0.025
Magneto		
Make	Phelon	Phelon
Point gap	0.018	0.018
Timing	See Text	See Text
Carburetor		
Make	Tillotson	Tillotson
Model	See Text	KB5A
Adjustment	See Text	See Text
Fuel—Oil Ratio	20:1	20:1

*Not more than 15 psi variation between cylinders.

SIZES—CLEARANCES	
Piston Rings	Publication Not Authorized by Manufacturer
End gap	
Side Clearance	
Piston Skirt Clearance	
Crankshaft Bearing Journal Diameter	
Upper main bearing	
Center main bearing	
Lower main bearing	
Crankpin	

Crankshaft Bearing Diametral Clearance	
Upper main bearing	Roller Brng.
Center main bearing	....
Lower main bearing	Roller Brng.
Crankpin	Roller Brng.
Piston Pin Diameter Clearance	Roller Brng.

TIGHTENING TORQUES (All Values In Inch—Pounds)	
Connecting Rod	80
Flywheel Nut	480
Spark Plug	180

LUBRICATION

The power head is lubricated with oil mixed with the fuel. If "Kiekhaefer Quicksilver" 2-cycle engine oil is used, one 12 ounce can should be mixed with each 2 gallons of gasoline. If "Quicksilver" oil is not available, a good grade "Type MM," SAE 30 motor oil may be substituted by mixing ½-pint of oil with each gallon of fuel. Gasoline and oil should be thoroughly mixed. Marine white, automotive white, or light-aircraft gasoline is recommended. If not available, use a suitable "Regular" gasoline.

The lower unit gears and bearings are lubricated by oil contained in the gear case. Special "Quicksilver Outboard Gear Lubricant" or a non-channeling, waterproof marine gear lubricant should be used. Gearcase is filled through the forward plug hole on starboard side of case, with motor in an upright position. The vent plug (located aft of fill plug) should be removed when filling. Lubricant should be maintained at level of vent plug.

FUEL SYSTEM

CARBURETOR. Tillotson, float type carburetors are used on all models. Early Merc 60 uses a Model AJ-57A carburetor. Late Merc 60 uses Model KB-6A, while Merc 110 uses model KB-5A. Refer to Fig. M25.

All carburetors employ a fixed, high-speed jet, with optional sized jets available for adjusting the calibration for altitude or other special conditions. Motor should perform satisfactorily with the standard jet at altitudes below 4000 feet. At higher altitudes, a jet of smaller diameter should be installed. Optional jets must be ordered separately, as only the standard jet is included in repair kit. Refer to parts lists for the standard and optional jets available.

Initial setting for the idle adjustment needle (16) is one turn open. Readjust **under load** at slow speed after engine is warm. Turning needle clockwise will lean the mixture.

The recommended fuel level is approximately $\frac{11}{16}$-inch below gasket surface of float bowl. To adjust the float, remove bowl cover (5) and refer to Fig. M26. Invert the cover and, with inlet needle (6) closed, measure the distance between primary lever (9) and gasket surface of bowl cover as shown at (A). This distance should be $\frac{13}{32}$-inch; if it is not, bend the curved tang on secondary lever (8) until correct measurement is obtained. After adjusting float height, bend the vertical tang on primary lever (9) to allow a maximum clearance of 0.040 between secondary lever (8) and inlet needle (6) as shown at (B).

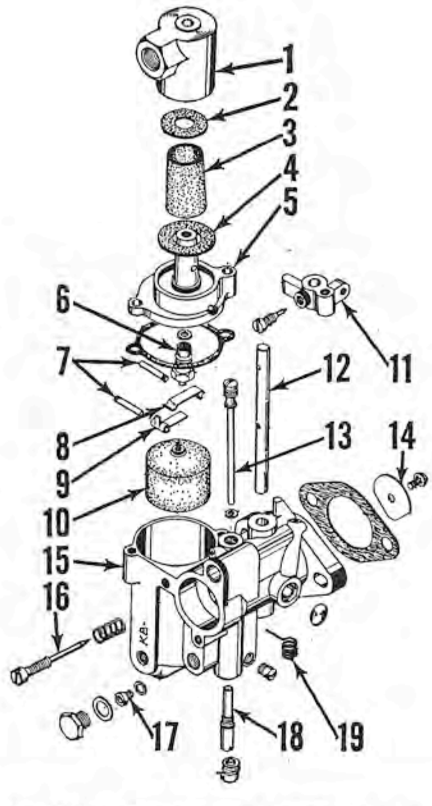


Fig. M25—Exploded view of Tillotson carburetor of the type used.

1. Strainer cover
2. Gasket
3. Strainer
4. Gasket
5. Bowl cover
6. Inlet needle & seat
7. Shaft
8. Secondary lever
9. Primary lever
10. Float
11. Throttle lever
12. Throttle shaft
13. Idle tube
14. Throttle valve
15. Body
16. Idle needle
17. High speed jet
18. Main nozzle
19. Spring

Tillotson parts lists are as follows:

Model AJ-57A

Repair kit	RK-461
Gasket set	GS-123
Inlet needle & seat	010790
Filter element	010741
Main fuel jet (0.049)	011763
Main fuel jet (0.047)	012027
Main fuel jet (0.045) Std.	012101
Main fuel jet (0.043)	012284
Main fuel jet (0.041)	012370

Model KB-5A

Repair kit	RK-513
Gasket set	GS-149
Inlet needle & seat	010790
Filter element	012107
Main fuel jet (0.051)	011764
Main fuel jet (0.049) Std.	011763
Main fuel jet (0.047)	012027
Main fuel jet (0.045)	012101
Main fuel jet (0.043)	012284

Model KB-6A

Repair kit	RK-539
Gasket set	GS-149
Inlet needle & seat	010790
Filter element	012107
Main fuel jet (0.047)	012027
Main fuel jet (0.045) Std.	012101
Main fuel jet (0.043)	012284
Main fuel jet (0.041)	012370

SPEED CONTROL LINKAGE. The speed control grip or lever moves the magneto stator plate to advance or retard the ignition timing. The throttle valve is synchronized to open as timing is advanced. It is extremely important that ignition timing and throttle valve opening be correctly synchronized to obtain satisfactory operation. To synchronize the linkage, move the speed control grip until the throttle cam (1—Fig. M27), attached to bottom of the magneto stator plate, is at the front centerline of the power head. Loosen the cam attaching screws and move the cam on stator plate until it contacts follower lever (2) and just starts to open the throttle valve.

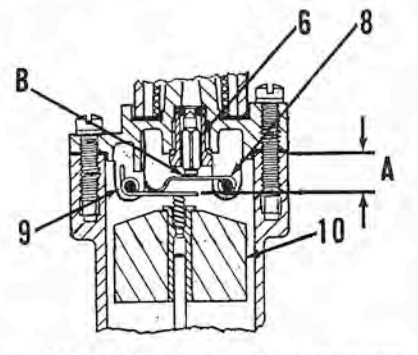


Fig. M26—Schematic view of float mechanism showing method of adjustment. Refer to text.

A. Closing adjustment
B. Open adjustment
6. Inlet needle
8. Secondary lever
9. Primary lever
10. Float

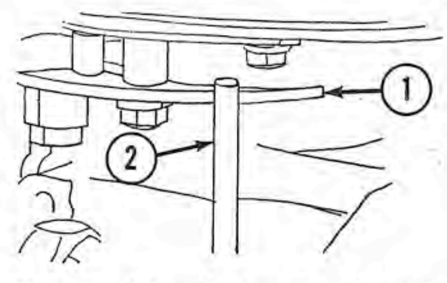


Fig. M27—Schematic view of speed control linkage. Refer to text for details of adjustment.

1. Throttle cam
2. Follower lever

REED VALVES. The inlet reed valves are located on the crankshaft center main bearing assembly as shown in Fig. M28. Crankshaft must be removed before reed valves can be serviced.

Reed petals (RP) should be perfectly flat and have no more than 0.007 clearance between free end of reed petal and seating surface of center main bearing. The reed stop (RS) must be carefully adjusted to provide correct clearance between end of stop and seating surface on bearing housing as shown at (A). The recommended clearance is 7/64-inch for Merc 60 or $\frac{5}{32}$-inch for Merc 110. Seatng surface of bearing must be smooth and flat, and may be refinished on a lapping plate after removing reed valves and dowels. Do not attempt to bend or straighten a reed petal to modify performance, and never install a bent petal. Lubricate the reed valve units with "Quicksilver" Multipurpose lubricant or a light distributor cam grease when reassembling.

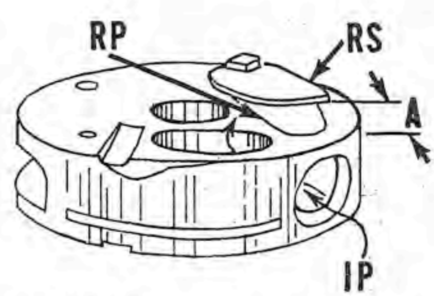


Fig. M28—Center main bearing showing inlet reed valves. Refer to text for adjustment.

A. Adjustment
IP. Inlet port
RP. Reed petal
RS. Reed stop

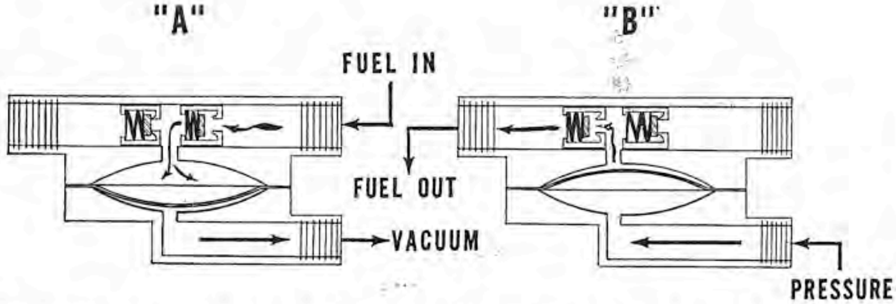


Fig. M29—Schematic view of diaphragm type fuel pump showing method of operation. Vacuum - Pressure line attaches to lower crankcase. When powerhead piston moves upward in cylinder, vacuum in crankcase draws diaphragm out and fuel in as shown in view "A". Crankcase pressure resulting from power stroke forces diaphragm in and fuel out as shown in view "B".

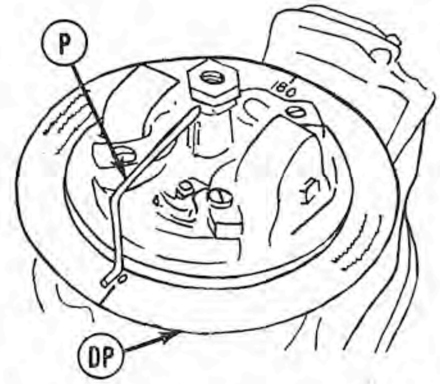


Fig. M31—Synchronizing tool installed for adjusting the magneto points. Refer to text for details.

DP. Degree plate
P. Pointer

FUEL PUMP. A diaphragm type fuel pump is used, which is operated by pressure and vacuum pulsations in the lower crankcase as shown in Fig. M29. Vacuum in the crankcase draws the diaphragm down, pulling fuel past the inlet check valve as shown in view "A." Crankcase pressure forces the diaphragm out and the trapped fuel enters the carburetor line past the outlet check valve as shown in view "B."

All defective or questionable parts should be renewed.

IGNITION

Breaker point gap should be set at approximately 0.018. The two sets of points should be set to open at exactly 180 degree intervals. The points may be synchronized by using the Mercury Synchronizing Tool Set, part number 91-28619A1 shown in Fig. M31 (or equivalent), plus a timing test light such as that shown in Fig. M32. To adjust the timing, remove the flywheel and install the degree plate (DP—Fig. M31) and pointer (P). Set the contact points for top cylinder at 0.018. Remove the spark plugs and install the test light by attaching one clip to insulated point connection and the other clip to a suitable ground. Turn the crankshaft clockwise slowly until the points just open as indicated by the test light bulb going out. Turn the degree plate until the 0° timing mark is aligned with pointer as shown. Attach the test light to the other set of points and turn the crankshaft ½-turn until the timing pointer is aligned with the 180° timing mark on degree plate; then adjust the second set of points to barely open. Recheck both sets of points with the degree plate and timing light. If the synchronizing tools are not available, renew the points or dress the contacts, then set each set of points to exactly 0.018 with a feeler gage.

A quick check of magneto condition can be made without disassembly by removing the spark plugs and holding one spark plug wire about ⅛-inch away from cylinder head. Have someone spin the motor and note the condition of the spark. Although, in bright daylight, the spark may not be visible, a distinct snap will be noted as spark jumps the gap. If spark is weak or erratic, adjust the points as outlined above. Be sure to note point condition. While flywheel is off, carefully examine the wiring and the insulation of the magneto coils. Look for broken or worn insulation or broken wires. Also check for loose or corroded connections. Renew any parts which are damaged or in poor condition. Lubricate the cam wick and breaker arm pivot with a high melting point distributor or magneto grease.

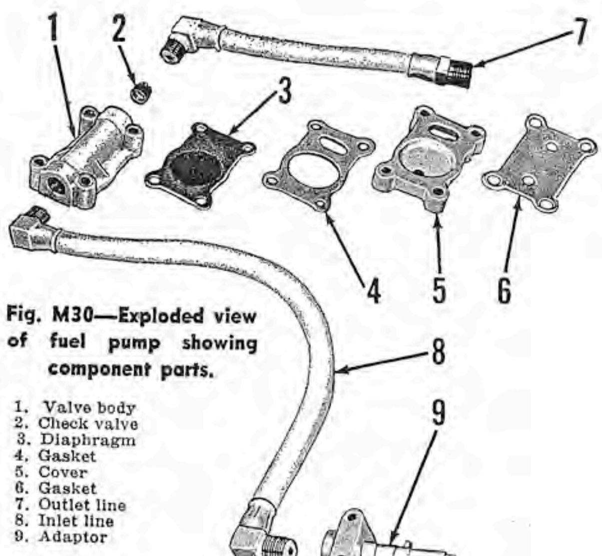


Fig. M30—Exploded view of fuel pump showing component parts.

1. Valve body
2. Check valve
3. Diaphragm
4. Gasket
5. Cover
6. Gasket
7. Outlet line
8. Inlet line
9. Adaptor

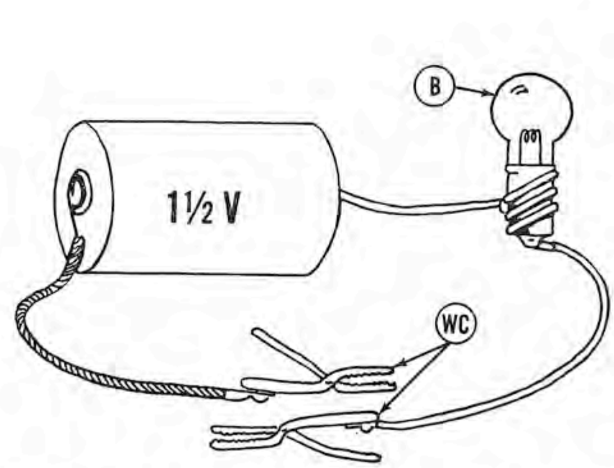


Fig. M32—A timing test light can be constructed as shown, using a flashlight battery, bulb (B), two wire clips (WC) and short pieces of wire.

COOLING SYSTEM

WATER PUMP. The rubber impeller type water pump is housed in the gearcase housing. The impeller is mounted on and driven by the lower unit drive shaft. The pump housing is offset with relation to driveshaft as shown in Fig. M33. Flexing of the impeller blades varies the displacement volume which causes water to be drawn into water pump through inlet (IN) and forced upward into power head (OUT). At high speeds the impeller blades remain partially curved as shown by the broken lines (HS) and pump operates in part by centrifugal force.

When cooling system problems are encountered, first check the water inlet for plugging or partial stoppage, then if not corrected, remove the gearcase housing as outlined in LOWER UNIT section and examine the water pump, water tubes and seals. The water inlet is located on the anti-cavitation plate immediately above the propeller.

POWER HEAD

R&R AND DISASSEMBLE. To remove the power head assembly, first remove the top cowl and disconnect stop wire switch, speed control linkage and choke shutter spring. Remove the screws which secure fuel line check unit to lower cowl and the nuts securing power head to lower unit; then lift off the complete power head assembly.

Place the unit on Mercury powerhead stand 91-24282, or equivalent, and remove fuel pump, carburetor, flywheel and magneto. Exhaust manifold cover plate, cylinder block cover plate and transfer port cover should be removed for cleaning and inspection.

Remove the capscrews which retain upper end cap (4—Fig. M34) to power head, remove center main bearing locking screw (15); then unbolt and remove crankcase front half (7). NOTE: A special recess is located at the center on each side of crankcase half (7). Loosen the crankcase by carefully prying at these points ONLY with a screwdriver. Use extra care not to spring the parts or to mar the machined, mating surfaces. Crankcase half (7) and cylinder (12) are matched and align bored, and are available only as an assembly.

The crankshaft and bearings assembly, with pistons and connecting rods attached, can now be lifted out of cylinder block for service and overhaul as outlined in the appropriate following paragraphs. Assemble by following the procedures outlined in the ASSEMBLY paragraph.

ASSEMBLY. Because of the two-cycle design, crankcase must be completely sealed against both vacuum and pressure. Exhaust manifold and water passages must be sealed against water leakage. Whenever power head is disassembled, it is recommended that all gasket surfaces and machined joints without gaskets be carefully checked for nicks and burrs which might interfere with a tight seal. Slight damage can sometimes be remedied by lapping the surfaces on a lapping block using No. 00 emery cloth. Remove only the high spots without lowering the surface. If parts are warped, sprung or excessively damaged, renew the parts.

Completely assemble the crankshaft, bearings (except upper main bearing and cap), connecting rods, pistons and rings; and install the assembly by inserting pistons in lower ends of cylinders. The two angle ring compressers of Mercury Ring Compressor Kit 92-28891A2, should be used. If ring compressor kit is not available, two men must work together and use extreme care in installing the crankshaft and pistons assembly. Thoroughly lubricate the pistons, rings and bearings using new engine oil and make sure that ring end gaps are aligned with the locating pins in ring grooves. Work each piston ring individually into cylinder, taking special precautions not to distort or break the rings or score the surfaces of rings or pistons. After crankshaft is installed, turn the shaft until each ring appears in the exhaust ports and test the ring for tension, using a blunt tool. If the ring does not spring back when released, it is probably broken or distorted and the assembly should be removed and rechecked.

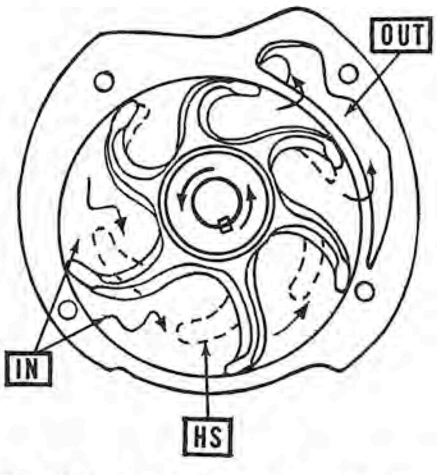
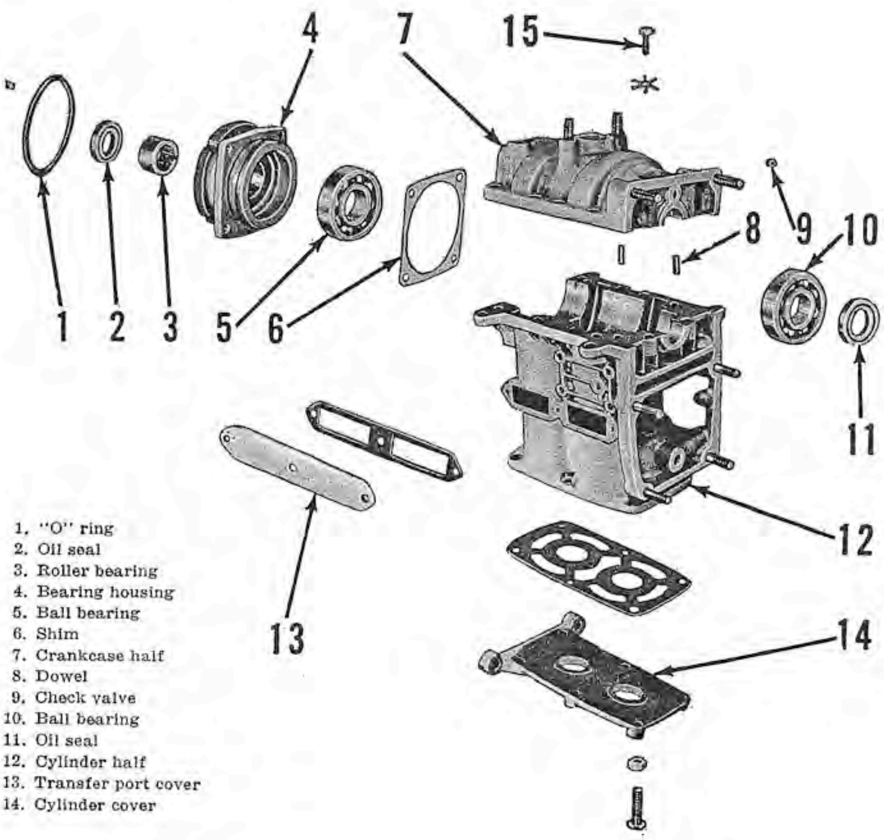


Fig. M33—Schematic view of rubber impeller type water pump. Flexing of impeller blades in offset housing causes water to be drawn into pump through inlet ports (IN) and forced into power head through outlet ports (OUT). At high speeds, blades remain partially curved as shown by broken lines (HS) and pump becomes a centrifugal pump.



1. "O" ring
2. Oil seal
3. Roller bearing
4. Bearing housing
5. Ball bearing
6. Shim
7. Crankcase half
8. Dowel
9. Check valve
10. Ball bearing
11. Oil seal
12. Cylinder half
13. Transfer port cover
14. Cylinder cover

Fig. M34—Exploded view of powerhead crankcase and associated parts.

Make sure the center main bearing dowel (6—Fig. M35) is in place and that main bearing (5) is properly located over dowel. Assemble the upper main bearing cap (4—Fig. M34) and install over crankshaft using the shim pack (6) which was removed. Install and tighten the two cap screws which retain the cap to cylinder block, tap the crankshaft back and forth using a soft mallet, then measure the gap between bearing (5) and the crankshaft. The clearance should be 0.008-0.012. If it is not, remove the end cap and vary the thickness of shim pack (6) until the proper end play is obtained. Shims are available in thicknesses of 0.002, 0.003, 0.005 and 0.010.

Remove the end cap to cylinder block screws, withdraw cap slightly and coat the seating surface of cap with gasket sealer (92-28804) or similar impervious liquid sealer. Coat joint surface of crankcase with a thin coat of the gasket sealer then install the crankcase on the cylinder assembly. Tighten the crankcase cap screws by working each way from the center, to prevent possible distortion.

Turn the engine several times before installation to distribute the oil and to make certain the parts are free and do not bind.

PISTONS, PINS, RINGS & CYLINDERS. Before detaching connecting rods from crankshaft assembly, make sure that rod and cap are properly identified for correct assembly to each other and in the correct cylinder.

Each piston is fitted with three rings which are interchangeable in the ring grooves and are pinned in place in piston.

Piston pin is pressed in piston bosses and secured with retaining rings. Piston end of connecting rod is fitted with 17 loose needle bearings which use the connecting rod bore and the piston pin as bearing races. Install bearing washers and needle bearings in piston end of connecting rod using light non-fibrous grease to hold them in place, then install and center the piston pin using Mercury tool (91-24263). Piston must be installed so that sharp vertical side of deflector will be to starboard (intake) side of cylinder block. See Fig. M36. Thoroughly lubricate all friction surfaces during assembly.

CONNECTING RODS, BEARINGS & CRANKSHAFT. Upper end of crankshaft is carried by a ball bearing which also controls end play, plus a caged needle bearing. The unbushed center main bearing (5—Fig. M35) also contains the inlet reed valves. Lower main bearing is a ball bearing which is interchangeable with the upper ball bearing.

Connecting rod rides in 17 loose needle rollers at piston end and 25 loose needle rollers at crankpin end. Check rod for alignment, using Mercury Alignment Tool (91-28441A1), or by placing rod on a surface plate and checking with a light.

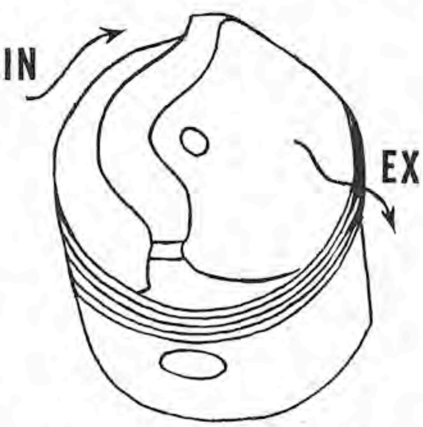
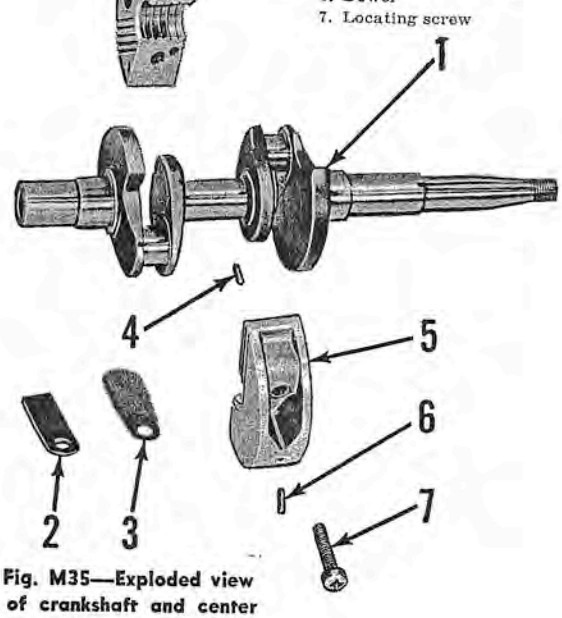


Fig. M36—Piston crown is designed to improve scavenging efficiency. Be sure piston is installed as indicated, with relation to inlet and exhaust ports.

If bearing surface of rod and cap is rough, scored, worn, or shows evidence of overheating, renew the conecting rod. Inspect crankpin and main bearing journals. If scored, out-of-round, or worn, renew the crankshaft. Check the crankshaft for straightness using a dial indicator and Vee-blocks.

Inspect and adjust the reed valves as outlined in REED VALVE paragraph, and reassemble as outlined in ASSEMBLY paragraph.



1. Crankshaft
2. Reed stop
3. Reed petal
4. Dowel
5. Center main bearing
6. Dowel
7. Locating screw

Fig. M35—Exploded view of crankshaft and center main bearing assembly.

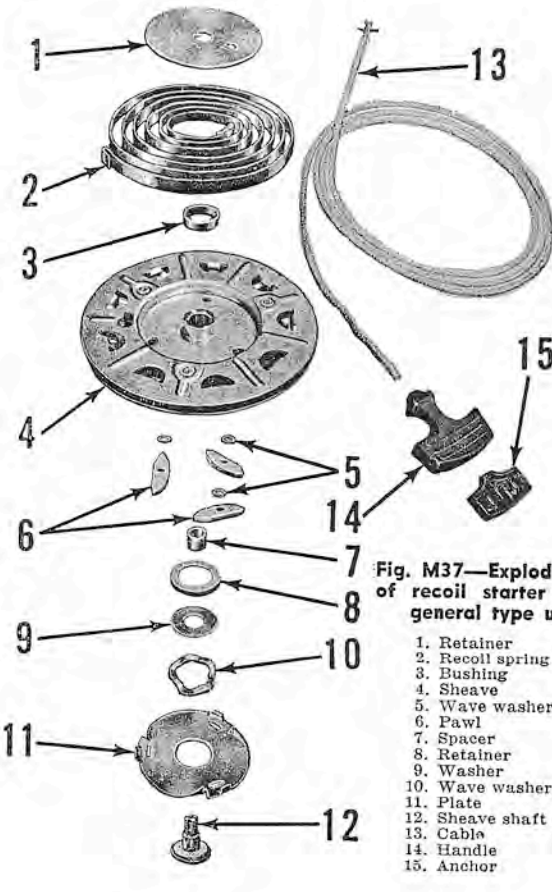


Fig. M37—Exploded view of recoil starter of the general type used.

1. Retainer
2. Recoil spring
3. Bushing
4. Sheave
5. Wave washer
6. Pawl
7. Spacer
8. Retainer
9. Washer
10. Wave washer
11. Plate
12. Sheave shaft
13. Cable
14. Handle
15. Anchor

MANUAL STARTER

Refer to Fig. M37 for a starter of the general type used. To disassemble the manual starter, remove the top cowl; then remove the screw and trim cap from top of cowl. Insert a screwdriver in slot in top of sheave shaft (12) and loosen the shaft nut (left hand thread). Allow the screwdriver and shaft (12) to turn clockwise until recoil spring (2) is completely unwound. Pry the anchor (15) out of starter handle (14) and remove the anchor and handle. Remove the nut from upper end of sheave shaft (12), invert the assembly and remove the parts, making sure that recoil spring (2) remains in housing recess as sheave (4) is removed. Protect hands with cotton gloves or a cloth, grasp recoil spring (2), remove spring and allow it to unwind slowly to prevent personal injury.

Lubricate the parts with Multipurpose Lubricant, and assemble by reversing the disassembly procedure. Make sure that pawls (6) are all installed the same way, with flat radius to outside. Install wave washer retainer (9) with cup end up and make sure the tab in spring retainer (1) engages slot in sheave shaft (12). Loosely install the shaft nut, pull free end of cable through top cowl and install handle (14) and anchor (15). After handle is installed, turn sheave shaft (12) counter-clockwise until cable handle is pulled against top cowl; then turn shaft an additional 1¼ turns and tighten the shaft retaining nut.

LOWER UNIT

PROPELLER AND DRIVE CLUTCH. Protection for the motor is built into a special cushioning clutch built into the propeller hub. Propeller is splined to the shaft. No adjustment is possible of the propeller or cushioning clutch. Two-blade aluminum propitch and a special 6-inch pitch for Merc 60; or optional 9 or 10 inch pitch for Merc 110. Propellers other than those designed for the motor must not be used.

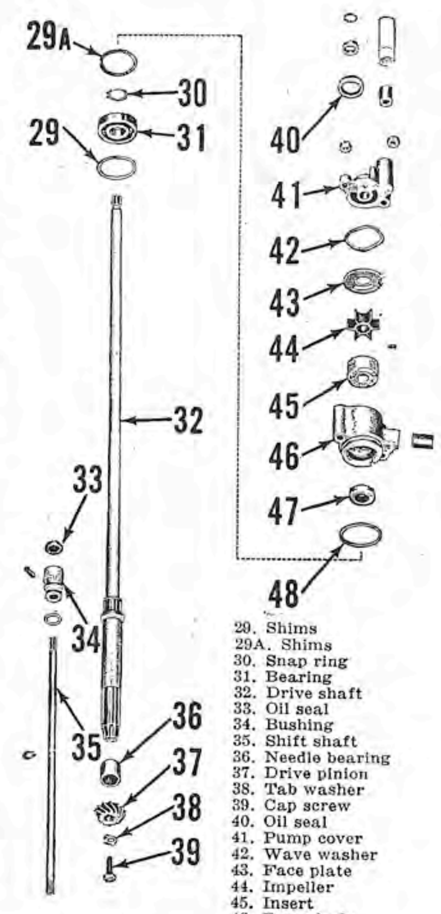
R&R AND OVERHAUL. Most service on the lower unit can be performed by detaching the gearcase housing from the driveshaft housing. To remove the housing, remove the two stud nuts (A—Fig. M38) and withdraw the lower unit gearcase assembly.

Remove the housing plugs and drain the housing, then secure the gearcase in a vise between two blocks of soft wood, with propeller up. Wedge a piece of wood between propeller and anti-cavitation plate, remove the propeller nut, then remove the propeller.

Check the backlash of the propeller drive gears before disassembly by pulling out on the drive shaft and pushing in on the propeller shaft, then rotating drive shaft lightly while noting backlash by feel. No more than 0.003-0.005 backlash should exist if gears are properly adjusted.

Disassemble the gearcase by removing the gearcase housing cover nut (27—Fig. M39) using the Gear Housing Cover Tool (91-30798). Nut is secured with left hand thread. Clamp the outer end of propeller shaft in a soft jawed vise and remove the gearcase by tapping with a rubber mallet. Forward gear (13) will remain in housing. Withdraw the propeller shaft from bearing carrier (23) and reverse gear (18). Remove and save the shims (19) and thrust washer (20) from inside of gear housing. Shims should be reinstalled if gear backlash was within limits before disassembly.

Clamp the bearing carrier (23) in a soft jawed vise and remove reverse gear (18) and bearing (21) with an internal expanding puller and slide hammer. Remove and discard the propeller shaft rear seal (25).



29. Shims
29A. Shims
30. Snap ring
31. Bearing
32. Drive shaft
33. Oil seal
34. Bushing
35. Shift shaft
36. Needle bearing
37. Drive pinion
38. Tab washer
39. Cap screw
40. Oil seal
41. Pump cover
42. Wave washer
43. Face plate
44. Impeller
45. Insert
46. Pump body
47. Oil seal
48. "O" ring

Fig. M40—Exploded view of lower unit drive shaft and associated parts. Refer also to Fig. M39.

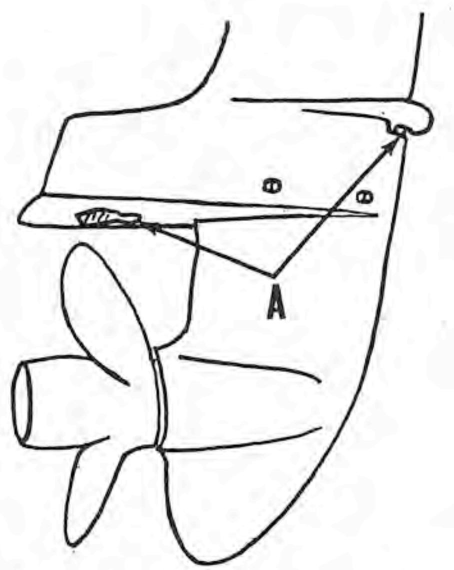


Fig. M38—To remove the lower unit gearcase assembly, first remove the attaching stud nuts (A).

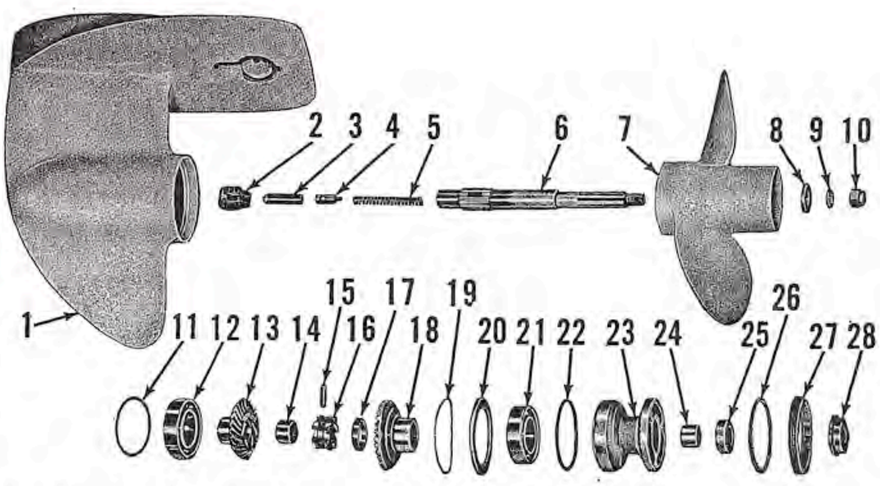


Fig. M39—Exploded view of lower unit gearcase and associated parts. See also Fig. M40.

1. Gearcase
2. Shift cam
3. Plunger
4. Slide
5. Spring
6. Propeller shaft
7. Propeller
8. Splined washer
9. Washer
10. Propeller nut
11. Shim
12. Bearing
13. Forward gear
14. Needle bearing
15. Cross pin
16. Clutch dog
17. Retaining ring
18. Reverse gear
19. Shim
20. Thrust washer
21. Bearing
22. "O" ring
23. Bearing carrier
24. Roller bearing
25. Oil seal
26. Washer
27. Housing cover
28. Guide collar

To remove clutch dog (16) from propeller shaft, insert the cam follower (3) in hole in shaft and apply only enough pressure on end of cam follower to remove the spring pressure. Remove retaining ring (17), then push out the pin (15) with a small punch. The pin passes through drilled holes in clutch dog (16) and slide (4), and operates in slotted holes in propeller shaft.

To disassemble the drive shaft and associated parts, reposition gearcase in vise with drive shaft projecting upward, remove the rubber slinger from upper end of shaft; then unbolt and remove the water pump cover (41 — Fig. M40). Remove the wave washer (42) and face plate (43); then remove impeller (44) and impeller drive pin. Withdraw the remainder of the water pump parts. Clamp upper end of drive shaft in a soft jawed vise, remove the pinion retaining cap screw (39); then tap the gearcase off the drive shaft and bearing. Note the position and thickness of shims (29 & 29A) on drive shaft upper bearing. Mesh position of pinion is controlled by shims (29) placed underneath the bearing, while shaft end play is controlled by total shim pack thickness. The shims are identical but should not be interchanged or mixed, except to adjust the mesh position of drive pinion.

After drive shaft has been removed, the forward gear (13—Fig. M39) and bearing (12) can usually be dislodged by jarring open end of gearcase against a block of soft wood. Remove and save the shim pack (11).

Shift shaft (35—Fig. M40) can be removed after removing the set screw retaining bushing (34). When installing, make sure that long shaft splines are on upper end, and that shift cam (2—Fig. M39) is installed with the notches up and on starboard side as shown.

Increasing the thickness of shim pack (11) decreases the backlash of forward gear (13). Increasing the thickness of shim pack (19) INCREASES the backlash of reverse gear (18). The number and thickness of shims (29—Fig. M40) controls mesh position of drive pinion. Shims are available in thicknesses of 0.002, 0.003, 0.005 and 0.010.

When renewing gearcase housing, or when correcting backlash and mesh of drive gear train, first install drive shaft (32—Fig. M40), bearing (31), shims (29 & 29A) and water pump housing (46). Adjust total thickness of shims (29 & 29A) so that water pump will seat on housing with no shaft end play. Remove the shaft and lay shims (29 & 29A) aside for reinstallation during assembly. Make a trial assembly of forward gear (13—Fig. M39) and bearing (12) using the removed shims (11). Install drive shaft (32—Fig. M40), bearing (31) and shims (29). Install drive pinion (37) and install and tighten locking screw (39). Coat gears with bearing blue then check mesh pattern by pressing drive shaft down and turning clockwise to rotate the gears. If pressure is heavy on lower end of pinion tooth, remove one shim from pack (29). Place the removed shim with pack (29A) to retain end play adjustment. Reverse the procedure if pressure is heavy on upper end of tooth. After adjusting mesh position, check and adjust backlash to 0.003-0.005 by adding or removing shims (11—Fig. M39). Install reverse gear (18) and bearing (21) in bearing carrier (23); then install assembled parts in gearcase without propeller shaft. Adjust to minimum backlash without binding, by adding or removing shims (19).

Complete the assembly by reversing disassembly procedure.

MERCURY

KIEKHAEFER CORP.

(General Offices)
Fond Du Lac, Wisc.

(Parts and Service Division)
Beaver Dam, Wisc.

CONDENSED SERVICE DATA

Series	10-15 hp	18-20 hp	20-25 hp	35 hp
Year Produced				
1955	....	Mark 20, 20H, 25	....	....
1956	....	Mk 20H, 25	....	....
1957	Mk 10	Mk 25	....	....
1958	Mk 10	Mk 25	Mk 28	....
1959	Mk 10A, 15A	....	Mk 28A	....
1960	Merc 100, 150	....	Merc 200	....
1961	Merc 100, 150	....	Merc 200	....
1962	....	....	Merc 250	....
1963	....	....	Merc 200	Merc 350
TUNE-UP				
Rated Horsepower	10 - 15	16 - 20	20-25	35
Rated rpm	4500	5400	5400	5200
Bore—Inches	$2\frac{11}{32}$	$2\frac{7}{16}$	$2\frac{9}{16}$	$2\frac{7}{8}$
Stroke—Inches	$2\frac{1}{8}$	$2\frac{1}{8}$	$2\frac{1}{8}$	2.3
Number of cylinders	2	2	2	2
Displacement—Cu. In.	18.5	19.8	22	30
Compression @ Cranking Speed	Not more than 15 psi variation between cylinders			
Spark Plug				
Champion	J7J, J7M, J6J or J6M	J6J or J6M	J6J or J6M	J6J
AC	M45 or M44C	M44C	M44C	M44C
Electrode gap	0.025	0.025	0.025	0.025
Magneto				
Make	Phelon	Phelon	Phelon	Phelon
Point gap	0.018	0.018	0.018	0.020
Timing	See Text	See Text	See Text	See Text
Carburetor				
Make	Tillotson	Tillotson or Carter	Tillotson	Tillotson
Model	See Text	See Text	See Text	KC-4A
Adjustment	See Text	See Text	See Text	See Text
Fuel—Oil Ratio	20:1	20:1	20:1	20:1
SIZES—CLEARANCES				
Piston Rings	Publication Not Authorized by Manufacturer			
End gap				
Side clearance				
Piston Skirt Clearance				
Crankshaft Bearing Journal Diameter				
Upper main bearing				
Center main bearing				
Lower main bearing				
Crankpin				
Crankshaft Bearing Diametral Clearance				
Upper main bearing	Roller Brng.	Roller Brng.	Roller Brng.	Roller Brng.
Center main bearing				
Lower main bearing	Roller Brng.	Roller Brng.	Roller Brng.	Roller Brng.
Crankpin	Roller Brng.	Roller Brng.	Roller Brng.	Roller Brng.
Piston Pin Diameter				
Clearance	Roller Brng.	Roller Brng.	Roller Brng.	Roller Brng.
TIGHTENING TORQUES (All Values In Inch—Pounds)				
Connecting Rod	180	180	180	180
Flywheel Nut	780	780	780	780
Reed Valve	35 - 40	35 - 40	35 - 40	35 - 40
Center Main Brng.	150	150	150	150
Cylinder Cover	60	60	60	60
Exhaust Cover	60	60	60	60
Transfer Port Cover	45 - 60	45 - 60	45 - 60	45 - 60
Spark Plug	180	180	180	180

LUBRICATION

The power head is lubricated with oil mixed with the fuel. If "Kiekhaefer Quicksilver" 2-cycle engine oil is used, one 12 ounce can should be mixed with each 2 gallons of gasoline. If "Quicksilver" oil is not available, a good grade "Type MM," SAE 30 motor oil may be substituted by mixing ½-pint of oil with each gallon of fuel. Gasoline and oil should be thoroughly mixed. Marine white, automotive white, or light-aircraft gasoline is recommended. If not available, use a suitable "Regular" gasoline.

The lower unit gears and bearings are lubricated by oil contained in the gearcase. Special "Quicksilver Outboard Gear Lubricant" or a non-channeling, waterproof, marine gear lubricant should be used. Gearcase is filled through the lower filler hole, located on starboard side of gear case, until lubricant reaches the level of the upper (vent) plug hole. Lubricant should be maintained at level of upper vent plug.

FUEL SYSTEM

CARBURETOR. Carter or Tillotson carburetors are used. Refer to the appropriate following paragraphs for overhaul and adjustment procedures.

Carter Model N-2150S carburetors are used on Mark 20H motors. Refer to Fig. M45. Initial setting is 1¼ turns open for both the idle adjustment needle (6) and high speed adjustment needle (16). Final adjustment must be made under load after operating temperature has been reached. Adjust the high speed needle to provide the leanest setting which will permit full power and acceleration. Adjust the idle needle after high speed needle has been adjusted, to provide smooth operation under load at slow speeds. Clockwise rotation of the high speed adjustment needle leans the mixture. Clockwise rotation of the idle needle provides a richer mixture.

To disassemble the carburetor, scribe a line on the body and bowl to assure proper assembly, then remove the bowl nut and fuel bowl. To check and adjust the float level, invert the carburetor body with bowl removed, and measure the clearance between nearest edge of float and gasket surface of body flange. This clearance should be $\frac{3}{32}$-inch with body inverted and float resting against the seated inlet needle. Adjust by bending lip of float.

When installing throttle valve (3), make sure the "C" trademark is toward idle port. Seat the valve by tapping lightly with a screwdriver and use new screws to secure the valve.

Carter parts numbers are as follows:

Repair kit	1772
Inlet needle and seat	25-219S
Main nozzle	12-413
Float and lever assembly	21-162S
Idle adjustment screw	30A-60
High speed adjusting needle	37-66S
Throttle valve screw	39-10

Tillotson Carburetors: All models except Mark 20H are normally equipped with Tillotson Series AJ, KA, KB or KC carburetors. Construction is similar for all carburetors. Refer to Fig. M46. Some early models are equipped with a high speed mixture adjustment needle instead of the fixed jet (17); and are not equipped with the fuel filter (3).

Initial setting for carburetors equipped with the high speed adjustment needle is one turn open from the closed position for the idle needle (16); and 1½ turns open for the high speed adjustment needle which replaces high speed jet (17). Run motor until operating temperature is reached, then shift to forward gear and open the throttle. Slowly turn the high speed adjustment needle clockwise until engine falters or slows down because of a too lean mixture; then back needle out approximately ½-turn. After high speed needle has been properly adjusted, regulate the idle adjustment needle (16) until engine runs smoothly **under load** at slow speed. Turning idle mixture needle clockwise will lean the mixture.

On carburetors employing the fixed main jet, high speed mixture adjustment may be made for special conditions by changing the size of the jet (17). The standard jet should normally be used. If motor is operated at altitudes above 2,500 feet, performance can usually be improved by installing a smaller jet. On most models, the standard jet is a part of the carburetor repair kit, and optional jets must be obtained separately. NOTE: On K and KC models, the main jet is not listed as a part of the repair kit, and the required jet should be ordered. The standard jet is indicated on the parts lists.

On carburetors employing the fixed main jet, initial setting for the idle adjustment needle (16) is one turn open from the closed

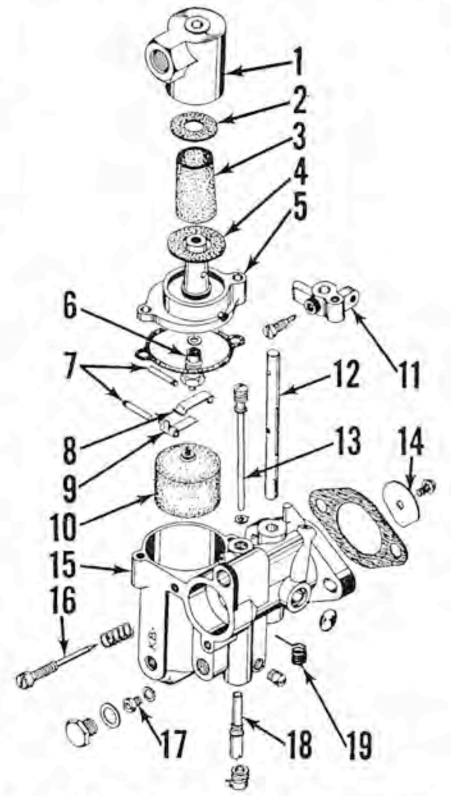


Fig. M46—Exploded view of Tillotson carburetor of the type used on most models.

1. Strainer cover
2. Gasket
3. Strainer
4. Gasket
5. Bowl cover
6. Inlet needle & seat
7. Shaft
8. Secondary lever
9. Primary lever
10. Float
11. Throttle lever
12. Throttle shaft
13. Idle tube
14. Throttle valve
15. Body
16. Idle needle
17. High speed jet
18. Main nozzle
19. Spring

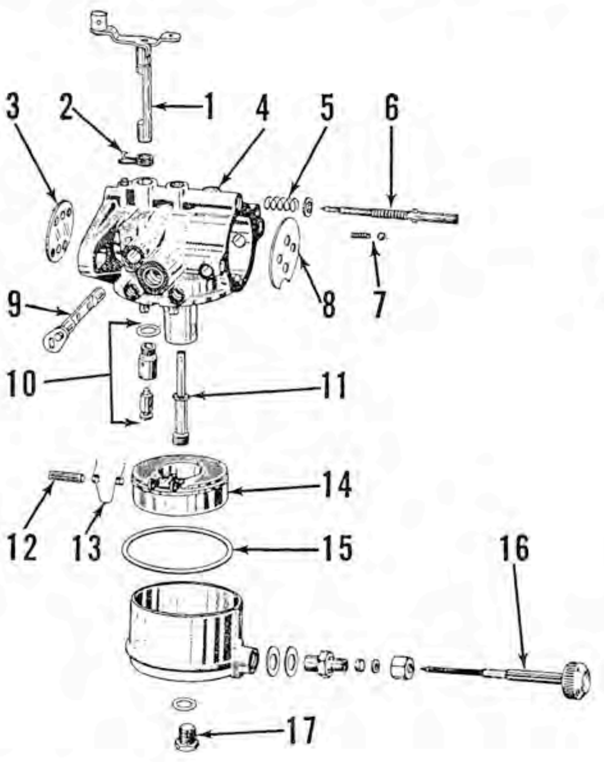


Fig. M45—Exploded view of Carter carburetor used on some early models.

1. Throttle shaft
2. Spring
3. Throttle valve
4. Body
5. Spring
6. Idle needle
7. Choke detent
8. Choke valve
9. Choke shaft
10. Inlet needle & seat
11. Main nozzle
12. Float shaft
13. Spring
14. Float
15. Gasket
16. High speed needle
17. Cap screw

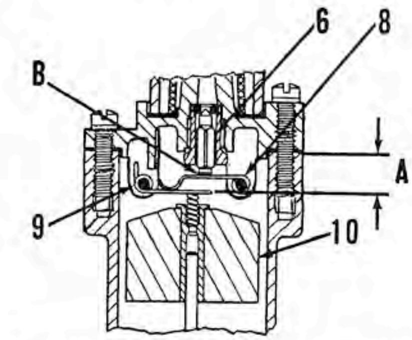


Fig. M47—Schematic view of float mechanism showing method of adjustment. Refer to text.

A. Closing adjustment
B. Open adjustment
6. Inlet needle
8. Secondary lever
9. Primary lever
10. Float

position. Idle needle must be adjusted under load to obtain smooth operation at slow speeds. Turning the needle clockwise will lean the mixture.

The recommended fuel level is approximately $\frac{11}{16}$-inch below gasket surface of float bowl. To adjust the float, remove bowl cover (5) and refer to Fig. M47. Invert the cover and, with inlet needle (6) closed, measure the distance between primary lever (9) and gasket surface of bowl cover as shown at (A). This distance should be $\frac{13}{32}$-inch; if it is not, bend the curved tang on secondary lever (8) until correct measurement is obtained. After adjustment is made, bend the vertical tang on primary lever (9) to allow a maximum clearance (B) between the secondary lever (8) and inlet needle (6). The contact spring located in center of float should extend 5/64-inch above top of float (10). Check to see that spring has not been stretched or damaged.

Tillotson model numbers and parts lists are as follows:

Model AJ-41A

Repair kit	RK-107
Gasket set	GS-107
Inlet needle and seat	010400
Float	09805
Idle adjustment screw	08690
Idle tube	06907
Main adjusting screw	09981

Model AJ-47A

Repair kit	RK-168
Gasket set	GS-107
Inlet needle and seat	010400
Float	09805
Idle adjustment screw	010402
Idle tube	010433
Main adjustment needle	010410

Models AJ-50A—AJ-50AT

Repair kit	RK-313
Gasket set	GS-123
Inlet needle and seat	010790
Filter element	010741
Float	09805
Idle adjustment screw	010402
Idle tube	010433
Main adjustment needle	010410

Model AJ-52A

Repair kit	RK-371
Gasket set	GS-123
Inlet needle and seat	010790
Filter element	010741
Float	09805
Idle adjustment screw	011389
Idle tube	010433
Main adjustment needle	09968

Model AJ-56A

Repair kit	RK-396
Gasket set	GS-123
Inlet needle and seat	010790
Filter element	010741
Main fuel jet (0.057) Std.	011394
Main fuel jet (0.055)	011722
Main fuel jet (0.053)	011765
Main fuel jet (0.051)	011764

Model AJ-56AB

Repair kit	RK-426
Gasket set	GS-123
Inlet needle and seat	010790
Filter element	010741
Main fuel jet (0.055) Std.	011722
Main fuel jet (0.053)	011765
Main fuel jet (0.051)	011764
Main fuel jet (0.049)	011763

Model KA-5A

Repair kit	RK-370
Gasket set	GS-142
Inlet needle and seat	011357
Filter element	010741
Float	09805
Idle adjustment screw	011748
Idle tube	011387
Main fuel jet (0.063) Std.	011385
Main fuel jet (0.061)	011396
Main fuel jet (0.059)	011395
Main fuel jet (0.057)	011394

Model KA-5B

Repair kit	RK-471
Gasket set	GS-142
Inlet needle and seat	011357
Filter element	010741
Main fuel jet (0.063) Std.	011385
Main fuel jet (0.061)	011396
Main fuel jet (0.059)	011395
Main fuel jet (0.057)	011394

Model KA-15A

Repair kit	RK-505
Gasket set	GS-142
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.065)	011252
Main fuel jet (0.063) Std.	011385
Main fuel jet (0.061)	011396
Main fuel jet (0.059)	011395
Main fuel jet (0.057)	011394

Model KA-20A

Repair kit	RK-560
Gasket set	GS-142
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.063)	011385
Main fuel jet (0.061) Std.	011396
Main fuel jet (0.059)	011395
Main fuel jet (0.057)	011394

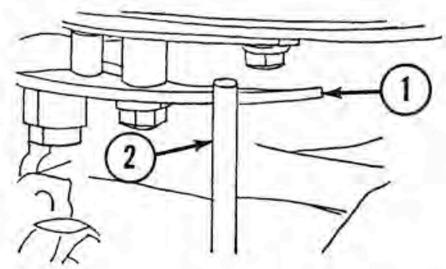


Fig. M48—Schematic view of speed control linkage. Refer to text for details of adjustment.

1. Throttle cam
2. Follower lever

Model KB-1A

Repair kit	RK-441
Gasket set	GS-149
Inlet needle and seat	010790
Filter element	010741
Float	09805
Idle adjustment screw	012074
Idle tube	012077
Main fuel jet (0.051) Std.	011764
Main fuel jet (0.049)	011763
Main fuel jet (0.047)	012027
Main fuel jet (0.045)	012101

Model KB-4A

Repair kit	RK-442
Gasket set	GS-149
Inlet needle and seat	010790
Filter element	010741
Float	09805
Idle adjustment screw	012074
Idle tube	012077
Main fuel jet (0.051) Std.	011764
Main fuel jet (0.049)	011763
Main fuel jet (0.047)	012027
Main fuel jet (0.045)	012101

Model KC-4A

Repair kit	RK-532
Gasket set	GS-157
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.071)	012645
Main fuel jet (0.069) Std.	012515
Main fuel jet (0.067)	011397
Main fuel jet (0.065)	011252

SPEED CONTROL LINKAGE. The speed control grip or lever moves the magneto stator plate to advance or retard the ignition timing. The throttle valve is synchronized to open as timing is advanced. It is extremely important that ignition timing and throttle valve opening be correctly synchronized to obtain satisfactory operation.

All Models Except Merc 350: To synchronize the linkage, set the troll control lever in "RUN" position and turn speed control grip until forward gear is engaged and engine is operating at 1000 rpm. Refer to Fig. M48. With controls set as outlined, the control cam (1) attached to magneto stator should just contact the throttle follower lever (2). Adjust by loosening the screws attaching control cam to stator, and shifting the cam (1) slightly until contact is

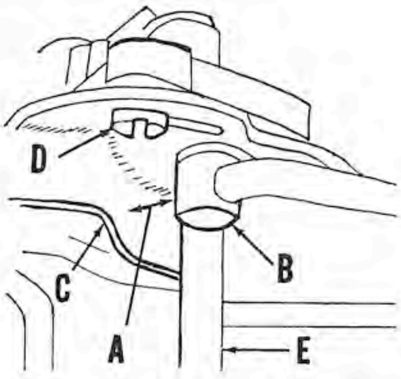


Fig. M48A — Synchronizing cam adjustment on 2 cylinder Merc 350. Distance A should measure 9/32-inch. Refer to Text.

A. Adjustment
B. Swivel link
C. Cam
D. Locking screw
E. Throttle lever

made. On Mark 20 and 25 motors with adjustable throttle control linkage rod, adjust the rod length to 2$\frac{5}{16}$ inches center to center.

Merc 350: To synchronize the linkage, first be sure that ignition timing is properly adjusted and maximum timing advance screw properly set. Check position of synchronizing cam (C—Fig. M48A) to be sure it is correctly positioned. Clearance (A) should be $\frac{9}{32}$-inch when measured between nearest points of swivel link (B) and cam (C). To reposition the cam, loosen the two screws (D) and shift the cam in the slotted holes. NOTE: The cam is properly positioned at the factory, and no adjustment should be necessary unless throttle lever or synchronizing cam are renewed.

Carburetor throttle is correctly synchronized when throttle butterfly valve is wide open when magneto is fully advanced; and a clearance (F—Fig. M48B) of 0.089 exists between edge of throttle valve and carburetor throat when throttle shaft is in economy position (H) as shown. Make the adjustments by loosening clamp screw (G) and repositioning throttle lever (E) on throttle shaft; and/or by bending throttle lever (E). Move speed control lever to full idle position and adjust idle speed stop screw, if necessary, to provide an idle speed of 600-700 rpm. Bend idle end of speed control cam (C), if necessary so that cam contacts throttle lever ¼-⅝-inch from end of cam.

REED VALVES. The inlet reed valves are located on the crankshaft center main bearing assembly as shown in Fig. M49. Crankshaft must be removed before reed valves can be serviced.

Reed petals (RP) should be perfectly flat and have no more than 0.007 clearance between free end of reed petal and seating surface of center main bearing. The reed stop must be adjusted to $\frac{5}{32}$-inch on models

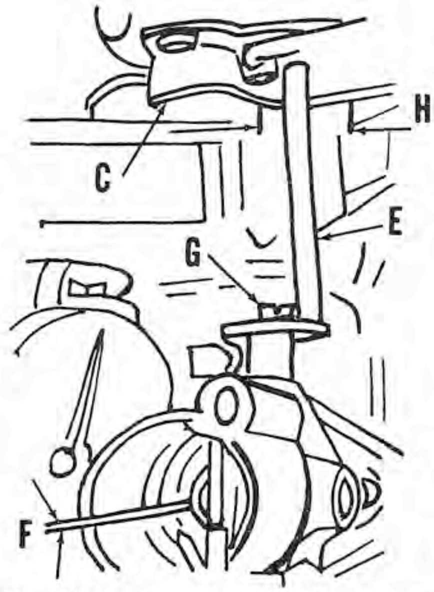


Fig. M48B—Move speed control lever until throttle shaft (E) is in economy position (H). Loosen the screw (G) and reposition throttle shaft until a clearance of 0.089 exists between edge of throttle and carburetor throat as shown at (F). Clearance can be measured using a No. 43 drill.

before 1962; or $\frac{3}{16}$-inch on later models. This clearance is measured from end of stop to seating surface of bearing housing as shown at (A). Seating surface of bearing must be smooth and flat, and may be refinished on a lapping plate after removing

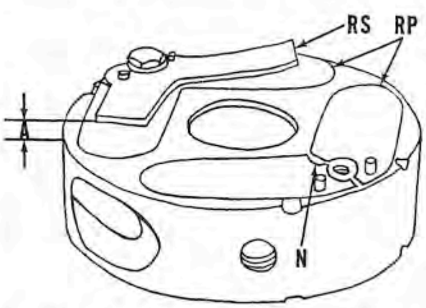


Fig. M49—Center main bearing showing inlet reed valves. Reed petals (RP) are right and left hand units. When installing reed petals, place the reed with the cut-out notch (N) on the left as shown. Adjust free height of reed stop (RS) to 5/32 inch as shown at (A).

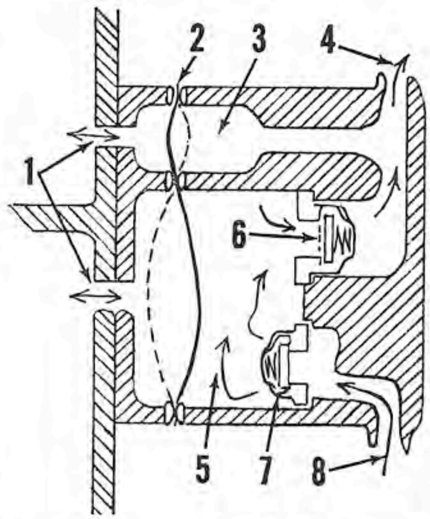


Fig. M50—Schematic view of diaphragm type fuel pump. Pump body mounts on side of cylinder block and is ported to both crankcases as shown. Refer to text for details of operation.

1. Pressure ports
2. Diaphragm
3. Booster chamber
4. To carburetor
5. Main fuel chamber
6. Outlet check valve
7. Inlet check valve
8. Fuel inlet

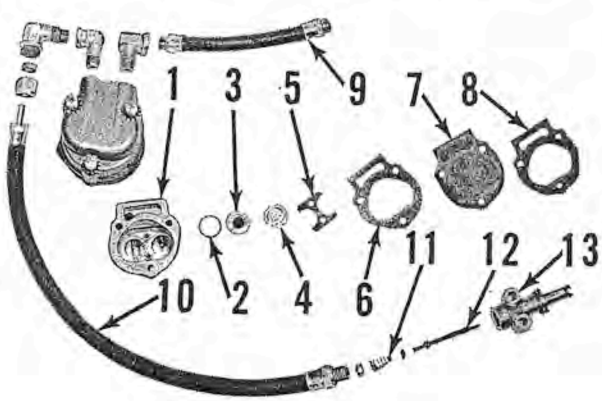
reed stops, reed valves and dowels. Do not attempt to bend or straighten a reed petal to modify performance or to salvage a damaged reed. Never install a bent reed. Lubricate the reed valve units with "Quicksilver" Multipurpose lubricant or a light distributor cam grease when reassembling.

Models 10, 10A, 15A and 100 are equipped with four reed petals which are available individually. Other models have eight reeds which are right-hand and left-hand units, and are available only in a matched set. When installing reed valves on these models, place the reed petal with the cut-out notch (N) on the left as shown in Fig. M49.

FUEL PUMP. A diaphragm type fuel pump is used. It is operated by pressure and vacuum pulsations from the crankcases which alternate to pull the fuel from the fuel tank and supply the carburetor. Most of the work is performed by the main sup-

Fig. M51—Exploded view of fuel pump and associated parts.

1. Pump body
2. Valve gasket
3. Outlet check valve
4. Inlet check valve
5. Retainer
6. Gasket
7. Diaphragm
8. Gasket
9. Outlet hose
10. Inlet hose
11. Spring
12. Adapter valve
13. Adapter



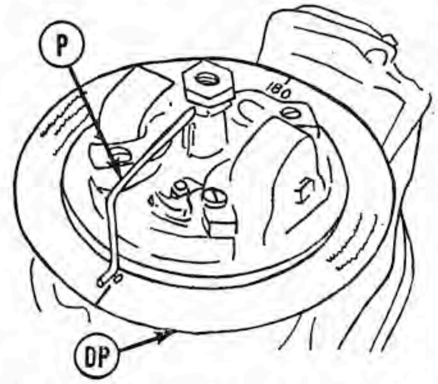


Fig. M52—Synchronizing tool installed for adjusting the magneto points. Refer to text for details.

DP. Degree plate
P. Pointer

ply chamber (5—Fig. M50). Vacuum in the crankcase pulls the diaphragm (2) in, causing fuel to be drawn through inlet line (8) past inlet check valve (7). The alternate pressure forces diaphragm down, and fuel out past the outlet check valve (6). The booster pump chamber (3) serves to dampen the action of the larger, main pump chamber (5), and increase the maximum potential fuel flow.

When overhauling the fuel pump, use Fig. M51 as a guide. All defective or questionable parts should be renewed.

IGNITION

All Models Except Merc 350: Breaker point gap should be set at approximately 0.018. The two sets of points should be set to open at exactly 180 degree intervals. The points may be synchronized by using the Mercury Synchronizing Tool Set, part number 91-28619A1 shown in Fig. M52 (or equivalent); plus a timing test light such as that shown in Fig. M53. To adjust the timing, remove the flywheel and install the degree plate (DP—Fig. M52) and pointer (P). Set the contact points for top cylinder at 0.018. Remove the spark plugs and install the test light by attaching one clip to insulated point connection and the other clip to a suitable ground. Turn the crankshaft clockwise slowly until the points just open as indicated by the test light bulb going out. Turn the degree plate until the 0° timing mark is aligned with pointer as shown. Attach the test light to the other set of points and turn the crankshaft ½-turn until the timing pointer is aligned with the 180° timing mark on degree plate; then adjust the second set of points to barely open. Recheck both sets of points with the degree plate and timing light. If the synchronizing tools are not available, renew the points or dress the contacts, then set each set of points to exactly 0.018 with a feeler gage.

On Mark 25, adjust spark advance as follows: Turn twist grip until carburetor throttle arm is approximately ¾-inch from end of magneto cam travel; then turn the adjusting screw (2—Fig. M54) to just touch control lever as shown. Adjust the stop screw (1) to limit the slow-speed travel to a point where best performance is obtained.

On Mark 28 and 28A, and on Merc 100, 150 and 200, make sure points are correctly adjusted; then turn adjusting screw (A—Fig. M55) to limit magneto advance. The advance spark should occur when No. 1 (top) piston crown reaches a point 0.275 BTDC on Mark 28 and 28A, and Merc 150 and 200; or 0.235 BTDC on Merc 100. The timing can be correctly adjusted by removing No. 1 spark plug and using the correct Mercury Timing Gage or a depth gage to measure piston position; then adjusting the link (1) until points just break. Adjust the stop screw (A) to limit magneto advance travel at this point. After maximum advance and carburetor have been adjusted, set the magneto idle stop (S—Fig. M56) to obtain the desired smooth performance with levers set for "Troll."

Merc 350: Breaker point gap should be adjusted to about 0.020. The two sets of points must be adjusted to open at exactly 180° intervals and maximum advance stop screw adjusted so that each set of points open when the affected piston is 0.222 before top dead center.

Timing and synchronizing is best accomplished using the Mercury Timing Gage (Tool No. 91-32253A1) and a timing test light such as that shown in Fig. M53. Adjust the points as follows:

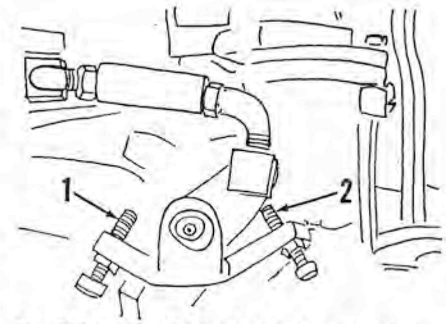


Fig. M54—On Mark 25, the timing advance stop screws must be adjusted as outlined in text.

1. Slow speed stop screw
2. Maximum advance stop screw

Remove flywheel and spark plugs, and set breaker points for top cylinder to 0.020 using a feeler gage. Thread the Timing Gage (9132253A1) into spark plug hole of top cylinder, making sure center plunger of gage fits into notches of threaded outer body. Turn crankshaft until piston strikes the gage; then thread gage out until crankpin will pass over-center while in contact with gage plunger. Turn crankshaft counterclockwise; then without moving threaded outer gage body, depress center plunger and turn plunger ¼-turn. Turn crankshaft clockwise until piston crown strikes the plunger, positioning crankshaft at correct advance timing position. Attach one lead of a timing test light to breaker point terminal and the other test lead to a good ground. Move the speed control lever toward the

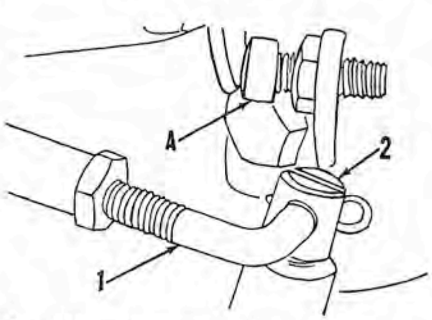


Fig. M55—Maximum advance stop screw used on some models. Refer to text.

1. Adjusting link
2. Control lever
A. Stop screw

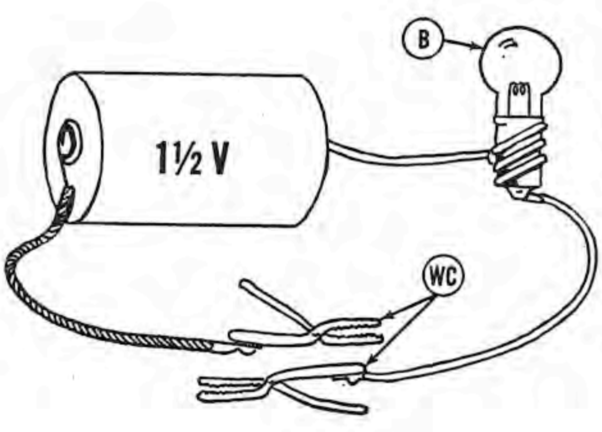


Fig. M53—A timing test light can be constructed as shown, using a flashlight battery, bulb (B), two wire clips (WC) and short pieces of wire.

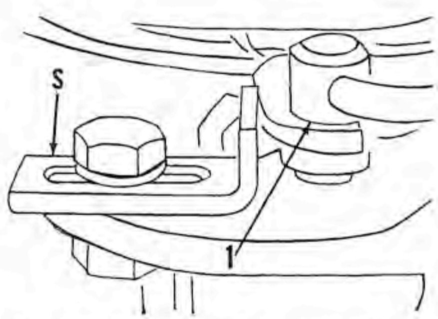


Fig. M56 — Idle stop adjustment used on some models.

1. Control cam
S. Idle stop

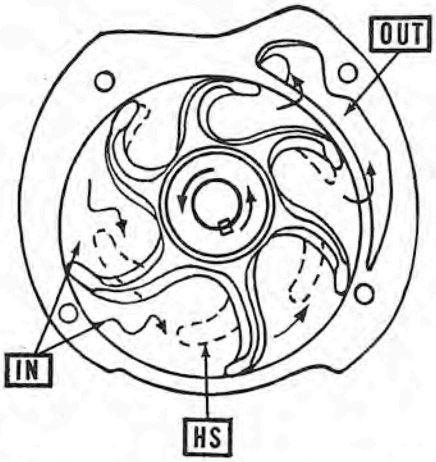


Fig. M57—Schematic view of rubber impeller type water pump. Flexing of impeller blades in offset housing causes water to be drawn into pump through inlet ports (IN) and forced into power head through outlet ports (OUT). At high speeds, blades remain partially curved as shown by broken lines (HS) and pump becomes a centrifugal pump.

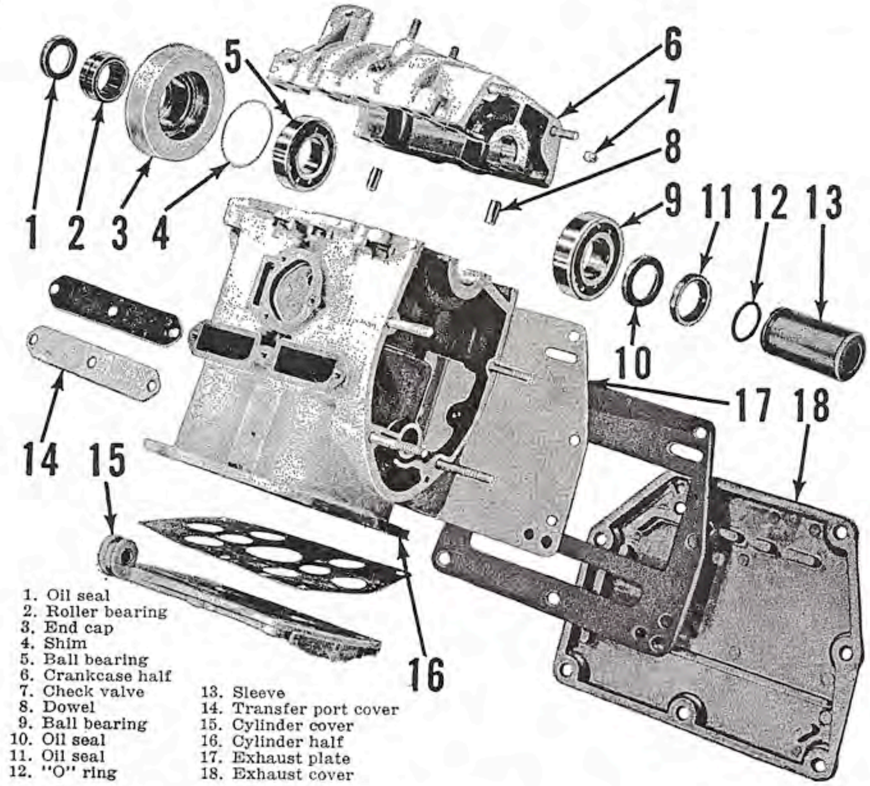


Fig. M59—Exploded view of crankcase and associated parts used on late models.

"FAST" position (back out stop screw, if necessary) until points break as indicated by test light going out. Turn the maximum advance stop screw in until it just contacts the stop; then adjust the other set of points to just open with lower piston against the timing gage plunger and speed control lever in maximum advance position. Recheck the adjustment of both sets of points before reinstalling flywheel and spark plugs.

COOLING SYSTEM

WATER PUMP. The rubber impeller type water pump is housed in the lower unit driveshaft housing and can be removed after removing the transmission. The pump housing is offset with relation to driveshaft as shown in Fig. M57.

When cooling problems are encountered, first check the water inlet for plugging or partial stoppage, then if not corrected, remove the water pump as outlined in TRANSMISSION paragraph and examine water pump, water tubes and seals. The water inlet is located in the anti-cavitation plate immediately above the propeller.

POWER HEAD

R&R AND DISASSEMBLE. Two types of power heads are used: On Mark 20, 20H and 25, the crankcase is a one-piece unit with a detachable cylinder; on later models, the front half of the split crankcase can be detached for removal of the crankshaft and piston units. The cylinder assembly is an integral part of the rear crankcase half.

To disassemble the power head, refer to the appropriate following paragraphs:

Detachable Cylinder Type: To remove the powerhead, first remove the cowling and detach interfering lines and linkage, then unbolt and remove power head from lower unit driveshaft housing. Place the power head on a stand and remove the flywheel, magneto, spark plugs, carburetor and fuel pump, then remove the stud nuts securing

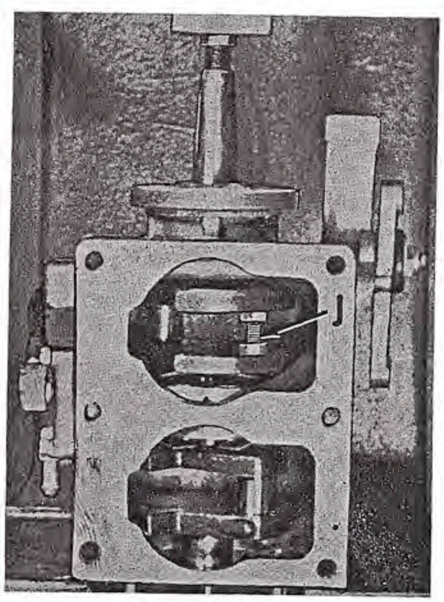


Fig. M58—When pressing out the crankshaft assembly, place a jack (J) between counterweights of upper crankpin as shown.

the cylinder to crankcase. Use a putty knife as an aid in separating cylinder and crankcase, using extreme care not to scratch or damage the gasket surfaces. Remove the connecting rod and piston assemblies from crankshaft, making sure the units are properly identified for correct assembly. Use care not to lose any of the 25 loose needle bearings located in the crankpin bearing. The bearing needles must all be removed from crankcase before crankshaft is pressed out.

Remove the stud nuts retaining the crankcase lower bearing housing, then remove housing by tapping with a plastic hammer. Do not attempt to pry the assembly from crankcase.

Remove the screw retaining the center main bearing assembly to crankcase, and install a jack (J—Fig. M58) between the counterweights of upper crankpin to keep from springing the crankshaft; then press crankshaft assembly downward out of crankcase as shown. NOTE: Use flywheel nut or other means to prevent damage to threads on crankshaft.

Crankshaft, pistons, bearings and other components may be overhauled as outlined in the appropriate paragraphs. Assemble by following the procedures outlined in the ASSEMBLY paragraph.

Split Crankcase Models: To remove the power head, first remove the cowling and detach interfering lines and linkage.

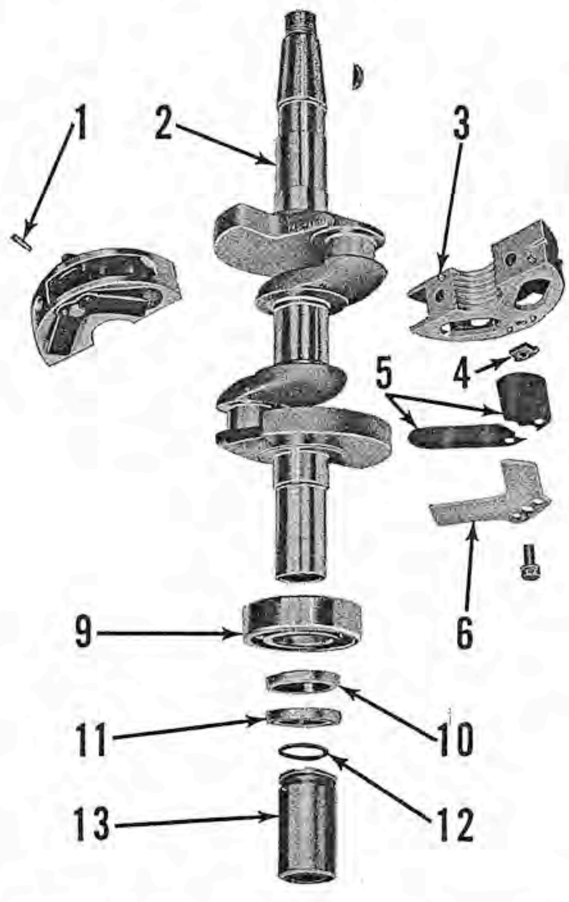


Fig. M60—Exploded view of crankshaft and associaated parts.

1. Dowel
2. Crankshaft
3. Main bearing
4. Nut
5. Reed petals
6. Reed stop
9. Ball bearing
10. Oil seal
11. Oil seal
12. "O" ring
13. Sleeve

On Mark 10, 10A and 15A, remove the carburetor, detach magneto drag link at control end; then remove control handle and control bracket from motor. Remove the transmission cover plate located on leading edge of lower unit driveshaft housing just below lower stem bracket mounting; and disconnect the lower control shift rod from shift arm.

On all models, remove the nuts securing power head to lower unit; then free the power head mounting gasket by jarring power head with heel of hand on exhaust side. Remove the power head from lower unit by lifting straight up until power head is clear of motor.

Remove the flywheel, and the carburetor if not previously removed. Detach spark plug leads, disconnect high tension lead wire clip; then remove power head by turning unit clockwise until free from hold-down ring. Remove exhaust cover plates, transfer port cover plates and cylinder block cover to assist in cleaning and reassembly.

Remove the screws retaining upper crankcase end cap (3—Fig. M59), the screw retaining the center main bearing, and the screws retaining crankcase front half (6) to cylinder (16); then remove the crankcase half by prying with two screwdrivers in the recesses provided in center of each side joint. Be careful not to mar or damage the mating surfaces of the joint.

Crankshaft, pistons, bearings and connecting rods may now be removed for service as outlined in the appropriate following paragraphs. When assembling, follow the procedures outlined in the ASSEMBLY paragraph.

ASSEMBLE. Because of the two-cycle design, crankcase must be completely sealed against both vacuum and pressure. Exhaust manifold and water passages must be sealed against both vacuum and pressure. Exhaust manifold and water passages must be sealed against water leakage. Whenever power head is disassembled, it is recommended that all gasket surfaces and machined joints without gaskets be carefully checked for nicks and burrs which might interfere with a tight seal. Slight damage can sometimes be remedied by lapping the surfaces on a lapping block using No. 00 emery cloth. Remove only the high spots without lowering the surface. If parts are warped, sprung or excessively damaged, renew the parts.

All gasket and sealing surfaces should be lightly and carefully coated with an impervious liquid gasket sealer such as Mercury Gasket Sealer Compound (92-28804). Surface must be completely coated, using care that excess sealer does not squeeze out into bearings. crankcase or other passages. Lubricate all bearing and friction surfaces thoroughly with engine oil. Loose needle bearings may be held in place during assembly by using a light non-fibrous grease.

Check the assembly by turning the crankshaft after each step to check for binding or locking which might indicate improper assembly. Remove the cause before proceeding. After piston and crankshaft assembly is installed and secured, rotate the shaft until each piston ring in turn, appears in one of the exhaust ports, then check by pressing on ring with a blunt tool. Ring should spring back when released; if it does not, a broken or binding ring is indicated and the trouble should be corrected.

Refer to the CONDENSED SERVICE DATA table for tightening torques.

Detachable Cylinder Types: The recommended crankshaft end play of 0.008-0.012 is controlled by means of shims placed under each of the end, ball-type main bearings. Shims of approximately equal thickness should be used under each bearing. When assembling, use the removed shim packs. Press the assembled crankshaft and center main bearing into the crankshaft using the Mercury Center main Bearing Tool (91-23701 for Mark 20; or 91-25061 for Mark 25); making sure that locking screw hole in center main bearing is aligned with hole in crankcase. If Center main Bearing Tool is not available, use a "jack" as shown in Fig. M58, between BOTH sets of crankshaft counterweights. After center main bearing is properly aligned, install the locking screw, install and tighten the crankcase lower bearing housing; then check the crankshaft end play between end main bearing inner race and thrust face on crankshaft. Tap the crankshaft each direction with a plastic hammer when measuring. If end play is not as specified, remove the crankshaft and add or remove shims as required.

When installing the connecting rod and piston assemblies, make sure the sharp, vertical side of deflector is installed to starboard (intake) side of cylinder block. See Fig. M61.

Split Crankcase Models: Completely assemble the crankshaft, bearings, connecting rods and pistons, making sure the sharp, vertical side of deflector on piston crown is installed toward starboard (intake) side of cylinder block. Thoroughly lubricate the pistons and rings and make sure that ring end gaps are aligned with the locating pins in ring grooves. The two angle ring compressers of Mercury Ring Compressor Kit 91-28891A2 should be used to insert the pistons in lower ends of cylinders. If ring compressers are not available, work each ring individually into cylinder, taking special precautions not to distort or break the rings or score the surfaces of rings or pistons. Check the rings carefully after installation.

Make sure that center main bearing dowel (1—Fig. M60) is in place and that main bearing (3) is properly located over dowel. Assemble and install the upper main bearing cap, using the shim pack (4—Fig. M59) which was used when power

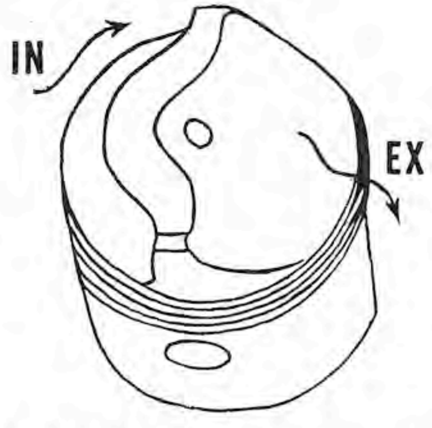


Fig. M61—Piston crown is designed to improve scavenging efficiency. Be sure piston is installed as indicated, with relation to inlet and exhaust ports.

head was disassembled. Install and tighten the cap screws retaining the main bearing cap to cylinder half of crankcase; then check the clearance between upper bearing (5) and thrust face of crankshaft. Tap crankshaft each direction with a plastic hammer to make certain bearing is fully seated. Crankshaft end clearance should be 0.008-0.012. If clearance is not correct, add or remove shims (4) as required. Shims are available in thicknesses of 0.002, 0.003, 0.005 and 0.010. NOTE: If more than one shim is required, center the crankshaft by placing half of shim pack below the lower ball bearing (9).

Tighten the crankcase and exhaust cover cap screws by working each way from the center. The coarse thread aluminum lock screw for intermediate main bearings should be tightened to a torque of 120 inch pounds. Fine thread brass screws in this location should be tightened to a torque of 150 inch pounds. Other tightening torques are given in CONDENSED SERVICE DATA table.

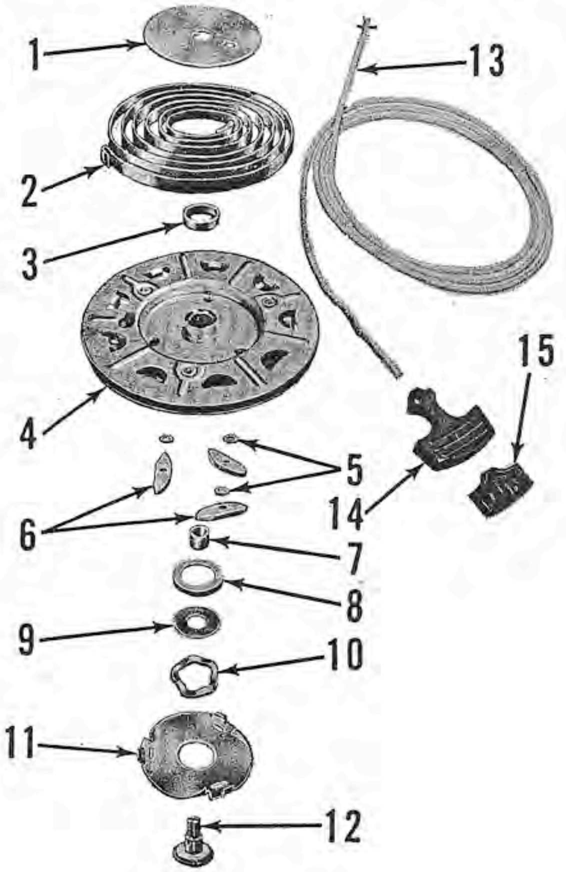
PISTONS, PINS, RINGS & CYLINDERS. Before detaching connecting rods from crankshaft, make sure that rod and cap are properly identified for correct assembly to each other and in the correct cylinder.

Each piston is fitted with three rings which are interchangeable in the ring grooves and are pinned in place in piston.

Piston pin is pressed in piston bosses and secured with retaining rings. Piston end of connecting rod is fitted with 22 loose needle bearings which use the connecting rod bore and the piston pin as bearing races. Install bearing washers and needle bearings in piston end of connecting rod using light non-fibrous grease to hold them in place, then install and center the piston pin using Mercury tool (91-24263). Piston must be installed so that sharp, vertical side of deflector will be to starboard (intake) side of cylinder block. See Fig. M61. Thoroughly lubricate all friction surfaces during assembly. Pistons and rings are available in 0.015 oversize.

Fig. M62—Exploded view of recoil starter of the general type used.

1. Retainer
2. Recoil spring
3. Bushing
4. Sheave
5. Wave washer
6. Pawl
7. Spacer
8. Retainer
9. Washer
10. Wave washer
11. Plate
12. Sheave shaft
13. Cable
14. Handle
15. Anchor



CONNECTING RODS, BEARINGS & CRANKSHAFT. Upper end of crankshaft is carried by a ball bearing plus a caged needle bearing.

In early Mark 25 motors, the center main bearing contained 22 loose needle bearings. The center main bearing on later Mark 25 motors consisted of a renewable insert which fitted in the bearing housing. On all other models the center main bearing consists of the unbushed housing. On all models, the center main bearing housing also contains the inlet reed valves.

The lower main bearing is a ball bearing which is interchangeable with the upper ball bearing.

Connecting rod rides in 22 loose needle rollers at piston end and 25 loose needle rollers at crankpin end. Check rod for alignment, using Mercury Alignment Tool (91-28441A1), or by placing rod on a surface plate and checking with a light.

If bearing surface of rod and cap is rough, scored, worn, or shows evidence of overheating, renew the connecting rod. Inspect crankpin and main bearing journals. If scored, out-of-round, or worn, renew the crankshaft. Check the crankshaft for straightness using a dial indicator and Vee-blocks.

Inspect and adjust the reed valves as outlined in REED VALVE paragraph, and reassemble as outlined in ASSEMBLY paragraph.

MANUAL STARTER

Refer to Fig. M62 for a starter of the general type used. To disassemble the manual starter, remove the top cowl; then remove the screw and trim cap from top of cowl. Insert a screwdriver in slot in top of sheave shaft (12) and loosen the shaft nut (left hand thread). Allow the screwdriver and shaft to turn clockwise until recoil spring (2) is completely unwound. Pry the anchor (15) out of starter handle (14) and remove the anchor and handle. Remove the nut from upper end of sheave shaft (12), invert the assembly and remove the parts, making sure that recoil spring (2) remains in housing recess as sheave (4) is removed. Protect hands with cotton gloves or a cloth, grasp recoil spring (2), remove spring and allow it to unwind slowly to prevent personal injury.

Lubricate the parts with Multipurpose Lubricant and assemble by reversing the disassembly procedure. Make sure that pawls (6) are all installed the same way, with flat radius to outside. Install wave washer retainer (9) with cup end up and make sure the tab in spring retainer (1) engages slot in sheave shaft (12). Loosely install the shaft nut, pull free end of cable through top cowl and install handle (14) and anchor (15). After handle is installed, turn sheave shaft (12) counter-clockwise with a screwdriver until cable handle is pulled against top cowl; then turn shaft an additional 1¼ turns and tighten the shaft retaining nut.

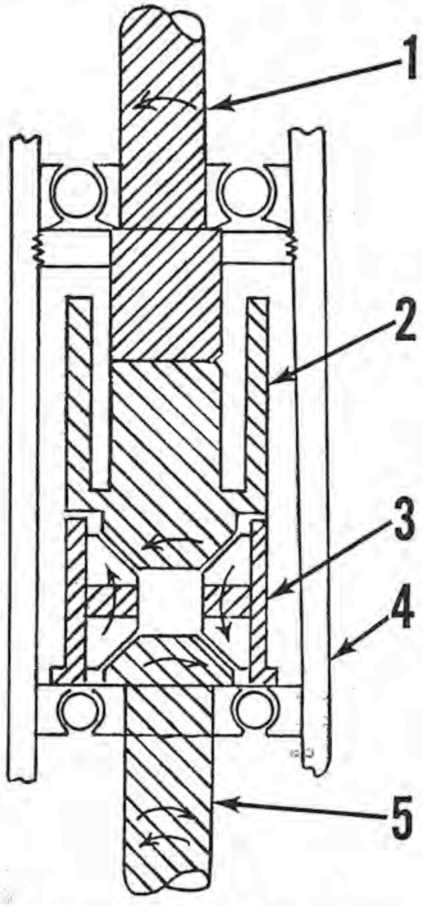
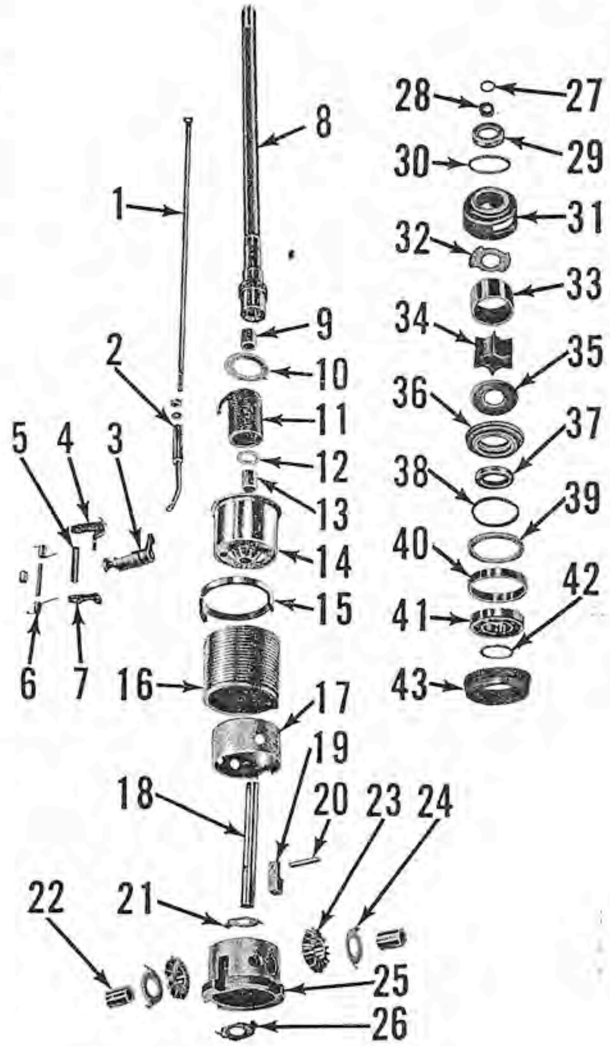


Fig. M63—Schematic view of the automatic transmission used on all models. Refer to text for complete description of method of operation.

1. Upper drive shaft
2. Input drum
3. Trunnion carrier
4. Driveshaft housings
5. Lower drive shaft

Fig. M64—Exploded view of transmission and associated parts.

1. Shift shaft
2. Adjusting coupling
3. Shift shaft
4. Neutral pawl
5. Pawl shaft
6. Pawl spring
7. Reverse pawl
8. Upper driveshaft
9. Bushing
10. Washer
11. Neutral clutch spring
12. Thrust washer
13. Bushing
14. Input drum & gear
15. Control sleeve
16. Reverse clutch spring
17. Sleeve
18. Pilot shaft
19. Catch key
20. Locking pin
21. Thrust washer
22. Idler gear shaft
23. Idler gear
24. Thrust washer
25. Trunnion carrier
26. Thrust washer
27. "O" ring
28. Slinger
29. Oil seal
30. "O" ring
31. Pump cartridge
32. Bottom plate
33. Liner
34. Impeller
35. Top plate
36. Retainer
37. Oil seal
38. Sealing ring
39. "L" washer
40. Bearing sleeve
41. Ball bearing
42. Shim
43. Lock ring



LOWER UNIT

NOTE: Models before 1957 and after 1962 are equipped with gear shift transmission similar in design and operation to that used on Four Cylinder models. For service on these models, refer to overhaul section for Four Cylinder Lower Unit.

PROPELLER AND DRIVE CLUTCH. Protection for the motor is built into a special cushioning clutch in the propeller hub. Propeller is splined to the shaft. No adjustment is possible on the propeller or clutch. Various pitch propellers are provided, and propeller should be selected for best performance under applicable conditions. Propellers other than those designed for the motor must not be used.

TRANSMISSION. Some models are equipped with an automatic transmission in which forward, reverse and neutral positions are controlled by the speed control grip. The transmission is located in lower part of driveshaft housing and consists of differential gearing and two helical-spring clutches controlled by a cam and pawls.

OPERATION. Refer to Fig. M63. In normal operating position, the upper drive shaft (1) is connected to input drum and gear assembly (2) by the neutral spring. The input drum (2) and trunnion carrier (3) are locked together by the forward and reverse spring, and the entire transmission rotates as a unit. When the control lever is moved to the neutral position, the neutral pawl (4—Fig. M64) moves in to catch the extended upper end of neutral spring (11). When the spring is stopped, the rotative force of upper driveshaft (1—Fig. M63) tends to unwind the spring, releasing the connection between driveshaft (1) and input drum (2); and the input shaft rotates within the unit without transmitting power. When the control lever is moved to the reverse position, the reverse pawl (7—Fig. M64) moves inward into a notch in control sleeve (15). The control sleeve is attached to upper end of forward and reverse spring (16). Lower end of spring rests against the key (19) which is attached to trunnion carrier (25). When upper end of forward and reverse spring is stopped by the reverse pawl, the rotative force of the transmission unit releases the connection between input drum (2—Fig. M63) and trunnion carrier (3); and the trunnion carrier tends to rotate in the same direction at a slower speed. This further rotation plus the action of the spring key causes the forward and reverse spring to further expand, locking the trunnion carrier (3) to the driveshaft housing (4). Power is then transmitted through the differential gears (23—Fig. M64) to turn the lower driveshaft in the reverse direction. Because the transmission control shaft (3) is connected to the speed control lever, the clutches are engaged and disengaged only at idle speed. The helical-spring clutches are so designed that their holding power increases as torque increases so that power is transmitted by the spring clutches, relieving the operating pawls of overload.

R&R AND OVERHAUL. To remove the transmission, first remove the transmission control cover plate at lower side of driveshaft housing; then remove the three stud nuts retaining gearcase housing to driveshaft housing. NOTE: One nut is located beneath the previously removed control cover plate, the other two on lower side of anti-cavitation plate on gearcase housing.

Remove the gearcase housing by pulling while tapping with a soft mallet to free the "O" ring seal.

If the power head has been removed, turn the transmission control shaft (3—Fig. M64) until lever is vertical, then remove the complete driveshaft and transmission assembly by pressing downward on upper end of driveshaft (8).

If power head is not removed, hold the trunnion carrier (25) from turning by inserting a screwdriver in notch, then remove the short screw from lower end of pilot shaft (18). Thread a long No. 10-32 screw in end of pilot shaft to serve as a puller. Hold trunnion carrier (25) from turning, pull down on the puller screw, and turn the powerhead flywheel in a reverse direction to free the grip of the neutral spring (11). Transmission may be removed in this manner, leaving upper drive shaft (8) in housing.

The spiral winding of neutral spring (11) and forward and reverse spring (16) is designed to lock the assembly together when turned in the normal direction of rotation. Transmission components can be easily disassembled or assembled by hand, by turning the top unit counter-clockwise as the units are pulled apart or assembled. NOTE: When removing the input drum (14) from trunnion carrier (25), it may be necessary to release the lower end of forward and reverse spring by prying it over the catch key (19) after securing a slight amount of slack.

To disassemble the trunnion carrier, remove the sleeve (17) by pulling upward, then withdraw the locking pin (20). Both are a slip fit. Remove the thrust washers (21 and 26), then remove pilot shaft (18), using an arbor press. Idler pinion shafts (22) can be pressed out after pilot shaft has been removed. Assemble by reversing the disassembly procedure. Idler pinion shafts (22) must be installed flush with outer edge of trunnion bushings. When installing pilot shaft (18), make sure the hole for pin (20) is aligned in shaft and trunnion carrier. Check and note thickness of thrust washers (21 and 26). On some early models, the washers are interchangeable and are 0.020 in thickness. On most motors, the upper thrust washer (21) is 0.031 in thickness, while the lower washer (26) is 0.020. Make sure the washers are installed in the proper location.

Upper drive shaft (8) on Merc models can be removed without removing the power head, by threading a long No. 10-32 screw or rod in lower end of shaft to serve as a puller. On older models, remove the power head to remove the drive shaft. Shim pack (42) controls the transmission end play and will be found on the bearing shoulder when drive shaft (8) is removed.

The upper drive shaft ball bearing (41) and the water pump assembly are retained in the driveshaft housing by the retaining ring (43) which is threaded into housing with a left-hand thread. To disassemble the bearing and water pump, remove the retaining ring with Mercury tool 91-27532A1 or equivalent; then remove the components with a suitable expanding puller. NOTE: On early models, the water pump cartridge (31) is reversed, with closed end down. Cartridge must be removed before impeller (34) can be renewed. A water pump puller (91-27780) is provided by the manufacturer. When removing the cartridge on these models, expand the puller below the upper cover plate (35) as cover plate must be tilted for removal from housing.

When reassembling, make sure that all components are properly assembled with the inner holes aligned so that the drive shaft (8) can be inserted. Lubricate all parts liberally with a good, light grease such as "Quicksilver" Multipurpose Lubricant. The Assembly Tool (91-28742A1) will facilitate installation.

The transmission must be installed with 0.006-0.010 end play. Thickness of shim pack depends on the assembled height of the gearcase drive pinion (2—Fig. M66). If service on the gearcase or components is required, complete the necesary work before measuring the transmission end play. Transmission end play is adjusted by adding or removing shims in shim pack (42—Fig. M64) which fits between bearing (41) and the shoulder of upper drive shaft (8). To determine the required shim pack thickness, completely assemble the transmission, omitting the clutch springs (11 and 16). Install the assembly in driveshaft housing; then measure and record the distance between lower face of thrust washer (26) and the mounting flange of driveshaft housing. Measure and record the height of thrust washer face of lower drive shaft pinion (2—Fig. M66) above the mounting flange of gearcase housing (29). Subtract the second measurement from the first to obtain the existing clearance. Remove the transmission assembly and upper drive shaft (8—Fig. M64) and add or remove shims (42) as required to establish the recommended end play. Shims are available in thicknesses of 0.002, 0.003, 0.010, 0.020, 0.030 and 0.040. The manufacturer has designed a transmission gage (91-28987A1) which can be used to determine the shim pack thickness. See Fig. M65. When using the gage, omit one 0.010 shim (42—Fig. M64) from the previously installed shim pack, then measure the gap between lower drive pinion and the slide as shown. The measured gap indicates the thickness of shims to be added, as end play is provided for by the length of the slide on the gage.

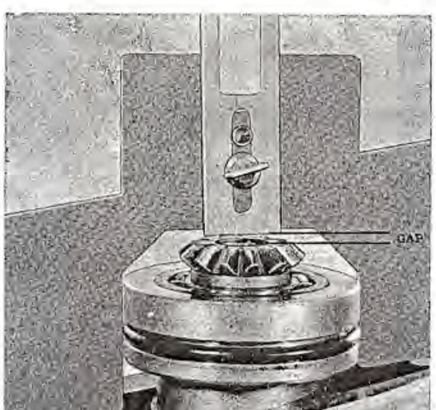


Fig. M65—Using the recommended tools to adjust transmission end play. Refer to text for details.

ADJUSTMENT. To adjust the transmission linkage, set the speed control grip or lever in the "Neutral" position, and adjust the length of shift rod (1—Fig. M64) until the lever on transmission control shaft (3) points horizontally forward.

GEARCASE HOUSING. To overhaul the lower unit gearcase, unbolt and remove the unit from driveshaft housing and clamp the assembly in a vise, using formed blocks of wood to protect the gearcase housing. Remove the propeller by removing nut (10—Fig. M66). Before disassembly, check the backlash of the gears by pushing in on propeller shaft (25) and pulling out on the lower driveshaft (2); then rotating the driveshaft slightly to determine backlash. The backlash should be 0.003-0.005.

To disassemble the gearcase, remove the threaded cover (13) using Mercury Tool 91-27534A1 or a suitable spanner wrench. Cover is retained to gearcase by a left-hand thread. Clamp the end of propeller shaft (25) in a soft-jawed vise and tap the housing (29) from shaft using a rubber mallet. Remove and save the washer (22) and shims (23) from gearcase housing shoulder, if they were not removed with shaft and bearing assembly. The shims control the backlash of the propeller drive gears. Tap the propeller shaft and bearing assembly from the bearing carrier (17). Remove snap ring (19) and shims (20); then remove the bearing (21) using bearing plates and an arbor press. The shims (20) control end play in the propeller shaft. Driven gear (24) can be pressed from propeller shaft after removing the drive pin (26). NOTE: this drive pin is retained by the bearing inner race, and should drop out after bearing is removed. On early models with closed hole, pin must be drilled out if it is tight.

To remove the drive shaft (2) clamp the upper pinion in a soft jawed vise and remove the retaining screw (9); then tap gearcase housing (29) if necessary, to free pinion (8) from lower drive shaft. Shaft and pinion can now be withdrawn from housing. Clamp upper end of pilot assembly (6) in protected vise and tap housing (29) to remove the pilot. Shims (4) control the mesh position of the propeller drive gears. Shims of same thickness should be used when reassembling; unless pilot (6), gearcase (29), or the gears (8 & 24) are renewed. If parts are renewed, make a trial assembly using bearing blue to check and adjust the mesh position. Shims are available in thicknesses of 0.002, 0.003, 0.005, 0.010 and 0.020.

Reassemble by reversing the disassembly procedure. Be sure to align drive pin hole in propeller shaft (25) and driven gear (24); and press the gear on shaft until drive pin (26) can be inserted. Install and seat the ball bearing, then install snap ring (19), using sufficient shims (20) to remove all clearance between snap ring groove and bearing. Shims are available in thicknesses of 0.003, 0.005 and 0.010. Install the propeller shaft assembly using the shim pack (23) removed on disassembly, then check the backlash between pinion (8) and gear (24). If the recommended 0.003-0.005 backlash is not obtained, disassemble and add or remove shims (23). Increasing the shim pack thickness increases the backlash. Shims are available in thicknesses of 0.002, 0.003, 0.005 and 0.010. Install the assembled gearcase as outlined in TRANSMISSION paragraph.

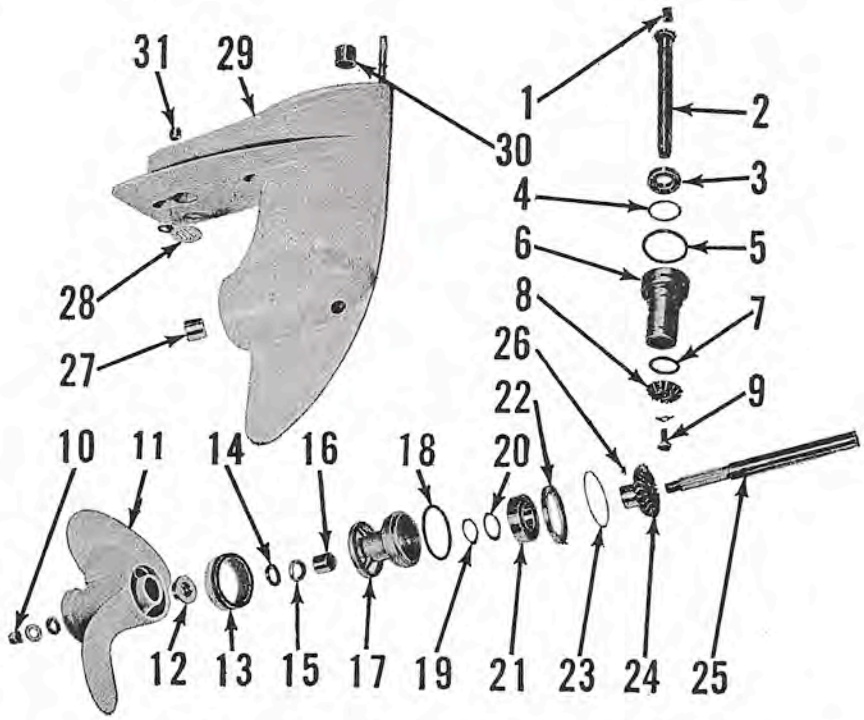


Fig. M66—Exploded view of lower unit gearcase and associated parts.

1. Bushing
2. Lower drive shaft
3. Ball bearing
4. Shim
5. "O" ring
6. Pilot assembly
7. "O" ring
8. Drive pinion
9. Cap screw
10. Nut
11. Propeller
12. Collar
13. Housing cover
14. Oil seal
15. Oil seal
16. Roller bearing
17. Bearing carrier
18. "O" ring
19. Snap ring
20. Shim
21. Ball bearing
22. "L" washer
23. Shim
24. Driven gear
25. Propeller shaft
26. Drive pin
27. Roller bearing
28. Water inlet
29. Gearcase
30. Roller bearings

MERCURY

KIEKHAEFER CORP.

(General Offices)
Fond Du Lac, Wisc.
(Parts and Service Division)
Beaver Dam, Wisc.

CONDENSED SERVICE DATA

FOUR CYLINDER MODELS

Year Produced				
1955	....	Mk 55	....	....
1956	Mk 30, 30H	Mk 55, 55H	....	....
1957	Mk 30, 30H	Mk 55, 55H	....	....
1958	Mk 30, 30H	Mk 55, 55H	Mk 58	....
1959	....	Mk 35A	Mk 55A, 58A	....
1960	....	Merc 300	Merc 400	....
1961	....	Merc 350	Merc 400, 500	....
1962	....	....	Merc 450, 500	....
1963	....	....	Merc 500	Merc 650
TUNE-UP				
Rated Horsepower	30	35 - 40	40 - 50	65
Rated rpm	5400	5500 - 5800	5500 - 5800	5200
Bore—Inches	2 7/64	$2\frac{7}{16}$	$2\frac{9}{16}$	$2\frac{7}{8}$
Stroke—Inches	$2\frac{1}{8}$	$2\frac{1}{8}$	$2\frac{1}{8}$	2.3
Displacement—Cu. In.	29.78	39.6	44	60
Firing Order	1 - 3 - 2 - 4			
Compression @ Cranking Speed	Not more than 15 psi variation between cylinders			
Spark Plug				
Champion	J6J	J6J	J6J	J4J
AC	M44C	M44C	M44C	
Electrode gap	0.025	0.025	0.025	0.025
Magneto				
Make	Kiekhaefer or FM		Kiekhaefer	Kiekhaefer
Point gap	0.008 - 0.010	0.008 - 0.010	0.008 - 0.010	0.008-0.010
Timing	See Text	See Text	See Text	See Text
Carburetor				
Make	Tillotson	Tillotson or Carter	Tillotson	Tillotson
Model	See Text	See Text	See Text	KC2A
Adjustment	See Text	See Text	See Text	See Text
Fuel—Oil Ratio	20:1	20:1	20:1	20:1
SIZES—CLEARANCES				
Piston Rings	Publication Not Authorized by Manufacturer			
End gap				
Side clearance				
Piston Skirt Clearance				
Crankshaft Bearing Journal Diameter				
Upper main bearing				
Intermediate bearing				
Lower main bearing				
Crankpin				
Crankshaft Bearing Diametral Clearance				
Upper main bearing	Roller Brng.	Roller Brng.	Roller Brng.	Roller Brng.
Intermediate bearing				
Lower main bearing	Roller Brng.	Roller Brng.	Roller Brng.	Roller Brng.
Crankpin	Roller Brng.	Roller Brng.	Roller Brng.	Roller Brng.
Piston Pin Diameter				
Clearance	Roller Brng.	Roller Brng.	Roller Brng.	Roller Brng.
TIGHTENING TORQUES				
(All Values In Inch-Pounds Unless Otherwise Noted)				
Connecting Rod	180	180	180	180
Flywheel Nut	65 ft. - lb.	65 ft. - lb.	65 ft. - lb.	65 ft. - lb.
Reed Valves	35 - 40	35 - 40	35 - 40	35 - 40
Intermediate Main Bearing	150	See Text	See Text	See Text
Crankcase Screws	150	150	150	150
Cylinder Cover	60	60	60	60
Exhaust Cover	60	60	60	60
Intake Manifold	45 - 60	45 - 60	45 - 60	45 - 60
Spark Plug	180	180	180	180

SIX CYLINDER MODELS

Year Produced				....
1957	Mk75E	....	....	....
1958	Mk75E	Mk78E	....	....
1959	....	Mk75A, 78A	....	....
1960	....	Merc 600, 700	Merc 800	....
1961	....	Merc 600, 700	Merc 800	....
1962	....	....	Merc 850	Merc 1000
1963	....	....	....	Merc 850, 1000
TUNE-UP				
Rated Horsepower	60	60 - 70	80 - 85	85 - 100
Rated rpm	5500	5500	5200	5200
Bore—Inches	$2\frac{7}{16}$	$2\frac{9}{16}$	$2\frac{3}{4}$	$2\frac{7}{8}$
Stroke—Inches	$2\frac{1}{8}$	$2\frac{1}{8}$	$2\frac{1}{8}$	2.3
Displacement—Cu. In.	59.4	66	76	90
Firing Order	1-6-4-2-5-3		1-4-5-2-3-6	
Compression @ Cranking Speed	Not more than 15 psi variation between cylinders			
Spark Plug				
Champion	J6J	J6J	J4J	J4J
AC				
Electrode gap	0.025	0.025	0.025	0.025
Distributor				
Make	Own	Own	Own	Own
Point gap	90° Dwell	90° Dwell	90° Dwell	90° Dwell
Timing	See Text	See Text	See Text	See Text
Carburetor				
Make	Tillotson	Tillotson	Tillotson	Tillotson
Model	See Text	See Text	See Text	See Text
Adjustment	See Text	See Text	See Text	See Text
Fuel—Oil Ratio	20:1	20:1	20:1	20:1
SIZES—CLEARANCES				
Piston Rings	Publication Not Authorized by Manufacturer			
End gap				
Side clearance				
Piston Skirt Clearance				
Crankshaft Bearing Journal Diameter				
Upper main bearing				
Intermediate bearing				
Lower main bearing				
Crankpin				
Crankshaft Bearing Diametral Clearance				
Upper main bearing	Roller Brng.	Roller Brng.	Roller Brng.	Roller Brng.
Intermediate bearing				
Lower main bearing	Roller Brng.	Roller Brng.	Roller Brng.	Roller Brng.
Crankpin	Roller Brng.	Roller Brng.	Roller Brng.	Roller Brng.
Piston Pin Diameter				
Clearance	Roller Brng.	Roller Brng.	Roller Brng.	Roller Brng.
TIGHTENING TORQUES (All Values In Inch-Pounds Unless Otherwise Noted)				
Connecting Rod	180	180	180	180
Flywheel Nut	65 ft. - lb.	65 ft. - lb.	85 ft. - lb.	85 ft. - lb.
Reed Valves	35 - 40	35 - 40	35 - 40	35 - 40
Intermediate Main Bearing	See Text			
Crankcase Screws	150	150	150	150
Cylinder Cover	60	60	60	60
Exhaust Cover	60	60	60	60
Intake Manifold	45 - 60	45 - 60	45 - 60	45 - 60
Spark Plug	180	180	180	180

LUBRICATION

The power head is lubricated by oil mixed with the fuel. If "Kiekhaefer Quicksilver" 2-cycle engine oil is used, one 12 ounce can should be mixed with each 2 gallons of gasoline, or one 30 ounce can with each 5 gallons of gasoline. If "Quicksilver" oil is not available, a good grade "Type MM," SAE 30 motor oil may be substituted by mixing ½-pint of oil with each gallon of fuel. Gasoline and oil should be thoroughly mixed. Marine white, automotive white, or light-aircraft gasoline is recommended. If not available, use a suitable "Regular" gasoline.

The lower unit gears and bearings are lubricated by oil contained in the gear case. Special "Quicksilver Outboard Gear Lubricant" or a non-channeling, waterproof, marine gear lubricant should be used. Gearcase is filled through the filler hole until lubricant reaches the level of the vent hole. NOTE: On most models, the plugs are located on port side of gearcase. If both plugs are the same height, the forward plug is the filler hole. If one plug is above the other, the LOWER plug is the filler hole. Lubricant should be maintained at level of vent plug.

FUEL SYSTEM

CARBURETOR. Tillotson carburetors are used on all models except some Mark 55H motors, which use Carter Type N carburetors. Two carburetors are used on four cylinder motors; three carburetors on six cylinder models. Refer to the appropriate following paragraphs for overhaul and adjustment procedures.

Carter Model N-2537S: Refer to Fig. M75. Initial setting is 1¼ turns open for both the idle adjusting needle (6) and high speed adjusting needle (16). Final adjustment must be made under load after operating temperature has been reached. Adjust the high-speed needle to provide the leanest setting which will permit full power and acceleration. Adjust the idle needle after high speed needle has been adjusted, to provide smooth operation under load at slow speeds. Clockwise rotation of the high speed adjusting needle leans the mixture. Clockwise rotation of the idle needle provides a richer mixture.

To disassemble the carburetor, scribe a line on the body and bowl to assure proper assembly, then remove the bowl nut and fuel bowl. To check and adjust the float level, invert the carburetor body with bowl removed, and measure the clearance between nearest edge of float and gasket surface of body flange. This clearance should be 11/64-inch with inlet needle seated. Adjust by bending lip of float.

When installing throttle valve (3), make sure the "C" trademark is toward idle port. Seat the valve by tapping lightly with a screwdriver and use new screws to secure the valve.

Carter parts numbers are as follows:

Inlet needle & seat	25-317S
Main nozzle	12-483
Float & lever assembly	21-163S
Idle adjustment screw	30A-70
High speed adjusting needle	37-74
Throttle valve screw	39-10

Tillotson Carburetors: Fig. M76 shows an exploded view of carburetor typical of that used on all models. Minor difference will be apparent upon examination. AJ-49A carburetors used on some early models do not use the fuel filter (1 through 4). Some early carburetors employ an adjustable high speed needle instead of the fixed jet (17).

Initial setting for carburetors equipped with the high speed adjustment needle is one turn open from closed position for the idle needle (16); and 1½ turns open for the high speed adjustment needle (which replaces the high speed jet 17). Run motor until operating temperature is reached, then shift to forward gear and open the throttle. Slowly turn the high speed adjustment needle clockwise until engine misses, then back needle out approximately ½-turn. Adjust the high speed needle for all carburetors in the same manner, for equal performance. After high speed needles have been properly adjusted, regulate the idle adjustment needles (16) for all carburetors until engine runs smoothly under load at slow speed. Turning idle mixture needle clockwise will lean the mixture.

On carburetors employing the fixed main jet, high speed mixture adjustment may be made for special conditions by changing the size of jet (17). The standard jet should normally be used. If motor is operated at altitudes above 2500 feet, performance can usually be improved by installing a smaller jet. Be sure the same size jet is used in all carburetors on the motor. On most models, the standard jet is a part of the carburetor

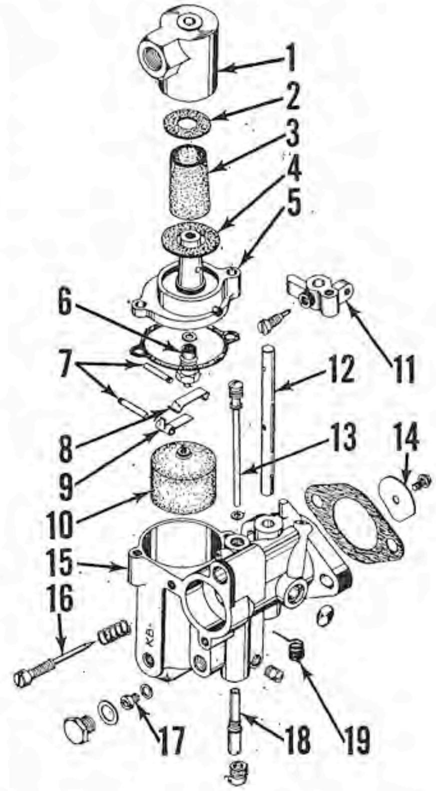


Fig. M76—Exploded view of Tillotson carburetor of the general type used on most models.

1. Strainer cover
2. Gasket
3. Strainer
4. Gasket
5. Bowl cover
6. Inlet needle & seat
7. Shaft
8. Secondary lever
9. Primary lever
10. Float
11. Throttle lever
12. Throttle shaft
13. Idle tube
14. Throttle valve
15. Body
16. Idle needle
17. High speed jet
18. Main nozzle
19. Spring

repair kit, but optional jets must be obtained separately. NOTE: On KB models, the main jet is not listed as a part of the repair kit, and the required jets should be ordered. The standard jet is indicated in the parts lists.

On carburetors employing the fixed main jet, initial setting for the idle adjustment needle (16) is one turn open from the closed position. Idle needle must be adjusted under load to obtain smooth operation at slow speeds. Turning needle clockwise will lean the mixture.

The recommended fuel level is approximately $\frac{11}{16}$-inch below gasket surface of float bowl. To adjust the float, remove bowl cover (5) and refer to Fig. M77. Invert the cover and, with inlet needle (6) closed, measure the distance between primary lever (9) and gasket surface of bowl cover as shown at (A). This distance should be $\frac{13}{32}$-inch; if it is not, bend the curved tang on secondary lever (8) until correct measurement is obtained. After adjustment is made, bend the vertical tang on primary lever (9) to allow a maximum clearance (B) of 0.040, between the secondary lever (8) and inlet needle (6). The contact spring located in

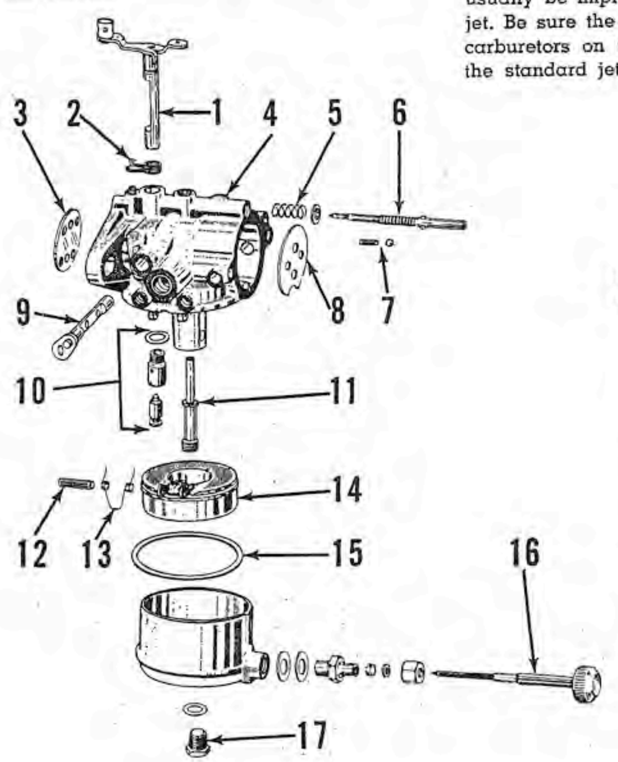


Fig. M75—Exploded view of Carter carburetor used on some early models.

1. Throttle shaft
2. Spring
3. Throttle valve
4. Body
5. Spring
6. Idle needle
7. Choke detent
8. Choke valve
9. Choke shaft
10. Inlet needle & seat
11. Main nozzle
12. Float shaft
13. Spring
14. Float
15. Gasket
16. High speed needle
17. Cap screw

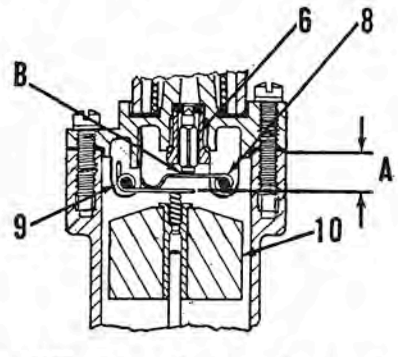


Fig. M77—Schematic view of float mechanism showing method of adjustment. Refer to text.

A. Closing adjustment
B. Open adjustment
6. Inlet needle
8. Secondary lever
9. Primary lever
10. Float

center of float should extend 5/64-inch above top of float (10). Check to see that spring has not been stretched or damaged.

Tillotson model numbers and parts lists are as follows:

Model AJ-49A

Repair kit	RK-232
Gasket set	GS-107
Inlet needle & seat	010400

Model AJ-50A

Repair kit	RK-313
Gasket set	GS-123
Inlet needle & seat	010790
Filter element	010741

Model AJ-51A

Repair kit	RK-313
Gasket set	GS-123
Inlet needle & seat	010790
Filter element	010741

Model AJ-53A

Repair kit	RK-313
Gasket set	GS-123
Inlet needle & seat	010790
Filter element	010741

Model AJ-54A

Repair kit	RK-394
Gasket set	GS-123
Inlet needle & seat	010790
Filter element	010741
Main fuel jet (0.055) Std.	011722
Main fuel jet (0.053)	011765
Main fuel jet (0.051)	011764
Main fuel jet (0.049)	011763

Model AJ-55A

Repair kit	RK-395
Gasket set	GS-123
Inlet needle & seat	010790
Filter element	010741
Main fuel jet (0.055) Std.	010722
Main fuel jet (0.053)	011765
Main fuel jet (0.051)	011764
Main fuel jet (0.049)	011763

Model KA-2A

Repair kit	RK-369
Gasket set	GS-142
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.063) Std.	011385
Main fuel jet (0.061)	011396
Main fuel jet (0.059)	011395
Main fuel jet (0.057)	011394

Model KA-7A

Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.081) Std.	011482

Model KA-8A

Repair kit	RK-427
Gasket set	GS-142
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.063)	011385
Main fuel jet (0.061) Std.	011396
Main fuel jet (0.059)	011395
Main fuel jet (0.057)	011394
Main fuel jet (0.055)	011722

Model KA-9A

Repair kit	RK-428
Gasket set	GS-142
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.063)	011385
Main fuel jet (0.061) Std.	011396
Main fuel jet (0.059)	011395
Main fuel jet (0.057)	011394
Main fuel jet (0.055)	011722

Model KA-10A

Repair kit	RK-438
Gasket set	GS-142
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.065) Std.	011252
Main fuel jet (0.063)	011385
Main fuel jet (0.061)	011396
Main fuel jet (0.059)	011395

Model KA-11A

Repair kit	RK-452
Gasket set	GS-142
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.065) Std.	011252
Main fuel jet (0.063)	011385
Main fuel jet (0.061)	011396
Main fuel jet (0.059)	011395

Model KA-12A

Repair kit	RK-463
Gasket set	GS-142
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.061) Std.	011396
Main fuel jet (0.059)	011395
Main fuel jet (0.057)	011394
Main fuel jet (0.055)	011722

Model KA-13A

Repair kit	RK-465
Gasket set	GS-142
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.061)	011396
Main fuel jet (0.059) Std.	011395
Main fuel jet (0.057)	011394
Main fuel jet (0.055)	011722
Main fuel jet (0.053)	011765

Model KA-14A

Repair kit	RK-496
Gasket set	GS-142
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.071)	012645
Main fuel jet (0.069) Std.	012515
Main fuel jet (0.067)	011397
Main fuel jet (0.065)	011252
Main fuel jet (0.063)	011385

Model KA-16A

Repair kit	RK-496
Gasket set	GS-142
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.071)	012645
Main fuel jet (0.069) Std.	012515
Main fuel jet (0.067)	011397
Main fuel jet (0.065)	011252
Main fuel jet (0.063)	011385

Model KA-17A

Repair kit	RK-520
Gasket set	GS-142
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.061)	011396
Main fuel jet (0.059) Std.	011395
Main fuel jet (0.057)	011394
Main fuel jet (0.055)	011722
Main fuel jet (0.053)	011765

Model KA-18A

Repair kit	RK-465
Gasket set	GS-142
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.061)	011396
Main fuel jet (0.059) Std.	011395
Main fuel jet (0.057)	011394
Main fuel jet (0.055)	011722

Model KA-19A

Repair kit	RK-465
Gasket set	GS-142
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.061)	011396
Main fuel jet (0.059) Std.	011395
Main fuel jet (0.057)	011394
Main fuel jet (0.055)	011722

Model KB-2A

Repair kit	RK-429
Gasket set	GS-149
Inlet needle & seat	010790
Filter element	010741
Main fuel jet (0.055) Std.	011722
Main fuel jet (0.053)	011765
Main fuel jet (0.051)	011764
Main fuel jet (0.049)	011763

Model KB-3A

Repair kit	RK-433
Gasket set	GS-149
Inlet needle & seat	010790
Filter element	012107
Main fuel jet (0.057) Std.	011394
Main fuel jet (0.055)	011722
Main fuel jet (0.053)	011765
Main fuel jet (0.051)	011764

Model KC-1A

Repair kit	RK-510
Gasket set	GS-157
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.073)	012447
Main fuel jet (0.071) Std.	012645
Main fuel jet (0.069)	012515
Main fuel jet (0.067)	011397

Model KC-2A

Repair kit	RK-549
Gasket set	GS-157
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.073)	012447
Main fuel jet (0.071) Std.	012645
Main fuel jet (0.069)	012515
Main fuel jet (0.067)	011397

Model KC-3A

Repair kit	RK-551
Gasket set	GS-157
Inlet needle & seat	011357
Filter element	012107
Main fuel jet (0.057)	011397
Main fuel jet (0.055) Std.	011722
Main fuel jet (0.053)	011765
Main fuel jet (0.051)	011764

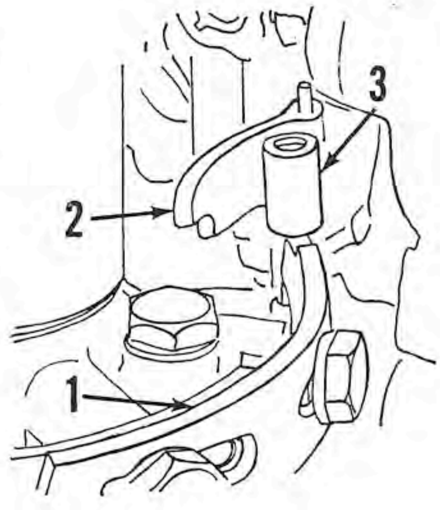


Fig. M79—Speed control mechanism used on Mark 30 & 55 series. Refer to text for details.

1. Actuating bracket
2. Throttle pickup
3. Follower roller

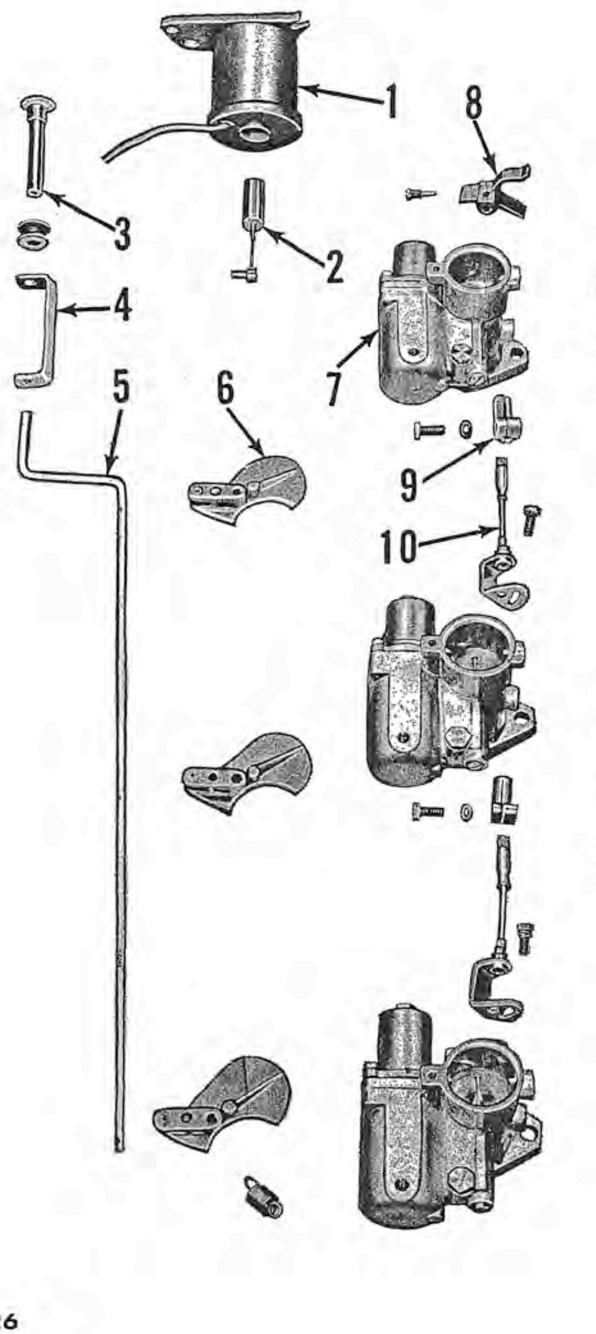


Fig. M78 — Carburetor connecting linkage used on six cylinder models. Four cylinder models are similar.

1. Choke solenoid
2. Plunger
3. Choke button
4. Link
5. Choke rod
6. Choke valve
7. Carburetor
8. Cluster lever
9. Clamp
10. Pickup bracket

SPEED CONTROL LINKAGE. The speed control lever is directly attached to the magneto or distributor to advance or retard the ignition timing. The throttle valve is synchronized to open as the timing is advanced. It is extremely important that ignition timing and throttle valve opening be correctly synchronized to obtain satisfactory operation. When synchronizing the speed control linkage, first adjust the timing as outlined in the IGNITION section; then proceed as outlined in the appropriate following paragraphs:

Mark 30 and 55 Series: Make certain that magneto is properly timed and adjusted; then adjust carburetor to obtain a smooth idle speed of 600 rpm. Loosen the cap screws retaining the actuating bracket (1—Fig. M79) to magneto frame and slide the follower roller (3) away from throttle pick-up (2). With motor at operating temperature, shift to forward gear and move the speed control lever until engine speed increases to 1000-1100 rpm for Mark 30, 30E, 30H or Mark 55H with Tillotson carburetor; 1100-1200 rpm for Mark 55 and 55E; or 2000-2400 rpm for Mark 55H with Carter carburetor. With engine speeds as indicated, move actuating bracket (1) until follower roller (3) just touches throttle pick-up arm (2); then tighten the retaining screws.

Other Four-Cylinder Models: First make certain that magneto is properly timed and adjusted. With the engine not running, slowly move the speed control lever toward the "Fast" position until magneto advance stop just touches the crankcase. Refer to Fig. M80. Loosen the screws (3) securing the throttle actuator assembly to economizer collar; then move the actuator plate until 0.015 clearance (A) exists between follower (2) and throttle cluster lever (1). Tighten the attaching screws. Move the speed control lever to "Fast" position and adjust the full throttle stop screw (4) to allow throttle lever (1) 1/64-inch travel to full open throttle position.

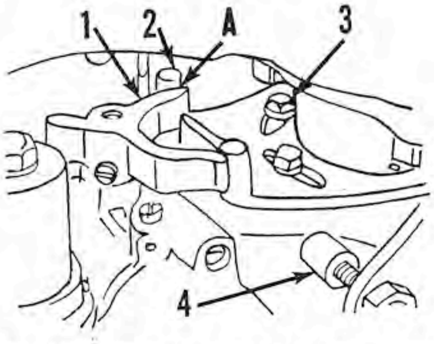


Fig. M80—Throttle control mechanism used on late four cylinder models.

1. Cluster finger
2. Pickup pin
3. Adjusting cap screw
4. Full throttle stop screw

A. Adjustment clearance

Move speed control lever fully to "Slow" position and adjust the idle limiter screw (opposite full throttle stop screw 4) until the recommended slow idle speed of 525 rpm is obtained.

Mark 75, 75A, 78 and 78A: First make certain that the distributor is properly timed and adjusted. On Mark 75 and 75A, fully retard the throttle and, with throttle valve closed, loosen the set screw (S—Fig. M82) in throttle valve cluster (3). Move the cluster (3) on throttle valve shaft until a clearance (A) of $\frac{3}{32}$-inch exists between pickup finger and No. 1 pickup pin (5). On later motors, the cluster is automatically positioned by the set screw.

On all models, slowly move the speed control lever in the "forward" position (engine not running) until the magneto advance stop just touches the crankcase. Refer to Fig. M81. Loosen the screws securing the throttle actuator assembly (1) to sector gear; then move the plate until $\frac{1}{16}$-inch clearance exists between pickup finger (4) and pickup pin (2). Secure advance plate in this position.

On older models, move the speed control lever slightly toward "Slow" position and check the adjustment of the latch spring as shown in Fig. M83. Hold the speed control sector and move the distributor body counter-clockwise toward the advance stop. Note the clearance between latch spring (L) and sector pin (P) while torque is applied. The spring should latch over the pin with no more than 1/64-inch clearance between pin and latch spring. Adjust by loosening the screws retaining latch (L) to distributor. After the adjustment is made, move control lever until distributor advance stop contacts the crankcase; then adjust the screw (A) until latch (L) is unhooked from pin (P).

Synchronize the reverse throttle mechanism with motor in operation as follows: Loosen the screws which retain the reverse throttle lever (1—Fig. M84) to the sector gear and move the lever as far as possible away from throttle reverse pickup (2). Advance the distributor in the "Reverse" direction until engine speed is 1000 rpm. Move the lever (1) until it just touches reverse pickup (2) and tighten the screws. Limit the maximum reverse speed to 4000 rpm or less by moving the lever stop on the lower cowl.

Merc 600, 700 and 800 Direct Reversing: First make certain that distributor is properly timed and adjusted. To synchronize the forward throttle refer to Fig. M85. With the engine not running, move the speed control lever until distributor pilot just touches the maximum advance stop screw. Loosen the screws (S) attaching pickup plate (2) to the sector gear and move the plate until the nylon covered pickup pin (5) is not touching the cluster finger (6); then bend pickup tab (3) in or out until a No. 48 twist drill (0.076 gage) can just be inserted between port side of throttle valve and carburetor barrel as shown at (D). Remove the drill or gage. Move the speed control lever

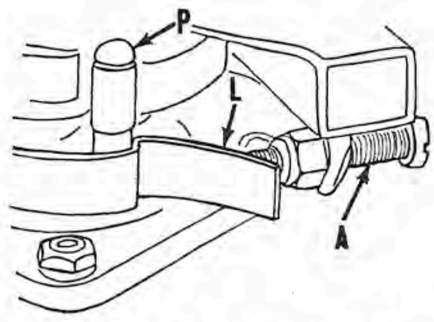


Fig. M83—Latch spring adjustment is required on some early models.

A. Adjusting screw
L. Latch
P. Sector pin

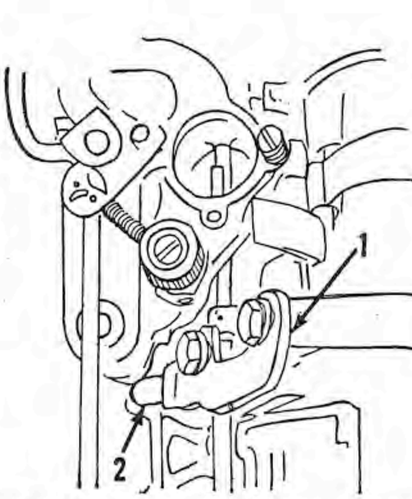


Fig. M84—Reverse throttle pickup adjustment used on older models.

1. Reverse lever
2. Reverse pickup finger

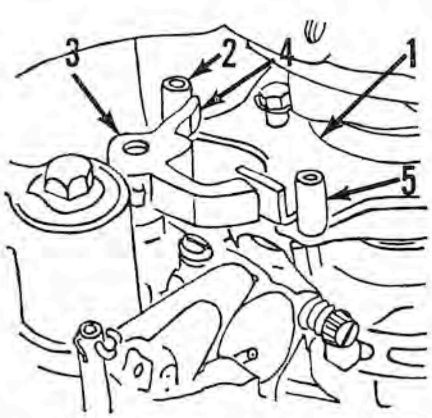


Fig. M81—Throttle control mechanism used on early six cylinder models.

1. Actuator assembly
2. Pickup pin
3. Cluster lever
4. Pickup finger
5. No. 1 pickup pin

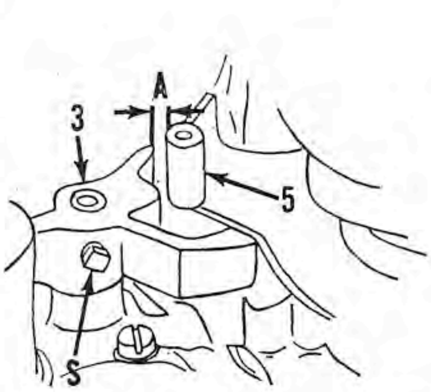


Fig. M82—Cluster lever (3) must be adjusted on throttle shaft on some early models. Refer to text.

A. Clearance
S. Set screw
3. Cluster finger
5. No. 1 pickup pin

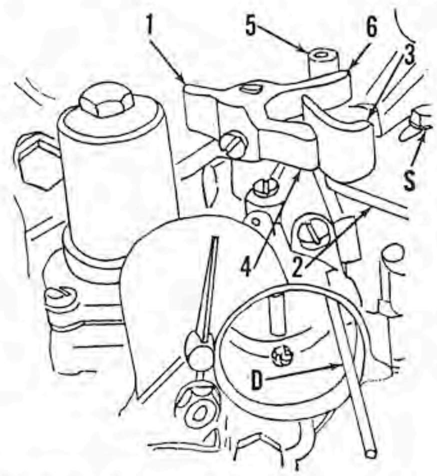


Fig M85—Forward throttle control mechanism used on late models. Refer to text for method of adjustment.

1. Cluster lever
2. Pickup plate
3. Pickup tab
4. Pickup finger
5. Pickup pin
6. Pickup finger

D. Drill (gage)
S. Attaching screw

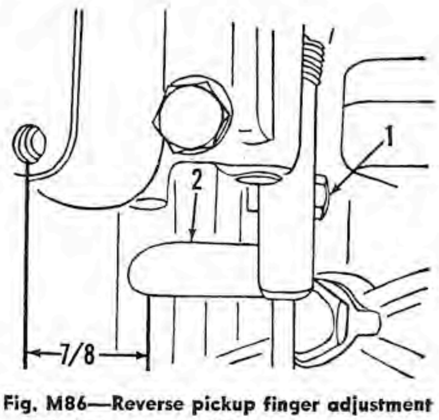


Fig. M86—Reverse pickup finger adjustment used on some models. Refer to text.

1. Clamp screw
2. Reverse pickup finger

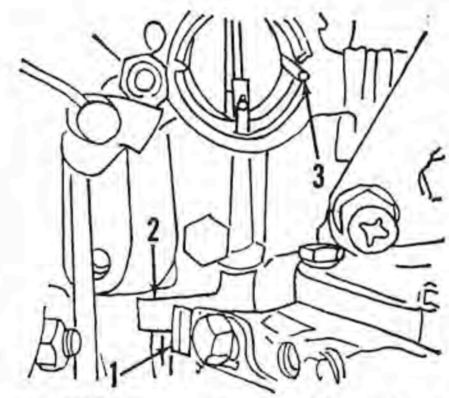


Fig. M87—Reverse throttle pickup adjustment used on Merc 800.

1. Pickup stop
2. Pickup finger
3. Drill (gage)

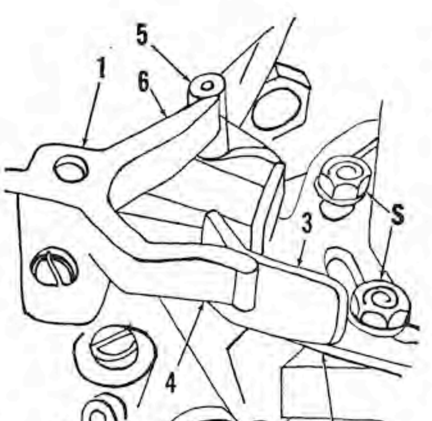


Fig. M87A — With distributor in intermediate advance position, loosen screws (S) and reposition pickup plate (2) until tab (3) just touches cluster finger (4).

1. Carburetor cluster
2. Pickup plate
3. Pickup tab
4. Cluster finger
5. Pickup pin
6. Cluster finger
S. Cap screws

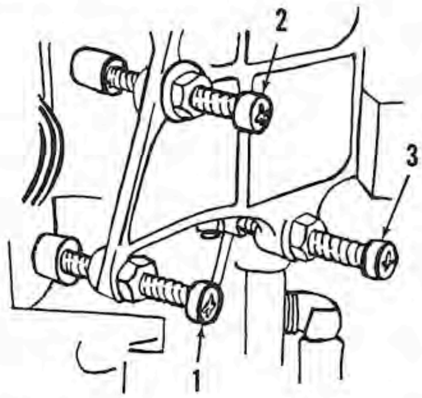


Fig. M87B — View of stop bracket showing location of throttle stop screws.

1. Spark advance stop
2. Throttle stop
3. Idle stop

to retard the ignition until spark occurs at 0.030 (inches) before TDC of piston.

NOTE: This intermediate timing advance position can be determined using Mercury Timing Gage 91-31161A1 for gear shift models; or 91-30290A1 for direct reversing models. Thread timing gage into No. 4 (from top) spark plug hole on Merc 600 or 700 models; or No. 3 spark plug hole for Merc 800 models. Make sure that center plunger of gage fits into notches of threaded outer body. Turn flywheel until the piston strikes gage; then thread gage out until crankpin will pass over center while in contact with gage plunger. Rotate flywheel counter-clockwise; then without moving threaded outer gage body, depress center plunger and turn plunger ¼-turn. Rotate flywheel clockwise until piston crown strikes the plunger. Attach one lead of a timing test light to the No. 1 Coil Primary (White) Lead of Terminal Block, and ground the other test lead. Retard the distributor (clockwise) until test bulb lights; then move to the advance direction (counter-clockwise) until test bulb just goes out.

With the intermediate timing position determined, move the pickup plate (2) until the tab (3) just touches the cluster finger (4) and tighten the attaching screws. Again move the speed control lever until distributor pilot just touches the maximum advance stop screw; then bend the nylon covered pickup pin (5) until 0.000-0.015 clearance exists between pickup finger (5) and cluster finger (6).

To synchronize the reverse throttle, proceed as follows:

On Merc 600 and 700, make sure that throttle valves are closed; then loosen clamp screw (1—Fig. M86) and position reverse pickup finger (2) so that leading edge is approximately ⅞-inch in front of carburetor float bowl as shown. Loosen the screws attaching the reverse pickup stop to the distributor sector gear and adjust the reverse timing until points break at 0.030 (inches) before Top Dead Center of the piston.

NOTE: Proceed as previously outlined for determining intermediate advance; except rotate flywheel clockwise from top dead center, then counter-clockwise to the advance REVERSE position. Move distributor COUNTER-CLOCKWISE until test bulb lights; then CLOCKWISE to the timing position.

When intermediate timing position has been determined, move the reverse pickup stop to just contact reverse finger (2) and tighten the attaching screws.

On Merc 800 direct reversing motors refer to Fig. M87. The reverse pickup lever (1) should be moved to the end of slot away from pickup finger (2) and the retaining screw tightened and safety wired. If correctly adjusted, this lever should not be moved. Move the speed control lever toward "Fast" (reverse) direction until distributor contacts the maximum (reverse) stop. Loosen the screw which clamps the reverse pickup lever to throttle shaft. Manually open the carburetor throttle until a No. 40 (0.098) drill bit can be inserted between throttle valve and port side of carburetor barrel as shown at (3). With drill bit holding throttle valve open, move the pickup finger (2) on throttle shaft until it contacts pickup stop (1) and tighten the clamping screw. Remove the drill.

Merc 700, 800, 850, 1000, Full Gear Shift: First make sure that distributor is properly timed and adjusted. Correct synchronization requires that an intermediate timing advance position of 0.015 (inches for piston crown before TDC) be determined. This is most conveniently done by using the special Mercury Timing Gage (Part No. 91-31161A1) and a continuity timing light. Make sure center plunger of gage is seated in notches of threaded outer case and thread the gage into No. 4 spark plug hole for Merc 700; or No. 3 spark plug hole for other models. Turn flywheel until the respective piston is in approximately Top Dead Center position, then thread the gage in or out until crankshaft will rock over TDC while piston crown is in contact with gage plunger. Rotate crankshaft counter-clockwise; then, without moving threaded portion of gage, depress center plunger and turn plunger ¼ turn. Rotate flywheel clockwise until piston crown strikes the plunger. Attach one lead of timing test light to the No. 1 Coil Primary (White) lead of Terminal Block, and ground the other test lead. Retard the distributor (clockwise) until test bulb lights; then move in the advance direction until test bulb just goes out.

Refer to Fig. M87A. With distributor in previously established intermediate advance position, loosen the cap screws (S) securing pickup plate (2) to distributor body, and move the plate until the tab (3) just touches the cluster finger (4). Tighten the cap screws. Move the control lever to advance timing until the maximum timing advance screw

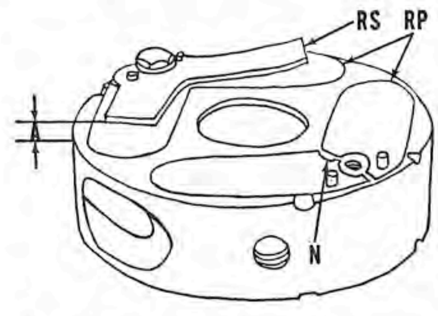


Fig. M88—Intermediate main bearing showing inlet reed valves. Reed petals (RP) are right and left hand units. When installing reed petals, place the reed with the cut-out notch (N) on the left as shown. Adjust free height of reed stop (RS).

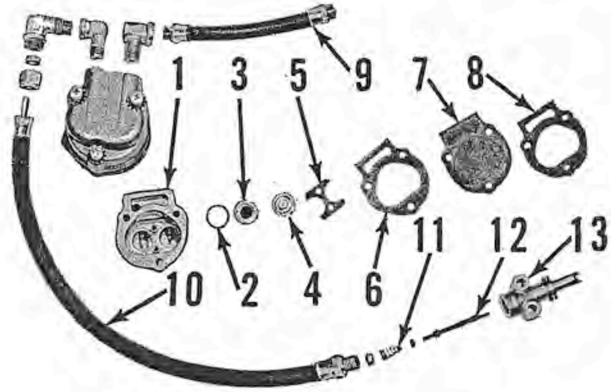


Fig. M90—Exploded view of fuel pump and associated parts.

1. Pump body
2. Valve gasket
3. Outlet check valve
4. Inlet check valve
5. Retainer
6. Gasket
7. Diaphragm
8. Gasket
9. Outlet hose
10. Inlet hose
11. Spring
12. Adapter valve
13. Adapter

just touches distributor body and bend the nylon covered pickup pin (5) until a clearance of 0.0000-0.015 exists between pickup pin and cluster finger (6).

Move the speed control lever fully to "Fast" position and adjust the full throttle stop screw (2—Fig. M87B) to allow the throttle shaft 1/64-inch travel to full open position. Adjust the idle stop screw (3) to obtain an idle speed of 500 rpm in forward gear with motor at operating temperature.

REED VALVES. The inlet reed valves are located on the crankshaft second and fourth main bearing assemblies on four cylinder models; and on the second, fourth and sixth main bearings on six cylinder models. Each reed valve unit supplies fuel mixture from one of the carburetors to the two adjoining cylinders.

Reed petals (RP—Fig. M88) should be perfectly flat and have no more than 0.007 clearance between free end of reed petal and seating surface of center main bearing. The reed stop (RS) must be carefully adjusted to $\frac{3}{16}$-inch on Merc 650 and 1000; and $\frac{5}{32}$-inch on other models. This clearance is measured between end of stop and seating surface of reed plate as shown at (A). Seating surface of bearing must be smooth and flat, and may be refinished on a lapping plate after removing reed stops, reed valves and dowels. Do not attempt to bend or straighten a reed petal to modify performance or to salvage a damaged reed. Never install a bent reed. Lubricate the reed valve units with "Quicksilver" Multipurpose Lubricant or a light distributor cam grease when reassembling.

Each reed valve unit has eight reeds which are right-hand and left-hand units, and are available only as a matched set. When installing reed valves, place the reed petal with the cut-out notch (N) to the left as shown. Crankshaft must be removed before reed valve units can be serviced.

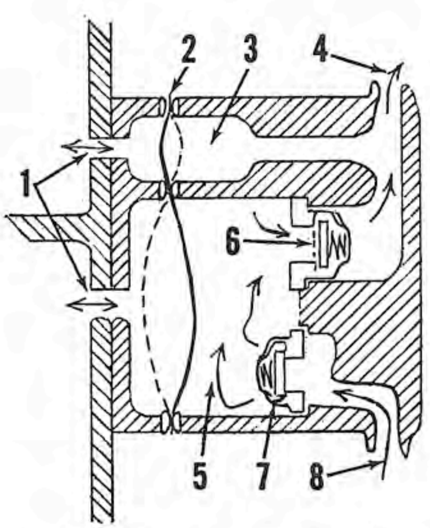


Fig. M89—Schematic view of diaphragm type fuel pump. Pump body mounts on side of cylinder block and is ported to two crankcases as shown. Six cylinder models use two fuel pumps.

1. Pressure ports
2. Diaphragm
3. Booster chamber
4. To carburetor
5. Main fuel chamber
6. Outlet check valve
7. Inlet check valve
8. Fuel inlet

FUEL PUMP. Diaphragm type fuel pumps are used. Two fuel pumps are used on six cylinder models. Pressure and vacuum pulsations from the crankcases alternate to pull fuel from the supply tank and supply the carburetor. Most of the work is performed by the main supply chamber (5—Fig. M89). Vacuum in the crankcase pulls the diaphragm (2) downward causing fuel to be drawn through inlet line (8), past inlet check valve (7) into main pump chamber (5). The alternate pressure forces diaphragm out and fuel leaves the chamber through outlet check valve (6). The booster pump chamber (3) serves to dampen the action of the larger, main pump chamber (5), and increase the maximum potential fuel flow.

When overhauling the fuel pump, use Fig. M90 as a guide. All defective or questionable parts should be renewed.

IGNITION

Four cylinder models use a belt driven magneto. Six cylinder models use a V-belt driven distributor. Refer to the appropriate following paragraphs.

MAGNETO. Breaker point gap should be 0.008-0.010; or to 54° dwell if equipment is available. Breaker point spring tension should be 33-37 ounces, measured from curve of breaker arm next to rubbing block.

A quick test of magneto condition can be made by removing high tension wire from one spark plug with engine running. Spark should jump a $\frac{3}{16}$-inch gap at idle speed.

To install the magneto drive belt, remove the flange plate on top of magneto pulley; then remove the flywheel using a puller. Turn the magneto pulley until the arrow cast into top of pulley points toward crankshaft as shown in Fig. M91. When installation is complete, flywheel and magneto timing marks must be toward each other and on the axis of a line connecting the crankshaft and magneto shaft as shown at (TM). The magneto shaft has a blind spline which aligns with a similar spline in magneto pulley shaft.

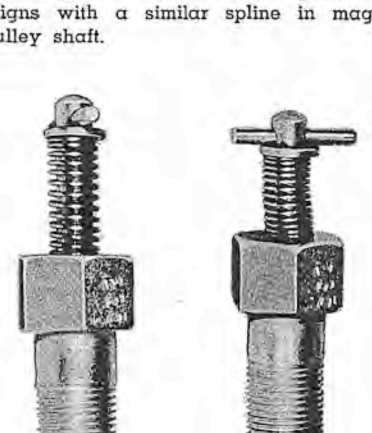


Fig. M90A — Recommended timing gage showing adjusting position (left) and advance timing position (right). Refer to text.

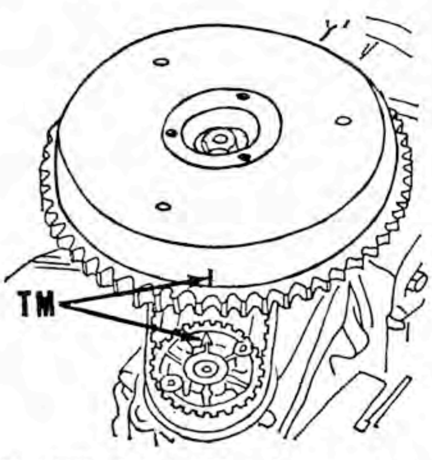


Fig. M91—When timing the magneto or distributor; or installing a new timing drive belt, timing marks (TM) must be aligned as shown.

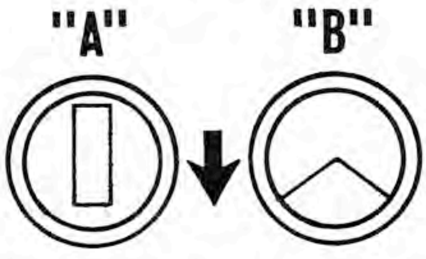


Fig. M93—To install and time the distributor on direct reversing models, turn the drive tang until the offset end of tang faces forward as shown at (A). On gearshift models, cut-out notch should be facing forward as shown in view (B). Align pulley timing marks as shown in Fig. M91.

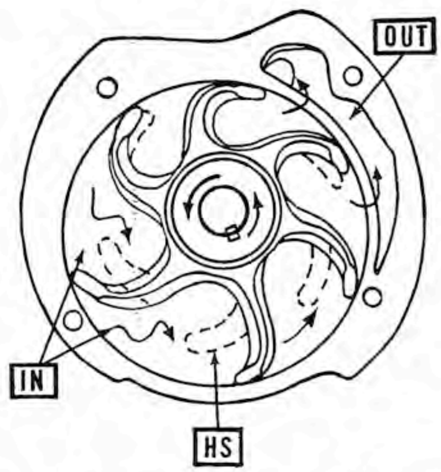


Fig. M94—Schematic view of rubber impeller type water pump. Flexing of impeller blades in offset housing causes water to be drawn through inlet ports (IN) and forced into power head through outlet ports (OUT). At high speeds, blades remain curved as shown by broken lines (HS) and pump becomes a centrifugal pump.

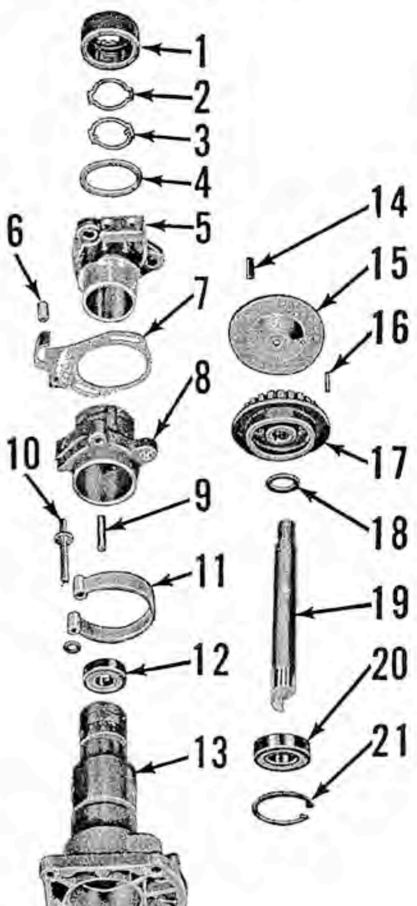


Fig. M92—Exploded view of distributor mounting bracket and drive mechanism used on some models. Others, including magnetos, are similar.

1. Cap
2. Wave washer
3. Tab washer
4. Thrust washer
5. Adaptor
6. Nylon pin
7. Actuator assembly
8. Advance collar
9. Retainer pin
10. Terminal pin
11. Retard spring
12. Ball bearing
13. Pilot assembly
14. Key
15. Flange plate
16. Key
17. Drive pulley
18. Thrust washer
19. Drive shaft
20. Ball bearing
21. Snap ring

DISTRIBUTOR. Distributors are equipped with two sets of alternate firing breaker points. Motor is equipped with two coils; each of which is connected to its own set of points and completing a separate ignition system for three of the motor's six cylinders. The contact points must be adjusted to 90° dwell period and a 60° alternate opening position; using the Mercury Distributor Point Dwell and Synchronizing Plate 91-30356A1 or a distributor stroboscope.

To install the distributor drive belt, remove the distributor pulley flange plate (15—Fig. M92); then remove the flywheel using a puller. Turn the distributor pulley until the arrow cast into top of pulley points toward crankshaft as shown in Fig. M91. Install drive belt and flywheel with timing marks aligned as shown at (TM).

To install the distributor to the drive pulley and housing, align drive end of distributor shaft as shown in Fig. M93. NOTE: The arrow indicates direction of boat travel in forward gear.

Firing order is 1-4-5-2-3-6 for Merc 800, 850 or 1000; or 1-6-4-2-5-3 for other models.

TIMING. Maximum timing advance is 32½° BTDC for Merc 650, Merc 1000 and the 1963 (90 cu. in.) Merc 850. Maximum advance for Mark 30H and Mark 55H is 40½° BTDC; and for all other four and six cylinder models, 34½° BTDC.

The advance timing mark is not indicated on flywheel on most models. The manufacturer recommends that the special timing gage (See Fig. M90A) designed for the motor be used. This gage is threaded into No. 1 (top) spark plug hole on four cylinder models; No. 3 spark plug hole on Merc 800, 850 and 1000; or No. 4 spark plug hole on other models. Make sure that center plunger of gage fits into notches of threaded, outer body as shown in left hand view. Turn flywheel until piston is at top dead center, then thread the gage in or out until crankpin will pass over center while piston is in contact with gage plunger. Rotate flywheel counter-clockwise; then without moving threaded outer gage body, depress center plunger and turn ¼-turn. Rotate flywheel until piston strikes the plunger to establish crankshaft position for maximum advance timing. NOTE: If a protractor is used to scribe a degree mark on flywheel for timing purposes, be sure to check for proper TDC position. The timing mark inscribed in the flywheel is for magneto or distributor INSTALLATION purposes only. The No. 1 piston is 20° ATDC on most models when magneto or distributor timing marks are aligned.

With the advance timing position established, connect a continuity test light to the No. 1 Coil Primary (White) Lead on distributor models, or to primary ground terminal on magneto models. Attach the other test lead to a suitable ground. Rotate the magneto or distributor body clockwise until points are closed as indicated by continuity light, then counter-clockwise until points just open. Limit magneto or distributor advance at this point by means of the spark advance stop screw (1—Fig. M87B) on models so equipped; or by sliding magneto stop bracket against crankcase.

COOLING SYSTEM

WATER PUMP. The rubber impeller type water pump is contained in the lower unit gearcase housing and can be removed after removing the gearcase. The pump housing is offset in relation to the driveshaft or propeller shaft as shown in Fig. M94. The water pump on direct reversing models contains a valve which permits reversal of water pump rotation without affecting water flow.

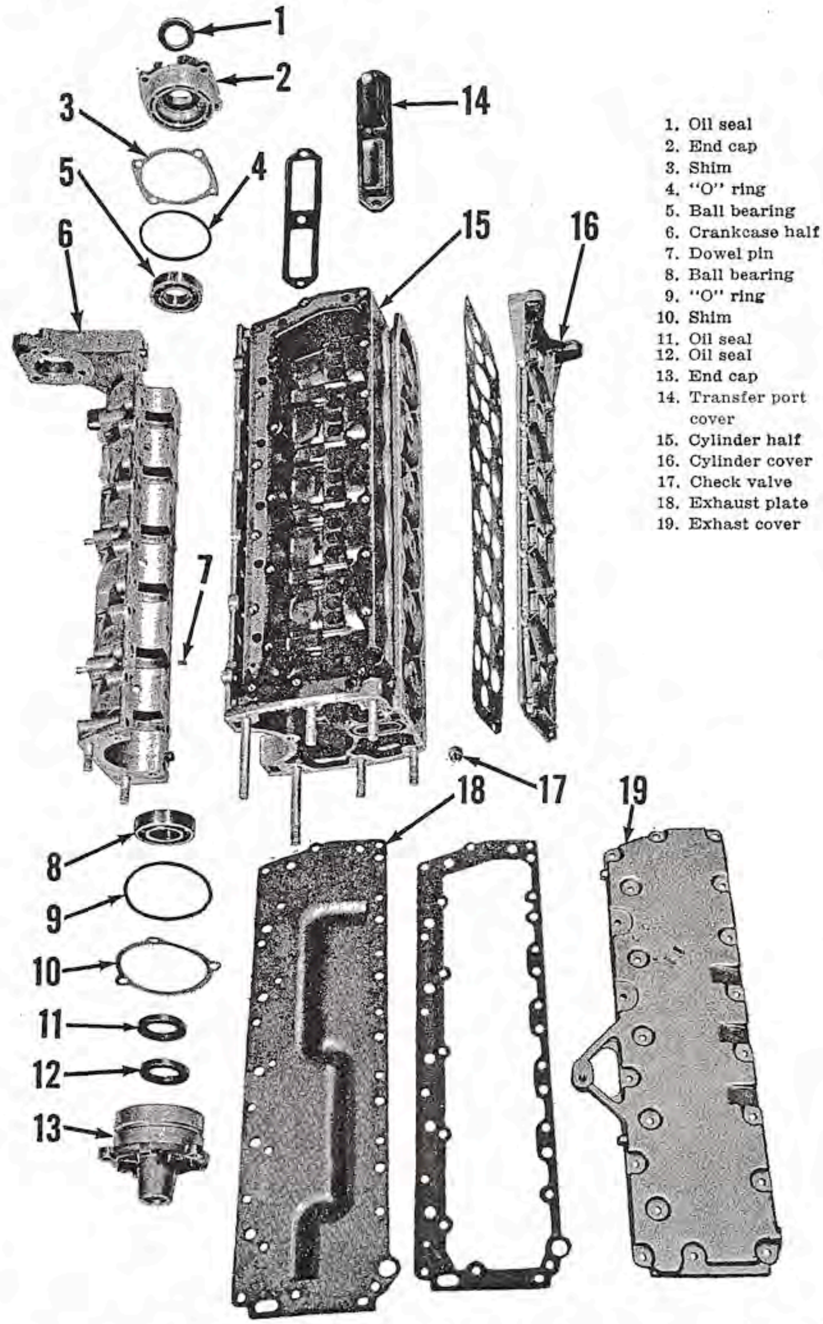


Fig. M95—Exploded view of crankcase and associated parts used on six cylinder models. Four cylinder models are similar.

When cooling system problems are encountered, first check the water inlet for plugging or partial stoppage, then if not corrected, remove the gearcase housing as outlined in LOWER UNIT section and examine the water pump, water tubes and seals. The water inlet is located on the anti-cavitation plate immediately above the propeller.

POWER HEAD

R&R AND DISASSEMBLE. To remove the power head assembly, first remove the top and side cowling, remove the electric starter assembly; then disconnect all interfering wiring and linkage. Remove the stud nuts which secure the power head to lower unit, jar power head on exhaust side with heel of hand to loosen gasket; then lift off the power head. Place power head on a suitable stand and remove the flywheel, magneto or distributor, alternator-generator and the carburetors. Exhaust manifold cover plates, cylinder block cover plate and transfer port cover plates should be removed for cleaning and inspection.

Remove the upper and lower crankcase end caps by using a suitable puller attached to threaded holes in caps. Remove the main bearing locking bolts from front crankcase half, remove the flange bolts; then remove crankcase front half by inserting screwdriver in the recesses provided on side flanges. Use extra care not to spring the parts or to mar the machined, mating surfaces. The crankcase half (6—Fig. M95) and cylinder assembly (15) are matched and align bored, and are available only as an assembly.

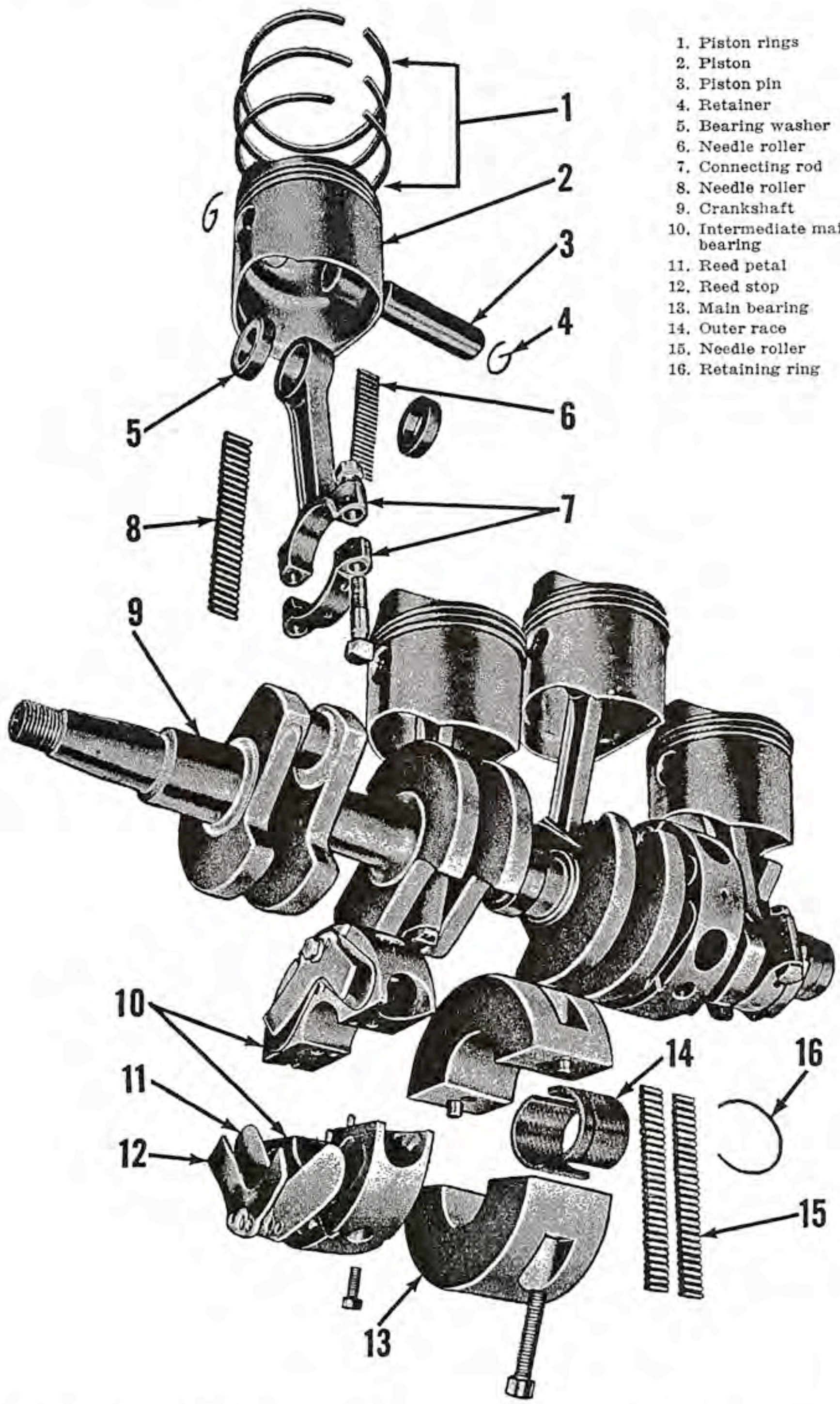
Crankshaft, pistons, bearings and connecting rods may now be removed for service as outlined in the appropriate following paragraphs. When assembling, follow the procedures outlined in the ASSEMBLY paragraph.

ASSEMBLY. Because of the two-cycle design, crankcase must be completely sealed against both vacuum and pressure. Exhaust manifold and water passages must be sealed against water leakage. Whenever power head is disassembled, it is recommended that all gasket surfaces be carefully checked for nicks and burrs which might interfere with a tight seal. Machined sealing surfaces without gaskets should be similarly checked. Slight damage can sometimes be remedied by lapping the surfaces on a lapping block using No. 00 emery paper. Remove only the high spots without lowering the surface. If parts are warped, sprung or excessively damaged, renew the parts.

All gasket and sealing surfaces should be lightly and carefully coated with an impervious liquid sealer such as Mercury Gasket Sealer Compound (92-28804). Surface must be completely coated, using care that excess sealer does not squeeze out into bearings, crankcase or other passages. Lubricate all bearing and friction surfaces thoroughly with engine oil. Loose needle bearings may be held in place during assembly by using a light, non-fibrous grease.

Check the assembly by turning the crankshaft after each step to check for binding or locking which might indicate improper assembly. Remove the cause before proceeding. After piston and crankshaft assembly is installed and secured, rotate the shaft until each piston ring in turn appears in one of the exhaust ports, then check by pressing on ring with a blunt tool. Ring should spring back when released; if it does not, a broken or binding ring is indicated, and the trouble should be corrected.

The recommended crankshaft end play of 0.008-0.012 is controlled by means of shims (3 & 10—Fig. M95) placed under each crankcase end cap. Shims are available in thicknesses of 0.002, 0.003, 0.005 and 0.010, and a shim pack of approximately equal thickness should be used under each end cap. To check the end play, temporarily install the crankshaft and end caps on the cylinder block, omitting the sealing rings (4 & 9).



1. Piston rings
2. Piston
3. Piston pin
4. Retainer
5. Bearing washer
6. Needle roller
7. Connecting rod
8. Needle roller
9. Crankshaft
10. Intermediate main bearing
11. Reed petal
12. Reed stop
13. Main bearing
14. Outer race
15. Needle roller
16. Retaining ring

Fig. M96—Exploded view of crankshaft and associated parts used on four cylinder models. Six cylinder models are similar.

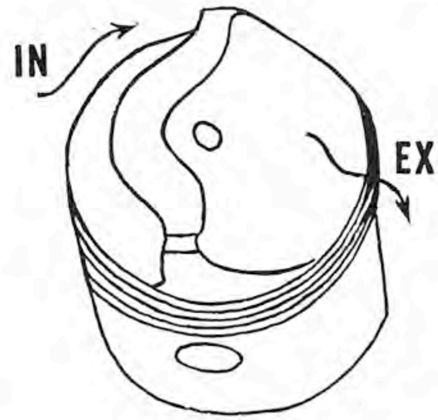


Fig. M97—Piston crown is designed to improve scavenging efficiency. Be sure piston is installed as indicated, with relation to inlet and exhaust ports.

Use the removed shims in the trial installation. Install and tighten the end cap retaining screws. Tap the crankshaft each way with a plastic hammer; then measure the clearance between ball bearing inner race and thrust face of crankshaft using a feeler gage. Determine the shims to be added or removed; then equalize the shim pack thickness on final assembly.

Tighten the crankcase exhaust cover and cylinder cover cap screws by first tightening the center screws, then tightening screws evenly working toward top of power head. When upper half is tightened, again start at the center and tighten screws alternately toward bottom of power head. Tightening torques are given in the CONDENSED SERVICE DATA table.

PISTONS, PINS, RINGS AND CYLINDERS. Before detaching connecting rods from crankshaft, make sure that rod and cap are properly identified for correct assembly to each other and in the correct cylinder.

Each piston is fitted with three rings which are interchangeable in the ring grooves and are pinned in place in the piston.

Piston pin is pressed in piston bosses and secured with retaining rings. Piston end of connecting rod is fitted with 25 loose needle bearings in Merc 800, 850 & 1000; and 22 loose needle rollers in other models. The needle rollers use the connecting rod bore and the piston pin as bearing races. When assembling, install bearing washers and needle bearings in piston end of connecting rod using light non-fibrous grease to hold them in place, then install and center the piston pin using Mercury tool (91-24263). Piston must be installed so that sharp, vertical side of deflector will be to starboard (intake) side of cylinder block. See Fig. M97.

Assemble the connecting rod and piston assemblies, together with the main bearing units to the crankshaft; then install the complete assembly in cylinder half of block. On four cylinder models No. 2 and No. 3 piston should be started into cylinders first. On six cylinder models No. 2 and No. 4 pistons should be started first. Use the Mercury Ring Compressor Kit (91-28819A2), if available; or carefully compress each ring with the fingers if kit is not available. Thoroughly lubricate pistons and rings during assembly. Pistons and rings are available in 0.015 oversize.

CONNECTING RODS, BEARINGS AND CRANKSHAFT. Upper and lower ends of crankshaft are carried by a ball bearing. The second and fourth main bearings (10—Fig. M96) on four cylinder models; or the second, fourth and sixth main bearings on six cylinder models also contain the inlet reed valves. The third main bearing (13) on

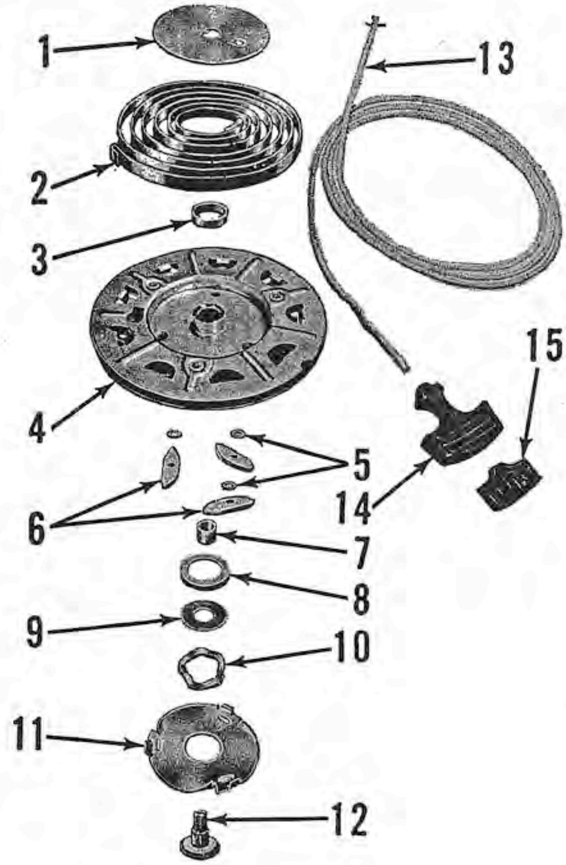


Fig. M98—Exploded view of recoil starter used on models so equipped.

1. Retainer
2. Recoil spring
3. Bushing
4. Sheave
5. Wave washer
6. Pawl
7. Spacer
8. Retainer
9. Washer
10. Wave washer
11. Plate
12. Sheave shaft
13. Cable
14. Handle
15. Anchor

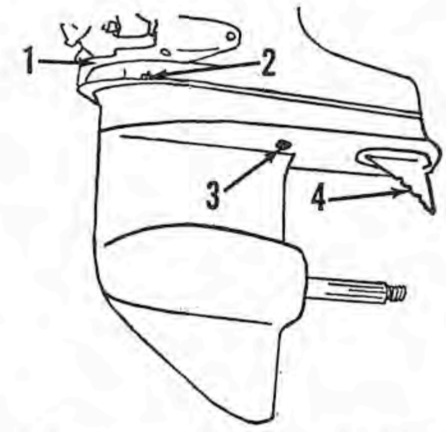


Fig. M99—View of typical lower unit showing location of attaching screws securing gearcase housing. Refer to text for details.

four cylinder models; or the third and fifth main bearings on six cylinder models; each contain two rows of 28 loose needle rollers (15) which ride in a split type outer race (14), held together by a retaining ring (16).

The connecting rod for Merc 800, 850 and 1000 rides in 25 loose needle rollers at piston end and 30 loose needle rollers at crankpin end. On other models, the connecting rod contains 22 loose needle rollers at piston end and 25 loose needle rollers at crankpin end. Check rod for alignment, using Mercury Alignment Tool (91-28441A1), or by placing rod on a surface plate and checking with a light.

If bearing surface of rod and cap is rough, scored, worn or shows evidence of overheating, renew the connecting rod. Inspect crankpin and main bearing journals. If scored, out-of-round or worn, renew the crankshaft. Check the crankshaft for straightness using a dial indicator and vee-blocks.

Inspect and adjust the reed valves as outlined in REED VALVE paragraph, and reassemble as outlined in ASSEMBLY paragraph.

MANUAL STARTER

Refer to Fig. M98 for a starter of the general type used on models so equipped. To disassemble the starter, remove the top cowl; then remove the screw and trim cap from top to cowl. Insert a screwdriver in slot in top of sheave shaft (12) and loosen the shaft nut (left hand thread). Allow the shaft and screwdriver to turn clockwise until recoil spring (2) is completely unwound. Pry the anchor (15) out of starter handle (14) and remove the anchor and handle. Remove the nut from upper end of sheave shaft (12), invert the assembly; and remove the parts, making sure that recoil spring (2) remains in housing recess as sheave (4) is removed. Protect hands with cotton gloves or a cloth, grasp recoil spring (2), remove spring and allow it to unwind slowly to prevent personal injury.

Lubricate the parts with Multipurpose Lubricant and assemble by reversing the disassembly procedure. Make sure that pawls (6) are all installed the same way, with flat radius to outside. Install wave washer retainer (9) with cup end up and make sure the tab in spring retainer (1) engages slot in sheave shaft (12). Loosely install the shaft nut, pull free end of cable through cowl and install handle (14) and anchor (15). After handle is installed, turn sheave shaft (12) counter-clockwise with a screwdriver until cable handle is pulled against top cowl; then turn shaft an additional 1¼ turns and tighten the shaft nut.

LOWER UNIT

PROPELLER AND DRIVE CLUTCH. Protection for the motor is provided by a special cushioning clutch built into the propeller hub. Propeller is splined to the shaft. No adjustment is possible on the propeller or cushioning clutch. Various pitch propellers are provided, and propeller should be selected for best performance under applicable conditions. Propellers other than those designed for the motor must not be installed.

R&R AND OVERHAUL. Lower units are divided into two main types; the gear shift type used on early models, late four cylinder motors; and late six cylinder Full Gear Shift motors; and the straight drive type used on direct reversing motors. Direct drive models are further subdivided into standard-rotation and counter-rotation types which are designed to be paired for twin-motor installation.

Most service on the lower unit can be performed by detaching the gearcase housing from the driveshaft housing. When removing the housing check carefully at the locations shown in Fig. M99, to make sure that all securing cap screws or stud nuts are removed. On some early motors the gearcase housing was secured by two studs. On some later units, securing studs will be found at all of the indicated locations. NOTE: On motors equipped with trim tab on water intake as shown at (4), remove the intake by removing plug and screw on top side of anti-cavitation plate; then check for cap screw under water intake. On models not equipped with propeller hub exhaust, the cap screw on trailing edge will be found in exhaust outlet.

Remove the housing plugs and drain the housing. Secure the gearcase in a vise between two blocks of soft wood with pro-

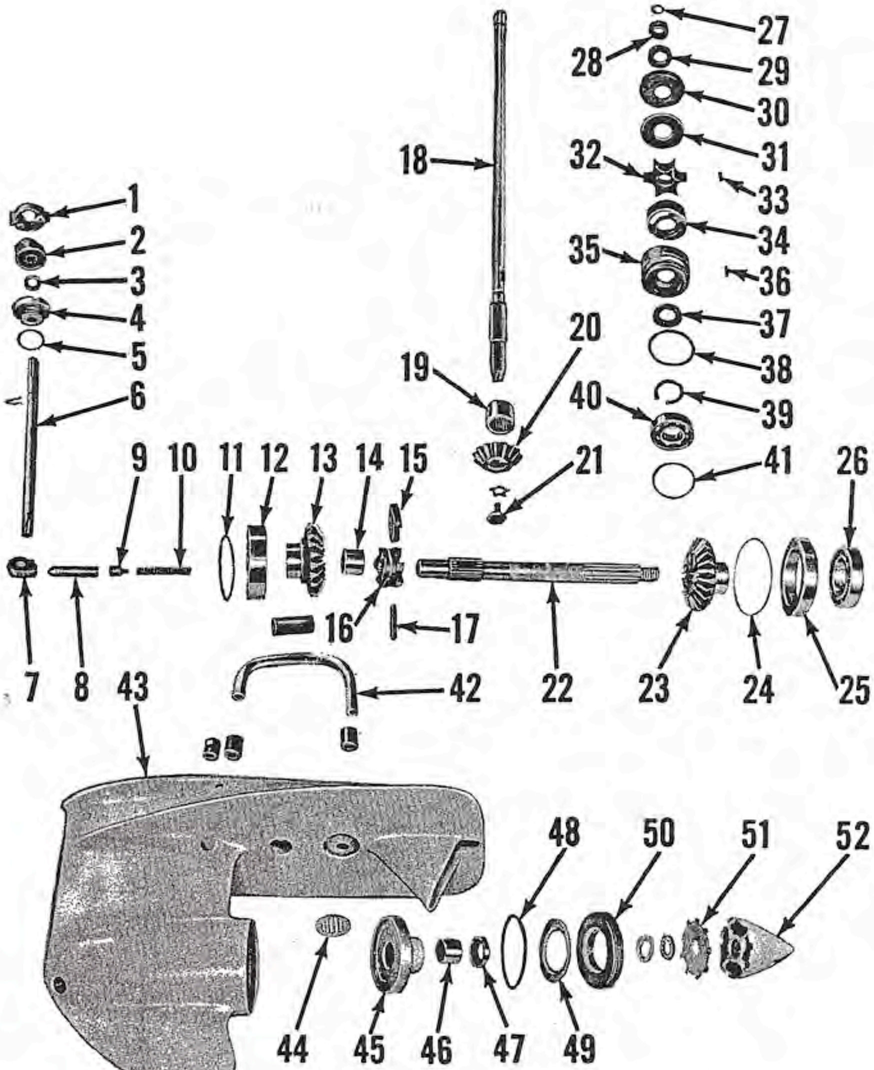


Fig. M100—Exploded view of gearcase assembly used on Four Cylinder models.

1. Reverse lock cam	14. Needle bearing	27. "O" ring	40. Ball bearing
2. Reverse lock cam	15. Retaining ring	28. Slinger	41. Shim
3. Oil seal	16. Clutch dog	29. Oil seal	42. Inlet tube
4. Bushing	17. Cross pin	30. Cover	43. Gearcase
5. "O" ring	18. Drive shaft	31. Outlet plate	44. Water inlet
6. Shift shaft	19. Needle bearing	32. Impeller	45. Bearing carrier
7. Shift cam	20. Drive pinion	33. Drive pin	46. Needle bearing
8. Shift plunger	21. Cap screw	34. Insert	47. Oil seal
9. Slide	22. Propeller shaft	35. Cartridge	48. "O" ring
10. Spring	23. Reverse gear	36. Key	49. Washer
11. Shim	24. Shim	37. Oil seal	50. Gearcase cover
12. Ball bearing	25. Adaptor ring	38. "O" ring	51. Tab washer
13. Forward gear	26. Ball bearing	39. Retaining ring	52. Propeller nut

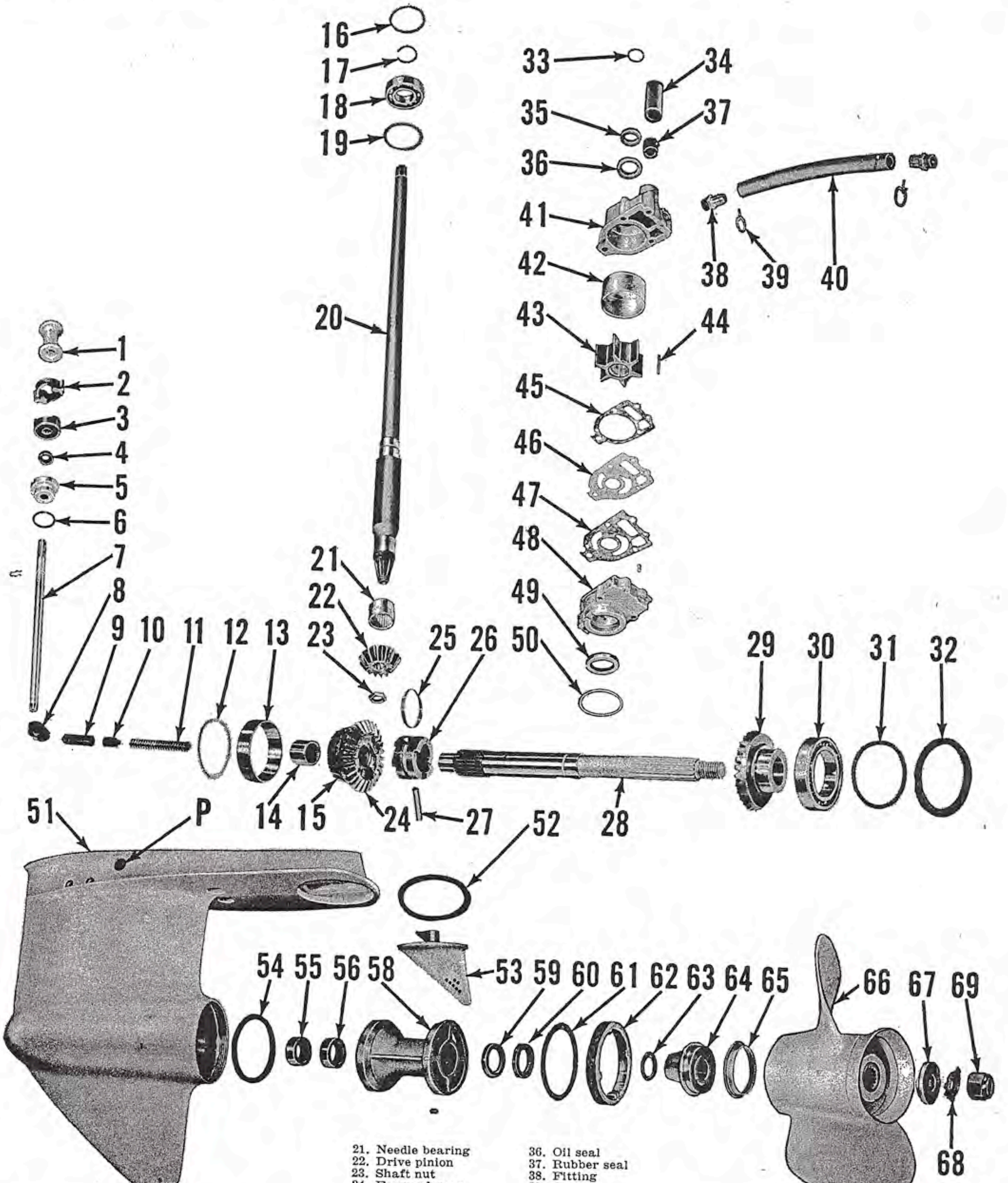
peller up. Wedge a piece of wood between propeller blade and anti-cavitation plate to hold propeller; then remove propeller nut and propeller.

Overhaul the unit as outlined in the appropriate following paragraphs.

Gear Shift Type: Measure and record the backlash in forward and reverse gears before disassembling the gearcase. To disassemble the gearcase after the propeller is removed, clamp the housing in a protected vise and remove the gearcase cover (50—Fig. M100 or 62—Fig. M101) with a suitable spanner wrench such as 91-22119 for four cylinder models; or 91-30291A1 for six cylinder models. Grasp the propeller shaft in the vise and remove shaft and bearings by tapping housing off with a soft mallet. Forward gear (13—Fig. M100 or 24—Fig. M101) will remain in housing. On four cylinder models, remove the adaptor ring (25—Fig. M100) and save the shims (24). Shims control the backlash of reverse gear (23).

Clutch dog can be removed from propeller shaft by removing the retaining ring; then applying slight pressure on shift plunger while cross pin is removed.

To disassemble the drive shaft, the water pump must first be removed. On four cylinder models, remove the water pump cover (30—Fig. M100) using Mercury tool 91-22119



1. Spacer
2. Reverse lock cam
3. Reverse lock cam
4. Oil seal
5. Bushing
6. "O" ring
7. Shift shaft
8. Shift cam
9. Plunger
10. Slide
11. Spring
12. Shim
13. Bearing cup
14. Needle bearing
15. Bearing cone
16. Shim
17. Retaining ring
18. Ball bearing
19. Shim
20. Drive shaft
21. Needle bearing
22. Drive pinion
23. Shaft nut
24. Forward gear
25. Retaining ring
26. Clutch dog
27. Cross pin
28. Propeller shaft
29. Reverse gear
30. Ball bearing
31. Shim
32. Thrust washer
33. "O" ring
34. Guide sleeve
35. Slinger
36. Oil seal
37. Rubber seal
38. Fitting
39. Clamp
40. Inlet line
41. Pump body
42. Insert
43. Impeller
44. Drive pin
45. Gasket
46. Face plate
47. Gasket
48. Pump base
49. Oil seal
50. "O" ring
51. Gearcase
52. Gasket
53. Water pickup & trim tab
54. "O" ring
55. Needle bearing
56. Needle bearing
58. Bearing carrier
59. Oil seal
60. Oil seal
61. Washer
62. Gearcase cover
63. Thrust washer
64. Thrust hub
65. Cupped washer
66. Propeller
67. Splined washer
68. Tab washer
69. Propeller nut

Fig. M101—Exploded view of lower unit gearcase and associated parts used on six cylinder, full gear shift models.

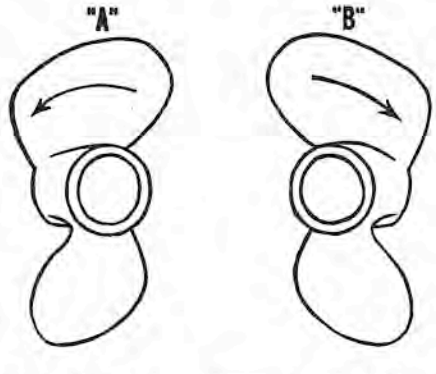


Fig. M102—Before disassembling the direct drive lower unit, check to see if it is Standard Rotation (A) or Counter Rotation (B).

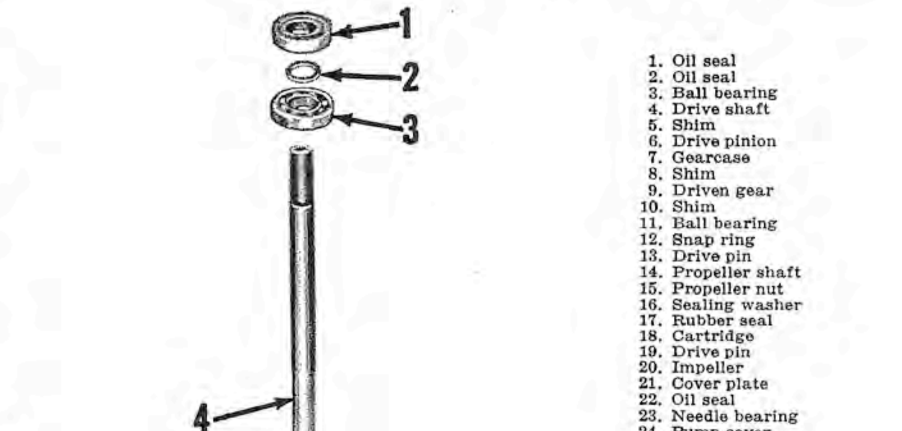


Fig. M103—Exploded view of "Quicksilver" gearcase and associated parts used on older models.

or a suitable spanner wrench. Lift off the outlet plate (31); then remove impeller (32) by prying it out with two screwdrivers. Remove the impeller drive pin (33). Removal of the water pump cartridge (35) requires the use of Mercury Cartridge Removal Tool (91-22118A1) or equivalent, to pull the cartridge.

On six cylinder models, disassemble pump as removed, using Fig. M101 as a guide. The flushing plug must be removed from plug hole (P) before pump base (48) can be withdrawn.

To remove the drive shaft, remove the retaining screw (21—Fig. M100) or nut (23—Fig. M101). Clamp the drive shaft in a protected vise and tap the housing downward with a soft mallet. Remove and save the shim pack (41—Fig. M100 or 19—Fig. M101) located under the drive shaft ball bearing. These shims control the mesh position of drive pinion. On six cylinder motors, shims (19—Fig. M101) are identical to shims (16) above the bearing which control shaft end play. The two shim packs should not be mixed.

The forward gear (24—Fig. M101) on six cylinder models can be removed after drive shaft and drive pinion have been removed. Forward gear (13—Fig. M100) on four cylinder models can usually be removed after drive shaft is out by jarring open end of gearcase on a wooden block.

If any of the major components are renewed, or if incorrect before disassembly, the backlash must be checked and adjusted. On four cylinder models install forward gear (13—Fig. M100) and bearing (12) using the same thickness shims (11) as were removed. Temporarily install drive shaft (18) and bearing (40) using the removed shim pack (41). Install pinion (20) and retaining screw (21); then tighten screw. Backlash should be 0.003-0.005 and ends of teeth on gear (13) and pinion (20) should be even and fully meshed. Adjust backlash by disassembling; then adding or removing shims (11). If mesh position was incorrect, add or remove shims (41). Shims are available in thicknesses of 0.002, 0.003, 0.005 and 0.010.

On six cylinder models make a trial assembly by installing bearing cup (13—Fig. M101) and shims (12); then forward gear (24) and bearing cone (15). Install driveshaft (20) and bearing (18) using the removed shim pack (19); then install pinion (22) and nut (23). Tighten the driveshaft nut. Insert the stripped propeller shaft (28) through forward gear to hold it in position; then check the backlash. Adjust to 0.003-0.005 by adding or removing shims (12). Adjust mesh position by means of shims (19). Shims are available in thicknesses of 0.002, 0.003, 0.005 and 0.010.

When adjustment is complete, reassemble by reversing the disassembly; then measure backlash of the reverse gear. Adjust to 0.003-0.005 by means of shims (24—Fig. M100 or 31—Fig. M101). NOTE: Adding shims in four cylinder models will INCREASE backlash.

On six cylinder units, add sufficient quantity and thickness of shims (16—Fig. M101) to bring the assembled height flush with seating surface of water pump base (48). This measurement can best be determined by installing additional shims, then measuring the resulting gap with a feeler gage.

Direct Drive Types: Direct drive type lower units have no shifting mechanism or clutches. The direction of travel is reversed by reversing direction of rotation of the engine. On late models, the propeller shaft may rotate in either the standard (counterclockwise) direction as shown in view "A" (Fig. M102) or clockwise as in the counter-rotation unit shown in view "B". Refer to Fig. M102 to determine the type of unit being serviced.

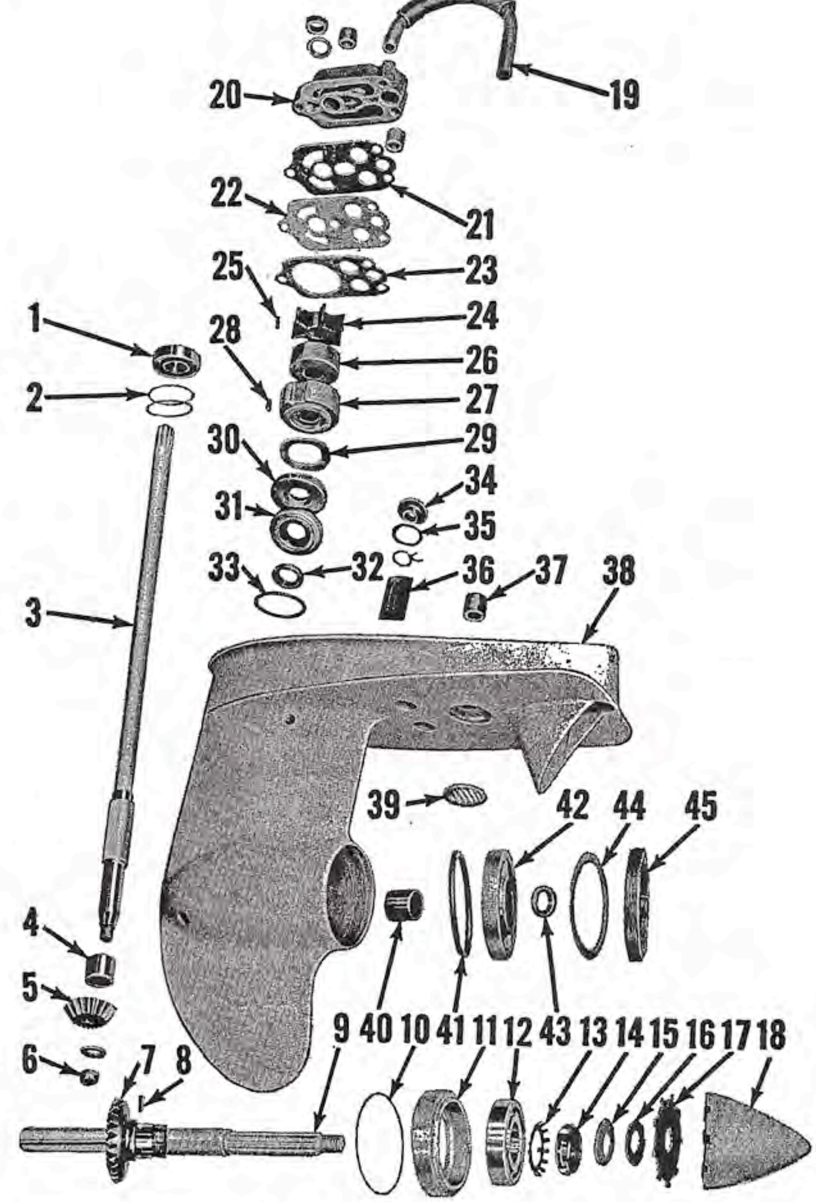


Fig. M104—Exploded view of Standard Rotation gearcase and associated parts used on direct reversing models. Illustrated is Merc 600 unit. Refer also to Fig. M105.

1. Ball bearing
2. Shim
3. Drive shaft
4. Needle bearing
5. Drive pinion
6. Shaft nut
7. Driven gear
8. Drive pin
9. Propeller shaft
10. Shim
11. Adaptor ring
12. Ball bearing
13. Tab washer
14. Bearing nut
15. Washer
16. Splined washer
17. Tab washer
18. Propeller nut
19. Water tube
20. Pump cover
21. Gasket
22. Face plate
23. Gasket
24. Impeller
25. Drive pin
26. Insert
27. Cartridge
28. Key
29. Wave washer
30. Cover
31. Carrier
32. Oil seal
33. "O" ring
34. Valve adaptor
35. Shim
36. Water valve
37. Rubber seal
38. Gearcase
39. Water inlet
40. Needle bearing
41. "O" ring
42. Bearing carrier
43. Oil seal
44. Washer
45. Housing cover

QUICKSILVER UNIT. Refer to Fig. M103. The water pump is housed on and driven by the propeller shaft as shown. Gearcase cover cone (27) has a left hand thread. Remove cover cone using Mercury tool 91-24117 or equivalent. Lift off cover (24) and remove impeller (20) by prying out with screwdrivers. Remove water pump cartridge (18) using Mercury puller 91-24120. Secure propeller shaft (14) in a protected vise and tap housing (7) from shaft with a soft mallet. Remove nut from lower end of drive shaft (4) then remove the shaft by tapping on housing (7) to free the pinion and bearing.

Assemble by reversing the disassembly procedure. Adjust the backlash to 0.003-0.005 by adding or removing shims (8); then adjust propeller shaft to minimum end play by adding or removing shims (10). Shims (8) are available in thicknesses of 0.002, 0.003, 0.005 and 0.010; shims (10) in thicknesses of 0.003, 0.005 and 0.010.

STANDARD ROTATION UNIT. Refer to Fig. M104. Measure and record the gear backlash before disassembling the gearcase.

To remove the propeller shaft, clamp the housing in a protected vise and remove the gearcase cover (45) using the appropriate Mercury Gearcase Cover Tool or a suitable spanner wrench. Gearcase cover is secured by a left-hand thread. Grasp propeller shaft in a vise and remove shaft assembly by tapping housing (38) from shaft with a soft mallet. NOTE: On Merc 800 models, the bearing carrier is similar to that shown at (31—Fig. M105). Carrier can only be partially removed without first removing dowel locating pin (32).

Disassemble the propeller shaft by removing the snap ring and shims (early models); or the nut (14—Fig. M104) (late models); then pressing bearing off gear (7). Check to see if nut (14) is right-hand or left-hand thread. Nut is stamped "LH" if secured with left-hand thread.

After bearing is removed, withdraw the pin (8) and press gear (7) from shaft. The pin is normally a loose fit, and is retained by the bearing. If pin cannot be jarred out, remove by inserting a small punch in hole on opposite side of gear and shaft. On early models without extra hole, the pin must be drilled out if excessively tight.

To disassemble the drive shaft, remove the water pump stud nuts and disassemble the water pump as it is removed. Remove nut (6) from lower end of drive shaft, secure upper end of shaft in a protected vise, then tap gearcase from shaft using a soft mallet.

Shims (2) control the mesh position of the drive pinion. Mesh position can be determined by making a trial installation of drive shaft and bearing, using the removed shim pack. Install drive pinion (5) and install and tighten the retaining nut (6). Assemble propeller shaft gear (7) to shaft (9); insert the assembly without bearing into gearcase and check for full engagement of gear teeth. Add or remove shims (2) as required.

Install adaptor ring (11), bearing (12), washer (13) and nut (14) on propeller shaft and tighten and secure the nut. Install the assembly in gearcase using the shims (10) which were removed. Tap the shaft securely into place and check the backlash; which should be 0.003-0.005. If backlash is not correct, add or remove shims (10) as required. Shims are available in thicknesses of 0.002, 0.003, 0.005 and 0.010 on Merc 800 models; and 0.002, 0.003 and 0.005 on other models.

When assembling the water pump, check the neoprene water valves (36) to be sure they are in good condition. Install the adaptors (34) so that flat sides are together, using a sufficient quantity of shims (35) to bring top surface of adaptors even and flush with top of housing. Shims are available in thicknesses of 0.003, 0.005 and 0.010.

COUNTER-ROTATION UNIT. Refer to Fig. M105. Service and adjustment procedures are similar to that of Standard Rotation Units covered in the preceding paragraph. Follow the procedures outlined in the preceding paragraph except for the following differences.

Propeller shaft cannot be withdrawn until after driveshaft is removed. After removing the housing cap (39), withdraw bearing carrier (31—Fig. M105 or 42—Fig. M104) using Mercury tool 91-27780 for Merc 700 and 800 models; or 91-29456A3 for other models. Bend down the locking tabs on washer (14—Fig. M105); then remove nut (15) using Mercury tool 91-29925A1 for Merc 700 and 800; or 91-28953 for other models. Remove ball bearing (13) and adaptor (12) using Mercury puller 91-29456A3. If puller is not available, jar the end of propeller shaft sharply on a block of wood to dislodge the bearing.

After bearing has been removed, remove the drive shaft as outlined for Standard Rotation Units; then withdraw the propeller shaft. Adjust the gear backlash by adding or removing shims (8). NOTE: Adding shims will DECREASE the backlash on Counter-Rotation units.

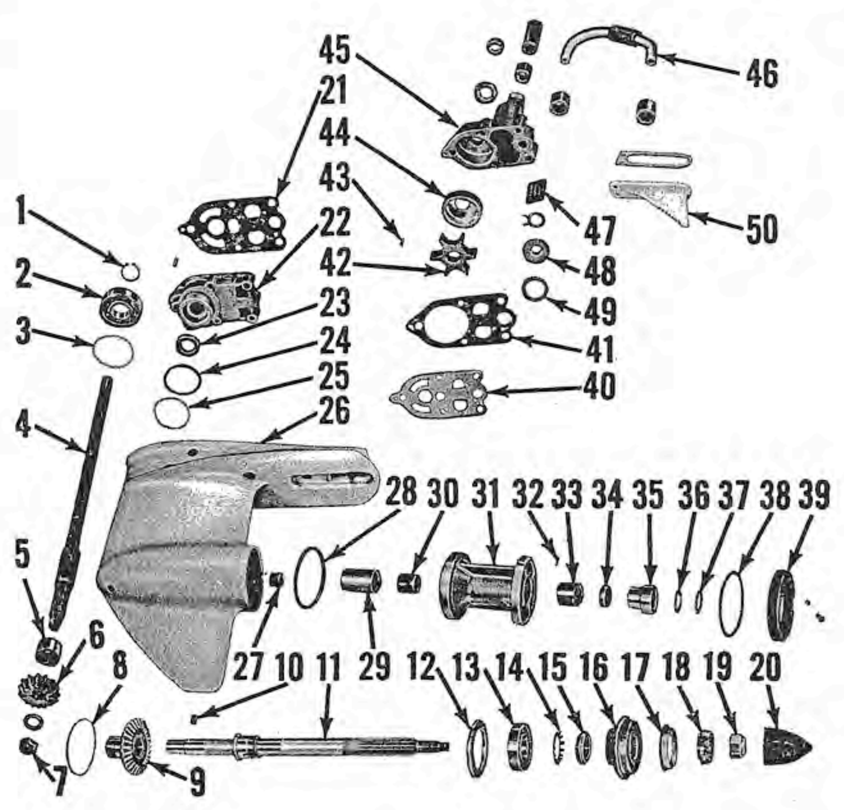


Fig. M105—Exploded view of Counter Rotation gearcase and associated parts used on direct reversing models. Illustrated is Merc 800 unit. Refer also to Fig. M104.

1. Snap ring
2. Ball bearing
3. Shim
4. Drive shaft
5. Needle bearing
6. Drive pinion
7. Shaft nut
8. Shim
9. Driven gear
10. Drive pin
11. Propeller shaft
12. Washer
13. Ball bearing
14. Tab washer
15. Bearing nut
16. Thrust hub
17. Cupped washer
18. Cupped washer
19. Propeller nut
20. Cap
21. Gasket
22. Pump cover
23. Oil seal
24. "O" ring
25. Shim
26. Gearcase
27. Needle bearing
28. "O" ring
29. Spacer
30. Needle bearing
31. Bearing carrier
32. Locating pin
33. Needle bearing
34. Oil seal
35. Sealing sleeve
36. "O" ring
37. "O" ring
38. Washer
39. Housing cover
40. Facing plate
41. Gasket
42. Impeller
43. Drive pin
44. Insert
45. Pump body
46. Inlet line
47. Water valve
48. Valve adaptor
49. Shim
50. Water inlet

MERCURY

KIEKHAEFER CORP.
(General Offices)
Fond du Lac, Wisc.
(Parts and Service Division)
Beaver Dam, Wisc.

ELECTRICAL SYSTEMS

Electrical starting systems are available on the larger motors. Four cylinder and six cylinder motors with electric starter are also equipped with an alternator type generator. Refer to the appropriate wiring diagram for installation, and to the components section for overhaul data.

BATTERY

A 12 volt battery is used on all electric starting models. On early two cylinder and four cylinder motors (before 1957), the positive battery terminal was grounded. On all late models the negative terminal is grounded. CAUTION: On models with alternator-generator, the rectifier will be damaged if battery terminals are reversed. Make certain battery is properly connected. Also make sure battery is safely located in the boat. Refer to the appropriate wiring diagram when performing service on the electrical system.

STARTER

American Bosch starting motors were used on early models. Late models use Delco-Remy units. The two makes are interchangeable as a complete unit on gear shift models with negative ground.

American Bosch starters should draw 180-240 amperes while cranking a warm engine. The Delco-Remy starter should draw approximately 160 amperes. Armature end play of 0.010-0.020 on American Bosch models is adjusted by means of shimming washers on armature shaft at brush end. End plate bushings are align reamed, if excessively worn renew the end plate. On Delco-Remy models with shock absorbing

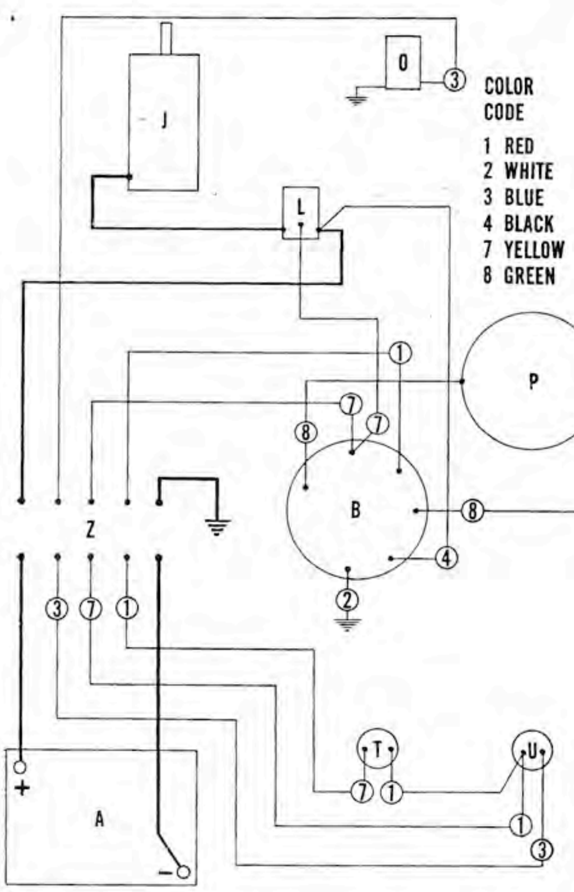


Fig. M110 — Wiring diagram used on Mark 25E motor. Refer to Fig. M114 for legend.

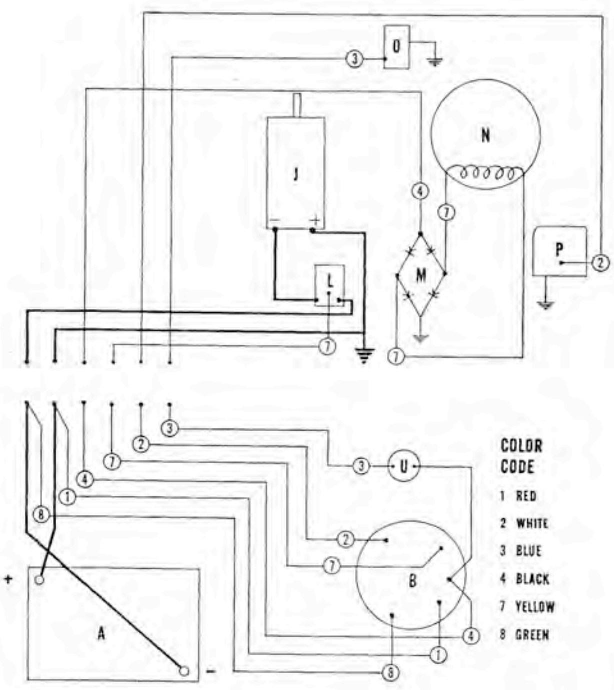


Fig. M111 — Wiring diagram used on early Mark 50E and 55E with positive ground. Refer to Fig. M114 for legend.

rubber cushion in drive mechanism, tighten the drive retaining nut to a torque of 200 inch-pounds; then continue tightening until cotter pin can be installed.

ALTERNATOR

A flywheel type alternator-generator is used on all four cylinder and six cylinder models. Maximum output at full throttle with a partially discharged battery should be approximately 7 amperes for four-cylinder models; 9½ amperes for Mark 75; and 14 amperes for all other six cylinder models. The charging unit is designed to be self-regulating, and a separate regulator is not required.

RECTIFIER

The rectifier assembly is designed to convert the alternating current of the generator to direct current suitable for charging the battery and supplying the other electrical needs of the system. The rectifier is available only as a complete unit.

The rectifier is composed of two positive and two negative wafers which restrict the flow of current to one direction only. A positive and negative wafer is connected to each of the alternator leads, thus channeling the generated alternating current in a single direction.

The rectifier can be damaged by reversing the battery cables, by attempting to "polarize" the generating system, by disconnecting battery cables when motor is in operation, by an open generating circuit caused by a broken wire or loose connection, or by manually breaking the generating circuit by turning the ignition key to "OFF" position when motor is operating at above idle speed. To prevent damage to the rectifier when operating the motor with battery disconnected or removed, disconnect the alternator to rectifier (yellow) leads at the quick-disconnect couplings and tape each lead individually. The alternator will not be damaged by operation with charging circuit open, but the rectifier will if left connected to alternator. NOTE: Disconnect one alternator as outlined above, when operating twin motors from a single battery. Do not attempt to charge the same battery with two motors.

A damaged rectifier usually has a burned or discolored appearance. If output of charging circuit is satisfactory, it can generally be assumed that rectifier is in good condition. If charging circuit does not work, check each component of the system.

The rectifier can be tested with an ohmmeter. Tests can be performed with the rectifier in operating position on the motor; or with rectifier removed. If rectifier is to be tested on the motor, disconnect all rectifier leads.

To make the tests, connect one ohmmeter test lead to either of the yellow alternator leads, touch the other test lead to the ouput lead and note the ohmmeter reading. Move the test probe from output lead to a suitable ground (or to rectifier through-bolt), and again note the reading. Ohmmeter reading should be very high (or infinity) in one test and very low (or zero) in the other. If readings are the same or nearly the same, the rectifier must be re-

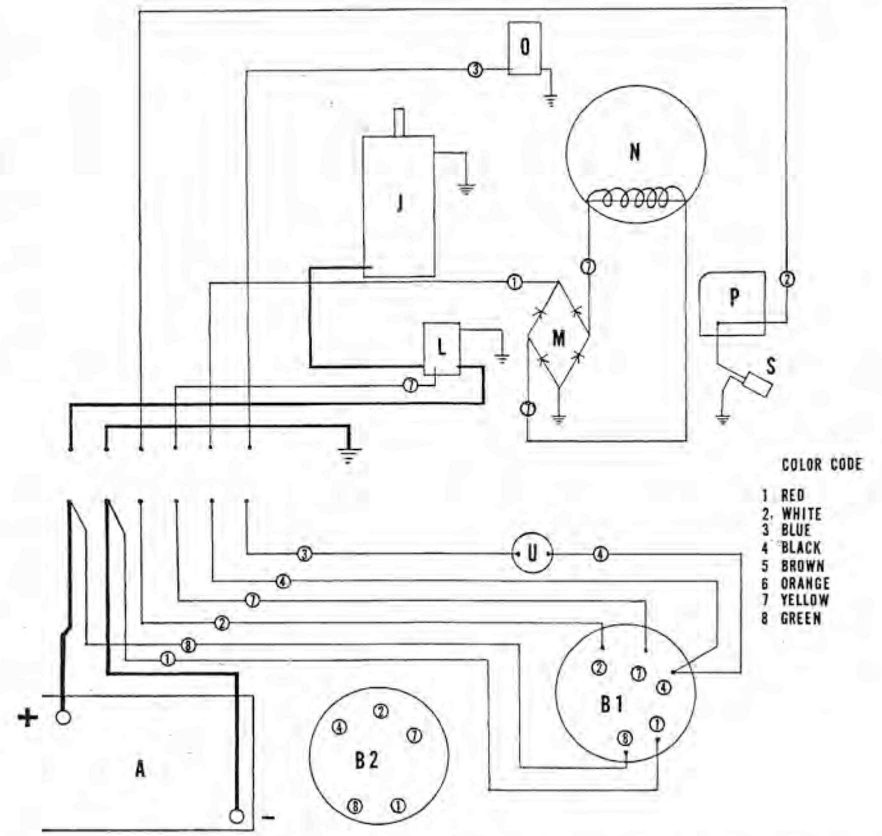


Fig. M112 — Wiring diagram used on four cylinder models with single lever control. Refer to Fig. M114 for legend.

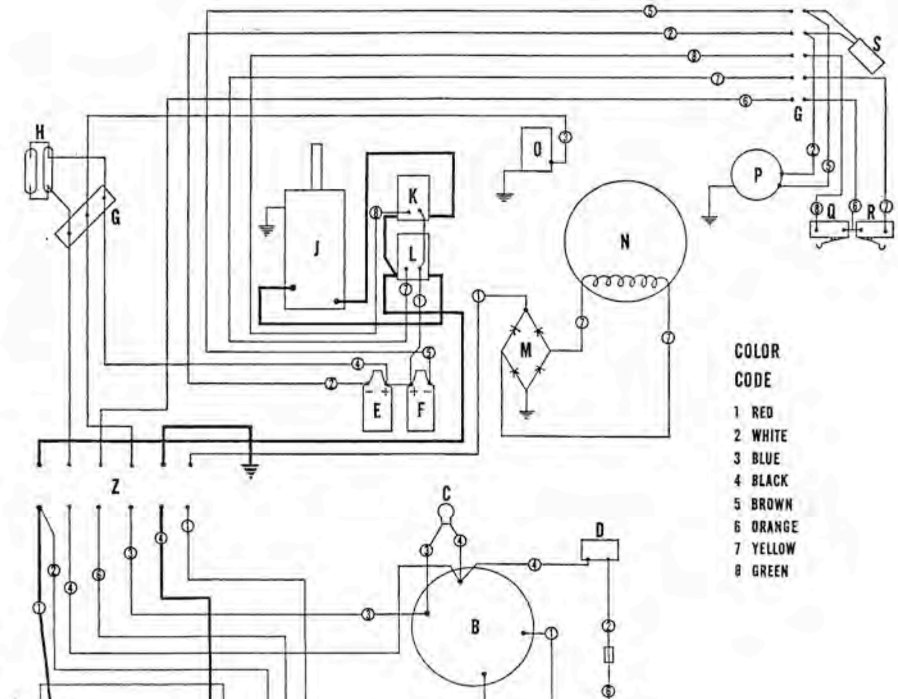


Fig. M113 — Wiring diagram used on Merc 600, 700 and 800 direct reversing models. Refer to Fig. M114 for legend.

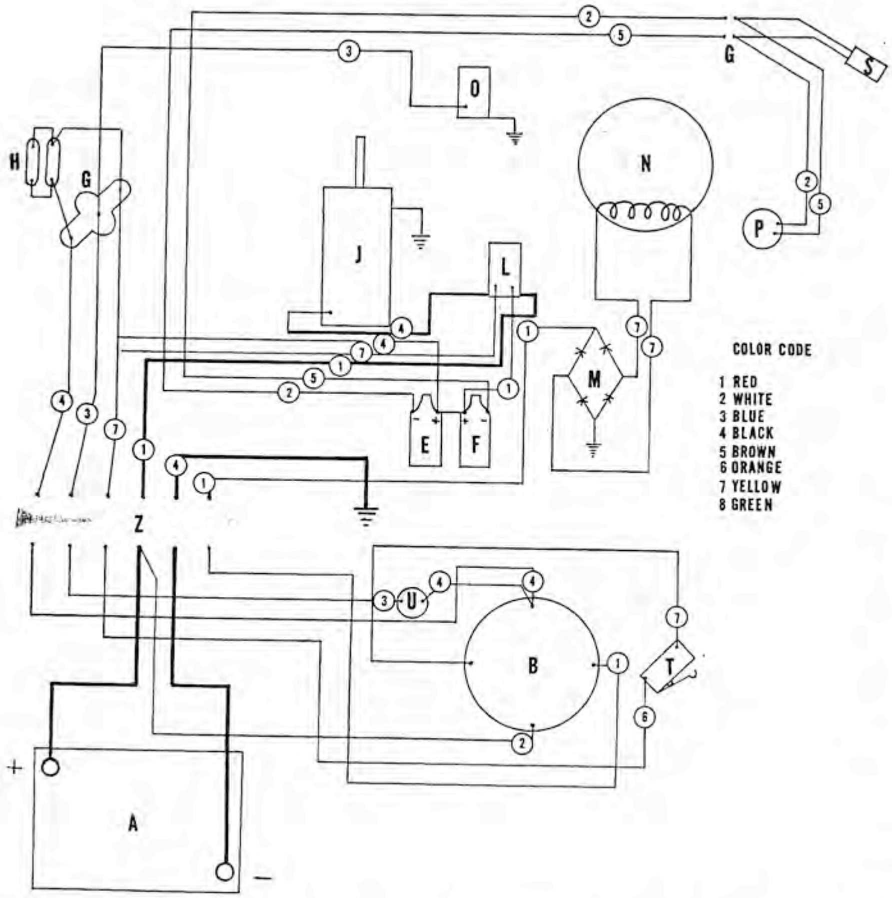


Fig. M114 — Wiring diagram used on Merc 600, 700 and 800 full gear shift models. Later models are similar except for terminal block and resistor wiring shown in Fig. M115.

A. Battery
B. Ignition switch
C. Pilot light
D. Starter switch
E. Rear coil
F. Front coil
G. Terminal block
H. Resistors
J. Starting motor
K. Reverse solenoid
L. Starter solenoid
M. Rectifier
N. Alternator
O. Choke solenoid
P. Distributor
Q. Reverse switch
R. Forward switch
S. Mercury switch
T. Starter switch
U. Choke switch
Z. Connector

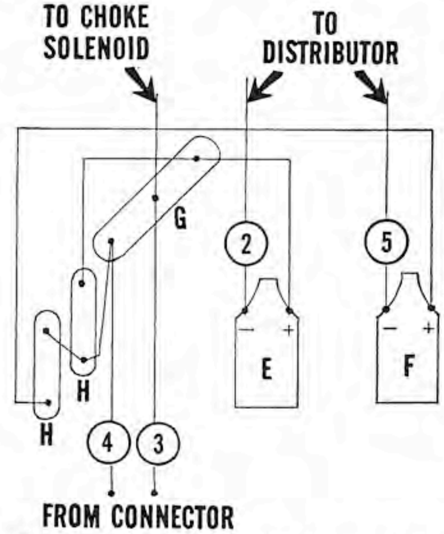


Fig. M115 — Diagram of wiring used for terminal block and resistor on late 700, 850 and 1000. Remainder of wiring is similar to that shown in Fig. M114.

newed. Reverse the test leads and repeat the series of tests. The readings should be similar to the first series of readings except reversed.

Repeat the two series of tests, using the other alternator (yellow) lead. The readings should be similar to those obtained in the first tests. If the two tests within any series result in similar readings, the rectifier must be renewed. High ohmmeter readings indicate an open diode while low readings indicate a burned (shorted) diode.

The positive ground rectifier used on early four-cylinder models is no longer available for service. If renewal is indicated, install the new-type negative ground rectifier, and reverse the battery leads before attempting to start the motor. Leave the yellow warning tag attached to rectifier or attach a warning notice of some sort, so that battery leads will not be again reversed.

PARTS DISTRIBUTION

If name and location of nearest MERCURY dealer is not known, write to Parts & Service Division, KIEKHAEFER CORPORATION, Beaver Dam, Wisconsin, for parts procurement information.