I N D E X

INDEX TO SUPPLEMENT (Pages 100 to 134 incl.)

INTRODUCTION

NO MECHANICAL contrivance is any better than the service rendered on it. Johnson Outboard Motors are no exception to this rule.

This Service Manual was prepared for the Johnson Outboard mechanic who wants to make the best repairs possible consistent with a fair charge to the customer.

Before trying to perform first class work on any Johnson Motor, make sure that you have the proper special tools, reamers, etc., with which to do the work, otherwise, you are greatly handicapped from the start. Consult the tool section when references are made to various tools.

The Johnson Motor Company will be very glad to give any Johnson Outboard mechanic free service training in our factory Service Department at Waukegan, Illinois, during the months of November, December, January, February, March and April. We have many such factory trained men in the field.

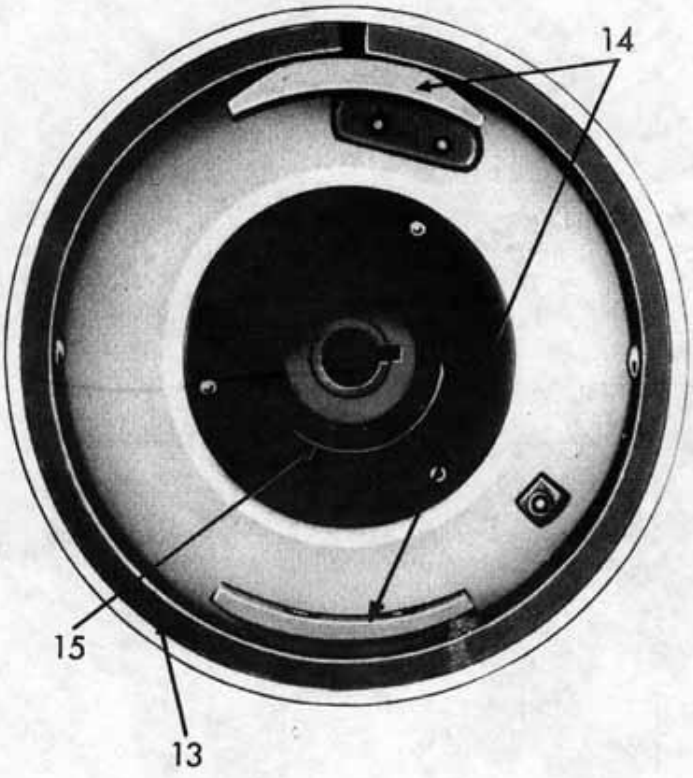
This is not an instruction book for the motor owner, it is strictly a service manual for the shopman.

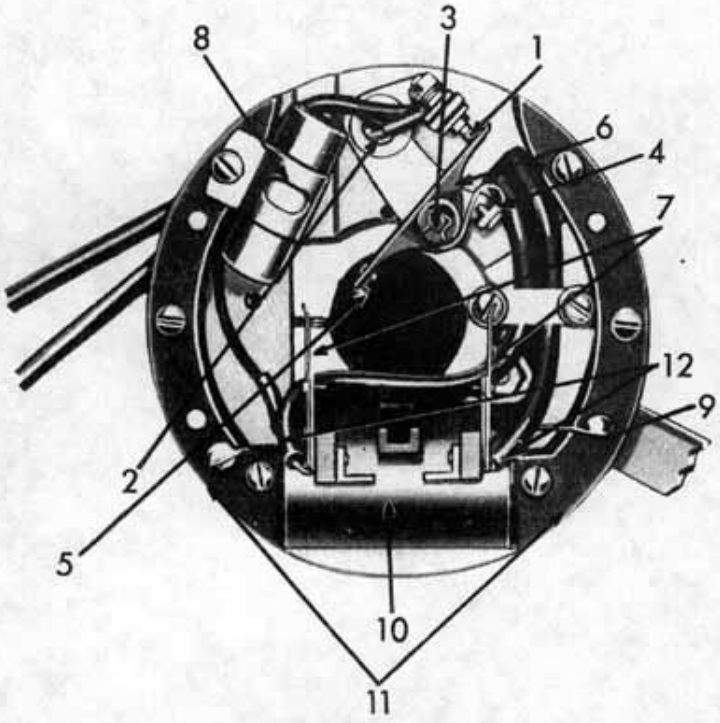
Service Manager
JOHNSON MOTOR COMPANY

MAGNETO - SERVICE SUGGESTIONS

1937, 38, 39, 40, LT, AT & DT Models

The magneto, with which above Sea Horse motors are equipped, is a self contained unit, requiring no assistance from outside sources such as a dry cell or storage battery to produce the strong spark so essential to easy starting.





It consists chiefly of the armature plate, on which are mounted the ignition coil, condenser and breaker point assembly and a permanent magnet built into the flywheel. Illustrated above. Its operation is extremely simple. As the pole pieces of the magnet pass over the coil heels, a magnetic field is built up about the coil, causing a current to flow thru the primary winding.

At the proper time, the breaker points are separated by action of a cam, thus breaking the primary circuit. This stops the flow of primary current, which causes the magnetic field to break down instantly - an electrical current of exceptionally high voltage is induced in the fine secondary windings of the coil which is transmitted to the spark plug where it jumps the gap between the points of the plug to ignite the compressed charge in the cylinder.

Each part of the magneto thus has a very definite and specific function to perform. On Page 2 are listed possible causes of the "T" series magneto failure and points to be checked when attempting to correct.

1. BREAKER POINTS - Corroded or improperly adjusted. Correct gap setting is .020".
2. BREAKER POINT ADJUSTING SCREW - Loose, affecting breaker point gap setting.
3. BREAKER ARM PIVOT POST - Tight in breaker arm bushing causing sluggish action of arm. Bushing short circuited.
4. BREAKER ARM SPRING - Weak or broken.
5. BREAKER ARM RUBBING BLOCK - worn excessively, loose or broken.
6. BREAKER ARM - Broken.

7. HIGH TENSION GROUND BRUSHES - Worn, broken or improperly adjusted (to adjust, use tool No. S-262).

8. CONDENSER - Weak or shorted out.
9. PRIMARY GROUND - Loose or broken.
10. COIL - Weak or broken.
11. COIL HEELS - Improperly adjusted - clearance between heels and magnet pole shoes (14) should be .015".
12. IGNITION LEADS - Broken, leakage thru insulation. BE SURE all electrical connections are secure and tight. DON'T use acid flux on soldered connections - use SOLDERING PASTE.
13. MAGNET - Weak or broken.
14. MAGNET POLE SHOES - See No. 11 above.
15. HIGH TENSION GROUND BLOCK - Broken, cracked or short circuited.

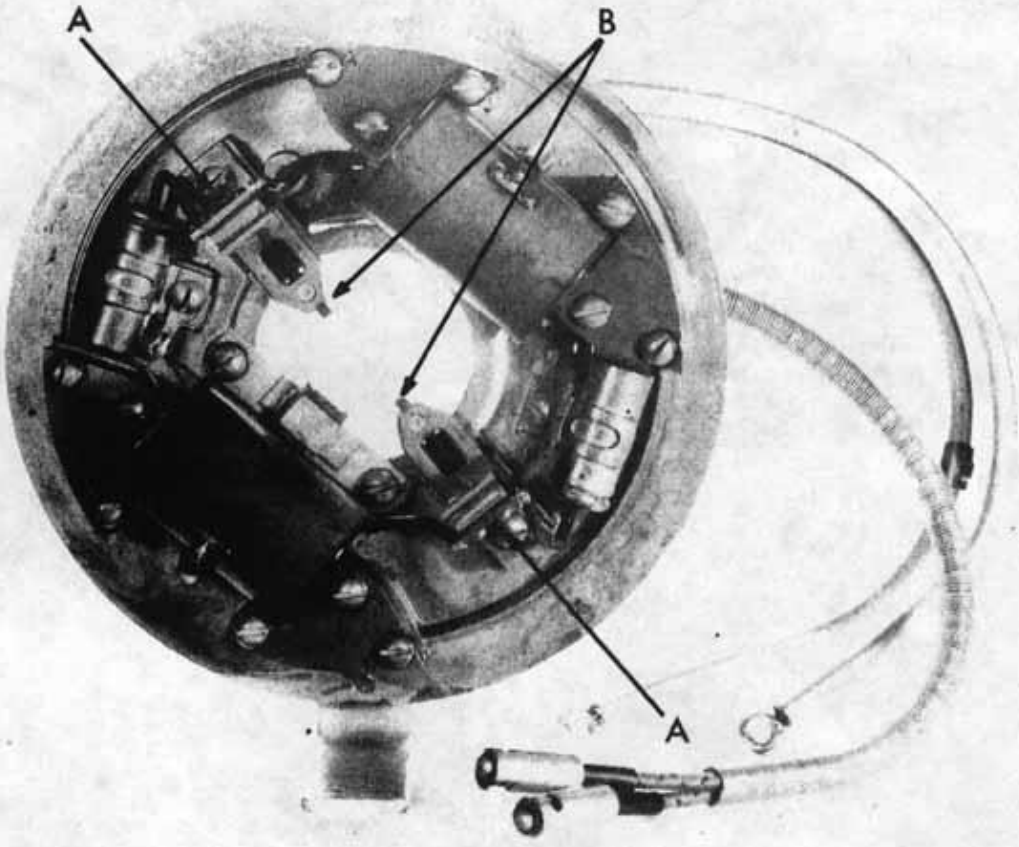
A careful check-up of the above will lead to the source of difficulty.

A special Sea Horse coil and condenser testing device is available thru the Stevens Experimental Shop of this city.

SD-10 ARMATURE PLATE

Herewith is an illustration of the Model SD-10 Magneto armature plate, consisting of coils, condensers, breaker points, etc. It is constructed similarly in many respects to the armature plate used on the KA series, with exception of the breaker point assembly - principle of operation, however, is identical.

Breaker points are operated by a "flat", machined on the crankshaft, through push rods "B". To adjust points, loosen screws "A". Revolve crankshaft until push rods ride on high side of crankshaft. Move breaker assembly towards crankshaft to a point where the breaker point gap is .020". Tighten screw "A" to properly secure assembly.



Note: Push rods "B" have flat and rounded ends- flat end should ride on crankshaft, round end, against breaker spring. THIS IS IMPORTANT.

When removing armature plate from motor, both push rods should ride on high side of crankshaft to prevent their breaking on removal. Be careful, too, that both push rods clear key on crankshaft to prevent breakage.

SOLDERING IGNITION LEADS TO COIL

Except on some of the real old Sea Horse models, the high tension ignition lead is attached to the coil by a soldering operation. Extreme care should be exercised when attaching the lead. Many coils are ruined because of carelessness in this respect.

First - USE A SOLDERING PASTE - do not under any circumstances use an acid flux. Acid burns into the coil tube, ruins the connection and produces corrosion, thus, a new coil spoiled.

Second - Don't use too much heat - heat the soldering iron just enough to make a good soldered connection. Excessive heat will burn the coil tube and the small high tension wire leading to the terminal post.

Third - Be careful - don't use too much solder - wipe off excess soldering paste when completed.

Brackets are provided on the LT coils - perform all soldering operations on the brackets. (See instructions provided with each LT coil)

Soldering paste can be obtained from your local electrical store - DON'T USE ACID FLUX.

SECTION ONE

INSTRUCTIONS FOR REPAIRING MAGNETOS

TO REMOVE THE FLYWHEEL:

To remove the flywheel of the Single Cylinder and old Light Twin Motors, simply remove the magneto cover plate, flywheel nut and lockwasher. Replace nut with wheel puller (No. S-210). Have someone grasp the rim of the flywheel and raise up on it so as to absorb the shock, then strike the puller a sharp blow with a hammer. (See Fig. 1.)

Fig. 1

One or two applications of this nature should loosen the flywheel so that it can easily be lifted from the crankshaft after having removed the puller.

On all other models, provided with a puller plate, and nut, simply back off the flywheel nut until it bears snugly against the puller plate. Lift up on the rim of the flywheel, as above described, and strike the nut sharply with a hammer. Should the first effort fail to loosen the flywheel, further back off the flywheel nut to exert more pressure on the plate, striking the nut a sharp blow, raising up on the flywheel at the same time, to absorb the shock. Several applications of this nature should loosen the most stubborn flywheel. Remove the plate, nut and flywheel.

TO REMOVE THE ARMATURE PLATE:

Loosen clamp screw, located on underneath side of the plate and simply lift off the plate.

TO INSTALL THE MAGNETO:

Mount armature plate to the motor and tighten the clamp screw just enough to prevent the plate from turning while the motor is in operation. Extreme care should be taken not to draw the clamp screw up too snugly, as this will cause undue pressure, resulting in an overheated journal bearing.

Before replacing flywheel, make certain the keys are set tightly in the keyway of the crankshaft. Loose keys are likely to drop inside of the magneto when installing the flywheel, resulting in serious damage when starting the motor, or causing the edges of the keyway to become chipped, resulting in a loose flywheel, after the motor has been in operation for some time and possibly a split or broken flywheel hub.

After having installed the flywheel it is important that the flywheel nut be drawn up as tightly as possible in order to prevent the flywheel from becoming loose during operation of the motor.

A loose flywheel will result in the motor knocking, pounding out the keyway and possibly cracking or breaking the hub, and in consistent shearing of the shear pins. It is advisable, after having operated the motor for some time, to tighten the flywheel nut **several times** to make sure the flywheel is securely seated to the crankshaft. **This is very important.**

TESTING ARMATURE PLATE

Disconnect the primary lead of the igntion coil, from the breaker or insert a piece of paper between the breaker points and attach one of the leads to the testing equipment. Attach the other lead of the test equipment to the ground of the plate and connect ignition leads to the terminals of the spark gap. (See Fig. 2). Each spark produced

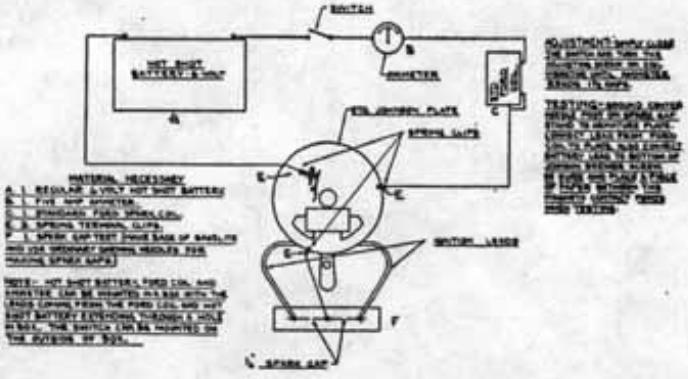


Fig. 2

by the coil should jump approximately one-fourth of an inch, providing the coil is in good condition.

The testing equipment should be checked and adjusted frequently by testing a new armature plate. With the gap set at one-fourth inch, the spark should penetrate a piece of paper, equivalent to the thickness of a calling card, approximately .015". Failure to penetrate this thickness would indicate broken down insulating material, coil or faulty condenser.

To test the condenser, disconnect lead from the breaker. Attach one lead from the condenser tester to the lead of the condenser and the other to the metal strap of the condenser. Readings vary on the various types of condenser testing devices.

Condensers for various motors and their correct

readings on the Weidenhoff breakdown condenser test are as follows:

Condenser No.	Motor	Readings
72-13	J-25	40 to 45
72-702	All Lt. Twins, K-35, K - 40, K-45, S - 45, V-45, OA-55 and OA-60	75 to 80
72-651	TR-40, P-30, 35,40 and 45	85 to 90
72-864	OK-55 and 60, S, P and V-50 models	75 to 80
72-873	A and K-50	55 to 80
72-905	SE and PE-50	85 to 90
72-930 & 931	VE-50	85 to 90

A shorted condenser will register 110 volts on voltmeter. A condenser with an open circuit will not register at all, as the circuit of the condenser is broken.

NOTE: Condensers cannot be repaired.

In testing these Magnetos, attach the leads to one coil at a time.

REPAIRING MAGNETOS BREAKING DOWN ON ONE SIDE

Remove ignition lead, rubber packing washer and contact spring. Take out the paper or glass tube with a knife or pointed tool. Ground the opposite ignition lead to the armature plate and test on the testing equipment. If the spark jumps from the brass clip of the ignition coil, through the hole, from which glass or paper tube was removed, to metal of the armature plate, the plate is alright and can be reassembled, leaving the paper or glass tube out. The difficulty in such a case is due to moisture collecting back of the tube and spark following it to the ground. This being eliminated by removing tube.

In making this test, if the spark does not jump through ignition lead hole to the plate, remove the korite or black compound with a screw driver or similar tool. Care must be taken, that the contact clip is not disturbed, as a very fine wire is threaded through it and soldered, which may be broken.

Upon removal of the korite, test the plate again, in the previous manner. This test will determine where the spark is grounding. In most cases it follows around the end of coil to the metal of the plate, burning a streak of carbon on the coil tube. With a knife, scrape this burnt streak off, and refill the plate with a battery compound or korite (korite preferrable.)

REPAIRING MAGNETO WITH BROKEN DOWN COIL

In making this test, test armature plate on testing equipment. A magneto with no spark may not be the result of a broken down coil. Quite often both sides of the armature plate are broken down and can be corrected by removing the korite from both sides and refilling. If testing determines the coil to be broken down, remove it from the plate by taking out the screws on the metal ends (of heels) and prying it loose by inserting a screw driver between it and the plate. Do not remove the one screw holding the laminations together, as they are rather difficult to reassemble and may be lost.

After the coil has been removed, from the armature plate, remove korite from the plate. Remove the heels from the old coil and assemble them on the new one. Assemble coil on the plate. Tighten the screws so that the coil will not move on the plate, while the motor is being operated, as this, no doubt, will result in the flywheel striking the heels of the coil. Machine heels down to the proper size and refill the plate with korite. (See Fig. 3).

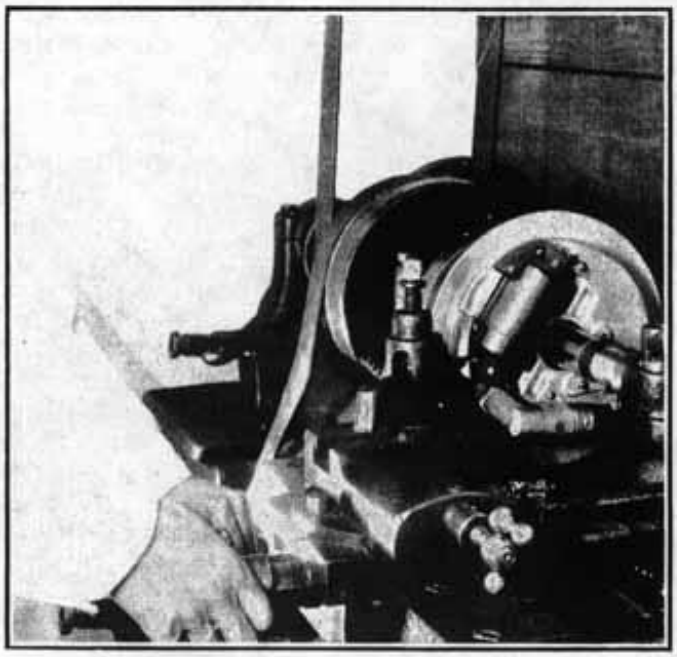


Fig. 3

Following are the various sizes the armature should be machined:

Models	Sizes
J-25, J-65	2.8295
A-25, 35, 45, OA-55 & 60 & 65	3.112
P-30, 35, 40, PR-40, P-45 & TR-40	3.886
K-35, 40, KR-40, K-45, OK-55 & 60	3.609
S-45, V-45, P-50, SR-45, 50, 55, PR-50, 55, VR-45, 50, 55, XR-55, S-65, P-50, 65, V-65	3.609
A-50, A-65, K-50, K-65 and KR-55, KR-65	3.078

If a lathe is not available, the heels can be lined up by tapping them back with a hammer or by filing down high spots, until the pole pieces of the flywheel pass without striking. The clearance between the heels and the pole pieces of the flywheel should be approximately .015". The most satisfactory manner of checking this, is to drill holes through a scrap flywheel, directly above pole pieces. A thickness gauge can then be inserted through these openings, between the pole pieces and the heels.

TO STRAIGHTEN BENT FLYWHEELS

Mark the high side of the flywheel with a pencil, while it is running at low speed on the test stand. Place an old scrap crankshaft in a vertical position in a vise and mount the flywheel. Straighten by striking the high side of the flywheel with a heavy rawhide or wooden mallet.

TO STRAIGHTEN BENT ARMATURE PLATES

Place the armature plate on a turning arbor and between centers of a lathe. Tap on the edge of the plate until it runs true.

TO ADJUST THE CONTACT POINTS AND FINAL TEST THE MAGNETO

Place the armature plate on a rotary test stand, adjusting the points by turning the contact screw until the points are perfectly aligned. To clean the points, pull a narrow strip of No. "00" sand paper folded over so the sand is exposed on both sides, through them several times, thus, polishing both points at the same time. Considerable pressure will have to be exerted on the breaker blade if the points are badly pitted.

After having installed new breaker points, or having reconditioned those previously installed, it is essential that they are properly adjusted in order to obtain maximum efficiency of the magneto.

Upon observing the construction of the magneto, it will be noticed that the entire breaker point assembly can be moved forth and back, to obtain the correct time of the points breaking, with relation to the position of the magnet pole pieces; and, that it also can be moved toward or away from the breaker cam, in order to obtain the proper breaker point gap setting. (See Fig. 4).

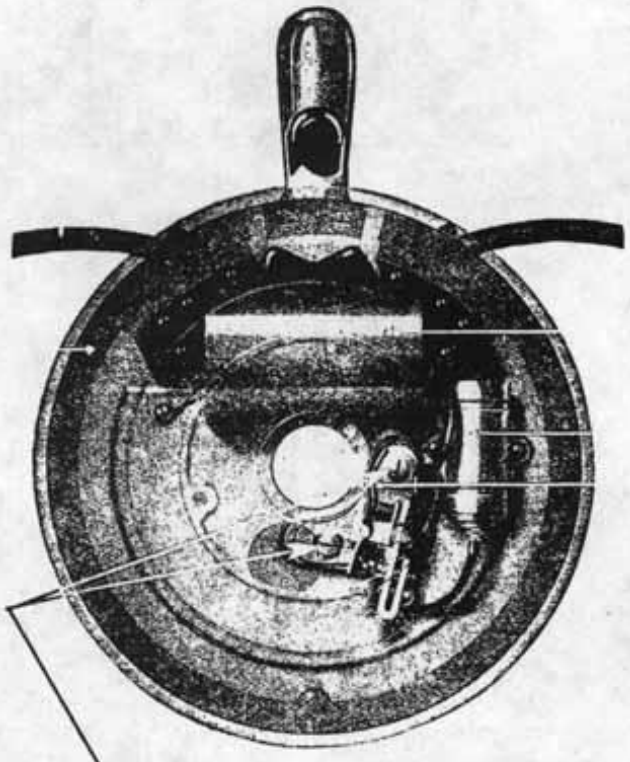


Fig. 4

TO ADJUST THE POINTS, set the breaker point gap at approximately .019". Then, upon further inspection, two marks will be observed, one located on the lower rim of the flywheel and one on the underneath side of the armature plate. Turn the flywheel in the direction of motor rotation until the breaker points are just on the verge of opening. Observe location of the marks referred to. The points, when correctly adjusted, should be on the verge of breaking when the mark on the flywheel and that on the armature plate index, or are in line. Should the points open before or after this position it will be necessary to move the breaker point assembly forth or back, as the case may be, in order that the points break at the proper time.

The construction of the magneto is such that the current in the coil reaches its greatest intensity at this position, so, should the points open before or after the marks index, the spark delivered at the plug will be weak, due to the fact, that it has occurred before or after the current in the coil has reached greatest intensity. Failure to adjust the points in this manner will result in hard starting and interfere greatly with operation of the motor at low or trolling speeds. This does not apply to the magnetos installed on the A-50, K-50, OA-55, 60 and 65, OK-55, 60, S, V, and P-50 or 65 SR and PR-50, 55, 60 or 65 and the XR-55 Motors. The magnetos of these motors are adjusted at the factory and can only be set for correct breaker point gap. (See Fig. 5).

Fig. 5

TABLE OF CONDENSERS SHOWING MOTOR MODELS USED UPON

Our Part Numbers and Condenser Capacities

Model Used Upon	Part No.	Capacity
J-25, 65, A, A-25	72-13	.12 M.F.R.
K, S-45, V-45, OA-55, and A-35, 45	72-702	.3 M.F.R.
P-30, P-35 and TR-40	72-651	.4 M.F.R.
S-50, 65, P-50, 65, V-65 all Racing Motors & OK-55	72-864	.3 M.F.R.
Electric Motors	72-930	.4 M.F.R.
	72-931	.4 M.F.
A & K-50 & KR-55, 65	72-873	.22 M.F.

(NOTE — Above capacities when tested 440 volts).

Do not adjust the gap by turning the contact screw, this will result in the points operating out of line.

Upon operating magneto on the test stand, it should deliver about a one-fourth inch spark, without missing at low or high speed.

If the magneto misses at high speed, the breaker spring should be removed and stretched, so as to exert added pressure on the breaker blade, causing it to close more rapidly.

A blue flame at the contact points, when magneto is operating on the test stand, is an indication of a defective condenser or breaker points, broken off blade, or contact screw.

A red or shooting spark at the contact points is due to dirt or grease between the points. A weak magnet will cause the magneto to miss at low speed.

Following is the correct routine to proceed, when repairing magnetos:

1. Test plate with a battery.
2. Test condenser.
3. Install parts necessary for repairs.
4. Place armature plate on test stand, clean and adjust the points.
5. Tighten all screws.
6. Operate magneto on test and check for spark.

REMAGNETIZING MAGNETS

Refer to the instructions furnished with the Weidenhoff remagnetizing block. This remagnetizer is the only one available for service work on Johnson magnetos, and can be purchased thru the Crerar-Adams Company, 36th and Morgan Streets, Chicago, Illinois.

The magnet should always have a metal bar or keeper placed across the poles, when the flywheel has been removed from the motor, in order to retain its magnetic strength. It is extremely important to test each magnet with a magnetometer to determine its flux strength.

CHECKING AND REPAIRING CARBURETORS

(For all carburetors with the exception of the Vacturi float feed and fuel lift.)

Remove the fuel line, screen and bushing from the gas tank to thoroughly clean.

Remove the carburetor by loosening screw that clamps it to the crankcase. Remove large nut on the gas line.

If the large gas line nut does not come off readily, remove the gas line with the carburetor, and then loosen it. In this manner, the spout on the crankcase will not be broken.

Disassemble the carburetor to remove sediment and corrosion. Insert a small wire through the needle valve hole and spray nozzle to force out particles of foreign substance that may have lodged there.

The float valve and seat should then be checked for rust and pit. If the float valve is pitted, a new one will be required. If the float valve seat is pitted, it may be spot faced, but if the pits are too deep, a new carburetor body will be necessary, as spot facing will raise the fuel level causing the carburetor to flood. (See Fig. 6).

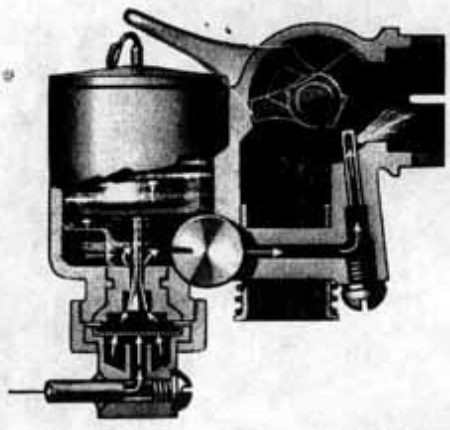


Fig. 6

After installing a new float valve or spot facing the seat, test the carburetor by filling the bowl with gasoline, replacing the lid, and by drying the gasoline from the bottom of carburetor and float valve seat, note if gasoline seeps through. If a leak occurs, grasp the top end of the float valve, that protrudes through the cover, with a pair of pliers and twist back back and forth with considerable pressure until a good seat is formed. Be sure to pull directly out on the float pin while doing this or the pin will bend and break.

REPLACING SPRAY NOZZLE IN JOHNSON CARBURETORS—(Not Vacturi Carburetors)

Press out the old nozzle on a small arbor press, using a pin, a trifle smaller than the spray nozzle, to press it through into throttle chamber. Press the new nozzle in so that the small hole, to be drilled at the end, will protrude about one-fourth inch above the opening. (See Fig. 7). It is advisable

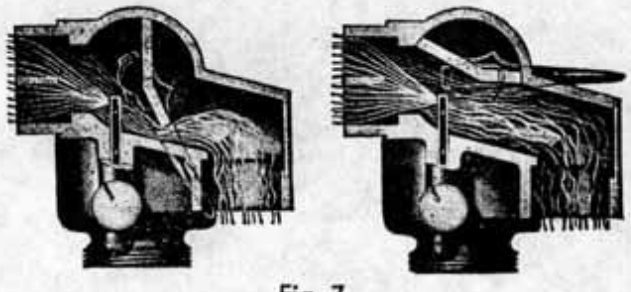


Fig. 7

to check this with another carburetor of the same type, to obtain, as near as possible, the correct height. After placing the nozzle, drill a hole crosswise through the nozzle about 3/32 of an inch from the top.

Following are the correct drill sizes for the various carburetors:

No. 60 drill for J-25, J-65, A-25, 35, 45, 50 and 65, OA-55, 60 and 65 motors.

No. 50 drill for K-35, 40, KR-40, K-45, 50 and 65, OK-55 and 60 motors.

No. 50 drill for P-30, 35, 40 and 45 and PR-40 motors.

No. 40 drill for S and V-45 and SR and VR-45 motors.

After this operation, redrill the hole length wise through nozzle, being careful to run the drill only as far as the hole drilled crosswise at the top end, in order to remove the burrs.

Following is a list of drills for this operation on the various carburetors:

Size 1/16 drill for J-25, A-25, 35, 45 and 50, OA-55 and 60 motors.

Size 35 (.110) drill for K-35, 40, 45 and 50, KR-40, OK-55 and 60 motors.

Size 35 drill for P-30, 35, 40, 45 and PR-45 motors.

Size 30 (.1285) drill for S-45, SR-45, V-45 and VR-45 motors. (Not for Vacturi carburetors).

Having properly drilled the spray nozzle, bend the top of the nozzle about 3/16 of an inch toward the crankcase.

If after having set the carburetor needle valve for high speed, it is found that the mixture is too rich at low or trolling speeds, requiring the necessity of closing the needle valve somewhat; remove the carburetor valve and bend the spray nozzle back slightly, that is, away from the motor. If, on the other hand, the mixture is found too lean at low speeds, bend the spray nozzle forward, toward the motor. (See Fig. 8). By attempting this adjustment several times, it will be found possible to adjust the carburetor for high speeds without interfering with the needle adjustment, when the motor is being operated at low speeds.

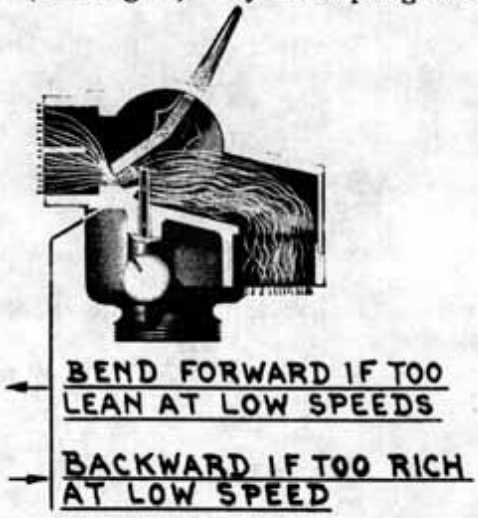


Fig. 8

The throttle should be adjusted so that "slow" and "choke" position have the proper opening, when the throttle lever is all the way up or down. This adjustment can be made with the screws on the side of the throttle cover.

Following are the proper settings:

Motors	Slow	Choke
J-25 & 65	.157	.125
A-25, 35, 45, 50 & 65, OA-55, 60 & 65	5/32	.125
K-35, 40, 45, 50 & 65, KR-40 & OK-55 & 60	.156	.156
P-30, 35, 40 & 45 & PR-40	15/64	3/16
S & V-45 & SR & VR-45 (Not including ones with Vacturi Carburetor)	11/64	1/8
T & TR-40	5/16	1/4

The correct way of making this adjustment is as follows:

Loosen screws on the side of throttle cover and back them partly out. Insert a bar or rod, of the proper size, in the choke or slow opening of the throttle valve, turn the valve down against it. This will allow for the correct opening. Turn the screws up to the stop, and lock in place with lock nuts.

When installing the carburetors, be sure they are set level and mounted securely to the crankcase to prevent the possibility of an air leak.

The carburetor set "off level" will often cause an over flow at the nozzle.

If the gasket at the settling basin has hardened, it should be replaced or it may leak.

The screen should also be inspected occasionally and cleaned. Do not operate the motor without a screen, as foreign substances will pass through and lodge in the spray nozzle.

TO REMOVE DENTS FROM THE GAS TANK

When attempting to remove dents from the gas tank, it is first advisable to make two blocks that will fit on either side of the tank, when placed in position between the jaws of a vise, to prevent any tendency toward bulging when pressure is applied.

With the filler cap securely in position, air can be forced in to the tank, thru the shut-off valve, until the pressure reaches approximately 40 lbs.; then with a light rawhide or wooden mallet, tap lightly around the edge of the dent, until that portion of the tank forms back to its normal position. If a torch is available, play the flame over injured section—being careful not to over heat—while dented section assumes normal position. (See Fig. 9.)

Fig. 9

If the dents are too deep to remove by this method, it is advisable to remove a section of the tank opposite the injured portion, which will allow the insertion of a block to pound out the dent. After completing this operation it will, of course, be necessary to replace the section previously removed.

WELDING GAS TANKS

Remove all gasoline from the tank. Make a paste, by adding water to Oxweld sheet alumnium flux. Use ⅛" Oxweld sheet alumnium rod. Note: This can be purchased from the Oxweld Acetylene Co., Jasper Place & 36th Street, Chicago, Illinois.

Clean the spot to be welded with a scratch or wire brush.

Adjust acetylene torch to neutral flame. Heat section to be welded, by moving the flame back and forth. Do not hold the flame in one spot while welding, as the tank will become too hot and probably melt through.

While welding, the tank must be heated enough so that the metal of the tank and the welding rod will melt and run together. Do not pile the alumnium up.

A cracked tank can be welded by cutting a hole approximately two inches in diameter about the crack. A patch, made of the same gauge metal as used in the tank, can be placed in the opening and welded into place.

After the welding is finished and the tank is cooling or partly cooled, wash off the flux with water. If the tank is allowed to cool with the flux remaining, it will crack near the spot of welding.

It is advisable to practice on an old tank, that is of no value, before attempting to weld a good one.

WELDING MOTOR PARTS

Welding the cylinder, gear cases and other parts of the motor have not proven successful. It is more practical to install new parts.

TO INSTALL NEW TRANSFERS ON THE GAS TANKS

Buff the old transfer off, or soak it with a lacquer thinner. If the tank is scratched or rough, it must be polished, as it should be smooth before installing the new transfer. Wash the film of grease and dirt from the tank with denatured alcohol and allow to dry.

Wipe the transfer free of soapstone with a dry cloth, and lay face down upon a heavy piece of paper.

The sizing, (transfer cement) to be used on the transfer, should be kept very thin. When not in use, keep tightly covered—to prevent evaporation. Sizing cannot be thinned; when it becomes thickened it should not be used, as it will cause the transfer to blister when drying.

With a brush, apply a **very thin** and even film of sizing, on the side of transfer next to the tank. This can best be accomplished by using a brush about one and one half inches wide, and by putting just enough sizing on it so that considerable pressure must be exerted to completely cover the transfer.

THE COATING MUST BE THIN.

Before attempting to apply transfer, allow the sizing to dry twenty-five to thirty minutes, or until the sizing is tacky and seemingly dry when touched with the fingers.

Start at one corner of the transfer to peel the heavy paper from it.

Place the transfer lightly in position on the tank. take hold of the transfer with one hand and lift half of it from the tank. With a sponge soaked with water, **start at center of the transfer** to press it down on the tank. Then do likewise with the other half. Rub the transfer lightly with a sponge, using plenty of water, until the thin paper is thoroughly soaked. Take hold of one corner of the thin paper and pull it off, leaving only the transfer on the tank. Wash the transfer slightly with water and dry with a soft cloth. Roll the transfer down with an **all rubber** roller. Do **not** use a roller with a **wooden center** as it will likely tear the transfer. Note: Rollers can be purchased thru Crerar, Adams & Company, 36th & Morgan Sts., Chicago, Ill. Tool number S-103.

After the transfer is properly rolled down, and absolutely dry, apply a coat of quick drying varnish, such as Pyramid Four Hour Varnish.

In case of a rush job, varnish can be left off, although the transfer will not be as durable. Note: Sizing or transfer cement can be purchased from the Johnson Motor Company.

TO CHECK AND REPAIR MUFFLERS

(Models A-25, 35, & 45, OA-55 & 60, K-35, 40 & 45, KR-40, OK-55 & 60, P-30, 35, 40 & 45, PR-40 & TR-40)

Remove muffler from the motor to disassemble. Remove the carbon from around, and in the holes of the inner shell. Remove carbon from outer shell and exhaust holes in the exhaust casting; carbon will restrict the flow of exhaust gases and create back pressure, resulting in loss of power.

To assemble muffler, spread form-a-gasket in the grooves of the casting, to prevent exhaust gases from leaking past the ends of the outer shell.

When assembling new shells, flatten the crimp in the shell, with a pair of pliers so they will fit into the grooves of the castings easily. Assemble the inner shell **with exhaust holes down** and directed from the gas tank. **This is important:** should the holes of the inner shell direct upward, excessive heat will concentrate on the top side of the muffler, which will cause the fuel in the tank to boil. Tighten the muffler bolt extremely snug; a loose inner or outer shell will interfere with the operation of the motor, also rattle.

INSTRUCTIONS FOR INSTALLING NEW TRANSFER

A new transfer is now being installed on all models going thru production, the design of which you all are familiar with, the difference being merely in construction.

This new transfer is much heavier and stronger, therefore, simplifying installation considerably, if the following instructions are closely adhered to:

1. Apply a very thin coat of "4 & 1" cement (supplied by factory) to lacquered side of transfer.
2. Allow to set until practically dry. (THIS IS VERY IMPORTANT)
3. Wet surface of tank with sponge.
4. Place transfer in position.
5. Smooth down with a sponge, well saturated with water (to loosen heavy paper).
6. Roll out with rubber roller (be sure roller has been immersed in water prior to using).
7. Remove heavy paper.
8. Roll down with rubber roller to insure transfer making contact at all points. WORK FROM CENTER OUT. (Note - in event of creases being evident, the transfer material is strong enough so that it can be raised from the tank to permit correction and to be rolled out.)
9. Allow to dry for 24 hours.
10. Apply thin coat of varnish over entire transfer to protect surface.

The new transfer can be distinguished from the older type in that one side has a glossy lacquered finish, while the old transfers are covered with a thin tissue or supplied with a dull powdered finish. NOTE - To insure a perfect job everything used to apply the transfer must be CLEAN and free from any trace of oil. Tank also must be clean and polished.

CYLINDERS CAN BE CHECKED FOR OVERSIZE WITH PLUG GAUGES

Following is a list of plug gauges for the various motors:

S-81 plug gauge for J-25, A, A-25, 35 and 45, OA-55 and 60 and 65 motors.

S-153 plug gauge for K-40 and 45, KR-40, OK-55, 60, and S and V models.

S-36 plug gauge for P-35, 40 and 45 and PR-40 motors.

S-235 plug gauge for P, all P-50, 65 and PR-50-55, 60 and 65.

S-236 plug gauge for A-50 and 65 motors.

S-237 plug gauge for K-50-65 and KR-55-65 motors.

TO INSTALL JOURNAL BEARINGS

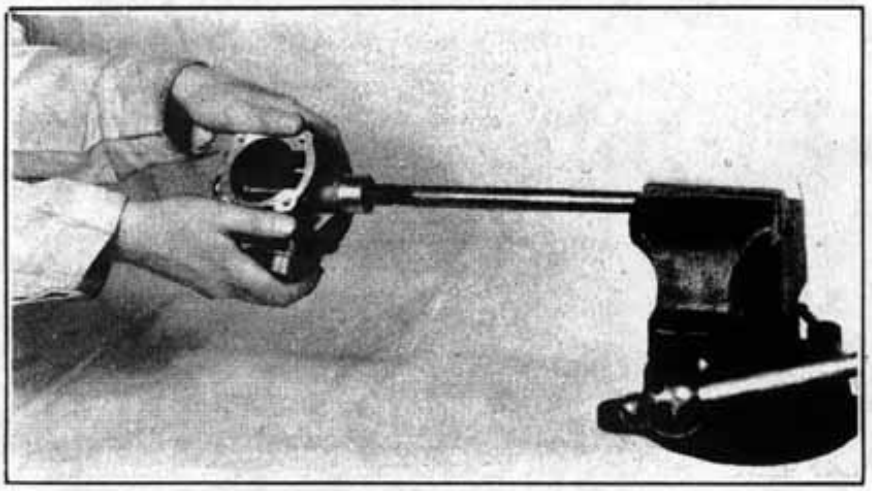


Fig. 10

Dissemble the crankcase to remove the bearings to be replaced, using the special tools for that purpose, as listed in the Crerar-Adams Catalog.

Inasmuch as it is advisable to press the bearing toward center of the crankcase, it is important that a fixture be used to support the crankcase section, in order to prevent it's being sprung when the pressure is applied.

We recommend the following support fixtures:

S-63 for J-25 and 65, A-25, 35 and 45, OA-55, 60 and 65.

S-45 and S-71 for P-30, 35, 40 and 45, PR-40.

S-68 for upper bearing TR-40.

S-69 for lower bearing TR-40.

S-99 and S-100 for S-45, SR-45, SE-50 and S-65.

S-99 and S-102 for V-45, VR-45, VE-50 and V-65.

Bear in mind that all journal bearings should be pressed in from the **inside** of the crankcase sections and flush with the machined surfaces.

After having installed the bearings, reassemble the crankcase so that both sections are flush at the cylinder base locations.

To Ream Journal Bearings

Before attempting to line ream the journal bearings, it may be found necessary to remove the burrs in order to admit the pilot of the line reamer.

Burr reamer S-33 for J-25, 65, A-25, 35 and 45, OA-55, 60 and 65.

Burr reamer S-5 for K-35, 40 and 45, KR-40, OK-55, 60.

Place the burr reamer in a vice and proceed to remove burrs by rotating the crankcase about the reamer in a clockwise direction, until the reamer has passed through both bearings. (See Fig. 10). Remove the reamer by rotating the crankcase in the same direction, in order to prevent injury to the blades of the reamer.

TO LINE REAM, place the line reamer upright in the vise, and proceed as previously described.

Line reamer S-13 for J-25 and 65, A-25, 35 and 45, OA-55, 60 and 65.

Line reamer S-207 and 208 for A-50 and 65.

Line reamer for S-206 and 205 for K-50 and 65.

Line reamer S-3 for K-35, 40 and 45, KR-40, OK-55, 60.

Line reamer S-1 for P-30, 35, 40 and 45, PR-40.

Line reamer S-29 for TR-40.

Rough reamer S-86 for S-45 and 65, SR-45, SE-50 and 65, P-50 and 65, PE-50, PR-50, SR-45 and SR-50.

Line reamer S-83 for S-45, SE-50 and S-65, P-50, PE-50, P-65.

Special reamer S-82 for SR-45 and 50, PR-50.

Rough reamer S-88 for V-45 and 65, VR-45, VR-50, VE and VA-50 and 65.

Line reamer S-92 for V-45 and 65, VR-45, VR-50, VE and VA-50 and 65.

Special reamer S-91 for VR-45 and VR-50.

BELL REAMING: All motors constructed with

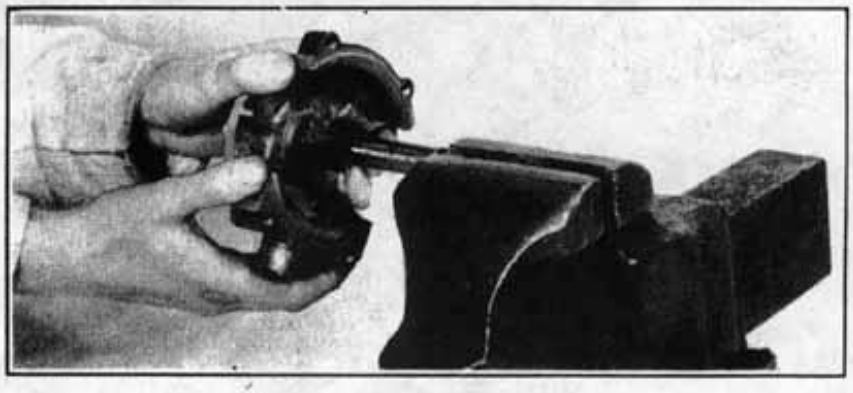


Fig. 11

the split type crankcase, require bell reaming of the top and lower journal bearings to allow for proper lubrication and alignment. To accomplish this operation, disassemble the crankcase in order that the bearings may be belled from the inside, (See Fig. 11) with:

Bell reamer S-14 for J-25 and 65, A-25, 35 and 45, OA-55, 60 and 65.

Bell reamer S-4 for K-35, 40, 45, KR-40, OK-55 and 60.

Bell reamer S-15 for P-30, 35, 40 and 45, PR-40.

Bell reamer S-17 for TR-40, upper journal bearing.

Bell reamer S-20 for TR-40 lower journal bearing.

The reamers should be set at .0015 to .002" above the reamed size of the bearings, belling the top journal bearing approximately one-third of its length from the inner edge, and the lower journal bearing one-fourth of its length. Bell ream A and K-50 and 65 upper bearings, only, up to the oil hole.

TO CHECK THE BEARINGS FOR ALIGNMENT:

(Models J-25, 65, A-25, 35 and 45, OA-55, 60, 65, K-35, 40, 45, OK-55, 60 and P-30, 35, 40 and 45.)

Reassemble the crankcase sections and check with the following lining bars:

S-50 for J-25 and 65, A-25, 35 and 45, OA-55, 60 and 65.

S-80 for K-35, 40 and 45, KR-40, OK-55 and 60.

S-34 for P-30, 35, 40 and 45 and PR-40.

Insert the lining bar thru the lower journal bearing until it enters the top bearing, then by bearing down slightly on the bar, move the bar in and out of the top bearing, at the same time slowly rotate the crankcase, to determine whether or not the bearings are properly aligned. (See Fig. 12).

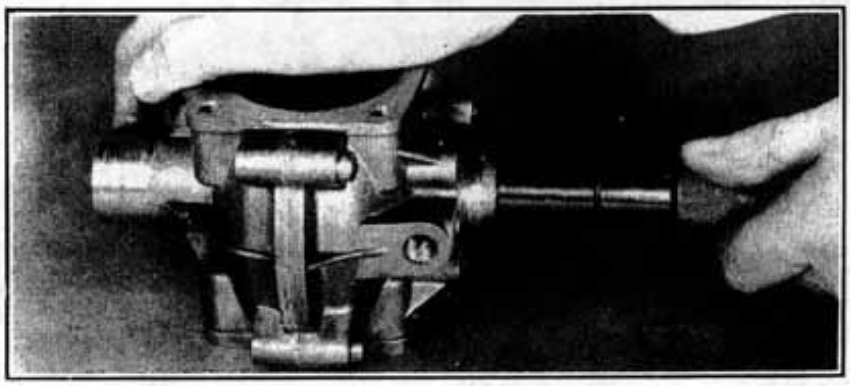


Fig. 12

If the bearings are in line, the bar will strike the end of the opposite bearing on all sides with equal pressure. Should they be out of line, the bar will strike one side of the bearing with considerably more force than the other. This can be corrected by removing the bar from the top bearing and by striking the bar, protruding from the lower bearing, a sharp blow on the side opposite the high spot, located on the top bearing. (See Fig. 13). This

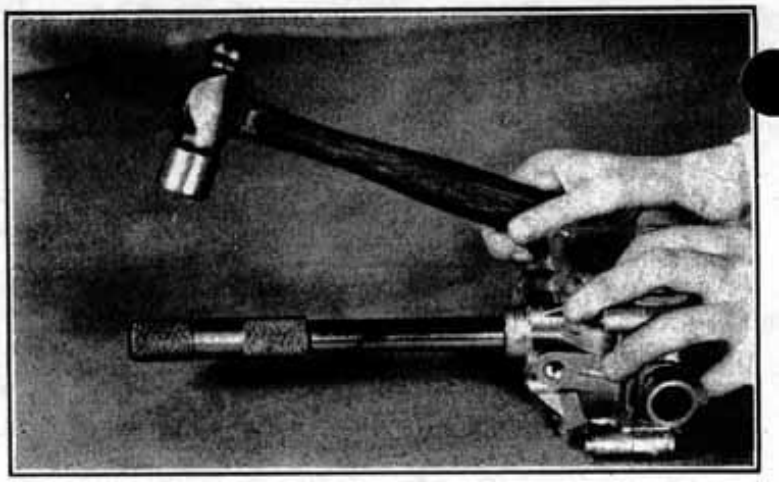


Fig. 13

should spring the case sufficiently to properly align the bearings.

After having installed, reamed and aligned the journal bearings, assemble the crankcase with the crankshaft and gaskets in position. Upon further checking, the crankshaft should be free in any position, with a noticeable amount of free end play, approximately 1/64".

Should the end play exceed the specified amount, the upper journal bearing can be driven down with tool S-74, to the proper clearance. Should the end play be less, it will be necessary to spot face the upper journal bearing to the desired clearance.

THIS IS IMPORTANT: A too small amount of end clearance will result in the crankshaft binding and, likewise, interfere with the operation of the motor. Too great a clearance, at this point, is apt to result in a motor knock.

ALIGNING BEARINGS:

(On Models A-50, 65, K-50, 65, S, S-45 and 65 and SR-45, SR, SE, P-50, 65, PR, PE, V-45, 65, VR and VE-50 and VR-45.)

No lining bars are provided for alignment of the bearings on these models, inasmuch as, the crankcase castings are of a different design and cannot be realigned in the same manner.

When the bearings are found to be out of alignment, remove the crankshaft from the crankcase, reassemble the head and run the line reamer thru the bearings, as instructed in "Installing New Bearings in Crankcase."

STRAIGHTENING THE CRANKSHAFT

(All Models)

Thoroughly clean and inspect the centers which are located in the ends of the crankshaft. The centers should be in good condition and free from burrs.

Place the shaft between centers of a lathe, being careful to not exert too much pressure, as this will spring shaft at the crank arms. (See Fig. 14).

Check the shaft for alignment by using a dial indicator, then by turning it slowly, locate the high side. Place a bar or piece of wood between the high side of the crankshaft and the tool post rest. Exert enough pressure to true the crankshaft to the following limits:

.0005 on motors J-25, 65, A, A-25, 35 and 45, OA-55, 60, and 65, A-50, 65 and K-50, 65.

.001 on motors K-35, 40 and 45 and KR-40, OK-55 and 60, P-30, 35, 40 and 45, PR-40, P-50, 65, PR-55, all S and V Motors and XR-55 Motors.

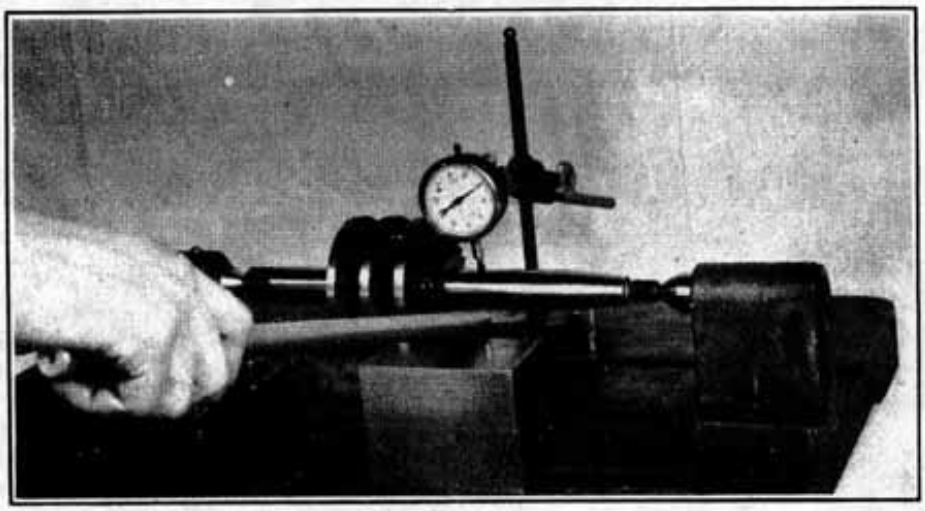


Fig. 14

TRUEING PISTONS

(All Models)

Check pistons with outside micrometers, for being out of round, and mark the high side with a pencil.

Place the piston in a fixture, which can be made by boring a hole through a block of wood the same size as the piston. Saw the block in half through the center, and use only one-half for holding the piston while rounding it.

After piston has been placed in this holder or fixture, tap very lightly on the high side (using a rawhide mallet) and check with micrometers until it is within .0005 of being perfectly round.

INSTALLING PISTON PINS

(All Models)

All lynite pistons are reamed at the factory for a heat fit of the piston pins.

Before installing piston pins in the lynite pistons, heat the pistons, by allowing them to stand in water, near the boiling point.

After the piston has been thoroughly heated, place it in the block designed for trueing, drive the pin in place, and lock it with cotter-pin or lock screw. Exceptional care should be taken to properly install the cotter pin or lockscrew, should one of these become loose while the motor is in operation, considerable damage will result.

Cast iron pistons are reamed at the factory for slip fit of the piston pin on one side and drive fit on the other.

To accomplish this, first, press pin through the slip fit hole. (This hole is located opposite the hole, provided for locking devices.)

After piston pins have been installed and locked in place, file off lynite or cast iron, around the piston pin holes. Usually the lynite will swell around the holes, during this operation, leaving high spots. Use a smooth file to relieve. Again, check the piston with micrometers for trueness, as occasionally pressing or driving the piston pin in place will cause the piston to spring out of shape.

The piston pins should always be checked in the pin holes of the connecting rods to determine if they fit freely and do not bind.

If they are not free, tap on connecting rod, directly around the piston pin, with a small hammer until the pin will turn freely in the hole. Always insert the pin in the rod before tapping on it.

If the piston pin fits tightly in the connecting rod after the rod has been installed in the piston, loosen it by tapping on the rod around the pin, with a hammer and punch.

Occasionally, the piston pin hole in the piston may become damaged and necessitate reaming.

A and K-50, 65, PR-60, have full floating piston pins.

FITTING CONNECTING ROD TO THE CRANKSHAFT

(All models with bronze connecting rods.)

On Motors equipped with bronze connecting rods, check the rods for wear, by taking hold of the rod with one hand and by pushing and pulling it directly to and from the crankshaft. If the connecting rod has worn over the clearance specified on page 77 it is advisable to take up the excessive clearance as follows:

Remove rod from the crankshaft. Place a fairly large mill file upon a flat surface, and by placing the flat side of the connecting rod cap on the file, move it back and forth with a slight pressure until a few thousandths have been removed.

Assemble the rod to the crankshaft and tighten cap screws. Enough should have been filed from the cap so that the rod will cling slightly to the shaft, when moved back and forth. If the rod does not cling, a little more will have to be filed from the cap. However, care must be taken not to file too much off, as, in this event, the rod cannot be loosened on the crank pin, and will have to be replaced or reamed.

After the cap has been filed to the desired clearance and assembled to the rod and crankshaft, tighten the screws as much as possible. Hold the connecting rod in one hand, with the crankshaft hanging down, then with a very light hammer, strike the rod directly around the crank pin at different angles, until the rod is free on the shaft and does not bind at any point. **The rods must be free, but never tight.**

Re-tighten screws and thread the wires through the screw holes drilled for this purpose, making sure that wires are pressed close to the rod so they will not drag on the crankshaft while the motor is operating.

(Note: The pistons and connecting rods should always be installed on the crankshaft so that the deflector, on the head of piston, is located on the intake side of the cylinder, **directly opposite the exhaust port.)**

TO ASSEMBLE THE CRANKSHAFT, CONNECTING ROD AND PISTON ASSEMBLY, IN THE CRANKCASE

(Models A-25, 35, 40 and 45, K-35, 40 and 45, P-30, 35, 40 and 45, TR-40, OA and OK Series)

Upon observing the upper crankcase section of the motors using the split type crankcase, an arrow will be found located at the base of the bearing boss.

When installing the crankshaft assembly, make certain that the keyway of the crankshaft is in line with the arrow stamped on the crankcase, and that the pistons are in the outstretched position, in other words, at the top dead center. (See Fig. 15).

This is extremely important, should the rods be turned around so that the pistons are down, the spark will occur at the bottom center which, naturally, would result in failure to either start or operate the motor.

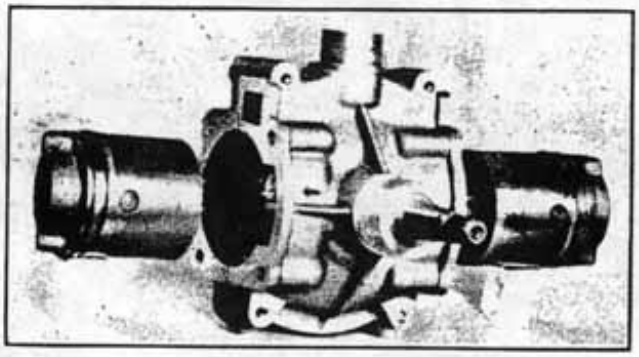


Fig. 15

TO CHECK AND STRAIGHTEN THE CONNECTING RODS

(Models With Off-set Connecting Rods)

Remove the cylinder base gaskets and piston rings. Replace the cylinder and mount loosely with two cylinder base screws, located at opposite corners. Bear down lightly on the cylinder and notice the gap between crankcase and the base of the cylinder. Then lift up lightly on the cylinder and take notice of the gap between the crankcase and the base on the lower side of the cylinder. If the connecting rods are in line, the gap, between the crankcase and the upper side of the cylinder base, will be equal to the gap observed (See Fig. 16 and 17) between the crankcase and lower side of the cylinder base.

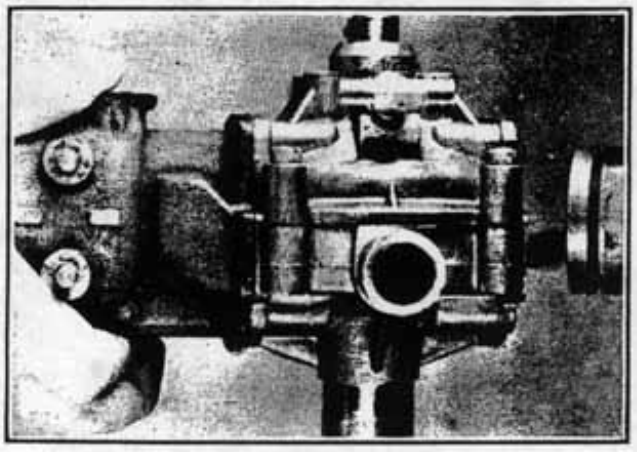


Fig. 16

Should the rod be bent, there will be a noticeable difference in the two gaps. If it is found that there is practically no gap on the top side and a comparatively large gap at the bottom, the rod will be found bent upward. This can be corrected by exerting enough pressure on the top side of the cylinder to bend the rod down to a point where both gaps will be found to be equal. If there is no gap on the bottom side and a large gap on the top, lift up on the cylinder until both gaps are equal.

After having checked the rods in this manner, turn the motor over until the piston reaches the bottom center and recheck as previously described.

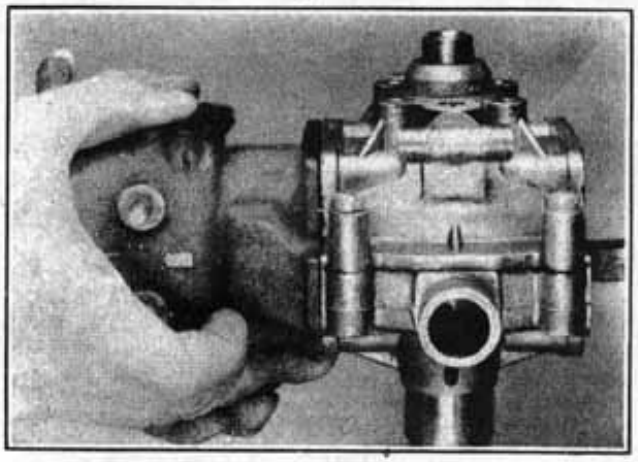


Fig. 17

TO CHECK AND STRAIGHTEN TWISTED CONNECTING ROD (All Models Using Off-set Rods)

Remove crankshaft, connecting rod and piston assembly from the crankcase.

Place the crankshaft between centers of lathe, so that the piston will lie on the flat surface of the tool post rest. This flat surface must be on a horizontal line with the centers of the lathe.

With a pair of inside calipers, measure the distance from the flat surface of the lathe to the upper side of the wrist pin hole, on both sides of the piston. The distance on both sides should be the same. (See Fig. 18).

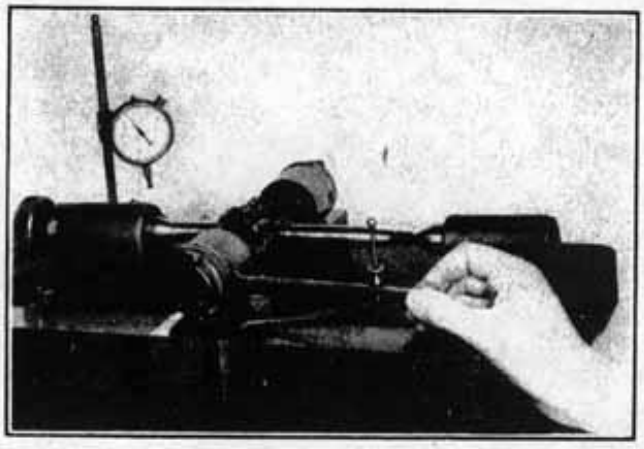


Fig. 18

If the distance is greater on one side than on the other, the rod is twisted and should be straightened by twisting into place with a wrench.

(Note: After this difficulty has been corrected, the rods will again have to be straightened as directed in "checking connecting rods for alignment and straightening".)

For all straight rods use fixture No. S-104, check for twist by rocking piston. (See Fig. 19).

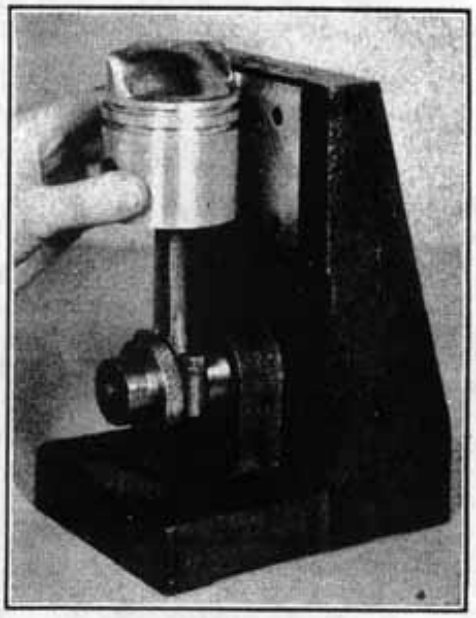


Fig. 19

TO ASSEMBLE ROLLER JOURNAL BEARINGS AND CRANKSHAFT IN CRANKCASE (Models SR-55, 60, 65, PR-55, 60, 65, VR-55 and XR-55)

Press oil seal in the roller bearing race of the crankcase head so that it is directly in the center and measures the same distance from each end.

Press roller race in the crankcase head so that it will come to rest on the machined shoulder.

Clamp reamer No. S-82 vertically in a vise and turn crankcase head down over the top cutters, reaming the oil seal to size.

Press oil seal into the top crankcase roller race, so that the oil holes are directly in line with those in the race, and so that it will be in the center of the race and measure the same distance from each end.

Ream the oil seal in the manner, described above.

Locate roller race in position to be pressed into the crankcase. This should be pressed from the inside of the case, with the four external slots at the top of the case, and the two long external slots directly in line with the two elbows located in the crankcase. (See Fig. 20).

With gauge No. S-238 press the roller race into position until the gauge comes to rest on the machined surface of crankcase.

Four cylinder motors have a center journal bearing which should be installed on the crankshaft in the following manner:

Assemble bronze oil seal on the lower part of the center bearing surface of the crankshaft, with the oil groove down. Then assemble rollers in place about the crankshaft journal and on top of the oil seal, being very careful that the roller retainers are matched.

Assemble the bearing race about the rollers with the oil groove down and toward the oil seal.

Assemble the center head about the bearing, with the center head ring groove toward the top of the crankshaft, and with the dowel pins located on the inner machined surface in their proper place—in the holes of bearing race and oil seal. (Note: The hole drilled completely through the bearing race is for oiling purposes.)

Tighten the screws holding the halves of center head, exceptionally tight and slip the center head ring in place.

Assemble the inner roller assembly on the top journal.

Insert crankshaft, compressing the center head ring with tool No. S-90 until the ring fits into the machined groove of the crankcase, which holds the center head in place.

Assemble inner roller assembly in the crankcase head and place the head in position over the crankshaft. Tighten screws to hold it in place.

Assemble the outer roller assemblies in the top and bottom bearing races, lock the top assembly in position with the oil slinger, and the bottom, with the spring lock located in the machined groove of crankcase.

Check the crankshaft for end play. The correct end play, being .012 plus .004 or minus .004.

If the end play is not within these limits, the crankshaft will have to be removed and the upper bearing race pressed one way or the other to the correct setting.

TO ASSEMBLE THE ROLLER JOURNAL BEARINGS AND CRANKSHAFT IN THE CRANKCASE OF THE KR-55 AND 65

If necessary to replace the oil seal, in the bottom bearing race, place the seal in postion to be pressed into the race, so that the oil hole will line with the hole in the crankcase. Press the oil seal to a point in the bearing race halfway between the upper edge of the spring lock groove and the extreme top edge of bearing race.

(Note: The oil seal will not have to be reamed as it is machined to size at the factory.)

Due to a complicated method of installing the bearing race in the crankcase head, the races and heads can be purchased only as an assembly.

However, an oil seal can be replaced in the field and should be accomplished in the following manner:

Locate the oil seal in position to be pressed into the crankcase head, so that the four holes nearest the edge of the seal, will be directed to the top of the motor, when pressed into place. The oil holes must be in this position in order to line up with the oil holes drilled in the crankcase head.

Press the oil seal into the bearing race so that the end of it will be 15/32" from the bottom of the bearing race.

Assemble bronze thrust washer on the bottom end of the crank shaft so that the chamfered inner edge of the roller retainer is directed to the upper end of the crankshaft.

Assemble one set of rollers and retainer on the bottom end of the crankshaft, with open end of the roller retainer next to the thrust washer.

Hold the crankshaft in an inverted position, bottom end up, and slip the crankcase down over it. Assemble one set of rollers and retainer on the bottom end of the crankcase head, with the open end of the retainer toward the top end of the head.

Place the thrust washer over the bearing, so that the two extended points rest in the grooves of the head.

Hold the complete assembly of crankcase head in an inverted position bottom end up, and by holding the crankshaft in position in the case, slip it down into the crankcase head.

Assemble the magneto stop on the two studs and draw the head into place with the four nuts. (Note: Draw nuts down evenly so the head will not come to rest out of line.)

Assemble the lower set of rollers in place, with the open end of the retainer toward top end of motor and lock with the spring lock. Be sure the lock is free in the groove and does not bind on the bearing. If it should bind, press the oil seal in a slight amount.

The top set of rollers is designed with a two piece retainer and can be assembled either side up. Lock in place by pressing the oil slinger down over the crankshaft as far as it will go. The groove of the oil slinger should be located on the bottom side.

Check the crankshaft for end clearance. Correct end play is .006 plus .003 or minus .001.

If the end play is not correct, the crankshaft will have to be removed and shims assembled under the top or bottom thrust washer. In the event of not enough end play, the top and bottom thrust washers will have to be filed or ground down slightly.

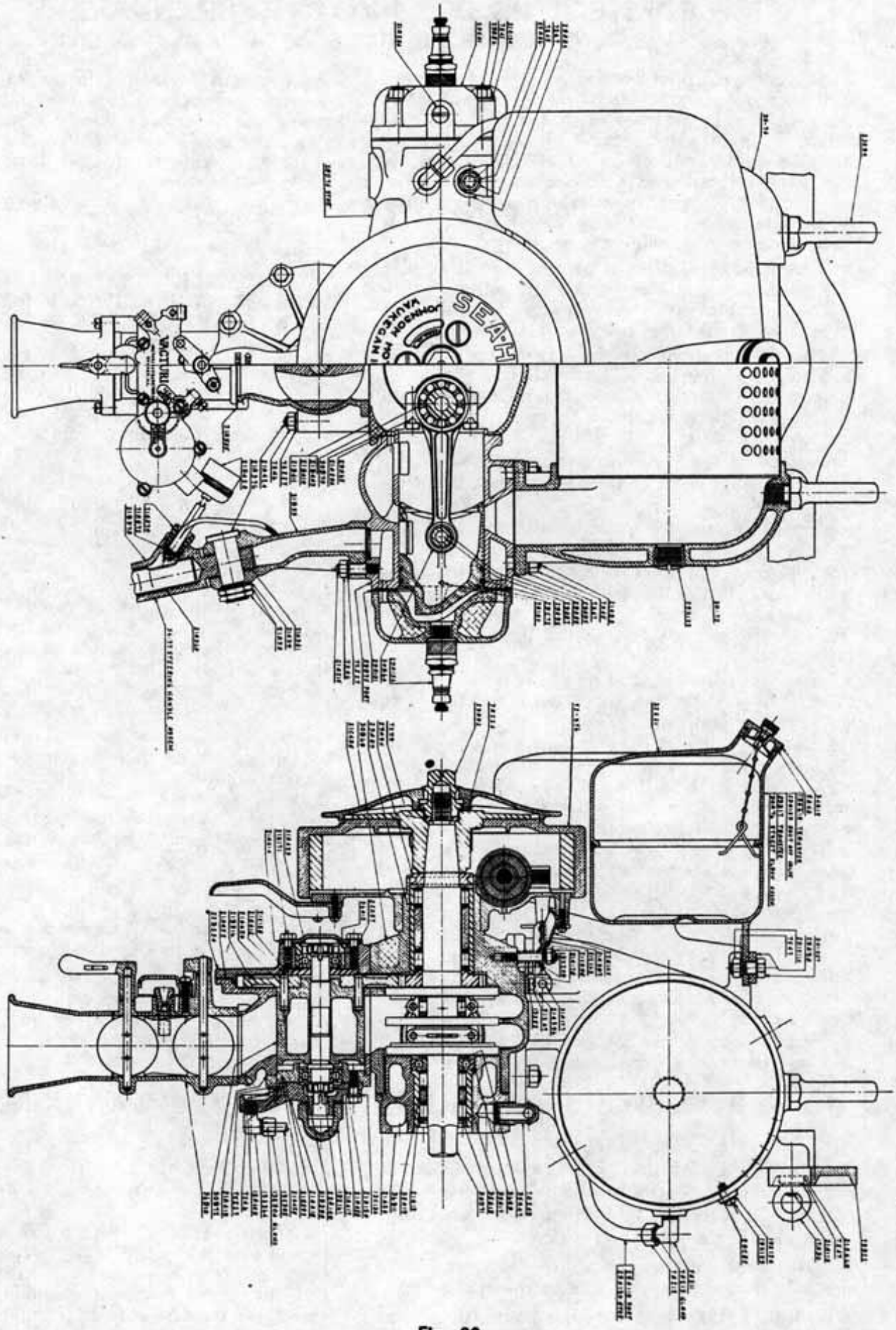


Fig. 20

ASSEMBLING CONNECTING ROD ROLLER BEARING AND CONNECTING RODS TO THE CRANKSHAFT

(For models S, SR, V, VR-45, SR, PR, VR, SE, PE and VE-50, SR, PR, VR and XR-55)

Different types of roller bearing assemblies have been used in these motors, all of which are interchangeable. The first bearing assembly used, consisted of a four piece retainer of very light construction, using long rollers. This type of retainer was manufactured with a groove machined in the center and broken in two, leaving a rough edge. When assembling, these sections should be properly matched to provide a true fit.

The second type of roller bearing, consisted of a two piece bronze retainer with short rollers, which can be assembled either way, inasmuch as, the two sections of the retainer are machined to match.

The third type consisted of a two piece steel retainer open at one end. The two halves of this retainer are also machined to match. However, care must be taken to assemble them with the open end toward the top of the motor.

Any one of these assemblies can be used in any motor although parts of the assemblies are not interchangeable.

A five section retainer, with two rollers to each section, was later installed in the PR-60.

To assemble the rollers and connecting rod to the crankshaft, place roller assembly about crankshaft and assemble the cap, rod and screws. The cap and rod are marked and should be assembled in the manner removed.

Draw the connecting rod screws down snugly, although, do not tighten them until the following has been accomplished:

Line the machined edges of the cap and rod by tapping on one side or the other, until the machined edges are perfectly in line. This is important, inasmuch as, the cap and rod act as a roller race, they must form a true circle, otherwise, serious damage is likely to occur to the rods, roller bearings and crank pins. Alignment of the connecting rod and cap can be checked by drawing a pencil point over the joined surfaces.

After this operation, tighten the connecting rod screws as much as possible, without straining the bolt, and again check the machined edges of the rod and cap, to determine if the cap has shifted out of line, when tightening the screws.

Bend the connecting rod screw locks into place, locking the screws firmly, to prevent them from working loose. Be sure the edges of the lock are down far enough to pass the crankarms without touching. **Never use old locks when repairing mottors.** The tongues are weakened, with a possibility of them breaking, resulting in damage to the motor when in operation.

(Note: Connecting rods of this type cannot be taken up in the event of wear. Usually the wear occurs on the crankshaft, necessitating a new one.)

TO ASSEMBLE THE CONNECTING ROD ROLLERS AND CONNECTING ROD TO THE CRANKSHAFT OF KR-55, 65 MOTOR

The rollers, used in the connecting rods of this motor, are of the needle type. No retainers are necessary; assemble in the following manner:

Apply a slight amount of hard oil or grease around the crank pin to hold the rollers in place. Place the rollers about the crank pin—29 to each rod.

Obtain a screw, approximately four or five inches long, that can be screwed into the threads of the connecting rod cap, and use this for placing the cap into position.

After the cap has been set in position, hold it in place with one finger, remove the long screw, assemble the screws and connecting rod. Both the cap and rod are marked with a prick punch and should be assembled so that they are properly matched. Draw the connecting rod screws up snugly; do not tighten them with force at this time.

Line the machined surfaces of the cap and rod, by tapping on one side or the other until they are perfectly lined. This can best be determined by drawing a pencil point over the joint of the two halves. After the cap and rod are in perfect alignment, tighten the connecting rod screws as tightly as possible.

Bend the locks down into place, being careful to bend them down far enough to clear the crankshaft. **Always install new locks,** as used ones will break, causing serious damage to motor.

(Note: After considerable service on motors of this type, the rods may become loosened, from excessive wear. The wear usually occurs on the crank pin and can be corrected only by the installation of a new crankshaft.)

TO INSTALL CRANKSHAFT INTO THE CRANKCASE

A-50, 65 and K-50, 65 MOTORS

After the bearings have been reamed to size, as instructed, place the shims, which were previously removed, in place on the bottom of the crankcase head, underneath the thrust washer.

Place thrust washer on top of the shims, with the ends in the slots, provided in the crankcase.

With the crankcase in the inverted position, so as not to disturb the spacer or shims, insert the crankshaft, replace the lower bearing head, gasket, nuts and washers, then draw securely into place.

Check the crank shaft for correct end play, which should be .004" to .005". If the end play is not correct, the crank case head will have to be removed and the shims removed or additional shims installed, as the case may be. Shims are supplied by the motor manufacturer in .003" and .010" sizes.

TO INSTALL CRANKSHAFT IN THE CRANKCASE

(Models S, SR-45 and SE-50, P, PR and PE-50, also 65 series.)

Insert the crankshaft. Install the gasket and the head, check for correct end play of .008" to .014".

If the end play is found to be insufficient, it will be necessary to remove crankcase head and withdraw the crankshaft. Specified end clearance can then be obtained by dressing the face of the lower journal bearing the required amount.

In case of excessive end clearance, place a sleeve or old bearing over the upper end of the crankshaft to drive the top bearing down the desired distance.

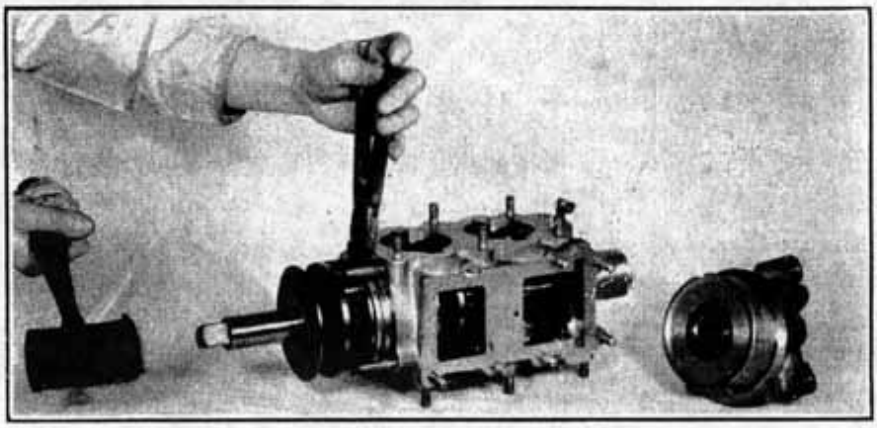


Fig. 21

TO INSTALL THE CRANKSHAFT IN CRANKCASE

(Models V and VR-45, VR and VE-50 V and VE-65)

Insert the center bearing halves in the two halves of the center head, so that the dowel pin of the head is located in the hole provided for it in the bearing. The dowel pin is used for one half of the bearing only. When assembling make certain that the bearing halves are properly matched.

Lock the two halves of the center head in place about the crankshaft center journal, with the screws provided for this purpose. Be sure the ring groove of the head is directed toward the upper end of the crankshaft.

Assemble ring in the ring groove of the center head, using tool No. S-89 to expand it, so that it will slip over the end of the head and into place. Insert the crankshaft by compressing the ring with tool No. S-90. (See Fig. 21)

When the crankshaft has been inserted far enough into the head, so that the ring is directly in line with the bottom cylinder, turn the head and crankshaft around slightly, so the teeth of the gear will pass by the dowel pin in the case and that the small groove on the outer edge of the head will line with the dowel pin in the crankcase.

Compress the ring again with tool No. S-90 and drive the crankshaft forward, until the ring slips into the groove of the crankcase.

Replace the lockscrew in order to anchor the center head. Replace the gasket and crankcase head, then secure with the nuts provided for this purpose.

Check the crankshaft for end play, which should be from .008 to .014.

If it is not within these limits, the crankcase will have to be disassembled; the top bearing and case **slightly** spot faced to obtain the desired clearance.

In the event of too much end play, the top journal bearing can be driven down to the desired limits.

TO INSTALL NEW GEAR ON THE CRANKSHAFT

(Models S, SR, V and VR-45)

Remove the old gear by drilling out the rivets, securing it to the crankshaft. Locate new gear on the crankshaft and insert the rivets in place.

Place a flat bar of metal, approximately ½" thick, one inch wide and 8 inches long, in the jaws of a large vise. The jaws of the vise should be opened slightly more than the width of the crankshaft. Place the crankshaft on the bar so that the heads of the rivets rest on it.

With a straight point punch, slightly larger than the hole in the rivet, spread the rivet by driving the punch down through the hole.

Draw the rivets snugly into place by driving down on the gear, with a sleeve or tool that can be placed over rivets.

Rivet the gear in place with a large flat punch, making sure the rivets are drawn up snugly.

TO INSTALL NEW GEAR ON THE CRANKSHAFT

(Models SE, VE, PE, SR, PR, VR and P-50, SR, PR, VR and XR-55 Including 65 Series)

Remove old gear with gear puller tool No. S-239.

Install the new gear by placing a bar under the top crankarm of the crankshaft and by pressing the gear into place or driving it on with a sleeve or similar tool. **Do not attempt to press the gear on without a support under the top crankarm;** this would spring the crankshaft. The bar should be arranged so that the pressure is directly upon the crankarm and not on the lower end of the crankshaft.

TO REPAIR AND CHECK THE ROTARY VALVE

(All Models Equipped with Gear Driven Rotor Valve)

To disassemble rotary valve, remove the top and bottom bearing cover. Clamp the top shaft nut in a vise. Leave the cotter pin in place to remove the lower nut.

Remove the rotary valve from the vise, and with a wooden or rawhide mallet, drive the rotor from the housing by striking **directly** on the end of the shaft. Clamp lower end of the shaft in a vise to remove the top nut. Hold the gear in one hand and drive the shaft through it with a mallet. Place the rotor and shaft between the centers of a lathe and check with a dial indicator for alignment.

Straighten by prying against the rotor with a bar, until indicator shows a true alignment.

It is not advisable to enlarge the openings of the rotor by filing, as, this will change the timing of the opening and most likely interfere with efficient operation of the motor.

Do not machine any metal from the outside surface of the rotor, as the clearance will then become great enough to create a loss of crankcase compression and result in blow back through the carburetor.

TO TIME THE ROTARY VALVE

Remove spark plugs from the cylinder heads and insert a narrow steel scale through one of the spark plug holes (four cylinder motors time from the top cylinder) so that it will come to rest on the top of the piston.

Slowly turn the flywheel, **in the direction in which motor operates,** until the piston reaches top dead center and has travelled down the following distance past dead center:

½ inch on Sea Horse "16", "32" regular motors.
11/16 inch on Sea Horse "16", "32" and "50" racing motors.
9/16 inch on Sea Horse "24" regular motors.
¾ inch on Sea Horse "24" racing motors.

The letter "J" stamped on the rotary valve gear should appear in the inspection hole of the rotary valve cover. If it does not, remove the rotary valve assembly and turn the rotor until the "J" appears, then replace in this position making certain the fly wheel has not been turned.

After installing the rotary valve, it should be checked again to be sure that the piston is the correct distance on the downward stroke when the letter "J" appears in the inspection hole.

TO CHECK AND ADJUST ROTARY VALVE GEARS FOR PROPER CLEARANCE

Remove the inspection plug from the rotary valve cover.

With a sharp pointed tool, inserted through the inspection hole, move the gear back and forth to determine the amount of back lash or clearance necessary to prevent the gears from binding. Turn the flywheel of the motor to check the gear at points of about every other tooth to check for high spots.

If the gear is found to be slightly off center and with no back lash at the high point, remove the rotary valve assembly and insert one or more .00 shims, required for proper clearance (.002-.003) on the high side of the gear.

When installing the rotary valve, follow above instructions "To Time the Rotary Valve."

STARTER GENERATORS ON ELECTRIC MODELS

Unless you are thoroughly acquainted with the principles of the starter generator, no attempt should be made to repair this unit. The complete assembly should be removed from the motor and delivered to the manufacturer. The Owen-Dyneto Corporation, Syracuse, New York, or to one of their various service stations.

TO REMOVE UNIT

Following are instructions for removing the unit, checking for electrical difficulties and timing of the ignition:

Remove the cover by loosening the clamp screw, raise the cover sufficiently to enable you to disconnect the spark advance control wire from the breaker assembly, then lift the cover clear.

Remove the breaker assembly. Disconnect the coil wires from the breaker plate. Remove the screws and clamps which hold the leads in position on the breaker plate and field frame. Remove the six small screws, holding the breaker support in place on the field frame. The breaker assembly unit is then free to be lifted off.

Remove the pulley used for hand cranking. This pulley is attached to the armature by means of a split sleeve, threaded into the armature hub and tapered to fit a taper plug, serving to lock the pulley in position on the armature. To remove the pulley, loosen the nut on the stud projecting from the center of the starting pulley, tap the end of the stud lightly, driving it downward to release the taper plug. After the taper plug has been driven loose, the pulley may be unscrewed. The pulleys on later models, were secured by six screws. To remove the pulley, simply remove the screws and lift off.

Remove the brush ring assembly. Take out the three screws holding the brush ring in place on the field frame. Remove the two terminal stud nuts, which connect the main brushes to the series field coil and to the ground. Disconnect the shunt field coil lead from the regulator unit.

To remove the armature. Remove the nut, holding the armature in place on the crankshaft, with a socket wrench. The armature can then be drawn from the shaft by using the puller supplied in tool kit of the motor.

To remove the field frame. The field frame held in position on the crankcase by means of four machine screws. Upon removal of these, the field frame can be lifted from its mounting.

STARTER SWITCH

The starting switch is of the three position slide bar type, "off", "neutral" (or ignition only) and "on" position.

"Off" is the position in which the switch normally rests when the engine is not running. (See Fig. 22.)

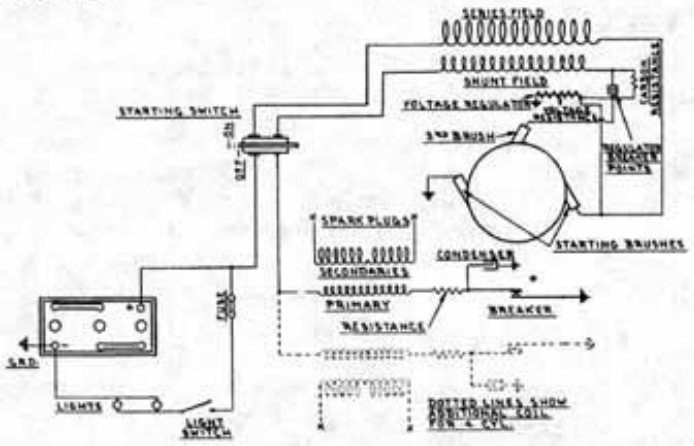


Fig. 22

"Neutral" is the position in which the bar is moved approximately 3/16" from the "off" position with ignition on only. This completes the ignition circuit and permits operation of the engine without functioning of the generator. This feature is desirable for hand cranking and for speeds of the motor below 1000 R. P. M., at which point the unit will not generate, but operate as a motor, thereby discharging the battery.

"On" position is the normal starting and running position. Recharging the battery as the motor is in operation.

The starting switch is held in position on the mounting bracket by four size 10/32 screws, lockwashers and nuts. To disassemble the switch for examination of the contacts, etc., remove the four screws.

STARTER FAILS TO CRANK MOTOR

To locate electrical difficulties if the starter fails to crank the engine when the switch is in "on" position:

First check the battery to determine if it is fully charged.

Second, inspect the battery cables and cable connections, both at the battery and starting switch. See that all connections are free from corrosion and securely fastened.

Third, check the starting switch. Remove the battery cable from the terminal on the starting switch and short it to the switch terminal of the large cable, running from the motor generator to the starting switch. If the starter generator then turns the engine over, the difficulty will be found in the switch. If doing this fails to crank the engine, and shunting the contacts fail to produce a spark, the difficulty lies elsewhere.

Fourth, check the cables and cable connections between the starting switch and the generator.

Fifth, check the brushes. Remove the generator cover and examine the brushes to make certain they are making proper contact with the commutator and that all brush connections are tight.

Sixth, check the generator ground connection by shorting the battery cable to the grounded main brush terminal. A hot spark will indicate a good connection.

If the unit still refuses to crank the engine after these tests have been made, it is an indication of internal difficulty. The unit should then be taken to an official Owen-Dyneto Service Station for inspection and repairs.

IF THE STARTER GENERATOR DOES NOT GENERATE:

First, remove the cover to inspect the regulator points, which should be closed.

Second, examine the brushes to see that they are free in the holders, are making proper contact with the commutator, and that all connections are tight.

Third, check the small cable from the generator to the switch, also terminal connections of this wire.

Fourth, check the starting switch by using a small piece of wire and bridging across the switch terminals of the generator cables. Should the unit generate with this bridge installed, the difficulty is in the switch, if the unit does not generate, it should be tested by an Owen-Dyneto Service Station for internal generator difficulty.

If the starter generator cranks the engine, but the engine will not start, first check the gas supply in the carburetor.

Second, check the ignition. Turn the starting switch to the "on" position, remove one spark plug wire and hold it a short distance from the plug. The spark should jump a ¼" gap. If the spark is good, the plugs may be fouled or the fuel supply obstructed. If there is no spark, remove the cover from the generator and examine the breaker points to see whether or not they are making contact. If the points are making contact and are found to arc, it is an indication that the primary circuit is complete, but that the coil or condenser may be broken down and should be replaced. Check for broken connections or wires and poorly soldered terminals.

TO TIME THE MOTOR, retard the spark until the mark on the breaker plate and the one on the breaker plate support are in line.

Remove the spark plugs.

Turn the engine over until the pistons are on the outer dead center. (Four cylinder motors, time from top cylinder and forward breaker.) Loosen the cam nut and turn the cam in the direction of motor rotation, until the breaker points **just start to open.** Tighten cam securely in this position. Replace the spark plugs and connect the wires. Check the breaker points opening, which should be .020 when fully opened. If the points need readjusting, loosen the breaker screw and move the breaker toward or away from the cam until the correct point opening is secured.

Note: All Owen-Dyneto Starter Generators are

tested before leaving the factory and should perform with the following data:

As a Motor	R. P. M.	Lbs. Torque	Volts	Amp.	As a Generator	R. P. M.	Lbs. Torque	Volts	Amp
Stalled	0	27	5.5	290	Cut in	1000		6.3	0
Cranking	400	4	6	65	Maximum amperes	2500		7.6	16
					Maximum speed	4500		7.4	13

LOWER UNITS

TO INSTALL WATER TUBES IN THE DRIVESHAFT CASINGS

(Models J-25, J-65, A and A-25)

Remove old tubes from the driveshaft casing by heating the top part of the casing with a torch until the solder around the end of the tube melts: thus allowing the tube to be pulled free from the casing.

Insert the new tubes and hold in position by putting the nut on the lower end, protruding through the casing. Drive a bar of metal or wood down through the center of the casing, to force the tubes against the walls of the casing, so that the driveshaft will not strike them. Be careful to not use a bar of too great thickness for this purpose, as it will flatten the water tubes.

Heat the flange with a torch until it is hot enough to melt the solder. Apply soldering acid around the tubes and run the solder into place, by holding it against the tube and casing, allowing it to flow around the tube, completely sealing it.

Saw off the protruding ends and file flush with the surface of the flange.

TO ASSEMBLE WATER TUBES IN DRIVESHAFT CASING

(All Models except A and K-50, 65, OA and OK)

Remove the old water tubes, by tapping on the end of them with a small flat punch. (This will break the ends loose from the ferrule and casing). Drive the tubes down into the center of the casing, where they can readily be removed. Care must be taken, in this operation, to not damage the machined taper of the casing. Injury to the machine taper will result in the inability of obtaining a water tight connection when installing the new tubes.

After the old water tubes have been removed, twist an old round file down into the ferrule, clamp the file in a vise and remove the ferrule by striking the casing with a mallet until it breaks loose.

Press the new water tubes down through the center of the casing and through one of the holes in the end of the casing, then back through hole in the opposite end.

Slip ferrules down over the protruding ends of the water tubes and into place in the casing. With an improvised tool or sleeve, the size of the ferrule, slipped over the end of the water tube, drive the ferrule snugly into the taper.

Saw off the protruding ends flush with driveshaft casing. Place counterbore (Note Tool No. S-152 for use on driveshaft casings of all A and K Motors, Tool No. S-151 for all S, V, P and XR Motors) in a drill press. Place a block of wood on the drill press table, in such a manner, that the driveshaft casing can be supported, with the end of the water tube directly in line with the counterbore. Clamp the casing in place and run the counterbore over the tube, facing it down to within ¼" of the ferrule.

Force the water tubes against walls of the casing so the driveshaft will not strike them while the motor is in operation.

To properly do this, design a long round piece of wood that can be driven down through the center of the casing. Do not make it too large as it will flatten the water tubes when pressed through.

Remove counterbore from the drill press and place the spinning tool No. S-152 or S-151 (Note: These tools are supplied in sets consisting of counterbore and spinning tool) in the drill chuck. Apply a few drops of cylinder oil to the end of the water tube; roll the end of the tubes down over the ferrule with the spinning tool. This operation will spread the water tube and ferrule snugly against the casing.

Test the water tubes for leakage by closing one end and applying air pressure through the other; at the same time submerging the casing in water. (Hot preferably). If the tubes leak, it will be necessary to respin them slightly with the spinning tool.

NOTE: The spinning in of new water pipes, so as to be absolutely water tight, is a difficult job and had best be done at factory.

TO STRAIGHTEN DRIVESHAFT CASINGS

(J-25, J-65, A and A-25 MODELS)

Driveshaft casing for these models are manufactured of bronze tubing and may be sprung, due to striking a submerged obstacle, when in operation.

Remove the power head from lower unit.

To straighten the casing, make two "V" blocks of hard maple. Place one at each end of the casing and strike directly between the two ends, with a mallet. This will spring the casing back to its original shape. If sprung near the upper flange, a new driveshaft casing is in order.

STERN BRACKETS

Very seldom any difficulty is experienced with the stern brackets. However, occasionally, the clamp screws may become galled and cannot be turned in threads of the bracket or the tilting tubes. On the smaller motors, they may become so badly corroded as to be difficult to remove.

When the clamp screws become galled and cannot be readily turned in the threaded section, apply a very light or penetrating oil to the threads and work the screw back and forth until it breaks loose and can be removed from the bracket. After the screw has been removed, retap the threads, apply grease to the threads of a new screw and install.

REMOVING TILTING TUBES

To remove tilting tubes on models J-25, J-65, A, A-25, A-35, A-45, K-40, KR-40, K-45, P-30, P-35, P-40, PR-40 and P-45, use tool No. S-40. Remove the screws holding the tilting tube to the bracket, loosen swivel bracket clamp screw, insert this tool in the end of the tube and drive it out by striking on the end of the tool with a heavy hammer.

TO DISASSEMBLE THE LOWER UNITS ON MODELS

(Models J-25, J-65, A and A-25)

Remove screws holding the driveshaft casing to the gearcase. Clamp the top section in a vise and twist the gearcase back and forth until it pulls free from the casing. If it refuses to break loose, carefully tap around the casing, next to the gearcase, with a small hammer.

Loosen the locknut located on the side of the gearcase and next to the pump to remove the set screw holding the pump in position.

With a small mallet, drive the pump around until the water intake is on the side of the gearcase; then by striking on the lower edge of the pump intake, drive the pump upward and out of the gearcase. Occasionally the pump is loose enough to be removed by hand.

Remove the two screws from the gearcase head and pull it off. Withdraw the propeller shaft. Turn the bevel gear over, with teeth upward, to slip it past the pinion gear and out of the gearcase.

If the bearings are badly worn, necessitating new ones, proceed as follows:

To remove the propeller shaft thrust bearing, loosen the nut on the set screw. This screw anchors the bearing in position. Remove the bearing by inserting a small rod through the adjusting screw hole to drive it out. (Located at the end of the case).

To remove the driveshaft from the gearcase, spread the spring retainer at the lower end of the shock-absorber, slip it down and out of the groove. (Note: Some of the first motors manufactured were not equipped with shock-absorbers). Drive the pin out, located underneath the retainer, then remove the upper part of the driveshaft and shock-absorber from the lower end of the driveshaft.

Press the lower driveshaft down into the gearcase. Spread the spring retainer with a screw driver and slip it up on the shoulder of the gear. Drive the pin out with a small punch. If the pin is in very tightly and there are possibilities of springing the shaft or bearings out of alignment, by striking too hard on the pin, insert the curved end of tool No. S-56 through the pump hole in the gearcase, and turn it in a position so that the gear rests on the curved end. This tool will support the gear while driving out the pin. When in position on the gear, clamp the other end of it very tightly in a vise, in a position so that the opening of the gear case will be directed upward. With this tool supporting the gear, drive the pin out.

After the pin has been removed, the gear can be slipped from the end of the pinion shaft and the shaft removed from the bearings.

To remove upper driveshaft bearing from the gearcase, place tool No. S-55 in a vise. Slip the top bearing over the hooked end, and strike upon the gear case with a mallet until the bearing has been driven out. (See Fig. 23).

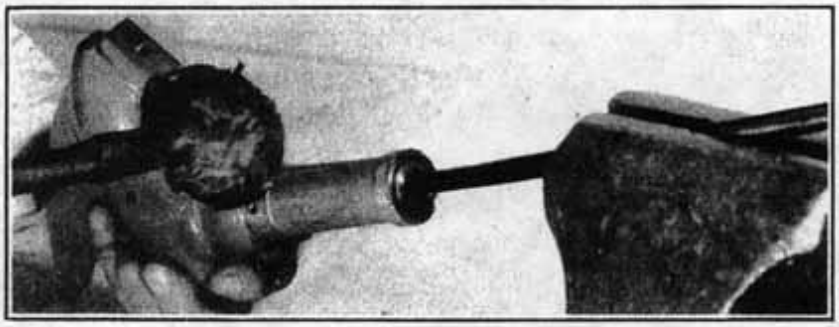


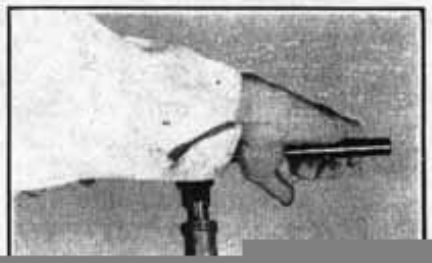
Fig. 23

To remove the lower driveshaft bearing, use tool No. S-44 for "A" Motors up to A-25. (These motors have a smaller driveshaft than the others). Tool No. S-57 for J-25 and A-25 Motors. Drive the bearings down and out of the gearcase.

INSTALLING NEW BEARINGS IN THE GEARCASE

(Models J-25, J-65 and A-25)

After the old bearings have been removed, place a new upper driveshaft bearing on tool No. S-41. Slip the tool down through the gearcase, place the lower bearing and threaded bar in position, inside of the gearcase. Turn the handle of the tool to the right, screwing down into the threaded bar, at the same time pulling both bearings into place. (See Fig. 24A).



To install thrust bearing, press it into place, making sure the flat surface is toward the open end of the gearcase. Lock it into place with the set screw, located on the top of the case and forward of the pump.

To ream the propeller shaft and thrust bearing, use reamer No. S-18. (Note: This reamer is ground from .002"-.003" larger at the end than at

sleeve (next to brass cone) in a vise, close the vise until it presses the cone out of the sleeve. Drive the pin out with a small punch and remove assembly from the vise. Slip the cone and sleeve up the shaft to remove the small pin at the end of the drive shaft. This will allow all parts to be removed from the shaft.

Inspect cone and sleeve; if found to be rough and pitted, lap the cone into the sleeve with a very fine valve grinding compound, until all high spots have been removed and a good seat formed. (Note: High spots on the cone will cause the shock absorber to slip. A galled or rough cone will cause it to stick.)

To assemble the shock absorber, slip the cone over the shaft; then place the sleeve, spring and cup washer on the shaft. (Note: If the spring is weak and the shock absorber has a tendency to slip when the motor is rapidly accelerated, place a washer, part No. 13-508 back of the spring to increase the tension).

Pack the inside of the sleeve with grease, and insert the bushing. In the same manner as when disassembling, clamp the assembly in a vise and compress to insert the pin in the cone. With a small riveting hammer, slightly roll the edges of the holes down over the pin so that it will not work out.

Remove the shock absorber from the vise to install the large pin. Make sure the flat side of the pin is toward the lower end of the assembly so that the lower driveshaft will be properly located.

Clamp bushing of the shock absorber tightly in a vise, and with a wrench, grasp the driveshaft and turn until the cone breaks loose from the sleeve. If properly adjusted, the unit should slip when enough force is applied. This operation is necessary, as when assembling the unit, the pressure applied to it by clamping in the vise may cause the parts to stick and, unless broken loose, will not function properly. (See Fig. 27).

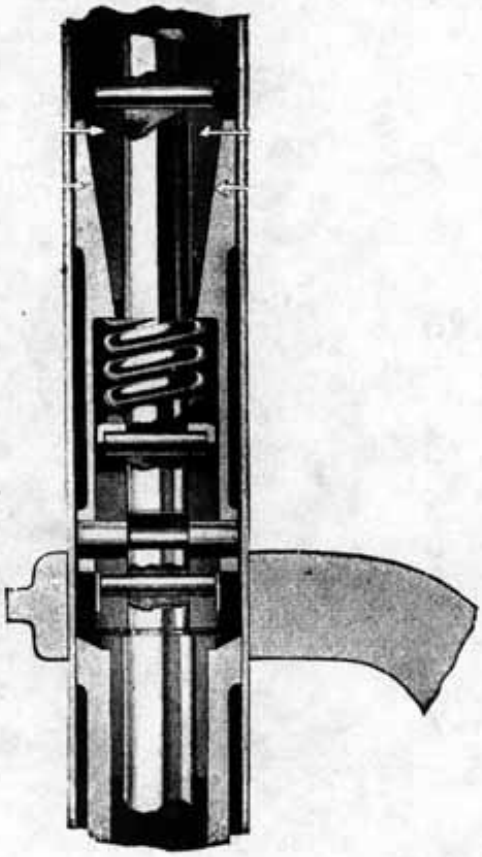


Fig. 27

REPAIRING WATER PUMPS

(Models J-25, J-65, A and A-25)

Failure of water pumps to function properly, can be determined by the flow from water outlet, located on the rear side of the driveshaft casing. If water does not flow from this outlet, when the motor is operating, the difficulty may be due to valve leaks, an excessively worn plunger, or possibly an inactive plunger, due to corrosion, a broken or worn plunger spring. Sand will also cause considerable difficulty and will have to be cleaned out.

To correct this difficulty, remove the pump from the gearcase. Check the plunger, by working it in and out of the casing, to determine if it is free and does not bind. If it is found to be binding, ream the casting with reamer No. S-16. Check the plunger with 1" micrometers to determine if it is out of round. True the plunger by carefully filing the high spots with a **very fine** mill file.

Check the plunger for water leakage by holding the pump assembly under water and work the plunger back and forth until the pump is filled with water, then remove it and by holding the water outlet closed, force the plunger in as far as possible. If there is too much clearance between the plunger and casting, the water will flow quite rapidly past plunger. The only remedy in this case is a new plunger or body.

To check the valves for leaks, proceed in the same manner. If the valves leak, water will flow by them when pressure is exerted on the plunger.

The best method, of grinding the valves is to acquire an old pump cap, and drill a ¼" hole directly thru the center.

Remove the caps and valves from the pump to thoroughly free them of sand and corrosion.

Place a small amount of **very fine** grinding compound on the seat of the valve and drop it into place.

Screw the drilled out cap into place over the valve, and with a small screw driver, insert through the ¼" hole, turn the valve back and forth until a perfect seat has been formed. Then remove the cap and valve to thoroughly clean before assembling.

Quite often, motors are operated over considerable periods without refilling the gearcase, thus allowing water to accumulate, rusting the eccentric on the bevel gear. When this occurs, a groove will

rapidly wear through the bottom of the pump plunger, necessitating a new one. To overcome this rapid wear, remove the bevel gear from the gearcase and polish the eccentric until all pits have been removed. If the rust pits are too deep, to be removed, a new gear should be installed.

When locking the pump into place in the gearcase, **do not tighten the set screw with force;** this will spring the pump casting, and interfere with the free action of the plunger.

GEAR ADJUSTMENT OF THE LOWER UNIT

(Models J-25, J-65, A and A-25)

To properly adjust the gears of this lower unit, loosen the set screw, holding the thrust bearing, located near the base of the water pump. Loosen the adjusting screw lock nut, (located at the end of the gearcase) and turn the adjusting screw to the right, until the gears mesh close enough to lock. Release the adjusting screw approximately ½ turn; tap lightly on the end of the propeller shaft with a rawhide mallet and check for gear mesh. (See Fig. 28).

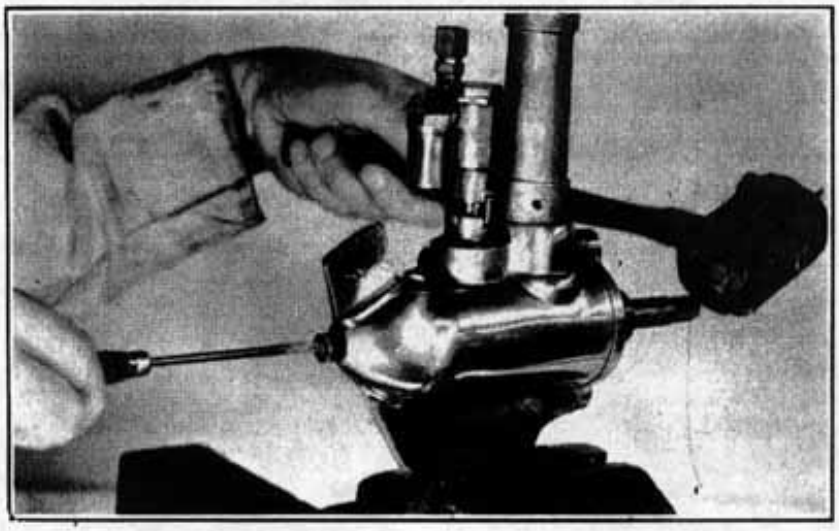


Fig. 28

Should the gears be found to drag or bind, further, release the adjusting screw approximately ¼ turn. Strike the end of the propeller shaft, to drive the bearing back to the new setting of the adjusting screw, before proceeding to check the gear mesh.

The gears, when properly adjusted, should operate freely, with no trace of drag or bind and should mesh with a minimum amount of back lash.

Having adjusted the gears, draw up lightly on the set screw, anchoring the thrust bearing, lock in position, by tightening the lock nut. Draw up on the lock nut to secure the adjusting screw.

(Important: Do not draw up too tightly on the thrust bearing anchor screw in order to prevent distortion of the bearing).

The gearcase should be filled with a gear lubricant. (Ironsides "L" preferrably or "Mobile No. 4").

Care should be taken not to fill the gearcase too high as the excessive gear lubricant will most likely interfere with the action of the pump plunger, resulting in inefficient cooling of the motor.

TO DISASSEMBLE LOWER UNIT

(Models A-35, and 45, K-35, 40 and 45, KR-40, P-35, 40 and 45, PR-40 and A and K-50 and 65)

Remove the gearcase head and withdraw the propeller shaft, bevel gear and shock absorber assembly.

Remove gearcase from the driveshaft casing, by taking out the two bolts holding the assemblies together.

Push the pinion shaft down into the gearcase. To remove the pinion gear, slip the retainer up on the shoulder of the gear to drive the pin out; the gear and pinion shaft can then easily be removed.

TO INSTALL NEW BEARINGS IN GEARCASE

(Models A-35, 45, 50 and 65)

Remove the old bearings in the following manner:

Thread the upper driveshaft bearing with the tap supplied with tool No. S-76.

Arrange tool No. S-76 in position to pull the upper bearing, by first screwing the nut to the top of threaded section of the bolt, place the bushing over the threaded end, protruding.

Screw the threaded end of the bolt into the top bearing, previously tapped. Remove the bearing by drawing up on the nut.

After the top driveshaft bearing has been removed, drive the lower bearing down and out of the gearcase with tool No. S-57.

To install new driveshaft bearings, slip the upper driveshaft bearing over the threaded shaft on tool No. S-54. Insert the tool down through the gearcase, then place the lower driveshaft bearing on the threaded end. Place the threaded bar on the end of the shaft to pull the bearings into place by turning the handle of the tool to the right.

Ream the bearings to size by first running burr reamer No. S-30 completely through both bearings. Ream the upper bearing with line reamer No. S-25.

After the upper bearing has been reamed, pass the line reamer No. S-26 down through upper bearing to ream the lower bearing. (Note: Do not turn reamer when passing it through the upper bearing, as it will ream this bearing oversize).

Should the propeller shaft bearings require re-

placement, due to insufficient lubrication over long periods of service, remove the thrust bearing from the gearcase head, by simply loosening the thrust bearing anchor screw; the bearing then can easily be removed and replaced.

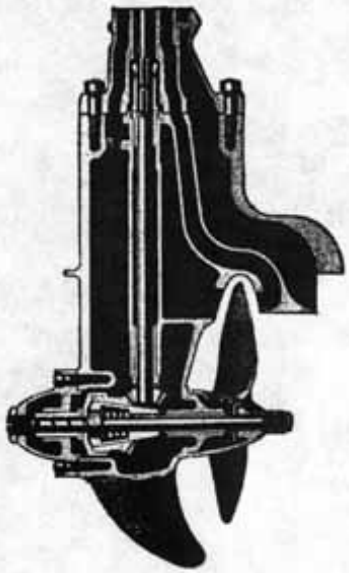


Fig. 29

The propeller shaft bearing should be pressed out and replaced by inserting tool No. S-35 through the open end of the gearcase, to act as a gauge when inserting the new bearing. (Note: Press the new bearing in until it rests snugly on the surface of the gauge).

Assemble the gearcase head to the gearcase, pass the burr reamer No. S-27 through both bearings to remove the burrs before proceeding to line ream with reamer No. S-31.

Remove the gearcase head, adjust the bell reamer No. S-28 to approximately .0015" above the reamed size of the propeller shaft bearing. Bell ream from inside about half the length of the propeller shaft bearing only, to allow for proper alignment and sufficient lubrication.

Reassemble and adjust the gears as previously instructed.

TO INSTALL NEW BEARINGS IN THE GEARCASE

(Models K-35, 40, 45, 50 and 65, P-35, 40 and 45). (See Fig. 29).

To remove upper driveshaft bearing, use tool No. S-32 for K-35, 40, 45, 50 and 65. Tool No. S-79 for P-30 and 35, 40 and 45. (See Fig. 30).

To remove lower driveshaft bearing, use tool No. S-47 for K-35, 40, 45, 50 and 65. Tool No. S-38 for P-35, 40 and 45.

To replace upper and lower driveshaft bearings, use tool No. S-46 for all K-35, 40, 45, 50 and 65, P-30 and 35, 40 and 45. (See Fig. 31).

To remove propeller shaft bearing, press out with tool No. S-48, for K-35, 40, 45, 50 and 65.

Press out with tool No. S-43 for P-30 and 35, 40 and 45.

To remove thrust bearing, simply loosen the thrust bearing anchor screw and withdraw.

To replace the propeller shaft bearing, use gauge S-61 and tool S-48 for K-35, 40, 45, 50 and 65.

Use gauge No. S-37 and tool No. S-43 for P-30 and 35, 40 and 45.

To ream driveshaft bearings, use burr reamer No. S8-1 for K-35, 40, 45, 50 and 65.

Use burr reamer No. S-21 for P-30 and 35, 40 and 45.

To line ream driveshaft bearings, (upper and lower) use reamer No. S7 and 8 for K-35, 40, 45, 50 and 65.

Use reamer No. S-22 and 23 for P-30, 35 and 40.

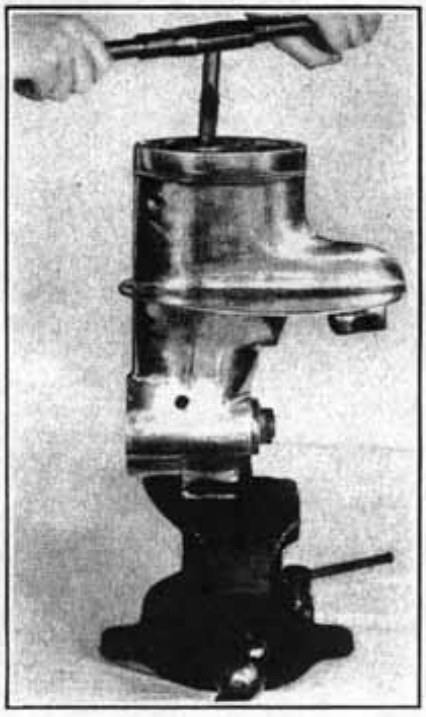
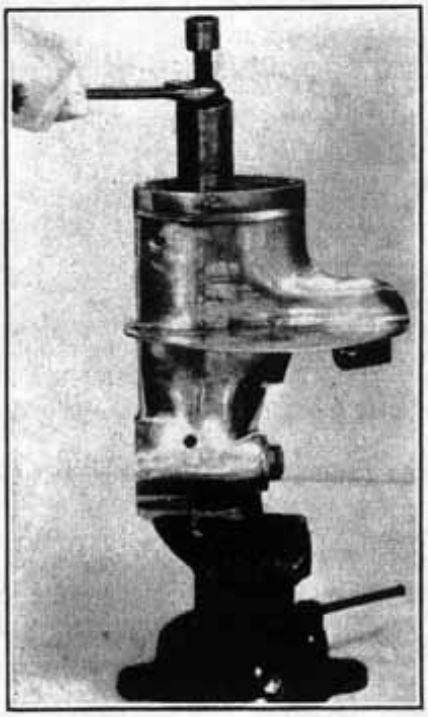


Fig. 30



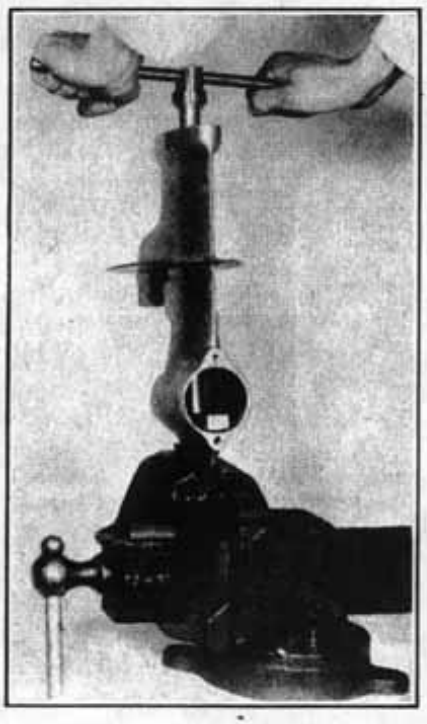


Fig. 31

To ream propeller shaft bearings, use burr reamer No. S-11 for K-35.

Use burr reamer No. S-21 for P-30 and 35, 40 and 45.

To burr ream propeller shaft bearing use burr reamer S-11 for K-35, 40, 45, 50, 65, burr reamer S-21 for P-30 and 35, 40 and 45.

To line ream propeller shaft bearings, use line reamer No. S-9 for K-35, 40, 45, 50 and 65.

Use line reamer No. S-24 for P-30 and 35, 40 and 45.

Bell burr ream propeller shaft bearing only, use bell reamer No. S-10 for K-35, 40, 45, 50, and 65.

Use bell reamer No. S-21½ for P-30 and 35, 40 and 45.

(Note: Bell ream from inside of the gearcase).

TO DISASSEMBLE GEARCASE

(All S, P, V and XR Models Except SR and PR-60-65)

Remove the two nuts mounting the gearcase to the driveshaft housing. The gearcase and pinion shaft casing can then be pulled from the driveshaft housing, and the pinion shaft casing lifted from the long studs of the gearcase. After this operation is completed, thoroughly wash the grease from the gearcase by washing in a pan of gasoline.

Remove the gearcase head by taking out the large screw holding it in place. Unscrew the large adjusting nut, located directly underneath the head and remove it. Next to the adjusting nut, will be found the propeller thrust retainer. To remove this, simply insert a screw into the threaded hole, and withdraw by grasping the screw with a pair of pliers.

Straighten the ends of the star washer holding the nut in place. Clamp the propeller end of propeller shaft in a vise to remove the nut with a socket wrench.

Drive the propeller shaft out of the ball bearing by striking the threaded end of the shaft. After the shaft has been driven far enough to clear the ball bearing, tap on the teeth of the bevel gear, driving it from the shaft. Remove the gear and extract the key. The propeller shaft can then be easily withdrawn. (Note: Make certain there are no burrs on the keyway before withdrawing the shaft, to prevent injury to the bearing surface).

To remove the pinion shaft from the pinion shaft casing, drive the pinion shaft, ball bearing and gear assembly out by striking the top end with a mallet.

Clamp the pinion shaft in a vise to remove the nut and gear.

TO INSTALL BEARINGS IN GEARCASE

(All S, P, V and XR Models Except SR and PR-60-65)

Remove the upper pinion shaft bearing by inserting tool, No. S-57 or a similar bar up through the casing to drive the bearing out.

Place tool No. S-85 on the end of the new bearing to press it into place. Line ream this bearing with reamer No. S-97.

Press out the bronze gearcase bearing on an arbor press and with tool No. S-84 press the new bearing into place, flush with the end of the gearcase.

(Note: To properly align the upper pinion shaft bearing, it is important that the pilot, furnished with the reamer, is placed in the lower roller bearing counterbore before proceeding to ream.) Line ream this bearing with reamer No. S-96.

TO ASSEMBLE SR-PR 60-65 GEARCASE

Install pinion shaft, gear and lower bearing assembly by inserting thru opening at the lower end of the gearcase housing. Press upper pinion shaft ball bearing into position.

Assemble steel needle bearings about the propeller end of the propeller shaft (23 to each row)—Hold in position by placing a rubber band around each assembly. Insert propeller shaft, far enough to permit installation of the bevel gear, thrust bearing and the necessary shims. Further insert—remove rubber bands as the needle bearing assemblies slip into place. Install spacer, lock plate, washer and nut. Draw up snugly on the nut and lock in position by bending lugs of the lock plate up and about the nut.

Assemble gearcase head gasket—screw gearcase head snugly into position by inserting a rod or punch thru the hole provided for that purpose.

Satisfactory gear mesh can be obtained by adding or deducting shims, placed between the thrust bearing and housing: When properly adjusted, the heel and toe of each gear should be flush, and adjusted with approximately .002" back lash. (See Fig. 38A).

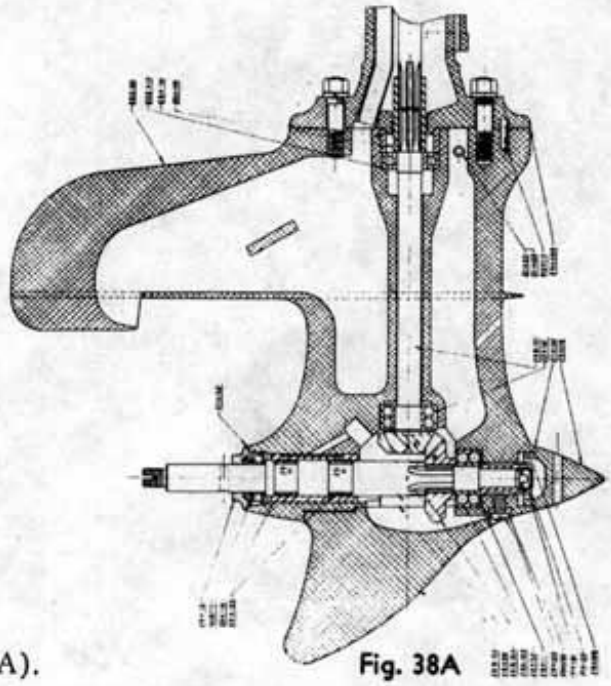


Fig. 38A

COOKE SEAL

Assemble COOKE SEAL in the following order:

1. Spring
2. Steel Washer
3. Leather Washer
4. Gasket
5. Large Brass Nut

(Note: **Under no circumstances compress the spring** before having installed the large nut. The spring should be compressed ONLY by the retainer bearing against the machined surface of the nut as it is screwed in place.)

Install skeg plate and gasket—mount securely in place, using "tite-unit" gasket compound. (See Fig. 38B).

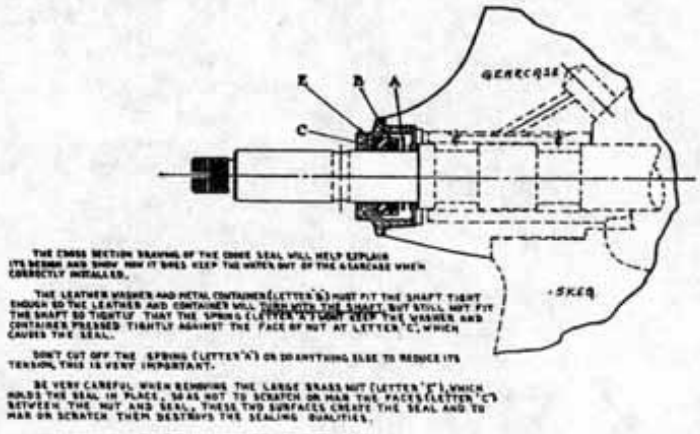


Fig. 38B

TO ASSEMBLE THE OA-65 GEAR CASE

Insert pinion shaft from the top—the pinion gear, shims, pin and pin retainer thru the gearcase head opening. Assemble pinion with necessary shims—drive in pin to secure pinion, slip pin retainer into position. Locate upper spacer, secure with pin and pin retainer ring.

Correct pinion shaft end play—approximately .004".

Insert propeller shaft and gear with spacer washers in place. Slip gearcase head and gasket over the propeller shaft protruding, and bolt in place.

When properly adjusted, the heel and toe of each gear should be "flush"—and adjusted with approximately .002" back lash. Correct gear adjustment can be obtained by inserting shims fore and aft of the propeller gear, as the case may be.

TO INSTALL NEW BEARING IN GEARCASE

(Models V-45, 65, P, PE and VE-50 and 65)

Remove the upper pinion shaft bearing by inserting tool No. S-47 up through the casing to drive it out.

Press the new bearing into place and ream with reamer No. S-95. This reamer is provided with a pilot, which should be placed in the machined counterbore, retaining the ball bearing.

If necessary to replace the bronze propeller shaft bearing in the gearcase, press it out on an arbor press.

Place the gearcase over tool No. S-101 in a position so that the pilot of the tool protrudes through the propeller end of the case.

Place the new bearing over end of the pilot; press the bearing and pilot down into place in the case. The purpose of this pilot is to maintain the bearing alignment while pressing it in, and also to prevent the case from springing, due to the pressure applied.

Ream bearing with reamer No. S-94, locating the pilot in the machined counterbore.

TO REPAIR SHOCK ABSORBERS

(Models A-35, 45, 50 and 65, OA-55, 60 and 65, K-35, 40, 45, 50 and 65, OK-55 and KR-40)

If necessary to disassemble the shock absorber, due to sticking and causing pins to shear, or to slippage, when the motor is rapidly accelerated. Place the teeth of the bevel gear upon a flat bar, with a 2" hole drilled through it, on an arbor press; press the shaft down to release the tension of the spring on the cover plate. Hold the shaft in this position on the arbor press, unscrew the cover plate with spanner wrench, No. S-78. All parts can then be removed from the propeller shaft. (See Fig. 33).

In event of the clutch slipping, lap the cone into the sleeve with fine valve grinding compound, until it forms a perfect seat, then wash thoroughly in gasoline.

When assembling the shock absorber, place a washer back of the spring, increasing the tension to prevent possible slippage. Washer No. 13-508 for A Models and No. 15-119 for K Models, equipped with the shock absorber drive.

If the clutch sticks, due to cone galling, lap the cone into the sleeve but do not place the washer back of the spring.

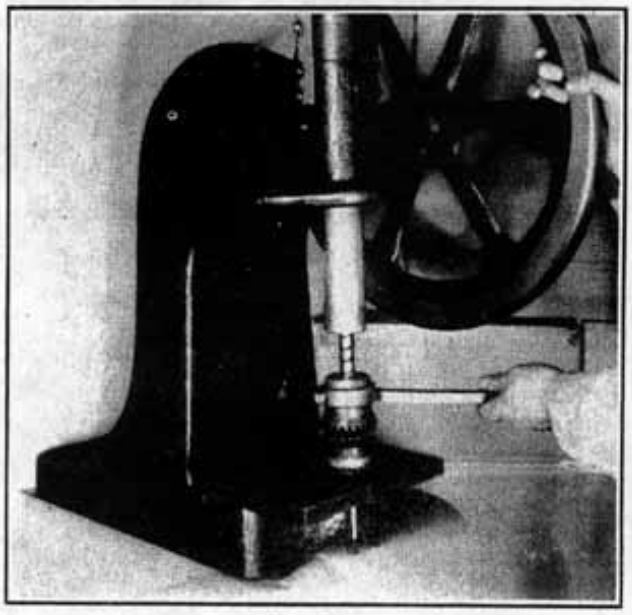


Fig. 33

TO REPAIR LOWER UNIT OF KR-55 AND 65 MOTOR

To disassemble the gearcase of this motor, remove the two nuts holding the gearcase and pinion shaft casing to the driveshaft casing. The gearcase can then be removed and the pinion shaft casing separated from the gearcase. Wash thoroughly with gasoline to remove grease.

Clamp the skeg in a vise. Remove the bronze cook seal nut located at the propeller end of the propeller shaft, threaded into the gearcase with a right hand thread. Remove the gearcase head, adjusting screw and thrust bearing retainer.

Clamp propeller end of propeller shaft in a vise and remove the nut.

Drive the propeller shaft out of the ball bearing, then by driving on the teeth of the bevel gear, with a punch, remove the gear.

After the gear has been removed, extract the key. The shaft and opposite ball bearing can then be pulled free of the gearcase.

The ball bearing located on the propeller end of the shaft is a press fit, and if necessary to remove, press it off on an arbor press.

The ball bearing on the opposite end of the shaft is a slip fit, and can be easily removed.

The pinion shaft and gear are machined of one piece and can easily be removed from the pinion shaft casing, by striking the upper end.

To replace the bronze bearing in the pinion shaft casing, remove the old one by inserting a bar up through the casing to drive it out.

Press the new bearing in place and ream to size (with reamer No. S-223).

Before assembling lower unit, place the propeller shaft and pinion shaft between centers of a lathe and check for trueness with a dial indicator.

If the shafts are found to be sprung or bent, straighten by locating the high side, and by giving it a sharp blow with a mallet, until it checks to within .0005 of being perfectly straight.

Assemble the gearcase in the reverse order from which it was disassembled, being sure that both shafts turn freely and do not bind at any point. See "Gear Adjustment" below.

GEAR ADJUSTMENT IN LOWER UNIT

(All S, P, V, XR, KR-55, 65 Models)

To obtain the most accurate adjustment of the lower unit gears, it is advisable to remove the gearcase assembly from the driveshaft housing and to bolt both sections securely together. To accomplish this adjustment, remove the gearcase head. Turn the large adjusting nut to the right until the gears lock. Then back off about ¼ turn, and by striking propeller end of propeller shaft with mallet, drive the shaft and gear back against adjusting nut. (See Fig. 34).

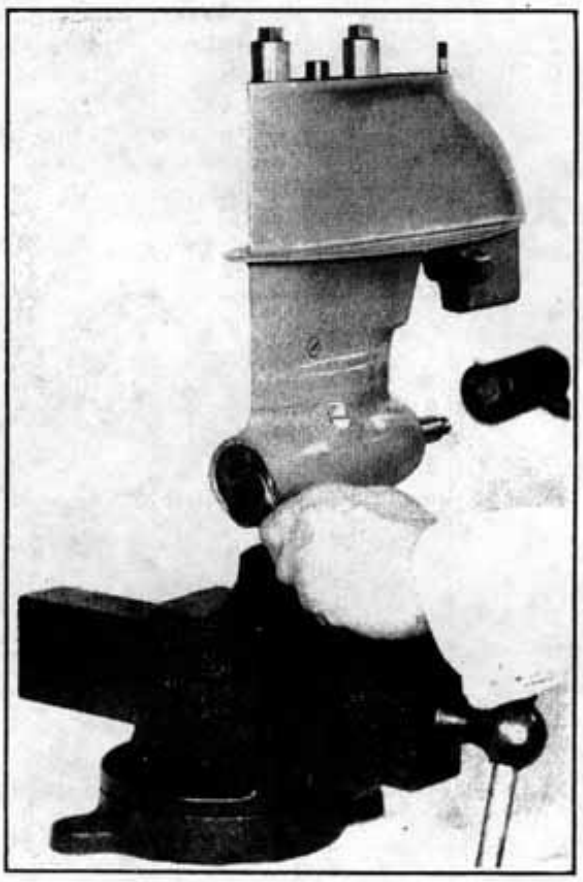


Fig. 34

Turn the propeller shaft slowly, make certain that the gears are meshed with sufficient backlash and that they do not bind or drag at any point.

If gear adjustment is too close, the propeller shaft will not turn freely, but will chatter, due to the binding gears. In this event, release the adjusting nut **slightly** to a point where the proper adjustment is obtained.

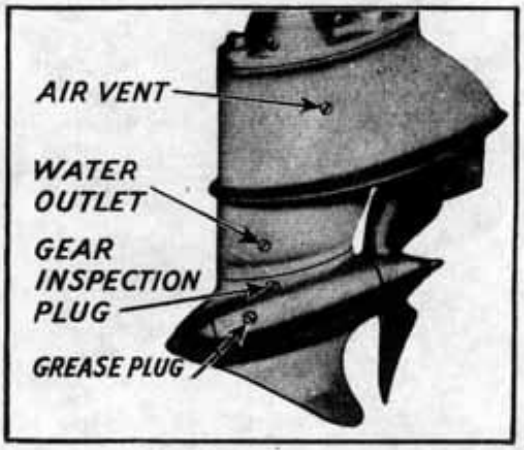


Fig. 35

Fill with Seahorse gear lubricant until grease is forced out through air vent. (See Fig. 35).

REPAIR OF LOWER UNITS ON MODELS OA-55

(Models OA-60, OK-55 and OK-60)

The water pump on these models is of the sliding vane type containing no valves. (See Fig. 36).

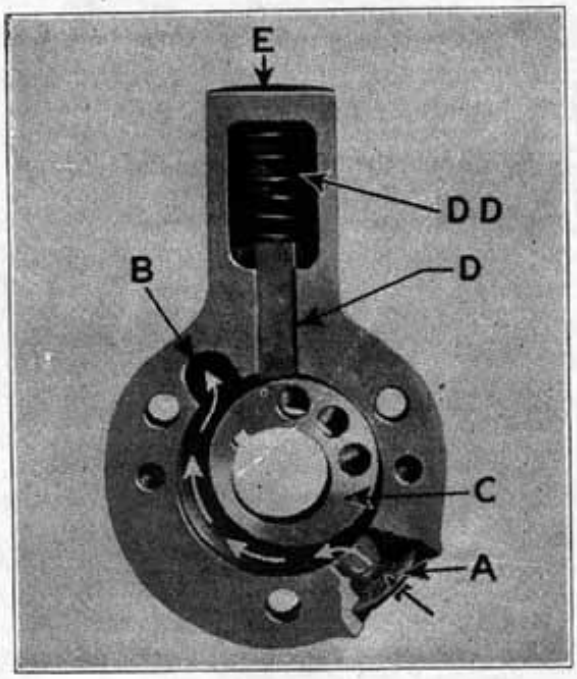


Fig. 36

The eccentric is keyed to the propeller shaft and revolves with it. Water is drawn through the inlet on the bottom end "A" and by the action of the eccentric "C" is forced through the opening at the top "B" and through the water tubes to the power head, emptying into the underwater exhaust tube.

This pump has no adjustment. The end of the sliding vane "D" may wear somewhat after long periods of service in limestone or muddy waters, resulting in inefficient water circulation. To overcome this condition, remove the vane and polish the contact surface with a fine hone so that it will properly seat on the eccentric.

When the motors are operated in salt water, the pumps should be removed periodically and all parts, especially the sliding vane, freed of corrosion and salt crystals.

To disassemble the gearcase, remove the propeller and pump, to extract the small key which secures the pump eccentric to the shaft. Remove the gear case head by removing the screws holding it in place. The propeller shaft and shock absorber assembly can then be drawn from the gearcase.

Wash the gearcase and all parts free of grease with gasoline. Press the pinion shaft down slightly, and with a screw driver, spread the pin retainer, located on the upper part of the pinion gear, slightly apart and slip it up on shaft. Drive the pin out with a small punch. The shaft can then be drawn from the gear and case.

REPLACING PINION SHAFT BEARINGS

If necessary to replace pinion shaft bearings, remove the upper bearing first, by cutting threads in it with the tap supplied with tool No. S-76 (for OA-55 and OA-60 Motors) and tool No. S-32 (for OK-55 and 60 Motors).

After the bearing has been tapped, screw the threaded section of the tool down into the bearing, then by turning the large nut down against the bushing of the tool, pull the bearing free from the case. After this bearing has been removed, drive out the lower bearing with tool No. S-57 (for OA-55 Motors) and tool No. S-47 (for OK-55 Motors).

Remove the threaded nut or bar from tool No. S-54 (for OA-55 and 60 Motors) and tool No. S-46 (for OK-55 and 60 Motors). Place a new upper bearing on the shaft of the tool and insert down through the casing. Place the lower bearing over the threaded end of the shaft, replace the threaded bar or nut. Both bearings can then be drawn into place, by turning the handle of the tool to the right, drawing up on the threaded bar or nut.

REAMING NEW PINION SHAFT BEARINGS

To ream the driveshaft bearings in the OA-55 and 60 Motors, first ream the upper bearing with reamer No. S-25, and the lower with reamer No. S-26.

The driveshaft bearings in the OK-55 and 60 Motors are of two different ream sizes, the top bearing being slightly larger than the bottom.

For reaming these bearings, one reamer is supplied, No. S-224. This reamer is designed with two sets of blades, and will ream both bearings at the same time.

PROPELLER SHAFT BEARINGS

In view of the fact that the propeller shaft, on both the OA and OK-55 and 60 Model Motors, operates on one ball thrust bearing and one plain bronze bushing, located in the gearcase head, the

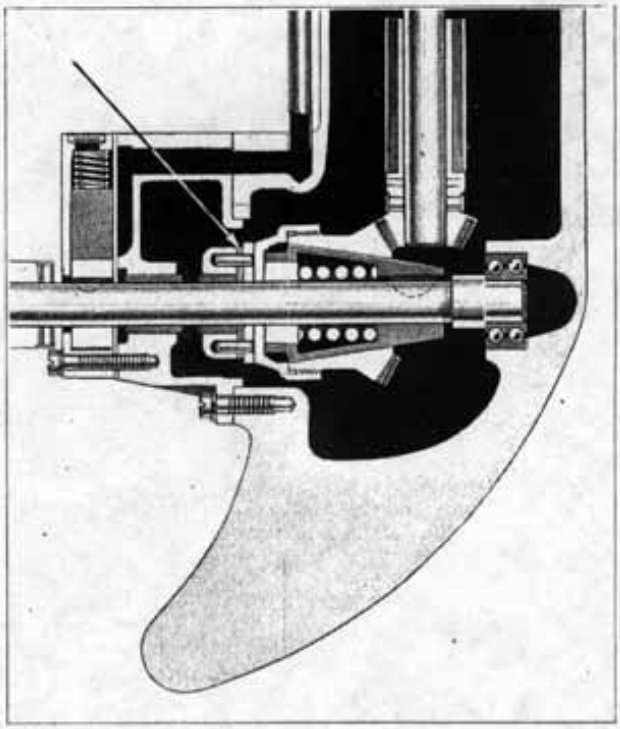


Fig. 37

bushing cannot be purchased as an interchangeable part; but as an assembly, with the gear case head, machined to size and adjusted for proper alignment. (See Fig. 37).

The cost of equipment, to the service station, for reaming and aligning this bearing, would not be justified, inasmuch as the complete assembly can be purchased from the manufacturer or the head shipped to the factory for installation of a new bearing.

SHOCK ABSORBER

If necessary to disassemble the shock absorber refer to "To Repair Shock Absorbers".
(Note: OA-60 Motor with serial numbers above 161623 and OK-60 Motors with serial numbers above 161730 are not equipped with shock absorbers.)

When reassembling the gearcase, make sure th the propeller and pinion shaft are free and do no bind at any point.

To properly adjust the gears, remove the propeller, pump housing and the gear case head, place shims as needed between the thrust washer and bevel gear in order to reduce or increase the amount of back lash. (Shims .002 and .005 thickness are listed in parts catalog under part numbers 33-50 and 33-51 respectively). Adjust the gears so that the pinion and propeller shafts will operate freely, with no indication of high spots or gear chatter and with a minimum amount of back lash.

ASSEMBLING POWERHEADS ON MODELS LS, DS, LT & DT

Below is illustrated the correct procedure for assembling the powerheads on the above models. The illustrations show each step and if closely followed, will assist considerably in assembly.

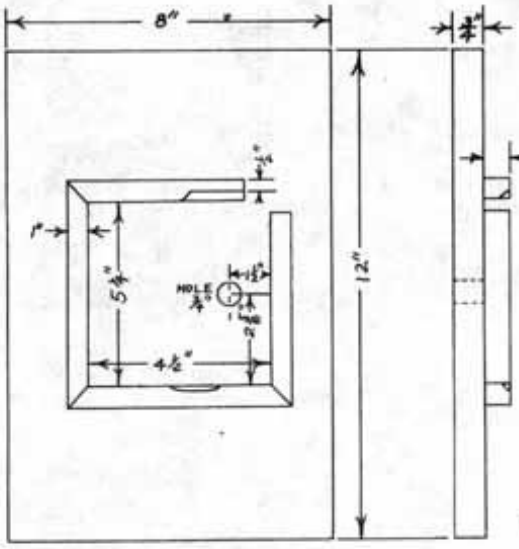


FIG 1.

1. Figure one is a drawing of the fixture used to hold the cylinder when assembling the powerhead - all of the necessary dimensions are given and it can be constructed in but a few minutes. A piece of 3/4" pine, a saw, hammer, bit and brace and a few nails is all you need to make it.

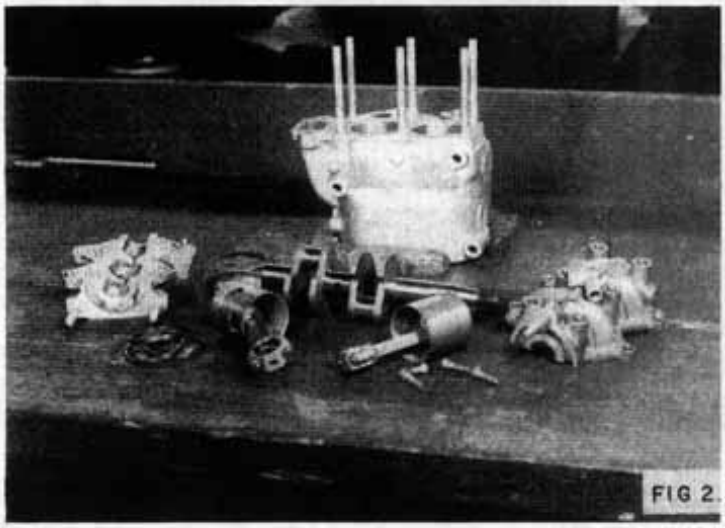


FIG 2.

2. Place cylinder in the fixture as shown in Figure two. Note - If the fixture is built according to the drawing (fig. 1) the cylinder will fit in only one way.

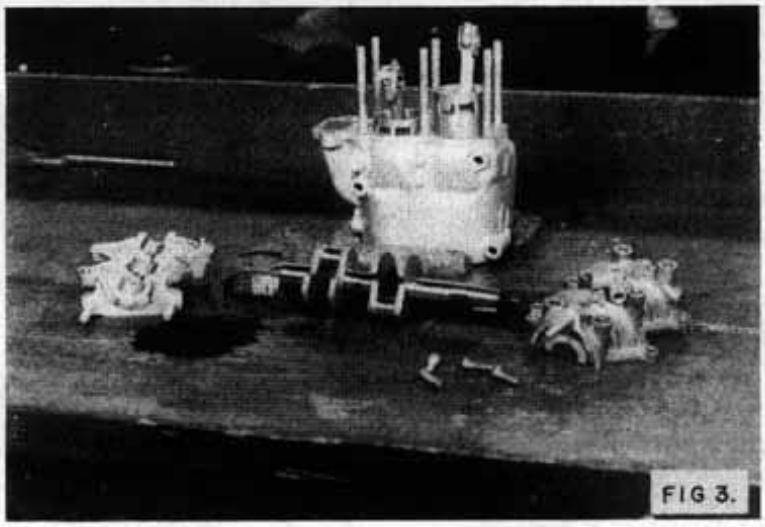


FIG 3.

3. Install piston rings on pistons. Be sure the ring grooves are free of carbon and that the rings do not bind in any manner - also, that the rings are properly seated in the ring grooves. (Recommended gap clearance is .005" to .010", groove clearance .0015" to .0025") Insert piston and rod assemblies as shown in Figure three. Note ports in piston - when inserting, same should be opposite exhaust ports in cylinder or opposite the muffler side of the cylinder as shown.

4. Install cylinder base gasket. Remove all traces of cement from faces of the crankcase sections. (unless this is done, the crankcase cannot be properly assembled) Install crankcase section as shown in Figure four.

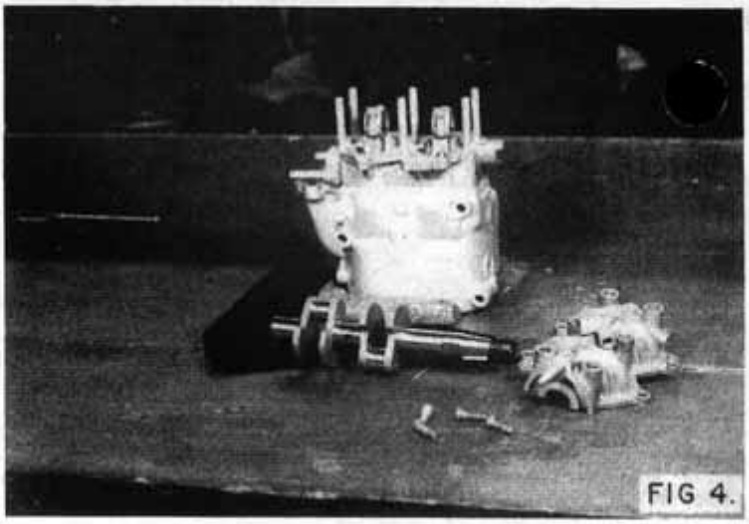


FIG 4.

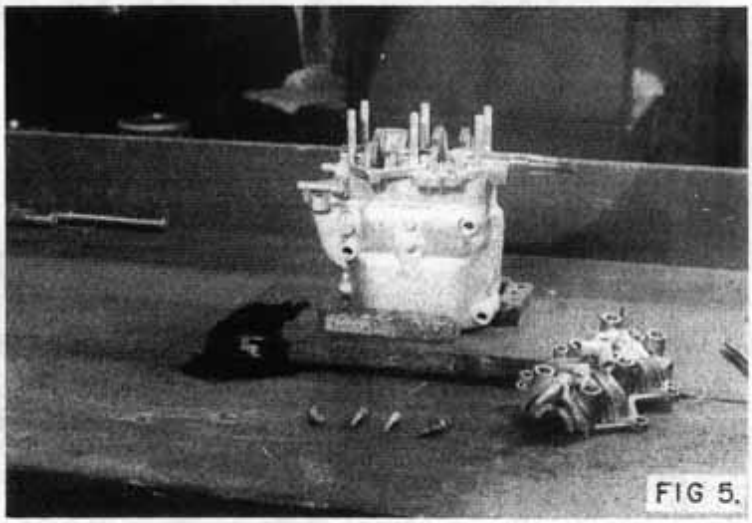


FIG 5.

5. Remove caps from the connecting rods - place crankshaft in position as shown in Figure five. (put a drop or two of oil on the bearings, crank pins and journals) Place connecting rods in position on crank pins, replace connecting rod caps and bolt down. The connecting rod bearings must be free with no indication of binding. After drawing down on cap screws, tap lightly on the side of the bearings (connecting rods) to make sure the caps are in proper alignment. Lock screws in position. (use new lock plates)

6. Prior to assembling upper half of crankcase, apply a light (thin) coat of Permatex gasket cement to each surface. (a light coat is essential - if too much is applied or if the cement is too thick, it will be impossible to maintain proper journal bearing clearance (.002" to .0025") Assemble upper half of crankcase as shown. Figure six. Replace screws, washers and nuts - draw down securely.

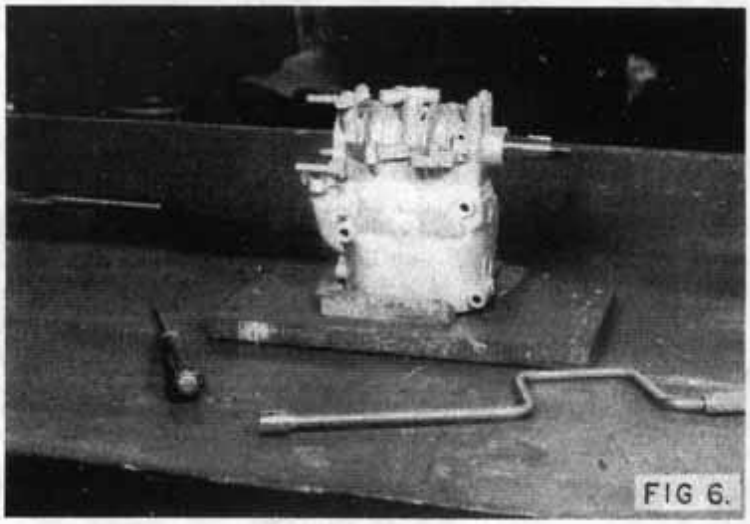


FIG 6.

7. Assemble powerhead to lower unit - install carburetor, magneto, gas tank, etc.

Note - to disassemble, remove gas tank, magneto and carburetor - remove powerhead from lower unit and place in fixture. Disassemble powerhead in reverse order from that described above.

CRANKCASE ASSEMBLY ON MODELS LS, DS, LT, DT, AT, TS, TD, HS, HD and HA

Since there are no gaskets between the crankcase sections for the above models, it is extremely important that the surfaces of both halves are properly cemented when assembling. These surfaces are very accurately machined but must rely on a thin film of cement to guard against loss of crankcase compressions.

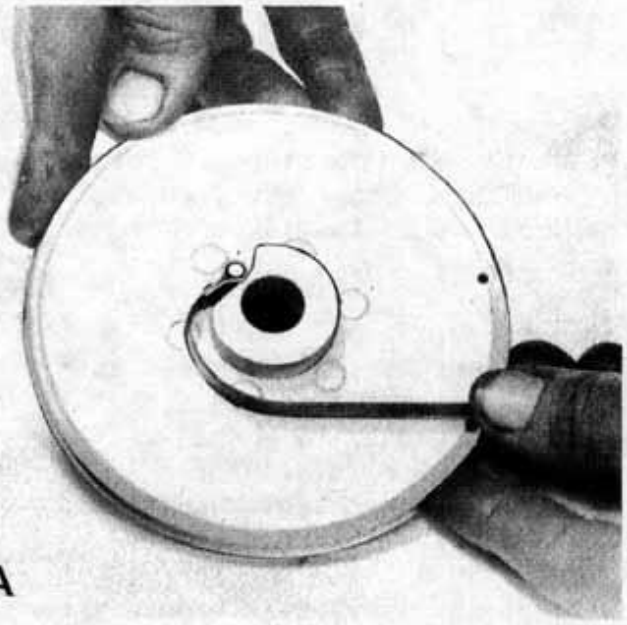
When assembling, be sure both surfaces are clean and that all traces of old cement has been removed. If the crankcase is assembled with the old cement still remaining and freshly coated with additional cement, bearing clearances are likely to be excessive - this will affect performance of the motor. Correct bearing clearance can be maintained only if, when assembling, the old cement is thoroughly removed and a thin coat of fresh cement applied to the surfaces. DO NOT USE THICK CEMENT. Apply only enough to cover the surfaces - be sure none of the oil passages are obstructed by an over abundance of cement.

Gasket cement dries quickly - everything should be in readiness to complete assembly immediately after applying the cement. If permitted to dry before assembling, bearing clearance will be greater than it would have been had the cement been in a fluid state at the time of tightening crankcase bolts.

In event the cylinder is removed for inspection of the piston, rings, etc., it will be necessary to disassemble the crankcase to remove the old cement and to apply a fresh coat. Removal of the cylinder bolts cause the crankcase to open up slightly - the film of cement cracks. Unless the original cement is removed and a fresh coat applied, there is danger of leakage between the halves of the crankcase.

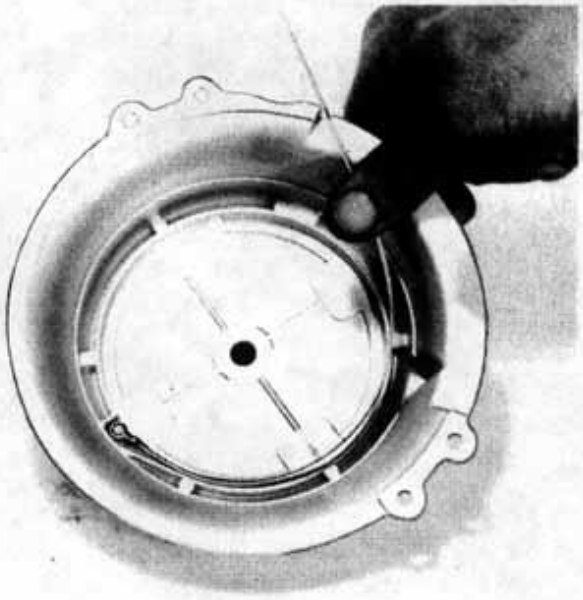
INSTALLATION OF NEW STARTING SPRING:

I. Place the rivet head towards the outside of pulley; with it in this position, put the loop over the pin on the pulley. Fig. A. Bend the spring around the hub, half way. Fig. A.



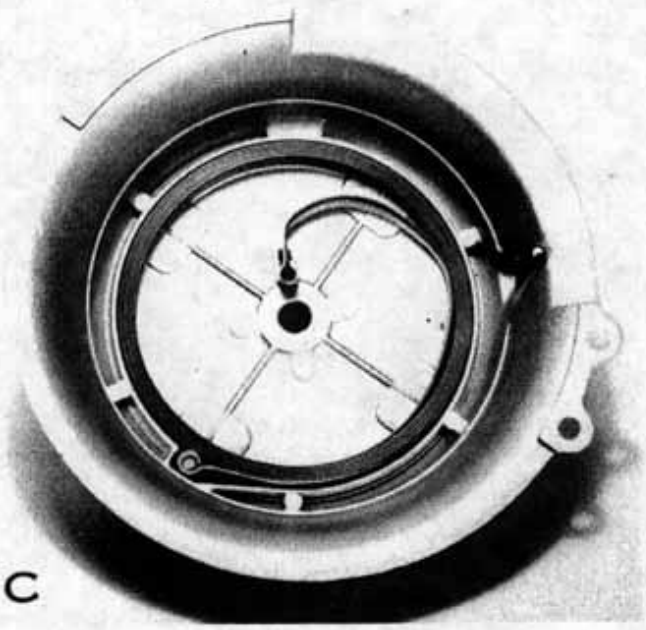
A

II. Take the opposite end of the spring, place the rivet head towards the outside of the starter housing, and put the loop of the spring on the pin in the housing. Fig. B.



B

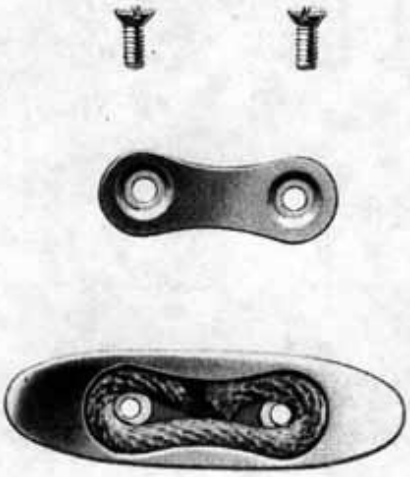
III. Work the spring around in an anti-clockwise direction until it is all in place as shown in Fig. C. Bend the inside end of spring as shown in Fig. C. Place the pin of the pulley through the loop of the spring in the center of housing. Place the bolt, washer and nut to fasten the housing and pulley together.



C

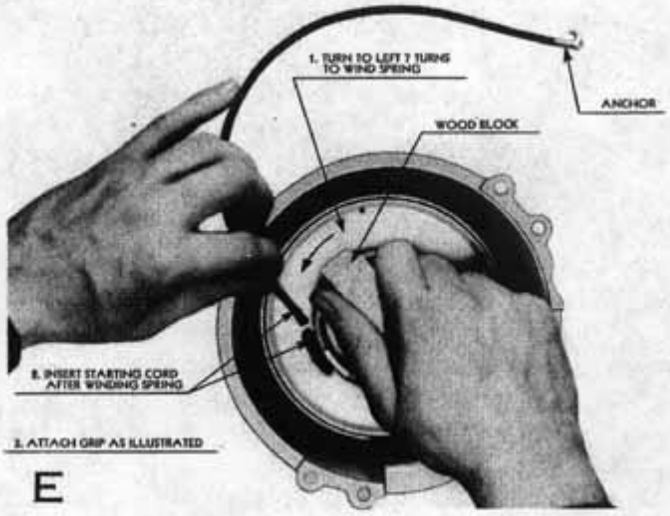
INSTALLATION OF NEW STARTING CORD:

I. Remove ready pull assembly from motor and remove the fragments of broken starting cord from pulley. Take the new cord which should be 72" long and attach it to the grip as shown in Fig. D.



D

II. Take a small piece of wood and cut to fit in the ratchet as shown in Fig. E. Install starting cord as shown in Fig. E and with the anchor properly placed on the pulley, turn in anti-clockwise direction (right to left) 7 turns, using marker as indicated. (be sure to turn right to left - to do otherwise will damage the recoil spring.



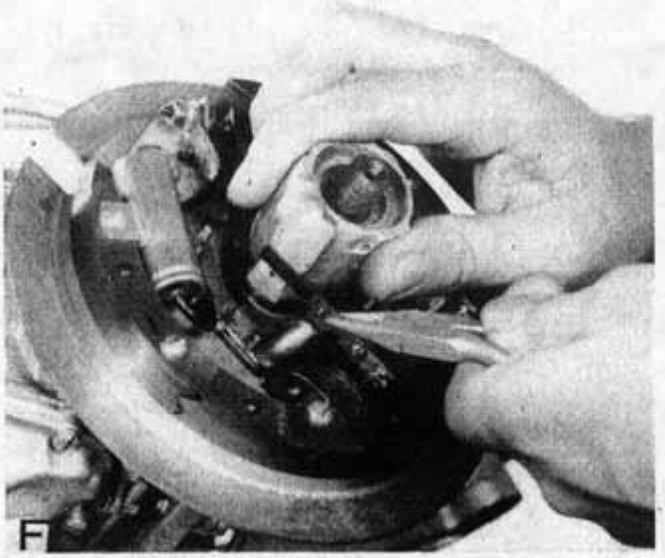
E

Attach the grip as shown in Fig. D., and gradually release until all of the cord has been taken in. The ready-pull may now be attached to the motor.

ADJUSTING GROUND BRUSHES ON LT & DT'S:

I. The armature plate should first be placed on the motor and tighten the clampscrew to the proper tension for normal operation.

II. Place S-262 gauge on the crankshaft, Fig. F., making certain that it is perfectly seated on taper. It is extremely important the gauge be properly seated on the crankshaft taper to insure proper adjustment of brushes.


F

III. Check each brush for proper setting by turning the gauge around until the steel insert is in line with brush. Fig. F. Brushes should touch gauge very lightly and yet not be forced outward as gauge is turned into position.

IV. In the event one or the other of the brushes does not make contact or has too much tension, it will be necessary to bend the brush support in or out, whichever is necessary to provide the correct adjustment. CAUTION - do not bend the brushes but bend the heavy metal strip to which the brushes are attached. This should be carefully done to prevent breakage of the bakelite brush support lugs which are moulded onto the ignition coil.

V. After brushes are properly adjusted, remove gauge and carefully install flywheel on motor. Considerable care should be exercised when installing the flywheel to prevent bending or breaking the brushes.

REMOVAL & INSTALLATION OF SLOW SPEED INTAKE ON THE LT, DT, AT, HS, HD, & HA:

I., When removing the slow speed in-

take it is necessary to remove slow speed needle, packing nut and gas line to carburetor.

II. With a pair of pliers, grasp the intake seat firmly and work back and forth and take a screw driver and pry upwards on one of the ears at the intake until the seat assembly is removed. Fig. G. The new seat may be installed by tapping it in with a rawhide mallet.

G

The above procedure also applies to the H series motor including the following:

III. Place the small lead seat in the crankcase before you install the intake seat.

IV. After the seat is installed and pressed in firmly, use a 5/32" drill, the same size as the hole in the intake seat and drill thru the lead seat that was first placed in the crankcase. This is important - if not done, motor will not idle.

LAPPING PISTON RINGS:

Three things are basically required to make any gasoline engine run, regardless of whether it be a two stroke (outboard motor) or four stroke cycle engine - they are namely, 1. Spark 2. A combustible ratio of air and gasoline, or in other words, "gas" and 3. Compression.

Spark must be of sufficient strength to jump the spark plug gap under compression in the cylinder and must be properly timed with relation to position of the piston.

Gas must be of correct air-gasoline ratio - that is, if the mixture is too rich (too much gasoline) it will not ignite; also, if too lean (too little gasoline) it will not ignite. This is largely a matter of carburetor adjustment.

Compression must be good - the amount of compression depending on ability of the piston rings to prevent its escaping. Condition of the cylinder, piston ring grooves and the rings are naturally contributing factors.

An engine will run with some deficiency in either of the above but to get the most out of it, Spark, Gas and Compression must be good.

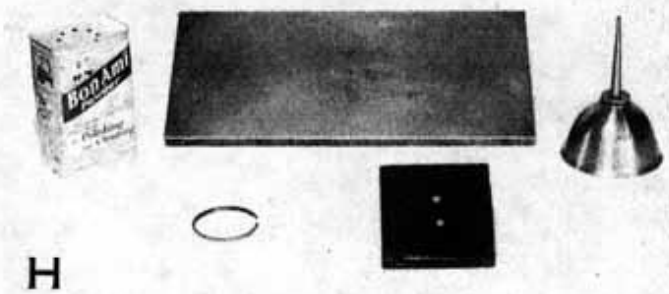
To obtain good compression, the cylinder must of course be round, the piston rings should seat on the cylinder walls and should also seat in the piston (ring grooves) to prevent compression escaping past the rings by way of the ring grooves.

The sides of the rings may not be flat, thus permitting loss of compression, which can be eliminated by lapping. To lap, proceed as follows:

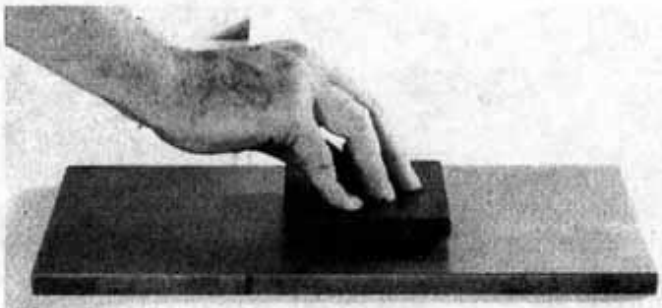
1. Obtain a small piece of plate glass - about 8" x 8". Fig. H.
2. Construct a lapping block, consisting of a flat piece of wood large enough to cover the average size ring. Fig. H. Glue a piece of felt to one face - attach a small drawer knob to the opposite side to enable lapping

with equal pressure at all points of the ring.
3. Place a piece of #00 emery cloth on the plate glass - be sure it lies flat.
4. Place the ring to be lapped on the emery paper - place the lapping block on the ring. Grasp knob, bear down lightly and move slowly over the emery cloth in a figure 8 fashion. Fig. I.
5. Be careful not to remove too much of the ring stock but only enough to insure its flatness. This can very easily be determined by frequent observation - low spots will be dark. Cease when the entire surface is bright. Proceed in similar manner to rough lap other side. If too much stock must be removed to obtain flatness, discard the ring.
6. To finish lap, sprinkle plate glass with powdered Bon-Ami. Mix with oil to form lapping compound (not too thick or not too thin). Place ring on plate glass, lap with block in position as described above. Be sure to maintain equal pressure when both surfaces are bright throughout the entire circumference.
7. To lap piston ring grooves - apply mixture of Bon-Ami and oil to ring grooves, then install rings in their respective positions. Push up and down with turning motion - a minute or two is sufficient.
8. Remove piston from cylinder & wash free of all traces of lapping compound. THIS IS IMPORTANT

Minor descrepancies in the rings or ring grooves are not so noticeable at high speeds as at slow speeds for trolling purposes - unless the rings seat properly there is sufficient loss of compression to affect slow speed performance. Compression must be maintained in both the crankcase and cylinder in a two stroke cycle engine to obtain satisfactory results.

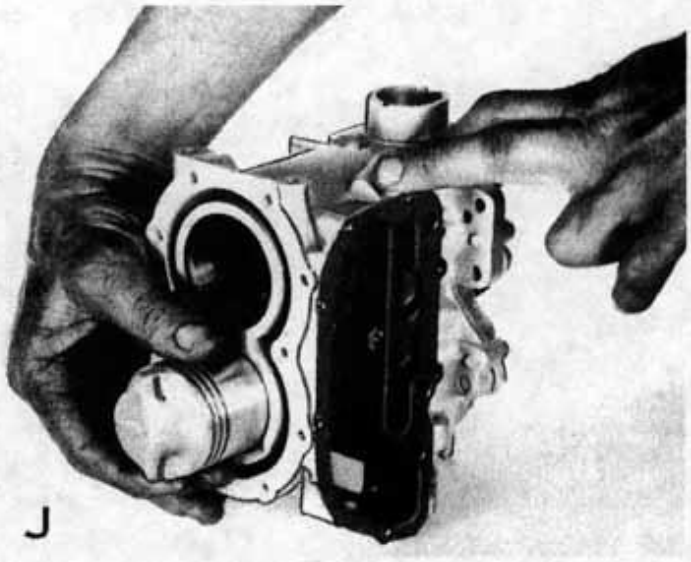


H



I

When assembling new pistons in the cylinder they should be placed in this position. Fig. J. Hold the piston so the exhaust deflector is on the same side as the exhaust manifold. Fig. J.



J

TO REPAIR LOWER UNIT ON LS, DS, LT, DT, & AT:

In order that you may be able to repair the lower unit on the Models LS,

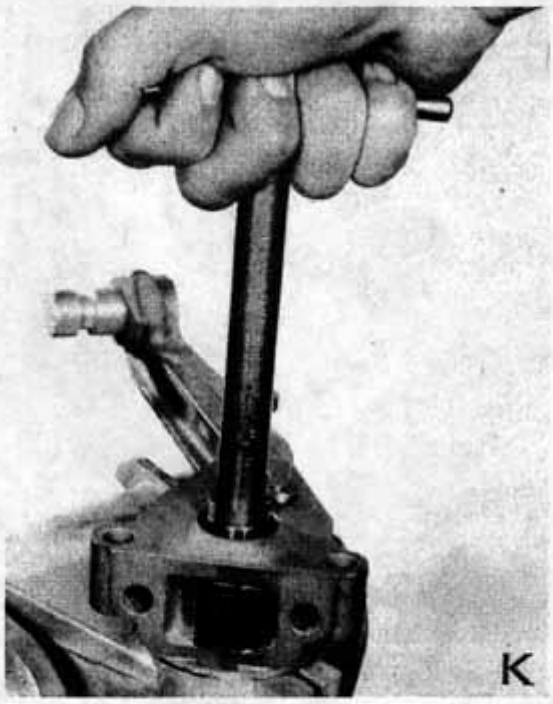
DS, DT, LT & AT motors, the powerhead will have to be removed from the lower unit.

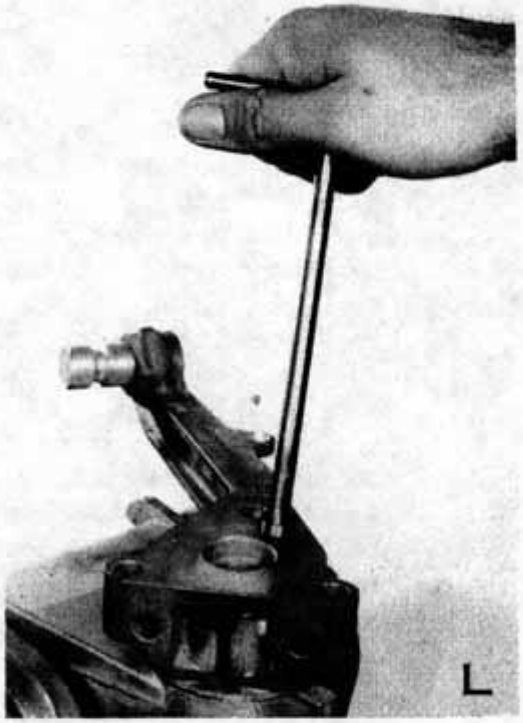
Removing the powerhead is a very easy task - remove three hexagon nuts holding powerhead to driveshaft casing - remove two hexagon bolts holding the exhaust outlet on cylinder to driveshaft casing. Remove the lower water connection from the water outlet elbow. Lift off powerhead.

After the powerhead is removed, the driveshaft may be pulled out from the top as it is splined on both ends and just slips out.

On the gearcase where the exhaust outlet is fastened, remove the four screws that hold it and remove exhaust outlet from gearcase. After this has been removed, you will notice where the water tube in the driveshaft casing fastens to the water pump - remove the water pipe nut just above the pump.

Remove the inner driveshaft casing with an S-261 tool and remove the water tube with an S-260 tool. Fig. K & L.


K


L

When removing the gearcase from the driveshaft casing, remove the clamp-screw that holds the gearcase to the driveshaft casing. Remove gearcase.

TO DISASSEMBLE THE LOWER UNIT:

First remove the propeller nut, washer and propeller. Remove the gearcase head and pump assembly. Pull it off the propeller shaft. You may find that the propeller shaft, eccentric, shock absorber spring may all come out together.

After the propeller shaft has been removed, the pinion gear will drop down out of position and the bevel gear may be removed from its position in the bearing.

In the event that the bearing is worn or needs replacing, it will be necessary to purchase a new gearcase.

GEARCASE HEAD & WATER PUMP ASSEMBLY:

You have probably already noticed that the water pump and the gearcase head are combined in one unit.

If the bearing in the gearcase hea is proven worn and a new one is re-

quired, it will be necessary to purchase the complete gearcase head.

To install a new cork seal on the gearcase head, the cork seal cap may be removed by the use of two screwdrivers prying up gently on both sides of the cap.

TO DISASSEMBLE THE WATER PUMP:

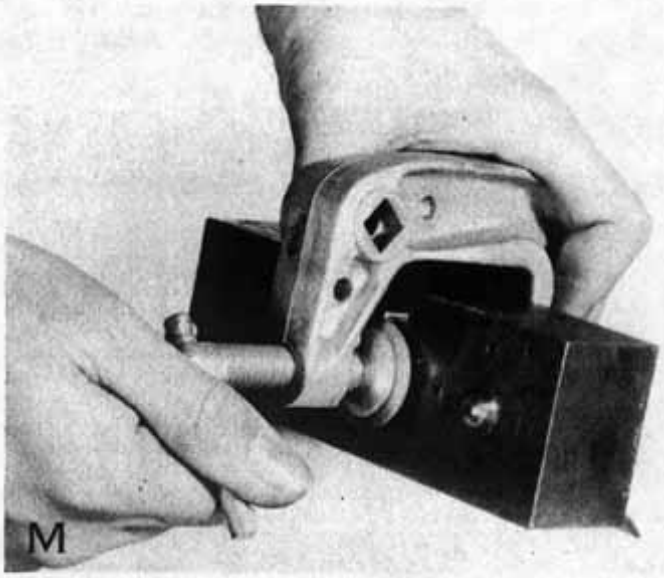
Place the gearcase head or water pump in the vice. Take a wrench & remove the outlet valve and ball retainer. While the pump is still in the vice, remove the five screws holding the pump body cover. Remove the cover and the pump plunger spring and plunger will easily be removed.

If you are unable to remove the ball retainer from the intake valve, take two small screwdrivers or small pieces of metal and pry it out gently. If you are unable to pry it out, unscrew the screen and retainer nut as much as possible and then push down on it until you are able to grasp the ball retainer with the fingers. Then by inserting a pointed pair of pliers you will be able to Hold the intake valve seat so you can remove the screen and retainer nut.

Reassemble the water pump, gearcase and driveshaft casing in the reverse order as you disassemble it.

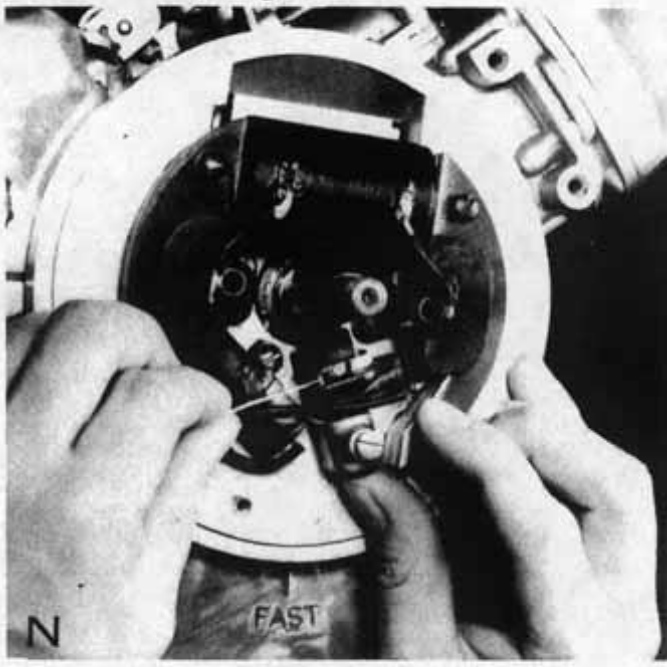
INSTALLATION OF SWIVEL PLATE TO WING SCREW:

The swivel plate and wing screw on the later models are constructed so that by riveting over the end of the wing screw, the swivel plate will be held in place. If you have to install a new swivel plate, it can be installed on the wing screw and placed on a fixture, Fig. M. and screw it up until the end of the screw is riveted securely.


M

ADJUSTMENT OF BREAKER POINTS ON MS, MD, HS, HA, & HD:

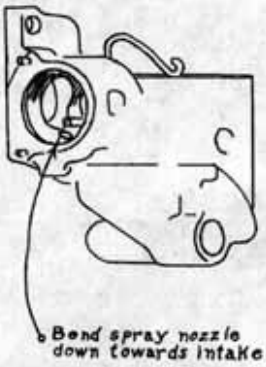
To adjust the breaker points on the Models MS, MD, HD & HA motors, turn crankshaft to the right or left so the flat on the shaft is pointed toward the coil assembly - loosen the set screw holding the breaker assembly fast (in picture, screw above the thumb). To increase the gap, push towards the crankshaft as shown. To lessen the gap, let points slide back to the desired setting, (the spring tension on the point assembly will let the assembly slide back. Points should be set at .020" gap clearance, for best performance.) Fig. N.



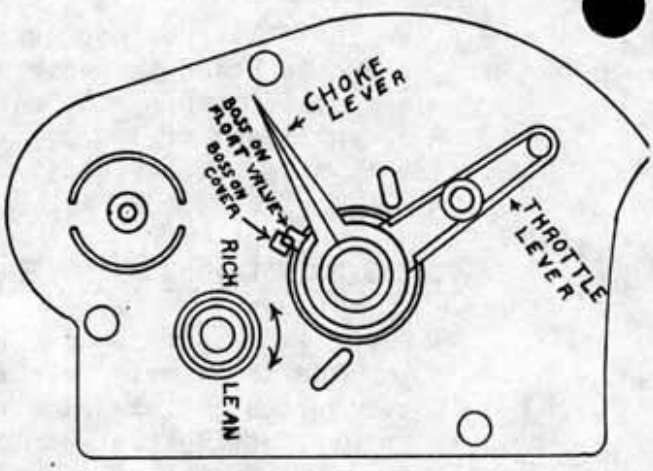
N

CARBURETOR ON MS & MD MOTORS:

Possibly you have been experiencing some difficulties with the MS motors not idling satisfactorily at slow speeds. In some cases we have found that by bending the spray nozzle down towards the intake, as shown in drawing, Fig. O, that these difficulties can be corrected.



O



P

THE NECESSARY CARBURETOR ADJUSTMENTS WHEN INSTALLING THE NEW K CYLINDER CONVERSIONS:

When installing the new K cylinder conversion, it will be necessary for you to make a minor adjustment in the carburetor float valve.

First observe the position of the boss on the float valve in respect to the boss on the carburetor cover. Adjust the float valve so the boss on the float valve lever is half way on the boss of the carburetor cover. Fig. P. This is accomplished with the magneto lever in the wide open position or to the right as far as it will go, facing the motor.

The proper way to set the throttle valve screw is by removing the carburetor from the motor. In the carburetor on the KA-37, 38, 39, and slow speed jet is machined in the casting, and with the throttle valve turned so the high speed intake is closed, the screw on carburetor cover boss should be touching the boss on throttle lever. When the screw is touching the boss on the K-80 carburetor, there should be a 5/32 opening in the throttle valve.

NEW SERVICE TOOL

S-271 Tool for Pressing on Oil Slinger, LT, DT, AT-10

$1.35 each net
Order direct from factory

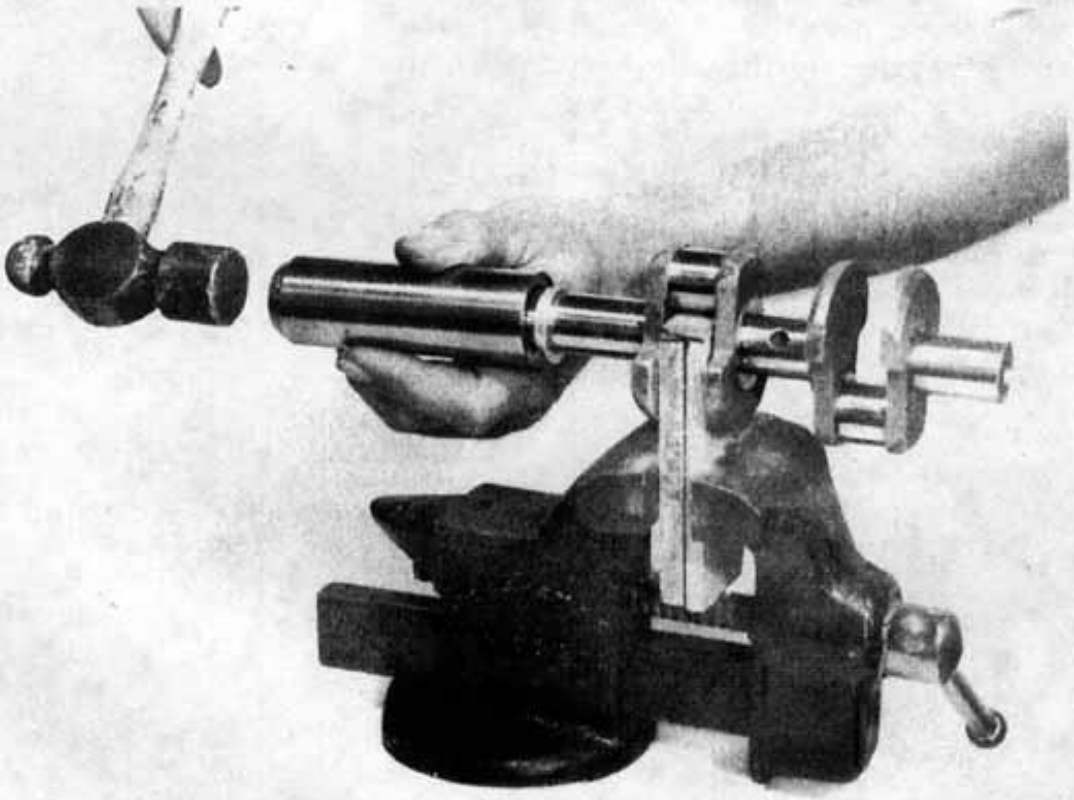
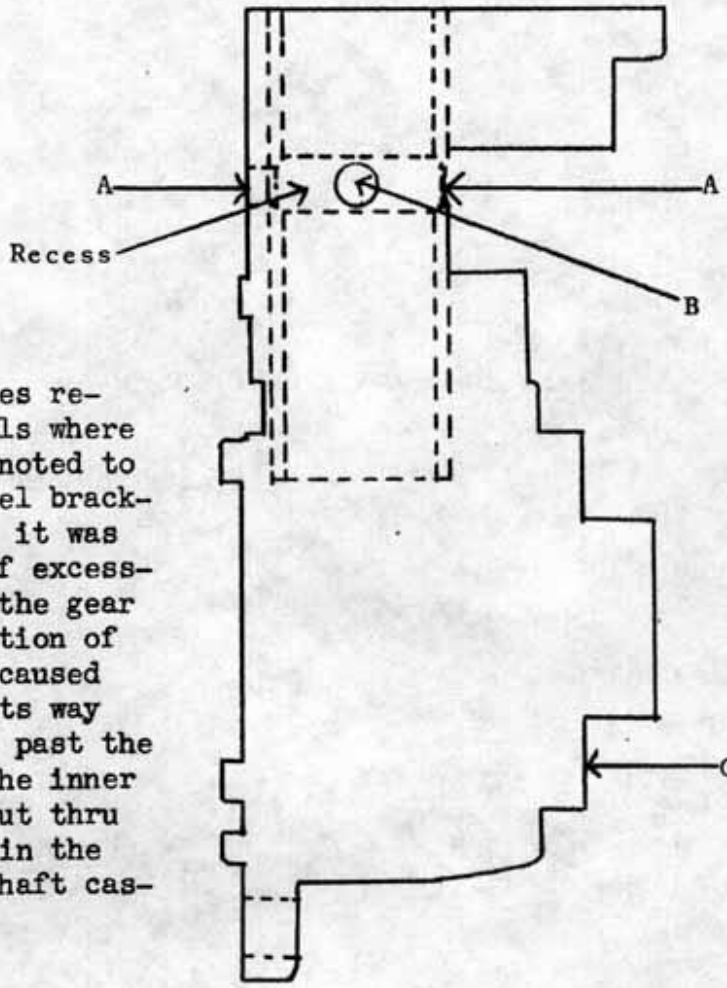


Illustration how the tool is used

GEAR CASE HEADS - M, H & LT series - 1939, '40



There have been some cases reported on the above models where gear lubricant has been noted to ooze out around the swivel bracket. Upon investigating, it was found to be the result of excessive pressure created in the gear case by reciprocating action of the pump plunger. This caused the lubricant to force its way out of the gear case, up past the drive shaft seal, into the inner drive shaft casing and out thru the small holes drilled in the upper end of the drive shaft casing.

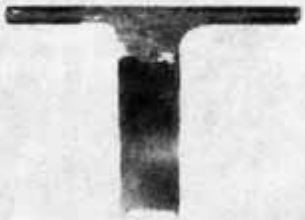
This condition can be overcome by drilling additional holes in the pump housing to relieve the pressure --

1. Remove gear case head from gear case.
2. Remove pump plunger and spring.
3. Remove inlet screen and seat.
4. Note hole drilled in pump housing immediately below pump inlet screen - (LT series are drilled 3/16" and M and H series are drilled 5/32").
5. Run a drill straight thru the housing as indicated by "A" on the above sketch (LT, 3/16" drill - M & H, 5/32" drill).
6. On the same plane, but at 90° from the first hole, drill a second hole "B" thru the housing - same as above.
7. Clean out chips and reassemble.

NEW SERVICE TOOLS

S-268 Tool for crimping
No. 375077 ignition terminal
$2.00 each net

S-276 Tool for installing
inlet water seat on LT
series -
$1.35 each net



Order from factory direct

SD CARBURETOR

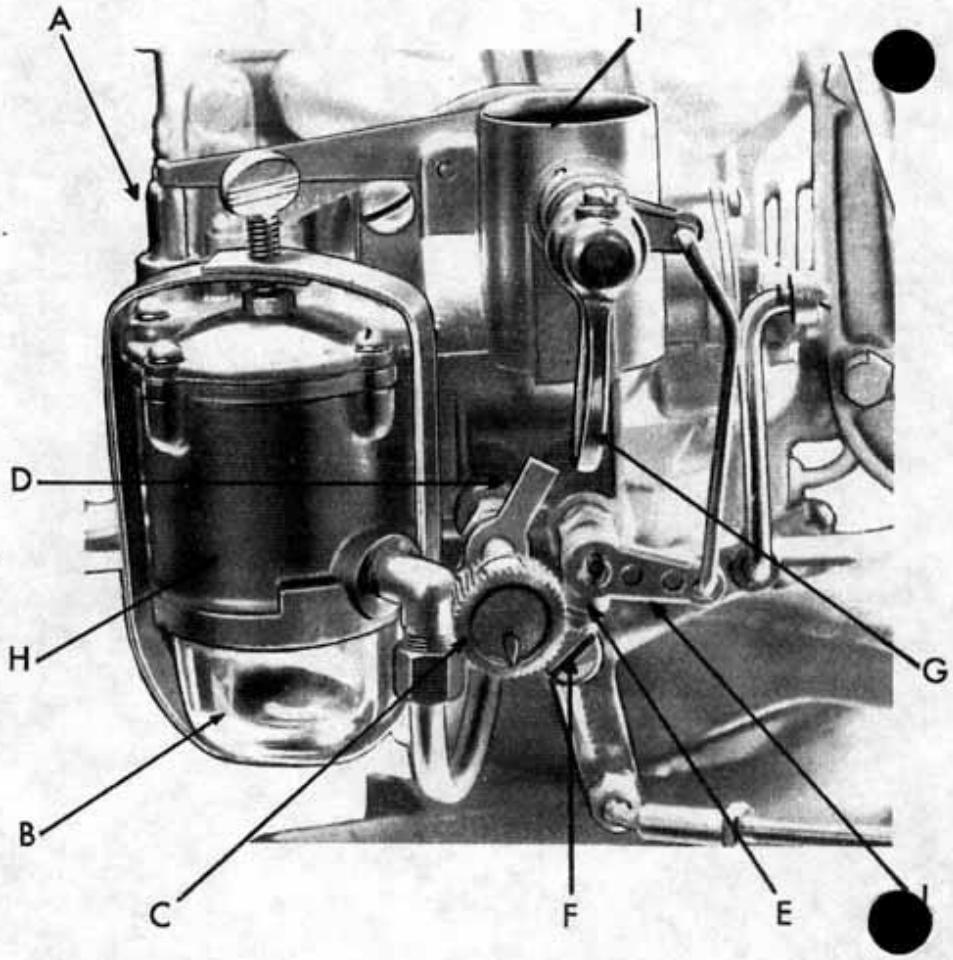
Herewith is illustrated the Model SD-10 carburetor with cover removed - showing:

A. Primer
B. Sediment basin
C. Slow speed needle and knob
D. Slow speed needle stop
E. High speed needle
F. High speed needle lock screw
G. Lever - (high speed adjustment) primer and shut-off
H. Float chamber
I. Air intake
J. High speed needle arm

Model SD is of the two port rotary valve type, whereby fuel mixture enters the crankcase by way of two rotary valves built into the crankshaft, thus eliminating the third port in the cylinder wall. Action of carburetor control is such that only the small opening (rotary valve) in the center journal of crankshaft functions to permit fuel mixture to enter the crankcase at slow speed. The area of this opening, being comparatively small, results in high velocity of fuel mixture so essential to maintaining proper fuel distribution in the lower speed range. From intermediate to full speed range, the large opening (rotary valve) in the cheek of the crank functions - this opening being of large area permits full charge entering the crankcase for maximum power.

High and slow speed needle valves (carburetor) are set at the factory for adjustment within a limited range, that is, providing an adjustment range of approximately 90 degrees on the high speed needle valve and 120 degrees on the slow speed needle valve.

The purpose of the lever to which the high speed needle is attached is three fold - namely, by moving it to the extreme left, it shuts off the fuel supply to the carburetor (fuel shut-off); by moving to the right, it increases the flow of fuel to provide a proportionately rich mixture (high speed needle adjustment) - the lever is linked to the primer thus, by moving it to the extreme right and upwards against spring pressure and permitting it to return to normal position, the primer discharges a spray of fuel into the crankcase by way of the slow speed intake to provide a rich mixture for easy starting (primer).



To obtain final high and slow speed needle valve adjustment, start motor as instructed and run until normal motor operating temperature is reached (two or three minutes is sufficient). Set spark lever to full advance and throttle control to full open. Move high speed needle lever to right or left as required to obtain maximum speed and best performance. (Lever moved to left results in lean mixture - to right, rich mixture. If mixture is too lean, motor will slow down - if too rich, motor will run sluggishly and smoke profusely). Note position of high speed needle lever when set at best running position for future operation.

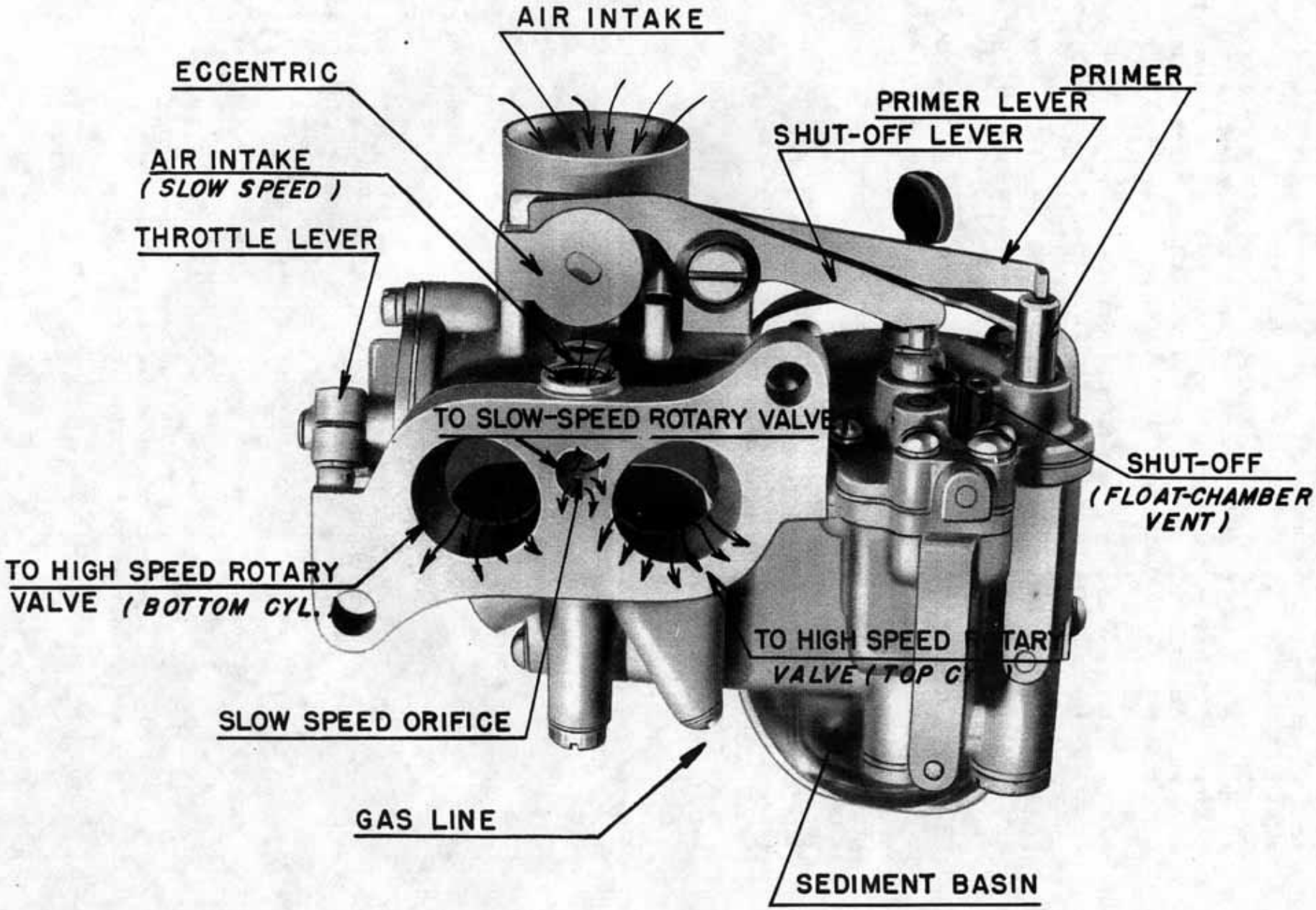
To adjust slow speed needle valve, close throttle and retard spark to a position midway between full advance and full retard. If motor runs unevenly, turn slow speed knob to right or left as required to best running position (left for richer mixture - right for leaner mixture). Further retard spark and repeat as above until satisfactory slow speed operation is obtained. Once the slow speed needle valve has been correctly adjusted, it should require little or no attention thereafter.

Note - there is no vent in the gas tank filler cap - fuel in the tank is under slight pressure, built up in the crankcase to provide constant flow to the carburetor. The filler cap must be kept tight.

The carburetor on the Model SD is provided with a sediment basin to gather foreign material and moisture which may be present in the fuel and may require cleaning from time to time. To clean, remove high speed needle valve lever and slow speed needle knob - remove cover to gain access to the carburetor. Sediment basin can then be removed for cleaning by loosening the screw at top of float chamber and swinging aside the bracket holding the basin in position. Reassemble in reverse order.

In event the carburetor has been removed for cleaning purposes and both slow and high speed needles have been thrown completely out of adjustment, proceed as follows:

1. Open slow speed needle "C" approximately 3/4 turn from closed position.
2. Open high speed needle "E" approximately 1/4 turn from closed position.
3. Start motor usual way - run until normal operating temperature is reached.
4. Retard spark lever to slow running position. Turn slow speed needle to right or left as required to obtain smooth slow speed operation.
5. Set slow speed needle stop "D" in vertical position and so that it will rest on high speed needle when slow speed needle is turned to right - lock in position. (Note - stop should not set on high speed needle packing nut - this will affect range of movement).
6. Advance spark to fast running position - turn high speed needle "E" right or left (with screw driver) as required to obtain best high speed setting.
7. Set high speed needle arm "J" at horizontal position - tighten lock screw "F".
8. Replace cover - attach slow speed needle knob and high speed lever "G". Final adjustment on both needles is thus provided by limited movement of the slow speed needle knob and high speed needle lever when the motor is operated on the boat.

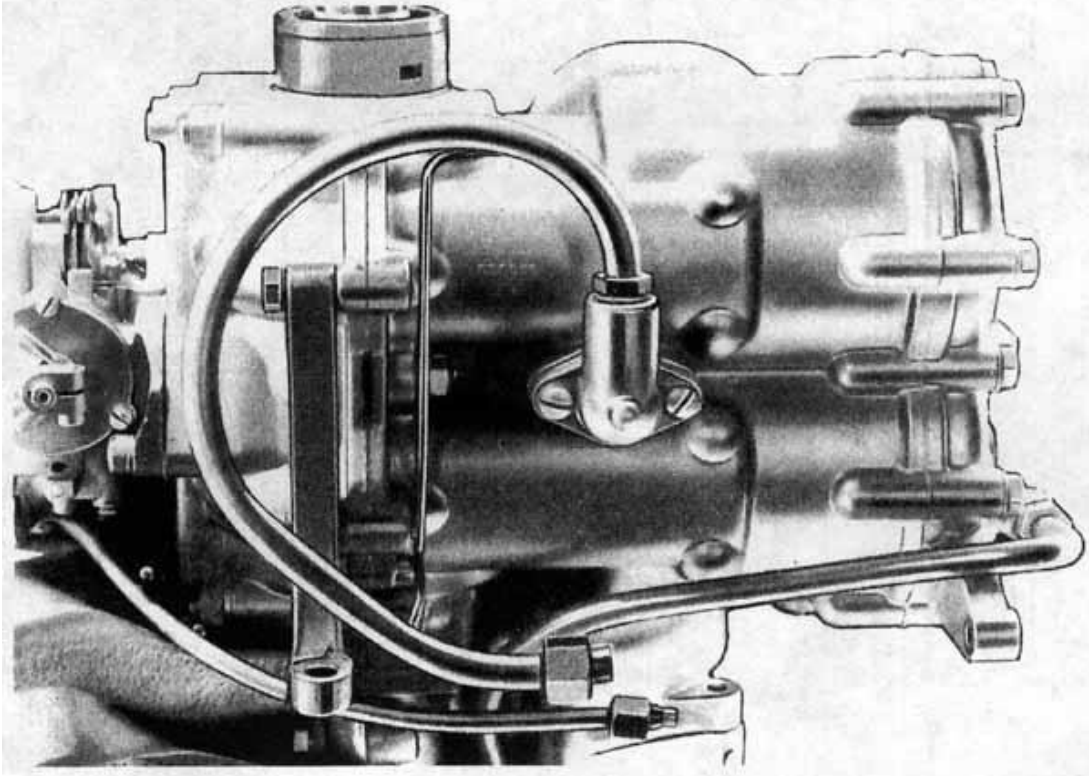

AIR INTAKE
ECCENTRIC
PRIMER
PRIMER LEVER
SHUT-OFF LEVER
AIR INTAKE
(SLOW SPEED)
THROTTLE LEVER
TO SLOW-SPEED ROTARY VALVE
SHUT-OFF
(FLOAT-CHAMBER VENT)
TO HIGH SPEED ROTARY VALVE (BOTTOM CYL.
TO HIGH SPEED ROTARY VALVE (TOP C
SLOW SPEED ORIFICE
GAS LINE
SEDIMENT BASIN

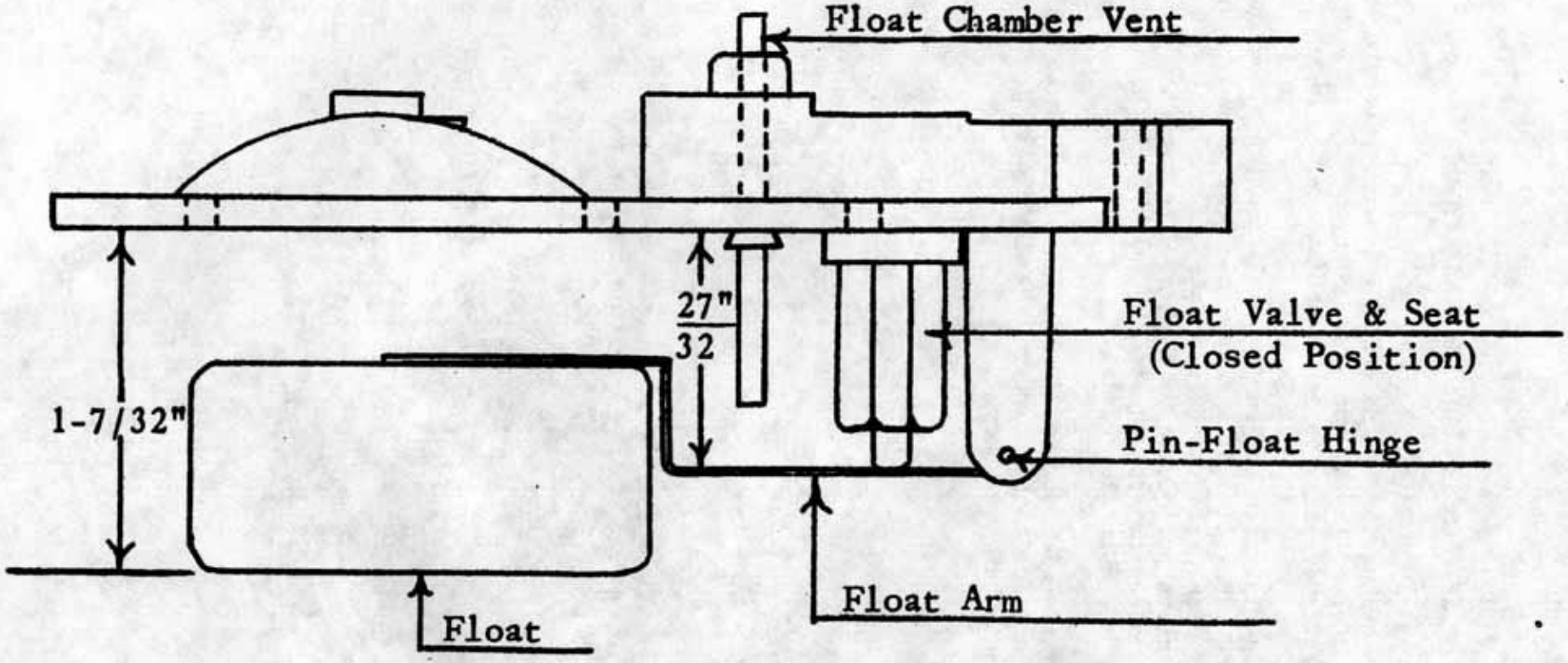
SD PRESSURE FEED TO CARBURETOR

Since fuel to the carburetor is fed under pressure, pressure built up in the crankcase is transferred to the gas tank by way of a simple check valve arrangement and tube leading directly to it as illustrated below.

The valve mechanism is installed in the small housing attached to the side of the cylinder block consisting of a seat, check valve, and spring. At period of high pressure (in crankcase) valve is forced off its seat to permit transfer to tank - at low pressure period, valve is forced back on the seat by the spring, to prevent pressure escape from the tank. Valve continues to function in this manner as long as the motor is running.

Two or three cranking efforts are all that is necessary to build up sufficient pressure in the tank for starting purposes. Upon having started, pressure is maintained by running of the motor.





FLOAT SETTING—SD CARBURETOR

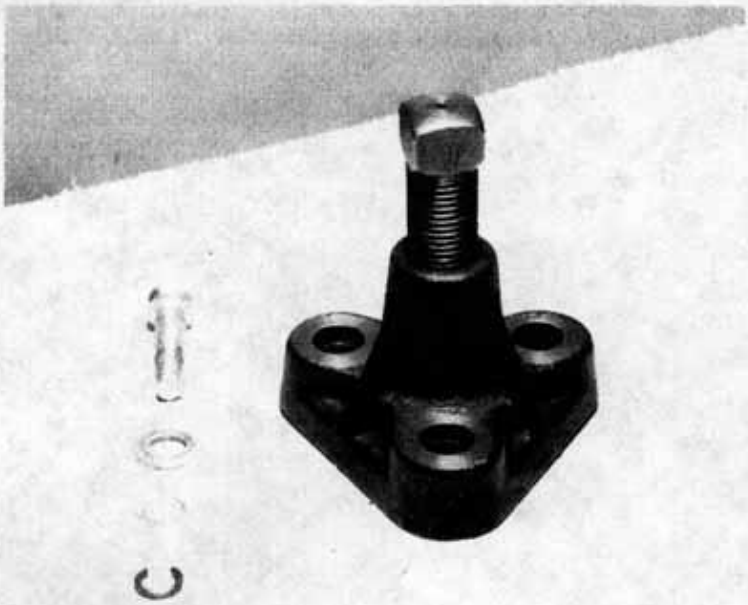
Above is sketch of the SD carburetor float and float valve arrangement, with correct measurements for adjusting float to proper level. This adjustment is accomplished by merely bending the float arm up or down as may be required to obtain correct setting. (Distances are all measured with the float valve closed.) Hold assembly in an inverted position when making adjustments.

FLYWHEEL PULLER

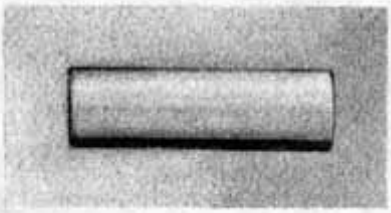
Below is illustrated a flywheel puller for use on all Sea Horse motors except Models S, V, P & PO.

It is a practical tool of sturdy construction and can be put to use to a good advantage in every Sea Horse outboard motor shop. It's just the thing you've been looking for.

S-288 Flywheel puller at the nominal price of $1.50 each net



NEW SERVICE TOOL



S-275 Tool for installing propeller shaft seal on
H, M & LT series

$1.00 each net
Order direct from factory

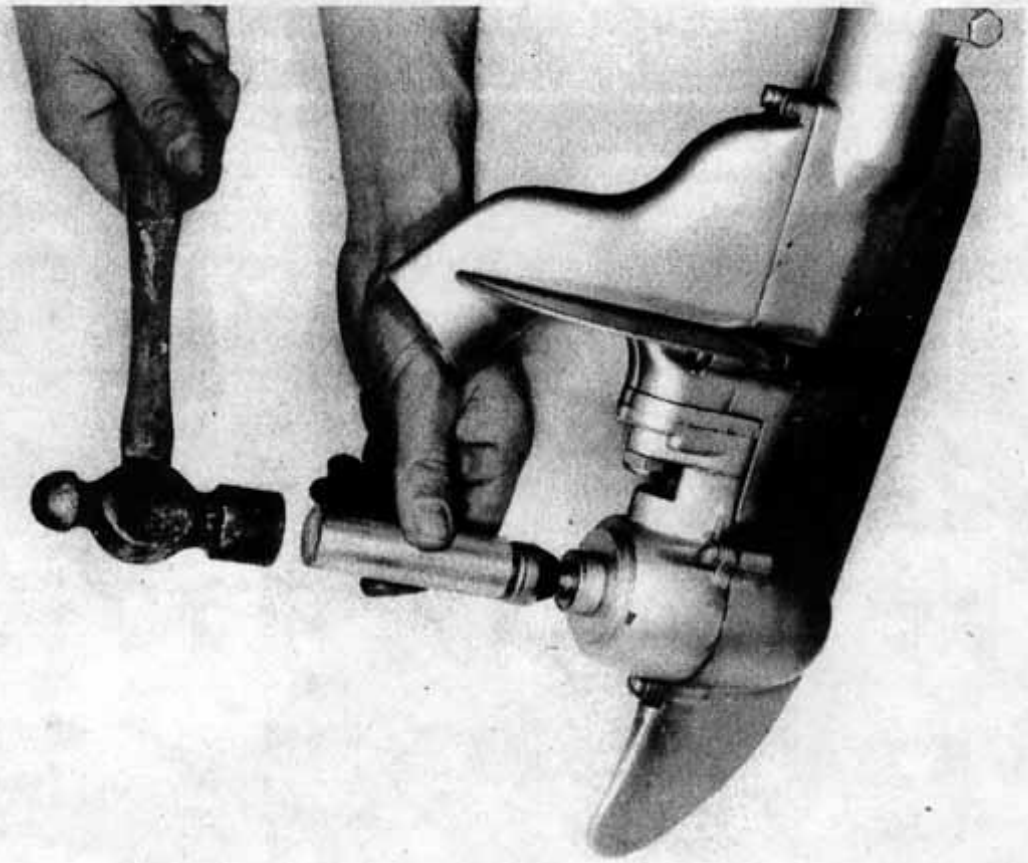


Illustration how the tool is used

SECTION TWO

GENERAL MOTOR TROUBLES

BURNING OF LYNITE PISTONS

The burning or melting of the heads on lynite pistons is due to extremely high temperatures and may be caused by any of the following:

1. Advancing of magneto lever beyond the point where maximum speed is obtained.

2. The use of high test gasoline or fuels to which have been added picric acid, benzol, ether, etc., causing motor to run hot. (Use ordinary gasoline mixed with the specified amount of oil. See instructions on gas tank).

3. Increasing the compression by milling off cylinder heads.

4. Particles of metal or dirt passing through gas passage, lodging between the piston and cylinder wall. This usually is the result of misalignment of the rotary valve, causing rotor to rub against the housing and the lynite metal to flake off, being drawn into motor. Also, metal or dirt being drawn through carburetor while the motor is in operation.

5. Wrong type of spark plugs, running too hot. Use only those recommended on page 35 for the various type of motors.

6. Operating the motor with the carburetor needle valve cut down, giving too lean a mixture, causing the cylinder temperature to run higher than normal. This applies especially to motors equipped with dual carburetors.

7. Using a propeller that permits the motor to turn at higher R. P. M. than recommended for maximum efficiency. See chart pages 40-41.

8. Excessive clearance between the piston and cylinder walls, causing heat to concentrate in the piston, through lack of contact between piston and cylinder walls. See chart of piston clearance page 42.

LOSS OF POWER

Loss of power, or a noticeable decrease in R. P. M. of the motor from no apparent reason, may be caused by any of the following:

1. Cylinder worn oversize, causing a loss of compression and hard starting.

2. Reciprocating parts or lower unit out of alignment, causing excessive friction. In this case it will be necessary to disassemble the power head or lower unit to correct the misalignment.

3. Excessive back pressure, created by carbon deposit in the ports or exhaust outlets, driveshaft casings or muffler.

4. Piston rings worn, or seized in ring grooves.

5. Operating motor with spark advanced beyond the point where maximum efficiency is obtained.

6. The use of improper fuel mixture. Use correct fuel mixtures as instructed on pages 36-37.

7. Faulty ignition or spark plugs. This can be determined by trying a new set of recommended plugs, or by checking the magneto as instructed on page 1. (Refer to spark plug chart).

8. Carburetor out of adjustment or not mounted level, screen or gasoline line clogged.

KNOCKING

In case of an audible knock, open the needle valve, to enrich the mixture, then cut it down. If the knock continues, something is radically wrong and should be immediately checked for the following:

1. Loose flywheel nut. This should be absolutely tight at all times.

2. Connecting rod bearings exceptionally loose. (Unless extremely loose, the bearings will not knock in a Johnson Outboard Motor).

3. Connecting rods or the crankshaft striking crankcase.

4. Faulty ignition or spark plugs, causing motor to miss at high speed.

5. Pole pieces of flywheel, striking armatures of ignition coil.

6. Too much end play of the crankshaft, especially on the A and K-50, 65.

Caution: Do not continue to operate motor if knocking persists, as serious damage may result.

HARD STARTING

If the motor starts exceptionally hard, but runs alright after being started, check for the following:

1. Weak magnet. To determine this, remove the flywheel to test magnetic strength with magnetometer. Check with new flywheel for comparison.

2. Weak or defective coil and condenser. Remove the spark plugs. Ground one ignition lead to the motor and hold the other about ¼" from cylinder head. Give the flywheel a quick pull to note if a spark jumps the ¼" gap. If it does not, remove the magneto to test on regular test stand for further difficulty.

3. Connecting rods twisted, or motor assembled out of alignment. Lift the flywheel up and down to determine if the crankshaft has sufficient end play. If the power head is properly aligned, an audible knock can be heard by raising the flywheel and allowing it to drop. This should be determined by rotating the flywheel and checking at different positions. If out of line and tight, the flywheel will spring back to its normal position. Motor will also crank stiffly.

4. Cylinders worn oversize, causing loss of compression. Check cylinders for being worn oversize with plug gauge. See page 7.

MOTOR FAILS TO START

If motor fails to start, after cranking it several times, check for the following:

1. Fouled or broken spark plugs. If fouled, re-

move oil or carbon and wash thoroughly with gasoline, or replace with new plugs.

2. Flooded motor. Remove spark plugs to clean them; replace plugs, completely close needle valve on the carburetor, crank the motor until it starts. Run until the accumulation of gasoline in the crankcase is consumed. Then open the needle valve to the proper setting.

3. Gasoline line, carburetor or screen clogged. Remove these parts to thoroughly clean.

4. Faulty ignition. Check magneto by removing one spark plug lead at a time, holding it ¼" from the motor while cranking. If no spark occurs, remove the flywheel, check the breaker points for correct opening, dress points as instructed on page 3. If this does not correct the difficulty, remove the complete magneto and test for further trouble as instructed.

MOTOR SLUGGISH

If at any time the motor appears to be sluggish and you are reasonably sure it is equipped with the correct propeller and spark plugs, it is advisable to check the following:

1. Journal bearing clearance. While motor is operating, feel of the crankcase at the top and bottom bearing to ascertain if they are heating to any extent. A hot journal bearing indicates one of three things; bearings too tight, out of line, crankshaft sprung or lack of lubrication.

2. Too little or no end play of the crankshaft. This can be determined by moving flywheel up and down, noting the amount of end play.

3. Improper spark plugs. The plugs being too hot usually result in difficulties of a nature that the operator will invariably interpret as a faulty carburetor; also causing the motor to slow down and knock considerably.

4. There are possibilities of shafts being sprung, bearings out of line, or the gears meshed too closely in the lower unit.

5. Back pressure, created by exhaust ports or muffler outlet becoming clogged with carbon.

FLOODED MOTOR

Failure of warm motor to start is usually due to flooding. Remove and clean the spark plugs, closing the needle valve, completely, while cranking the motor. If the motor starts and operates for a short time before stopping, it indicates an accumulation of gasoline in the crankcase, or, in other words, a flooded motor. Excessive flooding of the motor is usually caused by the following:

1. Attempting to start motor with the needle valve opened too far.

2. Float valve seat leaking, with gasoline flowing by and into the crankcase while the motor is standing idle.

Note: It is usually very hard to flood the motor while first starting when cold. A warm or hot motor is easily flooded.

FOULING OF SPARK PLUGS

Frequent fouling of plugs, when starting or operating the motor is usually caused by any of the following:

1. Wrong type spark plugs, or plugs too cold for the particular type of motor. See spark plug chart.

2. Leaking water tubes in the driveshaft casing, creates an accumulation of water in the casing, creeping up the driveshaft and through the bottom journal bearing into the crankcase. This can be determined by removing the drain plug in the lower end of the casing and noting the amount of water accumulated; or, by removing one spark plug (lower plug in 4 cyl. models) tap lightly in palm of hand to check for presence of water.

In the event of leaking tubes, the driveshaft casing will have to be removed and repaired according to instructions.

3. Water leaks in cylinders or cylinder heads. Remove cylinders and check for leaks under pressure.

PROPELLER CAVITATING

Cavitation of the propeller is determined by a noticeable irregular speeding up of the motor at intervals, with little or no increase in boat speed. This is due to the water being pushed aside faster than it flows in to replace the displaced water; in other words, a pocket is created, with the propeller rotating in it at high speeds. Difficulty of this nature may be caused by the following:

1. Motor too high on transom of the boat, thus allowing the propeller to operate too near the surface of the water, permitting air to enter the water stream through propeller. See "Transom Heights".

2. Water-soaked grass, weeds, paper, or leaves will some times collect on the forward end of the gearcase, or pinion shaft casing, on the larger, faster motors, causing an air pocket to be created. This will cause the motor to race; the only remedy is to stop and remove the refuse.

3. There are some boats that produce cavitation by simply having too much keel in front of the propeller and a peculiar shaped stern that is hard to correct. This is especially true with the high speed fast motors. Note: A slipping shock absorber drive may some times be mistaken for cavitation.

MOTOR WILL NOT TURN UP IT'S RECOMMENDED R. P. M.

When the motor is known to be in first class mechanical condition, although it will not turn up to its proper R.P.M., when operating on a boat, check for the following:

1. Propeller with too great a pitch, holding motor down below it's recommended R. P. M. See propeller chart.

2. Motor mounted to a boat too heavy for the particular type of motor; or the boat too heavily loaded for the pitch of propeller.

3. Marine growth on the bottom of boat, such as frequently occurs in salt water. Barnacles often collect beneath the water line where they cannot be detected unless the boat is raised or turned over

for inspection. Any obstruction on the surface exposed to the water will cut down the speed.

4. Improper fuel mixture. See "Oiling Instructions".

5. Motor may not be firing on all cylinders.

6. Weeds or other refuse wrapped around the propeller.

MOTOR OVER HEATING

Cylinder temperature can be determined by feeling of the heads or ends of cylinders while the motor is operating at full speed. If the temperature is higher than normal or the cylinders become extremely hot, do not under any circumstances, continue to operate the motor, but check the following:

1. Water pump.

2. Clogged, corroded or broken water tubes and fittings.

3. Foreign matter obstructing water circulation.

4. Insufficient amount of oil in fuel mixture.

5. Exhaust ports and piston ring grooves clogged with carbon.

6. Bearings out of line, sprung or twisted crankshaft and connecting rod.

7. Muffler clogged with carbon.

TROUBLE CHART ON FOLLOWING

PAGES A THRU F

TROUBLE CHART

POWER HEAD

MOTOR FAILS TO START

- **Ignition**
  - Defective Spark Plugs
    - Wrong Type.
    - Fouled or cracked porcelain.
    - Gap (Too Wide / Too Close.
  - Defective Magneto
    - Broken Wires.
    - Loose Connections.
    - Shorted Ground Wire.
    - Breaker Points Out of Adjustment.
    - Breaker Points Pitted.
    - Condenser Defective.
    - Insulation Broken Down.
    - Ignition Coil Defective.
    - Weak or Cracked Magnet.
- **Fuel**
  - Defective Fuel Supply
    - Fuel Improperly Mixed.
    - Fuel Line Obstructed.
    - Screens Clogged.
  - Defective Carburetion
    - Float Valve Stuck.
    - Fuel Jet Clogged.
    - Needle Valve Not Adjusted.
    - Needle Valve Seat Clogged
    - Air Leak—Crank Case Spout Broken.
    - Carburetor Flooded, Crankcase.
    - Carburetor Not Level.
    - Carburetor Float Valve Seat Leaking.
    - Water in Crank Case
- **Assembly**
  - Pistons and Cylinders (Motors with split crank case, OA & OK)
    - Worn Excessively.
  - Crank Shaft and Rods
    - Arrow on Crank Case Aligned with Keyway on Crank Shaft, Pistons Outstretched or At Top Center.
- **Motor Binding**
  - Journal Bearings
    - Reamed Too Close.
    - Out of Line.
  - Crank Shaft
    - Sprung.
    - Twisted.
  - Connecting Rods
    - Not Straight.
    - Twisted.
    - Fitted Too Close.
  - Pistons
    - Fitted Too Close.
    - Out of Round.
  - Piston Rings
    - Gap Too Close.
  - Crank Case
    - Sprung
    - Porous Casting causing leak.
  - Cylinder
    - Not Squarely Mounted.
  - Rotor Valve Gears
    - Meshed Too Close.
  - Rotor Valve
    - Binding.
  - Rotor Valve
    - Not Properly Timed.
- **Gearcase Binding**
  - Gears
    - Meshed Too Close—binding.
  - Propeller and Pinion Shafts
    - Sprung
  - Bearings
    - Reamed Too Close Or Out of Line.

MOTOR HARD TO START

- **Spark Plug**
  - Wrong Type.
  - Gap set too close, too wide.
  - Fouled.
  - Cracked Porcelain.
- **Magneto**
  - Loose Connections—primary.
  - Shorted Wires.
  - Breaker Points Pitted.
  - Breaker Points Loose in Mounting.
  - Breaker Points Gap Incorrect.
  - Breaker Points Not Adjusted with Relation to Position of Cam.
  - Breaker Arm Binding on Post
  - Weak Condenser.
  - Soldered Connections Loose—condenser.
  - Moisture Collected Underneath Coil & Insulation.
  - Broken Glass or Paper Tube.
  - Weak Coil.
- **Fuel**
  - Excessive Oil Content.
  - Improperly Mixed.
  - Water in Fuel
- **Fuel Line**
  - Air Vent Closed—gas tank.
  - Screens Clogged.
  - Fuel Line Obstructed.
- **Carburetor**
  - Not Mounted Level—flooding.
  - Fouled Jets.
  - Air Leak—broken crank case spout.
  - Needle Valve Improperly Adjusted or Closed.
  - Over or Under Choked.
- **Motor Binding**
  - Bearings Fitted Too Close or Out of Line.
  - Crank Shaft, Connecting Rods, sprung or twisted.
  - Crank Case Sprung.
  - Drive Shaft Case Sprung.
  - Fly Wheel Binding on Armature.
- **Cylinder**
  - Excessively Worn, Scored.
  - Exhaust Ports Clogged with Carbon.
- **Piston**
  - Excessively Worn.
  - Scored.
  - Ring Grooves Filled with Carbon.
  - Installed Inverted Position.
- **Piston Ring**
  - Excessively Worn.
  - Gap Too Close or Too Wide.
  - Stuck in Ring Groove.
- **Muffler**
  - Clogged with Carbon. Holes Stopped Up.
  - Exhaust Cut Out Closed.
  - Drive Shaft Casing Clogged with Carbon on A & K 50-65.
- **Rotor Valve**
  - Binding.
  - Incorrectly Timed.
- Water Entering Crank Case up Thru Lower Journal Bearing.

- **FAULTY OPERATION AND MISSING**
  - Fuel Mixture
    - Too Rich
      - Oil content.
    - Too Lean
      - Oil content.
  - Fuel Supply
    - (Partially Obstructed
      - Fuel line.
      - Screen.
      - Carburetor nozzle.
      - Float valve.
      - Needle valve.
  - Carburetor
    - (Not Level—flooding.
  - Ignition
    - Loose Connections.
    - Spark Plug
      - (Wrong Type
    - Breaker Points
      - Pitted.
      - Weak Spring.
      - Arm Binding on Post.
      - Loose in Mounting.
      - Incorrect Timing.
    - Condenser
      - Weak.
      - Loose Connections.
    - Moisture Underneath Insulating Material.
    - Coil
      - Loose Connections.
      - Weak.
      - Broken Glass Tube.
    - Magnet
      - Weak.
      - Cracked.
    - Insulation Worn Off Wires.
  - Assembly
    - Bearings
      - Fitted Too Close.
      - Out of Line.
    - Crank Shaft and Connecting Rod
      - Sprung.
      - Twisted.
      - Out of True.
      - Worn.
    - Piston
      - Worn.
      - Out of Round.
      - Fitted Too Close.
    - Piston Rings
      - Worn.
      - Bound in Ring Groove.
      - Incorrect Gap Adjust.
    - Crank Case
      - Sprung.
      - Porous Casting.
  - Water Entering Crankcase Up Thru Lower Journal Bearing.

OVER-HEATING

- **Water Pump**
  - **Plunger-Vane**
    - Worn.
    - Corroded. Sand.
    - Bound—set screw too tight, (plunger pump).
  - **Spring**
    - Weak.
    - Broken.
  - **Check Valves**
    - Bound.
    - Corroded.
    - Leaking.
    - Filled with Sand.
  - **Housing**
    - Worn.
    - Out of True.
- **Tubes and Fittings**
  - Broken.
  - Corroded.
  - Clogged.
- **Foreign Matter Obstructing Water Circulation.**
- **Over Supply of Grease in Gear Case, J-25, 65, A & A-25.**
- **Fuel Mixture**
  - Insufficient Amount of Oil.
- **Cylinder**
  - Exhaust Ports Clogged with Carbon.
  - Excessively Worn.
  - Water Jackets Corroded–hole leading into cylinder
- **Piston**
  - Excessively Worn.
  - Ring Grooves Filled with Carbon.
  - Piston Rings Bound in Ring Grove.
  - Piston Ring Worn, Insufficient Gap Clearance
- **Bearings**
  - Out of Line.
  - Fitted Too Close.
- **Crank Shaft and Connecting Rods**
  - Sprung.
  - Twisted.
- **Muffler**
  - Clogged with Carbon.
  - Assembled Incorrectly.
  - Water Jacket Porous—leaking.
- **Armature Plate**
  - Clamp Screw Too Tight.
  - Heels Striking Poles of Magnet.

MOTOR KNOCKING

- Carburetor ..... (Set Too Rich at Needle Adjustment.
- Bearings ..... Loose. / Out of Line.
- Crank Shaft ..... Worn. / Sprung. / Excess End Play.
- Connecting Rods Bent. / Twisted. / Bearing Surface Worn.
- Flywheel ..... Loose. Cracked Hub. Worn Keyway. / Striking Heels of Coil. Loose Rivets.
- Spark Plug ..... (Wrong Type—too hot.

SPARK PLUG DIFFICULTIES

- Plug Fouls ..... Fuel Mixture Too Rich—oil content. / Carburetor Set Too Rich. / Wrong Type—too cool. / Water Entering Crank Case. / Rotor Valve Dragging in Housing.
- Plug Burns Out .. Wrong Type—too hot. / Water in Crank Case. / Fuel Mixture Too Lean—oil content. / Carburetor Set Too Lean.
- Motor Knocks..... (Plug Too Hot.

ERRATIC MOTOR OPERATION (Speed Varies.)

- Spark Plug ..... (Too Hot.
- Bearings ..... (Binding.
- Propeller ..... (Pitch Too Great—(cavitation, racing).
- Shock Absorber.... (Slipping.
- Transom of boat... (Too High.
- Gears-gear case... (Meshed too close.
- Cavitation ..... Transom too High. / Keel Interfers. / Grass—Weeds Collected on Gear Case.

GEAR CASE

GEAR DIFFICULTY

- Gears ..... (Improperly Adjusted.
- Bearings ..... Worn. / Reamed Over Size. / Out of Line
- Water in Gear Case ..
  - Propeller Shaft Bearing— (Worn. / Reamed Oversize.
  - Loose Inspection or Grease Plugs.
  - Leaking Water Tubes or Connections (driveshaft)
  - Propeller Shaft Out of True.
  - Cook Seal ..... Leather Washer Don't Slide on Shaft. / Spring Binding or Corroded. / Injured Retainers.
  - SR-PR 60-65.
  - KR-55-65.
  - Injured Gaskets.

WATER IN DRIVE SHAFT CASING (Leaking Water Tubes or Connections (Corrosion).

ELECTRIC STARTING UNITS

- **FAILS TO START**
  - Battery
    - Run Down.
    - Posts Corroded.
  - Wires
    - Loose.
    - Broken.
    - Terminals Corroded.
    - Insulation Worn or Cracked.
  - Switch
    - Contacts Loose.
    - Contacts Pitted-Worn.
    - Contacts Corroded.
  - Starter
    - Loose or Corroded Connections.
    - Excessively Worn Brushes.
    - Commutator Pitted.
    - Brush Holder Loose.
    - Armature Striking Pole Pieces.
    - Armature Shorted.
    - Armature Burned Out.
    - Field Shorted.
  - Ignition
    - Plugs Defective.
    - Breaker Points Pitted—Out of Adjustment
    - Wires—Broken or Loose.
    - Condenser Broken Down.
    - Coil Defective.
    - Switch Defective.
  - Motor
    - Bearings or Gear Case Binding.
- **FAILS TO CHARGE BATTERY**
  - Broken or Loose Wires.
  - Corroded Battery Terminals.
  - Defective Switch.
  - Worn Brushes.
  - Defective Brush Holder.
  - Pitted Armature Segments.
  - Voltage Regulator Out of Adjustment.
  - Grounded Shunt Field.
- **PROPELLER DIFFICULTY**
  - Motor Races
    - Cavitation
      - Keel Interference.
      - Pitch Too Great (racing models).
      - Transom Too High.
    - Pitch Too Low—motor turns above recommended R.P.M.
  - Motor Fails to Turn Up
    - Pitch Too Great.
    - Transom Too Low.
    - Marine Growth on Bottom of Hull.

SECTION THREE

SPECIFICATIONS

USEFUL TABLES AND SIZES

MOTOR SERIAL NUMBERS—YEAR MODELS WERE MANUFACTURED

Serial Number	Year Built	Model
501 to 3,930	1922	A
Note: About 100 motors were built in late 1921.		
3,931 to 7,500	1923	A
		BN
7,501 to 20,000	1924	A
		AS
		BN
20,001		A-25
to	1925	AB-25
30,559		J-25
30,560		A-25
to	1926	AB-25
44,977		J-25
		P-30
44,978	1927	A-35
to		J-25
65,524		P-35
		K-35
65,525	1928	A-35
to		J-25
96,408		K-40
		P-40
		TR-40
		KR-40
		PR-40
96,409	1929	A-45
to		J-25
128,000		K-45
		P-45
		S and SR-45
		V and VR-45
		TR-40
128,001	1930	J-25
to		A-50
152,777		K-50
		S-45
		SR-50
		P-50
		PR-50
		V-45
		VR-50
		SE-50
		PE-50
		VE-50
		PA-50
		VA-50
152,778		J-25
to	1931	A-50
161,326		K-50
		OA-55
		OK-55
		S-45
		SR-55
		P-50
		PR-55
		V-45
		VR-55
		XR-55
		KR-55
		SE-50
		PE-50
		VE-50
		PA-50
		VA-50
161,327		J-25
to	1932	A-50
167,430		K-50
		OA-60
		OK-60
		S-45
		SE-50
		SR-60
		P-50
		PE-50
		PR-60
		V-45
		VE-50
		VA-50
		KR-55

Note: The foregoing table shows the year in which the motors were manufactured, and not the year they were sold by the territorial dealer. A number of the various models were manufactured for several years, and it is possible that some of these motors were carried by dealers for a period of time after they were built, before being sold. However, motors with the same model number are identical, regardless of the year manufactured.

TYPES OF ALL JOHNSON MOTORS BUILT BY JOHNSON MOTOR COMPANY FROM 1921 TO 1933 INCLUSIVE

Note: A number of the following models of motors are not listed in other tables, charts and instructions in this book, in view of the specifications being the same as standard make motors, except for the following:

MOTOR SERIAL NUMBERS AND YEAR MODELS WERE MANUFACTURED

Serial No.	Year Built	Model
167,431 to 208,583	1933	A-65 J-65 K-65 OA-65 S-65 P-65 V-65 PR-65 SR-65 KR-55
208,584 to 219,371	1934	A-70 J-70 F-70 K-70 KR-70 P-70 S-70 SR-70 V-70
219,372 to 232,156	1935	A-75 J-75 K-75 F-75 P-75 300
232,157 to 252,675	1936	A-80 J-80 K-80 P-80 100 200 300
252,676 to 283,888	1937	AA-37 KA-37 110 210 300 PO-37 LT-DT-37 LS-DS-37 OK-75

A Motors (1922 and 23 Model)

A	Light Twin (freshwater)
C	With Canoe Bracket (freshwater)
AL	Extra Long (freshwater)
BN	Saltwater (Bronze Lower Unit)
BNL	Extra Long Salt Water (Bronze Lower Unit)
DN	Salt Water with Canoe Bracket (Bronze Lower Unit)
AS	Light Twin with Shock-Absorber
ALS	Extra Long with Shock-Absorber
BNS	Salt Water Motor with Shock-Absorber (Bronze Lower Unit)
BNLS	Extra Long Saltwater with Shock-Absorber (Bronze Lower Unit)

J Motors

J-25	Single Cylinder Motor—Sea Horse Single
JC-25	With Canoe Bracket

A-25 Motors (1925 and 26 Model)

A-25	Fresh Water Motor
AC-25	With Canoe Bracket
ABC-25	Salt Water with Canoe Bracket (Bronze Lower Unit)
ABCL	Extra Long Salt Water Motor with Canoe Bracket (Bronze Lower Unit)
AL-25	Extra Long
AB-25	Salt Water Motor (Bronze Lower Unit)
ABL	Extra Long Salt Water Motor (Bronze Lower Unit)
ACL-25	Extra long with Canoe Bracket

A-35 Motors (1927 and 28 Models)

A-35	Light Twin
AL-35	Extra Long Motor
AC-35	With Canoe Bracket
ACL-35	Extra Long with Canoe Bracket

A-45 Motors (1929 Model)

A-45	Sea Horse "3" Motor
AL-45	Extra Long
AC-45	With Canoe Bracket
ACL-45	Extra Long with Canoe Bracket

OK-55 Motors (1931 Model)

OA-55	Light Twin (1931 Model)
OAL-55	Light Twin (1931 Model)

OK-55 Motors (1932 Model)

OK-55	Standard Twin (1931 Model)
OKL-55	Standard Twin (1931 Model)

Light Twin (1932 Model)

OAL--60	Light Twin Extra Long Drive Shaft Housing
OK-60	Standard Twin (1932 Model)
OKL-60	Standard Twin Long Drive Shaft Housing

A-50 Motors (1930, 31 and 32 Models)

A-50	Sea Horse "4" Motor
AL-50	Extra Long
AC-50	With Canoe Bracket
ACL-50	Extra Long with Canoe Bracket
AXL-50	Special Long Motor for Cod Fish Boats

K-35 Motors (1927)

K-35	Standard Twin Motor
KL-35	Extra Long

K-40 Motors (1928)

K-40	Standard Twin Motor
KL-40	Extra Long Motor
KR-40	Racing Motor

K-45 Motors (1929)

K-45	Sea Horse "10" (with underwater exhaust)
KF-45	Full pivot (less underwater exhaust)
KFL-45	Extra Long Full Pivot (less underwater exhaust)
KL-45	Extra Long Motor

K-50 Motors (1930, 31 and 32)

K-50	Sea Horse "12" Motor
KL-50	Extra Long

P-30 Motors (1926)

P-30	Big Twin Motor
PB-30	Salt Water (Bronze Lower Unit)
PL-30	Extra Long
PBL-30	Extra Long Salt Water (Bronze Lower Unit)
PF-30	Cruiser Motor
PBF-30	Salt Water Cruiser Motor (Bronze Lower Unit)

P-35 Motors (1927)

P-35	Big Twin Motor
PL-35	Extra Long
B-35	Aquaflier Motor

P-40 Motors (1928)

P-40	Big Twin Motor
PL-40	Extra Long
PR-40	Racing Motor

P-45 Motors (1929)

P-45	Sea Horse "14" with underwater exhaust
PL-45	Extra Long
PF-45	Full Pivot (less underwater exhaust)
PFL-45	Extra Long Full Pivot (less underwater exhaust)

P-50 Motors (1930)

P-50	Sea Horse "24" Motor (with magneto)
PL-50	Extra Long
PR-50	Racing Motor
PE-50	Electric Starting
PA-50	Electric Starting (Aquaflier Motor less Gas Tank)
PEL-50	Extra Long (Electric Starting)

TR-40 Motors (1928)

TR-40	Giant Twin Motor
TRL-40	Extra Long

S Motors "45" Models (1929)

S-45	Sea Horse "16" Motor
SL-45	Extra Long
SR-45	Racing Motor

S Motors "50" Models (1929)

SR-50 Racing Motor
SE-50 Electric Starting
SL-50 Extra Long (with magneto)
SEL-50 Extra Long (Electric Starting)

S Motor "60" Model (1932)

SR-60 Sea Horse "16" Racing

V Motors "45" Models (1929)

V-45 Sea Horse "32" Motor
VL-45 Extra Long
VR-45 Racing Motor

V Motors "50" Models (1930, 31 and 32)

VE-50 Sea Horse "32" Motor (Electric Starting)
VL-50 Extra Long (with magneto)
VA-50 Electric Starting (Aquaflier Motor less Gas Tank)
VR-50 Racing Motor

K Motor "55" Model (1931 and 1932)

KR-55 Sea Horse "12" Motor (Racing Model)

S Motor "55" Model (1931)

SR-55 Sea Horse "16" Motor (Racing Model)

P Motor "55" Model (1931)

PR-55 Sea Horse "24" Motor (Racing Model)

P Motor "60" Model (1932)

PR-60 Sea Horse "24" Racing

P Motor "65" Model (1933)

PR-65 Racing
XR-55 Sea Horse 50 Model (1931) Racing

J-65 Single Cylinder (1933)
JC-65 Single Cylinder with Canoe Bracket

OA-65 Light Twin (1933)
OAL-65 Light Twin with long Drive Shaft Casing

A-65 Alternate Firing Light Twin (1933)
AL-65 Alternate Firing Light Twin with Long Drive Shaft Casing

AC-65 Alternate Firing Light Twin with Canoe Bracket
ACL-65 Alternate Firing Light Twin with Canoe Bracket and Long Drive Shaft Housing
AXL-65 Alternate Firing Light Twin with Special Long Drive Shaft Housing

K-65 Alternate Firing Twin (1933)
KL-65 Alternate Firing Twin with Long Drive Shaft Housing
S-65 1933 Service Model
SL-65 1933 with long Drive Shaft Housing
SR-65 1933 Racing Model

P-65 1933 Service Model
PL-65 1933 Service Model with Long Drive Shaft Housing
PR-65 1933 Racing Model

V-65 1933 Service Model
VL-65 1933 Service Model with Long Drive Shaft Housing

MOTOR SPECIFICATIONS

Model	Bore	Stroke	Cu. Inches	Gear Ratio	RPM	Horsepower	Net Weight
J-25	2	1½	4.71	14.19	2700	1.5	27 lbs.
J-65	2	1½	4.71	14.19	3000	*1.4	27 lbs.
A	2	1½	9.42	14.19	2250	2	35 lbs.
A-25	2	1½	9.42	14.19	2400	2 plus	35 lbs.
A-35	2	1½	9.42	14.24	2600	2½	37 lbs.
A-45	2	1½	9.42	14.24	2700	3	38 lbs.
A-50	1⅞	1½	8.28	14.24	3500	4	45 lbs.
A-65	1⅞	1½	8.28	14.24	4000	*4.1	46 lbs.
OA-55	2	1½	9.42	14.24	2800	3	45 lbs.
OA-60	2	1½	9.42	14.24	2800	3	45 lbs.
OA-65	2	1½	9.42	13.21	3000	*2.8	41½ lbs.
K-35	2 5/16	2 1/16	17.32	14.24	2750	6	60 lbs.
K-40	2⅜	2¼	19.93	14.24	3500	7.15	61 lbs.
KR-40	2⅜	2¼	19.93	14.24	3700	9	61 lbs.
K-45	2⅜	2¼	19.93	14.24	3500	7.15	63 lbs.
K-50	2⅛	1 31/32	13.96	14.24	3500	8	60 lbs.
K-65	2⅛	1 31/32	13.96	14.24	4000	*9.2	63 lbs.
OK-55	2⅜	2¼	19.93	14.24	2800	8	60 lbs.
OK-60	2⅜	2¼	19.93	14.24	2800	7	70 lbs.
P-30	2⅞	1¾	22.7	14.20	2500	6	80 lbs.
P-35	2 11/16	2 7/16	27.5	14.20	2750	8	83 lbs.
P-40	2 11/16	2⅝	29.78	14.20	3700	13.15	85 lbs.
PR-40	2 11/16	2⅝	29.78	14.20	3800	16.5	85 lbs.
P-45	2 11/16	2⅝	29.78	14.20	3000	12	87 lbs.
TR-40	3	3½	49.48	14.20	3500	25.75	110 lbs.
S-45	2⅜	2¼	19.93	12.21	4000	13	99 lbs.

Model	Bore	Stroke	Cu. Inches	Gear Ratio	RPM	Horsepower	Net Weight
S-65	2⅜	2¼	19.93	12.21	4000	*13.3	102 lbs.
V-45	2⅜	2¼	39.86	12.21	4000	26	120 lbs.
V-65	2⅜	2¼	39.86	12.21	4000	*26.1	133 lbs.
P-50	2¾	2.52	29.92	12.21	3500	20	102 lbs.
P-65	2¾	2.52	29.92	12.21	4000	*21.4	114 lbs.
KR-55, 65	2⅛	1 31/32	13.96	12.19	5500	12	60 lbs.
SR-45	2⅜	2¼	19.93	12.21	5200	16	102 lbs.
SR-50	2⅜	2¼	19.93	12.21	5200	16	103 lbs.
SR-55	2⅜	2¼	19.93	12.21	5500	18	103 lbs.
PR-50	2¾	2.52	29.92	12.21	5000	24	113½ lbs.
PR-55	2¾	2.52	29.92	12.21	5500	27	113½ lbs.
VR-45	2⅜	2¼	39.86	12.21	5200	32	138 lbs.
VR-50	2⅜	2¼	39.86	12.21	5200	32	139 lbs.
VR-55	2⅜	2¼	39.86	12.21	5500	36	138 lbs.
XR-55	2 21/32	2¼	49.87	12.21	5500	50	144 lbs.
SE-50	2⅜	2¼	19.93	12.21	4000	13	146 lbs.
PE-50	2¾	2.52	29.92	12.21	3500	20	154 lbs.
VE-50	2⅜	2¼	39.86	12.21	4000	26	182 lbs.

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CYLINDER HEAD DEPTHS

Model Motor	Depth of Cylinder Head	Model Motor	Depth of Cylinder Head
S-45	61/64"	PR-55	1-1/16"
SR-45	25/32"	XR-55	15/16"
V-45	61/64"	VR-55	13/16"
VR-45	25/32"	KR-55	23/32"
SE-50	27/32"	S-65	23/32"
SR-50	23/32"	SR-60	13/16"
VE-50	27/32"	V-65	27/32"
VR-50	23/32"	P-65	15/16"
P-50	15/16"	PR-60	15/16"
PE-50	15/16"	KR-65	27/32"
PR-50	13/16"		
SR-55	13/16"		

(Note: Other model motors do not have detachable cylinder heads)

SPARK PLUG RECOMMENDATIONS

Motor Model	Our Part No.	Spark Plug Recommended	Other Plugs that can be Substituted
All Single Cyl. models	76-40	AC-N-1	Champion No. C-7
A to A-45 Inclusive Old Light Twin	76-40	AC-N-1	Champion No. C-7
A-50 Sea Horse "4" and A-65 Models	76-112	Champion No. 18	AC No. 4½
K-35 to K-45 Inclusive Old Standard Twin	76-131	Champion R-7	AC No. 4½
K-50 Sea Horse "12" and K-65 Models	76-131	Champion R-7	AC No. 4½
P-30 to P-45 Inclusive Old Big Twins	76-131	Champion R-7	AC No. 4½
P-50 Sea Horse "24" and P-65 Models	76-131	Champion R-7	AC No. 4½
All "S" Models Sea Horse "16"	76-131	Champion R-7	AC No. 4½
TR-40 Giant or Sea Horse "25"	76-131	Champion R-7	AC No. 4½
All "V" Models Sea Horse "32"	76-131	Champion R-7	AC No. 4½
All OA Motors Std. Light Twins	76-40	AC-N-1	Champion No. C-7
All OK Motors Standard Twins	76-131	Champion R-7	AC No. 4½
Racing Motors	76-179	R-1-V	We recommend Champion R-1-V for all ordinary racing motors.
PR-60	76-130	R-11	Where special racing fuels are used and motors turning exceptionally fast.

Note: The correct spark plugs to use in any motor depends upon kind of service to which the motor is subjected.

Spark plugs furnished in motor, as regular equipment, are for ordinary service.

Should you use the motor on extremely light weight fast boats and operate it at top speed for hours, some motors may burn plugs, now and then, and it may be necessary to use slightly colder plugs.

At extreme slow trolling speeds some plugs have a tendency to foul; from oil not burning off the porcelain—in such cases, a warmer plug may be required, likewise this plug would get too hot running at full speed. This is a case of extreme heat range and may be hard to control by the use of one plug.

MOTOR SPECIFICATIONS

Model	Bore	Stroke	Cu. Inches	Gear Ratio	R.P.M.	Horsepower	Net Weight
J-25	2"	1 1/2"	4.71	14.19	2700	1.5	27 lbs.
J-65	2"	1 1/2"	4.71	14.19	3000	*1.4	27 lbs.
J-70	2"	1 1/2"	4.71	14.19	3000	*1.4	28 3/4 lbs.
J-75	2"	1 1/2"	4.71	14.19	3000	*1.4	29 1/4 lbs.
J-80	2"	1 1/2"	4.71	14.25	3300	*1.7	28 1/2 lbs.
A	2"	1 1/2"	9.42	14.19	2250	2	35 lbs.
A-25	2"	1 1/2"	9.42	14.19	2400	2 plus	35 lbs.
A-35	2"	1 1/2"	9.42	14.24	2600	2 1/2	37 lbs.
A-45	2"	1 1/2"	9.42	14.24	2700	3	38 lbs.
A-50	1 7/8	1 1/2"	8.28	14.24	3500	4	45 lbs.
A-65	1 7/8	1 1/2"	8.28	14.24	4000	*4.1	46 lbs.
A-70	1 7/8"	1 1/2"	8.28	14.24	4000	*4.1	46 lbs.
A-75	1 7/8"	1 1/2"	8.28	14.24	4000	*4.5	48 lbs.
A-80	1 7/8"	1 1/2"	8.28	14.24	4000	*4.5	48 lbs.
AA-37	1 7/8"	1 1/2"	8.28	14.24	4000	*4.5	48 lbs.
F-70	2"	1 1/2"	9.42	14.24	3000	*3.3	43 lbs.
F-75	2"	1 1/2"	9.42	14.24	3000	*3.3	43 lbs.
OA-55	2"	1 1/2"	9.42	14.24	2800	3	45 lbs.
OA-60	2"	1 1/2"	9.42	14.24	2800	3	45 lbs.
OA-65	2"	1 1/2"	9.42	13.21	3000	*2.8	41 1/2 lbs.
K-35	2 5/16"	2 1/16"	17.32	14.24	2750	6	60 lbs.
K-40	2 3/8"	2 1/4"	19.93	14.24	3500	7.15	61 lbs.
KR-40	2 3/8"	2 1/4"	19.93	14.24	3700	9	61 lbs.
K-45	2 3/8"	2 1/4"	19.93	14.24	3500	7.15	63 lbs.
K-50	2 1/8"	1 31/32"	13.96	14.24	3500	8	60 lbs.
K-65	2 1/8"	1 31/32"	13.96	14.24	4000	*9.2	63 lbs.
K-70	2 1/8"	1 31/32"	13.96	14.24	4000	*9.2	63 lbs.
K-75	2 1/8"	1 31/32"	13.96	14.24	4000	*9.3	64 lbs.
K-80	2 1/8"	1 31/32"	13.96	14.24	4000	*9.3	64 lbs.
KA-37, 38	2 1/8"	1 31/32"	13.96	14.24	4000	*9.3	64 lbs.
KA-39	2 1/8"	1 31/32"	13.96	14.24	4000	*9.8	64 lbs.
OK-55	2 3/8"	2 1/4"	19.93	14.24	2800	8	60 lbs.
OK-60	2 3/8"	2 1/4"	19.93	14.24	2800	7	70 lbs.
OK-75	2 3/8"	2 1/4"	19.93	14.24	2800	8.1	70 lbs.
P-30	2 7/8"	1 3/4"	22.7	14.20	2500	6	80 lbs.
P-35	2 11/16"	2 7/16"	27.5	14.20	2750	8	83 lbs.
P-40	2 11/16"	2 5/8"	29.78	14.20	3700	13.15	85 lbs.
PR-40	2 11/16"	2 5/8"	29.78	14.20	3800	16.5	85 lbs.
P-45	2 11/16"	2 5/8"	29.78	14.20	3000	12	87 lbs.
P-50	2 3/4"	2.52"	29.92	12.21	3500	20	102 lbs.
P-65	2 3/4"	2.52"	29.92	12.21	4000	*21.4	114 lbs.
P-70	2 3/4"	2.52"	29.92	12.21	4000	*21.4	114 lbs.
P-80	2 3/4"	2.52"	29.92	12.21	4000	*22.0	109 lbs.
P-75	2 3/4"	2.52"	29.92	12.21	4000	*22.0	109 lbs.
PO-37, 38	2 3/4"	2.52"	29.92	12.21	4000	*22.0	109 lbs.
PO-39	2 3/4"	2.52"	29.92	12.21	4000	*22.0	109 lbs.
TR-40	3"	3 1/2"	49.93	14.20	3500	25.75	110 lbs.
S-45	2 3/8"	2 1/4"	19.93	12.21	4000	13	99 lbs.
S-65	2 3/8"	2 1/4"	19.93	12.21	4000	*13.3	102 lbs.
S-70	2 3/8"	2 1/4"	19.93	12.21	4000	*13.3	102 lbs.
V-45	2 3/8"	2 1/4"	39.86	12.21	4000	26	120 lbs.
V-65	2 3/8"	2 1/4"	39.86	12.21	4000	*26.1	133 lbs.
V-70	2 3/8"	2 1/4"	39.86	12.21	4000	*26.1	133 lbs.
KR-55, 65	2 1/8"	1 31/32"	13.96	12.19	5500	12	60 lbs.

MOTOR SPECIFICATIONS - Con't.

Model	Bore	Stroke	Cu. Inches	Gear Ratio	R.P.M.	Horsepower	Net Weight
KR-70	2 1/8"	1 31/32"	13.96	12.19			60 lbs.
KR-80	2 1/8"	1 31/32"	13.96	12.19			63 1/2 lbs.
KR-38	2 1/8"	1 31/32"	13.96	12.19			63 1/2 lbs.
SR-45	2 3/8"	2 1/4"	19.93	12.21	5200	16	102 lbs.
SR-50	2 3/8"	2 1/4"	19.93	12.21	5200	16	103 lbs.
SR-55	2 3/8"	2 1/4"	19.93	12.21	5500	18	103 lbs.
SR-70	2 3/8"	2 1/4"	19.93	13.19			104 lbs.
SR-80	2 3/8"	2 1/4"	19.93	13.19			113 1/2 lbs.
SR-38	2 3/8"	2 1/4"	19.93	13.19			113 1/2 lbs.
PR-50	2 3/4"	2.52"	29.92	12.21	5000	24	113 1/2 lbs.
PR-55	2 3/4"	2.52"	29.92	12.21	5500	27	113 1/2 lbs.
VR-45	2 3/8"	2 1/4"	39.86	12.21	5200	32	138 lbs.
VR-50	2 3/8"	2 1/4"	39.86	12.21	5200	32	139 lbs.
VR-55	2 3/8"	2 1/4"	39.86	12.21	5500	36	138 lbs.
XR-55	2 21/32"	2 1/4"	49.87	12.21	5500	50	144 lbs.
SE-50	2 3/8"	2 1/4"	19.93	12.21	4000	13	146 lbs.
PE-50	2 3/4"	2.52"	29.92	12.21	3500	20	154 lbs.
VE-50	2 3/8"	2 1/4"	39.86	12.21	4000	26	182 lbs.
100, 110	2"	1 1/2"	4.71	13.19	3300	*1.7	24 3/4 lbs.
200, 210	2"	1 1/2"	9.4	13.19	3300	*3.3	38 3/4 lbs.
300	1 7/8"	1 3/8"	7.59	14.25	4000	*3.7	37 lbs.
LT-37, 38	1 7/8"	1 1/2"	8.28	14.25	4000	*4.2	40 lbs.
DT-37, 38	1 7/8"	1 1/2"	8.28	14.25	4000	*4.2	45 lbs.
LS-37, 38	1 7/8"	1 1/2"	4.14	14.25	4000	*2.1	33 lbs.
DS-37, 38	1 7/8"	1 1/2"	4.14	14.25	4000	*2.1	39 lbs.
MD-38, 39	1 3/8"	1 3/8"	2.04	13.20	4000	*1.1	21 lbs.
MS-38, 39	1 3/8"	1 3/8"	2.04	13.20	4000	*1.1	17 lbs.
HD-39	1 3/8"	1 3/8"	4.08	13.20	4000	*2.5	28 lbs.
HA-39	1 3/8"	1 3/8"	4.08	13.20	4000	*2.5	26 lbs.
HS-39	1 3/8"	1 3/8"	4.08	13.20	4000	*2.5	21 1/2 lbs.
DT-39	1 15/16"	1 1/2"	8.84	14.25	4000	*5.0	42 1/2 lbs.
AT-39	1 15/16"	1 1/2"	8.84	14.25	4000	*5.0	38 lbs.
LT-39	1 15/16"	1 1/2"	8.84	14.25	4000	*5.0	33 1/2 lbs.

*Certified Brake Horsepower
N.O.A.

Motor Specification

Model Motor	Bore	Stroke	Cu. Inches	Gear Ratio	R.P.M.	Horse Power	Weight
J-70	2"	1½"	4.71	14 to 19	3000	1.4	28¾ lbs.
J-75	2"	1½"	4.71	14 to 19	3000	1.4	29¼ lbs.
J-80	2"	1½"	4.71	14 to 25	3300	1.7	28½ lbs.
F-70	2"	1½"	9.42	14 to 19	3000	3.3	43 lbs.
F-75	2"	1½"	9.42	14 to 25	3000	3.3	43 lbs.
A-70	1 7/8"	1½"	8.28	14 to 24	4000	4.1	46 lbs.
A-75	1 7/8"	1½"	8.28	14 to 24	4000	4.5	48 lbs.
A-80	1 7/8"	1½"	8.28	14 to 24	4000	4.5	48 lbs.
AA-37	1 7/8"	1½"	8.28	14 to 24	4000	4.5	48 lbs.
K-70	2 1/8"	1 31/32"	13.96	14 to 24	4000	9.2	63 lbs.
K-75	2 1/8"	1 31/32"	13.96	14 to 24	4000	9.3	64 lbs.
K-80	2 1/8"	1 31/32"	13.96	14 to 24	4000	9.3	64 lbs.
KA-37,38	2 1/8"	1 31/32"	13.96	14 to 24	4000	9.3	64 lbs.

Model Motor	Our Part No.	Recommended	Substitute
J-25, 65, 70, 75, 80	#76-40	Champion #C7	
A & A-25 to A-45	#76-40	Champion #C7	
A-50, 65, 70, 75, 80, AA-37	#76-112	Champion #5M	AC #G5
OA-55, 60, 65	#76-40	Champion #C7	
OK-55, 60, 75	#76-131	Champion #R7	AC #G3
F-70, 75	#76-334	Champion #C7	AC #G8
K-35, 40, 45	#76-131	Champion #R7	AC #G3
K-50, 65, 70, 75, 80 KA-37, KA-38	#76-131	Champion #R7	AC #G3
KA-39	#76-112	Champion #5M	AC #G5
P-30	#76-40	Champion #C7	
P-35, 40, 45, 50, 65 70, 75, 80, PO-37, 38, 39	#76-131	Champion #R7	AC #G3
TR-40 (Giant)	#76-131	Champion #R7	AC #G3
S-45, 65, 70	#76-131	Champion #R7	AC #G3
V-45, 65, 70	#76-131	Champion #R7	AC #G3
LS-37, LS-38, DS-37, DS-38	#76-152	Champion #J8	AC #K7
LT-37, 38, 39, DT-37, 38 39, AT-39	#76-152	Champion #J8	AC #K7
M^{S}-38, 39, MD-38, 39	#76-152	Champion #J8	AC #K7
HS-39, HA-39, H^{D}-39	#76-152	Champion #J8	AC #K7
100, 110	#76-152	Champion #J8	AC #K9 (14MM)
200, 210	#76-334	Champion #C7	AC #G8
300	#76-140	Champion #J6 (14MM)	AC #K9 (14MM)
Racing Motors	#76-179	Champion #R1	
Racing Motors	#76-130	Champion #R11	

CORRECT STERN HEIGHTS

Model Motor	Stern Height
J-70, 75, 80	15"
F-70, 75	15"
300	15"
A-70, 75, 80, AA-37	14"
K-70, 75, 80, KA-37, KA-38	15 3/8"
S-70	16"
P-70, 75, 80, PO-37, PO-38	16½"
V-70	16"
KR-70, 80	13½"
SR-70, 80	13¼"
100, 110	15"
200, 210	15"
LS, DS-37, LS, DS-38	15"
LT, DT-37, LT, DT-38	15"
OK-75	15"

SPARK PLUG RECOMMENDATION - 1934, 35, 36, 37, 38 MOTORS

Model Motor	Our Part No.	Recommended	Substitute
J-70, 75	#76-40	AC N-1 (Titan)	Champion #C7
J-80	#76-152	Champion #J8 (14MM)	AC #K9 (14MM)
A-70, 75, 80	#76-112	Champion #5 M	AC #G-5
AA-37	#76-112	Champion #5M	
100, 110	#76-152	Champion #J8 (14MM)	AC #K9 (14 MM)
200, 210	#76-334	Champion #C-7	AC #G8
300	#76-152	Champion #J-8	AC #K9 (14 MM)
K-70, 75, 80, KA-37, KA-38	#76-131	Champion #R7	AC #G3
S-70	#76-131	Champion #R7	AC #G3
P-70, 75, 80, PO-37, PO-38	#76-131	Champion #R7	AC #G3
V-70	#76-131	Champion #R7	AC #G3
LS, DS-37, LS, DS-38	#76-152	Champion #J8	AC #45
LT, DT-37, LT, DT-38	#76-152	Champion #J8	AC #45
OK-75	#76-131	Champion #R7	AC #G3
KR-70, 80	#76-179	Champion #R1	
SR-70, 80	#76-179	Champion #R1	
100, 200, 300 series Iron Horse	#53-110	Champion #7	
300 series Iron Horse Generator	#53-110	Champion #7	
400 series Iron Horse	#53-301	Champion #J8	
400 series Iron Horse Generator	#53-301	Champion #J8	
MS, MD-38	#76-152	Champion #J8	AC #45

CORRECT STERN HEIGHTS

The correct stern height of a boat is an important factor in operation of an outboard motor. The stern should be of such height as to allow the propeller to operate with no cavitation and with the greatest possible forward speed of the boat.

The stern height of a boat is measured from top to bottom of the boat--outside measurement.

The following is a table of the correct height of sterns for various Johnson outboard motors:

Model	Stern Height
J-25 & J-65	14 inches
J-70, 75 & 80	15 "
F-70 & 75	15 "
A-25, 35, 40, 45, 50, 65, 70, 75, 80 & AA-37	14 "
OA-55, 60 & 65	14 "
OK-55, 60 & 75	15 "
K-40, 45, 50, 65, 70, 75 & 80	15 "
KA-37, KA-38, KA-39 & 10, KS & KD-15	15 "
P-40, 45, 50 & 65	16 "
P-70, 75, 80, PO-37, 38 & 39, PO-10 & 15	15 "
TR-40	16 "
S-45, 50, 65 & 70	16 "
SE-50	16 "
PE-50	16 "
V-45, 50, 65 & 70	16 "
VE-50, VA-50	16 "
SR-45, 50 & 55	14 "
VR-45, 50 & 55	14 "
PR-50 & 55	14 "
XR-55	14 "
SR-60, 65, 70, 80, SR-38 & 39	13½ "
PR-60 & 65	13½ "
KR-70, 80, KR-38 & 39	13½ "
300	15 "
100, 110	15 "
200, 210	15 "
LS-37 & 38, DS-37 & 38	15 "
LT-37, 38, 39 & 10, DT-37, 38, 39 & 10	15 "
MS-38, 39, 10, 15 & 20, MD-38, 39, 10, 15 & 20	15 "
HS-39, 10, 15 & 20, HA-39, 10 & 15 HD-39, 10, 15 & 20	15 "
TS & TD-15	15 "
SD-10	15 "

OILING SPECIFICATION - 1934, 35, 36, 37, 38 MOTORS

Mobiloil "A" or any good grade S.A.E. No. 40 oil of similar character and made by a reputable concern.
Gasoline containing Ethyl Lead can be used successfully although it is not essential.
High test gasoline is not beneficial in easy starting of Johnson Motors.

Model Motor	
J-70, 75, 80	½ pt. S.A.E. #40 to 1 gal. gas
F-70, 75	½ pt. S.A.E. #40 to 1 gal. gas
A-70, 75, 80, AA-37	½ pt. S.A.E. #40 to 1 gal. gas
100, 110	½ pt. S.A.E. #40 to 1 gal. gas
200, 210	½ pt. S.A.E. #40 to 1 gal. gas
300	½ pt. S.A.E. #40 to 1 gal. gas
K-70, 75	3/4 pt. S.A.E. #40 to 1 gal. gas
K-80, KA-37, KA-38	1 pt. S.A.E. #40 to 1 gal. gas
S-70	1 pt. S.A.E. #40 to 1 gal. gas
P-70, 75, 80, PO-37, PO-38	1 pt. S.A.E. #40 to 1 gal. gas
V-70	1 pt. S.A.E. #40 to 1 gal. gas
LS, DS-37, LS, DS-38, MS-38	½ pt. S.A.E. #40 to 1 gal. gas
LT, DT-37, LT, DT-38, MD-38	½ pt. S.A.E. #40 to 1 gal. gas
KR-70, 80	1½ pt. Mobiloil "B"or S.A.E. #50 to 1 gal. gas
SR-70, 80	2 pt. Mobiloil "B"or S.A.E. #50 to 1 gal. gas

GREASE CAPACITY OF GEARCASE

Model Motor	Grease Necessary
J-70	3 Ounces
J-75, J-80	4 "
F-70	3 "
F-75	4 "
A-70, A-75, A-80, AA-37	7½ "
K-70, K-75, K-80, KA-37, KA-38	9 "
S-70	12 "
P-70, P-75, P-80, PO-37, PO-38	15 "
V-70	15 "
KR-70, KR-80	5 "
SR-70, SR-80	9 "
OK-75	12 "
100, 110	3½ "
200, 210	3½ "
300	4 "
LT-37, DT-37, LT-38, DT-38	3 "
LS-37, DS-37, LS-38, DS-38	3 "
MD-38	1½ "
MS-38	1½ "

Mobiloil Marine light heavy or Mobiloil "AF" or an S.A.E. No. 40 of similar character and manufactured by a reputable concern.

Quantity of Oil per Gallon of Gasoline	Model
1/2 Pint S.A.E. #40	(Single Cylinder (J-25, 65, 70, 75, 80, 100, 110, LS-37, DS-37 (MS-38, MD-38, MS-39, MD-39 (Light Twins (A, BN, A-25, 35, 45, OA-55, 60, 65, F-70, 75 (200, 210 (Alternate Firing Light Twins (A-50, 65, 70, 75, 80, AA-37, LT-37, DT-37, LT-38, (DT-38, LT-39, DT-39, AT-39, HS, HA, HD-39 (Model 300 (Standard Twin K-35
3/4 Pint S.A.E. #40	(Standard Twins (K-40, 45, OK-50, 60, 75 (Alternate Firing Twins (K-50, 65 & 70 (Big Twins (P-30,& 35
1 Pint S.A.E. #40	(Alternate Firing Twin (K-75, 80 & KA-37, KA-38 & KA-39 (Big Twins (P-40 & 45 (Sea Horse (S-45, 50, 65, 70, SE & SA-50 (P-50, 65, 70, 75, 80, PE & PA-50, & PO-37, 38, 39 (V-45, 50, 65, 70, VE & VA-50 (Giant Twin (TR-40
1 1/2 Pint S.A.E. #50	(All KR Racing Models
2 Pints S.A.E. #50	(All SR, PR, VR & XR Racing Models

Be sure correct quantity of oil is mixed thoroughly with each gallon of gas before pouring into gasoline tank. Use only FRESH gasoline to eliminate gasoline gum.

Arvid Olson - Service Manager

GREASE CAPACITY OF GEARCASES

Model Motor	Grease Necessary	Model Motor	Grease Necessary	Model Motor	Grease Necessary	Model Motor	Grease Necessary
J-25 & 65	3 oz.	TR-40	11 oz.	KR-40	9 oz.	VR-45	10 oz.
A	3 oz.	S-45 & 65	12 oz.	K-45	9 oz.	VR-50	10 oz.
A-25	3 oz.	V-45 & 65	15 oz.	K-50 & 65	9 oz.	VR-55	10 oz.
A-35	7½ oz.	P-50 & 65	15 oz.	OK-55 & 60	12 oz.	XR-55	10 oz.
A-45	7½ oz.	KR-55	5 oz.	P-30	15 oz.	SE-50	12 oz.
A-50 & 65	7½ oz.	SR-45	9 oz.	P-35	13 oz.	PE-50	15-oz.
OA-55, 60 & 65	9 oz.	SR-50	9 oz.	P-40	13 oz.	VE-50	15 oz.
K-35	9 oz.	SR-55	9 oz.	PR-40	13 oz.	OA-60 & 65	9 oz.
K-40	9 oz.	PR-55	10 oz.	P-45	13 oz.	OK-60	12 oz.

MOTOR LUBRICATION

Lubrication is the most important factor in the operation of internal combustion engines. Correct lubrication insures long life and satisfactory performance, whereas, incorrect lubrication invariably results in premature wear and unnecessary expense.

The cylinders, pistons, crankshaft and connecting rod bearings are lubricated by mixing the oil with the gasoline.

The following instructions therefore, should be carefully observed if you wish to obtain the maximum of service from the motor.

There are two conditions entering into the lubrication of Johnson Motors; one for ordinary service when the motor is used with the muffler and all equipment installed; the other for high speed, in racing trim, where high speed is desired on light fast boats.

Never attempt (except in emergency) to mix the oil with the gasoline in the motor tank, as the oil will settle to the bottom of the tank before becoming thoroughly mixed with the gasoline, clogging the gas line and carburetor. Measure the proportions carefully as directed in the following "Fuel Proportions" and shake the mixture thoroughly in a separate container. A good five gallon can, a pint measure with a fine brass screen soldered in it, are good investments. Never (except in emergency) fill the motor tank without straining the fuel.

OILING INSTRUCTIONS

Make sure of the type of motor you have before mixing the oil and gasolne. Then consult the following tables for that particular type:

OILING FOR ORDINARY SERVICE

Mobiloil "A" S. A. E. No. 30

Light Single	½ pint Mobiloil "A" to 1 gallon gas .
Light Twin	½ pint Mobiloil "A" to 1 gallon gas .
Light Twin OA-55 and OA-60, 65	½ pint Mobiloil "A" to 1 gallon gas .
Standard Twin OK-55 and OK-60	¾ pint Mobiloil "A" to 1 gallon gas.
Standard Twin Model K-35	½ pint Mobiloil "A" to 1 gallon gas .
Standard Twin Model K-40	¾ pint Mobiloil "A" to 1 gallon gas.
Big Twin Model P-30	¾ pint Mobiloil "A" to 1 gallon gas.
Big Twin Model P-35	¾ pint Mobiloil "A" to 1 gallon gas.
Big Twin Model P-40	1 pint Mobiloil "A" to 1 gallon gas.
Sea Horse "3" Model A-45	½ pint Mobiloil "A" to 1 gallon gas .
Sea Horse "4" Model A-50, A-65	½ pint Mobiloil "A" to 1 gallon gas .
Sea Horse "10" Model K-45	¾ pint Mobiloil "A" to 1 gallon gas.
Sea Horse "12" Model K-50, K-65	¾ pint Mobiloil "A" to 1 gallon gas.
Sea Horse "14" Model P-45	1 pint Mobiloil "A" to 1 gallon gas.
Sea Horse "24" Model P-50, P-65	1 pint Mobiloil "A" to 1 gallon gas.
Aquaflyer "24" Model PA-50	1 pint Mobiloil "A" to 1 gallon gas.
Sea Horse "16" Model SE-50	1 pint Mobiloil "A" to 1 gallon gas.
Sea Horse "16" Model S-45, S-65	1 pint Mobiloil "A" to 1 gallon gas.
Aquaflyer "16" Model SA-50	1 pint Mobiloil "A" to 1 gallon gas.
Sea Horse "24" Model PE-50	1 pint Mobiloil "A" to 1 gallon gas.
Sea Horse "25" Model TR-40	1 pint Mobiloil "A" to 1 gallon gas.
Sea Horse "32" Model V-45, V-65	1 pint Mobiloil "A" to 1 gallon gas.
Aquaflyer "32" Model VA-50	1 pint Mobiloil "A" to 1 gallon gas.

OILING FOR HIGH SPEED SERVICE IN RACING TRIM

Mobiloil "B" S. A. E. 50

Sea Horse "12" KR-55, KR-65	1½ pint Mobiloil "B" to 1 gallon gas.
Standard Twin Model KR-40	1½ pint Mobiloil "B" to 1 gallon gas.
Big Twin Model PR-40	1 quart Mobiloil "B" to 1 gallon gas.
Giant Twin Model TR-40	1 quart Mobiloil "B" to 1 gallon gas.
Sea Horse "24" Model PR-50.	1½ pint Mobiloil "B" to 1 gallon gas.
Sea Horse "16" Model SR-45	1½ pint Mobiloil "B" to 1 gallon gas.
Sea Horse "16" Model SR-55, 60, 65	1½ pint Mobiloil "B" to 1 gallon gas.
Sea Horse "16" Model SR-50	1½ pint Mobiloil "B" to 1 gallon gas.
Sea Horse "25" Model TR-40	1 quart Mobiloil "B" to 1 gallon gas.
Sea Horse "32" Model VR-45.	1½ pint Mobiloil "B" to 1 gallon gas.
Sea Horse "24" Model PR-55, 60, 65	1½ pint Mobiloil "B" to 1 gallon gas.
Sea Horse "32" Model VR-55	1½ pnits Mobiloil "B" to 1 gallon gas.
Sea Horse "32" Model VR-50	1½ pnits Mobiloil "B" to 1 gallon gas.

Note—Mobiloil "A" or Marine Medium Heavy S.A.E. No. 30.
Mobiloil "B" or Marine Heavy S.A.E. No. 50.
Mobiloil "A" in proportions specified, should be used for average service—Mobiloil "B" for racing only.

The use of heavy oils, with increased proportions for service, will result in continual fouling of the spark plugs, excessive carbon — clogging the ring grooves, exhaust ports, muffler and the driveshaft housing (A & K 50-65).

In event of operating service models on light weight hulls, with the muffler or muffler plat removed resulting in very high motor speeds, it will be necessary to double the amount of oil specified for service. To insure adequate lubrication at increased motor speeds—Use Mobiloil "B".

CORRECT STERN HEIGHTS

The correct stern height of a boat is an important factor in the operation of an outboard motor. The stern should be of such height as to allow the propeller to operate with no cavitation and with the greatest possible forward speed of the boat.

A stern that is too high for the type of motor used, will allow the propeller to operate too near the surface of water, air will follow down the gearcase forming a pocket of air in which the propeller may turn at dangerously high speed with very little boat speed.

Transoms that are to low for the particular type of motor used, will allow the propeller to operate too far below the surface of the water, thus causing a loss of boat speed, due to the additional area of the lower unit that must be forced through the water.

Following is a table of the correct heights of sterns for the various Johnson Motors:

Model	Stern Height
J-25 & 65	14 inches
A-35	14 inches
OA-55	14 inches
OA-60 & 65	14 inches
OK-55	15 inches
OK-60	15 inches
K-40	15 inches
P-40	16 inches
TR-40	16 inches
A-45	14 inches
A-50 & 65	14 inches
K-45	15 inches
K-50 & 65	15 inches
P-45	16 inches
S-45 & 65	16 inches

Model	Stern Height
SE-50	16 inches
P-50 & 65	16 inches
PE-50	16 inches
V-45 & 65	16 inches
VE-50	16 inches
VA-50	16 inches
SR-45	14 inches
SR-50	14 inches
SR-55	14 inches
VR-45	14 inches
VR-50	14 inches
VR-55	14 inches
PR-50	14 inches
PR-55	14 inches
XR-55	14 inches
SR-60 & 65	13¼ inches
PR-60 & 65	13¼ inches

For ordinary service the foregoing table shows the correct height of stern from the top to bottom of the boat (outside measurements).

For high speed work on light weight racing boats, the stern should be as high as possible without causing propeller to cavitate from running too near the surface.

On cruisers, large runabouts and boats used in rough water, the stern should be low enough so the propeller does not come out of the water when riding over the crest of large waves.

Note: The above table covers the regular length motors only. All of these motors, except Sea Horse Single, can be furnished with six inches longer drive shaft with the exception of models A-50 and K-50 which are only five inches longer.

GASOLINE TANK CAPACITIES AND FUEL CONSUMPTION

The amount of fuel consumed by an outboard motor is governed by the speed at which motor is driven.

To obtain economy, slow the motor down with the throttle and cut down needle valve to satisfactory boat speed. If motor is driven at maximum speed, economy must be sacrificed.

Motor Model	Fuel Tank Capacity	One Tank Will Last (App.)
J-25, J-65	½ gal.	1½ hours
A-25, 35 and 45	¾ gal.	1¼-1½ hours
OA-55	7¼ pints	1½ hours
OA-60, OA-65	6½ pints	1⅓ hours
A-50 and 65	7 pints	1¾ hours
K-40, KR-40, K-45	1½ gal.	1 hour
OK-55	14½ pints	1-1/5 hours
OK-60	13 pints	1-1/10 hours
K-50, K-65	13 pints	1½ hours
P-40, PR-40, P-45	2½ gal.	1½ hours
S-45, SE-50, S-65	2.4 gal.	1½ hours
P-50, PE-50, P-65	2.4 gal.	1¼ hours
V-45, VE-50, V-65	4 gal.	1 to 1½ hours
TR-40	4 gal.	1 hour

The above table is approximate consumption with the muffler and all standard equipment installed and operated under full throttle. This can be reduced by partly closing the throttle, cutting down on needle valve, and reducing the speed of motor.

Due to the great variation and conditions in which the exceptionally fast racing motors are subjected, it is impossible to give very accurate fuel consumption data. However, these motors, under ideal conditions, used on a light fast boat designed for the particular motor and carrying one person of average weight, will consume considerably more fuel than regular motors. The increased fuel consumption will be in proportion to the increased power developed at the higher speeds.

BOAT TABLE SHOWING MOTORS AND PROPELLERS RECOMMENDED FOR KIND OF BOAT AND APPROXIMATE BOAT SPEEDS TO BE EXPECTED

1. Ordinary flat bottom fishing boats 14 to 18 feet in length of heavy construction where speed is of little consideration.

Motor	Propeller	Boat Speed
J-25, 65	2 Blade Std.	2 to 6 miles per hr.
A-25	2 Blade Std.	2 to 8 miles per hr.
A-35 and A-45	3 Blade Std.	2 to 8 miles per hr.
A-50 and 65	3 Blade Std.	2 to 7 miles per hr.
OA-55, 60	2 Blade Std.	2 to 8 miles per hr.
OA-65	3 Blade Std.	2 to 8 miles per hr.
OK-55, 60	2 Blade Std.	2 to 14 miles per hr.
K-50, 65	3 Blade Std.	2 to 12 miles per hr.

Note: This type of boat is usually of heavy construction but occasionally one may be found that is light in weight and fast. Some of these type of boats may be of such construction as to permit the use of slightly larger motors.

2. Common row boats built for rowing, usually designed of light construction and of displacement type 14 to 18 feet in length.

Motor	Propeller	Boat Speed
J-25, 65	2 Blade Std.	2 to 7 miles per hr.
A-25	2 Blade Std.	2 to 9 miles per hr.
A-35 and A-45	3 Blade Std.	2 to 9 miles per hr.
OA-55, 60	2 Blade Std.	2 to 9 miles per hr.
OA-65	3 Blade Std.	2 to 9 miles per hr.
A-50, 65	3 Blade Std.	2 to 10 miles per hr.

Note: The OK-55 and K-50 Motors are too powerful for most ordinary row boats, but can be used by experienced boat men, although they must be handled with care.

3. Canoes with pointed sterns 18 to 20 feet in length.

Motor	Propeller	Boat Speed
J-25, 65	2 Blade Std.	2 to 8 miles per hr.
A-25	2 Blade Std.	2 to 10 miles per hr.
A-35 and A-45	3 Blade Std.	2 to 10 miles per hr.
OA-55, 60	2 Blade Std.	2 to 10 miles per hr.
A-50, 65	3 Blade Std.	2 to 9½ miles per hr.

Note: Larger motors cannot be used on pointed stern canoes with any degree of safety. The above motors are not recommended on canoes under 18 feet in length.

4. Square stern canoes 14 to 20 feet in length.

Motor	Propeller	Boat Speed
J-25, 65	2 Blade Std.	2 to 7 miles per hr.
A-25	2 Blade Std.	2 to 9 miles per hr.
A-35 and A-45	3 Blade Std.	2 to 9 miles per hr.
OA-55, 60	2 Blade Std.	2 to 9 miles per hr.
OA-65	3 Blade Std.	2 to 9 miles per hr.
A-50, 65	3 Blade Std.	2 to 8 miles per hr.
OK-55 & OK-60	2 Blade Std.	2 to 14 miles per hr.
K-35, K-40, KR-40 and K-45	3 Blade Std.	2 to 14 miles per hr.
K-50, 65	3 Blade Std.	2 to 12 miles per hr.

5. Outboard Motor Boats (displacement types) 14 to 18 feet in length—heavy construction.

Motor	Propeller	Boat Speed
J-25, 65	2 Blade Std.	2 to 6 miles per hr.
A-25	2 Blade Std.	2 to 8 miles per hr.
A-35 and A-45	3 Blade Std.	2 to 8 miles per hr.

Motor	Propeller	Boat Speed
OA-55, 60	2 Blade Std.	2 to 8 miles per hr.
OA-65	3 Blade Std.	2 to 8 miles per hr.
A-50, 65	3 Blade Std.	2 to 7 miles per hr.
K-35, K-40, KR-40 and K-45	3 Blade Std.	2 to 12 miles per hr.
OK-55, OK-60	2 Blade Std.	2 to 12 miles per hr.
K-50, 65	3 Blade Std.	2 to 10 miles per hr.
P-35, P-40, PR-40 and P-45	3 Blade Std.	3 to 14 miles per hr.
S-45, SE-50 and S-65	2 Blade Std.	3 to 15 miles per hr.

6. Vee-bottom runabouts built to plane, or rise and run on surface of water. (Heavy construction) 500 to 1,000 lbs.—16 to 20 feet in length.

Motor	Propeller	Boat Speed
P-35, P-40, PR-40 and P-45	3 Blade Std.	4 to 17 miles per hr.
S-45, SE-50	2 Blade Std.	4 to 18 miles per hr.
TR-40	3 Blade Std.	4 to 27 miles per hr.
P-50, PE-50 and P-65	3 Blade Std.	4 to 25 miles per hr.
V-45, V-50 and V-65	3 Blade Std.	4 to 30 miles per hr.

Note: This class of boats require the larger and more powerful motors to obtain satisfactory results. They are very slow with small low powered motors. Heavy boats of this type and heavily loaded, are hard to plane and may require a lower pitch propeller than the one supplied with motors as regular equipment, to allow the motor to turn up to its recommended R.P.M.

7. Fast vee-bottom runabouts (light construction) 125 to 400 lbs.—14 to 20 feet in length.

Motor	Propeller	Boat Speed
K-50, 65	3 Blade Std.	3 to 15 miles per hr.
OK-55, OK-60	2 Blade Std.	3 to 17 miles per hr.
K-40, KR-40, K-35 and K-45	3 Blade Std.	3 to 17 miles per hr.
P-35, P-40, PR-40 and P-45	3 Blade Std.	4 to 22 miles per hr.
S-45, SE-50	2 Blade Std.	4 to 25 miles per hr.
P-50, PE-50 and P-65	3 Blade Std.	4 to 30 miles per hr.
TR-40	3 Blade Std.	4 to 32 miles per hr.
V-45, VE-50 and V-65	3 Blade Std.	4 to 35 miles per hr.

Note: These light weight fast boats may permit the motor to turn too fast with one or two passengers in the boat, using the propeller supplied with motor as regular equipment. In this event, a propeller with higher pitch should be installed, to hold the motor down to its recommended R.P.M.

8. Outboard Cruisers and extra large boats of heavy construction.

Motor	Propeller	Boat Speed
P-35, P-40, PR-40 and P-45	3-Blade 10¼x10½	2 to 10 miles per hr.
TR-40	3 Blade 12 x13	2 to 16 miles per hr.
S-45, SE-50 and S-65	3 Blade 10 x10	2 to 10 miles per hr.
P-50, PE-50 and P-65	3 Blade 12 x10	2 to 14 miles per hr.
V-45, VE-50 and V-65	3 Blade 12 x10	2 to 18 miles per hr.

Note: Smaller motors can be used with standard propellers if speed is of little importance. There are some light weight fast cruisers built that may require higher pitch propellers than shown above to hold the motor down to normal revolutions.

Refer to "How to Select an Efficient Propeller" below for the selection of propellers other than ones listed above.

HOW TO SELECT AN EFFICIENT PROPELLER

To obtain maximum performance and service from the motor it must be equipped with a propeller suited to the weight, design and speed of the boat on which it is to be used.

Quite often the wrong type propeller causes owner to complain of the performance, and he is lead to believe the motor is at fault.

The size of propellers are given in two dimensions; first, the diameter, and then the pitch. They are constructed with two or three blades, depending upon the nature of the service. The diameter of a propeller is the distance from the extreme tip of one blade to the tip of the other, in the two blade type; or the diameter of the circle described by the periphery of the blades in the three blade type. The pitch is the theoretical distance the propeller will advance through the water in one revolution. For example, a propeller having a ten inch pitch would advance ten inches in one revolution, providing it was operating in a solid substance that would not permit it to slip. However, water is not solid substance. Hence, the propeller does not move forward a distance equal to the pitch of the propeller, this loss of theoretical advance is known as slippage. This is brought about by the fact that the hull of the boat offers resistance to forward movement which increases slippage.

To use a propeller of too great a pitch, on a heavy boat, would result in a slow boat speed, caused by the motor not being permitted to turn at it's most efficient R.P.M. Then at intervals, there might be a noticeable speeding up of the motor with little boat speed, which is due to cavitation. (Light hulls). This is caused by the water being pushed aside faster than the water flows in to replace the displaced water; in other words, a pocket of air is created, with the propeller rotating in it at high speed. This is especially true fast racing hulls.

A propeller of too low a pitch on a light, fast boat would allow the motor to turn beyond its

recommended speed and possibly to a point where the motor may be seriously damaged.

Bear in mind, when selecting a propeller for a certain type of boat, that it should be of such dimensions as to permit the motor to turn at the recommended R.P.M. That the propeller operate with the least amount of slippage with the greatest possible boat speed. This can best be determined by actual trial, remembering that for a light, fast boat it is advisable to use a high pitch propeller, while on a slow heavy boat a propeller of low pitch and large area is desirable.

Following is a table of the recommended R.P.M. for maximum motor performance and a propeller chart for your assistance in the selection of the correct propeller for the type of motor and boat it is to be used on.

PROPELLERS FOR ALL SERVICE MOTORS

Model	Prop. No.	Material	Dia.	Pitch	Blade	Shaft-Dia.	Service	Price
J-25-65	11-22	Lynite	7⅝	5⅝	2	½	All	4.00
A	13-67	"	8	7	2	½	"	4.00
A-25	13-569	"	8⅞	6½	2	½	"	5.00
BN	13-266	Bronze	8	7	2	½	"	5.00
AB-25	13-623	"	8⅞	6½	2	½	"	5.00
A-35	13-378	Lynite	9⅛	7.7	3	½	"	5.50
A-45	13-378	"	9⅛	7.7	3	½	"	5.50
A-50	25-73	"	9⅛	6	3	½	"	5.50
A-65	25-73	"	9⅛	6	3	½	"	5.50
OA-55	32-11	"	9⅛	8	2	½	"	5.00
OA-60	32-11	"	9⅛	8	2	½	"	5.00
OA-65	31-149	"	8⅝	7½	3	½	"	5.00
K-35	15-103	"	10	10	3	⅝	"	10.00
K-35	15-105	Bronze	10	12	2	⅝	2	8.00
K-40	15-153	Lynite	10¼	13	3	⅝	All	8.00
K-45	15-153	"	10¼	13	3	⅝	"	8.00
K-45	15-154	Bronze	10	15	2	⅝	2	8.00
K-50	27-57	Lynite	9½	7¾	3	⅝	All	8.00
K-65	27-73	"	9½	9½	3	⅝	"	8.00
OK-55	34-11	"	10¼	13	2	⅝	"	6.00
OK-60	34-11	"	10¼	13	2	⅝	"	6.00
P-30	7-109	"	10⅛	12½	3	¾	1	10.00
P-30	7-277	"	10 9/32	18	4	¾	4	15.00
P-35	17-94	"	10¼	10½	3	¾	1	11.00
P-35	7-277	"	10 9/32	8	4	¾	4	15.00
	7-192	"	10⅛	12½	3	¾	3	11.00
P-40	17-94	"	10¼	10½	3	¾	1	11.00
	7-277	"	10 9/32	8	4	¾	4	15.00
	7-284	Bronze	10¼	11½	2	¾	3	9.00
P-45	17-94	Lynite	10¼	10½	3	¾	1	11.00
P-45	7-277	"	10 9/32	8	4	¾	4	15.00
	21-288	Bronze	10	11	2	¾	1	8.00
S-45	21-179	"	10	17	2	¾	2	8.00
S-65	21-292	"	10	14	2	¾	3	8.00
	21-452	"	10	10	3	¾	4	12.00
	21-525	"	10	12	2	¾	3	8.00
	21-288	"	10	11	2	¾	1	8.00
SE-50	21-452	"	10	10	3	¾	4	12.00
	21-525	"	10	12	2	¾	3	8.00
	23-39	"	12	12	3	⅞	1	12.00
	23-28	"	12	15	2	⅞	5	10.00
P-50	23-38	"	12	13	2	⅞	3	9.00
P-65	29-45	"	12	12	2	⅞	3	10.00
	23-126	"	12	10	3	⅞	4	12.00
	23-126	"	12	10	3	⅞	4	12.00
PA-50	23-39	"	12	12	3	⅞	1	12.00

PE-50	29-45	"	12	12	2	7/8	3	10.00
	23-38	"	12	13	2	7/8	3	9.00
	23-39	"	12	12	3	7/8	1	12.00
	23-32	"	12	17	2	7/8	2	9.00
V-45	23-28	"	12	15	2	7/8	5	10.00
V-65	23-38	"	12	13	2	7/8	3	9.00
	29-45	"	12	12	2	7/8	3	10.00
	23-126	"	12	10	3	7/8	4	12.00
	23-39	"	12	12	3	7/8	1	12.00
VE-50	23-38	"	12	13	2	7/8	3	9.00
VA-50	29-45	"	12	12	2	7/8	3	10.00
	23-126	"	12	10	3	7/8	4	12.00

PROPELLERS FOR ALL RACING MOTORS

KR-40	15-154	Bronze	10	15	2	5/8	2	8.00
KR-55 KR-65	27-102	"	8 1/4	12	2	.582	.....	6.00
SR-45	21-159	"	9	14	2	3/4	.....	8.00
SR-50	21-286	"	9	15	2	3/4	.....	8.00
SR-55	21-287	"	9	16	2	3/4	.....	8.00
SR-60	21-584	"	9	12	2	3/4	.....	10.00
SR-65	21-589	"	9	13	2	3/4	.....	10.00
	29-76	"	9	14	2	3/4	.....	10.00
PR-40	17-92	"	10 1/4	12 1/4	2	3/4	.....	8.00
	17-141	"	10 1/4	13 1/4	2	3/4	.....	8.00
PR-50	21-179	"	10	17	2	3/4	.....	8.00
PR-55	23-29	"	10 3/8	18	2	3/4	.....	8.00
	23-30	"	10 3/8	19	2	3/4	.....	8.00
PR-60	29-76	"	9	14	2	3/4	.....	10.00
	29-137	"	9	15	2	3/4	.....	10.00
PR-65	29-138	"	9	16	2	3/4	.....	10.00
	21-179	"	10	17	2	3/4	.....	8.00
VR-45	23-29	"	10 3/8	18	2	3/4	.....	8.00
VR-50	23-30	"	10 3/8	19	2	3/4	.....	8.00
VR-55	23-37	"	10	20	2	3/4	.....	8.00
XR-55	35-69	AL-Bronze	10 3/8	20	2	3/4	.....	10.00
TR-40	19-105	Bronze	12	18	2	7/8	.....	10.00
	19-215	"	12	13	3	7/8	1	15.00

*NOTE:
1. For Baby Buzz and other V-bottom fast boats. Supplied as regular equipment.
2. For Light Weight Racing Boats sold as an accessory only.
3. For light displacement boats—sold as an accessory only.
4. For heavy displacement boats and small cruisers—sold as an accessory only.
5. For medium weight racing boats—supplied as regular equipment.
6. For heavy weight racing boats—sold as an accessory only.
7. For exceptionally fast racing motors on exceptionally light racing boats.

TABLE OF CYLINDER BORE AND PISTON CLEARANCES

Model Motor	Cylinder Bore	Piston	Piston Clearance	Model Motor	Cylinder Bore	Piston	Piston Clearance
J-25-65	2.0	1.996	.003 to .005	V-45	2.375	2.370	.0045 to .006
A	2.0	1.998	.001 to .003	P-50-65	2.750	2.7445	.005 to .0065
A-25	2.0	1.998	.001 to .003	KR-55-65	2.125	2.120	.004 to .0055
A-35	2.0	1.998	.001 to .003	SR-45	2.375	2.369	.0055 to .007
A-45	2.0	1.998	.001 to .003	SR-50	2.375	2.369	.0055 to .007
A-50-65	1.875	1.8725	.002 to .0035	SR-55	2.375	2.369	.0055 to .007
OA-55	2.0	1.998	.001 to .003	PR-50	2.750	2.743	.0065 to .008
K-35	2.3125	2.310	.0015 to .0035	PR-55	2.750	2.743	.0065 to .008
K-40	2.375	2.370	.004 to .006	VR-45	2.375	2.369	.0055 to .007
KR 40	2.375	2.367	.007 to .009	VR-50	2.375	2.369	.0055 to .007
K-45	2.375	2.370	.004 to .006	VR-55	2.375	2.369	.0055 to .007
K-50-65	2.125	2.122	.00225 to .00375	XR-55	2.6562	2.649	.0067 to .0082
OK-55	2.375	2.370	.004 to .006	SE-50	2.375	2.3705	.004 to .0055
P-30	2.875	2.872	.002 to .004	S-65	2.375	2.3705	.004 to .0055
P-35	2.6875	2.6845	.002 to .004	PE-50	2.750	2.7445	.005 to .0065
P-40	2.6875	2.6775	.009 to .011	VE-50	2.375	2.3705	.004 to .0055
PR-40	2.6875	2.6775	.009 to .011	V-65	2.375	2.3705	.004 to .0055
P-45	2.6875	2.6775	.009 to .011	OA-60-65	2.0	1.998	.001 to .003
TR-40	3.0	2.988	.011 to .013	OK-60	2.375	2.370	.004 to .006
S-45	2.375	2.370	.0045 to .006	PR-65	2.750	2.746	.004 to .007

PISTON RING SPECIFICATIONS

Model Motor	Ring Pt. No.	Diameter of Ring	Width	Lbs. Comp. Aimed at	Gap Clearance
J-25-65	5-194	2.000	.124	4	.005 to .012
A	5-194	2.000	.124	4	.005 to .012
A-25	5-194	2.000	.124	4	.005 to .012
A-35	5-194	2.000	.124	4	.005 to .012
A-45	5-194	2.000	.124	4	.005 to .012
A-50-65	25-25	1.875	.125	2½	.005 to .010
OA-55-60-65	5-194	2.000	.124	4	.005 to .012
K-35	15-17	2.3125	.1545 to .155	4	.004 to .012
K-40	15-148	2.375	.1545 to .155	4	.005 to .012
KR-40	15-148	2.375	.1545 to .155	4	.005 to .012
K-45	15-148	2.375	.1545 to .155	4	.005 to .012
K-50-65	27-25	2.125	.125	2¾	.005 to .012
OK-55-60	15-148	2.375	.1545 to .155	4	.005 to .012
P-30	7-91	2.875	.186 to .1865	5	.006 to .012
P-35	17-48	2.6875	.186 to .1865	4¾	.006 to .012
P-40	17-187	2.6875	.1245 to .125	3.16	.006 to .012
PR-40	17-187	2.6875	.1245 to .125	3.16	.006 to .012
P-45	17-187	2.6875	.1245 to .125	3.16	.006 to .012
TR-40	19-17	3.000	.140 to .1405	5	.006 to .012
S-45-65	21-10	2.375	.125	3½	.005 to .012
V-45	21-10	2.375	.125	3½	.005 to .012
P-50-65	29-10	2.750	.125	4	.005 to .012
KR-55	27-141	2.125	.125	4½	.009 to .013
SR-45	21-10	2.375	.125	3½	.005 to .012
SR-50	21-519	2.375	.125	3½	.012 to .016
SR-55-60-65	21-546	2.375	.125	5	.012 to .016
PR-55-60-65	29-35	2.750	.125	4	.012 to .016
PR-55-60-65	29-60	2.750	.125	5½	.012 to .016
VR-45	21-10	2.375	.125	3½	.008 to .012
VR-50	21-519	2.375	.125	3½	.012 to .016
VR-55	21-546	2.375	.125	5	.012 to .016
XR-55	35-4	2.656	.125	5½	.012 to .016
SE-50-65	21-10	2.375	.125	3½	.005 to .012
PE-50-65	29-10	2.750	.125	4	.005 to .012
VE-50-65	21-10	2.375	.125	3½	.005 to .012

CRANKSHAFT SIZES

Model Motor	Top Journal	Center Journal	Bottom Journal	Model Motor	Top Journal	Center Journal	Bottom Journal
J-25-65	.686	None	.686	S-45	.999	None	1.039
A	.686	None	.686	V-45	.999	1.019	1.039
A-25	.686	None	.686	P-50-65	.999	None	1.039
A-35	.686	None	.686	KR-55-65	.8745	None	.8745
A-45	.686	None	.686	SR-45	.999	None	1.039
A-50-65	.7485	None	.8105	SR-50	.999	None	1.039
OA-55-60-65	.686	None	.686	SR-55-60-65	1.000	None	1.000
K-35	.999	None	.999	PR-50	.999	None	1.039
K-40	.999	None	.999	PR-55	1.000	None	1.000
KR-40	.999	None	.999	PR-60-65	1.256	None	1.000
K-45	.999	None	.999	VR-45	.999	1.019	1.039
K-50-65	.873	None	.904	VR-50	.999	1.019	1.039
OK-55	1.004	None	.999	VR-55	1.000	1.000	1.000
P-30	1.124	None	1.124	XR-55	1.000	1.000	1.000
P-35	1.124	None	1.124	SE-50	.999	None	1.039
P-40	1.124	None	1.124	PE-50	.999	None	1.039
PR-40	1.124	None	1.124	VE-50, V-65	.999	1.019	1.039
P-45	1.124	None	1.124	OA-60-65	.686	None	.686
TR-40	1.249	None	1.374	OK-60	1.004	None	.999

JOURNAL BEARING REAM SIZES

Model Motor	Top Journal Bearing	Center Journal Bearing	Bottom Journal Bearing	Model Motor	Top Journal Bearing	Center Journal Bearing	Bottom Journal Bearing
J-25-65	.6875	None	.6875	P-50-65	1.0015	None	1.0415
A-	.6875	None	.6875		Roller		Roller
A-25	.6875	None	.6875	KR-55-65	Bearing	None	Bearing
A-35	.6875	None	.6875	SR-45	1.003	None	1.043
A-45	.6875	None	.6875	SR-50	1.003	None	1.043
A-50-65	.750	None	.8125		Roller		Roller
OA-55	.6875	None	.6875	SR-55-60-65	Bearing	None	Bearing
K-35	1.001	None	1.001	PR-50	1.003	None	1.043
K-40	1.001	None	1.001		Roller		Roller
KR-40	1.002	None	1.002	PR-55	Bearing	None	Bearing
K-45	1.001	None	1.001	VR-45	1.003	1.023	1.043
K-50-65	.8755	None	.906	VR-50	1.003	1.023	1.043
OK-55	1.006	None	1.001		Roller	Roller	Roller
P-30	1.1265	None	1.1265	VR-55	Bearing	Bearing	Bearing
P-35	1.1265	None	1.1265		Roller	Roller	Roller
P-40	1.1265	None	1.1265	XR-55	Bearing	Bearing	Bearing
PR-40	1.129	None	1.129	SE-50, S-65	1.0015	None	1.0415
P-45	1.1265	None	1.1265	PE-50	1.0015	None	1.0415
TR-40	1.1254	None	1.379	VE-50, V-65	1.0015	1.021	1.0415
S-45	1.0015	None	1.0415	OA-60-65	.6875	None	.6875
V-45	1.0015	1.021	1.0415	OK-60	1.006	None	1.001

JOURNAL BEARING CLEARANCE

Motor Model	Upper	Center	Lower	Motor Model	Upper	Center	Lower
J-25, 65	.00125 .00225	None	.00125 .00225	A-50, 65	.00125 .00225	None	.0015 .0025
A	.00125 .00225	None	.00125 .00225	OA-55	.00125 .00225	None	.00125 .00225
A-25	.00125 .00225	None	.00125 .00225	K-35	.0015 .0025	None	.0015 .0025
A-35	.00125 .00225	None	.00125 .00225	K-40	.0015 .0025	None	.0015 .0025
A-45	.00125 .00225	None	.00125 .00225	KR-40	.0025 .0035	None	.0025 .0035

Motor Model	Upper	Center	Lower
K-45	.0015	None	.0015
	.0025		.0025
K-50, 65	.00425	None	.00225
	.00525		.00325
OK-55	.00175	None	.0015
	.00275		.0025
P-30	.00225	None	.00225
	.00325		.00325
P-35	.00225	None	.00225
	.00325		.00325
P-40	.00225	None	.00225
	.00325		.00325
PR-40	.0045	None	.0045
	.006		.006
P-45	.00225	None	.00225
	.00325		.00325
TR-40	.0045	None	.0045
	.006		.006
S-45	.00225	None	.00225
	.00325		.00325
V-45	.00225	.002	.00225
	.00325	.003	.00325
P-50, 65	.0025	None	.00225
	.0035		.00325
KR-55, 65	Roller Bearing	None	Roller Bearing
SR-45	.00375	None	.00375
	.00475		.00475
SR-50	.004	None	.00375
	.005		.00475
SR-55	Roller Bearing	None	Roller Bearing
PR-50	.004	None	.00375
	.005		.00475
PR-55, 60, 65	Roller Bearing	None	Roller Bearing
VR-45	.00375	.004	.00375
	.00475	.005	.00475
VR-50	.004	.004	.00375
	.005	.005	.00475
VR-55	Roller Bearing	Roller Bearing	Roller Bearing
XR-55	Roller Bearing	Roller Bearing	Roller Bearing
SE-50	.0025	None	.00225
S-65	.0035		.00325
PE-50	.0025	None	.00225
P-65	.0035		.00325
VE-50	.0025	.002	.00225
V-65	.0035	.003	.00325
OA-50	.00125	None	.00125
	.00225		.00225
OK-60	.00175	None	.0015
	.00275		.0025

WRIST PIN SIZES, WRIST PIN BEARING REAM SIZES AND CLEARANCES

Motor Model	Wrist Pin Size	Bearing Ream Size	Bearing Clearance
J-25, 65	.365	.3655	.000 to .001
A	.365	.3655	.000 to .001
A-25	.365	.3655	.000 to .001
A-35	.365	.3655	.000 to .001
A-45	.365	.3655	.000 to .001
A-50, 65	.437	.4375	.000 to .001
OA-55	.365	.3655	.000 to .001
K-35	.562	.5625	.000 to .001
K-40	.562	.5625	.000 to .001
KR-40	.562	.5625	.000 to .001
K-45	.562	.5625	.000 to .001
K-50, 65	.4995	.500	.000 to .001
OK-55	.562	.5625	.000 to .001
P-30	.6245	.625	.000 to .001
P-35	.6244	.625	.0001 to .0011
P-40	.6244	.625	.0001 to .0011
PR-40	.6244	.625	.0001 to .0011
P-45	.6244	.625	.0001 to .0011
TR-40	.7495	.750	.000 to .001
S-45	.562	.5625	.000 to .001
V-45	.562	.5625	.000 to .001
OA-60, 65	.365	.3655	.000 to .001
OK-60	.562	.5625	.000 to .001
P-50, 65	.625	.6255	.000 to .001
KR-55, 65	.4995	.500	.000 to .001
SR-45	.562	.5625	.000 to .001
SR-50	.562	.5625	.000 to .001
SR-55	.562	.5625	.000 to .001
PR-50	.625	.6255	.000 to .001
PR-55	.625	.6255	.000 to .001
VR-45	.562	.5625	.000 to .001
VR-50	.562	.5625	.000 to .001
VR-55	.562	.5625	.000 to .001
XR-55	.625	.6255	.000 to .001
SE-50, S-65	.562	.5625	.000 to .001
PE-50	.625	.6255	.000 to .001
VE-50, V-65	.562	.5625	.000 to .001

Note: Clearances are from tap fit to .001 clearance on all wrist pins except those on models P-35, P-40, PR-40 and P-45 which are from .0001 to .0011 clearance.

PISTON WRIST PIN HOLE REAM SIZES

Model Motor	Slip-Fit Side	Drive-Fit Side	Heat Fit Both Sides Reamed Same
J-25, 65	.3656	.3647	
A	.3656	.3647	
A-25	.3656	.3647	
A-35	.3656	.3647	
A-45	.3656	.3647	
A-50, 65			.437
OA-55	.3656	.3647	
K-35	.5626	.5617	

Model Motor	Slip-Fit Side	Drive-Fit Side	Heat Fit Both Sides Reamed Same
K-40	.5626	.5617	
KR-40	.5626	.5617	
K-45	.5626	.5617	
K-50, 65			.4995
OK-55	.5626	.5617	
P-30	625	.62425	
P-35	.625	.62425	
P-40	.625	.62425	
PR-40	.625	.62425	
P-45	.625	.62425	
TR-40			.7495
S-45			.562
V-45			.562
OA-60	.3656	.3647	
OA-65			
OK-60	.5626	.5617	
P-50, 65			.625
KR-55, 65			.4995
SR-45			.562
SR-50			.562
SR-55			.562
SR-65			
PR-50			.625
PR-55			.625
PR-65			
VR-45			.562
VR-50			.562
VR-55			.562
XR-55			.625
SE-50			.562
S-65			
PE-50			.625
VE-50			.562
V-65			

Note: Pistons with slip and drive fit wrist pin holes, are reamed slightly larger on the side opposite the hole drilled for the cotter pin, which locks the wrist pin in position, than on the other side. This facilitates pressing the wrist pin through the hole on one side by hand and driving it in place on the other side.

Pistons reamed for heat fit should be heated in hot water, wrist pins inserted in place and allowed to cool.

CRANK PIN SIZES, CONNECTING ROD REAM SIZES AND CLEARANCES

Motor Model	Crankshaft Crank Pins	Connecting Rod Ream Size	Clearance
J-25, 65	.624	.625	.00075 to .00225
A	.624	.625	.00075 to .00225
A-25	.624	.625	.00075 to .00225
A-35	.624	.625	.00075 to .00225
A-45	.624	.625	.00075 to .00225
A-50, 65	.686	.6875	.00125 to .00225
OA-55	.624	.625	.00075 to .00225
K-35	.873	.875	.00175 to .00325
K-40	.873	.875	.00175 to .00325
KR-40	.873	.875	.00175 to .00325
K-45	.873	.875	.00175 to .00325
K-50, 65	.873	.876	.003 to .004
OK-55	.873	.875	.00175 to .00325
P-30	.998	1.000	.00175 to .00325
P-35	.996	1.000	.00375 to .00525
P-40	.996	1.000	.00375 to .00525
PR-40	.996	1.000	.00375 to .00525
P-45	.8745	Roller Bearing	
TR-40	1.120	1.124	.00375 to .00525
S-45	.8745	Roller Bearing	
V-45	.8745	Roller Bearing	
P-50, 65	.8745	Roller Bearing	
KR-55, 65	.815	Roller Bearing	
SR-45	.8745	Roller Bearing	
SR-50	.8745	Roller Bearing	
SR-55-60-65	.8745	Roller Bearing	
PR-50	.8745	Roller Bearing	
PR-55-60-65	.8745	Roller Bearing	
VR-45	.8745	Roller Bearing	
VR-50	.8745	Roller Bearing	
VR-55	.8745	Roller Bearing	
XR-55	.8745	Roller Bearing	
SE-50	.8745	Roller Bearing	
PE-50	.8745	Roller Bearing	
VE-50	.8745	Roller Bearing	
OA-60-65	.624	.625	.00075 to .00225
OK-60	.873	.875	.00175 to .00325

LOWER DRIVESHAFT (PINION SHAFT) SIZES

Motor Model	Top Grind Size for Bearing	Bottom Grind Size for Bearing
J-25, 65	.4885	.4885
A	.426	.426
A-25	.4885	.4885
A-35	.4885	.4885
A-45	.4885	.4885
A-50, 65	.4885	.4885
OA-55	.4885	.4885
K-35	.605	.605
K-40	.605	.605
KR-40	.605	.605
K-45	.605	.605
K-50, 65	.605	.605
OK-55	.610	.605
P-30	.9375	.9375
P-35	.9375	.9375
P-40	.9375	.9375

Motor Model	Top Grind Size for Bearing	Bottom Grind Size for Bearing	Motor Model	Top Grind Size for Bearing	Bottom Grind Size for Bearing
PR-40	.9375	.9375	VR-50	.6235	.669
P-45	.9375	.7872	VR-55	.6235	.669
TR-40	.8266	.787	XR-55	.6235	.669
S-45	.6235	.669	SE-50	.6235	.669
V-45	.6235	.787	S-65	.6235	.669
P-50, 65	.6235	.787	PE-50	.6235	.787
KR-55, 65	.4865	.591	VE-50	.6235	.787
SR-45	.6235	.669	V-65	.6235	.787
SR-50	.6235	.669	OA-60, 65	.4885	.4885
SR-55	.6235	.669	OK-60	.610	.605
PR-50	.6235	.669	SR-60-65	.6688	.6692
PR-55	.6235	.669	PR-60-65	.6688	.6692
VR-45	.6235	.669			

PINION SHAFT BEARING REAM SIZES

Model Motor	Top Bearing	Bottom Bearing	Model Motor	Top Bearing	Bottom Bearing
J-25, 65	.4905	.4905	V-45	.625	Ball Bearing
A	.4275	.4275	P-50, 65	.625	Ball Bearing
A-25	.4905	.4905	KR-55, 65	.490	Ball Bearing
A-35	.4905	.4905	SR-45	.625	Ball Bearing
A-45	.4905	.4905	SR-50	.625	Ball Bearing
A-50, 65	.4905	.4905	SR-55	.625	Ball Bearing
OA-55	.4905	.4905	PR-50	.625	Ball Bearing
K-35	.607	.607	PR-55	.625	Ball Bearing
K-40	.607	.607	VR-45	.625	Ball Bearing
KR-40	.607	.607	VR-50	.625	Ball Bearing
K-45	.607	.607	VR-55	.625	Ball Bearing
K-50, 65	.607	.607	XR-55	.625	Ball Bearing
OK-55	.6115	.607	SE-50, S-65	.625	Ball Bearing
P-30	.939	.939	PE-50	.625	Ball Bearing
P-35	.939	.939	VE-50, V-65	.625	Ball Bearing
P-40	.939	.939	OA-60, 65	.4905	.4905
PR-40	.939	.939	OK-60	.6115	.607
P-45	.939	Ball Bearing	SR-60, 65	Ball Bearing	Ball Bearing
TR-40	.8281	Ball Bearing	PR-60, 65	Ball Bearing	Ball Bearing
S-45	.625	Ball Bearing			

PINION SHAFT BEARING CLEARANCES

Motor Model	Top Bearing	Bottom Bearing	Motor Model	Top Bearing	Bottom Bearing
J-25, 65	.0018 to .0027	.0018 to .0027	S-45	.00125 to .00225	Ball Bearing
A	.0012 to .0022	.0013 to .0022	V-45	.00125 to .00225	Ball Bearing
A-25	.0018 to .0027	.0018 to .0027	P-50, 65	.00125 to .00225	Ball Bearing
A-35	.0018 to .0027	.0018 to .0027	KR-55 and 65	.003 to .004	Ball Bearing
A-45	.0018 to .0027	.0018 to .0027	SR-45	.00125 to .00225	Ball Bearing
A-50, 65	.0018 to .0027	.0018 to .0026	SR-50	.00125 to .00225	Ball Bearing
OA-55	.0018 to .0027	.0018 to .0027	SR-55	.00125 to .00225	Ball Bearing
K-35	.0018 to .0026	.0018 to .0026	PR-50	.00125 to .00225	Ball Bearing
K-40	.0018 to .0026	.0018 to .0026	PR-55	.00125 to .00225	Ball Bearing
KR-40	.0018 to .0026	.0018 to .0026	VR-45	.00125 to .00225	Ball Bearing
K-45	.0018 to .0026	.0018 to .0026	VR-50	.00125 to .00225	Ball Bearing
K-50, 65	.0018 to .0026	.0018 to .0026	VR-55	..00125 to .00225	Ball Bearing
OK-55	.00125 to .00225	.0018 to .0026	XR-55	.00125 to .00225	Ball Bearing
P-30	.001 to .00225	.001 to .00225	SE-50, S-65	.00125 to .00225	Ball Bearing
P-35	.001 to .00225	.001 to .00225	PE-50	.00125 to .00225	Ball Bearing
P-40	.001 to .00225	.001 to .00225	VE-50, V-65	.00125 to .00225	Ball Bearing
PR-40	.001 to .00225	.001 to .00225	OA-60	.0018 to .0027	.0018 to .0027
P-45	.001 to .00225	Ball Bearing	OK-60	.00125 to .00225	.0018 to .0026
TR-40	.00075 to .00235	Ball Bearing	OA-65	.002	.002

PROPELLER SHAFT FINISH GRIND SIZES FOR BEARINGS

Model Motor	Propeller End	Thrust Bearing End	Model Motor	Propeller End	Thrust Bearing End
J-25-65	.500	.500	V-45	.874	.787
A	.500	.500	P-50, 65	.874	.787
A-25	.500	.500	KR-55, 65	.582	.590
A-35	.500	.499	SR-45	.750	.6685
A-45	.500	.499	SR-50	.750	.6685
A-50, 65	.500	.499	SR-55	.750	.6685
OA-55	.500	.4724	PR-50	.750	.6685
K-35	.625	.624	PR-55	.750	.6685
K-40	.625	.624	VR-45	.750	.6685
KR-40	.625	.624	VR-50	.750	.6685
K-45	.625	.624	VR-55	.750	.6685
K-50, 65	.625	.624	XR-55	.750	.6685
OK-55	.625	.5906	SE-50, S-65	.750	.6685
P-30	.750	.750	PE-50	.874	.787
P-35	.750	.750	VE-50, V-65	.874	.787
P-40	.750	.750	OA-60	.500	.4724
PR-40	.750	.750	OA-65	.500	.500
P-45	.750	.750	OK-60	.625	.5906
TR-40	.874	.874	SR-60, 65	.755	.6685
S-45	.750	.6685	PR-60, 65	.755	.6685

PROPELLER SHAFT BEARING REAM SIZES

Model Motor	Front Bearing	Back Bearing	Model Motor	Front Bearing	Back Bearing
J-25, 65	.502	.502	V-45	Ball Bearing	.875
A	.502	.502	P-50, 65	Ball Bearing	.875
A-25	.502	.502	KR-55, 65	Ball Bearing	Ball Bearing
A-35	.502	.502	SR-45	Ball Bearing	.751
A-45	.502	.502	SR-50	Ball Bearing	.751
A-50, 65	.502	.502	SR-55	Ball Bearing	.751
OA-55	Ball Bearing	.502	PR-50	Ball Bearing	.751
K-35	.6277	.6277	PR-55	Ball Bearing	.751
K-40	.6277	.6277	VR-45	Ball Bearing	.751
KR-40	.6277	.6277	VR-50	Ball Bearing	.751
K-45	.6277	.6277	VR-55	Ball Bearing	.751
K-50, 65	.6277	.6277	XR-55	Ball Bearing	.751
P-30	.751	.751	SE-50	Ball Bearing	.751
P-35	.751	.751	PE-50	Ball Bearing	.875
P-40	.751	.751	VE-50	Ball Bearing	.875
PR-40	.751	.751	OA-60	Ball Bearing	.502
P-45	.751	.751	OK-60	Ball Bearing	.6277
OK-55	Ball Bearing	.6277	OA-65	.502	.502
TR-40	.875	.875	SR-60, 65	Ball Bearing	Needle Bearing
S-45	Ball Bearing	.751	PR-60, 65	Ball Bearing	Needle Bearing

PROPELLER SHAFT BEARING CLEARANCES

Model Motor	Front Bearing	Back Bearing	Model Motor	Front Bearing	Back Bearing
J-25, 65	.0013 to .0022	.0013 to .0022	P-30	.001 to .002	.001 to .002
A	.0013 to .0022	.0013 to .0022	P-35	.001 to .002	.001 to .002
A-25	.0013 to .0022	.0013 to .0022	P-40	.001 to .002	.001 to .002
A-35	.0028 to .0037	.0013 to .0022	PR-40	.001 to .002	.001 to .002
A-45	.0028 to .0037	.0013 to .0022	P-45	.001 to .002	.001 to .002
A-50, 65	.0028 to .0037	.0013 to .0022	TR-40	.00075 to .00175	.00075 to .00175
OA-55	Ball Bearing	.0013 to .0022	S-45	Ball Bearing	.00075 to .00175
K-35	.0032 to .0048	.0017 to .0033	V-45	Ball Bearing	.00075 to .00175
K-40	.0032 to .0048	.0017 to .0033	P-50, 65	Ball Bearing	.00075 to .00175
KR-40	.0032 to .0048	.0017 to .0033	KR-55 and 65	Ball Bearing	Ball Bearing
K-45	.0032 to .0048	.0017 to .0033	SR-45	Ball Bearing	.00075 to .00175
K-50, 65	.0032 to .0048	.0017 to .0033	SR-50	Ball Bearing	.00075 to .00175
OK-55	BallBearing	.0017 to .0033	SR-55	Ball Bearing	.00075 to .00175

Model Motor	Front Bearing	Back Bearing	Model Motor	Front Bearing	Back Bearing
PR-50	Ball Bearing	.00075 to .00175	SE-50, S-65	Ball Bearing	.00075 to .00175
PR-55	Ball Bearing	.00075 to .00175	PE-50	Ball Bearing	.00075 to .00175
VR-45	Ball Bearing	.00075 to .00175	VE-50, V-65	Ball Bearing	.00075 to .00175
VR-50	Ball Bearing	.00075 to .00175	OA-60	Ball Bearing	.0013 to .0022
VR-55	Ball Bearing	.00075 to .00175	OK-60	Ball Bearing	.0017 to .0033
XR-55	Ball Bearing	.00075 to .00175	OA-65	.002	.002

GASOLINE TANK CAPACITIES

1934 to 1938 motors

Model Motor	Fuel Tank Capacity
J-70, 75, 80	4 Pints
F-70, 75	7 "
A-70, 75, 80, AA-37	7 "
K-70, 75, 80, KA-37	13 "
S-70	2½ Gals.
P-70, 75, 80, PO-37	2½ "
V-70	4¼ "
300	6½ Pints
100, 110	4 "
200, 210	7 "
LS	2 5/8 Pints
DS	4 Pints
LT	5 "
DT	6 "
KR-70, 80	13 "
SR-70, 80	2½ Gals.

TABLE OF CYLINDER BORE AND PISTON CLEARANCE

Model Motor	Cylinder Bore	Piston Size	Piston Clearance
LT-37	1.8745 - 1.8750	1.8730 to 1.8735	.001 to .002
DT-37	1.8745 - 1.8750	1.8730 to 1.8735	.001 to .002
DS-37	1.8745 - 1.8750	1.8730 to 1.8735	.001 to .002
LS-37	1.8745 - 1.8750	1.8730 to 1.8735	.001 to .002
PO-37	2.750 ± .0005	2.7445+.000-.0005	.005 to .0065
KA-37	2.125 ± .0005	2.122± .00025	.00225 to .00375
AA-37	1.875 ± .0005	1.8725+.000-.0005	.002 to .0035
OK-75	2.375	2.370	.004 to .006
110	2.000+.000-.0005	1.997± .00025	.00225 to .00375
210	2.000+.000-.0005	1.998± .0005	.001 to .003

PISTON RING SPECIFICATION

Model Motor	Part No.	Diameter of Ring	Width of Ring	Lbs. Comp. Aimed at	Gap Clearance
LT-37	25-25	1.875± .000	1.25	2.5	.005 to .010
DT-37	25-25	1.875± .000	1.25	2.5	.005 to .010
DS-37	25-25	1.875± .000	1.25	2.5	.005 to .010
LS-37	25-25	1.875± .000	1.25	2.5	.005 to .010
PO-37	29-10	2.750	.125	4.0	.005 to .012
KA-37	27-25	2.125	.125	2.75	.005 to .012
AA-37	25-25	1.875	.125	2.5	.005 to .010
OK-75	15-148	2.375	.1545 to .155		.005 to .012
110	5-194	2.000	.124	4.0	.005 to .012
210	5-194	2.000	.124	4.0	.005 to .012

PISTON WRIST PIN HOLE REAM SIZES

Model	Motor	Slip Fit Side	Drive Fit Side	Heat Fit Both Sides Reamed Same
LT-37				.4367 - .4370
DT-37				.4367 - .4370
LS-37				.4367 - .4370
DS-37				.4367 - .4370
PO-37				.625 + .000 -.0005
KA-37				.4995 + .000 -.0005
AA-37				.437 + .000 -.0005
OK-75		.5626	.5617	
110		.3656 + .000 - .00025	.3647 + .000 - .00025	
210		.3656 + .000 - .00025	.3647 + .000 - .00025	

CRANKSHAFT SIZES

Model	Motor	Top Journal	Center Journal	Bottom Journal
J-70, 75, 80		.686 + .000 -.0005	None	.686 + .000 -.0005
F-70, 75		.686 + .000 -.0005	None	.717 + .000 -.0005
A-70, 75, 80,	AA-37	.7485 + .000 -.0005	2.278 + .000 -.0005 Rotor	.8105 + .000 -.0005
K-70, 75, 80,	KA-37	.873 + .000 -.0005	3.057 + .000 -.0005 Rotor	.904 ± .00025
S-70		.999 + .000 -.0005	None	1.039 + .000 -.0005
P-70, 75, 80,	PO-37	.999 + .000 -.0005	None	1.039 + .000 -.0005
V-70		.999 + .000 -.0005	1.019 + .000 -.0005 Rotor	1.039 + .000 -.0005
KR-70, 80		.8745 + .000 -.0005	3.058 + .000 -.0005 Rotor	.8745 + .000 -.0005
SR-70, 80		1.000 + .000-.0005	None	1.000 + .000 -.0005
300		.686 + .000 -.0005	None	.717 + .000 -.0005
100, 110		.686 + .000 -.0005	None	.686 + .000 -.0005
200, 210		.686 + .000 -.0005	None	.717 + .000 -.0005
LT-37, DT-37		.8105 + .000 -.0005	.8105 + .000 -.0005	.8105 + .000 -.0005
LS-37, DS-37		.8105 + .000 -.0005	None	.8105 + .000 -.0005
OK-37		.1004 + .000 -.0005	None	.999 + .000 -.0005

JOURNAL BEARING REAM SIZES

Model	Motor	Top Journal	Center Journal	Bottom Journal
J-70, 75, 80		.6875 ± .00025	None	.6875 ± .00025
F-70, 75		.6875 ± .00025	None	.7185 ± .00025
A-70, 75, 80,	AA-37	.750 ± .00025	2.282 + .000 -.0005 Rotor	.8125 +.000 -.0005
K-70, 75, 80,	KA-37	.8755 + .0003-.0002	3.0615+.000 -.0005 Rotor	.907 +.0005-.000
S-70		1.0015 + .0005-.000	None	1.0415 +.0005-.000
P-70, 75, 80,	PO-37	1.0015 + .0005-.000	None	1.0415 +.0005-.000
V-70		1.0015 + .0005-.000	1.021 ± .00025 Rotor	1.0415 +.0005-.000
KR-70, 80		Roller Bearing	3.0625 ± .0005 Rotor	Roller Bearing
SR-70, 80		Bearing	None	Bearing
300		.6875 ± .00025	None	.7185 ± .00025
100, 110		.6875 ± .00025	None	.6875 ± .00025
200, 210		.6875 ± .00025	None	.7185 ± .00025
LT-37, DT-37		.8125 + .000 -.0005	.8125 + .000 -.0005	.8125 +.000-.0005
LS-37, DS-37		.8125 + .000 -.0005	None	.8125 +.000-.0005
OK-37		1.006 + .000 -.00025	None	1.001 +.000-.0005

JOURNAL BEARING CLEARANCE

Model Motor	Top Journal	Center Journal	Bottom Journal
J-70, 75, 80	.00125 to .00225	None	.00125 to .002
F-70, 75	.00125 to .00225	None	.00125 to .002
A-70, 75, 80, AA-37	.00125 to .00225	.0035 to .0045	.0015 to .0025
K-70, 75, 80, KA-37	.0023 to .0033	.0040 to .0050	.00275 to .00375
S-70	.0025 to .0035	None	.00225 to .00325
P-70, 75, 80, PO-37	.0025 to .0035	None	.00225 to .00325
V-70	.0025 to .0035	.002 to .003	.00225 to .00325
KR-70, 80	Roller Bearing	None.	Roller Bearing
SR-70, 80	Bearing	None	Bearing
300	.00125 to .00225	None	.00125 to .00225
100, 110	.00125 to .00225	None	.00125 to .00225
200, 210	.00125 to .00225	None	.00125 to .00225
LT-37, DT-37	.0015 to .0025	.0015 to .0025	.0015 to .0025
LS-37, DS-37	.0015 to .0025	None	.0015 to .0025
OK-75	.00175 to .00275	None	.0015 to .0025

WRIST PIN SIZES, WRIST PIN BEARING REAM SIZE AND CLEARANCE

Model Motor	Wrist Pin Size	Bearing Ream Size	Bearing Clearance
J-70, 75, 80	.365 + .00025 - .000	.3655 + .0005-.000	.00025 to .001
F-70, 75	.365 + .00025 - .000	.3655 + .00025-.000	.00025 to .00075
A-70, 75, 80, AA-37	.437 + .00025 - .000	.4375 + .00025-.000	.00025 to .00075
K-70, 75, 80, KA-37	.4995+ .00025 - .000	.500 ± .00025	.0000 to .00075
S-70	.562 + .00025 - .000	.563 ± .00025	.0005 to .00125
P-70, 75, 80, PO-37	.625 + .00025 - .000	.6265 ± .00025	.001 to .001
V-70	.562 + .00025 - .000	.563 ± .00025	.0005 to .00125
KR-70, 80	.4995+ .00025 - .000	.500 ± .00025	.0000 to .00075
SR-70, 80	.562 + .00025 - .000	.563 + .00025-.000	.0005 to .00125
300	.4995+ .00025 - .000	.500 ± .00025	.0000 to .00075
100, 110	.365 + .00025 - .000	.3655 ± .00025	.00025 to .001
200, 210	.365 + .00025 - .000	.3655 + .00025-.000	.00025 to .001
LT, DT, LS, DS-37	.437 + .00025 - .000	.4375 ± .00025	.0000 to .00075
OK-75	.562 ± .00025	.5625 ± .00025	.000 to .001

CRANK PIN SIZES, CONNECTING ROD REAM SIZES & CLEARANCES

Model Motor	Crankshaft Crank Pins	Connecting Rod Ream Size	Clearance
J-70, 75, 80	.624 + .000 - .001	.6875 ± .00025	.06325 to .06475
F-70, 75	.624 + .000 - .001	.625 ± .00025	.00075 to .00225
A-70, 75, 80, AA-37	.686 + .000 - .0005	.6875 ± .00025	.00125 to .00225
K-70, 75, 80, KA-37	.873 + .000 - .0005	.876 + .0005 - .000	.003 to .0045
S-70	.8745+ .000 - .0005	Roller Bearing	
P-70	.8745+ .000 - .0005	Roller Bearing	
P-75, 80, PO-37	.998 + .0005- .000	Roller Bearing	
V-70	.8745+ .000 - .0005	Roller Bearing	
KR-70, 80	.815 + .000 - .0005	Needle Bearing	
SR-70, 80	.8745+ .000 - .0005	Roller Bearing	
300	.686 + .000 - .0005	.6875 ± .00025	.00125 to .002
100, 110	.624 + .000 - .001	.6875 ± .00025	.06325 to .064
200, 210	.624 + .000 - .001	.625 ± .00025	.00075 to .00225
LT, DT-37, LS, DS-37	.8100± .8105	.8125 + .000 - .0005	.0015 to .002
OK-75	.873 + .000 - .0005	.875 ± .00025	.00175 to .0025

LOWER DRIVESHAFT (PINION SHAFT) SIZES

Model Motor	Top Grind Size for Bearing	Bottom Grind Size for Bearing
J-70	.4885 + .000 - .0005	.4885 + .000 - .0005
J-75, 80	.4885 + .000 - .0005	.4885 + .000 - .0005
F-70	.4885 + .000 - .0005	.4885 + .000 - .0005
F-75	.4885 + .000 - .0005	.4885 + .000 - .0005
A-70, 75, 80, AA-37	.4885 + .000 - .0005	.4885 + .000 - .0005
K-70, 75, 80	.605 + .000 - .0005	.605 + .000 - .0005
S-70	.6235 + .000 - .0005	.669 + .000 - .0005
P-70, 75, 80, PO-37	.6235 + .000 - .0005	.787 + .000 - .0005
V-70	.6235 + .000 - .0005	.787 + .000 - .0005
KR-70, 80	.4865 + .000 - .0005	.590 ± .0002
SR-70, 80	.6688 + .000 - .0005	.6690 ± .0002
300	.4885 + .000 - .0005	.4885 + .000 - .0005
100, 110	.4885 + .000 - .0005	.4375 + .002
200, 210	.4885 + .000 - .0005	.4375 ± .002
LT-37, DT-37	.488 to .4885	.488 to .4885
LS-37, DS-37	.488 to .4885	.488 to .4885
KA-37	.738 + .000 - .0005	.738 + .000 - .0005
OK-75	.610 + .000 - .0005	.605 + .000 - .0005

PINION SHAFT BEARING REAM SIZES

Model Motor	Top Bearing	Bottom Bearing
J-70, 75, 80	.4895 ± .0002	.4895 ± .0002
F-70, 75	.4895 ± .0002	.4895 ± .0002
A-70, 75, 80, AA-37	.4905 ± .0002	.4905 ± .0002
K-70, 75, 80	.607 ± .0002	.607 ± .0002
S-70	.625 ± .00025	Ball Bearing
P-70, 75, 80, PO-37	.625 ± .00025	Ball Bearing
V-70	.625 ± .00025	Ball Bearing
KR-70, 80	.490 + .000 - .0005	Ball Bearing
SR-70, 80	Ball Bearing	Ball Bearing
300	.4895 ± .0002	.4895 ± .0002
100, 110	.4905 ± .0005	.4905 ± .0005
200, 210	.4905 ± .0005	.4905 ± .0005
LT, DT-37	.4905 ± .0005	.4905 ± .0005
LS, DS-37	.4905 ± .0005	.4905 ± .0005
KA-37	.740 ± .0005	.740 ± .0005
OK-75	.6115 ± .00025	.607 ± .0002

PINION SHAFT BEARING CLEARANCE

Model Motor	Top Bearing	Bottom Bearing
J-70	.0009 to .0017	.0632 to .0633
J-75, 80	.0007 to .0017	.0007 to .0017
F-70	.0009 to .0017	.0632 to .0633
F-75	.0007 to .0017	.0007 to .0017
A-70, 75, 80, AA-37	.0018 to .0027	.0018 to .0027
K-70, 75, 80	.0018 to .0027	.0018 to .0027
S-70	.00125 to .00225	Ball Bearing
P-70, 75, 80, PO-37	.00125 to .00225	Ball Bearing
V-70	.00125 to .00225	Ball Bearing
KR-70, 80	.003 to .004	Ball Bearing
SR-70, 80	Ball Bearing	Ball Bearing
300	.0007 to .0017	.0007 to .0017

PINION SHAFT BEARING CLEARANCE - Con't.

Model Motor	Top Bearing	Bottom Bearing
100, 110	Bearing Cast in Case	
200, 210	Bearing Cast in Case	
LT-37, DT-37	Bearing Cast in Case	
LS-37, DS-37	Bearing Cast in Case	
KA-37	.0015 to .003	.0015 to .003
OK-75	.00125 to .00225	.0018 to .0027

PROPELLER SHAFT FINISH GRIND SIZES FOR BEARINGS

Model Motor	Propeller End	Thrust Bearing End
J-70, 75, 80	.500 + .0005 - .0000	.500 + .0005 - .0000
F-70, 75	.500 + .0005 - .0000	.500 + .0005 - .0000
A-70, 75, 80, AA-37	.500 + .0005 - .000	.499 + .000 - .0005
K-70, 75, 80	.625 + .0005 - .000	.624 + .000 - .0005
S-70	.750 + .000 - .0005	.6685± .00025
P-70, 75, 80, PO-37	.874 + .000 - .0005	.787 + .000 - .0005
V-70	.874 + .000 - .0005	.787 + .000 - .0005
KR-70, 80	.591 + .000 - .0005	.590 + .000 - .0005
SR-70, 80	.755 + .000 - .0005	.6685± .00025
300	.500 + .0005 - .000	.500 + .0005 - .000
100, 110	.874 + .000 - .0005 gear	.4885+ .000 - .0005
200, 210	.874 + .000 - .0005 gear	.4885+ .000 - .0005
LT, DT-37	.5005 to .5000	.5005 to .5000
LS, DS-37	.5005 to .5000	.5005 to .5000
KA-37	.738 + .0005 - .000	.590 + .000 - .0005
OK-75	.625 + .0005 - .000	.5906+ .00025- .000

PROPELLER SHAFT BEARING - REAM SIZES

Model Motor	Propeller Back Bearing	Thrust Bearing Front
J-70, 75, 80	.501 + .0005 - .000	.501 + .0005 - .000
F-70, 75	.501 + .0005 - .000	.501 + .0005 - .000
A-70, 75, 80, AA-37	.502 ± .0002	.502 ± .0002
K-70, 75, 80	.6277± .0005	.6277± .0005
S-70	.751 ± .0005	Ball Bearing
P-70, 75, 80, PO-37	.875 ± .00025	Ball Bearing
V-70	.875 ± .00025	Ball Bearing
KR-70, 80	Ball Bearing	Ball Bearing
SR-70, 80	Needle Bearing	Ball Bearing
300	.501 + .0005 - .000	.501 + .0005 - .000
100, 110	.875 ± .00025 Gear	.4905± .0005
200, 210	.875 ± .00025 Gear	.4905± .0005
LT, DT-37	.5010 to .5015	.750 ± .0005 Gear
LS, DS-37	.5010 to .5015	.750 ± .0005 Gear
KA-37	.740 ± .0005	Ball Bearing
OK-75	.6277± .00025	Ball Bearing

PROPELLER SHAFT BEARING CLEARANCE

Model Motor	Propeller Back Bearing	Thrust Bearing Front
J-70, 75, 80	.0005 to .0015	.0005 to .0015
F-70, 75	.0005 to .0015	.0005 to .0015
A-70, 75, 80, AA-37	.0013 to .0022	.0028 to .0037
K-70, 75, 80	.0017 to .0032	.0032 to .0047

PROPELLER SHAFT BEARING CLEARANCE - Con't.

Model Motor	Propeller Back Bearing	Thrust Bearing Front
S-70	.0005 to .002	Ball Bearing
P-70, 75, 80, PO-37	.00075 to .00175	Ball Bearing
V-70	.00075 to .00175	Ball Bearing
KR-70, 80	Ball Bearing	Ball Bearing
SR-70, 80	Needle Bearing	Ball Bearing
300	.0005 to .0015	.0005 to .0015
100, 110	.00075 to .00175 Gear	.0015 to .003
200, 210	.00075 to .00175 Gear	.0015 to .003
LT, DT-37	.0005 to .0015	.2490 to .2505 Gear
LS, DS-37	.0005 to .0015	.2490 to .2505 Gear
KA-37	.001 to .0025	Ball Bearing
OK-75	.00195 to .00225	Ball Bearing

CRANKSHAFT SIZES

Model Motor	Top Journal	Center	Bottom
LT, DT-38	+ .000 .8105 - .0005	+ .000 .8105 - .0005	+ .000 .8105 - .0005
LT, AT, DT-10	.8085 .8080	.8085 .8080	.8075 .8080
MS, MD-38, 39	.6877 .6872	None	.6877 .6872
KA-38, 10	.873 + .000 - .0005	Rotor 3.057 + .000 - .0005	.904 + .00025 -
PO-38, 10, 15	+ .000 .999 - .0005	None	1.039 + .000 - .0005
HS, HA, HD-10	.6847 .6852	.6852 .6857	.6852 .6857

JOURNAL BEARING REAM SIZES

LT, DT-38	.812 + .0005 - .0000	.812 + .0005 - .0000	.812 + .0005 - .0000
LT, AT, DT-10	.8100 .8095	.8100 .8095	.8100 .8095
MS, MD-38, 39	.6897 .6892	None	.6897 .6892
KA-38, 10	+ .0003 .8755 - .0002	Rotor + .000 3.0615 - .0005	+ .0005 .907 - .000
PO-38, 10, 15	1.0015 + .0005 - .000	None	1.0415 + .0005 - .000
HS, HA, HD-10	.6867 .6872	.6867 .6872	.6867 .6872

JOURNAL BEARING CLEARANCE

LT, DT-38	.0015 to .0025	.0015 to .0025	.0015 to .0025
LT, AT, DT-10	.0010 to .0020	.0010 to .0020	.0015 to .0025
MS, MD-38, 39	.0015 to .0025	None	.0015 to .0025
KA-38, 10	.0023 to .0033	Rotor .0040 to .0050	.00275 to .00375
PO-38, 10, 15	.0025 to .0035	None	.00225 to .00325
HS, HA, HD-10	.0015 to .0025	.0010 to .0025	.0010 to .0025

CRANK PIN SIZES, CONNECTING ROD REAM SIZE & CLEARANCE

Model Motor	Crankshaft Crank Pin	Connecting Rod Ream Size	Clearance
LT, DT-38	.8105 + .000 - .0005	.8115 .8110	.0005 to .0015
LT, AT, DT-10	.8105 .8100	.8115 .8110	.0005 to .0015
MS, MD-38, 39	.6255 .6250	.6267 .6262	.0007 to .0017
KA-38, 10	.873 + .000 - .0005	.8745 .874	.001 to .002
PO-38, 10, 15	.998 + .0005 - .000	Roller bearings	
HS, HA, HD-10	.6255 .6260	.6267 .6262	.0007 to .0017

WRIST PIN SIZES, WRIST PIN BEARING REAM SIZE & CLEARANCE

Model Motor	Conn. Rod Bearing	Wrist Pin Size	Bearing Clearance
LT, DT-38	.43775 .43725	.437 + .00025 - .000	.00000 to .00075
LT, AT, DT-10	.43775 .43725	.437 + .0002 - .0000	.00000 to .00075
MS, MD-38, 39	.376 .3755	.3749 .3751	.0004 to .0011
KA-38, 10	.50025 .49975	.4995 + .0002 - .000	.00005 to .00075
PO-38, 10, 15	.6265 + - .00025	.625 + .00025 - .000	.00100 to .00175
HS, HA, HD-10	.376 .3755	.3749 .3751	.0004 to .0011

PISTON WRIST PIN HOLE REAM SIZES

Model Motor	Drive Fit Side	Slip Fit Side	Heat Fit Both Sides Reamed Sa
LT, DT-38	.4367 .4372	.4355 .4360	
LT, DT, AT-10	.4367 .4372	.4355 .4360	
MS, MD-38, 39	.3751 .3749	.3746 .3744	
KA-38, 10	.4992 .4997	.498 .4985	
PO-38, 10, 15	.6245 .625	.6245 .625	
HS, HA, HD-10	.3751 .3749	.3746 .3744	

PROPELLER SHAFT FINISH GRIND SIZES FOR BEARINGS

Model Motor	Propeller End	Thrust Bearing End
LT, DT-38	.5005 .5000	Gear .7475 .7480
AT, LT, DT-10	.5005 .5000	Gear .7475 .7480
MS, MD-38, 39	.4375 .4365	.4375 .4365
KA-38, 10	.738 + .0005 - .000	Roller Bearing
PO-38, 10, 15	.874 + .0000 - .0005	Roller Bearing
HS, HA, HD-10	.4375 .4365	.4375 .4365

PROPELLER SHAFT BEARING REAM SIZE

Model Motor	Propeller End	Thrust Bearing End
LT, DT-38	.5015 .5010	.750 ± .0005
LT, DT, AT-10	.5015 .5010	.750 ± .0005
MS, MD-38, 39	.4390 .4395	.4390 .4395
KA-38, 10	.740 ± .0002	Roller Bearing
PO-38, 10, 15	.875 ± .00025	Roller Bearing
HS, HA, HD-10	.4390 .4395	.4390 .4395

PROPELLER SHAFT BEARING CLEARANCE

Model Motor	Propeller End	Thrust Bearing End
LT, DT-38	.0005 to .0015	.0015 to .0030
LT, DT, AT-10	.0005 to .0015	.0015 to .0030
MS, MD-38, 39	.0030 to .0015	.0015 to .003
KA-38, 10	.0013 to .0022	Roller Bearing
PO-38, 10, 15	.00075 to .00175	Roller Bearing
HS, HA, HD-10	.0030 to .0015	.0015 to .003

LOWER DRIVESHAFT (PINION SHAFT) SIZES

Model Motor	Top Grind Sizes for Bearing	Bottom Grind Size for Bearing
LT, DT-38		.4885 + .0000 - .0005
LT, DT, AT-10		.488 .4885
MS, MD-38, 39		.375 .374
KA-38, 10	.738 + .000 - .0005	.738 + .000 - .0005
PO-38, 10, 15	.6235 + .0000 - .0005	Roller
HS, HA, HD-10		.375 .374

PINION SHAFT BEARING REAM SIZES

Model Motor	Top Bearing	Bottom Bearing
LT, DT-38		.4905 ± .0005
LT, DT, AT-10		.4905 ± .0005
MS, MD-38, 39		.377 .3765
KA-38, 10	.7405 + .001 .000	.740 ± .0005
PO-38, 10, 15	.625 ± .00025	Roller
HS, HA, HD-10		.377 .3765

PINION SHAFT BEARING CLEARANCE

Model Motor	Top Bearing	Bottom Bearing
LT, DT-38		Bearing Cast in Case
LT, DT, AT-10		Bearing Cast in Case
MS, MD 38, 39		Bearing Cast in Case
KA-38, 10	.0025 to .0040	.0015 to .0030
PO-38, 10, 15	.00125 to .0025	Roller
HS, HA, HD-10		Bearing Cast in Case

TABLE OF CYLINDER BORE AND PISTON CLEARANCE

Model Motor	Cylinder Bore	Piston	Piston Clearance
LT, DT-38	1.8745 1.8750	1.8735 1.8730	.0010 to .0020
LT, DT, AT-10	1.9375 1.9370	1.9360 1.9355	.0010 to .0020
MS, MD 38, 39	1.3750 1.3745	1.3735 1.3730	.0010 to .0020
KA-38, 10	2.125 ± .0005	2.1223 2.1218	.0022 to .0037
PO-38, 10, 15	2.750 ± .0005	2.7445 + .000 - .0005	.005 to .0065
HS, HA, HD-10	1.3750 1.3745	1.3735 1.3730	.0010 to .0020

PISTON RING SPECIFICATION

Model Motor	Part No.	Dia. of Ring	Width of Ring	Lbs. Comp. Aimed At	Gap Clearance
LT, DT-38	25-25	1.875 ± .000	.125 + .0000 - .0005	2.5	.005 to .010
LT, AT, DT-10	41-333	1.9375 ± .000	.0935 .0930	2 7/8	.005 to .010
MS, MD-38, 39	43-78	1.375	.09325 .09275	1.5	.004 to .009
KA-38, 10	27-25	2.125	.125 + .0000 - .0005	3 1/2	.005 to .012
PO-38, 10, 15	29-10	2.750	.125 + .0000 - .0005	4.0	.005 to .012
HS, HA, HD-10	43-78	1.375	.09325 .09275	1.5	.004 to .009

GREASE CAPACITY OF GEARCASE

Model Motor	Grease Necessary
LT, DT-38	3 oz.
LT, AT, DT-10	3 oz.
MS, MD-38, 39	1 1/2 oz.
KA-38, 10	9 oz.
PO-38, 10, 15	15 oz.
HS, HA, HD-10	1 1/2 oz.

SECTION FOUR

SPECIAL TOOLS FOR SERVICING OF JOHNSON OUTBOARD MOTORS

As the bearings, pistons and all reciprocating parts of Johnson Motors are machined to very close limits and perfect alignment, special tools and reamers have been designed for the purpose of properly servicing them.

These tools and reamers are manufactured of high grade steels, perfectly tempered, machined and ground to correct sizes, having special pilots for accomplishing the alignment of various bearings, connecting rods, shafts, etc.

These tools and reamers are made especially for Johnson service and should not be used for any other purpose.

Through agreement with the Johnson Motor Company, the special tools are supplied by CRERAR, ADAMS & COMPANY, 36th & MORGAN STREETS, CHICAGO, ILLINOIS. If you do not already have a copy, write to the above company, requesting one of their CERTIFIED JOHNSON SERVICE TOOL CATALOGS, which completely describes and illustrates the tools essential in servicing Johnson Outboard Motors.

CARE OF SPECIAL TOOLS AND REAMERS

When properly handled and used, the special tools as supplied by Crerar, Adams & Company, will last indefinitely. Following are instructions on the handling and care of them.

1. Never turn a reamer backwards in a bearing; this will tend to turn the cutting edges of the blades, causing them to ream undersize.

2. Never lay a reamer upon any metal object, or among other tools; this will damage or nick the cutting edges.

3. After using a tool or reamer, thoroughly clean and oil it before putting away.

4. Build a wooden tool cabinet or tray with separate compartments so that the reamers and tools cannot come in contact with each other.

5. Never strike upon a tool with a steel hammer; always use a wooden or rawhide mallet.

6. After considerable service, the reamers may become worn undersize. Readjust them in the following manner:

Reamers with detachable blades can be shimmed up by removing the cutters, cutting a piece of tinfoil with a razor blade the exact size of base of cutters and placing it underneath the blade. After the cutters have been drawn snugly down on the tinfoil, procure a very fine carborundum hone, dip in a mixture of oil and gasoline, such as motor fuel and by placing the flat side of hone on the outside machined surface of cutters, hone them to the correct reaming size. This size can be determined by reaming a new bearing and inserting the particular shaft to determine the correct clearance listed in the tables of clearances.

Expansion reamers can be sharpened in the same manner with a carborundum hone and then set to correct size.

Note: In the manufacture of motor parts, certain variable tolerances are allowed for machining over or under the specified dimensions.

Motor parts, manufactured by the Johnson Motor Company, are restricted to limits of but a fractional thousandth, plus or minus. Therefore, should the machined surface of a part be found to caliper a fractional thousandth over or under the specified dimension, you can rest assured that it is within the tolerable limits, as all parts are carefully checked and inspected before leaving the factory.

TOOLS AND REAMERS FOR ALL JOHNSON MOTORS

(For All Models J and A Motors up to A-65)

Tool No.	Name of Tool	Price
S-2	Pinion shaft bearing reamer (straight) for all A models up to 1925	
S-13	Line reamer for journal bearings in crankcase on all A and J models	
S-14	Expansion reamer for finishing journal bearings—A and J models	
S-16	.625 reamer for pump for all J and old style A motors	
S-18	Reamer for propeller shaft bearing in all J and A models up to A-35	
S-18-1	Burr Reamer to be used with S-18	
S-19	Reamer for pinion shaft bearing for A-25 motors	
S-25	Line reamer for upper driveshaft bearing in A-35 and A-45 gearcases	
S-26	Line reamer for lower bearings in all A-35 and A-45 gearcases	
S-27	½" expansion reamer with 7" extension for burr reaming propeller shaft bearing on A-35 and A-45	
S-28	½" expansion reamer with 7" extension for bell reaming propeller shaft bearing in A-35 & A-45	
S-30	Pinion shaft burr reamer for A-35 and A-45 gearcases	
S-31	Line reamer for propeller shaft bearing in A-35 and A-45 Gearcases	
S-33	Burr reamer for journal bearings A and J motors	
S-35	Tool for pressing in propeller shaft bearing on A-35 and A-45 motors	
S-41	Tool for pulling pinion shaft bearing in gearcase on A-25	
S-44	Bar for pressing lower driveshaft bearing out of motors up to A-25	
S-50	Lining bar for light twin crankcase journal bearings and Sea Horse "33"	
S-54	Tool and equipment for pulling driveshaft bearings in gearcase of A-35 motors	
S-55	Tool for pulling upper driveshaft bearings out of all A Motors up to A-35 and J motors	
S-56	Tool for holding pinion gear for taking pin out on all J and A models up to A-35	
S-57	Bar for pushing out lower pinion bearing in gearcase of Light Twin	
S-60	Tool for putting in propeller shaft bearing on A-35 and A-45 gearcases	
S-62	Bearing shrinker for gearcase on all J motors and A motors up to A-35	
S-63	Bar for pressing both journal bearings out and upper bearings in on Single cylinder and Light Twin motors	
S-64	Tool for holding crankcase for pressing out and in journal bearing on light Twin and Single Cylinder	
S-65	Bar for pressing out bearing in gearcase head in all A and J	
S-70	Piston ring compressor for all Light Twin and Single cylinder	
S-72	Bar for pressing in lower journal bearing on Single cylinder and Light Twin motors	
S-73	Plug that goes with bar for pressing in journal bearings (use S-72)	
S-74	Tool for driving upper journal bearing down to take end play out of crankcase on all Light Twin and Single cylinder	
S-76	Tool for pulling out upper driveshaft bearing on A-35 and A-45 gearcases	
S-78	Spanner wrench for assembling shock absorbers on all K motors and A-35 and A-45	
S-81	Plug cylinder gauge for all J and Light Twin	
S-202	Finish line reamer for upper driveshaft bearing in gearcase of A-50 motor	
S-203	Finish line reamer for propeller shaft bearing in gear case of A-50 motor	
S-204	Finish line reamer for lower driveshaft bearing in gear case of A-50 motor	
S-207	Rough line reamer for journal bearing of A-50 motor	
S-208	Finish line reamer for main journal bearing of A-50 motor	
S-209	Roughing reamer for using before reamer S-204 on A-50 motor	
S-210	Nut for knocking off flywheels on all A motors up to A-45 and also Utilimotor	
S-214	Puller for removing A-50 crankcase head	
S-231	Propeller fixture for OA-55	
S-233	Test propeller for OA-65 (final)	
S-234	Propeller fixture for OA-65	
S-236	Cylinder plug gauge for A-50 and 65	

FOR MODEL K MOTORS UP TO K-65

S-3	Line reamer for crankcase bearings on all K model motors	
S-4	1" standard expansion bell reamer for fitting journal bearings on K models	
S-5	1" expansion burr reamer (plus pilot on end) (pilot 6¼") for crankcase journal bearings K models	
S-6	Standard ⅞ expansion reamer used for all K connecting rods (crank pin end)	
S-7	Line reamer for pinion shaft bearings in all K models (Upper bearing)	
S-8	Line reamer for pinion shaft bearings in all K models (Lower bearing)	
S-8-1	Burr reamer to be used with S-8	
S-9	Line reamer for propeller shaft bearings in all K gearcases	

S-10 Expansion reamer (.625 bell type) with 8" extension for propeller shaft bearing on all K models
S-11 Propeller shaft bearing burr reamer for all K models
S-32 Fixture for pulling upper driveshaft bearings out of all K gearcases (including ¾-10 tap)
S-39 Complete set of tools for removing and replacing upper and lower journal bearings on all K motors (consisting of 3 pieces)
S-47 Bar for driving out lower driveshaft bearing on all K motors
S-48 Bar for pressing out propeller shaft bearings on all K motors
S-51 Ring compressor for K-35
S-58 Ring compressor for K-40 and K-45
S-61 Tool for putting in propeller shaft bearing on all K models
S-78 Spanner wrench for assembly shock absorbers on all K motors and A-35 and A-45
S-79 Tool for pulling out upper bearing in pinion shaft all Big Twins
S-80 Bar for lining journal bearings up on all K crankcases
S-205 Special line reamer for journal bearing of K-50 motor
S-206 Rough line reamer for journal bearing of K-50 motor
S-211 Test propeller for running K-50 motor in test tank
S-215 Puller for removing K-50 crankcase head
S-216 Bell reamer for upper journal bearing of K-50 motor
S-217 Bell reamer for lower journal bearing of K-50 motor
S-218 Straightening fixture for 27-73 propeller (9½x9½) 3 blade—K-50 motor
S-219 Straightening fixture for 27-102 propeller (8¼x12) 2 blade—KR-55 motor
S-220 Tool for removing cap on gearcase head of KR-55 motor
S-221 Bushing for magneto test stand for testing KR-55 magneto
S-222 Bushing for tool S-104 for straightening KR-55 conn. rods
S-223 Line reamer for upper driveshaft bearing KR-55 motor
Note: To be used with lower ball bearing for alignment
S-224 Line reamer for OK-55 pinion shaft bearings
S-232 Propeller fixture for OK-55
S-237 Cylinder plug gauge for K-50 and 65 and KR-55 and 65

FOR MODEL P MOTORS

S-1 Line reamer for crankcase journal bearings on all P models up to P-50
S-12 Reamer 1" expansion for connecting rods on all P models (crankpin end) up to P-50
S-15 Journal bearing bell reamer for belling journal bearings on crankcase of all P motors up to P-50
S-21 Burr-reamer for propeller shaft bearing in all P model gearcases up to P-50
S-21½ Bell reamer for propeller shaft on P models up to P-50
S-22 Reamer for lower pinion shaft bearing on all P model gearcases up to P-50
S-23 Reamer for line reaming upper pinion shaft bearing in all P model gearcases up to P-50
S-24 Line reamer for line reaming propeller shaft bearings in all P model gearcases up to P-50
S-34 Lining bar for journal bearings for all P motors up to P-50
S-36 Cylinder plug gauge for P-35, 40 and 45 cylinders up to P-50
S-37 Tool for pressing in propeller shaft bearing in P-35, 40 and 45
S-38 Bar for pressing lower driveshaft bearing out on gearcases of all P motors up to P-50
S-43 Bar for pressing propeller shaft bearing out of all P motors up to P-50
S-45 Bar for pressing in lower journal bearing of crankcases of all P motors up to P-50
S-46 Tool and equipment for pulling in driveshaft bearings on all K and P models up to P-50
S-49 Tool for holding crankcase while pressing in journal bearings on all P motors up to P-50
S-52 Ring compressor for all P-35, 40 and 45 motors
S-53 Ring compressor for P-30 Big Twin
S-71 Bar for pressing out both journal bearings and upper bearings in crankcases of all P motors up to P-50
S-200 Straightening fixture for 29-45 propeller (12x12) 2 blade bronze, P-50 motors
S-212 Propeller straightening fixture for 23-126 propeller
S-235 Cylinder plug gauge for P-50, 65, PR-50, 55, 60 and 65

FOR GIANT MODEL MOTORS

S-17 Bell reamer for upper Journal bearing for Giant Motor
S-20 Expansion reamer for belling lower journal bearing in Giant crankcase
S-29 Journal bearing line reamer for all Giant motors
S-59 Ring compressor for Giant model motors
S-66 Bar for pressing upper and lower bearing out, and upper bearing in on all Giant crankcases
S-67 Tool for holding crankcase while pushing lower bearing in all Giant crankcases

S-68 Tool for pressing upper bearing in crankcase on Giant
S-69 Bar for pressing in lower journal bearing in Giant crankcase

FOR MODEL S AND SR MOTORS

S-82 Finish reamer (special) for journal bearings SR, and PR-50 model motor (racing motor)
S-83 Line reamer (special) for journal bearing of S and P-50 model
S-84 Tool for pressing bushing in gearcases of S motors
S-85 Plug to press bushing in pinion shaft case of S motors
S-86 Line reamer (special) for journal bearing of regular S-45 and P-50
S-87 Line reamer for wrist pin end of conn. rod of S and V
S-96 Line reamer (special) for propeller shaft bearing on regular S, SR, VR and P-50-55 models
S-97 Line reamer for pinion shaft bearing in S, SR, VR and PR-50
S-99 Tool for pressing bearing in crankcase head (consisting of five pieces) for S models
S-100 Tool for pressing upper journal bearing in crankcase of S models (consisting of 5 pieces)
S-104 Tool for checking piston and rod assembly after inserting new wrist pin bearing in rod
S-225 Bushing for magneto test stand for testing magnetos on models SR-55, PR-55, VR-55, XR-55
S-201 Straightening fixture for 21-525 propeller (10x12) 2 blade bronze, S-45 and SE-50 motors

FOR MODEL V AND VR MOTORS

S-87 Line reamer for wrist pin end of connecting rod—S and V
S-88 Line reamer (special) for journal bearing of regular V-45
S-89 Pliers to remove ring from body and cap assembly crankcase center bearing on V and VR
S-90 Special tongs to install or remove center bearing head in crankcase
S-91 Finish line reamer (special) for journal bearings in VR (racing)
S-92 Line reamer for journal bearings of V (service)
S-93 Handle for inserting center bearing for line reaming main bearings in V models
S-94 Line reamer (special) for propeller shaft bearing V-45-65, P-50-65
S-95 Line reamer for pinion shaft bearing on regular V and P gearcases
S-97 Line reamer for pinion shaft bearing on S, SR, VR and PR-50-55
S-101 Fixture for pressing bushing in gearcase
S-102 Tool for pressing in upper bearing in crankcase of V models (consisting of 5 pieces)
S-104 Tool for checking piston and rod assembly after inserting new wrist pin bearing in rod

MISCELLANEOUS

S-40 Tool for driving out tilting tubes on all model motors
S-75 Socket stud wrench for putting in 5/16-24 studs
S-77 Socket stud wrench for putting in 1/4-28 studs
S-77½ Socket stud wrench for putting in 3/8-24 studs
S-103 2 Rubber rollers for rolling transfers on gas tanks 1-2", 1-4", pair
S-151 Tool for spinning in water pipes in all S, V, T and P motors including all long driveshaft casings of all mentioned models. (old part No. UH-15-16-T-9) (1⅝" std. counterborer also needed)
S-152 Tool for spinning water pipes in all A, AL, K and KL motors—includes all driveshaft casing in all mentioned model. (New models beginning A thru K complete) use this spinning tool. All other models (that is old style A and Single Cyl. J are soldered in. Old part number of tool UO-257-T-8) (1-.475 Std. counterborer also needed)
S-153 Cylinder plug gauge for all S, V and K models
S-155 Std. plug for checking journal bearing on all V models
S-160 Plug for putting paper tubes in armature plate
S-161 Plier for putting Bakelite plugs in magneto
S-162 Plug to hold glass tube while pouring Korite
S-165 Reamer for dowel pin holes in rotor valve of S and V-50
S-166 Reamer for dowel pin holes in rotor valve of S and V-45
S-213 Tool for pulling flywheels on S, P, V, K and X motors
S-226 Flywheel puller—models P-50, PR-50, S-45, V-45, SE-50, VE-50, SR-55, PR-55, VR-55, XR-55
S-227 Gauge for setting piston when timing rotary valve S, P, V, and X motors
S-238 Gauge for pressing roller race into position—SR-55, 60 and 65, PR-55, 60 and 65, VR and XR-55
S-239 Crankshaft gear puller, all S, P and V series except S and V-45

PROPELLER STRAIGHTENING FIXTURES FOR ALL MODELS

S-105 Straight. fixture for H-94 propeller (10¼x10.5) Big Twin 3 blade Lynite
S-107 Straight. fix. for 21-292 propeller (10x14) S-45—2 blade bronze
S-108 Straight. fix. for 23-32 propeller (12x17) V-45—2 blade bronze

S-109 Straight. fix. for K-105 propeller (10x12) Std. Twin 2 blade bronze
S-110 Straight. fix. for 21-288 propeller (10x11) S-45—2 blade bronze
S-111 Straight. fix. for 21-159 propeller (9x14) SR-45—2 blade bronze
S-113 Straight. fix. for H-92 propeller (10¼x12¼) Big Twin—2 blade bronze
S-114 Straight. fix. for O-378 propeller (9⅛x7.7) Lt. Twin—3 blade Lynite
S-115 Straight. fix. for 23-30 propeller (10⅜x19) VR-45—2 blade bronze
S-116 Straight. fix. for 23-28 propeller (12x15) V-45—2 blade bronze
S-117 Straight. fix. for 0-67 propeller (8x7) Lt. Twin—2 blade Lynite
S-118 Straight. fix. for H-141 propeller (10¼x13½) Big Twin—2 blade bronze
S-119 Straight. fix. for 23-29 propeller (10⅜x18) VR-45—2 blade bronze
S-120 Straight. fix. for 21-286 propeller (9x15) SR-45—2 blade bronze
S-121 Straight. fix. for P-109 propeller (10⅛x12½) Big Twin—3 blade Lynite
S-122 Straight. fix. for P-63 propeller (10x10) Big Twin—3 blade Lynite
S-123 Straight. fix. for K-103 propeller (10x10) K-35—3 blade Lynite
S-124 Straight. fix. for K-154 propeller (10x15) KR-40—2 blade bronze
S-125 Straight. fix. for 21-287 propeller (9x16) SR-45—2 blade bronze
S-126 Straight. fix. for J-22 propeller (7⅝x5⅛) Single Cylinder—2 blade Lynite
S-128 Straight. fix. for 0-266 propeller (8⅞x6½) Lt. Twin—2 blade bronze
S-130 Straight. fix. for 23-37 propeller (10x20) VR-45—2 blade bronze
S-131 Straight. fix. for 23-28 propeller (12x13) V-45—2 blade bronze
S-132 Straight. fix. for 23-39 propeller (12x12) V-45—3 blade bronze
S-163 Straight. fix. for 25-73 propeller (9⅛x6) A-50—3 blade Lynite
S-164 Straight. fix. for 27-57 propeller (9½x7¾) K-50—3 blade Lynite

TEST PADDLE WHEELS FOR ALL MOTORS

(For Running Motors in Test Tanks)

S-136 Test propeller for Std. Twin motor—1928
S-141 Test propeller for 9 hp. Big Twin motor
S-142 Test propeller for Lt. Twin (2½ hp) and A-50
S-143 Test propeller for Single Cylinder (J motors)
S-145 Test propeller for Std. K-45 and 50 (final test)
S-148 Test propeller for S-45 and S-50 motors (final test)
S-150 Test propeller for V-45, V-50 and P-50 test paddle (final test)

To Remove and Install New Bearings in the Gearcase of Models OA-65, J-70 and F-70

Model OA-65

First remove screws holding the gearcase-head in position—the gearcase-head can then be removed and the propeller shaft and bevel gear withdrawn. (The propeller shaft and bevel gear are integral parts and removed as one unit).

To remove the pinion shaft—Slip the pin retainer up far enough to drive out the pin. Remove pinion shaft and pinion gear.

The upper pinion shaft bearing should be removed by first tapping with a 9-16" - 12 tap (shown in Fig. 30 page 23). Arrange tool S-76 in position to pull the upper bearing—as shown—by first turning the nut to the top of threaded section of the bolt, placing the bushing over the threaded end protruding.

Screw the bolt into the top bearing, previously tapped. Remove bearing by drawing up nut. The lower pinion shaft bearing to be removed by simply driving out with tool S-57.

Press propeller shaft bearing out with tool No. S-35.

To remove the thrust bearing—Tap bearing with 9-16" - 12 tap. Turn nut to upper end of threaded bolt—as illustrated. Place puller plate in position, screw bolt into tapped bearing and remove by drawing up on the nut.

To install new pinion shaft bearings, use tool No. S-54. Slip upper pinion shaft bearing over threaded shaft—insert tool down through gearcase, then place lower pinion shaft bearing in position. Insert threaded bar (as shown in Fig. 31, page 23). Draw bearings into place by turning handle of tool to the right.

Ream pinion shaft bearings by first running burr reamer No. S-30 through both bearings. Ream upper bearing with reamer No. S-25, lower bearing with reamer No. S-26.

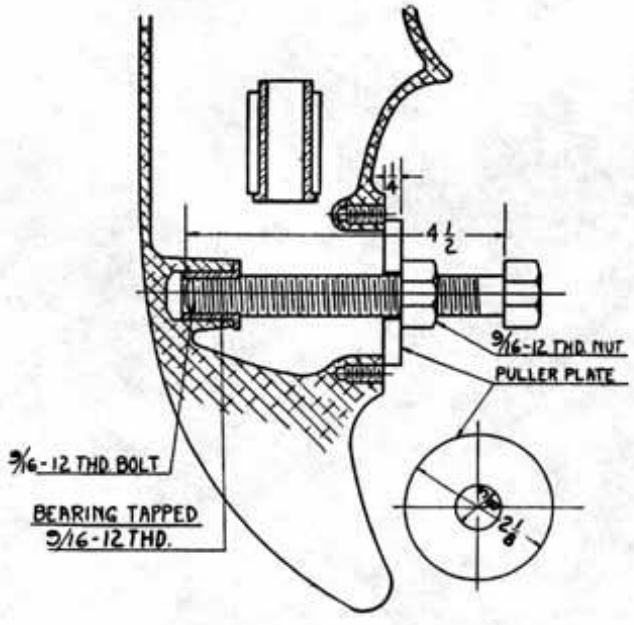
Press thrust and propeller shaft bearings into position.

Assemble gearcase head to gearcase—remove burrs by passing burr reamer No. S-27 through both bearings prior to line reaming with line reamer No. S-31.

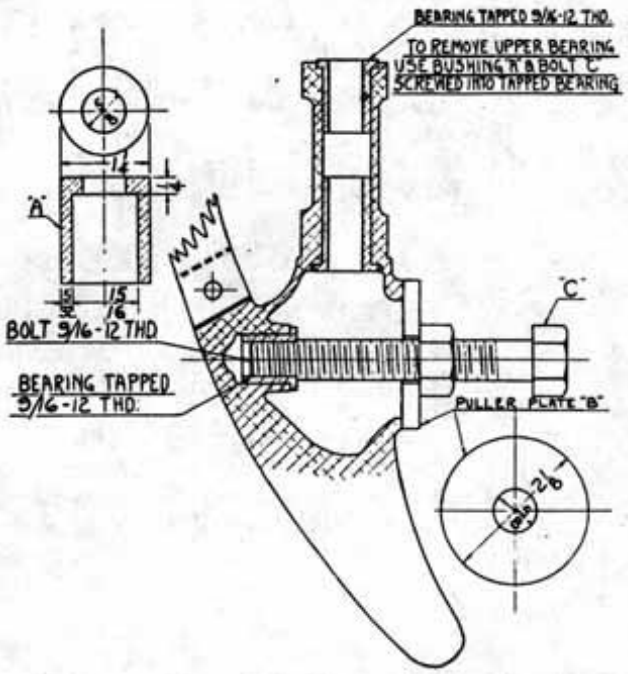
Remove gearcase head, adjust bell reamer No. S-28 to approximately .0015" above reamed size of the propeller shaft bearing. Bell ream from inside about one-half length of bearing only to allow for proper alignment and sufficient lubrication.

Reassemble gearcase, installing necessary new parts.

To obtain proper gear mesh, insert shims fore or aft of the bevel gear, as required. .003" backlash recommended.



To Remove Thrust Bearing OA-65



To Remove Upper Pinion Shaft and Thrust Bearings J and F-70.

Models J-70 and F-70

After having removed the water pump—remove screws holding gearcase head in position, remove gearcase head, propeller shaft and bevel gear.

Remove shock-absorber as instructed on pages 20 and 21.

Slip retainer up on pinion far enough to drive the pin out. Remove pinion shaft and pinion gear.

Press propeller shaft bearing out with tool No. S-35.

Tap thrust bearing with 9-16" - 12 tap—place puller plate "B" in position, as illustrated. Screw bolt "C" into tapped thrust bearing—remove by drawing up on nut.

The upper pinion shaft bearing should be removed in like manner—using bushing "A" and bolt "C".

To replace pinion shaft bearings, use tool No. S-41 as illustrated in Fig. 24A.

The propeller shaft and thrust bearings can then be pressed into place.

Ream pinion shaft bearings by placing reamer No. S-19 in position between the jaws of a vice and ream as shown in Fig. 24B.

Ream propeller shaft bearing with reamer No. S-18 as illustrated in Fig. 25. Assemble gearcase head to ream thrust bearing—illustrated in Fig. 26.

Reassemble gearcase with necessary new parts.

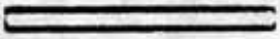
No gear adjustment is necessary as all parts are machined to permit proper gear mesh.

JOHNSON MOTOR

DRIVE PIN CHART

Always carry a few extra drive pins in your tackle box — don't let your fishing be spoiled for lack of a drive pin.

(NOTE—If in doubt, simply place the pin in question on the profile. Profile is actual size. If it fits, it's the pin you want.)

DRIVE PIN		MODELS USED IN
	No. 43-72, MONEL	MS-38, MD-38, MS-39, MD-39, HS-39, HD-39, HA-39. MS-15, MD-15, HS-15, HD-15, HA-15, MS-20, MD-20, HS-20, HD-20, HD-25.
	No. 13-40, BRASS	J-25, J-65, A, BN, A-25, AB-25, A-35, A-45, A-50, A-65, A-70, AA-37, LS-37, DS-37, LT-37, DT-37, LS-38, DS-38, LT-38, DT-38.
	No. 31-54, BRASS	OA-55, OA-60, J-70, J-75, J-80, F-70, F-75, 100, 200, 110, 210, 300.
	No. 41-300,592, MONEL	TS-15, TD-15, TD-20.
	No. 31-148, BRASS	OA-65.
	No. 25-286, MONEL	A-75, A-80, LT-39, DT-39, AT-39, LT-10, DT-10, AT-10.
	No. 15-102, BRASS	K-35, K-40, KR-40, K-45, K-50, K-65, K-70, K-75, K-80, KA-37, KA-38, KA-39, KA-10, KS-15, KD-15.
	No. 33-54, BRASS	OK-55, OK-60, OK-75.
	No. 27-156, STEEL	KR-55, KR-65, KR-70, KR-80, KR-39, KR.
	No. 7-72, BRASS	P-30, P-35, P-40, P-45, S-45, SE-50, S-65, S-70.
	No. 19-102, BRASS	TR-40, P-50, PE-50, P-65, P-70, P-75, P-80, PO-37, V-45, VE-50, VA-50, V-65, V-70, PO-38, PO-39, PO-10, PO-15.
	No. 7-92, STEEL	PR-40, SR-45, SR-50, SR-55, PR-50, PR-55, VR-45, VR-50, VR-55, XR-55.
	No. 29-110, STEEL	SR-60, SR-65, SR-70, SR-80, PR-60, PR-65, SR-38, SR-39, SR.
	No. 45-300,079, BRASS	SD-10, SD-15.

USE JOHNSON SEA-HORSE GEAR LUBRICANT — INQUIRE HERE

Service Models	Prop. No.	Material	Diam.	Pitch	Blades	Shaft	Service	Price
J-25, 65	11-22	Lynite	7⅝	5⅛	2	½	Note 8	$4.20
J-70	12-78	Lynite	7⅝	5⅛	2	½	Note 8	5.00
J-75	11-123	Lynite	8	8	2	½	Note 8	4.50
DS-37, LS-37, LS- DS-38	41-277	Alum.	8	5¼	2	½	Note 8	3.00
DT-37, LT-37, LT- DT-38	41-279	Alum.	8	7½	2	½	Note 8	3.00
Old Light Twin	13-67	Lynite	8	7	2	½	Note 8	4.75
A-25	13-569	Lynite	8⅞	6½	2	½	Note 8	5.50
AA-37	25-73	Lynite	9⅛	6	3	½	Note 8	7.00
AB-25	13-623	Bronze	8⅛	6½	2	½	Note 8	6.00
A-35 & 45	13-378	Lynite	9⅛	7.7	3	½	Note 8	6.00
A-50, 65, 70, 75 & 80	25-73	Lynite	9⅛	6	3	½	Note 8	7.00
OA-55, 60	32-11	Lynite	9⅛	8	2	½	Note 8	5.50
OA-65	31-149	Lynite	8⅝	7½	3	½	Note 8	7.00
F-70	38-64	Lynite	8¼	6	2	½	Note 8	5.00
F-75	37-159	Lynite	8	9	2	½	Note 8	5.00
100, 110	11-176	Alum	7⅝	4½	2	½	Note 8	1.50
200, 210	37-170	Alum	7⅝	5½	3	½	Note 8	2.00
300 & J-80	39-91	Lynite	8	6¼	2	½	Note 8	5.00
K-35	15-103	Lynite	10	10	3	⅝	Note 8	10.00
K-40, 45	15-153	Lynite	10¼	13.02	3	⅝	Note 2	9.00
K-45	15-154	Bronze	10	14.9	2	⅝	Note 2	9.00
K-50	27-57	Lynite	9½	7¾	3	⅝	Note 8	8.00
K-50 (1932 Model) & K-65	27-73	Lynite	9½	9½	3	⅝	Note 8	8.00
K-70, 75 & 80	27-207	Lynite	9½	9	3	⅝	Note 8	8.00
K-75 & 80	27-245	Lynite	9¾	7¼	3	⅝	Note 4	8.00
KA-37, KA-38	27-275	Lynite	9½	9	3	⅝	Note 8	7.50
KA-37, KA-38, KA-39	27-297	Alum.	9¾	7¼	3	⅝	Note 4	8.00
OK-55, 60	34-11	Lynite	10¼	13	2	⅝	Note 8	6.50
S-45,SA-& SE-50,S-65&70	21-288	Bronze	10	11	2	¾	Note 1	9.00
S-65 - 70	21-179	Bronze	10	17	2	¾	Note 2	6.00
S-65 - 70	21-292	Bronze	10	14	2	¾	Note 3	8.00
S-45,SA-&SE-50,S-65&70	21-452	Bronze	10	10	3	¾	Note 4	9.25
P-35, 40 & 45	17-92	Bronze	10¼	12¼	2	¾	Note 2	9.00
P-35, 40 & 45	17-94	Lynite	10¼	10½	3	¾	Note 1	10.75
P-45	17-141	Bronze	10¼	13¼	2	¾	Note 2	8.00
P-40 & 45	7-109	Lynite	10⅛	12½	3	¾	Note 1	12.00
P-50 to PO-15 inc	23-39	Bronze	12	12	3	⅞	Note 1	13.00
P-50 to PO-15 inc	23-28	Bronze	12	15	2	⅞	Note 6	11.00
P-50 to PO-15 inc	23-38	Bronze	12	13	2	⅞	Note 3	9.50
P-50 to PO-15 inc	23-126	Bronze	12	10	3	⅞	Note 4	12.75
PA- & PE-50	23-39	Bronze	12	12	3	⅞	Note 1	13.00
PA- & PE-50	23-28	Bronze	12	15	2	⅞	Note 5	11.00
PA- & PE-50	23-38	Bronze	12	13	2	⅞	Note 3	9.50
PO-37, PO-38, PO-15	29-175	Bronze	12	13	3	⅞	Note 1	13.00
V-45, 65 & 70	23-39	Bronze	12	12	3	⅞	Note 1	13.00
V-45, 65 & 70	23-32	Bronze	12	17	2	⅞	Note 2	9.00
V-45, 65 & 70	23-28	Bronze	12	15	2	⅞	Note 3	11.00
V-45, 65 & 70	23-38	Bronze	12	13	2	⅞	Note 3	9.50
VA- & VE-50	23-39	Bronze	12	12	3	⅞	Note 1	13.00
VA- & VE-50	23-126	Bronze	12	10	3	⅞	Note 4	12.75
MS, MD-38	43-2	Alum.	6½	3¼	2	1″	Note 8	1.25
MS-39	43-2	Alum.	6½	3¼	2	1″	Note 8	1.25
MD-39	43-2	Alum.	6½	3¼	2	1″	Note 8	1.25
LT-39, LT-10	41-279	Alum.	8	7½	2	½	Note 8	3.00
DT-39, DT-10	41-279	Alum.	8	7½	2	½	Note 8	3.00
AT-39, AT-10	41-279	Alum.	8	7½	2	½	Note 8	3.00
HS-39-10	43-260	Alum.	6⅝	5¼	2	1″	Note 8	1.25
HD-39-10	43-260	Alum.	6⅝	5¼	2	1″	Note 8	1.25
HA-39-10	43-260	Alum.	6⅝	5¼	2	1″	Note 8	1.25
KA-39, KA-10	27-275	Lynite	9½	9	3	⅝	Note 8	7.50
PO-39, PO-10	29-175	Bronze	12	13	3	⅞	Note 3	13.00
MS-15	300-247	Alum.	6½	4¼	2	1″	Note 8	1.25
MD-15	300-247	Alum.	6½	4¼	2	1″	Note 8	1.25
HS-15	300-034	Alum.	6⅝	5¼	2	1″	Note 8	1.25
HD-15	300-034	Alum.	6⅝	5¼	2	1″	Note 8	1.25
HA-15	300-034	Alum.	6⅝	5¼	2	1″	Note 8	1.25
PO-15	23-39	Bronze	12	12	3	⅞	Note 1	13.00
SD-10	300-188	Alum.	10	10	3	¾	Note 1	10.00
MS-15 (shock absorber)	300-275	Alum.	6½	4¼	2	1″	Note 8	1.25
MD-15 (shock absorber)	300-275	Alum.	6½	4¼	2	1″	Note 8	1.25
HS-15 (shock absorber)	300-032	Alum.	6⅝	5¼	2	1″	Note 8	1.25
HA-15 (shock absorber)	300-032	Alum.	6⅝	5¼	2	1″	Note 8	1.25
HD-15 (shock absorber)	300-032	Alum.	6⅝	5¼	2	1″	Note 8	1.25

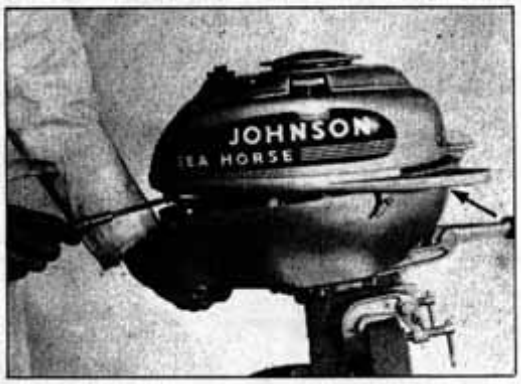
NOTE: 1—For V-Bottom medium fast boats, supplied as regular equipment.
2—For light weight racing boats, sold as an accessory only.
3—For light displacement boats, sold as an accessory only.
4—For heavy displacement boats and small cruisers, sold as an accessory only.
5—For medium weight racing boats, supplied as regular equipment.
6—For heavy weight racing boats, sold as an accessory only.
7—For exceptionally fast racing motors on exceptionally light racing boats.
8—For all kinds of boats.

(Prices Subject to Change Without Notice)

MAGNETO—MODELS H & T—15, 20

TO LOWER OR REMOVE COVER

For inspection of spark plugs, carburetor, etc—loosen screws as indicated. Four screws are used to hold cover in position — namely, two at rear and two at front, arrow directed to location.



Dropping Spark Plug Cover

TO REMOVE FLYWHEEL FOR INSPECTION OF MAGNETO

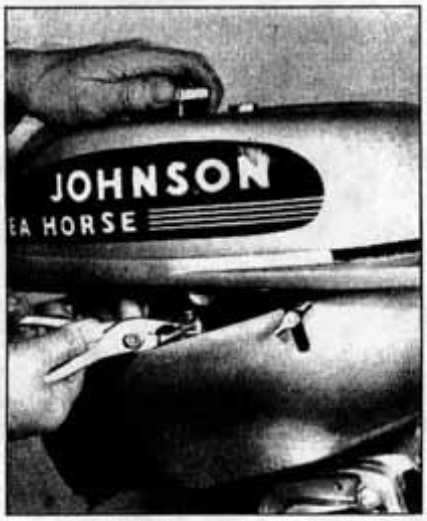
Proceed as follows:

1. Remove spark plug cover as described above.

2. Remove starter pulley and spacer from flywheel. See motor illustration.

3. Remove high speed needle and primer by withdrawing small tapered pin from end of shaft as shown.

4. Disconnect gas line, gas tank is held in position by four ¼-20 x 1-⅛ screws. Remove tank from bracket as illustrated.



Removing Pin From High Speed Needle

5. Remove flywheel nut, using a ¾" socket wrench. Grasp rim of flywheel to prevent turning when unscrewing nut. If nut appears to be too tight to loosen with socket wrench only, strike handle of wrench with a hammer—resulting jar should be sufficient to loosen nut.

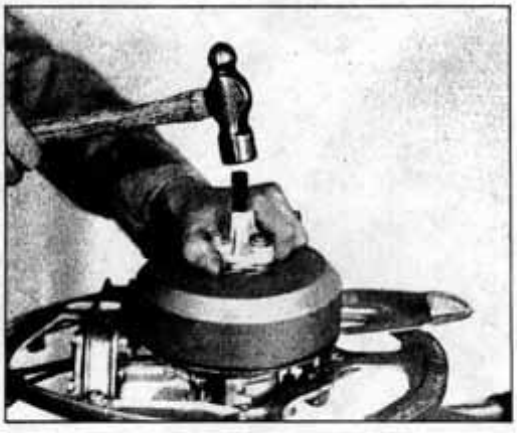
6. Attach wheel puller No. S-288 to flywheel as shown.

7. Turn puller screw down until it rests firmly against end of crankshaft. Grasp puller with one hand, as illustrated, lift upward to absorb shock and strike puller screw head sharp blow with medium size hammer.

Removing Gas Tank

If first application fails, draw up further on puller screw and repeat as above. Two or three similar attempts should be sufficient to loosen flywheel on taper of crankshaft.

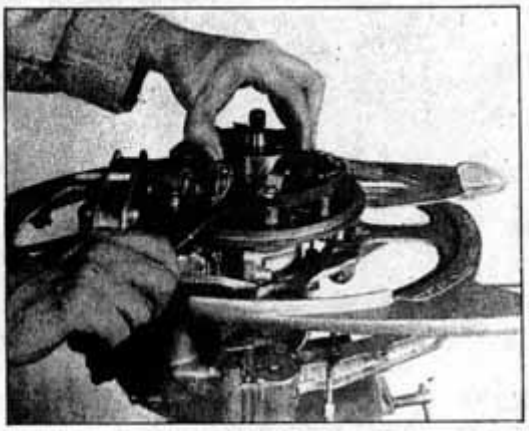
8. After having loosened flywheel, simply lift off.



Pulling Flywheel

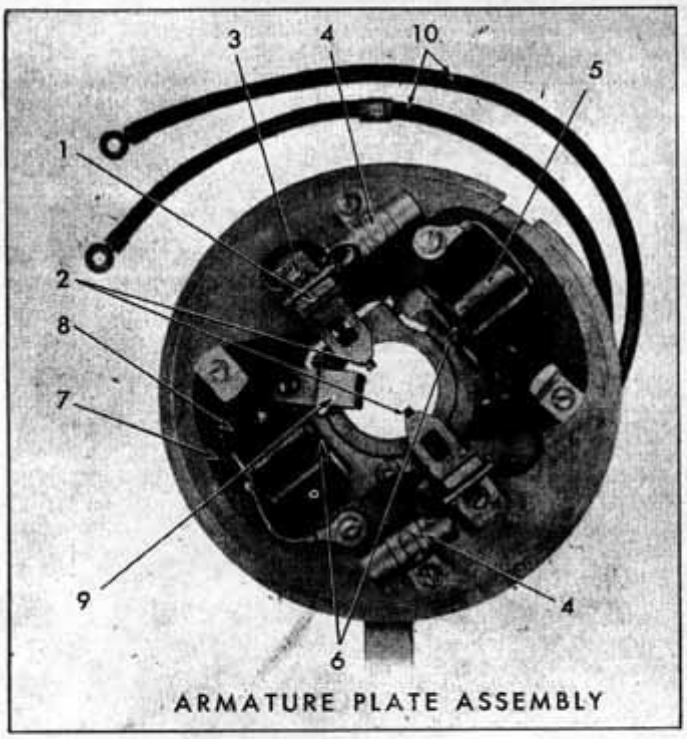
To install flywheel after inspection of magneto, proceed in reverse order of that described about. Note—Be sure flywheel is securely mounted before attaching spacer and starter pulley—the nut must be tight to prevent flywheel from loosening in operation.

To remove magnet rotor, simply grasp rotor between thumb and forefinger—lift up. Rotor slips over end of crankshaft, but in event fit is found to be a bit snug, pry gently using screw driver as illustrated. Excessive force not required to replace rotor — slip over end of crankshaft and press down lightly.

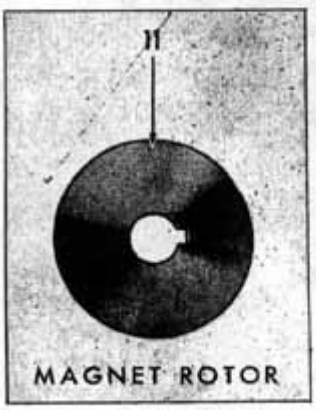


Removing Magnet Rotor

MAGNETO—MODELS HS, HD, TS, TD—15-20



ARMATURE PLATE ASSEMBLY



MAGNET ROTOR

1. Breaker Point Assembly
2. Breaker Point Push Rods
3. Breaker Point Adjusting Screw
4. Condensers
5. Ignition Coils
6. Coil Core
7. Ignition Coil Pole Shoes
8. Maverick Spark Suppressor (under coil shoe), Model TS, TD-15 only
9. Rubbing Block
10. Ignition Leads
11. Magnet Rotor

Maverick Spark Suppressors—The word maverick means *stray* or, in terms of the cattlemen, unbranded—here it is but whose is it. The word also is associated with the characteristics of an electrical ignition system — a stray spark, unwanted but still present.

Maverick spark does not occur at slow speeds but prevails in the higher speed range, resulting in a spark jumping the spark plug gap before the breaker points actually open. This effects timing, causes pre-ignition and faulty operation of the motor at high speeds. It is not a particularly strong spark and is easily controlled, but if not suppressed is strong enough to interfere considerably. Control consists of installing a small gap in the secondary (high tension) circuit Maverick Spark Suppressor (8). It is located between the armature plate (ground) and ground lead of the secondary winding.

Operation of the Maverick Spark Suppressor is extremely simple—the gap provided merely sets up sufficient resistance to keep the secondary circuit open, thus suppressing the spark (maverick) until the breaker points open, when the controlled spark is strong enough to jump both the plug gap and the suppressor gap. Consequently, every time the plugs fire, a spark jumps the Maverick suppressor gap—this is visible when operating on a test stand with the flywheel removed.

MAGNETO—MODELS TS-15, TD-15, TS-20, TD-20

While outwardly there is no difference in appearance between the TS-, TD-15 and TS-, TD-20 models, there is a difference in the magneto.

1. Maverick Spark Suppressors have been omitted from the TS-, TD-20 armature plate. This has been accomplished by increasing strength of the magnet in the rotor and by machining a longer flat (cam) on the crankshaft to permit breaker points remaining closed over a longer period, thus eliminating the Maverick spark entirely.

2. The new rotor bears the same part number as the rotor originally installed in assembly of Models TS-, TD-15 but can be identified by the letter "V" cast on its top side. The old rotor, with the smaller maget, is no longer available.

3. The crankshafts on both models (TS-15, Models TS-, TD-15 but can be identified by the letspects but one, the difference being in the cam on the top journal which operates the breaker points. Models TS-15, TD-15 use part number 41-300503 crankshaft, machined with a comparatively short-

er cam than the cam on crankshaft number 41-301392 for Models TS-20, TD-20. The length of the cam determines the length of time the breaker points remain open and closed, during operation of the motor.

4. The new rotor (with the larger magnet) can be used on Model TS-15 and TD-15. (Maverick spark suppressors become more important under this condition. Irregular motor operation results if the suppressors are defective or otherwise fail to function.) The old rotor (with the smaller magnet) cannot be used with the TS-20, TD-20 crankshaft under any conditions.

5. Models TS-20, TD-20.
Crankshaft #41-301392
Rotor #71-300540
*Armature plate complete #72-375458

*No suppressors required.

6. Models TS-15, TD-15.
Crankshaft #41-300503
Rotor #41-300540
*Armature plate complete #72-375250

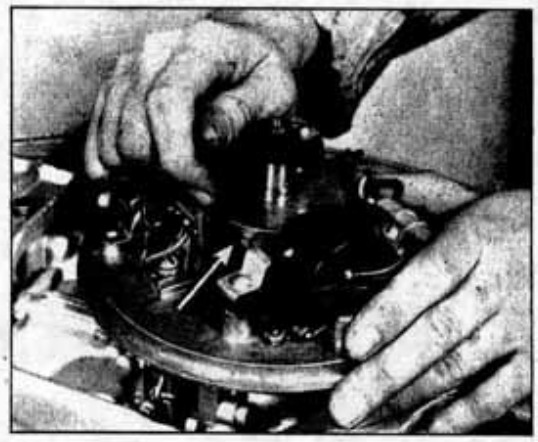
*The suppressors #72-375249 must be used on this combination.

TO INSTALL NEW COIL

Remove screws attaching coil and shoe assembly to armature plate. Detach ground wire, high tension lead and primary lead to breaker assembly. (Use only enough heat to loosen soldered connections.) Flatten out small lugs on end of coil core, using blunt punch. Remove coil by sliding off core. Install new coil. Upset lugs on core to hold coil in position. Attach ground wire, primary lead to breaker assembly and high tension lead. (Under no circumstances use acid flux — use soldering PASTE or ROSIN and just enough heat to obtain a good soldered connection.) Attach coil and shoe assembly to armature plate but do not tighten screws.

TO ADJUST CLEARANCE BETWEEN COIL SHOES AND MAGNET ROTOR

Attach armature plate assembly to motor. Adjust armature plate screw to desired tension. (This screw is located underneath armature plate and in clamp arrangement provided for attaching same to crankcase.) Install magnet rotor. Move coil and shoe assembly to a point where .008″ exists between shoe and rotor (use .008″ feeler gauge). Tighten screws holding coil assembly to armature plate.



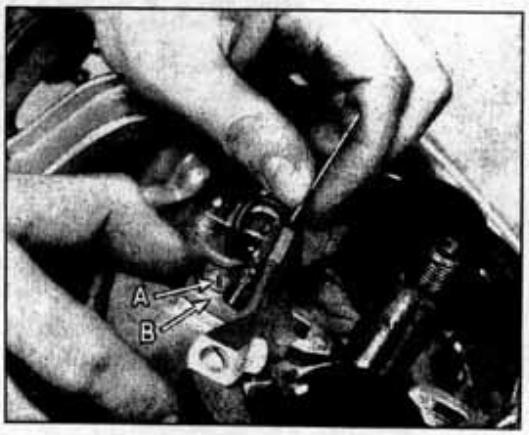
Checking Rotor Clearance

TO ADJUST MAGNETO BREAKER POINTS

Since two coils are used (one for each cylinder) two condensers and two sets of breaker points are required, both of which may need occasional inspection from time to time.

Note flat machined on crankshaft and two push rods operating both sets of points are open when respective push rods ride on high side of crankshaft—closed when on flat. Correct breaker point gap setting is .020″ (full open).

To adjust gap setting loosen screw "a". Turn crankshaft to position where push rod rides on high side. Check gap between points, using .020″ feeler gauge as illustrated. If gap is less than .020″ push breaker point bracket "b" in (towards crankshaft), sufficiently to obtain correct gap setting. Tighten screw "a". If gap is over .020″ slide bracket "b", out (away from crankshaft). Adjust both points in like manner.



Adjusting Breaker Points

MAGNETO—K, KA, KS, KD

Due to its simple and rugged construction, the magneto will perform efficiently throughout the entire life of the motor. It requires no lubrication, therefore, little or no attention other than an occasional inspection of the breaker points and electrical connections.

Should you find the motor a bit difficult to start after having used it for some time and have reason to suspect the ignition of being at fault, examine first, condition of spark plugs and connections. If found to be in good condition, the difficulty might be due to pitted or corroded breaker points.

This can be determined by removing the cover plate from the flywheel or magneto dome. An inspection hole in the dome provides access to the breaker points for inspection and adjustment.

Adjusting Screws

Spread breaker points with a blunt instrument. If found to be pitted, place a narrow strip of 00 sandpaper between the points, folded in such a manner that both points can be dressed down simultaneously by drawing back and forth between the points. (Do not use emery cloth.)

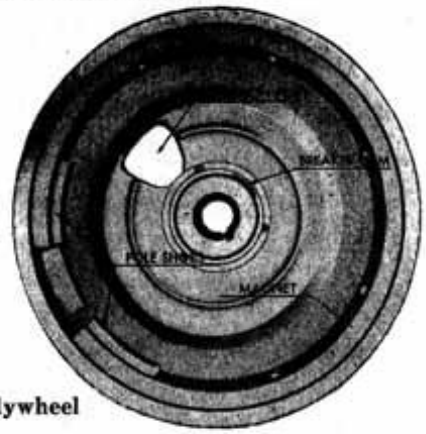
Upon completion of this operation, it is well to check the gap between the points. This can be accomplished by turning the flywheel slowly until the points are wide apart. Insert a feeler gauge between the points — correct setting should be .020″. Should you find it necessary to make corrections, loosen the adjusting screw. If the gap is too great, move the breaker assembly away from cam; if too narrow, move towards cam.

A screw is provided underneath armature plate to adjust tension of magneto lever.

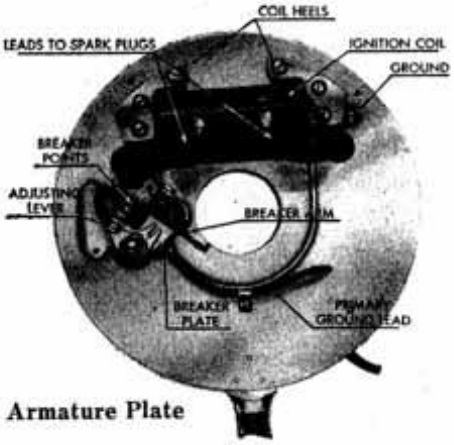
Be sure the flywheel is secure at all times.

TIGHTEN FLYWHEEL NUT OCCASIONALLY ON A NEW MOTOR.

MODEL PO MAGNETO



Flywheel

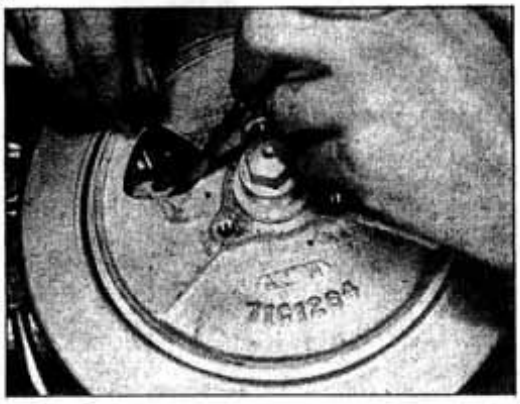


Armature Plate

TO CLEAN BREAKER POINTS

Remove starter plate. Note inspection port in flywheel. Turn flywheel to uncover points and to a position where points are open (spread). Install flexible point cleaner between points. Turn flywheel back until points close on cleaner. Clean or dress points by carefully moving back and forth. Continue operation until point surfaces are clean and smooth. After dressing with cleaner, insert piece of paper between points to remove particles of cleaner which may have lodged on point surfaces. If points are pitted or corroded beyond reconditioning with cleaner, install a new set.

Scrape corrosion, if any, from outside diameter of points so that no loose particles may fall between points.

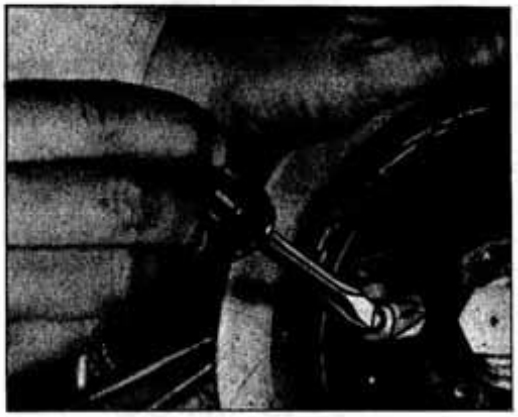


Cleaning Breaker Points

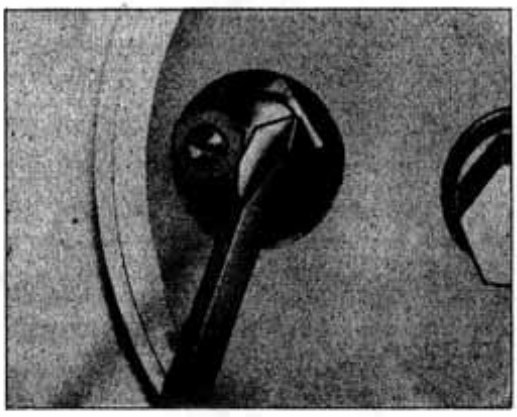
TO ADJUST BREAKER POINT GAP

The correct breaker point gap is .020". After having removed starter pulley, turn flywheel to expose point assembly and to a position where points are full open. Insert feeler gauge (.020") to check gap. If necessary to adjust gap, loosen screw. Turn adjusting lever to right or left as required to obtain correct gap setting. After setting gap at .020", tighten screw to lock in position.

Checking Breaker Points



Loosening Screw



Adjusting Breaker Points

NOTE: Since points are operated by breaker arm rubbing block riding on cam attached to flywheel hub, point gap is increased by shifting assembly towards hub—decreased by moving away from hub.

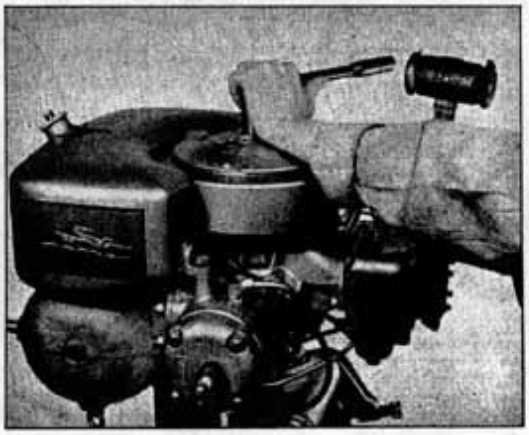
TO REMOVE FLYWHEEL—MODEL PO

1. Flywheel nut and cover (starter) plate act in combination as a puller when unscrewing the flywheel nut. The nut is provided with a shoulder and bears against underside of cover plate.

2. Unscrew flywheel nut until it tightens against cover plate. Use socket with "L" handle.

3. Strike handle of wrench sharp blow with hammer or mallet. Two or three similar applications should be sufficient to jar flywheel loose from taper on crankshaft.

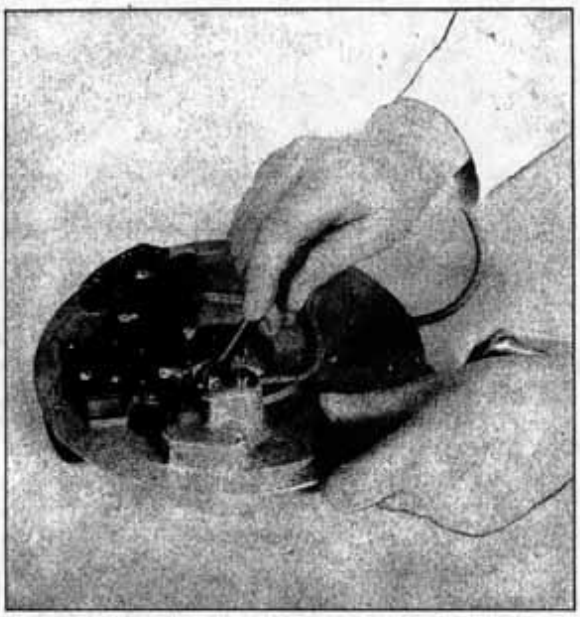
(Note: If flywheel puller is not available, flywheels on smaller motors can be removed in like manner.)



Removing Flywheel—Model PO

TO INSTALL NEW BREAKER POINTS
(Breaker Point and Breaker Arm Assembly)

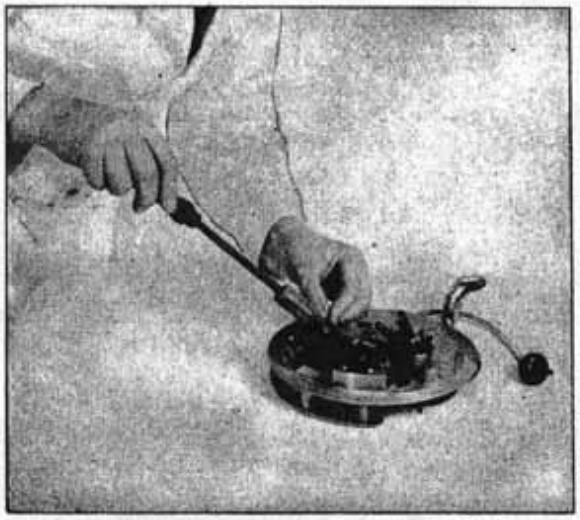
Loosen and remove nut holding breaker arm spring fast to armature plate. Remove small clip holding breaker arm on pivot post. Lift breaker arm assembly off pivot post. Remove nuts and washers holding stationary breaker point in breaker plate. Install new points (stationary point and breaker arm assembly) in reverse order of that described. Be sure breaker arm operates freely on pivot post and that all nuts and washers are drawn up securely. Adjust points as instructed. Note: Since the breaker point cam is attached to the hub of the flywheel, the flywheel must be mounted to the crankshaft prior to attempting adjustment of the points—see instructions.



Removing Breaker Points

TO INSTALL NEW CONDENSER

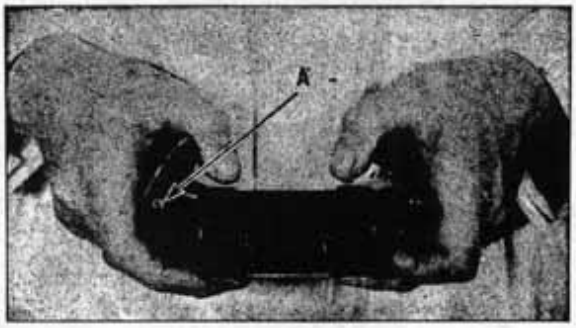
(Note: Condenser is fastened to underneath side of armature plate.) Remove screws. Detach condenser lead soldered to bracket on breaker plate. Lift condenser from cavity in plate. When attaching new condenser, thread small wire (condenser lead) through hole in armature plate provided for this purpose. Solder lead to bracket. Set condenser in cavity and replace screws to hold it fast.



Soldering Leads to Coil

TO INSTALL NEW IGNITION COIL

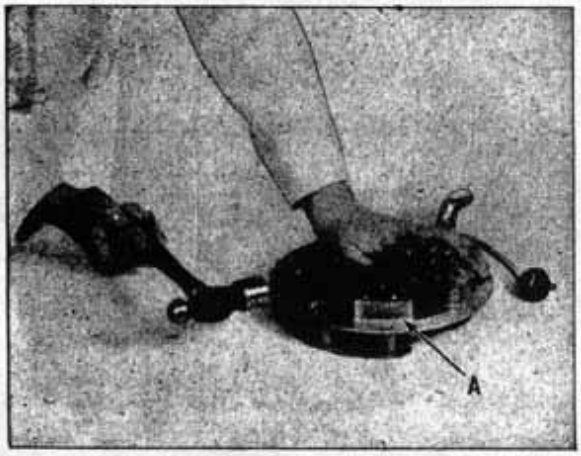
Detach ground wire from armature plate. Detach primary lead (small wire) soldered to bracket on breaker plate. Detach high tension leads (spark plug wires) soldered to coil. Use small soldering iron and just enough heat to loosen soldered joint to permit pulling wires away. Remove screws (see note below) holding coil heels and coil to plate. Lift coil and heel assembly from armature plate.



Removing Coil Heels

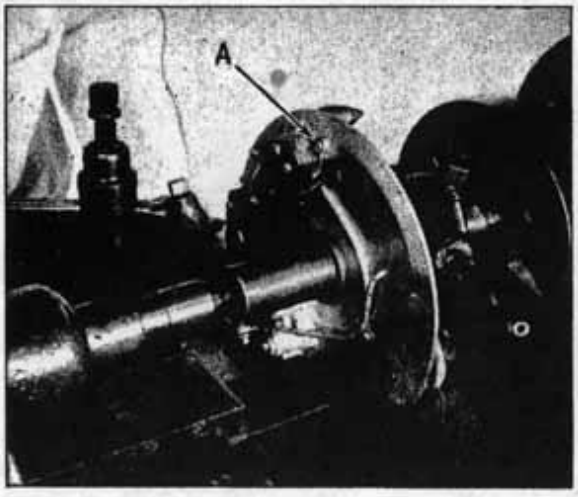
(Note: The middle screw, "A" on each heel is used to hold plates of heel assembly together—do not remove this screw, merely loosen.) Pry heels gently from coil. Simply pull off by hand.

Place coil and heel assembly in position on armature plate. Insert and tighten screws holding assembly to plate. Solder high tension leads (spark plug wires) to coil in their respective positions. Use soldering paste or rosin flux. Do not under any circumstances use acid flux—avoid detrimental effects of corrosion by NOT using acid flux. Use just enough heat, solder and flux to obtain a good substantial connection. Application of excessive heat is apt to burn off small secondary lead from coil. Over use of solder or flux will result in short circuits to render the coil inoperative.



Adjusting Coil Heels

Coil heels must be made flush with boss on armature plate "A" to prevent striking pole shoes of magnet in the flywheel when motor is in operation. This can be accomplished in two ways—namely; by tapping heel assemblies with hammer as illustrated. If a lathe is available, mount armature plate assembly on a mandrel between centers and turn heel surfaces down until flush with boss on armature plate "A". On having completed this operation, draw down further on all screws in heel assembly to make certain coil is securely mounted.



Turning Coil Heels

SOLDERING IGNITION LEADS TO COIL

Except on some of the real old Sea Horse models, the high tension ignition lead is attached to the coil by a soldering operation. Extreme care should be exercised when attaching the lead. Many coils are ruined because of carelessness in this respect.

First—USE A SOLDERING PASTE — do not under any circumstances use an acid flux. Acid burns into the coil tube, ruins the connection and produces corrosion, thus, a new coil spoiled.

Second—Don't use too much heat — heat the soldering iron just enough to make a good soldered connection. Excessive heat will burn the coil tube and the small high tension wire leading to the terminal post.

Third—Be careful—don't use too much solder —wipe off excess soldering paste when completed.

Brackets are provided on the LT coils — perform all soldering operations on the brackets.

Soldering paste can be obtained from your local electrical store — DON'T USE ACID FLUX.

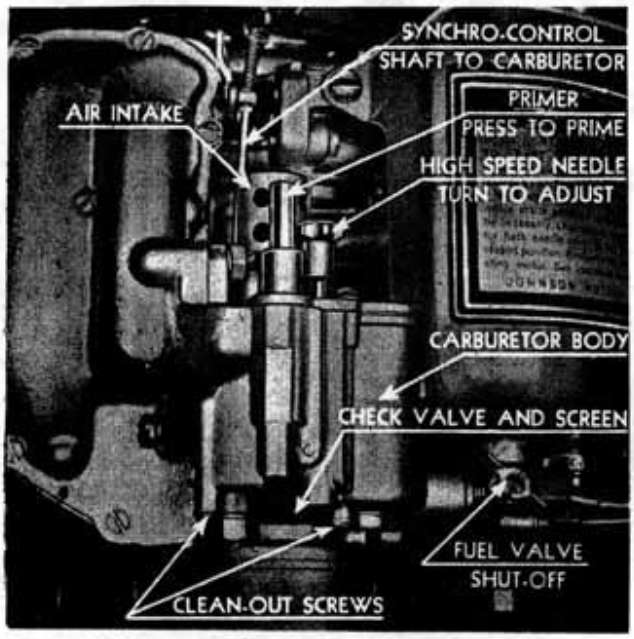
TO INSTALL FLYWHEEL—ALL MODELS

With cover (starter) plate removed, make certain keys are secure in position on crankshaft. Place flywheel over taper on crankshaft at same time aligning keys and keyway in flywheel hub. Replace flywheel nut—screw down tightly. Strike handle of wrench several sharp blows with hammer or wrench to make fast. Replace cover plate. Start and run motor ten to fifteen minutes—stop to further tighten nut as described above. Newly installed flywheel will settle slightly on taper of crankshaft after a few minutes operation and unless tightened, is apt to cause serious damage to both flywheel hub and crankshaft taper. BE SURE FLYWHEEL NUT IS TIGHT. Repeated shearing of propeller pins for no apparent reason is result of loose flywheel.

STARTING MIXTURE—LS, LT, T

Since a rich starting mixture is essential for starting purposes, some arrangement must be built into the carburetor to accomplish it. Models LT and TS do not employ use of the conventional choke built into the carburetor, but rely on a primer (manually operated) to supply additional fuel for starting purposes.

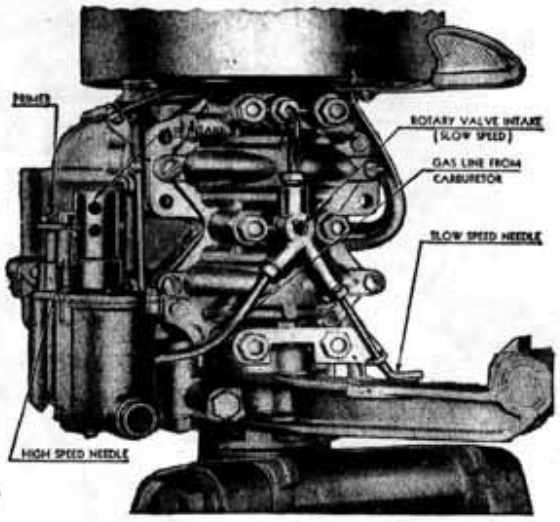
The primer is operated by depressing the plunger or high speed needle adjusting button as desired to obtain necessary starting mixture.



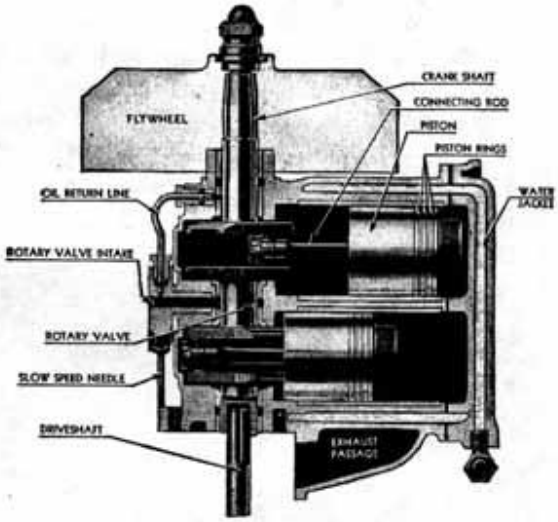
Carburetor—Models LT, DT, AT, TS, TD

CARBURETION

Carburetion is of the full range type, thus providing efficient carburetion at all speeds — some departure from customary construction has been made nevertheless, in that only the high speed needle and jet are built into the carburetor body; the slow speed needle and jet are actually not a part of the carburetor proper — this feature is part of the crankcase assembly and functions throughout the entire speed range of the motor.



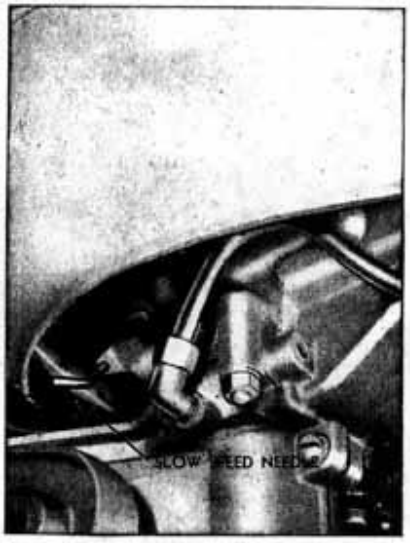
Since both third port and rotary valve principles are employed, there are two independent systems of carburetion. The carburetor itself is of the conventional type — consisting of a float chamber, mixing chamber, throttle valve, needle for adjusting mixture and a connection to the intake manifold. The carburetor and third port operate only at intermediate and high speeds and cease to function entirely at slow speeds. Slow speed operation is maintained, however, by mixing air and gasoline in the slow speed opening which is conducted to the crankcase chamber by way of the rotary valve.



To adjust carburetor, proceed as follows—(note, carburetion is properly adjusted prior to shipping motors from the factory.)

Some adjustment may however be necessary due to type of service or climatic conditions. There are two (2) adjustments—namely, High and Slow speed.

1. Close slow speed needle, turn right until it rests gently on its seat, then unscrew approximately ¾ turn. (Turn left).



Showing Location of Slow Speed Needle—Models LT, TS

2. Close high speed needle, turn right until it rests gently on its seat, then unscrew approximately ¾ turn. (Turn left).

3. Start motor as instructed.

4. Operate at full speed with spark at full advance until normal motor running temperature is reached. Turn high speed needle to left or right as required to obtain maximum speed.

5. Retard spark by moving magneto lever to position midway between center and full retard (left of center facing motor). Turn slow speed needle to left or right as required to obtain smooth and consistent running at slow speeds.

High and slow speed needles should be adjusted separately — adjusted one at a time. Some may prefer to close the high speed needle entirely when making the slow speed adjustment. In this case open the slow speed needle approximately ¾ turn from closed position, start the motor and run until warm. Retard spark to slow speed range, turn slow speed needle to right or left slightly to obtain consistent slow speed operation.

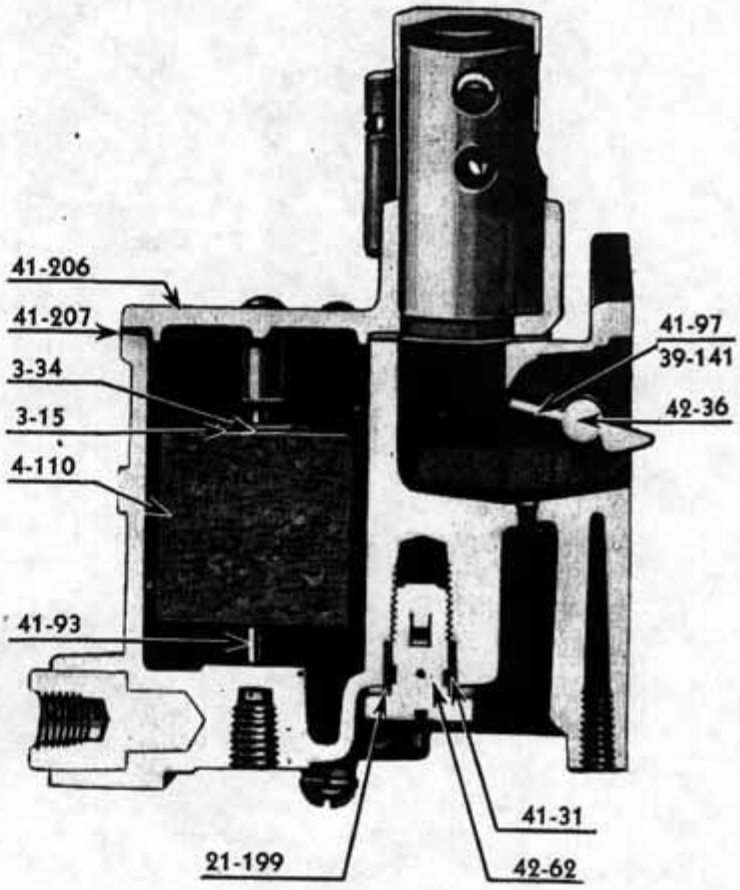
Move spark lever to full advance position, gradually open the high speed needle until maximum speed is reached.

Do not change position of the slow speed needle to correct high speed performance. Once the slow speed needle is set, it should require little or no attention — do not change setting unless necessary.

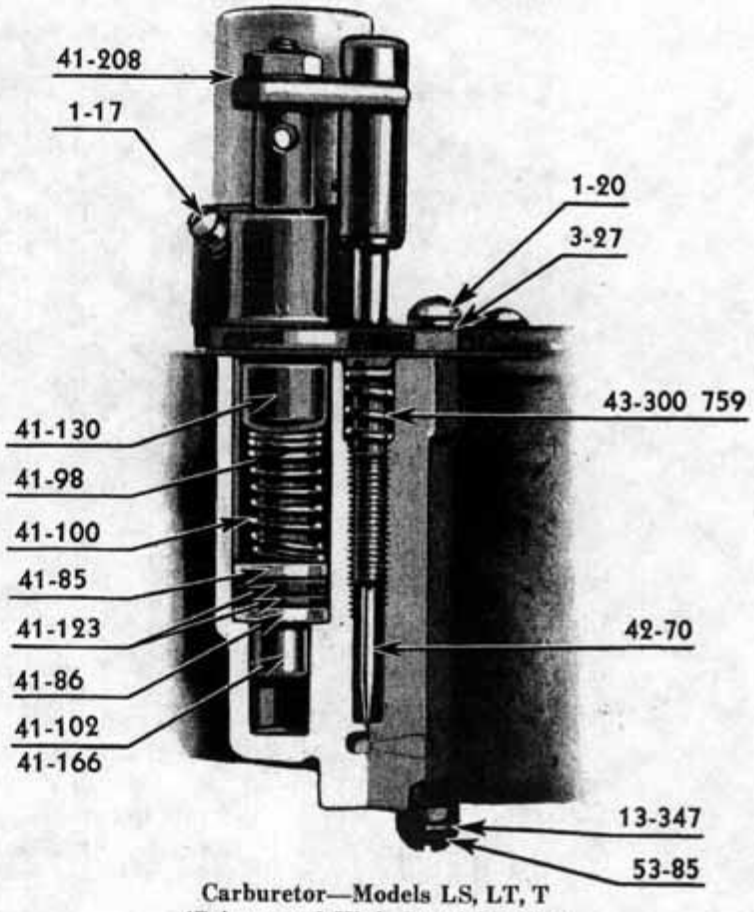
In event the slow speed intake is obstructed with foreign matter, simply open the slow speed needle three or four turns — depress primer vigorously several times to force out obstruction. Readjust slow speed needle as instructed above. Be sure check valve screen is clean.

Spark and magneto levers are synchronized, therefore movement of the magneto lever controls both spark and carburetor simultaneously.

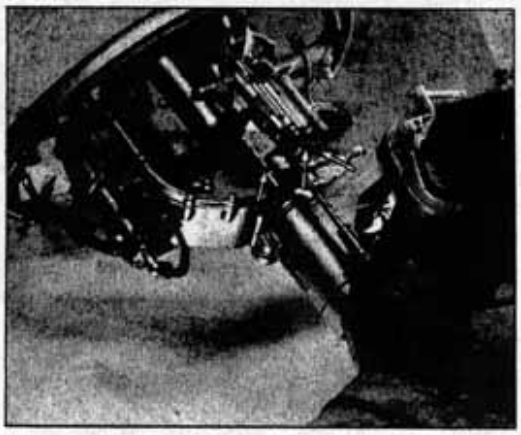
THE PRIMER consists of a small cylinder and plunger built into the carburetor body, which, when depressed, forces a small amount of gasoline into the slow speed opening to provide rich starting mixture. Since priming is accomplished through the slow speed opening, the slow speed needle must be open. The motor cannot be primed if the slow speed needle is closed. Do not, however, open the slow speed needle beyond that required for best slow speed operation of the motor.



Carburetor—Models LS, LT, T
(Float Chamber, Check Valve and Mixing Chamber)



Carburetor—Models LS, LT, T
(Primer and High Speed Needle)

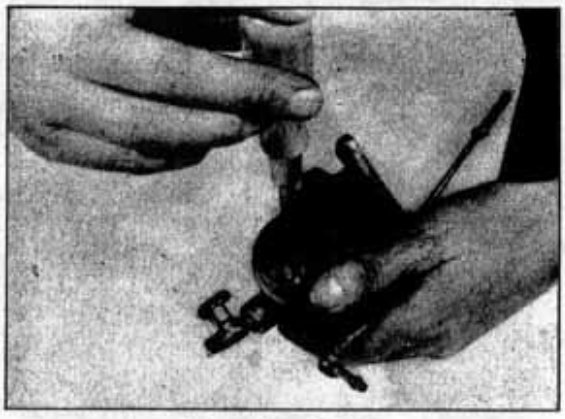


Showing removal of Check Valve Screen Assembly and Drain Screws for Cleaning Purposes. (Carburetor).

TO INSTALL NEW CARBURETOR FLOAT —LS, LT, T

In event the carburetor float becomes gasoline logged, it should be replaced to correct flooding condition produced. Remove cover from float chamber, to expose float and float valve. Float is held in correct position of float valve stem by a small cotter which fits into a groove in the valve stem. To remove float, spread ends of cotter with screw driver, then press down on end of float valve with thumb. Lift float off valve stem.

To install new float, proceed in reverse order of that above. Care should be taken to see that cotter ultimately anchors in groove on float valve stem to prevent fuel level being too high or too low.



Removing Float

SLOW SPEED PERFORMANCE

As you know, carburetion on the new light twins and the light singles (LS–DS) is accomplished by a dual system, that is, the customary type carburetor for high speed performance and the slow speed mixing valve (attached to crankcase) to obtain slow speed for docking and trolling purposes. Consequently, there are two adjustments — one for high speed (carburetor high speed needle) and one for slow speed (crankcase low speed needle).

It cannot be said that each is entirely independent of the other — the motor can be operated with either the high speed or the slow speed needles closed, but with no degree of satisfaction. Both needles must be properly adjusted to realize maximum performance. The slow speed needle, however, is less dependent on the high speed needle since the motor can be started, operated at slow speeds and at approximately half maximum speed with the high speed needle closed (spark full advanced). If the slow speed needle is closed, it is practically impossible to start the motor — it may be started by full advancing the spark lever and continuous cranking. If started under these conditions, full speed can be obtained only by opening the high speed needle excessively — the motor cannot, nevertheless, be idled down for slow speed performance with the slow speed needle closed. Both high and slow speed needles must be properly adjusted to obtain maximum performance throughout the entire speed range. See instruction book.

To obtain slow speed performance, the motor must of course be in good mechanical condition— the slow speed adjustment functions only if properly adjusted and if in good mechanical condition. The carburetor must be clean, particularly the check valve assembly and screen — the line from the carburetor to the slow speed intake should likewise be clean and free of foreign obstruction as well as the slow speed jet.

Check valve and screen are accessible by removing the large screw at bottom of carburetor— rinse off in gasoline if clogged with foreign particles. If a gummy condition exists, rinse in alcohol —this gum is not soluble in gasoline, therefore, little good will come of attempting to remove it with gasoline.

If there is reason to believe the slow speed gas line and intake are obstructed, open the slow speed needle three or four turns— depress primer (on carburetor) several times to force out foreign particles (dirt). In event the system is clogged beyond the possibility of cleaning out in this manner, remove the slow speed gas line and needle— blow out with high pressure air line.

Remove the slow speed needle to note condition of needle and intake seat. If the needle is badly ringed or grooved, it should be replaced. The same is true of the seat in the intake — replace if necessary. It is impossible to obtain slow speed adjustment with a badly seated needle valve. This is the result of the needle having at some time or other been screwed down too tightly against the seat in the intake. Be sure both seats are in good condition.

To remove the slow speed intake from the crankcase, simply grasp with pair of pliers — twist back

and forth at the same time prying up from underneath with a screw driver. Install new one by tapping lightly into position. Make certain the new intake fits snugly in the crankcase. It is important too that connections between gas line, slow speed intake and carburetor are air tight — air seepage will interfere with adjustment.

Part No. 42-98—Slow Speed Intake, Models LS and DS-37.

Part No. 41-184—Slow Speed Intake, Models LT and DT-37.

Part No. 42-124—Slow Speed Intake, Models LS and DS-38.

Part No. 41-309—Slow Speed Intake, Models LT and DT-38.

Part No. 41-309—Also for LT, DT and AT-39 and 10, TS and TD-15-20.

Part No. 41-91—Slow Speed Needle for above Models.

Part No. 43-234—Slow Speed Intake, Models HS, HA, HD-39, 10, 15.

Part No. 43-234—Slow Speed Intake, Models HS, HD-20-25.

Part No. 43-227—Slow Speed Needle for above Models.

CLEANING CARBURETOR MODELS LS, DS, LT, AT, DT, TS, TD, HS, HA, HD

Some difficulty may be experienced with hard starting on the above models during the early part of this coming season as a result of foreign substance or corrosion having accumulated in the carburetor during the idle winter months.

If accumulation is excessive, it is likely to obstruct the small passages to interfere with free flowage of gasoline through the carburetor — all gasoline lines and passages must be clear and free of obstruction.

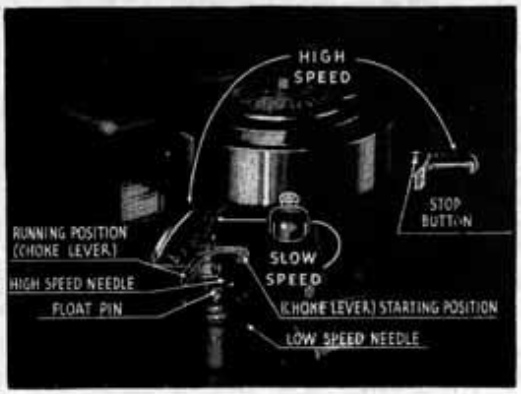
To properly clean the carburetor, it must be removed from the motor and taken apart for a thorough washing out with gasoline. Remove the high speed needle and float cover to enable getting at the primer plunger and small passages — remove plunger and check valve assembly (large screw on bottom of carburetor). Submerge carburetor body and parts in gasoline for rinsing. After rinsing, inspect all parts to be sure they are clean and passages are clear.

Gasoline gum may have collected on the check valve to render it inactive. In this event wash the assembly with alcohol. This gum is not soluble in gasoline, thus alcohol must be used. The check valve must be free if the motor is expected to operate well at slow speeds. Since its function is to maintain proper fuel level at the slow speed intake in the crankcase, sluggish action will result in failure to obtain satisfactory slow speed adjustment and performance as well as to contribute towards hard starting.

Be sure the small gas line from the carburetor to the slow speed intake is also clean and free of obstruction.

CARBURETOR ADJUSTMENT—K, KS, KD

Carburetors are of the full range type, that is, constructed with two jets to insure efficient carburetion throughout the entire speed range of the motor. The slow speed jet provides correct carburetion at slow and intermediate speeds; the high speed jet from intermediate to top speeds.



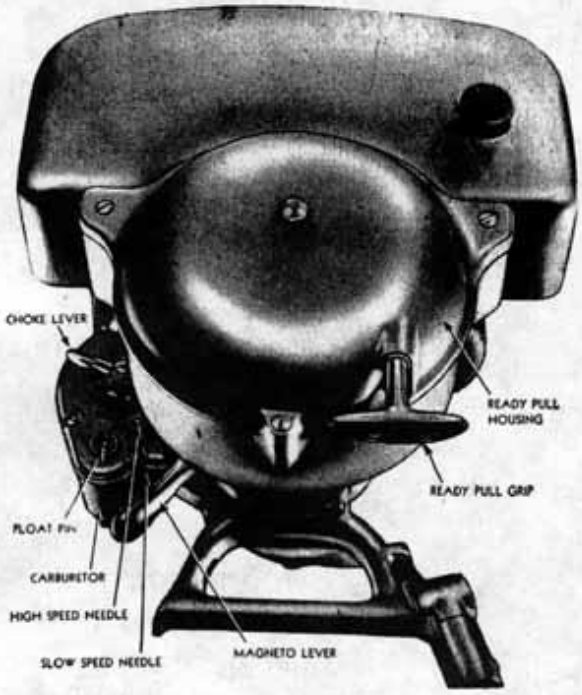
KS(L) Controls

Two adjustments are thus necessary —slow and high speed needles.

Slow speed adjustments are made at the factory and should not be altered unless circumstances require it.

TO ADJUST SLOW SPEED (slow speed adjustment should be made with retarded spark and at normal running temperature)—Close slow speed screw or needle (turn right until it rests gently on its seat). Open approximately ½ to ¾ turn (turn left). Start motor as instructed and operate at full throttle until it reaches normal temperature. Move magneto lever midway between center position and full retard. Turn slow speed needle to right or left as required to obtain smooth operation at slow speed.

TO ADJUST HIGH SPEED—Start motor as instructed. Operate at full throttle and full spark advance until motor reaches normal operating temperature. Turn high speed needle to right or left as required to obtain maximum speed.



Showing Controls on Model KD(L)

CARBURETOR ADJUSTMENT—PO

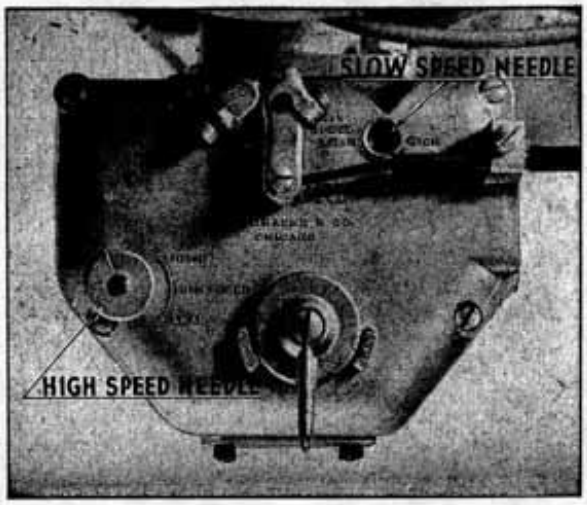
Carburetor is of the full range type, that is, constructed with two jets to insure efficient carburetion throughout the entire speed range of the motor. The slow speed jet provides correct carburetion at slow and intermediate speeds; the high speed jet from intermediate to top speeds.

Two adjustments are thus necessary — slow and high speed needles.

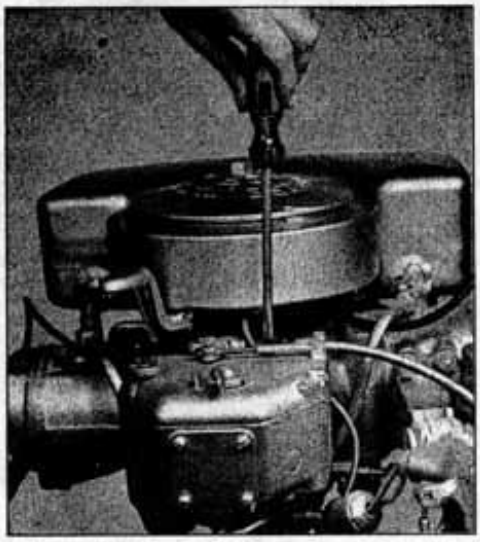
Slow speed adjustments are made at the factory and should not be altered unless circumstances require it.

TO ADJUST SLOW SPEED (slow speed adjustment should be made with retard spark and at normal running temperature). Close slow speed screw or needle (turn right until it rests gently on its seat). Open approximately ½ turn (turn left). Start motor as instructed and operate at full throttle until it reaches normal temperature. Move magneto lever midway between center position and full retard — close throttle. Turn slow speed needle to right or left as required to obtain smooth operation at slow speed.

TO ADJUST HIGH SPEED—Start motor as instructed. Operate at full throttle and full spark advance until motor reaches normal operating temperature. Turn high speed needle to right or left as required to obtain maximum speed.

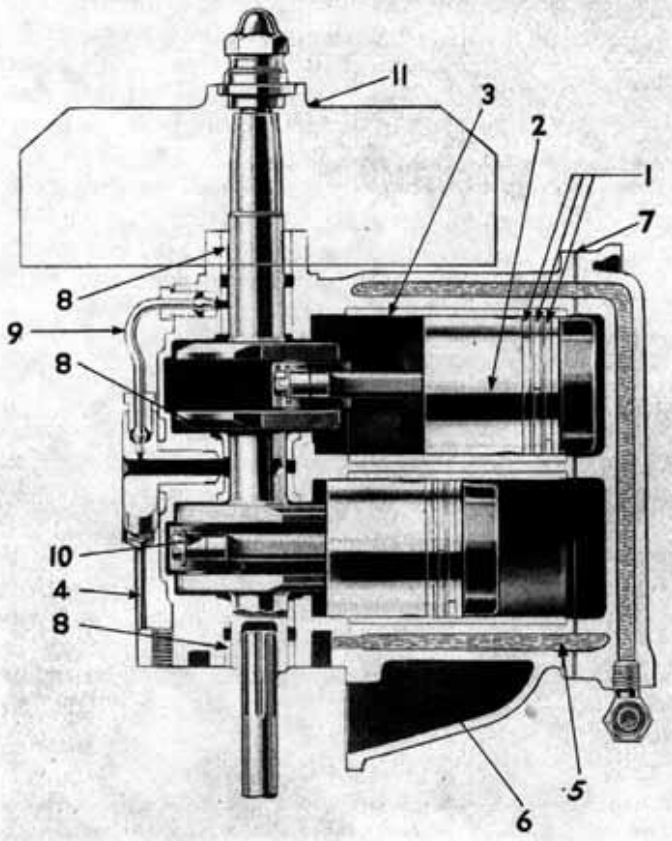


Model PO Carburetor



Adjusting Slow Speed Needle

POWER HEAD—LT, TS



Power Head Assembly

POWER HEAD—SERVICE SUGGESTIONS

1. Piston rings—worn or fast in ring grooves, resulting in loss of compression. (Ring groove may be clogged with carbon causing rings to stick.)

2. Piston—worn or scored.

3. Cylinder—worn or scored, causing loss of compression.

4. Low speed needle—improperly adjusted, needle and seat in low speed insert may be damaged beyond point where satisfactory adjustment can be obtained. This frequently results from screwing needle down too tightly on seat.

5. Water jacket—clogged with foreign matter, causing motor to overheat.

6. Exhaust passage—clogged with carbon to restrict flow of exhaust gases — will cause loss of power and motor to overheat.

7. Cylinder head gasket—leaking or blown out —cause water to enter or motor to overheat.

8. Journal bearings—excessively worn, causing loss of crankcase compression.

NOTE: Journal bearings are cast in the cylinder-crankcase assembly and, therefore, not replaceable. If bearings are worn to point where replacement is required, it is necessary to install a new cylinder-crankcase assembly. Crankshaft journals and bearings in cylinder-crankcase assembly are machined to such sizes as to permit bearing clearance of .001″ to .002″. Excessive journal bearing wear results in loss of crankcase compression and is indicated by oil smearing on magneto armature plate.

9. Oil return—clogged, causing excess oil to escape from bearing.

10. Connecting rod bearing—loose, causing motor to knock.

11. Flywheel—loose, causing motor to knock. Tighten flywheel nut.

TO REMOVE PISTON RINGS FROM PISTON

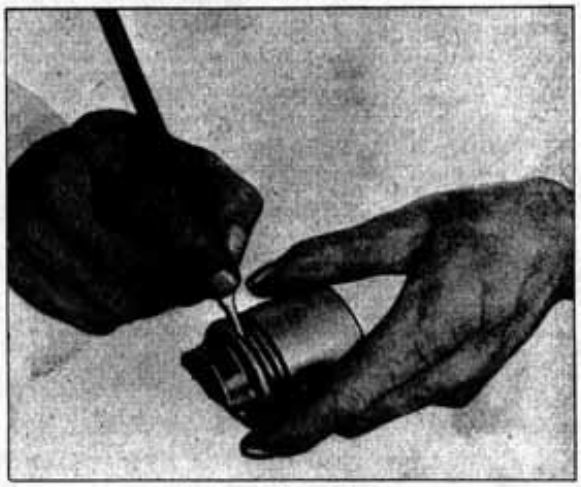
Expand rings by spreading with thumbs as illustrated, and slide over end of piston. There are three rings per each piston. Be careful not to spread too far, rings can be broken. Spread only far enough to permit slipping off piston.

Removing Piston Rings

Rings are replaced in reverse order of that described above — spread enough by hand to slide over piston and into position in respective ring grooves.

TO CLEAN PISTON RING GROOVES

The piston ring grooves frequently become clogged with carbon after long periods of operation, which requires removal to prevent rings from sticking and becoming partially inoperative. This condition results in loss of compression and noticeable deterioration in power.



Cleaning Ring Grooves

It is a simple matter to remove carbon from the ring grooves by scraping as shown in illustration. A suitable scraper can be easily made from a discarded file or hack saw blade — make it slightly narrower than ring grooves in piston and sharp enough to scrape out accumulated carbon.

After removing carbon from ring grooves (piston) and prior to installing new rings, care should be exercised to make certain rings fit in piston grooves with no indication of tight spots or binding. This can be determined by rolling each ring, in their respective grooves, around the piston as illustrated. Resistance will be encountered where tight spots exist — this may be result of particles of carbon, burrs in piston ring grooves or high spots on edge of ring. Check grooves to see that all traces of carbon has been removed. If burrs exist, they usually can be removed with a sharp edge scraper.

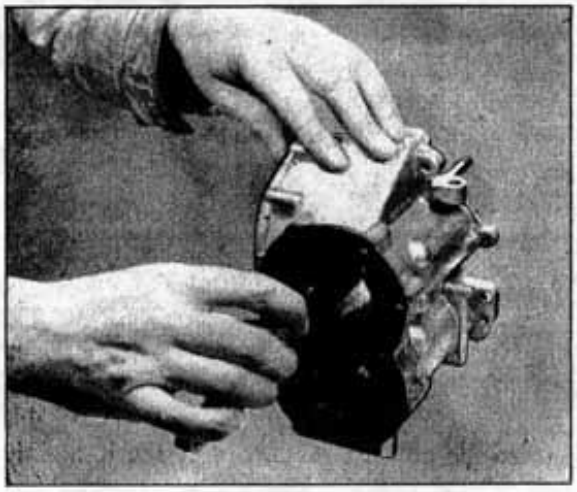
Checking Ring Grooves

Handle piston carefully. Burrs are the result of rough handling or dropping.

High spots on edges of rings are not frequent occurrences, but if such is the case, they can be dressed down by rubbing edge (side) of ring lightly over a piece of fine sandpaper or emery cloth placed on a flat surface.

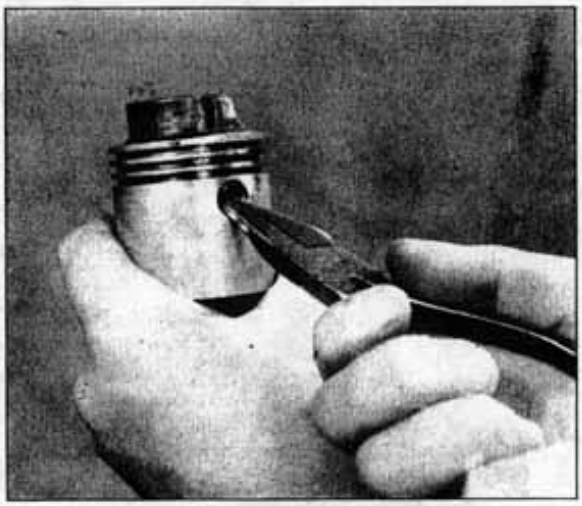
NOTE: Rings must fit freely in piston ring grooves. Recommended clearance in piston grooves is .0015″ to .0025″. Piston rings and piston grooves are machined in correct sizes at factory and will fit properly, providing all carbon has been removed from piston grooves and no burrs are present.

Piston rings are ground to size at factory, but it is advisable to check gap clearance to make sure recommended .005″ to .010″ is maintained. Place each ring squarely in cylinder as illustrated. Insert feeler gauge between ends of ring (gap). Repeat same operation for each ring in respective cylinders. If noted clearance falls below .005″, file end of ring carefully until desired gap is obtained. If clearance is considerably in excess of .010″, cylinder is worn oversize and should be replaced.



Checking Piston Ring Gap

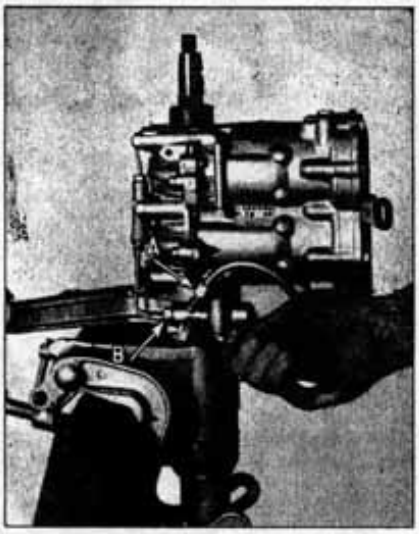
If found advisable to INSTALL A NEW PISTON, it must be detached from the connecting rod. First remove both lock rings from wrist pin hole as illustrated. Use long nose pliers, grasp protruding end of ring and pull out with twisting motion. The pin can then be driven out as shown. Use small flat end punch. If the fit appears a bit snug, hold piston in hot water for a few seconds to expand. Do not drive out wrist pin by laying piston on bench or hard surface — this will result in springing it out of round. Handle the piston assembly carefully.



Removing Lock Ring

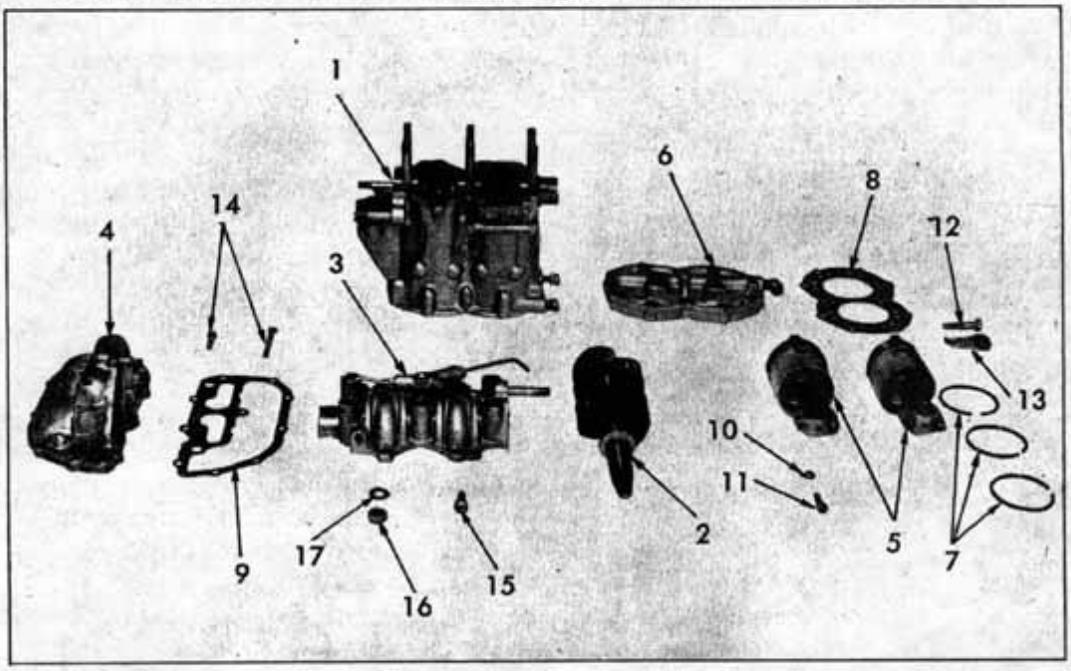
Attach new piston in reverse order of that described above. Note grooves in wrist pin hole for lock rings. Reinstall lock rings — grasp end of ring with long nose pliers, insert with twisting motion at the same time making certain ring comes to rest in groove provided for this purpose.

Removing Wrist Pin



Illustrating removal of powerhead from lower unit. Detach water tube connection A. Remove nut as shown and screw B. (Note—a similar nut and screw are located on reverse side which must also be removed). After removing nuts and screws, simply lift power head from lower unit.

CORRECT PROCEDURE FOR ASSEMBLING POWER HEAD



1. Cylinder
2. Crankshaft
3. Crankcase
4. Manifold
5. Piston and Connecting Rod
6. Cylinder Head
7. Piston Rings
8. Cylinder Head Gasket
9. Manifold Gasket
10. Lock Plate
11. Connecting Rod Screw
12. Cylinder Head Bolt (Screw)
13. Spark Plug Wire Support
14. Manifold Screws
15. Crankcase Screws
16. Crankcase Nut
17. Crankcase Washer

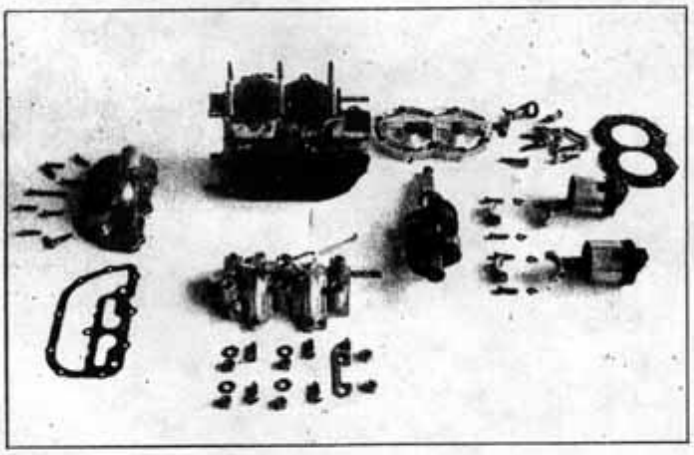
1. Make certain all parts have been thoroughly cleaned and that piston rings are properly fitted in piston ring grooves. Ring grooves must be free of carbon to prevent rings sticking. (Recommended gap clearance .005" to .010"—groove clearance .0015" to .0025".)

Remove all traces of gasket cement from face of both crankcase sections —this is important.

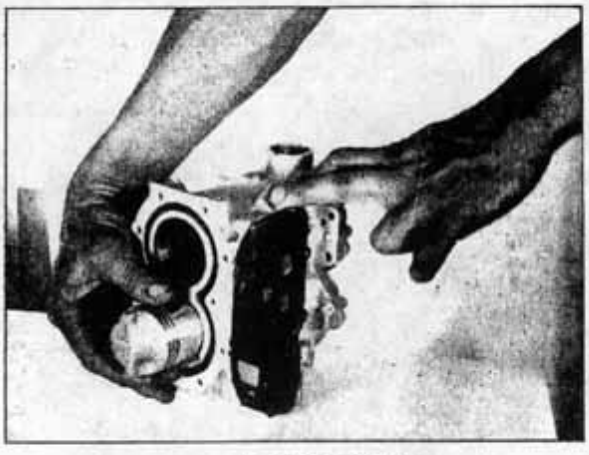
Lay all parts on a convenient assembly bench as illustrated.

2. Place a few drops of oil on pistons and in ring grooves. Insert piston, ring and rod assemblies. Note deflector on piston, one side is abrupt while the other slopes gradually towards outer edge of piston. Piston should be installed with sloping side of deflector directed towards exhaust outlet as illustrated. Note compress rings with fingers.

3. Place a drop or two of oil on each of the three bearings in the cylinder assembly — also a drop or two on each connecting rod bearing. Install crankshaft. Attach connecting rods to crankpins. Do not neglect bending small lug on lock plate *up* to prevent connecting rod screw from turning.

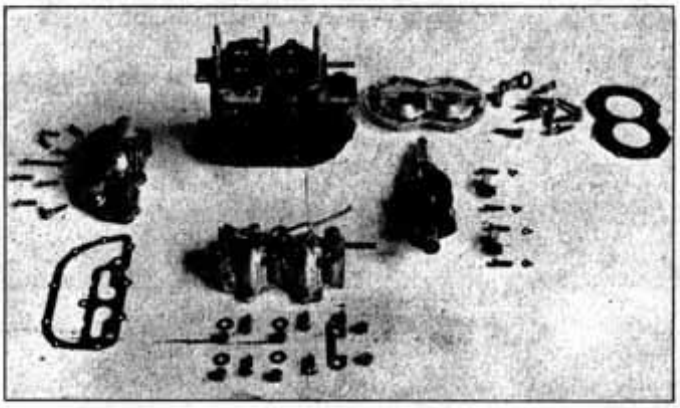


Parts to be Assembled



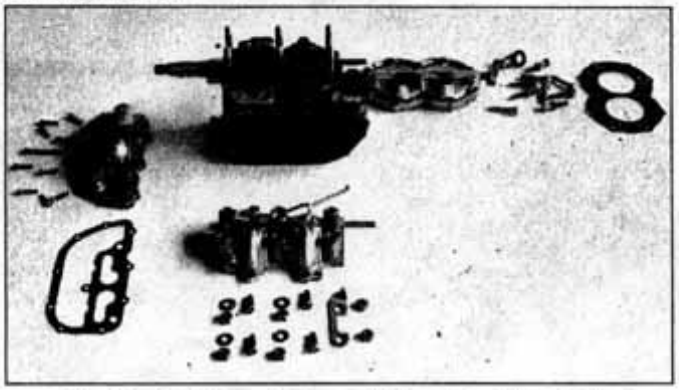
Inserting Piston

4. Spread thin coat of gasket cement over surfaces of both crankcase sections—(a light coat is essential — if too much is applied or if the cement is too thick, it will be impossible to maintain proper journal bearing clearance, .002" to .0025")—see crankcase assembly.



Showing Piston and Rods Installed

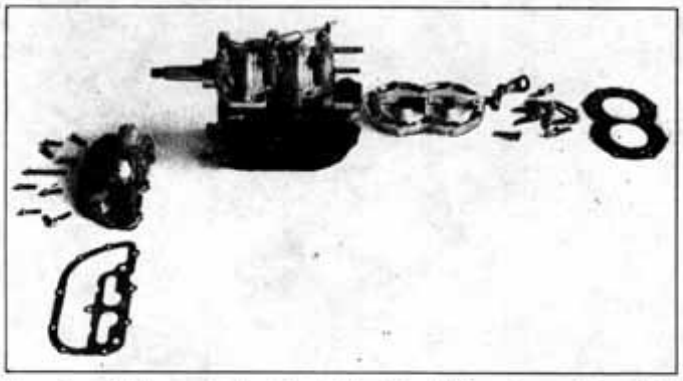
Place a drop or two of oil on each of the three bearings in crankcase section. Assemble necessary screws, nuts and washers — draw down evenly and securely.



Showing Pistons, Rods and Crankshaft Installed

CRANKCASE ASSEMBLY

Since there are no gaskets between the crankcase sections it is extremely important the surfaces of both halves are properly cemented when assembling. These surfaces are very accurately machined but must rely on a thin film of cement to guard against loss of crankcase compression.

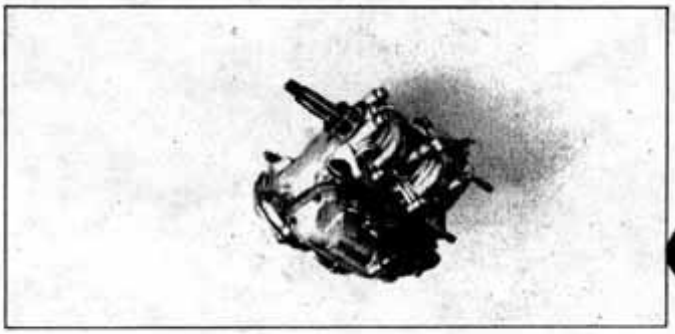


Showing Pistons, Rods, Crankshaft and Crankcase Installed

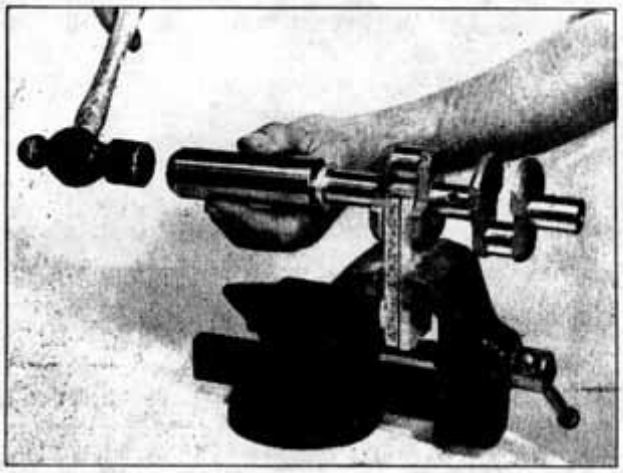
When assembling, be sure both surfaces are clean and that all traces of old cement have been removed. If the crankcase is assembled with the old cement still remaining and freshly coated with additional cement, bearing clearances are likely to be excessive — this will affect performance of the motor. Correct bearing clearance can be maintained only if, when assembling, the old cement is thoroughly removed and a thin coat of fresh cement applied to the surface. DO NOT USE THICK CEMENT. Apply only enough to cover the surfaces — be sure none of the oil passages are obstructed by an over abundance of cement.

Gasket cement dries quickly—everything should be in readiness to complete assembly immediately after applying the cement. If permitted to dry before assembling, bearing clearance will be greater than it would have been had the cement been in a fluid state at the time of tightening crankcase bolts.

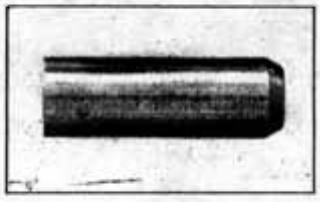
5. Complete assembly by installing gaskets, muffler-manifold assembly and cylinder head.



Complete Power Head Assembled

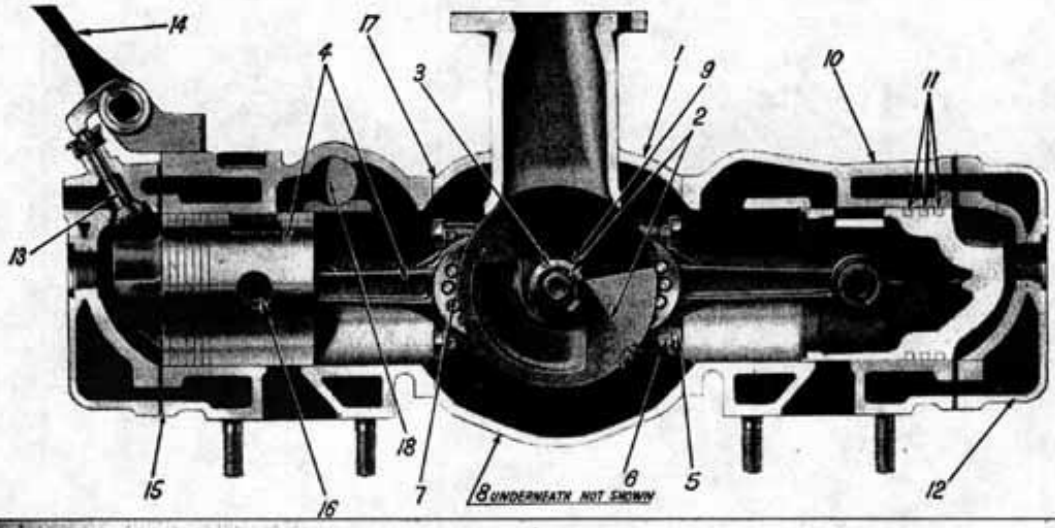


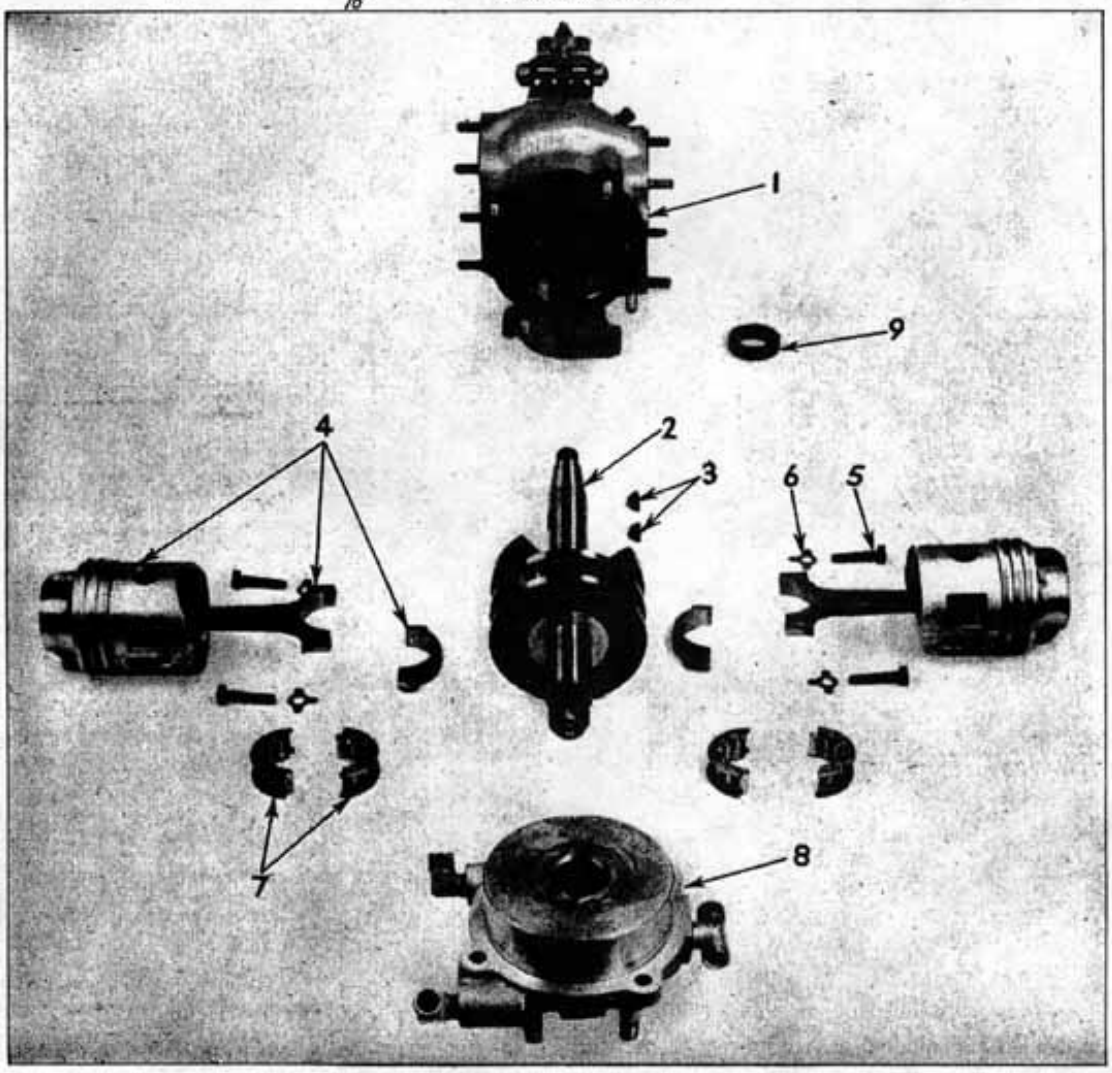
Illustrating Use of Tool No. S-271



Tool for Installing Oil Slinger on Crankshaft No. S-271

PO POWERHEAD





Powerhead Assembly Group

1. Crankcase
2. Crankshaft
3. Flywheel Keys
4. Piston and Connecting Rod Assembly
5. Connecting Rod Bolt
6. Connecting Rod Bolt Lock Plate
7. Roller Bearing Assembly
8. Crankcase Head
9. Oil Slinger
10. Cylinder
11. Piston Rings
12. Cylinder Head
13. Release Valve
14. Release Valve Lever
15. Cylinder Head Gasket
16. Wrist Pin
17. Cylinder Base Gasket
18. Bypass Valve

TO REMOVE PISTON RINGS FROM PISTON

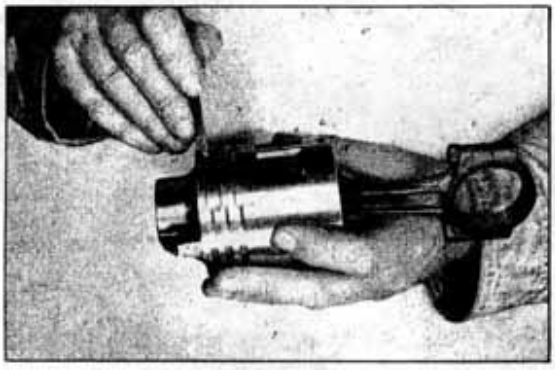
Expand rings by spreading with thumbs as illustrated and slide over end of piston. There are three rings per each piston. Be careful not to spread too far, rings can be broken. Spread only far enough to permit slipping off piston.

Rings are replaced in reverse order of that described above — spread enough by hand to slide over piston and into position in respective ring grooves.

The piston ring grooves frequently become clogged with carbon after long periods of operation, which requires removal to prevent rings from sticking and becoming partially inoperative. This condition results in loss of compression and noticeable deterioration in power.

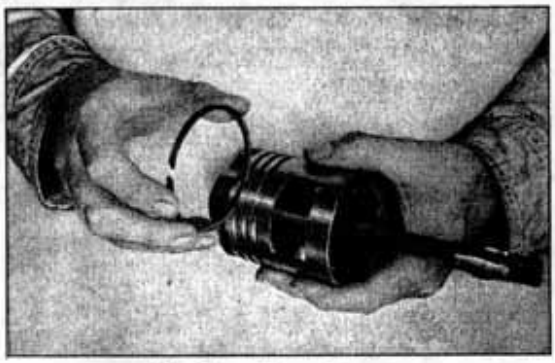
Removing Piston Rings

It is a simple matter to remove carbon from the ring grooves by scraping as shown in illustration. A suitable scraper can be easily made from a discarded file or hack saw blade — make it slightly narrower than ring grooves in piston and sharp enough to scrape out accumulated carbon.



Cleaning Ring Grooves

After removing carbon from ring grooves (piston) and prior to installing new rings, care should be exercised to make certain rings fit in piston grooves with no indication of tight spots or binding. This can be determined by rolling each ring, in their respective grooves, around the piston as illustrated. Resistance will be encountered where tight spots exist — this may be result of particles of carbon, burrs in piston ring grooves or high spots on edge of ring. Check grooves to see that all traces of carbon have been removed. If burrs exist, they usually can be removed with a sharp edge scraper.



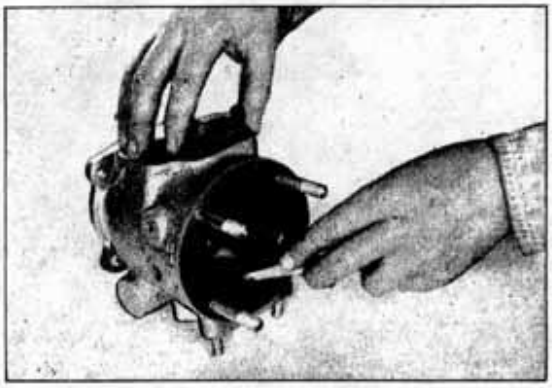
Checking Ring Grooves

Handle piston carefully — burrs are the result of rough handling or dropping.

High spots on edges of ring are not frequent occurrences, but if such is the case, they can be dressed down by rubbing edge (side) of ring lightly over a piece of fine sandpaper or emery cloth placed on a flat surface.

NOTE: Rings must fit freely in (piston ring) grooves. Recommended clearance in piston grooves is .0015″ to .0025″. Piston rings and piston grooves are machined to correct size at factory and will fit properly, provided all carbon has been removed from piston grooves and no burrs are present.

Piston rings are ground to size at factory, but it is advisable to check gap clearance to make sure recommended .005″ to .010″ is maintained. Place each ring squarely in cylinder as illustrated. Insert feeler gauge between ends of ring (gap). Repeat same operation for each ring in respective cylinders. If noted clearance falls below .005″, file end of ring carefully until desired gap is obtained. If clearance is considerably in excess of .010″, cylinder is worn oversize and should be replaced.



Checking Ring Gap

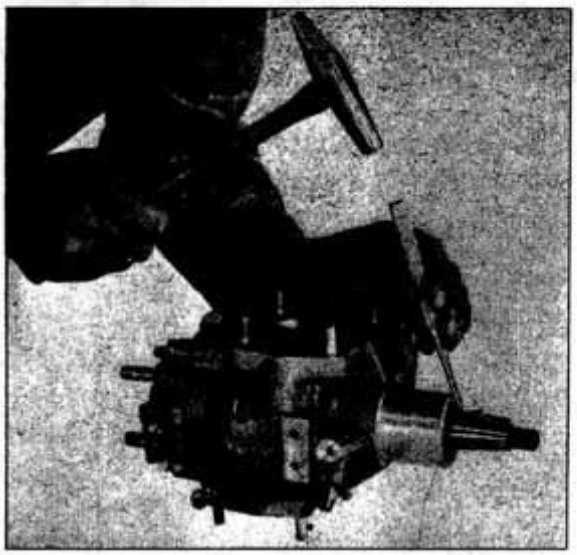
If found necessary to install a new piston, it must be removed from the connecting rod assembly. The wrist pin is held fast in the piston by a set screw which is made secure by a lock washer and lock nut. Loosen lock nut and remove set screw. The wrist pin can then be driven out — this is best done by placing assembly between the knees when in a seated position to prevent springing piston as driving force is applied. Drive from side of piston containing wrist pin set screw and lock nut. If fit appears a bit snug, hold piston in hot water to expand.

Removing Wrist Pin

Install new piston in reverse order of that above. NOTE: Hole in wrist pin and threaded hole in wrist pin boss (piston)—insert wrist pin through opposite hole in piston, end of pin with hole first. Drive pin home. Hole in wrist pin must line up with threaded hole in wrist pin boss (piston). Install wrist pin set screw—be sure end fits squarely into hole in wrist pin provided for this purpose. When set screw has been made tight in position, tighten lock nut, with lock washer in place, to properly secure set screw. This is important.

TO REMOVE CRANKSHAFT FROM THE CRANKCASE

The flywheel keys must first be dislodged as they protrude beyond inside diameter of bearing. Both keys can be easily driven out of keyways by using a small flat end punch as illustrated. Care should be taken in this operation not to nick or gouge the crankshaft taper. If accidentally nicked, simply dress down with file prior to withdrawing crankshaft from bearing. Removal of keys can also be performed before detaching crankcase assembly from the driveshaft casing.

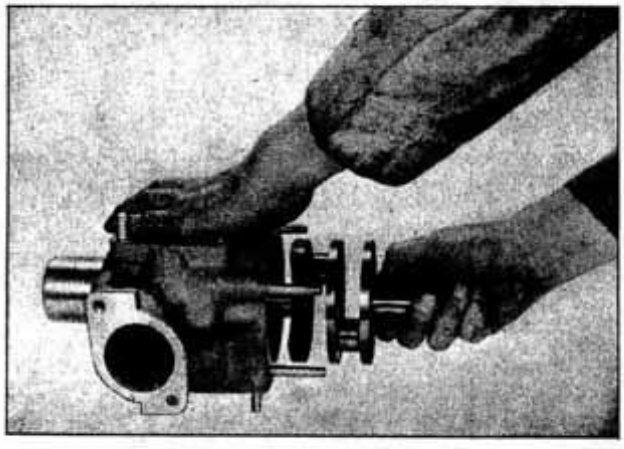


Removing Keys from Crankshaft

REMOVE CRANKCASE HEAD to permit withdrawing crankshaft as shown. Assemble in reverse order of that described above (be sure to install gasket between crankcase proper and crankcase head). Draw nuts, holding head in position, up tightly and evenly.

Removing Crankcase Head

IMPORTANT—Spread coat of oil on crankshaft journals and on bearing surfaces before assembling.



Installing Crankshaft

TO ASSEMBLE CRANKSHAFT, CRANKCASE, PISTONS AND CONNECTING RODS, proceed as follows:

1. Make certain all parts are in good mechanical condition, clean and free of foreign matter (dust, grit, etc.).

2. Spread thin coat of oil on crankshaft journals and crankpins — also a few drops in bearings of crankcase and crankcase head.

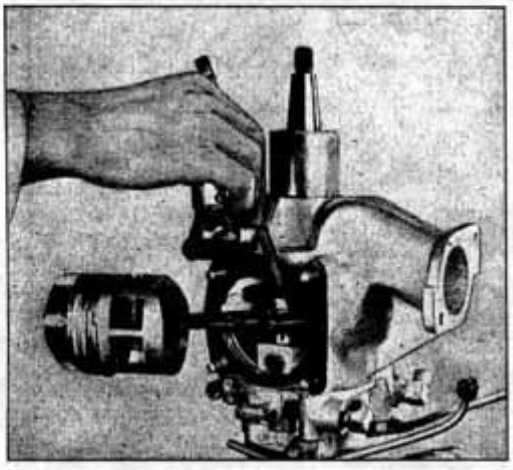
3. Insert crankshaft.

4. Install crankcase head (be sure gasket is in place) and bolt in position. Crankshaft should turn freely on completing this operation.

5. Slip oil slinger on over top of crankshaft—tap down lightly until it rests on top surface of journal bearing in crankcase. This should be followed by tapping both ends of the crankshaft lightly with a mallet or hammer to make sure clearance exists between oil slinger and top end of bearing. (Oil slinger should not ride or rub on bearing.) Note groove cut in outside wall of oil slinger, leaving a narrow and wide edge. Narrow edge should be directed downward — this is important to prevent oil escaping from the crankcase.

6. Piston rings should be properly fitted — correct gap clearance is .005″ to .012″, with no indication of binding at any point in the ring groove. Place several drops of oil in each ring groove—turn rings around in grooves to spread oil film.

7. Assemble roller bearings and retainers to crankpins. Note two free rollers, one fitting on each side of the crankpin and between ends of retainers.

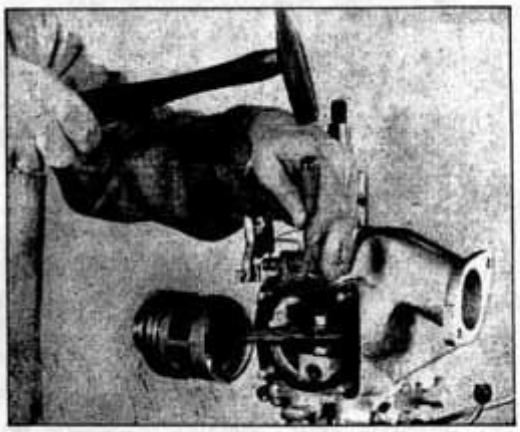


Checking Rod and Cap Alignment

8. Note large ports in wall of piston and punch marks on connecting rod and cap. When attaching connecting rod and piston assembly to crankpins, ports in piston should be directed towards carburetor side of crankcase; connecting rod and cap should be assembled with both marks on same side. This is important.

9. Turn crankshaft to bring crankpins to outer most position — slip connecting rod cap back of crankpin and around rollers. Place piston and rod assembly in position. Assemble lock plates and screws. (Be sure both marks are on same side.) Tighten connecting rod screws — bend two lugs on each lock plate protruding opposite each other down over connecting rod.

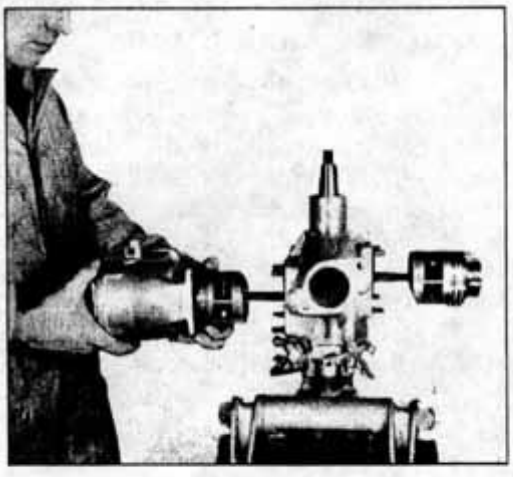
10. Connecting rod and cap must be properly aligned — that is, cap must line up perfectly with rod — sides of both must be flush. This can be accomplished by turning roller assembly so that gap between retainers comes to rest over junction of cap and rod. By sliding a pencil over junction, as illustrated, it is a simple matter to determine whether or not surfaces are flush. In event one



Align Rod and Cap

side or the other is high, drive high side down until flush with other. Check again with pencil. When surfaces are flush, tighten screw and bend remaining protruding lug up and against screw head to lock in position.

TO ATTACH CYLINDERS—Be sure cylinder walls and pistons are clean. Spread film of oil on cylinder walls and skirt of piston. Install cylinder base gasket over studs on crankcase. (Not necessary to cement this gasket.) Compress piston rings with fingers. Slide cylinder over piston and up to crankcase — attach necessary washers and nuts and tighten to securely mount cylinder.

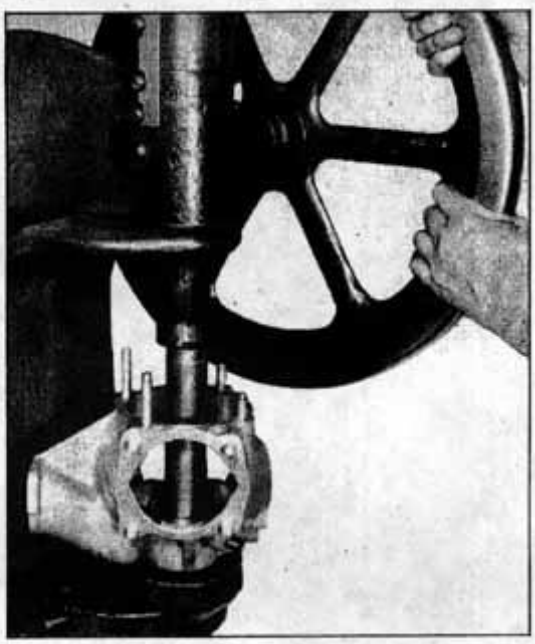


Attaching Cylinder

TO INSTALL JOURNAL BEARINGS— (MODEL PO)

(Crankcase)

The journal bearings seldom require replacing; while appearing to be loose (when compared to similar bearings in automotive practice) they are originally fitted with considerable clearance at the factory to provide sufficient lubrication. There is no noticeable crankcase compression loss under these conditions and the bearings need only replacing when clearance has reached the point where oil from the crankcase begins to smear on the magneto armature plate.

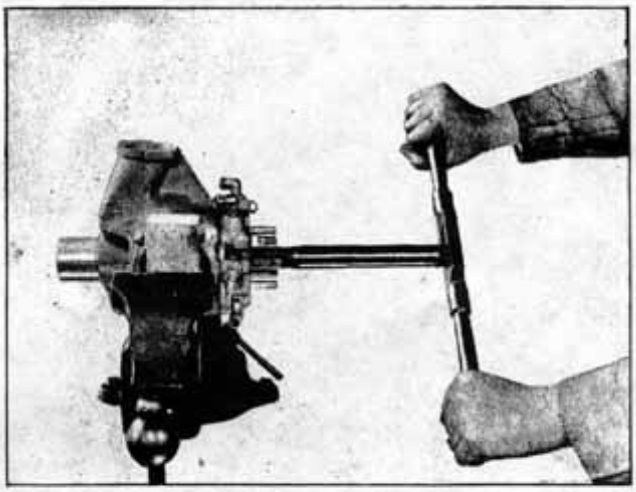


Driving Out Journal Bearing

TO INSTALL NEW CRANKSHAFT JOURNAL BEARINGS, the old bearings must, of course, be removed. This is accomplished on an arbor press as illustrated. Both top and bottom bearings are pressed out in a similar manner — use a round bar or mandrel slightly smaller than the bearing to permit driving all way through bearing bosses. NOTE: Top bearing fits into crankcase proper; while the bottom bearing is pressed into the crankcase head (lower section of the crankcase).

On removal of old bearings, to install new top bearing, crankcase should be placed on the press table with bearing boss up. Bottom end of top bearing is machined to match contour of inside of crankcase. Line up bearing with respect to contour of crankcase (inside) and press into case until bottom of bearing is flush with inside of crankcase. It is advisable to note position of the old bearing before pressing out to install a new one.

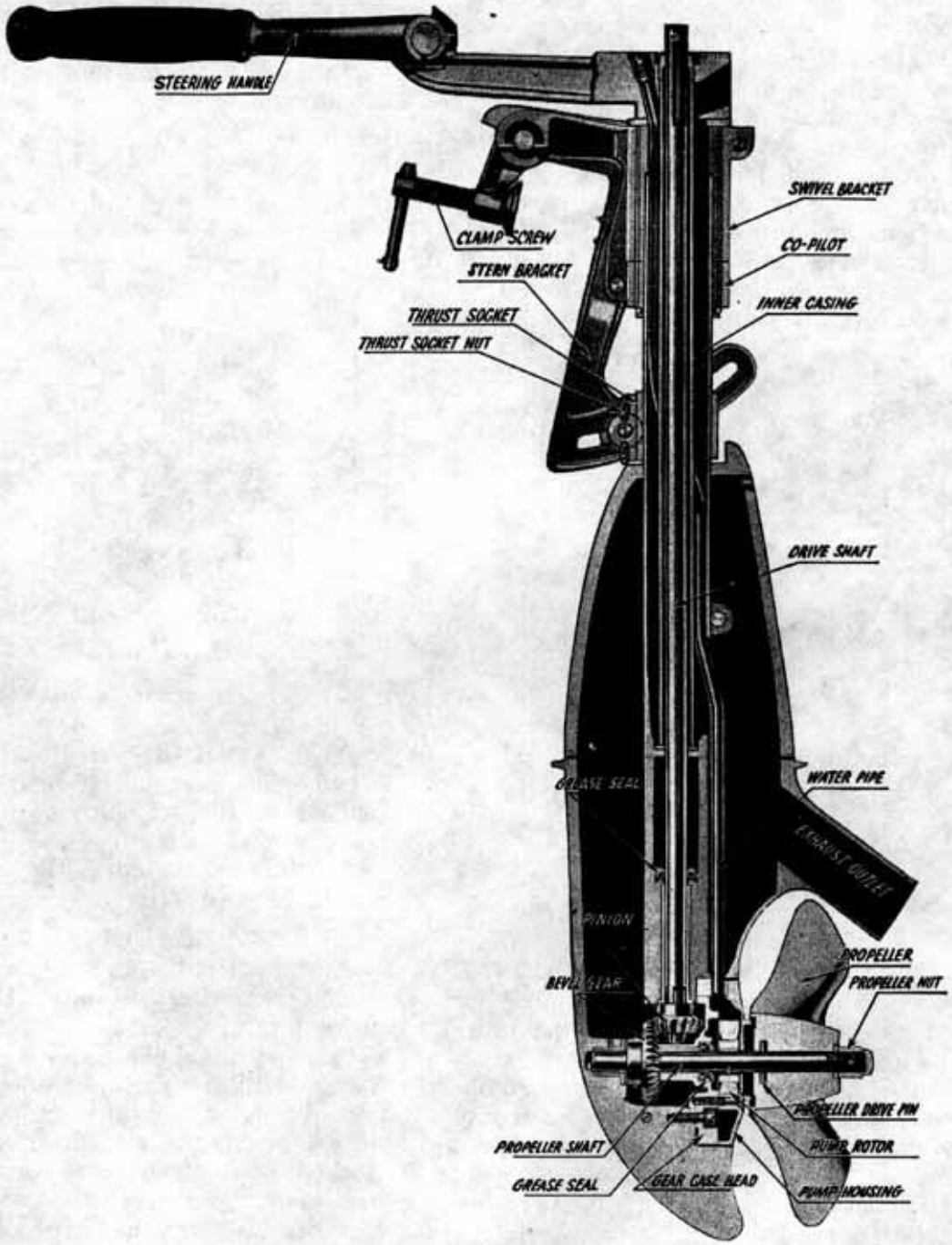
TO INSTALL BOTTOM JOURNAL BEARING, place crankcase head on press table with inside surface up. Note oil holes in bearing and corresponding holes in crankcase head — align bearing accordingly and press in until thrust face of bearing comes to rest solidly against head.



Reaming Journal Bearings

TO REAM JOURNAL BEARINGS. After having installed new journal bearings, they must be reamed to size — top bearing 1.002″, bottom bearing 1.042″. This permits clearance of .003″ at top and bottom journals since they are ground to .990″ and 1.039″ respectively.

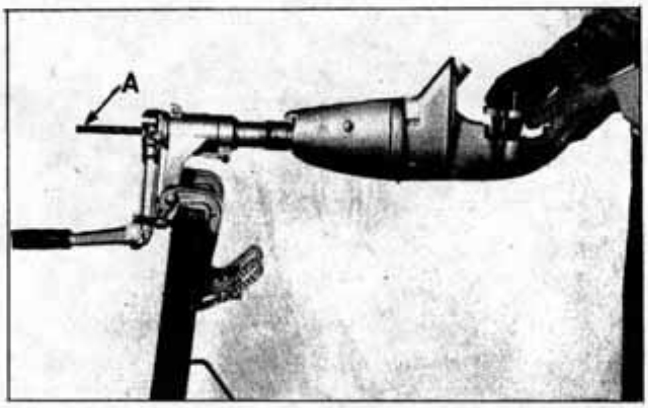
TO REAM BEARINGS, attach crankcase head —draw up tightly and evenly. Place crankcase assembly in vise as shown. Use wood blocks to prevent injury to studs. Two reamers are used in this operation, namely — the rough reamer No. S-86 and the finish line reamer No. S-83. Insert pilot of rough reamer through bottom journal bearing and on into top bearing while turning reamer in clockwise direction (facing bottom bearing). These reamers are provided with two cutters — one for each bearing since they are of different size. Continue turning reamer at same time forcing it gently forward until cutters pass through bearing. Withdraw reamer slowly with same turning motion — clockwise. Insert finish line reamer and proceed in like manner. The bearings should now be reamed to correct size and ready for assembly of the motor.



Lower Unit Assembly—(Models HS, HD, TS, TD)

To remove propeller shaft, gears and drive shaft from lower unit, proceed as follows:

1. Partially withdraw drive shaft as shown here.

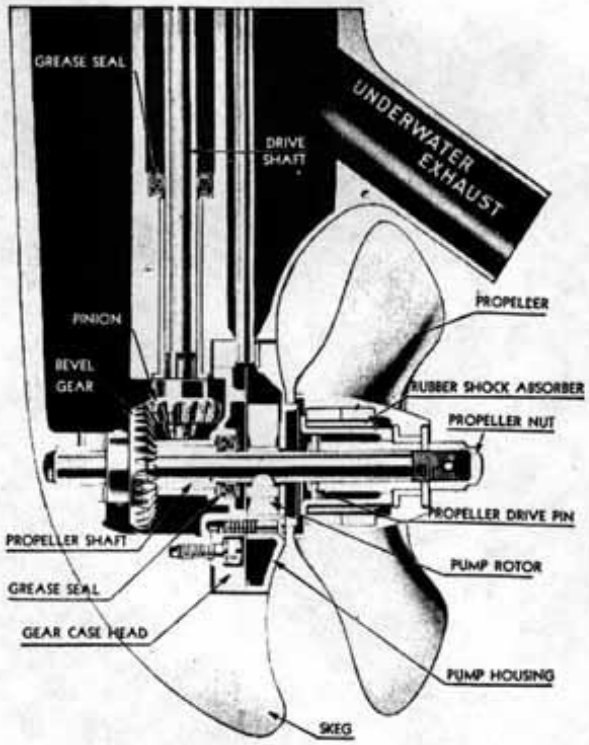


Showing Removal of Gear Case Head from Lower Unit

2. Remove pump housing and gear case head—each held in position by three screws.

3. Lift out propeller shaft, gear assembly and pinion. (Gear case houses only propeller shaft, bevel gear and pinion.)

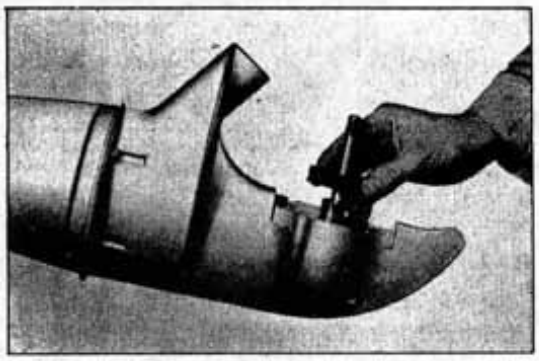
4. Reassemble in reverse order of that described above—installing whatever new parts may be necessary. Note: Bearings in gear case and gear case head are cast in, consequently when found to be excessively worn are not replaceable — a new gear case and gear case head are required under these circumstances. Drive shaft, propeller shaft and bearing are machined to such sizes to permit clearance of .0015″ on propeller bearing and .0025″ on drive shaft bearing. When necessary to install new gear case and gear case head, it is advisable to include new drive shaft and propeller shaft assembly.



Gear Case—(Models HS, HD, TS, TD)

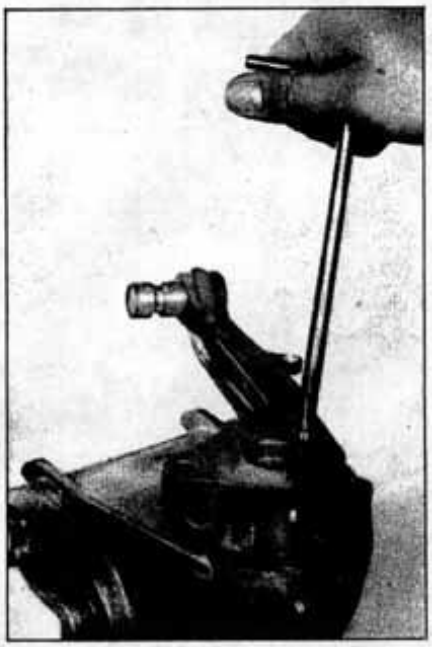
5. Refill with fresh gear lubricant as instructed.

In event of excessive overheating of motor, source of difficulty may lie in the pump rotor, which probably will necessitate replacing. To install new pump rotor, proceed as follows:

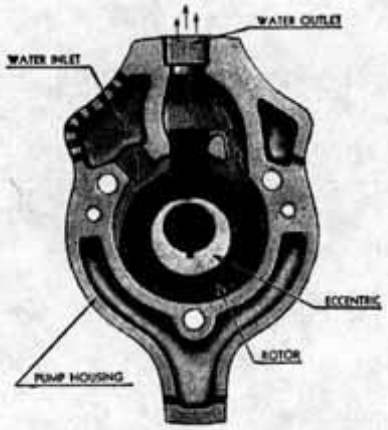


Showing Installation of New Pump Rotor

1. Remove propeller nut cotter pin.
2. Remove propeller nut.
3. Remove propeller.
4. Remove water pump housing (held in position by three screws).
5. Lift old rotor from eccentric.
6. Install new rotor — slip over pump eccentric.
7. Reassemble all parts in reverse order of above.

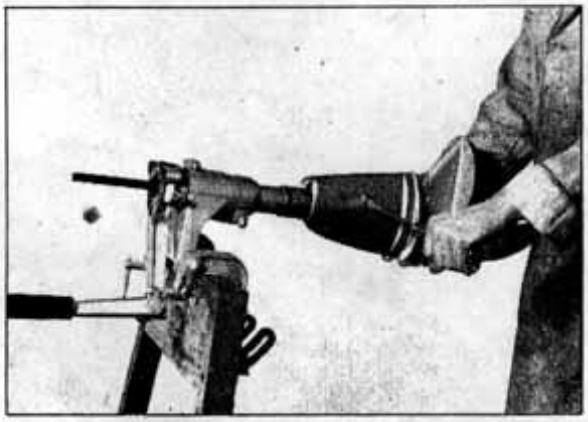


Illustrating Use of Tool No. S-260 for Removing Water Tube from Drive Shaft Casing



Positive Rotor, Pump

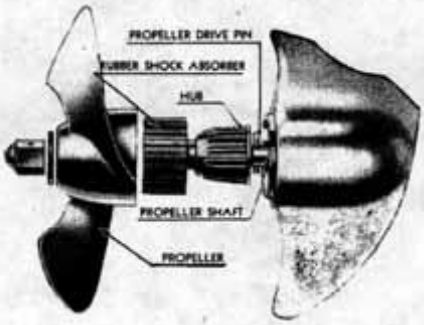
Illustrating Use of Tool No. S-261 for Removing Inner Tube from Drive Shaft Casing



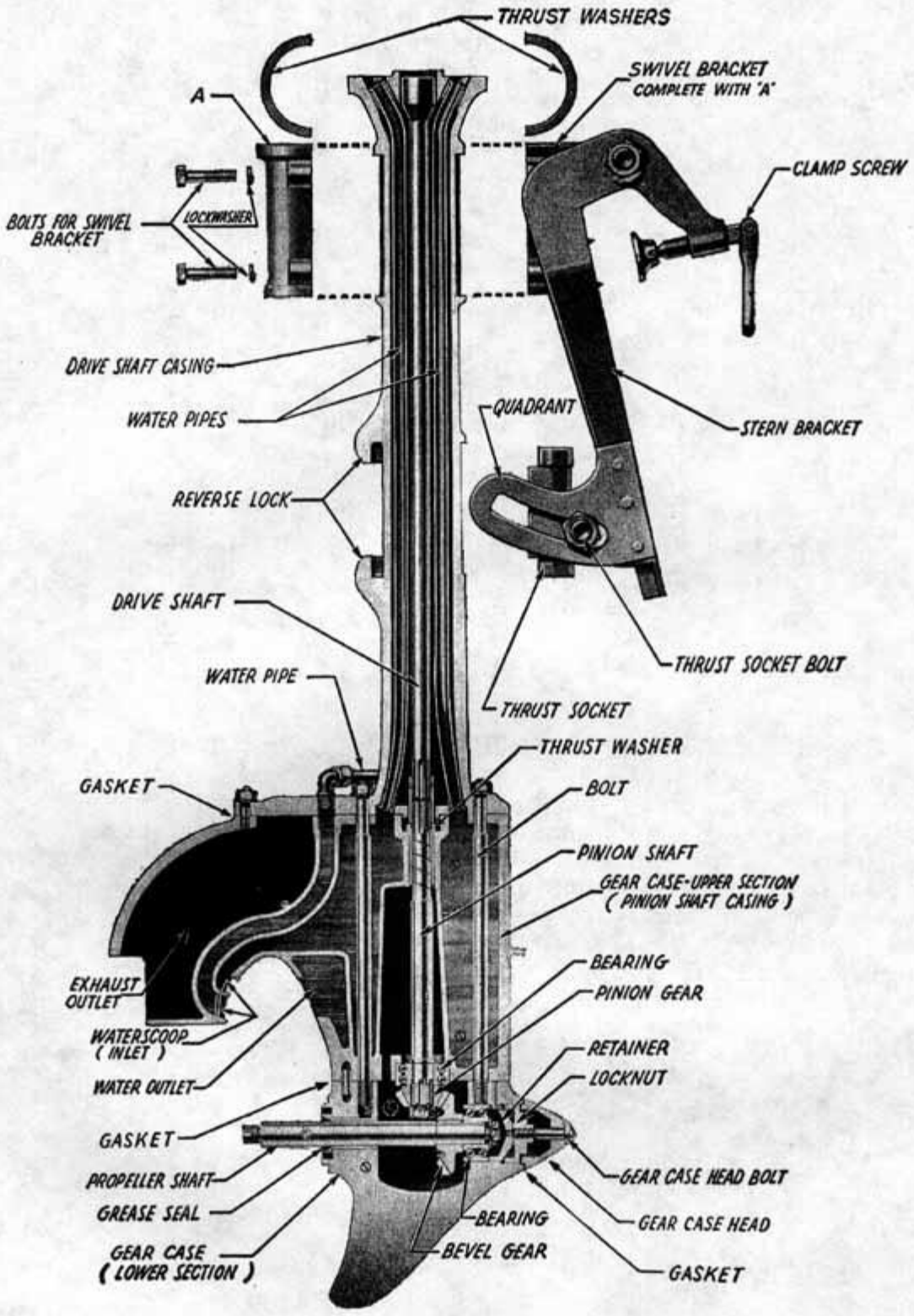
If it becomes necessary to remove the gear case housing from drive shaft casing, simply loosen large screw and pull in twisting motion as shown above. Assemble in reverse order.

THE SHOCK ABSORBER

Models HS, HD-20, TS, TD are equipped with a shock absorber device built into the propeller, consisting of the propeller, rubber shock absorber and hub. The purpose of this feature is to reduce shearing of propeller drive pins to a minimum and to absorb shocks which otherwise might be injurious to the motor in event of striking underwater obstructions. Shock is absorbed by the rubber insert — it acts as a cushion between the propeller and hub.



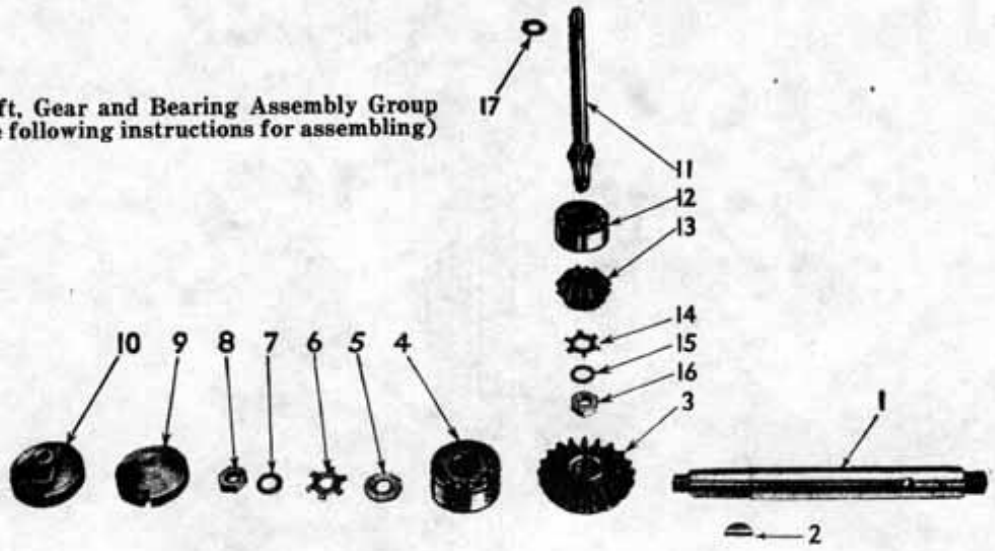
Showing Rubber Shock Absorber and Hub



Lower Unit Assembly—(Similar to Model PO)

GEAR CASE ASSEMBLY—(MODEL PO)

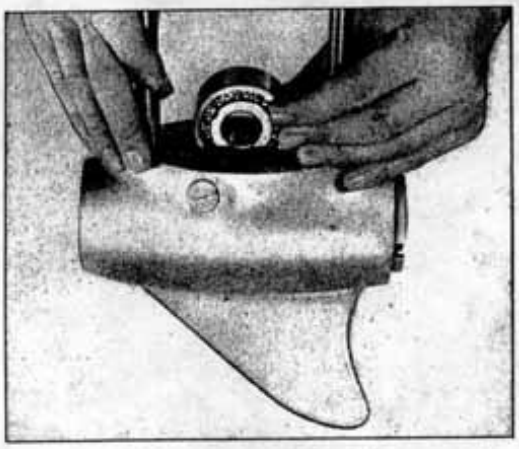
Shaft, Gear and Bearing Assembly Group
(see following instructions for assembling)



1. Propeller Shaft
2. Propeller Shaft Key
3. Bevel Gear
4. Ball (thrust) Bearing
5. Washer
6. Lockwasher
7. Washer
8. Nut
9. Retainer
10. Lock Nut
11. Pinion Shaft
12. Ball (thrust) Bearing
13. Pinion Gear
14. Lockwasher
15. Washer
16. Nut
17. Thrust Washer

TO ASSEMBLE GEAR CASE, PROCEED AS FOLLOWS:

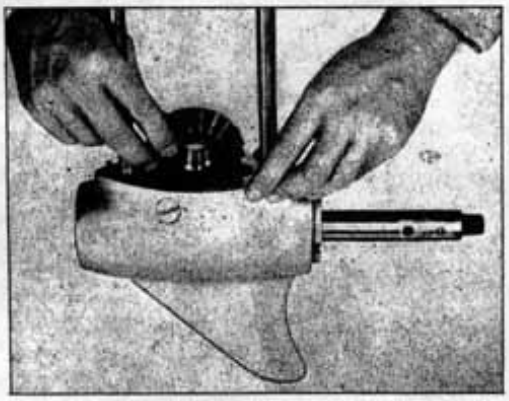
1. Insert ball bearing through top opening in gear case. Note location (seat) machined for bearing. Turn bearing around and press into seat as far as possible with fingers. Bearing cannot be seated unless square with seat. To square bearing, insert propeller shaft through both bearings to line them up, tap ball bearing in place by tapping end of propeller shaft with a mallet.



Installing Ball Bearing

2. Withdraw propeller shaft until it is on the verge of coming out of the bearing on propeller end. Insert bevel gear as shown, turn gear around, when in gear case, to permit sliding propeller shaft through hole (in gear).

3. Install Woodruff Key in propeller shaft keyway provided for this purpose. Key must be installed when end of propeller shaft has been inserted in gear case, propeller shaft cannot be pushed through bearing in gear case with key installed.



Inserting Bevel Gear

4. Key must line up with keyway in gear. Push propeller shaft through gear until gear is up against the shoulder on the shaft. Continue pushing propeller shaft until it enters hole in ball bearing, then tap lightly on end of propeller shaft to force bearing down in seat and gear up to the shoulder of shaft. Note small pin protruding at end of bearing seat inside gear case — drive propeller shaft, gear and bearing assembly in until bearing comes to rest against this pin.

5. Install large washer, lock washer, small washer and nut in order as laid out. Tighten nut with fingers for time being.

6. Slip ball bearing over end of pinion shaft, this followed by the gear, lockwasher, plain washer and nut in order as laid out. Draw up tightly on nut to make certain assembly is secure on pinion shaft. Bend all six lugs on lock washer up and against sides of nut to prevent its turning and becoming loose.

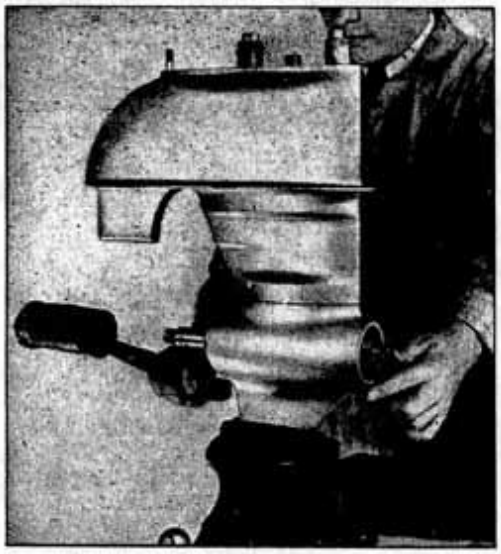
Drawing Up Propeller Shaft Assembly

7. Insert pinion shaft, bearing and gear assembly in upper section of gear case — install gear case gasket. Attach upper gear case section to gear case by sliding over long studs provided for this purpose. Install spacers on long studs, attach nuts and draw down tightly.

8. Place gear case assembly in vise to tighten propeller shaft nut. Insert punch through propeller pin hole to prevent turning when tightening nut as illustrated. When nut has been drawn up sufficiently, lock in place by bending at least three lugs of the lock washer up and against side of nut.

9. Install bearing retainer (note slot provided for pin in gear case — both of which must line up). Screw bearing lock nut in gear case to prepare for adjusting gears.

10. TO ADJUST GEARS—Draw up tightly on bearing lock nut, that is, until there is no clearance between bevel gear and pinion in gear case. Unscrew lock nut approximately ¼ turn. Strike end of propeller shaft with mallet to drive propeller shaft and gear assembly away from pinion to obtain necessary clearance between teeth of gears. Turn propeller shaft with fingers to note if gears bind in any position. If binding occurs, unscrew lock nut slightly and drive propeller shaft back again. When proper gear mesh has been attained, there will be no binding between gears when turning propeller or pinion shafts — a small amount of back lash should be noted.

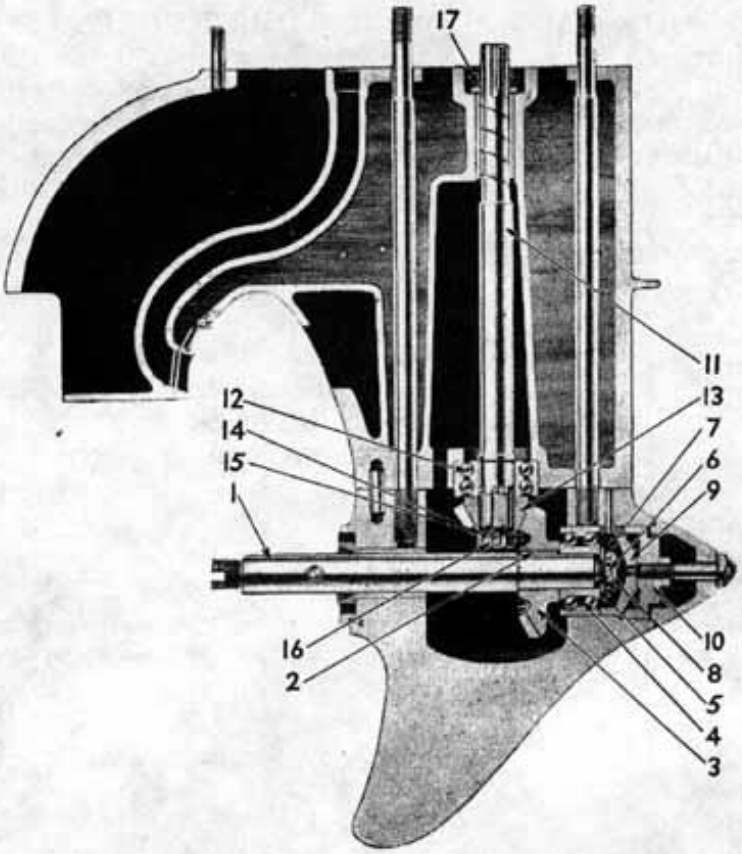


Adjusting Gear Mesh

11. Install gasket, gear case head and gear case head bolt.

12. Remove spacers, install gasket and thrust washer. Attach gear case assembly to motor — be sure all nuts are tight. Fill gear case with gear lubricant as instructed.

TO DISASSEMBLE GEAR CASE, proceed in reverse order of that described above. Wash gear lubricant off parts and out of gear case to make all parts accessible for inspection.

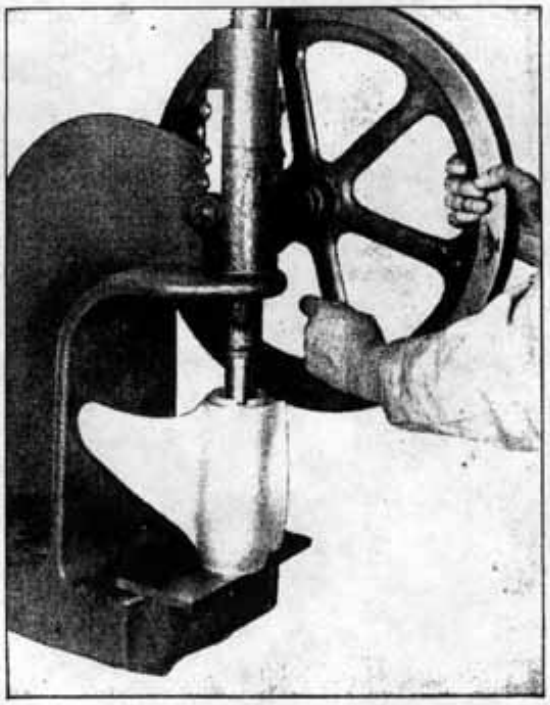


1. Propeller Shaft
2. Propeller Shaft Key
3. Bevel Gear
4. Ball (thrust) Bearing
5. Washer
6. Lockwasher
7. Washer
8. Nut
9. Retainer
10. Lock Nut (Bearing)
11. Pinion Shaft
12. Ball (thrust) Bearing
13. Pinion Gear
14. Lockwasher
15. Washer
16. Nut
17. Thrust Washer

Gear Case Assembly (Completed)—(Model PO)

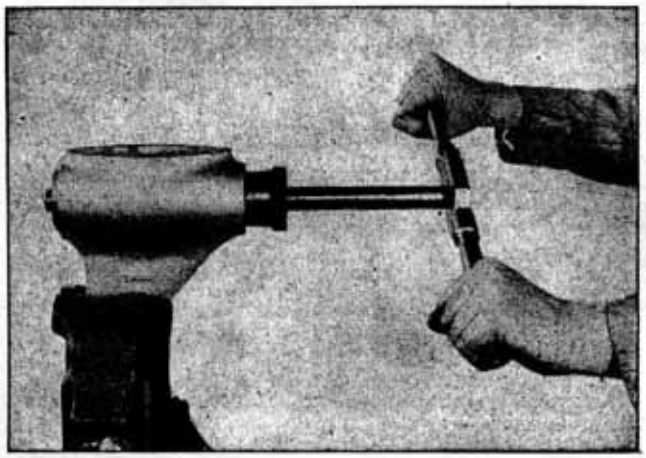
TO INSTALL NEW BUSHING (BEARING) IN GEAR CASE—(MODEL PO)

Since the gear case is provided with one bushing (propeller shaft bearing) and one ball bearing (propeller shaft thrust bearing), only one reaming operation is required when replacing propeller shaft bearing (bushing)—the ball bearing is removed and replaced as a unit.



Installing Propeller Shaft Bearing

When it becomes necessary to install a new propeller shaft bearing (bushing) the old one must be removed — this can be accomplished by driving out on arbor press in manner similar to removing journal bearings, previously described. Place gear case on table of press with bushing downward. Use round bar or mandrel slightly smaller than bushing to permit driving all way out. Install new bushing. Drive bushing (bearings) down until shoulder rests firmly against gear case.

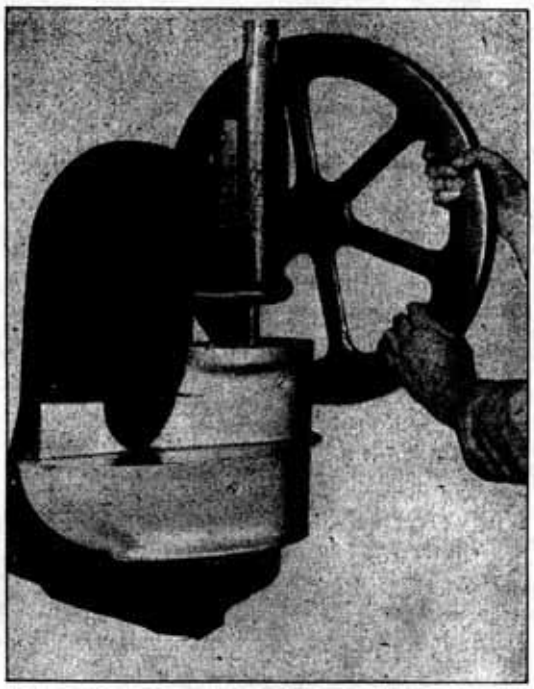


Reaming Propeller Shaft Bearing

Ream bearing to size .875". Use reamer No. S-94. Place gear case in vise (note large pilot right side of gear case). Insert reamer, pilot on reamer proper in propeller shaft bearing (bushing) and large pilot fitting over reamer shaft into the gear case to obtain correct alignment when reaming. Turn reamer in clockwise direction (facing back of gear case) at the same time forcing gently forward until cutter passes through bearing. Withdraw reamer slowly with same turning motion.

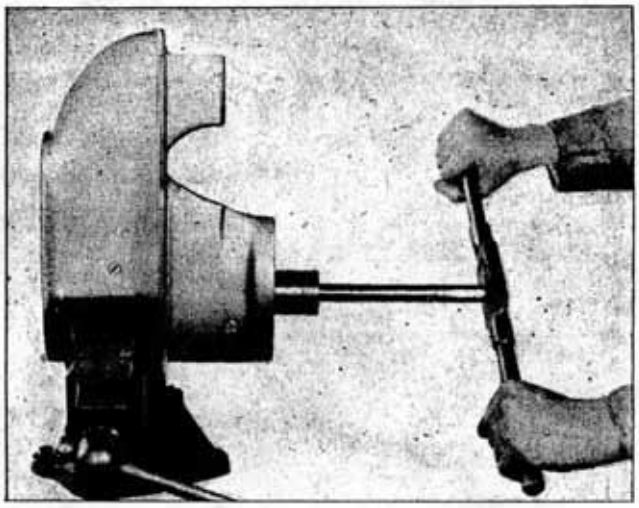
TO INSTALL NEW BEARING (BUSHING) IN PINION SHAFT CASING—(MODEL PO)

The pinion shaft casing, like the gear case, is provided with one bushing (top) and one ball bearing (thrust-bottom) consequently only one reaming operation is necessary to install new bearing (bushing). To install a new bushing the old one must be driven out and a new one pressed in, while the ball bearing is removed and replaced as a unit.



Driving Out Pinion Shaft Bearing

To drive out top bushing, place pinion shaft case on table of press as shown. Insert round bar or mandrel slightly smaller than bushing to permit driving all way out. To install new bushing, place case on table of press with bushing location up. Press new bushing (bearing) in until thrust face rests solidly against casing.



Reaming Pinion Shaft Bearing

Place casing in vise to ream bearing as illustrated. Ream to size .625" with reamer No. S-95, in manner similar to reaming propeller shaft bearing (bushing) described above.

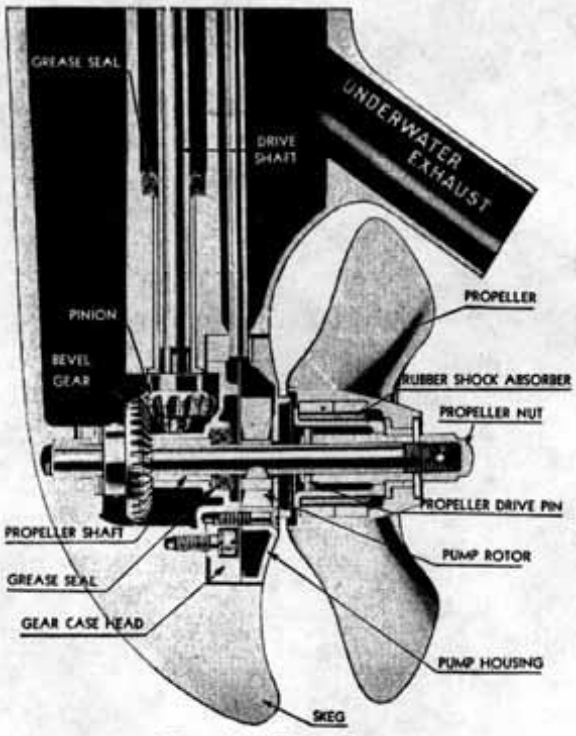
LUBRICATION AND CARE OF THE GEAR CASE

Since the gear case is submerged in water when in use, it is IMPORTANT that the gears, bearings, etc. be properly lubricated at all times.

INSPECTION of the gear case is necessary at regular intervals to drain accumulation of water which may be present and to refill with fresh lubricant. (Remove "vent" and "grease" plugs.)

Water in the gear case is injurious if allowed to remain for any length of time, particularly if placed in storage, causing gears, bearings, propeller and pinion shafts to rust and become pitted.

To refill with gear lubricant, place motor in an upright position. Remove lower grease plug and upper vent plug. Fill with MOBILGREASE UW or SEA-HORSE GEAR LUBRICANT — using a grease gun or tube inserted through lower opening. Insert lubricant until it flows from vent opening. Replace plugs — making certain they are secure.



H and T Gear Case

In extremely cold weather when water is apt to be near freezing point, gear lubricant can be mixed with motor oil S.A.E. 30 or 40 to make it more fluid; this, however, necessarily will have to be left to discretion of the operator.

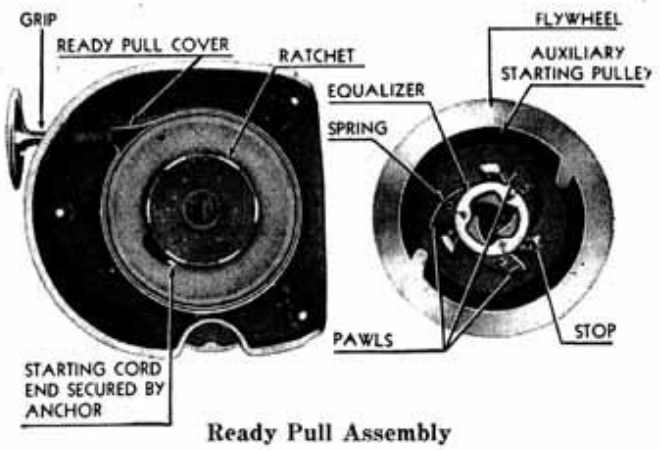
Inserting Gear Lubricant

Prior to storage for any length of time be sure to remove all drain, vent and grease plugs to allow any water present in the gear case and water channels to drain off. This will prevent freezing and bursting of the gear case, drive shaft housing, water tubes and cylinder blocks, if the motor is to be exposed to freezing temperatures, likewise eliminates all danger of rusting.

Costly repairs can be avoided if above instructions are closely adhered to.

THE READY PULL—HD, TD

This simple device is built into the motor for the express purpose of eliminating the necessity of manually wrapping the cord around the starting pulley for cranking. It consists of a ratchet plate about which are coiled a return spring and the starting cord and a pawl arrangement mounted on top of the magneto flywheel.



Ready Pull Assembly

When at rest, the pawls are held in an extended position by small springs, making a positive connection with the ratchet — thus when pulling on the starting cord grip, cranking effort is applied directly to the flywheel.

Upon having started the motor, the pawls disengage the ratchet automatically due to centrifugal force created by rotation of the flywheel. Once having started, "Ready Pull" mechanism remains idle, consequently since there is no action while the motor is in operation, there can be no wear on any of the parts. It is for this reason very little attention is necessary.

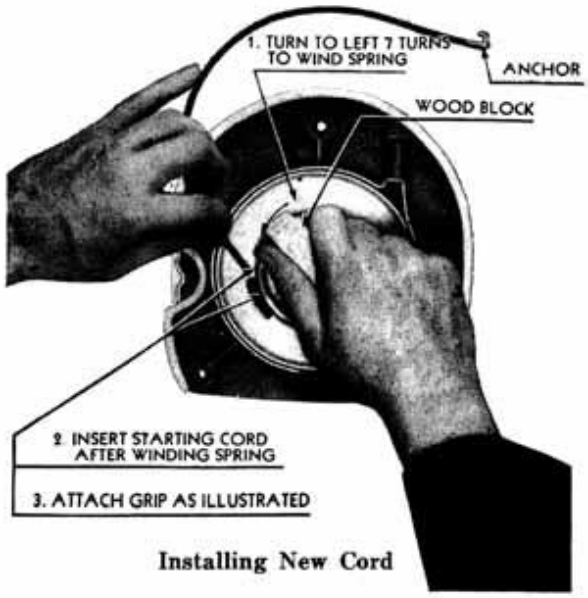
Immediately upon stopping the motor, centrifugal forces cease to act causing the spring to extend the pawls to engage with the ratchet — the "Ready Pull" is then again in position for cranking. Its action is automatic — simply pull on the cord to crank.

Care of the "Ready Pull"—Under no circumstances let the starting grip "snap" back into position after cranking by letting go. Retain hold of the grip until the cord has returned to normal position. Care should be exercised in this respect to prevent possible injury to the "Ready Pull" cover and starting cord.

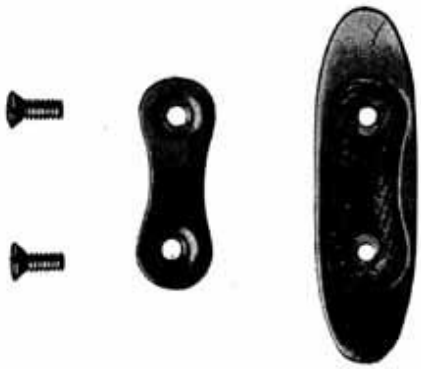
In event the starting cord should break, remove the "Ready Pull" and crank motor in usual way by wrapping cord around auxiliary starting plate on the flywheel.

TO INSTALL NEW STARTING CORD proceed as follows:

1. Remove "Ready Pull."
2. Remove fragments of broken starting cord.
3. Obtain new cord. Attach grip as shown. Use only the special cable provided by the manufacturer.
4. Cut a small piece of wood to fit in ratchet as shown.
5. Turn in anti-clockwise direction (right to left) 7 turns, using marker as indicated. (Be sure to turn right to left — to do otherwise will damage the recoil spring.)
6. Insert starting cord as illustrated.
7. Attach grip as shown.
8. Gradually release until all of cord has been taken up.
9. Attach "Ready Pull" to motor.



Installing New Cord



Cord Grip

TO INSTALL NEW STARTING CORD, PROCEED AS FOLLOWS:

(Models KD, SD)

1. Remove "Ready Pull" from motor.
2. Place in vise as illustrated (assembly can be held fast by placing nut on top of "Ready Pull" between jaws of vise).
3. Remove fragments of broken or damaged cord.
4. Obtain new cord — use only special cord provided by manufacturer.

Installing New Cord

5. Insert punch in hole in pulley provided for this purpose. Turn pulley against tension of spring, as indicated by arrow until all of tension is taken up, then permit pulley to unwind one (1) turn.

6. Insert new cord as illustrated. (End opposite anchor on cord through slot in pulley.)

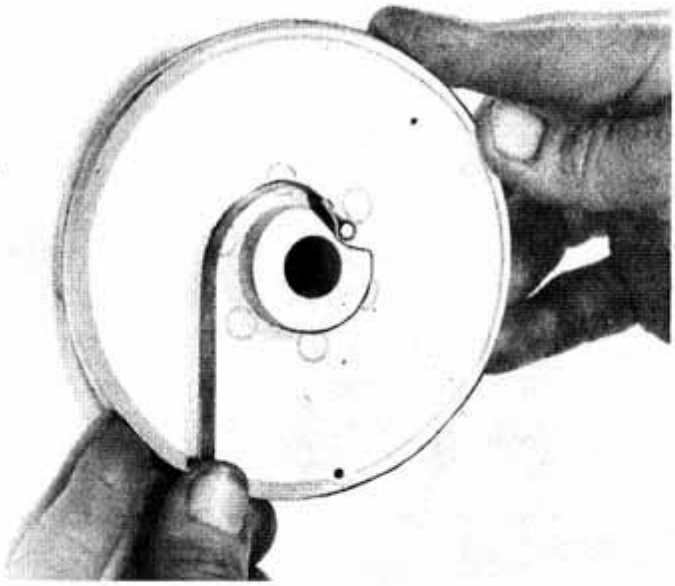
7. Attach grip to cord.

8. Gradually release tension on pulley until all of cord is taken up.

9. Attach "Ready Pull" to motor.

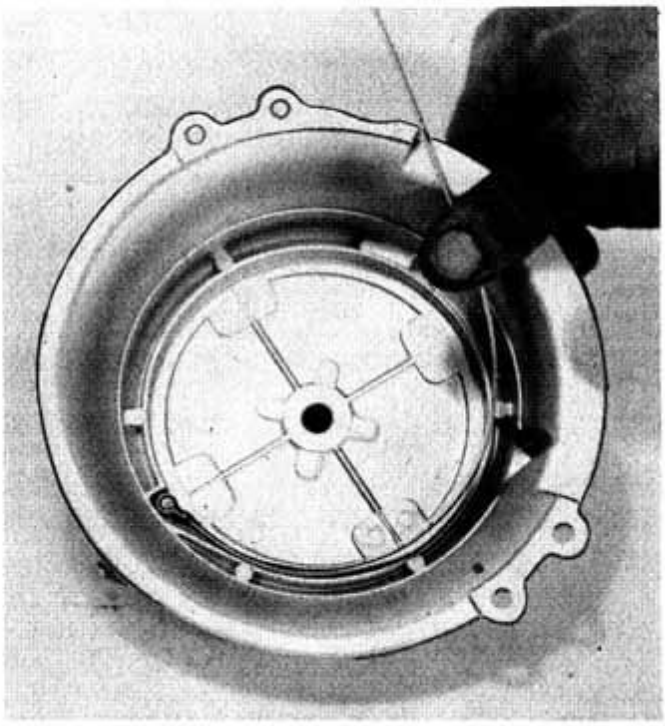
INSTALLATION OF NEW READY PULL STARTING SPRING

1. Place the rivet head towards the outside of pulley; with it in this position, put the loop over the pin on the pulley. Bend the spring around the hub, half way.



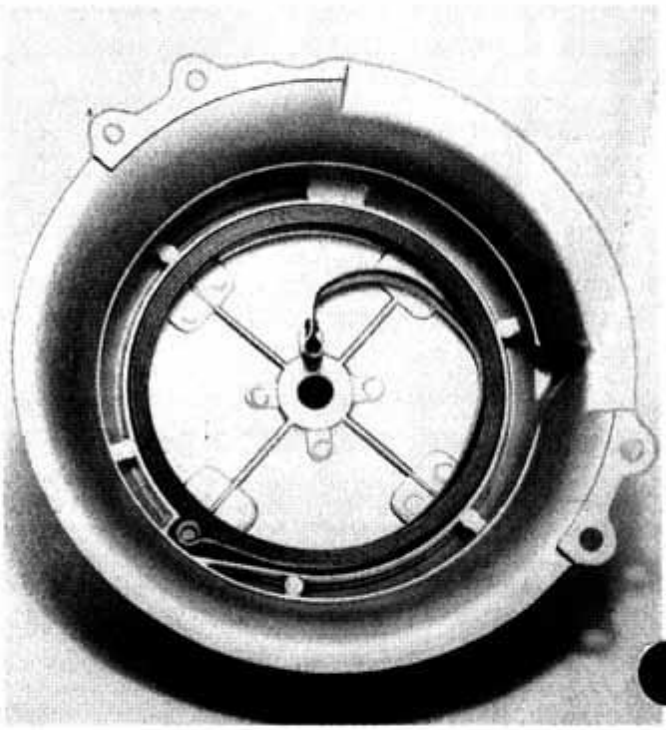
Attaching Spring to Pulley

2. Take the opposite end of the spring, place the rivet head towards the outside of the starter housing, and put the loop of the spring on the pin in the housing.



Installing Spring

3. Work the spring around in anti-clockwise direction until it is all in place as shown. Bend the inside end of spring as shown. Place the pin of the pulley through the loop of the spring in the center of the housing. Place the bolt, washer and nut to fasten the housing and pulley together.



Spring Installed