Johnson
SERVICE MANUAL

TENTH EDITION

JOHNSON MOTORS
WAUKEGAN, ILLINOIS

△ SAFETY WARNING

PROPER SERVICE AND REPAIR IS IMPORTANT FOR THE SAFE, RELIABLE OPERATION OF ALL MECHANICAL PRODUCTS. THE SERVICE PROCEDURES WE RECOMMEND AND DESCRIBE IN THIS SERVICE MANUAL ARE EFFECTIVE METHODS FOR PERFORMING SERVICE OPERATIONS. SOME OF THESE SERVICE OPERATIONS REQUIRE THE USE OF TOOLS SPECIALLY DESIGNED FOR THE PURPOSE. THESE SPECIAL TOOLS SHOULD BE USED WHEN AND AS RECOMMENDED.

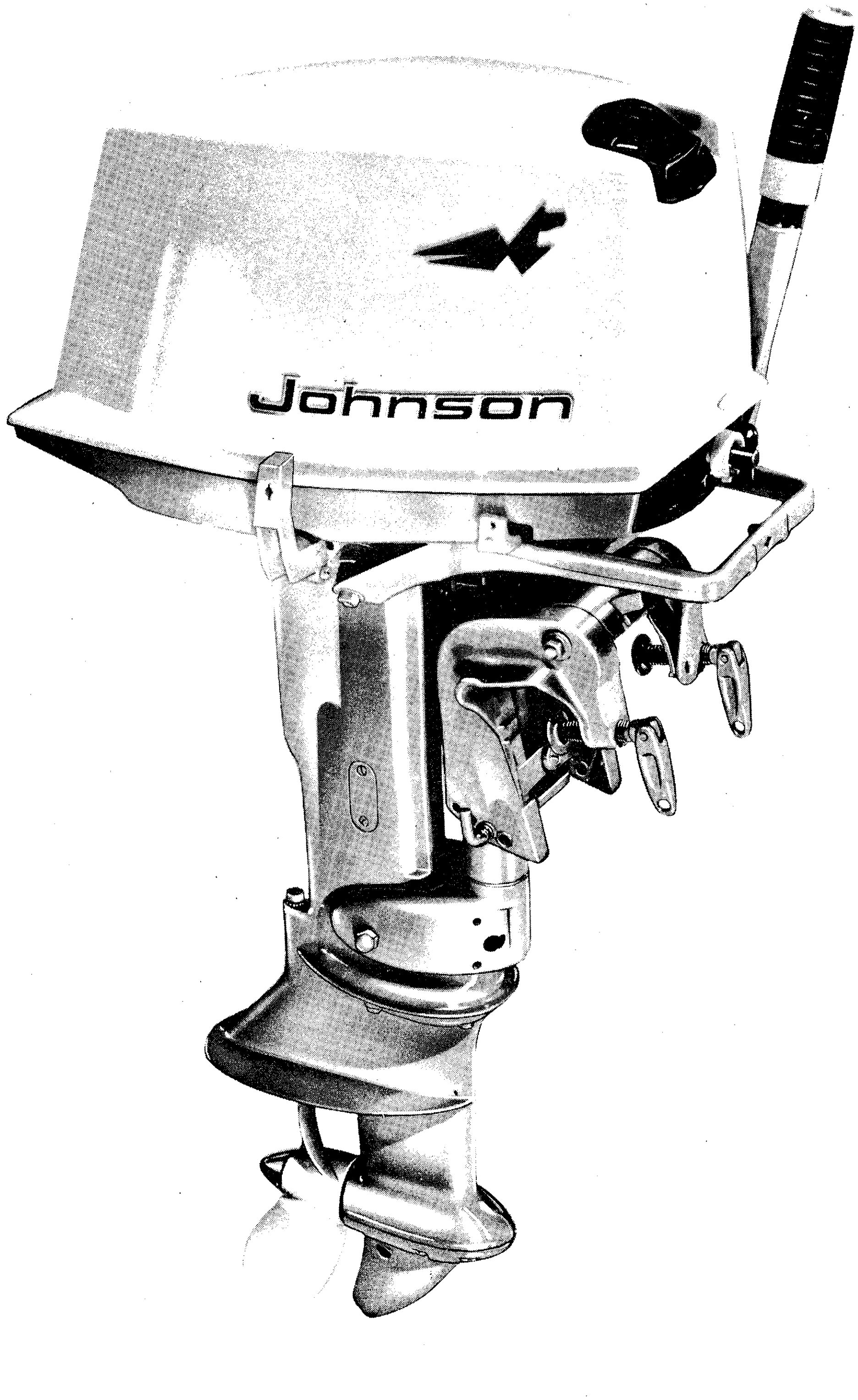
IT IS IMPORTANT TO NOTE THAT SOME WARNINGS AGAINST THE USE OF SPECIFIC SERVICE METHODS THAT CAN DAMAGE THE ENGINE OR RENDER IT UNSAFE ARE STATED IN THIS SERVICE MANUAL. HOWEVER, PLEASE REMEMBER THAT THESE WARNINGS ARE NOT ALL INCLUSIVE. SINCE JOHNSON OUTBOARDS COULD NOT POSSIBLY KNOW, EVALUATE AND ADVISE THE SERVICE TRADE OF ALL POSSIBLE WAYS IN WHICH SERVICE MIGHT BE DONE OR OF THE POSSIBLE HAZARDOUS CONSEQUENCES OF EACH WAY, WE HAVE NOT UNDERTAKEN ANY SUCH BROAD EVALUATION. ACCORDINGLY, ANYONE WHO USES A SERVICE PROCEDURE OR TOOL WHICH IS NOT RECOMMENDED BY JOHNSON OUTBOARDS MUST FIRST THOROUGHLY SATISFY HIMSELF THAT NEITHER HIS NOR THE ENGINE'S SAFETY WILL BE JEOPARDIZED BY THE SERVICE METHODS SELECTED.

SAFETY

The purpose of the safety symbols is to attract your attention to possible dangers. The symbols, and the explanations with them, deserve your careful attention and understanding. Safety warnings do not by themselves eliminate any danger. The instructions or warnings they give are not substitutes for proper accident prevention measures.

△ **SAFETY WARNING**
FAILURE TO OBEY A SAFETY WARNING MAY RESULT IN INJURY TO YOU OR TO OTHERS.

■ **NOTE**
Advises you of information specially useful in the servicing and overhaul of your motor.



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MAGNETO
CARBURETION
POWERHEAD
LOWER UNIT
ELECTRICAL
MISCELLANEOUS
BASIC MODELS

FOREWORD

They say, "It ain't the fixin' that's so hard, it's findin' out just what needs the fixin'."

Finding and fixing require two essentials:

1. A thorough knowledge of the product — its fundamental principles of construction and operation.
2. A systematic search.

Diagnosis (determining what's to be done) must always precede the actual job of restoration. The ability to seek out or track down disturbing causes of malfunctioning may be acquired only through persistent study and an all-inclusive understanding of the principles involved — furthered by observation and experience.

This manual as such is devoted to the basic fundamentals of construction, operation and maintenance of Johnson Outboard Motors and thus includes information and pertinent data relating to adjustments, repairs and assemblies as are apt to be conducted in the service shop from time to time by qualified personnel.

It is well to recall here that three basics are required during the performance of all reciprocating internal combustion engines whether they be of two-stroke (outboard motor) or four-stroke cycle engines. They are, namely —

1. Gas — a vaporized combustible mixture of liquid fuel and air. (Carburetor.)
2. Compression — to prepare the vapor charge for ignition. (Cylinder, combustion chamber, piston assembly.)
3. Spark — to fire the compressed fuel vapor charge. (Magneto, spark plug.)

Evidence of substandard engine performance in most instances may obviously be traced to deficiencies in either or all of the above basics — not too difficult to overcome with full knowledge of the product, its characteristics of performance and proper diagnosis.

Learn to know the basics well —

And of significance — observation will reveal that both design and construction of all later vintage Johnson Motors are fundamentally alike — the ignition system, the fuel system, the powerhead and the lower unit assembly. Except for certain construction details confined to a specific model, diagnosis and service procedures will be found to be similar in most all respects. Otherwise, details of assembly will be found in the several parts catalogs — a catalog for each model and type series as published accordingly.

And, not to be neglected is periodic reference to the current operator's manual and other service instructions (service bulletins, etc.) circularized from time to time.

Knowledge of the product is the Service Technician's most valuable asset . . . knowledge of its construction details and characteristics of performance is the true foundation upon which to build and maintain a successful service organization.

JOHNSON MOTORS
WAUKEGAN, ILLINOIS

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JOHNSON MOTOR SPECIFICATIONS

Model	Year	Original List Price	Bore"	Stroke"	H.P.	R.P.M.	Gas Tank Capacity	Spark Plug No.	Propeller Drive Pin	Weight
A	1922-23	$140.00	2	1-1/2	2	2250	3/4 Gal.	Champion C7	13-40	35 lbs.
BN	1922-23	145.00	2	1-1/2	2	2250	3/4 Gal.	Champion C7	13-40	40 lbs.
A	1924	140.00	2	1-1/2	2	2250	3/4 Gal.	Champion C7	13-40	35 lbs.
BN	1924	145.00	2	1-1/2	2	2250	3/4 Gal.	Champion C7	13-40	40 lbs.
A-25	1925	140.00	2	1-1/2	2	2400	3/4 Gal.	Champion C7	13-40	35 lbs.
AB-25	1925	145.00	2	1-1/2	2	2400	3/4 Gal.	Champion C7	13-40	40 lbs.
J-25	1925	125.00	2	1-1/2	1.5	2700	1/2 Gal.	Champion C7	13-40	27 lbs.
A-25	1926	140.00	2	1-1/2	2	2400	3/4 Gal.	Champion C7	13-40	35 lbs.
AB-25	1926	145.00	2	1-1/2	2	2400	3/4 Gal.	Champion C7	13-40	40 lbs.
J-25	1926	125.00	2	1-1/2	1.5	2700	1/2 Gal.	Champion C7	13-40	27 lbs.
P-30	1926	210.00	2-7/8	1-3/4	6	2500	2-1/2 Gal.	Champion C7	7-72	80 lbs.
A-35	1928	140.00	2	1-1/2	2-1/2	2600	3/4 Gal.	Champion C7	13-40	37 lbs.
J-25	1927	125.00	2	1-1/2	1.5	2700	1/2 Gal.	Champion C7	13-40	27 lbs.
P-35	1927	220.00	2-11/16	2-7/16	8	2750	2-1/2 Gal.	Champion R7	7-72	83 lbs.
K-35	1927	180.00	2-5/16	2-1/16	6	2750	1-1/2 Gal.	Champion R7	15-102	60 lbs.
A-35	1928	140.00	2	1-1/2	2-1/2	2600	3/4 Gal.	Champion C7	13-40	37 lbs.
J-25	1928	115.00	2	1-1/2	1.5	2700	1/2 Gal.	Champion C7	13-40	27 lbs.
K-40	1928	165.00	2-3/8	2-1/4	7.15	3500	1-1/2 Gal.	Champion R7	15-102	61 lbs.
P-40	1928	210.00	2-11/16	2-5/8	13.15	3700	2-1/2 Gal.	Champion R7	7-72	85 lbs.
TR-40	1928	275.00	3	3-1/2	25.75	3500	4 Gal.	Champion R1	19-102	110 lbs.
A-45	1929	150.00	2	1-1/2	3	2700	3/4 Gal.	Champion C7	13-40	38 lbs.
J-25	1929	115.00	2	1-1/2	1.5	2700	1/2 Gal.	Champion C7	13-40	27 lbs.
K-45	1929	185.00	2-3/8	2-1/4	7.15	3500	1-1/2 Gal.	Champion R7	15-102	63 lbs.
P-45	1929	230.00	2-11/16	2-5/8	12	3000	2-1/2 Gal.	Champion R7	7-72	87 lbs.
S-45	1929	250.00	2-3/8	2-1/4	13	4000	2.4 Gal.	Champion R7	7-72	99 lbs.
V-45	1929	325.00	2-3/8	2-1/4	26	4000	4-1/4 Gal.	Champion R7	19-102	120 lbs.
SR-45	1929	250.00	2-3/8	2-1/4	16	5200	2.4 Gal.	Champion R1	7-92	102 lbs.
VR-45	1929	325.00	2-3/8	2-1/4	32	5200	4-1/4 Gal.	Champion R1	7-92	138 lbs.
TR-40	1929	275.00	3	3-1/2	25.75	3500	4 Gal.	Champion R1	19-102	110 lbs.
J-25	1930-32	115.00	2	1-1/2	1.5	2700	1/2 Gal.	Champion C7	13-40	27 lbs.
A-50	1930-32	145.00	1-7/8	1-1/2	4	3500	7 Pints	Champion 5M	13-40	45 lbs.
K-50	1930-32	165.00	2-1/8	1-31/32	8	3500	13 Pints	Champion R7	15-102	60 lbs.
KR-55	1930-32	225.00	2-1/8	1-31/32	12	5500	13 Pints	Champion R1	27-156	60 lbs.
P-50	1930-32	245.00	2-3/4	2.52	20	3500	2-1/2 Gal.	Champion R7	19-102	102 lbs.
PR-50	1930-32	350.00	2-3/4	2.52	24	5000	2-1/2 Gal.	Champion R1	7-92	113½ lbs.
PR-55	1930-32	350.00	2-3/4	2.52	27	5500	2-1/2 Gal.	Champion R1	7-92	113½ lbs.
PR-60	1930-32	350.00	2-3/4	2.52	27	5500	2-1/2 Gal.	Champion R11	7-92	113½ lbs.
S-45	1930-32	215.00	2-3/8	2-1/4	13	4000	2.4 Gal.	Champion R7	7-92	99 lbs.
SR-50	1930-32	300.00	2-3/8	2-1/4	16	5200	2.4 Gal.	Champion R1	7-92	102 lbs.
SR-55	1930-32	300.00	2-3/8	2-1/4	18	5500	2.4 Gal.	Champion R1	7-92	103 lbs.
SR-60	1930-32	300.00	2-3/8	2-1/4			2.4 Gal.	Champion R11	29-110	103 lbs.
V-45	1930-32	280.00	2-3/8	2-1/4	26	4000	4-1/4 Gal.	Champion R7	19-102	120 lbs.
VR-50	1930-32	375.00	2-3/8	2-1/4	32	5200	4-1/4 Gal.	Champion R1	7-92	139 lbs.
VR-55	1930-32	375.00	2-3/8	2-1/4	36	5500	4-1/4 Gal.	Champion R1	7-92	138 lbs.
KR-55	1930-32	225.00	2-1/8	1-31/32	12	3500	13 Pints	Champion R1	27-156	60 lbs.
OA-55	1930-32	109.00	2	1-1/2	3	2800	7-1/4 Pints	Champion C7	31-54	45 lbs.
OA-60	1930-32	97.50	2	1-1/2	3	2800	7-1/4 Pints	Champion C7	31-54	45 lbs.
OK-55	1930-32	145.00	2-3/8	2-1/4	8	2800	14-1/2 Pints	Champion R7	33-54	60 lbs.
OK-60	1930-32	135.00	2-3/8	2-1/4	7	2800	13 Pints	Champion R7	33-54	70 lbs.
J-65	1933	72.75	2	1-1/2	*1.4	3000	1/2 Gal.	Champion C7	13-40	27 lbs.
OA-65	1933	96.50	2	1-1/2	2.8	3000	6-1/2 Pints	Champion C7	31-148	41½ lbs.
A-65	1933	125.50	1-7/8	1-1/2	4.1	4000	7 Pints	Champion 5M	13-40	46 lbs.
K-65	1933	144.50	2-1/8	1-31/32	9.2	4000	13 Pints	Champion R7	15-102	63 lbs.
S-65	1933	206.50	2-3/8	2-1/4	13.3	4000	2.4 Gal.	Champion R7	7-72	102 lbs.
P-65	1933	226.50	2-3/4	2.52	21.4	4000	2-1/2 Gal.	Champion R7	19-102	114 lbs.
V-65	1933	278.50	2-3/8	2-1/4	26.1	4000	4-1/4 Gal.	Champion R7	19-102	133 lbs.
J-70	1934	85.00	2	1-1/2	1.4	3000	1/2 Gal.	Champion C7	31-54	38¾ lbs.
F-70	1934	105.00	2	1-1/2	3.3	3000	7 Pints	Champion C7	31-54	43 lbs.
A-70	1934	140.00	1-7/8	1-1/2	4.1	4000	7 Pints	Champion 5M	13-40	46 lbs.
K-70	1934	160.00	2-1/8	1-31/32	9.2	4000	13 Pints	Champion R7	15-102	63 lbs.
S-70	1934	225.00	2-3/8	2-1/4	13.3	4000	2-1/2 Gal.	Champion R7	7-72	102 lbs.
P-70	1934	250.00	2-3/4	2.52	21.4	4000	2-1/2 Gal.	Champion R7	19-102	114 lbs.
V-70	1934	290.00	2-3/8	2-1/4	26.1	4000	4-1/4 Gal.	Champion R7	19-102	133 lbs.
J-75	1935	87.50	2	1-1/2	1.4	3000	4 Pints	Champion C7	31-54	29¼ lbs.
F-75	1935	115.00	2	1-1/2	3.3	3000	7 Pints	Champion C7	31-54	43 lbs.
300	1935	130.00	1-7/8	1-3/8	3.7	4000	6-1/2 Pints	Champion J6	31-54	37 lbs.
A-75	1935	145.00	1-7/8	1-1/2	4.5	4000	7 Pints	Champion 5M	25-280	48 lbs.
K-75	1935	165.00	2-1/8	1-31/32	9.3	4000	13 Pints	Champion R7	15-102	64 lbs.
P-75	1935	255.00	2-3/4	2.52	22	4000	2-1/2 Gal.	Champion R7	19-102	109 lbs.
OK-75	1935	150.00	2-3/8	2-1/4	8.1	2800	14-1/2 Pints	Champion R7	33-54	70 lbs.

Model	Year	Original List Price	Bore"	Stroke"	H.P.	R.P.M.	Gas Tank Capacity	Spark Plug No.	Propeller Drive Pin	Weight
A-80	1936	145.00	1-7/8	1-1/2	4.5	4000	7 Pints	Champion 5M	25-286	48 lbs.
K-80	1936	165.00	2-1/8	1-31/32	9.3	4000	13 Pints	Champion R7	15-102	64 lbs.
J-80	1936	90.00	2	1-1/2	1.7	3300	4 Pints	Champion C7	31-54	28½ lbs.
P-80	1936	255.00	2-3/4	2.52	22	4000	2-1/2 Gal.	Champion R7	19-102	108 lbs.
100	1936	62.50	2	1-1/2	1.7	3300	4 Pints	Champion J8-J	31-54	24¾ lbs.
200	1936	82.50	2	1-1/2	3.3	3300	7 Pints	Champion C7	31-54	38¾ lbs.
300	1936	125.00	1-7/8	1-3/8	3.7	4000	6.5 Pints	Champion J6	31-54	37 lbs.
LS-37	1937	75.00	1-7/8	1-1/2	2.1	4000	2-5/8 Pints	Champion J8-J	13-40	33 lbs.
DS-37	1937	95.00	1-7/8	1-1/2	2.1	4000	4 Pints	Champion J8-J	13-40	39 lbs.
LT-37	1937	105.00	1-7/8	1-1/2	4.2	4000	5 Pints	Champion J8-J	13-40	40 lbs.
DT-37	1937	130.00	1-7/8	1-1/2	4.2	4000	6 Pints	Champion J8-J	13-40	45 lbs.
210	1937	85.00	2	1-1/2	3.3	3300	7 Pints	Champion C7	31-54	38¾ lbs.
110	1937	59.50	2	1-1/2	1.7	3300	4 Pints	Champion J8-J	31-54	24¾ lbs.
AA-37	1937	145.00	1-7/8	1-1/2	4.5	4000	7 Pints	Champion 5M	13-40	48 lbs.
KA-37	1937	175.00	2-1/8	1-31/32	9.3	4000	13 Pints	Champion R7	15-102	64 lbs.
PO-37	1937	260.00	2-3/4	2.52	22.0	4000	2-1/2 Gal.	Champion R7	19-102	109 lbs.
MS-38	1938	49.50	1-3/8	1-3/8	1.1	4000	1.8 Pints	Champion J8-J	43-72	17 lbs.
MD-38	1938	62.50	1-3/8	1-3/8	1.1	4000	2.3 Pints	Champion J8-J	43-72	21 lbs.
LS-38	1938	77.50	1-7/8	1-1/2	2.1	4000	2-5/8 Pints	Champion J8-J	13-40	30¾ lbs.
DS-38	1938	94.50	1-7/8	1-1/2	2.1	4000	4 Pints	Champion J8-J	13-40	38 lbs.
LT-38	1938	109.50	1-7/8	1-1/2	4.2	4000	5 Pints	Champion J8-J	13-40	37½ lbs.
DT-38	1938	129.50	1-7/8	1-1/2	4.2	4000	6 Pints	Champion J8-J	13-40	39¼ lbs.
KA-38	1938	177.50	2-1/8	1-31/32	9.3	4000	13 Pints	Champion R7	15-102	64 lbs.
PO-38	1938	269.50	2-3/4	2.52	22.0	4000	2-1/2 Gal.	Champion R7	19-102	109 lbs.
MS-39	1939	49.50	1-3/8	1-3/8	1.1	4000	1.8 Pints	Champion J8-J	43-72	17 lbs.
MD-39	1939	62.50	1-3/8	1-3/8	1.1	4000	2.3 Pints	Champion J8-J	43-72	21 lbs.
HS-39	1939	79.50	1-3/8	1-3/8	2.5	4000	3-1/2 Pints	Champion J8-J	43-72	21½ lbs.
HA-39	1939	86.50	1-3/8	1-3/8	2.5	4000	3-1/2 Pints	Champion J8-J	43-72	26 lbs.
HD-39	1939	94.50	1-3/8	1-3/8	2.5	4000	3-3/4 Pints	Champion J8-J	43-72	28 lbs.
LT-39	1939	109.50	1-15/16	1-1/2	5.0	4000	5-1/4 Pints	Champion J8-J	25-286	33½ lbs.
AT-39	1939	117.50	1-15/16	1-1/2	5.0	4000	5-1/4 Pints	Champion J8-J	25-286	38 lbs.
DT-39	1939	129.50	1-15/16	1-1/2	5.0	4000	6-1/2 Pints	Champion J8-J	25-286	42 lbs.
KA-39	1939	177.50	2-1/8	1-31/32	9.8	4000	13 Pints	Champion R7	15-102	64 lbs.
PO-39	1939	269.50	2-3/4	2.52	22.0	4000	2-1/2 Gal.	Champion R7	19-102	109 lbs.
MS-15	1940	49.50	1-1/2	1-3/8	1.5	4000	1.8 Pints	Champion J8-J	43-72	19 lbs.
MD-15	1940	62.50	1-1/2	1-3/8	1.5	4000	2.3 Pints	Champion J8-J	43-72	24 lbs.
HS-10, 15	1940	79.50	1-3/8	1-3/8	2.5	4000	3-1/4 Pints	Champion J8-J	43-72	21½ lbs.
HA-10, 15	1940	86.50	1-3/8	1-3/8	2.5	4000	3-1/4 Pints	Champion J8-J	43-72	26 lbs.
HD-10, 15	1940	94.50	1-3/8	1-3/8	2.5	4000	3-1/4 Pints	Champion J8-J	43-72	28 lbs.
LT-10	1940	109.50	1-15/16	1-1/2	5.0	4000	5-1/4 Pints	Champion J8-J	25-286	33½ lbs.
AT-10	1940	117.50	1-15/16	1-1/2	5.0	4000	5-1/4 Pints	Champion J8-J	25-286	38 lbs.
DT-10	1940	129.50	1-15/16	1-1/2	5.0	4000	6-1/2 Pints	Champion J8-J	25-286	42½ lbs.
KA-10	1940	177.50	2-1/8	1-31/32	9.8	4000	13 Pints	Champion R7	15-102	64 lbs.
SD-10	1940	244.50	2-1/2	2-1/4	16.0	4000	2-1/2 Gal.	Champion 5M	45-300079	88 lbs.
PO-10	1940	269.50	2-3/4	2.52	22	4000	2-1/2 Gal.	Champion R7	19-102	109 lbs.
MS-20	1941	55.00	1-1/2	1-3/8	1.5	4000	4.88 Pints	Champion J8-J	43-72	24 lbs.
MD-20	1941	62.00	1-1/2	1-3/8	1.5	4000	4.88 Pints	Champion J8-J	43-72	26 lbs.
HS-20	1941	87.00	1-3/8	1-3/8	2.5	4000	4.88 Pints	Champion J8-J	43-72	27 lbs.
HD-20	1941	94.00	1-3/8	1-3/8	2.5	4000	4.88 Pints	Champion J8-J	43-72	29 lbs.
TS-15	1941	118.00	1-15/16	1-1/2	5.0	4000	7 Pints	Champion J8-J	41-300592	40 lbs.
TD-15	1941	125.00	1-15/16	1-1/2	5.0	4000	7 Pints	Champion J8-J	41-300592	42 lbs.
KS-15	1941	185.00	2-1/8	1-31/32	9.8	4000	13 Pints	Champion 5M	15-102	64 lbs.
KD-15	1941	195.00	2-1/8	1-31/32	9.8	4000	13 Pints	Champion 5M	15-102	71 lbs.
SD-10	1941	255.00	2-1/2	2-1/4	16.0	4000	2-1/2 Gal.	Champion 5M	45-300079	89 lbs.
PO-15	1941	280.00	2-3/4	2.52	22.0	4000	2-1/2 Gal.	Champion R7	19-102	109 lbs.
MS-20	1942	62.00	1-1/2	1-3/8	1.5	4000	4.88 Pints	Champion J8-J	43-72	24 lbs.
MD-20	1942	70.00	1-1/2	1-3/8	1.5	4000	4.88 Pints	Champion J8-J	43-72	26 lbs.
HS-20	1942	97.00	1-3/8	1-3/8	2.5	4000	4.88 Pints	Champion J8-J	43-72	27 lbs.
HD-20	1942	105.00	1-3/8	1-3/8	2.5	4000	4.88 Pints	Champion J8-J	43-72	29 lbs.
TS-15	1942	132.00	1-15/16	1-1/2	5.0	4000	7 Pints	Champion J8-J	41-300592	40 lbs.
TD-15	1942	140.00	1-15/16	1-1/2	5.0	4000	7 Pints	Champion J8-J	41-300592	42 lbs.
KS-15	1942	205.00	2-1/8	1-31/32	9.8	4000	13 Pints	Champion 5M	15-102	64 lbs.
KD-15	1942	215.00	2-1/8	1-31/32	9.8	4000	13 Pints	Champion 5M	15-102	71 lbs.
SD-10	1942	280.00	2-1/2	2-1/4	16.0	4000	2-1/2 Gal.	Champion 5M	45-300079	89 lbs.
PO-15	1942	310.00	2-3/4	2.52	22.0	4000	2-1/2 Gal.	Champion R7	19-102	109 lbs.
HD-25	1946	115.50	1-3/8	1-3/8	2.5	4000	4.88 Pints	Champion J8-J	43-72	29 lbs.
TD-20	1946	154.00	1-15/16	1-1/2	5.0	4000	7 Pints	Champion J8-J	41-300592	42 lbs.
KD-15	1946	250.00	2-1/8	1-31/32	9.8	4000	13 Pints	Champion 5M	15-102	71 lbs.
SD-15	1946	308.00	2-1/2	2-1/4	16.0	4000	2-1/2 Gal.	Champion 5M	45-300079	89 lbs.
PO-15	1946	350.00	2-3/4	2.52	22.0	4000	2-1/2 Gal.	Champion R7	19-102	109 lbs.
HD-25	1947	120.00	1-3/8	1-3/8	2.5	4000	4.88 Pints	Champion J8-J	43-72	29 lbs.
TD-20	1947	160.00	1-15/16	1-1/2	5.0	4000	7 Pints	Champion J8-J	41-300592	42 lbs.
KD-15	1947	250.00	2-1/8	1-31/32	9.8	4000	13 Pints	Champion 5M	15-102	71 lbs.
SD-15	1947	310.00	2-1/2	2-1/4	16.0	4000	2-1/2 Gal.	Champion 5M	45-300079	89 lbs.
PO-15	1947	350.00	2-3/4	2.52	22.0	4000	2-1/2 Gal.	Champion R7	19-102	109 lbs.

* J-65 1933 and all following motors are O.B.C. Certified Horsepower ratings.

Model	Year	Original List Price	Bore"	Stroke"	H.P.	R.P.M.	Gas Tank Capacity	Spark Plug No.	Piston Dspl. Cu. In.	Weight
HD-25	1948	120.00	1-3/8	1-3/8	2.5	4000	4.88 Pints	Champion J8-J	4.08	29 lbs.
TD-20	1948	160.00	1-15/16	1-1/2	5.0	4000	7 Pints	ChampionJ8-J	8.44	42 lbs.
KD-15	1948	250.00	2-1/8	1-31/32	9.8	4000	13 Pints	Champion 5M-J	13.96	71 lbs.
SD-15	1948	310.00	2-1/2	2-1/4	16.0	4000	2-1/2 Gal.	Champion 5M-J	22.09	89 lbs.
PO-15	1948	350.00	2-3/4	2.52	22.0	4000	2-1/2 Gal.	Champion R7		109 lbs.
HD-25	1949	130.00	1-3/8	1-3/8	2.5	4000	4.88 Pints	Champion J-6-J	4.08	31 lbs.
TD-20	1949	170.00	1-15/16	1-1/2	5.0	4000	7 Pints	Champion J-6-J	8.44	44 lbs.
QD-10	1949	300.00	2-3/8	1-7/8	10.0	4000	5 Gal.	Champion J-6-J	16.60	56 lbs.
SD-20	1949	350.00	2-1/2	2-1/4	16.0	4000	5 Gal.	Champion 5M-J	22.09	85½ lbs.
PO-15	1949	395.00	2-3/4	2.52	22.0	4000	2-1/2 Gal.	Champion R-7	29.92	115¾ lbs.
HD-25	1950	125.00	1-3/8	1-3/8	2.5	4000	4.88 Pints	Champion J-6-J	4.08	31 lbs.
TN-25, 26	1950	170.00	1-15/16	1-1/2	5.0	4000	7 Pints	Champion J-6-J	8.44	44 lbs.
QD-10, 11	1950	285.00	2-3/8	1-7/8	10.0	4000	5 Gal.	Champion J-6-J	16.60	56 lbs.
SD-20	1950	340.00	2-1/2	2-1/4	16.0	4000	5 Gal.	Champion 5M-J	22.09	85½ lbs.
PO-15	1950	395.00	2-3/4	2.52	22.0	4000	2-1/2 Gal.	Champion R7	29.92	115¾ lbs.
HD-26	1951	137.50	1-3/8	1-3/8	2.5	4000	4.88 Pints	Champion J-6-J	4.08	31 lbs.
TN-27	1951	187.50	1-15/16	1-1/2	5.0	4000	7 Pints	Champion J-6-J	8.44	44 lbs.
QD-12	1951	295.00	2-3/8	1-7/8	10.0	4000	5 Gal.	Champion J-6-J	16.60	58 lbs.
RD-10-11	1951	390.00	2-7/8	2-3/4	25.0	4000	5 Gal.	Champion J-6-J	35.70	95 lbs.
RD-12	1951	390.00	2-7/8	2-3/4	25.0	4000	6 Gal.	Champion J-6-J	35.70	95 lbs.
JW-10	1952	145.00	1-9/16	1-3/8	3.0	4000	5 Pints	Champion J-6-J	5.28	30 lbs.
TN-28	1952	187.50	1-15/16	1-1/2	5.0	4000	7 Pints	Champion J-6-J	8.44	44 lbs.
QD-13	1952	295.00	2-3/8	1-7/8	10.0	4000	6 Gal.	Champion J-6-J	16.60	58 lbs.
RD-13	1952	390.00	2-7/8	2-3/4	25.0	4000	6 Gal.	Champion J-6-J	35.70	95 lbs.
JW-10	1953	145.00	1-9/16	1-3/8	3	4000	4.88 Pints	Champion J6-J	5.28	32 lbs.
TN-28	1953	187.50	1-15/16	1-1/2	5	4000	7 Pints	Champion J6-J	8.44	44 lbs.
QD-14	1953	275.00	2-3/8	1-7/8	10	4000	6 Gal.	Champion J6-J	16.60	60 lbs.
QD-14A	1953	275.00	2-3/8	1-7/8	10	4000	6 Gal.	Champion J6-J	16.60	60 lbs.
RD-14	1953	390.00	2-7/8	2-3/4	25	4000	6 Gal.	Champion J6-J	35.70	98 lbs.
RD-15	1953	390.00	2-7/8	2-3/4	25	4000	6 Gal.	Champion J6-J	35.70	98 lbs.
JW-10	1954	145.00	1-9/16	1-3/8	3.0	4000	4.88 Pints	Champion J6-J	5.28	32 lbs.
CD-10-11	1954	210.00	1-15/16	1-1/2	5.5	4000	4 Gal.	Champion J6-J	8.84	47 lbs.
QD-15	1954	297.00	2-3/8	1-7/8	10.0	4000	6 Gal.	Champion J6-J	16.60	60 lbs.
RD-16, 16A	1954	410.00	2-7/8	2-3/4	25.0	4000	6 Gal.	Champion J6-J	35.70	99 lbs.
RDE-16, 16A	1954	498.00	2-7/8	2-3/4	25.0	4000	6 Gal.	Champion J6-J	35.70	111 lbs.
JW-11	1955	147.25	1-9/16	1-3/8	3.0	4000	4.88 Pints	Champion J6-J	5.28	32 lbs.
CD-12	1955	213.00	1-15/16	1-1/2	5.5	4000	4 Gal.	Champion J6-J	8.84	47 lbs.
QD-16	1955	314.50	2-3/8	1-7/8	10.0	4000	6 Gal.	Champion J6-J	16.60	67½ lbs.
RD-17	1955	436.00	2-7/8	2-3/4	25.0	4000	6 Gal.	Champion J6-J	35.70	110 lbs.
RDE-17	1955	531.00	2-7/8	2-3/4	25.0	4000	6 Gal.	Champion J6-J	35.70	125 lbs.
JW-12	1956	146.00	1-9/16	1-3/8	3.0	4000	4.88 Pints	Champion J6-J	5.28	32 lbs.
CD-13	1956	216.00	1-15/16	1-1/2	5.5	4000	4-1/4 Gal.	Champion J6-J	8.84	51 lbs.
AD-10	1956	241.00	2-1/8	1-3/4	7.5	4000	4-1/4 Gal.	Champion J6-J	12.40	56 lbs.
QD-17	1956	321.00	2-3/8	1-7/8	10.0	4000	6 Gal.	Champion J6-J	16.60	70½ lbs.
FD-10	1956	362.00	2-3/8	2-1/4	15.0	4000	6 Gal.	Champion J6-J	19.94	75 lbs.
FDE-10	1956	452.00	2-3/8	2-1/4	15.0	4000	6 Gal.	Champion J6-J	19.94	88½ lbs.
RD-18	1956	462.00	2-7/8	2-3/4	30.0	4000	6 Gal.	Champion J6-J	35.70	112 lbs.
RDE-18	1956	552.00	2-7/8	2-3/4	30.0	4000	6 Gal.	Champion J6-J	35.70	126 lbs.
RJE-18	1956	582.00	2-7/8	2-3/4	30.0	4000	6 Gal.	Champion J6-J	35.70	128 lbs.
JW-13	1957	155.00	1-9/16	1-3/8	3.0	4000	4.88 Pints	*	5.28	33¼ lbs.
CD-14	1957	230.00	1-15/16	1-1/2	5.5	4000	4-1/4 Gal.	*	8.84	56 lbs.
AD-11	1957	260.00	2-1/8	1-3/4	7.5	4000	4-1/4 Gal.	*	12.4	59 lbs.
QD-18	1957	340.00	2-3/8	1-7/8	10.0	4000	6 Gal.	*	16.6	72½ lbs.
FD-11	1957	395.00	2-1/2	2-1/4	18.0	4500	6 Gal.	*	22.0	79 lbs.
FDE-11	1957	475.00	2-1/2	2-1/4	18.0	4500	6 Gal.	*	22.0	88½ lbs.
RD-19	1957	495.00	3-1/16	2-3/4	35.0	4500	6 Gal.	*	40.5	123 lbs.
RDE-19	1957	585.00	3-1/16	2-3/4	35.0	4500	6 Gal.	*	40.5	134 lbs.
RJE-19	1957	625.00	3-1/16	2-3/4	35.0	4500	6 Gal.	*	40.5	136 lbs.
JW-14	1958	160.00	1-9/16	1-3/8	3.0	4000	4.88 Pints	*	5.28	33¼ lbs.
CD-15	1958	230.00	1-15/16	1-1/2	5.5	4000	4-1/4 Gal.	*	8.84	56 lbs.
AD-12	1958	270.00	2-1/8	1-3/4	7.5	4000	4-1/4 Gal.	*	12.4	59 lbs.
QD-19	1958	310.00	2-3/8	1-7/8	10.0	4000	6 Gal.	*	16.6	67 lbs.
FD-12	1958	395.00	2-1/2	2-1/4	18.0	4500	6 Gal.	*	22.0	77 lbs.
FDE-12	1958	475.00	2-1/2	2-1/4	18.0	4500	6 Gal.	*	22.0	87 lbs.
RD-19C	1958	495.00	3-1/16	2-3/4	35.0	4500	6 Gal.	*	40.5	123 lbs.
RDE-19C	1958	585.00	3-1/16	2-3/4	35.0	4500	6 Gal.	*	40.5	129 lbs.
RDS-20	1958	625.00	3-1/16	2-3/4	35.0	4500	6 Gal.	*	40.5	138 lbs.
V4-10	1958	740.00	3	2-1/2	50.0	4000	6 Gal.	*	70.7	197 lbs.
V4S-10	1958	840.00	3	2-1/2	50.0	4000	6 Gal.	*	70.7	205 lbs.

*Champion J-4J, Auto-Lite A21X, AC M-42K

Model	Year	Original List Price	Bore"	Stroke"	H.P.	R.P.M.	Gas Tank Capacity	Spark Plug No.	Piston Dspl. Cu. In.	Weight
JW-15	1959	160.00	1-9/16	1-3/8	3	4000	4.88 Pints	*	5.28	33¼ lbs.
CD-16	1959	230.00	1-15/16	1-1/2	5.5	4000	4-1/4 Gal.	*	8.84	56 lbs.
QD-20	1959	310.00	2-3/8	1-7/8	10	4000	6 Gal.	*	16.6	67 lbs.
FD-13	1959	395.00	2-1/2	2-1/4	18	4500	6 Gal.	*	22	77 lbs.
RD-21	1959	495.00	3-1/16	2-3/4	35	4500	6 Gal.	*	40.5	123 lbs.
RDS-21	1959	625.00	3-1/16	2-3/4	35	4500	6 Gal.	*	40.5	138 lbs.
V4-11	1959	740.00	3	2-1/2	50	4000	6 Gal.	*	70.7	197 lbs.
V4S-11	1959	840.00	3	2-1/2	50	4000	6 Gal.	*	70.7	205 lbs.
JW-16	1960	160.00	1-9/16	1-3/8	3	4000	4.88 Pints	*	5.28	33¼ lbs.
CD-17	1960	235.00	1-15/16	1-1/2	5.5	4000	6 Gal.	*	8.84	55½ lbs.
QD-21	1960	325.00	2-3/8	1-7/8	10	4500	6 Gal.	*	16.6	67 lbs.
FD-14	1960	395.00	2-1/2	2-1/4	18	4500	6 Gal.	*	22	77 lbs.
RD-22	1960	525.00	3-3/16	2-3/4	40	4500	6 Gal.	*	43.9	127 lbs.
RDS-22	1960	640.00	3-3/16	2-3/4	40	4500	6 Gal.	*	43.9	139 lbs.
V4S-12	1960	895.00	3-3/8	2-1/2	75	4500	6 Gal.	*	89.5	216 lbs.
JW-17	1961	160.00	1-9/16	1-3/8	3	4000	4.88 Pints	*	5.28	33¼ lbs.
CD-18	1961	235.00	1-15/16	1-1/2	5.5	4000	6 Gal.	*	8.84	57 lbs.
QD-22	1961	330.00	2-3/8	1-7/8	10	4500	6 Gal.	*	16.6	70 lbs.
FD-15	1961	395.00	2-1/2	2-1/4	18	4500	6 Gal.	*	22	79 lbs.
RD-23	1961	530.00	3-3/16	2-3/4	40	4500	6 Gal.	*	43.9	132 lbs.
RDS-23	1961	645.00	3-3/16	2-3/4	40	4500	6 Gal.	*	43.9	146 lbs.
V4S-13	1961	895.00	3-3/8	2-1/2	75	4500	6 Gal.	*	89.5	224 lbs.
V4A-13	1961	960.00	3-3/8	2-1/2	75	4500	6 Gal.	*	89.5	244 lbs.
JW-17R	1962	165.00	1-9/16	1-3/8	3	4000	4.88 Pints	*	5.28	33¼ lbs.
CD-19	1962	250.00	1-15/16	1-1/2	5.5	4000	6 Gal.	*	8.84	55½ lbs.
QD-23	1962	345.00	2-3/8	1-7/8	10	4500	6 Gal.	*	16.6	67 lbs.
FD-16	1962	425.00	2-1/2	2-1/4	18	4500	6 Gal.	*	22	77 lbs.
RX-10C	1962	495.00	2-7/8	2-3/4	28	4500	6 Gal.	*	35.7	127 lbs.
RD-24	1962	560.00	3-3/16	2-3/4	40	4500	6 Gal.	*	43.9	131 lbs.
RDS-24	1962	665.00	3-3/16	2-3/4	40	4500	6 Gal.	*	43.9	143 lbs.
RK-24	1962	795.00	3-3/16	2-3/4	40	4500	6 Gal.	*	43.9	150 lbs.
V4S-14	1962	925.00	3-3/8	2-1/2	75	4500	6 Gal.	*	89.5	220 lbs.
V4A-14	1962	1065.00	3-3/8	2-1/2	75	4500	6 Gal.	*	89.5	240 lbs.
JW-18	1963	165.00	1-9/16	1-3/8	3	4000	4.88 Pints	*	5.28	34 lbs.
CD-20	1963	250.00	1-15/16	1-1/2	5.5	4000	6 Gal.	*	8.84	56 lbs.
QD-24	1963	345.00	2-3/8	1-7/8	10	4500	6 Gal.	*	16.6	69 lbs.
FD-17	1963	385.00	2-1/2	2-1/4	18	4500	6 Gal.	*	22	79 lbs.
RX-11	1963	465.00	2-7/8	2-3/4	28	4500	6 Gal.	*	35.7	127 lbs.
RD-25	1963	570.00	3-3/16	2-3/4	40	4500	6 Gal.	*	43.9	131 lbs.
RDS-25	1963	665.00	3-3/16	2-3/4	40	4500	6 Gal.	*	43.9	147 lbs.
RK-25	1963	775.00	3-3/16	2-3/4	40	4500	6 Gal.	*	43.9	162 lbs.
V4S-15	1963	925.00	3-3/8	2-1/2	75	4500	6 Gal.	*	89.5	222 lbs.
V4A-15	1963	1065.00	3-3/8	2-1/2	75	4500	6 Gal.	*	89.5	239 lbs.
JW-19	1964	175.00	1-9/16	1-3/8	3	4000	4.88 Pints	*	5.28	34 lbs.
JH-19	1964	175.00	1-9/16	1-3/8	3	4000	4.88 Pints	*	5.28	34 lbs.
CD-21	1964	265.00	1-15/16	1-1/2	5.5	4000	6 Gal.	*	8.84	57 lbs.
MQ-10	1964	355.00	2-5/16	1-13/16	9.5	4500	6 Gal.	*	15.2	59 lbs.
FD-18	1964	395.00	2-1/2	2-1/4	18	4500	6 Gal.	*	22	78½ lbs.
RX-12	1964	465.00	2-7/8	2-3/4	28	4500	6 Gal.	*	35.7	127 lbs.
RD-26	1964	575.00	3-3/16	2-3/4	40	4500	6 Gal.	*	43.9	137 lbs.
RDS-26	1964	665.00	3-3/16	2-3/4	40	4500	6 Gal.	*	43.9	150½ lbs.
RK-26	1964	775.00	3-3/16	2-3/4	40	4500	6 Gal.	*	43.9	163½ lbs.
VX-10	1964	850.00	3	2-1/2	60	4500	6 Gal.	*	70.7	225 lbs.
V4S-16	1964	935.00	3-3/8	2-1/2	75	4500	6 Gal.	*	89.5	226½ lbs.
V4A-16	1964	1065.00	3-3/8	2-1/2	75	4500	6 Gal.	*	89.5	240½ lbs.
V4M-10	1964	1175.00	3-3/8	2-1/2	90	4500	6 Gal.	*	89.5	242 lbs.

Johnson SERVICE MANUAL

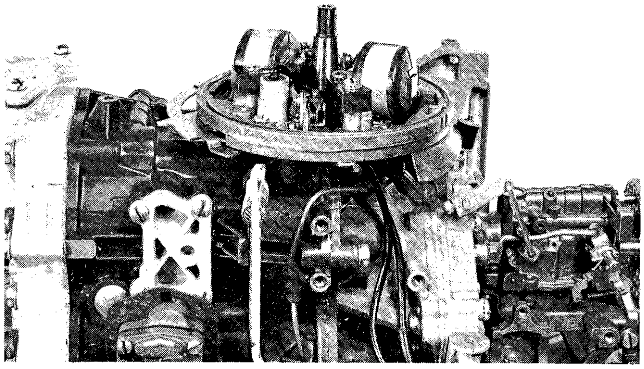
MAGNETO

INDEX — FOLLOWING PAGE

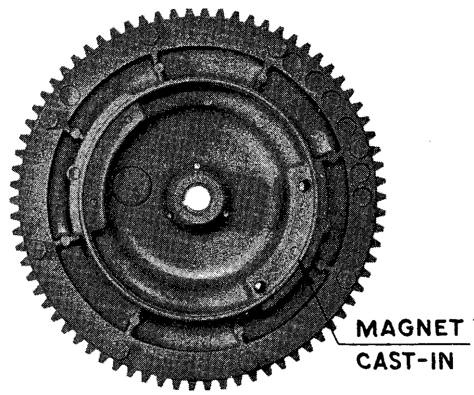
MAGNETO INDEX

SERVICING INFORMATION – DIAGNOSING AND REPAIR

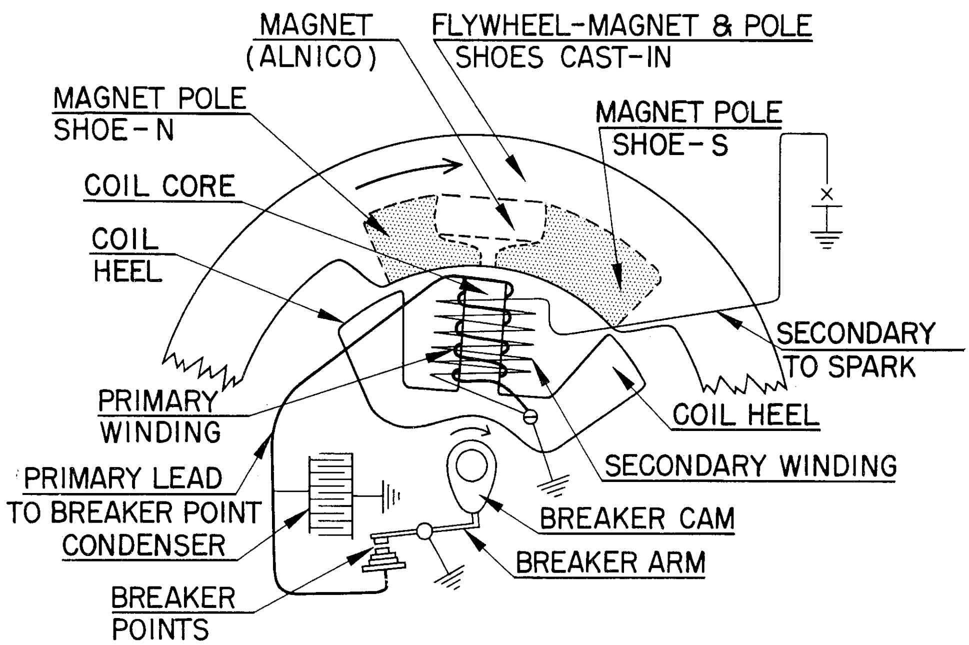
THE MAGNETO



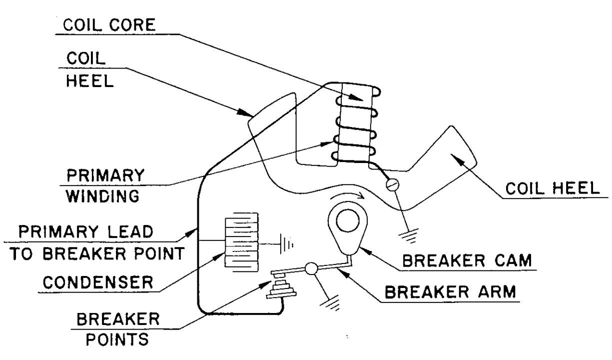
The Armature Plate Installation.



The Flywheel.



Schematic Drawing of the Magneto Layout – Showing Flywheel Magnet Installation.



The Primary Circuit.

THE MAGNETO –

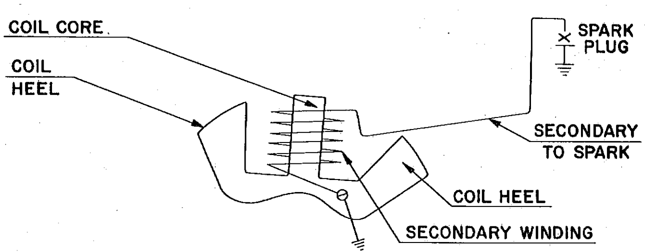
No attempt will be made here to go too deeply into the electronics of the Magneto Assembly as employed in the assembly of Johnson Outboard Motors, except to state that it is a self-contained ignition unit – requiring no assistance from outside sources such as dry cells or a storage battery to generate the strong spark so necessary for ease of starting and efficient sparking performance throughout the entire speed range of the engine. For a more complete understanding, consult your local library on books relating to basic electronics.

As such, it consists chiefly of an armature plate or base, upon which are mounted two ignition coil and core/heel assemblies, two condensers and two sets of primary breaker points — a permanent magnet cast into the rim of the engine flywheel and a cam (eccentric) properly assembled to the upper crankshaft journal or a "flat" milled into the journal, to activate the breaker points in either event.

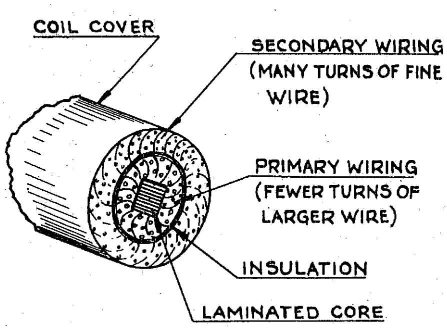
With the exception of a common flywheel and breaker cam, it will be noted that two separate systems are involved — one for each of the two cylinders and, from the diagrams, readily seen that each comprise two wiring circuits, namely,

1. The primary circuit which consists of —
   - A. Several hundred turns of fairly heavy wire (copper-insulated) around a laminated steel core of special alloy for the purpose — extended and shaped to form the poles or more frequently referred to as the coil heels.
   - B. A set of breaker points — one, insulated and attached to the primary by means of an insulated copper wire lead. The other point not being insulated is thus connected through to the armature base to the ground terminal of the primary winding to complete the primary circuit.

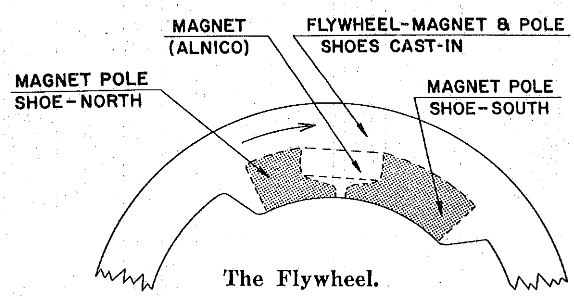
     Since the purpose of the breaker point assembly is to make and break the primary circuit, the insulated point is obviously made stationary, while the other (not insulated), which actually makes and breaks the circuit, is riveted to a rocking arm and actuated by the revolving breaker cam.
   - C. A condenser with one side (lead) insulated and wired to the stationary insulated breaker point — the other attached to the armature base (ground) to shunt the assembly across the breaker points. See diagram schematic.
2. The secondary circuit consists simply of —
   - A. Several thousand turns — fine gage insulated copper wire wound into a coil and placed in position in primary winding — each insulated from the other. One end of the secondary winding leads to ground (coil/heel assembly to armature base); the other end is attached to a heavily insulated stranded wire and which leads to the spark plug terminal to complete the circuit after arcing the point gap.



The Secondary Circuit.



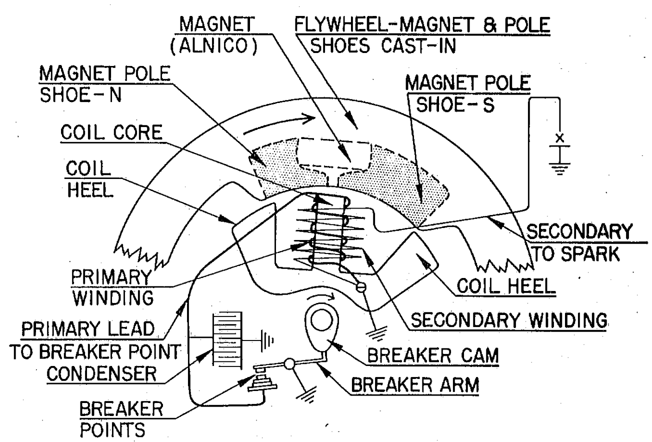
Cross Sectional View of Conventional Ignition Coil



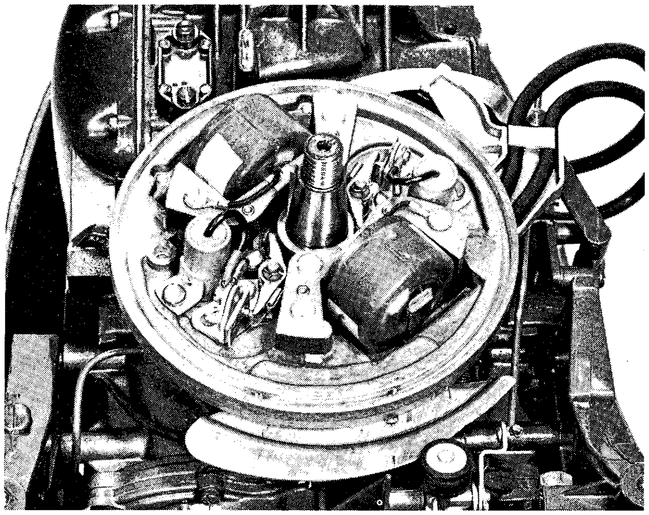
The Flywheel.

Its operation basically should not be too difficult to understand. As the magnet pole pieces, cast into the revolving flywheel, pass over the area of the coil poles (heels) a current is characteristically caused to flow in the primary winding circuit, followed subsequently by a magnetic field build up about the coil.

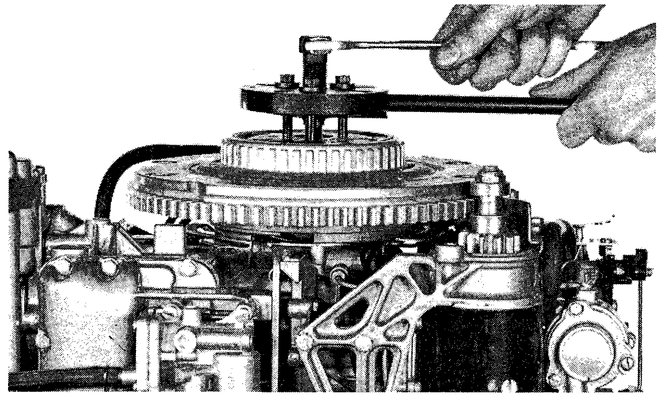
At the appropriate time, predetermined in design, the breaker points of one set at a time are separated by action of the revolving cam — thus, breaking the primary circuit. The primary current then suddenly ceases to flow and since the magnetic field now established about the coil is for the moment no longer supported by the primary current flow it collapses instantly. During the period of instant field collapse, a current of exceptionally high voltage intensity is induced in the many fine wire turns of the secondary winding which is conducted through an ignition lead to the spark plug where it arcs the gap between the points to ignite or fire the compressed fuel vapor in the combustion chamber above the piston and do develop the power impulse.



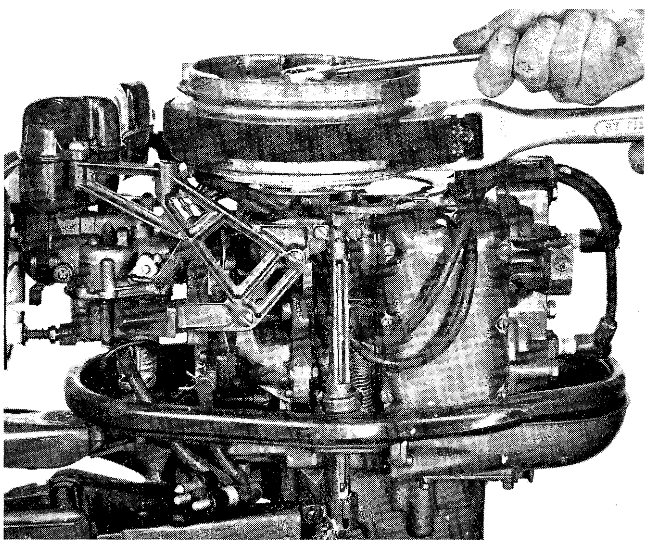
Magneto Schematic — a Composite of (1) the Primary Circuit, (2) the Secondary Circuit, and (3) the Flywheel.



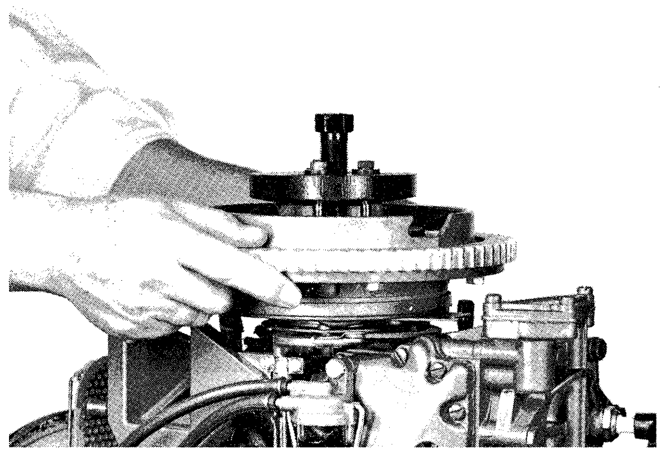
Armature Plate Assembly Installed.



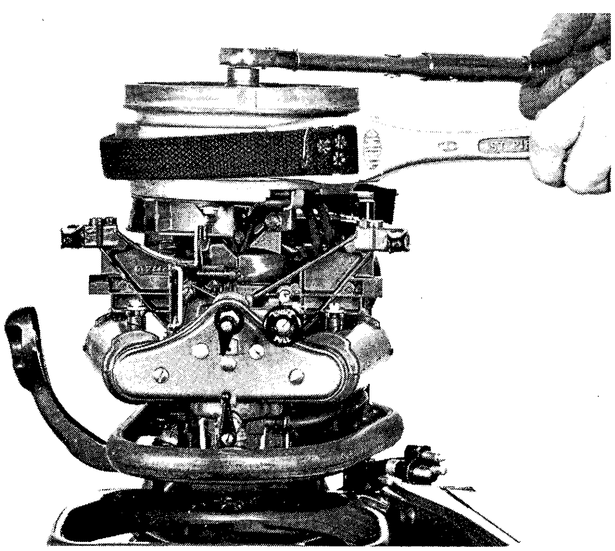
Removing the Flywheel with Puller No. 378103.



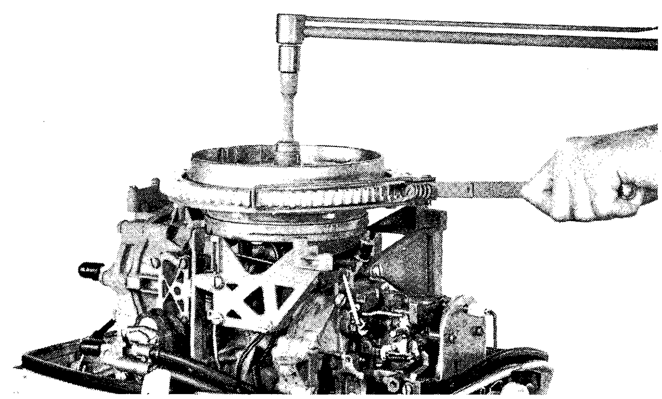
Removing Flywheel Nut with Strap Wrench.



Remove Flywheel Nut and Three Flywheel Screws. Using Flywheel Puller (Special Tool #378103), Pull Flywheel From Crankshaft.

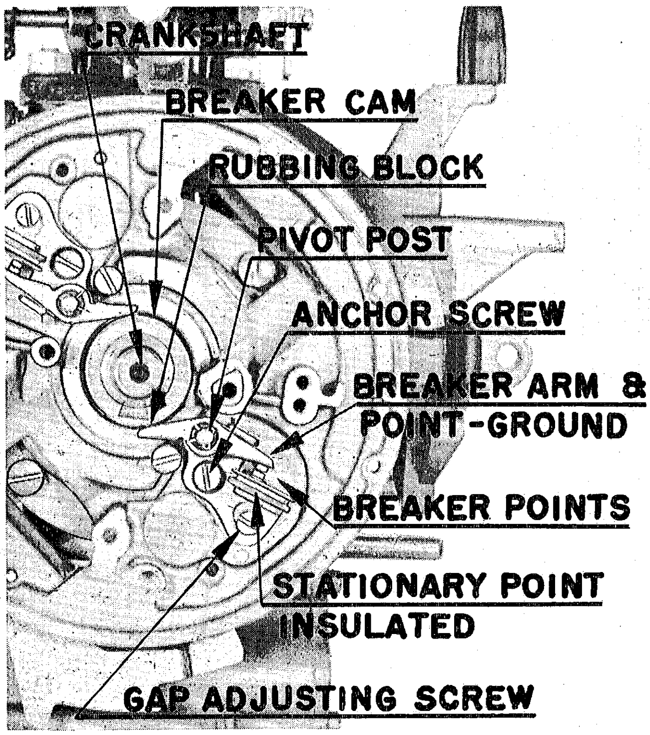


Torquing Flywheel Nut with Torque Wrench and Strap Wrench.



Torquing Flywheel Nut – See Torque Chart, Page 362

MAGNETO – BREAKER POINTS AND CONDENSER



Since efficiency and intensity of spark is dependent to some considerable extent on condition of the breaker point contact surfaces and gap setting, faulty or irregular operation of the motor may often be laid to a deficiency in breaker action. Contact surfaces must be clean, free of pitting and/or corrosion, in alignment and adjusted to the specified .020" gap with the breaker arm rocking freely on its pivot post to realize the maximum in breaker point performance.

Other factors, of course, enter into the picture of a badly acting magneto, such as a faulty coil, condenser, spark plugs, wiring and particularly "loose" or corroded electrical connections but for the moment consider the breaker point assemblies.

Pitting, discoloration (oxidation) and misadjustment of the gap appear with normal operation of the motor in time and oxidation during periods of inactivity while in storage, etc., to affect starting. Excessive pitting is frequently associated with a faulty condenser, loose or corroded terminal leads at point of attachment, faulty wiring, etc. Abnormal recurrence of breaker gap misadjustment may be attributed to a "rough" or cracked breaker cam surface causing rapid wear of the rubbing block (riveted to the breaker arm) with resultant lessening of the gap to throw spark timing off—that is with relation to "time" of maximum voltage intensity reached in the secondary winding of the coil to cause weak sparking. It is of extreme importance to constantly maintain the specified .020" gap setting. Install new breaker cam and breaker arm in this event, should condition of the rubbing block reveal too much wear.

Waste no time when there is evidence of excessive pitting—it's economical and more practical to install new point assemblies rather than attempt reconditioning unless in an emergency—an ordinary point dresser will do as a temporary measure of expediency in this event but, when the magneto is available for shop repair, it is advisable to remove the flywheel for a better and more thorough job of service which at the same time provides an excellent opportunity for inspection of other details in the assembly. Tungsten point faces have been employed; however, in recent years, platinum point faces have been used exclusively.

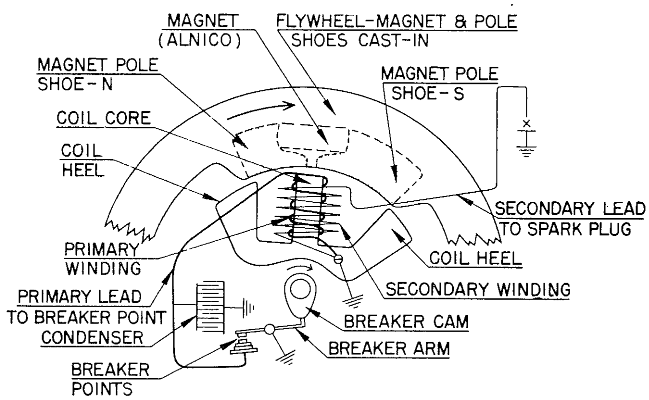
Make certain the breaker cam surface is smooth—roughness acts to wear excessively on the breaker arm rubbing block to rapidly alter gap setting. Cracks in the cam face contribute to like results.

Set breaker points as instructed to .020" gap full open—breaker arm rubbing block "riding" on high side of cam. This is **IMPORTANT** to obtain desired results. After having installed and adjusted new points, run the motor for several minutes (in tank), then recheck gap setting—slight roughness on face of rubbing blocks, perhaps minute burrs, etc., wears down quickly to cause decrease in gap setting until the rubbing surface eventually "smoothens" up. Re-set gap if necessary.

Breaker points and their direct relation to spark efficiency

Fundamentally, the performance of an electric ignition (sparking) system is dependent on current intensity, induced or "built up" first in the primary and subsequently in the secondary windings of the coil during normal functioning of the magneto assembly — revolving flywheel magnet and pole shoe assembly passing by corresponding but stationary pole pieces of the coil to induce primary current and resulting magnetic field.

Due to nature of the magneto's construction and its principle of operation, current generated to cause "sparking" is not maintained at constant level but fluctuates between "points" of high and low voltage. It is readily understood, therefore, that current for maximum "sparking" strength must be "picked up" at the peak of current intensity. The breaker points simply function then as a "trigger" to fire the spark.



Schematic drawing of the magneto layout—showing flywheel magnet installation.

Greater voltage (pressure) is required to overcome the resistance presented by a 1/4″ spark gap under normal atmospheric conditions than a gap of but 1/8″ or, a .030″ gap over one of .010″ under compression (compressed atmosphere) as existing in the combustion chamber at the time of ignition. This fact is responsible for a weak spark firing "outside the cylinder" but failing under compression within the cylinder (combustion chamber).

Actually what takes place in the magneto is that with separating or opening of the breaker points, the primary circuit is broken to interrupt flow of current through the primary winding. The attendant magnetic field set up about the coil assembly at this time suddenly collapses to start a current flow of high voltage through the "fine" windings of the secondary coil (induction), which, when conducted to the spark plug terminal, fires across the gap to ignite the compressed fuel charge. Inasmuch as sparking occurs at the instant of breaker point (contact) separation, to gain utmost efficiency of the coil for greatest sparking strength, the magneto points are "timed" to open or "break" at the precise "time" of reaching peak range or maximum current flow through the primary winding. Timing in this respect is predetermined in design but maintained in service by adjusting the breaker gap to .020″ full open for best average setting. Basically, gap setting of greater than the specified .020″ results in proportionately "earlier" breaking or spark occurring on the build-up of current intensity in the primary circuit (prior to reaching its peak) thus, "weaker" sparking; while a gap setting of less than .020″ causes proportionately "later" breaking or spark taking place on the falling side of current intensity (**after** passing its peak)—similarly, "weaker" sparking.

Minor variations in magneto characteristics normally exist during the process of overall production, which occasionally accounts for an individual motor starting more readily with the breaker point gap adjusted to slightly above or below the specified .020″. In this instance there is evidence of variation or tolerance affecting "time" at which current intensity in the primary circuit reaches its maximum.

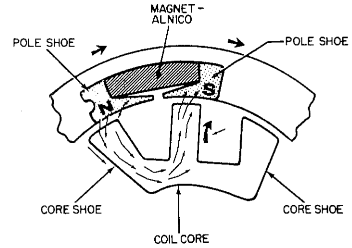


Figure A

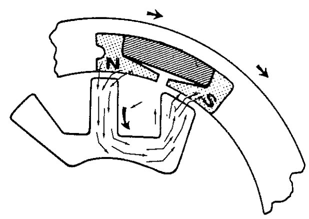


Figure B

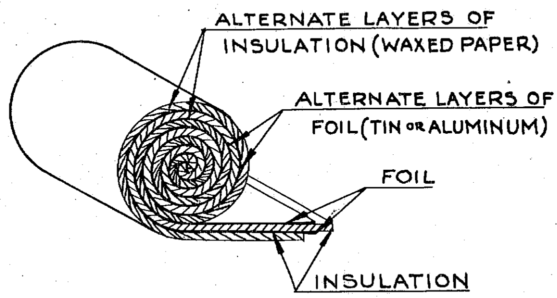
Illustrating principle of reverse flux. Note position of magnet pole shoes of the revolving magnet Figure A above, and that when in this position, the magnetic lines of force flow from N (north) through the core shoe and UP through the coil core and to S (south) to complete the magnetic circuit. Figure B – since the magnet has advanced to the position shown, the magnetic lines now flow DOWN through the coil core and on through to S. It may be easily seen that the path or direction magnetic line flow through coil has suddenly reversed itself during the interim – the point of greatest flux activity when secondary voltage intensity reaches its maximum.

Beyond adjusting the breaker point gap setting, however, other conditions enter to affect "sparking" efficiency merely as result of normal operation—like "pitting," corrosion or erosion of the breaker point faces. Breaker points "wear out" in time because of constant "pounding" received during ordinary performance. Pitting and erosion, the result of arcing across the points when in normal operation or exaggerated because of deficiencies in the condenser or primary wiring system contribute to faulty spark. The corrosive effect of "salt air" is kindred to breaker point deterioration and performance. Circulating oil vapor within the magneto assembly is similarly conducive to breaker point deterioration and eventual failure.

Breaker point faces ordinarily are finished off extremely smooth but with a slight curvature (contour) to insure good contact and a minimum of arcing when in action—a clean "break" (with just enough arc to assure clean contact surfaces).

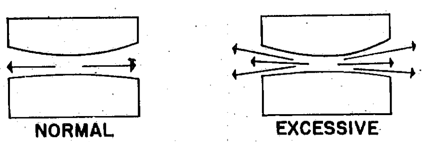
The Condenser—since it is characteristic of the primary current continuing to flow (as result of primary induction) by "jumping" or bridging across the gap created on instant of point breaking some steps must be taken to minimize this tendency towards "arcing" if maximum sparking intensity is to be expected at the spark plug gap — thus, a condenser shunting the breaker point gap.

In construction—the condenser consists of alternate layers of a metal foil (tin or aluminum) and waxed paper of proper area specified in design for the particular ignition unit—"rolled" up for compactness. Each layer of foil is then insulated from the other with one side (layer) attached to the insulated (stationary) breaker point by means of a copper wire lead and the other attached to ground.



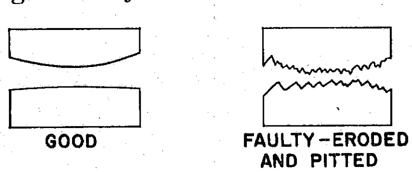
Schematic Diagram of Condenser

In operation — fundamentally, function of the condenser is twofold: (1)—to momentarily absorb or "store" induced primary current which otherwise would proceed to "bridge" the gap on instant of point opening and in this respect, avoid contact "arcing"; (2)—when loaded to capacity, the "charge" is suddenly expelled to start a current flowing in the opposite direction, which gives added impetus to the collapsing magnetic field (about the coil at this time) as it affects sparking efficiency at the plug. By this time, however, the breaker gap has been increased or opened (by cam action) beyond ability of current flow to overcome resistance introduced by the wider gap—thereby, avoiding the establishment of an arc or bridge. Surging currents created by action of the condenser in this manner, continue as long as the breaker points remain open but progressively diminish as the induced current characteristically dissipates itself.



Schematic drawings to illustrate normal and excessive breaker point "arcing."

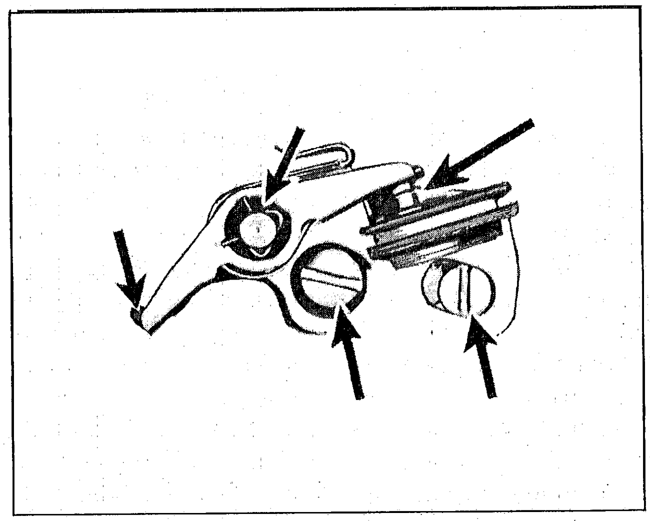
Any interference with condenser capacity, such as "seepage" or short circuiting between the insulated layers of foil, loose or faulty terminal connectors, etc., affects efficiency and as a consequence, results in weak or faulty sparking at the plug. Minor seepage between the foil plates causes a proportionate increase of arcing across the breaker point gap—identified by "flashing." A complete or full "short circuit" across the condenser plates, renders ineffective action of the breaker points—a "dead" ignition system.



Schematic drawings to illustrate good and faulty breaker point faces.

Erosion or pitting of the breaker point faces follows in line with "arcing" to cause faulty spark. Observed "flash" of the arc actually consists of incandescent particles of material vaporized or eroded from the face of the points. This frequently causes a cavity to form on one face and a corresponding pinnacle or dome to build up on the other as result of material transfer during the process from the face of one point to the other.

Maximum sparking intensity at the plug depending on rate or "suddenness" with which the

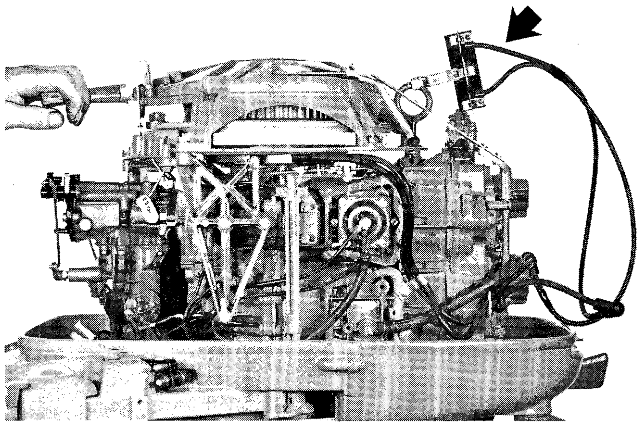


Details of the Breaker Assembly to check when suspecting faulty breaker action.

magnetic field (set up about the coil) collapses, demands a "clean" break between the points on instant of separation—absence of excessive arcing. (A minimum or slight amount of arcing is desired to maintain clean active contact area, otherwise oxidized or faulty contact faces retard the "build up" of primary current in the coil to proportionably affect sparking strength.) The introduction of incandescent metal particles to partially bridge the gap because of arcing, causes retarded or gradual interruption of primary current flow and corresponding delay or "laziness" of magnetic field collapse to eventually induce a weak or faulty spark. It can easily be seen then that maximum sparking intensity depends on a condenser in good condition and a "clean" break of contact faces at time of primary current interruption—(breaker action) and of considerable import, clean and "solid" primary terminal connections.

Oil and other foreign material accumulating on faces of the breaker points contribute to arcing as do "rough" contact faces which similarly affect sparking efficiency. Redressing of the contact faces should be performed only as a temporary measure unless special equipment for "reconditioning" is available. Make no attempt to "redress" contacts of platinum in the ordinary manner.

DIAGNOSIS – MAGNETO



Proper diagnosis of magneto (spark) difficulty is most important when attempting to correct faulty spark, but it is not too mysterious if it is remembered that (for practical purposes) electricity flows much the same as water—high pressures (voltage) seeking the level of low pressure and moving in a circuit. Water flows through a pipe—electricity flows or is conducted generally through a copper wire. Thus, a broken water pipe is comparable to a broken wire in that water stops flowing in a prescribed circuit and similarly electricity stops flowing if the wire is broken or the circuit otherwise interrupted. In like manner, a water system does not function as it should if the conductors (pipes) leak nor does an electrical system properly function if the conductors leak (faulty insulation).

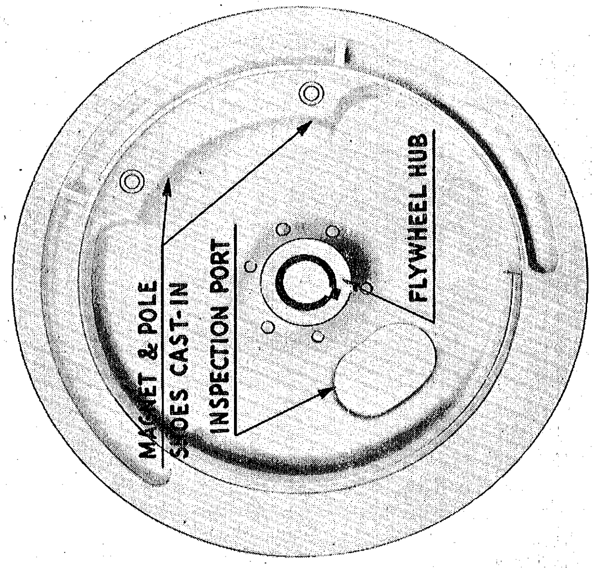
Naturally, any discrepancy in the ignition system makes its presence known by a faulty spark at the plug to result in non-starting, hard starting, misfiring or otherwise irregular operation of the motor. The object is, therefore, to locate the source of difficulty and to arrange for corrective measures.

Proceed with diagnosis carefully and in an orderly manner—start with the spark plug since it is most readily accessible and continue throughout the entire ignition system until the source of difficulty is brought to light.

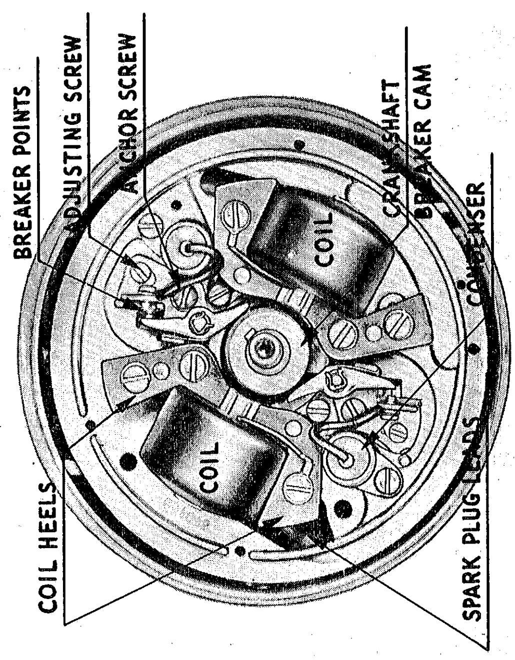
1. Spark plug
   - (a) Loose connections
   - (b) Fouled
   - (c) Wrong type for model motor
   - (d) Residue on porcelain—salt water areas
2. Spark plug leads
   - (a) Loose
   - (b) Faulty insulation—shorting to motor
3. Wiring on armature plate
   - (a) Loose or broken connections
   - (b) Corroded connections, particularly in salt water areas
   - (c) Faulty insulation to cause short circuits
   - (d) Faulty connections in ground or cutout switch
4. Breaker points
   - (a) Improperly adjusted
   - (b) Pitted or corroded
   - (c) Breaker arm binding on pivot post or breaker push rod binding in bracket
5. Condenser
   - (a) Loose connections
   - (b) Faulty
6. Coil heels
   - (a) Improperly adjusted with relation to magnet pole shoes
   - (b) Rubbing on magnet pole shoes
7. Coil
   - (a) Loose connections
   - (b) Faulty

NOTES

UNIVERSAL MAGNETO

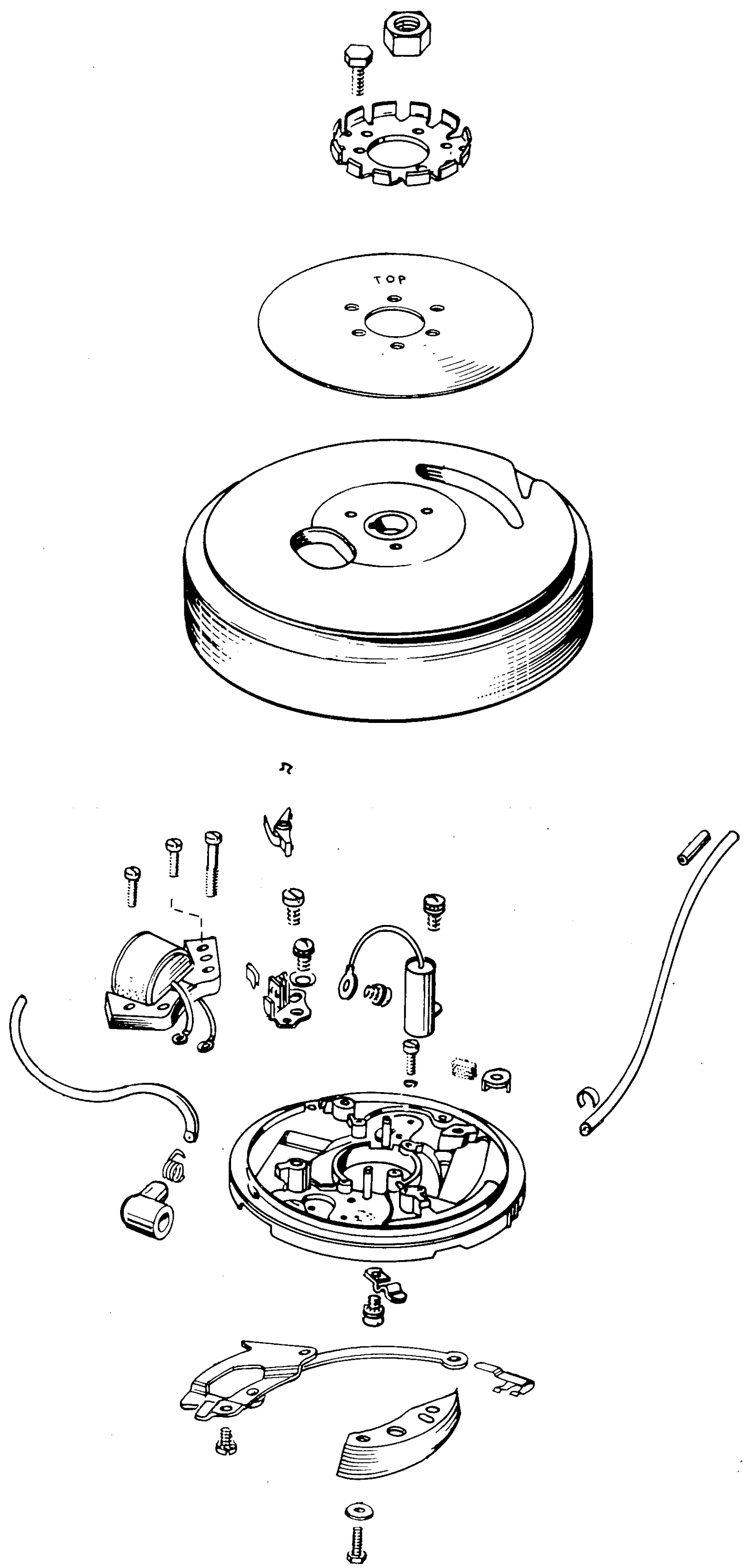


Flywheel

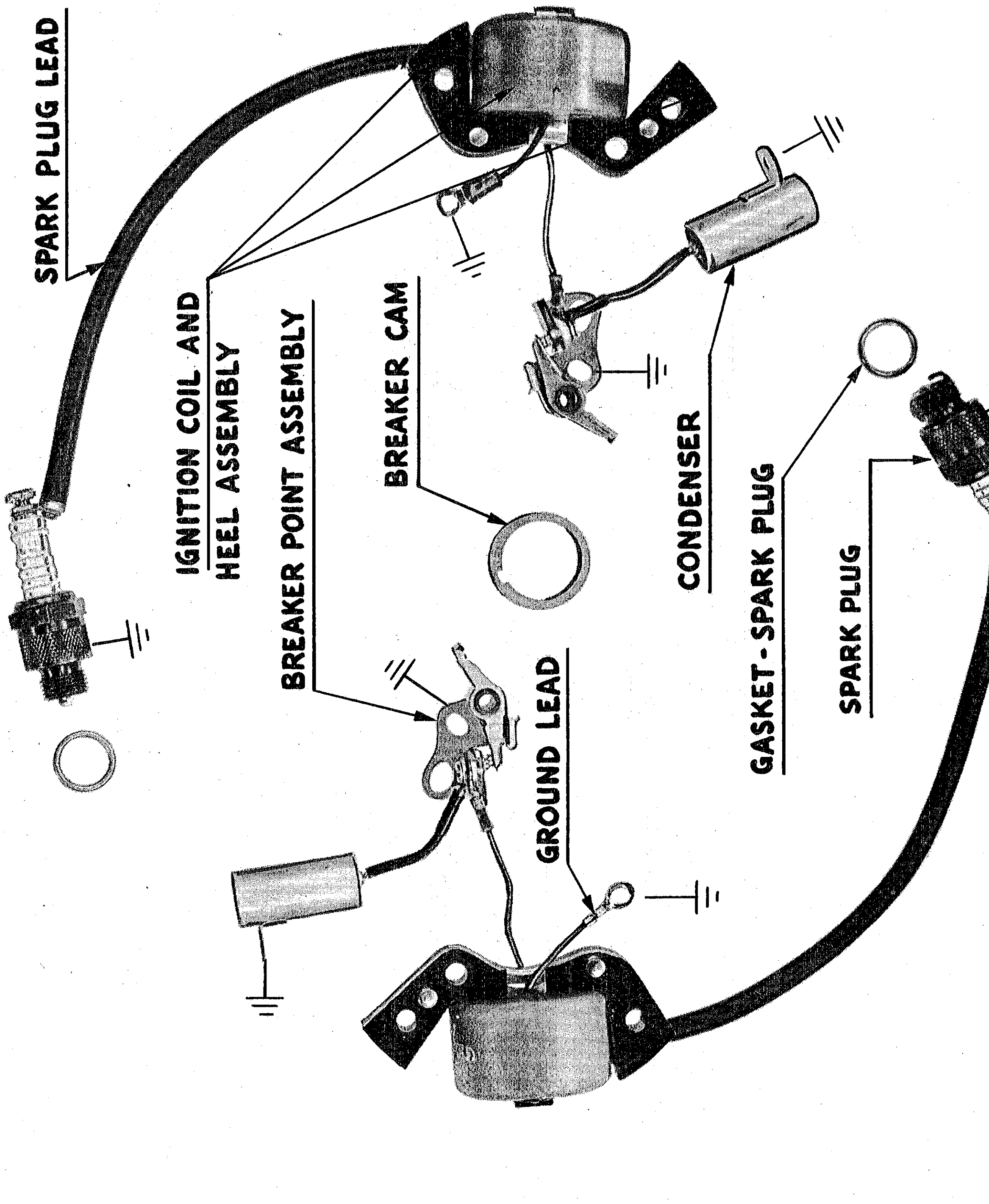


Armature Plate

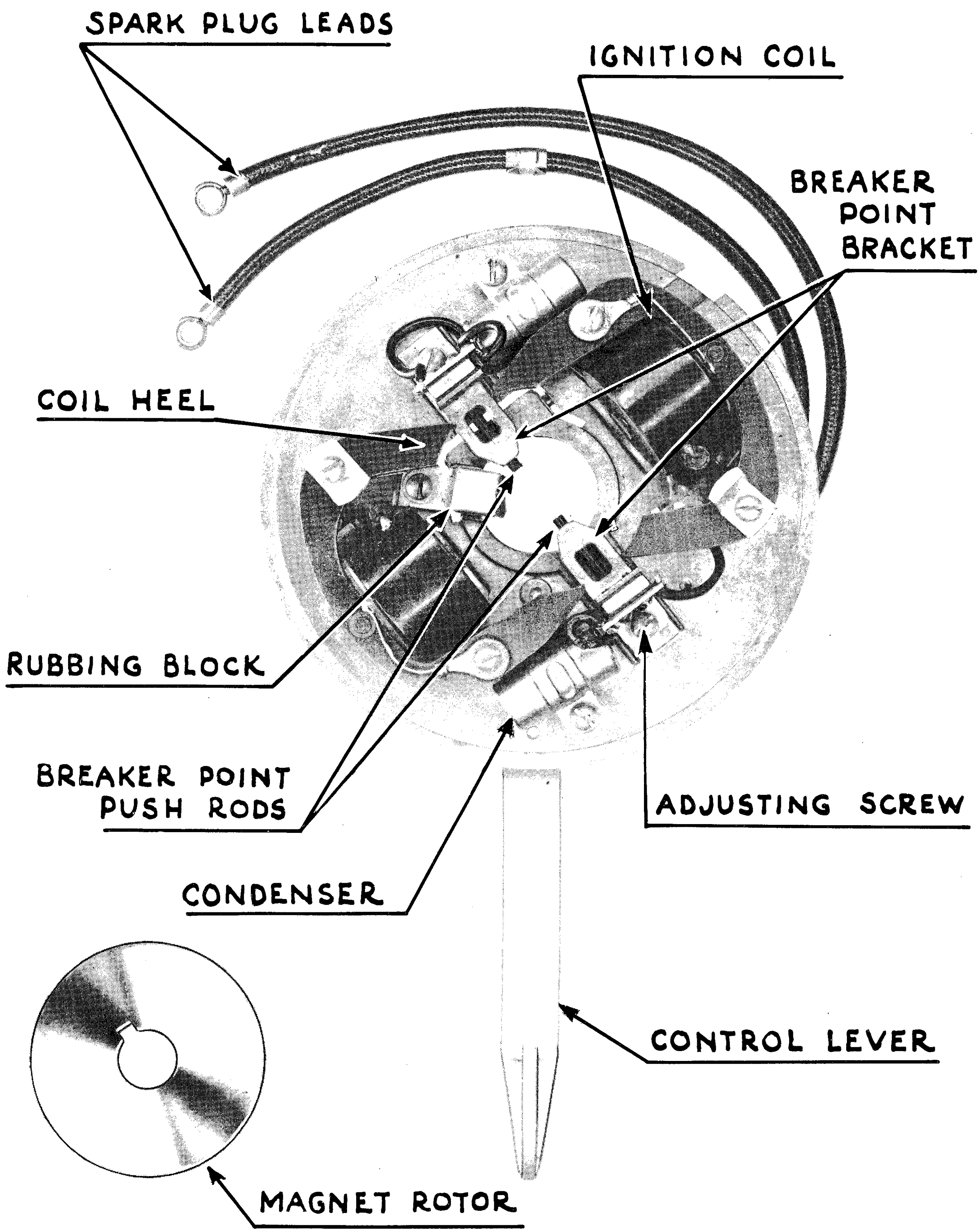
Models JW, TN-27/28, CD, AD, QD-12 up, FD, RD, RDE, RK, RX.



UNIVERSAL MAGNETO



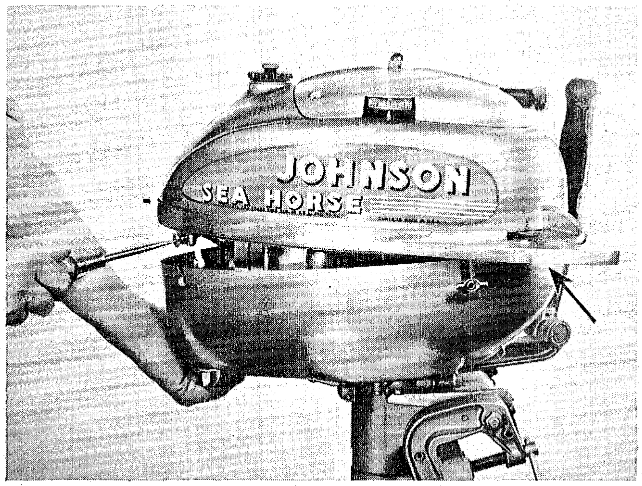
Functional Parts Removed from Armature Plate to Show Wiring System—Actually, a Complete Ignition System for Each Cylinder.



HS, HD-25 TS, TD-20 MAGNETO

MAGNETO—MODELS H & T—15, 20 & HD-25 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.

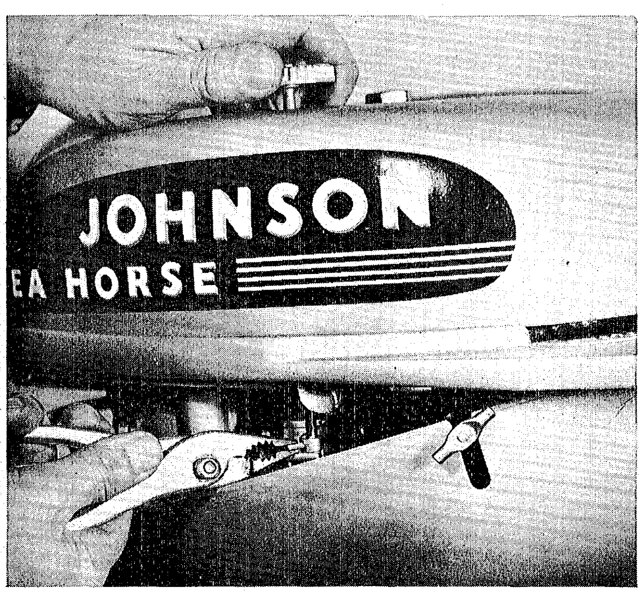


Dropping Spark Plug Cover

TO REMOVE FLYWHEEL WHEN DISASSEMBLING MOTOR

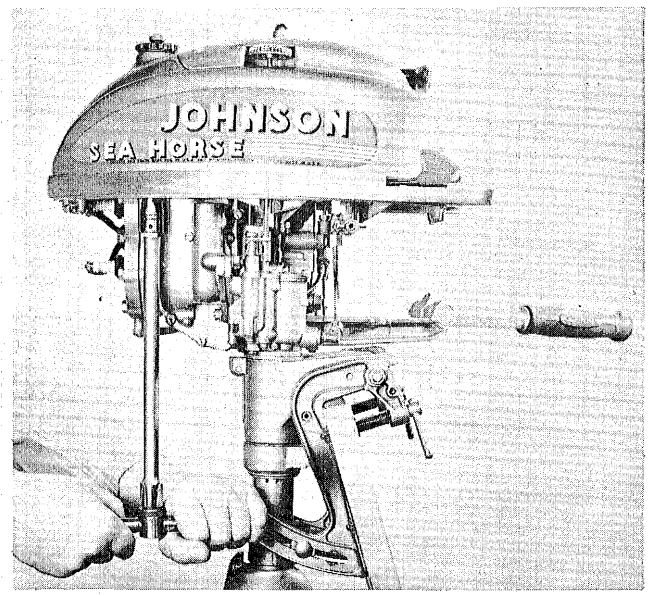
Proceed as follows:

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.



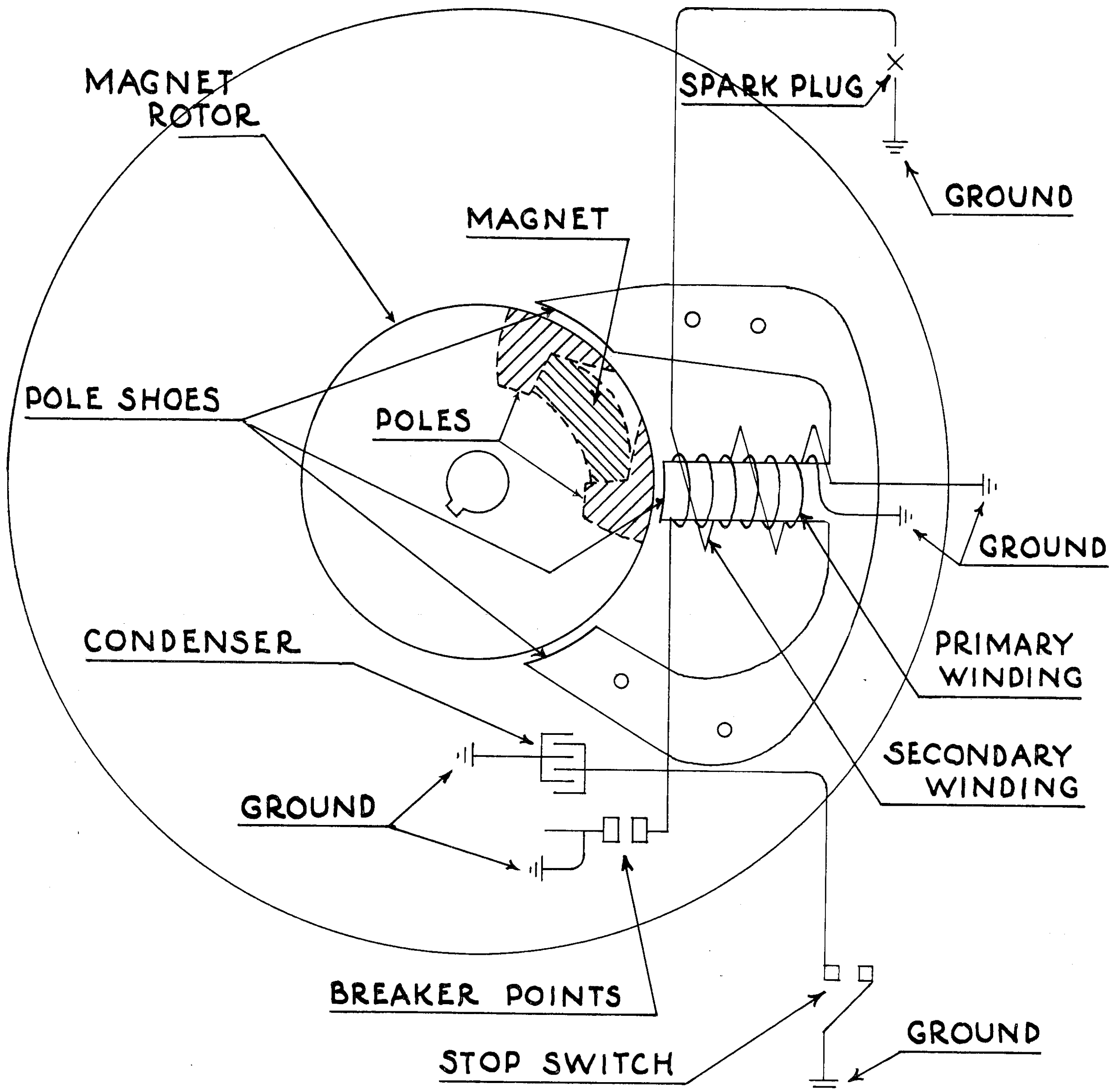
Removing Pin from High Speed Needle

5. Remove flywheel nut, using a 3/4" 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 Flywheel Puller (Special Tool #378103). See Page 13.
7. Turn puller screw down until it rests firmly against end of crankshaft.
8. After having loosened flywheel, simply lift off.

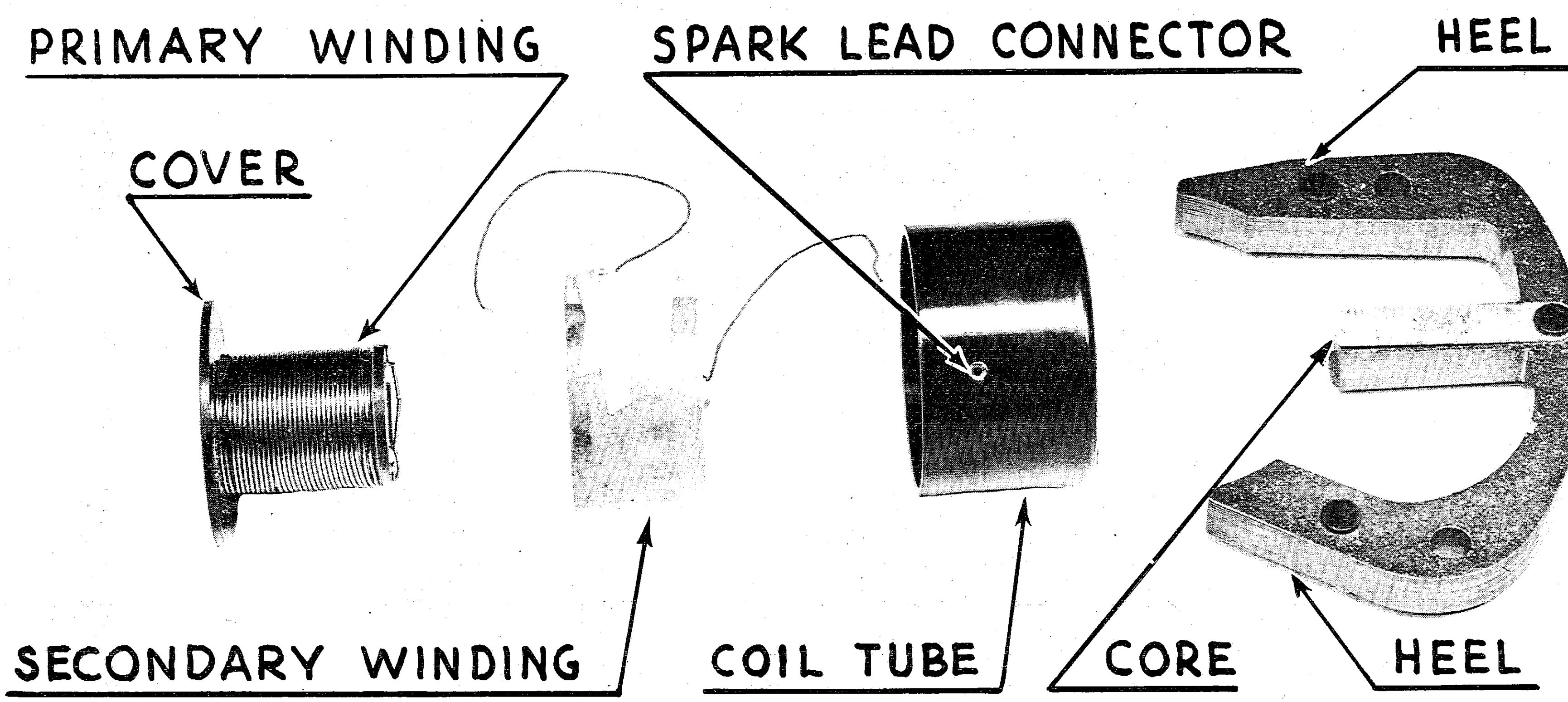


Removing Gas Tank

To install flywheel after inspection of magneto, proceed in reverse order of that described above. Note—Be sure flywheel is securely mounted before attaching spacer and starter pulley (Model TS)—the nut must be tight to prevent flywheel from loosening in operation.

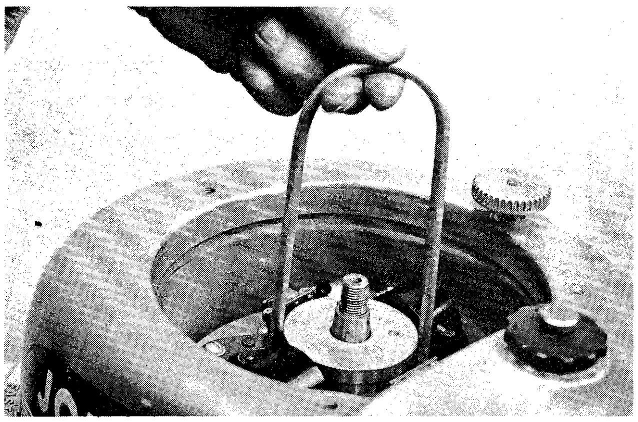


Schematic Diagram of Armature Plate – Rotor Type Magnet
(One Unit for Single Cylinder Motor – Two Units for Alternate Firing Twin)



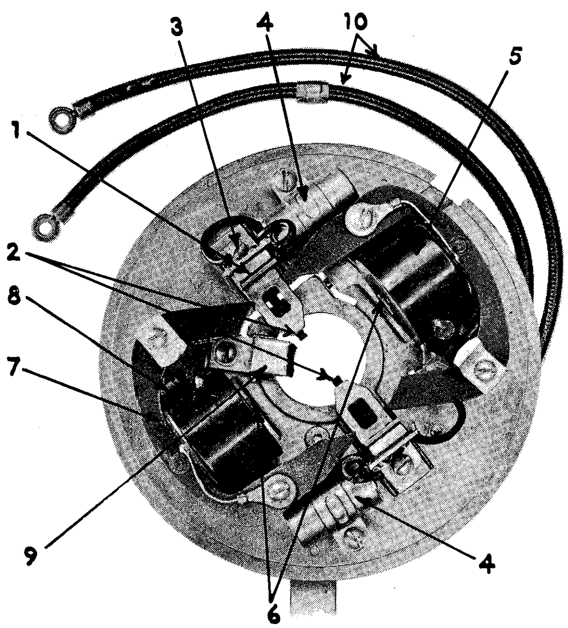
Extended View of Coil Assembly Used on Alternate Firing Motor – H & T Models
With Magnet Rotor

To remove magnet rotor, simply insert tool as shown—lift up. Rotor slips over end of crankshaft, but in event fit is found to be a bit snug, apply additional force (pull up). Excessive force not required to replace rotor — slip over end of crankshaft and press down lightly.

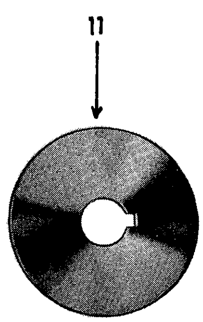


Removing Magnet Rotor

MAGNETO—CHECK CHART



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, Apply Oil
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 simultaneously.

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 magnet, is no longer available.

3. The crankshafts on both models (TS-15, TD-15 and TS-20, TD-20) are identical in all respects 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 shorter 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 Models 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 suppressor #72-375249 must be used on this combination.

TO INSTALL NEW COIL

Remove screws attaching coil and shoe assembly to the armature plate. Detach ground wire, spark plug wire and primary lead to the breaker assembly.

NOTE: Wherever necessary to detach leads previously soldered in position such as the spark plug lead, be careful not to apply too much heat — just enough to break the connection loose. Proceed carefully. Lift coil assembly from the plate and discard if faulty.

Install new coil assembly. Replace coil mounting screws but do not tighten for the time being. Attach all primary leads and solder spark plug lead to the coil. Again—do not apply excessive heat—just enough to provide a good soldered connection. The coil can be ruined by applying too much heat at this point.

IMPORTANT: Under no circumstances use an acid flux — it causes corrosion and ultimately a faulty connection. Use a soldering paste or rosin.

TO ADJUST CLEARANCE BETWEEN COIL SHOES AND MAGNET ROTOR

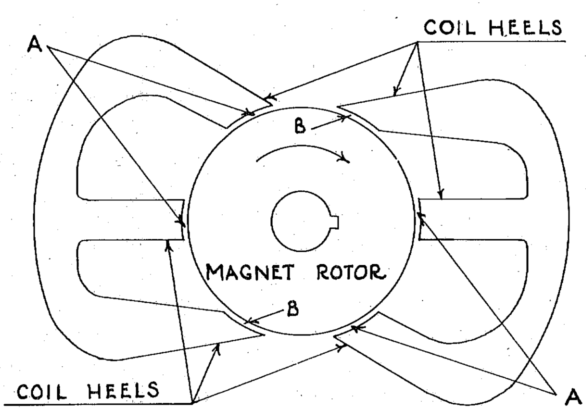
To get the most out of the magneto, one of the important things to consider is correct clearance between the magnet rotor and the coil heels.

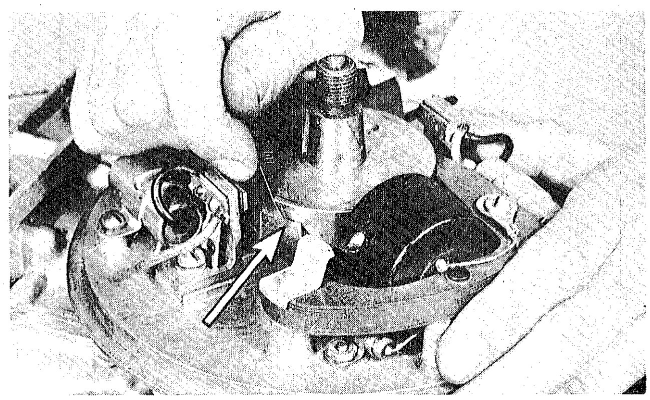
This clearance is obtained by shifting the coil-heel assembly towards or away from the magnet rotor. Proceed as follows:

1. Loosen screws, attaching coil assembly to armature plate, slightly.
2. Adjust position of coil assembly so that clearance at point "A" is .008″ for models HS-HD-20, TS-TD-15 (armature plates equipped with spark suppressors) and .012″ for Models HS-HD-25, TS-TD-20.

NOTE: Clearance at point "B" should not be less than at point "A"—it may be greater. Under no circumstances should the heel be permitted to ride or rub on the magnet rotor.

3. Tighten screws to hold coil assembly fast.
4. Repeat same operation on both coils.





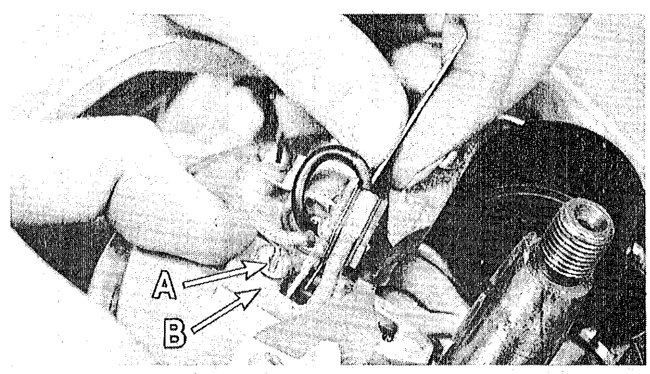
Checking Rotor Clearance

TO ADJUST MAGNETO BREAKER POINTS

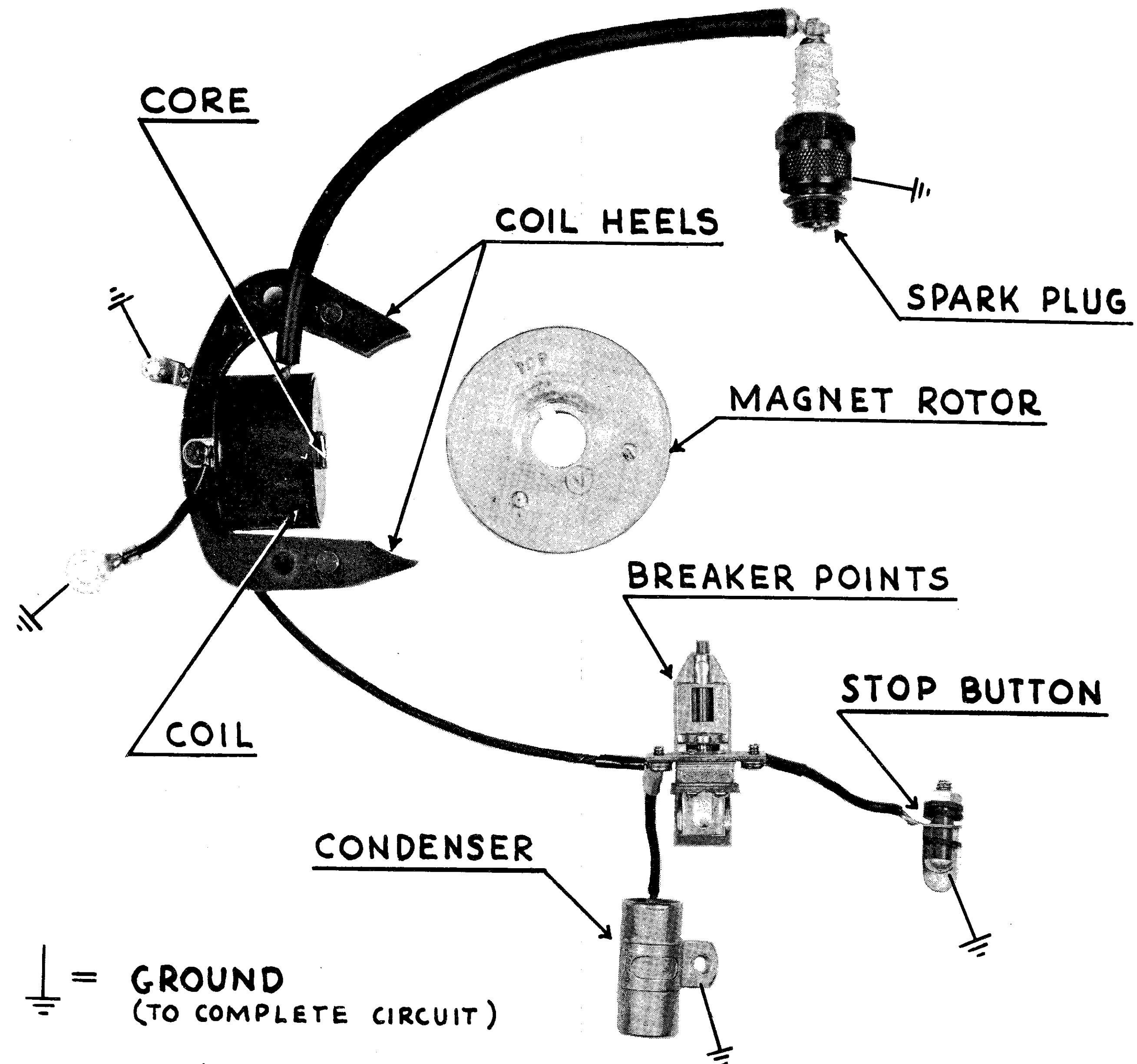
Since two coils are used (one for each cylinder) two condensers and two sets of breaker points are required, both of which may need occasional inspection from time to time.

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).

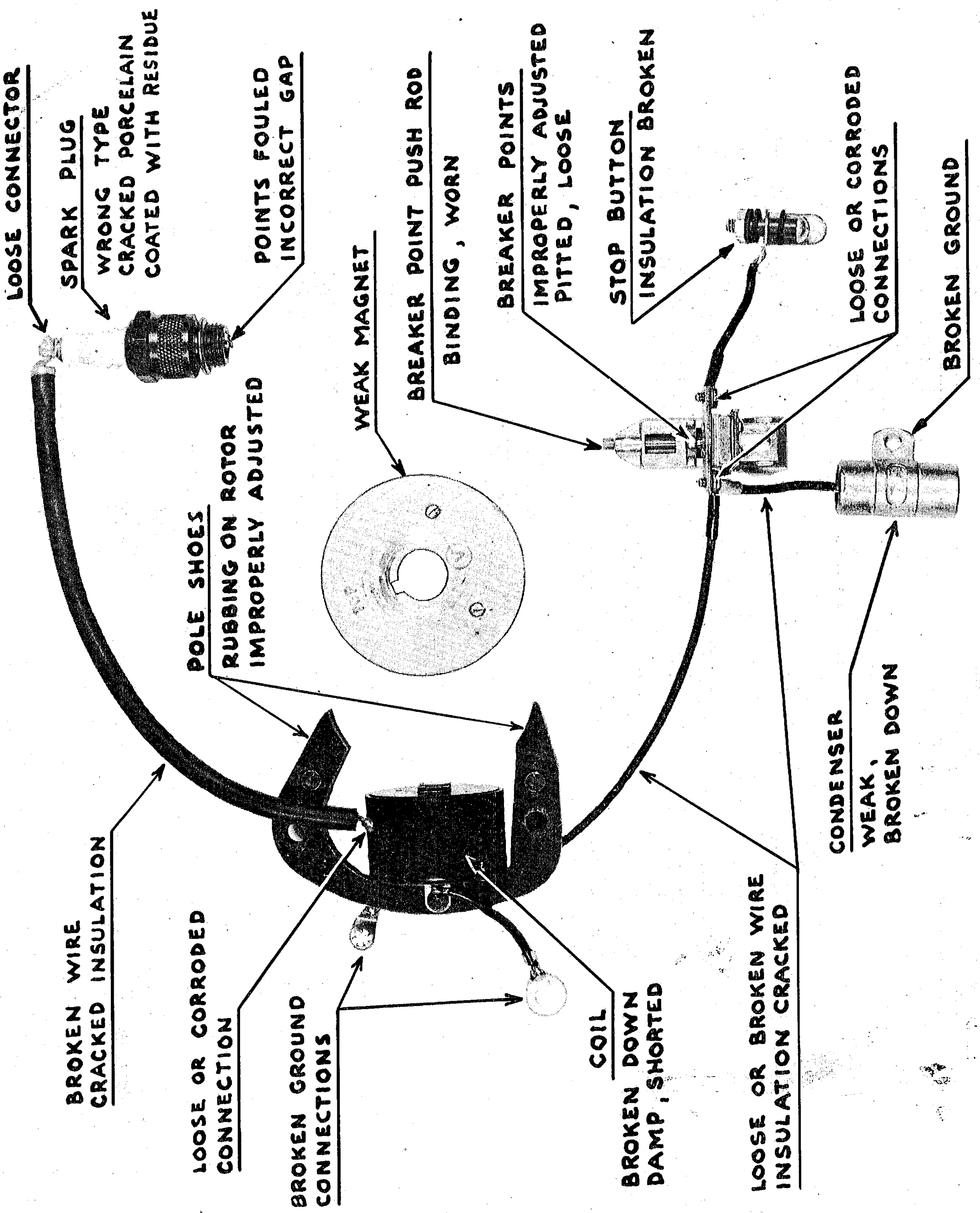
To adjust gap setting loosen screw "A." Turn crankshaft to position where push rod rides on high side. Check gap between points, using .020″ feeler gauge as illustrated. If gap is less than .020″ push breaker point bracket "B" in (towards crankshaft) sufficiently to obtain correct gap setting. Tighten screw "A". If gap is over .020″ slide bracket "B" out (away from crankshaft). Adjust both points in like manner.



Adjusting Breaker Points



Showing How the Ignition Coil, Condenser, Breaker Points, Spark Plug and Ground (Shut Off) are Connected (Wired) Including the Magnet Rotor.



CHECK CHART – ROTOR TYPE MAGNET

MAGNETO – JOHNSON UNIVERSAL INSTALLED ON MODELS JW, TN-27/28, CD, AD, QD-12 UP, FD, RD, RDE, RK, RX

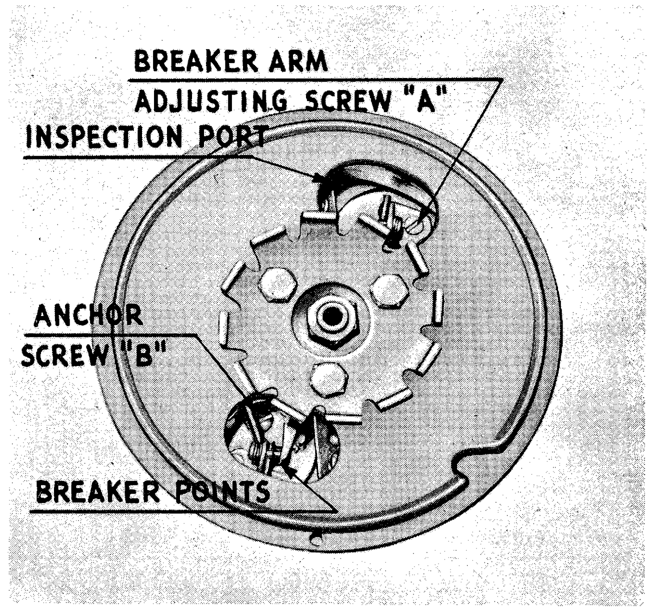
Except for individual flywheels and "trim" parts (carburetor control cams, etc.) magneto assemblies installed on above models are basically alike in construction, employing the use of identical ignition coils, condensers, breaker point assemblies and armature plate castings. Otherwise, mechanical construction is of conventional Johnson design, employing the use of two ignition coils, two sets of breaker points operated by a cam keyed to the crankshaft, and two condensers mounted on an armature plate arranged to swivel on the crankcase boss to accomplish speed control. A flywheel with built-in permanent magneto completes the assembly to energize the coils during starting and operation of the motor.

Its simple construction requires but little attention except for periodic cleaning of the breaker point surfaces and subsequent adjusting of the breaker point gap to overcome faulty sparking and operation of the motor. Long periods of operation cause "pitting" and oxidizing of the point surfaces to interfere with starting and consistent running throughout speed range of the motor. Similarly, storage in areas of high humidity frequently results in oxidation or "scumming" of the breaker point surfaces to cause like results.

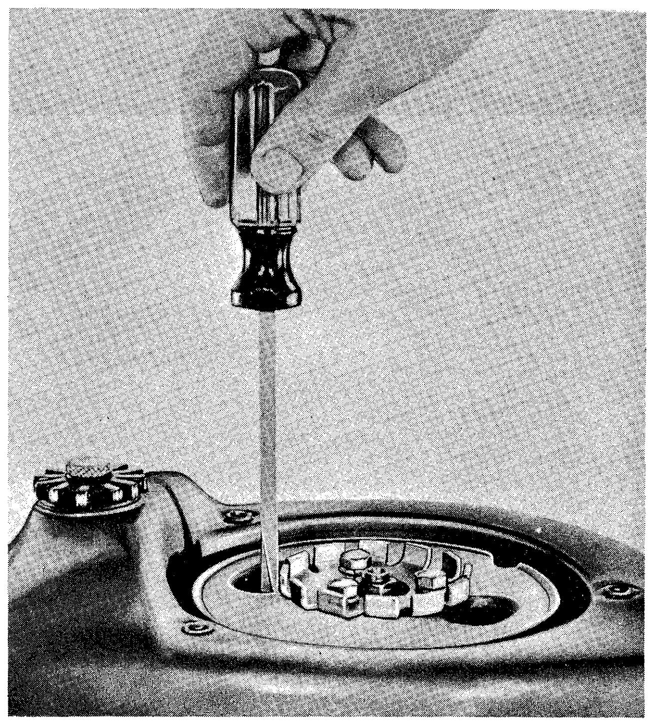
EMERGENCY ONLY – PROCEDURE FOR CLEANING AND ADJUSTING THE BREAKER POINTS

As noted from accompanying illustrations, the flywheel is provided with two inspection ports to gain ready access to the breaker points for cleaning and gap setting. Proceed as follows:

1. Remove Ready Starter Head.
2. Remove starter ratchet and flywheel port cover.
3. Turn flywheel to expose both sets of breaker points.
4. Carefully spread breaker points with blunt instrument — small screw driver.
5. Insert point dresser between points — remove instrument to release points — work point dresser up and down carefully until relatively smooth surfaces are obtained. (Note — in event the operation is being performed in a shop with parts available, installation of new points is recommended since resurfacing as described here is only a temporary measure.)
6. On completion of the cleaning operation, insert strip of paper and work up and down in like manner to remove possible traces of dressing material left on point surfaces, later to affect starting and normal running of the motor.



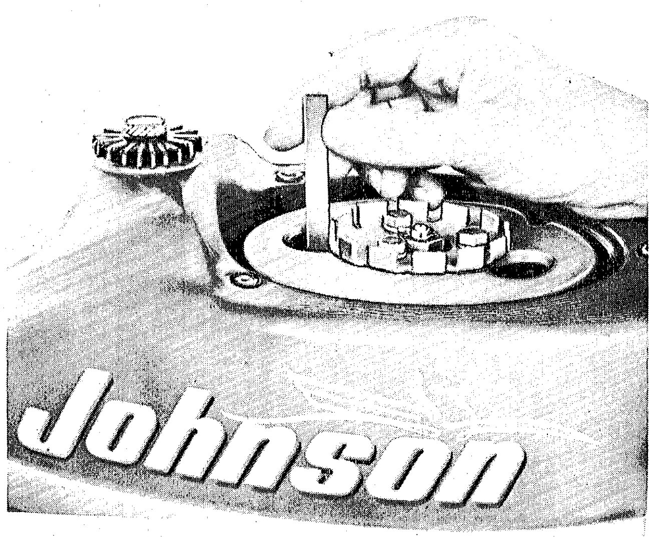
Flywheel Port Cover Removed to Expose Breaker Points for Adjusting Gap Setting.



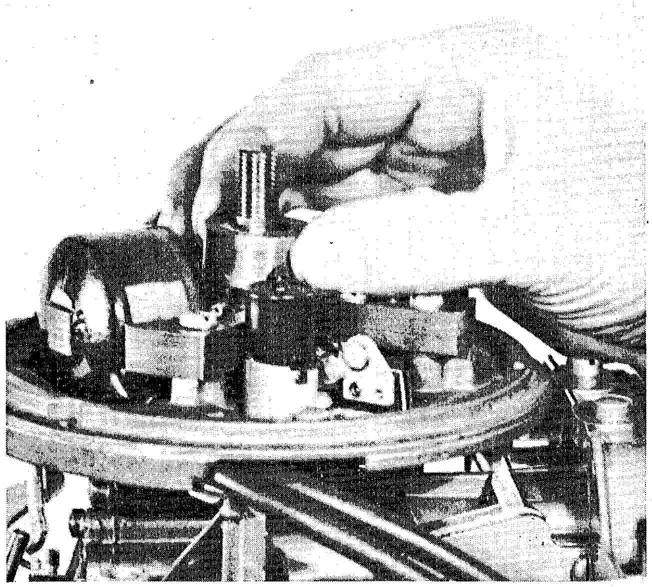
Adjusting Breaker Point Setting Through "Port" in the Flywheel Provided for this Purpose.

To Adjust the Breaker Point Gap

7. Turn flywheel to position where breaker point gap is at its maximum — recommended gap setting is .020″ full open.
8. Insert feeler strip (.020″ thick) to check gap clearance. If gap appears over or under specified .020″, proceed with required adjustment.



Checking Breaker Point Gap with Feeler Strip—
Correct Gap Setting is .020″ Full Open.

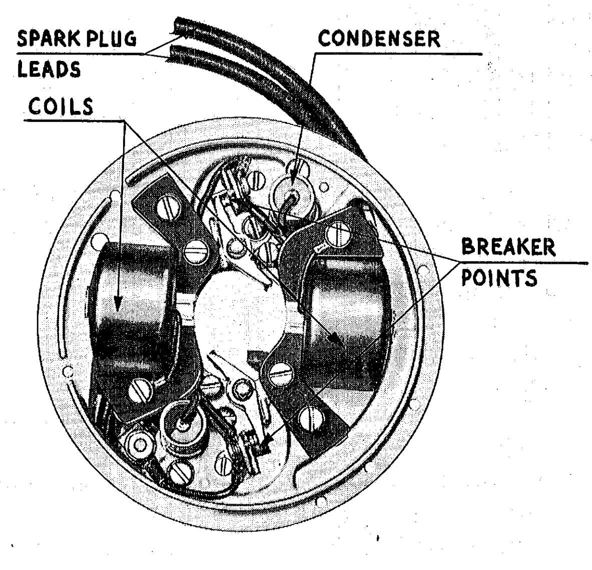


The Magneto Breaker Point Cam or Eccentric is Keyed to the Crankshaft thus, when Installed, "Times" Breaker point Action Automatically with Relation to Degree of Spark Advance, Position of Piston and Since Gas and Spark are Synchronized, with Respect to Volume of Fuel Charge. Do not "Force" Installation of the Cam — Line Up Squarely with the Key and Crankshaft, then Gently Push Down to Position by Hand.

The breaker base bracket is held fast on the armature plate by two screws "A" and "B" as shown in the illustration. Screw "A" is provided with an offset or eccentric head which is inserted through the slotted or elongated hole in the bracket. Turning of screw "A" consequently causes the bracket assembly to be shifted in and out to obtain ultimate breaker gap setting. The bracket assembly thus pivots on screw "B." (Illustration, page 29)

Since the rubbing block on the breaker arm follows or "rides" contour of the cam keyed to the crankshaft, actual breaker point gap is obtained by "pivoting" the breaker base and point assembly — pivoted towards cam face, the gap is widened; oppositely, the gap narrows.

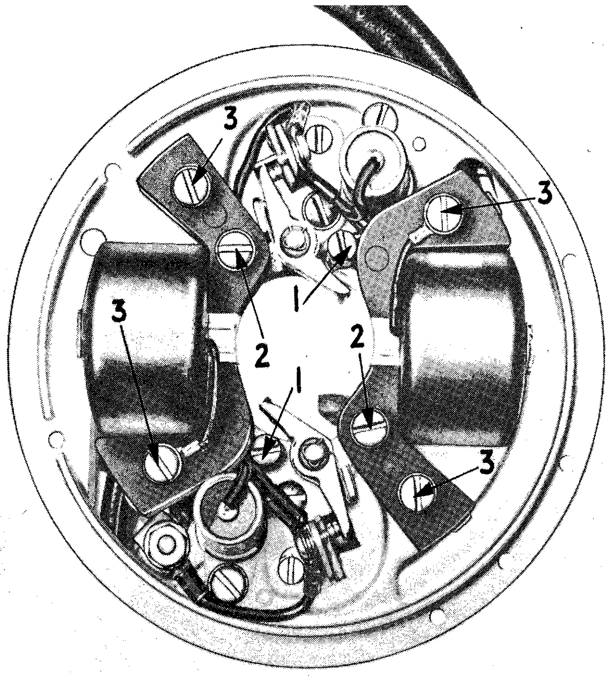
9. Carefully turn adjusting screw "A" to left or right as required to obtain specified gap setting of .020″ full open. Note—turning screw "A" to left (counter clockwise) increases the gap — to right (clockwise) reduces or narrows the gap — correct gap setting is attained when the testing feeler strip is felt to bind slightly between the point faces.
10. Check tension on anchor screw "B" to secure assembly.
11. Turn the flywheel several revolutions – then re-check gap setting to assure gap opening of .020″ full open.
12. Repeat same operation on removing breaker assembly.
13. Make certain adjusting screw head seats in breaker bracket slot. IMPORTANT!
14. Replace the inspection port cover, starter ratchet and starter head.



Basic Armature Plate — Universal Magneto.

To replace the breaker point assemblies, simply detach primary and condenser leads, remove entirely both breaker base anchor and adjusting screw—lift assembly from the armature plate.

Obtain and install new assembly in reverse order of that described above. Work piece of paper strip up and down between point faces to insure their cleanliness and absence of foreign particles which otherwise would interfere with starting and operation of the motor.



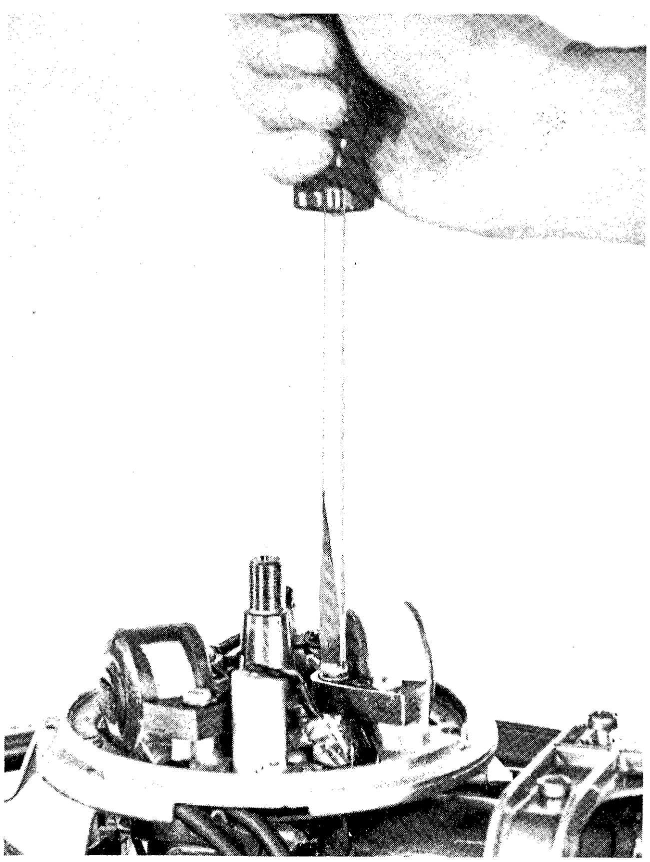
Armature Plate Showing Screws 1 and 2 to be Removed when Detaching from the Powerhead and Screws 3 for Detaching the Ignition Coils.

It is advisable after installing the breaker assemblies to check breaker point contact on the Stevens (continuity) tester assuring that maximum contact is being made to realize full capacity of the magneto assembly. See following instructions for contact checking.

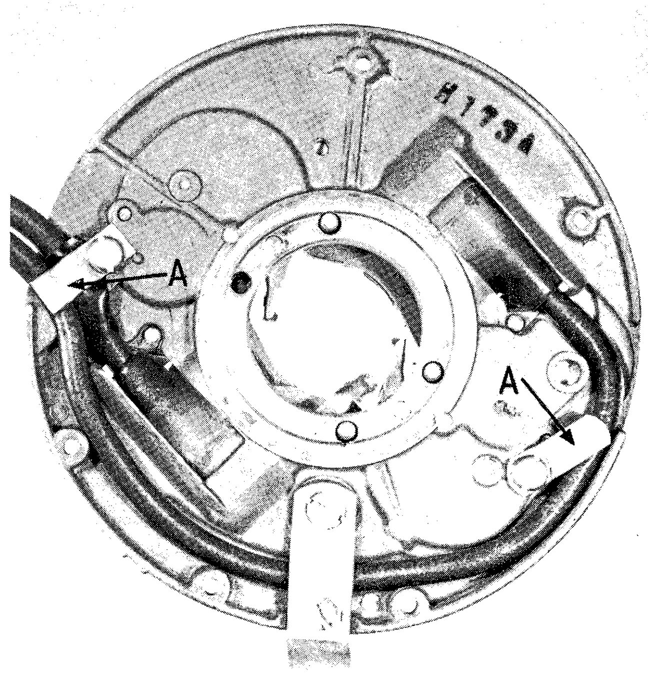
To replace the condenser, detach lead from the breaker assembly — remove screw holding condenser to armature plate — install new condenser in reverse order, making certain all connections are clean, solid and intact. Contact surface (ground) of the condenser mounting bracket and corresponding location on the armature plate must be clean to insure ground contact. Faulty ground contact in this respect has its effect on condenser capacity and function. Similarly loose condenser connections have their effect on condenser performance. See following instructions for checking condensers on the Stevens tester – pages 62 and 63.

To replace the ignition coil, proceed as follows:

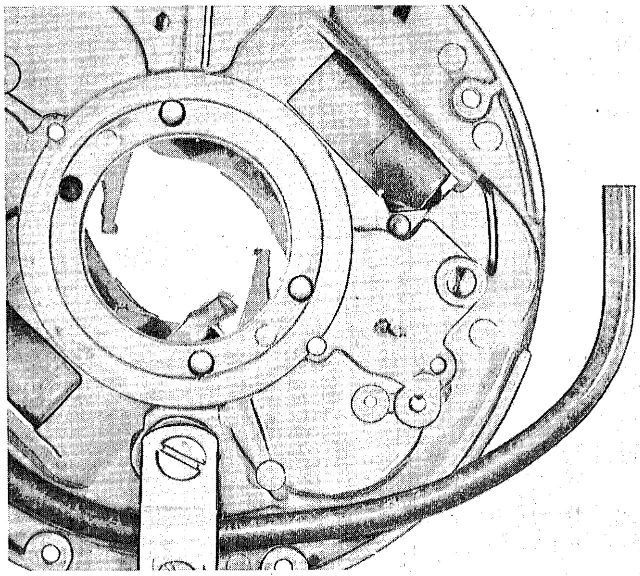
1. Remove screws 1 and 2 (4 screws) to permit detaching armature plate assembly from the powerhead.
2. Turn armature plate over on its reverse side. Remove or loosen brackets "A" holding spark plug leads fast to the armature plate.



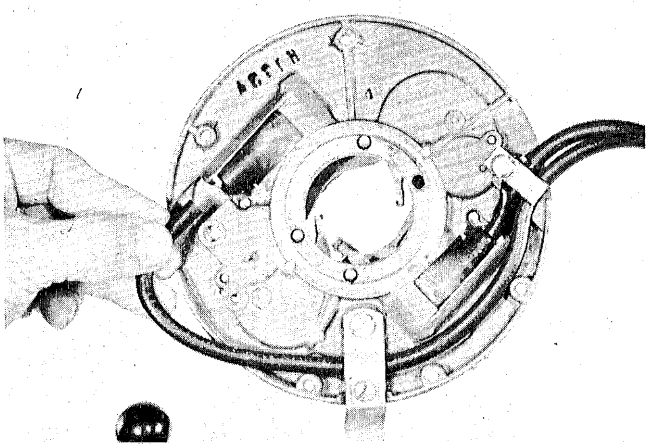
Removing Armature Plate from the Power Head, Remove Screws 1 and 2 as Indicated Above.



Showing Under Side of Armature — Brackets "A" Supporting Spark Plug Leads.



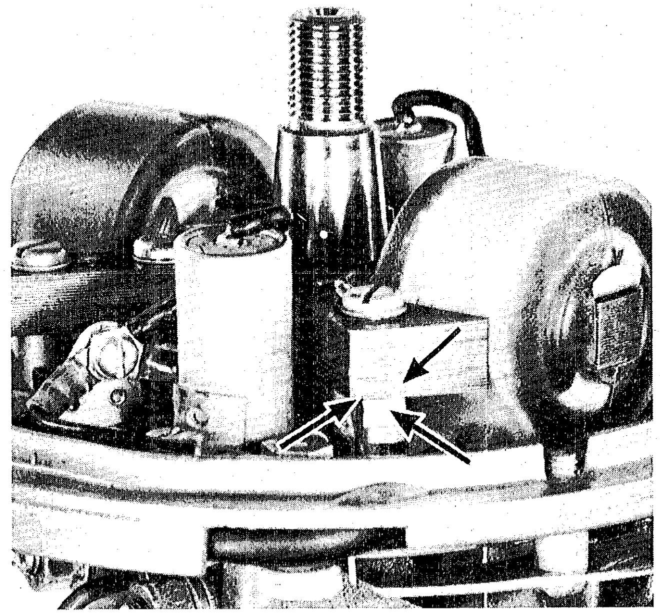
Showing Ignition Lead "Pulled" Free of the Coil.



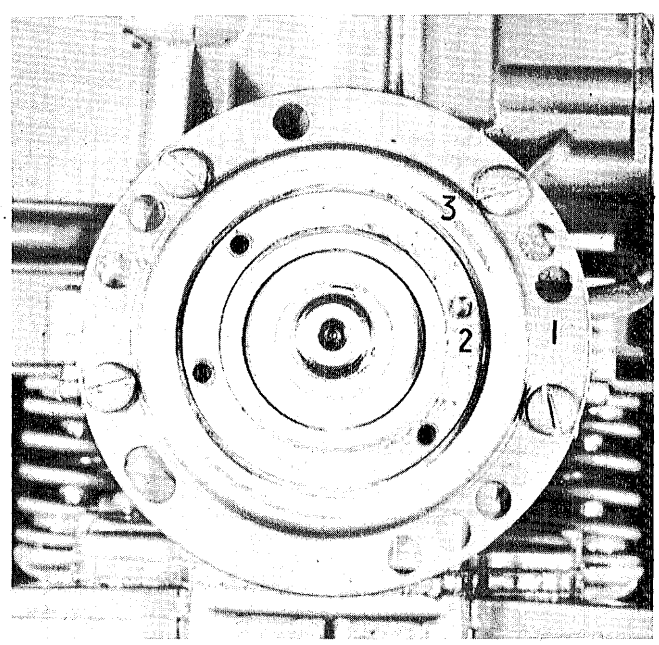
To Detach the Ignition Lead, Simply Pull it "Free" of the Coil. On Installation, Note that Secondary Lead (Coil) Terminates at a Needle Point which Penetrates the Stranded Core of the Lead to Gain Contact. Insert Ignition Lead as shown here until it "Bottoms" — Making Certain the Needle in the Coil has Penetrated the Stranded Core of the Lead. Replace Brackets "A" to Insure Position of the Lead — To Achieve Maximum Insulation at this Point, Coat End of the Lead Liberally with DC-4 (a Silicon Product by Dow Chemical Co.) Prior to Inserting the Ignition Lead.

3. Pull spark plug leads "free" of coil as shown here.
4. Turn armature plate over on its top side — detach primary (coil) leads from breaker assemblies.
5. Remove screws 3 — lift coil and hub assembly free of the armature plate.
6. Install new coil in reverse order. Note, machined bosses on the armature plate to assist in locating and properly positioning the coil with respect to clearance required between face of pole shoes and magnet pole pieces cast into flywheel. Set pole shoe (coil) faces flush with machined bosses on armature plate—tighten screws 3 to hold fast in this position. This is IMPORTANT — excessive clearance or gap between pole shoe faces of the coil assembly and magnet pole pieces in the flywheel will lead to a "weak" spark, resultant hard starting and faulty performance.

Care should be exercised with regard to permitting the coil pole shoe faces "hanging" out beyond machined bosses on the armature plate —this, to avoid possibility of pole shoe faces striking against magnet pole pieces in the fly-

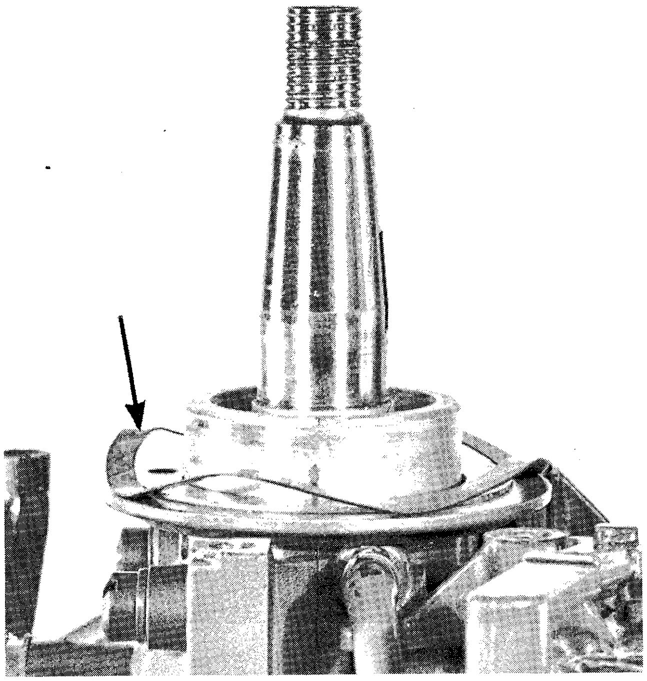


Arrows Indicating Face of Coil Pole Shoe Flush with Machined Boss on Armature Plate Casting.

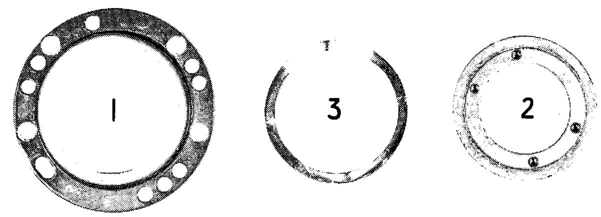


wheel and subsequent damage to trip armature plate assembly and flywheel. Expensive and unnecessary repairs can be avoided by proceeding cautiously at this time.

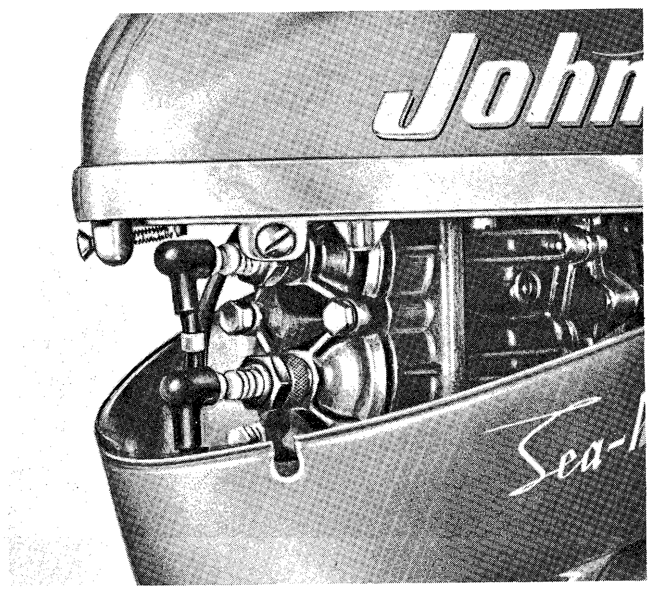
See following instructions for checking the coil on the Stevens Coil Tester, page 64. See Magneto Check Chart.



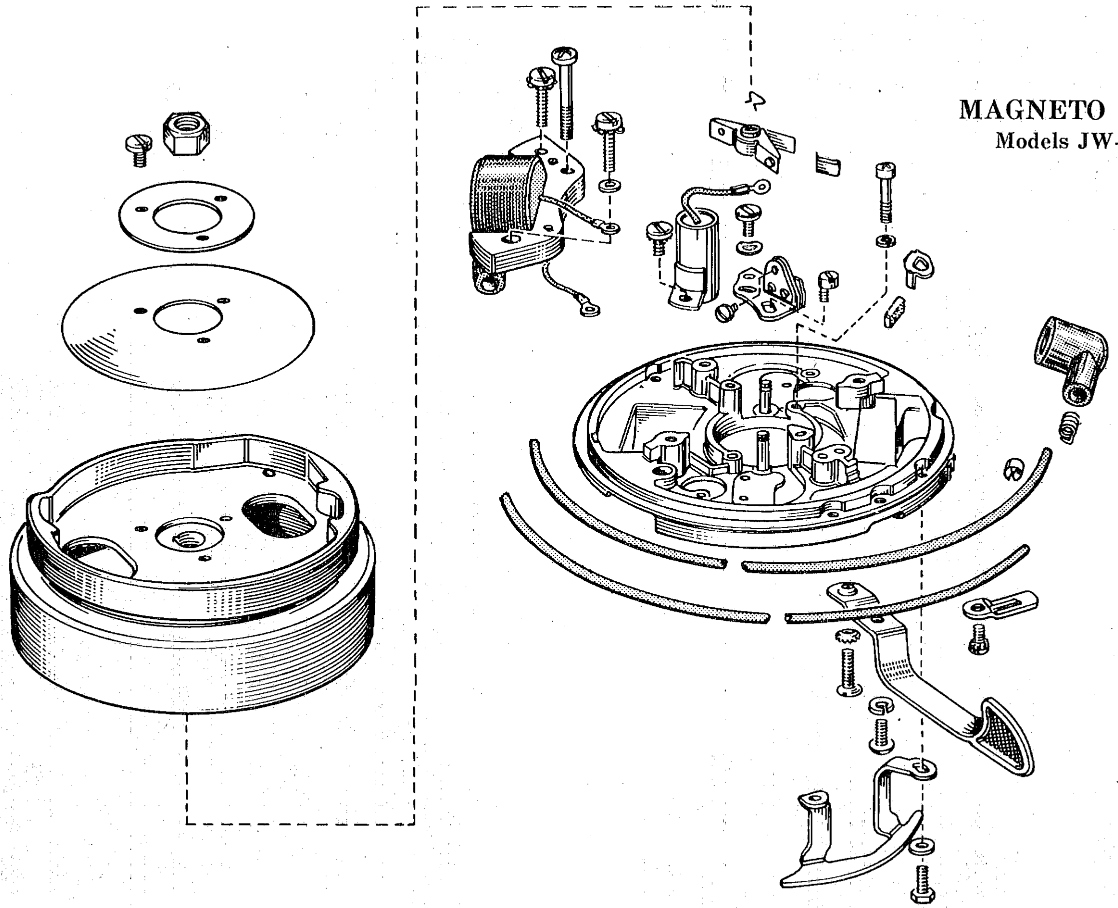
Showing Installation of Spring Washer to Apply Armature Plate Tension. Later Remove where Provisions were made for Remote Control.



Armature Plate Mounting Details — (1) Support, (2) Retaining Ring, (3) Spring Washer.

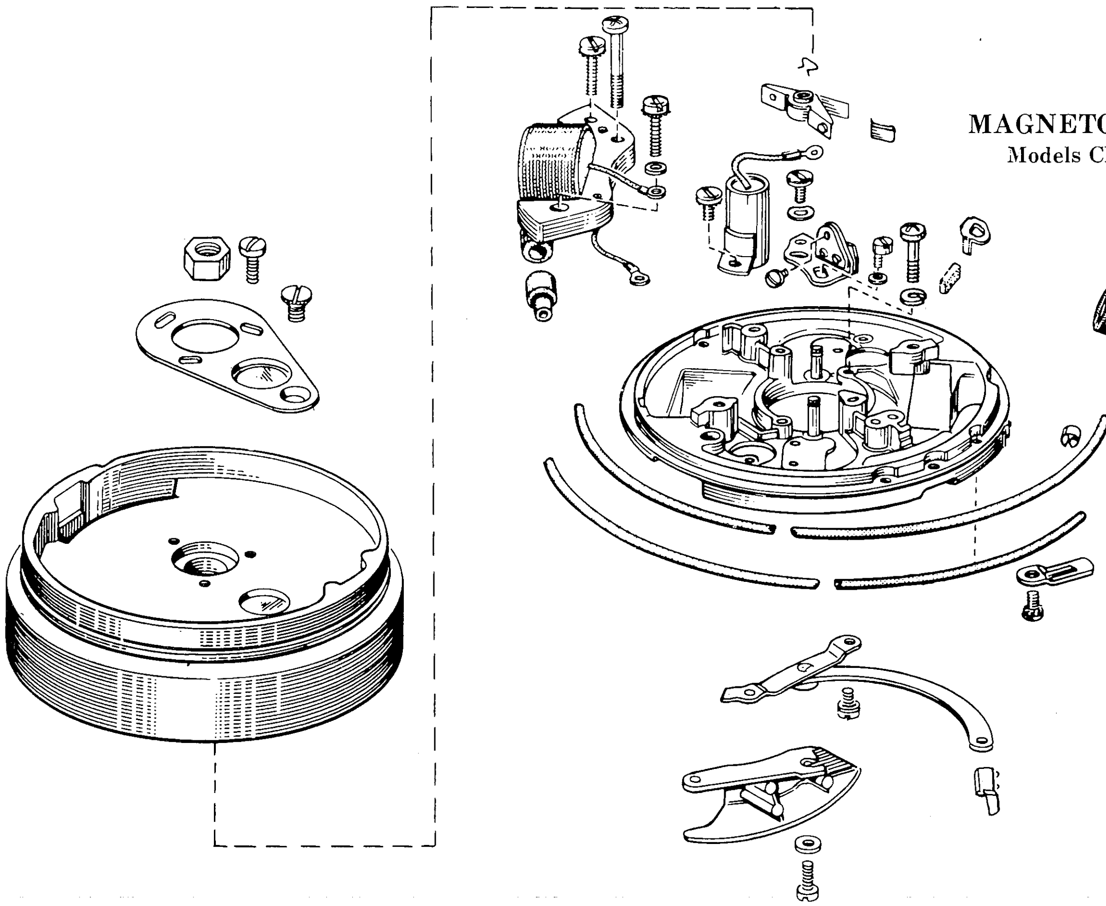


Motor Cover Down to Give Access to the Spark Plugs for Removal and/or Replacement, Showing Spark Cover Installation.



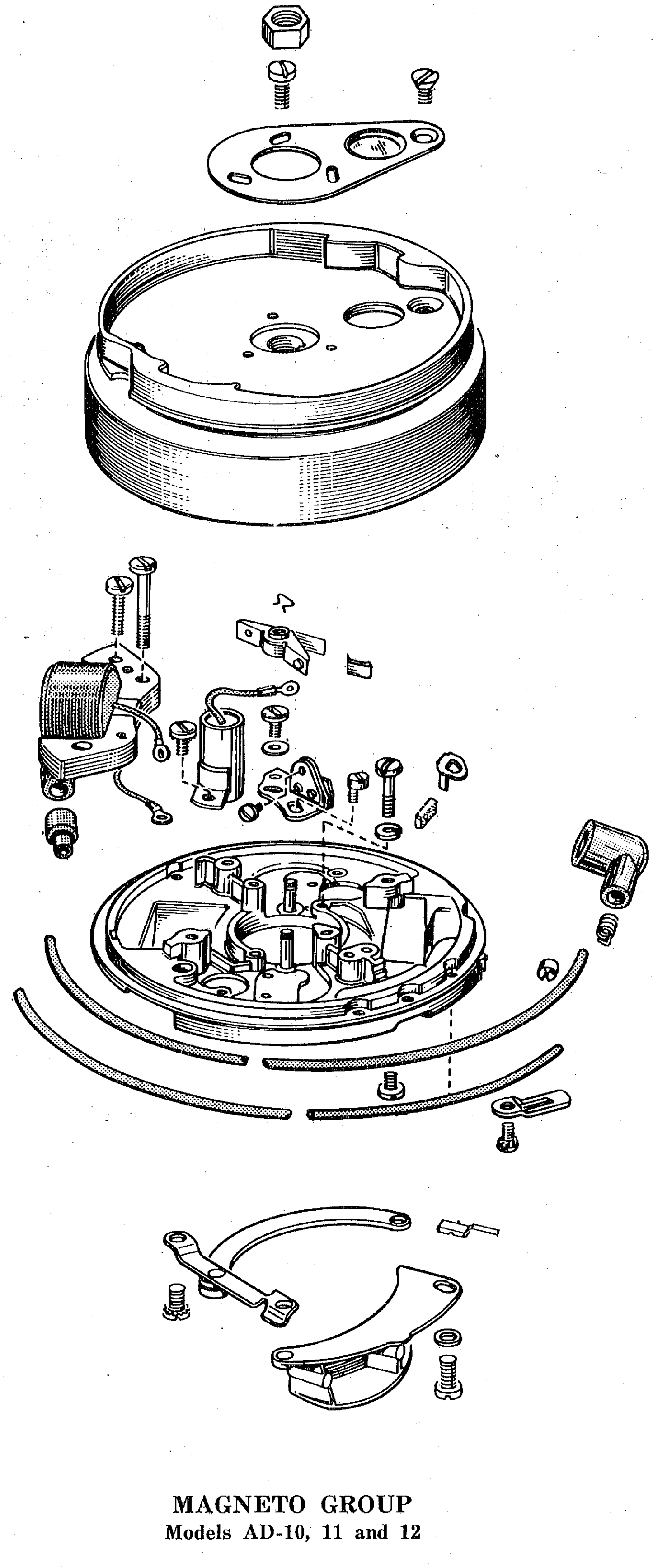
MAGNETO GROUP
Models JW-10 Up

NOTES



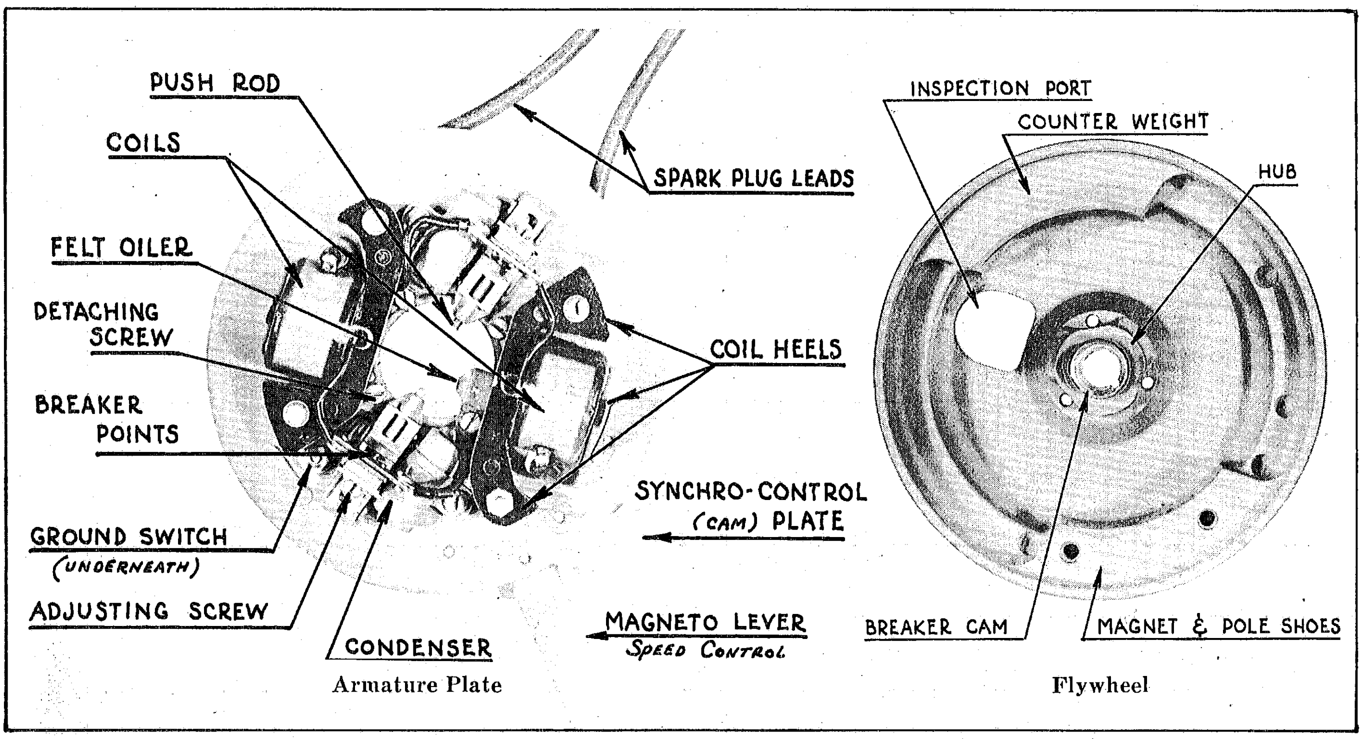
MAGNETO GROUP
Models CD-10 Up

NOTES



MAGNETO GROUP
Models AD-10, 11 and 12

NOTES

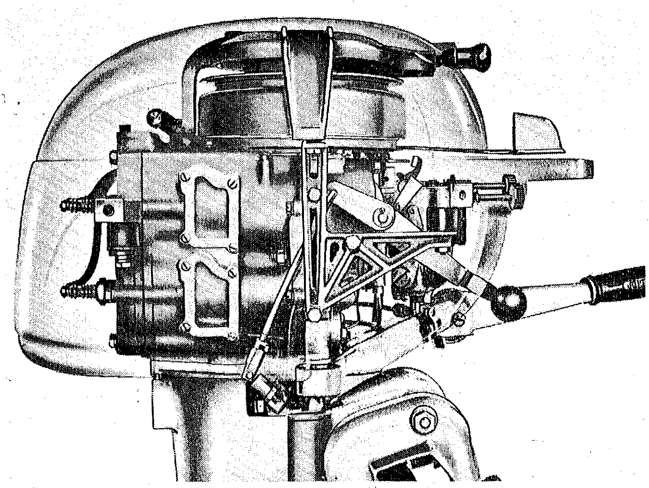


Armature Plate

Flywheel

MODEL QD-10 THROUGH 11 MAGNETO

Construction of the Model QD magneto does not differ a great deal from early Johnson magneto construction except that the customary ring type magnet riveted to the inside of the flywheel rim has been replaced with an Alnico magnet cast into a dome or flywheel of zinc. In size, the magnet itself is rather small, approximately 1⅜"x¾"x½", and occupies a position in the flywheel rim comparable to the pole shoes where the ring type of magnet is employed. Alnico is a composition of aluminum, nickel and cobalt, cast into blocks of various sizes as individual requirements demand. An Alnico magnet is also used in HD and TD magnetos — same being die cast into the magnet rotor rather than into the flywheel.

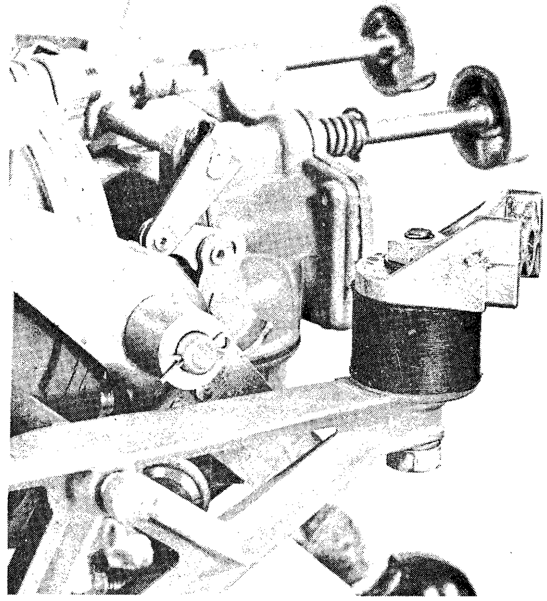

Phantom View—Showing Position of Power Head, Carburetor, Magneto, Ready Pull Starter, etc., Under Cover.

It will be noted from the magneto illustration above that three poles (heels) have been provided for the core of each coil to gain advantage of "reverse flux" at the time of breaker point separation, which results in maximum spark intensity—the strong spark required for easy starting and efficient magneto operation throughout entire speed range of the motor. HD and TD magnetos function on like principle—the difference being only in location of the magnet and pole pieces.

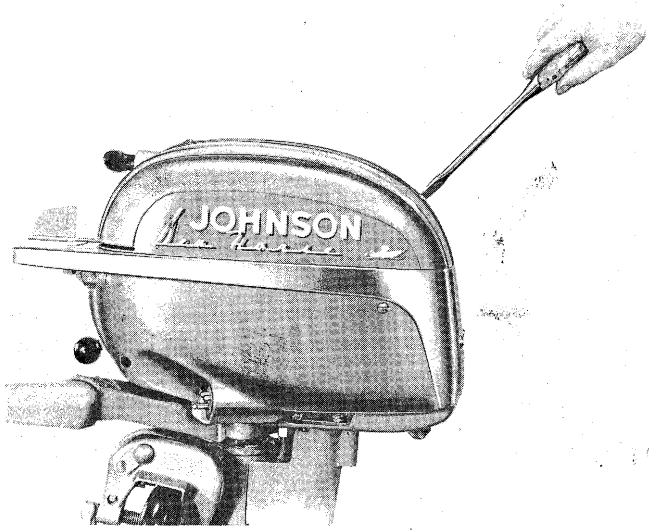
The breaker point assembly is like that of HD, TD and SD magnetos, employing the use of a plunger or push rod to separate the points as it rides against a cam built into the flywheel hub: (In case of HD, TD and SD, a "flat" machined into the crankshaft journal).

The ignition coils and condensers are of conventional construction—see pages 11 to 17. An oiler felt is installed to minimize push rod or plunger wear by providing breaker cam lubrication. The felt should at all times ride against the high side of the cam. Two or three drops of oil should be applied to the felt pad each season—do not over oil. Excessive plunger wear can be laid to lack of lubrication in this respect.

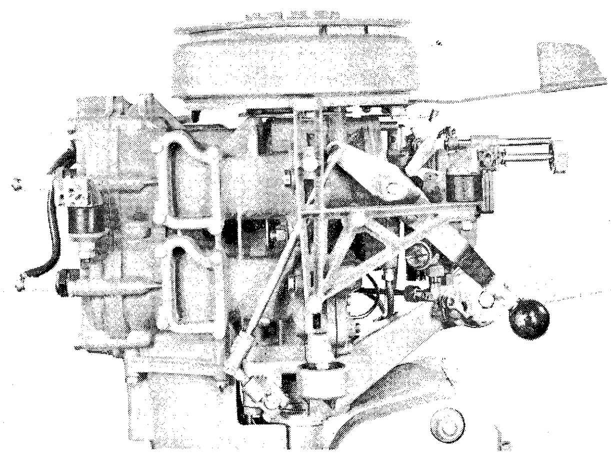
Cam attached to the armature plate controls degree of carburetor shutter (butterfly) opening with respect to position of spark timing as governed by movement of the speed control lever.



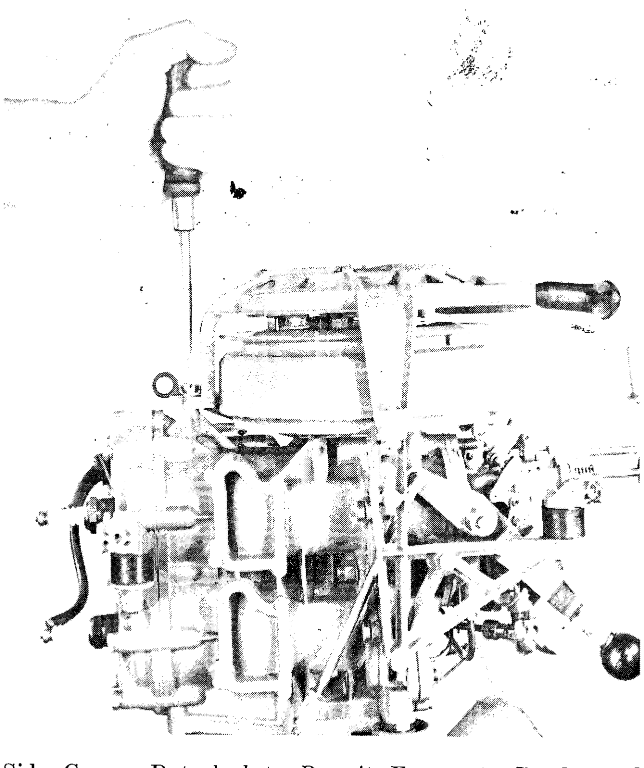
Illustrating Side Cover Flexible Mount—Four of Which Are Provided to Hold Covers Fast and Minimize Vibration Noises.



Removing Screws and Side Covers for Access to Power Head.



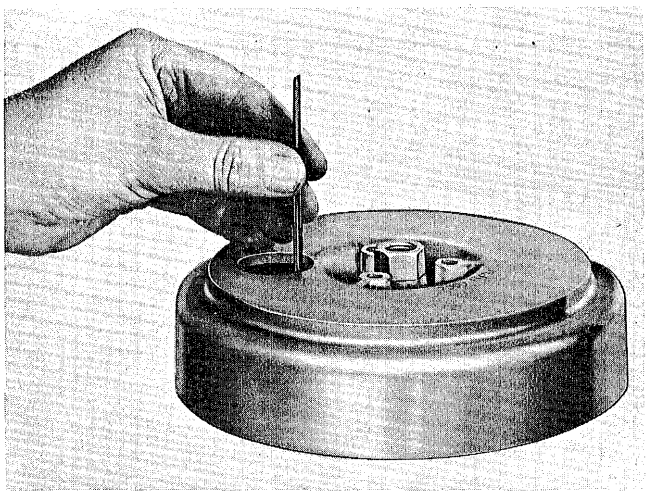
Side Covers and Starter Removed for Access to Breaker Points for Inspection, Cleaning or Adjusting. Showing also, Position of Shift Lever and Link.



Side Covers Detached to Permit Excess to Ready Pull Starter, Magneto, Carburetor, etc.

To Clean Breaker Points — Emergency Only.

After having removed the side covers, starter assembly, starter ratchet and flywheel cover plate, turn flywheel to position where inspection port comes to rest above the breaker point assembly. Carefully spread points with a blunt instrument (small screw driver) then insert point dresser. Release points. Work point dresser up and down until assured point surfaces are clean and smooth. (Excessively rough surfaced points should be replaced). On completion of cleaning operation, insert strip of paper and in like manner work up and down to remove possible traces of dressing material left on point surfaces to interfere with proper contact.

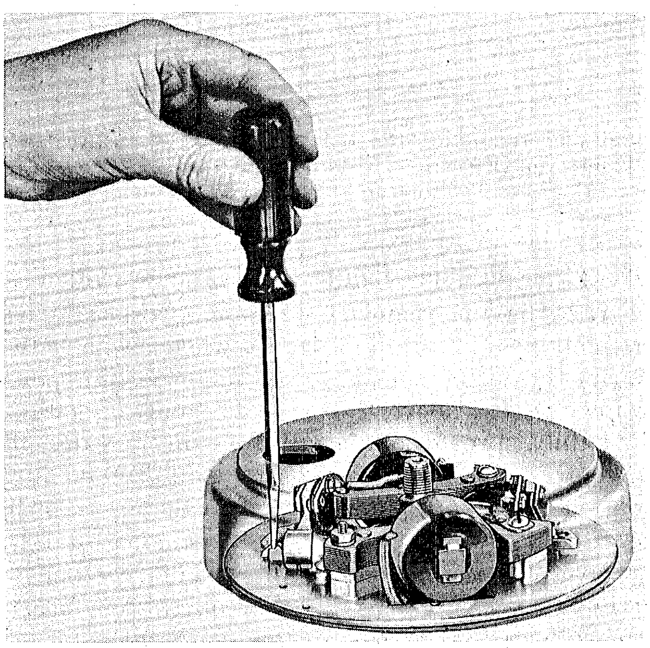


Inserting Breaker Point Dresser and Method of Checking Point Gap with Feeler Strip of Correct Thickness, .020".

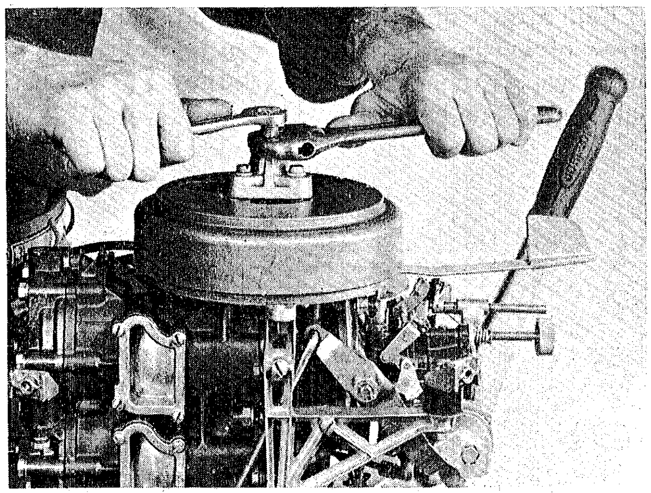
To Adjust Breaker Point Gap

Correct breaker point gap setting is .020" full open.

To adjust, loosen breaker point bracket screw slightly to allow for movement of the bracket. Shift position of assembly either way as required to obtain proper gap opening. Slots are provided on the breaker point bracket and armature plate base to permit accomplishing this adjustment with the aid of a screw driver. Insert screw driver through port in the flywheel—locate in adjusting slots. Turn screw driver to right to increase gap—left to reduce. Check with .020" feeler strip. Tighten screw to secure position of the assembly. Repeat procedure for adjusting other point assembly.



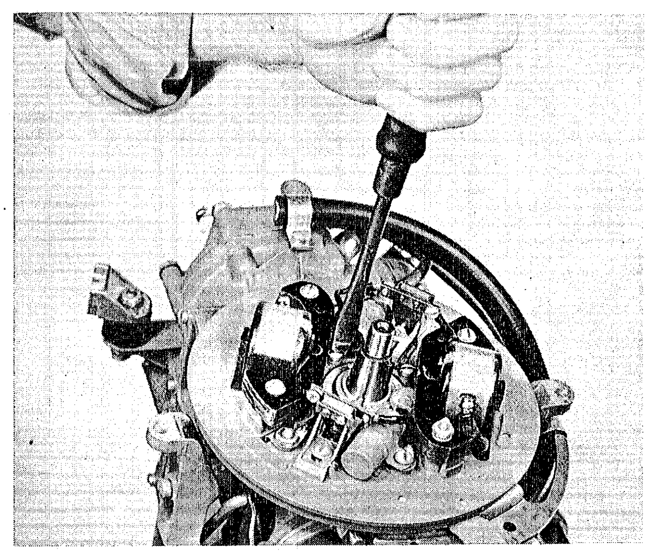
Adjusting Breaker Points.



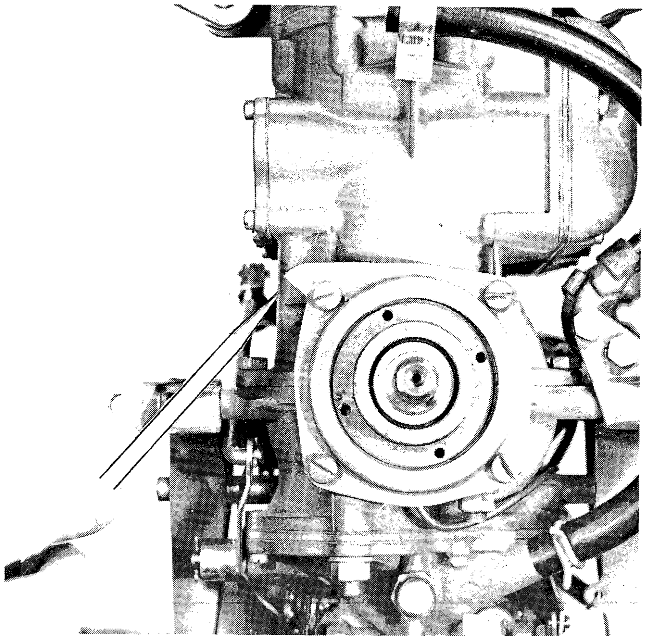
Removing Flywheel as Instructed on Page 13.

Removing the Armature Plate for Repairs

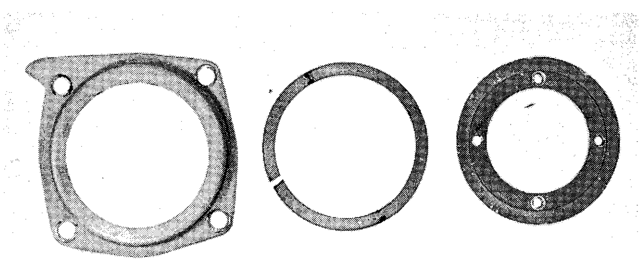
It will be noted that armature plate installation on the Model QD is accomplished in a manner considerably different from that of early models and past conventional Johnson practice. Rather than relying on the customary armature plate clamp and screw to provide mounting on the crankcase, the armature plate in this case is assembled to the crankcase by means of four screws driven into a ring which rides against a comparatively large wave washer (beryllium copper) installed between the ring and a bracket attached to the crankcase. The "wave" in the washer builds up spring action or tension between the bracket and the ring into which the screws are driven from the armature plate to provide necessary friction in this respect. This tension or friction is required to maintain manual setting of speed control lever.



Removing Four Screws Holding Armature Plate Fast to Crankcase.



Showing Armature Plate Removed, Bracket Attached to Crankcase Under Which Are Mounted the Wave or Tension Washer and Ring to Which the Armature Plate is Attached. Note Lug on the Bracket Which Acts to Ground Out Ignition When Speed Control Lever is Moved to Extreme Left—Stop Position. Above Shows Proper Installation of the Mounting Bracket—Lug Must Come to Rest as Indicated to Ground Out Magneto When Stopping Motor.

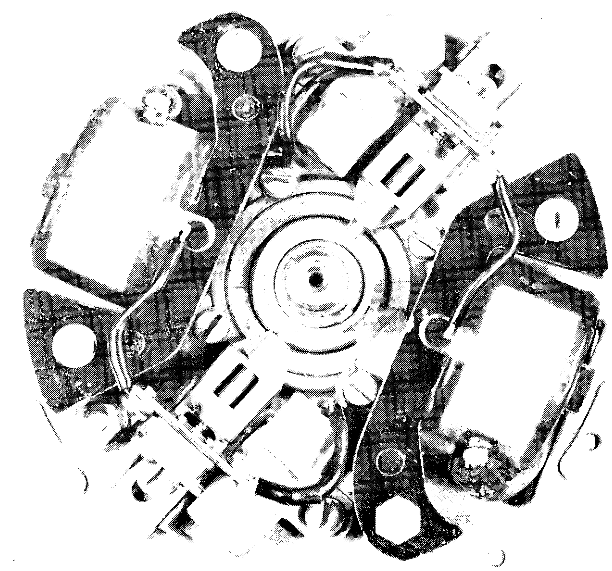


Showing (1) Bracket, (2) Wave Washer and (3) Armature Plate Mounting Ring Removed from the Crankcase Assembly.

Repairs on the armature plate are conducted in the customary manner, which involves checking of the breaker points, condenser, ignition coil and wiring system as instructed. Replace condenser and coils as result of testing warrants. Coil heel clearance is automatically maintained if, when installing the coil, the coil heels are all set "flush" with corresponding boss on armature plate. Make certain all connections are tight and free of corrosion – that breaker assemblies, condensers and coils are securely mounted to the armature plate.

Perform all operations on a clean bench, with clean tools and clean hands – cleanliness pays off.

When replacing the flywheel, it is necessary first to loosen the breaker assembly mounting screws (adjusting) then move the assemblies as far out as the slot in each bracket will permit—at the same time seeing that the push rods are seated against the breaker point springs. The purpose of this operation is to guard against damage to the breaker push rods (plungers) when assembling the flywheel—the push rods must be set to clear the breaker cam on the flywheel hub.

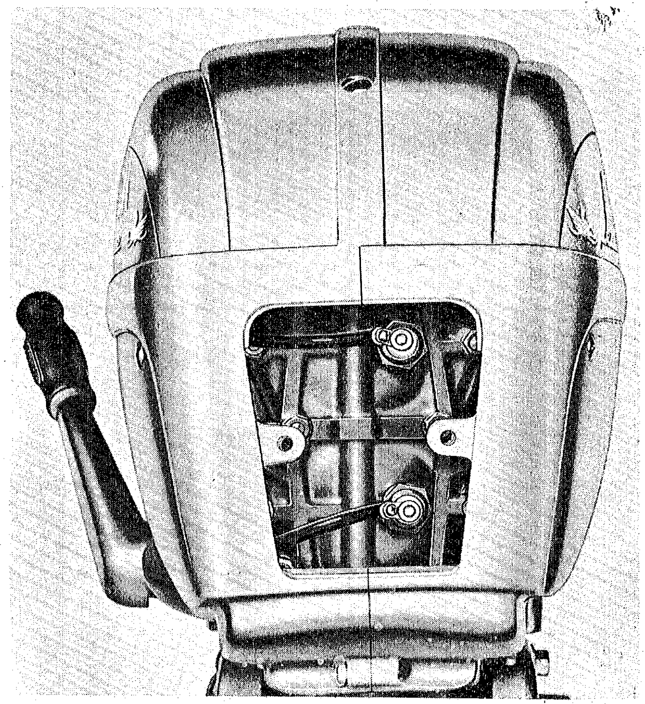


Showing Position of Breaker Brackets and Push Rods Prior to Installing the Flywheel.

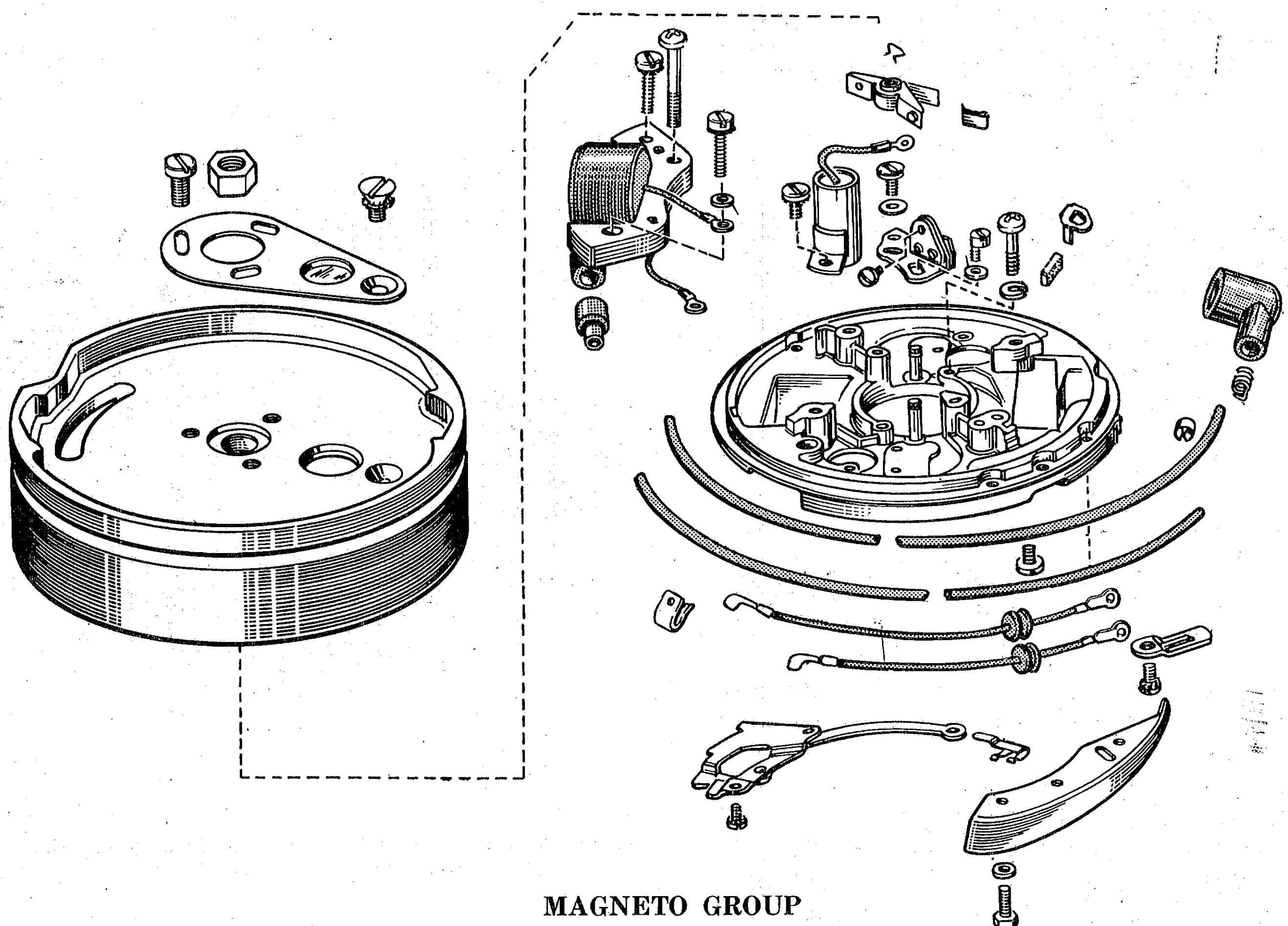
Note position of key in taper of the crankshaft and position of keyway in flywheel hub—turn crankshaft so that when the key and keyway in the flywheel hub are in line for assembly, the high side of the breaker cam (on flywheel hub) falls midway between the breaker push rods. Care must be exercised when performing this installation to prevent high side of the cam from causing damage to one of the push rods and possibly the bracket, if forced.

When in proper alignment, carefully push the flywheel down over the crankshaft taper against tension of the bearing seal spring (be sure spring and washers are in place prior to attaching the flywheel). Install and tighten the flywheel nut as instructed, pages 13 and 362. Adjust breaker points as instructed.

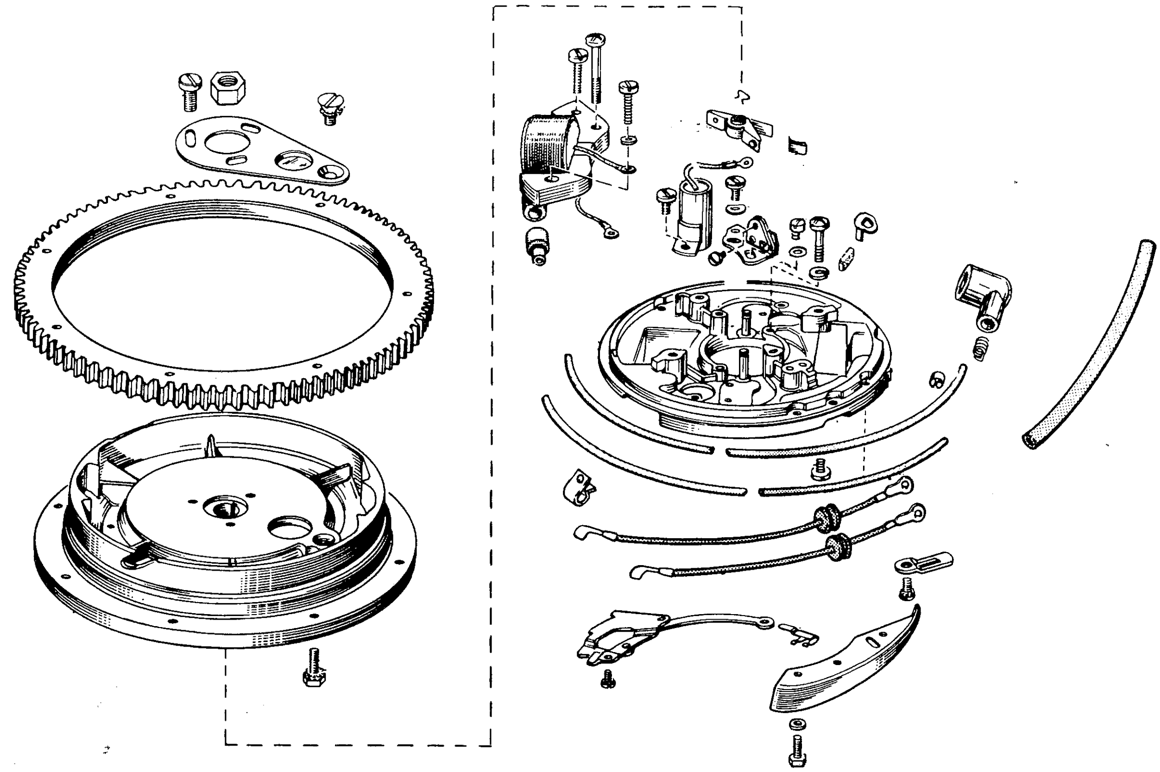
NOTE: If the breaker points are properly set for gap, they need not be disturbed in event it becomes necessary to remove and install the flywheel for other reasons. Simply make sure the high side of the cam in the flywheel comes to rest midway between the push rods and that the push rods are seated against the breaker point spring. They can slip out and be damaged by the cam during flywheel installation unless caution is exercised in this manner.



Spark Plug Cover Removed to Make Plugs Accessible for Removal.



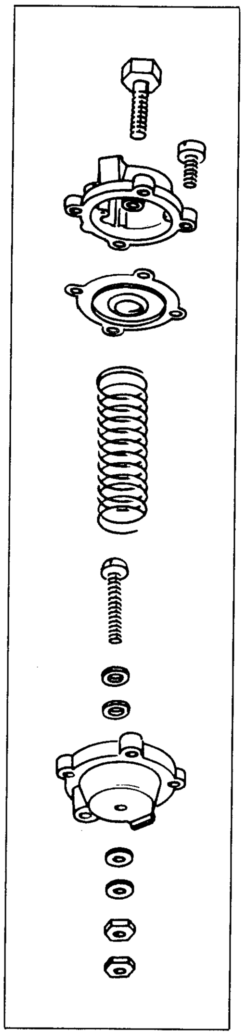
MAGNETO GROUP
Models QD-QDL-12 Up



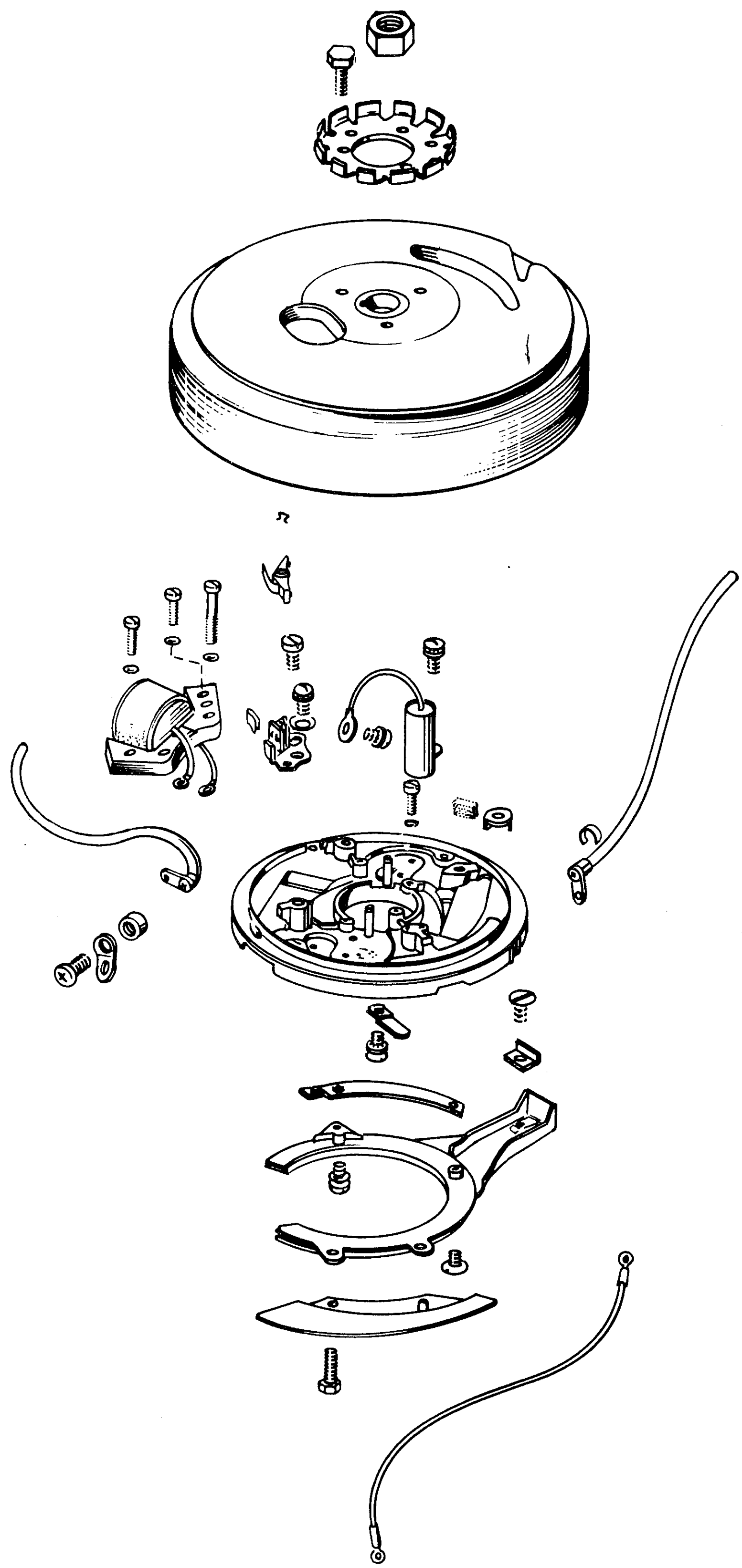
MAGNETO GROUP
Models FD, FDE-10 Up

NOTES

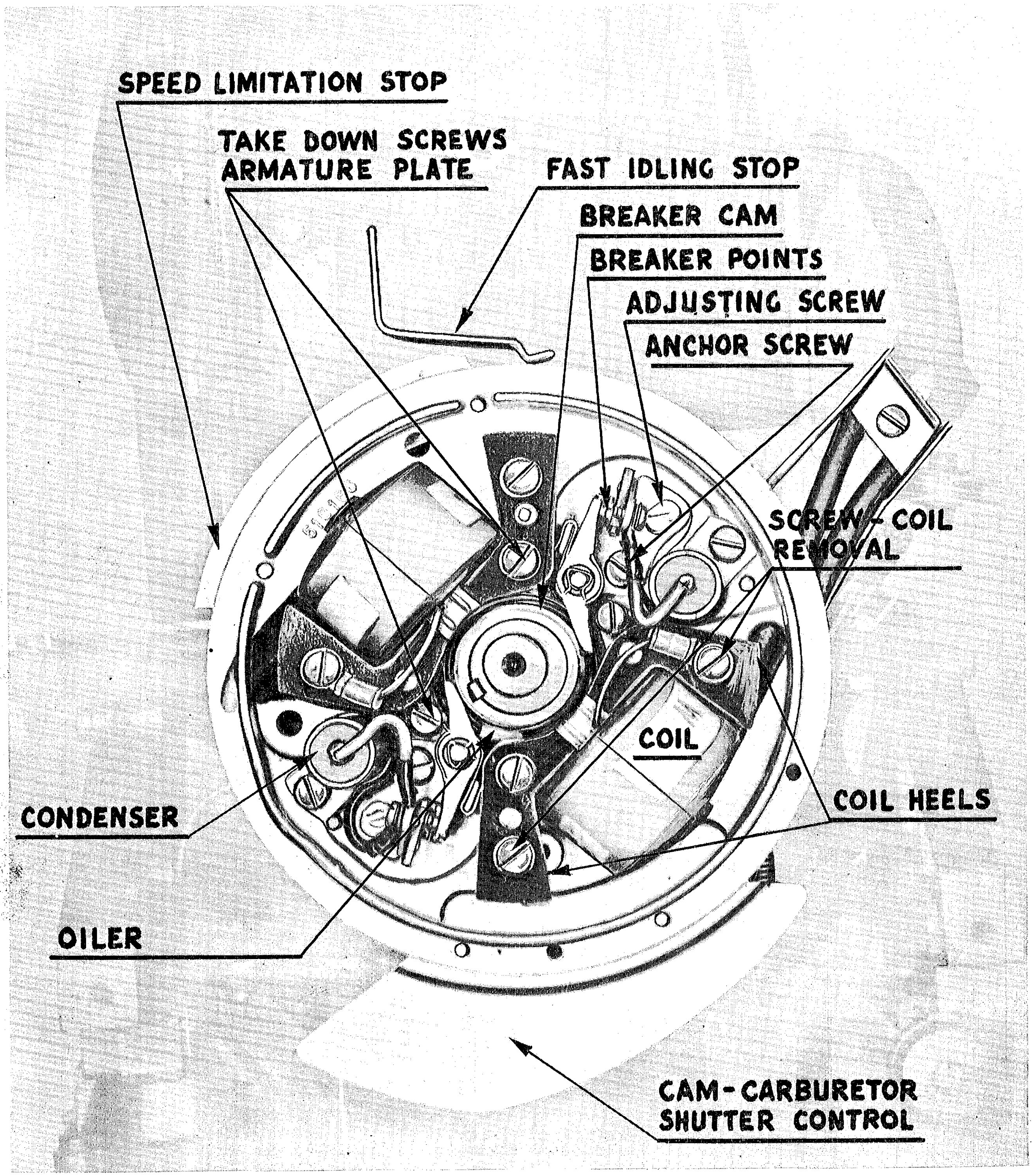
NOTES



USED ON MODELS
RD, RDS-10, 11, 16, 17, 18



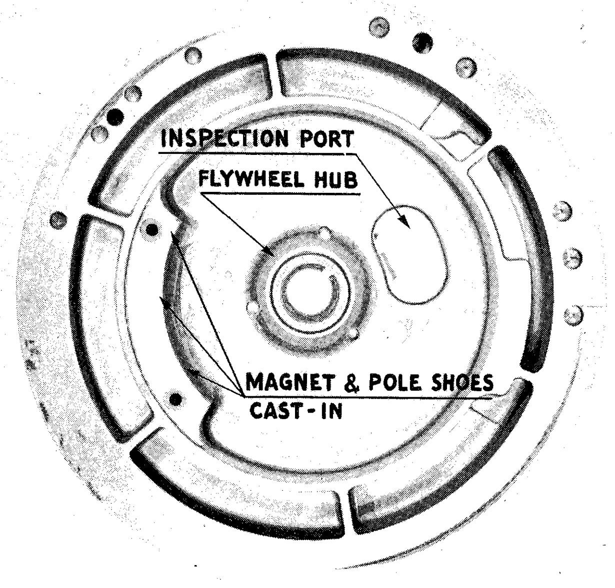
Assembly Layout – Automatic Cutout and Magneto – Models RD-10 through 19C



Magneto Armature Plate – Model RD Series.

MAGNETO—MODEL RD

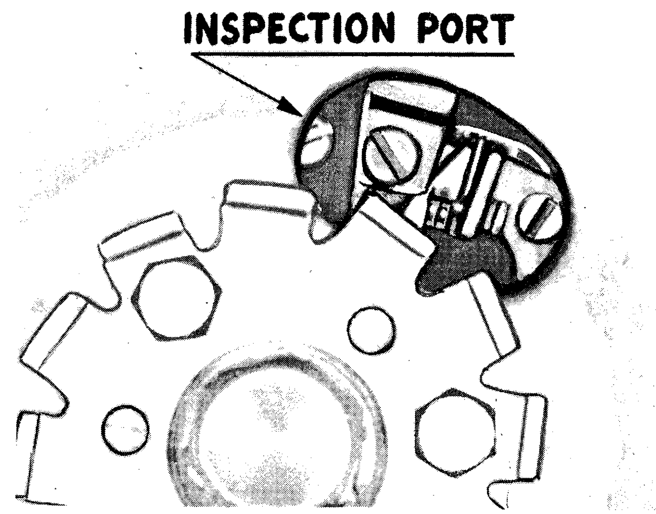
Ordinarily the ignition system requires little attention except for replacing of spark plugs and occasional cleaning and adjusting of the breaker points — at times, replacing the breaker points, ignition coils and/or condensers when necessary to restore sparking at the plugs in event of failure. Should there be reason to suspect faulty ignition because of hard starting, irregular operation of the motor or failure to start at all, disconnect and remove both spark plugs; ground one of the spark plug leads (wires) to a convenient part of the motor—hold the "live" end of the lead snugly against the cylinder block or other part of easy access; hold live end of remaining lead approximately 1/8″ from some part of the motor—not too near the open spark plug port in the cylinder head to guard against igniting fuel vapor escaping from the cylinder; pull rapidly on starter grip to crank the motor; if the magneto is functioning in good order a strong spark should be noted "jumping" the 1/8″ gap between the live terminal lead and the motor block. Repeat operation for other spark plug lead.



Flywheel.

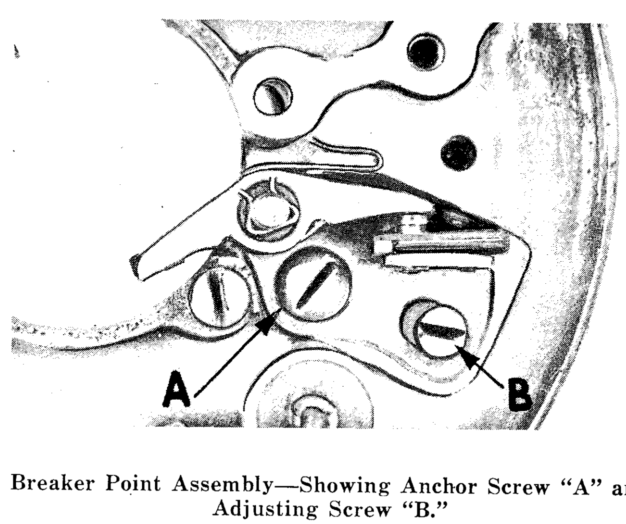
Condition of the spark plugs can be checked in same manner—attach leads to the spark plugs for this operation; however, weak or intermittent sparking (at the spark plug) is often caused by corroded, pitted or improperly adjusted breaker points; faulty condenser; faulty ignition coils; loose electrical connections; faulty insulation. See check chart.

Check the spark plug for excessive carbon accumulation, proper gap between the points—correct setting is .030″. If fouled (shorted) or there is evidence of considerable erosion or "burning" away of the electrodes to make readjusting the point gap impractical, discard the plug for a replacement. Install new recommended spark plug.



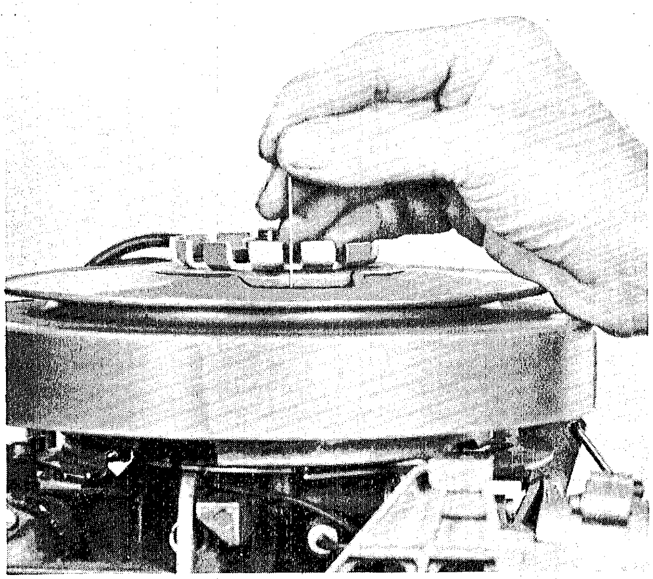
Breaker Points Accessible Through Port in Flywheel for Inspection and Adjusting.

When required to check breaker point gap, clean or adjust the breaker points, turn the flywheel over by hand until port or elongated opening comes to rest immediately above the breaker point assembly to make accessible for the operation. Breaker point surfaces become oxidized or coated, thus requiring occasional cleaning after long periods of idleness which sets up a barrier in the primary circuit to result in faulty sparking at the spark plug or complete failure of spark. In like manner, faulty spark occurs when the breaker point surfaces become "rough" or pitted after long service. To function properly, the breaker point surfaces must bear flatly against each other when gap is closed; be clean and smooth and adjust to recommended gap clearance of .020″ when fully open or separated.



Breaker Point Assembly—Showing Anchor Screw "A" and Adjusting Screw "B."

Breaker points may be cleaned with a breaker point dresser—this operation is carried on through the port in the flywheel. To dress or clean with point dresser, spread points with finger or blunt instrument sufficiently to permit inserting the point dresser after which work up and down until surfaces are clean and smooth. After having dressed or cleaned the points in this manner, insert a piece of paper between the points and in similar fashion work up and down to remove the traces of dressing material which may have lodged between the points to prevent good contact.

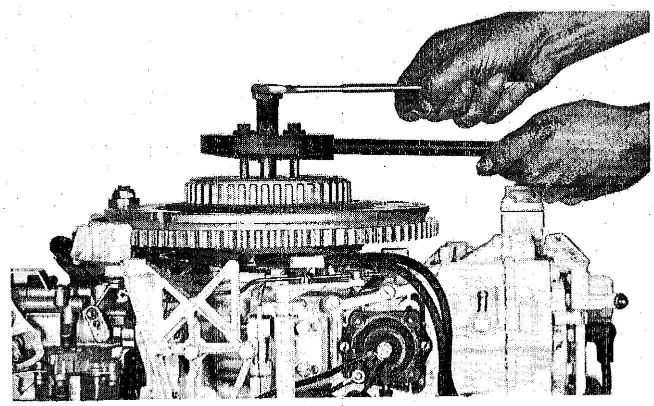


Checking Breaker Point Gap with Feeler Strip Through Inspection Port in Flywheel.

To adjust breaker point gap: Note that breaker point action is by rubbing block on the breaker arm following contour of the cam (eccentric) attached to the crankshaft (since the breaker arm "pivots" on its post, gap opens and closes as the rubbing block rides high and low sides of the cam —eccentric) and that breaker base assembly is held fast to the armature plate by two screws—namely, (A) the anchor or pivot screw and (B) the adjusting screw. Head of the adjusting screw is eccentric and "rides" the elongated slot in the breaker base plate. Turning screw (B) to right or left causes the breaker plate to "swing" or pivot on screw (A)—thus, breaker gap setting is accomplished by shifting the breaker base plate toward or away from the breaker cam on the crankshaft. Breaker point gap is increased by moving the assembly toward the cam—decreased when moved away from the cam.

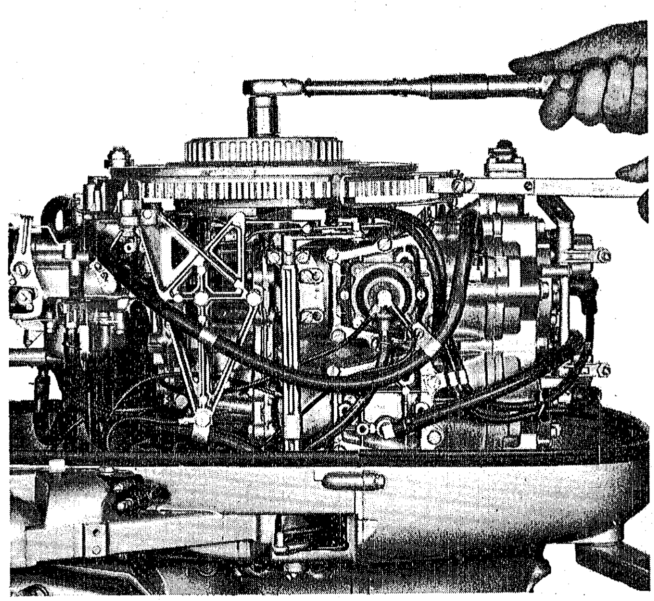
Turn flywheel until rubbing block rides on high side of the cam—maximum gap opening. Insert gauge strip of .020″ thickness to check gap. In event the gauge strip "fits" too tightly or loosely, loosen slightly anchor screw (A); turn adjusting screw (B) to right or left to obtain the desired gap opening. When correct, both faces of the gauge strip should bear slightly against both breaker point faces—"fit" the gap without tightness or excessive looseness. Draw down on anchor screw (A) to insure position of breaker base assembly. Repeat as above to adjust gap of other breaker point set.

To replace or install the breaker point assembly, condenser, ignition coil or spark plug leads, it becomes necessary, after having removed the starter assembly, to remove the flywheel. See Instructions, page 13.



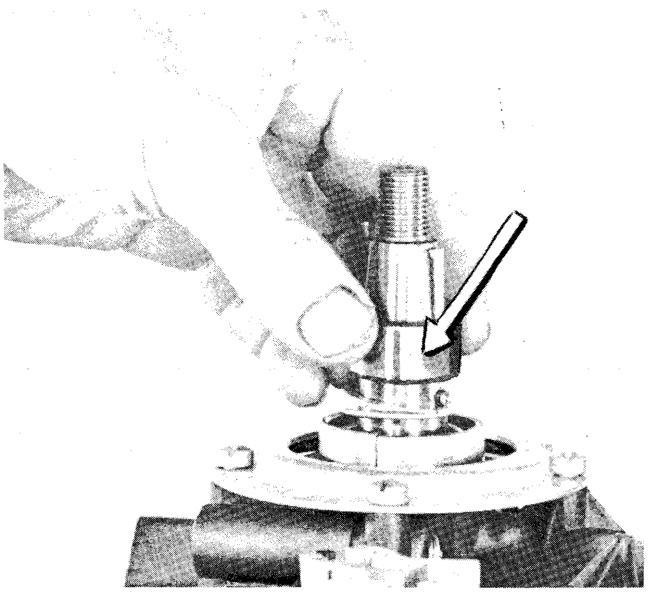
Removing Flywheel from Crankshaft Taper with Puller.

To remove and install the flywheel: Remove the flywheel nut — attach Flywheel Puller (Special Tool #378103) (turn large center screw to outer limit — attach to flywheel with screws provided); turn large center screw down until it comes to rest against the end of the crankshaft; hold flywheel and flywheel puller with bar — turn down on large screw with wrench until flywheel can be lifted from tapered end of the crankshaft.



Showing Torquing Flywheel Nut. See Torque Chart, page 362, for Torque Specifications. Note use of Holding Wrench on Flywheel for Torquing.

To install the flywheel, check first condition of the flywheel key and its location in the keyway on tapered end of the crankshaft; make certain surfaces of the crankshaft taper and corresponding surface in the flywheel hub are clean, smooth and *dry* (use no oil or grease on surfaces prior to installing the flywheel); carefully place flywheel in position – aligning keyway in hub with key on the crankshaft. Note: Be sure to remove traces of oil or grease from crankshaft taper and taper in flywheel – assemble "dry" to properly seat flywheel on the crankshaft. This is IMPORTANT. Torque flywheel nut. See Specifications, page 362.

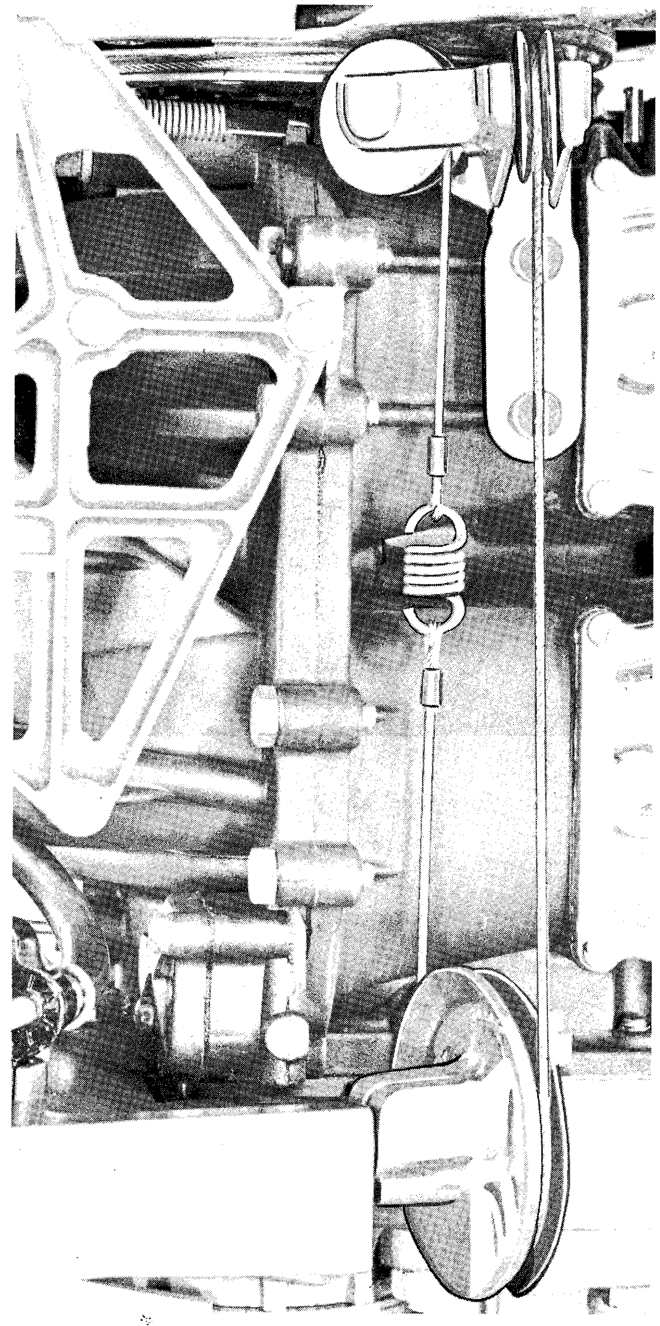


Installing or Removing Breaker Point Cam.

To remove and replace breaker cam: inside surface of the cam is slotted to "fit" over key in crankshaft taper and driving pin near end of the taper—simply lift off to remove; to replace, align slot in cam with key and pin in the crankshaft—push down squarely and carefully over the crankshaft. Do not force—if lined up squarely it will slip easily into position.

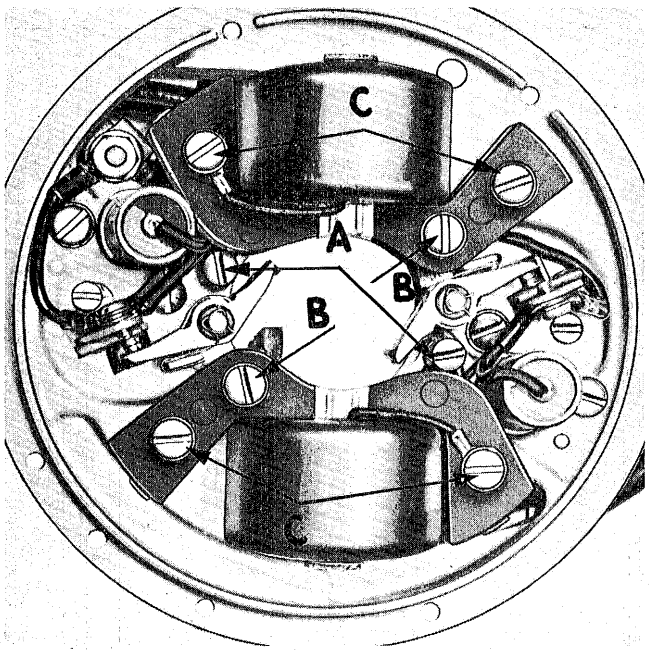
To remove and install condenser: simply disconnect the condenser lead; remove the screw holding condenser fast to the armature plate; lift off; install new condenser in reverse order—making sure that all "contact" surfaces are clean and free of foreign matter and that terminal nuts or screws are made secure to guard against faulty ignition —all electrical connections must be clean, free of corrosion and tight.

To remove and install breaker point assembly: disconnect the ignition coil primary and condenser leads from breaker point assembly; remove anchor and adjusting screws; lift from position; install new breaker point assembly in reverse order and like the condenser, all electrical connections must be free of corrosion, clean and tight to assure proper sparking—adjust wires (leads) to rest close to assemblies to prevent "rubbing" against breaker cam or hub of flywheel to eventually cause short circuit and faulty ignition.



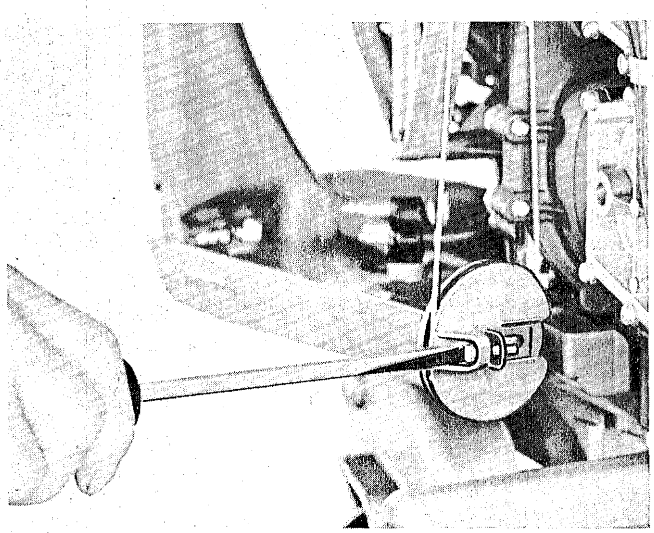
Cable Arrangement—Speed Control.

To remove and replace armature plate: "spark" and "gas" are synchro controlled — functioning through a system of cam and linkage to proportion volume of fuel-vapor charge with respect to degree of spark advance throughout speed range of the motor—desired motor speed is by way of twist grip located at end of the steering handle through pulley and stranded wire cable (anchored to armature plate); reduce tension on stranded cable as shown by releasing the tension adjusting



Armature Plate.

bracket on pulley; loosen clamp screw holding pulley fast to shaft; remove pulley and cable assembly from the shaft; remove screws A, B and C on armature plate; lift armature plate assembly free of the crankcase; replace armature plate and cable assembly in reverse order of that described above. Note the method of attaching ends of cables to the armature and small steel ball "swedged" to the cable to prevent slipping over the pulley and tension adjusting bracket; turn up on tension adjusting screw until the cable is taut with slight

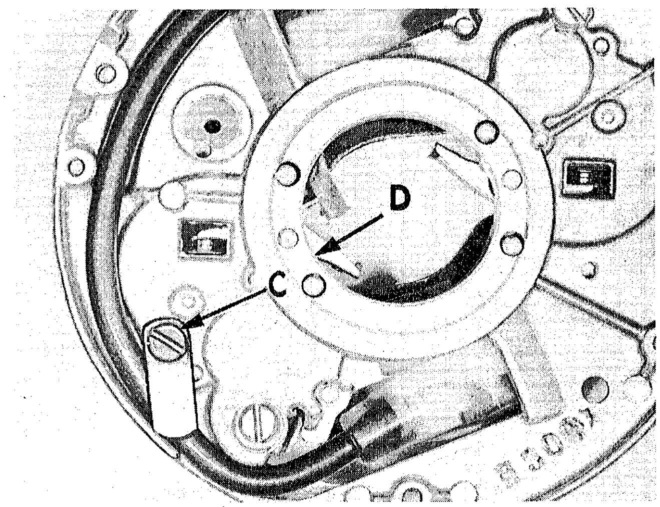


Releasing or Adjusting Tension of Control Cable.

tension only on the spring. Some tension or "drag" against free turning of the armature plate is required for satisfactory speed control. The armature plate in this case is assembled to the crankcase by means of four screws (A and B) driven into a ring which bears against a comparatively large "wave" washer installed between the ring and a bracket attached to the crankcase. Wave or curvature of washer band when compressed, acts to build up spring action or tension between bracket and ring into which screws are driven from the armature plate.

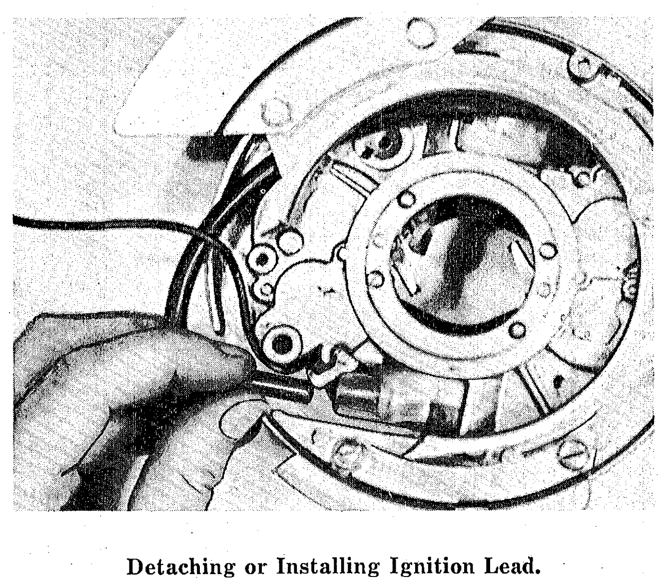
NOTE: When replacing the armature plate, turn high side of the breaker cam (on the crankshaft) toward core in center of the ignition coil indicated by arrow as required to avoid damage to rubbing blocks on the breaker point arms and for ease of assembly.

To remove and replace the ignition coil: Remove screws "A" and "B" to detach armature plate—lift from crankcase; remove screw "D" under the armature plate; pull ignition lead free from coil; remove screw "C"; lift coil from its position. Note



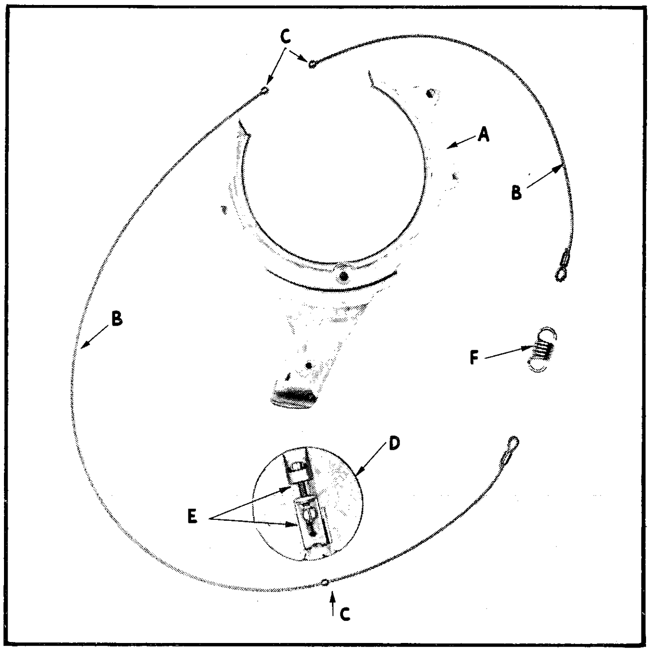
Showing Clip and Screw "C" to Secure Position of Ignition Lead.

that the ignition lead is inserted over a "needle" imbedded in coil tube; install new coil in reverse order—coat end of the ignition lead liberally with DC-4 (a Dow Chemical product) if available, to further insulation at this point; force end of the ignition lead into the coil tube—"needle" penetrat-

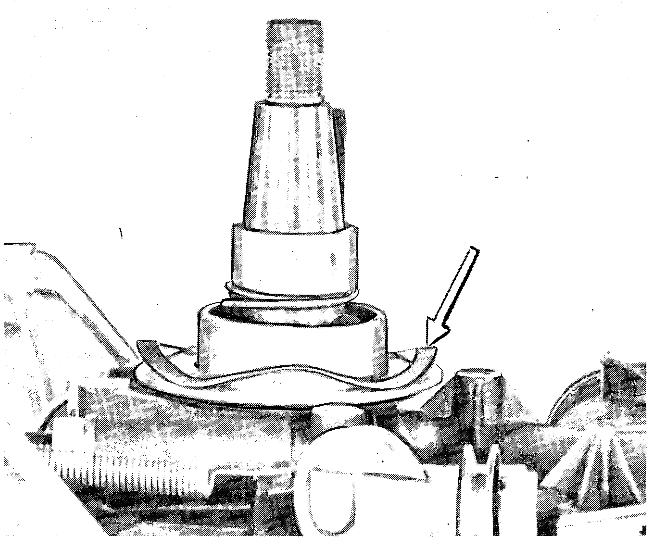


Detaching or Installing Ignition Lead.

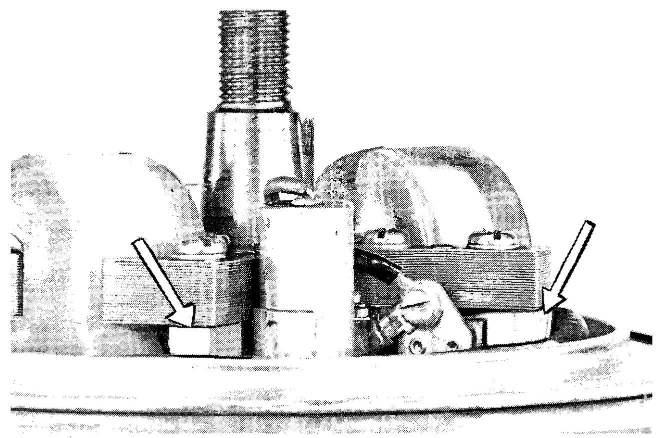
ing stranded core of the lead to insure contact. Insert and tighten screws "A" to hold armature plate fast to the crankcase; insert screws "B" and "C" and draw up to hold—snugly but not tightly at this time; note machined bosses on armature plate casting—adjust position of the coil to where face of the coil heel rests "flush" with face of the machined boss; draw up tightly on screws holding coil fast to the armature plate—this operation provides correct clearance or space between coil heels and pole shoes of the magnet cast into the flywheel; replace screw and clip holding ignition lead fast to the armature plate; repeat in like manner for installation of both coils.



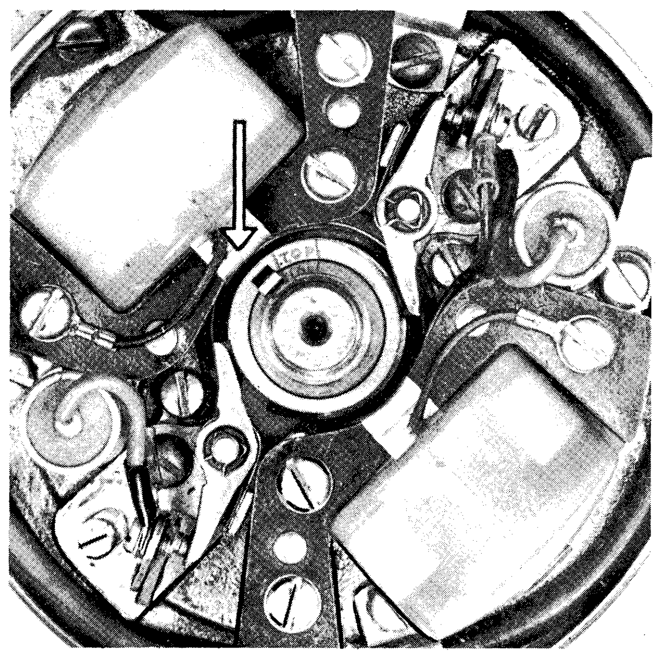
Underside Parts of Armature Plate Showing Synchro-Control Mechanism "A"—Pulley (Attached to Armature Plate); "B"—Control Cable; Beads "C" to Secure Position; Pulley "D" with Arrangement "E" to Adjust Cable Tension Applied to Spring "F."



Showing Location of "Wave" Washer.



Showing Coil Heels Installed "Flush" with Corresponding Boss on Armature Plate Casting.



Showing Position Recommended for Breaker Cam to Avoid Injury to the Breaker Arm Rubbing Blocks when Installing the Armature Plate—High Side of Cam Contour Directed Towards Center Core of the Ignition Coil.

AUTOMATIC CUT-OUT – RD SERIES

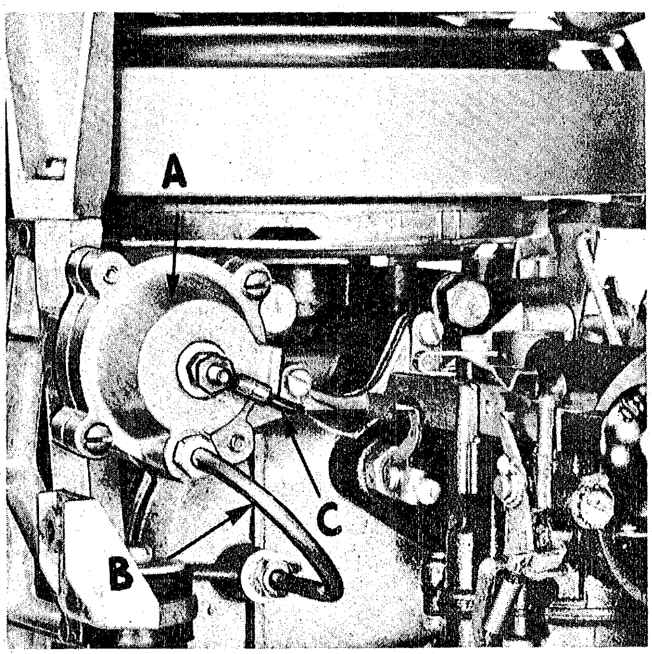
When checking the RD Series, a device will be noted attached to crankcase assembly, "piped" to the intake manifold and wired to the armature plate – employed only on the RD Series.

The purpose of this device is to momentarily cut out ignition at the top spark plug (idling only), thus, limiting maximum speed at which the motor may operate when set for idling in neutral. It consists of a spring loaded diaphragm encased in a housing and piped to the intake manifold. Action is such that when suction in the manifold reaches a certain predetermined point, the diaphragm flexes against spring tension to make a "ground contact"—cutting ignition at top spark plug. As suction in the manifold decreases the diaphragm resumes its normal position and subsequently breaks ground contact to permit firing of both spark plugs.

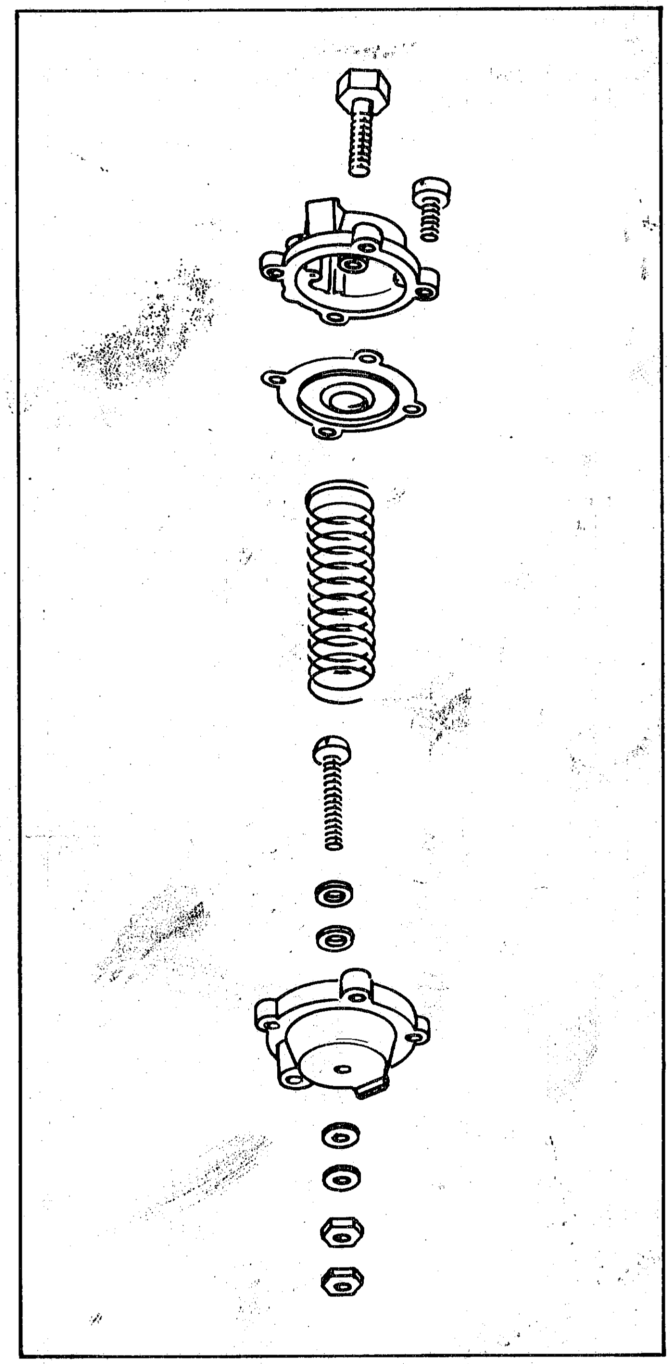
Manifold suction is governed by the degree of carburetor throttle opening and speed at which an engine operates. Normally, manifold suction is high in any engine when operating with closed throttle, becoming proportionately lower with the opening of the carburetor throttle. Otherwise, for purpose of illustration, it may be said that manifold pressure is but slightly less than normal atmospheric pressure (15 pounds per square inch—sea level), with full open throttle and engine running at top r.p.m. (full load)—maximum suction or low pressure occurs when running with closed throttle at a fast idle under no load.

Arrangements have been made for Neutral, Forward and Reverse. The motor can be started in Neutral and run at idling speeds as long as the operator desires or until ready to shift into Forward or Reverse. This speed control or automatic cut-out as described, normally acts during Neutral running when suddenly decelerating from fast idle, therefore necessary in a motor (2 stroke cycle) the size of a 25, where provisions are made for idle running; it does not normally function, however, when operating under load in Forward or Reverse.

Conditions under which the control operates to limit maximum idling speed are as follows: If, when running the motor at fast idle in Neutral (2000 r.p.m. or more) the throttle is suddenly closed, a surge or sudden increase in manifold suction is introduced. Under influence of abnormal manifold suction in this instance, the mixture is not consistently ignited but will tend towards firing erratically to result in irregular but excessively strong power impulses to speed up the motor even though the throttle is closed. Resultant high motor speed cannot, under the circumstances, be otherwise reduced or controlled by conventional method of simply retarding the spark, thus the necessity of providing other means to accomplish this purpose—the automatic cut-out or speed control as described.

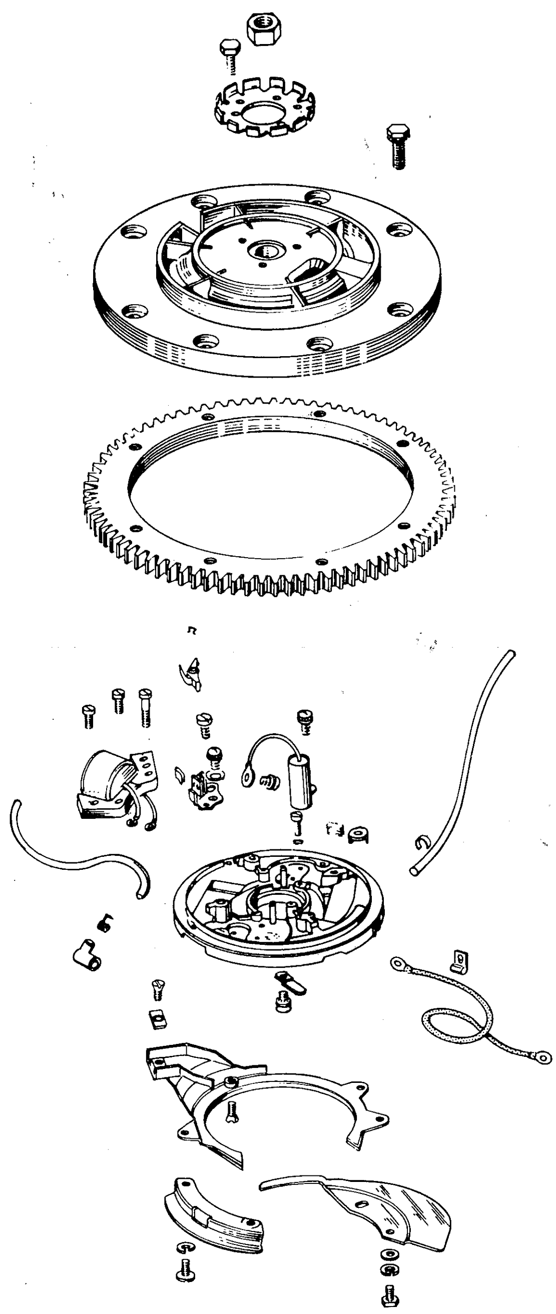


Showing Position of the Automatic Cut-Out "A" Attached to Models RD-10 and 11 Powerheads; "B"—Copper Tube to the Intake Manifold and "C"—Ground Lead to Armature Plate (to Ground Out Momentarily One Set of Breaker Points—See Explanation).



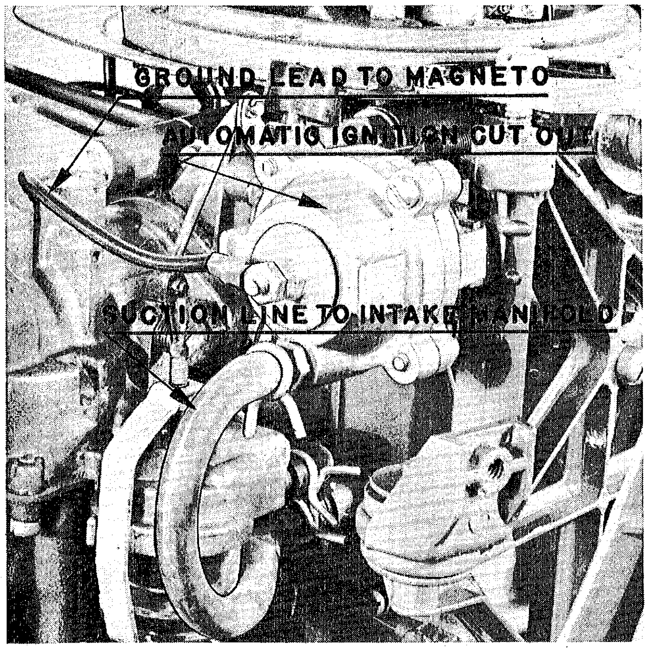
Assembly Layout of the Automatic Cut-Out. Used on Models RD, RDE-10, 11, 16, 17, 18

MODEL RDE MAGNETO



Models RDE-16 through 19C.

AUTOMATIC IGNITION CUT-OUT— MODELS RD AND RDE



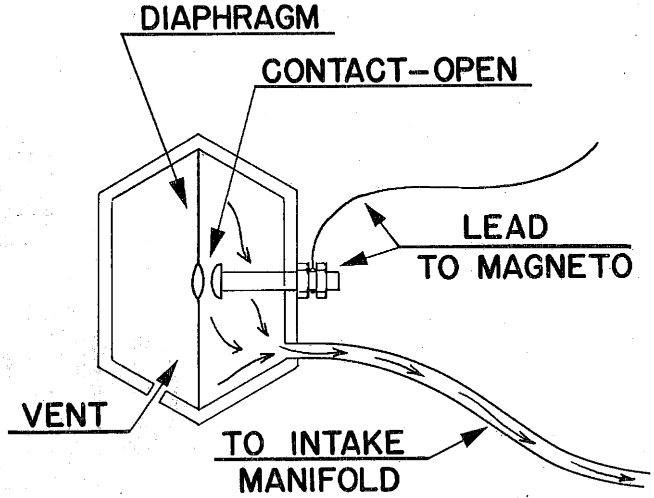
Showing Location of the Automatic Ignition Cut-out.

It will be recalled that in 1951 when the Model RD was in its first year of production, an automatic ignition cut-out attached to the crankcase, piped to the intake manifold and wired to the armature plate, was installed. It was later removed but has since been reinstated in Model RD and RDE-16 up.

Construction of the cut-out is of simple design consisting of a housing which includes a spring loaded diaphragm with contact button grounded to the housing and an insulated "contact" with a lead to the insulated side of the lower (cylinder) breaker point assembly to complete the ground circuit when diaphragm contact is established. An outlet leading to the intake manifold is provided to permit manifold pressure (suction) acting on the diaphragm as illustrated and described below.

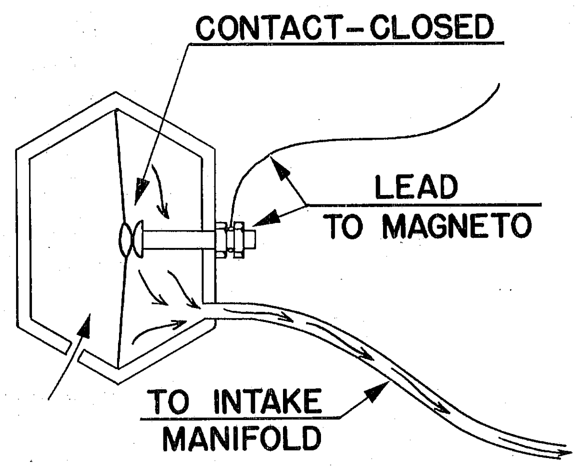
Purpose of the device is to **momentarily** cut out ignition at the bottom spark plug when idling in neutral only, thus limiting maximum speed at which the motor may operate when set for neutral running. It consists of a spring loaded diaphragm encased in a housing "piped" to the intake manifold with a ground contact wired to the breaker point assembly acting on the bottom plug.

Performance is such that when "suction" in the manifold reaches a predetermined point, the diaphragm is caused to flex and overcome tension of a spring acting against it to make ground contact which "cuts" sparking at the bottom plug. Suction in the manifold decreases with resulting drop in motor RPM's — the diaphragm then returns to its normal position to break ground contact and the magneto resumes firing on both plugs — It must be remembered that "grounding" of the bottom plug is but **momentarily** and only when idling in neutral as explained below.



Schematic (sectional) Drawing to Illustrate Position of Diaphragm with Relation to Ground Contact when Operating at Normal Manifold Pressure — Diaphragm Spring Omitted for Purpose of Illustration.

Manifold suction (pressure) is controlled by degree of carburetor throttle opening and speed at which the engine operates; ordinarily high in any reciprocating engine operating at closed throttle and becoming proportionately less with increase of throttle's opening. Otherwise, for the purpose of illustration, it may be said that manifold pressure is but slightly less than atmospheric (approximately 15 pounds per square inch — sea level) with full open throttle and engine running at top RPM— full load. Maximum suction or low pressure occurs when running with closed throttle at fast idle— under no load.

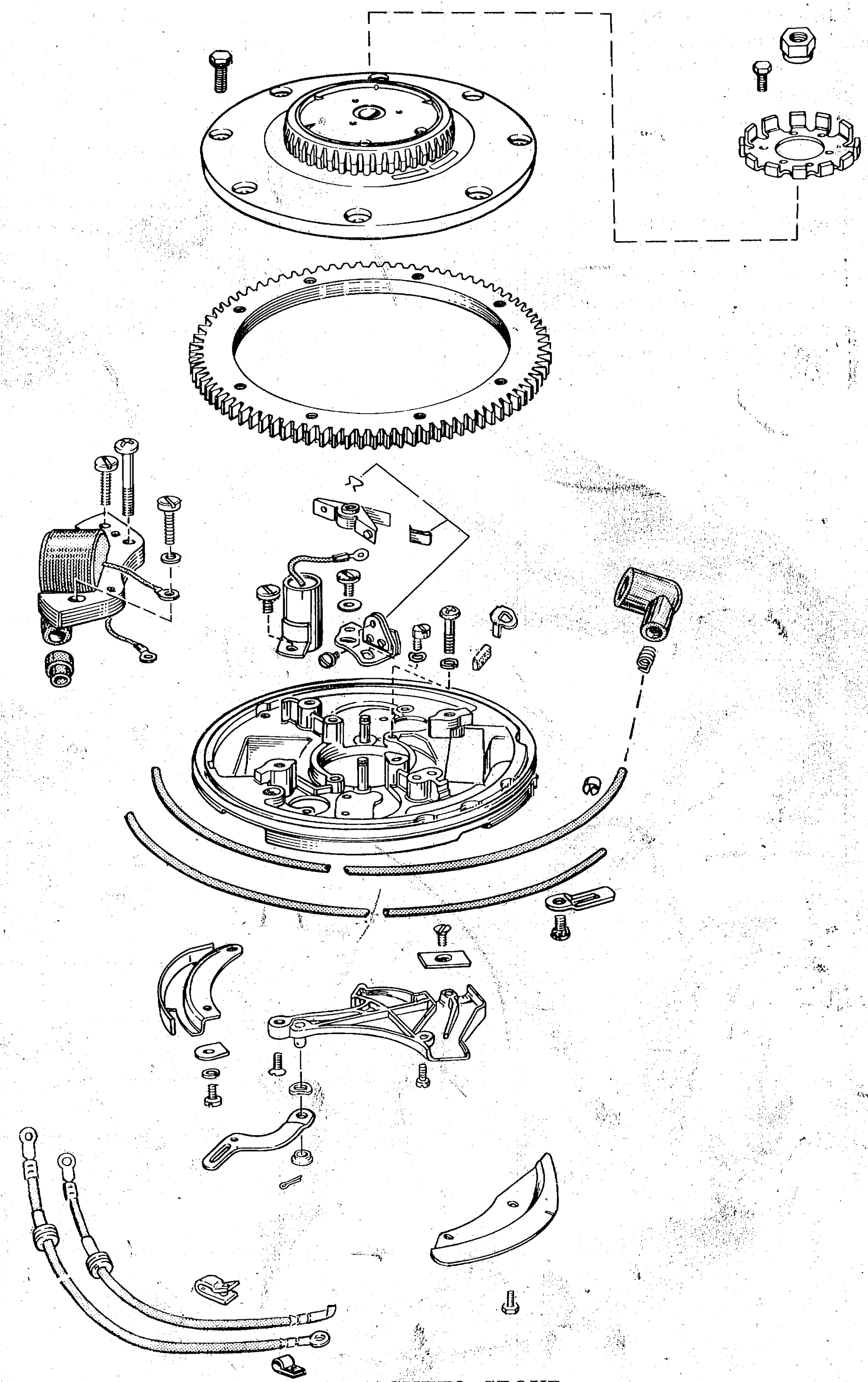


Schematic Drawing to Illustrate Diaphragm Making Ground Contact as Result of Abnormally High Manifold "Suction" on Instant of Rapidly Throttling from High to Slow Idle Speeds when in Neutral—Diaphragm Spring Omitted for Purpose of Illustration.

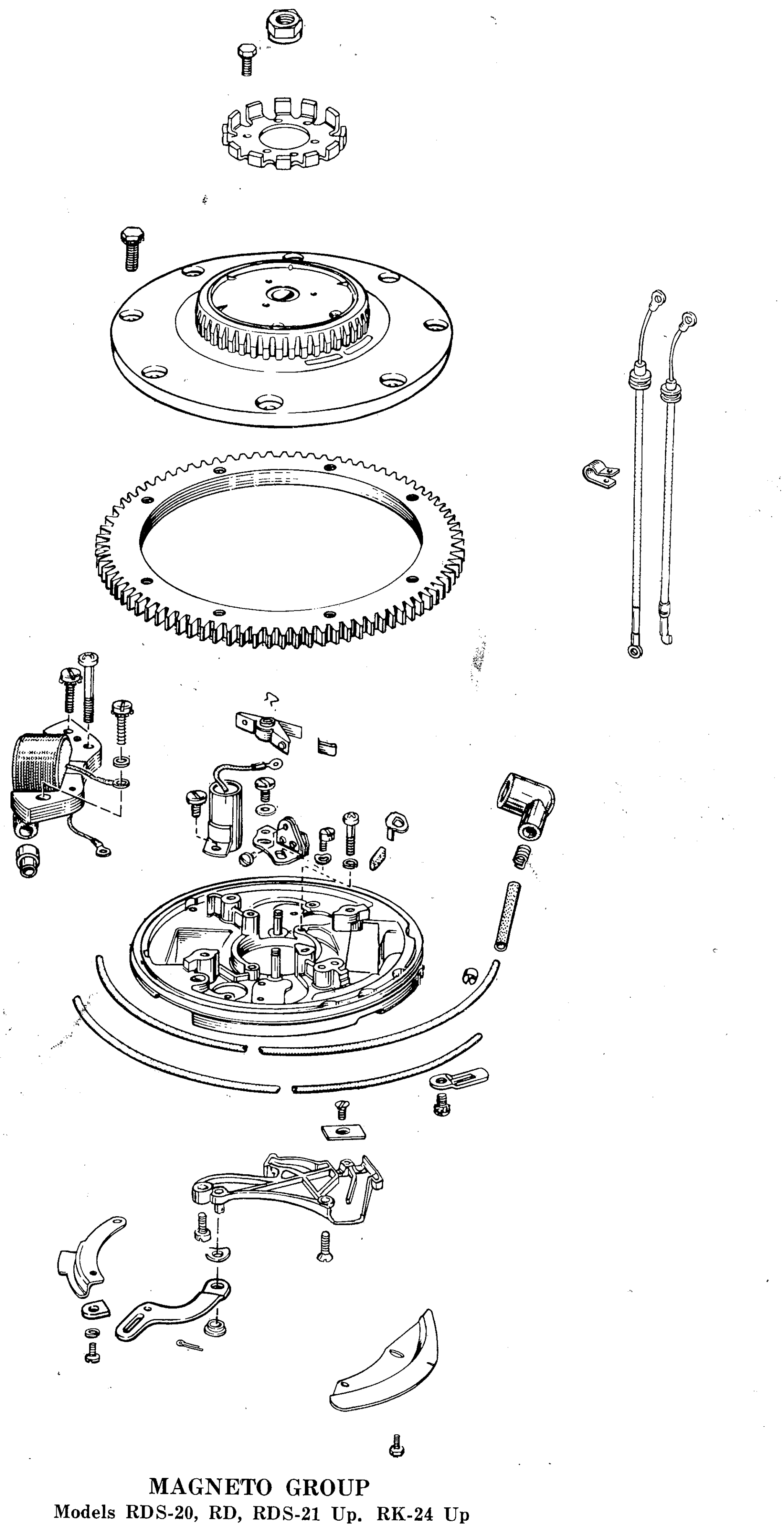
Conditions under which the cut-out functions to limit maximum idling speed are as follows: If when running at fast idle in neutral (2000 RPM or more), the throttle is suddenly closed, a surge or sudden increase in manifold suction is introduced. Under influence of abnormal manifold suction in this instance, the fuel vapor mixture is not consistently ignited but will tend towards firing erratically (as combustible mixtures form*) to result in irregular but excessively "strong" power impulses to sharply increase motor RPM's even though the throttle is closed — Resultant high motor speed (RPM's) cannot under the circumstances be otherwise reduced or controlled by simply closing the throttle and since no manually operated ground switch is employed, other means are required — thus, the automatic cut-out as described and illustrated above.

*NOTE—A combustible mixture is fundamentally one in which fuel and air are correctly proportioned (mixed) to permit combustion. In event of too much fuel and not enough air, the mixture will fail to ignite (too rich), or, if too much air and too little fuel (lean) the mixture similarly cannot be made to ignite. Thus, at the moment of rapid deceleration, carburetion is temporarily out of control. Resultant fuel mixture (vaporization) becomes momentarily too rich — rich enough to prevent firing but somehow, during idle strokes of the piston, sufficient air enters to form a combustible mixture which accounts for spasmodic or uncontrolled firing.

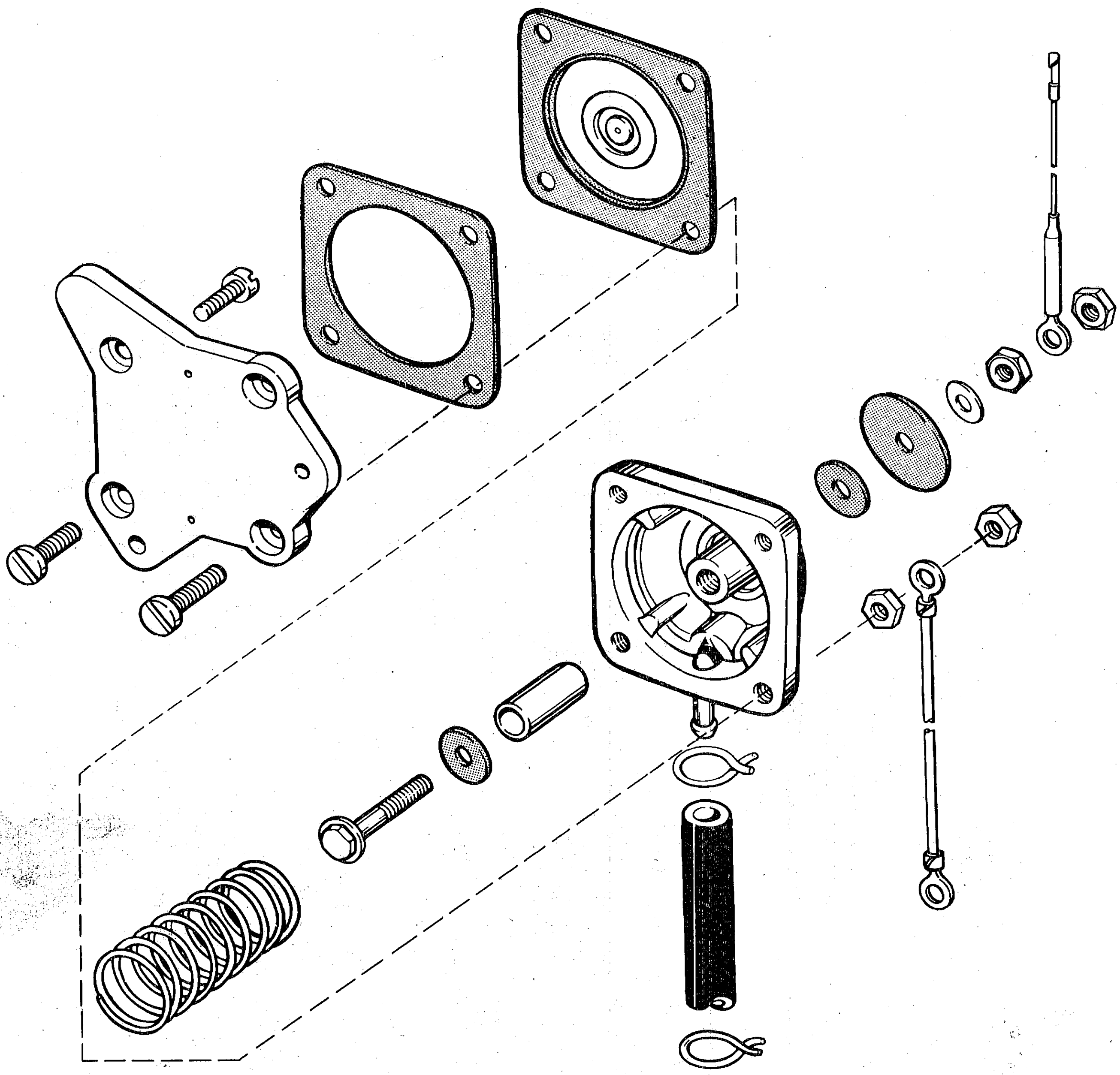
NOTES



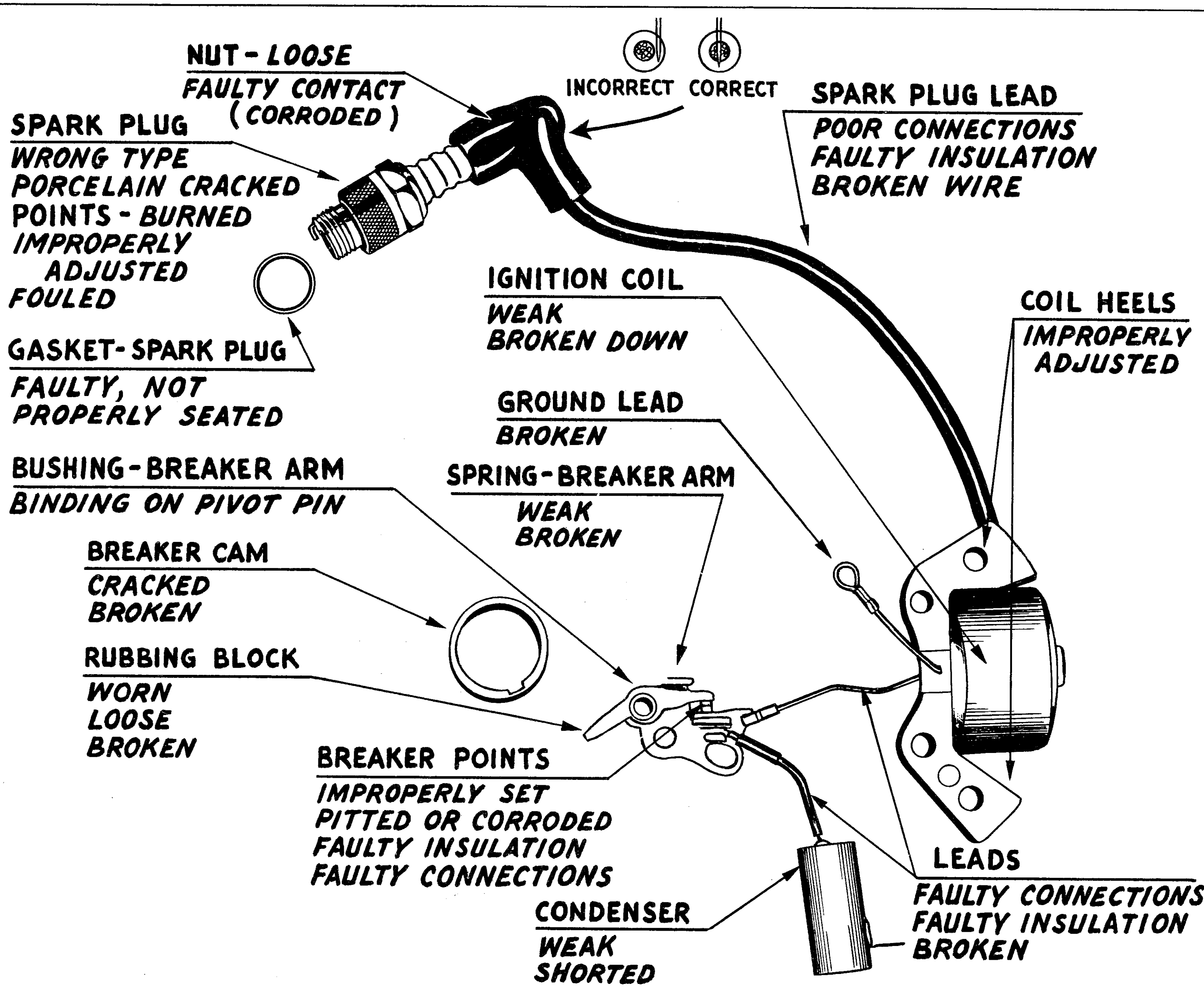
MAGNETO GROUP
Model RX-RXL-10C up



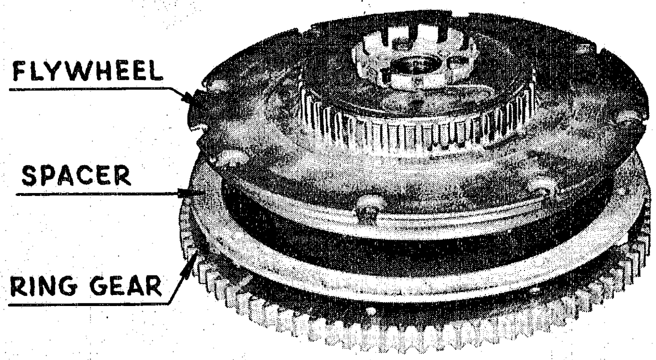
MAGNETO GROUP
Models RDS-20, RD, RDS-21 Up. RK-24 Up



CUT-OUT SWITCH GROUP
RD-19 Series Up
RX-10C Up
RK-24 Up



Magneto—Armature Plate Check Chart.



Three-piece Flywheel on early 1962 — 40 H.P. Engines.

Early 1962 — 40 h.p. engines were built with flywheel assemblies which consisted of three (3) basic components, i.e., flywheel, spacer and ring, or ring gear. Shown above are the three components for an electric starting model. Manual starting engines use a similar assembly, but do not contain a generator pulley, and substitute a ring for a ring gear.

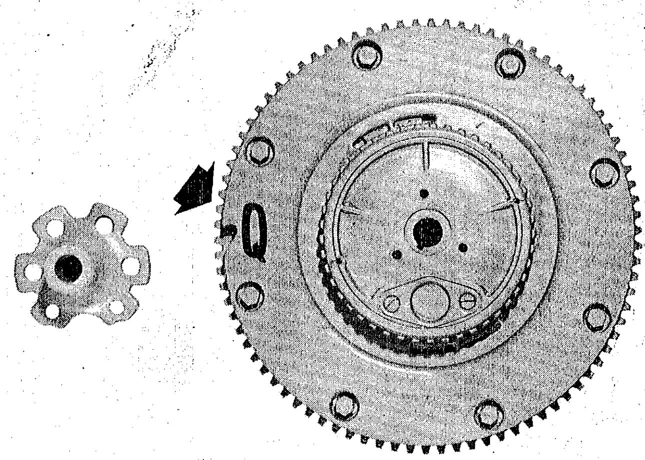
The spacer was used on the early 1962 — 40 h.p. engines to add mass to the flywheel for the purpose of improving motor performance in both the idle and operating rpm ranges. Later 1962 models use rings or ring gears which are made heavier than previous units, and thus eliminate the necessity for a spacer. NEITHER THE SPACER NOR THE NEW RING, OR RING GEAR, CAN BE USED ON PRODUCTION RD MODEL SERIES PRIOR TO 1962.

When assembling the components of both the three-piece and two-piece flywheel assemblies, screw number 309059 must be used because of the increased depth provided by the spacer, the new rings and the new ring gears.

The illustrated spacer is not available as a service part. As a result there are several precautions to be observed whenever the component parts of the three-piece flywheels require replacement. It is consequently necessary to service component parts as follows:

1. FLYWHEELS ONLY. Replace as follows:
   a. Manual *and* electric starting engines — use 580410 Flywheel less ring gear.
2. SPACERS (not serviced). If the spacer cannot be reused for some reason, discard it along with the ring or ring gear, and replace both components as follows:
   a. Manual starting engines — use 1-piece 308853 ring;
   b. Electric starting engines — use 1-piece 308852 ring gear.
3. RINGS OR RING GEARS. When only these parts need replacement, discard the spacer (it cannot be used with the parts specified here), and replace both components as follows:
   a. Manual starting engines — use 1-piece 308853 ring;
   b. Electric starting engines — use 1-piece 308852 ring gear.
4. COMPLETE FLYWHEEL ASSEMBLIES. When required, service as follows:
   a. Manual starting engines — use 580413 Flywheel assembly, complete;
   b. Electric starting engines — use 580412 Flywheel assembly, complete.

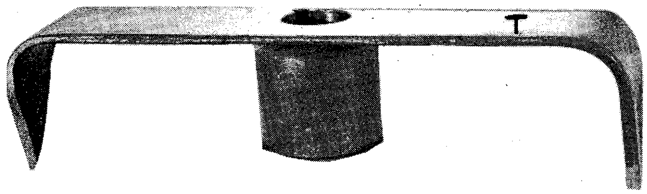
Page 7 of the 1962 model RD and RDL-24M parts catalog contains erroneous part numbers for items 2 and 4. To avoid ordering and servicing the incorrect parts, correct both items as follows:
Item 2 — Change to read 580410 instead of 580409
Item 4 — Change to read 308853 instead of 510320.

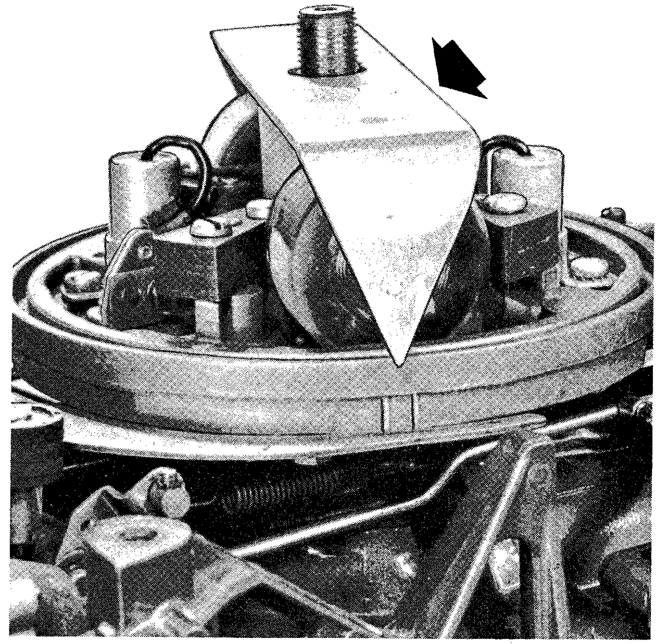


Illustrating strengthened Flywheel Hub and Identification Letter "Q" (arrow) on all Flywheels utilizing strengthened Hub.

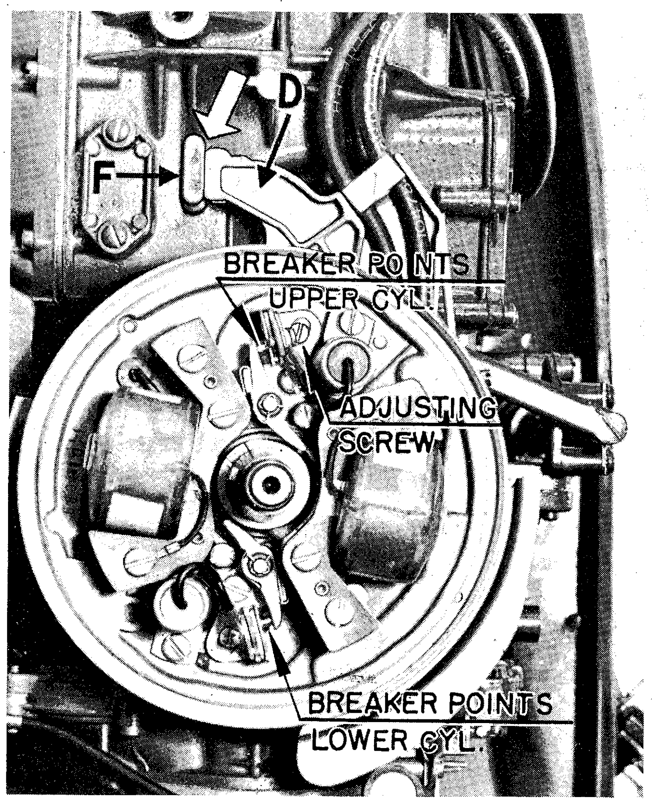
A forged steel hub cast into flywheels for model series RD's since 1959 provides strength superior to any previously used, and is still utilized on current production engines as well as in flywheels intended for servicing engines in the field.

TIMING FIXTURE INSTRUCTIONS





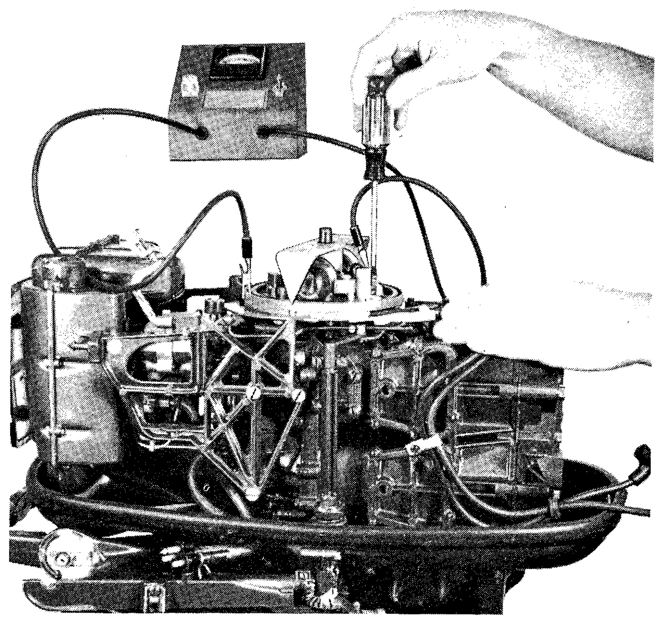
The purpose of this timing fixture is to permit setting of the magneto breaker points accurately and with a minimum of effort. The conventional and familiar method of adjusting the breaker gap with aid of a feeler strip has been dispensed with and succeeded by a somewhat different approach — adjusting to position of point opening as shown here.



To set the breaker points, proceed as follows:

1. It is assumed that the flywheel and spark plugs have been previously removed to expose the armature plate. Note two embossings (about 3/8″ distant from each other) on edge of the armature plate above and that index pointer of the fixture rests midway between the two — position at which the points should just break. Letter "T" on top face of the fixture denotes index pointer for setting *upper* cylinder breaker points — the opposite end of the fixture for the lower cylinder.

2. Install fixture on crankshaft — be sure it seats properly on taper. Tap down lightly with handle of screw driver if necessary. Shunt Stevens point tester (continuity meter) across points by grounding one of the leads to the armature plate and attaching the other to the *insulated* bracket of the point assembly. Set points to close position in conventional manner with screw driver. This presents an opportunity to check continuity across the points — in event needle on meter falls within the red range, point faces should be made clean. Swab off with alcohol. When clean and good contact has been established (needle in green range), proceed with setting.



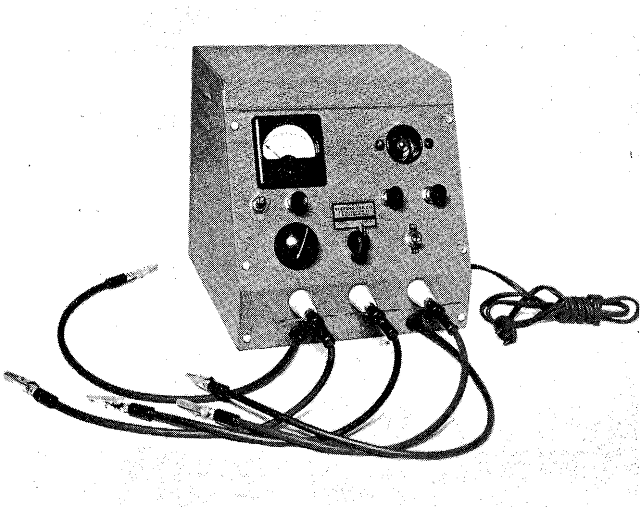
Move spark control to full advance, hold in this position with finger as shown above. With points closed, needle on meter will rest in green range. To insure accurate setting, turn adjusting screw to right until it comes to rest gently on its seat, then back off (turn left) approximately 1/2 turn. Turn adjusting screw slowly and carefully to right until circuit across the points breaks (arrow falls back to normal "rest" position). Under no circumstances back off on the adjusting screw to achieve final "break" setting — in event of having "gone by," back off 1/2 turn, then carefully turn right to position of points breaking.

Caution — Make certain the adjusting screw head rests fully in the slotted hole in the breaker bracket — to prevent the bracket "creeping" underneath. Anchor assembly in this position.

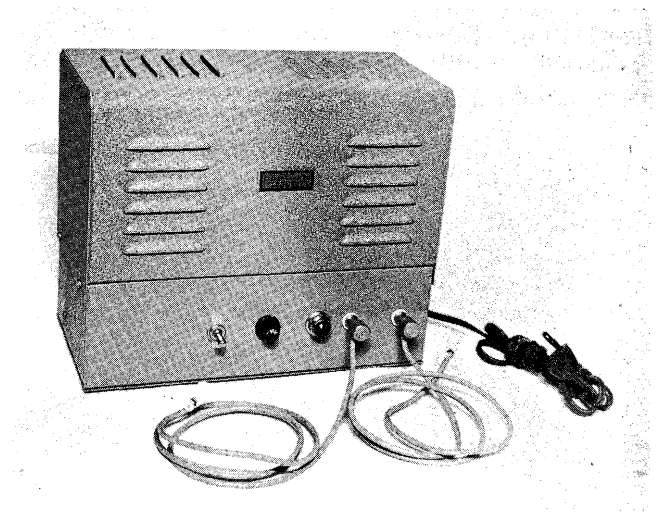
3. Turn motor 180° with fixture until opposite index finger falls midway between embossings. Repeat the same operation for remaining set of breaker points.

NOTES

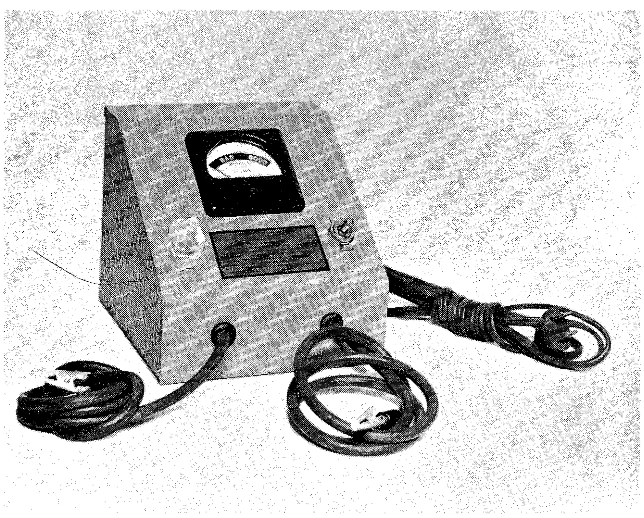
IGNITION SYSTEM TESTING



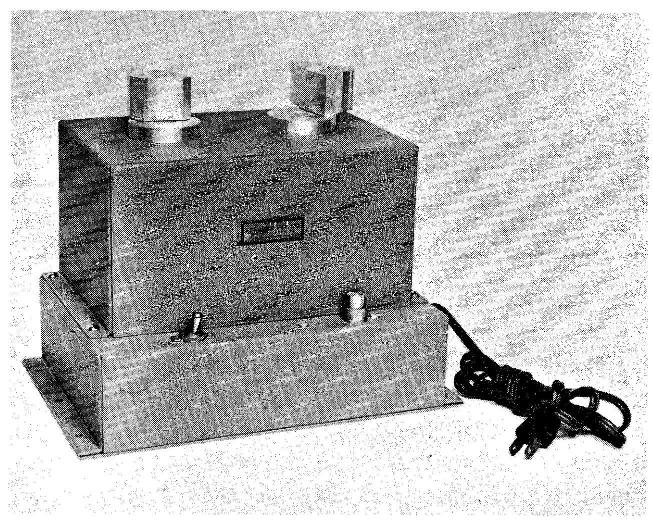
Coil and Condenser Tester.



Power Supply.



Breaker Point Contact Tester.

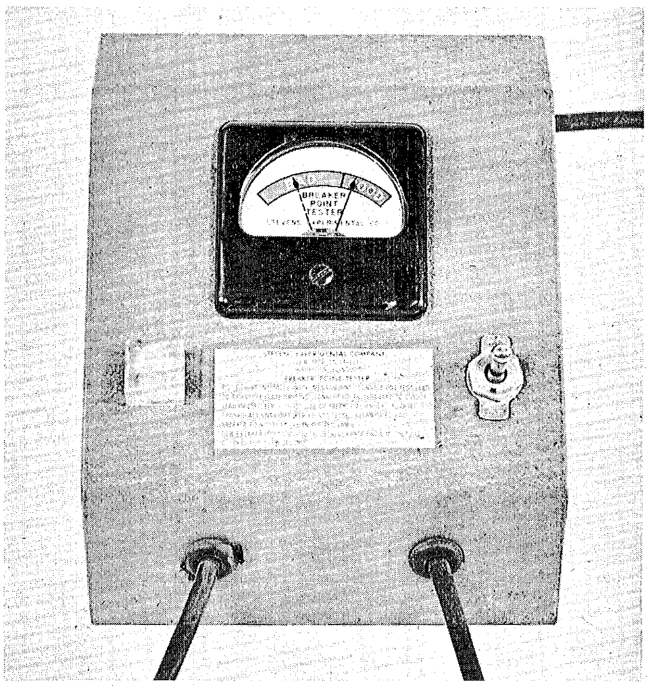


Magnet Charger.

Faulty ignition, exclusive of what difficulty might be experienced with the spark plugs, can ordinarily be attributed to (1) improperly adjusted, pitted or corroded breaker points; (2) a weak or otherwise ineffective condenser; (3) a weak (partially short circuited — secondary winding) or "dead" ignition coil; (4) faulty wiring — insulation broken down to short circuit; loose or corroded terminal connections.

When probing for corrective measures, the simplest details to observe naturally ought to be the first to be investigated — the wiring system (after having checked breaker point gap setting). Be on lookout for loose or defective spark plug connections — broken and/or damaged insulation on spark plug leads. On having removed the flywheel to expose the armature plate assembly, check thoroughly insulation and all terminal connections (ignition coil, primary and condenser leads to breaker point assembly and condenser mounting to insure ground contact). In event a ground (stop) switch wired into the primary system is employed, check for short circuit as result of faulty insulating washers — broken or perhaps oil soaked.

Check Breaker Point Contact—Should inspection of the breaker point surfaces reveal excessive pitting (or corrosion), waste no time — install new points. If otherwise, dress and polish with strip of crocus cloth (or wet and dry paper — grit) folded back to back to permit dressing both point faces simultaneously by moving back and forth gently. When removing the crocus cloth, do not pull it out abruptly but spread points with finger to hold apart while removing; purpose is to prevent points "snapping" together, thereby preventing particles of the "dressing" material (if any) imbedding point surfaces to interfere later on — continue holding points apart. Insert strip of clean paper, work back and forth between point surfaces to remove whatever dressing material might have lodged between the points. Further, point surfaces may be "brushed" off with carbon tetrachloride to assure freedom of scum, lint or other foreign material.

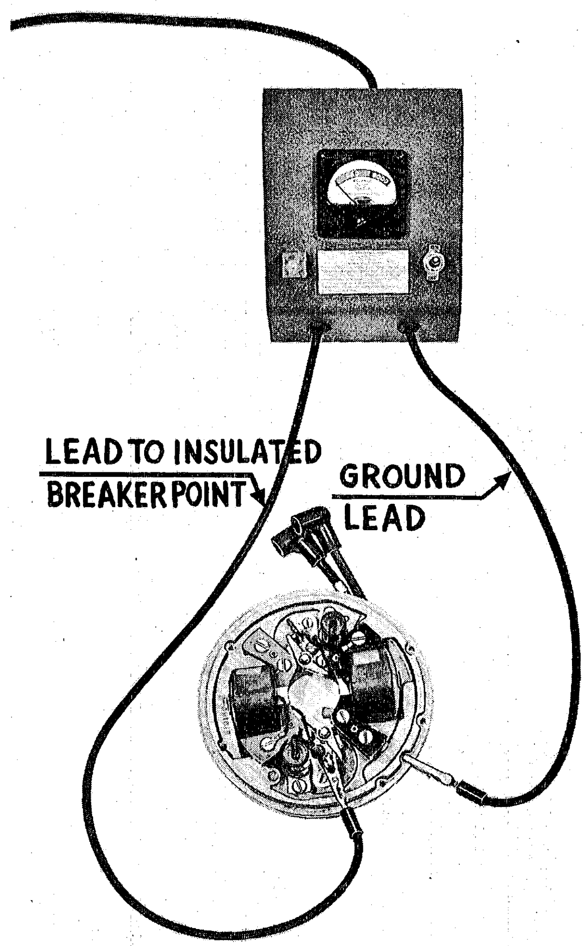


On Magneto Breaker Point Contact Testing—Needle Falling in RED Area Denotes Faulty Contact; in GREEN Area Contact Resistance is within Passable Range.

Since efficiency and intensity of spark is dependent to considerable extent on degree of breaker point contact, a check should be made with an instrument designed for the purpose — designed to measure resistance existing between the "closed" point faces — pitting, corrosion, oxidation, foreign particles, scum, etc., build up resistance to flow of primary current "across" the points to cause faulty spark — hard starting, missing, etc. Point surfaces which may have the appearance of making good contact may not be doing so. Every breaker point installation ought to be checked in this respect to insure the good breaker point action.

To check with the Stevens Contact Tester, attach one terminal of the tester to the armature plate casting (ground) — the other, to the insulated side of the breaker assembly as shown here. "Throw" switch (ON). Note range scale on the instrument panel; "Bad" (red area); "Good" (green area). If contact is good and up to predetermined specifications, needle will come to rest in the green area—if otherwise (poor contact) in the red area.

First application of the test may find needle resting in the **Red** area. Do not in this case presume the points to be faulty but rather look for possible loose or faulty terminal connections — both tester and breaker terminals. Investigate point surfaces again for cleanliness — make certain no "bits" dressing material or other foreign particles remain, etc. Repeat test for contact — needle in green area. Install new breaker assembly if necessary.

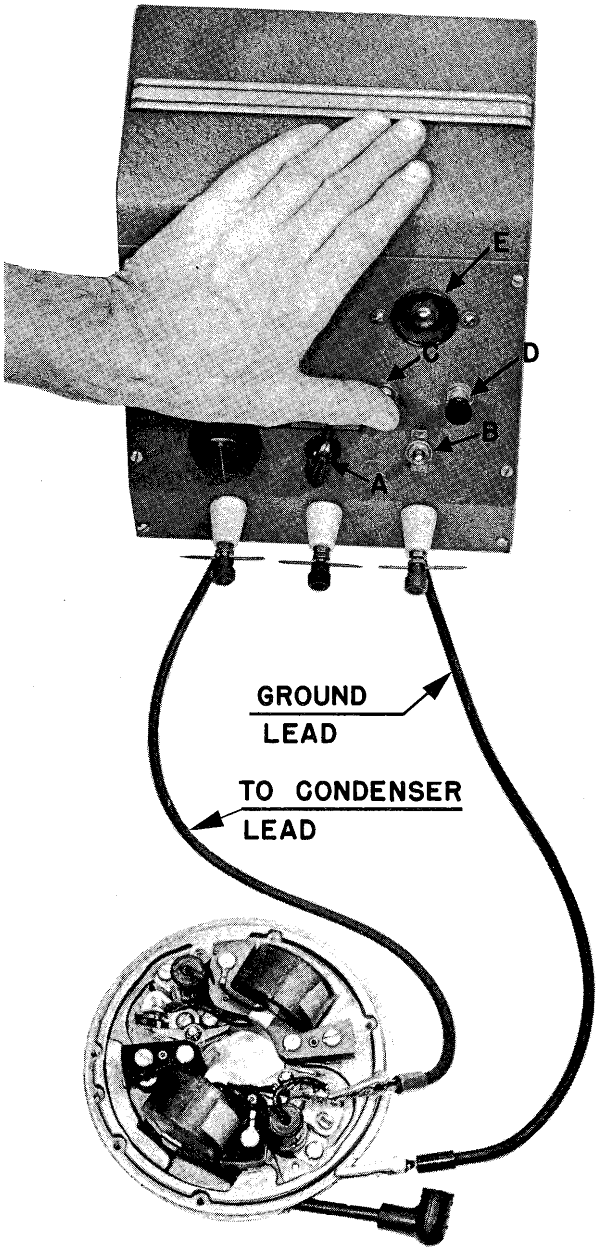


Checking breaker point contact.

To Check the Condenser (Stevens testing unit) —Observe first condition of terminal connections, insulation and be certain of good ground contact. Detach the condenser lead. Set selector (A) to position indicated as COND (condenser) on the instrument panel — Throw main switch (B) to position ON. Allow several minutes for the unit to warm up prior actually testing. Attach BLACK (ground) lead to the condenser case or mounting strap and RED (positive) lead to condenser lead terminal.

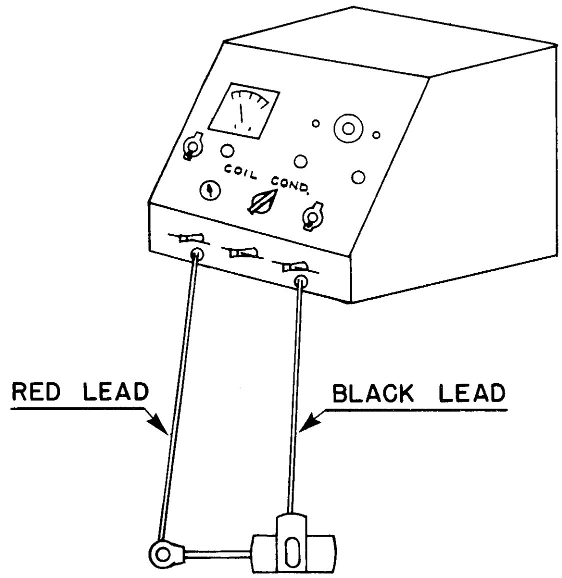
Depress and hold button (C) for at least ten seconds.

Note that but a single "flash" takes place in the neon bulb (E) instantaneously as the button is depressed and held, if the condenser is in good operating condition. Repeated flashes in the tube indicate a partially shorted condenser which should be discarded and replaced. A continual glow in the tube at this time reveals a short circuit — the condenser is unfit for use and should be replaced. Absence of either flash or glow is indication of an open circuit or a "dead" condenser unfit for use.

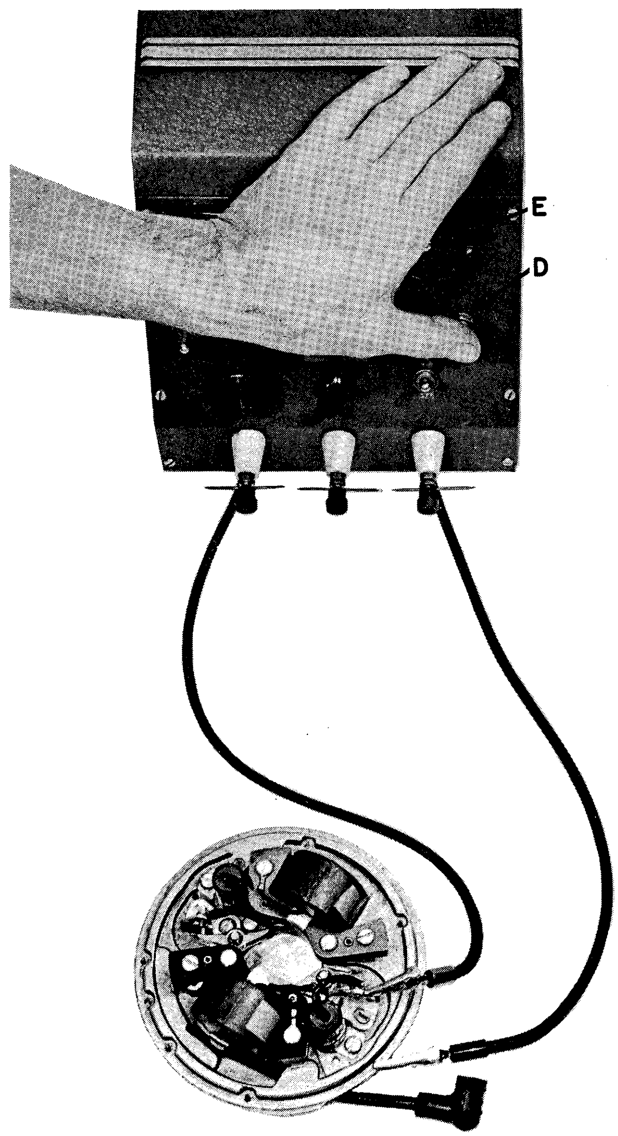


Showing Condenser Wired up for Testing — Charging by Depressing Button "C." The Condenser may be Removed from the Armature Plate and Tested in Like Manner.

Assuming now the condenser is in good condition, having flashed but once at time of charging (when depressing button C), release button C and depress button D to discharge, at which time a distinct flash will be noted in the neon tube.



Hook-up for Checking Condensers.



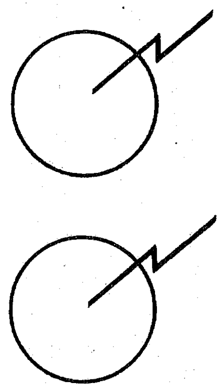
Discharging the Condenser by Depressing Button "D."

Repeated flashing or constant glow in the neon tube at time of depressing button C (charging) reveals a faulty condenser; a single flash on charging (button C) and on discharging (button D) with no intermittent flashing in between (charge and discharge) indicates a good condenser.

GOOD

Charging
(Button C)

Discharging
(Button D)

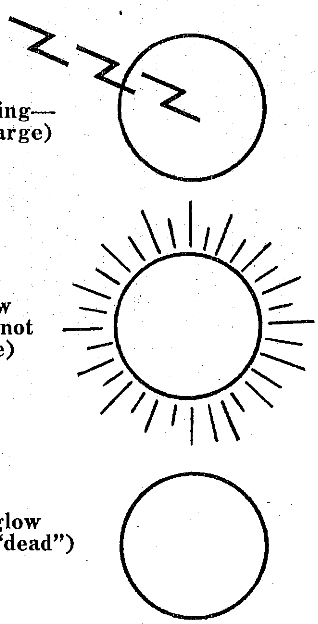


FAULTY

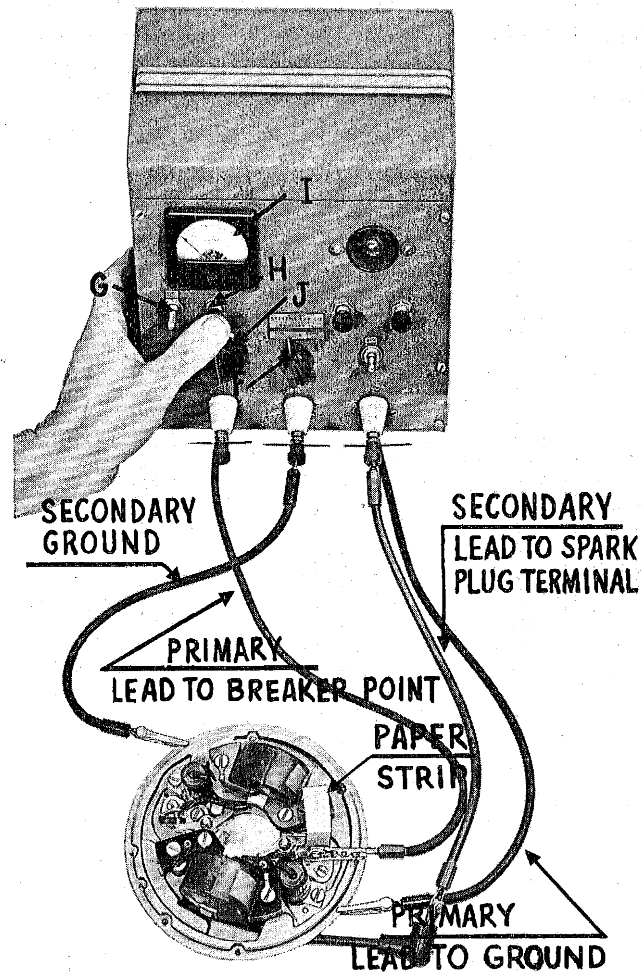
Charging
(Repeated flashing—
will not hold charge)

Constant Glow
(Shorted—will not
receive charge)

No flash or glow
(open circuit—"dead")

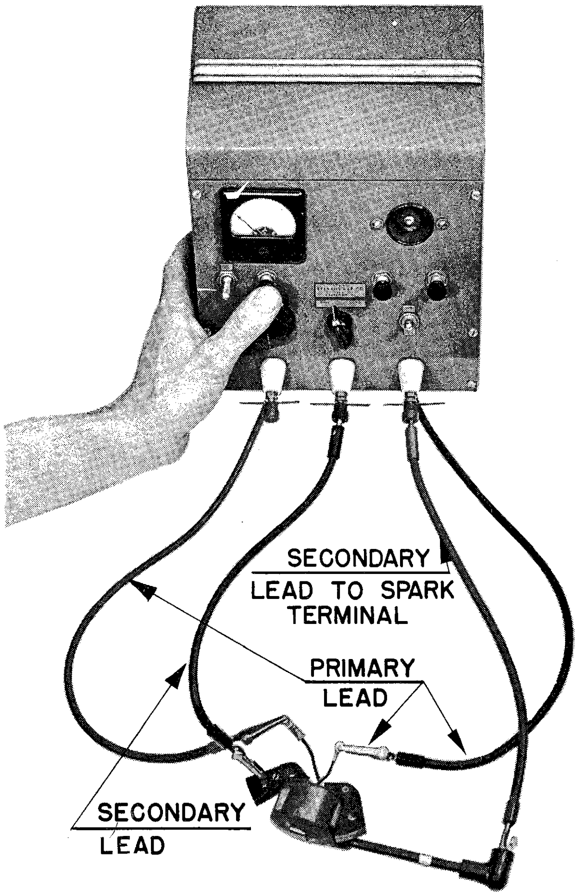


To Test the Ignition Coil—The coils may be tested on the armature plate or as detached, whichever is most convenient at the time. However, in either case, turn selector switch F to position COIL imprinted on the instrument panel. Refer to amperage value (for testing), page 67, as designated for the coil to be tested. If amperage range indicated is less than 2, set toggle switch G on panel to position "B"; if range is 2 and over, set toggle to position "A." Adjust breaker gap on instrument to 1/4″ (dress needle points periodically with three-cornered file to remove traces of oxide which is resistant to sparking.)

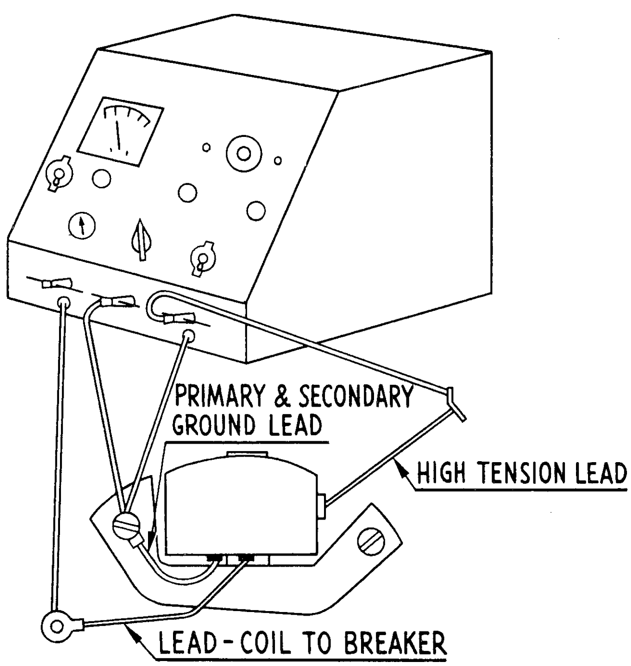


Armature Plate Wired for Testing One of the Two Coils Employed—the Remaining Coil Should be Checked in Like Manner.

Testing with coil attached to the armature plate—(1) Insert paper strip of card thickness to spread breaker points; (2) detach condenser lead (to breaker point bracket); (3) the lower leads on the instrument are PRIMARY—attach Black (ground) lead to the armature plate casting, Red lead to insulated breaker bracket; (4) top row of leads are SECONDARY—attach center (black-ground) to the armature plate casting—attach each of the Red leads to spark plug leads from the coils as shown here; (5) depress button H—note amp-meter reading I—adjust rheostat J knob to ampere reading range specified for the coil on test; (6) a satisfactory coil will yield a strong spark across the 1/4″ gap—with a clearly audible "snap" and no indication of "missing" or intermittent hesitancy — should the spark be weak, barely audible and hesitant, the coil is unfit for use and should be discarded. Repeat same operation for testing the remaining coil.



Coil Wired up fo. Testing as Removed from the Armature Plate.

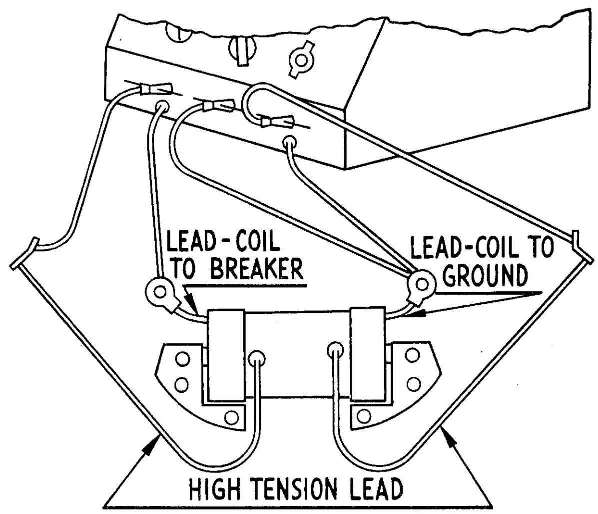


Hook-up for Checking Coils Used on Alternate Firing Engines.

Testing coil removed from the armature plate—

(1) attach primary and secondary (black-ground) leads of the instrument to heel or shoe of coil; (2) attach Red primary lead to primary lead of the coil as shown; (3) attach Red secondary lead from the instrument to secondary or high tension lead from the coil.

A. When testing a twin spark coil (such as employed on opposed twin motors) attach primary and secondary ground (black) leads of the instrument to primary ground lead as shown. Attach both secondary leads (Red) from the instrument to both high tension leads from the coil. Two sparks will appear in this case — one for each side of the coil.



Hook-up for Checking Coils Used on Opposed Firing Engines.

Magnet charging factors affecting spark intensity for maximum efficiency have been given consideration in the foregoing pages — however, magnetic "strength" retained in the magnet (rotor or ring type) should attract attention since it so vitally enters into overall performance of the magneto.

Ring type magnets as installed in the flywheels of earlier production models are constructed of high carbon, hardened steel. The ring type magnet has been replaced by one constructed of Alnico (aluminum, nickel, and cobalt) cast into the magnet rotor or flywheel and provided with laminated pole shoes—See pages 11 and 12. In either case both are magnetically "charged" by being placed across the poles of an electro magnet (charger)—momentarily charged by a "surge" electric current flowing through its windings.

Under certain conditions, magnets are known to lose some of their magnetic strength which affects "sparking" efficiency — though considerably less apt to occur with the Alnico than the ring type (steel) magnet. Magnetic "strength" can be restored when required, by charging on a "Magnet Charger."

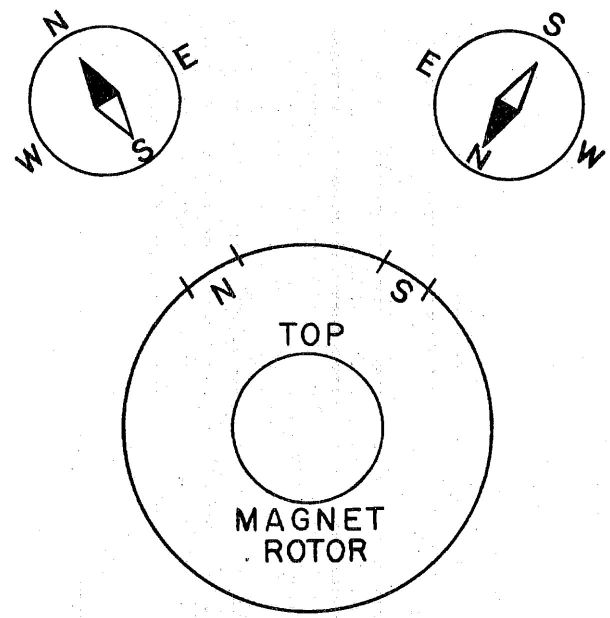
All magnets (permanent, like "charged" hardened steel and Alnico — electro, like the magnet charger depending on an electric current flowing through its windings) have two poles — namely, north and south. Magnetic lines of force flow in the atmosphere around the "poles"—from North (N) to South (S). When charging, the North (N) pole of the magnet to be charged should contact the South (S) pole of the magnet charger; the South (S) pole of the magnet should contact the North (N) pole of the charger, as illustrations below indicate.

When properly charged (polarity), leading pole of the magnet should be South (S) — arrows in illustrations indicate direction of motor rotation.

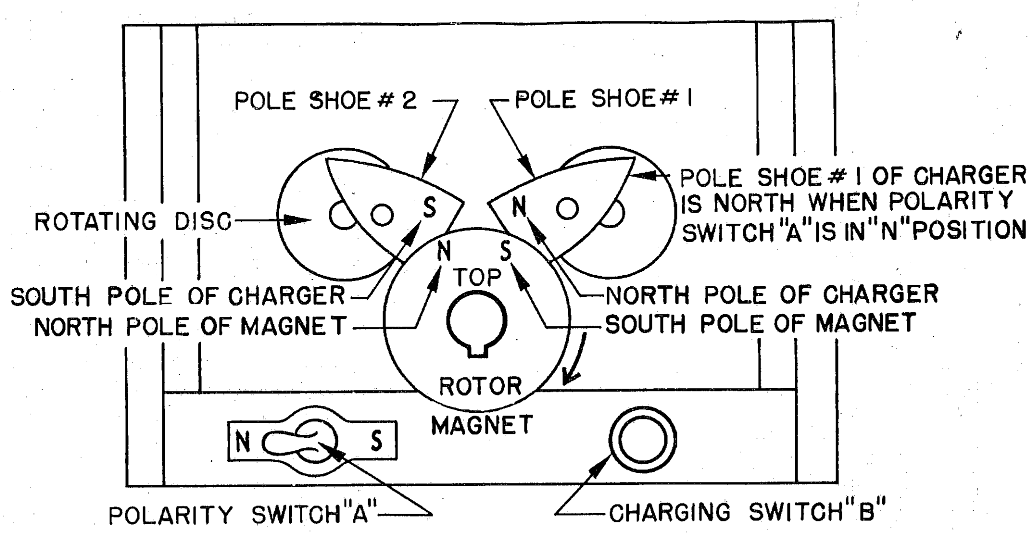
Note curvature on pole shoes of charger (movable pieces) may be adjusted to fit contour of the magnet to be charged. Rotating discs below the pole shoes may be rotated for adjusting by loosening screws in center. Adjust the rotating discs and pole shoes to approximate radius of the magnet to be charged — tighten screws.

Plug charger cord into 110-115 volt, 50-60 cycle, AC current outlet.

Determine polarity of the magnet to be charged with a compass, if it is not already known. (North seeking pole of the compass points to the south pole of the magnet.)



Note — When testing, precautionary measures should be taken as assurance that line voltage to the instruments is up. If in doubt, your local power company will assist in checking accordingly. Do not, however, "pull" too many instruments, motors, etc., from the same line in the shop. Excessive "drain" in this respect results in line voltage drop to affect efficiency of the testing equipment.



Charging Rotor Type Magnet.

This is for the benefit of those who are using the old style Stevens Coil and Condenser Tester, which contains ammeter, neon glow tube and spark gap electrodes; 1949 through 1962 engines.

These specifications apply only when using a 1/4″ spark gap. When testing coils on armature plates, condensers must be disconnected from coils or points.

A. TESTING COIL ON THE ENGINE:

1. ALWAYS DISCONNECT THE PRIMARY WIRES FROM COIL TO INSURE AN ACCURATE COIL TEST.
2. Connect black primary lead (ground) to negative (—) terminal of coil.
3. Connect black high tension lead from center electrode post (ground) to same terminal as specified in step 2 [negative (—) terminal of coil].
4. Connect red primary lead (hot) to positive (+) terminal of coil.
5. Connect a red high tension spark gap lead to secondary circuit (tower) of coil.
6. Adjust switch setting and ampere value as follows:

COIL NO.	SWITCH SETTING	AMPERES
580416	A	2.0 – 2.5

7. Test coil in the conventional manner.

B. TESTING COIL OFF THE ENGINE (bench testing):

1. Test as outlined under steps A2 through 7.

H.P.	ENGINE MODEL NO.	PART NO.	SWITCH SETTING	AMPERAGE With Heels	AMPERAGE Without Heels
2.5	HD(L)-25	375189	B	1.5 – 2.0	See footnote*
2.5	HS(L) & HD(L)-26	580118	A	2.0 – 2.5	
3	JW(L)-10 thru 17	580118	A	2.0 – 2.5	
5	TD(L)-20	375189	B	1.5 – 2.0	See footnote*
5	TN(L)-25 & 26	375189	B	1.5 – 2.0	See footnote*
5	TN(L)-27 & 28	580118	A	2.0 – 2.5	
5.5	CD(L)-10 thru 19	580118	A	2.0 – 2.5	
7.5	AD(L)-10 thru 12	580118	A	2.0 – 2.5	
10	QD(L)-10 thru 11	580040	B	1.6 – 2.0	See footnote*
10	QD(L)-12 thru 23	580118	A	2.0 – 2.5	
15	FD(EL)-10, 10L & 10S	580118	A	2.0 – 2.5	
16	SD(L)-15 & 20	375102	B	.8 – 1.2	1.0 – 1.3
18	FD(EL)-11, 11K & 12; FD(L)-13 thru 15F	580197	B	1.3 – 1.8	
18	FD(L)-16	580197†	B	1.3 – 1.8	
		580416†	A	2.0 – 2.5	
22	PO(L)-15	72-852	B	.8 – 1.3	1.0 – 1.5
25	RD(L)-10 thru 17S; RDE(L)-16 thru 17S	580118	A	2.0 – 2.5	
28	RX(L)-10C	580416	A	2.0 – 2.5	
30	RD(EL) thru RJE(L)-18 thru 18C	580197	B	1.3 – 1.8	
35	RD(EL) thru RJE(L)-19 & 19M; RD(EL)-19C; RDS(L)-20; RD(SL)-21 & 21B	580197	B	1.3 – 1.8	
40	RD(SL)-22 thru 23	580197	B	1.3 – 1.8	
40	RD(L) thru RK(L)-24	580416	A	2.0 – 2.5	

* Coil must be mounted on a laminated core to test.

† Either the 580197 or 580416 coils will be found in matched pairs on early 1962 — 18 h.p. engines. Coil identification can be determined as follows: 580197 has blue tinted plastic insulation, 580416 has purple tinted plastic insulation.

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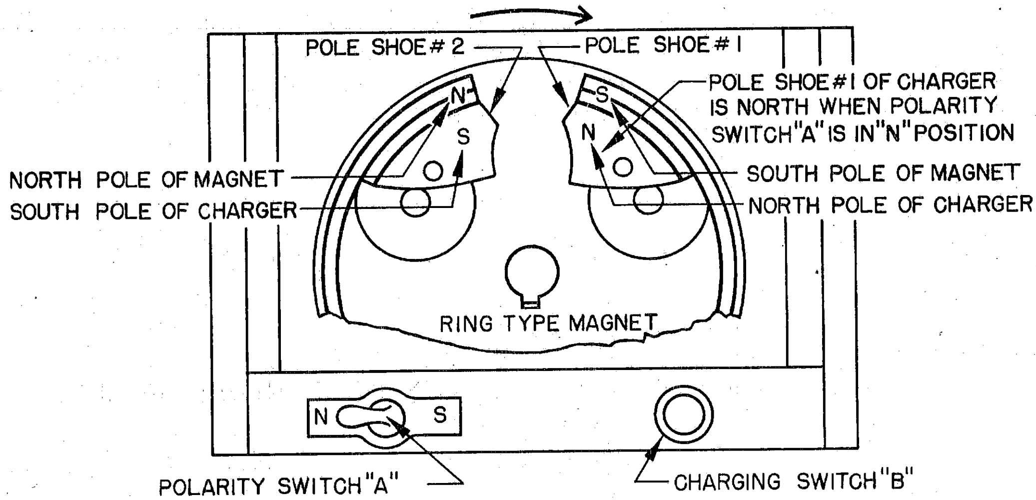
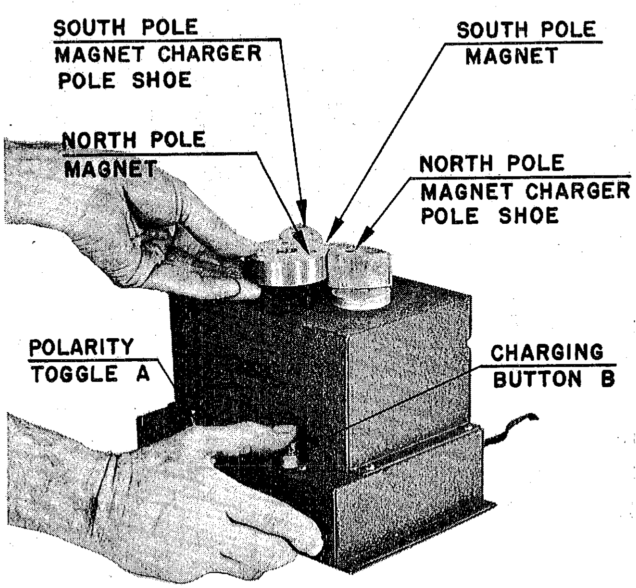
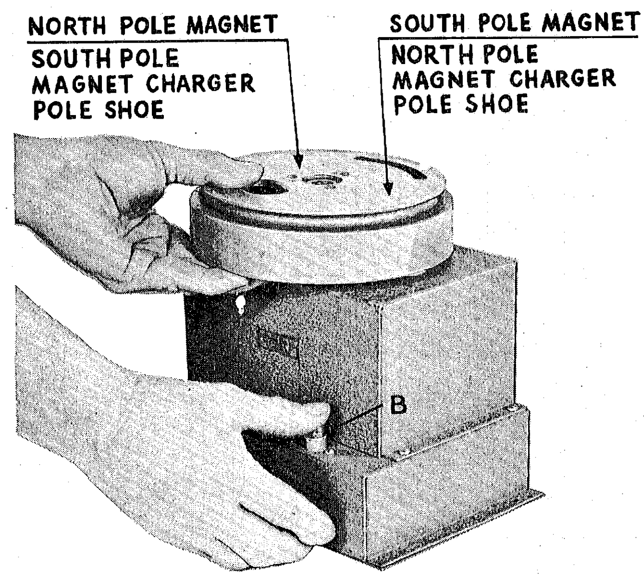


Charging Ring Type Magnet or Flywheel with Alnico Insert.

Shift polarity switch toggle A in position N. Place magnet north pole against pole shoe #2 as in sketch above; south pole of magnet against pole #1. Adjust position of the magnet so that as much of the pole pieces as possible are covered by the pole shoes of the magnet charger. Hold magnet in position while depressing charging switch (button) "B" for not more than **one second.** One second only to safeguard windings of the instrument.



Charging Rotor Type Magnet.

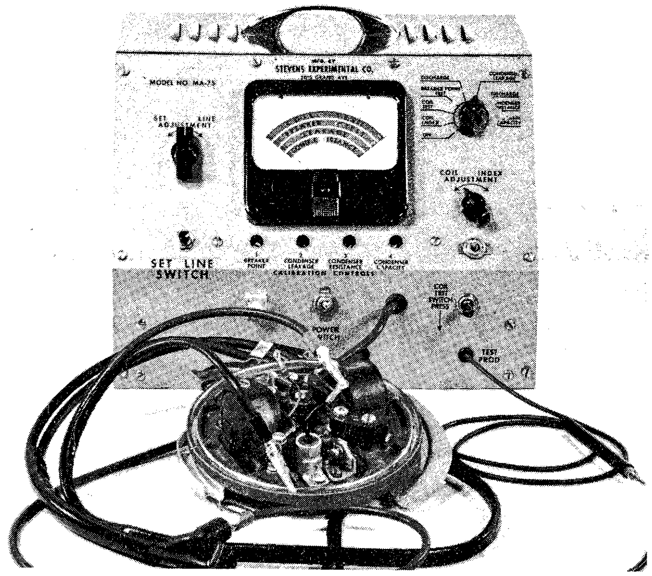


Charging Flywheel with Ring Type Magnet.

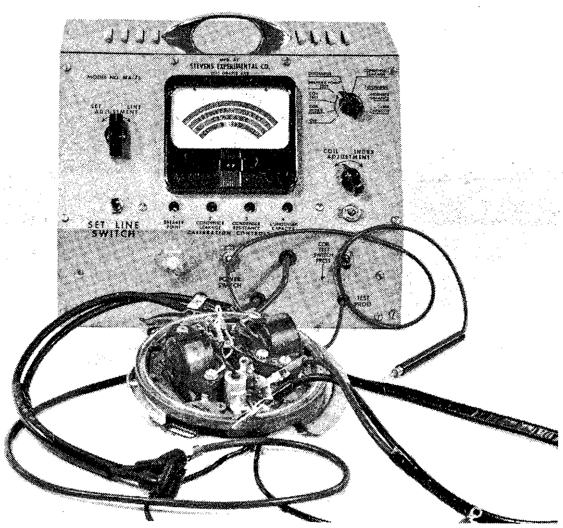
Bear in mind when testing that voltage is "up" – in event a storage battery is used, it must be fully charged to gain results. If the Stevens Power Supply unit is employed, line voltage must similarly be up. Periodic check with voltmeter (110 AC) is advisable. Do not operate the Power Unit on an overloaded line – make certain voltage is up when testing. Your local power company will be pleased to assist in this respect.

STEVENS IGNITION ANALYZER

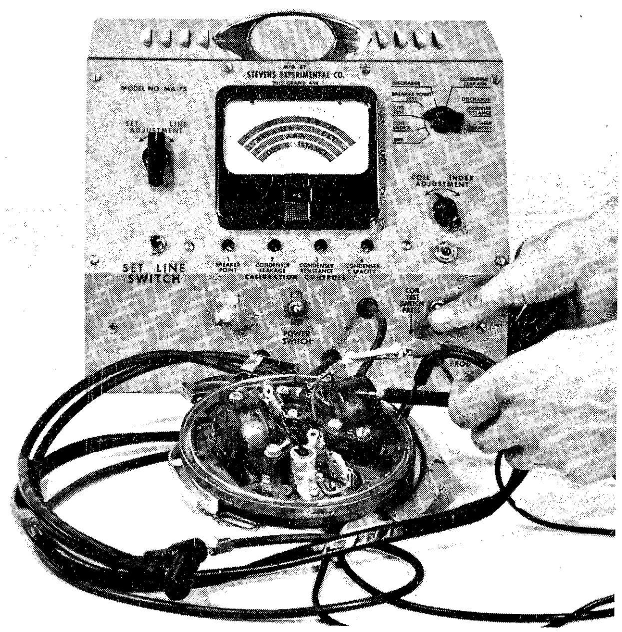
Checking the Ignition Coil with the Stevens Ignition Analyzer – See Stevens Operators' Manual.



Checking the Condenser.



Checking Breaker Point Contact.



Probing for Surface Leaks.

For operating instructions, refer to Stevens Manual.

COIL AND CONDENSER USAGE WITH TEST SPECIFICATIONS
1949 THROUGH 1962 ENGINES

Listed are the coil index setting numbers and condenser capacities required when testing currently serviced Johnson magnetos and battery ignition systems with Stevens' latest Magneto Analyzer.

		COILS			CONDENSERS	
H.P.	ENGINE MODEL NO.	Part No.	Switch Setting	Index No.	Part No.	Capacity in Mfd.
2.5	HD-25	375189	A	24	300153	.150 – .205
2.5	HS & HD-26	580118	A	24	580321*	.18 – .22
3	JW-10 thru JWL-17	580118	A	24	580321*	.18 – .22
5	TD-20	375189	A	24	300153	.150 – .205
5	TN & TNL-25 & 26	375189	A	24	300153	.150 – .205
5	TN & TNL-27 & 28	580118	A	24	580321*	.18 – .22
5.5	CD-10 thru CDL-19	580118	A	24	580321*	.18 – .22
7.5	AD-10 thru ADL-12	580118	A	24	580321*	.18 – .22
10	QD-10 thru QDL-11	580040	B	23	300153	.150 – .205
10	QD-12 thru QDL-23	580118	A	24	580321*	.18 – .22
15	FD thru FDEL-10, 10L & 10S	580118	A	24	580321*	.18 – .22
16	SD & SDL-15 & 20	375102	B	16	300153	.150 – .205
18	FD thru FDEL-11, 11K & 12; FD & FDL-13 thru 15F	580197	A	22	580422**	.25 – .29
18	FD(L)-16	580197†	A	22	580422**	.25 – .29
		580416†	A	24	580422**	.25 – .29
22	PO & POL-15	72-852	A	10	72-864	.27 – .33
25	RD & RDL-10 thru 17S; RDE thru RDEL-16 thru 17S	580118	A	24	580321*	.18 – .22
28	RX-10C	580416	A	24	580422**	.25 – .29
30	RD & RDEL thru RJEL-18 thru 18C	580197	A	22	580422**	.25 – .29
35	RD & RDEL thru RJEL-19 & 19M; RD thru RDEL-19C; RDS thru RDSL-20; RD thru RDSL-21 & 21B	580197	A	22	580422**	.25 – .29
40	RD thru RDSL-22 thru 23	580197	A	22	580422**	.25 – .29
40	RD(L) thru RK(L)-24	580416	A	24	580422**	.25 – .29
50	V4 thru V4SL-10 thru 11B	580243	B	23	580256	.37 – .41
75	V4S & V4SL-12 thru 14	580243	B	23	580256	.37 – .41
75	V4A & V4AL-13 thru 14	378231	B	25	580256	.37 – .41

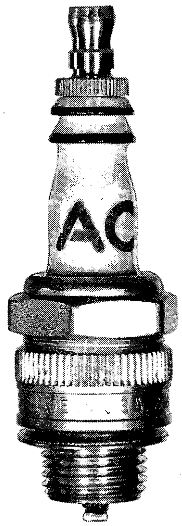
* For service, 580321 supersedes 510173. Capacity for the 510173 condenser is the same as for 580321 – .18 to .22 microfarads.

** See SB-861 for details of service requirements on condenser 580422.

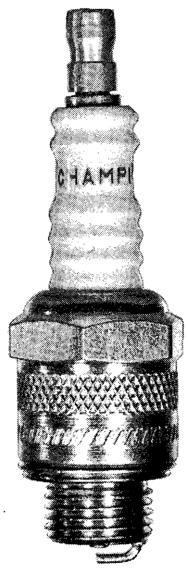
† Either the 580197 or 580416 coils will be found in matched pairs on early 1962 – 18 h.p. engines. Coil identification in a given engine can be determined as follows: 580197 has blue tinted plastic insulation, 580416 has purple tinted plastic insulation.

Service Bulletin No. 885 – 12/15/61.

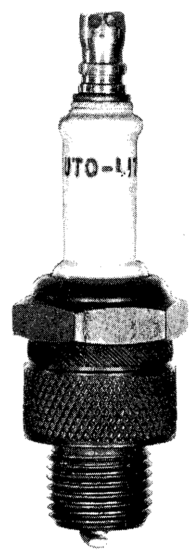
SPARK PLUGS



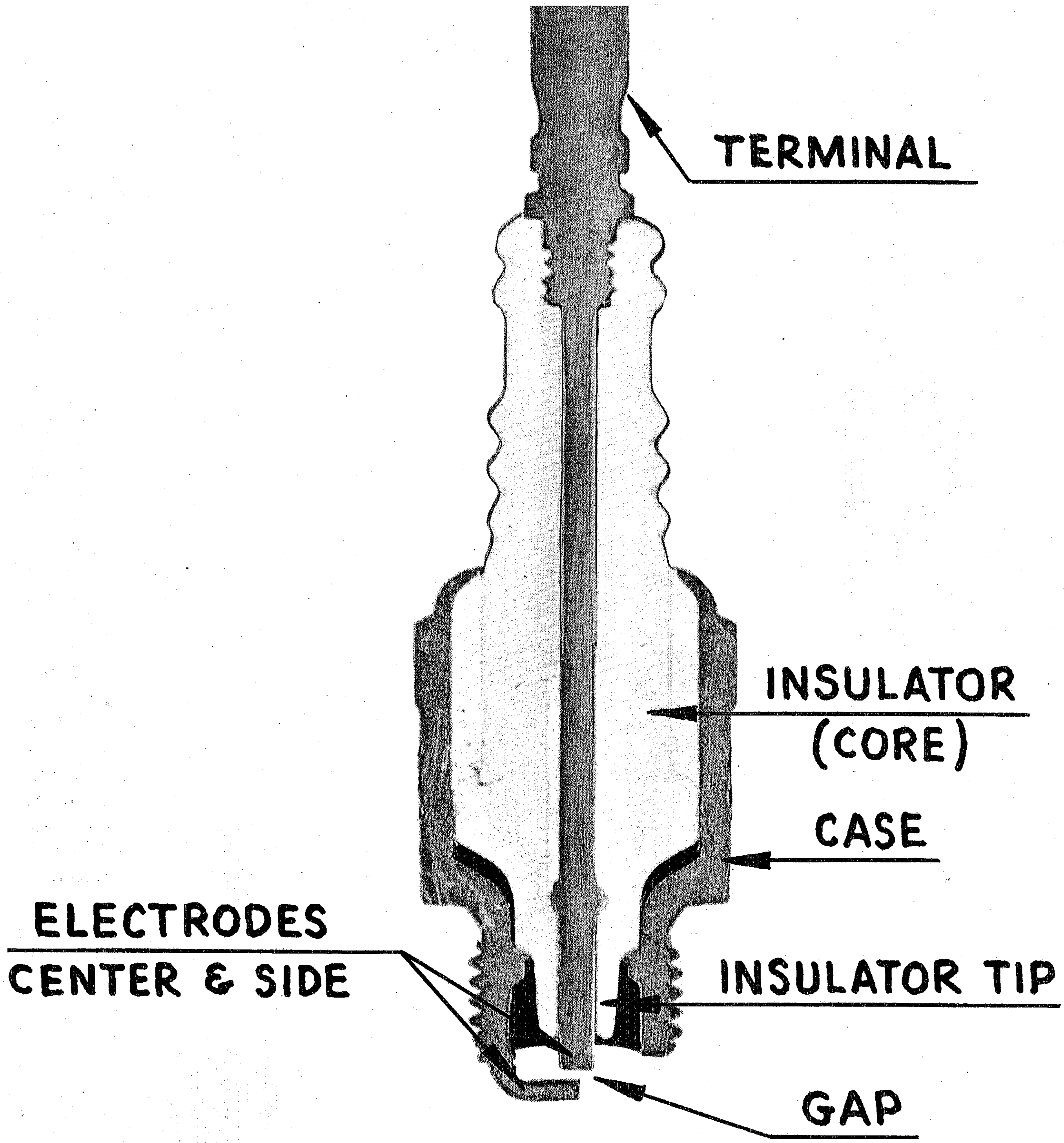
AC
M42K



CHAMPION
J4J



AUTO-LITE
A-21X



Spark Cut Away.

Spark Plug – Sectional View.

THE SPARK PLUG AND DETAILS RELATING TO ITS PERFORMANCE

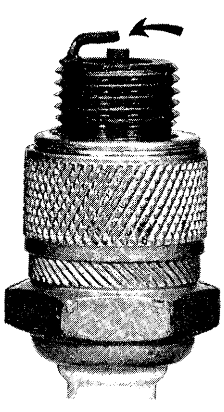
It is well known that all reciprocating internal combustion engines exclusive of the diesel, are fired by an electric spark – an electric arc between two points (spark plug) inserted into the combustion chamber of each cylinder for the purpose. And as such, no ignition system can be more proficient than the performance qualities (determined by design and construction) of the spark plug installed.

The modern spark plug while appearing extremely simple in construction is the result of extensive engineering and long research to withstand the rigorous activity expected of it.

In construction the spark plug consists of –

1. A hard core or insulator – usually a specially treated aluminum oxide compound fabricated to meet the demands of intermittent periods of high shock pressures and correspondingly high temperatures, the stress of high voltage and chemical attack during the process of combustion.
2. The electrodes – center and side are of special alloys to resist the rigors of high combustion temperatures, the ever-present corrosive effects of chemical action and sparking erosion.
3. A shell in which to contain the core assembly – provided with a threaded area for cylinder head installation and an all-important gasket.

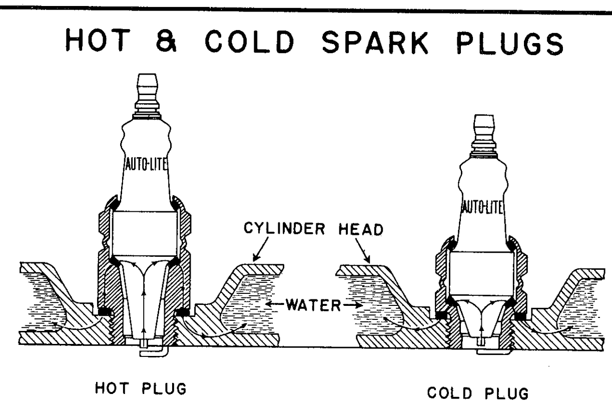
It will be seen and it should be noted from the assembly drawing here that the side electrode of the outboard spark plug does not extend over the entire width of the center electrode as it ordinarily does in the automotive spark plug. Reason – the two-stroke outboard engine does not scavenge as effectively as the four-stroke automotive engine with the result that bits of loose carbon are apt to be left floating in the cylinder and combustion chamber to eventually lodge or wedge between the points to short-circuit the plug. The shorter side electrode in this event presents less area for carbon wedging.



Note clipped side electrode – recommended for 2-stroke outboard motor installation. Spark gap normally adjusted to .030" for best performance.

Beyond this, all spark plugs regardless of usage are classified to perform within certain heat ranges – each classification depending upon temperature characteristics developed in the combustion chamber of the respective engines. Obviously, not all engines are by nature of their design constructed to operate under like conditions. Thus, specifying heat range qualities of the plug to be installed in a given engine then becomes the cooperative effort of the spark plug manufacturers' and engine builders' engineering departments.

The heat range ultimately established for any spark plug is determined fundamentally in design by the amount of core or insulator section exposed to the burning fuel charge within the combustion chamber and upon this depends the rate of absorption and heat flow from the region of the spark gap electrode and insulator tip to be eventually dissipated through the cooling system. Thus, for most effective sparking throughout any desired RPM range and/or conditions of operation, the degree of electrode and insulator tip temperature should be maintained at a level sufficiently high to vaporize or burn off, so to speak, any or all particles of the fuel mix having collected in the area during the process of induction, compression and combustion. Low level operating plug temperatures obviously result in wet fouling due to the progressive accumulation of unburned fuel particles, carbon bits, sludge, etc., while excessively high temperatures are responsible for premature firing (preignition) because of the insulator tip and electrodes having reached a state of incandescence to fire the compressed fuel vapor charge prior to the time of sparking as predetermined for normal ignition.



Courtesy of Electric Auto-Lite Co., Toledo, Ohio

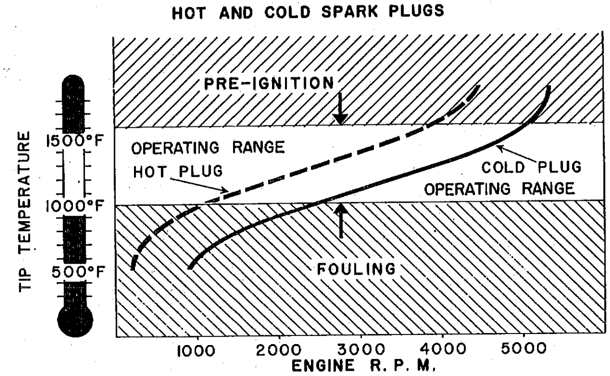
Spark plugs are therefore classified as hot or cold with intermediate designations in accordance with the nature of service expected. The hot plug may easily be recognized by the comparatively large insulator section exposed to the flame of combustion — conversely, a cold plug may be pointed out by the relatively small insulator sections exposed.

The low compression engine running at moderate RPM operates naturally at lower combustion temperatures and therefore requires the installation of a spark plug leaning towards the hot end of the operating temperature scale. In almost direct opposition, the high-compression, high-speed engine demands the use of spark plugs classified in the cold end of the scale for best performance. Or, it might be said that basically, a cold running engine requires a hot plug and that a hot running engine demands a cold plug. By the same token, a cold plug in a cold running engine would wet foul with but short running time while a hot plug performing in a hot engine would preignite. It is for this fact that spark plugs are designed and classified to function efficiently in engines developing various performance characteristics — each to the temperature range requirements for the particular installation.

Further, since a given engine running at idle or otherwise at the low end of the RPM scale does not develop the power nor the combustion temperatures it does at high RPM under full load conditions, the operating temperature range of the plug installed must be great or wide enough to permit effective firing at both ends of the (engine) performance range without fouling at idle or intermediate RPM nor preigniting at top RPM under full load.

COMPARISON OF TYPICAL OPERATING TEMPERATURES

HOT AND COLD SPARK PLUGS

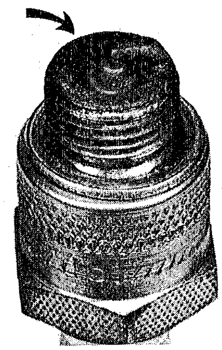


THIS GRAPH SHOWS TIP TEMPERATURES FOR A TYPICAL COLD SPARK PLUG AND A HOT SPARK PLUG OF THE SAME SIZE. ACTUAL VALUES VARY SLIGHTLY DEPENDING ON ENGINE AND OPERATING CONDITIONS

Courtesy of Electric Auto-Lite Co., Toledo, Ohio

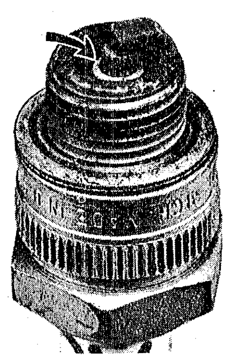
Due to design and performance characteristics of the high RPM two-stroke (cycle) engine, heat range selected for best optimum results would lean more towards the colder end of the operating temperature range than a plug performing under like conditions in a four-stroke engine of equal piston displacement — and still colder for like use in an air-cooled engine of either two or four-stroke design. There are no sharply drawn lines of distinction between the heat range classifications of cold and hot running plugs.

Assuming the ignition system and engine assembly are up to standard for good performance qualities, observation of insulator tip coloration upon removal of the spark plug after a reasonable period of use will aid in determining whether or not the heat range selected for the installation is correct.



Cocoa or tannish coloration of the insulator tip above reveals generally that the established heat range of the plug selected for the installation is meeting its requirements. However, prolonged periods of slow or intermediate speed running results in a darker or sootish coloration. Conversely, with high-speed (RPM) running, the hotter tip shades toward lighter appearance.

Fundamentally, if the heat range is correct or acceptable, the insulator tip will have taken on a cocoa tannish color — if an exceptionally light tan and/or leaning to whitish, the heat range may be considered as being too hot. A dark, black or sootish coloration, or wet in appearance, ordinarily reveals the heat range as being too cold. On the other hand, a definitely white coloration may indicate the presence of moisture (water) in the combustion chamber, if not caused by preignition.



Whitish coloration of the insulator tip shown here indicates perhaps incorrect heat range (spark plug) for the application — too hot. If otherwise black, gummy or oil wet — too cold.

Carburetor needle settings (fuel/air ratio) should not be overlooked at this time — set or adjusted toward the lean side, coloration tends toward a lighter than normal tan because of the slower burning fuel charge after ignition; conversely, towards a black or sooty appearance with a richer than required setting as result of incomplete combustion. Fixed high-speed jets provided in many outboard carburetors may be expected to aid in avoiding a situation of this sort — slow speed adjustment should not however be overlooked in this event as an overly rich slow speed adjustment normally contributes to plug fouling.

Preignition may be traced to excessive carbon accumulation. Small pinnacles of carbon building up and clinging to the head of the piston and/or wall of the combustion chamber often approach a state of incandescence during normal running to prefire the compressed fuel vapor charge.

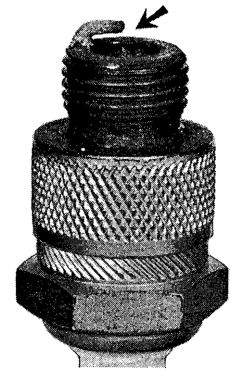
The fuel mix, too, has its effect with regard to useful life of the spark plug in that the presence of an overabundance of oil content in the mix, due either in failure to adhere to the manufacturer's oil/gasoline ratio recommendations or perhaps careless blending, contributes as well toward sooting and eventual carbon fouling.

Preignition may ordinarily be identified by a slight knock or "pinging" when rapidly accelerating or running under full load conditions. During extreme instances of high temperature preignition, a gradual and characteristic drop in engine RPM will follow and as such maintained until the plugs will have cooled due to correspondingly lower combustion temperatures developing at the time.

On reaching this state, normal sparking and RPM will be restored but only so until the spark plugs will have again reached their high level of temperature when the cycle repeats itself and continues to repeat until corrected.

Performance of this sort should not, however, be confused with engine assembly discrepancies such as, misalignment of the functional parts, improper bearing, piston and/or piston ring fits, etc., to create a similar situation because of binding or "dragging" as expansion and contraction occurs with alternate rising and falling temperatures.

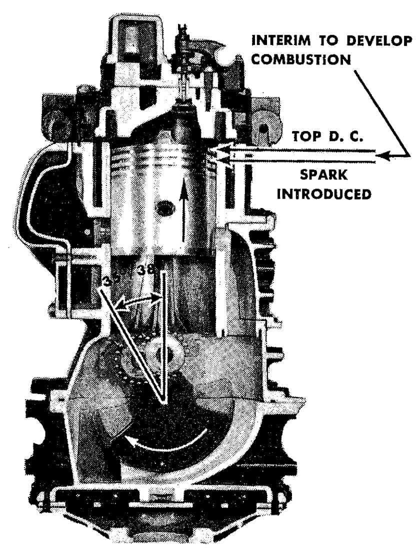
Whether the difficulty lies with the spark plug or engine assembly in this instance is easily determined by removal and inspection of the plugs. Indications of excessively high plug temperatures or preignition is ordinarily revealed by very light (sometimes nearly white) coloration of the insulator tip — if of extended duration, perhaps a severely blistered, cracked or broken insulator tip customarily accompanied by burned or eroded electrodes. Otherwise, normal appearance of the insulator tip and electrodes would suggest a search of the assembly for disturbing factors.



Eroded or burned center electrode to affect spark gap and sparking performance.

Attention should be directed to other possible malfunctions leading to overheating and attendant preignition or preignition-like performance, such as — a faulty cooling system because of substandard performance of the water pump to impair water circulation, an obstruction in the cooling system channels, a faulty cylinder head gasket or an irregularity in the thermostat — where provided.

A significant and predominant factor frequently responsible for the persistent existence of preignition during normal operation of the outboard unit is simply the aftereffect of overloading with too much propeller (pitch and blade area) for the particular installation and performance expected — thus, prohibiting the engine's ability to attain its desired and recommended RPM range at full throttle for best performance. See "Propellers, RPM and Performance" on page 581.



In the manually-operated spark/gas synchronized control system, degree of spark advance and carburetor shutter opening is fixed with relation to each other regardless of whether running at idle, intermediate or at full open RPM. At full open throttle then, spark is adjusted to full advance and the carburetor shutter to full open for top performance and horsepower of which the unit is capable — spark advanced to fire the plug at approximately 35 to 38 degrees before piston top dead center on compression with RPM at desired 4400 to 4800.

The time required to fully develop combustion for maximum effect after sparking (ignition) is basically calculated at the given RPM range to be the time consumed or interim of piston travel from its position in the cylinder at the instant of spark introduction to the moment of reaching top dead center.

Destructive preignition (sparking prematurely) inevitably occurs when engine RPM is retarded or caused to fall below recommended RPM while operating under full throttle conditions due to overloading with too much propeller for the specific installation and kind of service — simply too much pitch and perhaps blade area to permit engine running within the desired RPM range.

During a situation of this kind, ignition of the compressing fuel vapor charge is introduced at precisely the same time regardless — at 35 or 38 degrees before top dead center. Combustion develops normally but the interim or time of piston travel from the point of ignition to top dead center has now been correspondingly increased because of the lower RPM rate. As a consequence, the permissible time element available to fully develop combustion has been lengthened and combustion actually completed before the slower moving piston has had time to reach its top dead center position. The subsequent aftereffect of the opposing forces prevailing under the circumstances, is the creation of a sudden shock wave or impulse as the approaching piston and the pressure of combustion clash.

The destructive effects of preignition due to propeller overloading are varied and many — contributing to —

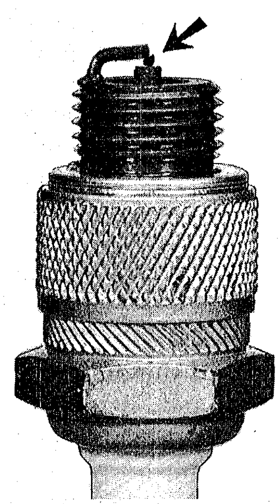
1. Intense temperature rise in the combustion chamber area — spark plugs.
2. Burned or eroded spark plug electrodes.
3. Carbon caked or blistered insulator core section.
4. Insulator erosion.
5. Cracking or breakage of insulator.
6. Over-all malfunctioning of the unit assembly.
7. The persistent telegraphing of damaging shock waves through the entire assembly of the functional parts — pistons, connecting rods, crankshaft, drive shaft, gear assembly, etc., to eventually result in major and expensive corrective measures.
8. Burned or eroded piston heads.

All of which (above) may be avoided by strict adherance to the factory recommended RPM range under any and all conditions for top performance at full open throttle. Note this for its significant value — the spark plug heat range specified by the manufacturer for the given unit (outboard motor) *does not* in any manner enter into the situation or picture of preignition when caused by lower than recommended RPM at full throttle as result of overloading with too much propeller for the installation.

Spark plugs foul because of —

1. Malfunction of the magneto.
2. Excessive oil content in the fuel mix and/or overly rich settings of either the high or slow speed needles — slow speed needle adjustment only in the event a fixed high-speed jet is provided.
3. Malfunction of the thermostat (where installed) to make its presence known particularly in the slow and intermediate RPM ranges — plugs running too cold under the circumstances or too hot in event of thermostat control seizing closed.
4. Preignition — described as above.
5. Improper heat range (spark plug) installation for nature of service or failure to adhere to manufacturer's spark plug recommendations.
6. Faulty spark plug installation — see below.
7. Moisture (water) seeping into motor assembly.
8. Cracked and/or broken insulator.
9. Burned or eroded electrodes.
10. Faulty spark plug terminal connection.
11. Repeated carbon wedging because of excessive carbon accumulation.

Misfiring when rapidly accelerating frequently reveals a deficiency in the ignition system.



An illustration of carbon wedging — frequent recurrence of carbon wedging as above suggests detaching the cylinder head for a carbon removal job. Bits of carbon breaking loose from head of the piston and/or the combustion chamber persistently wedge in the spark gap to foul an otherwise well-performing plug. Wedging will continue intermittently until carbon is removed.

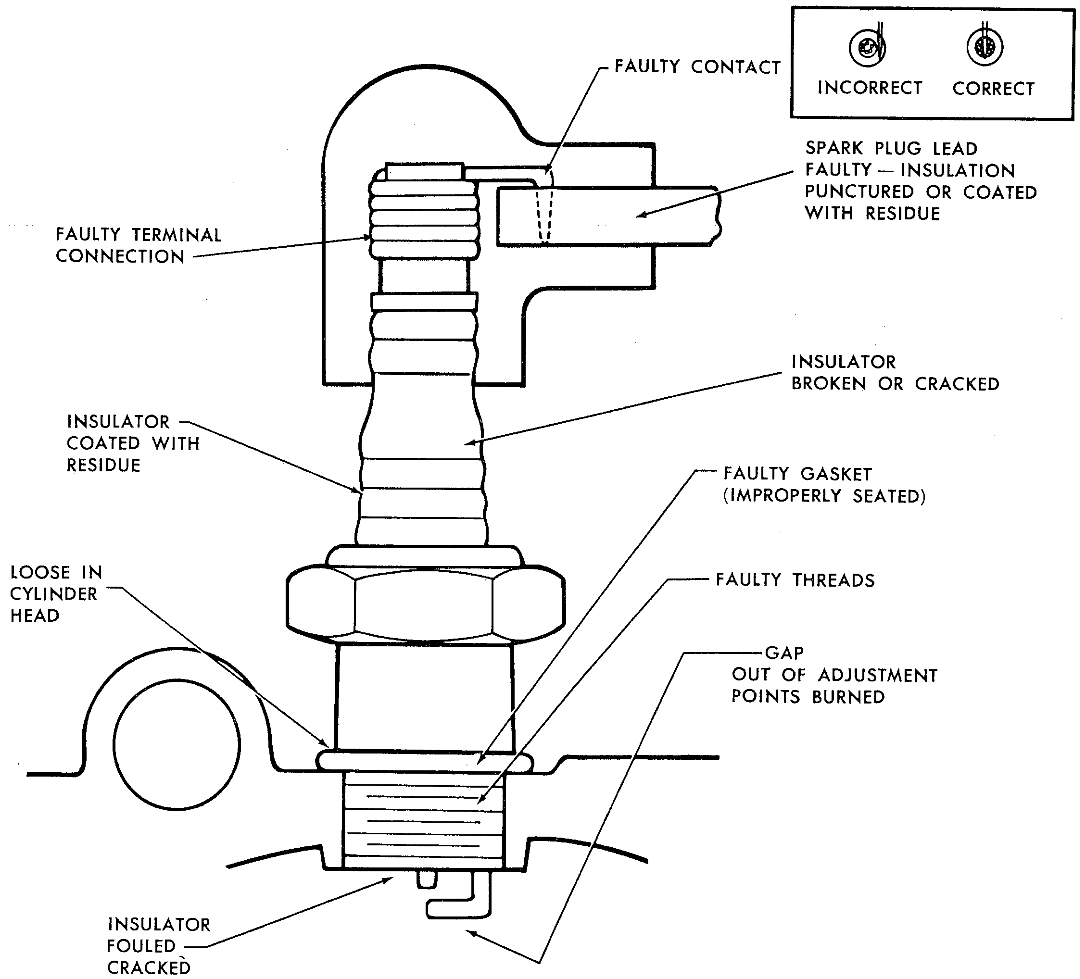
Illustrating the result of extensive pre-ignition. Note piston head erosion.

Spark plug installation (seating in the cylinder head) is a most important factor relating to proficient and expected performance of the plug.

Suggestions for proper installation:

A check of the spark plug threads in the cylinder head to assure all are clean, intact and with no indication of cross threading or stripping.

A check of the spark plug gasket and gasket face machined into the cylinder head – gasket ought to be new preferably but otherwise in good condition. The gasket face should be clean and inspected for possibility of burrs, chips or



(Pressure seepage because of faulty installation causes operating temperature of the plug to rise.)

excessive pitting — correct if required.

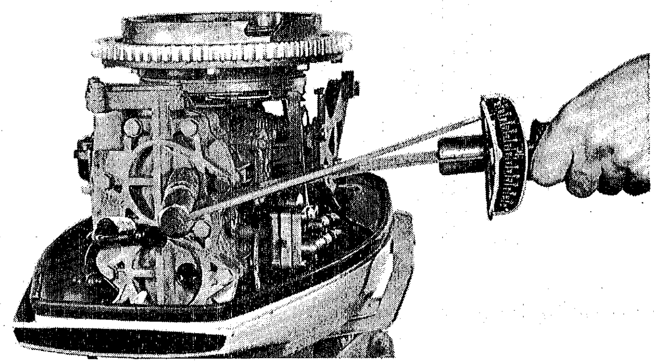
Installation—first make certain the plug (if new) to be installed is of correct heat range specifications.

1. Install gasket (on plug).
2. Insert plug and draw up to finger tightness.
3. Apply torque wrench with appropriate deep socket attached and draw up to 20-20½ foot-pounds as specified for the aluminum cylinder head.

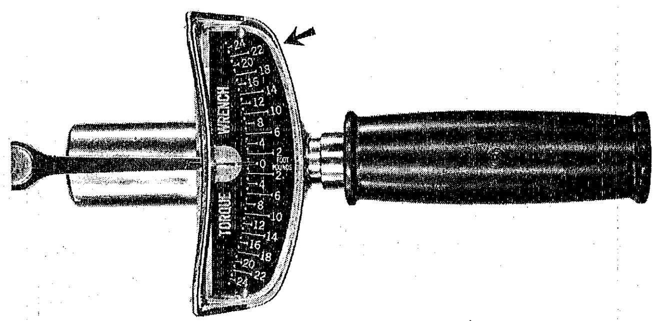
Note — All details above, relating to installation of the spark plug should be adhered to explicitly to avoid possible compression or combustion seepage. Seepage by way of the threads and/or gasket affects to a significant extent the original heat range characteristic built into the plug in that an abnormal heat rise follows, often leading to preignition and irregular engine performance sometimes difficult to diagnose.

And, in as much as heat from the spark plug is dissipated through the cooling system by way of the threads, plug body, gasket and cylinder head casting, the importance of proper torque tension applied during installation cannot be overemphasized. Unless sufficient tension is applied, a heat barrier is established between the spark plug body, gasket and cylinder head casting to interfere with the expected rate of heat transfer from the plug to the cooling system.

The end result is obvious — simply higher than normal (plug) operating temperatures and ever lurking preignition. The gasket must be tightly compressed between the spark plug body and the cylinder head casting to avoid possible seepage and to assure proper rate of heat transfer but not to the point of excessively straining or perhaps stripping the threads — particularly in the aluminum cylinder head. Therefore the torque specification is from 20 to 20½ foot-pounds.



Torquing Spark Plug — Torque to 20 - 20½ Ft.-Lbs.



Torque Spark Plugs 20 to 20½ Ft.-Lbs.

SPARK PLUG CHART FOR JOHNSON SERVICE MODELS
ALSO
MAGNETO POINT GAP SETTING

Model of Motor	Champion Type	AC Type	Auto-Lite Type	Spark Plug Gap	Breaker Point Gap
AD Series	J4J	M42K	A21X	.030″	.020″
CD Series	J4J	M42K	A21X	.030″	.020″
FD and FDE Series	J4J	M42K	A21X	.030″	.020″
HD-25, 26	J4J	M42K	A21X	.030″	.020″
JW Series	J4J	M42K	A21X	.030″	.020″
KD Series	D-9JM	84M	—	.030″	.020″
PO Series	K-61R	83M	—	.030″	.020″
QD Series	J4J	M42K	A21X	.030″	.020″
RD Series through RD and RDS-21	J4J	M42K	A21X	.030″	.020″
RD, RDS-22-23-24M, RK-24	J4J	M42K	A21X	.030″	.020″
RX-10C	J4J	M42K	A21X	.030″	.020″
SD-15, 20	D-9JM	84M	—	.030″	.020″
TD-20, TN Series	J4J	M42K	A21X	.030″	.020″
35 and 40 H.P. (Resistor Plug for Radio Noise Suppression)	XJ4J	—	—	.030″	.020″

Johnson SERVICE MANUAL

CARBURETION

INDEX — FOLLOWING PAGE

CARBURETION INDEX

SERVICING INFORMATION — DIAGNOSING AND REPAIR

HORSE-POWER	MODEL	SPECIFIC REPAIRS Page No.	GENERAL REPAIRS Page No.
2½ H.P.	HS, HD-20	87 to 97	(Basic) 83 to 86
3 H.P.	JW-10 Up	99 to 106	(Basic) 83 to 86
3 H.P.	JH-19 Up	99 to 106	(Basic) 83 to 86
5 H.P.	TS, TD-20	87 to 97	(Basic) 83 to 86
5 H.P.	TN-25 to 28	87 to 97	(Basic) 83 to 86
5½ H.P.	CD-10 Up	107 to 116	(Basic) 83 to 86
7½ H.P.	AD-10, 11 and 12	107 to 114	(Basic) 83 to 86
9.8 H.P.	KS, KD Series	97 to 98	(Basic) 83 to 86
10 H.P.	QD-10 to 14	117 to 129	(Basic) 83 to 86
10 H.P.	QD-15 to 24	130 to 141	(Basic) 83 to 86
15 H.P.	FD, FDE-10	130 to 142	(Basic) 83 to 86
18 H.P.	FD, FDE-11 Up	130 to 142	(Basic) 83 to 86
25 H.P.	RD-10 to 13	143 to 153	(Basic) 83 to 86
25 H.P.	RD-14 and 15	154 to 155	(Basic) 83 to 86
25 H.P.	RD, RDE-16 and 17	156 to 161	(Basic) 83 to 86
28 H.P.	RX-10C Up	158, 162 to 170	(Basic) 83 to 86
30 H.P.	RD, RDE-18	161 to 163	(Basic) 83 to 86
35 H.P.	RD, RDE-19	162 to 164	(Basic) 83 to 86
35 H.P.	RDS-20	162 to 164	(Basic) 83 to 86
35 H.P.	RD, RDS-21	162 to 164	(Basic) 83 to 86
40 H.P.	RD, RDS-22 Up	162 to 172	(Basic) 83 to 86
40 H.P.	RK-24 Up	162 to 172	(Basic) 83 to 86

THE CARBURETOR

THE TWO-STROKE CYCLE

The two-stroke (cycle) engine as built into the assembly of all Johnson Outboard Motors, differs considerably in design and construction from the familiar four-stroke (cycle) engines used almost universally in automotive practice and in a number of fractional and low horsepower engines adapted for various appliance installations. This is due principally to the method of conducting fuel vapor and exhaust gases through the cycle — intake, compression, power and exhaust. With the aid of an automatic reed valve system and ports machined into the cylinder wall rather than employing mechanically-operated poppet valves for the purpose, the steps of the cycle are accomplished in but two strokes of the piston or one revolution, whereas four strokes or two revolutions are required in the four-stroke automotive engine to complete the cycle. The two-stroke then fires once each revolution — the four-stroke once every other revolution. See page 110, Reed Valve.

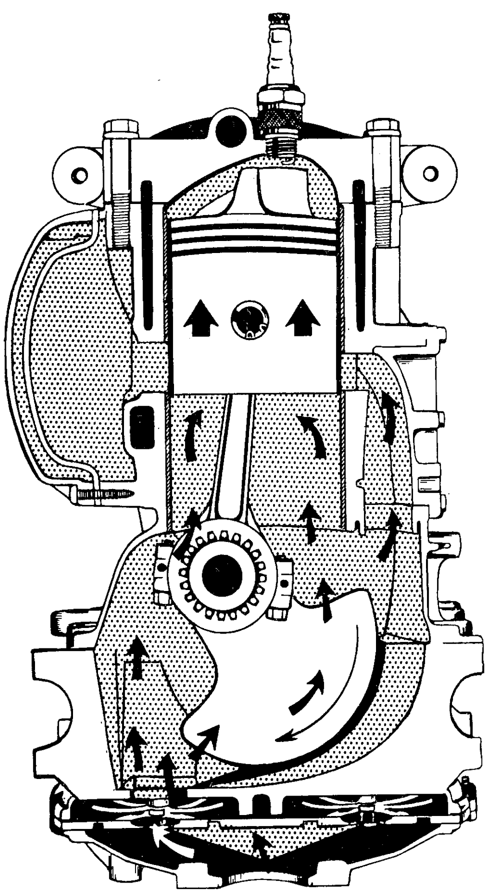


Illustration 1

During the first upward stroke of the piston, a negative pressure or suction is created in the crankcase and in so doing, the reed is caused to be lifted from its seat in an effort to equalize atmospheric and crankcase pressures existing at the moment. During the process, fuel vapor is drawn in from the carburetor to charge the crankcase. See page 110.

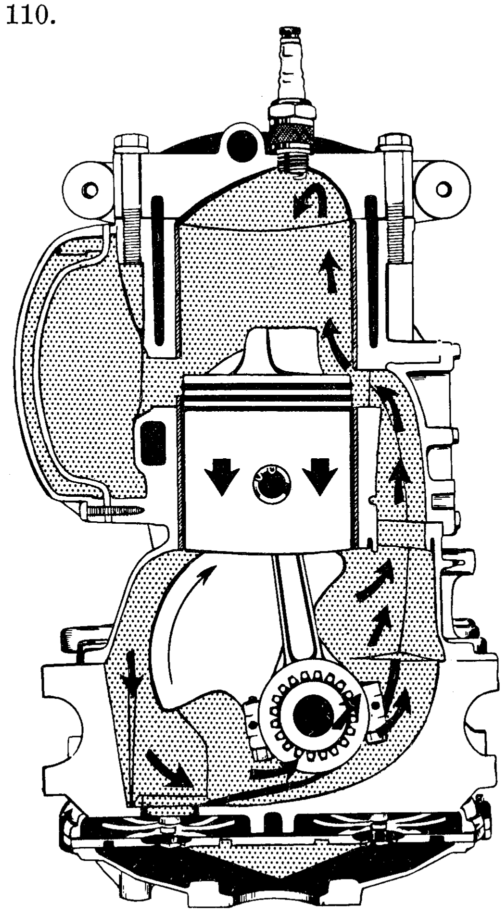


Illustration 2

As the reed automatically closes on the following downward stroke, the crankcase charge is compressed — compressed only until the bypass (intake) port is uncovered by the head of the moving piston, thus releasing the charge to bypass into the upper cylinder region. The charge is subsequently directed upward to the combustion chamber by contour of the piston deflector, as shown.

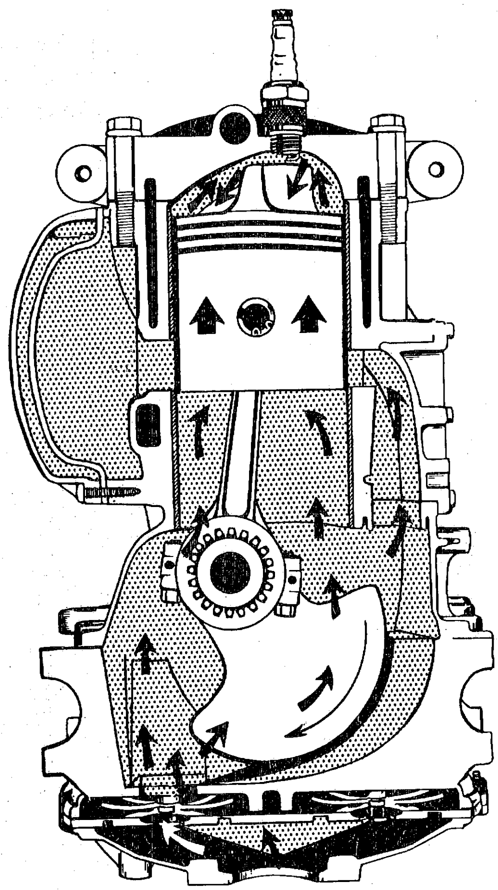


Illustration 3

Since the bypass port is covered (closed) by the piston moving upward on the succeeding stroke, the trapped fuel vapor charge, released from the crankcase during the preceding stroke, is now compressed above the piston in preparation for ignition. Note here that a second fuel vapor charge simultaneously enters the crankcase.

Near the end of the compression stroke, a spark created by the magneto arcs the gap between the spark plug points — igniting the compressed fuel vapor charge. Rapid expansion of the burning vapor following ignition, forces the piston downward to develop the power impulse. The full length of the power stroke, is not, however, consumed in developing of the power impulse — some time is required to rid the cylinder of resulting spent or burned gases and to receive a fresh charge from the crankcase for the succeeding power impulse.

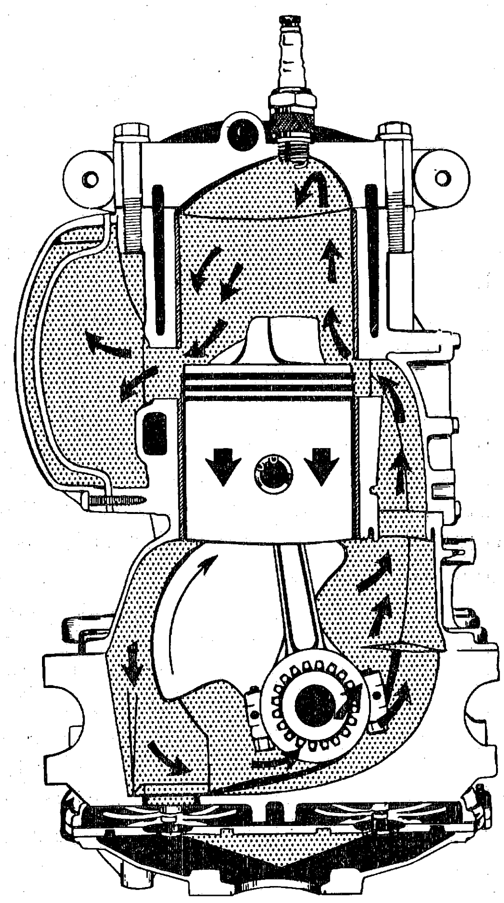


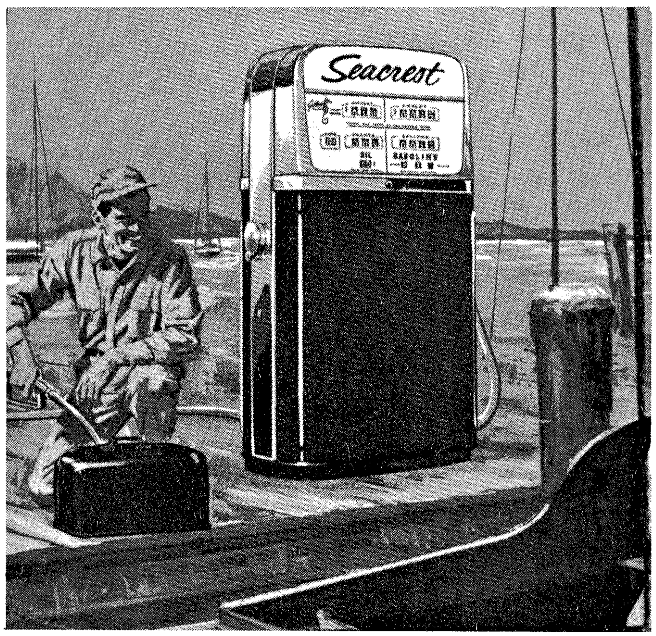
Illustration 4

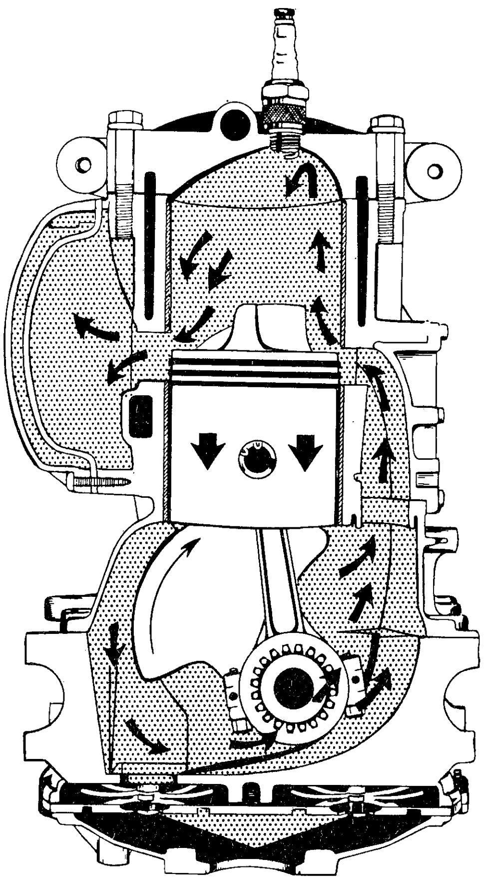
Close observation of the illustrations above reveals that the width of the exhaust port is somewhat greater than that of the bypass port and as such, time of its opening significantly precedes opening of the bypass port by the downward moving piston. Relatively high pressure exists within the cylinder at this time consequently at partial uncovering (opening) of the exhaust port, the spent (exhaust) gases commence to flow out through the exhaust port — being directed in that direction by the gradually sloping side of the piston deflector.

Further downward progress of the piston uncovers (opens) the bypass port which instantly releases the compressed fuel vapor charge now contained in the crankcase and as noted in the illustration, proceeds to crowd the burned gases out of the cylinder and into the atmosphere to complete the cycle.

LUBRICATION – FUEL BLENDING

Lubrication for outboard motors is achieved primarily through the mixing or blending of oil and gasoline in certain proportions according to the manufacturer's specifications. As such, the oil for lubrication and the gasoline for combustion flow simultaneously through the carburetor, where appropriately mixed with air enter the crankcase in a vapor-like stream, thereafter to be compressed and transferred to the combustion chamber. The oil content thus performs its chore of lubricating the internal moving parts after which it is dissipated by combustion and discharge through the exhaust system.





Lubrication to be most effective in the two-stroke (cycle) engine requires just so much oil content in the fuel mix – a definite ratio of oil to gasoline. The use of too little oil obviously leads to premature wear and early breakdown. On the other hand, a fuel mixture richer in oil than recommended or demanded is not only wasteful and costly but contributes to faulty performance and in time, to expensive corrective measures because of the disturbing effects of excessive carbon accumulation which characteristically follow. The frequent occurrence of spark plug changes may similarly be traced to an overabundance of oil in the fuel mixture.

Our Engineering Department has, after long research and evaluation, developed a ratio of 1 part oil to 24 parts of gasoline by volume as best suited for the efficient lubrication of Johnson motors and economy of operation. The ratio of 1 to 24 is equivalent to 1/3 pint to 1 gallon or 1 quart per each 6 gallons.

We cannot stress too emphatically the value and importance of adhering to the engineered 1 to 24 ratio for continued uninterrupted performance. As a consequence, the operator's best assurance of maintaining consistently the specified fuel mix ratio is through the use of a 1 to 24 premix purchased from reliable and responsible fuel dealers dispensing a high quality outboard oil (S.A.E. 30) and nonpremium gasoline.

Instructions relating to the mixing of fuel as otherwise published in the Operator's Manual and provided with each new motor shipped from the factory, are explicit and correct in every respect – mixing 1/3 pint of high quality outboard oil (S.A.E. 30) with each gallon of gasoline or 1 quart per each 6 gallons, the ratio of which in either event is 1 to 24. Care, nevertheless, should be exercised during each refill to make certain that the recommended 1 to 24 ratio spread is being constantly maintained at all times for best results.

It is of utmost importance that oil of the grade and amounts specified, be thoroughly mixed with gasoline to assure efficient lubrication and operation of the motor throughout its operating RPM range. To properly mix or blend, pour approximately a gallon of gasoline in the tank, pour in the required amount of oil, shake the tank briskly for a minute or two to insure complete blending then add sufficient gasoline to fill the containers (tank). Rock tank back and forth several times to fully blend.

Unless the oil and gasoline be properly mixed, it is possible to operate first on an excessively oil rich blend to cause profuse smoking (exhaust) and sluggish performance – the heavier oil is inclined to linger near the lower position of the tank to be first consumed. The remaining fuel mix is obviously not rich enough in oil content to achieve ample lubrication – overheating, perhaps seizure and premature wear follow.

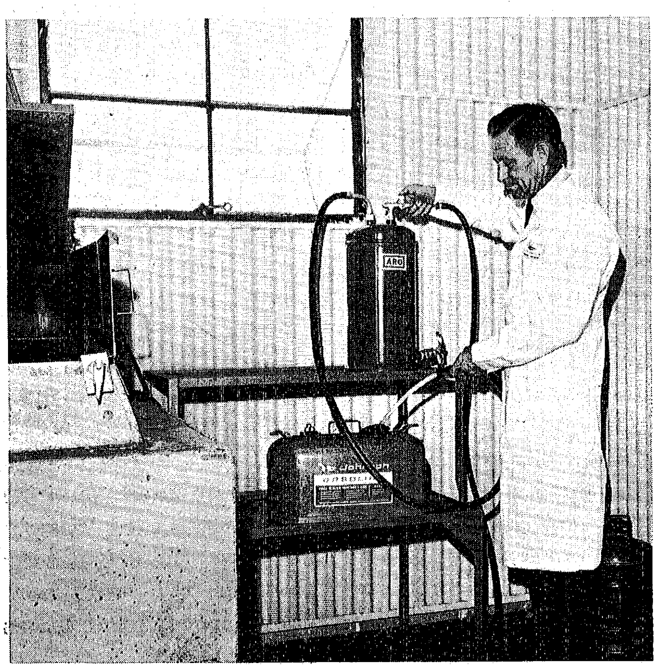
Many ills, all costly to the operator, can be laid to careless blending of the fuel mix during seasonal operation – wittingly or not. Every possible effort should accordingly be made to avoid them by adhering strictly to the desired and factory recommended 1 to 24 ratio of oil to gasoline for –

1. Best performance.
2. Uninterrupted boating.
3. Prolonged spark plug life.
4. Economy of operation.

Every tune-up and/or repair should among other things include –

1. Draining the operator's fuel tank of existing contents.
2. Replace with a known 1 to 24 fuel mix.
3. A word of advice to the operator for his benefit advocating the use of a reliable 1 to 24 premix during future refills where and whenever available or exercise caution when obtaining manually blended refills – insisting on a precise 1 to 24 mix of high quality outboard oil and nonpremium gasoline.

Note: The compression ratio is not high enough to warrant the use of gasoline containing ethyl lead (colored) to overcome certain combustion characteristics, common to high compression, high-speed engines; however, since most gasolines now on the market contain ethyl lead in various quantities, it can be used, however, it is advisable to adhere to a gasoline with minimum of lead content.



Due to atmospheric conditions and temperature changes, moisture condensation is more or less continually taking place within the gas tank. This results in water droplets accumulating in the tank, gas line and carburetor which, if excessive, are sufficient to interfere with performance of the motor, causing it to act, in many instances, as though it were starving for gasoline. (Water will not pass through the fine screens and small carburetor jets.) Be sure the fuel system is free of moisture – likewise, all fuel should be poured into the tank through a fine filter.

NOTE

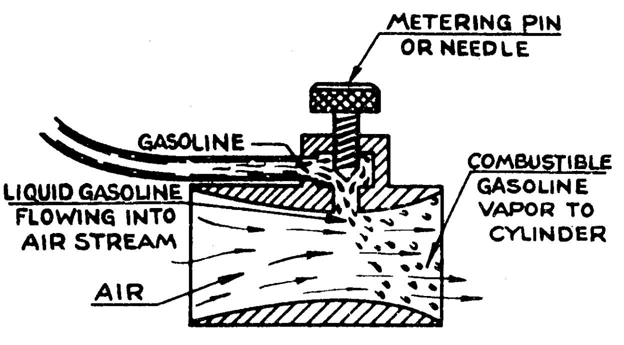
Starting with 1964 motors, Johnson's recommended oil and gasoline mixture is 1 part oil to 50 parts gasoline. Before the 50:1 gas-oil ratio can be used, the recommended break-in procedure must be followed using a 24:1 mixture.

NOTES

CARBURETION – BASIC

All gasoline operated engines are of the internal combustion type – that is, the fuel mixture is ignited and burned within the cylinder to result in expansion of the burning charge, thus creating comparatively high pressure which is applied to the head of the piston to force it downward, developing the power impulse.

The fuel (gasoline and air) must be prepared or mixed for combustion (vaporized) however, by an outside device – the operation being accomplished by a simple mixing valve or carburetor. Air and gasoline must be mixed in certain proportions to provide a combustible vapor – roughly, 1 part gasoline to 8-11 parts of air. Too much or too little of either (gasoline-air) affects combustible quality of the vaporized fuel, likewise performance of the engine. An arrangement is thus required to meter the amount of gasoline flowing into a stream of air created by suction in the cylinder of the engine, as the piston progresses on its downward stroke in a four-stroke cycle engine. The operation is carried on in a somewhat different manner, however, in a two-stroke cycle engine (outboard motor) in that suction is created in the crankcase on the **upward** stroke of the piston. **Air must be in motion to vaporize the gasoline** – (gasoline-oil mixture used in the outboard motor).

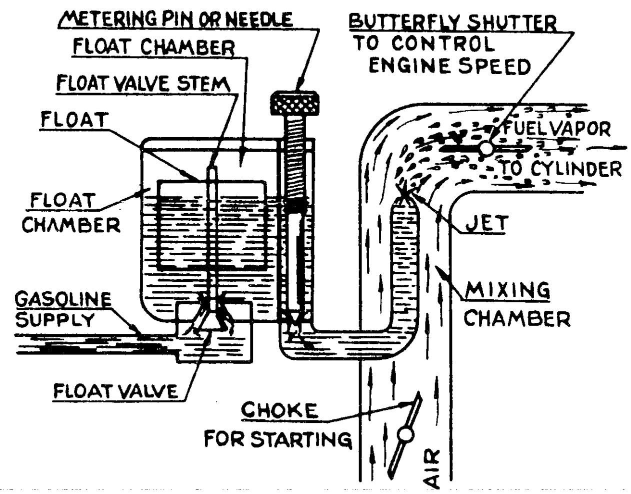


Schematic diagram of simple mixing valve.

The simple mixing valve consists of an air tube (venturi) to which is attached a metering pin – the pin being threaded to permit variations in metering the flow of gasoline into the air stream.

It can readily be seen from the above illustration that the more the metering needle is opened, the more will be the amount of liquid gasoline flowing into the air stream to be vaporized. The vapor thus becomes "rich" in gasoline – if excessively rich, partial combustion results (in the cylinder) due to insufficiency of air to produce sluggish operation of the engine. On the other hand, the more the metering needle is turned down, the less will be the amount of liquid gasoline flowing into the air stream. The vapor then becomes "lean" in gasoline to result in a slow burning fuel charge, evidenced by loss of power and faulty operation of the engine.

The mixing valve is the simplest form of carburetion for practical purposes though while suitable under certain conditions, it is not well adapted to variable speed engines as in the case of an outboard motor. Some arrangements must be made to maintain constant fuel level in proportion to the speed at which the engine is running to realize proper fuel-air ratio at the various speeds once the metering needle is correctly set. This is accomplished by the addition of a float chamber.



Schematic diagram of simple float feed carburetor – one needle to adjust for meter flow of liquid gasoline into the air stream to be vaporized.

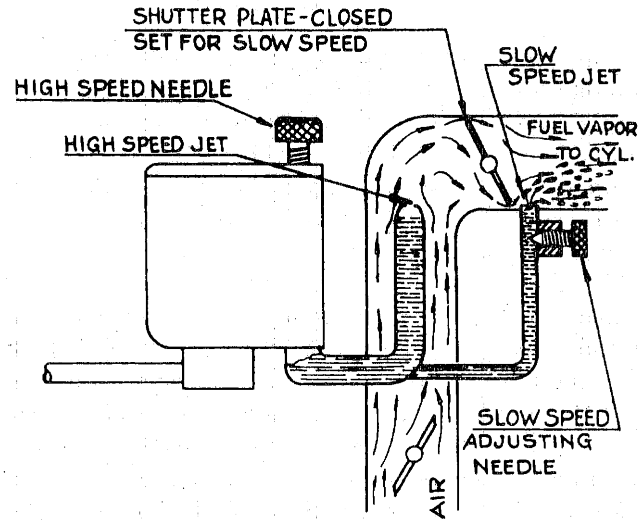
The float chamber, or float bowl as it is sometimes called, consists of a bowl or cavity large enough to contain a float, usually of cork or a hollow cylinder constructed of thin brass sheet, closed at both ends to permit it to float in a liquid (gasoline, in case of the carburetor). The purpose of the float is to maintain a predetermined level of gasoline in the carburetor by operating a valve (float valve) in the float chamber. Where a cork float is used, operation of the float valve is by direct connection as shown in above illustration, or more frequently by lever arrangement.

Naturally, with no gasoline in the float bowl, the float comes to rest at the bottom of the bowl, thus opens the float valve to permit the flow of gasoline. As gasoline flows into the bowl, the float rises to gradually minimize flow of gasoline by subsequently closing the float valve until a point where maximum level is reached when the float valve closes entirely to close off the flow of gasoline. As gasoline is consumed by operation of the engine, the float settles to permit additional flow of gasoline into the float chamber – this is in proportion to the rate of consumption by the running engine. The faster the engine runs, the greater is the fuel consumption, consequently, the float settles deeper in the bowl to proportionately increase the flow of gasoline by greater opening of the float valve. As engine speed is decreased, fuel consumption is lessened and the float rises to decrease the flow of gasoline in proportion to the rate of consumption by the slower running engine. When the engine is stopped, fuel consumption is nil — the float rises to maximum level and closes the float valve to stop flow of gasoline.

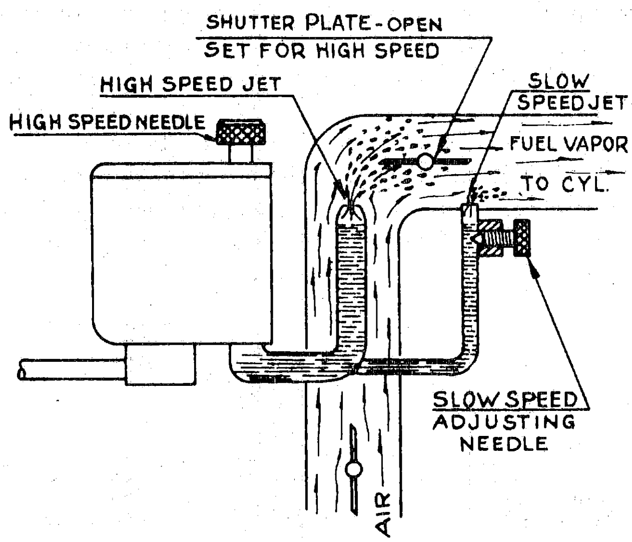
To obtain variable speed performance from any gasoline operated engine, some means must be provided to control the charge (gasoline vapor) admitted into the cylinder. The larger (heavier) the charge, so to speak, the faster the engine runs, conversely, the lesser the charge, the slower the engine runs. Spark timing naturally must be considered at this point since degree of advance is in relation to the fuel charge and engine speed. Engine speed, as far as the carburetor is concerned, is controlled by a damper or shutter plate built into the mixing chamber in such a manner that it can be manually opened or closed at will to increase or decrease speed as desired. See illustration. Full open shutter permits maximum vapor charge being drawn into the cylinder, thus maximum engine power for top-speed performance. Various degrees of opening of the shutter plate result in various engine speeds since the degree of opening governs charge to the cylinder.

Since a comparatively rich fuel mixture is required for starting a cold engine, a second shutter (choke) is built into the mixing chamber (forward of the gasoline jet) to restrict the flow of air through the mixing chamber, thus creating high suction at the jet to cause proportionately more liquid gasoline to flow into the air stream as required only for starting. On starting of the engine, the choke is gradually opened as engine temperature rises until open position is reached for normal operation — engine running on proper ratio of gasoline and air for maximum efficient performance.

To obtain greater flexibility of the engine (speed) a second jet is inserted into the mixing chamber (air stream) to provide more efficient carburetion at slow and intermediate speeds. This jet is usually placed slightly forward of closing position of the shutter plate and arranged to function at near closed position of the shutter when air velocity over the high-speed jet is not sufficient to properly vaporize the gasoline. See illustration. Comparatively high velocity of air over the slow speed jet at near closed position of the shutter plate causes the gasoline to be vaporized for slow speed performance. As the shutter is opened, the engine picks up speed with result that the slow speed jet becomes proportionately less effective since velocity of air through the mixing chamber becomes great



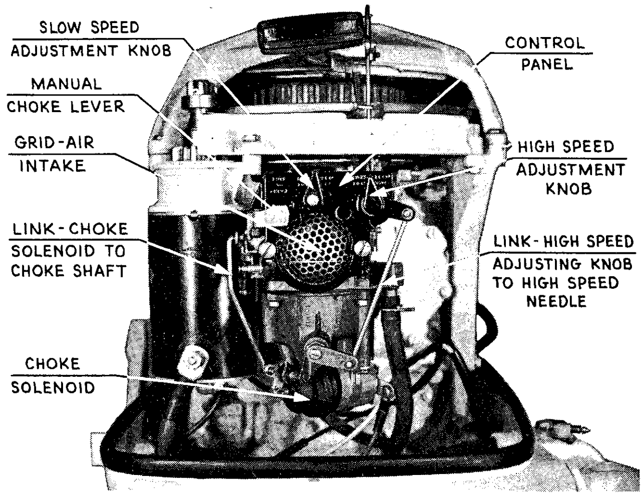
Schematic diagram of two-jet carburetor, showing shutter plate set for slow speed operation and fuel being vaporized at the slow speed jet. Note high-speed jet is inactive.



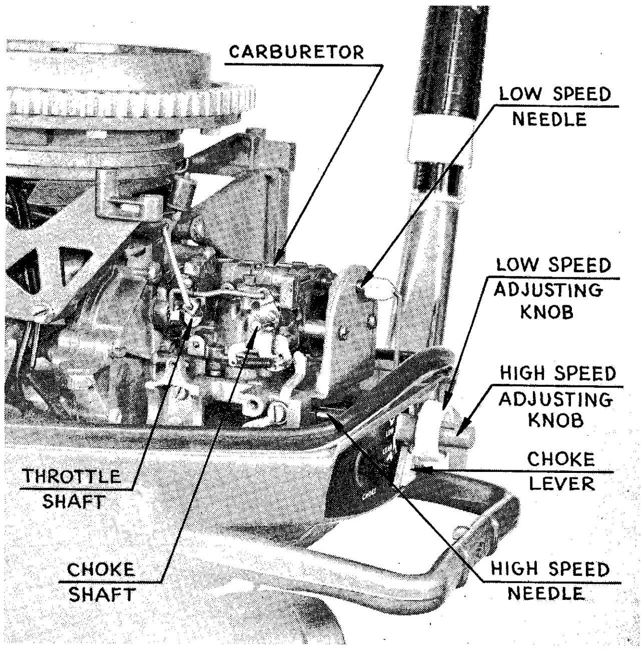
Schematic diagram of two-jet carburetor, showing shutter plate set full open for top speed performance and maximum vaporization at high-speed jet with almost imperceptible vaporization taking place at the slow speed jet.

enough to cause gasoline at the high-speed jet to vaporize. Vaporization at the slow speed jet gradually diminishes as the shutter plate is opened for maximum power but becomes effective again as the shutter is closed and engine speed decreases. In this simple arrangement the engine operates entirely on vaporization at the slow speed jet when the shutter is set for slow engine speed.

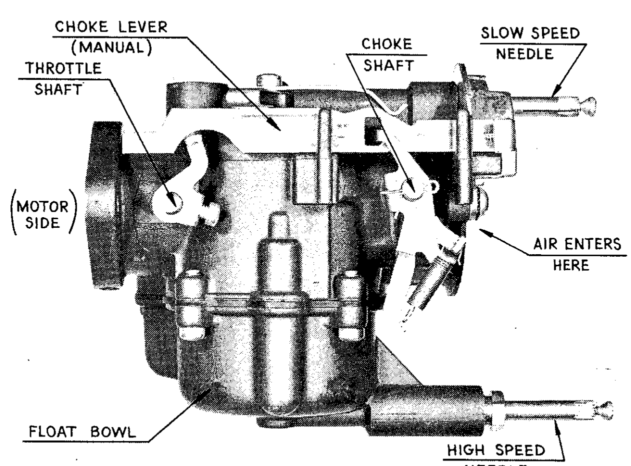
On testing the motor in a motor test tank after final assembly, be sure all exhaust gases are drawn off the tank. This is important since they accumulate under the shroud (motor cover) to interfere with carburetion, thus causing the motor to operate erratically for no apparent reason. Same holds true for tank testing of all outboard motors.



Model RDS (35 h.p.) Carburetor Installed with Solenoid Operated Choke.



Carburetor Installation on Motor.



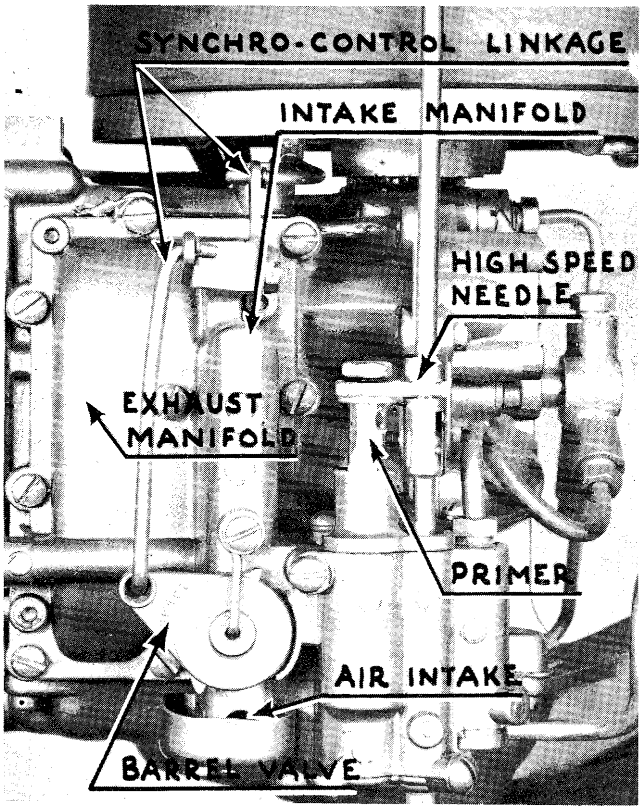
Model RD Carburetor – Prior to 1961 with Both High and Slow Speed Jets Adjustable.

NOTES

NOTES

CARBURETION – H AND T SERIES

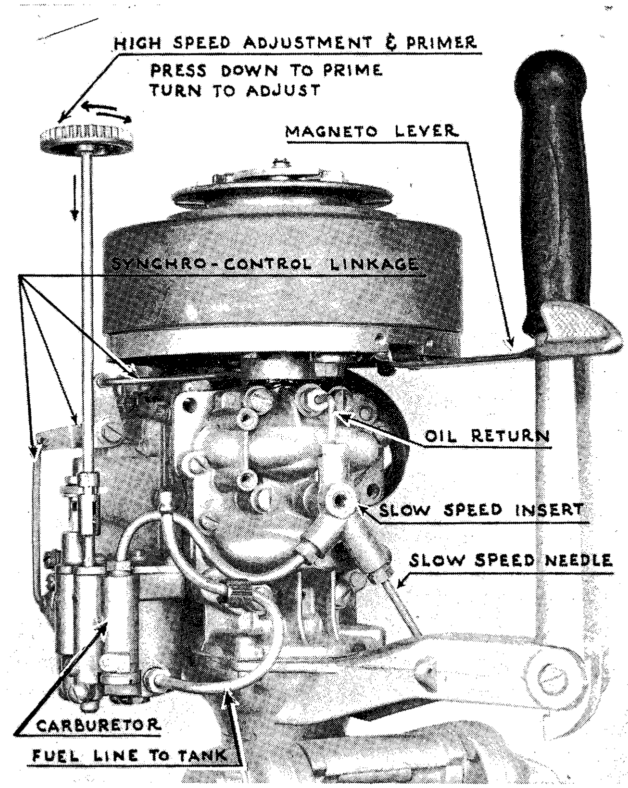
Carburetion is of the full range type, thus providing efficient carburetion at all speeds—some departure from customary construction has been made nevertheless, in that only the high speed needle and jet are built into the carburetor body; the slow speed needle and jet are actually not a part of the carburetor proper—this feature is made a part of the crankcase assembly and functions throughout the entire speed range of the motor.



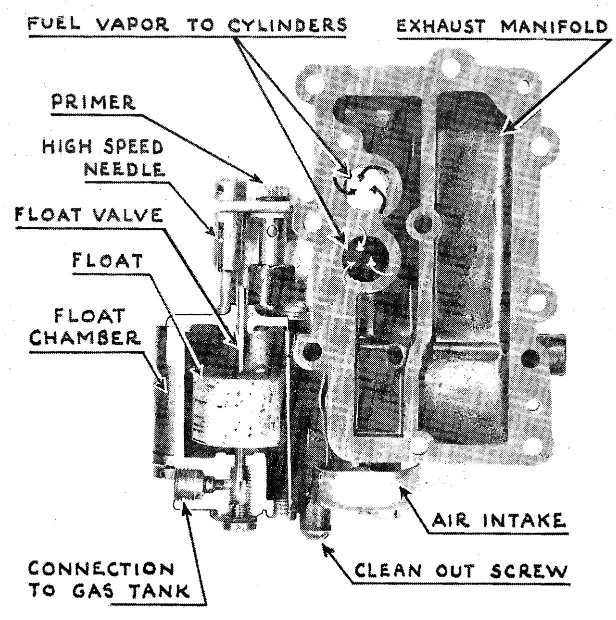
Carburetor and Manifold Assembly

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 fuel in the slow speed mixing valve to produce a combustible vapor which is conducted into the crankcase chamber by way of the rotary valve.

Some difficulty was experienced during the latter part of the summer (1947) with the Model HD-25 in that there was a tendency towards irregular running at high speed. The motors could be easily

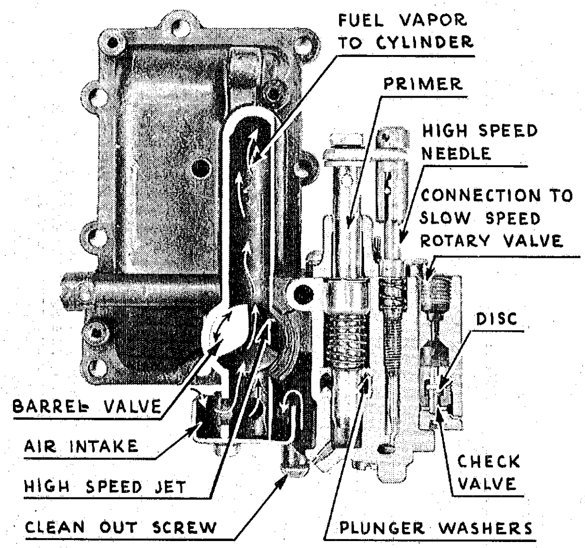


Carburetor and Slow Speed Insert



HS-HD Carburetor, Rear Sectional View

started and operated very well at slow speed for trolling, but at high speed there was a noticeable fluctuation, that is, they would run at high speed for a short period and then momentarily slow down and pick up speed again, etc.

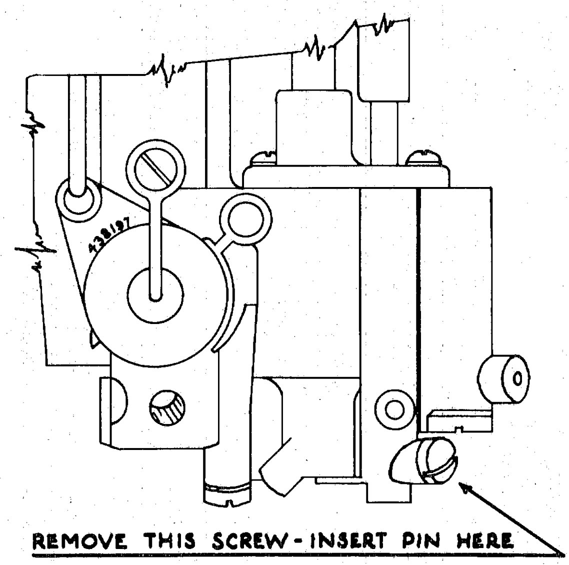


HS-HD Carburetor, Front Sectional View

Performance of this nature is frequently the result of too hot spark plugs; faulty action of the water pump and cooling system, or misalignment of the reciprocating and revolving parts to create excessively high operating temperatures, "drag" on the motor or to cause a vapor lock in the fuel system, etc., but in this particular case, it's different.

Note horizontal clean-out screw underneath the float bowl of the carburetor (see illustration), provided for clearing the passage between the bowl and mixing chamber of foreign matter. Motors prior to #618633 were not equipped with facilities for clearing the passage—those following were, however, the fuel passage was drilled too large which permitted formation of vapor bubbles to interfere with constant flow of fuel to the mixing chamber. Later, production was corrected in this respect.

Wherever necessary to overcome this condition, a small pin (1/8" x 1-5/16") can be installed in the passage to reduce its effective area. This can be accomplished by (1) removing the clean-out screw; (2) then unscrew the high speed needle five or six turns (far enough to clear the passage); (3) insert pin; (4) replace clean-out screw and (5) readjust high speed needle to best running position.



CARBURETOR ADJUSTMENT—HS-HD

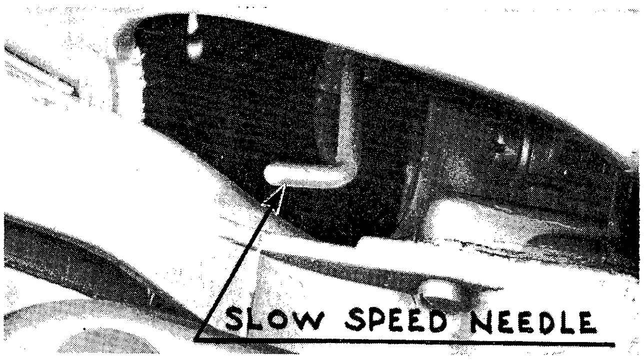
To adjust carburetor, proceed as follows:

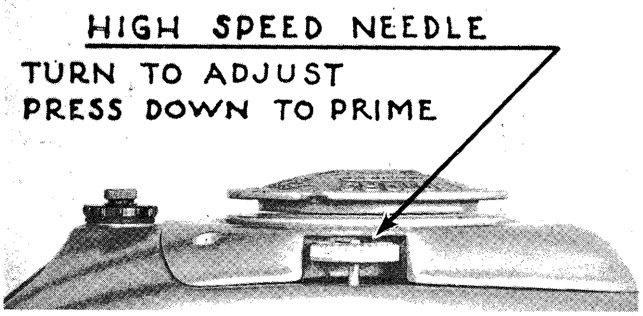
[There are two (2) adjustments—namely, High and Slow speed.]

1. Close slow speed needle, turn right until it rests gently on its seat, then unscrew approximately 3/4 turn. (Turn left.)
2. Close high speed needle, turn right until it rests gently on its seat, then unscrew approximately 3/4 to 1 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 3/4 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.

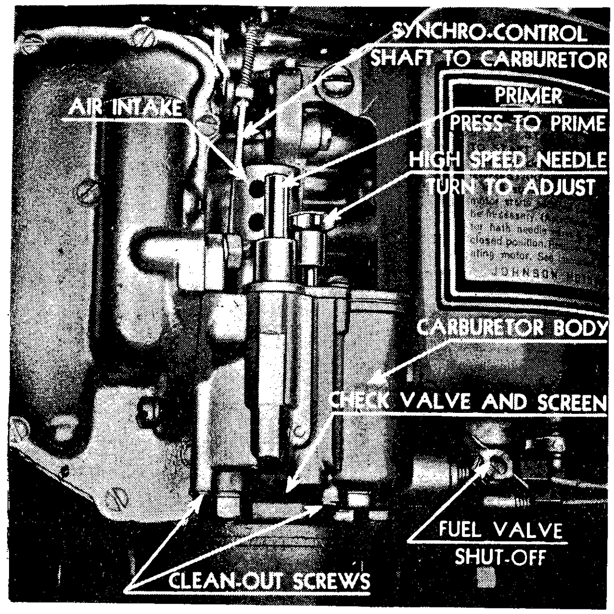
Spark and magneto levers are synchronized, therefore movement of the magneto lever controls both spark and carburetor simultaneously.

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.

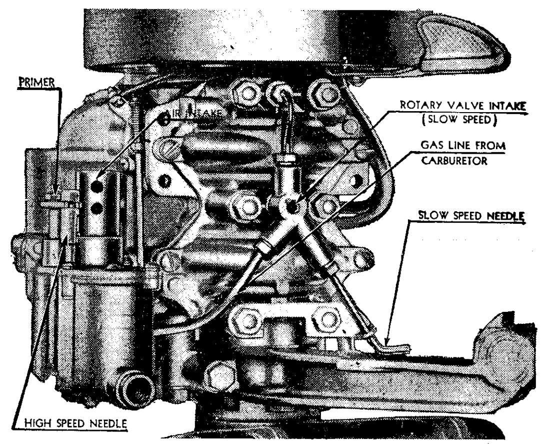
STARTING MIXTURE – TD AND TN SERIES

Since a rich starting mixture is essential for starting purposes, some arrangement must be built into the carburetor to accomplish it. Models TD and TN do not employ use of the conventional choke built into the carburetor, but rely on a primer (manually operated) to provide 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.



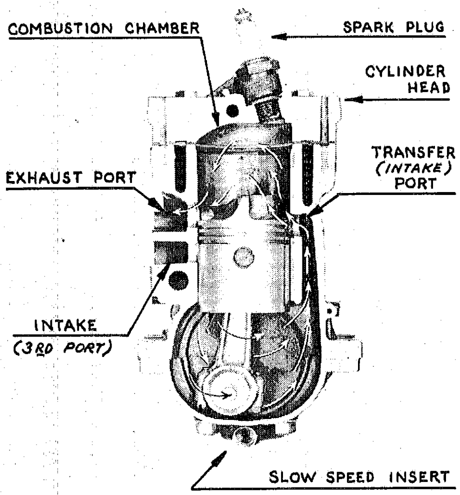
Carburetor – Models TS and TD.



CARBURETION – TD AND TN SERIES

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.

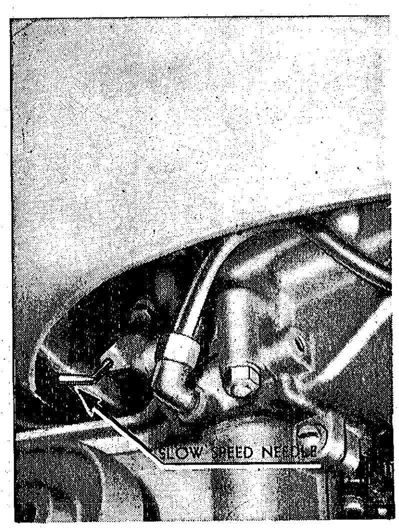
Since both third port and rotary valve principles are employed, there are two independent systems of carburetion. The carburetor itself is of the conventional type—consisting of a float chamber, mixing chamber, throttle valve, needle for adjusting mixture and a connection to the intake manifold. The 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 are 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 3/4 turn. (Turn left.)



Showing Location of Slow Speed Needle

2. Close high speed needle, turn right until it rests gently on its seat, then unscrew approximately 3/4 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 3/4 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.

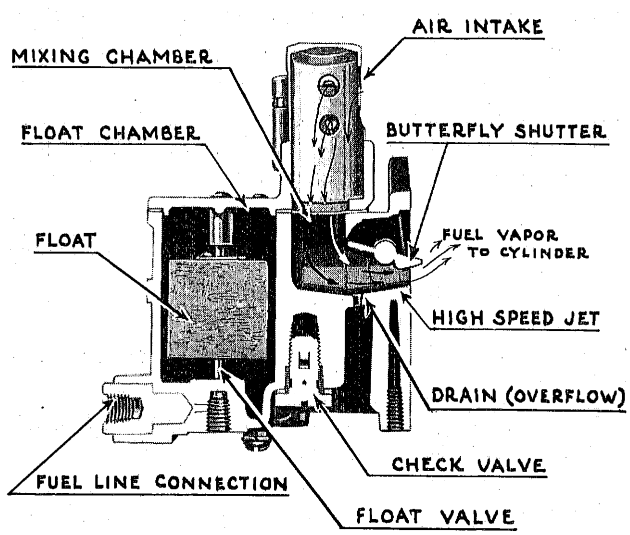
Move spark lever to full advance position, gradually open the high speed needle until maximum speed is reached.

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.

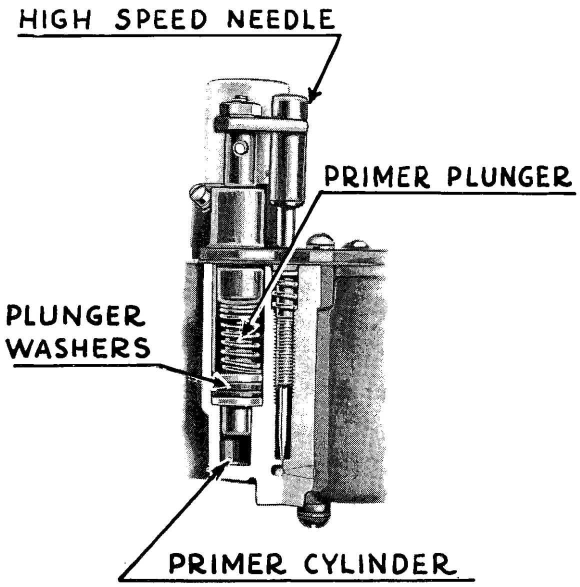
In event the slow speed intake is obstructed with foreign matter, simply open the slow speed needle three or four turns — depress primer vigorously several times to force out obstruction. Readjust slow speed needle as instructed above. Be sure check valve screen is clean.

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.



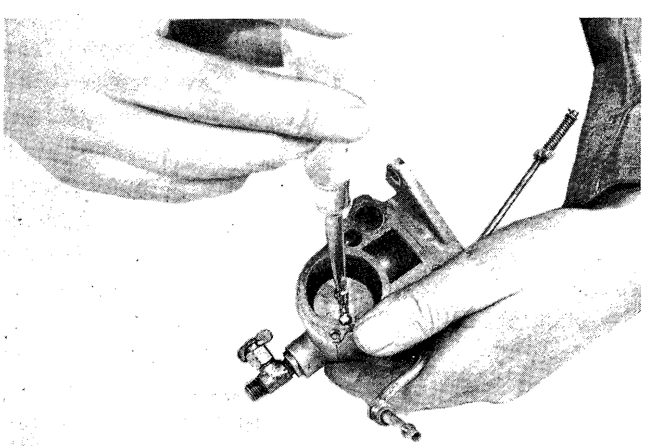
Sectional View of LT and T Carburetor.



Sectional View of Carburetor (Primer and High-speed Needle).

TO INSTALL NEW CARBURETOR FLOAT

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.



Removing Float

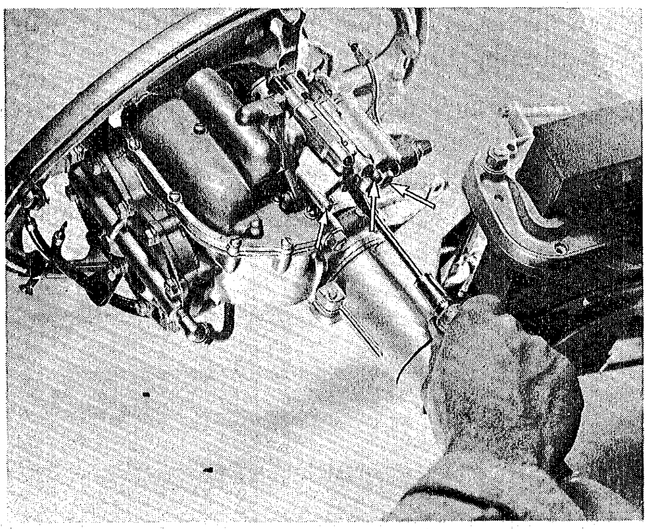
To install new float, proceed in reverse order of that above. Care should be taken to see that cotter ultimately anchors in groove on float valve stem to prevent fuel level being too high or too low.

SLOW SPEED PERFORMANCE

Carburetion on the light twins 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.

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.



Showing Removal of Check Valve Screen Assembly and Drain Screws for Cleaning Purposes (Carburetor).

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 its 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.

Excessive looseness in the swivel bracket will cause the motor to wobble or shake considerably, particularly when slow trolling speeds are desired to interfere with smooth running.

Many instances of unsatisfactory slow speed performance, however, can be overcome by simply tightening (not too tight) the adjusting screw on the swivel bracket as shown here but providing, of course, that the motor otherwise is in good mechanical condition.

CLEANING CARBURETOR MODELS TS, TD, HS, HA, HD, TN

Some difficulty may be experienced with hard starting on the above models during the early part of the spring 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 or commercial solvent 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 or a solvent is advised. 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.

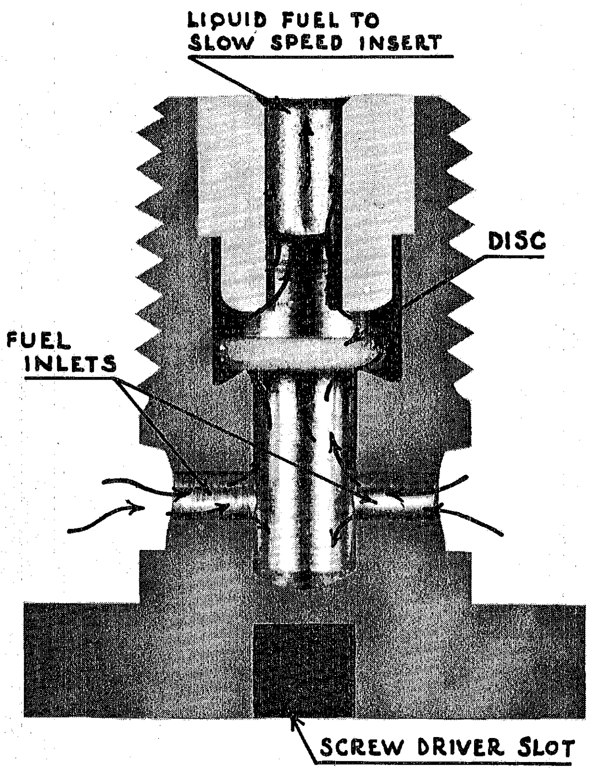
The leather washers in the primer, if excessively worn or are not properly seated, should be replaced since loss of seal at this point prohibits the primer functioning as it should.

Remove the high speed needle and carburetor cover along with the primer plunger. The two brass and leather washers undoubtedly will remain in the cylinder. Place tool #301785 in vise in such a manner that it can be inserted in the primer cylinder. The small flare at the end of the tube can be directed through the hole in the washers and "hooked" behind them to make removal simply a matter of tapping lightly on the carburetor body as shown.

It frequently becomes necessary to replace the primer cylinder sleeve because of scoring to interfere with primer action. Run a 1/2"-13 tap part way down the sleeve—enough to grasp it firmly. Then place the tap in a vise and drive out by carefully tapping the carburetor body with a mallet, as illustrated. Be careful not to damage the body.

CHECK VALVE – CARBURETOR H AND T MODELS

Function of the check valve in the carburetor is to maintain proper fuel level at the slow speed mixing valve (Y insert in crankcase) since actual vaporizing of the fuel is performed at a considerably higher level than the mean level of the carburetor proper. Thus, each time the motor is turned over (cranked) for starting, liquid fuel from the carburetor is drawn up through the tube, leading from the carburetor to the mixing valve (page 94), where it is mixed with air (vaporized) and conducted on into the crankcase by way of the slow speed rotary valve. This action takes place as result of suction or low pressure created in the crankcase on upward stroke of the piston. Fuel level, consequently, is maintained at the mixing valve only as long as low pressure (suction) exists in the crankcase unless some means are provided to hold the fuel in check as suction diminishes, which it does when the piston reaches the top of its upward stroke.

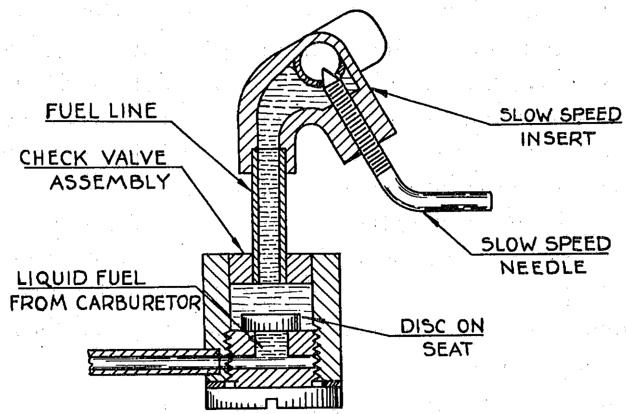


Sectional View of Check Valve

The result is a check valve built into the carburetor expressly for this purpose. It consists of a housing or body with openings at each end, between which is installed a small flat disc. The disc is free to be lifted off its seat when suction occurs to permit passage of liquid fuel and to seat to prevent return of the liquid above it when suction ceases.

Area of the disc and fuel passages above and below it are calibrated with respect to the volume of liquid fuel expected to flow through the check valve assembly—this, naturally, is governed by the rate of fuel consumption at the various engine speeds.

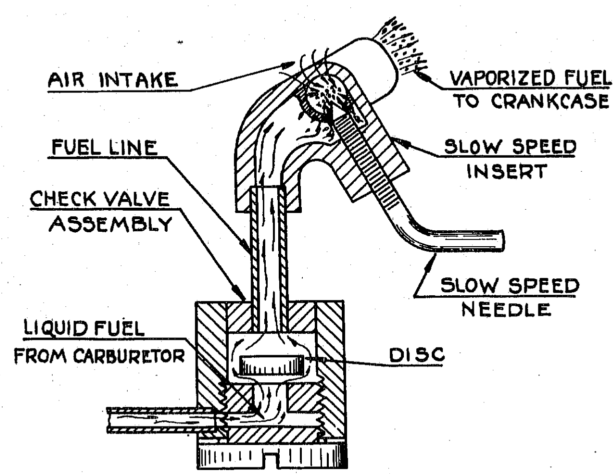
On cranking, the disc is lifted off its seat by suction created in the crankcase on upward stroke of the piston. This causes liquid fuel to flow around the disc (as illustrated) and on up through the fuel line to the mixing valve where it is vaporized and conducted into the crankcase. The fuel continues to flow in this manner as long as suction is built up in the crankcase as the piston travels upward. Suction ceases when the piston reaches top center and the fuel subsequently starts to drop down to seek normal level in the carburetor since no suction now exists to hold it at this high level. High level, nevertheless, is maintained, regardless



Schematic Drawing to Illustrate Function of the Check Valve. Note Disc Settled on its Seat Since there is no Suction (in Crankcase).

—weight of the liquid in the fuel line above the disc (and the weight of the disc) causes the disc to normally come to rest on its seat, thereby preventing return flow of the liquid. The disc then alternately lifts from its seat when suction occurs to pass the liquid fuel and settles on the seat to prevent excessive drop in fuel level when no suction is present to otherwise maintain it.

If the check valve disc is prevented from acting freely either as result of accumulation of foreign matter or corrosion in the assembly, sufficient level



Schematic Drawing to Show Disc of Check Valve Raised off its Seat by Suction Created in the Crankcase on Upward Stroke of the Piston, to Permit Flow of Liquid Fuel.

of fuel in the slow speed arrangement cannot be maintained—thus, improper carburetion at slow speeds and faulty operation of the motor. The fuel level in this case is extremely important and must be maintained.

Prior to actually suspecting the check valve to be at fault, make certain all fuel lines and passages are clear and free of obstruction. Pay particular attention to the check valve screen—be sure it is clean.

It is a simple matter to determine whether or not the disc in the assembly is functioning as it should—place the open end in your mouth (wash it off first to guard against infection) and blow. If the disc is seating properly, it should be impossible to blow through the valve assembly. Now "suck" on the same end of the assembly—if the disc floats freely, it should be possible to **draw** air through it but not **blow** air through it. If there is any doubt as to its condition, replace the check valve assembly.

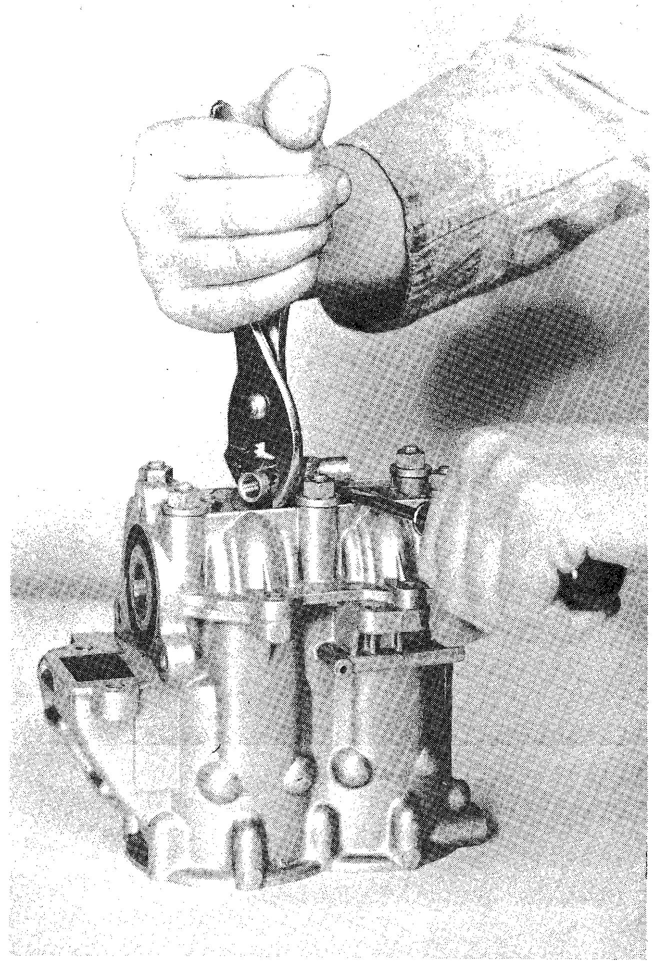
REMOVAL AND INSTALLATION OF SLOW SPEED INTAKE ON THE H AND T SERIES

There are times when it may seem impossible to obtain satisfactory slow speed adjustment on above models, even though the ignition system is in good working order, the power head in general is in good mechanical condition as well as the carburetor itself, spark is good, compression is good (no compression losses at slow speeds, resulting from faulty piston rings or excessive cylinder wear), carburetion is good at high, but not at slow, speeds.

In a situation of this nature, look to the slow speed insert on the crankcase—slow speed needle may be damaged or the slow speed needle seat in the insert may be damaged, or both.

Damage to the seat results from the motor operator screwing the slow speed needle down too tightly against the seat in his efforts to adjust the motor for slow speed performance. In doing so, the seat is frequently expanded or otherwise damaged which makes it impossible to obtain satisfactory slow speed adjustment thereafter.

Be sure the slow speed insert is clean and free of obstruction, however, and that the small check valve in the carburetor is clean. Open the slow speed needle several turns, then vigorously depress the primer button several times—this should force out any loose particles of obstruction. If gasoline is seen to spray into the opening in the insert, it is reasonable to assume there is no obstruction. If it is still impossible to adjust for slow speed operation, replace the insert and the slow speed needle. Proceed as follows:

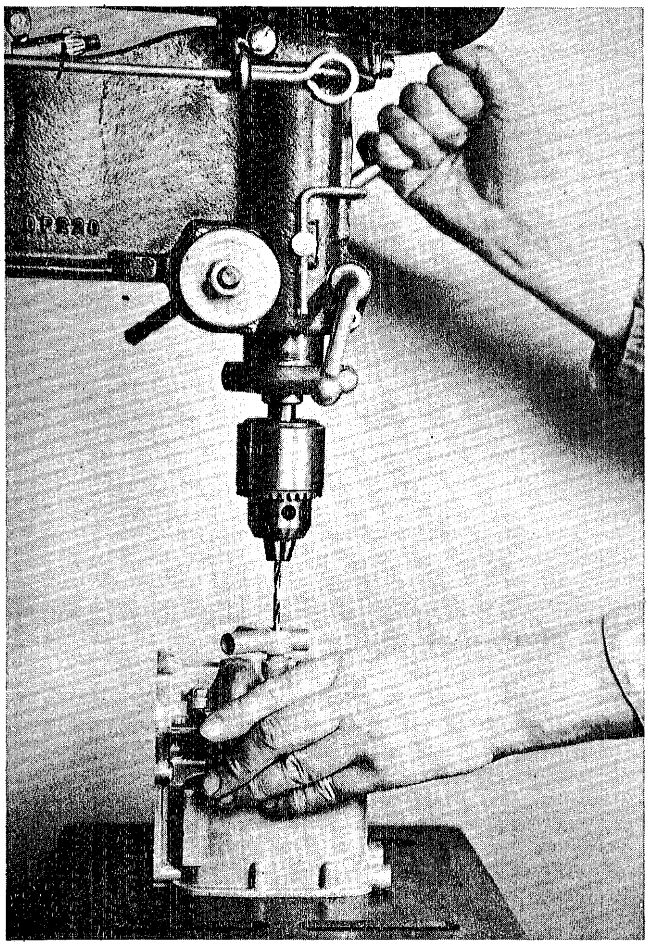


Remove the slow speed needle, packing nut and gas line to carburetor. Grasp the slow speed insert firmly with a pair of pliers, as shown in the illustration. Twist back and forth, at the same time pry upward with a screw driver placed between one of the ears of the insert and the crankcase. This is a press fit and not too difficult to remove as described.

Install new insert. Place a drop or two of oil on the boss which fits into the crankcase. Gently drive insert into place with a mallet, being sure it is properly aligned and does not cock when driving into position. Drive until the insert bottoms.

NOTE: On HS and HD models, a small lead seat (#43-298) must be inserted in the hole in the crankcase before the insert is installed. Push all the way down. **Small rib on seat must be down.** Rib must fit in corresponding recess at bottom of hole in the crankcase.

After having driven the insert "home," with lead seat in position, run a 5/32" drill through the hole in the insert and drill through the lead seat.

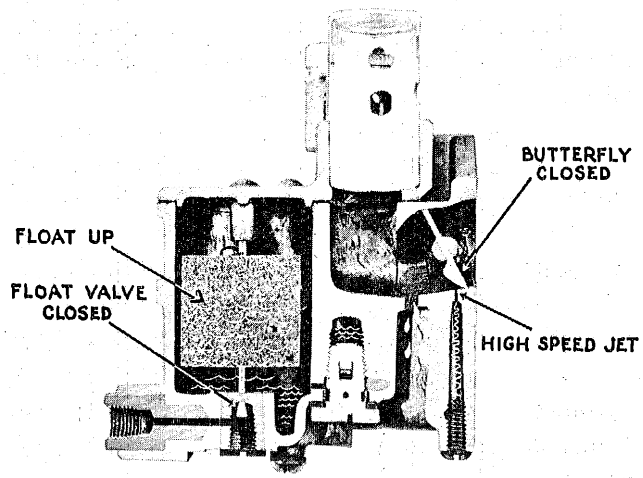


Drilling Lead Seat at Base of Slow Speed Insert
H Models Only

CARBURETOR – T SERIES (BUTTERFLY VALVE)

Quite often it appears that after having exhausted entire store of information regarding corrective measures for improvement of slow speed performance, an unsuspecting detail frequently comes to mind—for the time being, condition of the butterfly valve.

When removing the carburetor be sure to check the butterfly valve. Make certain it operates freely with no indication of binding whatever — that it is centered in the barrel and particularly that it closes when it should. Excessive leakage past the butterfly valve, when the magneto lever is set for slow speed operation, is one of the causes for your inability many times to obtain proper slow speed adjustment. At times one is apt to believe there is something wrong with the slow speed system or the magneto when actually it is right before us in condition of the butterfly valve.

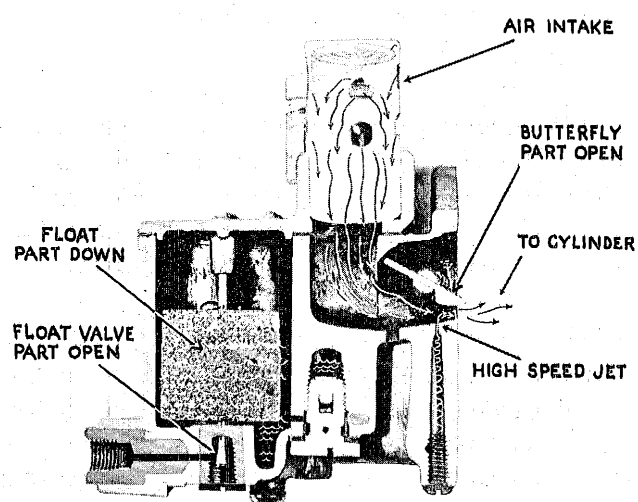


Butterfly Valve Closed

To check, set the butterfly valve in closed position (carburetor removed from motor) — blow through the barrel. If the butterfly is seating properly it should be practically impossible to blow by it. There will, of course, be some seepage but if it is felt that a great deal of air can be blown by, then try to find out what's wrong—the butterfly valve, when in closed position, should seat tightly.

The shaft should be free enough so that holding the butterfly valve closed is actually accomplished by tension of the spring on the small synchronizing shaft. If the valve can't be held closed by this tension, then it must be binding and should be made free.

In addition to this, note the small hole (high speed jet) drilled into the carburetor body just about where the bottom side of the valve closes. When the valve closes, this hole must be out of



Butterfly Valve Open

sight. If not, fuel will enter the mixture to interfere with properly setting the slow speed needle. BE SURE BUTTERFLY VALVE CLOSES FORWARD OF THE HIGH SPEED JET—DOES NOT CLOSE ON TOP OF THE JET.

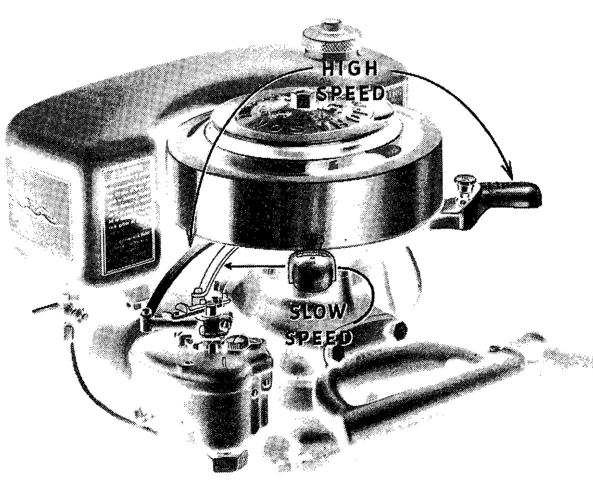
Actually, the way to properly check this setting is to close the butterfly, then indicate closed position in barrel of carburetor by running a scribe along the bottom outside edge of the butterfly. The barrel is thus scratched to show position of outside edge (lower) of the butterfly with relation to the high speed jet. If correctly adjusted, the distance between the scratch mark and near edge of the jet should be slightly greater than the thickness of the edge of the butterfly, so the butterfly does not close on top of the jet.

Keep above in mind when attempting to overcome a stubborn trolling condition in either of these two motors.

CARBURETION—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.

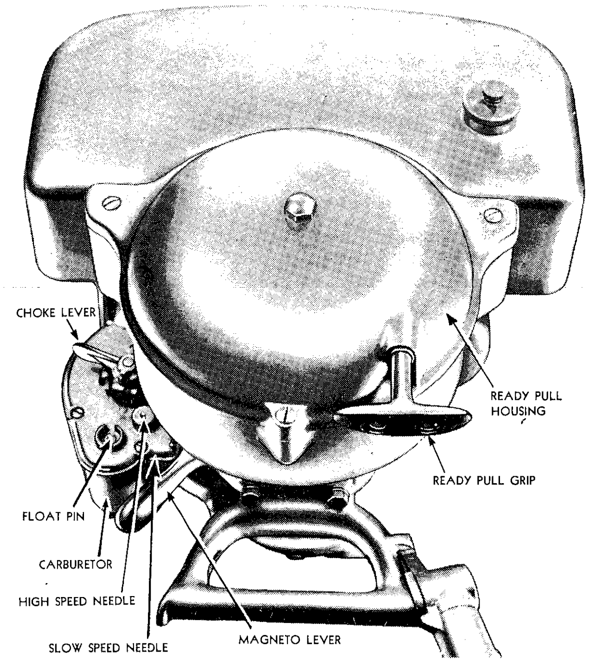
Two adjustments are thus necessary —slow and high speed needles.



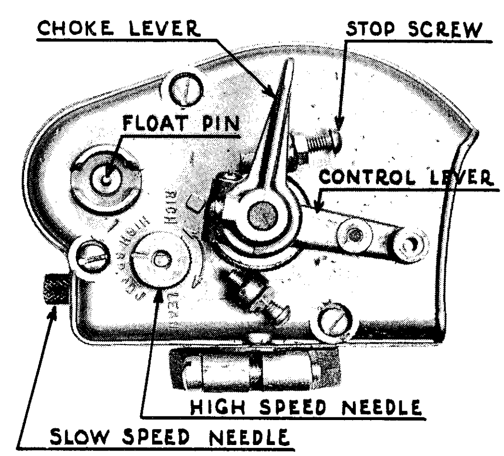
KS-KD Controls

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.

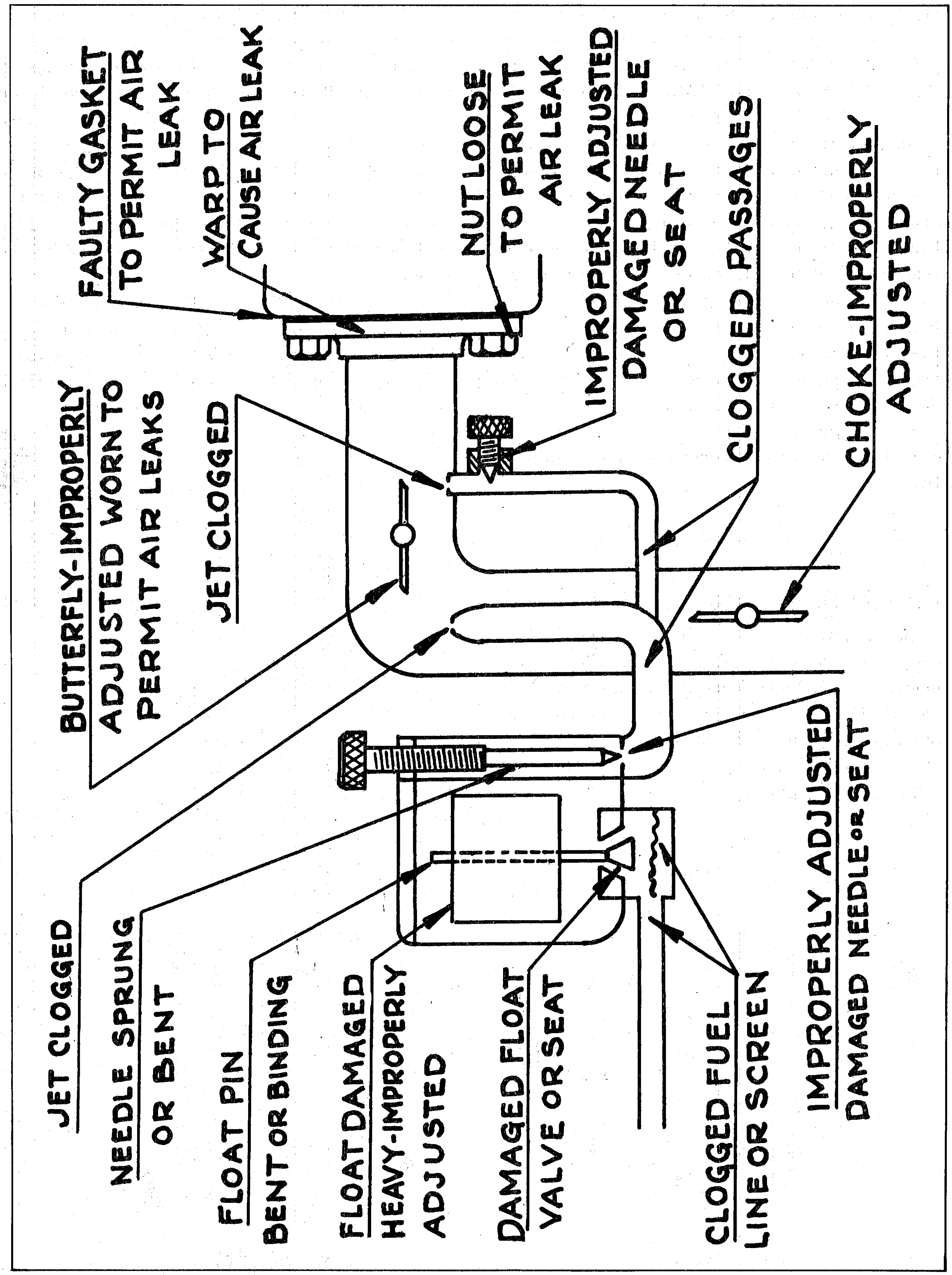
TO ADJUST HIGH SPEED—Start motor as instructed. Operate at full throttle and full spark advance until motor reaches normal operating temperature. Turn high speed needle to right or left as required to obtain maximum speed.



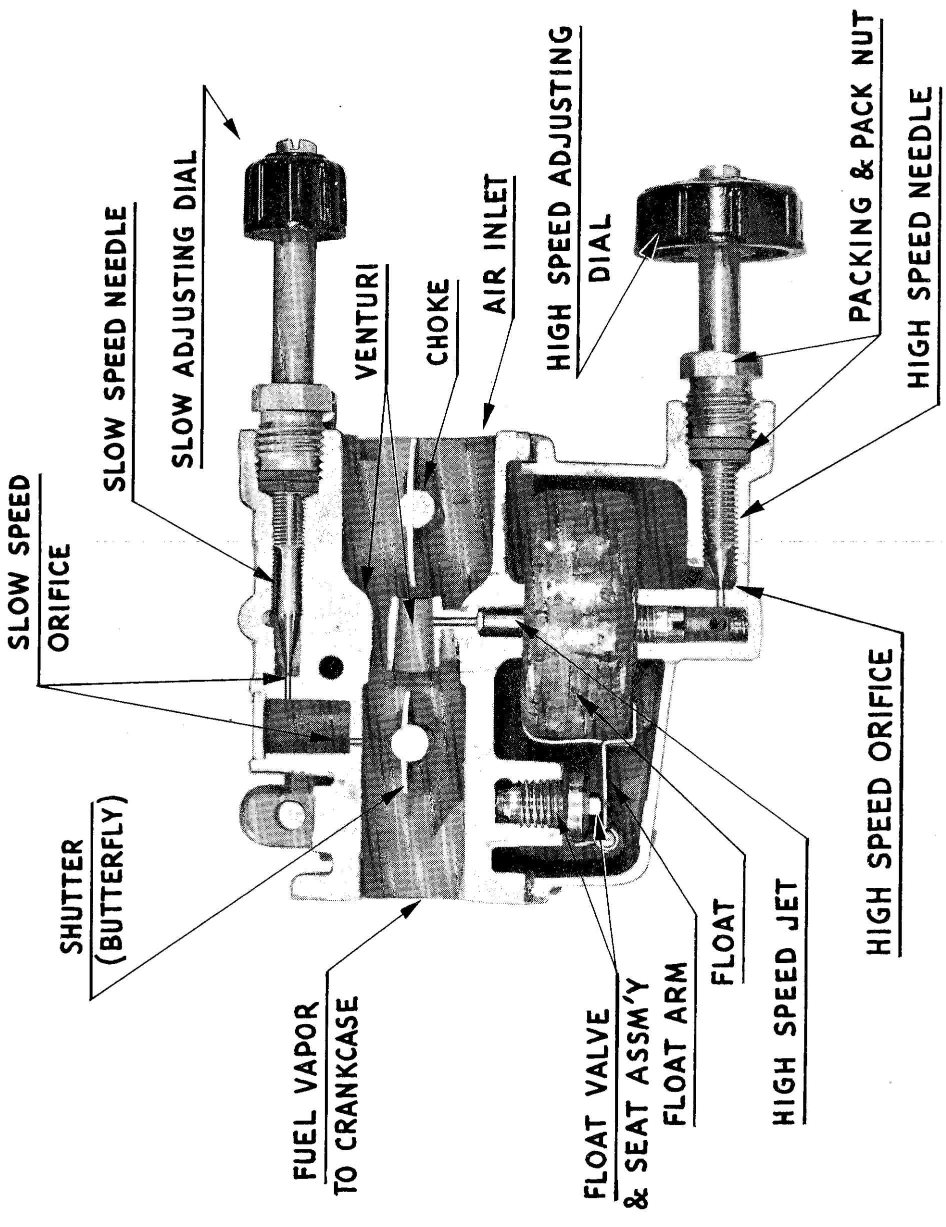
Showing Controls on Model KD(L)



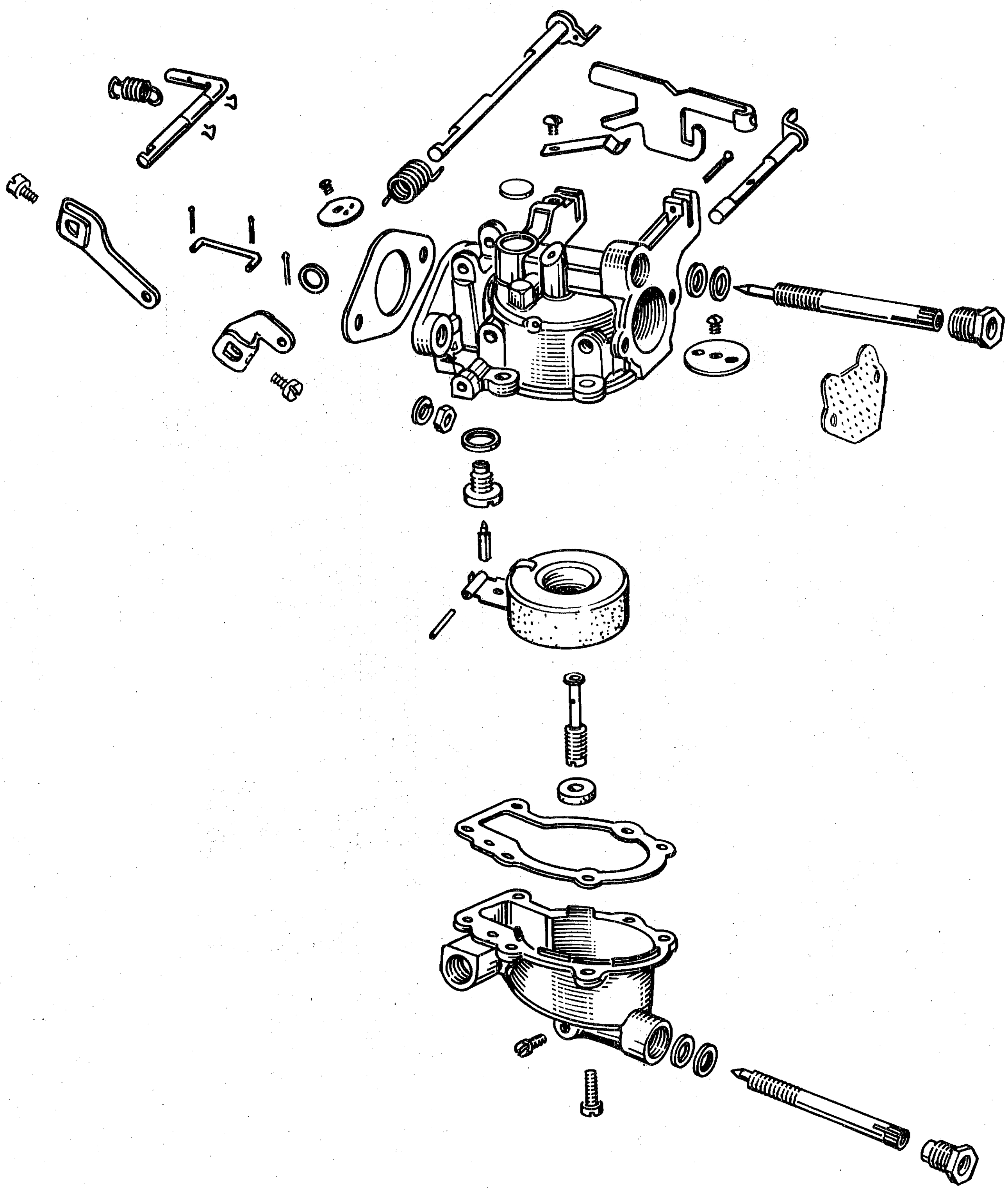
Showing Top View of Model KD Carburetor.


FAULTY GASKET TO PERMIT AIR LEAK
WARP TO CAUSE AIR LEAK
NUT LOOSE TO PERMIT AIR LEAK
IMPROPERLY ADJUSTED DAMAGED NEEDLE OR SEAT
CLOGGED PASSAGES
CHOKE-IMPROPERLY ADJUSTED
BUTTERFLY-IMPROPERLY ADJUSTED WORN TO PERMIT AIR LEAKS
JET CLOGGED
JET CLOGGED
NEEDLE SPRUNG OR BENT
FLOAT PIN BENT OR BINDING
FLOAT DAMAGED HEAVY-IMPROPERLY ADJUSTED
DAMAGED FLOAT VALVE OR SEAT
CLOGGED FUEL LINE OR SCREEN
IMPROPERLY ADJUSTED DAMAGED NEEDLE OR SEAT

MODEL JW CARBURETOR



Sectionalized View of Carburetor—Model JW.

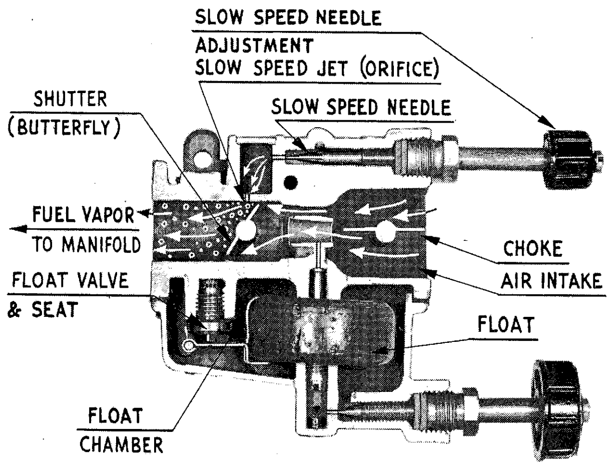


Assembly Layout — Carburetor Model JW.

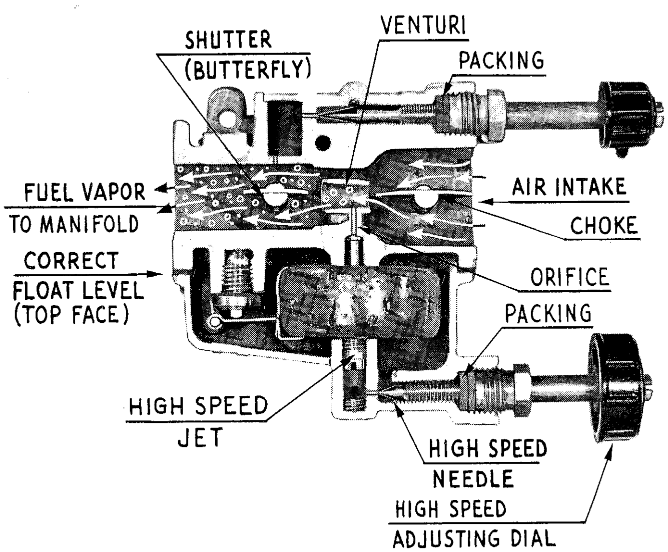
CARBURETOR — MODEL JW

Carburetor on the Model JW is similar to that employed on other Models (QD, RD, etc.) in that it is of the float feed two-jet type, consisting of a mixing chamber and conventional float chamber. Two adjustments are provided, namely — for high and slow speed performance.

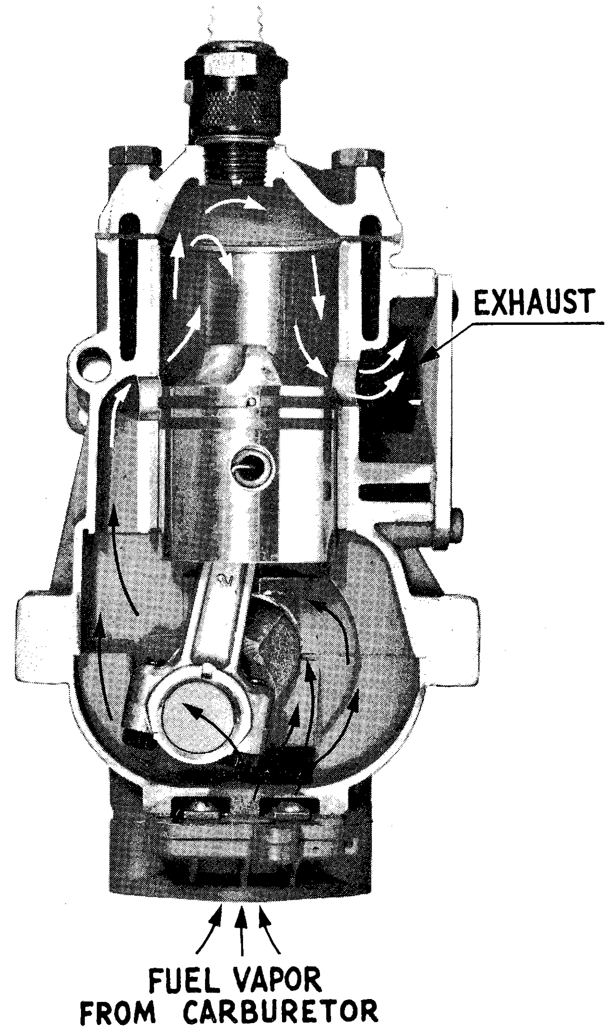
Induction to the crankcase similarly is by means of an automatic intake valve situated between the carburetor and crankcase which functions in accordance with changes in crankcase pressure as the pistons travel up and down to complete the cycle— see pages 79 to 80 inclusive for detail description.



Sectionalized View of Carburetor (Float and Mixing Chambers) Showing Butterfly Shutter Set for Slow Speed Operation (Closed). Note Maximum Fuel Vaporization at Slow Speed Jet — Vaporization at High Speed Jet is Nil.



Sectionalized View of Carburetor (Float and Mixing Chambers)— Butterfly Shutter Full Open for High Speed Performance. Note Maximum Vaporization at High Speed Jet (Orifice) with a Minimum of Vaporization at the Slow Speed Jet; also, Effect of Restriction Caused by the Venturi Tube Built into the Mixing Chamber to Increase Air Velocity in Area of the High Speed Jet (Orifice). Note Position of Float when Adjusted to Correct Level—Top Face Flush with Face of Float Bowl. See Instructions Pertaining to Float Valve and Float on Page 148.

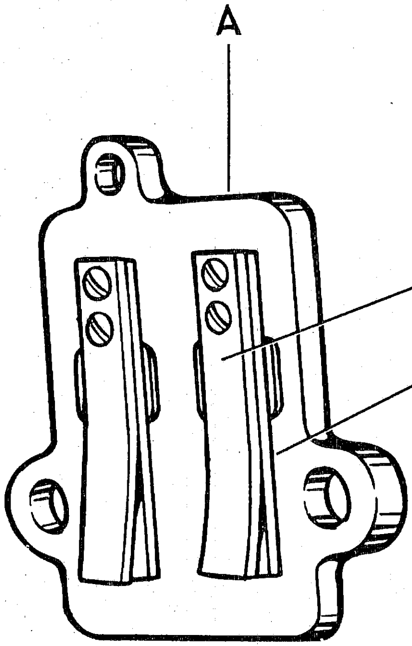


Arrows Indicate Path of Fuel Vapor as the Piston Progresses Through the Cycle. (Intake, Compression, Power and Exhaust).

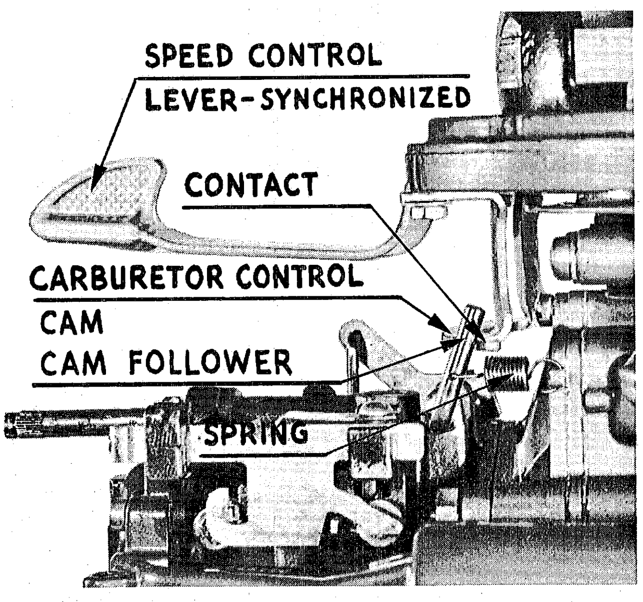
It will be noticed, however, that the automatic intake valve is not made up of several segments, as in the case of Models QD and RD, but of a single "strip"— one for each crankcase chamber as illustrated on following page.

CARBURETOR CONTROL (SPEED) ADJUSTMENT

Since gas and spark are synchronized to permit realizing consistent performance throughout entire speed range of the motor by correctly proportioning volume of fuel charge with respect to degree of spark advance, some adjustment is required to gain end results.

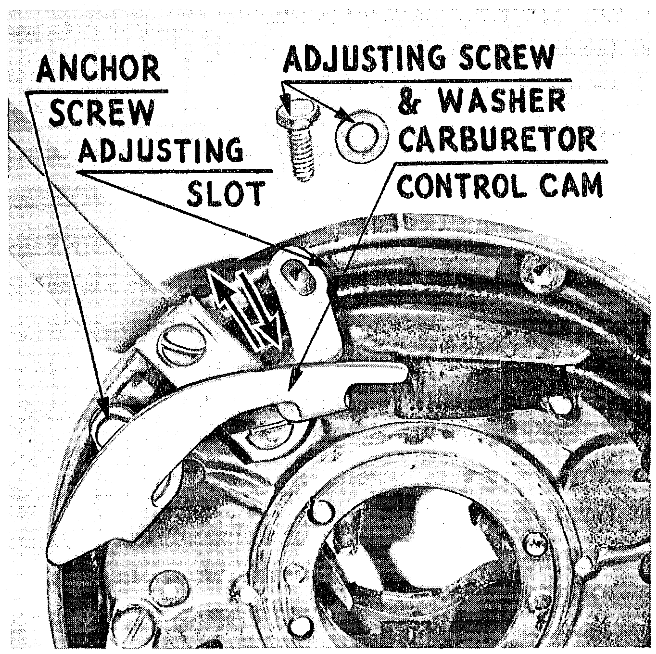


Illustrating the Model JW Automatic Valve Assembly Including (a) Valve Plate, (b) Automatic Valve, and (c) Automatic Valve Back-up Plate.

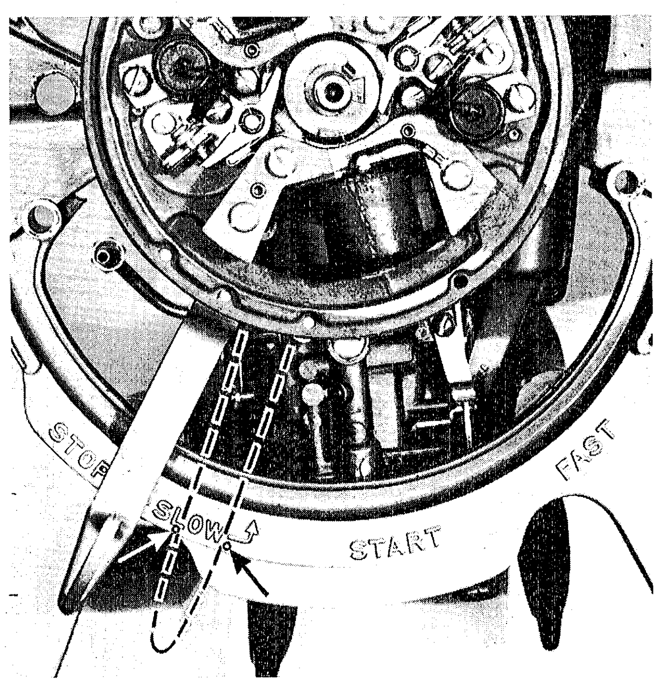


Illustrating Speed Control Synchronizing Mechanism, Namely — Speed Control Lever, Carburetor Control Cam and the Carburetor Control Cam Follower.

Synchronizing is accomplished by means of a cam, cam follower and linkage arrangement as shown here. The cam is attached to the armature plate and moves with it as the spark is advanced. At retard spark, the cam follower rides on the "low" end of the cam to result in but partial opening of the carburetor shutter (butterfly). With advance of spark (speed control level) the follower progresses toward "high" end of the cam — greater opening of the carburetor shutter to permit larger charge of fuel vapor and subsequent increase in power and speed.



Showing Slot in Free End of the Carburetor Control Cam to Permit Shifting In or Out as Required to Obtain Correct Synchronizing Adjustment.



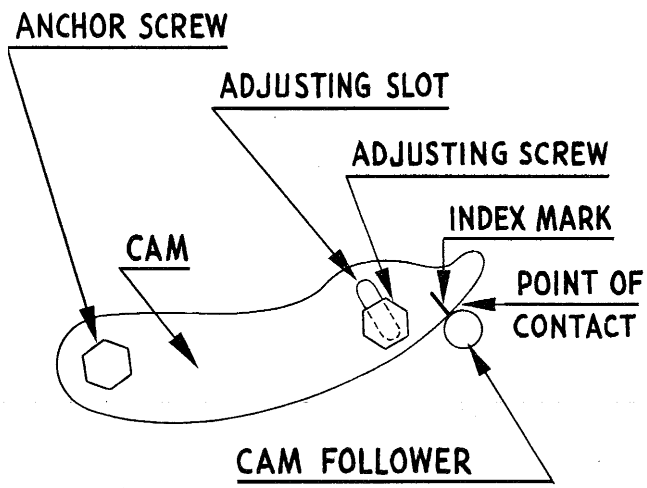
Showing Small "Embossings" on the Gas Tank Mounting Bracket to Locate Position of Speed Control Lever When Adjusting Carburetor Control Cam.

Some adjustment is required to properly synchronize — proceed as follows:

1. Loosen screws slightly at both ends of the

speed control cam (underside of armature plate).

2. Move speed control lever to position between embossings on the gas tank bracket as indicated by the dotted line in the illustration.
3. Note line stamped on top side of the control cam—with speed control lever set in position described above, move free end of the cam "out" until it makes contact with the cam follower (but only after slack in the linkage has been taken up) at point of index mark.
4. Draw up on both screws holding the cam to the armature plate to secure in this position.

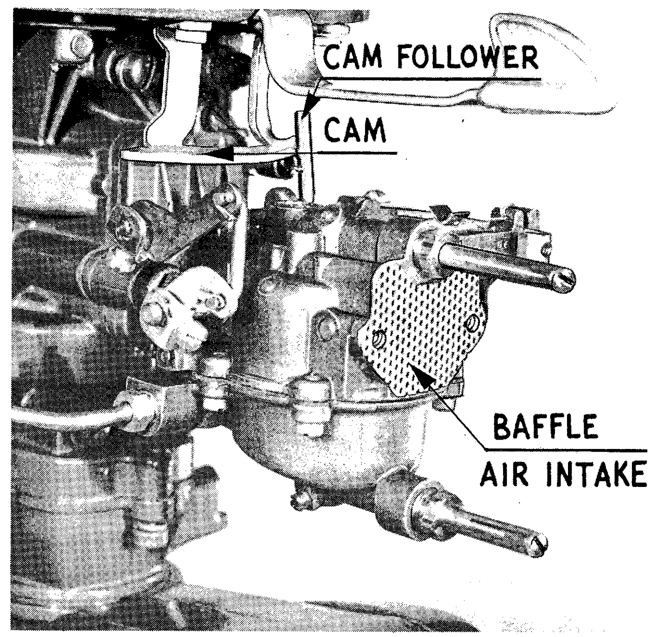


Schematic Drawing to Illustrate Cam and Cam Follower Adjustment.

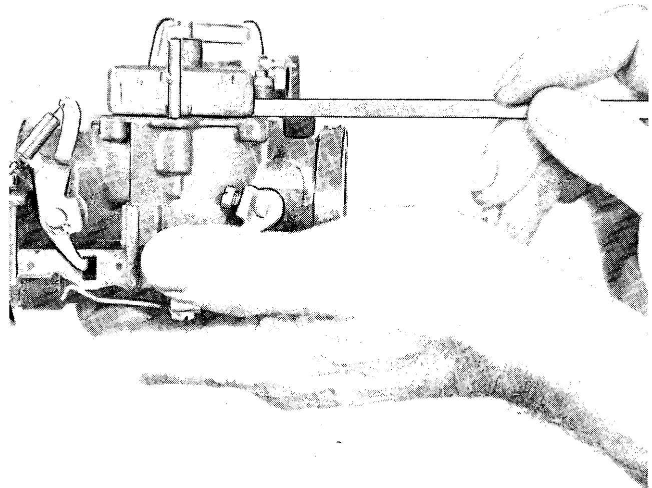
CARBURETOR ADJUSTMENT

The carburetor being of the two-jet (float feed) type, is designed for maximum, efficient carburetion at all speeds, two adjustments are thus required, namely: high and slow speed. Both high and slow speed needles are adjusted at the factory with provisions for limited variations to compensate for atmospheric conditions. However, if ultimate adjustment does not fall within the limited range or in case of repairs, proceed as follows:

Loosen, but do not remove screws in center of slow and high speed dials. (Dials are held firmly in position on their respective adjusting needle shaft by expansion of slotted serrated ends as a result of drawing up on the counter-sunk head screws.) Pull dials out until limiting stops on dial (back side) clear like stop cast onto the motor cover. Dial is now free to be turned beyond normal limited range: tighten center screws to secure to needle shafts.



Showing Screen or Baffle Attached to the Carburetor Intake — Function of which is to Counteract Effect of Surging Impulses Created by Action of the Automatic Intake Valve.



Method of Checking Float Level.

Carefully turn both dials to right, to position where adjusting needles come to rest gently on their seats. Be careful not to injure seats by turning down too tightly. Then back off (turn left) slow speed dial approximately one full turn — high speed dial about 3/4 turn.

SLOW SPEED ADJUSTMENT

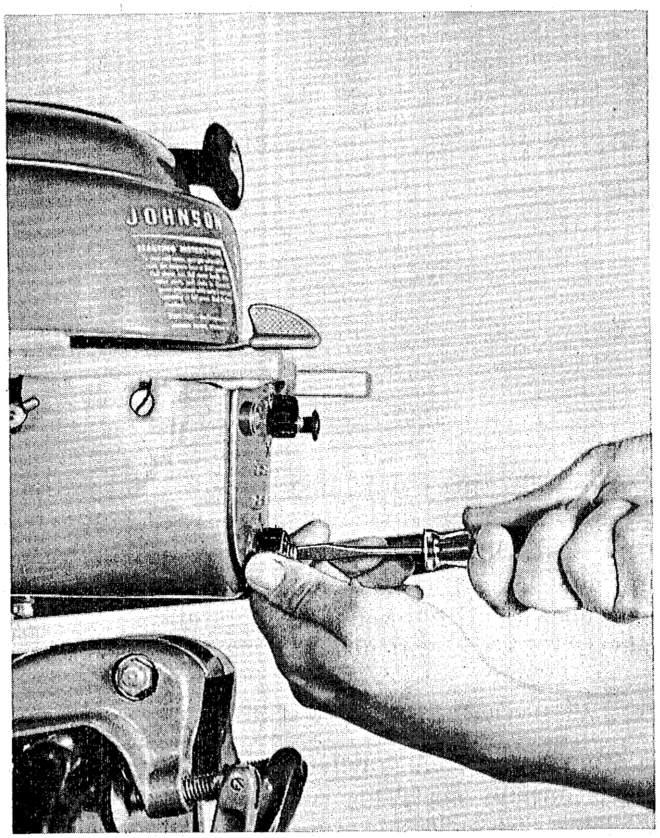
Start motor as instructed — run at "Fast" speed until normal operating temperature has been reached. Throttle down to "slow speed range." Turn dial to right or left as required to obtain best setting for slow speed.

(Note: Turning needles to left enriches the fuel mixture — that is, increases proportion of fuel to air to result in rich mixture. An excessively rich mixture is indicated by "rough" running of the motor. "Spitting or coughing" in the carburetor is indicative of a lean mixture, caused by turning needle too far to right.)

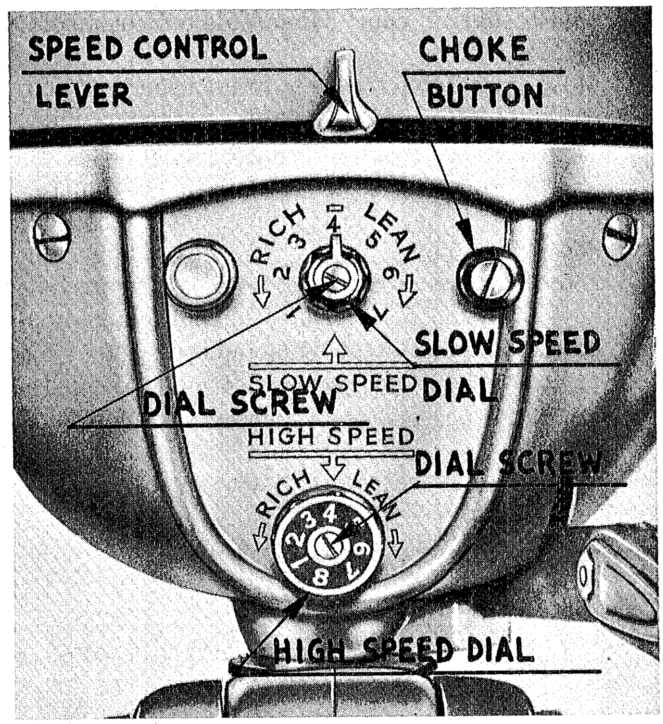
Loosen center screw to properly arrange dial, without disturbing position of the slow speed needle (this is IMPORTANT). Should dial tend towards binding on the needle shaft, it may become necessary to pull it free entirely to permit rearranging its position without affecting adjustment of the needle at this time. Arrange dial to position where pointer is directed to Numeral 4. Push dial back onto the shaft to distance clearing the motor cover by approximately 3/32″, which should be sufficient to engage limitation stop on the cover. Tighten center screw to firmly secure dial. Atmospheric conditions may necessitate slight variation from time to time — limited range provided in this respect should be sufficient, nevertheless.

HIGH SPEED ADJUSTMENT

(Must be performed only after final slow speed adjustment has been made.) Turn dial to left or right as required to obtain best setting for top



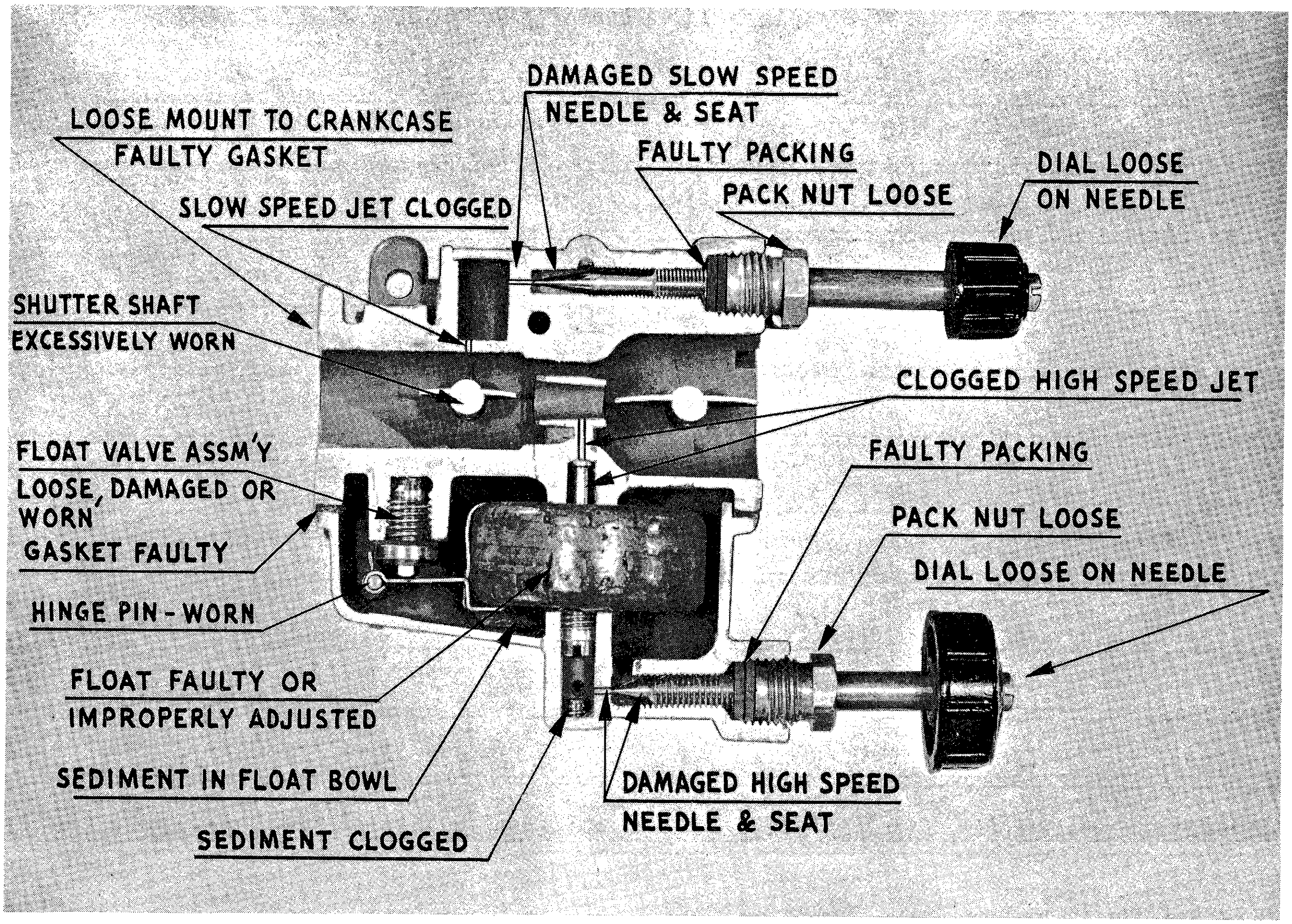
Showing Method of Adjusting Position of Carburetor Needle Dials



Showing Carburetor Control Panel.

speed performance. Rearrange dial numbers as described above — Number 4 should be directed up as shown above.

NOTES

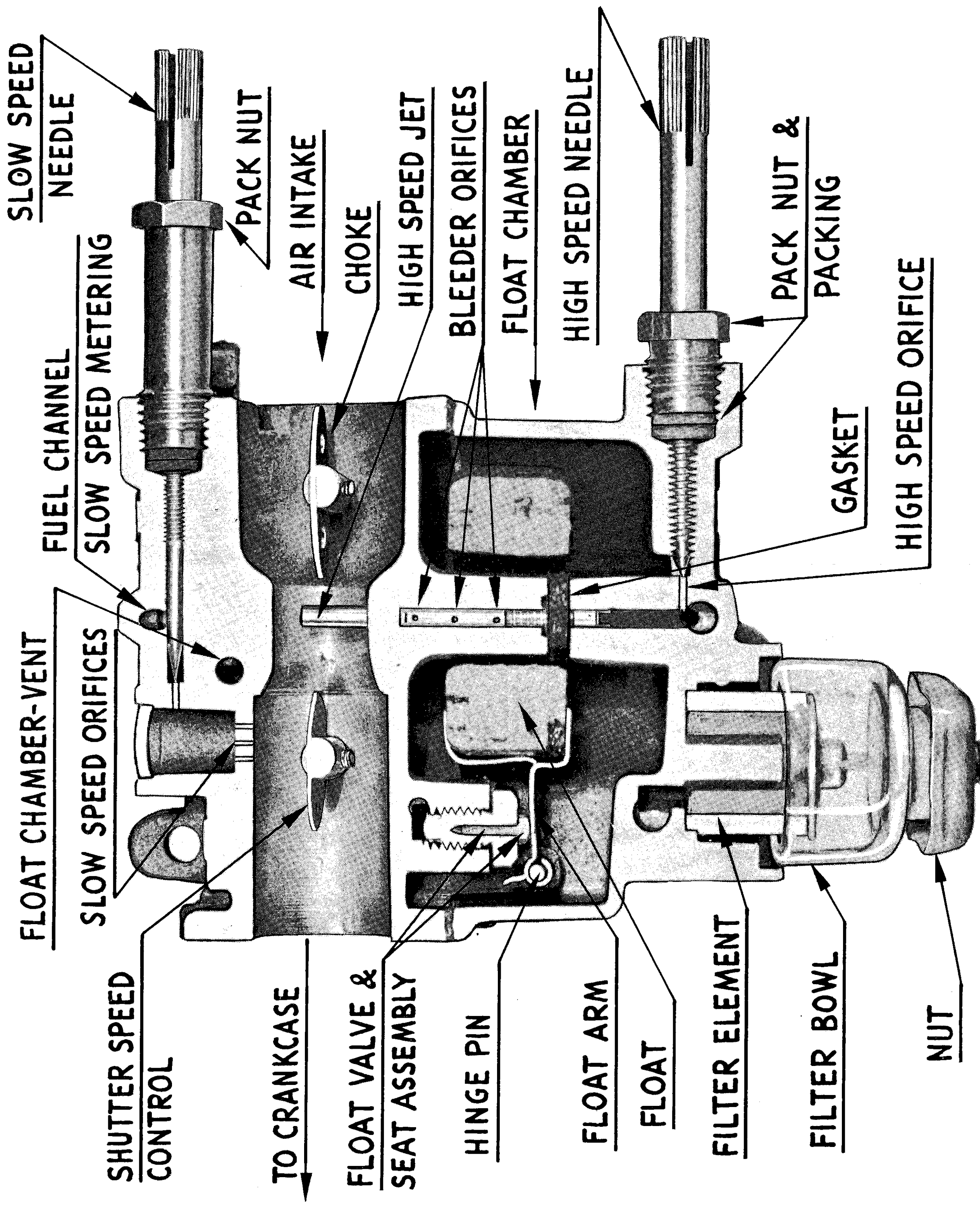


CARBURETOR CHECK CHART

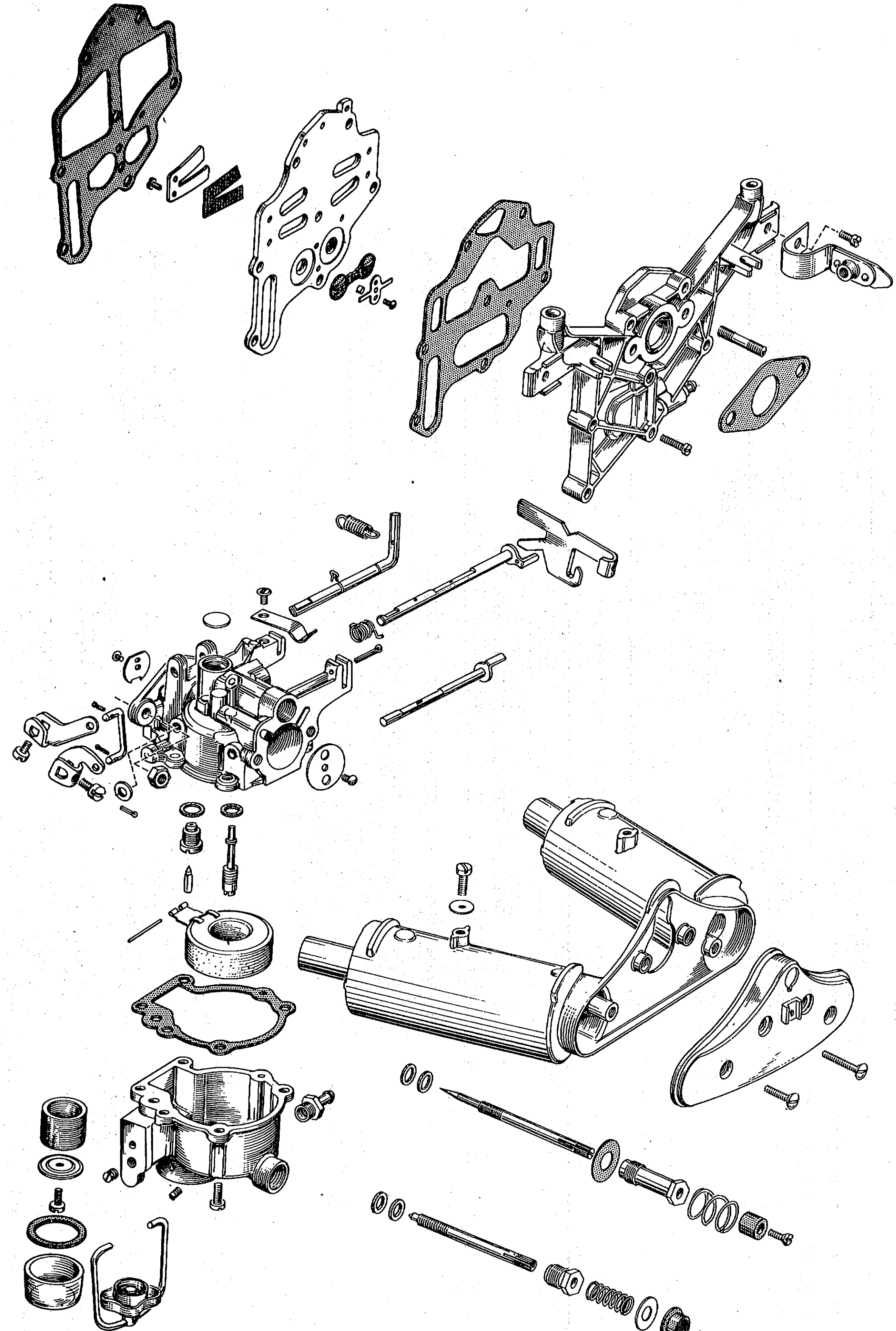
NOTES

NOTES

MODELS CD AND AD CARBURETOR



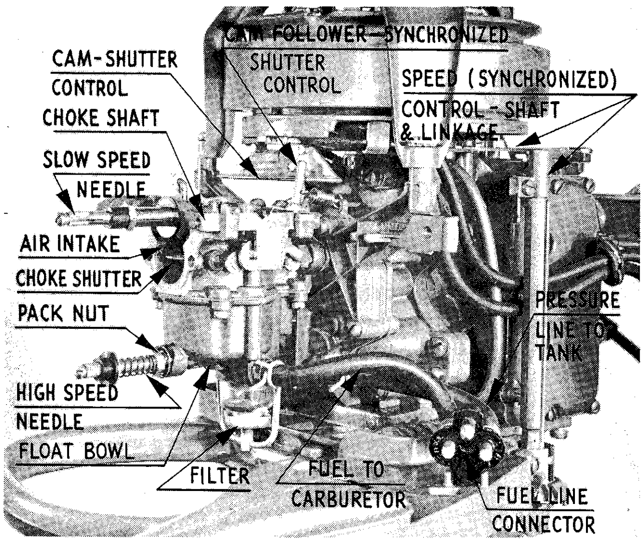
Sectionalized View of Models CD and AD Carburetor.



Carburetor, Manifold, Valve and Silencer Group

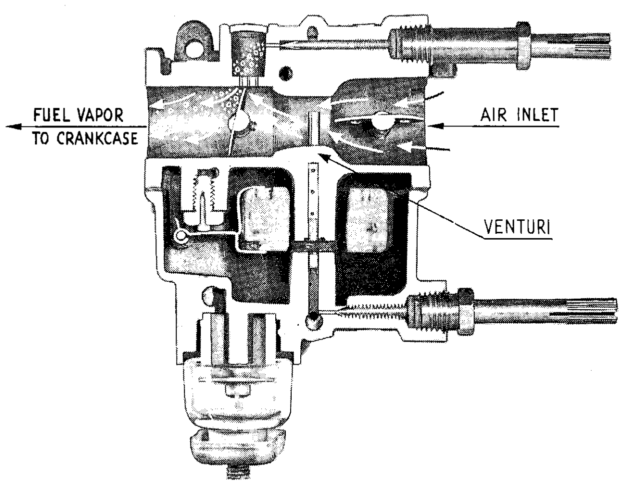
CARBURETOR – MODELS CD AND AD

Carburetion built into the Models CD and AD assembly is identical in principle to that used in the JW, QD, and the RD. Except for minor details in construction, functioning is similar, employing two carburetor adjustments to achieve efficient carburetion throughout entire speed range of the motor (high and slow speed), reed type of fuel vapor intake valve to the crankcase, synchronized shutter control (spark-gas), manually operated choke and a fuel filter attached as an integral part of the carburetor float body casting. Fuel supply is by means of pressurizing the Mile Master Tank.

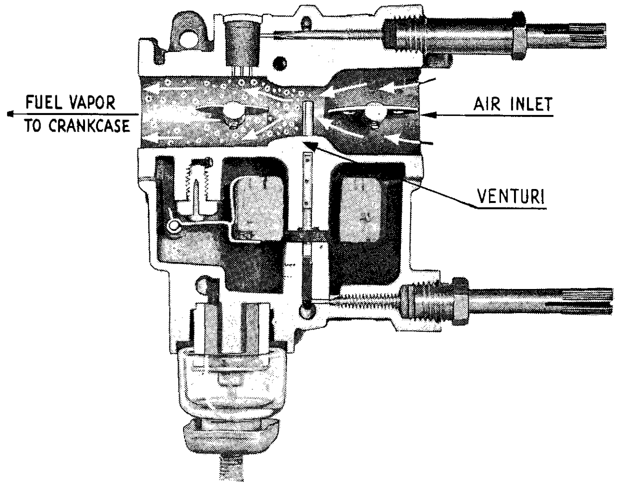


CARBURETOR INSTALLATION

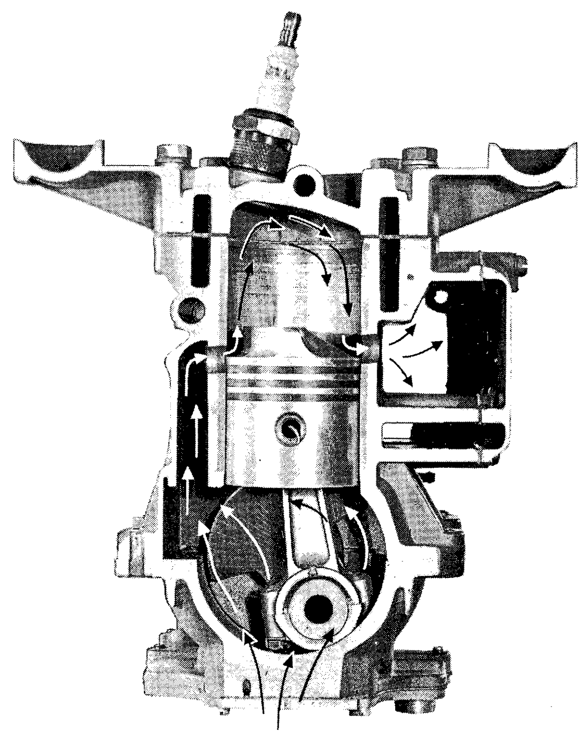
Shown above, carburetor and synchronizing control mechanism — Spark and fuel vapor (gas) are synchronized to obtain correct volume of fuel charge with relation to degree of spark advance to obtain maximum efficiency and over-all performance throughout speed range of the motor — slow, intermediate and high speeds, and during moments of rapid acceleration — deceleration.



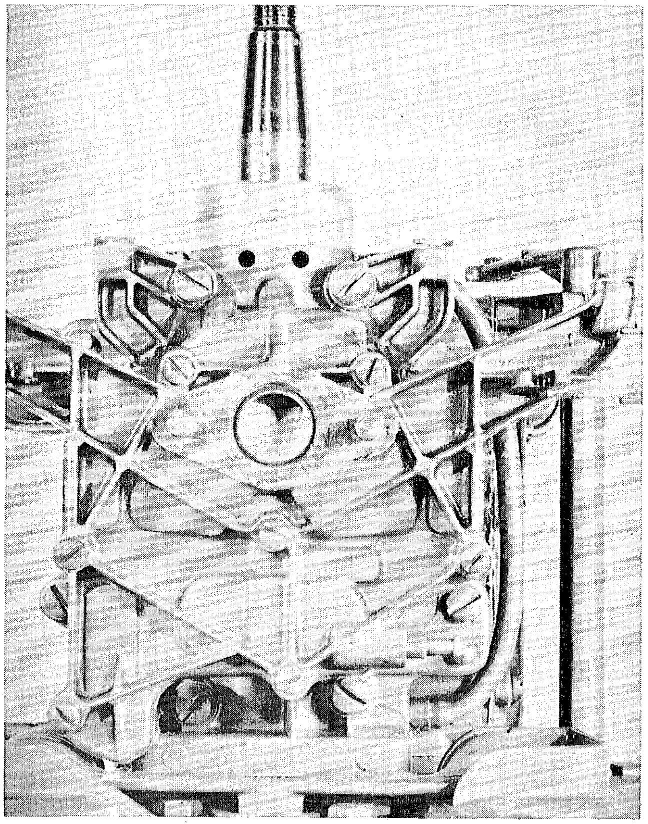
Sectionalized view of mixing chamber—showing butterfly shutter set for slow speed operation (closed). Note maximum fuel vaporization at slow speed jet—vaporization at high speed jet is nil.



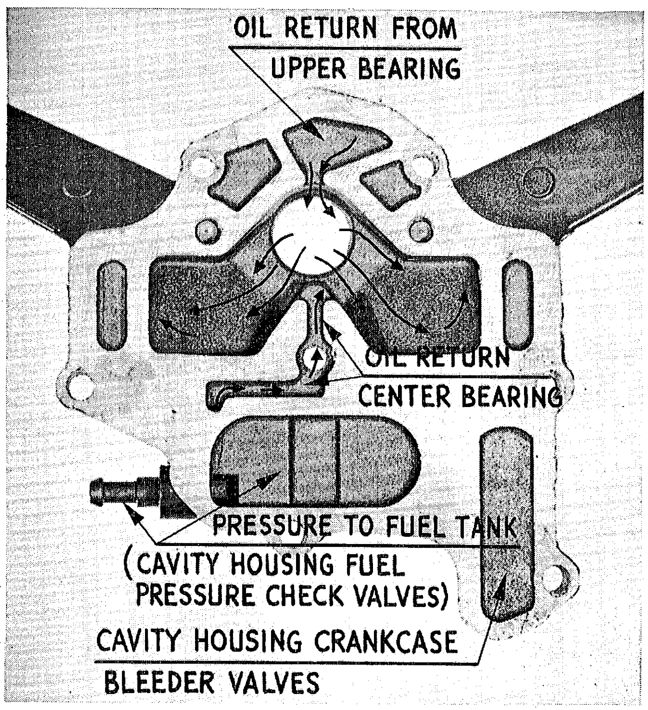
Sectionalized view of mixing chamber—butterfly shutter full open for high-speed performance. Note maximum fuel vaporization at the high speed jet with a minimum of vaporization at the slow speed jets. Also effect of restriction caused by the Venturi ring to increase air velocity in area of the high speed jet.



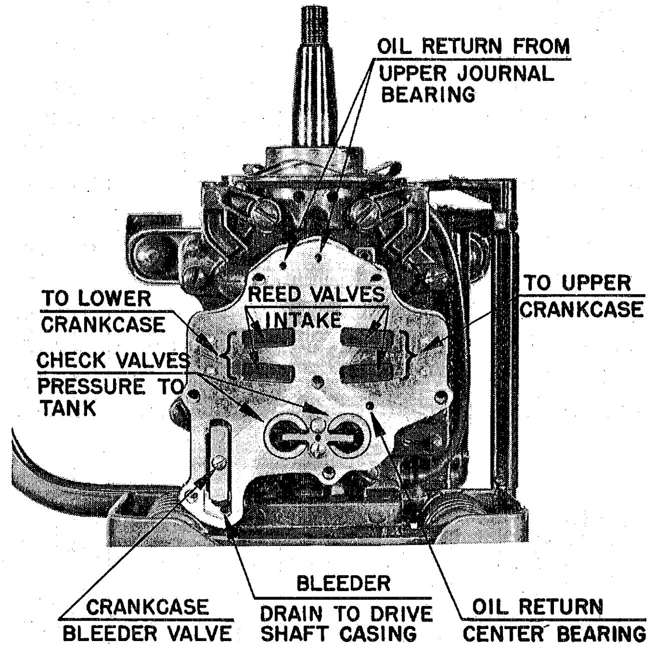
Showing path of fuel vapor as it progresses through the powerhead during completion of its cycle.



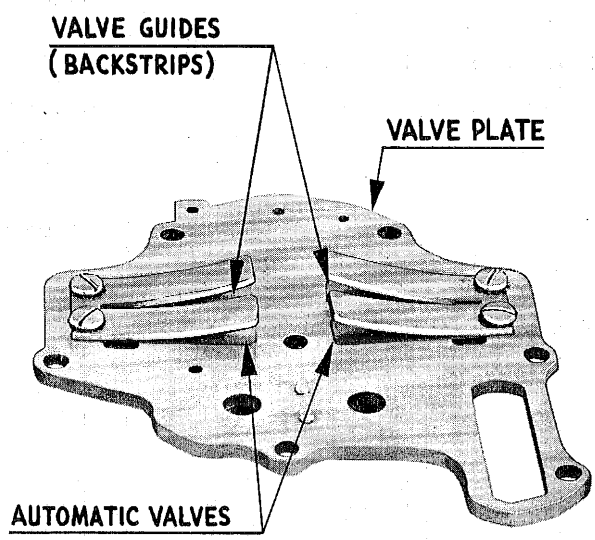
Carburetor removed to expose "Throat" in the intake manifold



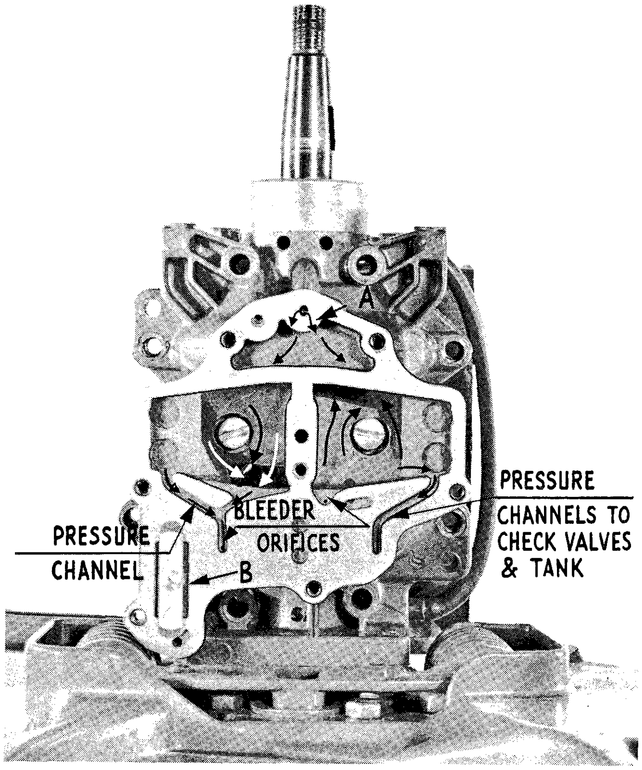
Illustrated above is back view of the intake manifold showing oil return channels leading into the manifold proper. Here, oil returning from the upper and center bearings enters the fuel-vapor stream to be conducted into crankcase chambers. Shown also are cavities housing the fuel pressure check valves and crankcase bleeder valves.



Shown here are carburetor and intake manifold detached to expose the valve plate, showing installation of the reed (automatic intake) valves, check valves — releasing crankcase pressure to the Mile Master Tank and crankcase bleeder valve arrangement employed for escape of "heavy" fuel vapor ends which settle out during slow speed running of the motor. See explanation on pages 173 and 174.

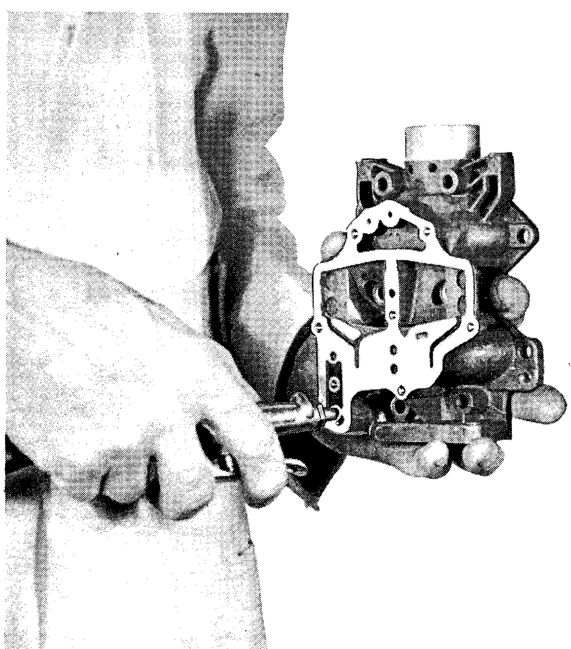


Back View of Valve Plate, Exposing the Automatic Valves and Guides (Back Strips).

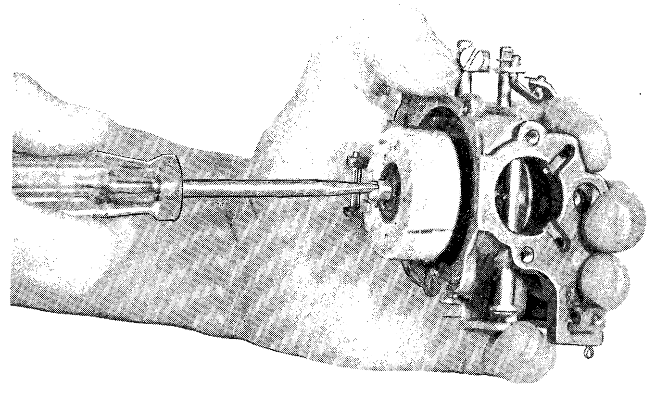


Above shows intake manifold and valve plate assembly removed to expose channels leading to upper and lower crank chambers — arrows indicate fuel-vapor entering each.

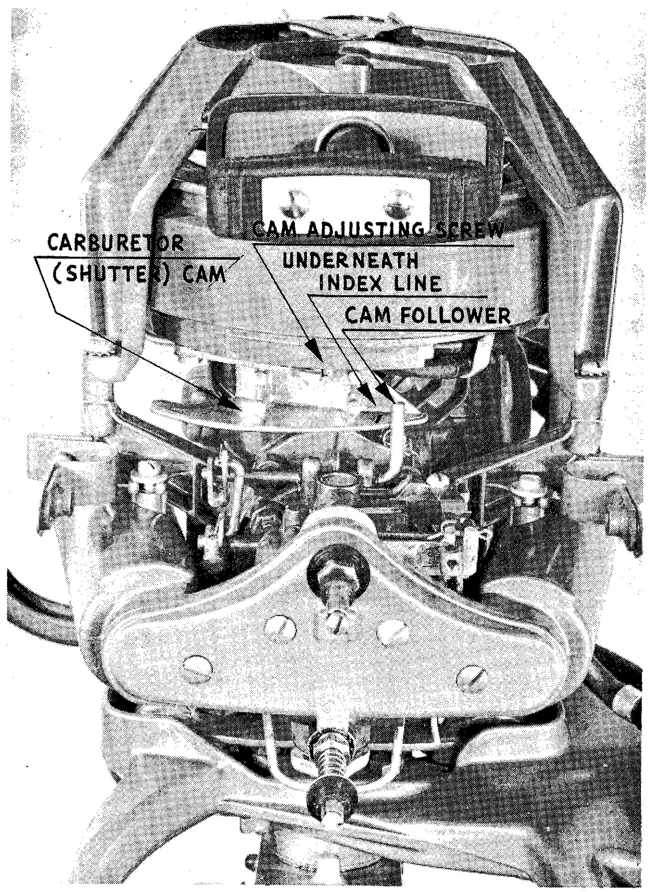
Small arrows A indicate oil return from the upper journal bearing where it flows through a corresponding hole in the valve plate to enter the fuel-vapor stream flowing through the intake manifold, re-entering the crankcase for further use. For explanation of check valves B, crankcase bleeder, see page 173.



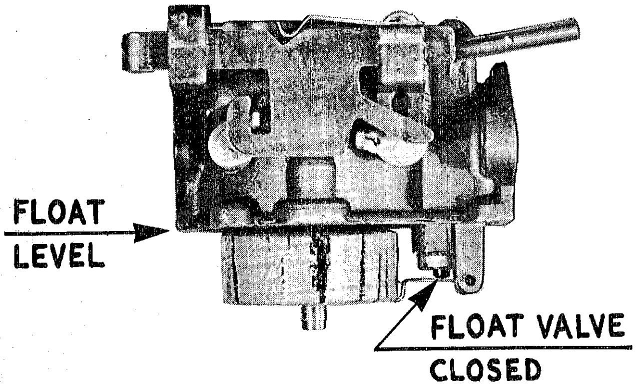
Blowing out the Oil Bleeder Orifices.



Removing the High Speed Jet



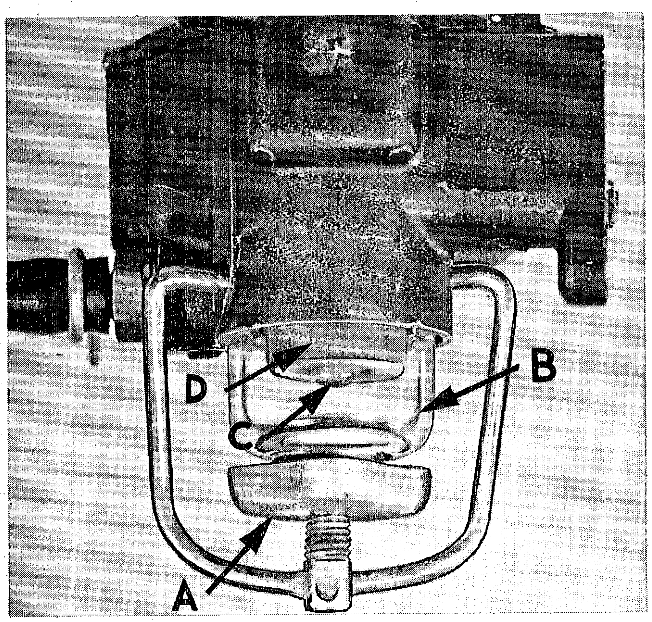
Spark and "gas" are synchronized by means of a cam and linkage arrangement for best motor performance shown above—some adjustment may be required. Note index line cast onto the cam and spring loaded cam follower. When properly adjusted, cam follower should "contact" or meet contour of the cam at point of the index line, but only after slack in linkage has been taken up with the carburetor shutter just on verge of opening. To adjust if necessary, loosen adjusting screw under the armature plate slightly (hole in cam is elongated), move "low" end of cam in or out as required to achieve correct indexing or contact of cam follower. Re-tighten adjusting screw. Carburetor shutter is closed when follower "rides" on low end of the cam—open at the "high" end for maximum top speed.



Maintaining correct fuel level in the float bowl is important to proper functioning of the carburetor throughout speed range of the motor. Since fuel level is controlled by the cork float acting on the float valve, some adjustment may be required in this respect. Fuel level is correct when top face of the float comes to rest "flush" with face of the carburetor body when turned up-side-down or as shown here.

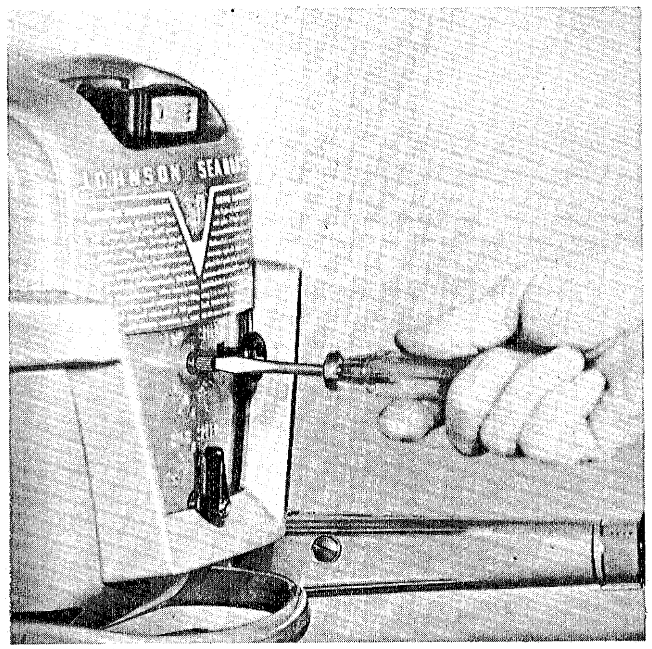
In event the float is too high or too low, carefully bend the float arm up or down as required to obtain position indicated by arrow — Float level too high causes overflowing, "dripping" of the carburetor and/or sluggish motor operation; level too low results in faulty operation — in extreme instance, "spitting" back through the carburetor.

In either case, carburetor needle adjustment appears to have little effect.

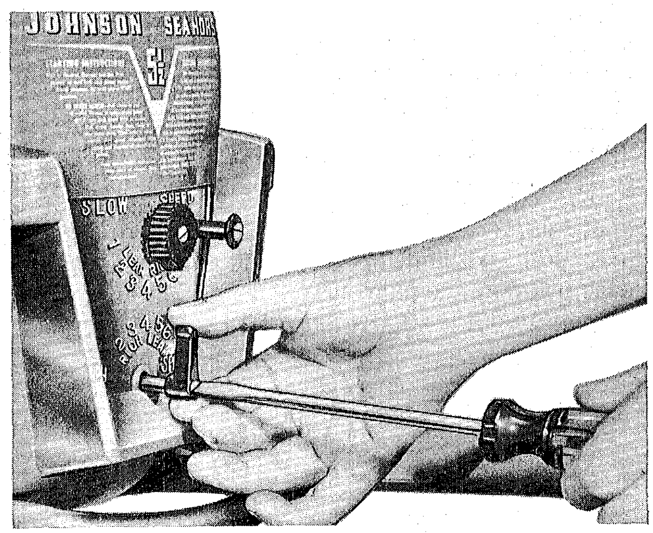


Showing above filter assembly attached to the carburetor float bowl — To clean, loosen nut A; swing supporting bracket aside to permit removing the filter bowl B; remove screw C to free filter element D for cleaning. Wash the filter element free of foreign accumulation in vessel of clean gasoline. Replace and complete assembly in order reverse of that described above. Check condition of filter bowl gasket at this time to insure against fuel seepage later on—install new gasket if in doubt.

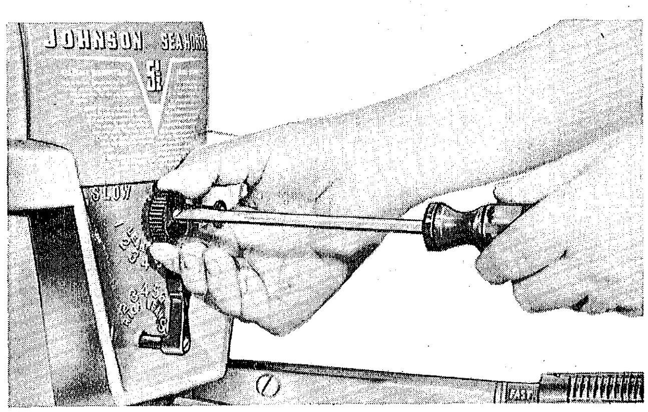
CARBURETOR ADJUSTMENT



Adjusting needle setting with screwdriver prior to final placing of the slow speed dial and high speed lever.



Adjusting Position of High Speed Lever



Adjusting Position of Slow Speed Dial

CARBURETOR ADJUSTMENT — SLOW AND HIGH SPEEDS

Both high and slow speed needles are adjusted at the factory on final assembly and testing, with a limited range for further adjustment provided the ultimate owner to compensate for local operating conditions such as temperature (atmospheric and water), atmospheric or barometric pressure (altitude), humidity, etc., which frequently require slight variations in needle settings. A boss or "stop" is cast on to the carburetor panel and a similar arrangement cast on to the back or inside of the slow speed adjusting knob which permits somewhat more than a half turn of the knob as and if required to achieve best performance—Note pointer on knob and numerals 1 to 7 on the control panel.

Similar provisions are made for compensating adjustment of the high speed needle for like reasons except that the limiting "stops" for the high speed adjusting lever are built into the cover—Note numerals 1 to 7 which limits adjusting to less than a half turn.

In event the carburetor has been "torn down" for cleaning and/or repairs, primary or initial adjustment will be required for both high and slow speed needles—best accomplished with the motor cover removed. Proceed as follows:

1. Note—that the slow speed knob and high speed lever are made fast to their respective needles by means of serrations on the slotted end of the needle as result of expansion when drawing up on the taper headed screw—remove both screws to gain access to slot at the extreme end of each needle.

2. Insert screw driver bit into slotted end of the high speed needle—turn right to close until the face of the pointed needle rests gently on its seat in the carburetor body (this is important, do not turn down tightly—to do so will cause the face of the needle to "ring" and the seat to expand or distort after which further adjustment becomes impossible due to damage caused). Then turn left or "unscrew" approximately 1/2 turn high speed.

3. Perform same function on the slow speed needle but open or "unscrew" about 1-1/8 turn.

4. Attach test wheel—start and run the motor in a test tank until normal running temperature has been attained.

5. Turn high speed needle (with screw driver) to right or left as required to obtain best setting for maximum performance.

6. Reduce motor speed towards idling position —turn slow speed needle to right or left as required to obtain smooth operation in the lower speed range. Further retard motor speed—adjust position in like manner for best performance. Repeat the operation until best setting for maximum slow speed running has been accomplished.

NOTE—rough or "jumpy" running of the motor denotes an excessively rich carburetor mixture (too much fuel—too little air) and as evidenced by a "smoky" exhaust. Spitting back or "coughing" through the carburetor is indication of a too lean mixture (too little fuel—too much air). Turning needle adjusting valve to right reduces flow of liquid fuel into the carburetor air stream thus "leaning out" the fuel vapor mixture; turning to left, increases the flow of liquid fuel to result in a correspondingly richer mixture.

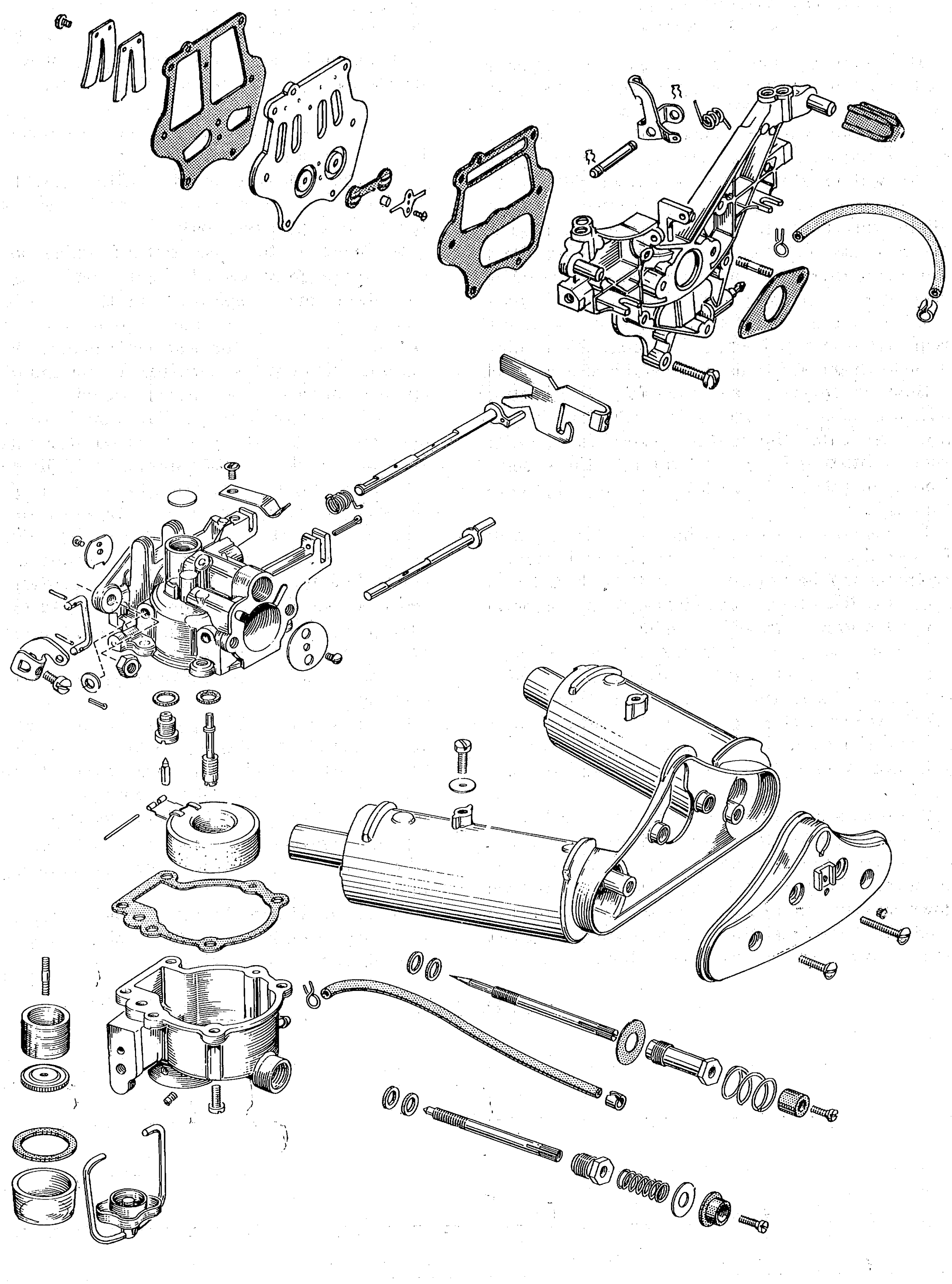
7. Re-check both needle settings to assure best performance.

8. Without disturbing position of the slow speed needle, install the slow speed knob over the protruding serrated end, with pointer directed towards numeral 4. Insert and draw up snugly on the taper headed screw provided for the purpose.

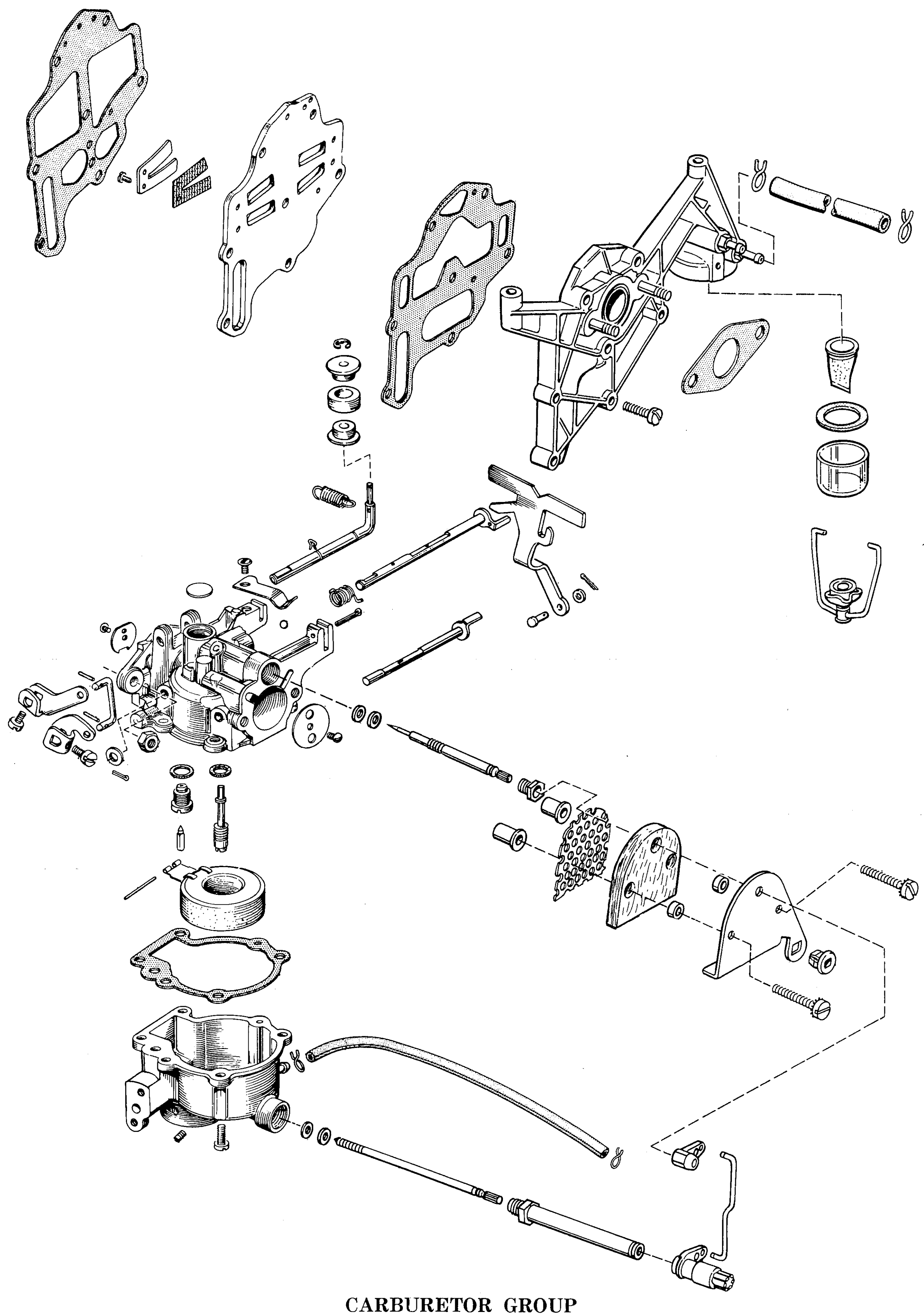
9. Locate position of the high speed needle lever as described above—lever directed towards the numeral 4

10. Make certain the taper headed screws are drawn up securely to hold the knob and lever fast on their respective needles.

NOTES



CARBURETOR GROUP
Models AD-10, 11 and 12

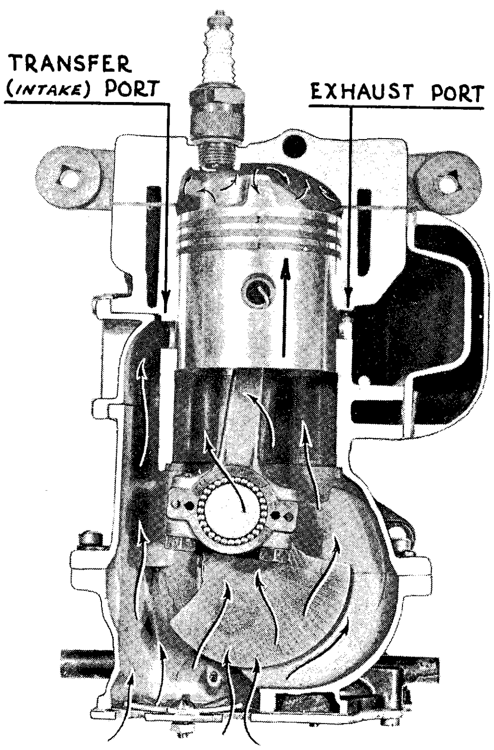


CARBURETOR GROUP
Models CD-19 Up

NOTES

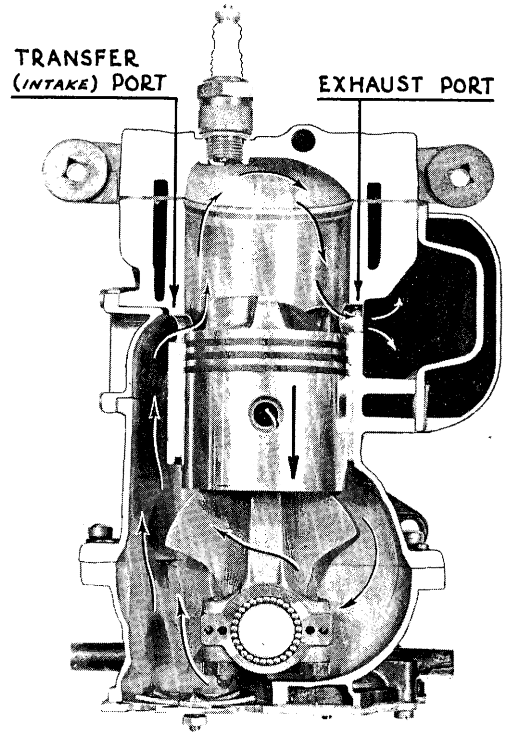
CARBURETION – BASIC MODELS QD AND FD

The Model QD is a two port, two (stroke) cycle engine, relying on the use of an automatic leaf valve for crankcase induction. As suction is created by upward movement of the piston to result in low crankcase pressure, the leaf valve is forced off its seat due to higher pressure without and comparatively low pressure within the crankcase. This causes an air stream to flow through the carburetor mixing chamber and the resultant fuel vapor to flow into the crankcase, thus charging the crankcase. Crankcase suction diminishes as the piston reaches the top of its stroke—the leaf valve then springs back against its seat to seal the crankcase. The charge in the crankcase is compressed on following downward movement of the piston—crankcase pressure builds up until head of the piston uncovers the transfer or intake port in the wall of the cylinder when the compressed vapor charge in the crankcase discharges into the cylinder. See pages 79 and 80.



Sectional View Showing Piston Moving Upward, Vaporized Fuel from the Carburetor Being Drawn into the Crankcase by Way of the Automatic Leaf Valve and Compression of a Previous Charge in the Combustion Chamber. Note Intake, Transfer and Exhaust Ports Are Covered by the Piston.

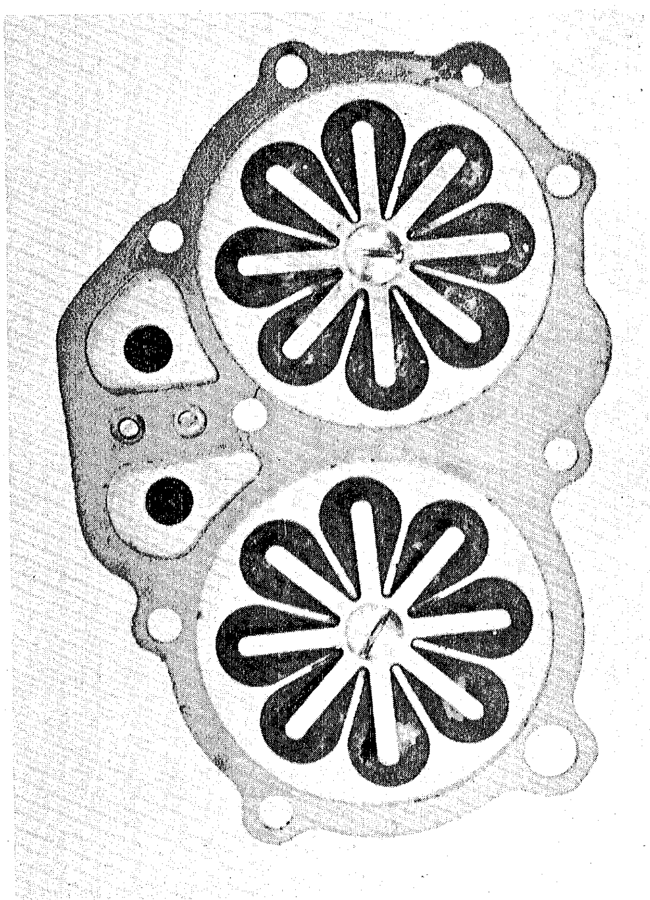
Actually, the automatic leaf valve consists of several leaves or segments arranged in daisy petal fashion anchored in center position to a plate drill-



Sectional View Showing the Piston Moving Down, Intake (Transfer) and Exhaust Ports Open (Uncovered by Piston) Exhaust Gases Discharging into Exhaust Manifold, and Compressed Crankcase Charge Flowing into Cylinder, Later to be Compressed and Ignited.

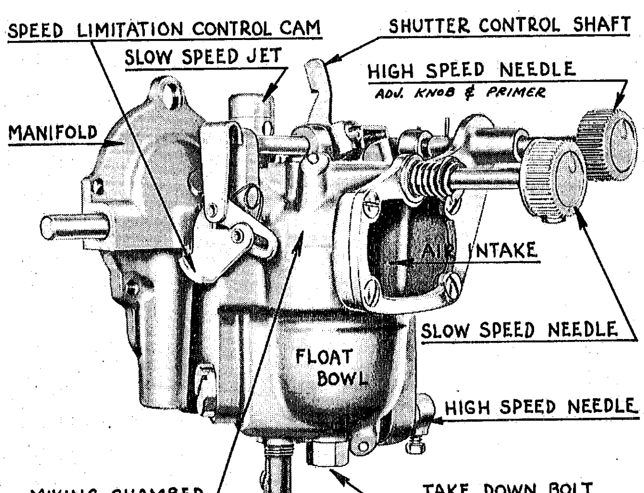
ed with corresponding holes to complete the valve assembly – one assembly for each crankcase chamber. The plate, of course, must be flat and true to maintain a "tight" seal with like surface of the leaf. A guide is attached to the assembly to limit movement of each segment. Naturally, all leaves or segments lift from their respective seats simultaneously to admit fuel vapor into the crankcase when sufficient suction or low pressure is built up and close together as suction diminishes. The leaves open into the crankcase. Leaf plate is constructed of specially heat-treated beryllium copper or plated steel. Do not, under any circumstances, bend or flex leaves of the valve by hand – in such event they are rendered unfit for use and should be discarded.

The automatic leaf valve in this case replaces the third port or rotary valve employed in older models. It is automatic in that it does not open until sufficient low pressure is built up in the crankcase to overcome leaf tension pre-established by special heat treatment of the material of which it is constructed. The degree of leaf opening depends upon



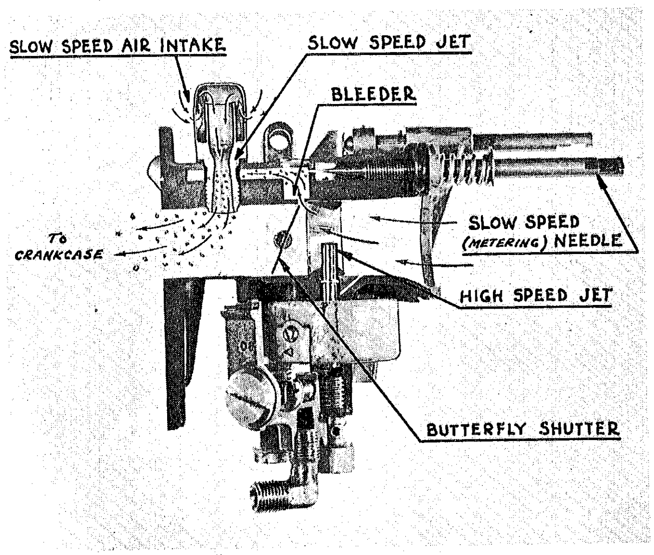
Leaf Plate Assembly—Side Opening into Crankcase

crankcase pressure which varies with the rate of speed at which the motor is operating. Such action results in more satisfactory performance throughout entire speed range of the motor. Both the third port and rotary valve (formerly employed) open to same degree regardless of motor speed, while the automatic leaf valve only in proportion to demand created at various motor speeds, thus acting more efficiently.



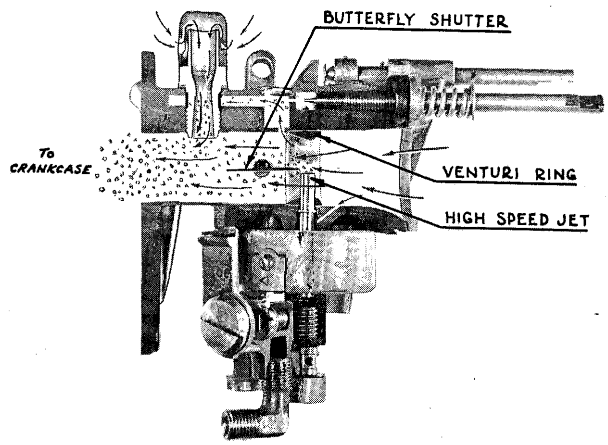
Model QD Carburetor Only.

The carburetor is of the float feed two-jet type consisting of a mixing chamber with integral intake manifold and conventional float chamber to which are added synchro and speed limitation control mechanisms (to be explained later) as required for gear shift. Two adjustments are provided, namely, for high and slow speed performance. See Carburetion – Basic, page 83.



Sectionalized View of Mixing Chamber Showing Shutter Set for Slow Speed Operation. Note Maximum Fuel Vaporization at Slow Speed Jet.

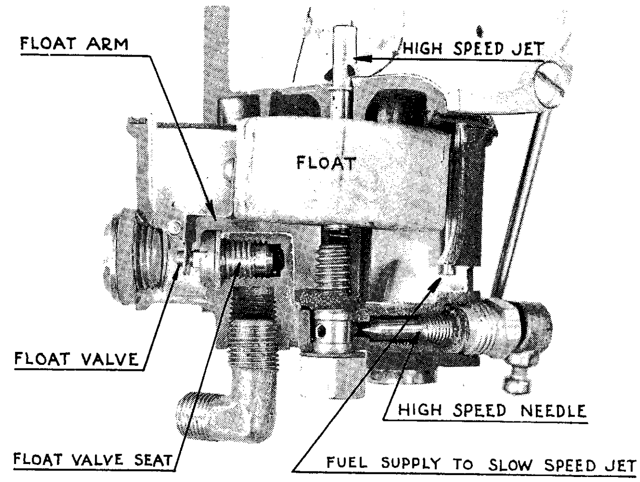
Above illustrates action of carburetion during slow speed performance of the motor. Note that the butterfly shutter is closed to permit very little air flowing through the mixing chamber except for the small stream entering the bleeder orifice. High suction created in the crankcase at this time, causes air to enter through the slow speed jet at high velocity, since area of the jet is comparatively small. Air velocity is further increased by constriction of the area as can be seen in sectional view (known as venturi). This subsequently results in partially vaporized fuel (effect of air bleeder has previously caused the liquid fuel to break up) flowing through the several small orifices (holes) in the slow speed jet to mix with the high velocity air stream to produce the fuel vapor essential to combustion.



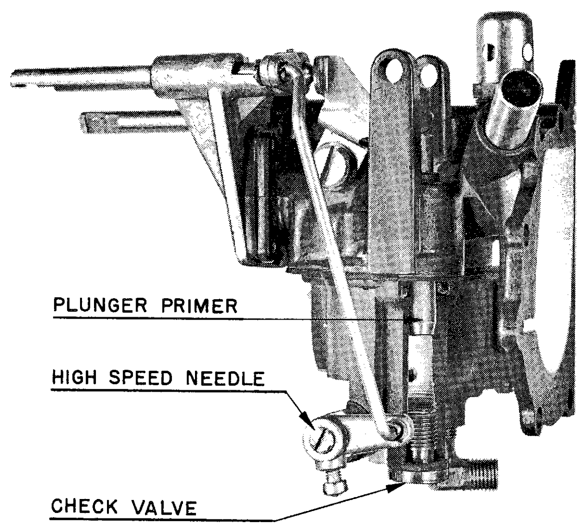
Sectionalized View of Mixing Chamber with Shutter Set for High Speed Performance. Note Maximum Fuel Vaporization at the High Speed Jet, also Effect of Restriction Caused by the Venturi Ring to Increase Air Velocity in Area of the High Speed Jet.

Sectional view above shows action of carburetion during top speed performance of the motor. Note that the butterfly shutter is full open to permit maximum flow of air through the mixing chamber. Velocity through the mixing chamber at this time is comparatively high but proportionately diminishes with closing of the butterfly shutter to reduce motor speed. To obtain maximum air velocity (required for maximum fuel vaporization) in area of the high speed jet, a venturi ring has been installed, as shown above. The ring actually consists of a constriction in the air stream (funnel like). Cross section of the venturi indicates a rather abrupt but curving constriction on the leading side—gradually tapering to full diameter on the trailing side to result in maximum air velocity in the jet area, thus maximum fuel vaporization.

High and slow speed jets do not function independently of each other, however, maximum vaporization occurs only at the slow speed jet when the butterfly shutter is closed for slow speed motor operation. Vaporization at the slow speed jet decreases in proportion to butterfly shutter opening. Conversely, vaporization at the high-speed jet proportionately increases until full open position of the butterfly shutter has been reached to result in maximum vaporization (at high-speed jet) and a minimum of vaporization at the slow speed jet. The slow speed jet then functions in various degrees throughout the entire speed range of the motor—the high speed jet remaining idle when the butterfly shutter is closed for slow speed motor performance.



Sectionalized View of Float Chamber.



Sectional View of Float Chamber Showing Primer Plunger and Check Valve Assembly.

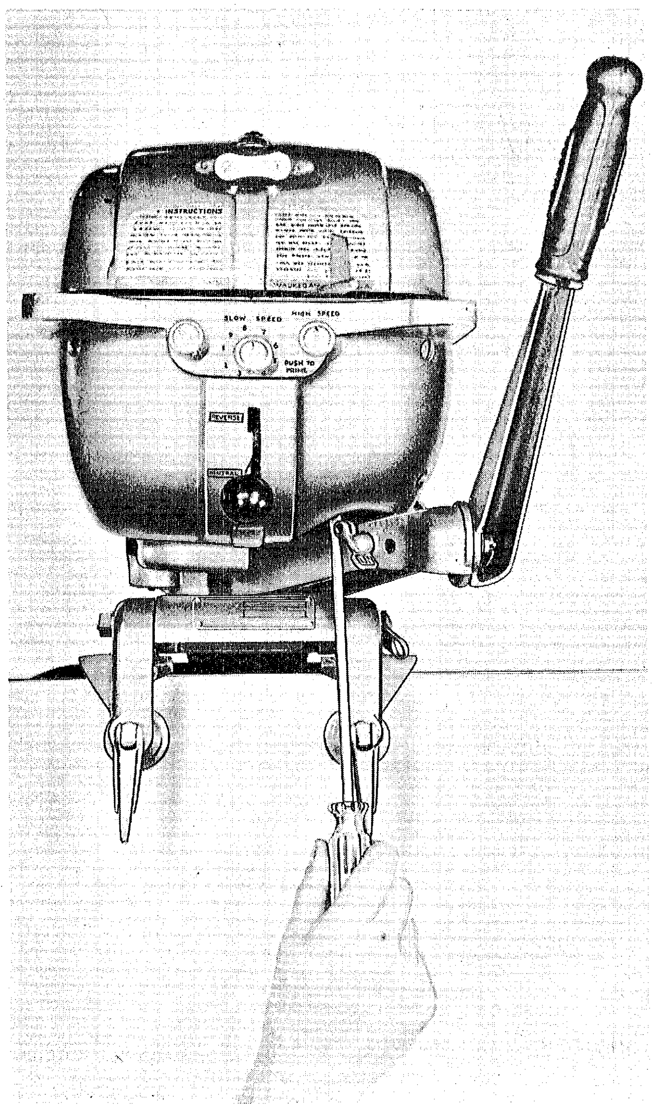
To Adjust High Speed Needle

Start motor, set shift lever to "forward" position and allow to run at top speed (move control lever to "fast" position) until normal operating temperature is reached. Turn "high speed" needle knob to right or left as required to obtain maximum performance. This adjustment should be performed only with control (speed) lever set for top speed—position "fast" (spark at full advance and carburetor shutter at full open).

The high speed needle is initially adjusted at the factory but provisions are made for limited adjustment to compensate for variations apt to be encountered during normal operation of the motor.

In event restricted range of adjustment is not sufficient to obtain proper high speed needle setting, proceed as follows:

Loosen screw holding small bell crank fast to the high speed needle—accessible under side cover as shown below.



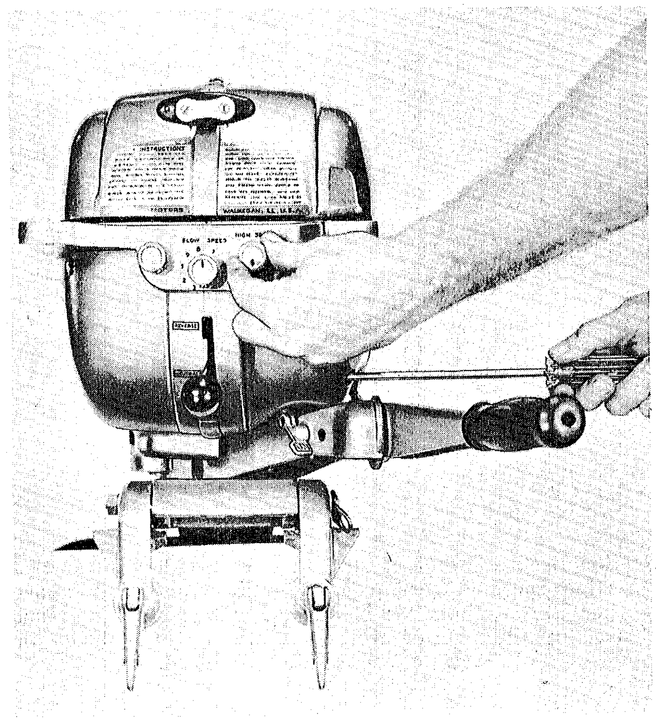
End of the high speed needle is slotted to accommodate screw driver bit.

Start and operate motor at "fast" speed until normal temperature is attained.

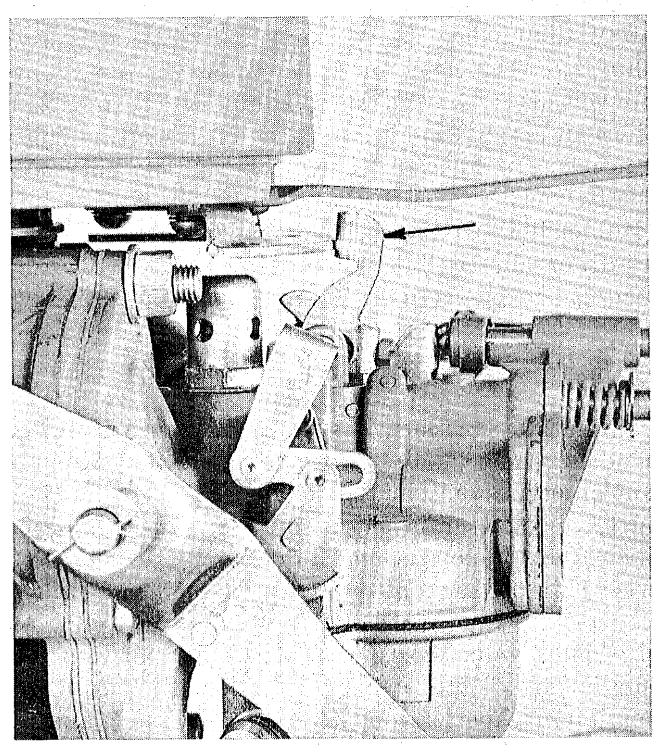
Set high speed (needle) adjusting knob to center position—arrow down, and hold in this position.

Insert screw driver through port in side cover to engage high speed needle.

Turn high speed needle to left or right as required to obtain maximum speed or best running position. (Left, to enrich mixture—right, to lean out).



While still holding high speed (needle) adjusting knob in center position, tighten screw in bell crank to secure.



Showing Carburetor Synchro-Control Lever Riding Against Cam Attached to the Armature Plate. In Following Contour of the Cam Plate as the Speed Control Lever Is Moved to Right or Left, the Carburetor Shutter (Butterfly) Opens or Closes in Proportion to Degree of Spark Advance (Speed of Motor).

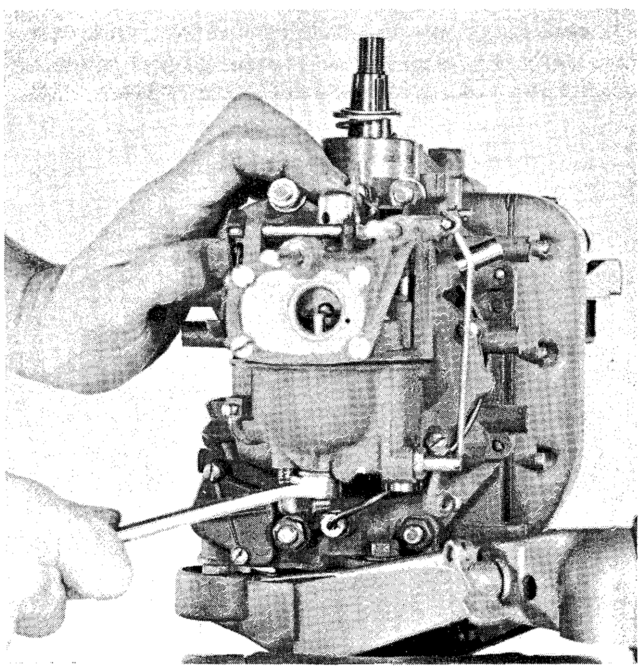
To Adjust Slow Speed Needle

Move control (speed) lever to "slow" range position. While operating within slow speed range, turn slow speed needle knob to right or left as required to obtain satisfactory slow speed performance. Move control lever farther to left to further retard motor speed. Reset slow speed needle as, and if, required to obtain smooth operation. (Note: Turning needle to left enriches the fuel mixture—that is, increases proportion of fuel to air. Turning the needle to right reduces proportion of fuel to air to result in lean mixture). An excessively rich mixture is indicated by "rough" running of the motor. "Spitting or coughing" in the carburetor is indicative of a lean mixture.

The high speed needle may require further attention (adjustment) on attaining final adjustment of the slow speed needle. Proceed as above in this event.

To Remove Carburetor

In event it becomes necessary to remove the carburetor, the float chamber must be first removed.

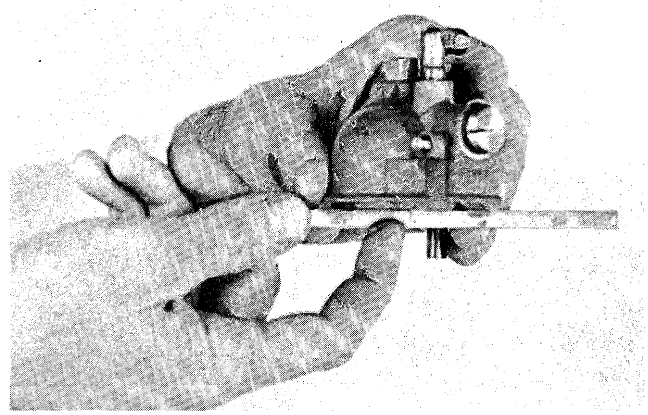


Removing Carburetor Float Bowl.

This operation is followed by removing the small screws holding the mixing chamber and integral manifold fast to the crankcase. One screw immediately back of the float bowl prohibits detaching the carburetor assembly without first removing the float bowl. Reassemble in reverse order, being careful to guard against damage to the gasket, float arm or primer spring. Careful assembly is not too difficult to accomplish.

To Adjust Float Level

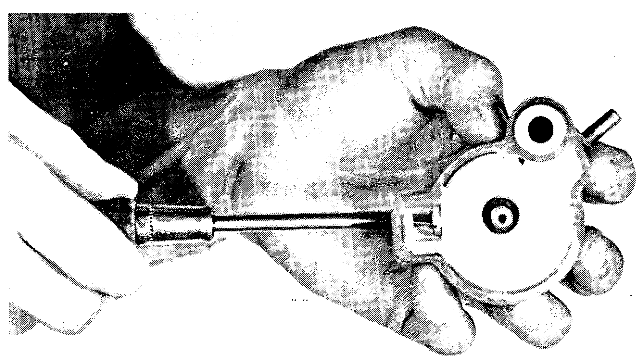
It may become necessary to adjust the float level, possibility resulting from attempting to install the float bowl to throw it slightly out of adjustment. Turn the float bowl assembly upside down—place a straight edge across edge of bowl. Float level is correct when top face of the cork float comes to rest flush with the edge of bowl. In event it falls below level of edge of bowl when in upside down position, fuel level will be too high causing float bowl to overflow and drip. (Dripping from the float bowl may also be caused by a loose fitting or otherwise impaired float valve and seat assembly. Make certain this assembly is secure in the float bowl).



Method of Checking Float Level.

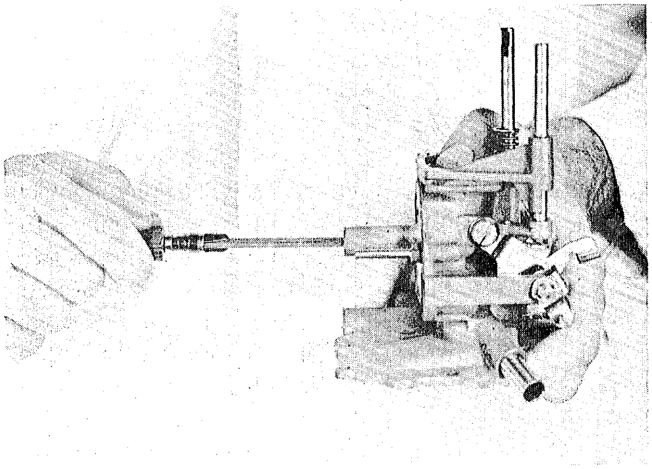
If top surface of the float fails to reach a position flush with the straight edge, fuel level will be too low to result in carburetor "starving" to interfere with motor performance particularly at high speed.

To correct float level, carefully bend float arm as required to obtain proper setting. Make sure no binding exists – the float must function freely to obtain maximum carburetor performance. See Carburetor Check Chart, page 139, and instructions regarding shutter, which apply equally to all models – faulty shutter closing affects slow speed operation, page 96.

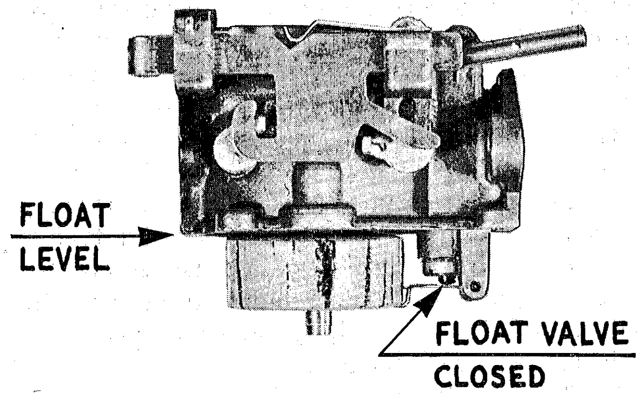


Removing or Installing Float Valve Seat.

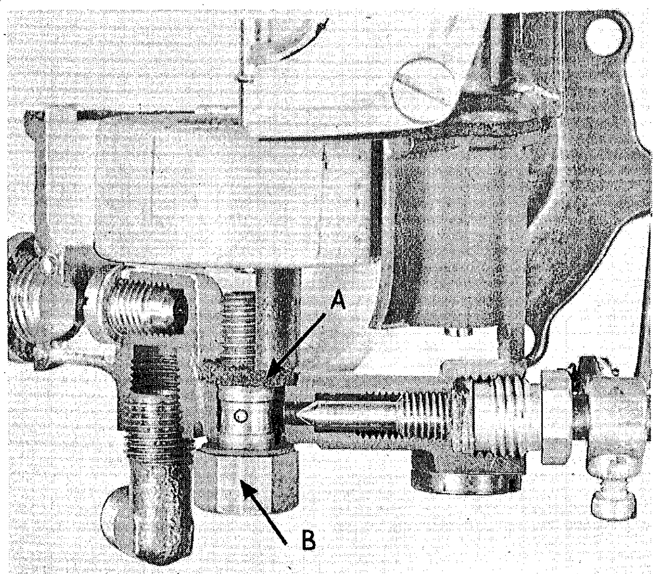
MODEL QD-10 THROUGH 14



Removing or Installing High Speed Needle—Loose High Speed Needle Can Result in Irregular Carburetor Performance.



Showing position of float when properly adjusted. See Page 121.



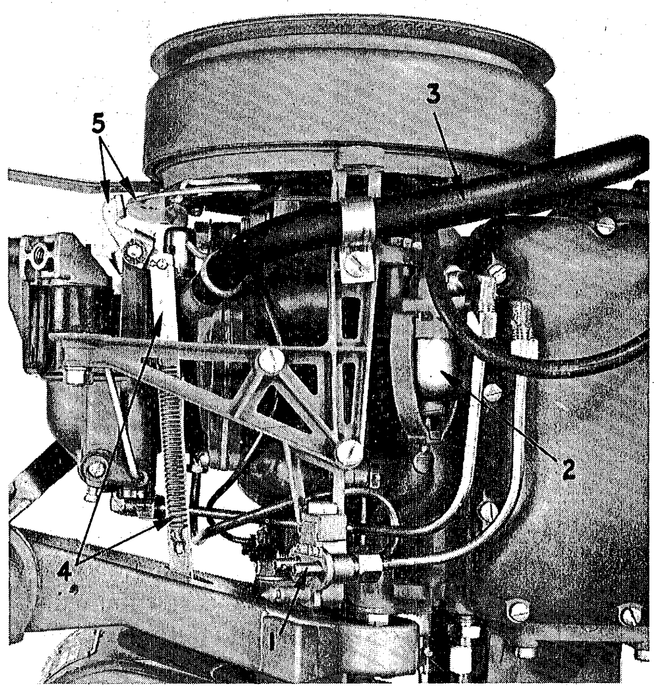
There may be occasion when it Appears Impossible to Obtain Satisfactory Carburetor Adjustment (high speed) on Models QD-10 to 14 Inclusive or "Fair" Adjustment on the High Speed Needle but with a Tendency Toward "Rough" Running Due to What Seems to be an Excessively Rich Mixture Even Though the High Speed is Set or Adjusted Scarcely off its Seat. In the Extreme, the Motor may be Found to run with the High Speed Needle Closed Entirely.

If and when Encountering a Similar Situation, Look to Condition of Washer #301999, Indicated by Arrow in the Illustration, as the Distributing Factor. On Observing Location of the Washer, it can be Easily Seen that being Improperly Seated, Damaged, or Omitted, Liquid Fuel will by-pass the High Speed Needle Seat to Enter the Jet Area Without Having been Metered (Fuel-Air Ratio.)

Corrective Measures in this instance can be Readily Accomplished by Removing Screw "B" to Detach the Carburetor Float Bowl. Insert Screw through Float Bowl, Install New Washer (on Screw—Inside Float Bowl) then Carefully Replace Float Bowl Assembly. Care Should be Exercised During Installation Procedure, Since Tension on the Primer (Plunger) Spring must be Overcome – See Page 119.

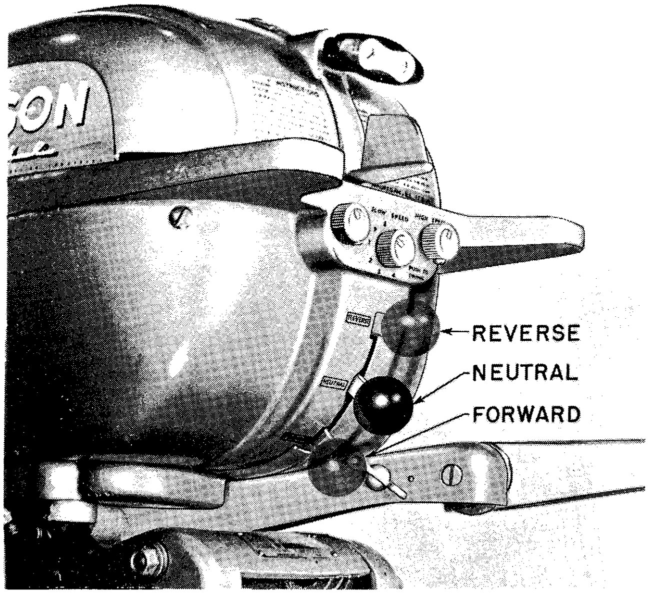
Speed Control

Since spark and carburetor shutter control are synchronized, motor speed is controlled by movement of the speed control (magneto) lever—slow, when to left (facing motor) and progressively gaining speed as the lever is moved to right.

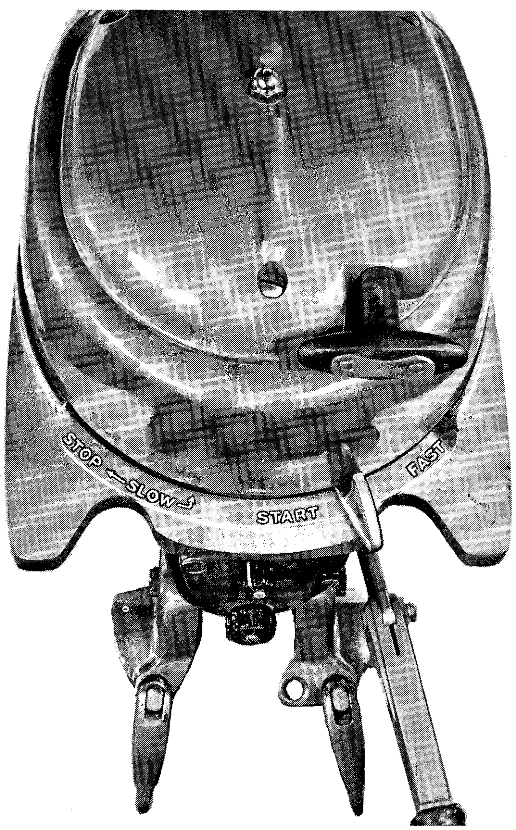


Showing (1) Fuel Line Connector, (2) Filter, (3) Leaf Valve Silencer Tube, (4) Spring and Lever Applying Tension on Carburetor Shutter Shaft and (5) Lever Riding Against Cam on Armature Plate—Synchro Control.

Gear Shift



Showing Three Positions of the Shift Lever.

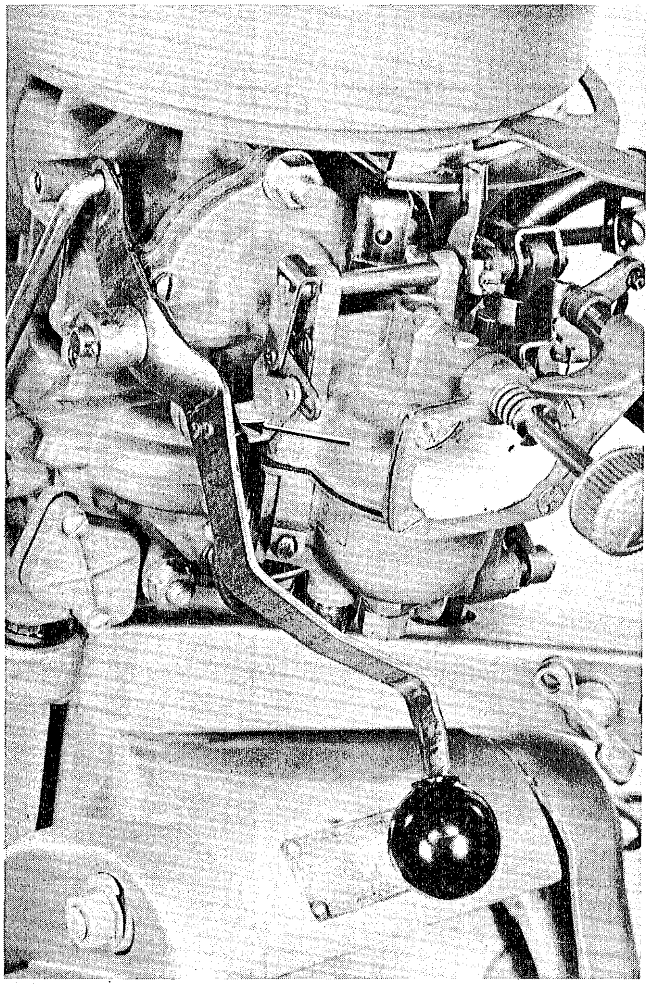


Showing Speed Control Lever on Panel.

FORWARD OPERATION. The shift lever can be moved into "forward" position regardless of control (speed) lever setting (Start, Slow, Fast, etc.) and while in this position, the motor functions in conventional manner. QD-10 to 14 only.

NOTES

NEUTRAL OPERATION. The shift lever can be moved into "neutral" position only when the control (speed) lever is set within "neutral" range (indicated on the motor rest bracket).

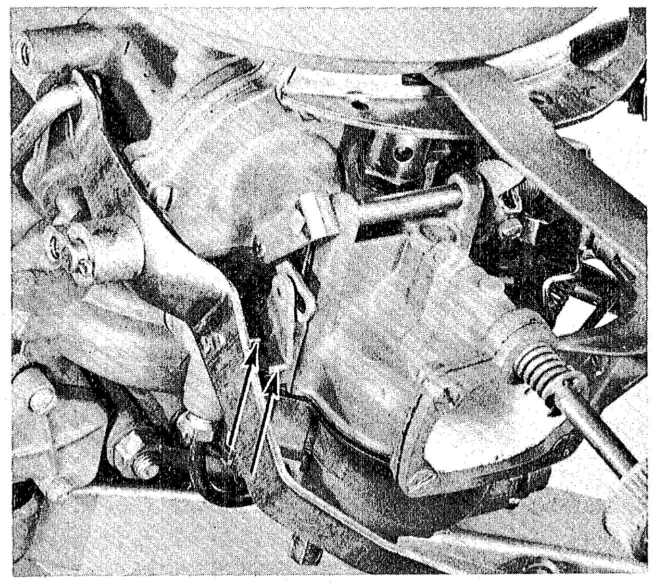


Showing Position of Speed Limitation Control Cam with Respect to Gear Shift Lever Set in "Forward" Position. When Set in This Position (Forward) the Motor May Be Operated at Any Desired Speed within the Limits of Its Capacity Since the Small Bracket on the Shift Lever Does Not Engage the Limitation Cam to Limit Opening of the Carburetor Shutter.

The control (speed) lever may be moved to any position with the gear shift lever in "neutral". However, it is not recommended that the motor be operated beyond range indicated for "neutral" or "reverse". It is possible, but not recommended, to shift into "forward" position with the control lever set beyond "neutral" or "reverse" range. The gear shift lever cannot be moved back into "neutral" once the control lever is moved beyond the "neutral-reverse" range.

The Control Lever Must Be Positioned Within the "Neutral-Reverse" Range Before Shifting Back to "Neutral." Do Not Force.

REVERSE OPERATION. The same speed restrictions apply to "reverse" as apply to "neutral" operation. The control (speed) lever must be set within "neutral-reverse" range prior to shifting into "reverse."



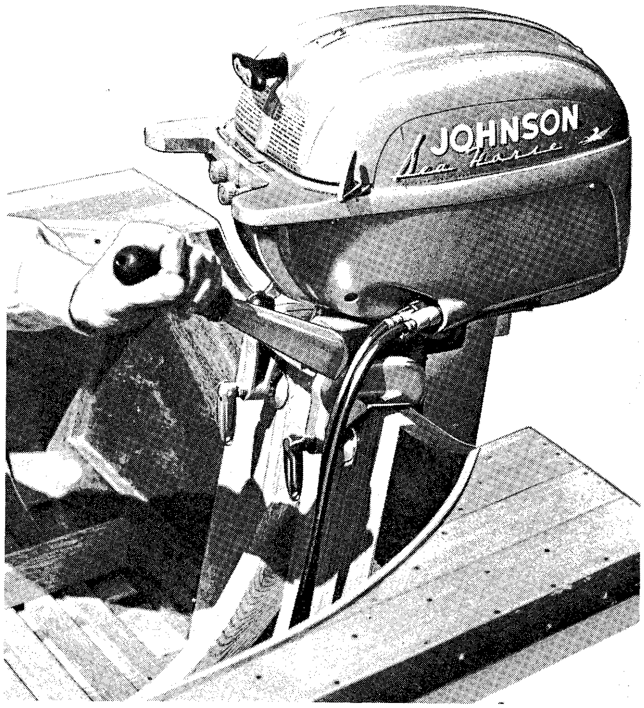
Showing Shift Lever Set at "Neutral" or "Reverse" Position. Note Position of Bracket on the Shift Lever with Respect to the Speed Limitation Cam on the Carburetor. In This Position the Small Bracket Engages the Cam to Restrict Its Degree of Travel and Subsequently Limiting Movement of the Carburetor Shutter to Prohibit Motor Speed Beyond a Narrow Range—Up to Approximately 2000 R.P.M.

Motor power and speed are automatically limited in reverse as a precaution against damaging the boat. The reversing feature is provided for maneuverability of the boat, though not efficient for pulling heavy loads.

Do not attempt to force the gear shift lever into "reverse" or "neutral." Move control (speed) lever within "neutral-reverse" range, then shift to "neutral" or "reverse" with ease. QD-10 to 14 only.

Actually, little is gained when attempting to test a motor (after repairs) in a tank with the regular propeller installed — it starts hard, it doesn't turn up as it should, neither does it idle as it should. Further— it is impossible to obtain proper carburetor needle settings, not to mention the impossibility of conducting a satisfactory demonstration for the owner or prospective buyer. Test wheels are important and very necessary equipment for the well equipped and organized Johnson Service Shop.

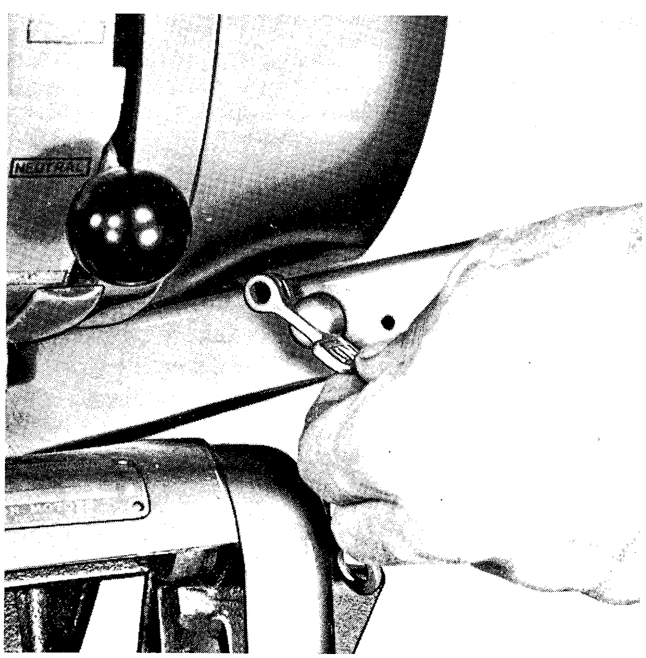
Occasions may arise when it is advisable to suddenly reduce motor speed at a moment's notice. This can be accomplished by simply raising or tilting the steering handle up as shown here (QD-10



Tilting Steering Handle to Reduce Motor Speed.

to 14) provided the small lever on the steering handle bracket has been preset to position "ON" as shown below.

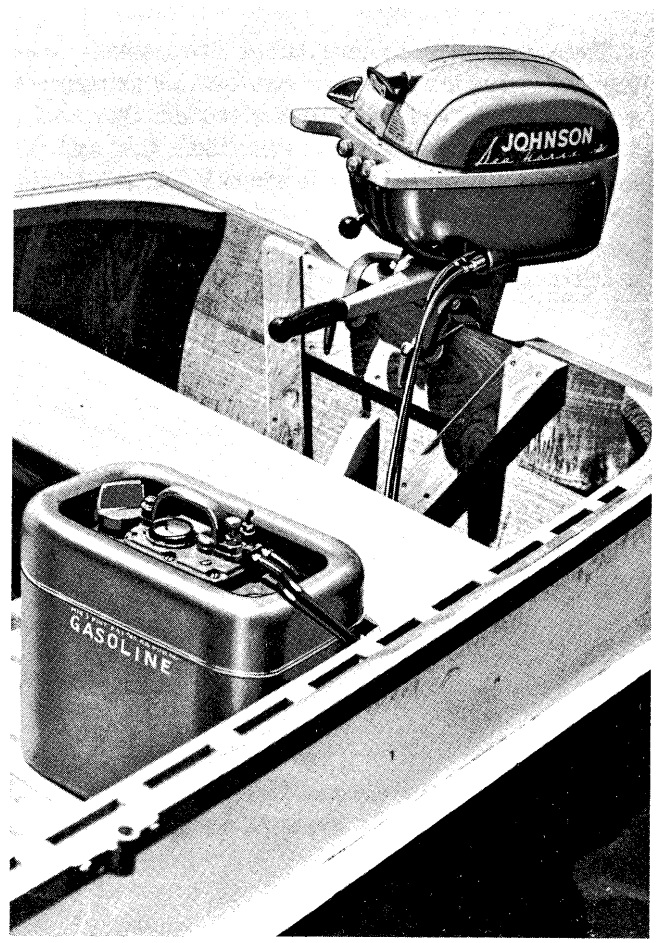
In event control action is not desired, set lever to "OFF" position and operate in conventional manner.



The motor will be found to run rather unevenly (sluggishly) when operating at reduced speed, as result of tilting the steering handle. To overcome this condition, move control (speed) lever to left—"slow" range. Resume speed by returning steering handle to original horizontal position and advancing speed control lever to desired position.

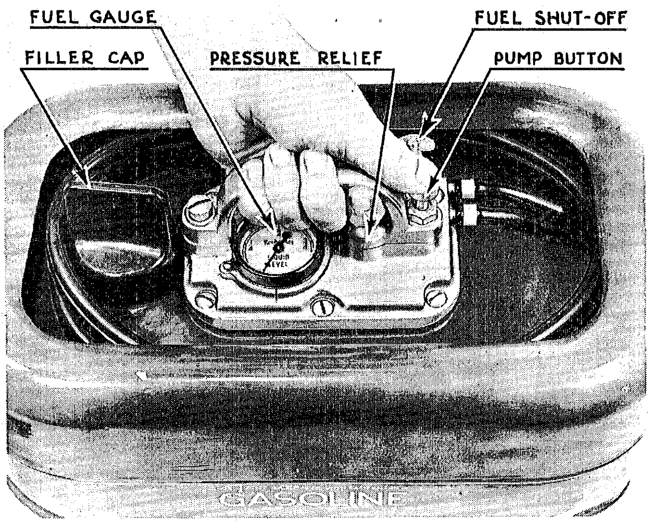
In situations where speed reduction is but momentarily required, it is not necessary to alter position of the speed control lever—resume normal "fast" speed by merely returning the steering handle to horizontal position.

THE MILE-MASTER FUEL TANK



Showing Application of the Mile-Master Tank.

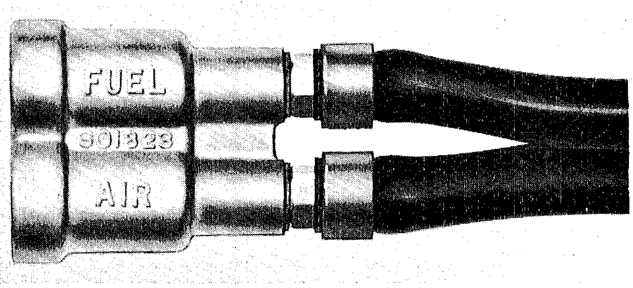
Pressure to lift and transport fuel from the tank to the motor is built up in the crankcase of the motor. While mechanical details differ somewhat, principle of operation is identical.



Top View of Mile-Master Tank.

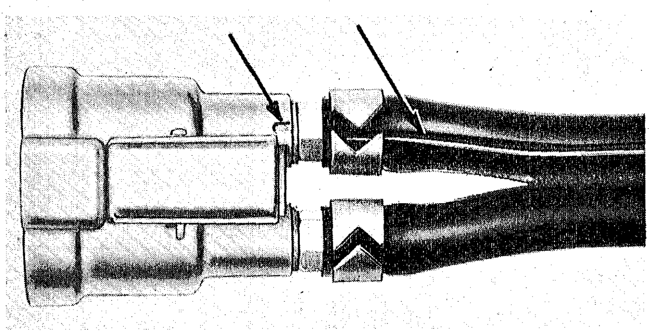
Twin synthetic rubber tubes (two tubes fused together) are employed to conduct air pressure to and fuel from the tank to the motor. One end of the assembly is anchored to the tank (air and fuel line fittings)—the other is provided with a fitting (connector) to connect air and fuel lines to corresponding fittings on the power assembly from which a tube leads to the crankcase check valve and a second tube to the carburetor.

The connector is marked "air" and "fuel," as shown below, and must be properly assembled to the fuel line so air pressure and fuel lines are not crossed.



Top View of Fuel Line Connector.

SEE PAGE 182 FOR REPAIRS.

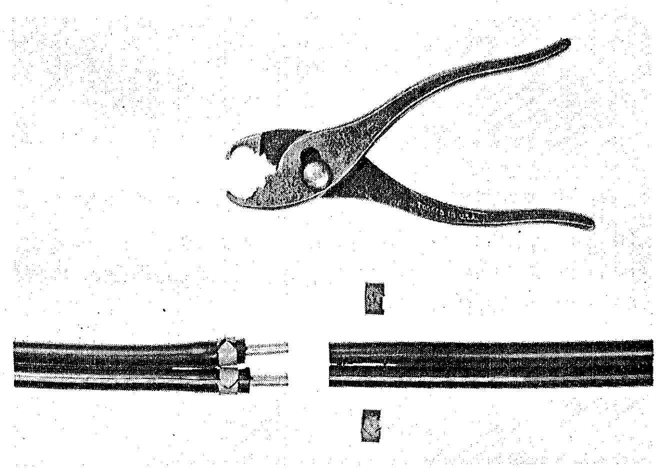


Bottom View of Connector—Arrows Directed to Embossing and Ridge on Air Line. Assembly Must Align Accordingly.

By turning the connector over, a small embossing will be noted on the "air" side and that the air line is ridged to correspond with the embossing. Should it become necessary to install a new connector or fuel line assembly, make certain the tubing provided with the identifying ridge lines up with embossing on air side of the connector.

The connector is provided with check valves to avoid fuel tank pressure release when disconnecting from the motor. Once pressure has been built up in the tank (normal 2 to 5 pounds), it is retained for a considerable time regardless of having detached the connector. Pressure is released only on removing the filler cap, and result of gradual seepage over periods of inactivity or because of irregularities in the assembly to cause air or fuel leaks.

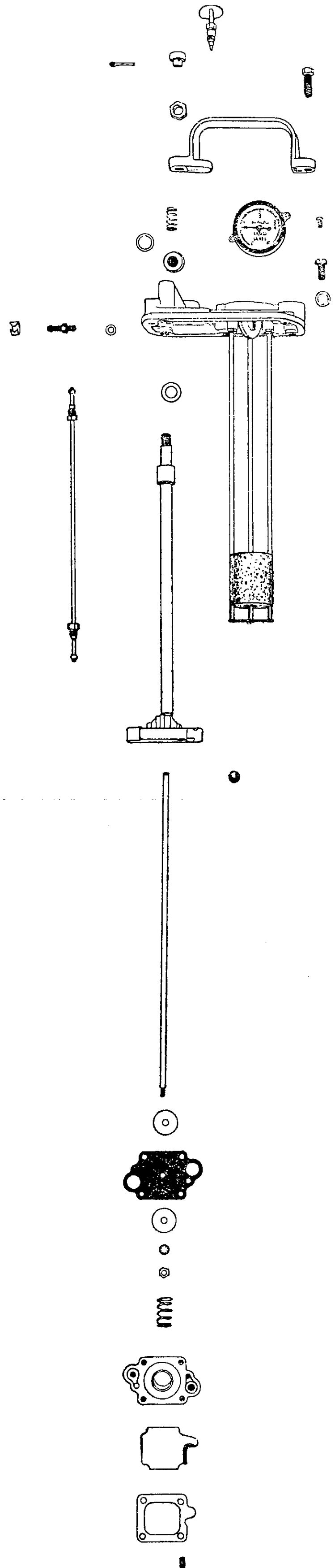
Broken fuel lines can be repaired by cutting ends square and inserting pieces of 3/16″ copper tubing (about 2″ long—one-half into each tube). Force the tubes together over the copper tubing, then secure with clips (#301822). Fuel line lengths can be extended as desired in like manner.



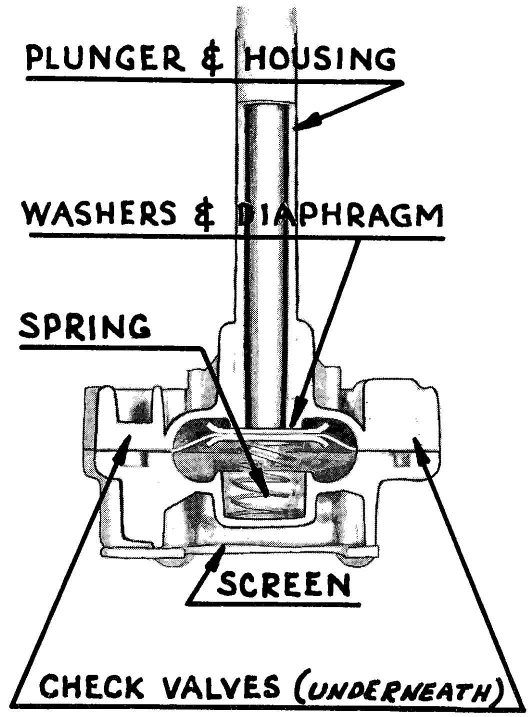
Illustrating Method of Splicing the Fuel Line and Specially Ground Pliers to Crimp Hose Clamps in Clips. An Inexpensive Pair of Pliers Can Easily Be Ground for the Purpose as Shown Above.

The fuel tank is of but simple and rugged construction—capacity 5 gallons. It contains the pump (for filling carburetor bowl), fuel level float and gauge, pressure relief valve, connections for fuel and air lines as well as a space into which the fuel line is coiled when not in use and a carry grip.

The pump employs the use of a diaphragm flexing in a small housing to pump fuel to the carburetor for starting purposes—necessary only when pressure has been released from the tank for refilling or as result of standing idle for some time. Two check valves are required—one for intake and another for discharge, as in any conventional pump. A screen is installed to avoid entrance of foreign matter.



Extended View of Tank Cover, Pump, Float, and Pressure Relief Assembly.



Sectional View of Pump.

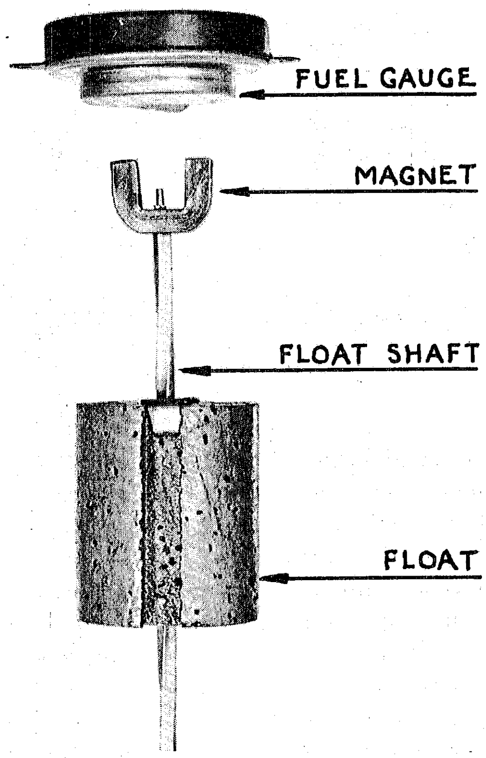
Failure to pump in most instances will be result of a punctured diaphragm which is easily installed. Like service operations on the power head or gearcase, they must be well performed, with care and same degree of carefulness.

Observe assembly prior to doing the job—dismantle and reassemble in reverse order. Install required new parts. Lap sections of the pump housing to insure flatness, if necessary.

When replacing the diaphragm, place a thin coat of hard drying cement on top side of curved washer, around the hole. Purpose is to eliminate possible seepage at this point. Note holes in diaphragm and corresponding holes in the pump housing—assemble so all line up. This is important. Do not neglect replacing the check valve discs and be careful they are not "cocked" and off their seats on assembly. Be careful not to wrinkle the diaphragm when bolting sections of the housing together (see that bolt holes line up and that diaphragm does not overlap). Result is failure of the pump to operate and leakage to interfere with functioning of the tank. Similarly, the gasket at top of the pump housing, next to cover, must be in place and in good condition to avoid possibility of air leaks.

The pump should be used only when the carburetor float bowl is empty—as indicated by little or no resistance when depressing the pump button except that set up by tension of the spring in the pump assembly. Float valve (in carburetor) closes as the bowl fills and closes entirely when filled to progressively build up resistance to pumping. Under no circumstances force the pump (depressing of pump button four to five times should be sufficient to fill the bowl)—the diaphragm is apt to be fractured.

Leaks in the pump assembly are indicated by failure of the pump and often fuel seepage around the tank cover. In some instances, the motor cannot be operated without necessity of constantly pumping fuel (fuel pump). In others, seepage may be slight, requiring manual pumping only at higher speeds.



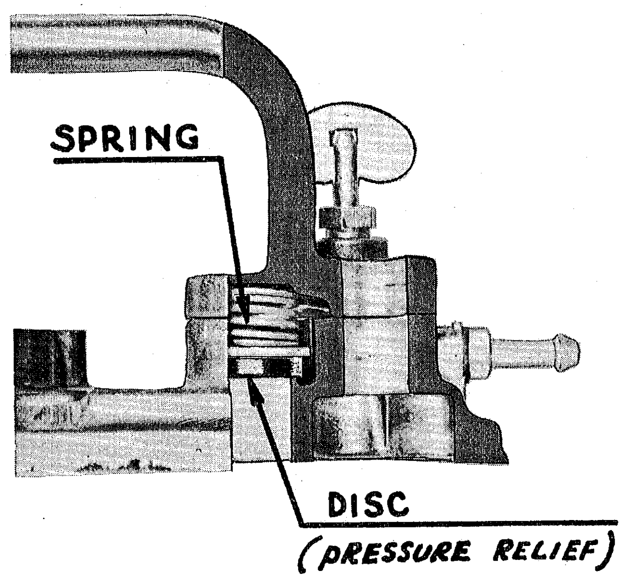
Illustrating Magnetic Control of Needle in the Fuel Gauge.

Since the fuel tank must be air tight, the gauge is magnetically operated. This is accomplished by attaching a small "U" shaped magnet to the end of the gauge needle shaft and a similar but larger magnet to the end of the float shaft. Thus, as result of magnetic attraction, the needle in the gauge is deflected with turning of the magnet on the float shaft to indicate quantity of fuel in the tank.

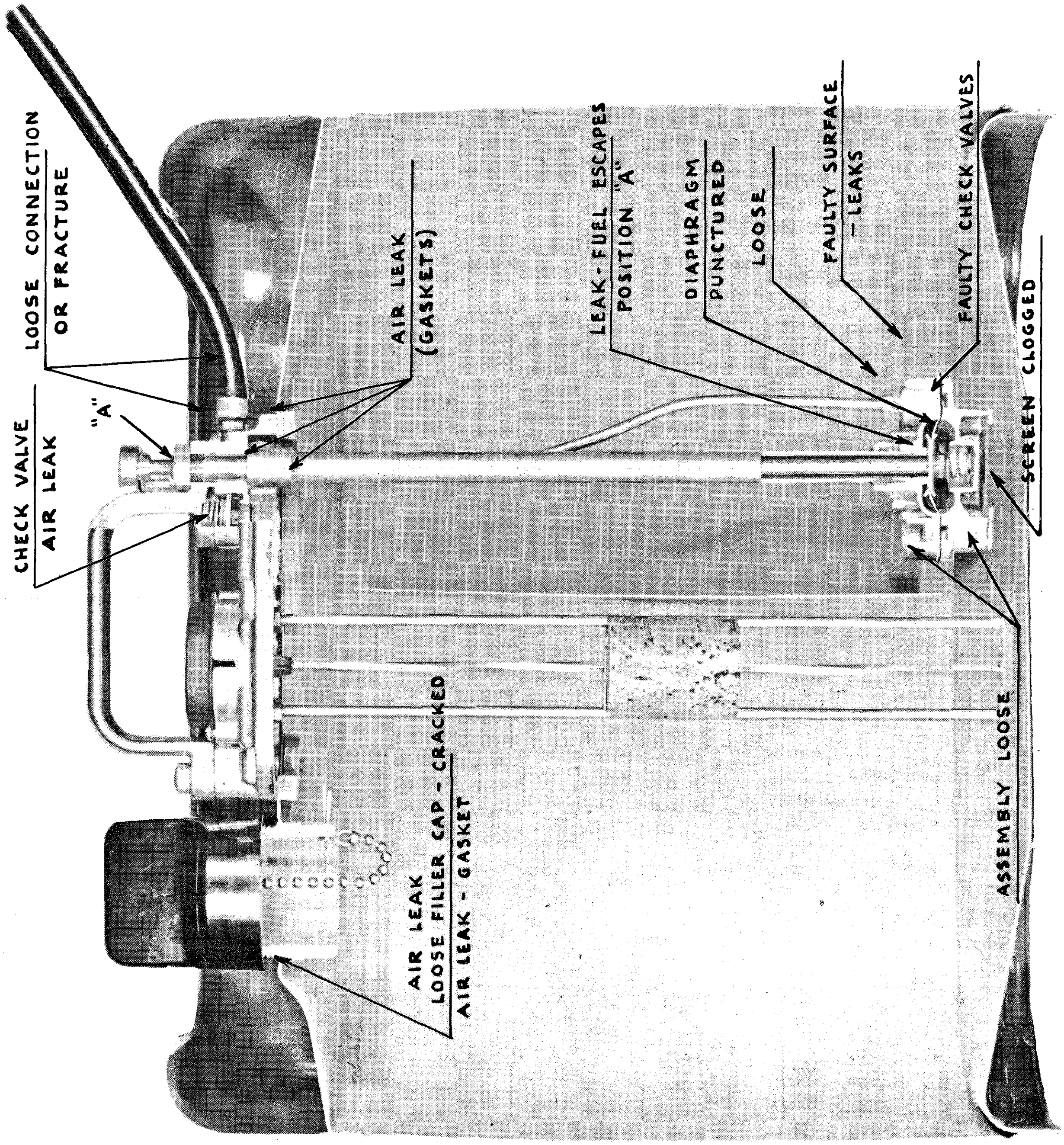
It will be noted from the illustration that the float shaft is constructed of square stock—twisted to cause it to turn as the float rises or falls. The float is grooved on one side into which fits one of the assembly supporting members and provided with a guide plate which straddles the support rod to prevent the float from twisting. A square hole is punched in the guide plate which slides on over the twisted float shaft in assembly. Inasmuch as the float is prevented from turning by the guide plate and support rod, the float shaft is caused to turn and proportionately deflect gauge needle with degree in rise or fall of the float.

Very little difficulty can be expected with this assembly—barring accident—magnets are permanent and should require no alteration. Chief concern is to make certain the float operates freely with no indication of binding.

The cross member (float shaft support) is soldered to the support rods— to remove, simply heat with soldering iron and replace in line manner. The float shaft can be improperly installed—four different ways since there are four sides to the square shaft. Check with gauge, with float resting on bottom, needle should point to "empty." If otherwise, detach float from the shaft—turn shaft and magnet to correct position, then replace the float. Solder cross member to support rods.

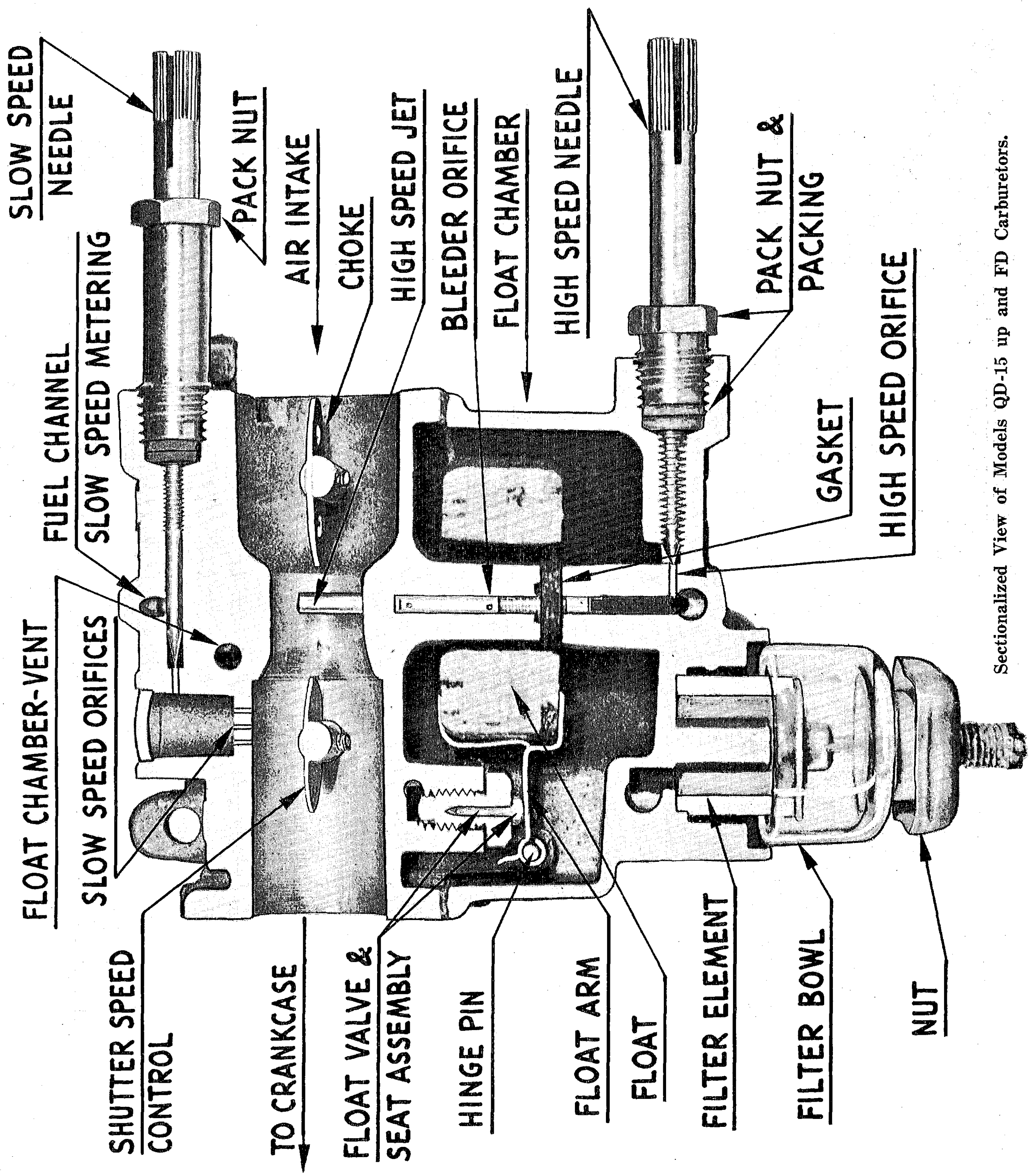


Sectional View of Tank Cover to Show Pressure Relief Valve Arrangement. Disc Is Forced Off Its Seat against Tension of the Spring When Tank Pressure Reaches Approximately Eight (8) Pounds. Check for Leaks if Tank Fails to Function.

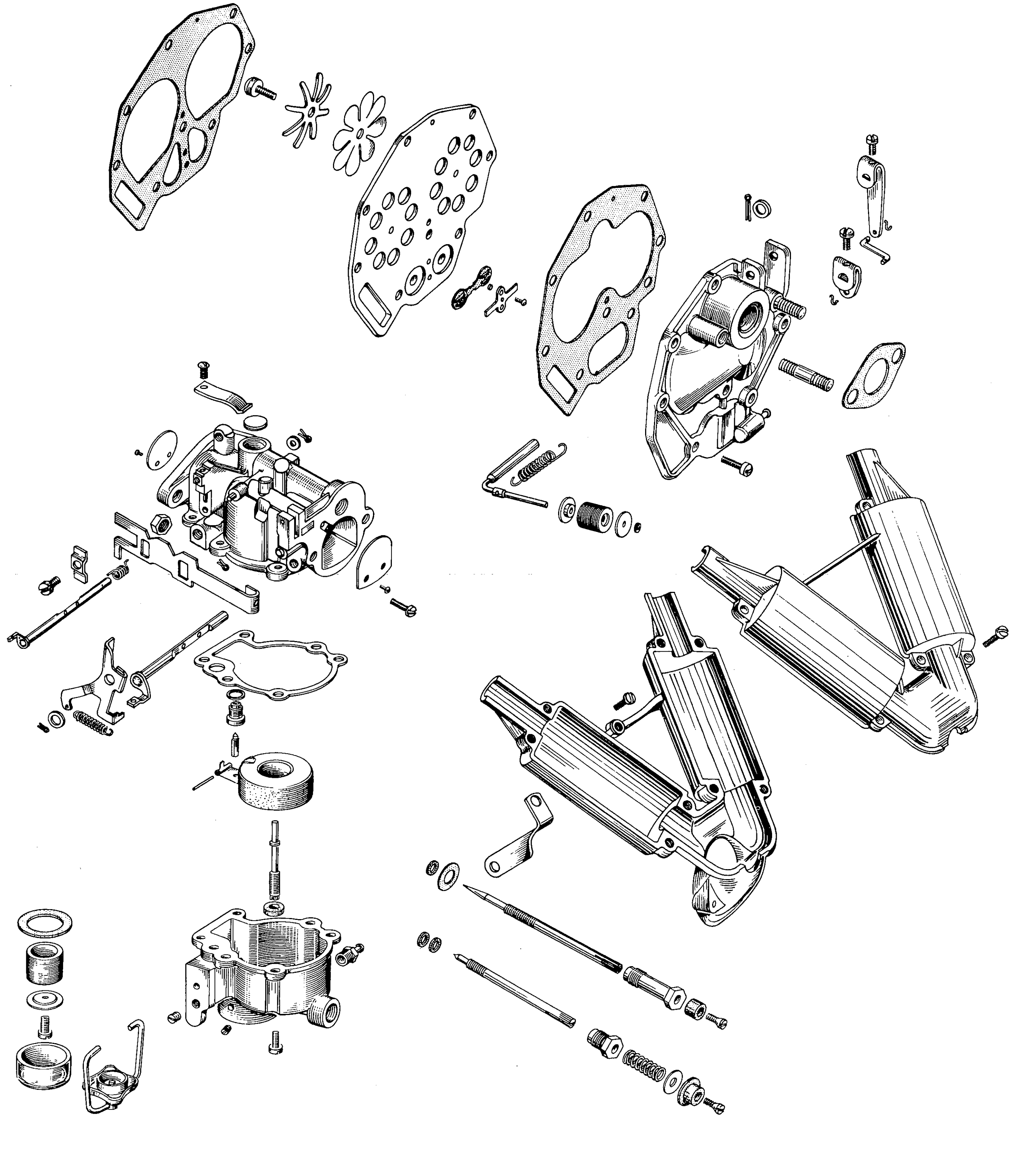


CHECK CHART—MILE-MASTER TANK

MODELS QD-15 AND FD CARBURETORS

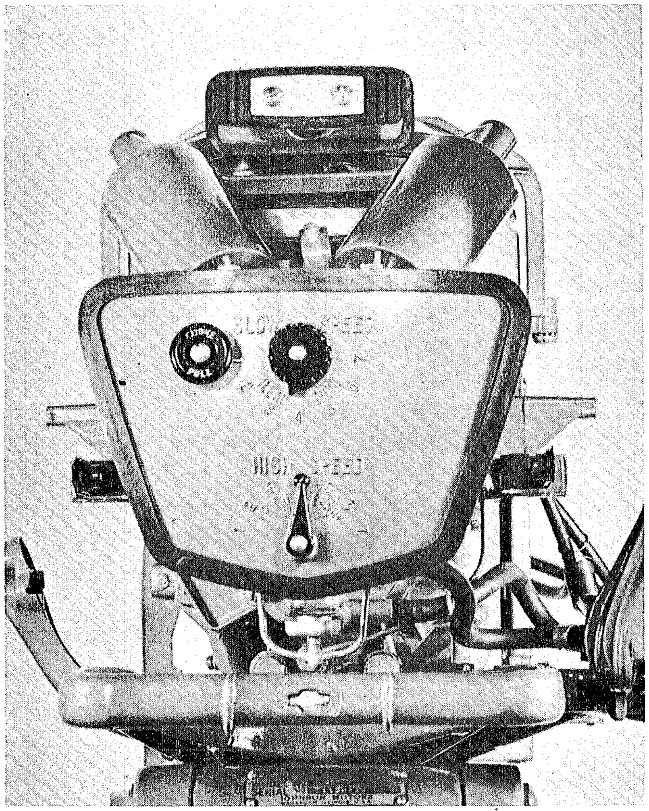


Sectionalized View of Models QD-15 up and FD Carburetors.

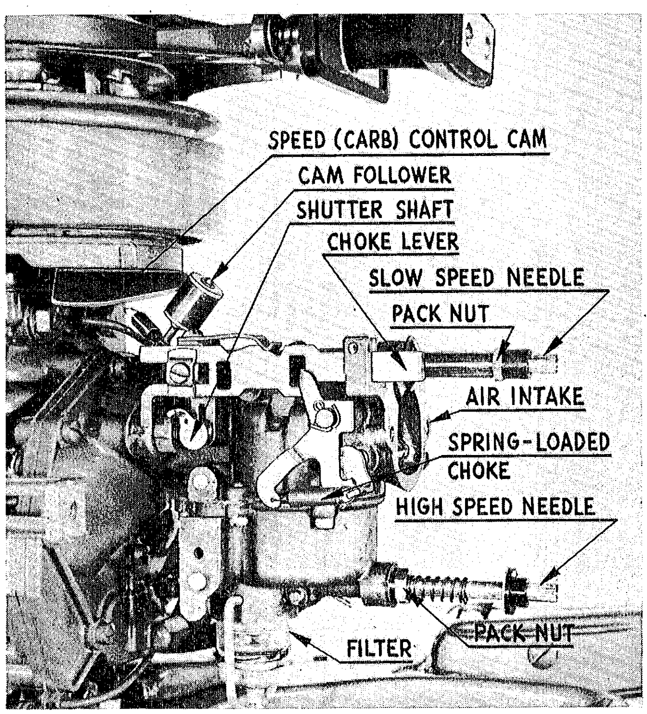


Carburetor, Manifold, Valve and Silencer Group.

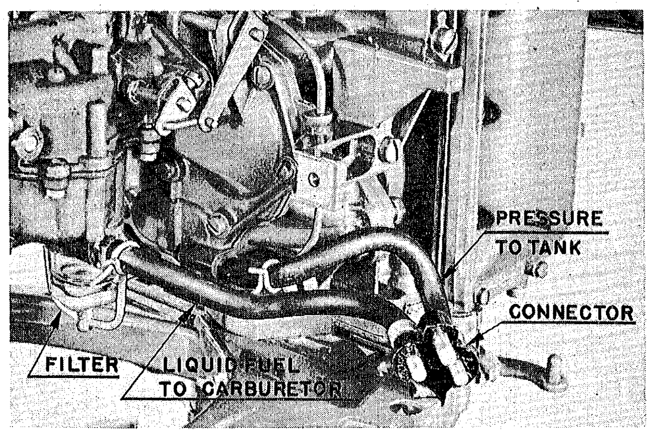
MODEL QD-15 CARBURETOR



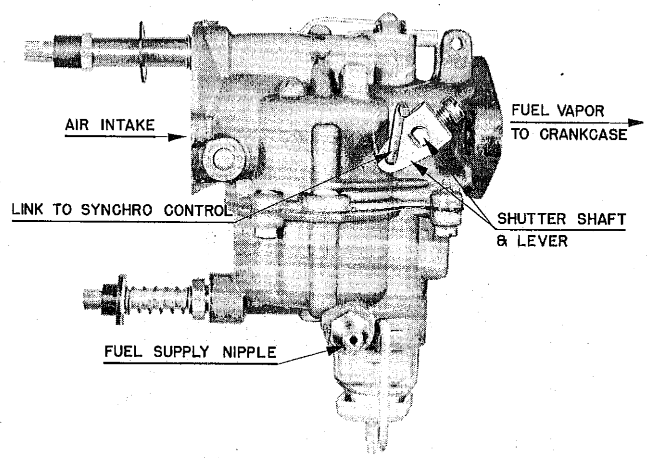
Front View of Carburetor Control Panel (Motor Cover Removed) Showing Position of the Choke Button, Slow Speed Adjusting Knob and High Speed Adjusting Lever.



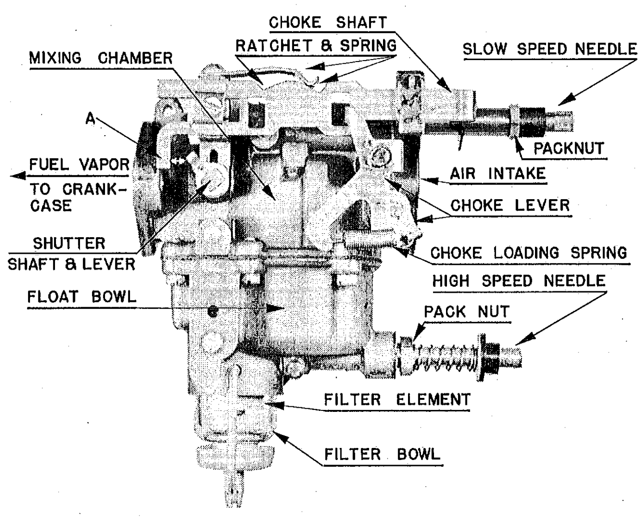
Carburetor Installation on Powerhead, Showing Cam and Cam Follower (Speed Control—Carburetor Shutter). Note that Choke Shutter is Spring Loaded to Avoid Excessive Choking During Movement of Starting.



Showing Pressure Line to Tank, Fuel Line to Carburetor and Fuel Filter.

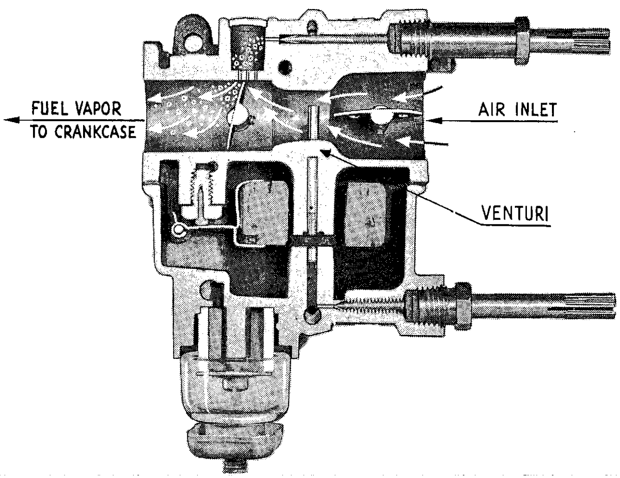


Port View of Carburetor Showing Shutter Shaft and Lever, Link to Synchro-Control Mechanism and Fuel Supply Nipple Attached to the Float Bowl.



Starboard View of Carburetor. Note that Choke Control is Spring Loaded to Guard Against Flooding Immediately After Starting and that Extreme End of Choke Shaft (A) is Arranged to Engage the Choke Shaft Lever to Permit Partial Opening (Cracking) of the Shutter at the Time of Starting—For Ease of Starting.

The carburetor employed in assembly of the Model QD-15 differs somewhat in design and construction from those of earlier models in that the familiar primer has been omitted and replaced with a spring loaded choke for simplification and for ease of starting. Otherwise principles of operation are similar, embodying slow and high speed carburetion. See illustrations below.



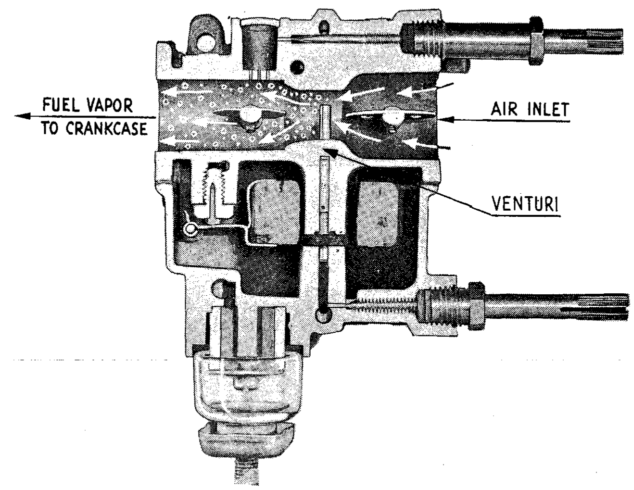
Sectionalized view of mixing chamber—showing butterfly shutter set for slow speed operation (closed). Note maximum fuel vaporization at slow speed jet—vaporization at high speed jet is nil.

Since a motor running in the slower speed range operates with the carburetor shutter closed or nearly closed, suction on the intake manifold side is sufficient to lift liquid fuel higher than the level normally maintained by the float in the float bowl, it reaches the slow speed "mixing" or vaporizing area on top side of the carburetor. Here the liquid fuel is metered by adjustment of the slow speed needle — to obtain a combustible vapor mixture as it enters the air stream.

With the existence of low pressure (suction) in the manifold during periods of "slow" operation, velocity of air rushing (squeezing) through the small gap on top side of the shutter is considerably increased, thus thoroughly vaporizes liquid fuel flowing from small orifices in the immediate area.

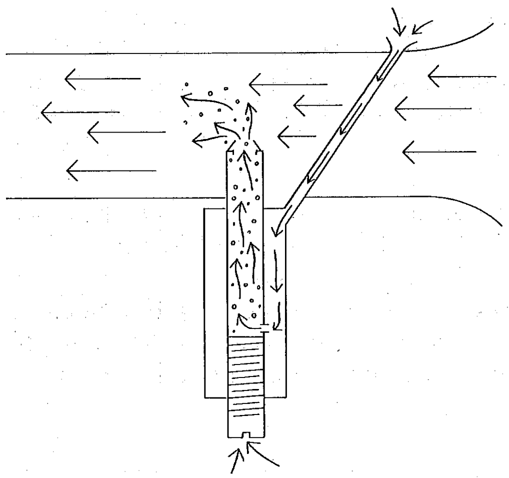
With speeding up as a result increasing degree of shutter opening suction in the manifold is progressively reduced while velocity and volume of air flowing through the carburetor throat is increased. At this stage vaporization at the slow speed orifices commences to diminish since manifold suction is not great ênough to maintain the high fuel level required for vaporization in the "slow speed" area. However, velocity of air flowing through the carburetor at this time is considerably increased by the choking or restricting effect of the Venturi into which the high speed jet is inserted.

The resultant high velocity air stream flowing or passing over the high speed jet in the Venturi causes liquid fuel to raise to point of overflow when it mixes or vaporizes in the rapidly moving air to be conducted into the crankcase and combustion chamber as a combustible mixture.



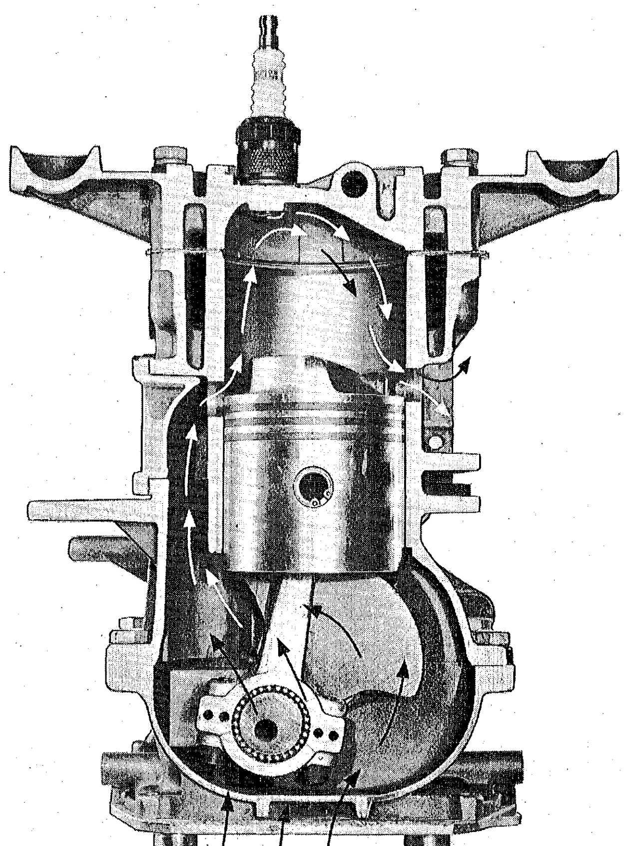
Sectionalized view of mixing chamber—butterfly shutter full open for high-speed performance. Note maximum fuel vaporization at the high speed jet with a minimum of vaporization at the slow speed jets. Also effect of restriction caused by the Venturi ring to increase air velocity in area of the high speed jet.

Since the rate of liquid fuel flow from the high speed jet increases out of proportion to increase of air velocity through the carburetor as motor speeds increase, some provisions must be taken to more nearly equalize or proportion the rate of liquid flow with respect to velocity of the air stream. This is usually accomplished by "bleeding"—that is, by means of injecting air into the high speed jet at desired levels to progressively reduce liquid flow as air velocity increases — see schematic sketch below and following sectional view of the carburetor. A decrease in motor speed obviously causes lower air velocity through the carburetor and subsequently lessens the effect of air bleeding to proportionately increase flow of liquid fuel and, therefore, maintain a more favorable balance in fuel-air ratio for best performance.



Schematic Drawing to Illustrate Principle of Carburetor Jet Bleeding.

Further, on reducing motor speed the shutter is closed to build up high suction in the manifold while simultaneously diminishing volume and air velocity through the carburetor. This increased suction or low pressure in the manifold causes fuel vaporization to be again resumed in the slow speed vaporizing area while vaporization at the high speed jet proportionately diminishes.



Showing Path of Fuel Vapor as it Progresses Through the Powerhead during Completion of its Cycle.

Both slow and high speed metering needles must be adjusted separately to realize maximum performance as instructed below.

The choke is spring loaded to avoid choking or flooding during initial period of starting. The choke remains closed for starting but as running commences, the choke is caused to open against tension of the spring applied to it, thus admitting sufficient air to maintain a combustible vapor mixture entering the crankcase and eventually the cylinder where it is ignited on ending of the compression stroke. Choking naturally ought to be released from closed position by pushing the choke button in as the motor gains speed.

Ordinarily the carburetor does not require a great deal of attention except for perhaps periodic cleaning and removal of gum deposits. Obviously all sludge or foreign matter should be removed—all channels, jets, orifices, etc., made free of it. If confronted with gum or "varnish" accumulation, it may be removed by immersion in one of the commercial gum solvents available for the purpose. However, before attempting to remove gum by this method remove first the cork float to avoid dissolving the coating applied to insure its buoyancy.

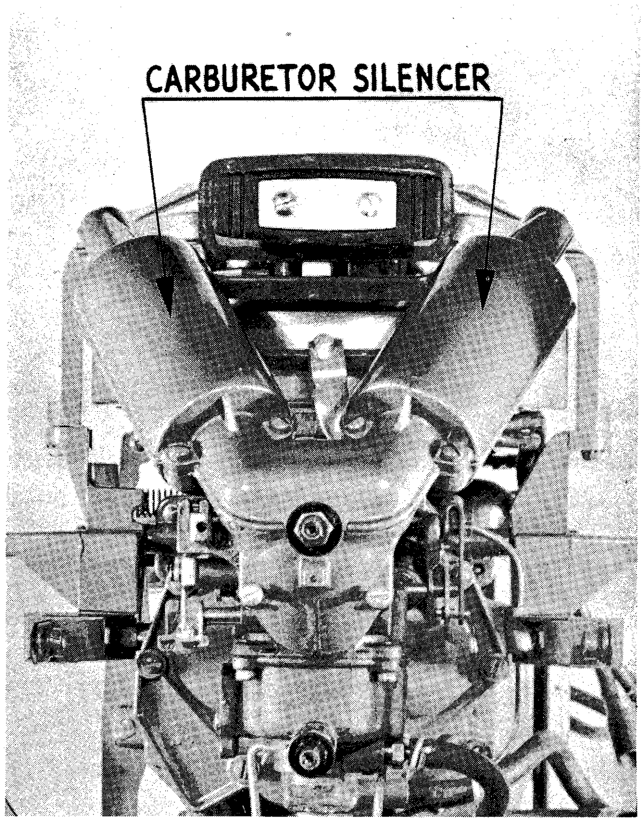
Constant flooding or overflowing can be traced to (1) improperly adjusted float level (see Page 148), (2) faulty float, (3) faulty float valve and its seat, and (4) float valve seat not made properly secure in the carburetor body — seepage past the threads in this case to by-pass the float valve assembly.

Under no circumstances should either the slow or high speed needles ever be turned (screwed) down "hard" against their respective needle point seats; in this event not only the pointed or metering end of needle becomes "ringed" or grooved but its seat in the carburetor becomes distorted or expanded after which further adjustment is impossible to obtain satisfactory motor performance thereafter. Adjusting needles can be replaced at but little cost but with "ruined" needle seats in the carburetor body, eventual necessary replacements become expensive.

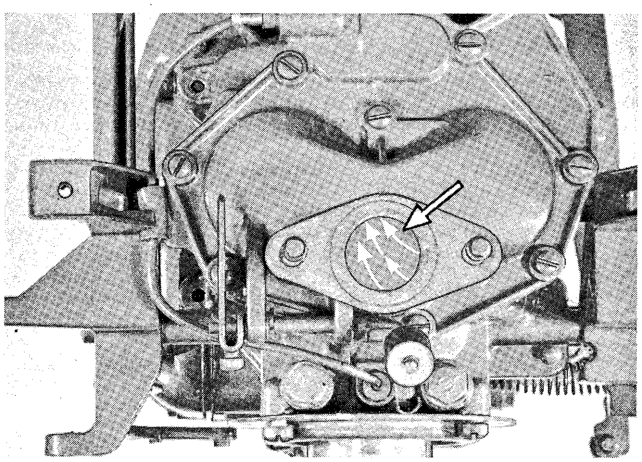
Naturally all screws should be tight, gaskets as employed in good condition and in place, and of considerable import, the carburetor should be securely mounted to the crankcase.

Look to the fuel lines, fuel line fittings and the fuel tank when normal attempt at correcting carburetor condition prove to no avail—assuming, of course, the ignition system is in good working order—See pages 151 and 152, Fuel Tank Check Chart.

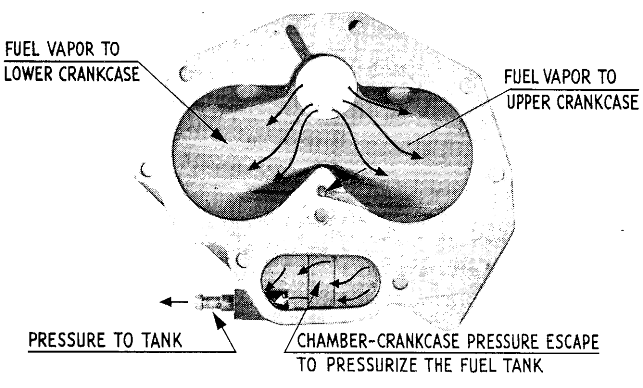
In extreme instances, look for excessive wear about the carburetor shutter shaft to permit unwanted air entering the vapor stream.



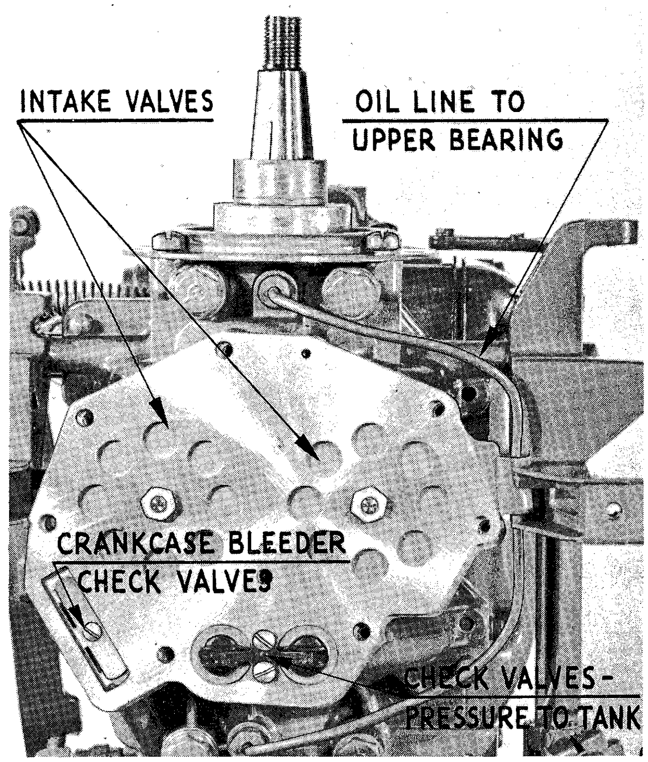
Front View of the Powerhead Showing Carburetor Silencer Attached to the Air Intake (Carburetor).



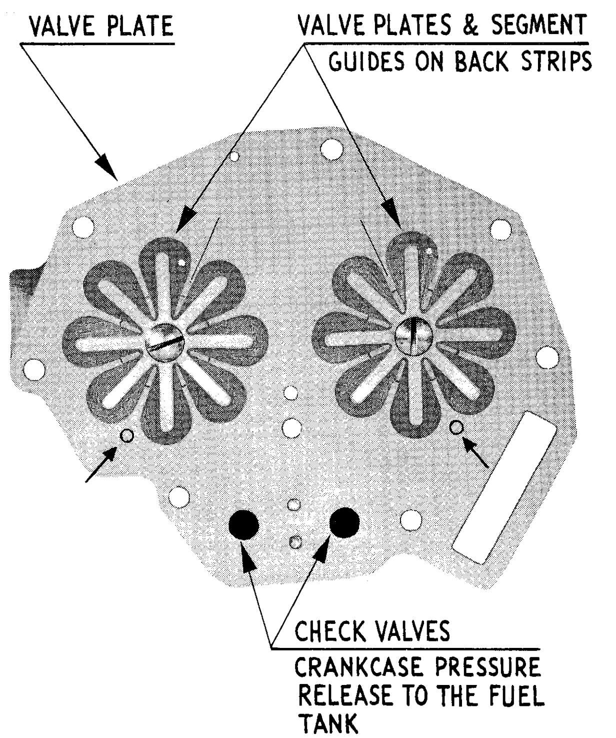
Carburetor Removed to Expose Intake Manifold Throat.



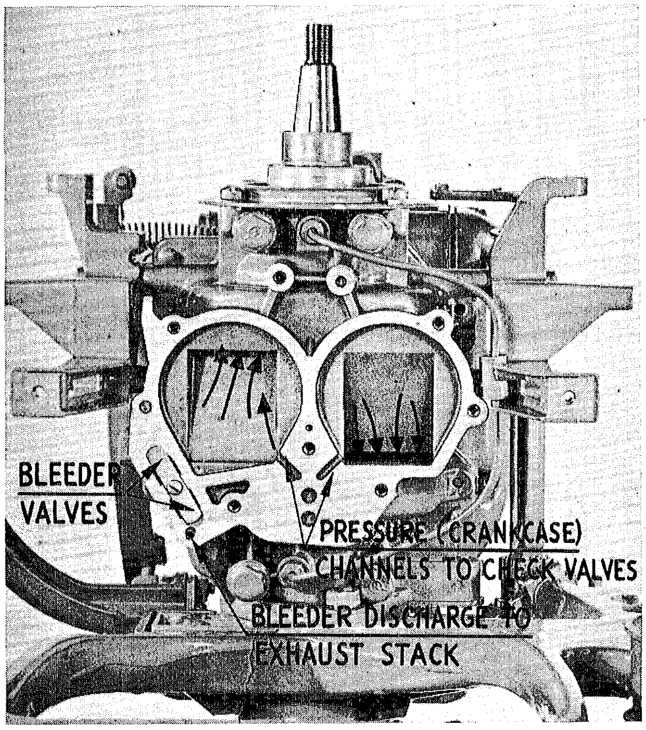
Inside or Back View of the Intake Manifold.



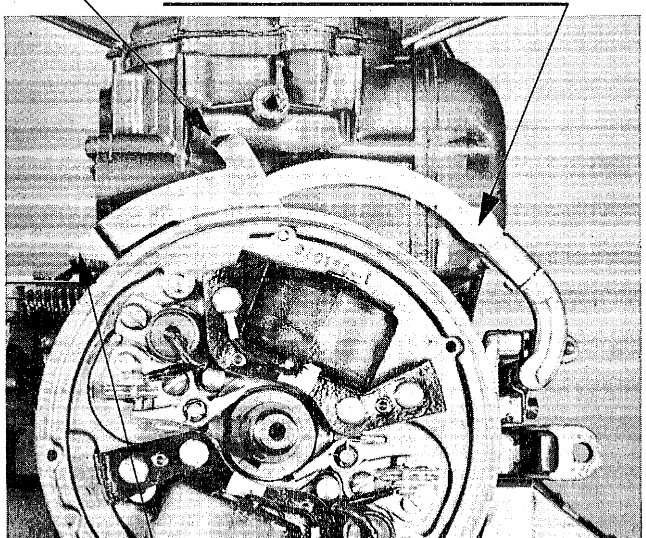
Intake Manifold Detached to Show Automatic Intake Valves (see page 147) Crankcase Pressure Release Valves to Pressurize the Tank, Crankcase Bleeder Valve and Oil Returns.



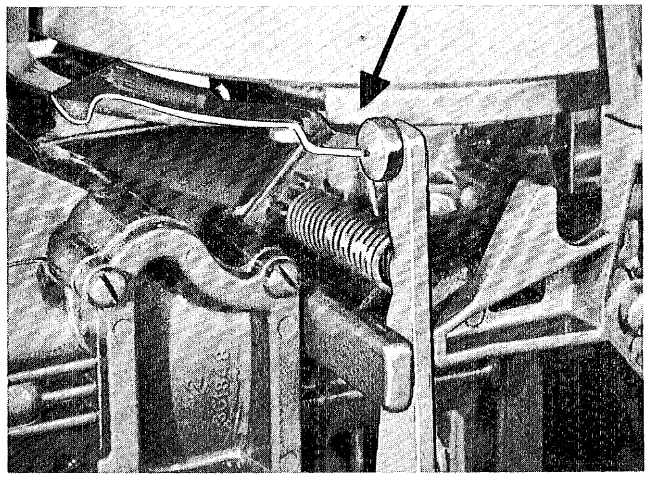
Back View of the Automatic Valve Plate Showing Valves and Back Plates (to Guide Each Segment) when Installing New Valve Plates, Include New Back Plates. Note "Ink" Dot on One of the Valve Segments which Should be Visible when Properly Installed – Also the Fine "Scratch" Line or Circular Embossing Equidistant Between Two of the Holes in the Valve Plate. On Securing Position of the Valve Plate, this Line Should Fall Midway Between Edges of the Corresponding Segments to Correctly Center.



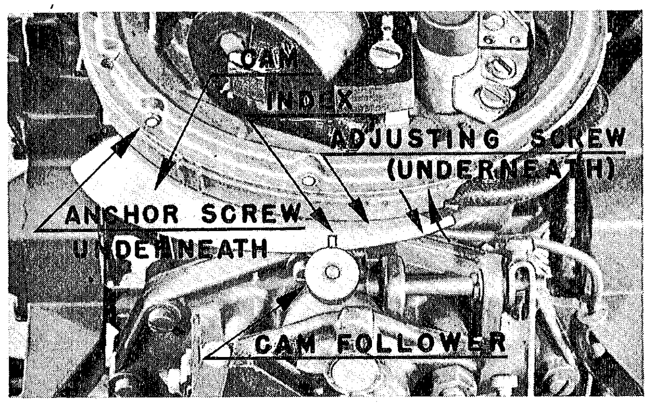
Valve Plate Removed to Expose Channels (Fuel-Vapor) to Upper and Lower Crankcase Chambers, Bleeder Check Valves, Pressure Channels (to Pressurize Tank), Oil Return and Bleeder Drain to the Exhaust Stack.



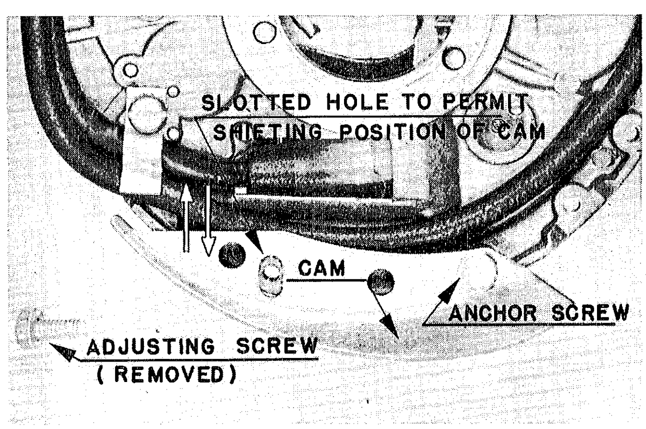
Showing synchro-control linkage with built in stops to limit idling and top speed running.



Speed Control Grip Set for Neutral Running—Note "Stop" Arrangement to Limit Idling on Neutral Running Speed.



Showing Synchro-Speed Control Arrangement and Adjusting Facilities, Note "Index" Mark on Cam which is Adjustable as Attached to the Lower Side of the Armature Plate and the Cam Follower. To properly Synchronize, (1) Loosen the Adjusting Screw which Seats in an Elongated or Slotted Hole in the Cam; Permitting "Low" End of the Cam Being Shifted "in" or "out" as Required (2) Adjust Position of Cam to Point where the Index (on cam) Aligns with Center of the Cam Follower, but only after all of the "Slack" in the Synchro-Control Linkage has been "Taken up" and the Carburetor Shutter is JUST on the Verge of Opening, (3) Tighten Adjusting Screw and if Necessary the Anchor Screw. Recheck Alignment since this Adjustment is of Extreme Importance to Achieve the Maximum in Performance.



Bottom View of the Armature Plate Showing Installation of the Carburetor Control Cam, Anchor Screw, Adjusting "Slot" and Corresponding Screw Removed for Purpose of Illustration.

CARBURETOR ADJUSTMENT — SLOW AND HIGH SPEEDS

Both high and slow speed needles are adjusted at the factory on final assembly and testing, with a limited range for further adjustment provided the ultimate owner to compensate for local operating conditions such as temperature (atmospheric and water), atmospheric or barometric pressure (altitude), humidity, etc., which frequently require slight variations in needle settings. A boss or "stop" is cast on to the carburetor panel and a similar arrangement cast on to the back or inside of the slow speed adjusting knob which permits somewhat more than a half turn of the knob as and if required to achieve best performance—Note pointer on knob and numerals 1 to 7 on the control panel.

Similar provisions are made for compensating adjustment of the high speed needle for like reasons except that the limiting "stops" for the high speed adjusting lever are built into the cover—Note numerals 1 to 7 which limits adjusting to less than a half turn.

In event the carburetor has been "torn down" for cleaning and/or repairs, primary or initial adjustment will be required for both high and slow speed needles—best accomplished with the motor cover removed. Proceed as follows:

1. Note—that the slow speed knob and high speed lever are made fast to their respective needles by means of serrations on the slotted end of the needle as result of expansion when drawing up on the taper headed screw—remove both screws to gain access to slot at the extreme end of each needle.

2. Insert screw driver bit into slotted end of the high speed needle—turn right to close until the face of the pointed needle rests gently on its seat in the carburetor body (this is important, do not turn down tightly—to do so will cause the face of the needle to "ring" and the seat to expand or distort after which further adjustment becomes impossible due to damage caused). Then turn left or "unscrew" approximately 1/2 turn high speed.

3. Perform same function on the slow speed needle but open or "unscrew" about 1-1/8 turn.

4. Attach test wheel—start and run the motor in a test tank until normal running temperature has been attained.

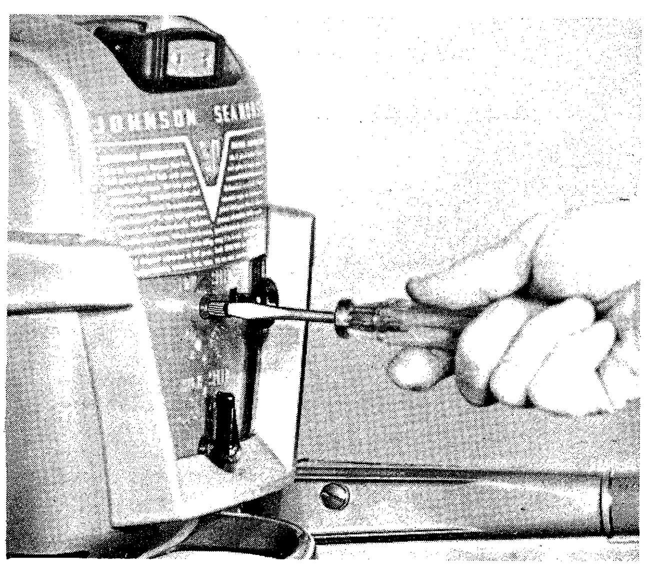
5. Turn high speed needle (with screw driver) to right or left as required to obtain best setting for maximum performance.

6. Reduce motor speed towards idling position —turn slow speed needle to right or left as required to obtain smooth operation in the lower speed range. Further retard motor speed—adjust position in like manner for best performance. Repeat the operation until best setting for maximum slow speed running has been accomplished.

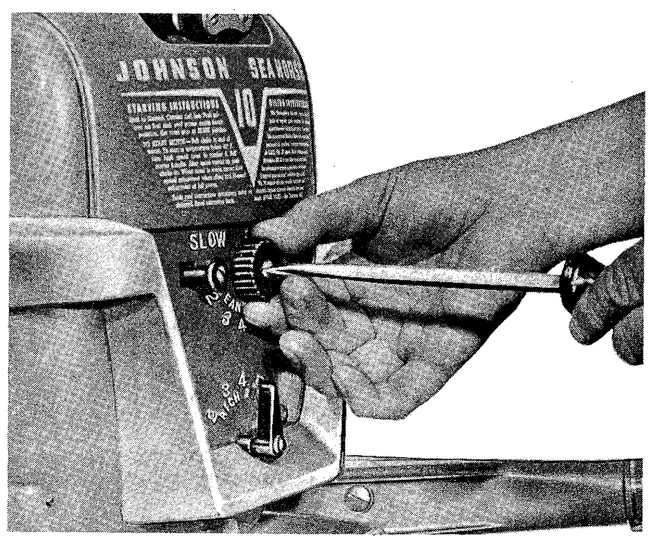
NOTE—rough or "jumpy" running of the motor denotes an excessively rich carburetor mixture (too much fuel—too little air) and as evidenced by a "smoky" exhaust. Spitting back or "coughing" through the carburetor is indication of a too lean mixture (too little fuel—too much air). Turning needle adjusting valve to right reduces flow of liquid fuel into the carburetor air stream thus "leaning out" the fuel vapor mixture; turning to left, increases the flow of liquid fuel to result in a correspondingly richer mixture.

7. Re-check both needle settings to assure best performance.

8. Without disturbing position of the slow speed needle, install the slow speed knob over the protruding serrated end, with pointer directed towards numeral 4. Insert and draw up snugly on the taper headed screw provided for the purpose.

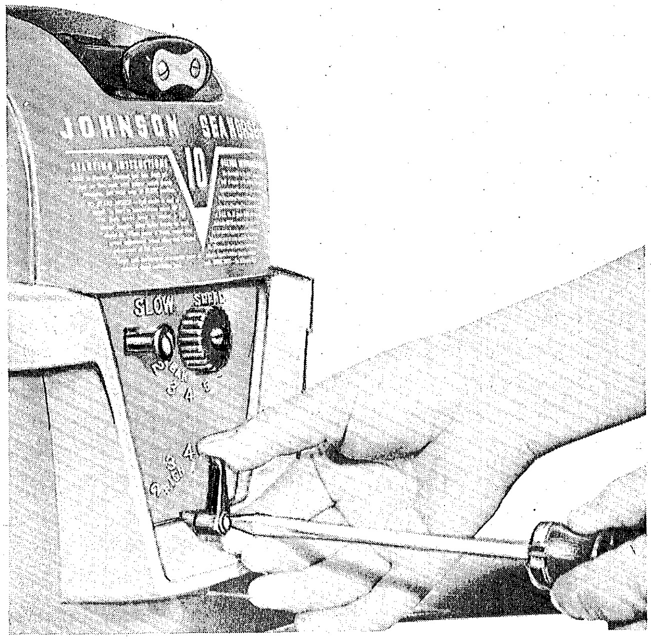


Adjusting needle setting with screwdriver prior to final placing of the slow speed dial and high speed lever.



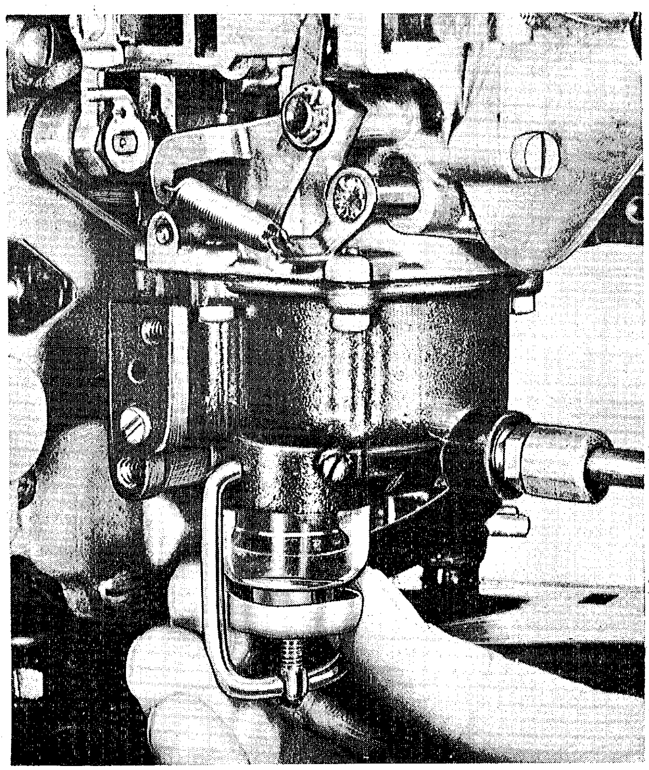
Locating Position of Knob on the Slow Speed Needle.

9. Locate position of the high speed needle lever as described above—lever directed towards the numeral 4 as shown below.



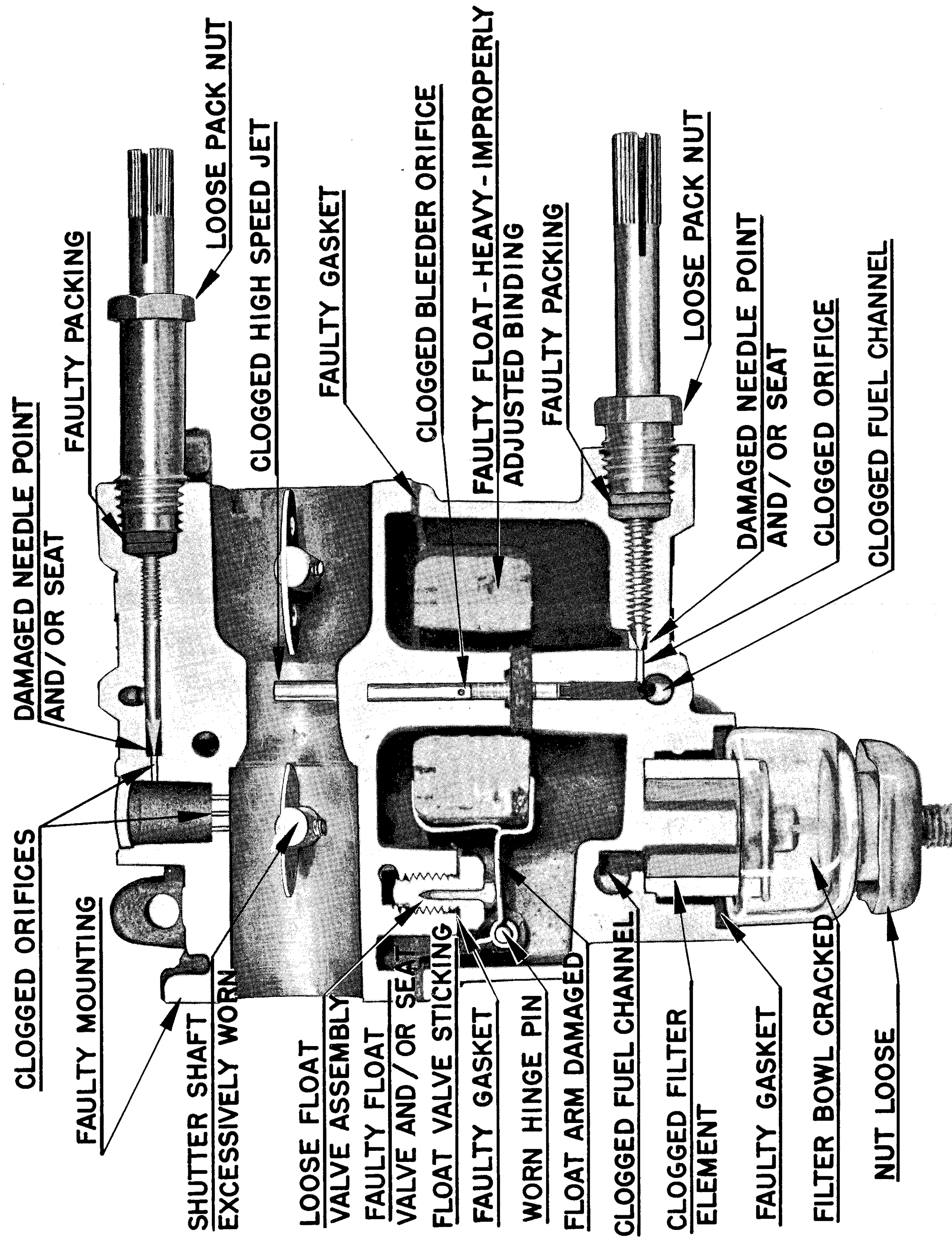
Locating Position of Lever on the High Speed Needle.

10. Make certain the taper headed screws are drawn up securely to hold the knob and lever fast on their respective needles.

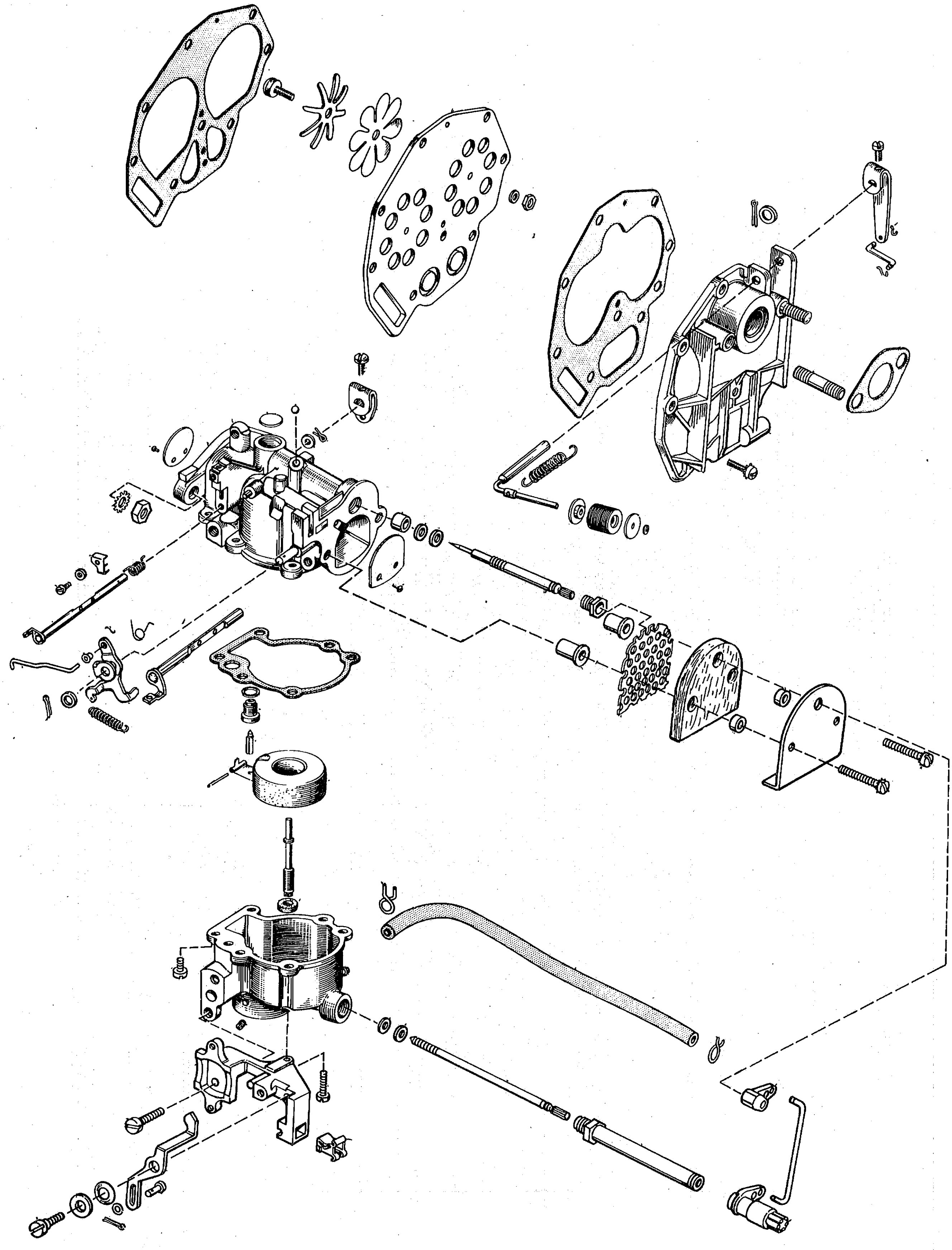


Removing Filter Bowl to Gain Access to the Filter Element for Cleaning—Simply Remove and Rinse in Clean Gasoline.

NOTES

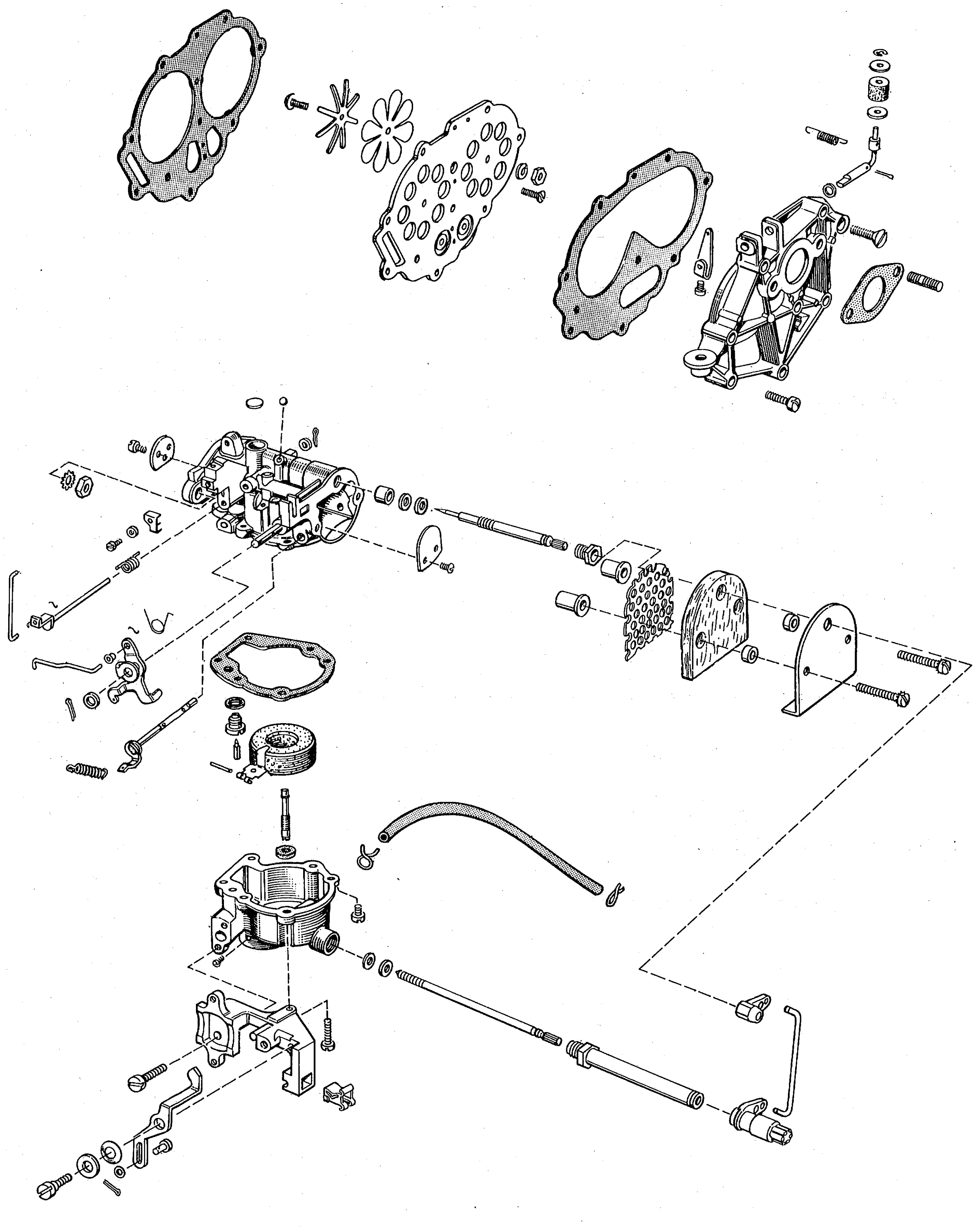


CHECK CHART MODEL QD-15 UP AND FD CARBURETORS

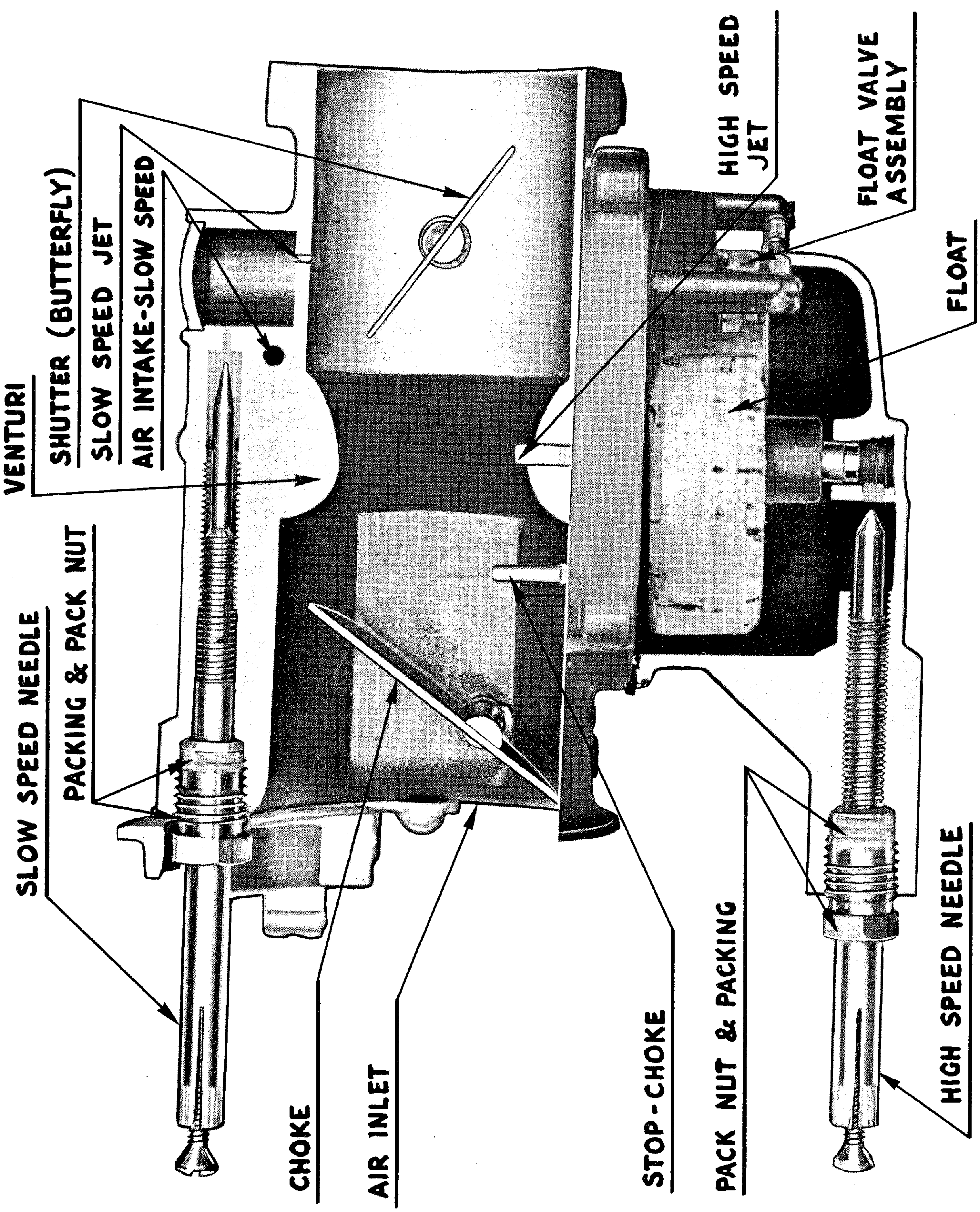


CARBURETOR GROUP
Models QD-QDL-23 up.

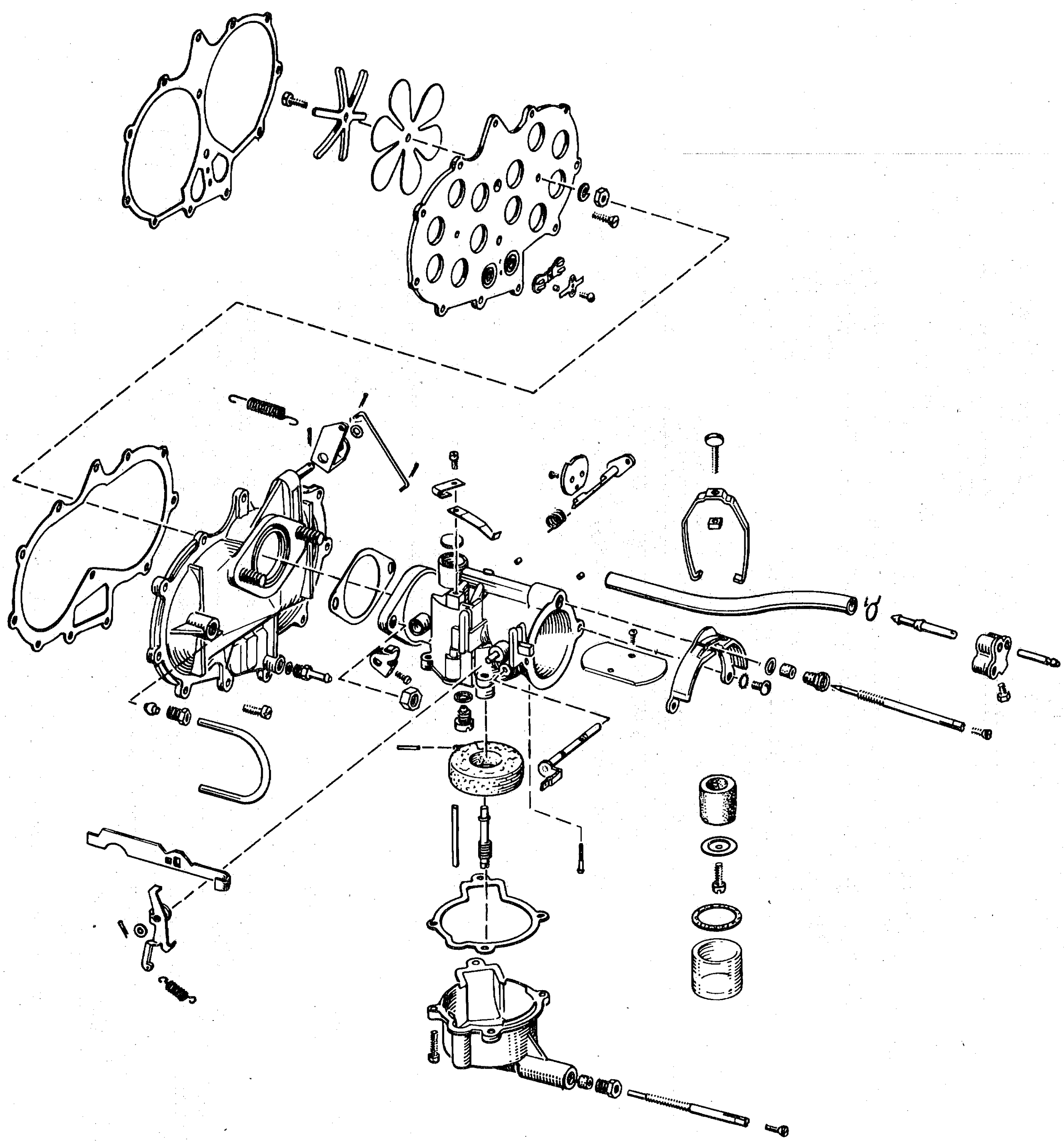
NOTES



CARBURETOR GROUP
Models FD-10 Up



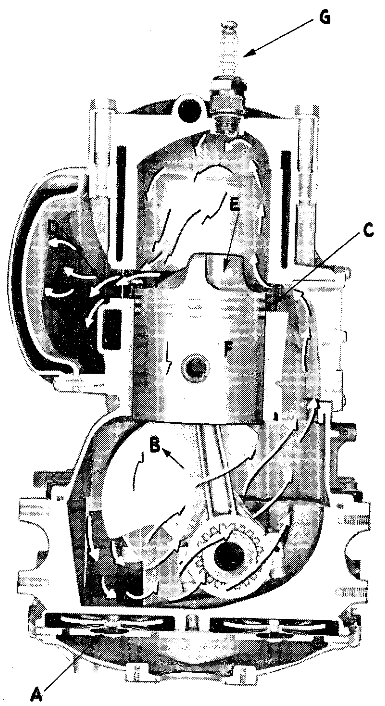
Sectional View of Carburetor (Fuel Filter Not Shown) – Model RD Series.



Assembly Layout – Carburetor and Automatic Intake Valve Group – Model RD Series.

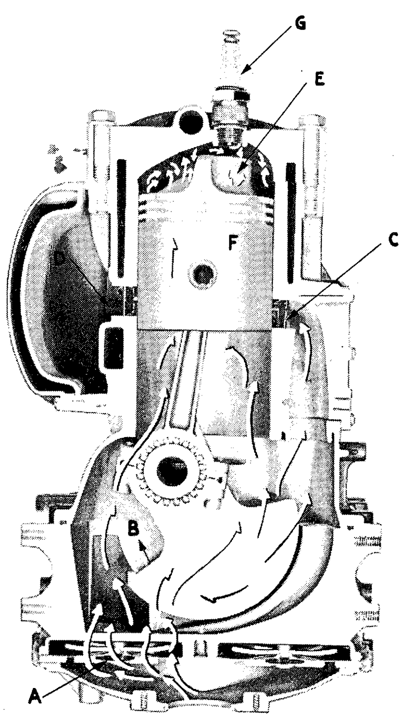
THE CARBURETOR — MODEL RD

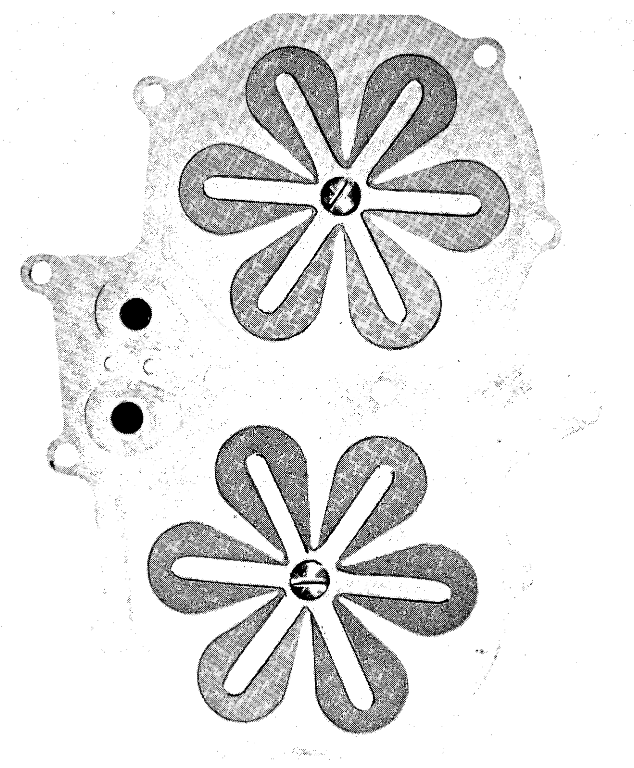
Carburetion: The motor is of a two port, two (stroke) cycle type, relying on the use of an automatic leaf valve for crankcase induction. As suction is created by upward movement of the piston to result in low crankcase pressure, the leaf valve is forced off its seat due to higher pressure without and comparatively low pressure within the crankcase. This causes an air stream to flow through the carburetor mixing chamber and the resultant fuel vapor to flow into the crankcase, thus charging the crankcase. Crankcase suction diminishes as the piston reaches the top of its stroke—the leaf valve then springs back against its seat to seal the crankcase. The charge in the crankcase is compressed on following downward movement of piston—crankcase pressure builds up until head of the piston uncovers the transfer or intake port in the wall of the cylinder when the compressed vapor charge in the crankcase discharges into the cylinder.



Actually, the automatic leaf valve as employed in the motor consists of six leaves or segments arranged in daisy petal fashion which are anchored in center position to a plate drilled with six corresponding holes to complete the valve assembly —one assembly for each crankcase chamber.

The plate, of course, must be flat and true to maintain a "tight" seal with like surface of the leaf. A guide is attached to the assembly to limit movement of each segment or leaf. Naturally, all six leaves or segments lift from their respective seats simultaneously to admit fuel vapor into the crankcase when sufficient suction or low pressure is built up and close together as suction diminishes. The leaves open into the crankcase. Leaf plate is constructed of specially treated steel. Do not, under any circumstances, bend or flex leaves of the valve by hand — in such event they are rendered unfit for use and should be discarded.



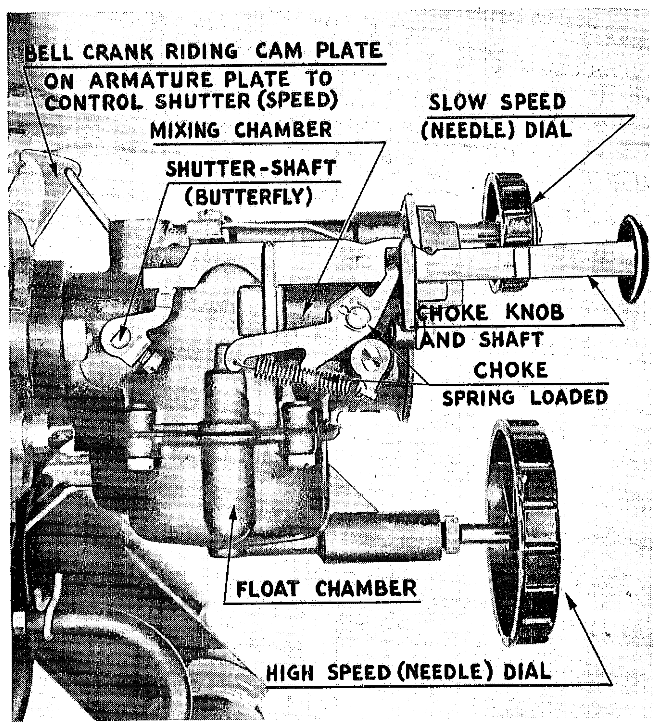


Leaf Plate (Automatic Intake Valve) Assembly Side Opening Into Crankcase.

they are rendered unfit for use and should be discarded.

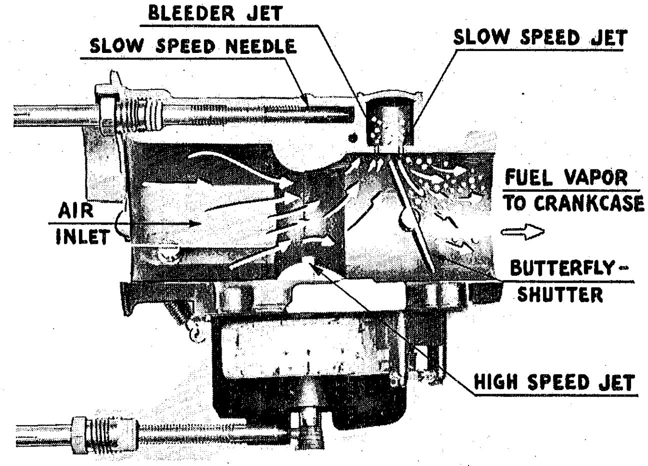
The automatic leaf valve in this case replaces the third port or rotary valve employed in other types of construction. It is automatic in that it does not open until sufficient low pressure is built up in the crankcase to overcome leaf tension, pre-established by special heat treatment of the material of which it is constructed. Degree of leaf opening depends upon crankcase pressure which varies with the rate of speed at which the motor is operating. Such action results in more satisfactory performance throughout entire speed range of the motor. Both the third port and rotary valve open to same degree regardless of motor speed, while the automatic leaf valve only in proportion to demand established at various motor speeds, thus acting more efficiently.

The carburetor is of the float feed two jet type, consisting of a mixing chamber and conventional float chamber to which are added synchro and speed limitation control mechanisms (to be explained later) as required for gear shift. Two adjustments are provided, namely, for high and slow speed performance.

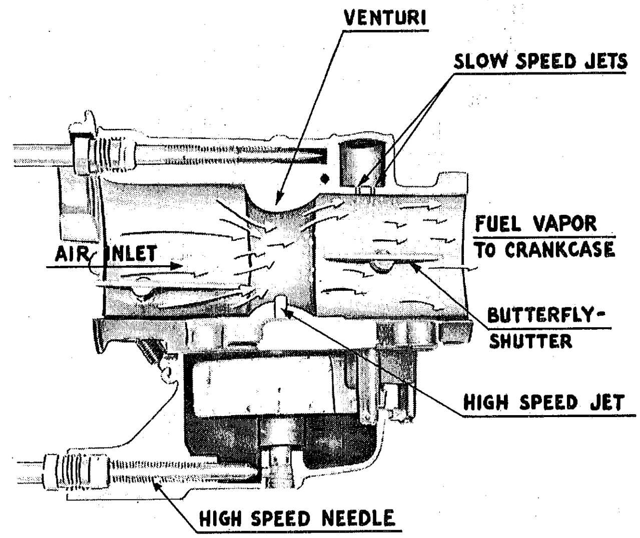


View of Carburetor as Attached to the Motor.

Below illustrates action of carburetion within the mixing chamber (carburetor) at period of slow speed motor performance. Note that the butterfly shutter is closed to permit very little air entering except that passing through the slow speed bleeder jet to partially vaporize the liquid fuel in the small pocket—later drawn into the mixing chamber and crankcase to be consumed as result of "suction" created by the upward moving piston. Since ultimate speed of the motor is dependent on volume of fuel vapor (air-fuel mixture) entering the crankcase, further opening of the butterfly shutter admits more air to be mixed with the liquid fuel (vaporized), thus a stronger or heavier charge to develop proportionately more power, etc.



Sectionalized View of Mixing Chamber—Showing Butterfly Shutter Set for Slow Speed Operation (Closed). Note Maximum Fuel Vaporization at Slow Speed Jet—Vaporization at High Speed Jet is Nil.

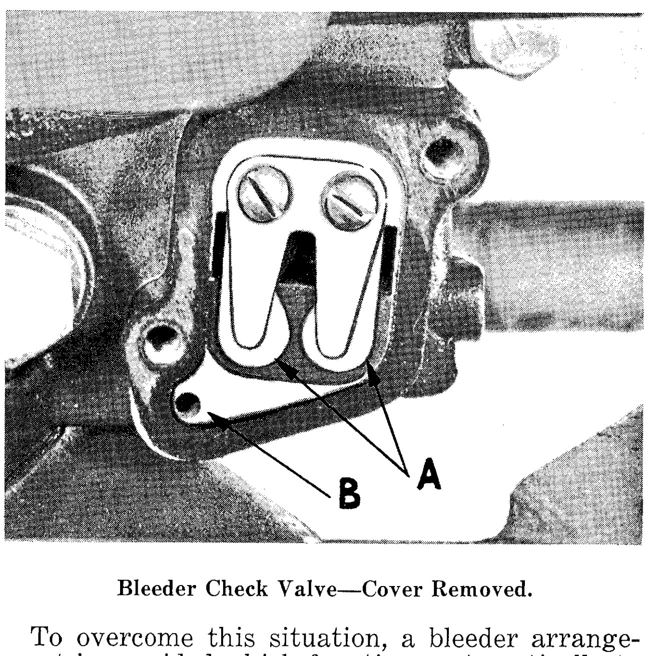


Sectionalized View of Mixing Chamber—Butterfly Shutter Full Open for High-Speed Performance. Note Maximum Fuel Vaporization at the High Speed Jet with a Minimum of Vaporization at the Slow Speed Jets. Also Effect of Restriction Caused by the Venturi Ring to Increase Air Velocity in Area of the High Speed Jet.

Sectional view shows action of carburetion during top speed performance of the motor. Note that the butterfly shutter is full open to permit maximum flow of air through mixing chamber. Velocity through the mixing chamber at this time is comparatively high but proportionately diminishes with closing of the butterfly shutter to reduce motor speed. To obtain maximum air velocity (required for maximum fuel vaporization) in area of the high speed jet, a venturi ring has been installed, as shown above. The ring actually consists of a constriction in the air stream (funnel like). Cross section of the venturi indicates a rather abrupt but curving constriction on the leading side —gradually tapering to full diameter on the trailing side to result in maximum air velocity in area of the jet, thus maximum fuel vaporization.

High and slow speed jets do not function independently of each other, however, maximum vaporization takes place only at the slow speed jet when the butterfly shutter is closed for slow speed motor operation. Vaporization at the slow speed jet decreased in proportion to butterfly shutter opening. Conversely, vaporization at high speed jet proportionately increases until full open position of the butterfly shutter has been reached to result in maximum vaporization (at high speed jet) and a minimum of vaporization at the slow speed jet. The slow speed jet then functions in various degrees throughout entire speed range of the motor—the high speed jet remaining idle when the butterfly shutter is closed for slow speed motor performance.

The crankcase of a two (stroke) cycle engine has a tendency toward loading up with unburned fuel (liquid) when operating for any length of time at slow speed with result that it is "flooded" when accelerated for high speed performance. Flooding in this respect likewise affects slow speed operation. This is evidenced by profuse smoking of exhaust gases, faltering and erratic operation until accumulated fuel has been discharged. In extreme instances, stoppage occurs as result of spark plugs fouling. The situation is created by the heavy ends of the fuel vapor settling out or condensing during slow speed operation since velocity through the crankcase is not sufficient to hold them in suspension.



Bleeder Check Valve—Cover Removed.

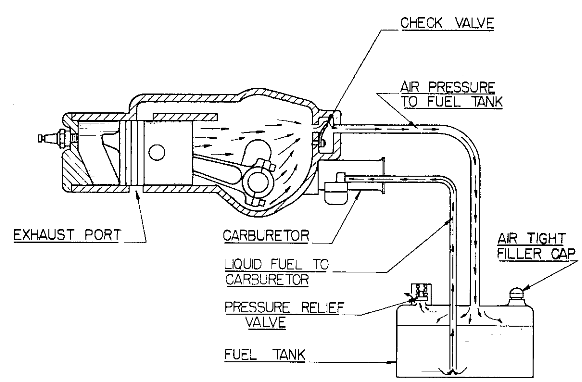
To overcome this situation, a bleeder arrangement is provided which functions automatically to discharge the resultant crankcase accumulation throughout entire speed range of the motor.

The arrangement consists of a small hole or channel leading from a pocket in each crankcase chamber to an automatic check valve located at the bottom of the power head as shown here. In operation, the fuel which settles out of the fuel mixture during periods of slow speed running, accumulates in the pocket provided for this purpose, fills the channel down to the check valve and there remains until the piston travels on its downward stroke. Subsequent crankcase compression (pressure) forces the check plate off its seat to permit liquid fuel escaping through outlet and on into the driveshaft casing where it is discharged with the exhaust gases. Note there are two check plates—one for each crankcase chamber. During upward stroke of the piston, there is no discharge since low pressure or suction exists in the crankcase—the check plate springs back on its seat to prevent air flow in opposite direction.

Action described above continues during entire period of motor operation with maximum bleeding of liquid fuel at slow speed performance and proportionately decreasing with increase in motor r.p.m. At top speed there is practically no discharge since the velocity through crankcase is sufficient to hold all particles (for practical purposes) of fuel in suspension to be later burned on compression and ignition in the combustion chamber.

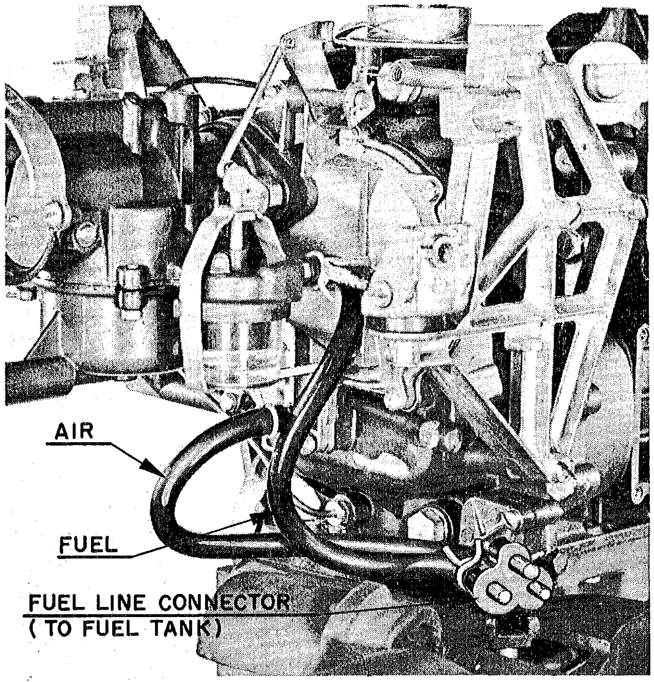
An oil "slick" may form on the surface of the water when operating for any length of time at slow speed—the result of crankcase bleeding as described.

FUEL PRESSURE SYSTEM



Carburetor-Drawing Showing Fuel Pressure System.

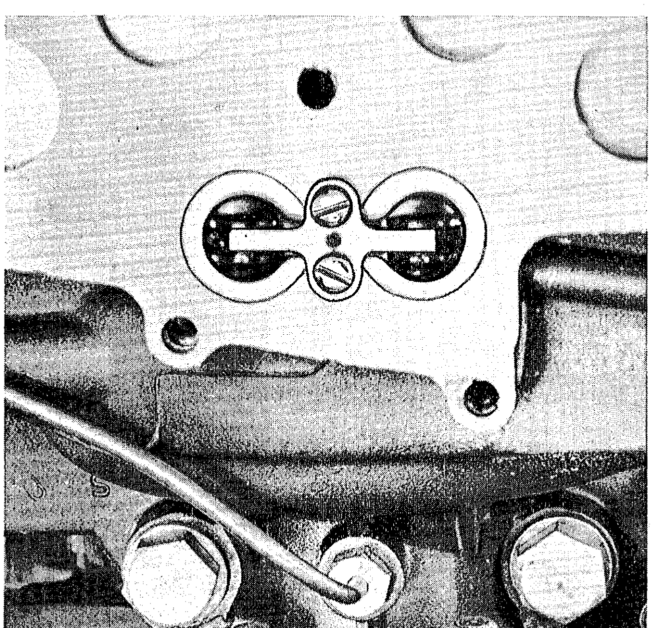
Since fuel supply to the carburetor is by means of a pressurized gas tank— a device is built into the motor assembly to permit a portion of pressure built up in the crankcase during operation, to escape by way of a flexible rubber tube into the tank. The fuel mixture then under pressure is conducted to the carburetor by a second flexible rubber tube. Both tubes, however, are molded together and provided with necessary connectors and terminal fittings for convenient handling.



Showing Arrangement of Air and Fuel Lines.

Attached to the aluminum valve or leaf plate, but not associated with functioning of the automatic intake, is the fuel pressure check valve assembly. This assembly consists of two small (connected) rubber discs held in position over two corresponding holes drilled into the plate, by a flat spring of predetermined tension to comprise a check for each crankcase chamber.

When pressure in the crankcase reaches a predetermined point (determined by tension of the spring) the disc is momentarily forced off its seat, permitting pressure thus escaping to be conducted by way of the air line to the fuel tank.

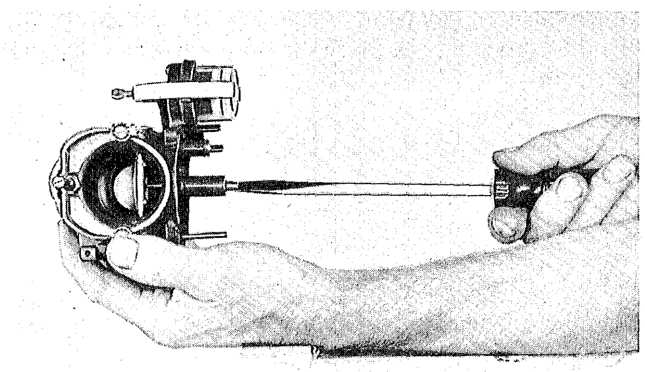


Showing Location of Fuel Pressure System Check Valves.

The checks function alternately as the cylinders fire—first one opens, then the other, to build up and maintain sufficient pressure in the tank to "feed" the carburetor. When pressure in the tank equals pressure built up in the crankcase, there is obviously no valve action in this respect. Degree of valve action depends on volume of fuel in the tank. As fuel level in the tank lowers, resulting increase in air "space" causes proportionately greater check valve activity. Normal fuel tank pressure is from 2 to 5 pounds, depending on motor speed and fuel level. An automatic pressure release is installed to relieve pressure above 8 pounds.

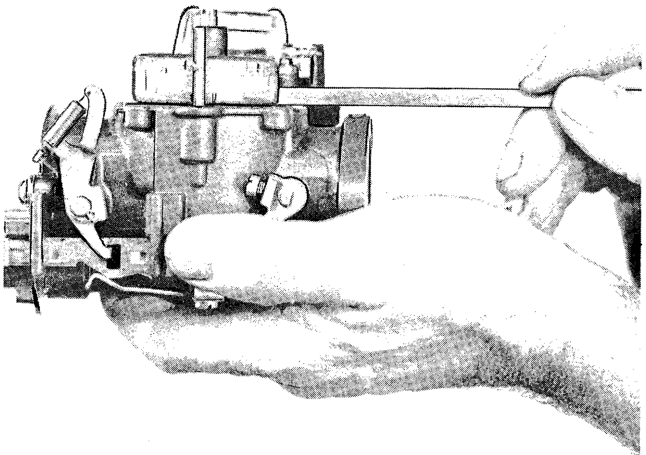
To clean filter element: loosen wing screw; remove bracket holding filter bowl in position; remove filter bowl, rinse out in clean gasoline; move screw holding filter element in position—lift the element free; rinse in container of gasoline to clean — replace if necessary — the elements frequently "clog" with a gummy substance after long periods of idleness, thus present a barrier to consistent flow of liquid fuel; replace filter bowl, making certain gasket is in good order to permit proper seating of the bowl; replace bracket and draw up wing screw to secure.

To check high speed jet: remove screws holding the float bowl fast to carburetor body; work bowl carefully off to make the float, float valve and seat assembly and high speed jet accessible for inspection and/or replacement; high speed needle is easily removed with screw driver as shown below —after inspection it can be similarly reinstalled or replaced if necessary, being careful to properly seat.



Illustrating Method of Removing and/or Installing High Speed Jet and Float Valve Seat.

To check float, float level and float valve assembly: remove small pin, float and arm assembly from position on brackets provided in the carburetor body; lift float free and remove the float valve; remove float valve seat with screw driver; check float for defects, replace if necessary; rinse float valve and seat in gasoline to clean—be on lookout for sticky gum coating seat and valve point to cause sluggish float action after long periods of idleness; replace float valve and seat assembly—if tapered face of float valve appears badly "ringed" or grooved; turn float valve seat into carburetor body with screw driver tightly—insert float valve; replace float—check for correct "level"; top face of float should come to rest flush with face of carburetor body as shown—otherwise, carefully bend float arm up or down as required to gain proper level—float action should be free—check for binding; replace carburetor body—install new gasket if required.



Method of Checking Float Level.

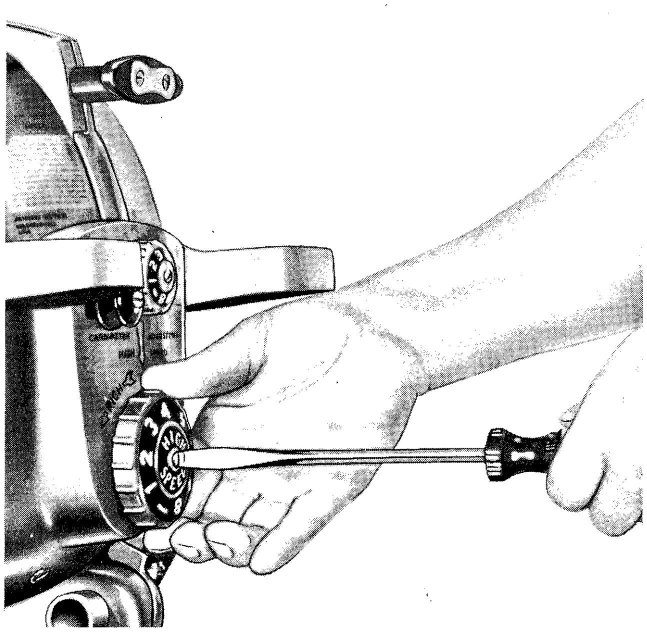
To adjust high and slow speed needles after repairs, proceed with the operation prior to installing the motor covers— it is more easily accomplished in this manner.

On removing the carburetor needle dials, note "stops" or ribs on inside surfaces of both and corresponding "stops" cast on to the motor covers which permit approximately one turn of each needle after initial setting to compensate for variations frequently encountered during normal operation of the motor.

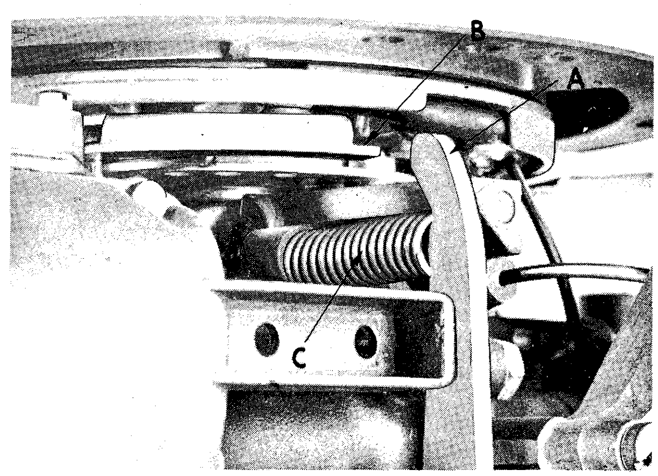
Dials are held fast to their respective needles by slotting and knurling a short distance on the end of each and by the installation of a counter sunk head screw which when screwed into the end of the needle causes expansion or binding to hold the dial fast. Thus to remove the dial, it is simply a matter of loosening the center screw to pull it free of the needle or to adjust its position as may be required.

Gently and carefully close both needles against their respective seats. Do not under any circumstances screw down tightly since doing so will only result in "ringing" the needle point face and distort the needle (valve) seat in the carburetor body to later make correct settings impossible. Damaged needle points and needle valve seats cannot be properly adjusted to obtain satisfactory motor performance.

After having loosened both needles, open slow speed needle approximately 1 turn; the high speed needle about 3/4 turn. Start the motor—let it run until normal operating temperature is reached. Adjust both needles to their best running position by first setting speed control grip to position marked fast and adjusting high speed needle "lower" for best running, then setting speed control grip to position marked slow and adjusting low speed needle "upper" for best running. Assemble both dials in their respective positions with numeral 4 in each case directed "up" without having disturbed either needle setting. Allow sufficient clearance between the dial and covers to prevent rubbing. Secure in this position by drawing up on the screw on the end of each needle. It is advisable to check each needle packing nut to make sure sufficient "drag" is present to prevent "creeping" during operation of the motor—don't overdo it, though. Any variations required in needle valve settings after the motor has been turned over to



Loosening Dial Center Screw to Permit Adjusting on Carburetor Needle Shaft.

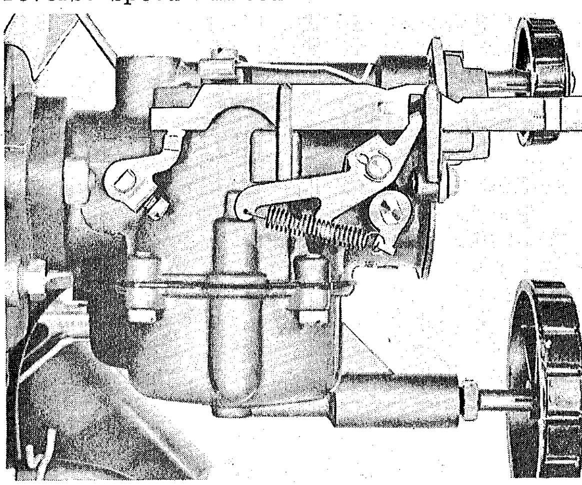


Showing Speed Control Limitation Lever "A" Engaging Stop "B" Attached to the Armature Plate, Acting Against Tension of Spring "C"—Speed Limited When Set For "Neutral" and "Reverse."

its operator can now easily be performed by the individual without throwing the carburetor too far out of adjustment, should he fail to understand the procedure. The dials can always be returned to "4" up and the motor made to perform, providing, of course, all other mechanical details are functioning as they should.

Speed limitation control is by means of a lever acting against a "stop" attached to underside of the magneto armature plate. The speed limiting lever is acted upon by an arm (an integral part of the shifting lever) in such manner that when set for neutral, limiting lever engages the "stop" under the armature plate to prevent further movement toward increasing speed.

Speed limitation occurs only when shifting lever is set at neutral to guard against excessive "racing" of the motor when shifting to forward or reverse as the case may be. Deeper recesses in notches (of the speed limiting lever) for reverse and forward prevent the lever from engaging the stop on the armature plate—thus, there is no limit to motor speed when in forward or reverse. Exercise *caution* when operating in reverse. Note — reverse speed limited in later models.



Carburetor—Showing Choke Lever Spring. Choke in Spring Loaded.

RD-12 Carburetor — Spring choke lever No. 376388. Tension on this spring was reduced to 12 ounces from the original 20 ounces to avoid possibility of over-choking when starting—the choke in this case being spring loaded. Arrow indicates spring in the illustration.

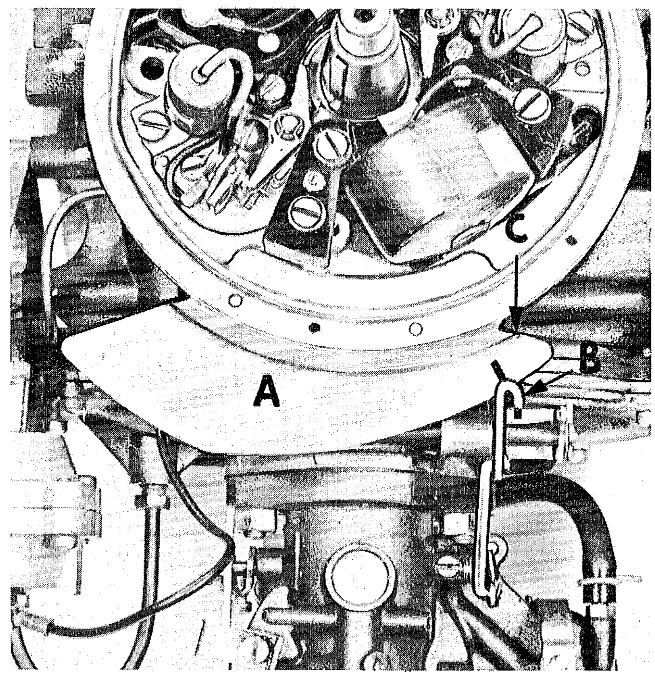
RD-12 Cutout Assembly No. 376441 removed entirely as not required due to minor changes in the carburetor butterfly valve and a slight change in the contour of the cam No. 302705 controlling the action. This accomplishes closing off all fuel vapor to the crankcase when turning the speed control grip to position "stop."

Carburetor—RD-10 & 11. Carburetor body No. 375867 (new part number) will be provided hereafter with the redesigned butterfly No. 302828 and the new cam No. 302830. When making the installation, remove the cam originally attached to the armature plate—replace it with new cam.

Similarly, carburetor complete No. 375868 (new part number) for the RD-10 & 11 comes with the new redesigned cam (No. 302830) and butterfly (No. 302828). When attaching carburetor in this case, remove and discard original cam attached to the armature plate—install new cam shipped with the carburetor.

RD-12 carburetor body No. 375932 (new part number) correct for model as is.

Part No. 375815 is part number assigned to the RD-12 carburetor complete—as ready to be installed.

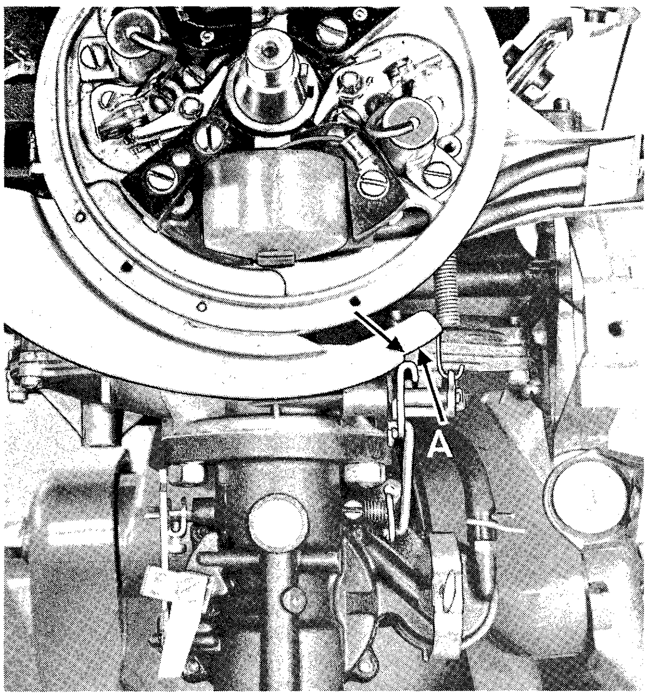


Showing Carburetor Control Cam "A" (Attached to Armature Plate—Synchro-Control) and Cam Follower "B." When Properly Adjusted, Cam Contour Edge Should Make Contact with Follower "B" at Point of Index "C." Models RD-10 and 11.

Cam follower "A" rides contour of cam "B," attached to the armature plate and through linkage with the carburetor shutter (butterfly) shaft acts to control speed of the motor as advance is toward high end of the cam. "Spark" and "gas" are thus synchronized to proportion opening of the shutter with respect to degree of spark advance. Carburetor shutter is full open for maximum speed with spark set at full advance—shutter closes to reduce motor speed with retard spark (cam follower riding low end of cam "B").

Cam "B" is adjustable for proper synchronization by means of slotted hole at "low" end. Low end of the cam can be shifted "in" or "out" to accomplish this adjustment. When correctly adjusted, the follower should make contact with contour edge of the cam when aligned with index mark "C" as shown here.

Models RD-12 & 13 make use of a similar arrangement to synchronize "spark" and "gas." Note —the index mark has been omitted from the cam in this case but that a depression has been provided at extreme end "A." Function of the depression is to cause "complete" closing of the carburetor shutter (butterfly) as the cam follower



Showing Method of Spark and Carburetor Control Installed on Models RD-12 and 13.

"drops" into position with maximum spark retard —speed control lever set to "stop."

FUEL TANK—PRESSURIZED

The fuel tank is of simple but rugged construction—capacity 5 gallons—plug oil content. It contains the pump (for filling carburetor bowl), fuel level float and gauge, pressure relief valve, connections for fuel and air lines as well as a bracket arrangement around which the fuel line is coiled when not in use and a carry grip.

The pump employs the use of a diaphragm flexing in a small housing to force fuel to the carburetor for starting purposes—necessary only when pressure has been released from the tank for refilling or as a result of standing idle for some time. Two check valves are required—one for intake and another for discharge as in any conventional pump. A screen is installed to avoid entrance of foreign matter.

Failure to pump in most instances will be the result of a fractured or improperly installed diaphragm which is easily replaced, or a "clogged" screen. Like service operations on the power head or gearcase, they must be well performed, with care and same degree of carefulness.

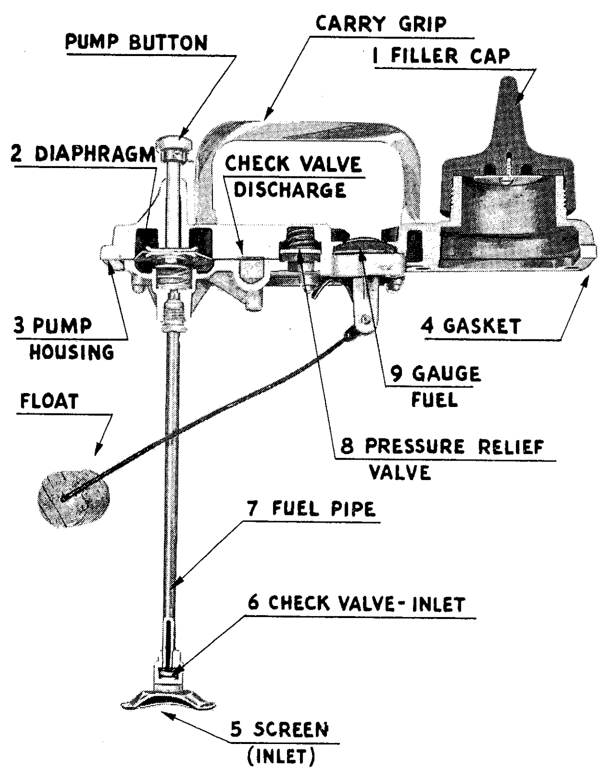
Observe assembly prior to doing the job— dismantle and reassemble in reverse order. Install required new parts. Lap sections of the pump housing to insure flatness, if necessary.

When replacing the diaphragm, apply a thin coat of hard drying cement (Sealer 1000) around the hole in both cupped washers—diaphragm contact side. Purpose is to eliminate possible seepage at this point. Note holes in diaphragm and corresponding holes in the pump housing—assemble so all line up. This is important. Do not neglect replacing the discharge check valve disc and be certain same is not "cocked" and off its seat on assembly. The intake disc is installed above the screen at lower end of the suction pipe as shown. Be careful not to wrinkle the diaphragm when bolting sections of the housing together (see that bolt holes line up and that diaphragm does not overlap). Result is failure of the pump to operate and leakage to interfere with functioning of the tank. Similarly, the gasket between the pump assembly and tank must be in place and in good condition to avoid possibility of air leaks.

The pump should be used only when the carburetor float bowl is empty—as indicated by little or no resistance when depressing the pump button, except that set up by tension of the spring in the assembly. Float valve (in carburetor) closes as the bowl fills and closes entirely when filled to progressively build up resistance to pumping. Under no circumstance force the pump (depressing of pump button four to five times should be sufficient to fill the bowl)—the diaphragm is apt to be fractured.

Leaks in the assembly are indicated by failure of the pump and often by fuel seepage around the tank cover. In some instances, the motor cannot be operated without necessity of constantly pumping fuel (fuel pump); in others, seepage may be slight, requiring manual pumping only at higher speeds. Seepage of fuel mixture around the pump shaft is evidence of an improperly installed or a faulty diaphragm.

FUEL TANK — CHECK CHART



Showing Pump Mechanism and Gauge as Attached to the Fuel Tank.

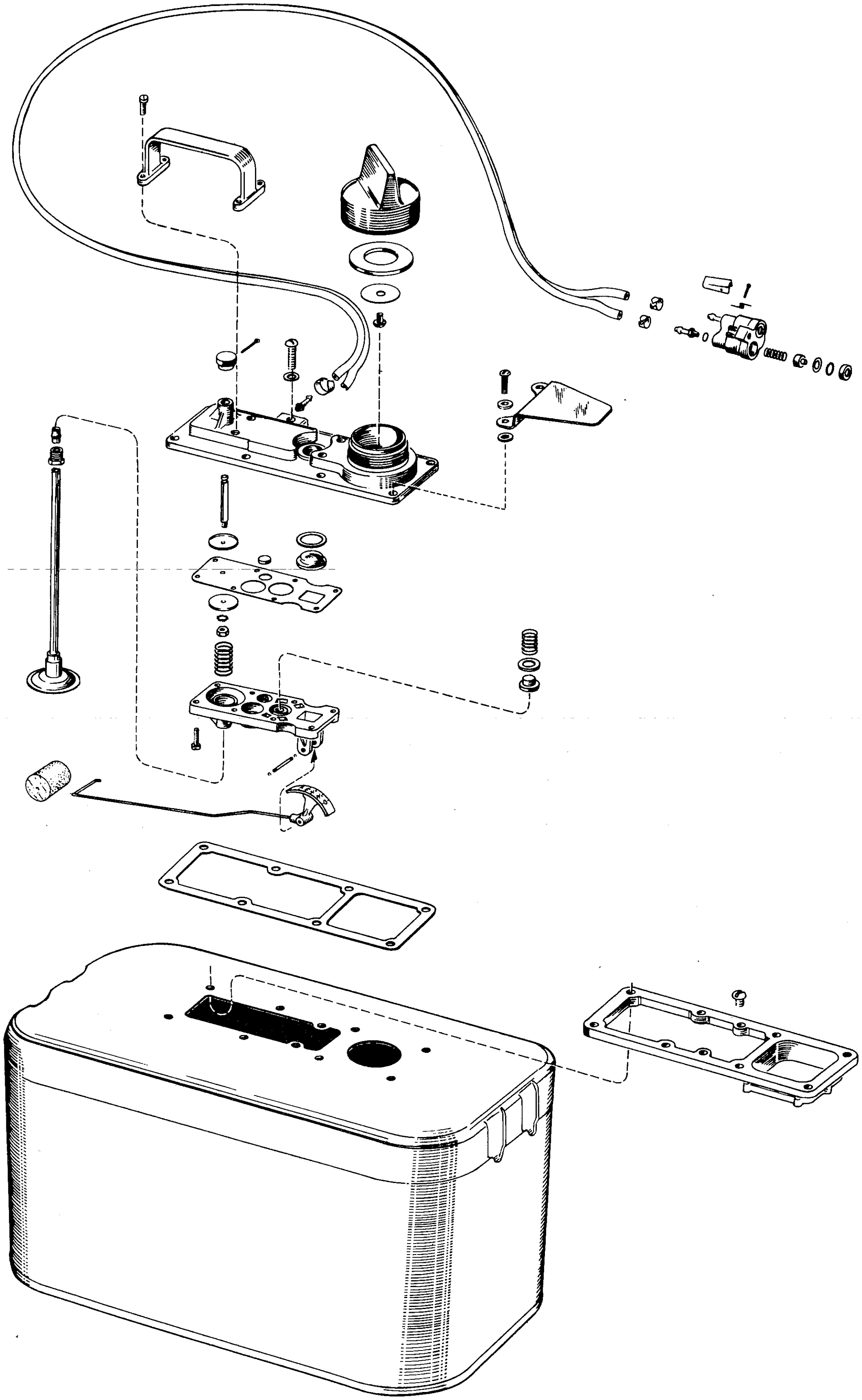
Since the fuel tank plays such an important part in over-all performance of the motor, it is imperative that it be checked as to fitness when conducting motor repairs — the motor cannot be made to perform with a faulty tank — always consider the fuel tank as part of the motor assembly.

Major tank difficulties involve principally air or pressure leaks.

Be guided by the following suggestions when diagnosing fuel tank irregularities and/or performing repairs on the tank.

1. Filler cap and gasket
   (a) Loose or cracked
   (b) Faulty or improperly seated
   (c) Damaged gasket faces
2. Diaphragm—No. 302563
   (a) Punctured
   (b) Leaks—end of pump shaft—fuel escapes under pump button—nuts at the end of pump shaft loose or area around cup washers (No. 301800) not properly cemented
   (c) Not properly seated between pump housings
3. Pump housings—No. 376276 and No. 302555
   (a) Surfaces not flat to cause air seepage and resultant pressure drop
   (b) Not bolted together securely
4. Gasket—No. 302577
   (a) Damaged
   (b) Not secure to seal against pressure loss between pump assembly and tank proper
5. Screen
   (a) Clogged with foreign matter
6. Check disc valves No. 302802 and No. 375846 (assembly)
   (a) Sticking
   (b) Improperly seated
7. Fuel pipe
   (a) Loose in pump housing to cause pressure leak
8. Pressure release valve
   (a) Improperly seated to cause pressure leak
   (b) Sticking
9. Fuel gauge glass
   (a) Cracked
   (b) Improperly seated
10. Fuel tank
    (a) Punctured to cause pressure leaks
11. Fuel line and connectors
    (a) Faulty to permit pressure escape
    (b) Clogged

NOTES



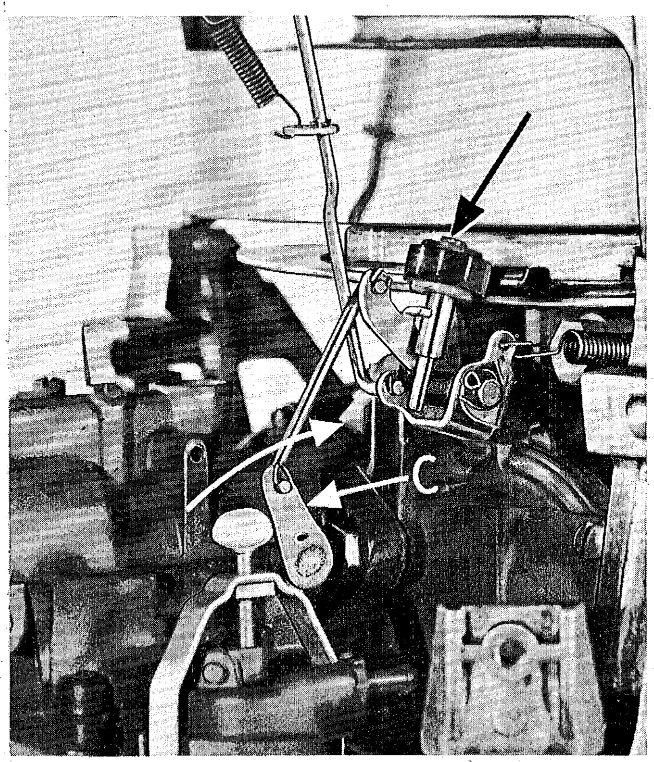
Assembly Layout – Mile-Master Fuel Tank – Pressurized.

RD CARBURETOR CAM FOLLOWER — SPEED CONTROL, MODEL RD-14, 15

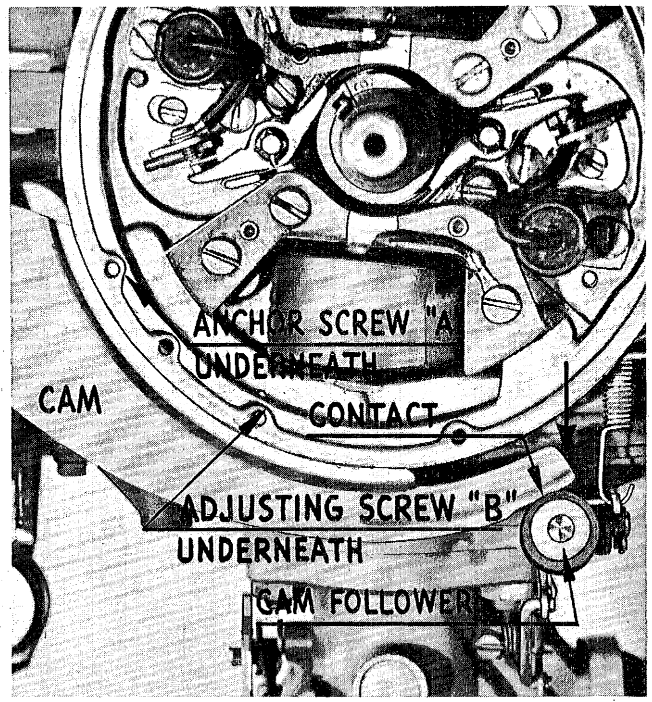
The "sliding" type of cam follower was replaced by one of "roller" construction commencing with the RD-14 to insure more precision in the synchronized linkage control by reducing wear at this point to a minimum.

Note step or depressed area at extreme (low) end of the carburetor control cam plate attached to the armature plate by two screws, one an anchor or pivot screw "A" and the other "B" adjusting screw. To adjust position of cam with respect to the cam follower (roller), proceed as follows:

1. Loosen anchor screw "A" slightly.
2. Loosen adjusting screw "B"—just enough to permit "pivoting" of the cam plate.
3. Set speed control grip to position indicated for "stop."
4. Exert pressure on lever "C" with thumb in direction indicated by long arrow to hold in closed position. The shutter (carburetor) must be fully closed during this moment of the operation to attain the proper synchronization.
5. With right forefinger, shift "free" end of cam plate to position of contact with the cam follower—roller.
6. Draw up on anchor and adjusting screws to secure position of the cam plate.

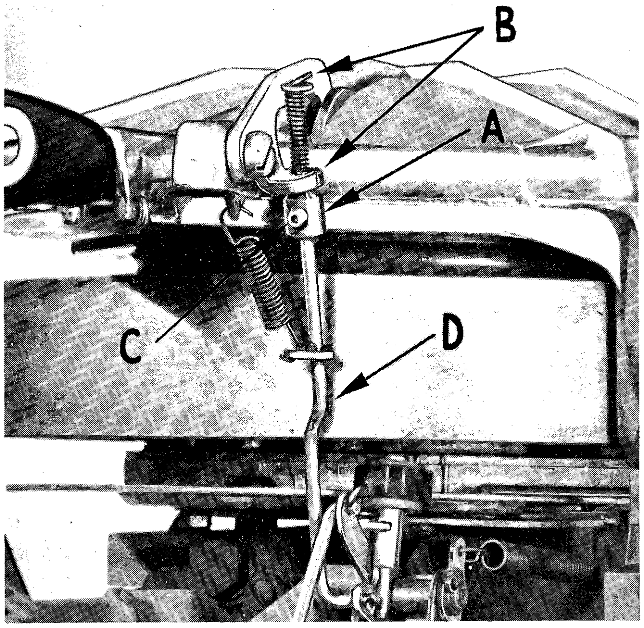


Exert Pressure with Thumb Against Lever "C" in Direction of Arrow.



Showing Cam Follower (Roller) Making Contact with "Depressed" Area at Far End of the Carburetor Control Cam as Required to Properly synchronize Shutter (Butterfly) Action with Relation to Cam Contour.

NOTES

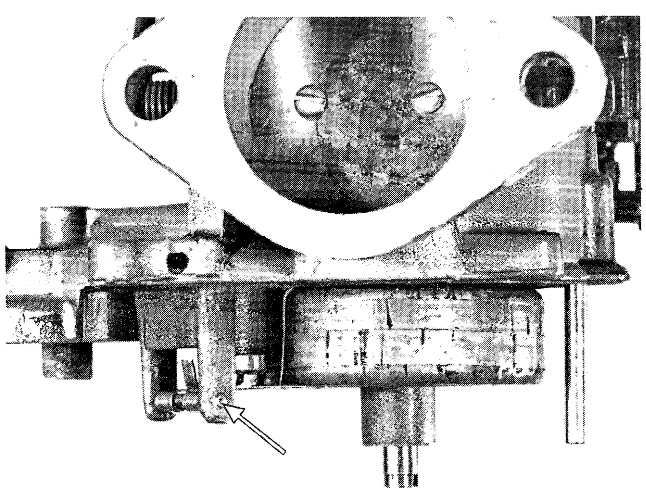


Hard starting of the Model RD may at times be laid to the automatic starter lock (latch) engaging too early—engaging too early to permit taking full advantage of top limit speed predetermined for starting as result of collar "A" (shown in illustration) being out of place or improperly adjusted.

To adjust position of locking "latch" "B", proceed as follows:

1. Set shift lever to "Neutral".
2. Loosen screw "C" securing collar "A" to shaft "D".
3. Turn speed control grip to top limit for starting as governed by limitation control mechanism built into the assembly.
4. Push collar "A" up against bracket on latch "B" just far enough to cause opposite end of latch "clearing" stop lugs on the starter pulley. Ultimate position can be determined by simultaneously pulling on the starting cord grip.
5. Draw up on screw "C" to hold collar "A" fast to control shaft "D".

The above adjustment is a simple one, however, in event latch "A" engages "stop" lugs too early, carburetor throttle and spark cannot be advanced far enough to accomplish "easy" starting.



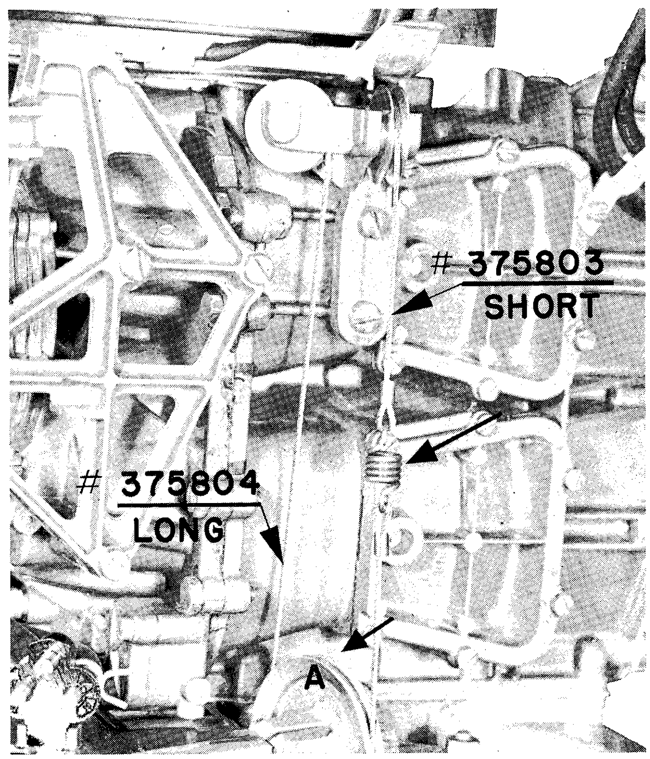
There may be Occasion when it is found Difficult to Obtain Satisfactory Float Level Adjustment on the Model RD Carburetor to Overcome Constant Flooding. (See Pages 148 and 149.

Investigation has Revealed this Situation to be Result of Excessive Wear on the Float Arm Hinge Pin (#302661) thus Establishing more than Normal Clearance (Play) between the Pin, its Supporting Bracket and Float Arm than can be Compensated for by Following Normal Procedure for Adjusting Float Level.

Installation of a new Hinge Pin (#302661) and Perhaps a bit of Careful "Crimping" of the loop on the Float Arm (around the pin) to obtain a Closer Fit, should take up enough "Slack" to Maintain Proper Fuel Level when Correctly Adjusted.

"Crimping" of the Float Arm Loop Around the Pin, if Necessary, should be Carefully Pursued with a pair of Pliers—Keeping in Mind that Clearance between the Loop and Hinge Pin ought to be just enough to Permit Free Movement without Possibility of Binding—but not a "Sloppy" Fit.

It is Advisable when Replacing the Hinge Pin to Install a New Float Valve and Seat Assembly #375798. And likewise a New Hinge Pin when Replacing the Float Valve and Seat Assembly.



A Change in Assembly of #375804 Speed Control Cable (from Armature Plate to Pulley at Rear End of the Steering Arm), Involved but Relocation of the "Bead," which Locates Position of the Cable in Pulley "A" and which Requires Reversing Position of the Cable When Attaching to the Armature Plate. Under these Circumstances the "Take-up" Spring will Locate Outside (adjacent to the Motor Cover) Rather than on the "in" Side, Next to the Cylinder Block as Heretofore. To Accomplish the installation Simply Reverse Positions of the Long Cable #375804 and the Short Cable # 375803 as illustrated here. See Pages 49 to 51 Inclusive.

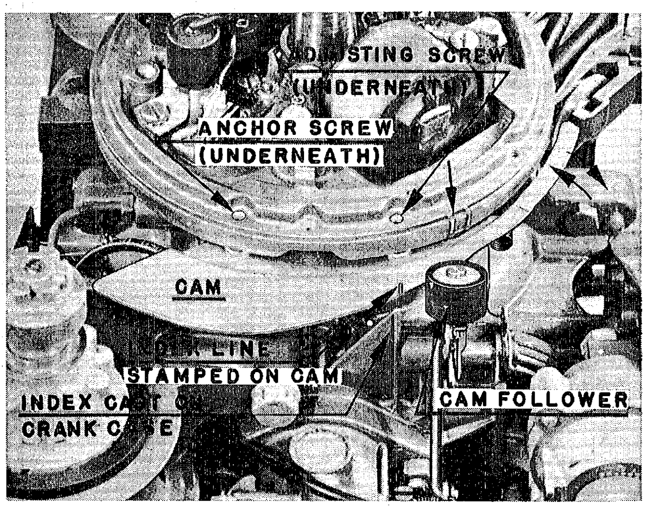
Purpose of the Revised Arrangement is to Prevent the Spring (Connecting Cables) from Advancing the Armature Plate to Engage the Shift Lock. This Occurs after Shifting with the Speed Control Grip Set to Maximum for Starting, thereby, making it Impossible to Shift Back to Neutral Without First Retarding Motor Speed.

SEE ILLUSTRATION, BOTTOM OF PAGE 149
AND TEXT, PAGE 150

SYNCHRONIZING SPARK AND GAS MODELS RD-16 AND RDE-16 UP

Quite frequently failure to obtain satisfactory motor performance for no seemingly known reason can be attributed to improper synchronization of spark and carburetor control — degree of spark advance out of proportion to degree of carburetor shutter opening.

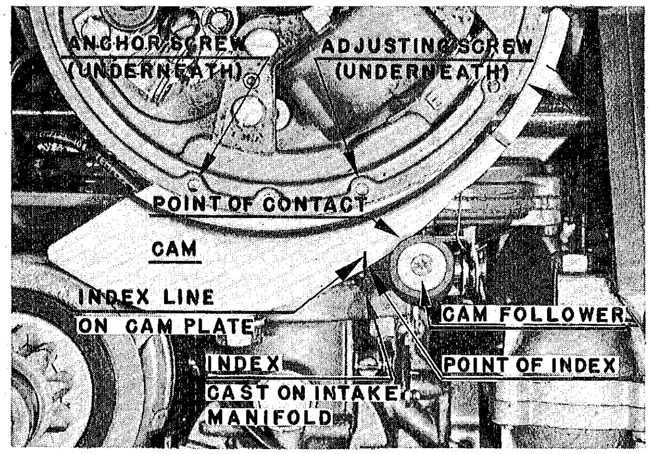
To achieve the maximum in performance, a definite relation has been established between degree of spark advance and shutter (butterfly valve) opening which must be maintained throughout entire speed range of the motor — accomplished by a roller acting on the carburetor shutter through an arrangement of linkage and following contour of a cam plate attached to the armature plate which has been carefully calibrated to correctly proportion volume of fuel charge with respect to degree of spark advance.



Showing speed control cam attached to armature plate, adjusting screws; index cast onto the intake manifold and cam follower (roller) acting on carburetor shutter through an arrangement of linkage.

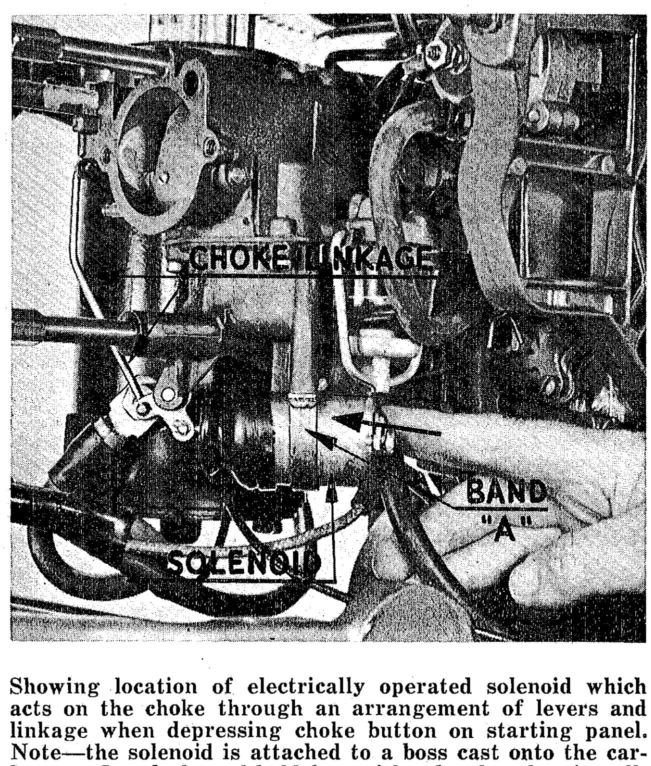
As may be observed from illustrations shown here, the control cam is rather long, slender and shallow at one end (slow speed range) and progressively increasing in width towards the opposite end (intermediate and high speed range). It will be noted that two screws are employed to hold the cam plate fast to the armature plate — one, an anchor or pivot screw, the other resting in a "slotted" hole to permit pivoting or shifting (in or out) as arrows indicate. Note, too, an index line stamped on top face of the cam plate and an index or "pointer" cast on to the intake manifold.

To synchronize — loosen anchor screw slightly, the adjusting screw a bit more, turn speed control grip to position where index line on the control cam comes to rest "flush" with straight side of the index (pointer). Exert light pressure against the roller to take up all "slack" in shutter linkage, with shutter *just* on the verge of opening as required to obtain best results. Hold in this position. Shift "free" end of cam out to make contact with the cam follower (roller). Cam follower contact with contour of the cam must occur when index line on face of the cam plate and index are in alignment. Draw up on anchor and adjusting screws to secure in this position.

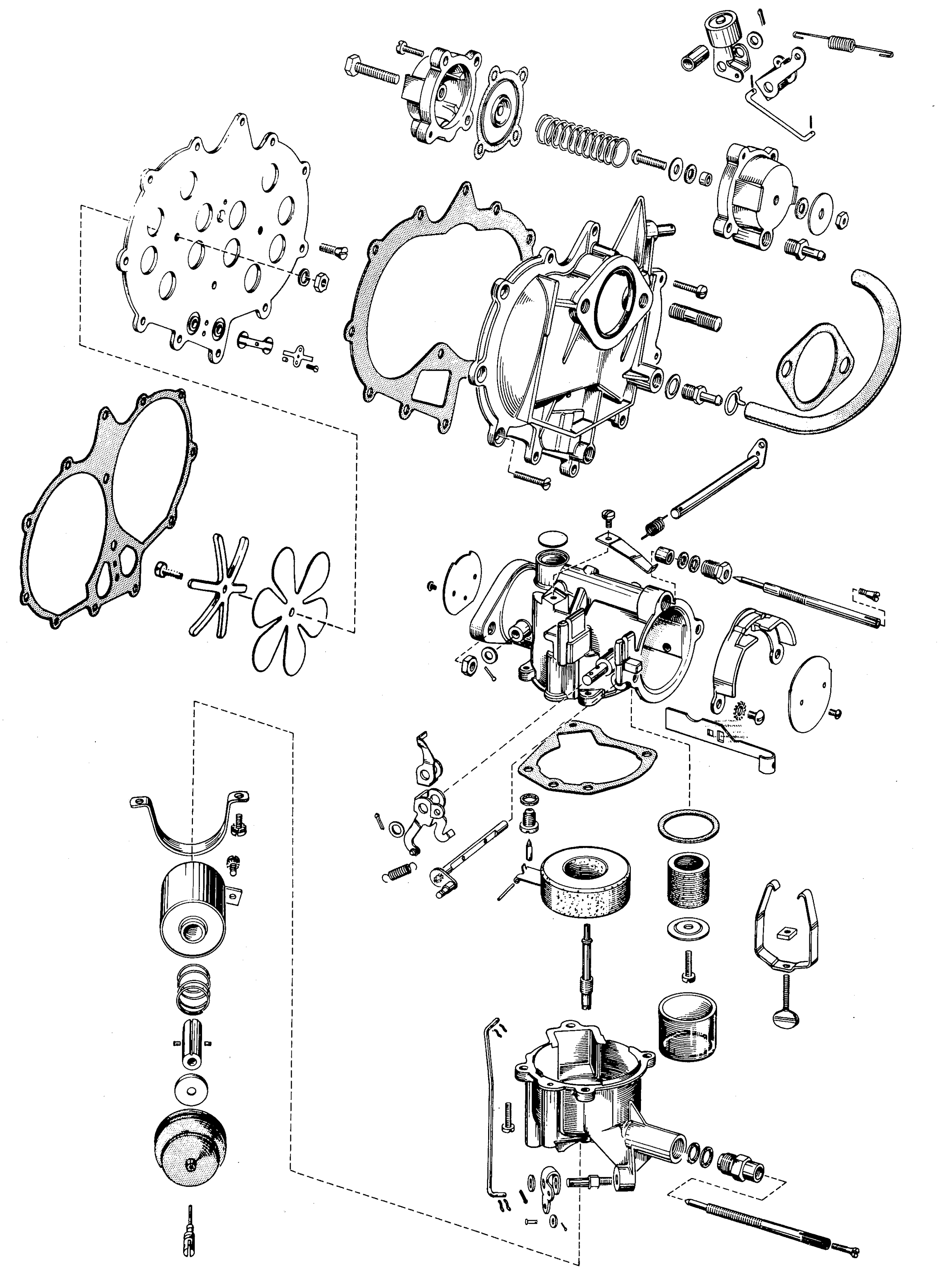


Showing position of cam follower (carburetor speed control) with relation to index and cam to obtain proper synchronization of spark and gas.

Turn the speed control lever back and forth several times — recheck to assure correct synchronizing as described and illustrated.

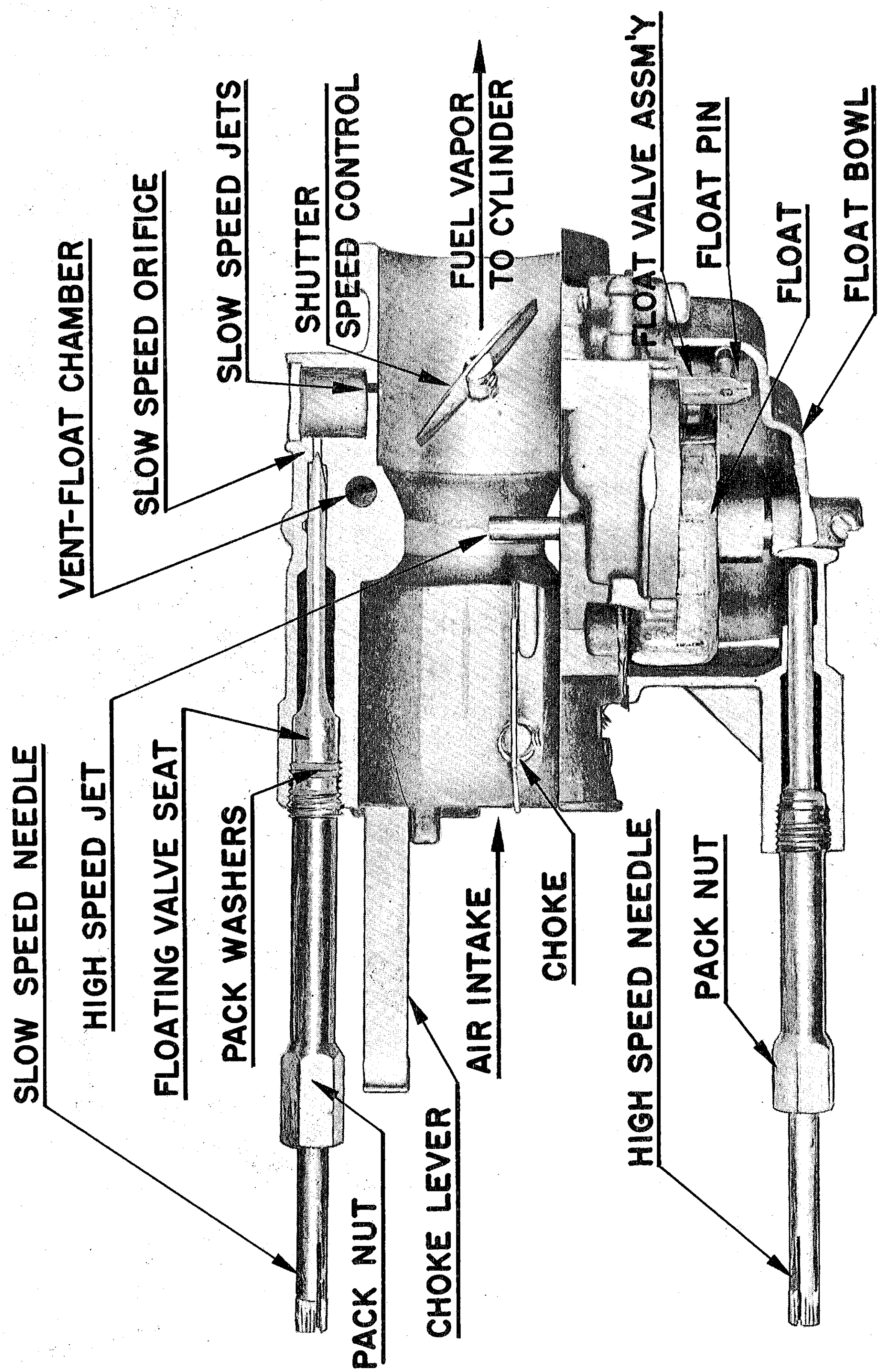


Showing location of electrically operated solenoid which acts on the choke through an arrangement of levers and linkage when depressing choke button on starting panel. Note—the solenoid is attached to a boss cast onto the carburetor float body and held fast with a band—when installing the solenoid, some alignment is required to properly locate. To adjust—pull choke button out to full choke, place solenoid in position with all connecting linkage attached—leaving band "A" slightly loose for the moment. Push solenoid forward—in direction of arrow—until plunger "bottoms" within the solenoid case and can be moved no further. Draw up on band screws to secure position of solenoid.

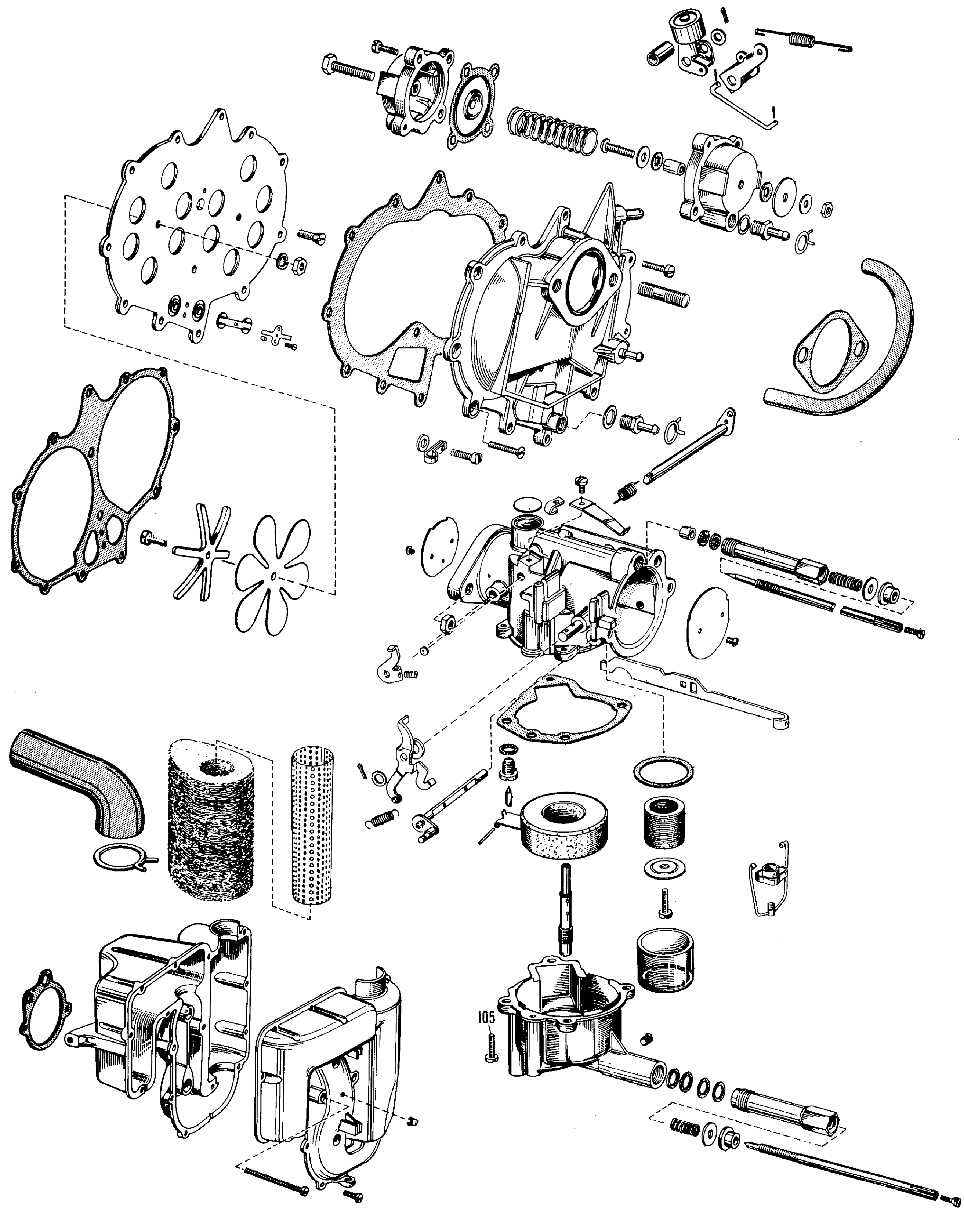


Model RDE carburetor, solenoid, intake manifold, valve plate, and automatic ignition cutout group layout.

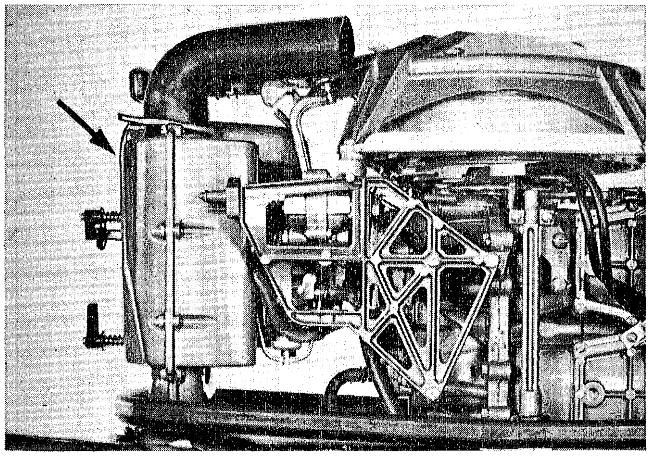
MODEL RD-17 CARBURETOR



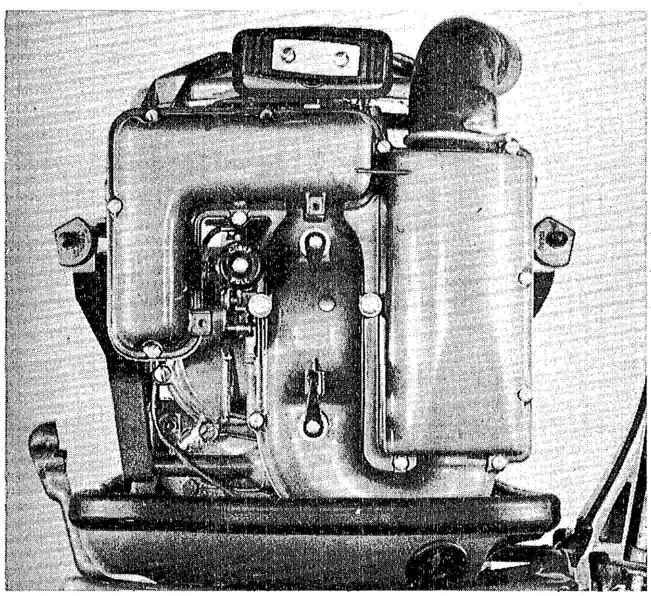
Basic Construction and Functional Details of Models RD and RX Carburetors.



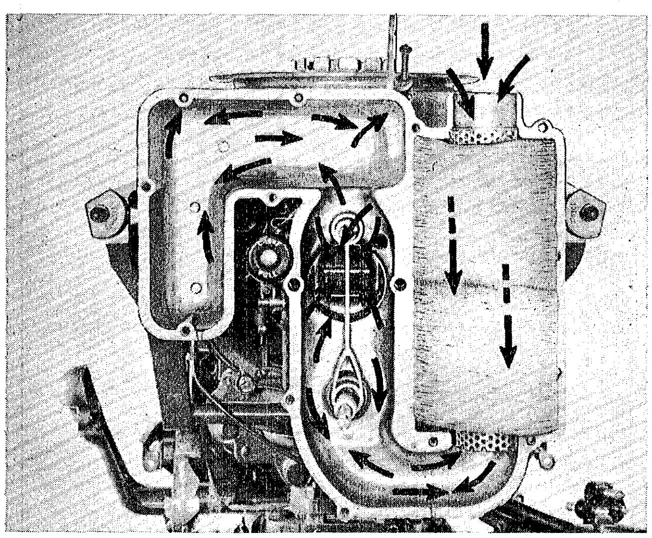
Extended view of the carburetor, valve plate—manifold
and carburetor silencer group—Model RD-17.



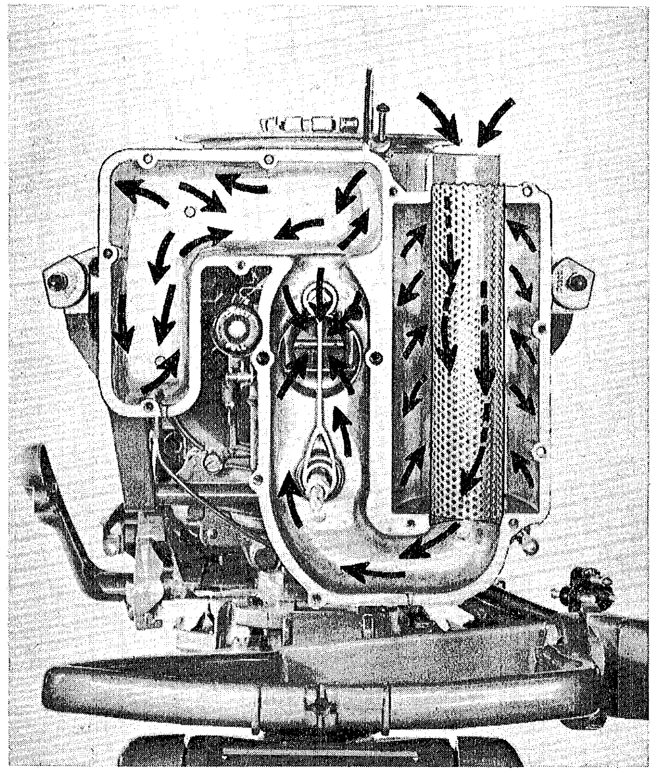
Side view (port) of the RD-17 Powerhead showing installation of the carburetor silencer.



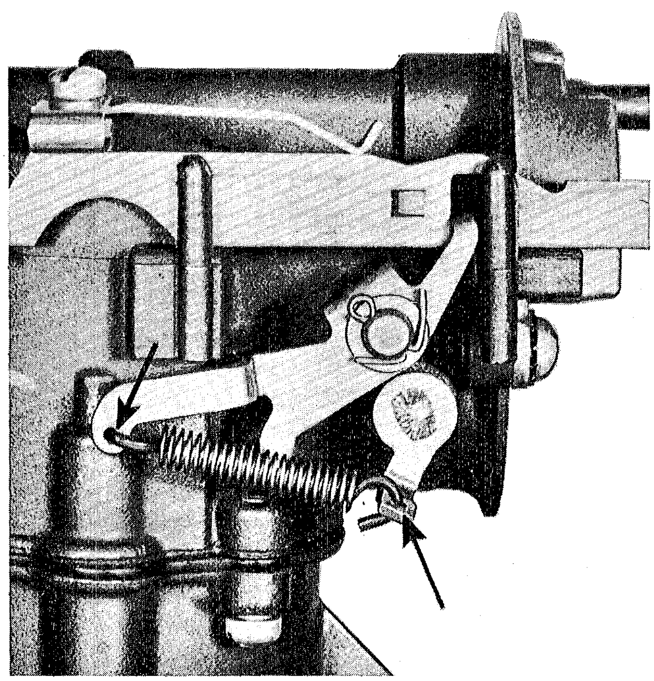
Front view of the RD-17 Powerhead showing the carburetor silencer installation.



Carburetor silencer with front (half) removed—showing spun glass wadding to assist in absorbing noises.



Carburetor silencer with front (half) removed to show perforated tube employed to support the glass wadding and further aid in absorbing motor noises through perforations.



#302747 choke spring as installed on the Model RD carburetor (#375815)—RD-14 and earlier—has been cancelled and superseded by spring #376388.

It is actually the same spring, however, but provided with a short length of "spaghetti" tubing fitted over each end to achieve better anchoring and thus reduce loss of the spring to a minimum during operation of the motor.

Installation of the new spring assembly is identical with that of the former except that it requires reaming or drilling out corresponding holes (indicated by arrows) in brackets.

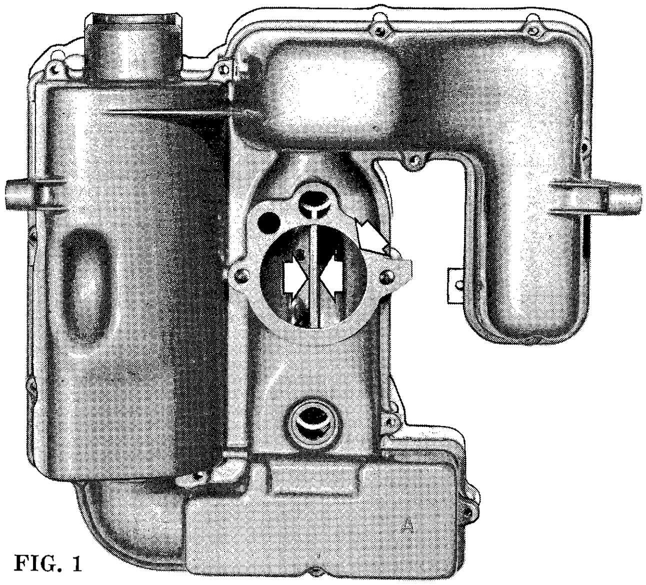


FIG. 1

No. 277584 — Air Silencer Assembly — RD-17 through RD-18 Series.

Assembly of the above air silencer and attachment to the carburetor are operations which must be performed with special care — misalignment or "overhanging" of the gasket between the silencer and carburetor must be avoided. The large hole in the gasket must align "precisely" with the corresponding throat walls of the silencer. Figure 1.

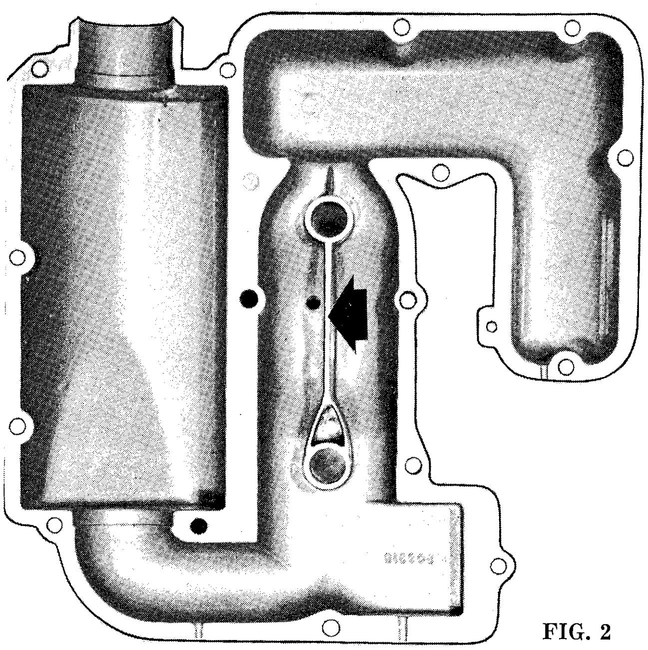


FIG. 2

In the event of misalignment in this respect or "overhanging," small eddy currents build up to interfere with normal air flow through the carburetor resulting in faulty fuel distribution (one cylinder running richer than the other). To minimize the possibility of a situation of this sort developing, coat the gasket face of the silencer with cement — place gasket (correctly aligned) in position to secure. Carefully attach assembly to the carburetor.

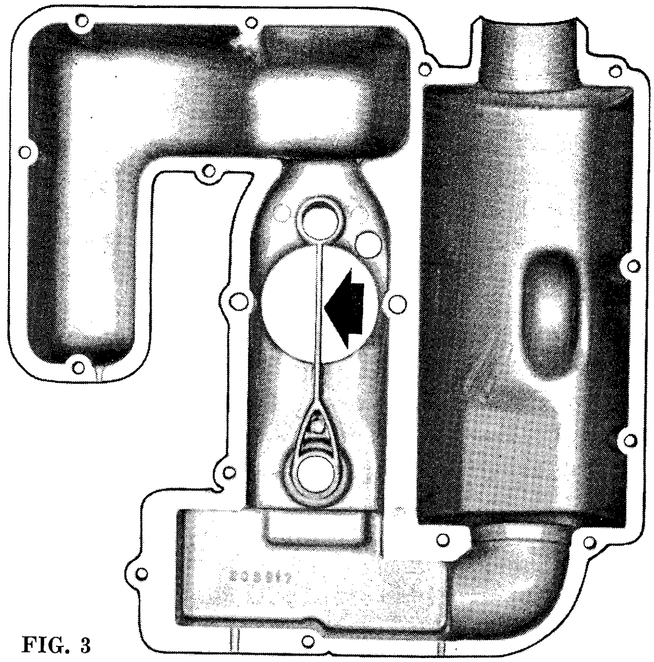


FIG. 3

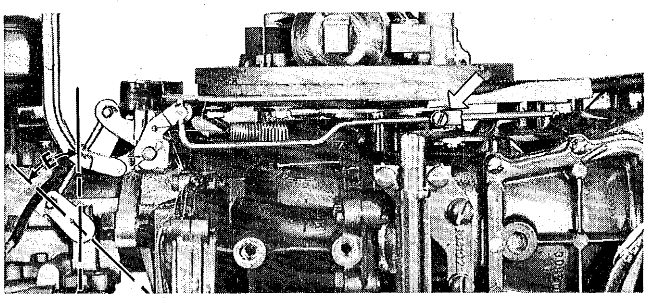
Similarly, on disassembly and re-assembly of the silencer sections (halves), the center "rib" in each section (indicated by arrows, Figures 1, 2 and 3) must be "lined up" — flush on both sides to avoid formation of eddy currents and resultant faulty carburetion.

NOTES

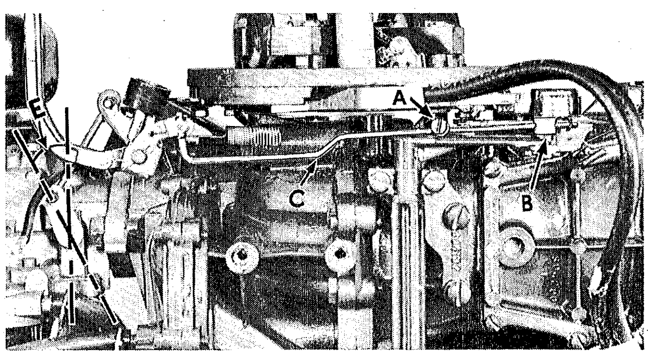
FUEL SAVER CONTROL RD-18 UP, RX AND RK – ADJUSTMENT

In principle, the fuel saver arrangement as installed on all RD-18's and the Javelin is of extremely simple construction — accomplished through a series linkage between the armature plate and carburetor shutter. Carburetor and spark control are synchronized as usual — but not "all the way" so to speak. That is, at full "fast" position, spark is fully advanced with full open carburetor shutter. But, it will be noted on observation, when "twisting" the speed control grip towards slow or retarded speed, the carburetor shutter partially closes before position of the spark (timing) has been affected.

In the higher speed ranges, it is possible to "cut" the carburetor control back a bit without changing degree of spark advance and causing but a slightly perceptible drop in RPM's — not enough to materially affect over-all performance of the unit — fuel saving. Actual control of the carburetor shutter then is governed by position of a small collar ("A") (secured with screw) on the synchronizing or fuel saver linkage ("B") as illustrated below.

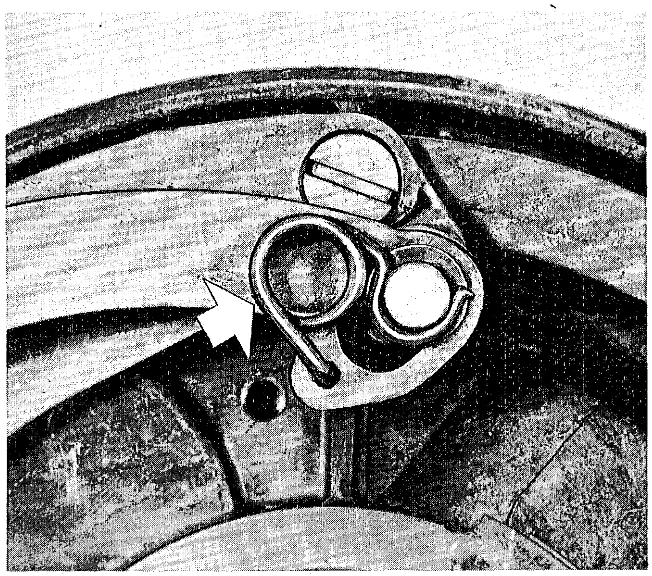


Showing Fuel Saver linkage arrangement — Spark at full advance, throttle (carburetor shutter) at full open. Note angle "E" — shutter opening.



Showing Fuel Saver linkage set in fuel saving range — Spark at full advance, throttle (carburetor shutter) slightly closed to reduce volume of fuel vapor entering the crankcase. Note angle "E" — shutter opening.

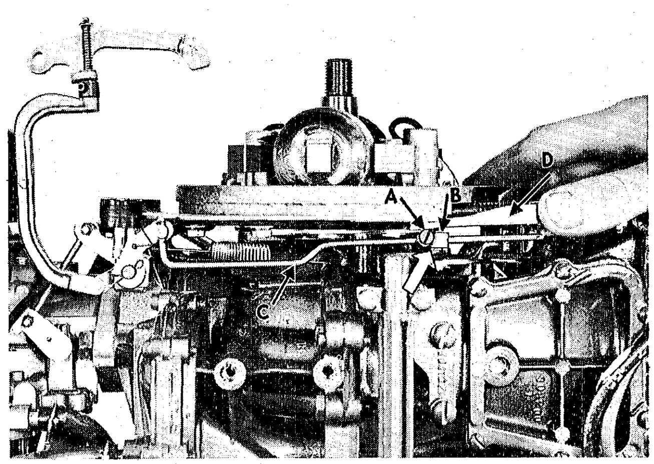
Possible fuel saving in this respect, of course, is largely dependent on loading conditions at the moment, hull design and other inherent characteristics of the particular craft.



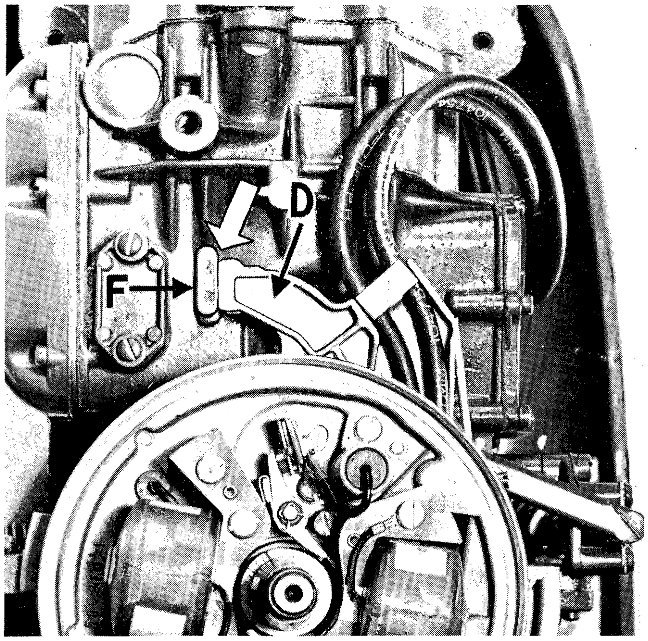
It may be noted in some instances that full spark advance has not been achieved when setting the speed control (grip on lever) to full "Fast" position — this, due to slack in control linkage (shown here) not being fully taken up by spring #304220 as it should.

The original spring #304220 has consequently been cancelled and replaced with one of "stiffer" tension — to obtain full spark advance at full throttle setting.

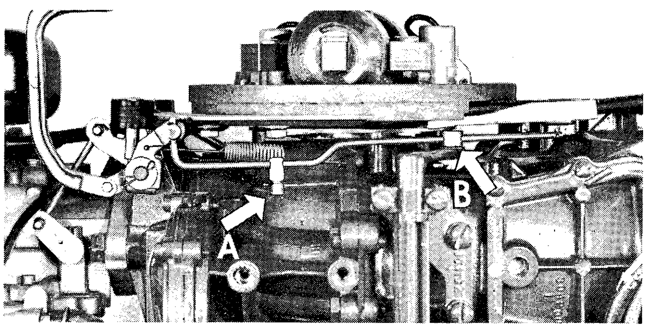
To be assured of full spark advance at full throttle, stop bracket (indicated by arrow in the illustration) should come to rest against the boss cast on to the cylinder block. In event the bracket must be further advanced to gain contact or new contact in this respect, simply replace spring #304220 with the "stiffer" spring #304656.



To adjust Fuel Saver linkage, (1) Set speed control grip to "fast" position (shift lever in forward); (2) To assure maximum spark advance, make certain armature plate bracket "D" comes to rest firmly against crankcase boss "F" by exerting thumb pressure as above; (3) Slide collar "A" up on link "C" until it rests firmly against pivot pin "B". Secure in this position by drawing up lightly on the lock screw.



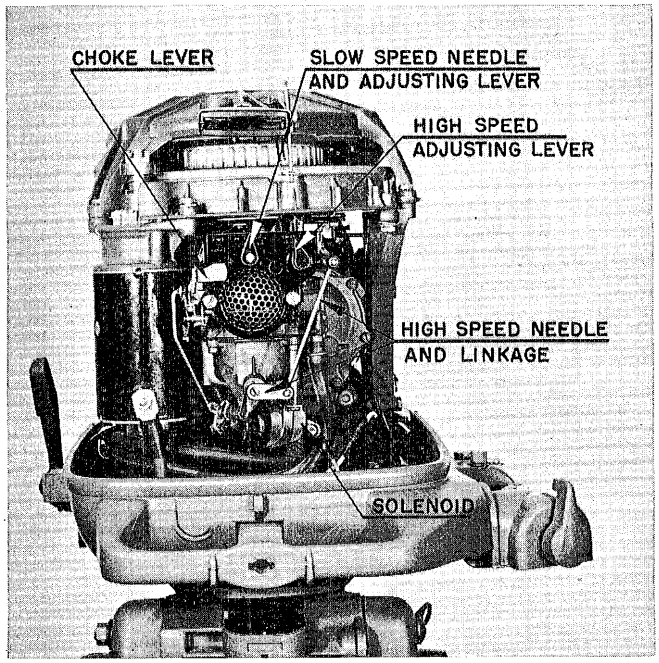
Showing armature plate bracket "D" resting firmly against crankcase boss to achieve full spark advance.



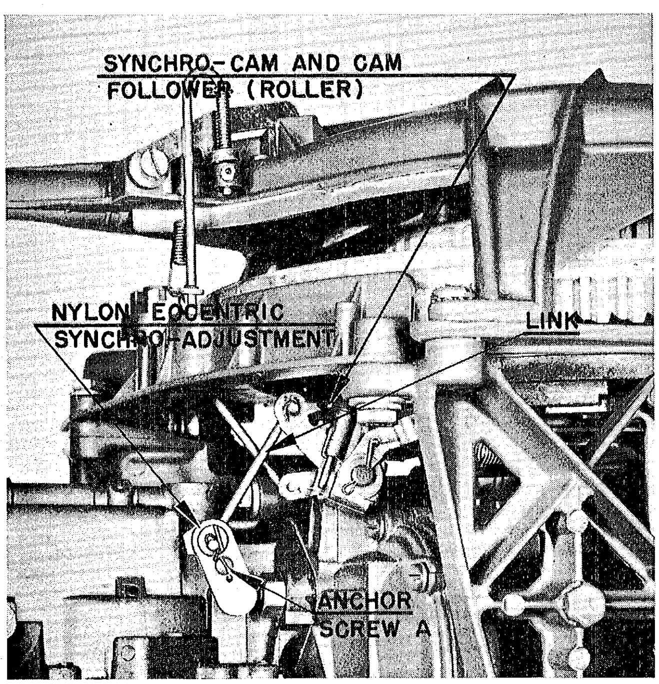
In event the motor fails to respond to throttle, check position of collar "A" on the synchronizing or Fuel Saver linkage—it may have become dislodged as shown here. Restore as instructed above.

NOTES

SHUTTER ADJUSTMENT – CARBURETOR RD SERIES – 19 (35 H.P.) UP AND RX (28 H.P.)



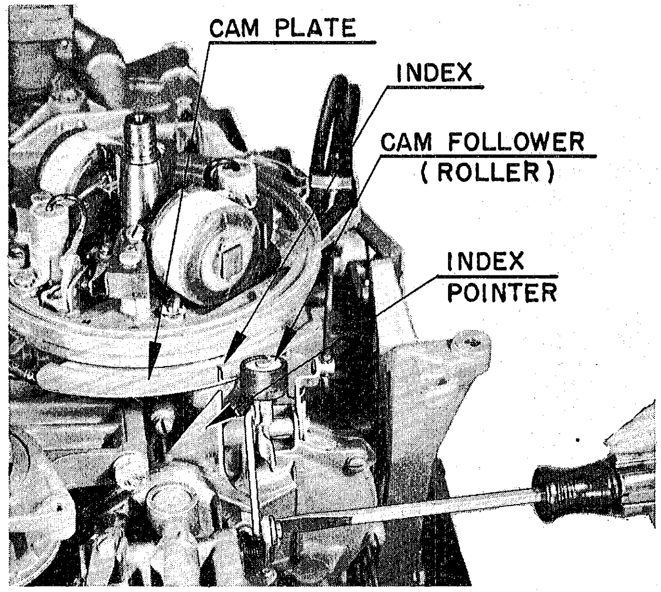
Front view showing Carburetor installation–Model RDS-20.



Showing installation of spark-gas synchronizing mechanism and details of adjustment.

REFERENCE – see page 156, "synchronizing spark and gas."

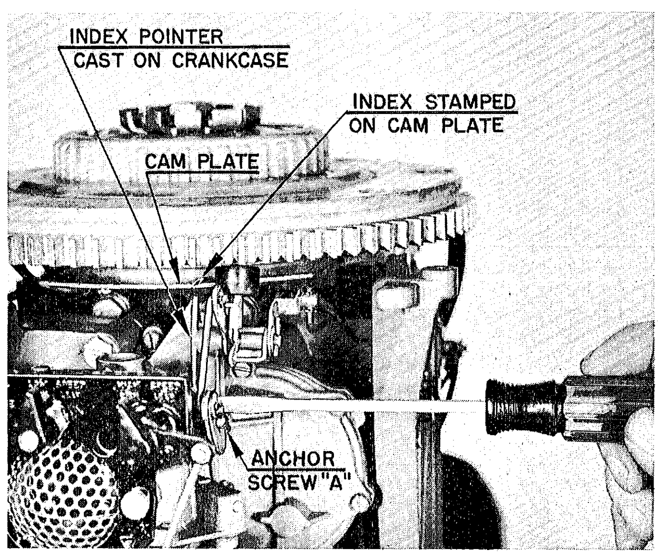
A change in the method of adjusting the carburetor shutter (gas) with respect to position of spark setting has been incorporated in the RD series, 19 up and RX. Principle of synchronizing the "spark and gas" is identical with that of other models except that the method of accomplishing final adjustment differs a bit. Pivoting of the control cam to achieve proper synchronization of spark and gas in this instance has been replaced by an eccentric (nylon) arrangement built into the carburetor lever as shown here.



Starter and Flywheel removed to expose the Cam Plate, Index Pointer and Cam Follower (Roller).

To adjust shutter position for best setting, proceed as follows:

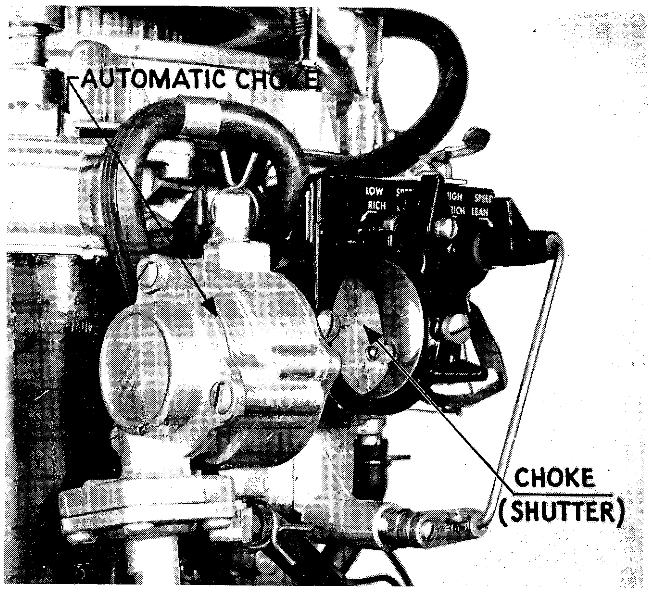
1. Loosen anchor screw "A."
2. Turn speed control (grip) to position where index mark on the control cam falls in line with the index pointer cast on to the intake manifold



Turning nylon eccentric to adjust position of carburetor shutter plate.

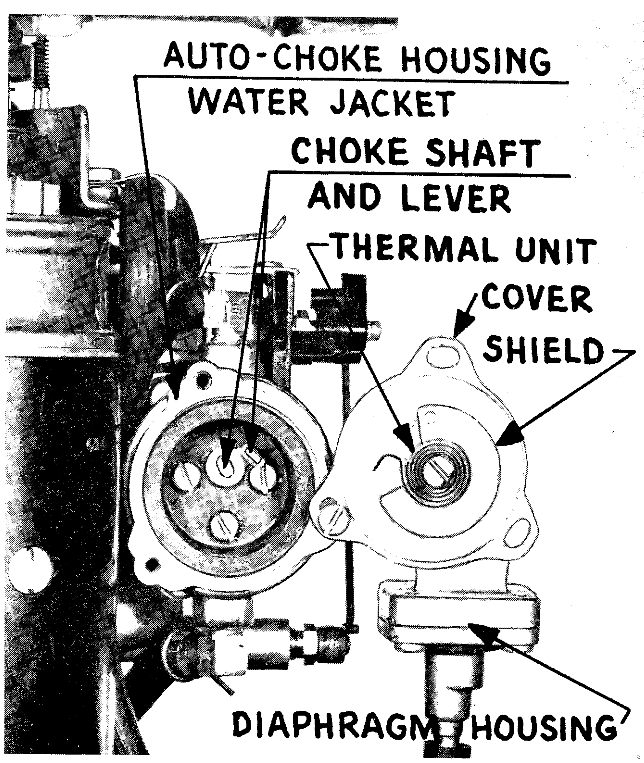
3. Turn nylon eccentric right or left with screw driver (as shown) to position where the shutter just "cracks" open.
4. Retighten the anchor screw "A."

THE AUTOMATIC CHOKE RD-RDS SERIES – 22 UP (40 H.P.), RK (40 H.P.)



The Automatic Choke Installation.

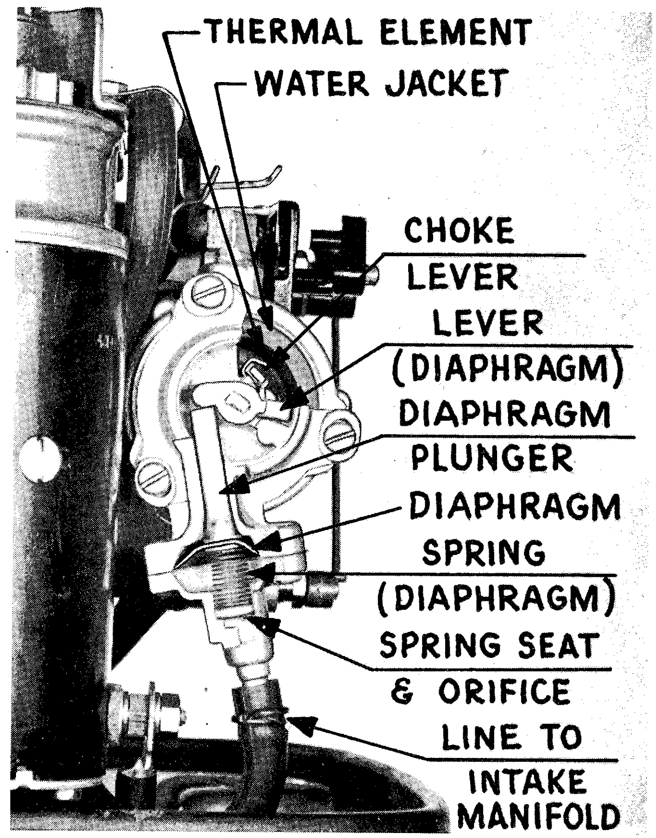
The automatic choke now installed on the carburetor of the RDS-22 (40 H.P.) like the manual choke, is provided to obtain the normally rich fuel vapor mixture required for starting. However, with the thermostatically controlled arrangement, choking when cold and degree of choking during the "warm-up" period is automatically accomplished with water jacket temperature rise as the motor is started and continues to operate.



Illustrating Details of Construction.

In construction, the choke control assembly consists of (1), a water jacketed housing, connected in series with the cylinder cooling system (2), a coiled thermal element "hooked" at one end to act on the choke lever and as such attached to the cover and seated in the housing.

The coiled thermal element is built up of two specially selected strips of dissimilar metal, each with a different coefficient of expansion and fused together to form a composite or integral unit and calibrated to hold the choke closed when cold. Shield installed to prevent excessive vibration of the thermal unit.

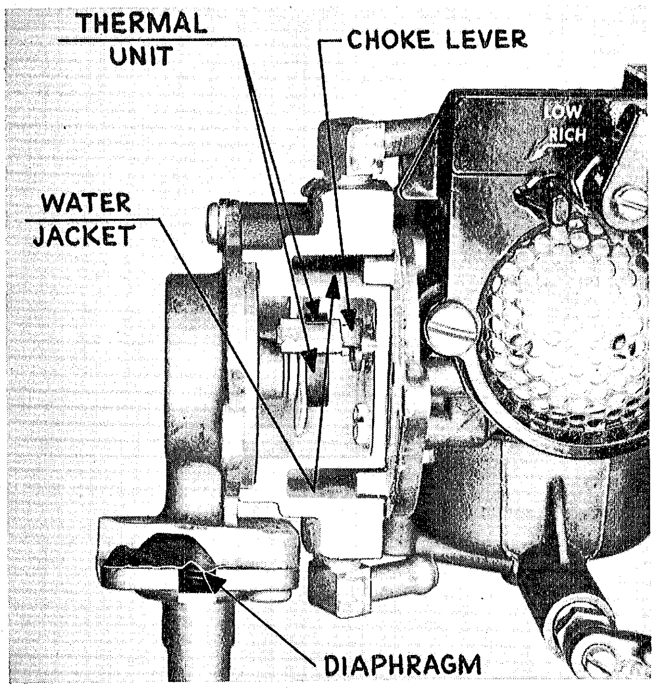


Sectional view of the Automatic Choke Assembly.

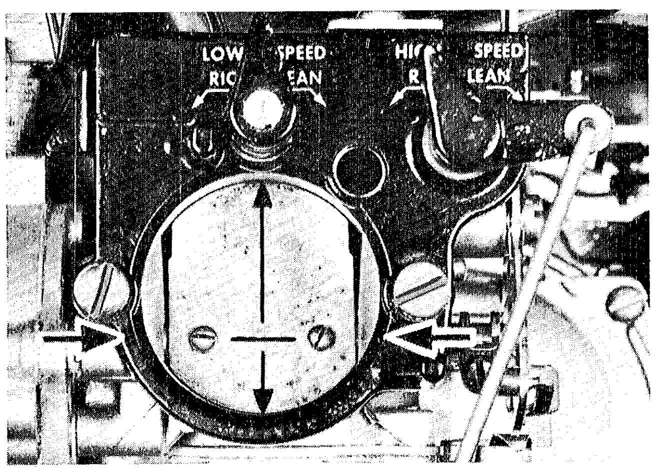
An additional feature, however, is included in the automatic choke assembly – a spring loaded diaphragm and plunger assembly, activated by intake manifold pressure to close the choke the instant the motor stops running, whether hot or cold, and releasing its "hold" only when the motor is again started. In this sense it operates independently of the thermal choke control. At atmospheric pressure (motor not running) the choke remains closed; at low manifold pressure or "suction" (motor running) the choke is released to open, at which time the thermal control takes over.

Purpose of the check valve and orifice is to prevent fluttering of the diaphragm and plunger as result of fluctuating pressure existing in the intake manifold during operation in the slower speed ranges.

Note — A punctured or otherwise fractured diaphragm will cause the choke to be held in closed position at all times when in automatic control position, but may be open by use of the manual control lever.



Automatic Choke — Sectional view showing the Water Jacket, Thermal Unit, Choke Lever and Diaphragm.



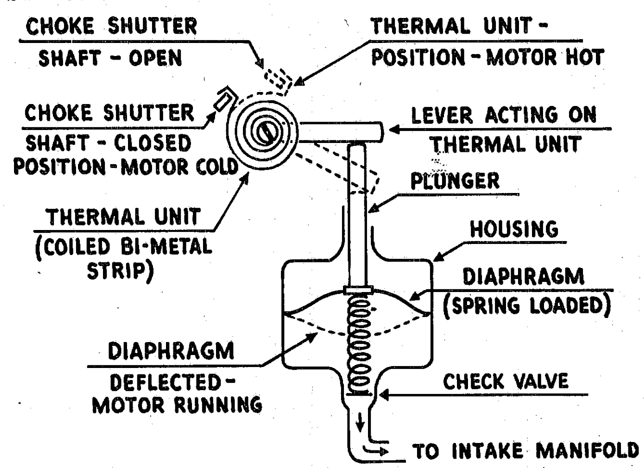
Showing the Offset Choke Plate (Shutter).

The choke shutter as will be noted in the illustration is located off center on the choke shaft and as such, presents a greater area to the air stream flowing through the carburetor on one side of its supporting shaft than the other. The resultant leverage thus achieved with starting and running of the engine causes the shutter to partially open against applied tension of the (cold) thermal unit against the choke lever. As a consequence, sufficient air enters to form a combustible fuel vapor mixture without excessive over-choking to prevent flooding at the moment. Degree of shutter opening is determined by rate of air flow through the carburetor. This is true regardless of whether the carburetor is on automatic or manual choke.

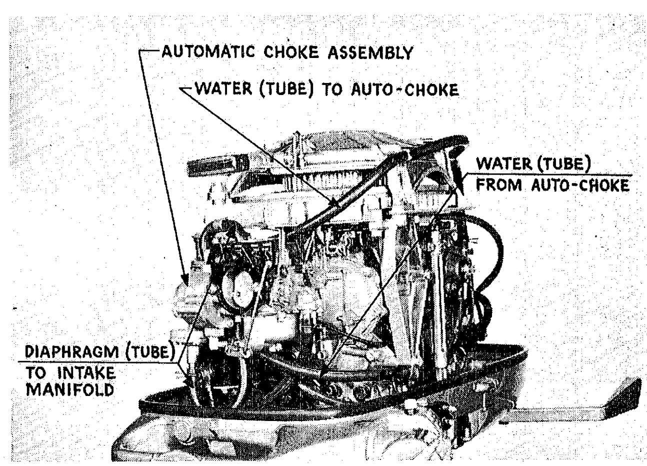
It should be remembered that the thermal unit acts only towards holding the choke closed when cold and that it progressively releases its "grip" with rising cylinder block temperature; the air stream and air stream only through the carburetor opens and holds the choke open.

In operation, heat radiated by the water jacketed housing is absorbed by the thermal element to result subsequently in expansion. Since the member with the greater coefficient of expansion is situated on the "outer" side of the coil loop and characteristically expands or elongates more than the other with temperature rise, the precoiled element tends toward further coiling or "tightening" of the coil loops. During the process, the "hooked" end of thermal element assumes a different position in the loop, thus releasing the choke to open.

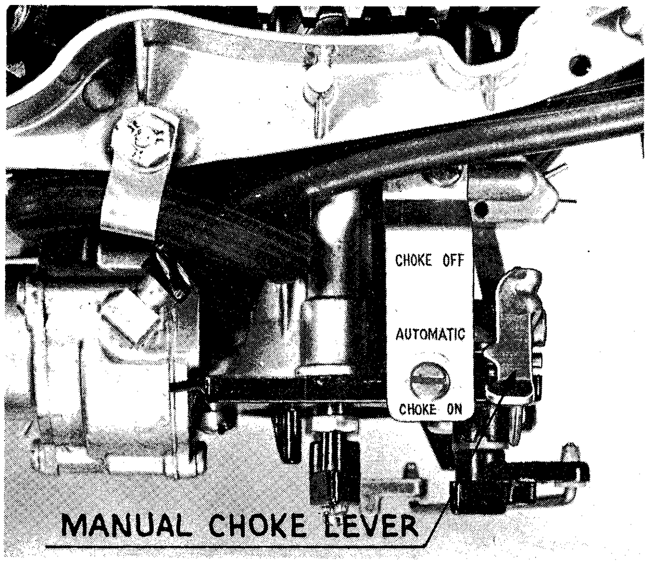
Conversely, with falling water temperature, resultant cooling permits the "tighter" wound thermal unit resuming its original state with the "hooked" end bearing against the choke lever. Subsequent tension thus applied acts to close the shutter.



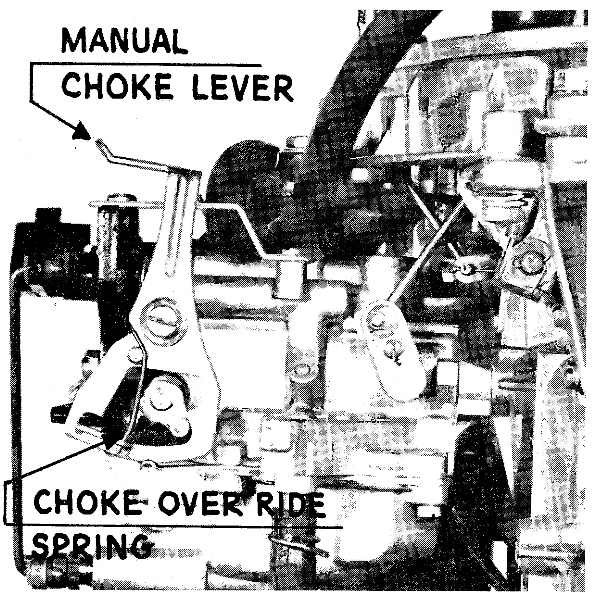
Schematic to Illustrate Thermal Unit and Diaphragm Illustration.



Powerhead — Showing Automatic Choke, Water Tube and Diaphragm Installation.



Top View — The Manual Choke Control.



Showing the Manual Choke Lever Installation.

Very little difficulty should be encountered with the automatic choke assembly but, of particular significance, should the unit be suspected of malfunctioning, it is *important* that a check be made of the cooling system thermostat. If inspection reveals a "frozen" (open) valve, the thermally controlled choke will continually operate at closed or near closed position since predetermined cylinder cooling temperature may never be achieved.

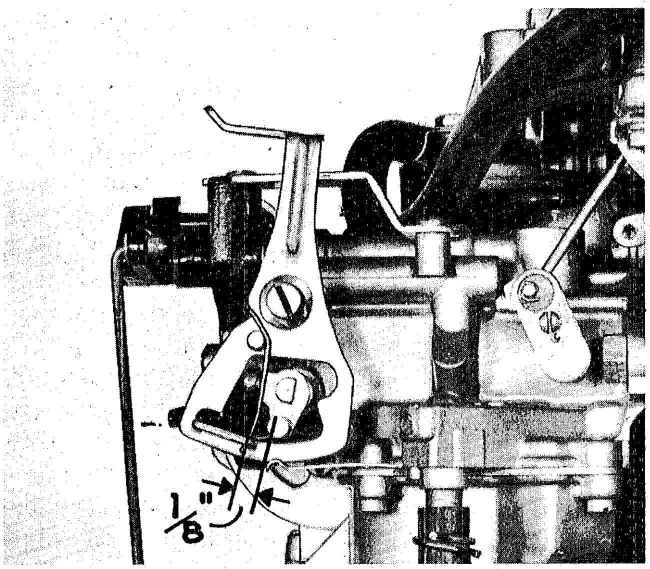
AUTOMATIC CHOKE ADJUSTMENT

The automatic choke is preset at the factory for best performance, however, should there be reason to suspect malfunctioning or improper adjustment, proceed as follows:

1. Check choke (shutter) shaft for evidence of binding – the choke shaft must be "free." Grasp small lever (end of choke shaft opposite autochoke installation), turn from left to right – the shaft should turn freely within a quadrant of approximately 45 degree in either direction. Should there be evidence of "stiffness," apply light machine oil to lubricate at points of support. Note possible presence of salt water corrosion to interfere in this respect after periods of idleness.
2. Start engine in customary manner.
3. Check functioning of the thermostat as indicated by water "spurting" from the discharge outlet (protruding from the exhaust cover) after "warm up." (In event of no discharge from the outlet after a reasonable period of running, discontinue further running and proceed with whatever thermostatic corrections may be required before resuming.)
4. Run engine at approximately half power capacity for at least ten minutes to stabilize water jacket temperature. Observe at this time that temperature of the automatic choke housing will be uncomfortable to the touch.
5. Place the manual choke lever in "off" position.
6. Check carburetor needle adjustment to assure correct setting for best performance throughout engine speed range – idle to top R.P.M.'s.
7. Place manual choke lever in "automatic" position. If no perceptible change in over-all performance is observed, it may be assumed that the automatic choke assembly is in proper adjustment and functioning as it should. Variation in performance at this time otherwise dictates a further check of choke adjustment and performance component details.
8. Since degree of choke (shutter) closing is dependent upon the tension the thermal unit exerts against the choke lever (see illustration) and the rate of air flow through the carburetor, provisions are made for limited adjustment or variation of the tension thus applied.

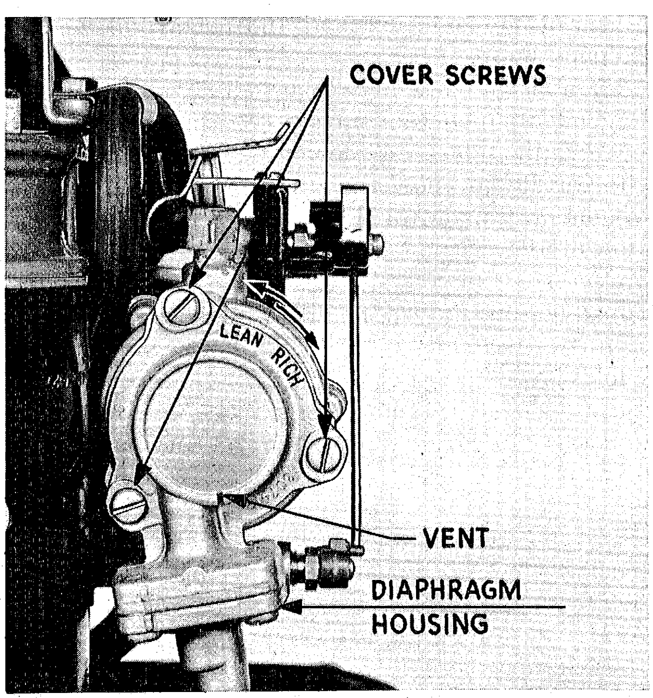
Note: During the process of original design and construction, thermal unit tensions at various temperatures are calibrated to act against the choke lever in predetermined relation to the pressure exerted against the surface of the offset shutter plate (choke) by the velocity of the air stream through the carburetor at variable engine spreads.

9. Continue running engine to maintain cylinder block temperature. Throttle down to idle – about 600 R.P.M.'s. Observe position of the choke (shutter) – it should be in full open (vertical) or near full open position at this time. To check tolerance in this respect, push lever "A" to full open choke position, then release. Resulting movement of the



Illustrating permissible Choke Shutter Tolerance when idling at approximately 600 RPM's — Normal Operating Temperature.

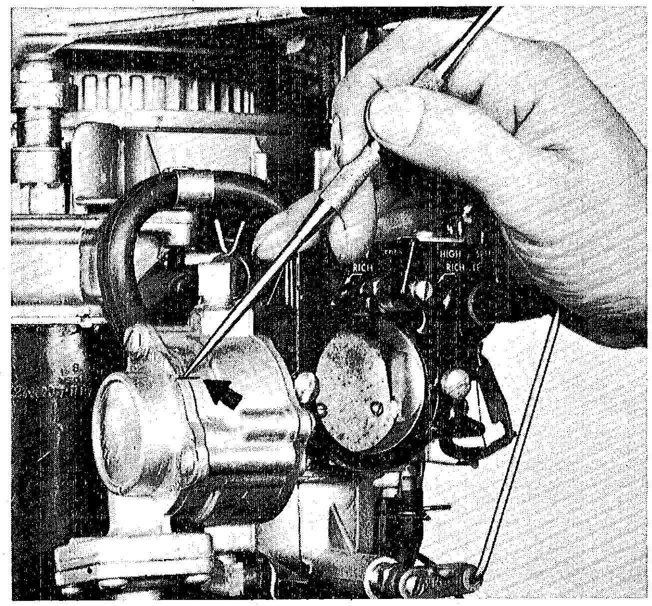
7/32" pin on the choke arm should not exceed 1/8" as shown. If greater than 1/8", first check the vacuum line to the intake manifold (a leaking or obstructed vacuum line or a fractured diaphragm permits the diaphragm acting to close the choke shutter). Loosen the three choke cover screws, turn cover to left (lean) as required to slightly reduce thermal unit tension against the choke lever. If otherwise there is reason to assume that under choking exists to perhaps result in more than expected cranking effort to start, turn cover to right (rich) as required to achieve desired results. Tighten cover plate screws.



Showing Auto-Choke Cover and Screws to Permit Adjustment.

10. Failure of the automatic choke to respond at all may be due to a broken or distorted thermal unit.

11. To check condition of the thermal unit, detach suction line to the intake manifold. Scratch mark the housing and cover to indicate original position for assembly later on. Remove the three screws securing position of the cover assembly.

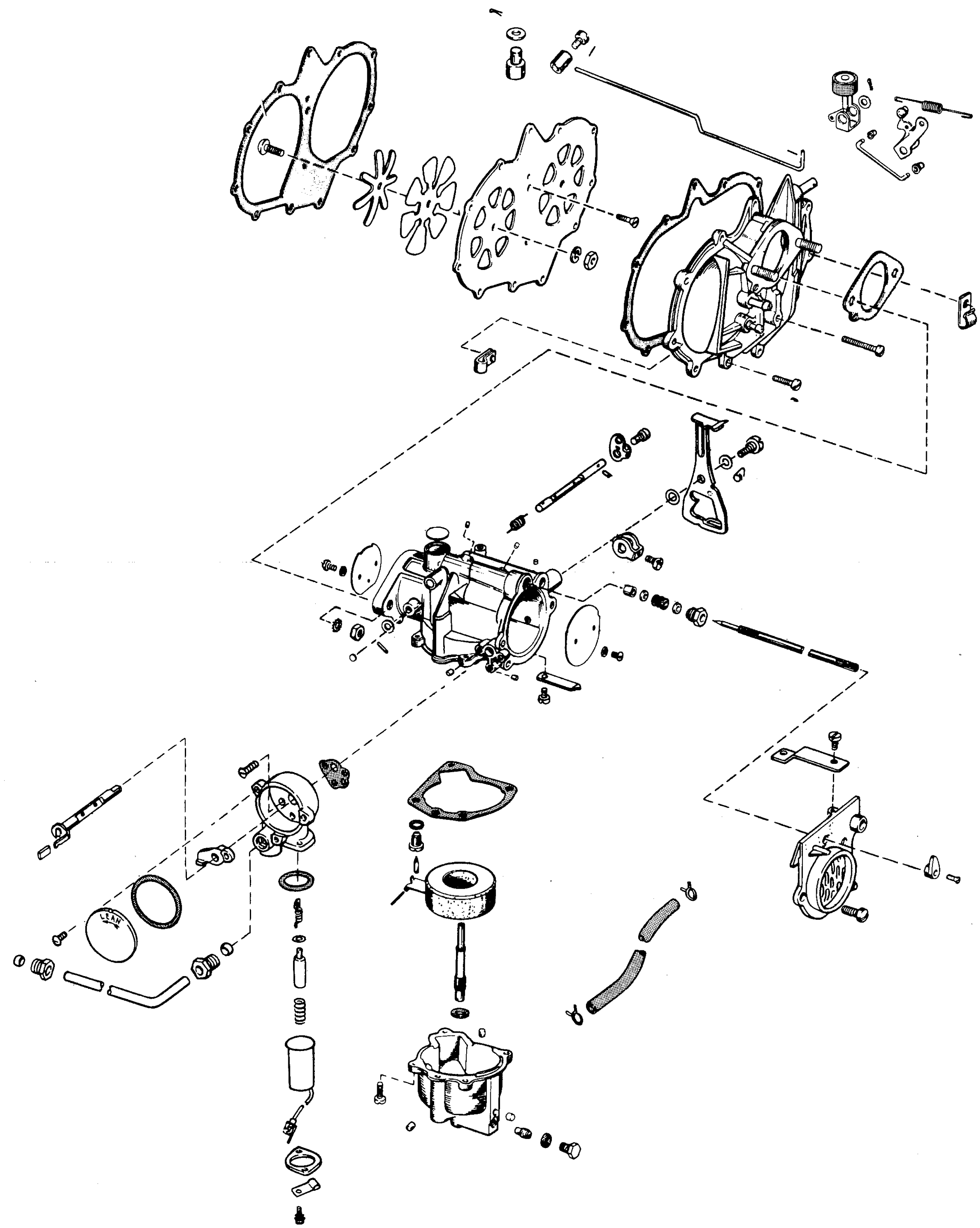


Scratch cover prior to removing to permit restoring original position if necessary.

Carefully remove the assembly to examine condition of the thermal unit. If broken or damaged in any manner, install new assembly #378023. The bi-metal thermal unit is available only in this assembly and as such cannot be purchased separately. Do not, out of curiosity, attempt to observe expansion of the bi-metal coil by subjecting it to the flame of a match or cigarette lighter – it will be ruined for further use. Note bosses cast onto the thermal unit and diaphragm housings – both must fall in line when assembled.

When installing the thermal unit/cover assembly, care should be exercised to make certain that the hooked end of the bi-metal strip properly engages the choke lever as shown in the illustrations above. Do not "force" the assembly – turn slightly to left to engage the choke lever. Restore cover to original position as indicated by the "scratch" line – replace cover screws. Recheck for proper choke (shutter) adjustment as described above.

HOT-AIR ACTUATED AUTOMATIC CHOKE — 1964 AND UP 40 HP
(Electric Start Engines Only)



GENERAL DESCRIPTION

A new hot-air actuated automatic choke is now being used on all 1964 – Electric starting 40 HP models. This hot-air choke offers certain advantages over the former hot-water actuated choke in that it is able to sense the choking demands of the engine very accurately and rapidly, regardless of lake and air temperatures.

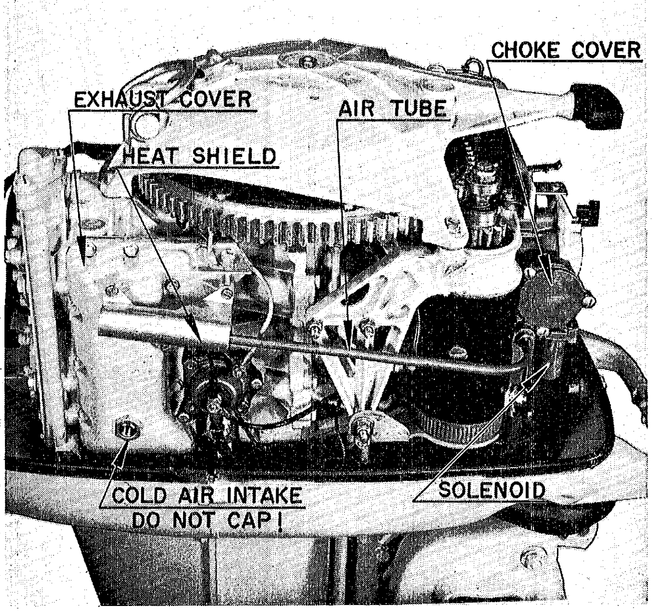


Figure 1

Basically, the new hot-air system consists of the following parts: (1) a heat exchanger inserted into the exhaust cover plate which is used to warm the air that is being supplied to actuate the bi-metal, (2) an air carrying tube which connects the heat exchanger to the choke housing, (3) a calibrated bi-metal element in the choke housing, hooked at one end over the choke shaft arm to effect the proper amount of butterfly choking action, and, (4) a vacuum passage – channeled through the carburetor – which connects the choke housing to the intake manifold to create the necessary suction that is required to cause air to flow through the choke system.

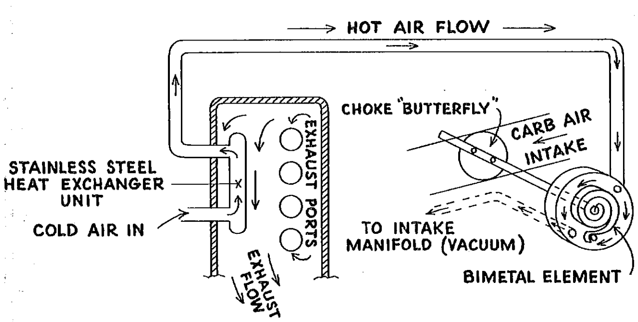


Figure 2

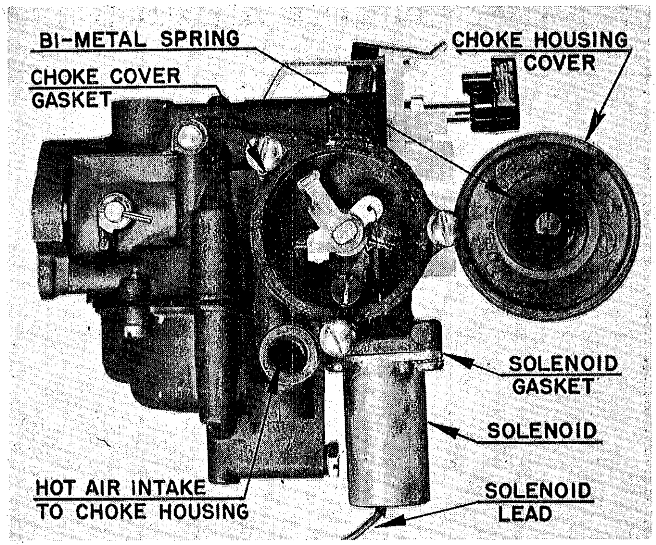


Figure 3

The bi-metal element in the choke housing is calibrated to hold the choke butterfly in a closed position when the engine is cold. Once the engine is started, air velocity through the carburetor intake acts against the offset butterfly and forces it open slightly against the torque of the bi-metal element.

In addition to this, heated air is almost immediately drawn from the heat exchanger and circulated around the bi-metal, causing the bi-metal to relax its torque against the choke shaft arm. This, together with continual air velocity against the choke butterfly, causes a gradual opening of the choke until wide open position is reached. In this manner, the degree of choke valve opening is always proportionate to the temperature of the air warming the bi-metal element.

An electrical solenoid is also incorporated into the new hot-air choke system to increase the effectiveness of the choke when starting the engine. Turning the ignition key to "start" position completes a circuit between the battery and choke solenoid. The solenoid plunger pulls through a spring which is attached to an arm which rotates about the choke shaft to hold the choke completely closed as long as the key switch is held in "start" position.

This circuit between the battery and solenoid is automatically broken when the operator returns the key to "on" position after the engine has started. At this point, the degree of choke closing is controlled entirely by the bi-metal element.

Use of electric choke solenoid is to provide full choking only when starting the engine. It should be noted, however, that even though a direct electrical connection exists between the "S" terminal of the ignition switch and choke solenoid, there is a means by which this circuit can be interrupted while the key is in "start" position – to prevent flooding should the engine fail to start after several seconds of cranking. Such solenoid uncoupling, as it were, is achieved by inserting a toggle switch *(override)* in the circuit between the ignition switch and solenoid. Pressing and holding the override toggle will interrupt the electrical circuit to the solenoid. Releasing the toggle again completes the circuit, and the solenoid becomes operative – providing the ignition key is still being held in "start" position.

To prevent stalling when warming up a cold engine, it is necessary to run the engine at a slightly higher RPM. On manual shift engines (models RDS) this is accomplished by moving the shift lever into *neutral gear* followed by advancing the throttle lever toward FAST (as far as it will go) (Figure 4) before starting the engine. On Electramatic engines (models RK) this is accomplished by moving the Remote Control Box red auxiliary throttle lever to full "start" position (Figure 5) before starting the engine. **Full advance is imperative for starting.**

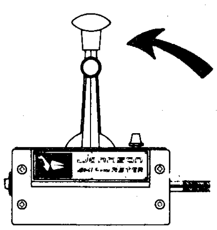


Figure 4

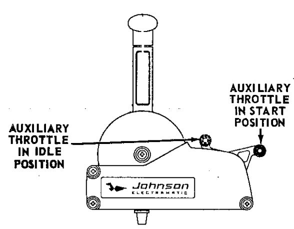


Figure 5

After the engine starts the fast idle setting should be reduced slightly until the engine has warmed up thoroughly. After warm-up, engine idle speed should then be returned to normal.

In the event the electric starter does not operate when the engine is placed in fast idle position, hold the starter key in "start" position and gradually retard the throttle (RDS) or auxiliary throttle (RK). Should the engine start only after the throttle has been retarded slightly, the safety switch setting should be re-adjusted.

In addition to safety switch adjustment, Electramatic models may also require adjustment in the remote control box (explained below in step six). Proceed as follows with safety switch adjustment:

1. Disconnect white wire from safety switch (Figure 6).
2. Attach leads of continuity meter to safety switch, one lead to terminal normally occupied by electrical lead, the other to safety switch bracket (Figure 7).

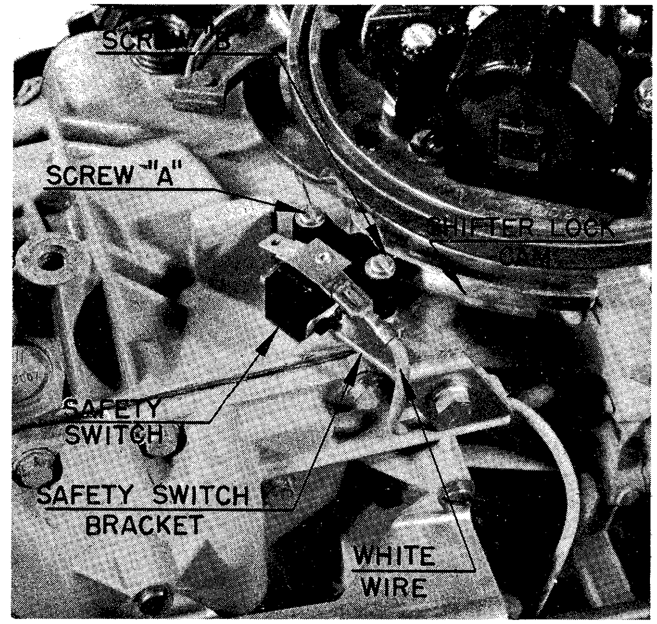


Figure 6

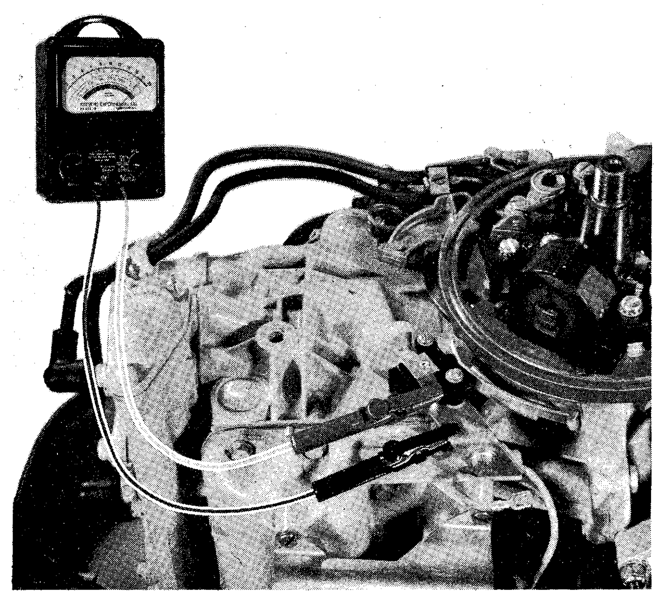


Figure 7

3. Retard armature plate to idle position. Continuity meter should now indicate that switch contacts are closed.
4. Advance armature plate slowly and stop the moment meter needle drops off to a "no continuity" reading (Figure 7). End of shifter lock stop should now be 1/4″ from boss on cylinder (Figure 8). If this dimension is off, adjust switch and re-check setting until specified dimension is attained.

NOTE: Loosen screws A and B (Figure 6) to adjust switch. If contacts break early, move switch assembly *towards* shifter lock cam. If contacts break late, move switch *away from* shifter lock cam.

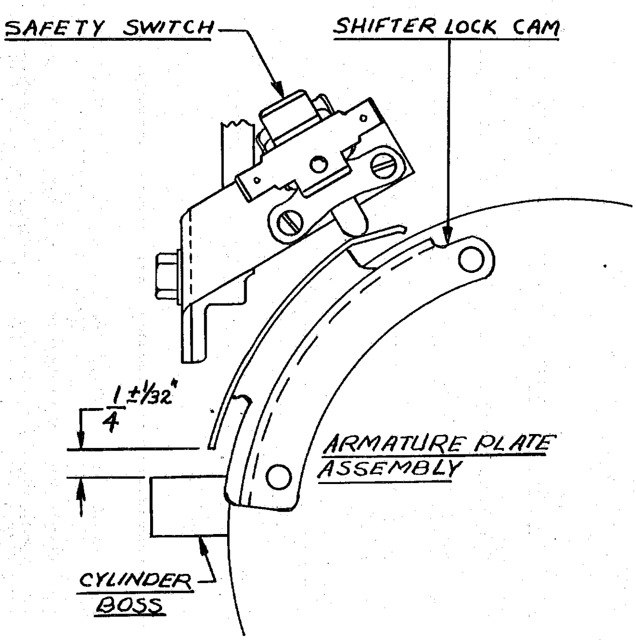


Figure 8

5. (Models RDS only.) Return to remote control box, shift engine into neutral, advance throttle lever towards FAST position until it stops. Starter should now crank motor.
6. (Models RK only.) Return to remote control box; move auxiliary throttle lever to "start" position and attempt to start engine. If starter will now crank engine, safety switch and control box are properly adjusted. If starter does not crank engine, however, move auxiliary throttle to full forward (idle position) and adjust idle stop screw 1/2 turn *counterclockwise* with small screwdriver (Figure 9). Move auxiliary throttle back to maximum "start" position and turn starter key to crank engine. Repeat this procedure, if necessary, until safety switch permits starter to crank engine. No further adjustment is normally required.

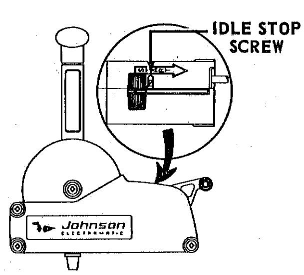


Figure 9

SERVICE OPERATIONS

Initial hot-air choke setting is achieved by aligning the choke cover groove with the center index mark on the choke housing. This setting is recommended for average warm weather use.

Operation of the engine in colder climates will necessitate an increase in the amount of choking action required for the starting and warming-up periods. This is attained by loosening the three choke cover retaining screws sufficiently to permit rotating the cover *clockwise* as required. Several marks richer should be sufficient for average cold weather use, although the choke may be adjusted slightly richer if so warranted by extremely cold temperature conditions. The exact amount of choke richening is ultimately dependent on prevailing local temperatures.

Operation of the engine in hot climates usually necessitates a decrease in the amount of choking required. Choke tension can accordingly be relieved by rotating the cover *counterclockwise* (several notches should suffice) to lessen bi-metal element tension on the butterfly. Prevailing local temperatures will determine the exact setting required.

Whenever a change in choke setting is made, it is important that the three cover retaining screws be re-tightened securely to prevent air leakage around the housing-to-cover gasket. Operation of the choke will be affected if the gasket is not completely sealing the hot-air chamber, and continual overchoking will usually result during and even after warm-up due to the entry of cold air into the choke housing. Therefore, it is recommended that this gasket be replaced when changing the choke setting if it is not in otherwise good condition.

Conditions of overchoking or underchoking may be detected by the manner in which the engine performs during start and warm-up. If the engine has a tendency to backfire during starting and persists in "popping" during warm-up, it can be assumed that the choke is set too lean. If, on the other hand, the engine "four cycles" during warm-up and continues to smoke profusely even after normal operating temperature is reached, it can be assumed the choke is set too rich. In either instance, the choke setting must be corrected for proper operation.

The **CHOKE SOLENOID** is held to the choke housing by a retaining plate and two screws and has no adjustment. Note that here, too, a gasket is inserted under the solenoid to prevent cold air induction. In event this gasket is not sealing properly, it should be replaced to prevent possible overchoking.

Operation of the solenoid may be checked by observing action of the choke butterfly when the engine is being cranked. If the butterfly is drawn completely closed during cranking, the solenoid may be assumed operable. The solenoid must also release the butterfly when the override switch is depressed during cranking.

If the solenoid does not draw the butterfly closed, it should be checked with an OHM meter. The model shown in Figure 10 is **STEVENS AT-100 VOLT/OHM** Meter. Set meter to LO OHM scale and calibrate needle. Then attach one lead to solenoid's electrical terminal, the other to ground on the coil case. Measurable resistance should be approximately three (3) OHMS if solenoid is good. An infinity reading indicates an open winding in the solenoid; a very low OHM reading indicates an internal short, both of which necessitate solenoid replacement.

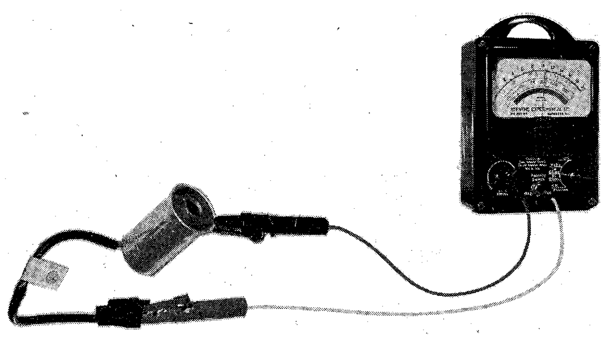


Figure 10

Should the OHM meter check prove that the solenoid is satisfactory, proceed to check the electrical wiring between the solenoid and ignition switch for possible loose connections or shorts. A red and white striped wire is used between the red solenoid pigtail lead and the override switch, while a white wire is used between the override and the "S" terminal of the ignition switch. All connections should be tightened. Any fraying of insulation on the electrical wiring which could be causing a short should be repaired.

Construction and operation of the 1964 – 40 HP carburetor has not changed from previous 40 HP models. Specifications required for initial setting-up of the carburetor after disassembly are as follows:

Float Height – Level with gasket surface of carburetor casting (carburetor body inverted).

Slow Speed Needle – 7/8 turns out.

When adjusting the carburetor float, always make sure the float arm is straight as shown in Figure 11. In event the float arm is bent (Figure 12), fuel level in the float bowl will be low, an overall condition of leanness can be expected throughout the entire operating range of the engine and a noticeable flat spot will appear in mid-range due to the lack of fuel in the high speed nozzle at the moment of transition from slow to high speed circuits in the carburetor.

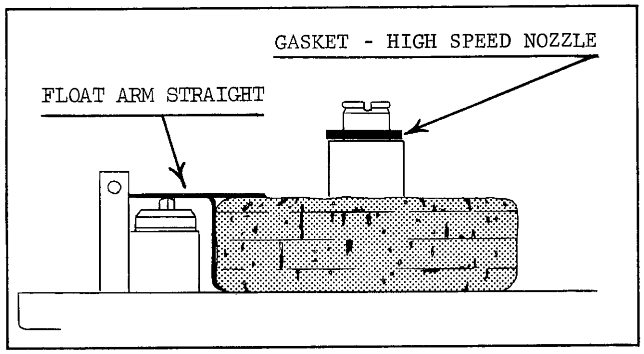


Figure 11 – PROPER ADJUSTMENT

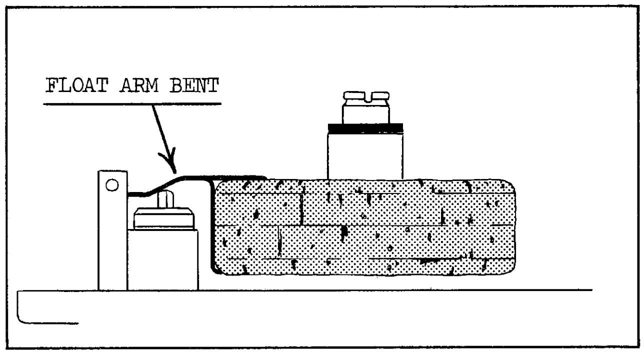


Figure 12 – IMPROPER ADJUSTMENT

It is also recommended that the float bowl gasket and high speed nozzle gasket be replaced before assembling the carburetor float bowl after float adjustment. (Location of high speed nozzle gasket is shown in Figure 11.)

NOTES

NOTES

HARD STARTING AUTOMATIC CHOKE ENGINES

It is indicated by reports from the field and our own testing that difficulty is being encountered occasionally starting the automatic choke engines with the choke set in the automatic position. Further reports and tests indicate that the hard starting only takes place after the engine has been subjected to lay-up or occasional usage such as on weekends only.

This type of hard starting is not to be confused with other types where something may be at fault in the assembly or the parts themselves. We have found this condition occurs because the gasoline mixture left in the carburetor bowl, at the time the engine is stopped, will evaporate partially, releasing all of the "light ends" from the fuel, and what is left is not an easy starting or good running fuel. Even if the fuel line primer bulb is squeezed before starting, and fresh fuel from the tank is introduced into the bowl, the resulting mixture is diluted with the evaporated mixture and requires more starting effort.

The lack of fresh fuel thus necessitates the use of the manual choke to provide an extra rich mixture for the initial starting after lay-up. This manual choke is very stiff, and will start the engine under conditions where it cannot be started with the automatic choke. We have found in cases where engines have been standing for long periods, the manual choke will always start the engine. After the initial starting place the choke lever in the automatic position, as it will not be necessary to choke the engine further manually. Should the engine be subject to only occasional usage it may be necessary to choke manually for the initial start each time the engine is used.

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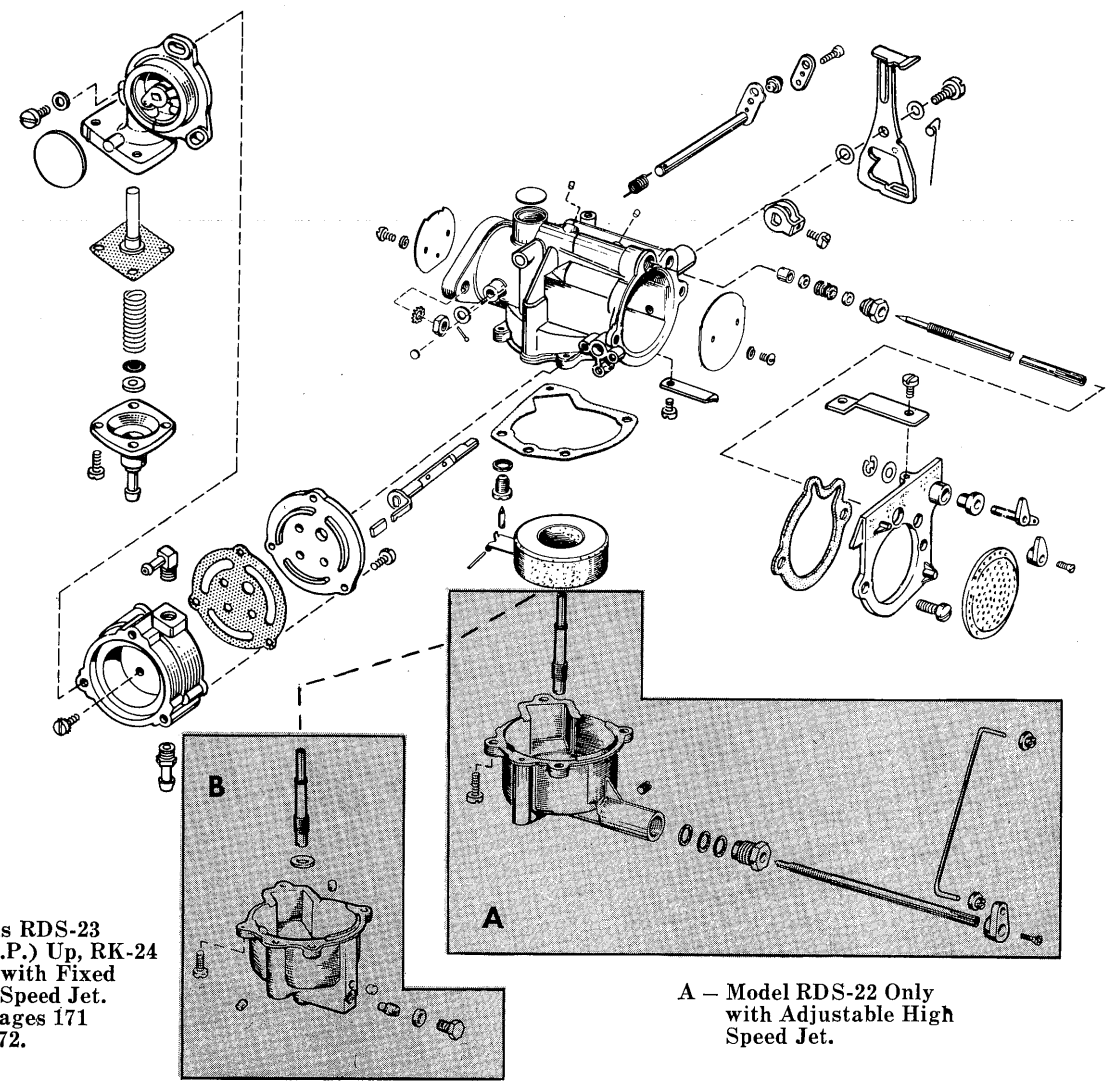
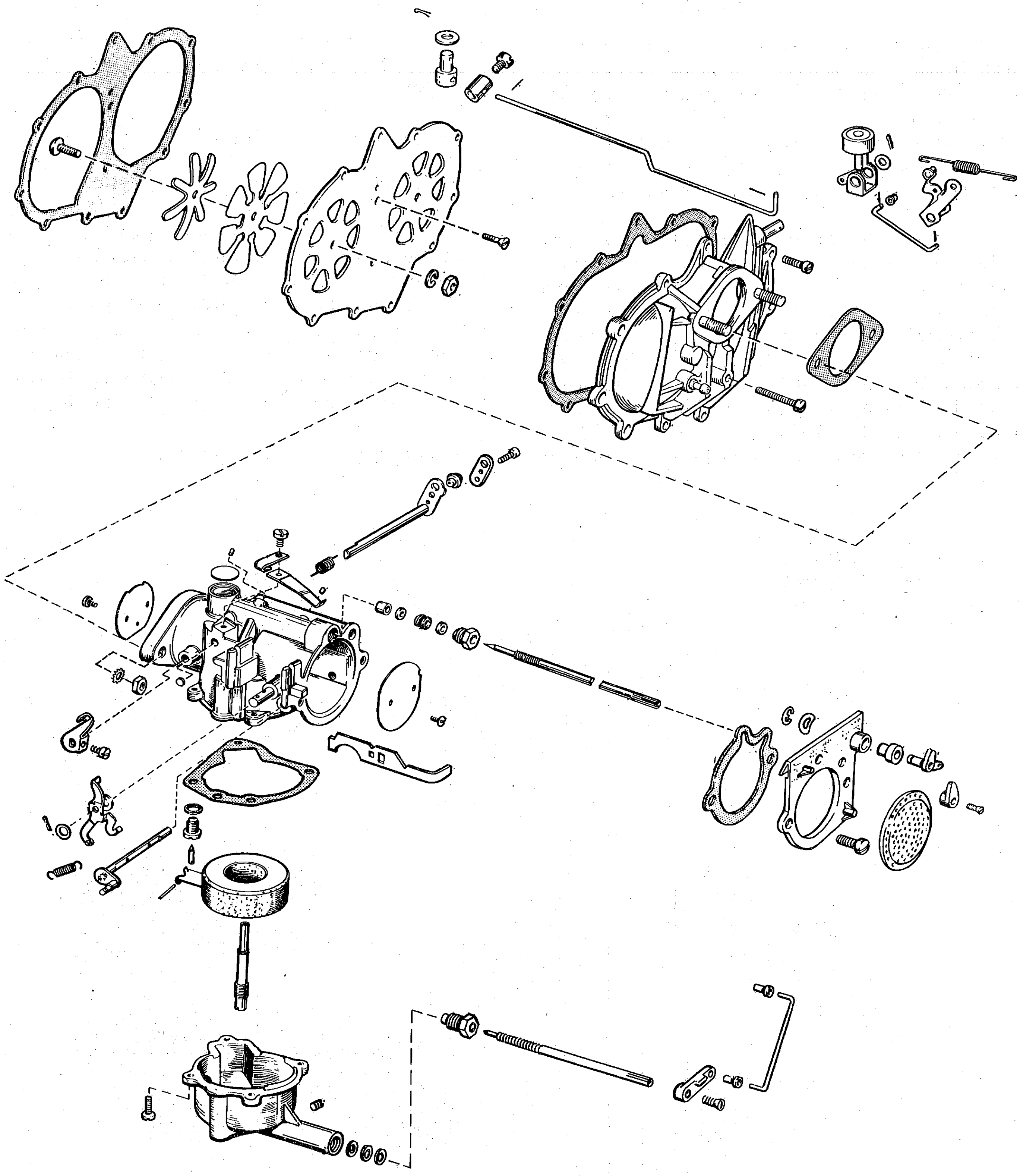


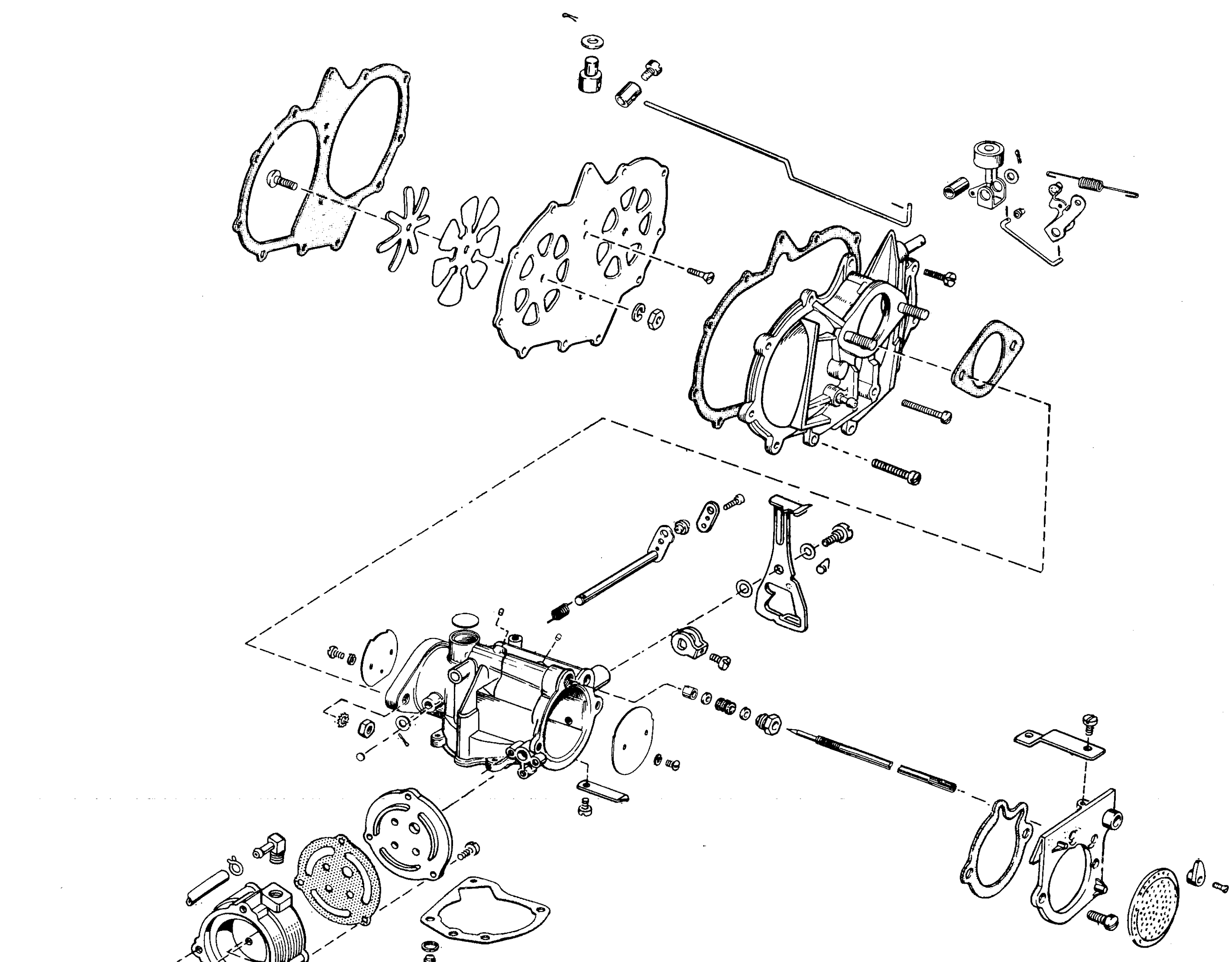
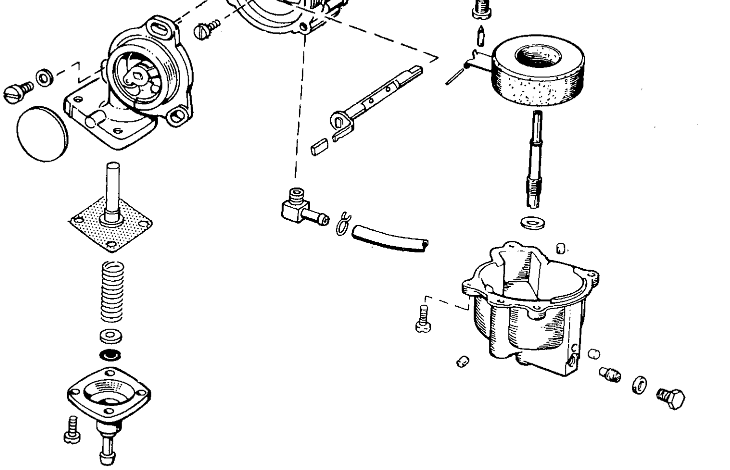
B – Models RDS-23 (40 H.P.) Up, RK-24 Up – with Fixed High Speed Jet. See Pages 171 and 172.

A – Model RDS-22 Only with Adjustable High Speed Jet.

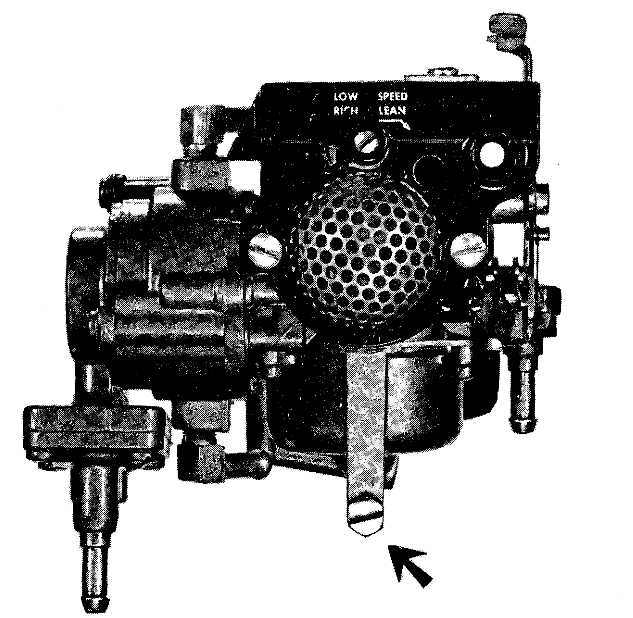
Extended view of Carburetors and Automatic Choke Assembly – Models RDS-22 (40 H.P.) Up, RK-24 (40 H.P.) Up



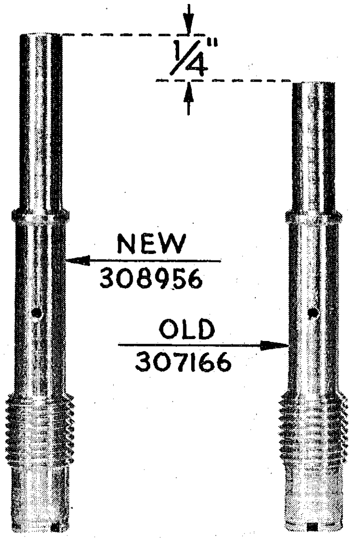
CARBURETOR GROUP
Models RX-RXL-10C (28 H.P.) Up

CARBURETOR GROUP
Models RDS and RK up



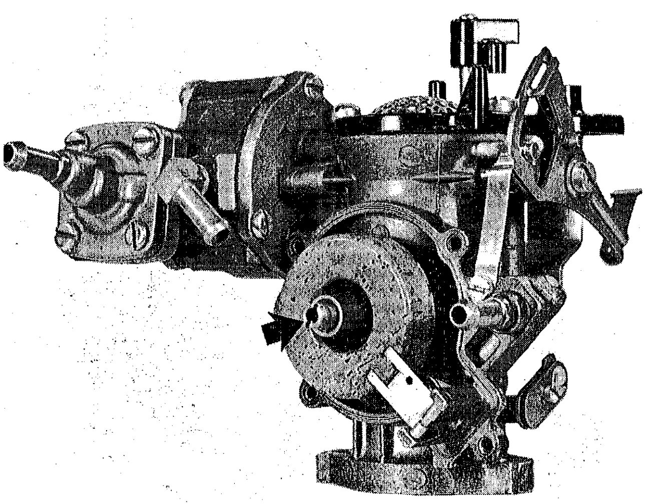
Carburetor Model RD Series – 1961 up. Note that high-speed Needle (adjustment) has been deleted and replaced with a fixed Jet.



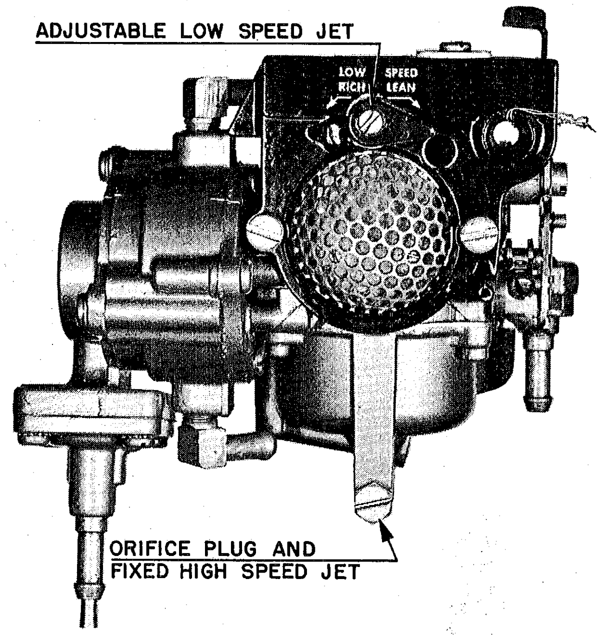
Showing both new and old style high-speed Fuel Nozzle. New style Nozzle used on 1962 Model Engines.

The modified high-speed fuel nozzle used on 1962 – 40 h.p. engines is approximately 1/4″ longer than those used on 1961 – 40 h.p. engines.

The modified nozzle can also be used on those 1961 engines which do not develop the recommended full throttle rpm even though compression is satisfactory, and the magneto, spark plugs and carburetor are properly adjusted and function correctly. Where these conditions exist on the subject engines, and provided also that the rpm loss is not caused by, (1) excessive carbon and/or petroleum gum, (2) an incorrectly propellered engine, (3) induction system leaks, etc., installations of the new nozzle will correct this rpm deficiency.



Illustrating location of high-speed Nozzle in Float Chamber.



A fixed high speed jet was first used on Models RD, RDS-23 (40 H.P., 1961) in place of the adjustable type previously used, to simplify carburetor adjustment. This practice was continued on 40 H.P. engines manufactured after 1961, including the Models RK-24 up.

Removal of this high speed jet should be accomplished with a screw driver that has a blade NOT WIDER THAN THE SLOT IN THE JET. This will prevent damage to orifice plug threads.

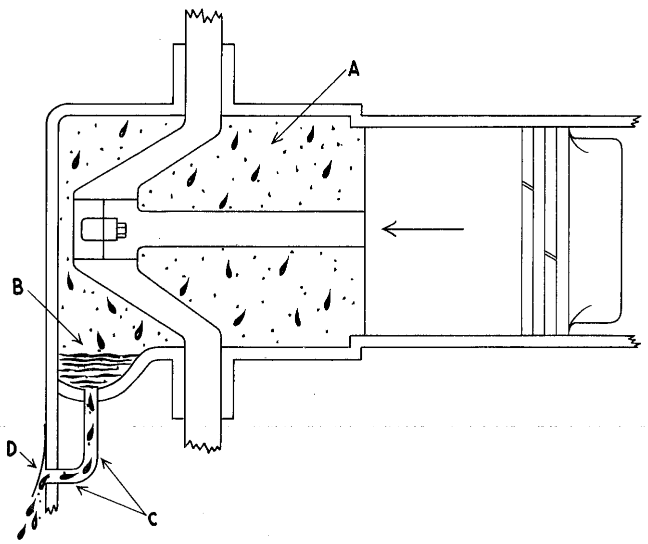
Here are two methods of obtaining a screw driver of proper size for fixed jet removal.

1. (a) Using a round shank screw driver, any length from 6″ to 10″, which has a shank diameter of 1/8″ minimum, 3/16″ maximum . . .
   (b) Grind width of the blade's flare to above dimensions to obtain a straight blade.
   (c) Bevel sharp edges formed by grinding to further reduce chance of damaging threads.
2. Purchase commercially a screw driver designed for occasional carburetor work. These have a round, straight shank (no flare of the blade), and vary in length to provide for any required reach. Since changing carburetor jets is an old practice in the automotive field, such screw drivers are readily available from local automotive parts houses, tool jobbers, etc. Be certain the shank's dimensions fall within the specified 1/8″ minimum, or 3/16″ maximum.

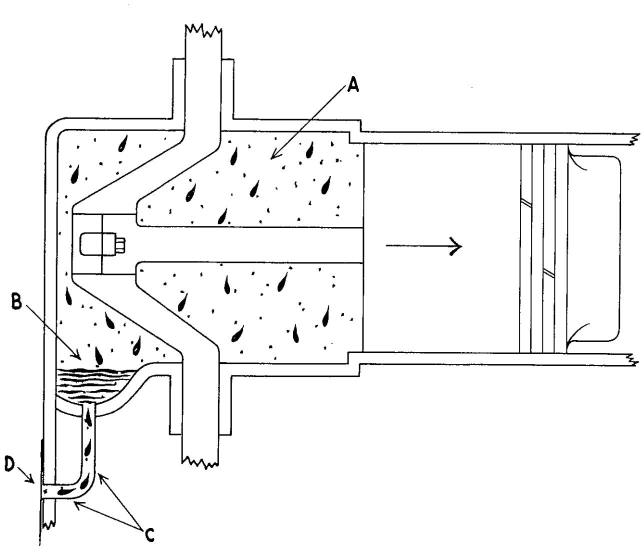
CRANKCASE BLEEDER BASIC ALL MODELS

Schematic drawings shown here are to illustrate crankcase bleeder action which becomes active with slow speed operation as when idling or trolling.

Maximum vaporization of the fuel mixture (after leaving the carburetor) is dependent upon degree of crankcase and manifold turbulence or "agitation" created by higher air velocities and the revolving crankshaft and movement of the piston. Constant or high velocity action is required to maintain suspension of all fuel particles for complete combustion and best performance.

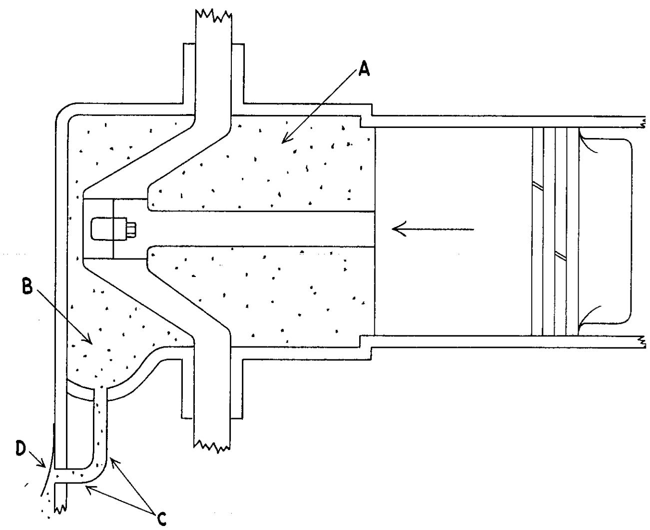


During periods of "slow" running, velocity or turbulence in the crankcase correspondingly diminishes to result in the heavier fuel particles "settling out" or condensing — characteristic of petroleum fuels. Eventually an accumulation of liquid fuel "pools" to slosh around in the crankcase and as such, contributes to faulty slow and intermediate speed operation, excessive carbon accumulation "smoky" exhaust and evidence of "choking" when accelerating unless means are provided for its dissipation.



On downward stroke of the piston, pressure is built up in the crankcase — bearing down on surface of the condensed pool "B" causes bleeder valve (flapper) "D" to be lifted from its seat, thus permitting a portion of the condensed fuel escaping.

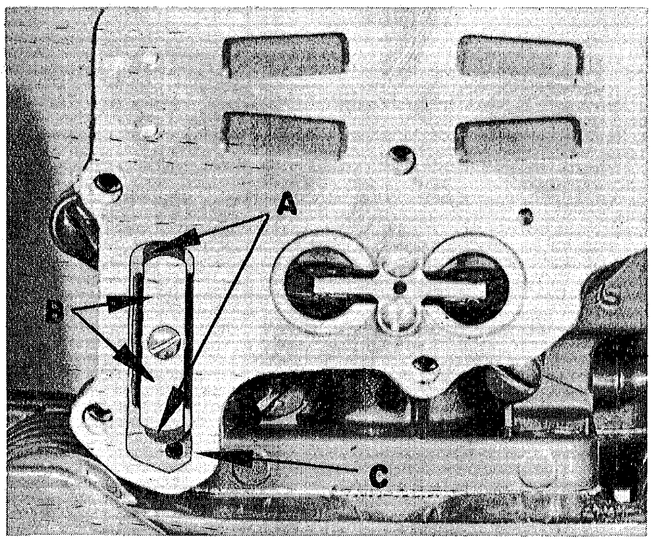
On the succeeding upward stroke, pressure diminishes and crankcase suction occurs when the bleeder valve "springs" back on its seat. However, crankcase pressure recurs on the following downward stroke to further clear the crankcase of condensed fuel which is eventually discharged into the exhaust system to account for the "oil slick" frequently observed as trailing on surface of the water when running at slow speed.



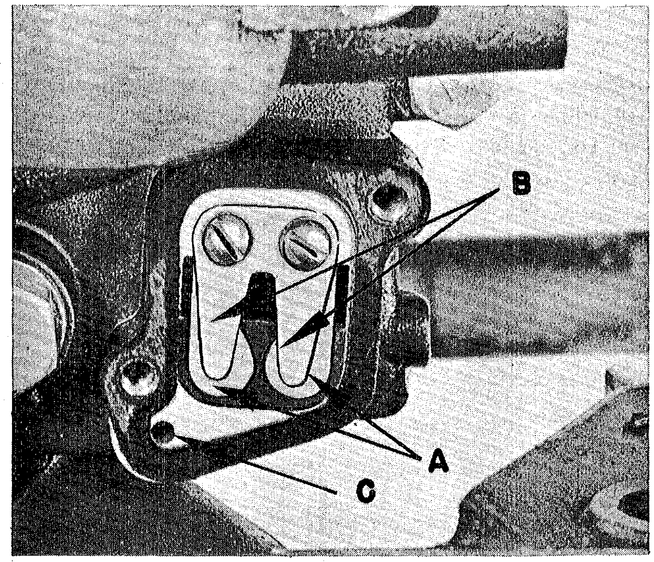
With increasing of motor speed (RPM's) turbulence or velocity in the crankcase is progressively increased to maintain suspension of a greater portion of the fuel particles (less condensation or settling out) — subsequently less bleeding of condensed fuel. The heavier fuel particles still continue to condense out but only to a point of where rate of turbulence (governed by motor speed) in the crankcase is sufficient to hold all particles of the fuel mixture in suspension at which time "bleeding" is reduced to practically nil, as sketch above indicates.

The bleeder valve arrangement as described functions at all times regardless and throughout entire speed range of the motor; when not bleeding liquid or condensed fuel (high speed) crankcase pressure loss (if any) is of little significance due to the extremely small bleeding orifice and rate of motor speed.

Ordinarily the bleeder system requires little or no attention except that when conducting major repairs, it is advisable to remove the bleeder valve and as precautionary measure "blow out" the bleeder channels or drains with high pressure air to insure against possible clogging later on. Should there be evidence of gum or varnishing within the crankcase, run a fine wire through the channels, being careful not to injure the bleeder valve seat. Make sure at this time that the bleeder valve comes to rest squarely on its seat when reassembling and that the supporting back strip is properly installed to permit function of the bleeder valve segments. Note—The Model CD bleeds only from the intake manifold chambers — top and bottom.



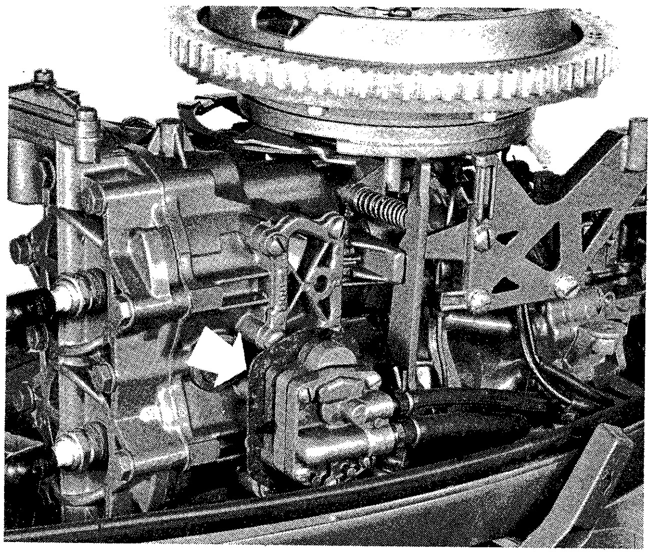
Illustrating arrangement of bleeder assembly as employed in construction of all models, except QD-11 through 14, RD and RX Series. "A" – bleeder valve; "B" – back strip to guide movement of bleeder valve; "C" – bleeder discharge.



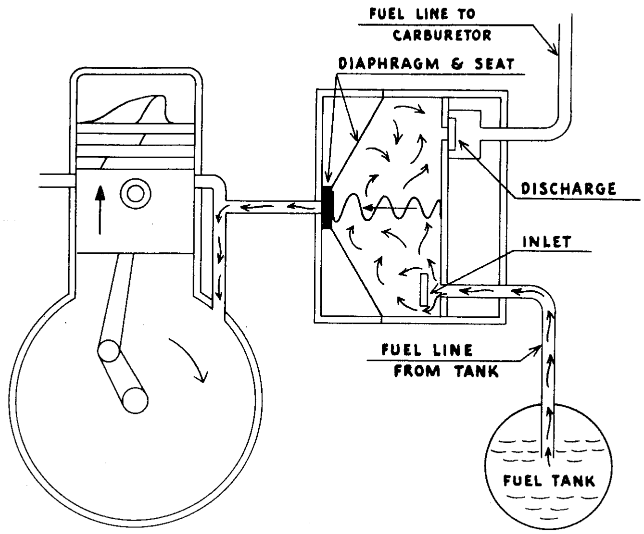
Showing arrangement of bleeder valve assembly as installed on the Model RD and QD previous to QD-15. "A"—bleeder valve segments; "B"—back strips to guide action of bleeder valves; "C"—bleeder discharge.

NOTES

THE FUEL PUMP



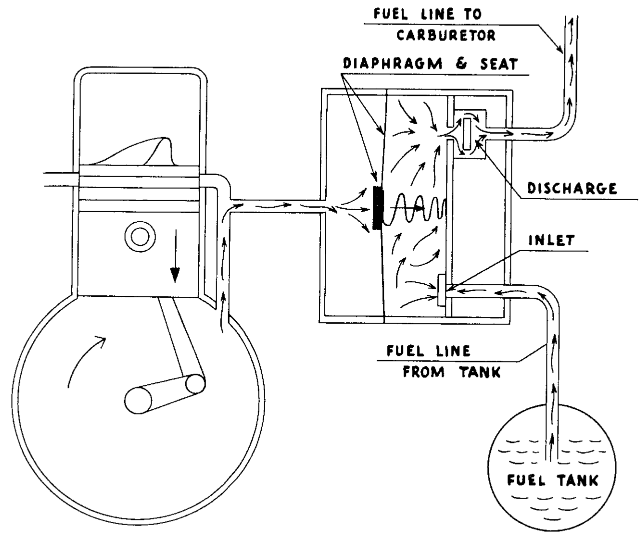
Fuel Pump Installation – Models CD, QD and FD (1962 up).



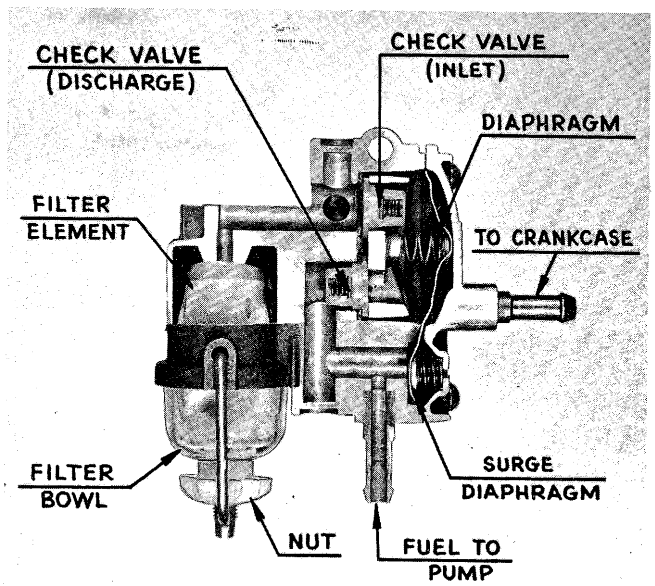
Schematic drawing to illustrate position of diaphragm, inlet and discharge (valve) discs on upward stroke of the piston and flow of fuel from tank to pump—suction. (Note —Inlet and discharge (valve) discs are spring loaded in the assembly but not shown here for simplicity of illustration.)

The familiar pressurized fuel system has been replaced by a fuel pump, non-pressurized tank and obviously a "single" fuel line with coupling assembly.

The pump assembly as observed from the illustration, is attached to the intake manifold immediately below the carburetor. It is of the diaphragm displacement type – operated by crankcase impulses and by means of a flexible tube leading from the diaphragm side of the pump to the lower crankcase chamber. In addition to the spring loaded diaphragm, the assembly includes two similarly spring loaded disc valves – inlet (suction) and outlet (discharge). Alternate suction and compression occurring in the crankcase as created by travel of the piston through its cycle, causes the diaphragm to pulsate. On upward stroke of the piston, the diaphragm aided by a spring loading, is caused to flex inward thus displacing volume on its opposite side to create "suction" and subsequently liquid fuel to be "drawn" in by way of the inlet (disc) valve.

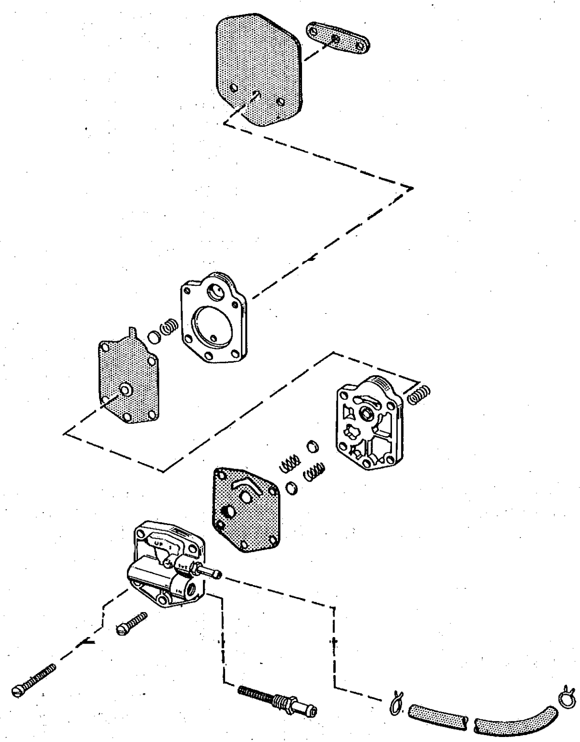


Schematic drawing to illustrate position of diaphragm, inlet and discharge (valve) discs on downward stroke of the piston and flow of fuel from pump to carburetor.



Sectional View of Fuel Pump.

On the following downward stroke of the piston, resultant crankcase pressure causes diaphragm flexing in the opposite direction to exert pressure against both the inlet and discharge discs. The disc for inlet is thus forced against its seat to prevent fuel returning to the tank, the discharge disc is simultaneously forced off its seat – liquid fuel "trapped" by the pulsating diaphragm then flows directly into the carburetor float chamber. Constant action or pulsation of the diaphragm as described results in a steady flow of liquid fuel to the carburetor.



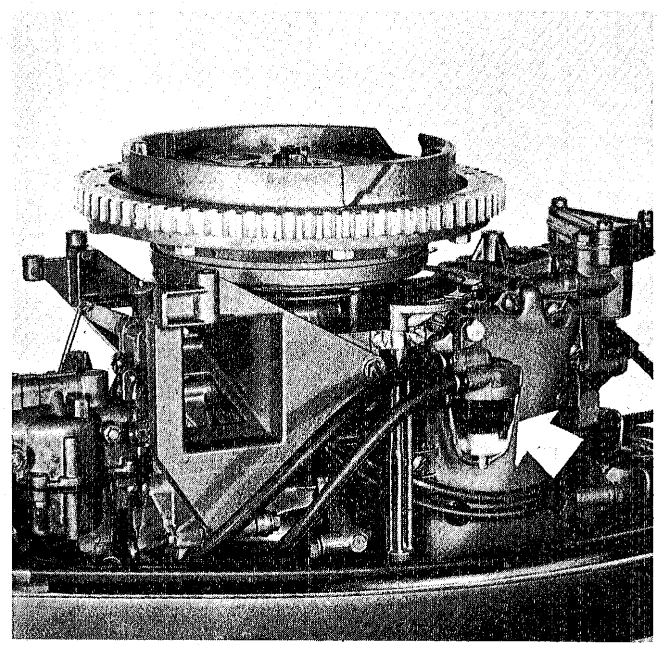
EXTENDED VIEW OF FUEL PUMP
Models CD, QD and FD

Fuel filter change
5½ h.p. CD(L)-16 thru 18S (1959 thru 1961);
18 h.p. FD(L)-11 thru 15F (1957 thru 1961);
18 h.p. FDE(L)-11 thru 12 (1957 thru 1958);
35 h.p. RD(L), RDE(L) & RJE(L)-19 & 19M ('57);
35 h.p. RD(L) & RDE(L)-19C (1958).

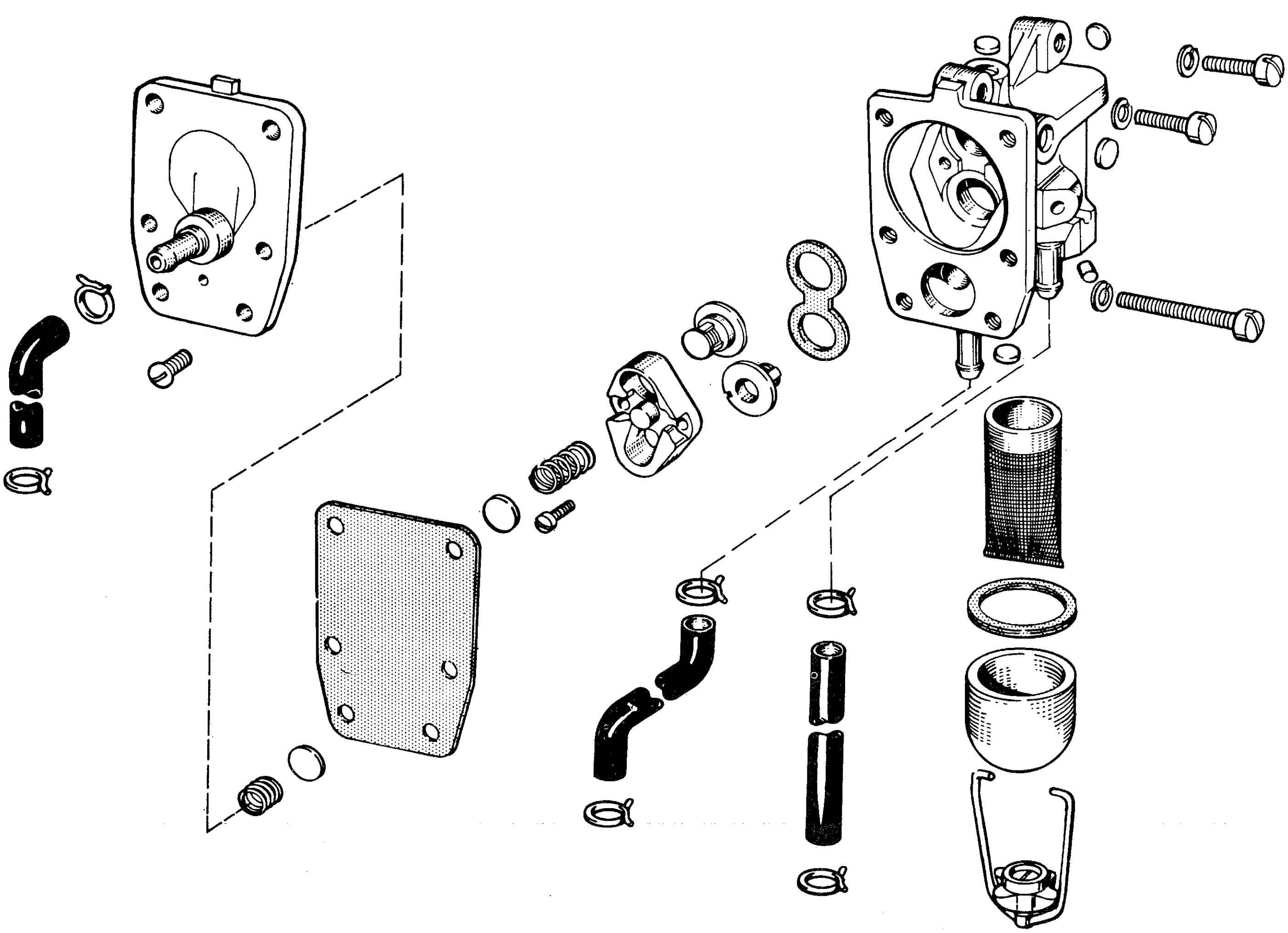
The 1962 model series QD and FD engines use a new fuel filter, part #378576, which has an improved filter element of saran plastic similar to the filter elements used in 40 and 75 h.p. engines. An additional change is a relocation of the fuel outlet passage in the body and nipple assembly which provides for an improved flow of gasoline through the filter with the new filter element.

The new filter assembly will also be serviced on the older engines listed above. However, because of the change made to the body and nipple assembly, the new filter element cannot be used in the old filter and vice versa. Therefore, whenever the old style filter assembly, #377599, or the old body and nipple assembly, #376836, require replacement, the new filter assembly complete, #378576, must be installed. Thereafter the following detail parts must be serviced as required. These parts also appear in the parts catalogs for the 1962 QD and FD engines.

378576	Fuel filter assembly complete
302675	Gasket
303967	Bowl
308239	Filter element
377600	Nut and yoke assembly
378575	Body and nipple assembly



Fuel Filter Installation – Models CD, QD and FD (1962 up).



EXTENDED VIEW OF FUEL PUMP

Models RDS-20, RD, RDS-21 Up, RK-24 Up and RX-10C Up.

FUEL PUMP FAILURES
35 AND 40 H.P. ENGINES

Improper operation of the fuel pump may be caused by the entrapment of oil in the fuel pump affecting its output. This oil, which originally is part of the fuel mixture, enters through the elbow (306266) located in the transfer port cover. It will collect over a period of time and finally affect the flow of crankcase pressure actuating the pump or the action of the pump itself. When the pump or hose is removed, the oil will drain away.

We have found that enlargement of the original 3/16″ hole in the elbow to a 7/32″ opening will eliminate this problem. All elbows used and serviced now have this new size passage.

This modification can easily be made. Remove the elbow and redrill the passages to the new 7/32″ dimension. Blow out the line leading from the elbow to the pump and reassemble.

The modified elbow retains its original part number (306266).

We recommend that these elbows be checked as part of your routine tune-up and modified or replaced, as necessary.

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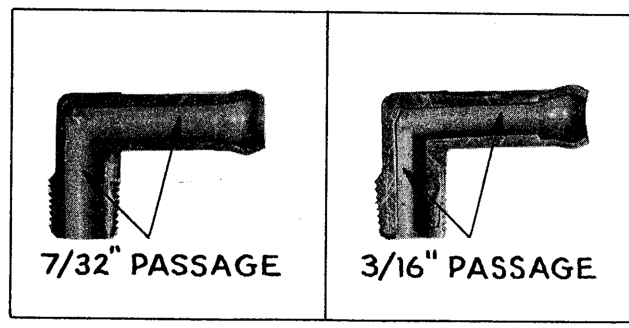
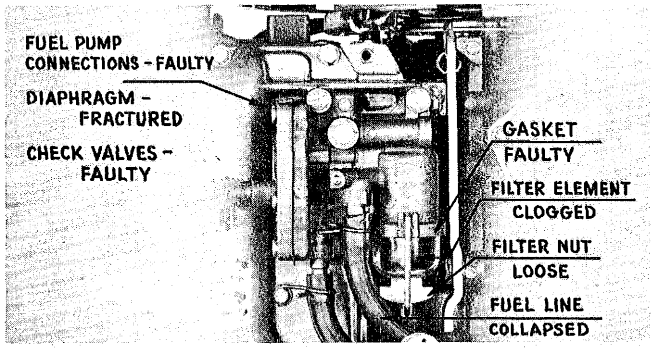


Volumetric capacity of the pump is 6+ gallons per hour at approximately 6 pounds pressure per square inch. Will lift the fuel mixture 20+ inches.

Little difficulty, if any, will be encountered, except perhaps for possible leaks in the "pressure" or "suction" lines — copper or the flexible neoprene tubing; a punctured diaphragm or air leaks between sections of the pump assembly and/or disc valves not properly seating.



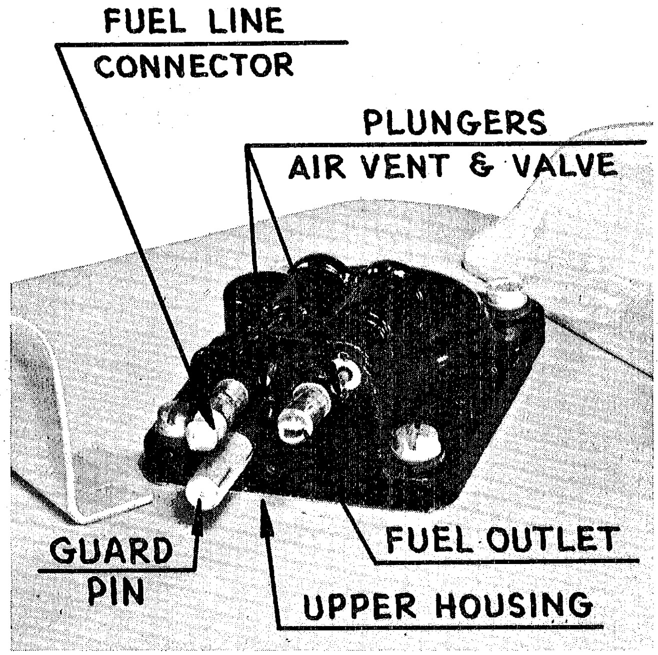
Fuel pump diagnosis chart.

THE FUEL TANK

Fuel tank and fuel line assembly – capacity, 6 gallons.

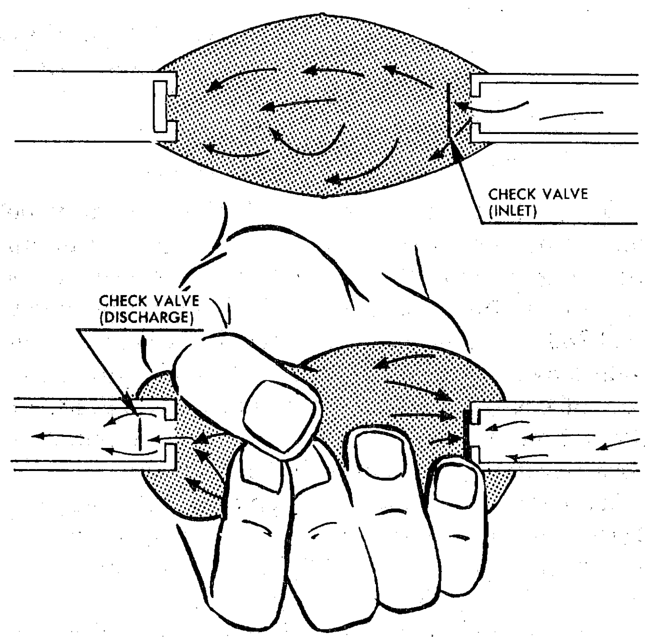
The fuel tank as mentioned previously is not pressurized and as such, not vented in familiar manner – venting being accomplished by a spring loaded disc activated by attaching of the fuel line coupler. When at rest with the fuel line uncoupled, the spring loaded disc comes to rest against its seat to close the vent; during process of attaching the fuel line coupling, the two small steel plungers (shown in the illustration) are depressed and subsequently force the discs off their seats to vent the tank and to the fuel passage to the pump.

A guard pin has been added to the gas tank upper housing on newer style tanks – which prevents improper attachment of the fuel line connector, this eliminates any possible damage to the O-ring seal in the fuel connector.

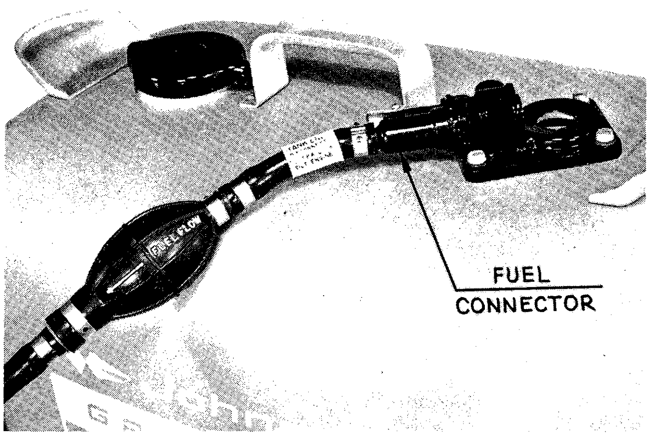


Showing fuel line connector – fuel outlet, connector, guard pin and vent plungers.

A bulb with necessary check valves included has been inserted into the fuel line to prime the pump – accomplished by compressing the bulb several times with hand. The bulb end of the fuel line should be attached at the fuel tank end – note arrow indicating direction of fuel travel.



Schematic to illustrate function of the primer bulb.



Showing primer bulb installation. Note: Arrow indicating direction of fuel flow – bulb installed at tank end of the fuel line.

Since most RD installations will undoubtedly be of a more or less permanent nature, it is assumed that a permanently installed fuel tank of greater capacity will be considered. This phase of the installation should be left to designer/builder of the craft or operator; however, its construction and all connecting fittings should conform to the current Fire Protection Standards for Motor Craft – by the National Fire Protection Association.

NOTE: It is suggested that the tank be fitted with a coarse screen at the outlet baffles and in the event a flat bottomed tank is used, a sump or trough be provided to "trap" part of the fuel at least when level is low, hence avoid running "dry" because of sloshing in a rolling sea.

POOR OR ROUGH IDLING TROUBLE SHOOTING

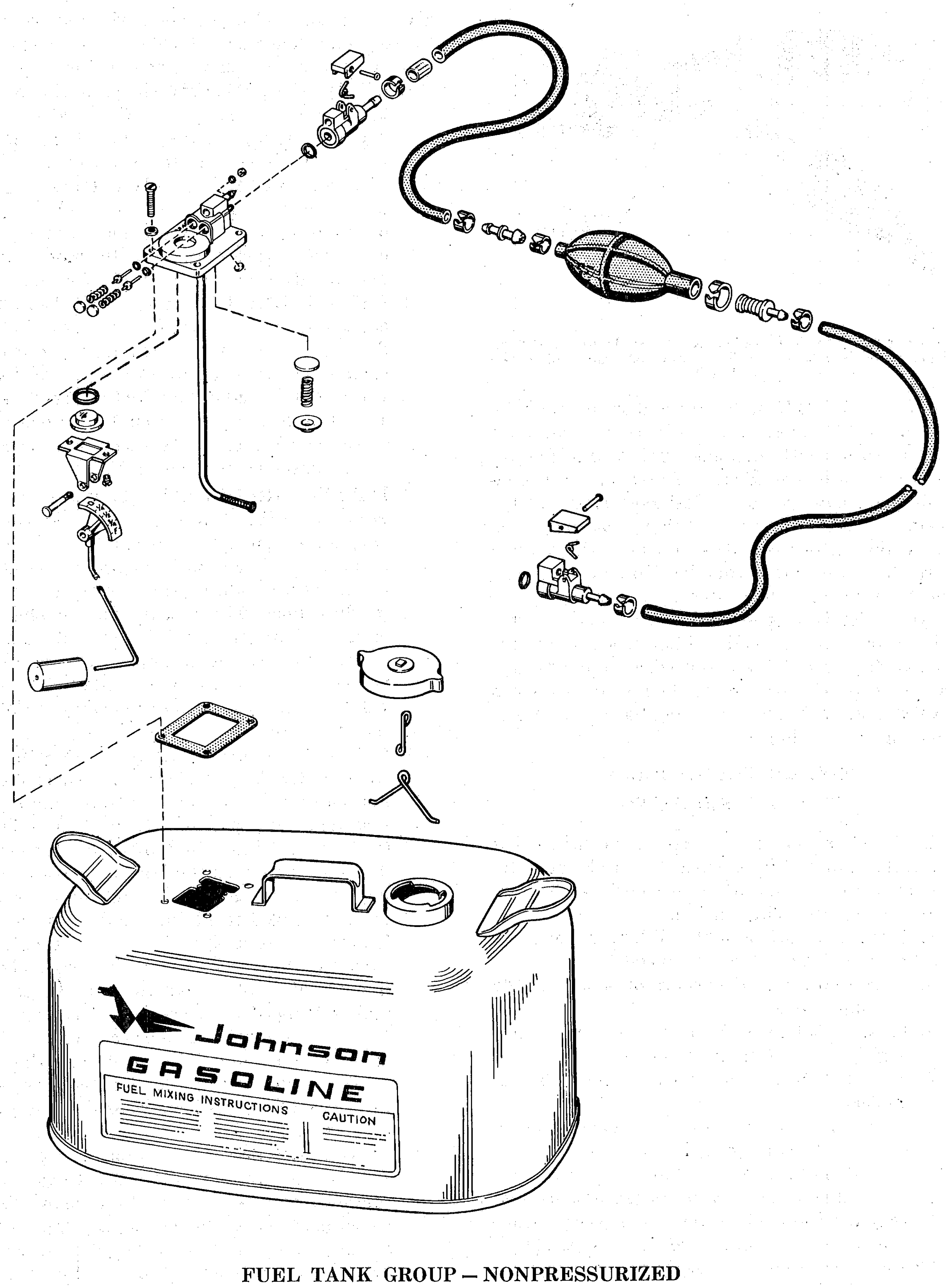
In trouble shooting poor idling, the first thing the technician can do is generally check the exterior of the motor and all adjustments to be sure they are correct. They include:

1. Carburetor adjustment (all h.p. models)
2. Spark advance (all h.p. models)
3. Synchronization of carburetor and magneto (all h.p. models)
4. Fresh gasoline with proper oil ratio thoroughly mixed (all h.p. models)
5. No pinched or kinked fuel lines (all h.p. models)
6. Fuel pump working (all h.p. models except those with gravity fuel systems)
7. Fouled spark plugs (all h.p. models)
8. No binding of internal parts (all h.p. models)
9. Breaker point adjustment and proper functioning of ignition system in its entirety.

These points are often missed; they are however important if the engine is to run as intended at any speed.

In the event all of the foregoing points are in good condition and adjustment, the following internal points should be checked because these problems have also often caused poor idling.

1. **OIL DRAIN SYSTEM:** The oil drains on the larger engines are very critical and *must* be maintained in good condition. Of particular importance is keeping the drain screens clean of accumulated carbon and dirt (these screens are in the reed plate base or in the lower part of crankcase). A plugged-up drain system can usually be recognized by the motor "loading up" after several minutes of idling.
2. **CARBURETOR FLOAT VALVE:** Poor idling can often be attributed to a worn or sticking float valve. The float valve and seat assembly should be inspected at this time; if found worn, replace and adjust float to proper level.
   a. If the float valve is found sticking, clean the carburetor in its entirety to remove the gasoline gum deposits.
3. **DIRT IN CARBURETOR:** Many cases of poor idling have been traced to stray bits of dirt clogging the small passages and orifices of the carburetor. Since such clogging can affect engine performance at any or all speeds, depending upon which passages are plugged, clean the carburetor in its entirety and be certain all passages are open. Exercise caution when removing and replacing needle valves so as not to force packing material into passages.
4. **BOTTOM CARBON SEAL–CRANKSHAFT BEARING:** We have had some cases of engines idling poorly because the bottom carbon seal and O-ring assembly was excessively tight on the crankshaft and thus prevented its seating against the bottom journal bearing. While the carbon seal and O-ring assembly is intended to fit the crankshaft snugly, it must not fit so tightly that the seal spring cannot push it back against the journal bearing. If this problem exists, or if the carbon seal is chipped or cracked, replace the seal. Note that the carbon seal has a narrow, raised flange on one side. When installing the seal on the crankshaft, be certain the side with this raised flange is located toward the journal bearing.
5. **PISTON RINGS:** One or more stuck piston rings will cause poor idling due to excessive compression leakage around the piston. This sometimes causes the engine to jump up and down in the vicinity of 1000 rpm. A scored cylinder will also act in the same manner.
6. **MAIN REED VALVES:** If the main reed valves are not lying flat against the reed plate, poor idling will also be experienced.



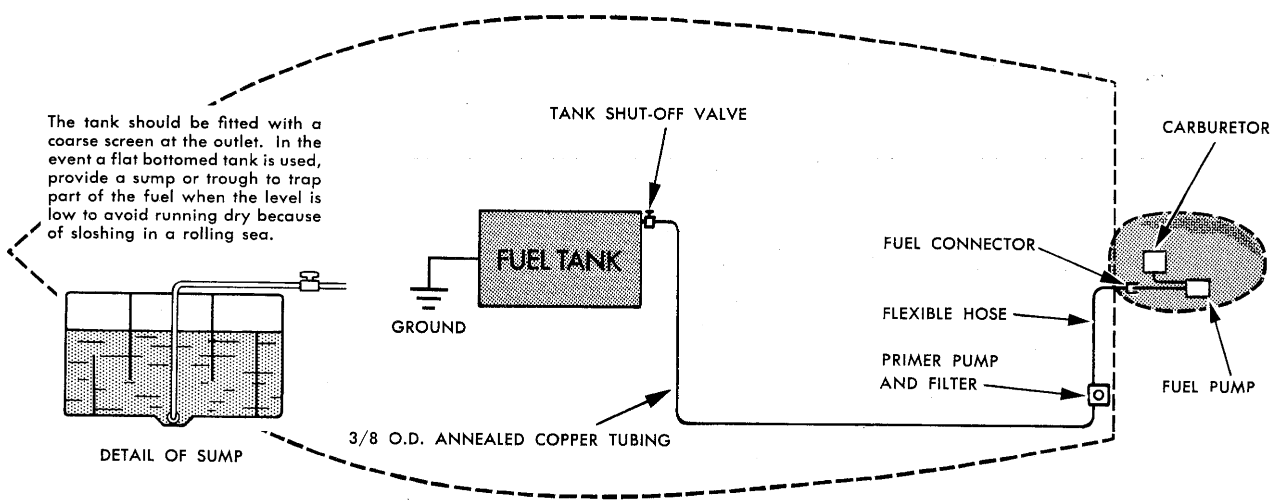
FUEL TANK GROUP – NONPRESSURIZED

GENERAL INSTALLATION INSTRUCTIONS FOR FUEL SYSTEM

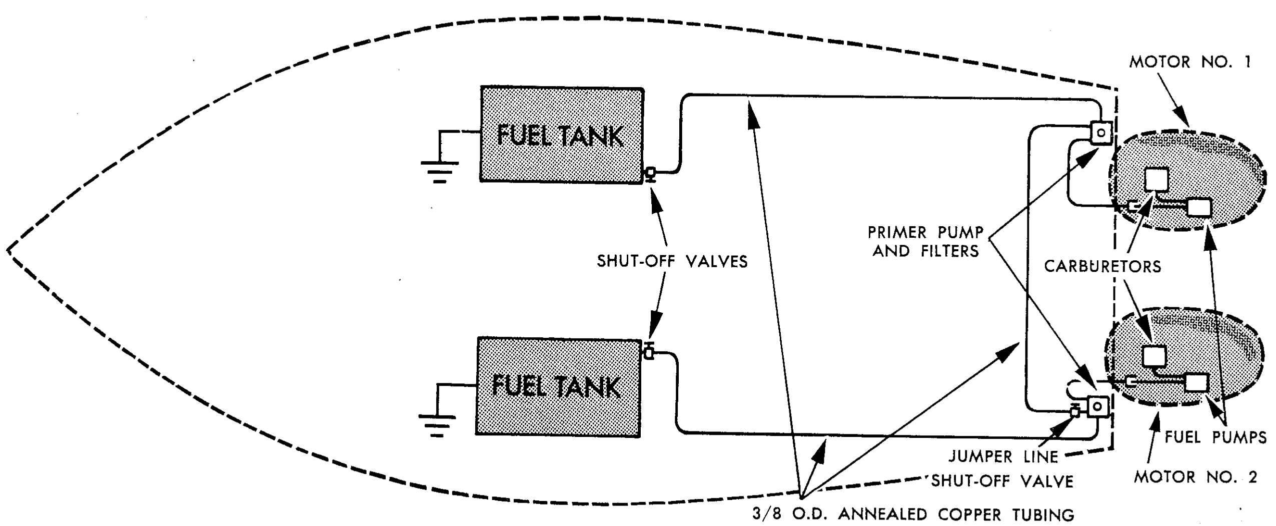
1. On all copper tubing connections, use flared type fittings.
2. All shut-off valves should be installed so as to be accessible in case of emergency.
3. All copper tubing should be clamped to permit a minimum of vibration. Clamps should have no sharp edges.
4. Mount fuel tank as low as possible in the boat and symmetrical with the keel.
5. Mount the priming pump and filter assembly so that its outlet is higher than the top of the fuel tank.
6. Cement all pipe thread connections with a gasoline resistant cement (Gasoila).
7. All flexible hose connections must be clamped securely.
8. Take precaution in locating the flexible hose, to eliminate possibility of cutting or crimping when engine is turned.
9. All copper tubing should be 3/8 O.D., annealed copper, and have a wall thickness of .049.
10. Locate the entire fuel line from the tank to the engine on an incline upward to the engine. Avoid loops and humps as much as possible.
11. Fuel tank filling spout should be located on the outside of the boat. (Not inside the cabin.) Ground the tank to metal strip on keel or ground plate attached exposed side of hull below water level. Ground filler cap to tank by means of chain (metal) etc.
12. Fuel tank must be vented to the outside.
13. Locate Tank Shut-Off Valve at top of tank for easy accessibility and to minimize possibility of leakage through faulty valve.

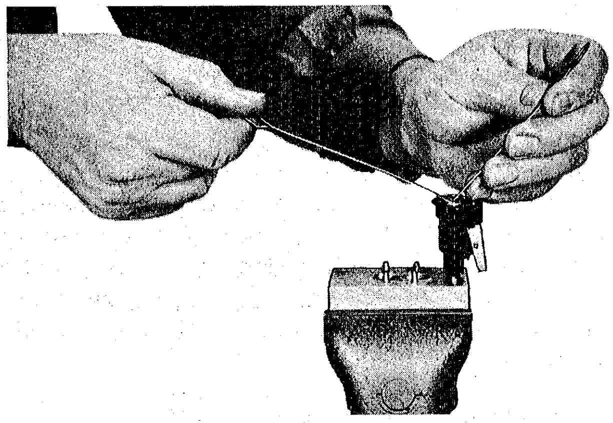
NOTE: Flaring tools for preparation of copper tubing are ordinarily available through local automotive, marine hardware, oil burner or refrigeration supply houses.

SINGLE TANK...SINGLE MOTOR INSTALLATION



TWIN TANK...TWIN MOTOR INSTALLATION





TOOL — "O" RING INSTALLATION — FUEL LINE CONNECTOR NO. 375587

See Page 126

Installation of the "O" ring in fuel line connectors of later design and construction requires a somewhat different approach than formerly, due to the connector nipples now being "cast-in" rather than "screwed" in.

Two easily made (in the do-it-yourself department) instruments are necessary — one to hold the plunger down and one to reach in and "hook" the "O" ring out. Not at all difficult to do.

Both instruments (shown here) are illustrated full scale and made of 16 (1/16″ diameter) gage steel wire — a piece of discarded remote control wire will do.

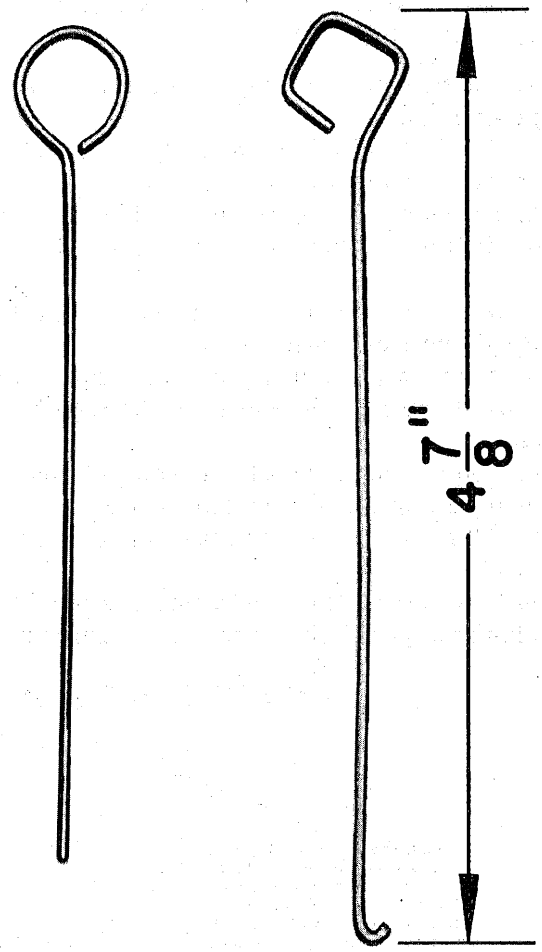
Form a small "hook" on the bottom end of the longer one of about 1/16″ radius — the other (shorter) should be straight. Loops at top end are merely for manipulation. Caution — after cutting the wires to length, be sure the "working" ends are rounded off to prevent scratching or causing damage to the "O" ring seats. Make to *actual* size of the illustration.

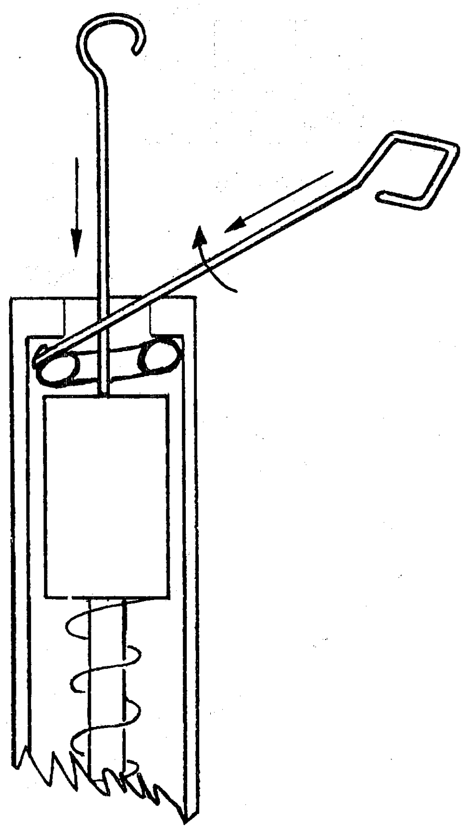
To remove the "O" ring:

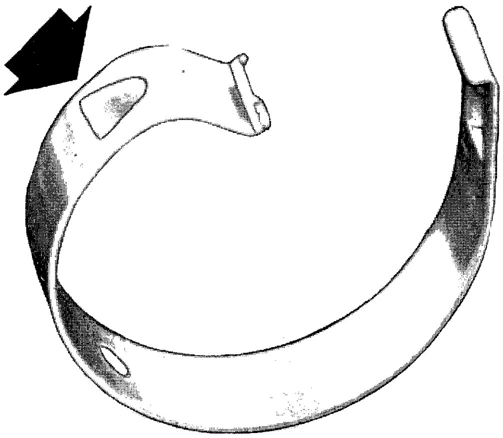
1. Place connector in holder (No. 277416) as shown.
2. "Push" plunger down off its seat with the straight instrument.
3. Insert the "hooked" instrument (hook in flat or horizontal position) between the "O" ring and its seat in the connector. See drawing.
4. "Twist" hook around to grasp the "O" ring — then carefully "hook" out.

To install the "O" ring:

1. Place a drop or two of oil on the "O" ring.
2. Place "O" ring on face of the connector.
3. Push plunger down with the straight instrument.
4. "Pinch" the "O" ring together and gently "force" into position with fingers.

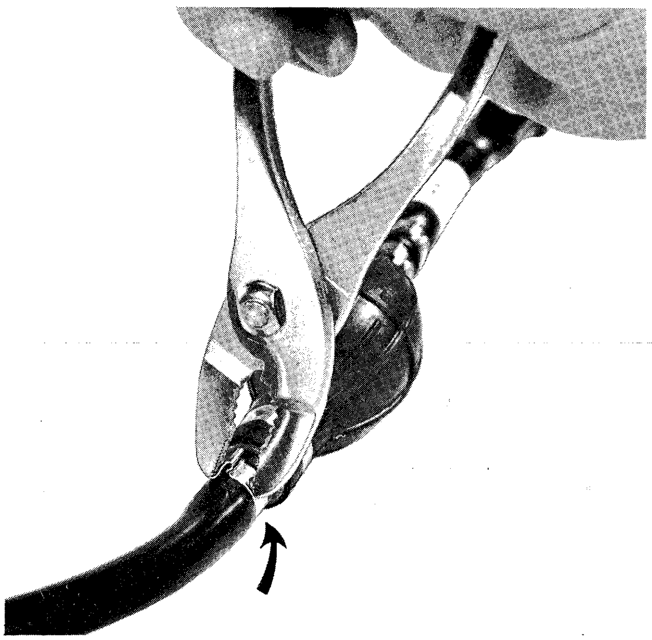




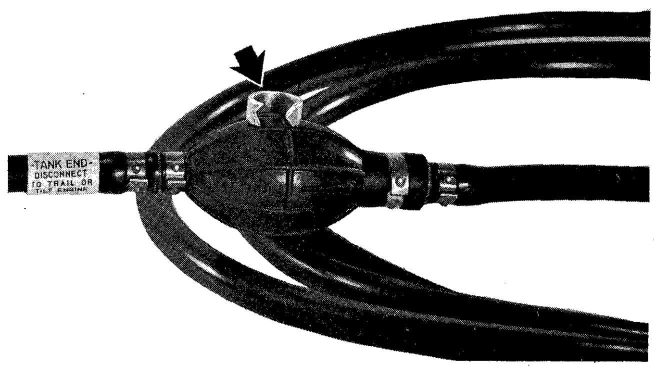


Showing new style Gas Hose Clamp. Arrow indicates raised shoulder for gripping with pliers when installing.

Using screw driver to force end of Clamp into position for securing.



Installing new style Gas Hose Clamp. Arrow shows gripping Clamp on raised shoulder with pliers.



Showing new style Gas Hose Clamps installed. Note old style Gas Hose Clamp (arrow) on Primer Bulb.

NOTES

Johnson SERVICE MANUAL

POWERHEAD

INDEX — FOLLOWING PAGE

POWERHEAD INDEX

GENERAL REPAIR INFORMATION

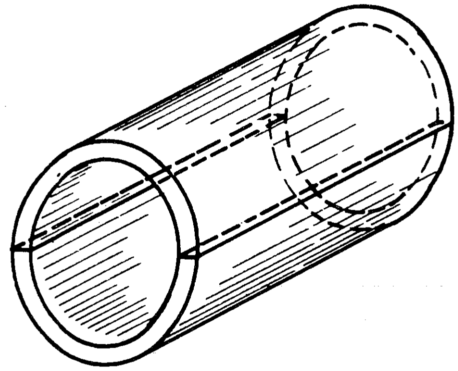
SPECIFIC REPAIR INFORMATION

THE POWER HEAD

BEARINGS

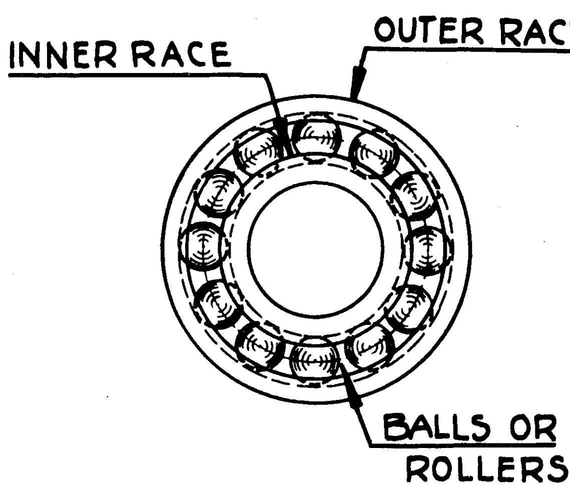
The purpose of bearings in any type of engine (reciprocating or otherwise) is to support the revolving or reciprocating parts such as crankshafts, connecting rods, pistons, etc. and in the outboard. motor, driveshafts and propeller shafts.

Bearings generally are classified as either friction or non-friction. The friction type of bearing as employed in the outboard motor consists of a bushing or cylindrical sleeve of bronze, machined to size. It may be of solid construction or split as required for assembly and performance of its function.



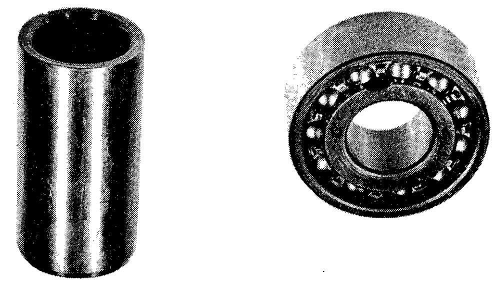
Schematic Drawing of Friction Type Bearing (Bushing)

While some of the bearings or bushings in the four (stroke) cycle engine are constructed of bronze, the principal friction type bearings (crankshaft mains and connecting rod) usually are of babbitt.



Schematic Drawing of Non-Friction Type Bearing (Roller or Ball)

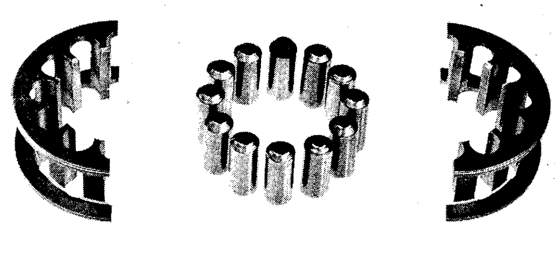
Non-friction bearings are normally constructed of an inner and outer race (steel) of proper dimensions to permit installing rows of steel balls or rollers—all elements being held together by a "cage" or retainer to make up a unit assembly.



Bronze Bushing (Friction); Ball Bearing Assembly (Non-Friction).

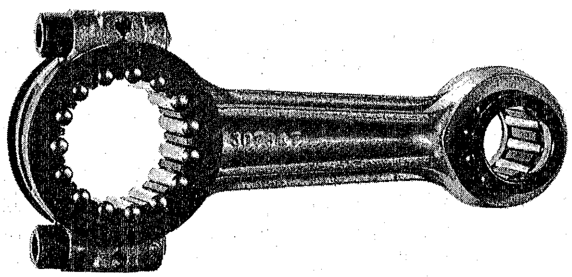
Being of a solid one-piece unit assembly, this type of construction (in the outboard motor) is limited to installation on the top and bottom journals of the crankshaft, the driveshaft and propeller shaft. Other means are necessary to provide non-friction bearings for the center journal (if designed with more than two journals) and crankpin unless the crankshaft is of assembled construction to permit the installation.

When non-friction bearings are installed on the crankpin, the connecting rod is generally constructed of steel, with the crankpin end of sufficient size to accommodate the necessary rollers. The inside faces of the rod and cap are hardened and accurately ground to size—thus, act as the outer race, while the hardened ground crankpin functions as the inner race. The rollers are set in a split "cage" or retainer—each half of the assembly then placed on the crankpin. This is followed by installing the connecting rod and cap which, when bolted together, makes up a non-friction bearing assembly.

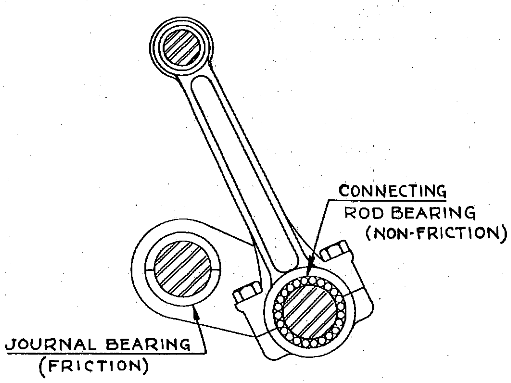


Split Cage (Retainers) and Rollers.

Steel needles (needle bearings) are frequently installed on the crankpin, rather than the roller-retainer assembly but otherwise perform as a non-friction type of bearing—the connecting rod and crankpin acting as outer and inner races.

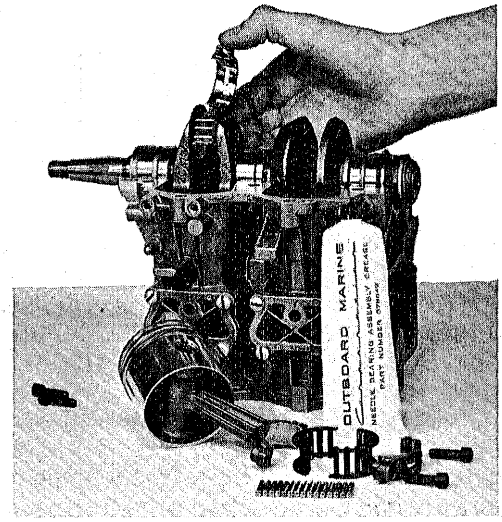


Steel Connecting Rod with Needle Bearings in Position Which, When Mounted on the Crankpin, Make Up a Non-Friction Type Bearing Assembly.



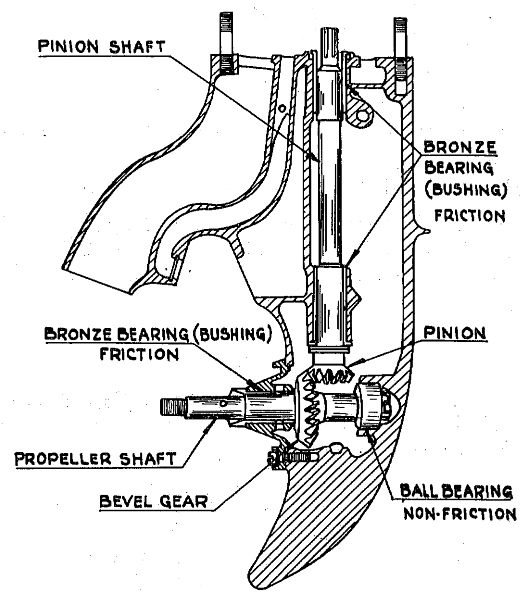
Drawing to Illustrate Common Application of Friction and Non-Friction Type Bearings.

Although most common practice is to provide friction type bearings for both the crankshaft journals and connecting rod, especially in the smaller models, a combination of the two is frequently employed in the larger motors; namely, friction on the crankshaft journals and non-friction on the crankpins as shown at bottom of preceding column.



Showing Needles and Retainer on Crankpin – held in place during Assembly with OMC Needle Bearing Assembly Grease.

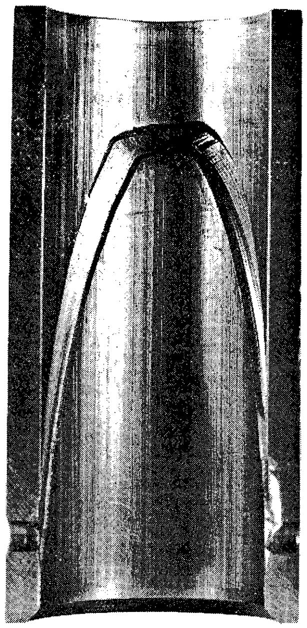
Friction type bearings (bushings) are most generally used for the drive and propeller shafts in motors of low horsepower range while both friction and non-friction types are employed in like positions in the higher powered models.



Drawing to Show Combination of Friction and Non-Friction Type Bearings as Frequently Employed in the Gearcase.

In some motors such as the racing type, non-friction bearings are used throughout—ball or roller bearing assemblies or needles on the crankshaft journals, rollers or needles on the crankpins, ball bearing assemblies on the drive or pinion shaft with ball bearings and needles on the propeller shaft—wrist pin bearings are most frequently of the friction type.

All bearings, regardless, must be fitted with a certain amount of clearance (space between the bearing surface and shaft, crankpin or journal or space between the balls, rollers, needles and races in the non-friction type) to provide ample "space" for lubrication and to allow for expansion as operating temperature rises. To further assist in obtaining efficient lubrication, grooves are cut in the

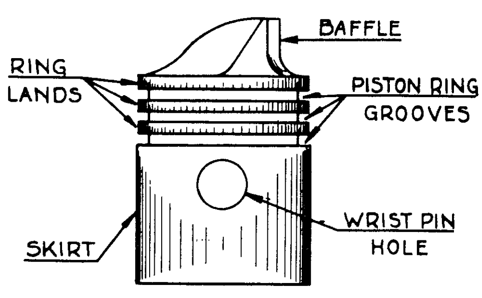


Sectionalized Bronze Bearing to Show Arrangement of Crooving for Oil Circulation.

bearing surfaces of friction type bearings, starting or ending at edge of the bearing or at holes drilled through the bearing wall and on through the bearing "boss" or support to the source of lubrication supply.

The grooves are arranged to circulate or spread the lubricant over the bearing surface—entering at one end of the groove and discharging at the other end to complete the circuit. Rotation of the shaft and spiral of the groove cause the lubricant to be spread over the bearing surfaces.

PISTON AND PISTON RINGS



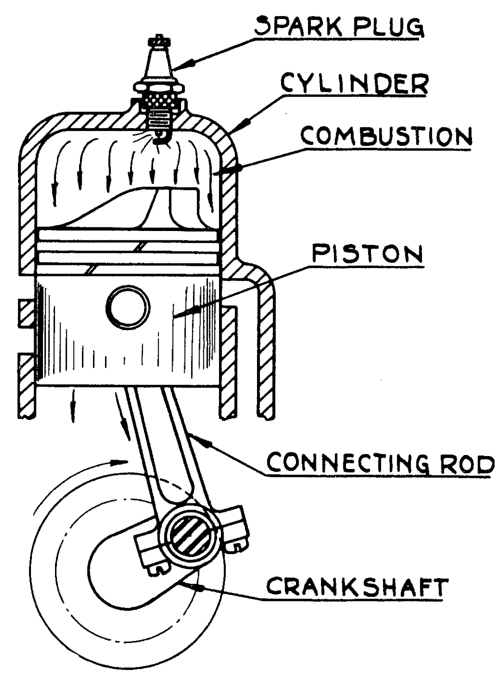
Drawing of Two (Stroke) Cycle Piston.

All Johnson pistons, except for some of the older models, are constructed of aluminum alloy. Cast gray iron pistons were used in models of early vintage.

Since the piston with piston rings installed, receives the force of combustion in the cylinder head (after vaporized fuel has been forced into the cylinder to be followed by compression and ignition), it is necessary that both the piston and piston rings be properly fitted and in good operating condition to seal this force or pressure above the piston head. Seepage past the piston rings and on down between the skirt of the piston and cylinder wall, results in loss of power—if excessive, interferes with operation of the motor, particularly at slow trolling speeds.

To retain maximum of power (pressure) within the cylinder above the piston head, the cylinder must of course be round and the piston rings correctly seated against the cylinder wall. Further, the rings must be properly seated in the ring grooves and the gap between the ends of the rings of sufficient width to prevent "butting" and ultimate warping of the rings to cause pressure loss in the cylinder.

The piston rings naturally cannot be expected to retain the force (power) of combustion if the pistons and cylinder walls are excessively worn or otherwise damaged (scored). In this instance, replacements are in order.



Drawing to Illustrate Function of the Piston.

Function of the piston in a two (stroke) cycle engine is two-fold—namely, to receive the force of combustion which is transferred by way of the connecting rod to the crankshaft in the form of power and to control the flow of fuel vapor and exhaust gases as it covers and uncovers the ports in the cylinder during its travel. The piston rings must be free (in the ring groove) to expand against the walls of the cylinder—any tightness or binding in this respect, will restrict normal activity of the ring to result in loss of compression and subsequently power. Seepage or escape of compression by way of the piston rings is frequently referred to as "blow-by" and is indicated by discoloration or carbon formation clinging to skirt of the piston.

Piston rings are caused to bind or seize in the ring grooves either by carbon accumulation piling up back of the rings and gradually filling in above and below to render them inactive, or, by insufficient groove or gap clearances. The piston then operates in the cylinder without the benefit of the rings expanding against the cylinder wall to seal the force of compression and combustion. Naturally, the result is loss of power, unsatisfactory slow speed performance and hard starting, the degree of which is dependent upon actual restriction of ring activity under the circumstances.

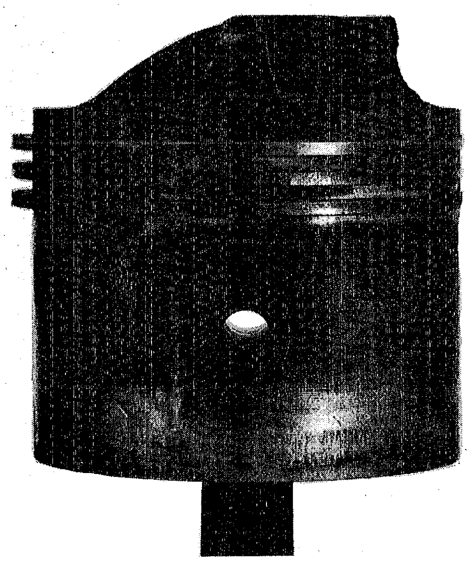
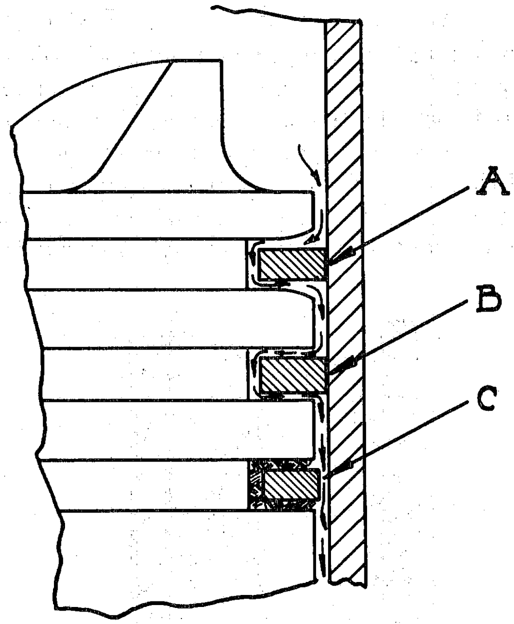


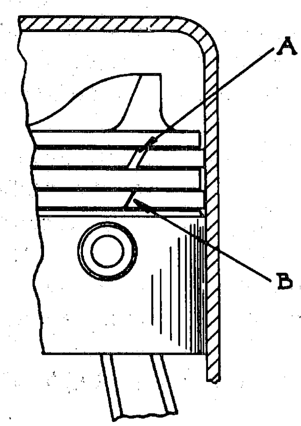
Illustration of Carbon Sooted Piston.



A. Loss of Compression (Power) Result of Worn Ring Grooves.

B. Loss of Compression (Power) Due to Faulty Ring Seat. ("Wavy" Ring Groove in Piston or "Wavy" Piston Ring Side Walls.) Loss of Compression (Power) Result of Ring "Warpage" Due to Insufficient Gap between Ring Ends Causing Ends to "Butt" as Normal Engine Running Temperature is Reached. (Rings Elongate in Proportion to Temperature Rise, Thus "Gap" Must be Sufficient to Prevent "Butting.")

C. Rings Inactive as Result of Excessive Carbon Accumulation in Ring Groove to Cause "Blow-By" or Escape of Compression (Power).



A. Correct Ring Gap Permits Freedom of the Ring to Act against the Cylinder Wall, Thus Sealing the Compression (Power) above the Piston. Excessive Gap (Clearance) Results in Compression (Power) Loss Due to "Blow-By."

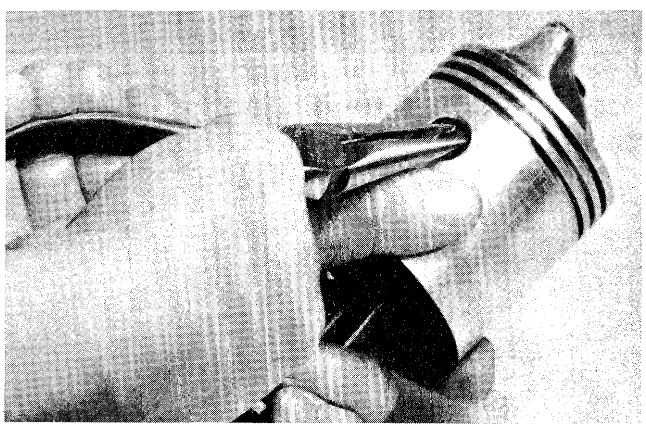
B. Insufficient Ring Gap Causes Ends of Ring to "Butt" to Result in Buckling and Ultimate Inactivity of the Ring.

Not all of the rings on the piston are affected to the same extent—usually the top ring (since the temperature is higher at the top of the piston) is first to become carbon clogged, followed by the second ring, etc., as temperature decreases in proceeding on down the land area and skirt of the piston to be ultimately dissipated via piston rings, piston skirt and as result of comparatively cool fuel vapor entering the crankcase and cylinder—thus absorbing a considerable degree of heat generated in the piston as it functions throughout the cycle.

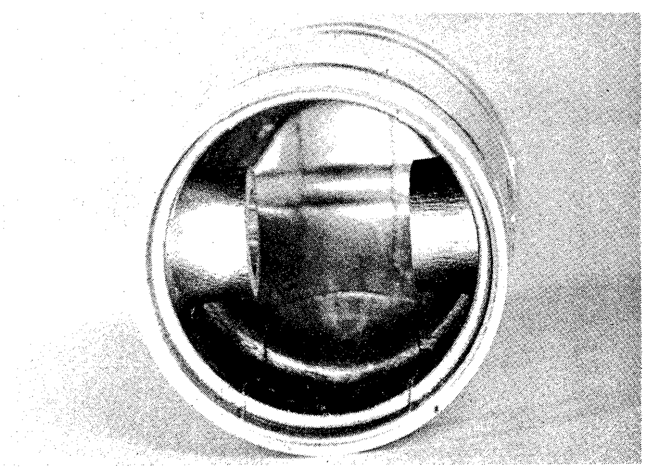
Excessively worn, scored or damaged pistons necessitate replacing which, in conjunction with other corrections, assists in restoring the motor to normal operating condition.

It is assumed that the piston and connecting rod assembly has been detached from the crankshaft and removed from the cylinder on disassembly of the motor for repair.

Remove carefully the wrist pin retaining clip (or other pin retaining device) in the piston at each end of the pin as illustrated below.

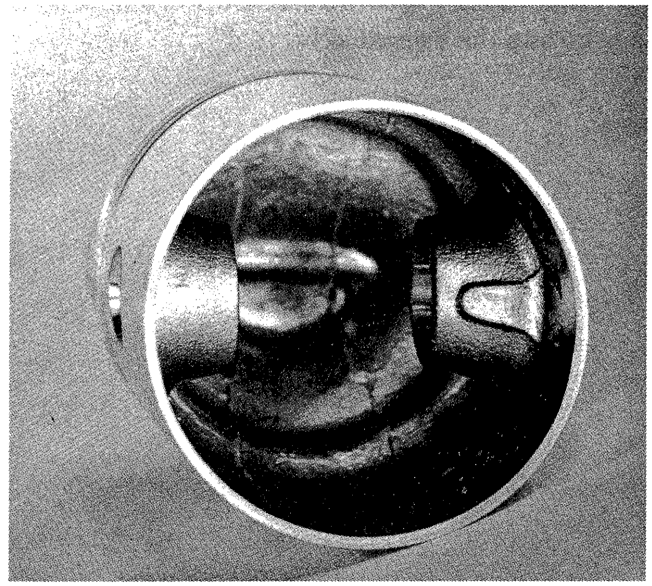


Removing–Installing Wrist Pin Clip (Retainer).



Rise on Boss to Indicate Slip-Fit (Wrist Pin).

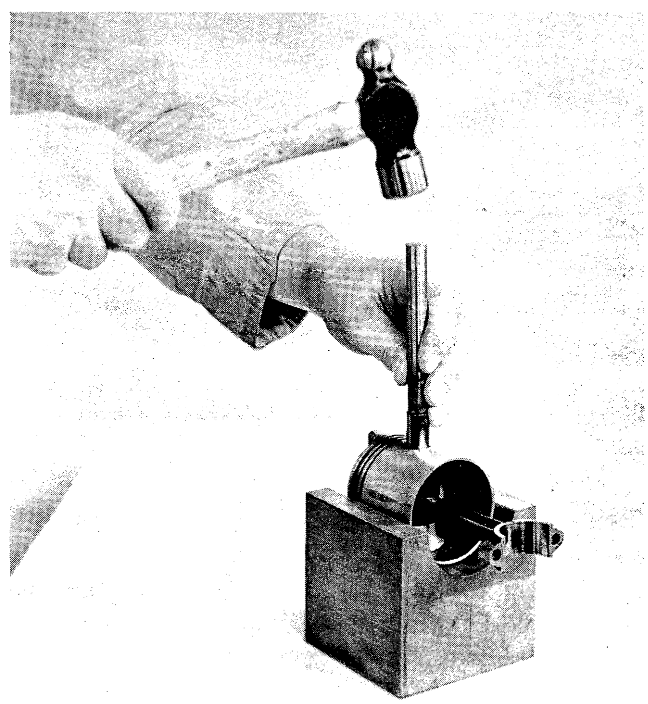
Observe wrist pin bosses inside of piston and note that a small rise is embossed on one wrist pin



Embossing to Indicate Slip-Fit (Wrist Pin).

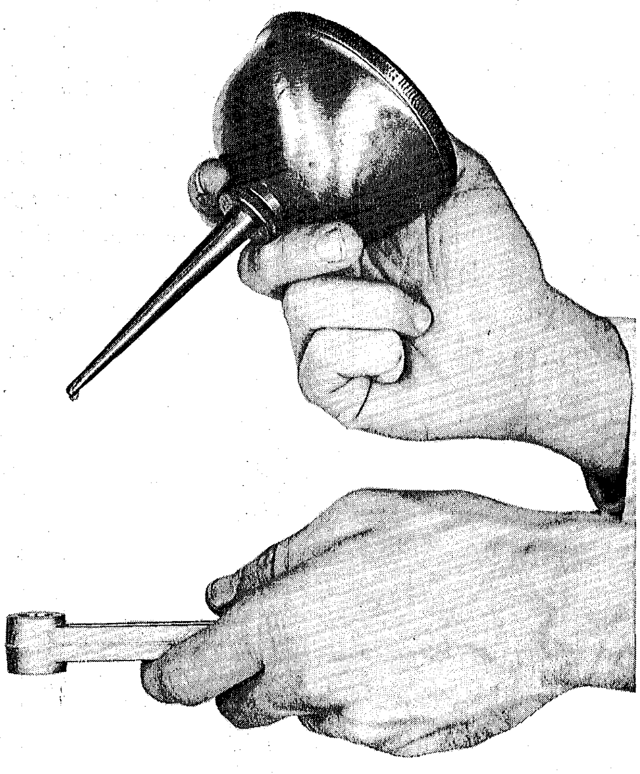
support (boss) or in lieu of the rise, a prick punch mark.

To prevent distortion of the piston as it expands on reaching normal running temperature of the motor, one of the bosses is bored for a slip-fit on wrist pin while the other for a press-fit. The **marked** boss contains the slip-fit bore, consequently, when driving the wrist pin out, in process of detaching



Driving Wrist Pin into Position.

the piston from the connecting rod, or when assembling, drive from the marked side, using a fixture, **as shown,** to guard against distortion or damage during the operation.

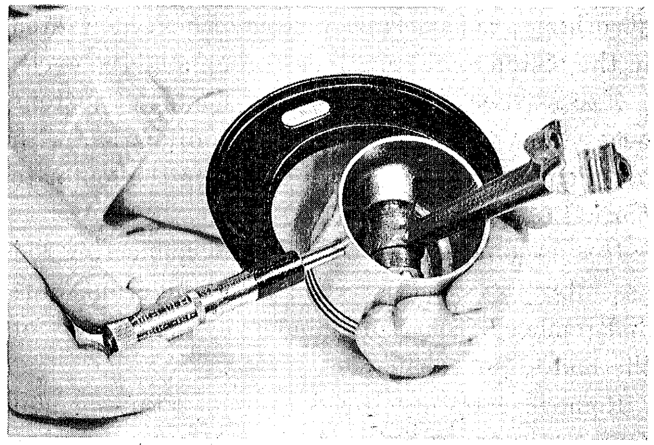


Place Drop of Oil on Wrist Pin Bearing (in Connecting Rod).

Attach new piston to connecting rod in similar manner—apply coat of oil to wrist pin—be sure surface is clean—also, a drop or two of oil in each pin hole in the **piston.** Insert wrist pin through slip-fit side. Oil wrist pin bearing in connecting rod.

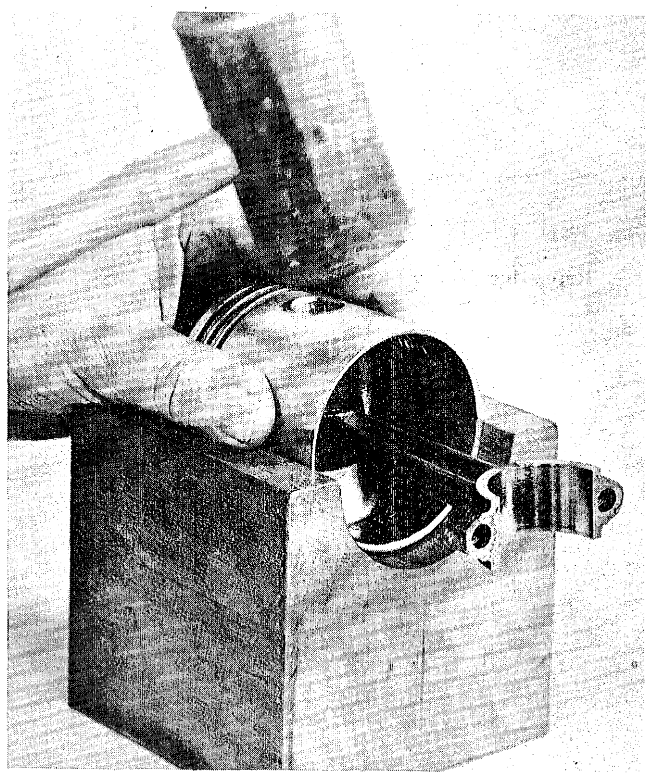
Place connecting rod in position, then proceed to drive the pin "home." (Note: This assembly can be accomplished with less difficulty if the piston is heated slightly to expand.) Replace retaining clips, making certain they come to rest securely in the groove provided for this purpose.

The piston may have been distorted during assembly procedure—check with micrometer to determine "roundness." If slightly out of round, place in fixture and tap high side with light mallet (do



Checking Piston for Roundness

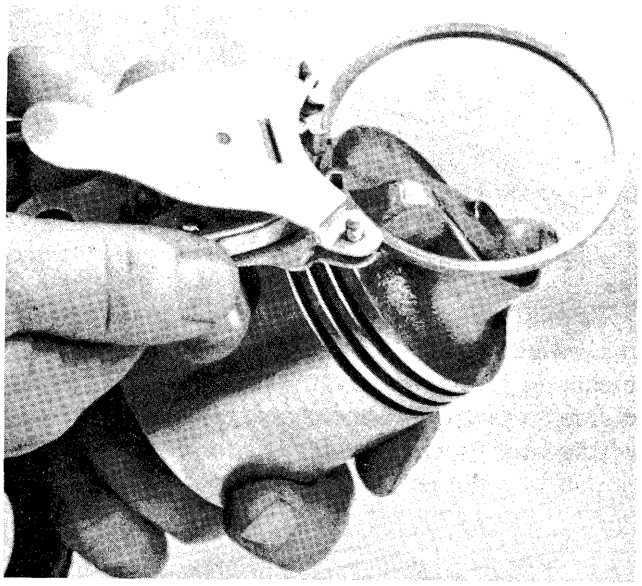
not use hammer) to restore original roundness. Proceed carefully in this respect and caliper frequently until the piston is "rounded" out. (Johnson pistons are not cam ground—oval.)



"Trueing" Piston After Installing Wrist Pin.

Extreme care should be exercised when removing the piston rings, particularly if they are partly "frozen" or binding in the ring grooves due to carbon accumulation, not so much in fear of breaking the rings as in all probability they should be replaced, but to guard against injury to the ring grooves.

When removing the rings, it is advisable to use one of the special ring expanders available for this purpose, as shown here.

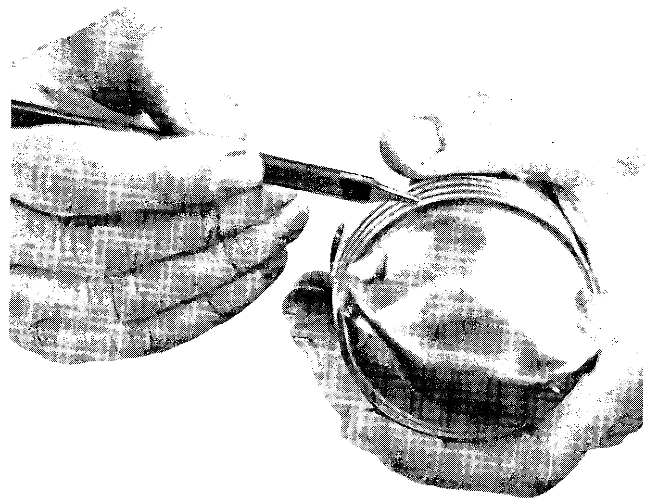


Removing–Installing Piston Ring with Expander.

However, if the tool is not on hand for this operation, work the ring loose gradually in the ring groove, then expand sufficiently to remove it from the piston by spreading the ends of the ring with thumbs. This practice, nevertheless, is not encouraged since skin abrasion is apt to occur to be followed later by infection.

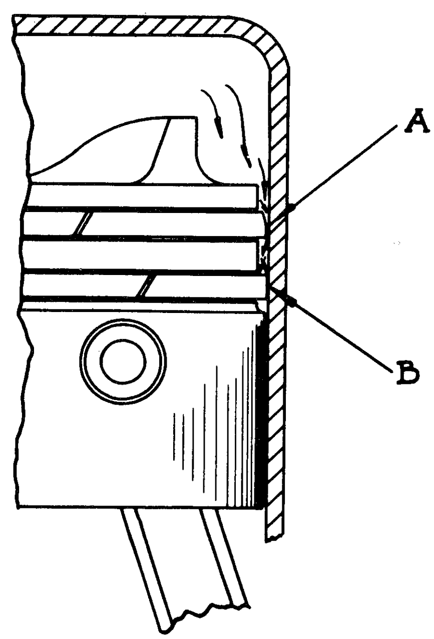
After having removed the rings, inspect the ring grooves for carbon accumulation, excessive wear or damage to the ring seats. Carefully scrape carbon from the ring grooves, if necessary—making certain that carbon clinging to the bottom and sides of the groove has been thoroughly removed without scratching or otherwise damaging the groove. Scratches or other damage to the ring seats of the groove results in loss of compression and power.

It may be possible that even though the piston rings are partially seized in the ring grooves because of carbon formation, they are still suitable for further service, requiring only freedom in the



Removing Carbon from Ring Grooves in Piston.

groove to function as they should. They are "worn," however, and should be replaced if the face of the ring is glass smooth—highly polished appearance or, if the edge of the ring is "rounded" off. The edges of the ring should be square, with the face not too smooth and rather dull in appearance if serviceable. If in doubt, install new rings.



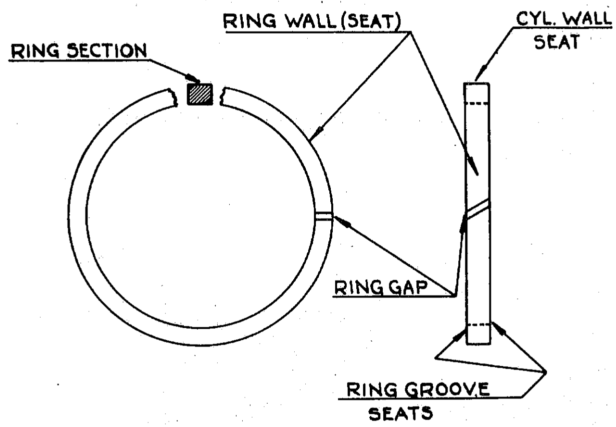
A. Worn Ring–Rounded Edge and Smooth Polished Face Result in "Blow-By," Loss of Compression (Power) and Carbon Coated Piston Skirt.

B. Serviceable Ring–Square Edge and Dull (Appearing) Face Retain Force of Combustion to Deliver Maximum Available Power. Skirt of Piston Clean and Reasonably Free of Carbon.

NOTES

PISTON RINGS

Piston rings are constructed of high quality cast iron and in such a manner that, when installed on the piston operating in the cylinder, expand against the cylinder walls to form a seal.



Schematic Drawing of Conventional Piston Ring.

Sealing effect is accomplished by pre-establishing a slight strain in the original casting or by other means in process of manufacture, thus, after machining to correct dimensions and severing, ends of the ring "spring" apart. Space created by this action is referred to as the ring gap.

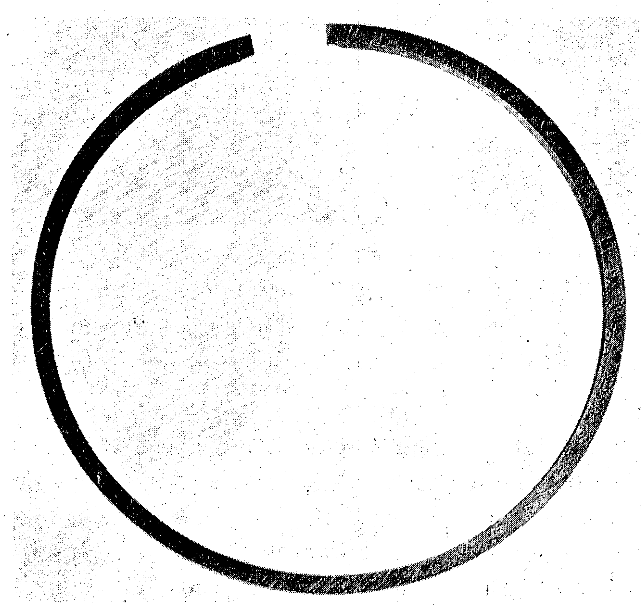
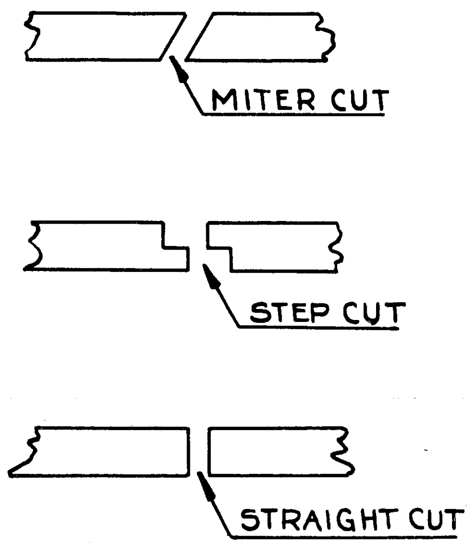


Illustration of Expanded Piston Ring Prior to Installing on Piston and Assembly in Cylinder.

Severing or cutting of the ring is required to provide flexibility of the ring wall (seat) to permit operating against the cylinder wall under slight tension (pressure). Tension in this respect must definitely be in relation to bore of the cylinder, width and depth of the ring.

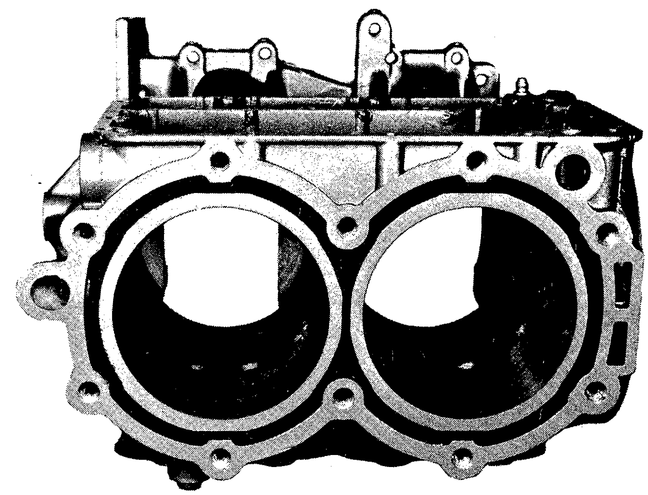
Excessive pressure against the cylinder wall results in drag (stiffness or friction within the cylinder), creating high operating temperature to cause sluggish performance, abnormal ring, ring groove and cylinder wall wear, if not actual scoring. Insufficient ring wall tension results in "blow-by" to cause loss of power, over-heating, carbon formation on skirt of piston, etc.—faulty performance.

There are several methods of cutting (severing) the rings—namely, (1) Miter, (2) Step and (3) Straight.



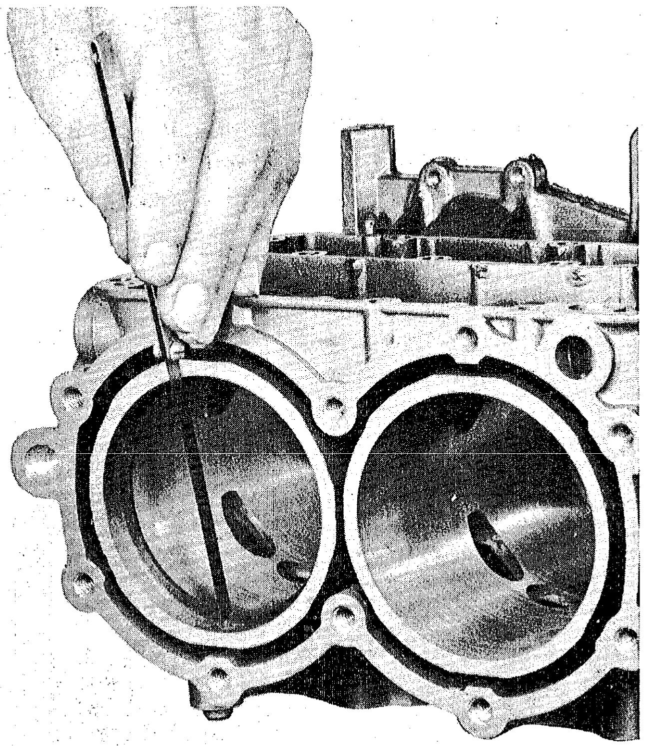
Piston rings are not true (round) until placed in the cylinder. Example—in process of manufacturing, the ring (solid) is turned to a definite O.D. (outside diameter) say, 2.5″ to fit a cylinder bore of 2.5″—curvature of the ring wall is then identical with curvature of the cylinder wall since both diameter of the solid ring and cylinder bore are equal (2.5″). After turning, the solid ring is "slotted" or cut to obtain flexibility with result that ends of the ring spring apart to create a gap. The O.D. subsequently becomes greater than the original 2.5″ actually turned—greater O.D. but not a perfect circle in contour. Although resulting variation in contour of the expanded ring could be measured only in "fractions of .001" of an inch, it nevertheless is not a true circle. True contour of the ring, however, can be restored by installing it in a cylinder of like diameter (2.5″).

The opposite is true if an attempt is made to fit an oversize ring in a cylinder of given standard size. Example—say the cylinder bore is 2.5″ but the O.D. turned size of the ring is 2.510″ (ten one-thousandths of an inch oversize.) Naturally, it is impossible to install an oversize ring in a standard bore of smaller diameter, without filing the ends of the ring. If the ends of the ring are filed or dressed down sufficiently to permit installation in the cylinder, actually, circumference or contour of the ring becomes out of round by "pinching" the ends together. The result is loss of power since the piston ring does not seat properly against the cylinder wall—the cylinder bore is round while circumference or contour of the ring is not.



Illustrating Piston Ring Fit in Cylinder.

Sufficient clearance (gap) must be established between the ends of the ring prior to "fitting" in the piston for installation in the cylinder. The ring must be flexible to "follow" cylinder contour in operation of the motor with enough space allowed between the ends of the ring to prevent them from "butting" to create the effects of a solid "lifeless" ring. Further, the ring expands (elongates) as temperature rises during operation—consequently, the gap must be of sufficient width to permit a certain amount of expansion or elongation without "butting" to render the ring inactive. Proper width of ring gap depends on diameter of the piston ring, width, depth (thickness) and mean operating temperature of the engine. (See clearance chart, page 312.)



Checking Ring Gap with Feeler Gauge of Required Thickness.

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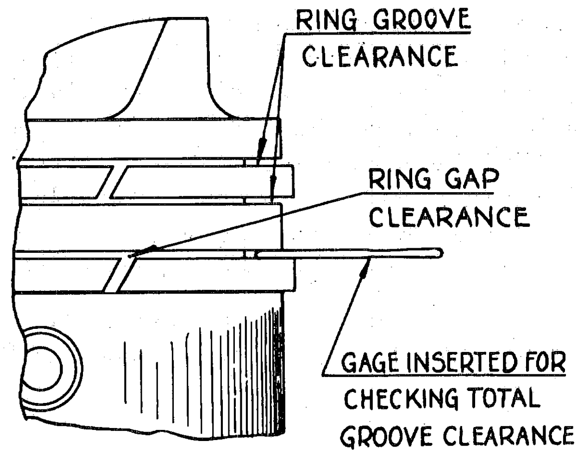
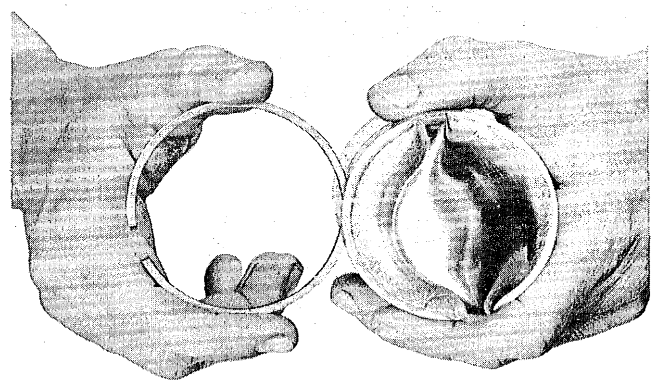
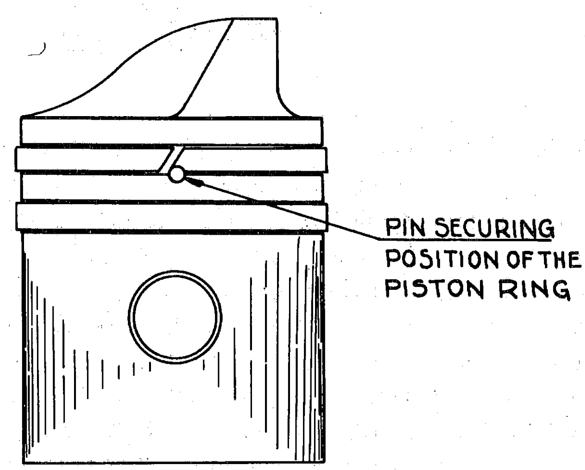


Drawing to Indicate Ring Gap and Ring Groove Clearance.



Check Piston Ring in Ring Groove (Piston) to Observe "Fit." Roll Ring in Groove around Piston—Check for Tight Spots and Binding as a Result of Burrs, etc.



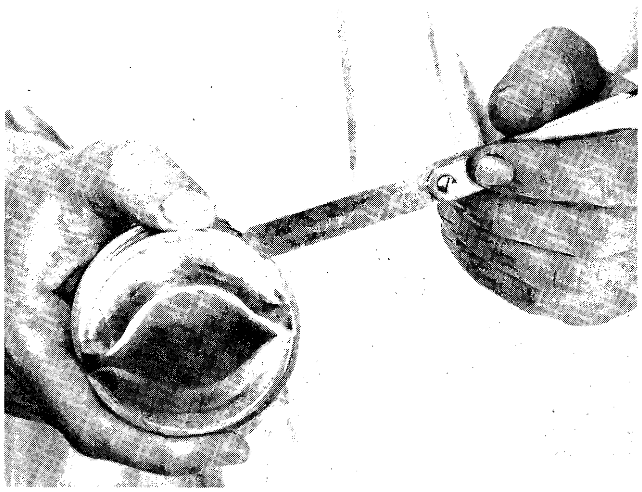
Drawing to Indicate Position of Pin in Piston to Secure Position of Piston Ring in Ring Groove and Staggered Arrangement of Ring Gaps (2 Rings in this Case). Gap of Second Ring on Opposite Side of Piston.

Excessive gap clearance (width) is undesirable, too, in that it permits escape or seepage of compression to result in proportionate loss of power.

When installing piston rings, the ring gaps should be staggered to retard as much as possible the resulting slight compression loss ever present, regardless.

The ring grooves in many Johnson pistons are pinned to secure position of the ring in the ring groove, not so much in view of staggering the ring gaps as to prevent ends of the ring "catching" on the edges of the ports (exhaust and intake) in the cylinder to cause breakage or excessive wear (ring) at this point.

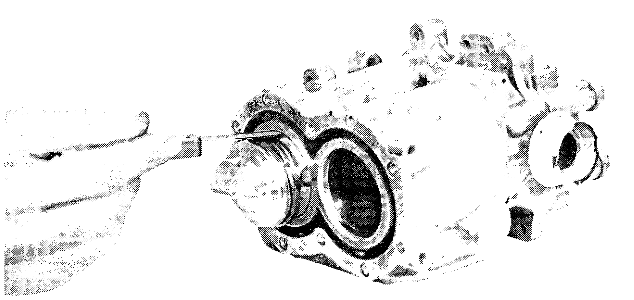
In addition to establishing proper gap clearance for the various size rings, it is equally important that clearance be provided between the ring and the ring groove to permit maximum flexibility. Like gap clearance—if excessive, the result is seepage (around the edges and back of the ring), while if insufficient, the ring is caused to bind in the groove to affect flexibility.



Checking Ring Groove Clearance with Feeler Gauge of Required Thickness.

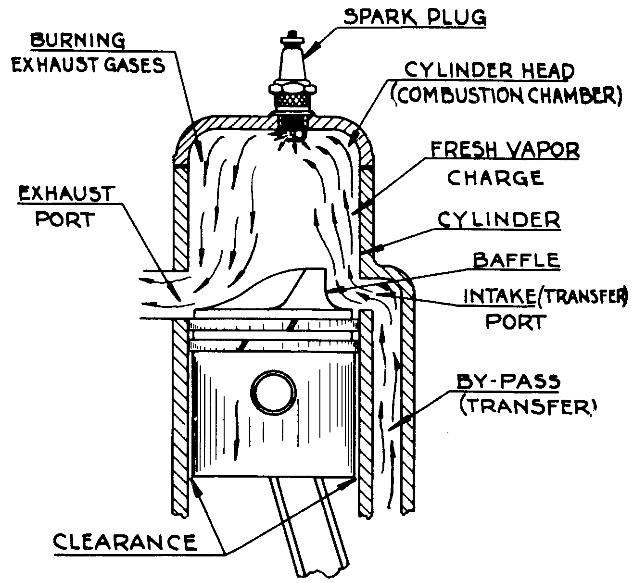
FITTING AND INSTALLING PISTON-RING ASSEMBLY

On having properly fitted the piston rings in the cylinder and in the ring groove, it is necessary that the piston be fitted in the cylinder with sufficient clearance to prevent binding to cause overheating and sluggish performance of the motor and at the same time providing ample space (clearance) between the piston and cylinder wall for lubrication and freedom of the piston to function as it should. Clearance at this point depends on diameter of the cylinder bore, material of which the piston is constructed, normal running temperature of the motor and the speed at which it operates. See table of clearances.



Checking Piston Clearance in Cylinder with Feeler Gauge of Required Thickness—Piston was Previously Checked for "Roundness."

Proceed by inserting the piston into the cylinder bore—check clearance with feeler gauge of thickness specified in "clearance chart" as proper clearance for the specific piston.



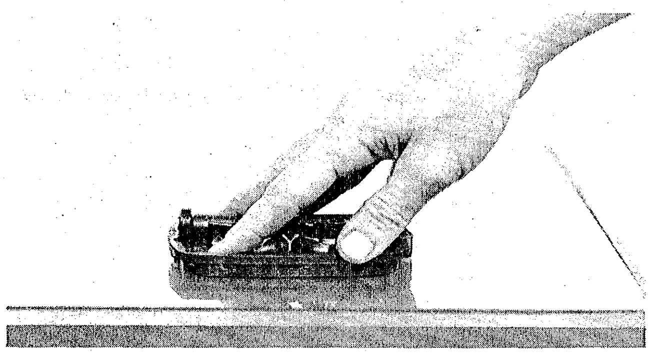
Schematic Drawing to Indicate Staggered Position of Piston Ring Gaps, Piston Clearance and Correct Position of Piston Baffle with Respect to the Intake (Transfer) Port—Straight Side of the Baffle Must be Directed toward the Intake (Transfer) Port to Insure Maximum Performance and Ease of Starting. This is Important.

In some two-stroke engines where contour of the combustion chamber permits, the piston may be inadvertently installed "backwards" to interfere considerably with starting and overall functioning of the motor. See drawing above and note that straight side of the piston baffle is placed adjacent to the intake (transfer) port in the cylinder. The purpose of this arrangement is to direct the incoming fresh vapor charge from the crankcase, upward along one side of the cylinder and in a manner, crowd the burning exhaust gases out through the exhaust port. Since width of the exhaust port is greater than that of the intake port, it is uncovered earlier by the downward moving piston to start exhaust gases moving out through the exhaust port, being directed in that direction by gradual decline of opposite side of the baffle and pressure existing in the cylinder at the moment.

Naturally, the process is not entirely efficient—not all of the "spent" gases are all discharged from the cylinder nor does all of the fresh vapor charge remain in the cylinder; some of the fresh charge escapes with the exhaust gases and some of exhaust gases remain in the cylinder to follow through in the subsequent cycle.

LAPPING GASKET FACES

It is advisable to check all gasket faces for flatness—gaskets will perform their assigned function of containing liquid, oil, grease or compression only when bolted between flat surfaces. Under certain conditions, gasket faces are apt to warp or spring, rendering the gaskets useless to result in loss of liquids, oil, grease, compression, air leaks, etc. This is particularly true where comparatively thin sections or flanges are employed and subject to temperature changes—cylinder heads, carburetor flanges, manifolds, etc.



When checking for flatness, the operation should be performed on a lapping block or piece of plate glass. Lay a sheet of No. 0 or 00 emery cloth on the lapping block or plate glass—place the surface to be checked on the emery cloth and move slowly back and forth several times in a figure 8 motion simultaneously exerting light pressure evenly distributed. Lift part from lapping surface to observe results. In event the surface is actually warped or sprung, high spots making contact with the lapping surface will be found to have taken on a dull polish, while the low areas will be noted to have retained their original state. To insure flatness over the entire surface, continue with above operation until gasket surface has been polished to a dull luster. If resulting surface appears too rough, finer lap can be provided by smearing lapping compound evenly and thinly over the plate glass and by proceeding with the lapping operation.

Consider for possibility of lapping the cylinder head, carburetor flanges, manifolds, mufflers, etc.

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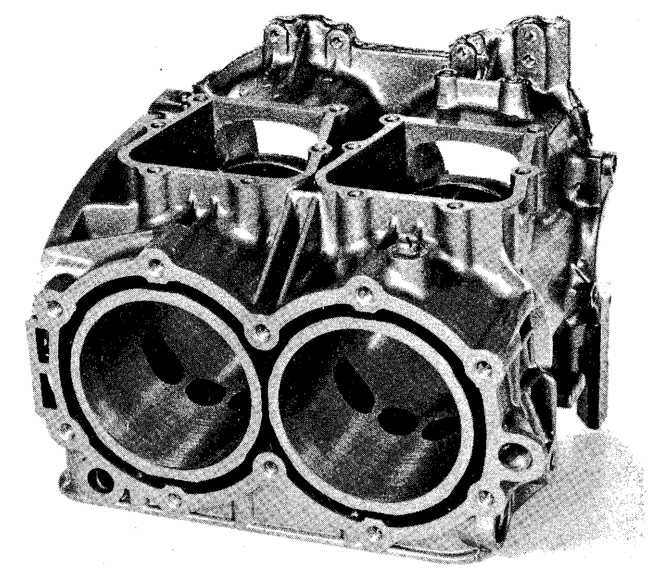
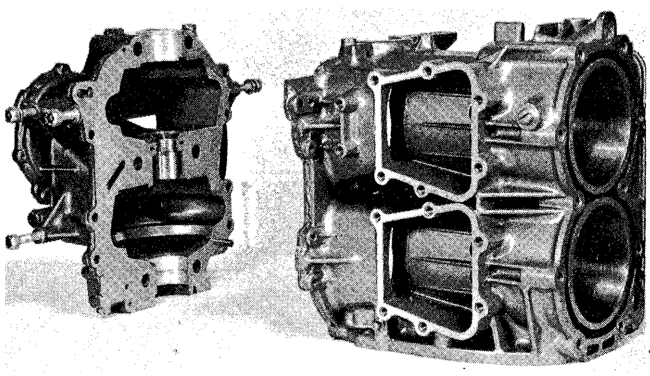


Illustration of Die-Cast Cylinder Block and Crankcase (Cast Iron Cylinder Sleeve – Aluminum Water Jacket).



Cast Aluminum Cylinder.

CYLINDER AND CYLINDER HEAD

Except for certain applications, cylinders generally (the bores at least) are constructed of high quality cast iron. More modern procedure, however, is to die-cast the cylinder assemblies which involves the construction of rather elaborate dies to permit the use of cast iron cylinder bores, aluminum water jackets, bearing supports, bronze bearing inserts, and crankcase sections (where required). This method of casting assists considerably in reducing weight of assembly, increasing production capacity and uniformity in quality of cylinder blocks.

One of the principal factors in realizing maximum performance of any outboard motor, or for that matter, any internal combustion engine (2 or 4-stroke cycle) is the condition of its cylinder bores, pistons and piston rings.

The bore must be round and straight. The cylinder wall must be free of scores and/or deep scratches – smooth, but not too smooth. A very minute degree of "roughness" is desired and required to retain the oil film for maximum compression seal between the cylinder and piston rings. In production a cylinder block is rejected if inspection here at the factory reveals the bore "too smooth" as well as "too rough" – same holds true for the piston ring walls.

With running of the engine, both the cylinder and piston ring walls commence progressively take on "polish," which is to be expected and as such accepted, but only to a degree of "dull luster" in appearance. Beyond the dull luster stage, a glazed or "glossy" like surface begins to appear to reduce the effectiveness of the piston rings as a compression seal – result is sagging power.

The solution here quite frequently is merely a matter of breaking through the "glaze" and installing a new set of piston rings in the customary manner to restore power. An inexpensive procedure for the conditioning of "trade-ins" for resale.

Insert the instrument into the cylinder bore as shown – just a *few* turns with an electric drill up and down the bore will do to break the glaze.

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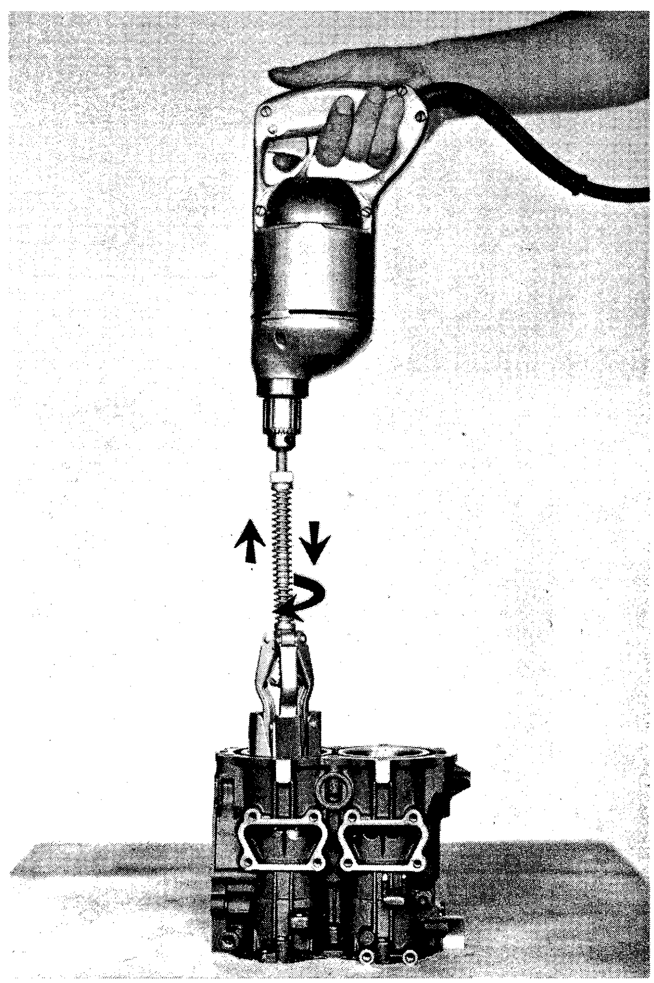
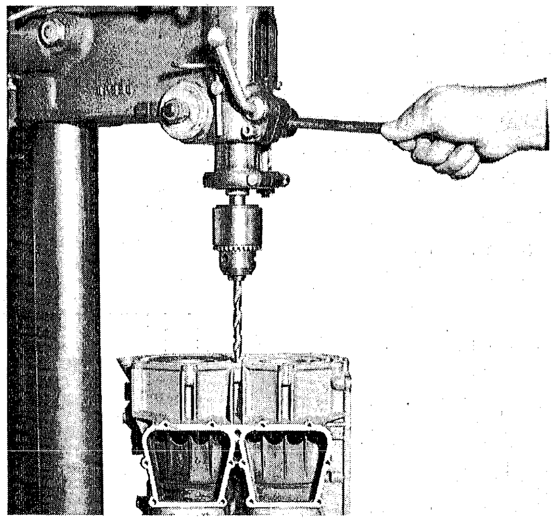
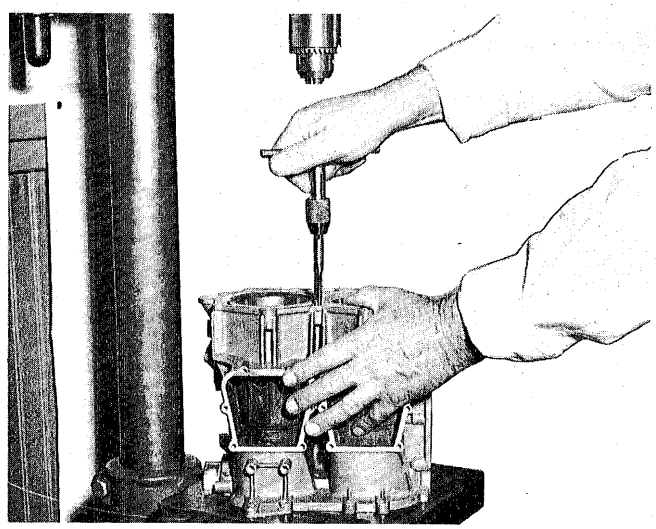


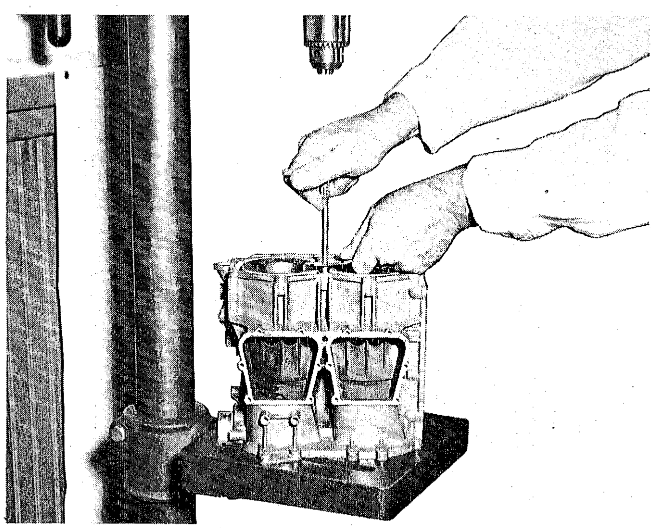
Using Glaze Buster in Cylinder Prior to Installing New Rings.



"Heli-Coil" Installation – (1) Drilling.



(2) Tapping.



(3) Insertion.

It is often possible to salvage damaged parts that are otherwise serviceable except for a "stripped" thread or two. Items damaged as a result of this condition can be rendered reuseable by the installation of a "Heli-Coil" in the stripped hole. "Heli-Coil" installation is a simple service operation that consists of drilling out the stripped hole, retapping the new hole for the "Heli-Coil" and installing the "Heli-Coil." Further details and instructions can be obtained by writing directly to: HELI-COIL CORPORATION, DANBURY, CONN.

CAUTION: Do not attempt to repair spark plug threads that have been stripped in a cylinder head. Doing this changes the heat range of the plug normally specified for the particular motor in that it hampers the transfer of combustion heat from the insulator tip of the plug to the cooling water – causing the plug to run hotter under otherwise normal conditions.

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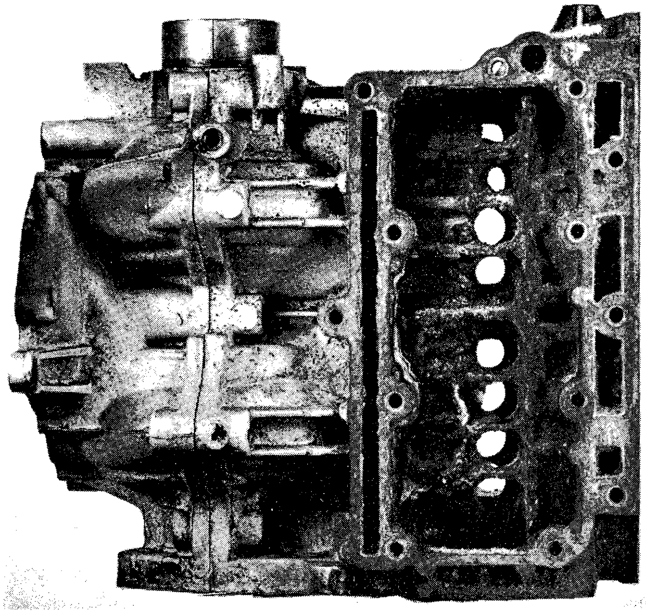
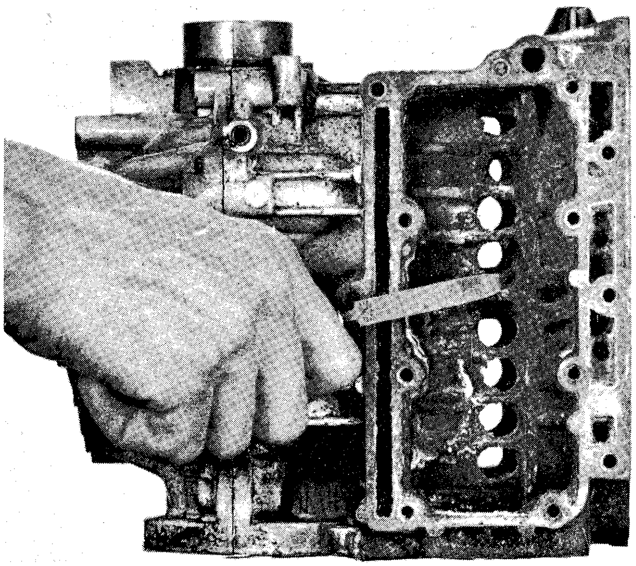


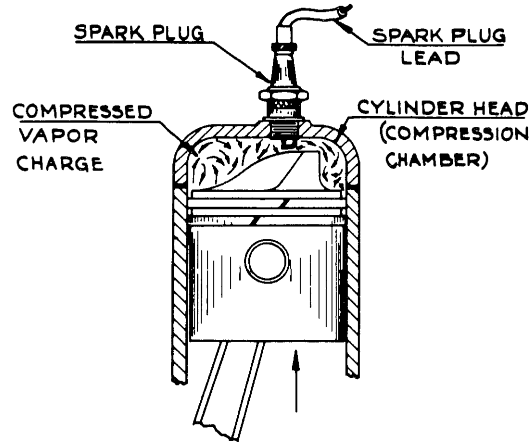
Illustrating an Example of Carbon Clogged Exhaust Ports (Cylinders) Causing Hard Starting, Sluggish Performance and Overheating.



Carefully Scrape Carbon Accumulation from Exhaust Ports with Scraper or Other Blunt Instrument. Walls of Exhaust Ports Must be Free of Carbon to Insure Maximum Performance.

The cylinder head, frequently referred to as the combustion chamber is detachable. It merely consists of a cavity placed at the top end of the cylinder, above the piston (when at top center) where the vapor charge transferred from crankcase to cylinder is compressed by upward stroke of the piston.

The spark plug is usually installed in the cylinder head and like the cylinder, the cylinder head is water jacketed for cooling purposes.



Drawing to Show Fuel Vapor Compressed in the Cylinder Head, Prior to Ignition and Combustion—Vapor Admitted into the Cylinder during Travel of the Piston from Top to Bottom of the Stroke.

When compression reaches maximum in the cylinder head, the compressed vapor charge is ignited (fired) by spark arcing across gap between points of the spark plug. The burning charge starts to expand rapidly to greatly increase pressure in the cylinder head (or cumbustion chamber). Resulting pressure acts on the piston to **drive** it downward, thus, delivering the power impulse.

HOW COMPRESSION RATIO IS DETERMINED

On four-cycle engines the piston's entire stroke (top to bottom) is used to compute piston displacement. However, on two-cycle engines that have induction and exhausting port holes in the bottom of the cylinder, piston displacement is computed by using the distance of piston travel from the top of the highest port hole in the cylinder to top dead center of piston travel.

All current production Johnson Outboard Engines are designed with the exhaust port located slightly higher in the cylinder than the intake port (exhaust opens first on power stroke; closes

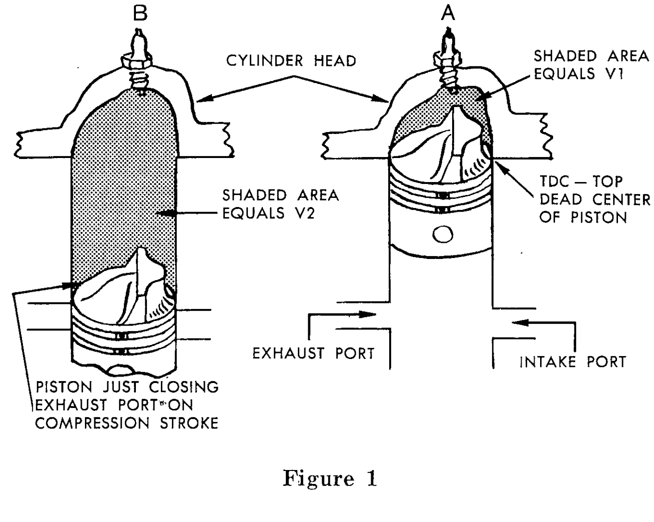


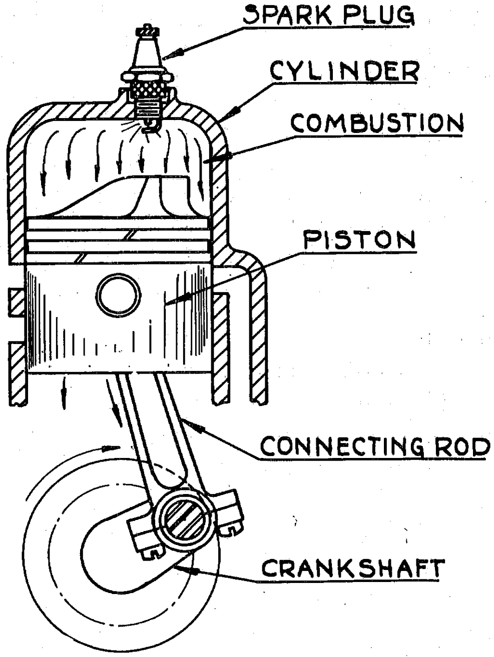
Figure 1

last on compression stroke), therefore, compression ratio on a Johnson two-cycle engine is figured by dividing the volume (V1) of the combustion chamber (illustration A, Fig. 1) into the total volume (V2) existing in the cylinder when the piston reaches a point where it just closes the exhaust port (illustration B, Fig. 1). Consequently, if the volume of the combustion chamber (V1) is 20% that of the sums of the combustion chamber and piston displacement volumes (V2), the compression ratio is 5 to 1. Use this formula:

$$\text{CR (compression ratio)} = \frac{V2}{V1}$$

CONNECTING ROD & CRANKSHAFT

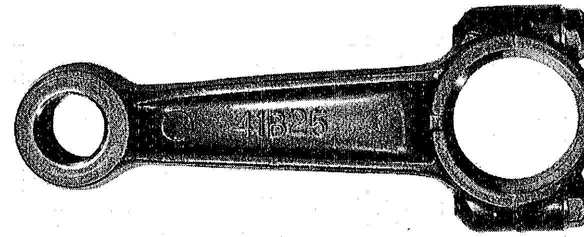
Purpose of the connecting rod is to provide linkage between the piston and the crankshaft—motion of the piston is reciprocative while that of the crankshaft is rotative.



Schematic Drawing to Show How Force Acting on the Downward Moving Piston is Converted to Power in Rotating Motion Through Linkage (Connecting Rod) with the Crankpin on the Crankshaft.

The force (power) of combustion being applied to the head of the piston in a downward thrust (straight line) is of no value for practical purposes unless it can be properly directed or gathered, so to speak, and applied where the resultant energy is required—to the propeller by way of the crankshaft, driveshaft, necessary gears and propeller shaft. Thus, energy originally directed in a straight line, is converted to rotating power (energy) through linkage (connecting rod) between the reciprocating piston and revolving crankshaft.

Customary practice is to design and construct connecting rods of an "I" section with bearing bosses at either end—large at one end to accommodate the crankpin bearing and a smaller boss to support the wrist pin at the opposite end.



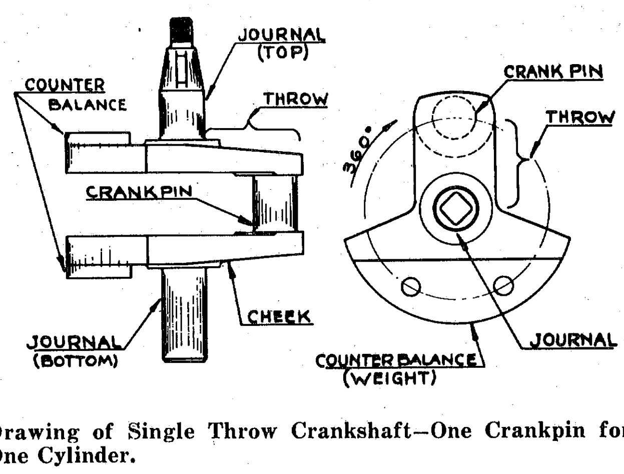
Conventional Connecting Rod Provided with Friction Type Bearing Surfaces.

Connecting rods are constructed normally of aluminum alloy with bronze bearing inserts (top only) or from steel forgings, depending upon the type of bearing to be used – aluminum when arrangements are made for friction type bearings – steel for non-friction bearings (roller or needle).

Wrist pin bearings on small end of the rod are usually of bronze (friction) since degree of actual movement at this point is comparatively limited, being governed by angularity of the connecting rod. (Long rod, short stroke = s narrow angle; short rod, long stroke = s wide angle, etc.) Modern practice however provides needles and/or rollers at both ends of the connecting rod.

The crankshaft is generally made up of two or more journals, a crankpin (number dependent on number of cylinders and application) and a cheek or web to support the crankpin—one supporting each end.

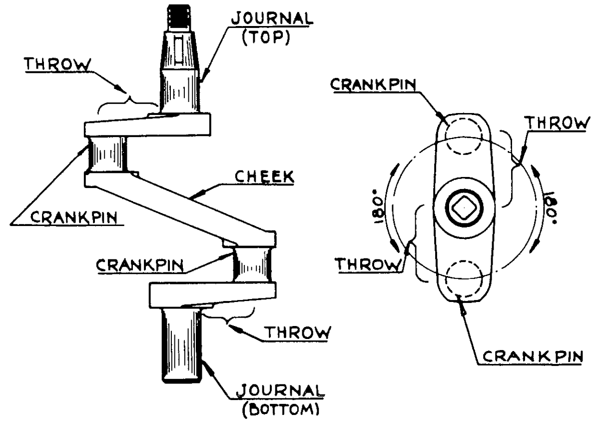
The cheek and crankpin together are referred to as a "throw." In event of but one crankpin, the crankshaft is classified as of "single throw" type.



Drawing of Single Throw Crankshaft–One Crankpin for One Cylinder.

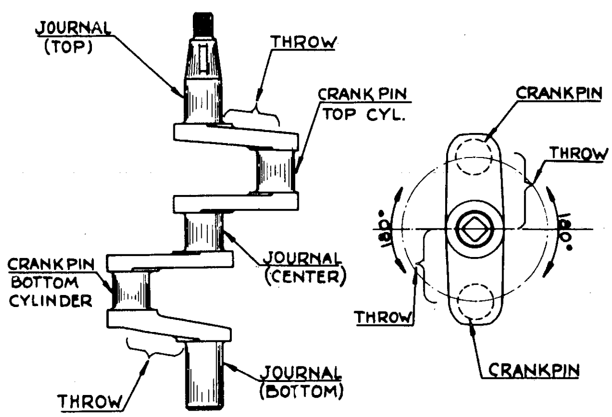
Single throw crankshafts are employed **only** in one cylinder outboard motors, however, are occasionally used in twin cylinder four (stroke) cycle engines. (Two crankpins in same plane.)

Single throw crankshafts must be counter-balanced to offset weight of the cheeks, crankpin and connecting rod to avoid excessive vibration.



Drawing of Two-Throw Crankshaft (Two Crankpins Spaced 180° Apart) as Used in Twin Opposed Motor.

Two-throw crankshafts are employed in construction of twin cylinder **alternate** firing motors also in four-cylinder outboard motors except that two crankpins arranged in pairs, are spaced 180° apart.



Drawing of the Two-Throw Crankshaft (Two Crankpins Spaced 180° Apart) as Employed in Alternate Firing Twins.

Crankshafts are machined from steel forgings —first turned to approximate dimension (journals and crankpins) followed by heat treating and final grind to finish size.

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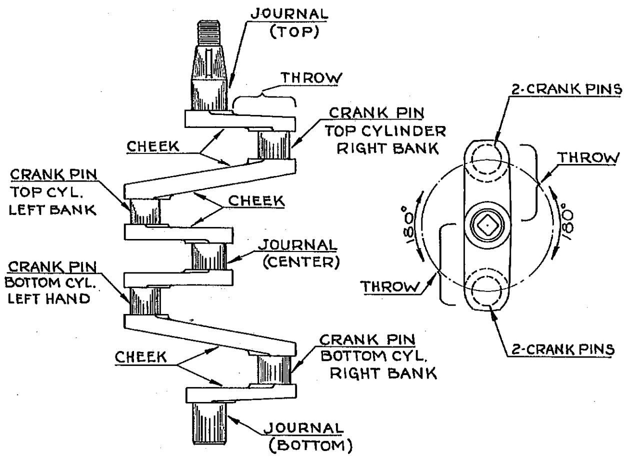
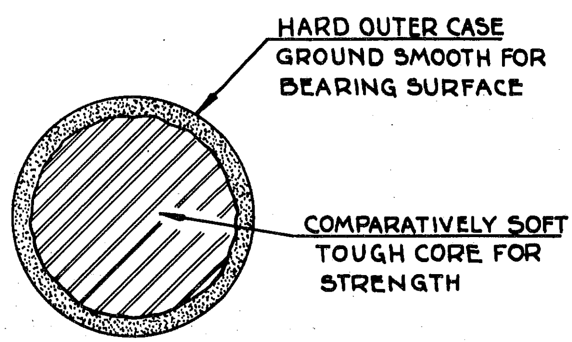


Drawing of Two-Throw Crankshaft (Two Pairs of Crankpins Spaced 180° Apart).

In preparation for heat treating, the cheeks or webs, threaded end of the crankshaft and a narrow area about the flywheel keyway are copperized. The crankshaft is then put to "soak" in a carburizing vat, that is, packed in a substance of high carbon content (charred bone or other substance, etc.). "Soaking" is accomplished under comparatively high temperature, during which time carbon emitted from the carburizing material penetrates or "soaks" into the uncoppered surfaces of the journals and crankpins. Depth of penetration is dependent on temperature and length of "soaking" period. On conclusion of pre-determined "soaking" period (time), the crankshaft is removed "red hot" from the vat and quenched to harden the carbon penetrated surfaces. This process of heat treatment is known as case hardening.



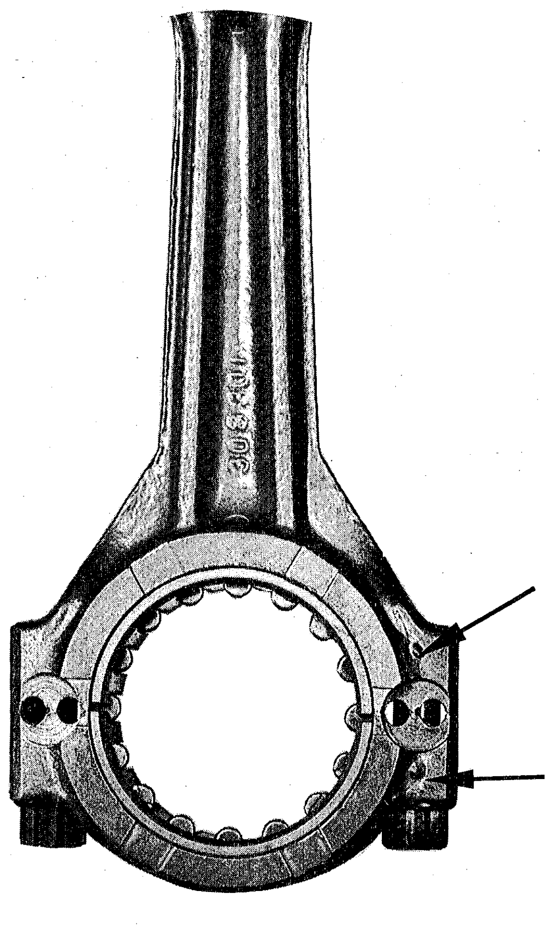
Schematic Drawing (Cross Section) to Show Character of Case Hardened Shaft.

The more modern method of case hardening for this purpose, however, employs the use of a carburizing oil, rather than charred bone, etc., to better control uniformity of carburization, depth of penetration and to reduce time of "soaking" period —a matter of importance in present day production. Carburizing in this instance is actually accomplished by soaking in vaporized carburizing oil.

As mentioned previously, only the bearing surfaces (journals and crankpins) require case hardening to withstand bearing loads. Since there is tendency towards brittleness in a hardened surface, remaining portions of the crankshaft are left comparatively soft and tough to carry the full load. This includes core of the journals and crankpin, cheeks or webs, threaded end of the crankshaft and a restricted area about the flywheel keyway, which are copper plated prior to carburizing. Carbon does not penetrate the copper plated areas during carburizing period, thus, are not materially affected (hardened) during quenching procedure but remain relatively soft and tough as required to withstand various degrees of distortion (bending-twisting) without cracking or breaking as result of effects caused by the power impulses and rate of rotation.

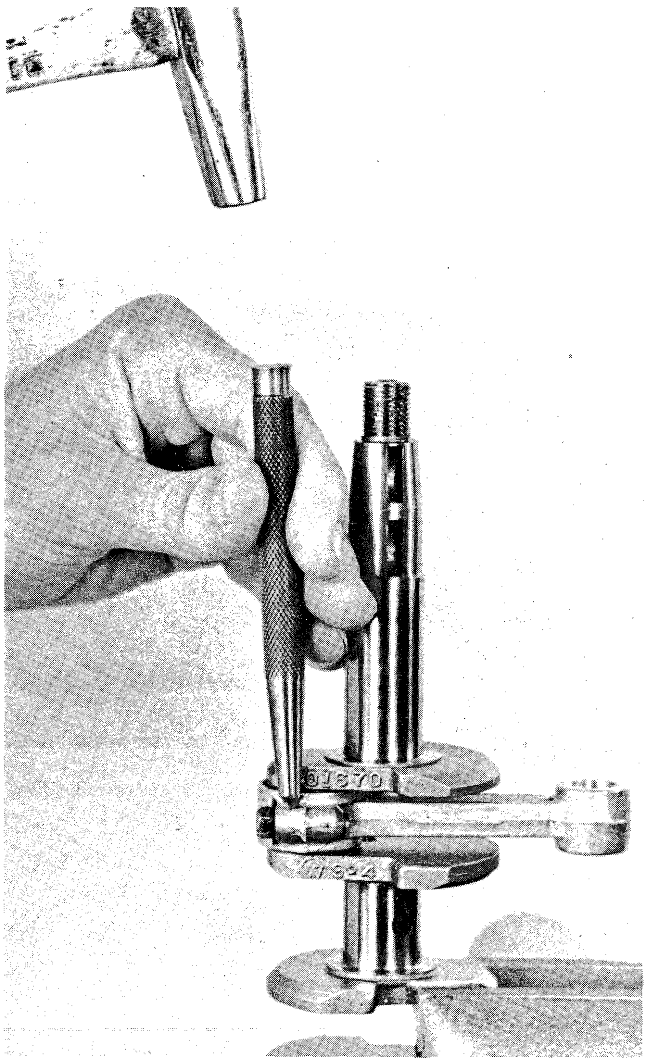
DETACHING CONNECTING ROD FROM CRANKPIN

When detaching the piston-connecting rod assembly from the crankshaft, it will be seen in many instances that the connecting rod and cap are marked or indexed with either a prick punch mark or a small elongated boss. The purpose of this marking is to indicate position of original assembly and to guide the repairman with respect to replacing the cap in its original position on the rod. (Index marks appear on one side only.)



Showing Index Marks on Connecting Rod and Cap. When Correctly Assembled Both Marks are in Alignment as Shown Above.

In the event no index marks appear on the rod or cap, make it a point to provide the indexes before removing the cap—on either a new rod or prior to removing rod assembly from the motor.

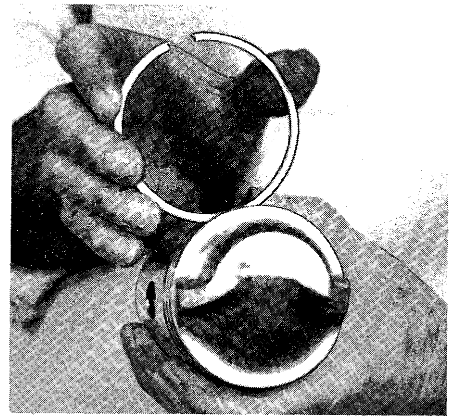


Crankshaft and Connecting Rod Only Mounted in Vise to Illustrate Procedure for Marking Connecting Rod and Cap.

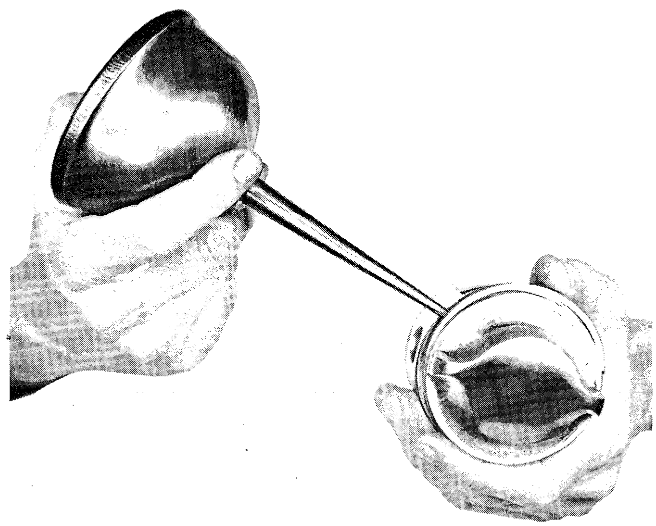
This is important since the rod and cap are machined as a matched assembly and fit properly only when matched as to original assembly. Use a small prick punch to mark or index the rod and cap. Do not strike punch too hard—the rod and cap can be damaged.

INSTALLING CONNECTING ROD-PISTON ASSEMBLY

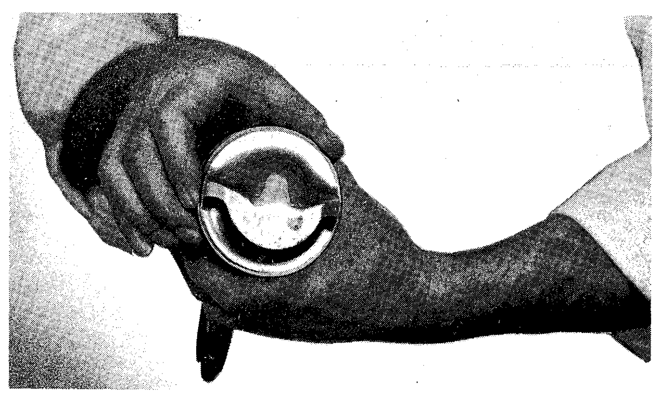
Make certain that all parts involved in the assembly are clean—bearing surfaces, piston ring grooves and cylinder walls coated with oil to guard against abrasion or scuffing until normal lubrication takes place during operation of the motor.



Checking Ring Clearance in Piston Ring Grooves.



Coat Piston Rings and Ring Grooves Liberally With Oil.

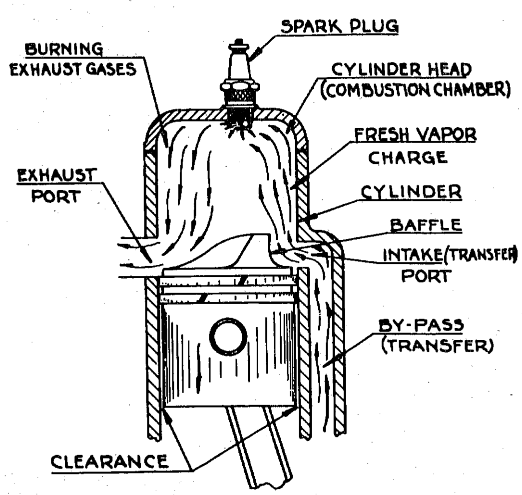


Spreading Oil in Piston Ring Grooves.

See that the piston is arranged with relation to position of the intake (transfer) port — straight side of baffle adjacent to it. Insert piston into the cylinder accordingly, if cylinder block and upper half of crankcase are integral parts. Otherwise, note position of port and straight side of baffle and assemble later in like fashion.

The piston rings, of course, must be compressed before the piston assembly can be fully inserted in

Using Bearing Assembly Grease to Hold Needles in Place During Assembly.

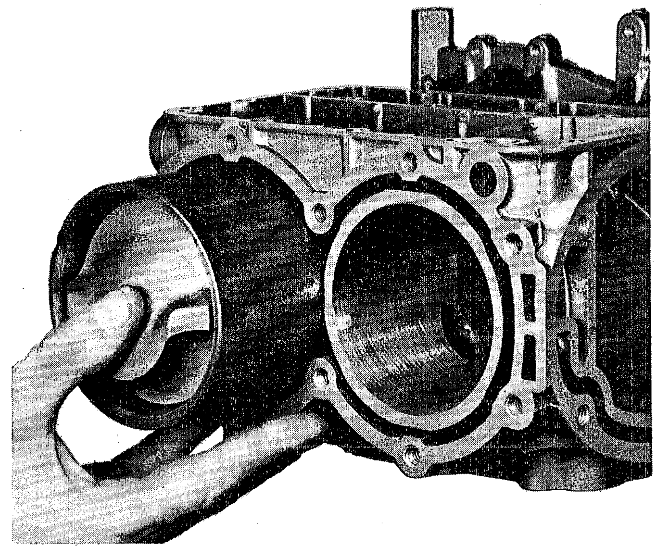


Schematic Drawing to Indicate Staggered Position of Piston Ring Gaps, Piston Clearance and Correct Position of Piston Baffle with Respect to the Intake (Transfer) Port—Straight Side of the Baffle Must be Directed toward the Intake (Transfer) Port to Insure Maximum Performance and Ease of Starting. This is Important.

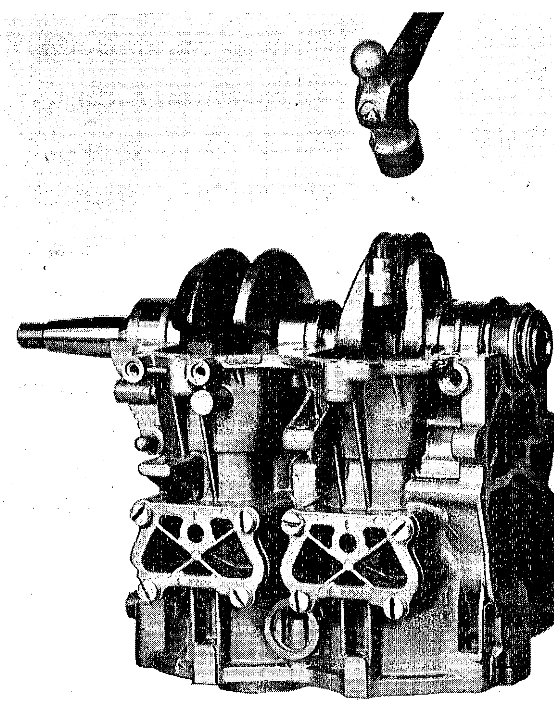
the cylinder. Be careful to see that the rings are properly seated in the ring grooves.

Note prick punch marks or other matching marks on the connecting rod and cap. Observe condition of connecting rod bolts or screws and lock plates—replace if necessary. Place connecting rod carefully in position on the crankpin—install the cap, with match or index mark to match like marking on the rod. This is important to insure proper bearing surface.

Place **new** lock plates on connecting rod screws when required, then bolt rod and cap together. Draw down snugly, being careful not to overdo to result in stripping of the threads. Strike sides of rod and cap lightly with small hammer if there is slight evidence of binding, to obtain final bearing seat. Do not strike aluminum rod (where used) too hard – if light tapping does not free it, look for other possible causes of binding – foreign particles on crankpin, etc.



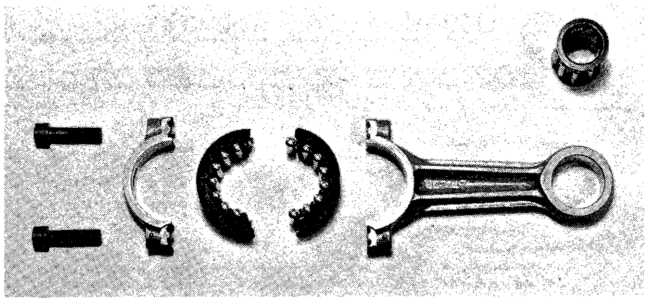
Direct Straight Side of Baffle (Piston) toward Intake Port When Installing Piston.



Strike Side of Connecting Rod Lightly to Obtain Final Alignment of Rod and Cap.

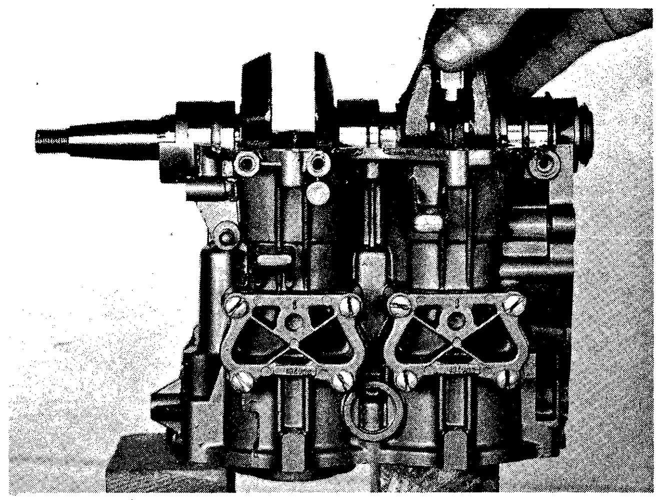
Check bolts or screws for tightness – bend two lugs (where provided) of the lockplate down over the rod, the remaining one up firmly against the head of the bolt to prevent its turning. (Some instances require bending only one lug – up against the bolt.)

In event of roller bearings, proceed in like manner except that roller and retainer assemblies are installed on the crankpin prior to attaching the connecting rod cap.

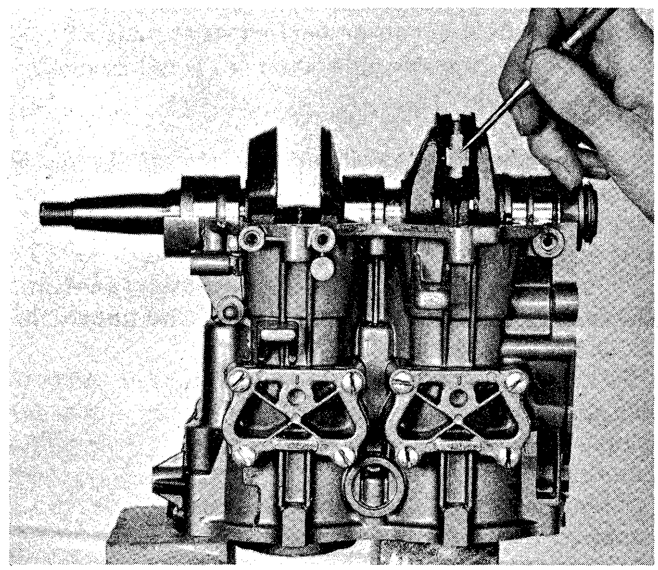


Connecting Rod and Needle Bearing Assembly.

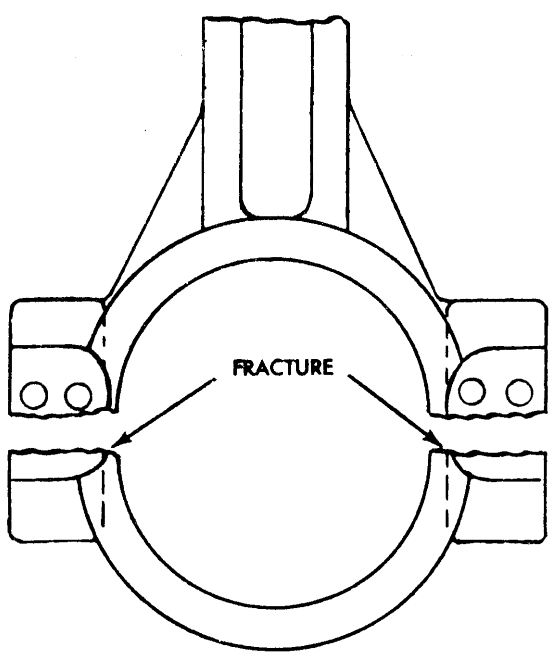
Arrange cap in position with match marks in alignment. Install new lockplates (where provided) on connecting rod screws – seal cap on the rod then draw up firmly on the connecting rod screws – see torque specifications. Draw pencil over edge surface (both sides of the rod) to make certain both rod and cap align at this juncture. If not aligned, offset edge can be felt in the pencil point.

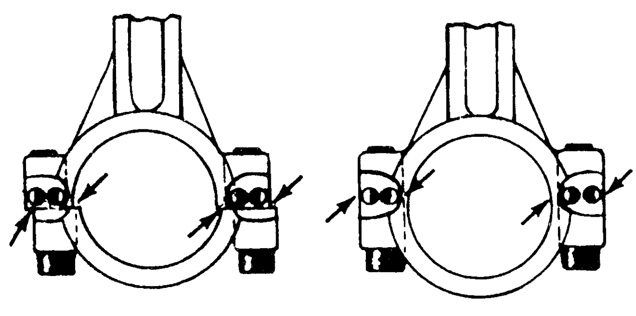


Aligning Connecting Rod Halves.



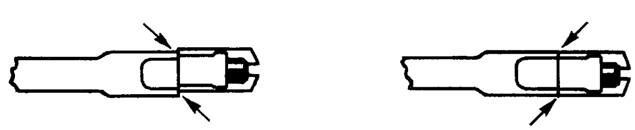
Using Scribe to Check Alignment of Connecting Rod Halves.





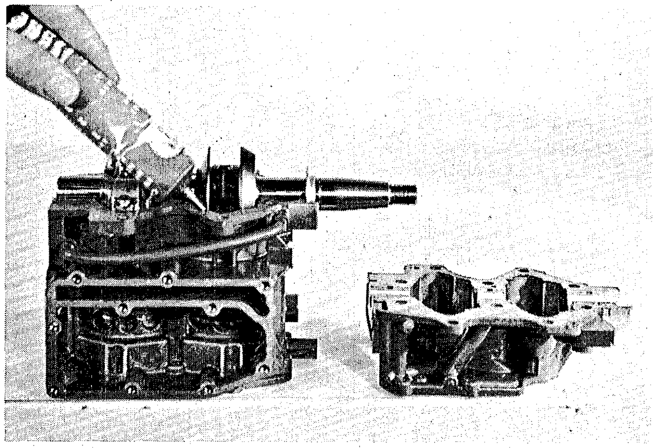
Incorrect.

Correct.



Incorrect.

Correct.



Applying Non-drying Cement to Crankcase Face.

MOTOR TROUBLE SIMILARITIES

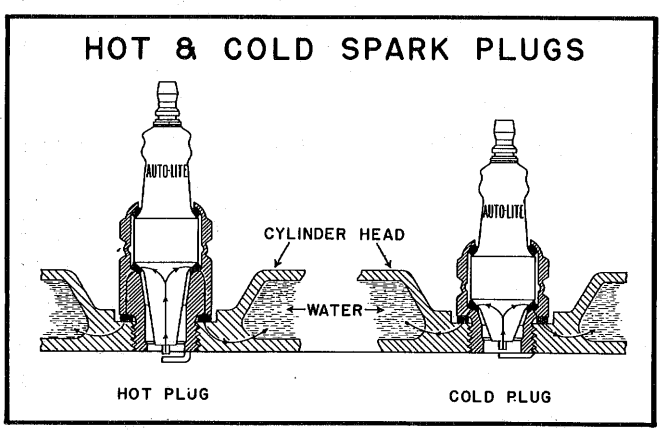
Three (3) irregularities (conditions) produce similar results in motor performance; namely,

1. Incorrect spark plug—too hot for the particular installation.
2. Vapor lock.
3. Insufficient clearance in bearings (slightly undersize), between piston and cylinder wall, piston ring gap or groove clearance and/or tight bearing fits (also gear mesh) in the gearcase.

Uneven running, that is, alternately **fast** and **slow** is or can be caused by any of the above singularly or in combination.

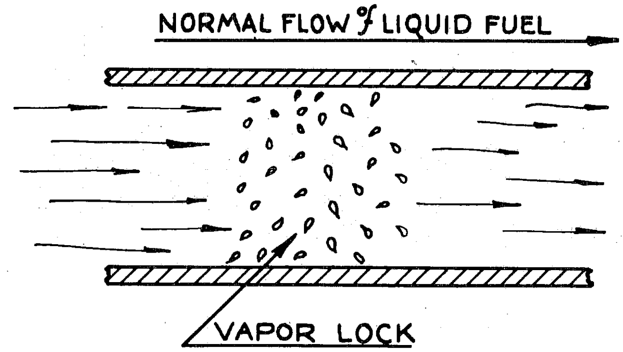
1. If the spark plug is "too hot" for the particular model, there is evidence of slowing down because of pre-ignition taking place as motor reaches running temperature.

Reduced r.p.m.'s, because of pre-ignition, cause temperature to fall—consequently, the plug cools off and functions normally again to permit motor "picking" up speed. However, with increased motor speed, temperature increases (the motor gets hotter) to cause the plug to overheat again. Result is repeat performance of pre-ignition and drop in r.p.m.'s. Solution: Install plug recommended for the model. If the plug is correct, "hunt" down possible causes for overheating.



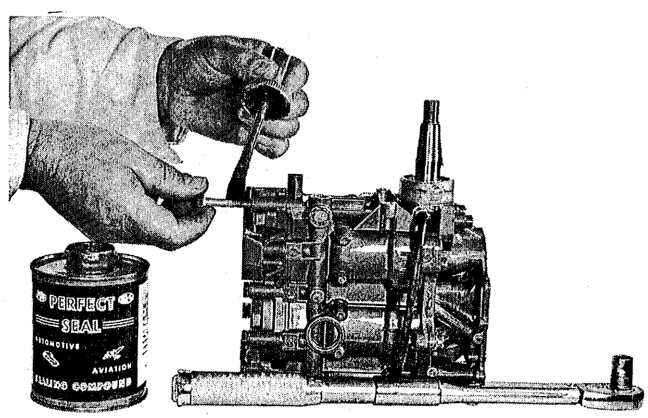
Courtesy of Electric Auto-Lite Co., Toledo, Ohio

2. In event of fuel boiling (vapor lock) in the gas line or carburetor passages, the motor simply slows down for want of fuel (starved). During temporary reduction in motor speed (r.p.m.'s), operating temperature falls (the motor gets cooler), fuel stops boiling (vapor lock broken) and flows normally again to result in accelerated motor speed. As temperature rises with resulting increased r.p.m.'s, a repeat performance of the above condition appears—fuel boils to cause another vapor lock, and so on.



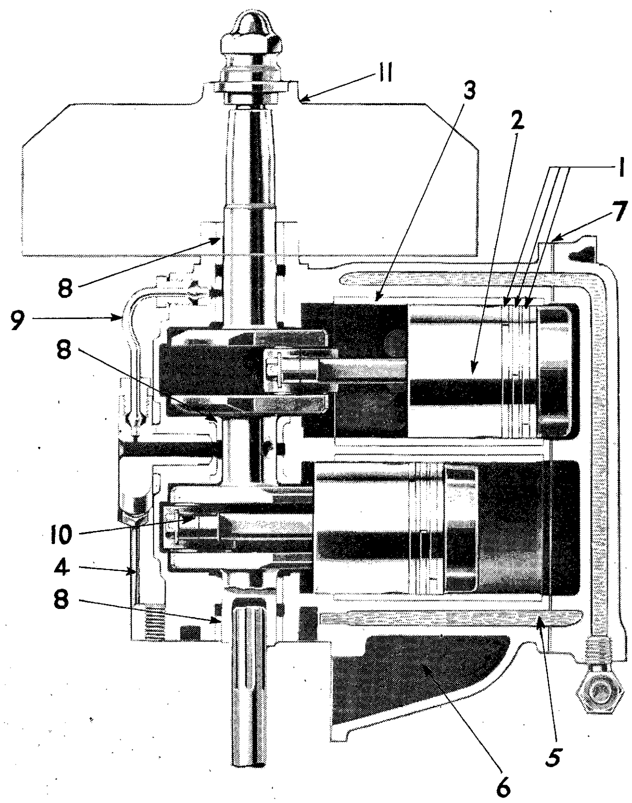
3. Every part of the motor assembly expands proportionately with degree of temperature rise—aluminum and bronze expanding more than cast iron or steel. As previously mentioned, the purpose of clearance between bearing surfaces is two-fold —(1) to make allowances for expansion and (2) to provide ample space for lubrication (oil film).

If clearance is insufficient, the oil, so to speak, is "squeezed" out and the bearing surfaces rub to create friction and subsequently heat. Added load, because of friction, causes motor r.p.m. to fall off.



Applying Perfect Seal to Threads prior to Torquing – gives accurate Torque Reading and Prevents Corrosion – a must in Salt Water Areas.

POWER HEAD HD MODELS



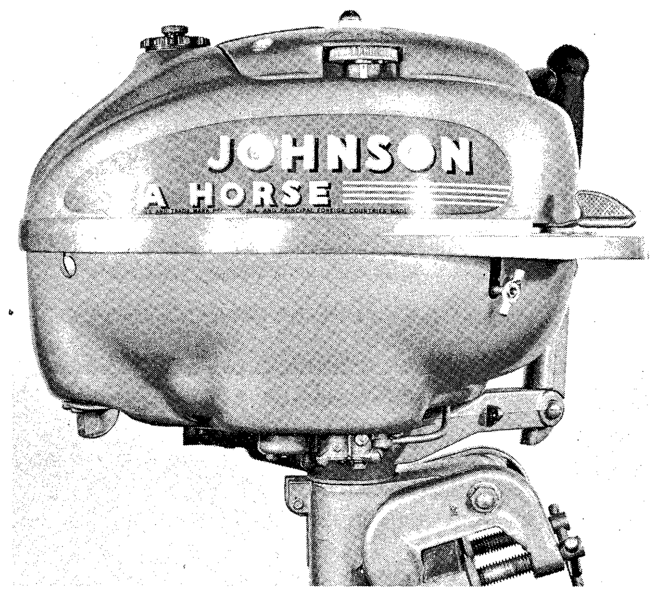
Power Head Assembly

POWER HEAD—SERVICE SUGGESTIONS

1. Piston rings—worn or fast in ring grooves, resulting in loss of compression. (Ring grooves 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.

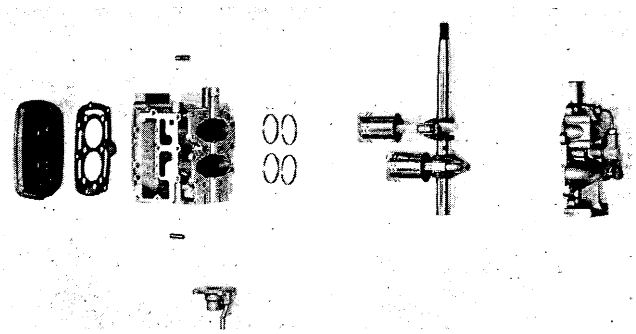
NOTE: Journal bearings are cast in the cylinder-crankcase assembly and, therefore, not replaceable. If bearings are worn to point where replacement is required, it is necessary to install a new cylinder-crankcase assembly. Crankshaft journals and bearings in cylinder-crankcase assembly are machined to 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.



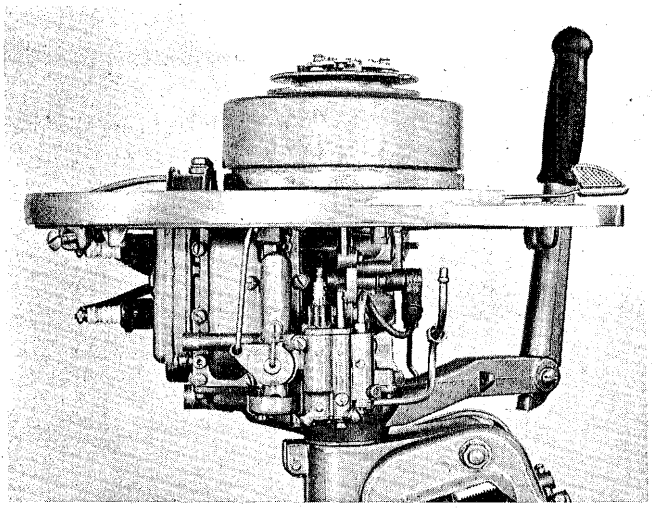
Model HD Power Head

Like service performed on any mechanical device, details of disassembly and final assembly (with necessary replacement parts installed) must be carefully thought out prior to actual procedure if the job is to be well done and with a minimum of



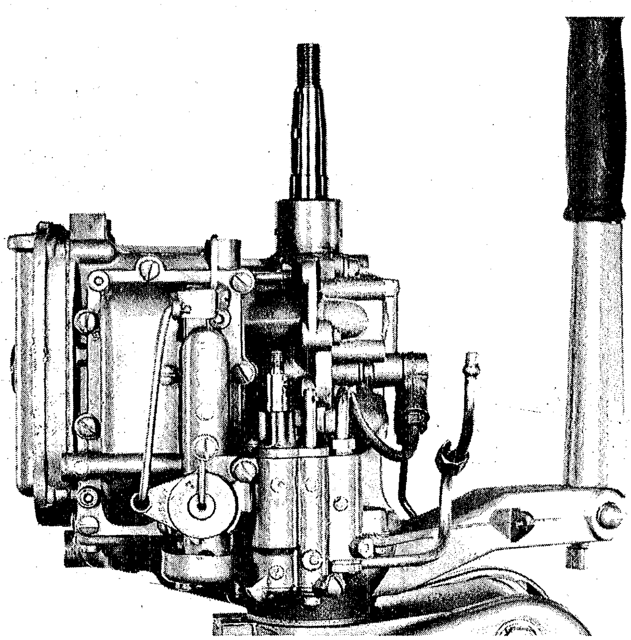
HD Power Head Assembly Layout

effort. Observe first construction and assembly of the unit, then establish order of disassembly—provide ample space (on a bench) for parts to be removed and proceed with the operation. Start out with clean tools and a clean bench top—avoid possibility of mixing parts of one assembly with like parts of another. Use small trays or pans for removed parts.



Showing Ready-Pull, Gas Tank and Shroud Removed

In the case of Model HD power heads – first, remove the ready-pull starter assembly (if provided) to be followed by removal of the shroud and gas tank. Remove next the flywheel (magnet rotor if provided) and armature plate, followed by removal of the carburetor and manifold assembly. Remove cylinder head carefully.



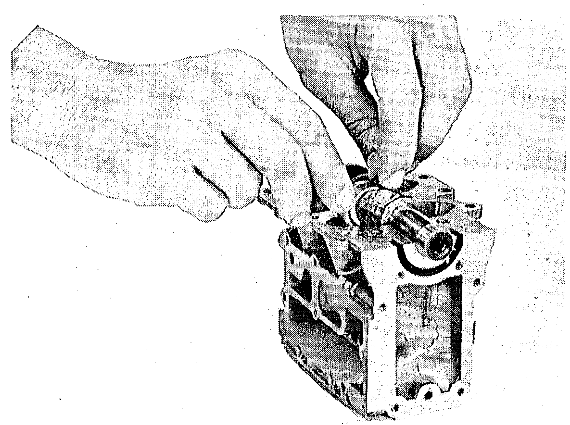
Showing Ready-Pull, Gas Tank, Tank Bracket, Shroud and Magneto Removed for Final Disassembly

Detach power head from the driveshaft casing—lift power head assembly from driveshaft casing and place on clean bench top. Remove screws holding crankcase fast to cylinder block. Drive out tapered pins aligning crank sections. The crankshaft and connecting rod assemblies are now accessible for removal.

Bend small lug, resting against one side of the connecting rod to prevent its turning, away from screw head. Note markings on rod and cap—if no markings appear, carefully prick punch rod and cap (one side only) of each rod assembly to permit aligning on reassembly. Remove screws holding cap fast to rod—lift caps free of connecting rods, being careful not to mix caps or screws (caps and screws must later be reinstalled in original positions). Lift crankshaft from block assembly, then push rod and piston assemblies out of their respective cylinder bores, remembering which is top and bottom. Mark with pencil accordingly. Replace caps and screws (loosely) on their respective rods to avoid interchanging later on. Wash all parts of the assembly.

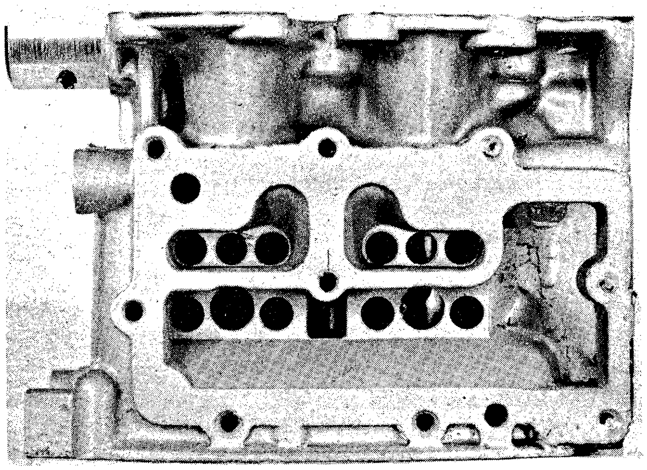
The power head is now completely disassembled for inspection of the functional parts to determine which are to be replaced or what otherwise is to be done to restore it to normal operating condition. The piston rings should be checked as to "freeness" in the ring grooves and for excessive wear (ring seats and ring grooves). The pistons and cylinder walls should be checked for excessive wear and arrangements made for installing new pistons, rings and cylinder block (or reconditioning) if necessary. Observe condition of walls of ports in the cylinders to make certain there is no obstruction as result of carbon accumulation – scrape free of port walls.

Check connecting rod wristpin and crankpin fits. Observe general condition of wristpins, crankpins and connecting rod bearings—if badly scored or worn, replace with new parts. To check for exces-



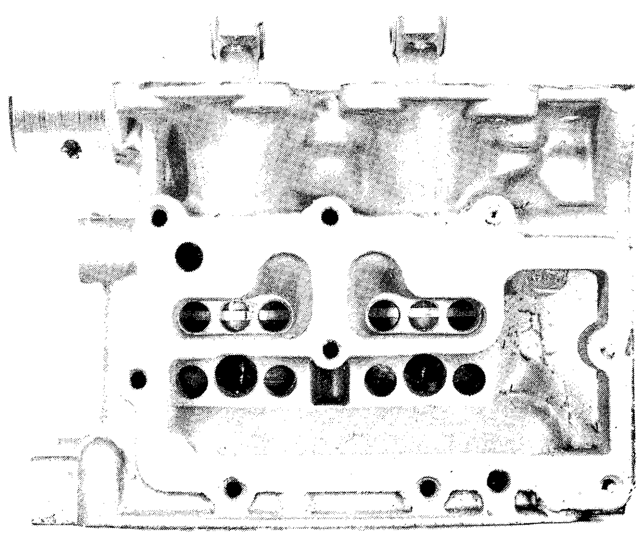
Checking Connecting Rod for Excessive Looseness on the Crankpin

sive looseness of the connecting rod on the crankpin, first check to ascertain freeness of the rod on the pin which can be accomplished by exerting up and down motion on the rod at right angle to the crankpin. This operation should indicate normal clearance; however, if excessive clearance (or wear) is evident, it will be found possible to rock the rod from side to side on the pin in a "cocking" motion, as illustrated. Similar procedure can be carried out for wristpin fit. Check connecting rod for straightness. Clean out manifold assembly — check carburetor for functional defects as previously described.



Cylinder Prepared and Ready for Assembly

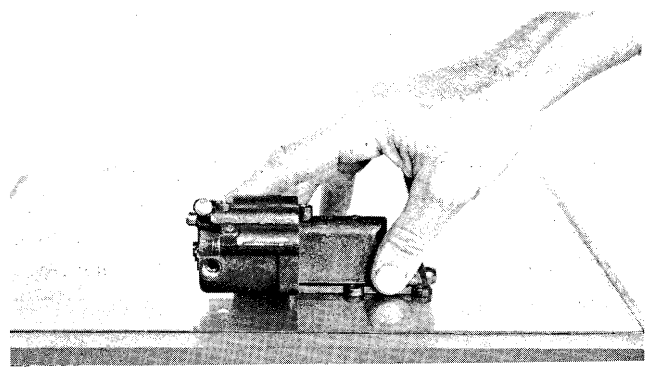
After having completed inspection of parts to determine their fitness for further use or provided the necessary replacement parts, the power head is ready for assembly. Carefully assemble in order reverse of that described above—be sure all bearings "fit" with proper clearance, including pistons



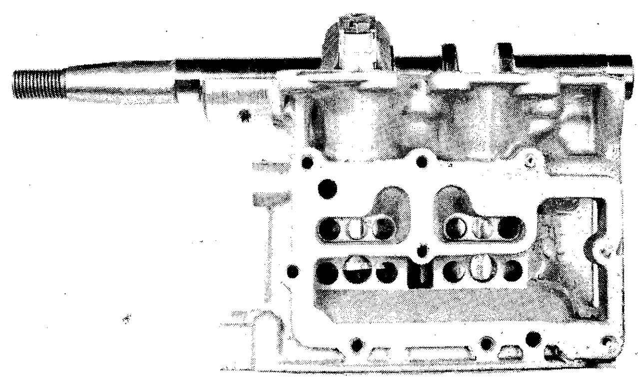
Cylinder Block with Piston and Connecting Rod Assemblies Installed

and rings. (Check pistons for roundness. First check for roundness is to insert the piston into its respective cylinder — if there is evidence of tightness or binding, the piston can be assumed to be out of round and should be "trued" up as previously described. Check with micrometer—otherwise if the piston slips into the cylinder freely, further check can be made by inserting a feeler gauge (.001″ thick) between the piston and cylinder wall at several points in the circumference. Provide new gaskets but make certain gasket faces have first been cleaned off and are "flat" with no indication of warp. Use Perfect Seal No. 4 (cement —non-drying) on gasket faces.

Work with clean tools, clean parts, a clean bench top and clean hands (free of grit, etc.)—an otherwise good job can be ruined by grit or foreign matter on hands, tools and parts.

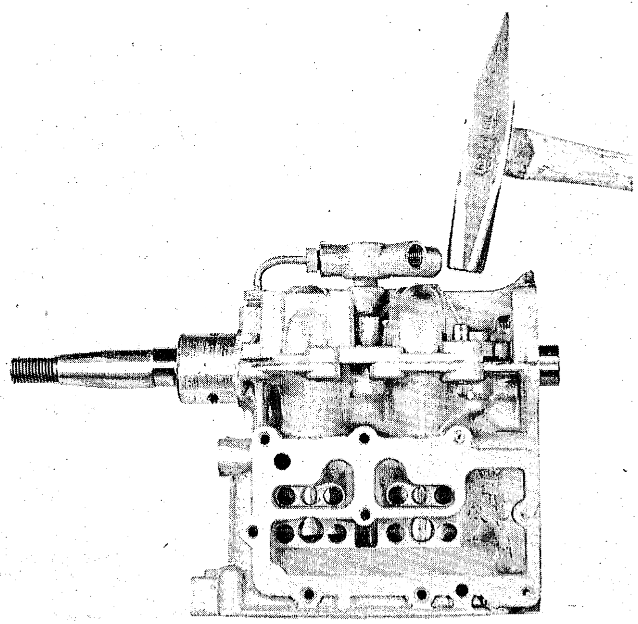


Lapping Manifold Face to Insure its Flatness



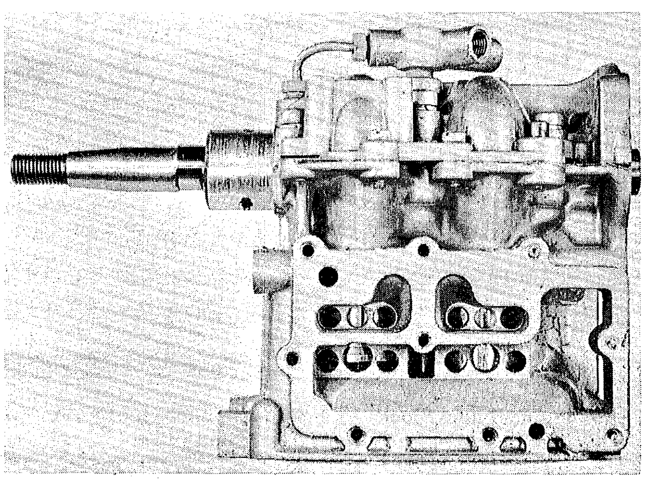
Showing Cylinder Block with Piston-Connecting Rod Assemblies and Crankshaft Installed

Coat all bearing surfaces liberally with clean oil prior to assembly—connecting rod and crankshaft bearings, cylinder walls, ring grooves, etc. Establish order of assembly and proceed accordingly—all assemblies must fit with no degree of tightness. Don't try to force fits—each piece has a definite place in the assembly and if properly installed, will satisfactorily perform its original function.



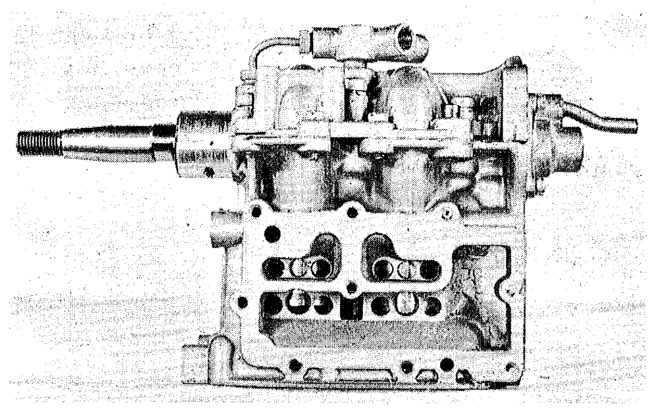
Driving in Tapered Pins to Properly Align Crankcase Section Prior to Bolting Down

Since there are no gaskets between the crankcase, it is extremely important that the top half of the crankcase be thinly coated with cement when assembling. The surfaces, though very accurately machined, must rely on a thin film of cement to guard against loss of crankcase compression. Be careful to guard against possibility of cement smearing on bearing surface under compression as crankcase screws are drawn up.



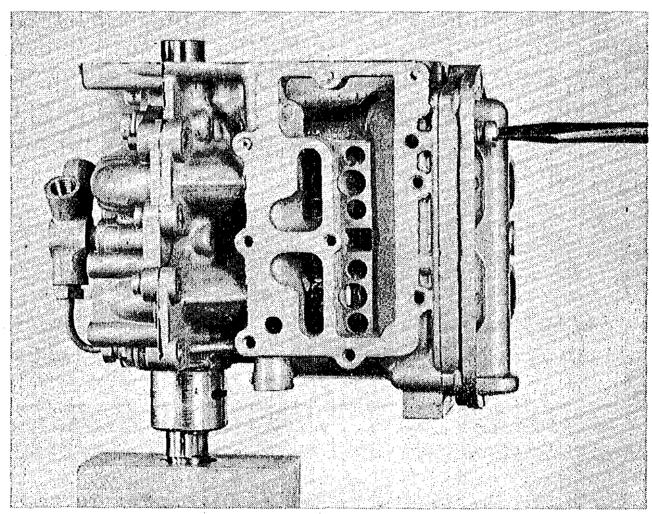
Showing Assembly with Crankcase Aligned and Properly Bolted Down

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 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.



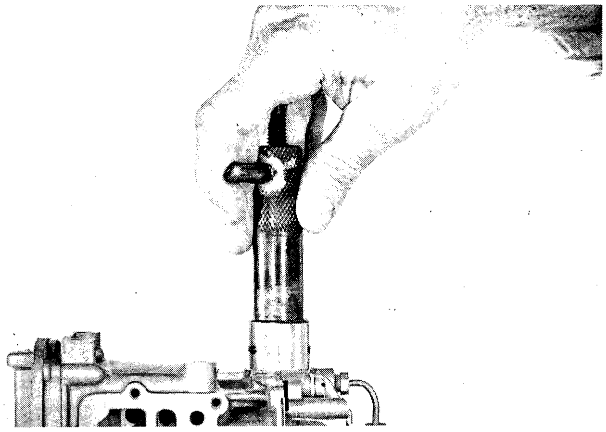
Power Head with Crankcase Cap and Water Outlet Attached

Some gasket cements dry 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.

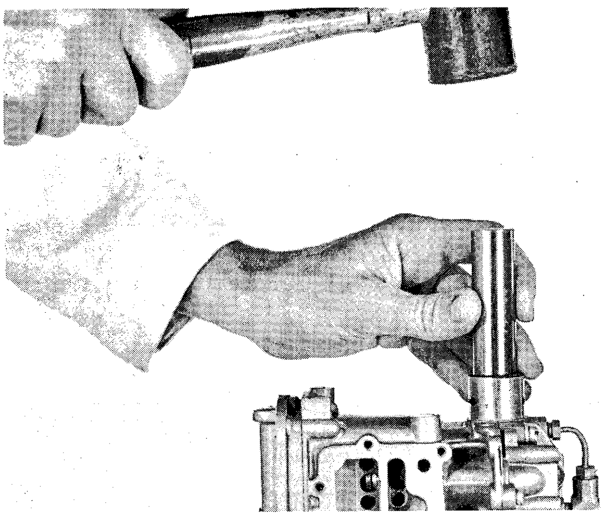


Removing or Installing Cylinder Head

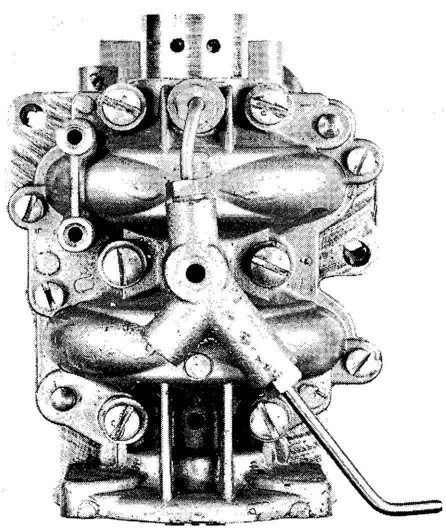
In event the cylinder is removed for inspection of the piston, rings, etc., it will be necessary when disassembling the crankcase to remove the old cement and to apply a fresh coat. Unless the original cement is removed and a fresh coat applied, there is danger of leakage between the halves of the crankcase.



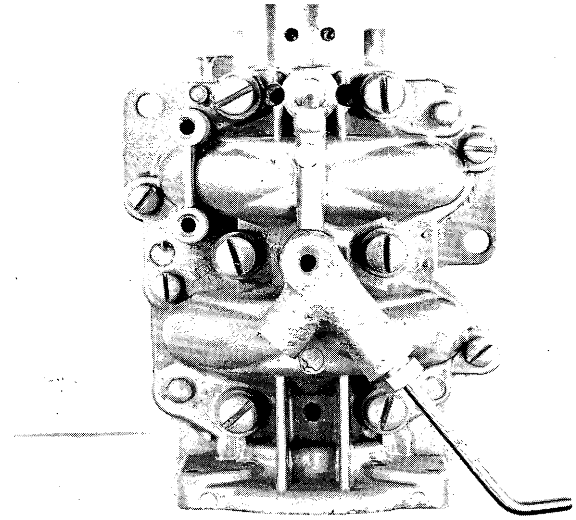
Removing Oil Slinger with Special Tool



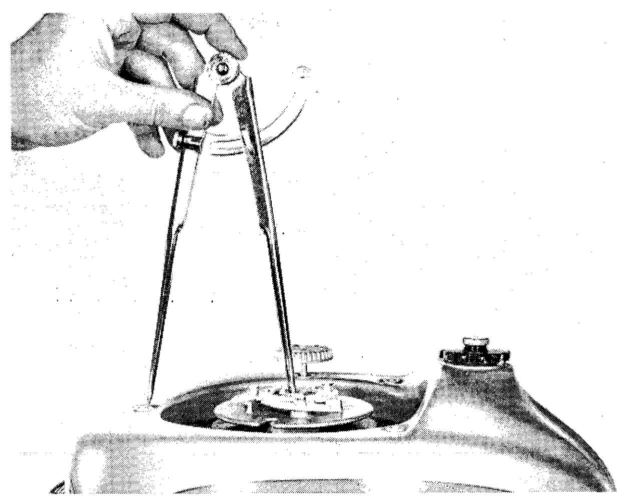
Installing Oil Slinger (Flange Section Down)



Many of the HD Cylinder Block and Crankcase Assemblies were not Provided with an Oil Return, the Purpose of which is to Assist in Circulation of Oil Over Surface of the Top Journal Bearing. Oil on Reaching Top of the Bearing is Drawn Off by Suction Created by Action of the Slow Speed Insert, thus Returning Excess Oil to the Crankcase. Outside Piping was Employed to Accomplish this Purpose on Many of the Motors, However Later Production Makes Use of a Cast-in Passage to Perform the Same Function



It Will be Noted that Construction of the Slow Speed Insert is Somewhat Different where the Cast-in Oil Return Passage is Provided in that Outside Piping Connections are Omitted. The Insert Shown in the Assembly Above can be Installed Satisfactorily, However, in Motors of Earlier Production not Equipped with Oil Return

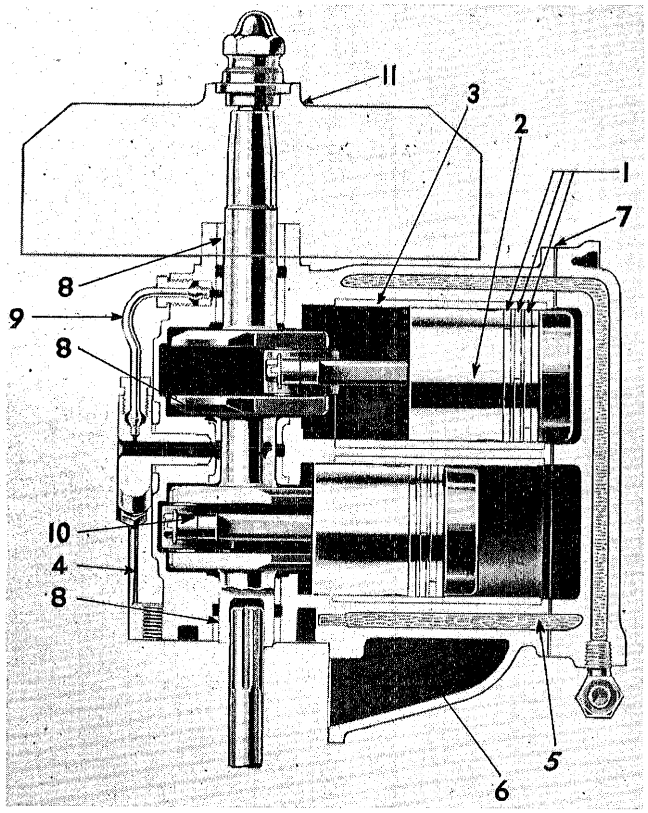


It is Extremely Important that the Gas Tank be Properly Lined up with Respect to the Center of the Crankshaft and Placed at the Correct Elevation to Prevent Mechanism in the Starter Head from Riding Against the Top of the Starter Pawl Plate on the Flywheel

To Check Alignment, Mount Tank in Place on the Bracket —Insert and Draw Up Snugly (not tightly) on the Mounting Screws. Check Position of the Starter Mount Holes in the Tank with Dividers as Shown Above. Holes (in the Tank) Should be Equidistant from the Center of the Crankshaft. In the Event the Tank is Slightly Out of Line, Tap Corresponding Side with Palm of Hand as Required to Obtain Correct Position. Tighten Mounting Screws. Install Starter Head and Check for Freedom of Action by Pulling on Starter Cord. If there are Indications of Rubbing Remove the Tank to Build up Elevation by Placing Flat, Thin Washers as Required Between the Tank and Mounting Bracket, then Proceed as Above Making Certain that the Starter Head Mounting Holes in the Tank are Spaced at Equal Distances from the Center of the Crankshaft. Finally Draw up Securely on Mounting Screws

An Improperly Mounted Tank Will Eventually Result in Damage to Starter Parts in Addition to Being Noisy

POWERHEAD – TD MODEL



Power Head Assembly

POWER HEAD—SERVICE SUGGESTIONS

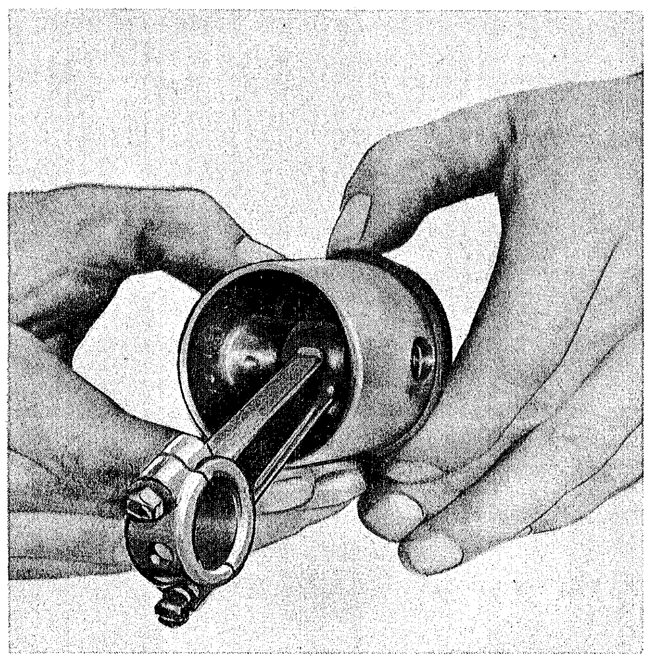
1. Piston rings—worn or fast in ring grooves, resulting in loss of compression. (Ring grooves may be clogged with carbon causing rings to stick.)
2. Piston—worn or scored.
3. Cylinder — worn or scored, causing loss of compression.
4. Low speed needle—improperly adjusted, needle and seat in low speed 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.

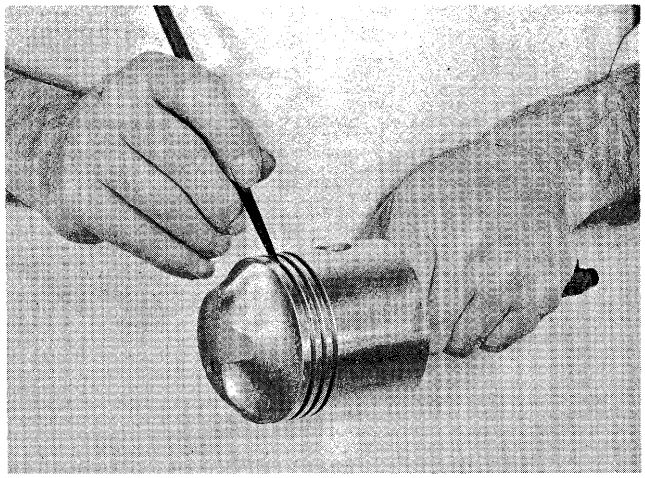


Removing Piston Rings

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

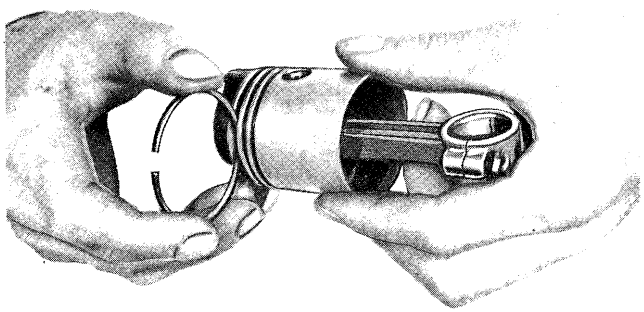
The piston ring grooves frequently become clogged with carbon after long periods of operation, which requires removal to prevent rings from sticking and becoming partially inoperative. This condition results in loss of compression and noticeable deterioration in power.



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 have been removed. If burrs exist, they usually can be removed with a sharp edge scraper.

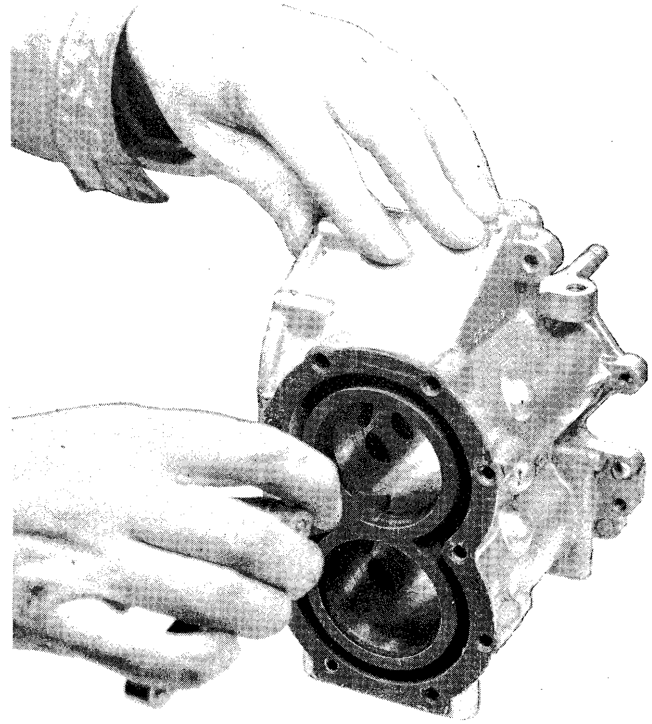


Checking Ring Grooves

Handle piston carefully. Burrs are the result of rough handling or dropping.

High spots on edges of 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.

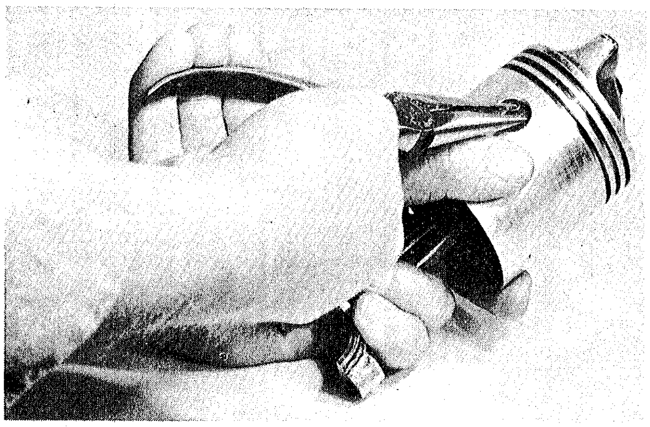


Checking Piston Ring Gap

Piston rings are ground to size at factory, but it is advisable to check gap clearance to make sure recommended .005″ to .015″ 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.

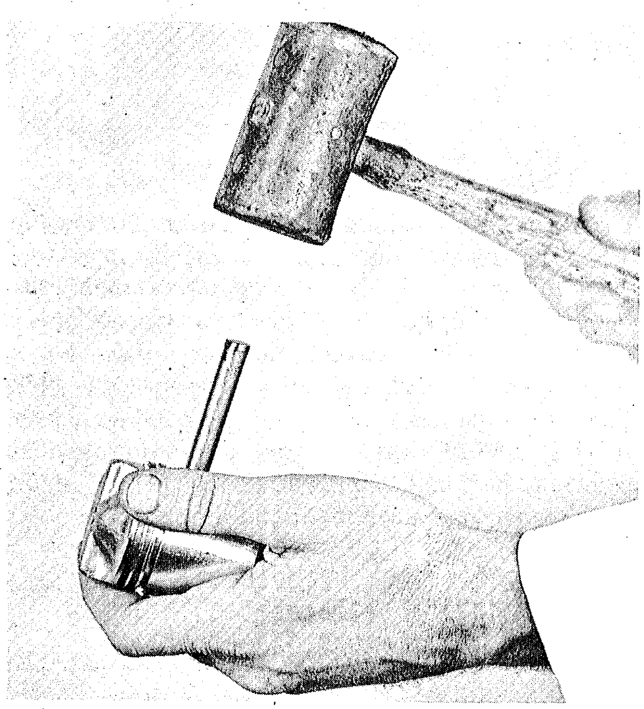
Cleanliness cannot be overemphasized—a good shop keeper is orderly about his personal appearance as well as that of his shop.

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.

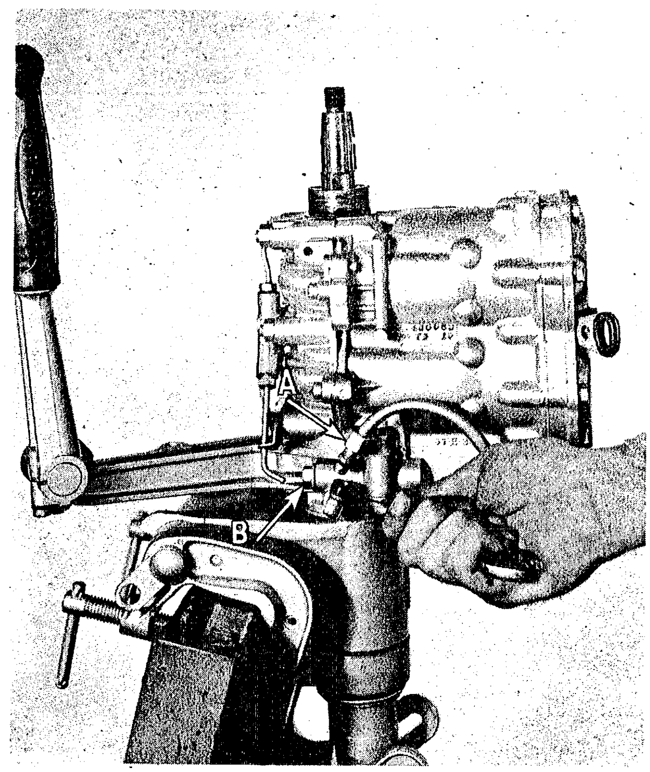


Removing Lock Ring

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.

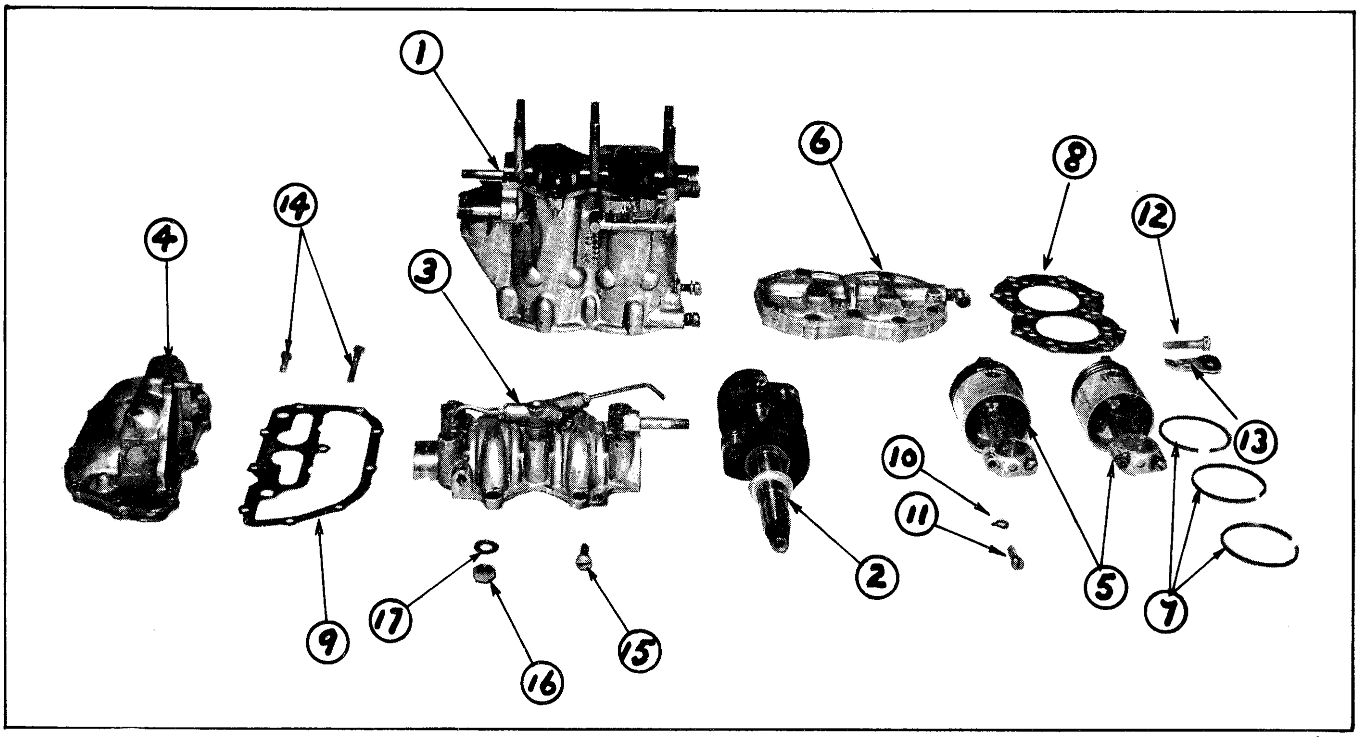
When installing the power head, use new gaskets and make certain gasket surfaces are clean and free of foreign matter—void of burrs or other irregularities apt to affect proper seal.

Install the mounting nuts and insert muffler screws (be sure gaskets are properly located). Draw up lightly first on nuts and muffler screws to position the power head, then tighten the nuts to secure the mounting. This should be followed by tightening the muffler screws.

Smear "glob" of grease on drive shaft and end of the crankshaft when assembling.

Avoid accumulation of oily rags about the shop or work bench—oily rags left lying about the shop are a hazard—a fire hazard and a threat to an otherwise promising business.

CORRECT PROCEDURE FOR ASSEMBLING POWER HEAD

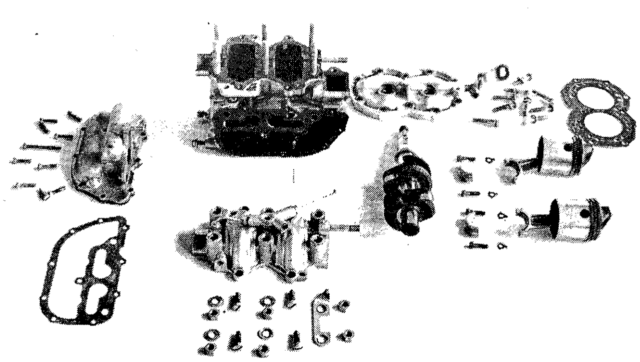


1. Cylinder
2. Crankshaft
3. Crankcase
4. Manifold
5. Piston and Connecting Rod
6. Cylinder Head
7. Piston Rings
8. Cylinder Head Gasket
9. Manifold Gasket
10. Lock Plate
11. Connecting Rod Screw
12. Cylinder Head Bolt (Screw)
13. Spark Plug Wire Support
14. Manifold Screws
15. Crankcase Screws
16. Crankcase 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 .015″ — groove clearance .0015″ to .0025″.)

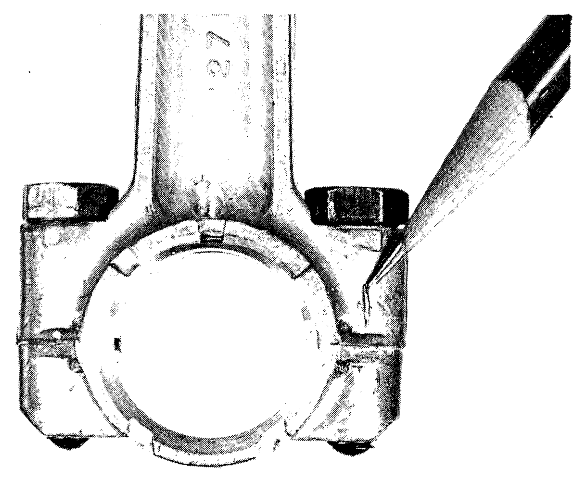
Remove all traces of gasket cement from face of both crankcase sections—this is important.

Lay all parts on a convenient assembly bench as illustrated.



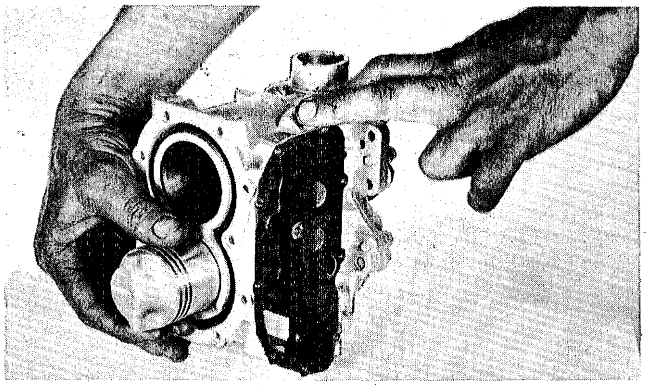
Parts to be Assembled

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.



Showing Index Marks on Connecting Rod

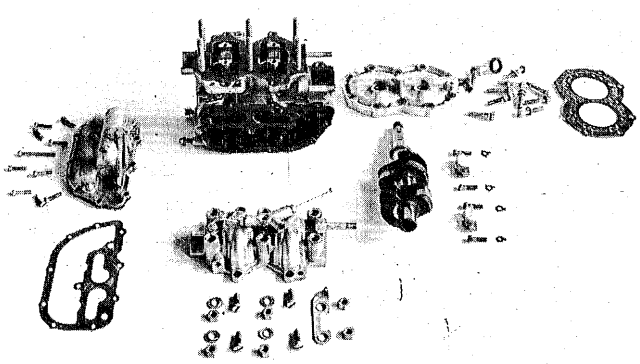
3. Place a drop or two of oil on each of the three bearings in the cylinder assembly — also a drop or two on each connecting rod bearing. Install crank-



Inserting Piston

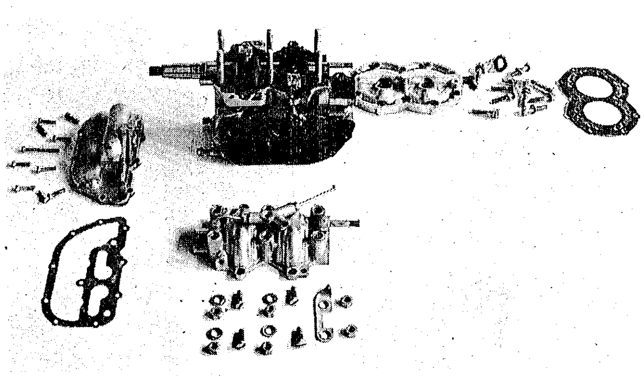
shaft. Attach connecting rods to crankpins. Do not neglect bending small lug on lock plate *up* to prevent connecting rod screw from turning.

4. Spread thin coat of gasket cement over face of the crankcase — (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, .001" to .0025")—see crankcase assembly.



Showing Piston and Rods Installed

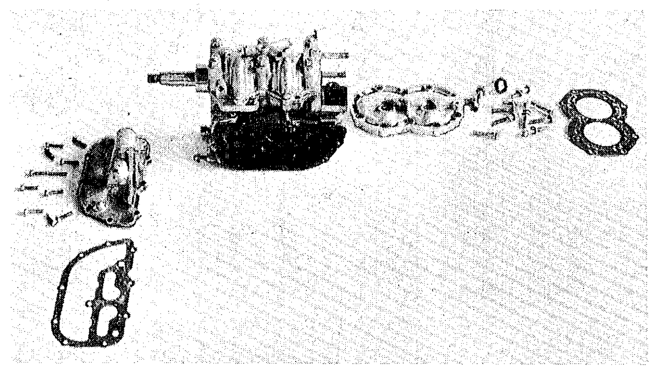
Place a drop or two of oil on each of the three bearings in crankcase section. Assemble necessary screws, nuts and washers — draw down evenly and securely.



Showing Pistons, Rods and Crankshaft Installed

CRANKCASE ASSEMBLY

Since there are no gaskets between the crankcase sections it is extremely important the surfaces be 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.

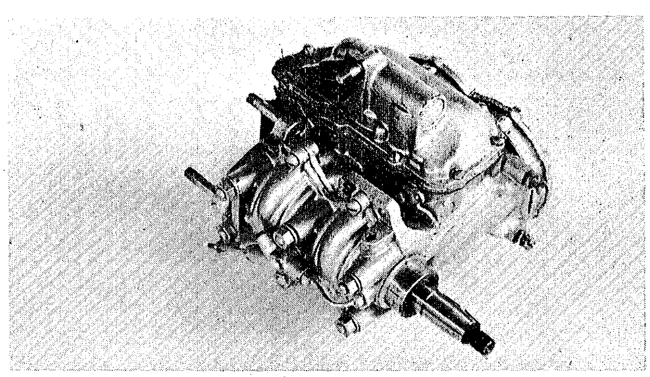


Showing Pistons, Rods, Crankshaft and Crankcase Installed

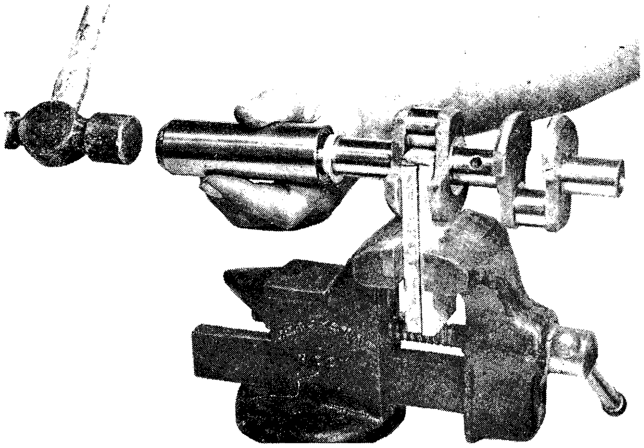
When assembling, be sure both surfaces are clean and that all traces of old cement have been removed. If the crankcase is assembled with the old cement still remaining and freshly coated with additional cement, bearing clearances are likely to be excessive — this will affect performance of the motor. 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.

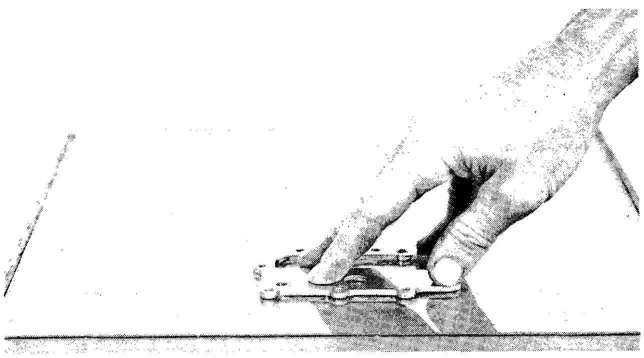


Complete Power Head Assembled

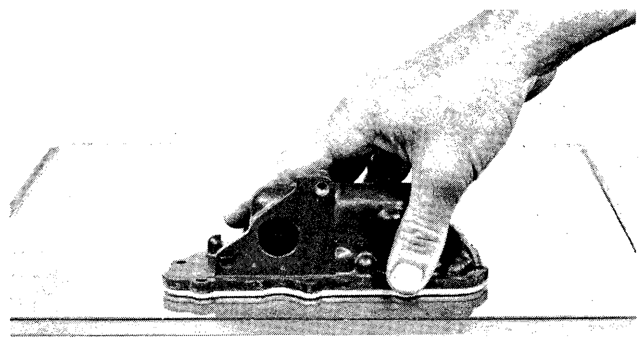


Driving Oil Slinger into Position

Lapping Cylinder Head to Insure its Flatness to Eliminate Possibility of Blown Gasket as the Result of Warpage. Lapping Operation Should be Accomplished on a Piece of Plate Glass or Other Flat Surface Covered with Lapping Compound or a Piece of No. 0 Emery Cloth. Move in a Figure Eight Motion to Properly Dress, Bearing Down Evenly on the Head



Lapping Manifold Plate to Insure Flatness

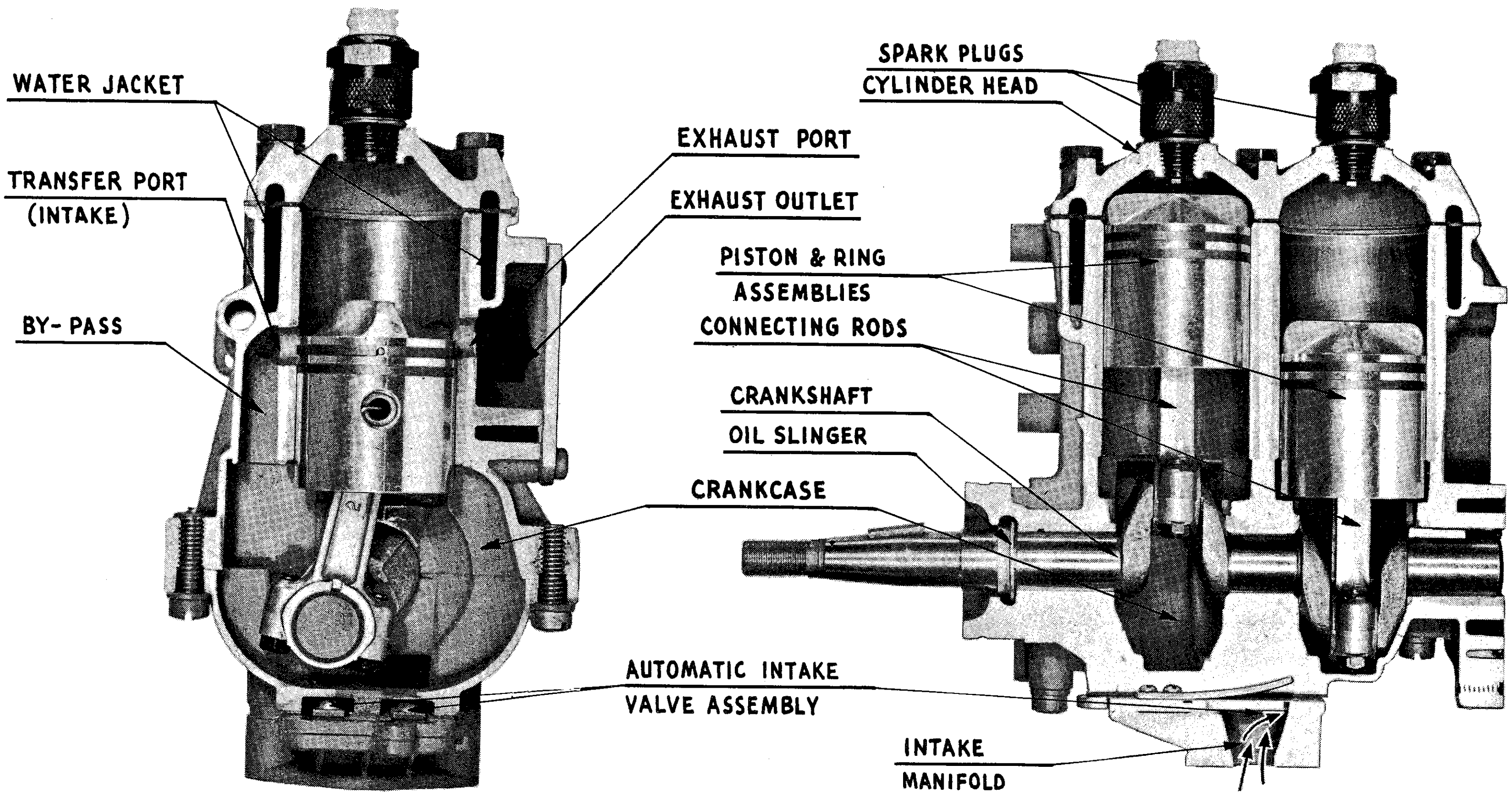


Lapping Manifold Assembly to Insure Flatness

NOTES

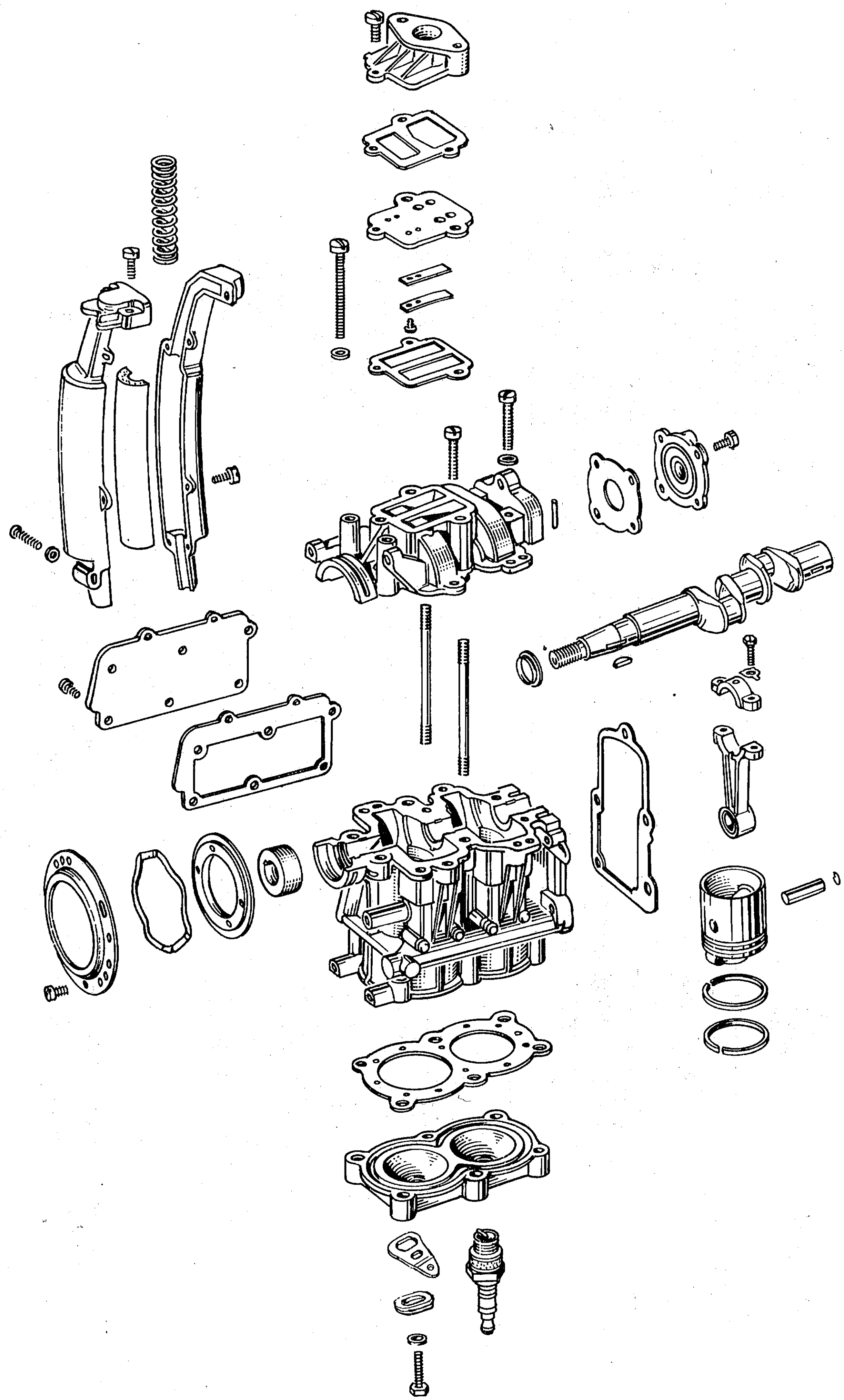
NOTES

MODEL JW POWER HEAD



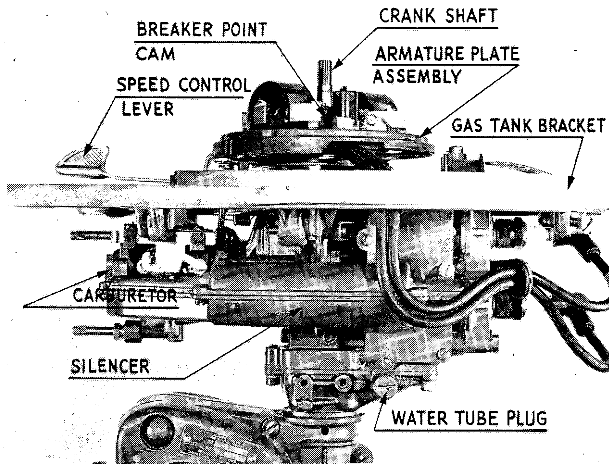
Sectional Views of the JW (3) Power Head.

Note that Fuel Induction is of the two-port Type (Transfer on Intake Port and Exhaust Port Built into the Cylinder Wall) – Employing in Conjunction an Automatic Intake Valve Arrangement to Charge the Crankcase. For Explanation of "Port" Action see Page 79 – for Explanation of Automatic Intake Valve Action, see Page 145. Automatic Valve Plate in the Model JW however, consists of but a single Segment, otherwise, Functional Service Operations are Identical.



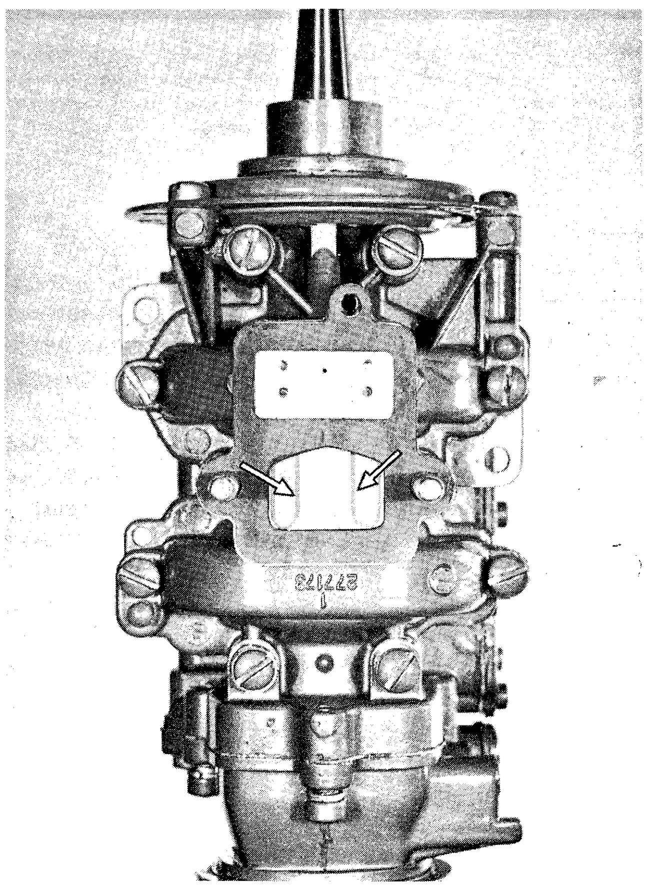
Model JW Power Head Group.

MODEL JW POWER HEAD

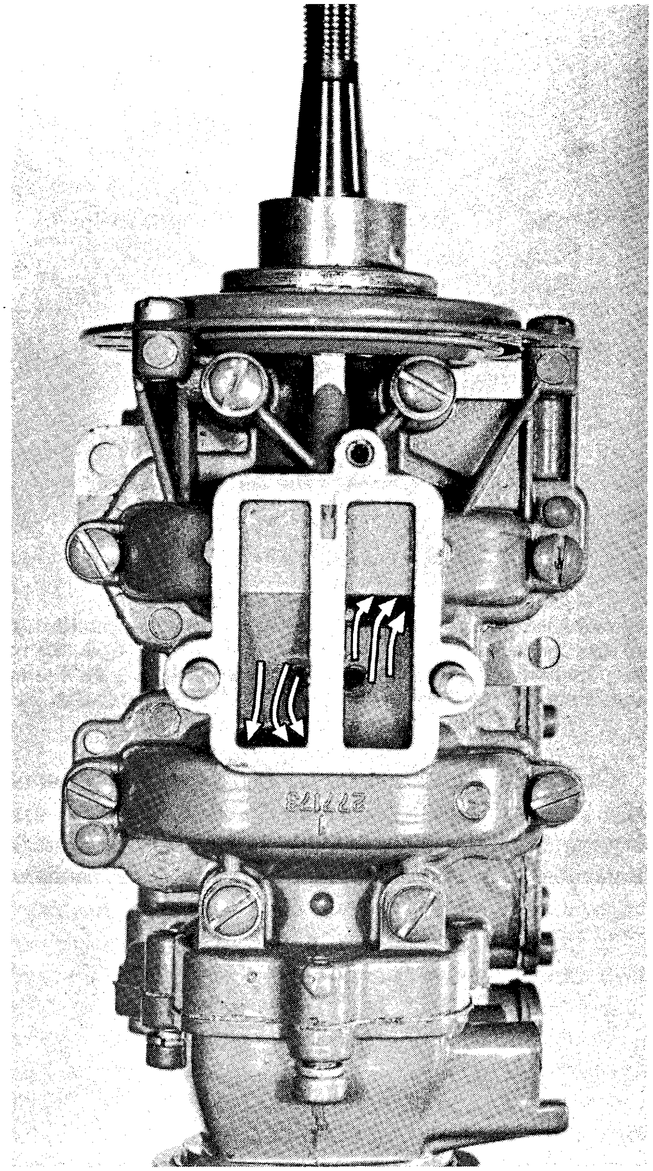


Powerhead Assembly with Gas Tank, Cover and Flywheel Removed.

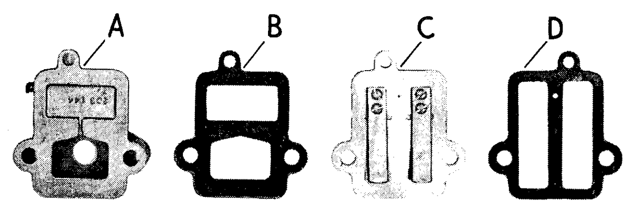
Procedure for disassembly, repair and assembly of the JW power head is similar to that accomplished in earlier models of small bore and corresponding horsepower as described on Pages 207 to 210 inclusive, and Page 213. Attention given bearing "fits" (connecting rod and crankshaft) should be exercised with the same care and degree of exactness.



Powerhead (Stripped) with Carburetor and Intake Manifold Removed to Expose Automatic Intake Valves — One for Each Crankcase Chamber is Indicated by Arrows.

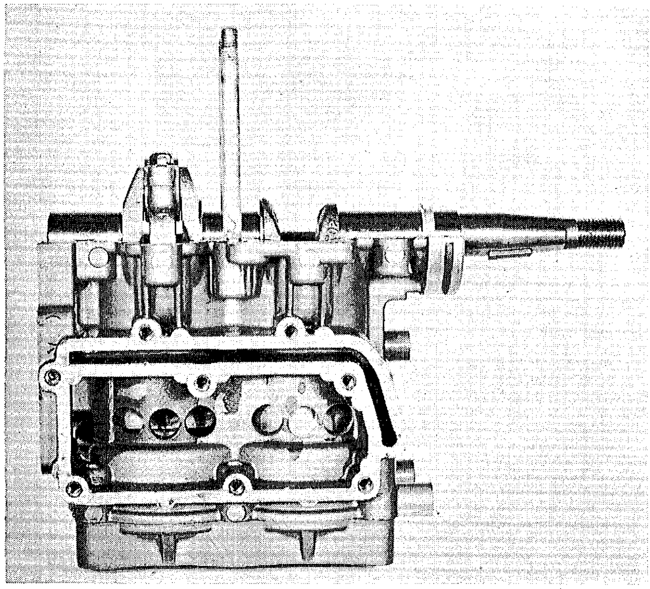


Powerhead (Stripped) with Carburetor, Intake Manifold and Automatic Valve Plate Assembly Removed to Expose Channels Directed to Each Crankcase Chamber as Indicated by Arrows.



Showing Manifold (A), Gaskets (B & D) and Automatic Valve Plate Assembly (C)

Make no "dry" assemblies — coat all functional moving parts (bearings, piston and cylinder walls and piston ring grooves) with a film of oil prior to installation assembly.

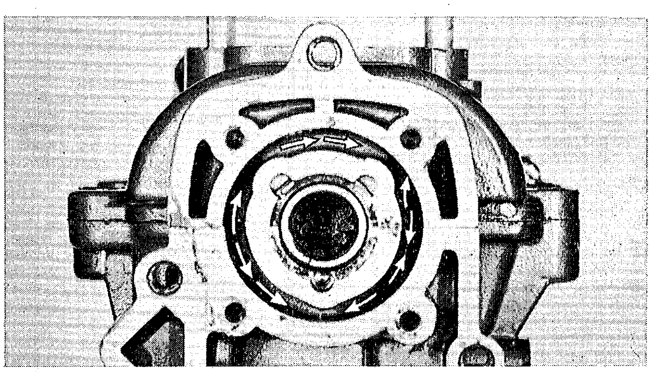


Showing Crankcase Removed for Removing or Installation of the Connecting Rod-Piston Assembly – see Pages 212 to 214 Inclusive for Detailed Instructions Relative to Piston and Piston Ring Installation. Correct Piston Ring Gap for the Model JW is .005″ to .015″.

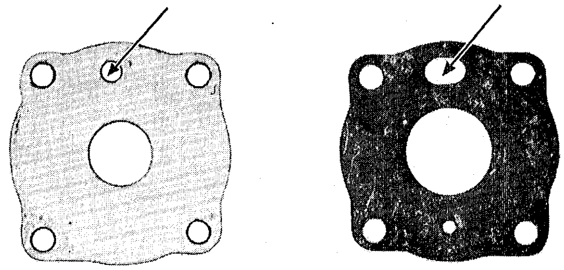
Crankcase faces should be clean prior to assembly. Apply thin coat of Sealer 1000 or similar hard drying cement to upper crankcase face – install lower section of crankcase immediately, replace tapered pins to align crankcase sections, see page 232, then draw up evenly and snugly on screws and nuts holding the assembly together. Torque crankcase screws. See Torque Chart, page 362.

Some precaution is necessary when attaching the lower flange and gasket. Make certain holes in gasket align with corresponding holes in the flange mounting face. Open hole in the flange provides water discharge from the cooling system into the drive shaft casing and should be placed toward "front" side of the power head (carburetor side).

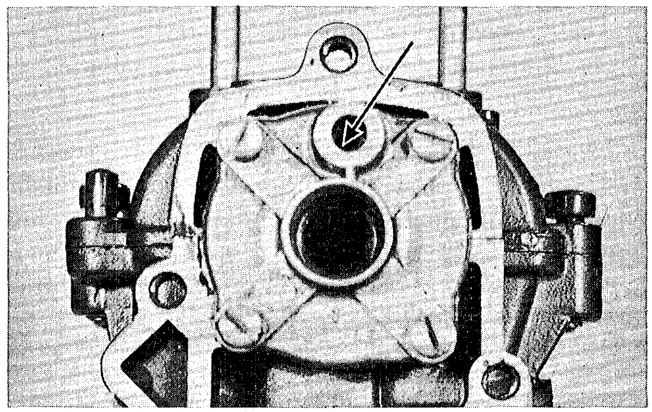
If placed in any other position, water through the cooling system will be obstructed to cause overheating.



Showing Water Channel Surrounding the Lower Journal Boss on Bottom End of the Powerhead Assembly to Permit Cooler Operation in Area of Bearing.



Holes in Gasket (shown above) must be Properly Aligned with Holes in the Crankcase Lower Flange — Elongated Hole in Gasket (right) Aligned with Hole in the Flange as Indicated by Arrows.



Showing Correct Installation of the Lower Crank Cover. Hole as Indicated by Arrow, Directed Toward Front or Carburetor Side of the Assembly. Important to Accomplish Open Circulating System.

CYLINDER HEAD AND GASKET INSTALLATION

Since it is possible to install the cylinder head and gasket end for end, care should be exercised when performing the operation to prevent baffle of the piston striking against inside wall of the cylinder head.

To aid in proper installation, a small boss is cast onto the top side of the cylinder block and a corresponding boss on top end of the cylinder head—when correctly installed, both boss on the cylinder head and cylinder block should "index" or align.

Carefully check the gasket face against face of the cylinder head to make certain ALL holes align. Carelessness in this respect will certainly lead to a great deal of difficulty later on. Head gaskets of later production are provided with a "tab" to match the boss on the cylinder block and cylinder head—in this case, simply align all three and "bolt" down. Torque (tighten) cylinder head screws at 5 to 7 foot pounds. Run the motor for several minutes then "re-torque" to compensate for whatever compression (in the gasket material) might have taken place.

Note this — head gaskets during early production of the JW included **no** "locating" tab to align with bosses on the cylinder head or cylinder blocks, so — make doubly sure that **all** holes in the gasket align with **all** holes in the cylinder head.

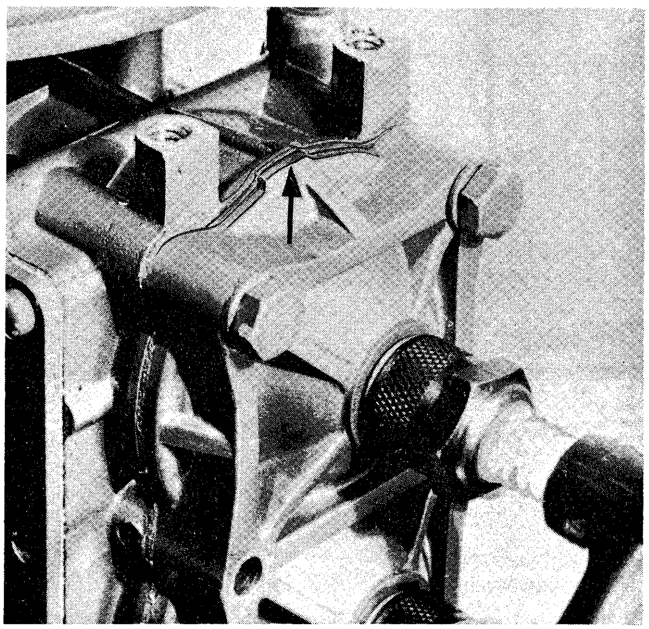
Observe too, that it is possible to line up the head screw holes — gasket and cylinder head, but at the same time, the holes "punched" out (gasket) for the pistons to clear do not align. In this case simply turn the gasket over on its other side.

Both head gaskets of early production and later, however, are identical in all other respects.

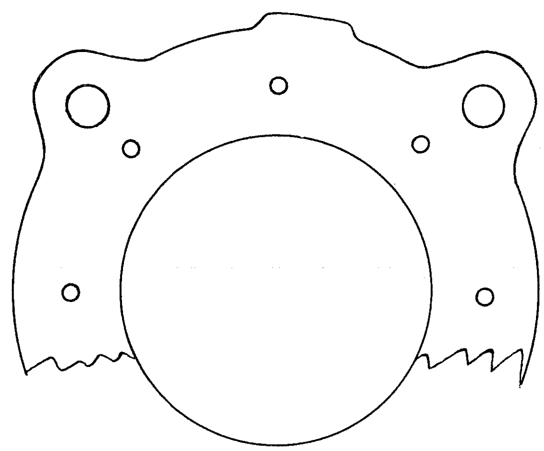
In case of doubt, note on observing contour of the combustion chamber (cylinder head) that one wall (side) "slopes" considerably more than the other. When correctly installed, the greater "sloping" side should be directed toward the exhaust (manifold) side of the cylinder to properly dispel exhaust gases and to prevent the baffle on the piston from striking.

Further, aligning bosses cast on to early production cylinder head and cylinder blocks are comparatively small — about the size of No. 5 or 6 shot while the boss cast during later production is wider —approximately 5/16″.

A persistently hard to "find" knock in the JW could be the result of the cylinder head being assembled end for end or the head gasket being improperly installed.

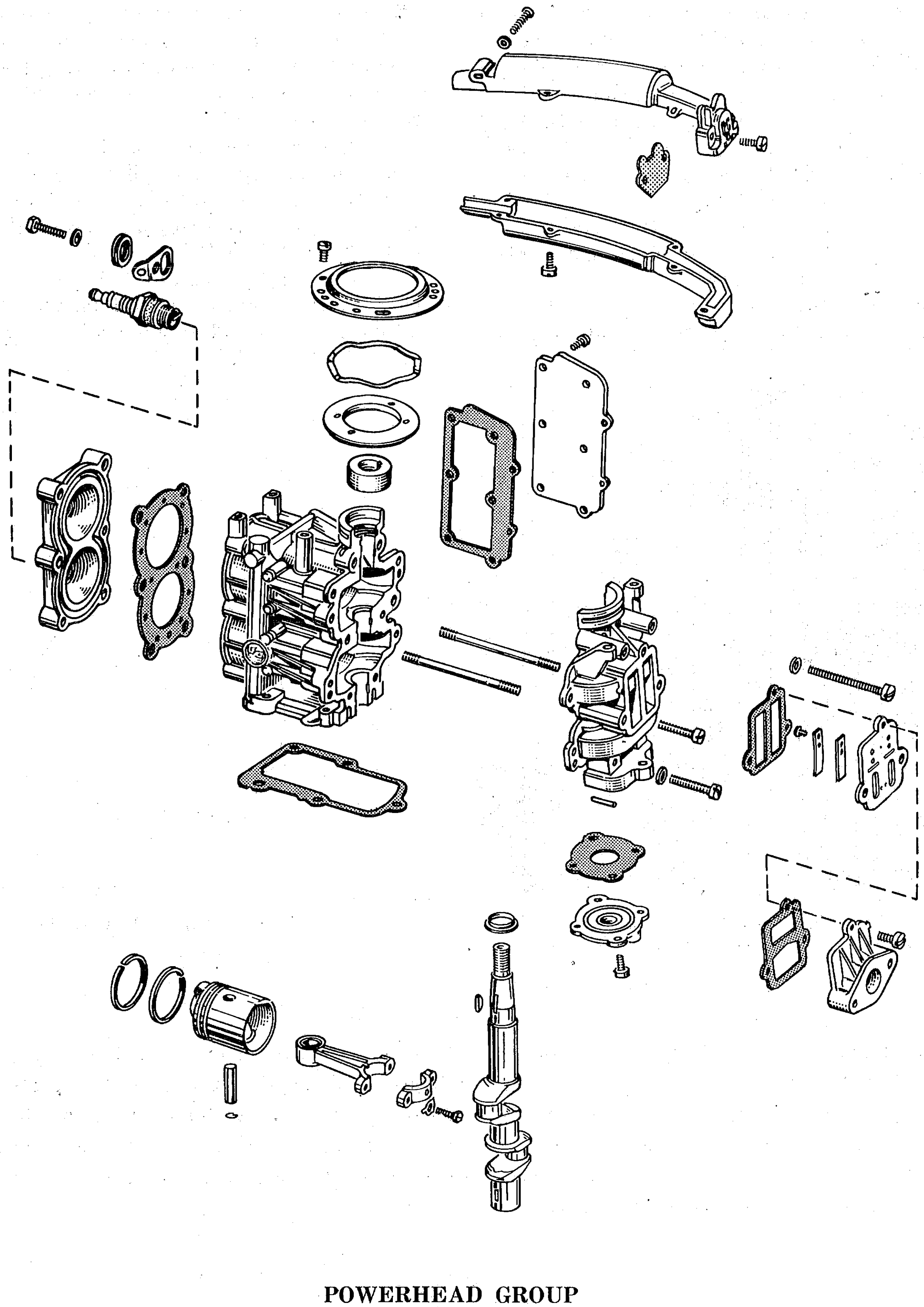


Showing "Embossing" on Cylinder Head and Cylinder Block —Both Should Index When Correctly Assembled.



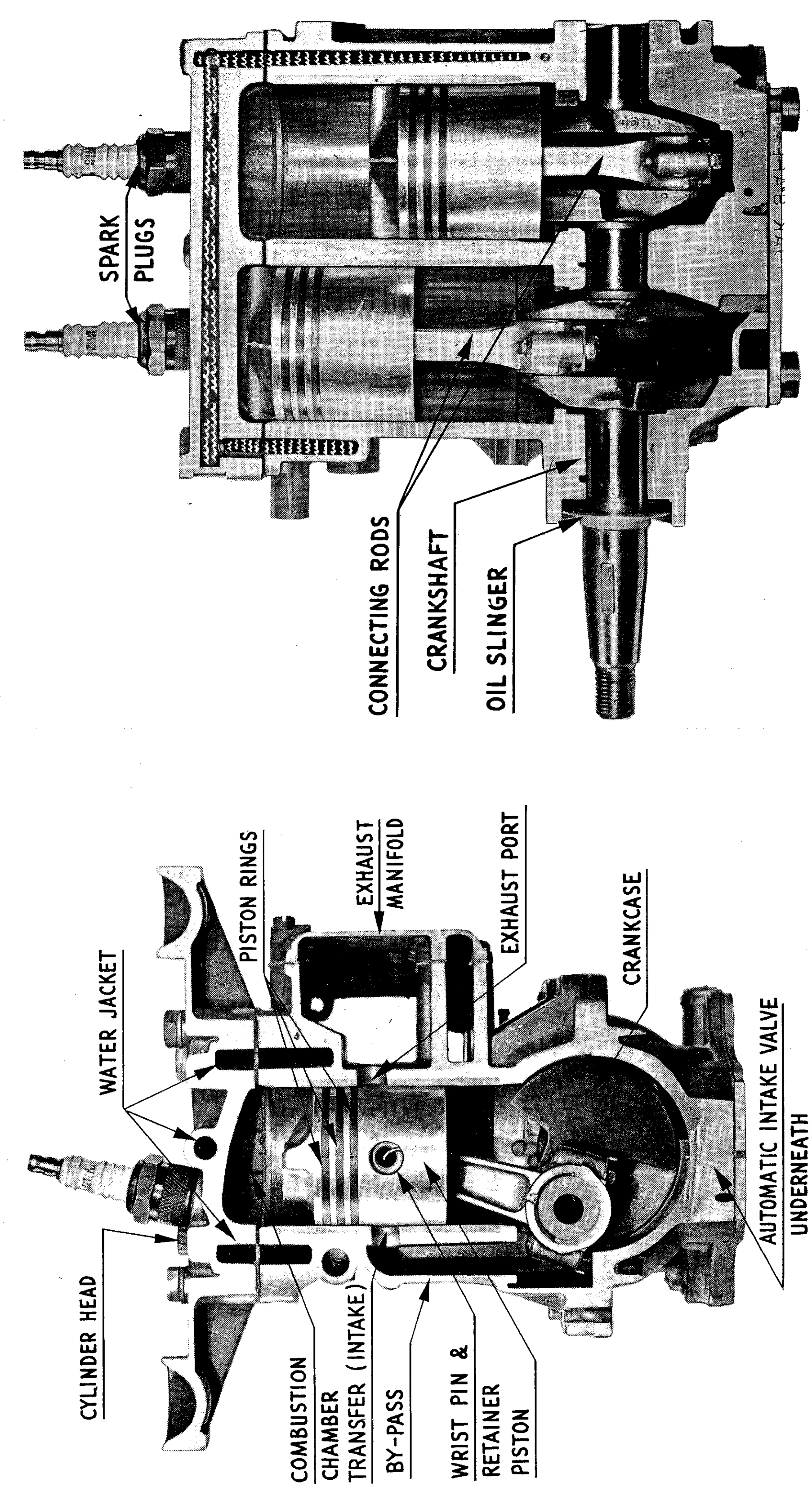
Contour-Cylinder Head Gasket.

Wherever convenient and when the occasion presents itself, carefully remove the cylinder head for cleaning of carbon deposits—inside surface of the combustion chamber, head of piston, walls of ports and upper edges of cylinder bores and gasket. Loose bits of carbon frequently dislodge and often find their way between the points of the spark plug gap to cause fouling. Constant spark fouling for no apparent reason can usually be attributed to carbon accumulation. Replace cylinder head. Torque screws at 5 to 7 foot pounds—install new head gasket if necessary.

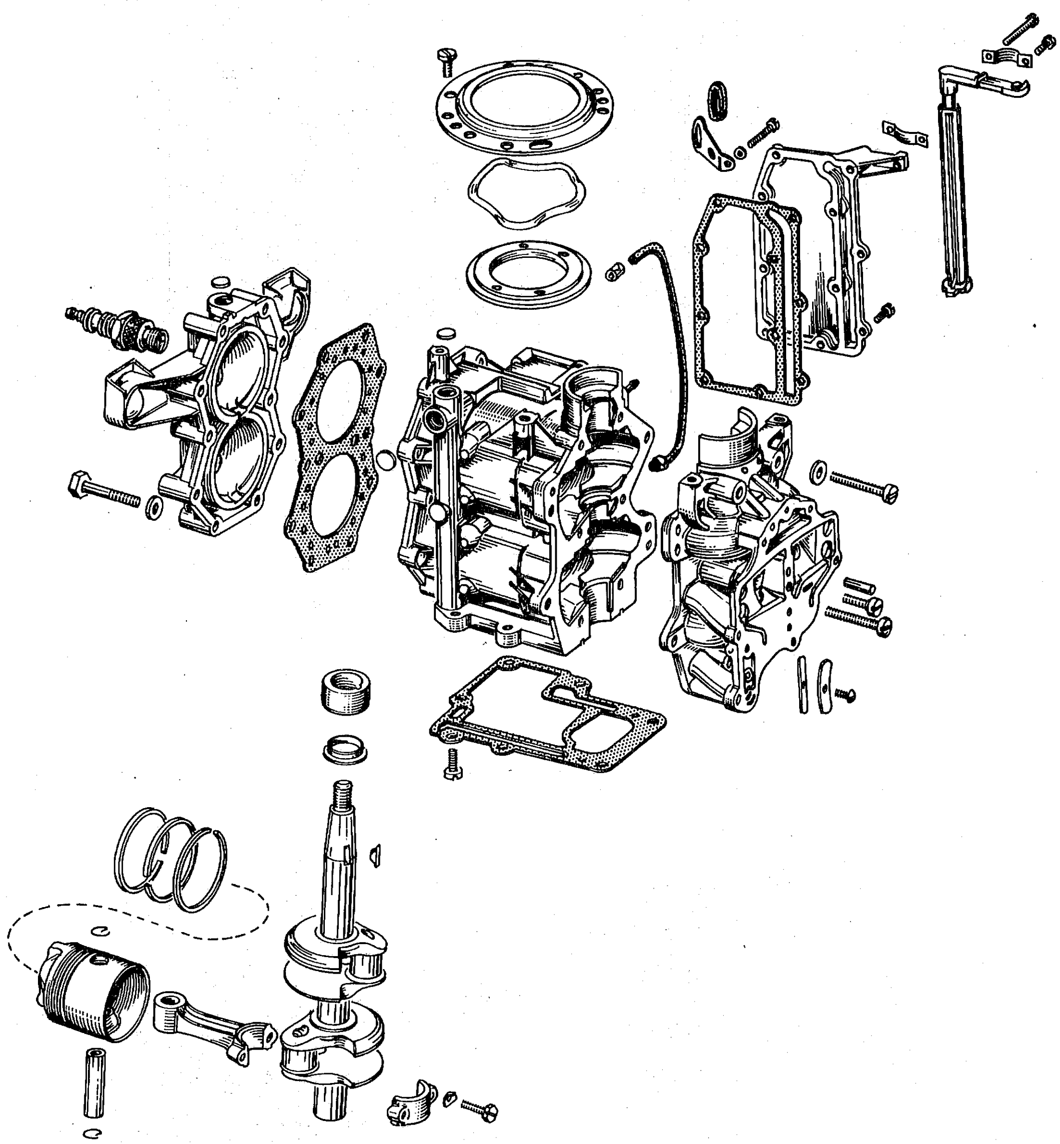


POWERHEAD GROUP
Models JW-17 Up

MODEL CD POWER HEAD



Sectional views of the Model CD Power Head



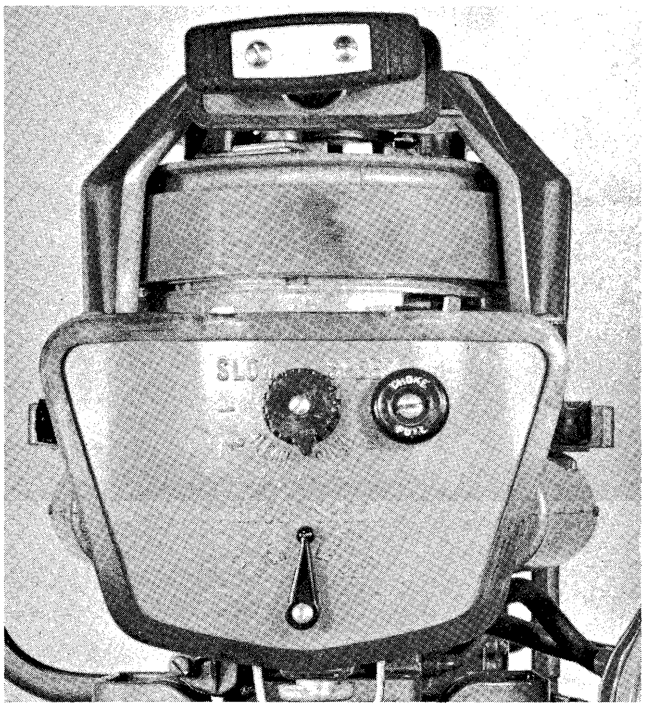
Model CD Power Head Group

MODEL CD POWER HEAD

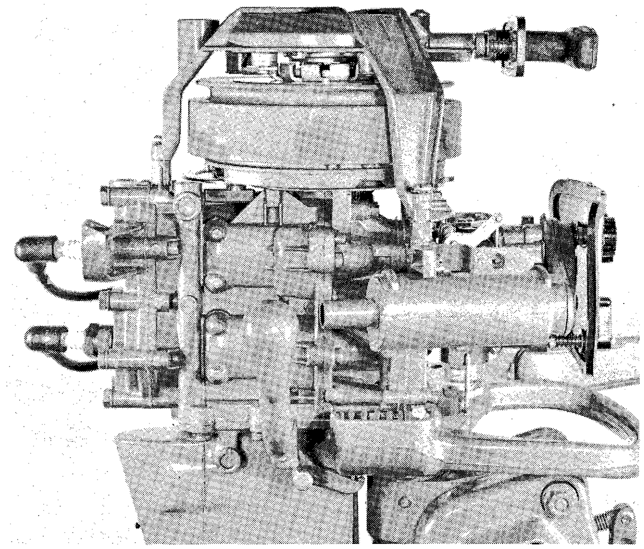
Repairs on the Model CD Power Head are conducted like those on earlier models of same horsepower range. Except for a difference in over-all design, service operations involving the functional parts are identical—each step exercised with precaution and exactness in clean surroundings. Treatment of the pistons, piston rings, connecting rods, crankshaft, and cylinder walls should be conducted as described on pages 187 to 208, inclusive.

A manifold bleeding arrangement has been installed for the first time in the lower horsepower range, to drain or bleed off heavy ends of the fuel mixture "puddling" in the manifold when running in the slower speed range for trolling, etc. See explanation of the manifold bleeder on pages 255 to 256, inclusive.

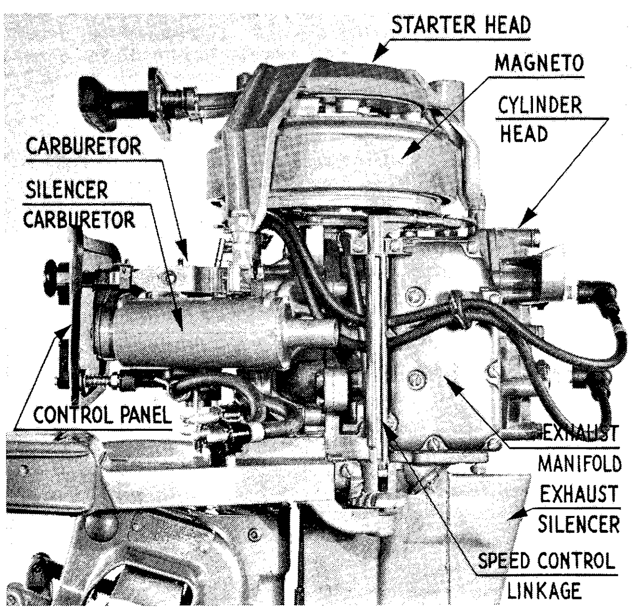
Fuel supply to the carburetor is by pressurizing the tank to require installation of pressure (crankcase) release valves as in the QD and RD series. See explanation of the pressurized fuel system on pages 147 and 151.



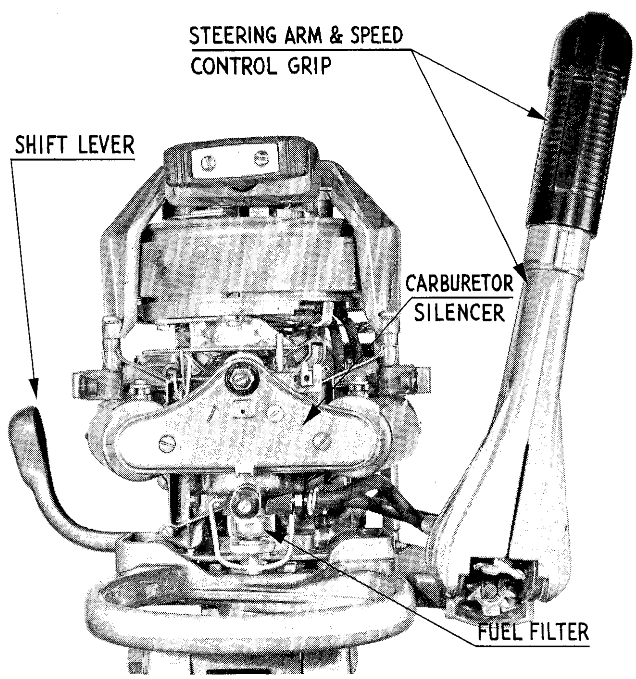
Showing Front View with Motor Cover Removed



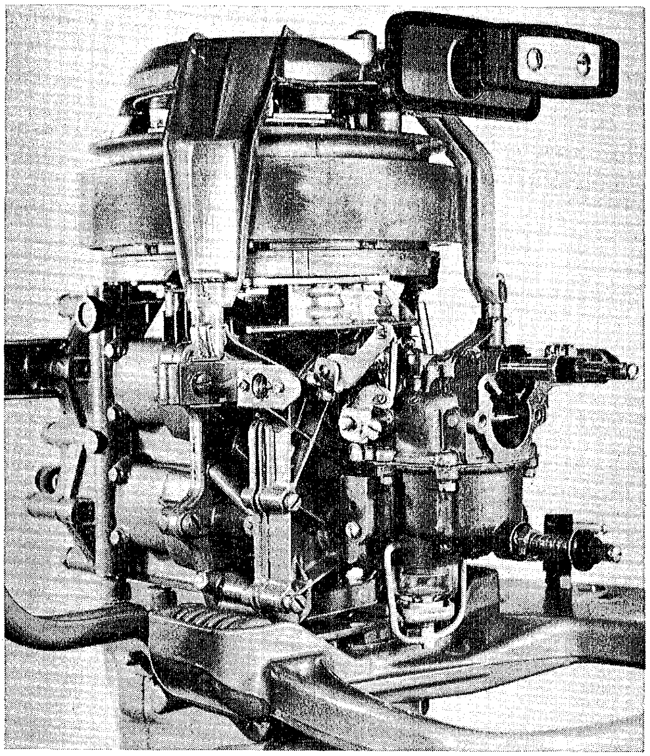
Side View of Power Head Cover Removed



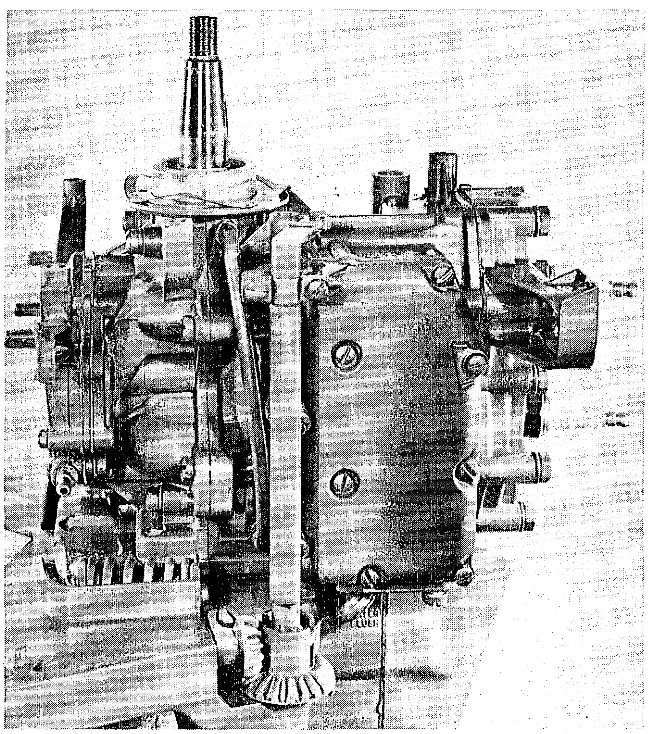
Side view of Power Head



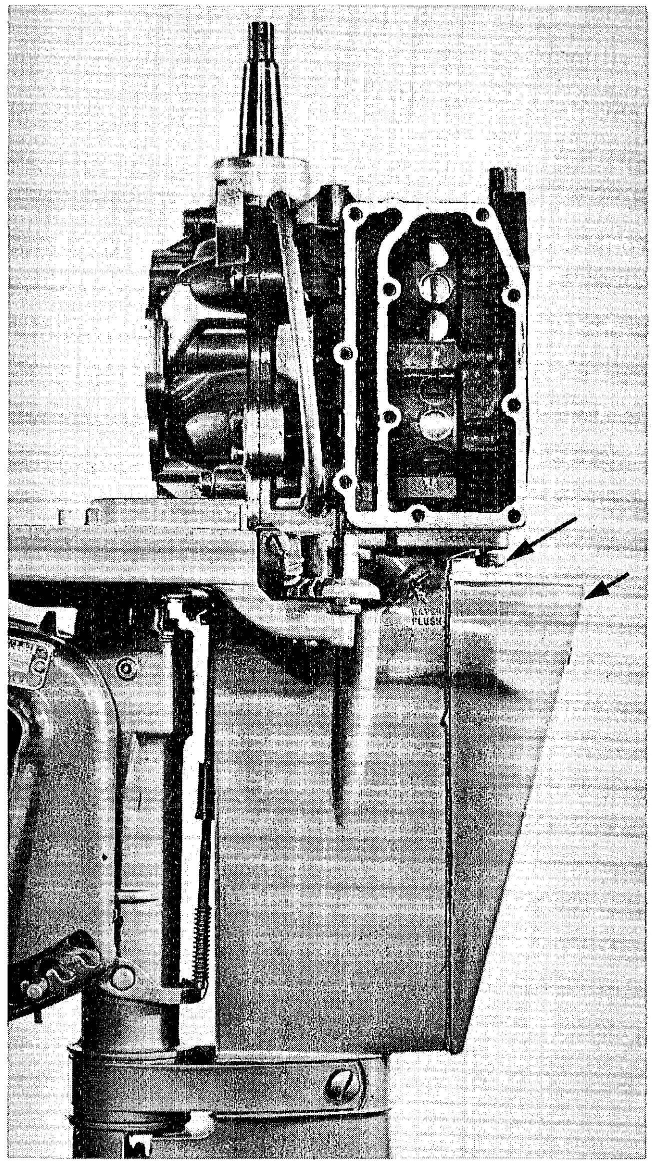
Front view of the Power Head



Power Head with Cover, Panel and Silencer Removed to Expose the Carburetor

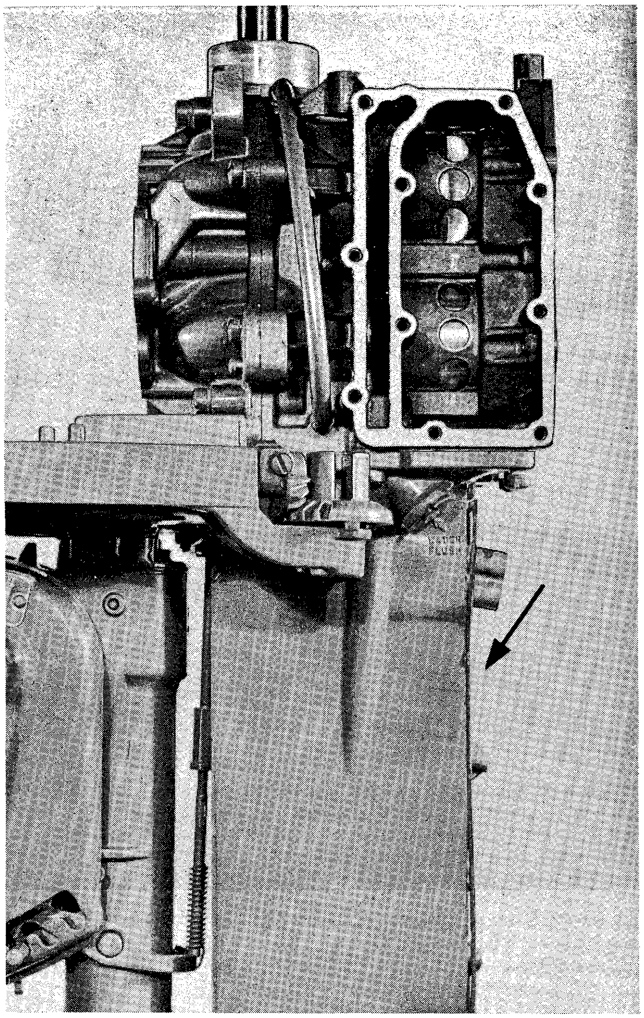


Power Head view showing starter head, magneto and carburetor head removed as attached to the lower unit assembly.

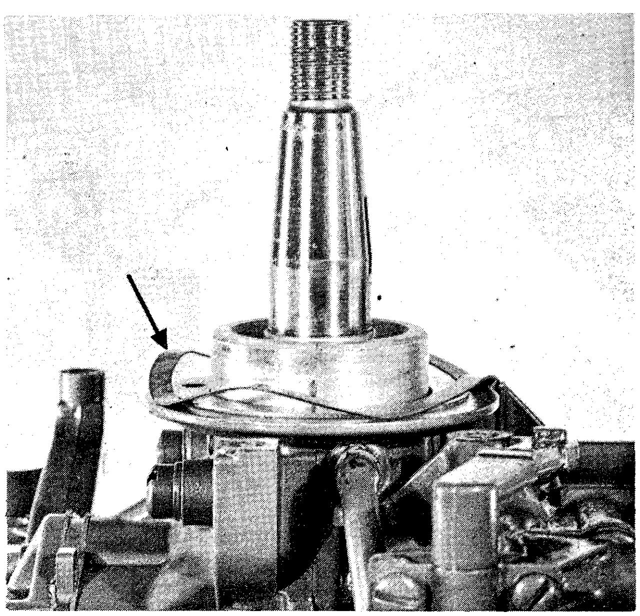


Power Head stripped prior to detaching from the lower unit — Note — the exhaust silencer (indicated by arrow) must be first removed to gain access to one of the screws holding the Power Head fast to the lower unit assembly.

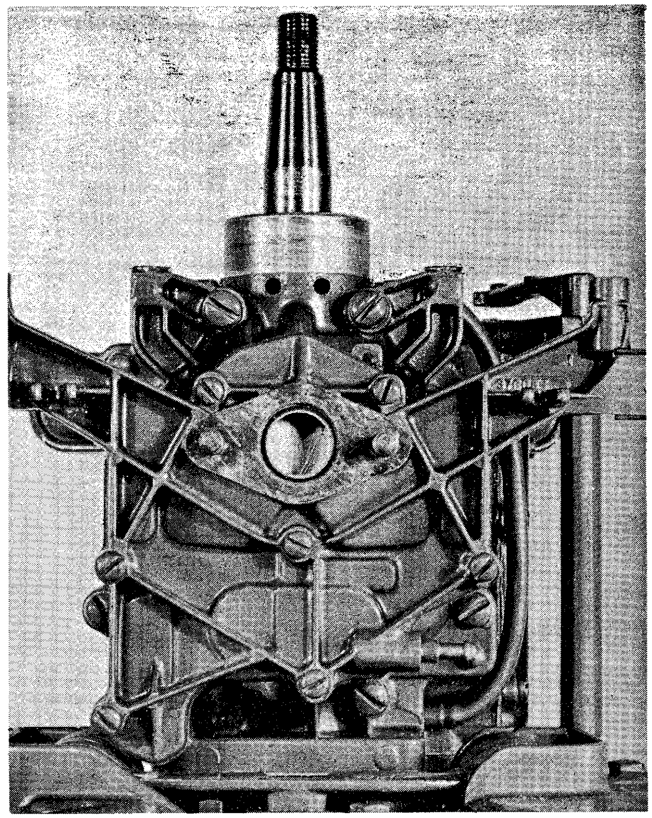
Avoid accumulation of oily rags about the shop or work bench. Oily rags left lying around the shop are a hazard—a fire hazard and a threat to an otherwise promising business with a future.



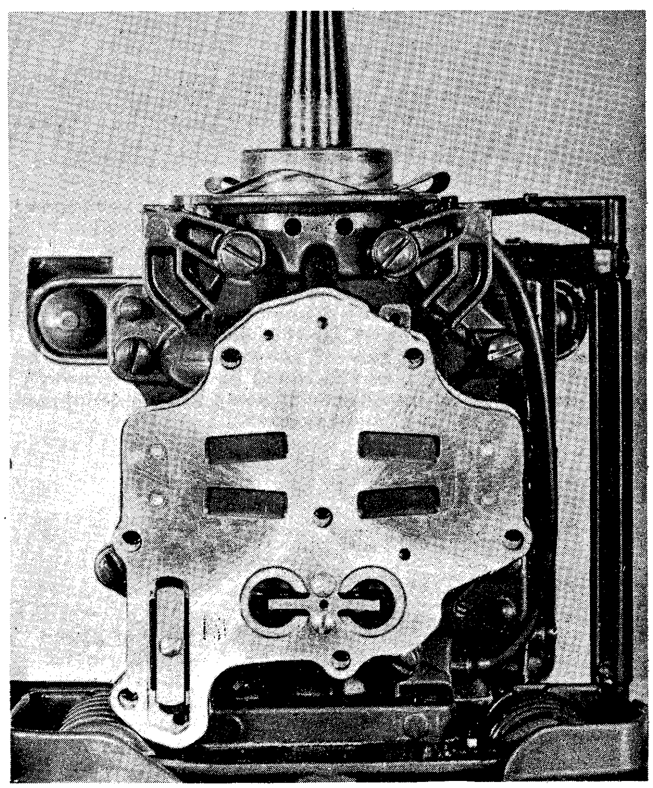
Exhaust Silencer Removed Prior to Detaching the Power Head



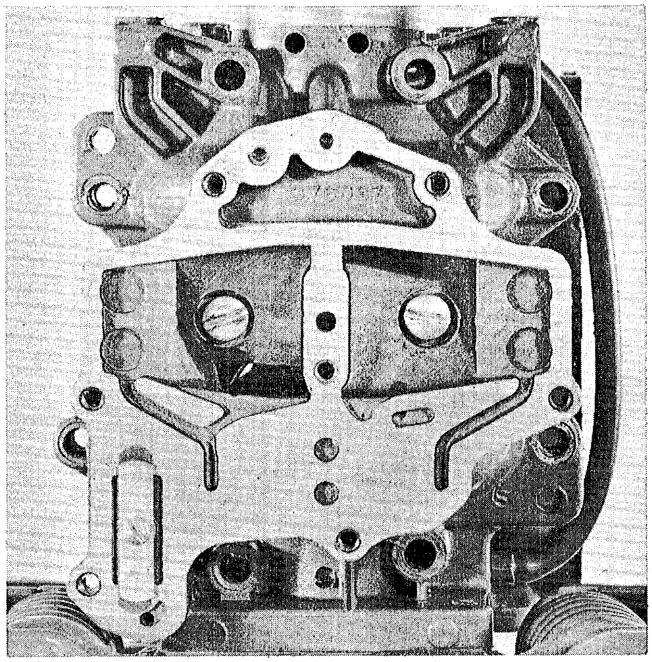
Showing magneto removed to expose wave washer against which the armature plate rides on the Model CD-10 but deleted from assembly of the CD-11.



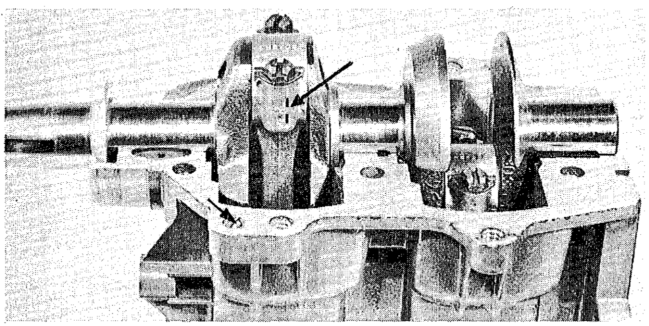
Power Head Magneto and Carburetor Removed



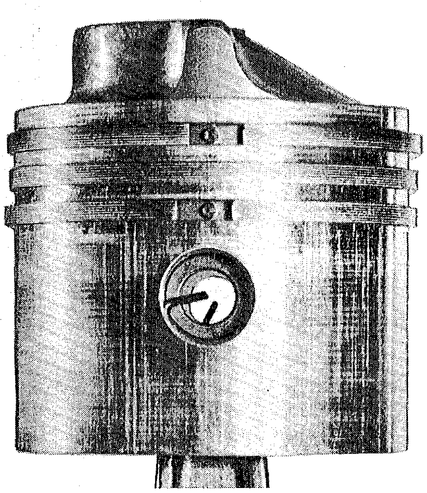
Front View of Carburetor Showing Intake Manifold Removed to Expose the Reed Valve, Fuel Pressure Valve and Manifold Discharge Valve Arrangements. See Explanation of Automatic Intake Valve on Page 145; Fuel Pressure System and Manifold Discharge or Bleeder on Page 147.



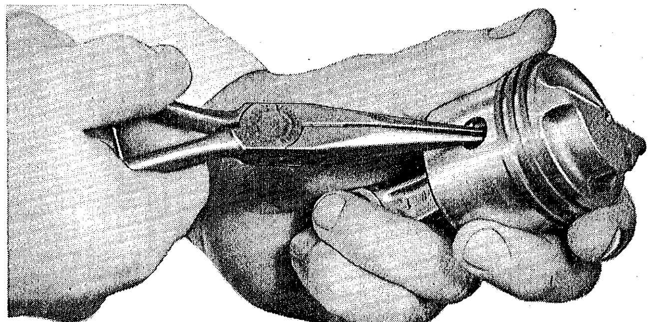
Valve plate removed to expose fuel vapor channels leading to upper and lower crankcase chambers. See explanation under Carburetion—CD



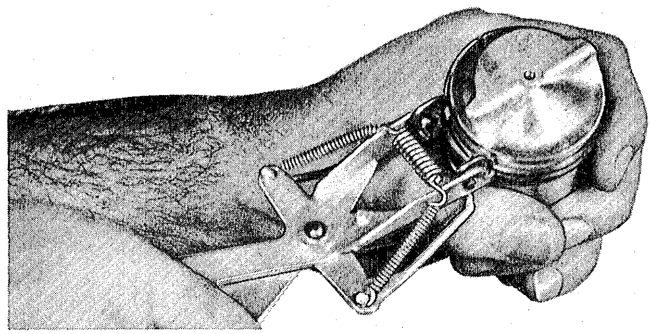
Crankcase removed to expose the crankshaft and connecting rod assemblies. When detaching connecting rod caps, first note index lines on each which must align if the rod is to be correctly assembled—Final assembly should be free with no indication of binding—it may be necessary to tap sides of the rod and cap lightly with hammer to line or free up—Torque screws at 5 to 5½ ft.-lbs. Bend lug on retaining washer up against side of screw head to secure—Be sure hole for tapered pins (indicated by arrow) is scrupulously clean to avoid misalignment when bolting crankcase sections together.



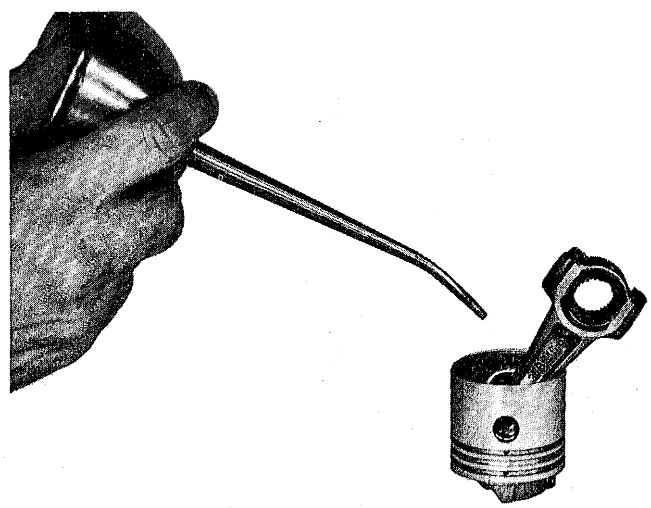
View of piston showing wrist pin retaining (lock)ring; note end protruding for removal.



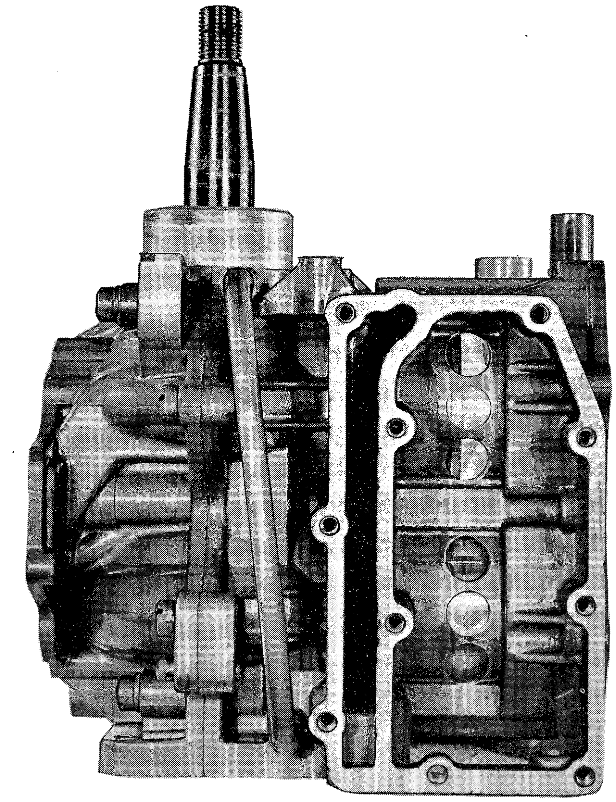
Removing wrist pin retainer—grasp protruding end of retainer (lock) ring with pair of long nose pliers—extract with twisting and slightly prying motion.



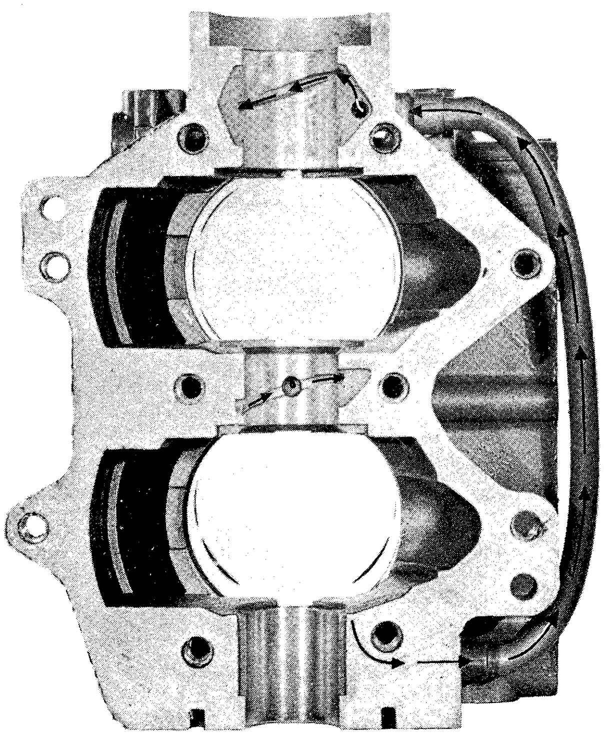
Installing and/or removing piston rings with ring expander shown here. This operation should be carefully performed, taking precaution against "nicking," scratching or otherwise damaging the piston ring grooves. After installing the rings make sure that each turns freely in its respective groove with no indication of tightness or binding. Apply oil to each ring groove, piston and cylinder walls on final assembly – see pages 187 to 195, inclusive. Correct ring groove clearance for the Model CD ring groove is .002" to .0035". Gap clearance .005" to .015".



Oiling Wrist Pin. Note – Make No Dry Assemblies.

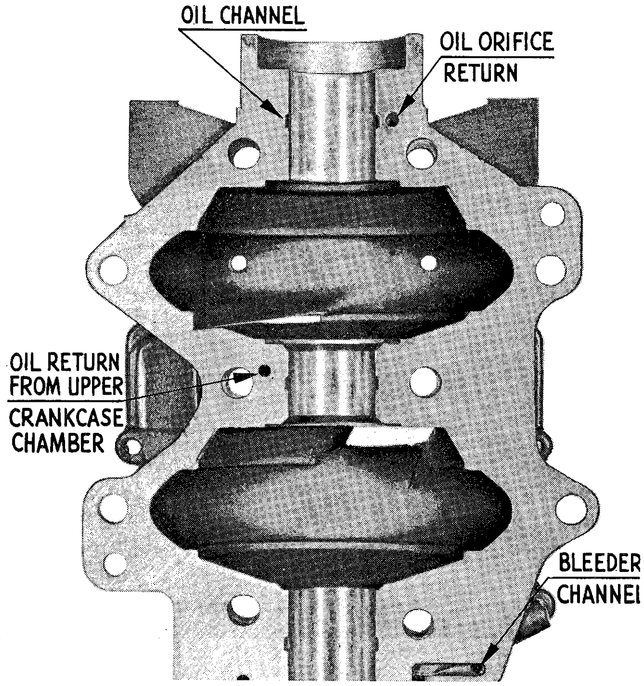


Power Head Detached from the Lower Unit for Further Disassembly — Note Flexible Oil Line Connecting Top and Bottom Journal Bearings. Oil is Fed from the Lower to Top Bearing Under Crank Pressure, Returned to Upper Crankcase Chamber by Suction as the Piston Travels on its Upward Stroke.

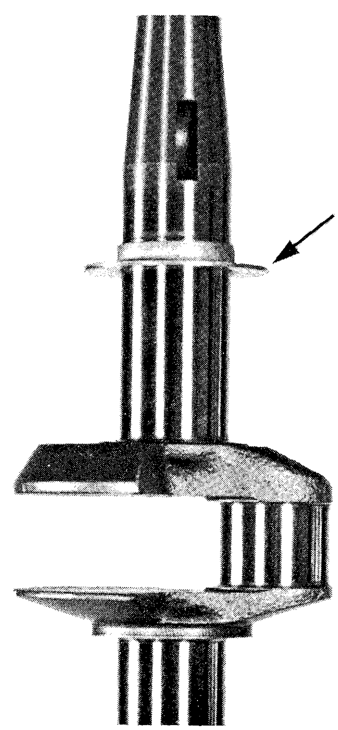


Oil pocketing in the lower crankcase chamber and under pressure as the piston progresses on its downward stroke, is conducted to the upper journal bearing by means of flexible tubing as shown above; here it enters the special groove to circulate around the journal. Bearing (half) in the lower crankcase is similarly "grooved" with a return channel leading to the intake manifold to complete the circuit.

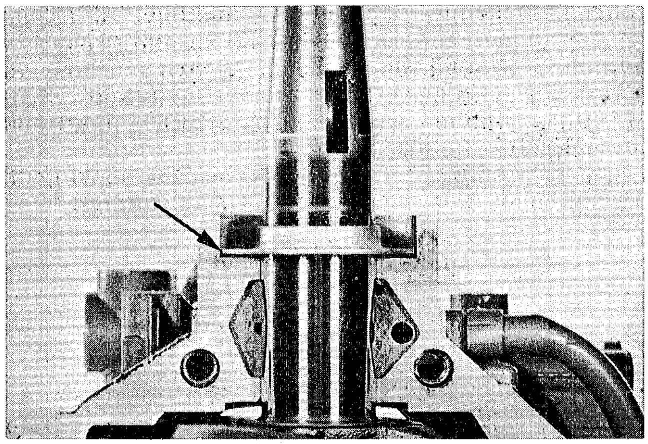
Oil is circulated through the center bearing in like manner but without the aid of tubing.



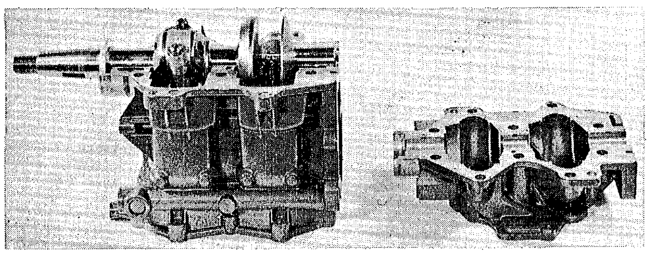
Showing Oil Channels in the Crankcase Section



Showing oil slinger installation on top journal of the crankshaft to prevent oil circling around the journal bearing from escaping and "spewing" over the armature plate.

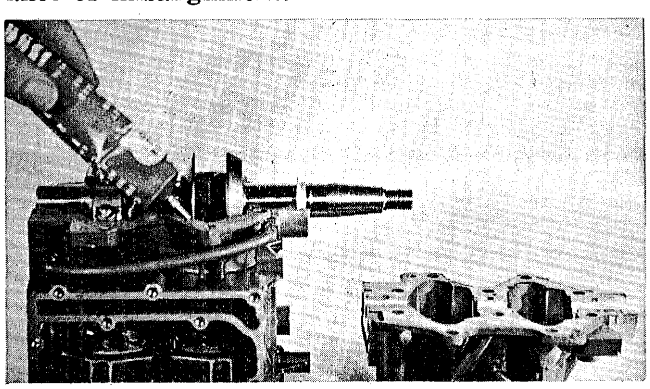


Showing oil slinger properly installed on the crankshaft. Care should be exercised when driving the oil slinger down and over the top journal—it must be driven down squarely and to a point where approximately 1/16" clearance is maintained above the top journal bearing as indicated by arrow.

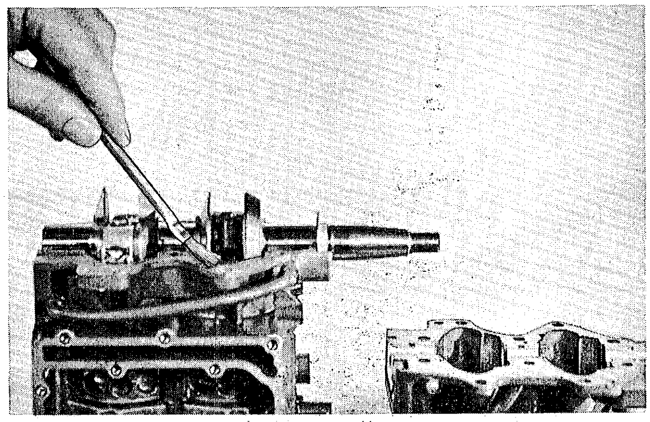


Showing Power Head with Crankcase Removed to Expose Crankshaft and Connecting Rod — When Replacing the Crankcase, all Surfaces must be made Clean and Free of "Old" Cement Used to Seal the Sections Originally. Have Everything in Readiness When Reassembling. Coat Face of Cylinder Block with Sealer 1000 or Other Similar Hard Drying Cement. Place Crankcase Immediately in Position; Drive Tapered Aligning Pins in Place to Obtain Crankcase Alignment. Install Screws — Torque to Tension Specified 5 to 7 foot-pounds.

After cleaning both crankcase faces scrupulously free of "old" cement, or other foreign material and removing burrs or nicks which may have accumulated during repair, smear thin coat of hard drying cement, such as Sealer 1000, or other product of similar characteristics over cylinder block faces as shown above. It is of extreme importance that all traces of old cement be removed. A coating of cement spread "on top" of another will prevent correct mounting of the crankcase sections to cause excessive journal bearing clearance or misalignment.

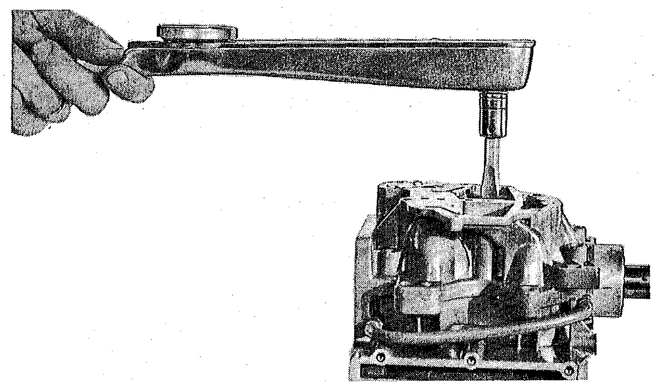


Applying Cement to Crankcase Face

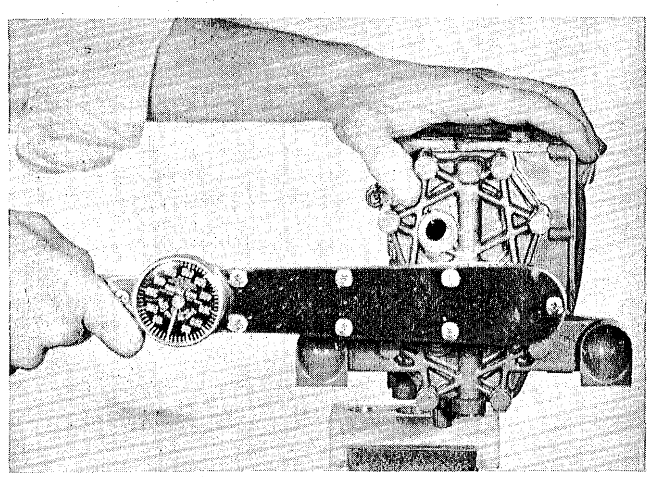


Spreading Cement With Brush

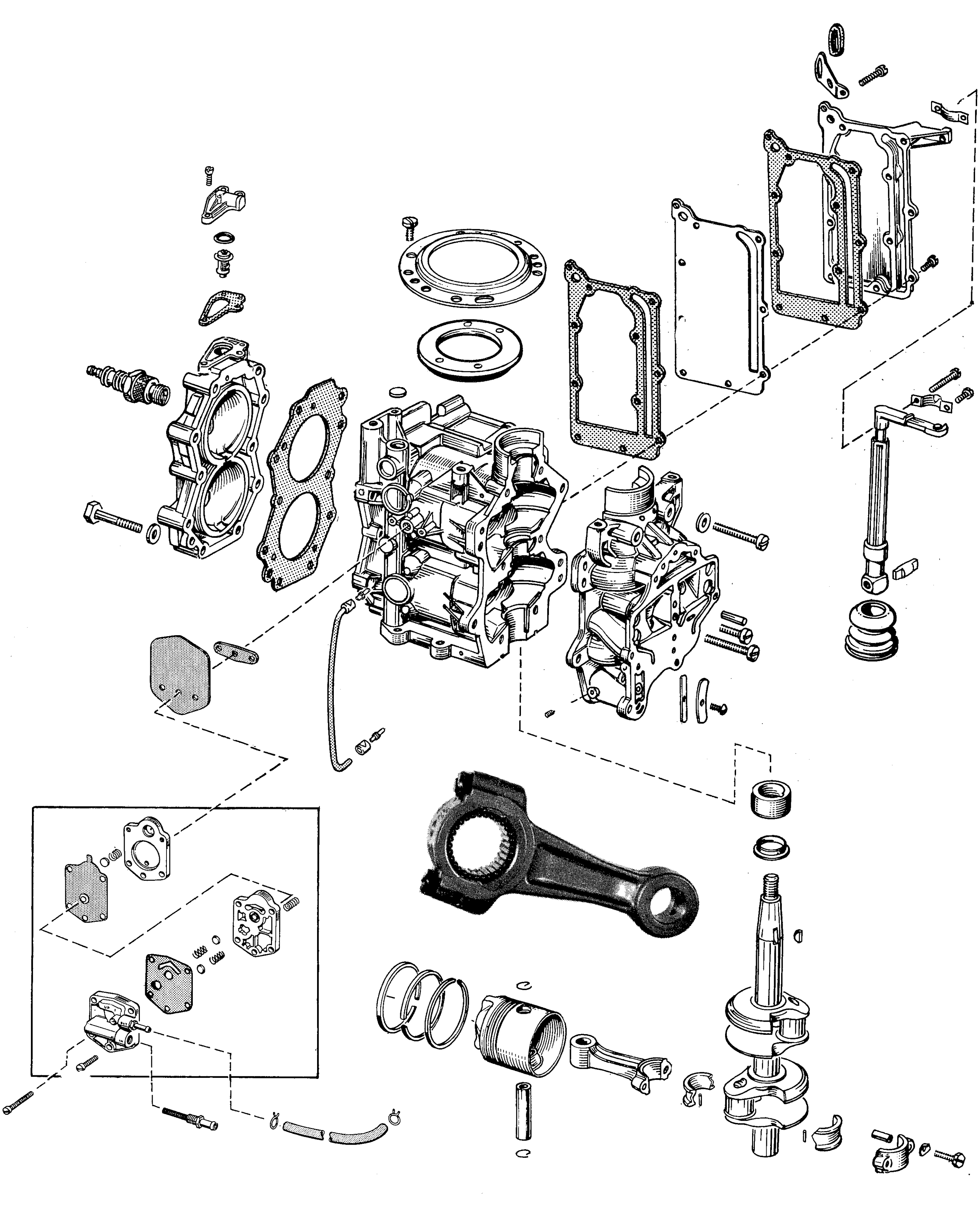
Tapered dowel pins are employed to align the crankcase sections. Precautions should be taken to make certain the corresponding holes are clean and free of burrs. Surfaces of the tapered pins similarly should be clean and free of burrs. Spread cement with brush as shown here—guard against excessive coating to prevent overabundance squeezing out to "plug" the oil channels on assembly. Install lower crankcase section with a minimum of delay to prevent cement hardening—Drive tapered pins home—Insert the crankcase screws.



Torquing Crankcase Screws – Torque at 5 to 7 foot-pounds.

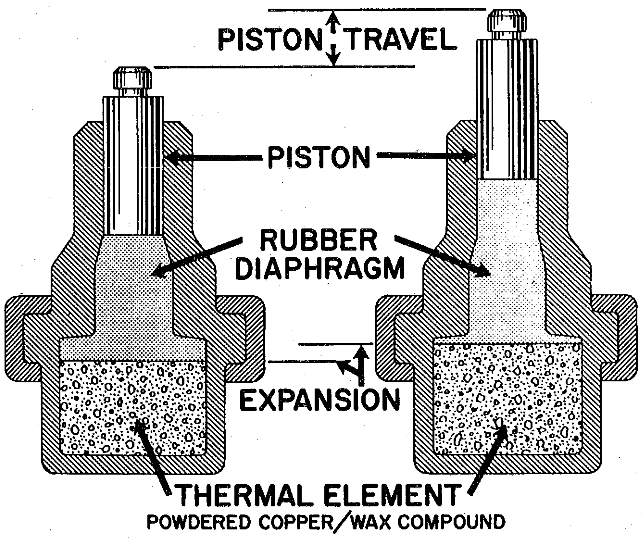


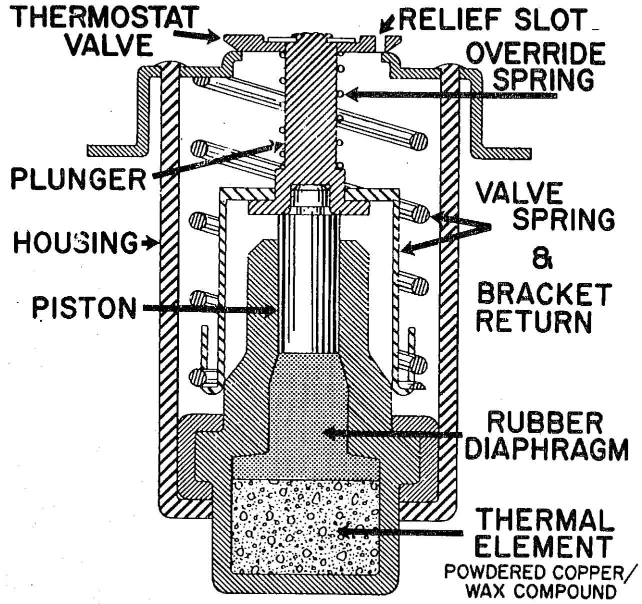
Extreme caution should be exercised when drawing up on the cylinder head bolts – should be drawn up evenly and torqued at 5 to 7 foot-pounds – 60 to 84 inch-pounds if calibrated in inches as above.



POWERHEAD GROUP
Models CD-19 Up

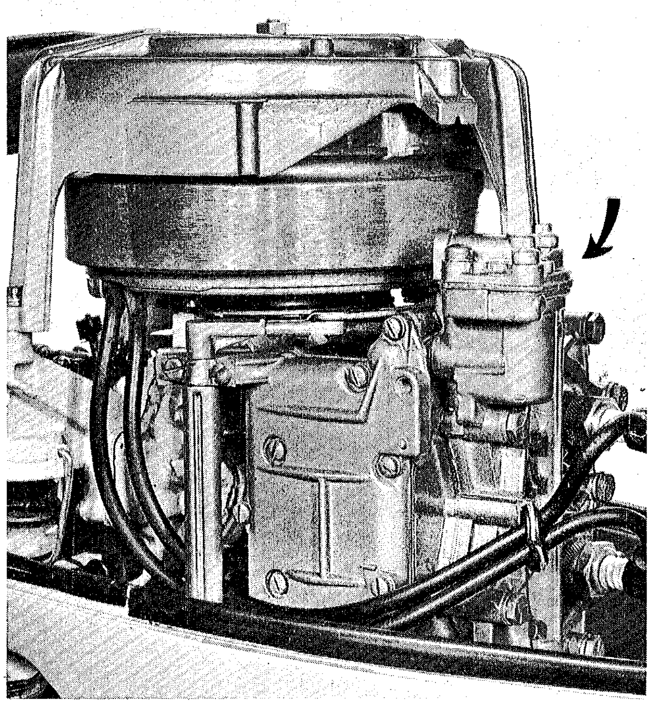
THE THERMOSTAT
Models CD, QD and FD



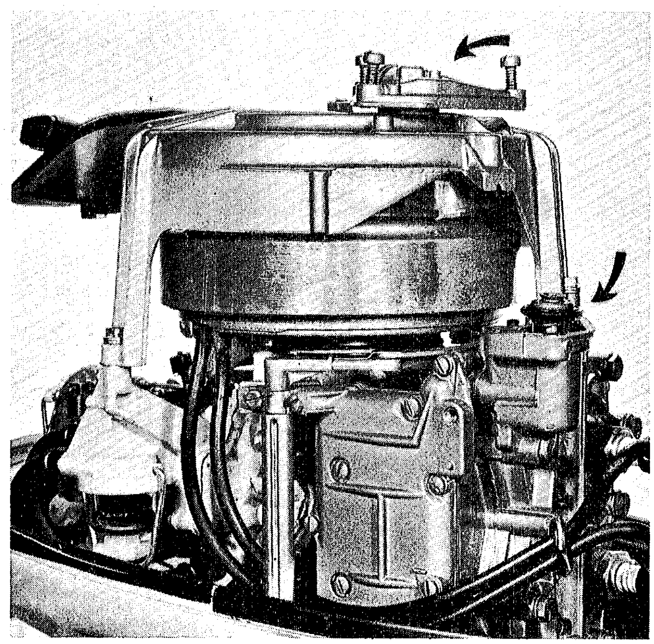


The cooling systems of Models CD, QD and FD (1959 and up) are thermostatically controlled to achieve improved performance and as such, a thermostat is installed in the cylinder head of each – conveniently located and readily accessible.

The thermostat unit consists of a thermal element composed of a powdered copper-wax compound, a rubber diaphragm and piston enclosed in a housing as revealed in the drawing above.



Thermostat Installation.



Cover Removed to Expose the Thermostat Element.

The thermostat assembly includes a housing in which the thermostat unit is inserted, a bracket and plunger assembly activated by the thermostat piston, valve return and override springs.

In operation with rising of water temperature, the copper-wax compound in the thermal unit is caused to expand. The expanding thermal unit, acting against the rubber diaphragm and simultaneously against tension of the valve return spring, forces the piston upward to "open" the valve. With the valve now raised off its seat, water is permitted to circulate thru the water jacket of the cylinder assembly and as such, maintains predetermined operating temperature. The thermostat unit is calibrated to open at water jacket temperature 145 to 150°F. Resultant degree of valve opening is obviously in proportion to cooling system requirements, since function of the cooling system is to dissipate heat.

Heat generation is by the motor running at various speeds. At high motor R.P.M.'s and under full load heat generation is at its maximum; consequently, a higher rate of water coolant flow is required, than when operating at slow or intermediate speeds when heat generation is less. The thermostatically controlled valve acts to proportionately meter flow of water thru the water jacket at all motor speeds to maintain as nearly as possible constant operating temperature — of particular significance when operating at slow and intermediate speeds. Activity of the thermostat is affected to some extent naturally by the temperature of the body of water on which the unit is being operated—governed ordinarily by seasonal changes and geographical locations.

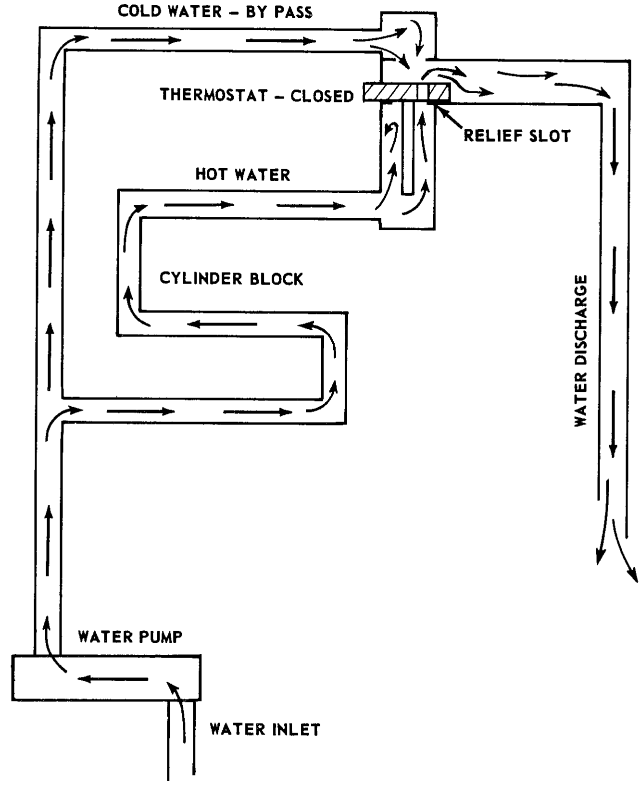
Since a rubber diaphragm, installed between the thermal element and the piston, is employed to "open" the valve, return to closed position, on contraction of the thermal element as it cools, is accomplished by tension of the valve return spring acting against the plunger bracket – see drawing.

The thermostat valve "floats" on the plunger shaft but is held in position by the small override spring.

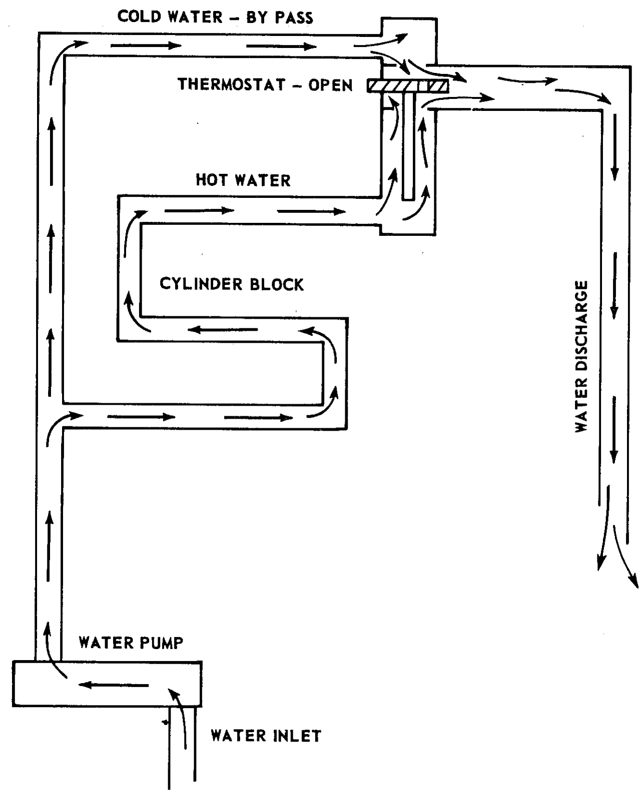
The schematics shown illustrate the plan of the cooling system, including the water pump, a cold water bypass, water jacket channels (cylinder), the thermostat installation, water discharge from the cooling system and conditions when running cold and at normal predetermined temperature.

Starting cold, the thermostat valve is "closed." Note relief slot machined into the valve plate. Water enters the pump and is subsequently directed into the cooling system – separately at junction of the water jacket and cold water bypass channels. A major portion of the circulating water at this time is directed to the upper portion of the cylinder head, bypassing the thermostat valve and flowing on out thru the discharge channel – cold water circulation not affected by rising water jacket temperature. A lesser portion of the circulating water simultaneously flows thru the water jacket of the cylinder block assembly and on thru the relief slot in the thermo slot valve to eventually enter the cold water bypass stream as shown.

Purpose of the relief slot is to purge the cylinder water jacket of air and to permit limited circulation. Naturally, with restricted water jacket circulation, the resulting temperature rise is quite hasty. Subsequent expansion of the thermal unit causes the thermostat valve to open. Circulation thru the water jacket is now considerably greater, however,



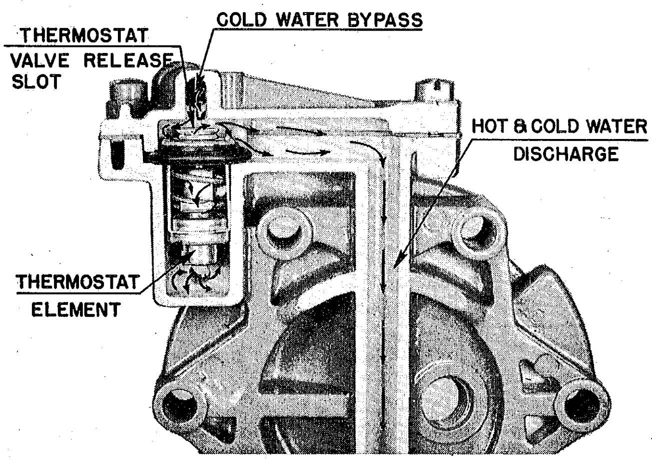
Schematic to illustrate Cooling System with Thermostat Valve closed (cold).



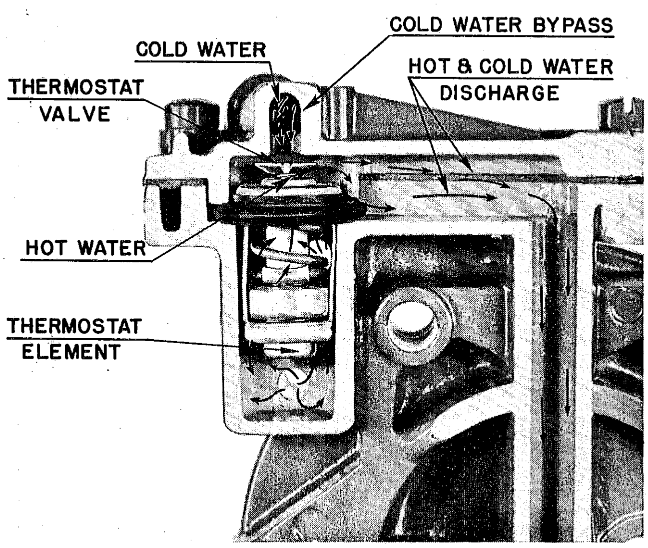
Schematic to illustrate Cooling System with Thermostat Valve open (normal operating temperature).

adjusted or modulated by action of the thermostat in accordance with various engine speeds. It should be noted that circulating hot water from the water jacket and bypassed cold water converge and discharge into the exhaust stream.

Normally, little if any difficulty can be expected with the thermostatic unit — adequate means have been taken to avoid damage because of freezing by providing necessary drains provided the motor is stored or hung in an upright position.

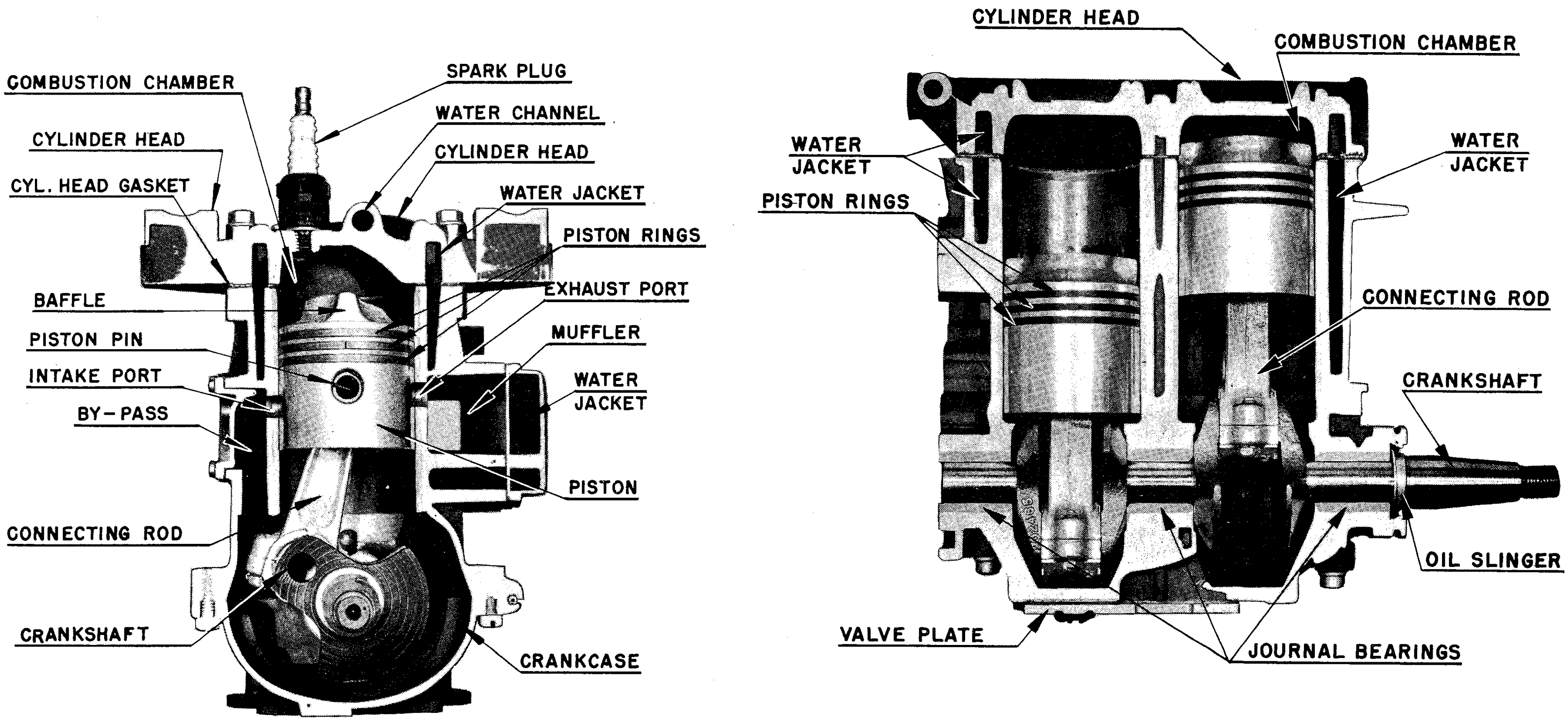


Showing position of Thermostat Valve immediately after starting and warm-up. Note Thermostat Valve is closed and that practically all water from the Pump is being bypassed at this time except a small volume being discharged from the Water Jacket through the Relief Slot cut into the Thermostat Valve. This Slot serves to purge the Water Jacket of air.

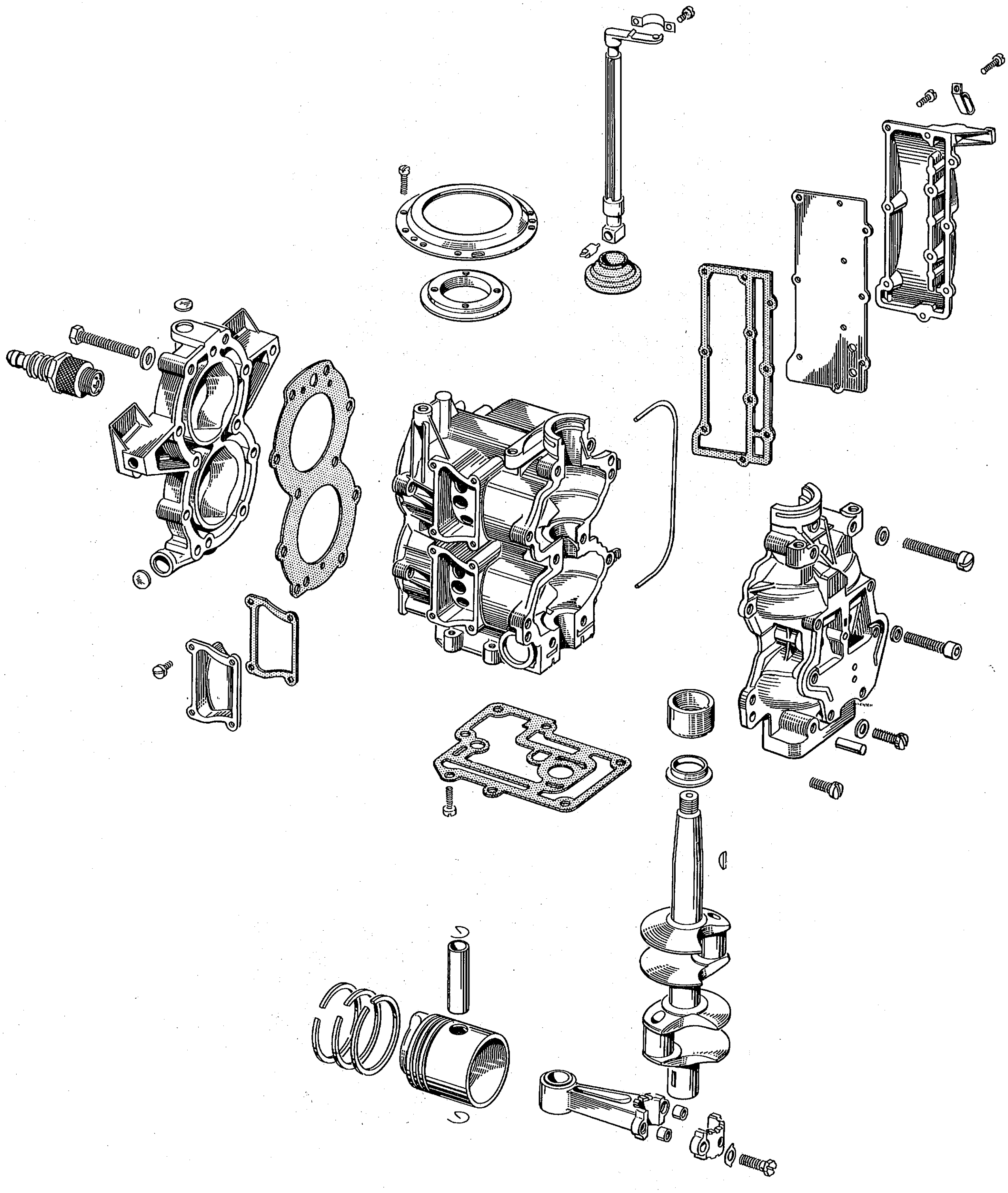


Showing position of Thermostat Valve when Automatically Adjusted to Normal Running Temperature. Note — Both hot water from the Water Jacket and Cold Water (Bypass) converge to discharge into the Exhaust Stack.

NOTES



Extended View—Powerhead Group, Models AD-10, 11 and 12.



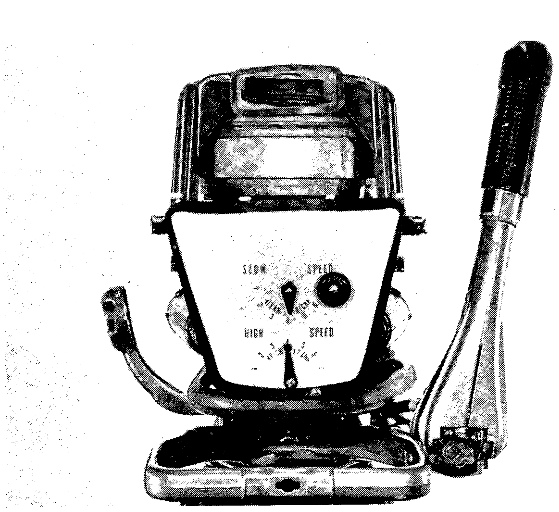
Extended View — Powerhead Group, Model AD

NOTES

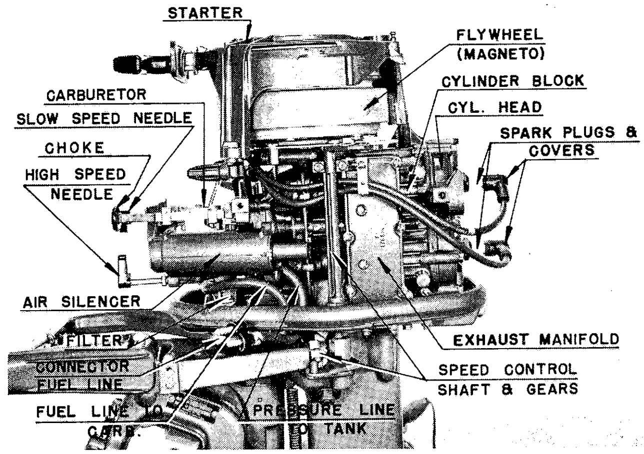
MODEL AD POWERHEAD

All work performed should of course be done in clean surroundings — clean and orderly bench top, clean tools and with clean hands — free of grit, "grime" or other foreign substance, which if permitted to adhere to highly machined surfaces (cylinder and piston walls, bearing surfaces, etc.) causes scoring, injury to bearings and contributes otherwise to faulty motor operation as well as premature wear.

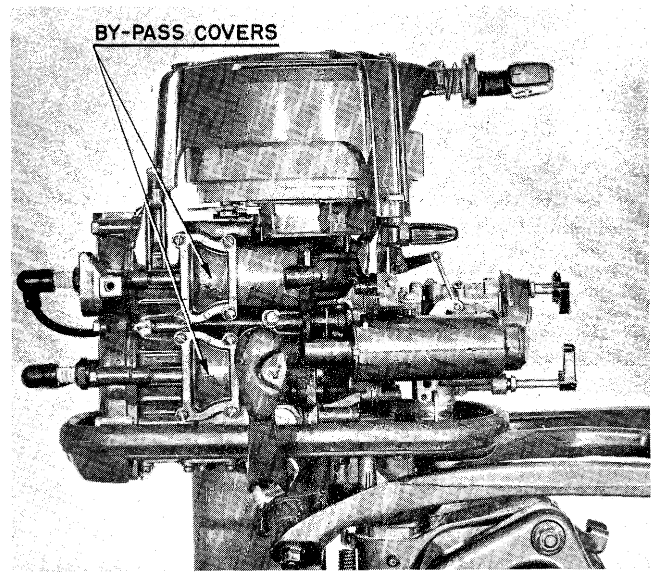
The following illustrations with corresponding comment will serve as a guide to assembly and disassembly.



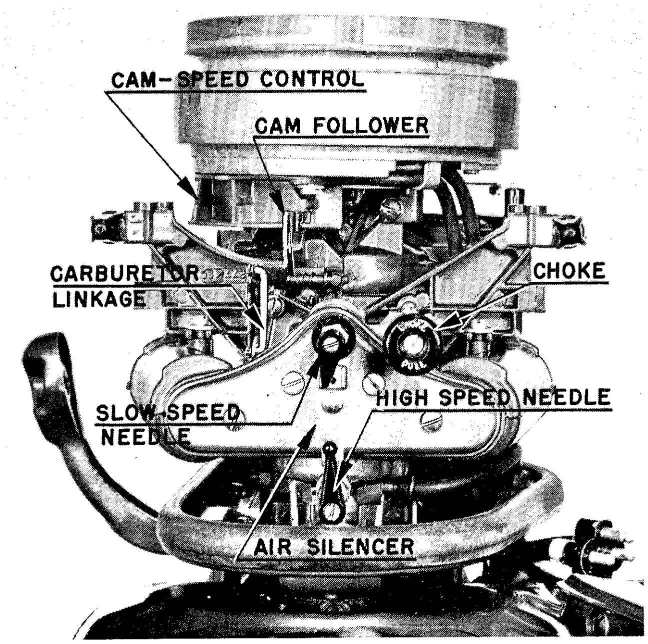
Powerhead — Front view with cover removed.



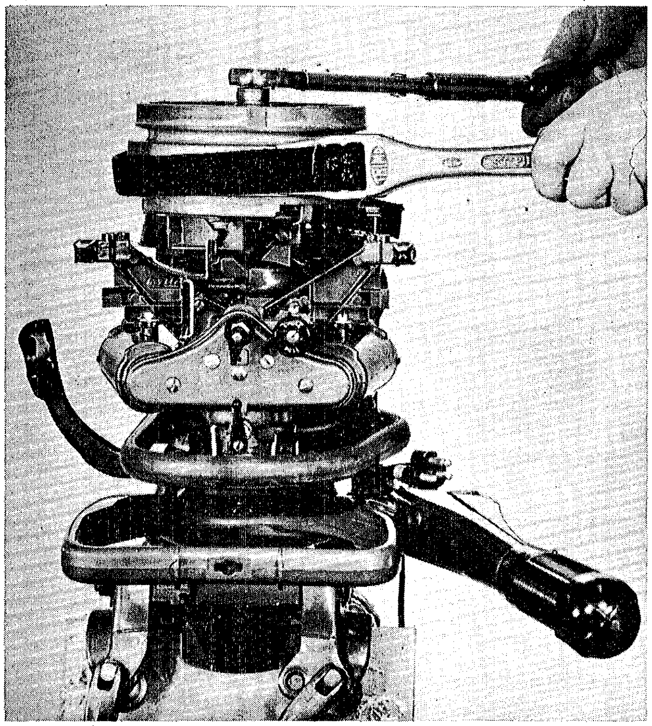
Powerhead — Port view



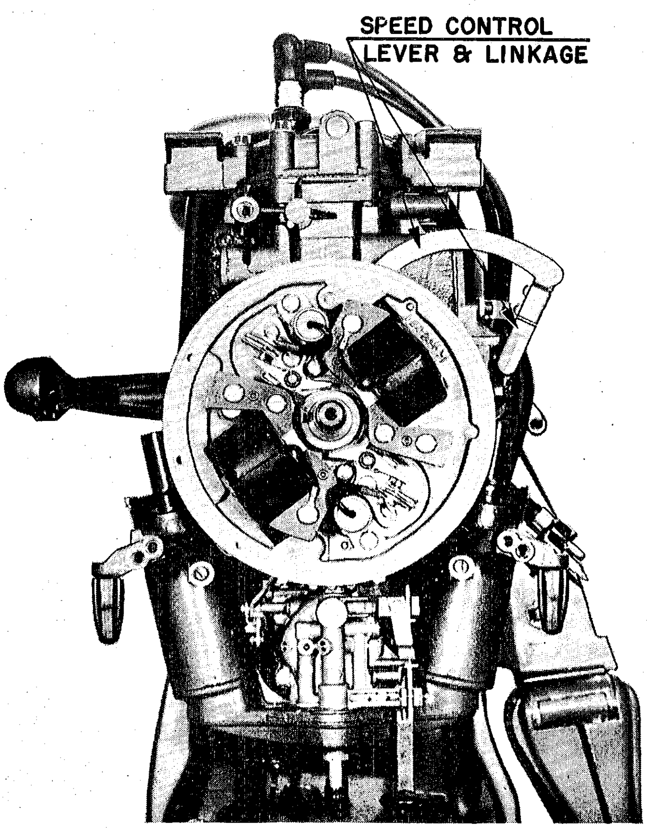
Powerhead — Star view



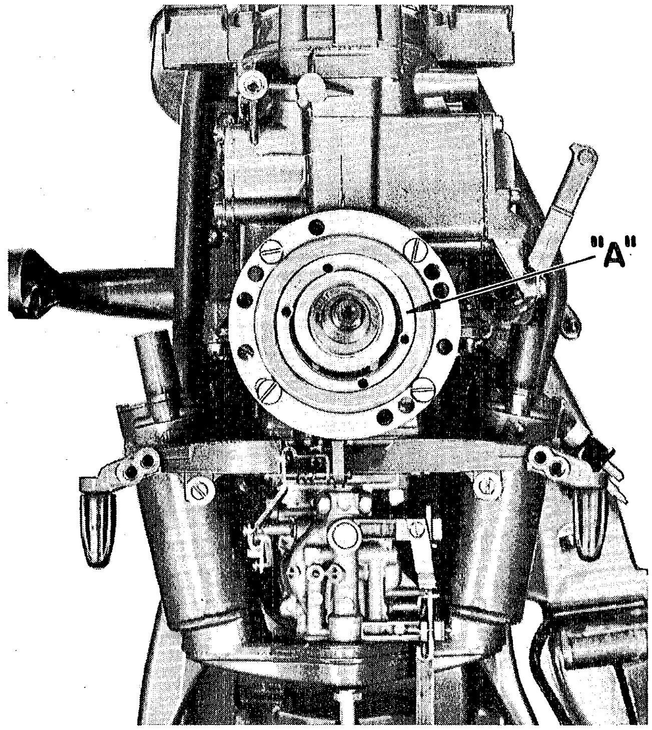
Powerhead — Front view, showing speed control cam and cam follower.



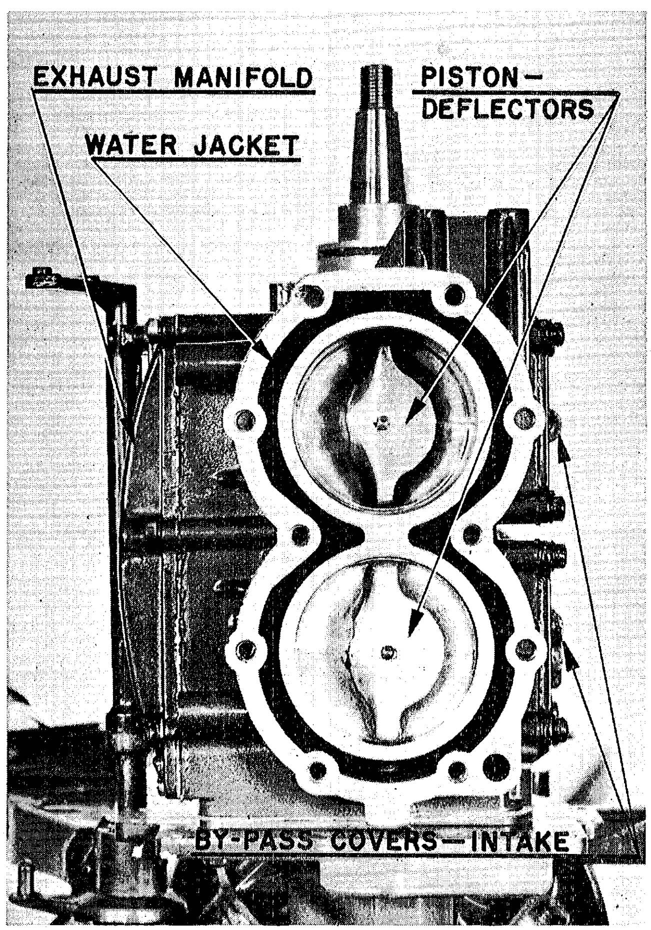
Releasing Flywheel Nut — Illustrating use of the flywheel holder. Like procedure for installing the flywheel with torque wrench and holder—torque nut to 40 to 45 ft. pounds. Make certain all burrs or other foreign matter are removed from the crankshaft taper and flywheel hub to achieve proper mount. Assemble *dry*—no oil or traces of oil on either the crankshaft taper or in flywheel hub, to avoid possibility of the flywheel hub "creeping" on the tapered end of the crankshaft.



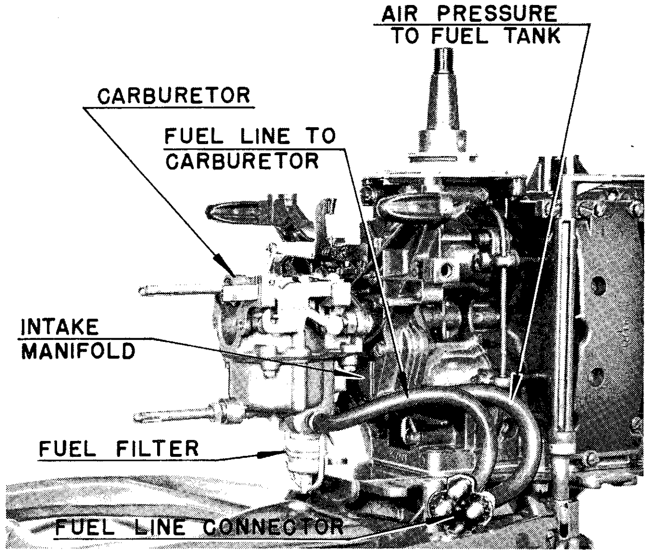
Top view with flywheel removed exposing the armature plate for inspection and/or repair.



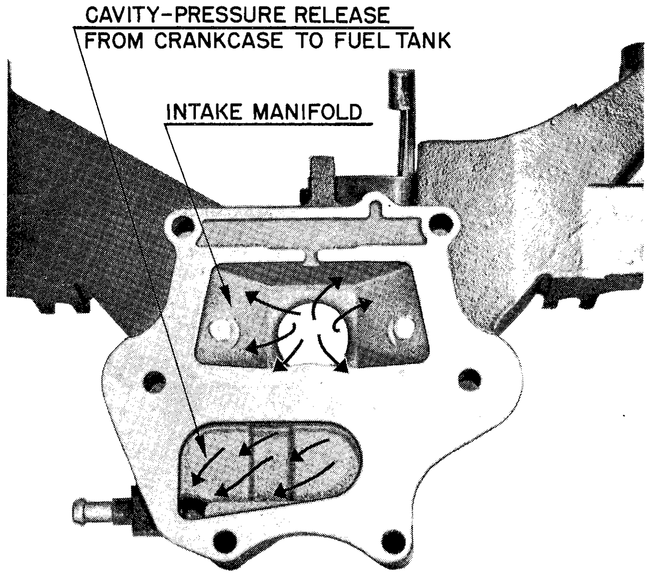
Armature plate removed to show mounting ring to which the armature plate is attached and on which it "swivels" to advance or retard motor speed.



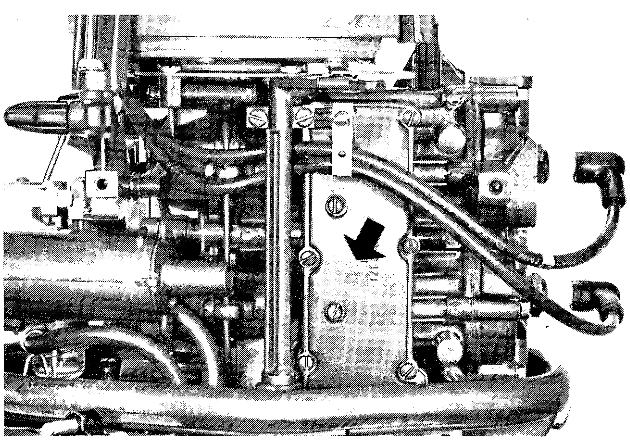
Cylinder head removed to expose pistons, cylinder bores and water jacket. Note that straight side of piston deflector is directed toward the intake or by-pass port — sloping side toward the exhaust port.



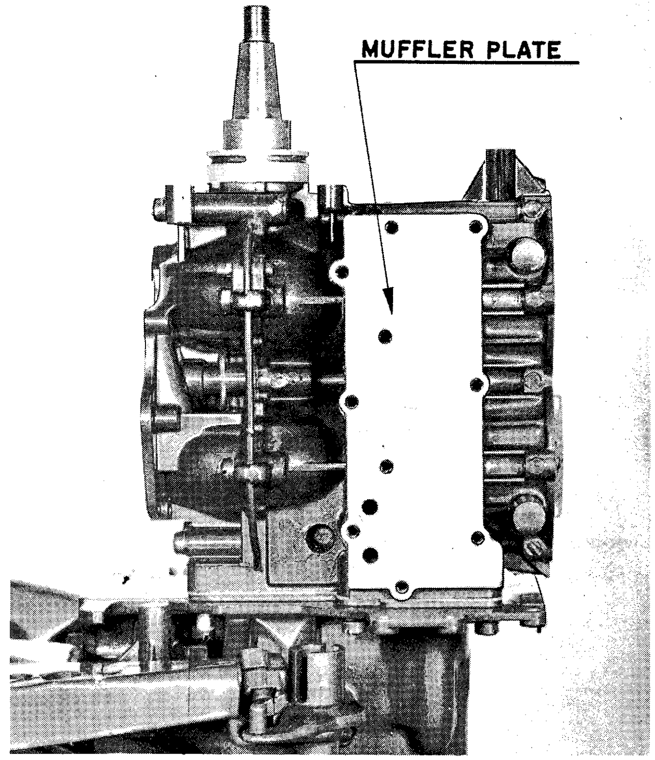
Showing carburetor installation, pressure line to fuel tank, fuel line to carburetor, fuel line corrector and intake manifold. See pages 107 through 139, 147 through 148 and 151 through 152.



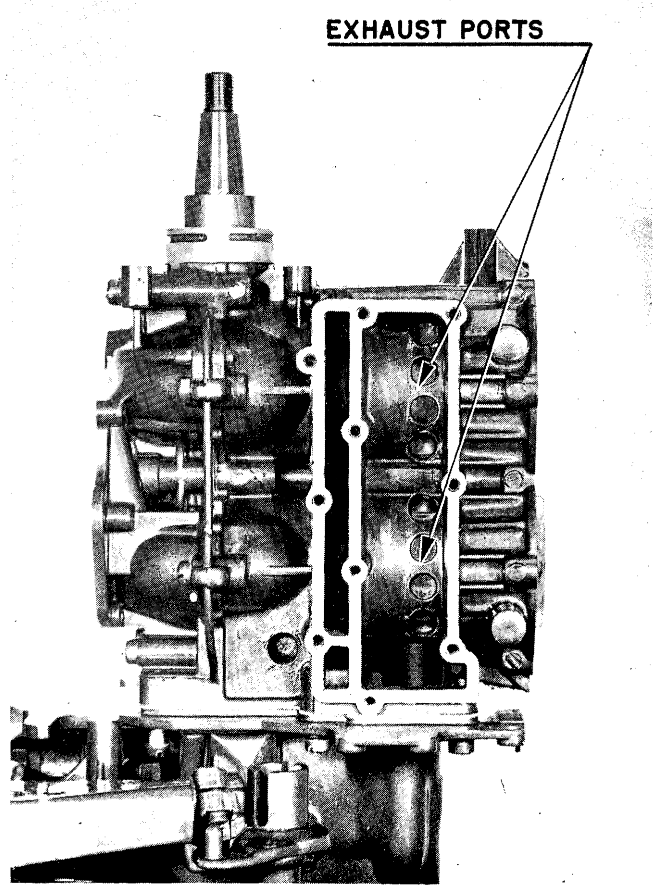
Intake manifold — Side exposed to the valve plate, showing manifold and pressure release cavities.



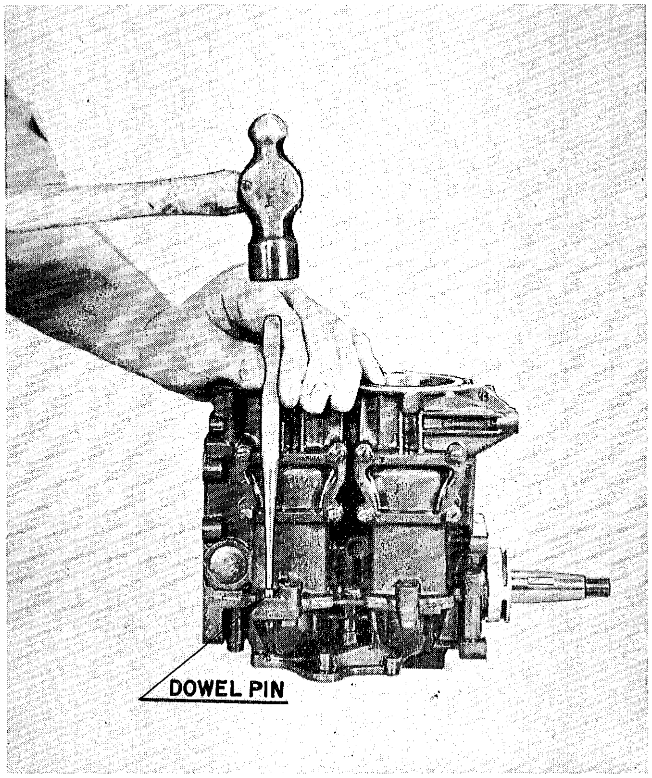
Showing port view of the Powerhead – muffler shell indicated by arrow. On removing and prior to reinstalling, lap gasket face on lapping plate as instructed on page 196 to insure a good mount.



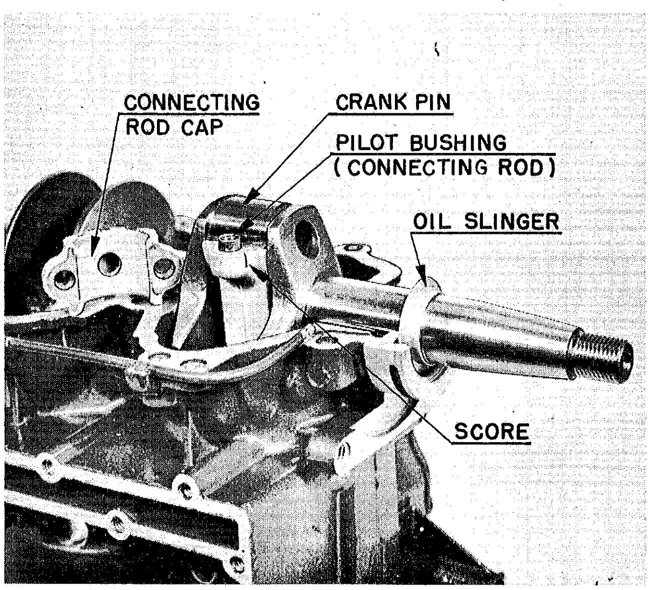
Showing the muffler cover removed to expose the muffler plate.



Showing muffler plate removed to expose the exhaust ports and casual inspection of the piston ring.

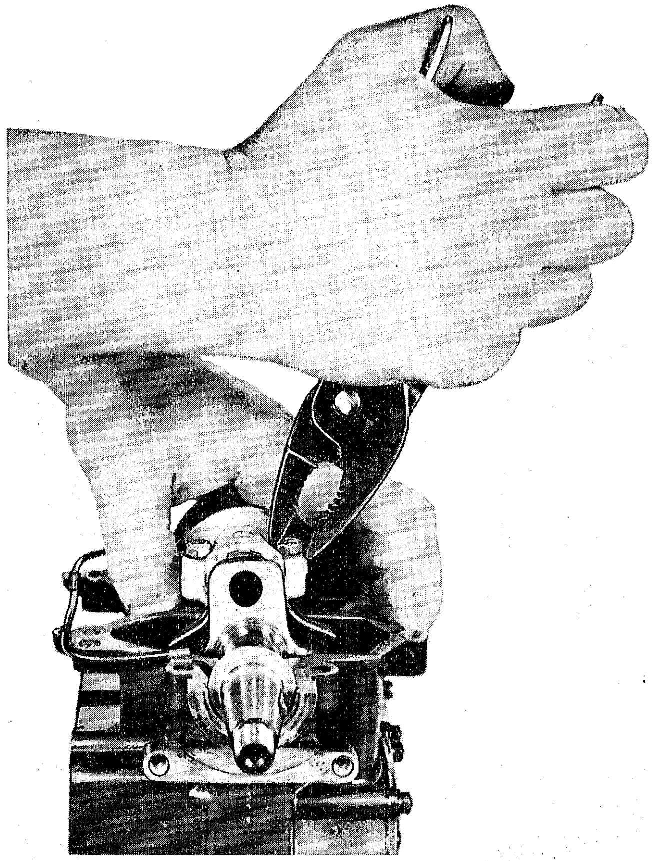


Driving on the crank case dowel pin (two in the assembly diagonally opposite). Perform this operation carefully to avoid nicking or burring tapered surfaces of the pins, edges and inside surfaces of the dowel pin holes.

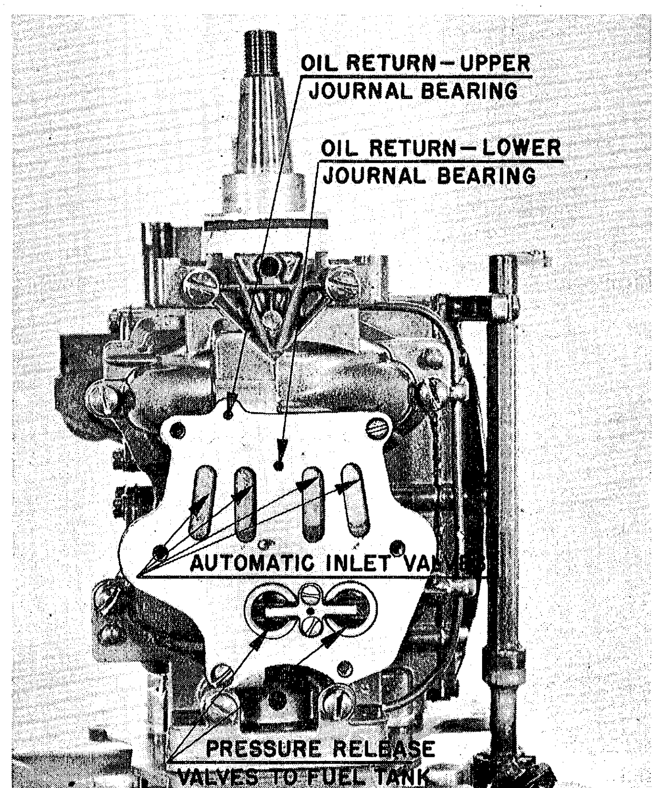


Two small pilot bushings are pressed into the connecting rod to achieve alignment of the rod and cap when bolted together—the protruding end of the bushing and a like one on the opposite side of the rod (not shown here) fit into corresponding holes machined into the connecting rod cap for alignment with screws through the bushing to hold the rod and cap fast.

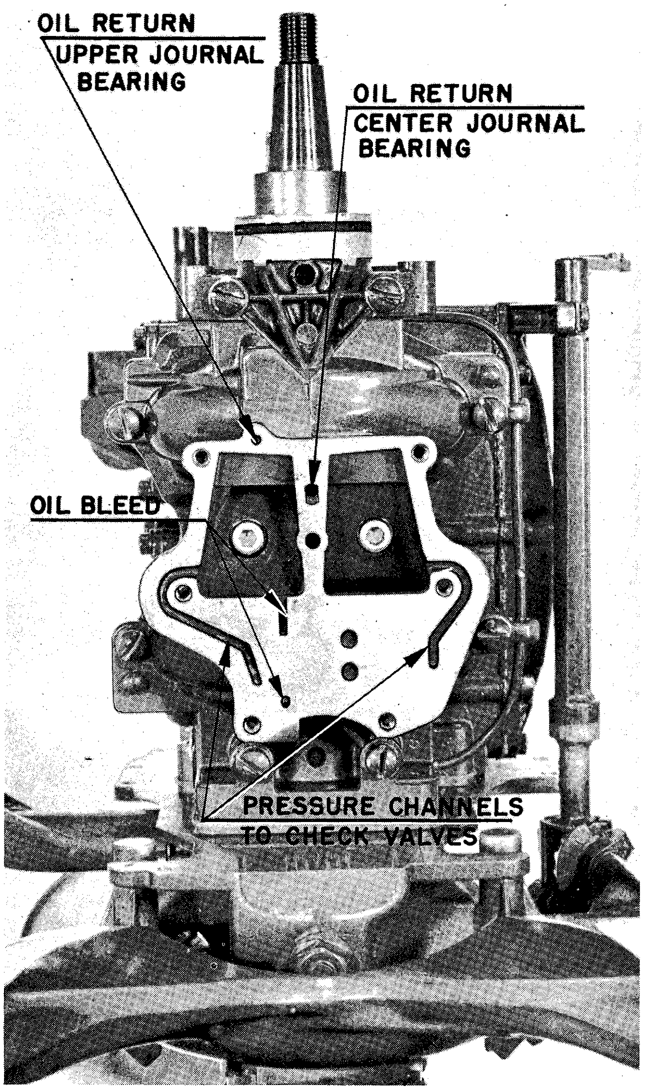
Since this is a matched assembly, the caps and rods are not interchangeable nor may the cap be installed end for end to retain the "matched" fit. The rods and corresponding caps are "scored" as indicated above to denote matched assembly—both score marks on the same side. If by chance the score marks have been obliterated, one side of the rod and cap may be "marked" with a prick punch to assure proper matching on re-assembly—this is important and should be done prior to removing the cap.



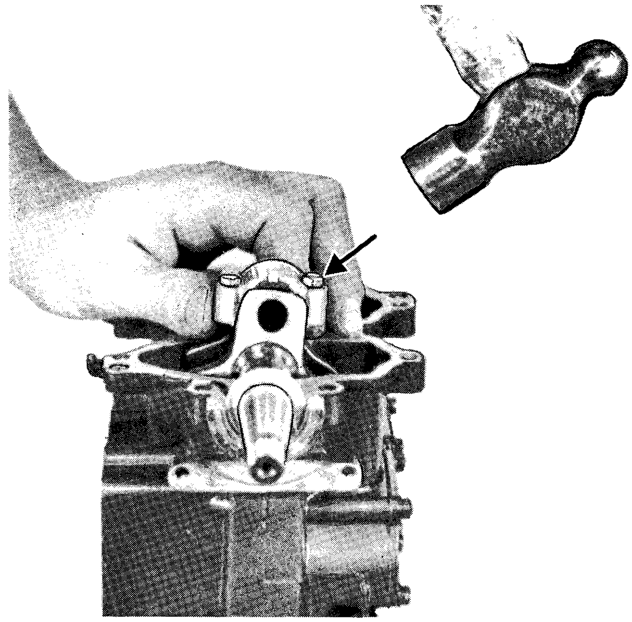
To secure position of the connecting rod screw, bend protruding lip of the lock plate up squarely against the head of the screw—first adjust position of the screw to obtain alignment with the lip. Discard used lock plates—replace with new, as insurance against the screw working loose.



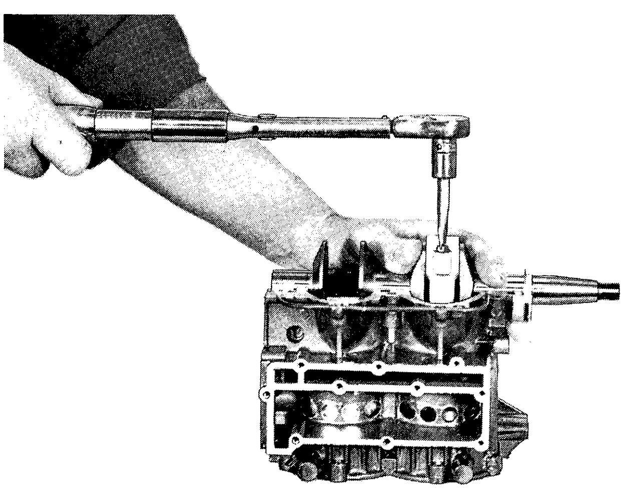
Intake manifold removed to expose the valve plate.



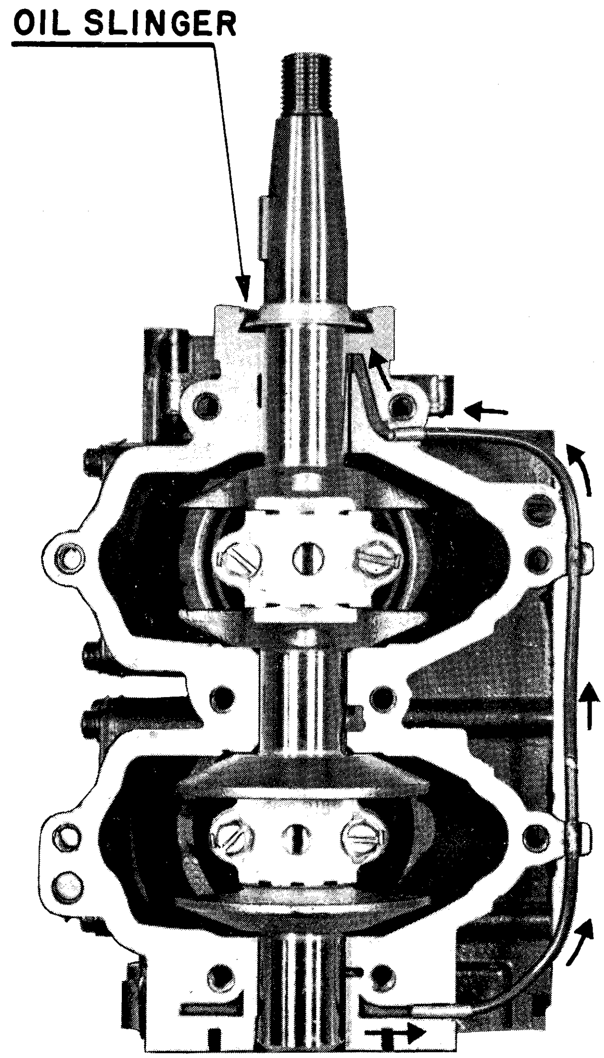
Valve plate removed to expose channels to upper and lower crankcase chambers, oil returns and pressure channels leading to the automatic pressure release valves.



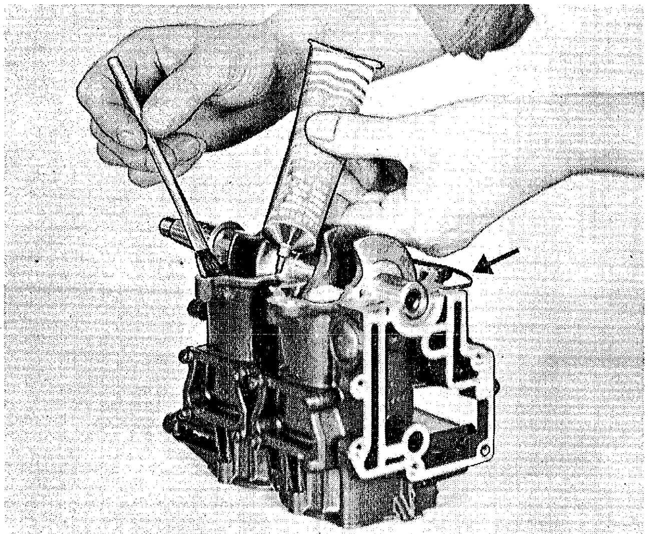
Lap lock plate lip tightly and carefully with hammer to secure its position.



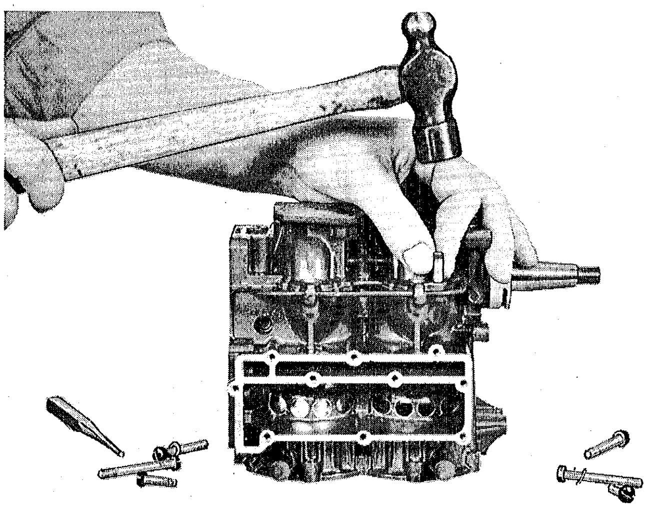
Torque connecting rod screws to 5 to 5½ foot-pounds. See Torque Chart on page 362.



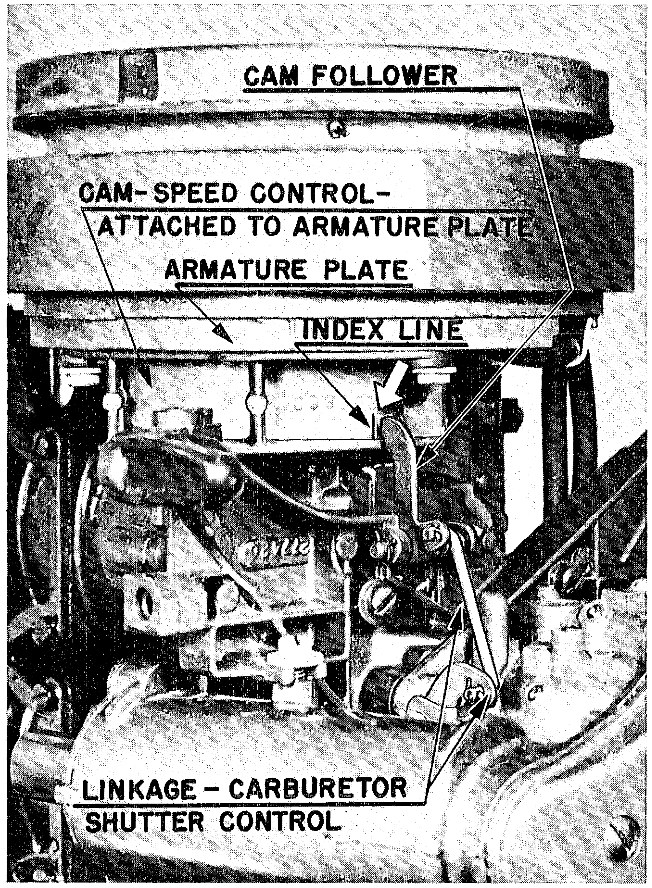
View of cylinder block assembly showing crankshaft, connecting rods, oil slinger and indicating path of oil from the lower to upper journal bearing.



Prior to attaching the crankcase, make certain that crankcase and cylinder block faces have been thoroughly cleaned —free of foreign matter, burrs, and all traces of old cement. Apply this coat of hard drying cement—Sealer 1000—spread evenly and quickly with brush as shown.

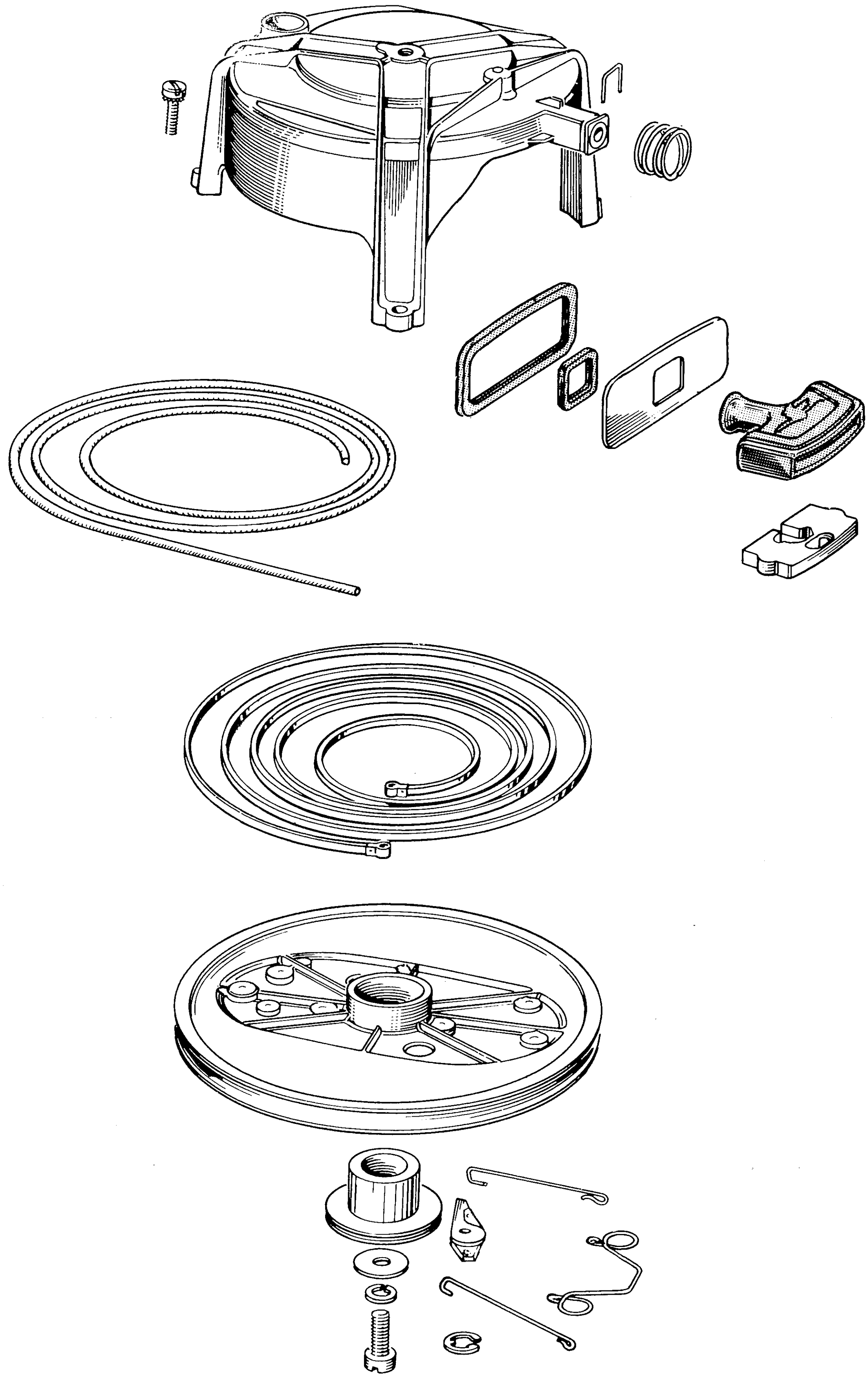


After spreading cement, place the crankcase in position on the cylinder block. Start all crankcase screws then carefully drive the tapered aligning dowel pins into position to align the crankcase with the cylinder block. Draw up evenly on crankcase screws. Torque to specifications indicated on Torque Chart, page 362.



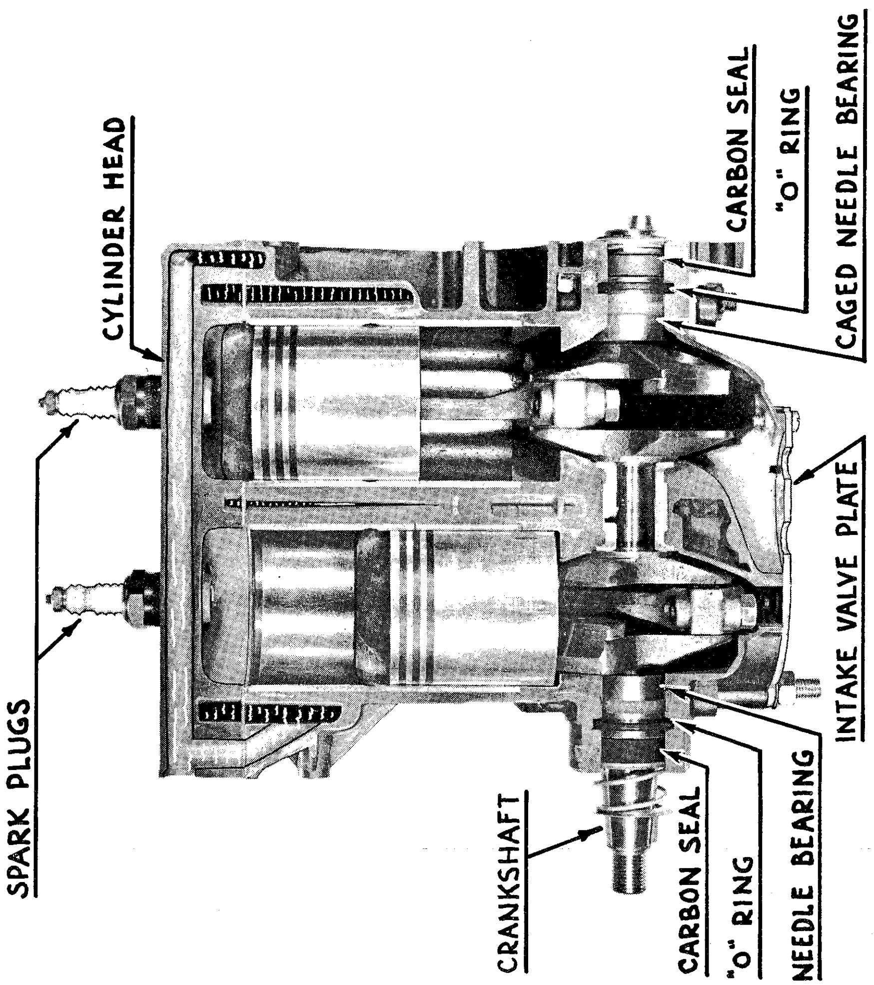
It is of extreme importance that spark advance and degree of carburetor (shutter) opening be correctly synchronized to realize maximum performance throughout the speed range of the motor. Above illustrates the synchronizing mechanism for the Model AD – see illustrations and text on pages 102 and 103. Bear in mind that the carburetor shutter be on the "verge" of opening when the cam follower makes point of contact with contour of the cam at position indicated by index line embossed on the cam casting. All "slack" in the linkage should be taken up at the time of making the adjustment.

NOTES

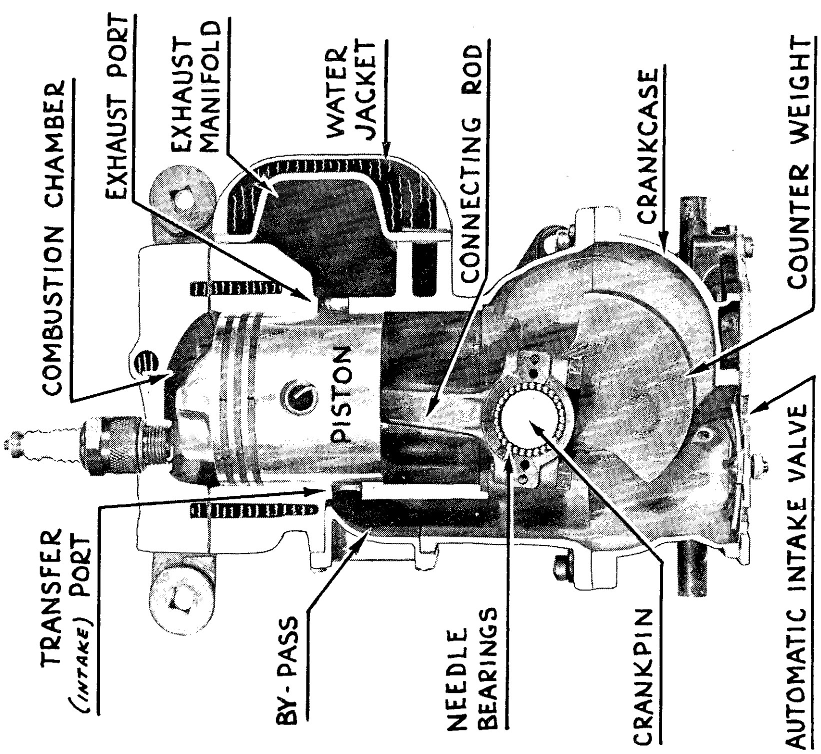


STARTER GROUP
Models AD-10, 11 and 12

NOTES



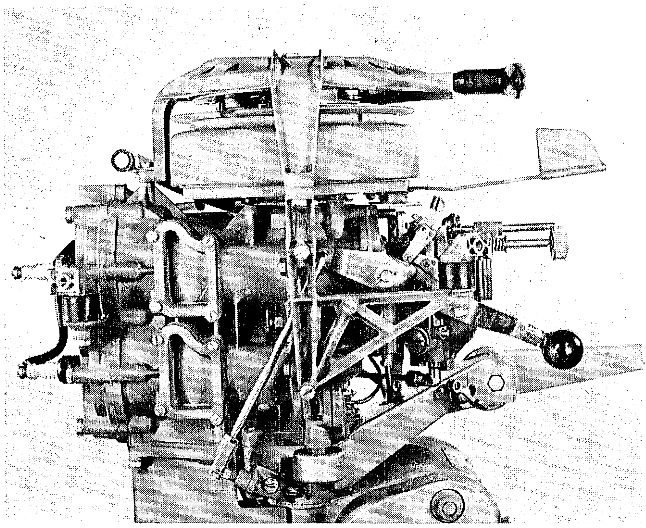
Vertical.



Horizontal

Sectional View of QD Power Head

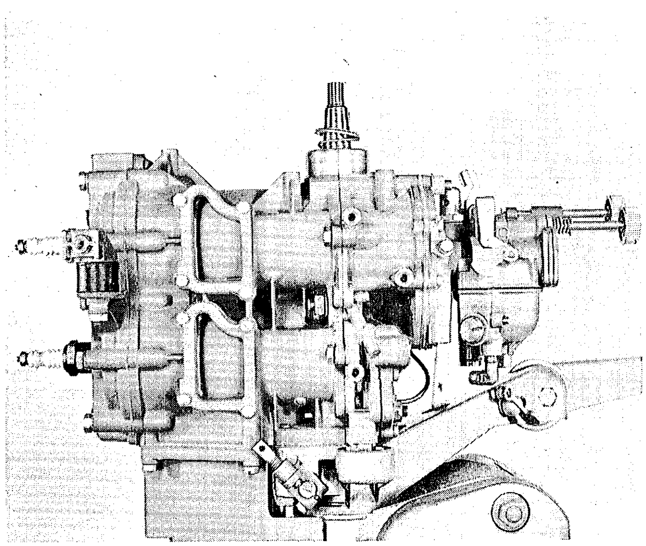
POWERHEAD – MODELS QD-10 THROUGH 15



Model QD Power Head–Ready Pull Starter Installed.

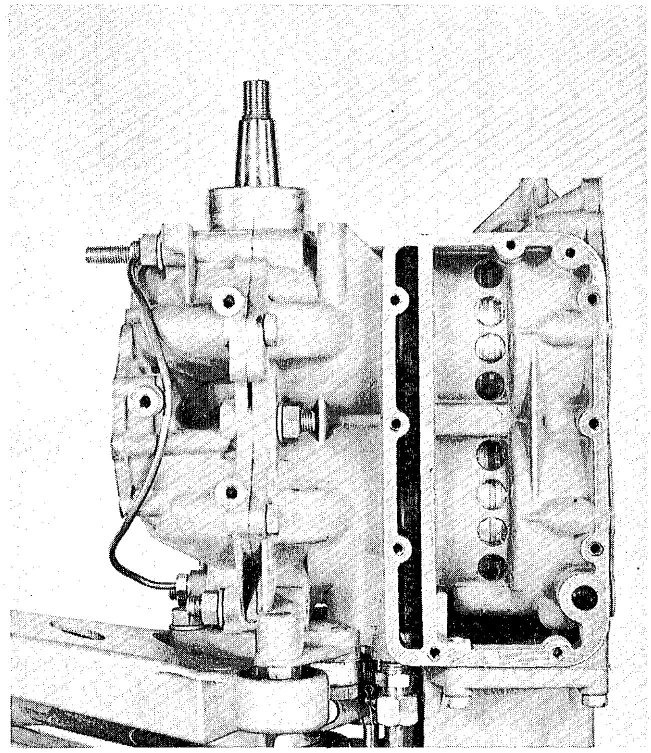
When major repairs on the power head such as installation of new piston rings, pistons or reconditioning of the cylinder bores, etc., are required, a disassembly operation becomes necessary which should be carefully performed in clean surroundings—on a clean and orderly bench top with sufficient space to temporarily store the various parts as removed.

First, remove the motor cover, followed by disassembly of the Ready Pull starter, flywheel and armature plate as previously instructed.



Power Head with Side Covers, Ready Pull Starter, Flywheel, and Armature Plate Removed. Notice Spring and Washer on the Crankshaft—Used to Hold Carbon Seal in Position Against the Caged Needle Journal Bearing Assembly.

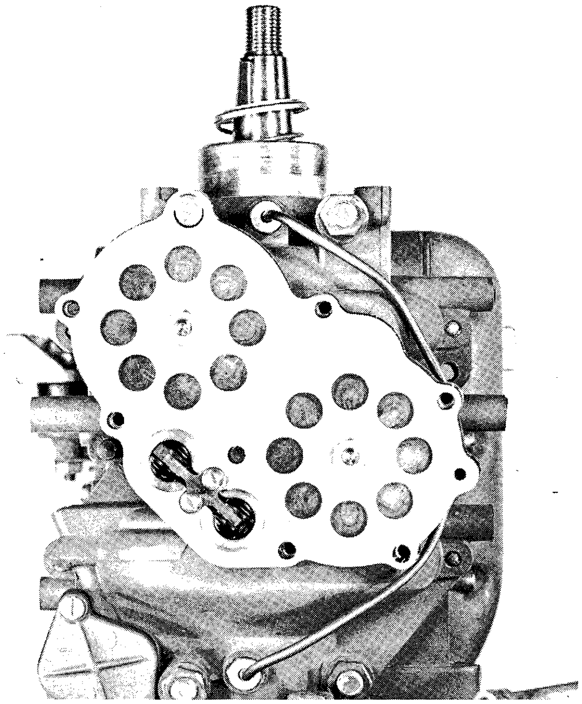
Detach carburetor assembly from crankcase (necessary to first remove carburetor bowl, then mixing chamber) – early models only. Remove cylinder head and muffler. The muffler is water cooled and is made up of two pieces, namely, a die-cast outer shell and a stamped inner shell. The inner shell being somewhat smaller than the outer shell, a space is created when the two are placed together and assembled to the cylinder block. The



Showing Carburetor, Cylinder Head and Muffler Removed. Exhaust Ports and Water Jacket Exposed.

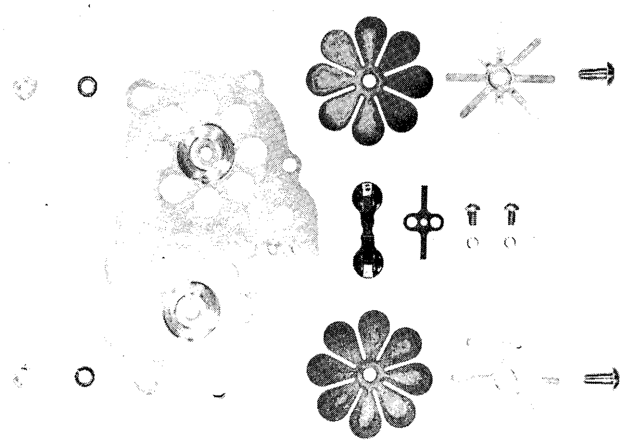
space thus created fills with water to assist in dissipating heat of exhaust gases during operation of the motor and becomes part of the water circulating system. As such, the muffler is sealed with two gaskets – one between the outer and inner shells and second between the inner shell and the cylinder, all of which are bolted to the cylinder block. The gaskets, of course, must be properly seated and in good condition at all times. Check at this time, possibility of warped gasket faces to guard against leaks. See page 196. Lap surfaces if necessary.

Carefully detach the automatic intake valve assembly—set safely aside until required for reassembly or repairs. Place assembly in a clean wooden or small cardboard box during repairs on the power head or wrap in clean paper. Be careful not to per-



Carburetor Removed Exposing Automatic Leaf (Intake) Valve Plate Assembly, and Check Valves.

mit foreign matter scratching surfaces of the plate which must be flat and true to maintain crankcase compression. Likewise, when reassembling to the crankcase, make certain gasket faces are flat and clean and that no scores or scratches appear. Check gaskets to determine fitness for further service—replace if necessary. Use nondrying cement on gaskets for this installation—use sparingly.

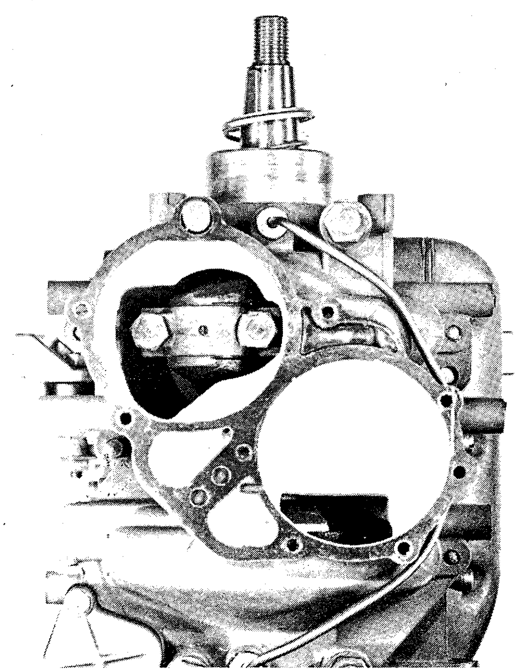


Disassembled Automatic (Leaf) Intake Valve Plate, Showing in Detail the Plate with Intake Ports, Leaf Plates, Leaf Guides, Pressure Check Valves (Controlling Pressure to Mile-Master Tank) and Minor Parts Incidental to Assembly.

The automatic intake valve assembly, as shown above, consists of an accurately machined aluminum plate with both faces true, flat and smooth. Holes (ports) are drilled into the plate to form part of the valve assembly. Two series of holes (ports) are employed to make up an intake assembly for each crankcase chamber. Attached to this plate are two valve plates, each provided with eight anchored discs or segments which, when properly assembled, come to rest over corresponding holes in the aluminum plate and thus comprise the valve assemblies. A guide with eight curved fingers is attached immediately back of the valve plate to limit degree of valve or disc opening. (Operation of the valve assembly is as described under "Carburetion").

Normally, this assembly requires little attention. Its performance can be affected only by foreign matter lodging between the disc or leaf plate and the aluminum plate to hold one or more of the segments off their seats to result in escape of crankcase compression. Likewise, if the plate is carelessly handled during power head repairs—becomes scratched or nicked, the result is crankcase compression loss to interfere with motor performance.

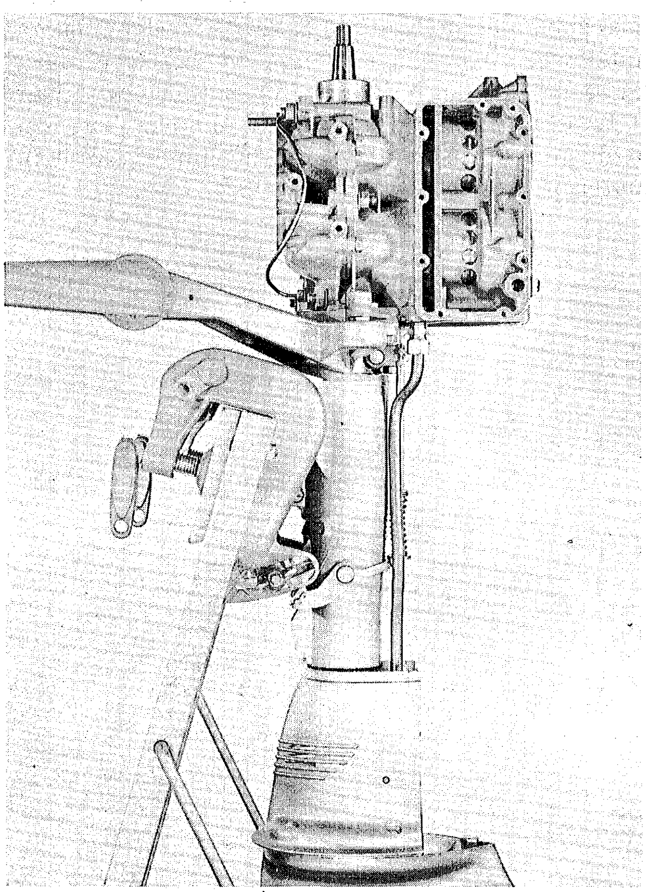
If there is occasion to install a new leaf plate, care must be exercised to see that each individual segment or leaf comes to rest squarely over the corresponding hole in the plate—overlapping an equal amount on each side. A small scribe mark (scratch) will be noted on the plate—adjust leaf plate so that it falls midway in the slot between segments. Adjust fingers of the guide to fall in center of each segment.



Crankcase with Automatic Intake Valve Assembly Removed—Showing Oil Line Connecting Top and Lower Journal Bearings.

Since the leaf plate is constructed of specially heat treated beryllium copper, do not, under any circumstances, flex or bend the segments by hand —to do so will render it unfit for further use (discard at once—replace with new one to avoid doing the job over again). This is IMPORTANT. The leaf plate should be stored between clean pieces of stiff cardboard to prevent bending—handle carefully. Heat treatment sets up a definite tension on each segment; if bent beyond critical point, tension "sets"—that is, the segment will no longer spring back to its normal position.

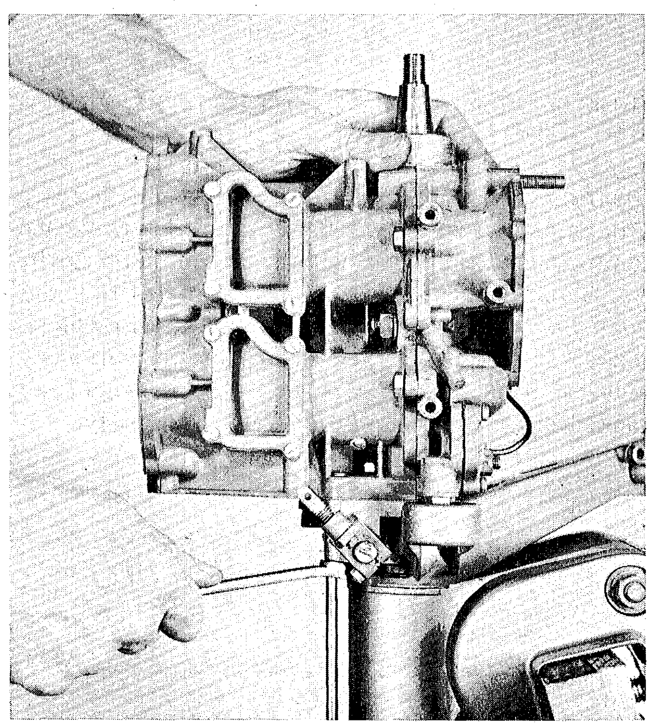
Attached to the aluminum valve plate also but not associated with functioning of the automatic intake valve, is the fuel pressure check valve assembly. This assembly consists of two small (connected) rubber discs or plates which are held in position over two corresponding holes drilled in the plate, by a flat spring of predetermined tension to comprise a check for each crankcase chamber. When pressure in the crankcase reaches a certain point (determined by tension of the spring) the rubber disc is momentarily forced off its seat, permitting pressure thus escaping to be conducted by way of the air line, into the Mile-Master Fuel Tank.



Power Head with Side Covers, Starter, Magneto, Carburetor, Muffler, Cylinder Head and Exhaust Tube Removed, Prior to Detaching from Lower Unit.

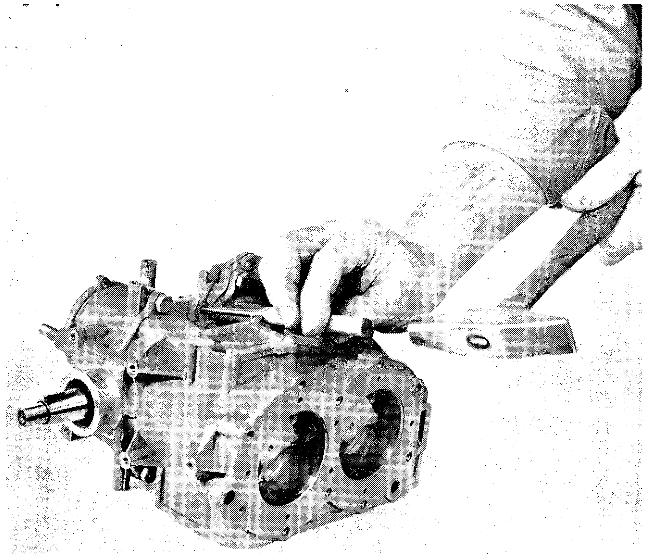
The checks function alternately as cylinders fire —first one opens, then the other, to build up and maintain sufficient pressure in the fuel tank to "feed" the carburetor. When pressure in the tank equals pressure built up in the crankcase, there is naturally no valve action in this respect. Degree of valve action depends on amount of fuel in the tank. As fuel level in the tank lowers, greater air space results to cause proportionately greater check valve activity. Normal fuel tank pressure is 2 to 5 lbs., depending on motor speed and fuel level, see page 346.

To remove balance of the power head from the lower unit, it is necessary to first remove the exhaust tube (top and bottom sections as shown above), followed by disconnecting the water tube leading from the pump housing, then by removing the nuts holding the power head fast to the driveshaft casing. Carefully lift power head from lower unit.

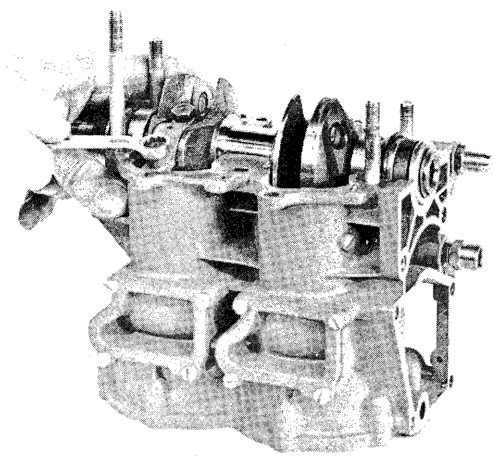


Detaching Power Head from Lower Unit.

It will be noted on removal of the power head that the driveshaft casing drops down approximately 1/4" but this need cause no concern since it was originally designed to do so under the circumstances. Observe also, at this time, the conical springs seated in arms of the steering bracket and attached to the power head by means of two large pins screwed into corresponding arms of the crankcase. Purpose of this arrangement is to absorb torque impulses between the power unit and steering bracket (arm).



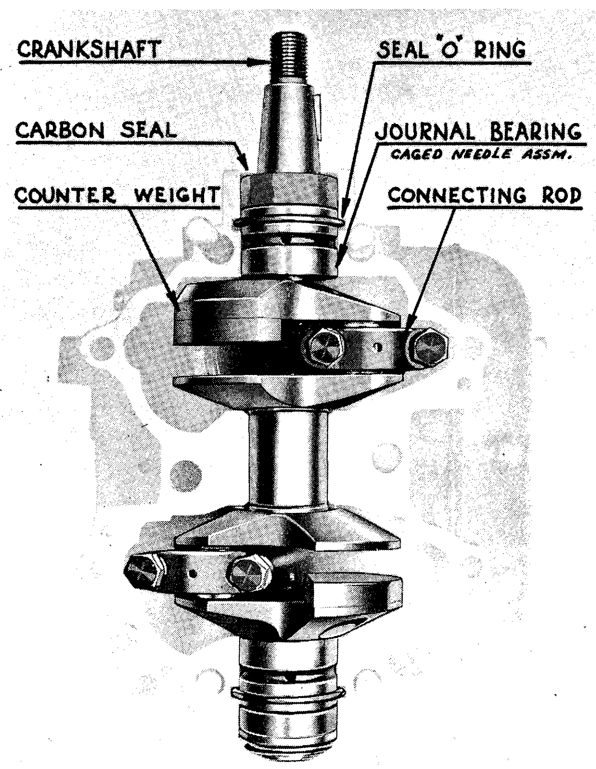
Driving Taper Aligning Pins from Crankcase.



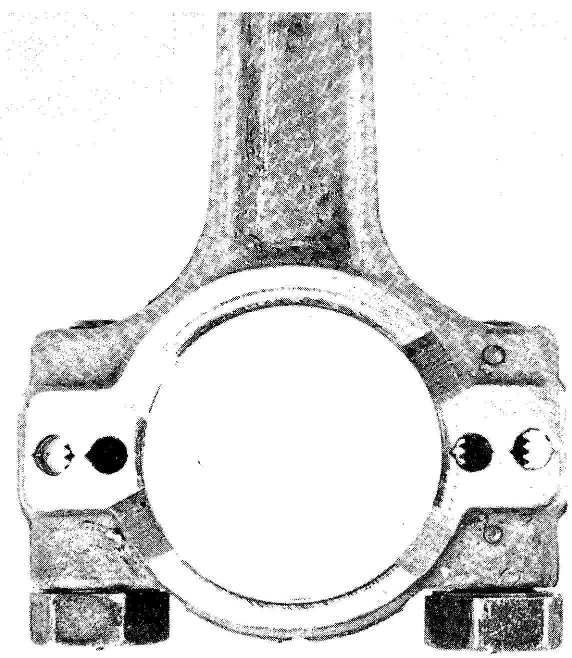
Removing Connecting Rod Screws.

Place power head on clean bench top to disassemble crankcase. Drive taper pins out with flat punch as shown here. Two are used—one on each side to obtain proper crankcase alignment. Remove nuts and screws holding crankcase fast to the block assembly, then carefully lift off. If found to be sticking to the cylinder block, tap crankcase lightly with a mallet to free.

On having removed the crankcase, the power head can be completely dismantled by detaching the connecting rod cap screws and simply lifting the crankshaft free. Piston and rod assemblies can then be pushed out through the top of the cylinder block. But, prior to doing this, the connecting rod caps should be marked with chalk or pencil, #1 top and #2 bottom. Mark the connecting rods and pistons accordingly if the same assemblies are to be reinstalled. Do not interchange the connecting rod caps. The rod and cap make up a matched assembly.

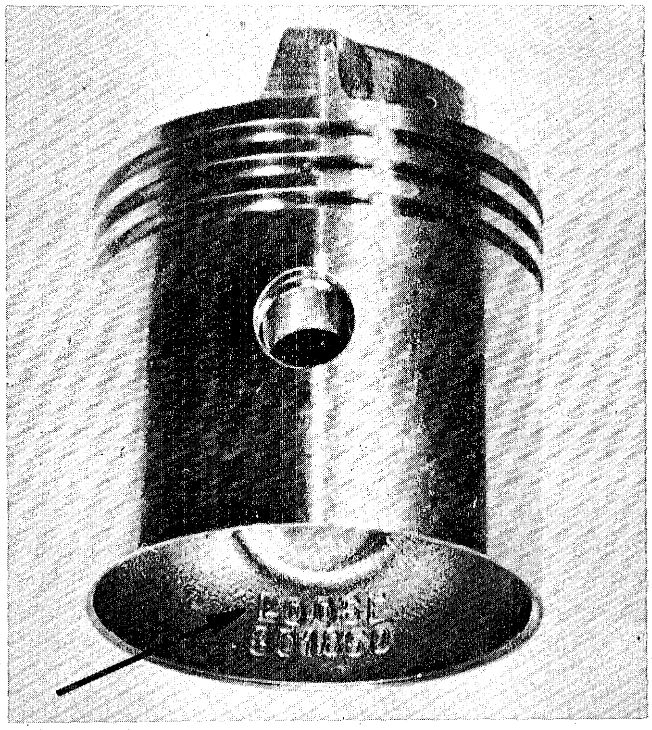


Crankcase Removed, Exposing Crankshaft, Connecting Rods, Caged Needle (Journal) Bearing Assemblies, and Crankcase Seals.



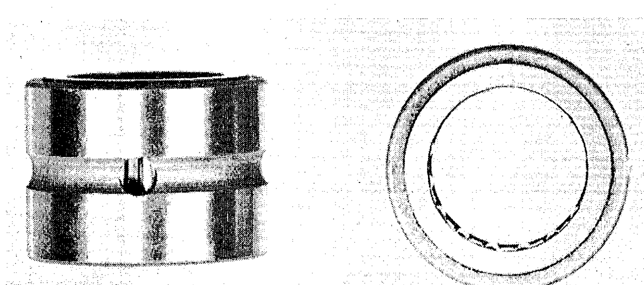
Showing Notch Marks on Connecting Rod and Cap. Cap Must Be Installed so that Marks Align on the Same Side.

See general instructions pertaining to cylinder bores, piston rings, pistons, connecting rods and crankshafts on pages 187 to 206 inclusive.



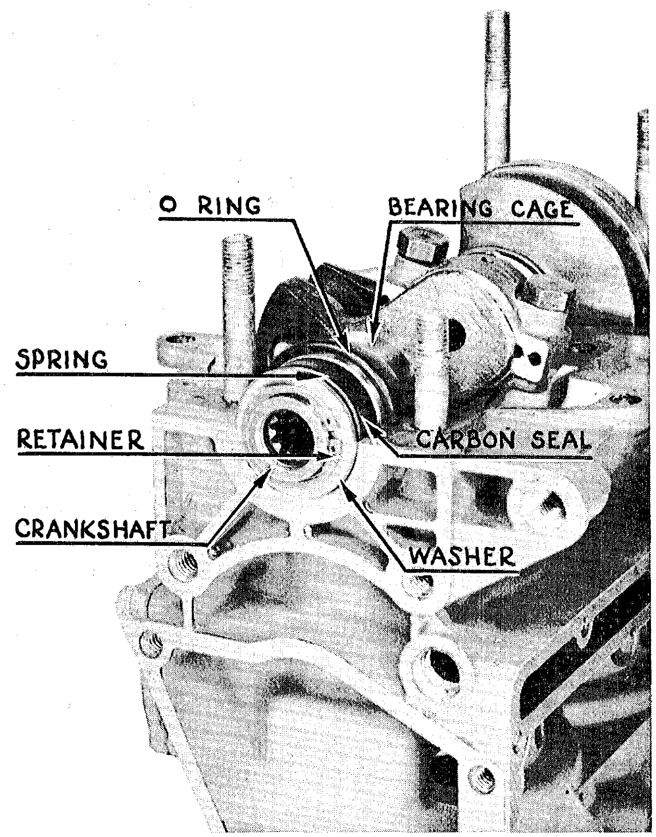
Note Wrist Pin Hole Bored for Slip Fit is Marked "Loose" Inside of Piston Skirt.

Johnson has employed for the first time caged needle bearings on top and bottom crankshaft journals in the Model QD whereas bearings in like position on other service models were of the friction type bronze bushings, reamed or fly-bored to specified size for proper journal bearing clearance.



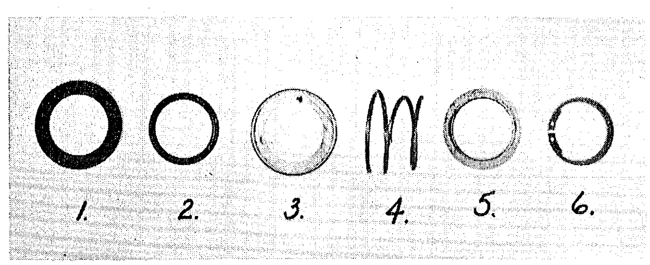
Caged Needle Bearing (Journal) Assembly—Side and End Views.

Since the caged needle bearing assemblies are not "air tight" and do not fit sufficiently tight in the crankcase bearing boss, some form of compression seal must be installed. This consists of a round rubber ring ("O" ring) fitted over the caged needle assembly and into a groove machined in the crankcase boss. Thus, on installation and assembly of the crankcase, the area between outer surface of the bearing cage and machined corresponding surface of bearing boss are sealed against crankcase losses by compression of the rubber "O" ring.

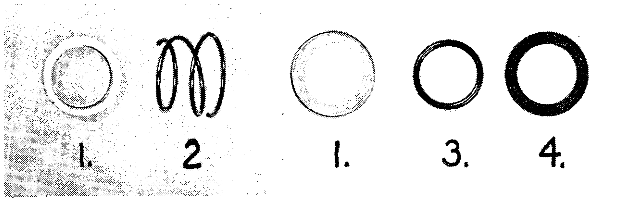


Showing Lower Bearing and Seal Assembly.

Compression loss between the bearing assembly and crankshaft is accomplished by installation of a carbon seal ring placed immediately forward of the bearing cage which is held tightly against thrust face of the cage by spring tension to prevent loss at this point. A second rubber "O" ring is installed in a groove machined on inside surface of the carbon seal; consequently, a seal is obtained by compression of the "O" ring when assembling the carbon seal on the crankshaft.

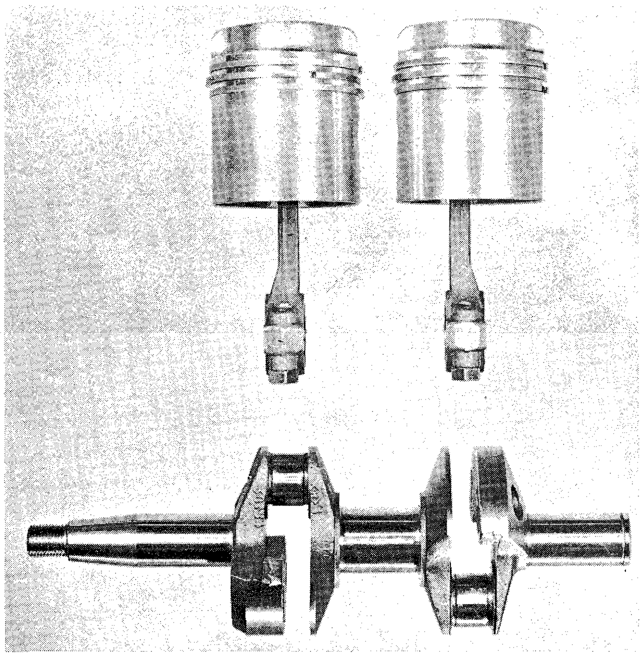


Details of Carbon Seal Assembly—Lower Journal: (1) Carbon Seal, (2) "O" Ring, (3) Washer, (4) Spring, (5) Washer, (6) Retaining Washer.



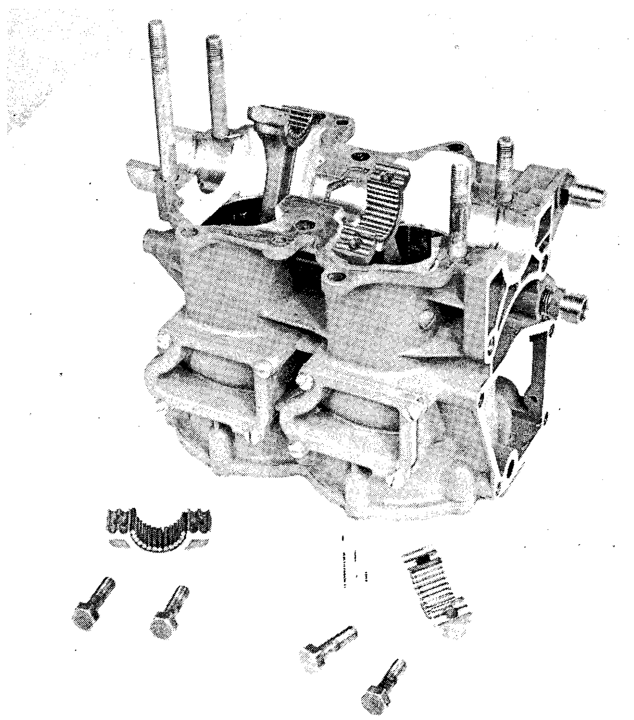
Carbon Seal Assembly of Top Journal: (1) Washers, (2) Spring, (3) "O" Ring and (4) Carbon Seal.

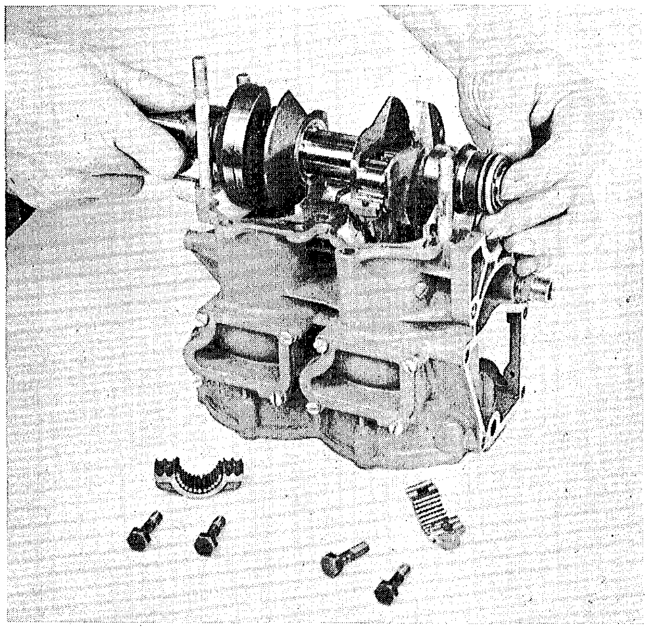
On completion of actual powerhead repairs, piston rings, pistons, cylinders, connecting rods, crankshaft, etc., reassembly becomes the order. Ordinarily, reassembly is performed in reverse of disassembly and it is assumed that careful observation was maintained during "tear down" procedure.


Illustrating Proper Assembly of Connecting Rods. Note Straight Sides of Rods Face Each Other to Facilitate Attaching to Crank Pins. Pistons Must be Correctly Installed on Connecting Rods to Permit Assembling Accordingly—Straight Sides of Piston Deflectors Should Align on Same Side.

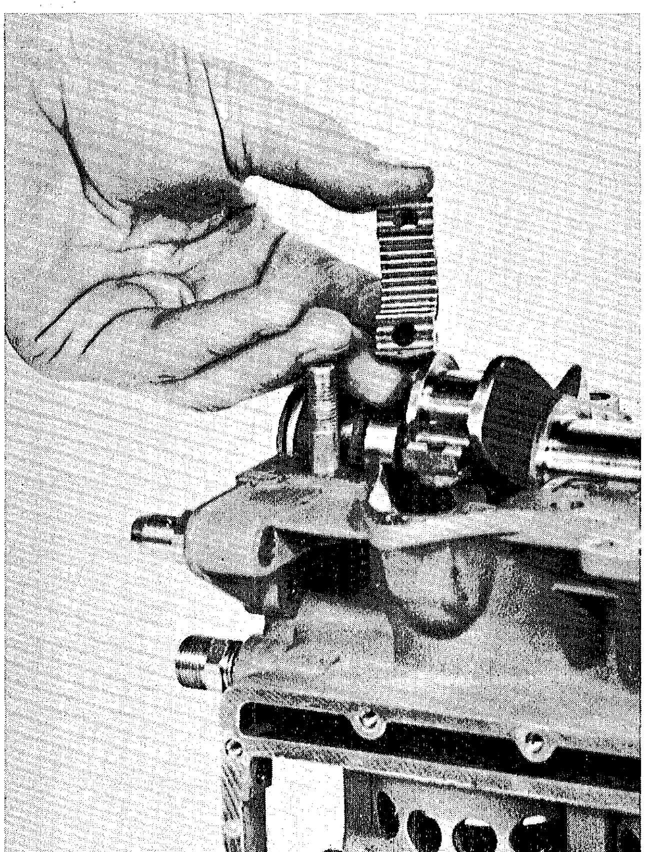
The piston and connecting rod assemblies are first to be installed—proceed slowly. Make no forced assemblies unless "press" fits are called for and make no "dry" assemblies. Be sure all parts to be assembled are clean and free of grit—severe damage and expense result from making "dirty" assemblies. Perfectly good cylinder walls, pistons and rings can be ruined in a few minutes of operation unless all forms of grit are removed before assembly. Work in clean surroundings and with reasonably clean hands. Coat all bearing surfaces, cylinder walls, etc., with clean oil preceding assembly.


Install Piston With Straight Side of Deflector Directed Toward the Intake (Transfer) Port in Cylinder. (Be Sure Assembly is Installed in Proper Cylinder Bore). Piston Rings Are Pinned in Grooves, Arrange Accordingly on Piston. Compress Rings as Shown, With Finger Tips. Tap Lightly and Carefully on Head of Piston to Drive Into Cylinder.


Showing Piston and Connecting Rods Assembled—Needle Bearings Inserted in Rods and Caps [Held in Place by a Coating of Clean Grease—Twenty-Nine (29) Needles to Each Connecting Rod] in Preparation for Installing of the Crankshaft.

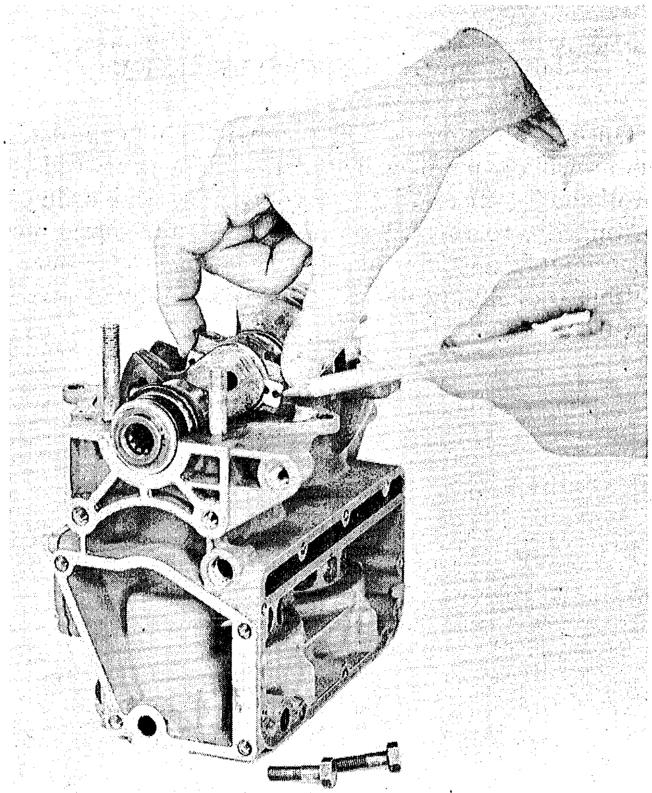


Installing Crankshaft.



Installing Connecting Rod Cap.

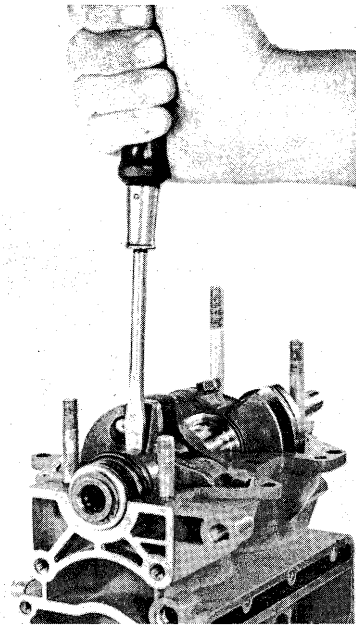
The Model QD connecting rod being of split type construction, makes it imperative that the rod and cap be assembled with index marks aligning on the same side since the broken surfaces (as result of splitting) must match when bolted together.



Checking Connecting Rod and Cap Alignment Prior to Bolting Together.

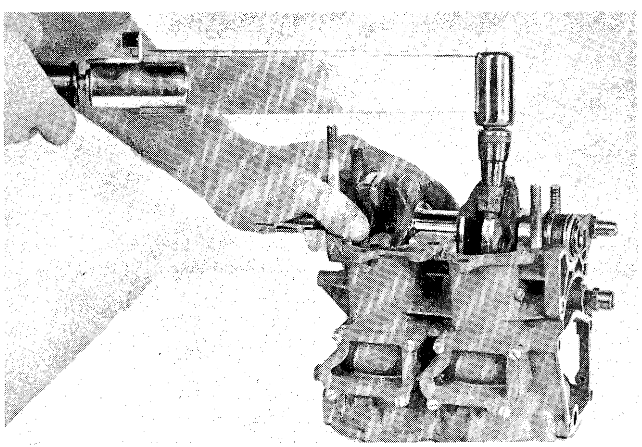
To be assured of this alignment, grasp the cap between the thumb and forefinger, rock back and forth slightly until the cap settles on the rod. Check parting line with pencil, surface must be "flush"—if not, rod and cap are out of line and should not be bolted together. Proceed in this fashion until both sides and end of the cap and rod "flush up." Bolt together snugly at this time but not too tightly, some adjustment on the caged needle bearing assemblies (crankshaft) is first necessary.

Note small pins protruding from crankcase boss (top half) and corresponding holes drilled in needle bearing cages. When placing the crankshaft in final position, the small pins must engage the holes in the bearing cages. The top bearing cage can easily be turned and adjusted to engage the pin, however, spring tension against the lower bearing must be overcome to engage the pin; this is readily done by carefully inserting a screw driver between the end of the bearing cage and cheek of the crankshaft and prying slightly until the pin and hole engage.



Prying Bearing Assembly Into Position in the Crankcase.

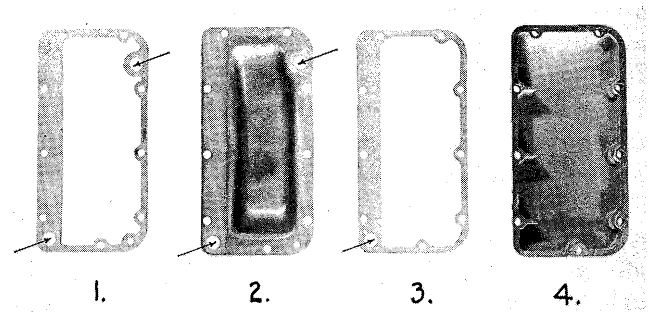
The connecting rod screws can now be finally adjusted with use of a torque wrench – see Torque Chart, page 362. No lock plates are used for this installation.



Drawing Up Connecting Rod Screws With Torque Wrench

After securing the connecting rod screws, apply a thin coat of hard drying cement, similar to Perma-Tex No. 1 to bottom crankcase faces—do not over cement; excess merely squeezes over to foul oil channels, etc. Place crankcase in position, replace tapered aligning pins. Replace nuts and screws—draw up tightly and evenly—be sure no foreign particles have been left on crankcase faces to cause seepage from the crankcase.

Install power head on lower unit—use new gaskets wherever required. Replace muffler, carburetor, magneto, starter, etc., and exhaust tube. Do not neglect spring, washers and carbon seal on top journal prior to installing the flywheel.

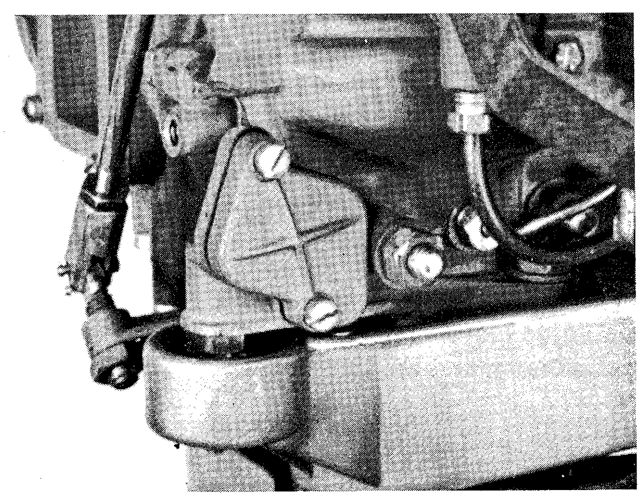


It is Extremely Important to Prevent Water Entering Cylinders, that the Exhaust Manifold (Muffler) Gaskets be Properly Installed when Attaching the Manifold. Gasket 1 Should be Placed Between Cylinder Block and Inner Shell (2) so that Water Openings (Indicated by Arrows) Align—Gasket 3, Between Inner Shell (2) and Outer Shell (4) Aligned in Like Manner with Respect to Water Openings.

Crankcase Bleeder

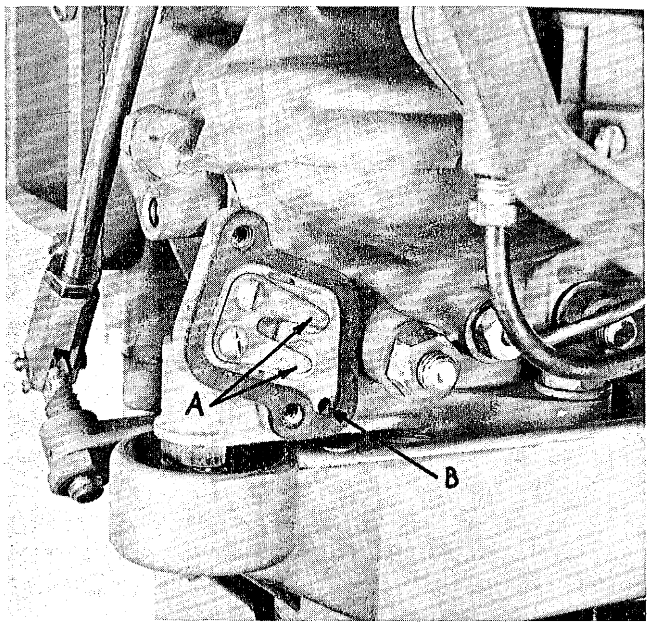
The crankcase in a two (stroke) cycle engine has a tendency towards loading up with unburned fuel (liquid) when operating for any length of time at slow speed with result that it is "flooded" when accelerated for higher speed performance. Flooding in this respect likewise affects slow speed operation. This is evidenced by profuse smoking of exhaust gases, faltering and erratic operation until accumulated fuel has been discharged. In extreme instances, stoppage occurs as result of spark plug fouling. It is the heavy ends of the fuel vapor which settle out during slow speed operation since velocity through the crankcase is not sufficient to hold them in suspension.

To overcome this condition in the Model QD, a bleeder arrangement is provided which functions automatically throughout entire speed range of the motor.



Showing Position of Crankcase Bleeder Valve.

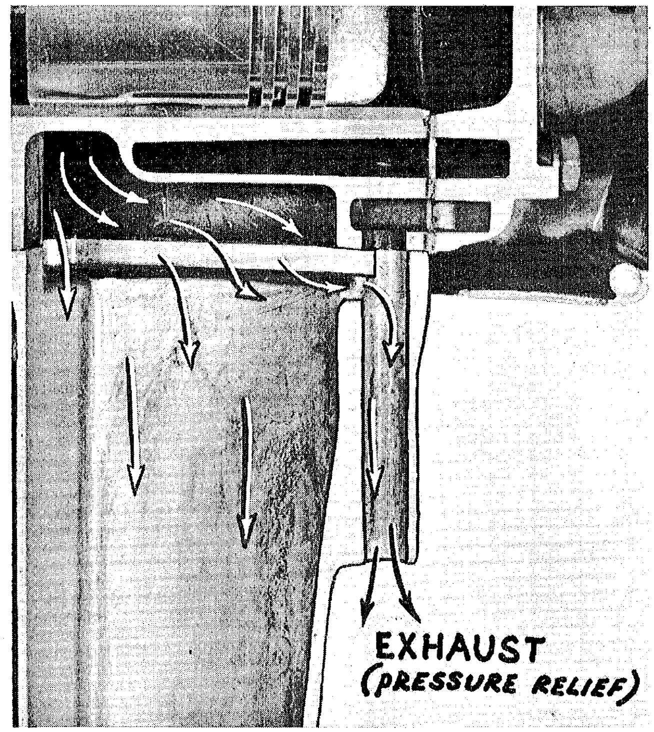
The arrangement consists of a small hole or channel leading from a pocket in each crankcase chamber to an automatic check valve located at the bottom of the power head as shown above. In operation, the fuel which settles out of the fuel mixture during periods of slow speed running, accumulates in the pocket provided for this purpose, fills the channel down to the check valve and there remains until the piston travels on its downward stroke. Resultant crankcase compression (pressure) forces the check plate (a) off its seat to permit liquid fuel escaping through outlet (b) and on into the driveshaft casing where it is discharged with the exhaust gases. Note there are two check plates—one for each crankcase chamber. During upward stroke of the piston, there is no discharge since low pressure or suction exists in the crankcase—the check plate springs back on its seat to prevent air flow in opposite direction.



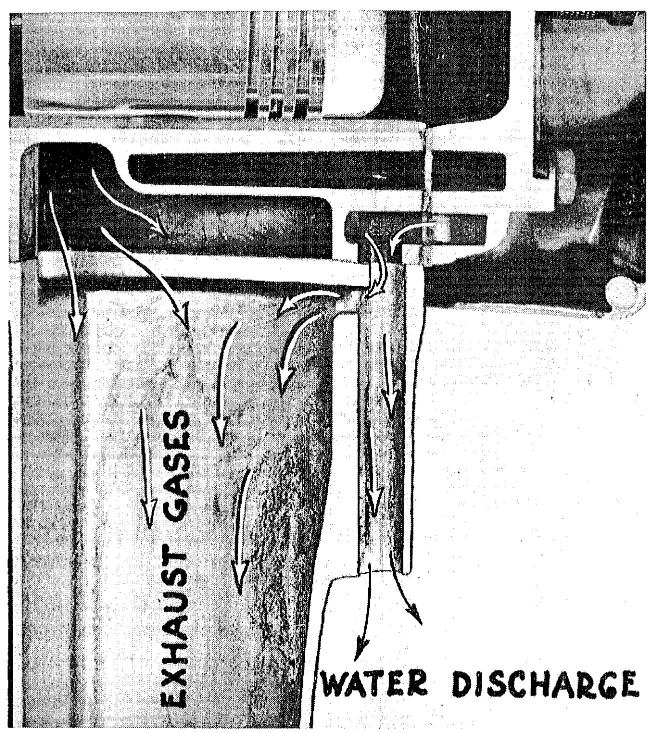
Bleeder Check Valve Showing Cover Removed.

Action described above continues during entire period of motor operation with maximum bleeding of liquid fuel at slow speed performance and proportionately decreasing with increase in motor r.p.m.'s. At top speed there is practically no discharge since velocity through the crankcase is sufficient to hold all particles (for practical purposes) of fuel in suspension to be burned later, on compression and ignition in the combustion chamber.

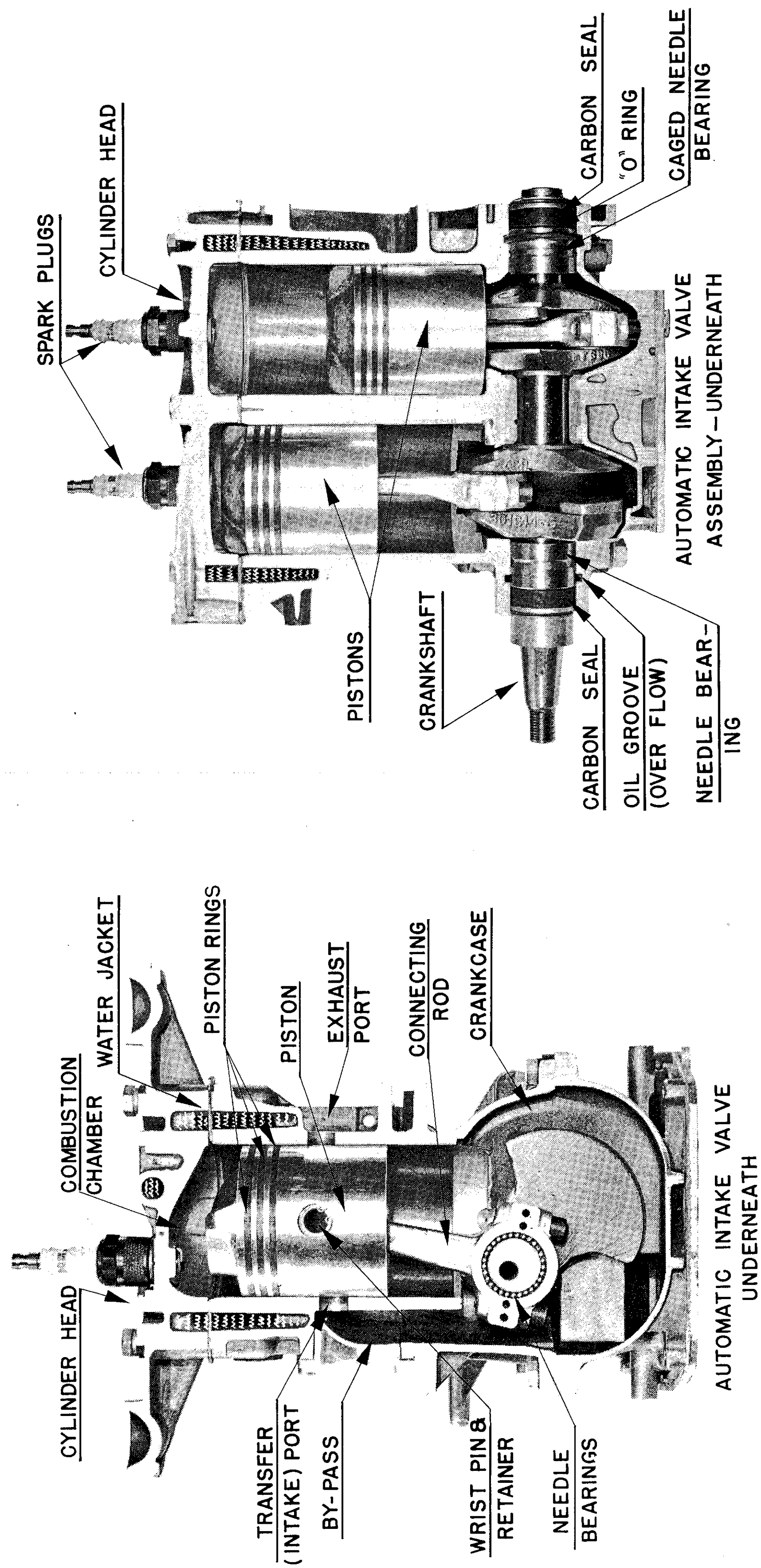
Do not be alarmed if an oil "slick" forms on the surface of the water when operating for any length of time at slow speed—it's the result of crankcase bleeding as described.



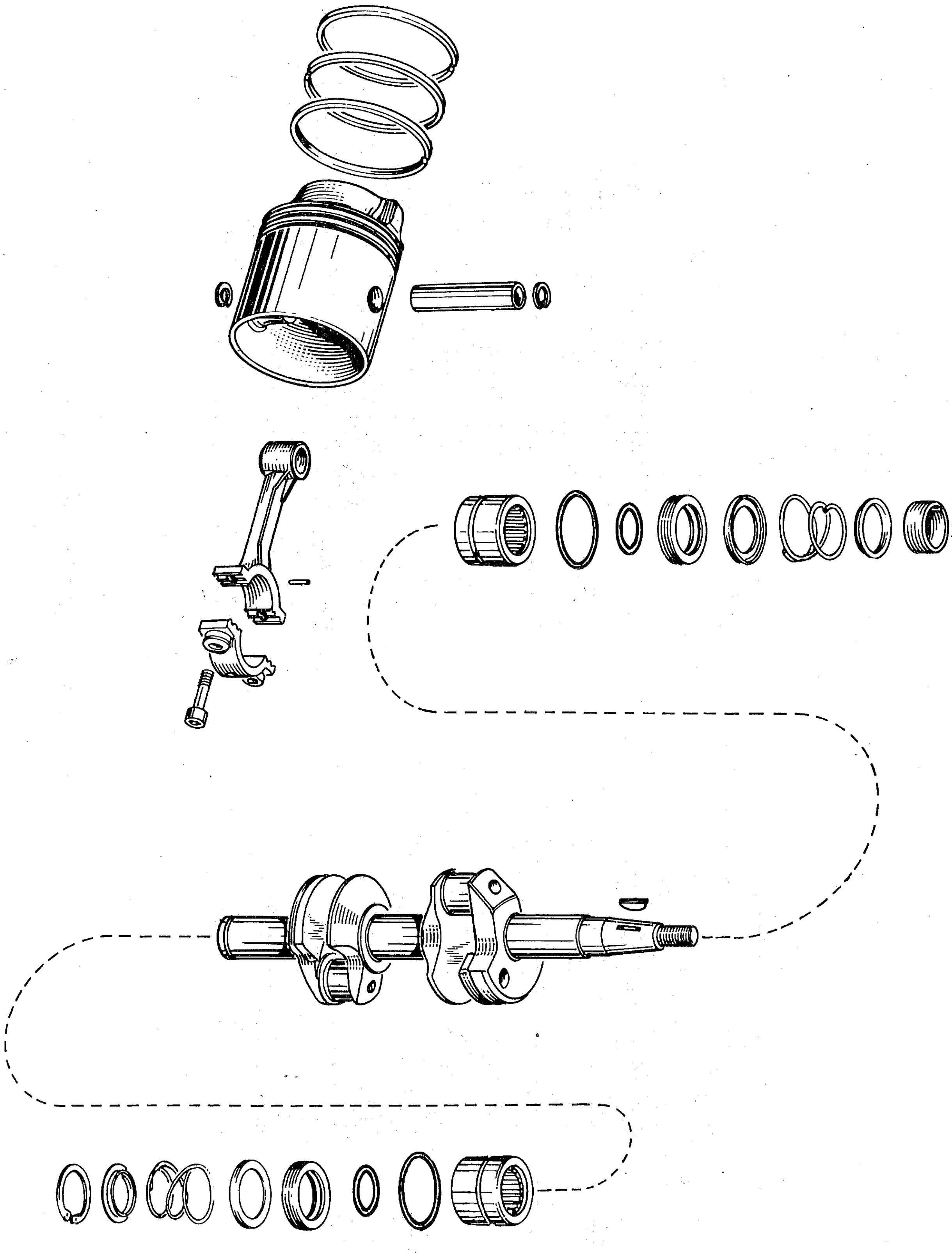
Illustrating Exhaust Relief for Starting Purposes. When Cranking to Start, Back Pressure Created by Underwater Exhaust is Relieved by Way of Opening into the Water Outlet as indicated by Arrows.



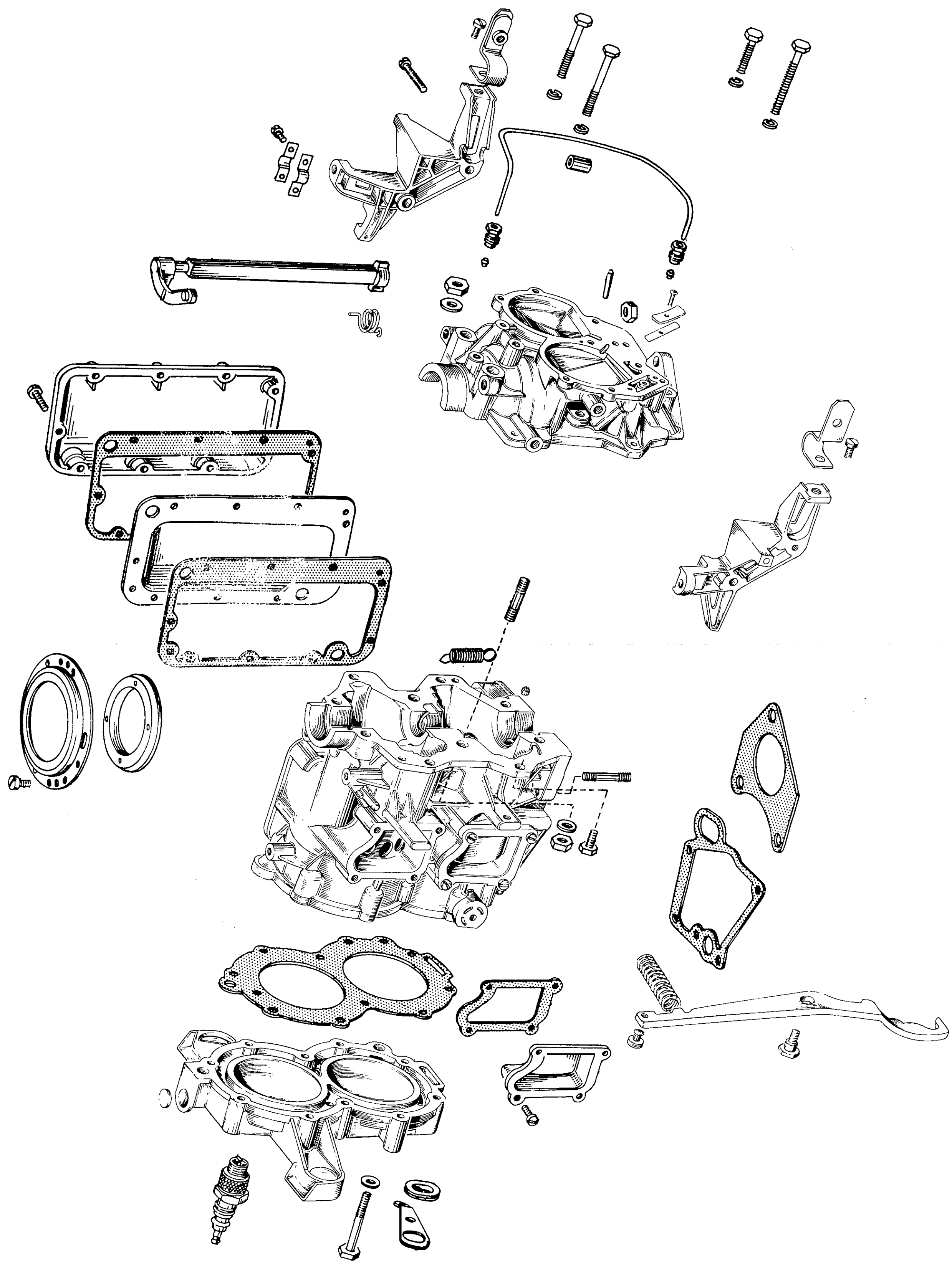
On Having Started the Motor, Water Starts Circulating Through the Cooling System Which Discharges Through the Water Outlet. This Action Results in Some of the Water Flowing Through the Exhaust Relief Opening and into the Exhaust Stream, Thus Obstructing or Closing the Relief Opening. Water Acts Also Towards Reducing Temperature of Exhaust Gases.



Sectionalized Views of Model QD-15 Powerhead Up.



Crankshaft, Piston-Connecting Rod Group.



Cylinder Block Group.

MODEL QD-15 POWERHEAD

Design and construction of the Model QD-15 powerhead are basically like that of previous models, employing the use of roller bearings (top and bottom only) and carbon seals on the journal bearings (top and bottom), needle bearings on the crank pins (connecting rods), a crankcase bleeder system, pressure (to tank) check valves, automatic intake reed valves for fuel vapor induction to the crankcase, but using full floating wrist pins rather than anchored in the piston as in earlier production.

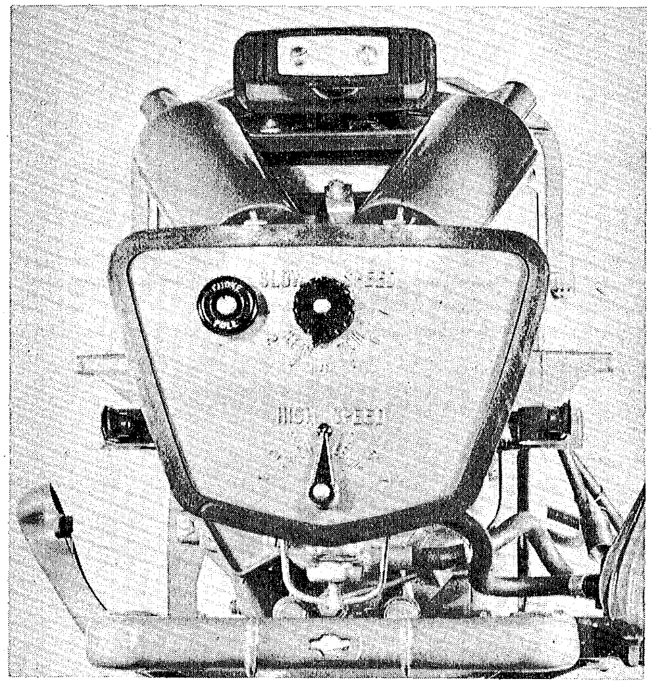
The cylinder head is a bit different in design though merely to support the "lift-off" cover, otherwise other details are alike.

The crankshaft-driveshaft "coupling" has been changed from the involute spline to a four fluted coupling to hold up better.

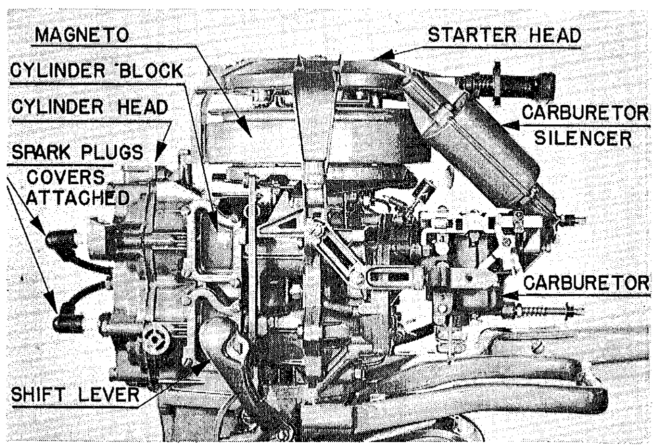
The familiar "O" ring on the top journal bearing cage has been deleted in favor of an oil return to the intake manifold where overflow (oil) "mixes" with fuel vapor from the carburetor and is subsequently returned to the crankcase chambers.

The automatic intake valves are now "side by side"—horizontally on the same plane whereas in design of earlier vintage the installation arrangement was staggered (one set of valves slightly above the other).

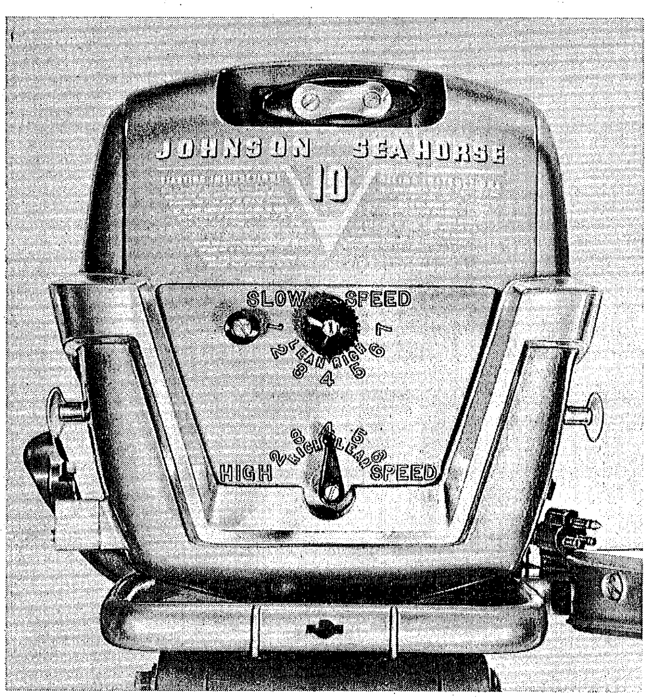
Service operations—treatment of the connecting rod—piston and ring assembly, crankshaft (bearings and seals), the cylinder block, cylinder head and gasket installation and automatic induction valve set-up are identical with those performed on QD Models, see pages 247 to 256 inclusive.



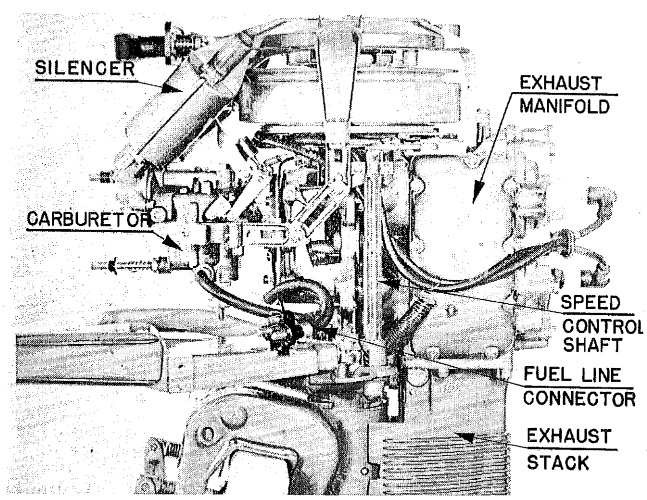
Front View of the Powerhead with "Lift-Off" Covers Removed.



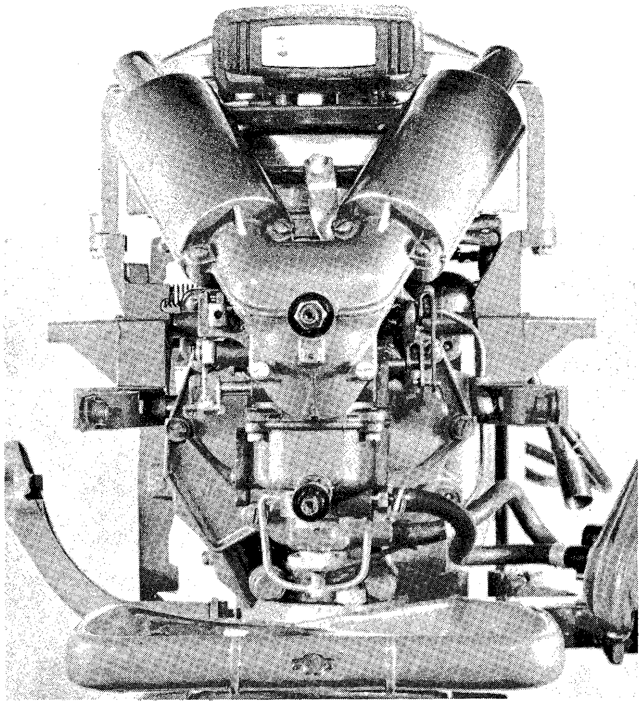
Starboard Side Powerhead Assembly.



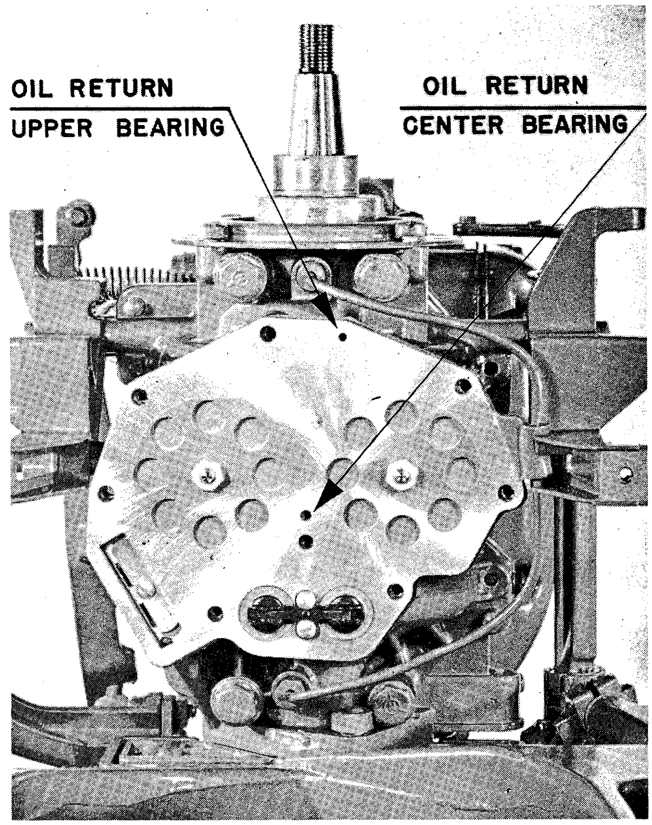
Front View of QD-15 Powerhead.



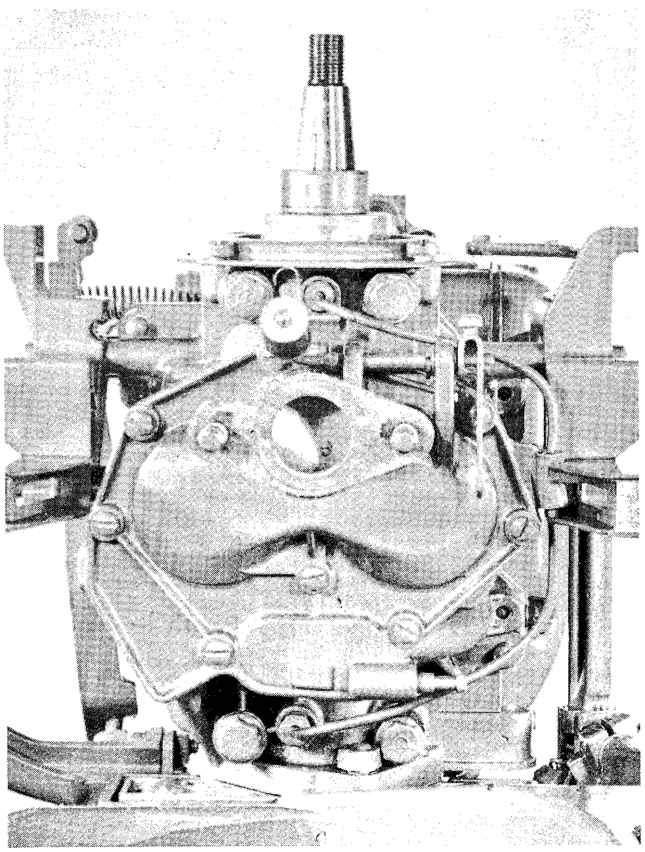
Powerhead Assembly Port Side.



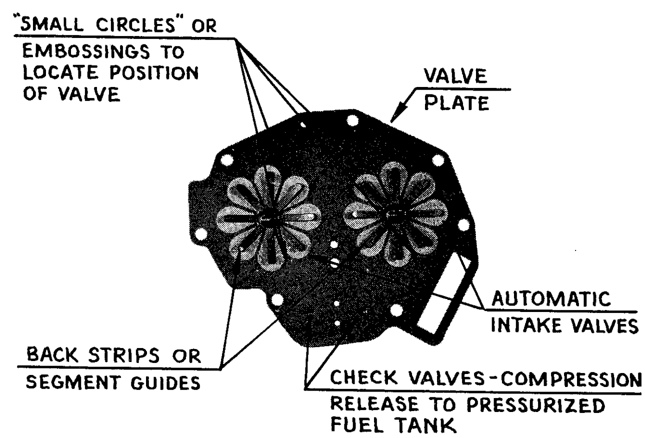
Front View of Powerhead with Carburetor Control Panel Removed to Expose the Carburetor and Silencer.



Showing Magneto, Carburetor Silencer, Carburetor and Intake Manifold Removed to Expose the Automatic Valve Plate, Bleeder and Pressure Check Valves.



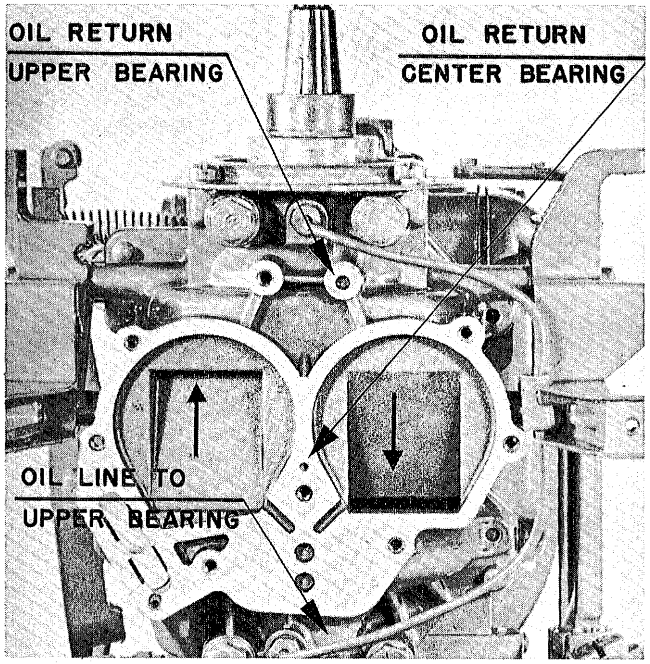
Front View of Powerhead with Starter, Magneto (see Instructions Under Universal Magneto of Preceding Pages), Silencer, and Carburetor Removed to Expose the Intake Manifold.



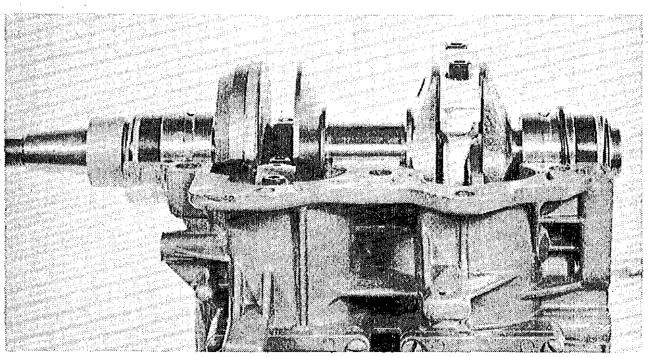
Back view of valve plate assembly showing installation of the automatic intake valve and back strip or segment guides and check valves employed to control compression release from the crankcase to pressurize the fuel tank. When required to replace the automatic valve because of a broken segment or for other reasons which may affect motor performance, it is advisable to install a new back strip (segment guide). Make certain locating surfaces are clean and free of burrs. "Cocking" or misalignment of the back strip for any reason will result in continued breaking of valve segments.

Note small ink spot on one of the valve segments – install with ink spot *out* as shown above to insure proper seating. Note also small "circles" on the valve plate – one for each valve. Prior to drawing the assembly together, space adjacent segments equidistant from "circle" as shown here to achieve full coverage and seating over corresponding ports (holes) in the valve plate.

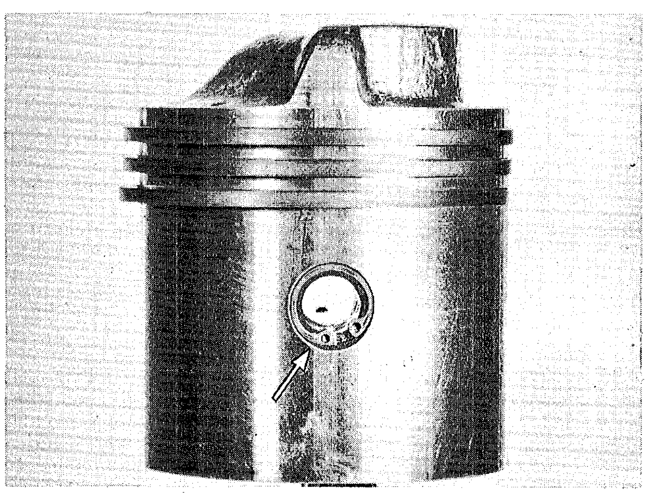
See pages 248 to 250, inclusive.



Front View of Powerhead Showing Starter, Magneto, Silencer, Carburetor Manifold and Valve Plate Removed to Expose Fuel Vapor Channels Leading to Top and Bottom Crankcase Chambers.

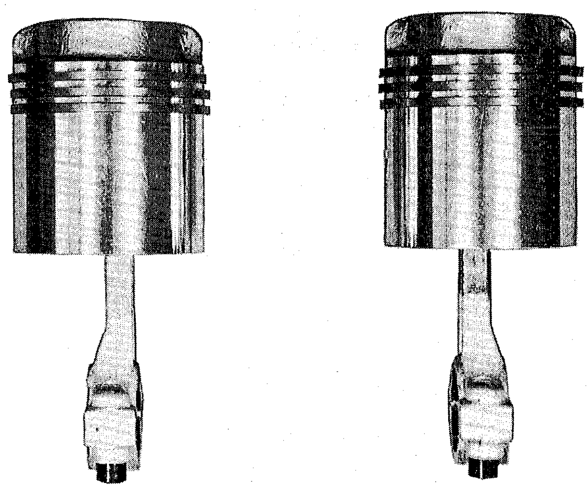


Showing the Crankcase Removed to Expose the Crankshaft and Crank Pin Ends of the Connecting Rods. See Pages 251 to 255, inclusive, for Treatment of Connecting Rod, Piston and Crankshaft Assemblies.



Showing Wrist Pin Retainer Installed to Retain Position of the Wrist Pin which "Floats" in Both the Piston and Connecting Rod.

Removing the Wrist Pin Retainer with Tru-Arc Pliers.

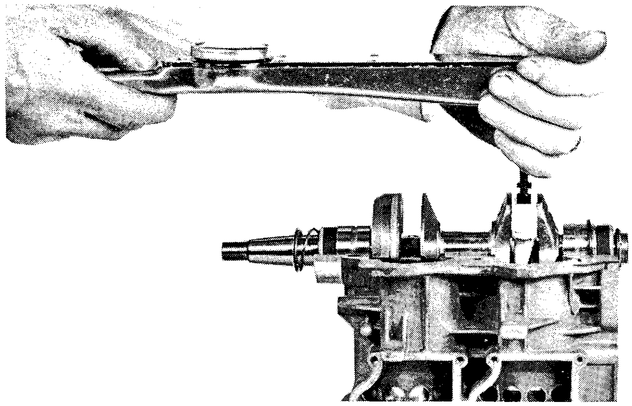


Illustrating proper assembly of connecting rods. Note straight side of rods face each other to facilitate attaching to crankpins. Pistons must be correctly installed on connecting rods to permit assembling accordingly—straight side of piston deflectors should align on same side.

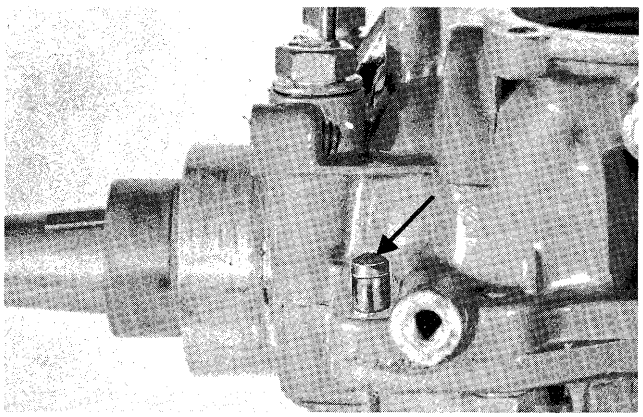
Commencing with the Model QD-14A, a change was made in the connecting rods and pistons to accommodate full floating wrist pins—floating in the connecting rod bushing and in wrist pin bosses of the piston. Resultant modification subsequently required some change in both the rod and piston. Wrist pin bosses (piston) were lengthened to gain increased bearing surface with the wrist pin end of the rod made narrower to maintain original overall dimension.

SHOP CLEANLINESS — ORDERLINESS

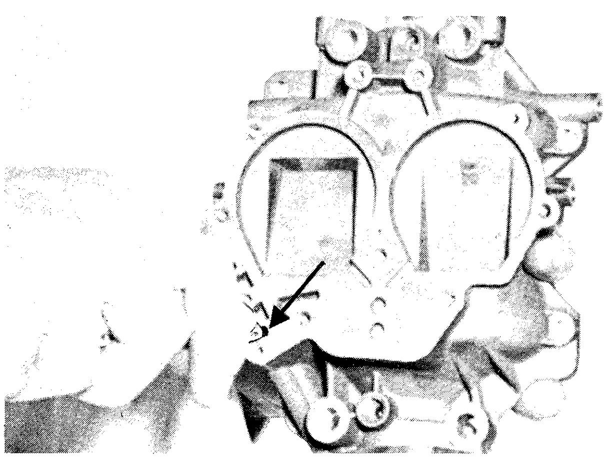
A clean, orderly shop pays dividends — it makes an impression on the customer and good impressions on his part, which are frequently related to others by word of mouth, are indirectly profitable to operator. The customer expects his motor to be repaired with the same careful degree of "exactness" exhibited in a well arranged and orderly shop — shop conditions generally convey (to the customer) expressions of the shop keeper.



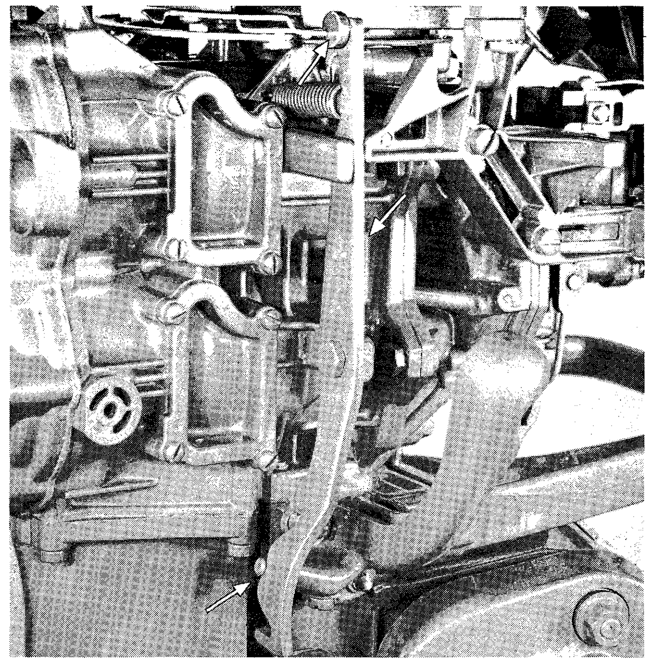
"Torquing" the Connecting Rod Screws, see Torque Chart, page 362.



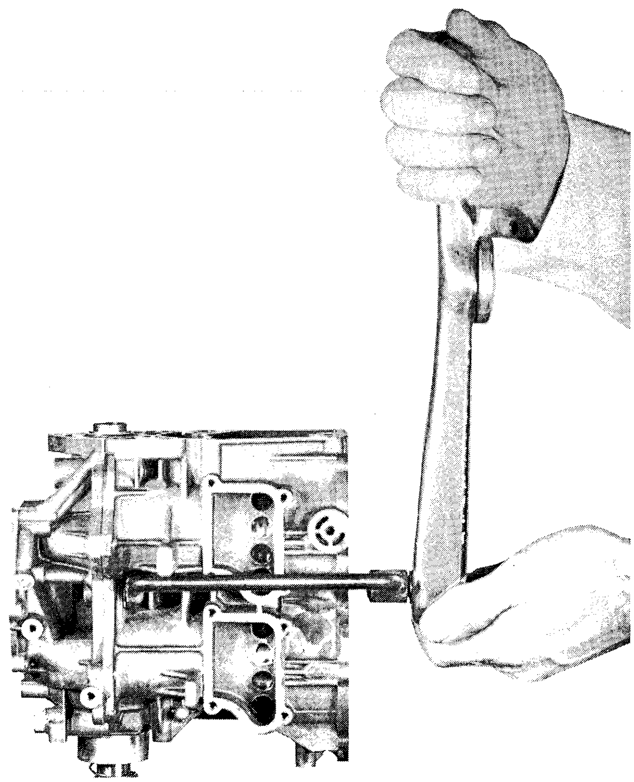
Showing Location of the Tapered (Dowel) Pin Employed to Achieve Correct Alignment of the Crankcase Sections—Two are Used. When Assembling, Make Certain Dowel Pin Holes in the Crankcase Sections are Scrupulously Clean, and Free of Burrs—Clean with Small Round Brush (Like an Electric Shaver Brush). Check Surfaces of Tapered Pins for Nicks, Burrs or Foreign Matter, Paint, Dry Cement, etc. Unless the Crankcase Holes are Clean, Free of Burrs, Paint or Dry Cement and/or the Pins are Similarly Clean and Smooth, the Crankcase Sections can be Thrown Off (Out of Line) when Driving the Pins "Home," Causing Mis-Alignment of the Crankshaft Journal Bearings and Resultant Faulty Operation for no Apparent Reason.



As a Precautionary Measure and Prior to Installing the Crankcase, Remove the Crankcase Bleeder Valve to Gain Access to the Bleeder Orifices—Blow Out with High Pressure Air Line to Avoid Possibility of Clogging Later on.

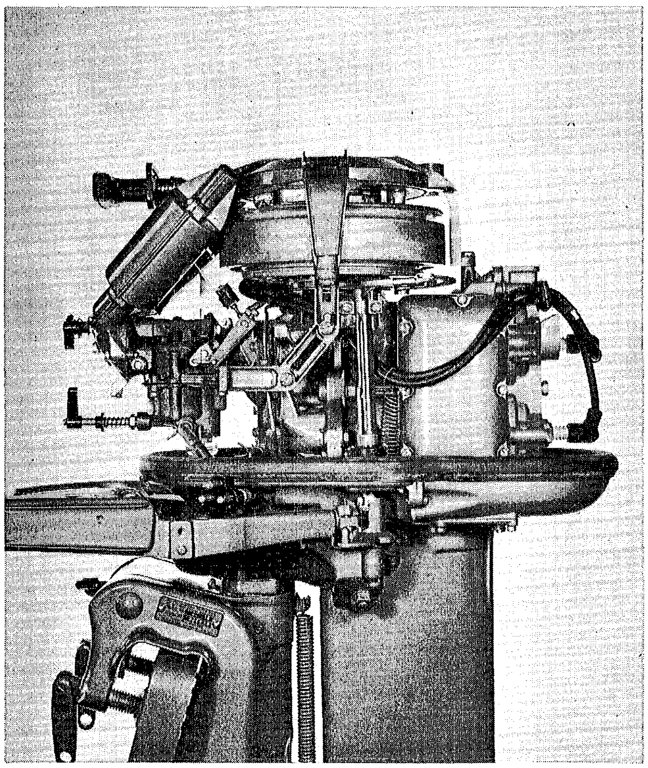


Powerhead Showing Location of the Shift Lever and Corresponding Speed Limit Control Mechanism — Top Idling or Neutral Running and Top Speed or Limit of Synchro-Control Advance.

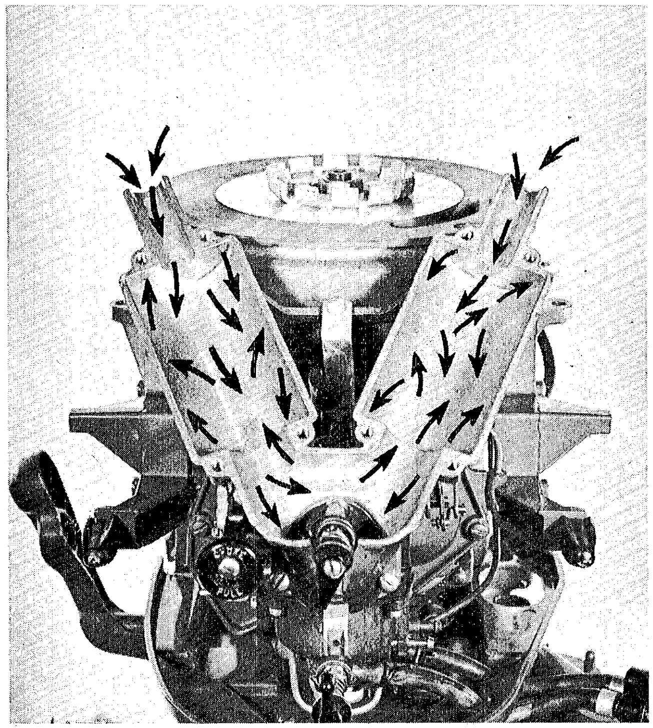


Make Sure Crankcase Faces Have Been Made Clean and Free of Traces of "Old" Cement. This is Important since "Piling" One Coating of Cement on Top of the Other Affects Journal Bearing (Center) Clearance and Seating of the Top and Bottom Journal Bearing Cages. Apply Coat of Sealer 1000 or Similar Hard Drying Cement on Crankcase Face (Cylinder Block). Spread Evenly with Small Stiff Brush. Attach the Crankcase Immediately (the Cement is Known to Dry Rapidly). Torque Crankcase Screws at 5 to 7 Foot Pounds — Nuts at 10 to 12 Foot Pounds.

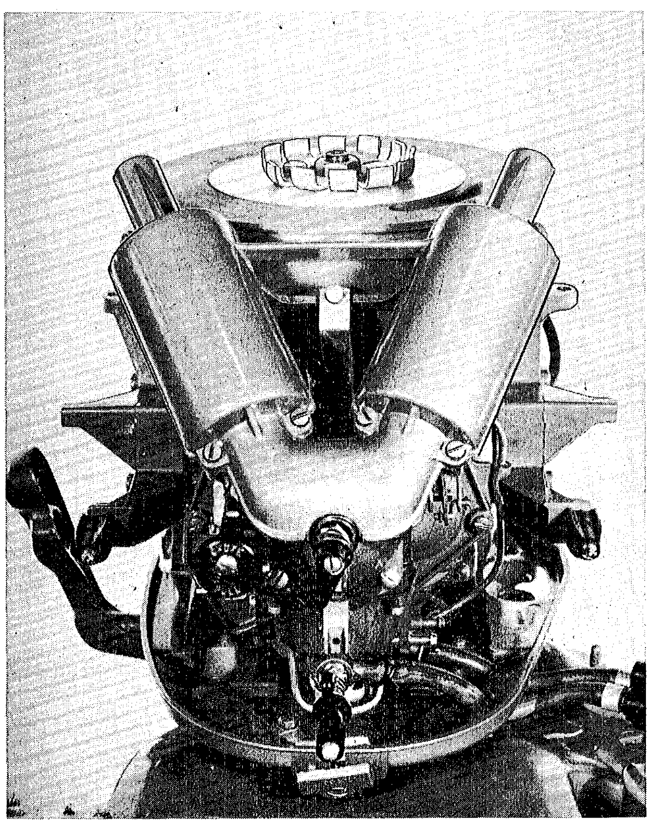
MODEL QD-16 POWERHEAD



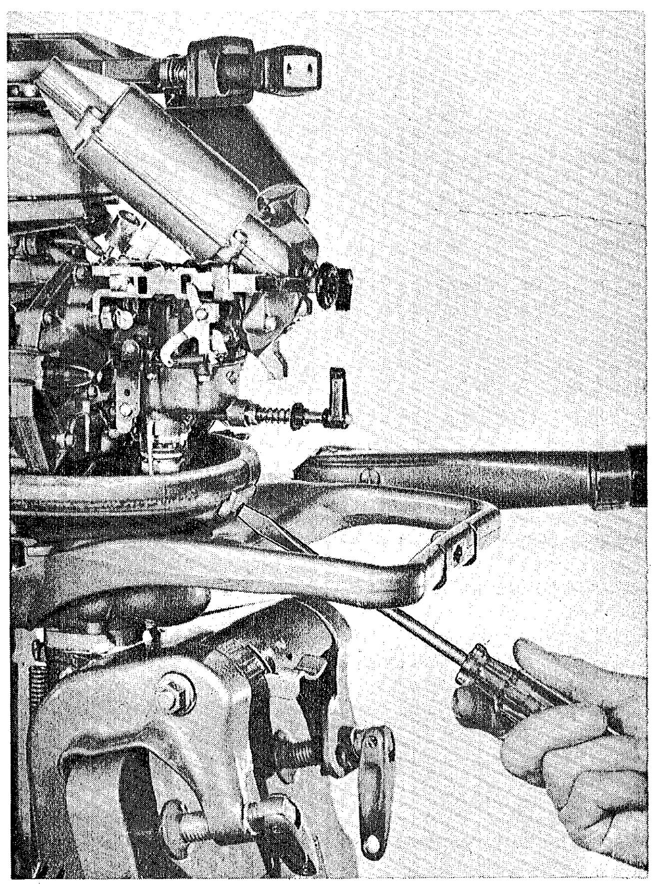
Since construction details of the Model QD-16 powerhead are basically like that of preceding models, refer to pages 247 to 256, inclusive and 257 through 263 for instructions pertaining to service procedure.



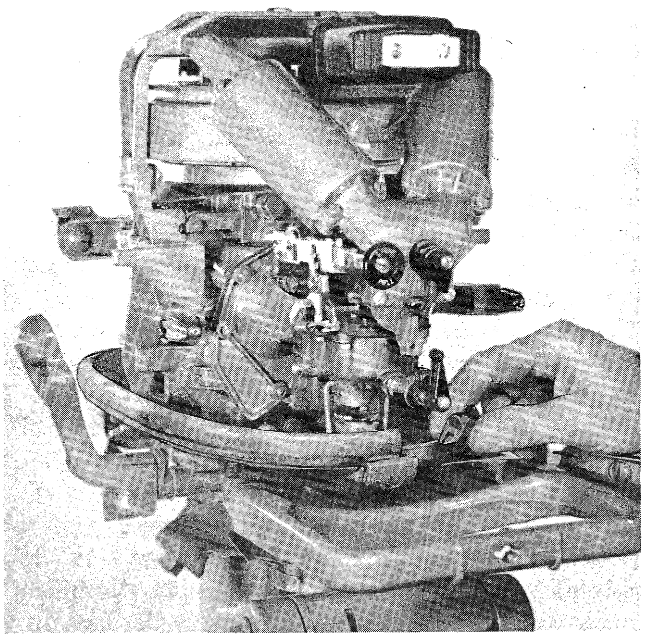
Carburetor silencer with top half removed.



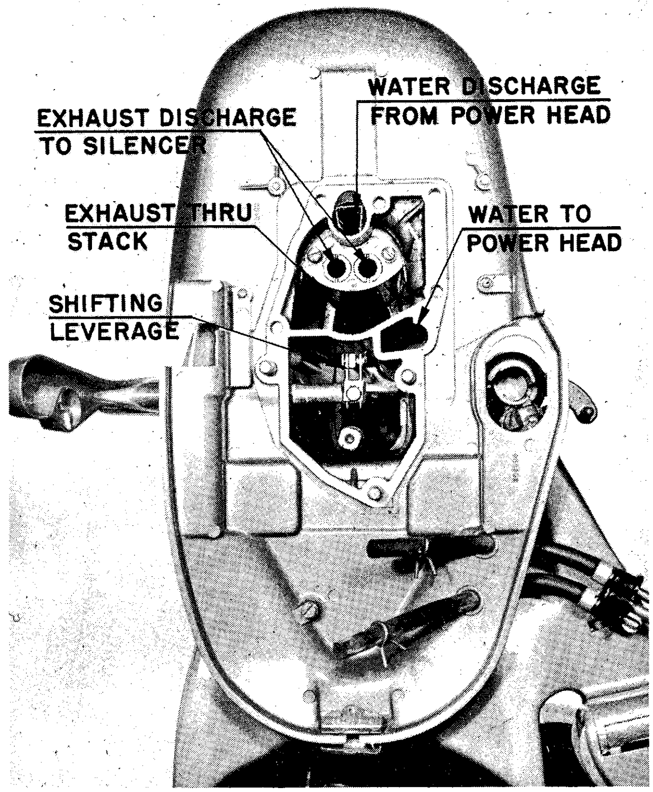
Front view of the QD-16 powerhead showing installation of the carburetor air silencer.



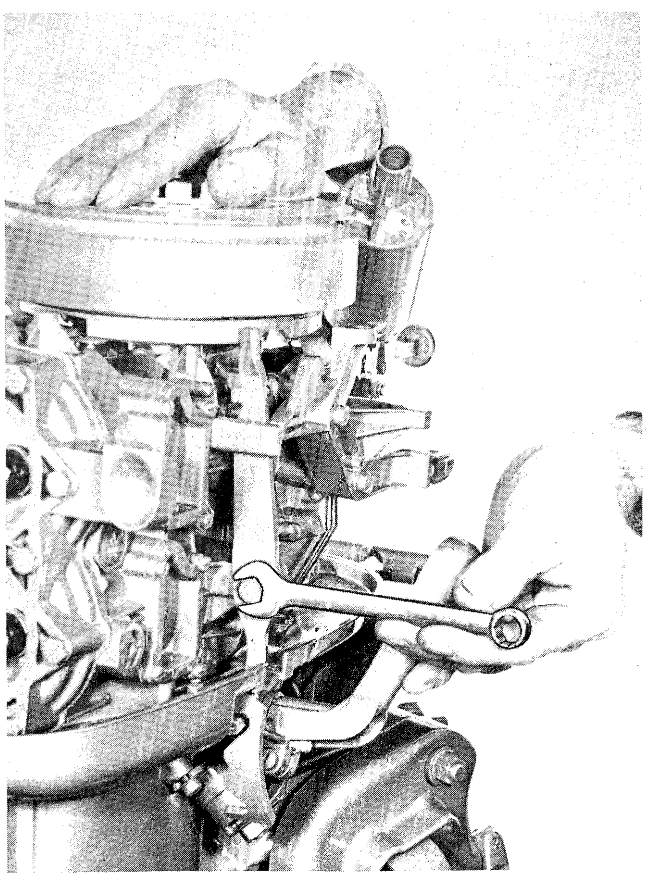
Releasing motor cover grommet.



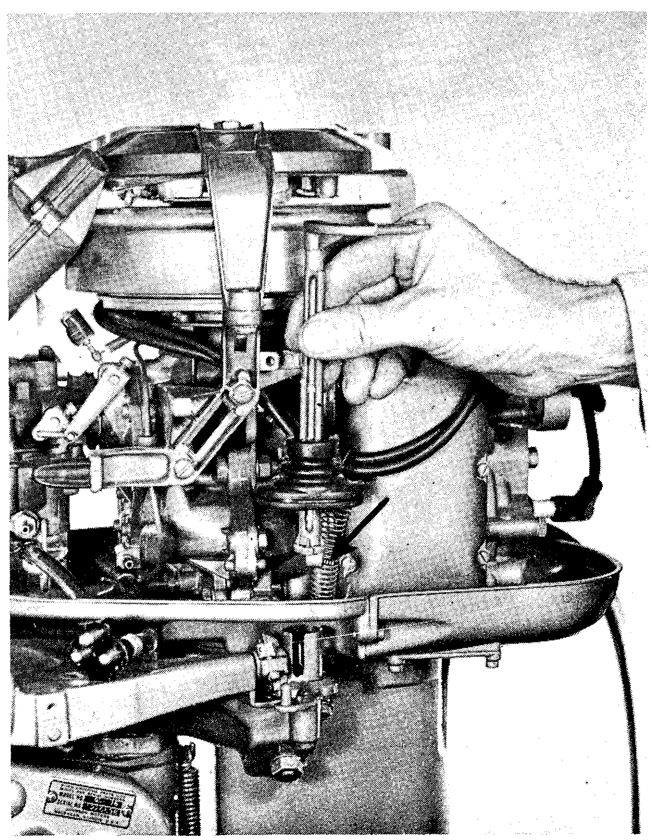
Removing or replacing the motor cover grommet—to assist in the installation, coat cover "pan" edges lightly with oil or liquid soap.



Powerhead detached from the lower unit—top view.



To finally accomplish removal of the powerhead, the speed limiting lever must be detached.

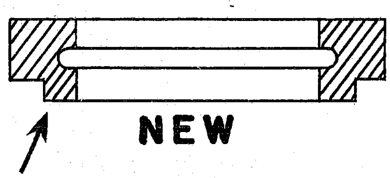


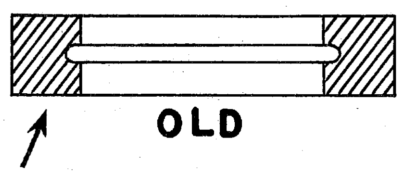
When replacing the speed control shaft, make sure the small spring shown above is in position.

NO. 302036 CARBON SEAL— CRANKSHAFT (TOP) — MODEL QD

No. 302036 carbon seal for the top end of the Model QD crankshaft has been changed some in design — this to facilitate a better oil seal at the top face of bearing No. 302499, the purpose of which is to minimize possibility of oil laden crankcase vapor escaping and eventually accumulating on the breaker point contact faces to interfere with magneto performance.

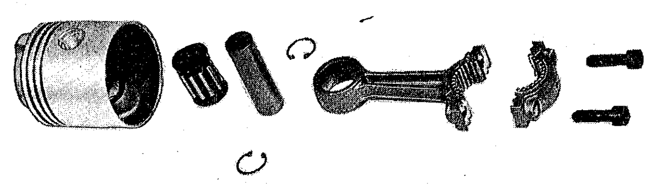
Above change has consisted of machining a narrow face on the lower side of the seal where it "rides" on the top face of the bearing; the original seal was cut "straight across" to leave a much wider seal face, which doesn't "seal" as well as the narrower face.





IMPORTANT — It is ***important*** that WHENEVER THE FLYWHEEL is removed or on other occasions when presented, the old seal be removed and one of the new design be installed as a safeguard against "oily" points and resultant faulty motor operation. Install with notches UP. Install also a NEW No. 301967 "O" ring.

The same seal (No. 302036), incidentally, is used on the bottom end of the crankshaft, too.



Showing improved QD Piston, Rod and Wrist Pin – with Wrist Pin Needle Bearing.

Commencing with Model QD-22 a change was made in the connecting rods and pistons to accommodate the use of needle bearings for the wrist pin. This was done to eliminate any possibility of failure due to wrist pins loosening, particularly in heavy duty application.

Changes were accordingly made to pistons, connecting rods and wrist pins as a result of having changed to wrist pin needle bearings on Model QD-22. The improved parts can be serviced in all 10 h.p. engines back through the Model QD-10 series.

NOTE – That because all QD engines prior to QD-22 originally used wrist pin bushings – all the new parts must be installed in making the initial change-over – to the wrist pin needle bearing.

Thereafter, any one of the new parts may be installed as required.

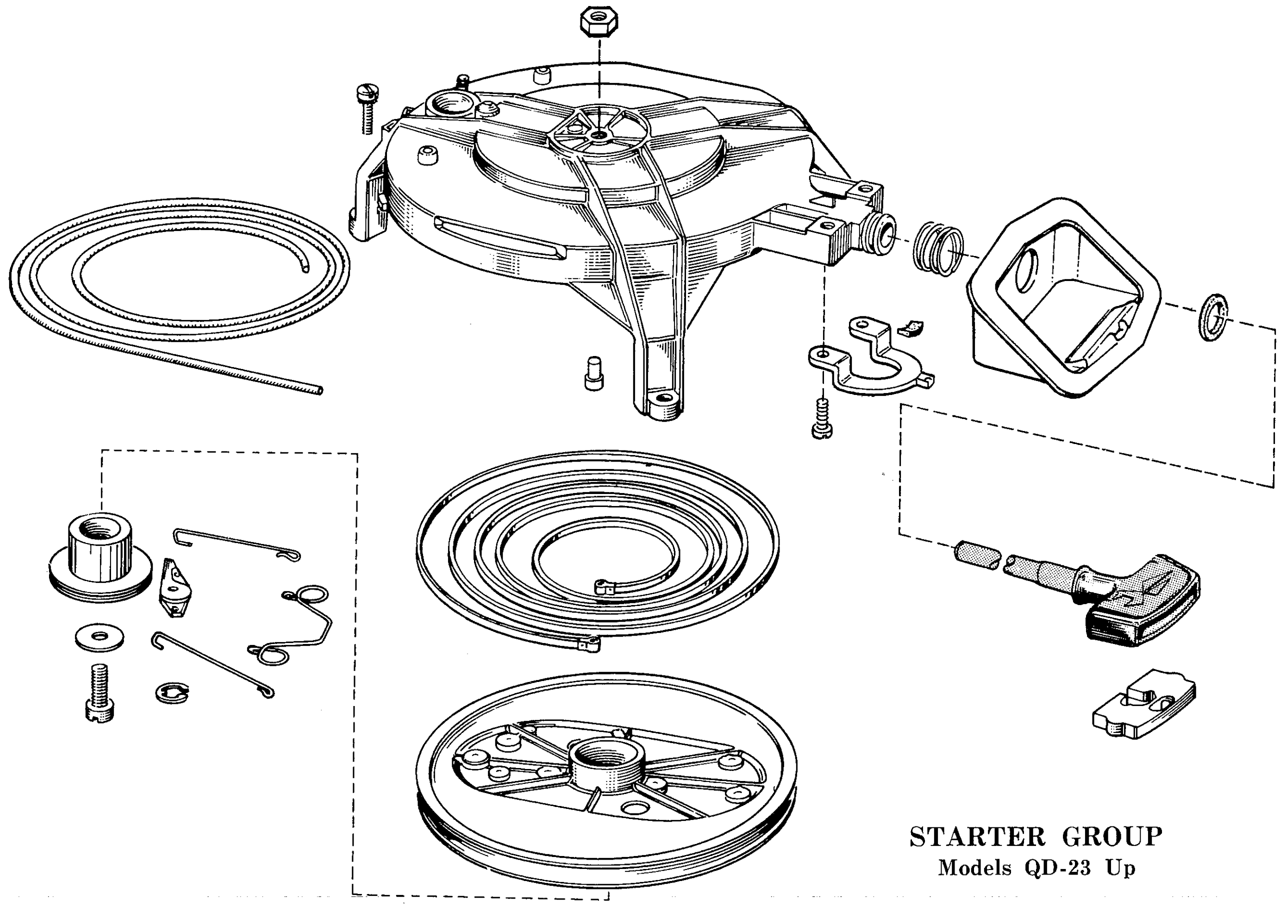
The detail parts involved in the initial change-over are:

2	302577	Lock Ring
1	307849	Wrist Pin
1	378251	Needle Bearing
1	378285	Piston
1	378330	Connecting Rod
1	378416	Piston Ring Set

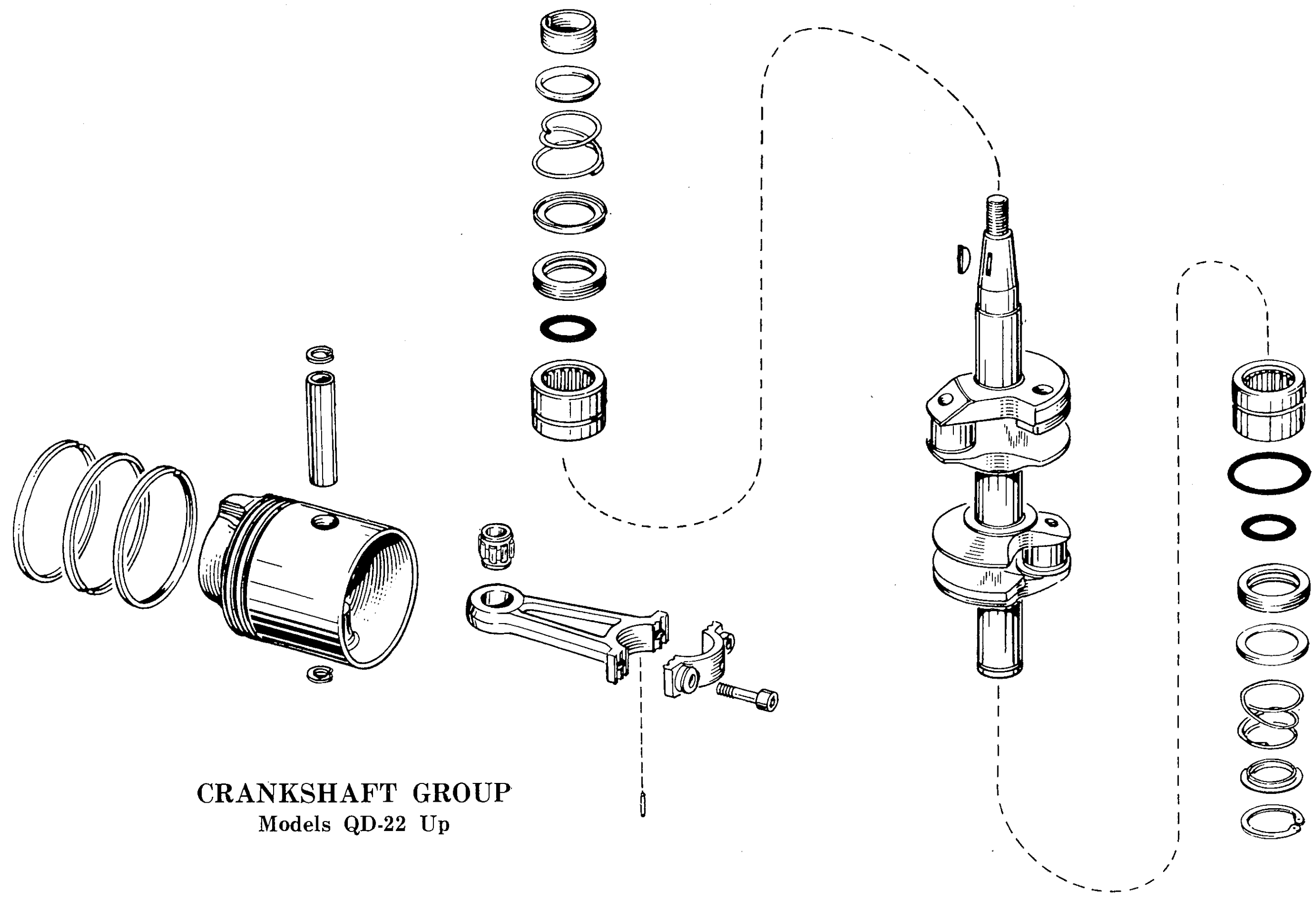
In the event an oversize piston is required, use either of the following:

.020″ O.S. – 378372 – Piston
.040″ O.S. – 378373 – Piston

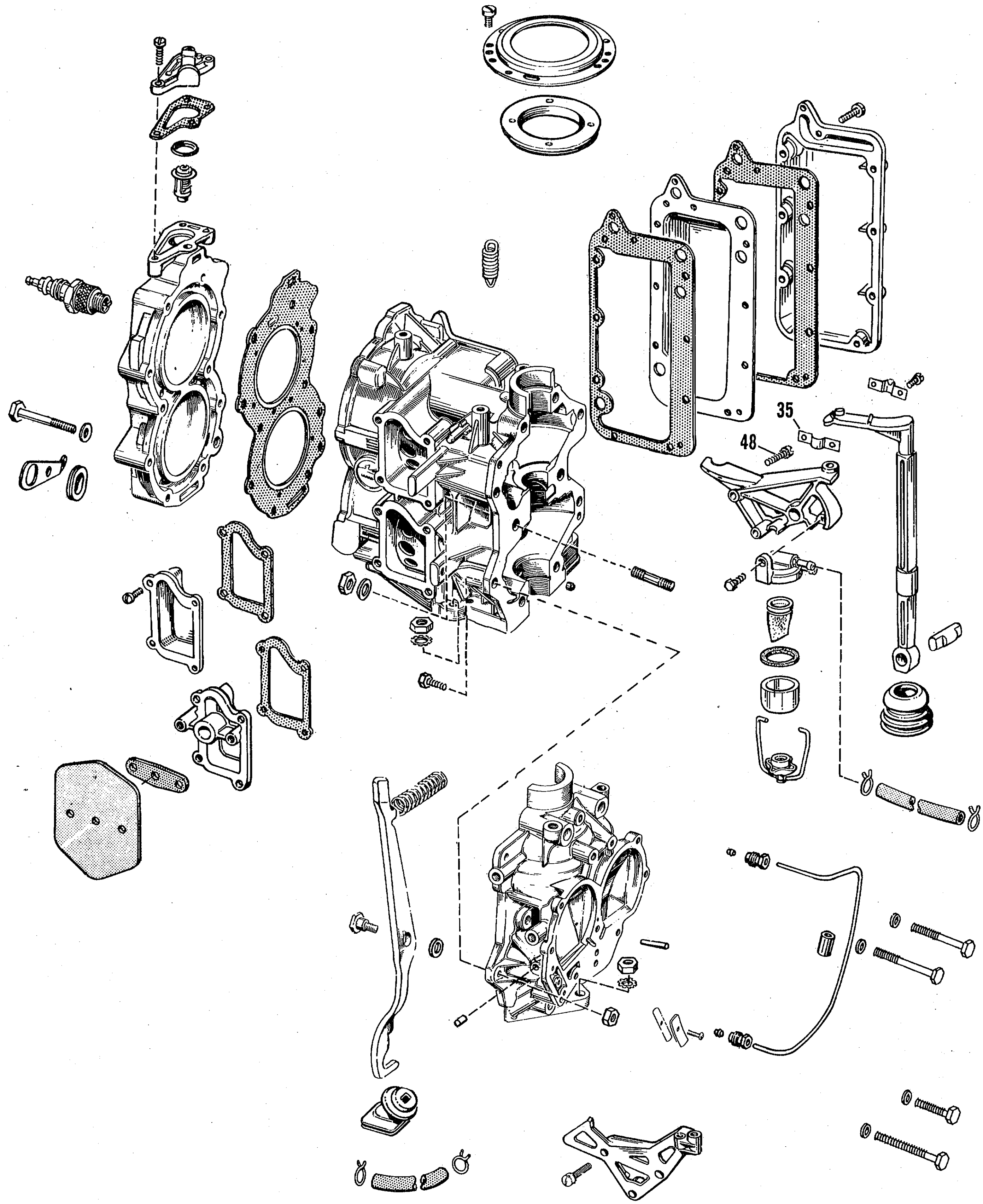
in place of Standard Piston 378285.



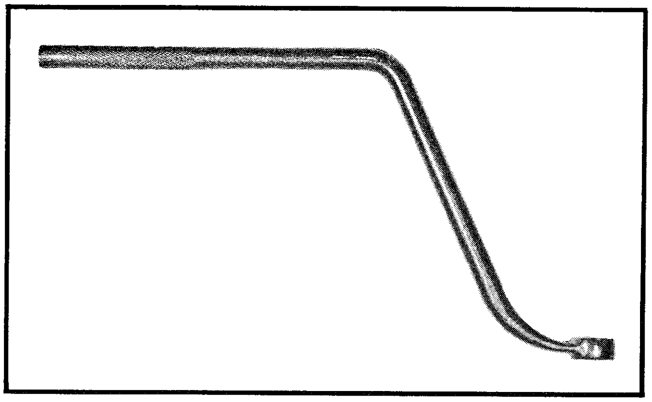
STARTER GROUP
Models QD-23 Up



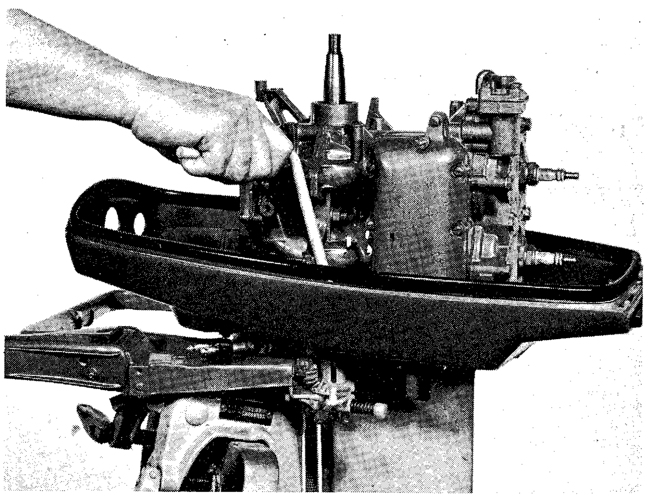
CRANKSHAFT GROUP
Models QD-22 Up



POWERHEAD GROUP
Models QD-23 Up



Illustrating 1/2″ Box End Wrench used for QD Powerhead Removal.



Removing QD Powerhead using 1/2″ Box End Wrench – a necessity for easy access to Powerhead Take Down Nuts.

Removing the powerhead from Models QD-20 up can be quite a chore because the three (3) powerhead take-down nuts . . . one on each side and one in front below the carburetor . . . are inaccessible with ordinary wrenches. The special offset 1/2″ box end wrench facilitates removal of the QD Powerhead. It is a very efficient and time-saving tool for this operation.

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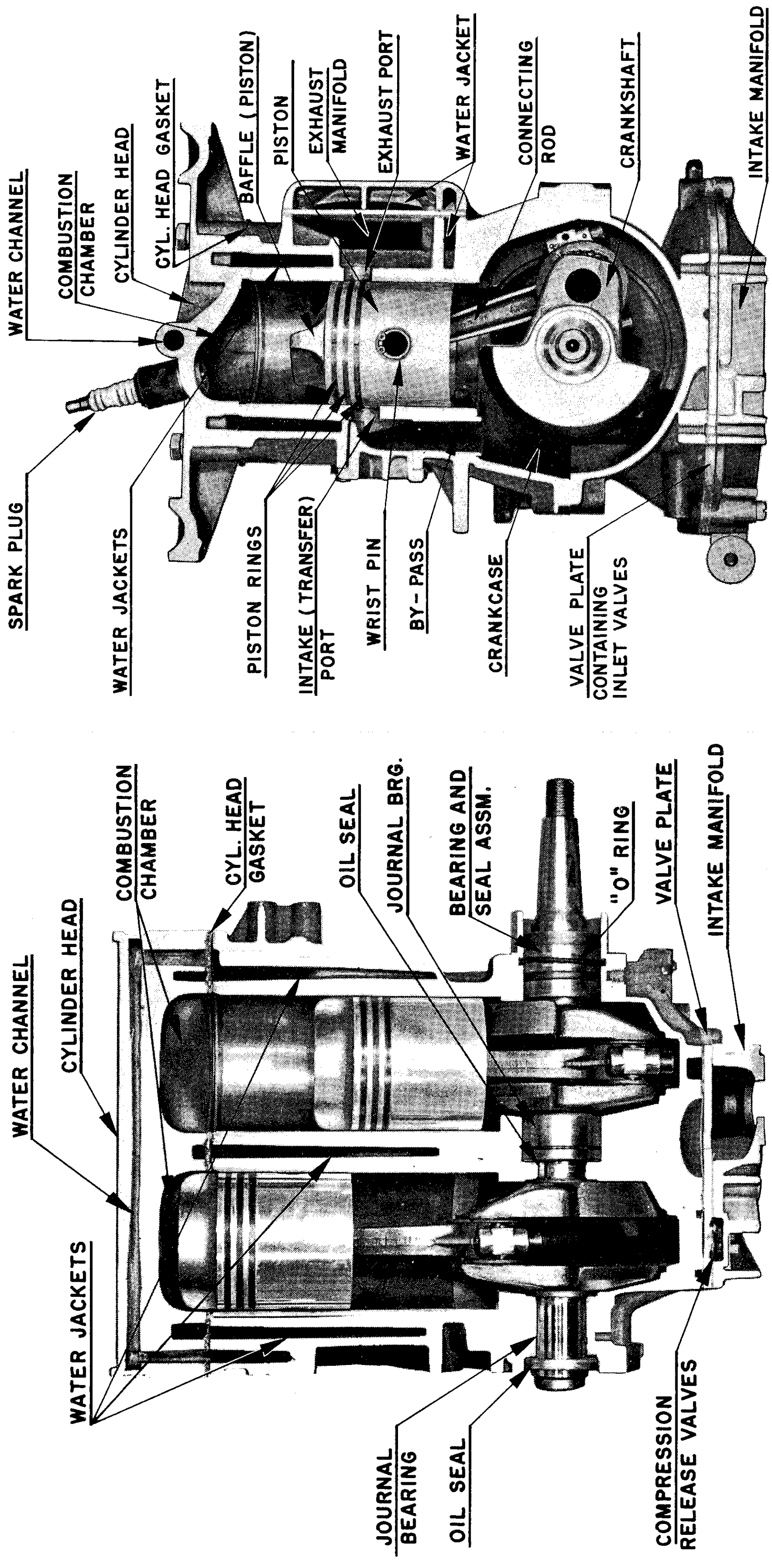
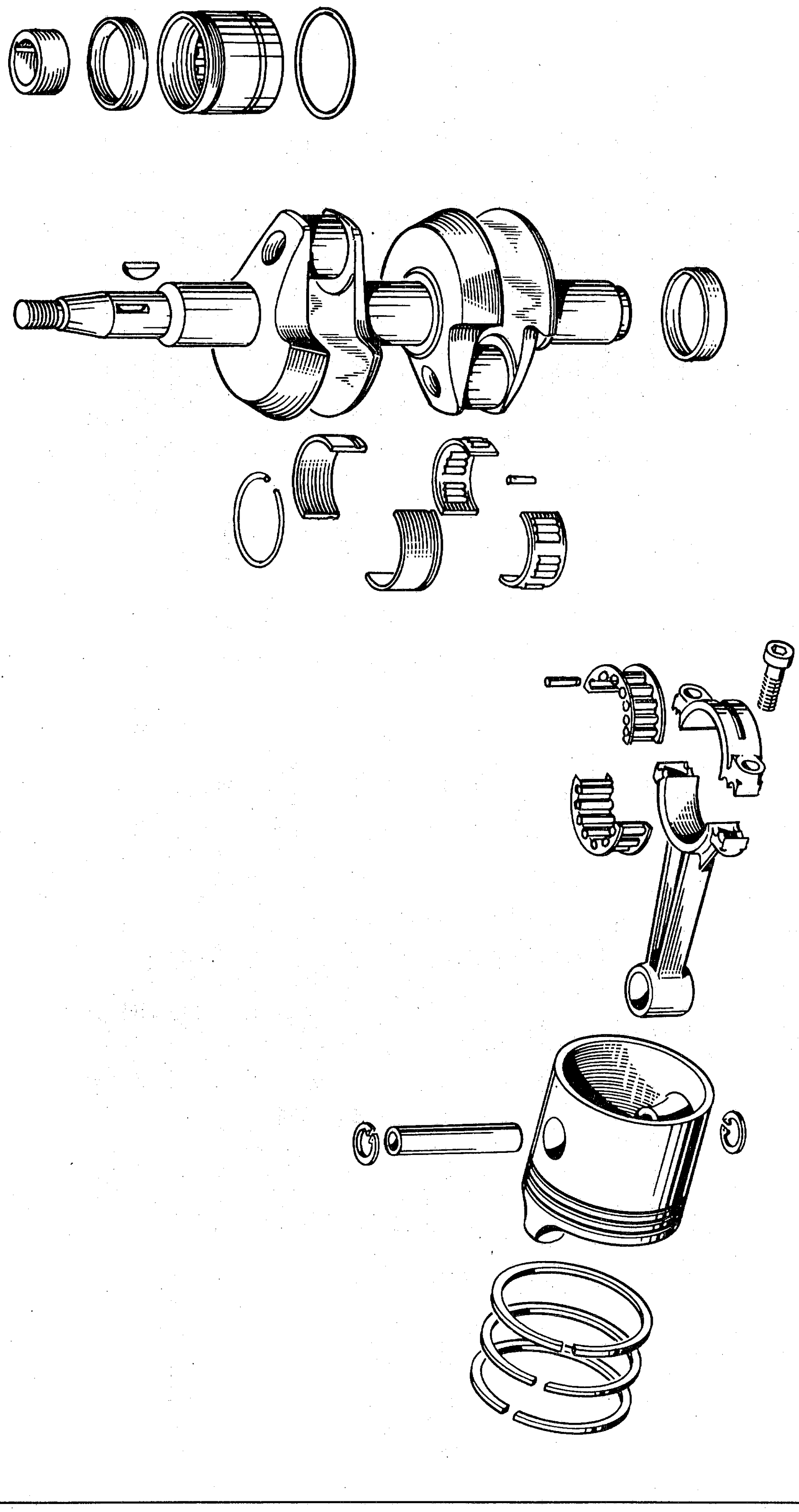
NOTES

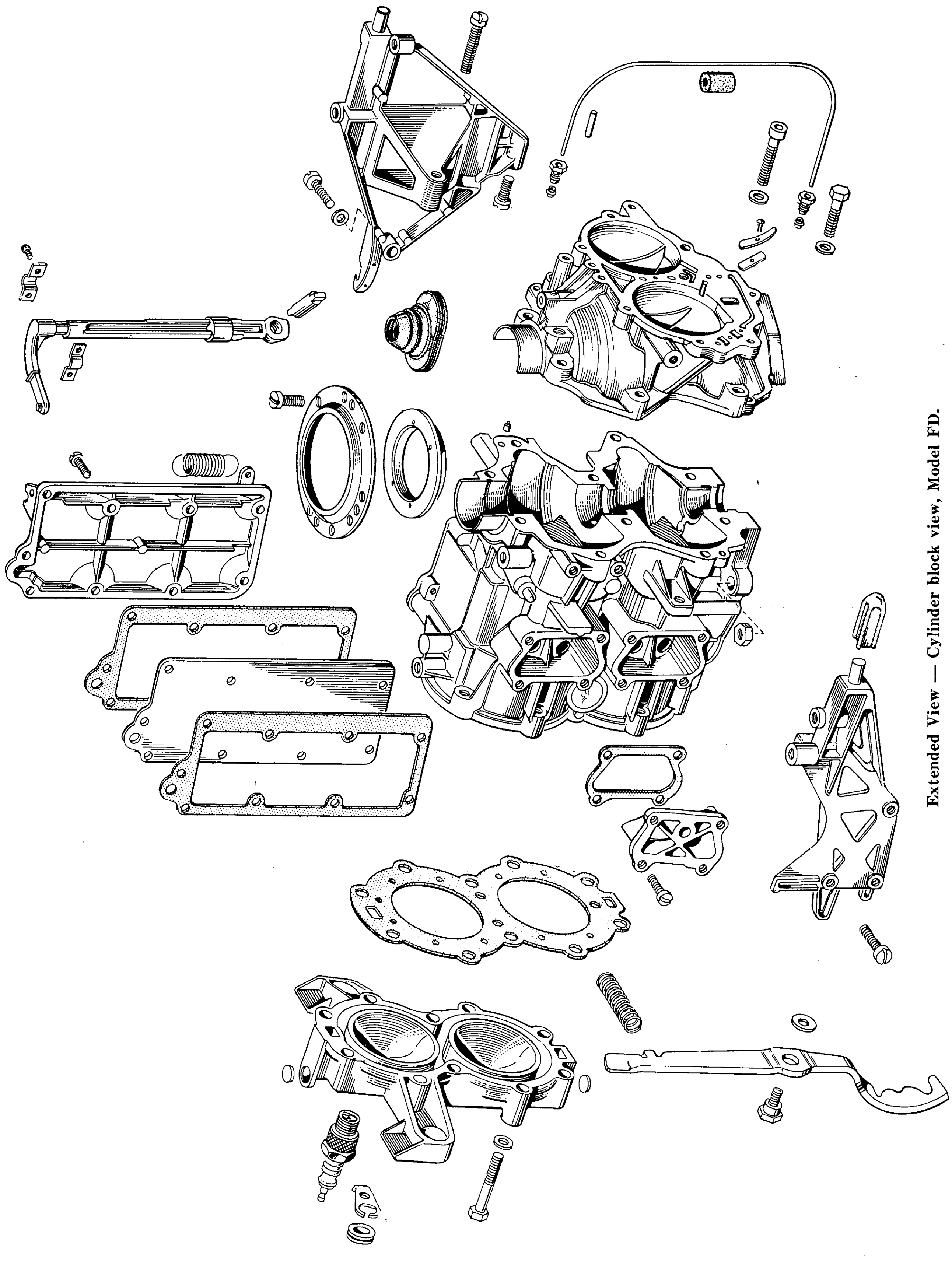
NOTES



Sectional views — Powerhead Model FD



Extended View – Crankshaft, Piston and Connecting Rod Group, Model FD-10.



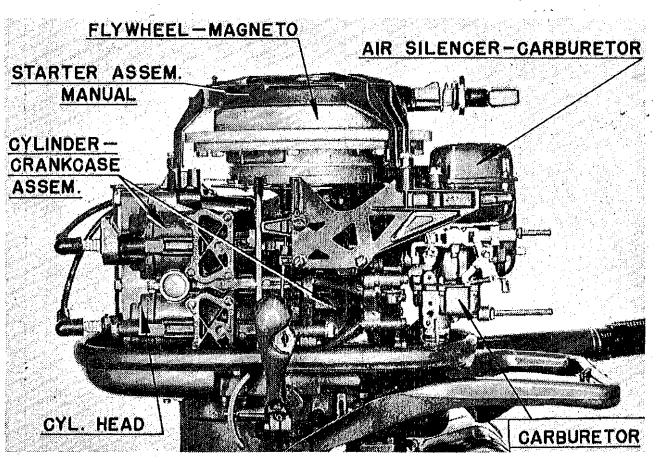
Extended View — Cylinder block view, Model FD.

NOTES

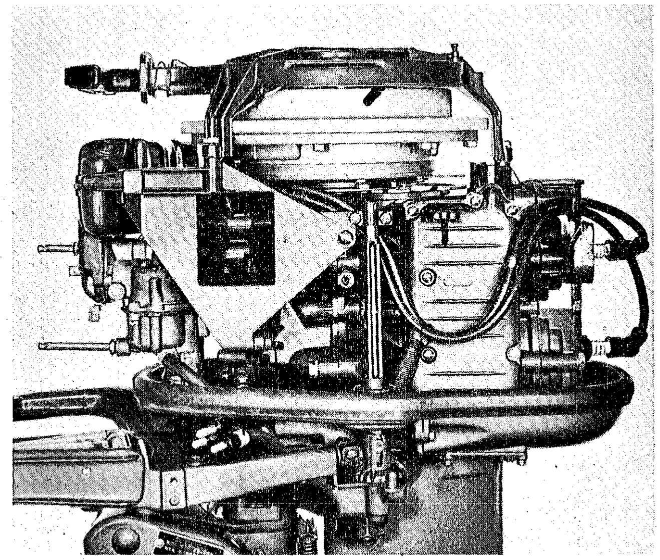
MODEL FD POWERHEAD

All work performed should of course be done in clean surroundings — clean and orderly bench top, clean tools and with clean hands — free of grit, "grime" or other foreign substance, which if permitted to adhere to highly machined surfaces (cylinder and piston walls, bearing surfaces, etc.) causes scoring, injury to bearings and contributes otherwise to faulty motor operation as well as premature wear.

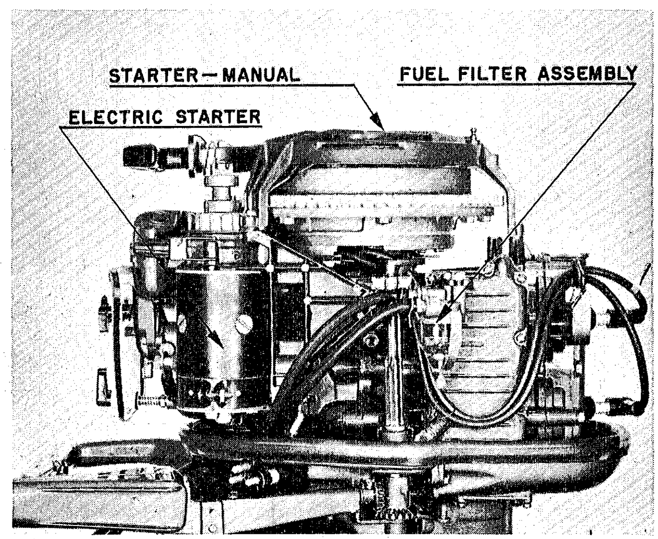
The following illustrations with corresponding comment will serve as a guide to assembly and disassembly. For diagnosis of performance irregularities, refer to pages 348 through 362 and to check charts on pages 351 (magneto), 353 (carburetor), 354 (pressurized fuel tank) and 356 (powerhead).



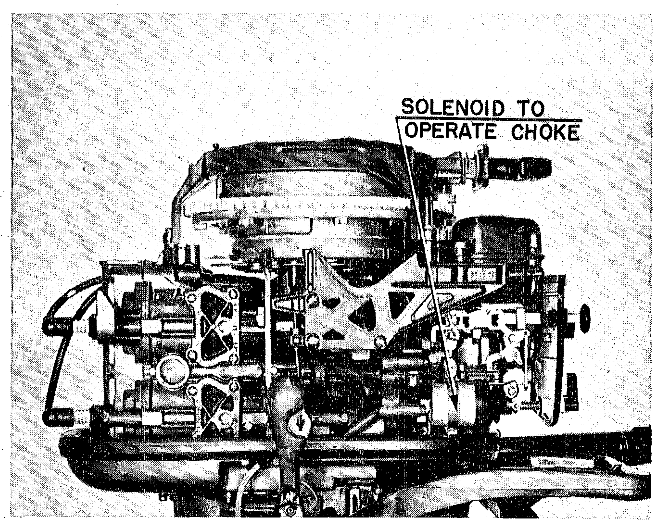
Powerhead — Star side — Model FD



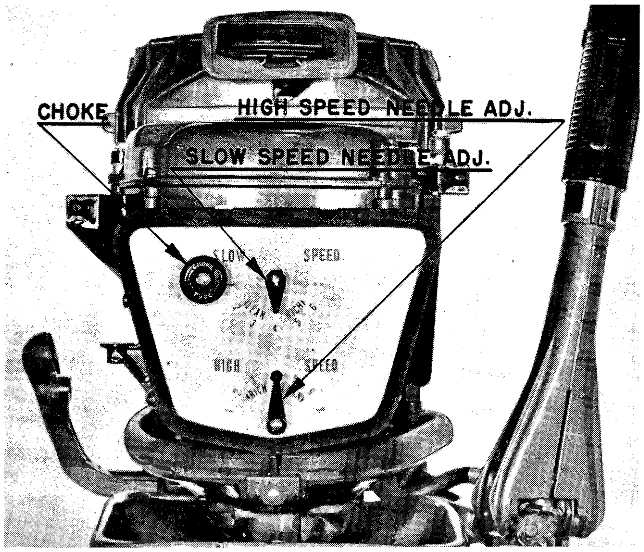
Exposing port view of the Powerhead.



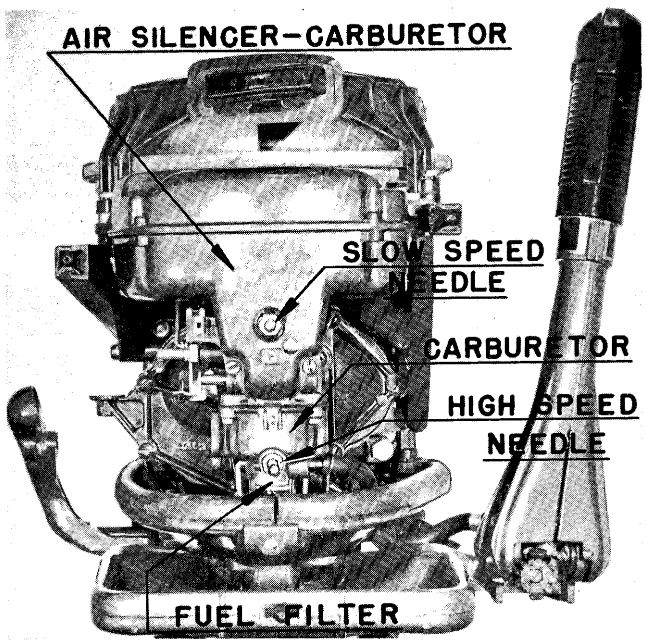
Powerhead – Model FDE – Electric starting – port side. See pages 492 through 498 and 543 through 548.



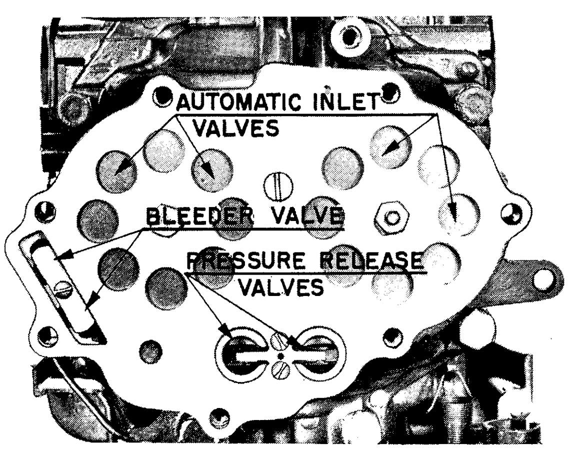
Model FDE Powerhead, exposing star view and showing position of the solenoid which permits remote control of the choke.



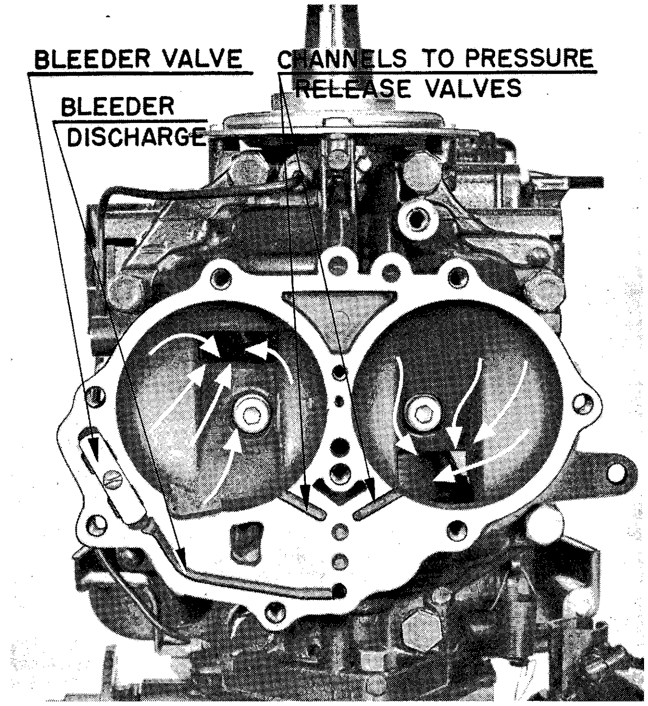
Front view of the Powerhead showing the carburetor panel control.



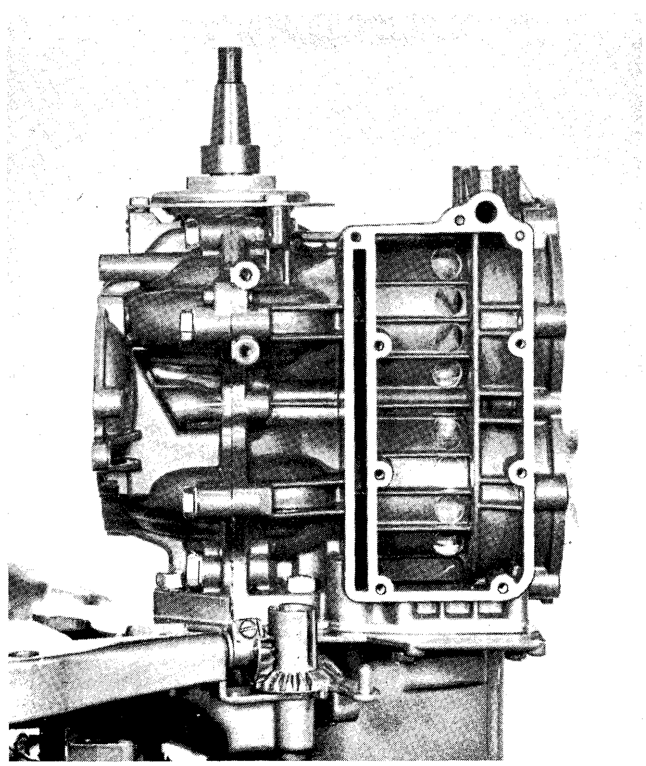
Front view — panel removed to expose the air silencer, carburetor and fuel filter.



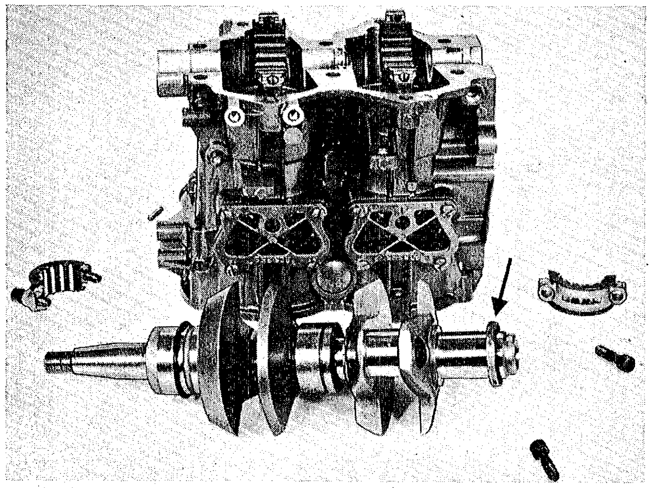
Carburetor and intake manifold removed to expose the valve plate containing the automatic intake and compression release valves.



Showing valve plate removed to expose fuel vapor to upper and lower crankcase chambers, channels directed to the compression release valve (see page 147), the crankcase bleeder valve (see page 173) and bleeder discharge channel.

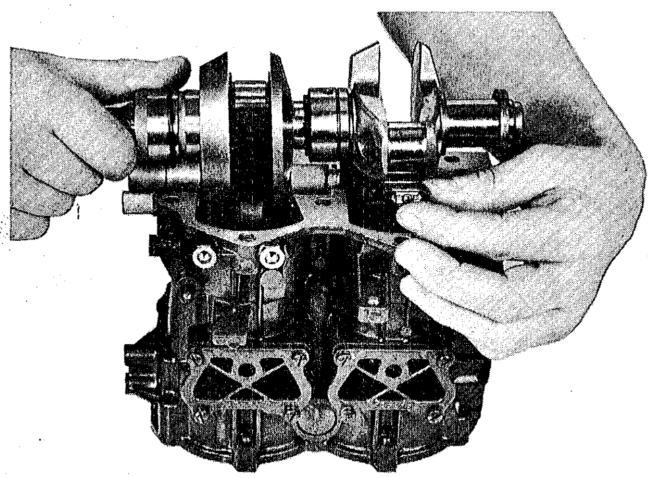


Powerhead — Port side showing the starter, magneto, carburetor, exhaust manifold and cylinder head removed; exhaust ports exposed for preliminary inspection of the piston rings, walls of the piston and cylinder bore. When reinstalling the muffler assembly, make certain gasket faces are flat and true or in no manner damaged, to permit exhaust pressure entering the cooling system to interfere with water circulation or water entering the exhaust chamber when running at slow speed — Check on lap surfaces as instructed on page 196.



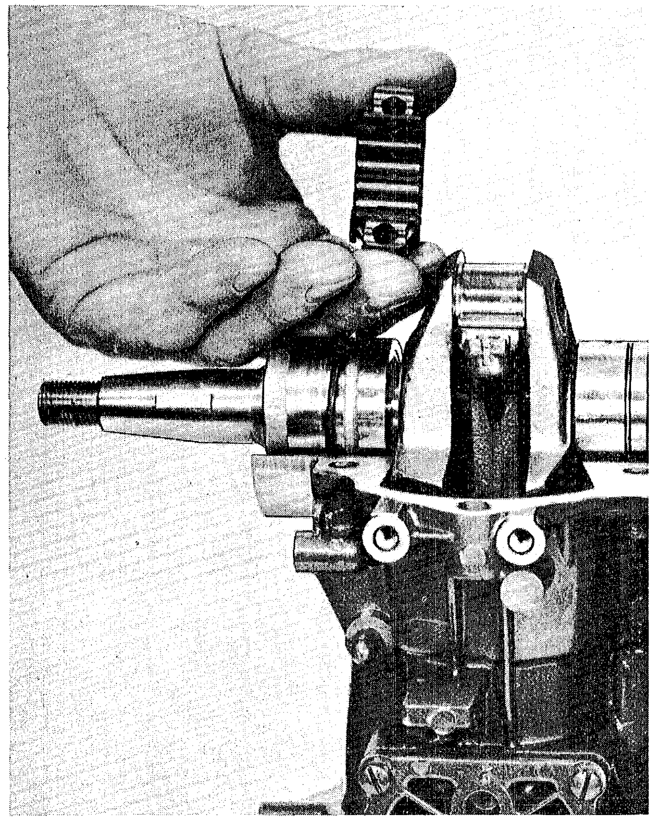
In preparation for installation of the crankshaft, care should be exercised with respect to cleanliness of all parts to be assembled; the function performed on a clean bench top and in clean surroundings with clean tools and hands. Apply oil film to all bearing surfaces to be assembled, then have everything in readiness for a good job of assembly.

Install the top and center journal bearing assemblies — oil to prevent scuffing when motor is first started after assembly. Top and center bearings are of caged steel roller type — the lower of bronze bushing type. A "lip" type oil seal is assembled into the upper bearing cage. A similar lip seal is provided the lower journal but is seated in a groove machined into the cylinder block casting and crankcase — CAUTION — Always install a new seal whenever the crankcase has been removed since the seal case is compressed somewhat on assembly of the crankcase — an "old" seal will rest loosely in its seal and thus defeat its purpose. Always install "new" seal on each occasion of crankcase removal.

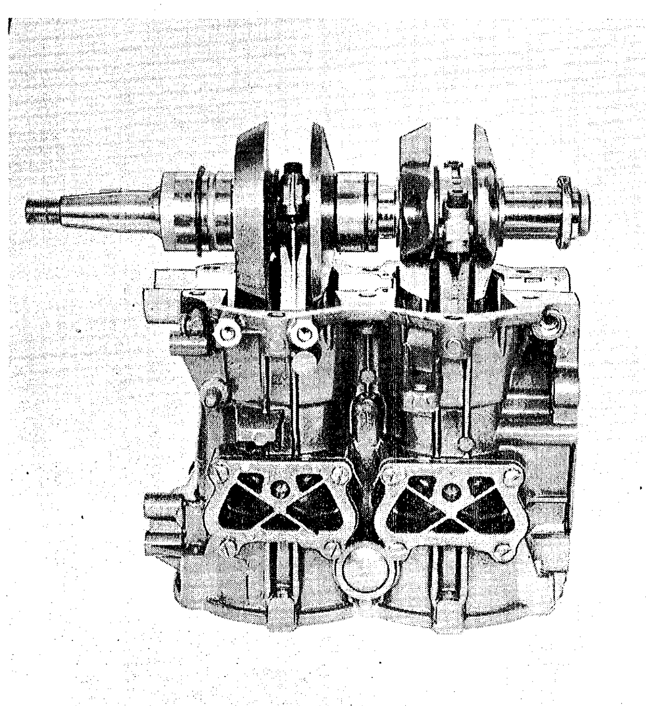


The connecting rods are of forged steel, machined and fractured to insure a "flush" fit when rod and cap are bolted together. See pages 202, 301 and 302. The rods and caps are NOT interchangeable nor may the caps be turned end for end or the rod – matched sides of the rod may be identified by small bosses on rod and cap as illustrated – extremely important on assembly. The bearing retainers similarly are matched assemblies, therefore, not interchangeable nor may they be turned end for end. Each retainer is machined and heat treated as a solid unit then "split" by sawing – see pages 301 and 302.

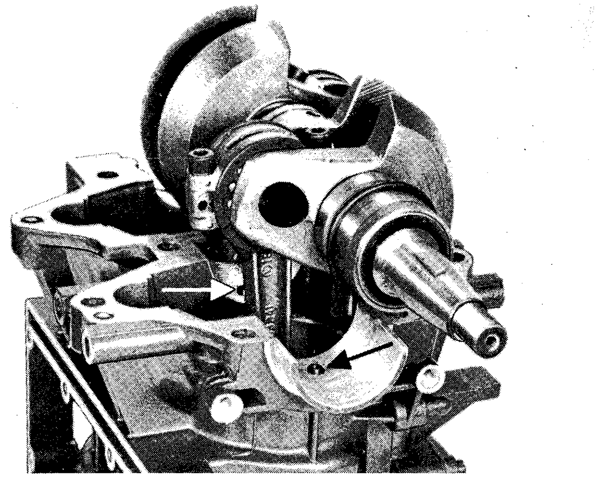
Carefully install piston and rod assemblies in their respective cylinder bores – see page 255. Spread light coat of grease (clean) or Vaseline on bearing retainers – Carefully insert rollers, then place in connecting rod – Restore to original positions. Grease will prevent rollers from becoming dislodged during the process. Place crankshaft in position, as shown above, being careful not to dislodge the rollers.



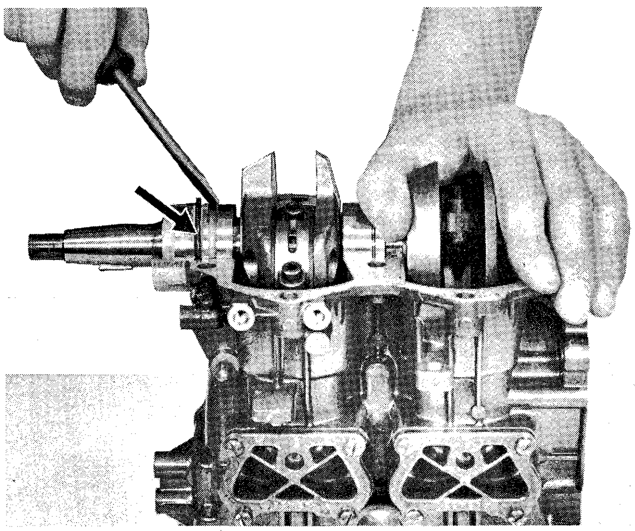
Apply coat of grease (Vaseline) to opposite half of retainer for the specific connecting rod. Place in corresponding connecting rod cap in such a manner that both the retainer and cap will "match." Align with the opposite retainer and rod when ready for assembly. Carefully insert rollers — Place cap, retainer and roller assembly in position as shown above. 15 rollers are required per each bearing assembly. Install connecting rod screws, but not tightly at this time — just enough to hold the bearing assembly together.



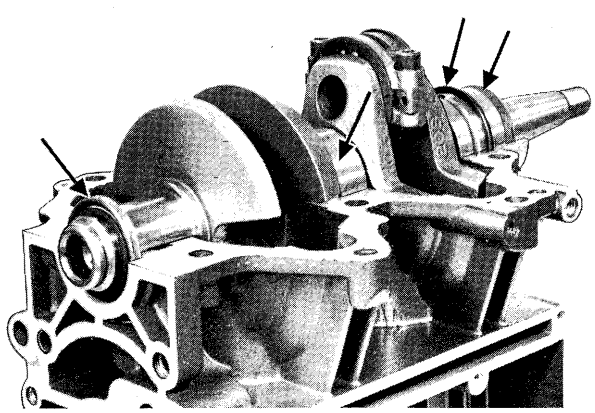
Showing connecting rods "loosely" assembled to the crank pins — Crankshaft raised slightly prior to seating in the crankcase.



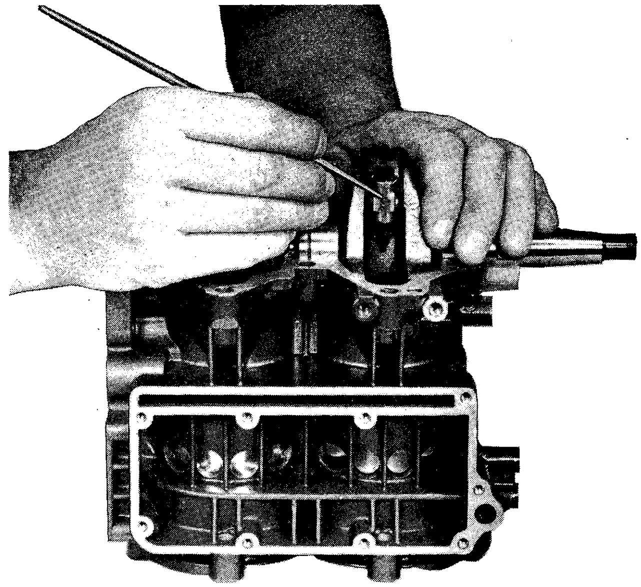
Note dowel pin protruding from bearing support area in the crankcase and a corresponding hole in the bearing assembly (upper and center bearings) the purpose of which is to properly locate each bearing in assembly.



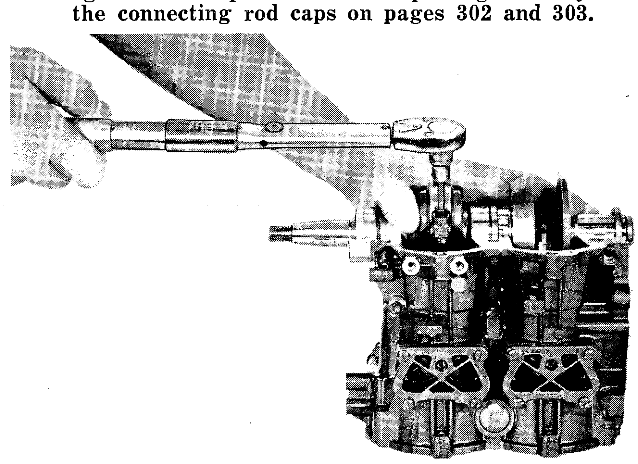
Aligning upper and center bearings with respect to dowel pin positions in the cylinder assembly. Both the "O" ring at upper end and the lip seal on the lower journal should simultaneously align to rest in the grooves provided for this purpose.



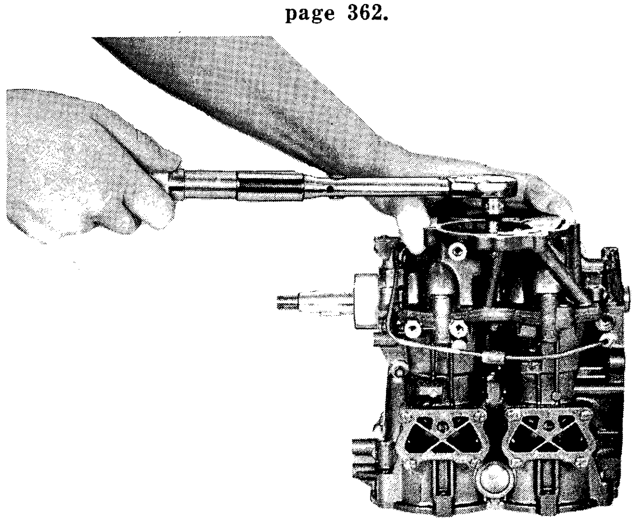
Showing crankshaft assembly properly seated in the cylinder block — "O" Ring (upper bearing), lip seal (lower journal) seated in respective grooves provided for the purpose, the upper and center bearings correctly seated in the assembly. Seating of the crankshaft should be completed prior to final seating and tightening of the connecting rod caps.



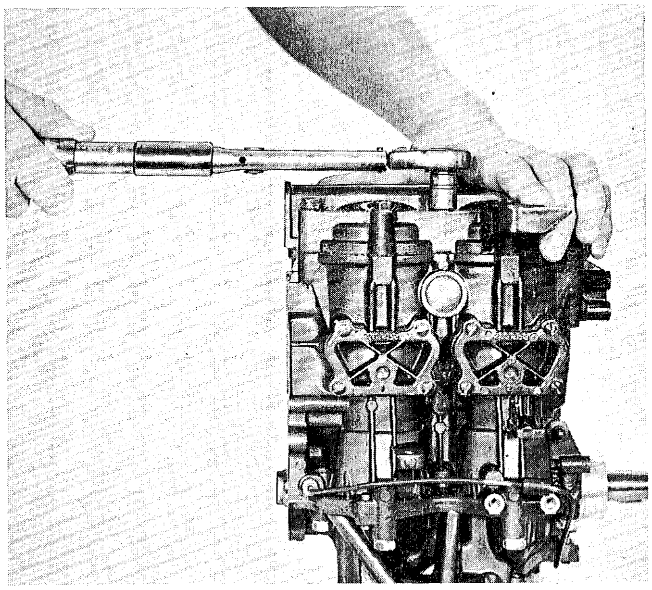
In as much as the connecting rod and cap are "split" by fracturing, the assembly is "matched" and must be reassembled in the same order. See important instructions relating to correct procedure for replacing and adjusting the connecting rod caps on pages 302 and 303.



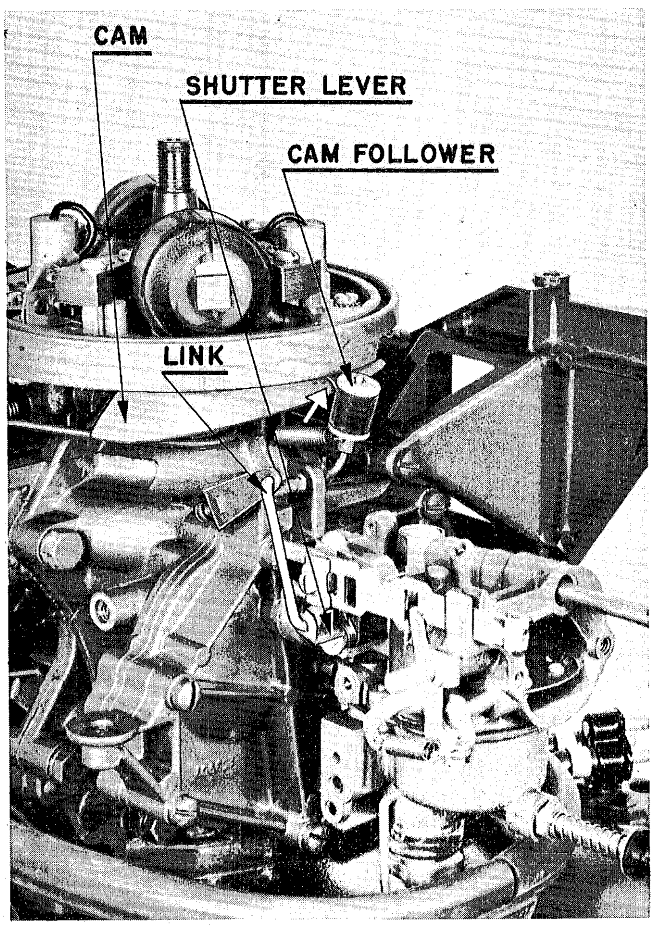
Make certain the connecting rod caps have been correctly seated and aligned, tighten connecting screws to secure — Torque to 15 to 15½ foot pounds. See Torque Chart on page 362.



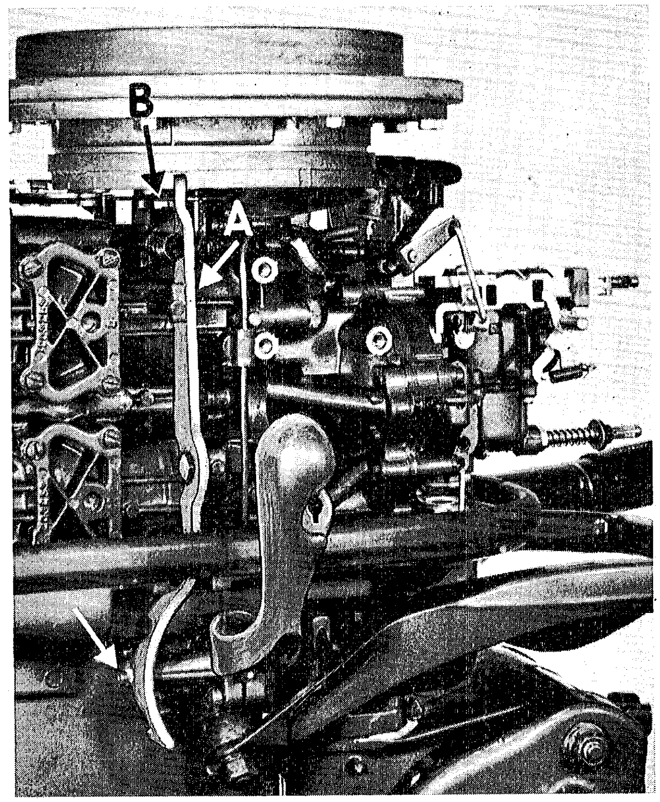
Clean, cement and align crankcase surfaces as instructed on page 232. Torque screws. See Torque Chart, page 362.



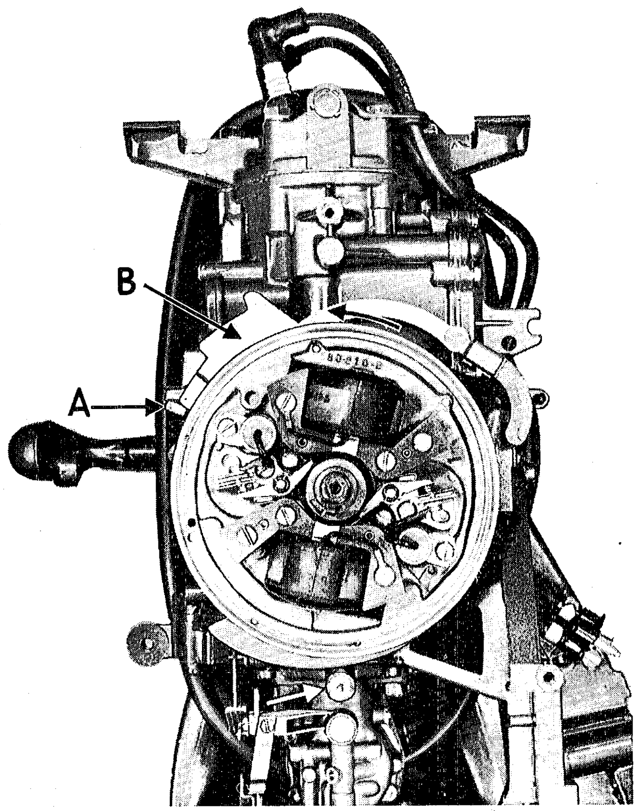
Prior to installing the cylinder head and gasket, make certain gasket faces are clean, flat and true – lap cylinder head and cylinder block faces on topping plate to insure "flatness" then rinse in solvent to remove all traces of lapping material. Install new gasket on assembly. Torque head screws. Torque Chart on page 362.



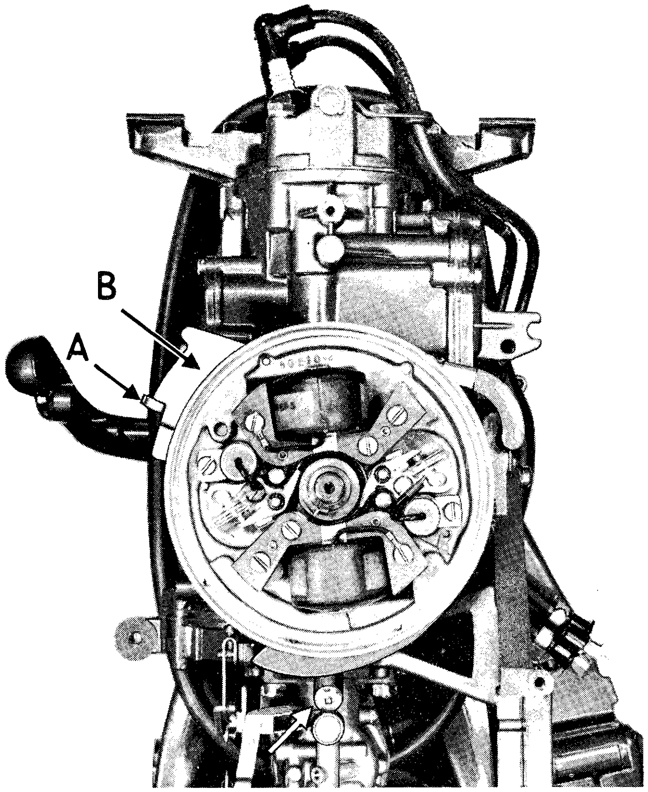
Showing synchro-control mechanism which may require some adjustment on occasion to achieve maximum in performance throughout entire speed range of the motor. Faulty operation particularly in the mid ranges may often be due to irregularity in this adjustment. Follow closely the instructions for adjusting, as directed on page 136.



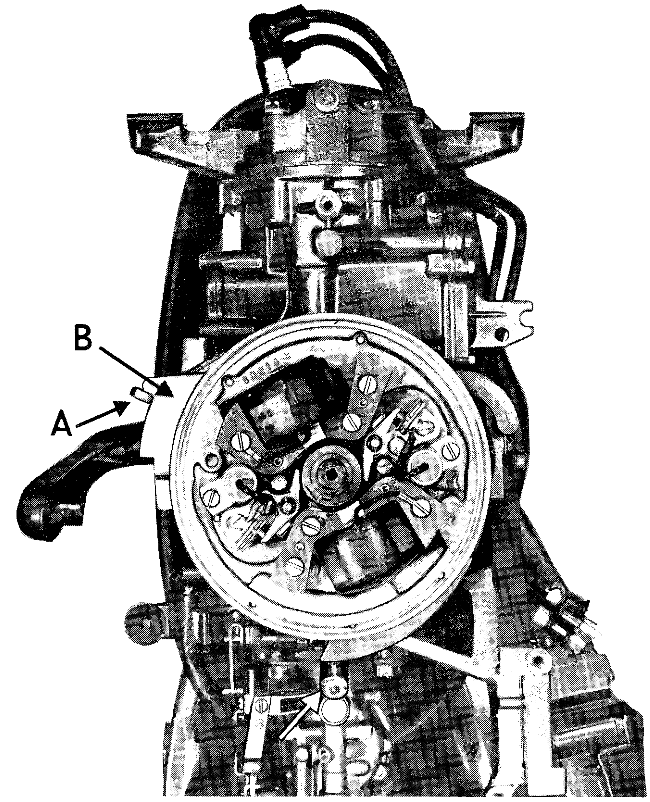
Limits are placed on RPM's to prevent excessive motor speeds when in neutral and in reverse — Accomplished by the gear shift lever acting through a cam arrangement causing lever A, above, to engage "stop" bracket B, above. See top views below.



Top view showing lever A engaging stop bracket B to limit motor speed when running in neutral.



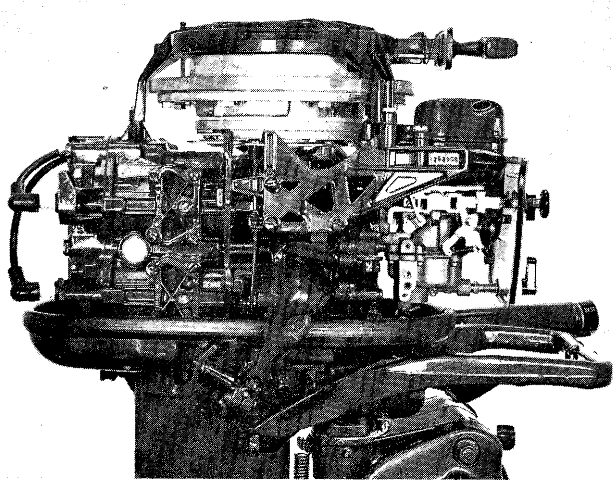
Top view showing lever A engaging stop bracket B to limit motor speed when running in reverse.

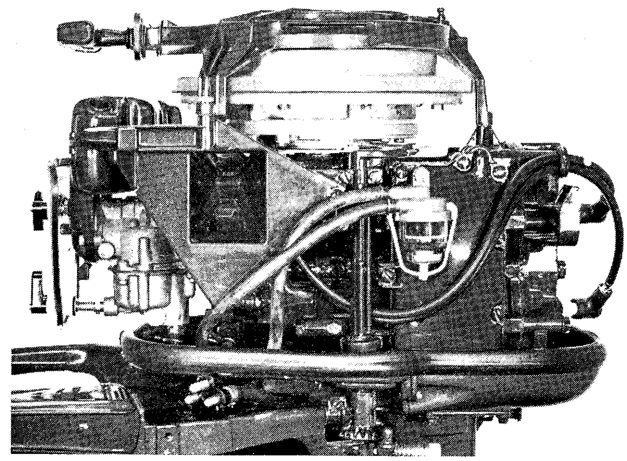


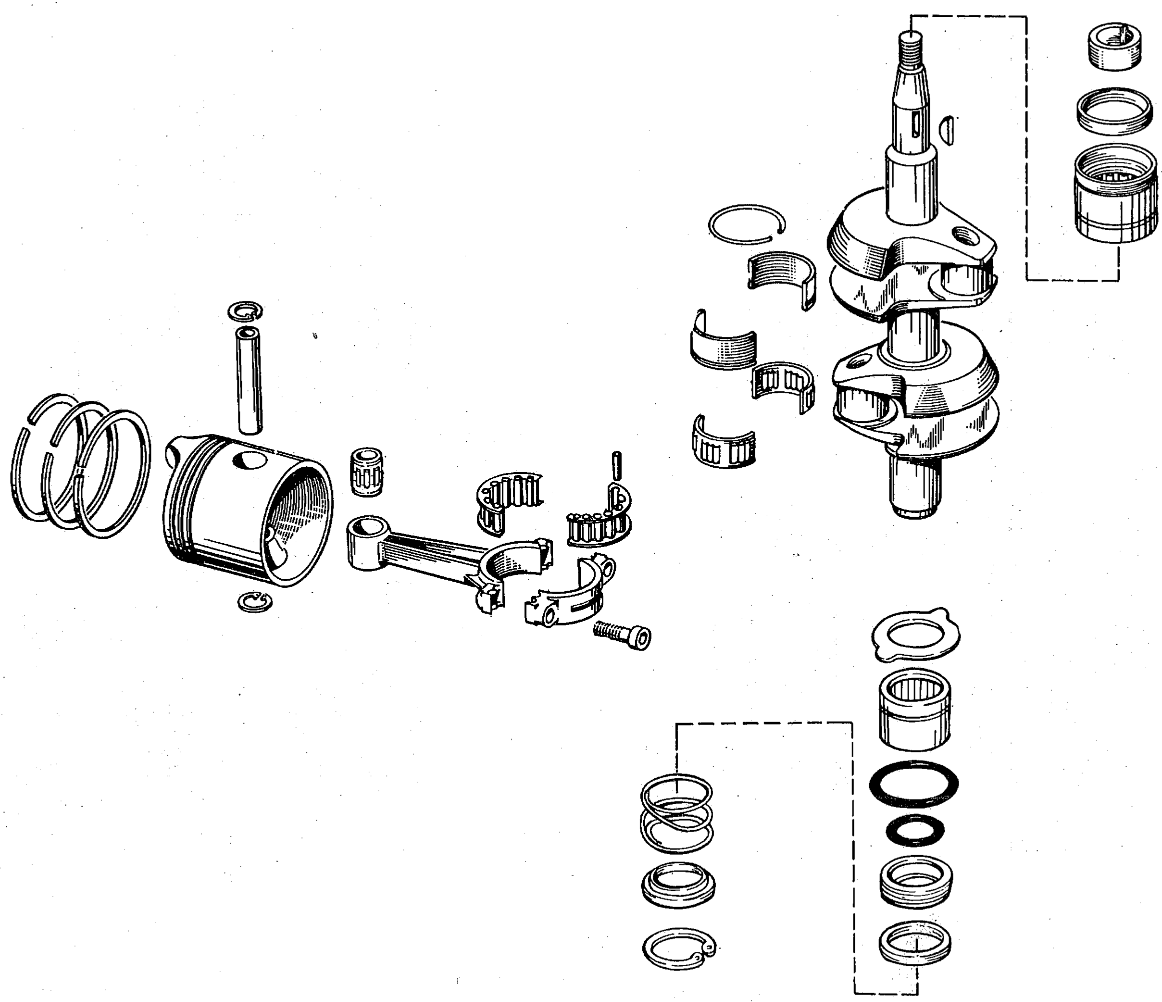
Top view showing lever A engaging bracket B at full open throttle for maximum speed.

THE MODELS FD-11 UP (18 H.P.)

With exception of the larger bore, the Model FD-11 power head is similar to the FD-10 as illustrated and described on the preceding pages — all service operations are conducted in like manner. The bronze bushing and "lip" seal at the lower end of the crankshaft, however, has been replaced with a roller bearing assembly and the familiar carbon seal as described on page 252.

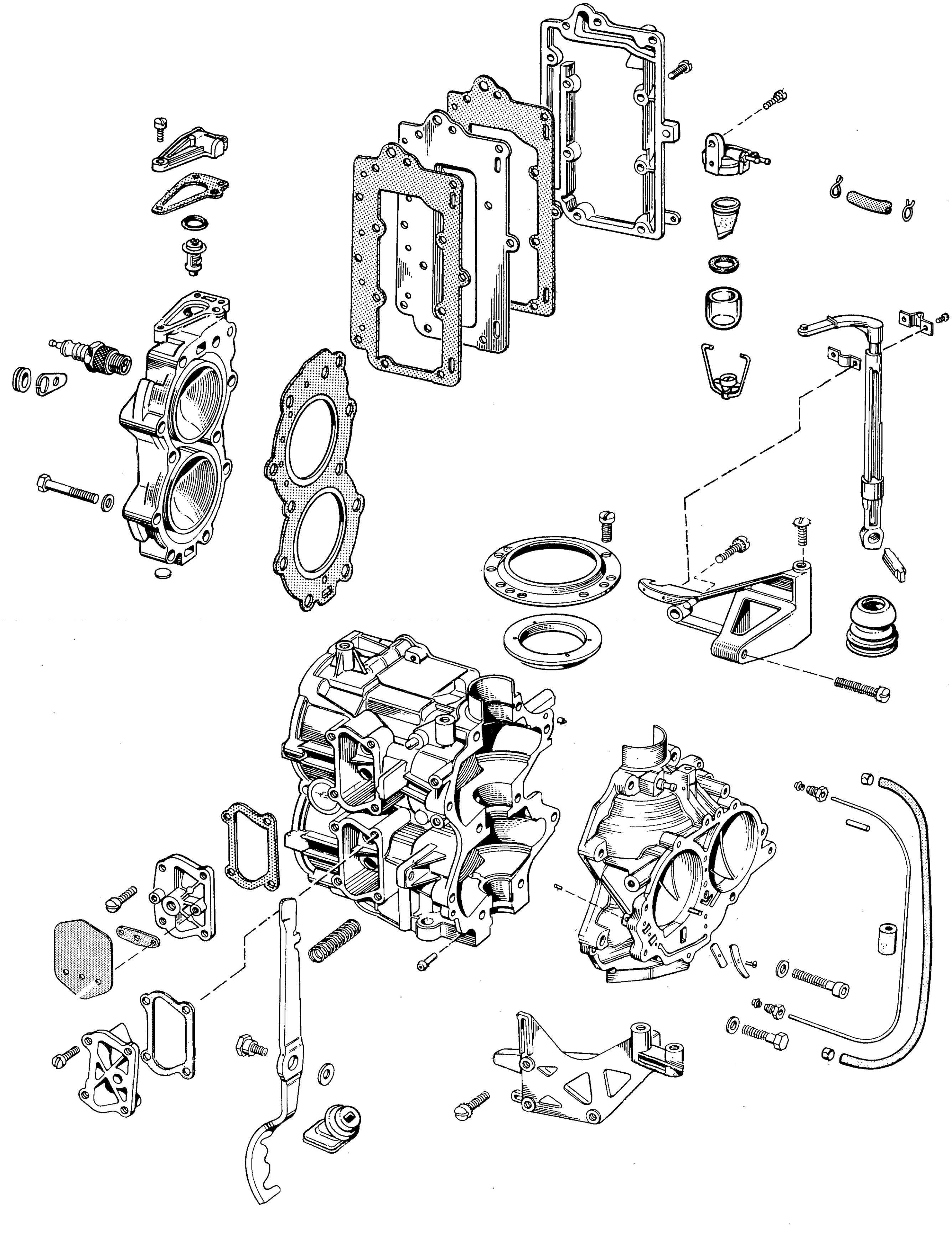




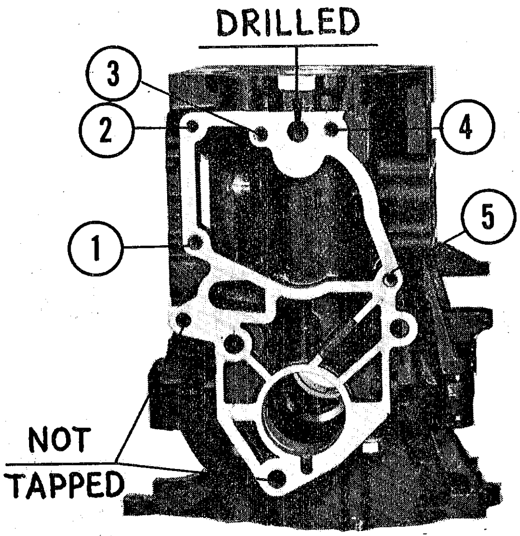


CRANKSHAFT GROUP
Models FD-16 Up

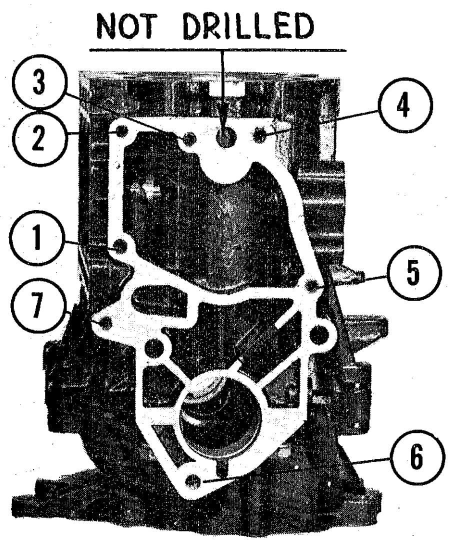
NOTES



POWERHEAD GROUP
Models FD-16 Up



376814: 5 Holes Tapped
18 H.P. Models FD and FDE-11 through 12

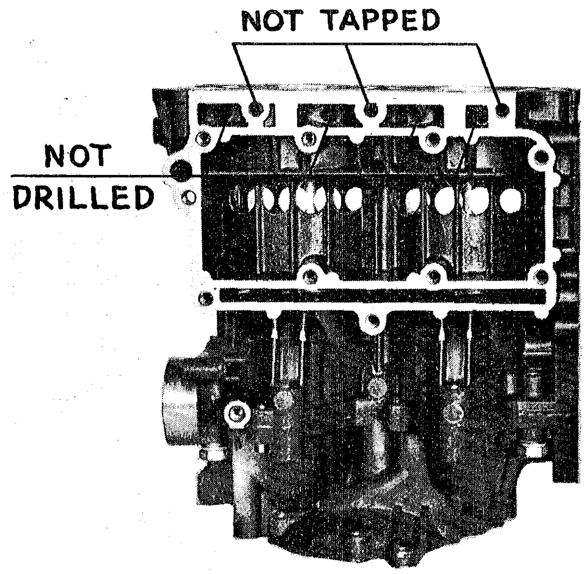


377643: 7 Holes Tapped
18 H.P. Models FD and FDL-13 through 15

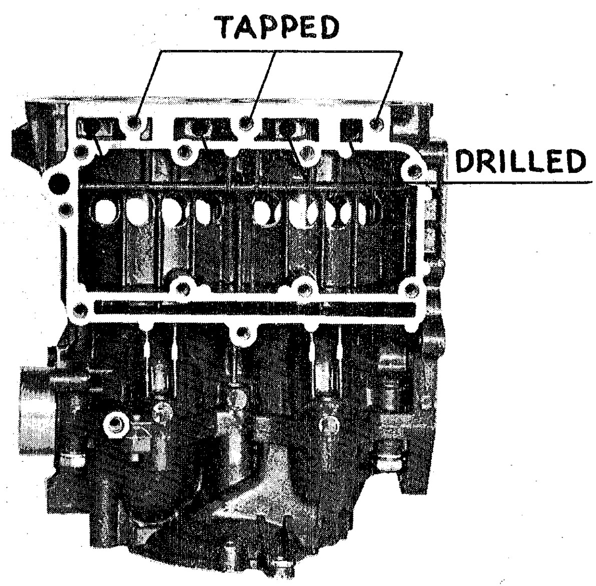
When the thermostat controlled cooling system was incorporated in the 18 H.P. engines a few years ago, several changes had to be made in the casting die. These changes altered the physical appearance of the cylinder assembly and a new part number was assigned (377643).

The same die is now also being used to make cylinder assembly 376814. Consequently, this cylinder now has the same outward appearance as cylinder 377643. The similarity ends here, however, as there are many important differences in machining of the two assemblies that affects their usage.

Cylinder 376814 has only five tapped holes in the mounting surface. There are seven tapped holes in cylinder 377643 in the same surface. Obviously the cylinders cannot be mounted on the wrong lower units. In addition, you will note the drilled hole in the water outlet of 376814 while this spot is blank in 377643.



376814



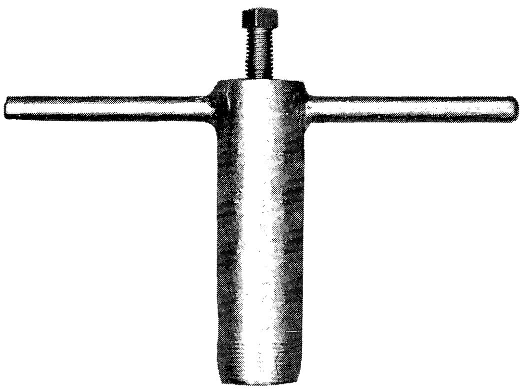
377643

The difference in the water jacket surrounding the exhaust ports is also readily apparent.

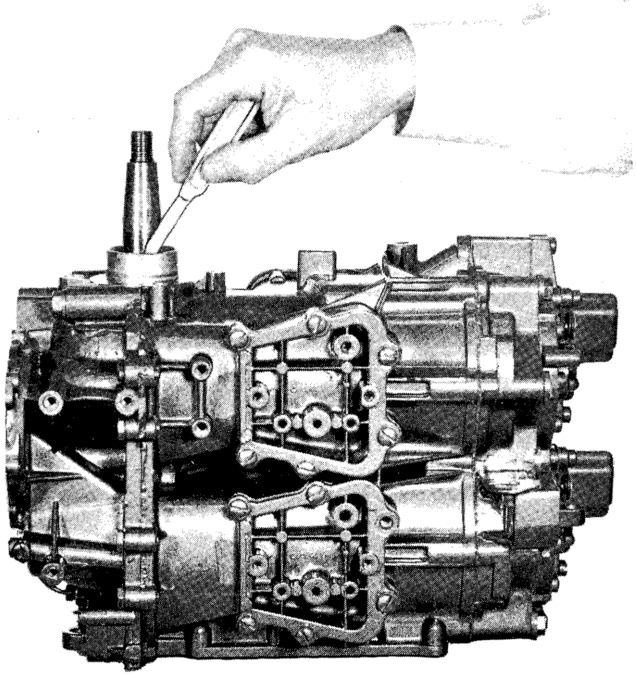
Another quick check of the two castings will also disclose the different drilling of the water transfer opening which leads to the thermostat. One (376814) is blank; the other (377643) is drilled out to allow water to flow to the thermostat when it is incorporated in the water system.

This is only one example of parts that are similar in appearance but different in function. Always check your service parts thoroughly to be sure they are correct for the particular application. Do not assume they are wrong because they look different and resemble new parts but not the old part they are to replace. You can avoid lost time and eliminate confusion by closer observation and inspection.

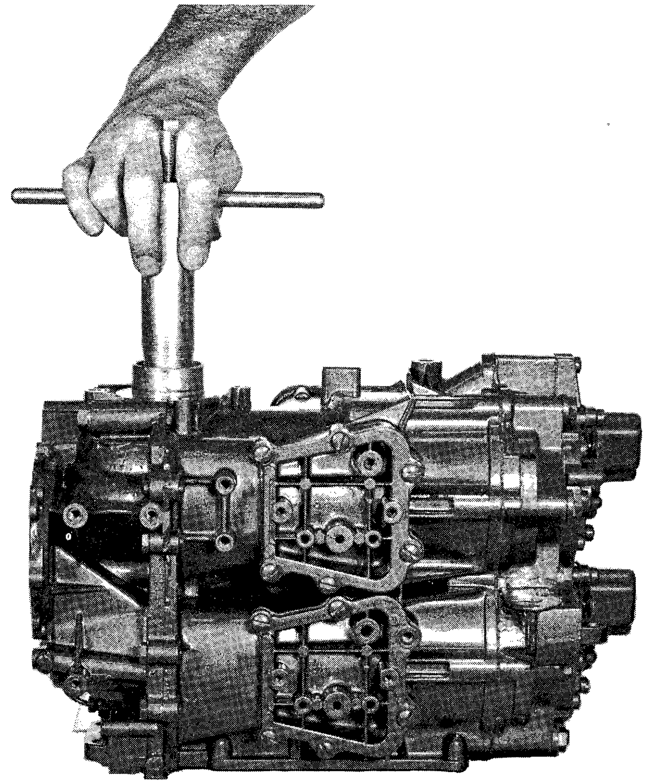
Service Bulletin No. 818 12/8/60



Showing Puller used to remove Lip Style Seal on Crankshaft – 18 H.P. Engines.



Using Knife to cut Upper Lip away from Seal – cut completely around circumference.



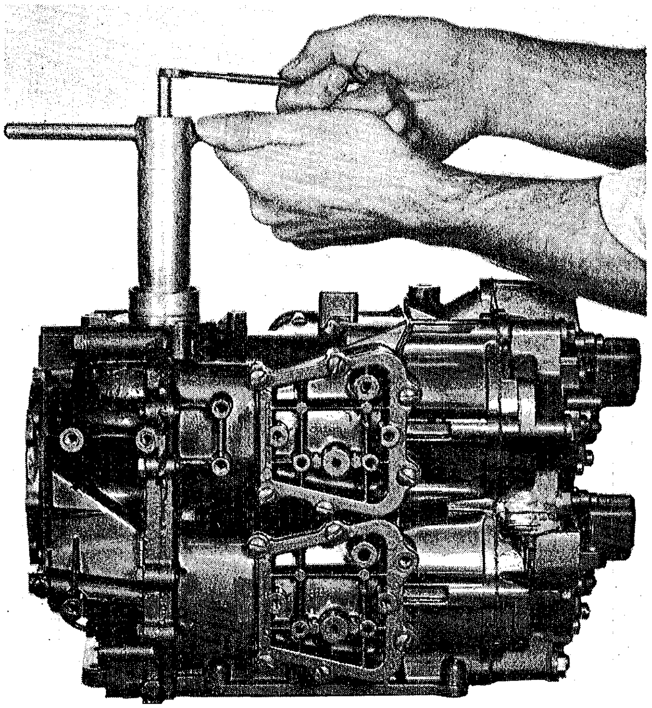
Installing Puller over Crankshaft – screw Puller into Seal until it stops.

A tool was originally designed to remove the single lip top crankcase seal formerly used without having to disassemble the powerhead. Although it works easily with the single lip seal, removal of the double lip seal currently used is more difficult. The difficulty arises in trying to force the puller past the upper rubber lip in order to engage the threads of the puller with the metal case of the seal.

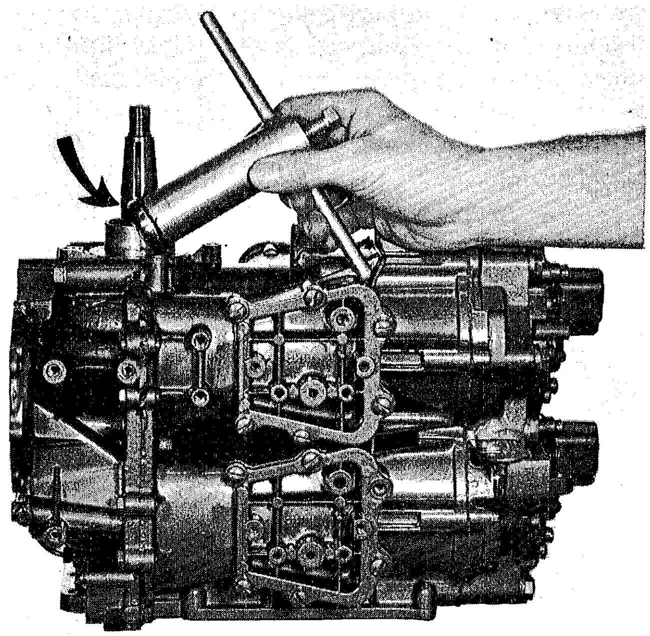
To eliminate this problem, use a sharp, thin-bladed knife to cut away the upper lip as follows:

1. Push the point of the blade through the lip next to the seal case and cut completely around the circumference. Remove loose piece of the lip.
2. Place the puller over the crankshaft in the conventional manner and screw it into the seal until it stops.
3. Turn the center screw of the puller until the seal is withdrawn from the crankcase.

Service Bulletin No. 767 3/14/60

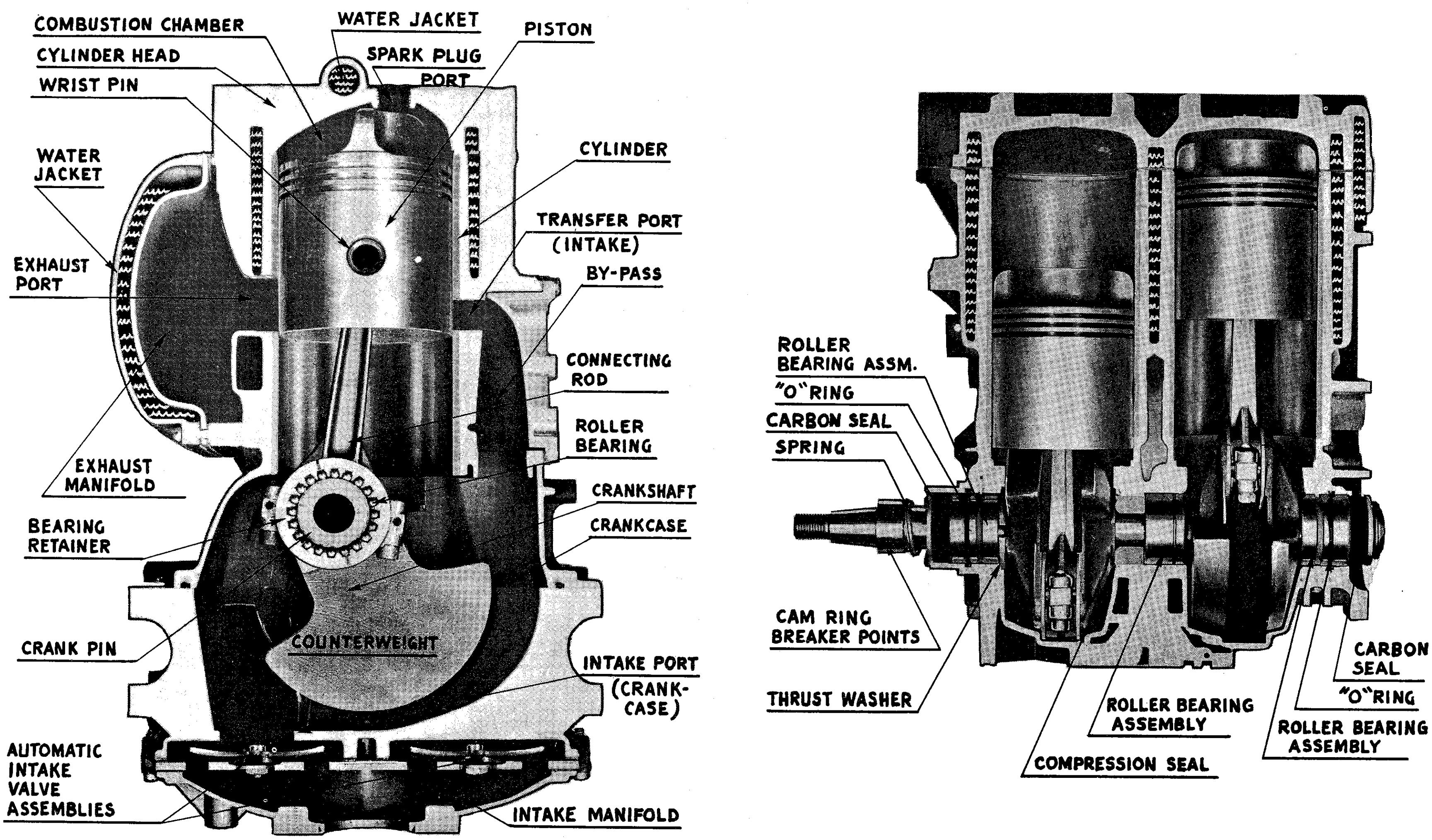


Center Screw pressing against Crankshaft to Remove Seal.

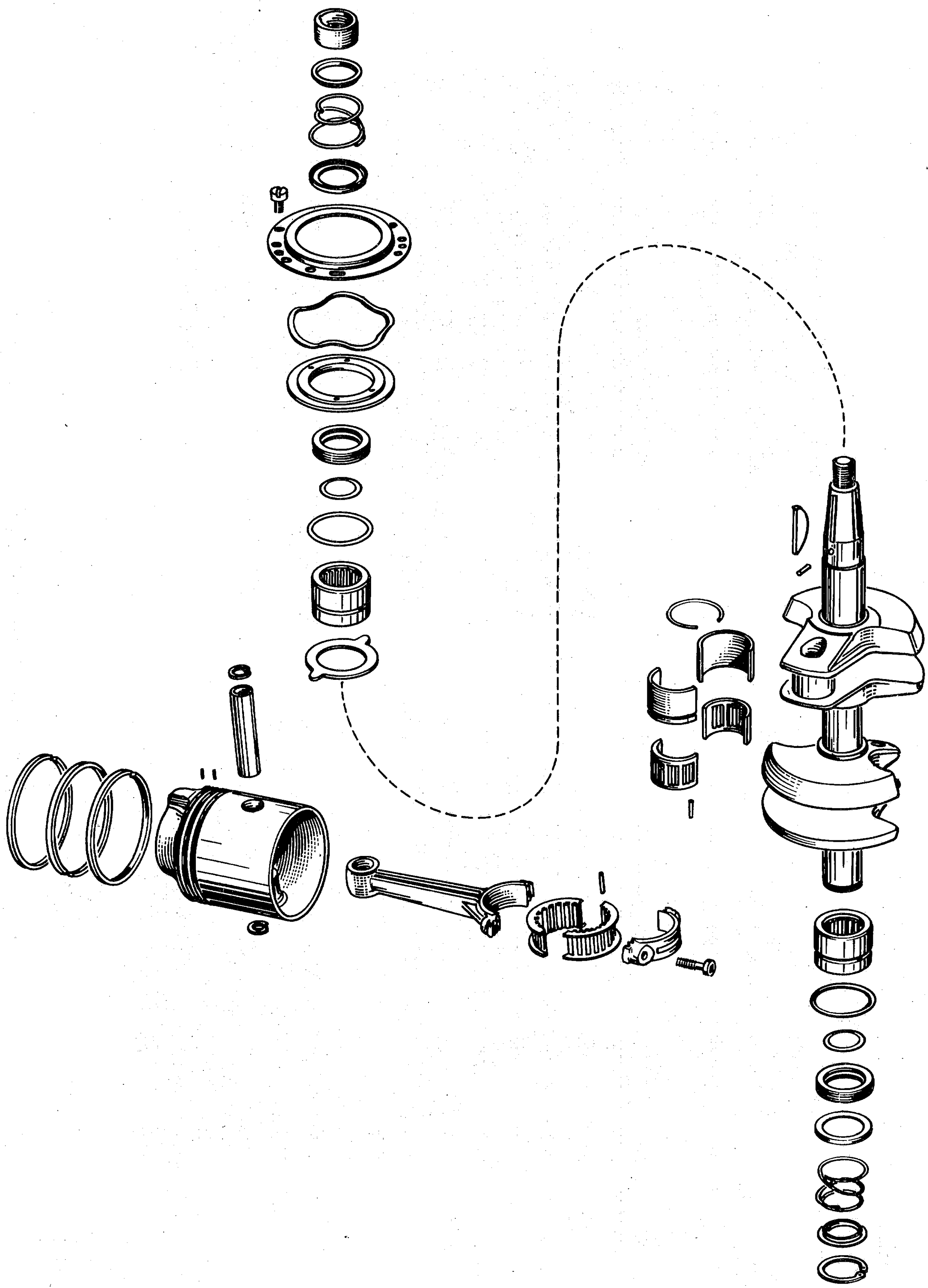


Showing Extracted Seal on Puller.

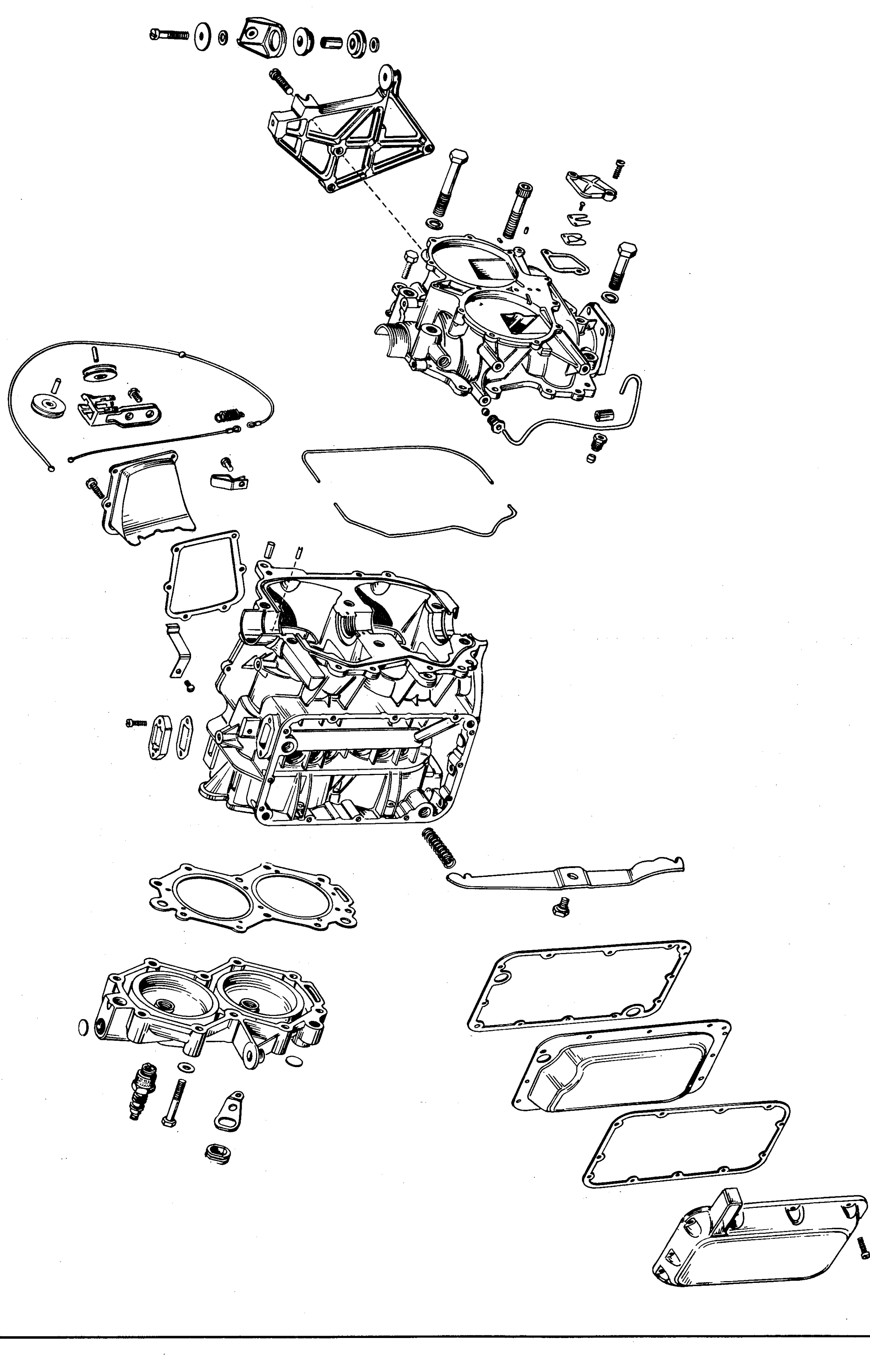
NOTES



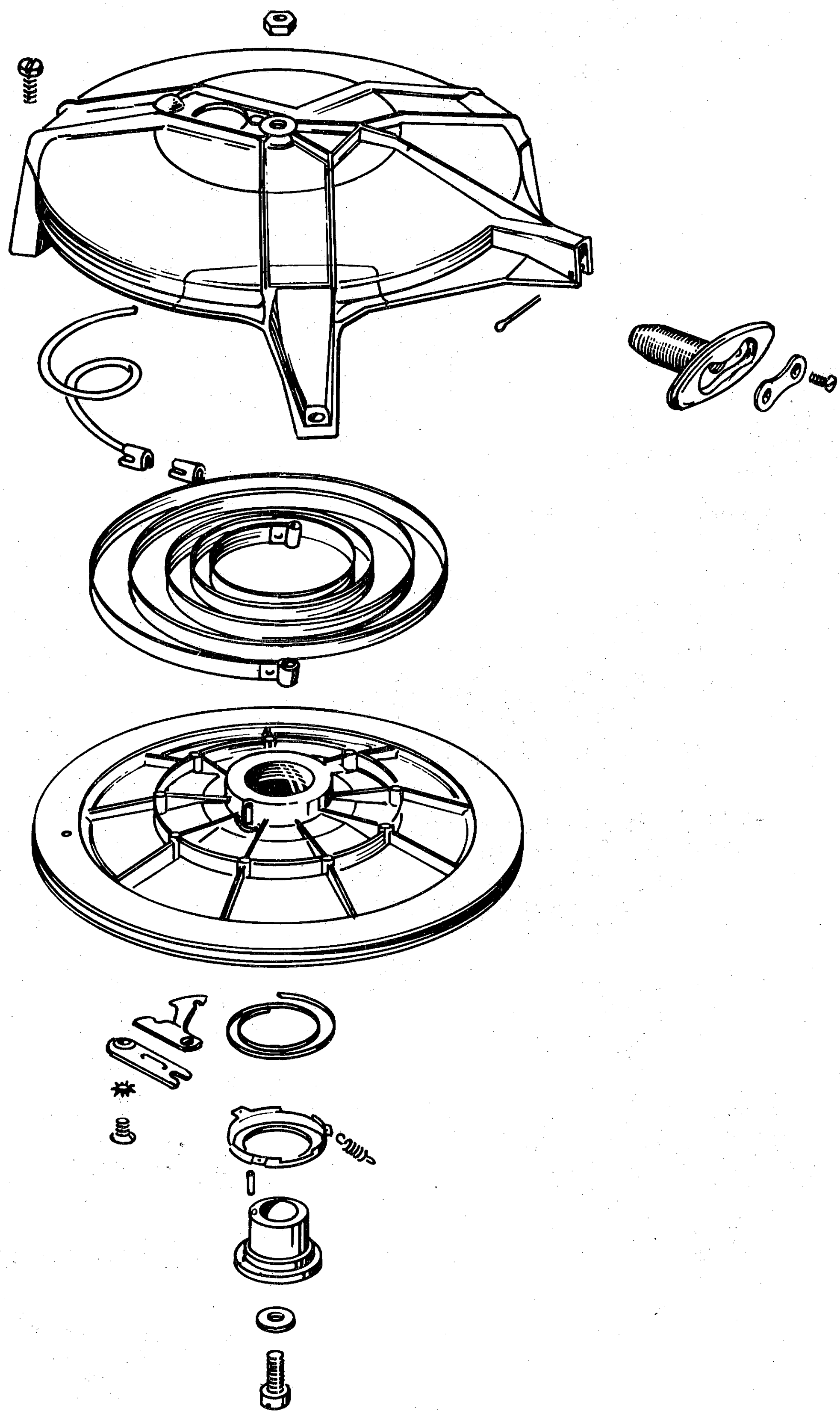
Sectional Views of Powerhead—Model RD



Assembly Layout—Piston, Connecting Rod and Crankshaft Group—Model RD

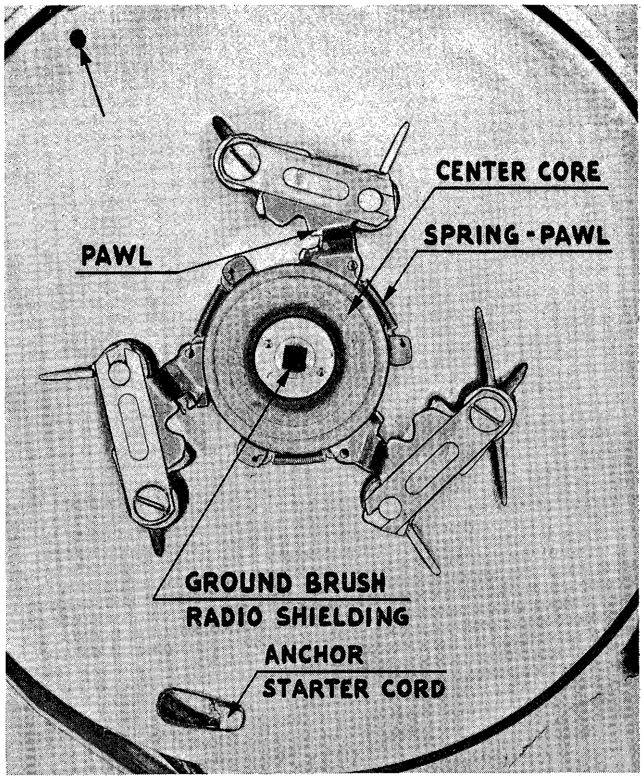


Assembly Layout—Cylinder Block Group

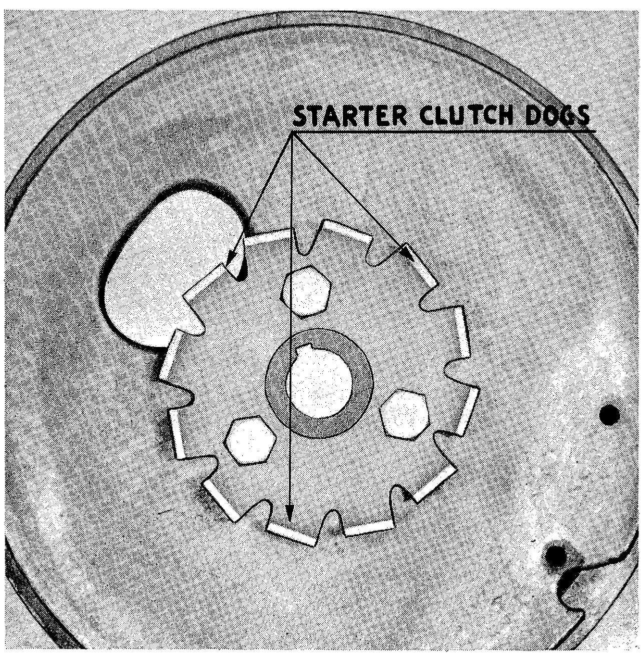


Assembly Layout—Starter Group

THE READY PULL STARTER—MODEL RD



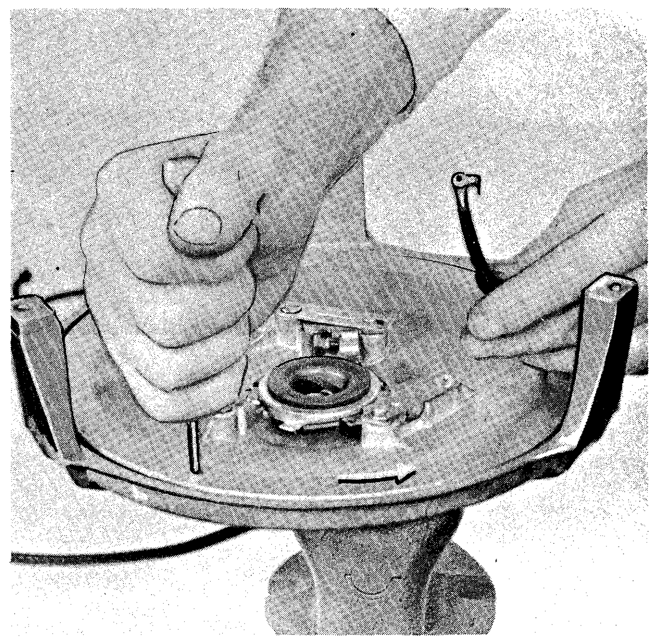
Starter Engaging Mechanism—Starter Head.



Starter Clutch "Dog" Bracket Attached to Flywheel.

The ready pull starter consists of a starting cord and grip, a rewind spring, an arrangement of pawls and corresponding clutch "dogs" and a housing required to contain the complete assembly. When pulling on the starter cord grip, the pawls automatically engage the clutch "dogs" attached to the flywheel to accomplish cranking for starting purposes.

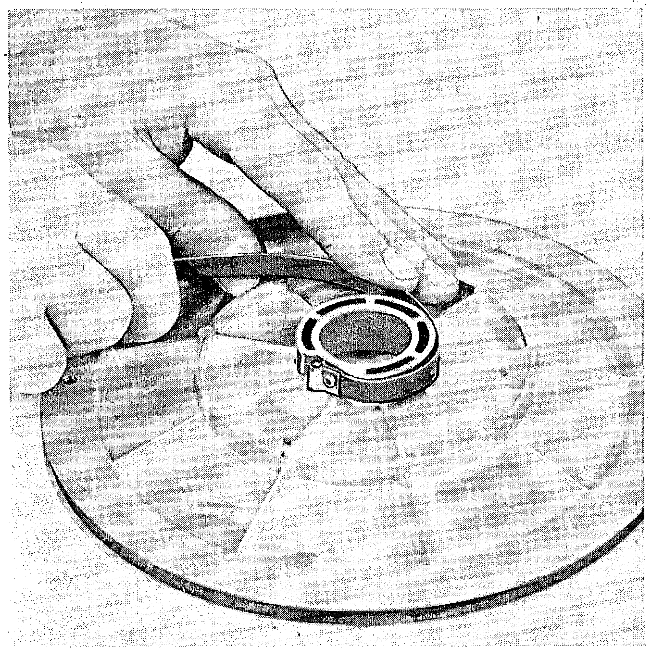
1. To install starter cord: remove starter assembly from the motor; detach grip from starter cord (remove screws and small plate—end of the grip); pull cord out to extreme limit; grasp starter pulley with hand to hold it fast; pull on anchor end of the cord to remove; gradually release tension of rewind spring; place starter assembly in vise to hold; insert straight punch in hole in the starter pulley provided for this purpose; "wind" spring up to full limit, then back off or "unwind" approximately one turn; thread new cord through slot in the pulley; attach opposite end to starter cord grip; gradually release spring tension to take up all of the starter cord; attach starter assembly to motor.



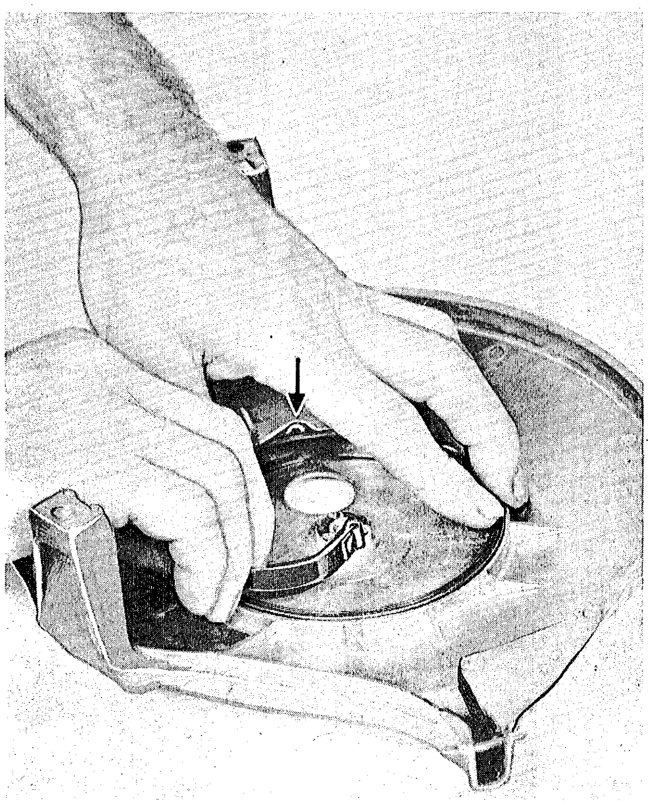
Winding Starter Spring and Inserting Cord.

2. To replace the rewind spring: remove starter cord as instructed above; detach the starter pawl springs; remove pulley from starter housing by removing center core bolt; lift center "core" from assembly, then the pulley; form a loop over pin in the pulley and by bending around boss as shown, then place loop on opposite end of the spring over pin in starter housing; "coil" spring into starter housing (counter-clockwise looking down on assembly); bend "looped" free end of coiled spring up or outward to permit slipping loop over corresponding pin in the pulley on final assembly; smear grease liberally over spring coils with small brush or finger; assemble pulley and housing (with coiled spring installed) as shown—being sure loop of free end of the spring is properly guided to "fit" over corresponding pin on the pulley; carefully replace center core with small spring correctly installed—wrapped clockwise looking down—avoid possibility of one loop riding on top of the other

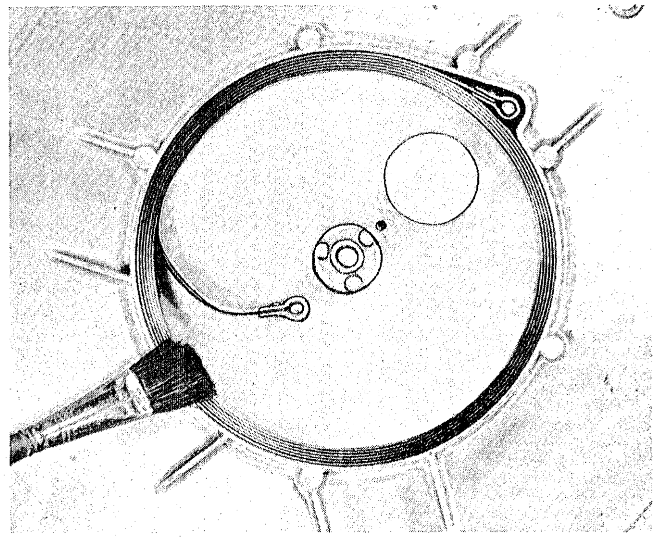
—note small hole in starter housing adjacent to boss and corresponding pin like boss on end of the center core—boss or pin must engage this hole to accomplish correct assembly in this respect; replace and secure center core; replace starter pawl springs; install starter cord as described above.



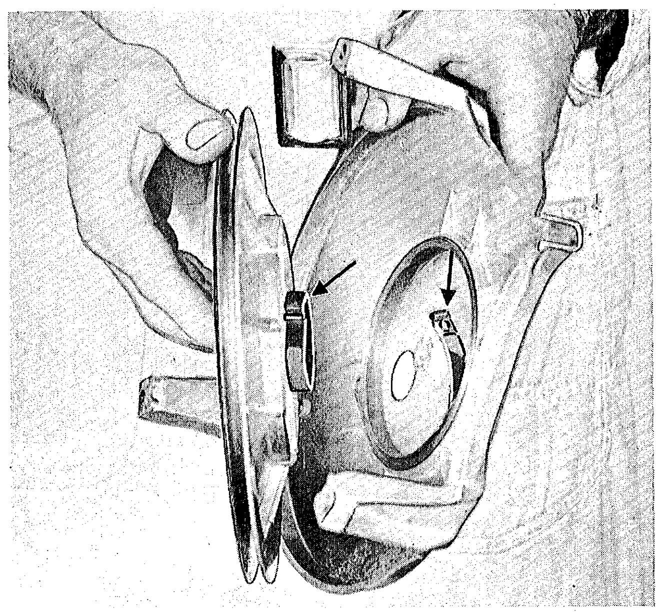
Forming Loop or "Hook" on End of Starter Spring.



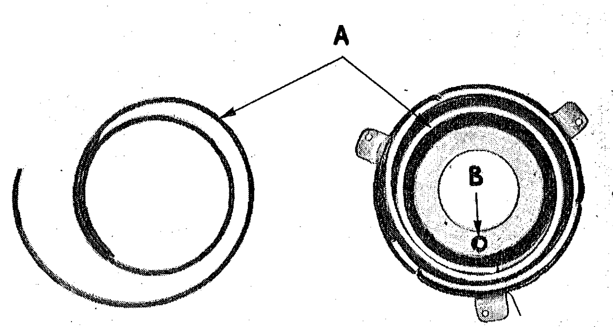
Coiling Spring into Starter Housing—One End Attached to Pin in Housing—Free End Bent Upward to Facilitate Final Assembly.



Showing Starter Spring Coiled into Housing—One End Anchored to Pin—Free End Attached to Pin in Starter Pulley —Applying Grease to Coils of Spring with Brush.

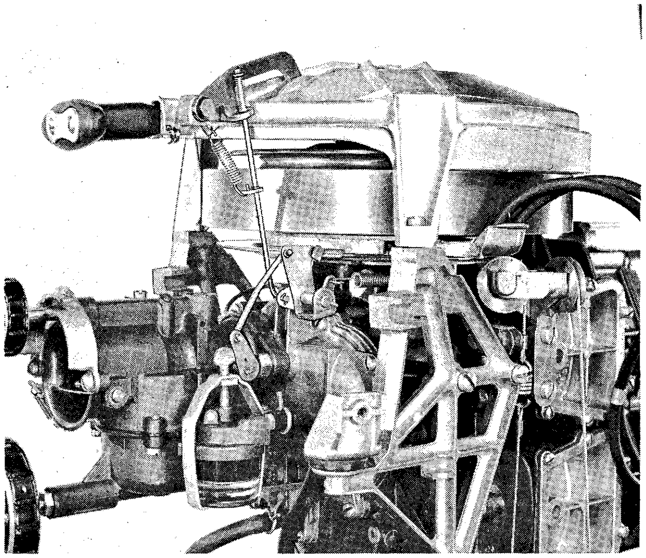


Assembling Starter Head and Pulley—"Loop" on End of Spring to Engage "Pin" in Pulley.

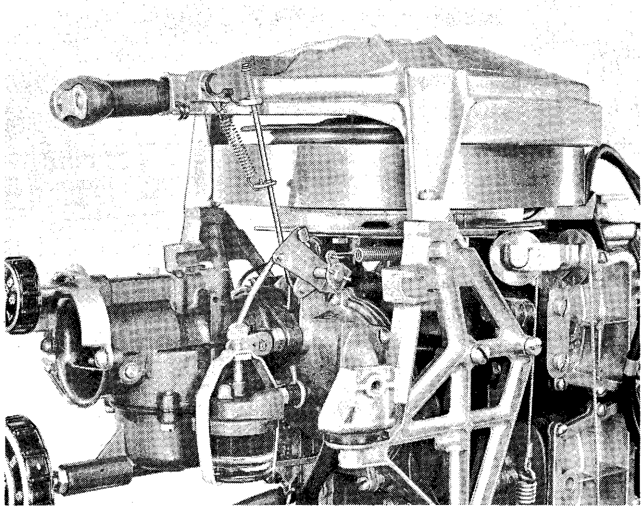


Showing Spring "A" Properly Installed in Starter Center Core—Also Pilot Boss "B" to Locate in Corresponding Hole in the Starter Housing.

STARTER LOCK — MODELS RD-13 UP



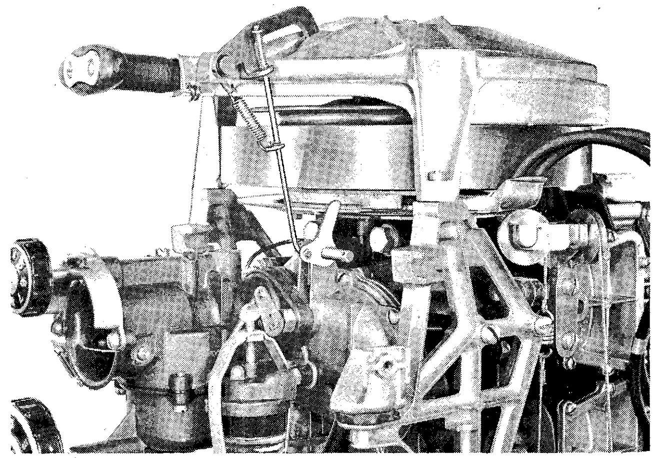
Showing Latch "Released" for Starting.



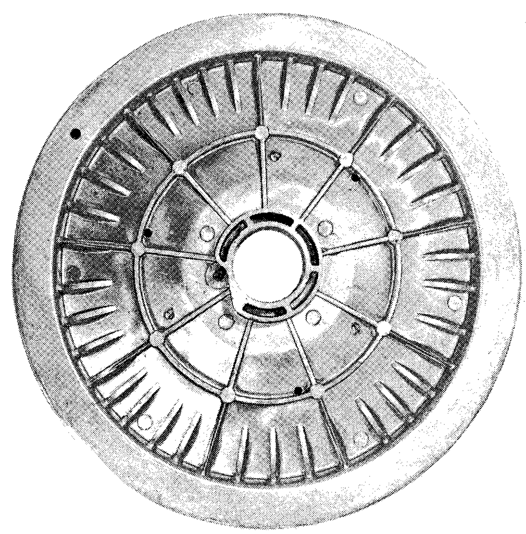
Showing Latch "Engaged" to Prohibit Starting in Gear at High Speed.

Shown here are several views of the starter "lock" as installed on the Model RD-13 to prevent starting in gear at high speed. The assembly is arranged in such a manner that through link, cam and spring action, the starter mechanism is automatically "locked" in event starting is attempted in gear at high speed—speed control grip set beyond position recommended for starting.

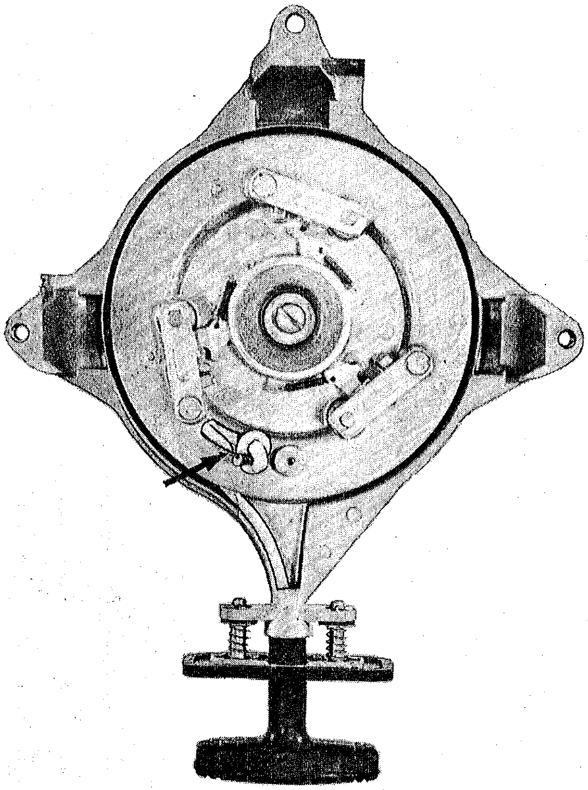
Action is extremely simple — as the speed control grip is advanced, the cam follower riding against high contour of the carburetor control cam (attached to the armature plate), causes latch to engage one of the "blocks" cast on to the starter pulley to prohibit its turning. The starter is "locked" when in this position. With retarding of the speed control grip, the cam follower in riding low contour of the carburetor control cam causes the latch to "lift" thus releasing its hold on starter pulley to permit cranking.



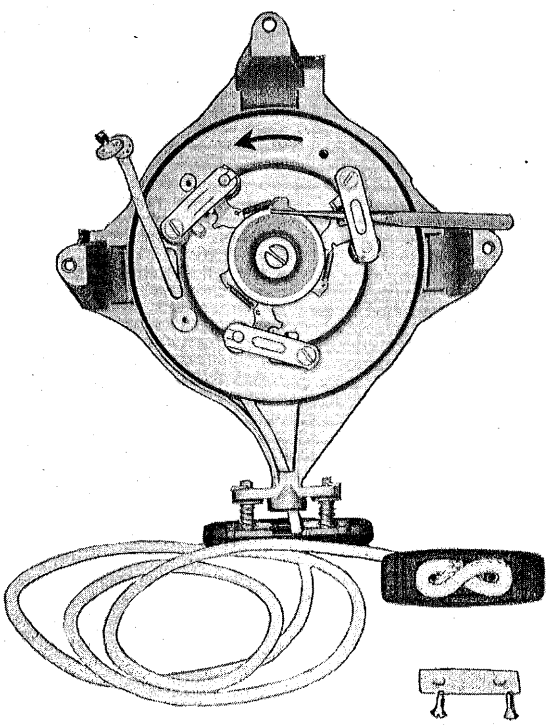
Showing Position of Starter Latch Cam Follower as it Rides Contour of the Carburetor Control Cam—Carburetor Control Mechanism Removed for Purpose of Illustration.



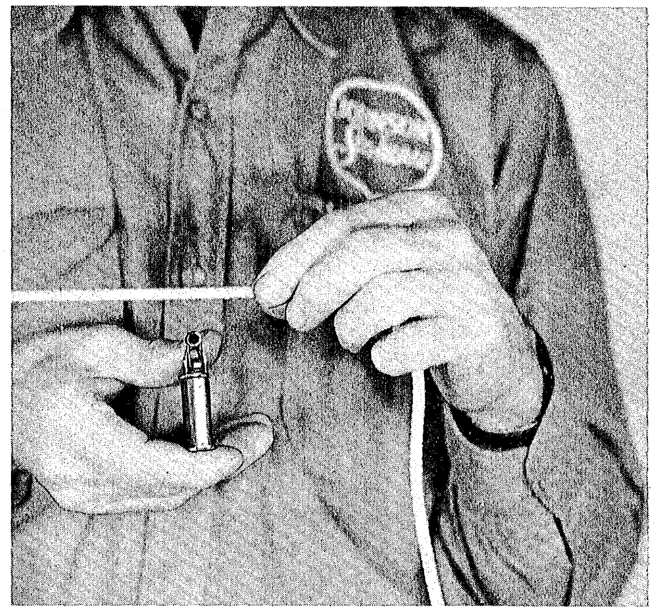
View of Starter Pulley—Topside—Showing Position of Cast —on "Blocks" to Engage the Latch.



It will be noted from the above starter assembly illustration that the familiar starter cord anchor has been replaced with a simple "knot" — made possible by the installation of a nylon cord.



Though the stranded core cord has been replaced by one of nylon, installation procedure remains basically the same. Take up all tension of the starter spring, then permit it to "release" approximately one turn — hold in this position with punch "wedged in" as shown here. Thread cord through the pulley, tie knot, attach opposite end of cord to the grip —looping the cord in a figure eight fashion to secure, then replace cover plate.



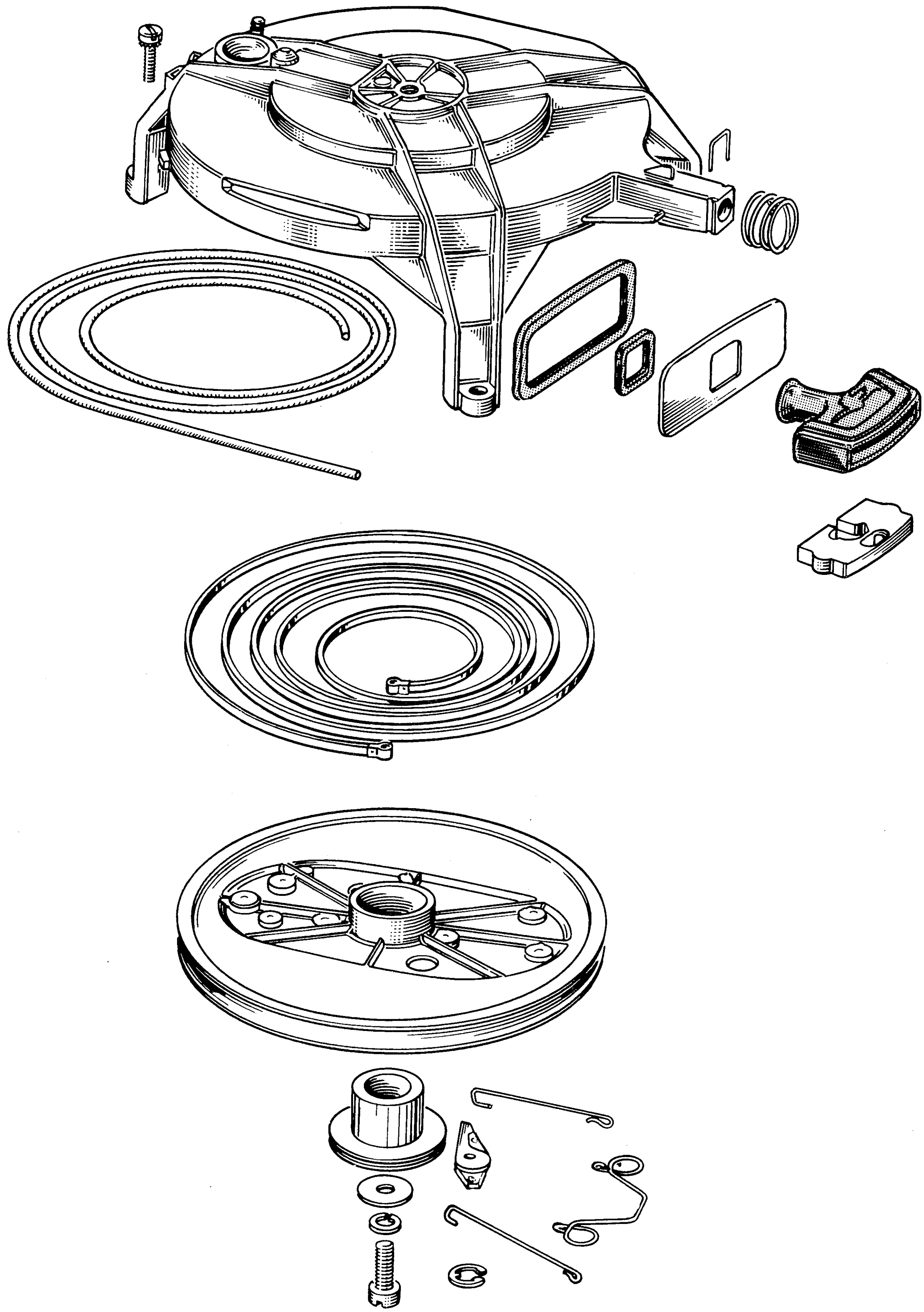
Singe area of the cord to be severed with match or cigaret lighter to slightly fuse strands together to prevent them from "unraveling."

NYLON STARTER CORD

The starter cord on all 1955 models has been changed to one of nylon weave to withstand wear with a center core of dacron to minimize stretch—replacing the familiar one of stranded bronze core, cotton covered and anchor attached.

Models JW, CD, QD, RD and RDE prior to 1955 may be converted for the nylon cord by replacing the starter pulley.

NOTES



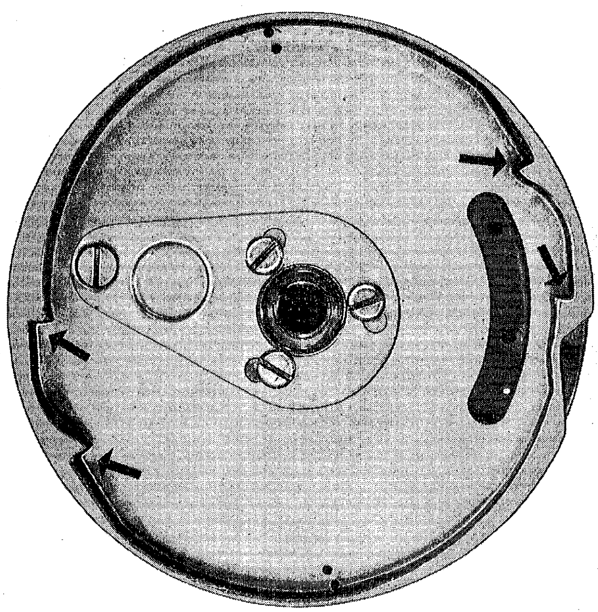
EXTENDED VIEW – STARTER ASSEMBLY USING THE ELLIPTICAL PULLEY

Models CD-13, AD-10, QD-17, FD-10 Up and RD-10 through RD-19.

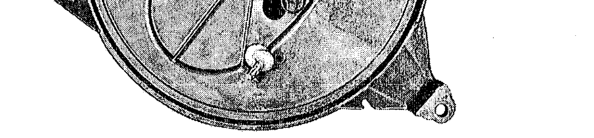
STARTER ASSEMBLY — CORD INSTALLATION

MODELS JW-12, CD-13, AD-10, QD-17, FD-10, RX, RD AND RK SERIES

On detaching the starter heads (above models) it will be noted the starter cord is coiled on an "oval" pulley, rather than round as heretofore and that the familiar ratchet and pawl assembly has been replaced by a ratchet arrangement cast into the flywheel and a single pawl of nylon. Changed for simplicity and "smoother" cranking. The cord is of dacron (core) overwoven with nylon — dacron for not stretching and nylon for its wearing qualities. The bronze anchor has been replaced by a knot — same as '55 but a new simply manipulated "grip" anchor has been provided on the cranking end.

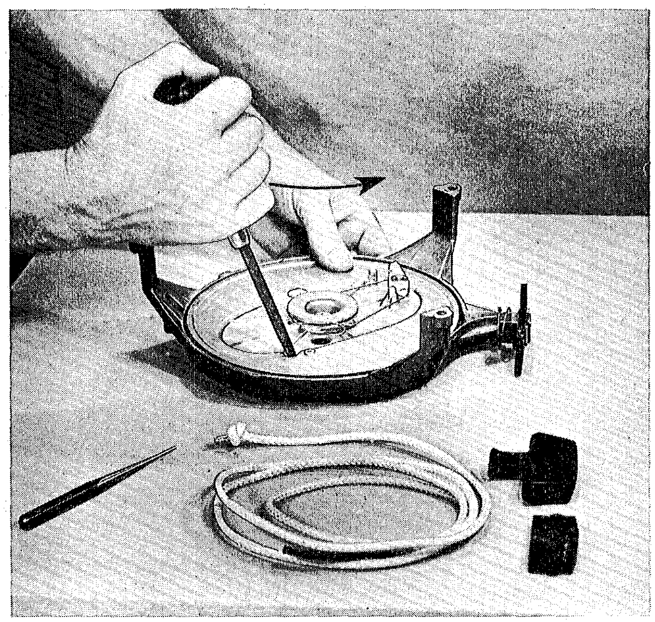


Flywheel — Showing ratchets cast in to the flywheel (indicated by arrows) and breaker point inspection cover.

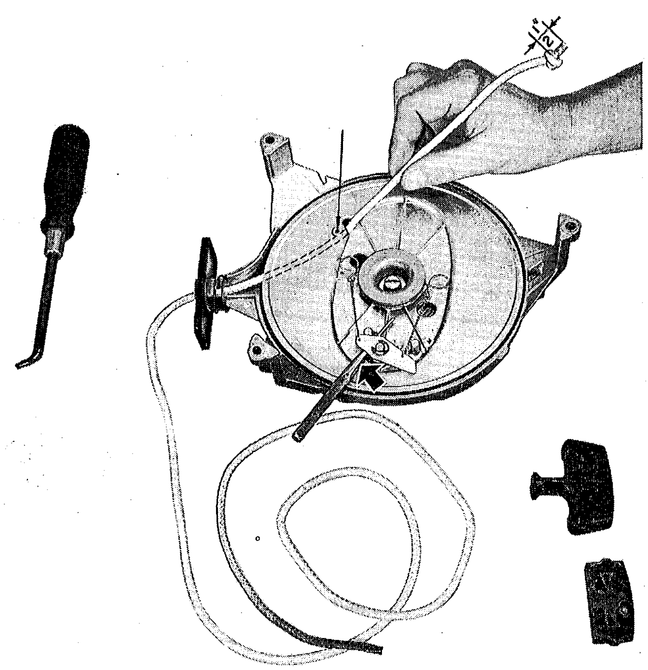


Under side of Starter head — Showing nylon pawl, letter "J" and aligning arrow.

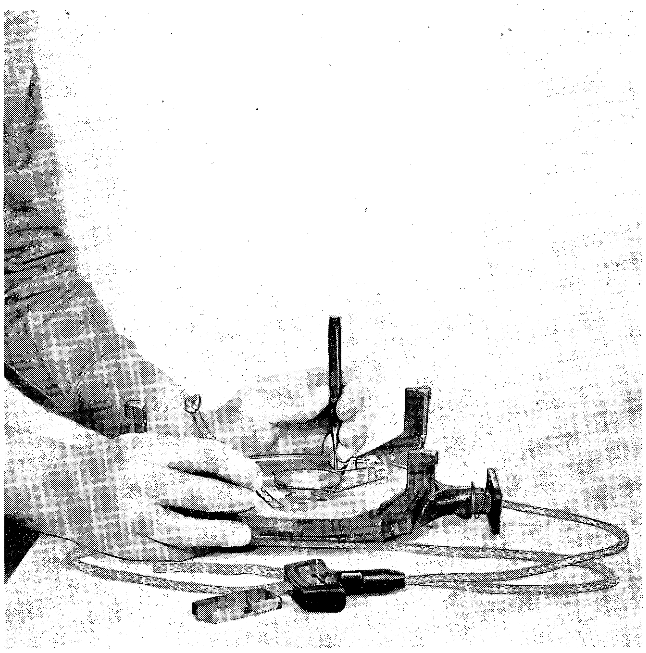
The oval pulley permits "cranking" alternately on a long and short radius — long for more leverage when cranking over compression, short (less leverage) for faster cranking at mid point to smoothen out cranking effort. This feature requires some "timing" during the process of cord installation — accomplished by a cord of specific length for each starter and some minor adjustment in the grip anchor (see below).



Winding Starter spring to full tight. A screwdriver blade tapered down and bent over at the tip as shown below will do nicely for this operation. Remove burrs and sharp edges from the tool to prevent scuffing of the Starter plate.



Release spring tension to a position where the hole provided in the Starter plate for the cord lines up with the "spout" in the Starter cover as shown above. Insert long tapered punch between the Starter pawl lug and cover bracket to hold in this position.



Some starter plate covers are provided with a hole into which a punch may be inserted to hold the plate in desired position for "threading" of the Cord.

Thread opposite end of the cord into the anchor—front side above, rear side below—then pull the grip to seat the anchor. Grasp hold of starter cord, remove punch, gradually release spring tension until grip comes to rest on its seat. Note letter "J" embossed on starter pulley and arrow on edge of starter housing—both should line up reasonably close if the new starter cord is of correct length, the knot tied approximately ½" from the end and the opposite end properly "laced" in the anchor as shown.

If by any chance the nylon cord is to be severed, singe the area slightly to prevent raveling. See page 292. If required to replace the starter spring, see pages 289 and 290.

Two basic Starter Ropes are available and can be used in place of all other ropes. These ropes are 204085 (7/32" diameter) and 203819 (5/32" diameter), from which all Starter Ropes for the various engine models must be made by cutting them to the required length specified in the following table:

5/32" Diameter Ropes

TO MAKE ROPE NO.	CUT NO. 203819 TO LENGTH SHOWN
203819	71-1/2" (Basic Rope)
203817	68-5/16"
203818	66-3/4"
203820	70"
304097	63-3/4"

7/32" Diameter Ropes

TO MAKE ROPE NO.	CUT NO. 204085 TO LENGTH SHOWN
204085	75-3/4" (Basic Rope)
203821	72-1/4"
203822	70-3/16"
304096	69-3/4"
305000	73-3/4"

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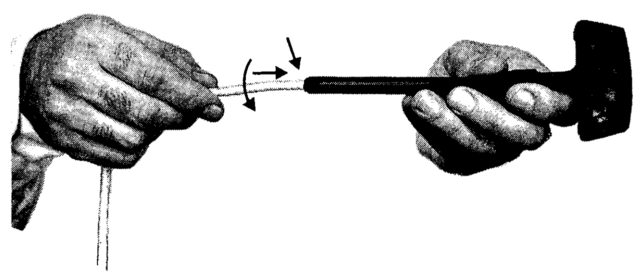
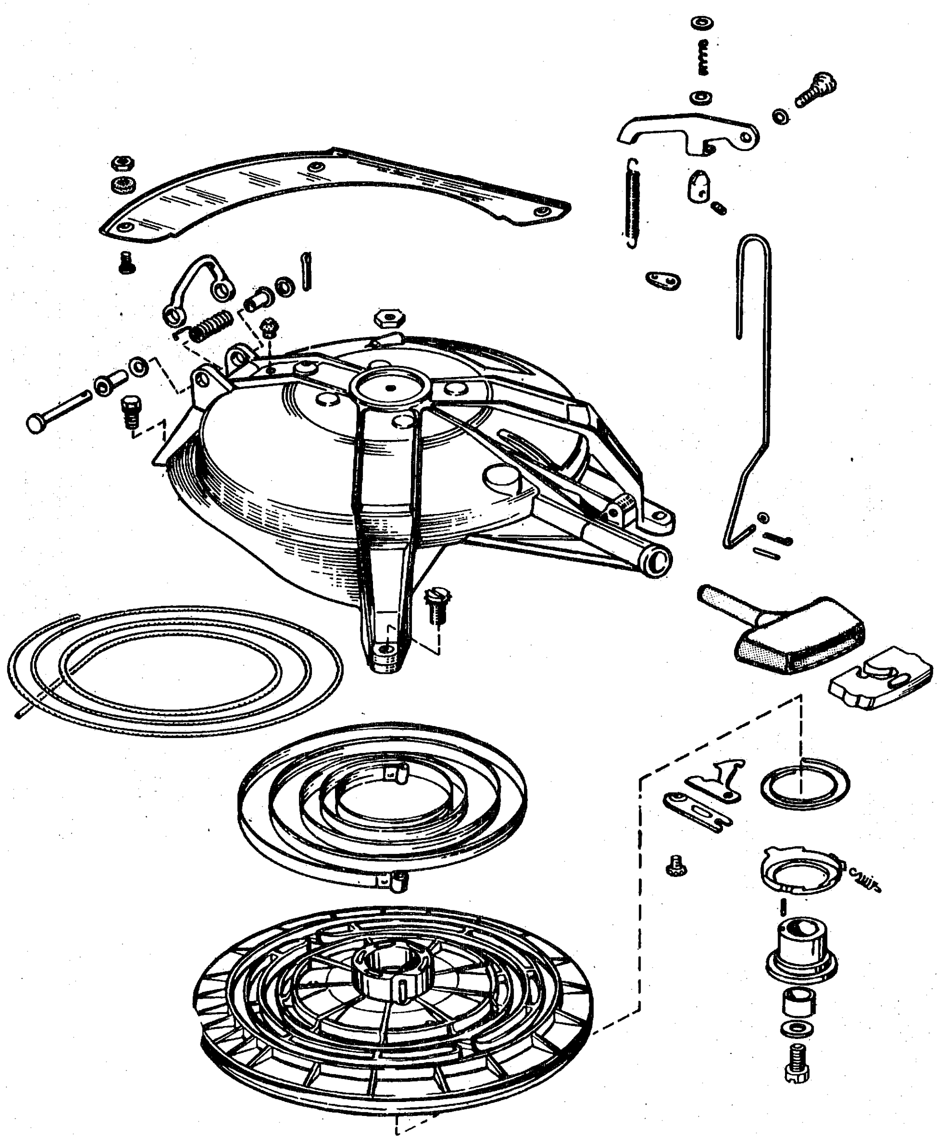


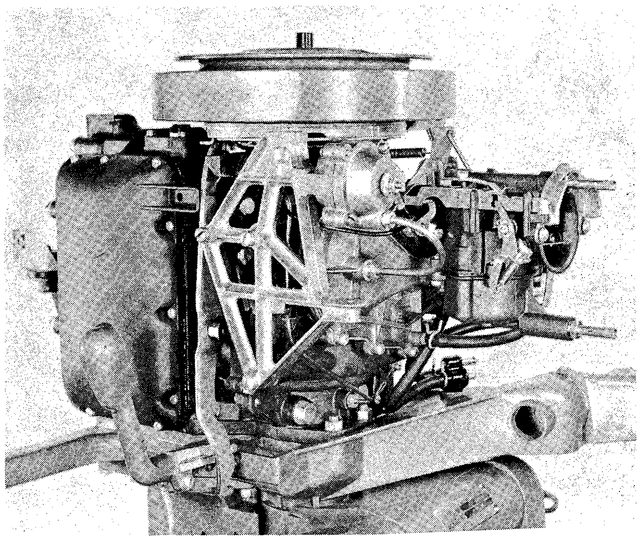
Some starter grips have been provided a longer nipple to aid in noise reduction in the starter head as a result of motor vibration. To thread the nylon cord into position, "dip" end in small container of liquid soap to achieve insertion with a minimum of effort—insert with turning motion.



STARTER GROUP
Models RX-10C Up

THE POWER HEAD — MODEL RD

When major repairs on the power head (engine) such as installation of new piston rings, pistons connecting rods, crankshaft, etc. are required, a disassembly operation becomes necessary which should be carefully performed in clean surroundings—with clean tools and on a clean and orderly bench top with sufficient space to temporarily store the various parts as removed for inspection, corrective measures or replacement.

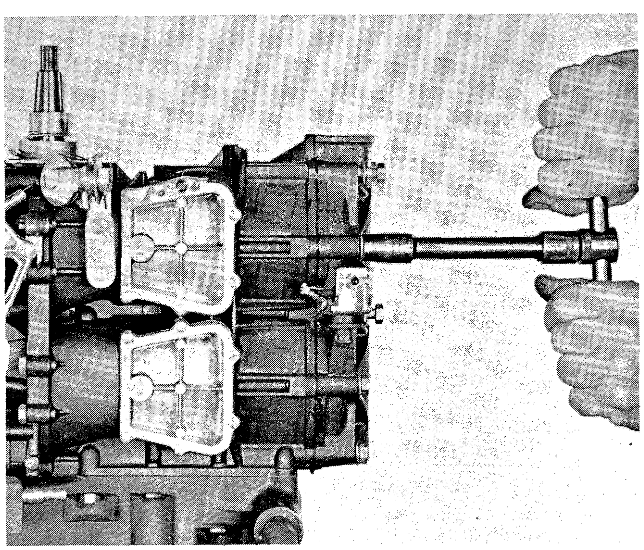


RD Powerhead.

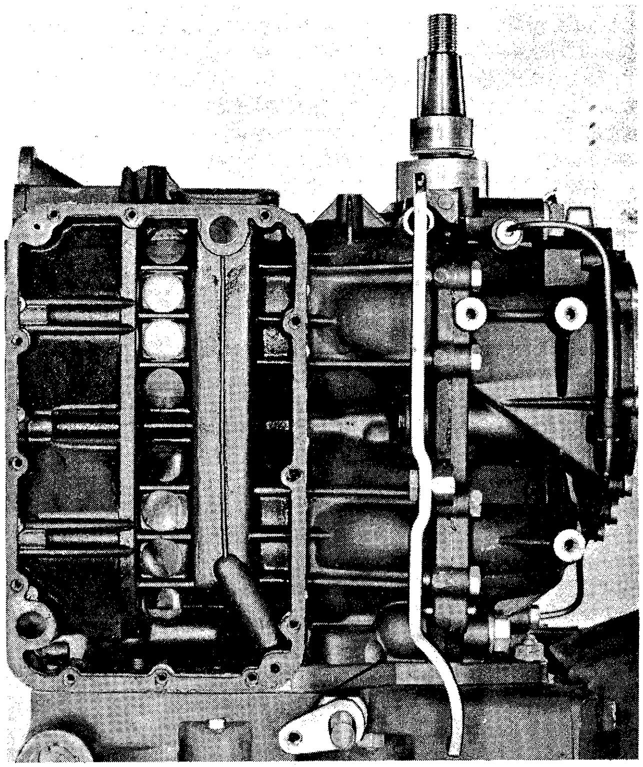
Remove first the motor covers followed by detaching the ready pull starter, flywheel and armature plate assembly as previously instructed.

Detach the fuel and air lines from the fuel filter and intake manifold followed by removing the carburetor.

Remove the intake manifold, cylinder head and muffler.

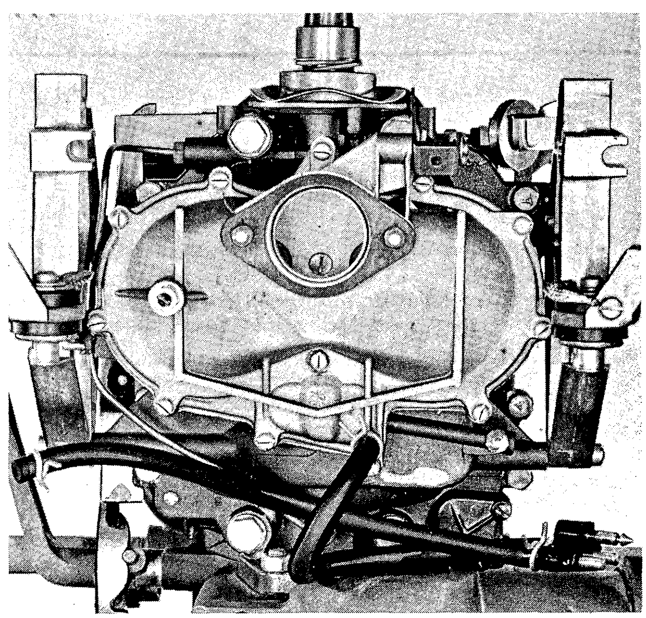


Removing Cylinder Head—Starter Head and Magneto Previously Removed.



Muffler Removed to Expose Exhaust Ports in Cylinder Block.

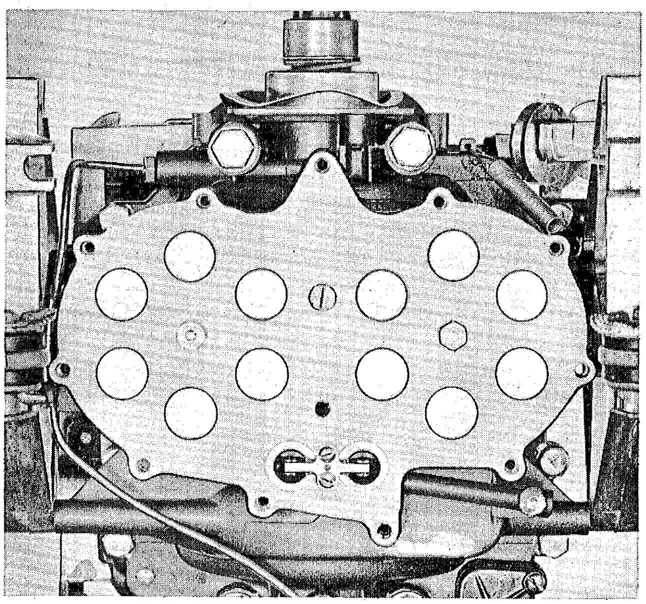
The muffler is water cooled and is of two-piece assembly, namely, a die cast aluminum outer shell and a stamped sheet steel inner shell. The inner shell being somewhat smaller than the outer shell provides space when assembled for circulation of water to assist in dissipating heat of exhaust gases during operation of the motor and becomes



Carburetor Removed to Expose Intake Manifold.

part of the water circulating system. As such, the muffler assembly is sealed with two gaskets—one between the outer and inner shells and a second between the inner shell and corresponding face of the cylinder block, when bolted together. The gaskets must be well seated and, of course, in good condition at all times to guard against water seepage. Faces of both the inner and outer shells must be flat to obtain water tight seat at this location —gaskets rarely hold against "warped" surfaces. Lap down to "true" if necessary—a piece of emery cloth placed on a square of plate glass or other flat surface will suffice for a lapping block. Move surface to be "lapped" carefully over lapping surface in figure eight motion until flat.

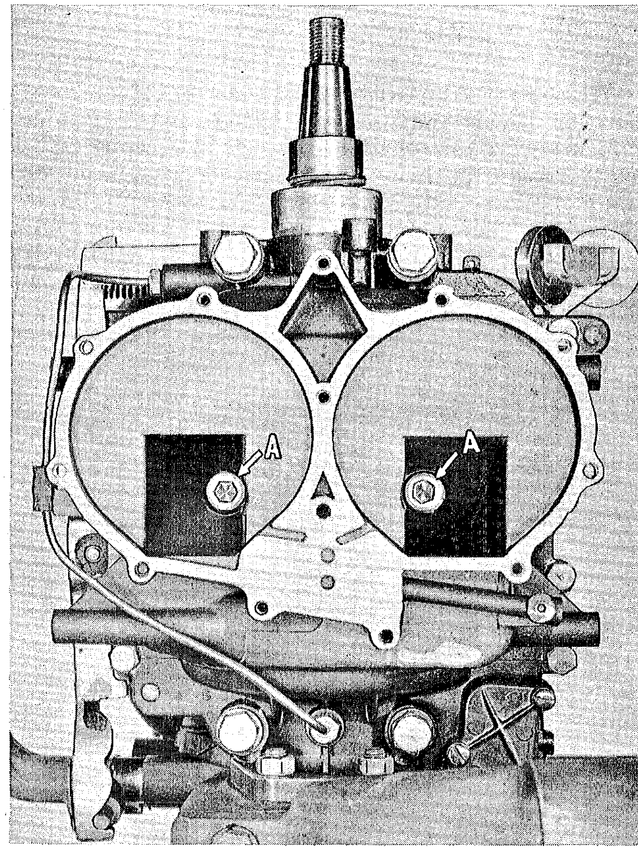
Carefully detach automatic intake valve assembly—place on clean surface, preferably in a small cardboard or wooden box or wrap in piece of clean paper until ready for inspection and repairs later during the process of overhaul. Do not permit foreign matter to scratch surfaces of the aluminum plate or enter the assembly in any manner—surfaces must be flat and smooth to maintain crankcase compression. Holes or ports drilled into the plate form a part of the valve arrangement against which segments of the valve or leaf plate come to rest—thus, surrounding surfaces must be free of scratches or not otherwise injured to prevent loss of crankcase compression.



Intake Manifold Removed to Expose the Automatic Intake Valve and Plate Assembly—Also, the Fuel Pressure Check Valves.

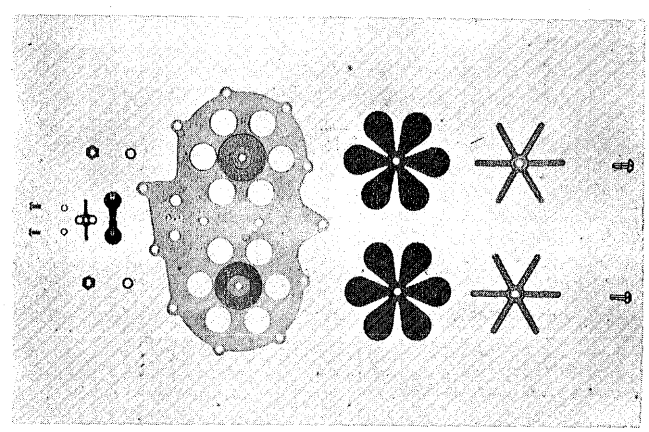
A guide with six corresponding curved fingers is attached immediately back of each valve plate to limit maximum degree of segment opening—operation of the valve is described under "carburetion."

In event there is occasion to install a new valve plate, care must be exercised to see that each segment is located squarely over corresponding holes in the valve plate—overlapping and equal distance on each side. Replace guide and adjust fingers of the guide member to fall in center of segment.

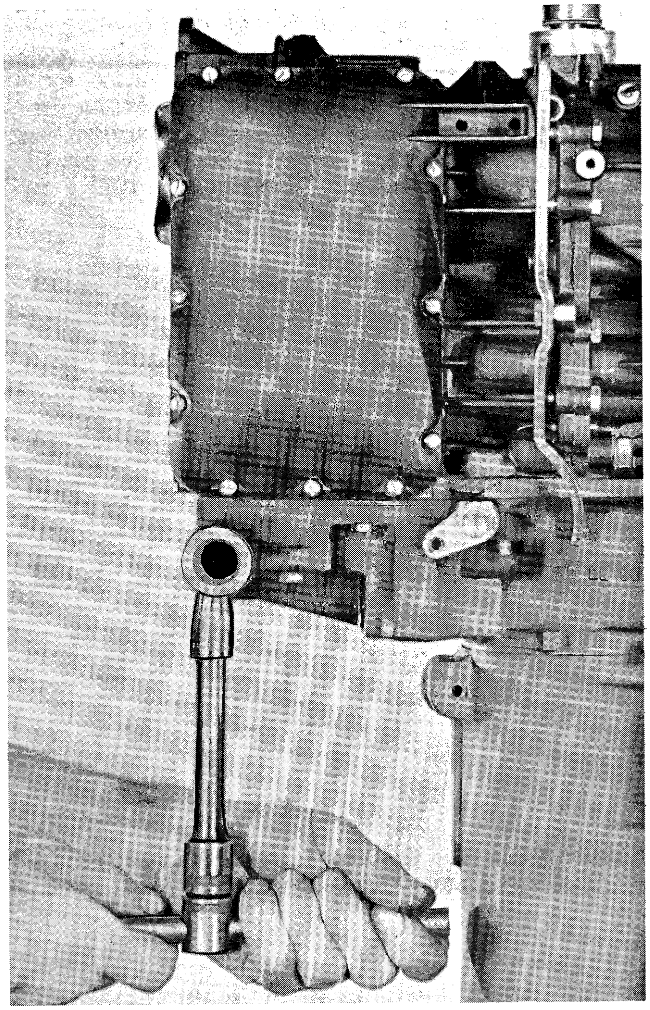


Valve Plate Assembly Removed to Expose Crankcase—Necessary to Remove Allen Head Screws for Complete Disassembly of the Cylinder Block.

Since the leaf or valve plate is constructed of treated steel, do not under any circumstances, flex or bend the segments by hand – to do so will render it "unfit" for further service – discard and replace with new valve. In the process of heat treating a definite tension (spring) is provided each segment; if bent beyond critical point, tension "sets" – that is, the segment will no longer spring back to its normal flat position against the aluminum valve plate. Result is loss of crankcase compression to cause hard starting and faulty operation of the motor. Similarly a broken segment will result in like performance.

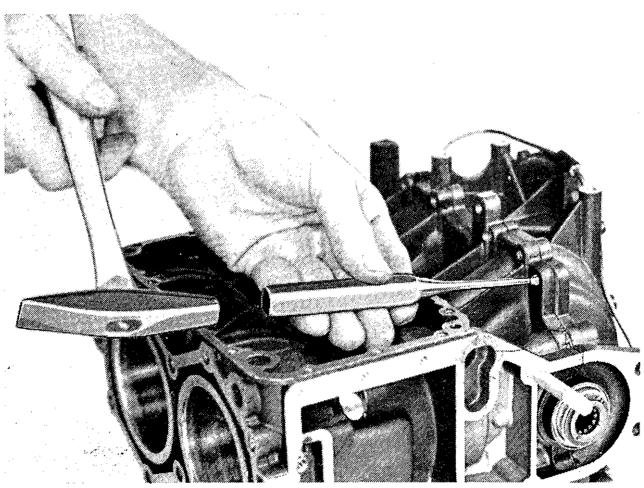


Automatic Valve Plate Assembly.



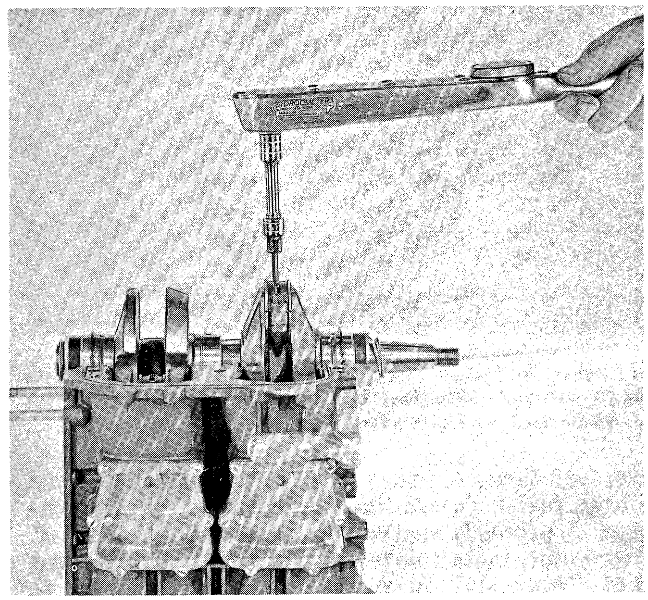
Removing Power Head from the Lower Unit.

To detach balance of the power head from the lower unit assembly, it requires removing all the screws holding it fast in this position. Carefully place power head on clean bench top for further disassembly. Note gasket placed between both assemblies to seal water transfer and exhaust gases at this location.



Driving Tapered Pin Out with Punch.

Tapered pins (2) are employed to attain proper alignment of the crankcase with respect to the cylinder block proper and crankshaft bearing locations. Drive pins out with flat punch as shown. Remove nuts and screws holding crankcase fast to the cylinder block. If necessary, tap the crankcase lightly with mallet to free — lift from position. (Note: Allen head screws in manifold areas—back of automatic intake assembly.)



Removing and/or Installing Connecting Rod Allen Head Screws.

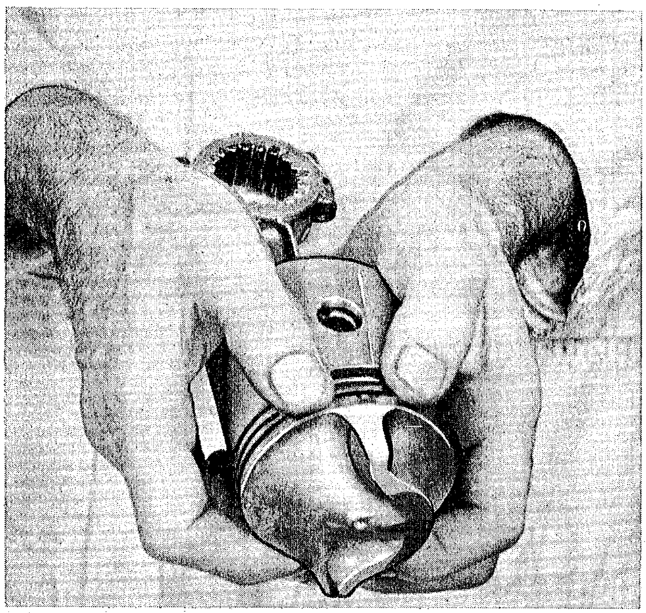
Crankshaft and connecting rod-piston assemblies are now accessible for inspection and removal. Connecting rods should be marked No. 1 (top) and No. 2 (bottom) with pencil or chalk to avoid interchanging on reassembly if same assemblies are again installed—also, at the time bear in mind to retain original position of roller bearing-retainer assemblies and connecting rod caps (connecting rod and caps are "matched" assemblies, do not attempt interchanging the connecting rod caps).

Piston and connecting rod assemblies may now be detached from the crankshaft. Remove Allen head connecting rod cap screws (use Allen head wrench) lift caps and bearing retainer assemblies from respective crankpins. Lay on clean bench top in positions like that removed to avoid interchanging later on.

Lift crankshaft assembly from the crankcase (upper half in cylinder block). Remove balance of connecting rod roller bearing-retainer assemblies —lay on bench next to corresponding caps to retain original position.

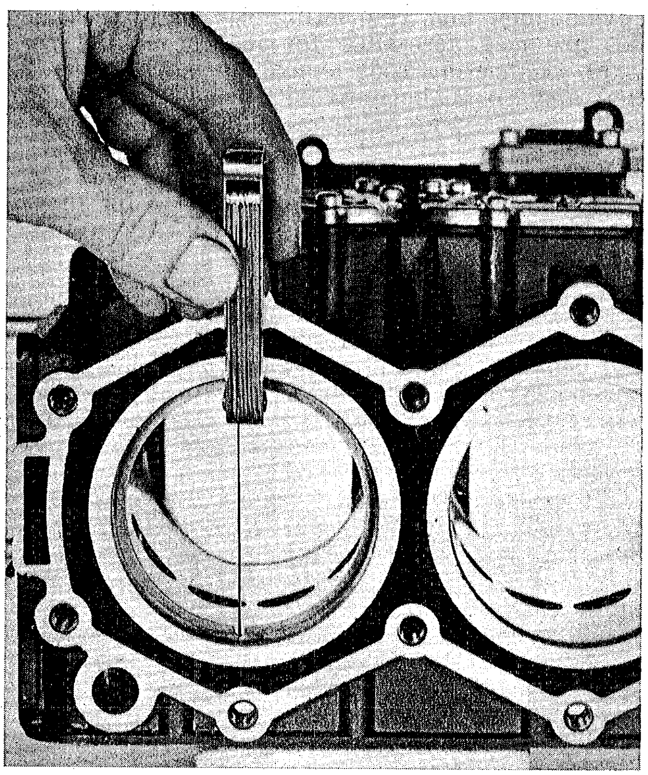
Push connecting rod-piston assemblies out of cylinder bores. For time being, replace respective connecting rod caps, bearing-retainers and caps to prevent later interchanging.

The piston rings may now be removed for inspection or replacement—spread between thumb and forefinger to slip off over head of the piston. Install in similar manner. Check piston rings for



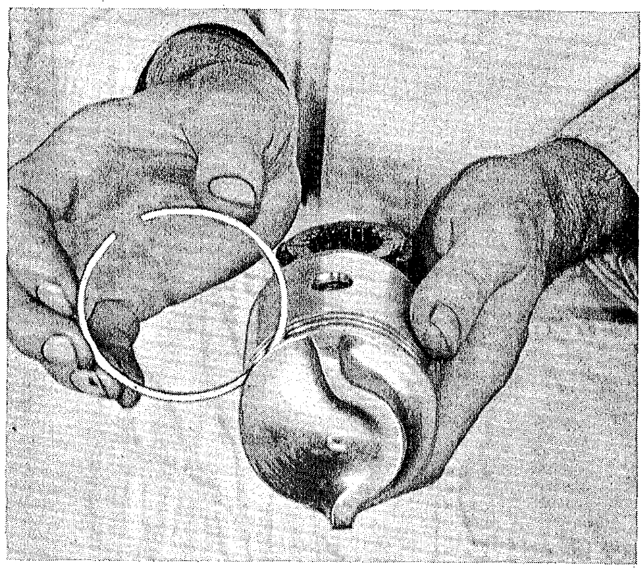
To Remove or Install Piston Rings, Spread Between Thumb and Forefinger—Slip Over End of Piston, Being Careful Not to Scratch or Otherwise Injure Piston Ring Lands.

wear—if faces exposed to cylinder wall are worn to high polish (glass-like appearance), replace the rings. A properly seated ring wears to a dull luster. If in doubt, install new piston rings. Place the new rings "squarely" in respective cylinder bores to check gap clearance between ends of ring-recommended .007" to .017", using feeler strip or gauge of corresponding thickness.



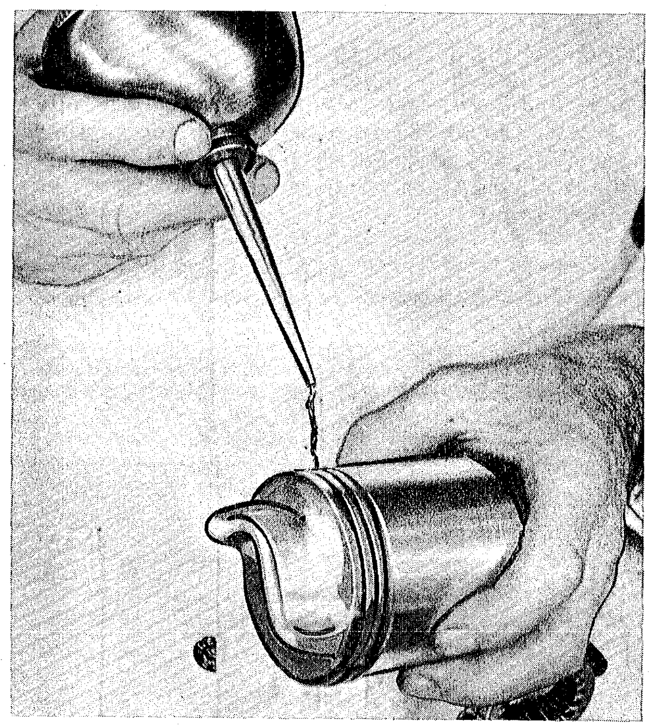
Checking the Piston Ring "Gap" Clearance with Feeler Strip of Recommended Thickness.

Remove carbon from piston ring grooves to prevent rings sticking and becoming partially inactive—result is loss of compression. Operation may be easily performed with small narrow scraper being careful not to scratch or otherwise damage the groove walls. Check each ring in respective piston ring groove for possible "tightness." Roll ring around groove as illustrated here.



Checking Piston Ring Grooves for Burrs or Other Damage to Prevent Piston Ring Binding.

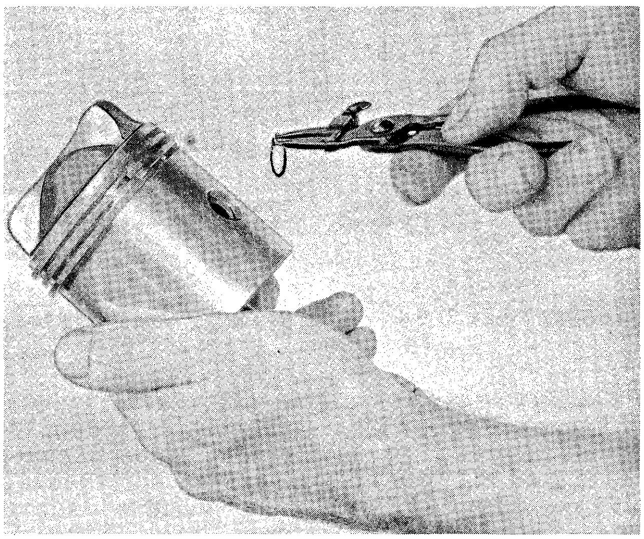
There should be no indication of sticking or binding—check ring grooves and side walls for possible causes (burrs, nicks, or other damage)—dress down high or tight areas.



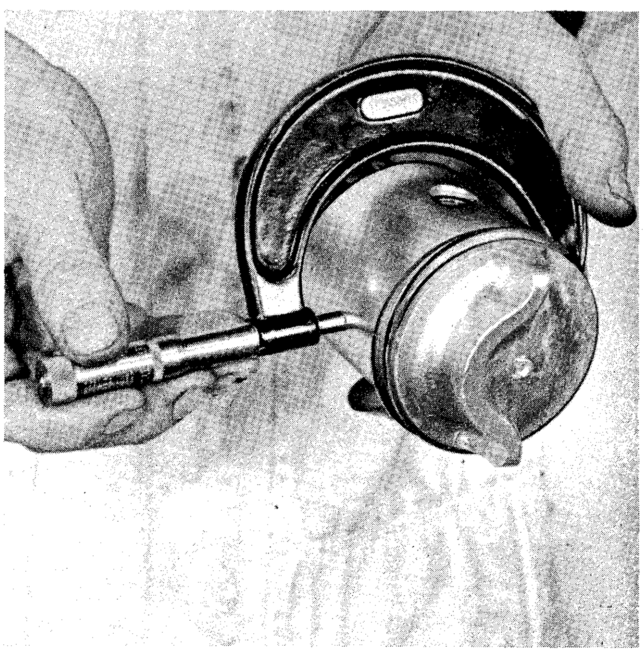
Oiling Piston Ring Grooves—Piston Rings Installed.

On having installed piston rings, apply oil to ring grooves as shown. Roll rings around piston to spread. Note pins in ring grooves to locate position of rings on piston—adjust rings so that gap locates over the pin.

Piston (wrist) pin is full floating (some models) – free in the piston bosses as well as being free in connecting rod top end. To remove, simply remove the retainer ring with sharp long-nose pliers – one on each side of the piston. It is then only a matter of pushing the pin out with thumb or finger. Reinstall in reverse order but apply oil to surfaces prior to doing so – make no dry assemblies where lubrication is involved.

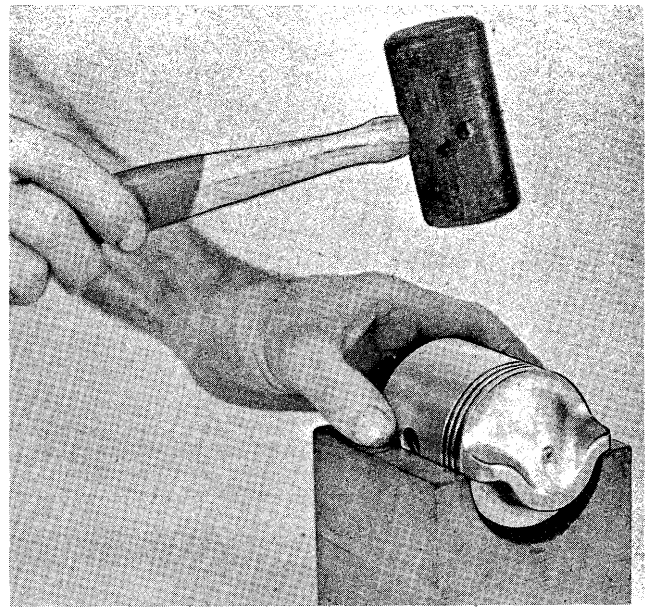


Removing and/or Installing Wrist (Piston) Pin Retainer.

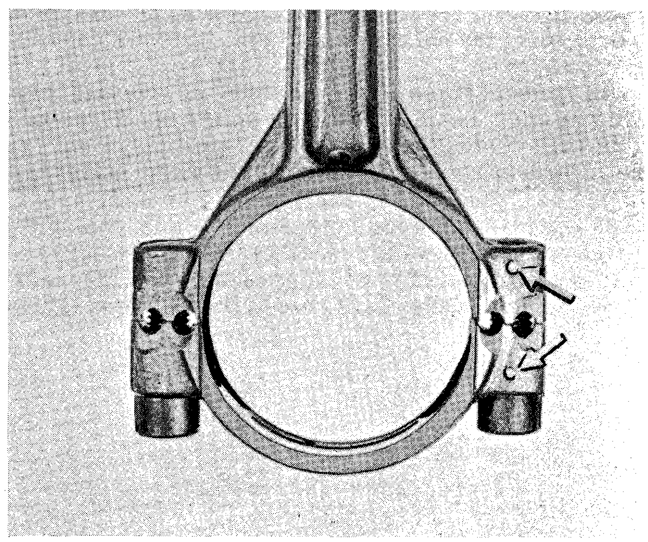


Checking "Roundness" of Piston with Micrometer.

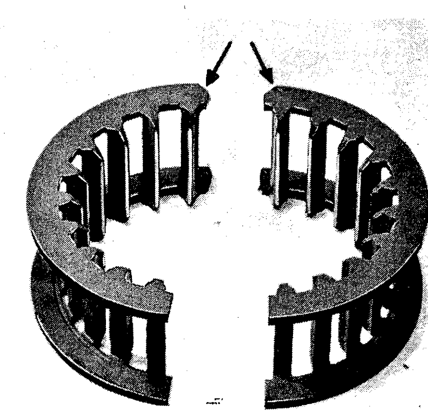
Check "roundness" of piston with micrometer. If necessary "true up" by placing piston in hollowed block, strike lightly on high side with mallet.



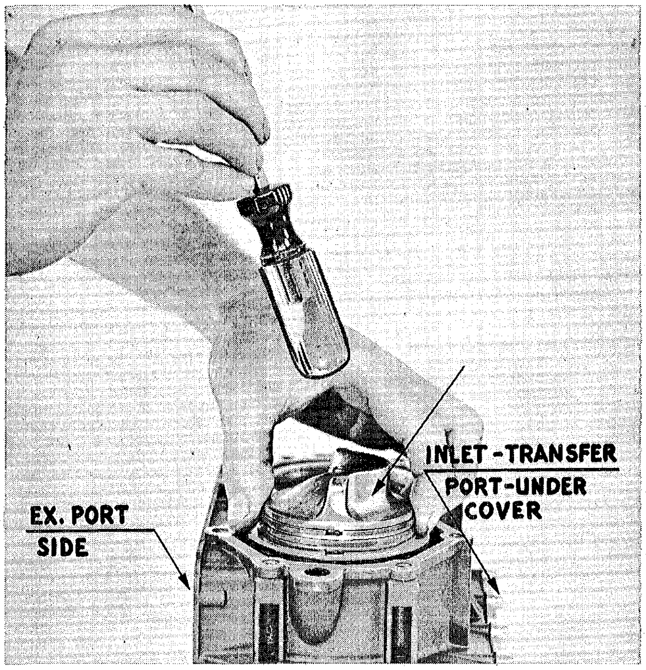
"Rounding" Piston.



Showing Match Marks on Connecting Rod and Cap.

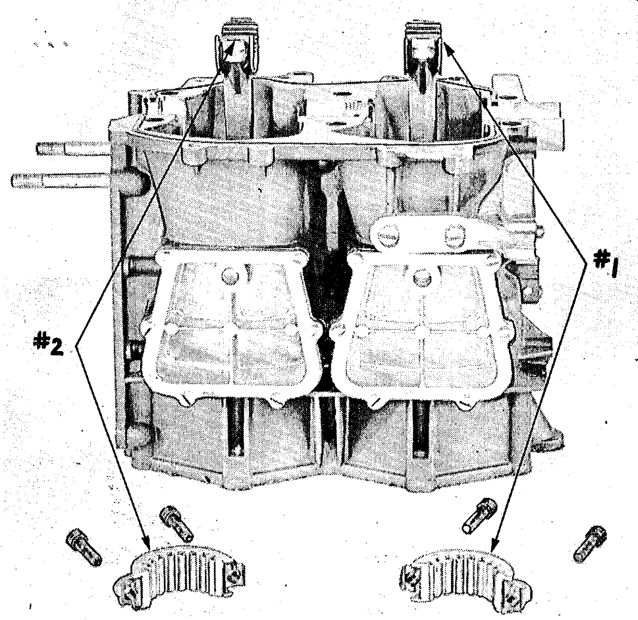


Showing Match Marks (Slants) on Connecting Rod Roller Bearing Retainers. RD-10 through 21.

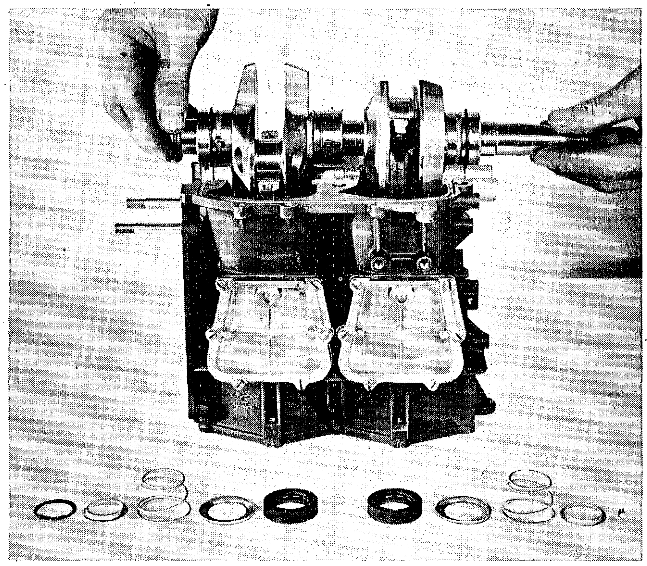


Showing Installation of Piston—Note the Straight Side of Piston Deflector Faces Side of Transfer or Intake Port—Opposite of the Exhaust Port. THIS IS IMPORTANT!

As before stated, the connecting rod and cap are matched assemblies—that is, not interchangeable with other like parts. In the process of manufacture, the rod and cap are machined as an integral or "solid" unit, then broken or split apart. This operation leaves both the rod and cap with rough or serrated-like surfaces which when replaced, provide correct alignment bearing surface and side walls. Care should be exercised when attaching the cap to assure its "falling" into place—rough areas "matching." To avoid turning the cap end for end—both rod and cap are marked to aid in matching.

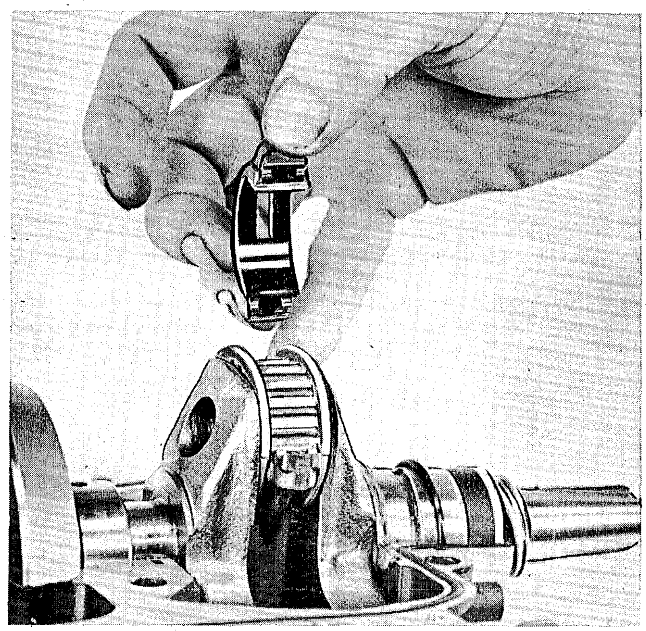


Piston-Connecting Rod Assemblies Installed Prior to Replacing the Crankshaft. Connecting Rod Caps and Bearing Retainers Laid Out as to Position of Assembly to Respective Connecting Rods.

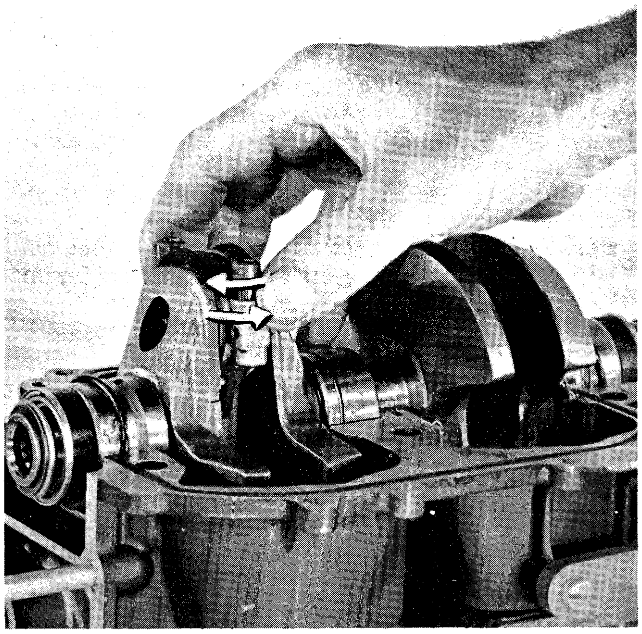


Installing Crankshaft—Prior to Replacing Connecting Rod Caps.

Connecting rod roller bearing retainers similarly machined as one piece later split by sawing to permit assembly on the crankpin, proper matching is required. The "halves" are not interchangeable and must at all times be kept together—wired or tied together in event there is possibility of "mixing" during repair procedure. Neither can they be placed or turned end for end on assembly. Note: "Slant" ground on matching ends or sides—always assemble accordingly.

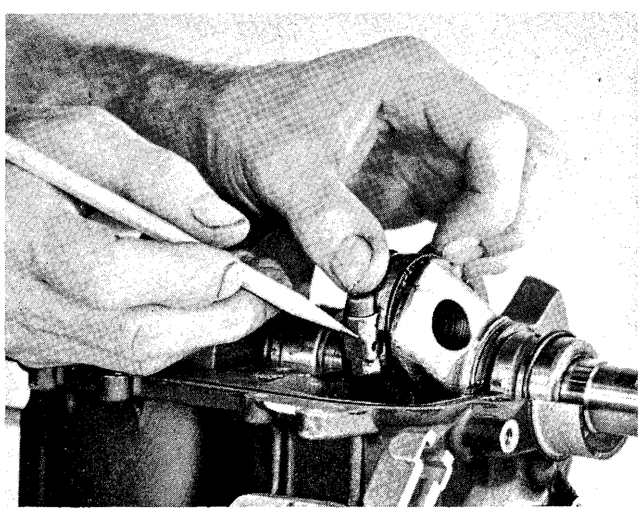


Showing Roller Bearing Assembly Installed on Crankpin and Replacing the Connecting Rod Cap—After Aligning Both Cap and Retainer with Respect to "Matching" Marks.

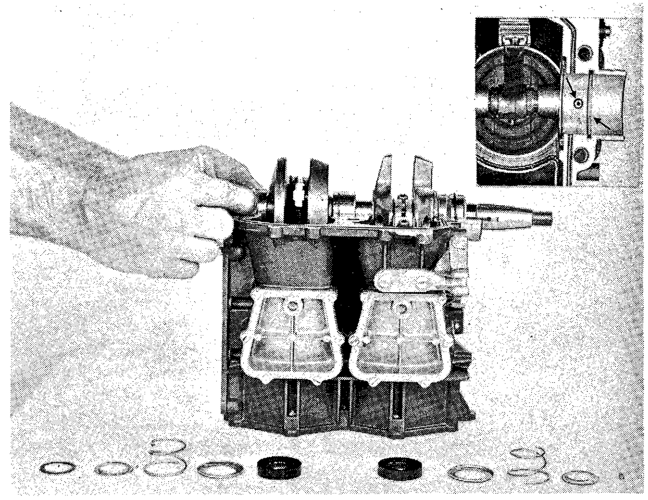


Rocking Connecting Rod Cap to Assure Proper Seating in Corresponding "Fractured" Surfaces of the Connecting Rod Prior to Drawing Up on Allen Head Screws.

Since all three of the "main" crankshaft bearings are of the caged needle or roller type, some provisions of necessity must be made to seal the crankcase compression—at both ends of the crankcase and the center journal or "main" between the two crankcase chambers. A carbon seal is arranged to ride under spring tension against the end of each roller bearing—top and bottom while a grooved bronze bushing is installed adjacent to the center roller bearing as shown. The crankcase being of "split" type requires sealing between the outer bearing assembly and crankcase support—thus the "O" ring as shown on page 304. Constructed of rubber, it compresses between the bearing race and crankcase to seal off compression.



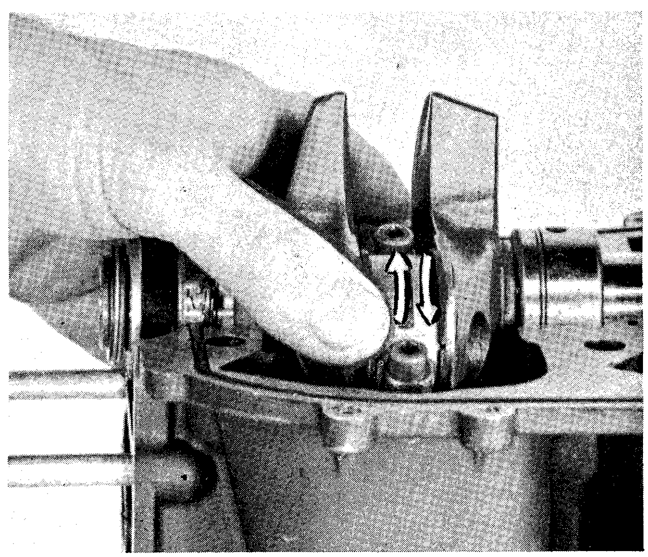
Checking Side Surfaces of Rod and Cap with Sharpened Pencil Point for "Flushness"—Neither Edge Should Overlap the Other. Flush Surface at this Point Indicates Proper Seating of Rod and Cap.



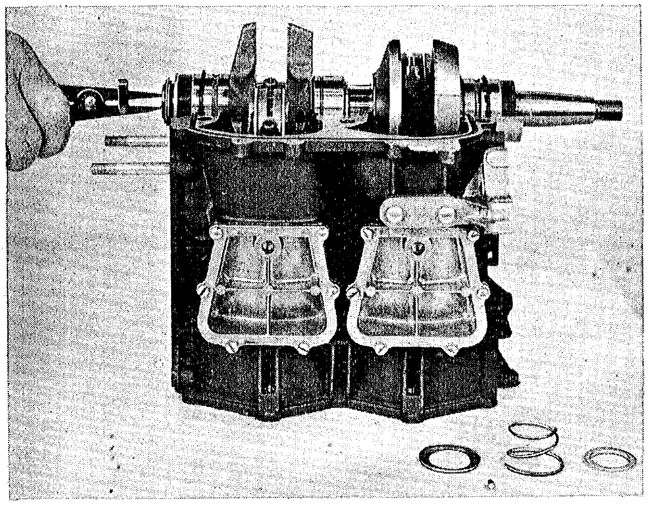
Aligning Journal Bearing Assemblies to Seat Over Pins in Crankcase Bearing Supports. Insert Shows Pin to Align Bearing in Support and Groove to Contain the "O" Ring. Carbon Seals and Attendant Parts to be Later Installed.

To install the piston and connecting rod assembly, note first that the straight side of the deflector on top of the piston must be directed toward the intake or by-pass port in the cylinder—opposite the exhaust port or muffler side of motor—this is IMPORTANT to assure proper functioning.

Insert piston-rod assembly in respective cylinder bore. Compress piston rings with fingers and carefully "tap" into bore with smooth end of screw driver or other object as shown. Gap between ends of the piston ring should ride over the pin in the piston ring groove. Turn assembly end for end—pull piston-rod assemblies out to limit. Insert connecting rod retainer with rollers installed—use clean light grease to retain position.

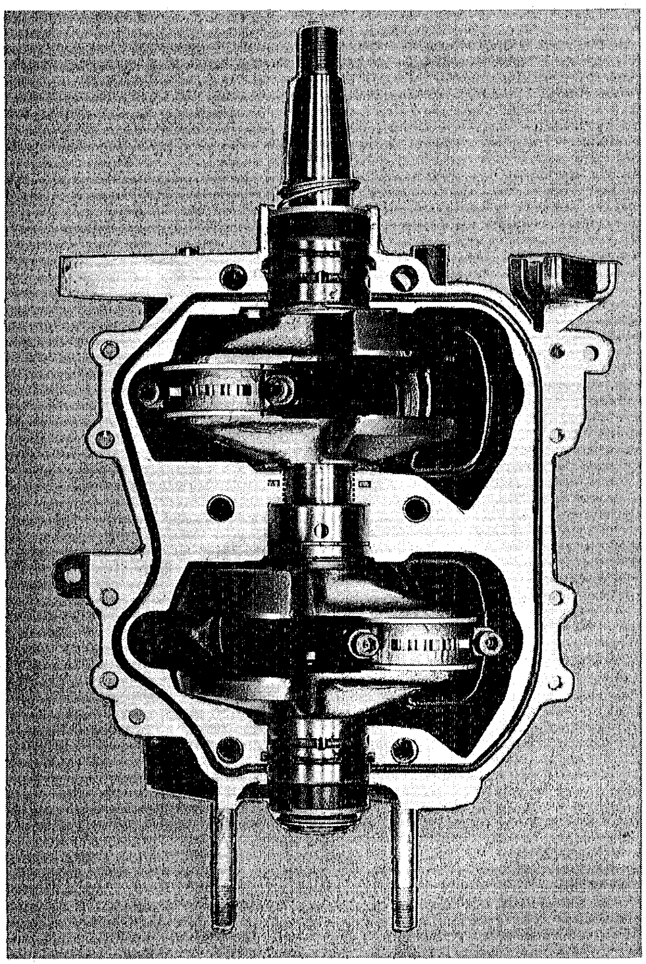


Checking "Freeness" of Roller Bearing Retainer After Assembly—Push Back and Forth with Thumb. Correct Assembly of Rod and Cap and Bearing Retainer Permits Free Movement in This Respect. "Binding" of Retainer Indicates Improper Assembly—Recheck as Instructed—Bearing-Retainer Assembly Should Revolve Freely on the Crankpin and Within the Connecting Rod.



Final Assembly of Crankshaft—Installing Carbon Seals, Springs, Retainer Washers and Retainer Washer on Bottom Journal—Using Pointed Nose Pliers.

Rock cap on rod to make sure proper seating is obtained—accomplished by "feel." Replace Allen head cap screws—draw up but not tightly at this time. Check outside surfaces with sharp pencil point for "flushness." Tighten the Allen head cap screws with torque wrench. See Torque Chart, page 362. Note: In the event wrench is calibrated in inch-pounds, multiply by 12.

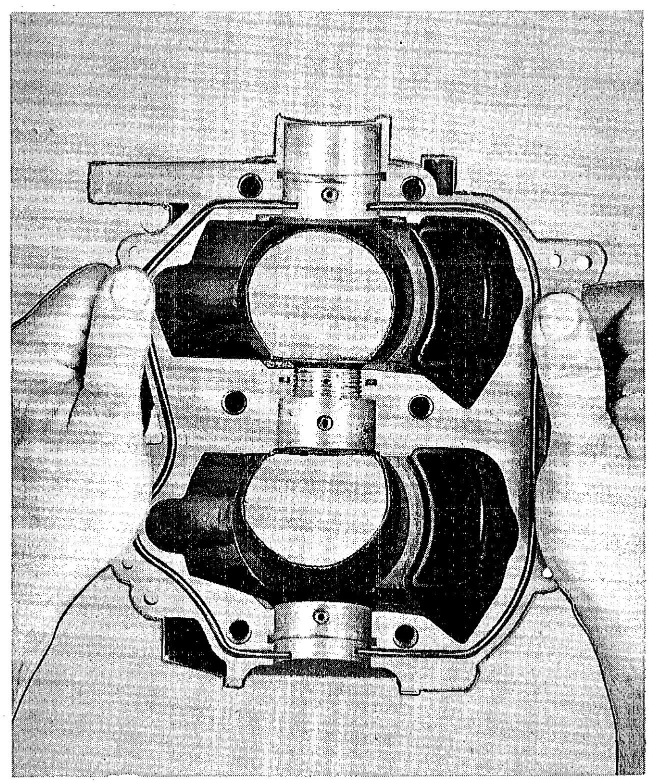


Showing Crankshaft Seated in Upper Crankcase and Seal Strip Installed.

Seat entire assembly of crankshaft and connecting rod assemblies in the crankcase. Note pins in crankcase "main" bearing bosses and corresponding holes in crankshaft main bearing assembly outer cages. Align bearings to engage pins in the crankcase bearing supports.

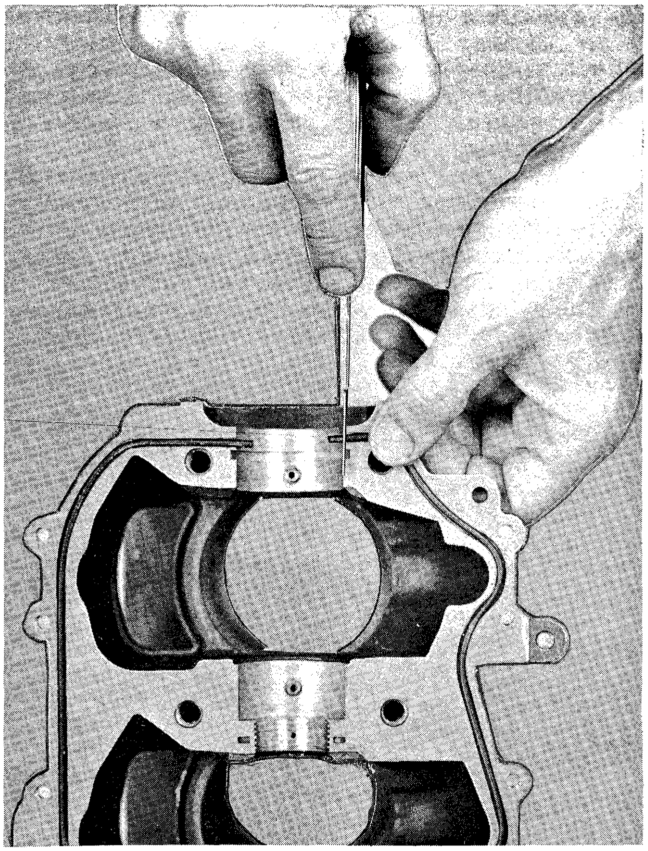
Replace carbon seal washers, springs and the retaining washer on the bottom end. Assembly on top end is held fast by hub of the flywheel.

Note that rubber seal strips of round cross sections are employed to seal the crankcase — fitted into shallow grooves of the upper section (cylinder block) provided for this purpose to accomplish crankcase compression seal in conjunction with "O" rings installed on the top and bottom bearing cages when crankcase sections are bolted together.



Placing Seal Strip in Bottom.

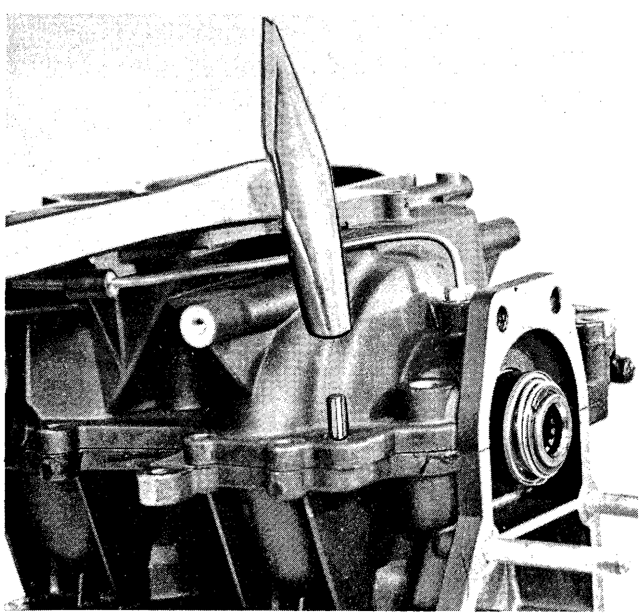
The seal strips, when obtained as service parts come just a bit too long for installation "as is"—this is to permit proper installation or adjustment in corresponding grooves. To install—remove all traces of cement on crankcase faces and grooves, if necessary. Apply Sealer 1000 (or similar hard drying cement) at several points along the grooves and particularly at the end of each groove. Place seal strip in position immediately (before the sealer dries) allowing each end to overhang slightly, then, before the sealer sets, guide the entire length of the strip towards outside edge of the groove in each case. Use thumbs of each hand to accomplish as illustrated. Trim ends with knife allowing ends to hang over just a "hair" to insure proper seal at the end of the strip.



Trimming Ends of Seal Strip.

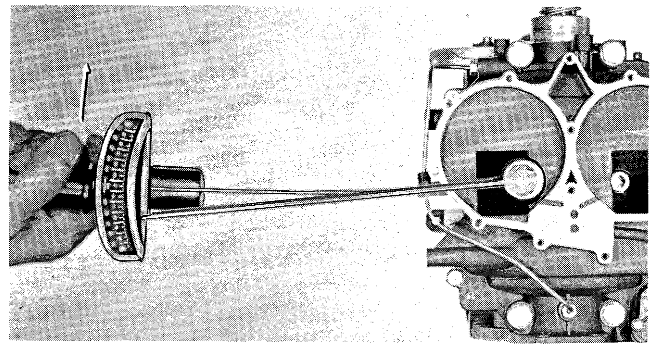
Apply thin coat of Sealer 1000 (or similar hard drying cement) to surfaces to be bolted together —be a bit more generous with sealer in areas at ends of the seal strips to insure a good "butt" seal.

Replace crankcase section — drive in aligning dowel pins. Replace and tighten the bolts and/or screws. Draw up Allen head screws in manifold. See Torque Chart, page 362.

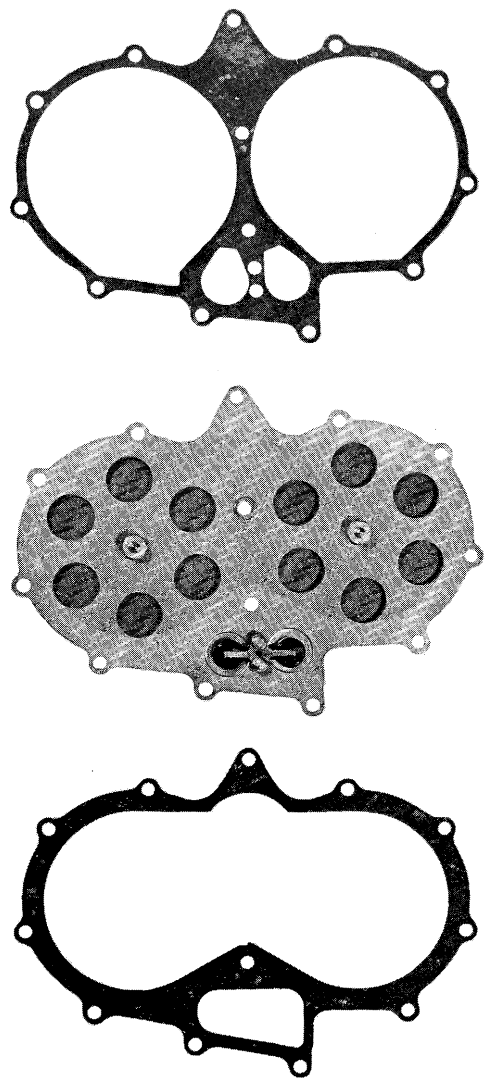


Driving Tapered Dowel Aligning Pins.

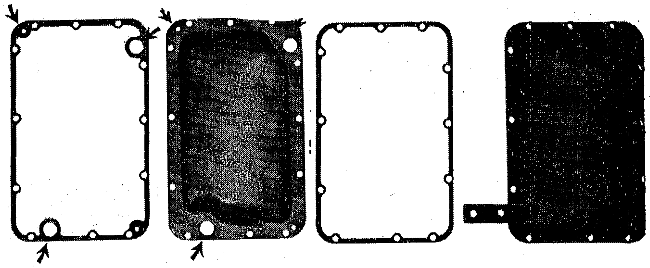
The power head is now ready for final assembly and attaching to the lower unit—followed by replacing the cylinder head, muffler, intake manifold, carburetor, magneto and ready pull starter. Make sure all gasket surfaces are clean, smooth, flat and undamaged—use new gaskets.



Drawing Up Allen Head Screws with Torque Wrench.



Showing Proper Arrangement of Gaskets and Valve Plate Assembly—Top Gasket Next to Crankcase, etc.



Showing Assembly Arrangement of Muffler and Gaskets.

RD GASKET INSTALLATION

It is extremely important that gaskets appearing somewhat alike are installed in their proper locations.

Intake Valve Assembly. Gasket No. 304262 should be installed next to the crankcase (between the automatic intake valve assembly and the crankcase).

Gasket No. 302605 should be installed next to the automatic intake valve assembly (between intake manifold and the automatic intake valve assembly).

Muffler Assembly. Gasket No. 302607 should be installed next to the crankcase (between the crankcase and inner muffler shell).

Note arrows directed to holes in the gasket and inner muffler shell. Make certain holes "match" —holes in the inner shell, holes in the gasket and corresponding holes in the crankcase.

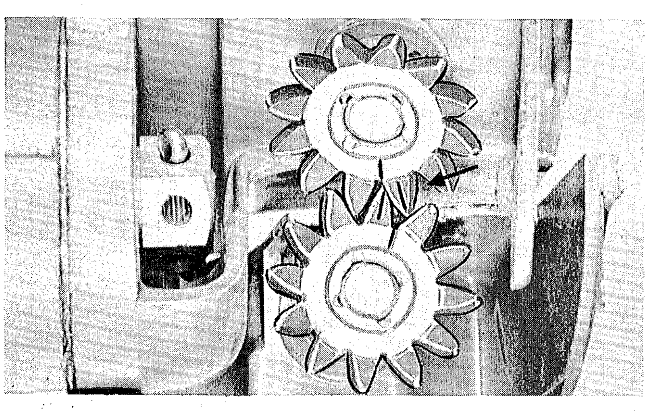
Gasket No. 302608 should be installed next to the muffler inner shell (between the inner shell and the outer shell).

When replacing the magneto armature plate, the cam attached to its under side should be adjusted to engage the carburetor shutter control follower at the point of recess. The cam is provided with slotted holes to accomplish this adjustment—it can be shifted in or out as required.

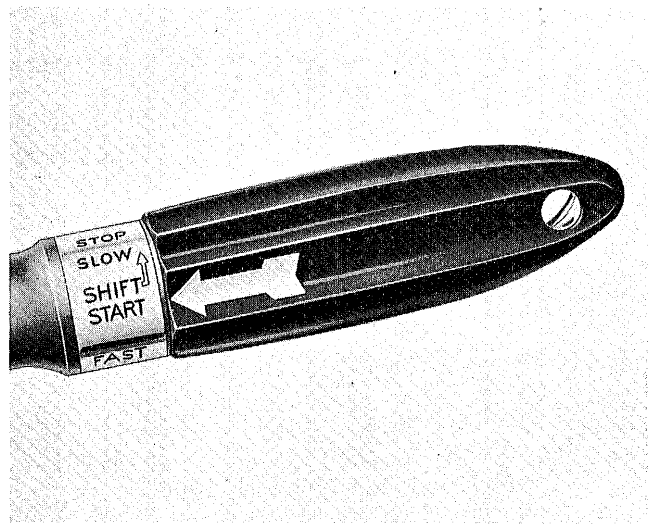
TO INSTALL STEERING HANDLE

Since spark and gas are synchronized and speed control is by the "twist grip" with provisions made for speed limitation when operating in Neutral, some "timing" is necessary when attaching the steering arm—this required to obtain correct position of the twist grip with respect to "markings" on the steering arm and synchronized speed control mechanism.

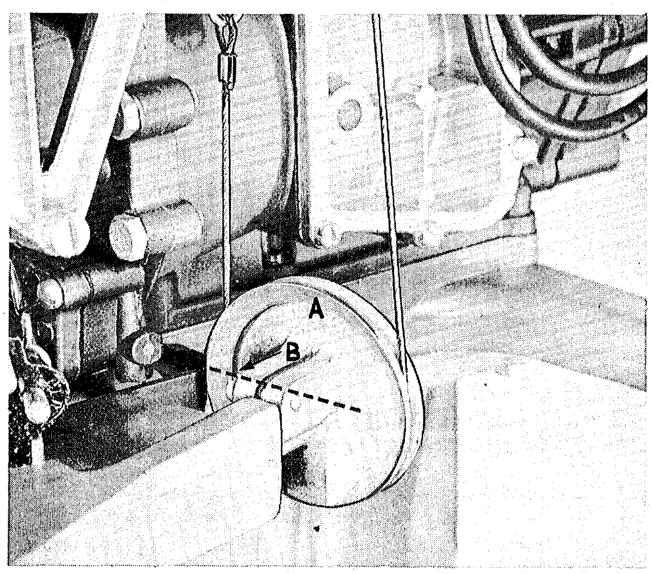
Timing can be easily accomplished—simply mesh teeth on coupling segments in accordance with markings provided for this purpose as shown here. Attach steering arm with segments meshed in this position. Install bolt and nut to hold arm in position—adjust nut as required to obtain the desired steering arm tilt—secure with *cotter pin* for safety.



Timing Marks on Coupling Segments.



Speed Control Grip—Set to "Start" Position.



Showing Position of "Flat" Area on Pulley Boss when Control Coupling Segments are Properly Aligned with Respect to Setting of the Speed Control Grip.

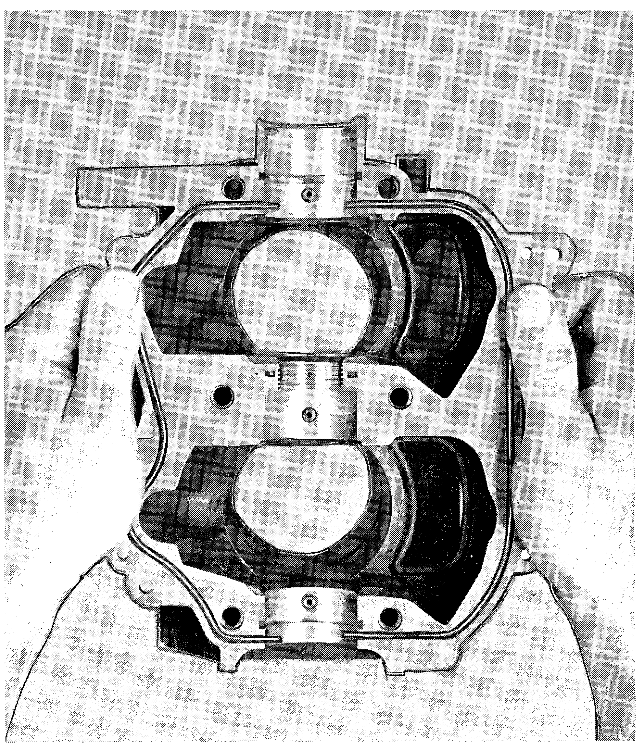
In event timing marks have become obliterated, set speed control grip to position marked "stop" —turn pulley "A" to position where flat area "B" on the pulley boss is horizontal as shown here; engage coupling segments — RD-10 through 16.

RD CRANKCASE ASSEMBLY — OIL SEALING

It is of extreme importance that the RD crankcase sections are properly sealed (cemented) on the repair assembly, particularly in regions where the rubber seal strip "butts" up against the top and bottom journal bearings. Note areas indicated by arrows in Figure 3, page 308, which should be given special attention in this respect. Oil escaping at top journal bearing installation finds its way up under the armature plate and eventually accumulates around and on the magneto breaker point faces to cause hard starting, faulty operation and other attendant difficulties associated with an oil drenched armature plate. Careful sealing and cementing at this point is of considerably more significance now that the "O" ring (#302537) has been removed from the top journal bearing to accommodate the oil return.

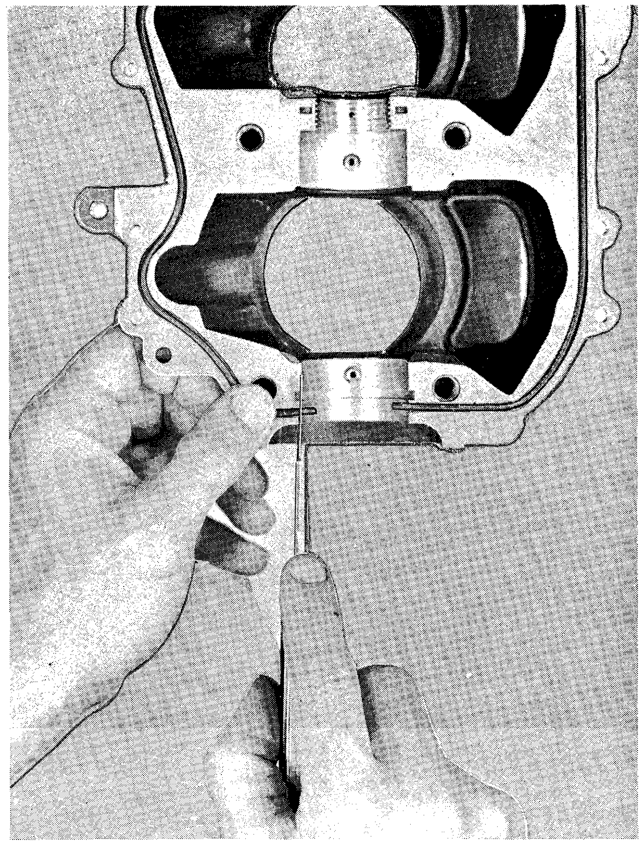
Do not excessively smear cement on areas adjacent to center bearing installation—a thin coat but well spread—surplus of cement here merely squeezes out inside the crankcase which is apt to clog the bleeder orifices to cause motor difficulty later on.

When reassembling always use new carbon seals (#302538) and carbon seal "O" rings (#302540). Install carbon seal with "notch" up.



Placing Seal Strip in position.

Note that rubber seal strips of round cross sections are employed to seal the crankcase — fitted into shallow grooves of the upper section (cylinder block) provided for this purpose to accomplish crankcase compression seal in conjunction with "O" ring installed on the top and bottom bearing cages (earlier models only) when crankcase sections are bolted together.

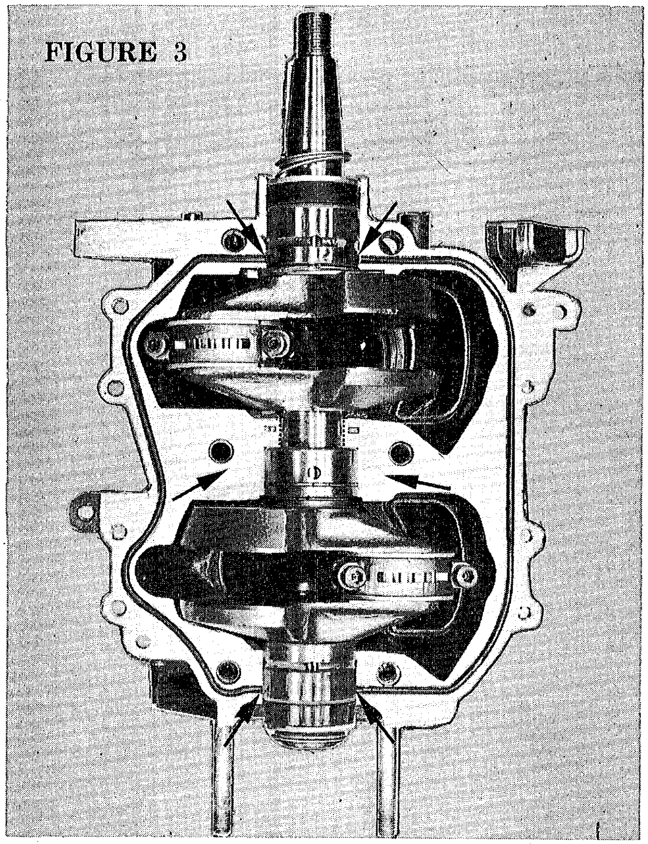


Trimming ends of Seal Strip.

The seal strips, when obtained as service parts come a bit too long for installation "as is"—this is to permit proper installation or adjustment in corresponding grooves. To install — remove all traces of cement on crankcase faces and grooves, if necessary. Apply Sealer 1000 (or similar hard drying cement) at several points along the grooves and particularly at the end of each groove. Place seal strip in position immediately (before the sealer dries) allowing each end to overhang slightly, then, before the sealer sets, guide the entire length of the strip towards outside edge of the groove in each case. Use thumbs of each hand to accomplish as illustrated. Trim ends with knifé allowing ends to hang over about 1/16″ to accomplish a good compressed "butt" seal at the end of the strip.

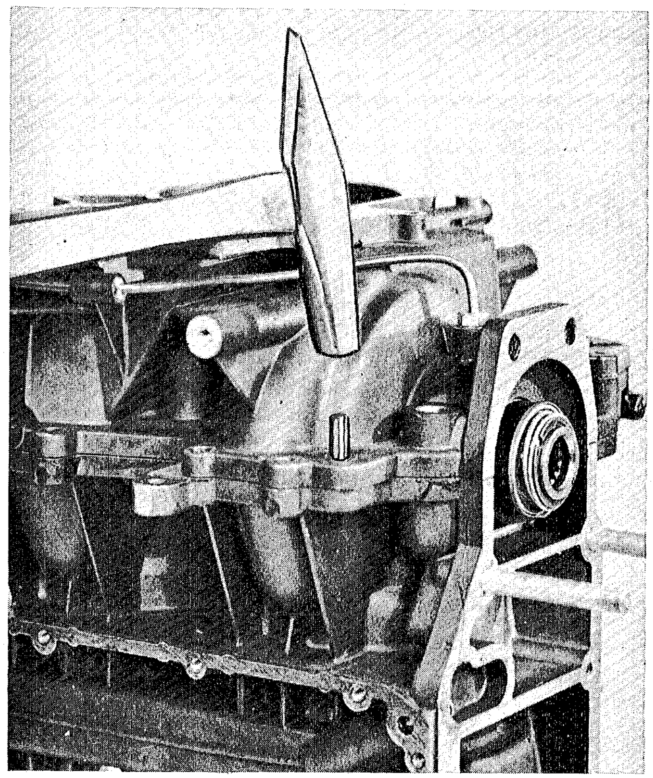
Apply thin coat of Sealer 1000 (or similar hard drying cement) to surfaces to be bolted together—be a bit more generous with sealer in areas at ends of the seal strips to insure a good "butt" seal.

Inspect dowel pins and dowel holes in the crankcase. It is important to remove burrs and traces of old cement, if any exist, to achieve proper alignment of crankcase sections. Make certain dowel pin holes in the crankcase are scrupulously clean with no indication of burrs or nicks on dowel pins.



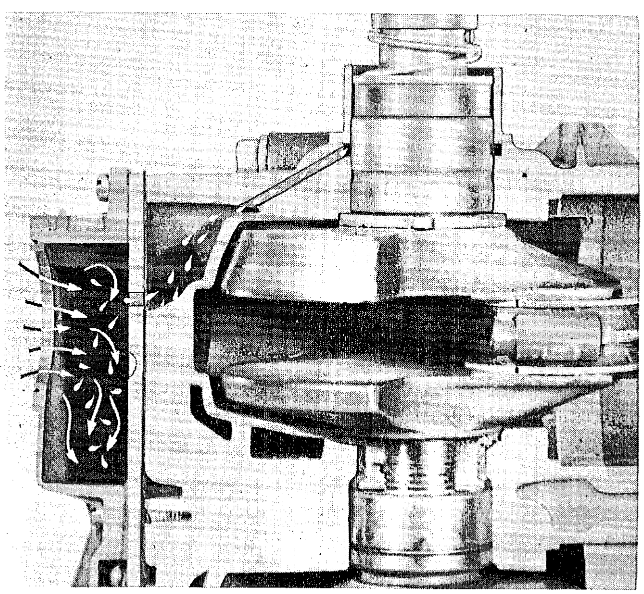
Showing crankshaft seated in upper crankcase and Seal Strip installed.

Replace crankcase section—drive in aligning dowel pins. Replace and tighten the bolts and/or screws. Draw up Allen head screws in manifold area and balance of crankcase screws to 12 to 14 ft. lbs. tension with torque wrench.



Driving tapered dowel aligning pins.

OIL RETURN – UPPER BEARING – "O" RING NO. 302537

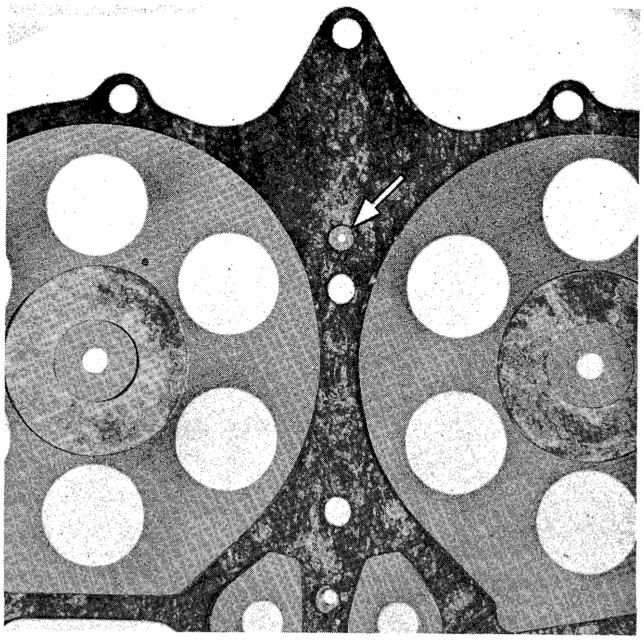


Schematic layout to illustrate oil return.

A change was made recently to provide an oil return from the top journal bearing in the Model RD which eliminated installation of "O" ring seal, #302537.

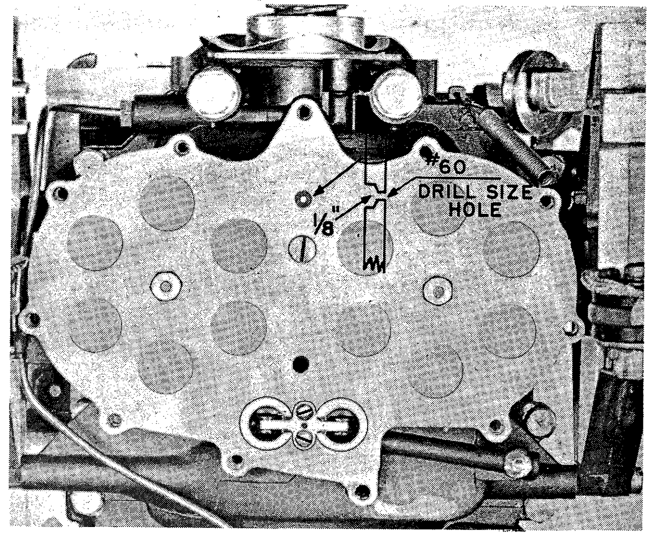
To accomplish, a small hole has been drilled in the crankcase groove formerly employed to locate the "O" ring—in the crankcase half. As may be observed from the illustration, overflow oil seeps into the small pocket back of the valve plate, where a corresponding hole permits its entering the fuel-vapor stream flowing through the manifold and on into the crankcase to complete the circuit.

When receiving and installing a new cylinder assembly during repair, exclude "O" ring #302537 from the assembly. Use gasket #304262 provided with the cylinder as a template laid on back side of the valve plate. It will be noted that all holes in the gasket will align with like holes in the valve plate, except one—indicated by arrow in the illustration. Scribe location of this hole on the valve



Arrow indicates hole to be scribed on the valve plate and later drilled as described here.

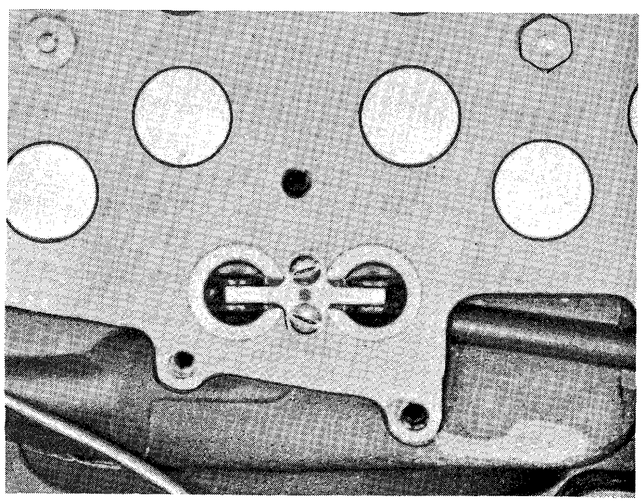
plate and drill through the plate with a No. 60 drill. Countersink with 1/8″ drill approximately half way through as shown in the cross sectional "sketch." Complete assembly thereafter in the customary manner.



Sectional sketch to illustrate drilling of the valve plate to accommodate oil return.

The above operation applies only to RD-14, 14A and earlier.

CRANKCASE PRESSURE RELEASE CHECK SPRING NO. 302048



Pressure Check Valves and Spring. Pressurized Gas Tank Models Only.

There may be occasion when a falling off in performance of the Model RD (and other models with pressurized tanks) is noted for no apparent reason except that perhaps it might be contributed to fuel supply — not quite enough pressure for maximum performance.

Ordinarily a situation of this sort could be traced to some irregularity in the fuel tank or fuel line assemblies — loss of pressure by way of faulty gaskets, fuel line fittings, punctured diaphragm, discrepancy in assembly, etc. (see Page 151 Service Manual); however, a temporary exchange of fuel tanks often fails to divulge any appreciable improvement.

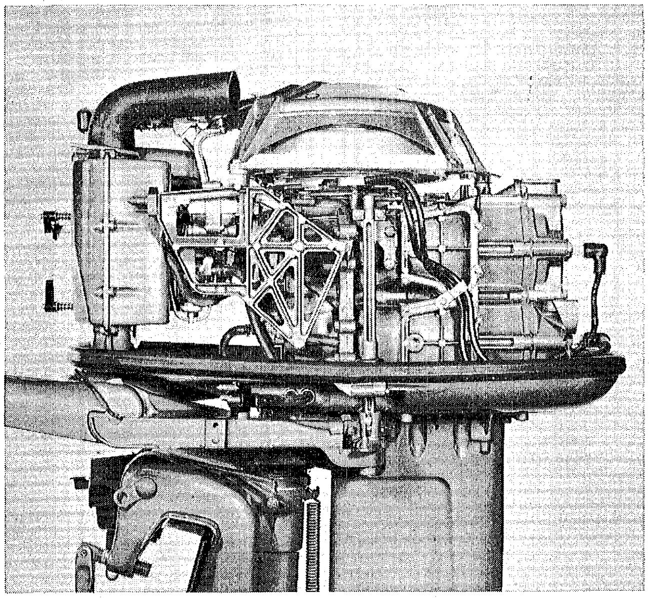
Since instances have been reported where removal of the filter element has led to better top speed performance, it is reasonable to assume the fault lies in the pressure "pumping" mechanism, providing the element removed was not excessively clogged with foreign matter.

In this event, look to the pressure check valves and/or spring attached to the valve plate as possible disturbing factors. Any irregularity in seating of the "rubber" checks, insufficient spring tension or otherwise faulty assembly, will interfere with pressurizing of the tank for best performance.

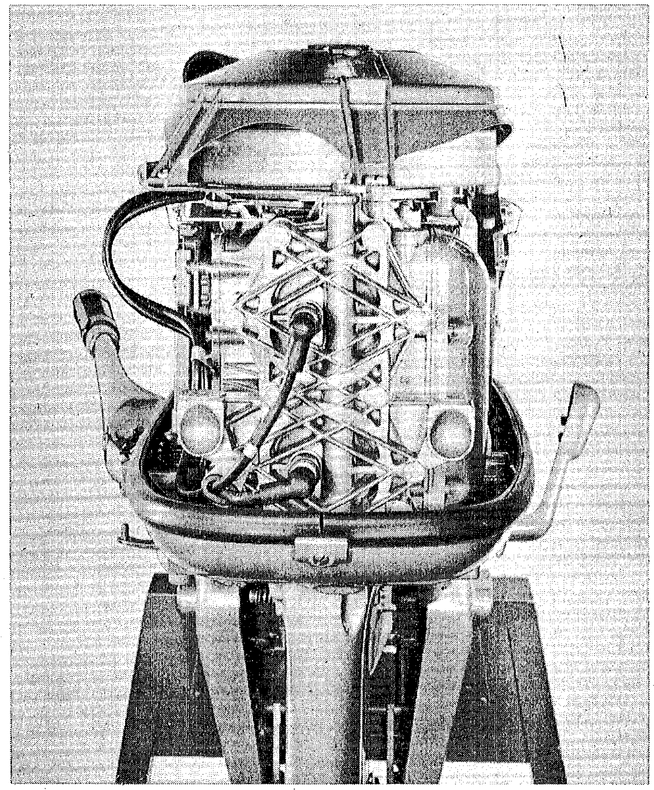
A change was made in tension of spring #302048 — tension increased to exert added pressure on the checks and thus insure more efficient valve action to maintain normal tank pressure — 4 to 5 pounds. The new spring may be identified by its .008″ thickness — the original was .005″.

Keep in mind when diagnosing performance difficulties — install one of the new springs at every opportunity and a new rubber check valve #302042 as a precautionary measure. Make sure assembly is securely mounted.

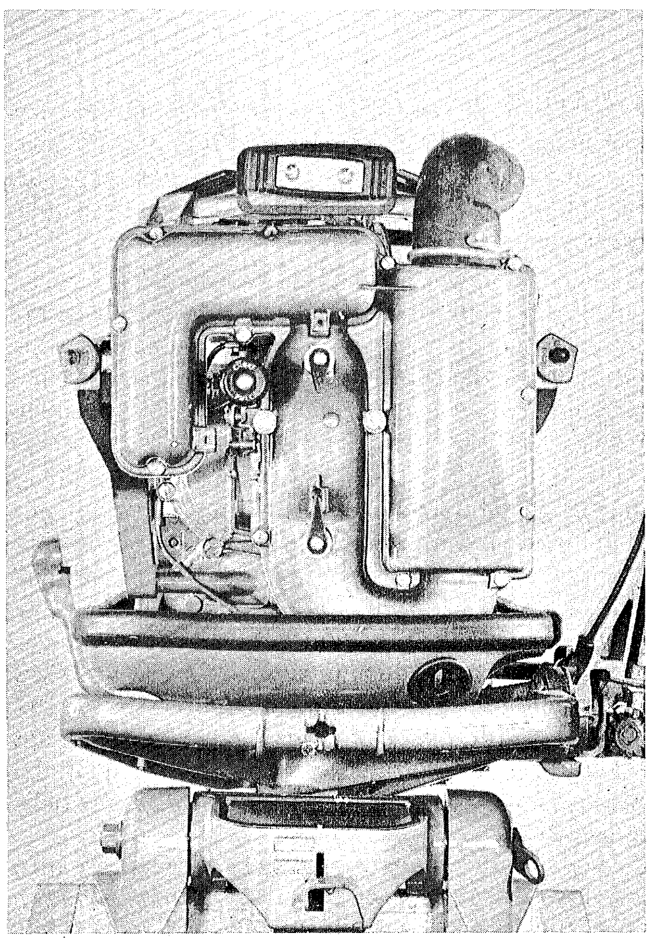
MODEL RD-17 POWERHEAD



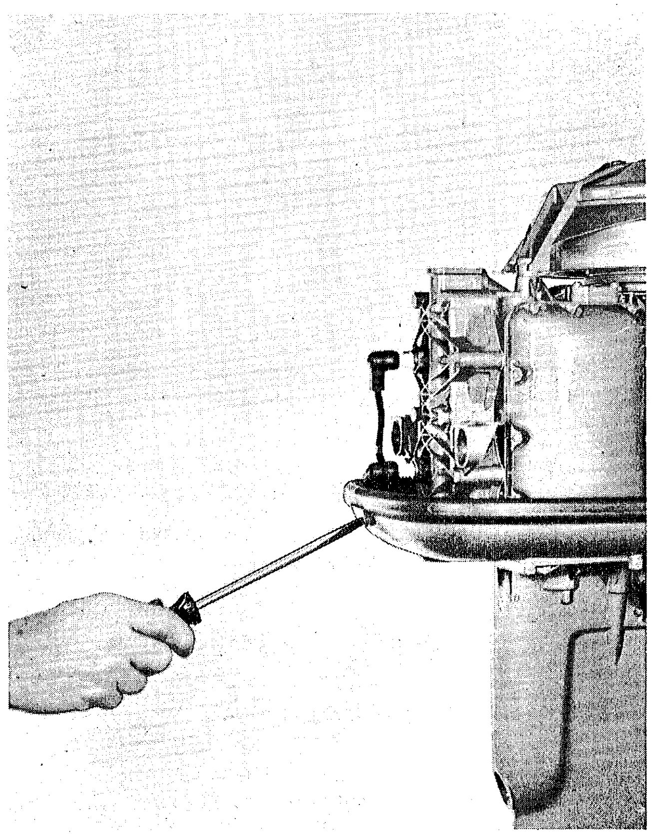
Since construction details of the RD-17 powerhead are fundamentally like those of the preceding models, the several service operations are to be performed in like manner. Refer to pages 292 to 306, inclusive and pages 309 through 492.



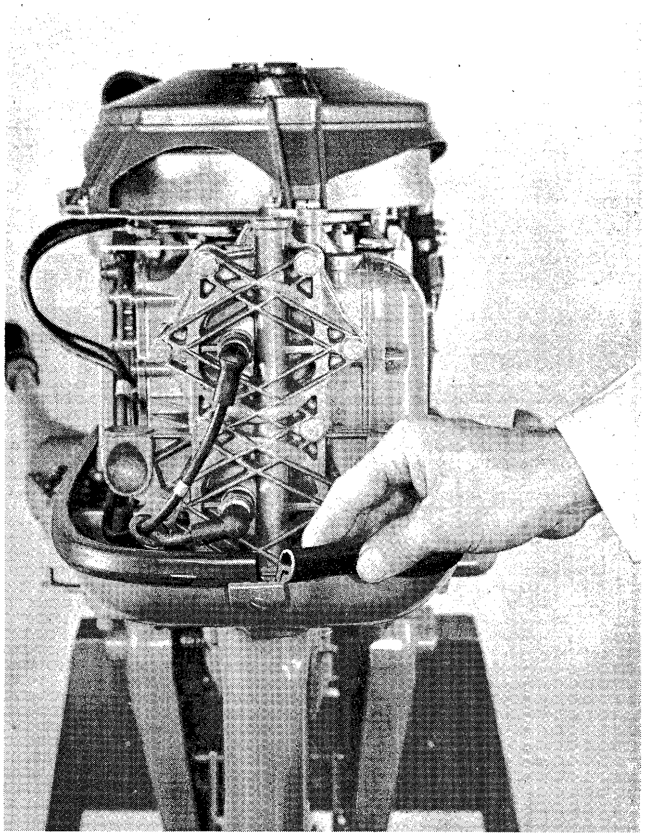
Rear view of powerhead showing installation of the motor cover pan grommet.



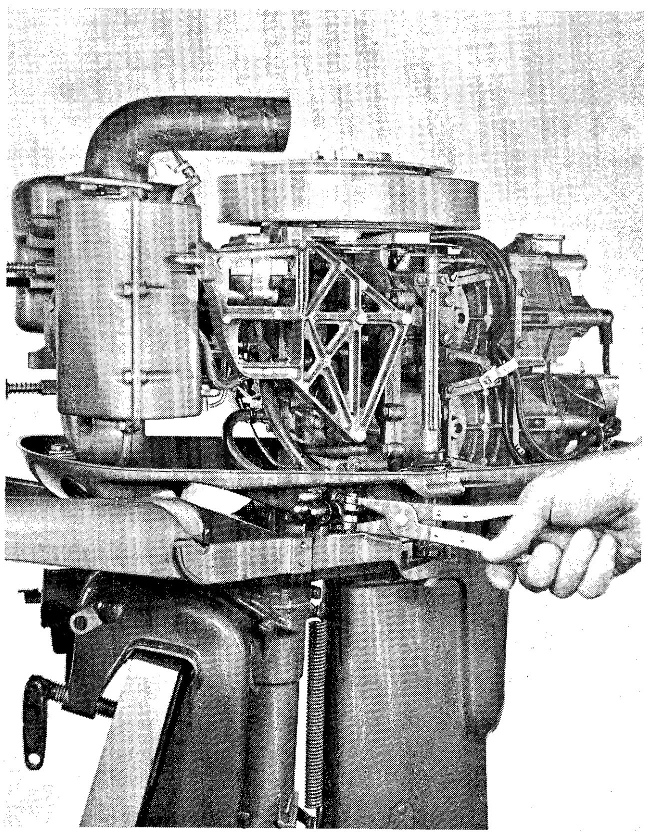
Front view of powerhead showing installation of the carburetor silencer.



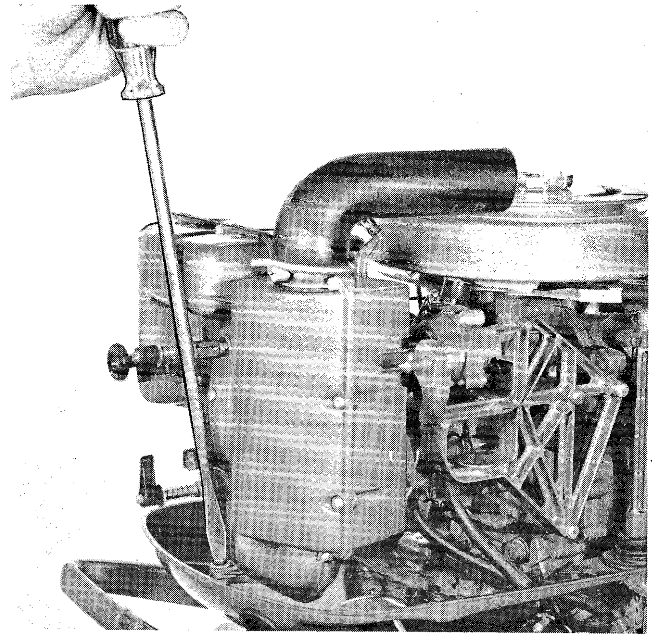
Releasing rubber grommet from the motor cover pan.



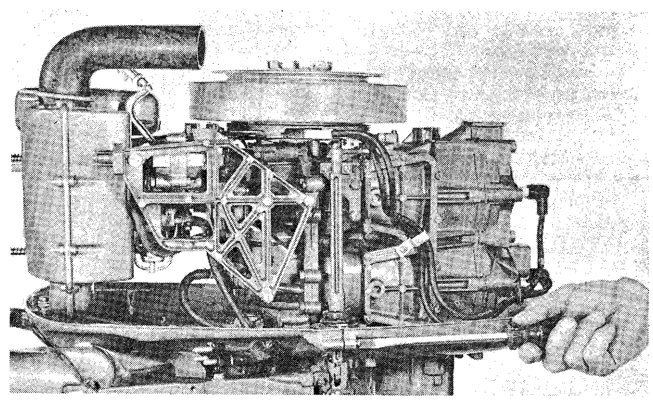
Removing and/or installing the motor pan grommet — to facilitate ease of installation, simply coat edges of the pan lightly with oil or liquid soap.



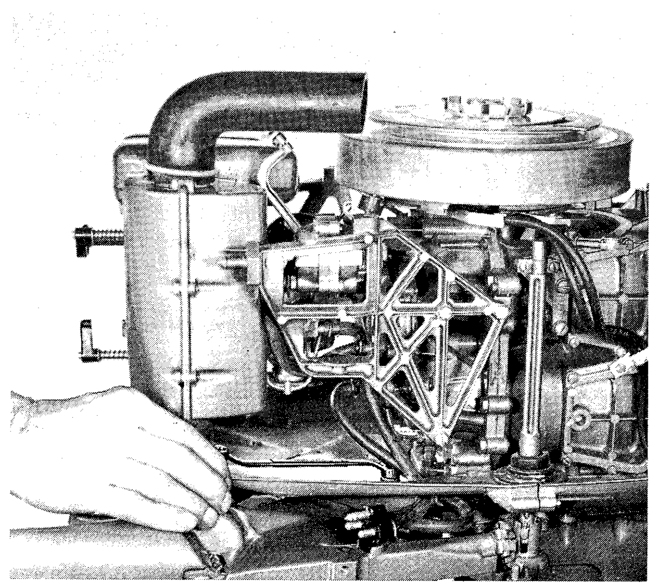
Detaching fuel and air pressure lines from the fuel connector to permit removing front section of the motor pan.



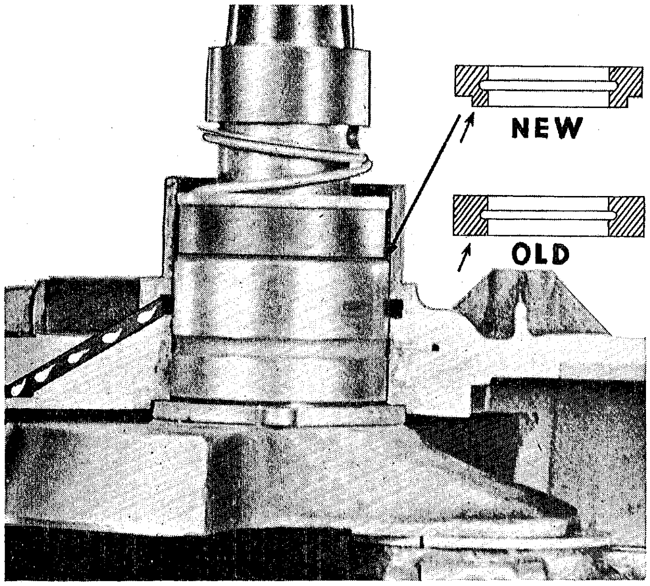
Releasing carburetor silencer from front section of the motor pan.



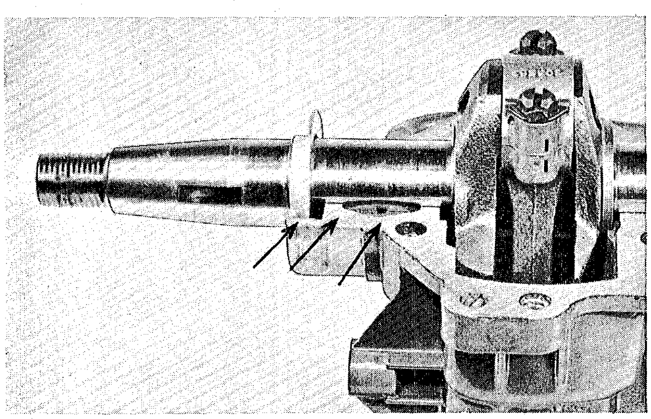
Releasing front section of the motor pan from the rear section.



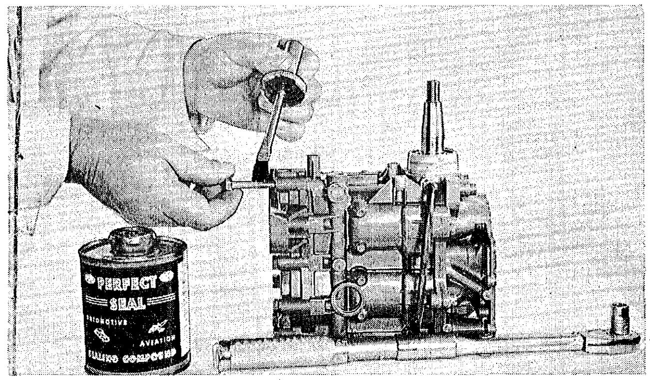
To finally detach the front motor pan section, remove screw shown above to free it of the lower unit assembly.



#302538 carbon seal for the top end of the Model RD crankshaft has been changed some in design—this to facilitate a better oil seal at the top face of bearing #375763, the purpose of which is to minimize possibility oil laden crankcase vapor escaping and eventually accumulating on the breaker point contact faces to interfere with magneto performance.
Above change has consisted of machining a narrow face on the lower side of the seal where it "rides" on the top face of the bearing; the original seal was cut "straight across" to leave a much wider seal face, which doesn't "seal" as well as the narrower face.
IMPORTANT—It is important that WHENEVER THE FLYWHEEL is removed or on other occasions when presented, the old seal (if installed) be removed and one of the new design be installed as a safeguard against "oily" points and resultant faulty motor operation. Install with notches UP. Install also a NEW #302540 "O" ring.

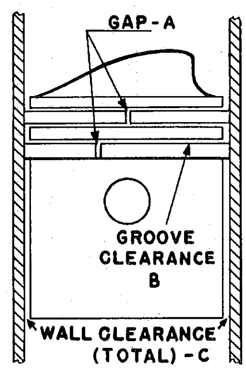


Function of the oil slinger (where installed) as attached to the crankshaft (shown here) is to prevent oil escaping from upper journal bearing "spewing" over the armature plate—escaping oil is subsequently returned to the crankcase by way of the intake manifold with following incoming vapor charges.
It is possible, however, for oil to find its way to top face of the armature plate in event "matched" surfaces of the crankcase and cylinder block in the area are not properly cemented on assembly. When installing the crankcase after motor repair or to overcome oil seepage in this respect, make certain regions indicated by arrows (both sides of the crankshaft) are well cemented with sealer 1000 or other similar hard drying cement — avoid an over abundance of cement which is apt to "clog" the oil return channel as it "squeezes" out when drawing up on the crankcase screws, but at the same time, assuring an "oil tight" assembly. Oil "spewing" over the armature plate contributes to early breaker point failure—keep the armature plate free of oil.



Spread thin coat of non-drying cement – Perfect Seal No. 4 or similar – on all threads prior to assembly, particularly in salt water areas, to avoid corrosive effects, stripped threads, broken studs, etc., on subsequent disassembly.

PISTON AND RING FITTING



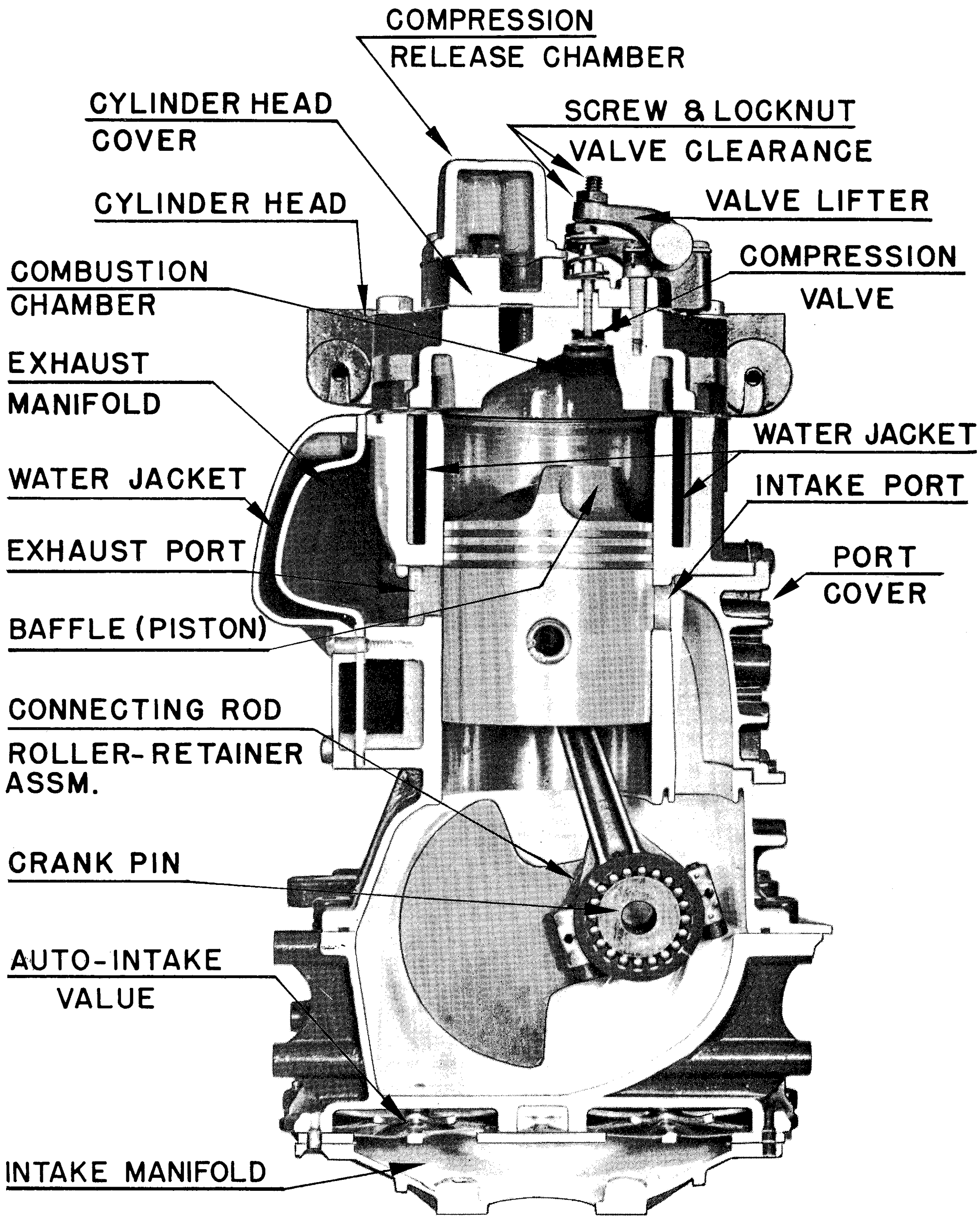
Factors contributing to good motor performance are concerned a great deal with properly fitted pistons and piston rings, and of course, round bores among other details — but the pistons and piston rings must be correctly fitted with just the right amount of clearance or "leeway" to compensate for various degrees of expansion as result of operating temperatures encountered, as follows:

	HD	JW	TD
A.	.004 - .0014	.005 - .015	.005 - .015
B.	.001 - .0035	.001 - .0035	.001 - .0035
C.	.0010 - .0025	.0013 - .002	.0010 - .0025

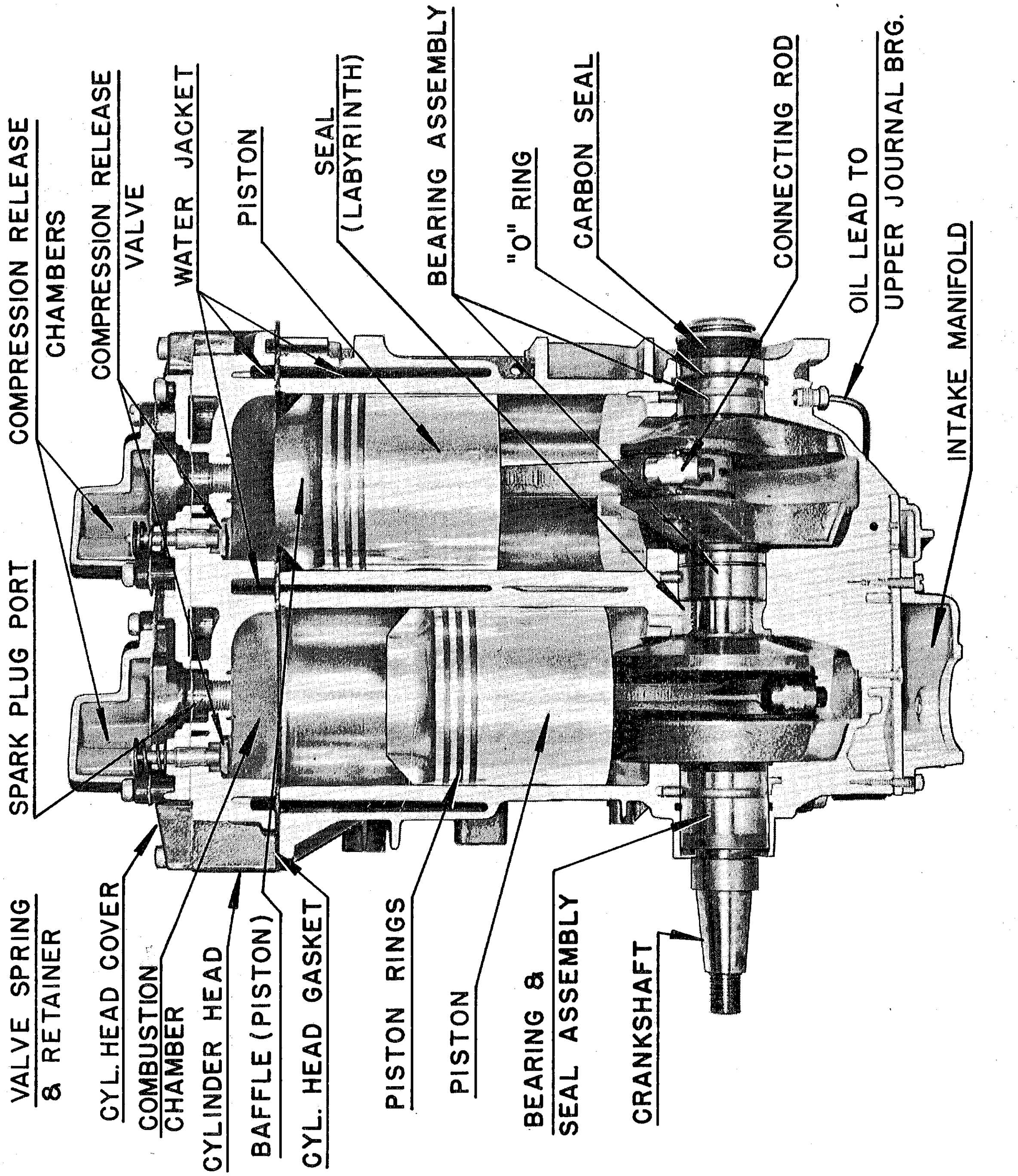
	TN	CD	QD
A.	.005 - .015	.005 - .015	.007 - .017
B.	.001 - .0035	.001 - .0035	.001 - .0035
C.	.0010 - .0025	.0013 - .0025	.002 - .0035

	SD	PO	RD
A.	.007 - .0017	.005 - .012	.007 - .017
B.	.001 - .0035	.0025 - .0045	.0045 - .007
C.	.002 - .0035	.005 - .0065	.0025 - .004

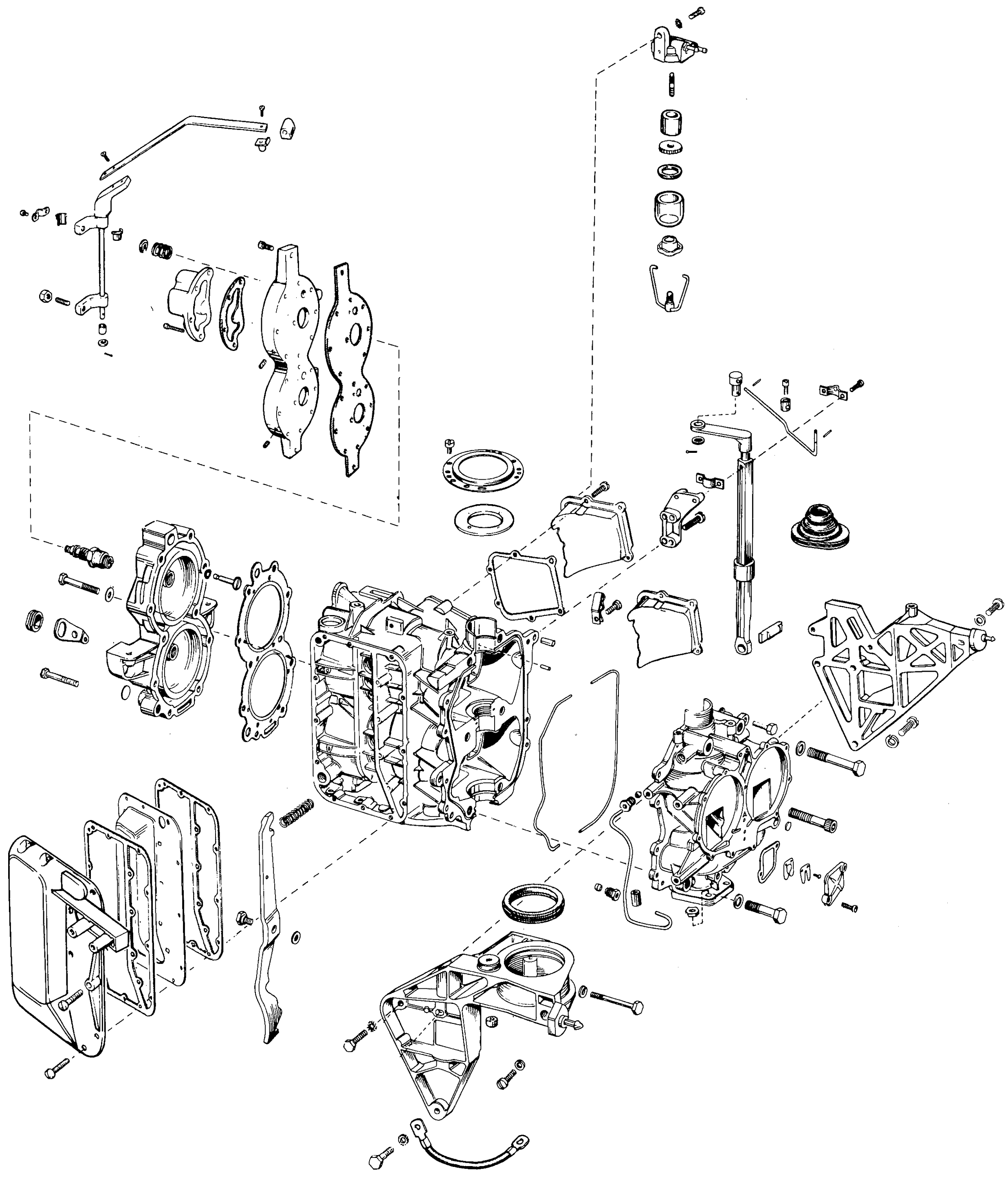
	AD	FD
A.	.007 - .0017	.007 - .017
B.	.001 - .0035	.001 - .0035
C.	.0015 - .003	.0025 - .004



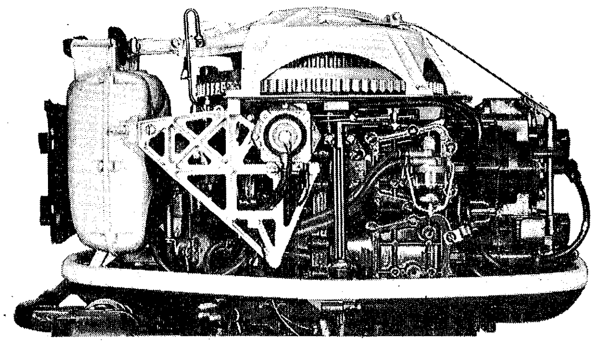
Sectional (horizontal) view — Model RD-19 Power Head.



Sectional (horizontal) view — Model RD-19 Power Head.

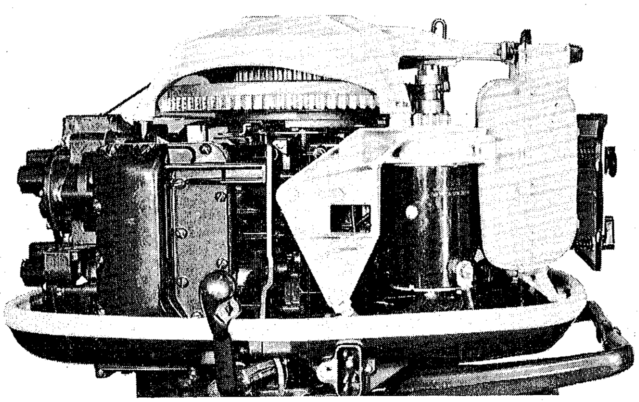


CRANKCASE AND CYLINDER HEAD GROUP — MODEL RD-19 SERIES

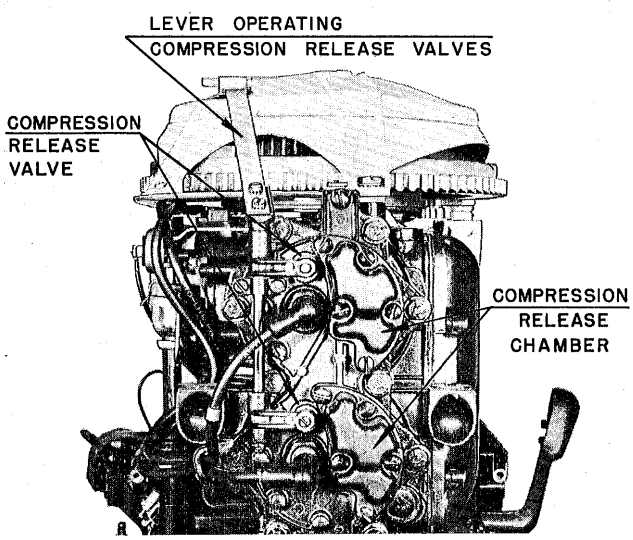


Power Head — Model RD-19.

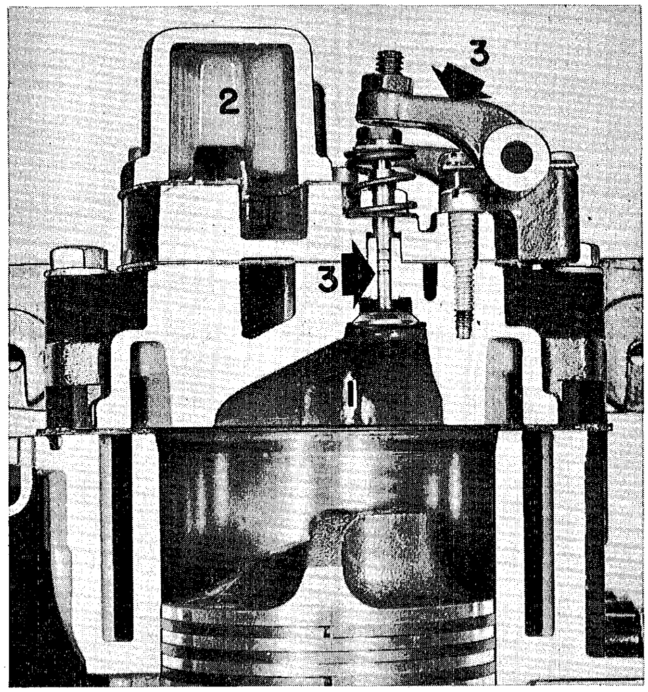
With exception of the larger bore, the seven segment automatic intake valve and corresponding valve plate and the compression release mechanism to facilitate easier starting (manually only), basic construction details are similar to power heads of the preceding RD series; the several service operations as a consequence are conducted in like manner as instructed on pages 285 to 324.



Power Head — Starboard (starter) side showing plug-in battery connector.



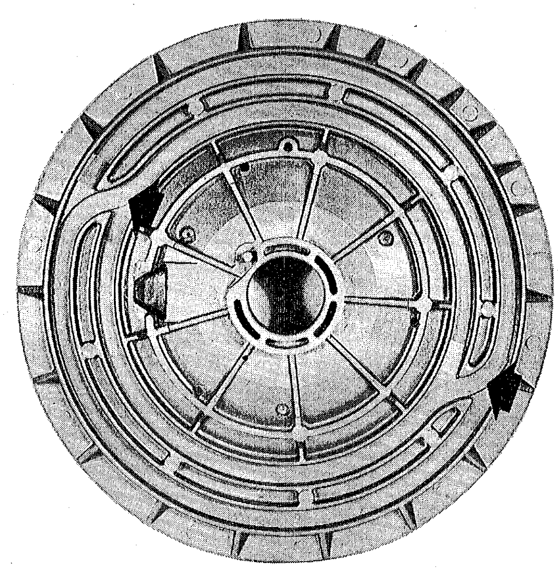
Rear view of Power Head showing compression release valves, lever operating the valve and the compression release chambers.



Compression Release.

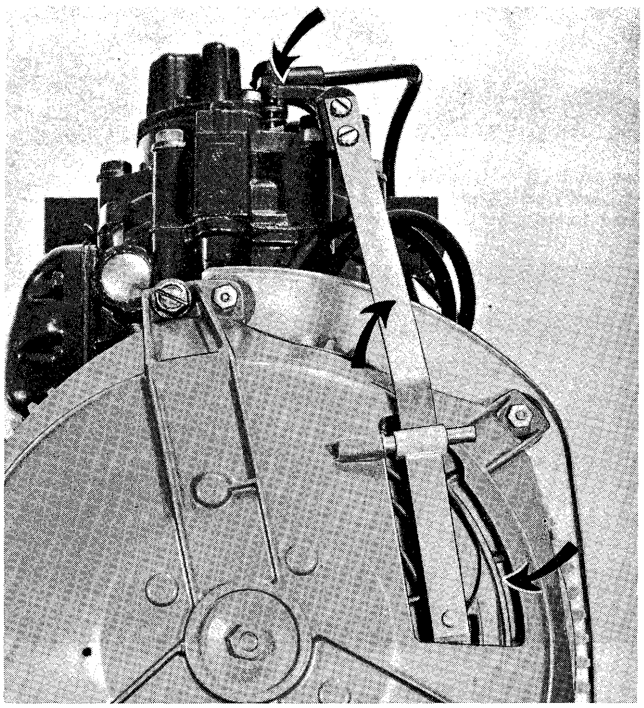
Shown here is a sectional view of the Model RD-19 (35 H.P.) combustion chamber — the combustion chamber proper (1), the compression release chamber (2), the compression release valve (3) and the compression release lever (acting on the valve) (4).

The purpose of this arrangement is to reduce compression pressure to facilitate cranking (manually) with less effort when starting — accomplished through valve action at the time of cranking, by releasing a portion of the compressed fuel vapor above the piston (1) into the relief chamber (2).

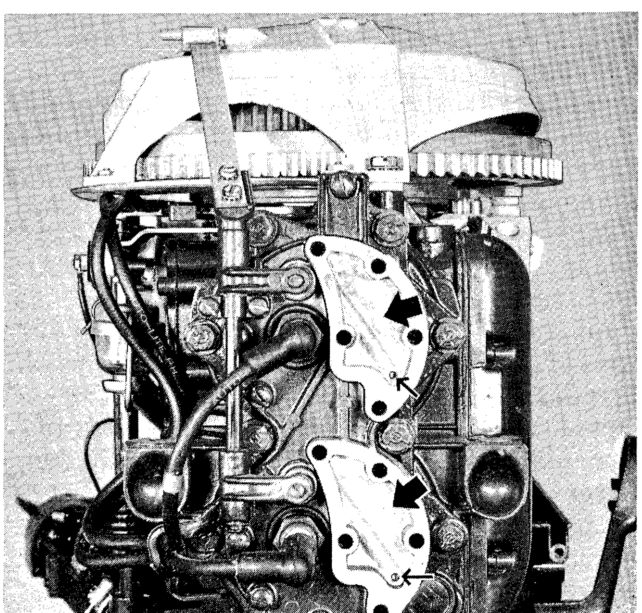


Starter pulley showing cam-track.

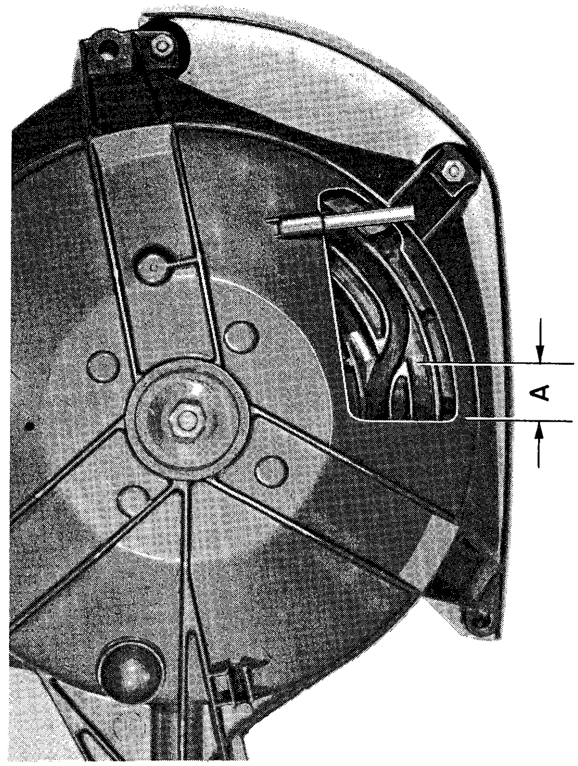
Release of compression is actuated through leverage by a cam or "track" cast into the top side of the starter pulley and functions *only* during the period when "pulling" on the starter cord grip to crank — action ceases (closing the valve) when the grip is "returned" to its normal resting position against the starter housing.



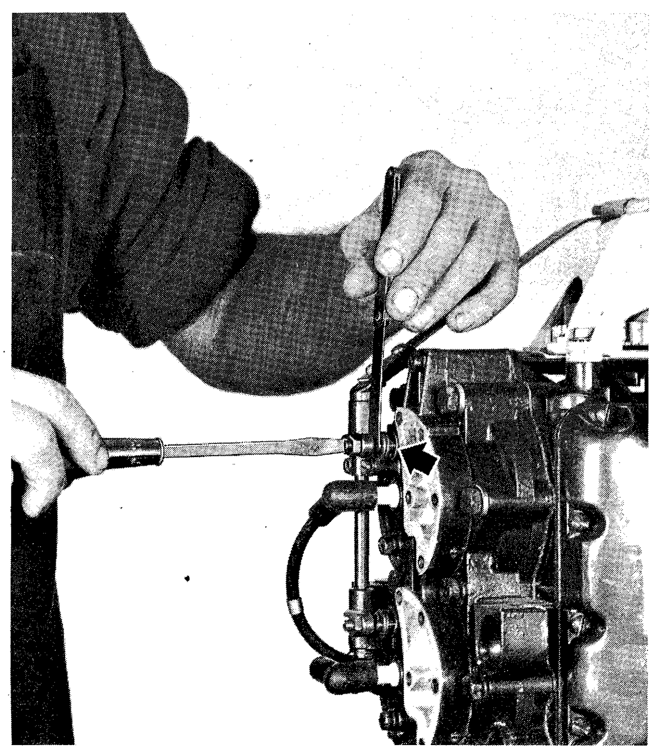
Note — Compression release acts only when "hand" cranking — *not* effective (does not function) when starting "electrically."



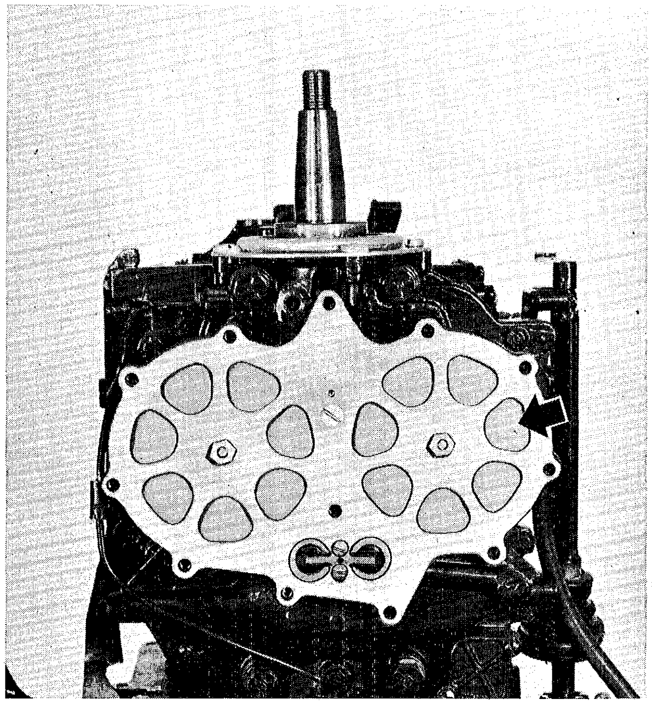
Showing compression release chambers removed and channels leading to valve area in cylinder head.



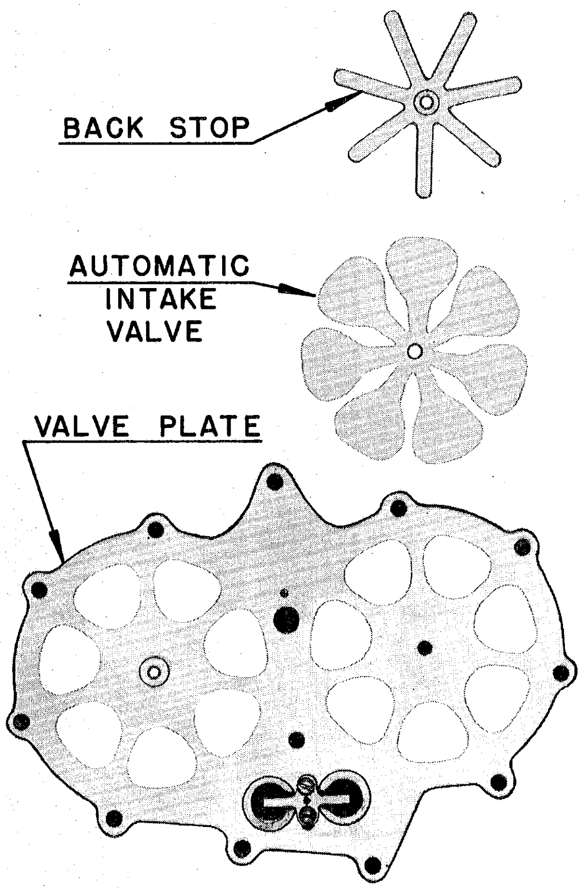
Some "timing" of the starter pulley is required to insure opening of the compression release valves at correct intervals — accomplished by adjusting length of the Starting Cord. With the Starting Cord in "rest" position, distance "A" (above) should measure approximately 1" — necessary variations obtained adjusting loop in the Starter Cord grip.



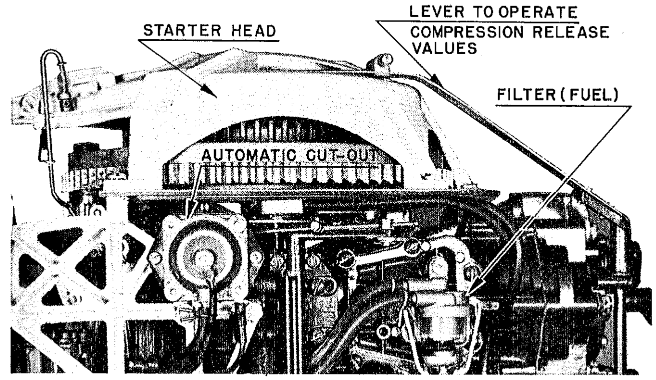
Adjusting release valve tappet clearance to .015 to .025 — with starter head installed and starter pulley in normal "rest" position.



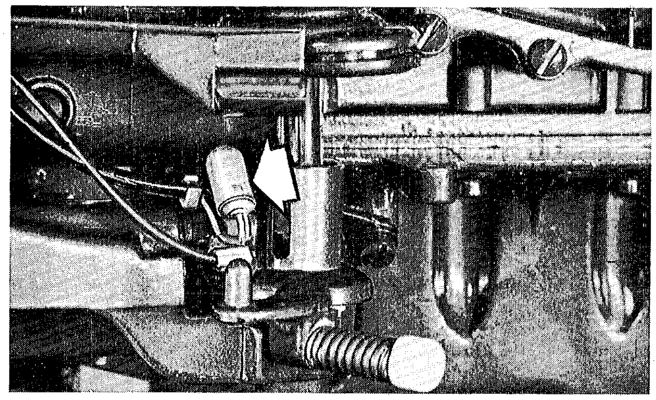
Carburetor and Intake Manifold removed to expose the seven (7) segment automatic intake valves and enlarged inlet areas to achieve greater crankcase "breathing" capacity.



Showing the valve plate, valve and back stop for the valve. Note — if required to replace the valve because of a broken segment, always include a new back stop, since in all probability breakage was caused by an irregularity in back stop.



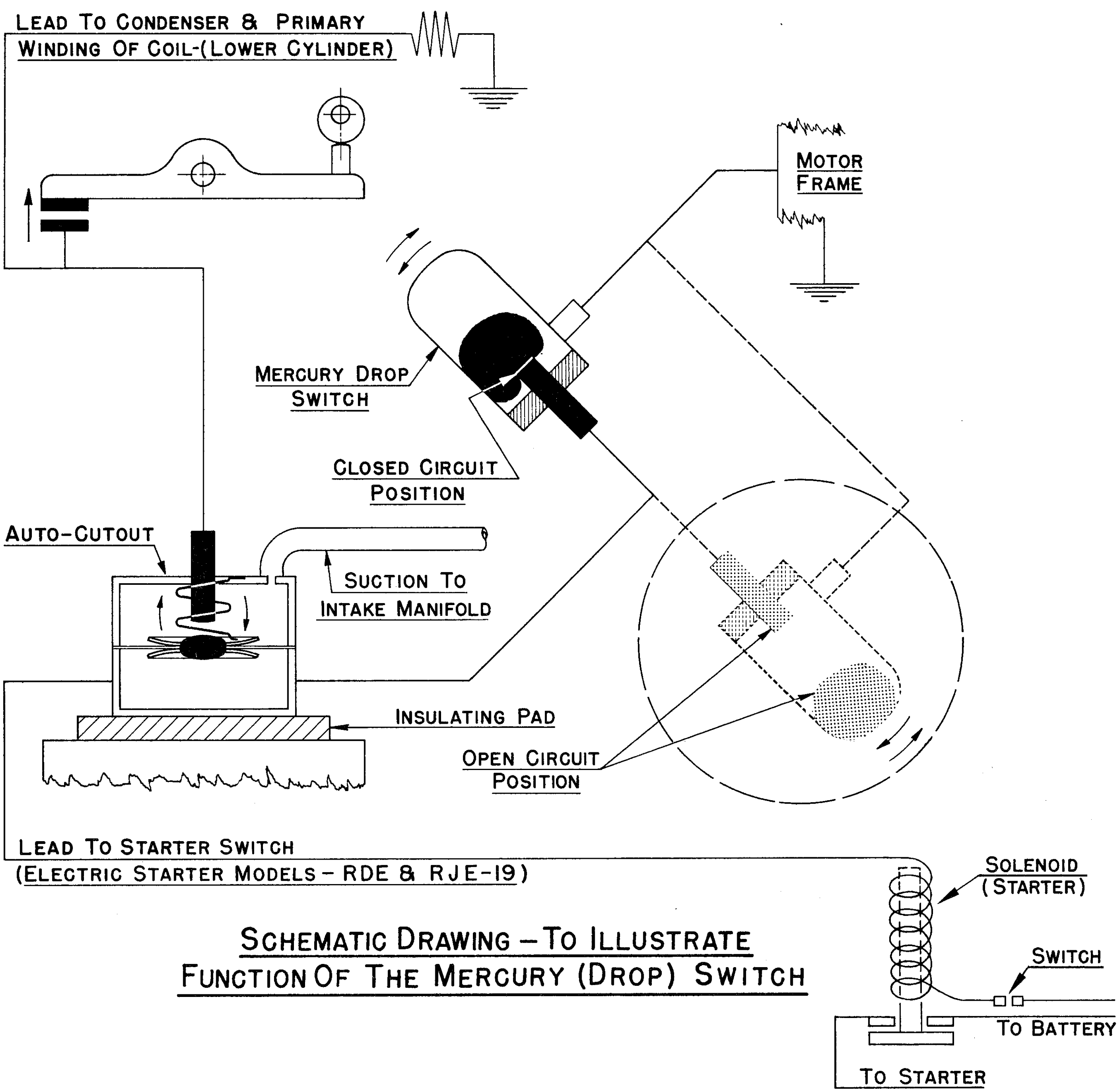
Power Head — showing installation of the automatic cut-out and fuel filter, also, lever extending from the starter head (manual) to operate the compression release valves.



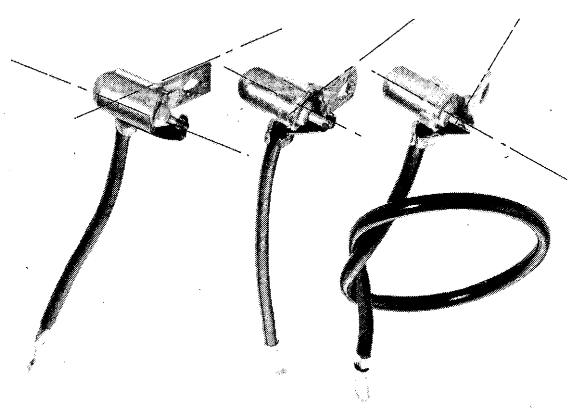
The Mercury Switch installation — RD, RDE and RJE-19 Series (35 H.P.).

Reference — See page 492 — Construction and function of the mercury switch. It will be recalled that the mercury switch was formerly installed on the electric starting models only — RDE and RJE. It will be noted that its installation has been included in the assembly of all RD's – 19 series (35 H.P.) and that the automatic cut-out switch previously grounded to the motor "direct" is now insulated by means of a hard rubber plate — further, a ground lead has been added — extending from the mercury switch bracket directly to the motor.

Purpose of grounding the automatic cut-out through the mercury switch is to avoid possibility of "missing" when operating at the "low end" of the fuel saver range. Operating as such, with full spark advance and partially closed carburetor shutter, suction in the manifold frequently is sufficient to cause "flexing" of the diaphragm in the cut-out to establish "ground" contact and resultant grounding of the breaker points (for lower cylinder only). However, since the ground circuit now includes the mercury (drop) switch, the circuit is open during normal operation of the motor thus, any flexing of the diaphragm occurring at this time is not effective — "missing" is avoided.



SCHEMATIC DRAWING – TO ILLUSTRATE FUNCTION OF THE MERCURY (DROP) SWITCH

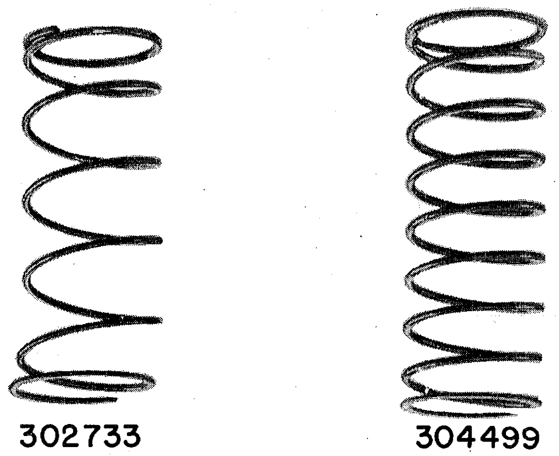


376242 376323 376867

Mercury Switch No. 376323 (RDE-17), No. 376242 (RDE-16) and No. 376867 (RD, RDE, RJE-19).

It's possible to experience a bit of difficulty with installation of the mercury cutout switch on the RDE series, unless noting on observation of the switch assembly that angularity of the mounting bracket attached to assembly No. 376323 (RJ, RJE) is somewhat greater than that provided No. 376242 (RDE-16) and a lesser angle provide bracket for No. 376867 installed on Models RD, RDE, RJE-19.

Avoid "switching" the installations, since doing so will result in one or the other of the following discrepancies (1) not permitting electric starting in high neutral position (cutting out too early), or (2) permit starting at excessively high speed (cutting out too late).



Spring No. 302733 for Cutout Assembly No. 376442 — Models RD-10 through 17 (25 H.P.) Series and Spring No. 304499 for Cutout Assemblies No. 376646, RD-18 (30 H.P.) Series, and No. 376919 (35 H.P.) Series.

Reference—See page 54, under heading Magneto.

With introduction of the 30 and now the 35 H.P. versions of the RD series, it was found advisable to increase tension of the spring acting against the diaphragm in the automatic cut-out assembly (Nos. 376646 and 376919 — RD-18 and 19) — this to compensate for change in manifold conditions (suction when operating in the low and intermediate speed ranges).

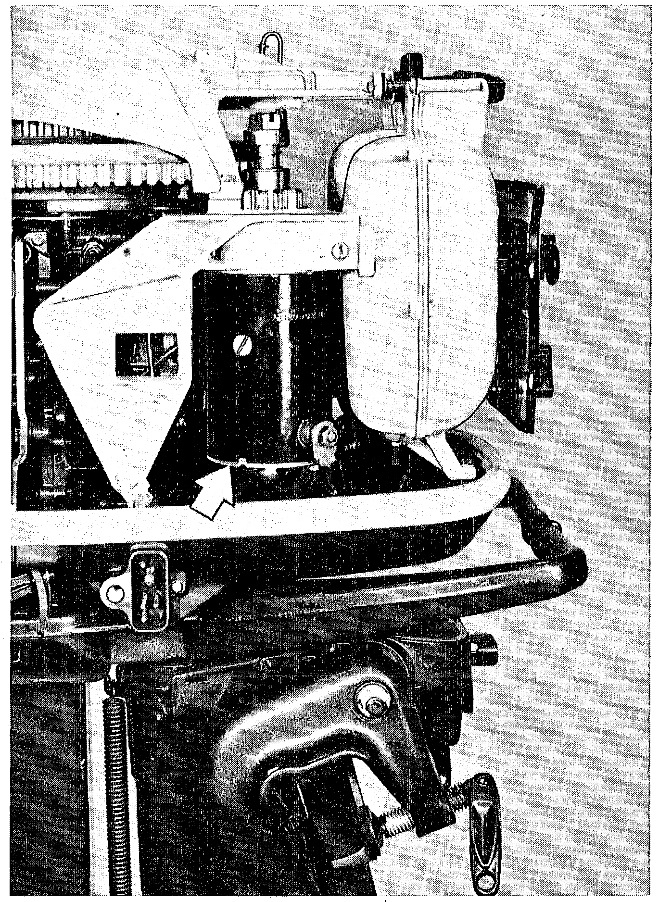
A "stiffer" spring (No. 304499), as included in the assemblies (Nos. 376646 and 376919) is required to resist the effect of greater manifold suction during this period of operation to avoid irregular firing (missing)—intermittent grounding of the breaker points.

Look to the automatic cut-out assembly if irregular firing (missing) persists when it is known that the magneto otherwise is in good operating condition, as a possible cause. To ascertain, make several "trial" runs and if "missing" continues, simply disconnect the cut-out lead; if regular firing is resumed (at some throttle setting), its cause can obviously be laid to an irregularity in the cut-out assembly — like the spring being of insufficient tension to prevent grounding of the breaker points at an undesirable time or, in salt water areas because of "shorting" due to salt water corrosion.

Spring No. 302733, identified by its greenish tint, is included in cut-out assembly No. 376442 for Models RD-10 through 17 series (25 H.P.).

Spring No. 304499 identified by its "copper-ish" color is included in cut-out assemblies Nos. 376646 and 377270 for Models RD-18 (30 H.P.) and 19 (35 H.P.) series, respectively.

Note — A comparatively small run of early RD-18 production included the automatic cut-out switch with the spring of lesser tension (No. 302733) which resulted in occasional missing in mid-range performance. Please bear this in mind when diagnosing.



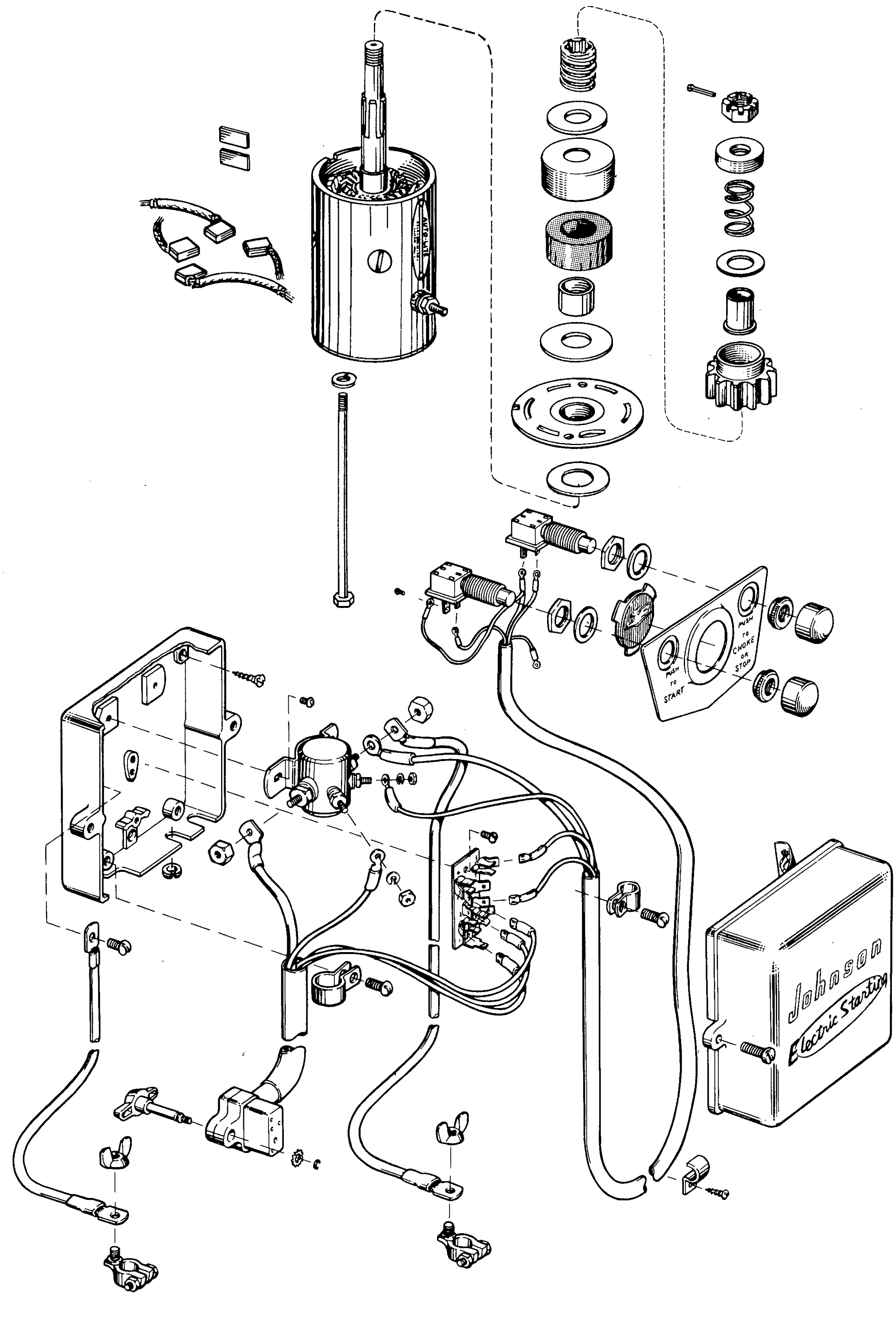
Electric Starter — Models RDE, RJE-19 and FDE-11.

With the increased bore (piston displacement) and resulting additional horsepower, it was found advisable to install a 12-volt starting unit; otherwise, in principle, wiring and over-all operation is similar to the original 6-volt system as employed on preceding models.

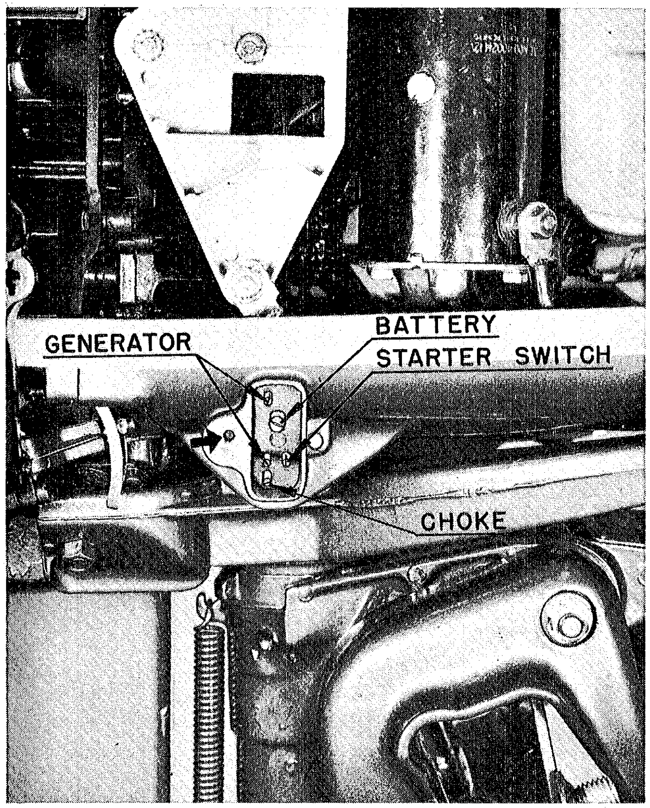
The starter as such requires no special attention except for occasional cleaning and lubrication of the starter gear — all starter, battery and ground connection must be clean, free of corrosion and secure (tight) at all times. Faulty battery and starter performance can be laid to faulty terminal connections. Abnormal "heating" of the cables or area of terminal connections can be attributed in most instances to loose or corroded connections.

For best results, use a battery of the following specifications:

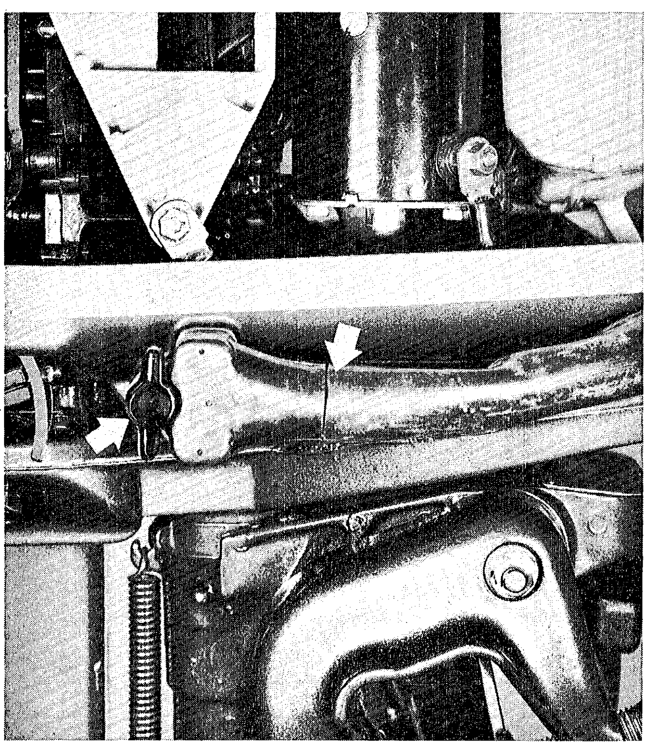
> 12-volt, 60-ampere-hour battery, or better, with a minimum of 5.2 minutes cold starting capacity at 150-ampere discharge, zero degrees Fahrenheit and a 5-second voltage rating of 9.1 volts.



STARTER AND JUNCTION BOX GROUP — MODEL RDE-19 SERIES



Plug-in connector for starter and generator leads. Make certain terminal posts are clean, and in salt water areas, free of corrosion. Check condition of threads of ground connection to insure proper "grounding."



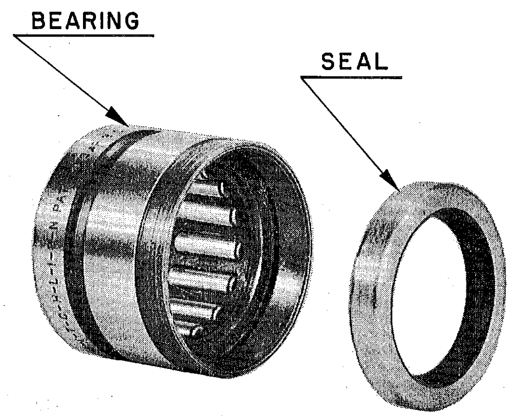
Showing battery — junction box cable attached. Since the wing bolt functions as a ground connection, it is essential that it is properly seated and turned down tightly. Overheating at this juncture could be caused by a faulty ground. Make sure the ground screw is "tight."

JUNCTION BOX INSTALLATION OF 35 H.P. MOTOR

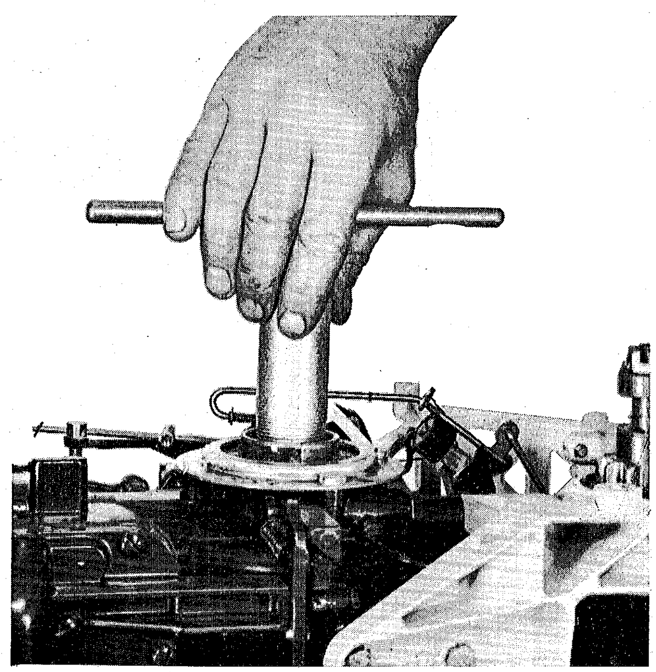
When installing the junction box on a metal boat, it should be well insulated from the boat. A piece of wood larger than the junction box and approximately 3/4 inch thick will make a sufficient insulator. Be sure attaching screws of the junction box do not go through the block and make contact with the metal of the boat.

The wing screw on the electrical connector plug makes the ground connection from the battery. It is very important that this screw be clean and tightened securely to assume a good ground.

In event the junction box is attached directly to the metal transom of the boat and a poor ground connection exists at the wing screw of the connector, the ground lead to the mercury switch may as a result of being overburdened, burn off entirely.

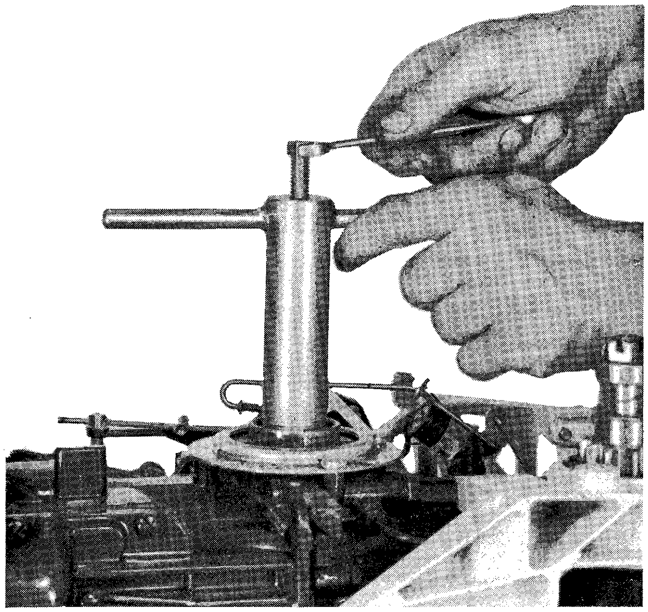


Upper Journal Bearing Assembly.



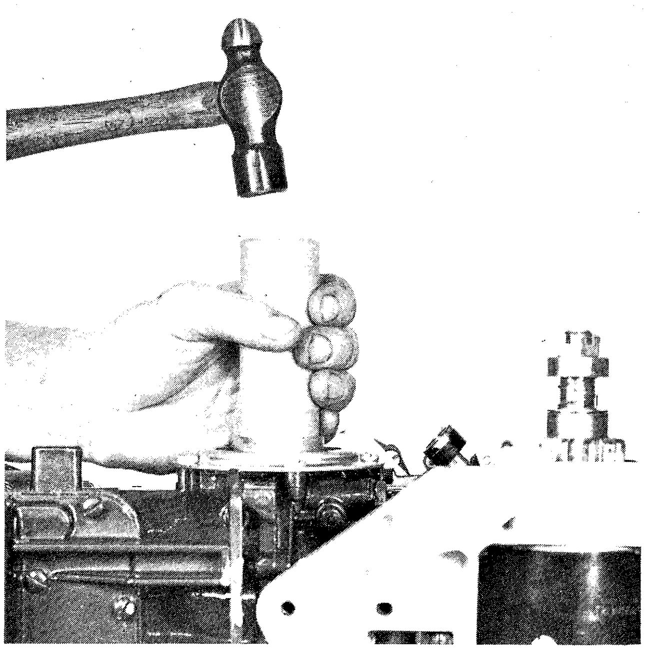
To remove Oil (Lip) Seal – upper Model RD.

In event of oil seepage at the upper journal bearing, the seal may be easily removed by installing tool No. 377067 over the protruding end of the crankshaft. Be sure the puller screw is "backed" out far enough so as not to interfere. Then by turning (to right) "screw" the tool into the seal until a substantial "grip" has been achieved. The lower end of the tool is tapered and threaded to permit locating in the seal as shown here.



Pulling Oil Seal.

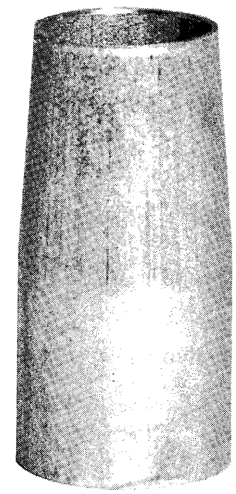
After obtaining a secure grip on the seal, grasp handle with one hand — turn down on puller screw until the seal has been pulled free.



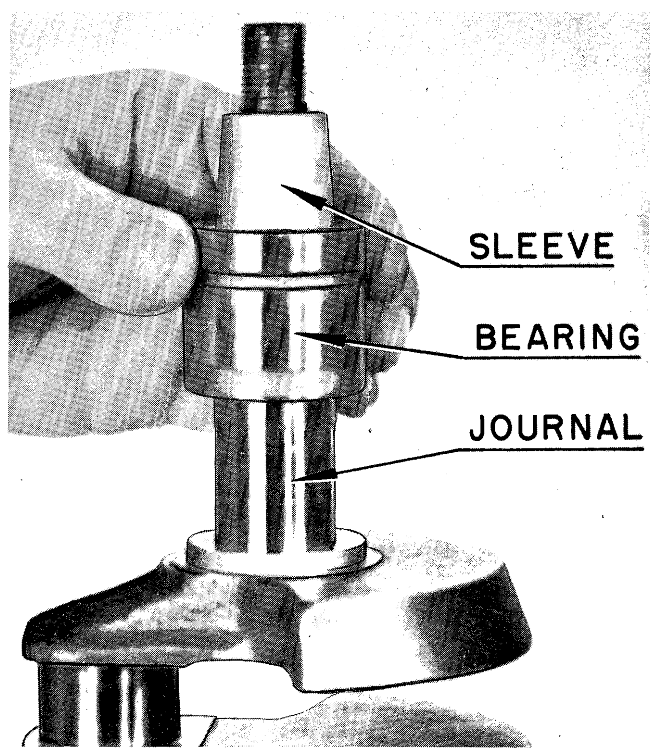
Driving Seal into position.

Make certain end of the crankshaft is clean and free of foreign matter. Spread thin coat of clean oil on end of crankshaft. Note at this time, whether or not a taper or step exists at the end of the journal. In event of a "step" it becomes necessary to install tool No. 376605 over the crankshaft to permit assembling the seal without damage to the seal surface. If a taper is noted the assembly tool is not required.

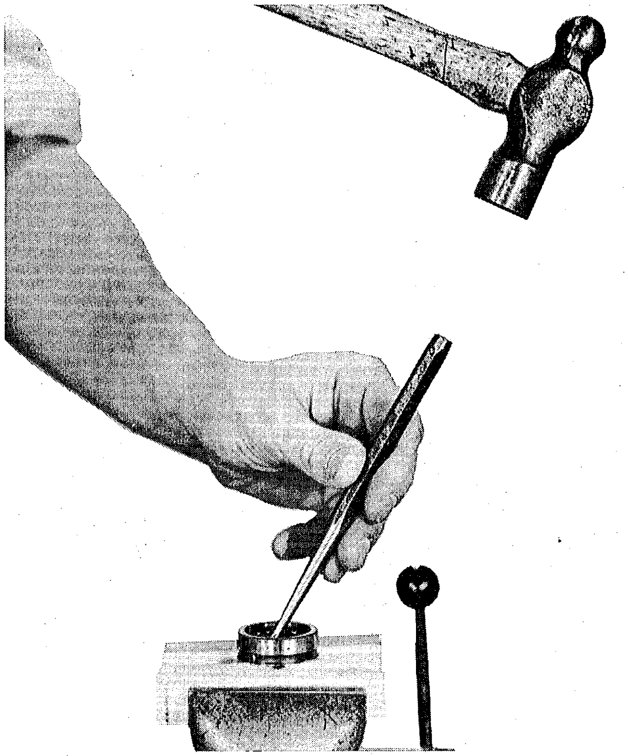
Carefully place seal in position on the journal — "lip" down, case up. Drive "home" with tool No. 304722 as shown above.



Tool No. 376605 (Sleeve) for assembling Oil Seal on the older crankshafts — provided with "step" at end of Journal.

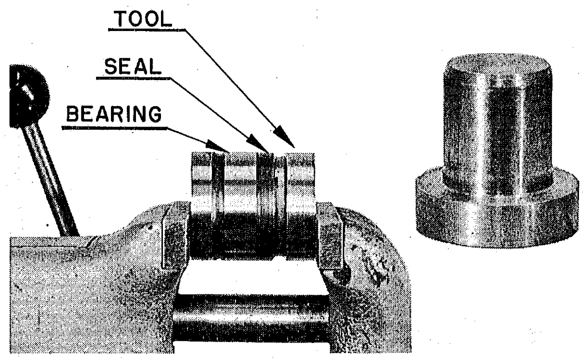


Showing Tool (Sleeve) No. 376605 in use.



Removing Oil Seal.

To remove the oil seal when bearing has been disassembled from the crankshaft, cut two "V" blocks of wood, place "V" blocks with bearing inserted in vise (seal down), drive seal out carefully with taper punch as shown here. Be careful not to scuff or scratch seal seat in the bearing — scuffing or scratching in this respect will permit oil from the crankcase by-passing the seal.



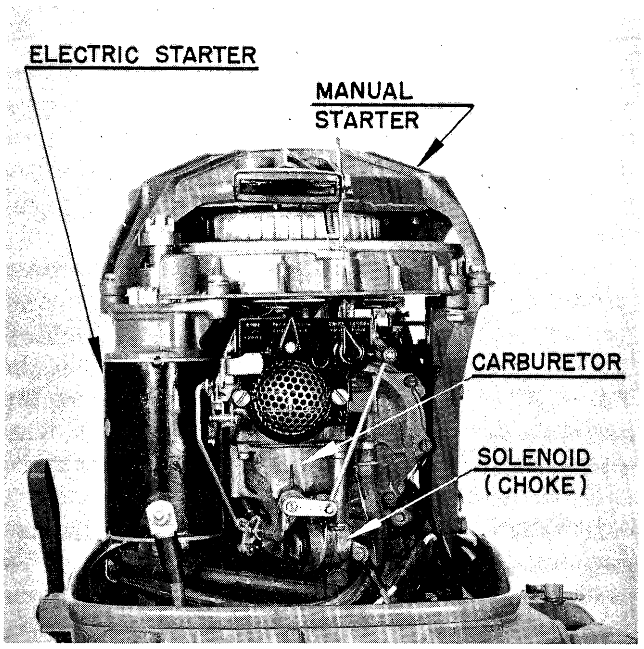
Assembling Seal and Bearing.

To install the oil seal, spread thin coat of oil on tool No. 304639 shown above, simultaneously checking the surface for burrs or abrasions; if present remove to avoid scratching the seal surface — a scratched or torn seal face (lip) will render the seal useless. Install seal on tool with "lip" out. Insert tool with seal properly installed into the bearing. Place between jaws of vise and "drive" home.

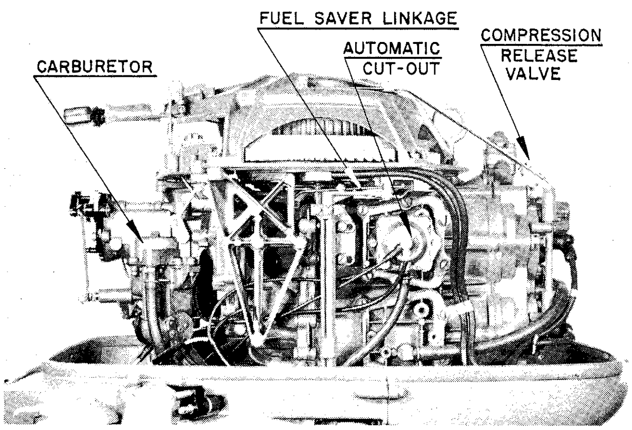
PISTON AND RING SETS (OVERSIZE)

	.020"		.025"		.040"	
MODEL	PISTON	RING SETS	PISTON	RING SETS	PISTON	SETS RING
AD-10 through 12	277200	378413	— —	— —	— —	— —
CD-10 through 19	376427	378417	— —	— —	— —	— —
FD, FDE-10-10L-10S	277418	378420	— —	— —	376831	378425
FD, FDE-11	377071	378419	— —	— —	377072	378423
FD-12-13, 14, 14B	377263	378419	— —	— —	377264	378423
FD-15, 16	378374	378419	— —	— —	378375	378423
HD-25-26	375712	378418	— —	— —	— —	— —
JW-10 through 17	277283	378414	— —	— —	— —	— —
KD-15	302394	302395	— —	— —	— —	— —
PO-15	375713	302393	— —	— —	— —	— —
QD-10 through 14	377035	378420	— —	— —	377038	378425
QD-14A through 21S	377034	378420	— —	— —	377037	378425
QD-22, 23	378372	378420	— —	— —	378373	378425
RD-10 through 15	375959	378422	— —	— —	376828	378424
RD, RDE-16-16A-17-17C-17S-17R	375959	378422	— —	— —	376828	378424
RD, RDE, RJE-18-18E-18C	376532	378422	— —	— —	376829	378424
RD, RDE, RJE-19-19C, RDS-20, RD, RDS-21	377073	378437	— —	— —	377074	378438
RD, RDS-22	— —	— —	378106	378433	— —	— —
RD, RDS-23	— —	— —	378358	378433	— —	— —
RD-24M, RDS-24M, RK-24	— —	— —	378697	378433	— —	— —
RX-10C	378910	378422	— —	— —	378911	378424
SD-15-20	375714	378419	— —	— —	— —	— —
TD-20	375687	378417	— —	— —	— —	— —
TN-25 through 28	375687	378417	— —	— —	— —	— —

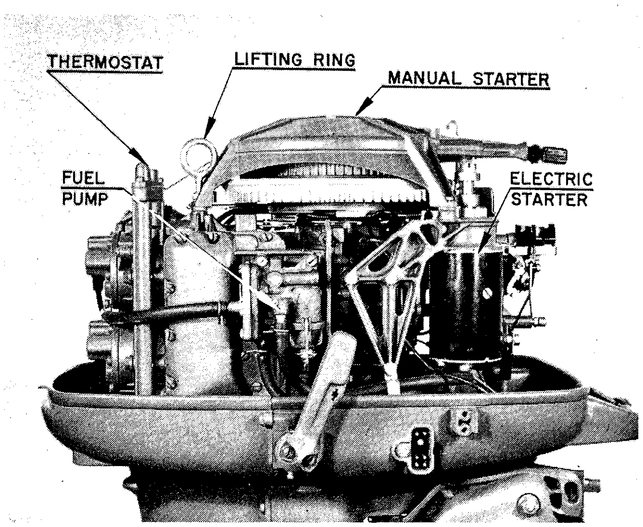
POWERHEAD — MODEL RDS-20



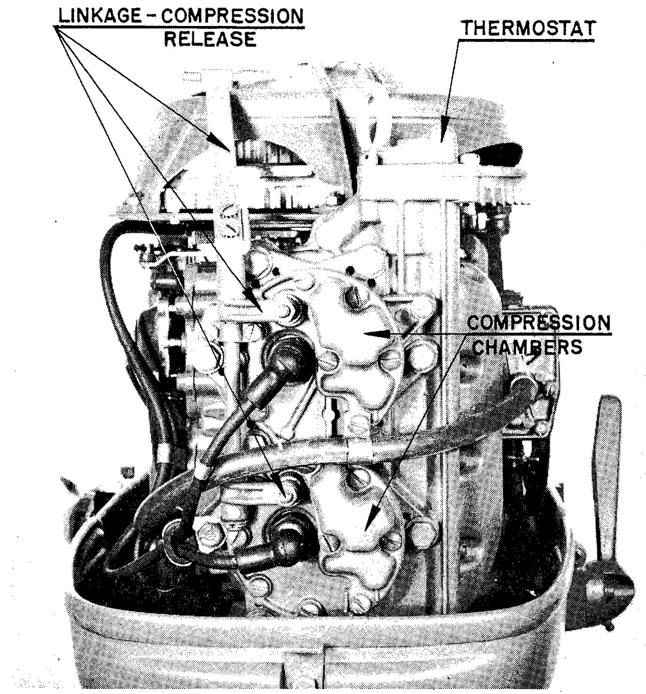
Front view — Powerhead Model RDS-20.



Port view — Model RDS-20 Powerhead.

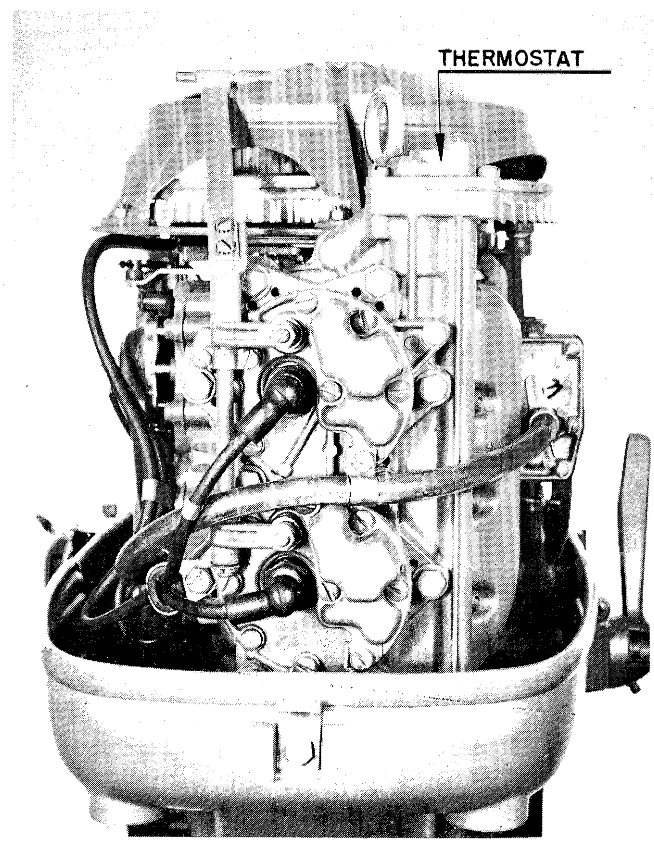


Starboard view — Model RDS-20 Powerhead.

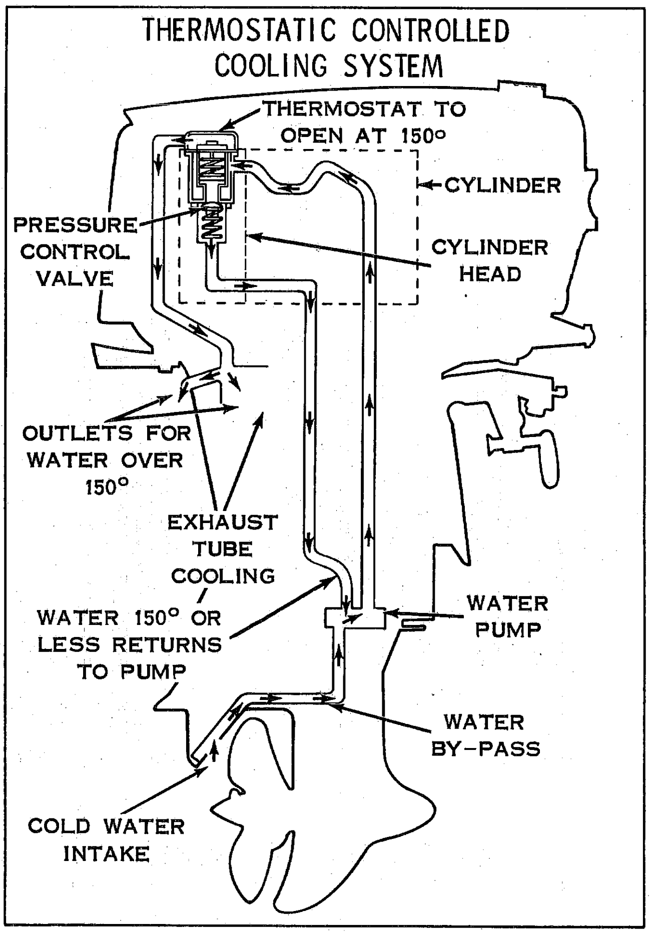


Rear view — Powerhead Model RDS-20 showing thermostat installation.

THE COOLING SYSTEM THERMOSTATICALLY CONTROLLED MODEL RDS-20



Rear view of Powerhead (Model RDS-20) showing the thermostat installation.



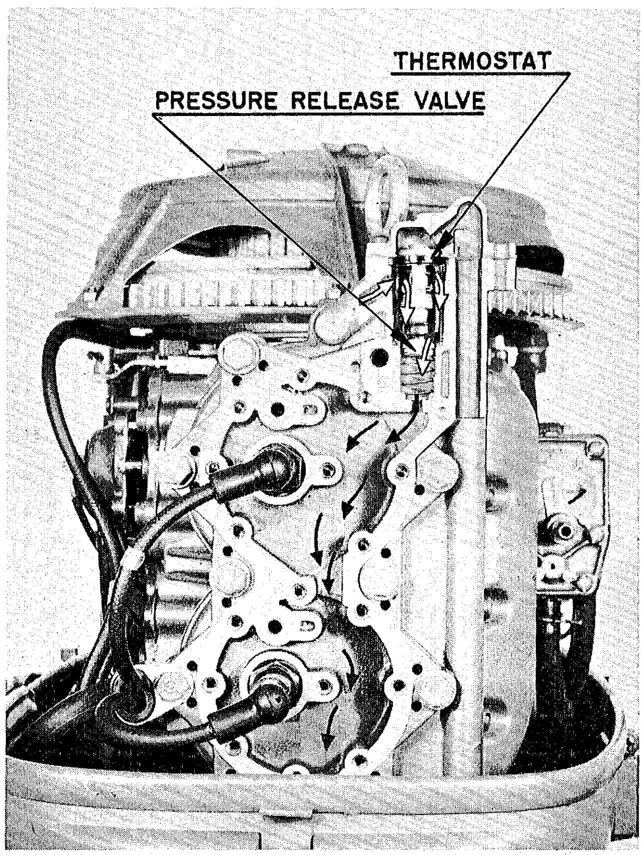
Circulation of water through the cylinder block and cylinder head water jackets for cooling purposes is accomplished by an impeller type of water pump or circulator attached to the upper end of the gear case and driven by the drive shaft.

In construction and assembly, the unit at slow motor speeds, functions as a positive displacement pump while at higher speeds, as a simple circulator. It will be seen from the following illustration that position of drive shaft is offset somewhat from the center of the pump housing to cause an eccentric flexing action of the impeller blades when in motion. Comparatively large volume exists between the impeller blades on "wide" side which compresses progressively as the blades approach the "narrow" side to create a pulsating action. During periods of high speed operation, resistance of water on its way through the pump is sufficient to prevent the impeller blades making contact and following inside periphery of the pump housing and as such, merely flex in toward center of the impeller to perform as a simple circulator. (See page 432.)

During performance, water enters the impeller housing by means of a slotted opening in the pump assembly cover plate and at a point where the volume between the impeller blades commences to expand, thereby creating a displacement effect. Water then rushes in to fill the "void" until the impeller blades begin to compress, thus forcing the "trapped" water out of the pump by way of a properly placed port in the housing. From there it is conducted to the cylinder water jackets for cooling purposes — later to be discharged into the exhaust stack assembly.

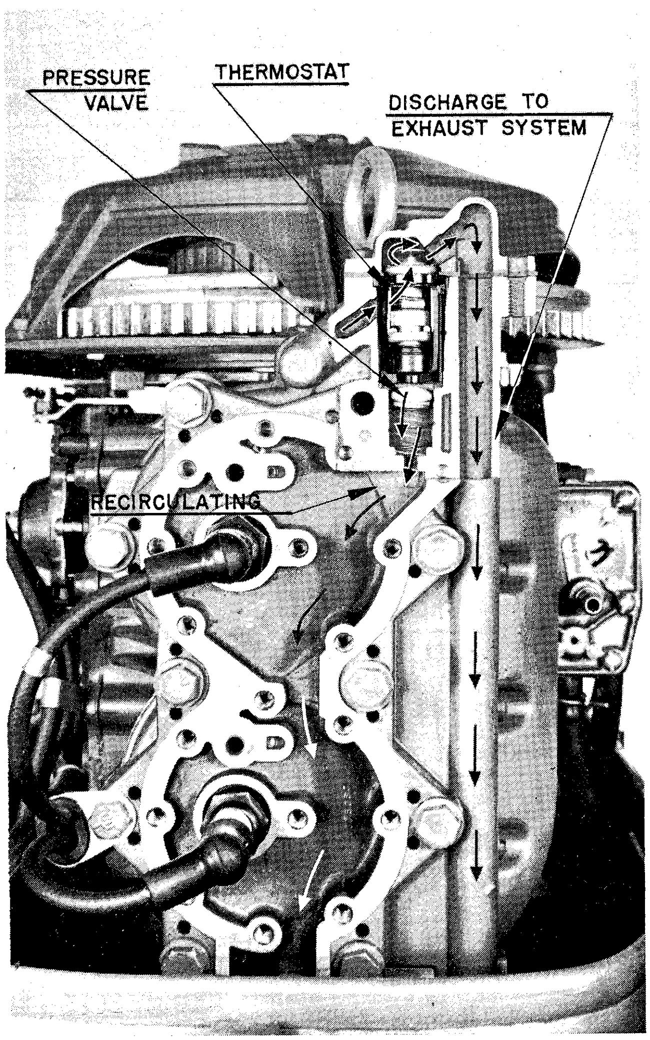
A thermostat has been assembled into the water circulating system to maintain a constant operating temperature, thereby achieving greater flexibility and more efficient operation throughout the entire range of operation. But of significant importance, the maintenance of predetermined operating temperatures particularly in the slow speed and intermediate ranges, results in more complete combustion of the fuel vapors — thus, a "cleaner" burning charge to minimize "sludgy" carbon deposits and the accumulation of petroleum gum or varnish which interfere with performance. In like manner, active life of the spark plug is considerably extended.

Assembly of the thermostat consists of a pressure release valve and a thermostatic control element enclosed in the cylinder head as shown here.

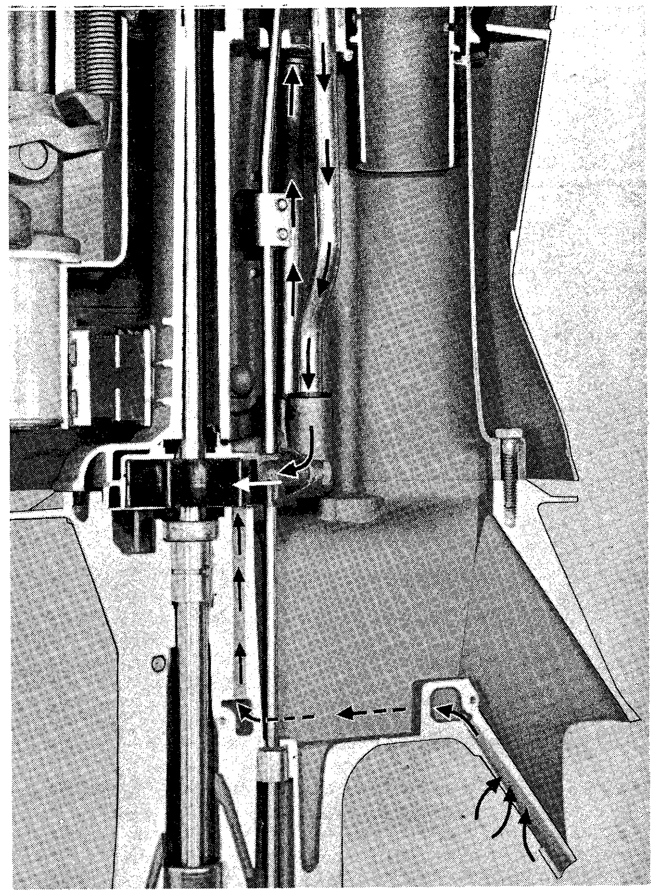


Showing path of water circulation prior to reaching normal operation temperature. During period of "warm-up," path of water is through the recirculation system as indicated by arrows and described in text.

In operation — upon starting of the motor, water is "pumped" into the water jacket system until a pressure of approximately one pound has been established. Then since tension of the spring acting against the pressure valve, is preset to "break" at one pound, the pressure valve is forced off its seat to commence water circulation. Water thus released by the pressure valve is directed by means of a second water tube "back" to the water pump to be recirculated. Recirculation continues in this manner until water jacket temperature has reached 130-150°F when the thermostatic valve is caused to open by action of the thermostat. Resulting overflow is conducted into the exhaust assembly where it circulates to cool the exhaust stack after which a portion is discharged immediately below the powerhead assembly (above the water line) with remainder of the water jacket discharge overflowing into the exhaust stream and on out through the underwater exhaust.



Showing path of water circulation when normal operating temperature of approximately 150°F has been reached. While some water continues to recirculate, main discharge is into the exhaust system.



Sectional view — Pump installation. Arrows indicate path of water through pump, to cylinder block and recirculating.

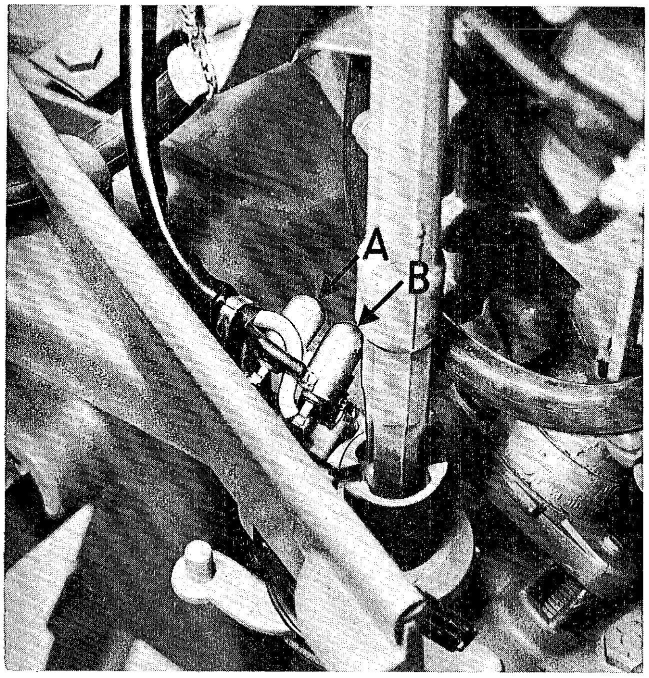
A "V" slot is formed into the thermostatic valve face, allowing air to escape and later, water to rinse the valve assembly — free of salt crystals, etc. When first starting and during period of warm-up but a few drops of water and steam (vapor) will be observed to discharge from the outlet above the water line, since water for cooling is being recirculated between the pump and water jacket at this time.

On having reached predetermined operating temperature, the thermostatic valve opens when a sudden spurt of water will be noted discharging from the discharge outlet. Failing to note "spurting" of water at the discharge after having operated the motor for a reasonable length of time, indicates possible pump failure. The motor should be immediately stopped and an investigation of the cooling system conducted. Under some circumstances, little water will be seen to emit from the water discharge due to suction created in the exhaust stack when operating at comparatively high boat speeds.

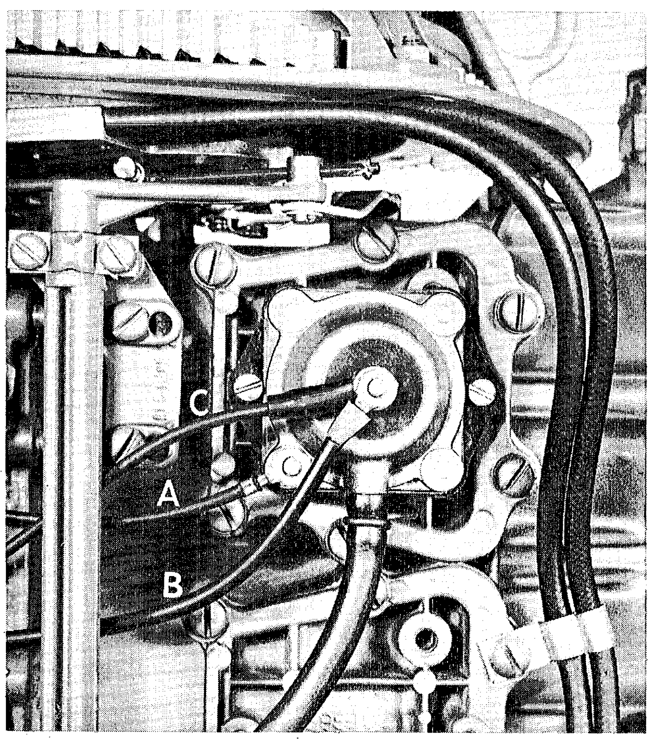
To check functioning of the thermostat, simply insert thermometer into the water discharge (after motor has reached running temperature).

Reading should not exceed 170°F.

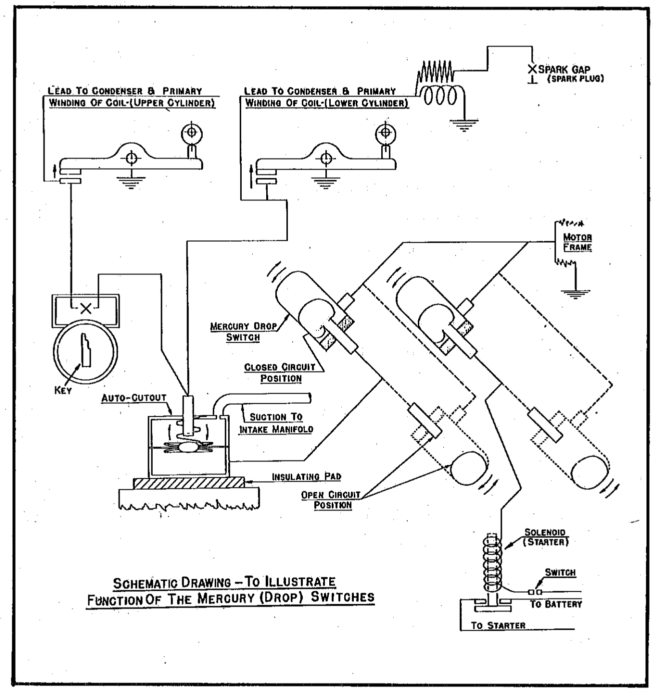
TWIN MERCURY INSTALLATION MODEL RDS-20



Showing twin Mercury Switch installation – Model RDS.
A – Mercury Switch in automatic cut-out circuit.
B – Mercury Switch in solenoid circuit (electric starting).
See text on Pages 54 and 493. Both Mercury Switches function independently and for different purposes. A, in conjunction with the automatic cut-out, to prevent over-running of the motor when in neutral. B, to prevent electric starting when in gear at high-speed throttle setting.



Installation of Automatic Cut-out. See text Page 54.
A — To Mercury Switch.
B — To Breaker on Armature Plate.
C — To Key Switch.



Schematic Drawing – To Illustrate Function Of The Mercury (Drop) Switches

NOTES

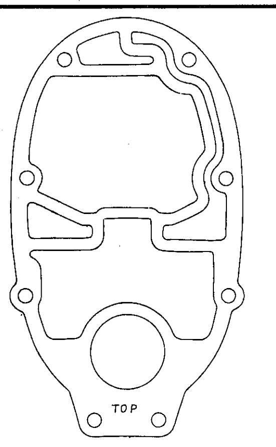
A new style take-down gasket designed to allow lubrication of the upper shifter cross shaft bearings by two grease fittings installed on the cylinder is presently in use. Relocation of the cross shaft lubrication fitting from the exhaust housing to the cylinder has made this change necessary.

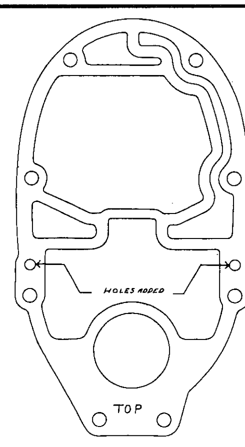
The new style gasket is also required when replacing a cylinder or powerhead assembly on an RDS-20 motor. All cylinders and powerheads presently available as replacement have the relocated lubrication fitting.

The old style gaskets can be converted to new style for use by merely punching additional holes as a comparison of the two parts would indicate.

Another necessary step when installing the new powerhead assembly on the RDS-20 motor is the modification of the thrust bearing part 305581, on the starboard end of the shifter cross shaft. It is necessary to drill an approximate 1/8 inch diameter hole through the thrust bearing in line with the lubrication hole in the exhaust housing. This thrust bearing is made of nylon and is split on one side. The bearing cannot be rotated to align the opening with the new lubrication source of entry, because it is keyed to the exhaust housing.

Service Bulletin No. 690 1/29/59



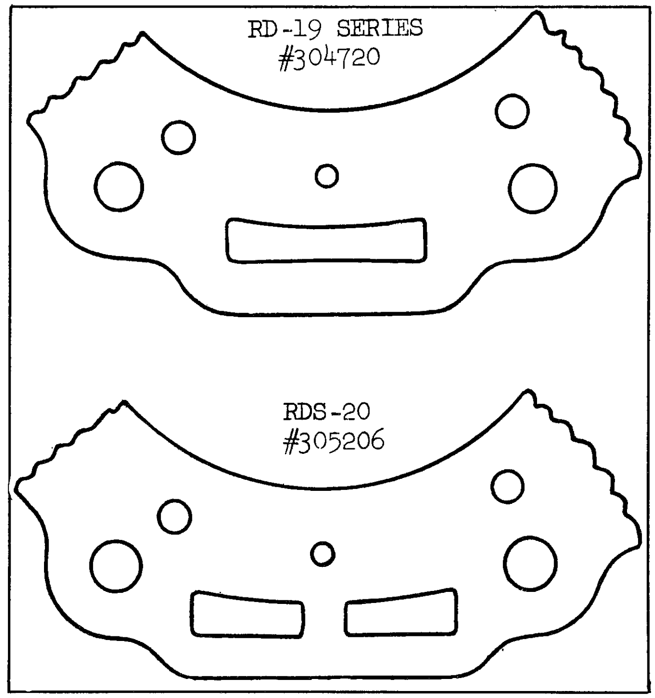


Comparing new and old style take-down Gaskets. Showing holes added to provide means of lubricating Shift Cross Shaft on Models RDS-20, RD and RDS-21 Motors.

When comparing the cylinder head gasket, Part No. 304720, RD-19 through 19C with the cylinder head gasket, Part No. 305206, RDS-20, you will find a difference in the cutout arrangement at the bottom.

It is possible, however, as far as general contour and bolt holes are concerned, to interchange the gaskets. This should *not* be done under any circumstances, since the water flow may be restricted and dangerous overheating may result.

Service Bulletin No. 658 6/15/58



**Comparing Cylinder Head Gaskets – 304720 and 305206. Do not use interchangeably. Application: 304720 – RD-19, 19C
305206 – RDS-20**

In order to eliminate any possibility of dowel pin failures, the 35 H.P. piston assembly was redesigned to incorporate a larger dowel pin, similar to that used in the 40 H.P. engines. This dowel pin change requires a new piston ring having greater relief at the gap so as to fit properly.

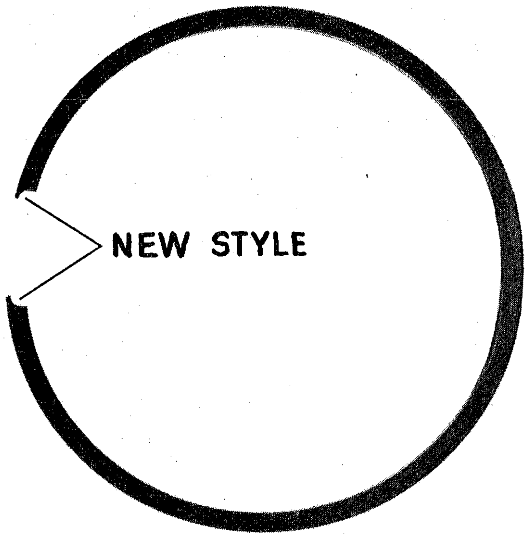
In order to reduce service problems to a minimum, the new ring was designed to be compatable with the old piston and dowel pin assembly as well as the new style piston and dowel pin assembly. Consequently, all the old 35 H.P. piston rings, both standard and oversize, have been obsoleted and superseded.

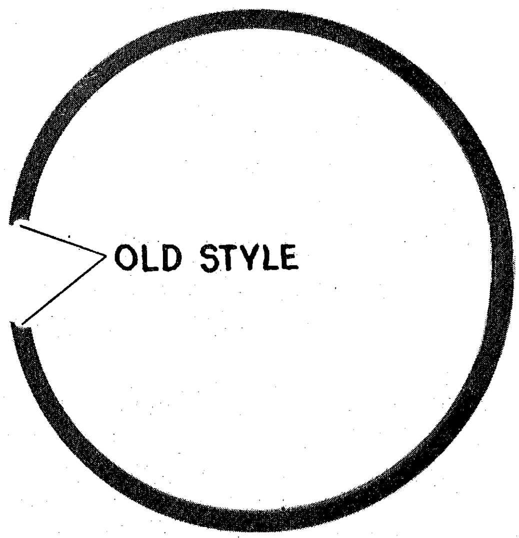
The new style piston and dowel pin assembly, still carrying the same number, is now being supplied for service. Exercise extreme caution when using the new piston assembly and be sure the new style piston ring is used. The larger dowel pin is easily identified and no problem should be encountered if reasonable care is exercised.

The following piston and dowel pin assemblies have been changed, using a larger dowel pin, but the part numbers remain the same:

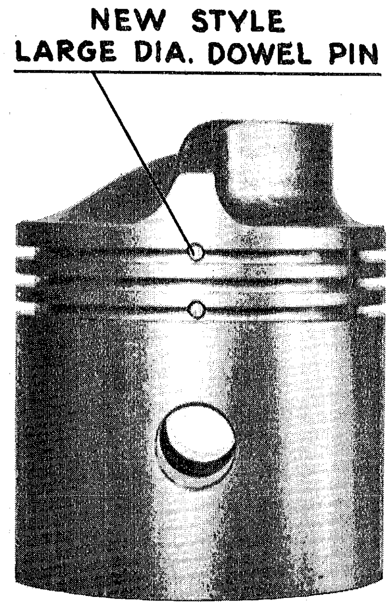
377409	Standard
377073	.020″ oversize
377074	.040″ oversize

Service Bulletin No. 791 7/1/60

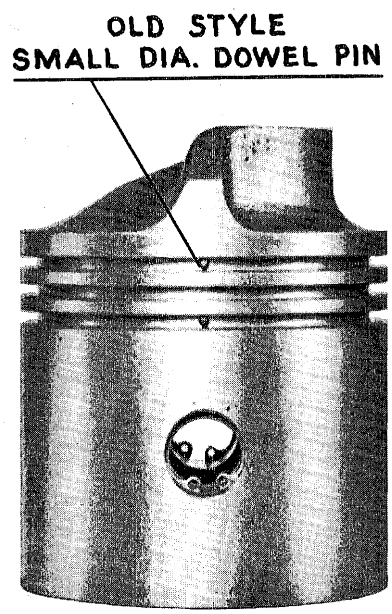




Showing both new and old style 35 H.P. Piston Rings. Note greater Dowel Pin relief on new style Piston Ring.



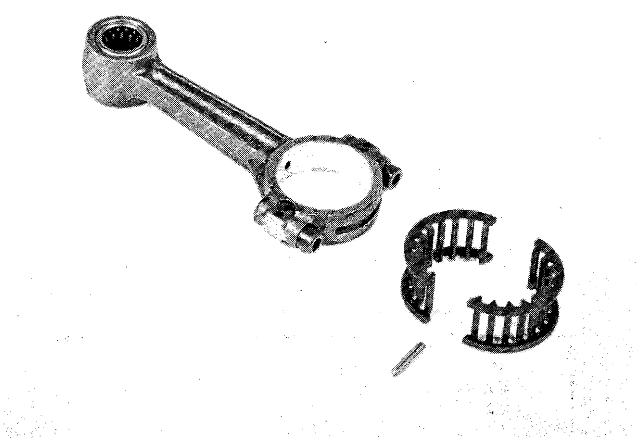
New Style



Old Style

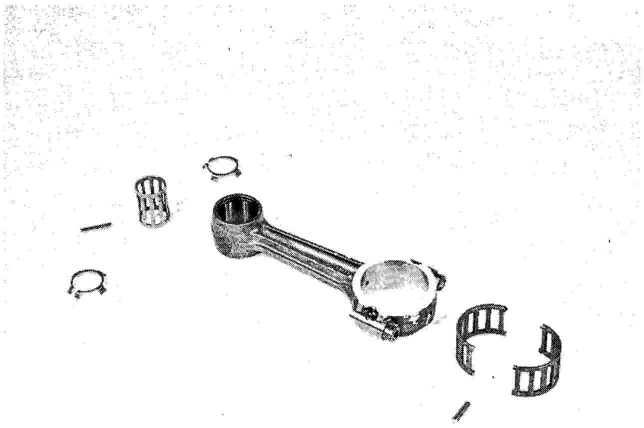
Showing new and old style 35 H.P. Pistons. Larger Dowel Pin used on new style Piston requires use of Piston Ring (new style) with greater Dowel Pin relief. Do not use old style Piston Ring with new style Piston.

SERVICING THE RD-RDS-21 AND RD-RDS-21B POWERHEAD



RD-RDS-21 Connecting Rod and Bearings.

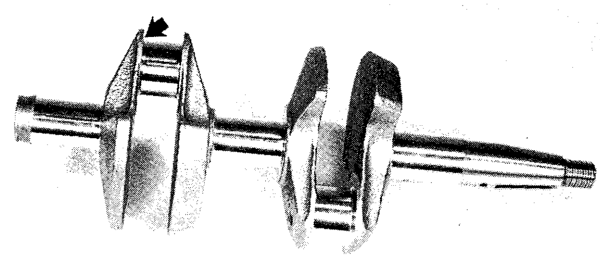
In November of 1958 a model change was made on the 1959 35 H.P. engine, from RD-RDS-21 to RD-RDS-21B. The changes made indicated by the letter "B" of the model designation, were to the crankshaft, connecting rod, wrist pin bearing and connecting rod retainer and needles.



RD-RDS-21B Connecting Rod and Bearings.

Illustrated here are the changes. When ordering the above listed parts for service on the 1959 35 H.P. engine, determine the exact model, from the serial number plate. When referring to your parts catalog you will note the parts required for the Model 21B are identified with an asterisk (*) to the right of the item number. The parts required for the Model 21 have the same item number but are not marked with an asterisk.

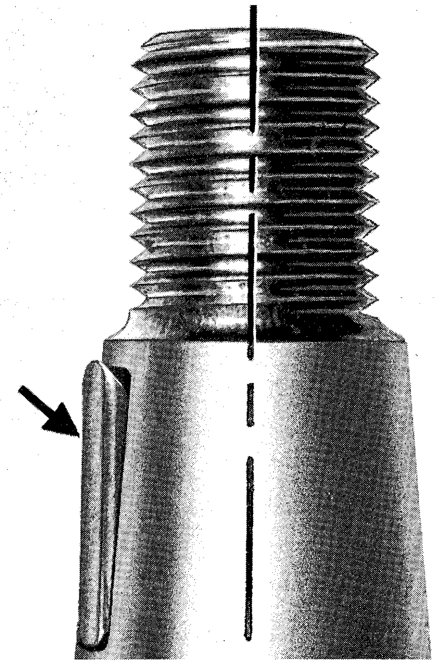
In order that there will be no delay in repairs, due to ordering of incorrect parts, be certain the exact model is determined before ordering.



RD-RDS-21B Crankshaft.

NOTE: The early crankshafts for the Model 21B, above, can be identified by an increased radius on the connecting rod journal as indicated by the arrow. The crankshafts presently being produced are identified by etching the part number on the crankshaft flywheel taper.

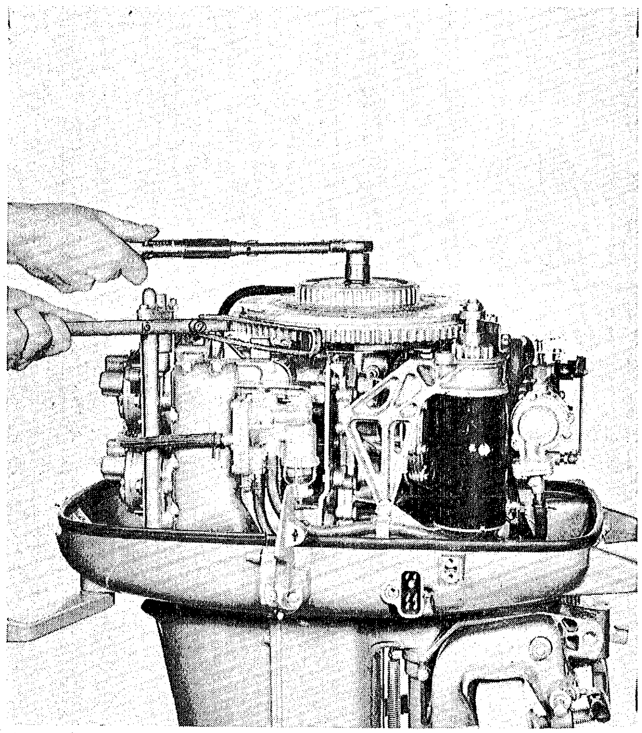
FLYWHEEL KEY INSTALLATION MODEL RD-RDS-22 (up) – 40 H.P.



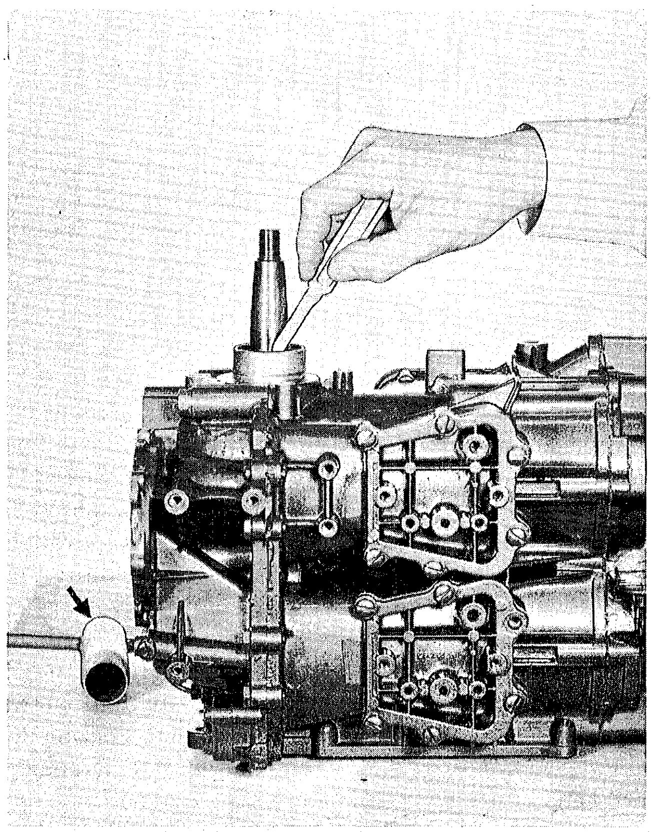
Illustrating position of correctly installed key.

Observation of crankshaft #307482 for all RD-22 Series and up – 40 H.P. – will reveal a smaller key slot to accommodate the smaller key #307480. Seating of the key should be done in such a manner that the edge of the key comes to rest parallel with center line of the crankshaft – straight up and down as shown above, not parallel with the taper. Note too, that the key slot in the flywheel (#580306 and #580304) hub is similarly cut parallel to the center line thus making it a tapered slot to accept the key when correctly installed.

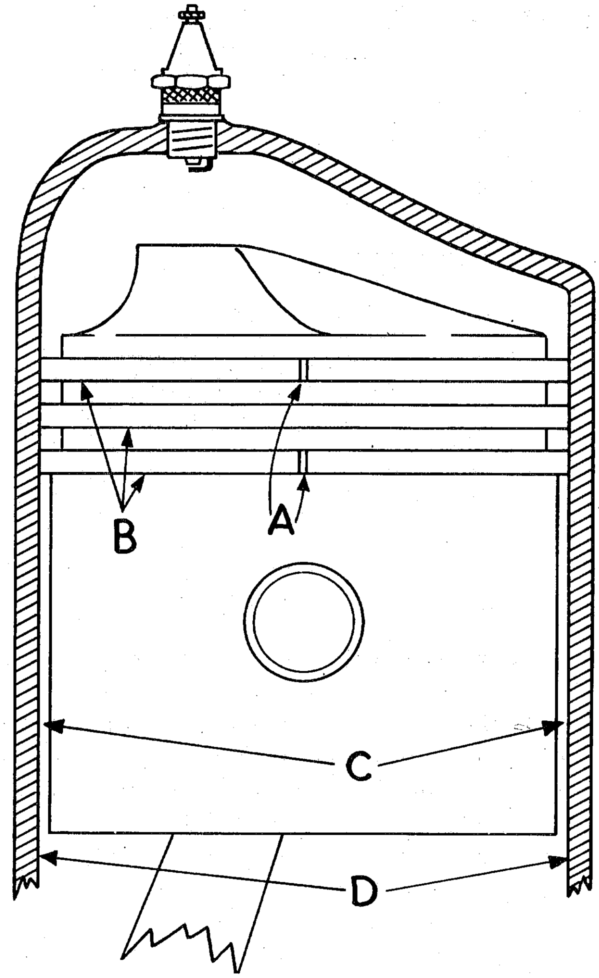
Extreme caution should be exercised when making the flywheel installation to assure seating on the crankshaft taper – not binding on an improperly installed key to result in permanent damage. When certain the flywheel is correctly seated, torque flywheel nut to 100-105 ft. lbs.



Model RD-RDS-22 (and up) — 40 H.P. — Torque Flywheel Nut 100-105 Ft. Lbs.



Since installation of the Double Lip Oil Seal on the RD Series, removal with Seal Puller No. 377067 can be simplified by cutting away the Upper Lip with a thin bladed knife as shown above.



Schematic to indicate clearance specifications:
A Piston Ring Gap
B Piston Ring Groove
C Piston/Cyl. Wall
D Cylinder Bore

JW-3 H.P.

A .005″-.015″
B .001″-.0035″
C .0013″-.002″
D 1.5636″
Piston Ring Wall Tension 2-3½ Lbs.

CD-5½ H.P.

A .005″-.015″
B .001″-.0035″
C .0013″-.0025″
D 1.938″
Piston Ring Wall Tension 2-4 Lbs.

AD-7½ H.P.

A .005″-.015″
B .0015″-.003″
C .0015″-.002″
D 2.125″
Piston Ring Wall Tension 3-5 Lbs.

FD-18 H.P.

A .007″-.017″
B .0015″-.003″
C .0035″-.004″
D 2.496″
Piston Ring Wall Tension 3-5 Lbs.

RD-25 & 30 H.P.

A .007″-.017″
B .045″-.007″
C .025″-.004″
D 2.875″
Piston Ring Wall Tension 4-6 Lbs.

RD-35 H.P.

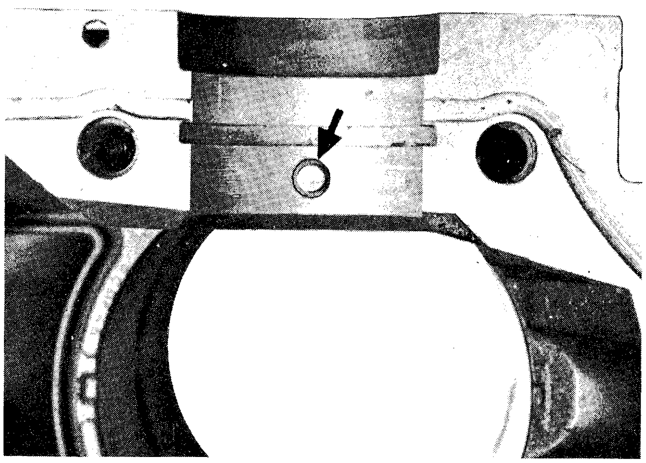
A .007″-.017″
B .005″-.0065″
C .0035″-.004″
D 3.0625″
Piston Ring Wall Tension 6-9 Lbs.

QD-10 H.P.
A .007″-.017″
B .0015″-.003″
C .003″-.0035″
D 2.375″
Piston Ring Wall
Tension 3-5 Lbs.

FD-15 H.P.
A .007″-.017″
B .0015″-.003″
C .003″-.0035″
D 2.375″
Piston Ring Wall
Tension 3-5 Lbs.

RD-40 H.P.
A .007″-.017″
B .005″-.0065″
C .0035″-.004″
D 3.1875″
Piston Ring Wall
Tension 6-9 Lbs.

THE JOURNAL BEARING DOWEL (LOCATING) PIN



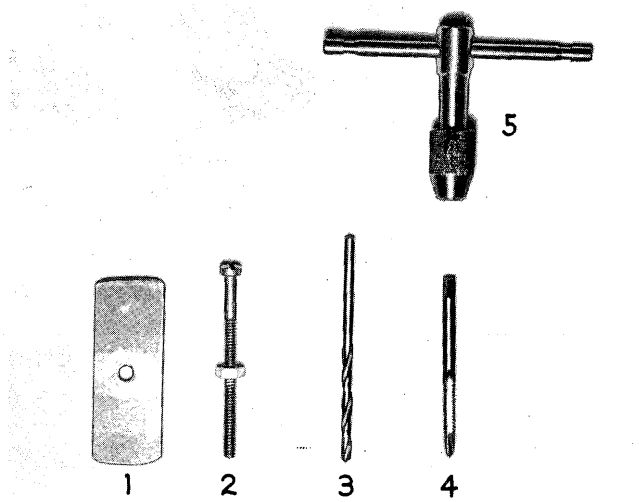
Showing location of Journal Bearing Dowel (Locating) Pin.

Purpose of the journal bearing dowel pin installed in the crankcase is to correctly position the journal bearing and to prevent possibility of its creeping.

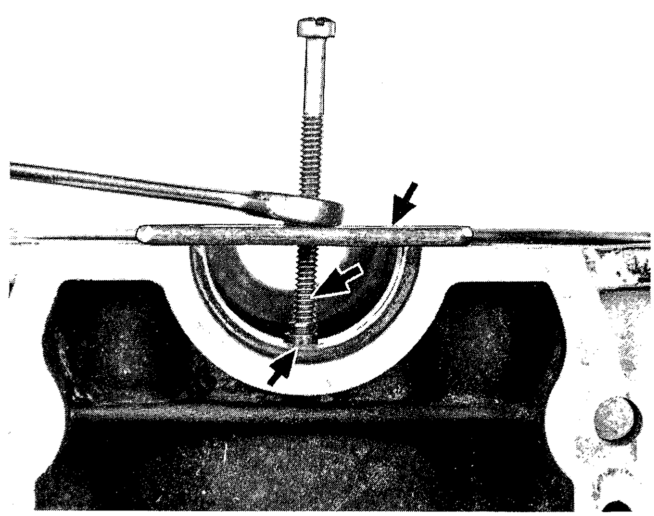
Prior to "bolting" down the crankcase, care should be exercised to make certain the journal bearing seats properly over the dowel pin. If otherwise out of line, the dowel pin will be forced flush into the crankcase during final assembly and as such, serves no purpose. In this event, it must be removed and replaced with a new pin.

A kit (illustrated below) for removal of the dowel pin can easily be assembled from material in the shop. To remove the dowel pin, proceed as follows:

1. Use No. 25 drill to drill hole in center of the dowel pin.
2. Tap with 10/24 tap.
3. Place puller plate on crankcase face, insert 10/24 screw and thread into the dowel pin.
4. Turn nut on puller screw to remove the pin.
5. Carefully insert new pin – drive in until shoulder on the pin comes to rest flush with crankcase – check to make certain the bearing does not "rock" on the pin but seats in the crankcase.

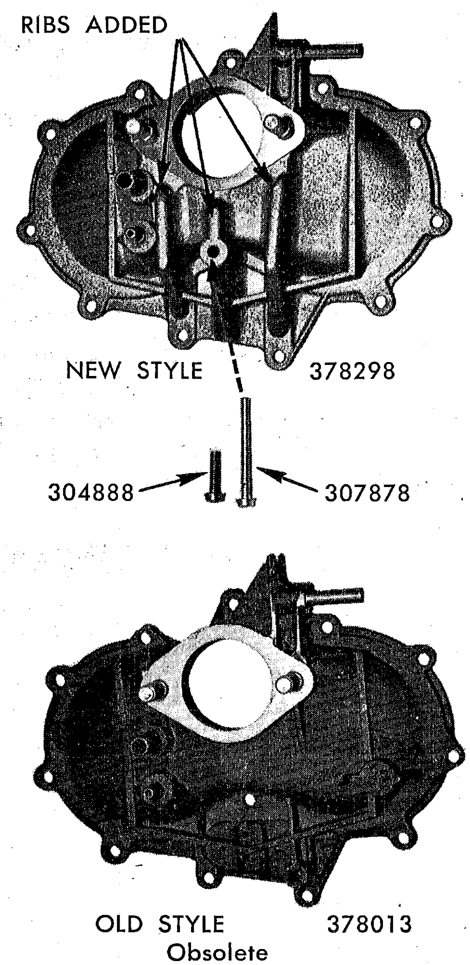


Suggested Kit for removing the Journal Bearing Dowel (Locating) Pin from Crankcase:
1 Puller Plate — 1″ × 2 1/2″ × 1/8″ – 3/16″ Hole
2 Drill — No. 25
3 Tap — 10-24
4 Puller Screw — 10/24″ × 2 1/2″ and Nut
5 Tap Holder



Pulling Dowel Pin from Crankcase.

RDS-22 (40 H.P.) POWERHEAD



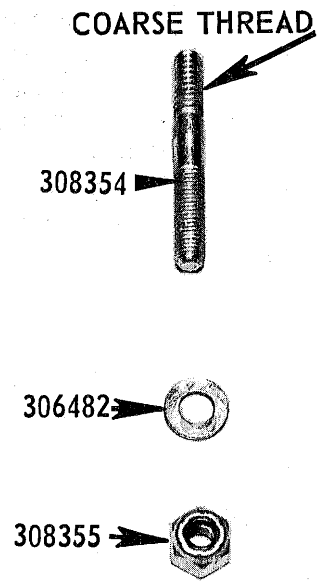
Comparing new with old style 1960 40 H.P. Intake Manifold. Rib added to new style for added support requires use of longer screw – Part No. 307878.

The 1960 – 40 H.P. intake manifolds have undergone a change which consists of having added reinforcing ribs to the outside of the manifolds. This change requires using a longer screw, Part No. 307878, instead of screw No. 304888 at the center of the manifold. Screw No. 304888 is still used as before around the outer circumference of the manifold. One long screw, No. 307878, is included in each new style manifold assembly and will be included when the new manifold is ordered.

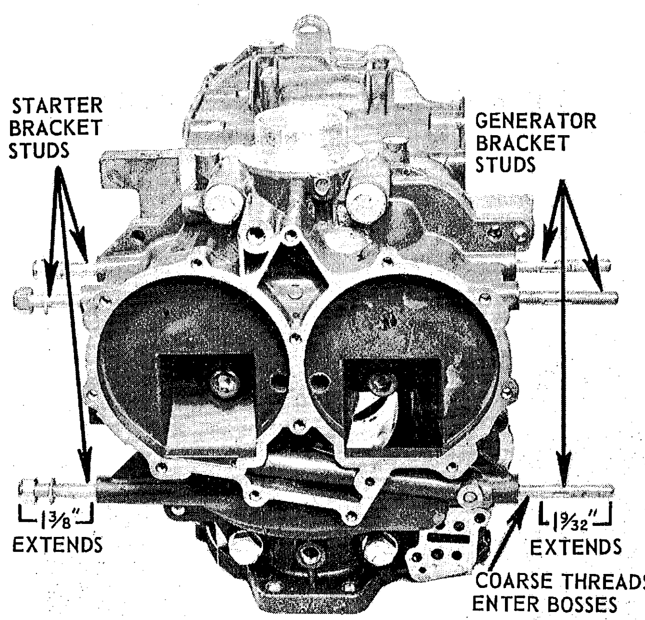
Both old and new style manifolds for the 1960 electric starting models feature an identical change also made for the manual starting engines. To insure receiving the correct manifold for the engine being serviced, be certain to correct all 1960 – 40 H.P. parts catalogs as follows:

RD, RDL-22 and 22C catalogs only; page 9: item No. 10, No. 376901* use No. 378297
RDS, RDSL-22 and 22C; page 11: item No. 10, No. 378013 superseded by No. 378298

Service Bulletin No. 802 10/19/60



Showing Stud, Washer and Self-locking Nut available for use on all 40 H.P. Engines. For Starter Motor and Generator Motor Bracket installation. Once Nuts have been removed DO NOT reuse – replace with new.



40 H.P. Cylinder Assembly showing proper installation of Studs–used to retain Starter and Generator Motor Brackets.

A change was made on 1961 Model RDS series production engines which consists of using studs instead of the former washer-faced cap screws to secure the electric starter and generator mounting brackets to the powerhead.

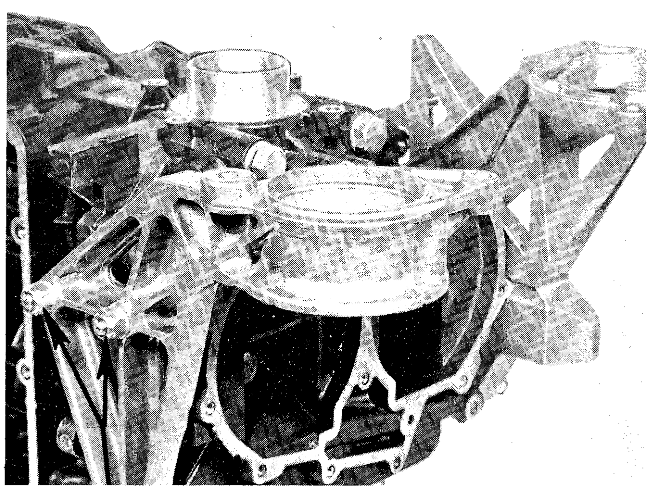
Since the studs are also used to secure generator mounting brackets, three complete sets of the parts will be included as part of future generator kits for the RDS series engines.

These studs are also interchangeable on those 1960 and early 1961 Model RDS series engines which have starter and generator mounting brackets secured with the former cap screw. Because we suggest replacing all such cap screws whenever you service any engine which still uses them, the following installation pointers are given to assist you in properly installing the studs:

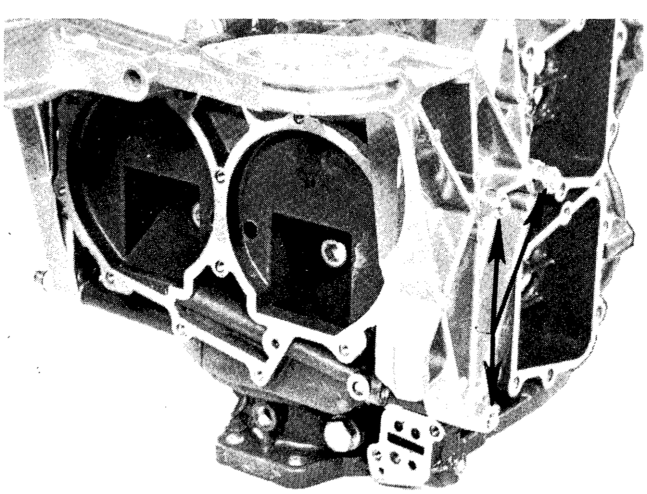
1. The end of the stud with the coarse thread must be entered into the cylinder block.
2. THIS STEP IS IMPORTANT! To insure holding power, apply some "Loctite"* compound to the coarse threads before entry.
3. Install all starter bracket studs so 1-3/8 inches extends from the casting (measured from face of boss).
4. Install all generator bracket studs so 1-9/32 inches extends from the casting (measured from face of boss).

*LOCTITE – Product of American Sealants Co. Hartford 6, Connecticut

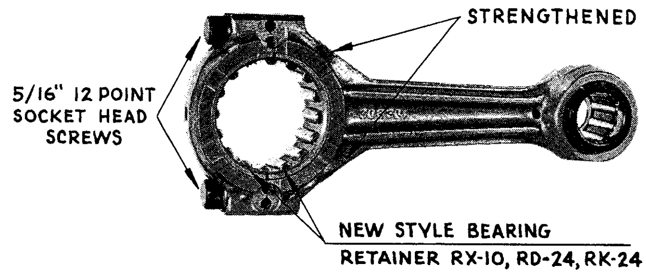
Service Bulletin No. 833 3/27/61



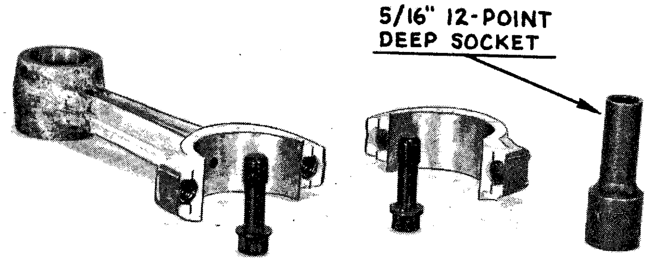
Showing installation of Starter Motor Bracket on Cylinder.



Showing installation of Generator Bracket on Cylinder.



Showing new style 40 H.P. Connecting Rod with 12-point Cap Screw.



New style Rod disassembled to show new 12-point Cap Screw and Socket used to apply torque.

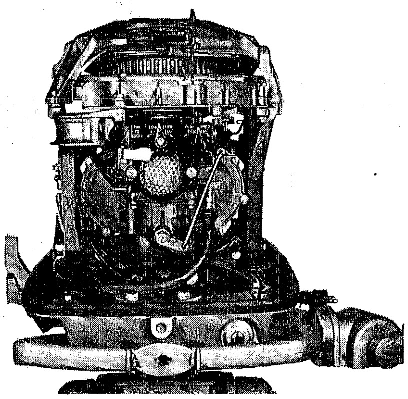
Connecting rods used for service on the early 1961 – 40 H.P. engines have been replaced by a new, stronger connecting rod.

The new rods are of a heavier cross section and use a new type, 12-point cap screw which facilitates application of the higher torque value.

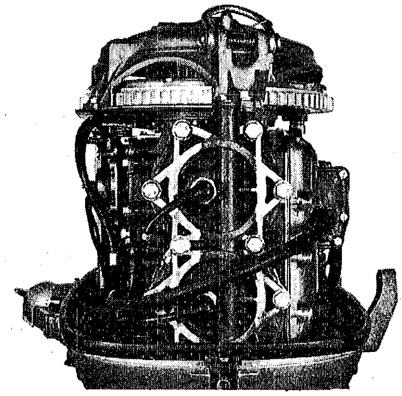
A 5/16" 12-point *deep* socket must be used to remove and torque the 12-point cap screws because the space between the cap and the screw was necessarily reduced in changing to a screw with a 12-point head. Torque to: 29 to 31 foot-pounds.

POWERHEAD – MODEL RX

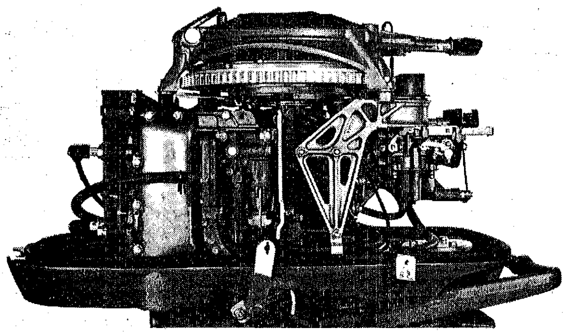
Shown here are four views of the Model RX Powerhead: front, rear, port and starboard sides. Since basic design and construction are like that of the previous Model RD series, all service operations are conducted in similar manner: 1 – Magneto, 2 – Carburetor, 3 – Powerhead, and 4 – Lower Unit. Refer to the RX series parts catalog as it relates to the parts nomenclature and assembly.



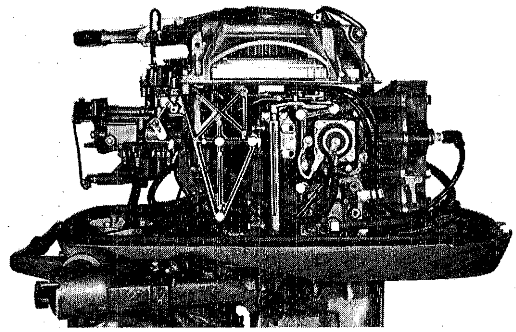
Powerhead Model RX – Front View.



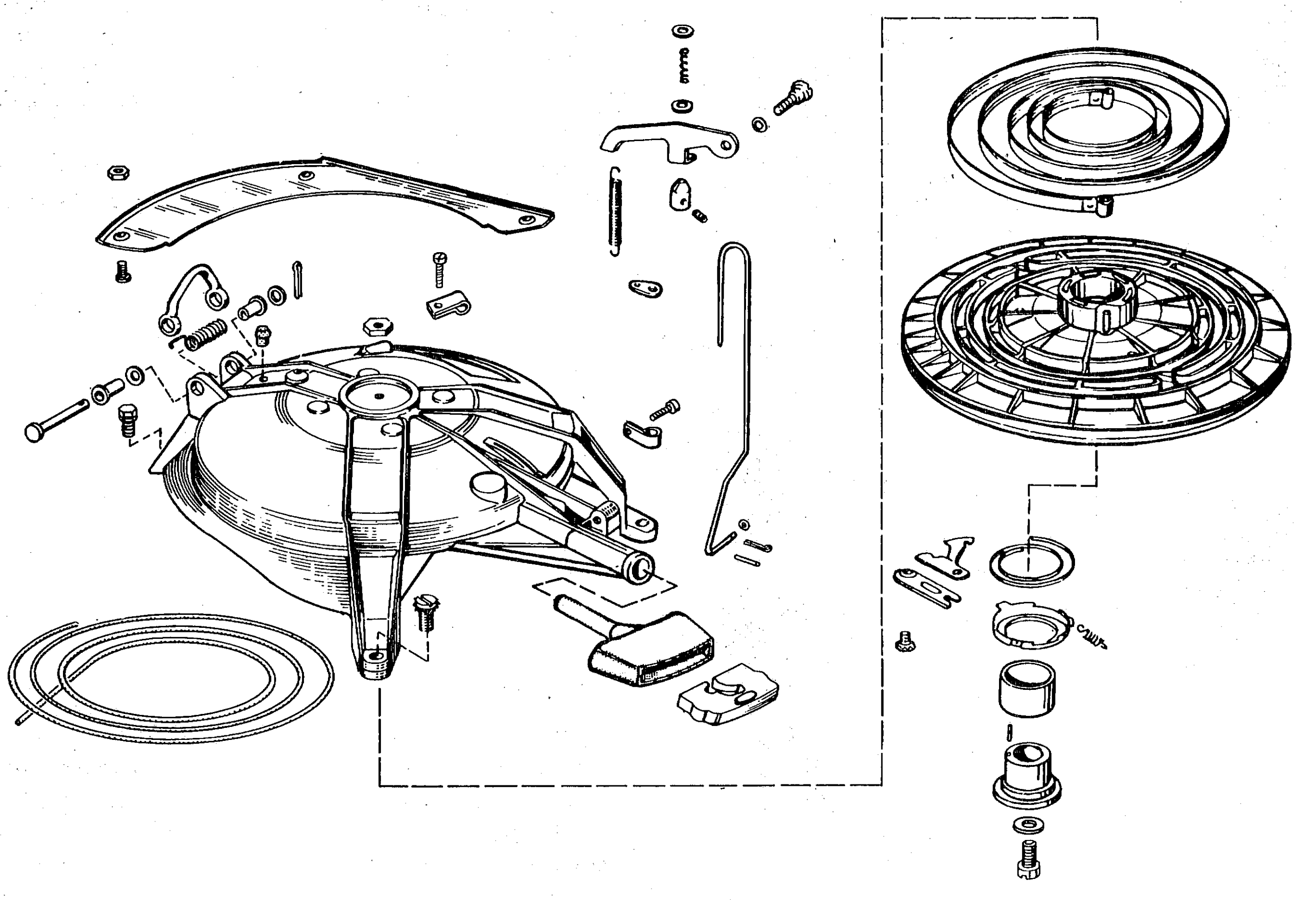
Powerhead Model RX – Rear View.



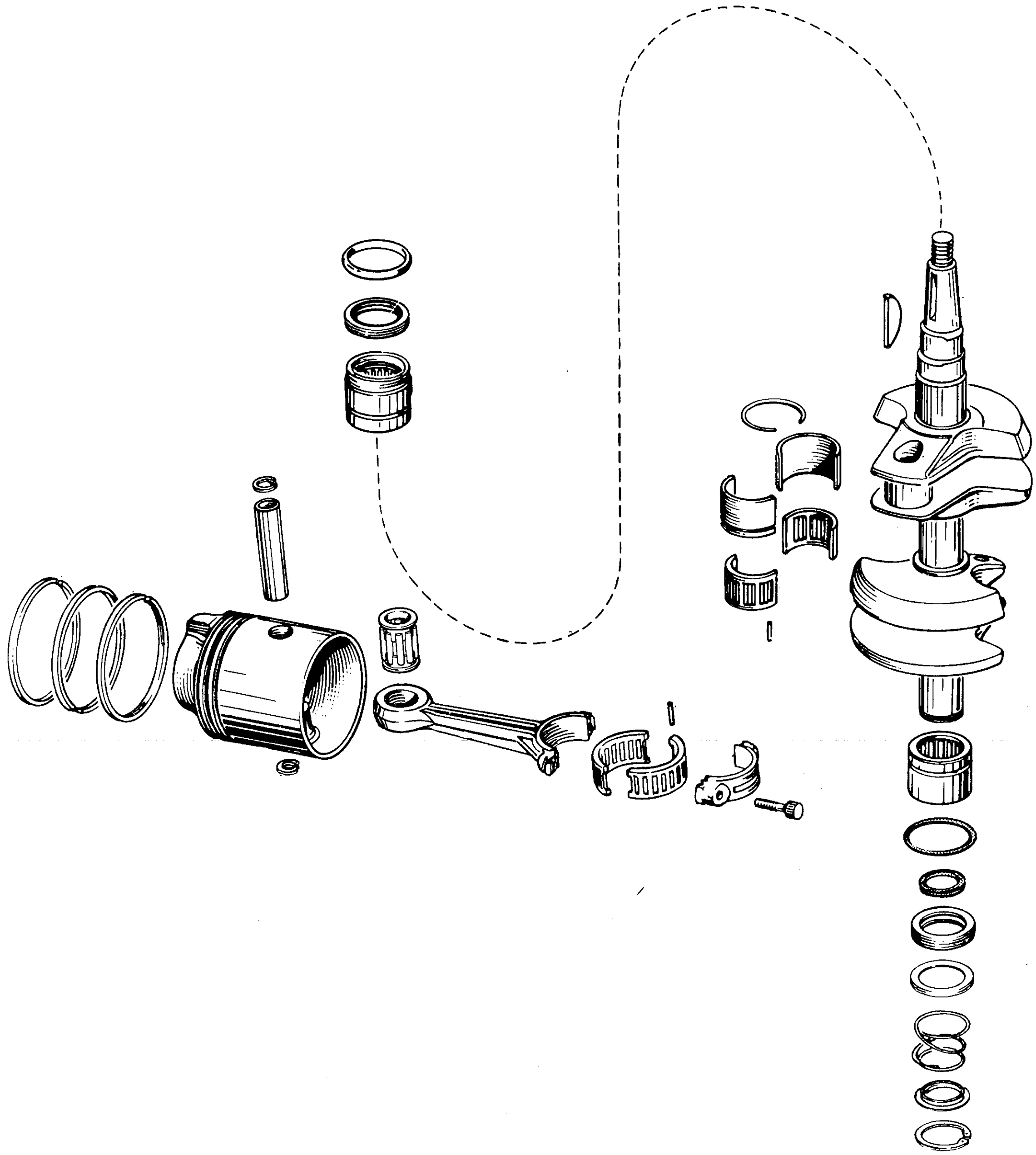
Powerhead Model RX – Starboard View.



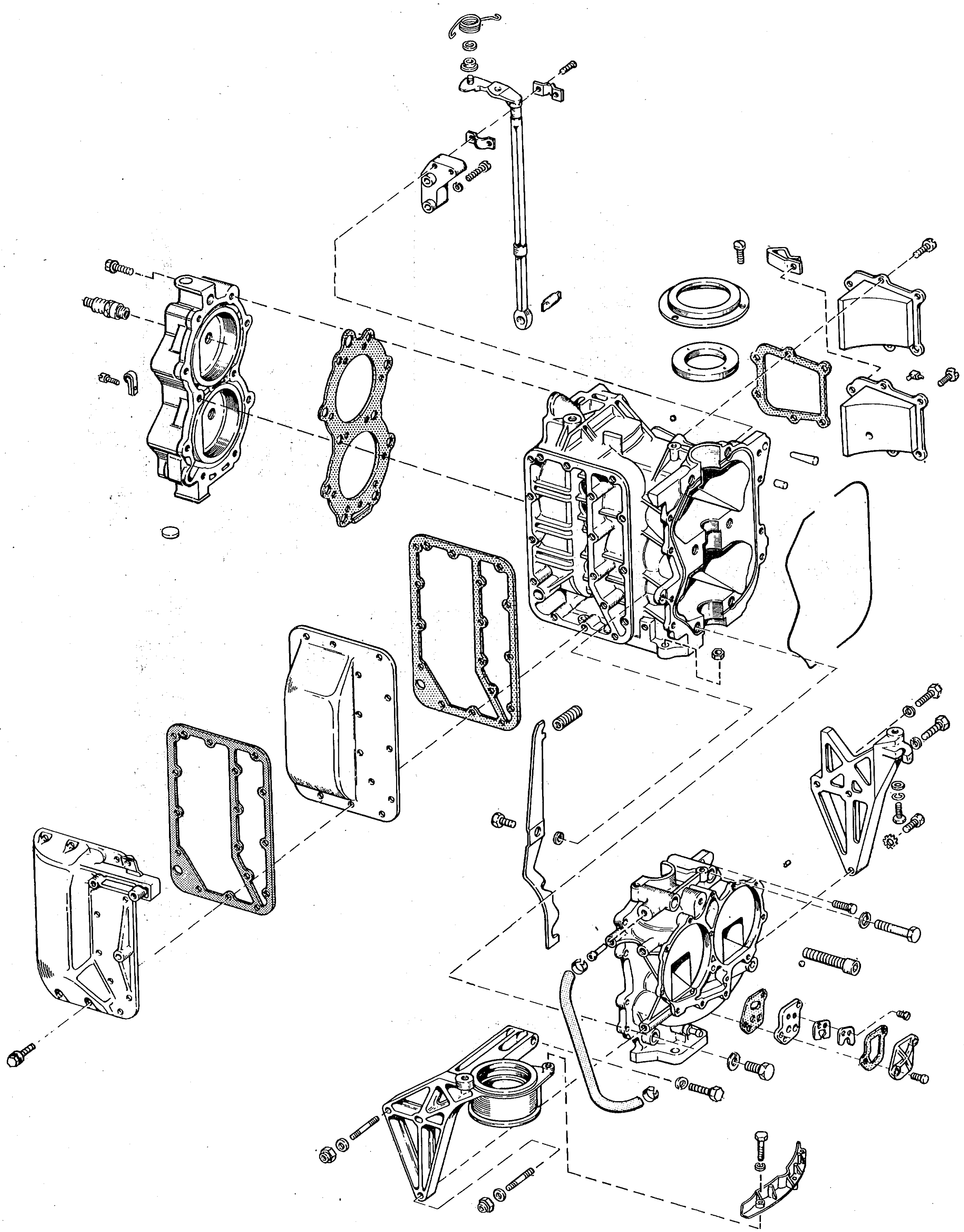
Powerhead Model RX – Port View.



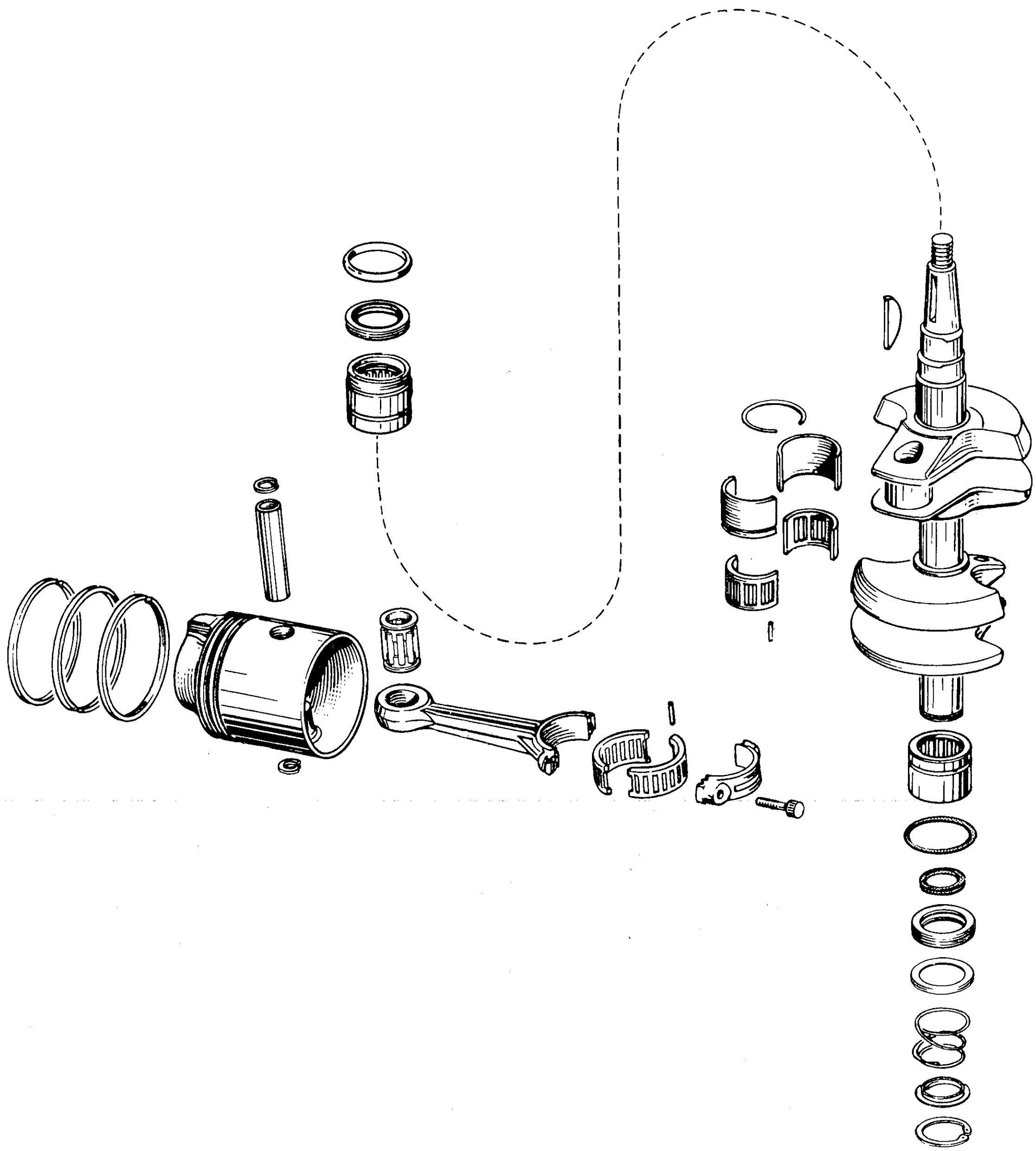
STARTER GROUP
Models RDS-24M Up



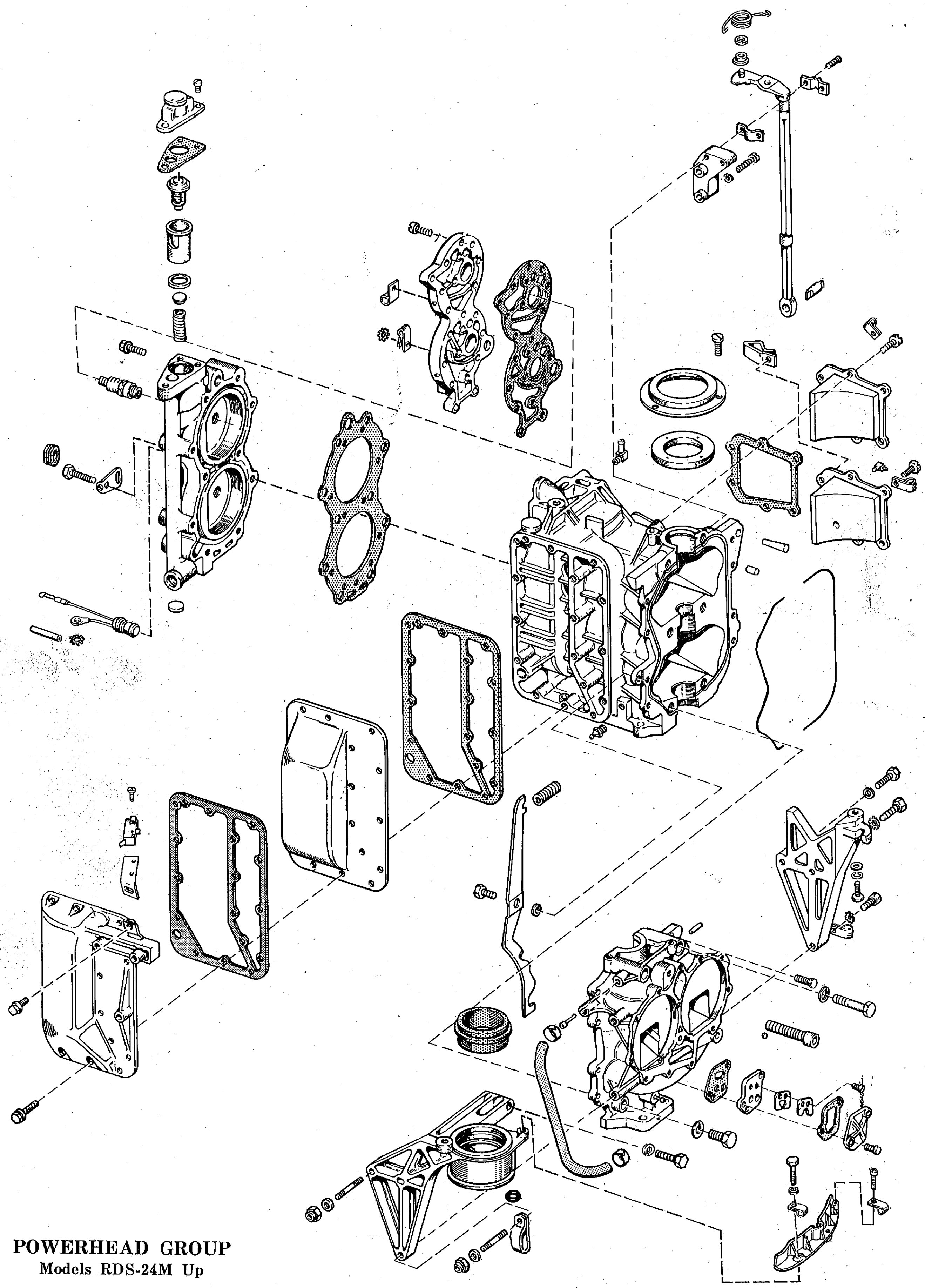
CRANKSHAFT GROUP
Models RX-10C Up



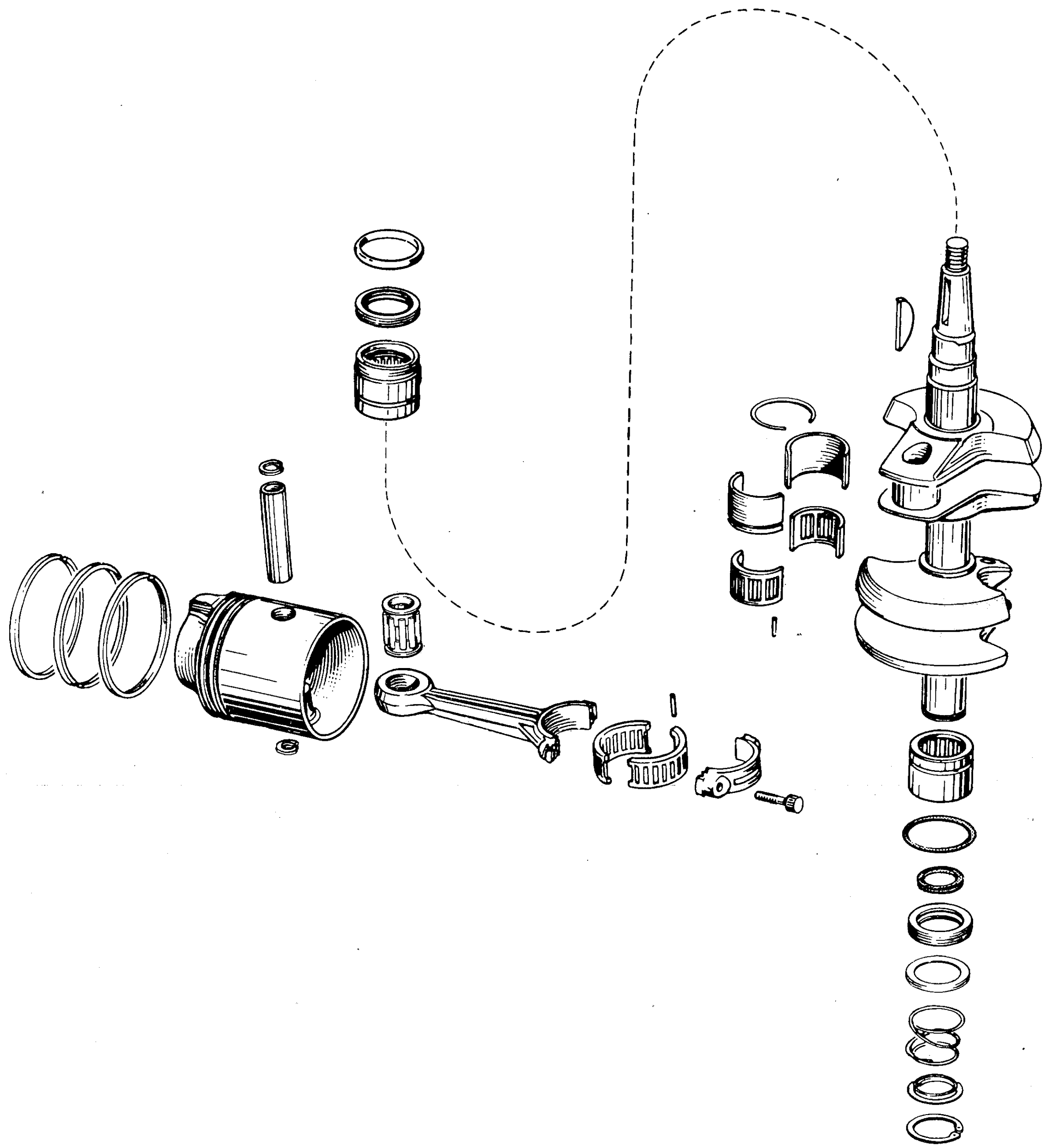
POWERHEAD GROUP
Models RX-10C Up



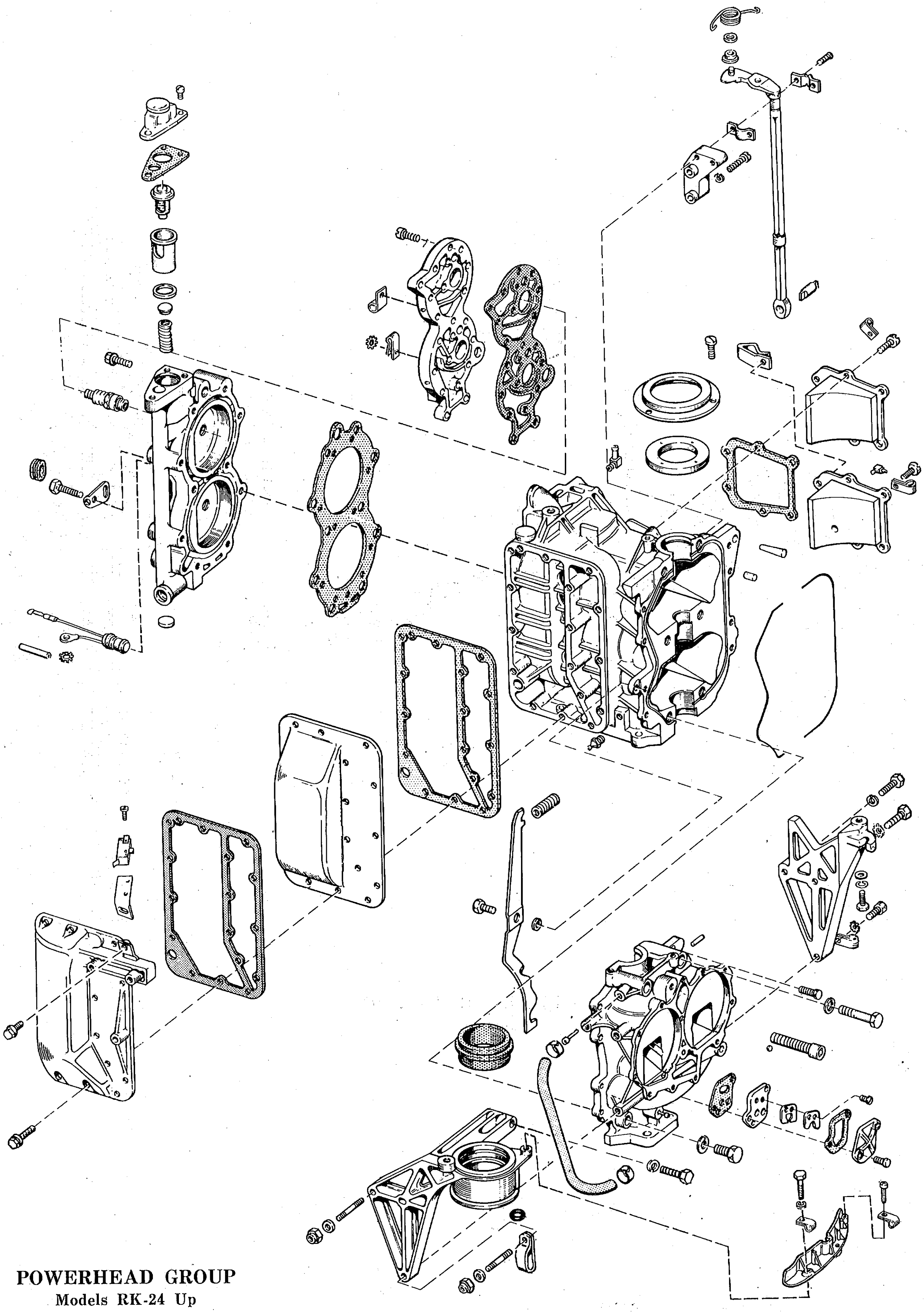
CRANKSHAFT GROUP
Models RDS-24M Up



POWERHEAD GROUP
Models RDS-24M Up



CRANKSHAFT GROUP
Models RK-24 Up



POWERHEAD GROUP
Models RK-24 Up

STEERING HANDLE KIT INSTALLATION INSTRUCTIONS

This kit is provided for owners who may desire to operate the motor temporarily on a boat without remote steering control. The kit replaces the throttle control and cover, and provides both throttle and steering control. Installation is accomplished in two steps. The throttle control and throttle control cover must be removed first, and then the steering handle installed. To insure proper and satisfactory operation of the steering handle and throttle control after installation, follow exactly the procedures given below.

Removal of Throttle Control and Cover

1. Remove pinion nut and screw, see Figure 1. The 35 horsepower model has mercury switches which will drop off. Allow them to hang suspended by lead wires where they will not interfere with your work.

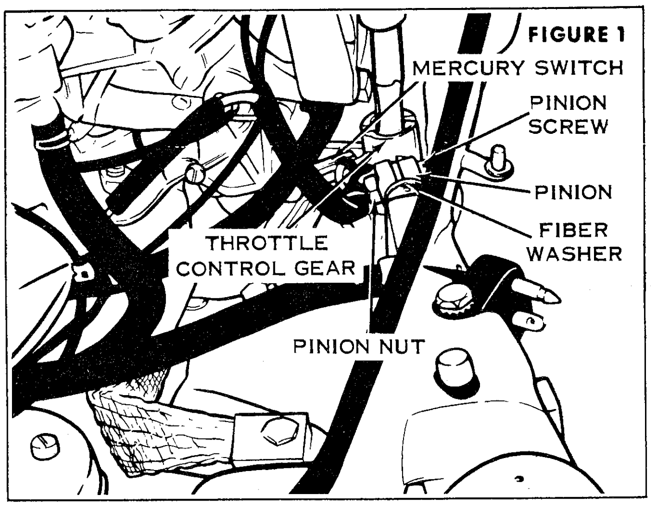


FIGURE 1

2. On 35 horsepower models only, drive out roll pin attaching idle control cam to shaft, see Figure 2. When throttle control shaft is removed, save the cam and roll pin for reassembly.

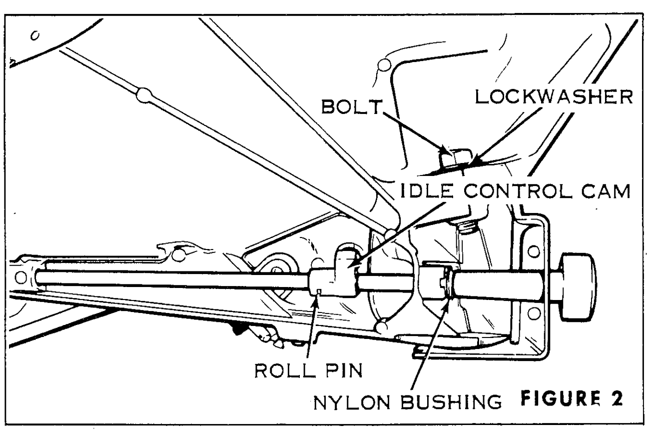


FIGURE 2

3. Pull control lever and shaft from the pinion. Allow pinion to remain in position on throttle control gear, see Figure 1. There is a nylon bushing on the shaft which must be saved for reassembly, see Figure 2.

4. Detach the throttle control cover by removing the attaching bolt and lockwasher, see Figure 2. A 5/8 inch wrench can be used for this operation. A separate bolt, nut, spring washer, thrust washer, and cotter pin are provided with this kit for installing the steering handle.

Installation of Steering Handle

1. Apply a substantial amount of lubricant over the short gear and shaft assembly. Place nylon bushing on short gear and shaft assembly. Insert the short gear and shaft assembly through hole in the carrying handle casting with flat on end of shaft up, see Figure 3. On 35 horsepower models, slide idle control cam on end of shaft, position over hole in shaft and secure with roll pin. See Figure 2 for correct position of cam.

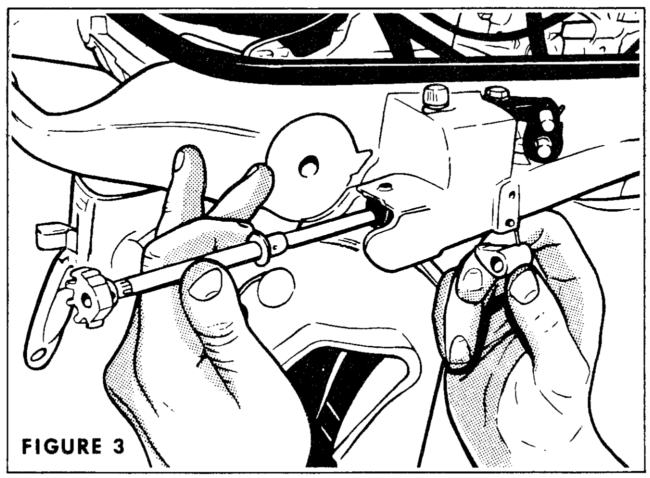


FIGURE 3

2. Before inserting shaft into pinion be sure fiber washer is properly positioned (see Figure 1), and the pinion and throttle control gears are matched for proper timing; last tooth on the pinion gear and the last notch on the throttle control gear must mesh. Rotate the shaft while inserting it into the pinion so as to align the corresponding flats of the shaft and the pinion.

3. Check assembly for free movement and proper meshing and timing of the pinion and throttle control gears. If everything works smoothly, place mercury switch bracket on the pinion (35 horsepower model only), insert the pinion screw, and tighten securely with nut, see Figure 1.

4. Assemble spring washer and steering handle-to-bracket screw. Place in position through the hole on the carrying handle bracket and place brass thrust washer over the protruding screw.

5. Position steering handle in place. Proper meshing of the gear on the steering handle with the gear and shaft assembly is important. This is done quite simply. Merely turn the steering handle

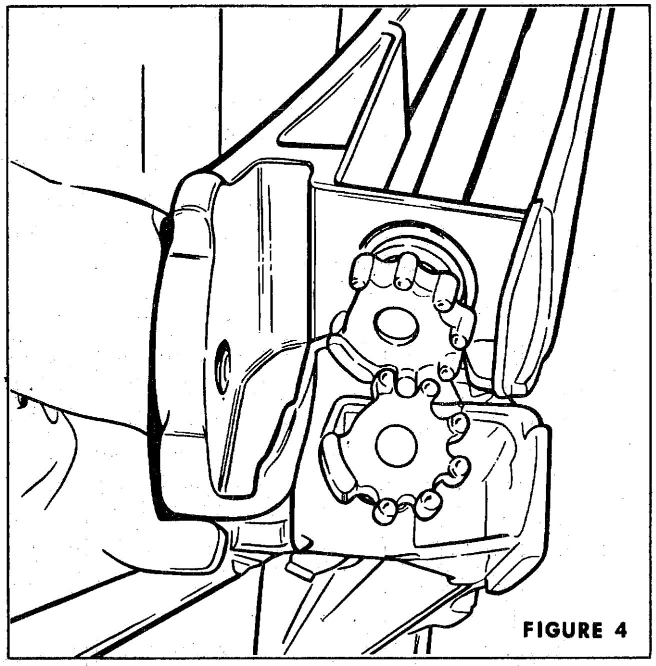


FIGURE 4

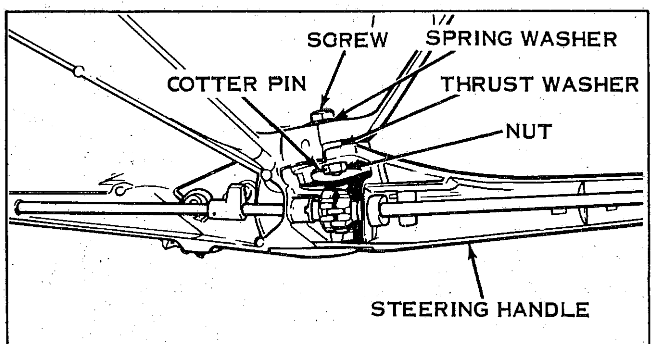


FIGURE 5

gear so that its large tooth and space mesh with the large tooth and space of the other gear.

6. Start the screw through the hole in the steering handle until one-half or all of one thread protrudes from the inside of the steering handle. Now position steering handle nut over protruding screw and continue to drive the screw in with a wrench until a slight effort is required to raise and lower the steering handle.

7. Check gears at this point to make sure they mesh, see Figure 4. Check the rest of the assembly to insure proper operation.

8. Tighten the steering handle nut a little further and align holes in the nut with the slot in the end of the screw. Insert the cotter pin and bend the ends of the pin over until they rest snugly against the nut, see Figure 5.

NOTES

TORQUE TENSIONS

All nuts, bolts and screws are drawn up or tightened by means of torque — a twisting motion exerted by wrench or screw driver, usually relying upon the individual's personal judgment as to degree of tightening.

With modern application of advanced design and construction, however, specific torque tension (tightening) applied to each group of screws, bolts or nuts in the assembly becomes a significant factor in the overall job—original assembly and/or repair.

All nuts, screws or bolts (flywheel, connecting rod, cylinder head, etc.) obviously cannot be drawn up to the same degree of tightness for several reasons, but mainly because of application, material used in construction, the type of threads, etc. For example, one screw or bolt may be considerably larger than another, yet specified torque tension for tightening may be greater for the smaller diameter screw — it was designed for a definite purpose with all details surrounding its installation engineered accordingly. The old days of "nuts and bolts simply being nuts and bolts" are gone forever — today's practice demands drawing to specific torque tensions. See Service Bulletin No. 816.

Torque is measured in foot-pounds ordinarily but frequently gauged in inch-pounds, depending largely upon the circumstances involved. Just to remind you, one foot-pound of torque tension is equal to resultant force of a one pound weight placed at one foot from a fulcrum or pivot or at 12 inch-pounds if the instrument is gauged in inch-pounds.

Torque wrenches are available and calibrated accordingly — either in foot- or inch-pounds as required for the purpose. We strongly recommend the use of an inch-pound torque wrench for all torque applications of under 10 pounds. To convert foot-pounds to inch-pounds — multiply foot-pounds × 12.

Nothing is gained by pulling up beyond specified torque (tightness) recommended for the particular nut, screw or bolt. The torque wrench is your guide — it tells you when correct tightness has been reached for the application. Stretching beyond the yield point of material and/or threads, simply weakens the installation to result in eventual failure.

Conversely, the fastener (nut, screw, etc.) does *not* hold as intended if *not* drawn to specified torque — following results are not too difficult to comprehend. See Service Bulletin No. 816.

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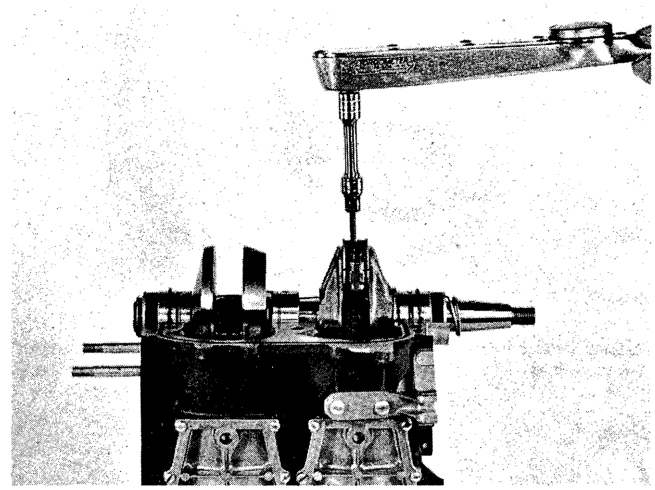
Note that a lubricant, is recommended for a better job of torquing. BUT DON'T — DON'T UNDER ANY CIRCUMSTANCES PERMIT LUBRICANT FINDING ITS WAY TO SURFACES OF THE CRANKSHAFT OR FLYWHEEL HUB TAPERS. BOTH TAPERS MUST BE DRY DURING FLYWHEEL INSTALLATION.



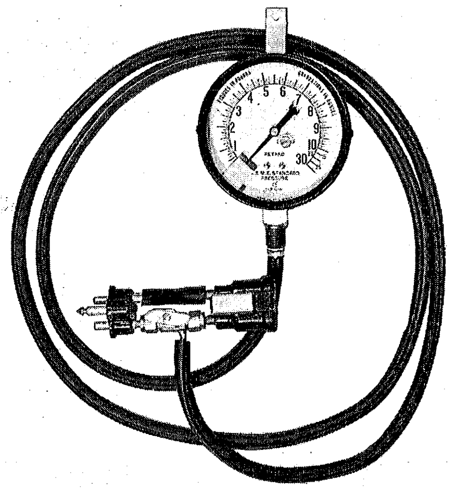
Applying Proper Torque Tension to Connecting Rod Screws.

OVERHEATING

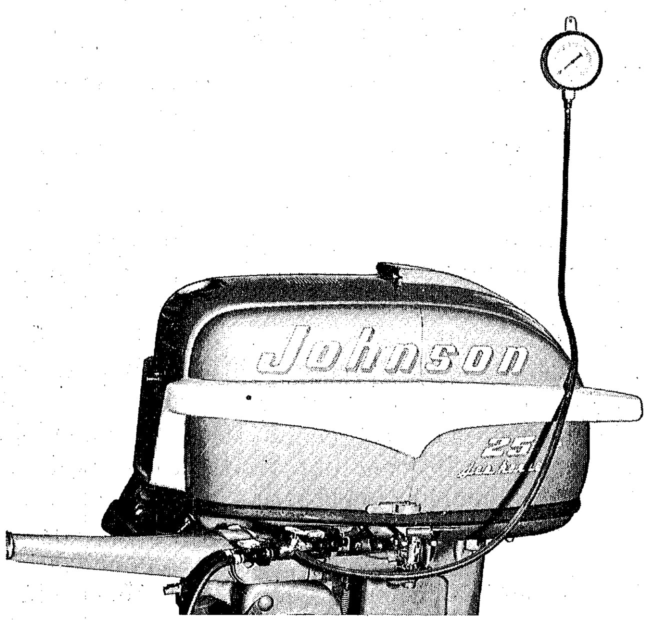
Overheating naturally is result of some failure or discrepancy in the water-circulating system; in some instances, mounting of the motor on a boat transom too high for the specific model. For Johnson, the recommended transom height is 15″, for the L (long models) 5″ higher to insure ample water supply for satisfactory cooling.

Component parts of the pump assembly must, of course, be in "fit" condition: water tubes (where employed) should be made secure to guard against "seepage"; gasket and gasket faces in the circulating system must be in good condition and water tight; grommets, where used, must be properly installed—not allowed to "crimp" over the end of the water tube to restrict volume of water to the cooling system. Situations of this sort are easily overlooked. Be on the lookout and alert for any irregularities apt to interfere with "free" passage of water for cooling.

Of extreme importance, but frequently overlooked, is condition of the cylinder head gasket. The least amount of compression "seepage" into the **cylinder water jacket** is enough to build up sufficient pressure (in the cooling system) to retard or stop water circulation; inevitable result is **overheating** and eventually, complete "blowing" of the gasket. "Good" compression when cranking does not necessarily indicate a good or tight gasket mount; seepage may still exist between gasket faces. When in doubt, install a new cylinder head gasket; draw head screws up to recommended torque tensions. (See page 362.)



Illustrated here is a Pressure Gauge Assembly for running a check on Fuel Tank Pressure to be assured of constant Fuel Supply.



Fuel Tank Pressure Gauge as Installed on Motor.

A CHECK ON FUEL TANK PRESSURE

While motors of recent production (except JW) are provided fuel pumps, there are still thousands of earlier production in use with the pressurized fuel system installation. Fuel tank pressure is easily checked with a gauge assembly to assure a constant fuel supply.

It's a rather simple arrangement consisting of a low-pressure gauge, about eight feet of rubber tubing with fittings at each end for attaching to the motor and to the fuel tank and a valve to close off pressure to the tank, if desired.

Simply place the gauge in a convenient position near the test tank – the air pressure line is long enough to permit "hanging" the gauge on a close-by wall (do not attach to the tank). Gauge must be mounted in a vertical position.

Along with checking out a motor for possible causes of unsatisfactory performance – slow and high speeds – condition of the fuel tank is frequently overlooked. Its primary purpose, of course, is to "hold" pressure as pressurized by the crankcase valving mechanism. Failure to retain pressure obviously is a signal of "seepage" or pressure escape which when reaching a certain limit, has its effect on motor performance – inability to maintain proper fuel level in the carburetor.

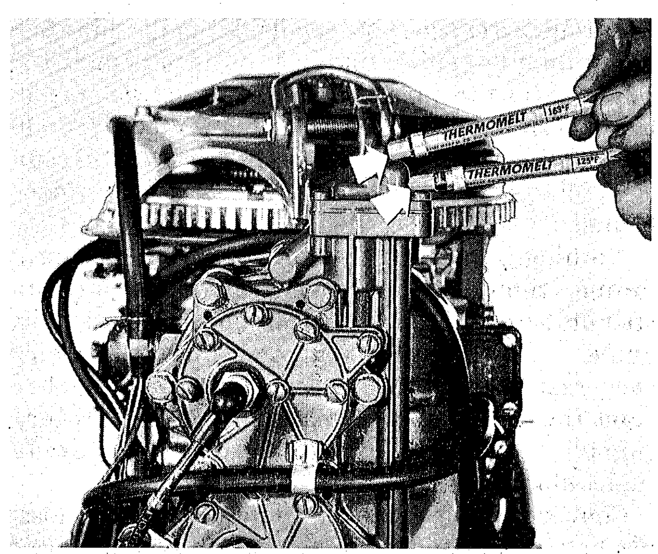
First, "check-out" of any motor in for service and provided with a pressurized fuel system should be accomplished with the "owner's" tank – the tank used with the motor.

"Falling-off" of pressure as indicated by needle "dip" when stopping the motor denotes pressure seepage in proportion to rate of the falling needle.

Failure to build up and hold sufficient pressure after a check of the tank, fuel line and fuel line connections for possible seepage, may otherwise result from faulty crankcase valving. In this event, start and run motor for a minute or so to build up gauge pressure – close valve in assembly. Should the needle indicate an abrupt or gradual "dip," crankcase valving may be suspected of seeping which must be corrected to restore normal functioning of the motor.

Each tank should build up and retain pressure as follows:

Model CD	3 to 4½	pounds
Model QD	3 to 5	pounds
Model RD	3 to 4½	pounds



THERMOMELT TEMPERATURE STIKS

With the introduction of the thermostatically controlled cooling system on our newer engines, many dealers have requested some means of measuring the water temperature of an engine in order to check the operation of the thermostat.

Our factory test cells have been using heat sensitive sticks, similar to a crayon, with great success. We have investigated these sticks and are now able to offer you a similar heat indicator called "Markal Thermomelt."

Checking the heat of an object with the Thermomelt Stik is very simple. Merely mark the surface to be checked with the Stik. The mark will appear dull and chalky. When the surface temperature reaches the temperature rating of the Stik, the mark becomes liquid and glossy in appearance. On some painted surfaces the Stiks will not leave a mark. It is only necessary to touch the surface with the Stik in these cases. The reaction will be the same if the surface is to the rated temperature.

To check an engine, it is merely a matter of warming up the engine and checking the heat of the water at a specified location. The engine is best checked when operating on a boat. However, if this is not possible, run the engine in a test tank for at least five minutes. (NOTE: Do not run engines rated at 40 H.P. or higher in a test tank at speeds over 3000 RPM for extended periods under any conditions. Warm-up can be accomplished satisfactorily at this RPM.)

Two Thermomelt Stiks are necessary to check an engine – a 125°F Stik and a 163°F Stik. Mark the engine to be tested on the thermostat housing. When the engine warms up, the 125°F mark should melt and the 163°F mark should not melt.

If the 125°F mark does not melt after a reasonable length of time, the thermostat is stuck open as the engine is running too cold.

If the 163°F mark also melts, the cooling system is not functioning properly, allowing the engine to overheat. Check for worn pump assemblies, leaky water systems, or faulty thermostats.

If the Thermomelt Stiks will not mark the surface to be checked, touch the Stiks to the area several times to be sure engine is warmed up completely for a proper check.

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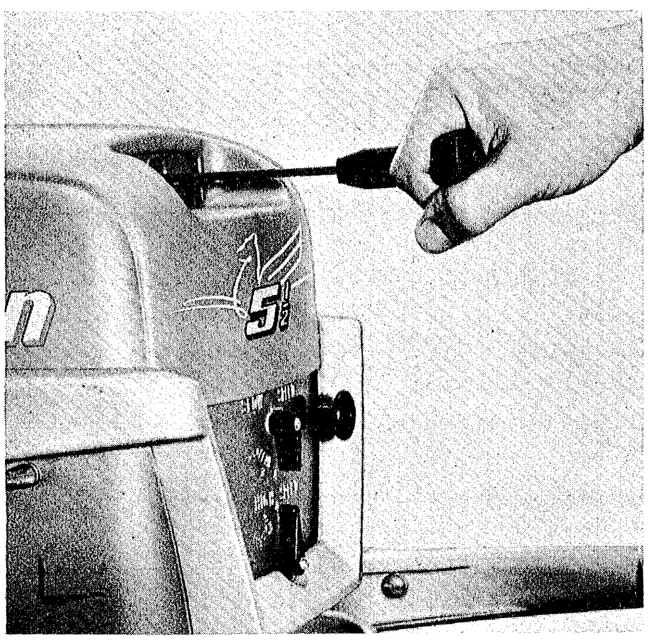
NOTES

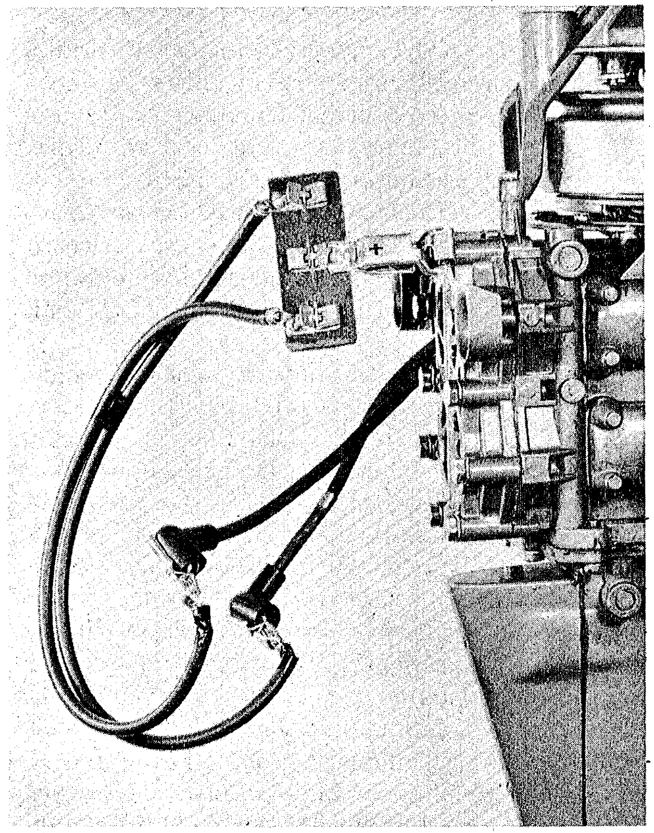
DIAGNOSIS

When attempting to "run down" or diagnose motor difficulties, bear in mind that three fundamentals are basically required to achieve performance, namely: (1) Spark, (2) A combustible mixture of gasoline and air — in other words GAS and (3) COMPRESSION. It's got to have SPARK — it's got to have GAS, and it's got to have COMPRESSION. Practically all motor difficulty can be laid to a deficiency in one or in a combination of deficiencies in all three. Check one at a time.

As a preliminary "once over" — probe the most accessible detail to get at first. The simplest thing to do and which comes naturally is to turn the flywheel to "see" if there is Compression (in each cylinder)—accomplished by merely pulling on the starting cord grip. A lively "bounce" when pulled over piston top dead center ought to indicate reasonably good Compression, the degree of which can be determined from past experience with the model.

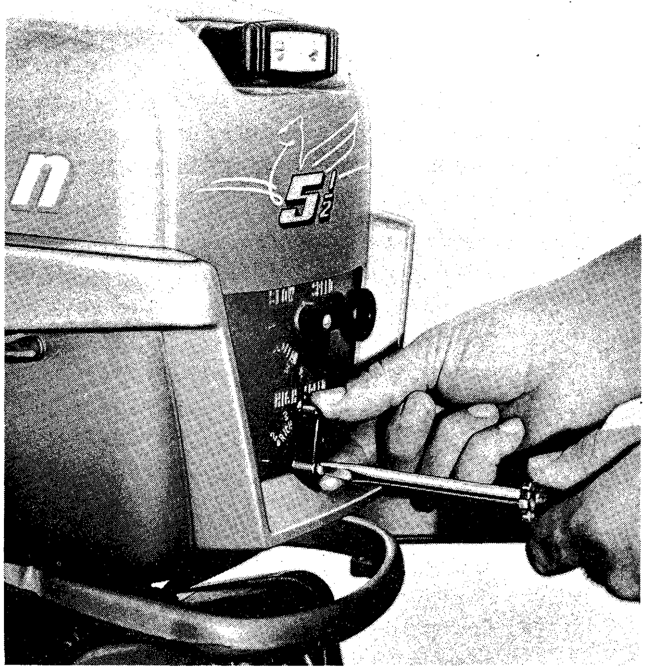


Next, divert attention to Spark. Remove and observe condition of spark plugs first; if appearance does not reveal wet or excessively coated insulators, badly eroded or misadjusted point gaps, lay them aside for the moment. Attach plug leads to spark gap fixture as shown here. Crank motor briskly. Good sparking is divulged by a strong "snap" at the gap—if visible, a "fat" spark; while presence of a less audible "snap" or hair line spark reveals weak or ineffective sparking. The effect of no spark is, of course, obvious. The spark plugs may then be attached to their respective



leads and checked in like manner—check one at a time; ground both plugs to frame of the motor (never let one "dangle" free without grounding at this time to avoid possible injury to the coil). A short length of wire with alligator clip attached to each end is more practical and serves better for grounding—clip to motor frame and "sparky" plug cover. A strong spark at the plug point gap ought to indicate good plugs; however, characteristics vary under compression when operating in the motor. Borderline "sparking" will break down under compression because of greater gap resistance introduced by the compressed atmosphere. Don't "fuss" with questionable plugs—install new plugs when in doubt. This should take care of "Spark" for the time being. Then—take a "gander" at the carburetion system. Observe if liquid fuel mixture is reaching the carburetor and check to ascertain correct position (adjustment) of carburetor needles as directed for each specific model. Don't overlook possibility of an empty fuel tank, water in the fuel mixture, clogged screens, fuel lines, loss of pressure if pressurized fuel tank is employed.

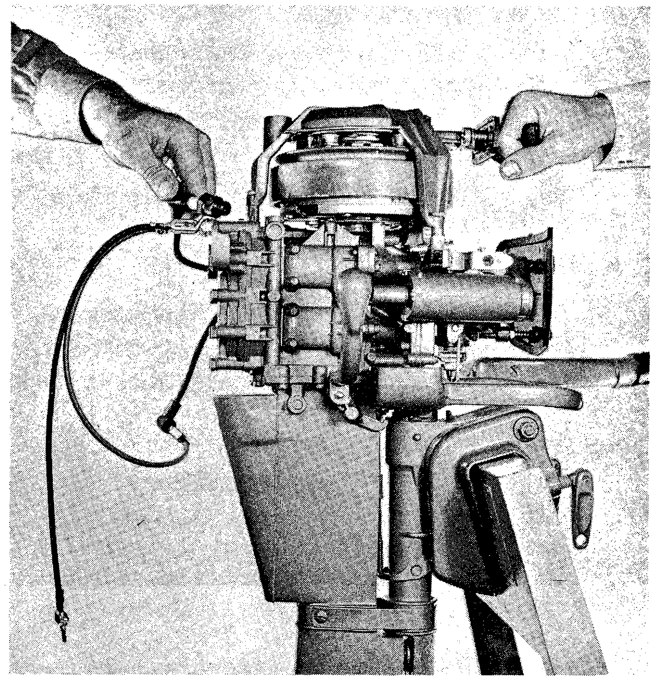
The above preliminary diagnosis may be accomplished in but a few moments and presumably by now, source of the difficulty has been traced to either (1) Spark, (2) Gas, or (3) Compression, or a combination of deficiencies in all three. To seek out corrective measures — proceed with checking



for ignition (Spark) irregularities as follows—assuming that ignition is found to be faulty.

SPARK

1. **Spark Plug** (see page 71)
   - (a) Wrong type — too hot or too cold for the model.
   - (b) Spark plug gasket faulty, incorrectly installed—leaking to cause abnormal rise in plug operating temperature.
   - (c) Point gap too wide or too narrow — correct at .030″.
   - (d) Electrodes (points) excessively eroded—"burned" away.
   - (e) Fouled—wet or carbon clogged.
   - (f) Cracked or broken insulator.
   - (g) Residue coated insulator (exterior) to cause spark seepage and/or periodic "shorts" particularly in salt water areas.
   - (h) Excessive carbon accumulation in the combustion chamber—loose bits of carbon breaking free and lodging in the plug gap to cause short circuiting (solution—remove carbon).
   - (i) Possibility of a clogged crankcase bleeder system not to be overlooked at this time.
   - (j) Deposits or coating (product of combustion) accumulating on surface of the insulator (interior) exposed to flame of combustion is often responsible for misfiring and/or failure at high speed because of current seepage. It is frequently characteristic of deposits of this sort to permit starting (firing) when cold but fail when hot.
   - (k) Spark plug lead—faulty terminal connections at the coil or plug; broken wire; fractured or residue coated insulator to cause spark seepage or direct short circuit.



2. **Breaker Points** (see page 14)
   - (a) Improperly adjusted, out of alignment or oil "smeared."
   - (b) Pitted or corroded
   - (c) Breaker surface loose in its mounting
   - (d) Faulty breaker point insulation—stationary point
   - (e) Loosely mounted or otherwise faulty rubbing block—worn down
   - (f) Weak or broken breaker arm spring
   - (g) Breaker arm binding on its pivot post to cause sluggish action
   - (h) Broken, loose or corroded terminal connections
   - (i) Cracked or "rough" breaker cam surface to cause rapid wear on face of the rubbing block, and its resultant effect on gap setting which should be maintained at .020″ full open.
3. **Condenser** (see page 16)
   - (a) Weak
   - (b) Shorted
   - (c) Improperly mounted
   - (d) Loose, broken or corroded terminal connections

(e) Faulty ground mount — corroded or broken loose on condenser case—ineffective ground mounting to armature plate.

4. **Coil** (see page 11)
   (a) Weak—partially shorted
   (b) Shorted—"dead"
   (c) Improperly mounted—coil heel to magnet pole shoe gap should be adjusted to .015″
   (d) Loose or corroded terminal connectors
   (e) Spark plug lead not properly installed
5. **Wiring** (see pages 11 and 23)
   (a) Loose (poorly soldered) or corroded terminal connections
   (b) Broken stranded core
   (c) Fractured insulation ("pinching" of hold down clamps, etc.)
   (d) Oil soaked to cause current seepage
   (e) Cracked, oil soaked or otherwise faulty insulating washers where used (breaker point)
6. **Carbon Seal** (see page 266)
   (a) Faulty "O" ring installation
   (b) Cracked, broken or
   (c) Improperly installed to permit oil smearing armature plate and eventually affecting breaker point performance.
7. **Flywheel**
   (a) Loose on crankshaft
   (b) Magnets weak
   (c) Improperly adjusted clearance between flywheel magnet pole pieces and coil heels — see page 12

   See magneto check chart

Beyond ignition, look to carburetion.

GAS—Check for (see pages 83 through 85 and 109 through 123)

1. Water in the fuel tank — improperly mixed fuel.
2. Clogged fuel lines, filters, screens, etc.
3. Aged (sour) fuel in tank.
4. Pressure seepage or absence of pressure if pressurized fuel tank is used.
5. Faulty fuel line connectors — seepage from pressure line.
6. Faulty crankcase pressure release to pressurized tank.
   (a) Obstructed pressure release orifices in crankcase.
   (b) Faulty or irregular compression release valve action—valves not seating — broken or faulty "flapper" valve spring (broken, bent out of shape).
7. Closed vent in gravity fuel tank, if used.
8. Broken segment automatic intake valve — power head.
9. Loose or poorly mounted valve and/or valve plate assemblies — power head (compression seepage around mounting screws to interfere with crankcase induction).
10. Carburetor (see page 83)
    (a) Adjusting needles (high and slow speeds) improperly "set" — damaged needle valve faces and their corresponding seats in the carburetor body.
    (b) Filter element, fuel passages and orifices obstructed with gasoline gum (varnish) or other foreign substance.
    (c) Improperly adjusted or faulty float affecting fuel level in the carburetor.
    (d) Faulty float valve action.
    (e) Faulty gasket installations.
    (f) Throttle shutter shaft excessively worn in the carburetor housing to admit a disturbing air stream, thereby upsetting fuel-air ratio.
    (g) Carburetor loosely mounted to crankcase.
    (h) Throttle shutter action not properly synchronized with spark timing—see carburetor check chart.

Finally, its COMPRESSION.

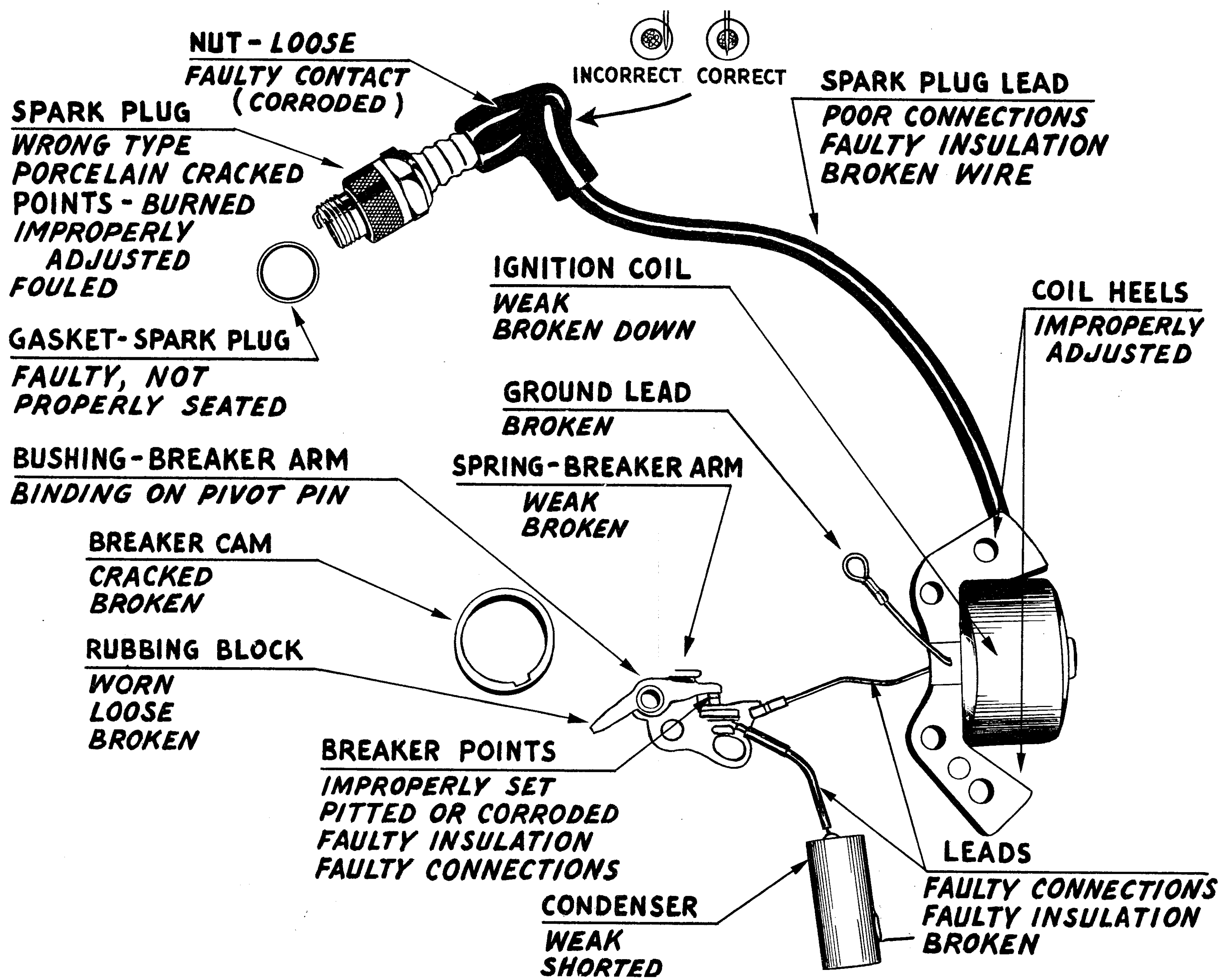
(See pages 187 through 195)

Loss of compression (and power) may be attributed to:

1. "Blown" cylinder head gasket.
2. Faulty piston ring installation — excessively worn or carbon clogged in piston ring grooves.
3. Worn, glazed or scored cylinder walls to permit compression escape and subsequent loss of power as well as contributing to difficult starting.
4. Faulty carbon seals (crankshaft) where used.

Other factors contributing to faulty motor performance are:

1. Failure of the cooling system to cause overheating.
   (a) Worn pump assembly.
   (b) Clogged water tubes, passages and/or water jackets.
2. Water entering the power head.
   (a) Faulty gaskets or gasket installation.
   (b) Faulty carbon seals (crankshaft—bottom end) where used.
   (c) Cracked or porous castings.
   (d) Operator "lifting" lower unit higher than level of the power head on removing the motor from the boat without allowing ample time for water in



MAGNETO CHECK CHART

the cooling and exhaust system to drain off.

See power head check chart, page 356.

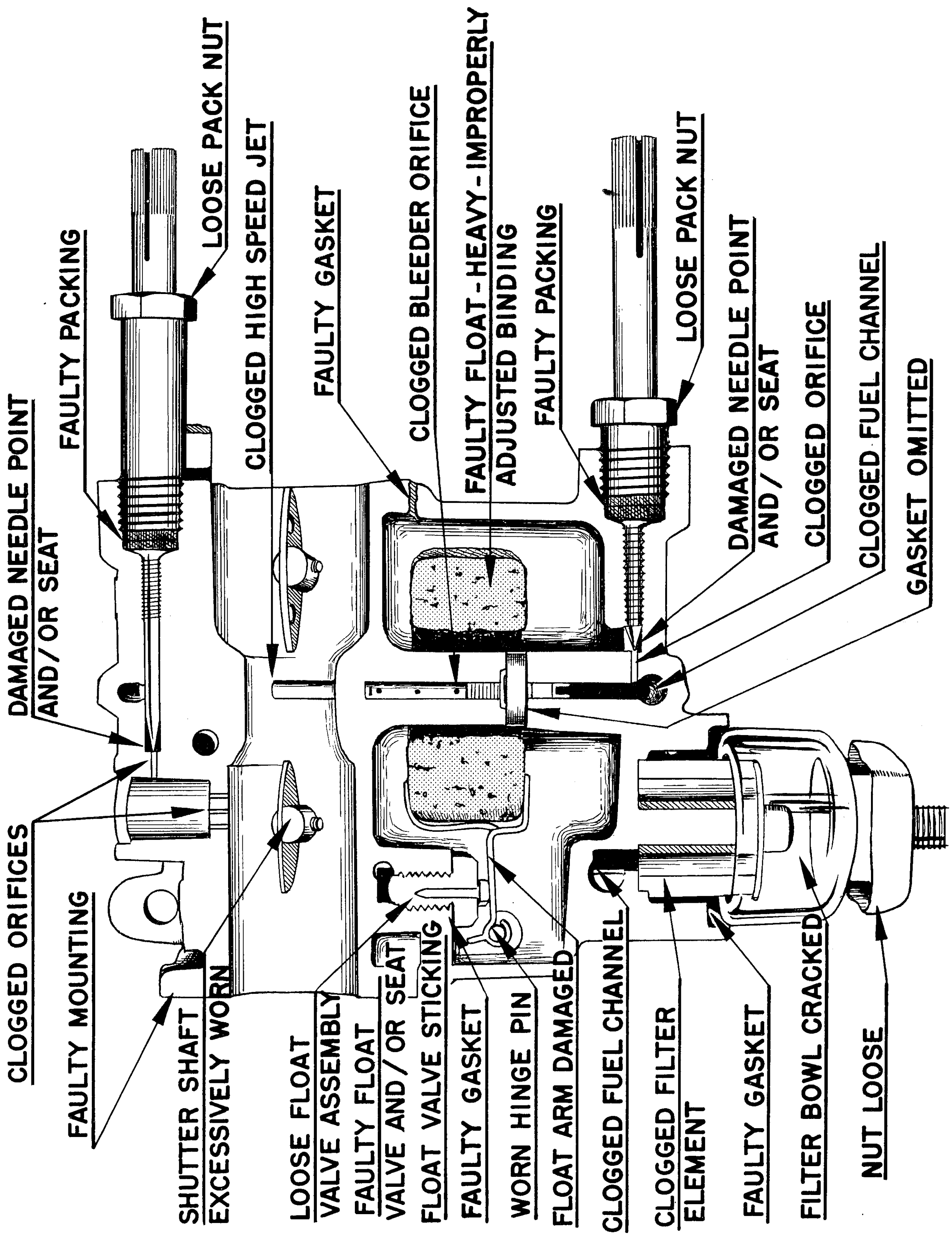
3. Misalignment on assembly of the crankcase to cause crankshaft "binding," ill fitted pistons, rings.
4. Misalignment of the lower unit by accident or faulty assembly.
5. Propeller damage — chipped or off pitch propeller blades, causing excessive vibration of the entire motor assembly—particularly "rough" or course running at slow and intermediate throttle, progressively increasing with higher motor speeds.

SYMPTOMS

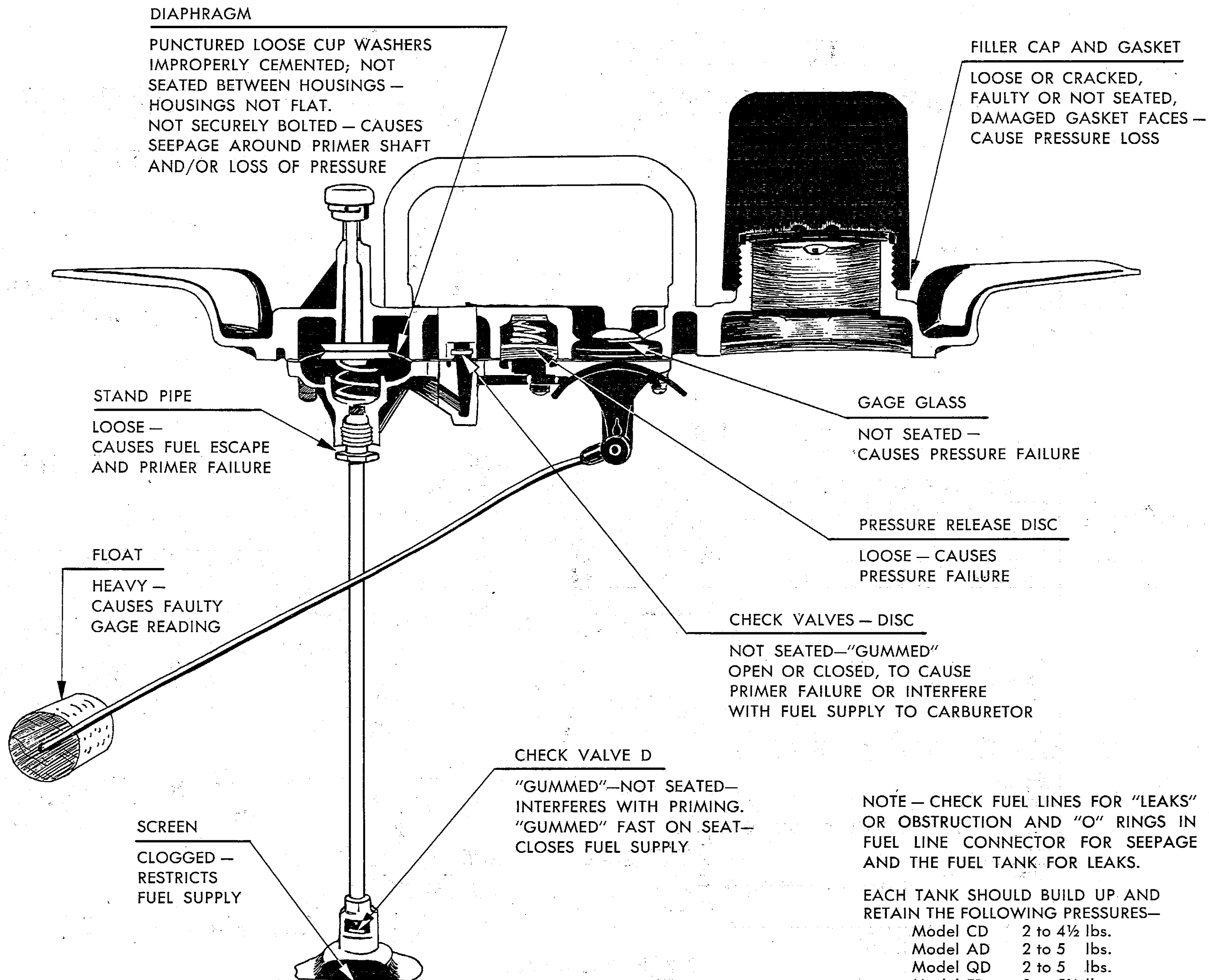
1. Failure to start.
   - (a) Fuel tank empty—Moisture (condensation) in fuel tank.
   - (b) Primer not functioning—if a pressurized tank or vent closed if a gravity tank.
   - (c) Clogged fuel lines, screens, filter element, etc. (gum or other foreign matter).
   - (d) Faulty fuel line connectors.
   - (e) Water in fuel tank and/or power head.
   - (f) Faulty carburetor—see "Gas" above.
   - (g) Faulty ignition.
   - (h) Spark plugs fouled.
   - (i) Spark failure—see "Spark" above.
   - (j) "Blown" head gasket— see "Compression" above.
   - (k) Broken intake valve segment (power head).
   - (l) Electric starting—faulty battery or battery connections or starting unit. Faulty remote starting switch, on "dash" or relay switch in junction box.
2. Hard to start—usually caused by:
   - (a) Refer to items (a) through (l) above.
   - (b) Improperly mixed fuel.
   - (c) Aged (sour) fuel mixture.
3. Missing—ordinarily the result of:
   - (a) Faulty spark plugs or wrong type—too hot, too cold.
   - (b) Faulty broken points—gap.
   - (c) Faulty condenser.
   - (d) Faulty coil.
   - (e) Faulty wiring (Magneto).

   (a)–(e): See "Spark" above
   - (f) Interrupted fuel supply.
   - (g) Excessive carbon—loose bits periodically "shorting" plugs.
4. Roughness or vibration.
   - (a) Loosely mounted on the boat.
   - (b) Propeller blades chipped or out of pitch.
   - (c) Flywheel loose on crank shaft (rarely)
5. Power fall-off—RPM's drop.

   Restricted fuel supply—(See "Gas" above)
   - (a) Improperly set carburetor needle—high speed, slow speed—foreign substance in carburetor.
   - (b) Pressure escaping from pressurized tank.
   - (c) Partially obstructed screens, filter elements, fuel line, carburetor orifices, air line if pressurized tank — vent closed in gravity tank.
   - (d) Faulty carburetor.
   - (e) Faulty pressure valving system — pressure to tank.
   - (f) "Leaky" cylinder head gasket.
   - (g) Blown cylinder head gasket.
   - (h) Faulty compression—see "Compression" above.
   - (i) Faulty cooling system.
   - (j) Propeller blades out of pitch—propeller pitch too great for the particular installation.
   - (k) Excessive carbon accumulation — (exhaust ports) to restrict flow of exhaust.
   - (l) Piston rings carbon "stuck" in ring groove.
   - (m) Worn and/or scored pistons and cylinder walls.
   - (n) Spark plug — too hot for the model or nature of service.
6. Irregular running—alternately fast and slow.
   - (a) Cavitation—see page 202. of the Service Manual.
   - (b) Intermittent fuel supply — see "Gas" above.
   - (c) Interrupted water circulation (cooling).
   - (d) Pistons — piston rings "fit" too snugly during repair—causes binding.
7. Motor knocks—
   - (a) Loosely mounted on boat.
   - (b) Flywheel loosely mounted on crankshaft.
   - (c) Coil heels striking magnet pole shoes (flywheel).
   - (d) Excessive wear—cylinder walls and/or piston.
   - (e) Loose wrist pin.
   - (f) Loose crank pin bearing — connecting rod.
   - (g) Bent or twisted connecting rod.
   - (h) Crank pin bearing too tight (if friction type), causing piston to "slap" as it passes over top and bottom "dead" centers.



CARBURETOR CHECK CHART

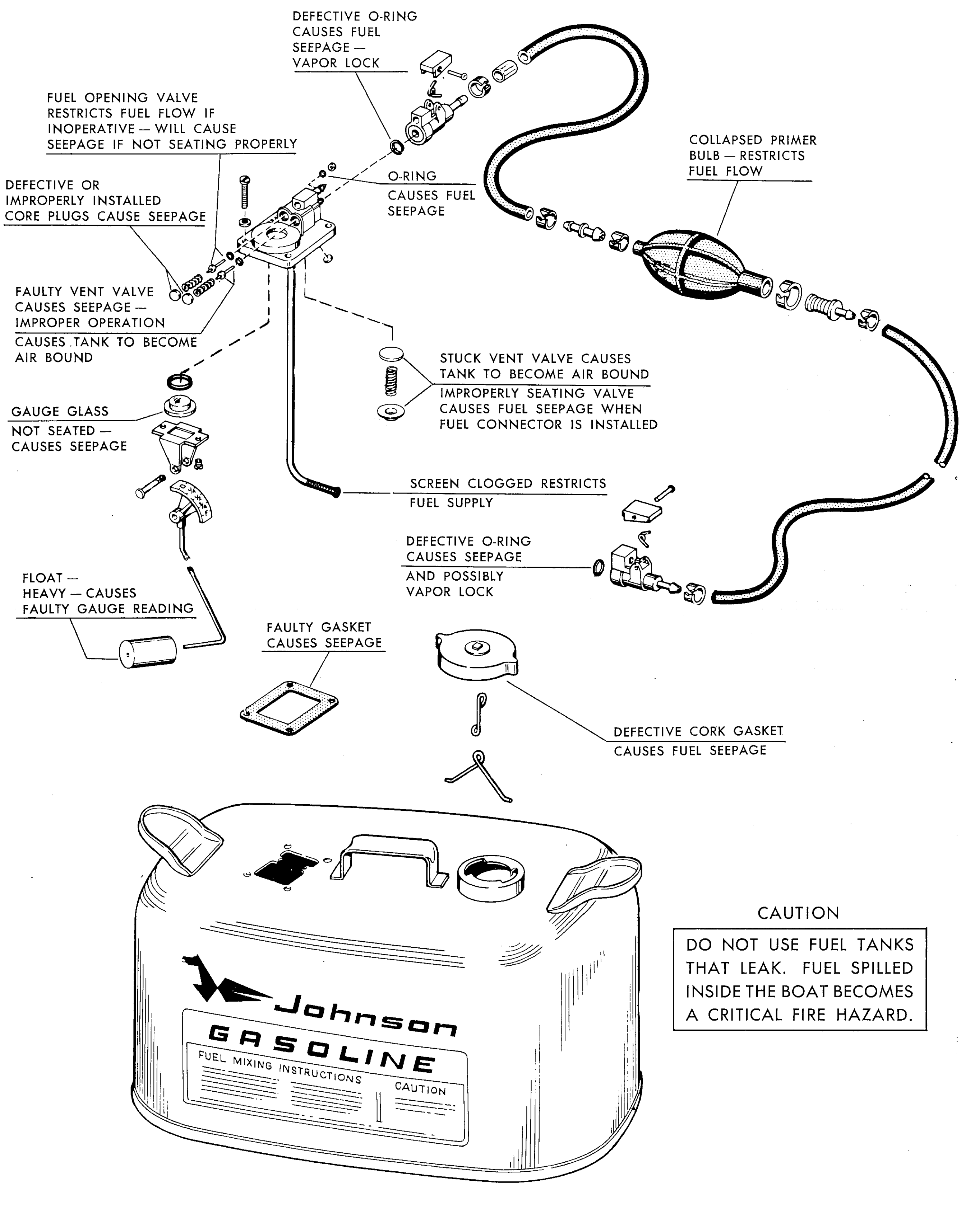


NOTE — CHECK FUEL LINES FOR "LEAKS" OR OBSTRUCTION AND "O" RINGS IN FUEL LINE CONNECTOR FOR SEEPAGE AND THE FUEL TANK FOR LEAKS.

EACH TANK SHOULD BUILD UP AND RETAIN THE FOLLOWING PRESSURES—

Model CD	2 to 4½ lbs.
Model AD	2 to 5 lbs.
Model QD	2 to 5 lbs.
Model FD	2 to 5½ lbs.
Model RD	2 to 4½ lbs.

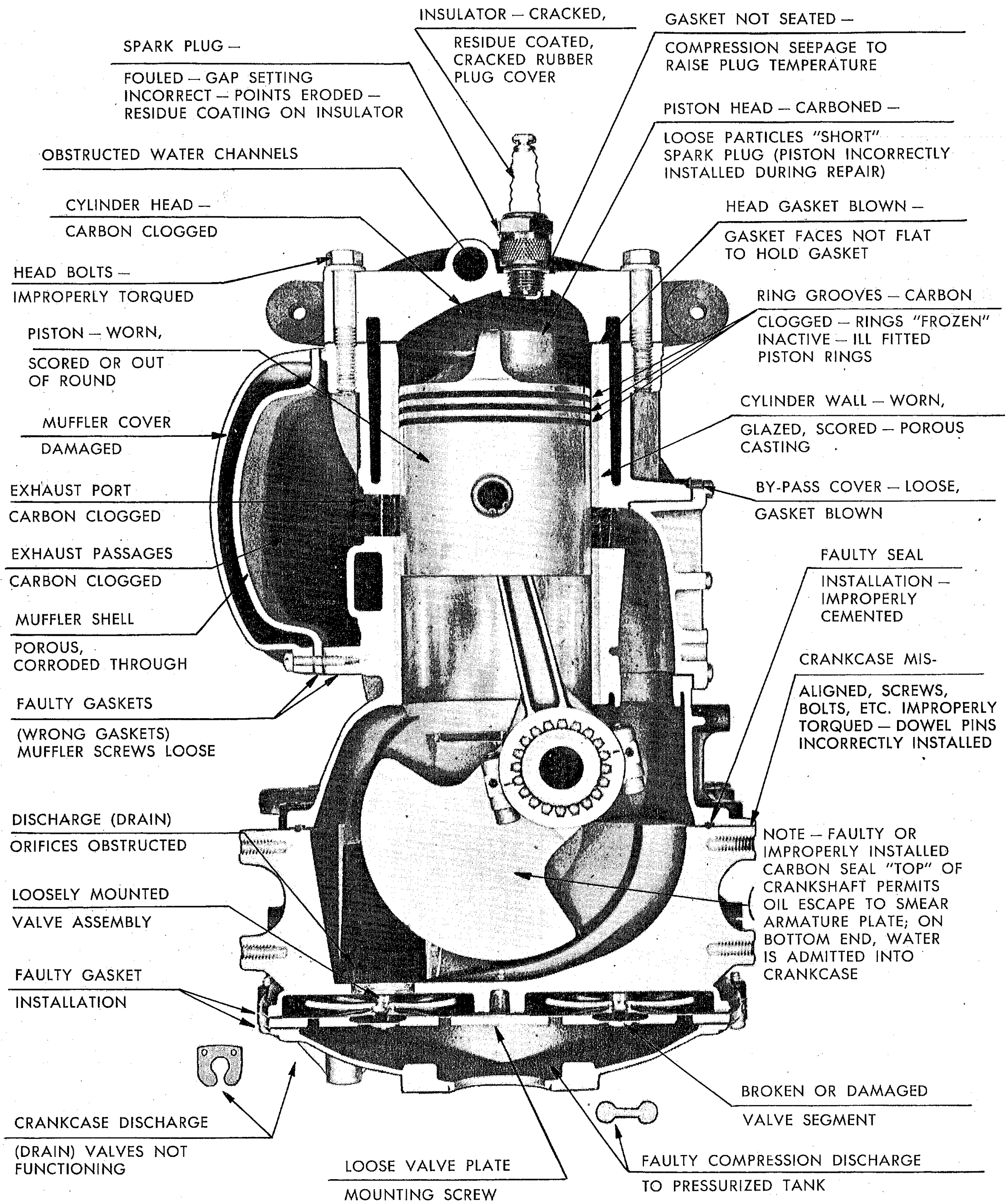
Fuel Tank Check Chart (Pressurized)



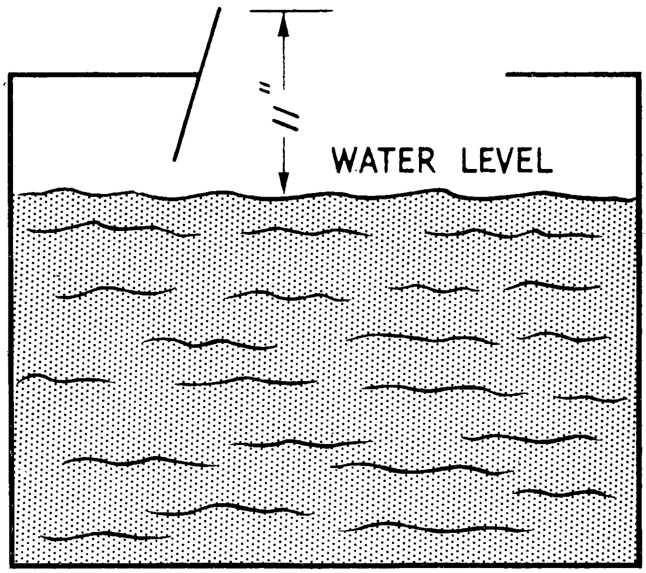
CAUTION

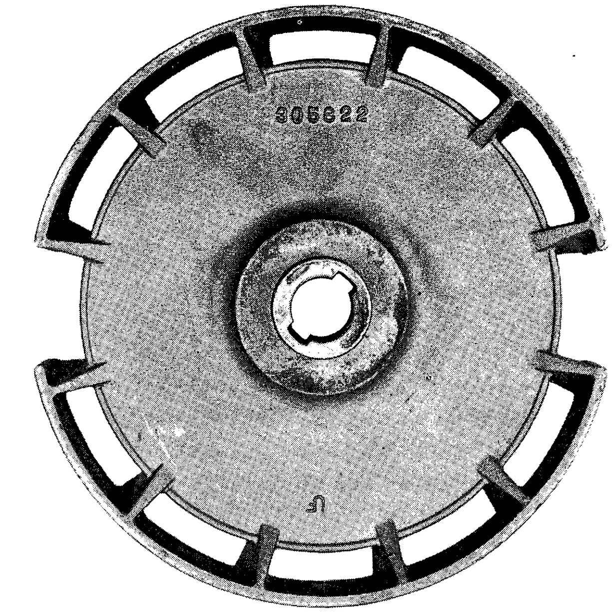
DO NOT USE FUEL TANKS THAT LEAK. FUEL SPILLED INSIDE THE BOAT BECOMES A CRITICAL FIRE HAZARD.

Fuel Tank Check Chart (Nonpressurized)



POWER HEAD CHECK CHART





TEST TANK WATER LEVEL

It is of extreme importance that depth of water in the test tank be maintained at level high enough to insure immediate water circulation upon having started the motor for testing after repairs, demonstrating or merely checking for minor adjustments — the pump housing of all models must be fully submerged — since the pump assembly is not primarily a suction pump and therefore will not "lift" water.

Running for any length of time without ample water circulation causes excessive impeller housing wear to interfere with efficient pumping later on when the motor is placed in service. Not only that, but overheating frequently results in damage to the cylinder head gasket installation which further aggravates interference with the circulating system to eventually result in major damage.

To be sure — check water level periodically (with rule) — distance between top face of tank mounting bracket and water level should be not more than eleven (11) inches. Keep the tank clean and fresh at all times.

TEST WHEEL FOR TANK TESTING

The function of final testing and tuning of any outboard motor is best performed under actual conditions — on a boat in open water where all conditions of normal operation may be observed. But, it's not always possible or convenient to do so because of the time consumed and more often, inaccessibility to water's edge — thus, the propeller test wheel for tank use.

It is a known fact that propeller thrust, the force required to drive the boat, is greatest at full throttle between the time the boat starts to move and the instant at which it breaks over to assume planing position — point of greatest thrust. On having reached the planing position, propeller thrust for a moment falls off abruptly but commences to gradually build up again as boat speed accelerates and engine RPM approaches the range established for best performance — normal operation for the particular unit.

With this in mind, each of the available Johnson propeller test wheels have been designed, constructed and calibrated for each specific model horsepower range to simulate in the test tank, as nearly as possible, thrust and load condition approximating those encountered during normal overall performance of the motor and at which time all final adjustments and tuning should be accomplished for maximum results.

Any attempt to check out or tune a motor laboring at low RPM in the shop test tank because of the "regular" propeller installation is futile and wasted effort which serves no purpose. RPM must be "up" to correctly perform required adjustments — particularly so, the slow and high-speed carburetor needle settings.

In view of the high-speed needles having been removed from the 1961 RD series carburetors and replaced with fixed jets, test tank running within the desired RPM range becomes significantly important since the jets are calibrated accordingly for best performance.

Minimum desired RPM shown for each model is average minimum for test running with the properly designated test wheel installed at 600 feet above sea level (Waukegan, Illinois) in a tank 60″ × 60″ × 40″ filled to approximately 565-gallon water capacity.

Several variables other than mechanical fitness however, enter the picture to affect testing performance, such as:

1. The type and size of test tank and resultant turbulence created by the rapidly turning test wheel.
2. Dissipation or dispersion of exhaust gases from the tank.
3. Area elevation above sea level and,
4. Atmospheric conditions (barometric principally) at time of testing.

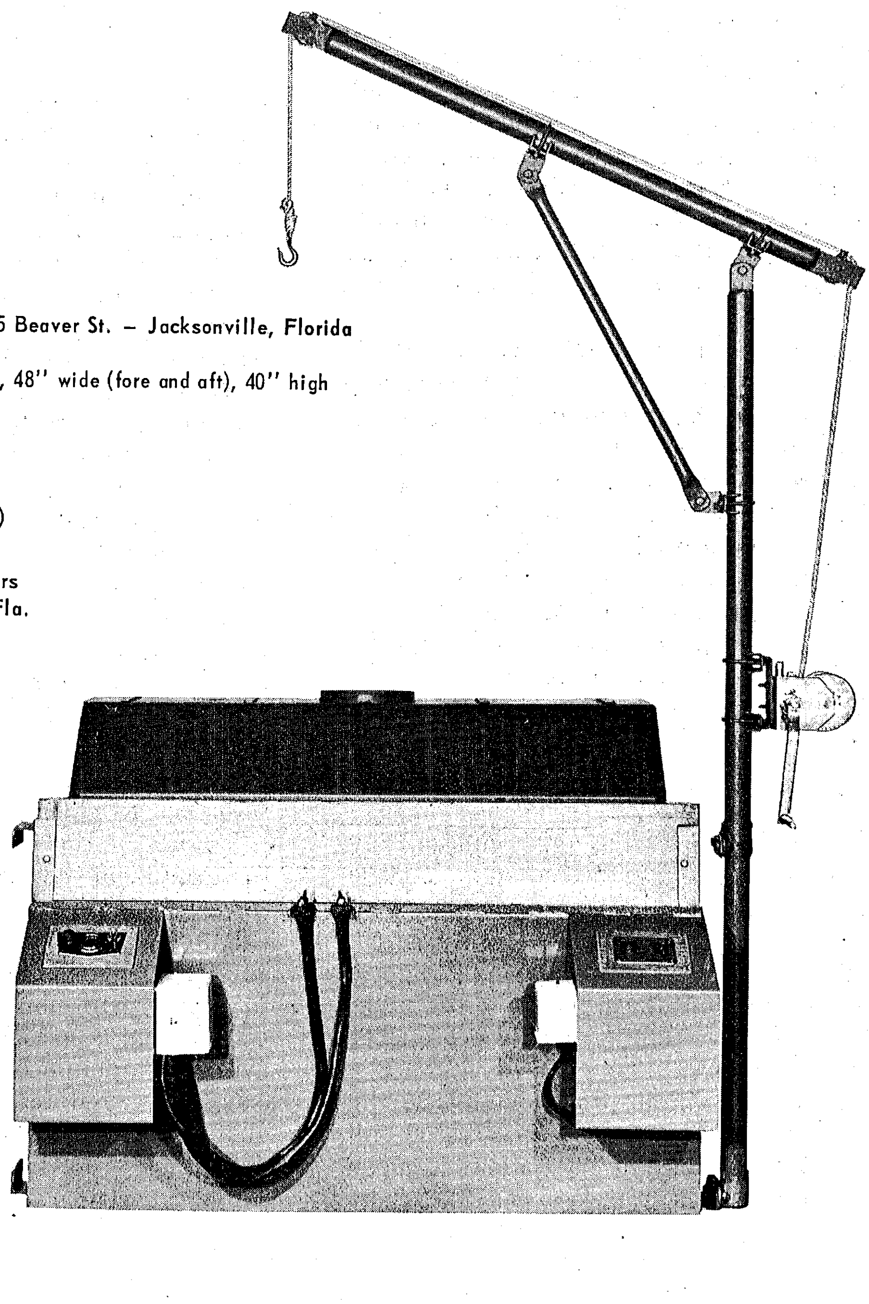
Using the chart as a guide, average tank performance (RPM) locally should not be too difficult to determine — simply by recording performance of several of each model as the occasions present themselves to establish an average of all recordings (of each model).

Keep in mind, too, that any internal combustion engine fundamentally develops its maximum horsepower at sea level where the air taken in with fuel vapor for combustion is denser than at higher than sea level elevations. Developed horsepower tapers progressively off at approximately 3% per each 1000 feet of elevation up to 8000 feet or so.

Constantly changing atmospheric conditions (barometric and humidity) in a like sense have their effects on engine performance; increased RPM to a minor degree on a high barometer — lesser on a low barometer. Variations of 100 to 150 RPM may perhaps be noted when testing or during normal operation of the motor for that matter, as result of changing atmospheric conditions.

Be guided by the test wheel chart when testing or tuning in the test tank while taking note of the above mentioned variables.

Service Promotion Bulletin No. 273 1/26/61



Peterson Bros. – 1925 Beaver St. – Jacksonville, Florida

Dimensions 60" long, 48" wide (fore and aft), 40" high

1. Tank
2. Davit
3. Winch
4. Battery bores (2)

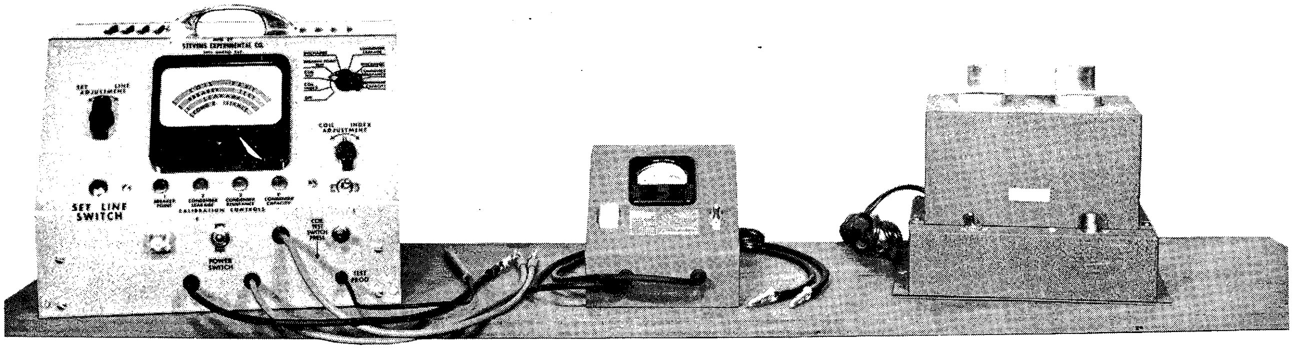
Order from manufacturers
FOB–Jacksonville, Fla.
Ft. Wayne, Ind.
Reno, Nevada

SPECIAL TEST EQUIPMENT

Electric Coil and Condenser Tester

Breaker Point Tester
(Operates on 110 volt AC current)

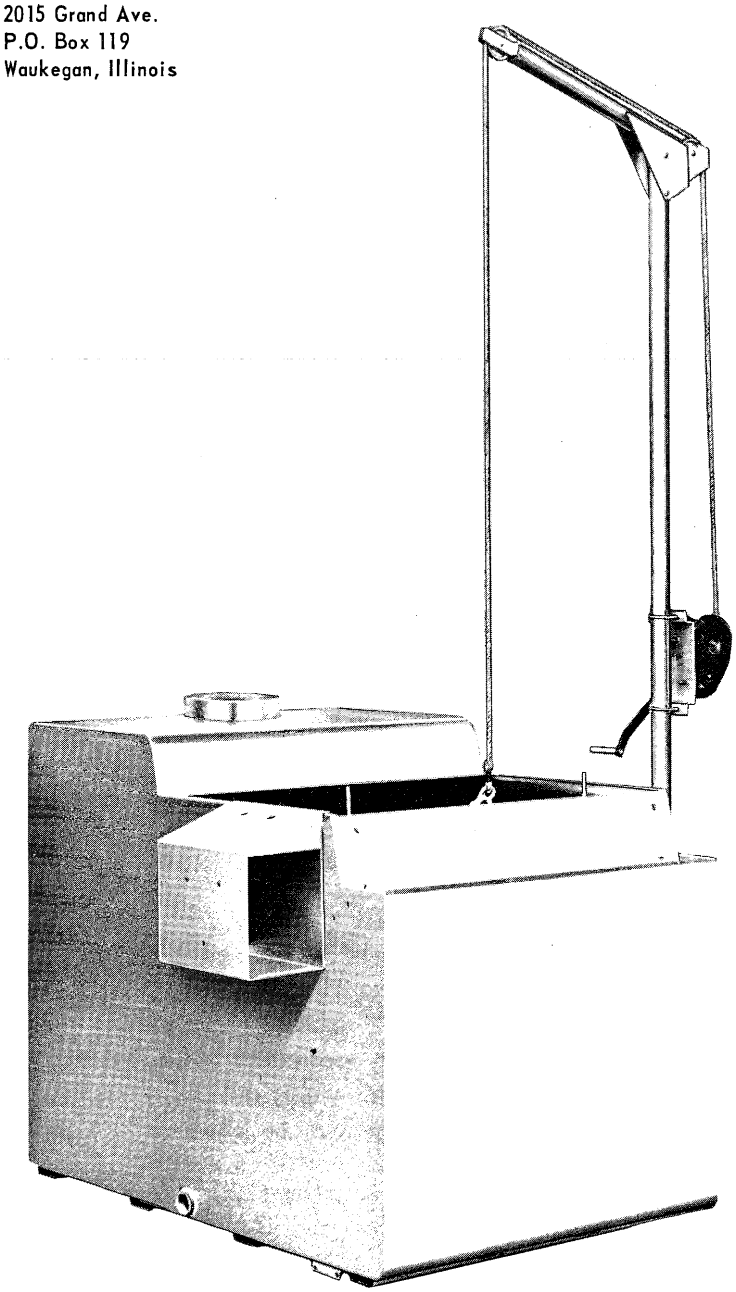
Magnet Charger
(Operates on 100 volt AC current)



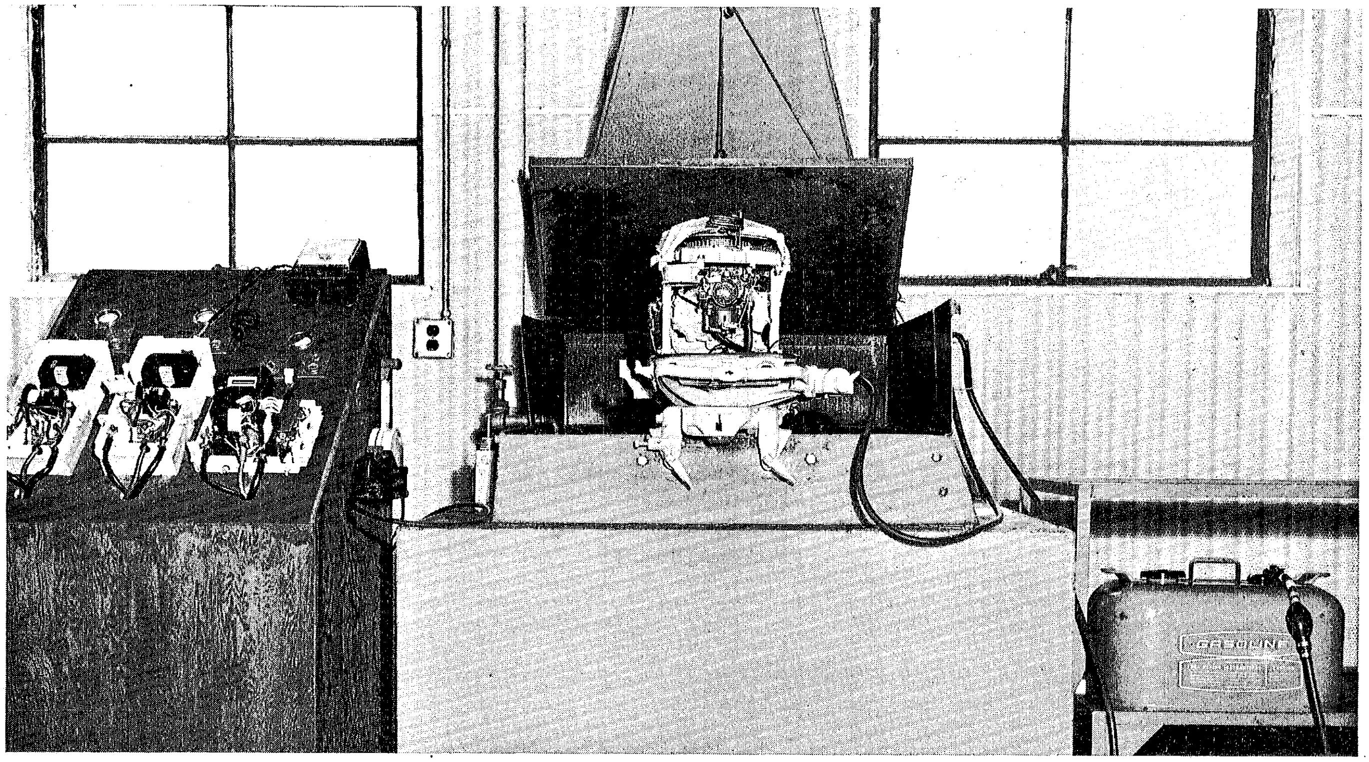
Stevens Experimental Co.
2015 Grand Ave.
P.O. Box 119
Waukegan, Illinois

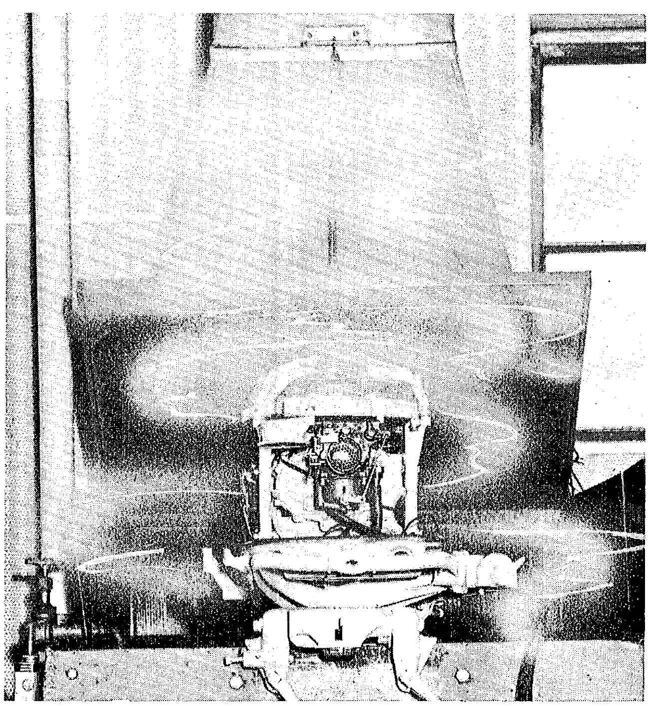
Stolper Steel Products – Menomonee Falls, Wisconsin

40" wide
58" fore & aft
40-3/4" high



TANK TESTING





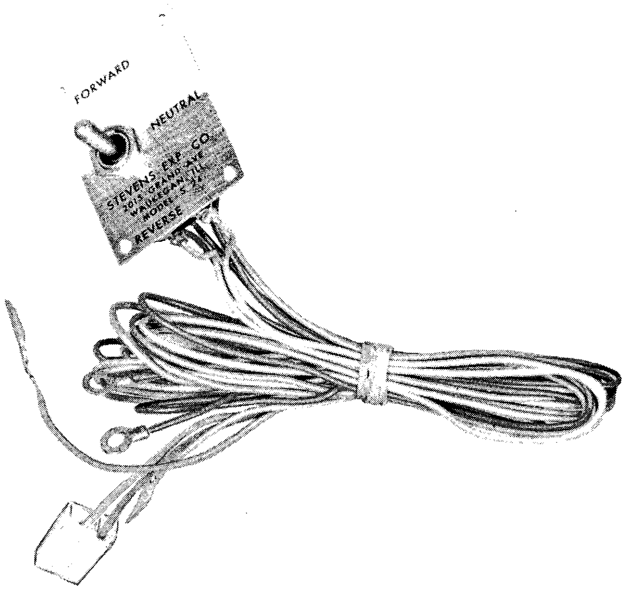
Showing typical test tank installation with exhaust stack.

Missing, uneven running and/or sluggish operation and the absence of response to throttle (speed) control for no apparent reason are frequently caused by exhaust fumes accumulating in the tank and finding their way on into the motor by way of air stream "rushing" through the carburetor.

Exhaust, of course, should be "piped" from the tank but that's really not enough — it requires installation of a "fan" or blower in the system to completely rid the tank of detrimental exhaust fumes.

As is generally known, it's impossible to satisfactorily tank test a motor unless provisions have been made for dispelling the exhaust gases (fumes). Air entering the carburetor throat will support just so much. It's either a case of fuel vapor or "spent" exhaust fumes—it can't be a mixture of all three to accomplish good running, much less proper testing after repairs.

Unless the exhaust gases are dispelled from the tank when set up for testing, carburetor adjustment, or simply demonstration, the effort is of little or no avail. Resultant polluted mixture entering the crankcase lacks enough oxygen to upset combustion characteristics of the fuel vapor charge which makes it impossible to correctly set high and slow speed needle settings. Further the piston on its upward stroke displaces so many cubic inches of crankcase volume. Say that (for purpose of illustrating) half of the mixture by volume flowing into the crankcase consists of "spent" exhaust fumes and the remaining half vaporized fuel, ultimate results are easily recognized — no power and irregular running.



Showing a Switch for use when Testing an Electramatic Motor in a Test Tank in the event a Control Box is not readily available.

CAUTION: There is no safety interlock incorporated in this switch to prevent starting and/or shifting at too high an engine RPM. Exercise caution and common sense along with the following recommendations when starting and shifting with this switch.

Designed for test tank installation to facilitate shifting the 1962 – 40 H.P. electric shift engines, this switch eliminates the necessity and expense of installing an electric shift control box at the test tank. In order to conserve additional space requirements and expense, this switch was designed to be used in conjunction with the 1961 – 40 H.P. junction box.

The switch assembly consists of a switch plate, a three-position switch (forward-neutral-reverse), and two complete switching circuits attached. Each switching circuit consists of one red or hot lead; one green and one blue, shift leads.

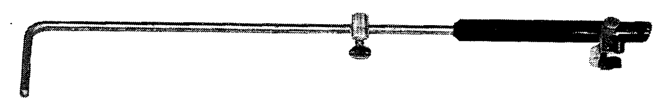
The green and blue wires coming from one side of the switch, terminating in a nylon connector, are for the 75 H.P. electric shift engine. The red lead, coming from the same side of the switch, should be connected to the terminal marked "I" on the 75 H.P. ignition switch.

The green and blue wires coming from the other side of the switch, terminate in separate tabs which plug into the nylon connector in the 1961 – 40 H.P. junction box as shown. Make sure the tabs lock in place.

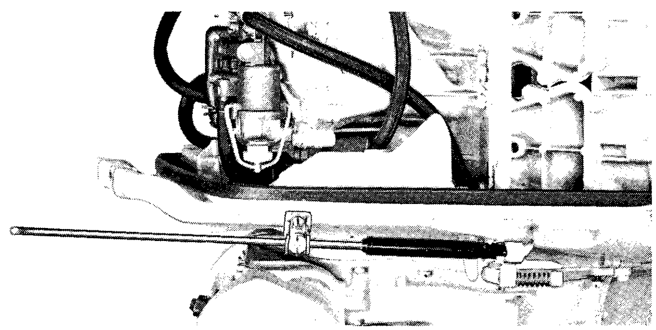
The red wire from this side connects to the accessory terminal marked "A" on the 40 H.P. ignition switch.

Mount the electric shift switch in a convenient location on your test panel, allowing for installation of the shift leads in the respective junction boxes.

When properly installed, this switch in no way affects the testing of earlier model engines without electric shift.



Throttle Control Rod for Test Tank use – adaptable to Remote Control Fittings on all Motors except 3 H.P. (Model JW).



Illustrating Hook of Test Tank Throttle Control Rod.

The absence of a steering handle, due to the exclusive use of remote controls with electric starting motors – has made test tank throttle operation slightly awkward. A convenient throttle control rod available from:

Stevens Experimental Co.
2015 Grand Avenue
Waukegan, Illinois

should readily assist the technician at the test tank. This throttle control rod provides throttle operation as well as a positive throttle lock by means of a wing screw in the trunnion for engine warm-up, etc. Also, use of this item when testing the engine on a boat eliminates continuous running back and forth to the control box.

FLYWHEEL NUT

MOTOR	FT.-LBS.
JW	30 - 40
CD	40 - 45
AD	40 - 45
QD	40 - 45
FD	40 - 45
RD SERIES (10 thru 21B)	60 - 65
RD SERIES (22 Up)	100 - 105
RK	100 - 105
HD	40 - 45
TD & TN	40 - 45

SPARK PLUG

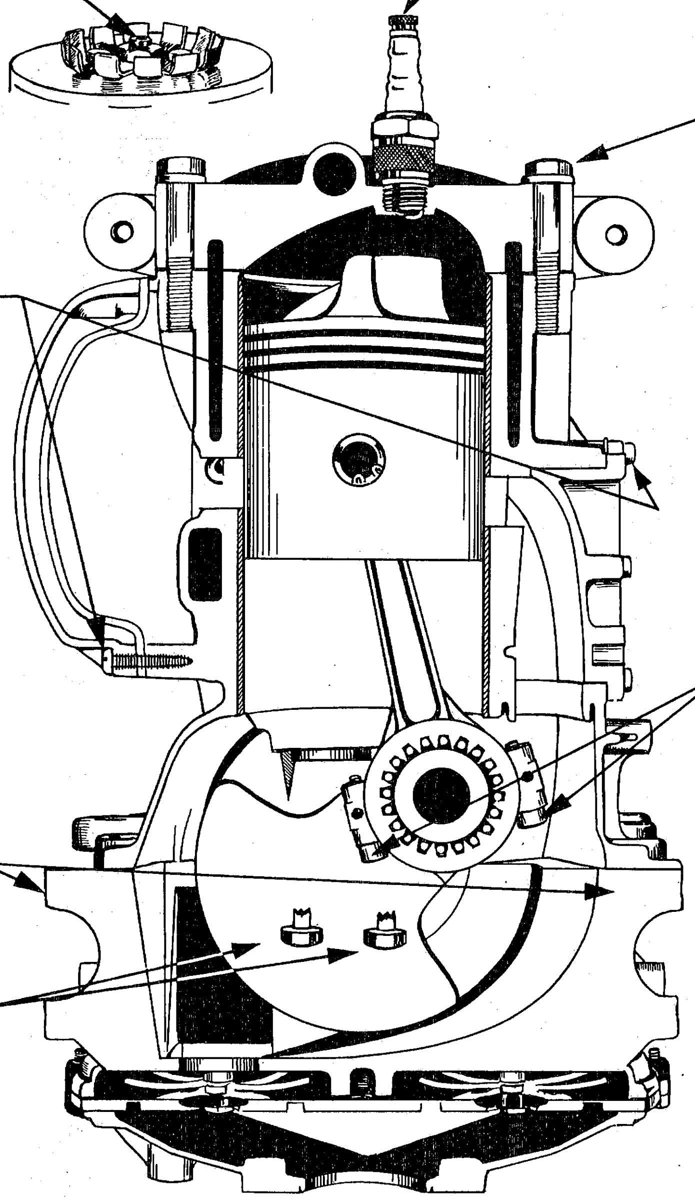
Motor	Ft. Lbs.
All Models	20 - 20½

MUFFLER AND BY-PASS SCREW

MOTOR	FT.-LBS.
JW	2 - 3*
CD	2 - 3*
AD	2 - 3*
QD	2 - 3*
FD	5 - 7*
RX	5 - 7*
RD SERIES (10 thru 18)	2 - 3*
RD SERIES (19 Up)	5 - 7*
HD	2 - 3*
TD & TN	2 - 3*

CYLINDER HEAD SCREW

MOTOR	FT.-LBS.
JW	5 - 7*
CD	5 - 7*
AD	5 - 7*
QD	8 - 10
FD	8 - 10
RX	14 - 16
RD SERIES (10 thru 21B)	18 - 20
RD SERIES (22 Up)	14 - 16
RK	14 - 16
HD	5 - 7*
TD & TN	5 - 7*



CONNECTING ROD SCREWS

MOTOR	FT.-LBS.
JW	5 - 5½*
CD	5 - 5½*
AD	5 - 5½*
QD	15 - 15½
FD	15 - 15½
RX	29 - 31
RD SERIES (10 thru 18)	15 - 15½
RD SERIES (19 thru 21B)	18 - 18½
RD SERIES (22 Only) Screw Size 9/32"x28	18 - 18½
RD SERIES Screw Size 5/16"x24	29 - 31
RD SERIES (23 Up)	29 - 31
RK	29 - 31
HD	5 - 7*
TD & TN	5 - 7*

CRANKCASE SCREWS

MOTOR	FT.-LBS.
JW	5 - 7*
CD	5 - 7*
AD	5 - 7*
QD	10 - 12
FD	10 - 12
RX	13½ - 14
RD SERIES (All)	13½ - 14
RK	13½ - 14
HD	5 - 7*
TD & TN	12 - 14
PO	12 - 14

*Use Inch Pounds for Greater Accuracy — Multiply Indicated Foot Pounds by 12. Use Torque Wrench Calibrated in Inch Pounds.

TORQUE CHART — POWERHEAD

GENERAL TORQUE VALUES FOR THE POWERHEAD

These apply to all engines unless otherwise specified under the individual engine specifications.

Screw Size:	Ft.-Lbs.	In.-Lbs.
#6 (32 and 40 thds.)	—	7 - 10
#10 (24 and 32 thds.)	2 - 3	24 - 36
#12 (24 and 28 thds.)	3 - 4	36 - 48
1/4″ (20 and 28 thds.)	5 - 7	60 - 84
5/16″ (18 and 24 thds.)	10 - 12	120 - 144
3/8″ (16 and 24 thds.)	18 - 20	216 - 240
Spark plugs (all models)	20 - 20½	240 - 246

3 H.P. Models JW and JWL-15 through 17 (1959 through 62):

Connecting rod screws	5 - 5½	60 - 66
Crankcase to cylinder screws — all bearings	5 - 7	60 - 84
Cylinder head screws	5 - 7	60 - 84
Exhaust cover screws	2 - 3	24 - 36
Flywheel nut	30 - 40	360 - 480
Gas tank to mounting plate screws	4 - 5	48 - 60
Intake manifold screws	2 - 3	24 - 36
Spark plugs	20 - 20½	240 - 246
Starter housing mounting screws	3 - 5	36 - 60

5½ H.P. Models CD and CDL-16 through 19 (1959 through 62):

Connecting rod screws	5 - 5½	60 - 66
Crankcase to cylinder screws — all bearings	5 - 7	60 - 84
Cylinder head screws	5 - 7	60 - 84
Exhaust cover screws	2 - 3	24 - 36
Flywheel nut	40 - 45	480 - 540
Intake manifold screws	2 - 3	24 - 36
Spark plugs	20 - 20½	240 - 246
Starter housing mounting screws	8 - 10	96 - 120

10 H.P. Models QD and QDL-20 through 23 (1959 through 62):

Bypass cover screws	2 - 3	24 - 36
Connecting rod screws	15 - 15½	180 - 186
Crankcase to cylinder screws — all bearings	10 - 12	120 - 144
Cylinder head screws	8 - 10	96 - 120
Exhaust cover screws	2 - 3	24 - 36
Flywheel nut	40 - 45	480 - 540
Intake manifold screws	2 - 3	24 - 36
Spark plugs	20 - 20½	240 - 246
Starter housing mounting screws	8 - 10	96 - 120

18 H.P. Models FD and FDL-13 through 16 (1959 through 62):

Bypass cover screws	5 - 7	60 - 84
Connecting rod screws	15 - 15½	180 - 186
Crankcase to cylinder screws — all bearings	10 - 12	120 - 144
Cylinder head screws	8 - 10	96 - 120
Exhaust cover screws	5 - 7	60 - 84
Flywheel nut	40 - 45	480 - 540
Intake manifold screws	5 - 7	60 - 84
Spark plugs	20 - 20½	240 - 246
Starter housing mounting screws	8 - 10	96 - 120

28 H.P. Model RX-10C (1962):

	Ft.-Lbs.	In.-Lbs.
Bypass cover screws	5 - 7	60 - 84
Connecting rod screws	29 - 31	348 - 372
Crankcase to cylinder screws — all bearings	13½ - 14	162 - 168
Cylinder head screws	14 - 16	168 - 192
Electric starter mounting bracket nuts	5 - 7	60 - 84
Exhaust cover screws	5 - 7	60 - 84
Flywheel nut	100 - 105	1200 - 1260
Intake manifold screws	2 - 3	24 - 36
Spark plugs	20 - 20½	240 - 246
Starter ratchet to flywheel screws	6 - 8	72 - 96

35 H.P. Models RD and RDEL through RJEL-19 and 19M (1957);
RD through RDEL-19C (1958);
RDS through RDSL-20 (1958); and
RD through RDSL-21 and 21B (1959):

	Ft.-Lbs.	In.-Lbs.
Bypass cover screws	5 - 7	60 - 84
Connecting rod screws	18 - 18½	216 - 222
Crankcase to cylinder screws — all bearings	13½ - 14	162 - 168
Cylinder head screws	18 - 20	216 - 240
Electric starter mounting bracket nuts	5 - 7	60 - 84
Exhaust cover screws	5 - 7	60 - 84
Flywheel nut	60 - 65	720 - 780
Generator mounting bracket screws	5 - 7	60 - 84
Intake manifold screws	2 - 3	24 - 36
Spark plugs	20 - 20½	240 - 246
Starter mounting screws — manual	8 - 10	96 - 120
Eye bolt (lift ring where used) — rear starter mount	14 - 16	168 - 192
Starter ratchet to flywheel screws	6 - 8	72 - 96

40 H.P. Models RD through RDSL-22 through 22CC (1960):

	Ft.-Lbs.	In.-Lbs.
Bypass cover screws	5 - 7	60 - 84
Connecting rods with 9/32″ × 28 screws	18 - 18½	216 - 222
Connecting rods with 5/16″ × 24 screws	29 - 31	348 - 372
Crankcase to cylinder screws — all bearings	13½ - 14	162 - 168
Cylinder head screws	14 - 16	168 - 192
Electric starter mounting bracket screws	5 - 7	60 - 84
Exhaust cover screws	5 - 7	60 - 84
Flywheel nut	100 - 105	1200 - 1260
Generator mounting bracket screws	5 - 7	60 - 84
Generator mounting nuts	5 - 7	60 - 84
Intake manifold screws	2 - 3	24 - 36
Spark plugs	20 - 20½	240 - 246
Starter mounting screws — manual (2 front)	8 - 10	96 - 120
. . . Eye bolt (lift ring) — rear mount	14 - 16	168 - 192
Starter ratchet to flywheel screws	6 - 8	72 - 96

40 H.P. Models RD through RDSL-24, RK-24 (1961 through 62):

	Ft.-Lbs.	In.-Lbs.
Bypass cover screws	5 - 7	60 - 84
Connecting rod screws	29 - 31	348 - 372
Crankcase to cylinder screws — all bearings	13½ - 14	162 - 168
Cylinder head screws	14 - 16	168 - 192
Electric starter mounting bracket screws	5 - 7	60 - 84
Exhaust cover screws	5 - 7	60 - 84
Flywheel nut	100 - 105	1200 - 1260
Generator mounting bracket screws	5 - 7	60 - 84
Generator mounting nuts	5 - 7	60 - 84
Intake manifold screws	2 - 3	24 - 36
Safety switch mounting screws	—	7 - 10
Spark plugs	20 - 20½	240 - 246
Starter mounting screws — manual (2 front)	8 - 10	96 - 120
. . . Eye bolt (lift ring) — rear mount	14 - 16	168 - 192
Starter ratchet to flywheel screws	6 - 8	72 - 96

LOWER UNIT

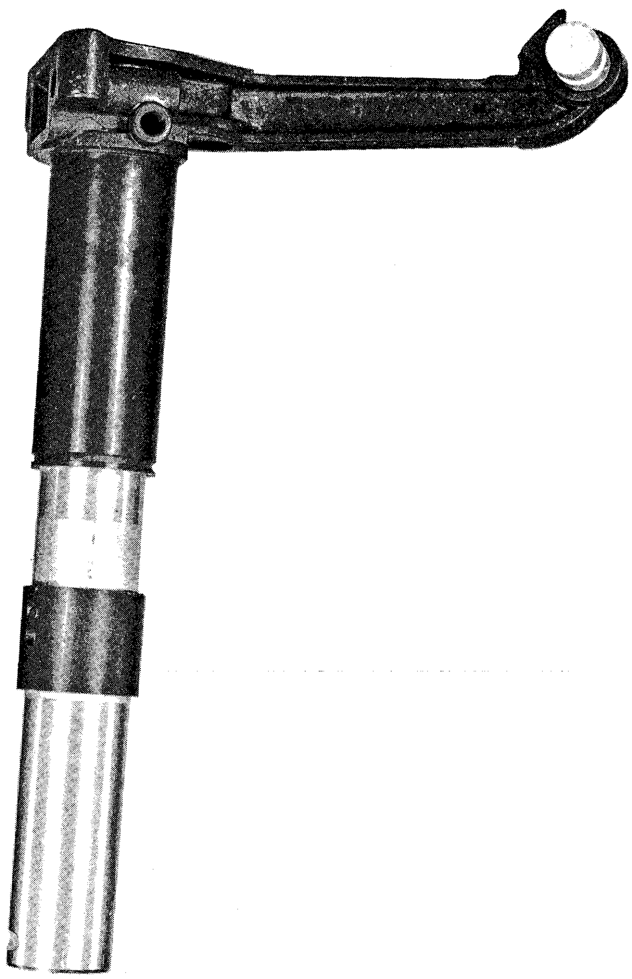
INDEX — FOLLOWING PAGE

LOWER UNIT INDEX

GENERAL REPAIR INFORMATION

SPECIFIC REPAIR INFORMATION

THE LOWER UNIT



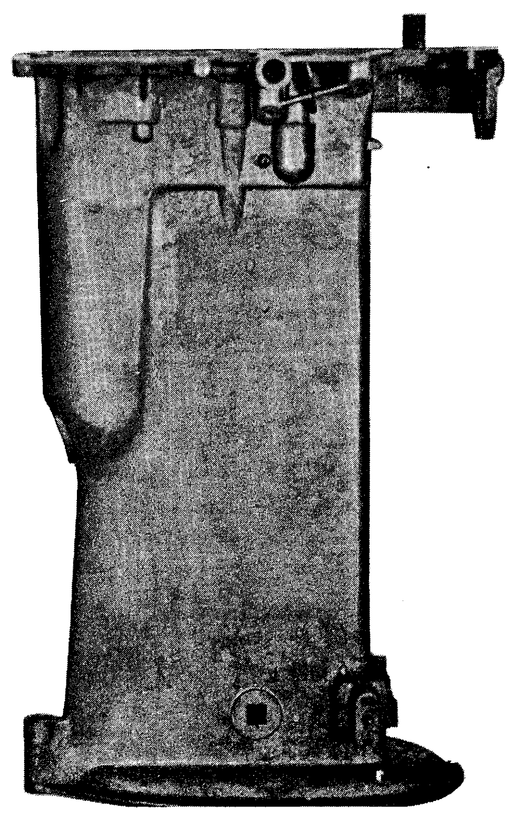
Tubular Exhaust Tube.

GENERAL TO ALL JOHNSON MODELS

The lower unit is that part of the outboard motor assembly comprising the stern brackets, driveshaft casing, or exhaust housing, gearcase and of course, necessary shafting and gearing required to deliver power generated (by the powerhead) to the propeller which ultimately drives the boat. It also contains the water pump and water scoop, shift linkage and piping for circulation, and in some instances recirculation of water through the cooling system.

The driveshaft casing may be of tubular construction or of cast aluminum, while the exhaust housing is constructed of die cast aluminum only. Both are provided with flanges at each end for mounting to the powerhead and upper part of the gearcase. A driveshaft casing of tubular construction, generally has some form of clamping arrangement provided for attaching to the gearcase to make up a solid assembly of the driveshaft casing and gearcase. The driveshaft casing or exhaust housing also contains water tubing or cast-in channels for the purpose of conducting water to and from the powerhead for cooling purposes. The water tubes where used in cast aluminum driveshaft casings are either spun in or secured by means of a jam nut. In later engines having exhaust housings, the water tubes are secured at either end by means of a rubber grommet. In either event, the connections must be water tight since loose water tubes contribute considerably to faulty cooling systems. Water tubes are most frequently assembled inside of the driveshaft casing or exhaust housing; however, on many models of early vintage, they were installed outside of the tubing, with means provided to permit full pivot steering.

The driveshaft casing, while of simple but rugged construction, requires a minimum of attention — the water tubes must be tightly mounted, flanges at either or both ends must be flat to guard against air seepage into the cooling system and, of course, the casing must be straight and true.



Die Cast Aluminum Exhaust Housing.

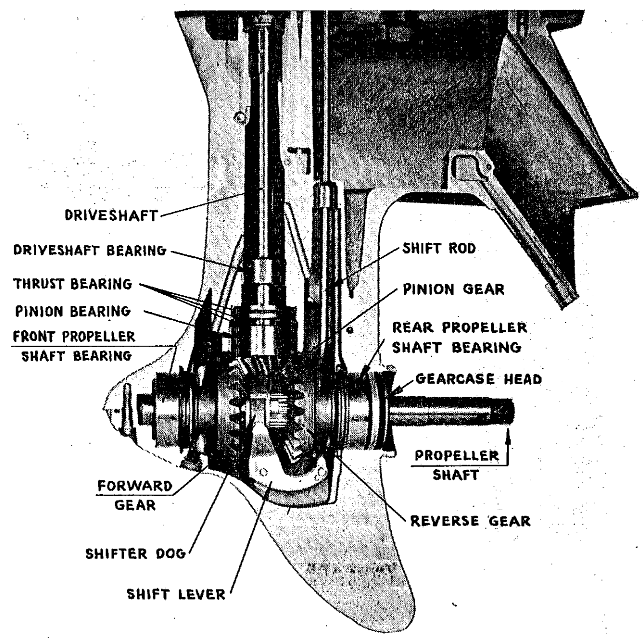
The exhaust tube or exhaust housing likewise requires a minimum of attention. Again, the water tubes must be *properly* inserted into the grommets at the top end of the exhaust housing, and the top of the water pump housing. Exhaust housings are always found on larger model motors and are capable of handling higher horsepower — and large enough to contain the driveshaft, water tube or tubes and shift mechanism.

Leaky water tube connections or cast-in water channels permit the inside of the driveshaft casing or exhaust housing to fill with water which eventually finds its way into the crankcase of the motor by way of the lower journal bearing to interfere with motor performance and subsequently injurious to functional parts. Water likewise finds its way into the gearcase to wash out the lubricant — look for water leaks if the gearcase requires an abnormal amount of grease. Water seepage may not necessarily be the result of leaking water tubes or water tube connections, but because of faulty gaskets or warped gasket faces. Take care to check gaskets (install new ones) and gasket faces. Make certain, too, that on assembly, holes or openings in the gasket align with like openings in the driveshaft casing or exhaust housing flange, base of cylinder or top end of the gearcase. It is possible in some instances to obstruct the flow of water through the cooling system by improper installation of a gasket.

The driveshaft casing or exhaust housing must be straight and true — if bent or sprung, excessive driveshaft coupling wear can be expected, not to mention added load on the bearings in both the powerhead (lower) and gearcase to cause abnormal wear in this respect.

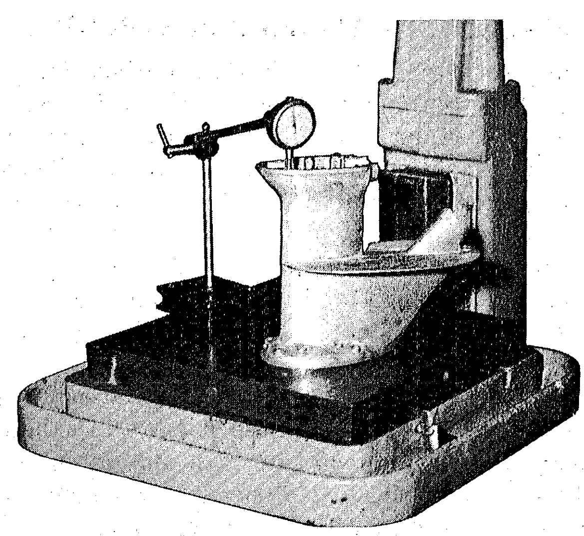
Except on some of the earlier models of Johnson motors, the gearcases are constructed of aluminum castings (die or sand casting, the former being of bronze to better withstand the ravages of salt water). Brass construction, however, made the motors considerably heavy and cumbersome to proportionately reduce their portability. Recent developments and improvements in aluminum castings, coupled with advanced manufacturing processes, have made the aluminum gearcase practical and well adapted for salt water service. The gearcase castings are given what is known as a lyfinite treatment — a chemical process which retards the action of salt water on aluminum. In addition, the castings are sprayed with a salt water resistant prime coat, followed by a highly salt water resistant enamel coat. The enamel coat is then baked dry, providing an even more durable finish.

Most gearcase housing assemblies are made up of the gearcase proper and a gearcase head while some include a separate bottom and top gearcase section and, of course, the gearcase head as are necessary to contain the required bearings, shafting and gears, etc.

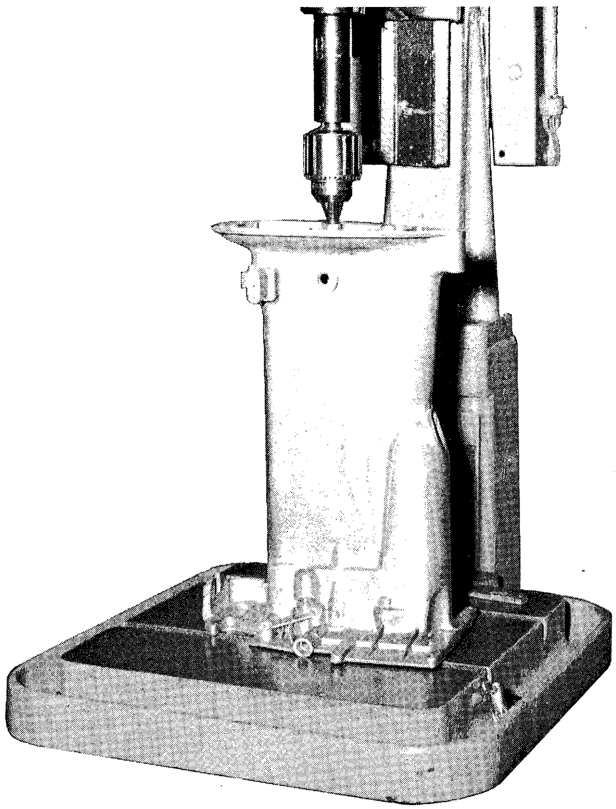


Illustrating Basic Components of the Gear Shifting Models.

In addition to containing the final driving gear, the gearcase housing on many models of comparatively early vintage included a slip clutch or shock absorber (installed on the driveshaft) to reduce shearing of propeller pins to a minimum or possible injury to motor parts as result of the propeller striking underwater obstructions; however, modern practice is to incorporate a slip clutch into the propeller.



Checking Alignment of Upper Gearcase with Dial Indicator.



Checking Alignment of Exhaust Housing on Drill Press.

CHECKING EXHAUST HOUSING AND UPPER GEARCASE ALIGNMENT

There has been evidence of broken driveshafts, worn or stripped driveshaft and crankshaft splines and premature gear failures for no apparent reason at the moment.

Probing for possible causes has revealed that in most cases, misalignment of either the gearcase or exhaust housing as the result of an accident or perhaps the striking of an underwater object has caused one or more of the above complaints.

Illustrated are two methods of checking for housing alignment.

When checking for alignment with a drill press, as illustrated, use the following procedure.

Set the housing to be checked on the drill press table and lower the chuck, with the jaws closed until a very light contact is made on the flat machined surface of the housing. Lock the drill press arbor in this position, so that the chuck cannot move up or down. Move the flat surface of the housing under the jaws, and follow the surface around to the starting point. If the housing is in perfect alignment, the clearance between the chuck jaws and the housing flat surface will be the same at all points. If there is any difference in clearance between the chuck jaws and the housing at any point, the housing is out of alignment and should be discarded.

NOTE: Both top and bottom housing surfaces must be parallel to one another for a perfectly aligned casting.

If a drill press is not available, a surface plate and dial indicator may be used as illustrated.

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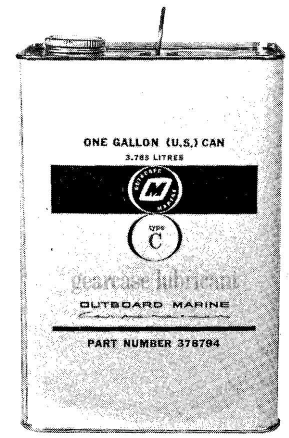
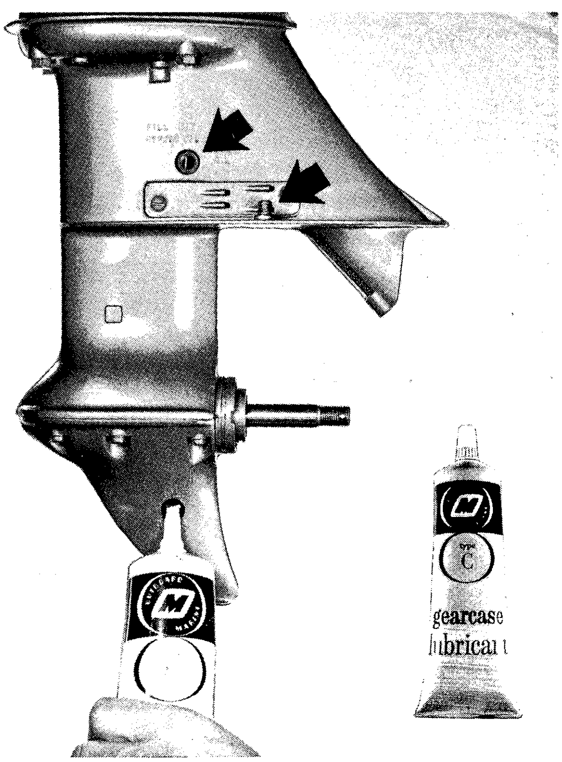
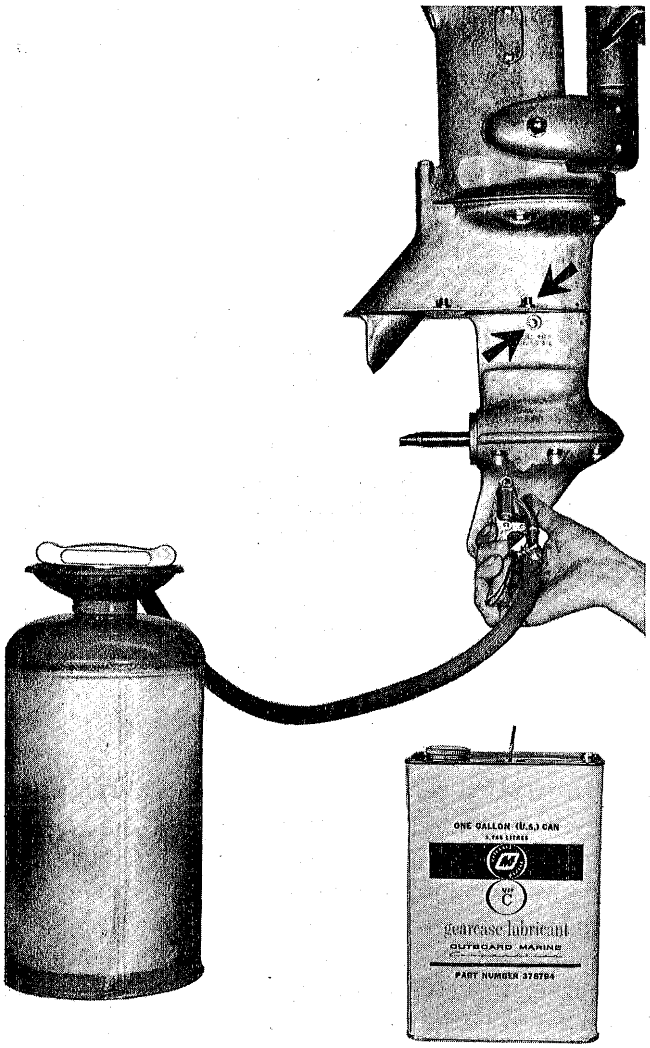


OMC Type "C" Lube in One Gallon Can.

It will be noted that in this section of the manual – reference to the use of Hypoid or Hypoid GX-90 gear oil is made quite frequently. This reference should be ignored as our current recommended gear lube is OMC type "C". This lube is available in a case of twelve, 8-oz. tubes as Part No. 378795, or in a 1-gal. can as Part No. 378794.



Inserting gear oil with tube. Fill to overflow, replace vent screw, remove tube, replace fill screw.

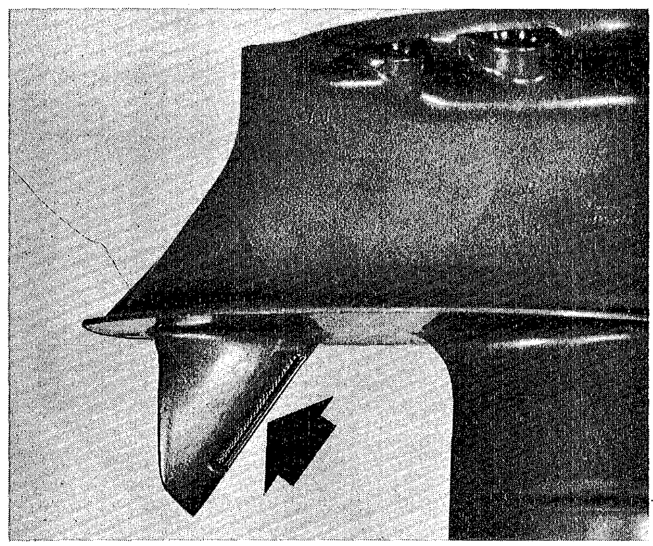


Filling Gearcase with Gear Oil – Adhere to Recommendations for the Model.

Note – Perhaps no more than a drop or two of gear oil will escape on removal of the fill spout due to the gearcase cavity becoming air-bound with the vent screw in position at the moment.

To drain the gearcase of gear oil, simply remove the vent screw at top end of the gearcase and the lower fill screw – allow to drain until empty.

To refill, insert spout into lower fill opening – fill to overflow point (vent). Replace vent screw. Remove fill spout — replace fill screw. Make certain the fill screw is clean and that it is securely installed.



Screen — Gear Case.

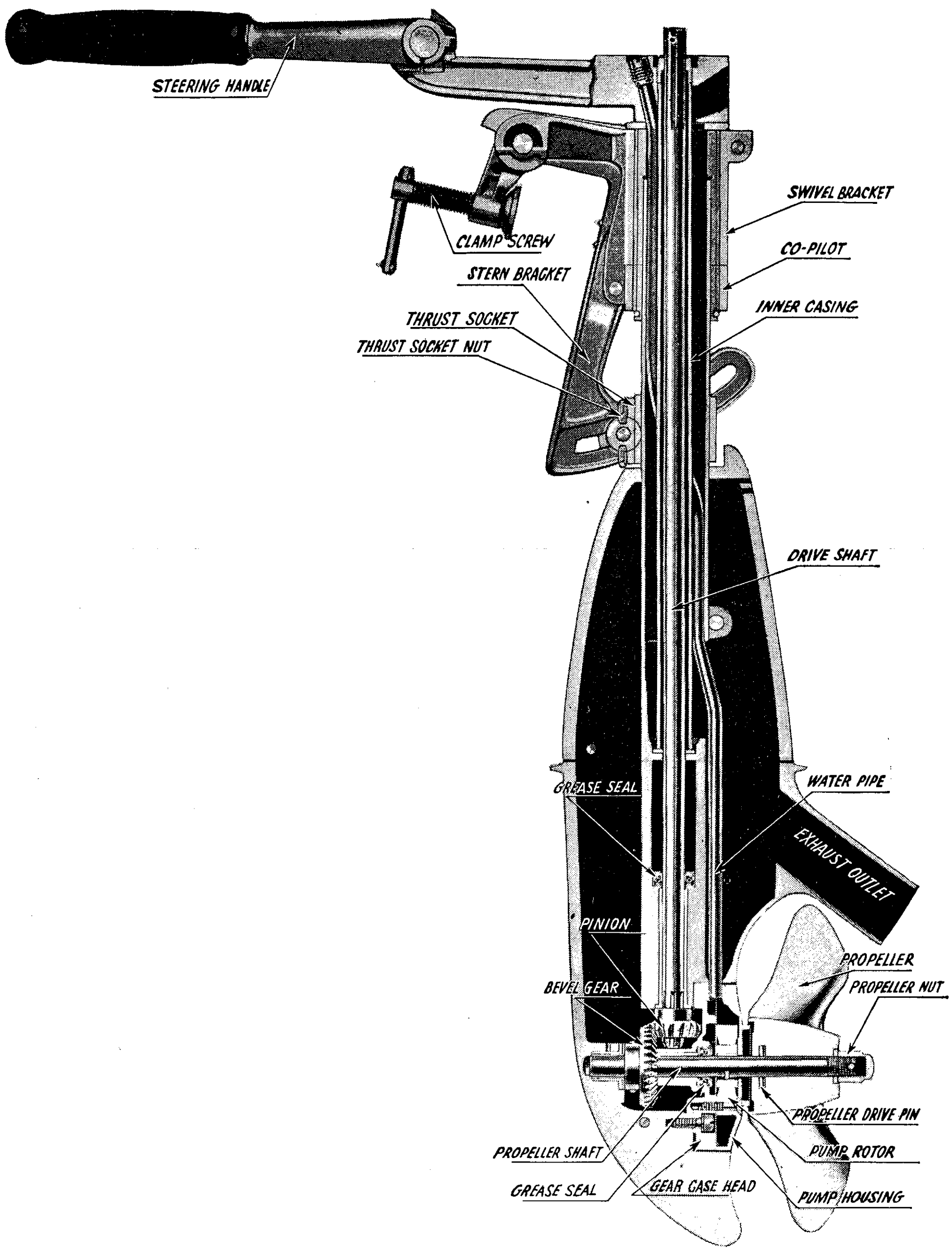
You are all familiar with the small cylindrical screen assembled in water scoop (intake) of the gear case on models CD, AD, QD, FD and RD, and realize that any obstruction clogging its mesh will interfere with circulation to cause overheating.

It appears to be a simple thing, but occasionally mesh of the screen becomes "clogged" with marine growth (greenish in color) to cut off water supply for cooling. When probing for details of irregularity which may lead to overheating — don't overlook condition of the screen. Brush off with a wire brush, then "blow" mesh out with an air stream.

GEARCASE CAPACITY AND RECOMMENDED LUBRICANT

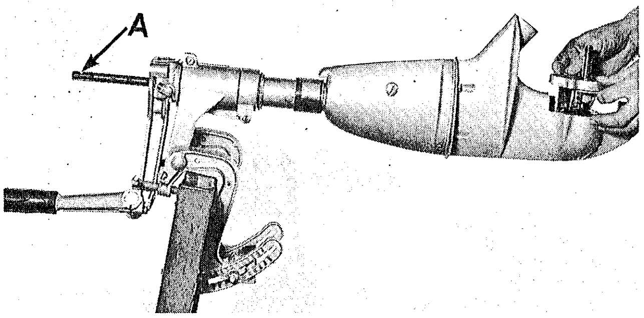
Model Series	H.P.	Years Manufactured	Capacity	Lubricant to Use
JW-10 through JWL-17	3	1952-1960 up	2.75 ozs.	OMC Type "C"
CD-10 through CDL-18	5½	1954-1958 up	6.18 ozs.	OMC Type "C"
AD-10 through ADL-12	7½	1956-1958 up	6.18 ozs.	OMC Type "C"
QD-10 through QDL-18	10	1949-1957 up	10.00 ozs.	OMC Type "C"
QD-19 through QDL-23	10	1958-1960 up	6.18 ozs.	OMC Type "C"
FD and FDEL-10	15	1956 up	7.43 ozs.	OMC Type "C"
FD-11 through FDL-16	18	1957-1960 up	7.43 ozs.	OMC Type "C"
RD-10 through RDEL-17	25	1951-1955 up	11.00 ozs.	OMC Type "C"
RD through RDEL-18	30	1956 up	11.00 ozs.	OMC Type "C"
RD through RDEL-19, RX-10C	35	1957-1958 up	11.83 ozs.	OMC Type "C"
RDS-20	35	1958 up	11.83 ozs.	OMC Type "C"
RD through RDSL-21	35	1959 up	11.83 ozs.	OMC Type "C"
RD through RDSL-22 Up	40	1960-1961 up	11.83 ozs.	OMC Type "C"
RK-24	40	1962 up	13.5 ozs.	OMC Type "C"

LOWER UNIT ASSEMBLY (MODELS HD AND TD)



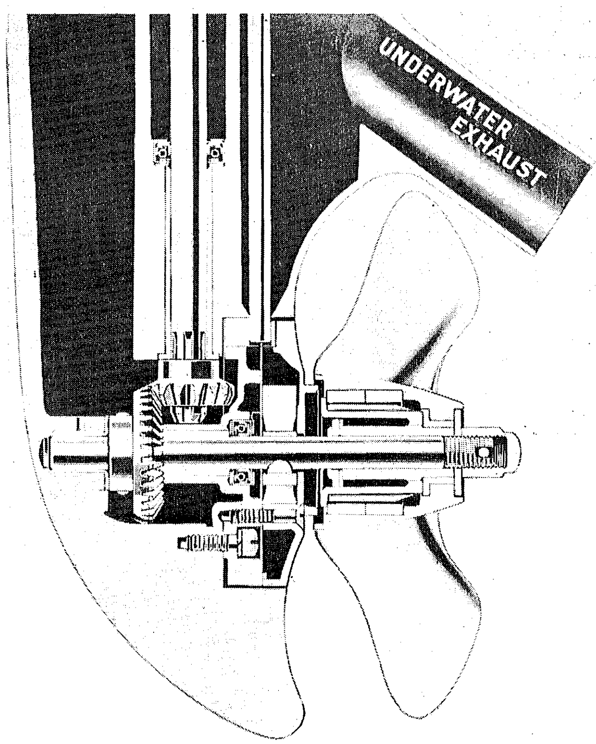
To remove propeller shaft, gears and drive shaft from lower unit, proceed as follows:

1. Partially withdraw drive shaft as shown here.



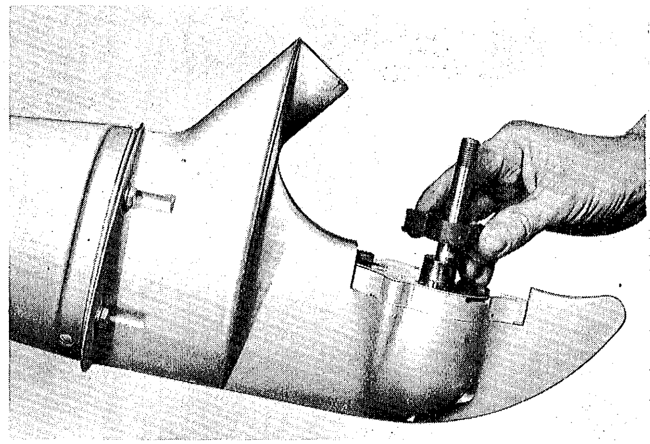
Showing Removal of Gearcase Head from Lower Unit

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.
5. Refill with fresh gear lubricant as instructed.



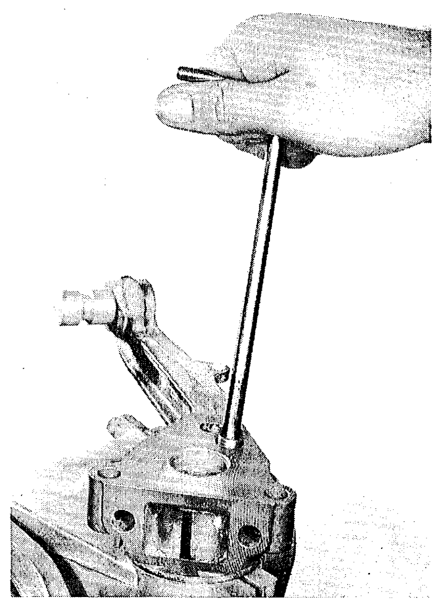
Gearcase (Models HS, HD, TS, TD)

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:

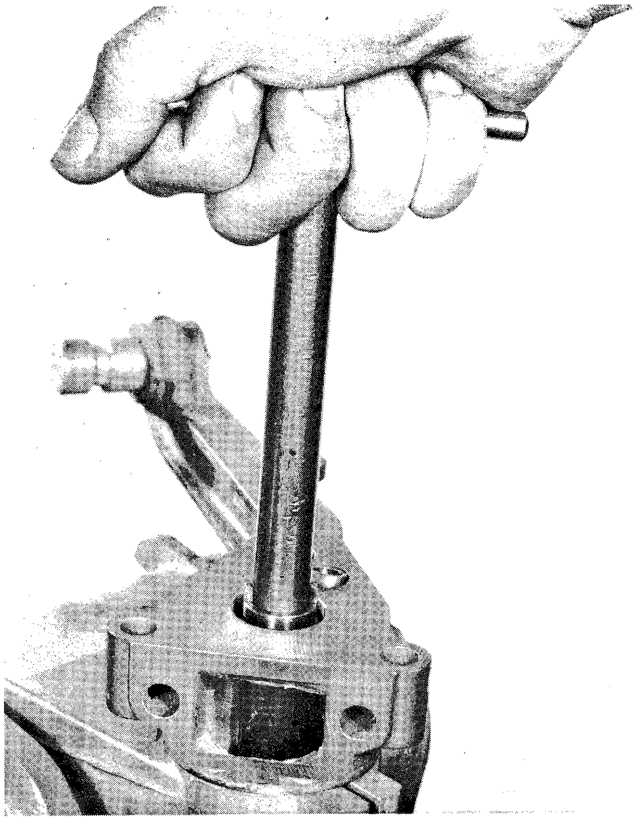


Showing Installation of New Pump Rotor

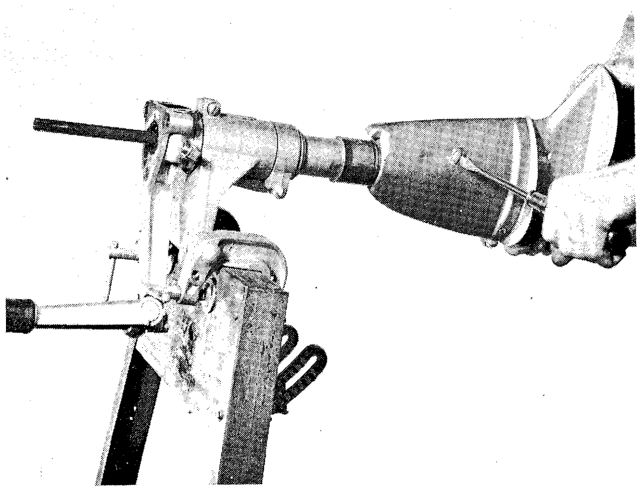
1. Remove propeller nut cotter pin.
2. Remove propeller nut.
3. Remove propeller.
4. Remove water pump housing and gearcase head (held in position by three screws).
5. Lift old rotor from eccentric.
6. Install new rotor – slip over pump eccentric.
7. Reassemble all parts in reverse order of above.



Removing Water Tube from the Driveshaft Casing



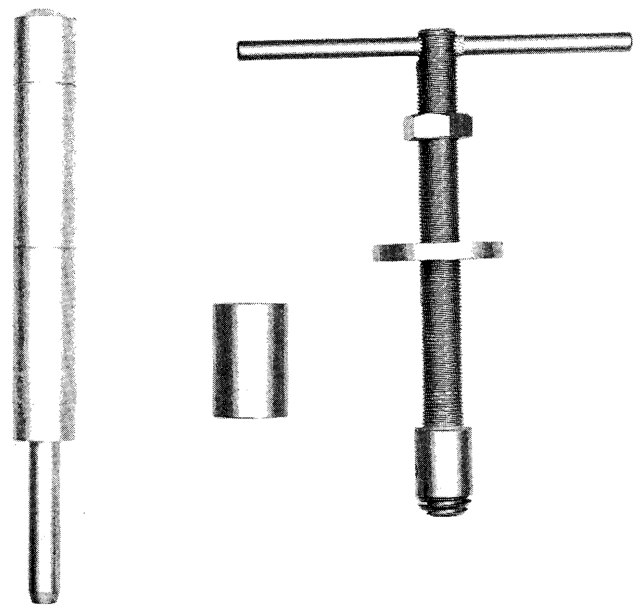
Illustrating Use of a Tool for Removing Inner Tube from Driveshaft Casing.



If it becomes necessary to remove the gear case housing from drive shaft casing, simply loosen large screws and pull in twisting motion as shown above. Assemble in reverse order.

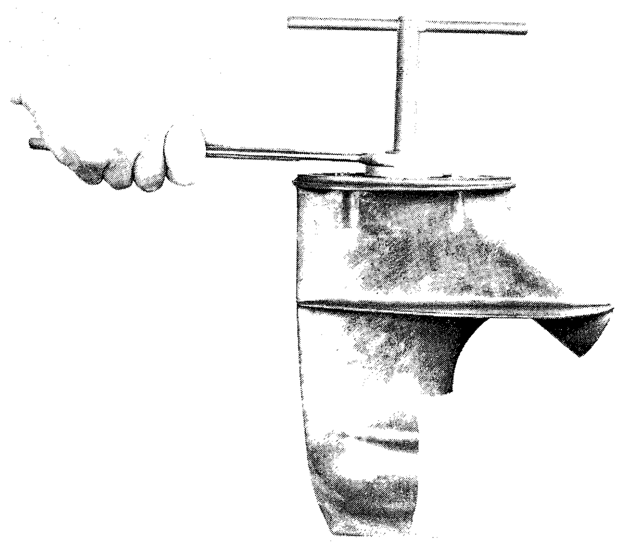
GREASE SEALS

Removal and installation of grease seals as employed in the gear cam and gearcase head of Model TS-TD, can easily be accomplished with aid of special tool illustrated below.



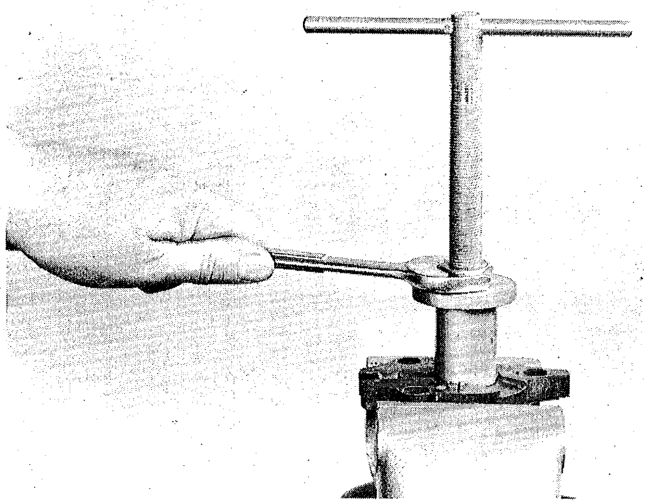
Seal Drive, Bushing and Seal Extractor

To remove the driveshaft seal from the gearcase, simply insert extractor into the gearcase, then turn extractor screw into the seal to obtain a firm grip. Turn nut on the bolt down against the plate provided for this purpose – continue turning until the seal is withdrawn from its seat.



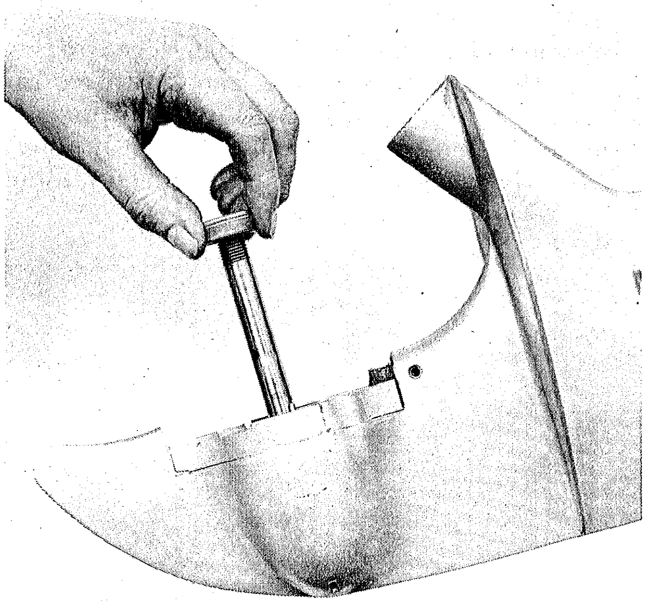
Removing Seal from the Gearcase

To remove seal from the gearcase head, proceed in like manner, using the bushing to pull against the head.



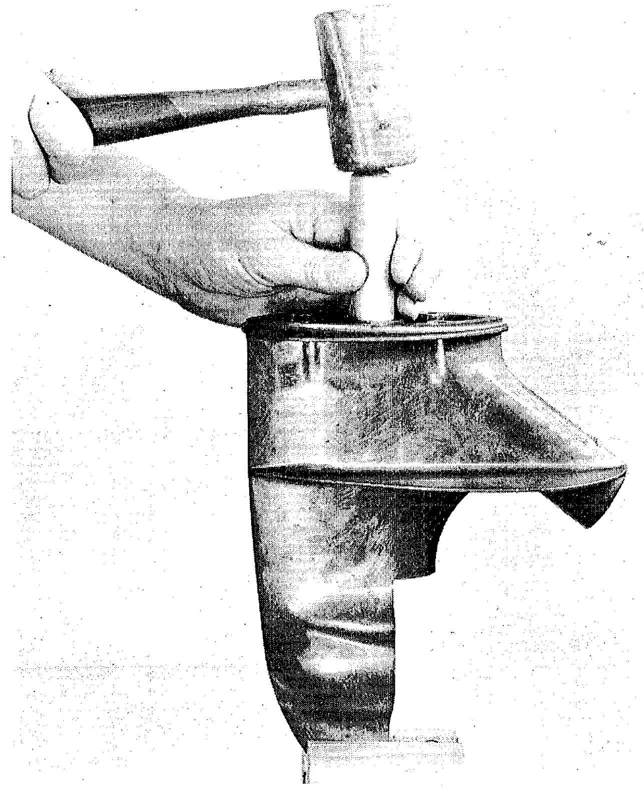
Removing Seal from Gearcase Head

Check seal seats in the housings for burrs, scores, or other damage which are apt to permit grease escaping around the seal even though the seal proper functions as it should. The seals must be properly seated in their respective housings.



It May Be Preferable in Some Instances after Removing the Grease Seal in the Gearcase Head to Attach the Seal to the Gearcase Prior to Installing a New Seal—the Propeller Shaft, in this Instance Acting as a Pilot. However, on Installing the Seal, Extreme Precaution Should be Taken when Assembling on the Propeller Shaft to Avoid Injury to the Seal Surface. Turn the Seal Down on the Threads as Shown Here. Do Not Force over the Threads. After Passing the Threaded End, Slide the Seal into Position for Seating. Carefully Drive Home to Seat—Do Not Crush the Seal

To install a new driveshaft seal, place the seal in position on the pilot of the tool — stamped end of seal up. This is important. Grease will continue to discharge from the gearcase if the seal is installed upside down. Insert tool with seal attached — pilot located in the driveshaft bearing. Drive the seal into position — lower guide line on the driver flush with top of the gearcase. Extreme caution should be exercised during this operation since it is possible to crush the seal by driving beyond points indicated.

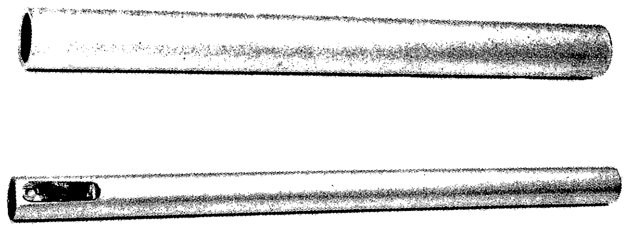


Driving Grease Seal into Position

When installing the gearcase head with seal in position, carefully "screw" the assembly down over threaded end of the propeller shaft to guard against damage to the seal—under no circumstances push the seal down over the threads.

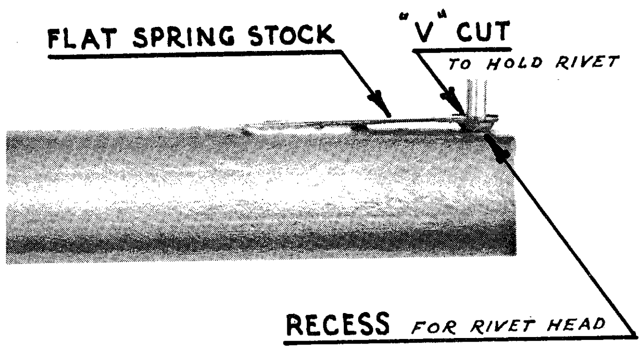
INSTALL THRUST SOCKET LINING ON DRIVESHAFT CASING

When necessary to install thrust socket lining on the driveshaft casing, Models HD and TD, a very simple arrangement can be constructed for



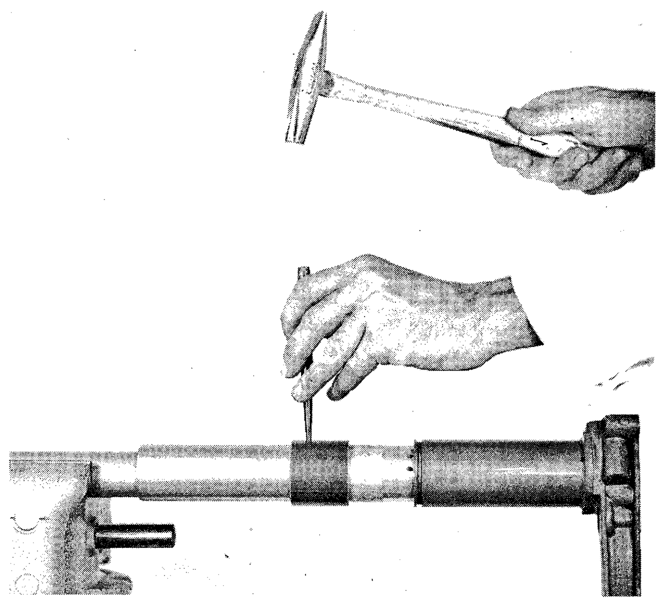
Tools for Installing Rivets in Driveshaft Casing

this purpose—using an 18″ length of ½″ and 1″ gas pipe. Grind a short flat space on one end of the ½″ pipe and about ½″ from the end of the pipe. On the flat, drill a recess deep enough to fit the head of the rivet. Sweat a narrow piece of spring stock (provided with a "V" at opposite end for holding the rivet) to the flat on the pipe, as shown here.



End View of Tool Inserting Rivet

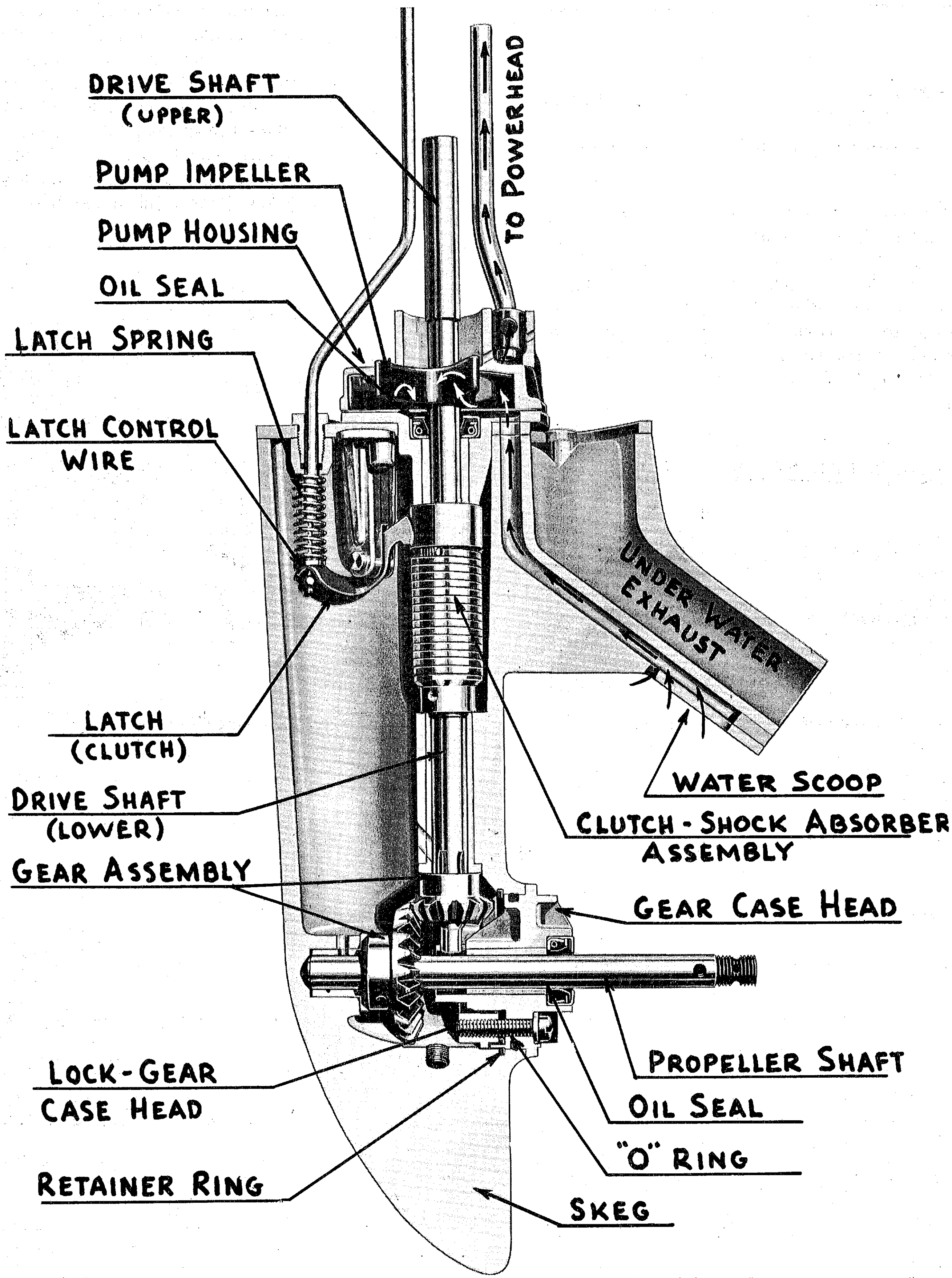
To accomplish the installation, first place liner in position on the driveshaft casing then insert rivet (end of small pipe) as shown above. Insert ½″ pipe, with rivet installed, into the driveshaft casing to guide rivet through hole in the driveshaft casing and the hole in the liner. "Cock" liner slightly to hold rivet in place—install second rivet in like manner. Place the large pipe in a vise—carefully slide the driveshaft casing, with liner and rivets in place, over the pipe. Upset rivet with punch as shown below. Upset just enough to secure the rivet.



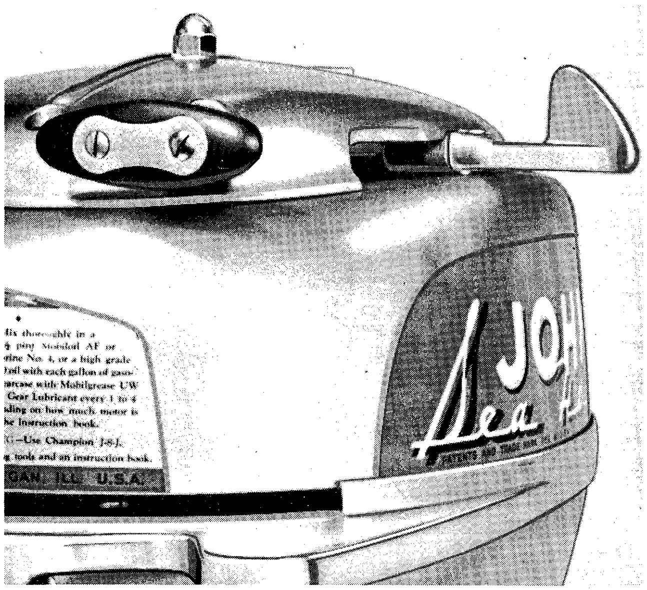
Riveting Lining into Position

NOTES

LOWER UNIT ASSEMBLY — MODEL TN



Design and construction of the Model TN lower unit, while it includes a neutral clutch and shock absorber, are such that disassembly and repair are not too difficult to accomplish with a bit of care and on careful observation during the procedure. All service operations, nevertheless, must be performed with care and in reasonably clean surroundings —clean bench, tools, etc. Cleanliness plays a most important part in repairs of all sorts—the gearcase of an outboard motor being no exception.

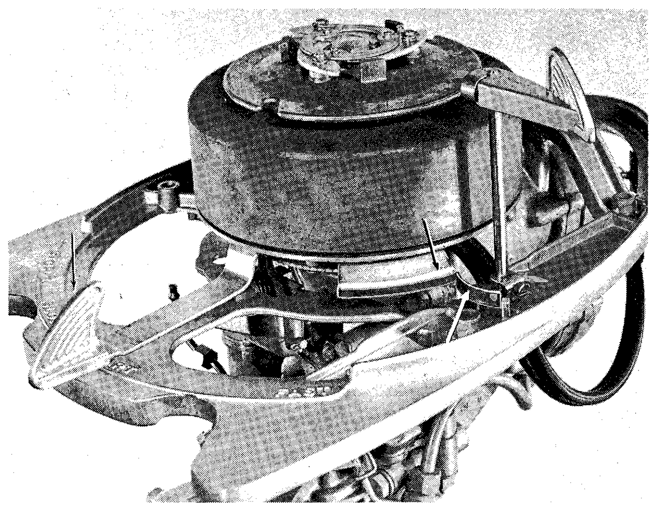


Showing Control Lever Set to "Neutral" Position

A "Neutral" arrangement is provided to permit starting the motor "out of gear"—the motor may be started at the dock and operated at idle speed until warmed up or until ready for power application. A clutch mechanism controlled manually, is built into the gearcase for this purpose. Control is accomplished by movement of the small lever installed adjacent to the Ready Pull starter—"in gear" when lever is set flush with contour of the fuel tank—"in neutral" when lever is extended.

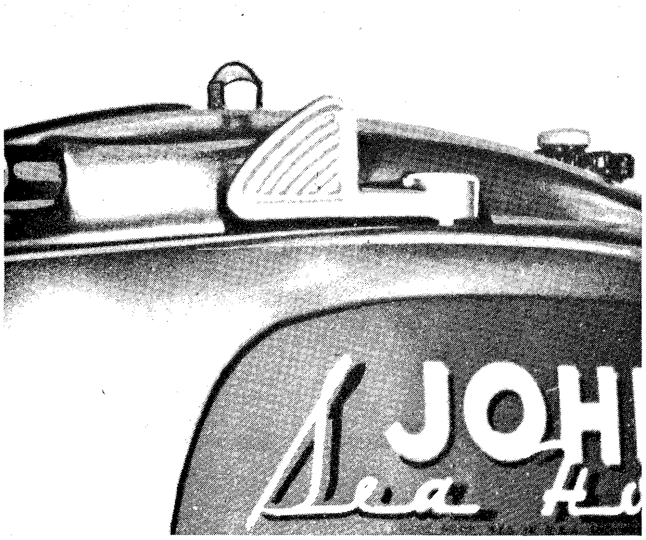
Note—The neutral control lever cannot be shifted with speed control (magneto) lever advanced beyond "start" position—required to prevent "racing" of the motor when in neutral. To accomplish shifting, the speed control lever must be retarded to "start" position or within the slow speed operating range. No attempt should otherwise be made to shift the neutral control lever.

Speed limitation control for "shifting" is obtained by installing a cam on the armature plate and a quadrant on the neutral control shift rod as illustrated here.

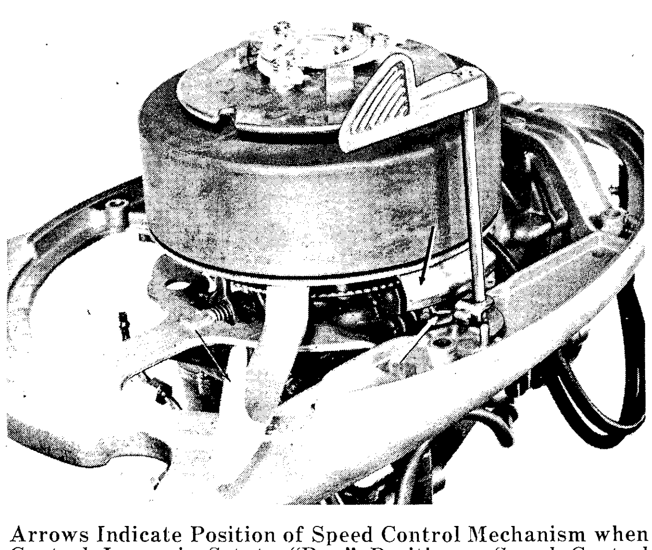


Arrows Indicate Position of Speed Limitation Control Mechanism when Control Lever is Set to "Neutral" Position— Speed Control Lever Set at "Start" Position

In operation, the quadrant attached to the control rod, engages the cam on the armature plate to prevent advancing the speed control lever beyond the "start" position, when set in "neutral." When



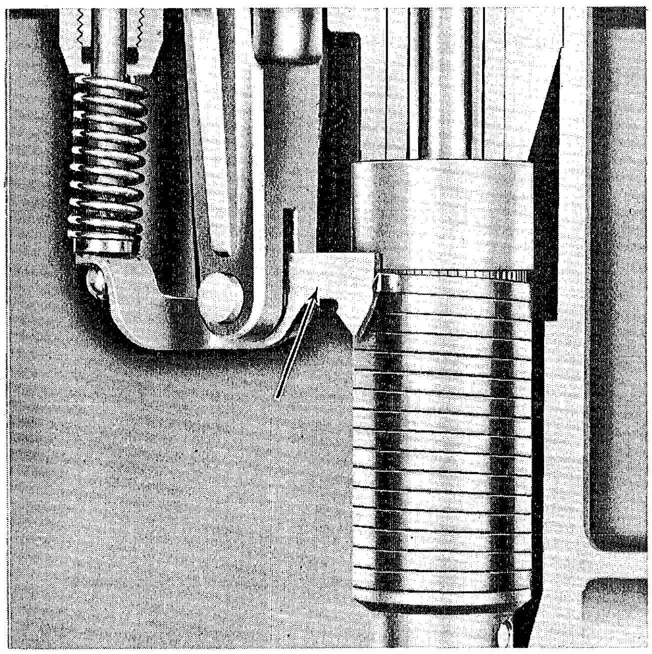
Showing Control Lever in "Run" Position



Arrows Indicate Position of Speed Control Mechanism when Control Lever is Set to "Run" Position — Speed Control Lever Advanced for High Speed Performance set for "running," the quadrant clears the cam to permit free movement of the speed control lever—the motor in this case, may be operated throughout its entire speed range.

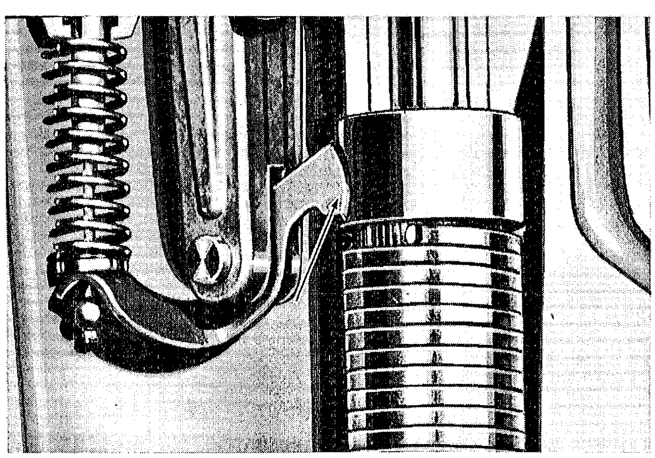
The neutral clutch consists of steel bushing keyed to the lower driveshaft, an accurately ground steel sleeve driven by the upper driveshaft and a spring which is coiled around both the steel sleeve and the bushing.

Propeller drive is thus accomplished by gripping effect of the clutch spring on the sleeve and bushing created during operation of the motor.



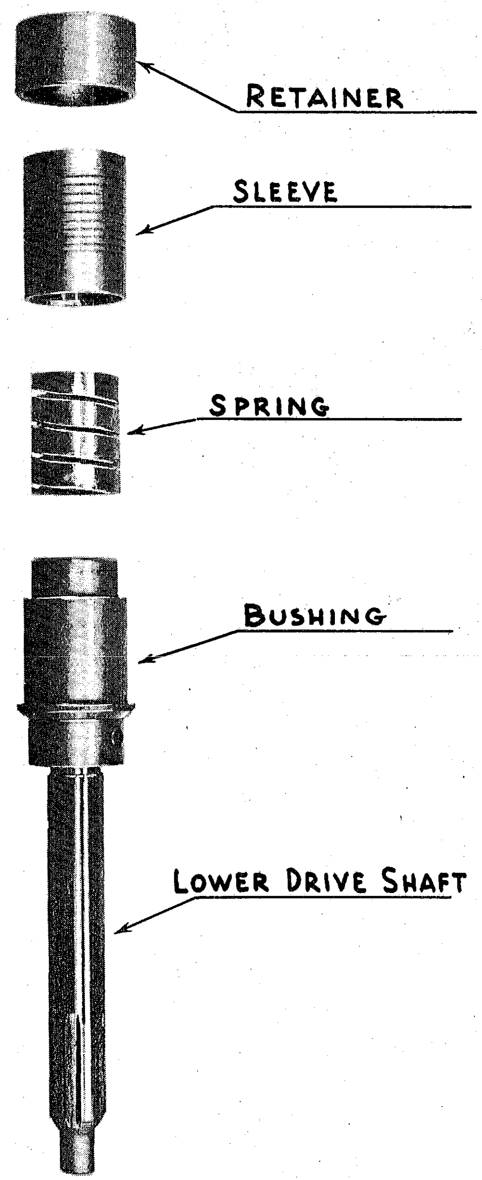
View of Clutch Assembly—Latch Down—"Neutral"

When set for neutral operation, the latch is lowered by movement of the neutral control lever to obstruct rotation of the clutch spring. This action causes the spring to unwind and to subsequently release its grip on the steel sleeve and bushing to permit "slippage" between the upper and lower driveshafts—neutral. When operating "in gear," the latch is lifted by moving the neutral control lever to running position to resume rotation of the clutch spring and its grip on both the steel sleeve and bushing. Rotation causes the spring to "wind up" to increase its grip as motor speeds up.



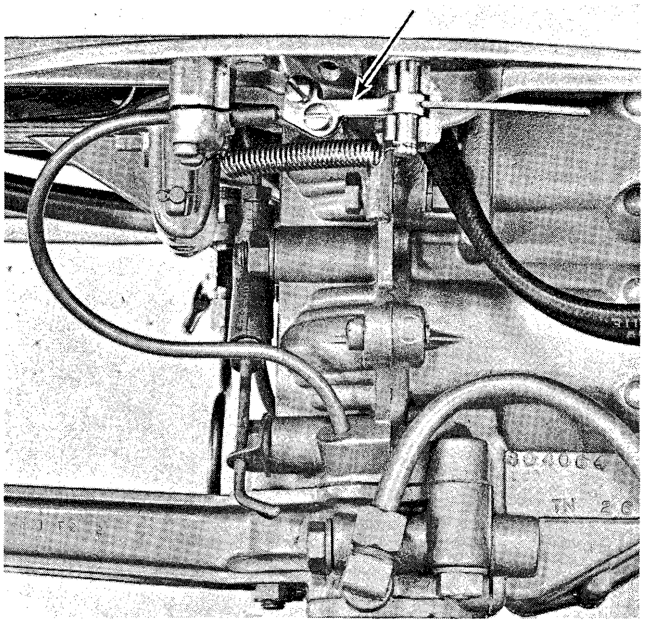
View of Clutch Assembly Showing Latch Up—Running

The propeller shock absorber consists of a comparatively strong spring keyed to the upper driveshaft and inserted tightly into the steel sleeve mentioned above which is actually part of the clutch. Action of the shock absorber is such that in event the propeller strikes an underwater obstruction, the shock absorber spring is caused to "coil" slightly in the steel sleeve to release its grip thereby absorbing shock of sudden impact.

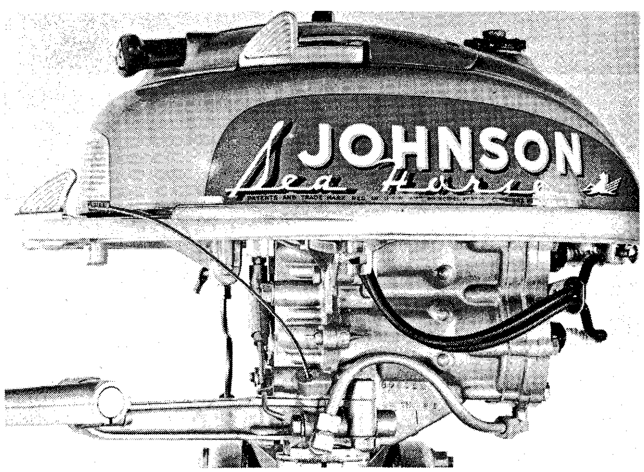


Showing Details of the Shock Absorber Assembly

In event it becomes necessary to detach the lower unit from the power head, the neutral clutch cable must be made free of its anchor. Simply loosen the two screws holding the anchor fast to the cable. Remove the cable guide tube, then the nuts and screws securing the power head and lower unit.

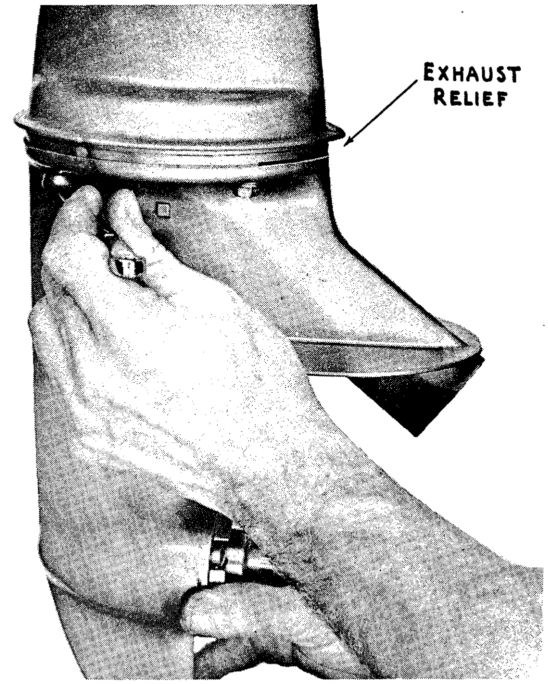


Showing Method of Anchoring the Clutch Control Cable

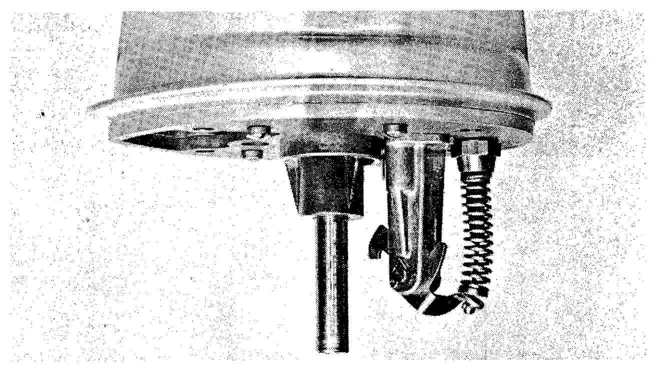


Showing Clutch Cable Detached from Anchor and Guide Tube Removed, Prior to Detaching Power Head from the Lower Unit

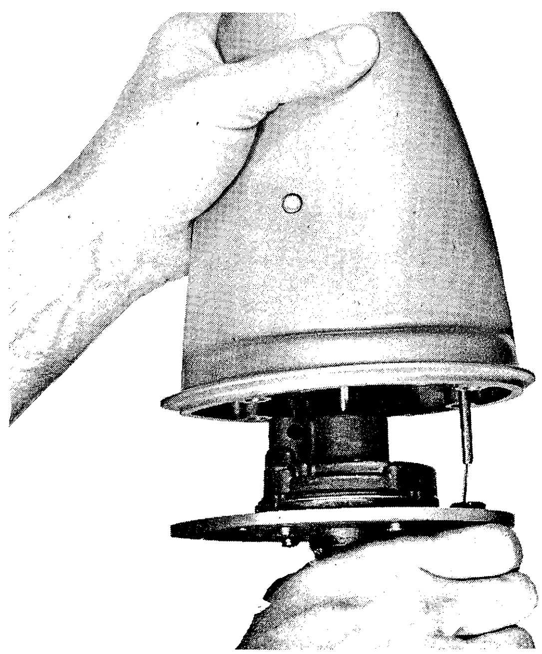
To remove the gearcase proper from the upper gearcase housing, it is necessary merely to remove the screws holding the assembly fast. The gearcase and upper section are easily separated. Note narrow "open slot" between the two sections above the exhaust outlet. Purpose—to provide exhaust relief for starting and slow speed operation.



Removing Gearcase from Lower Unit Assembly

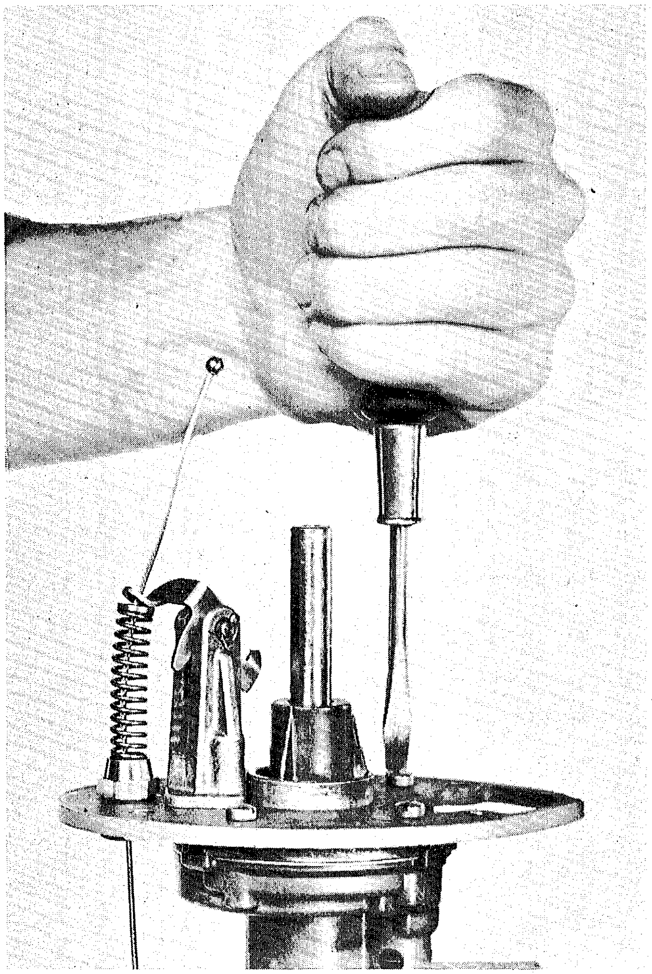


Gearcase Removed, Exposing the Upper Driveshaft and Clutch Control Mechanism

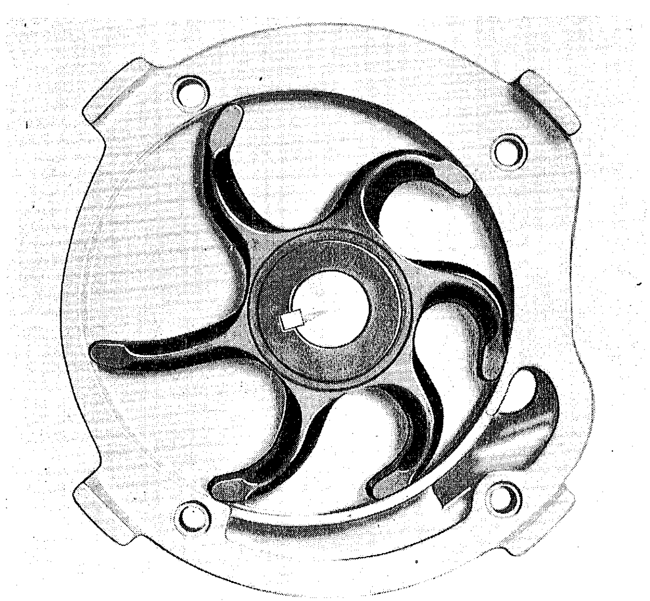


Removing Pump Assembly, Clutch Control Mechanism and Bearing Support from the Lower Unit Assembly

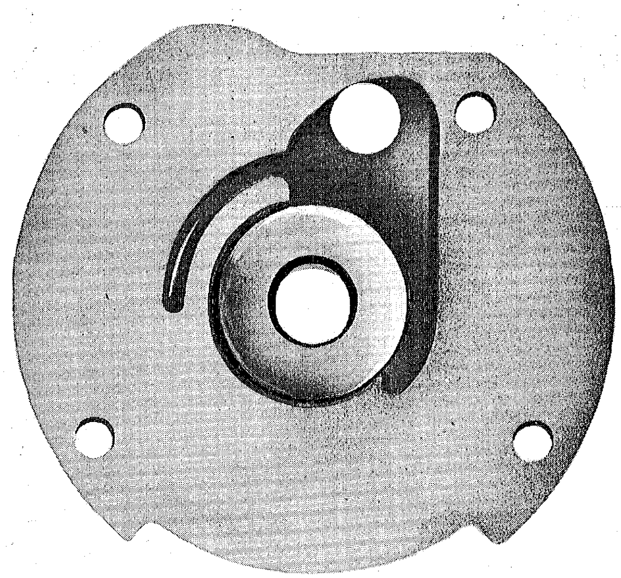
The water pump assembly is installed in the upper gearcase section and is made accessible for inspection or repair on removal from the bearing support plate as shown below.



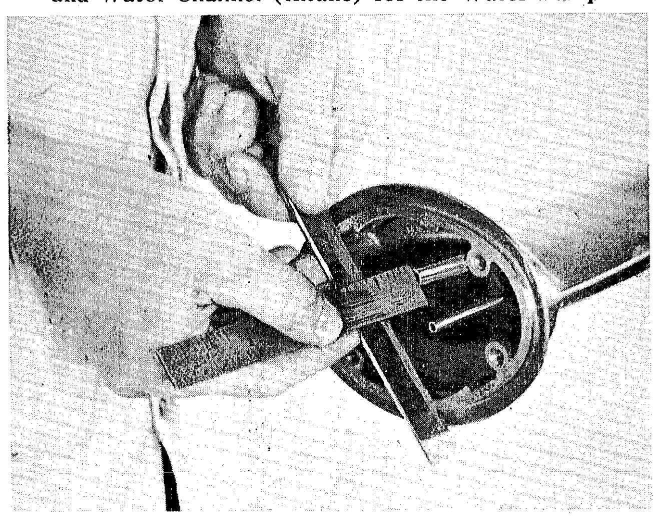
Detaching Bearing Support and Clutch Control Mechanism from the Water Pump Assembly



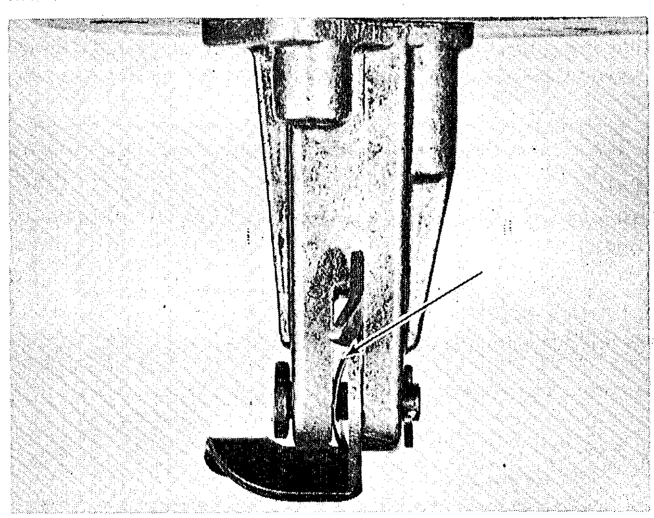
Showing Position of Impeller in the Water Pump Housing —for Further Explanation of the Pump, see Page 408



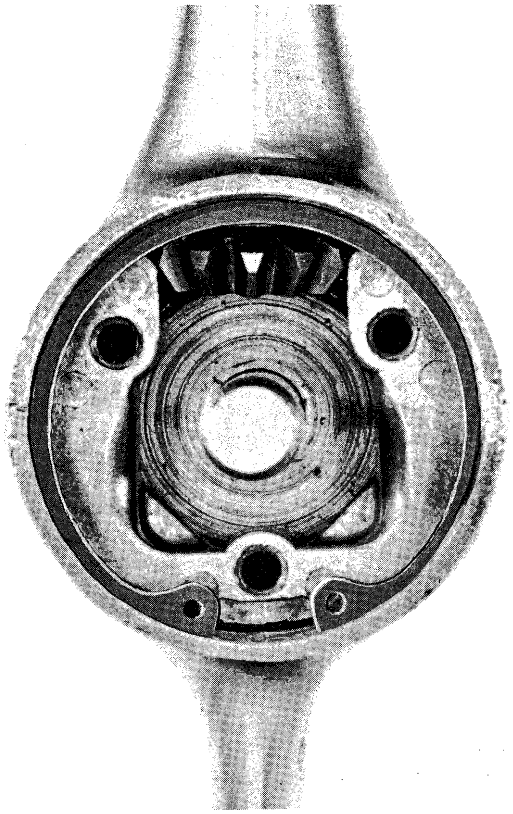
Top Side of Bearing Support Plate Showing the Oil Seal and Water Channel (Intake) for the Water Pump



Correct Procedure for Checking Position of the Water Tube (to Cooling System)—End of the Tube Should Locate 7/8" Below Surface of the Housing as Illustrated—IMPORTANT: End of Control Cable Tube Should Protrude 7/8"

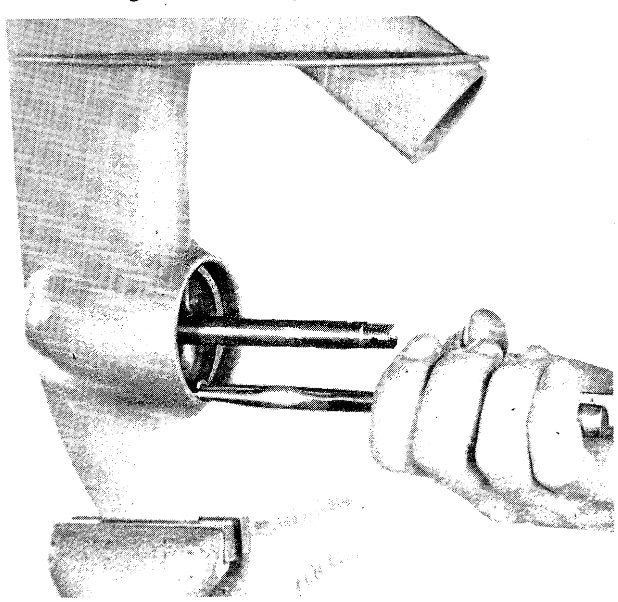


Note Correct Position of Spring Washer in Assembly of the Clutch Control Mechanism



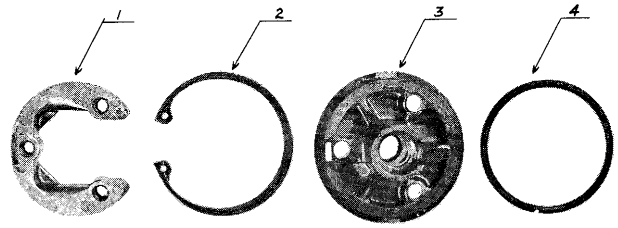
Showing Position of Retainer Ring in the Gear Case

To gain access to the gear assembly, remove three screws holding the gearcase head fast to the gearcase—withdraw the gearcase head. Final disassembly is accomplished by compressing the lockplate retainer ring with a pair of pointed nose pliers as shown here. Turn the gearcase upside-down to permit the clutch-shock absorber assembly falling out in palm of hand. Remove the lockplate and propeller shaft-gear assembly.

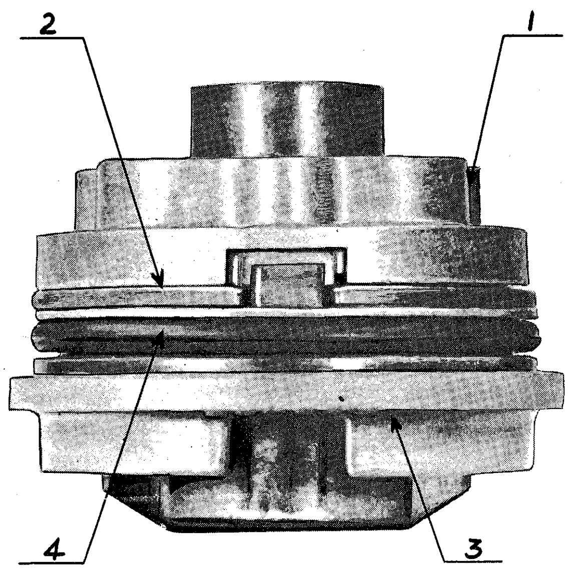


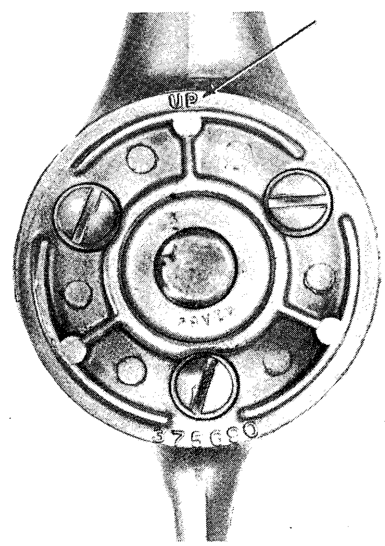
Illustrating Procedure for Removal of the Retainer Ring with Pointed Nose Pliers to Accomplish Final Disassembly of the Gearcase

All parts of the lower unit assembly should now be available for inspection or replacement as required. Bearings are cast in. Reassembly should be carefully performed in order reversed of that explained above.

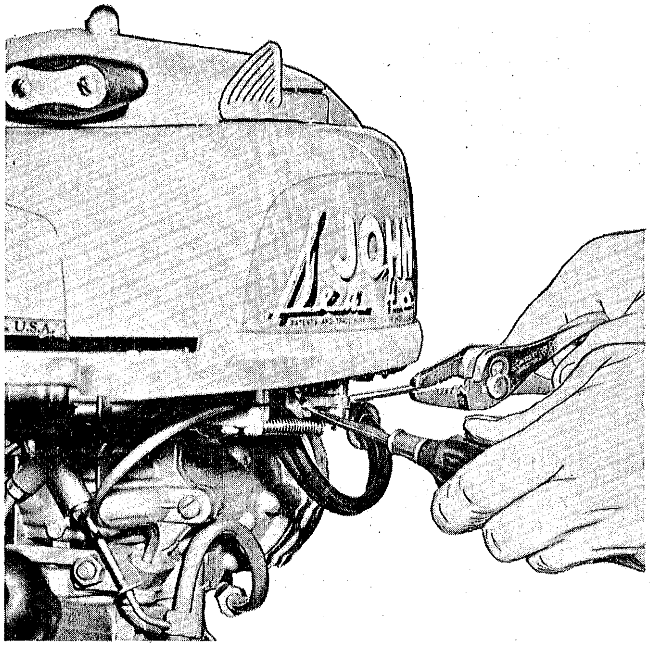


Top—Illustrating Details of the Gearcase Head Assembly: Below—Gearcase Head Assembly. (1) Lockplate, (2) Retainer, (3) Gearcase Head (Including Bearing and Oil Seal, (4) "O" Ring

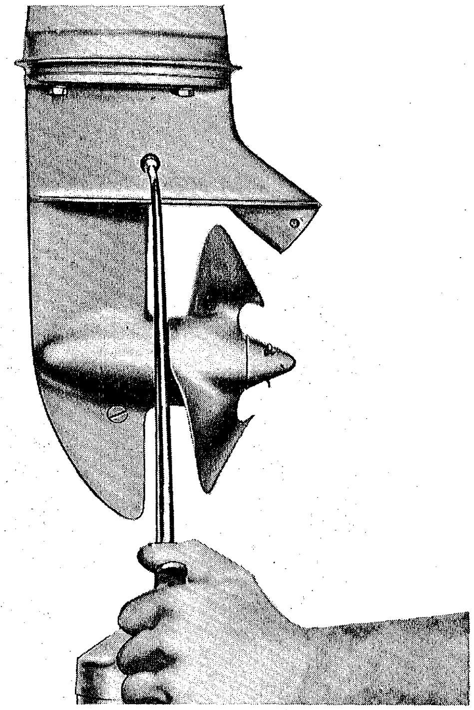




Illustrating Correct Position of the Gearcase Head when Attached to the Gearcase



Illustrating Procedure for Correct Anchoring of the Clutch Cable on Completion of Assembly. Note—Neutral Control Lever in "Run" Position. Grasp Protruding End of Control Cable with Pliers, as Illustrated—Pull to Take up Slack (to a Point Beyond Where Spring Tension is Felt). Draw up Snugly on Clamp Screws



The Gearcase is Lubricated with Hypoid Gear Lubricant. Oil Seals are Provided for the Propeller Shaft and Driveshaft. See Page 371 for Details of Oil Seal Installation.

NOTE: The inner driveshaft casing seal is not built into the lower unit assembly in the Model TN – same being replaced by a carbon seal, "O" ring, washer and a spring which bears against the carbon seal from below to insure contact with the end of the crankshaft. The "O" ring seals the space between the outside wall of seal and recess (which contains the above parts) in upper end of driveshaft casing.

NOTES

INSTALLATION INSTRUCTIONS FOR PART NO. 376311
SEAL ASSEMBLY KIT—UPPER DRIVESHAFT CASING TO DRIVESHAFT—
MODELS TN-27 AND TN-28

The following parts are included in this kit:

1	303894	Retainer
1	303347	O-Ring
1	303391	Seal
1	303357	Spring
1	303327	Washer
1	303261	Drive Pin
1	303904	Instruction Sheet

Installation Instructions for Model TN-27

A. Disassemble driveshaft casing assembly (#375727) and driveshaft (#302469) from motor and machine through the driveshaft casing flange 15/16″ diameter. (Ream or drill).

B. Apply a thin coat of lubricant on the outside of the retainer (#303894) and press retainer down in driveshaft casing flange so that the top of retainer is 1/8″ below top of driveshaft casing flange. See drawing on reverse side (TN-27) for proper position of retainer.

C. Drill .097 - .095 diameter through driveshaft. Location of hole being 2-11/16″ from top of driveshaft to center hole. Insert drive pin (#303261).

D. Place washer (#303327), spring (#303357), seal (#303391) and O-ring (#303347) in position and reassemble motor using new gaskets #302355 and #41-36 (if necessary) between the powerhead and lower unit.

E. It may be necessary to **slightly** bend the water and neutral clutch cable tubes for proper clearance of the seal assembly.

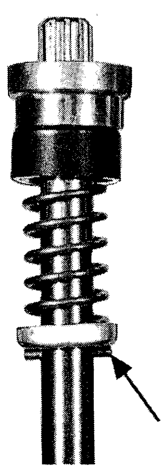
Installation Instructions for Model TN-28

A. Disassemble driveshaft casing (#375943) and driveshaft assembly (#375939) from motor. Apply a thin coat of lubricant on the outside of the retainer (#303894) and press retainer down in the driveshaft casing flange (#375943) so that top of retainer is 1/8″ below top of driveshaft casing flange.

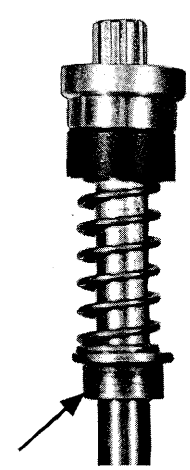
B. Press collar (#303031) down on driveshaft so that top face of collar is 2-5/8″ from top of driveshaft. Place spring (#303357), seal (#303 391), and O-ring (#303347) in position — see drawing on reverse side (TN-28)—and reassemble motor using new gaskets #302355 and #41-36 (if necessary) between powerhead and lower unit.

C. It may be necessary to **slightly** bend the water and neutral clutch cable tubes for proper clearance of the seal assembly.

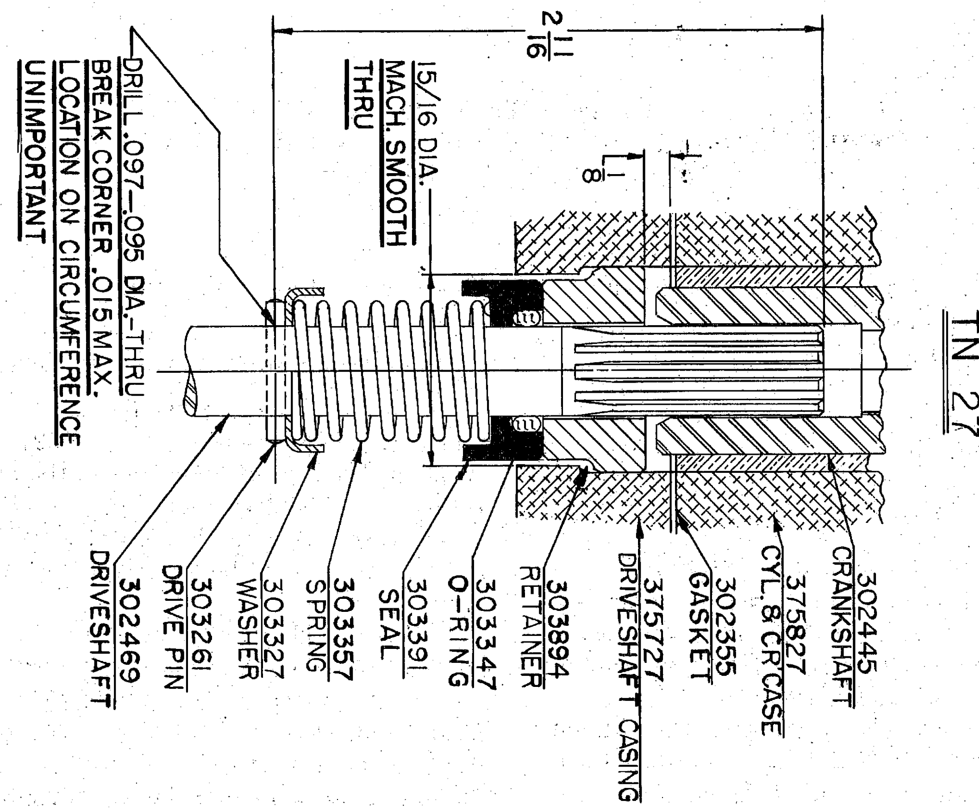
D. Part #303261 drive pin and #303327 washer not required for installation of seal assembly on Model TN-28, UNLESS collar #303031 on driveshaft breaks when pressing to proper position. If collar breaks, remove same from driveshaft and install #303261 drive pin and #303327 washer—see instructions — paragraph "C" and "D" for Model **TN-27.**

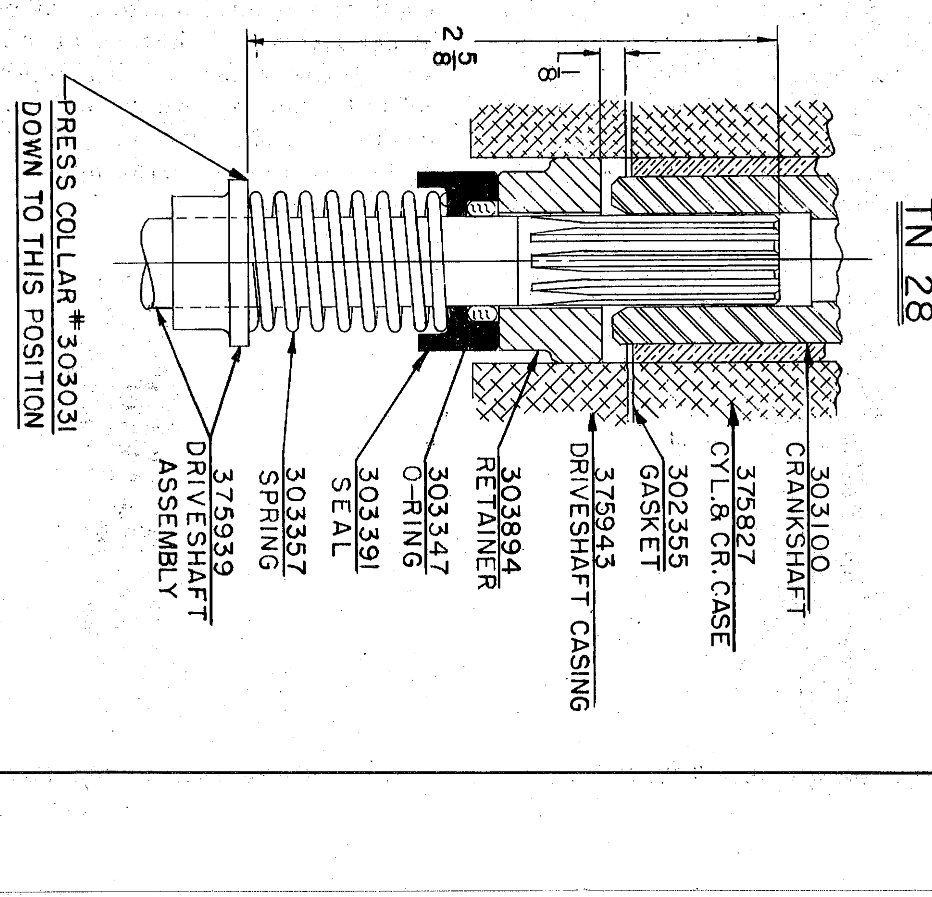


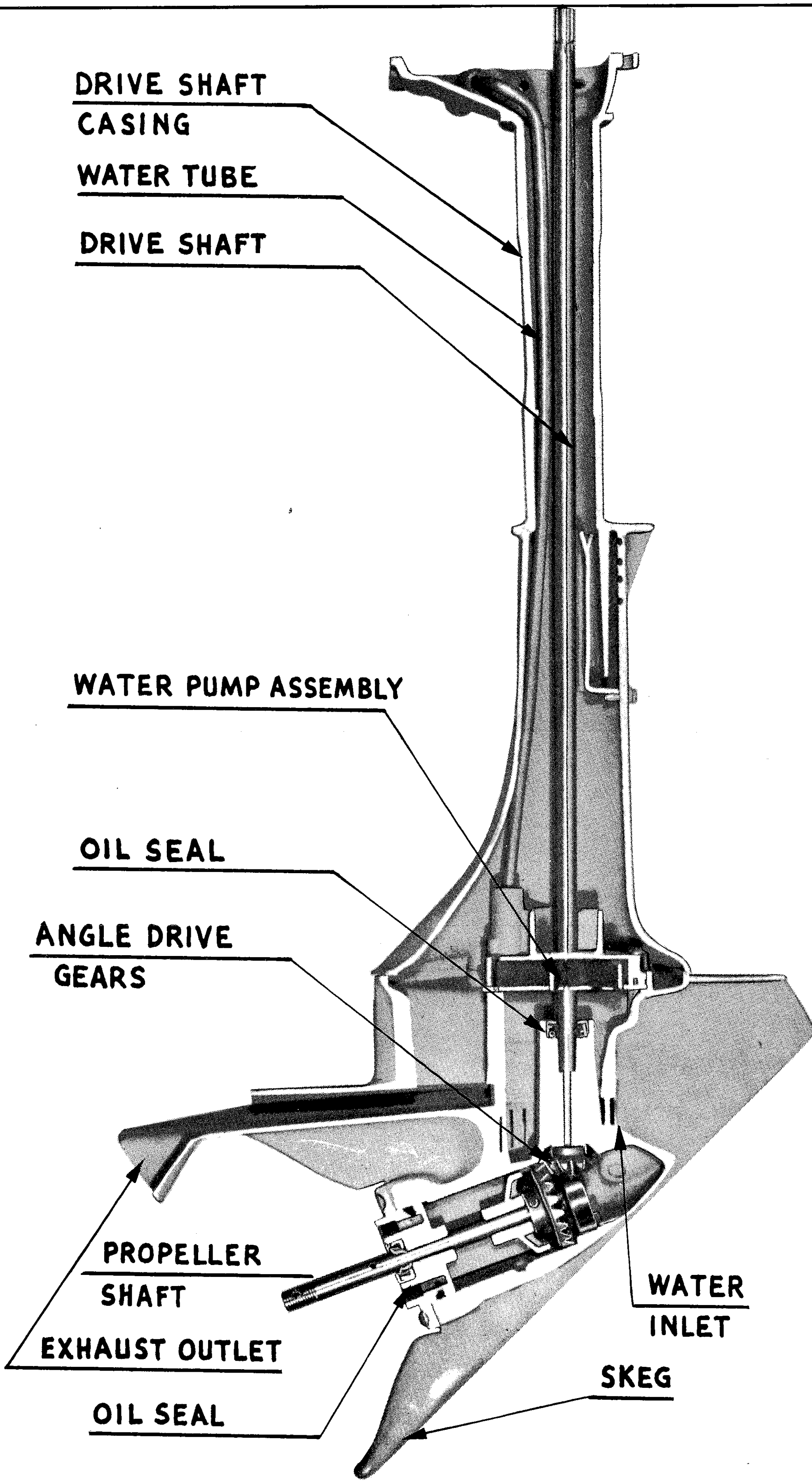
Carbon seal assembly—Model TN-27.



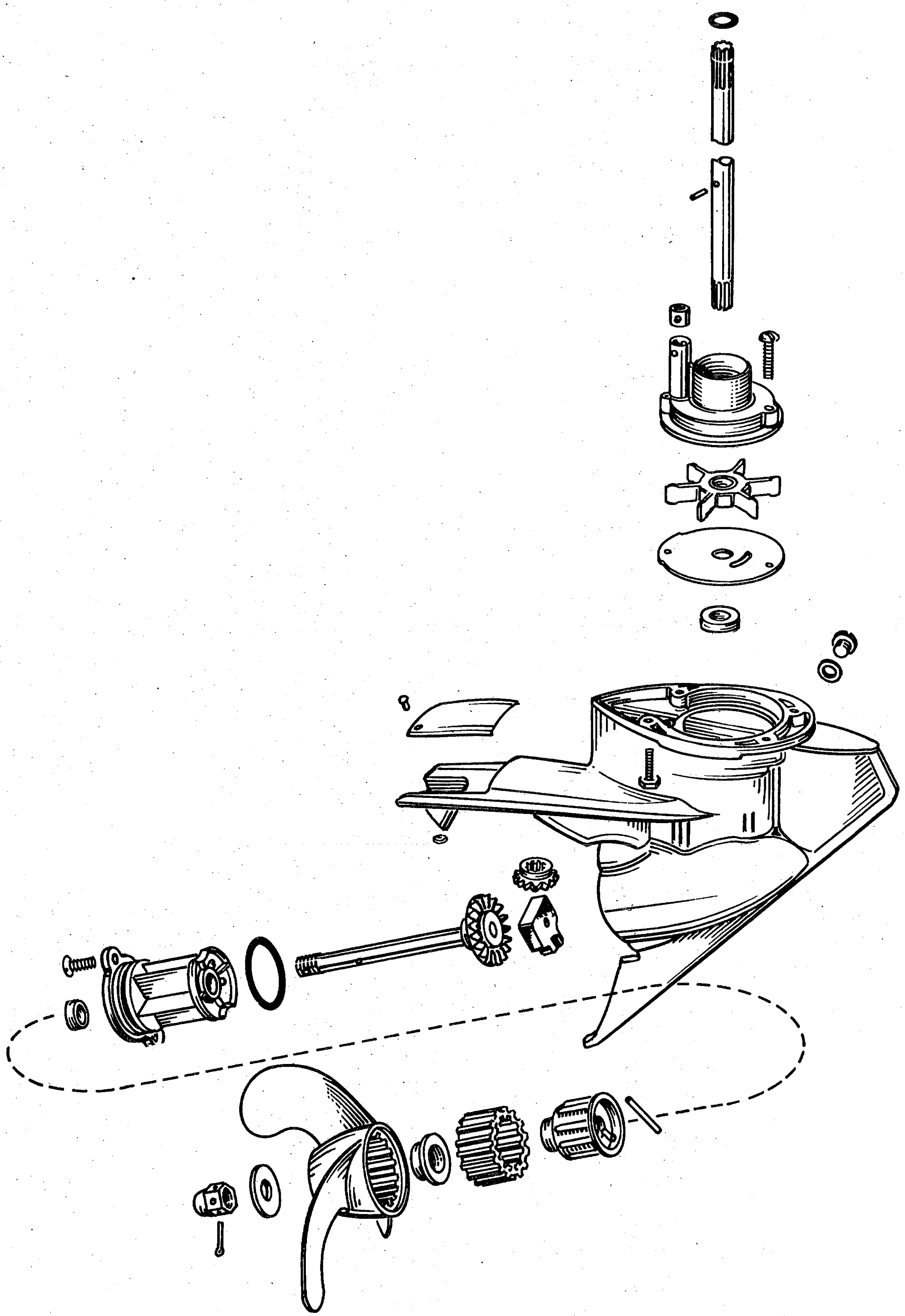
Carbon seal assembly—Model TN-28.


TN 27
$2\frac{11}{16}$
$\frac{1}{8}$
15/16 DIA. MACH. SMOOTH THRU
DRILL .097-.095 DIA.-THRU BREAK CORNER .015 MAX. LOCATION ON CIRCUMFERENCE UNIMPORTANT
302445 CRANKSHAFT
375827 CYL.& CR.CASE
302355 GASKET
375727 DRIVESHAFT CASING
303894 RETAINER
303347 O-RING
303391 SEAL
303357 SPRING
303327 WASHER
303261 DRIVE PIN
302469 DRIVESHAFT

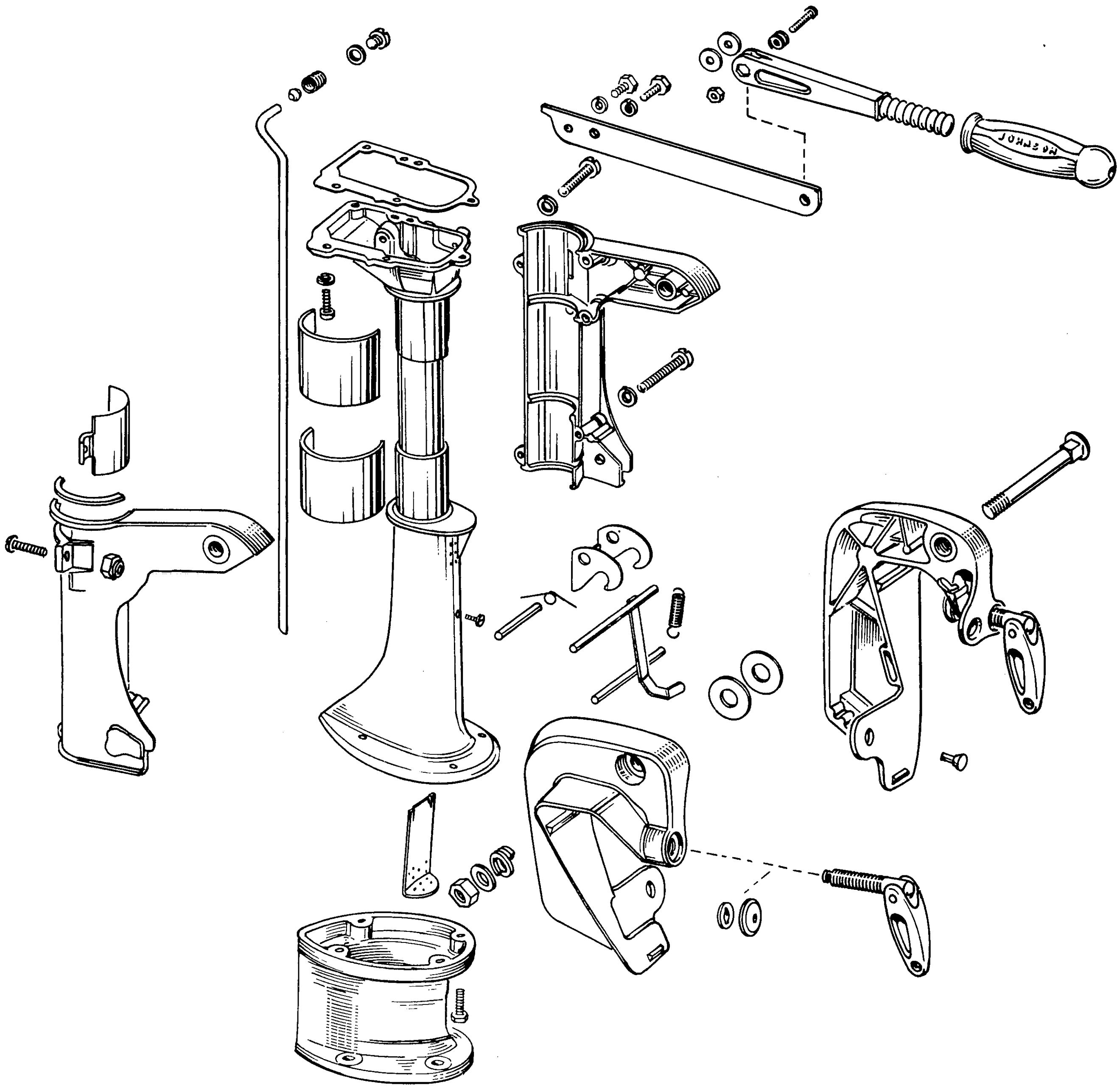

TN 28
$2\frac{5}{8}$
$\frac{1}{8}$
PRESS COLLAR #303031 DOWN TO THIS POSITION
303100 CRANKSHAFT
375827 CYL.& CR. CASE
302355 GASKET
375943 DRIVESHAFT CASING
303894 RETAINER
303347 O-RING
303391 SEAL
303357 SPRING
375939 DRIVESHAFT ASSEMBLY



Sectionalized View of Lower Unit – Models JW-10 Up.



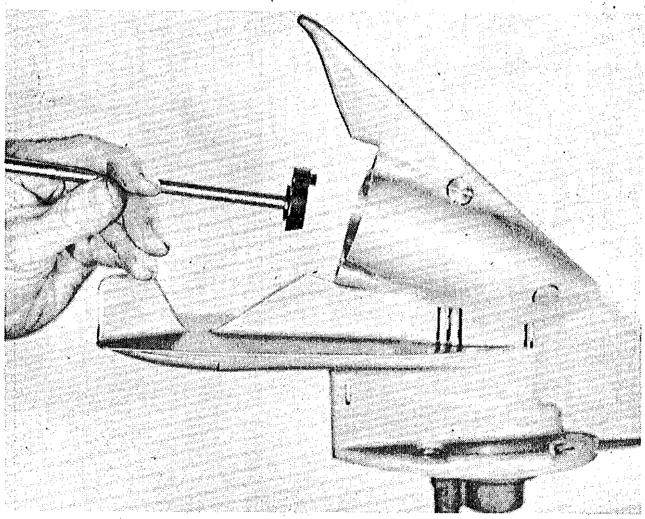
Assembly Layout — Gear Case Group.



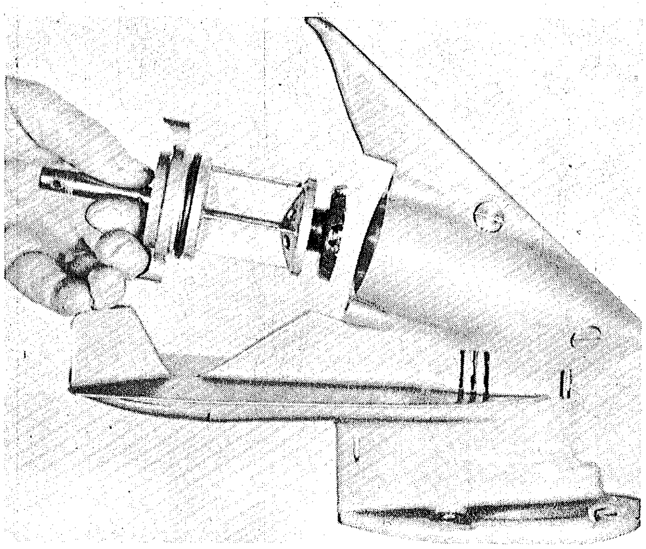
Assembly Layout — Driveshaft Casing.

LOWER UNIT – MODELS JW-10 UP

The lower unit on the Model JW is of conventional design and construction, except that a weedless type of gear case is employed which includes a propeller shaft driven at 30° "off" horizontal to permit operation in shallow water. Exhaust is under water. The water pump is driven by the drive shaft, as has been established practice for the past several years, see Page 408.



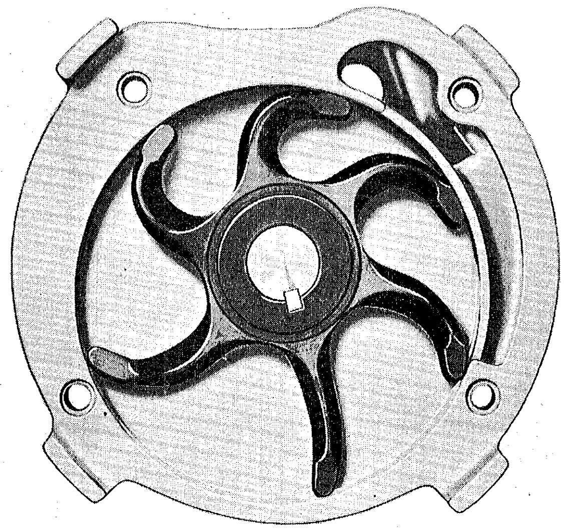
Illustrating Method of Installing the Thrust Block — Note Locating Pins in the Gear Case and Corresponding Notches in the Thrust Block. Align to Accomplish Proper Seating.



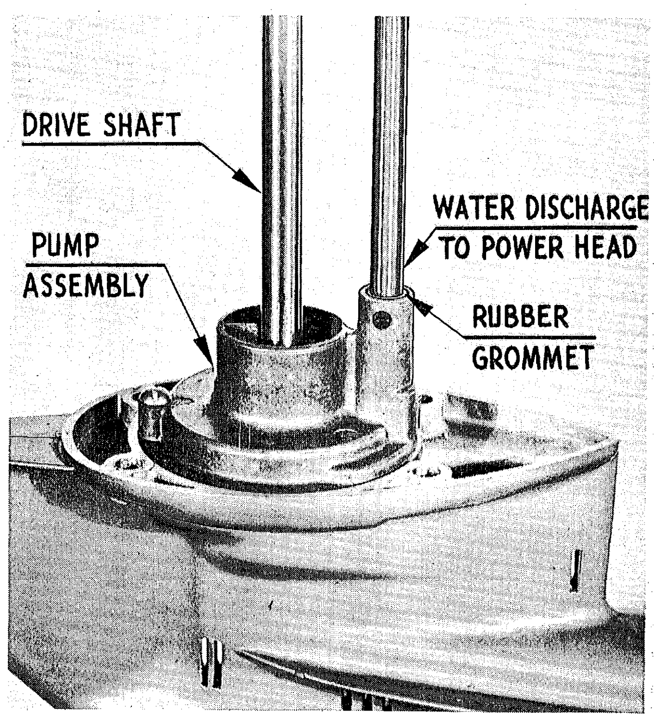
Installing Propeller Shaft-Gear and Gear Case Head and Bushing Assembly.

Assembly procedure (see assembly lay-out illustrations).

1. Insert drive shaft into gear case. 2. Install pinion on lower end of the drive shaft. 3. Insert thrust block. 4. Install propeller shaft bevel gear assembly into the gear case head — see that large "O" ring is in its correct position. 5. Coat mounting face of gear case head with thin film of Sealer 1000 or similar hard drying cement. 6. Insert assembly into the gear case head — make secure with screws provided for the purpose. 7. Install water pump cover plate. 8. Insert pin (to drive the impeller) into hole in the drive shaft. 9. Assemble pump housing — secure position of assembly with impeller screws provided for the purpose (coat threads of screws with Perfect Seal No. 4 to permit easy removal at a later date — of extreme importance in salt water areas).

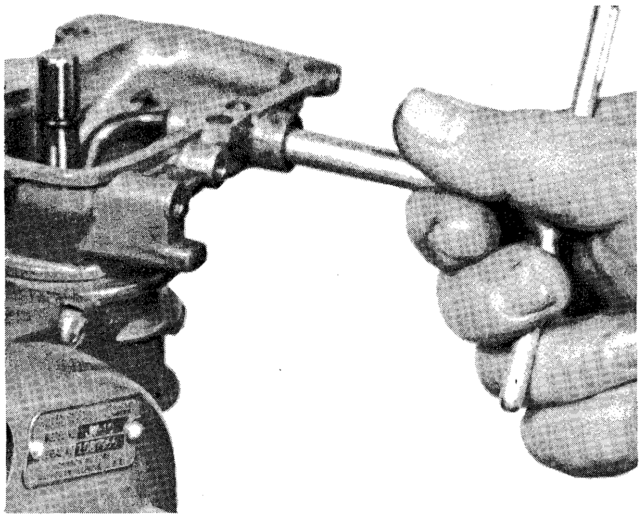


Showing Impeller Installed in the Pump Housing.

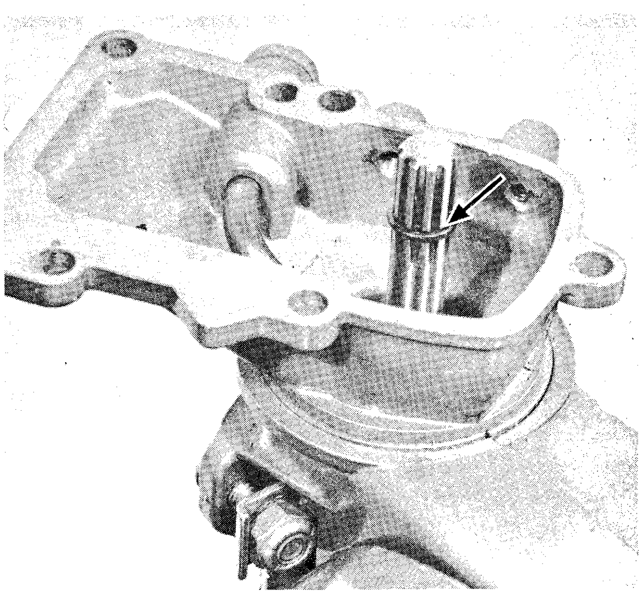


Showing Water Pump Assembly Attached to Top End of the Gear Case.

10. Install water tube grommet (rubber). 11. Attach drive shaft casing with water tube installed —make certain the water tube is properly directed into the rubber grommet. 12. Bolt drive shaft casing to the gear case and later attach to power head to complete repair.



Showing Installation and/or Removal of the Water Tube in the Driveshaft Casing.

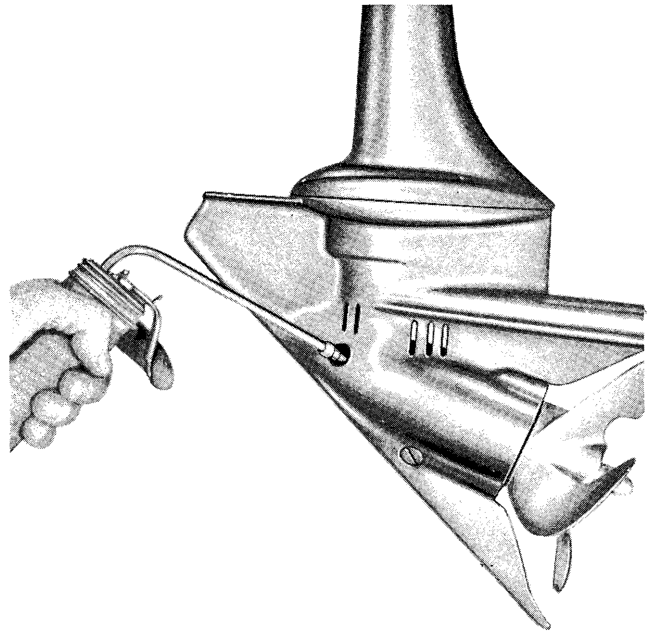


Upper Ends of the Driveshafts in Models JW, QD, and RD are Grooved and provided with an "O" Ring as Illustrated here (Model JW).

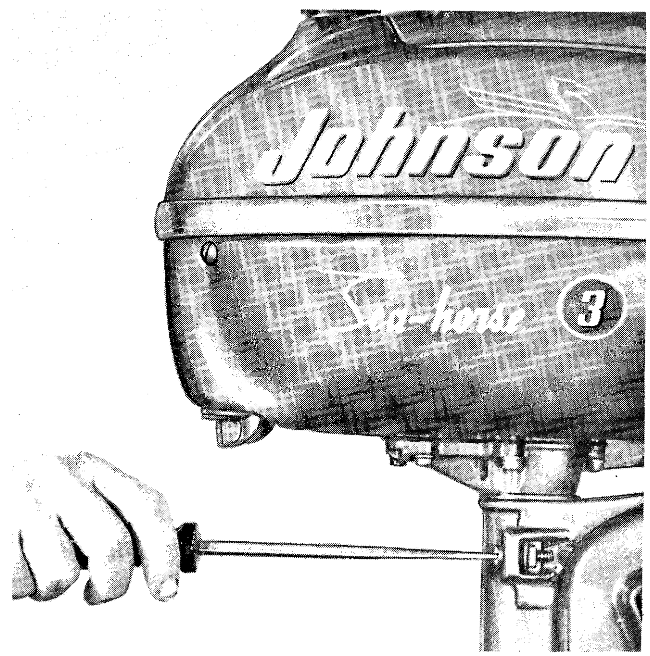
Purpose of the Installation is to Prevent Water and/or Salt Spray from Actually Reaching the Splined Areas (Crankshaft—Driveshaft).

Splined Surfaces should be Coated with Water Resistant Grease when Attaching the Power Head in each case. Do not "Pack" the Crankshaft Spline excessively with Grease (too full). Insert Just enough to Cover the Splined Surfaces. Over-Greasing here will merely act to force the "O" on the Driveshaft out of Position when Assembling to the Lower Unit and thus Void its Purpose since there is no Pressure Relief except by Forcing the "O" Ring out of Position.

The propeller is provided with shock absorber drive as illustrated in assembly lay-out — see page 415 for explanation.



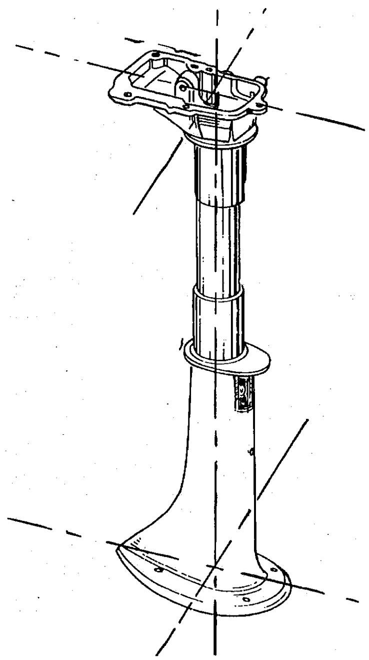
Inserting Gear Lubricant — Hypoid Oil.



Adjusting Swivel Bracket Tension (Steering).

Avoid accumulation of oily rags about the shop or work bench. Oily rags left lying around the shop are a hazard—a fire hazard and a threat to an otherwise promising business with a future.

DRIVESHAFT CASING INSTALLATION



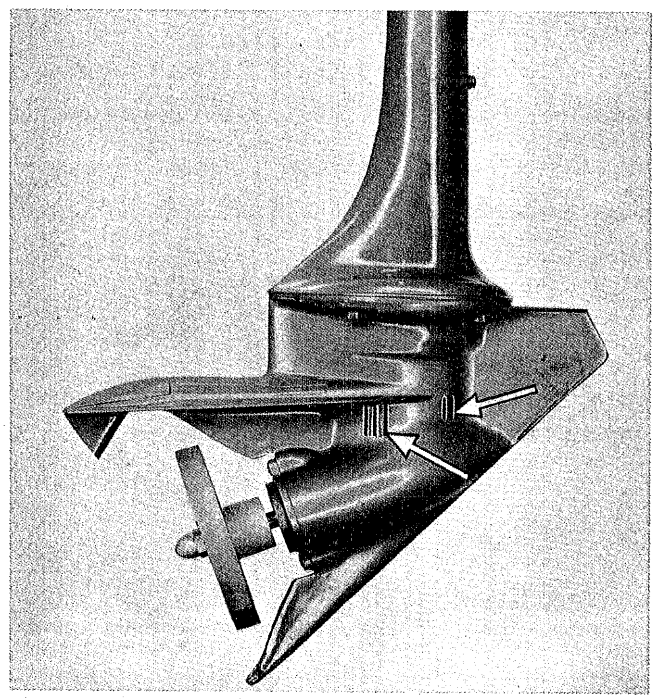
During process of servicing the Model JW from time to time, it may require removing the powerhead from the lower unit. Doing so provides an opportunity for checking alignment of the driveshaft casing with respect to attachment to the powerhead as it might affect wear on the driveshaft and crankshaft spline.

With the assembly in proper alignment, little if any action takes place in the splined coupling — it serves merely as a connection (driving member) between the crankshaft and driveshaft. However, misalignment of the driveshaft casing, perhaps as result of accident to cause bending or twisting, throws the driveshaft out of line with the crankshaft to result in "flexing" and rapid wear of the "splines" (driveshaft and crankshaft). It is extremely important the driveshaft casing be in proper alignment to avoid excessive spline "wear." Top and bottom flanges must be "square" with a line through the center of the driveshaft casing as shown here.

In event of misalignment, it becomes necessary to install a new assembly — **misalignment cannot** be corrected in the casting.

When reassembling, smear the splines with water resistant grease and make certain "O" ring No. 202893 is in proper position on the driveshaft since it acts to prevent water discharging from the cooling system attacking the splined areas — of extreme importance in salt water regions. Use the grease sparingly — enough to cover the splined surfaces; excessive application will cause the "O" ring to be forced from its seat on the driveshaft when attaching the powerhead. This incidentally, holds true for all splined couplings where the "O" ring is employed on the driveshaft — there is just so much "room" (volume) in the crankshaft spline for grease. An overabundance is forced out when assembling only to dislodge the "O" ring and subsequently destroy the seal provided for this purpose.

Further, any misalignment (bending or twisting) in the driveshaft casing, regardless of model motor, is the chief factor in premature and rapid spline wear.

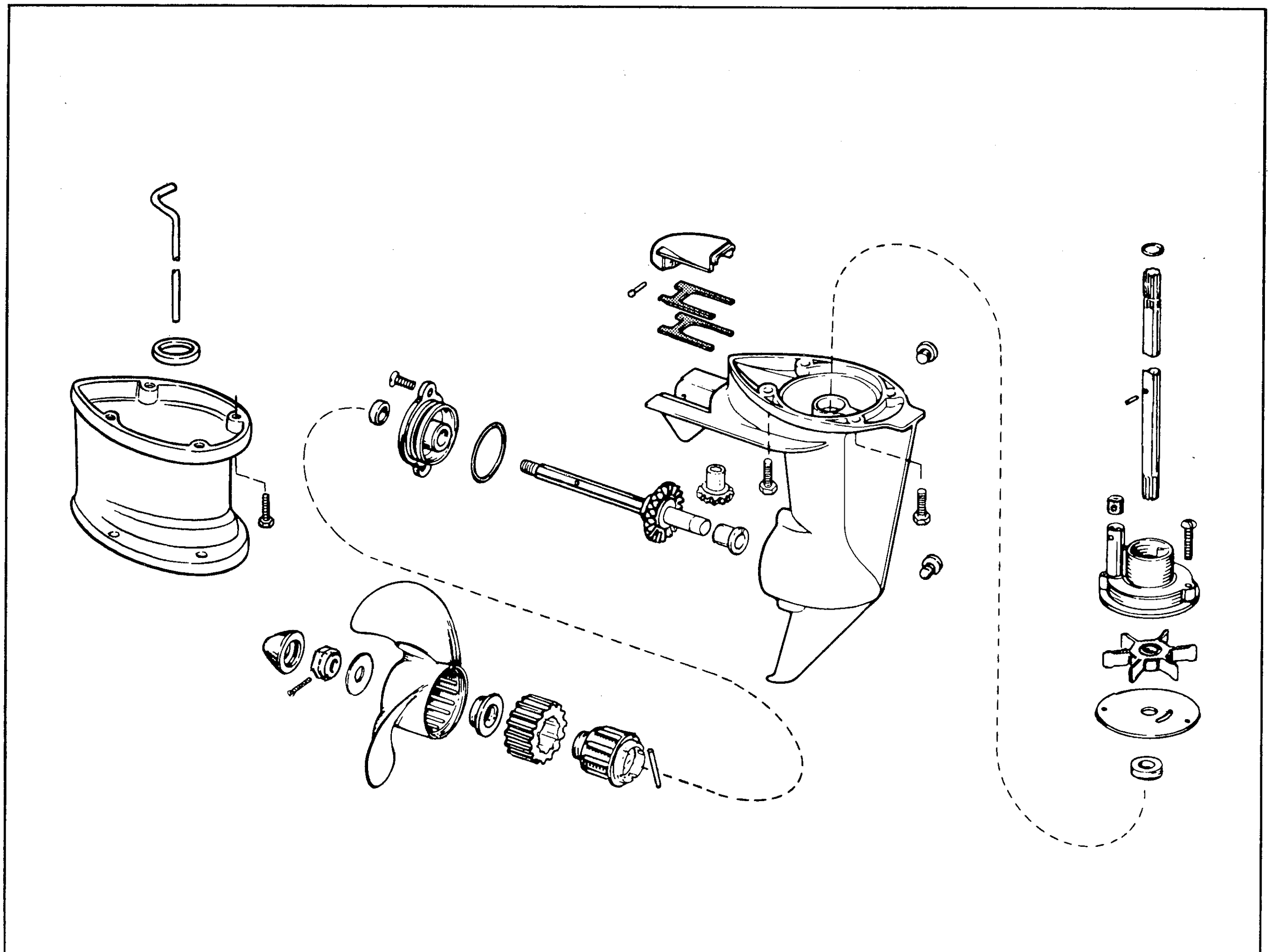


Gear Case with Test Wheel Installed. Arrows Indicate Water Inlet.

Lower Unit—Models JW and JH-19 Up

Specifications — Lower Unit

	JW (Angle-Matic Drive)	JH (High-Thrust Right-Angle Drive)
Gear Ratio	17:28	12:25
Drive	Full Pivot Reverse	Full Pivot Reverse
Propeller	2 Blade (6⅛″ Dia. × 6¼″ Pitch)	3 Blade (8″ Dia. × 4½″ Pitch)
Gearcase Oil Capacity	2.9 Ounces	2.9 Ounces



Exploded Parts View – Model JH-19 and Up Gearcase.

GENERAL DESCRIPTION

The exhaust housing and swivel bracket on both 1964 – 3 HP models (JW and JH) have been strengthened considerably over previous year 3 HP design, adding rigidity to the midsection of these lower units and making them adaptable to even more rugged service than was possible in years past. A single clamp screw and wider transom pad are also featured making installation on the boat a simple matter. Both 1964 – 3 HP models feature completely sealed pivot bearings in the swivel bracket – achieved through the use of two O-rings – which prevents salt corrosion build-up in this area (the result of use in salt water) and thus eliminates the occurrence of possible hard steering.

Service information on the new *Right-Angle Drive* JH gearcase and information on the strengthened exhaust housing and sealed swivel bracket for both JW and JH models follow. For service information on the *Angle-Matic Drive* JW gearcase, see page 383.

GEARCASE – MODEL JH-19 AND UP

The model JH gearcase is of one piece design, having but one driving gear. Reverse operation is accordingly achieved by rotating the engine 180° on the swivel bearings, which in effect permits the design and use of an extremely simplified lower unit with very few moving parts that can wear.

Four screws are used to secure the JH gearcase to the exhaust tube. Removal of these screws (Figure 1) permits detaching the gearcase from the exhaust tube in but one step. Since the water tube is held in place by the powerhead adaptor plate, it will conveniently remain in the exhaust housing when the gearcase is removed and need merely be re-inserted into the pump housing grommet when the gearcase is re-assembled to the exhaust housing.

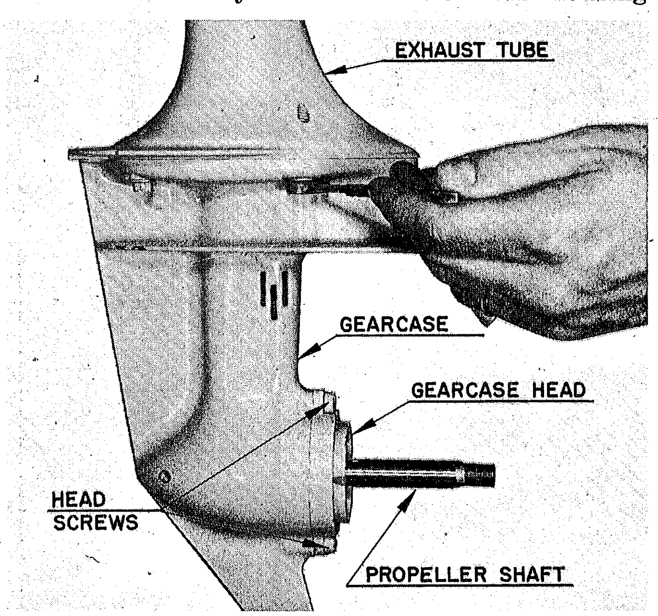


Figure 1

CAUTION NOTE! Remove both spark plugs before attempting to remove or install gearcase, since often the propeller and/or flywheel are turned by the mechanic when attempting to align the crankshaft and driveshaft splines.

GEARCASE DISASSEMBLY:

1. Remove fill and drain plug and oil level plug (Figure 1A) so that gear oil can be drained from gearcase. Do not re-use gear oil once it is drained.
2. Remove two impeller housing screws. Lift impeller housing, driveshaft, impeller, *impeller pin* and impeller plate from top of gearcase. Examine each of these parts carefully to determine their condition and replace any part that shows signs of wear. If impeller housing needs replacing, old water tube grommet can be transferred to new housing providing grommet is in good condition.
3. Remove two gearcase head screws (Figure 1). Pull gearcase head and propeller shaft from gearcase simultaneously. Separate gearcase head from shaft when removed.
4. Extract pinion gear through opening in rear of gearcase.
5. Wash all parts thoroughly in cleaning solvent and blow dry with air hose. Inspect all parts and replace any worn parts.
6. Check fit of pinion gear in gearcase bushing by slipping *dry* pinion gear in place and observing if side play exists. If gear appears excessively loose replace gearcase, since the pinion bushing is not a serviced item. Check pinion gear fit in bushing of new gearcase to determine if pinion too has worn. Should pinion fit loosely in new gearcase bushing, pinion must also be replaced.
7. Examine driveshaft oil seal in gearcase (located under water pump). Replace seal if worn, using service tool #377565 SEAL PULLER with #301927 SEAL EXTRACTOR. Install new seal, *lip facing in,* flush with start of seal recess in gearcase.
8. Condition of gearcase head bushing is best checked by installing propeller shaft and gearcase head to gearcase so that side deflection of propeller shaft (looseness) may be noted. O-ring need not be assembled to gearcase head for this operation. If shaft appears excessively loose in bushing, head should be replaced. Replacement gearcase head will include new propeller shaft oil seal.

9. In event gearcase head seal is not in otherwise good condition, it must be replaced. Use service tool #377565 SEAL PULLER with either #301927 SEAL EXTRACTOR or #306036 SEAL EXTRACTOR to pull seal. Install new seal, *metal pressing surface out*, flush with start of seal recess.

GEARCASE ASSEMBLY:

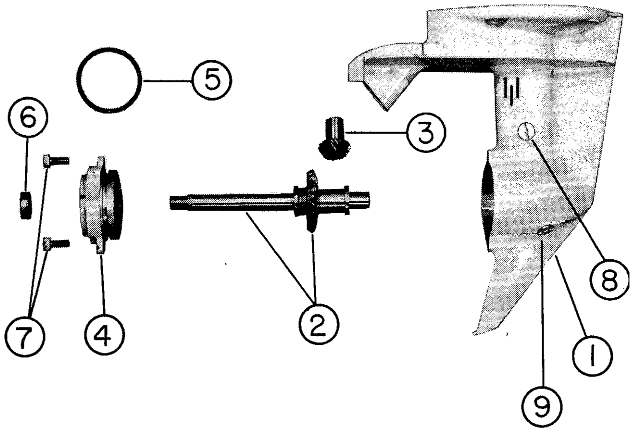


Figure 1A – MODEL JH GEARCASE

1. Gearcase, Exhaust and Seal Assembly.
2. Propeller Shaft, Gear and Bushing Assembly.
3. Pinion Gear.
4. Gearcase Head Assembly.
5. O-Ring – Gearcase Head.
6. Seal – Propeller Shaft.
7. Screw – Gearcase Head.
8. Oil Level and Vent Plug.
9. Drain and Fill Plug.

1. Coat pinion gear bearing surface lightly with OMC Type "C" lubricant and insert it into position in the gearcase (Figure 2).

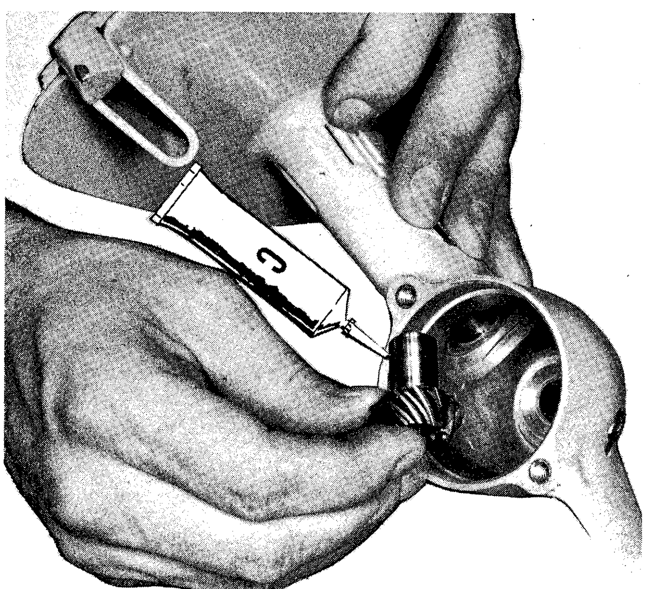


Figure 2

2. Invert gearcase once pinion is installed, and after coating front end of propeller shaft with OMC Type "C" lubricant; install propeller shaft (Figure 3). Turn shaft slightly during installation to engage gear teeth.

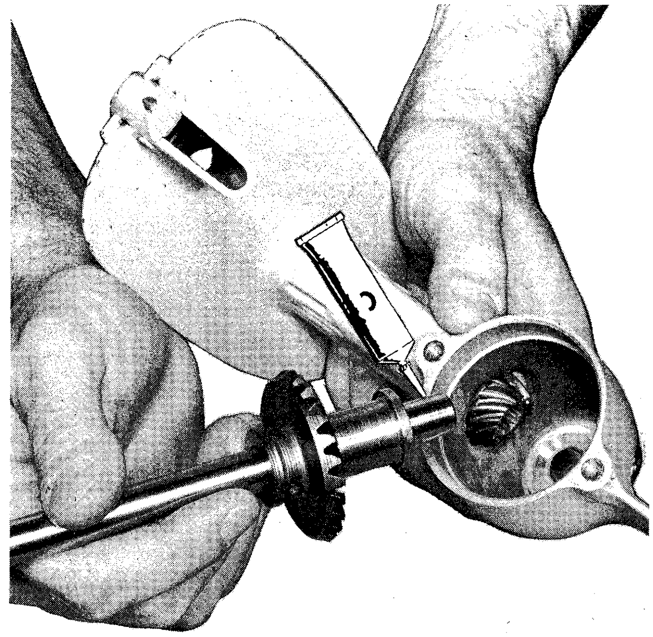


Figure 3

3. Apply light coating of OMC Type "C" lubricant to thrust surface and bearing surface of gearcase head bushing. Assemble O-ring to machined groove of head and install gearcase head with oil hole facing *down* (Figure 4). Install and tighten two gearcase head screws securely.

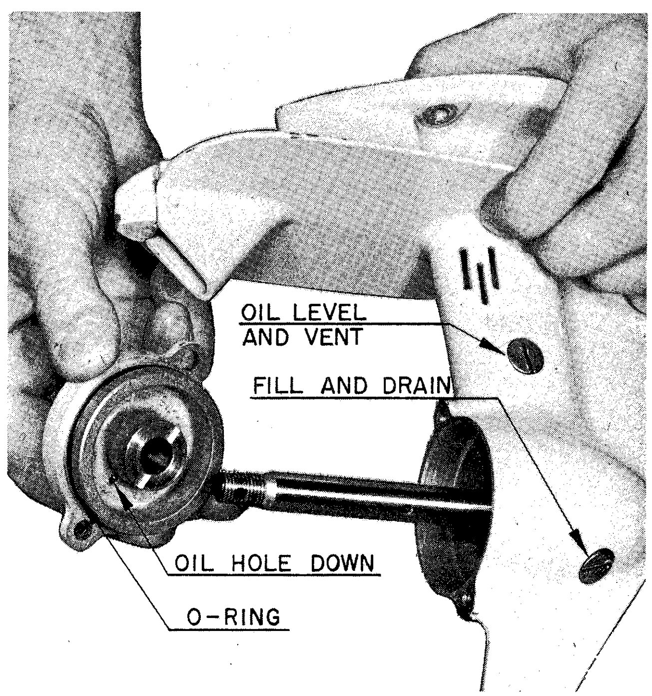


Figure 4

4. **Install PROPELLER,** propeller drive pin, propeller hub washer and propeller nut – drawing nut up snugly. Back nut off until first hole in nut aligns with propeller shaft cotter pin hole. Insert cotter pin through hole and bend ends as shown in Figure 5.

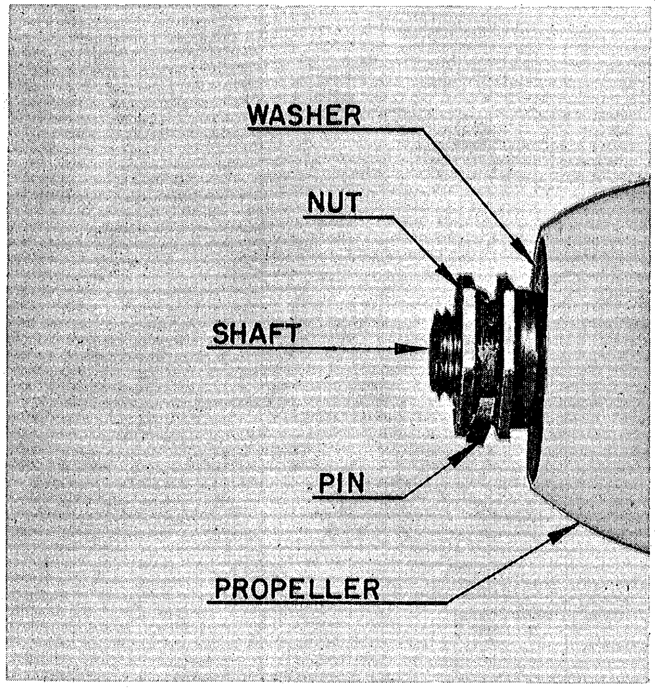


Figure 5

Propeller cap slips over propeller nut so that lip of cap engages slight recess between propeller hub washer and inner edge of propeller nut.

5. Clamp gearcase in suitable holding fixture and assemble water pump impeller plate (plate can only be installed one way). Fit impeller into impeller housing as shown in photo on page 386, then slip driveshaft through impeller and impeller housing holes.
6. Position impeller and housing just above drive pin hole on shaft – insert pin into shaft – and engage drive pin with slot in impeller. While holding impeller in this position slip entire assembly into gearcase being careful not to let drive pin fall out of place.
7. Rotate entire assembly to align impeller housing screw holes with holes in gearcase and bring assembly together. If necessary to turn driveshaft for alignment with splines in pinion gear, turn in *clockwise* direction only.
8. Install and tighten two impeller housing screws securely.
9. Fill gearcase with OMC Type "C" lubricant, following the instructions for gearcase filling on page 368. Tighten vent and fill plugs 4 to 5 foot-pounds.
10. Examine O-ring at top of driveshaft – if worn replace with new. Coat O-ring (assembled in groove) and driveshaft splines with OMC Type "A" lubricant.
11. Proceed to re-assemble gearcase to exhaust housing, working driveshaft splines into engagement with crankshaft splines. As splines engage, carefully push gearcase into position while aligning water tube with grommet in impeller housing (Figure 6). Once tube has been started into grommet, push gearcase firmly into position and install one screw sufficiently to hold gearcase in place. Apply **Perfect Seal** #4 to threads of all four screws used to secure gearcase to exhaust housing and tighten screws evenly – torquing 5 to 7 foot-pounds or 60 to 84 inch-pounds. Use of **Perfect Seal #4** gives accurate torque reading and prevents screw thread corrosion – a must in salt water areas. (Note: Assemble two long screws in rear exhaust housing holes.)

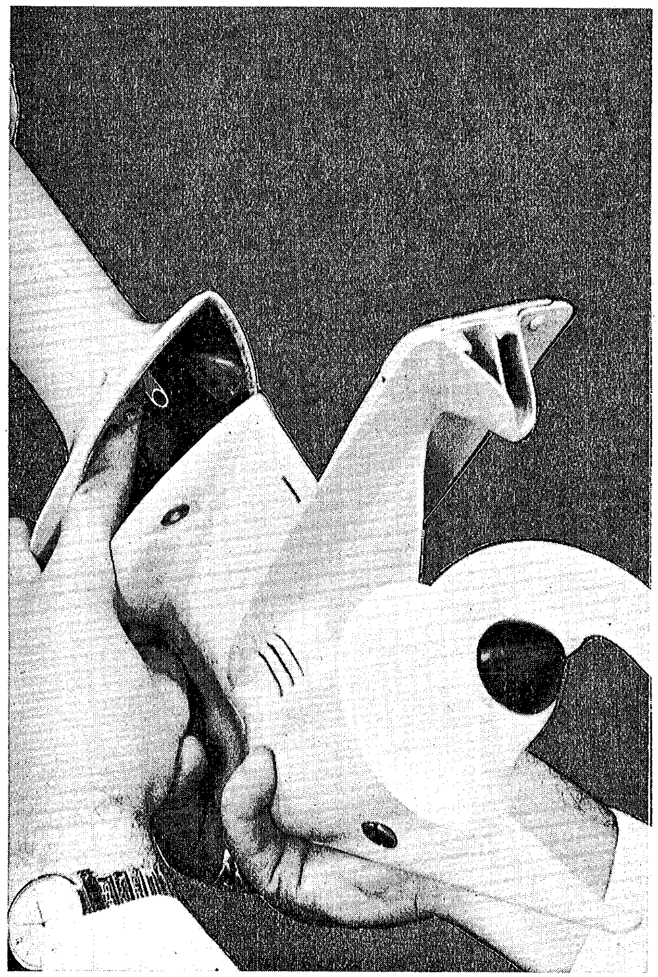


Figure 6

Because the model JW-JH-19 and Up water tube is small in diameter, it will bend rather easily. Therefore, extreme care must be taken during gearcase assembly to guard against tube bending, which could result in loss of or restricted water circulation. Applying a light coating of OMC Type "A" lubricant to the end of the water tube will aid in starting the tube into the impeller housing grommet.

GEARCASE EXHAUST COVER REPLACEMENT:

1. File attaching rivet head flush with casting (Figure 7).

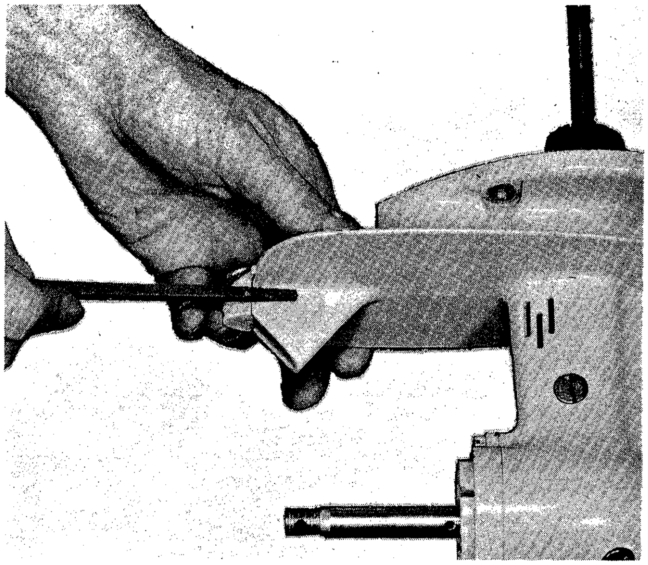


Figure 7

2. Drive rivet from housing using a small diameter punch. Remove exhaust cover and gasket.

   When replacing the gearcase exhaust cover, one of two different thickness gaskets must be used between the cover and gearcase to keep constant tension on the attaching rivet. Should the cover be installed without a gasket or with the incorrect gasket, the rivet could work loose resulting in loss of the exhaust cover.

   Two service gaskets are available for this application: one is 1/32″ thick and listed as part #310806, the other is 3/64″ thick and listed as part #310805. Always install the exhaust cover using the thinner of the two gaskets first (1/32″).

3. Place 1/32″ gasket over exhaust outlet passage (Figure 8) and engage cover's front lip with gearcase, pulling down on cover to align rivet holes. Gasket must be compressed slightly in the process to be suitable for use. If gasket has not been compressed when rivet holes are in alignment, replace 1/32″ gasket with 3/64″ size. After determining which thickness gasket is required, coat both sides of gasket with **Perfect Seal** #4 prior to final assembly.

   NOTE: ONLY ONE GASKET OF CORRECT THICKNESS IS REQUIRED.

4. Tap new rivet into place and peen end of rivet carefully.

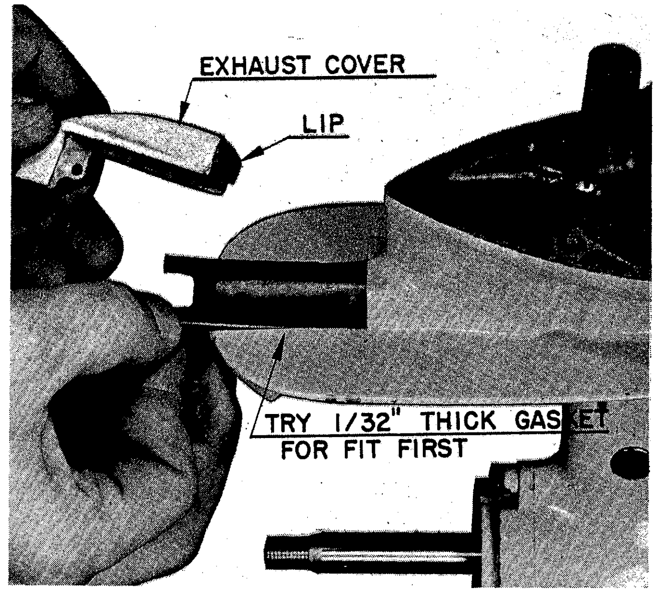


Figure 8

CHECKING OPERATION OF COOLING SYSTEM:

After gearcase has been re-installed, operation of cooling system should be checked to determine if water circulation is adequate, since there may be instances when the water tube has not been properly fitted into the water pump grommet.

One method commonly used to check for water circulation is that of running the engine in a test tank to observe whether or not water spray is being discharged at the exhaust relief openings in the rear section of the exhaust housing. Water spray will not be noted, however, until the engine is turning at least 1000 RPM (throttle quadrant approximately in "start" position) because of exhaust relief chamber design of this new strengthened exhaust housing.

A better method of checking for proper water circulation, however, would involve the use of THERMOMELT STIKS. These stiks are available through **Stevens Experimental Company, 2015 Grand Avenue, Waukegan, Illinois** and are used as follows:

1. Start and run engine in test tank (engine fitted with appropriate test wheel).
2. Allow engine to run at fairly fast idle, until normal operating temperature is reached.
3. Place a 165 degree THERMOMELT STIK against side of cylinder, preferably on serial plug (Figure 9). This stik should not melt, indicating that engine operating temperature is not exceeding 165 degrees.

Do not place THERMOMELT STIKS against the cylinder head of 3 HP engines, since the center of the head will run slightly hotter than 165 degrees fahrenheit.

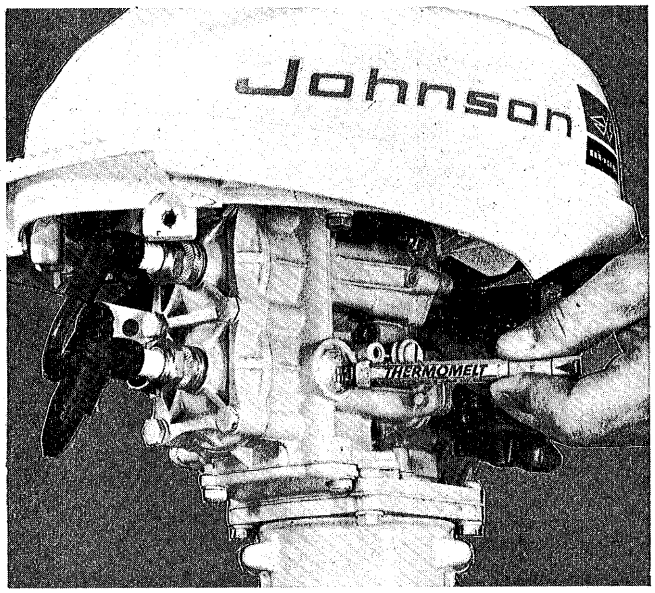
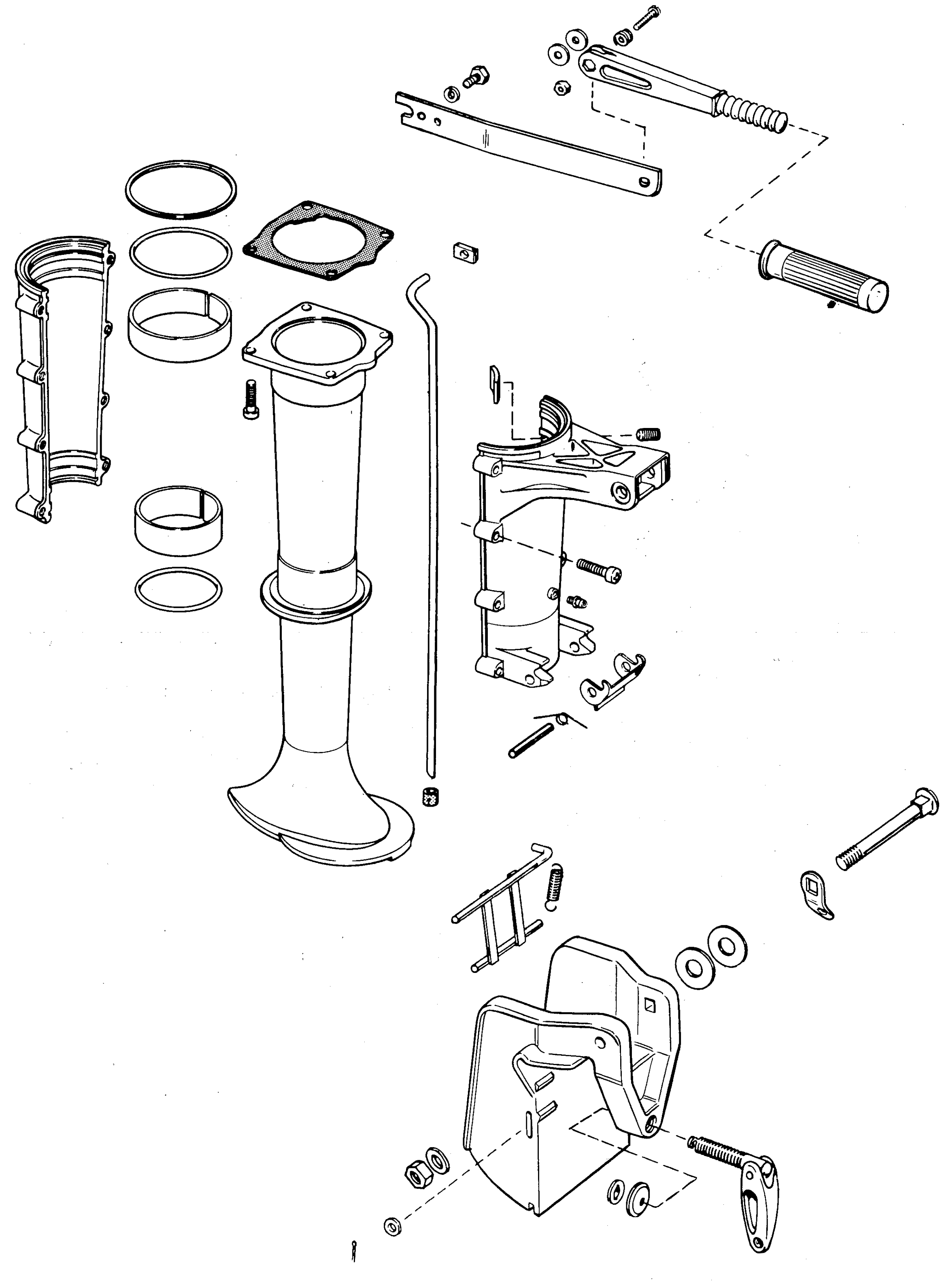


Figure 9

If in concluding the above test, indications are such that proper water circulation through the powerhead is doubtful, remove the gearcase to determine whether or not the water tube has been properly located in the impeller housing grommet. In most instances of inadequate water circulation after gearcase removal, the problem can be traced to an improperly located water tube.

NOTES



Exploded Parts View – Models JW and JH-19 and Up – Exhaust Tube Group.

EXHAUST HOUSING (TUBE) – MODELS JW, JH-19 AND UP

Repair work requiring disassembly of the swivel brackets on the JW, JH-19 and Up series lower unit is accomplished by removing both powerhead (four screws) and gearcase (four screws) from the exhaust tube.

Removal of the lower motor cover prior to powerhead removal permits easy accessibility to the four exhaust tube-to-adaptor plate screws (Figure 10).

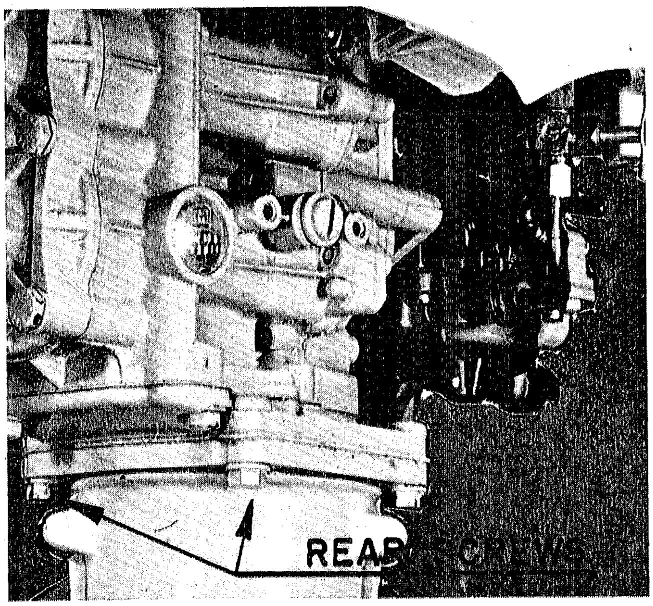


Figure 10

Once the two rear exhaust tube-to-adaptor plate screws have been removed, rotate the entire engine 180 degrees to provide access to the two front adaptor screws. When all four screws are removed, lift powerhead off of exhaust tube (Figure 11). Water tube will usually be lifted out of the exhaust tube with the powerhead.

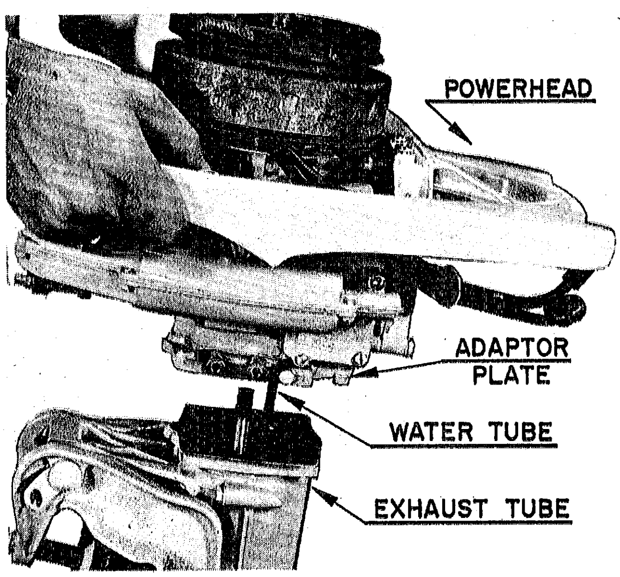


Figure 11

Proceed to remove gearcase (four screws, Figure 12).

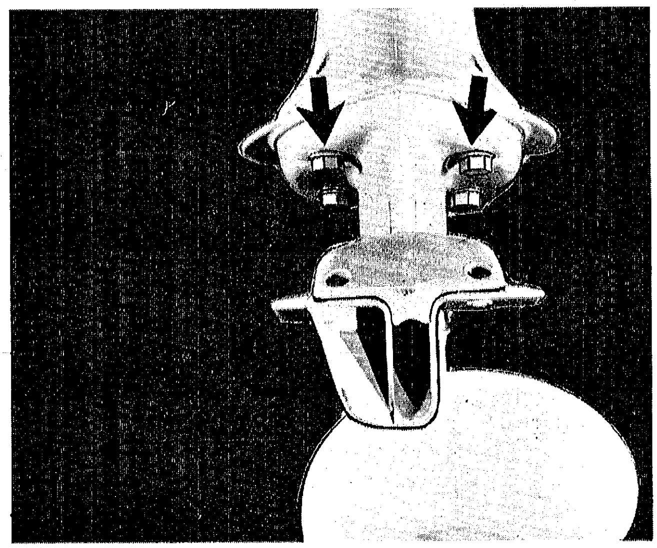


Figure 12

Swivel bracket and exhaust tube assembly can now be detached from the stern bracket by removing the long tilt bolt.

Little, if any, service should be required on the stern bracket assembly with the exception of possible clamp screw replacement. Use special tool #302435 CLAMPSCREW ASSEMBLY FIXTURE to assemble retainer to clampscrew and button.

SWIVEL BRACKET DISASSEMBLY

1. Remove eight screws securing swivel bracket halves and completely disassemble swivel bracket and exhaust tube. Wash all metal parts thoroughly in cleaning solvent and blow dry with air nozzle. Wipe all non-metal parts clean with a cloth. Inspect all parts for wear.

Because of sealed swivel bracket design, little or no wear should occur with this assembly, providing, of course, that recommended lubrication intervals have been observed. However, in the event some part has worn beyond acceptable standards, it should be replaced. Should swivel bracket replacement be required, both new halves (front and rear) must be installed, since the swivel bracket halves are machined and serviced in matched pairs only.

SWIVEL BRACKET ASSEMBLY

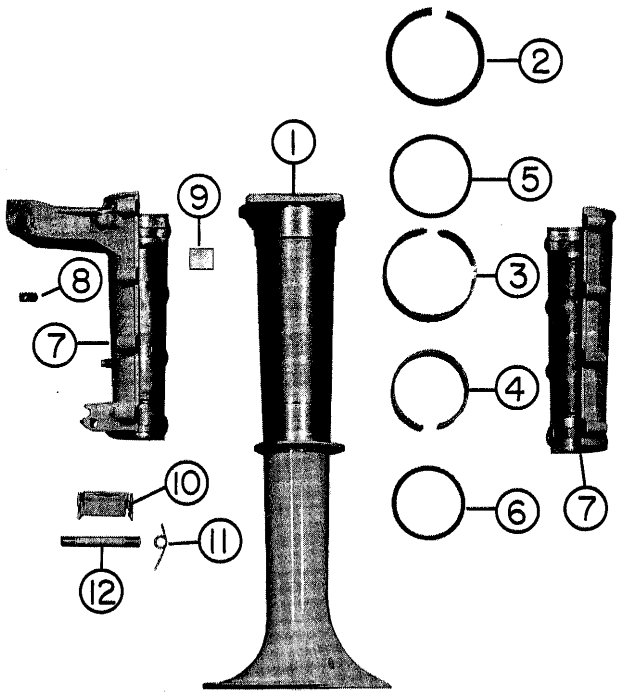


Figure 12A – MODEL JW, JH-19 AND UP – EXHAUST HOUSING GROUP

1. Exhaust Housing (tube).
2. Thrust Washer.
3. Upper Lining.
4. Lower Lining.
5. Upper O-Ring.
6. Lower O-Ring.
7. Swivel Bracket.
8. Friction Screw.
9. Friction Block.
10. Reverse Lock.
11. Reverse Lock Spring.
12. Reverse Lock Pin.

1. Assemble upper and lower O-rings to exhaust tube – over top flange (Figure 13).

Figure 13

2. Install upper and lower linings, coating both sides of each lining with OMC Type "A" lubricant. Install thrust washer, coating washer with OMC Type "A" lubricant.
3. Carefully align O-rings, thrust washer and linings to match location of machined recesses in the rear swivel bracket half and fit the rear bracket to the exhaust tube (Figure 14).

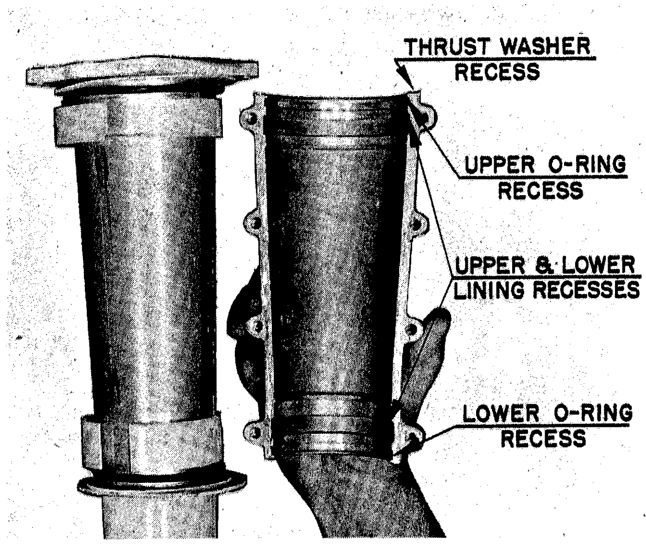


Figure 14

REVERSE LOCK replacement is accomplished by driving the reverse lock pin from the front swivel bracket half with an appropriate size punch. The reverse lock and its tension spring can be serviced once this pin is removed.

To assemble the reverse lock assembly, lay both reverse lock and spring in position and drive reverse lock pin into place (Figure 15), starting from side of housing opposite spring. Reverse lock pin is a press fit into the swivel bracket.

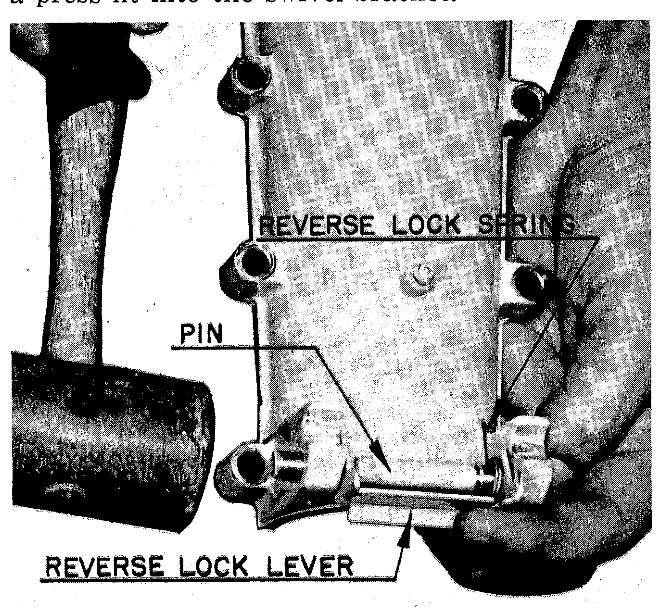


Figure 15

4. Coat matching surface of front swivel bracket half with **SEALER 1000** prior to assembly (Figure 16), to guard against water entry between these two machined surfaces. Once coated with sealer, fit the front swivel bracket half to the rear half quickly as **SEALER 1000** dries rapidly. It is also best to be sure O-rings, thrust washer and linings are properly arranged for assembly as shown in Figure 17 prior to coating front bracket with sealer so that no time is lost during the fitting operation.

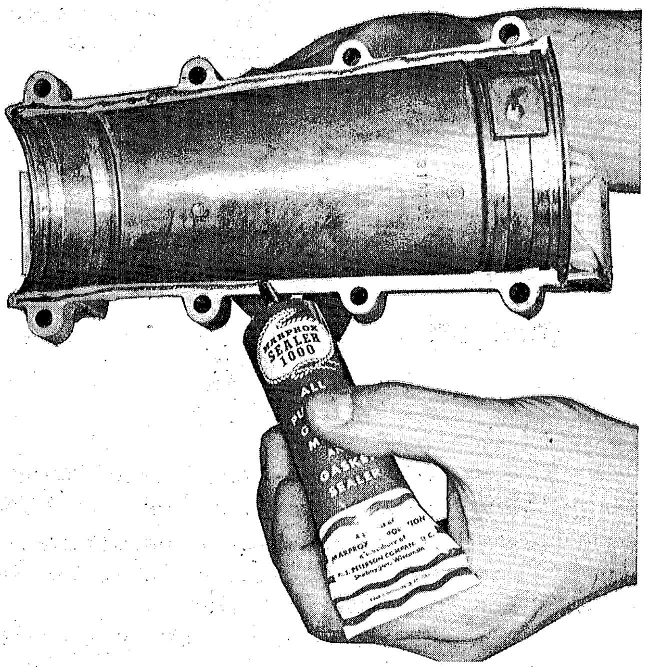


Figure 16

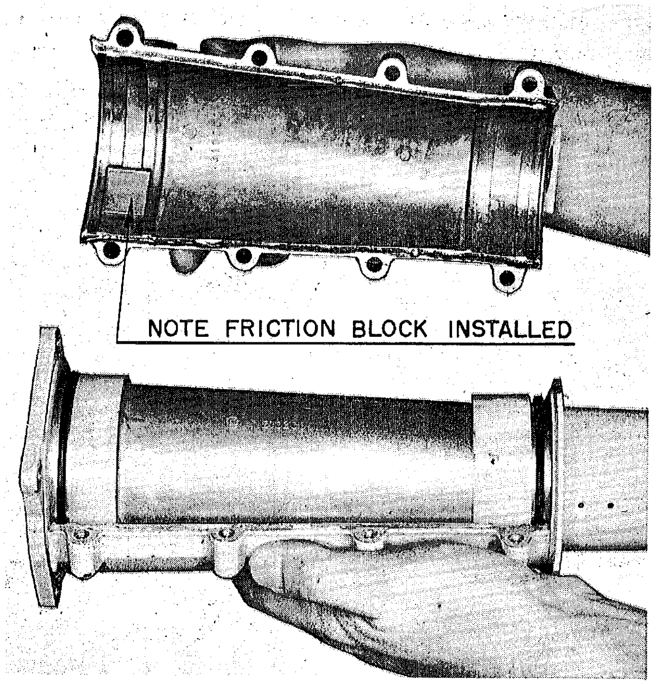


Figure 17

5. Tighten eight swivel bracket screws evenly and securely.
6. Install swivel bracket assembly to stern bracket, drawing tilt bolt nut up snug but not too tight.
7. Install a new gasket (Figure 18) between exhaust tube and powerhead adaptor plate, making sure protruding tab is positioned over water tube grommet (item 1, Figure 19) located in adaptor plate.

   Check position of water tube in adaptor plate prior to installing powerhead, making certain there is adequate clearance between the opening in the end of the tube and the wall of the adaptor plate (arrow A, Figure 19) for unrestricted water flow. Note that this end of the water tube is bellmouthed to prevent it from slipping out of the rubber grommet.
8. Assemble powerhead and water tube to exhaust housing simultaneously, guiding lower end of water tube into exhaust tube carefully.
9. Install and secure four exhaust housing-to-adaptor screws. Tighten these screws evenly to prevent water leaks at the gasket.
10. Install gearcase in manner described on page 388-4. Check for adequate water circulation in powerhead when this operation is complete.

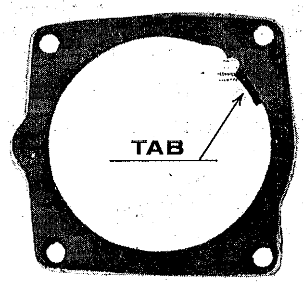


Figure 18

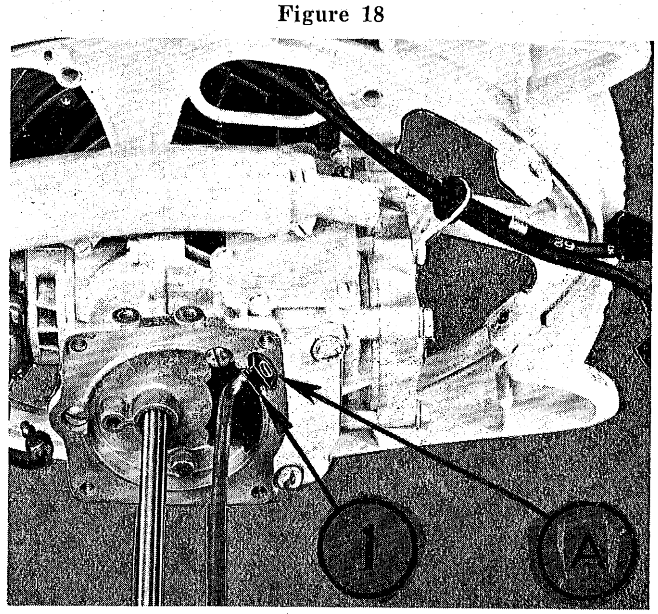


Figure 19

ADJUSTING TILT BOLT TENSION

Tighten tilt tension nut only enough to maintain motor in any tilt position (Figure 20), so that slight push by hand against top of motor is sufficient to return motor to vertical position.

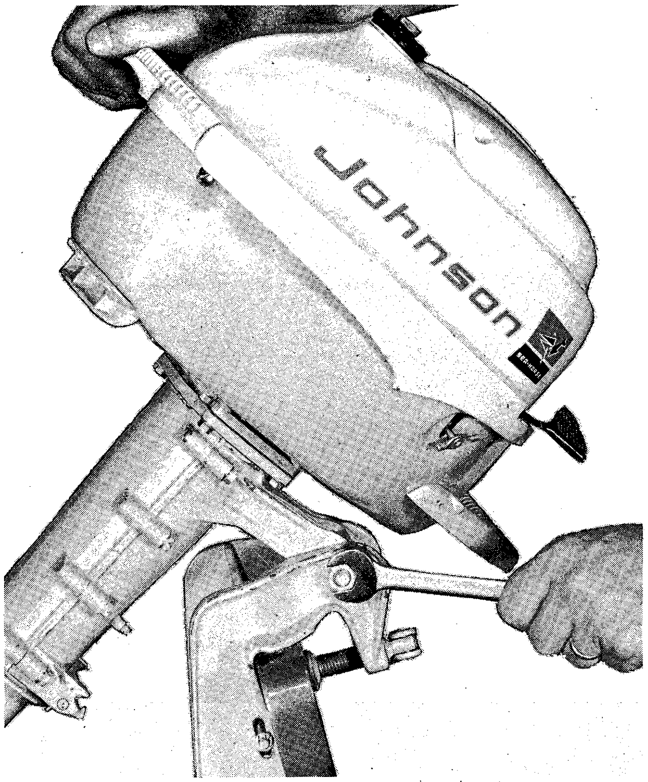


Figure 20

GREASING PIVOT BEARINGS AND ADJUSTING STEERING TENSION

1. Remove friction screw (insert, Figure 21) before greasing swivel bracket to vent pivot bearing cavity.
2. Using grease gun, fill cavity with OMC Type "A" lubricant. Stop filling when lubricant starts discharging from friction screw hole.
3. Insert and tighten friction screw so that a slight drag is felt when turning motor.

A small piece of nylon has been inserted into the steering friction screw (examine screw closely) to prevent the screw from backing out once the proper amount of steering friction has been adjusted. This nylon insert creates a slight amount of friction between the threads of the screw and the matching threads in the swivel bracket. Frequent removal will wear the nylon insert to a point where it is no longer effective in holding the screw. Because of this, remove the steering friction screw as little as possible. When resistance to turning can no longer be felt with this screw, replace it with service part #310266 SCREW.

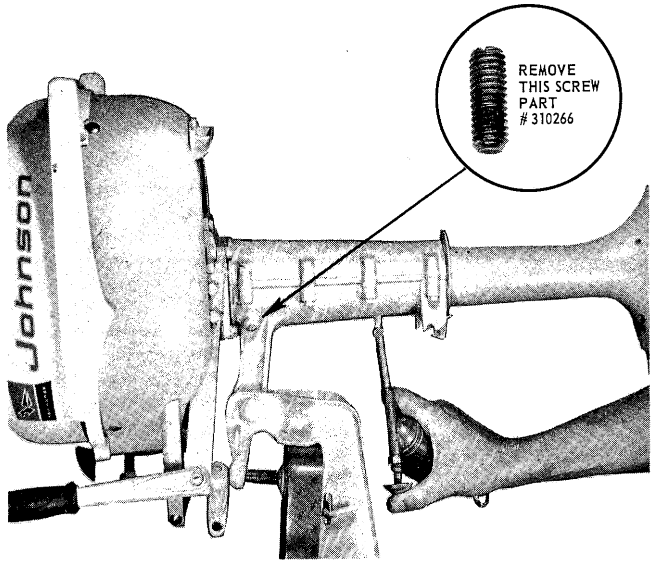


Figure 21

NOTES

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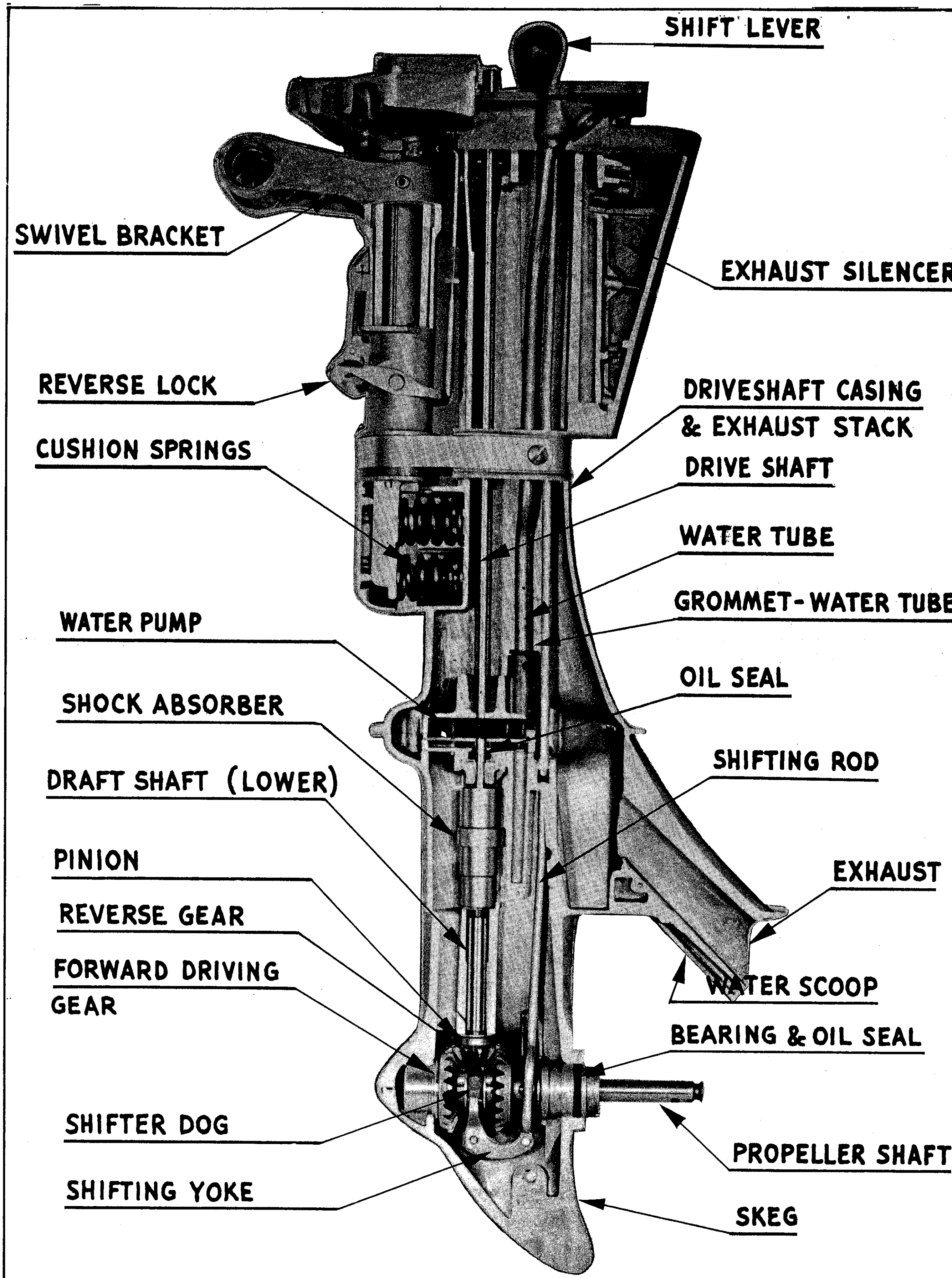
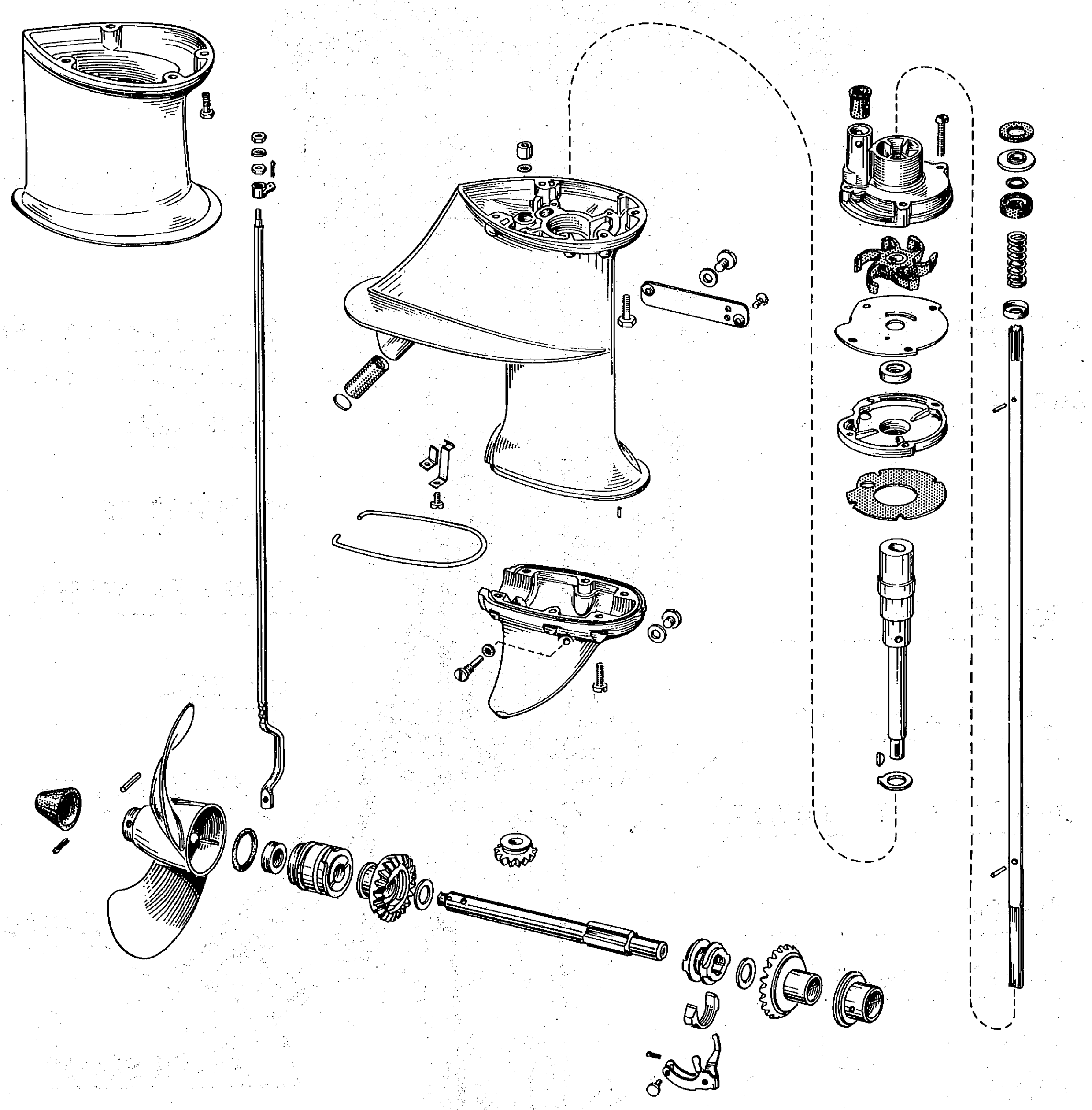
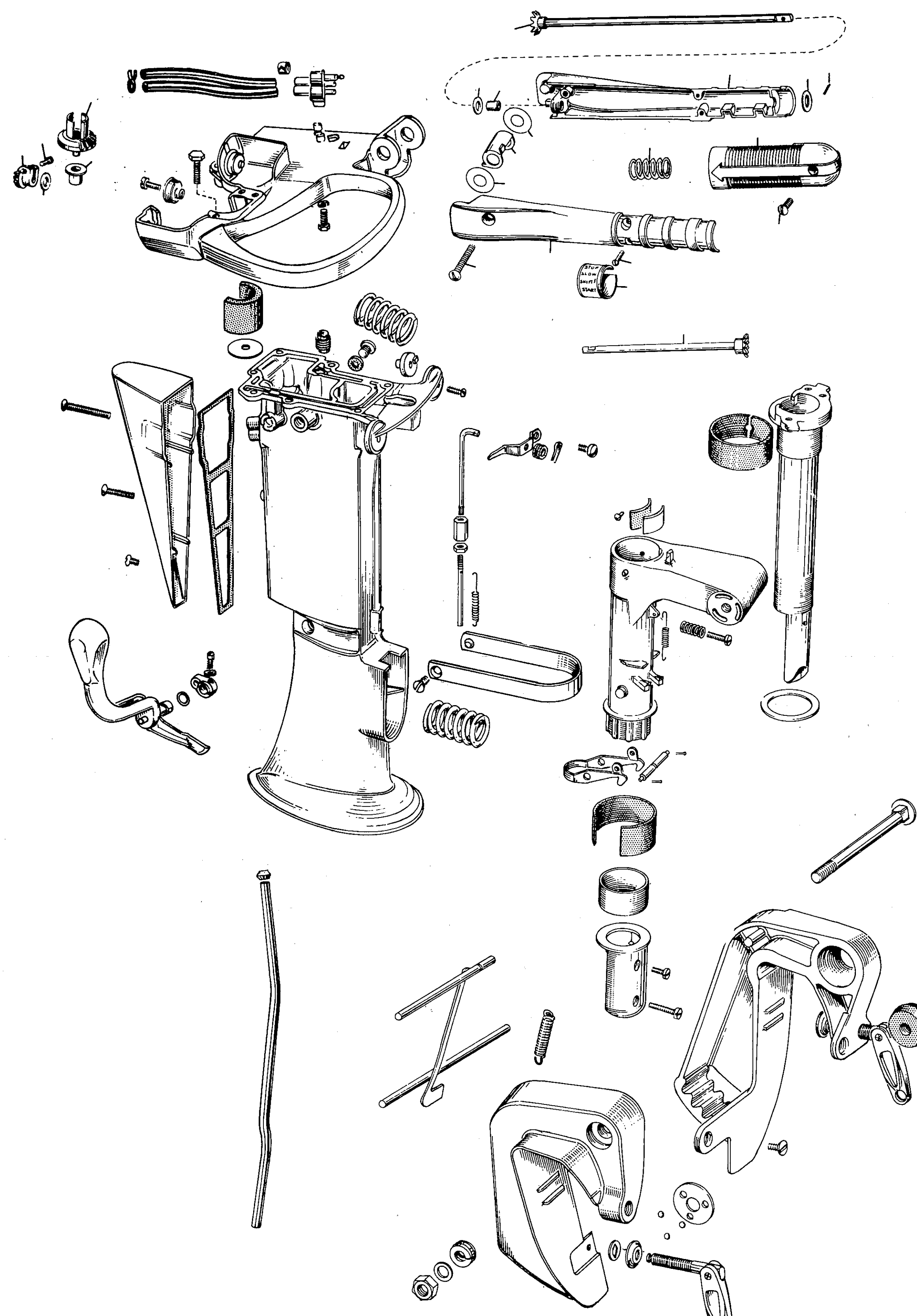


Sectionalized View of the Lower Unit – Models CD-10, 11 and 12.

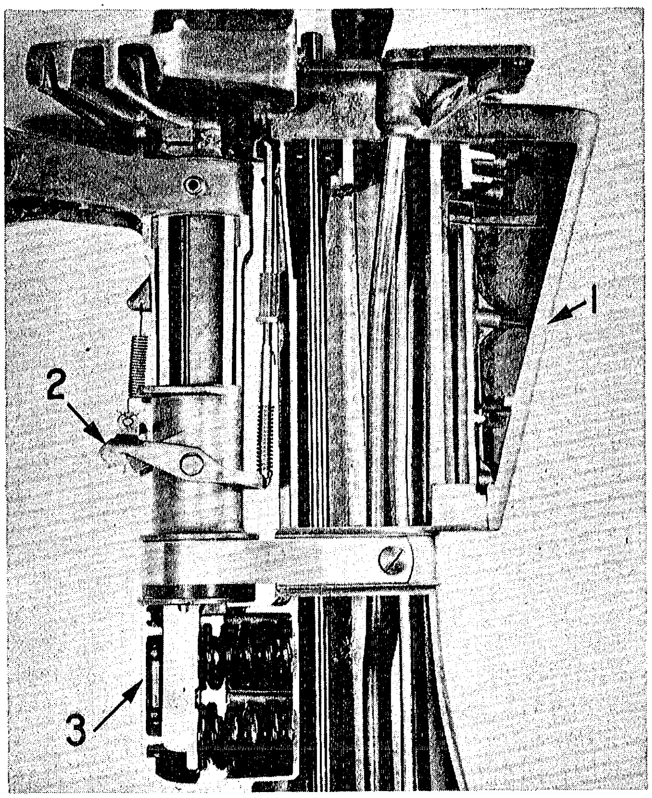


Models CD-10, 11 and 12 Gearcase Group

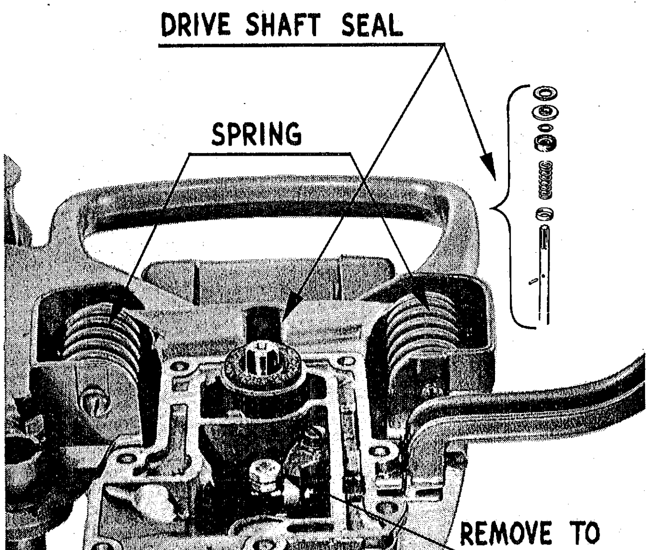


Models CD-10, 11 and 12 Stern Bracket, Exhaust Stack and Steering.

LOWER UNIT



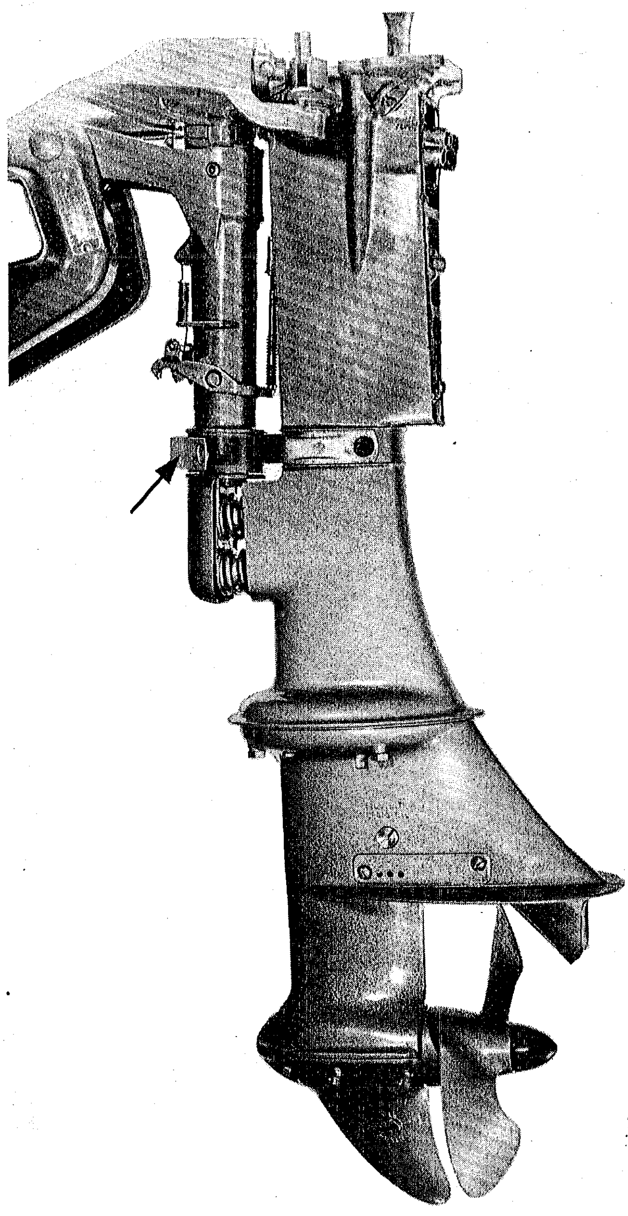
Upper section (sectionalized) of the lower unit showing (1) the muffler silencer, (2) the reverse lock and (3) cushion mount springs, which absorb shock of power impulses.



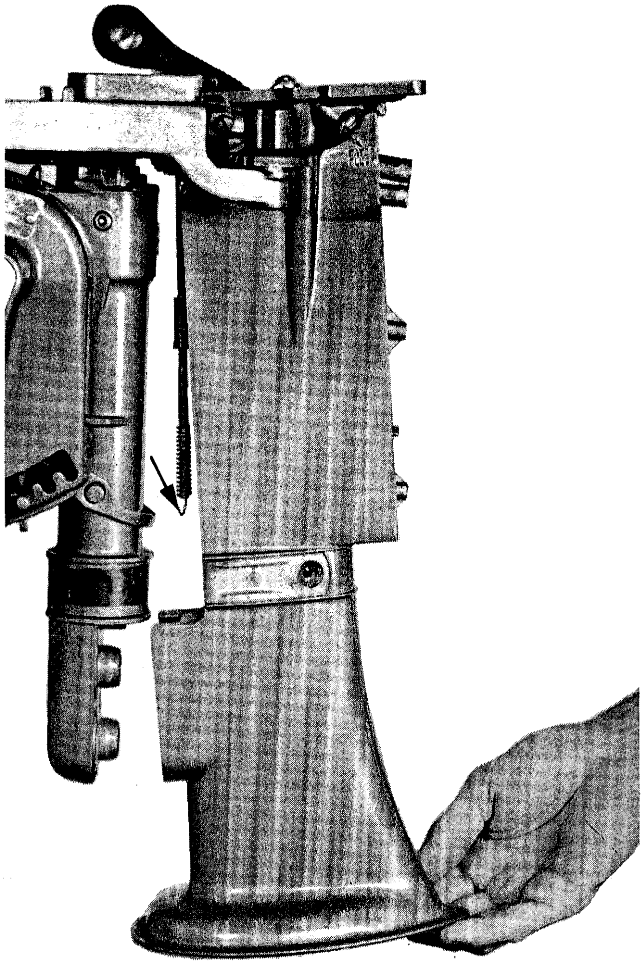
Showing top end of the lower unit, exposing the driveshaft and seal assembly, the shift rod lever and securing nuts and the cushion mount springs. Arrow indicates position of seal on the driveshaft and assembly lay-out to the right. To detach the shift rod as required when removing the gearcase, remove both nuts holding rod fast to the shifting lever swivel. Replace in reverse order. Springs are employed to absorb torque impulses created by the Power Head. Note—Always install a new cork washer (No. 303355)—top of crankshaft seal assembly when removing and prior to replacing the Power Head.

The Model CD lower unit is of simple but sturdy construction and built along conventional lines as employed in other models, except that cushion mounting and an exhaust expansion or silencing chamber — attached to the exhaust stack — have been included to reduce audible operating noises to a minimum. Cushion mounting minimizes sounding board effect of the transom to which the motor is attached while the exhaust silencer acts to reduce the staccato effect of exhaust discharge.

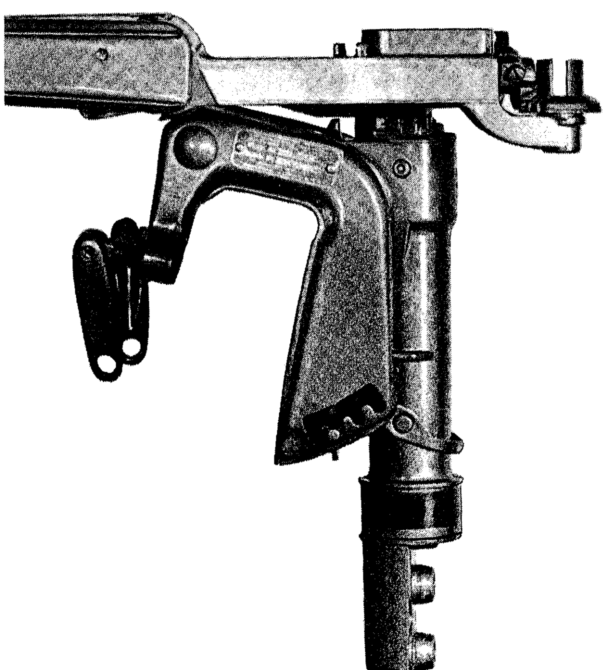
A gear shifting arrangement—forward, neutral and reverse is provided. See page 407 and a Vari-volume pump for cooling purposes. See page 408. A propeller shock absorber is built into the drive-shaft assembly—Maintenance and assembly operations are not difficult to perform—Note details of construction as they appear in sectionalized view of the lower unit assembly on page 389.



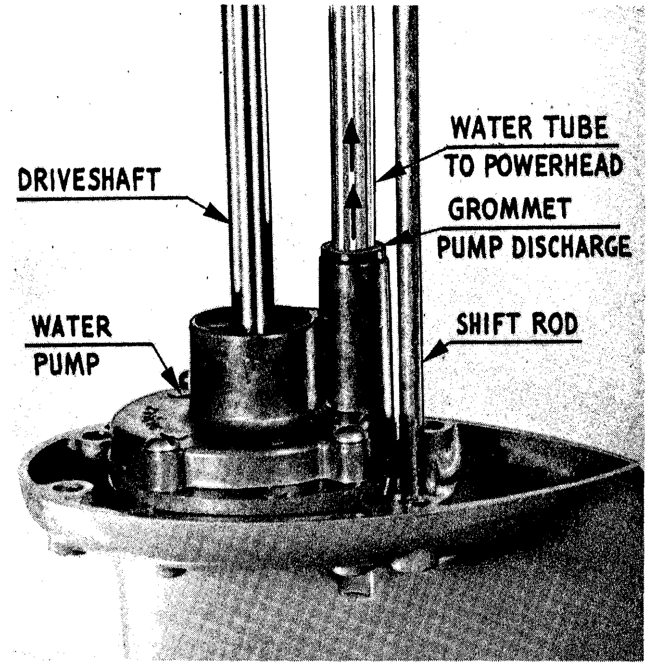
To detach gearcase-driveshaft casing assembly from the swivel bracket, remove band indicated by the arrow.



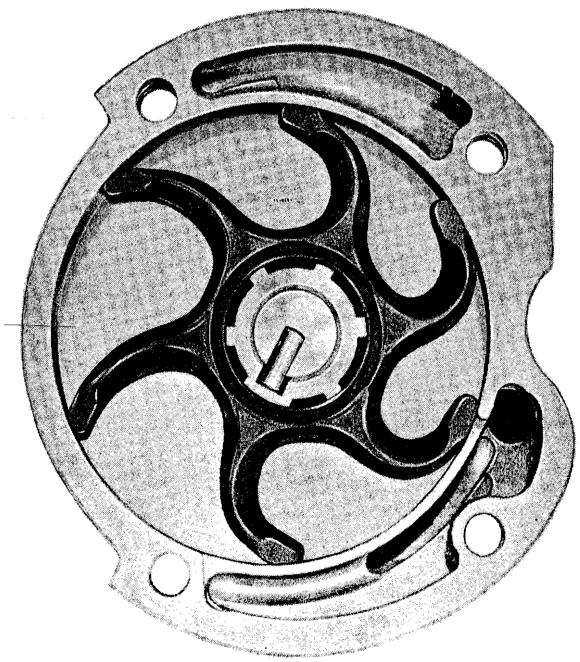
To detach driveshaft casing-exhaust stack from the swivel bracket, tilt with hand as shown, then lift up with "twisting" motion to free it from the torque springs on top end after disconnecting the reverse lock.



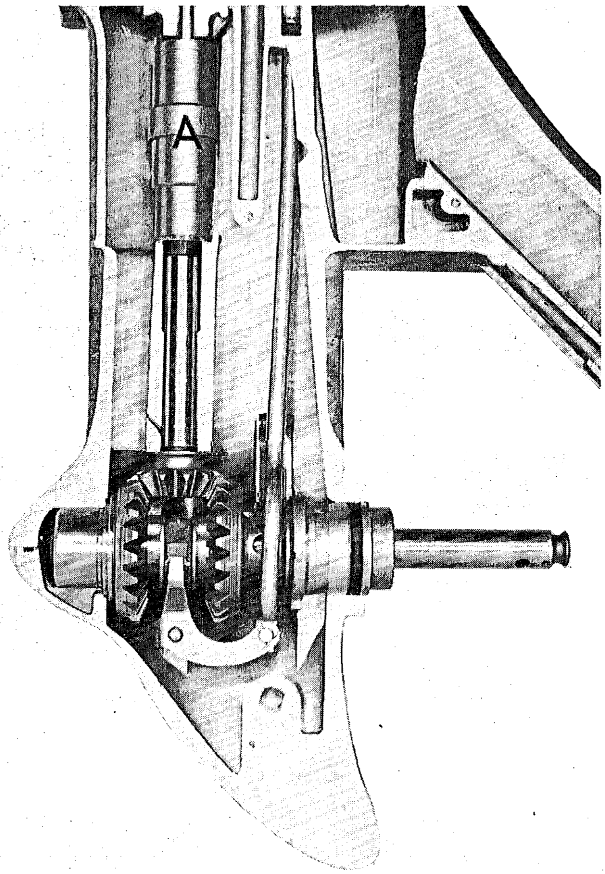
Showing stern and swivel bracket assembly after detaching the driveshaft casing and gearcase



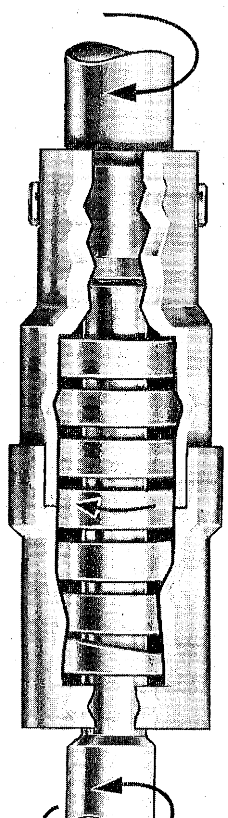
Showing location of the Water Pump



Showing the pump assembly — driveshaft, impeller and pump housing. See explanation of the Vari-Volume pump on page 431.

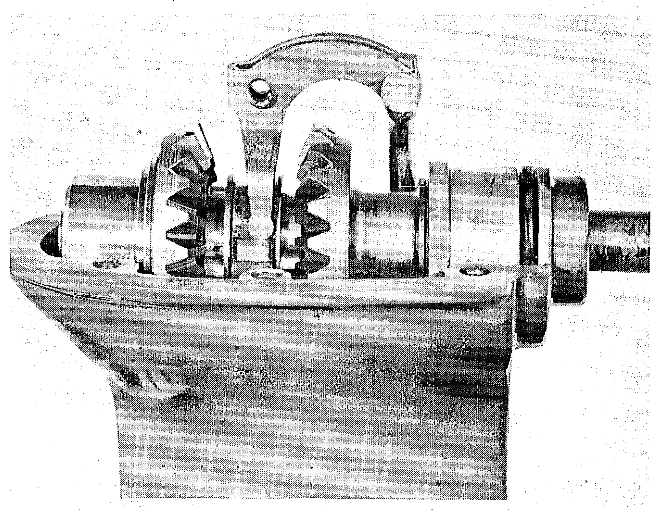


Sectionalized view of the gearcase showing gearshifting mechanism and the shock absorber "A"

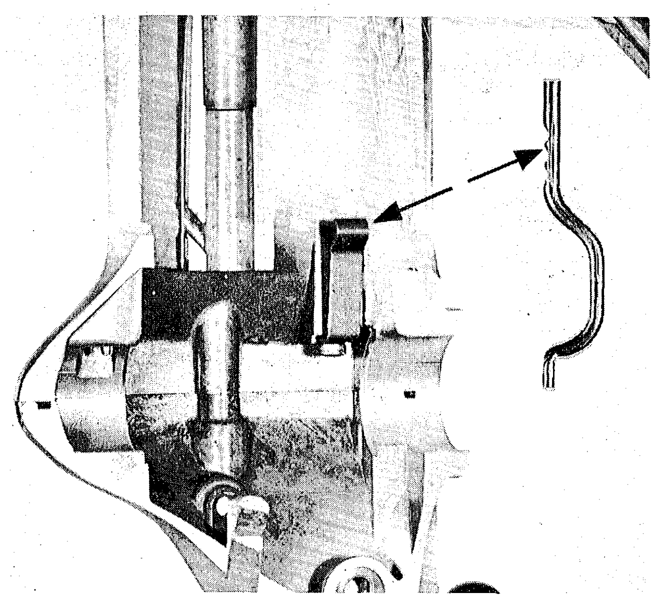


Sectionalized view of the Shock Absorber Assembly

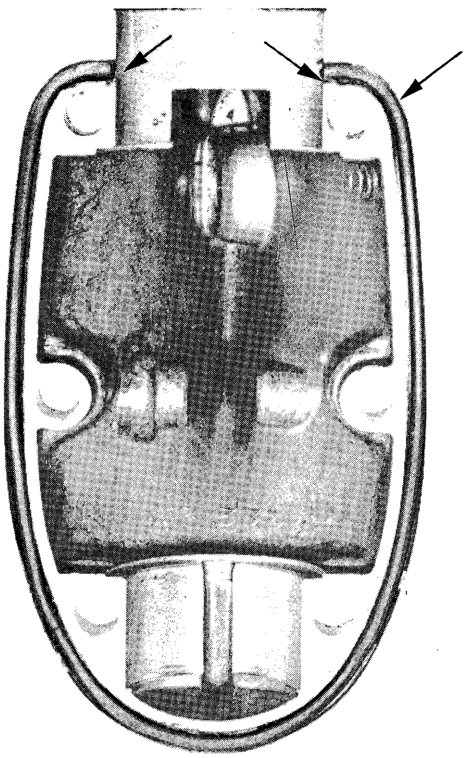
The shock absorber consists of two sleeves "riding" together, one keyed to the upper driveshaft, the other keyed to the lower driveshaft. As will be seen in the illustration, a spring of predetermined tension is inserted within the sleeves with tension bearing against the inner walls. Under ordinary operating conditions, the assembly turns as a unit to drive the propeller. However, on striking an underwater obstruction, the spring is caused to "coil" slightly; in doing so, outside diameter of the spring is reduced just enough to permit "slippage" between the spring and sleeves. On release of obstruction the spring returns to normal diameter and "drives" against inner walls of both sleeves to resume turning as a unit. The shock absorber requires no attention—replacement only in the event of failure.



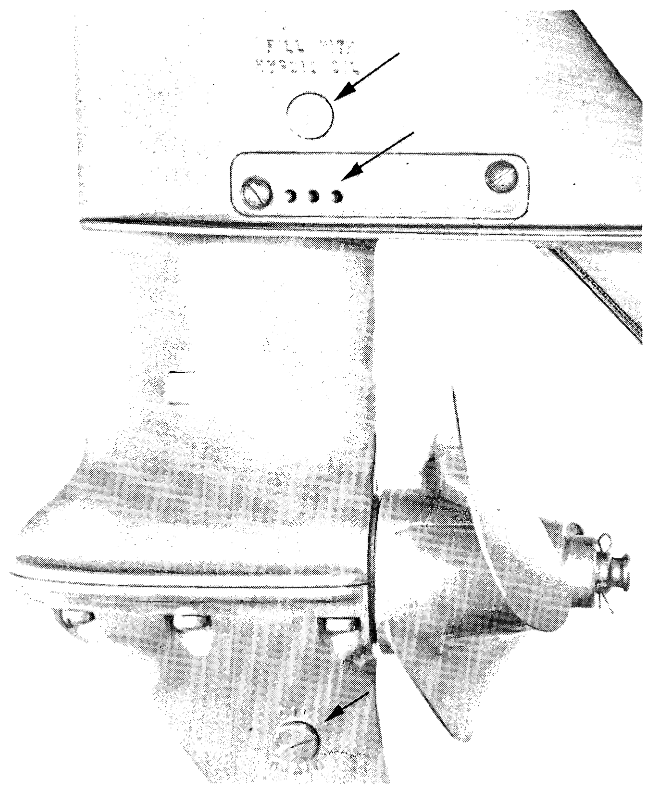
Skeg removed exposing Gear Shifting Mechanism



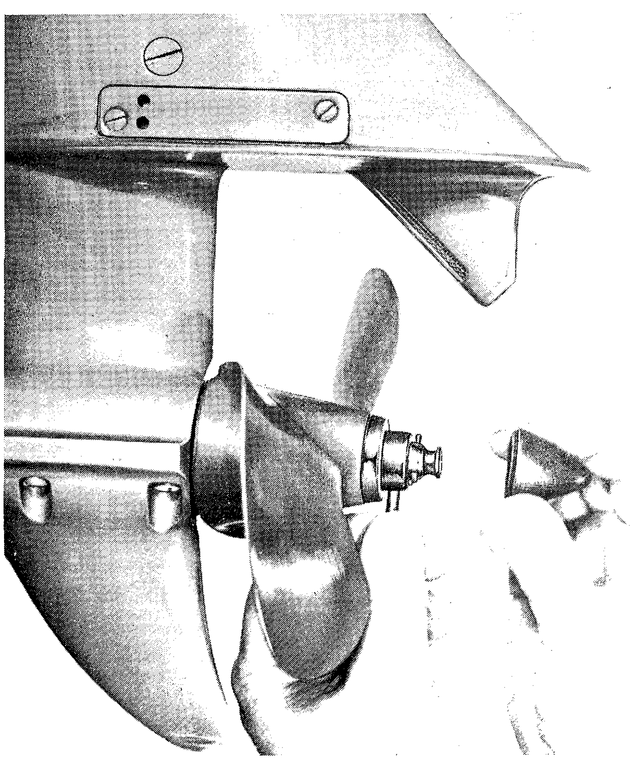
Sectionalized view of the gearcase showing spring ratchet which engages detents in the shifting rod to assure position of the shifter dog when engaged at forward, neutral, or reverse, as the case may be.



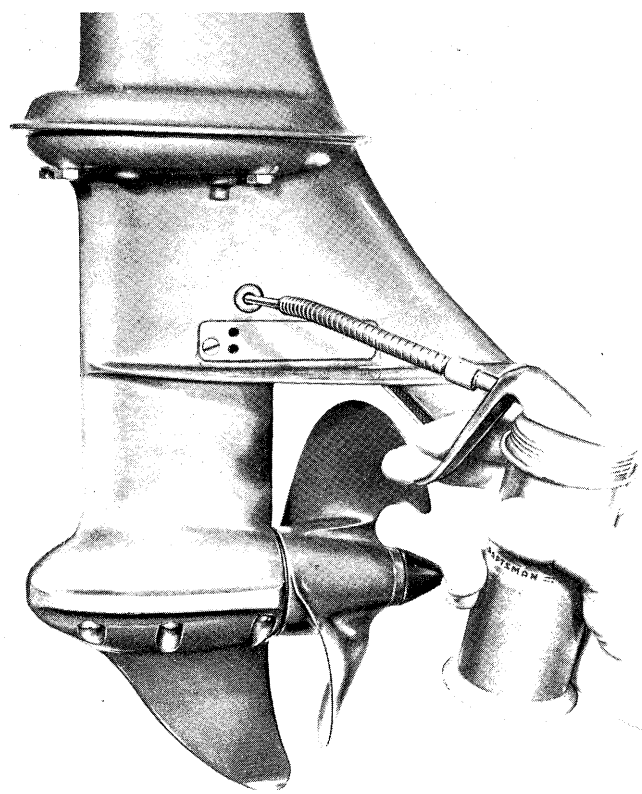
Top face of the gearcase skeg showing installation of seal strip. See explanation and installation instructions, page 433.



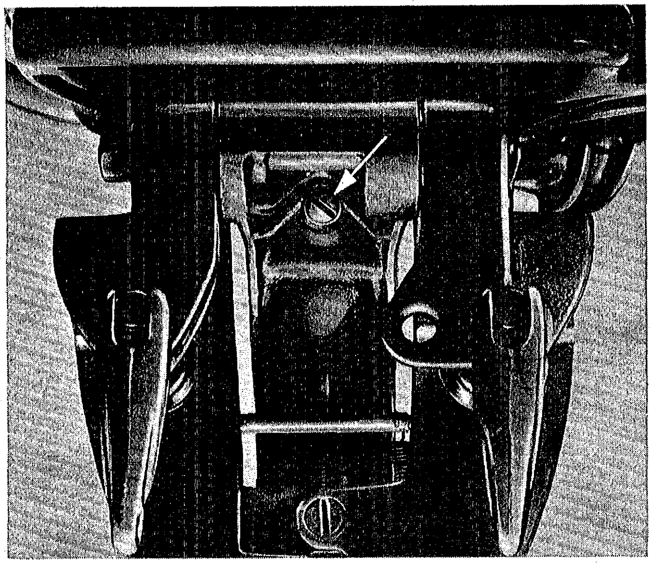
Holes in the rectangular plate attached to the gearcase are provided to insure ample water entrance for cooling when operating in reverse. Shown also are the drain and fill plugs (OMC Type "C" Lube) in the gearcase.

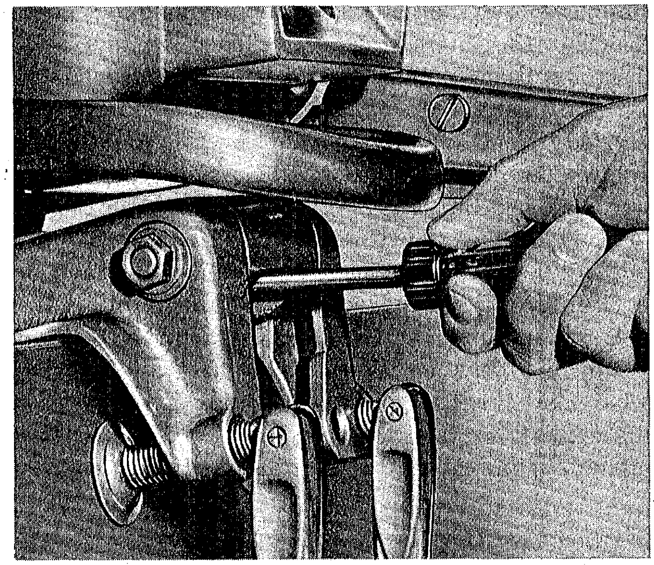


Removing and/or replacing the Propeller Drive Pin



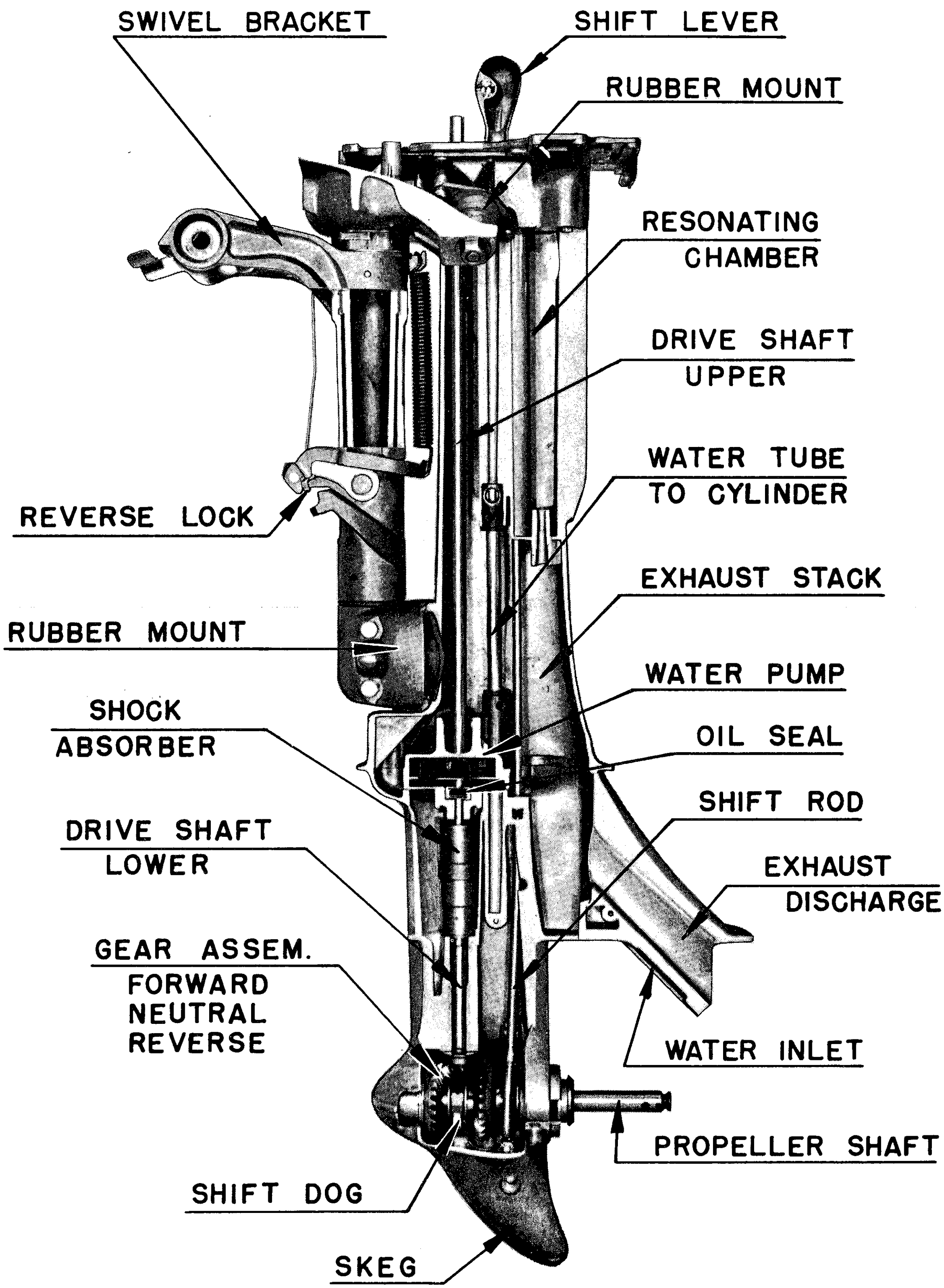
Inserting Type "C" Gear Lube – Fill to Point of Overflow.


Arrow indicates Screw for Adjusting Tension of Steering

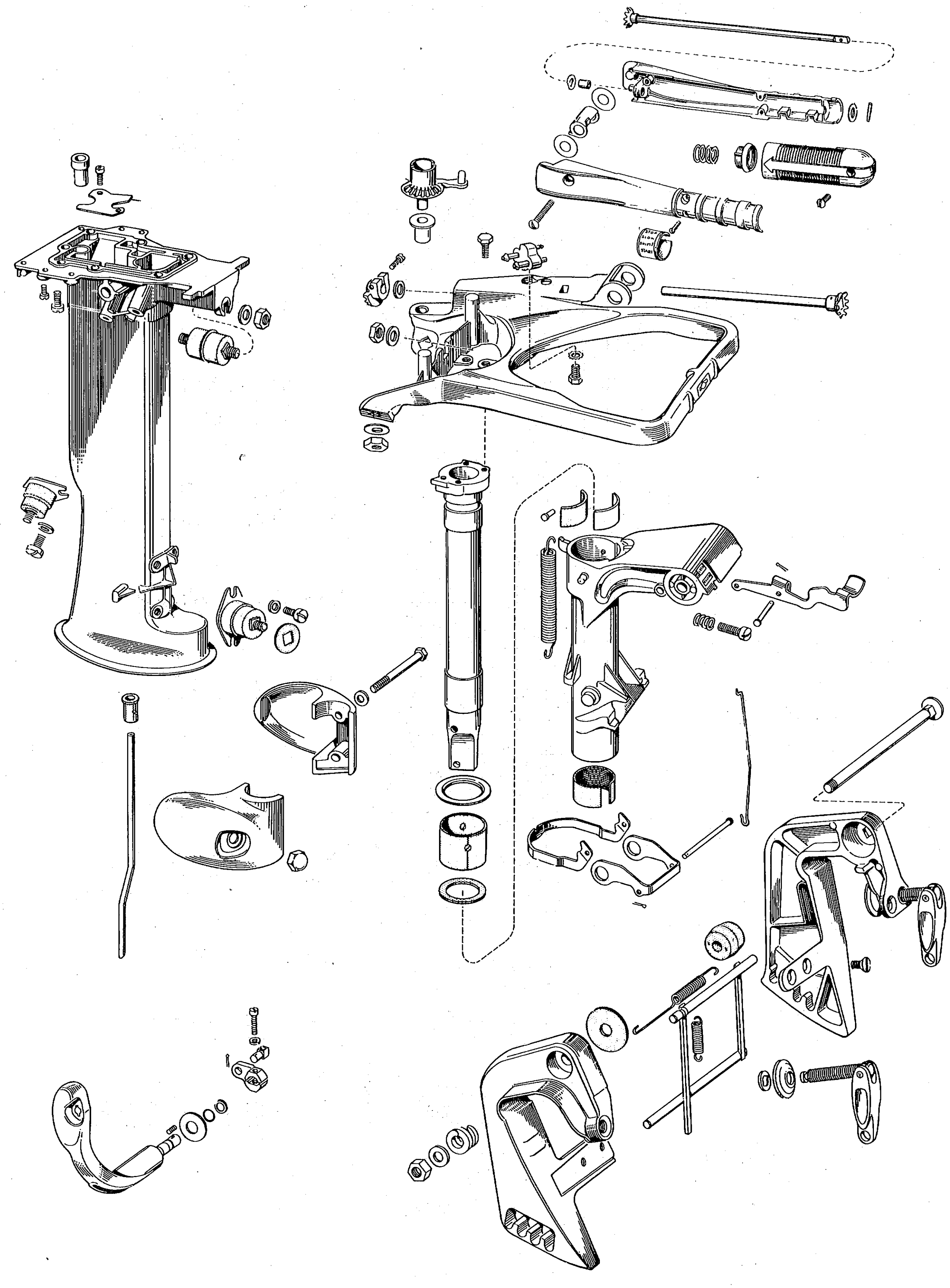

Adjusting Tension of Steering

NOTES

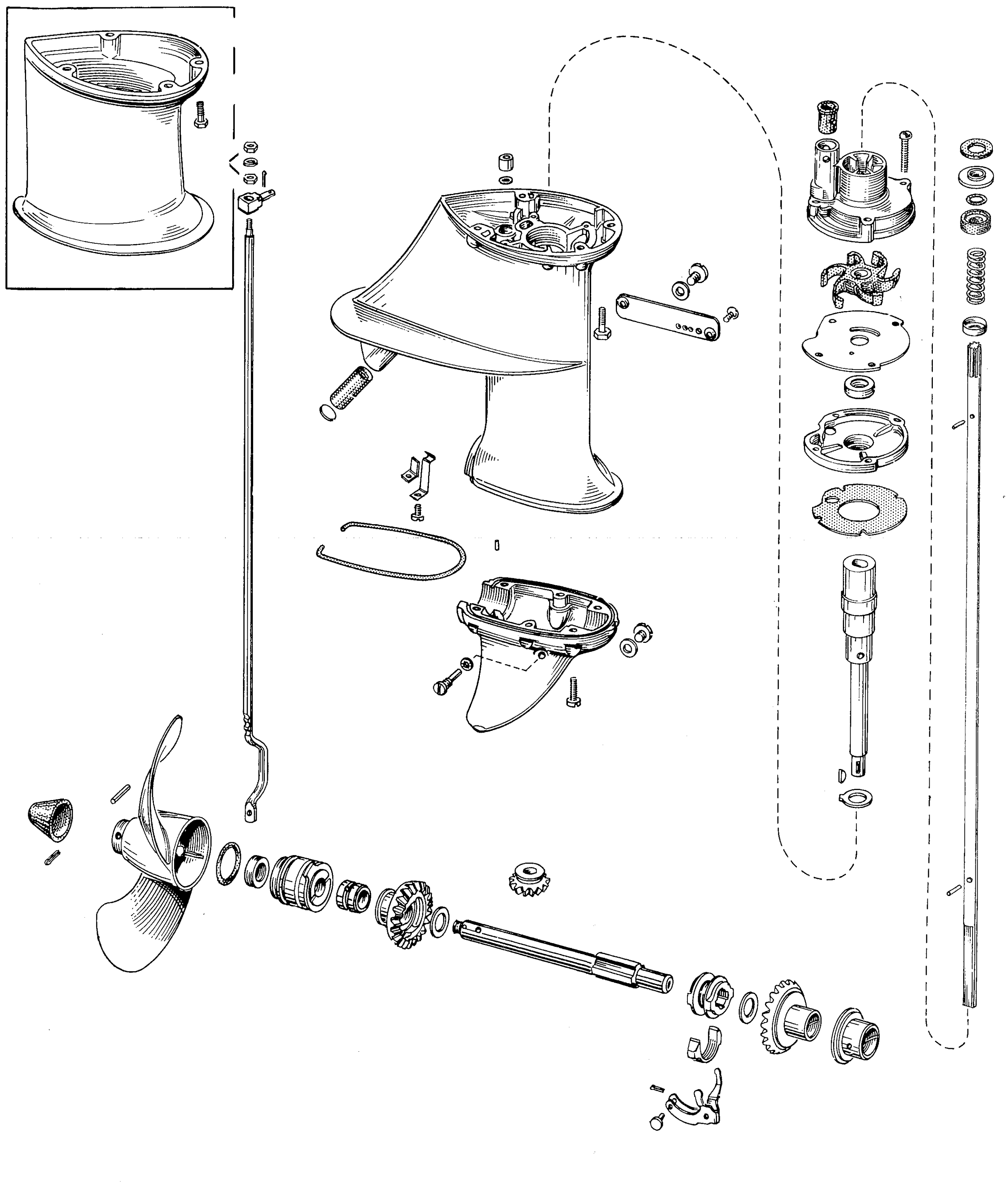
LOWER UNIT – MODELS CD AND AD



Sectional View – Lower Unit Models CD-13 Up and AD Series.



Extended View – Exhaust stack, steering, swivel and stern bracket group – Models CD-13 Up and AD Series.



Extended View – Gearcase Group – Models CD-13 Up and AD Series.

NOTES

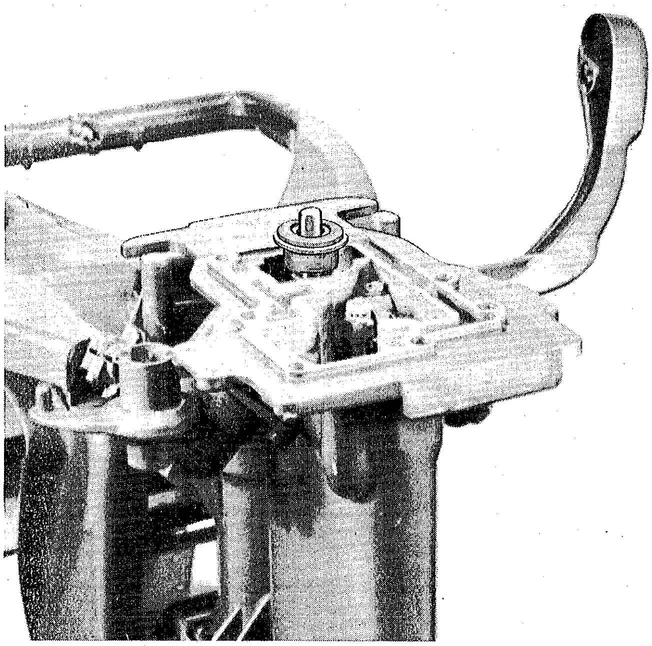
NOTES

LOWER UNIT — MODELS CD-13 UP AND AD SERIES

Since lower unit design and construction for Models CD and AD are basically alike (except for minor details) the illustrations, comment and references below will serve as a guide to general maintenance and repair.

Both units include rubber mount facilities, gear shift arrangement — see pages 431 and 440. Water pump — for explanation see page 408, illustrating water channels for circulation. The Models CD and AD gearcase contain a shock absorber clutch — see description, page 406.

Procedure illustrated and described below is for replacing the steering and/or swivel bracket without necessarily detaching the powerhead from the lower unit proper — a time saving operation.



Showing the lower journal bearing oil seal exposed on detaching the Powerhead (Model AD and like that employed on the Model CD).

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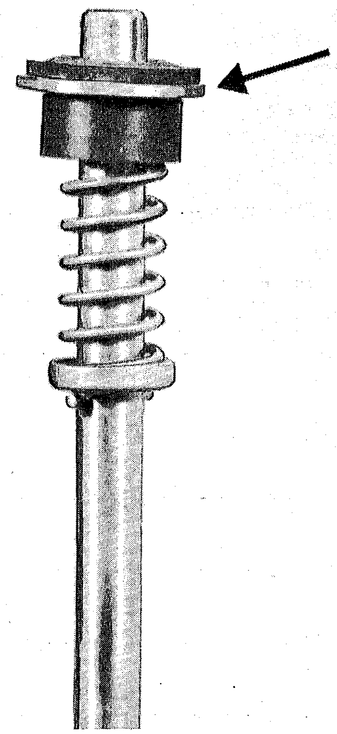
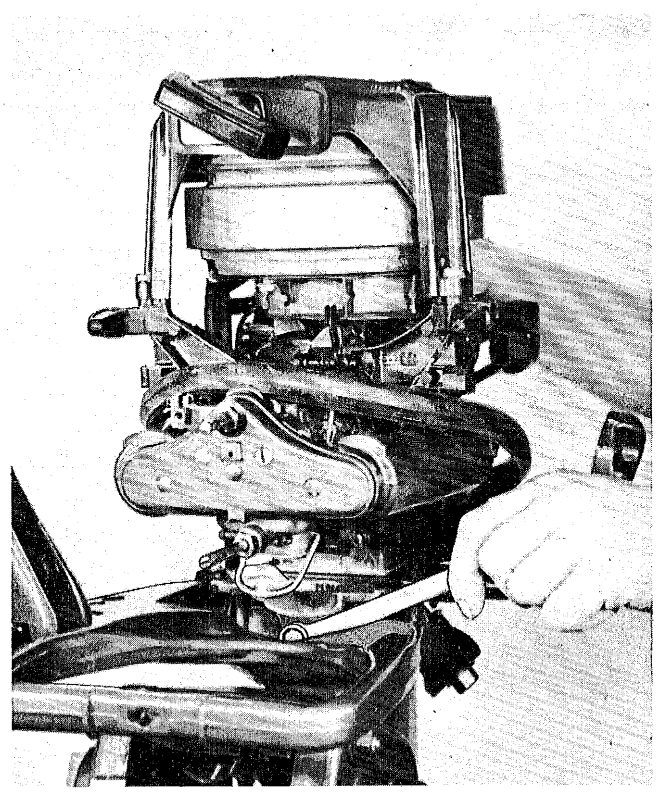
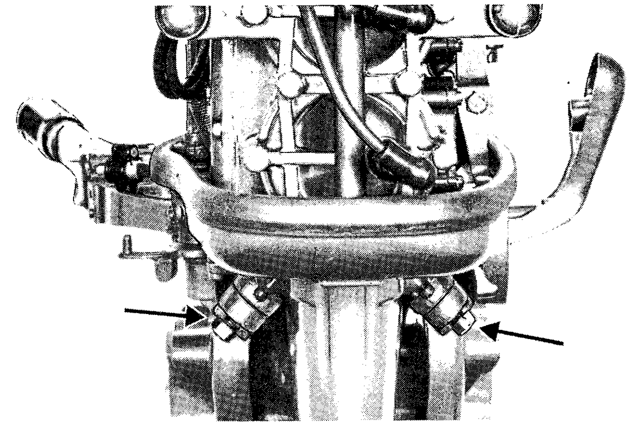


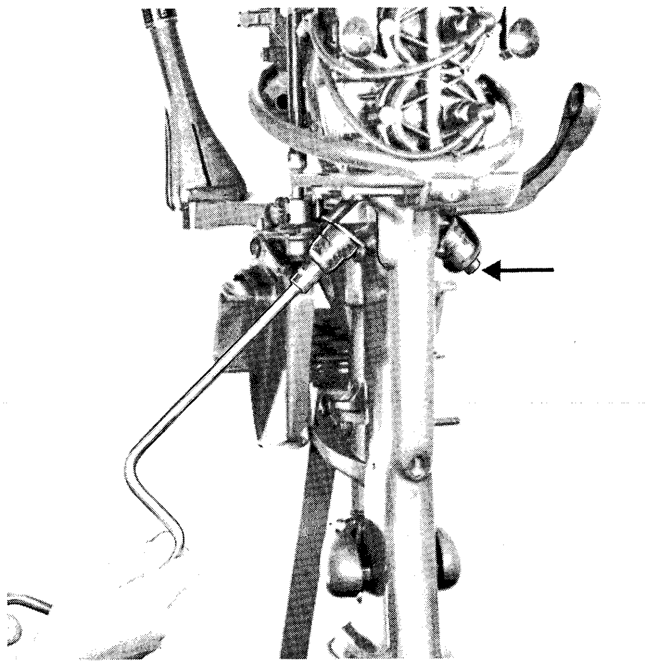
Showing detail assembly of the oil seal. Note—Washer indicated by arrow No. 303356 was originally machined of brass but since changed to stainless steel for better wearing qualities. On occasion of detaching the Powerhead, observe whether a brass or stainless steel washer had been installed—if brass, replace with stainless steel.



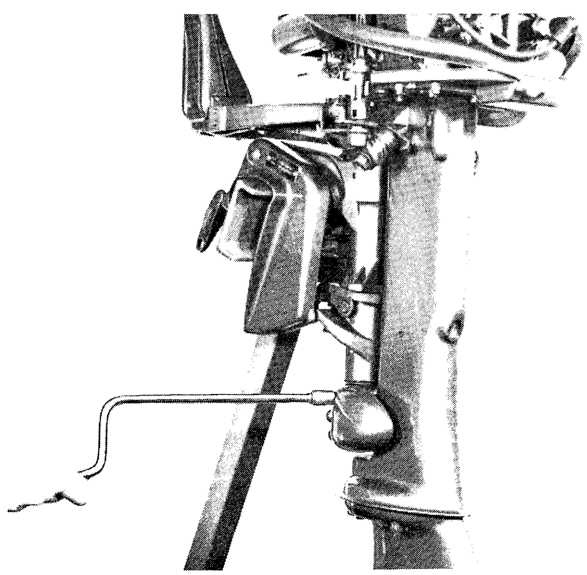
To detach the Powerhead and lower unit assembly from the steering bracket, remove the nut shown above and both nuts shown below to release the upper end of the assembly from the steering bracket.



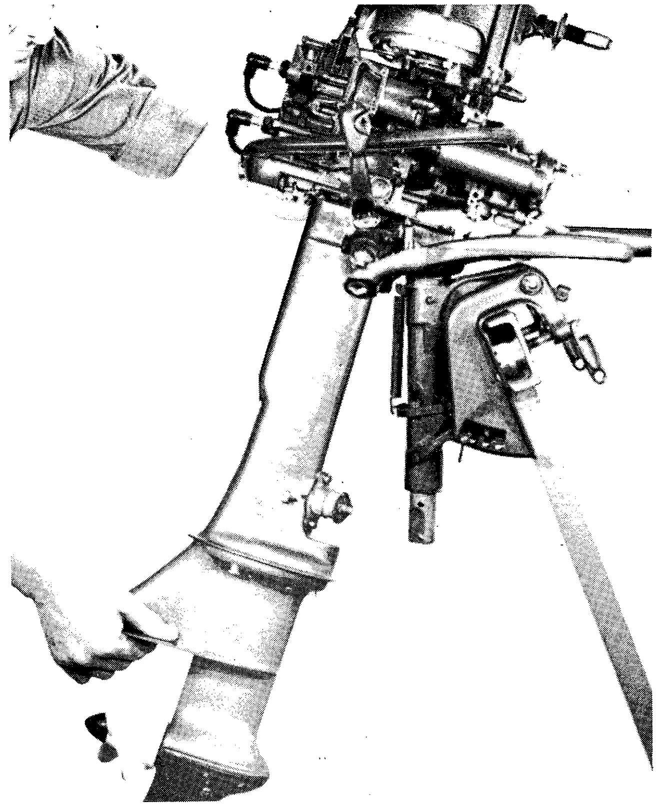
Showing position of rubber mount to absorb tortional shock —attached to the exhaust stack and steering bracket.



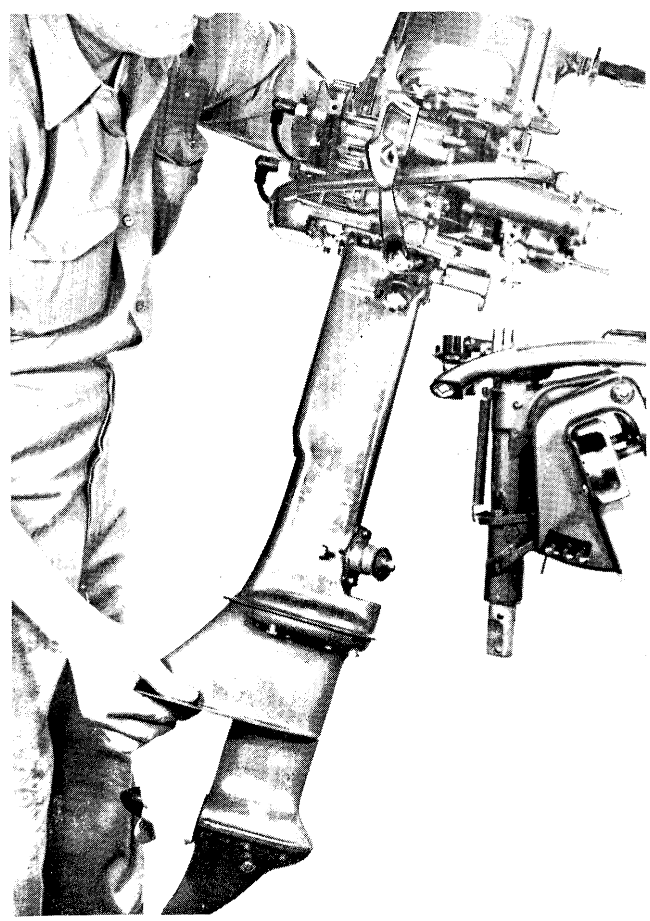
Removing nuts holding unit fast (through the rubber mount) to the steering bracket.



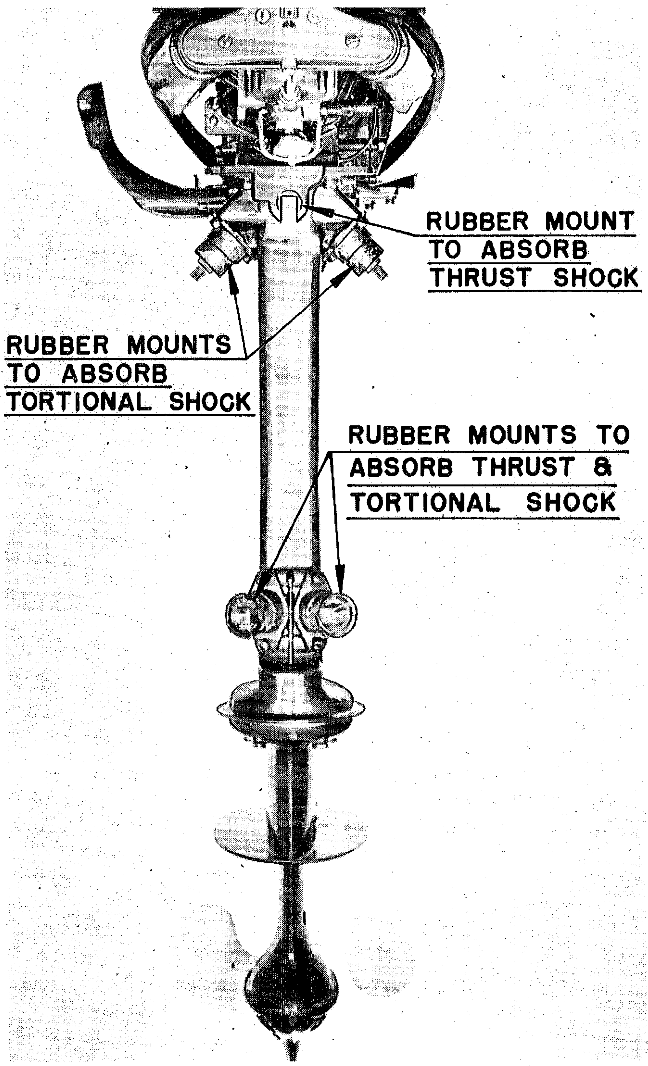
Removing "clam shells" to release the lower end of the unit from the pilot shaft.



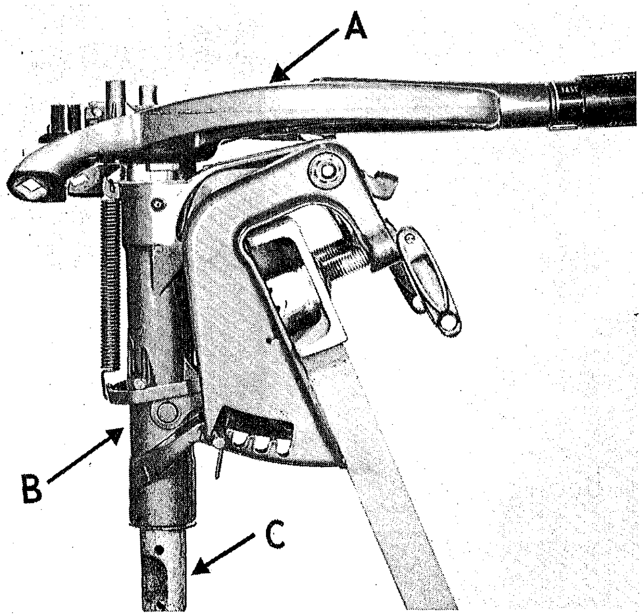
Pulling power unit free of the steering-swivel bracket assembly.



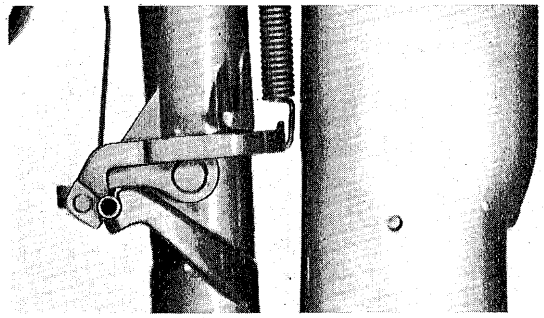
Lifting the power unit free of the steering-swivel bracket assembly.



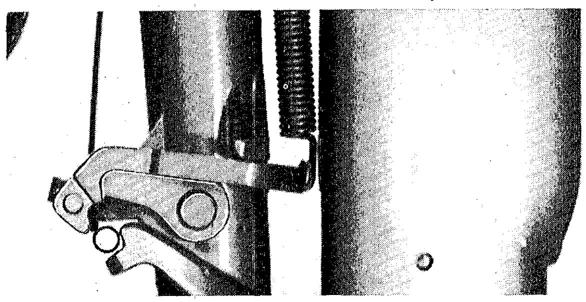
Showing power unit (Model AD) detached from the steering-swivel bracket assembly and position of rubber mounts to cushion or absorb thrust and tortional shock created by the running motor.



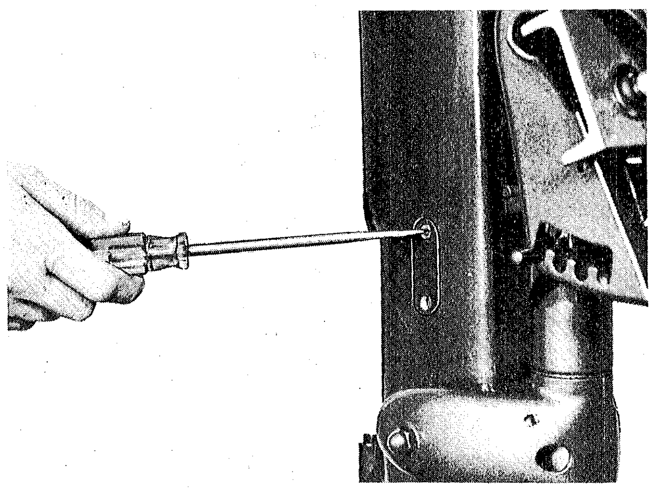
Showing steering bracket A, swivel bracket B and pilot shaft C remaining after having detached the power unit.



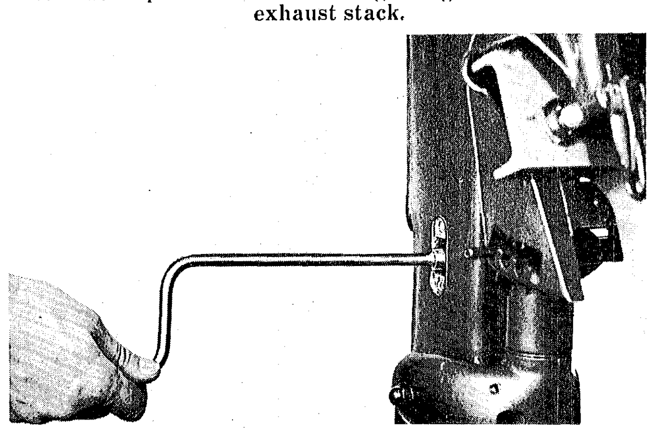
Showing tilt lock – trip release – engaged for normal operation of the motor. See page 444.



Showing the tilting lock released to permit tilting when striking an underwater obstruction. Since the locking device is spring loaded, it is calibrated to release on impact of ..
120 to 140 lbs. Models CD & AD
200 to 240 lbs. Models QD & FD
260 to 310 lbs. Models RD, RJE

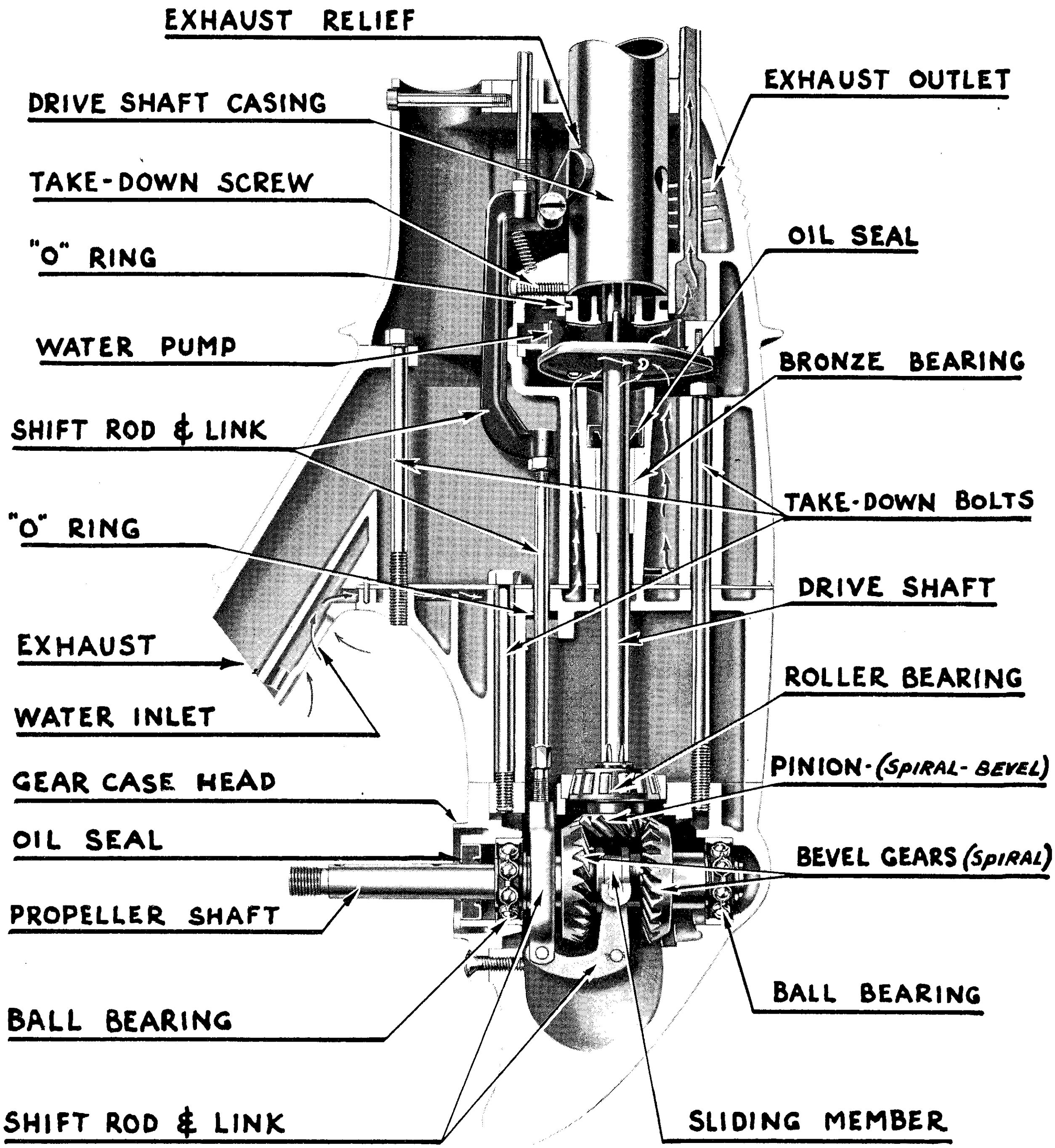


Removing side cover to gain access to the shift rod connector as required when detaching the gear case from the exhaust stack.

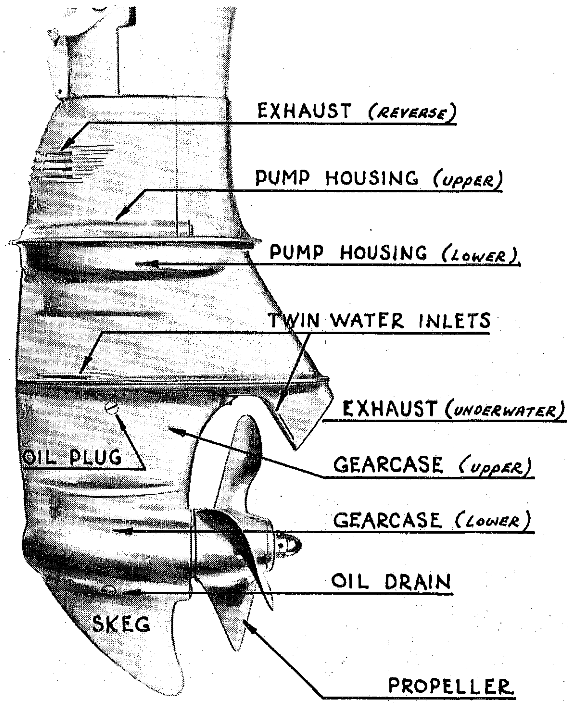


Cover removed to permit disengaging the shift rod connector to detaching of the gear case.

LOWER UNIT ASSEMBLY — MODEL QD



Sectional View of Gearcase Assembly – Models QD-10 and 11.

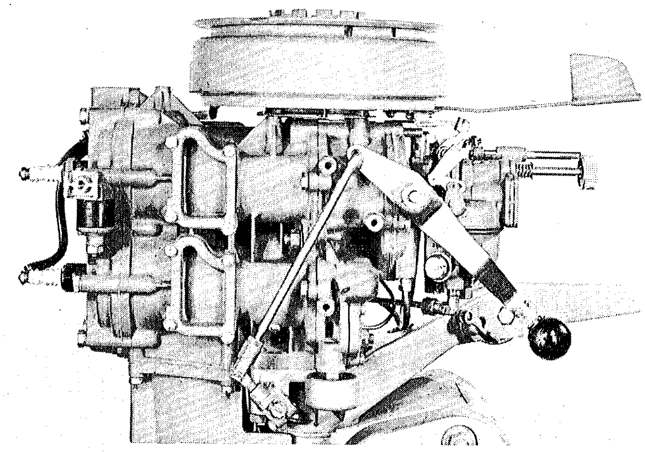


Gearcase Assembly.

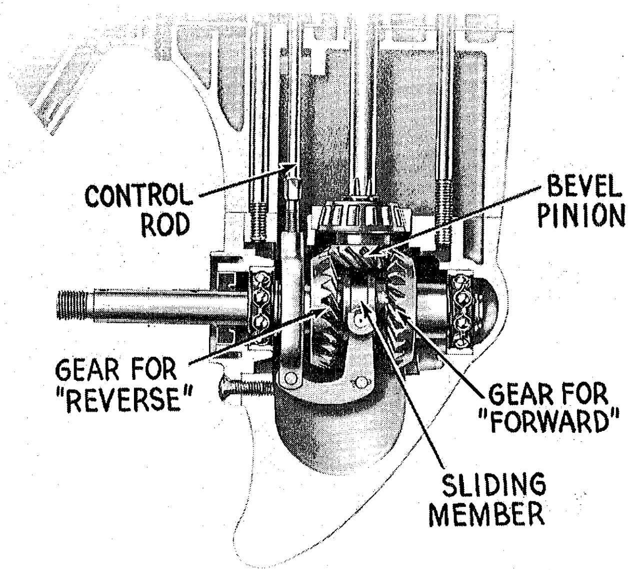
Disassembly and repairs on the Models QD-10 and 11 lower unit are not too difficult to perform if procedure and instructions below are closely followed.

Inasmuch as all but one of the bearings are of non-friction type and the only bronze bushing employed is "cast in" and machined to size, no reaming operations are required. Ball and roller bearings are replaced as units and rest in properly machined seats—(clearances established in original manufacture) while the bronze bushing can be replaced only, if necessary, by installation of a new lower pump housing. Possibly a new driveshaft may be required in event bronze bearing wear is excessive. As can be seen from the foregoing illustration, an oil seal is installed on the driveshaft above the bronze bearing and another on the propeller shaft immediately back of the propeller. Ball bearings are installed to support the propeller shaft with a taper roller bearing supporting the pinion and bottom end of the driveshaft—in this case to carry the load of gear thrust.

The gearcase housing assembly is built up of several sections, namely: the upper pump housing, lower pump housing, upper gearcase and lower gearcase and includes the water pump, driveshaft, propeller shaft, required gears and gear shifting mechanism.



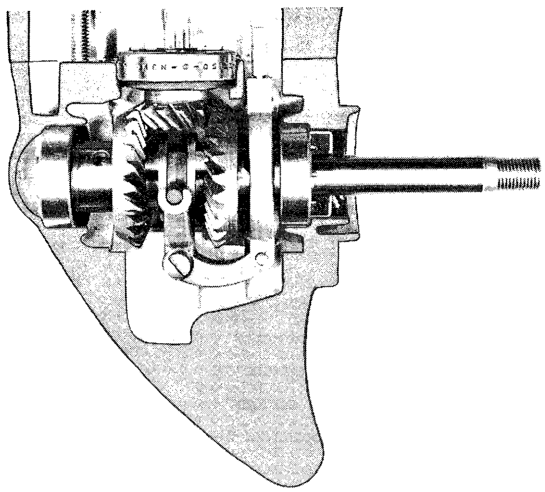
Motor Side Covers Removed to Show Shift Lever and Linkage.



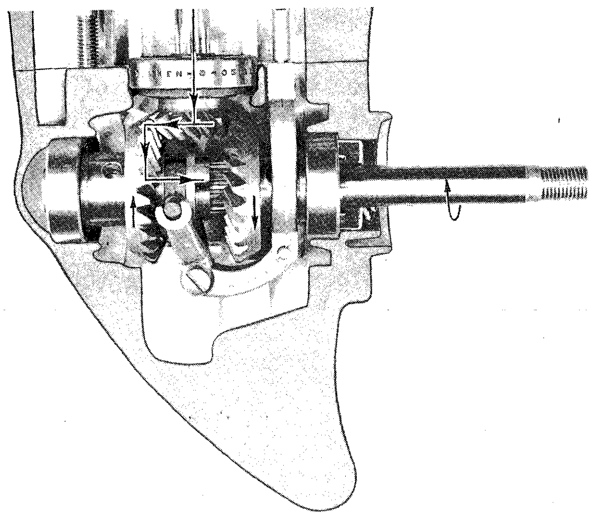
Sectional View of the Gearcase, Showing Gear and Gearshift Arrangement.

Gear Shift

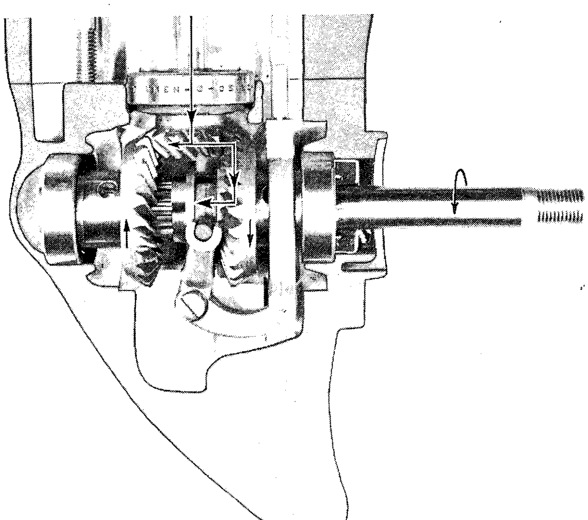
To accomplish "forward," "neutral" and "reverse," three gears, a sliding member and shifting mechanism are required. The pinion (gear) is splined to the driveshaft and rotates constantly with operation of the motor. The bevel gears (one forward and one aft) float on the propeller shaft and like the pinion, rotate with operation of the motor—one in one direction and one in the other. The sliding member is keyed or splined to the propeller shaft and remains motionless as does the propeller shaft and propeller (neutral) during operation of the motor, until the "dogs" of the sliding member engage like "dogs" on either gear—(forward or reverse, depending upon which gear is engaged).



Showing Gear in "Neutral"—Bevel Gears Floating on the Propeller Shaft Which is Motionless.

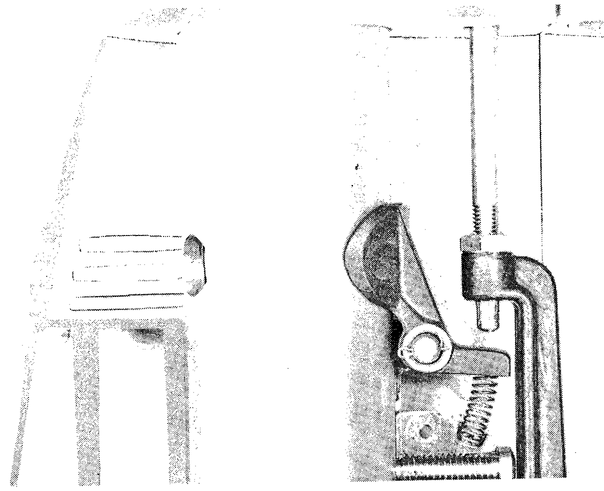


Showing Gear in "Forward"—Sliding Member Engaging Forward Gear. Note Line of Drive. Gear For Reverse is Now Floating on the Propeller Shaft.



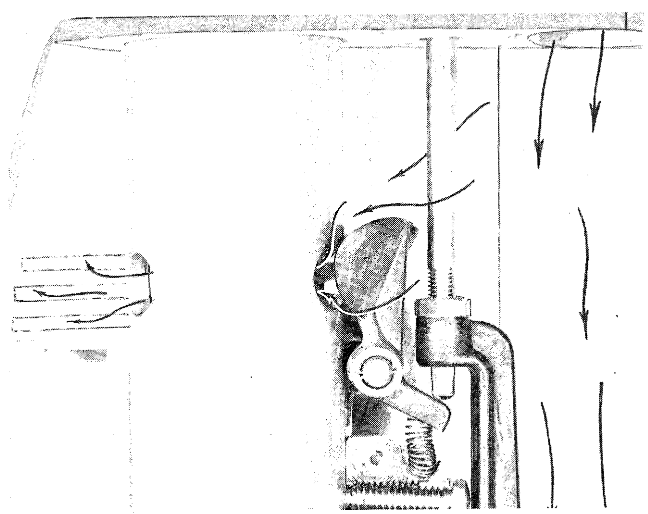
Showing Gear in "Reverse"—Sliding Member Engaging Reverse Gear. Note Line of Drive. Gear for Forward is Now Floating on the Propeller Shaft.

Exhaust Relief



Showing Exhaust Relief Valve Closed—"Neutral" and "Forward."

Exhaust gases are conducted down through the exhaust tube, upper pump housing, lower pump housing and discharge under water, through the exhaust outlet during "neutral" and "forward" operation. However, when in "reverse," water backing up into the normal exhaust outlet, creates excessive back pressure (against exhaust gases) which would interfere with functioning of the motor unless means were provided for relief in this respect. This has been accomplished in the Models QD-10 and 11 by drilling holes in the driveshaft casing, installing a valve and providing louvers in the upper pump housing.

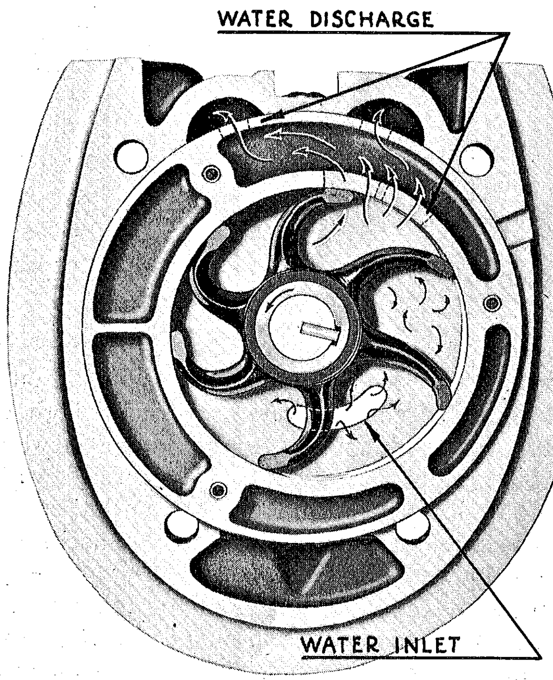


Showing Exhaust Relief Valve Open—"Reverse."

During neutral and forward operation, the valve remains closed, being held in position by a small spring. When shifting to "reverse," shifting mechanism is arranged to open the valve, as shown above. Exhaust gases subsequently "by pass" through the driveshaft casing and into the atmosphere by way of louvers in the upper pump housing.

The Water Pump

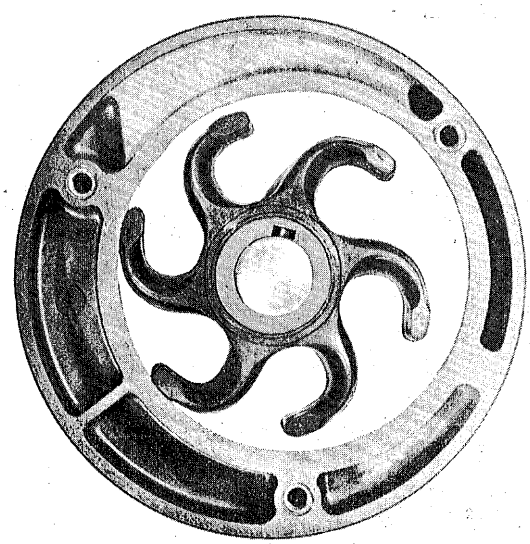
Cooling, of course, is provided by water circulating through jackets surrounding the cylinders, exhaust manifold and cast into the cylinder head. Water circulation is maintained by a Vari-Volume pump built into the gearcase assembly and operated by the driveshaft.



Illustrating Action of the Vari-Volume Pump—Pump Cover Removed to Expose the Impeller.

The pump actually consists of an impeller (with flexible synthetic rubber vanes or blades) rotating in an aluminum housing into which are cast ports for water discharge. Open end of the housing is closed by installation of a stainless steel plate including an elongated slot to serve as the water inlet. It will be noted from the illustration that the driveshaft does not center in the impeller or pump housing—the impeller thus offset to one side. This causes the impeller blades to flex or bend as they rotate in the housing—curved more while traveling through area of the narrow side than on the opposite wider side at which little curvature occurs. It can readily be seen that the volume or space between the individual blades varies with impeller rotation—volume in this respect is considerably constricted on the narrow side of the impeller housing but expands (grows) as the blades progress towards the wide side where little constriction exists.

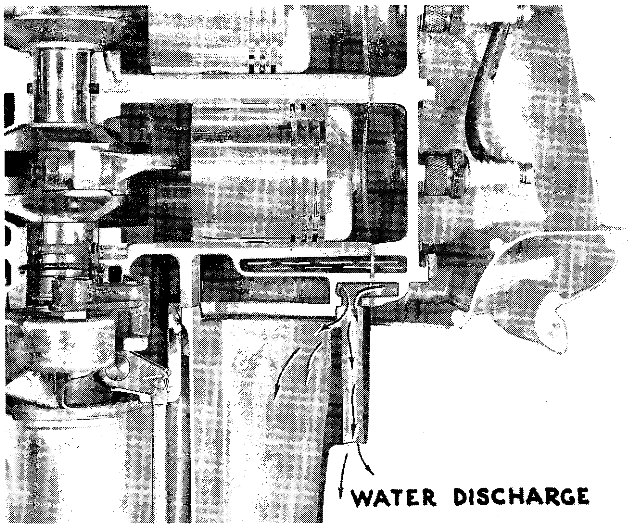
It is this flexing or bending of the impeller blades which makes it a displacement pump (at slow speeds). Note position of water inlet and discharge. Inlet slot in the cover plate is so spaced as to create an opening between the impeller blades at a point just after maximum constriction occurs and when the blades commence to straighten out. Resultant gradual increase in volume (between the blades) as the impeller rotates, causes water to be drawn in (suction) to fill up the space or volume thus created. At the proper moment of volume expansion, top edge of the impeller blade passes end of the slot— water stops flowing into this particular space. The water now trapped between the blades is carried around with the impeller until the blades start to flex or bend again on approaching the narrow side. Volume between the impeller blades now commences to constrict (grow smaller) to create pressure. The tip of the leading blade, however, at this time uncovers a slot (discharge) in the impeller housing which causes the trapped water to be discharged as the space it originally occupied constricts. Discharge continues in proportion to diminishing volume until tip of the following blade passes over (closes) the discharge slot. Identical action takes place in the space between each of the impeller blades to provide a constant stream of water, when operating the motor at slow and intermediate speeds. Creation of suction (as described) permits installing the water pump above water level.



Showing Position of Impeller Blades During Operation in Higher Speed Range.

At high operating speeds, water resistance within the impeller housing is sufficient to prevent the impeller blades stretching out, so to speak, to maintain contact with the impeller housing—simple impeller action results. The impeller acts now merely as a circulator, relying on pressure created by the revolving propeller and forward motion of the boat to provide sufficient water through the twin inlets in the gearcase for cooling purposes.

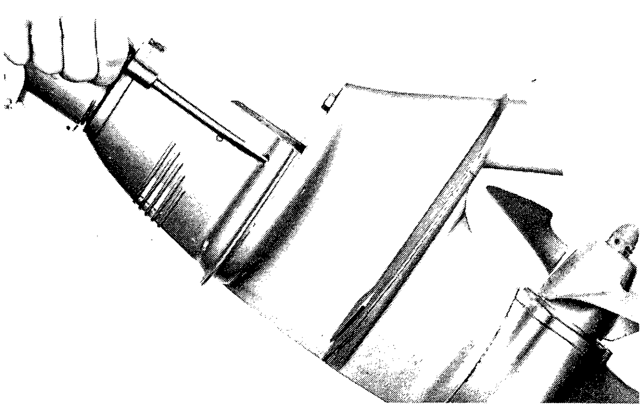
Water discharge is through the outlet in the exhaust tube immediately below the cylinder block.



Sectional View of Power Head to Show Position of Water Discharge.

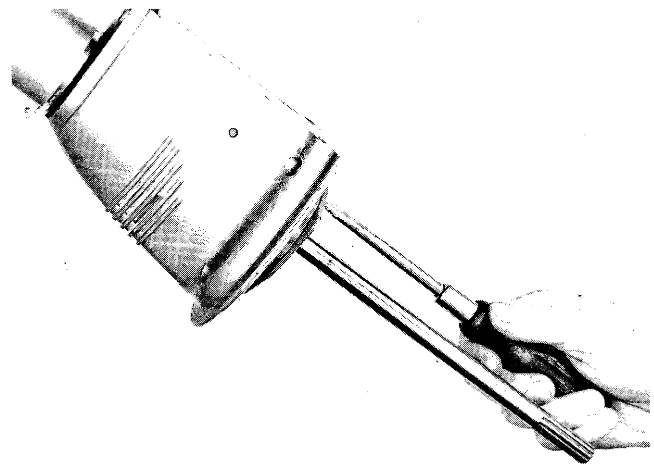
On decreasing motor speed, resistance within the impeller housing diminishes to permit the impeller blades resuming normal position, thus functioning again as a displacement pump. It's the flexing or bending of the impeller blades that causes pumping action as result of the volume or space between the blades alternately diminishing and increasing with rotation. If the impeller was centered in the housing, it would simply perform as a conventional impeller and not as a displacement pump to force water circulation at neutral, slow and intermediate speeds.

After having disconnected and unscrewed the (upper) shift rod (detached from the link), the gearcase is disassembled by first detaching it from the upper pump housing, as shown below.



Removing Gearcase Assembly From Upper Pump Housing.

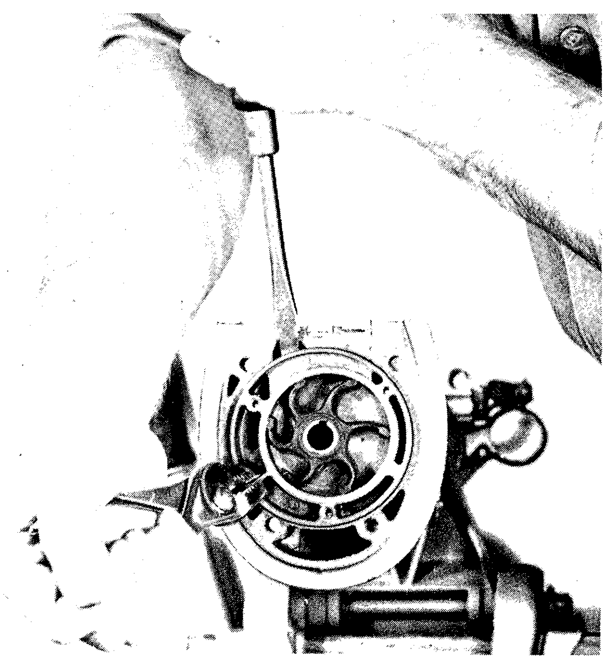
Since the impeller, housing and driveshaft assembly are attached to the upper pump housing by three screws, the screws must be removed to detach it. The impeller is keyed to the driveshaft by a small pin. Thus, on removing the impeller plate, the driveshaft can be withdrawn from the assembly. The impeller merely lifts out. In some



Removing the Impeller Plate.

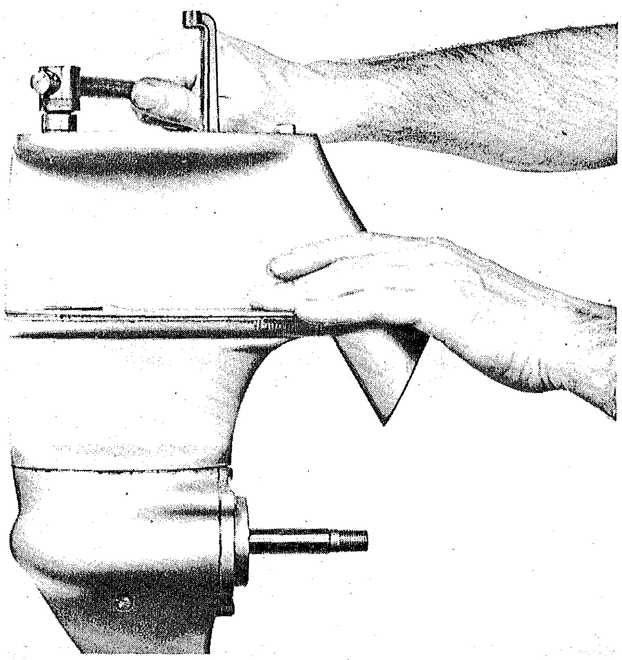
instances, the entire pump assembly may be removed as a unit by simply pulling on the driveshaft but most likely, the rubber "O" (seal) ring adheres sufficiently to prevent entire assembly removal in one operation.

To remove the impeller housing from the upper pump housing, gently grasp one of the webs in the housing with a pair of pliers and insert screw driver between the impeller housing and pump housing, as shown below. Carefully and evenly pull on

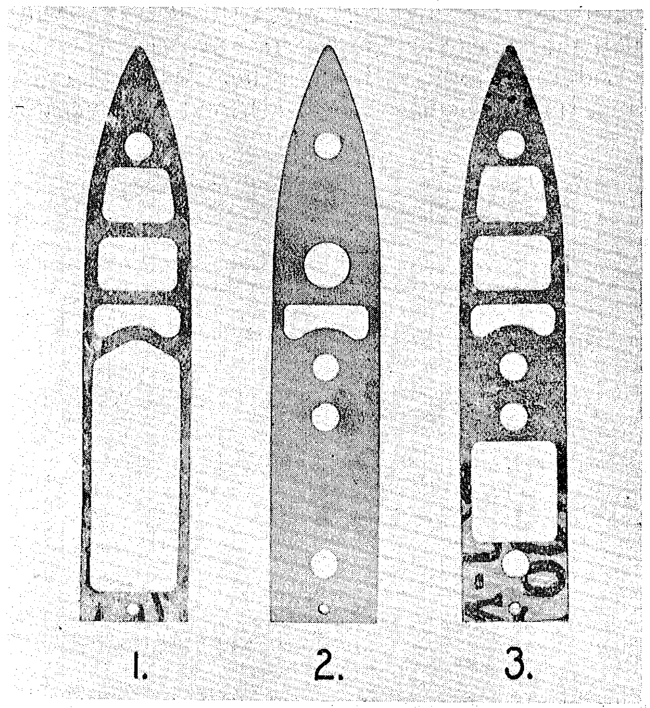


Removing the Impeller Housing.

the pliers and pry on the screw driver. Exercise caution during this operation. Do not force too hard and be careful not to "cock" the housings to cause unnecessary strain.

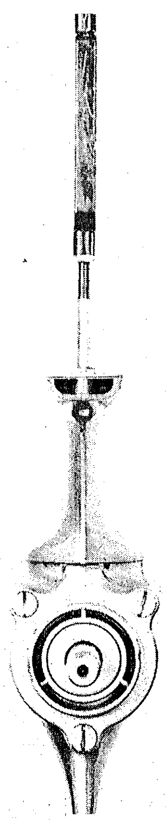


Removing the Upper Housing.

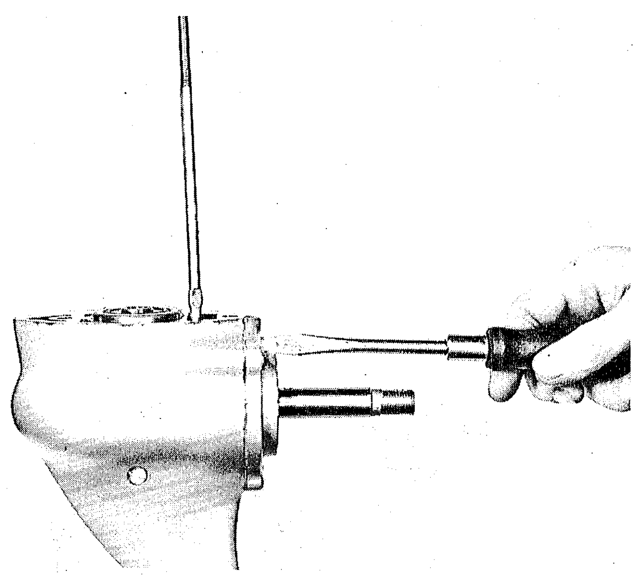


Showing (1) Gasket Top, (2) Aluminum Plate and (3) Gasket Bottom, All of Which Are Installed Between The Lower Pump Housing and the Upper Gearcase Section in the Order Given. This is Important. Gasket Surfaces Should be Coated with Nondrying Cement on Assembly.

On removal of the lower pump housing, detach the link (offset in shifting mechanism to accommodate the exhaust valve) then remove screws holding the upper gearcase section fast to the lower gearcase proper.

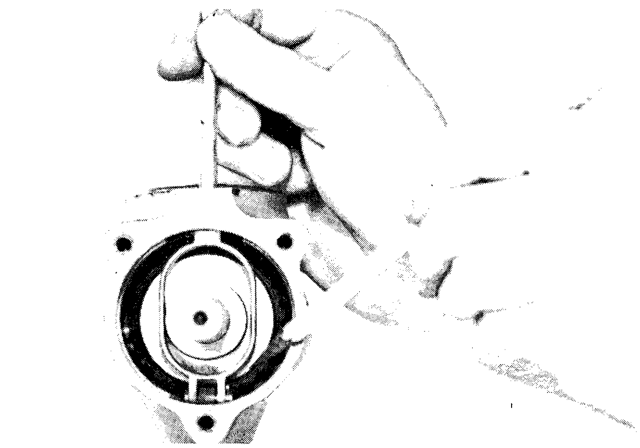


Showing Lower Pump Housing Removed. Link and Lower Shifting Rod Exposed.

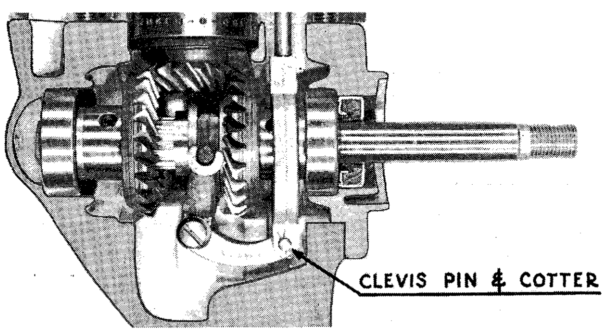


Removing the Gearcase Head.

After detaching the gearcase head, the lower rod and shifting yoke must be disconnected to permit withdrawing the propeller shaft and gear assembly. The yoke is pinned to the small shifting lever in the gearcase and the pin secured with a cotter, as shown below.



Showing Position of Clevis Pin.

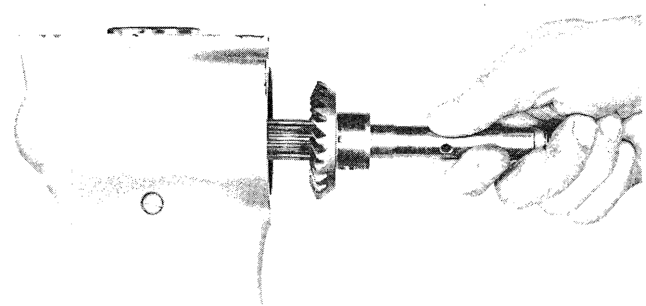


Sectional View Showing Clevis Pin and Cotter to be Removed.

Straighten ends of the cotter and remove the clevis pin with long nose pliers. Make certain the pin is removed, not dropped into the gearcase where it could cause damage later on. Discard the old cotter—always use new one on reassembly.

In like manner, carefully remove the clevis pin with long nose pliers. Detach shifting rod from shifting yoke, then carefully withdraw propeller shaft and gear (reverse). The shifting or sliding member and "forward" gear will fall off end of the propeller shaft and into the gearcase—simply lift out. Tap gearcase lightly on block of wood to jar front ball bearing free. Front and back ball bearings can be installed either way. Note there are two flat washers—one each installed next to each gear (between the gear and the shifting member). The shifting arm need not be removed at this time unless it is desired to do so. It is held in position by a long screw which incidentally must not be confused with the "oil drain" screw. The pinion and roller bearing assembly can then be pushed out of position easily by hand.

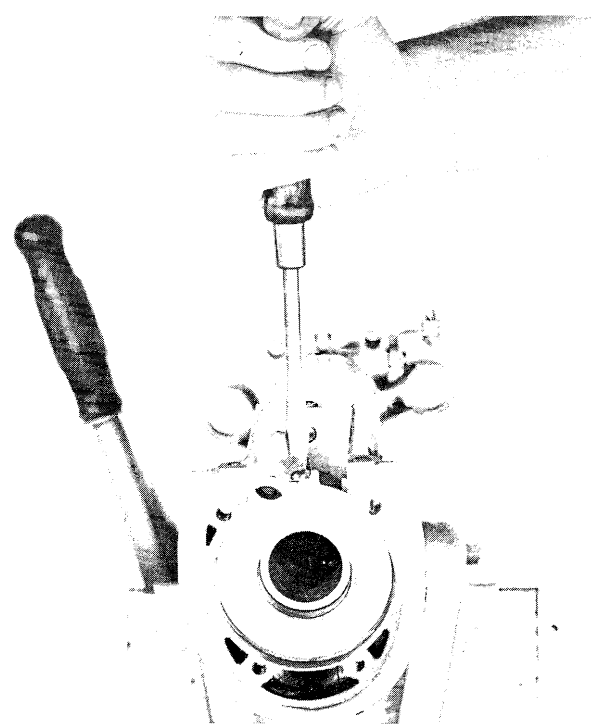
Assembly of the gearcase is in reverse of that described above—easily accomplished by exercising a bit of care. Make certain all parts are clean and thinly coated with oil and that no foreign particles remain in the gearcase. Replace parts as required. Do not install one new gear to operate with two old ones—the result is inevitably a noisy gearcase and possible damage later on. Be sure the bearings are clean and free of grit. Spin in hand to note presence of grit.



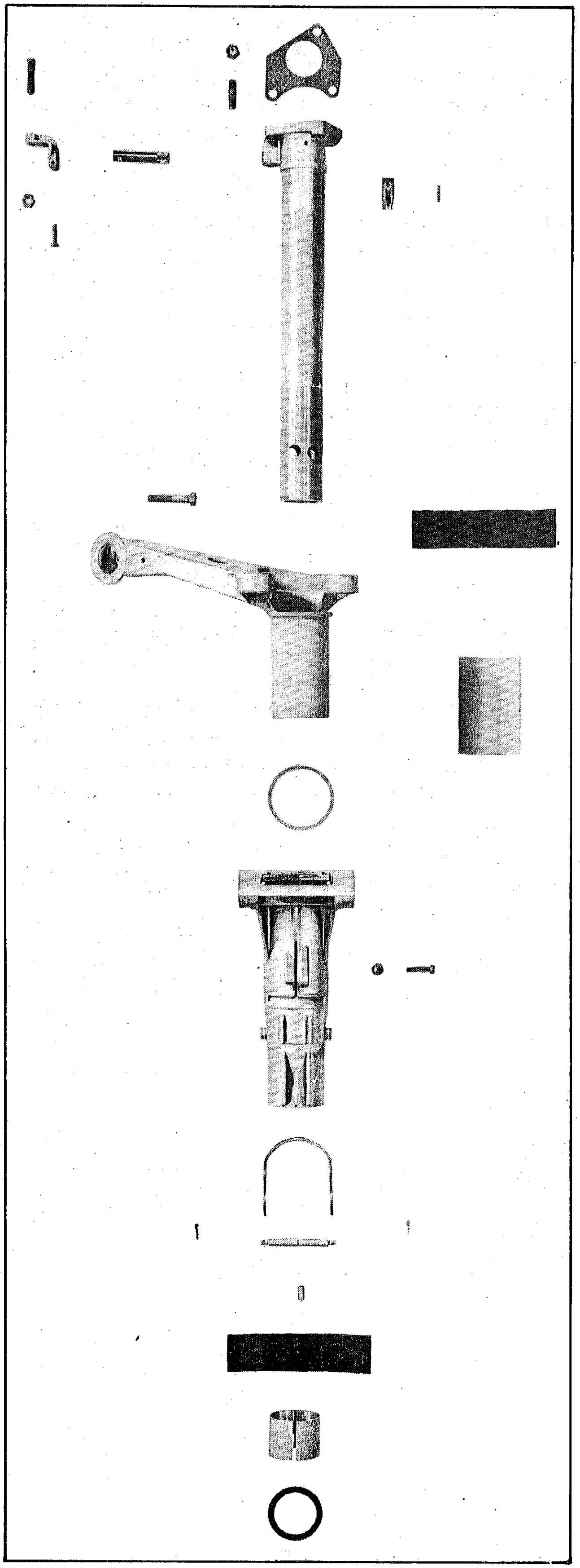
Removing Propeller Shaft and Bevel Gear from the Gearcase.

The driveshaft casing and swivel bracket assembly is easily taken apart by removing the large screw holding the upper pump housing fast to the driveshaft casing and carefully driving it off. The swivel bracket assembly and driveshaft can then be easily taken apart.

Reassemble in reverse order of that described above.

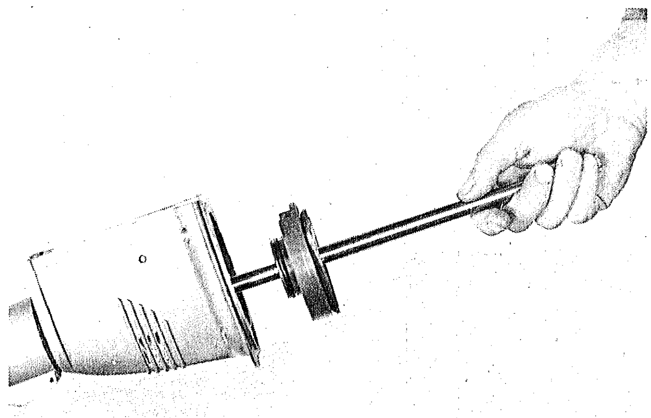


Detaching Upper Pump Housing from the Driveshaft Casing.

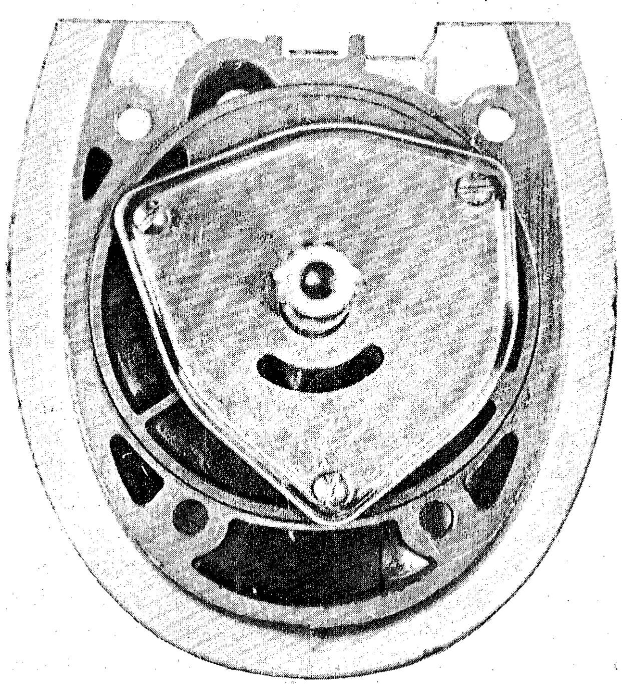


Extended View of the Swivel Bracket, Steering Arm and Driveshaft Casing Assembly.

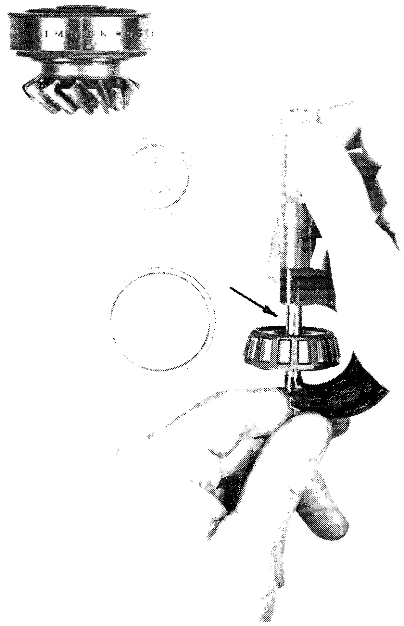
Make certain that all parts to be assembled are in good operation condition—that none of the housings are cracked or otherwise damaged to interfere with their performance in the assembly. See that all gasket faces are flat and true to avoid water or oil leaks. Lap faces if necessary; however, if in doubt as to their condition, replace with new parts. Check condition of bearing seats, oil seals, "O" (seal) rings, ball and roller bearing assemblies, gears, gear shifting mechanism, propeller and driveshafts and the bronze bushing in the lower pump housing to ascertain their fitness for use. Replace as required. Use nondrying cement on all gaskets.



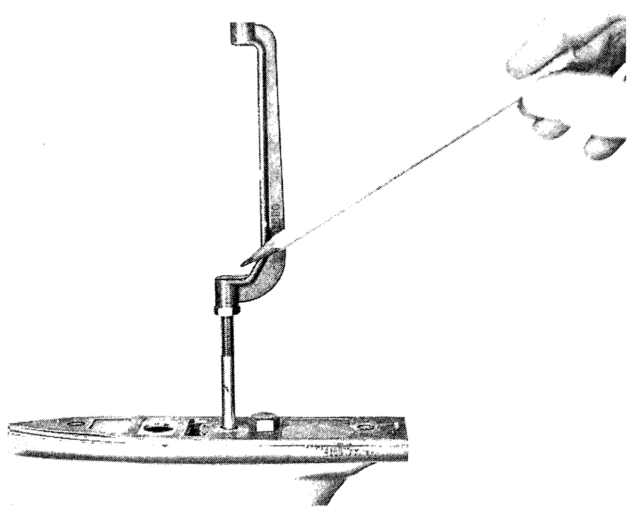
Prior to installing the Water Pump Assembly—Assemble to the Driveshaft as Shown Above. Do Not Neglect Replacing "O" Ring on the Housing—Install New One if Necessary.



The Pump Assembly Can be Installed in One Position Only as Illustrated Above.

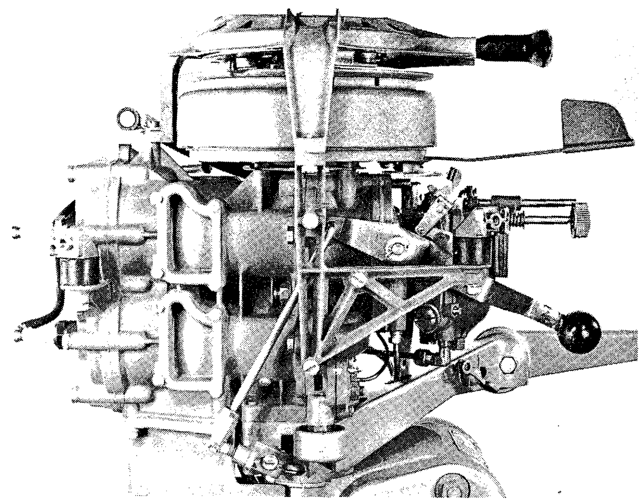


Showing Pinion and Taper Roller Bearing Assembly (Upper Left) and Method of Calipering Width of Bearing Race to Determine Correct Thickness of Spacer (Shim) to Install Between the Bearing Race and Gear on Assembly. The Bearing and Pinion are Provided by the Factory as an Assembly; However, in Event Assembly is Performed in the Field, the Operation is a Critical One and Must be Performed with Extreme Care. Since All Bearing Seats Are Machined to Close Limits to Obtain Proper Gear Mesh, Existing Variations in Width of Roller Bearing Race (Inner) Must be Compensated For by Addition of a Spacer or Shim Between Bearing Race and Face of Gear. Spacers or Shims Are Available in Thicknesses of .005" (#301932), .006" (#301933), .007" (#301934), .008" (#301935), and .009" (#301936). Correct Dimensions as Indicated by Arrow Are .578" to .580". This is Important to Provide Correct Gear Mesh. Install Shim or Combination of Several Shims to Build up Accordingly. Carefully Press Bearing and Required Shim or Shims on the Gear. Coat Gear Boss with Clean Oil to Facilitate Assembly–Do Not "Cock" When Pressing Into Position.



Showing Link Properly Attached to the Lower Shift Rod. The End of the Rod Should Be Screwed Into the Link–Flush With Inside of the Boss, as Shown. Lock Nut Should be Turned Tightly Against the Link to Anchor.

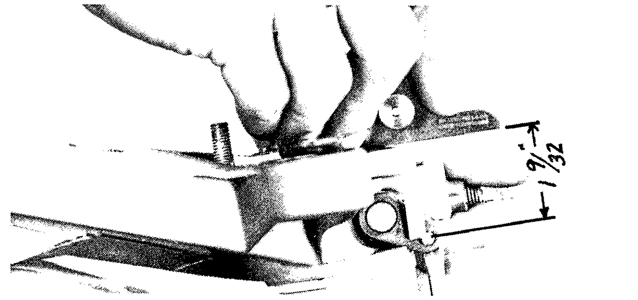
Gear Shift Adjustment



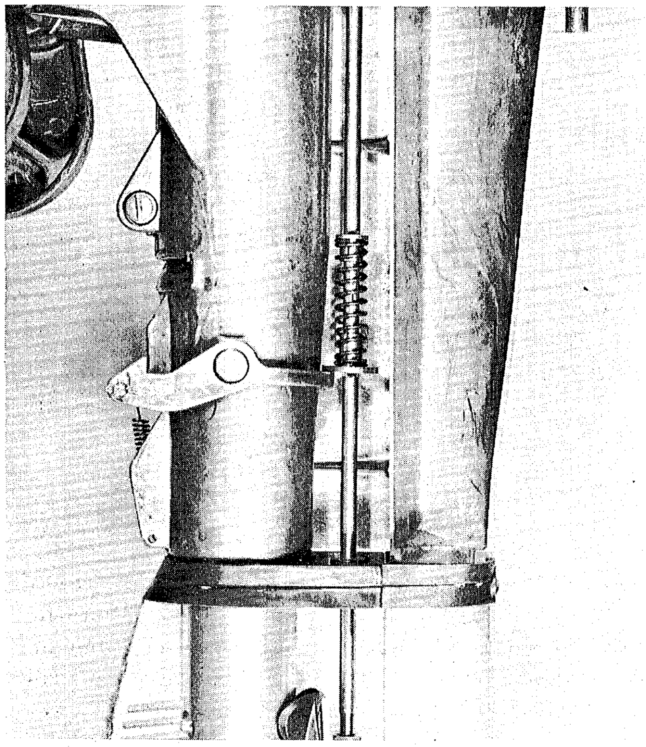
On completion of assembly, it becomes necessary to adjust the gear shift rod, that is, adjust the length of the rod to permit the sliding member on the propeller shaft engaging the forward and reverse gear and to take a neutral position with respect to position of shifting (hand) lever. When lever is set to either forward or reverse, the sliding member must fully engage either gear as the case may be and to assume a neutral position (midway between both gears) when the shifting lever is set in neutral.

The upper shift rod should be screwed into the top of the link to a point where the threads "flush" with bottom of the boss.

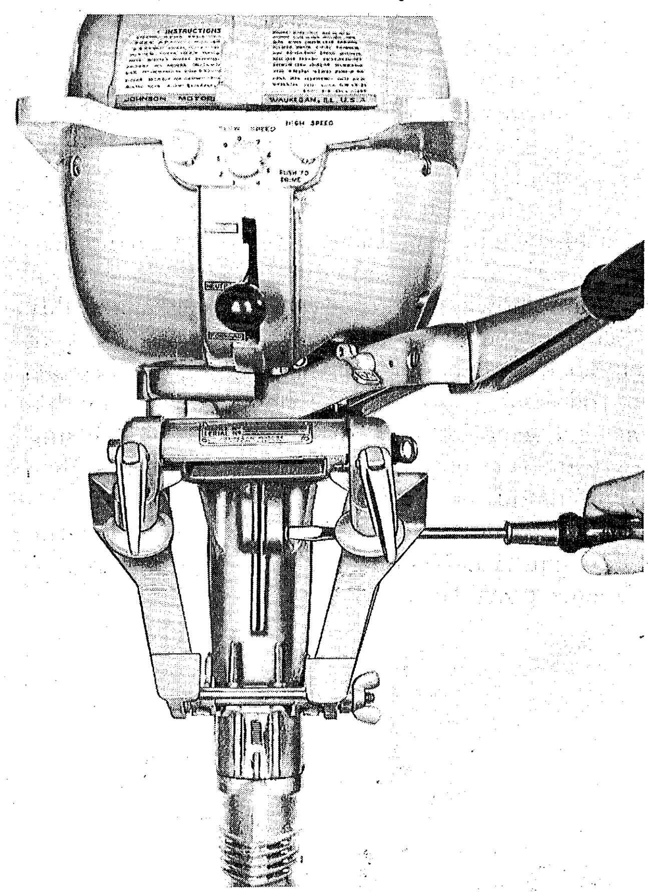
Attach other end of the rod to lever at top of the driveshaft casing by inserting pin to retain momentarily. Set a depth gauge to 1-9/32"—press lever down, as shown below—as far as it can possibly go. Turn propeller shaft to make certain the sliding member in the gearcase properly engages the gear. The rod is adjusted to proper length when the distance between the top face of the driveshaft casing flange and the center of the pin is 1-9/32", as shown here. This adjustment is accomplished by removing the pin and turning the rod into or out of the link as required. When final setting has been reached, secure pin with cotter.



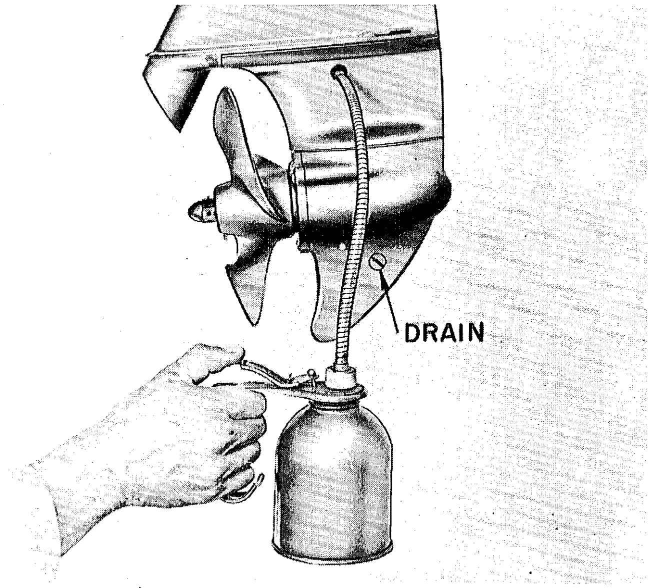
Checking Distance Between Driveshaft Casing Flange and Center of Clevis Pin. Driveshaft Casing Must be Lifted "Up" When Taking This Measurement.



Showing Reverse Lock Mechanism. Since the Locking Device is Spring Loaded, it is calibrated to release on impact of: 200 to 240 lbs. – Models QD and FD.



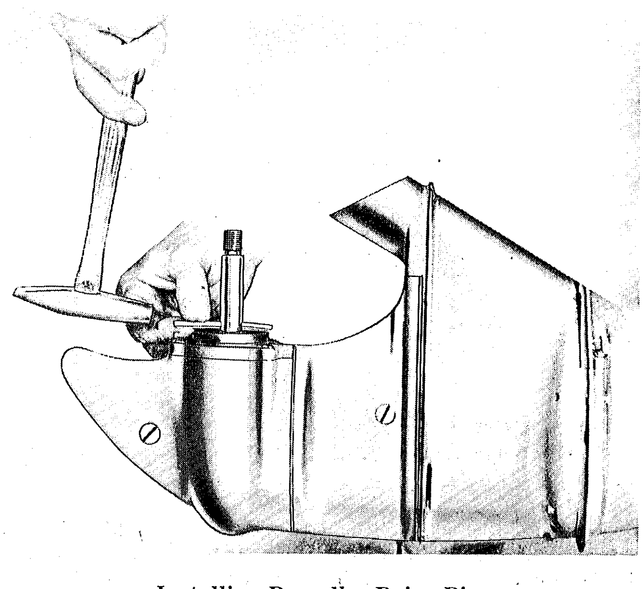
Steering Friction May be Adjusted to Individual Requirements by Simply Loosening or Tightening the Screw in the Swivel Bracket Provided For This Purpose. Tilt Motor From the Thrust Socket to Gain Accessibility to the Screw.



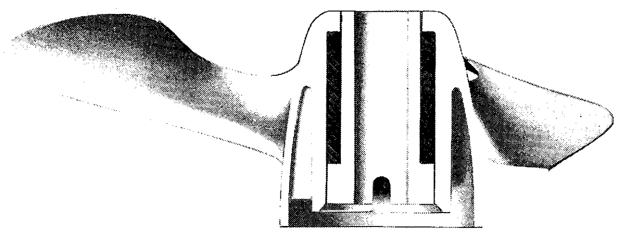
The Gearcase Uses a Different Lubricant Than Normally Used in Outboard Motors Prior to This Time. OMC Type "C" is Recommended For Best Operation. In the Event This Lubricant is Not Obtainable, Use Any Good Grade of SAE 90 Gear Oil (Suitable For Automotive Hypoid Gears). In Case of an Emergency Where Neither is Available, it is Permissible to Use an SAE 40 Oil, But Only Until Such Time as the Proper Lubricant Can Be Obtained.

Where a Complete Change of Lubricant is Required, Vent and Drain Plugs Should Both be Removed. Drain Out All of the Oil, Water or Residue; Replace the Drain Plug Then Fill the Gearcase Through the Vent Plug With a Pump Type Oil Can as Shown. Fill to Level of the Vent and Replace Screw. Capacity 10 Fluid Ounces (5/8 Pint).

When Checking for Water in the Gearcase it is Necessary to: First, Remove the Vent Screw; Second, Loosen the Drain Screw Partly to Allow Enough of the Lubricant to Run Out to Determine Whether or Not Water is Present. If There is No Water, the Drain Screw May be Retightened without an Excessive Loss of Lubricant. The Gearcase Should Then be Filled to the Vent Screw Level and the Vent Screw Replaced. Check Condition of Gasket on Both Screws to Avoid Possibility of Leaks. Replace if Necessary.



Installing Propeller Drive Pin.

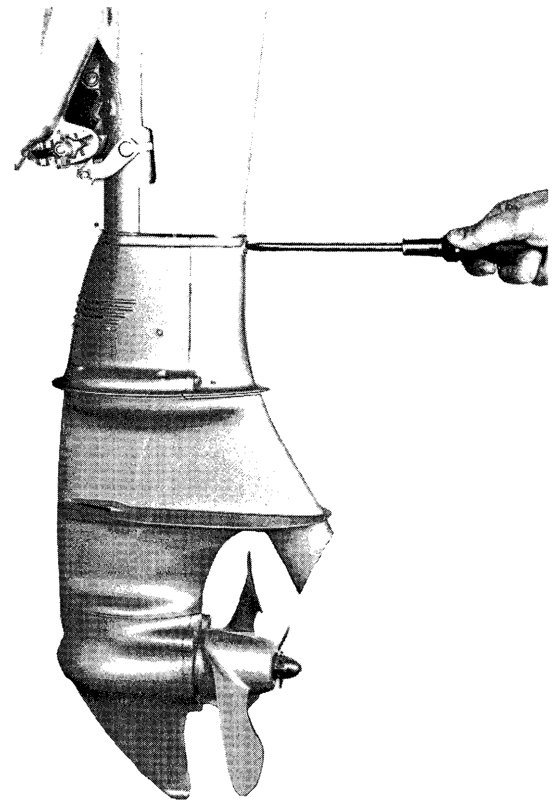


A Rubber Cushion Has Been Installed Between the Propeller Hub and Propeller for the Purpose of Absorbing "Shock" in Event the Propeller Blades Strike an Underwater Obstruction During Operation of the Boat. Shearing of Propeller Drive Pins and Possibility of Otherwise Damaging the Motor are Thus Considerably Minimized.

The Rubber Cushion Performs an Additional Function in the Case of the Model QD in that it Acts to Reduce Impact Load on the Reversing Mechanism.

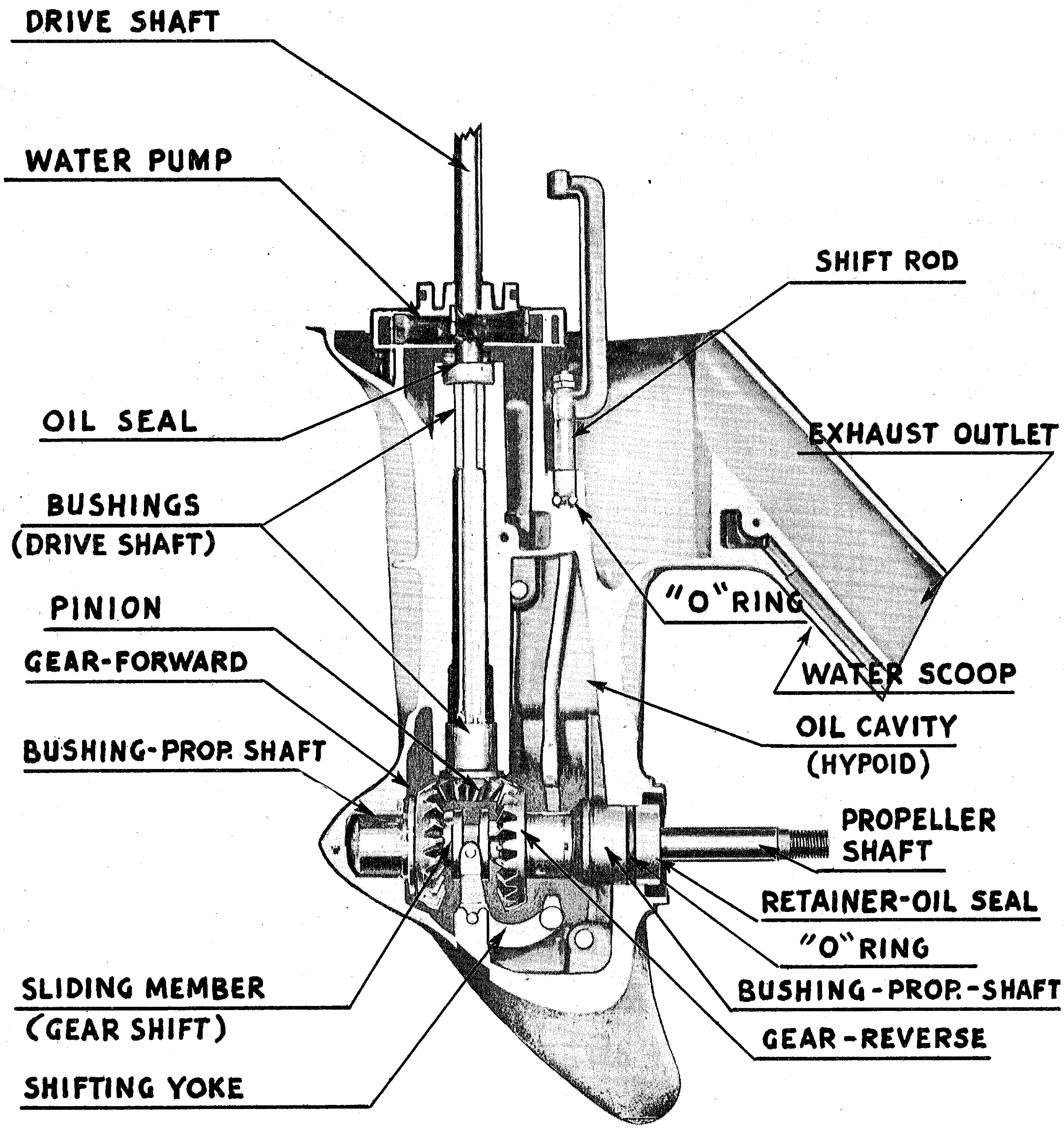
Under no Consideration Substitute Propellers Not Provided With the Rubber Shock Absorber, to Avoid Causing Rapid Wear of Reverse Mechanism.

On testing the motor in a motor test tank after final assembly, be sure all exhaust gases are drawn off the tank. This is important since they accumulate under the shroud (motor cover) to interfere with carburetion, thus causing the motor to operate erratically for no apparent reason. Same holds true for tank testing of all outboard motors.

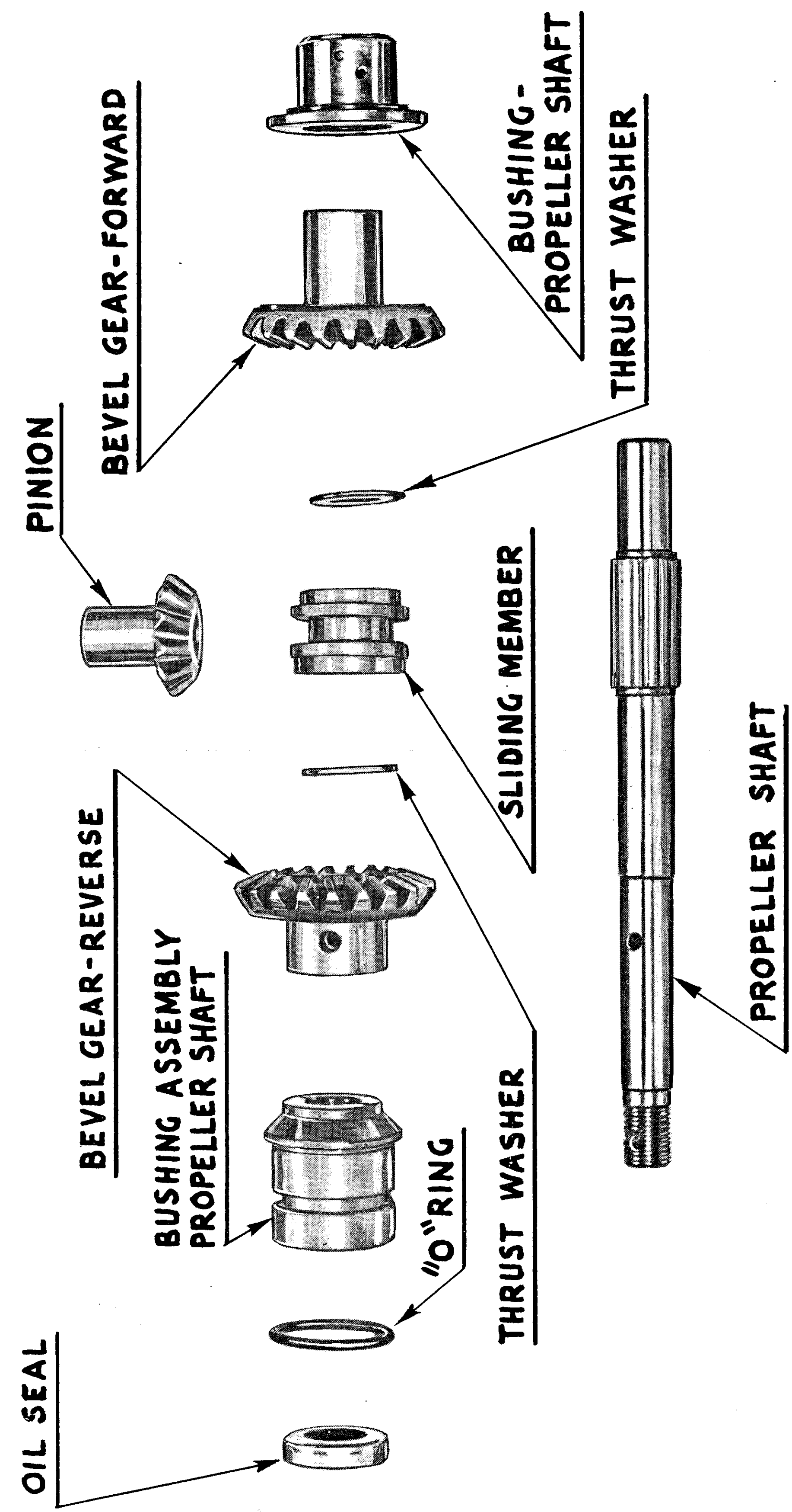


It is Extremely Important that the Screw at the Base of the Exhaust Tube is Made Secure—Be Sure it is Tight. Excessive Vibration Results from this Screw Being Loose or Dislodged.

NOTES

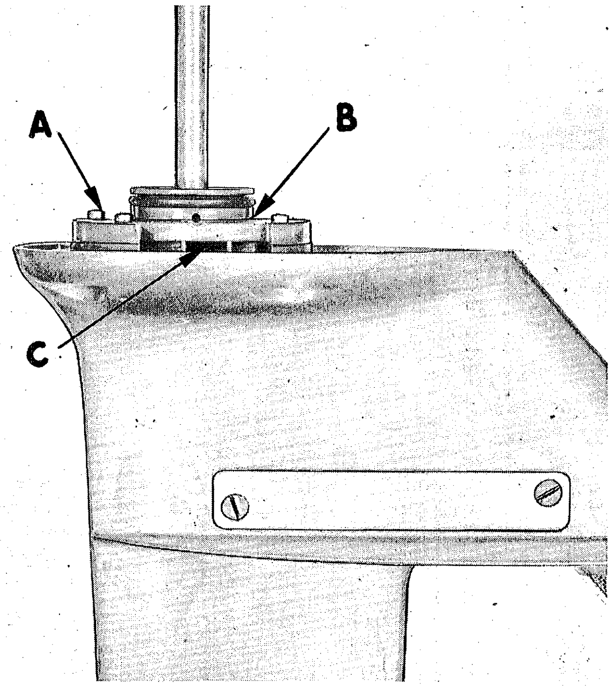


Sectional View of Gearcase – Models QD-12 and 13.



Assembly Layout – Propeller Shaft, Gears and Bushings (Bearings) – Models QD-12 and 13.

WATER PUMP ASSEMBLY – QD-12 AND 13



Showing Pump Assembly "B" Attached to the Gear Case and Position of Water Discharge "C."

Access to the water pump assembly ("B" shown above) in this case is gained obviously by detaching the gearcase from the driveshaft casing—remove screws holding gearcase fast to the driveshaft casing.

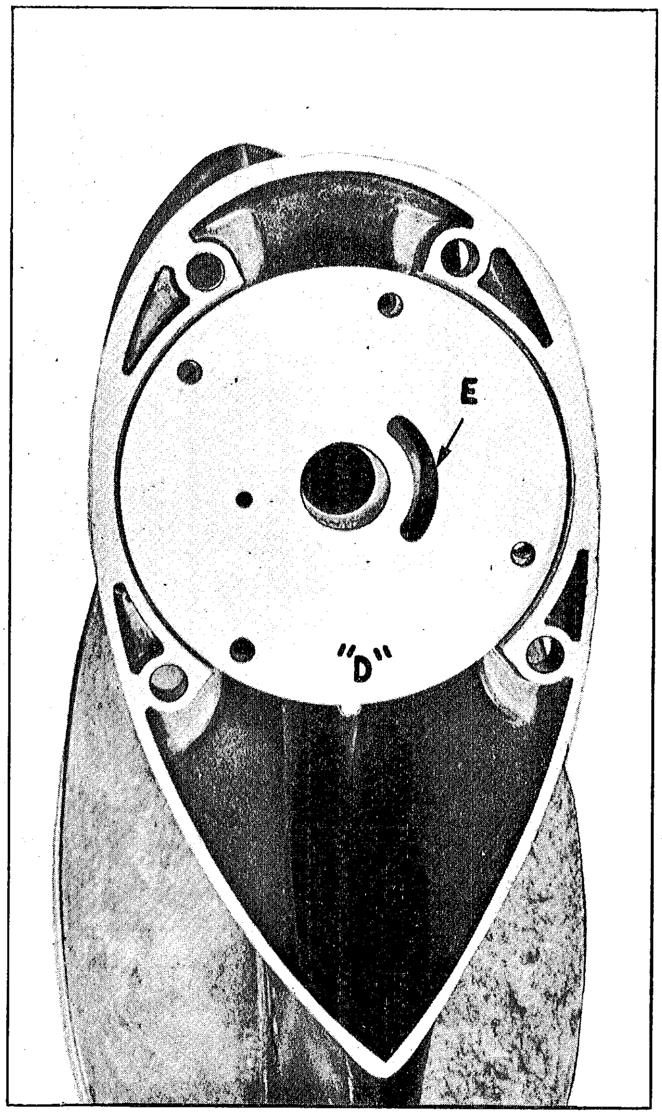
The pump housing, impeller cover plate make up the assembly — keyed (impeller) to the driveshaft and attached to the gearcase by screws "A" as shown above.

To detach the pump assembly, remove screws "A"—carefully lift or pry (if necessary) from the gearcase. In all probability cover plate "D," shown below, will remain in the gearcase. Pay particular attention to position of water inlet "E" at this time.

Repair and assembly of the water pump is extremely simple—replace parts indicating excessive wear—but, it is possible to install cover plate "D" incorrectly. Note position of water pump discharge "C" and water inlet "E" (cover plate).

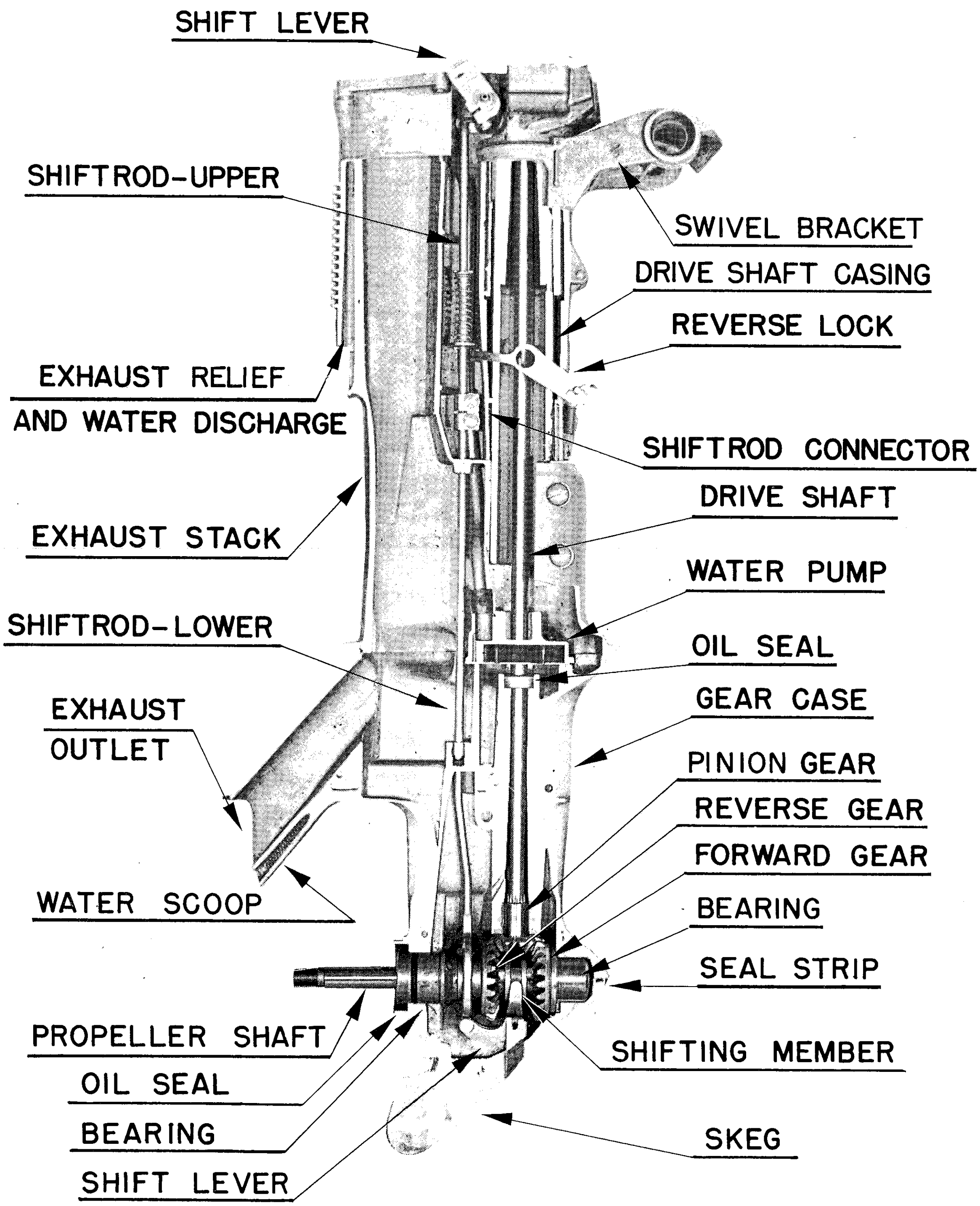
Inlet "E" should be placed to side opposite discharge "C" prior to securing the pump assembly as shown here. Inlet (cover plate) and discharge (pump housing) must be arranged directly opposite if the assembly is to function—extreme caution should be taken at this stage of assembly.

See page 408 regarding details of operation.

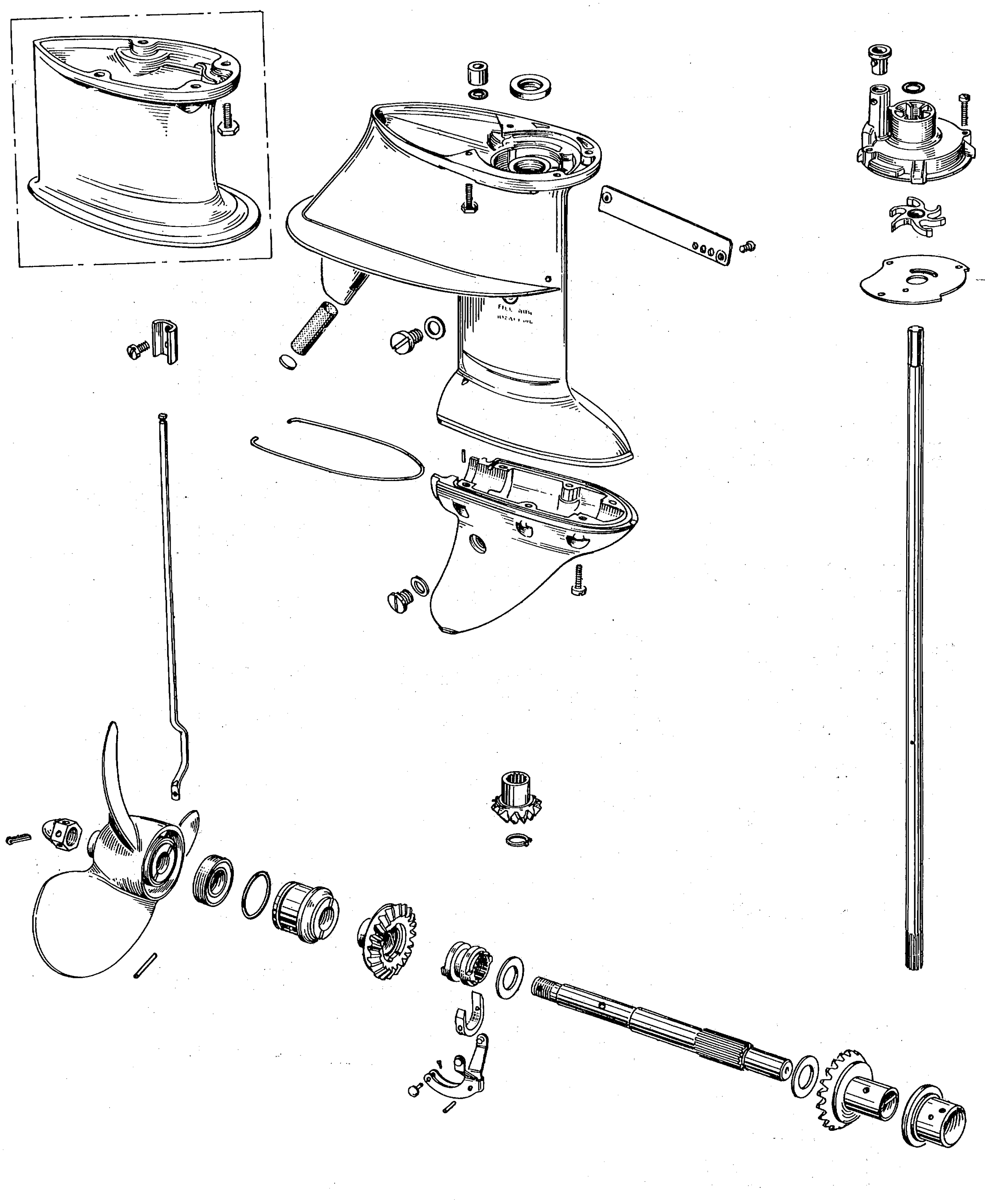


Showing Position of Cover Plate "D" when Correctly Positioned in the Gear Case.

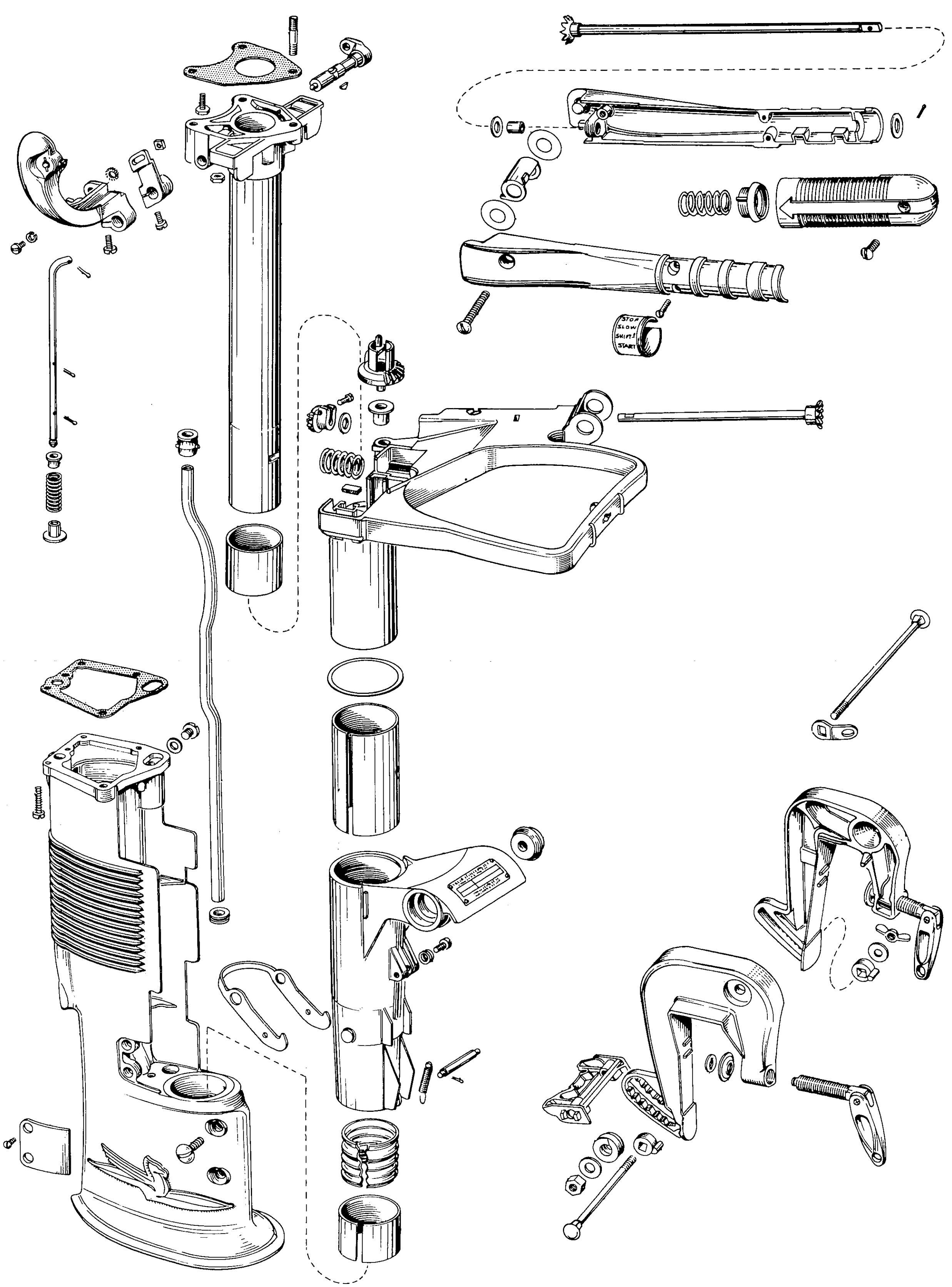
MODELS QD-14 AND 15 LOWER UNIT



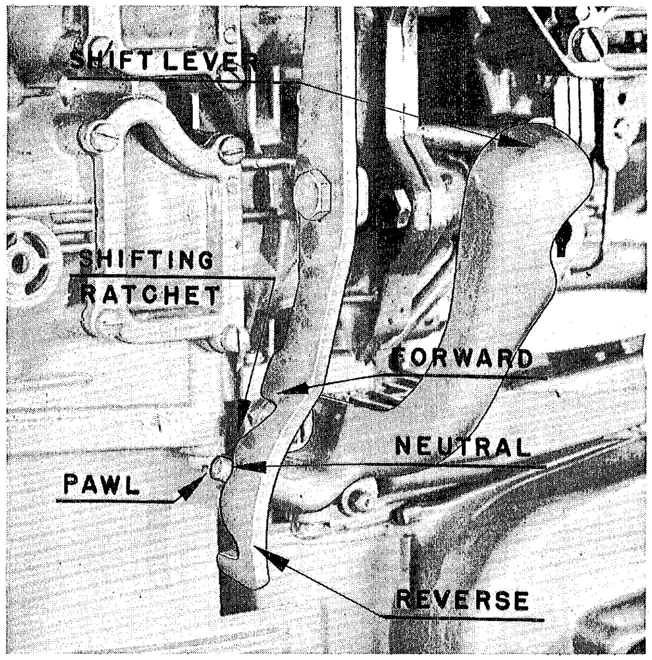
Sectional view of Models QD-14 and 15 lower unit.



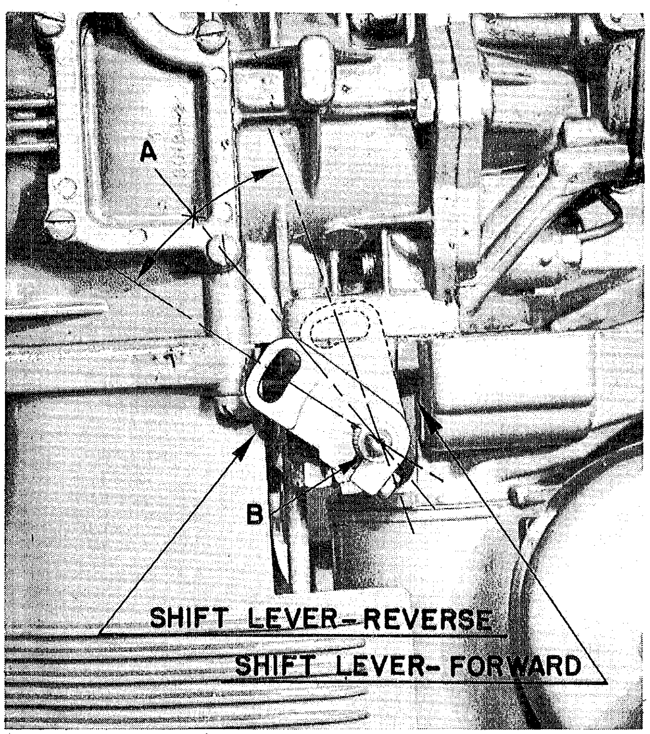
Gearcase Group – Models QD-14 and 15.



Exhaust Stack, Drive Shaft Casing and Swivel Bracket Group – Models QD-14 and 15.

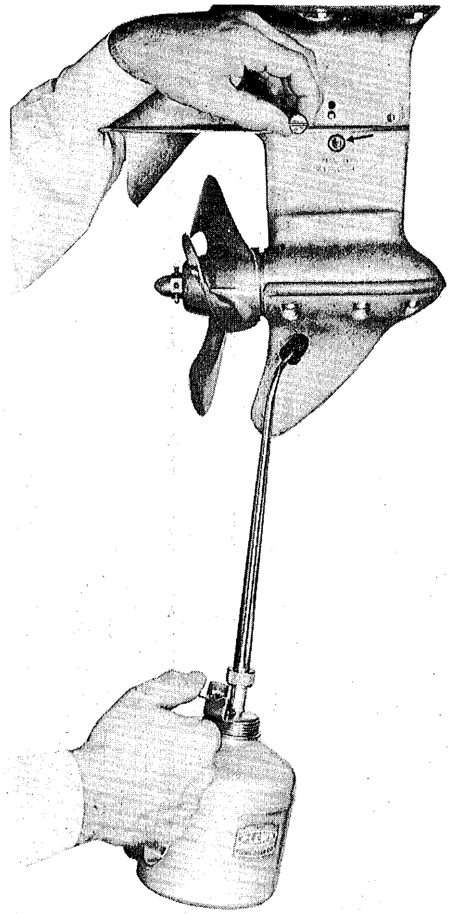


Showing location of shift lever and shifting ratchet—forward, neutral, and reverse.

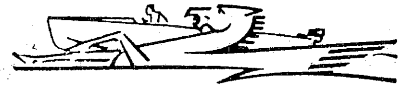


Showing positions of shift lever when in reverse and forward (phantom view). Arc and center line indicates midway position between forward and reverse. When attaching hand shifting lever, it becomes of extreme importance to first set shift lever midway between forward and reverse positions as indicated by center line "A" above. Note that hand shifting lever is made fast on shifting shaft "B" by an arrangement of serrations and a clamping device. Install hand shifting lever with pawl in neutral position of the ratchet. Place "star" washer between shift lever and pad provided on the hand shifting lever for this purpose—insert screw, install nut and "bolt" securely together.

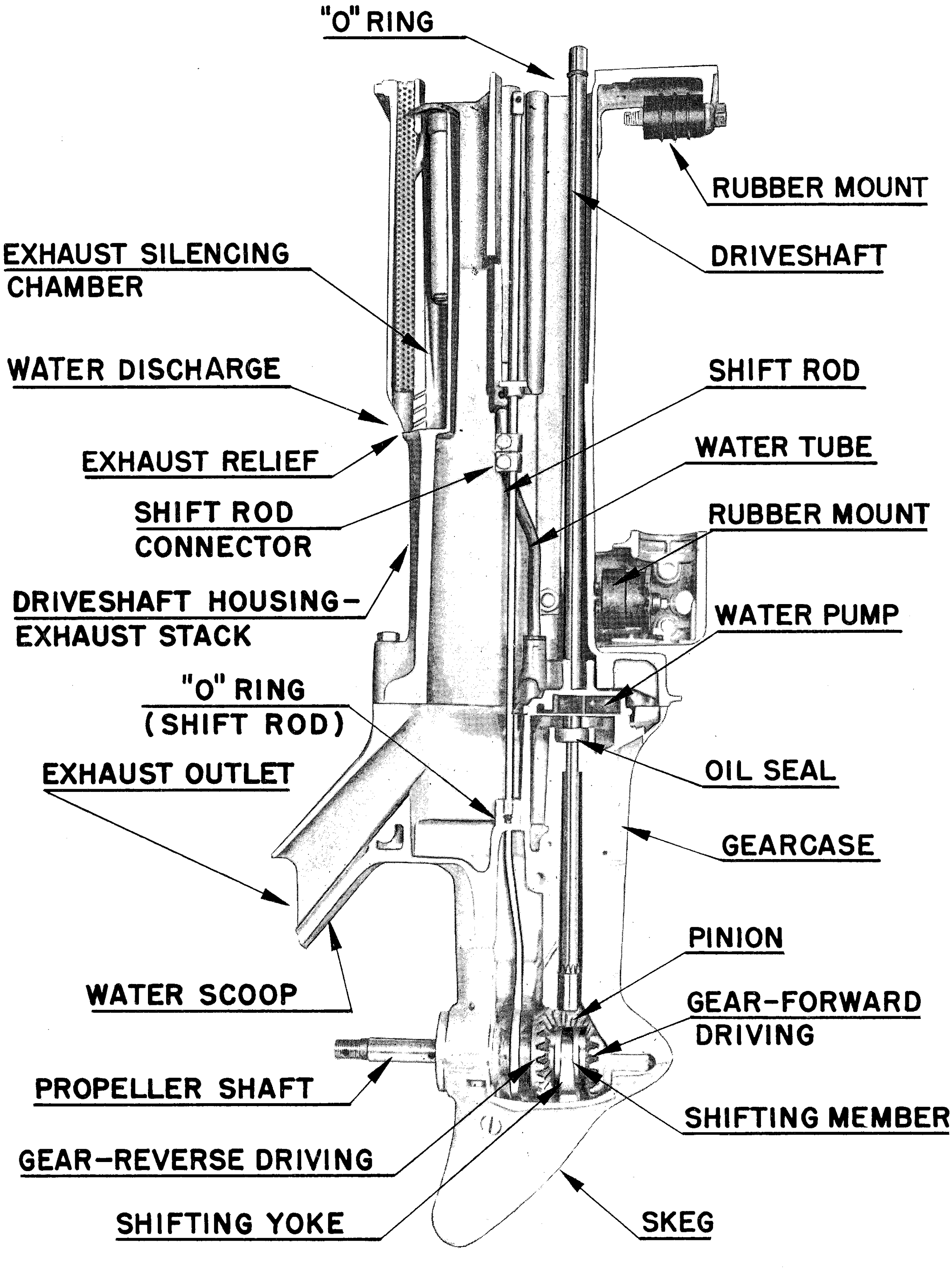
The above described operation *must* be carefully adhered to and carried out to gain "full" engagement of shifter dog (in gearcase) with forward and reverse running gears.



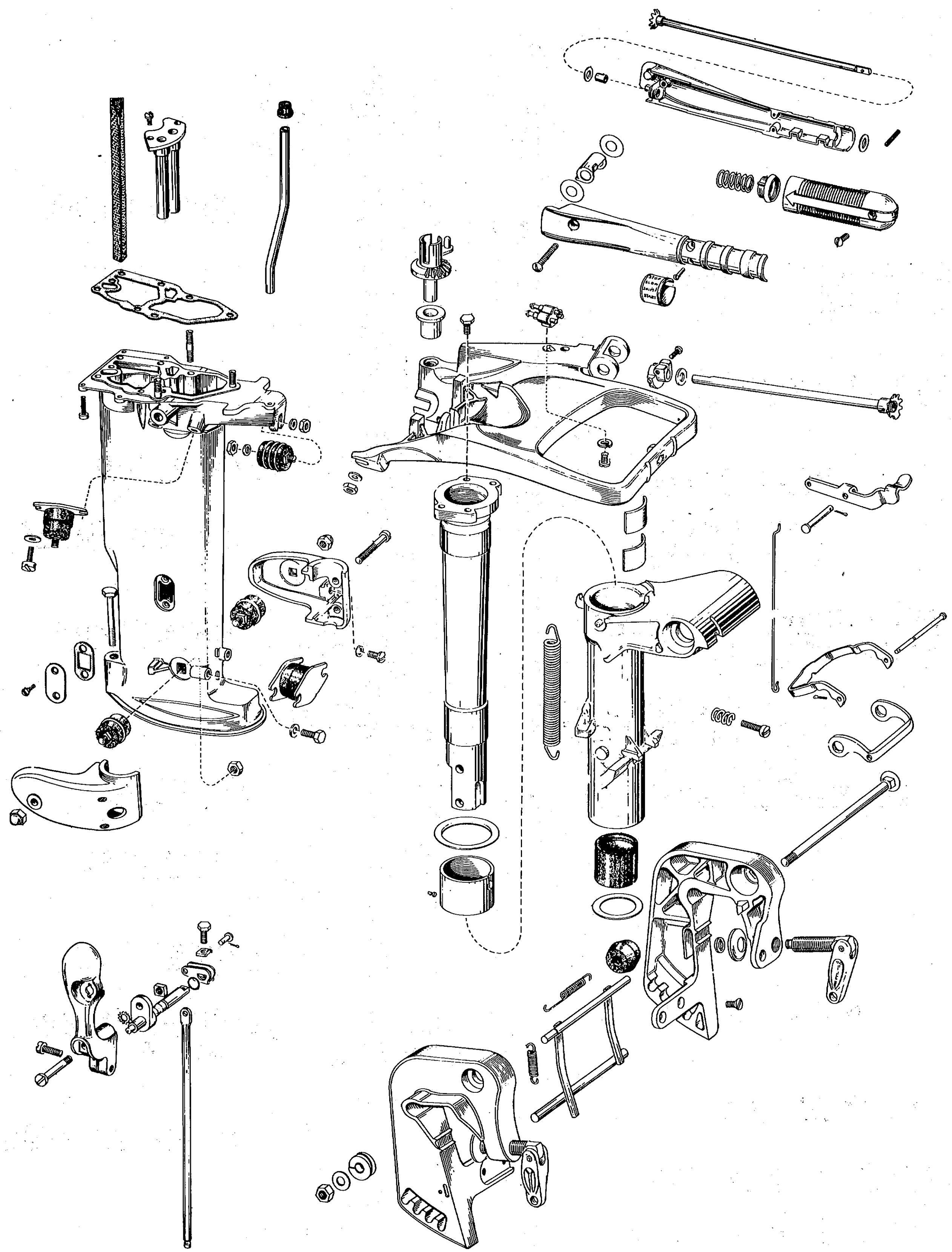
To simplify filling of the gearcase, remove the drain plug (bottom), remove fill (vent) plug at top end. Allow oil to drain in pan or other container. Install a rubber snubber on end of oil can spout as shown above (pump type oil can). Have fill plug in readiness—insert spout in drain hole. Pump oil to level of fill plug. Install "fill" plug—remove spout from drain, then install "drain" plug, since the gearcase becomes "air bound" on installing the fill plug, but little oil is lost when withdrawing the oil can spout. Make certain "plugs" and gasket washers are in good condition—install new washers whenever possible. Cement in position to avoid seepage and subsequent damage. Fill with OMC Type "C" Lube.



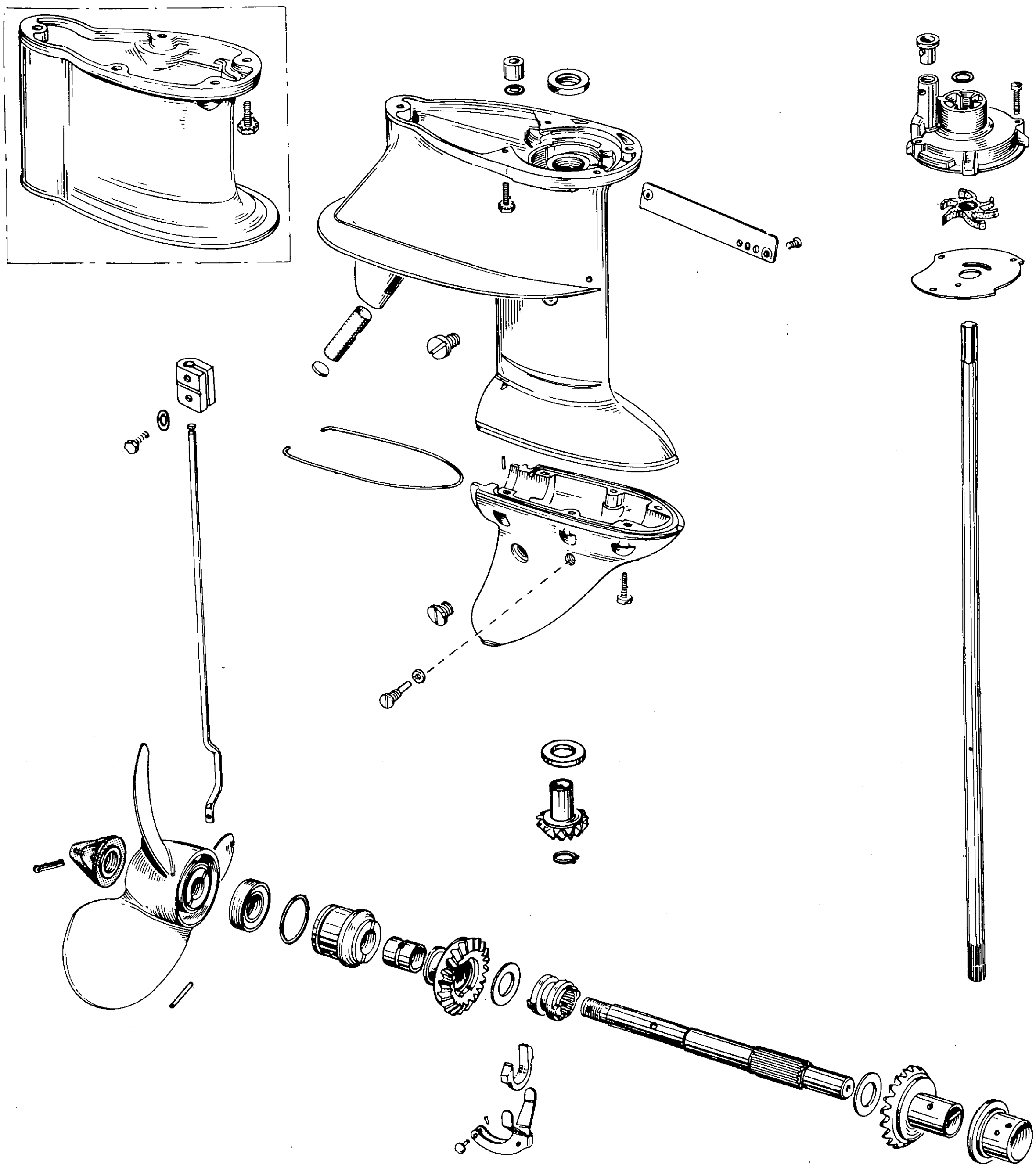
LOWER UNIT



Sectional View Models QD-16 Up, FD-10 Up, Lower Unit.

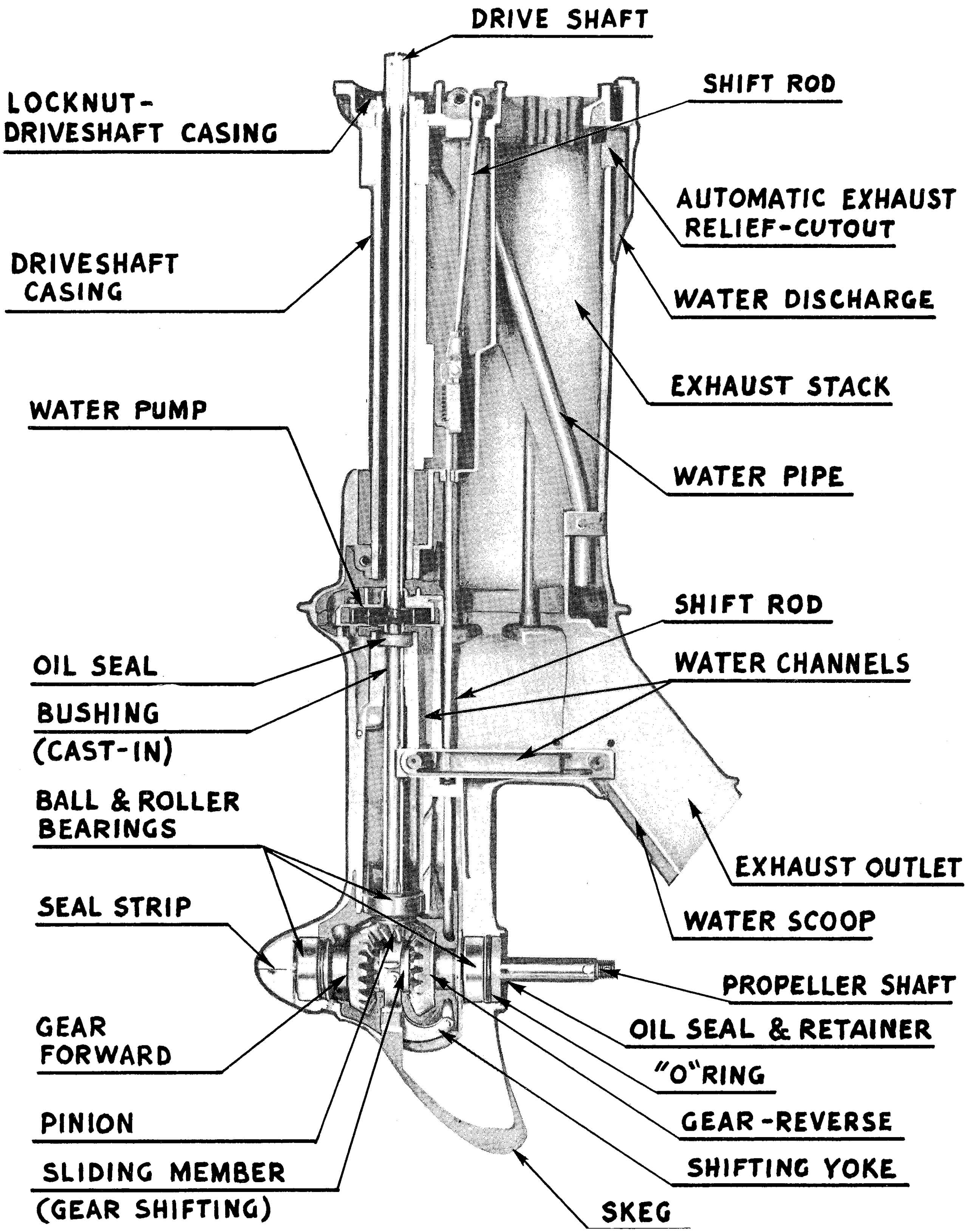


Extended View of the Stern Bracket, Swivel Bracket and Exhaust Stack Group – Models QD-16 Up, FD-10 Up.

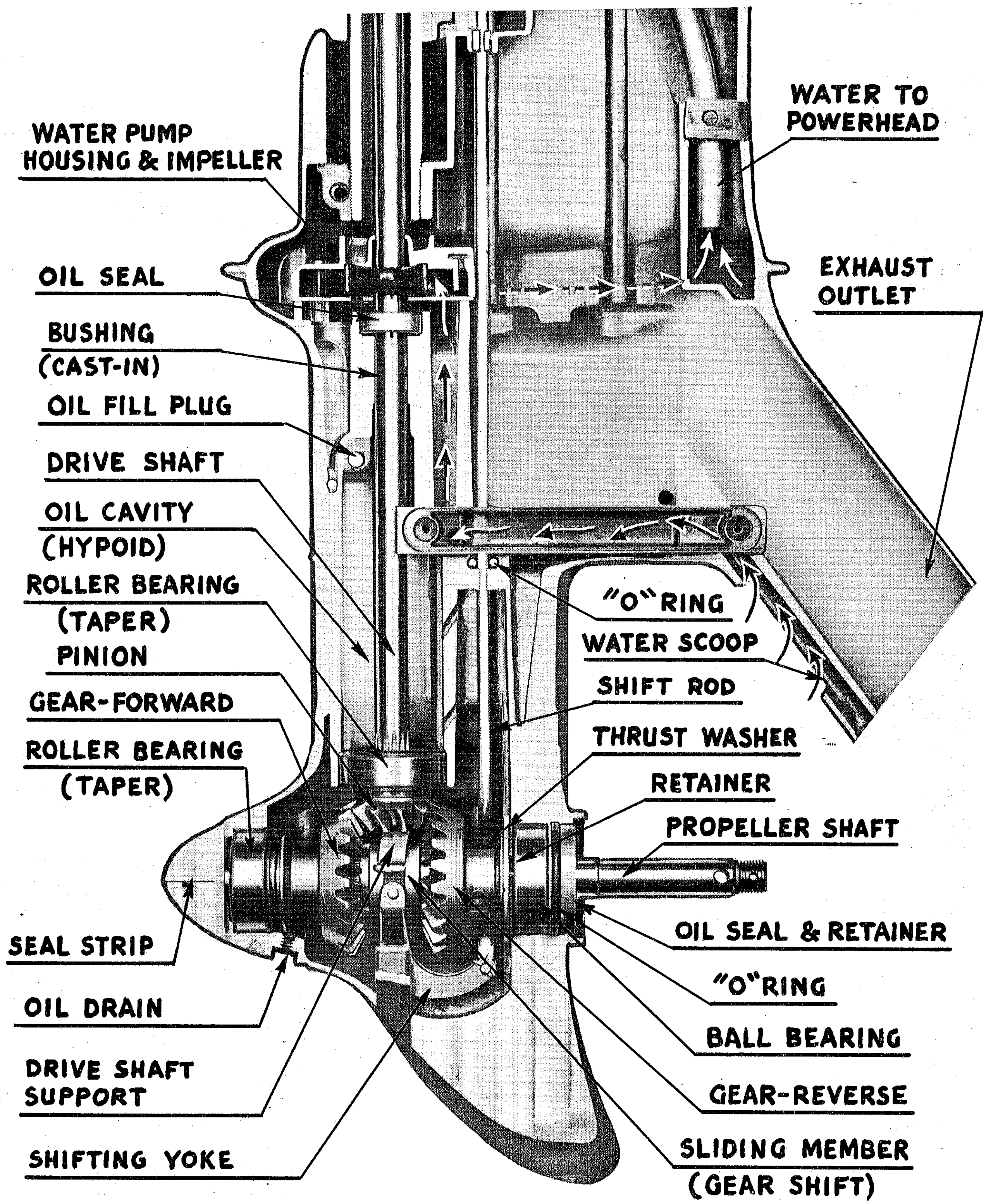


GEARCASE GROUP
Models QD-16 Up, FD-10 Up

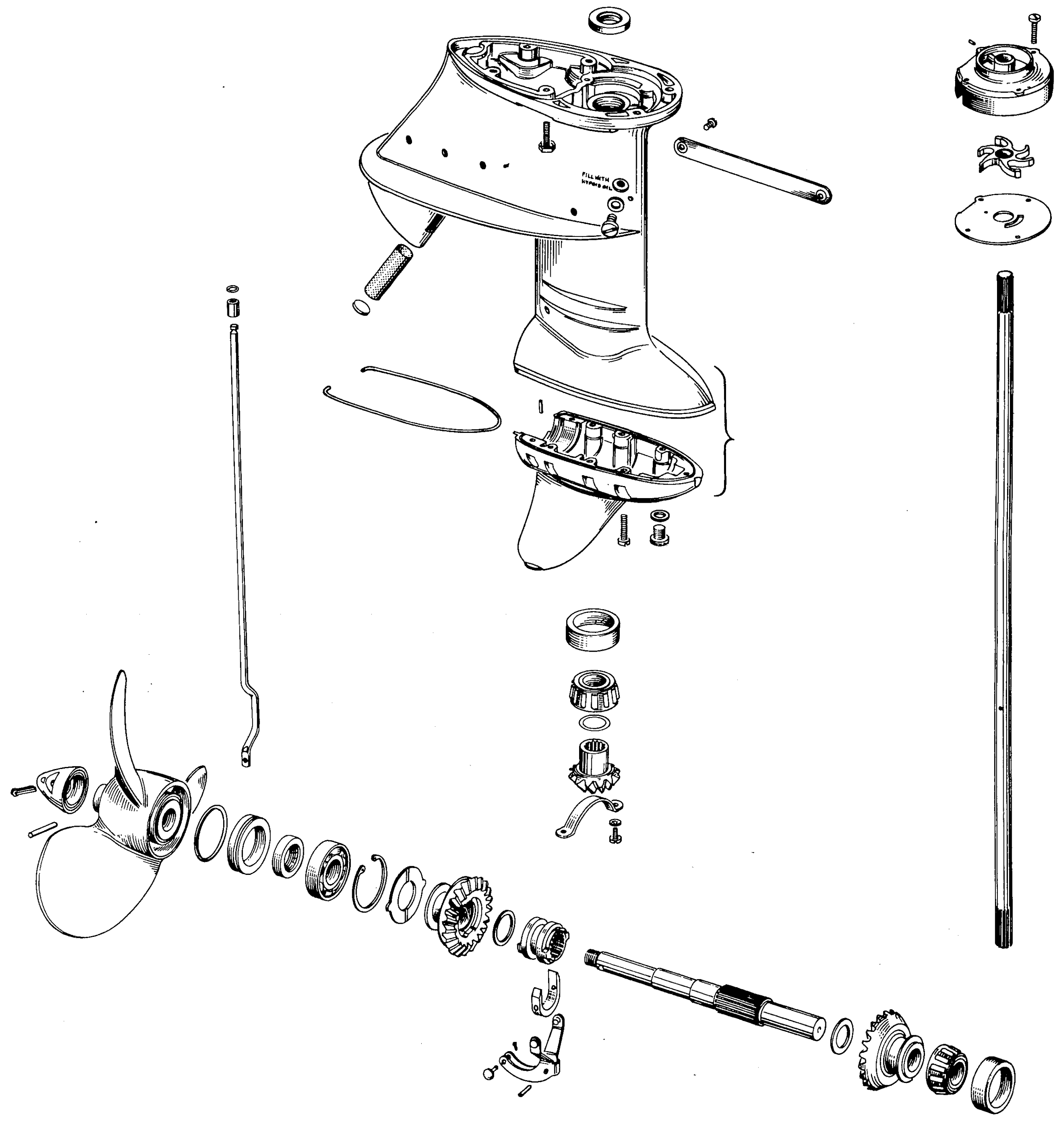
NOTES



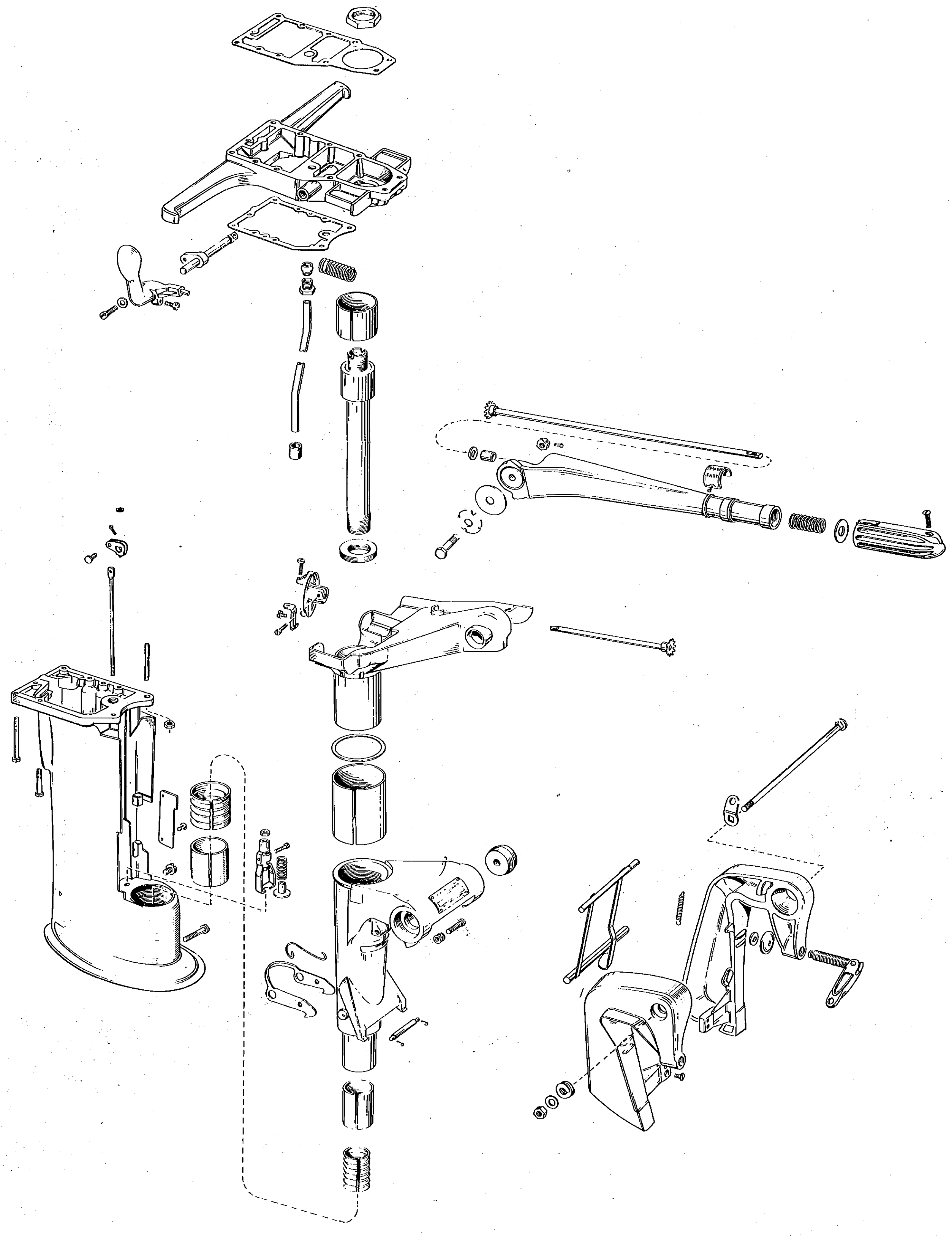
Sectional View of Lower Unit—Model RD



Sectional View of Gearcase—Model RD



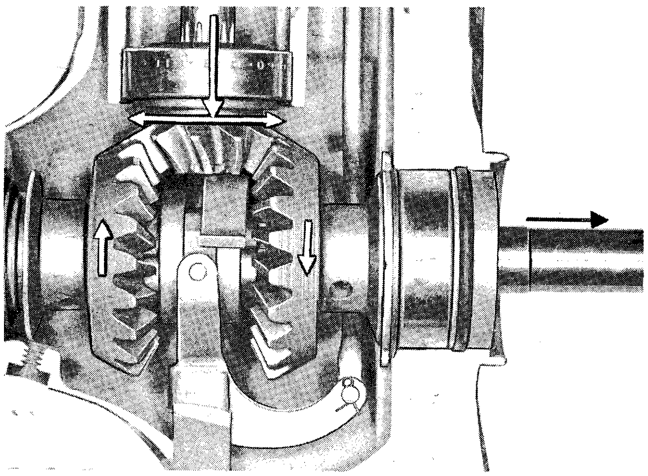
Assembly Layout of Gearcase Group—Model RD



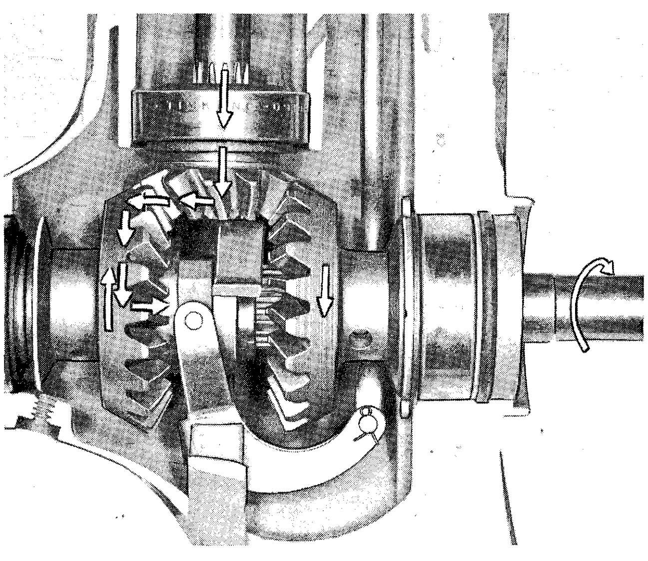
Assembly Layout—Swivel Bracket, Drive Shaft, Stern Bracket and Steering Arm Group

THE LOWER UNIT

The lower unit as can be seen from the sectionalized view contains: the driving gears (forward, pinion and reverse), driveshaft, the gear shifting, exhaust control and reverse locking mechanisms, the water pump, driveshaft casing, swivel bracket and stern brackets.

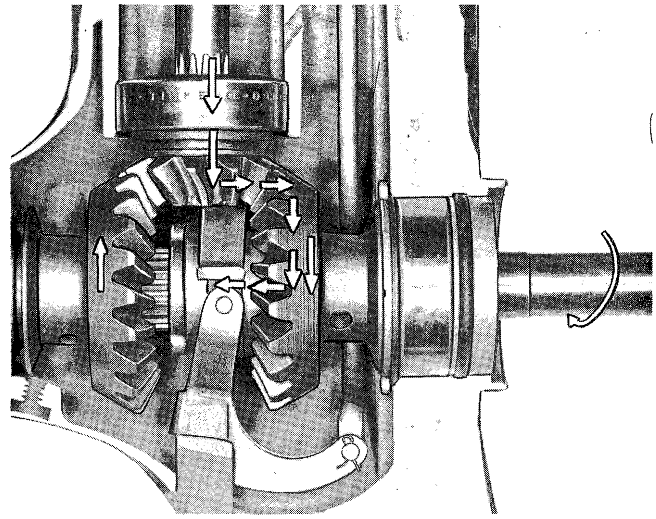


Gear Shift "Neutral"—Bevel Gears Floating Idle on the Propeller Shaft Which Remains Motionless.



Gear Shift "Forward"—Sliding Member Engaging the Forward Gear. Note Line of Drive. Gear for Reverse Is Now Floating Idle on the Propeller Shaft.

Gear shifting: To accomplish "forward," "neutral" and "reverse," three gears, a sliding member and shifting levers properly supported are required. The pinion (gear) is splined to the driveshaft and rotates constantly with operation of the motor. The bevel gears (one forward and one aft of the pinion) float or ride "free" on the propeller shaft—one in one direction and the other in the opposite direction. The sliding member is keyed or splined to the propeller shaft and remains motionless as does the propeller shaft and propeller

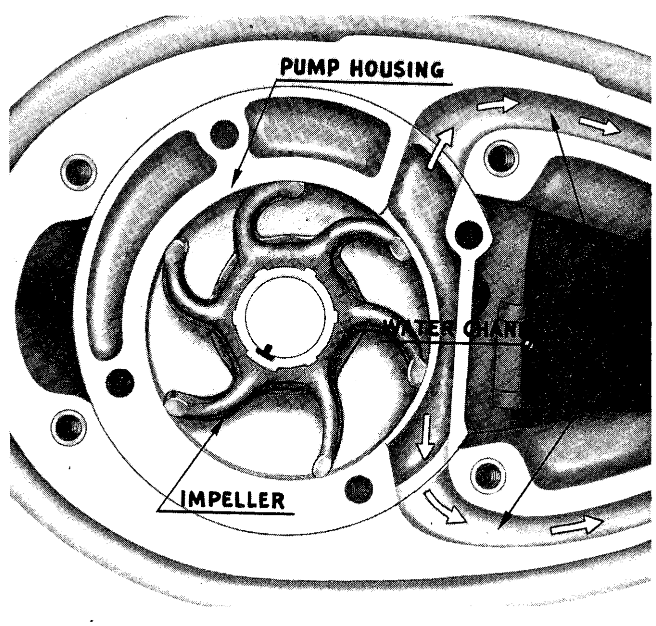


Gear Shift "Reverse"—Sliding Member Engaging the Reverse Gear. Note Line of Drive. Gear for Forward Is Now Floating Idle on the Propeller Shaft.

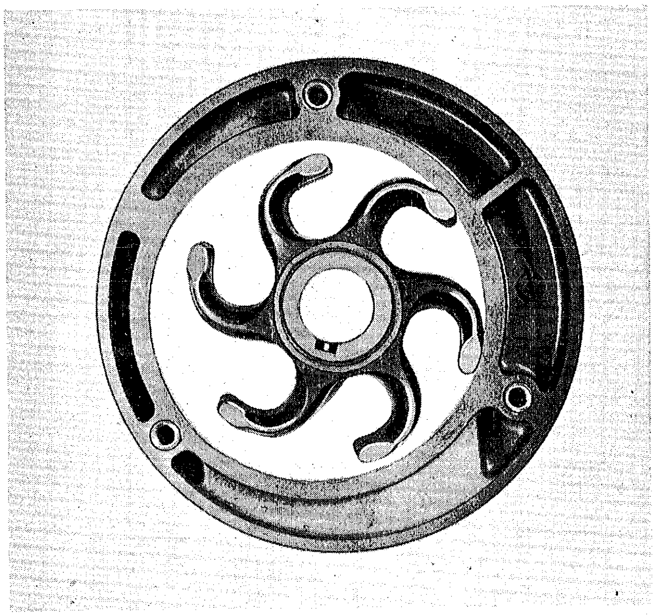
(neutral) during operation of the motor, until the "dogs" of the sliding member engage like "dogs" on either gear (forward or reverse, depending upon which gear is engaged).

The water pump provided for circulating water through the water jackets to dissipate heat consists of an impeller (with flexible synthetic rubber vanes or blades) driven by the driveshaft and rotating in an aluminum housing into which are cast ports for water discharge. Open end of the housing is closed by installation of a steel plate with elongated slot to act on the water inlet.

It will be noted from the illustration that the driveshaft does not center in the impeller or pump housing—the impeller is thus offset to one side. This fact causes the impeller blades to flex with

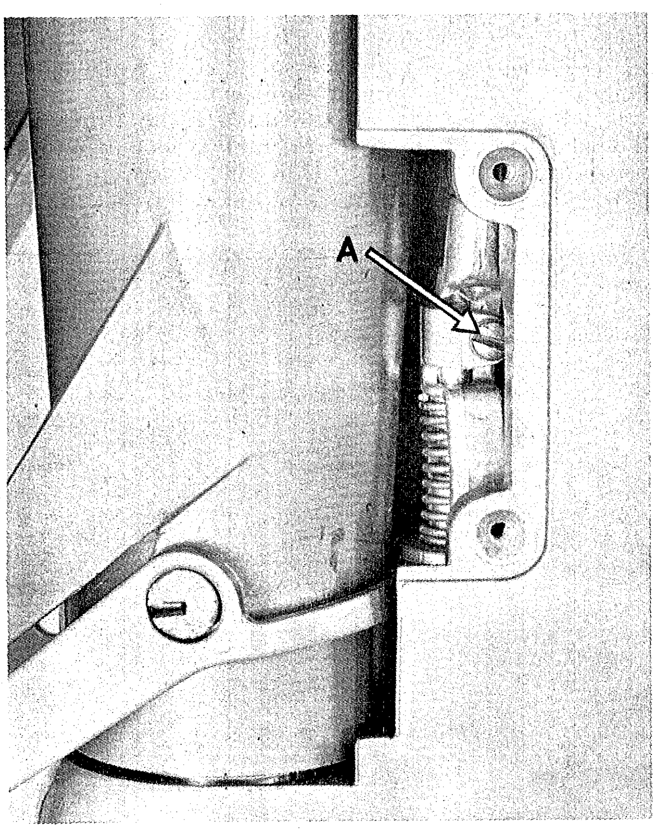


Pump Assembly.



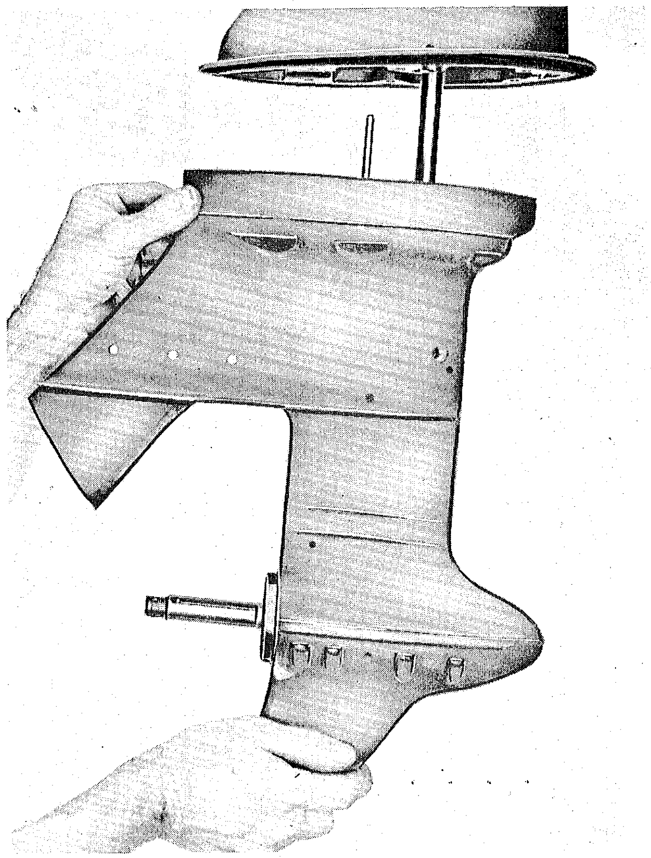
Showing Position of Impeller Blades during Operation in Higher Speed Range.

rotation — subsequently varying volume between the blades to make it a displacement type of pump when acting at low r.p.m. As motor speed increases, resistance within the pump housing increases to cause all of the blades to flex or bend in such manner it performs merely as an impeller to maintain water circulation.

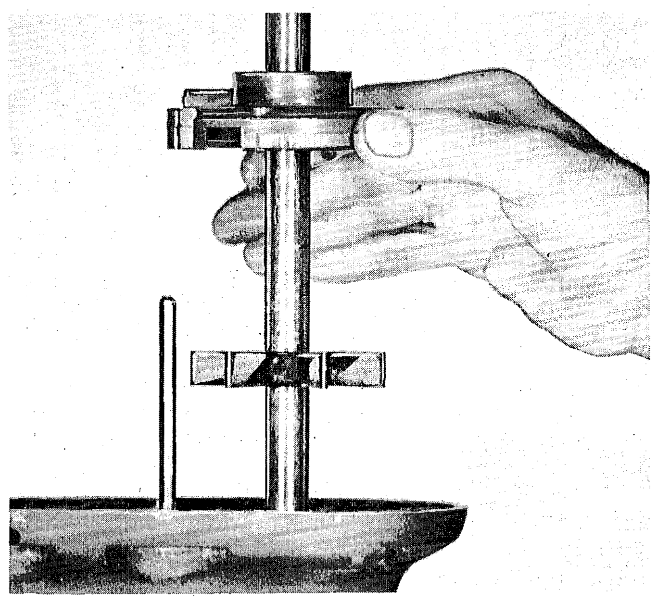


Showing Position of Screw "A" in Bracket, Connecting Upper and Lower Shift Rods.

To remove the gearcase for inspection and/or repair, remove small plate in upper housing — loosen exposed screw "A" shown below — to free lower end of shift rod. Loosen and remove bolts holding gearcase fast to the upper housing — pull from assembly as shown here. Install in reverse order.



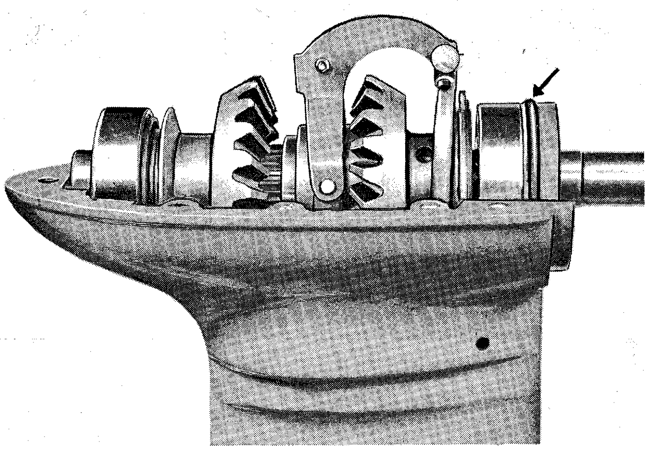
Removing Gear Case Assembly to Detach from Upper Housing.



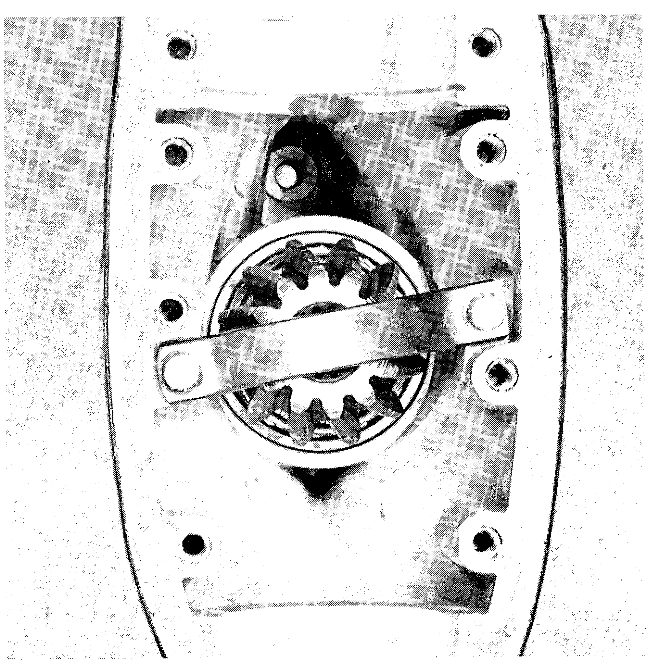
Removing Pump Housing and Impeller from the Gear Case. Pump Housing Held Fast to Gear Case by Four Screws.

To remove and disassemble the water pump, loosen and remove screws holding it to upper part of the gearcase—the pump housing, impeller and cover plate may then be separated and removed with the driveshaft.

To remove gearcase lower cover (skeg) for inspection and/or replacement of parts, remove screws holding it fast to the gearcase proper. It may adhere strongly—in this event, strike the skeg lightly with mallet to jar loose. Removal exposes running gear assembly and shifting mechanism for removal. Remove pin attaching shifting member to shifting shaft—lift shifting member off—lift propeller shaft, bearing and gear assembly from its "bed" in the gearcase. The propeller oil seal-retainer can be taken off over the end of the shaft—Note "O" ring to accomplish "seal" between the propeller shaft oil seal retainer and sections of the gearcase.



Skeg Removed to Expose Gear Case Mechanism for Inspection and/or Repair.

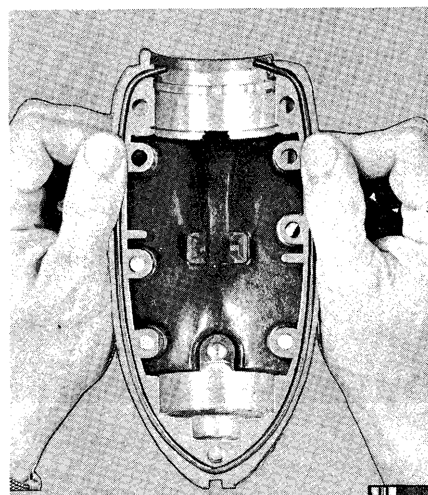


Showing Installation of "Bridge" Piece to Support Driveshaft and Gear.

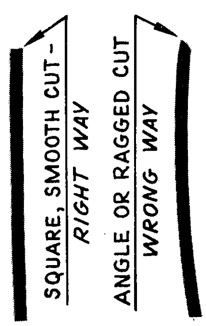
Pinion (gear) bearing assembly and driveshaft are supported in the gearcase by a small "bridge" held fast by two screws—to remove the gear and bearing assembly, simply detach the bridging piece. Gear and bearing are available as an assembly only.

Reassemble gearcase in reverse order of this, described with necessary new parts. Replace lower gearcase section (skeg).

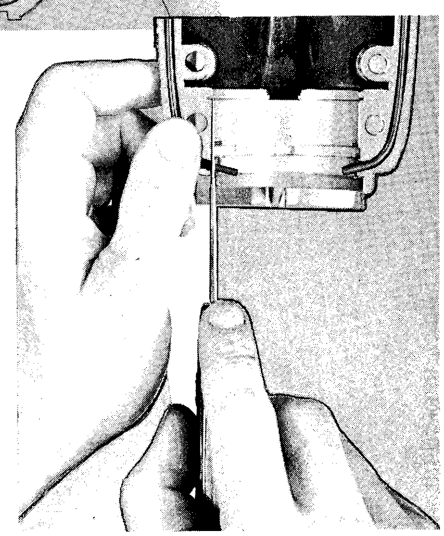
The seal strip, when purchased as a service part, comes just a bit too long for installation "as is"—this is to permit proper installation or adjustment in corresponding grooves—gearcase. To install—remove all traces of cement on gearcase faces and grooves, if necessary. Apply Sealer 1000 (or similar hard drying cement) at several points along the grooves and particularly at the end of each groove. Place seal strip in position immediately



Installing Seal Strip.



Illustrating Proper Cutting of Seal's Ends.



Trimming Seal Strip.

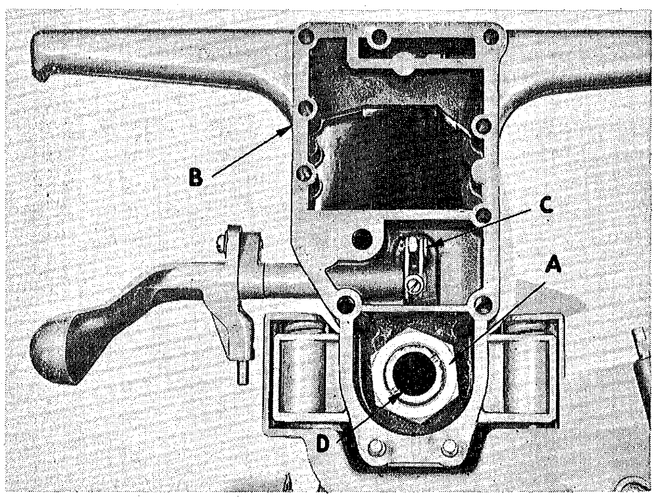
(before the sealer dries) allowing each end to overhang slightly, then, before the sealer sets, guide the entire length of the strip towards outside edge of the groove in each case. Use thumbs of each hand to accomplish as illustrated. Trim ends with knife as shown—ends hanging over just a bit to insure proper seal at the end of the strip.

Apply thin coat of Sealer 1000 to surfaces to be bolted together—be somewhat more generous with sealer in areas at ends of the seal strip to insure a good "butt" seal.

Apply Sealer 1000 (or similar hard drying cement) to threads of bolts holding sections together. The threaded areas must be "oil tight" too.

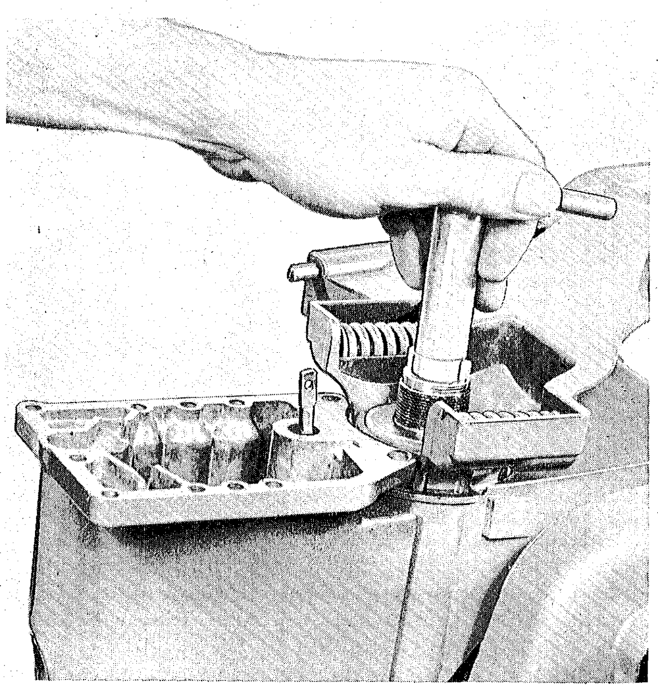
Refill with hypoid gear oil as instructed.

To disassemble the upper lower unit section, for replacement of the swivel bracket, it is, of course, necessary to detach the power head.

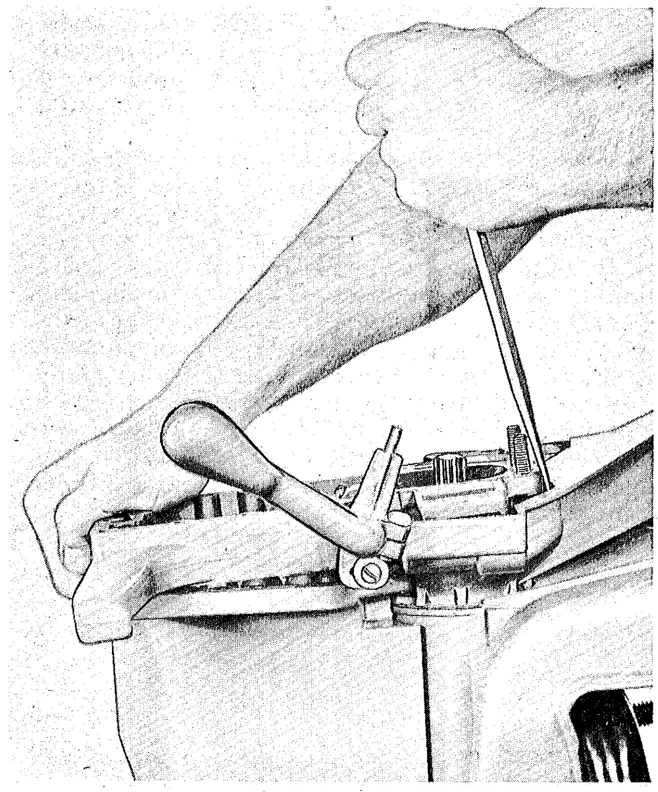


Power Head Removed to Expose Details of Lower Unit Assembly—Upper Section.

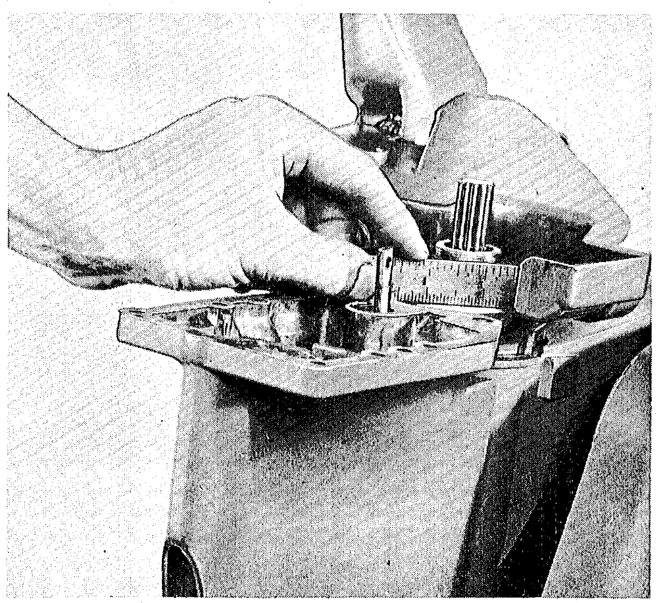
Remove nut "A" shown above and pin "C." Carefully pry adaptor "B" from its position. Remove driveshaft casing "D." Lift swivel bracket from its position; replace if required and reassemble in reverse order. Note collar on top end of the driveshaft casing. Turn driveshaft casing down until top surface is "flush" with top face of the exhaust stack. This is **Important** to avoid strain of misalignment.



Showing Method of Removing the Driveshaft Casing with Special Tool.

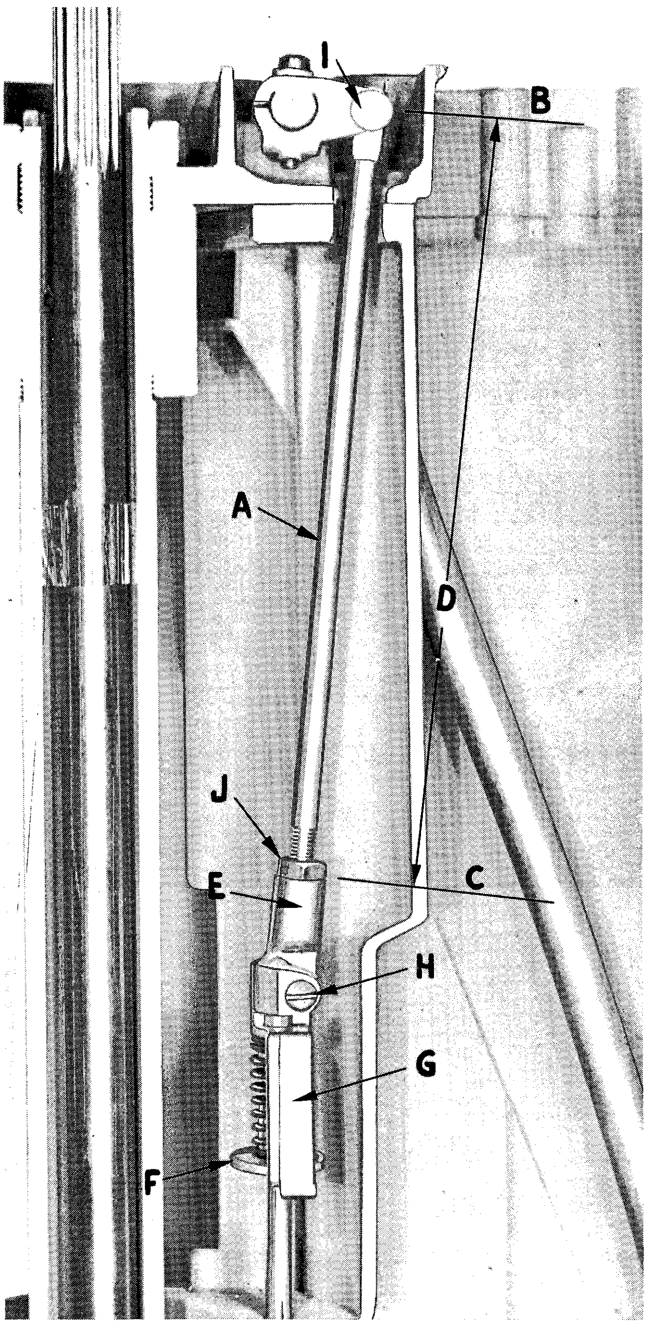


Illustrating Method of Replacing Adaptor "B"—Carefully Applying Pressure against Torque Springs to Properly Locate.



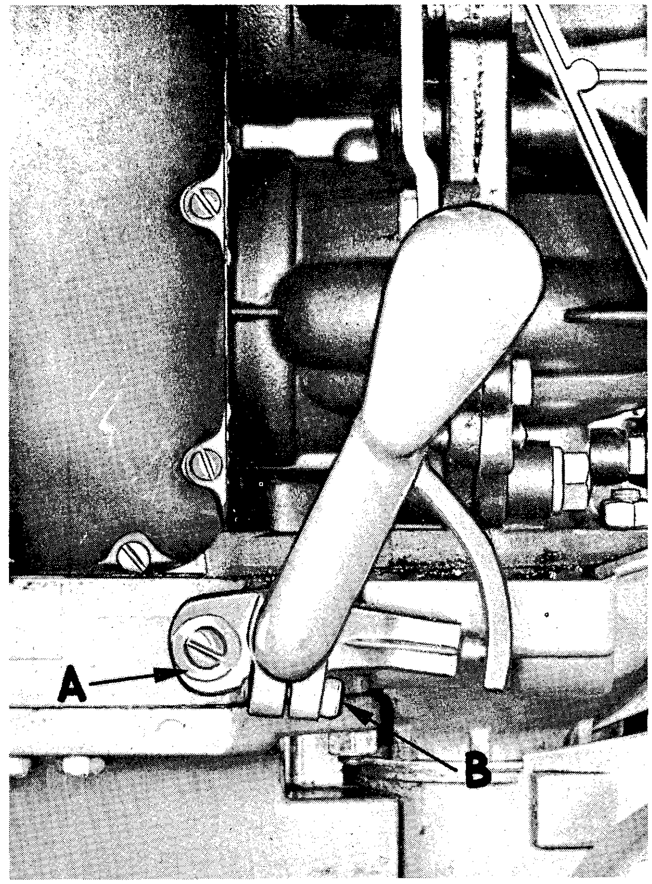
Checking Alignment of Driveshaft Casing and Top Face of Exhaust Stack.

After having completed assembly of the upper lower unit section and prior to attempting adjustment of gear shifting mechanism, it is advisable to check distance "D"—shown below. Correct distance between "B" (center of pin "I") and "C" (top face of bracket "E") is 7 1/8"—obtained by turning shaft "A" into or out of bracket "E" as required and locking to position with nut "J."

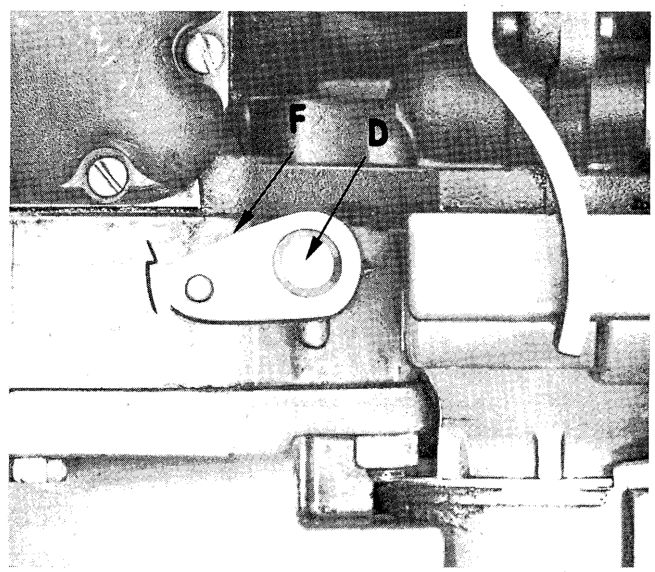


Sectional View to Show Upper View of Shifting Mechanism —"A," Upper Shift Rod; "E" and "G," Connecting Bracket; Washer "F" to Act on the Reverse Lock.

To adjust gear shifting mechanism: (1) loosen screws "A" and "B" (shown below) to permit free movement of the shift arm; (2) with screws "A" and "B" loose, move the shifting lever to FORWARD running position; reach back of the shift lever—move bell crank "F" up to extreme limit of its travel, then release slightly (just a "hair") to relieve pressure of sliding member in the gearcase against the "forward" gear; (3) rock the propeller back and forth to make certain sliding member properly engages the forward gear (does not "butt" against the gear without engaging); (4) draw up on screws "A" and "B" to secure in this position.

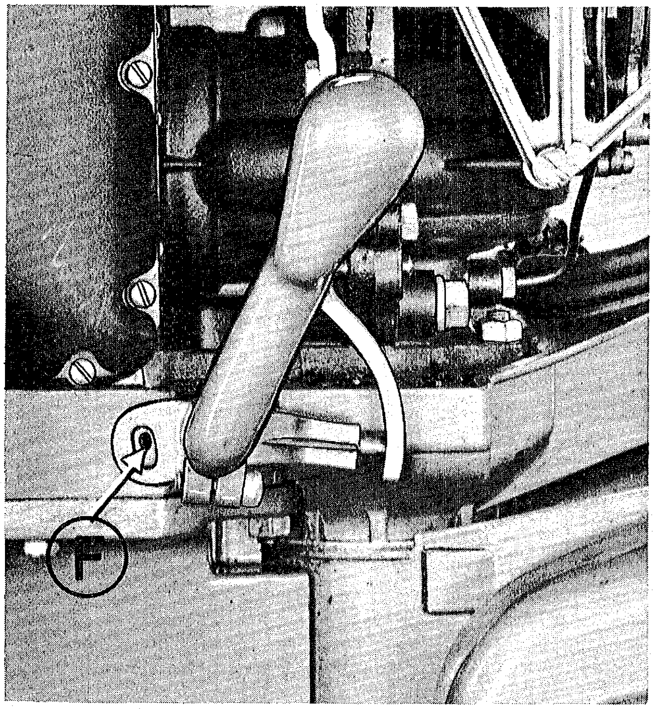


Illustrates Position of Shifting Arm when in Forward. Note "Pin" on Shifting Arm Comes to Rest in Lower Notch of Speed Limitation Control Arm.

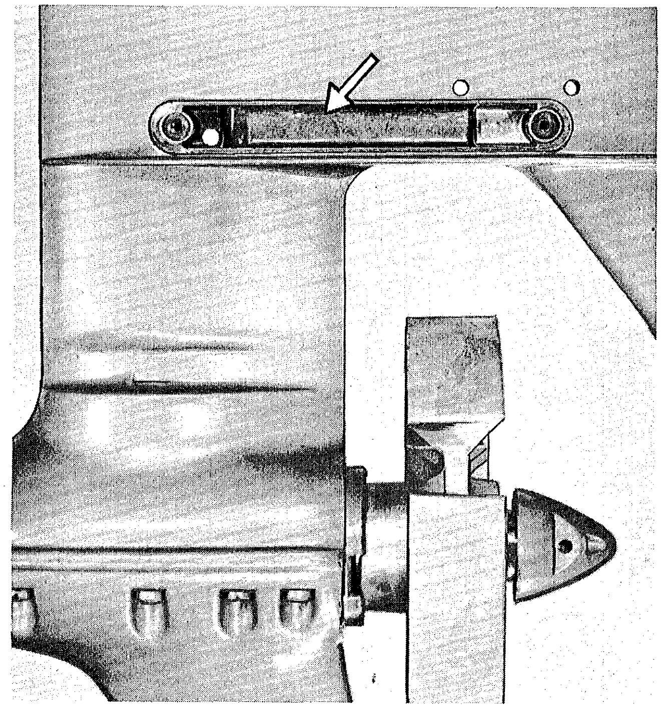


(Shift Lever Removed) Illustrates Forward Position of the Bell Crank Attached to Shaft "D" Resting Back of the Shifting Lever.

When tank testing the Model RD, it may be advisable to remove the strip plate above the anti-cavitation plate as indicated by arrow below — to assure sufficient water for cooling. Make sure it is restored on completion of tank test.



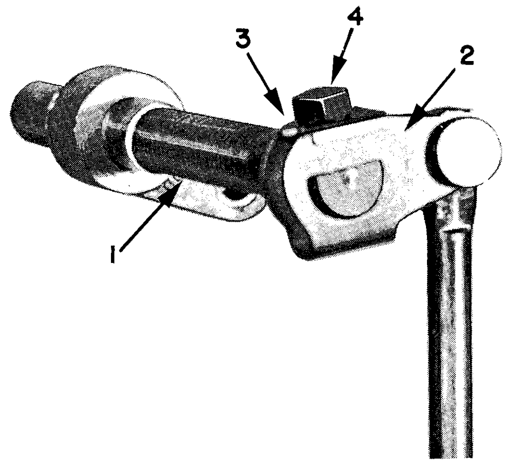
Illustrates Slot in Small Quadrant on the Shifting Lever to Permit Adjustment with Respect to Position of Bell Crank "F."



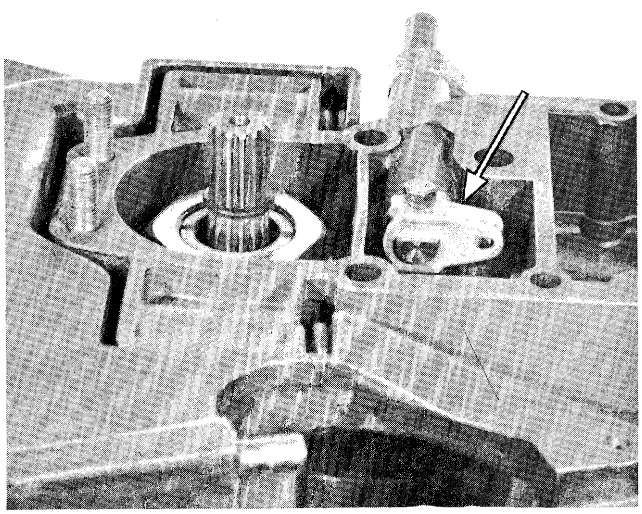
Showing Test Wheel Installed and "Strip" Removed for Tank Testing.

NOTES

RD—LOWER UNIT



(1) 376198 Shift Lever and Shaft Assembly
(2) 303720 Lever
(3) 303721 Lock Clip
(4) 303722 Screw

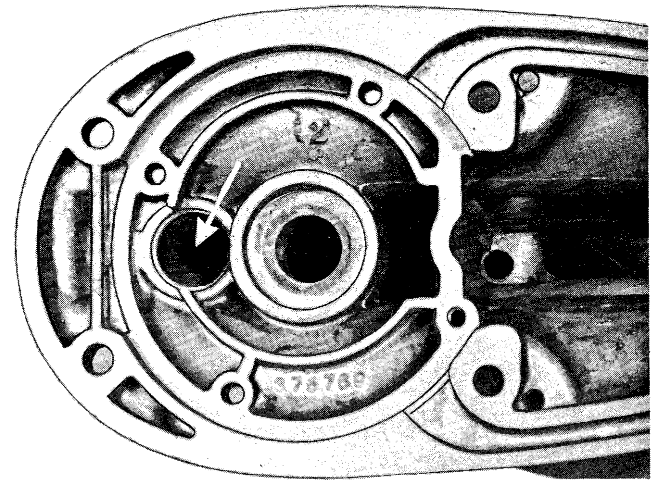


A change was put through affecting interchangeability of certain parts in the Model RD series — which resulted in setting up the Model RD-15A to distinguish it from earlier production. Parts affected which are not interchangeable include those that make up shift linkage in top end of the lower unit assembly as illustrated here. All parts illustrated can and should be installed on RD's brought into the shop and on every opportunity presented — but must be installed as a group on RD's earlier than RD-15A.

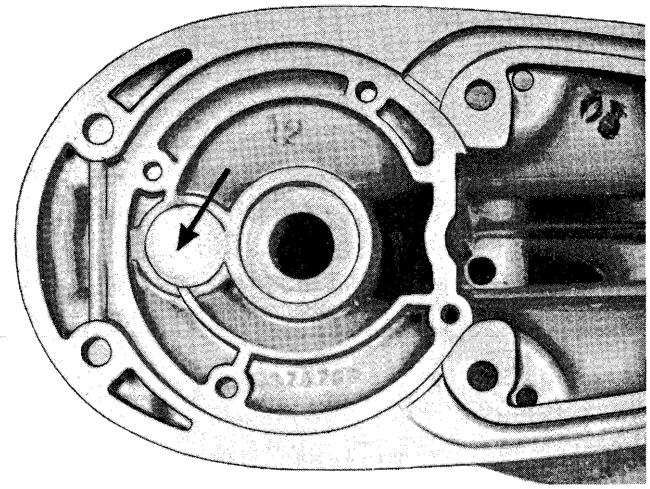
Reason for change in design and construction of this group of parts is to avoid possibility of lever #302644 working loose on shaft assembly #376198 and thus insure positive action of clutch dog (375783) in the gearcase — The parts are of more sturdy construction as will be noted and once properly installed will hold.

To install—

1. Insert shaft assembly (1)
2. Attach lever (2)
3. Place lock clip (3)
4. Install and draw up snugly screw (4). Shaft (1) is threaded to receive the screw.
5. Bend small lip or lap on lock clip (3) up against head of screw (4) to secure position.
6. Complete balance of assembly.



Arrow location for Core Plug Installation.



Showing Core Plug Installation.

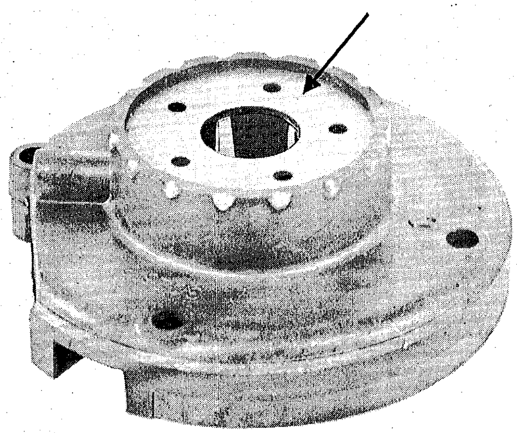
Illustrated here are two top views of the Model RD gearcase — observe that round hole indicated by arrow is open in the top view and closed in the lower view — by a core plug installation.

A cavity is cast into the gearcase with a drain hole at its bottom end to permit water escaping when the motor is removed from the boat. The drain hole is located just above the anti-cavitation plate — under certain conditions, it is possible that air enters the "suction" side of the cooling system to break the seal to cause irregular functioning of the pump.

To overcome and guard against possibility of "air" entering the "suction" side of the pump, the round hole observed in the top view has been sealed with core plug #306352.

To install the core plug, clean wall around the hole, smear sealer 1000 around edges; place core plug in position — convex side (hump) up; drive core plug into position — use a mandrel of 3/4″ round bar stock, "squared" off at the end; strike opposite end with hammer to expand and secure the core plug.

A change was made some time ago in design and construction of the RD pump housing to facilitate better pumping qualities in the higher speed ranges.

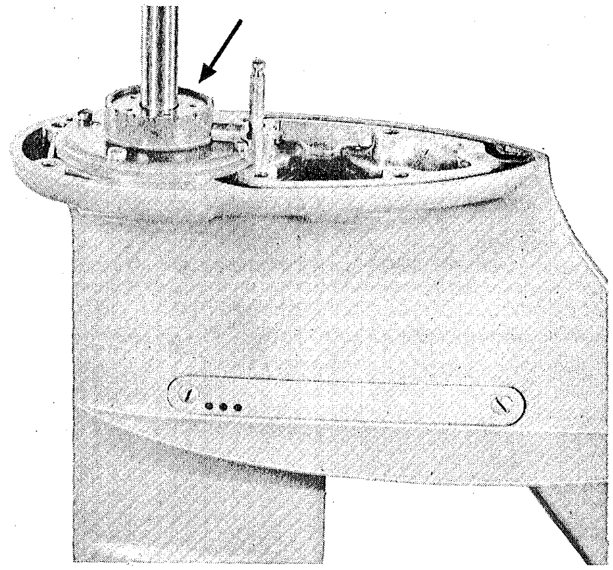


Improved Pump Housing.

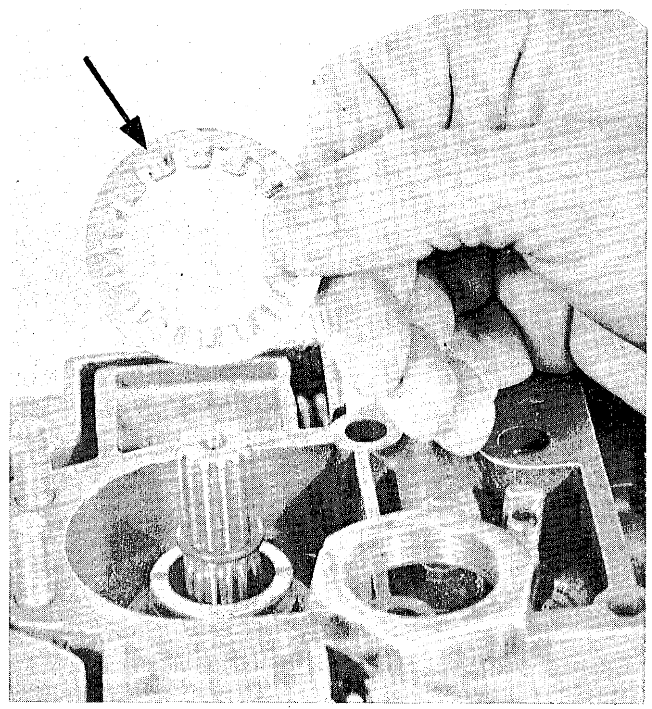
The old and new pump housings are alike in all respects except with relation to the top side, where baffles covered by a stainless steel plate have been introduced (as shown here) to obtain a more satisfactory water seal during high speed operation. Otherwise, there was a tendency for air to seep into the circulating system by way of the driveshaft; this possibility has been further eliminated by reducing clearance between the revolving driveshaft and pump housing.

To accomplish "sealing" at this juncture, some water is permitted to escape from the pump proper which is channeled into the newly created seal pocket—top side. The baffles prevent forming of a "whirlpool" within the seal pocket thus avoiding the entrance of air at its vortex about the driveshaft. A more "solid" body of water is subsequently maintained in the sealing area.

Some additional "sealing" of the pump is obtained by establishing slight convexity top (inner) side of the pump housing cover plate — scarcely noticeable on casual observation since but .010" to .020" of convexity is involved. The resultant "hump" is sufficient to bear against the impeller hub to cause a better seal on the bottom side too.



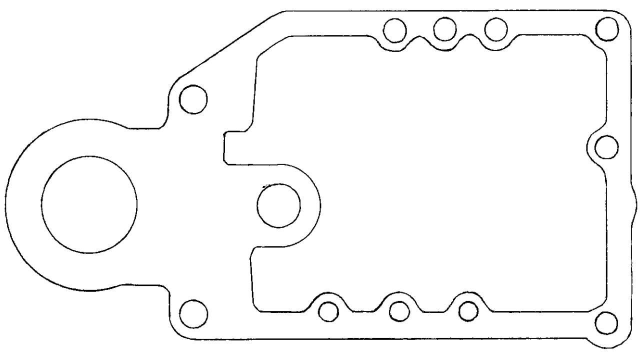
Showing location of the water pump as attached to the gearcase.



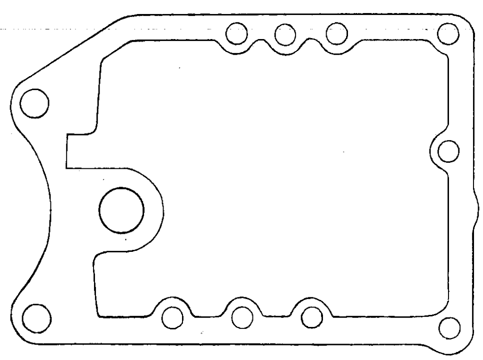
To better secure position of nut #302642 installed on the top end of the driveshaft casing — lower unit Model RD, a lockwasher #303755 has been added, as illustrated here. Installation is a simple procedure after having detached the powerhead — remove the nut, place washer in position over the driveshaft casing, then replace and draw up tightly on the larger nut. Use a 1-11/16" socket. Draw up to 65 foot pounds.

#302821 GASKET REDESIGNED FOR UPPER END OF MODEL RD-10 THROUGH 15a SERIES LOWER UNITS

Shown here are outlines of the current and former gasket #302821. The current gasket should be installed when making lower unit repairs on all Model RD-10 through RD-15a.



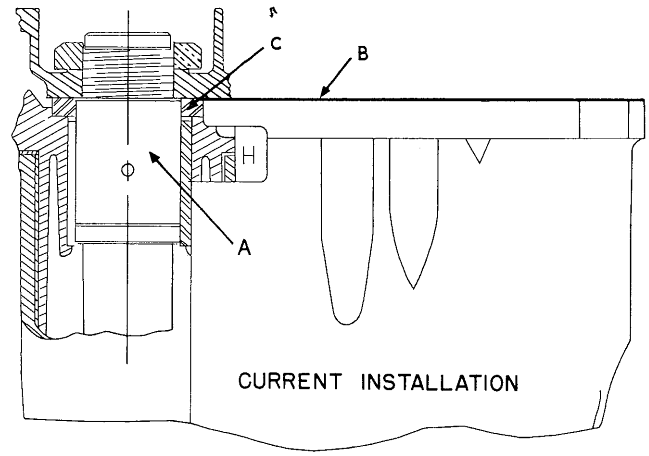
Outline of Former Gasket.



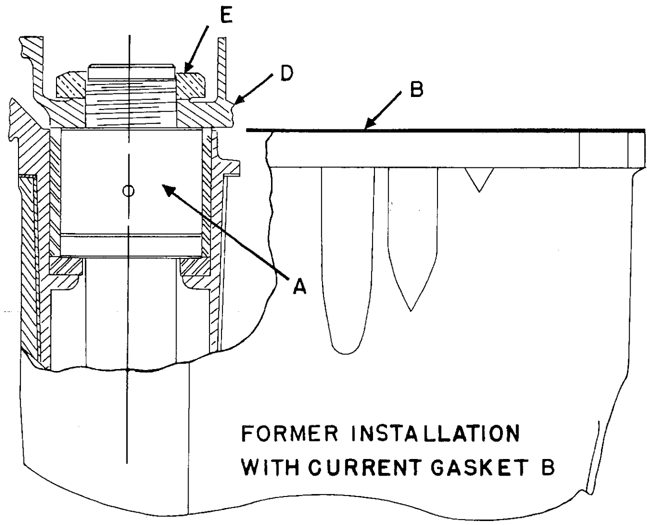
Outline of Current Gasket.

Reason for redesigning outline of the original gasket resulted from the fact that it was being damaged between the narrow shoulder on the driveshaft casing sleeve "A" and adapter "D" causing the driveshaft casing nut to work loose. Metal to metal contact is achieved on installation of the current gasket to better secure position of the nut with aid of lock washer #303755, torque nut to 65 foot pounds.

Some alignment of the driveshaft casing (tube) is required with installation of the gasket — top of sleeve "A" flush with top of gasket face "B." Important to avoid strain of misalignment. See page 434.

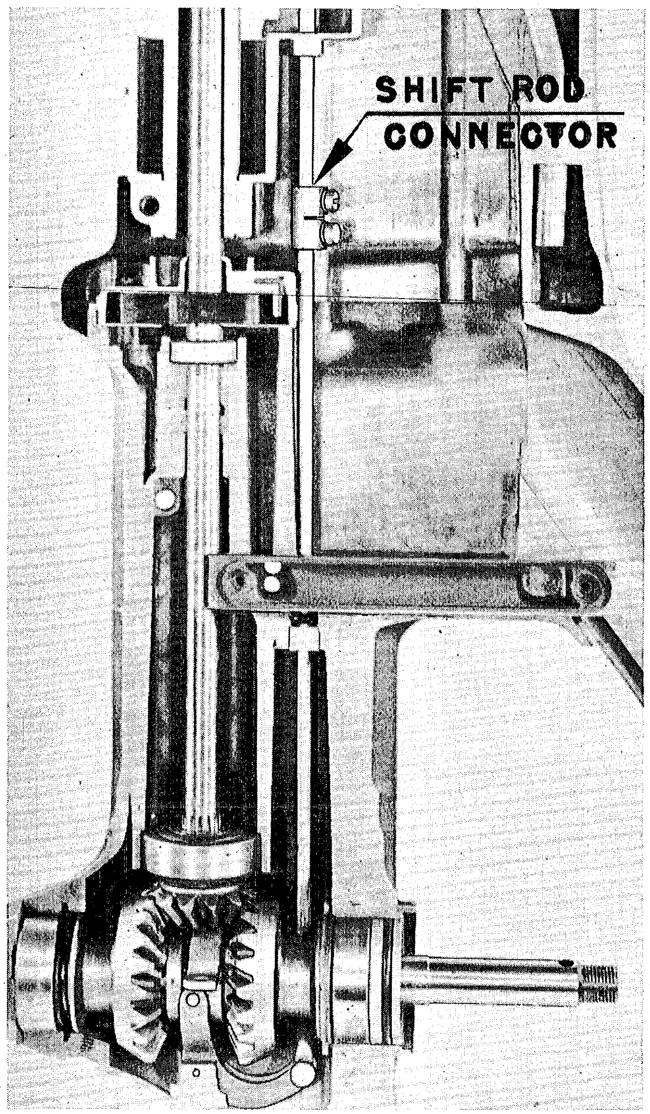


Adjusting, Removing and/or Installing Driveshaft Casing.

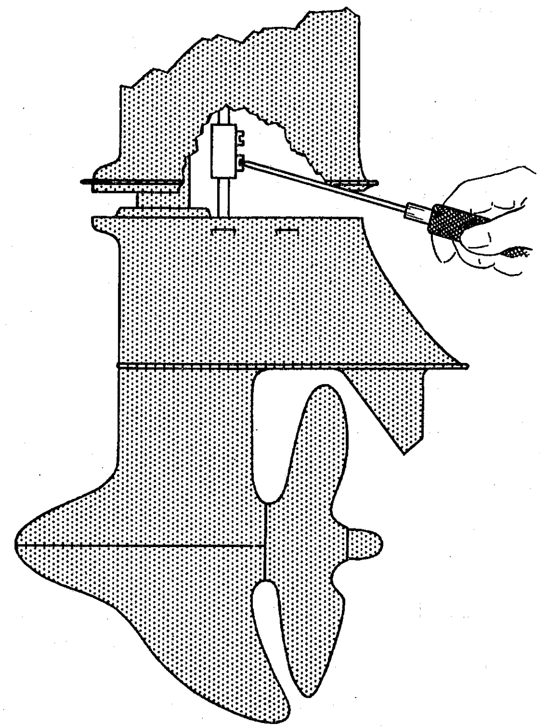


Checking Alignment Top Face of Sleeve A—Flush with Top Face of Gasket B.

When assembling RD-10 to 13, inclusive, apply thin coat of Sealer 1000, or similar hard drying cement, to top face of sleeve "A" prior to installing adapter "D" and driveshaft casing nut "E." Cementing operation not necessary on RD-14 and up since rubber washer "C" acts to seal in this case. However, its chief function is to absorb shock at this point.



Showing installation of the shiftrod (upper and lower) connector which must be disconnected to permit removal of the gearcase for repair or replacement of the waterpump.



Commencing with the RD-15 series, changes were made in the upper and lower shifting rods to accommodate a redesigned connector; upper shift rod #302641 was replaced with rod #303471 (RD-15), lower shift rod #302627 was replaced with #303472 (RD-15) and clamp (connector) #302628 was replaced with connector #303794 (RD-15).

Resultant change in position of the connector has required a different approach to gain access for disassembly. To accomplish, remove all screws holding the gearcase fast to the exhaust stack which permits "dropping" the gearcase approximately 1/2" to expose the connector screws for removal.

When replacing, make certain mounting faces are "flat" and smooth — coat threads of screws with Perfect Seal #4 (#301719) or similar non-drying cement to assure "easy" removal or subsequent repairs.

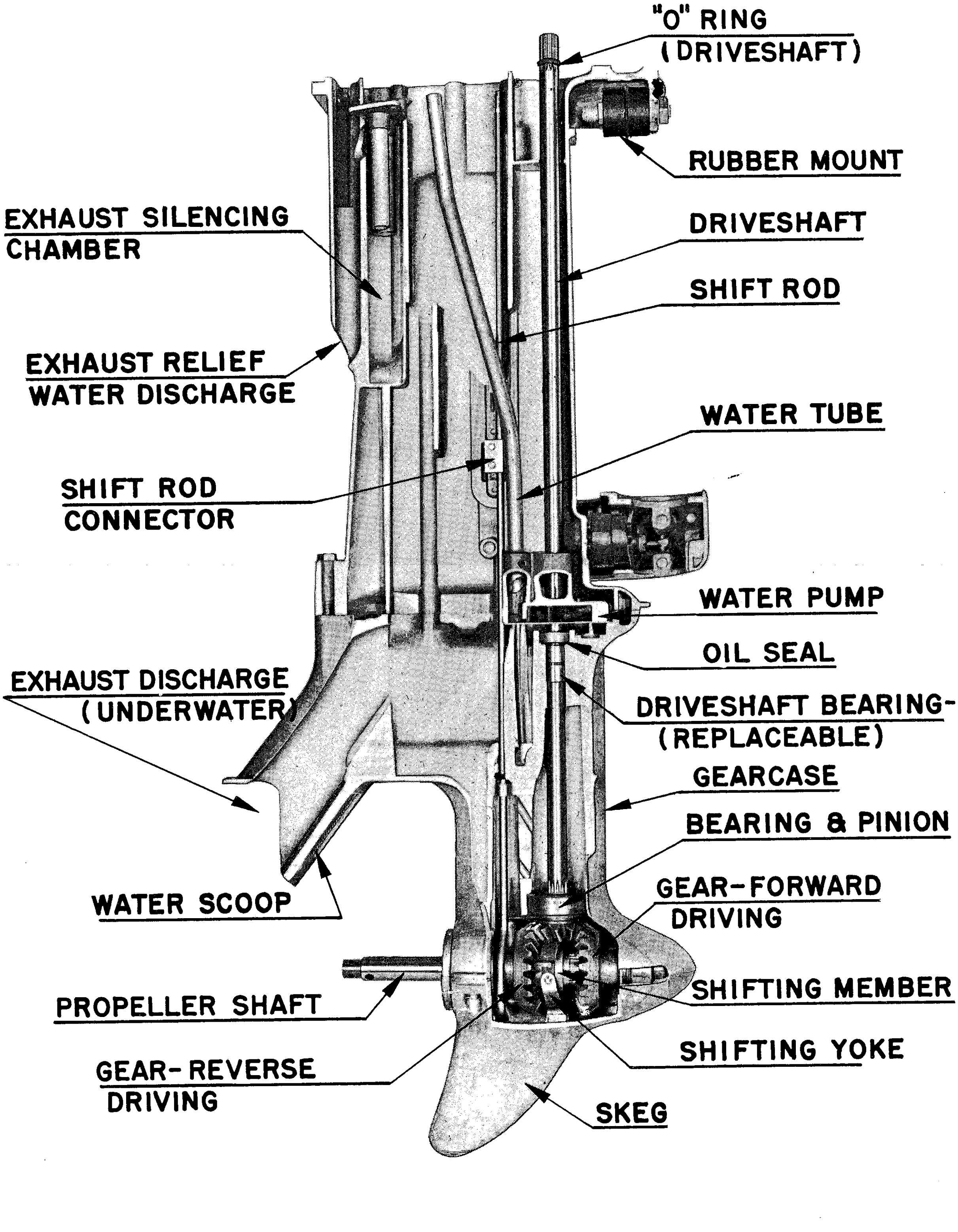
#375861 GEAR ASSEMBLY

A change in design of gear assembly #375861 was made to accommodate a floating or "slip fit" bushing in the reverse gear to result in the assembly consisting of—

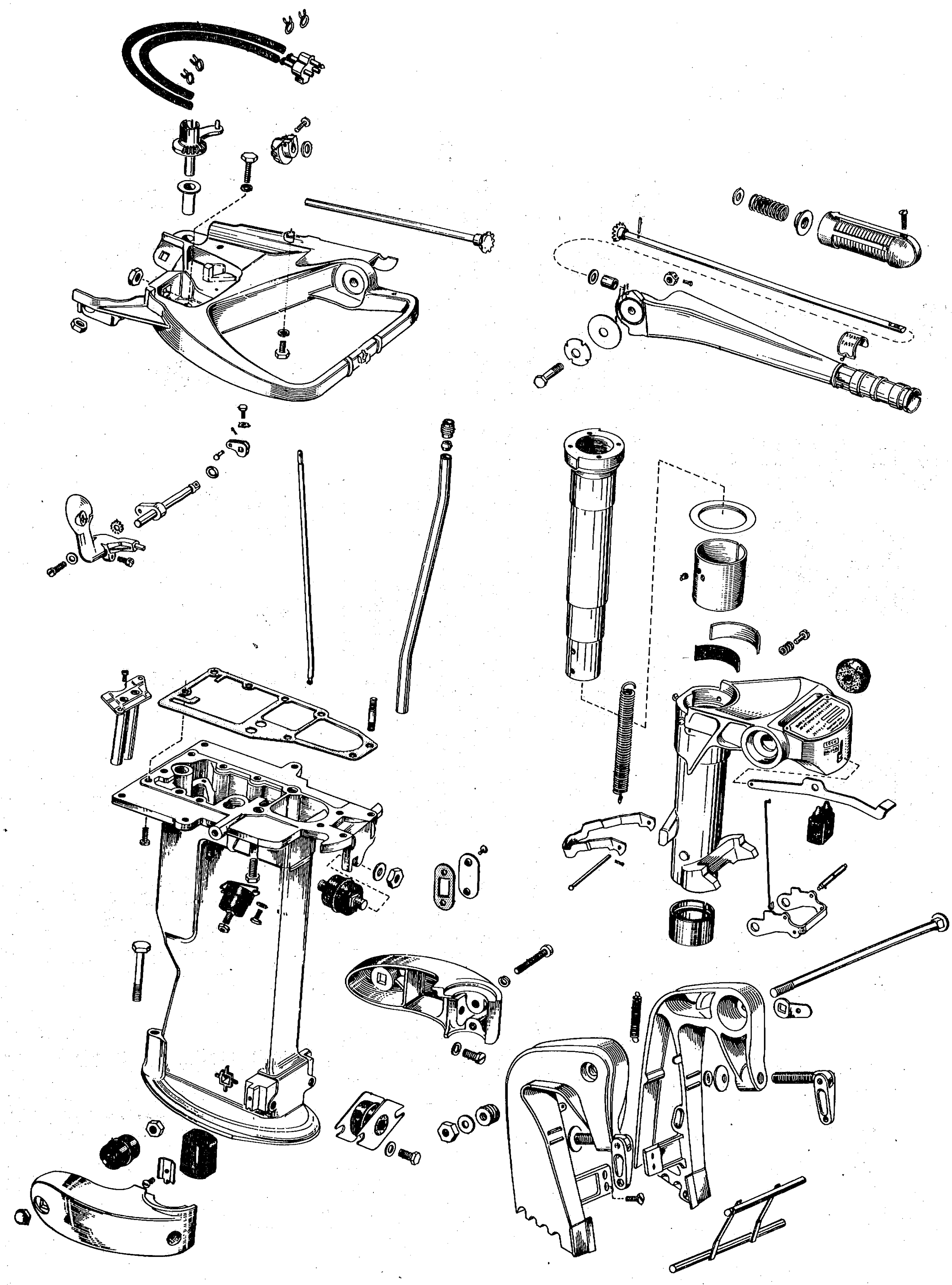
1 #375759 Gear and Bushing Assembly—Forward driving
1 #302517 Gear—Reverse driving
1 #303690 Bushing for Gear #302517
1 #375835 Pinion, Shim and Bearing Assembly

Some "scuffing" was known to take place on the bushing face during operation of the motor. Thus, the floating bushing to improve bearing performance and to facilitate corrective measures as and when required.

The new bushing is machined to "slip" fit into the reverse gear after removal of the bushing originally "pressed in." The old bushing should be carefully pushed out — on an arbor press, using the propeller shaft as a mandrel. Make certain inside surface of the gear is cleared of foreign matter, burrs, etc., coat with thin film of oil then "slip" new bushing (#303690) into position with thumb. The new bushing will be found to "float" in the gear.



Sectional View Models RD-17 through 19C Lower Unit.



Extended view of the stern bracket, swivel bracket and exhaust stack group – Models RD-17 through 19C.

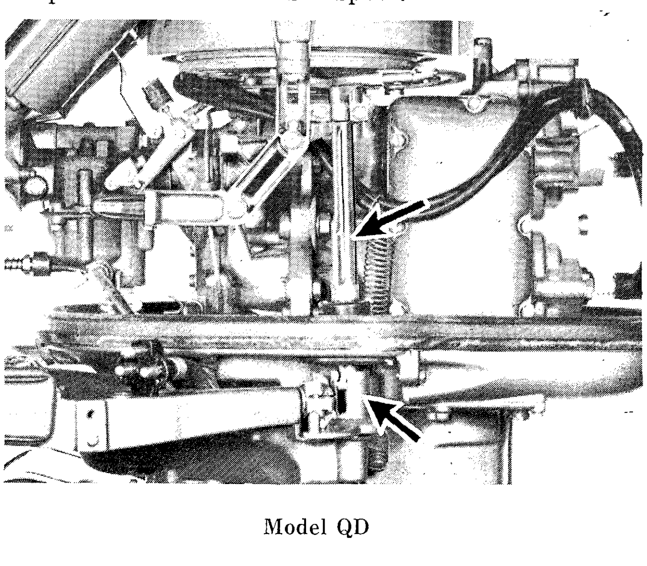
LOWER UNIT — MODELS QD AND RD

In addition to installing air silencers on the carburetor intake (Models QD-16 up and RD-17 series up) and with silencing chambers built into the exhaust stacks to reduce motor noise, the power unit complete is isolated in a manner from the boat by means of rubber mounting (cushion) to further achieve quiet performance. Shock of motor vibration is absorbed or taken up by the mountings rather than being transmitted directly to the transom and side walls of the boat, which otherwise act as a "sounding board" to amplify motor noises. Mounts observed on side walls of the exhaust stack (top and bottom) "cushion" the shock of motor torque while those on center line—forward (top and bottom) absorb or cushion the shock of thrust —"soften" the effect of power or thrust impulses transmitted to the propeller.

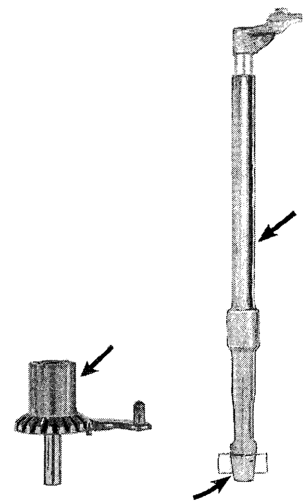
The swivel bracket—exhaust stack assembly in both the QD and RD are fundamentally alike, thus service operations are accomplished in like manner. Gearcase assemblies in each case are however of somewhat different design and construction — see pages 416 and 419, QD; 428, RD.

SPEED CONTROL LEVER — GEAR AND PIN ASSEMBLY — MODELS QD-16 AND RD-17 SERIES UP

With rubber mounting of the QD more wear than anticipated has been encountered between the bottom end of the speed control shaft (upright) and its corresponding socket in the control gear. To overcome the situation, a "pin" of nylon construction has been provided for installation at the point of wear—indicated by arrow. It's possible to achieve better wearing qualities with nylon—particularly when dry. This, in addition to maintaining closer tolerances and establishing smoother "rubbing" surfaces, leads to better overall performance in this respect.



Model QD



All Model QD, QDL-16's after serial #1227814, all Model RD, RDL-17's after serial #1228732, and all Model RDE, RDEL-17's after serial #1219876 have been assembled with the nylon pin installation as described above.

When requiring either the control shaft (upright) or the gear on QD-16 and RD-17 series prior to the above given serial number—

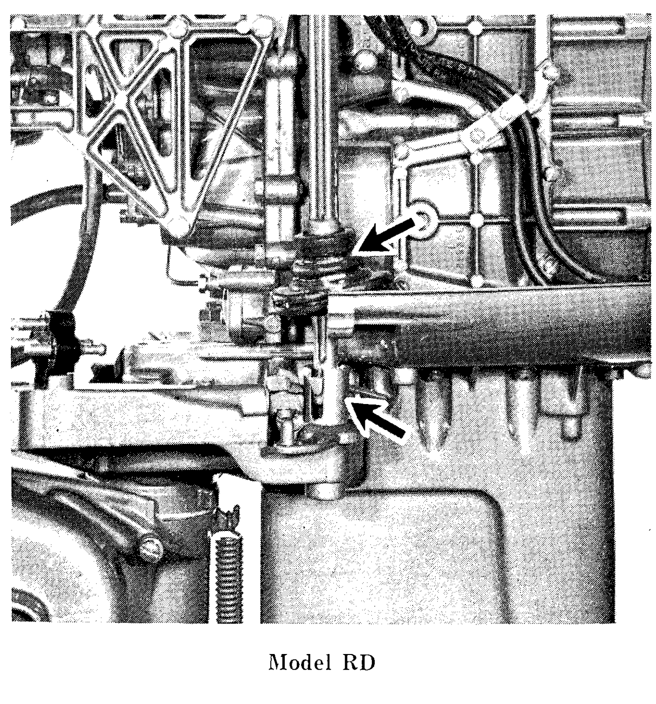
for the QD order assembly #376430, consisting of:

- 1 #304155 Pin (Nylon)
- 1 #304157 Gear
- 1 #304159 Shaft (lever—upright)

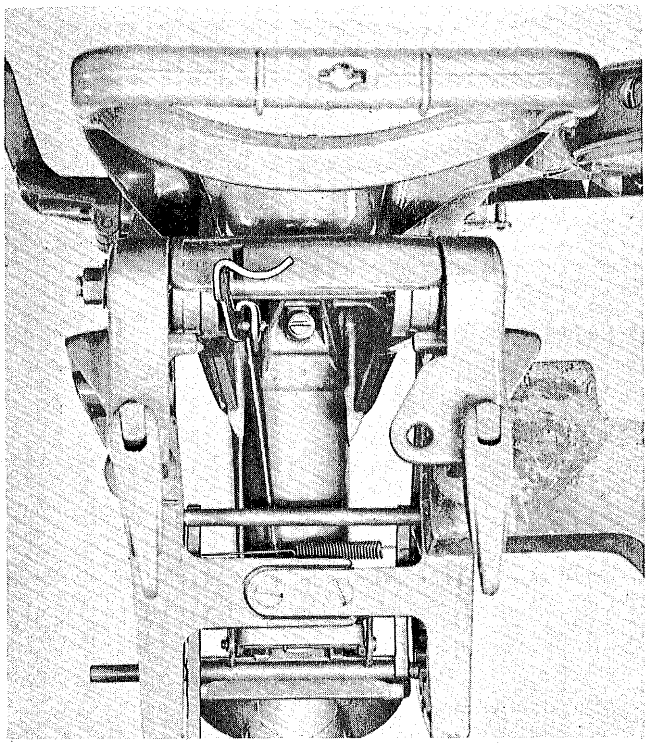
for the RD order assembly #376429, consisting of:

- 1 #304155 Pin (Nylon)
- 1 #304156 Shaft (lever—upright)
- 1 #304157 Gear

Always lubricate the assembly after installation with water-resistant lubricant.



Model RD

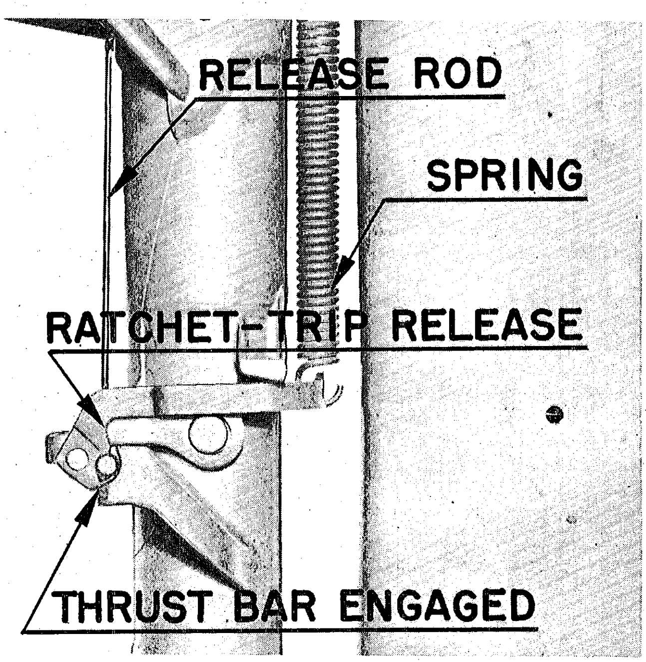


TILTING LOCK

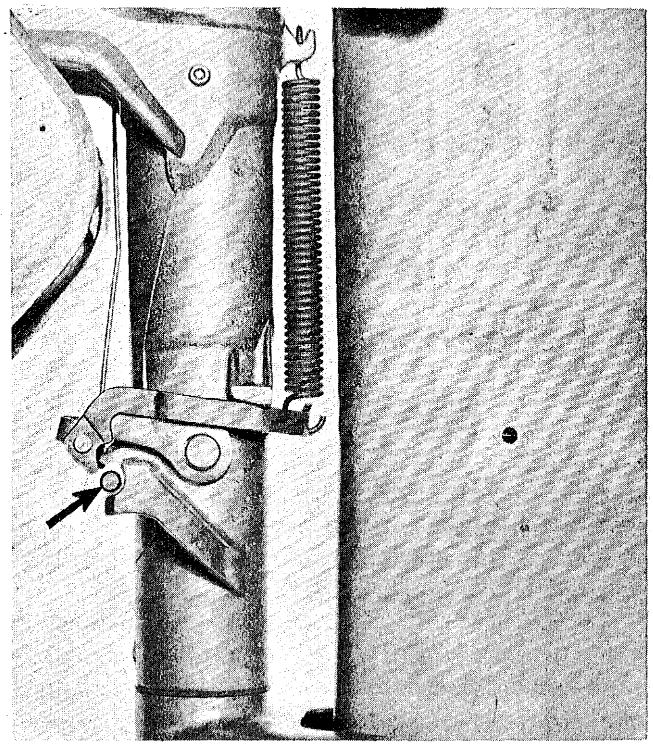
A trip release (spring loaded) arrangement of sufficient tension is made part of the tilting lock. The tilting lock prevents tilting when suddenly decelerating, yet permits tilt of the motor on shock of impact when striking underwater obstruction.

Normally operated by means of lever and linkage, the tilting lock may be released when desired by depressing lever and shifting slightly to left and restored by returning to normal running position.

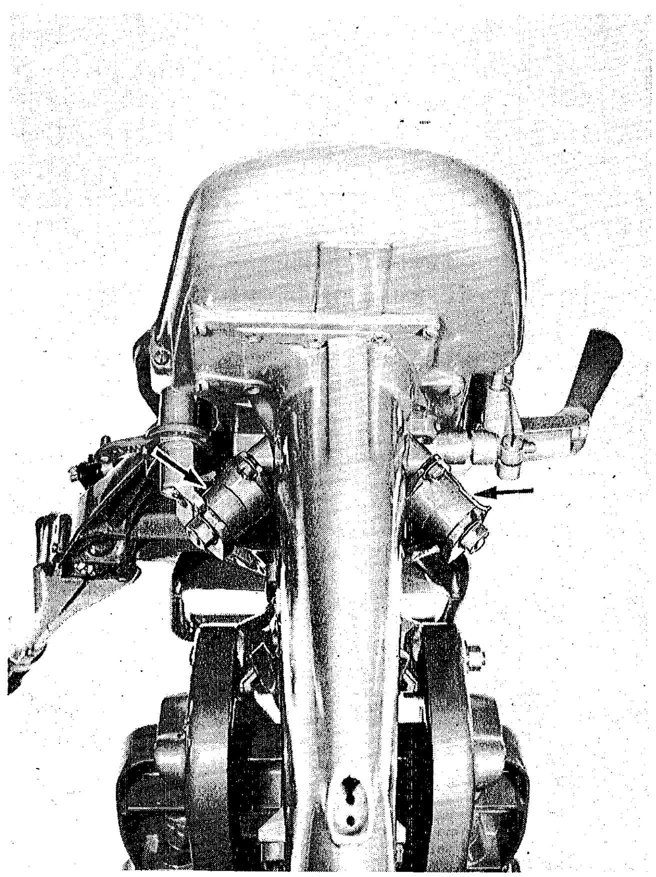
It is advisable to tilt the gearcase out of the water when not in use—set lever to release position, then tilt; set at running position when submerging the gearcase for operation. The motor does not tilt when operating in reverse.



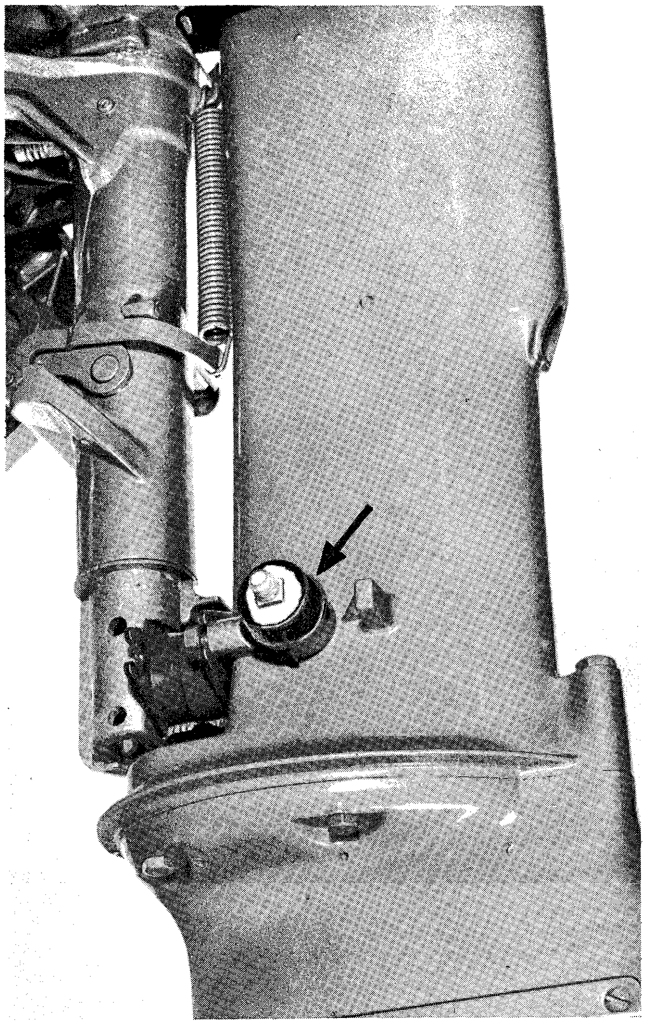
Showing the spring loaded tilt lock (thrust bar) engaged—during normal forward and reverse driving.



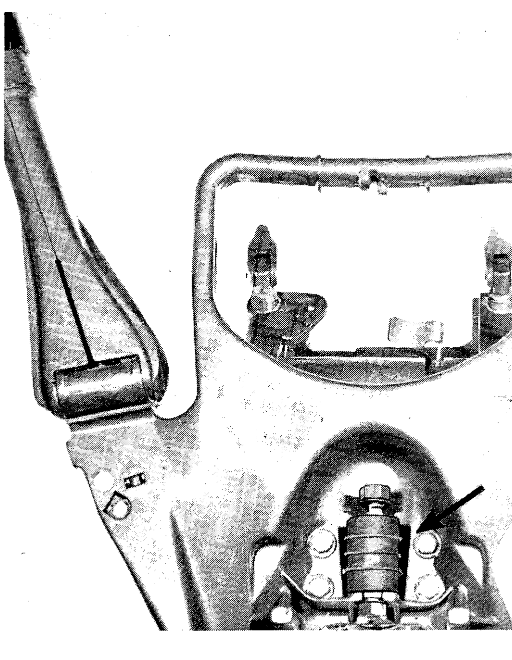
Illustrating the spring loaded tilt lock (thrust bar) released as occurs when striking an underwater obstruction. Since the locking device is spring loaded, it is calibrated to release on impact of 260 to 310 lbs. Models RD Series.



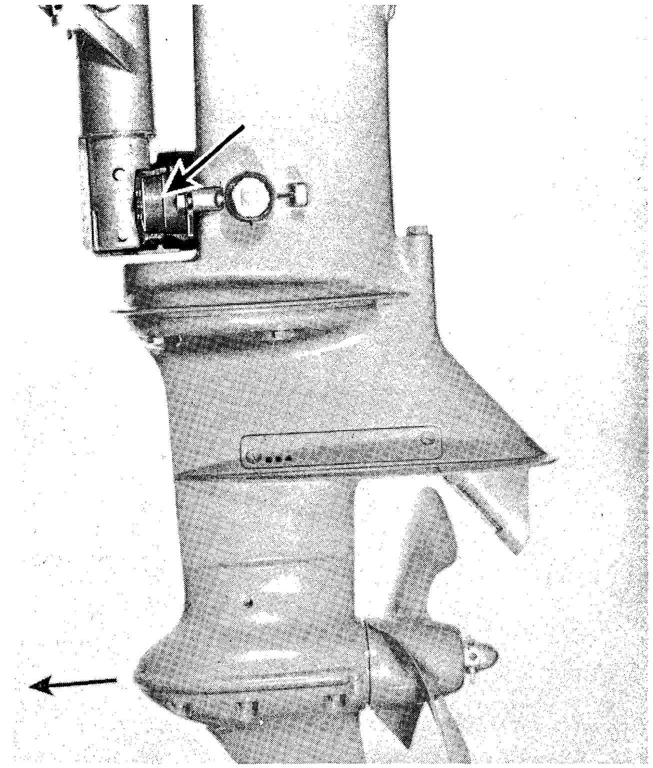
Rubber mounts (upper) to absorb effects of torsional shock.



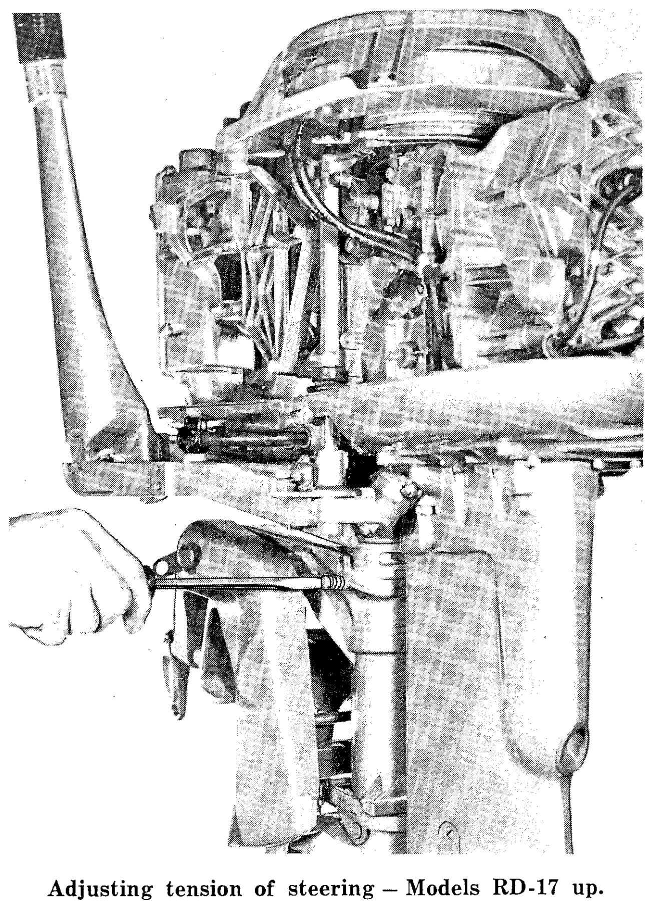
Showing location of rubber mounts—lower—to absorb effects of torsional shock.



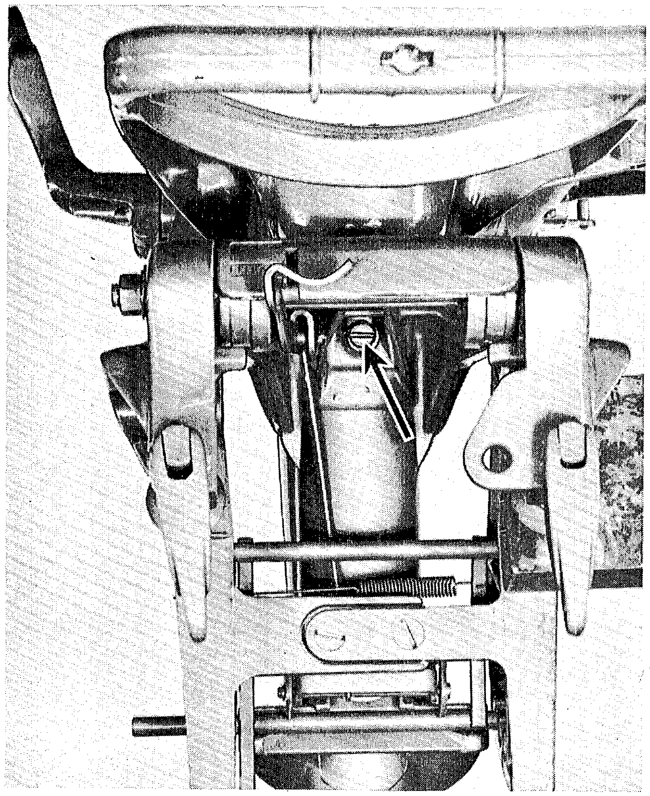
Showing location of rubber mount—upper—to absorb shock of power thrust as applied to the propeller.



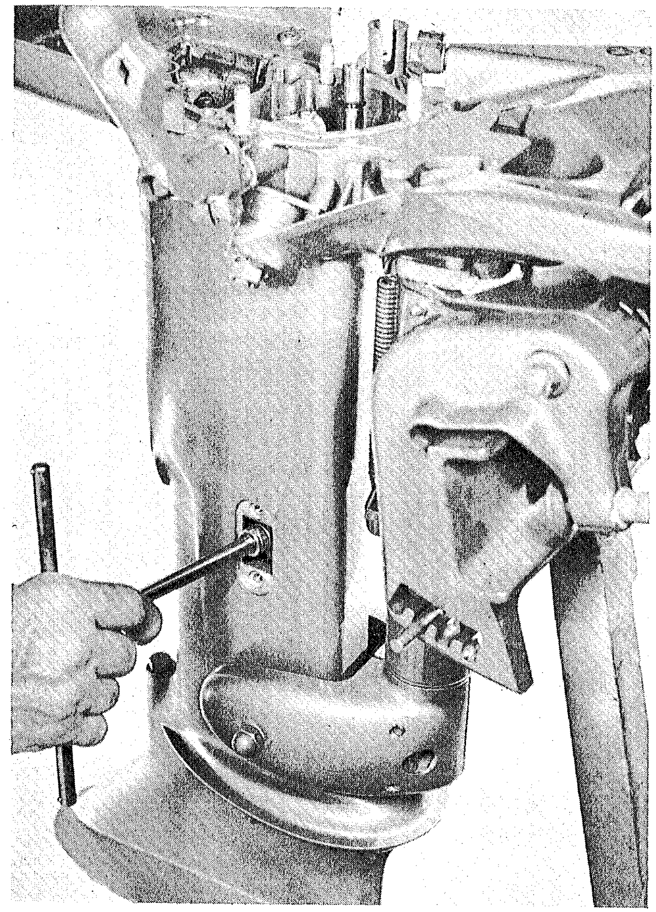
Lower rubber mount to absorb the effects of power thrust applied to the propeller.



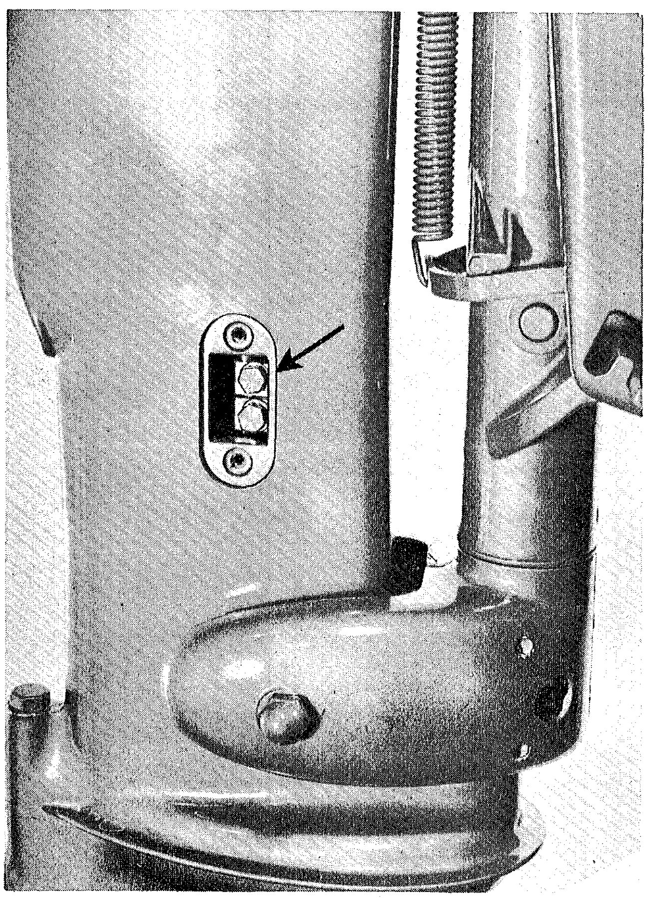
Adjusting tension of steering – Models RD-17 up.



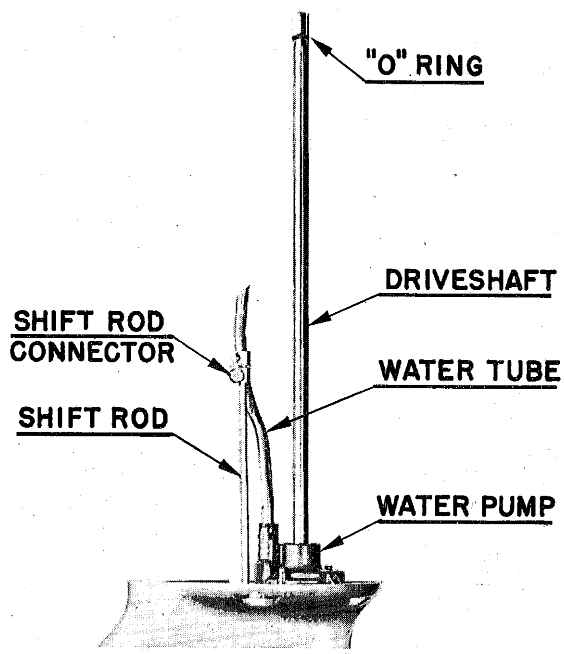
Showing location of steering tension adjusting screw—**Models QD-16 up.**



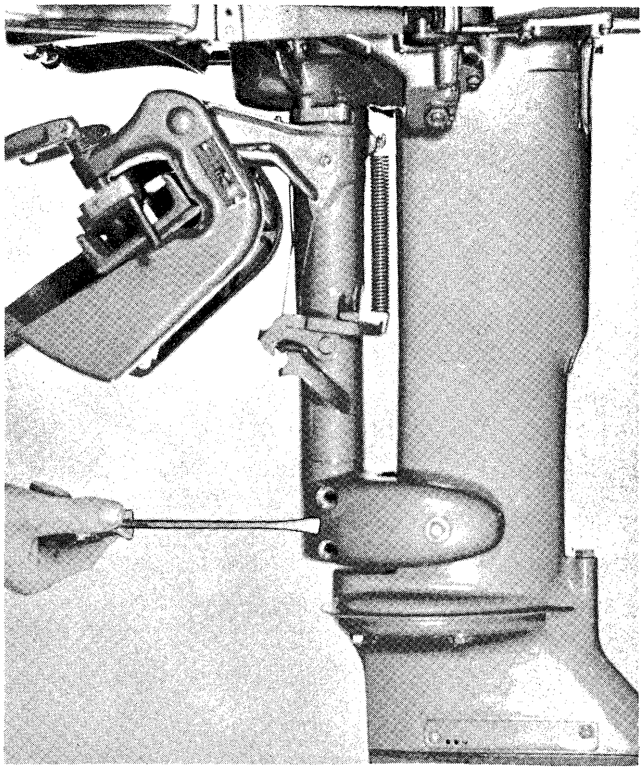
Removing the shift rod connector screw—remove the upper screw for ease of assembly later on.



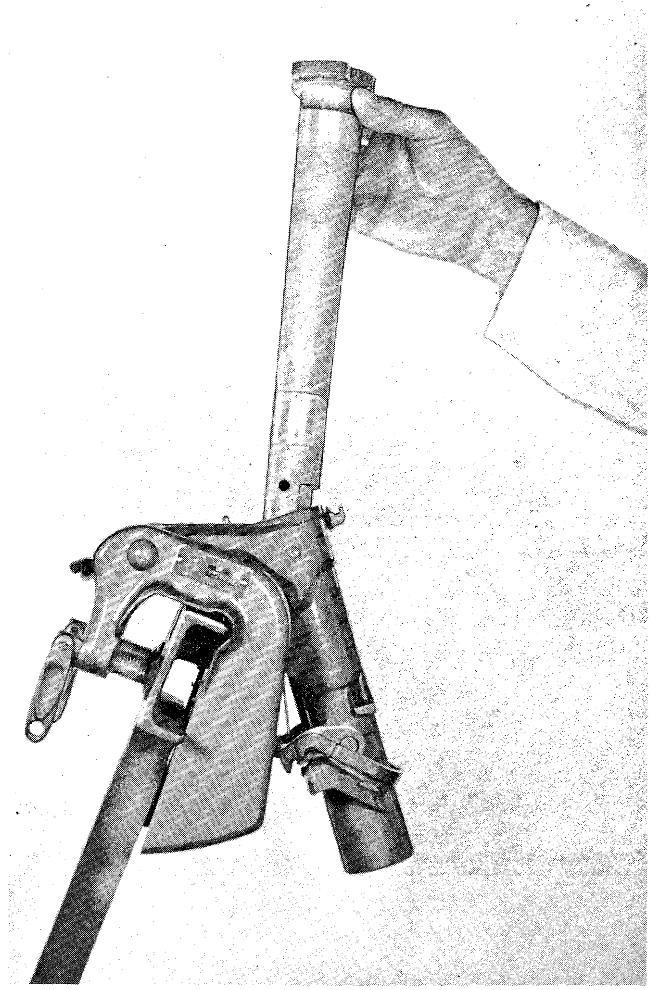
Showing cover removed to expose shift rod connector.



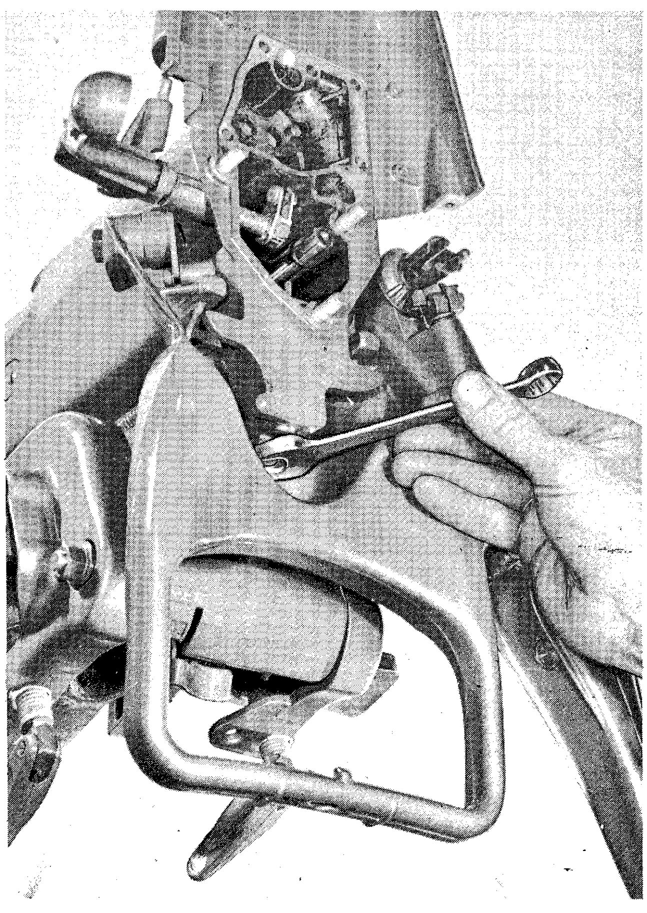
When attaching the gearcase assembly (shown above) to the exhaust stack, the operation may be simplified if the water tube is attached to the pump housing and the shift rod connector attached to the lower shift rod. Coat exposed end of the water tube with oil or liquid soap for ease of installation.



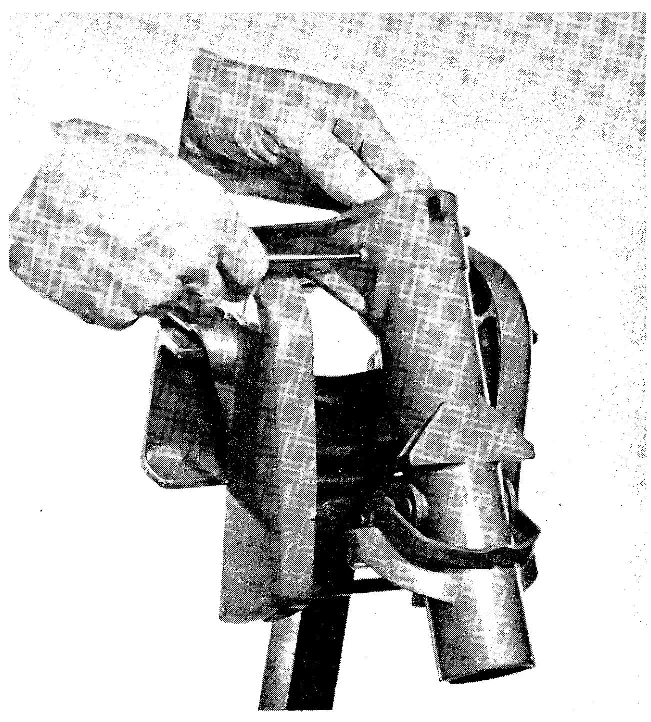
Removing rubber mount cover to provide accessibility to mounts for disassembly and/or repair.



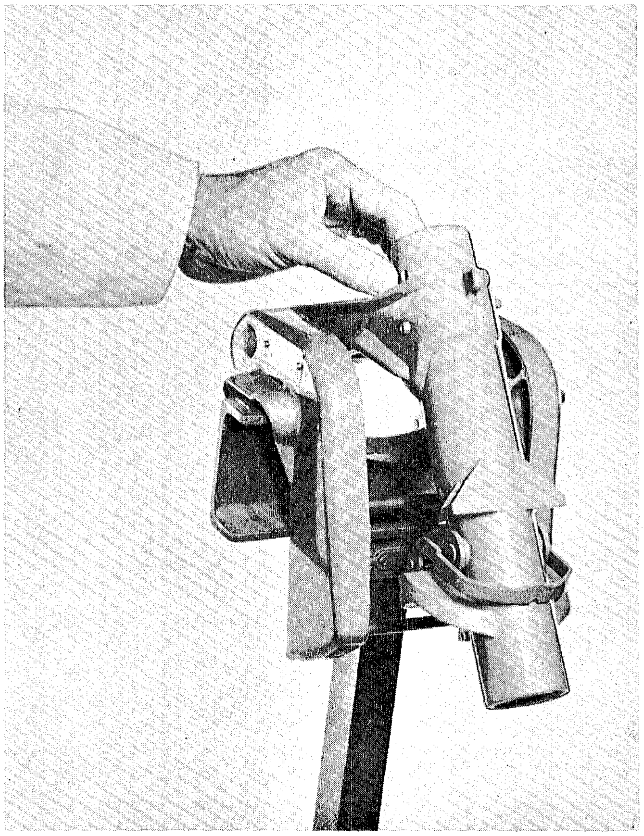
Removing pilot shaft from the swivel bracket.



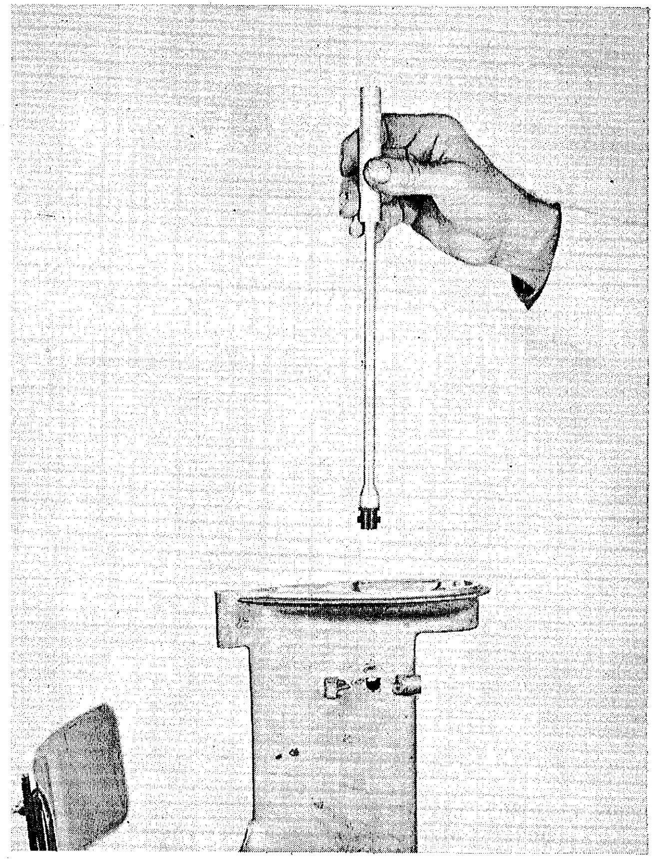
Detaching upper mount from the swivel bracket assembly.



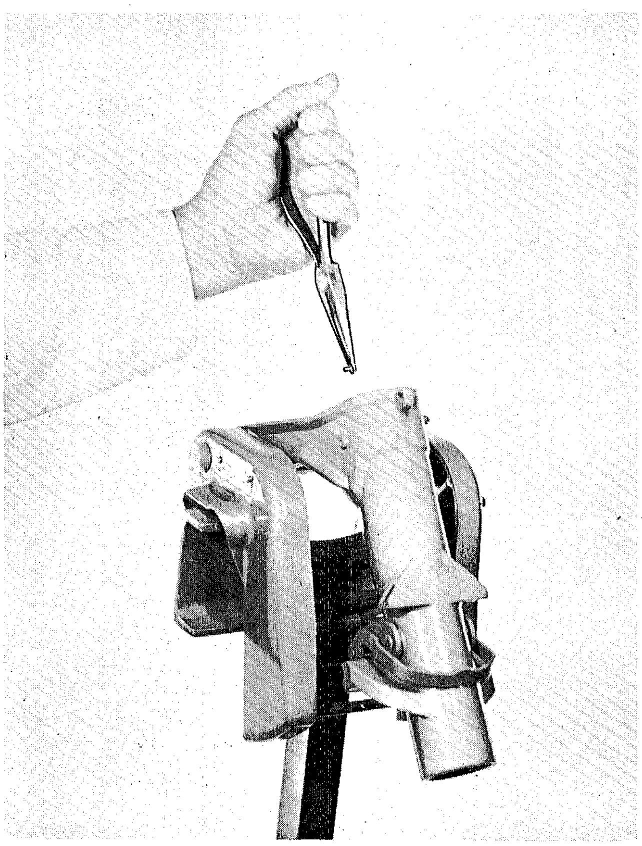
Pushing rivet free of the swivel bracket liner.



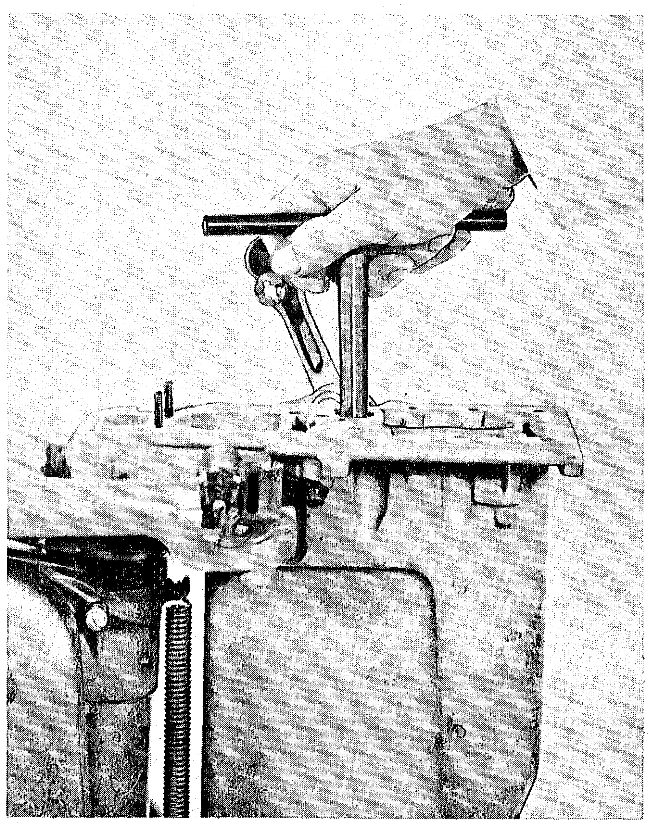
Removing and/or installing the swivel bracket liner—when installing, coat liberally with water resisting lubricant — OMC Type "A" Lube.



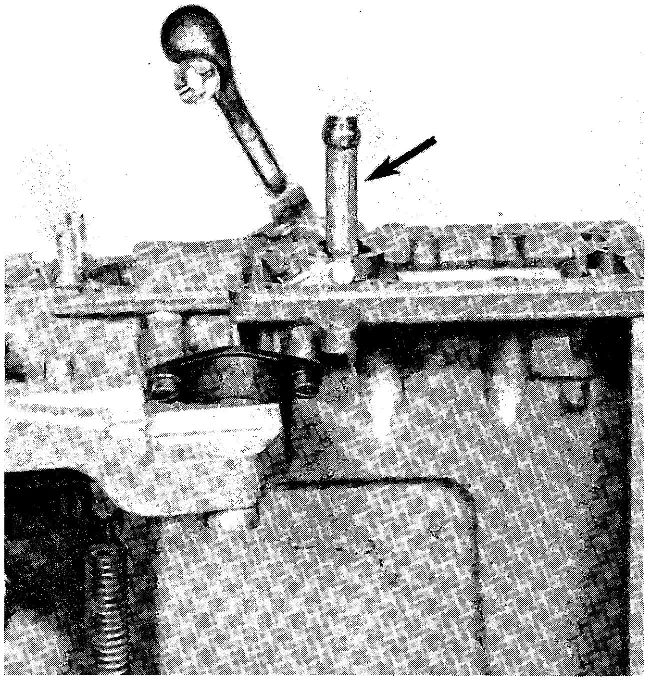
Inserting water tube grommet in the Model QD driveshaft casing and exhaust stock assembly.



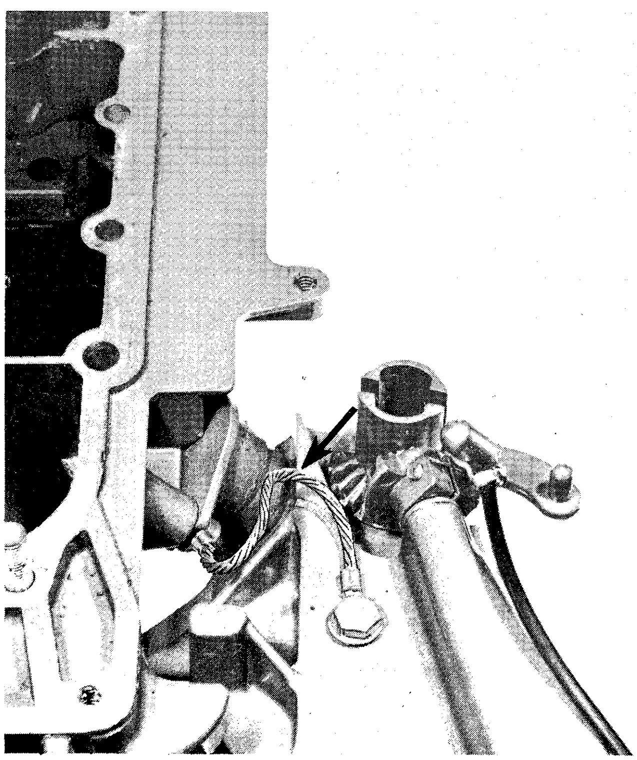
Installing rivet to hold the swivel bracket liner in position.



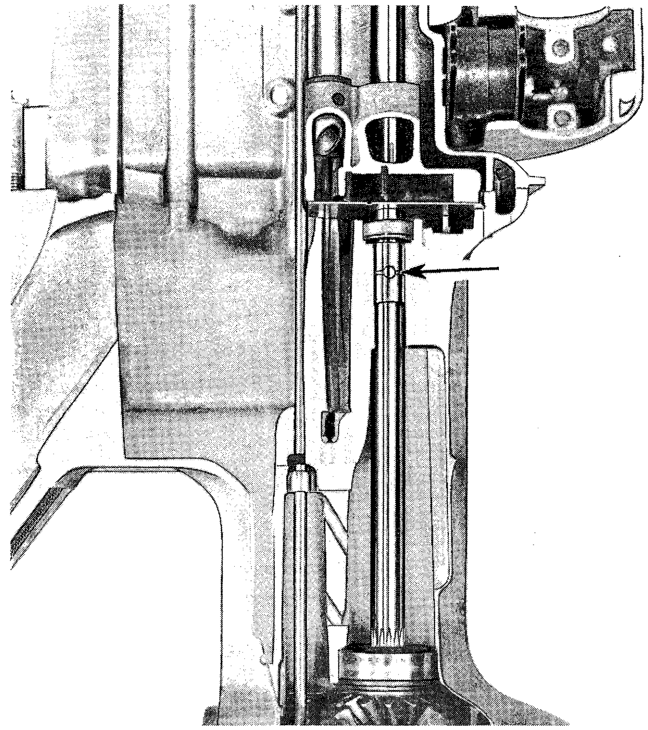
Removing and installing the water tube gland nut— Models RD-17 through 19.



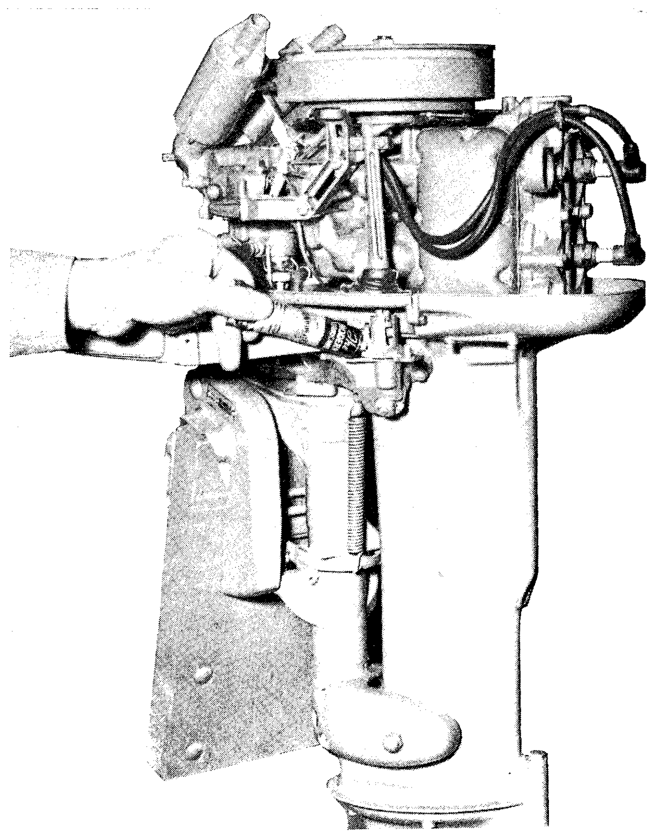
The installed gland prevents removal of the water tube. To remove water tube for replacing, cut off in area indicated by the arrow — discard original water tube later to be replaced with a new one.



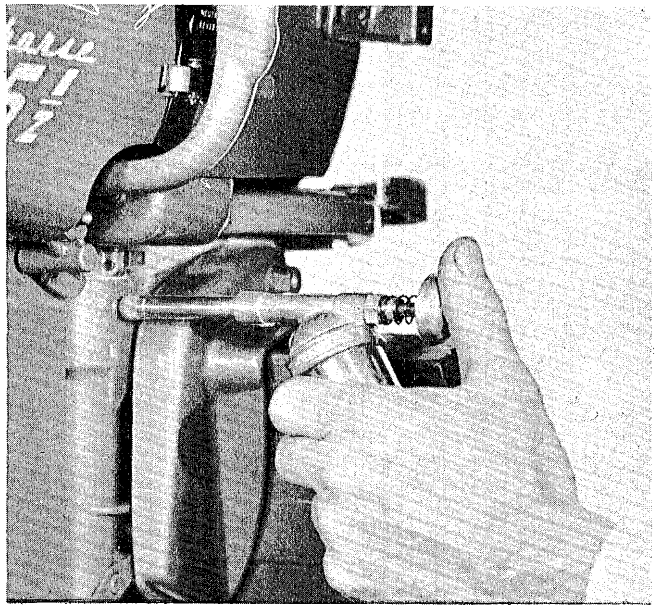
Showing installation of the safety switch (mercury) ground on lower unit of Models RDE-17 through RDS-22 – required because of rubber mounts "insulating" the power unit from the stern bracket assembly – make certain the ground lead is in place and properly attached.



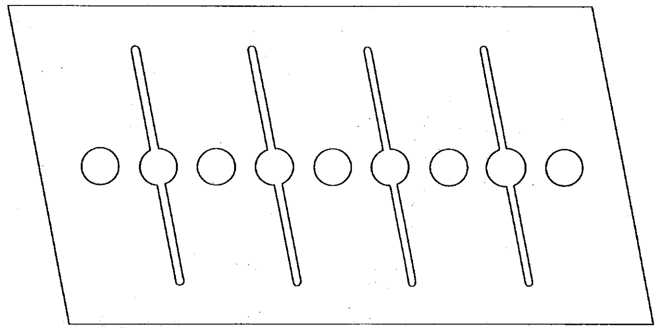
Showing location of upper Driveshaft Bushing — Floating (Model RD).



Lubricate all moving control mechanisms liberally with water resistant grease.



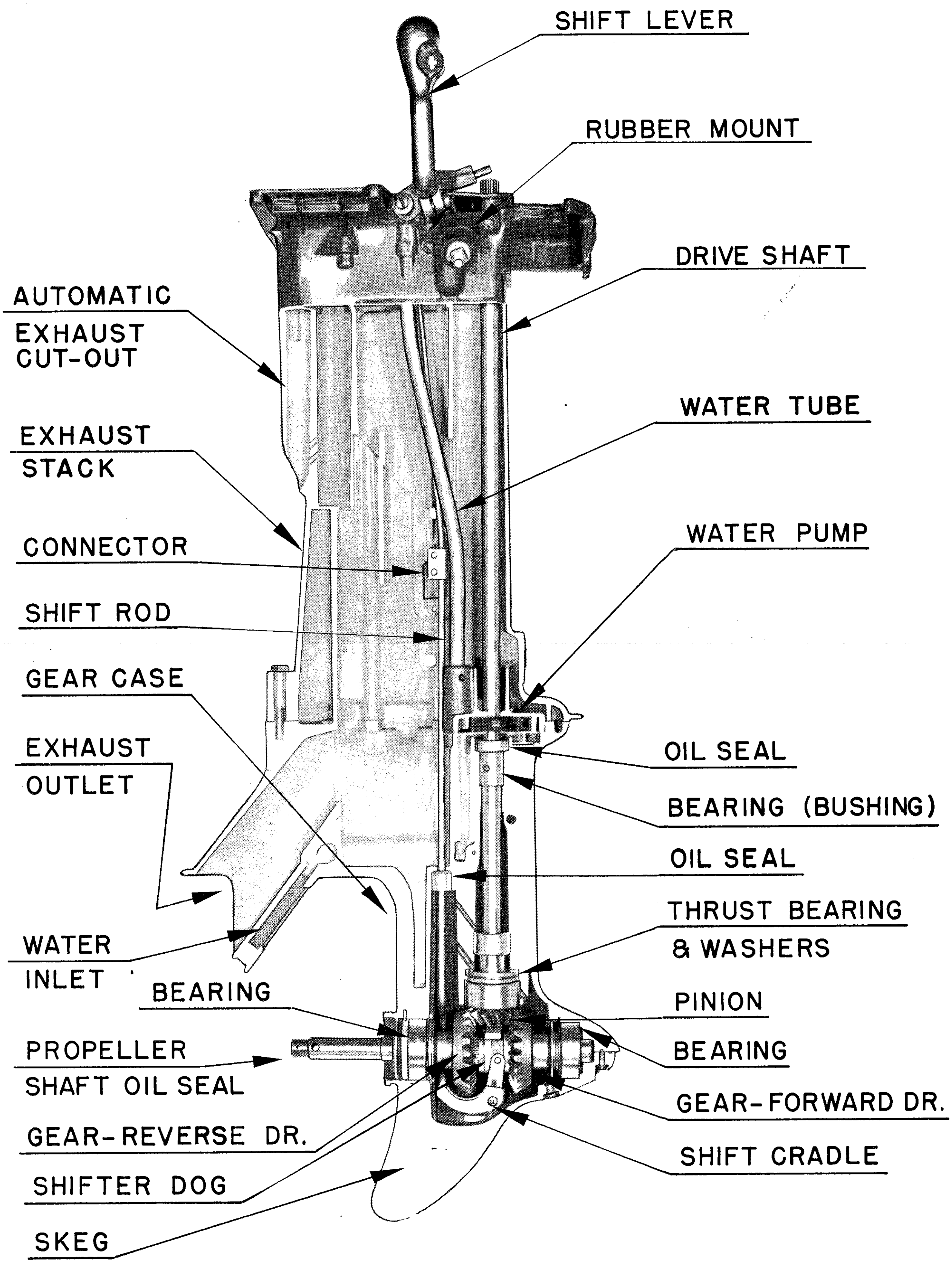
Lubricating the swivel bracket with water resistant grease to avoid seizure—particularly in salt water regions.



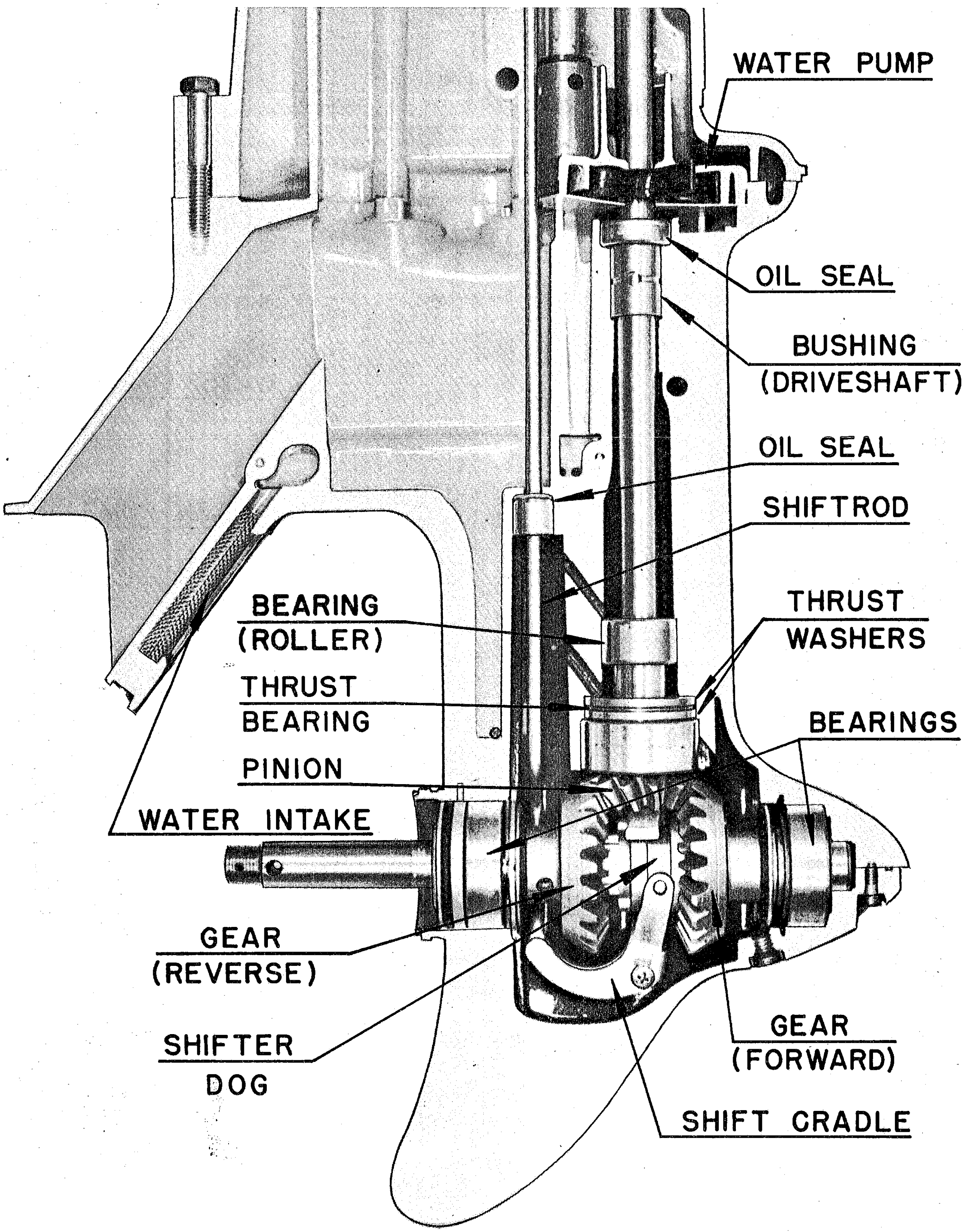
Swivel bracket liner #302638 (shown as Item 28 on page 16 of the RD-16 parts catalog) for Models RD-10 to and including RD, RDE-16 and 16A was cancelled and superseded by #304133 shown here. The new liner is of molded or extruded nylon and much better suited for the purpose than #302638 which was of asbestos composition. The new nylon liner will eliminate, or at least reduce to a minimum, possible seizure of the swivel bracket when used in salt water regions.

No change in installation procedure is required except that Mobilgrease Outboard is recommended as lubricant. Apply lubricant when installing—holes and slots are provided in the liner to hold and spread the lubricant. Grease periodically thereafter as further insurance against seizure.

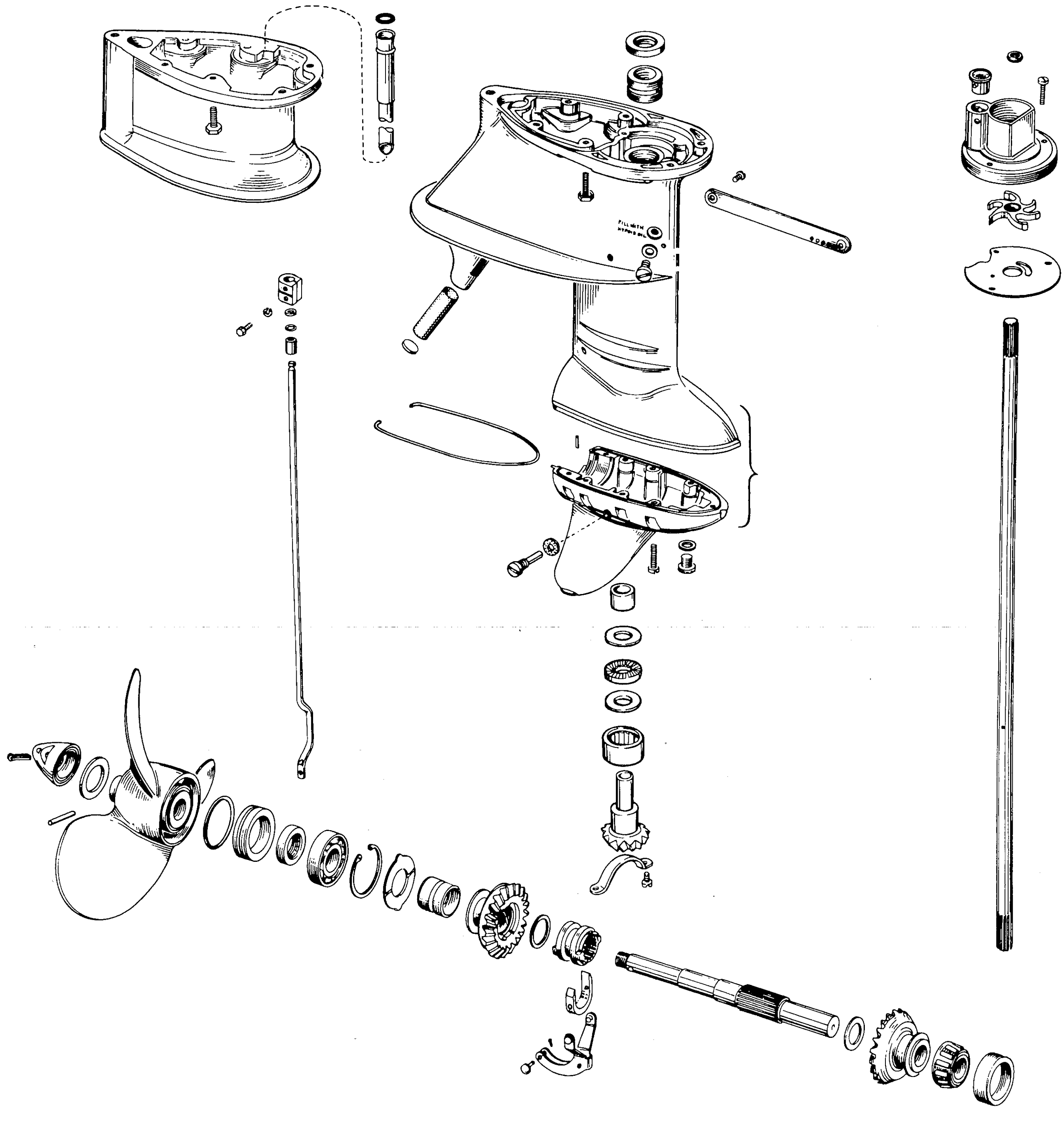
NOTES



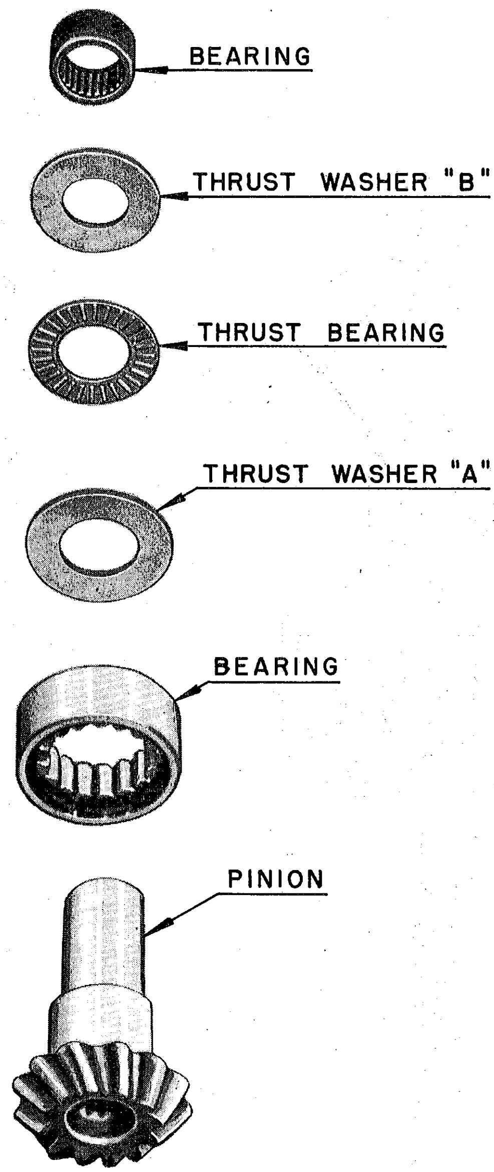
Sectional View – Lower Unit Model RD-19 Series.

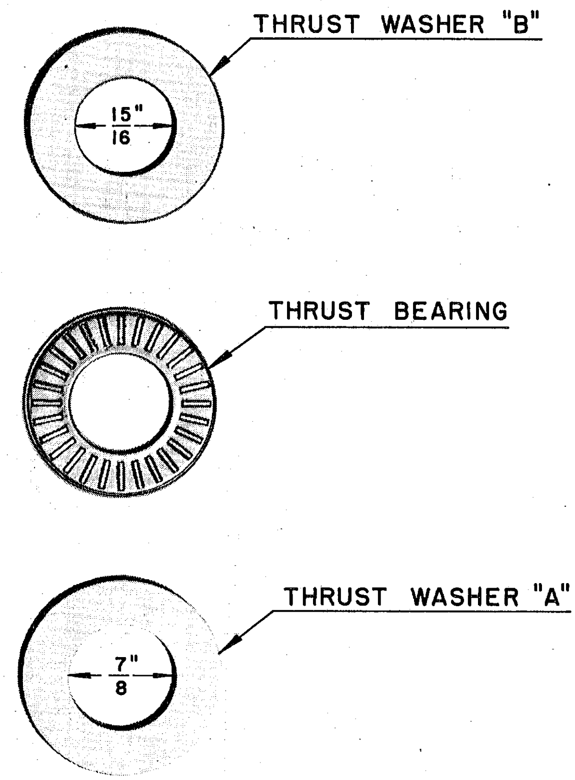


Sectional View – Gearcase Model RD-19 Series.



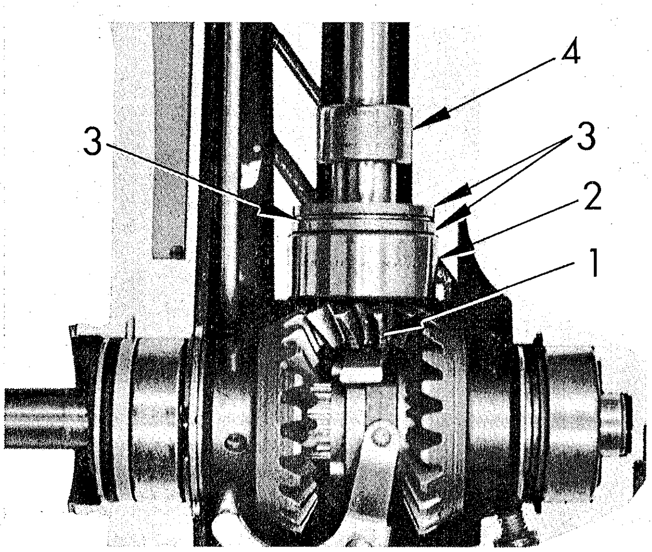
GEAR CASE GROUP — MODEL RD-19 SERIES



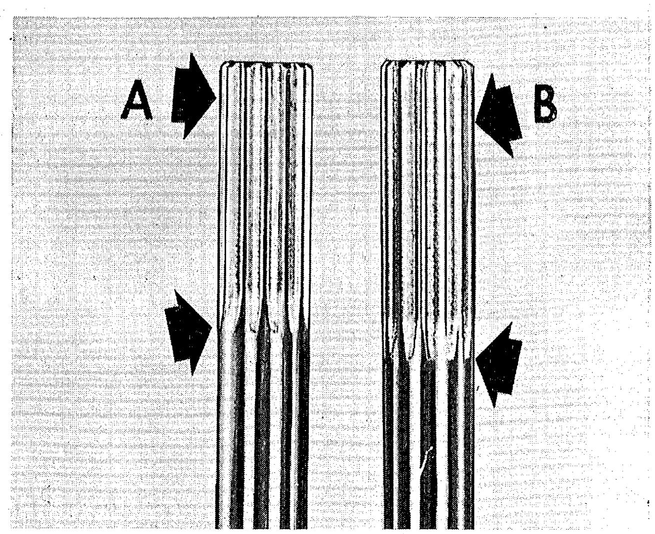


IMPORTANT — Note that hole in thrust washer "A" is of 7/8" diameter and that in washer "B" the diameter is 15/16" — 1/16" larger than the hole in washer "A." On assembly, washer "A" with the smaller hole *must* be assembled on the pinion *first*, followed by the thrust bearing and washer "B," with the larger hole. This order of assembly is of extreme importance, since washer "B" is designed to "fit" snugly in the gear case housing while washer "A," fitting more closely on the pinion, is provided with considerably more clearance in the housing.

Pinion and Bearing Assembly — Extended View.



Sectional View — Gear Case.



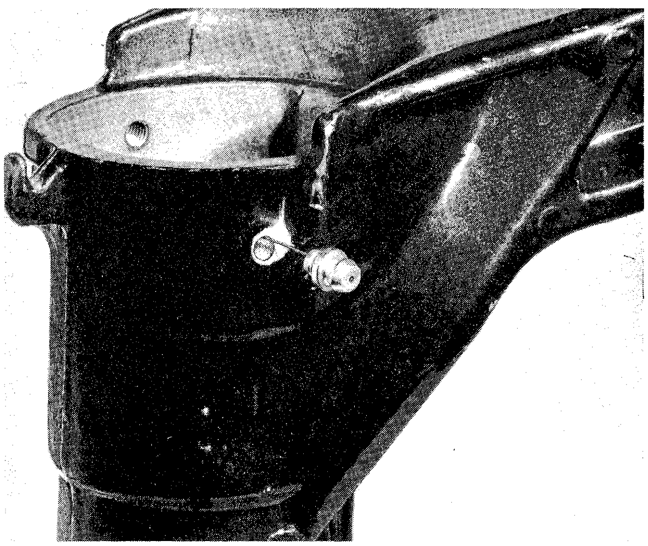
Driveshaft — Models RD-17 through the RD-19 Series.

Driveshaft No. 303871 (standard length) has been cancelled and superseded by No. 304933 — similarly driveshaft No. 304033 (long) has been cancelled and superseded by No. 304950.

It will be noted, as illustrated here, that the spline on driveshaft "A" (No. 303871 standard and No. 304033 long — all RD's up to RD-18) is shorter than the corresponding spline on "B" (No. 304933 standard and No. 304950 long — RD-19 series and to be used hereafter on all RD-17's through the RD-19 series).

It is possible that you have a supply of the "old" driveshafts (Nos. 303871 and 304033) in stock — they're OK to use on all RD-10's up to and including the RD-18 series; *do not* attempt using in the RD-19 series — the longer spline (on the driveshaft "B") is required to compensate for the redesigned pinion and bearing assembly.

The RD-19 driveshaft (Nos. 304933 and 304950) will be supplied from now on for all RD-17's through the RD-19 series.



Grease Fitting — Alemite No. 1728J.

Since there is some evidence of the lubricant applied to the swivel bracket liner (all models) boiling out due to the heat of the exhaust, we suggest the installation of an Alemite grease fitting — their No. 1728J, as shown here. This fitting includes a check to contain lubricant once inserted.

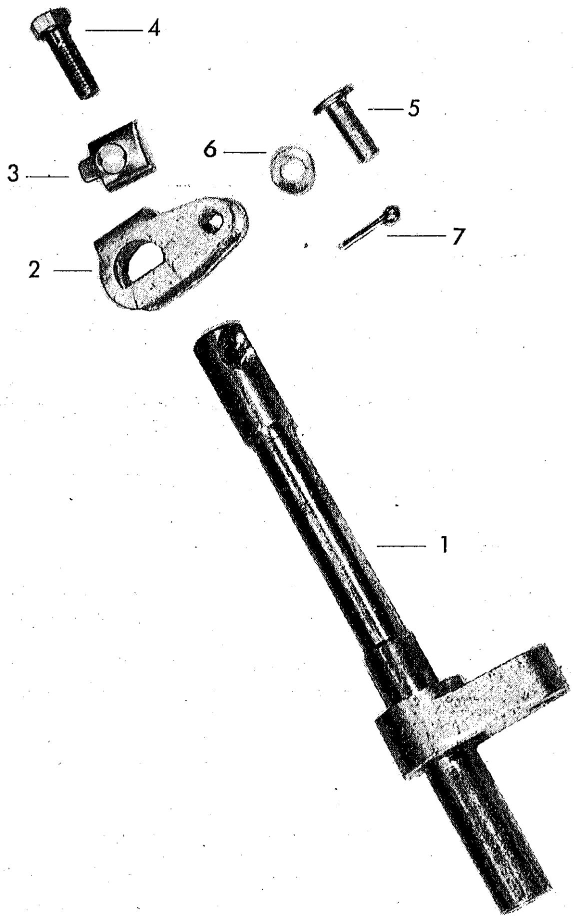
NOTES

RD-10 THROUGH 15 — NO. 376220 SHIFT LEVER, SHAFT AND CLIP ASSEMBLY

A change was made on service assembly No. 376220 shift lever, shaft and clip assembly. Part No. 303720 lever and Part No. 302504 clevis pin are now constructed of stainless steel. Also, Part No. 304380 bow washer and No. 306376 cotter pin have been added to the assembly.

No. 376220 assembly should be installed on all RD-10 through 15 motors on every opportunity presented.

Reason for changing the lever and pin to stainless steel is to eliminate corrosion and reduce wear on upper shift rod linkage.



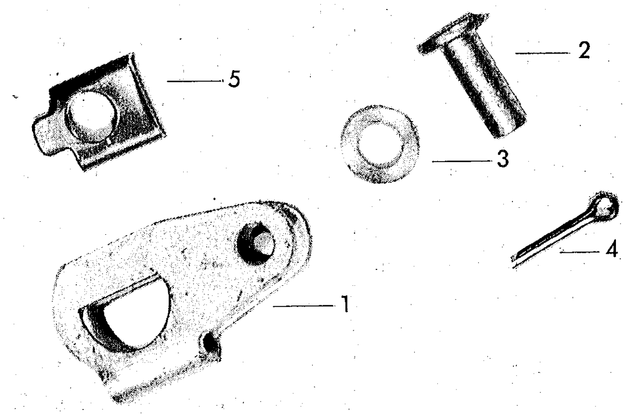
No. 376220 shift lever assembly consists of the following parts:

1. No. 376198 — bracket and shaft
2. No. 303720 — lever, shift rod
3. No. 303721 — clip, shift rod lever
4. No. 303722 — screw, lever to shift rod
5. No. 302504 — clevis pin, shift rod
6. No. 304380 — bow washer, shift rod clevis pin
7. No. 306376 — cotter pin, shift rod clevis pin

RD-15A THROUGH 17, RDE-16 THROUGH 17 AND QD-16 — NO. 377567 SHIFT LEVER ASSEMBLY

A new service assembly made available for mentioned motors. This assembly contains new stainless steel parts, No. 303720 lever and No. 302504 clevis pin.

The new No. 377567 shift lever assembly should be installed whenever possible to eliminate corrosion and reduce wear on the upper shift rod linkage.

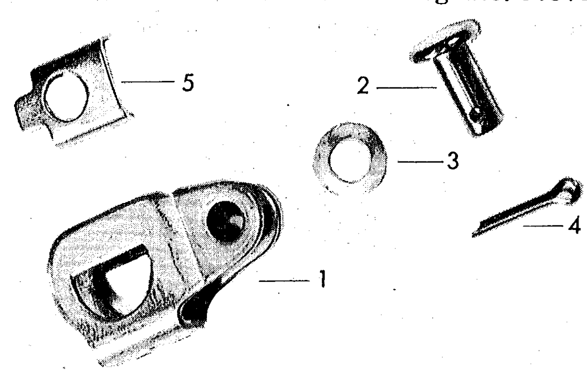


No. 377567 shift lever assembly consists of the following parts:

1. No. 303720 — lever, shift rod
2. No. 302504 — clevis pin, shift rod
3. No. 304380 — bow washer, shift rod clevis pin
4. No. 306376 — cotter pin, shift rod clevis pin
5. No. 303721 — clip, shift rod lever

RD-17C, 17S, 17R, NO. 376564 SHIFT LEVER ASSEMBLY

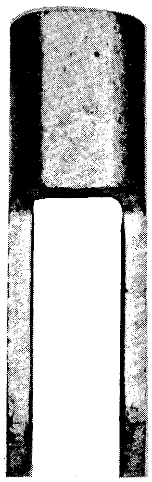
Recent investigation has revealed that some dealers are installing Part No. 304379 lever on motors built prior to the RD-17C through RD-17R series. Also, they are using Part No. 303720 lever designed for the earlier model RD's on RD-17C through 17R. Even though both levers can be interchanged, there is a difference in dimensions, Part No. 303720 being 3/64″ longer. Therefore, if the correct lever is not installed on the right model motor, incorrect travel of the shifter cradle will result, causing premature wear to the shifter dog No. 375783.



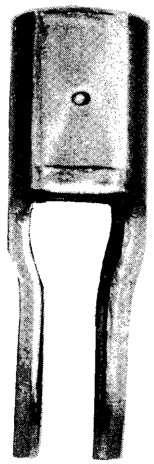
No. 376564 shift lever assembly must be installed on the RD-17C through RD-17R series only. No. 376564 assembly consists of the following parts:

1. No. 304379 — lever, shift rod
2. No. 304377 — clevis pin, shift rod
3. No. 304380 — bow washer, shift rod clevis pin
4. No. 306376 — cotter pin, shift rod clevis pin
5. No. 303721 — clip, shift rod lever screw

You may readily identify both levers from the illustration. No. 303720 has straight sides; No. 304379 has curved.



No. 303720
RD-10 through 17



No. 304379
RD-17C, RD-17R,
RD-17S

INSTRUCTIONS: Tool (No. 377542) for removing pinion bearings, gear case. MODELS — RD and RDE-19 series 1957 and 1958, and RDS-20 (1958)

To remove pinion bearings from the gear case of above models, proceed as follows:

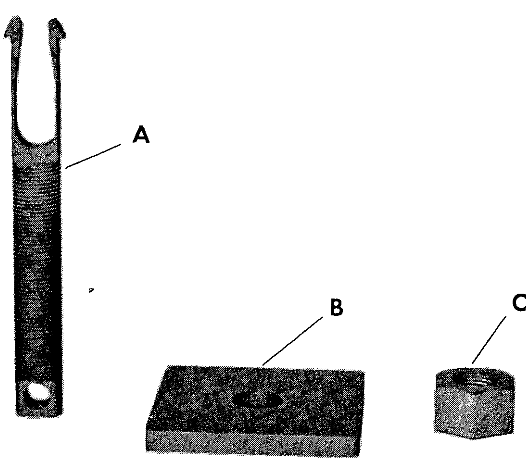


Figure 1. No. 377542 bearing puller

1. After having disassembled the gear case down to the pinion bearings, place gear case in holding fixture.
2. Push puller spindle "A" down through the bearing assembly—far enough to permit "hooks" at end of the spindle to grasp top edge of the needle bearing.
3. Place puller plate "B" in position on the gear case face.
4. Install puller nut "C."
5. Insert steel rod or screw driver through hole in the spindle to prevent turning.
6. Turn puller nut up against the puller plate as shown in Figure 2.
7. Draw up on nut until the bearing assembly has been pulled free of the gear case.
8. Remove puller plate "B" and nut "C" to remove bearing assembly from the puller spindle.

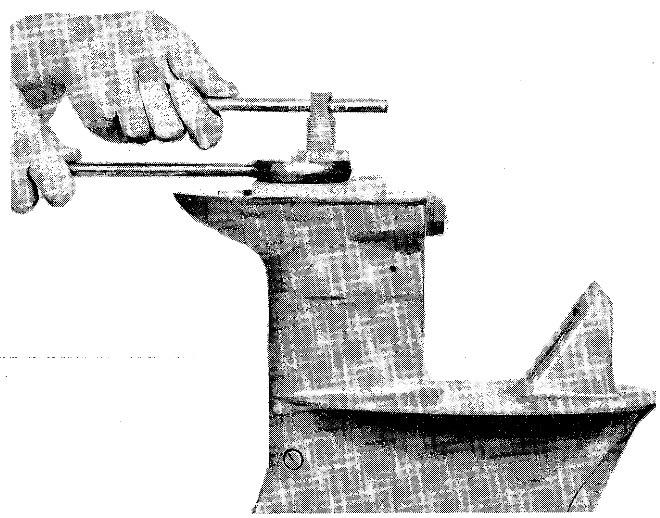


Figure 2. Removing the bearing assembly

INSTRUCTIONS: Tool (No. 377543) for installing pinion bearing assembly, gear case. MODELS — RD and RDE-19 series 1957 and 1958, and the RDS-20 (1958)

To install bearing assembly in the gear case of above models, proceed as follows:

1. Thoroughly clean and oil bearing locations.
2. Note that one end of the needle bearing assembly is provided with a comparatively thick heavy face and that the opposite end is "rolled" over.
3. Place the needle bearing on pilot of the installing spindle as shown in Figure 2 — but, make certain the flat (printed) face is directed downward. This is of utmost importance since *no* pressure while installing should be applied against the "rolled" end.
4. Clamp spindle with needle bearing in position as described in Figure 2 in vise, then, carefully place the gear case over the spindle and bearing. Align to seat the bearing.

5. Place puller plate "B" in position on top end of the gear case.

6. Install puller nut "C" — draw up until bearing has been seated as in Figure 4. The spindle will "bottom" at this point of the operation.

7. Remove puller spindle from the gear case.

8. Place bearing 1 (Figure 3) in position on the spindle.

9. Note that the thrust washers 2 and 3 (Figure 3) are of different outside diameters — one (No. 304795) is the larger while No. 304796 is of lesser outside diameter.

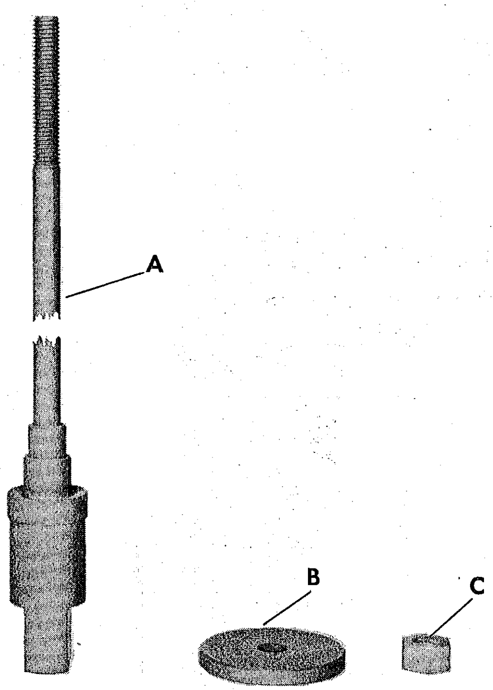


Figure 1. Tool No. 377543 for installing bearing assembly

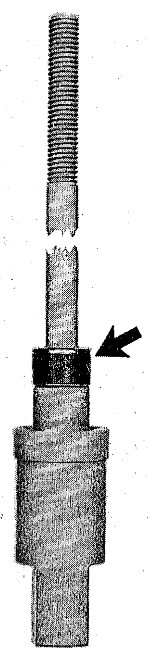


Figure 2. Showing needle bearing installed on spindle

10. Install No. 304796 of the lesser diameter — on top of the pinion bearing — 2 in Figure 3.

11. Place the thrust bearing in position above washer No. 304796.

12. Place thrust washer No. 304795 of the larger outside diameter (4 in Figure 3) above the thrust bearing.

13. Clamp the installing spindle in vise — install gear case over the assembly and carefully align.

14. Place puller plate in position on top of the gear case. Install puller nut "C" and draw up until the bearing assembly seats itself in the gear case.

15. Remove the puller spindle.

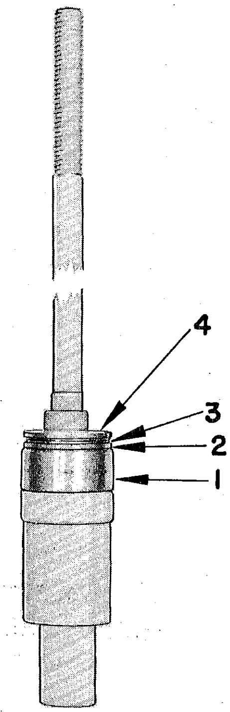


Figure 3. Showing thrust washers, thrust bearing and pinion bearing in position on spindle

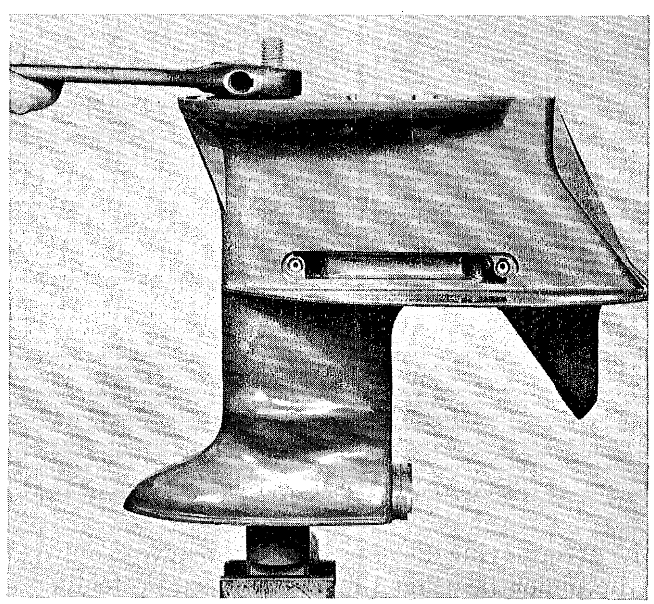
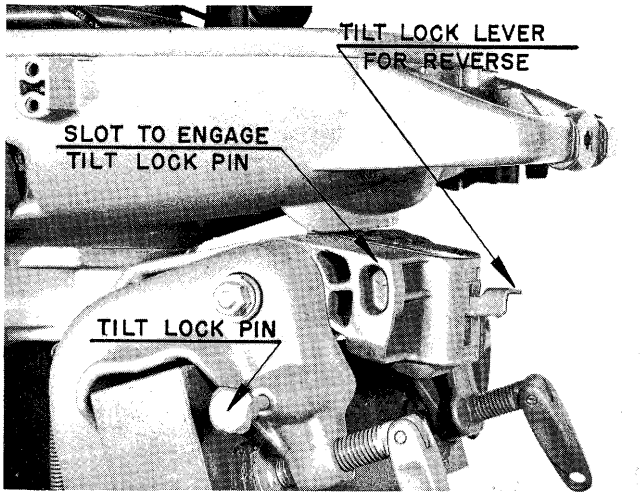
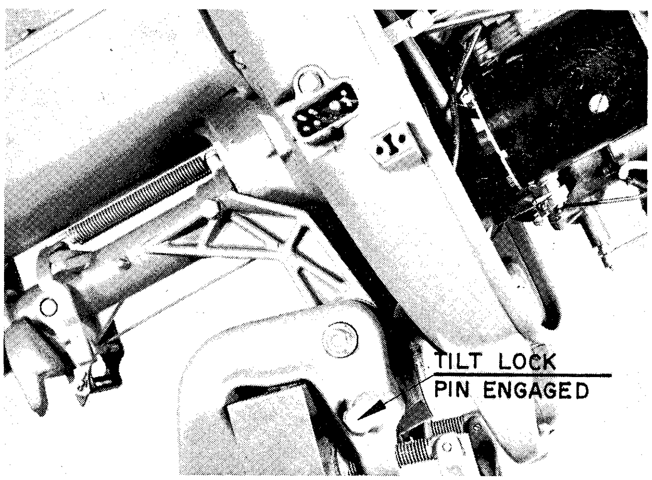


Figure 4. Installing bearing assembly

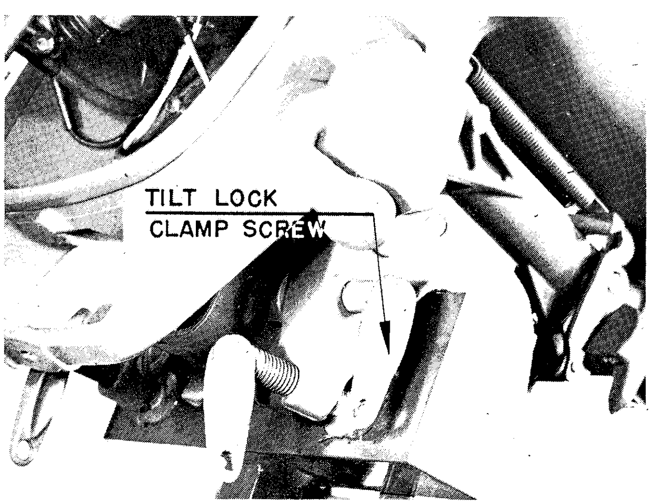
MODELS RDS-20 UP, LOWER UNIT ASSEMBLY



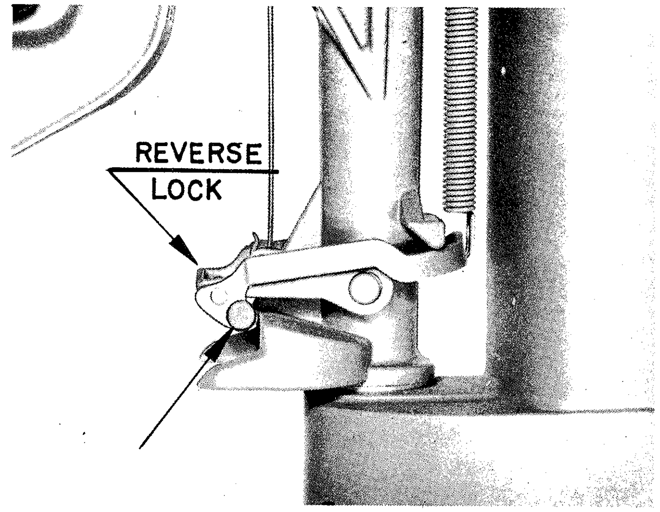
Provisions are made on Model RDS to tilt and hold the motor in a tilted position for replacing of the propeller and/or propeller pin. Tilting mechanism during normal operation of the motor, however, is controlled by the Tilt Lock Lever for reverse. See Page 444 for explanation.



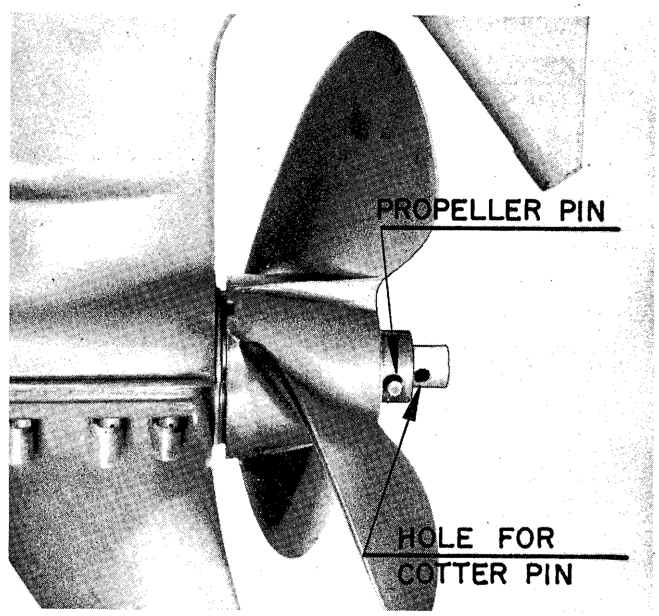
Showing the Tilt Lock Pin engaged to hold motor in tilted position for replacing propeller and/or propeller pin.



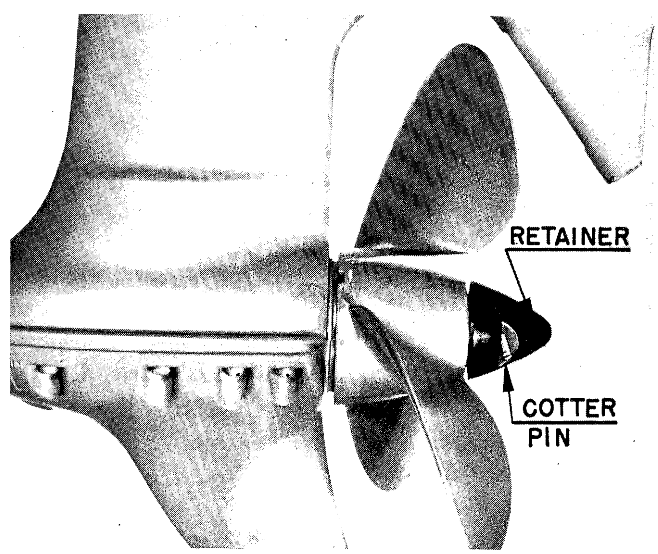
For trailing purposes, the motor may be adjusted to a tilt angle and held in this position by drawing up of the clamp screw provided for the purpose as shown above.



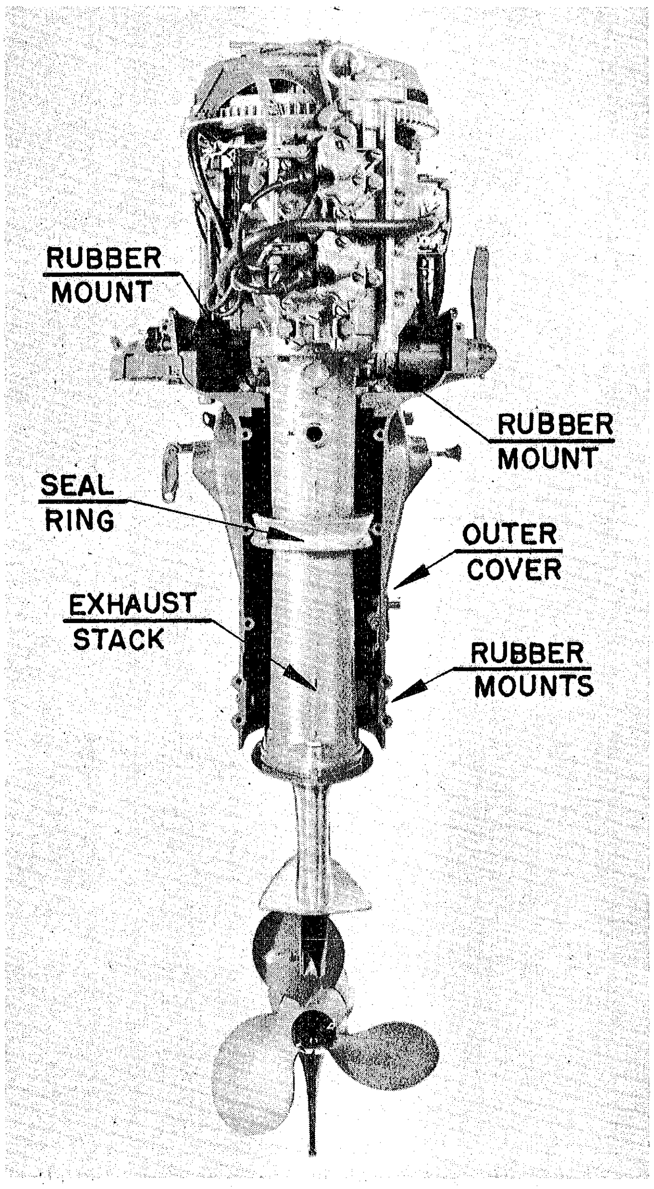
Showing Reverse Lock Mechanism – See Page 444.



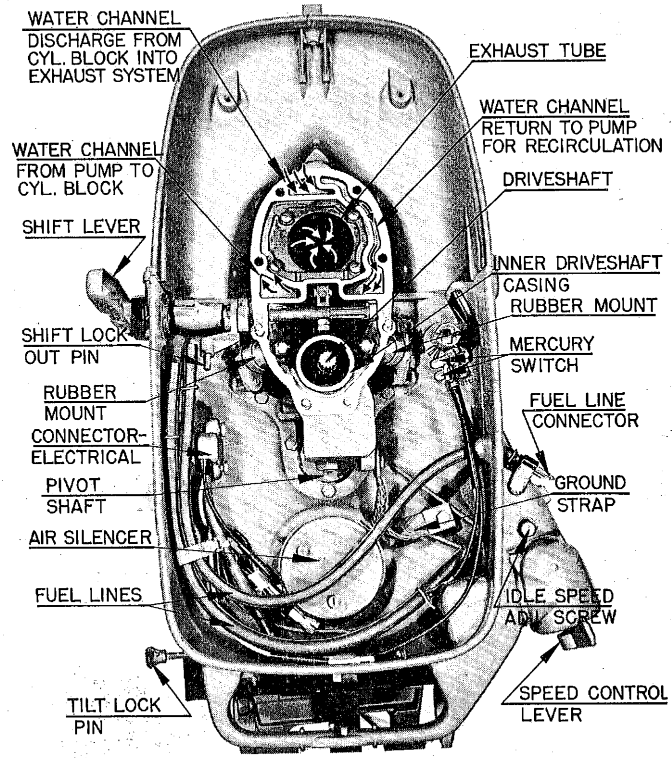
Note that the propeller shaft is not threaded. Propeller pin is held in position by a retainer secured with cotter pin.



Showing propeller retainer in position and secured by cotter pin.



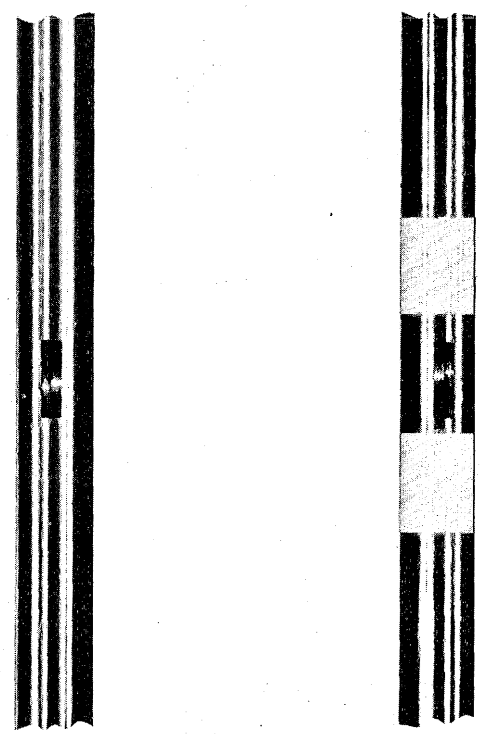
Rear cover removed to show Rubber Mount installation. Note that the power unit floats on rubber in the outer cover assembly. Models RDS-20 up.



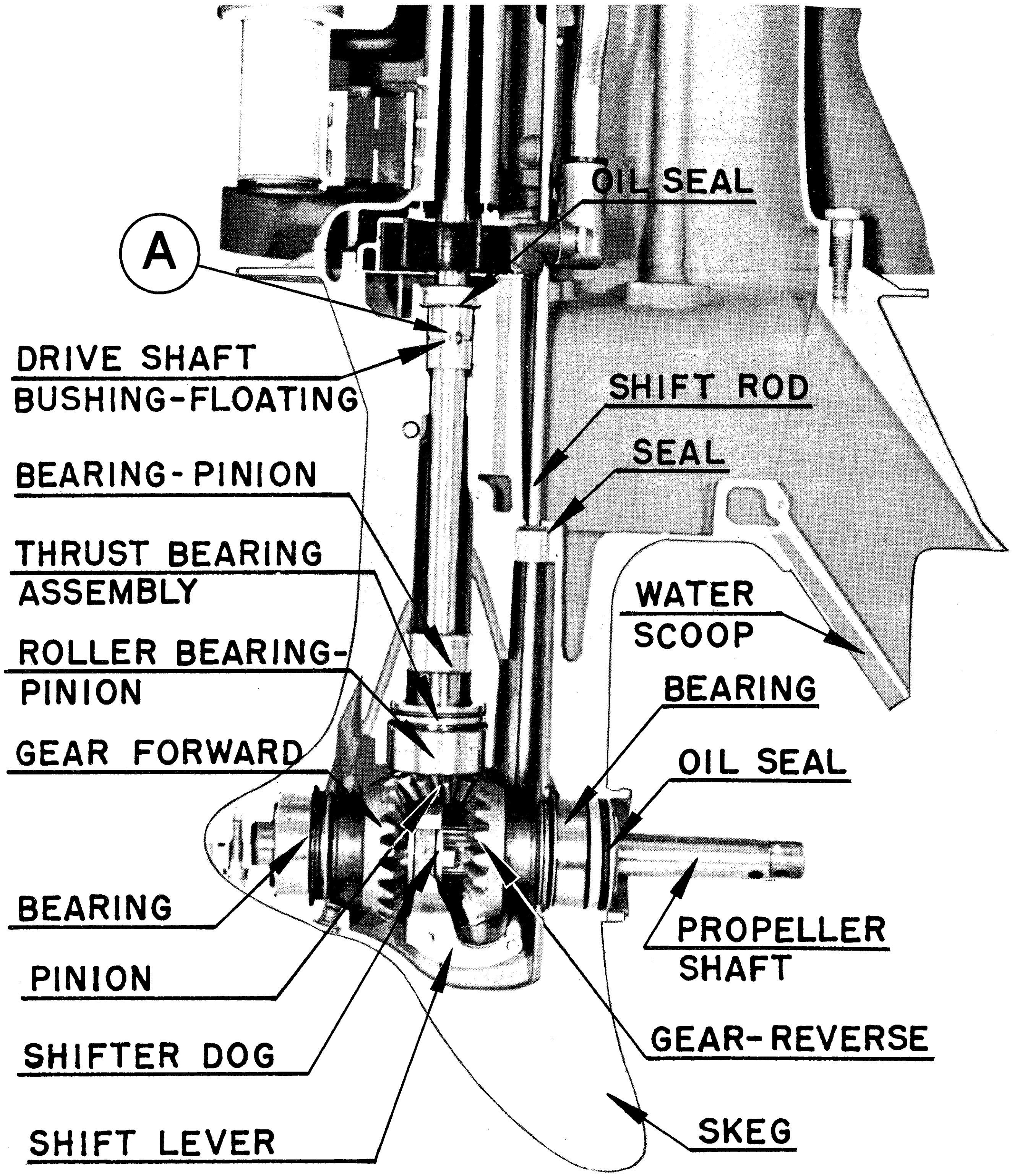
TOP VIEW – LOWER UNIT ASSEMBLY MODELS RDS-20 UP.

The gearcase shown on page 461 was changed during the model year 1962 – by replacing the full floating driveshaft support bushing with a caged needle bearing (arrow A). A similar change was made to the service gearcases used on Models RDS-20 up.

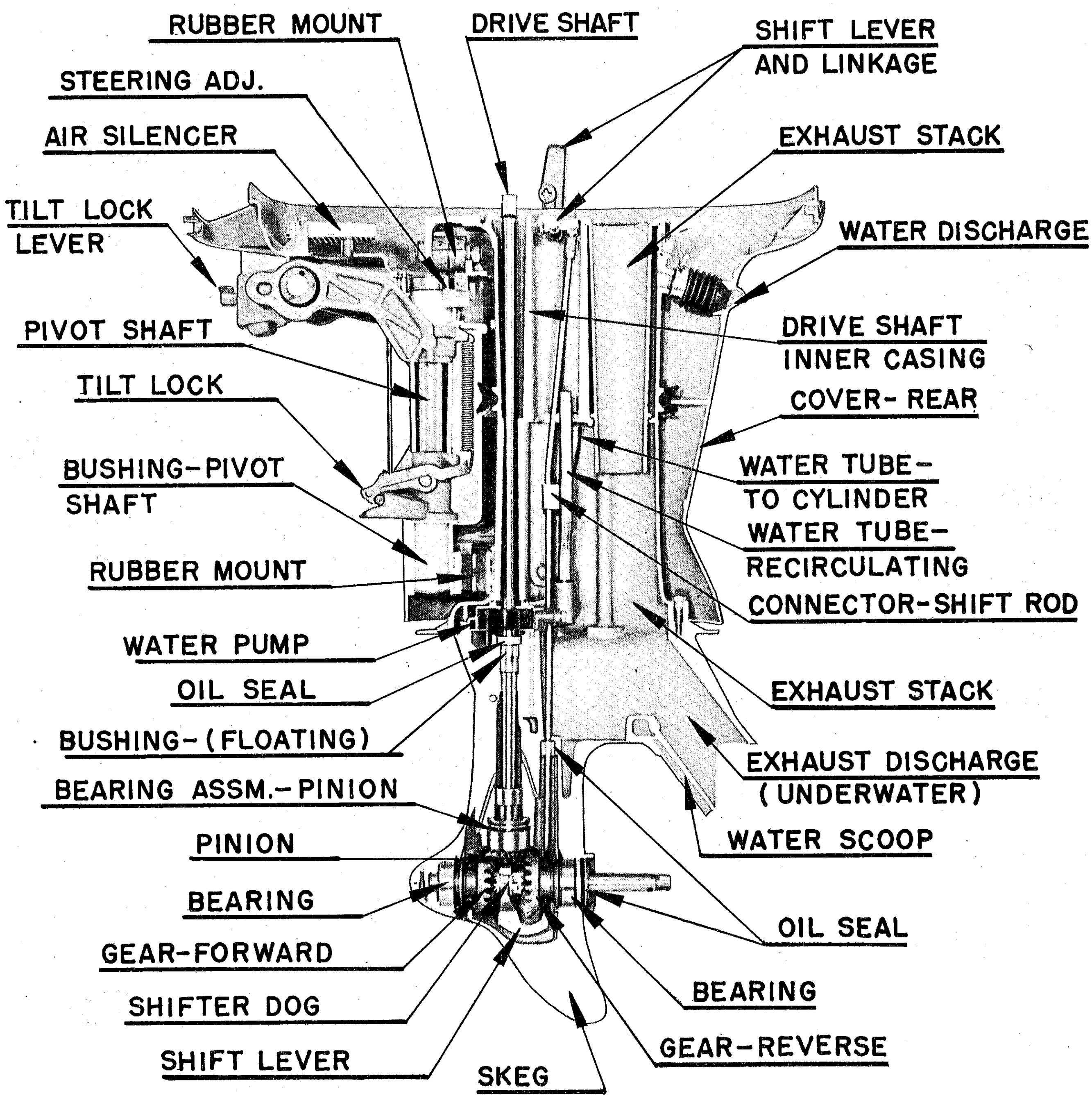
When replacing the driveshaft in a gearcase having this needle bearing as standard equipment – check the driveshaft prior to installation, making sure it has the double chrome-plated band as shown in the following illustration. The upper chrome-plated band prolongs the life of the seal in the water pump housing. The lower chrome-plated band provides a hard contact surface for the needle bearing mentioned here.



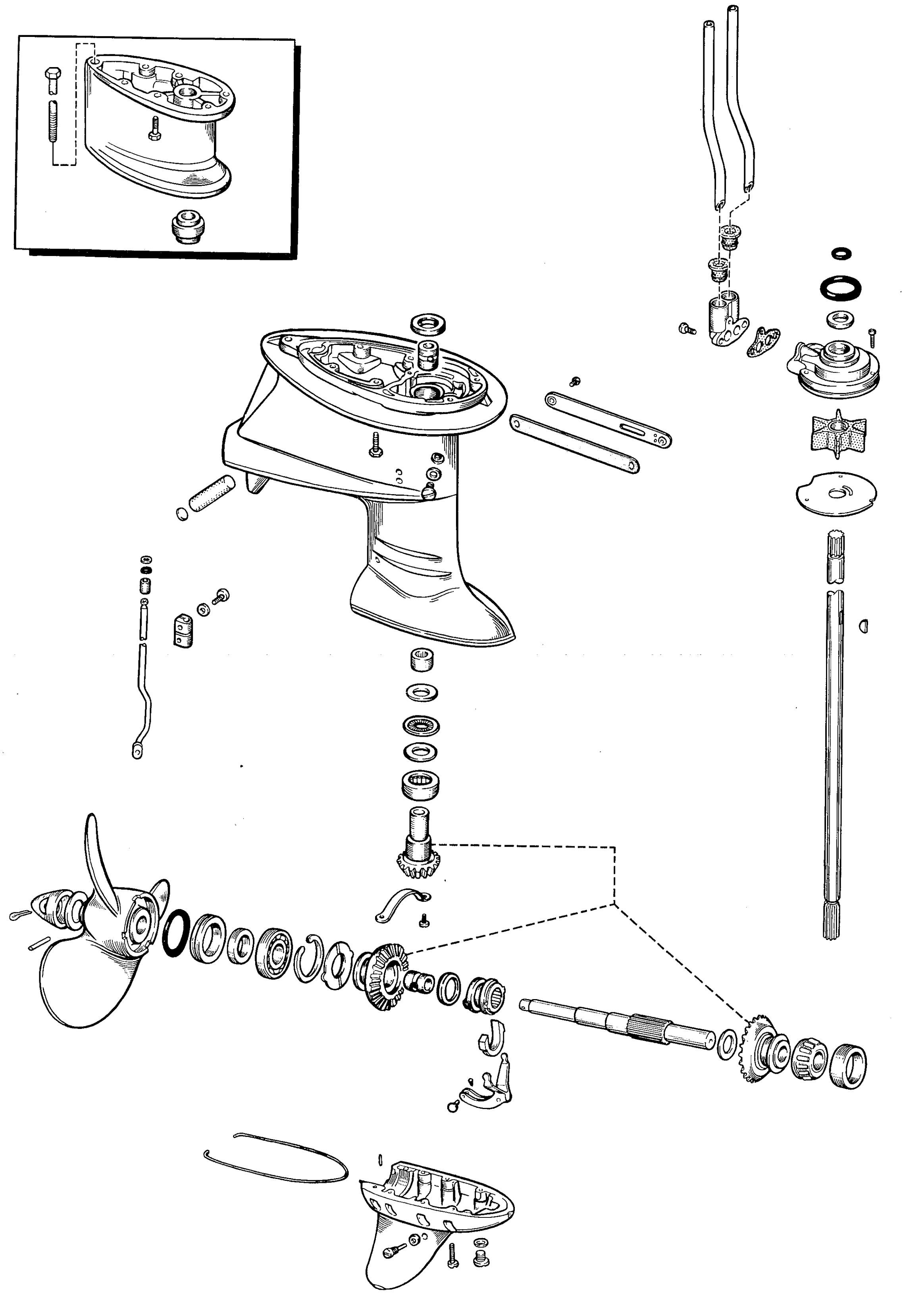
Showing old style driveshaft, and new style driveshaft with two chrome-plated bands to prolong seal and bearing life.



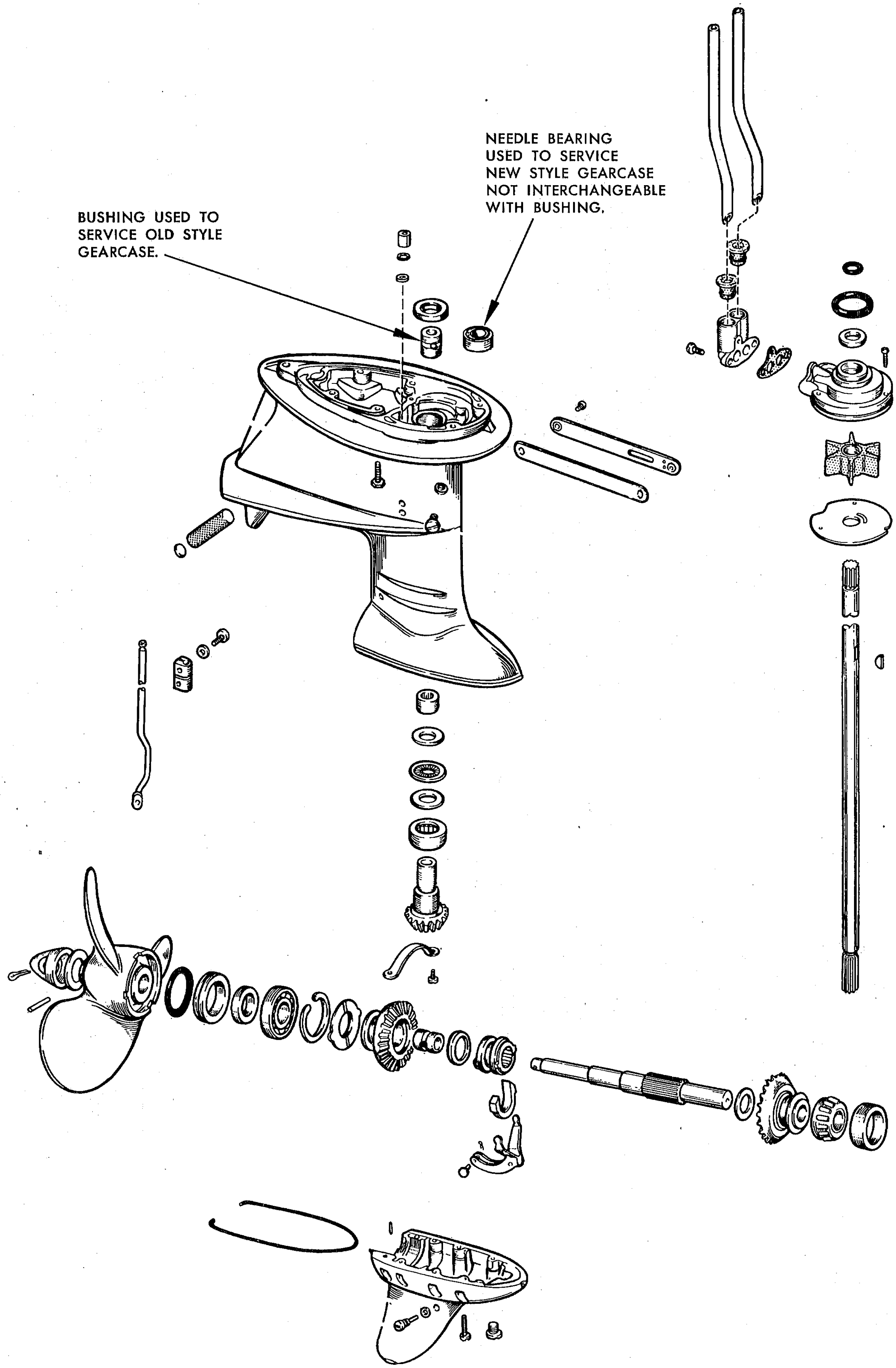
SECTIONAL VIEW – GEARCASE – MODELS RDS-20, RD, RDS-21 UP.



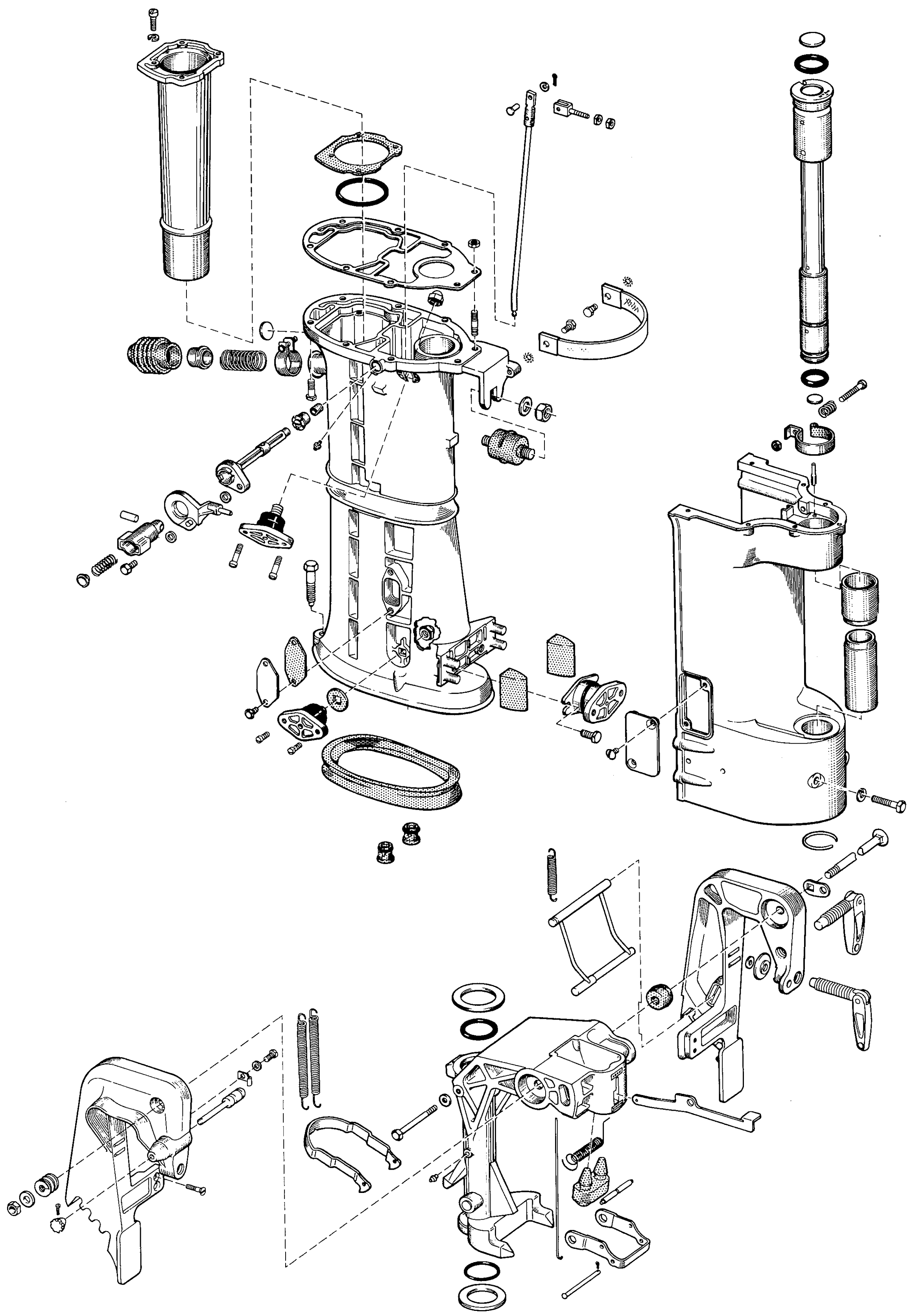
SECTIONAL VIEW – LOWER UNIT MODELS RDS-20, RD, RDS-21 UP.



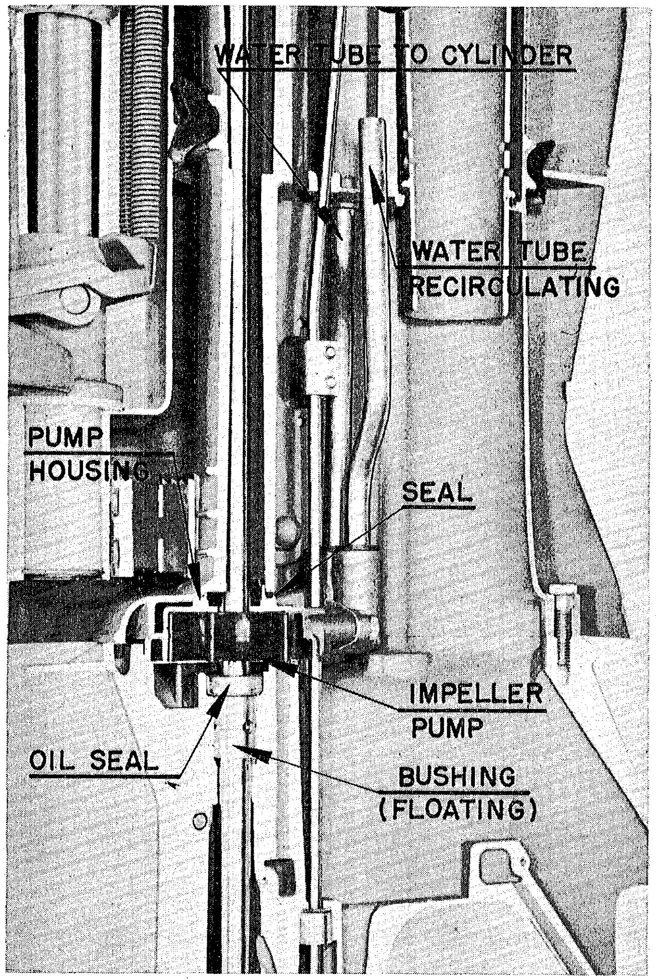
EXTENDED VIEW – GEARCASE ASSEMBLY GROUP – MODELS RDS-20, RD, RDS-21 TO 23.



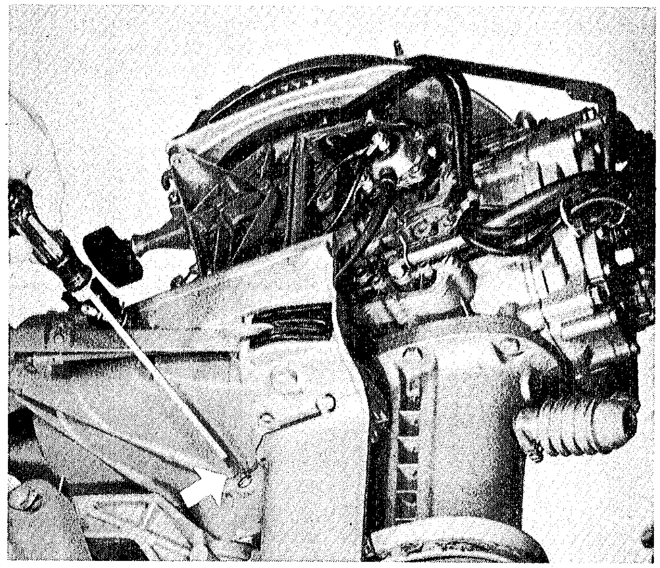
GEARCASE GROUP
Models RDS-24M Up



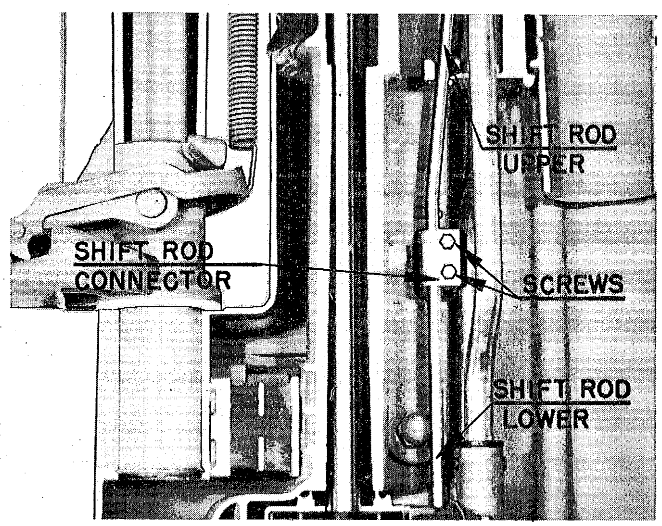
STERN BRACKET, COVER AND EXHAUST STACK GROUP – MODELS RDS-20, RD, RDS-21 UP.



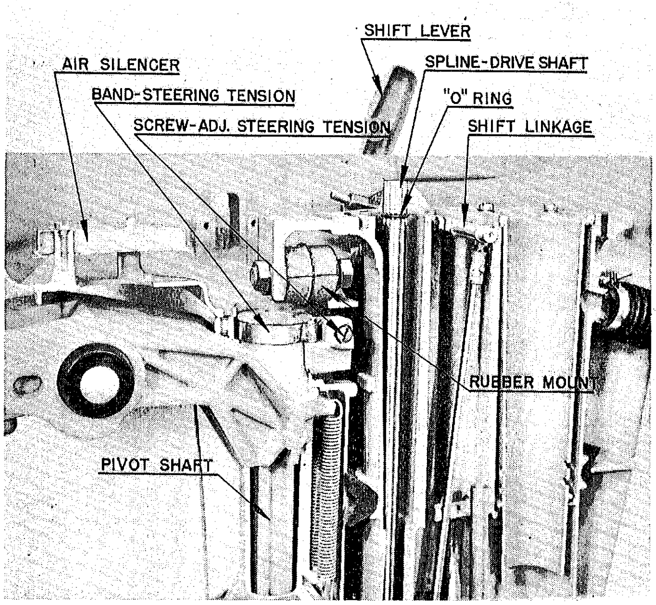
Sectional view – Showing Water Pump installation, Models RDS-20 up.



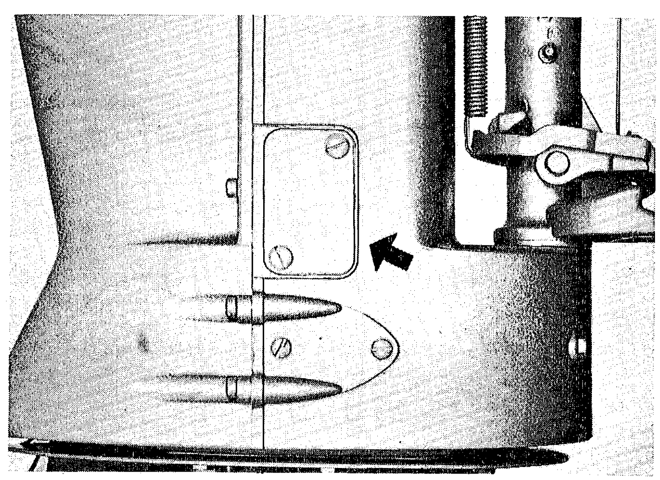
Adjust steering to desired tension with screw driver as shown above.



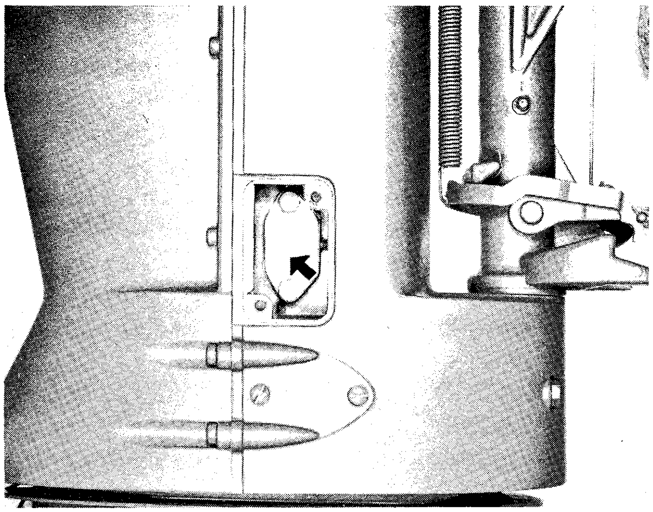
Sectional view — Showing upper and lower Shift Rods and installation of the Shift Rod Connector.



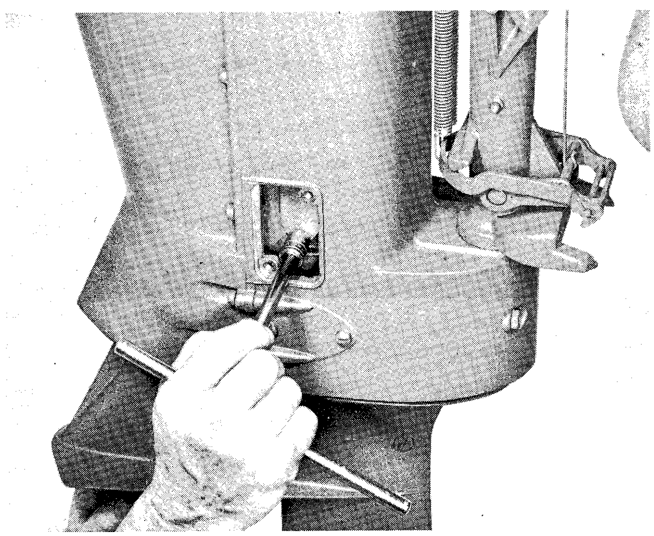
Sectional view lower unit upper — Showing Rubber Mount, Pivot Shaft, Band and Screw to adjust steering tension, Models RDS-20 up.



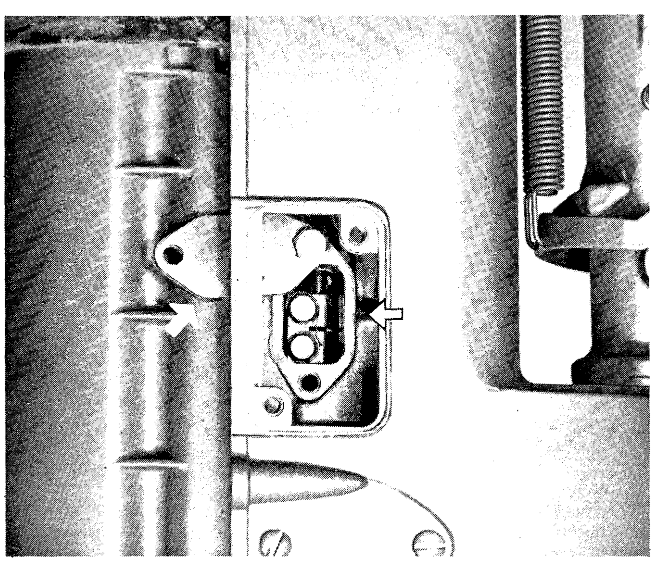
Prior to detaching the Gear Shift Assembly, one screw of the Shift Rod Connector must be removed to accomplish a break in the Shift Rod. To accomplish, remove cover indicated by arrow as above. On removal note that a second cover is assembled to the inner Exhaust Stack. See sectional view of the lower unit.



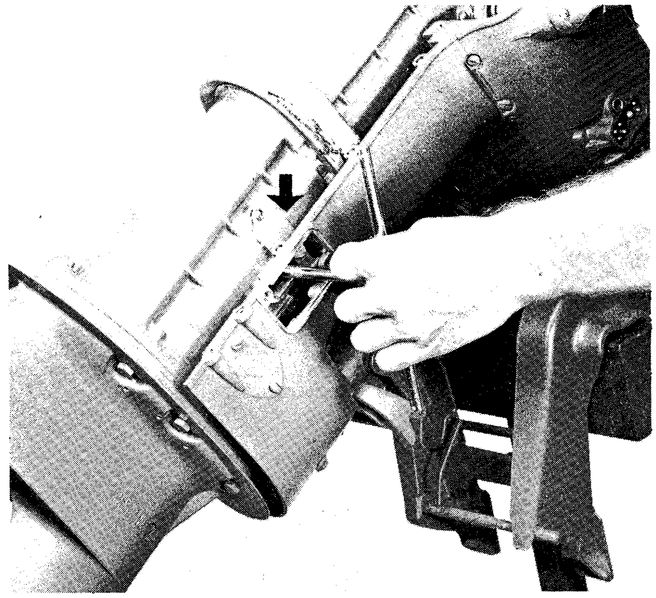
Outer cover removed to expose inner cover attached to the exhaust stack.



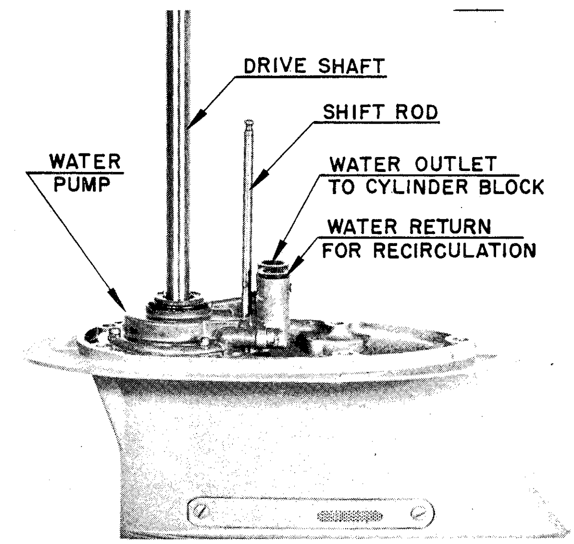
Removing inner cover to gain access to Shift Rod Connector Screw. Remove the bottom screw only; loosen the upper screw to permit moving the cover aside.



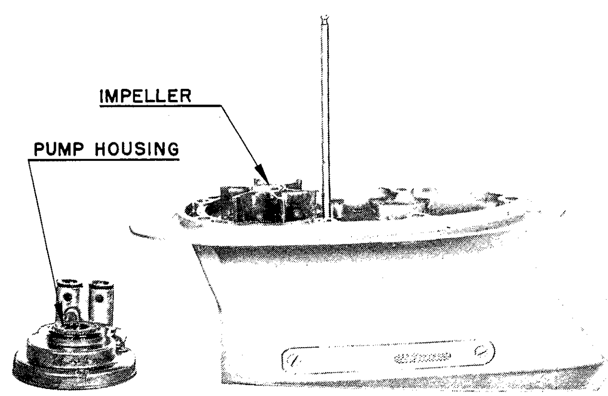
Outer cover removed, inner cover moved aside to expose the Shift Rod Connector and screws.



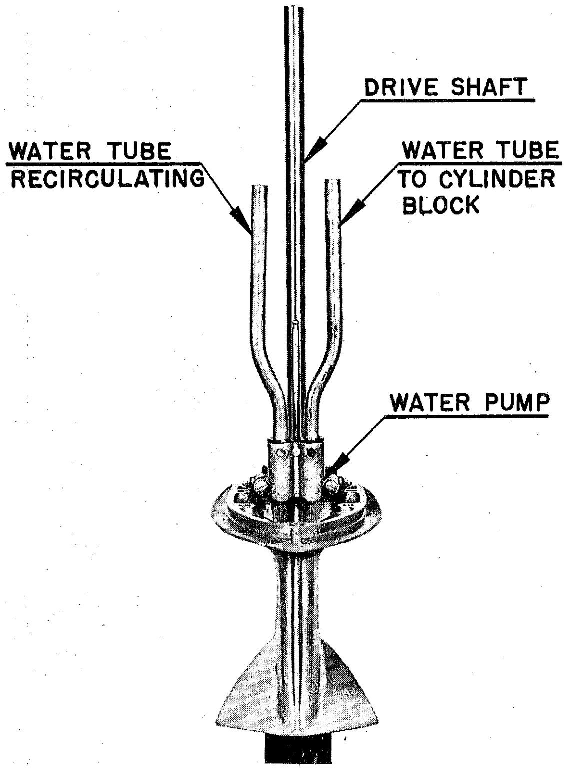
Removing Shift Connector Screw. Note that cover plate has not been removed but shifted to one side.



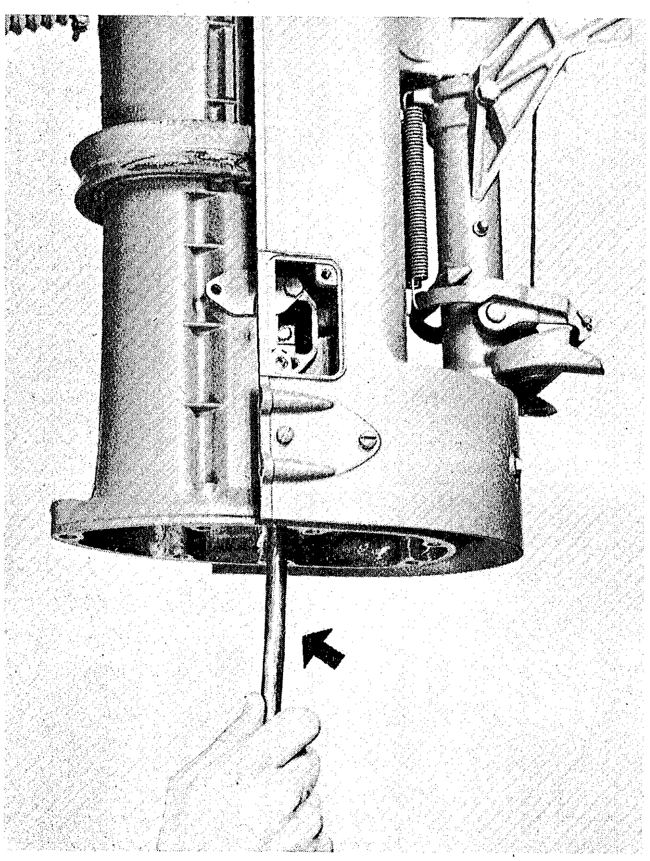
Water Pump installation.



Upper end of Gear Case — Pump housing removed to expose the Impeller for inspection as to fitness for further use. Corrosion or pitted inner surface of the pump housing contributes to faulty pumping. Replace parts in doubtful condition.



Showing Water Pump and Tube installation.



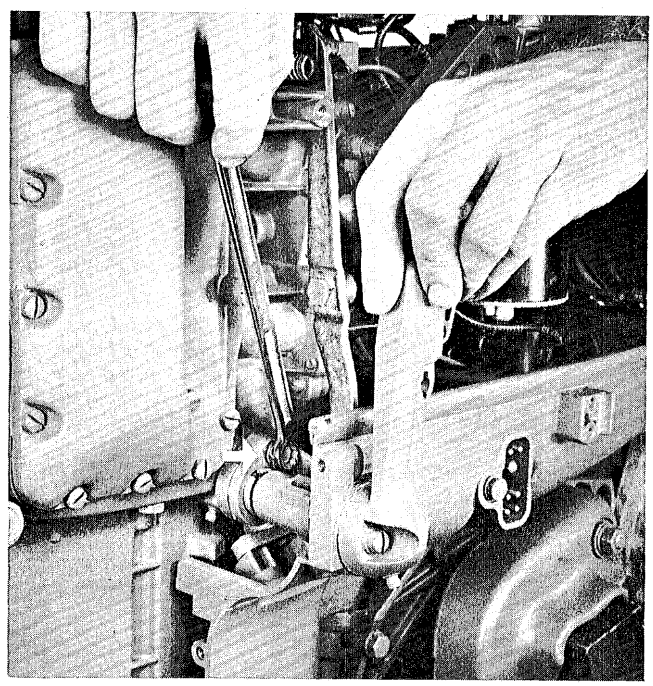
Inserting Water Tubes which seat in rubber grommets in the exhaust stack as well as in the pump housing. Care should be exercised during installation to improve proper seating. A thin coat of oil or grease applied to the ends of both tubes will be of assistance in this respect.

SHIFT LINKAGE ADJUSTMENT

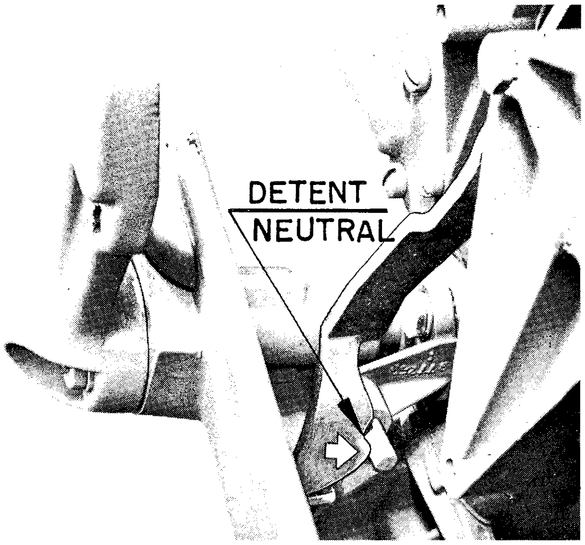
On completion of lower unit repair, particularly after having installed a new clutch dog, adjustment of the shift linkage must be checked to assure proper engagement with the forward and reverse driving gears. The operation, though a simple one and easily performed, should not be overlooked.

Proceed as follows:

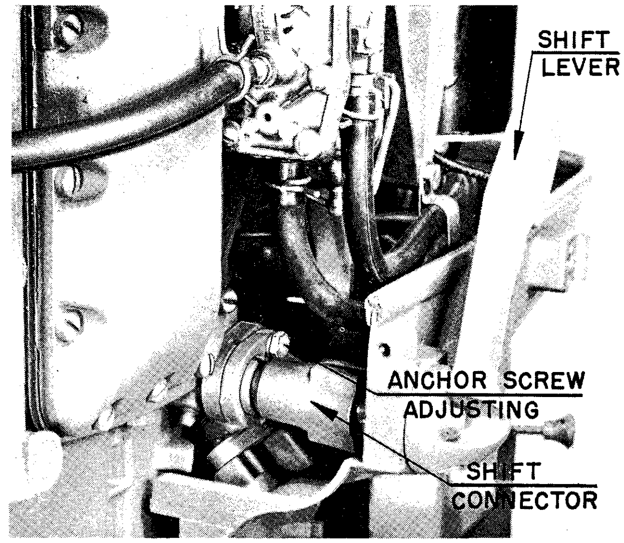
1. Loosen anchor screw as shown below.
2. Seat lockout pin in detent for neutral in the shifter lock.
3. Adjust shift lever to vertical position (straight up and down).
4. Draw up on anchor screw to secure in this position.
5. Check position of shifter dog engagements with forward driving gear by advancing the lockout pin to high contours of the detent areas as shown below.
6. Turn propeller and make note of actual position of the lockout pin at time of engagement.
7. Move shift lever in opposite direction to check position of the lockout pin when engagement with the reverse driving gear occurs.
8. When correctly adjusted, positions of clutch dog engagement forward and reverse, as indicated by the lockout pin, should be equidistant from center of detent for neutral in shifter lock. See illustration below. Minor variations in this respect can be overcome by slight readjustment.



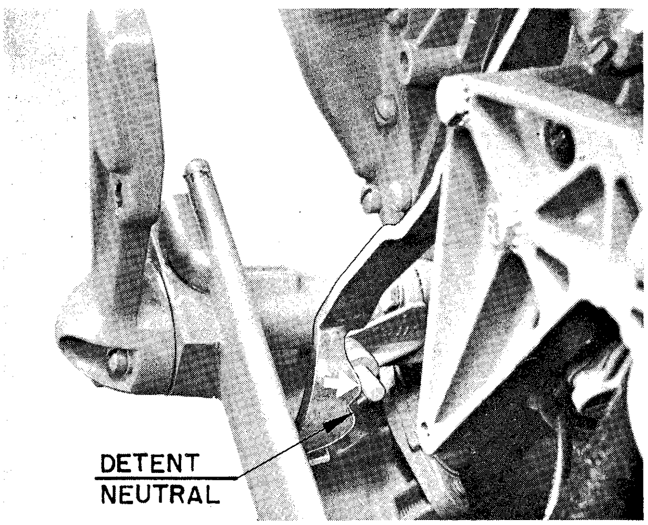
To adjust Shift Linkage — Loosen anchor screw indicated by arrow above, set lock pin to seat in neutral detent of shifter lock; set shift lever in vertical position (straight up and down). Secure in this position by drawing up snugly on screw as shown.



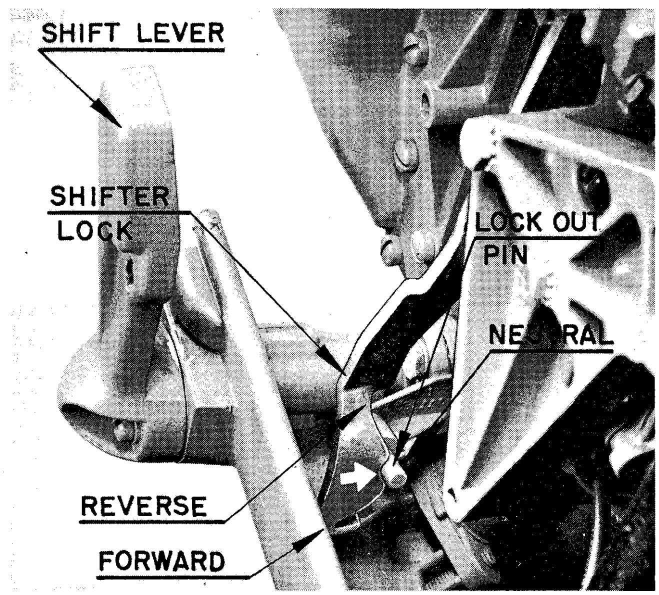
Showing position of Lock-out Pin with respect to neutral detent at instant of clutch dog (in gear case) engagement with forward driving gear.



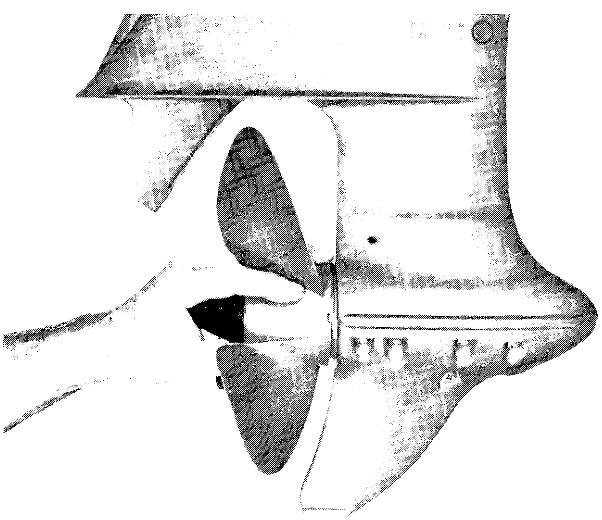
Shift Lever and Linkage.



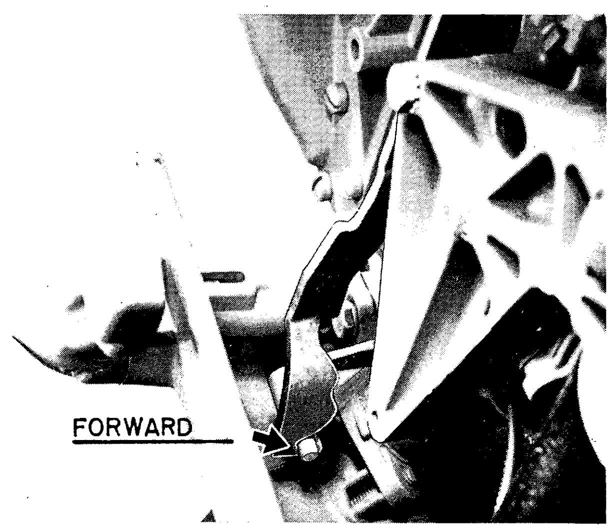
Showing position of Lock-out Pin with respect to neutral detent at instant of shifter dog (in gear case) engagement with the reverse driving gear.



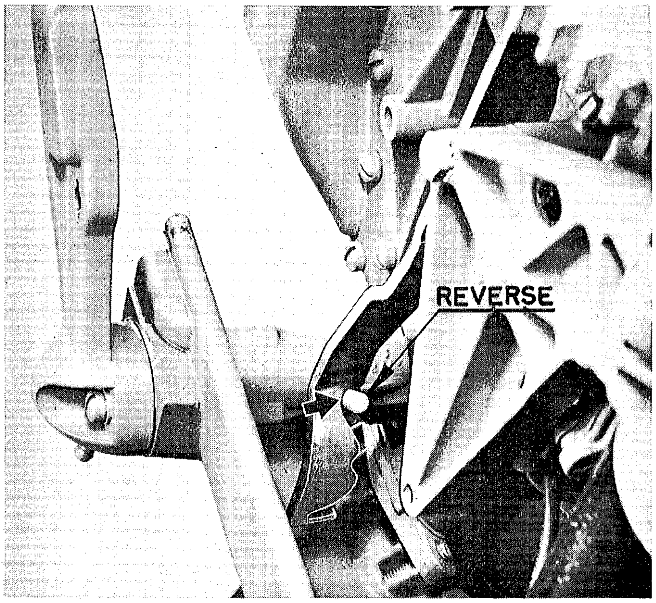
Neutral — Showing position of Lockout Pin engaging neutral detent in Shifter Lock—Shift Lever straight up and down.



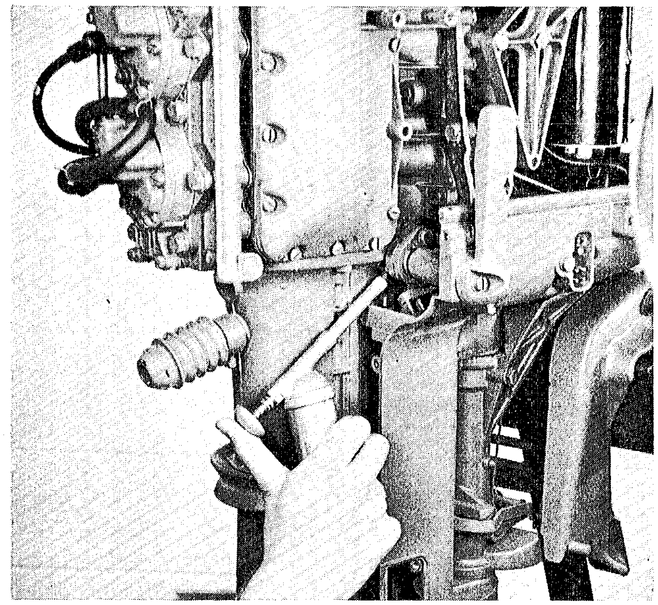
Turning propeller to check clutch dog engagement with forward and reverse driving gears.



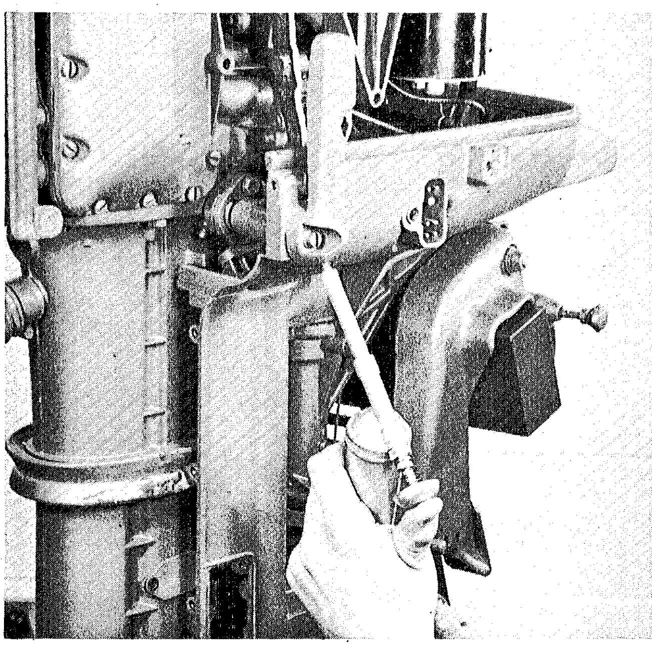
Forward — Shifting Lockout Pin engaging forward detent in Shifter Lock.



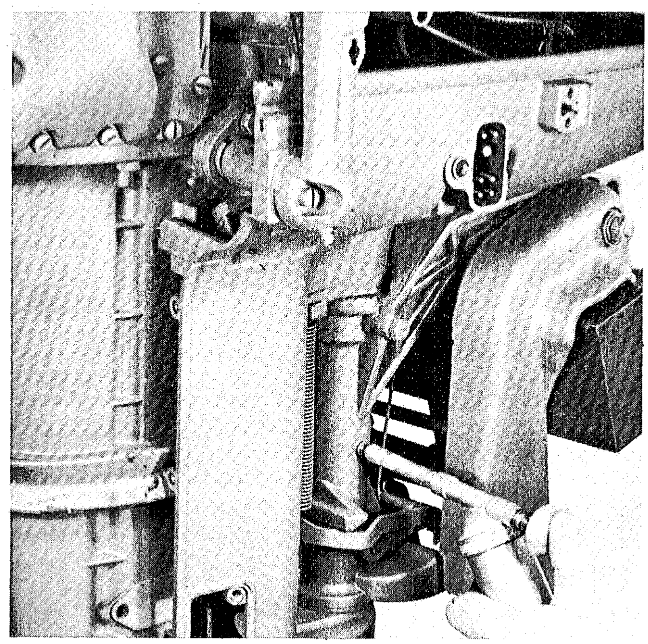
Reverse — Shifting Lockout Pin engaging reverse detent in Shifter Lock.



Lubricating Shaft for the Shifting Lever.

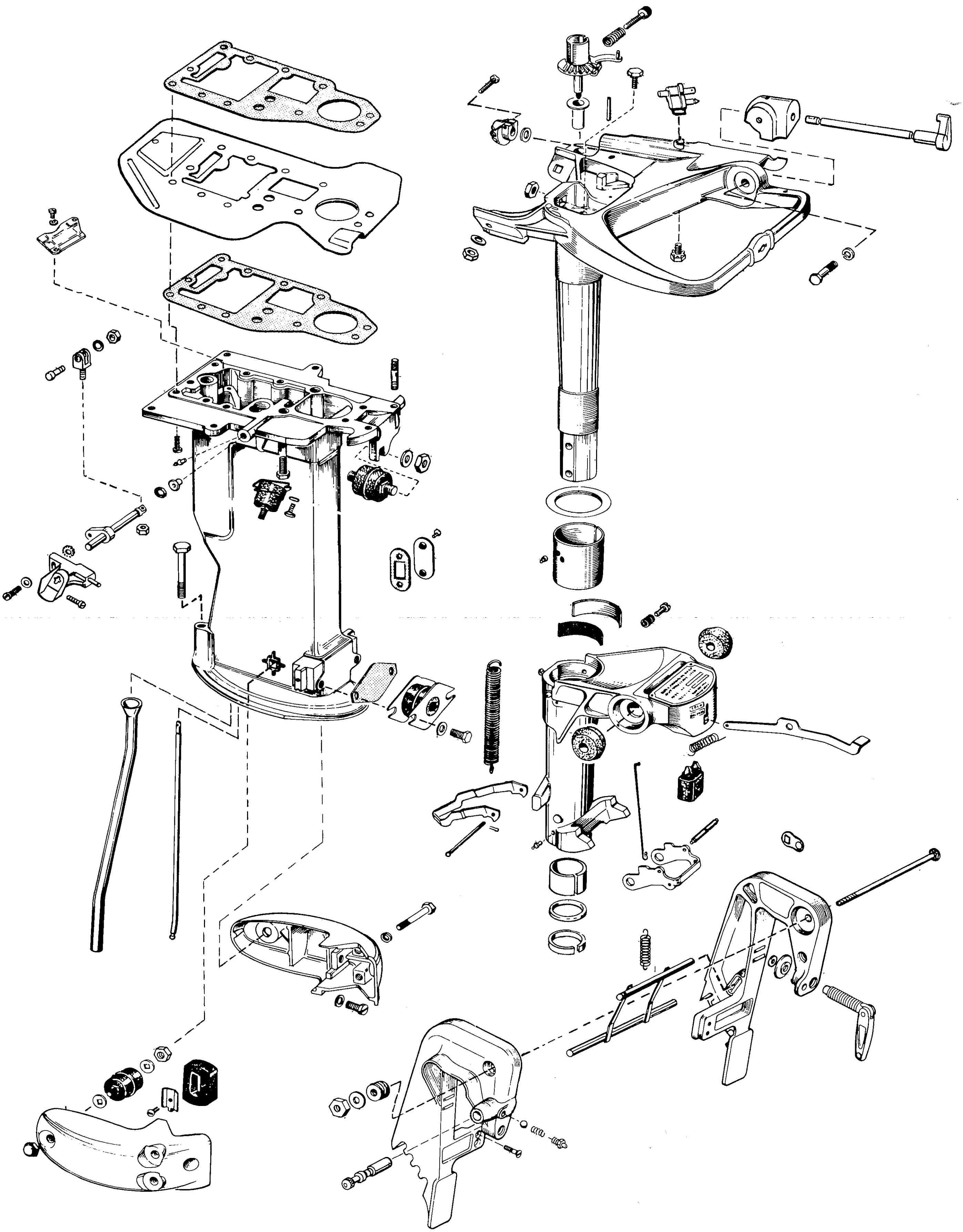


Lubricating Shaft for the Shift Lever.

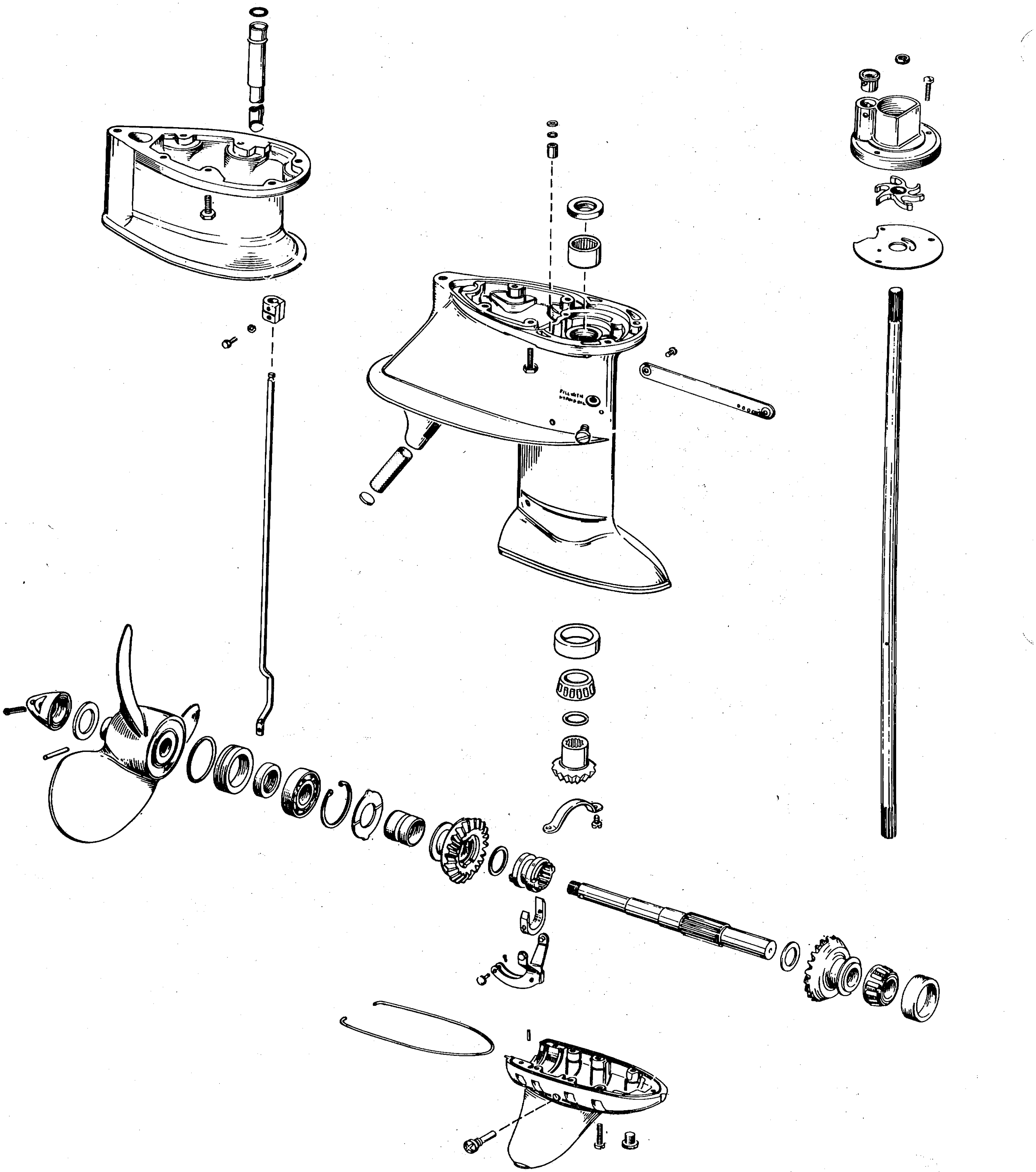


Lubricating Pivot Shaft Assembly.

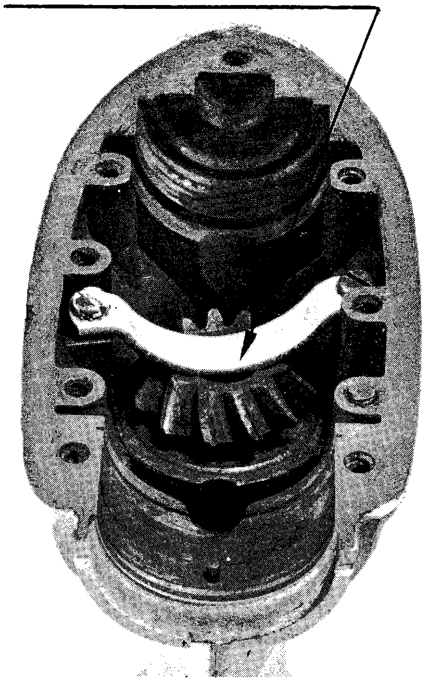
NOTES



LOWER UNIT GROUP
Models RX-10C up.



GEARCASE GROUP
Models RX-10C up.



Elimination of Driveshaft Support No. 302552, 40 H.P. RD(SL)-24 and later RD(SL) Model Series.

The first 1962 models of the 40 h.p. RD(SL) series engines were built with the conventional driveshaft support, No. 302552, shown in previous illustration. Later models do not contain this support because of a running change which eliminated the necessity for it.

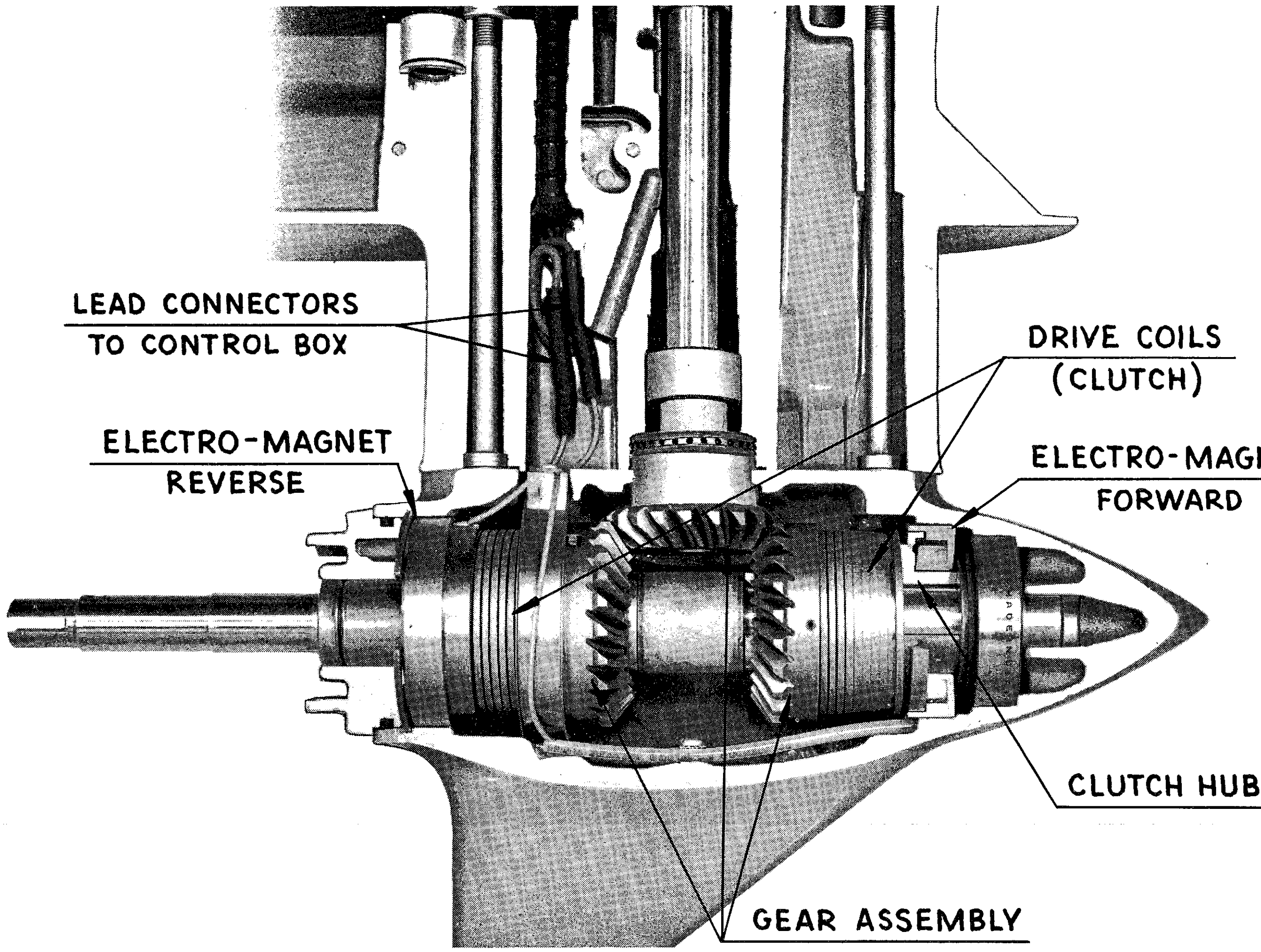
Absence of this support in such engines is no cause for concern since it was eliminated by a design change on the driveshaft and pinion gear rather than by error in assembly. In servicing gearcases of 1962 – 40 h.p. engines, adhere strictly to the parts catalogs and be certain to install only the parts specified for each model.

Service Bulletin No. 896 3/28/62

NOTES

NOTES

THE ELECTRAMATIC GEAR SHIFT



The ELECTRAMATIC gear shift employed in assembly of the Model RK – 40 H.P. Series and the familiar gear shift in other models function in like manner, except that clutch engagement in the former is achieved through an electrically activated arrangement rather than mechanical as in the latter.

Both the forward and reverse driving gear assemblies float on the propeller shaft until engaged or coupled to the propeller shaft – forward or reverse, whichever the case may be. The mechanical shifting principle, employed for these past many years is well understood.

The Electramatic gear shift assembly consists of:

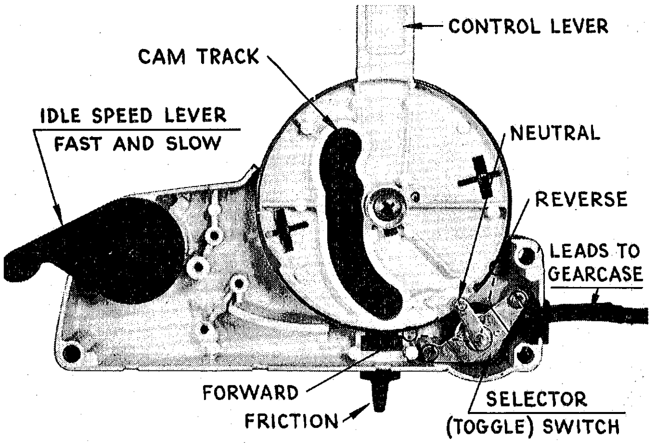
1. The pinion – attached to the driveshaft.
2. The forward driving gear.
3. The reverse driving gear.
4. The propeller shaft.
5. Two clutch hubs – splined to the propeller shaft.
6. Two clutch drive coils, each anchored respectively to the forward and reverse driving gears, and as such, both assemblies float on the clutch hub (splined to the propeller shaft).
7. Two electromagnets, energized by battery current. A lead from each is directed to a toggle switch in the control box and appropriately attached to the forward and reverse sides.

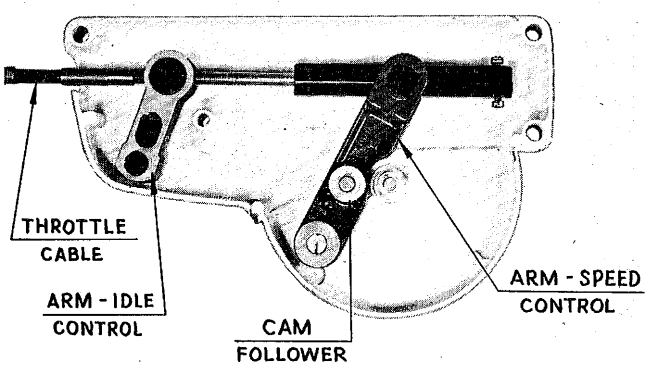
When shifting to forward, the toggle switch actuated by the control lever, establishes a forward driving circuit. The energized electromagnet then attracts and anchors the free end of the clutch drive coil to the clutch hub. In so doing, the revolving coil is caused to drag and subsequently wrap itself tightly around the hub to establish a direct coupling with the propeller shaft. It may be easily seen that the path of energy applied to drive the propeller is through the pinion, forward driving gear, clutch drive coil, clutch hub, propeller shaft and finally the propeller.

Forward drive is thus retained until the control lever is returned to neutral position at which time the circuit is automatically broken. The electromagnet instantaneously de-energizes. The clutch coil resumes its normal position to release its grasp on the clutch hub. The assembly now floats on the clutch hub and neutral is restored. Like action occurs in reverse.

Current drawn by each electromagnet when activated is 1.7 amp.

Remote Control Housing – inner half – showing Control Lever, Idle Lever and Gear Selector Switch with lead to Gearcase.



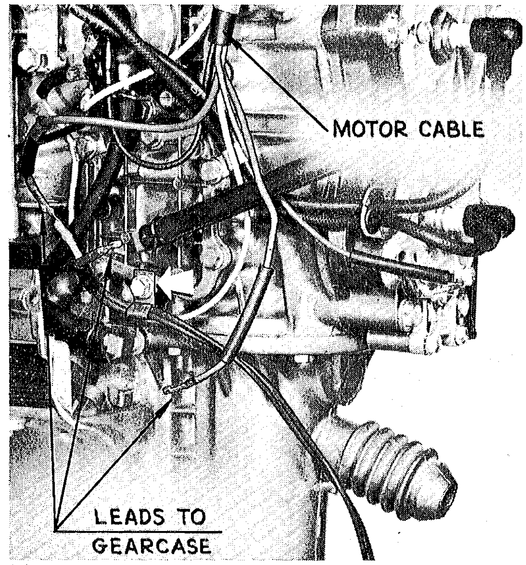


Remote Control Housing – outer half – showing Speed Control Arm, Idle Control Arm, and Throttle Cable.

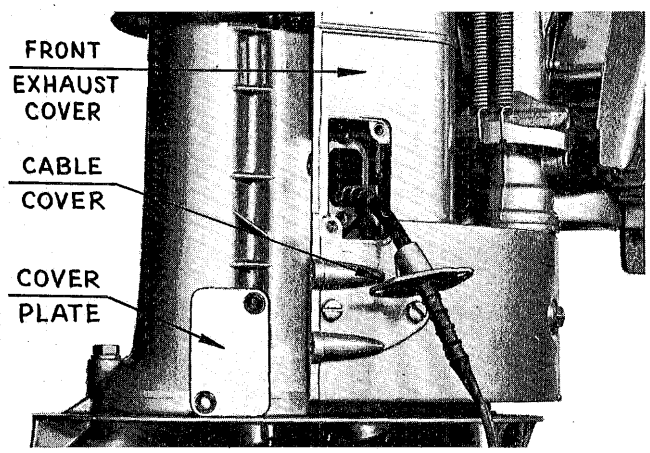
Power transmitted from the powerhead to the propeller follows basically the same path through the gear train and shafting as is employed in the manual shift models – the fundamental difference in this respect relates to the manner in which the forward and reverse gears are engaged and/or disengaged.

The following text and illustrations have been planned in a definite sequence and accordingly arranged to avoid the possibility of damage to the components during the process of disassembly – restoration of assembly.

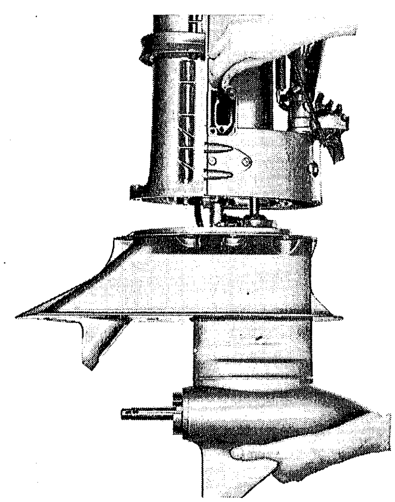
EXTREME CAUTION must be exercised in several instances during assembly procedure which is brought to the reader's attention as the specific occasions dictate. Failure to comply with these musts will result in a short-lived or inoperative unit.



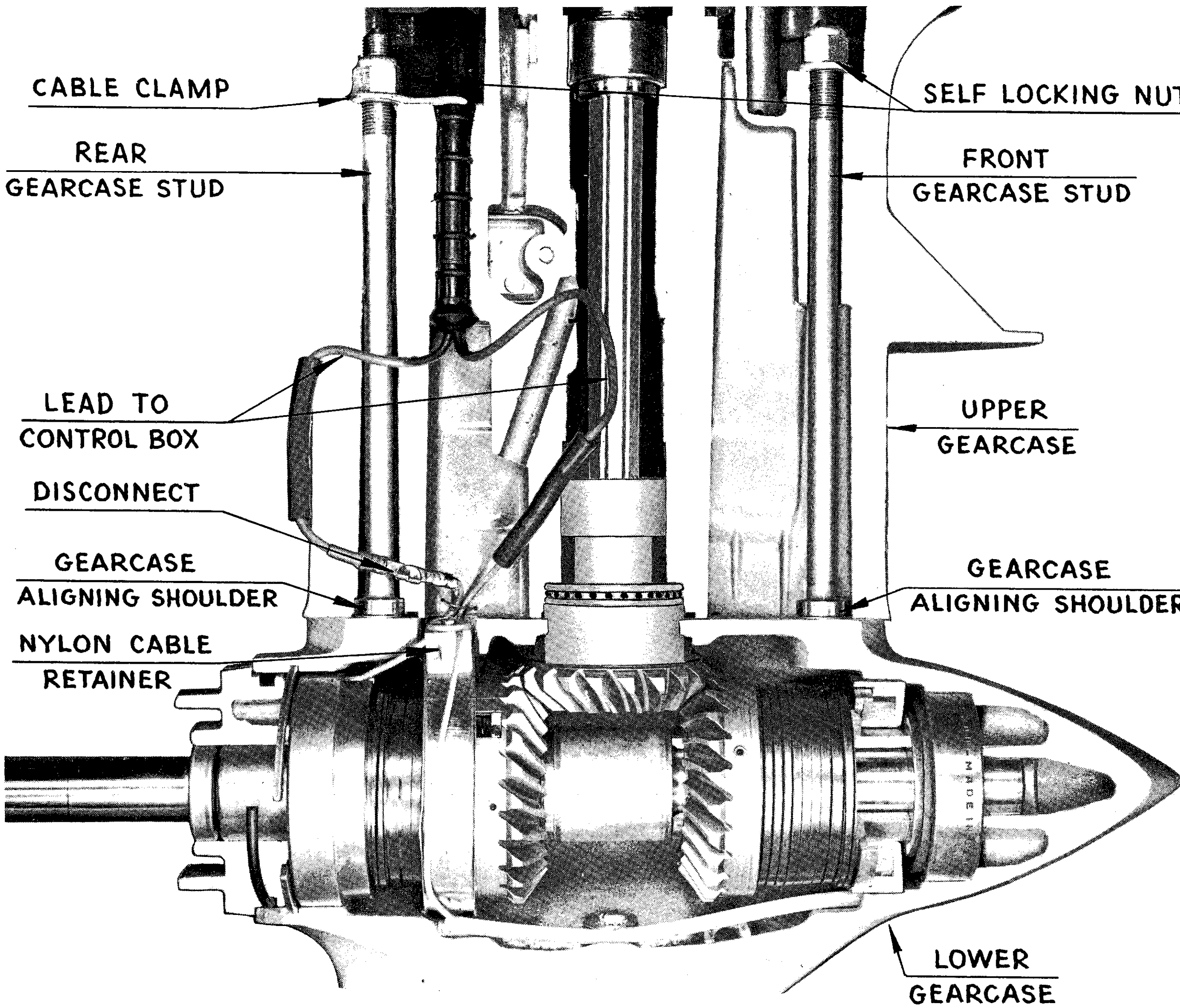
Disconnect leads from Motor Cable – Blue and Green Wires. Remove Clamp (arrow) from the lower Bypass Cover. Note that all wiring is color keyed.



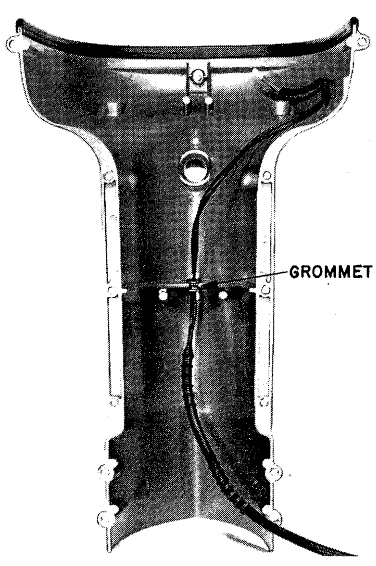
Rear Exhaust Cover removed – Cover Plate (front Exhaust Cover) removed exposing the Cable Cover which has been partially removed.



Removing Gearcase from the Exhaust Housing. Feed Cable through opening in the Exhaust Housing to prevent fraying of Cable on sharp edge of Casting. *Caution* – Electric Cable is easily damaged if insulation is damaged.



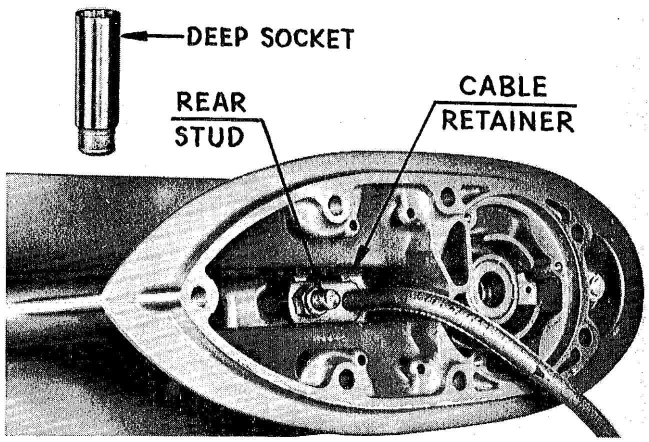
Showing Leads to Control Box and Disconnects.



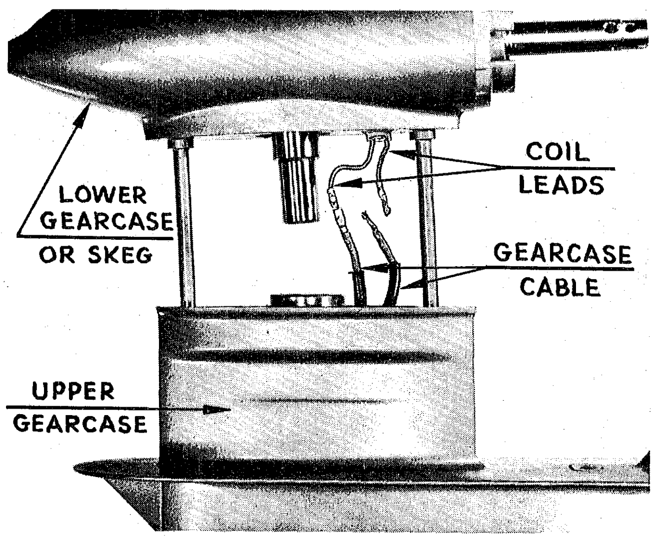
Inside view of rear Exhaust Cover showing Shift Cable and Grommet installed in groove provided for the purpose.

The upper and lower gearcase are held together by two studs which also serve to align the two gearcase sections. Alignment is accomplished by means of a close tolerance shoulder immediately above the bottom threaded section of each stud which fits into a similarly machined recess in the upper gearcase. Two self-locking nuts are used at the top end of the gearcase studs to draw the gearcase sections together — the nuts are torqued to 18 - 20 ft.-lbs.

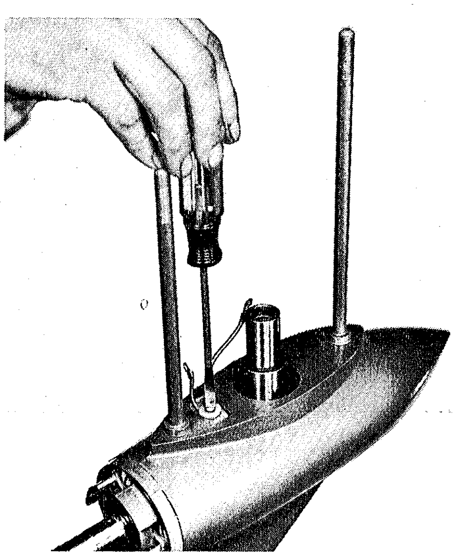
CAUTION — DO NOT RE-USE THE SELF-LOCKING NUTS. INSTALL NEW (UNUSED) NUTS ON EACH OCCASION TO ASSURE FUTURE SECURITY OF THE ASSEMBLY.



Length of rear Stud necessitates use of deep socket for removal of Nut. Position of Cable Retainer on rear Gearcase Stud shown.

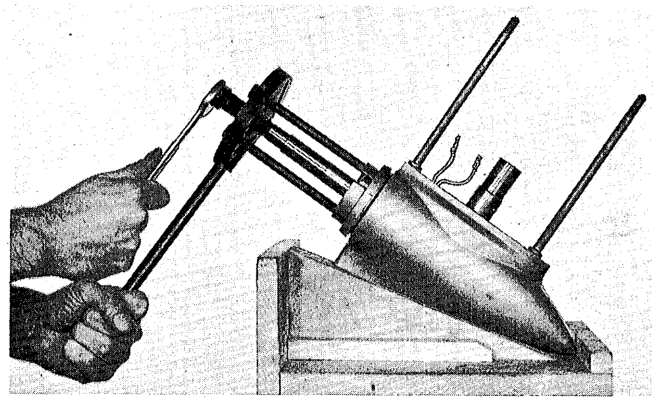


Separating upper and lower Gearcase. Pull apart 2″ to 3″ to disconnect Gearcase Cable from Coil Leads. Sections may then be completely separated. Working with assembly upside down prevents loose pinion bearing roller from dropping into lower gearcase. (There are 20 rollers.)



Removing Retaining Screw, Washer and Nylon Holding Block.

IMPORTANT – To prevent possible damage to the rear electromagnet lead, remove the small screw, washer and nylon holding block retaining the electromagnet leads immediately after separating the upper and lower gearcase. It should be readily seen that any attempt to remove the rear electromagnet without first removing the retaining screw, etc., could result in the lead being torn from the electromagnet.

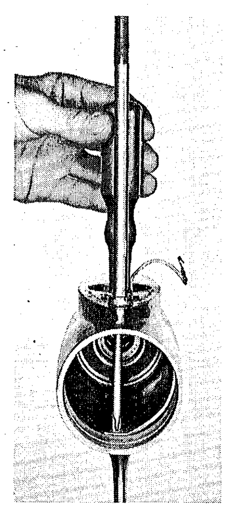


Pulling Gearcase Head with Tool No. 378103, using two Pulling Screws No. 309489 from No. 378104 Adaptor Kit.

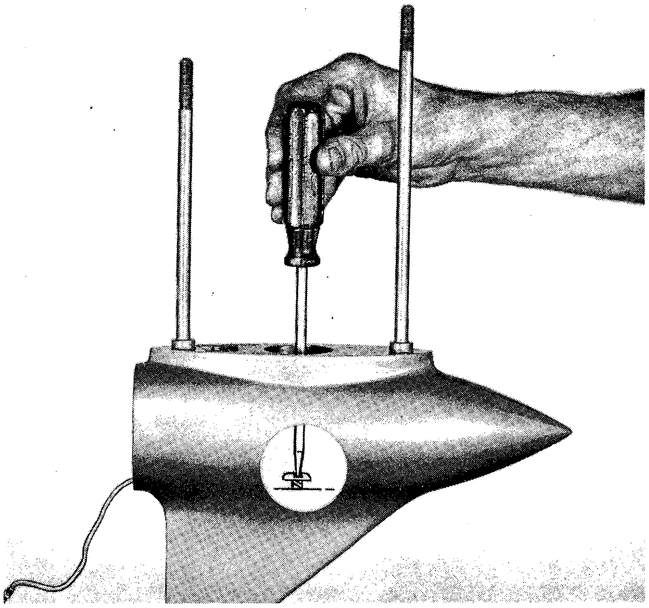
Since the rear electromagnet is a fairly snug slip fit into the gearcase there are no pullers or drivers required to remove or install this item. Merely insert a small punch into the drive pin hole of the propeller shaft – a few sharp pulls outward will remove this electromagnet. Again make certain the lead is free before attempting to remove the rear electromagnet.

As the propeller shaft is pulled from the gearcase the rear electromagnet and reverse gear assembly are brought out with it.

The pinion gear can now be extracted through the rear gearcase opening – followed by removing forward gear assembly.



Removing Metal Lead Guard using Phillips Screwdriver. If Lead Guard is bent it must be replaced.

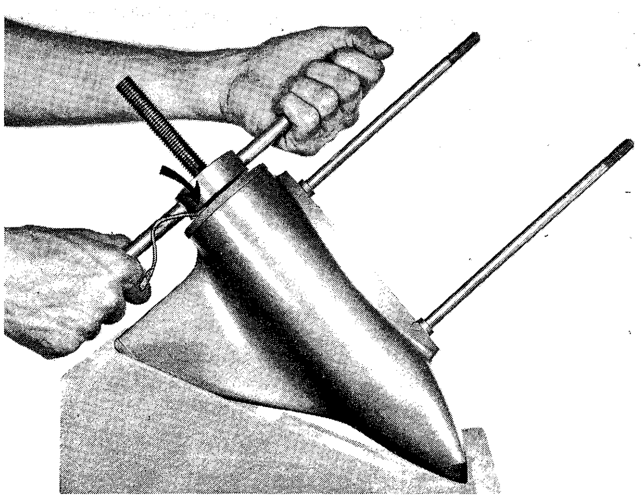


Removing Lead Tubing Retaining Screw and Washer from Gearcase.

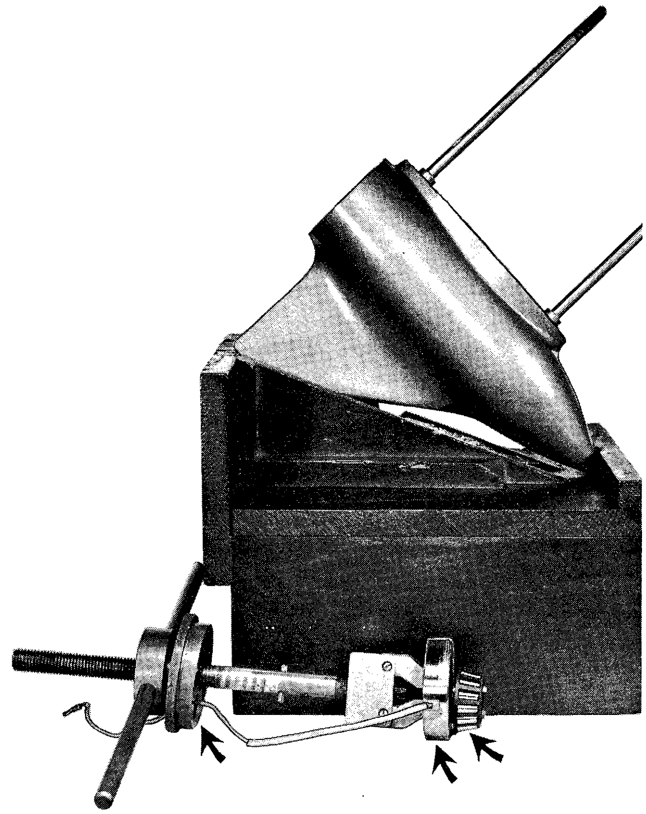
Note the manner in which the forward electromagnet lead is secured. A quick glance will reveal the small channel at the bottom of the gearcase provided for the lead and also the manner in which the lead is captured between the metal lead guard and side of the gearcase.

The stiff nylon covering near the electromagnet end of the lead conforms to the contour of the gearcase. Both this nylon covering and the metal guard prevent the lead from becoming entangled in the revolving gears.

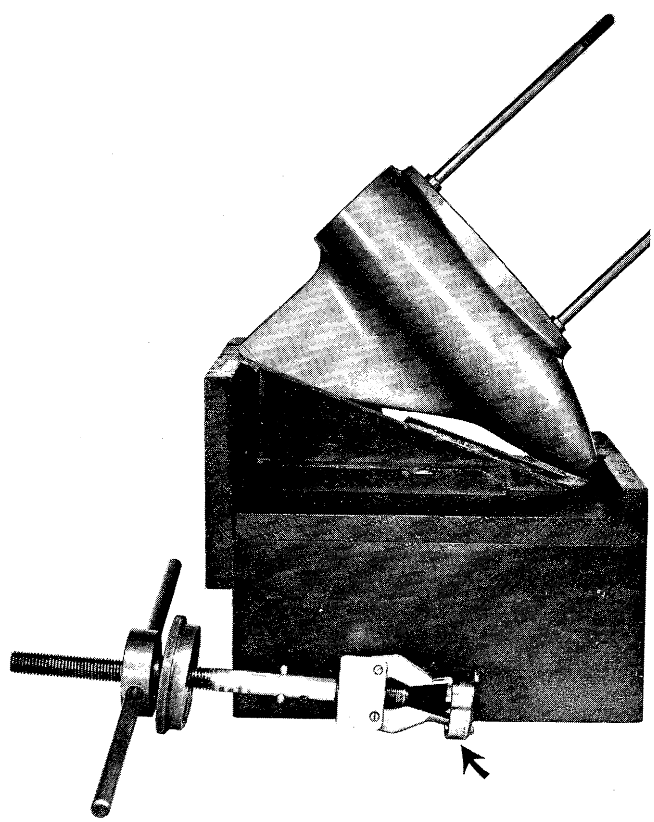
NOTE: Caution must be exercised when installing the metal guard over the lead – if part of the lead is left protruding from the guard, the insulation may fray, exposing the bare wire to eventually short-out the electromagnet.



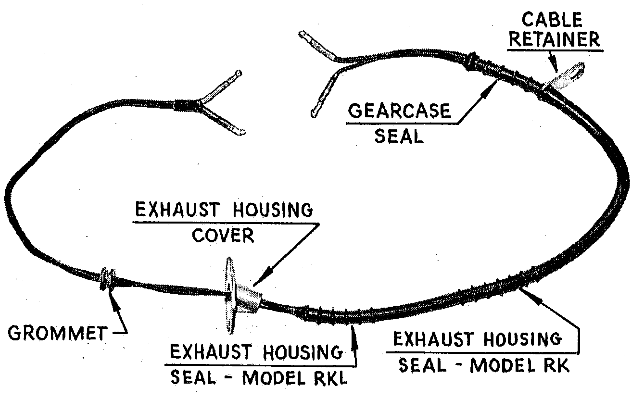
Removing forward Electromagnet and Cone Roller Bearing simultaneously with Puller Jaws drawing against Inner Race of Bearing. Electromagnet Lead (arrow) protruding through hole in Pressing Plate.



Showing forward Electromagnet and Bearing (removed) on Puller. Note position of Electromagnet Lead.



Forward Bearing Outer Race pulled separately – after removing Electromagnet and Bearing.



Electric Cable showing: 1–Gearcase Seal. 2–Exhaust Housing Seal, Model RK (Standard Length). 3–Exhaust Housing Seal, Model RKL (Long). 4–Exhaust Housing Cover. 5–Grommet-Exhaust Cover. 6–Cable Retainer.

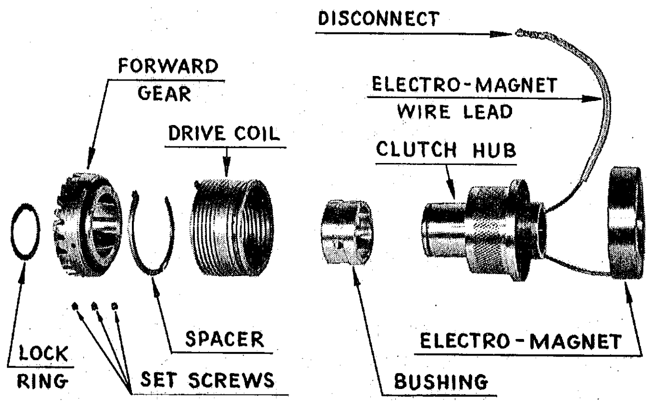
The electric shift cable can only be removed from the lower end of the upper gearcase. Same cable used on standard and long length motors – leads are identified: GREEN – forward; BLUE – reverse.

During disassembly of the electramatic shift gearcase – several items of significant importance should be noted.

1. Knurled forward clutch hub.
2. BUSHING used with FORWARD gear assembly.
3. NEEDLE BEARING used with REVERSE gear assembly.

The knurled clutch hub provides a more immediate drive coil engagement when used with forward gear assembly. It is not recommended that the knurled clutch hub be used with reverse gear assembly, since the greater percentage of motor operation is in forward gear – and at that time reverse gear and reverse clutch hub are turning in opposite directions (floating on propeller shaft).

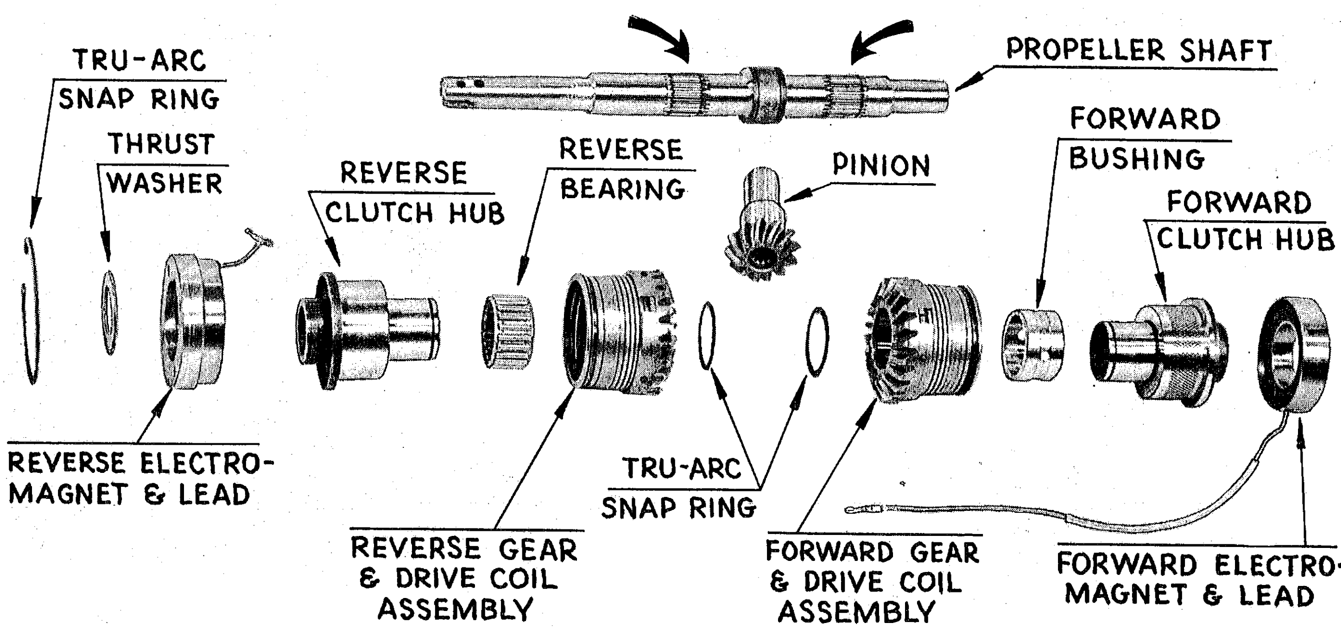
Similarly, do not interchange the forward gear bushing and the reverse gear needle bearing assembly. Again with the majority of motor operation in forward gear – and at that time both forward gear and forward clutch hub turning in the same direction, use of a needle bearing assembly between the two would result in the needles eventually being flattened out as affected by normal vibration at the juncture.



Extended view of Clutch Hub, forward Gear Assembly and Electromagnet.

BUSHING – forward gear.
NEEDLE BEARING – reverse gear.

Cleanliness and caution are emphasized during the assembly and/or disassembly of all gearcase components, particularly the forward gear and clutch hub. A metal chip, speck of grit or a hurried repair technician are frequently contributing fac-



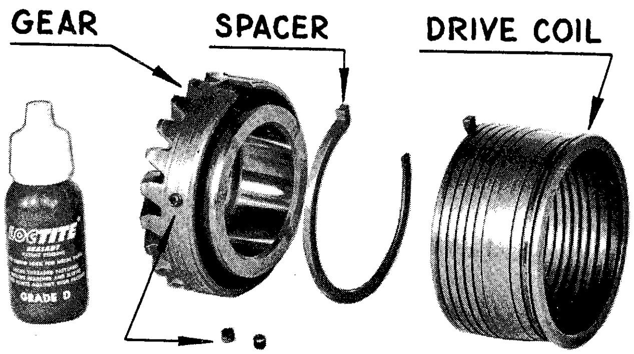
Extended view of Electramatic Drive Train. Splines on Propeller Shaft (arrows) are in constant mesh with Internal Splines on both forward and reverse Clutch Hubs.

tors leading to premature failure of the Electramatic gearcase.

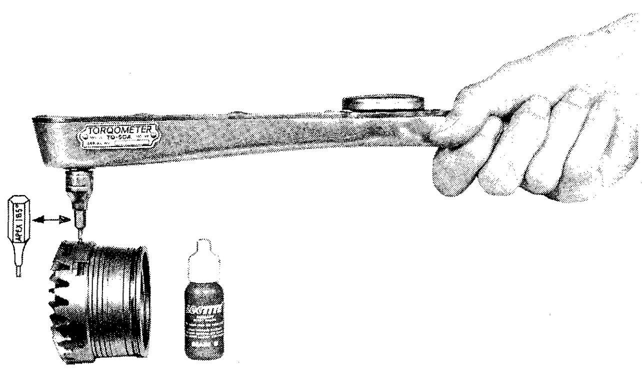
Disassembling forward gear and clutch hub is accomplished by:

1. Removing small tru-arc snap ring from clutch hub.
2. Carefully slipping forward gear from clutch hub.

If the bushing between forward gear and the clutch hub starts to bind when the two parts are being separated – STOP – carefully slip the two parts back together, clean the edges of the snap ring groove with crocus cloth, remove all traces of grit and again proceed to disassemble. The slightest scuffing or binding of the bushing renders it useless and as such it must be replaced.



Gear, Drive Coil, and Spacer, assembled in this manner. Drive Coil is retained by three Allen Setscrews.



Torquing three Allen Setscrews, 15 - 20 in.-lbs. Small drop of Loctite Grade "D" applied to threads of Setscrew during assembly to secure its position – a most important detail not to be overlooked.

The nylon spacer, installed as shown between the drive coil and gear maintains a parallel relationship between the two. With omission of this spacer, the drive coil is apt to fall out of line to have its effect on coupling with the clutch hub.

A recess is provided in the gear for the tabs on the spacer and drive coil. These tabs (1) prevent the drive coil from turning in the gear, and (2) locate the spacer.

The unit is held together by three Allen setscrews. The drive coil, spacer and gear must be held firmly together while the three Allen setscrews are tightened – to eliminate the possibility of misalignment.

The Allen setscrews, size 8-32 thread by 5/32" long, are torqued 15 to 20 in.-lbs. We recommend that a drop of LOCTITE GRADE "D" be applied to the threads of each Allen setscrew during assembly to secure its position. Do not overlook this detail.

An Apex – 185-O Allen wrench, used along with a 3/8" drive – 1/4" hex socket, or similar tool, is necessary for torquing the three setscrews.

LOCTITE GRADE "D" is a product of AMERICAN SEALANTS CO., Hartford 6, Connecticut.

We recommend that each shop have an inch-pound torque wrench for use on all torque applications of less than 10 foot-pounds. To convert foot-pounds to inch-pounds, multiply foot-pounds × 12.

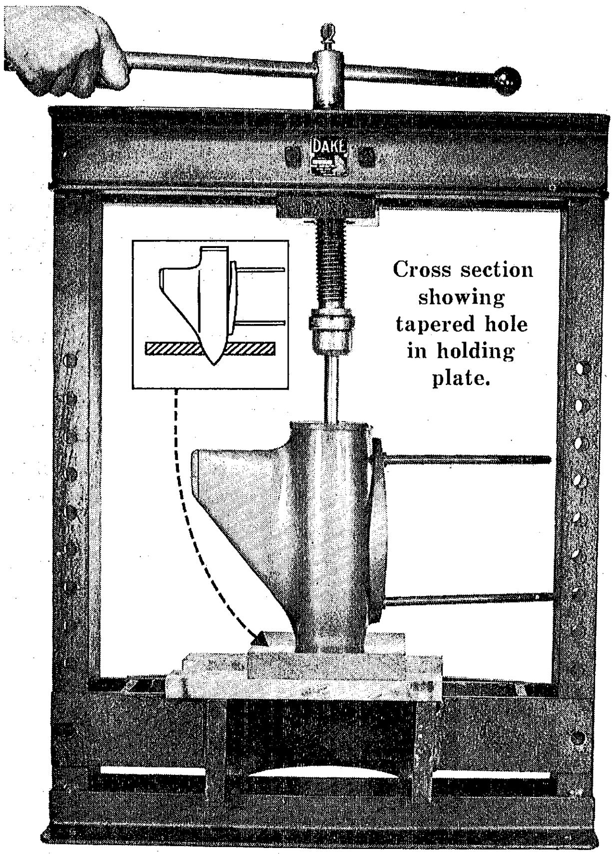
Checking Electromagnet with Stevens VOHM Meter.

The electromagnet has a rated current draw of 1.7 amperes plus or minus .2 ampere. This current draw can be checked on the LO-OHM scale of the Stevens VOHM Meter. Check in this manner:

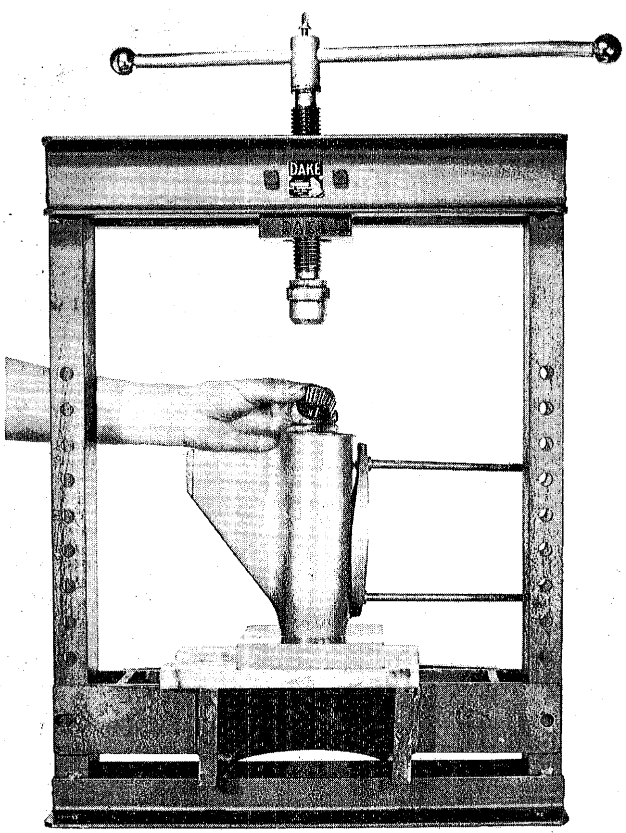
1. Set right-hand dial to LO-OHM scale.
2. Calibrate scale (red) to infinity with zero OHM dial.
3. Attach lead to electromagnet, as shown.
4. Scale reading should be approximately 8 OHMS.

The electromagnet is made up of many fine strands of copper wire coiled into a loop and contained within a steel casing. One end of the coil is attached to a lead, green or blue, the other to ground. As the toggle switch in the control box is actuated, the shift circuit is closed allowing current to flow through either forward or reverse electromagnet.

A magnetic field is then set up about the electromagnet and it is this magnetic field that accordingly attracts the free end of the drive coil. Once



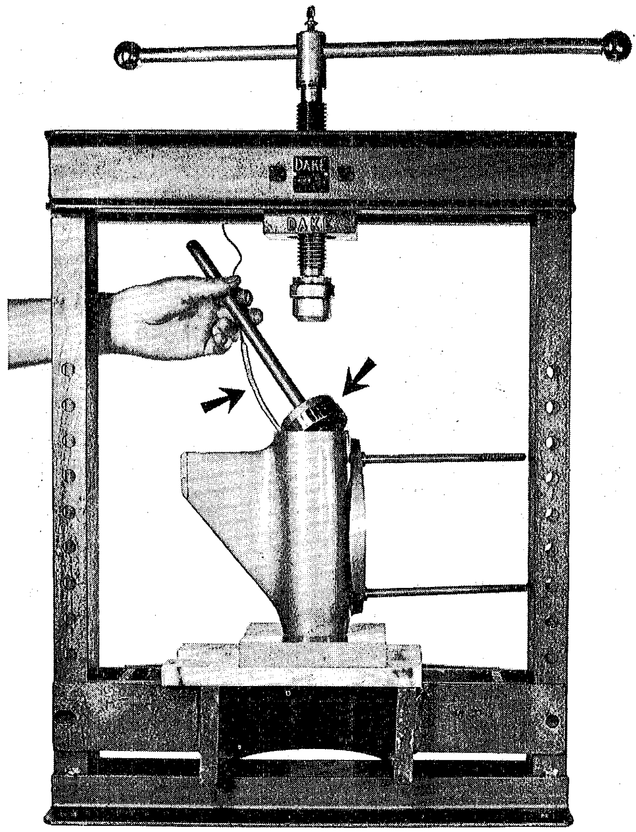
Installing front Propeller Shaft Bearing Race.



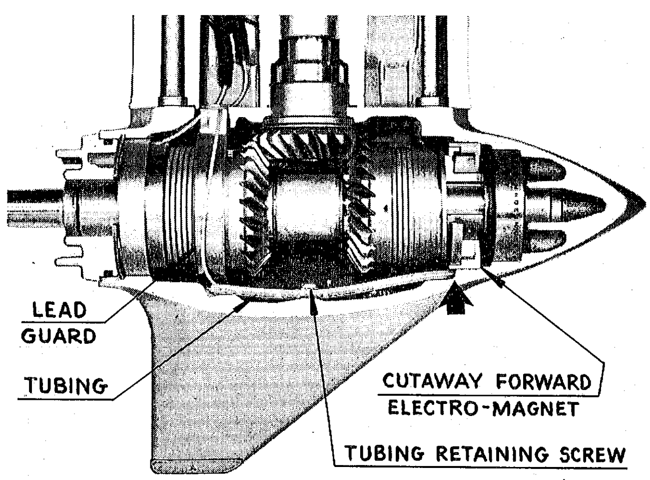
Installing cone-shaped Roller Bearing in Race – taper end first.

this has been accomplished the drive train is electrically coupled for operation in either forward or reverse gear, whichever has been selected.

As the operator shifts from in gear to neutral, the current flowing through the electromagnet is broken by the toggle switch causing the magnetic field about the electromagnet to collapse. This in turn automatically releases forward or reverse drive, whichever the case may be.



Installing forward Electromagnet. Locate green lead at precise bottom of Electromagnet. Recess in bottom of Gearcase provides clearance for lead.



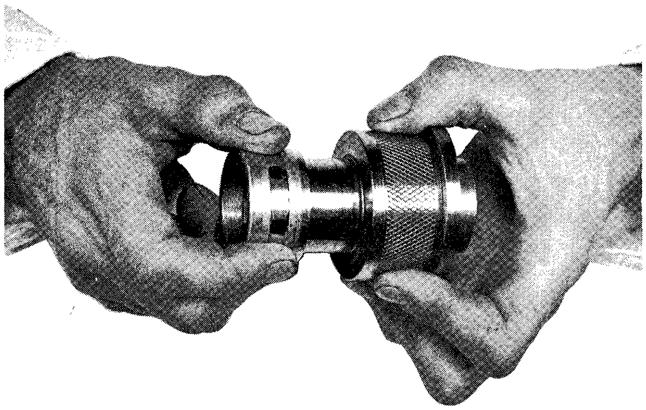
Showing proper installation of forward Electromagnet Lead. Note position of Tubing (arrow) butting against Electromagnet.

With the front electromagnet pressed securely in position, the following items should be installed:

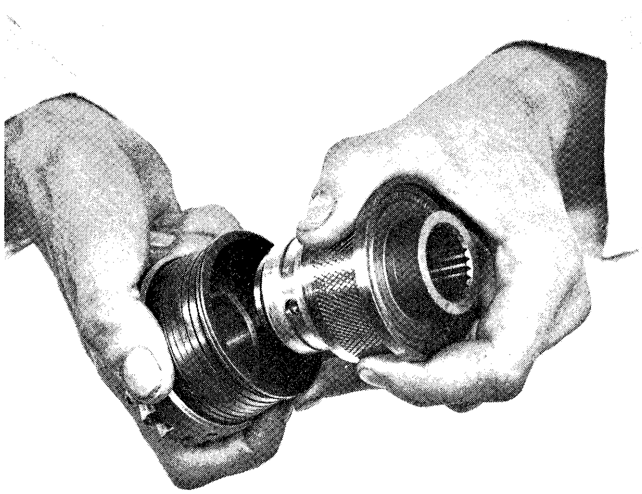
1. Lead retaining screw and washer — bottom of gearcase.
2. Lead guard.

Damage to the lead will result from omitting either of the above two items.

Note also that the end of the preformed plastic tube, assembled over the lead, must be adjusted to butt against the electromagnet assembly prior to anchoring firmly in the gearcase as shown. Failure of adhering to this procedure will prevent correct installation of lead behind the metal lead guard.



Exercise caution when installing Clutch Hub Bushing on forward Clutch Hub. Bushing and forward Clutch Hub should be void of burrs, clean, and well lubricated.

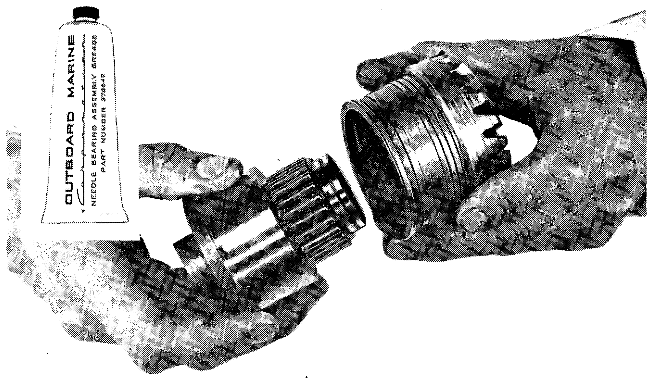


Exercise caution when assembling forward Gear to forward Clutch Hub and Bushing. All parts must be void of burrs, clean, and well lubricated to avoid scuffing.

Extreme caution must be exercised when assembling the clutch hub bushing to the forward clutch hub. All surfaces should be —

Scrupulously clean.
Void of burrs.
Lubricated to avoid scuffing.

Due to the close tolerances involved, under no circumstances should an attempt be made to force the assembly. Avoid attempting a rushed assembly.

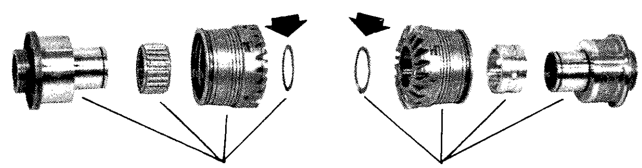


Showing method used for assembling reverse Gear to Clutch Hub. Caution — Needles are easily dislodged. Use Bearing Assembly Grease (insert) to hold Needles in position.

Reverse gear assembly, needle bearing, and clutch hub are easily assembled in the following manner:

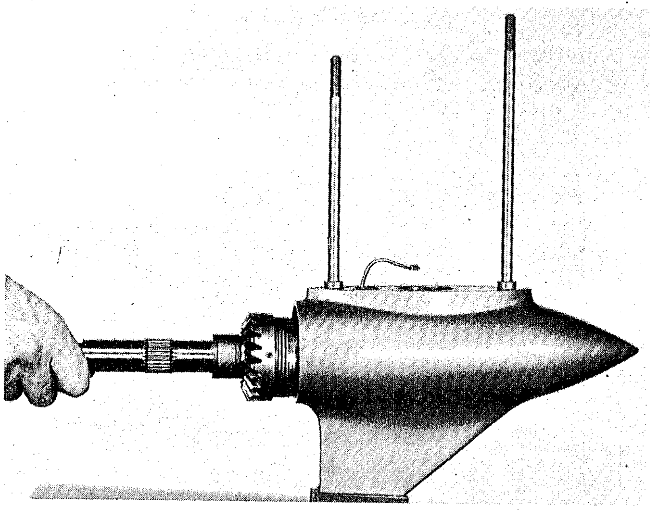
1. Install retainer on clutch hub.
2. Apply bearing assembly grease to retainer — needle openings.
3. Insert needles into position.
4. Carefully slip clutch hub and bearing assembly into gear.

Work cautiously so as not to dislodge any needles. Dislodged needles will fall between the clutch hub and gear preventing the proper positioning of the gear on the clutch hub. Also, making it impossible to install the Tru-Arc Snap Ring.

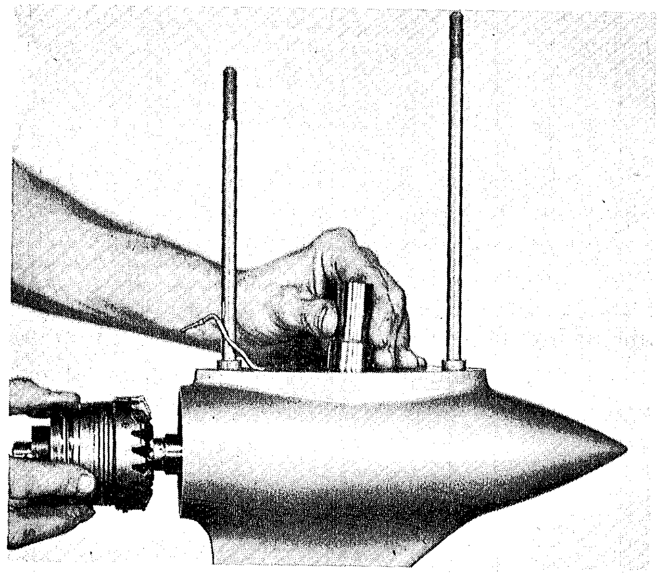


Check forward and reverse Gear-Clutch assemblies prior to installation in Gearcase to eliminate possibility of mixup. FORWARD (Knurled Clutch Hub and Bushing) Gear assembly installed in front end of Gearcase. REVERSE (Smooth Clutch Hub and Needle Bearing) Gear assembly installed in rear of Gearcase. Do not omit Tru-Arc Snap Rings (arrow).

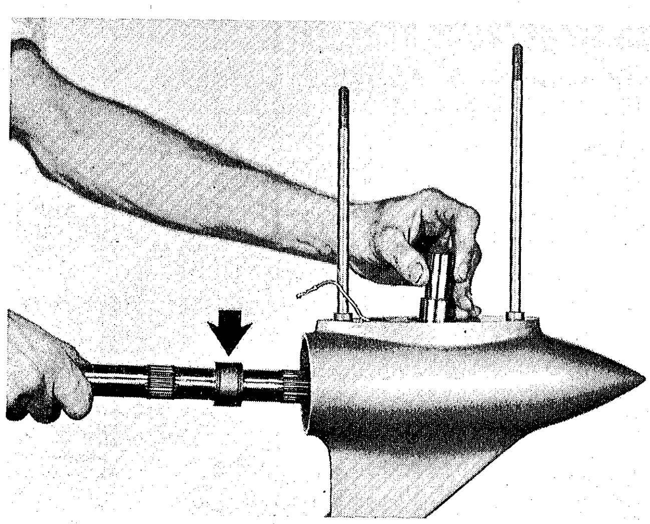
Remember, sharp edge of Tru-Arc Snap Ring always installed to outside, rounded edge to inside.



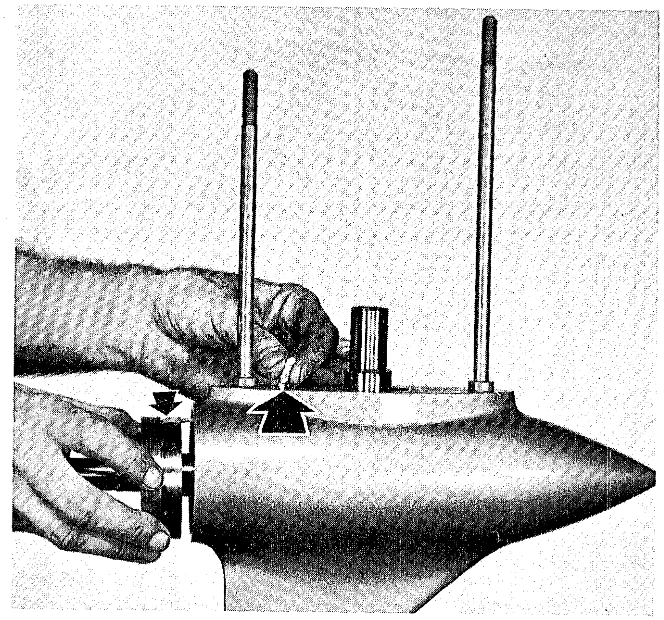
Using Propeller Shaft to install forward Gear assembly. Propeller Shaft must again be removed to permit installation of Pinion Gear through rear opening in Gearcase. Forward Electromagnet Lead held secure and out of way by Lead Guard.



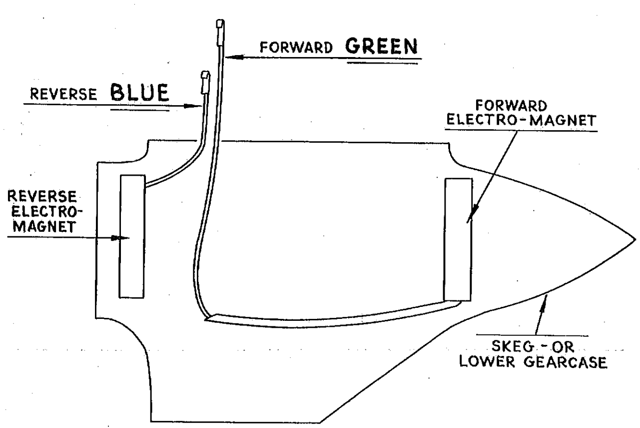
Installing reverse Gear assembly into position. Pinion Gear must be held in place to facilitate proper Gear engagement.



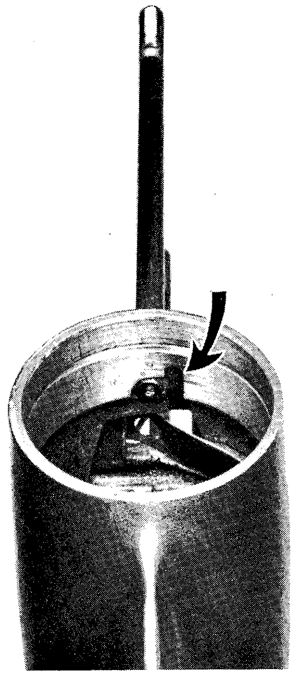
Holding Pinion in position while installing Propeller Shaft. Unmachined section of Propeller Shaft (arrow) is positioned immediately under Pinion Gear.



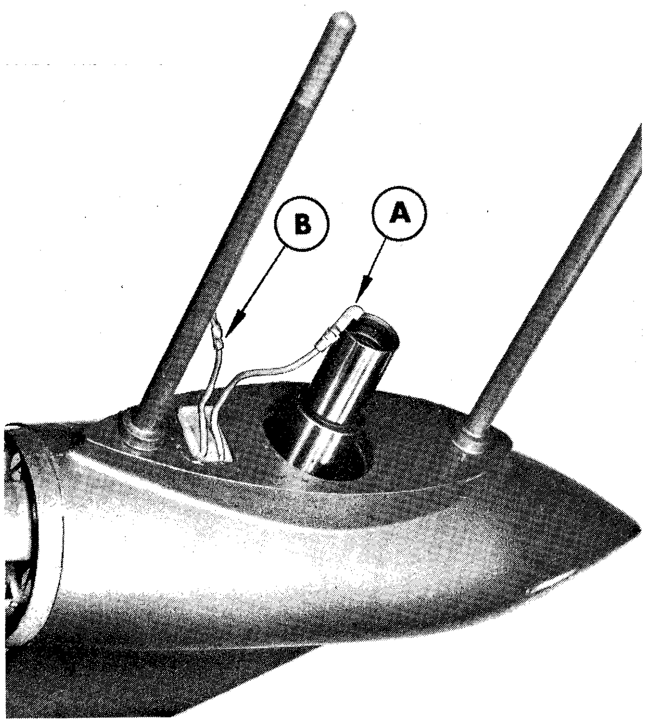
Showing installation of rear Electromagnet – carefully feeding Lead (blue) through opening in Gearcase. Offset Lead slightly to right of rear Stud, aligning Lead with recess in Gearcase.



Electromagnet Lead Wire identification by color code:
Blue – Reverse Green – Forward

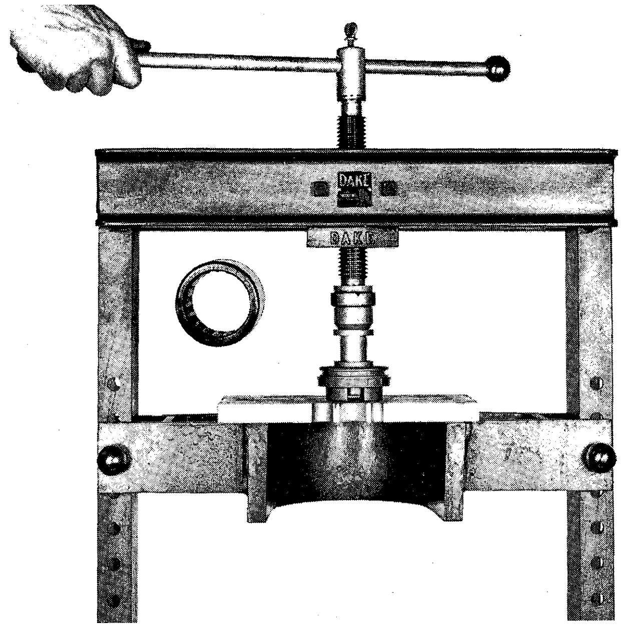


Showing clearance recess in rear of Gearcase (arrow) for reverse Electromagnet Lead. Align Lead with this recess during rear Electromagnet installation.

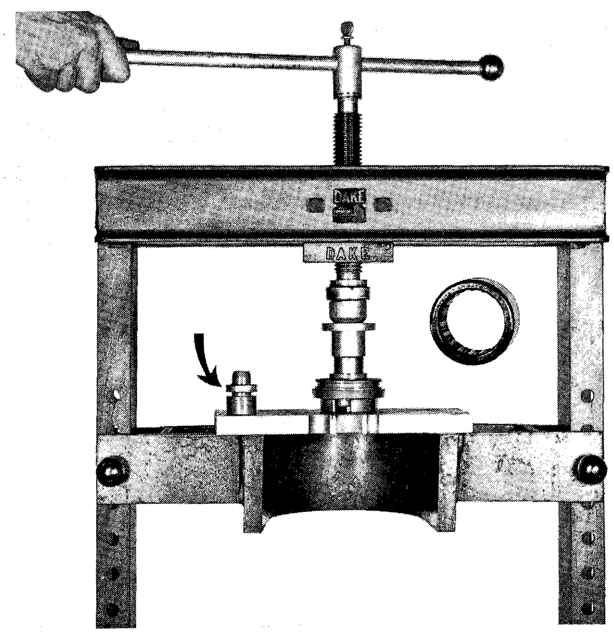


Electromagnet Leads positioned properly in Nylon Holding Block: A – Forward B – Reverse

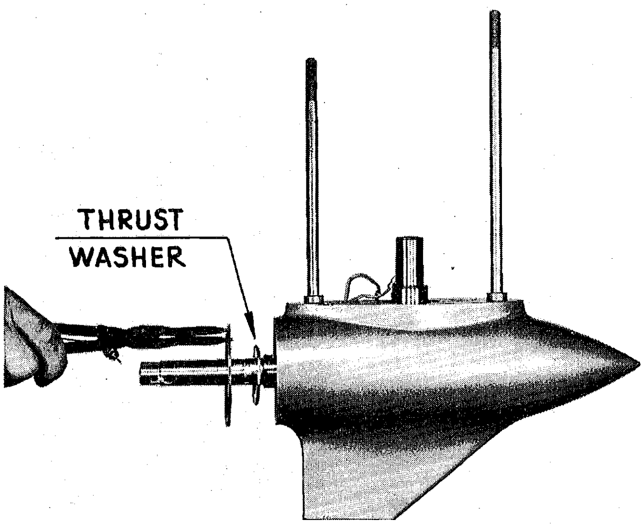
Correct positioning of leads in nylon holding block is important. Prior to installation of holding block a quick glance through the opening will determine if the leads are free of all obstructions and well protected by metal guard. Refrain from pulling too tightly on leads when securing in nylon holding block.



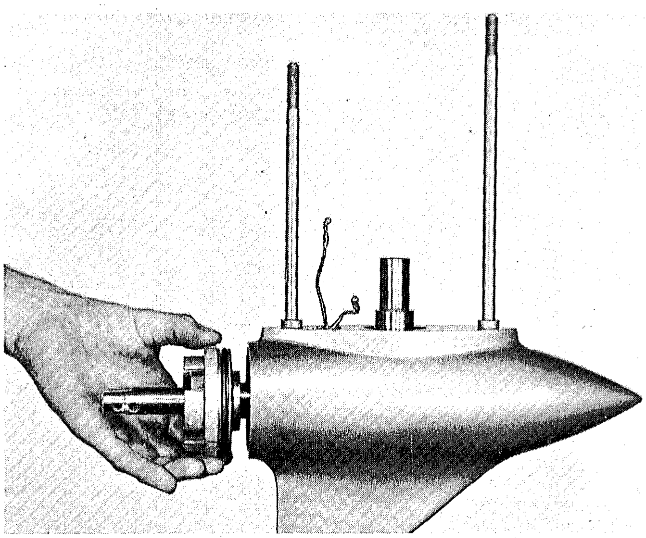
Removing Gearcase Head Bearing and Seal simultaneously. Press against lettered side of Bearing only (insert).



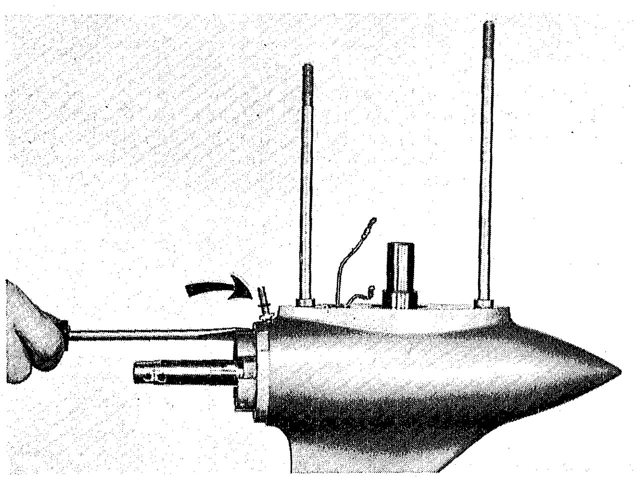
Installing Gearcase Head Bearing from inner side of Head – flush with inner surface. Press against lettered side only (insert). Gearcase Head Seal (arrow) installed from outer side – flush with outer surface. Install with lettered side of Seal facing out.



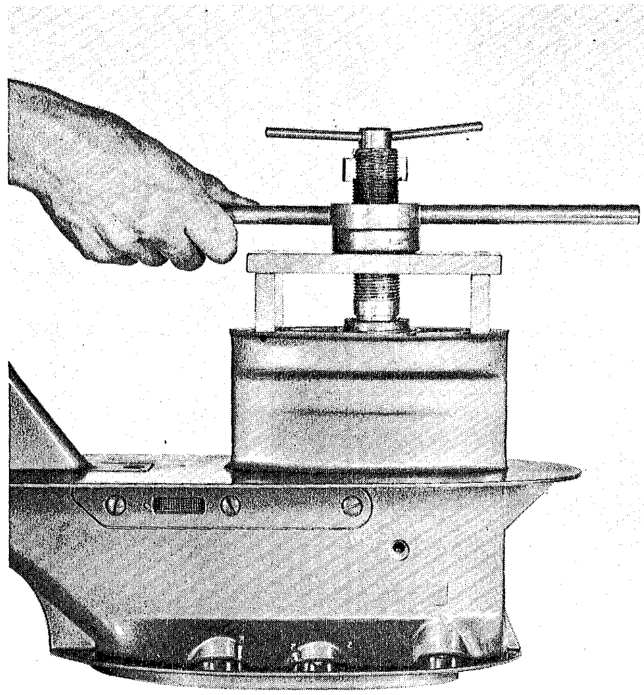
Installing Tru-Arc Snap Ring with Tru-Arc Pliers No. 5 – lettered side facing out. IMPORTANT: Thrust Washer installed with bronze side facing in.



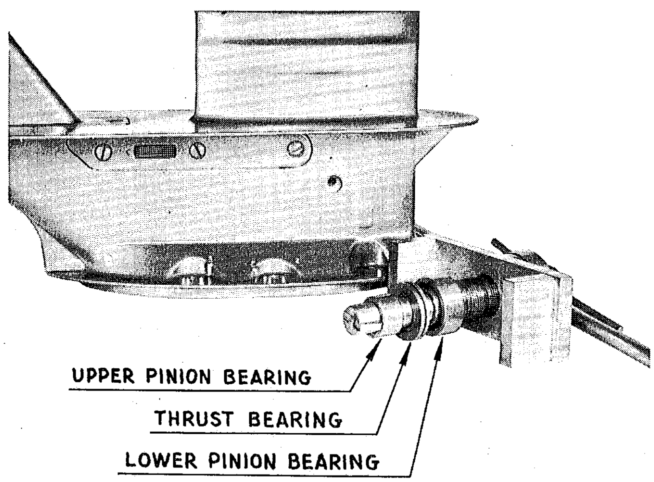
Installation of Gearcase Head showing rubber O-Ring in Position.



Securing Gearcase Head with four screws. Small rubber O-Rings (arrow) should always be replaced whenever screw is removed to avoid possibility of oil seepage later on.

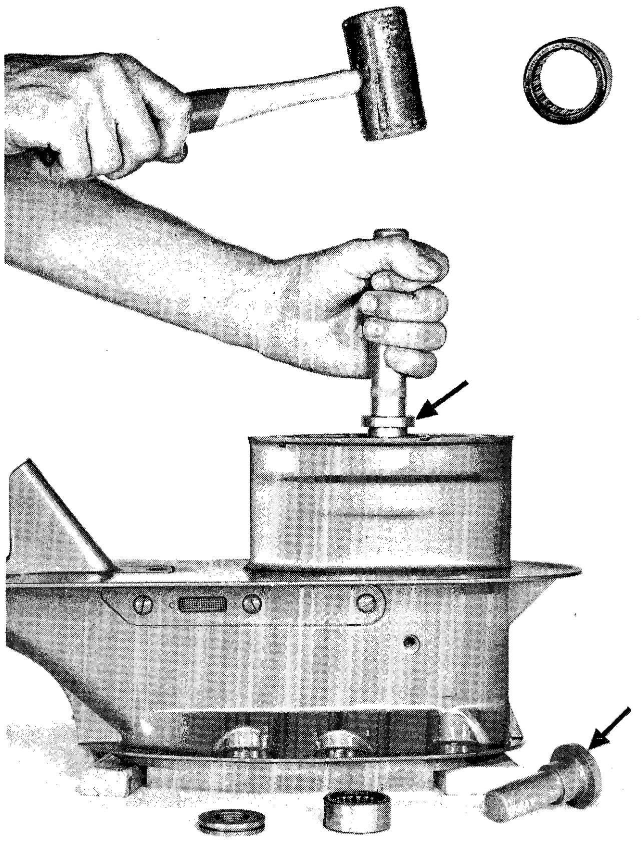


Pulling upper Pinion Bearing – Thrust Bearing – and lower Pinion Bearing simultaneously with Puller Jaws No. 308093.

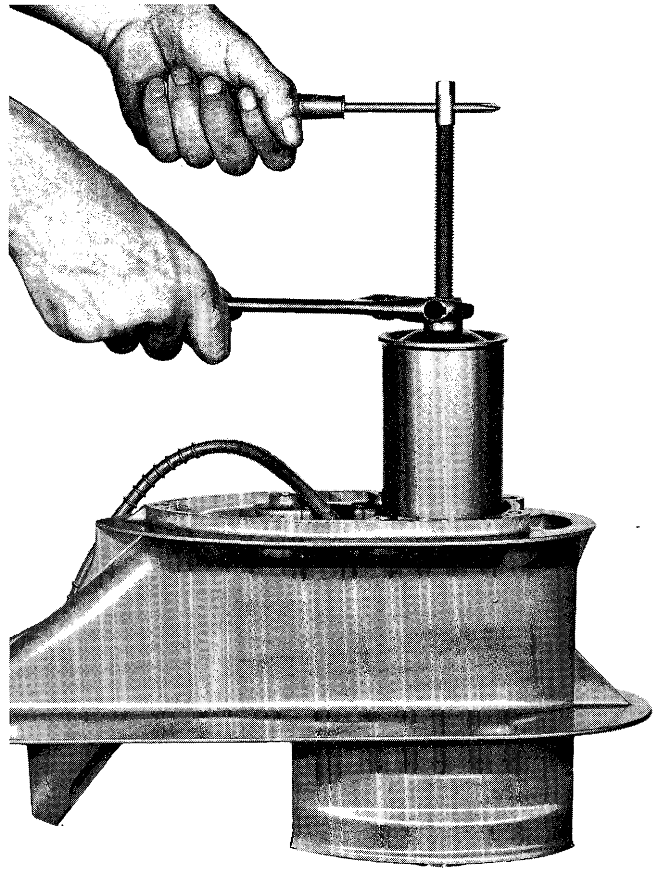


Upper Pinion Bearing – Thrust Bearing – and lower Pinion Bearing shown on Puller as removed.

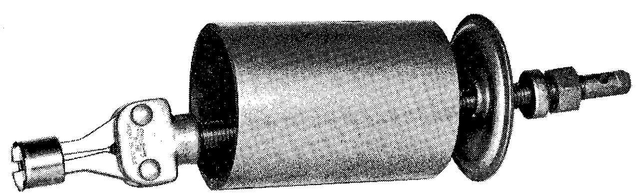
IMPORTANT: Do not reinstall used upper pinion bearing as it has undoubtedly been damaged during removal procedure.



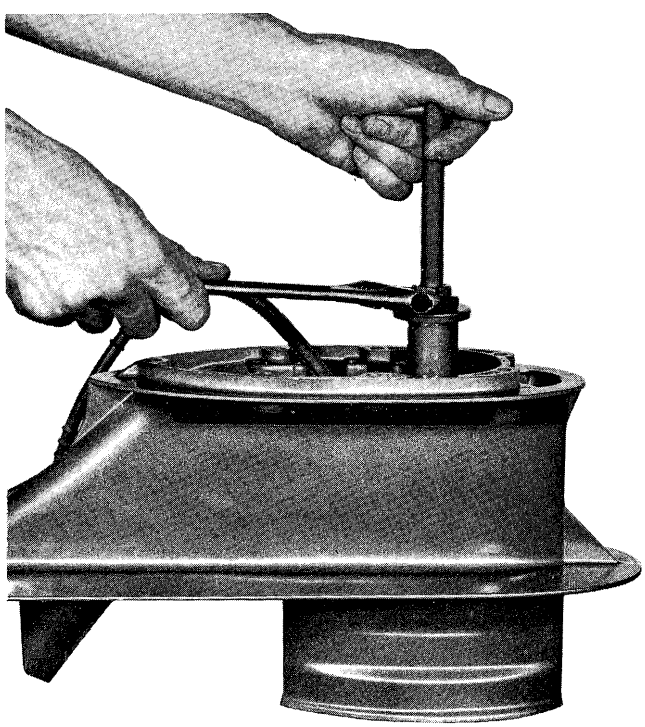
Showing installation of upper Pinion Bearing using Driver. Thrust Bearing and lower Pinion Bearing also shown. Note Driver (arrow) for installing lower Pinion Bearing. Drive against lettered side of upper Pinion Bearing (insert).



Removing upper Driveshaft Bearing. Do not re-use Bearing after removal.



Showing upper Driveshaft Bearing on Puller.

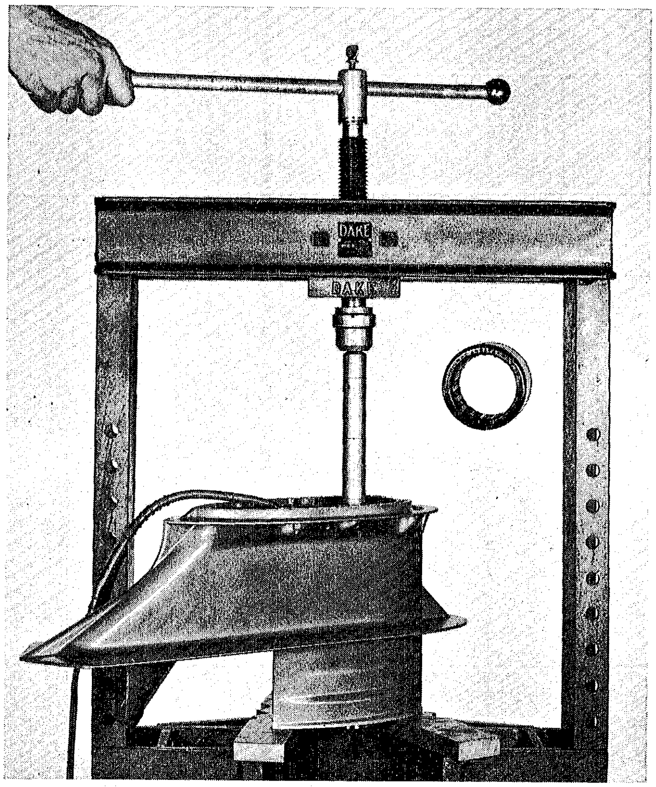


Removing Driveshaft Seal using Tool No. 377565. Do not re-use pulled Seal.

The small caged needle bearings used in several applications on the electramatic shift gearcase,

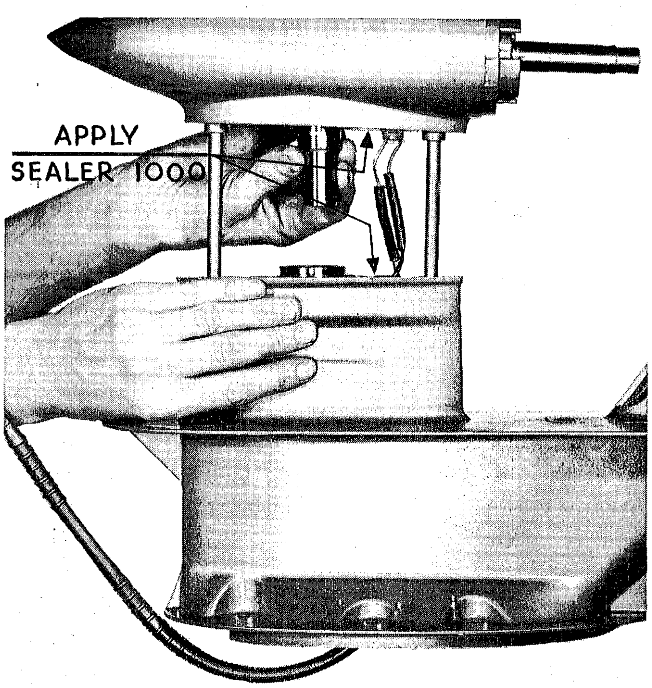
Upper pinion bearing
Upper driveshaft bearing
Gearcase head bearing

are not to be re-used once they have been pulled. The thin steel cage used with this type bearing is strong enough on one end for installation purposes and is always installed from this end (lettered side). It follows that all removing must be accomplished by drawing against the unlettered end, or soft end of the cage. This soft end is easily damaged in pulling, which in turn will cause the needles to bind. Re-using this bearing would result in very short bearing life.



Showing installation of upper Driveshaft Bearing and Seal – not installed simultaneously. Press against lettered side of Bearing only (insert).

It is not necessary to install the upper driveshaft bearing to bottom of machined recess. The un-lettered end of the bearing can be damaged in so doing. Top of bearing should be level with first step of machined recess. Seal should accordingly be installed level with top of machined seal recess.

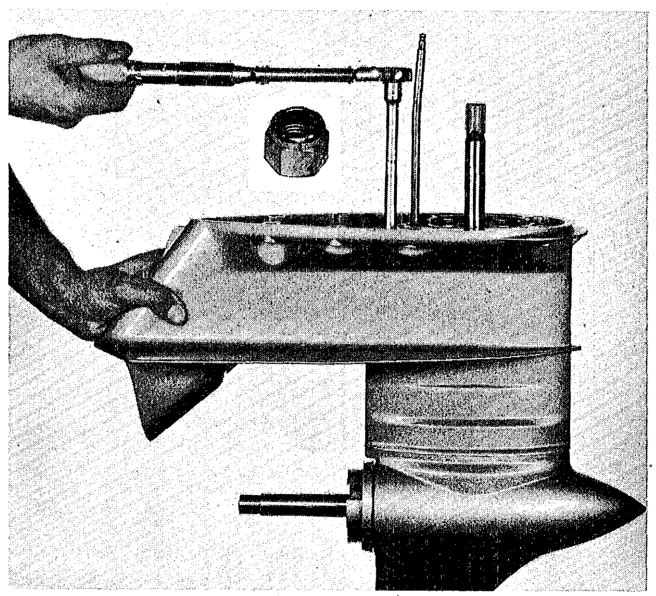


Assembling upper and lower Gearcase.

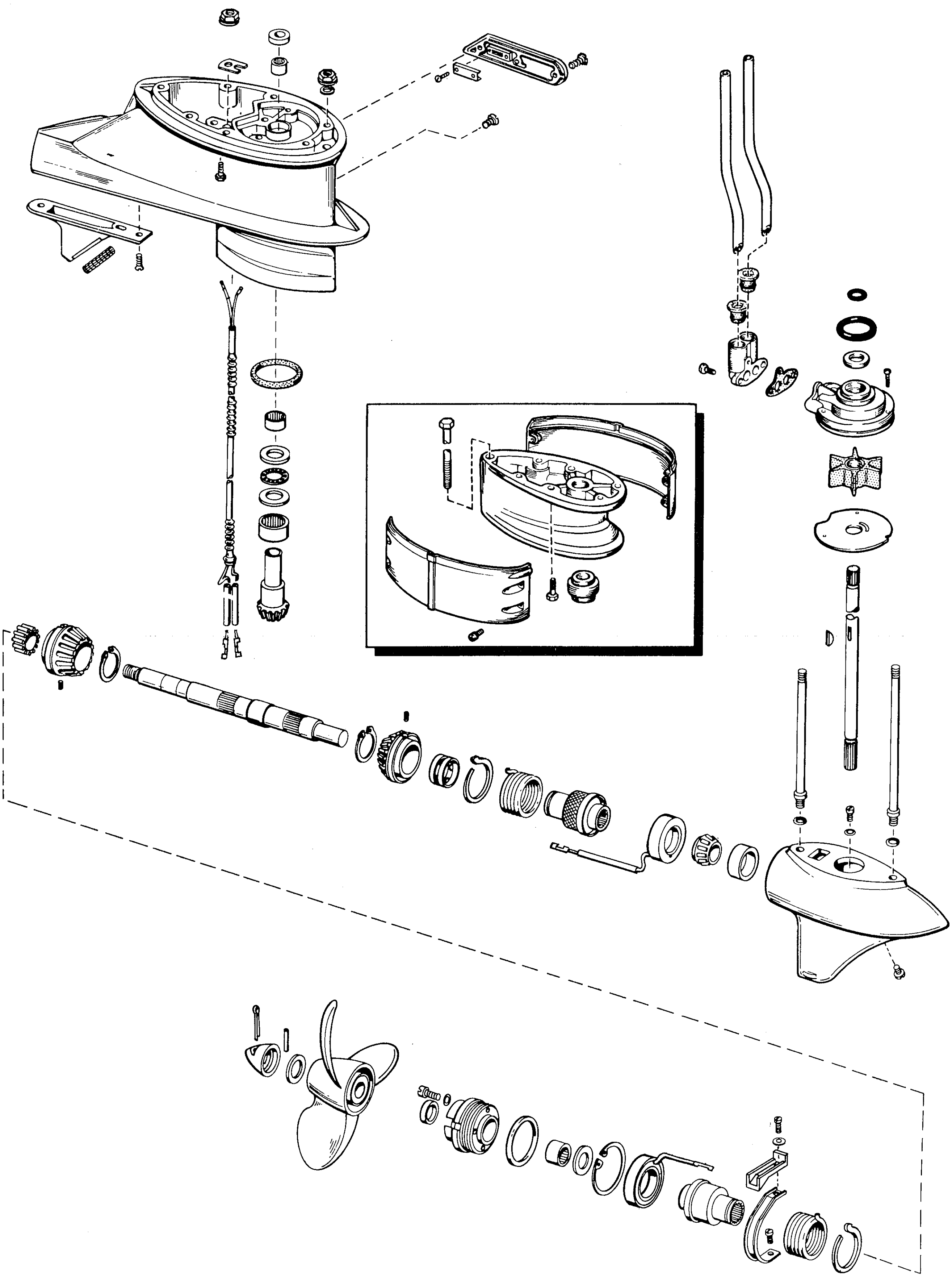
Final assembly of the upper and lower gearcase sections should be done with the sections in an inverted position. In the event one of the pinion bearing rollers should be dislodged, it will not drop into the lower gearcase. There are 20 rollers in this bearing.

While making certain the pinion is being properly aligned in the needle bearing assembly, the assembler must also simultaneously locate the attached gearcase leads in the cavity provided in the upper gearcase, thus avoiding the possibility of "pinching" the leads between the matching surface of the upper and lower gearcase sections during final assembly.

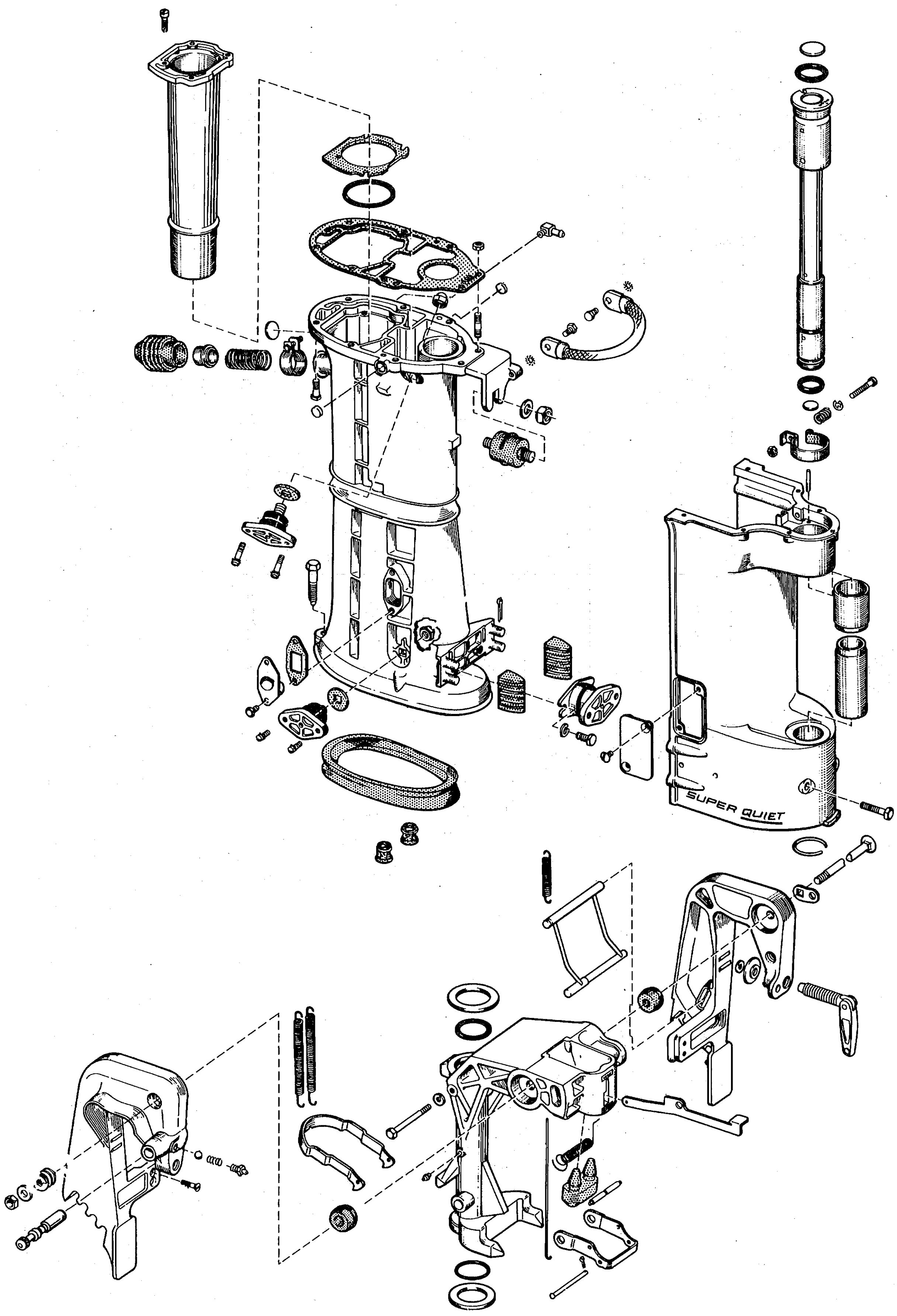
Care must be taken to assure proper installation of the O-Ring seal between the upper and lower gearcases. Cover entire surface of O-Ring seal groove and O-Ring contact surface on lower gearcase with No. 1000 sealer. If done properly the possibility of gear lube seepage at this area will have been eliminated.



Torque Crankcase Stud Nuts to 18 to 20 ft.-lbs. Studs to 24 ft.-lbs. Always replace self-locking Nuts (insert), once they have been removed, with new.



GEARCASE GROUP
Models RK-24 Up



LOWER UNIT GROUP
Model RK-24

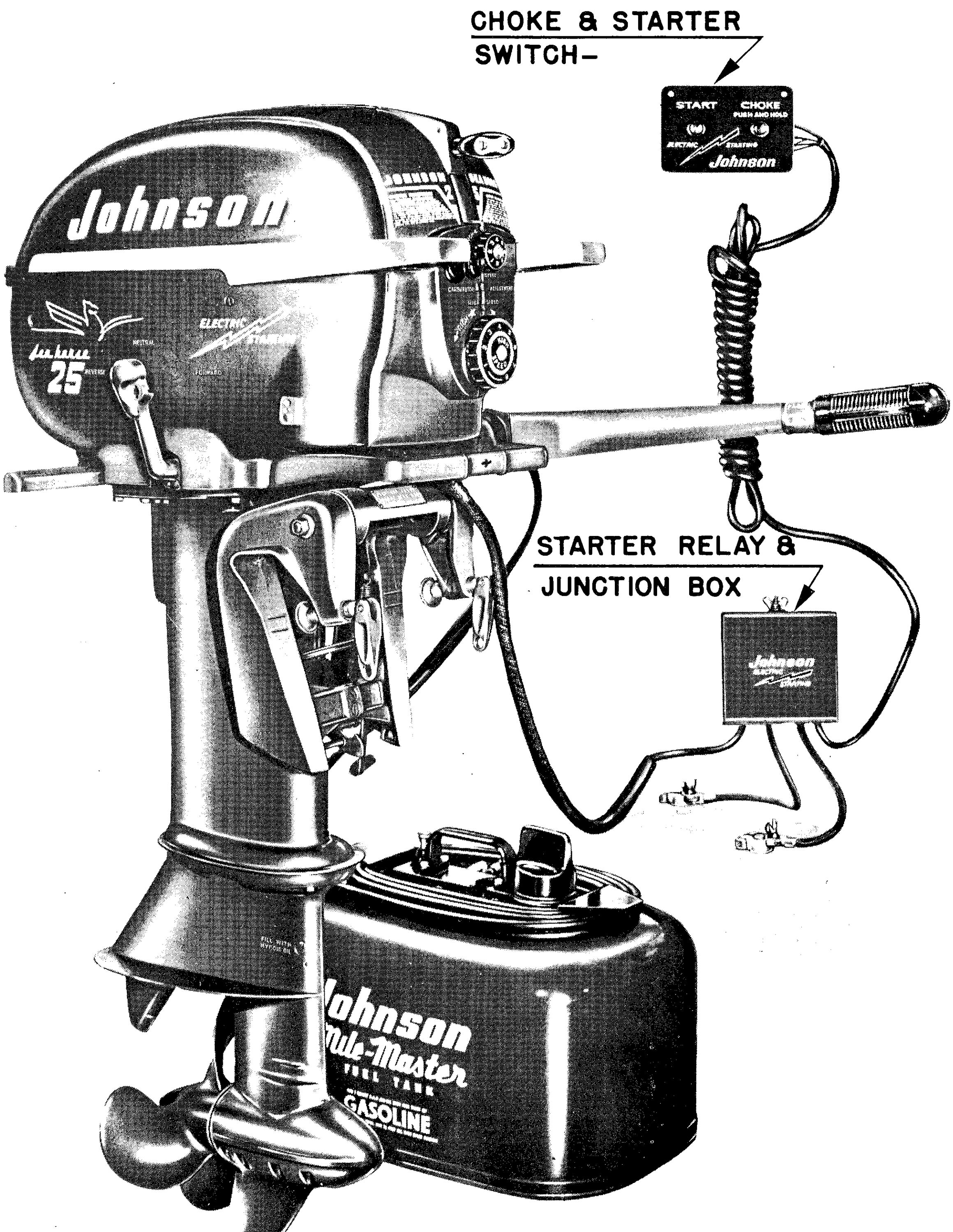
Johnson SERVICE MANUAL

ELECTRICAL

INDEX — FOLLOWING PAGE

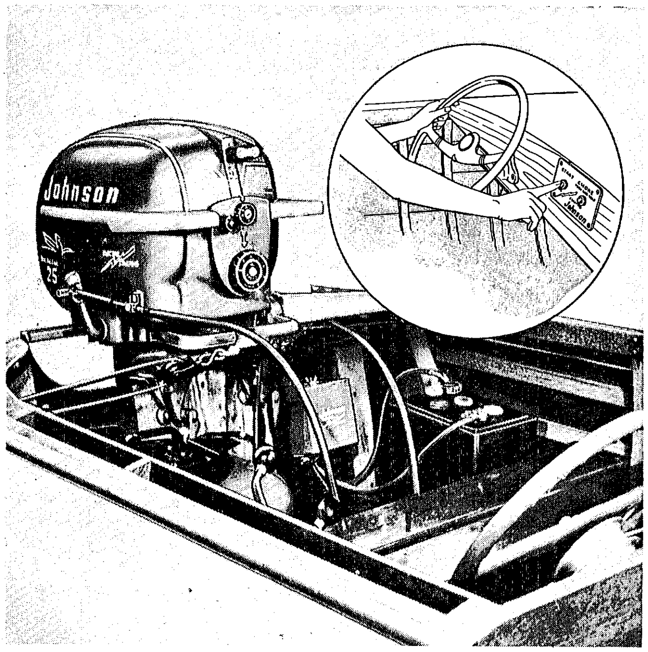
ELECTRICAL INDEX

*See same wiring diagrams listed under heading **ELECTRIC STARTING** for generator hook-up.


CHOKE & STARTER SWITCH–
START
CHOKE
PUSH AND HOLD
ELECTRIC
STARTING
Johnson
STARTER RELAY & JUNCTION BOX
Johnson
Johnson
Mile-Master
FUEL TANK
GASOLINE

Model RDE-16.

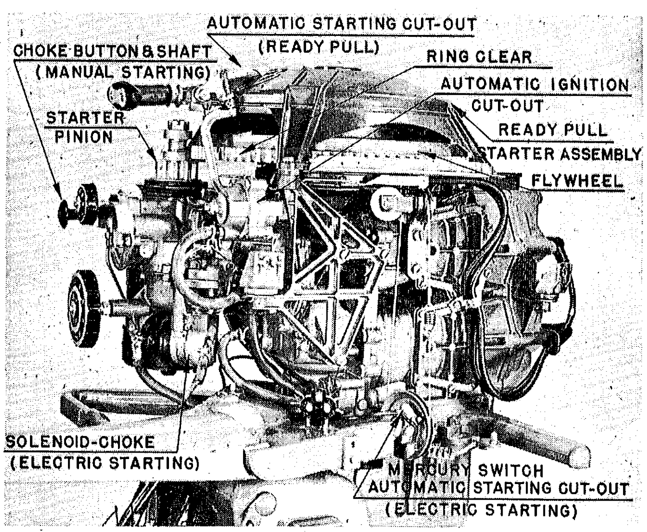
MODEL RDE — ELECTRIC STARTING 25



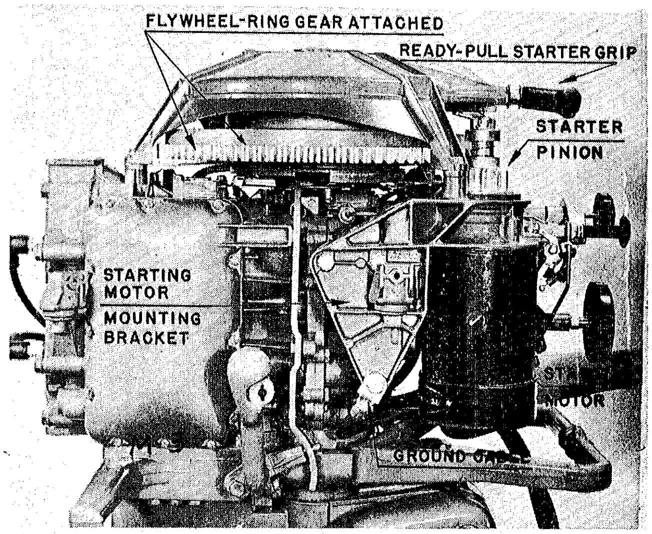
Model RDE Installation.

Basically, Models RD-16 and RDE-16 (electric starting) are alike in construction except for the built-in starting motor with pinion drive, a ring gear bolted to a flywheel of somewhat different design and a solenoid to act on the carburetor choke. Starting and choke is by remote control from the panel board at the driver's seat. Depressing of the starter button causes the relay (in junction box) to bridge the circuit between the battery and starting motor. Depressing the choke button causes the solenoid to close the choke at time of starting.

Like the Model RD, the motor cannot be started in gear with the grip control set for high speed. A mercury switch is employed to break the circuit



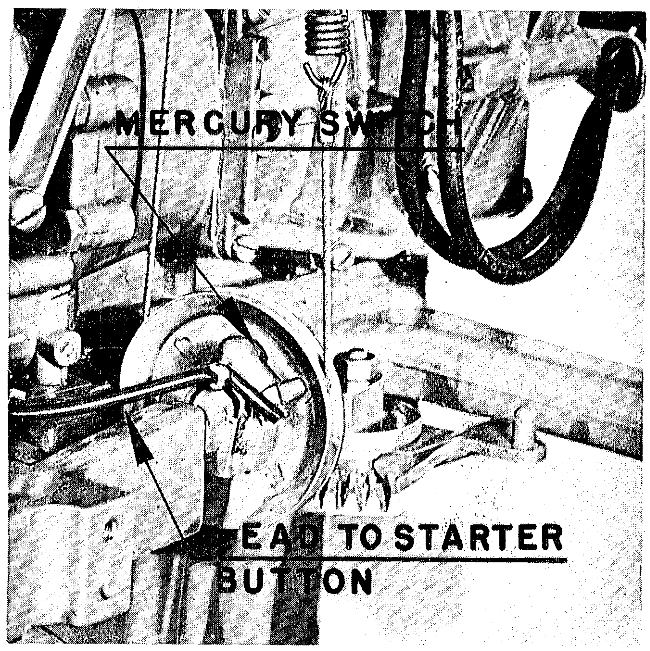
Model RDE powerhead assembly — port side.



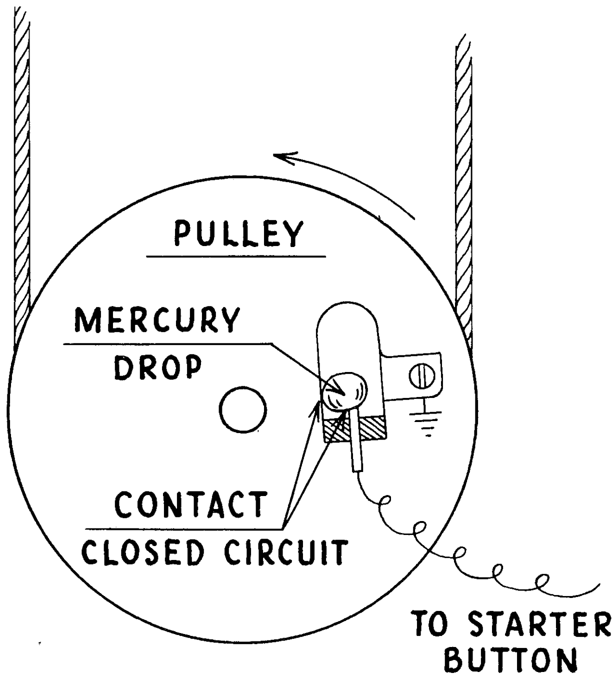
Model RDE powerhead—starboard side.

between the starting button and relay when set for high speed operation — likewise, the starter cannot be made to engage the flywheel unless the speed control grip is retarded to "starting range."

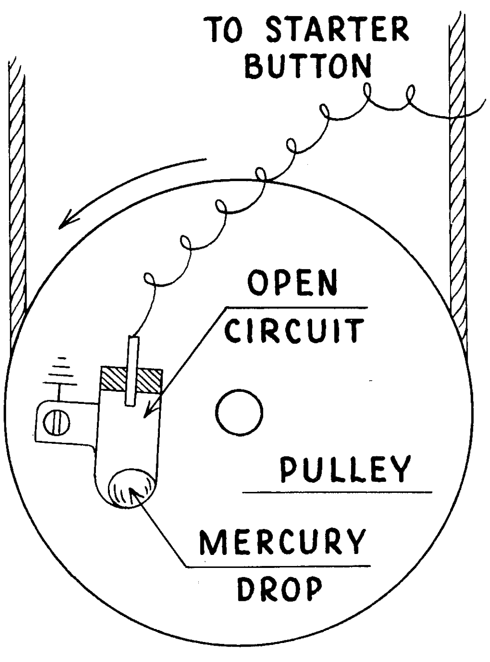
The mercury switch consists of a cartridge-like affair of stainless steel in which is sealed a single drop of mercury. The sealed end of the cartridge includes an insulated terminal leading to the remote starter button. Being attached to the speed control pulley, the cartridge is "up-ended" when advancing from slow to fast speed and "tipped" oppositely on retarding towards slow speed range for starting. With this movement, the mercury drop is caused to flow from one end of the cartridge to the other, etc., making and breaking the circuit whichever the case may be.



Showing location of the mercury switch (automatic starting cut-out) on speed control pulley.

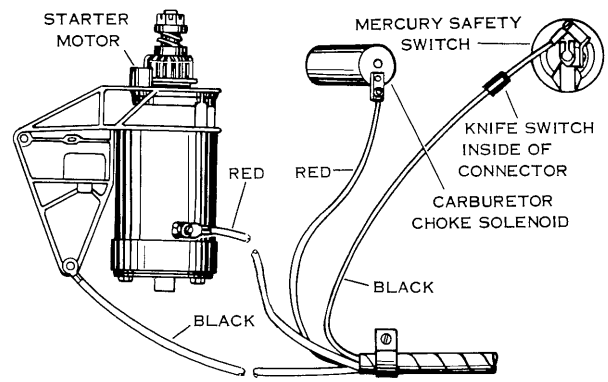


Schematic drawing to show position of mercury drop when speed control grip is set for starting. Note that contact has been established between the shell and insulated terminal lead to close the circuit to permit starting with remote button on the panel.



Schematic drawing to show position of mercury drop when the speed control grip is set for speeds above "starting" range. Note that on increasing speed, the switch has been up-ended with the mercury drop now resting on bottom end of the cartridge (full speed) thus breaking the circuit to result in no starter action when depressing the starter button.

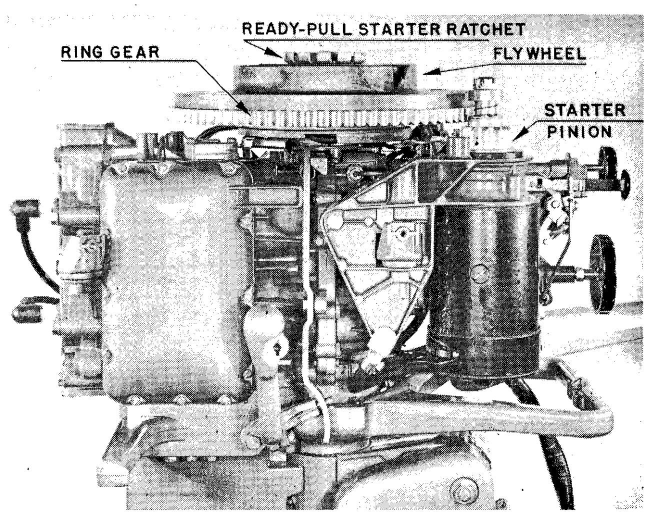
But little difficulty should be encountered with the electric starting unit; however, should the occasion require, look to the battery first. Make certain it is "up"; check terminal connections to assure their tightness and freedom from corrosion;



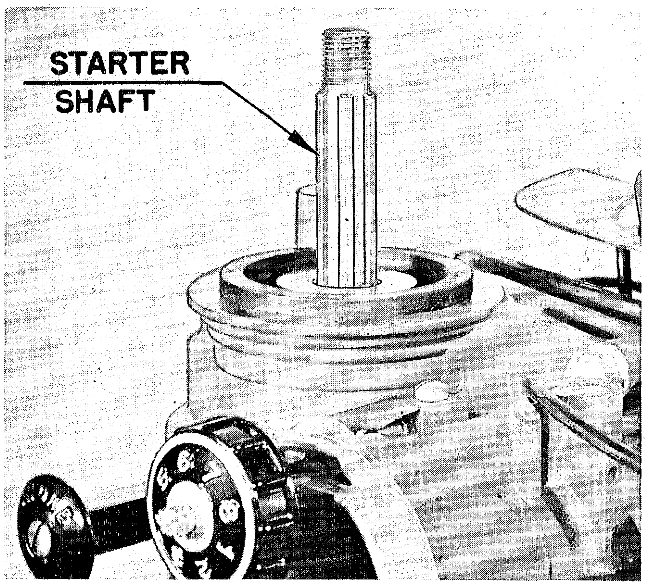
Schematic drawing showing the starter, choke solenoid and mercury switch arrangement.

investigate all terminal connections in the wiring system to determine their fitness, including the mercury switch; be on lookout for loose, broken or otherwise faulty wiring. Check remote starter and choke buttons on the panel — See wiring diagrams and assembly layouts shown here. In event the remote starter button fails, the small cap on bottom end of the starter relay may be removed to expose an auxiliary button — depress to start.

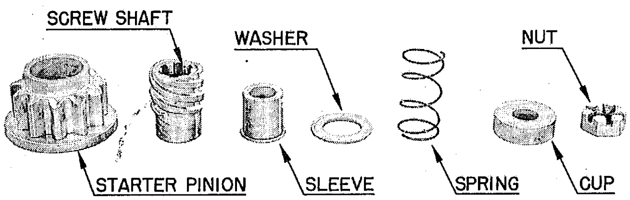
The pinion gear "screw" should be oiled periodically with motor oil or thinly coated with Lubriplate. Wash off occasionally with kerosene or gasoline if there is evidence of the pinion "sticking" (use sparingly) re-oil.



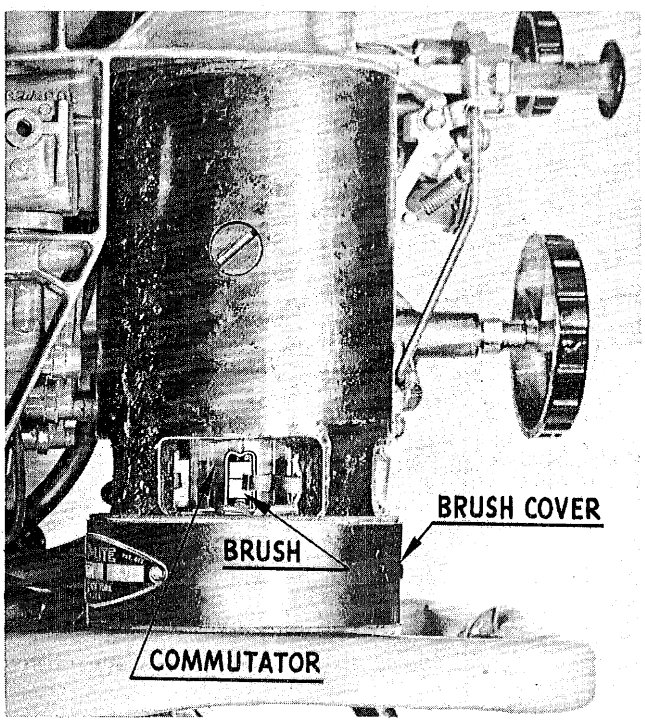
Model RDE powerhead—ready pull removed to expose the flywheel with ring gear attached and starter drive.



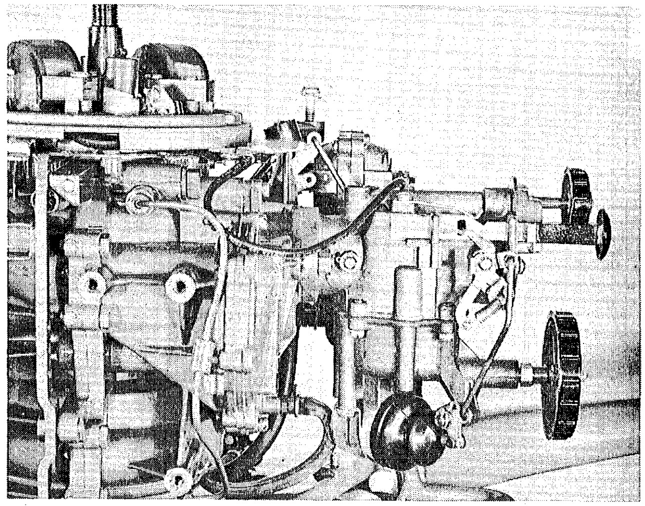
Showing starting motor with nut, spring, washer, screw, and gear removed for periodic cleaning. Rinse all parts of the assembly with gasoline to remove traces of scum and/or effects of salt water operation to avoid "sticking" of pinion gear. Lubricate with few drops of light oil.



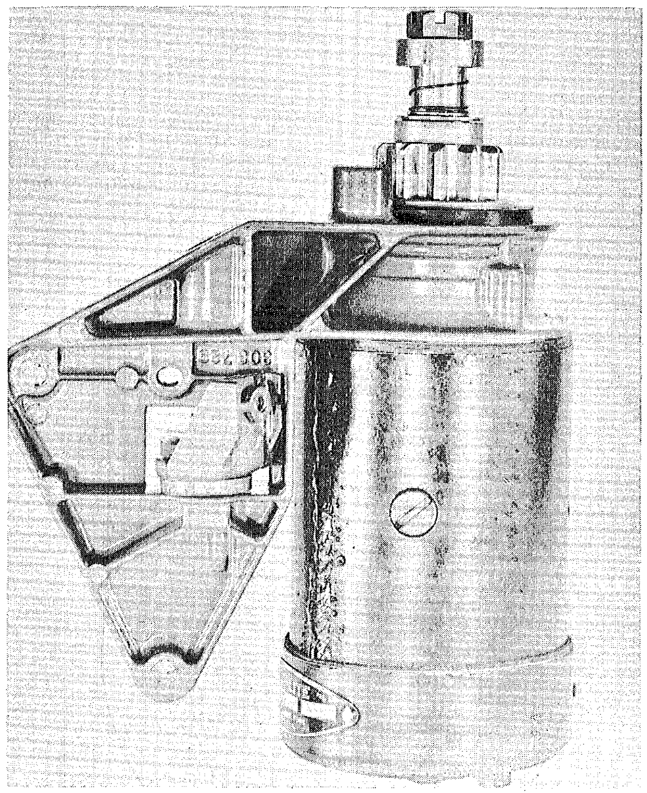
Layout of starter gear assembly. Note long shoulder on screw which must be directed downward on assembly.



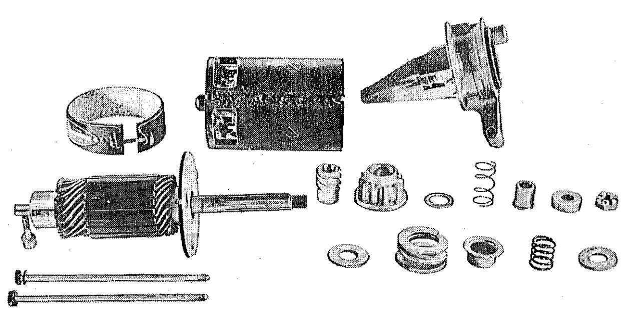
Brush cover removed for inspection of commutator segments and brushes.



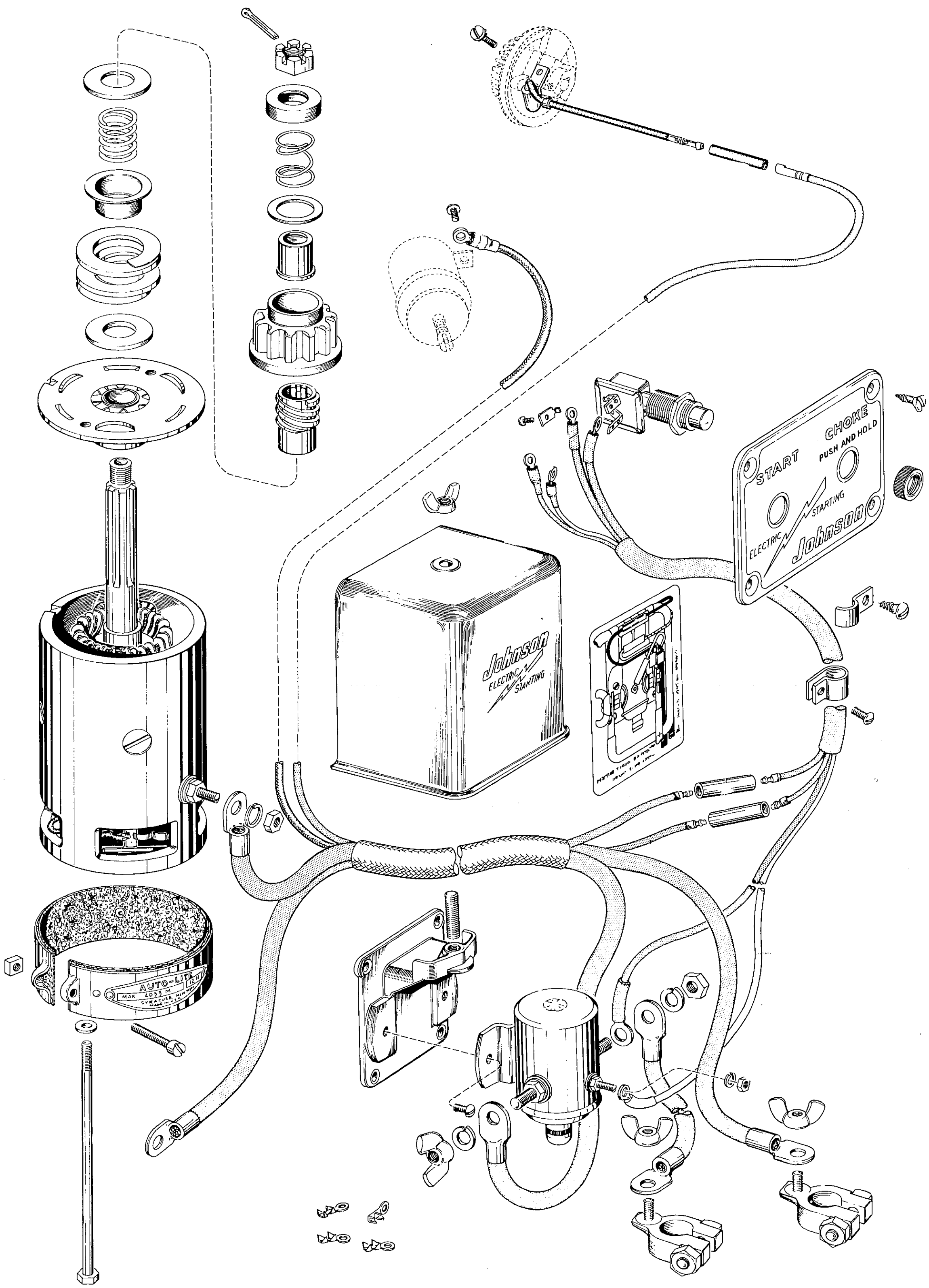
Power head with starter and mounting bracket assembly detached.



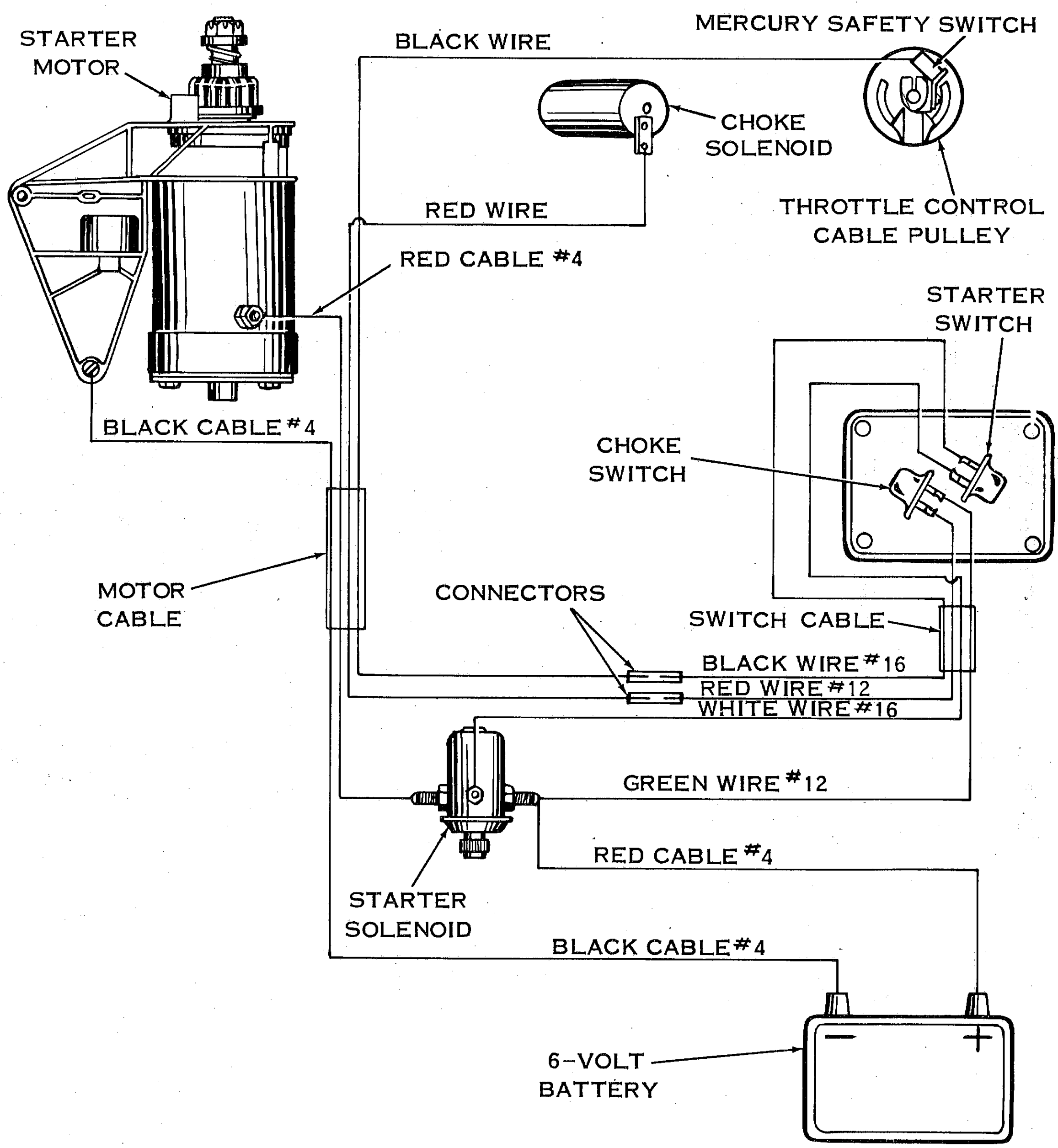
Showing the starter assembly and mounting bracket as removed from the motor.



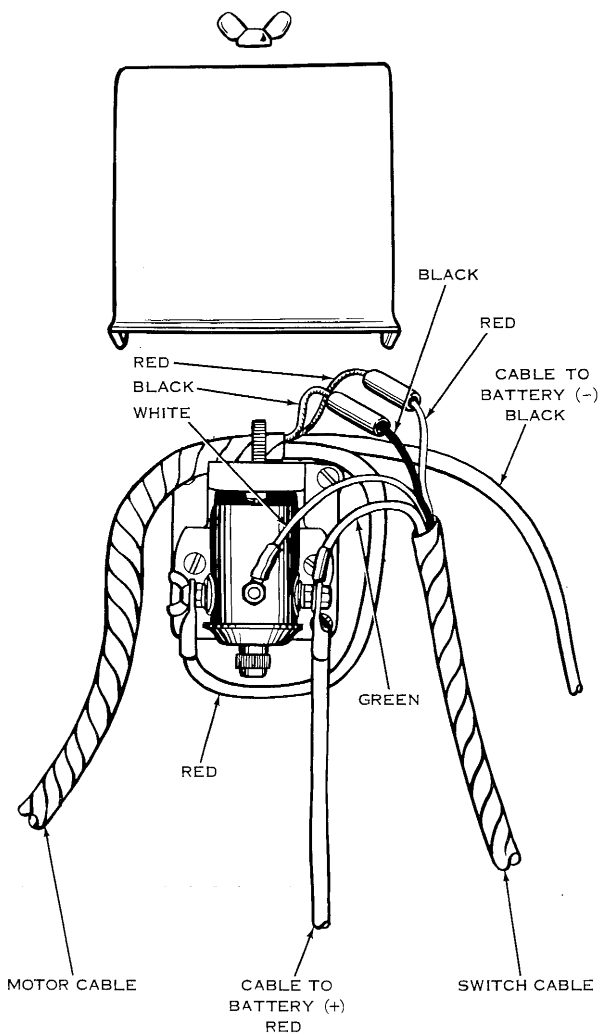
Break Down of Starter Assembly.



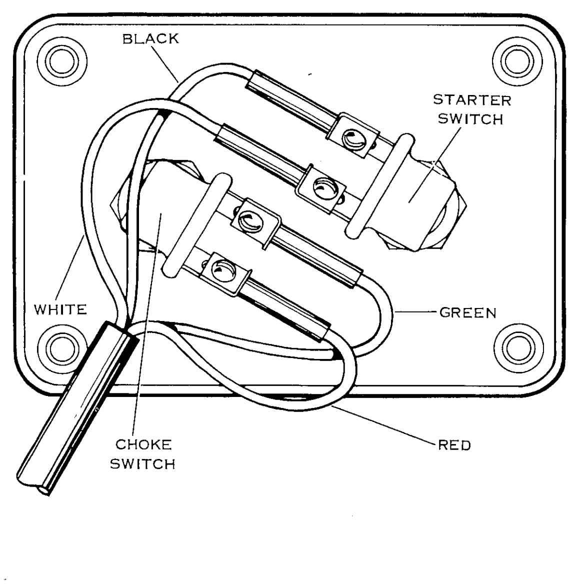
Model RDE electric starting group layout.



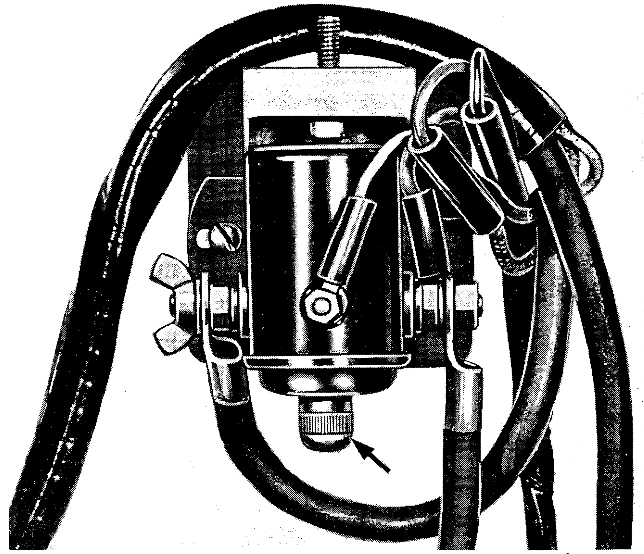
Wiring diagram.



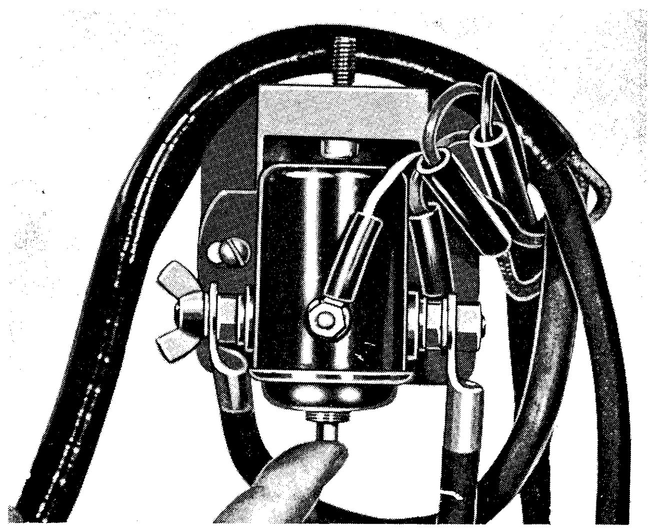
Junction box wiring diagram.



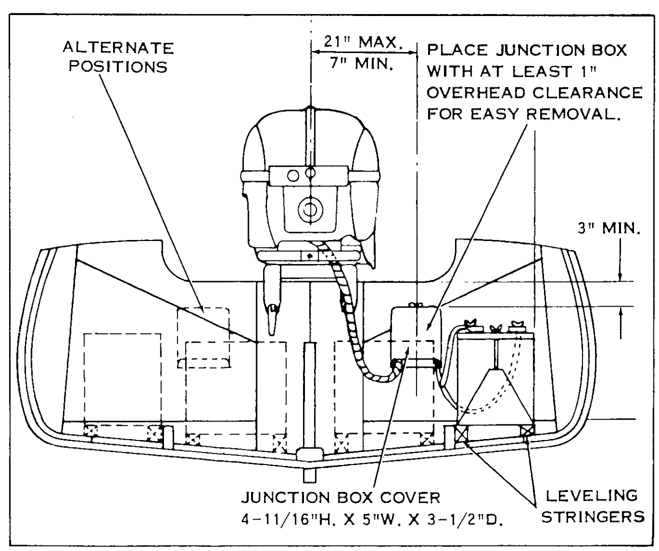
Wiring diagram—back of starter-choke switch panel.



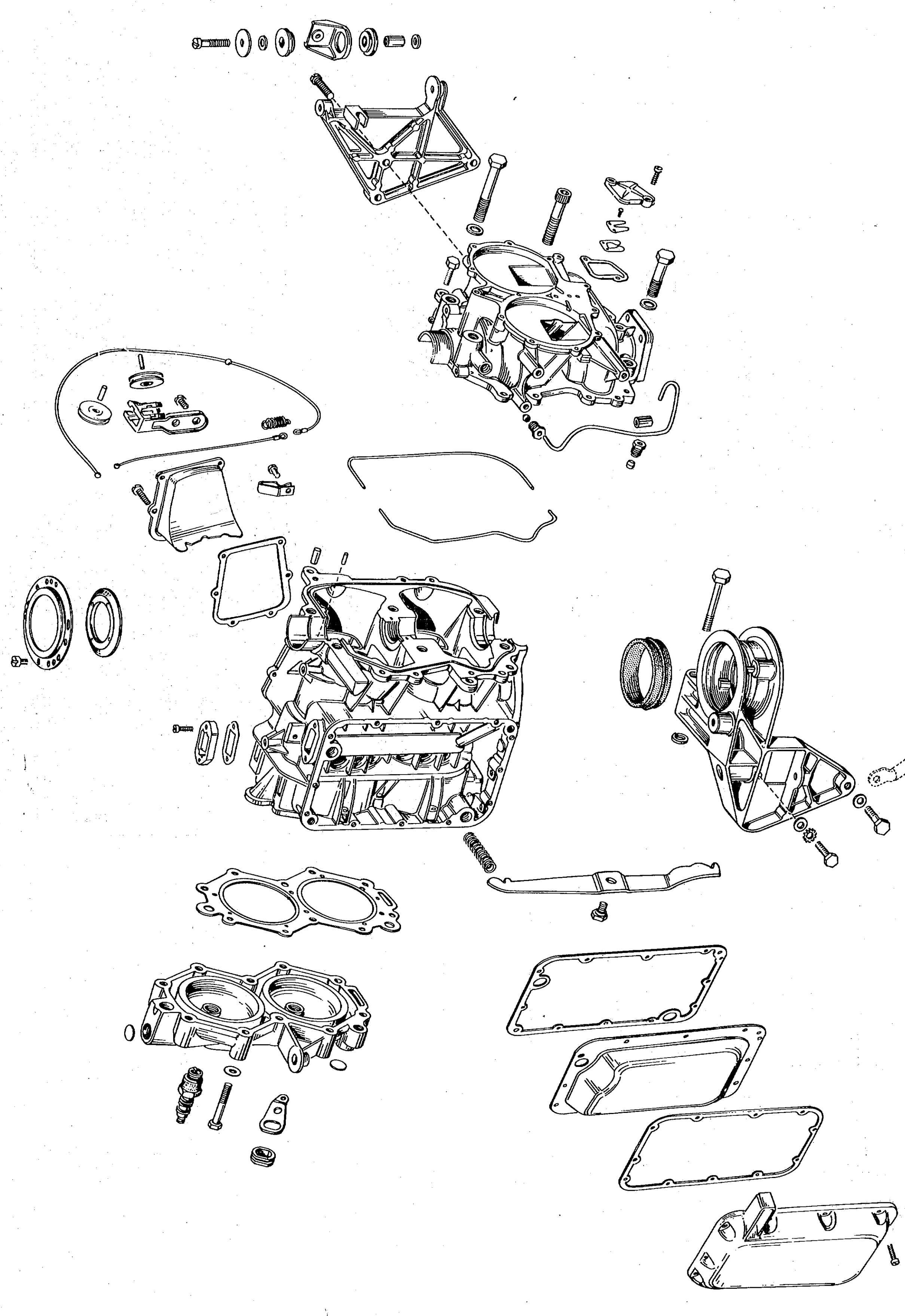
Showing starter relay and arrangement of wiring under the junction box. Note cap under relay indicated by arrow.



Showing relay cap removed, exposing the auxiliary starting button.



Motor installation plan.



Model RDE cylinder and starter mounting group layout.

Electric Starting

INSTALLATION INSTRUCTIONS FOR 40 HP ELECTRIC SHIFT MODELS

(12-VOLT SYSTEM) — 1962

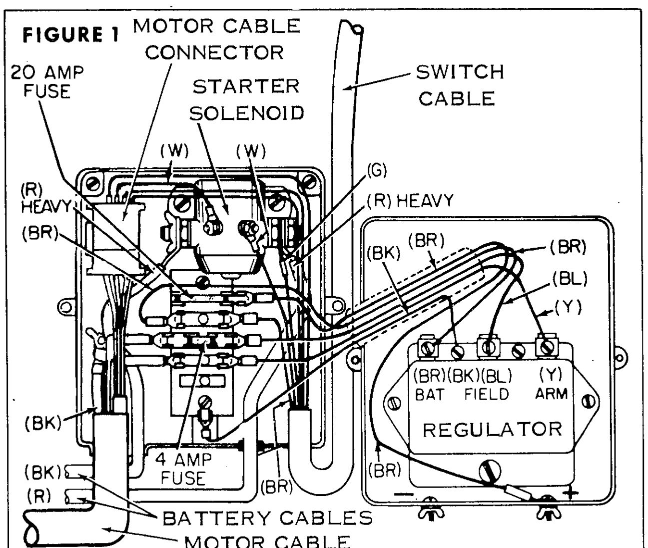
All equipment necessary for installation of the electric starting system, indicator light and ammeter are included with this kit, with the exception of the battery. A 12 volt battery can readily be obtained through local sources. For best performance, we recommend a 12 volt battery having a 60 ampere hour rating or better, with a minimum of 5.2 minutes cold starting capacity at 150 amperes discharge, zero degrees Fahrenheit and a 5 second voltage rating of 9.1 volts.

Installation will require mounting of the ignition switch, indicating light and ammeter on boat dashboard, mounting of the junction box and mounting of the battery in the boat. Tools required for the average installation consist of a brace and expansion bits for drilling 13/16", 1-7/16" and 2-1/16" holes, screw driver and 3/8" and 1-1/16" open end wrenches.

JUNCTION BOX AND MOTOR CABLE INSTALLATION

Install the junction box on boat transom or suitable location, within dimensional limits shown on Figure 2. It is important that the junction box base is mounted in a vertical plane (vertical within ± 15 degrees). Note alternate positions that may be used with junction box still in vertical position. Make sure that placement will not interfere with other remote controls, such as steering or throttle cables. Also make sure that the junction box cover can be removed for inspection or motor removal. Remove junction box cover and fasten junction box base to the boat with three of the wood screws included in the carton. See Figure 1. If boat is metal, junction box should be well insulated from boat. A piece of wood larger than the junction box and approximately 3/4" thick will make a sufficient insulator. Be sure junction box attaching screws do not go through the block and make contact with the metal of the boat.

FIGURE 1



Plug motor cable assembly connector into junction box connector (Figure 1). Red cable attaches to solenoid switch wing nut terminal and black cable to negative battery cable wing nut terminal. Note side of red and black cable terminals marked NUT SIDE. Connect cables and tighten wing nuts securely against NUT SIDE face.

Wiring diagrams of the junction box base and junction box cover are located in the junction box cover.

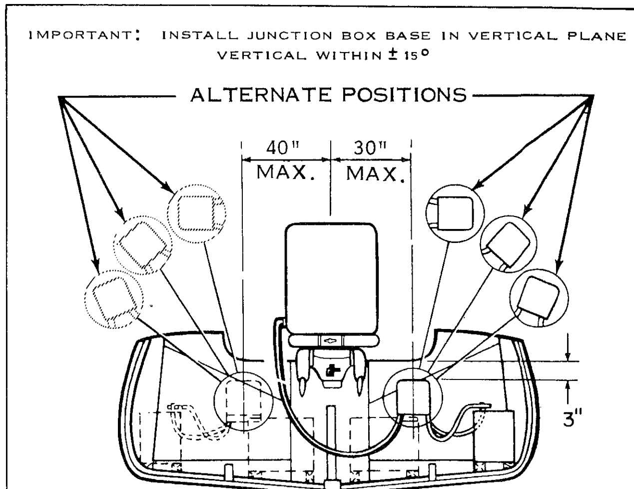


FIGURE 2

SWITCH ASSEMBLY, INDICATOR LIGHT, AND AMMETER INSTALLATION

The switch and indicator light leads are assembled to respective units when received from your dealer. For installation on your boat dashboard, use template Part No. 308171 furnished with this kit for location and size of holes required to mount key switch, indicator light and ammeter. NOTE: The 1" diameter hole shown on template Part No. 308171 is not used on 40 HP electric shift models. The 2-1/2 to 5-1/2 inch spacing provides mounting flexibility for most installations. See Figure 3.

Remove the key and knurled nut from the front of the switch. Remove the insulating washer with retaining bracket from the ammeter. Remove lens and sleeve assembly from indicator light by pressing lens against socket and twisting counterclockwise. Remove spring.

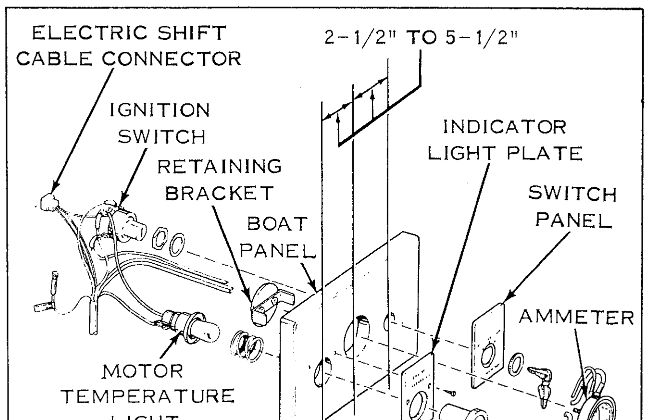


FIGURE 3

Insert switch through the hole, flat section of the threads up, from the rear of the dashboard. Be sure that the washer is between the hex nut and the dashboard. See Figure 3. Place the switch plate over the switch and position with round knurled nut. Then secure with hex nut from rear of dash.

Center indicator light plate over holes and screw to dashboard. Insert lens sleeve and reassemble to light receptacle.

Make small notch in bottom of ammeter hole in dash to position ammeter. Insert the ammeter through hole in the dashboard from the front. Install the retaining bracket and insulating washer. Reconnect the green wire to the terminal marked BAT and the two brown wires to the terminal marked GEN. See Figures 3 and 4.

NOTE

On boats with unusually thick dashboards the legs of the retaining bracket may have to be cut down slightly to permit assembly of the nuts, washers and ammeter leads.

The switch cable should be neatly fastened to the boat - in an out-of-the-way place. Necessary clamps are provided for this purpose. The cable may be strung under the floor boards, if desired, since it resists possible damage by bilge water. The cable may be shortened if required - contact your dealer for the extra terminals required. Be sure to crimp and solder terminals securely. Plug electric shift cable connector into cable from electric shift control box.

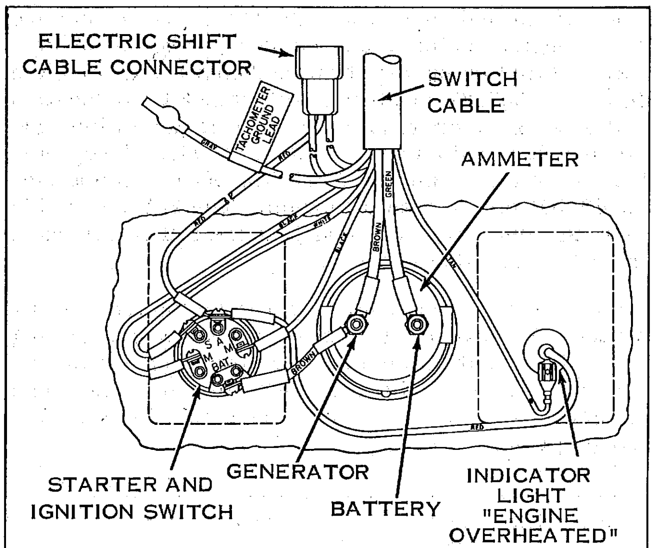


FIGURE 4 BACK OF DASHBOARD

TACHOMETER CONNECTIONS

Provisions have been made for connecting a tachometer if so desired. It must be of the type which operates off the primary circuit of the ignition system.

The leads from the breaker points and from the ground are available at the switch plate. The breaker point lead is available at the "M" terminals of the starting switch, and the ground lead is the gray wire labeled "Tachometer Ground Lead". (See Figure 4.)

Connect either of the "M" terminals to the tachometer "breaker point" terminal, and the gray lead to the "Tachometer Ground."

NOTE

If the tachometer reads erractically the wiring may be reversed. Check your connections carefully to insure proper polarity.

BATTERY INSTALLATION

Install the battery near the junction box. See Figure 5 for preferred locations and limiting dimensions. IMPORTANT: Do not place battery directly under front carrying handle of motor. When motor is tilted battery may be damaged. For mounting the battery, use a frame or box securely fastened to the boat. A loose battery may shift in the boat, damaging battery or other equipment. If a battery box and cover are used, drill two vent holes (3/16" will do) on each side of the cover to allow battery gas to escape. This gas is explosive when confined. CAUTION: Connect the positive battery lead (RED) from the junction box to the positive (+) battery terminal. Attach negative lead (BLACK) to negative (-) battery terminal. See Figure 1. Tighten connections securely. For service information for the battery, refer to instructions provided by the battery manufacturer. Fuses for accessory take-off and generator are in the junction box.

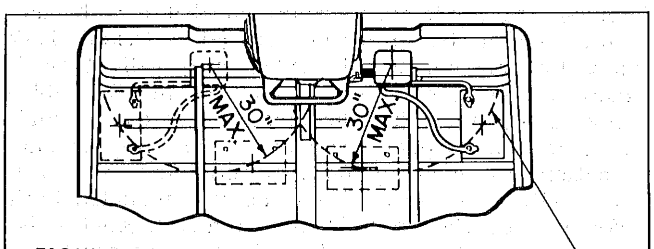


FIGURE 5 MAX. DISTANCE TO ℄ OF BATTERY

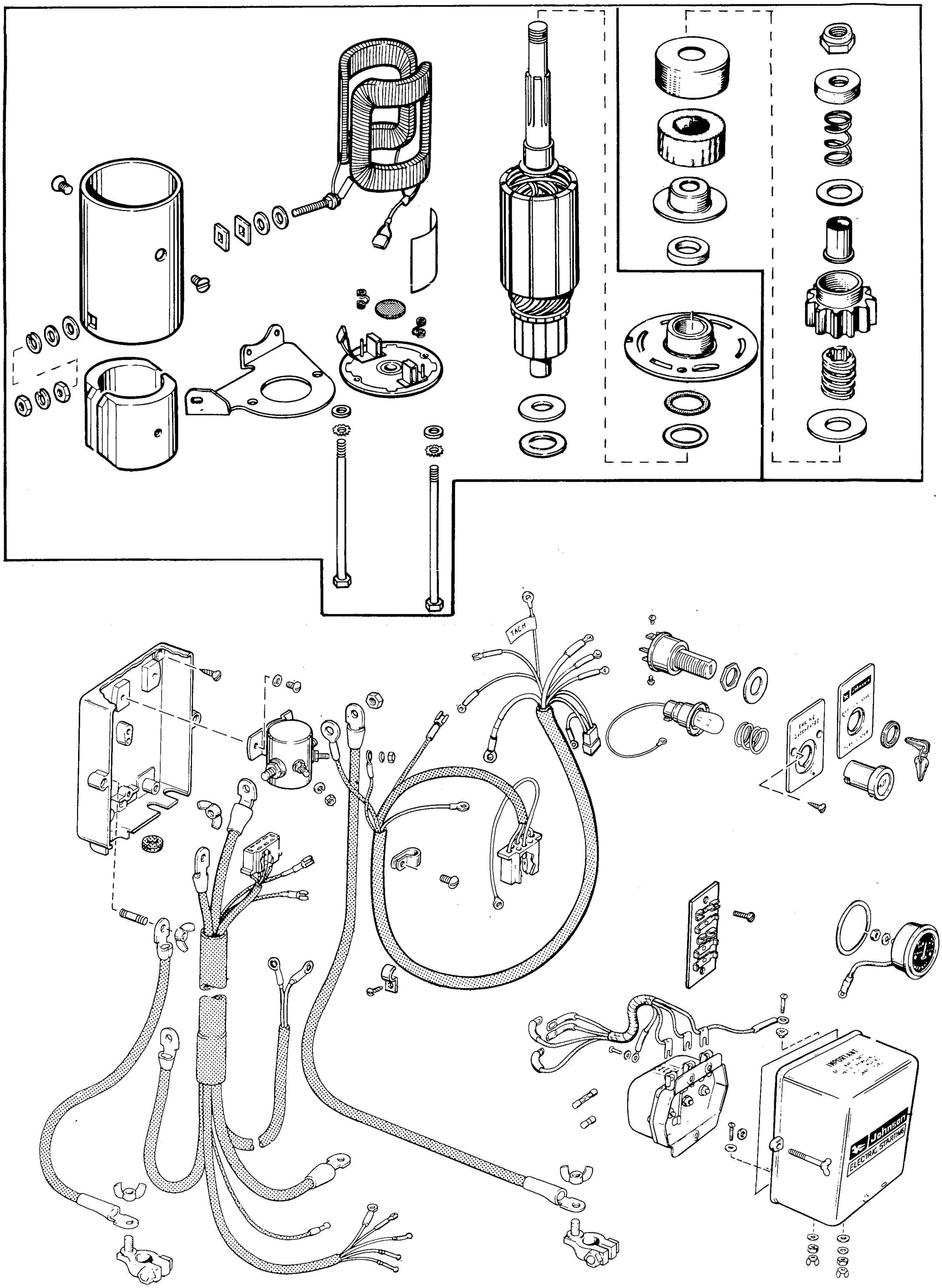
IMPORTANT

Disconnect battery before removing junction box cover or making any connections.

TWIN MOTOR INSTALLATION

A direct current generator is standard equipment on all 40 HP electric shift models. For dual motor installation, two junction boxes, two starting switches, two motor temperature warning lights and two ammeters are required (included with electric starting motors). A separate installation will be required for each motor. Before cutting holes in dashboard plan their location carefully. Two 12 volt batteries may be used. We recommend that the two batteries have the same characteristics and specifications mentioned previously. Connect each motor and battery as a separate and independent electrical system. To use one battery - disconnect one generator. Remove generator drive belt.

A current coupler is available as an accessory for use with two electric starting motors equipped with D.C. generators. A current coupler permits feeding two generators into one battery. See your local authorized dealer.



ELECTRIC STARTER GROUP
Model RK-24

Installation Instructions

ELECTRIC STARTING – 18 H.P.

All equipment necessary for converting the manual starting 18 HP motor to electric starting operation is included in the kit, with the exception of the battery. This system will require a 12 volt battery, readily obtainable through local sources.

For best performance we recommend a 12 volt battery having a 60 ampere-hour rating or better, with a minimum of 2 minutes cold starting capacity at 300 amperes discharge, zero degrees Fahrenheit and a 10 second voltage rating of 7.5 volts.

Installation will require preparing the motor for and installing the electrical components on the powerhead and carburetor, mounting and connecting the cable assembly in the lower front cover, mounting of the switch plate on boat dash, mounting the junction box on boat transom, and mounting the battery securely to the boat. We recommend that your dealer make the installation. However, if you decide to install the kit yourself, the following tools will be required: 7/16" and 1/2" combination wrenches, 7/8" and 1-1/16" open end wrenches, small and large screwdrivers, an offset screwdriver, common and needle nose pliers, and a brace with 5/8" and 13/16" wood bits.

Preparing Motor For Installation

1. Mount motor on a motor stand and remove motor cover assembly.

2. Remove the three mounting screws holding manual starter to powerhead and lift off the complete starter assembly. See Figure 1.

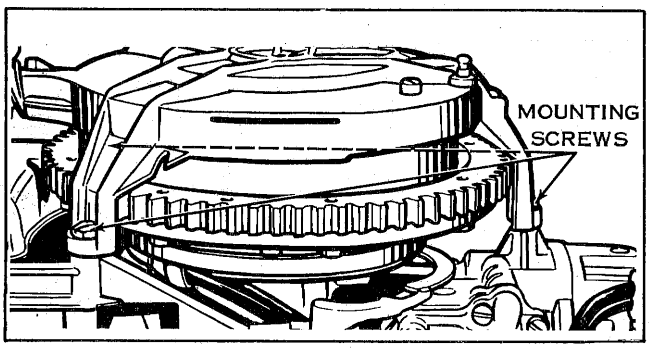


FIGURE 1

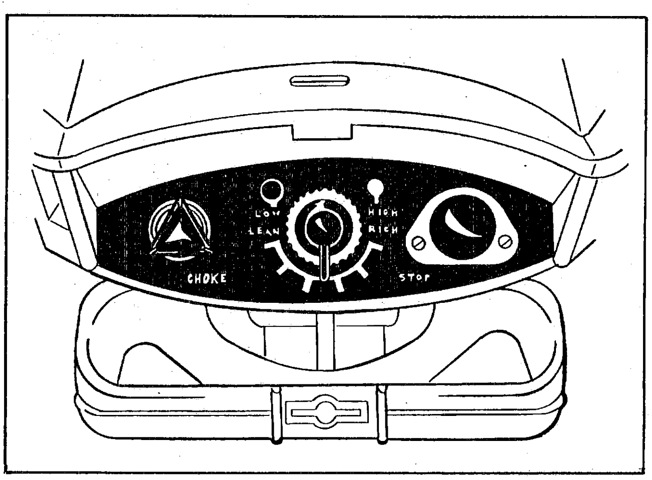


FIGURE 2

3. Remove carburetor controls and silencer assembly, if so equipped, as follows: Models having carburetor controls as shown in figure 2, proceed as follows:

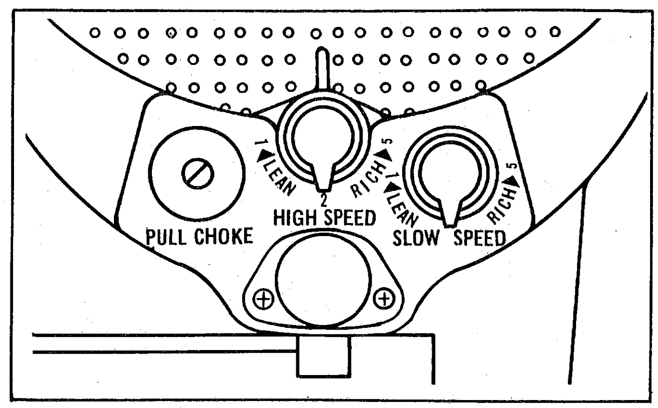


FIGURE 3

3a. Note knob settings, then pull off high and slow speed knobs. Do not disturb high speed needle setting.

3b. Remove choke rod cotter pin and washer. Remove rod.

3c. Disconnect slow speed control link at bottom end. Be careful not to bend linkage or disturb needle setting.

Models having carburetor controls as shown in figure 3, proceed as follows:

3d. Note knob settings, then pull off high and slow speed knobs. Loosen choke knob screw and remove knob.

3e. Disconnect the upper end of high speed link (pry off with screwdriver) figure 5. Remove the two air silencer plate screws with offset screwdriver. Remove air silencer plate.

Preparing Motor for Installation

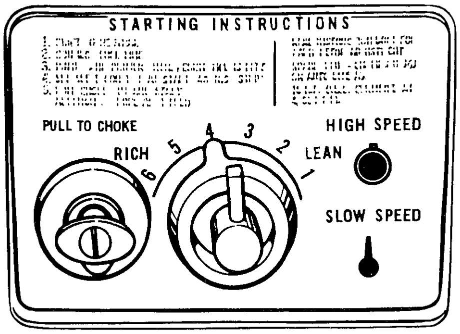


FIGURE 4

Models having carburetor controls as shown in figure 4, proceed as follows:

3f. Note knob settings, then remove slow speed knob. (If snap-on type, just pull off. If attached with screw, remove screw first.) Do not disturb needle setting.

3g. Remove choke knob screw only.

3h. Disconnect the upper end of high speed link (pry off with screwdriver) figure 5, then remove slow speed packing nut. High speed knob, choke knob and control panel can then be removed as a unit.

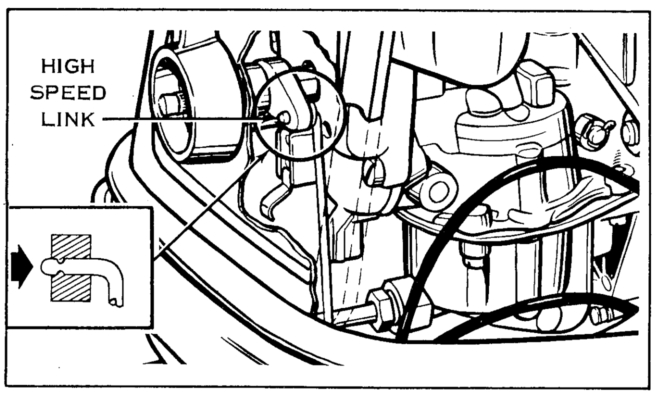


FIGURE 5

3i. Remove the four mounting screws from the air silencer and remove it from the carburetor.

Models having carburetor controls as shown in figure 6, proceed as follows:

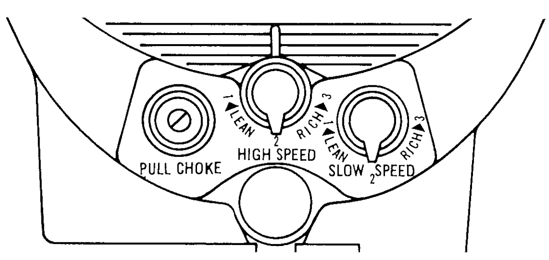


FIGURE 6

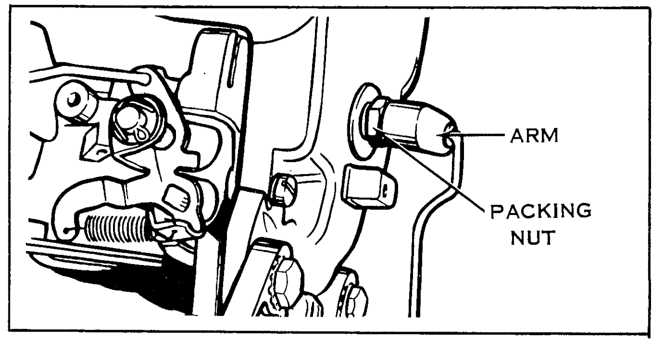


FIGURE 7

3j. Note knob settings, then remove slow speed arm (if snap-on type, just pull off; if attached with screw, remove screw first), packing nut and slow speed needle valve. (Turn packing nut and needle valve counterclockwise to remove.) See figure 7.

3k. Remove the four mounting screws from the air silencer and remove it from the carburetor. Air silencer and linkage support assembly can be removed by tilting it forward and withdrawing carefully from carburetor and lower cover.

4. Remove the control lever mounting screws and clamps and the mounting screws from the port starter mounting bracket. Bracket then can be removed from motor. See figure 8.

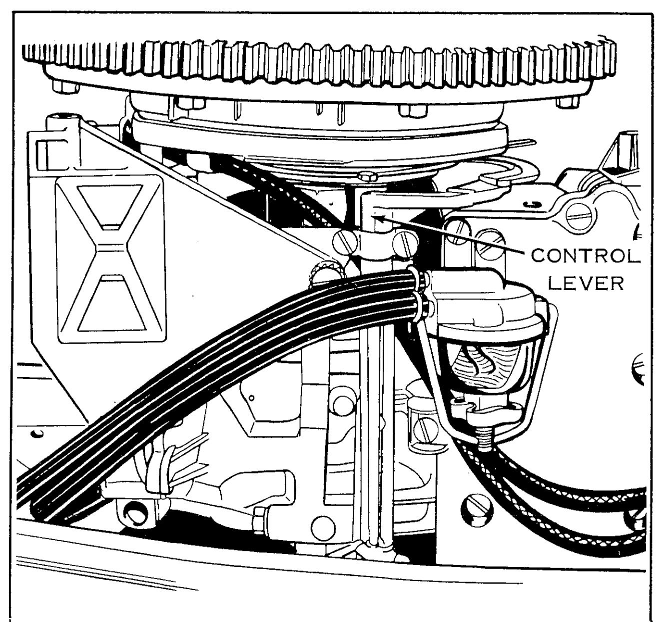


FIGURE 8

5. Next, disconnect upper end of throttle link from cam follower arm. See figure 9. Then remove the two carburetor nuts and slide carburetor forward and off of manifold studs. Disconnect fuel line from carburetor. See figure 10.

Preparing Motor for Installation

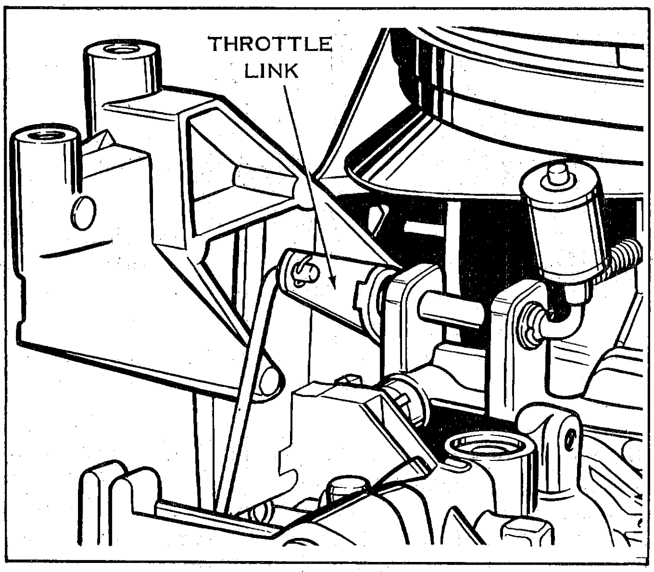


FIGURE 9

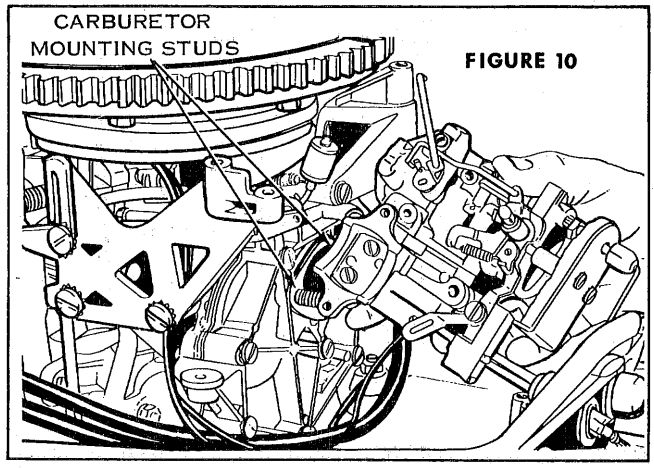


FIGURE 10

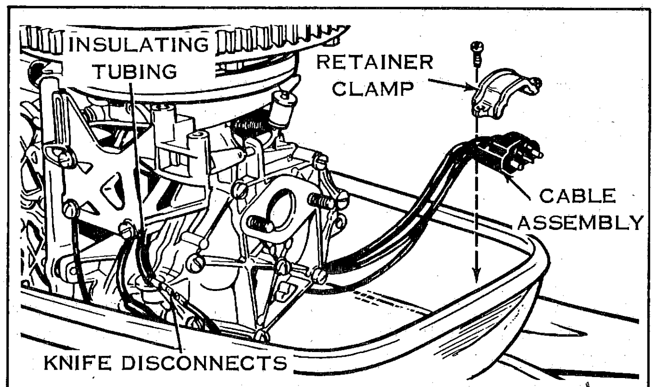


FIGURE 11

6. Slide insulating tubing from shorting switch wires toward magneto to expose knife disconnects. See figure 11. Disconnect leads from shorting switch. Then remove shorting switch assembly from lower front motor cover. The motor is now ready for installation of the electric starting kit.

Installation on Motor

The Electric Starting Kit consists of four basic assemblies; the cable assembly, choke solenoid and bracket assembly, starter motor and bracket assembly, junction box and switch plate assembly and necessary linkage and hardware. Installation is in the above order and proceed as follows:

1. Mount the cable assembly in lower motor cover with the large pins down and key into slot. Secure to cover with the retainer clamp and two screws provided. Next, connect the two small black wires from cable assembly to the shorting wires (black) from magneto then slide insulating tubing over connections. See figure 11.

2. Attach solenoid to carburetor as follows: Carburetors with factory installed solenoid brackets proceed as follows:

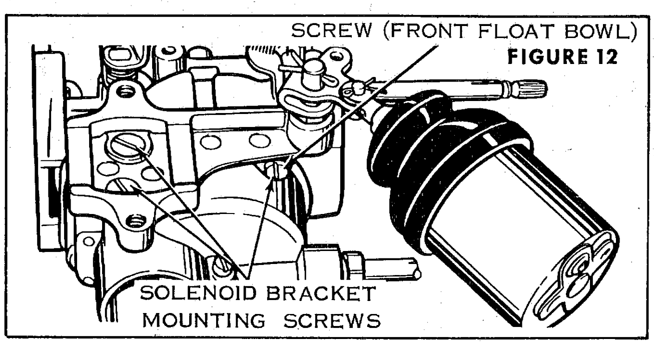


FIGURE 12

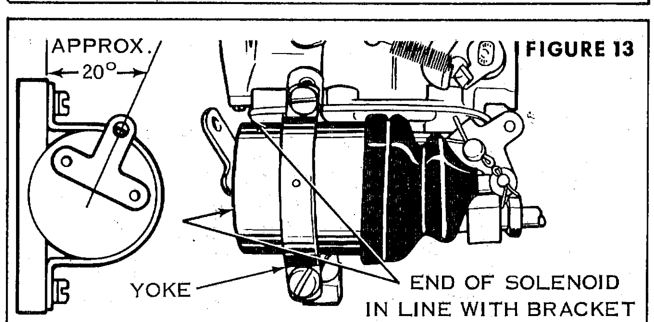


FIGURE 13

Installation on Motor

2a. Remove two screws and yoke from bracket supplied with solenoid. Attach solenoid to carburetor with yoke and two screws. Align as shown in figure 13, then tighten lower yoke screw. Tighten upper yoke screw just enough to hold solenoid in position.

Carburetors without solenoid bracket, proceed as follows:

2b. Remove the front float bowl to carburetor body screw (on right side of carburetor). See figure 12. Then remove the two screws and yoke holding solenoid to bracket, move solenoid to side and install bracket to carburetor with the three screws provided. See figure 12. Reassemble the solenoid to the bracket with yoke and two screws. Align as shown in figure 13, then tighten lower yoke screw. Tighten upper yoke screw just enough to hold solenoid in position.

2c. On motor with carburetor controls as shown in figure 2: Remove cotter pin, washer, spring (bellcrank to choke lever), bellcrank and nylon bushing, and choke return spring (discard spring). Install No. 304258 bellcrank and nylon bushing, No. 204492 throttle control arm, and No. 308481 link (bellcrank to choke solenoid) washer and cotter pin. See figure 14.

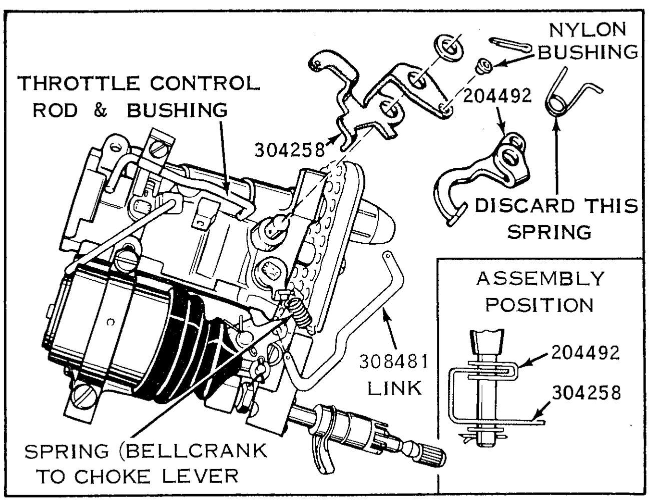


FIGURE 14

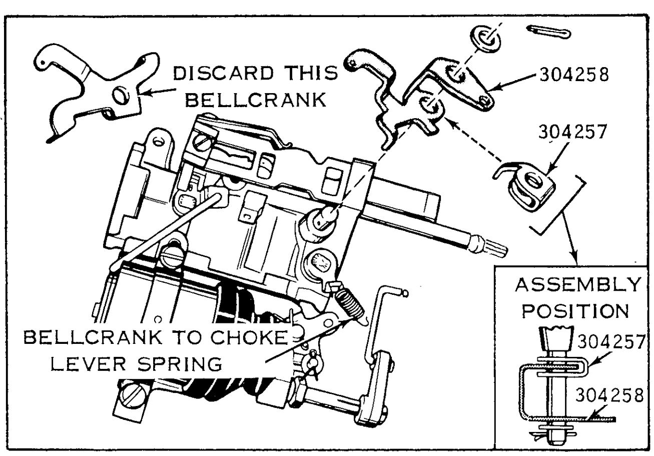


FIGURE 15

2d. On motor with carburetor controls as shown in figure 4. Remove cotter pin, washer, spring (bellcrank to choke lever), and bellcrank and install No. 304258 bellcrank and No. 304257 lever as shown in figure 15.

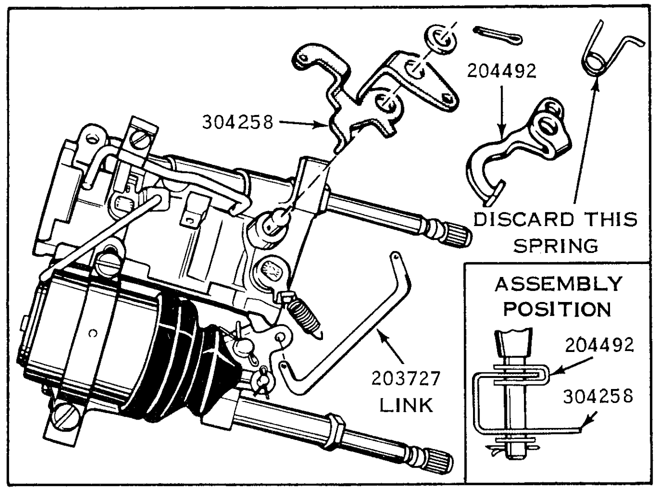


FIGURE 16

2e. On motor with carburetor controls as shown in figures 3 and 6. Remove link pin, throttle control rod. and bushing; cotter pin, washer, bellcrank to choke lever spring, bellcrank and choke return spring. Install No. 304258 bellcrank, No. 204492 throttle control arm and No. 203727 link as shown in figure 16.

3. Reassemble fuel line and clamp to carburetor, then fasten the small red wire from the cable assembly to the solenoid terminal with SEMS screw provided. Run wire across back of carburetor and secure in position as shown in figure 17. Assemble carburetor and gasket to manifold and securely fasten with the two nuts. Then reconnect the throttle lever link to cam follower arm and fasten with new pin provided. Connect solenoid lever link to choke bellcrank with pins provided as shown in figure 17.

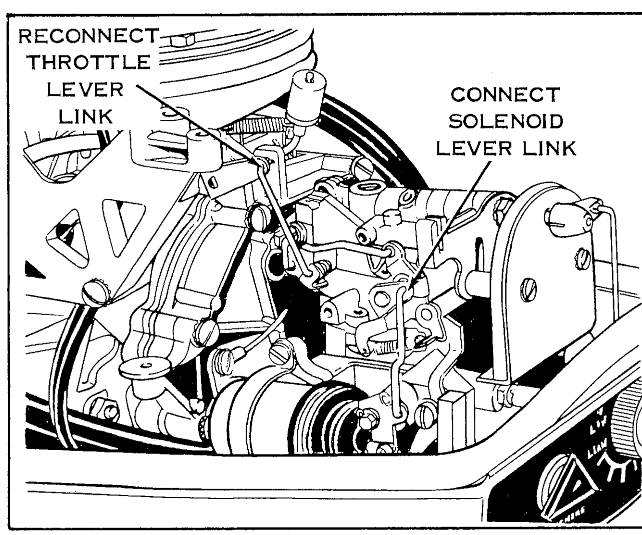


FIGURE 17

Installation on Motor

4. Install starter motor and bracket assembly on port side of powerhead with the three screws and lockwashers provided as follows:

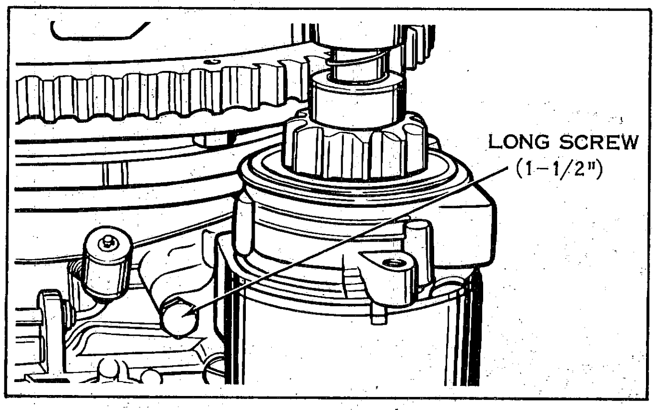


FIGURE 18

4a. Install the long screw (1-1/2") and lockwasher in the upper front mounting hole, do not tighten. See figure 18.

4b. Install the short screw (7/8") and lockwasher in the lower rear mounting hole, do not tighten. See figure 19.

4c. Place ring terminal of large black wire from cable assembly on remaining screw (1-1/8") followed by lockwasher (against bracket) and install in upper side mounting hole, (see figures 18 and 19). Then securely tighten the three mounting screws.

4d. Reassemble the control lever and bearing clamps (clamp with oiling lip to outside) then secure to bracket with two mounting screws (see figure 19).

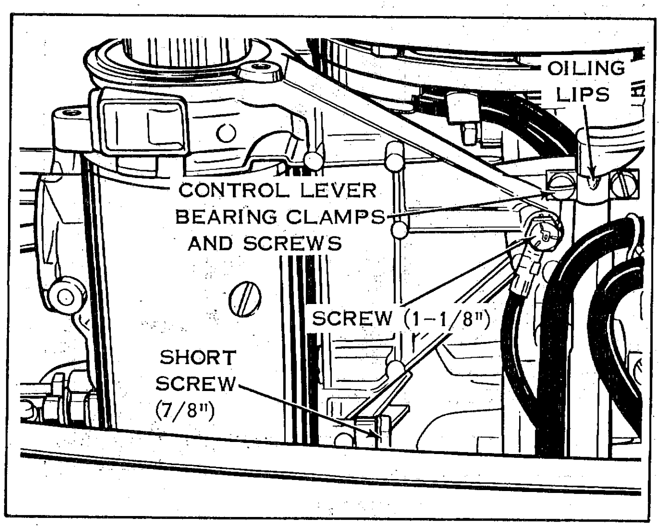


FIGURE 19

4e. Remove the hex nut and lockwasher from starter motor terminal stud, then place lug end terminal of red cable from cable assembly on starter motor terminal stud and replace lockwasher and nut, snug only. Arrange red cable so as not to rub on any part of the lower motor cover or carburetor when motor is operating, then tighten terminal nut securely. See figure 20.

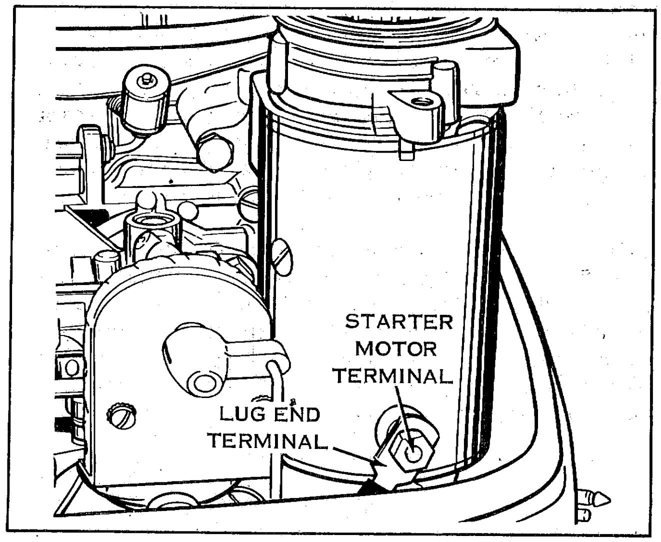


FIGURE 20

5. Reassemble carburetor controls and silencer assembly, if so equipped, as follows:

Motors having carburetor controls as shown in figure 2, proceed as follows:

5a. Reassemble carburetor to motor. Reconnect throttle link as in figure 17.

5b. Reconnect lower end of slow speed control link. Use care not to disturb needle setting. See figure 21.

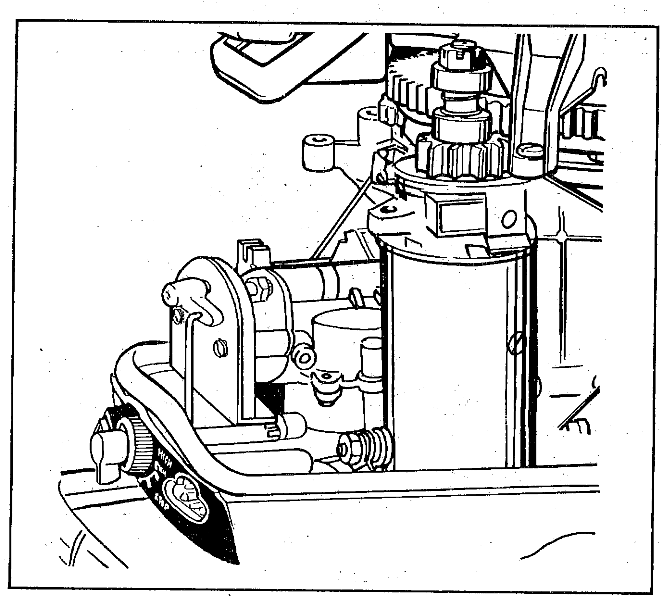


FIGURE 21

Installation on Motor

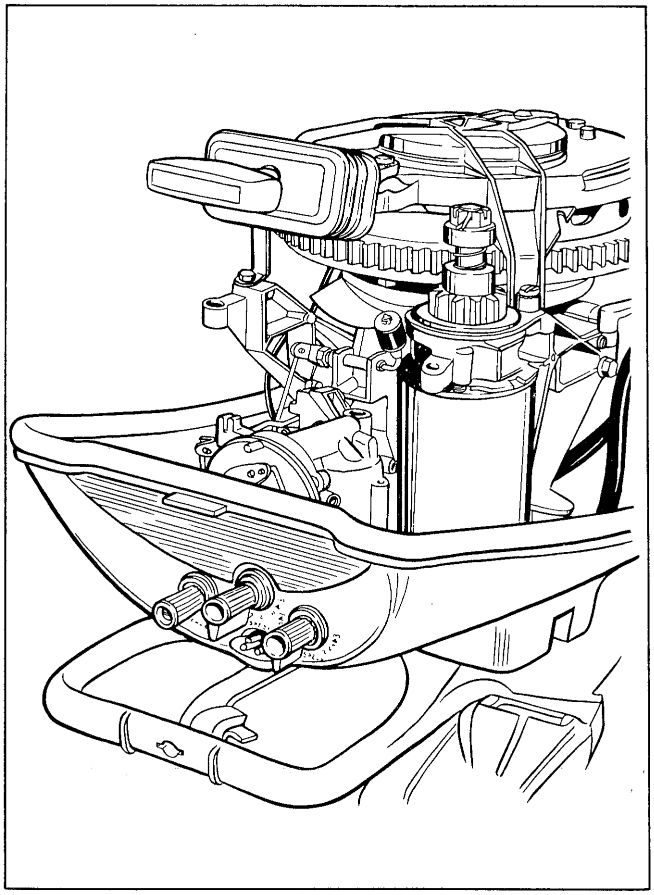


FIGURE 22

Motors having carburetor controls as shown in figure 3, proceed as follows:

5e. Assemble carburetor to motor. Install air silencer plate screws and tighten.

5f. Replace choke knob and screw. See figure 22.

Motors having carburetor controls as shown in figure 4, proceed as follows:

5g. Reassemble air silencer to carburetor and mounting brackets and fasten securely with the four mounting screws.

5h. Place control panel assembly over slow speed needle. Then assemble slow speed packing nut and tighten to desired friction, being careful not to disturb needle setting. Reconnnect upper end of high speed link to high speed knob lever.

5i. Install choke knob screw to choke shaft and tighten securely.

5j. Assemble slow speed knob to slow speed shaft in original setting position. Do not disturb needle setting while assembling knob. See figure 23.

Motors having carburetor controls as shown in figure 6, proceed as follows:

5k. Reassemble air silencer and linkage support assembly to lower cover and carburetor by tilting assembly forward and through the cover first. Fasten securely to carburetor and mounting brackets with the four mounting screws.

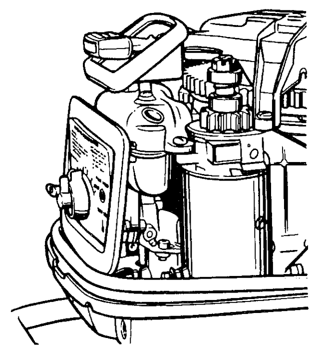


FIGURE 23

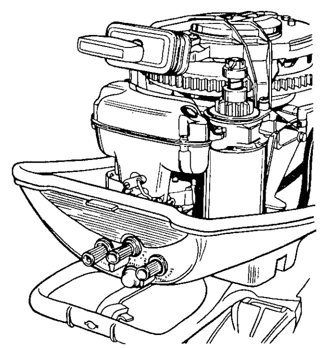


FIGURE 24

5l. Assemble slow speed needle and turn into closed position (clockwise) gently. Then assemble slow speed packing nut finger tight only. Back off needle 3/4 turn (counterclockwise). Hold needle in this position and tighten packing nut to desired friction. Hold slow speed knob (at lower front cover) in center position and replace slow speed arm and link assembly on the slow speed needle. If arm is the snap-on type, just press on; if attached with a screw, tighten the screw. Do not disturb needle position during this operation. See figure 24.

Installation on Motor

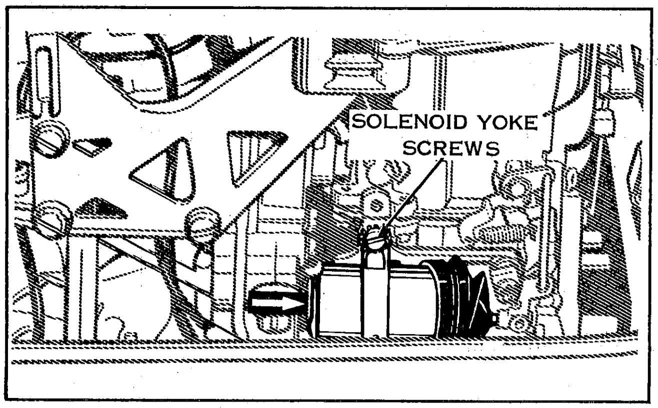


FIGURE 25

6. Adjust the choke solenoid assembly as follows: Loosen the solenoid yoke screws. Pull the manual choke knob all the way out. Push solenoid case forward until the plunger bottoms in the case, (limit of forward movement). Hold solenoid in this position and tighten upper yoke screw securely. See figure 25.

7. Place starter assembly (rope) on mounting bosses and fasten securely to powerhead with three mounting screws.

8. Replace motor cover assembly on motor. The conversion is now complete and the motor is ready to install on the boat transom for completion of the electric starting installation.

Installation on Boat

Install the junction box on boat transom, within dimensional limits shown on figure 26. Make sure that placement will not interfere with other remote controls, such as steering, throttle, or gear shift cables. Also make sure that the junction box cover can be removed for inspection. Remove junction box cover and fasten solenoid bracket to the boat transom with the four wood screws furnished with the kit. See figure 27. If boat is metal, insulate junction box from boat with 3/4" thick wood panel. Fasten wood panel to transom with separate screws. The switches and switch leads are assembled when received from your dealer.

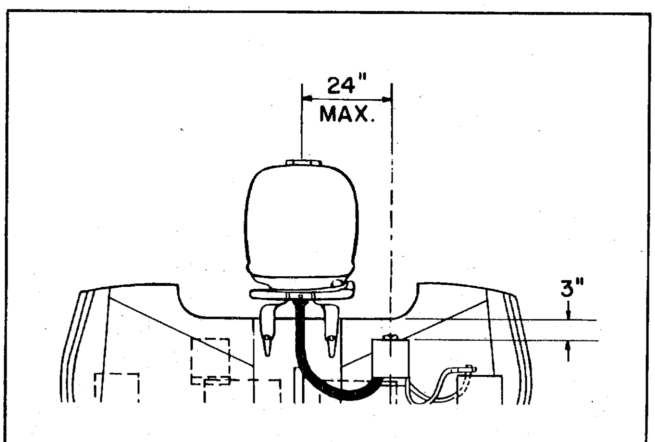


FIGURE 26

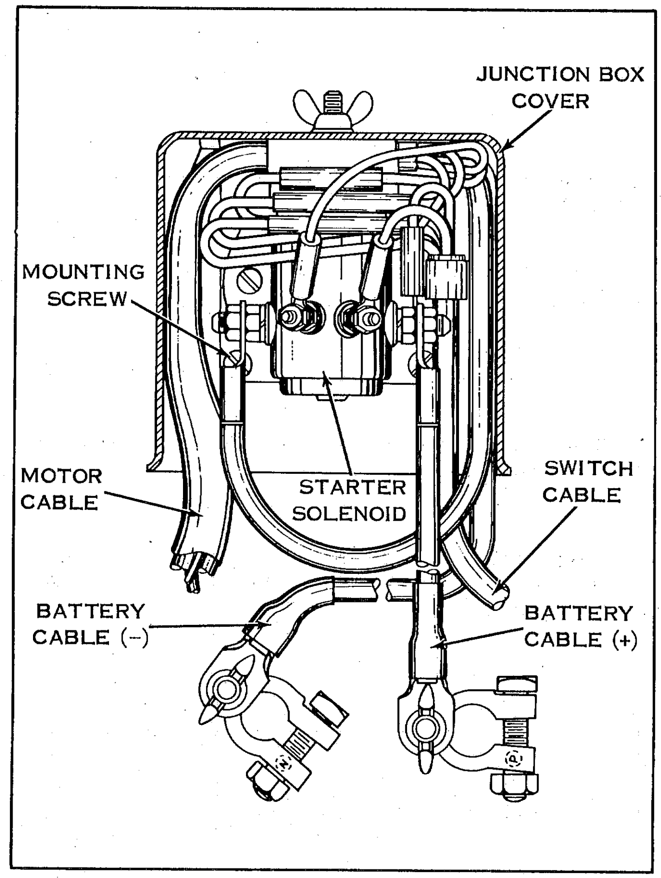


FIGURE 27

Installation on Boat

For installation on your boat dashboard, drill one 5/8 inch hole and one 13/16 inch hole with centers 1-1/2 inches apart, in position selected for installation, preferably near the steering wheel. These measurements must be adhered to exactly, to ensure proper fit. If desired, figure 32 can be cut out and used as a template. It is full size. Be sure to drill exactly at center marks, as shown.

Remove knurled nuts from the switches. Insert choke switch through 5/8 inch hole and the key starter switch through 13/16 inch hole from rear of dashboard. Be sure that the washer is between the hex head lock nut and the dashboard. Switch leads should point downward to protect switches from water. See figure 29.

Place switch plate over both the switches and secure to switches with knurled nuts. Tighten assembly securely to dashboard panel with hex head lock nuts. Assemble choke button cover on to switch. See figure 28.

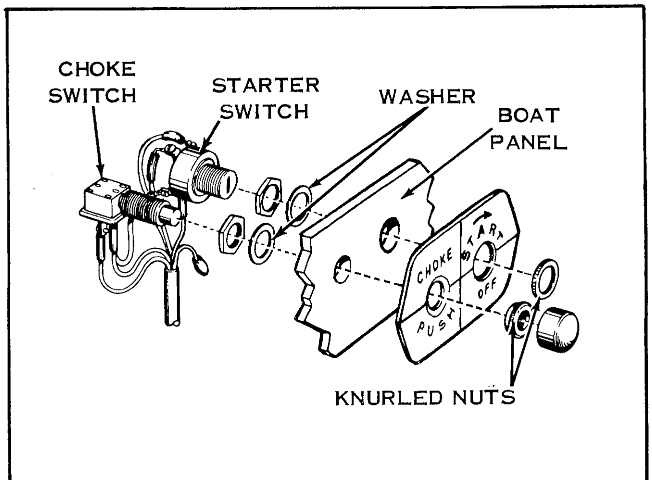


FIGURE 28

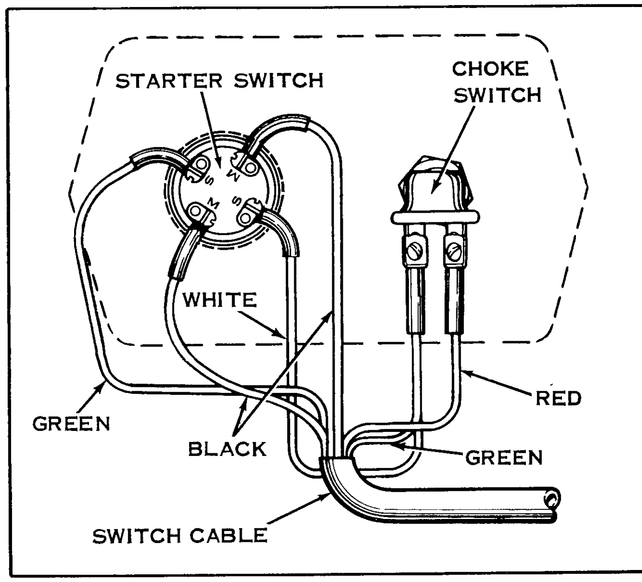


FIGURE 29

The switch cable should be neatly fastened to the boat - in an out-of-the-way place. Necessary clamps are provided for this purpose. The cable may be strung under the floor boards, since it resists possible damage by bilge water.

Install the battery near the junction box. See figure 30 for preferred locations and limiting dimensions. For mounting the battery, use a frame or marine type battery box securely fastened to the boat. A loose battery may shift in the boat, damaging battery or other equipment. Connect the positive battery lead (red) from the junction box to the positive (+) battery terminal. Attach negative lead (black) to negative (-) terminal on battery. See figure 27. Tighten connections securely.

For battery service information, refer to instructions provided by the battery manufacturer.

Twin Motor Installation

For twin motor installation, a special switch plate (with four switch holes) and two complete Electric Starting Kits are required. The switch plate is available as an accessory. For mounting the switch plate, two 5/8 inch holes and two 13/16 inch holes must be drilled in the dashboard, two holes 4 inches apart as with the single motor switch plate, and two more holes with centers 1-1/2 inches directly below the other two holes. A template is included with the accessory switch plate. Besides the extra holes, installation instructions are the same as for the single motor installation.

Twin Motor Installation

We recommend that a single 12 volt battery be used with the same characteristics and specifications mentioned on page 2. Connect both negative (black) cables from the junction boxes to the negative (-) battery terminal and both positive (red) cables from the junction boxes to the positive (+) battery terminal. Tighten connections securely.

Refer to the lubrication and fuel instruction section of your Owner's Manual for correct types and amount of fuel and oil before operating the motor.

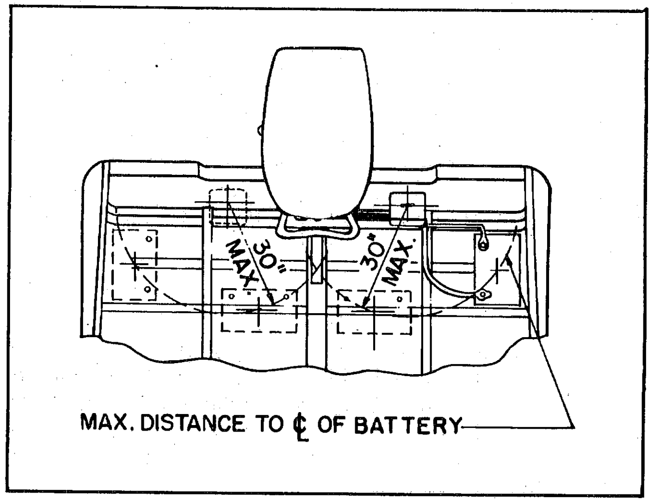


FIGURE 30

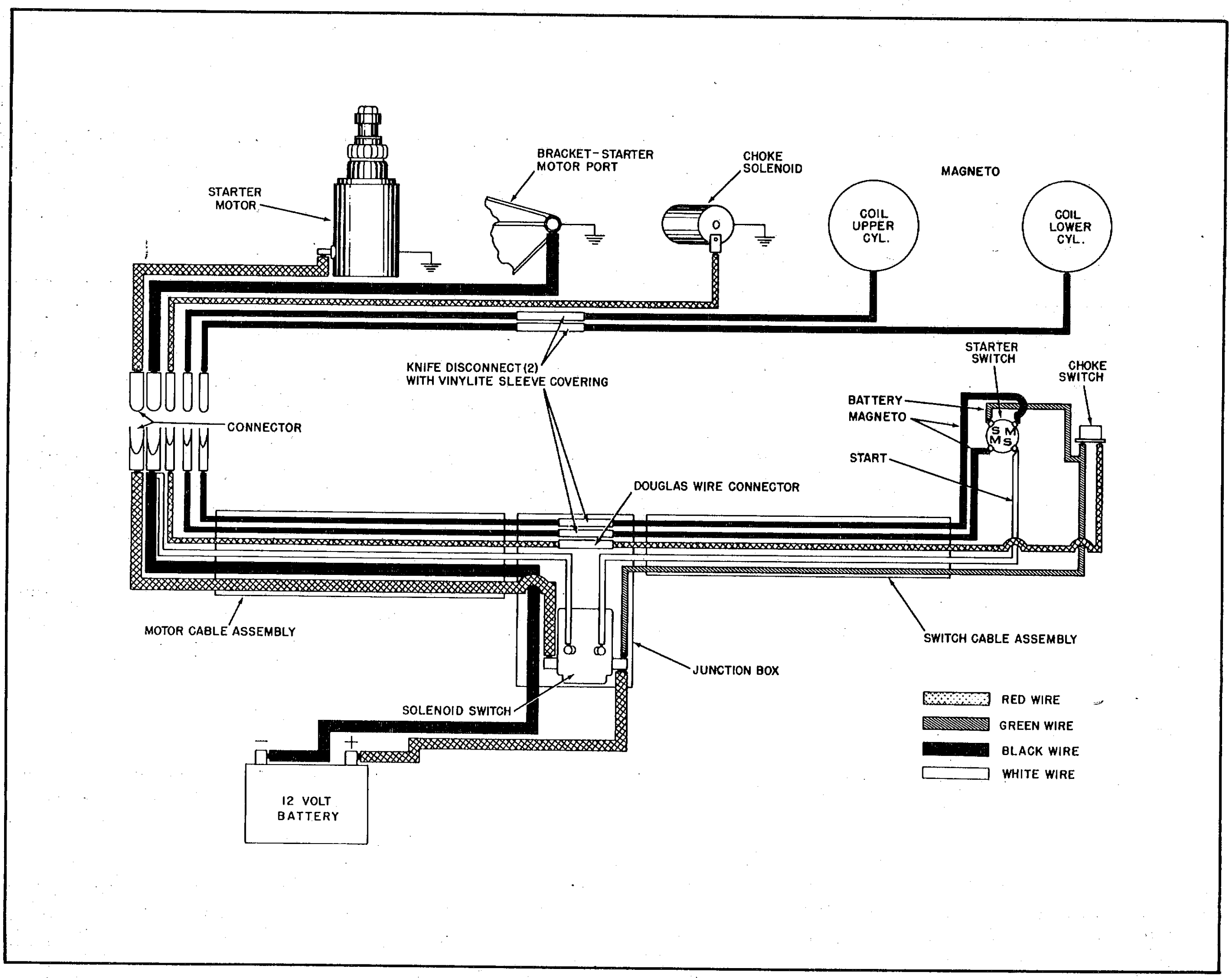


FIGURE 31

Twin Motor Installation

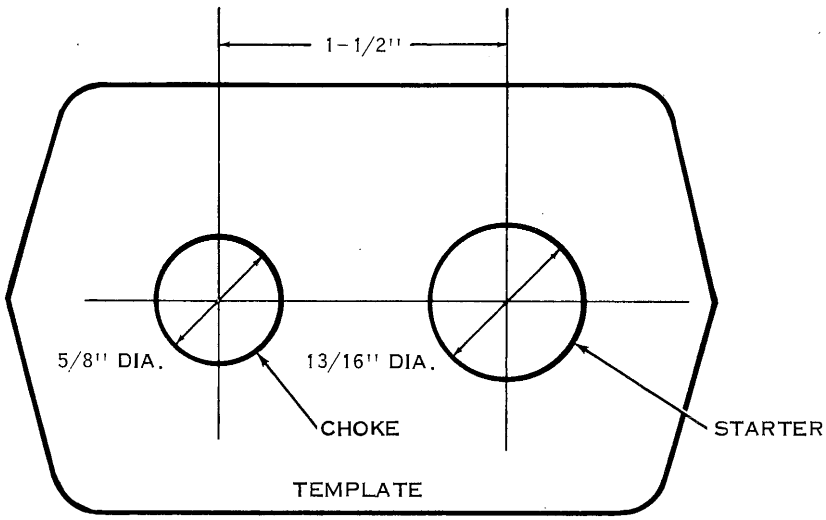


FIGURE 32

How To Get Started

Operating Instructions

1. Place fuel tank in boat so it will not shift about. Then connect fuel tank hose. See your Owner's Manual.

2. Prime the fuel system to get starting fuel into the carburetor. See your Owner's Manual.

3. Check reverse lock to be sure it is in LOCK position.

4. Move speed control to SLOW position.

> NOTE
>
> It is possible to shift only when speed control is set at a safe speed for starting.

5. Move shift control to NEUTRAL position. DO NOT START IN GEAR.

6. Move speed control toward FAST until it stops.

7. Set carburetor speed control knobs as directed in Owner's Manual for manual starting procedure.

8. While pressing choke button, turn starter key to the right to start motor. If motor doesn't start, don't hold starter on for over 10 seconds. Let go momentarily and then try again. Reduce motor speed after starting. After motor starts, immediately return key to the (vertical) RUN position and release choke. Additional choking may be necessary to keep a cold motor running.

CAUTION

Never turn starter key to actuate starter when motor is running.

9. After motor has warmed up, REDUCE SPEED TO SHIFTING RANGE and then shift to FORWARD or REVERSE as desired. Regulate speed with speed control as desired.

10. Adjust carburetor high speed needle to best setting while underway at full forward speed.

How to get Started

> NOTE
>
> If satisfactory carburetor adjustments can not be achieved, refer to your Owner's Manual for detailed instructions.

CAUTION

ALWAYS have someone at the helm (wheel) when making this adjustment. Reduce speed to slow and adjust slow speed control to best setting for idling. Further adjustments are seldom necessary.

11. To stop motor, retard speed, and turn key to OFF position.

12. TO START MOTOR MANUALLY: Turn key to RUN position (vertical) or disconnect PLUG-IN CONNECTOR at motor. Repeat step 1 through step 7. Pull choke knob all the way out. Pull starter handle gently until engaged then pull forcibly. Repeat until motor starts.

OUTBOARD MARINE CORPORATION
WAUKEGAN, ILLINOIS U.S.A.

PART NO. 308485 REV. 1

LITHO IN U.S.A.

Installation Instructions

ELECTRIC STARTING – 28 H.P.

All equipment necessary for converting the manual starting 28 HP motor to electric starting operation is included in the kit, with the exception of the battery. This system will require a 12 volt battery, readily obtainable through local sources.

For best performance we recommend a 12 volt battery having a 60 ampere-hour rating or better, with a minimum of 2 minutes cold starting capacity at 300 amperes discharge, zero degrees Fahrenheit and a 10 second voltage rating of 7.5 volts. Installation will require installing the electrical components on the powerhead and carburetor, mounting the cable assembly in the lower front motor cover, mounting of the switch plate on boat dash, mounting junction box on boat transom, and mounting the battery securely to the boat. We recommend that your local authorized dealer make the installation. However, if you decide to install the kit yourself, the following tools will be required: 7/16" and 1/2" combination wrench, 7/8" and 1-1/16" open end wrenches, small and large screwdrivers, common and needle nose pliers, a brace with 5/8" and 13/16" wood bits, and a round file.

A Generator Kit is also available as an accessory. See your local authorized Dealer, he can install this Electric Starting Kit and the Generator Kit in one quick and complete operation.

Installation on Motor

1. Mount motor on a stand and remove motor cover.

2. Remove the three screws attaching the manual starter to the powerhead and lift off the complete assembly. See Figure 1.

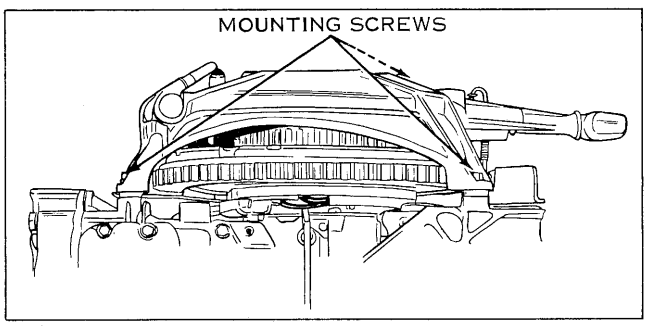


FIGURE 1

3. Remove starboard electric starting motor mounting bracket from powerhead and ring gear guard. See Figure 2.

4. Locate starter motor assembly (including lower bracket), remove thru-bolt seals and hex nuts from thru-bolts.

CAUTION

Care should be taken to prevent any further starter motor disassembly.

5. Discard hex nuts and reinstall seals on thru-bolts. Install starter motor assembly on starboard electric starting mounting bracket by threading thru-bolts into bracket. TORQUE thru bolts to 60-80 inch-pounds.

6. Remove lower cotter pin and disconnect throttle lever to cam follower link at carburetor. Remove high speed valve arm screw and detach high speed valve arm and link from high speed needle valve. Completely back off high speed valve packing nut and with the use of a screwdriver completely remove high speed valve and packing nut from carburetor bowl. See Figure 2.

7. Remove carburetor to manifold attaching nuts and remove carburetor from manifold. See Figure 3.

8. Install electric starter motor and bracket on powerhead. See Figure 4. Use the two longer manifold pan head screws provided.

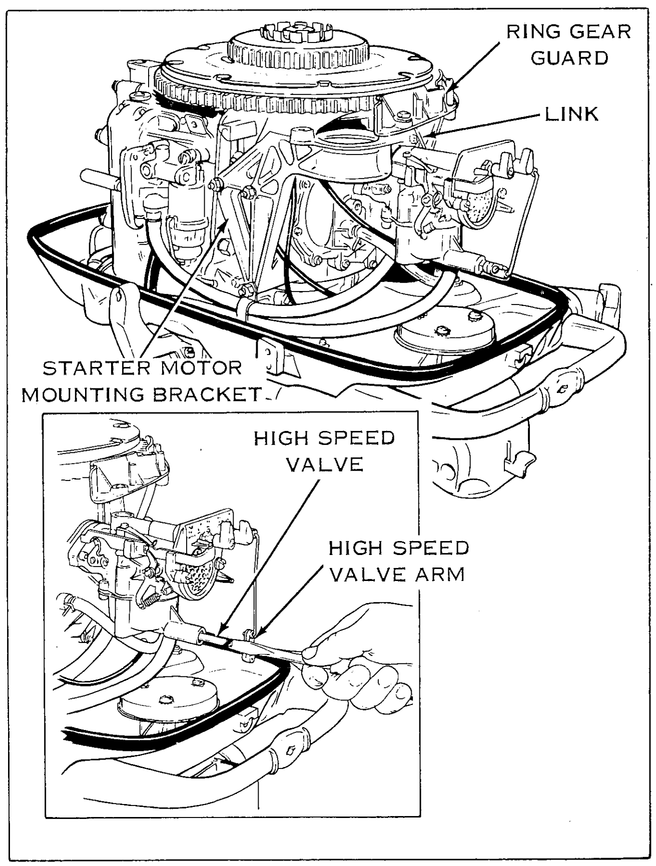


FIGURE 2

Installation on Motor

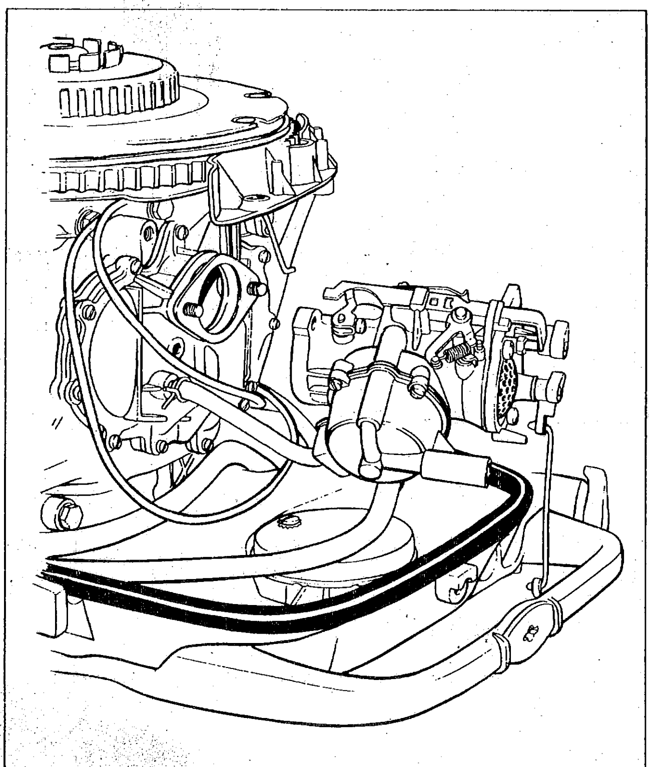


FIGURE 3

Torque Specifications

Bracket Stud Nuts	60-80 Inch-Pounds Torque
Powerhead Hex Capscrew	120-140 Inch-Pounds Torque
Manifold Pan Head Screws	25-35 Inch-Pounds Torque
Bracket to Guard Capscrew	12-24 Inch-Pounds Torque

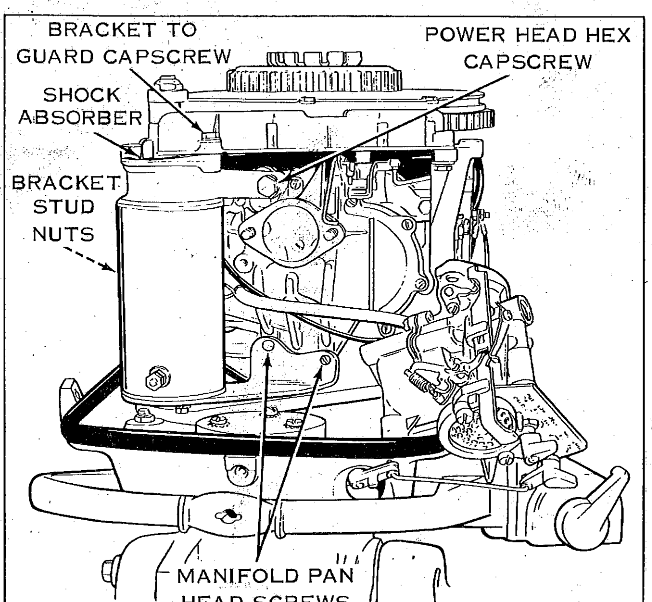


FIGURE 4

9. Install starter pinion rubber shock absorber in upper grooves of starter motor mounting bracket. See Figure 4.

NOTE

Make sure side of rubber shock absorber marked "Top" is facing upward.

10. Remove carburetor bowl and gasket; the bowl and gasket may be discarded.

11. Install new carburetor bowl, gasket and solenoid assembly on carburetor. See Figure 5.

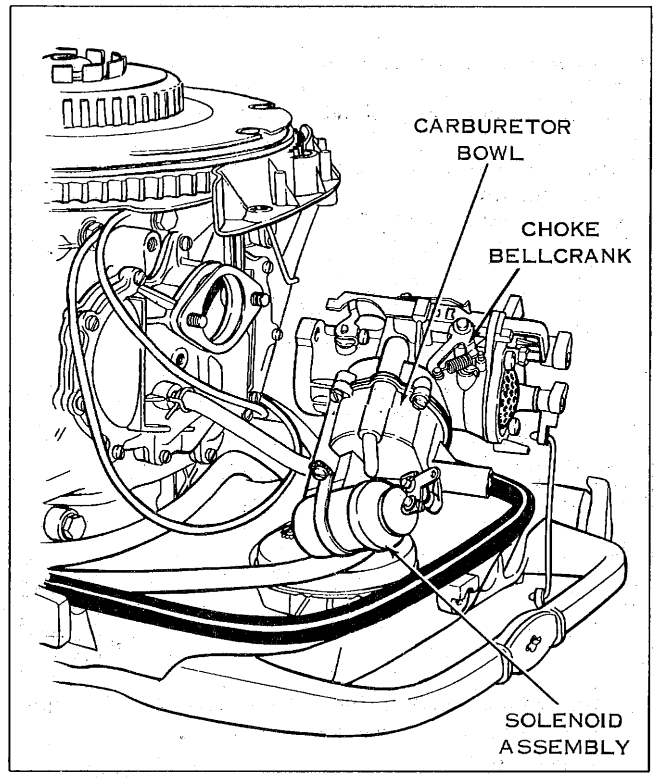


FIGURE 5

12. Reinstall carburetor assembly to manifold. Torque carburetor mounting nuts to 120-140 inch-pounds.

13. Reconnect cam follower link at carburetor and secure with cotter pin. See Figure 6.

14. Remove choke bellcrank and pin assembly from carburetor. The attaching cotter pin, washer and spring must be retained. The bellcrank and pin assembly may be discarded. See Figure 6.

15. Install the new bellcrank to choke control rod lever and choke bellcrank and pin assembly on carburetor. Secure in place with washer and cotter pin previously removed. Reinstall bellcrank to choke lever spring. See Figure 6.

Installation on Motor

16. Attach new bellcrank to solenoid lever link and secure with the four straight pins provided. See Figure 6.

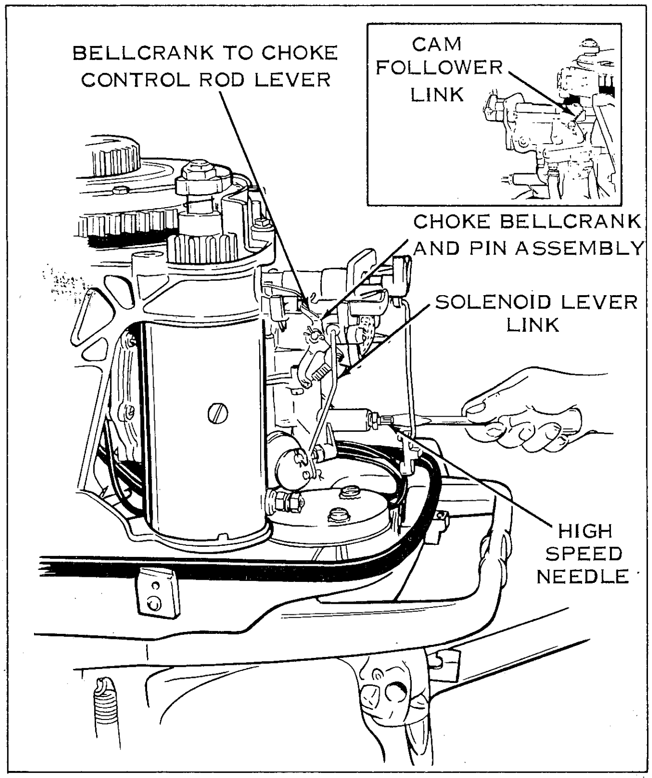


FIGURE 6

17. Thread high speed needle valve into carburetor bowl until it seats gently (not too tight). Back off approximately three turns, install four new valve packing washers over needle valve and press in place with packing nut. Turn high speed needle until it seats gently, then back off 3/4 turn. See Figure 6.

NOTE

DO NOT attach link and lever to high speed needle. See your Owner's Manual for final carburetor adjustment after electric starting installation has been completed.

18. Disconnect stop switch wires and remove stop switch from lower motor cover.

19. Remove and discard ground lead from port bracket to cut-out switch. See Figure 8.

20. With the use of a file enlarge stop switch hole to 1-1/16 inch diameter.

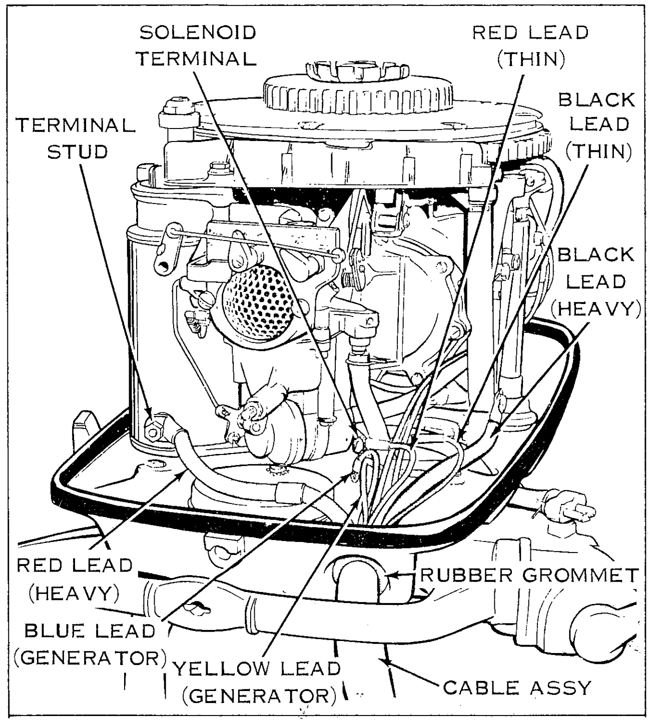


FIGURE 7

NOTE

For your convenience the present hole is counterbored to indicate the extent of filing necessary.

21. Insert rubber grommet (provided in kit) in enlarged stop switch hole in lower motor cover. See Figure 7.

22. Insert cable assembly through hole in grommet so that the outer insulation of the cable assembly extends through the grommet approximately one inch. See Figure 7.

23. Attach heavy red lead to starter motor terminal stud. Secure this heavy red lead to air silencer cover screw with clamp provided in kit. Caution: Be certain that there is sufficient slack in the cable between starter motor terminal and clamp to allow for powerhead movement. Attach other red lead to solenoid terminal with screw provided in kit. See Figure 7. Attach heavy black lead to lower port bracket mounting screw. See Figure 7. Attach short black lead (thin) to short lead from magneto (knife disconnect). See Figure 7.

NOTE

The yellow and blue wires are generator leads. The terminals are covered with insulation for protection.

Installation on Motor

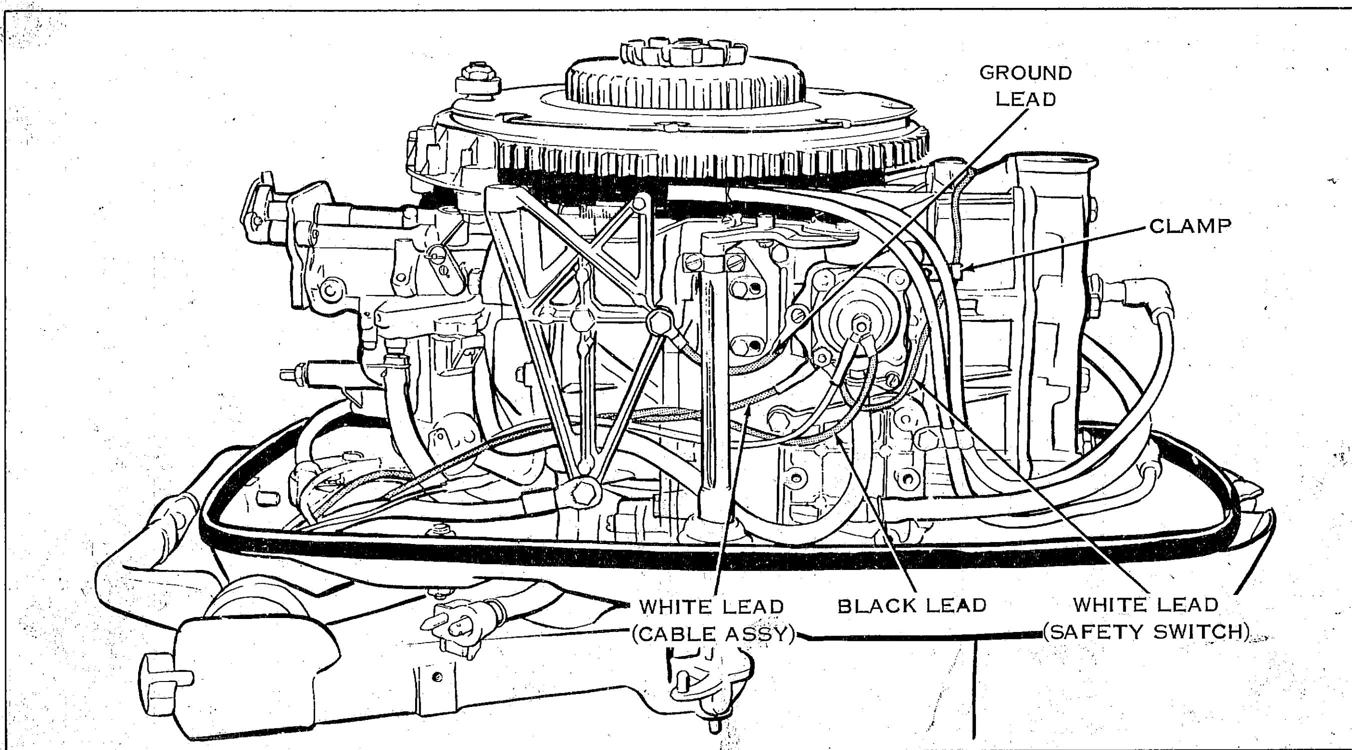


FIGURE 8

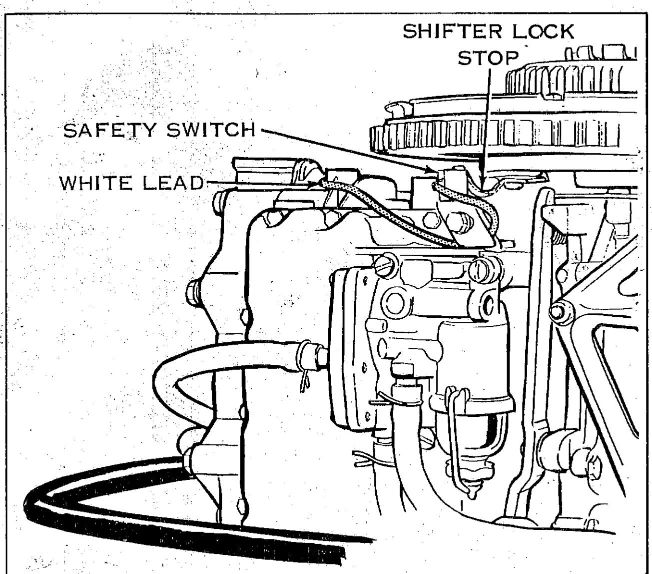


FIGURE 9

24. Attach long black lead (thin) to center terminal of cut-out switch. See Figure 8.

NOTE

The other lead from the magneto remains at it's original position (center terminal) of cut-out switch.

Connect white lead (thin) to cut-out switch as shown in Figure 8.

25. Attach safety switch to bracket with the two screws provided. Attach bracket and safety switch to exhaust cover with screw provided in kit. See Figure 9.

26. The safety switch mounting bracket attaching hole is elongated to allow safety switch plunger adjustment. Adjust as follows: Set throttle at minimum setting in neutral position. Push switch toward shifter lock stop until plunger makes a clicking noise. Tighten bracket.

27. Connect white lead (furnished with kit) to safety switch and cut-out switch. Secure to bypass cover with clamp provided. See Figures 8 and 9.

28. Attach ground strap provided in kit to the front attaching bolt of the port upper side mount and to the steering bracket with screw, nut and washer furnished in kit. See Figure 10. (Note - Make sure connections are free of paint and tightened securely.)

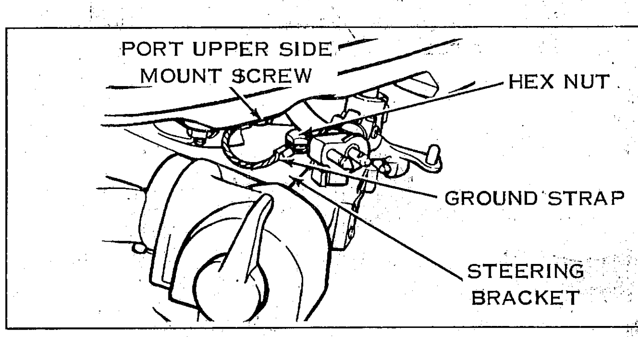


FIGURE 10

Junction Box and Motor Cable Installation

Install the junction box on boat transom, within dimensional limits shown on Figure 11. Make sure that placement will not interfere with other remote controls, such as steering, throttle, or gear shift cables. Also make sure that the junction box cover can be removed for inspection or motor removal. Remove junction box cover and fasten junction box base to the boat transom with three of the wood screws included in the kit. See Figure 12. If boat is metal, junction box should be well insulated from the boat. A piece of wood larger than the junction box and approximately 3/4 inch thick will make a sufficient insulator. Be sure junction box attaching screws do not go through wood block and make contact with the metal of the boat.

Plug motor cable assembly connector into junction box connector. See Figure 12. Red cable attaches to solenoid switch wing nut terminal and black cable to negative battery cable wing nut terminal. Note side of red and black cable terminal marked NUT SIDE. Connect cables and tighten wing nuts securely against NUT SIDE face.

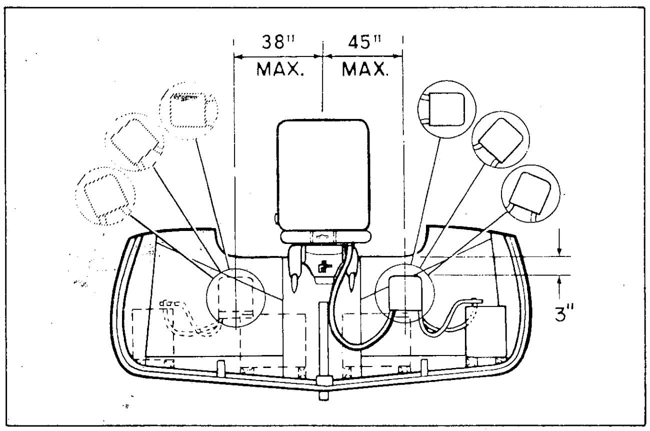


FIGURE 11

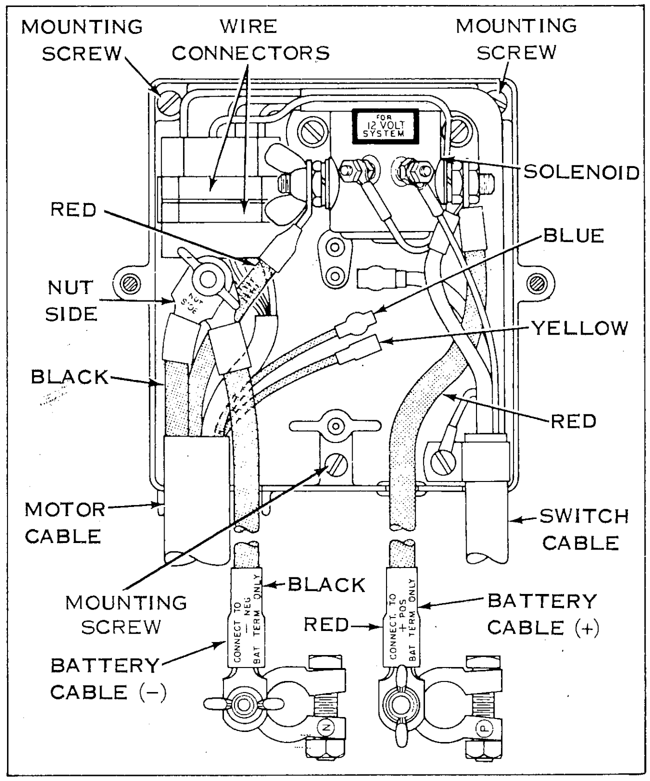


FIGURE 12

Switch and Switch Plate Installation

For installation on your boat dashboard, drill one 5/8 inch hole and one 13/16 inch hole with centers 1-1/2 inches apart, in position selected for installation, preferably near the steering wheel. These measurements must be adhered to exactly, to ensure proper fit. If desired, Figure 16 can be cut out and used as a template. It is full size. Be sure to drill exactly at center marks, as shown.

Remove knurled nuts from the switches. Insert choke switch through 5/8 inch hole and the key starter switch through 13/16 inch hole from the rear of dashboard. Be sure that the washer is between the hex head lock nut and the dashboard. Switch leads should point downward to protect switches from water. See Figure 14. Place switch plate over both the switches and secure to switches with knurled nuts. Tighten assembly securely to dashboard panel with hex head lock nuts. Assemble choke button cover onto switch. See Figure 13.

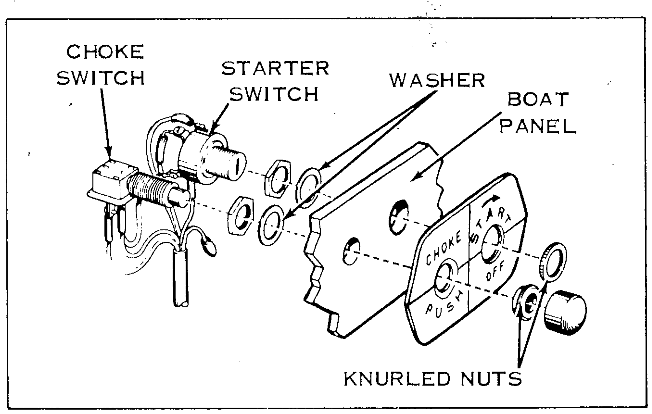


FIGURE 13

The switch cable should be neatly fastened to the boat in an out-of-the-way place. Necessary clamps are provided for this purpose. The cable may be

Switch and Switch Plate Installation

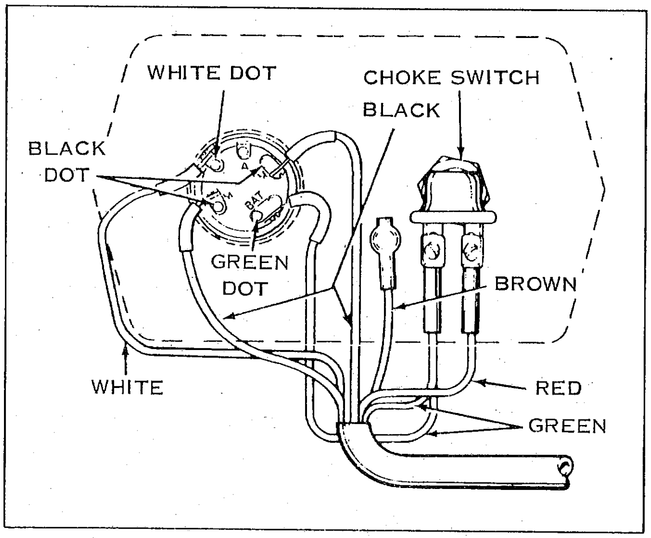


FIGURE 14

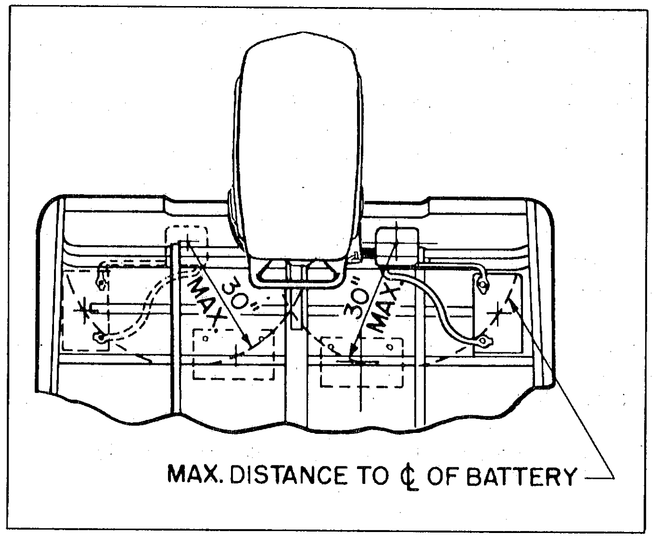


FIGURE 15

strung under the floor boards, since it resists possible damage by bilge water. Install the battery near the junction box. See Figure 15 for preferred locations and limiting dimensions. For mounting the battery, use a frame or marine type battery box securely fastened to the boat. A loose battery may shift in the boat, damaging battery or other equipment. Connect the positive battery lead (red) from the junction box to the positive (+) battery terminal. Attach negative lead (black) to negative (-) terminal on battery. See Figure 12. Tighten connections securely.

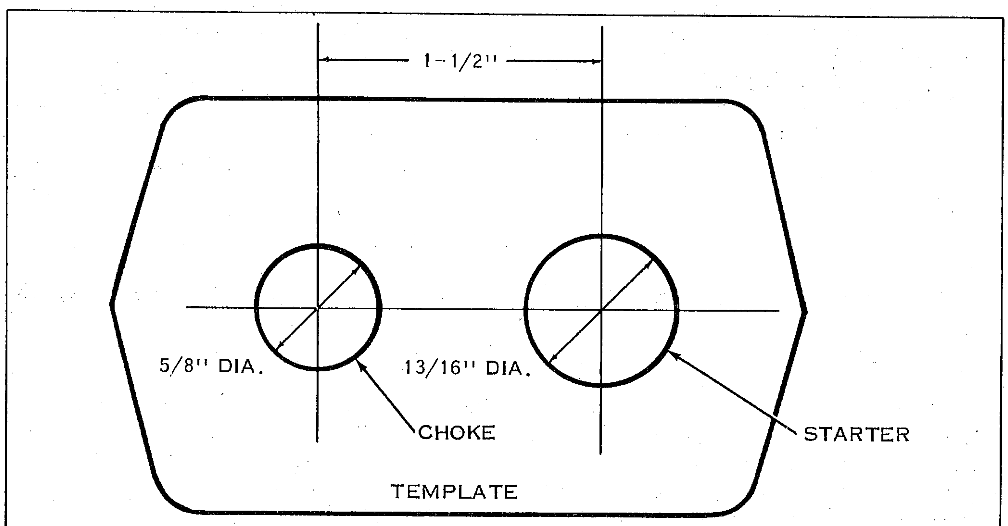


FIGURE 16

Twin Motor Installation

For twin motor installation, a special switch plate (with four switch holes) and two complete Electric Starting Kits are required. The switch plate is available as an accessory. For mounting the switch plate, two 5/8 inch holes and two 13/16 inch holes must be drilled in the dashboard, two holes 4 inches apart as with the single motor switch plate, and two more holes with centers 1-1/2 inch directly below the other two holes. A template is included with the accessory switch plate. Besides the extra holes, installation instructions are the same as for the single motor installation.

Twin Motor Installation

We recommend that a single standard 12 volt automotive type battery be used, connecting both negative (black) cables from the junction boxes to the negative (-) battery terminal, and both positive (red) cables from the junction boxes to the positive (+) battery terminal.

Refer to the lubrication and fuel instructions section of your Owners Manual for correct types and amount of fuel and oil before operating the motor.

How to Get Started

Operating Instructions

1. Place fuel tank in boat so it will not shift about. Then connect fuel tank hose. See your Owners Manual.

2. Prime the fuel system to get starting fuel into the carburetor. See your Owners Manual.

3. Check reverse lock to be sure it is in LOCK position.

4. Move speed control to SLOW position.

NOTE

It is possible to shift only when speed control is set at a safe speed for starting.

5. Move shift control to NEUTRAL position. DO NOT START IN GEAR.

6. Move speed control toward FAST until it stops.

7. Set carburetor speed control knobs as directed in Owners Manual for manual starting procedure.

8. While pressing choke button turn starter key to the right to start motor. If motor doesn't start, don't hold starter on for over 10 seconds. Let go momentarily and then try again. Reduce motor speed after starting. After motor starts, immediately return key to the (vertical) RUN position and release choke. Additional choking may be necessary to keep a cold motor running.

CAUTION

Never turn starter key to actuate starter when motor is running.

9. After motor has warmed up, REDUCE SPEED TO SHIFTING RANGE and then shift to FORWARD or REVERSE as desired. Regulate speed with speed control as desired.

10. Adjust carburetor high speed needle to best setting while under way at full forward speed.

NOTE

If satisfactory carburetor adjustments can not be achieved, refer to your Owners Manual for detailed instructions.

CAUTION

ALWAYS have someone at the helm (wheel) when making this adjustment. Reduce speed to slow and adjust slow speed control to best setting for idling. Further adjustments are seldom necessary.

11. To stop motor, retard speed, and turn key to OFF position.

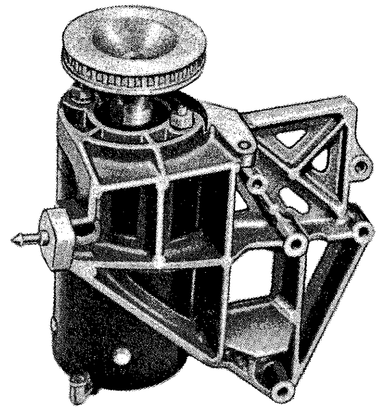
12. TO START MOTOR MANUALLY: Turn key to RUN position (vertical). Repeat step 1 through step 7. Pull choke knob all the way out. Pull starter handle gently until engaged then pull forcibly. Repeat until motor starts.

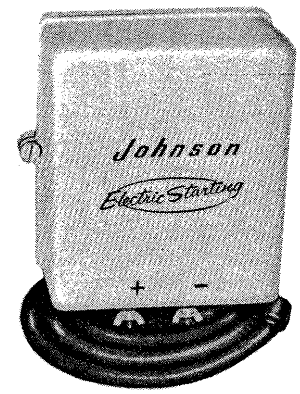
NOTES

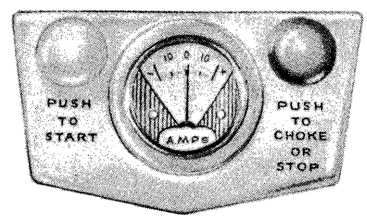
THE GENERATOR (POWER MASTER) KIT

A 12-volt generator for maintaining battery charge has been provided for all Models RDE and RJE-19 in a kit assembly which includes the generator, belt, a voltage regulator and required wiring. The above models are wired for the installation which is easily accomplished by adhering to instructions below.

Capacity of the generator is adjusted to a charging rate of 10 amperes at 12 volts. Ordinarily, little attention is required except that good electrical connections should be maintained at all times. An occasional inspection for corrosion (in salt water areas) and possibilities of loose connections is advisable. Be certain at all times of good ground connections — overheating of the wiring (or burning) usually can be laid to faulty ground connections — loose or corroded. Faulty ground or bonding may be caused by "paint" interference — paint at points of ground contact.







INSTALLATION AT MOTOR

1. Remove motor covers.

2. Remove manual starter assembly. Remove starter locking lever screw and spring, the two screws attaching compression relief valve actuating arm to compression relief valve actuating lever, and the three screws mounting starter to the powerhead and brackets. The manual starter can then be lifted off powerhead. See Figure 1.

3. Remove cut-out switch assembly from the port starter and silencer mounting bracket. First disconnect the lead wires from the cut-out switch, then remove the two mounting screws. It is not necessary to remove the hose, since the same cut-out switch must be mounted on the replacement bracket. See Figure 2.

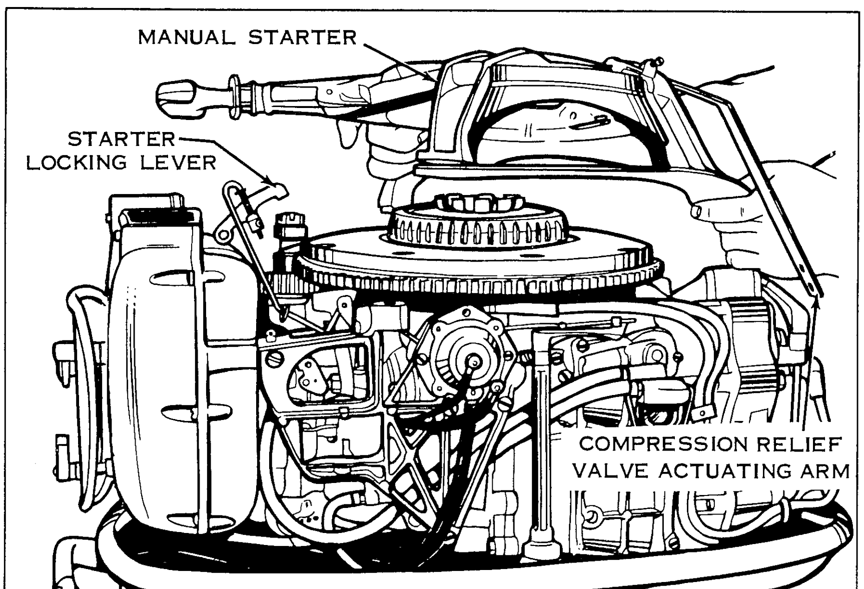


FIGURE 1

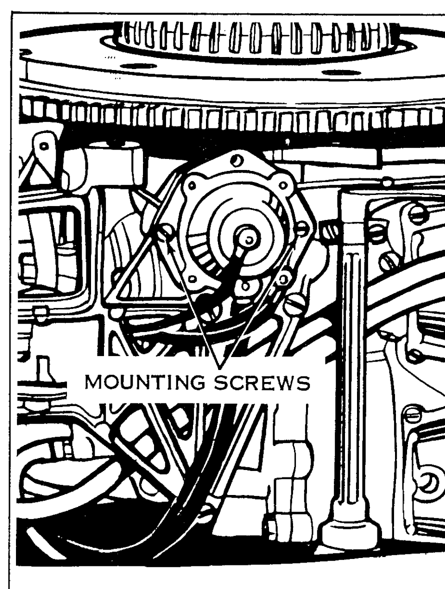


FIGURE 2

4. Remove the port starter and silencer mounting bracket. The bracket is attached with four screws.

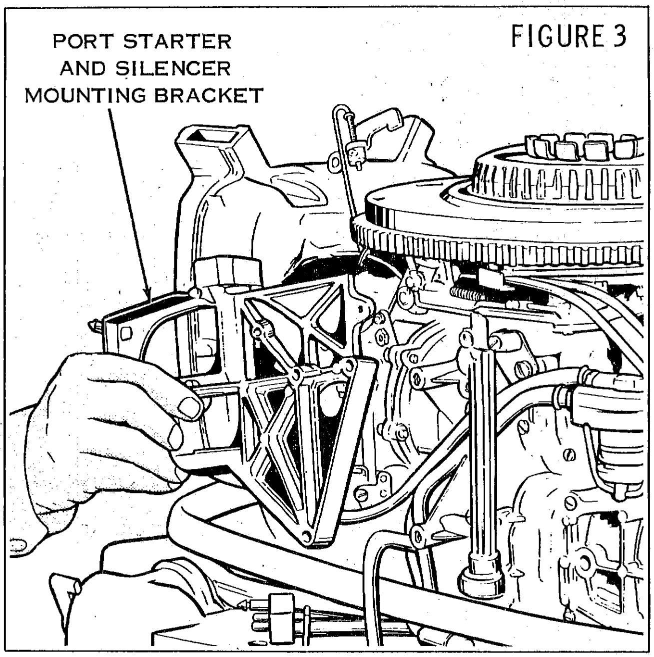


FIGURE 3

5. The powerhead is now ready for installation of the generator. See Figure 4.

6. There are two lead wires, fastened with a small metal band, in the front lower motor cover. The unattached terminals of these wires are covered with white insulation. Remove the metal band and insulators. See Figure 4.

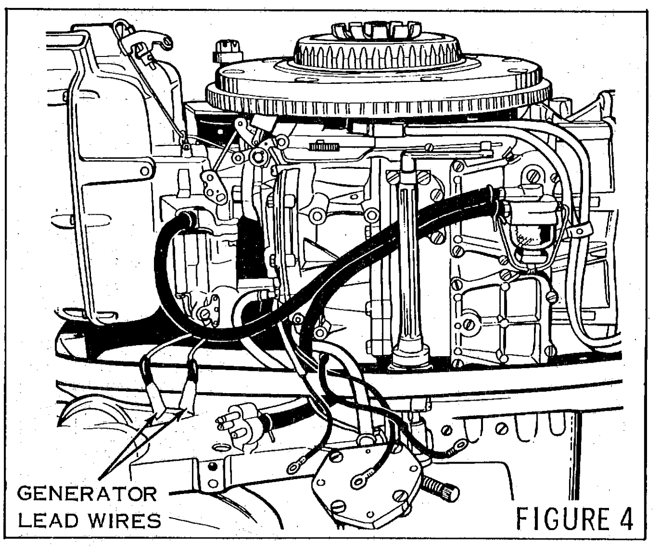


FIGURE 4

7. Attach these two terminals to posts on the bottom of the generator. The holes in the terminals are of different sizes so they cannot be assembled wrong. Yellow wire is to be attached to post near yellow dot. See Figure 5.

8. Attach the generator and bracket assembly to the powerhead. See Figure 6. Four hex head screws are included with the kit. Use these screws, three lockwashers from the original screws removed in Step 4, and one lockwasher enclosed with kit, to mount the generator bracket.

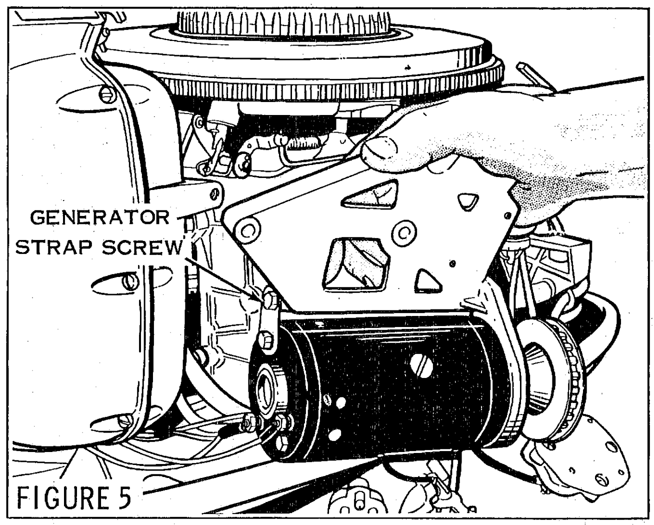


FIGURE 5

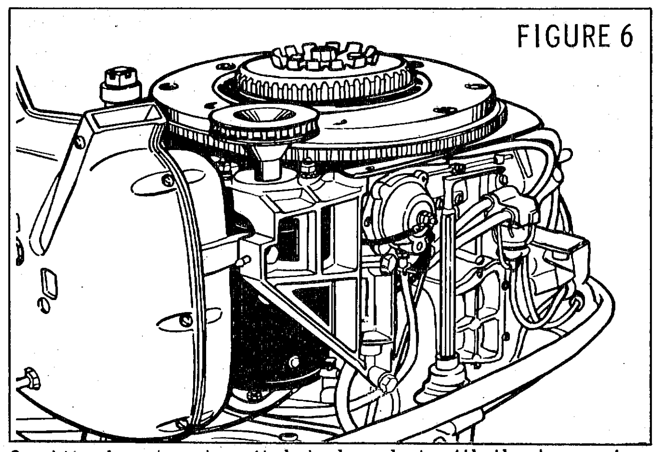


FIGURE 6

9. Attach cut-out switch to bracket with the two original screws. Replace lead wires on cut-out switch terminals. Be sure to attach lead wire from magneto to center terminal. Attach other two lead wires to side terminal. See Figure 2.

10. Using gauge provided with kit, align generator pulley vertically. See Figure 7. Place gauge in flat position on top of outer flywheel rim, then try to slide gauge under pulley flange. If the gauge will not slide under pulley flange, then it will be necessary to add spacer washers (provided with kit) under the generator pulley. Generator pulley can be removed from generator shaft by removing nut and lockwasher. When removing pulley, do not hammer on shaft, as damage may occur to bearing. This clearance is necessary to prevent belt from rubbing on flywheel flange.

11. Place belt on generator pulley first, then slide belt over pulley on flywheel. See Figure 8.

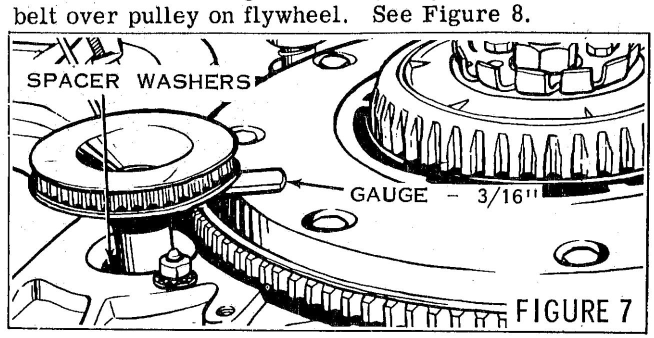


FIGURE 7

12. To adjust belt tension, the screw attaching generator strap to bracket (see Figure 5) and the two adjusting nuts on the generator bolts (see Figure 8) should be loosened. Then tighten screw and nuts finger tight, or just tight enough so generator can still be pivoted in the bracket by hand. The generator strap and one of the bolt holes in the bracket are slotted so that the complete generator can be pivoted to adjust belt slack. Pivot generator by hand to take up belt slack. Then check belt tension. Using finger pressure, belt should give from 1/4 to 3/8 inch. When tension is correct, first tighten the two nuts securely, then tighten screw on generator strap. DO NOT TIGHTEN STRAP SCREW BEFORE TIGHTENING NUTS. Recheck belt tension after tightening nuts and screw. If tension is not correct, excessive wear on generator bearings and belt can occur. **CAUTION: NEVER RUN BELT TOO TIGHT!**

13. Replace manual starter assembly on powerhead, reversing disassembly procedure. Be sure to check clearance gap in compression relief valve tappets (between end of valve stem and adjusting screw) after replacing starter. Gap should be 0.018 to 0.025 inches (cold motor). To adjust, loosen hex locknut, and turn adjusting screw in or out as necessary. Tighten locknut and recheck gap. Be sure to adjust both valves. Replace motor covers. The "at motor" installation of the generator is now complete.

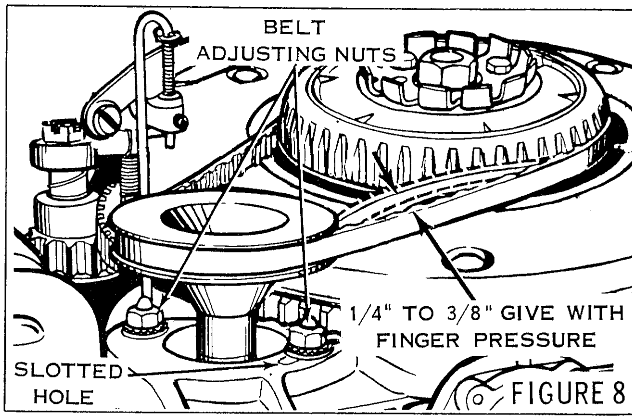


FIGURE 8

WIRING DIAGRAM

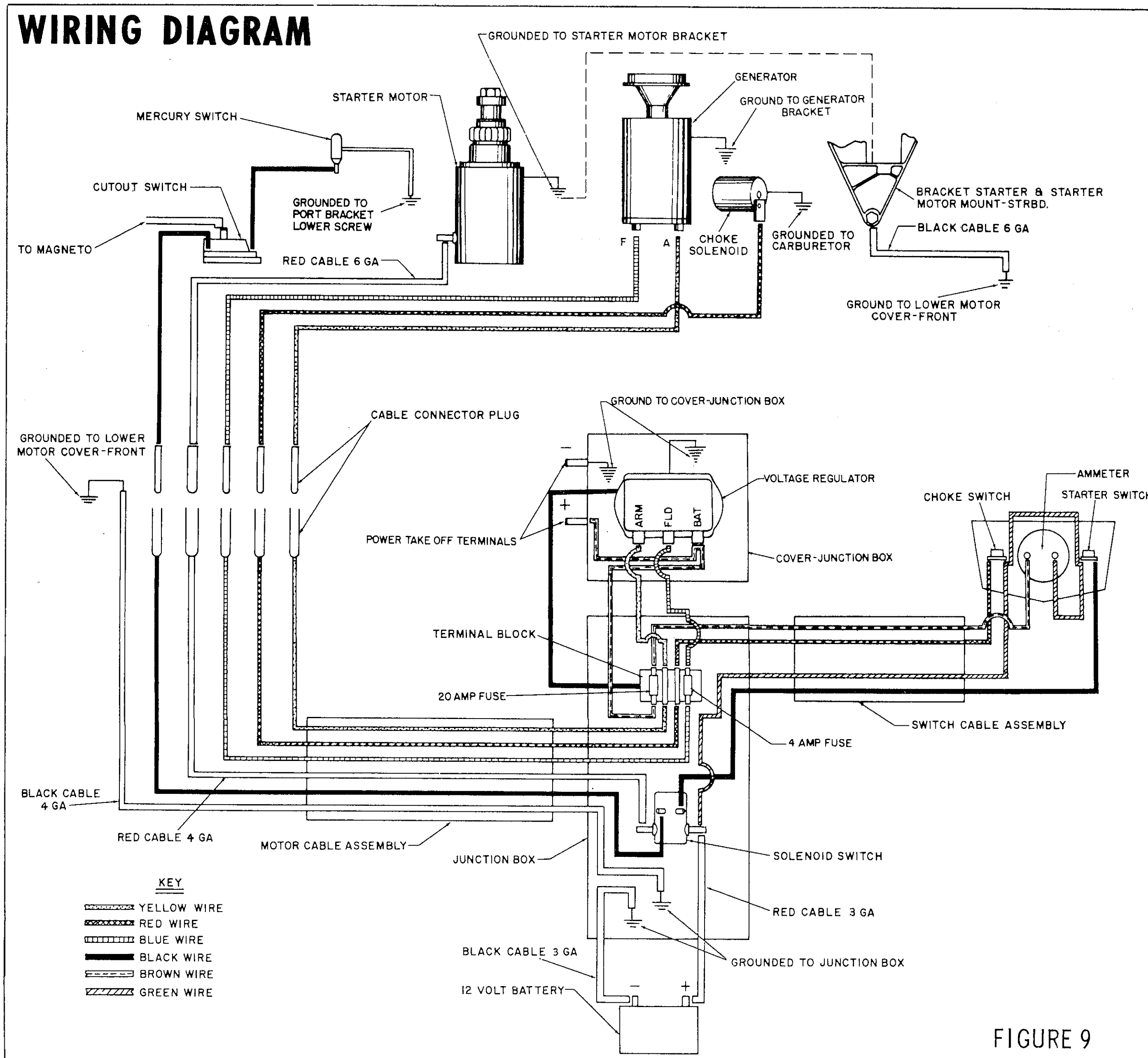


FIGURE 9

INSTALLATION AT JUNCTION BOX

WARNING

DISCONNECT BATTERY BEFORE MAKING INSTALLATION AT JUNCTION BOX.

1. Remove the original junction box cover. Cover is attached to junction box with two screws.

2. Place the two fuses supplied with the kit in the fuse clips on the terminal block. See Figure 10. The short fuse (4 amps) is placed in bottom fuse clip. This fuse will be in the field circuit of the generator and protects the generator from overload. The long fuse (20 amps) is placed in the top fuse clip. This fuse provides protection against overloading from the auxiliary electrical accessories.

3. Connect the slip-on connectors of the four wires in the generator junction box cover to the slip-on connectors on the terminal block in the junction box. See Figure 11. The wires and terminals are both color coded and number coded. Connect as follows:

Blue wire (No. 9) to terminal block connector (No. 9)
Yellow wire (No. 7) to terminal block connector (No. 7)
Brown wire (No. 4) to terminal block connector (No. 4)
Black wire (No. 6) to terminal block connector (No. 6)

Check to see that connections are properly made. Like colored wires should be opposite each other on the terminal block.

4. Fasten the generator junction box cover to the junction box, using the two screws which attached the original cover. Be sure screws are tight.

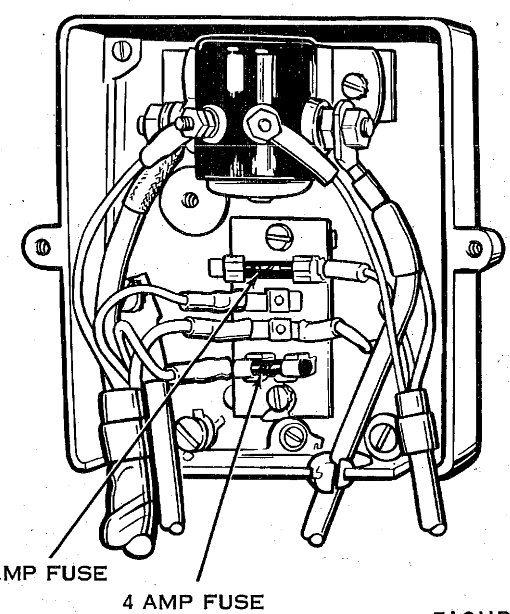


FIGURE 10

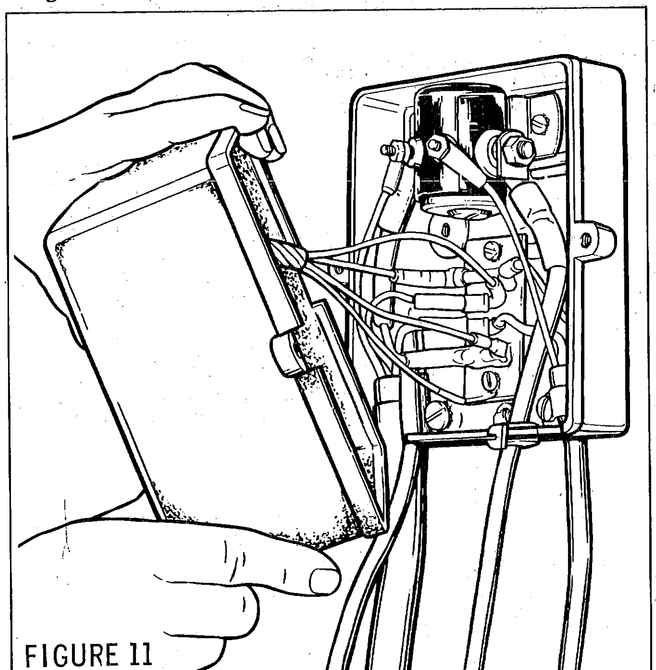


FIGURE 11

INSTALLATION AT SWITCH PLATE

1. Remove switches and switch plate from boat dashboard. For removal, loosen switch lock nuts at rear of dashboard. Then take rubber switch button covers off and remove knurled nuts from front of switches. Switches and switch plate can then be removed. IT IS NOT NECESSARY TO REMOVE WIRES FROM SWITCHES. See Figure 12.

2. The ammeter will be mounted on the switch plate in place of the medallion. Place the switch plate on the dashboard, exactly in its original position with switch holes coinciding. Use the center hole on the switch plate (medallion hole) as a template and draw a circle on the dashboard. Locate the center of this hole.

3. Cut out a hole with 2-1/4 inch diameter in the dashboard for the ammeter, using the center marked as the center of the hole.

4. Place the spring ring furnished with the kit on the ammeter. This ring must be in place to prevent the ammeter from slipping through the hole in the dashboard, and hold it tightly in place.

5. Insert the back side of the ammeter, with terminals and wire, through the hole in the dashboard from the front side. Spring ring will be between the front ammeter flange and the dashboard. See Figure 12.

6. Place the switch plate over the ammeter, so that the ammeter face protrudes through the large center hole. Insert switches through the holes in the dashboard and switch plate. Be sure washers are between lock nuts and boat panel. Fasten switches at the front of the switch plate with the knurled nuts. Tighten lock nuts on switches at the rear of dashboard to secure the assembly. Place the rubber covers over the switches. See Figure 12.

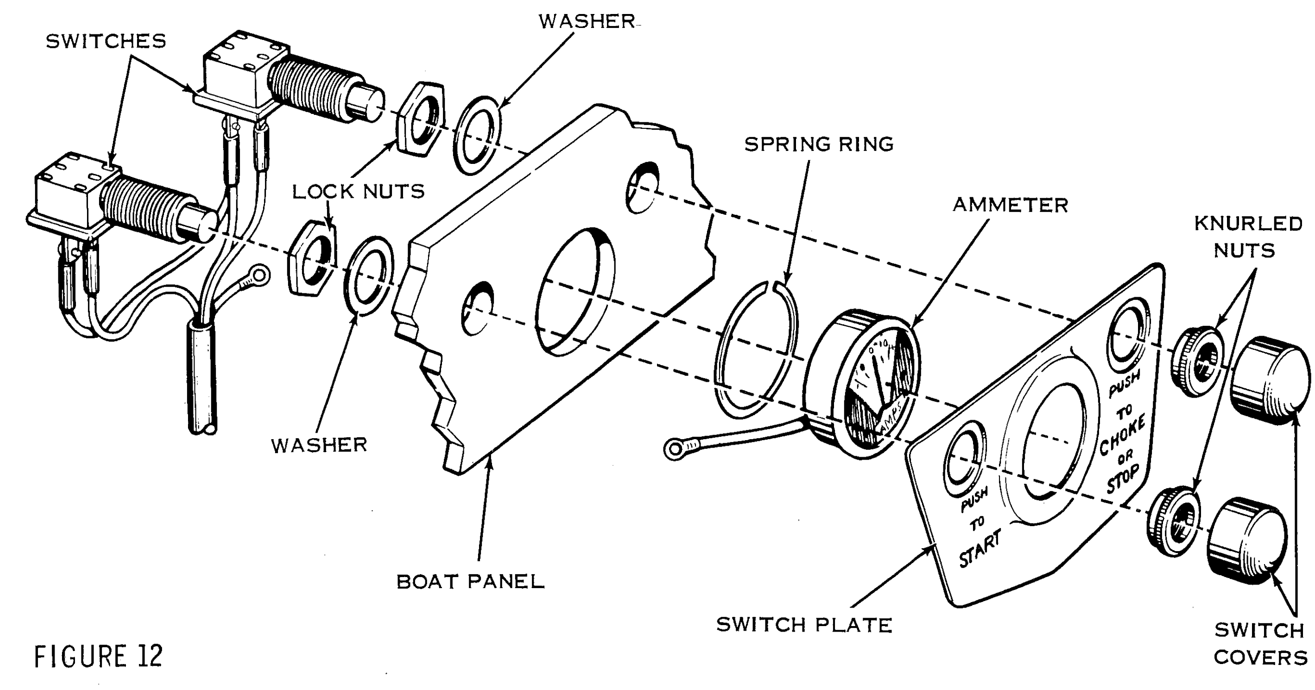


FIGURE 12

7. There is a green wire on one ammeter terminal as received in the kit. Connect the other end of this wire to the terminal of the switch with the single green wire (starter switch). Both terminals must be on one screw. See Figure 13.

8. Remove the insulating cover from the unused brown wire on the switch to junction box cable. Connect the wire to the vacant ammeter terminal post. See Figure 13.

9. The generator kit is now completely installed.

10. Recheck all wiring to be sure of positive contacts and tight connections.

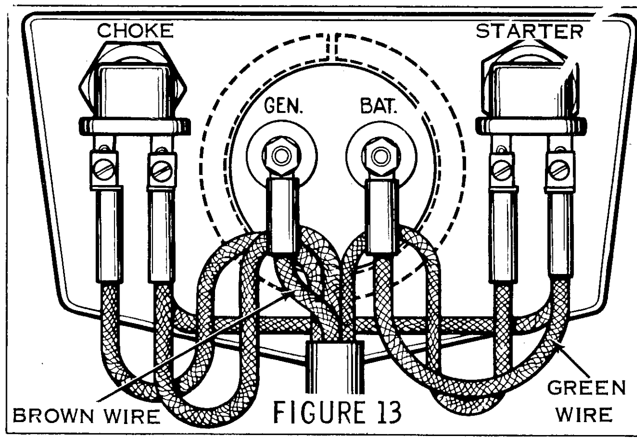


FIGURE 13

AUXILIARY POWER REQUIREMENTS

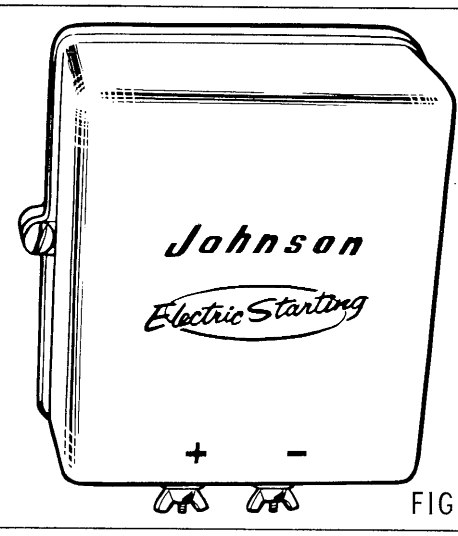


FIGURE 14

WARNING

All accessories or auxiliary 12 volt power requirements must be connected to the two power take-off terminals with wing nuts located at bottom of junction box. See Figure 14. This power source has a 20 ampere fuse to protect generator circuits and accessories. Also power taken from this source only will register at the ammeter and indicate the load being discharged from or charged into the battery.

The two power take-off terminals are marked positive (+) and negative (-). When connecting any accessory that has a ground connection, the ground connection wire should be attached to the negative (-) terminal at the junction box. This is to avoid the possibility of electrolysis problems.

GENERATOR CARE

Top performance of the generator will result if a few simple precautions are heeded.

1. The current and voltage regulator seal must be kept intact or the warranty on the generator kit is void.

2. Never tamper with blue wire on the regulator. If this wire is shorted out, it will result in a burned out regulator.

3. Oil the generator every 100 hours of operation or every six months. Put a few drops of oil in the oil cup at bottom of generator. Do not over oil.

4. If ammeter shows no charge or discharge at operating speeds (Engine R.P.M. of 1500 or more) this indicates that the 4 ampere fuse (short fuse) or the 20 ampere fuse (long fuse) is blown or both may be blown. Recheck wiring for loose connections before replacing fuse.

5. The rated capacity of the generator is 10 amps. Therefore the electrical accessory ampere load should not exceed 10 amps or current will be drawn from the battery in addition to the generator, resulting in a run-down battery. To calculate ampere load use the following formula:

Amperes = Watts/Volts

Voltage will always be 12. Accessories will usually be rated in watts. If candlepower is used, remember that one candlepower is approximately equal to one watt.

Example: A boat has running lights, requiring 8 watts, auxiliary lights, requiring 10 watts, and a radio, requiring 30 watts.

Amperes = 48 Watts/12 Volts = 4 Amperes

This load will be satisfactory, since it does not exceed 10 amperes.

6. The ammeter should show a charge when the motor is running at 2000 rpm or better, with no accessories drawing current. With a fully charged battery, approximately two amps will be generated. For a dead battery, approximately 10 amps will be generated.

TWIN MOTOR INSTALLATION

Only one generator kit is required for a twin motor installation. Installation at motor and installation at junction box will be the same as for a single motor installation. Be sure to install the generator junction box cover on the junction box for the motor on which the generator is mounted. Installation at the switch plate is essentially the same as for the single motor installation. Be sure that installation is made on the set of switches and cable connecting to the junction box with the regulator. Connect the green wire on the ammeter to the terminal on the switch with the single green wire (starter switch). Remove the insulating cover from the unused brown wire on the switch to junction box cable. Connect the wire to the vacant ammeter terminal post. See Figure 15.

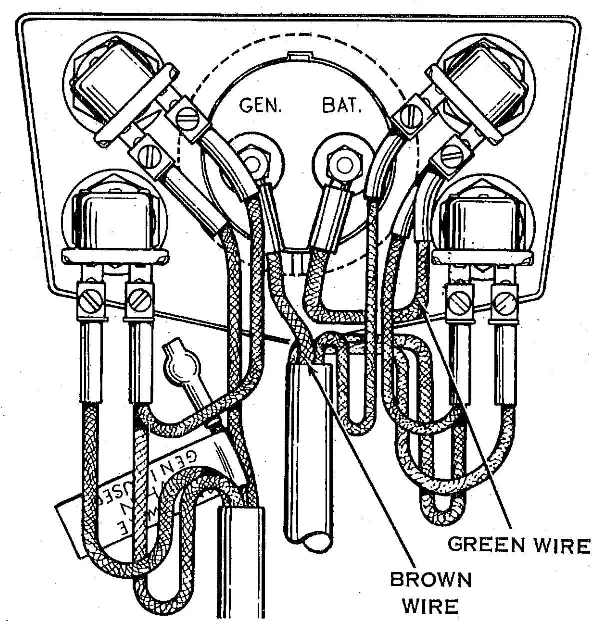
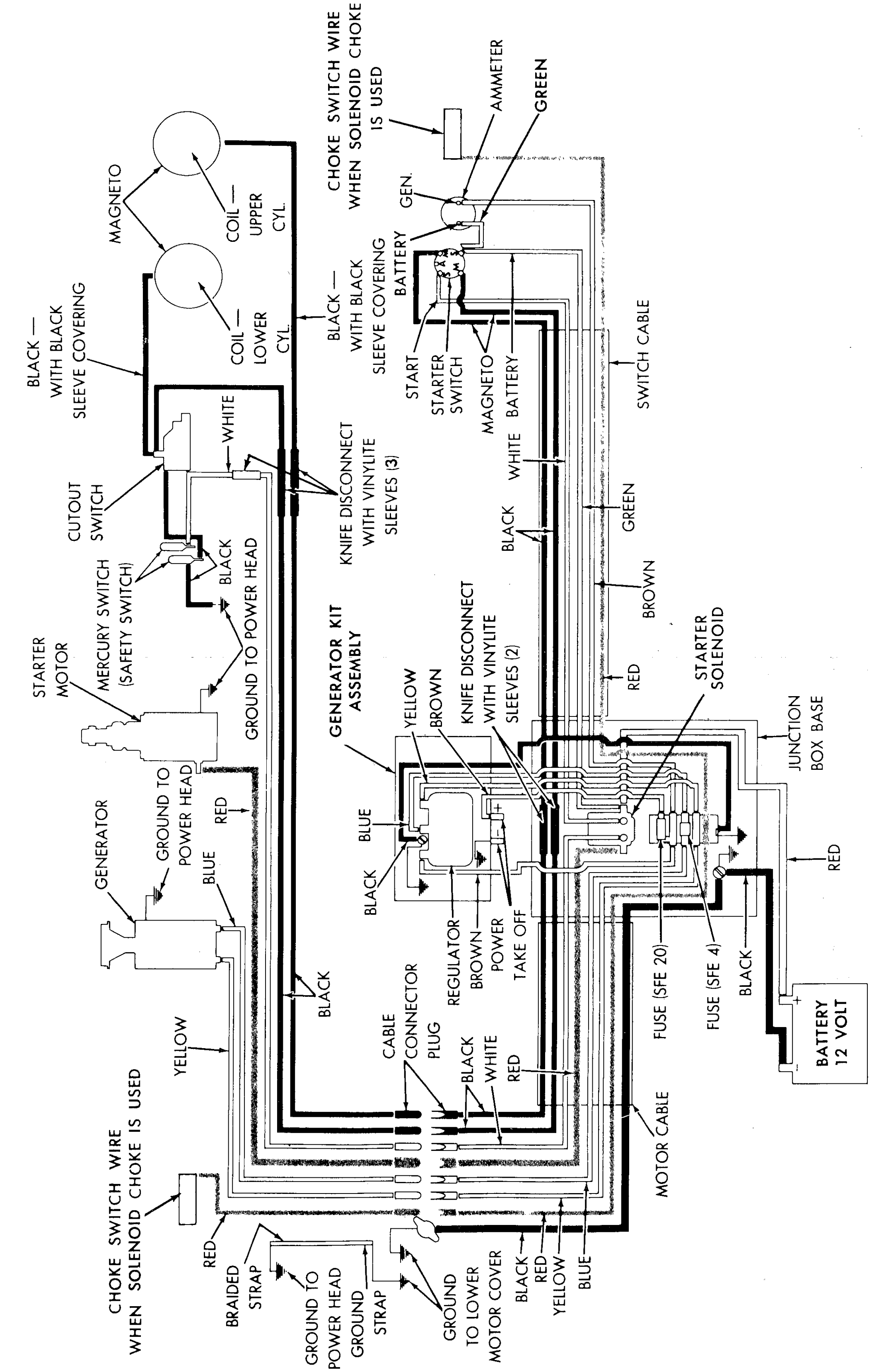


FIGURE 15

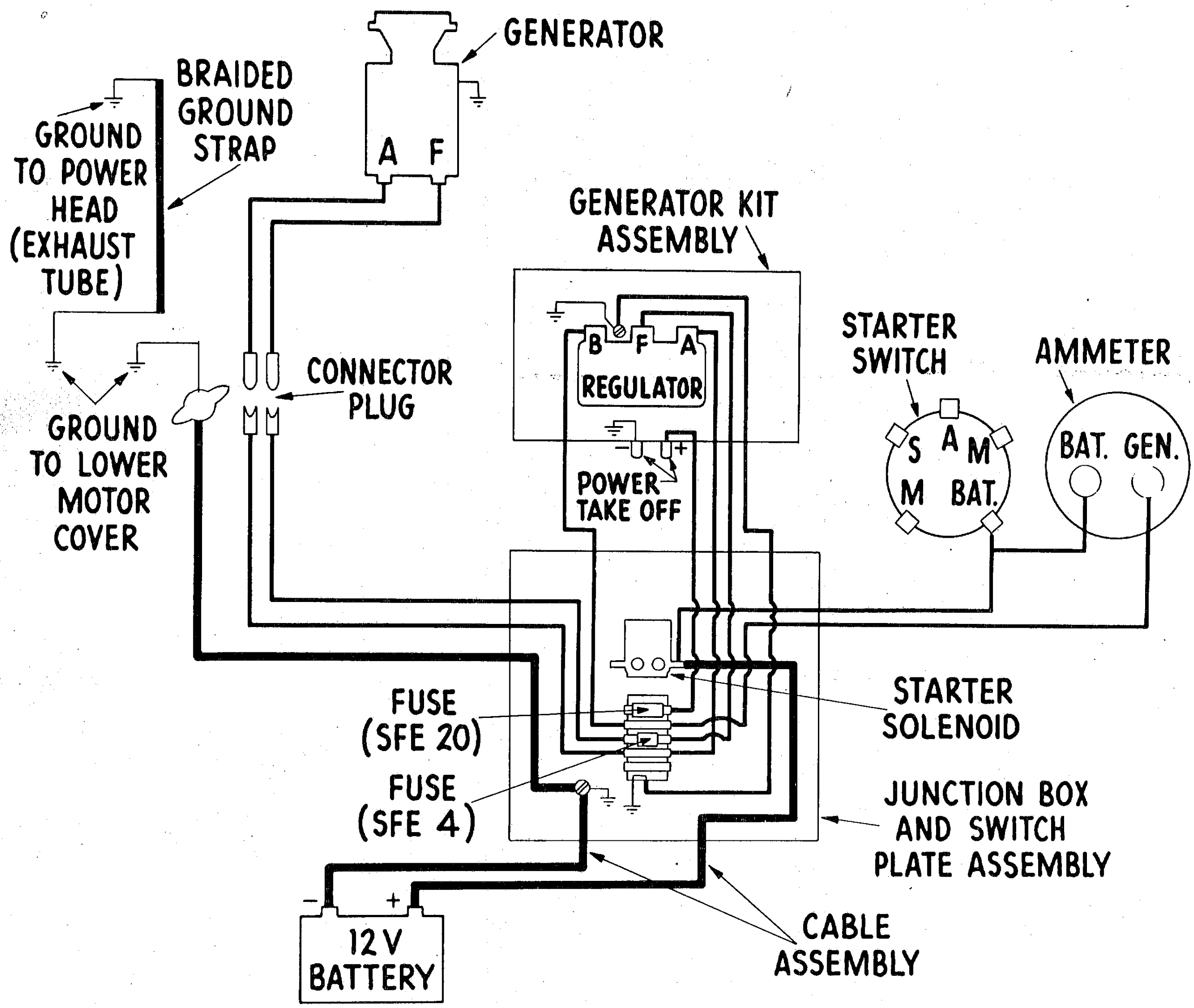
BATTERY SPECIFICATIONS

For best all-around battery service for your 12-volt starter and generator, we recommend a battery having the following characteristics:

12 volt, 60 ampere hour, or better, with a minimum of 5.2 minutes cold starting capacity at 150 amperes discharge, zero degrees fahrenheit and a 5 second voltage rating of 9.1 volts.



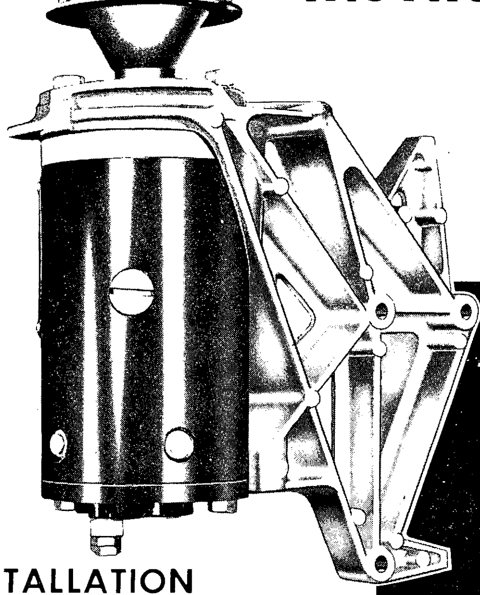
WIRING DIAGRAM MODEL RDS-22 (40 H.P.) AND 23 – GENERATOR INSTALLED

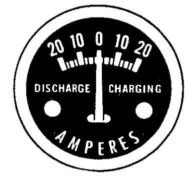


THE CHARGING CIRCUIT

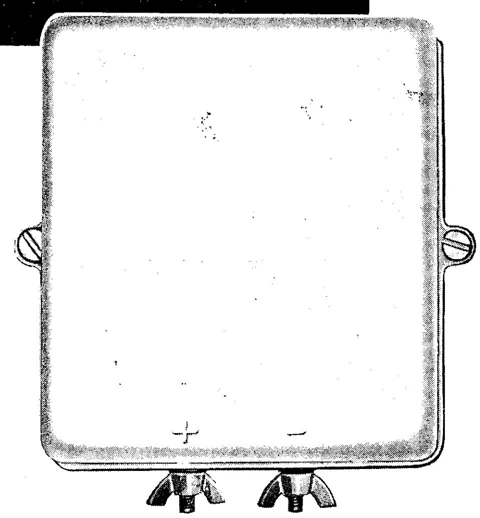
INSTALLATION INSTRUCTIONS

GENERATOR KIT





28, 35 & 40 h.p. Models



INSTALLATION AT MOTOR

1. Remove motor hood.

NOTE: - Ignore reference to auto-choke and compression relief valve actuating mechanism where motor is not so equipped.

2. Remove manual starter assembly: Remove starter lock-out lever screw and spring, the two screws attaching compression relief valve actuating arm to compression relief valve actuating lever, and the two screws and lifting ring mounting starter to the power-head and brackets. Also remove the four hose straps and the hose from the automatic choke to the port side of the cylinder. This hose will be replaced with a new hose supplied with the kit. The starter can then be lifted off power head. See Figure 1.

3. Remove ring gear guard from starter motor mount bracket and port starter mounting bracket. Save the screws for mounting ring gear guard furnished with kit. Remove the port starter mounting bracket. The bracket is attached with three screws. See Figure 2.

Figure 1

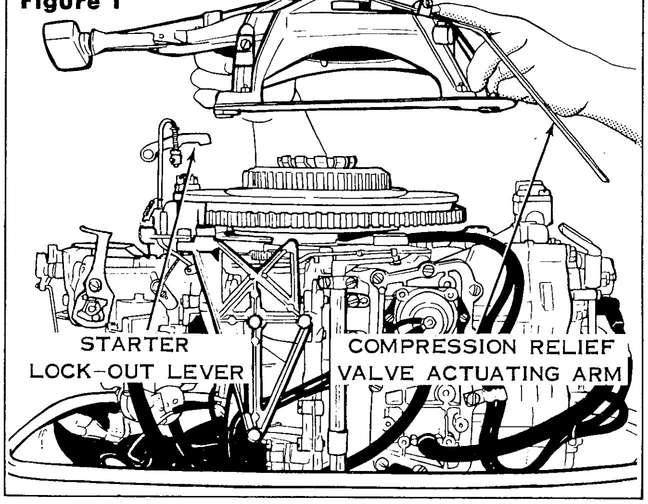
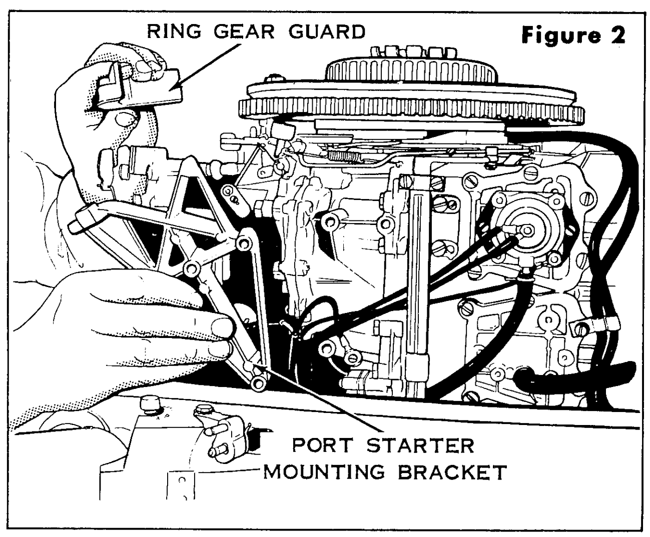


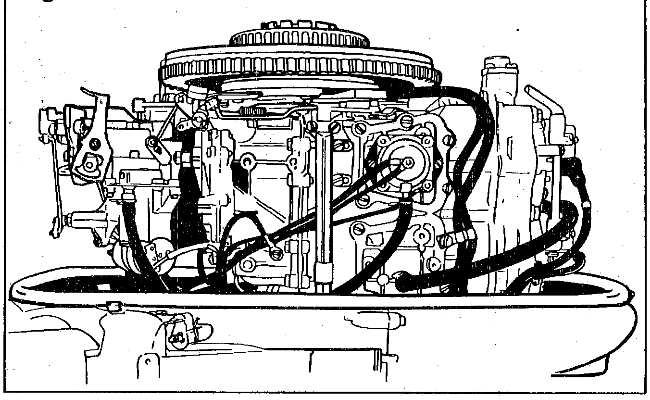
Figure 2



4. The powerhead is now ready for installation of the generator. See Figure 3.

5. There are lead wires, fastened with a small metal band, in the front lower motor cover. The unattached terminals of these wires are covered with white insulation. Remove the metal band and insulators from the blue and yellow wires.

Figure 3

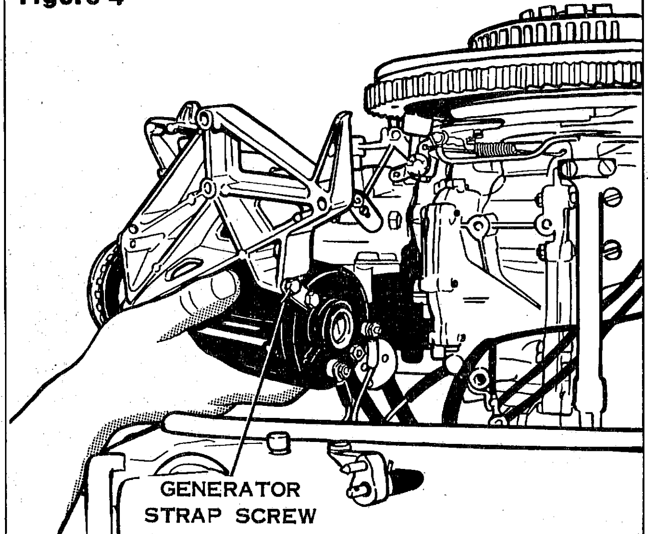


6. Attach these two terminals to posts on the bottom of the generator. The holes in the terminals are of different sizes and correspond to the terminal studs on the generator. This is to prevent incorrect assembly. Terminal post with yellow dot indicates position of yellow wire. See Figure 4.

7. Attach the generator and bracket assembly to the powerhead. See Figure 5. Three studs are included with the kit. Use these studs along with lockwashers and nuts provided to mount the generator bracket. (Do not tighten nuts yet.) Be sure to reassemble loose terminal to the bottom screw (see Figure 5).

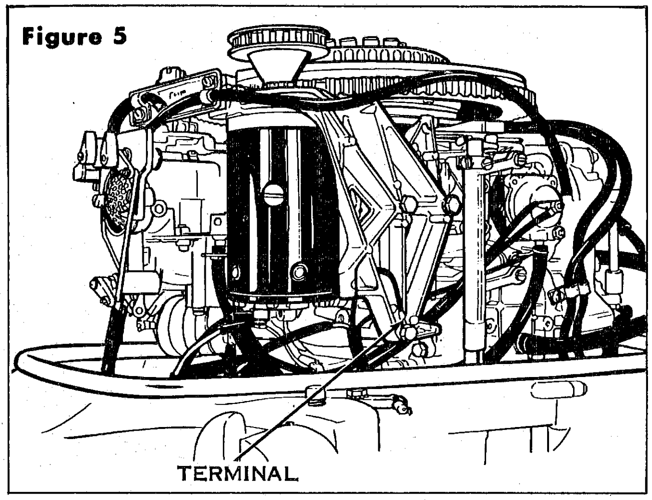
8. Push generator bracket toward rear of motor until the stops on the back of the generator bracket make contact with the two machined pads on the cylinder. Tighten mounting bracket nuts.

Figure 4



9. Attach new hose to automatic choke and port side of cylinder with hose clamps. Attach ring gear guard furnished with generator kit to the starter motor mounting bracket and the generator bracket. Use screws removed from standard guard in Step 3. Also attach both hoses to front of guard with the hose straps originally removed. See Figure 5.

Figure 5



10. Place belt on generator pulley first, then slide belt over pulley on flywheel. See Figure 6.

11. To adjust belt tension: the screw attaching generator strap to bracket (see Figure 4) and the two adjusting nuts on the generator bolts (see Figure 7) should be loosened. Then tighten screw and nuts finger tight, or just tight enough so generator can still be pivoted in the bracket by hand. The generator strap and one of the bolt holes in the bracket are slotted so that the complete generator can be pivoted to adjust belt slack. Pivot generator by hand to take up belt slack. Then check belt tension. Using finger pressure, belt should give from 1/4 to 3/8 inch. See Figure 7.

When tension is correct, first tighten the two nuts securely, (use 70 to 80 in./lbs. torque) then tighten screw on generator strap. DO NOT TIGHTEN STRAP SCREW BEFORE TIGHTENING NUTS. Recheck belt tension after tightening nuts and screw. If tension is not correct, excessive wear on generator bearings and belt can occur. CAUTION: NEVER RUN BELT TOO TIGHT!

Figure 6

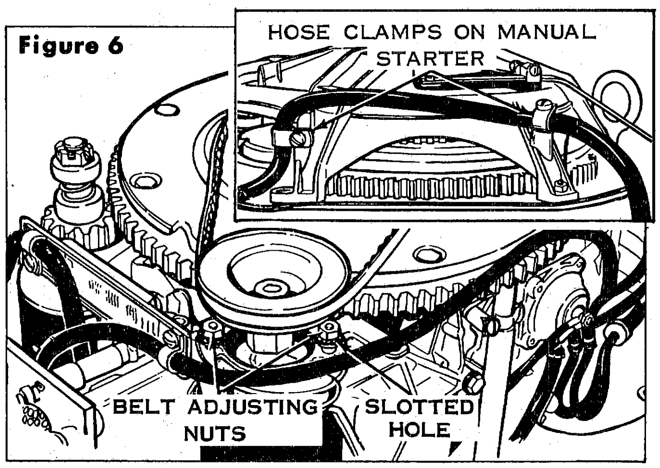
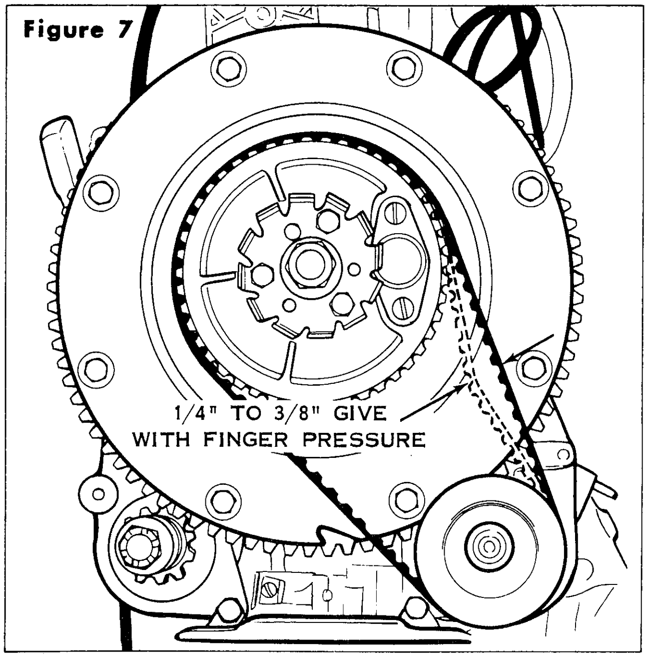


Figure 7



12. Replace manual starter assembly on powerhead, reversing disassembly procedure. Attach automatic choke hose to bosses on starter legs with two hose straps originally removed. The hose should have a loop formed in it so that it will go around the generator pulley without touching it. Be sure to check clearance gap in compression relief valve tappets (between end of valve stem and adjusting screw) after replacing starter. Gap should be 0.018 to 0.025 inches (cold motor). See Figure 8. To adjust, loosen hex locknut, and turn adjusting screw in or out as necessary. Tighten locknut and recheck gap. Be sure to adjust both valves. Replace motor covers.

Figure 8

INSTALLATION AT JUNCTION BOX

WARNING

Disconnect Battery Before Making Installation at Junction Box. Junction Box Must Be Mounted in Vertical Plane. Voltage Regulator is Designed to Operate in This Position.

PROCEDURE FOR MODELS WITH CABLE CONNECTOR AT MOTOR:

1. Remove the original junction box cover.

2. Place the two fuses supplied with the kit in the fuse clips on the terminal block. See Figure 9. The short fuse (4 amps) is placed in bottom fuse clip. This fuse will be in the field circuit of the generator and protects the generator from overload. The long fuse (20 amps) is placed in the top fuse clip. This fuse provides protection against overloading from the auxiliary electrical accessories.

3. Connect the slip-on connectors of the five wires in the generator junction box cover to the slip-on connectors on the terminal block in the junction box. See Figure 10. The wires and terminals are both color coded and number coded. Connect as follows:

Black wire (No. 1) to terminal block connector (No. 1)
Brown wire (No. 5) to terminal block connector (No. 5)
Brown wire (No. 6) to terminal block connector (No. 6)
Blue wire (No. 8) to terminal block connector (No. 8)
Yellow wire (No. 9) to terminal block connector (No. 9)

Check to see that connections are properly made. Like colored wires should be opposite each other on the terminal block.

4. Fasten the generator junction box cover to the junction box, using the two screws which attached the original cover. Be sure screws are tight.

Figure 9

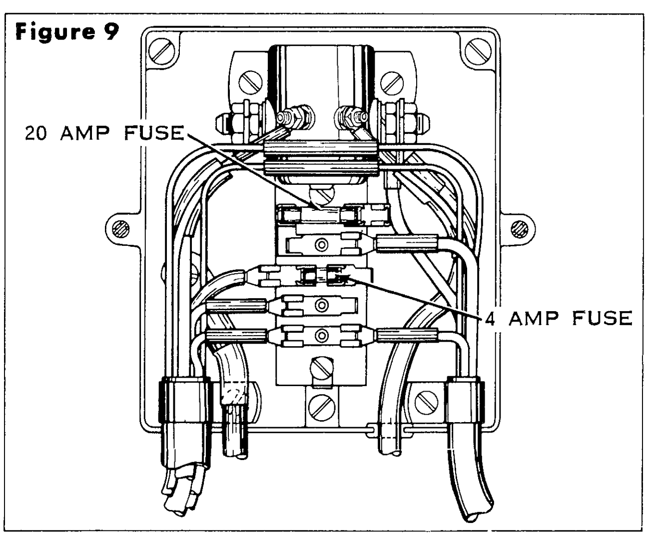
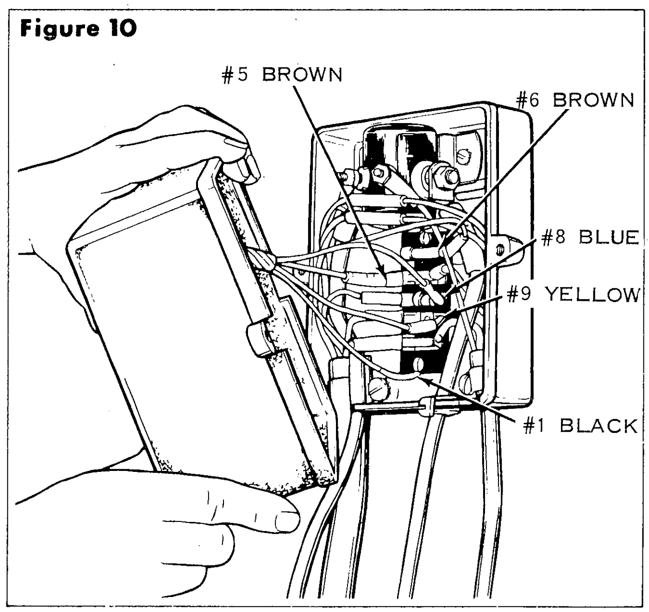


Figure 10



PROCEDURE FOR MODELS WITH CABLE CONNECTOR IN JUNCTION BOX

1. Remove the original junction box cover.

2. Install terminal block with No. 6 terminal end at solenoid. Place the two fuses supplied with the kit in the fuse clips on the terminal block. See Figure 11. The short fuse (4 amps) is placed in bottom fuse clip. This fuse will be in the field circuit of the generator and protects the generator from overload. The long fuse (20 amps) is placed in the top fuse clip. This fuse provides protection against overloading from the auxiliary electrical accessories.

3. Connect the slip-on connectors of the eight wires in the generator junction box cover to the slip-on connectors on the terminal block in the junction box. See Figure 12. The wires and terminals are both color coded and number coded. Connect as follows:

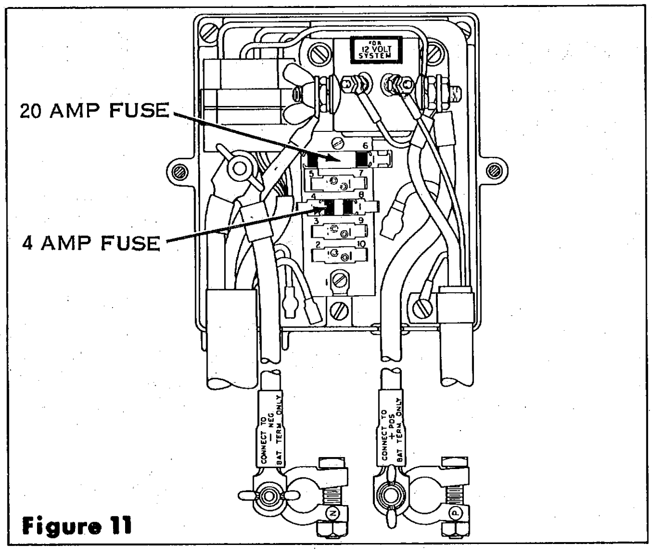


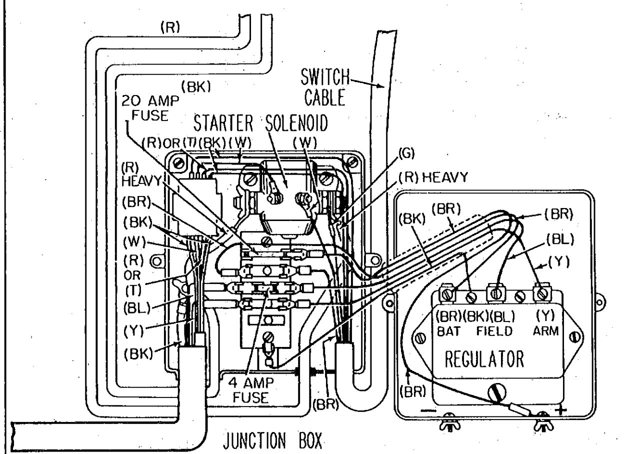
Figure 11

Black wire (No. 1) to terminal block connector (No. 1)
Yellow wire (No. 3) to terminal block connector (No. 3)
Blue wire (No. 4) to terminal block connector (No. 4)
Brown wire (No. 5) to terminal block connector (No. 5)
Brown wire (No. 6) to terminal block connector (No. 6)
Brown wire (No. 7) to terminal block connector (No. 7)
Blue wire (No. 8) to terminal block connector (No. 8)
Yellow wire (No. 9) to terminal block connector (No. 9)

Check to see that connections are properly made. Like colored wires should be opposite each other on the terminal block.

4. Fasten the generator junction box cover to the junction box, using the two thumb screws which are attached to the new cover. Be sure screws are tight.

Figure 12



INSTALLATION OF AMMETER

REFER TO ILLUSTRATION THAT APPLIES TO YOUR MOTOR

1. The ammeter must be mounted near the location of the starter switch plate on the dashboard. Be sure that the position selected is near enough so that the connecting leads will reach. See Figure 14, 15 and 16.

2. Cut a hole with 2-1/16 inch diameter in the position selected.

3. Remove the green wire and insulating washer and retaining bracket from the ammeter. On this installation, the spring ring (shown in Figure 17) is normally not used.

4. Insert the ammeter through hole in the dashboard from the front side. Install the retaining bracket and insulating washer, and reconnect the green wire to the ammeter terminal (marked BAT). Make sure the retaining bracket legs are bearing against the dashboard surface and tighten securely. See Figure 13.

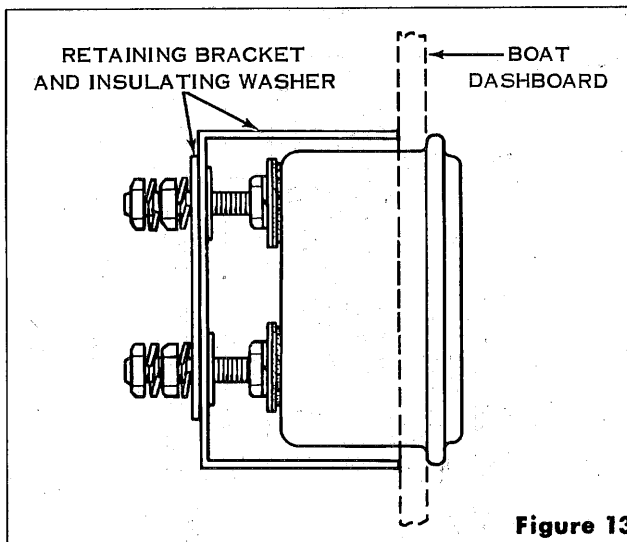


Figure 13

NOTE

Be sure GEN and BAT markings on insulating washer correspond to similar markings on ammeter case.

NOTE

On boats with unusually thick dashboards, the legs of the retaining bracket may have to be cut down slightly to permit assembly of the nuts, washers and ammeter leads.

5. Connect the loose end of the green wire to the terminal of the starter switch which is marked BAT. Two terminals will then be on one screw. See Figure 14.

6. Remove the insulating cover from the unused brown wire on the starter switch to junction box cable. Connect this wire to the vacant ammeter terminal post (marked GEN). See Figure 14.

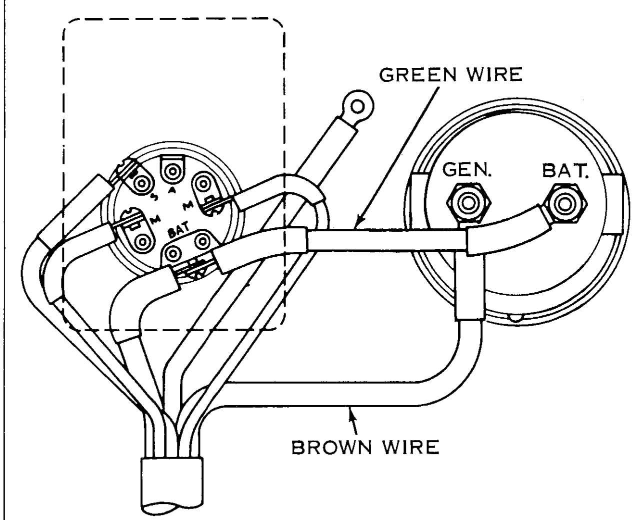


Figure 14

MOTOR WITH AUTOMATIC CHOKE

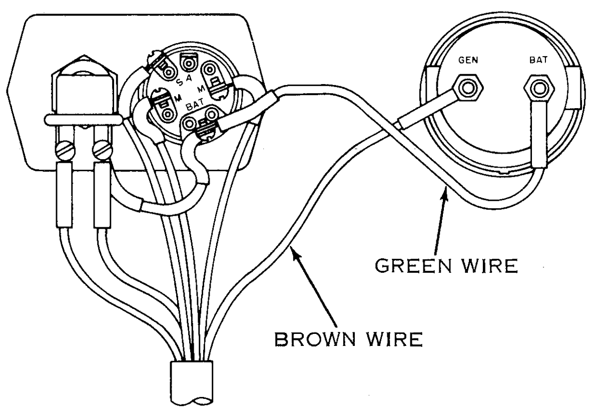


Figure 15

MOTOR WITH PUSH BUTTON CHOKE

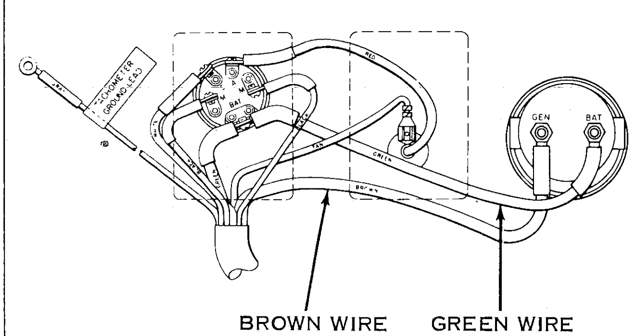


Figure 16

MOTOR WITH AUTOMATIC CHOKE AND HEAT INDICATOR

7. The generator kit is now completely installed. Recheck all wiring to be sure of positive contacts and tight connections. Reconnect the battery leads.

NOTE

If the dashboard opening for the ammeter should accidentally have been made too large, the spring ring may be used between the ammeter and dashboard.

INSTALLATION PROCEDURE FOR MOTORS HAVING BOTH STARTER AND CHOKE SWITCH PLATE (can also be used with twin engine switch plate):

1. Remove switches and switch plate from boat dashboard (if already assembled). For removal, loosen switch lock nuts at rear of dashboard. Then take rubber switch button cover off choke switch and remove knurled nuts from front of switches. Switches and switch plate can then be removed. It is NOT NECESSARY TO REMOVE WIRES FROM SWITCHES. See Figure 17.

2. The ammeter will be mounted on the switch plate in place of the medallion. Place the switch plate on the dashboard, exactly in its original position with switch holes coinciding. Use the center hole on the switch plate (medallion hole) as a template and draw a circle on the dashboard. Locate the center of this hole.

3. Cut out a hole with 2-1/4 inch diameter in the dashboard for the ammeter, using the center marked as the center of the hole.

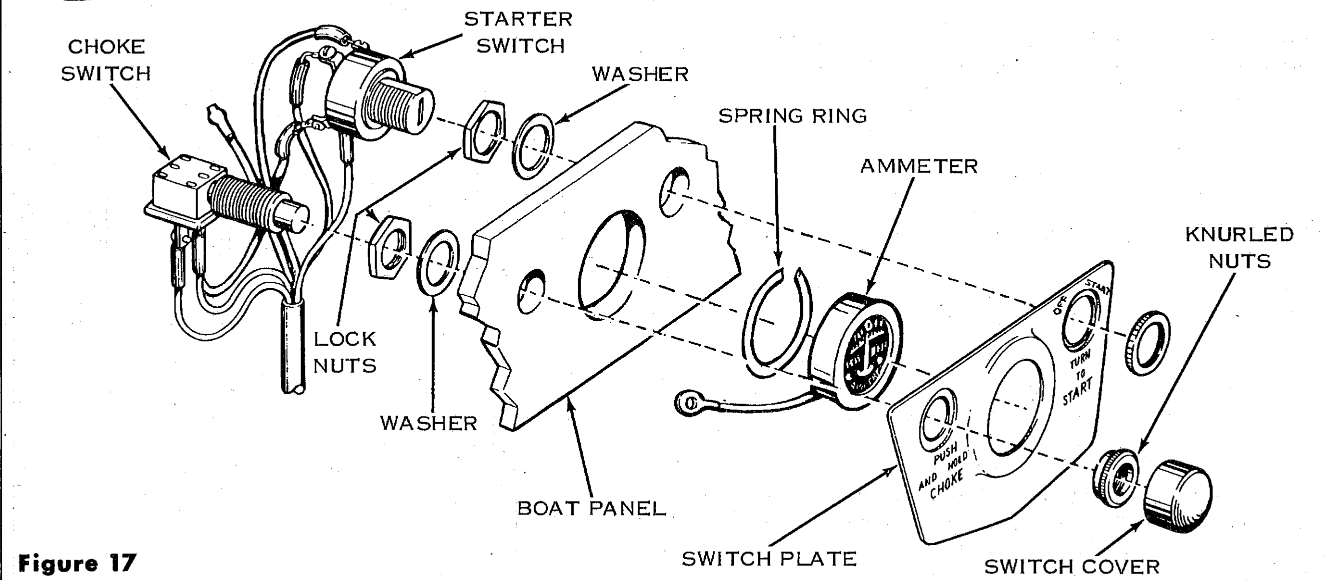


Figure 17

MOTOR WITH PUSH BUTTON CHOKE

4. Remove the terminal nuts and lock washers, green wire, and retaining bracket from ammeter. Reassemble green wire (to BAT terminal), terminal nuts and lockwashers to ammeter. The large insulating washer and retaining bracket are not used in this installation.

5. Place the spring ring furnished with the kit on the ammeter. This ring must be in place to prevent the ammeter from slipping through the hole in the dashboard, and hold it tightly in place.

6. Insert the ammeter, with terminals and wire, through the hole in the dashboard from the front side. Spring ring will be between the front ammeter flange and the dashboard. See Figure 17.

7. Place the switch plate over the ammeter, so that the ammeter face protrudes through the large center hole. Insert switches through the holes in the dashboard and switch plate. Be sure washers are placed between lock nuts and boat panel. Fasten switches at the front of the switch plate with the knurled nuts. Tighten lock nuts on switches at the rear of dashboard to secure the assembly. Place the rubber cover over the switch. See Figure 17.

8. Connect the loose end of the green wire to the terminal of the switch with the single green wire (starter switch). Both terminals must be on one screw. See Figure 18.

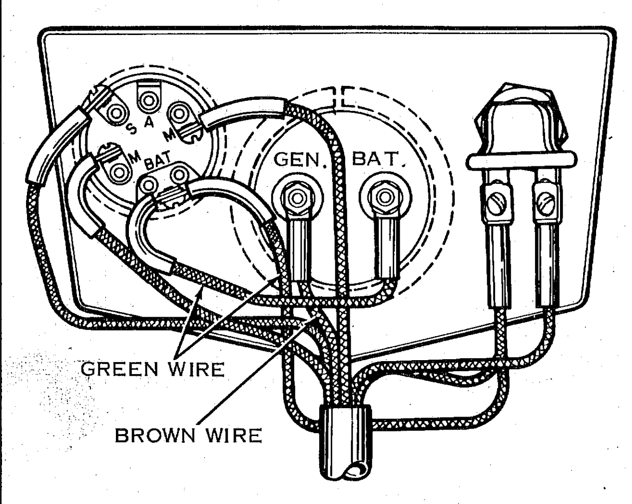


Figure 18

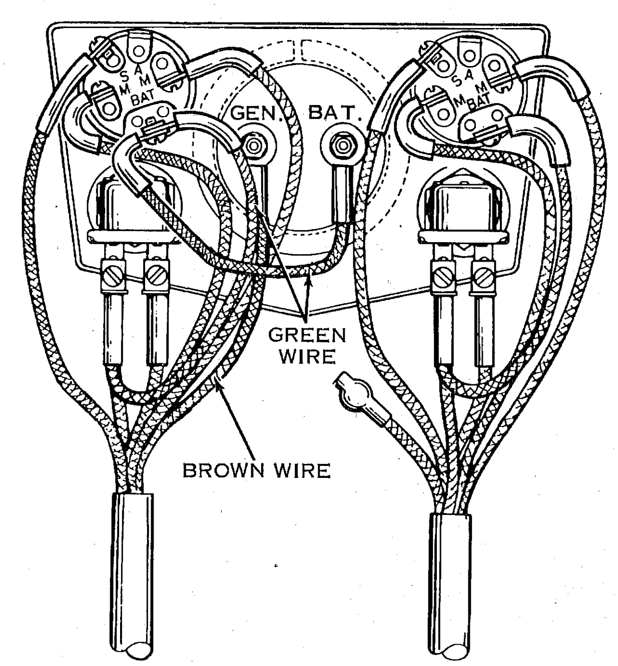


Figure 19

9. Remove the insulating cover from the unused brown wire on the switch to junction box cable. Connect the wire to the vacant ammeter terminal post (GEN). See Figure 18.

10. The generator kit is now completely installed. Recheck all wiring to be sure of positive contacts and tight connections, and reconnect battery.

TWIN MOTOR INSTALLATION

On twin motor installation, use a generator on one motor only to charge one battery. Do not use two generators to charge one battery. Installation at motor and installation at junction box will be the same as for a single motor installation. Be sure to install the generator junction box cover on the junction box for the motor on which the generator is mounted. Installation at the switch plate is essentially the same as for the single motor installation. Be sure that installation is made on the set of switches and cable connecting to the junction box with the regulator. Connect the green wire on the ammeter to the terminal on the switch with the single green wire (starter switch). Remove the insulating cover from the unused brown wire on the switch to junction box cable. Connect the wire to the vacant ammeter terminal post. See Figure 19 for installation on Starter and Choke Switch Plate. For Starter Switch only, installation will be similar to Figure 14.

BATTERY SPECIFICATIONS

For best all-around battery service for your 12-volt starter and generator, we recommend a battery having the following characteristics: 12 volt, 60 ampere hour, or better, with a minimum of 5.2 minutes cold starting capacity at 150 amperes discharge, zero degrees Fahrenheit and a 5 second voltage rating of 9.1 volts.

AUXILIARY POWER REQUIREMENTS

All accessories or auxiliary 12 volt power requirements must be connected to the two power take-off terminals with wing nuts located at bottom of junction box. See Figure 16. This power source has a 20 ampere fuse to protect generator circuits and accessories. Also power taken from this source only will register at the ammeter and indicate the load being discharged from or charged into the battery.

The two power take-off terminals are marked positive (+) and negative (-). When connecting any accessory that has a ground connection, the ground connection wire should be attached to the negative (-) terminal at the junction box. This is to avoid the possibility of electrolysis problems.

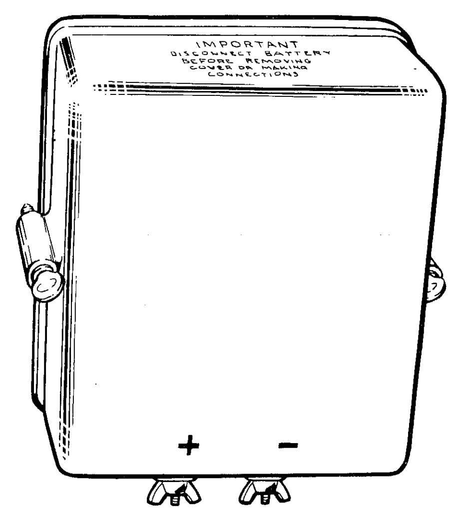


Figure 20

GENERATOR CARE

Top performance of the generator will result if a few simple precautions are heeded.

A. The rated capacity of the generator is 10 amps. Therefore the electrical accessory ampere load should not exceed 10 amps or current will be drawn from the battery in addition to the generator, resulting in a run-down battery. To calculate ampere load use the following formula:

Amperes = Watts/Volts

Voltage will always be 12. Accessories will usually be rated in watts. If candle power is used, remember that one candlepower is approximately equal to one watt.

Example: A boat has running lights, requiring 8 watts, auxiliary lights, requiring 10 watts, and a radio, requiring 30 watts.

Amperes = 48 Watts/12 Volts = 4 Amperes

This load will be satisfactory, since it does not exceed 10 amperes.

B. The current and voltage regulator seal must be kept intact or the warranty on the generator kit is void.

C. Never tamper with blue wire on the regulator. If this wire is shorted out, it will result in a burned out regulator.

D. If ammeter shows no charge or discharge at operating speeds (Engine rpm of 2000 or more) this indicates that the 4 ampere fuse (short fuse) or the 20 ampere fuse (long fuse) is blown or both may be blown. Recheck wiring for loose connections before replacing fuse.

E. The ammeter should show a charge when the motor is running at approximately 2000 rpm or better, with no accessories drawing current. With a fully discharged battery, approximately 10 amps will be generated. With a fully charged battery the ammeter movement will be slightly noticeable.

OUTBOARD MARINE CORPORATION
WAUKEGAN, ILLINOIS

PART NO. 307960 - REV. 3

LITHO IN U.S.A.

AUTO-LITE ELECTRICAL EQUIPMENT STARTING MOTOR SPECIFICATIONS

Test No.	Brush Spring Tension (Ounces)	Armature End Play (Inches)	No Load Test Volts	No Load Test Max. Amperes	No Load Test Min. R. P. M.	Stall Torque Test Volts	Stall Torque Test Max. Amperes	Stall Torque Test Min. Lbs. Ft.
MDO-0	42-66	.005 min.	10.0	38	10000	4.0	170	1.5
MDO-1	42-66	.010-.035	10.0	38	10000	4.0	170	1.5
MDW-0	42-66	.010-.035	10.0	26	8500	4.0	160	2.1
MDW-1	42-66	.005 min.	10.0	26	8500	4.0	160	2.1

Pinion position, 1-25/32 ± 1/16 inches from face of mounting flange to edge of pinion.

MDO-4002M	Use Test	MDO-0	CCW Rotation
MDO-4003M	Use Test	MDO-1	CW Rotation
MDW-4001M	Use Test	MDW-0	CW Rotation
MDW-4002M	Use Test	MDW-1	CCW Rotation

GENERATOR SPECIFICATIONS

Generator	Rot. D. E.	Ground Polarity	Brush Spring Tension	Field Coil Draw Volts	Field Coil Draw Amps.	Motoring Draw Volts	Motoring Draw Amps.	Gen. Output Volts	Gen. Output Max. Amps.	Max. R. P. M.
GJG-4001M	C	N	12-24 oz.	10.0	1.7-1.9	10.0	5.0-6.0	15.0	10.0	7000
GJG-4002M	C	N	12-24 oz.	10.0	1.7-1.9	10.0	5.0-6.0	15.0	10.0	7000

REGULATOR SPECIFICATIONS

Part No.	System Voltage	Ground Polarity	Armature Air Gap Circuit Breaker Inches	Armature Air Gap Voltage Reg. Inches	Current Reg. Inches	Current Regulator Setting Amperes
VRU-6101A	12	N	.031-.034	.048-.052	.048-.052	9.0-11.0

CB Shunt Winding 107 to 121 ohms. VR Winding 43.7 to 49.3 ohms.

Circuit Breaker Close Volts	Circuit Breaker Open Amperes Discharge	Regulator (HOT) Operating Voltages 50°F	80°F	110°F	140°F	Tolerance
12.6-13.6	3.0-5.0	15.2	15.0	14.8	14.6	±.4

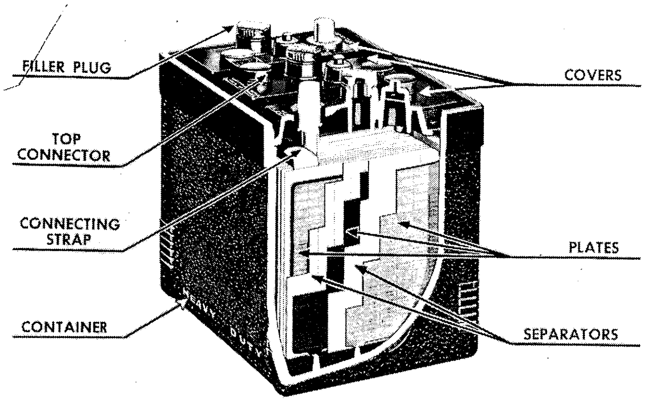
These figures are for a unit in normal operation while charging at 1/2 rated output or with 1/4 ohm fixed resistor in series with the battery.

Courtesy, The Electric Auto-Lite Co., Toledo, Ohio

NOTES

NOTES

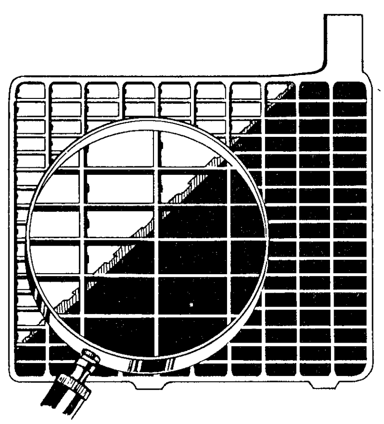
STORAGE BATTERY



Courtesy Willard Storage Battery Co., Cleveland, Ohio

Showing construction details of the Battery.

The storage battery as we know it is classified as a secondary chemical generator — an electrical current temporarily produced by chemical action on two dissimilar materials when submerged in an acid solution (electrolyte) but capable of being "revitalized" by reversal of current through it from an outside source.



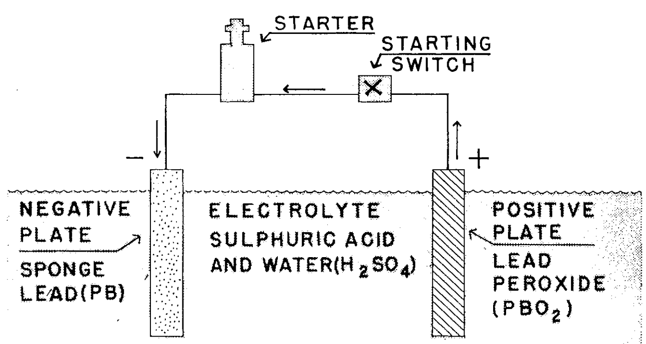
Positive plate with part of active material removed to show grid structure.

Its construction basically consists of a series of "skeletons" or grids composed of an alloy of lead and antimony on which are pressed and treated, masses of lead oxide—after initial charging, sponge lead (gray) for the negative plate and lead peroxide (brown) for the positive plate. Several of each are grouped and placed in a cell of hard rubber—number of positive plates determined by capacity specified for the particular assembly with one additional negative plate. The plates in assembly are alternated — negative, positive, negative, positive, negative, etc., and separated with sheets of corrugated wood or of special rubber construction. All positive plates are "bridged" to a common connector with a strap of lead across projections provided for this purpose — the negative plates are similarly "bridged" together and the entire assembly installed and sealed in a rubber container. This is followed by assembling three like assemblies in a "Master" rubber case—connected in series (positive to negative), sealed and finally filled with an electrolyte (sulphuric acid and water) to make up a 6-volt chemical generator (battery), after "charging" from an outside source. Six cells are employed in the assembly of a 12-volt battery.

Voltage (pressure) is predetermined by potential difference naturally existing between the chemical composition of sponge lead (negative) and peroxide of lead (positive) — established in average storage battery assembly at about 2.1 volts (per cell). Voltage is multiplied by the number of connecting individual cells in series (positive to negative) — thus 3 cells = 6 plus volts.

Amperage (rate of electrical current flow or quantity) is determined by battery plate area—size of plates and number included in the assembly—and nature of acid condition acting upon them.

Electrolyte (solution acting upon the battery plates) is "balanced" at a specific gravity of 1.260 or 1.280 as specified by the battery manufacturer—a mixture of water and sulphuric acid. Density or weight of water is established as 1.000; sulphuric acid for battery use, 1.400—meaning that the weight or density of the sulphuric acid is 1.4 times that of an equal volume of water. Or, in practice,



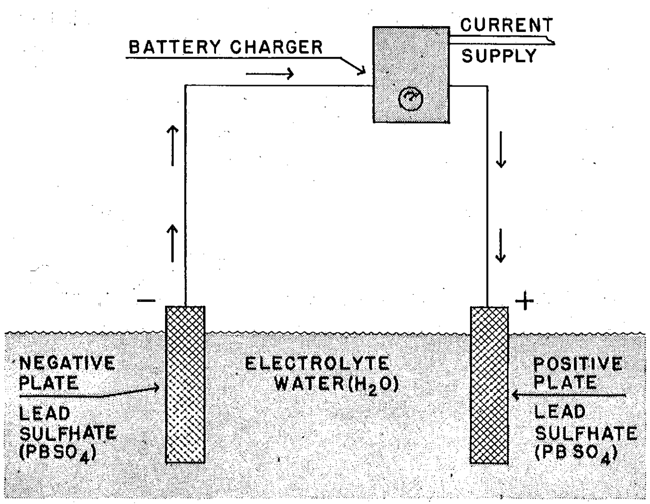
Schematic drawing to illustrate condition of battery in a fully charged state and showing current flow on discharge.

1. *Negative plate*—Sponge lead (PB) changing to lead sulfate ($PBSO_4$).
2. *Positive plate*—Lead peroxide (PBO_2) changing to lead sulfate ($PBSO_4$). O_2 uniting with liberated hydrogen (during process) to form water (H_2O).
3. *Electrolyte*—The sulfate of sulfuric acid unites with active material on plates leaving weaker acid solution — hydrogen of acid and oxygen of lead peroxide (positive plate) combine to form water, thus diluting the solution.

the density of a correctly prepared electrolyte is either 1.26 or 1.28 times the weight or density of water — as observed from floating a hydrometer "bulb" in a quantity of the solution.

On discharge of the battery as when electrically starting the RDE, current flows to turn the starting motor because of chemical action of the electrolyte acting on the positive (red) and negative (gray) plates. During this process, the SO_4 of the electrolyte (H_2SO_4) unites with the PB (lead) element of the negative plates, also with the PB (lead) element of the positive plate (PBO_2) to form lead sulphate ($PBSO_4$) on the baces of both. The O_2 of the positive plate (PBO_2) unites with hydrogen liberated during the procedure of discharging to form water (H_2O). In a sense, when lead sulphate accumulates on both plates to the extent that further acid penetration or contact with the lead and lead peroxide of either plate can no longer be maintained, the battery is said to be discharged—dead. Obviously, there are various interim stages or degrees of discharge to be considered.

Recharging—the restoration of normal battery activity as a chemical generator is accomplished by causing a specified current from an outside source to flow through it but in opposite direction (charging) — positive lead of the charging unit attached to positive post of the battery with negative lead to the negative post. Accepted practice is to start "charge" at approximately 7.4 volts and at the rate of one ampere per each positive plate in the battery. Example: a 15-plate battery contains 7 positive plates (8 negatives) — suggested charging rate, therefore, is 7 amperes.



Schematic drawing to illustrate condition of battery in a fully (theoretically) discharged state and showing current flow on charge.

1. *Negative plate* — Lead sulfate changes to sponge lead. Sulfate returns to electrolyte.
2. *Positive plate* — Lead sulfate changes to lead peroxide. Sulfate returns to electrolyte.
3. *Electrolyte*—Very dilute, made stronger by return of sulfate from the plates.

The function or purpose of recharging basically is to restore original battery consistency—convert the positive plates from lead sulphate ($PBSO_4$) to peroxide of lead (PBO_2), the negative plates from lead sulphate to sponge lead (PB) and to restore specific gravity of the electrolyte (H_2SO_4).

During the process of charging: (1) water (in the electrolyte) is "split" by electrolysis into hydrogen and oxygen gas — the components of its structure (H_2O); (2) the PB radical "leaves" the lead sulphate ($PBSO_4$) having accumulated on the surface of both the positive and negative plates and unites with liberated hydrogen to form sulphuric acid (H_2SO_4); (3) the liberated oxygen unites with the PB of the positive plate to form peroxide of lead (PBO_2); (4) the SO_4 having been liberated from the sulphated negative plate ($PBSO_4$), returns to the electrolyte as explained and leaving it sponge lead (PB). Thus, original state of the battery has been restored — sponge lead (negative plates), peroxide of lead (positive plates) and the electrolyte restored to specific gravity of 1.260 or 1.280 as the case may be.

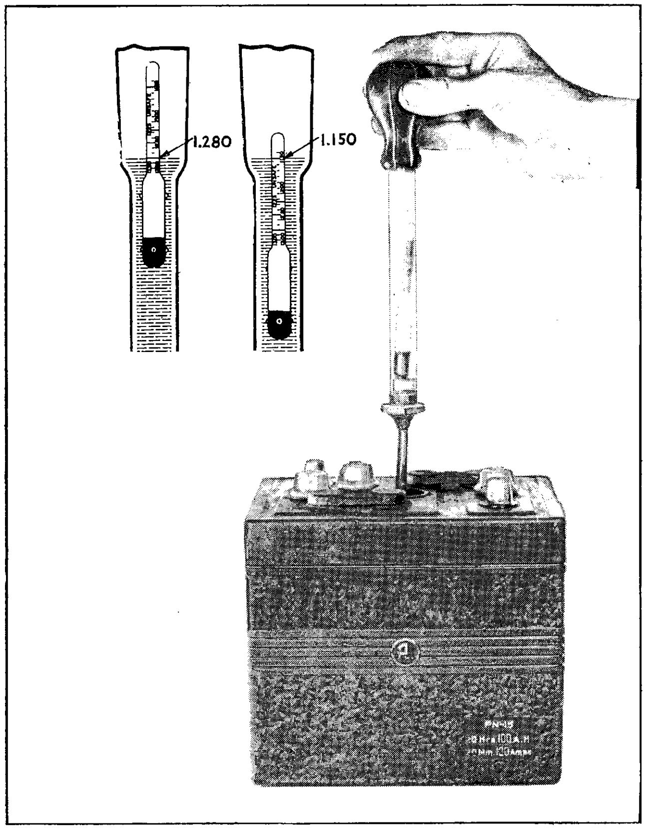
When charging the battery, it is advisable to follow instructions in this respect as provided by the battery manufacturers or builder of the charging unit.

Facts about storage batteries

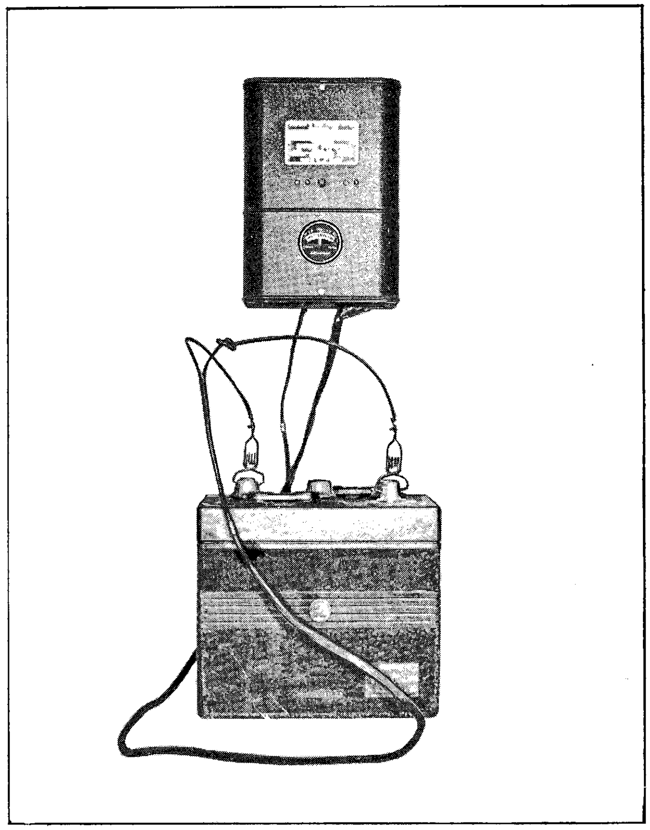
1. Battery liquid level should be retained at approximately ⅜″ above top edge of cell plates to avoid damage caused by exposure and to retain originally specified ratio of sulphuric acid and water in the electrolyte—1.260 or 1.280 specific gravity. Add water (distilled) if necessary but never acid to obtain desired liquid level. In event of accidentally "spilled" battery solution, seek assistance of the local battery dealer or distributor to restore normal acid-water balance.

2. Specific gravity (hydrometer) reading will be in error—low—if taken immediately after adding water. Proceed with charging for an hour or so to achieve thorough "circulation" through battery solution prior to attempting hydrometer reading.

3. Specific gravity readings vary with existing temperature of the battery solution (electrolyte); when relatively high, gravity reading will indicate "low" on the hydrometer scale due to proportionate **expansion** of the liquid and conversely, "high" with falling temperature as result of contraction or shrinkage—a denser concentration. Accepted practice, therefore, is to correct "taken" specific gravity readings to 80° F. (battery solution)—correction factor being .004 (4 points) specific gravity for each 10° F. above or below established 80° F. added to or subtracted from the "taken" reading as the case may be.



"Taking" specific gravity reading of the battery solution (electrolyte) to determine state of charge.



Charging storage battery with one of the chargers available for the purpose

EXAMPLE "A"

Hydrometer Reading	1.255	
Battery Solution Temperature		100° F.
Correction—Add	.008	
Corrected Specific Gravity is	1.263	

EXAMPLE "B"

Hydrometer Reading	1.260	
Battery Solution Temperature		70° F.
Correction—Subtract	.004	
Corrected Specific Gravity is	1.256	

Battery solution density (specific gravity) should not be permitted to fall below 1.220 (corrected to 80°F.) when idle, as in storage, to avoid the harmful effects of excessive cell plate sulphation but placed on "charge" before reaching low state of discharge.

4. Original specific gravity (electrolyte) specifications vary under certain conditions as follows and as established by the battery manufacturers—

	Specific Gravity		Voltage Readings per Cell 1.260 Gravity	1.280 Gravity
*Fully Charged	1.260	1.280	2.10	2.12
¾ "	1.220	1.250	2.08	2.10
½ "	1.170	1.200	2.05	2.07
¼ "	1.120	1.150	2.02	2.04
Discharged	1.070	1.100	1.98	2.00

*Current trend in battery construction is to deviate from the familiar 1.280 specific gravity (battery solution) in favor of a 1.260 gravity specification for the better quality batteries. Batteries filled with 1.260 solution are identified as such by embossing on the cell connectors. "Plain" connectors indicate a 1.280 solution filled battery.

5. A fully charged battery is known to withstand temperatures as low as -90° F.; a dead battery will freeze at about +19° F. and perhaps cause bursting of both the cell and battery cases.

Specific Gravity (Corrected to 80°F.)	Freeze at
1.280	-90° F.
1.250	-60° F.
1.200	-16° F.
1.150	+ 5° F.
1.100	+19° F.

6. It's characteristic of lead plate batteries to "self discharge" (run-down) during periods of idleness, thus requiring periodic charging. During process of charging, a slight amount of antimony dissolves from the positive plate grids which deposits on the sponge lead of the negative plates where it sets up a localized chemical action, thus, slowly discharging the negative plates. Further, the presence of other impurities or foreign matter in minor quantities may also create a like effect. The degree of self discharge is in direct relation to existing atmospheric temperature; relatively fast where high temperatures are involved—progressively slower with falling temperature as will be noted from the following chart, revealing approximate safe lapse time between charging at temperatures given.

Temperature at	Approx. number of days safe lapse time between charging
100° F.	17 days
80° F.	42 days
70° F.	56 days
60° F.	70 days
44° F.	140 days
31° F.	180 days (6 mos.)

Be guided by above time lapse table to avoid the harmful effects caused by permitting the battery to remain idle for long when in a discharged state.

7. Hydrometer readings of the solution in each cell should be taken every 30 days throughout the life of the battery whether in use or not (storage). An open circuit voltmeter may be used to test the condition of each cell with a fully recharged battery; it should indicate 2.10 volts per cell.

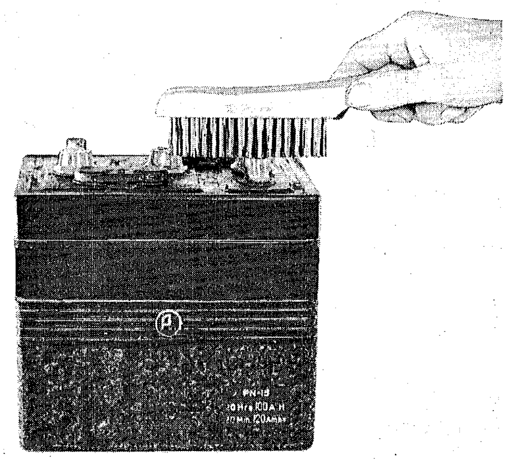
The battery should be placed on charge when the specific gravity (hydrometer) reading falls to 1.220. Note—do not attempt hydrometer reading immediately after adding water but proceed with charging for an hour or two to permit ample time for circulation throughout electrolyte solution. If an open circuit voltmeter is used the battery should be recharged when the voltage of each cell falls to 2.07 volts or less.

8. Avoid over-charging — over-charging causes excessive "gassing," harmfully high battery solution temperature, "mushing" or shedding of the lead peroxide active material on the cell plates and damage to the supporting grids, which eventually contributes to battery failure. Charge only until specific gravity of the electrolyte has been restored to either 1.260 or 1.280 as specified for the particular unit or, up to a point where three consecutive hydrometer readings taken hourly fail to reveal further rise or increase.

Hydrogen (gas) liberated from the battery cells on charge and to a considerably lesser degree when idle (off charge) is explosive and dangerous—keep open flame, sparks, etc. (cigarettes, cigars, pipes, electrical appliances) at prudent distance. Arrange for ample circulation of air about the batteries in storage—if in a room, it is essential that vents are provided for sufficient circulation to guard against mishap.

9. In event the battery is to be removed from the boat and "stored," it should be placed in a room where average temperature is not apt to fall below 32° F. or above 80° F., but preferably stored in the lower temperature bracket (cold). Batteries in storage should never be placed near steam pipes, boilers or other heating devices, on cement floors nor exposed to the direct rays of sunlight.

However, for those with the facilities and who may prefer not disturbing the battery installation, it is perfectly all right to arrange for "outside" storage (boat and motor) subject to normal winter temperatures, but providing the battery is fully charged and maintained in a fully or nearly full state of charge by periodic charging. Rate of self discharge is exceedingly slow in the lower temperature range. See chart.

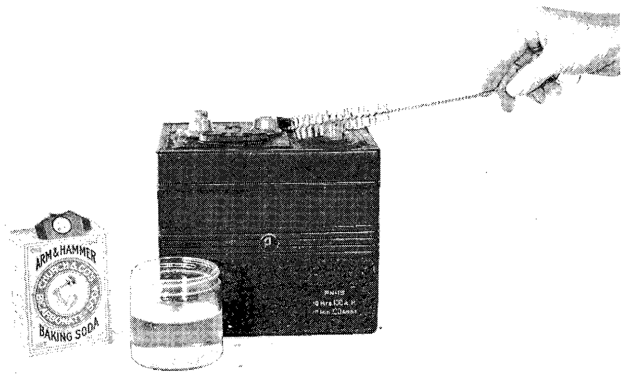


Removing evidence of corrosion from battery posts and connectors with wire brush.

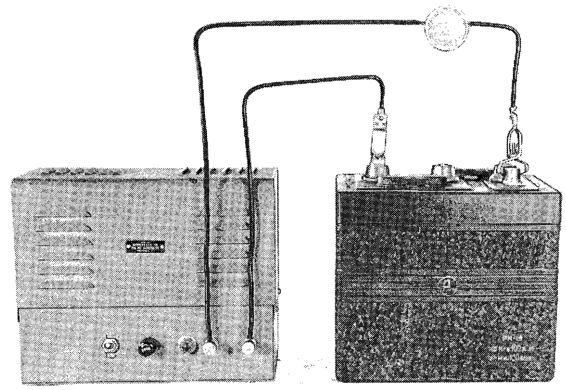
Corrosion, the "whitish" yellow substance often observed accumulating on the battery posts and connectors, is destructive and should be removed as it will damage the cable terminals, causing loose connections.

Remove evidence of corrosion from the battery posts and/or connectors by "swabbing or scrubbing" with a solution of household baking soda and water (mixed to ratio of about one tablespoon of baking soda to a quart of water). Scrub with stiff bristle brush if necessary, then smear "cleaned" surfaces with vaseline to prevent further corrosion. Be sure cell covers are in place when using the soda solution to avoid possibility of "spilling" into the battery electrolyte. Do not "slop" the soda solution around during this procedure. Finally, rinse off with fresh water.

When replacing the battery — come spring — make sure it is fully charged, all terminal connections made clean and on "connecting," apply a coat of vaseline to exposed areas of the battery posts and clamp connectors to avoid or at least retard accumulation of sulphation.

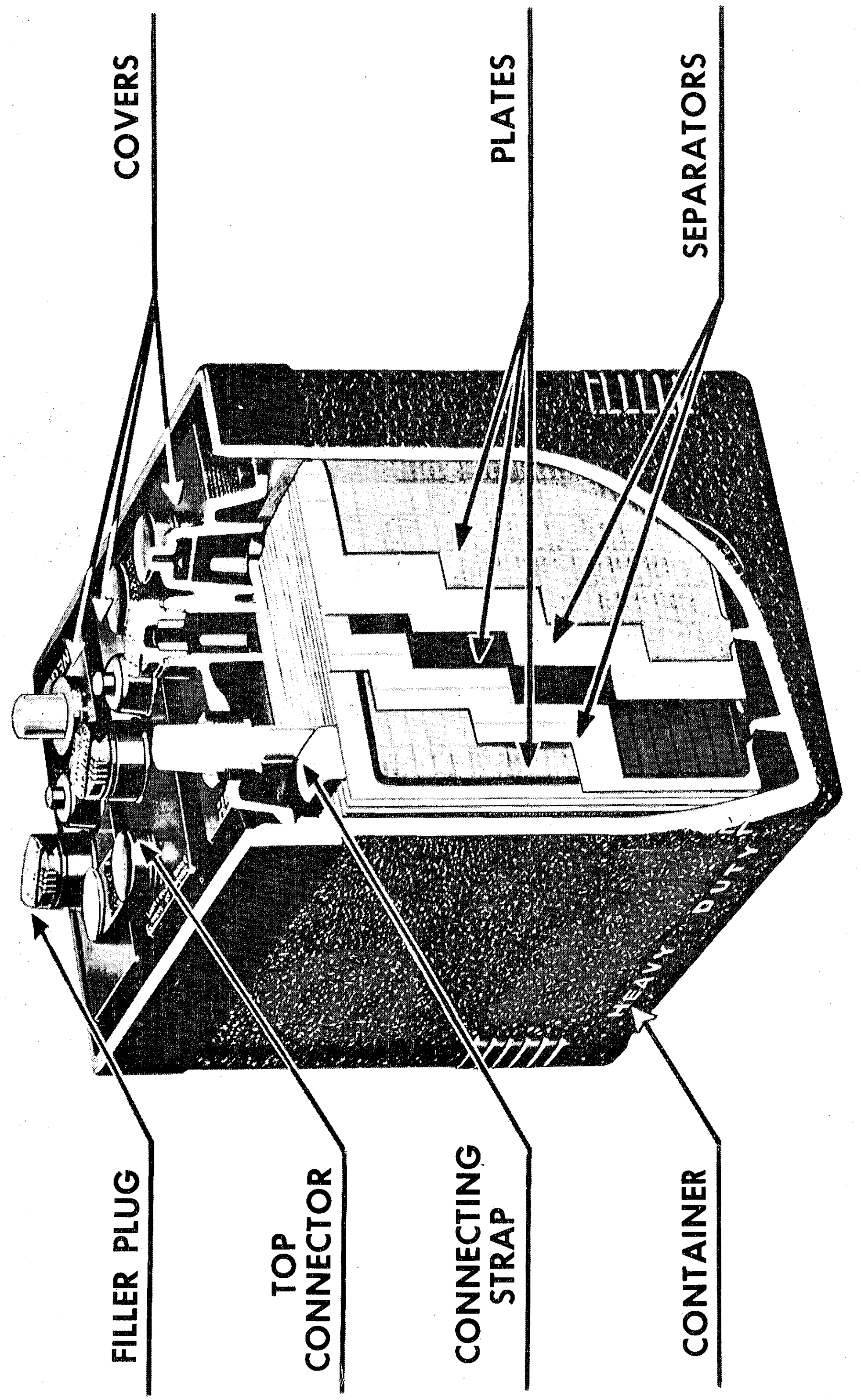


Swabbing battery posts and connectors with a solution of household baking soda and water to neutralize possible acid condition existing in the area. Rinse later with fresh water. Be careful not to "spill" soda solution into battery cells.



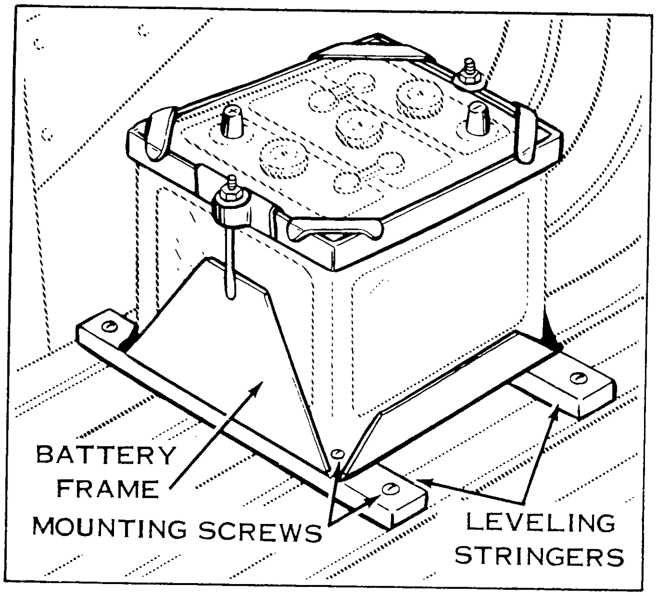
The Stevens Power Unit may be used in an emergency as a "slow" charger as illustrated here.

NOTES



Courtesy Willard Storage Battery Co., Cleveland, Ohio

Showing construction details of the Battery.



Showing suggested battery installation.

CARE OF THE BATTERY

A fully charged battery should read 1285-1300 on a hydrometer or 2.125 volts on a sensitive voltmeter. The battery should be recharged when the hydrometer reaches 1200 or the voltmeter 2.020 for maximum battery life. Starts can be expected, however, until the hydrometer reaches 1150 or the voltmeter 1.990. We recommend checking every thirty days for average use, or oftener in cases of exceptionally heavy use. The use of lights and other electrical accessories will, of course, greatly reduce the time between chargings.

Do not recharge the battery by the "fast charge" method. This method does not restore the full charge and also shortens the life of the battery. Have the battery slow charged by the service station, or purchase a 3 to 10 ampere battery charger for convenient use at home. With these chargers you can expect to recharge the battery in from 8 to 24 hours.

GENERAL BATTERY INFORMATION

A. The specific gravity reading of a fully charged battery is 1285-1300.

B. The voltage reading on a fully charged battery cell is 2.125.

C. The water in the battery should cover the plates 1/4 to 1/2 inch or enough water to fill a hydrometer.

D. A battery hydrometer reading is not accurate if water has been recently added. This is due to the fact that the water has not had a chance to mix with the electrolyte.

E. An idle battery should not be filled in freezing weather. The newly added water will not mix with the electrolyte immediately and may freeze.

F. Refer to instructions provided by battery manufacturer for additional information.

NOTES

MAGNETO RADIO SUPPRESSION KIT

INSTALLATION INSTRUCTIONS

for 35 and 40 HP Models

It is recommended that this RADIO SUPPRESSION KIT be installed and serviced by the factory authorized dealer from whom you made the purchase.

DISCONNECT BATTERY CABLES

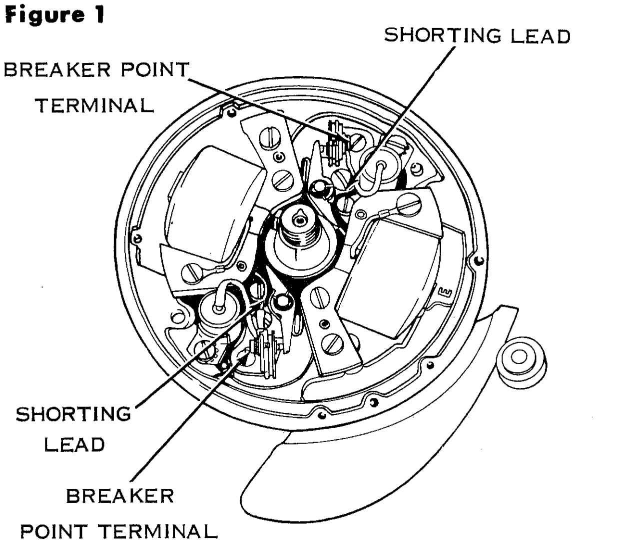
1. Remove starter housing, flywheel and armature plate from motor.

NOTE

Be certain to use recommended flywheel puller when removing flywheel.

2. Remove and discard existing shorting leads from clamps and breaker point terminals. See Figure 1.

Figure 1



3. Feed choke leads (long end) into armature plate and secure to breaker point terminals. Locate choke leads on armature plate in same manner as original shorting leads. See Figure 2.

Figure 2

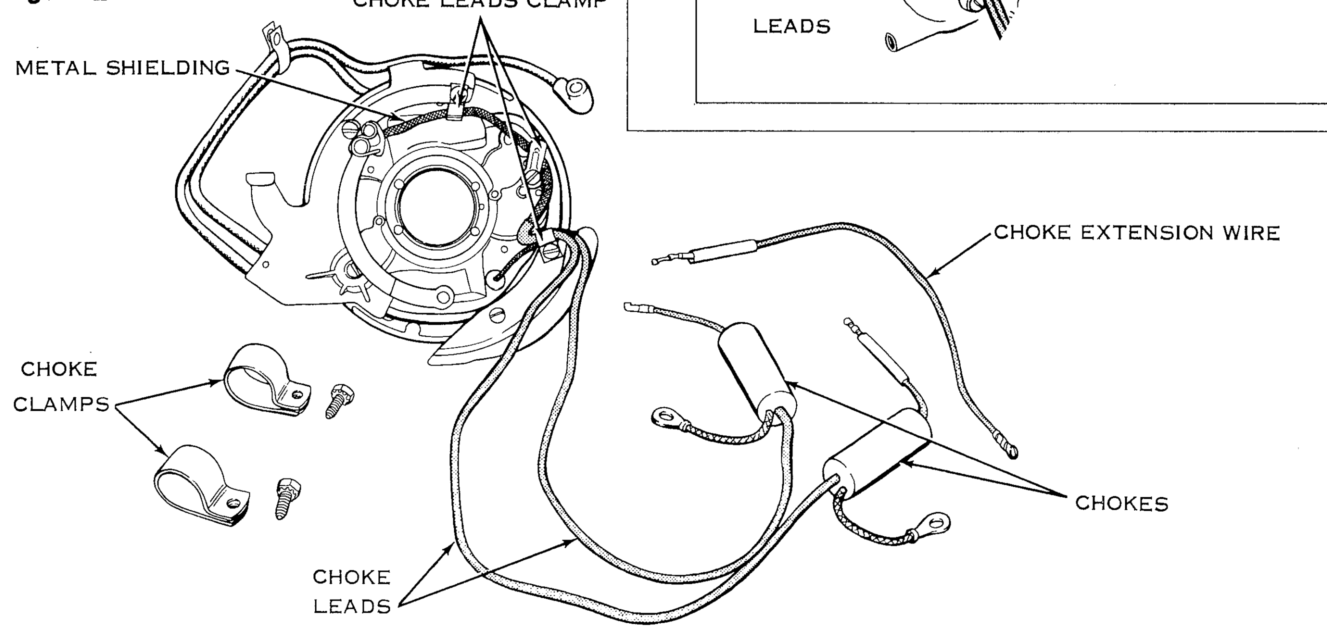
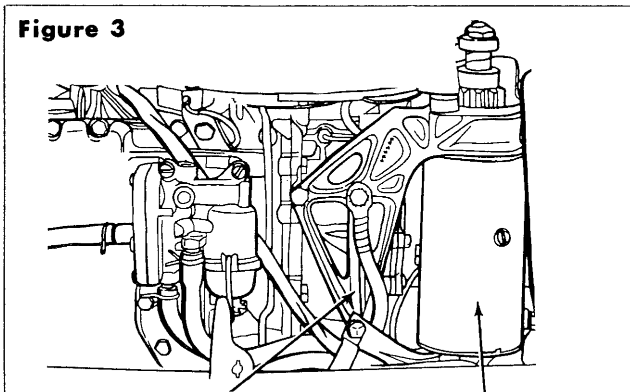


Figure 3

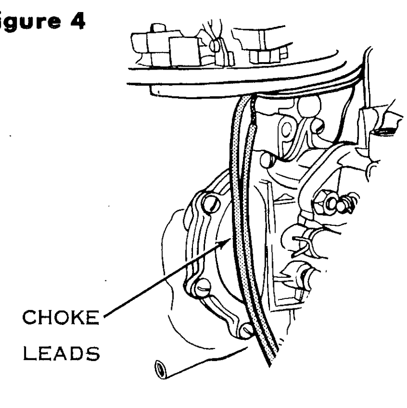


NOTE

Be certain the 3 clamps are positioned over the metal braided shielding of the choke leads, this is necessary to assure a positive ground.

4. Remove electric starter and bracket, Figure 3, to facilitate routing chokes to air entrance cover in lower pan. See Figure 4.

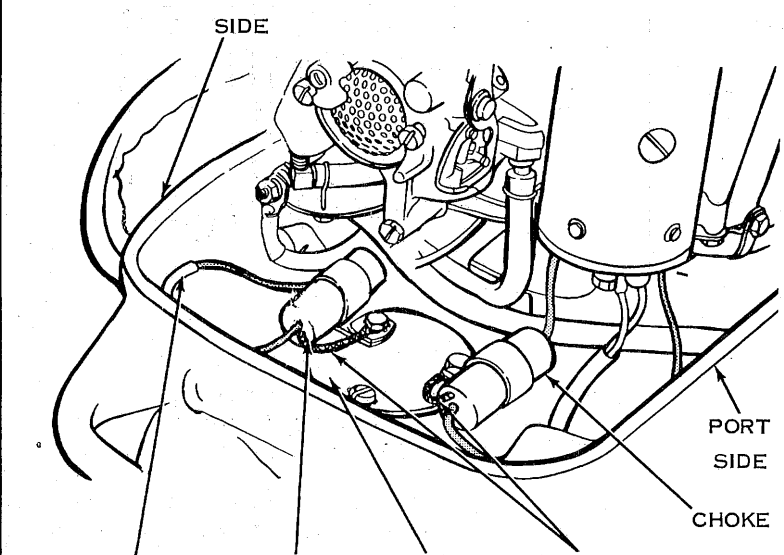
Figure 4



5. Remove existing port and starboard air entrance cover attaching screws. Install choke braided ground wires on longer hold down screws furnished with kit and mount chokes with clamps provided. See Figure 5.

6. Connect short wire (motor cable) knife disconnect terminal (which was disconnected when removing original shorting lead) to starboard choke lead. See Figure 5.

Figure 5



7. Connect port choke lead knife disconnect terminal to extension lead supplied with kit. New insulating tubing is furnished to cover knife disconnect terminals. Route lead behind generator or recoil starter bracket on port side. Connect to center terminal of cut-out switch mounted on upper by-pass cover. See Figure 7.

8. Detach multiple wire motor cable assembly from temperature switch (knife disconnect - color - tan wire), center terminal of cut-out switch (ring terminal- black wire) and safety switch (slip on terminal - white wire) on cut-out switch. On electric shift models also disconnect the blue and green electric shift wires at their knife disconnects. See Figure 6. *SEE NOTE

9. Remove clamp securing multiple wire motor cable to upper by-pass cover. Remove clamp securing safety switch wire to lower by-pass cover. See Figure 6.

10. Reroute multiple wire motor cable assembly around front of motor in lower pan and connect leads previously disconnected. See Figure 7.

11. Secure multiple wire motor cable assembly and safety switch wire as shown in Figure 7. Use clamps previously used.

*NOTE - ON MOTORS USING PLUG-IN CABLE DISREGARD REFERENCES TO RE-ROUTING OF MULTIPLE WIRE CABLE AND TEMPERATURE SWITCH LEAD.

Figure 6

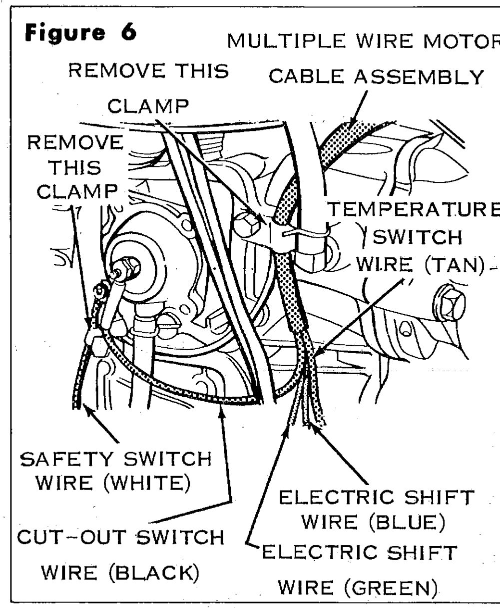
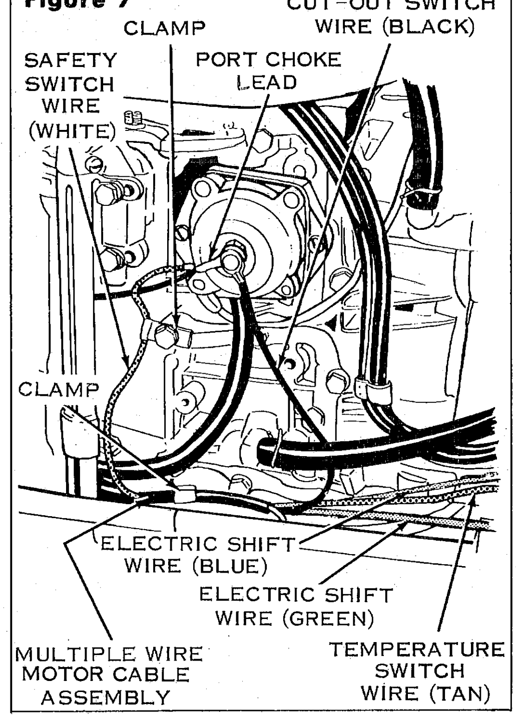


Figure 7



12. Replace standard spark plugs with XJ4J resistor type spark plugs furnished with kit.

13. Reassemble motor and torque to specification.

RECONNECT BATTERY CABLES

TORQUE SPECIFICATIONS (foot pounds)

	35 HP	40 HP
Manual Starter Housing	8-10	8-10
Eye Bolt		14-16
Flywheel	60-65	100-105
Electric Starter Bracket	5-7	5-7

OUTBOARD MARINE CORPORATION
WAUKEGAN, ILLINOIS

D. C. GENERATOR RADIO SUPPRESSION KIT

INSTALLATION INSTRUCTIONS

28 HP, 35 HP, and 40 HP Models

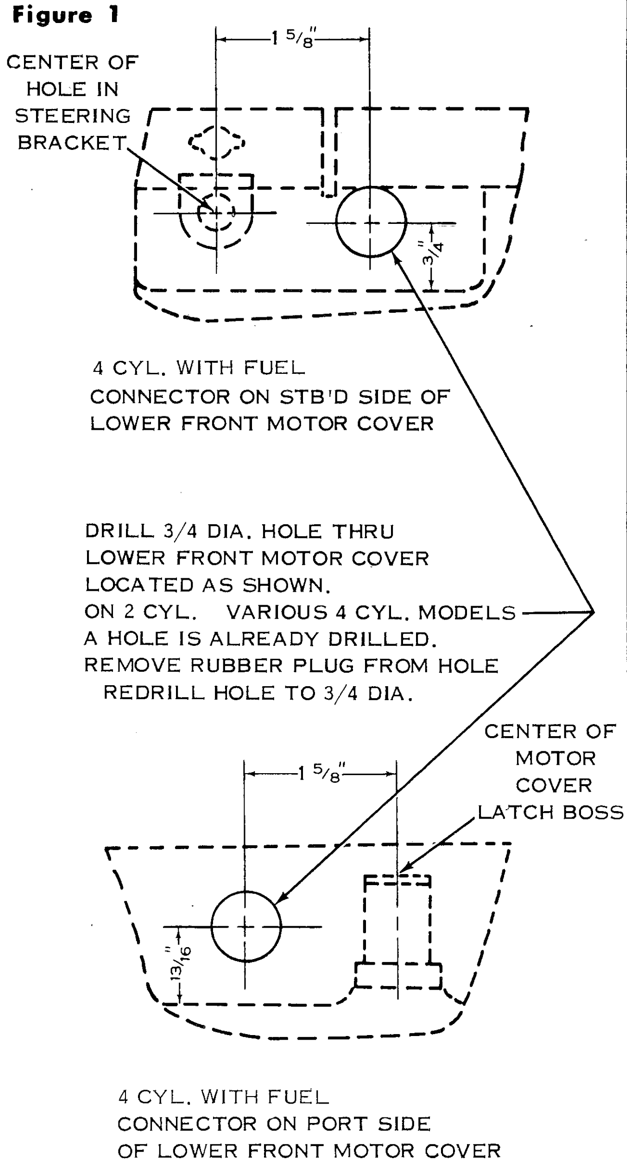
It is recommended that this RADIO SUPPRESSION KIT be installed and serviced by the factory authorized dealer from whom you made the purchase.

DISCONNECT BATTERY CABLES

INSTALLATION AT MOTOR

1. Refer to Figure 1 and drill a 3/4 inch diameter hole in the front of lower pan. On 2 cylinder engines and various 4 cylinder engines, a hole is already drilled in the specified location. On these motors, remove the rubber plug from the hole and enlarge the hole to 3/4 inch diameter.

Figure 1



2. Install generator cable and connector (1) as shown in Figures 2 and 4B with washer (2) on outside and nut (3) on inside of pan.

Figure 2

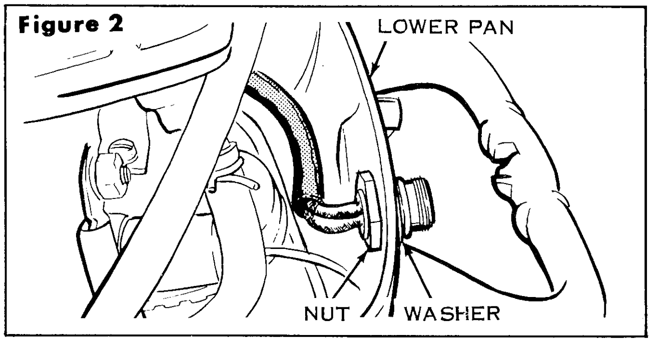
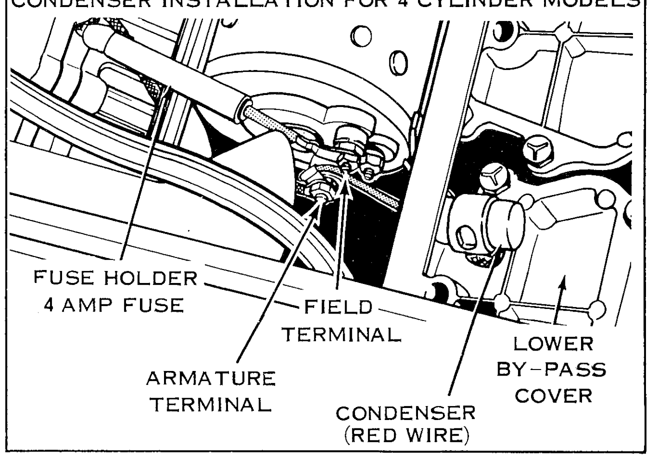


Figure 3

CONDENSER INSTALLATION FOR 4 CYLINDER MODELS



APPLIES TO ALL ENGINES EXCEPT 2 CYLINDER WITHOUT AUTOMATIC CHOKE

3. Remove existing generator leads from generator and remove small terminals from these wires. Replace these terminals with the terminals (4) furnished with kit. The terminals must be soldered to the wires. See Figure 4B. Use strap (5) furnished with kit to bundle the existing generator leads together. Assemble the new terminals of these leads together with the terminal of the shielded cable ground wire (6) and fasten under the front screw (7) attaching the air intake cover (8). See Figure 4B.

APPLIES TO 2 CYLINDER ENGINES WITHOUT AUTOMATIC CHOKE

4. Remove existing generator leads from generator. Enlarge field terminal hole and fasten under the outside choke solenoid clamp screw. (See Figure 5).

NOTE: Numbers in parentheses refer to numbers on center spread.

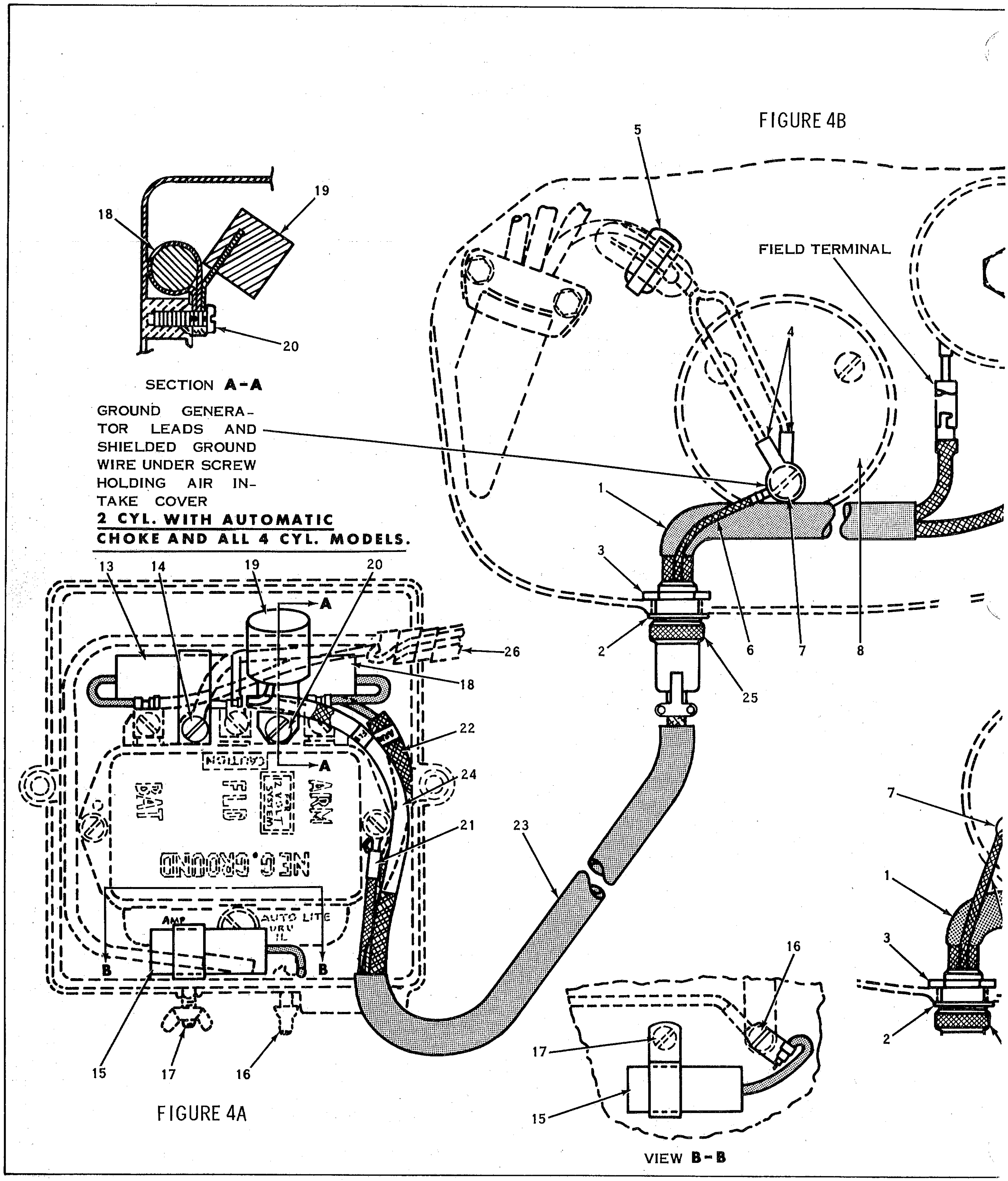


FIGURE 4B
5
FIELD TERMINAL
4
1
3
2
6
7
8
25
19
18
20
SECTION A-A
GROUND GENERATOR LEADS AND SHIELDED GROUND WIRE UNDER SCREW HOLDING AIR INTAKE COVER
2 CYL. WITH AUTOMATIC CHOKE AND ALL 4 CYL. MODELS.
13
14
19
20
A
26
18
22
24
21
23
ARM
FLD
BAT
NEG. GROUND
CAUTION
AUTO LITE
B
15
17
16
7
1
3
2
16
17
15
VIEW B-B

FIGURE 4A

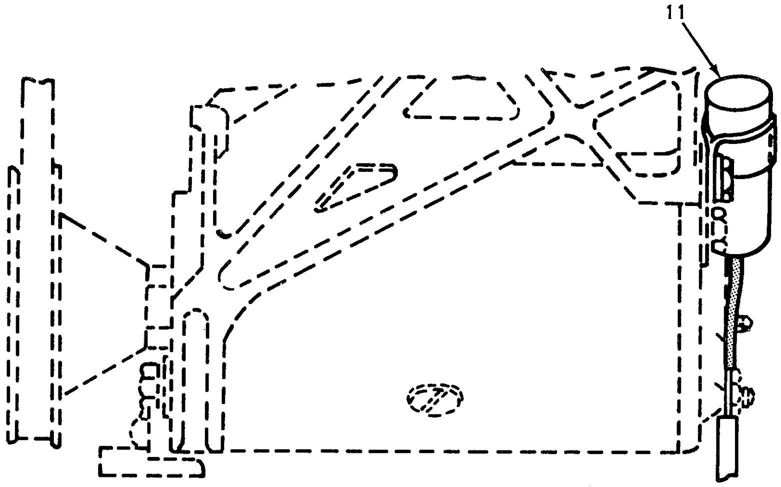


FIGURE 4C

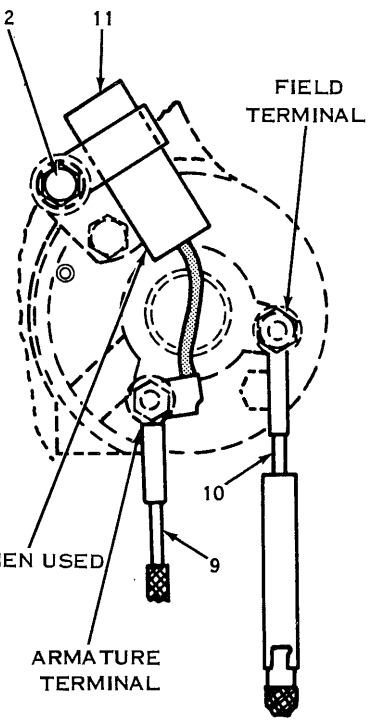


FIGURE 4D

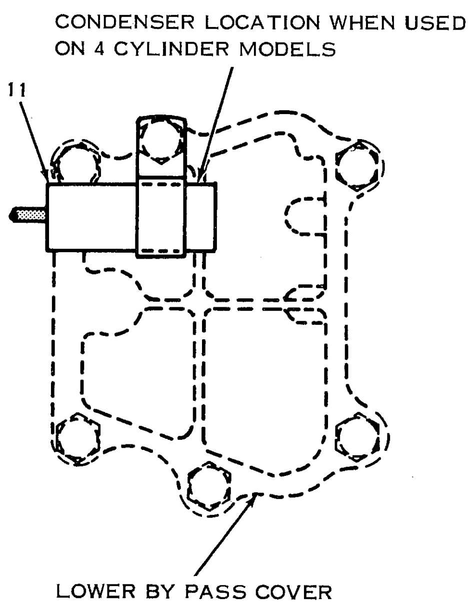


FIGURE 4F

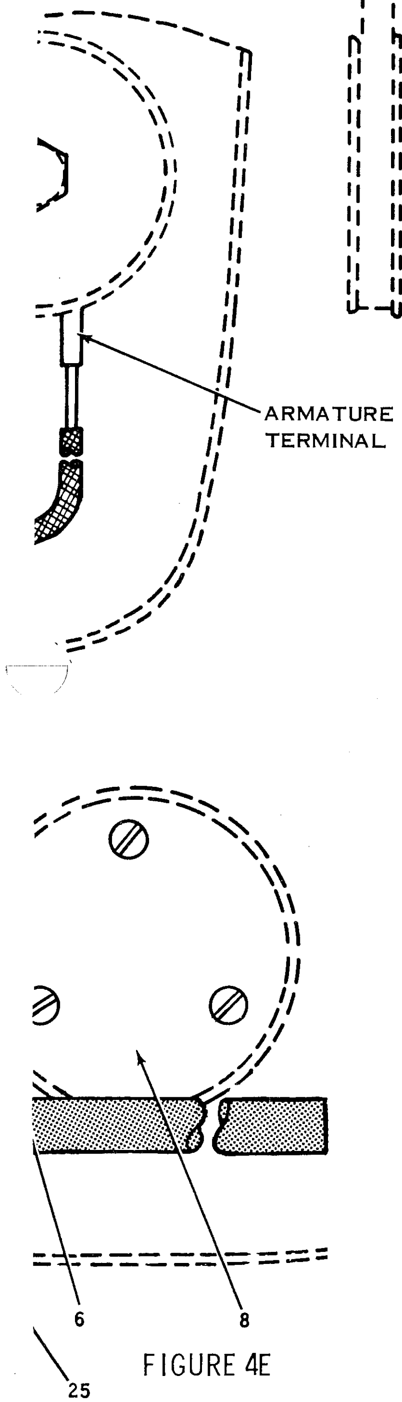


FIGURE 4E

GROUND THE SHIELDED GROUND WIRE UNDER SCREWS HOLDING AIR INTAKE COVER – 2 CYLINDER ENGINES WITHOUT AUTOMATIC CHOKE

1 Generator Cable and Connector
2 Washer
3 Nut
4 Terminals
5 Strap
6 Ground Wire
7 Screw
8 Air Intake Cover
9 Yellow Generator Lead
10 Blue Generator Lead
11 Condenser (with red wire)
12 Hex Head Screw
13 Condenser (with red wire)
14 Pan Head Screw
15 Condenser (with black wire)
16 Accessory Positive Terminal Screw
17 Accessory Negative Terminal Screw
18 Condenser (with black wire)
19 Suppressor
20 Pan Head Screw
21 Ground Strap
22 Yellow Lead
23 Shielded Cable
24 Blue Lead
25 Knurled Nut
26 Regulator Harness

INSTALLATION AT JUNCTION BOX

Figure 5

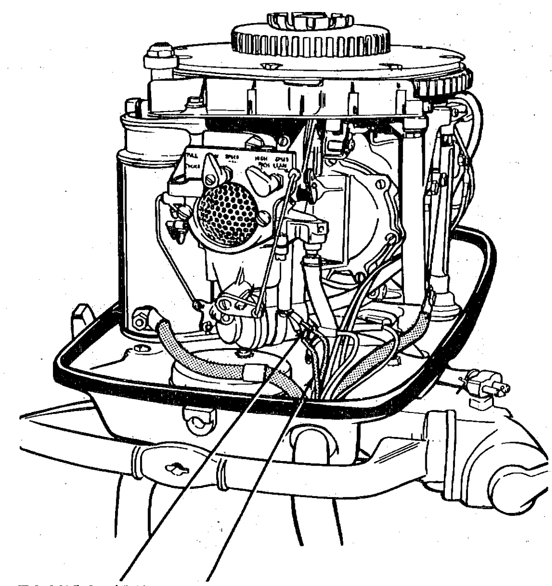
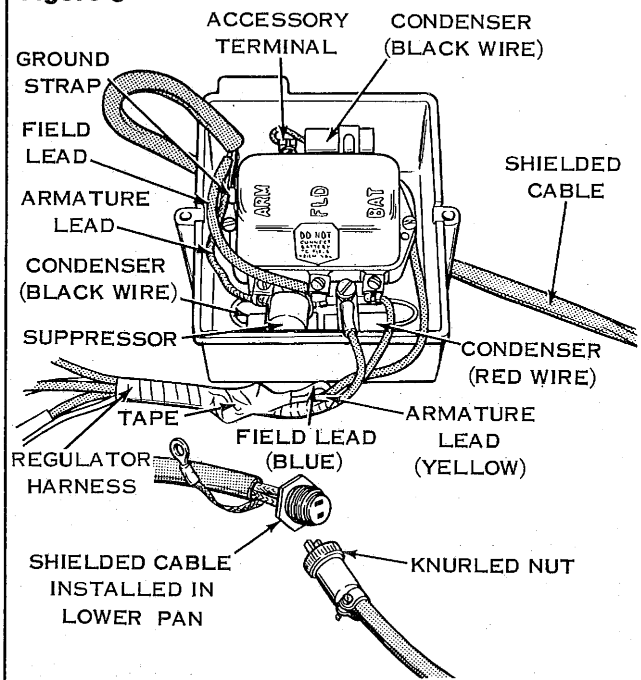


Figure 6



Fasten terminal of shielded cable (6) under starboard choke mounting screw on air intake cover. See Figure 4E.

5. Connect leads from shielded cable to generator terminals: yellow (9) to ARMATURE TERMINAL and blue (10) to FIELD TERMINAL. See Figures 3 and 4D.

6. Install condenser (11, with red wire) and connect lead to generator armature terminal as shown in Figures 3, 4D and 4F. Note that condenser is installed on generator lower bracket on 2 cylinder models and on the lower by-pass cover on 4 cylinder models. Use hex head screw (12) furnished with kit to install condenser on generator bracket.

CAUTION

DO NOT CONNECT CONDENSER TO FIELD TERMINAL

INSTALLATION AT JUNCTION BOX

1. Remove armature and field leads (yellow and blue wires) from voltage regulator, fold back along side of regulator harness and tape in place. See Figure 6.

2. Install condenser (13, with red wire) on voltage regulator as shown in Figures 4A and 6, connect condenser lead to battery terminal of regulator. When mounting condenser remove existing regulator mounting screw and replace with longer pan head screw (14) furnished with kit.

3. Install condenser (15, with black wire) and connect lead to accessory positive terminal screw (16) of junction box as shown in Figures 4A and 6. When mounting condenser use existing accessory negative terminal screw (17).

4. Install condenser (18, with black wire) and suppressor (19) as shown in Figures 4A and 5. When mounting condenser and suppressor remove existing regulator mounting screw and replace with longer pan head screw (20) furnished with kit. Connect condenser lead to armature terminal and suppressor lead to field terminal. Locate the regulator harness underneath the suppressor.

CAUTION

DO NOT CONNECT CONDENSER LEAD TO FIELD TERMINAL

5. Connect ground strap (21) on shielded cable (23) to regulator cover screw as shown in Figures 4A and 5.

6. Connect yellow lead (33) of shielded cable (23) to armature terminal on regulator and blue lead (24) to field terminal. See Figures 4A and 6.

7. Route shielded lead (23) out through cable opening in junction box base and replace cover.

8. Apply a light film of lubricant to the threaded portion of the connector and plug junction box shielded cable (23) into receptacle installed on lower pan. Tighten knurled (25) securely. See Figure 4B and 6.

RECONNECT BATTERY CABLES

OUTBOARD MARINE CORPORATION **WAUKEGAN, ILLINOIS**

PART NO. 308177 Rev. 2 LITHO IN USA

CURRENT COUPLER KIT INSTALLATION INSTRUCTIONS

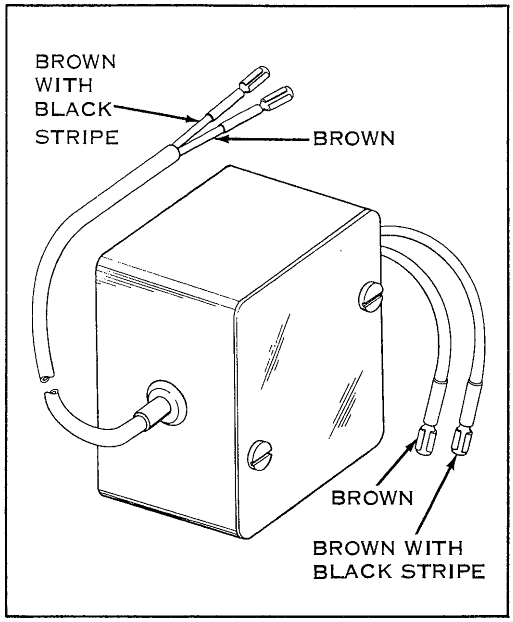
TO CONNECT TWO DC GENERATOR EQUIPPED ENGINES TO ONE BATTERY

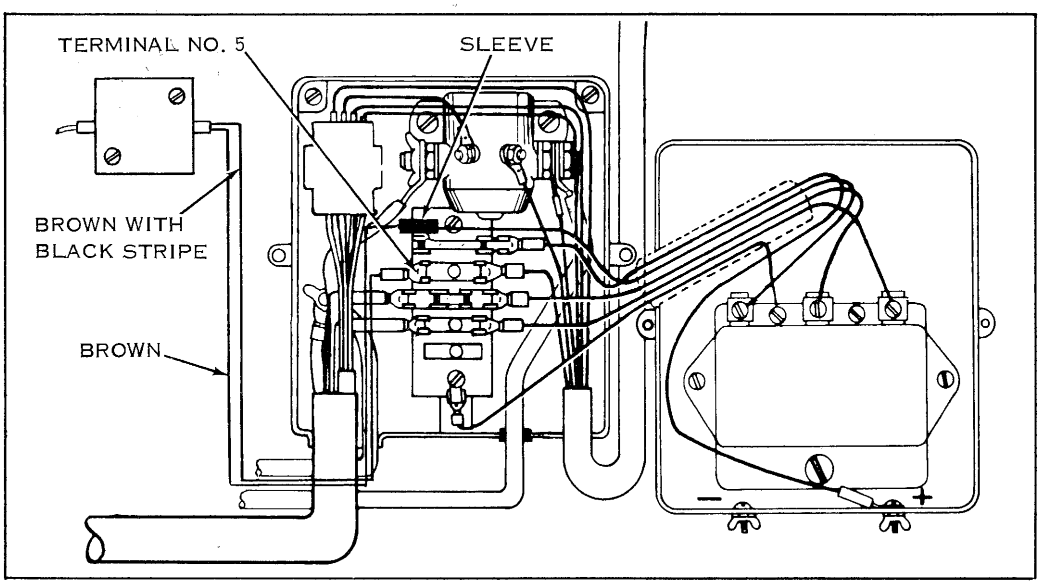
1. Disconnect the battery leads.

2. Remove current coupler cover.

3. Position current coupler so that the short leads side is within 12" of one junction box. Attach current coupler to boat with the three wood screws furnished. If boat is metal, the current coupler should be well insulated from the boat.

A piece of wood larger than the current coupler and 3/4" thick will make a sufficient insulator. Be sure current coupler attaching screws do not go through the block and make contact with the metal of the boat.





4. Replace the current coupler cover.

5. Remove the cover from the junction box next to the current coupler.

6. Disconnect the brown wire from terminal number 5 on the terminal block.

7. Connect this brown wire to the short brown lead from the current coupler. Slide the insulating sleeve over the connection.

8. Connect the short brown lead with black stripe from the current coupler to terminal number 5 on the terminal block.

9. Route the two leads out the bottom of the junction box alongside the battery cable.

10. Replace the junction box cover.

11. Remove other junction box cover.

12. Disconnect brown wire from terminal number 5 on terminal block.

13. Connect this wire to long brown lead from current coupler. Slide insulating sleeve over connection.

14. Connect long brown lead with black stripe from current coupler to terminal number 5 on terminal block.

15. Route leads out bottom of junction box alongside of battery cable.

16. Replace junction box cover.

17. Connect the battery cables. Installation is complete.

TO CONNECT ONE ALTERNATOR-EQUIPPED ENGINE AND ONE DC GENERATOR-EQUIPPED ENGINE TO ONE BATTERY

1. Follow steps 1 through 10 for the DC generator equipped engine. Be sure to locate the current coupler next to the DC equipped engine junction box.

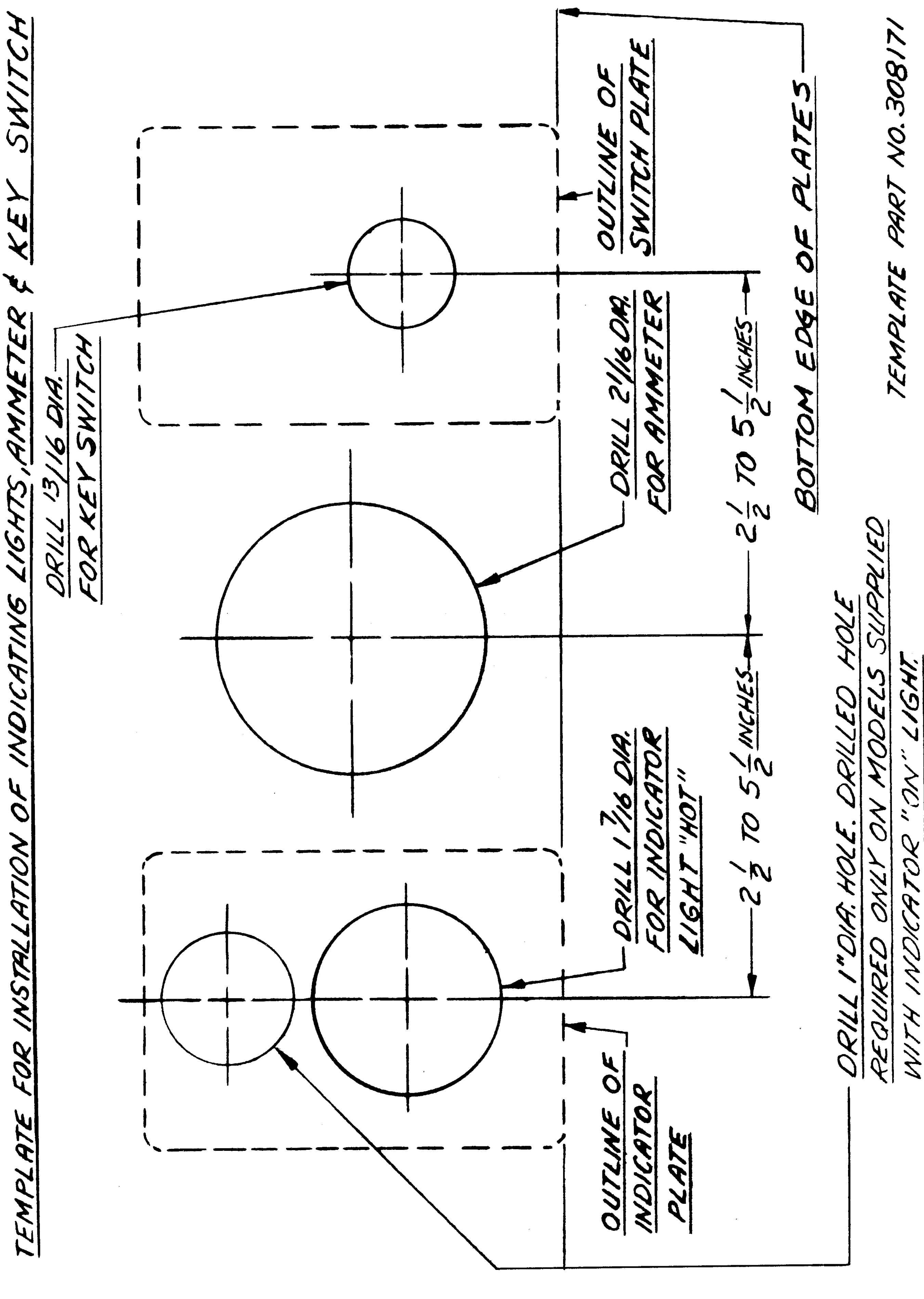
2. Coil the long leads from the current coupler and tape the ends. These leads are not used. It is unnecessary to do anything to the alternator equipped engine junction box. Installation is complete.

NOTE: MAXIMUM CURRENT RATING OF CURRENT COUPLER IS 15 AMPS PER ENGINE.

OUTBOARD MARINE CORPORATION
Waukegan, Illinois

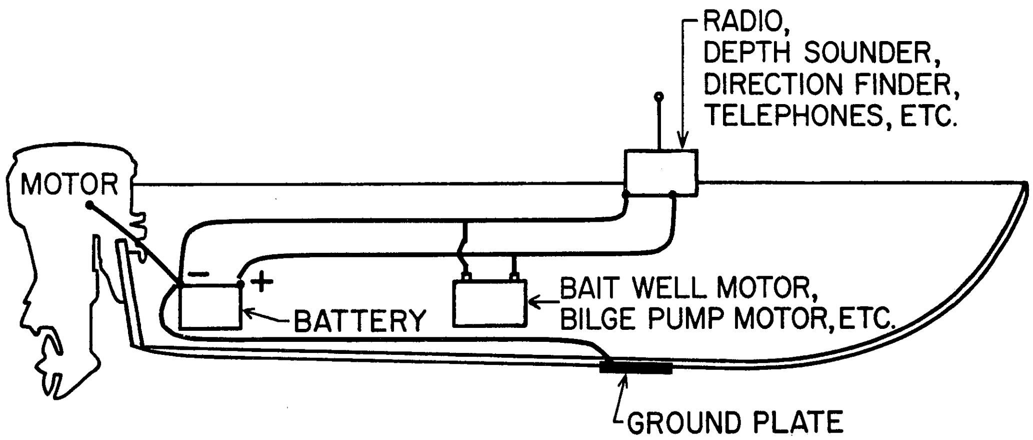
PART NO. 309544 REV. 1

LITHO IN U.S.A.


TEMPLATE FOR INSTALLATION OF INDICATING LIGHTS, AMMETER & KEY SWITCH
DRILL 13/16 DIA.
FOR KEY SWITCH
OUTLINE OF
SWITCH PLATE
DRILL 2 1/16 DIA.
FOR AMMETER
2 1/2 TO 5 1/2 INCHES
BOTTOM EDGE OF PLATES
TEMPLATE PART NO. 308171
DRILL 1 7/16 DIA.
FOR INDICATOR
LIGHT "HOT"
2 1/2 TO 5 1/2 INCHES
OUTLINE OF
INDICATOR
PLATE
DRILL 1" DIA. HOLE. DRILLED HOLE
REQUIRED ONLY ON MODELS SUPPLIED
WITH INDICATOR "ON" LIGHT.

NOTES

ELECTROLYSIS



GROUND PLATE INSTALLATION

The problem of electrolysis on engine gearcases can be very serious where electronic equipment is used; equipment such as radios, depth sounders, direction finders, telephones, etc. The identical problem also exists when other electric equipment is installed. Electric motors used to operate bait wells, bilge pumps, etc. are examples of the second type of electrical equipment which can cause electrolysis.

We have found in most instances that electrolysis is caused by improper hook-up of ground plates or the failure to use them at all. Although electrolysis occurs in both fresh and salt water, electrolytic action occurs at a greater rate in salt water where it is also much more severe in its end result. The above sketch shows our recommendations for proper grounding of any external hull fittings.

Ground plates are available through most marine hardware and/or radio dealers and should provide a *minimum rated* area equal to twelve (12) square feet of exposed area. This does not mean the ground plate must actually cover an area of 12 square feet; only that the plate's *rated* area must provide the *equivalent* of 12 square feet minimum for efficient grounding purposes. Such grounding plates are available in sizes as small as 3 3/4 inches in diameter and 1/4 inch thick, yet provide the minimum rated area of 12 square feet or more. Ground plates may, of course, be of other sizes and shapes; may be of various compositions and have higher ratings.

When hooking up a ground plate, it is imperative the plate be connected directly to the negative side of the battery and not directly to ground of the electrical equipment being used. This connection procedure prevents voltage drop between the engine and ground plate.

Check for a voltage drop between the ground plate and engine by using a sensitive D-C voltmeter with a scale reading from zero (0) to one (1) volt. Such voltmeters are available through most radio parts stores on special order.

Service Bulletin No. 684 (Revised) 5/2/60

GENERATOR CHARGING CIRCUIT MAINTENANCE AND CHECKS

The charging system supplies electric power for the electrical accessories and to keep the battery charged. It includes the battery, ammeter, generator, regulator and the wiring which connects these units.

The regulator controls the amount of electricity produced by the generator. It contains three electromagnetic devices — first, to automatically connect the generator to the battery when the generator is operating fast enough to charge the battery and to disconnect the generator from the battery when the generator slows or stops, thus preventing discharge of the battery through the generator — second, to limit the maximum current output of the generator to a value that is safe for the generator — third, to limit the voltage output of the generator to a value that will be safe for the battery, radio and other accessories.

The charging system requires no periodic maintenance except to see that all connections are clean and tight. All wiring and connections should be inspected frequently for looseness and corrosion. This inspection should include cleaning of terminals in the cable connector plug as well as the pins on the mating receptacle. Use care not to overtighten the terminal nuts at the generator and ammeter as too much force will twist off the terminals. All terminal nuts and screws should have lockwashers and be snug. The connections at the terminal block in the junction box should be tight and clean. Do not overlook the ground connections in the ter-

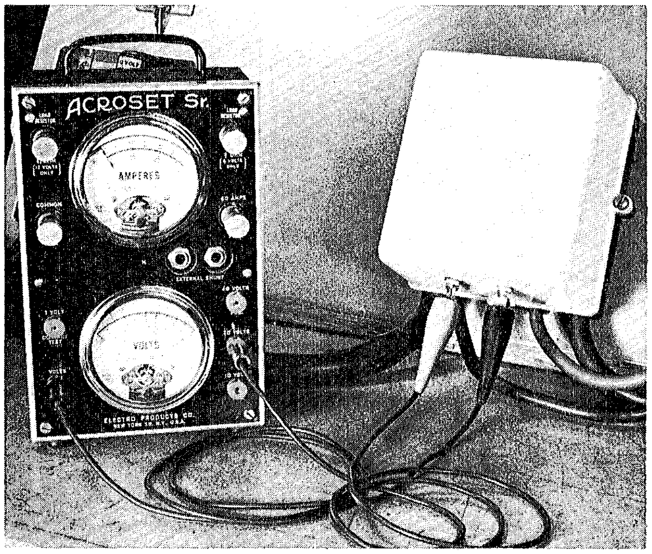


FIGURE 1

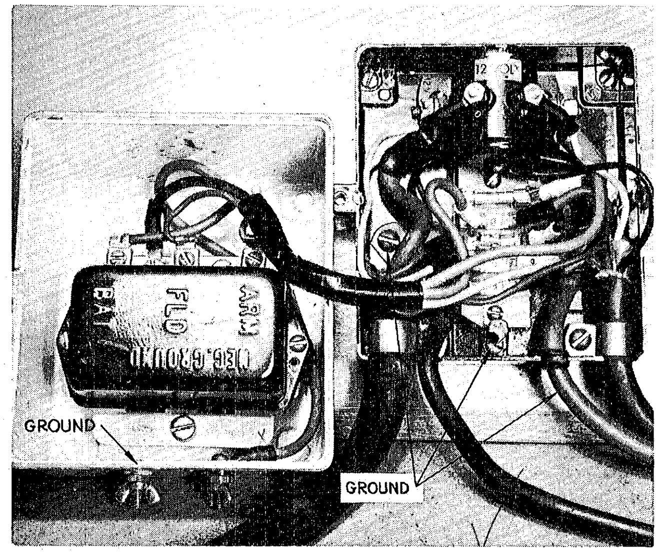


FIGURE 2

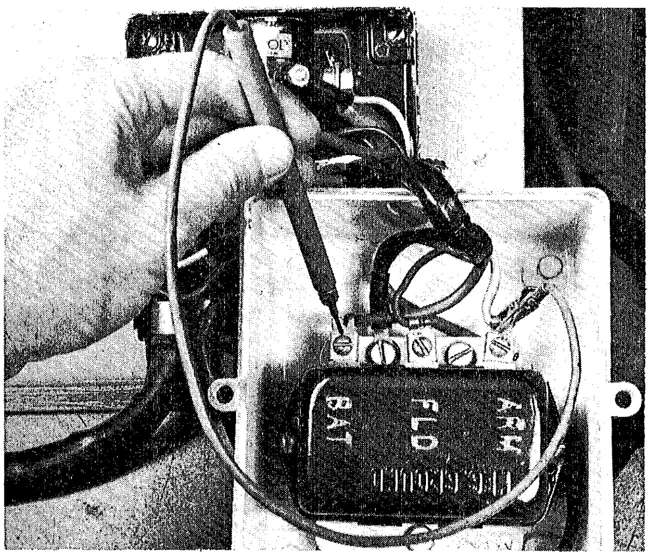


FIGURE 3

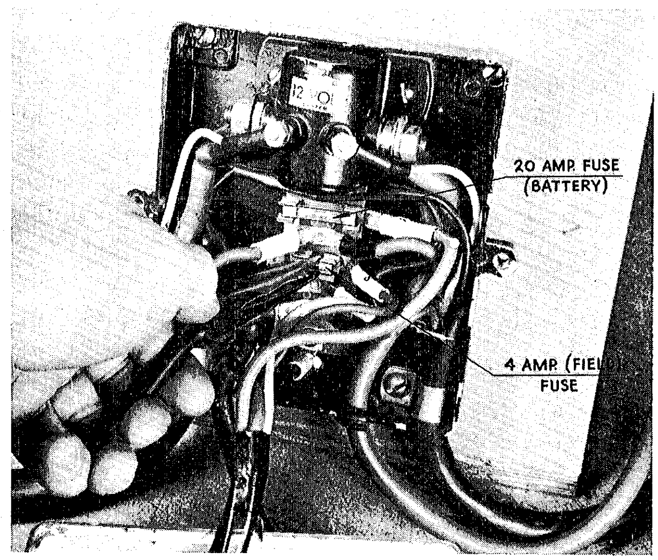


FIGURE 4

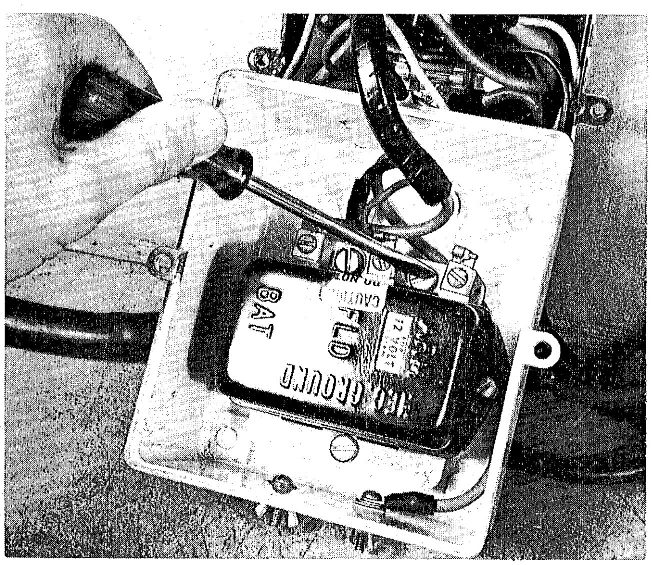


FIGURE 5

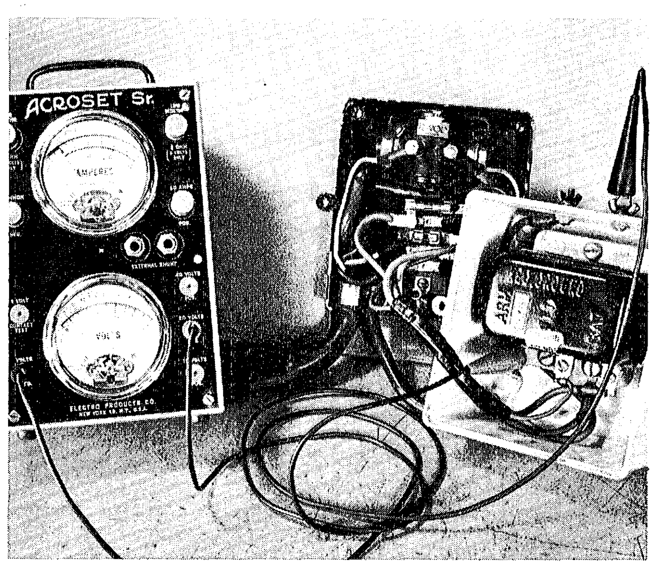


FIGURE 6

minal box, the terminal box cover and at the cable connector.

Check the generator mounting bolt nuts for tightness (70 to 80 in pounds).

VOLTMETER CHECKS

These tests are not needed unless there is some indication that the generator and regulator are not operating properly. If ammeter does not show the proper charge rate, the battery is consistently rundown, or if it requires an excessive amount of water, a voltmeter may be used to isolate cause of trouble. (Use 20-volt scale or higher.)

Be sure battery is connected correctly.

Disconnect all accessories from the power take-off terminals on the junction box and connect the voltmeter to the terminals, see Figure 1.

The accompanying charts show voltages and check points should any corrective measures be necessary.

Service Bulletin No. 783 5/10/60

READING	INDICATION	CHECK OR CORRECTION
Approximately 12.5 volts.	Fully charged battery.	OK – proceed with tests.
Slightly below 12.5 volts.	Partially discharged battery or bad connection in battery circuit.	Check wiring and connections. Fully charged battery may be installed to reduce checking time.
No reading.	Open battery circuit.	Check 20-amp. fuse in junction box. Clean fuse clips – replace fuse if needed. (See Figure 4.)
Still no reading.	Open battery circuit.	Check wiring and connections from battery to starter solenoid, at ammeter terminals and back to junction box.
Still no reading.	Open in ground side of battery circuit.	Check ground connections at battery and at two points in junction box and one in cover. (See Figure 2.)
Start engine and operate at 3500 r.p.m. or above, approximately 3/4 throttle. If motor is mounted on boat, suggest removal of propeller, install test propeller and operate motor in gear to accomplish this.		
Voltmeter reads above battery voltage, but not over 15.0 volts. Panel ammeter reads near 10 amps and decreases as voltage climbs.	Normal operation.	After 15 minutes operation voltage should hold steady at 14.5 to 15.2 volts and ammeter reading should have fallen off to less than 10 amps.
Voltage above 15.2 volts. Ammeter reading high.	Grounded field circuit or improperly operating regulator.	Disconnect field lead at regulator "FLD" terminal. Voltage should drop to 12.5.
If voltage drops to 12.5 with field lead disconnected at regulator.	Improperly operating regulator.	Regulator should be replaced or repaired by qualified electrical service station.
If voltage remains high with field lead disconnected at regulator.	Ground in generator field or field lead between generator and regulator.	Disconnect field lead at generator "F" terminal.
If voltage still remains high with field lead disconnected at generator.	Grounded generator field.	Refer generator to qualified electrical service station for repairs.

READING	INDICATION	CHECK OR CORRECTION
If voltage drops to 12.5 with field lead disconnected at generator.	Ground in field lead between generator and regulator.	Locate ground and retape or replace lead. Reconnect lead to generator and regulator "FLD" terminals.
If voltmeter reading is correct and ammeter shows discharge.	Reversed terminal connections at ammeter.	Be sure battery is installed for negative ground and reverse ammeter leads, if necessary.*
If voltmeter remains at battery voltage and ammeter remains at zero.	No generator output.	Remove 4-amp. fuse, clean clips. Install new fuse and recheck. (See Figure 4.) **CAUTION:** Disconnect battery while removing or replacing fuse as *any* contact between fuse clips (field) and adjacent terminal (battery) will permanently damage regulator.
If voltmeter still remains at battery voltage and ammeter at zero.	No generator output.	Check wiring for correct hookup and poor connections. Then carefully ground regulator "FLD" terminal to regulator base with screwdriver. (See Figure 5.)
If voltage climbs to a high value with "FLD" terminal grounded. Remove screwdriver immediately.	Inoperative regulator. (This operation bypasses voltage and current regulators.)	Regulator should be replaced or repaired by a qualified electrical service station.
If voltage remains low with field grounded.	Inoperative generator circuit breaker or defective wiring.	Move voltmeter lead (Figure 1) from (+) take-off terminal to regulator "ARM" terminal. (See Figure 6.) Repair grounding as shown in Figure 5.
If voltage now increases to a high value with field grounded.	Inoperative circuit breaker in regulator.	Regulator should be replaced or repaired by a qualified electrical service station.

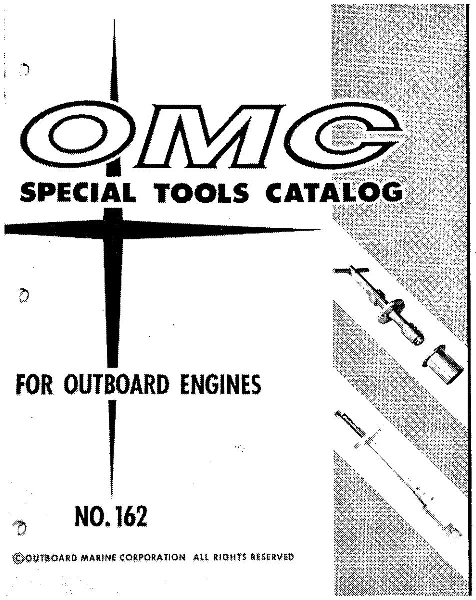
*If the battery connections were incorrect and are changed, it will be necessary to polarize the generator. To polarize, with a short piece of wire touch one end to the regulator "ARM" terminal, then momentarily touch the other end to the regulator "BAT" terminal. See Figure 3. **CAUTION:** Use extreme care that the center terminal (marked "FLD") is not touched, as battery voltage applied to any point in the field circuit will damage the regulator.

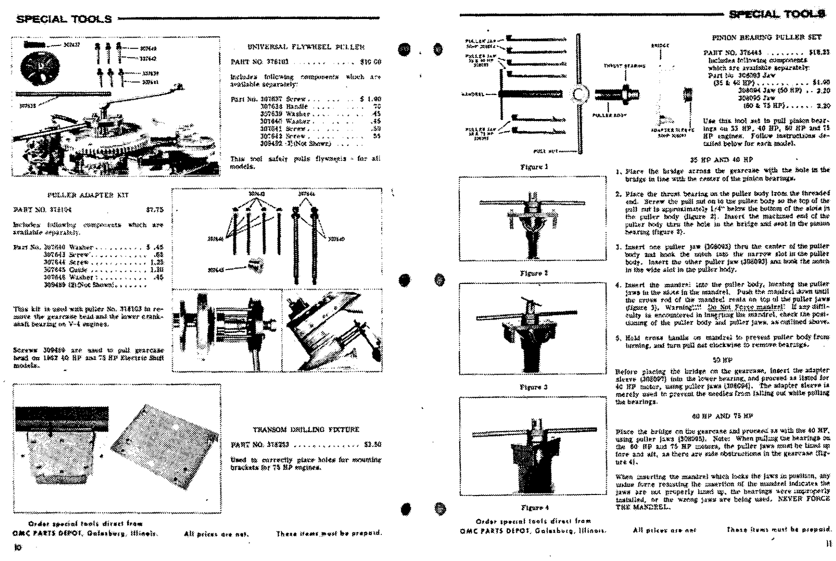
Johnson SERVICE MANUAL

MISCELLANEOUS

INDEX — FOLLOWING PAGE

MISCELLANEOUS INDEX





SPECIAL TOOLS

UNIVERSAL FLYWHEEL PULLER

PART NO. 378103 . . . . $10.00

Includes following components which are available separately:

Part No. 307637 Screw . . . . . . $ 1.90
307638 Handle 70
307639 Washer 45
307640 Washer 45
307641 Screw 50
307642 Screw 55
309492 (2)(Not Shown) . . . . . .

This tool safely pulls flywheels - for all models.

PULLER ADAPTER KIT

PART NO. 378104 $7.75

Includes following components which are available separately.

Part No. 307640 Washer . . . . $ .45
307643 Screw 65
307644 Screw 1.25
307645 Guide 1.10
307646 Washer 45
309489 (3)(Not Shown) . . . .

This kit is used with puller No. 378103 to remove the gearcase head and the lower crankshaft bearing on V-4 engines.

Screws 309489 are used to pull gearcase head on 1962 40 HP and 75 HP Electric Shift models.

TRANSOM DRILLING FIXTURE

PART NO. 378253 . . . . $3.50

Used to correctly place holes for mounting brackets for 75 HP engines.

Order special tools direct from OMC PARTS DEPOT, Galesburg, Illinois. All prices are net. These items must be prepaid.

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SPECIAL TOOLS

PINION BEARING PULLER SET

PART NO. 378443 . . . . $18.25

Includes following components which are available separately:

Part No. 308093 Jaw (35 & 40 HP) $1.90
308094 Jaw (50 HP) . . 2.20
308095 Jaw (60 & 75 HP) 2.20

Use this tool set to pull pinion bearings on 35 HP, 40 HP, 50 HP and 75 HP engines. Follow instructions detailed below for each model.

Figure 1

Figure 2

Figure 3

Figure 4

35 HP AND 40 HP

1. Place the bridge across the gearcase with the hole in the bridge in line with the center of the pinion bearings.

2. Place the thrust bearing on the puller body from the threaded end. Screw the pull nut on to the puller body so the top of the pull nut is approximately 1/4" below the bottom of the slots in the puller body (figure 2). Insert the machined end of the puller body thru the hole in the bridge and seat in the pinion bearing (figure 2).

3. Insert one puller jaw (308093) thru the center of the puller body and hook the notch into the narrow slot in the puller body. Insert the other puller jaw (308093) and hook the notch in the wide slot in the puller body.

4. Insert the mandrel into the puller body, locating the puller jaws in the slots in the mandrel. Push the mandrel down until the cross rod of the mandrel rests on top of the puller jaws (figure 3). Warning!!! Do Not Force mandrel! If any difficulty is encountered in inserting the mandrel, check the positioning of the puller body and puller jaws, as outlined above.

5. Hold cross handle on mandrel to prevent puller body from turning, and turn pull nut clockwise to remove bearings.

50 HP

Before placing the bridge on the gearcase, insert the adapter sleeve (308097) into the lower bearing, and proceed as listed for 40 HP motor, using puller jaws (308094). The adapter sleeve is merely used to prevent the needles from falling out while pulling the bearings.

60 HP AND 75 HP

Place the bridge on the gearcase and proceed as with the 40 HP, using puller jaws (308095). Note: When pulling the bearings on the 60 HP and 75 HP motors, the puller jaws must be lined up fore and aft, as there are side obstructions in the gearcase (figure 4).

When inserting the mandrel which locks the jaws in position, any undue force resisting the insertion of the mandrel indicates the jaws are not properly lined up, the bearings were improperly installed, or the wrong jaws are being used. NEVER FORCE THE MANDREL.

Order special tools direct from OMC PARTS DEPOT, Galesburg, Illinois. All prices are net. These items must be prepaid.

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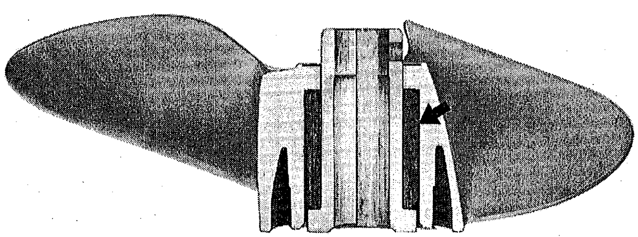
Due to many highly refined features on present-day outboards, it often becomes necessary for the technician to call on the assistance of special tools, i.e., Pullers and Installers for Bearing, Tru-arc Snap Ring Pliers, Seal and Grommet Removers and Installers, etc., which enables him to perform repairs more accurately and more readily. The "OMC Tool Catalog" lists various special tools other than the normally required bench tools necessary for disassembling and assembling Johnson Outboard Motors.

NOTES

NOTES

THE PROPELLER — HUB ASSEMBLY



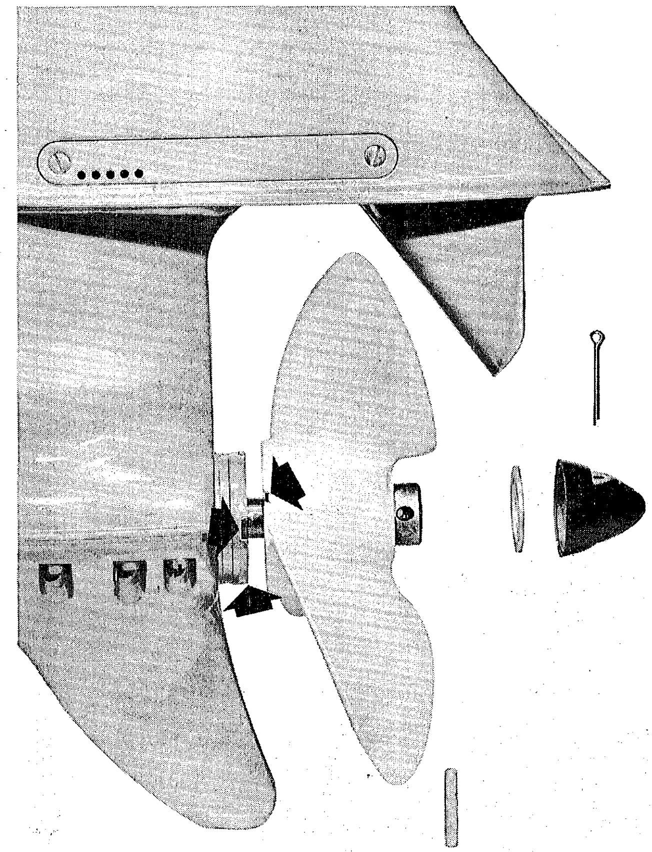
The Shock Absorber — Slip Clutch Propeller Models QD, FD and RD.

A further change was made in assembly of the propeller and rubber insert, which formerly acted as a shock absorber only but now permits it to function as both a shock absorber and slip clutch. The change is actually not perceptible on observation since it's largely a matter of having changed the tension or "grip" of the rubber insert against the propeller hub; the new propeller, nevertheless, may be identified by the line cutting slots in the propeller hub — leading edge. Current for 1957.

In original design, grip of the rubber insert on the propeller hub was of sufficient tension to permit shock of striking an underwater obstruction being absorbed only by the resultant "give" in the rubber inserted between the propeller and brass hub "pinned" (drive pin) to the propeller shaft.

The new design is calibrated to achieve like action under moderate shock condition, but in event of excessive shock, as much of the load as possible, is absorbed by "give" in the rubber insert but beyond this, the insert is permitted to turn or "slip" momentarily in the propeller hub as a safeguard against shearing of the propeller pin.

See subsequent Service Bulletins relating to specific propeller installation for each model.



The Weed and Line Cutter.

During midyear (1956) production of Models JW, CD, AD, QD, FD and RD series, a change was made in the gearcase and propeller — change in the gear case and propeller as shown here to accommodate the weed and line cutter and current for 1957.

The weed and line cutting arrangement consists of three square slots cast into the leading edge of the propeller hub and an extension of the gear case into which four similar slots are cast.

In principle, the propeller (hub) revolves around the closely fitted, slotted extension on the gear case. Consequently, should the propeller "pick up" a line or weed and either tends to wrap itself between the gear case and propeller to interfere with performance, it's "caught" and broken by the slots in the propeller hub and gear case extension before damage can be done.

PROPELLERS—OFF PITCH OR DAMAGED BLADES

Not to be overlooked when in process of diagnosing motor difficulties is condition of the propeller. Excessive vibration, faulty or irregular operation for no apparent reason may often be attributed to damaged or "off" pitch propeller blades as result of striking underwater obstructions.

When confronted with a situation of this sort, look to the propeller as the possible disturbing factor prior to going too far into the motor assembly for corrective measures.

As off pitch propeller blade frequently reveals symptoms of motor performance ordinarily associated with faulty ignition and/or carburetion—rough or "ragged" running throughout intermediate ranges with increasing roughness and vibration at top and near top speeds.

Casual observation generally will not divulge off pitch propeller blades, unless badly bent, thus the only assurance of true pitch is checking and correcting, if necessary, on a "pitch block" (propeller straightening fixture.)

PROPELLER STRAIGHTENING FIXTURES

Part No.	Description
376103	Model TN Series
376104	Model QD-10 through 17
376106	Model RD-10 through 18 – 10$\frac{3}{8}$×12½
376108	Model CD Series
376110	Model AD Series
376112	Model FD and FDE-10
376933	Model QD-18
376934	Model FDE-11 and 12, FD-11, 12, 13, 14, 15, 16
376951	Model RD, RDE and RJE-19, RD, RDE-19C, RD-21, 22, RDS-20, 21, 22, RK-24 – 10$\frac{3}{8}$×13¼
376952	Michigan Wheel AMC383
377537	Model QD-19, 20, 21, 22, 23
377539	Model RD-10-19C, RDE-16-19C, RDS-20, RX-10C Optional Propeller No. 378581 – 10$\frac{3}{8}$×11½
378136	Model RD, RDS-23, 24M – 10$\frac{3}{8}$×14

Checking and Correcting Propeller Blade Pitch

Contour face of the propeller straightening fixture (pitch block) represents true pitch of each propeller blade, thus, if propeller pitch is correct, each blade will lie "flat" against the pitch face.

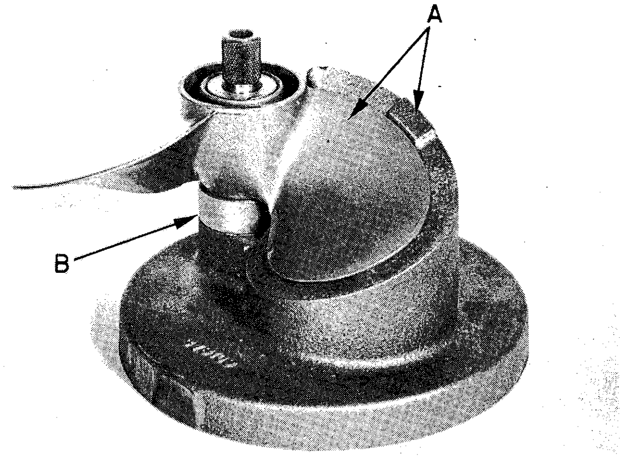


Figure 1.

To check and correct propeller pitch, proceed as follows:

1. Install propeller on fixture as shown Fig. 1. Make sure propeller hub seats at base of spindle (B) and that leading edge of the propeller blade rests firmly against guide as indicated by arrows "A." Any variation or "off pitch" will be in evidence where blade area does not conform to pitch face of fixture. (An adapter or bushing is used to locate the propeller on some fixtures—do not fail to insert where provided.)
2. Carefully strike "high" area of blade with rawhide or lead mallet to flatten against pitch face.
3. In event the blade cannot be "flattened" by this procedure—place a leather pad (about 3 inches wide and 1/8 inch thick) under low area as shown Fig. 3. Strike high blade area carefully

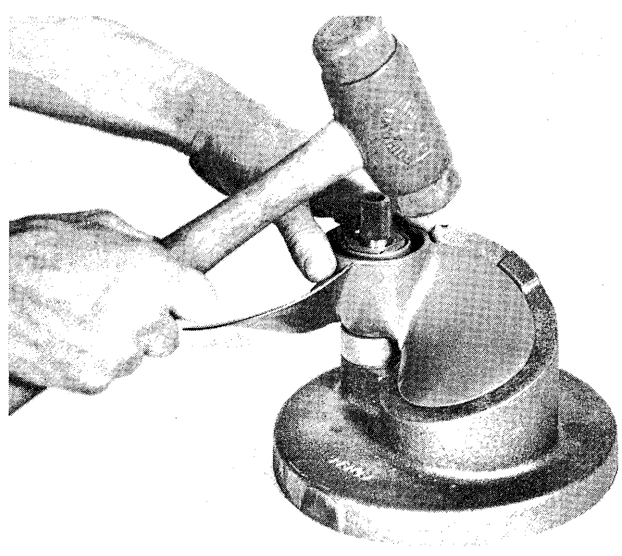


Figure 2.

with mallet to drive against pitch face.

4. Remove leather pad and recheck as shown Figure 1.

5. Repeat procedure until blade lies flat against the pitch face.

6. Perform same operations for each propeller blade.

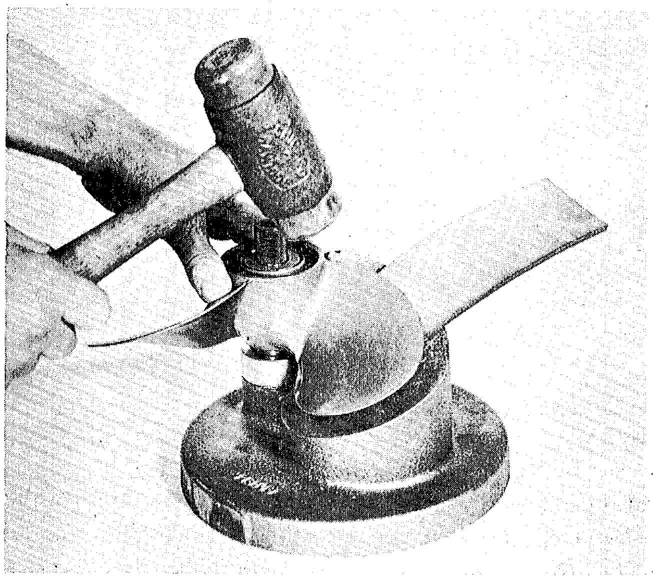
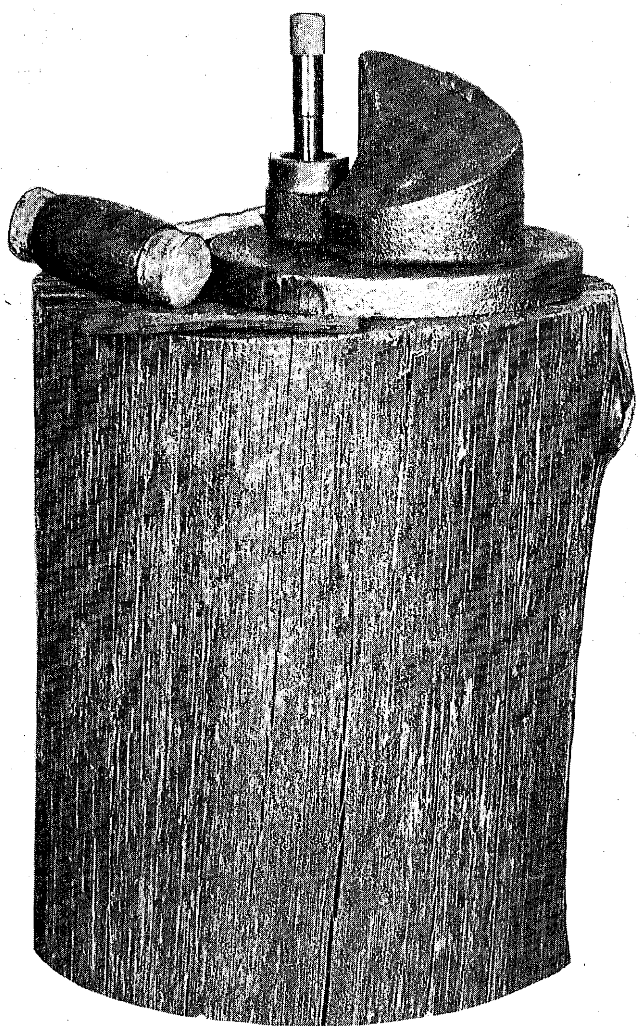


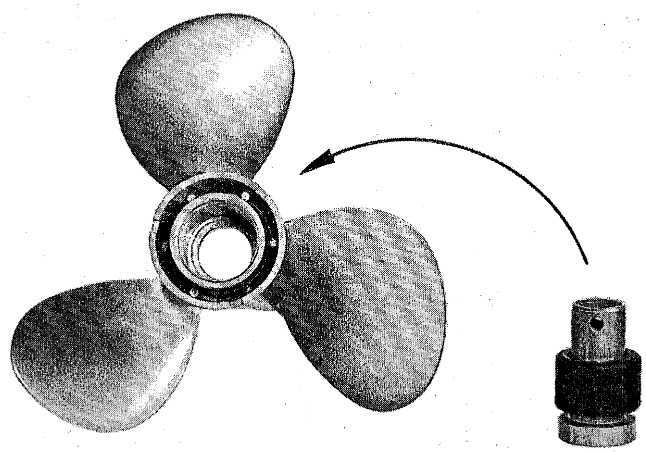
Figure 3.



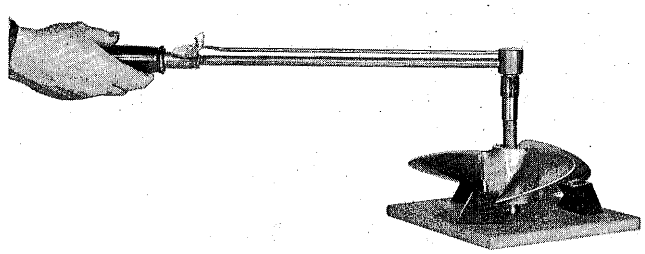
A tree stump for Propeller straightening to provide solid footing.

The torque values required to test propellers for hub slippage using propeller torque fixture No. 378448 are listed as follows. Should hub slippage occur at less than the torque specified to cause slippage the propeller should be replaced.

H.P.	Model	Prop. No.	Slip Torque Ft.-Lbs.
10	QD Series	277585	65 - 100
—	— —	277595	65 - 100
—	— —	377083	84 - 104
—	— —	377635	84 - 104
15	FD Series	All	65 - 100
18	FD Series	All	65 - 100
25	RD Series	All	150 - 210
28	RX Series	All	150 - 210
30	RD Series	All	150 - 210
35	RD Series	All	150 - 210
40	RD Series	All	150 - 210
40	RK Series	All	150 - 210

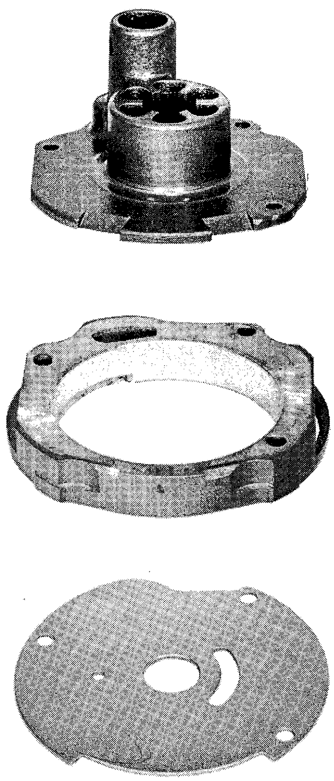


Showing Propeller and Propeller Hub Molded Rubber insert.

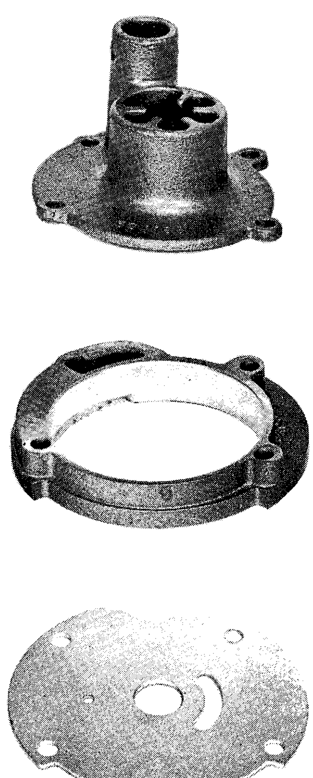


Checking Torque required to cause Clutch Hub to slip.

The slip clutch hub design is a feature intended to allow the propeller to stop momentarily if an obstruction is hit by one of the blades, minimizing the possibility of damage to the gears shafting or powerhead from the sudden impact. The force required to cause this slippage must be greater than the torque specified in the previous chart so that the propeller will not slip in normal operation.



No. 376436



No. 376509

CHROME PLATED PUMP ASSEMBLIES FOR SILT OR SAND LADEN WATERS

There are some areas where there is a high content of silt or sand in the water that may shorten the life of standard water pumps, due to excessive wear.

We have developed a water pump, as an accessory, that will practically eliminate any wear from silt and should be suggested to motor owners who operate motors in such waters.

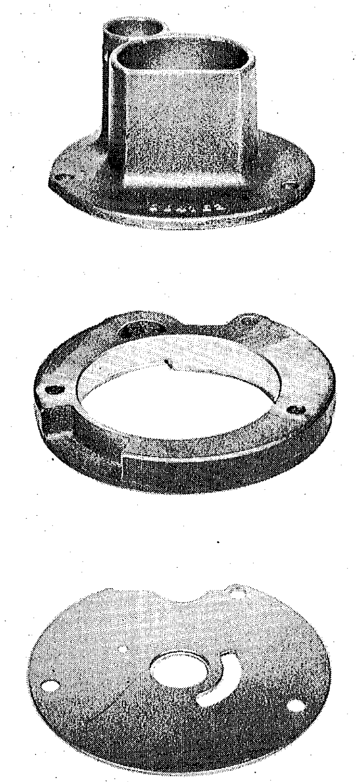
It differs from the standard pump in construction as well as material. The body parts are bronze, and it is chrome-plated on the inside wearing surfaces. It is suitable for either fresh or salt water use.

Installation is the same as standard water pump.

No. 376436 Chrome Pump CD-10 through CD and AD Series
No. 376509 Chrome Pump QD-14 through 18H, 17R and FD, FDE-10 Up
No. 376356 Chrome Pump RD-10 through RD, RDE-16A (not shown)
No. 376435 Chrome Pump RD and RDE-17 through 19C

Note: Gasket No. 303509 is included with No. 376356 assembly which is to be installed between the gearcase and exhaust stack.

Order Part No. 376436 Sea Horse 5½
Order Part No. 377449 Sea Horse 10
Order Part No. 376509 Sea Horse 18 and Electramatic 18
Order Part No. 376435 Sea Horse 28
Order Part No. 378746 Super Sea Horse 40
Order Part No. 378746 Super Sea Horse 40 Electric Shift



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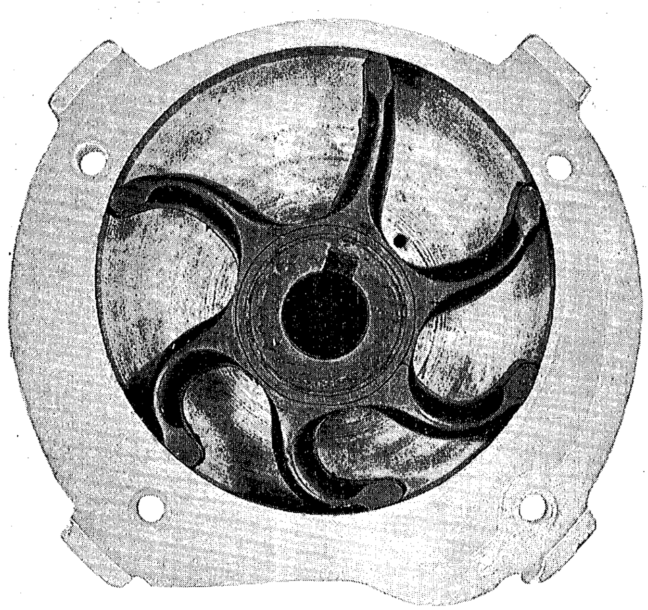
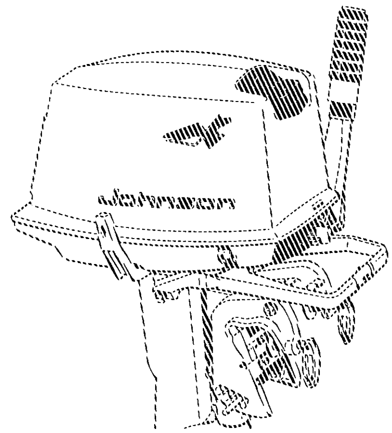


Water Pump Impeller.

Under no circumstances should the motor be run dry (out of water). It may be rather tempting, when after completing an installation of a motor on a boat, to start and run the motor dry for the purpose of checking electrical hookup. We urge you emphatically to desist from such practice — to avoid permanent damage to the pump impeller. Perform all trial checks with motor in the water.

NOTES



REMOTE CONTROL ADAPTER KIT FOR

JOHNSON SEA-HORSE MODELS CD AND QD (1962)

This remote control adapter kit completes your motor for attaching remote shift controls. Provisions for attaching throttle and steering remote control are already on the motor.

Follow these instructions for a quick and easy installation.

1. Mount the motor on a stand and remove the motor cover assembly, (refer to the owner's manual).

2. Place the shift control boss in the area provided on the starboard side of the lower motor cover. Slide the boss up against the cover bead and forward to the raised shoulder, see figure 1.

3. Hold the shift control boss in this position and mark the location of the mounting hole on the lower motor cover. Locate the center of the hole and center punch it, see figure 1.

4. Drill a 7/32 inch diameter hole through the cover and square with the mounting surface.

5. Mount the shift control boss on the lower motor cover with the screw and nut provided and tighten securely in the position described in step 2. See figure 2.

6. Replace the motor cover assembly (refer to the owner's manual). Your motor is now ready for installation of Johnson Remote Controls.

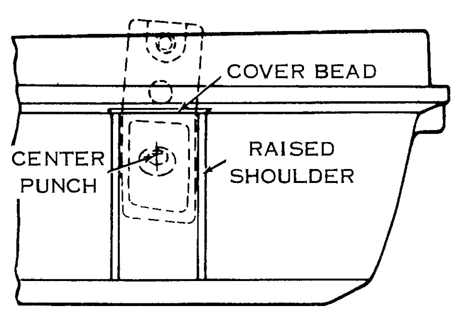


Figure 1

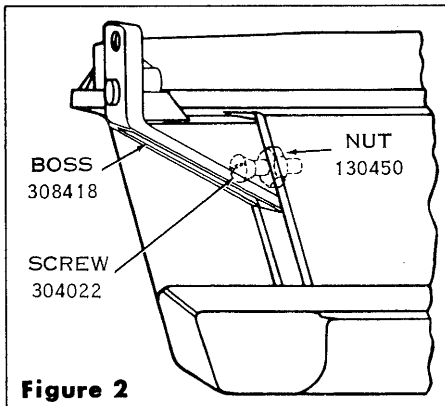


Figure 2

NOTES

INSTALLATION INSTRUCTIONS

FILTER PRIMER KIT

Figure 1

The Filter Primer Kit is designed to replace or supplement the standard portable fuel tank, furnished with your motor, where the greater capacity of a larger fuel tank or a custom (built-in) tank is desired.

The Filter Primer Kit consists of a filter-primer, flexible tubing and fuel connector assembly. Also, included are a clamp and screw for securing the flexible tubing to the boat.

The filter-primer assembly includes a brass filter element of ample size (enclosed in a glass bowl) which filters out water and foreign particles from the fuel mixture, and a push-button primer mounted on top of the assembly. By depressing the push-button a few times, sufficient fuel is forced into the carburetor to start the motor so that the engine fuel pump can take over. The filter-primer assembly also includes fittings for connecting copper tubing leading from the auxiliary fuel tank, (copper tubing is not included in the kit).

The fuel tank is not included in the kit. This phase of the installation is left to the designer/builder of the craft or the owner.

IMPORTANT

It is urged that you follow these recommendations where ever you may be operating and if the craft is to be used on waters under Federal jurisdiction, check with the nearest Coast Guard Station for current regulations governing installation. In addition, refer to the manual of "Fire Protection Standards for Motor Craft" published by the National Fire Protection Association, 60 Batterymarch Street., Boston 10, Massachusetts.

INSTALLATION INSTRUCTIONS - SINGLE TANK

1. Install the Filter-Primer assembly as illustrated in Figure 2 and on the following pages. The Filter-Primer has a primer button (shown being depressed) to force the initial charge of fuel mixture to the carburetor. This will be sufficient to start the motor, after which the engine fuel pump will take over.

2. Locate Filter-Primer unit higher than the top of fuel tank to prevent possibility of fuel draining in boat bilge due to leaky bowl gasket or bowl breakage, also for access to easy priming.

3. Check engine for complete freedom of steering when flexible fuel line is attached to engine.

4. For Twin Tank - Twin Motor application, see Figure 3 and the instructions on the following pages. The Jumper Line Valve is kept shut unless one of the tanks run dry. In that event, close the Fuel Tank Shut-Off Valve to the empty tank, and open the Jumper Line Valve. The Jumper Line, Valve and Fuel Line Connector are available through your Dealer.

NOTE

Flaring tools for preparation of copper tubing are ordinarily available through local automotive, marine hardware, oil burner or refrigeration supply houses.

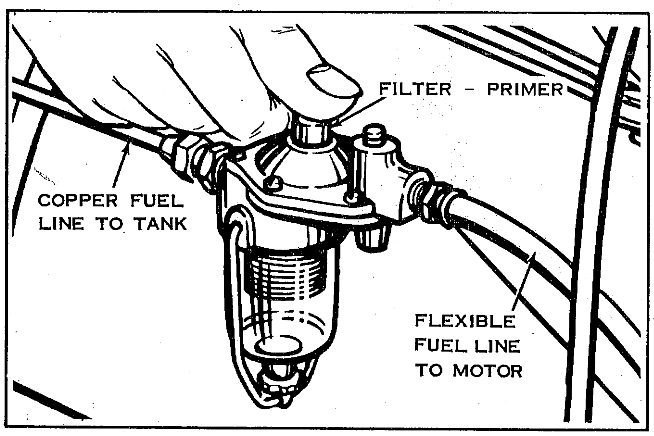


FIGURE 2
Filter Primer

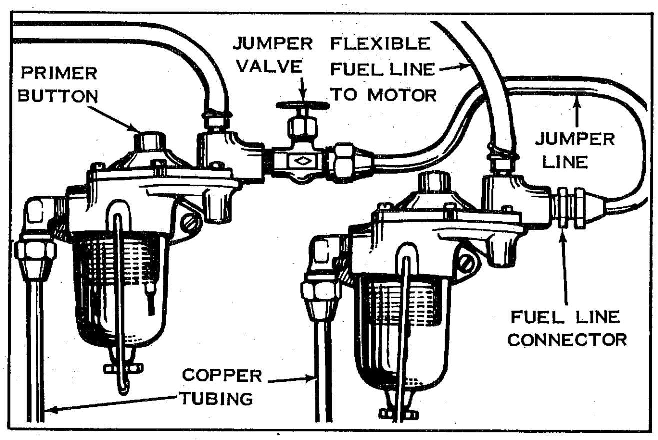


FIGURE 3
For Twin Tanks

GENERAL INSTALLATION INSTRUCTIONS FOR FUEL SYSTEMS

A. Install all shut-off valves so as to be easily accessible in case of emergency.

B. All copper tubing should be 3/8 O.D., annealed copper, with a wall thickness of .049.

C. Use flared type fittings on all copper tubing connections.

D. Clamp all copper tubing to minimize vibrations. Clamps should have no sharp edges.

E. Mount fuel tank as low as possible in boat and symmetrical with the keel.

F. Filter-Primer Assembly should be mounted so that its outlet is higher than top of the fuel tank.

G. Cement all the pipe thread connections with gasoline resistant cement. (Gasoila is recommended.)

H. Locate the flexible hose to eliminate any possibility of cutting or crimping of the hose when motor is turned.

I. Clamp all flexible hose connections securely.

J. The entire fuel line should be inclined upward from the tank to the motor. Avoid loops and humps as much as possible.

K. Place tank shut-off valve at top of tank for easy accessibility and to minimize any leakage through a faulty or worn valve.

L. Ground the fuel tank to a metal strip fastened on keel or to an unpainted copper ground plate of about 48 sq. in. area or a sintered bronze plate of the equivalent area attached to bottom of boat below water level, adjacent to keel.

M. Fuel tank must be vented outside of boat.

N. Locate the fuel tank filling spout above deck (not inside cabin). If filler spout is connected to fuel tank by means of a rubber or other non-metal tubing, filler spout must be grounded to fuel tank. Use a heavy flexible ground lead.

MIXING FUEL IN LARGER QUANTITIES

For larger capacity fuel tanks, follow these mixing instructions carefully to make sure the motor or motors receive proper lubrication. These recommendations apply to Outboard Marine Engines.

Suppose the tank capacity is 24-gallons. At a ratio of 1 to 24, the quantity of oil needed would be 4 quarts. Adding 4 quarts of oil to the tank before or after the gasoline would surely result in improperly mixed fuel. Therefore a portion of the fuel should be premixed before it is put into the tank.

The premix can will sometimes be carried aboard, so we will consider the smallest can that will do the job efficiently. A 2 gallon can will work out nicely. First pour 4 quarts of oil and 1 gallon of gas into the premix can. Mix thoroughly, then pour into fuel tank. Then add 23 gallons of gas to the fuel tank and the mixture is properly prepared.

NOTE

Oil that has been premixed by using equal parts of oil and gasoline or less oil than gasoline will disperse uniformly when additional gasoline is added. However, oil that has been premixed in a ratio of more oil than gasoline will not readily mix and disperse uniformly. Therefore never premix in a ratio of more oil than gasoline. Example: Never premix 3 quarts of oil and 2 quarts of gasoline.

The two gallon premix can will usually be large enough, since for replenishing fuel in the fuel tank you will usually use a quantity less than 20 gallons.

The following table will cover most refueling situations.

MIXTURE TABLE

SIX GALLON MIXTURE

Premix - 1 quart oil to 1 gallon gas
Add - 5 gallons of gas

TWELVE GALLON MIXTURE

Premix - 2 quarts oil to 1 gallon gas
Add - 11 gallons of gas

EIGHTEEN GALLON MIXTURE

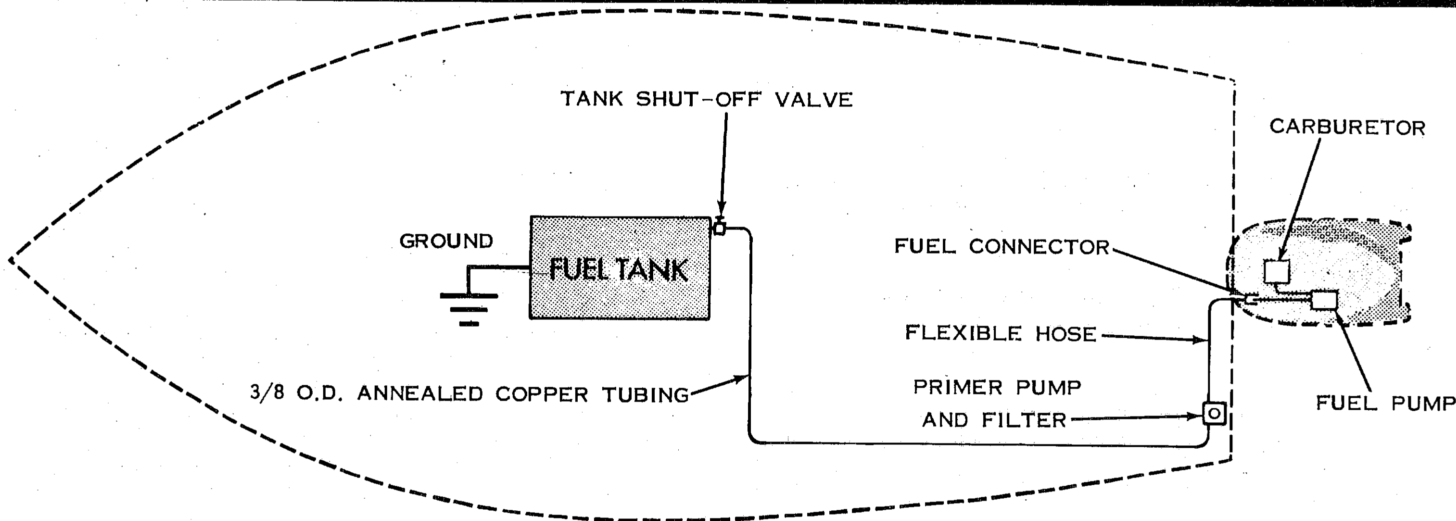
Premix - 3 quarts oil to 1 gallon gas
Add - 15 gallons of gas

TWENTY-FOUR GALLON MIXTURE

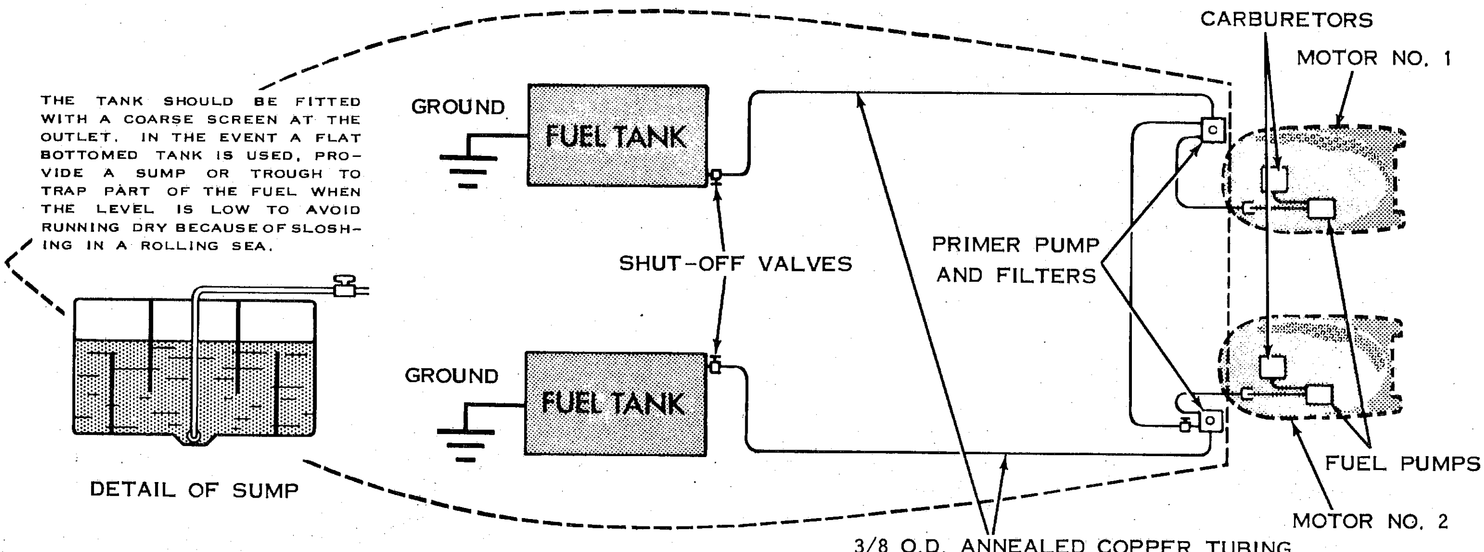
Premix - 4 quarts oil to 1 gallon gas
Add - 23 gallons of gas

REFER TO OWNER MANUAL SUPPLIED WITH YOUR MOTOR FOR OIL AND GASOLINE RECOMENDATIONS

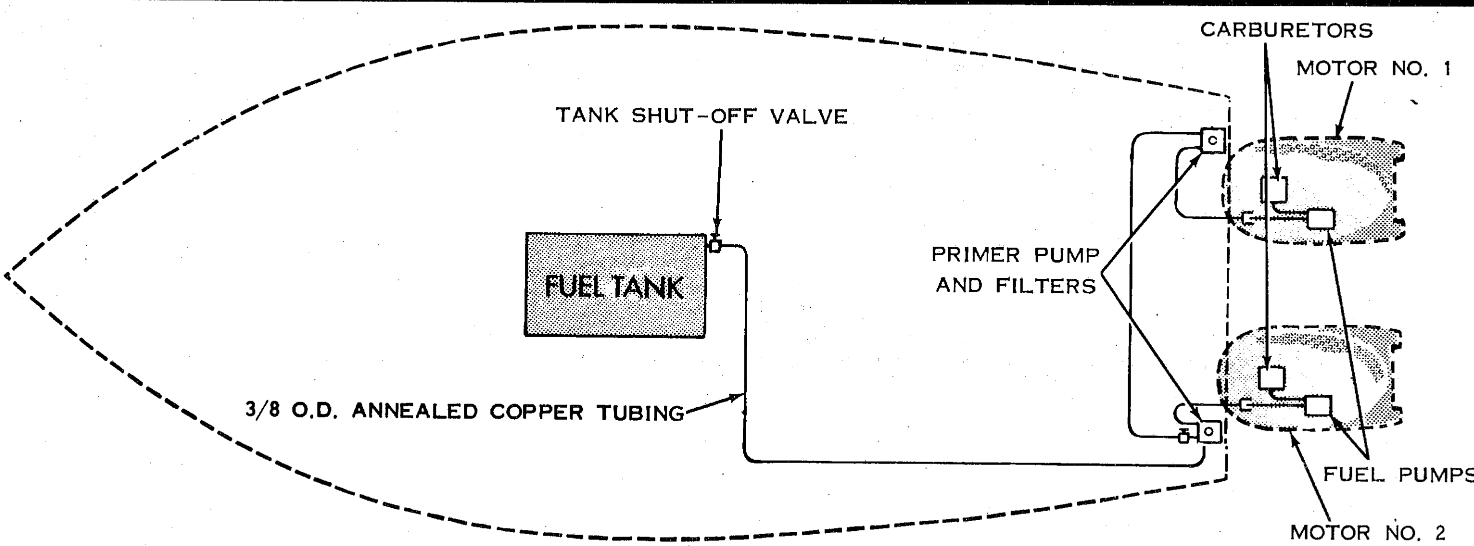
SINGLE TANK...SINGLE MOTOR INSTALLATION



TWIN TANK...TWIN MOTOR INSTALLATION



SINGLE TANK...TWIN MOTOR INSTALLATION



Fuel Tank Pump.

Illustrating Fuel Tank Drainage with Fuel Tank Pump. Note static Ground Wire (arrow) – a safety feature to eliminate static sparking.

Illustrated above is a substantially constructed and most practical fuel tank pump – a unit to drain every last drop of fuel mixture from the tank in but a minute or two prior to off-season storage.

The tank is too often neglected during tune-up and/or preparation for storage. While the motor may be in excellent mechanical and operating condition, faulty performance at the beginning of the season can frequently be traced to a quantity of "last year's gas" still remaining in the tank.

Petroleum gum and varnish characteristically precipitate with aging fuel mixture – an ailing mixture not only to clog screen and small orifices but to interfere with starting and normal running until content of the tank has eventually been consumed and as such, much to the owner's disgust – your customer.

A situation of this sort unfortunately is apt to create bad relations with the owner until the condition is explained and corrected, however, at some considerable expense to you. But, why not prevent it from occurring at all by simply draining and flushing the tank when the occasion first presents itself.

Start every owner out each season with a clean tank and a fill of fresh fuel mixture as economy of operation and retaining good owner relations.

Permanently installed tanks, too, should be given the same treatment for the very same reason.

MANUAL STARTER
1. STARTING CORD
2. REWIND SPRING – GREASE

IGNITION
1. SPARK PLUG AND LEADS
2. BREAKER POINTS
3. CONDENSER
4. COIL
5. ALL IGNITION WIRING
6. FLYWHEEL INSTALLATION

THERMOSTAT
1. CLOGGED
2. FAULTY-OPEN

FUEL PUMP
1. DIAPHRAGM
2. CHECK VALVES
3. PRESSURE AND FUEL LINES

POWERHEAD
1. REMOVE CARBON (Cyl. Hd. and Pistons)
2. PURGE WITH SOLVENT TO REMOVE GUM OR VARNISH
3. CHECK NUTS, SCREWS FOR SECURITY

WATER INLET

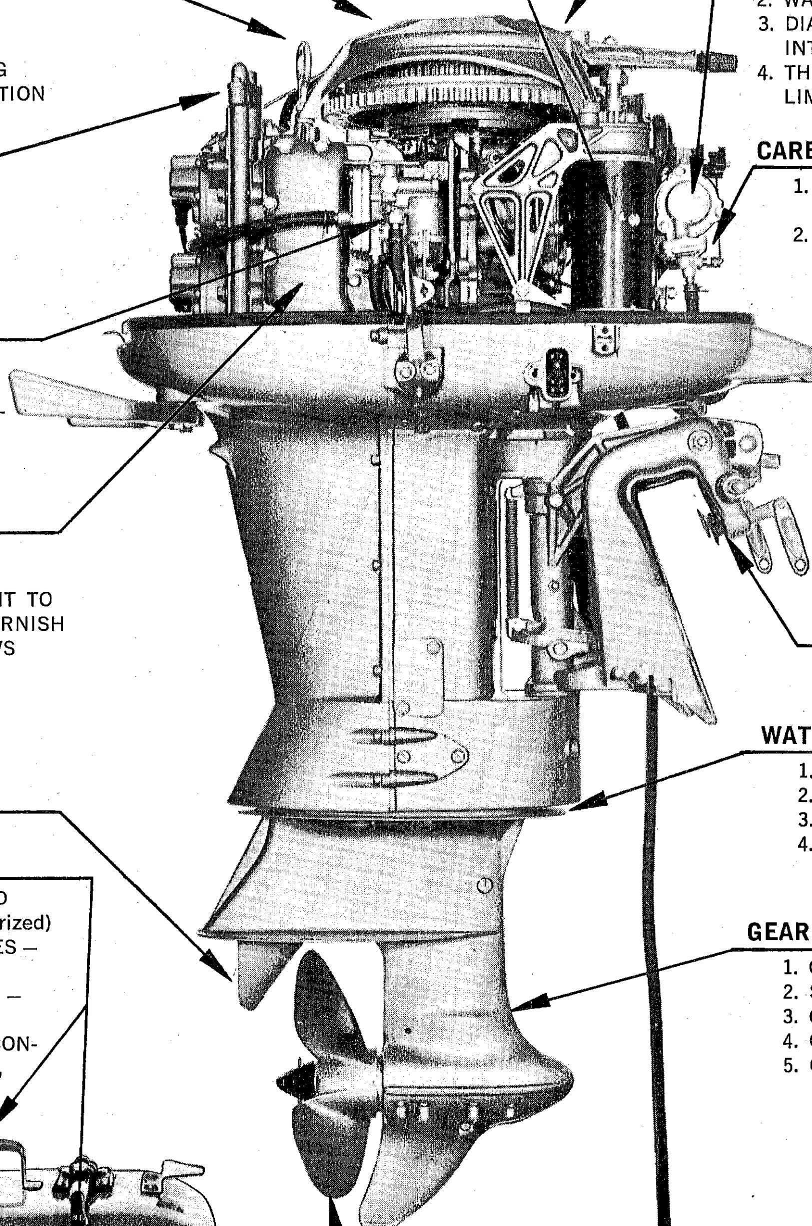
FUEL TANK
1. SCREEN OBSTRUCTED
2. DIAPHRAGM – (Pressurized)
3. FUEL AND AIR VALVES – (Non-pressurized)
4. FAULTY VALVE DISCS – (Pressurized)
5. FAULTY FUEL LINE CONNECTOR – FUEL LINE, PRIMER BULB
6. FAULTY TANK

ELECTRIC STARTER
1. WIRING
2. BRUSHES
3. COMMUTATOR
4. FIELD
5. WIRING

AUTOMATIC CUT-OUT
1. LOOSE WIRES
2. PUNCTURED DIAPHRAGM
3. FAULTY CONTACT
4. FAULTY SPRING
5. SALT WATER CORROSION
6. WIRING

AUTOMATIC CHOKE
1. CHOKE (Shutter) ACTION
2. WATER CONNECTIONS
3. DIAPHRAGM AND TUBE TO INTAKE MANIFOLD
4. THERMAL ELEMENT AND LIMITED ADJUSTMENT

CARBURETOR
1. REMOVE AND CLEAN (Sediment, Gum, Varnish)
2. CHECK OR REPLACE:
   - A. Float
   - B. Float Valve Assem.
   - C. Float Level
   - D. Needle Valves (Packing – Adjust)
   - E. Filter Element
   - F. Spark/Gas Sync.



SWIVEL BRACKET AND CONTROLS
1. GREASE

WATER PUMP
1. IMPELLER
2. IMP. HOUSING
3. PLATE
4. WATER CHANNELS

GEARCASE
1. GEAR AND BRG. ASSEM.
2. SHIFT LINKAGE
3. CLUTCH DOG
4. OIL LEAK
5. OIL LEVEL

PROPELLER
1. PIN AND RETAINER
2. PROPELLER BLADE
3. PROPELLER PITCH

SUGGESTED TUNE-UP CHART

CHECK LIST

Poor Performance-Lack of Power-Loss of Speed

1. Was engine checked before delivery – test tank – boat?
2. Have you verified the complaint? RPM at full throttle..................................
3. What have you done to correct the problem?
4. Have you checked the following:
   (a) Engine RPM's using a tachometer and test wheel?
   (b) RPM reading, full throttle?..............................
   (c) Timing, synchronizing and full throttle opening?
   (d) High- and low-speed needle valve adjustment?
   (e) Cooling system, automatic choke?
   (f) Correct fuel and oil ratio?
   (g) Spark plugs, magneto, high tension leads?
   (h) Remove intake bypass covers, inspect pistons, rings and cylinder? Marine care if carboned?
   (i) All reed valves for proper clearance and operation?
   (j) Condition of propeller, correct propeller application?
   Pitch.............................. Diameter..............................
   (k) Boat bottom for marine growth, hooks or rocker?
   (l) Remote control for full speed range?

Make of boat..

Total hours used............ Weight loaded.........................

Length................................. Beam.................................

Transom height.................................

Primary use..

Every tune-up and/or repair should among other things include –

1. Draining the operator's fuel tank of existing contents.
2. Replace with a known 1 to 24 fuel mix.
3. A word of advice to the operator for his benefit advocating the use of a reliable 1 to 24 premix during future refills where and whenever available or exercise caution when obtaining manually blended refills – insisting on a precise 1 to 24 mix of high quality outboard oil and nonpremium gasoline.

THE TACHOMETER – RPM Counter

The importance and necessity of a tachometer as an instrument of service equipment cannot be stressed too emphatically – in reality it's the modest assistant that puts the final OK on a job of engine tune-up, repair or installation.

It tells you in the test room whether or not the engine (motor) *with appropriate test wheel installed,* is measuring up to the performance characteristics established for it – by counting the RPM under full throttle running conditions. Should it fall short, it's back to the bench for further diagnosis and corrective steps.

Tachometer – RPM Counter.

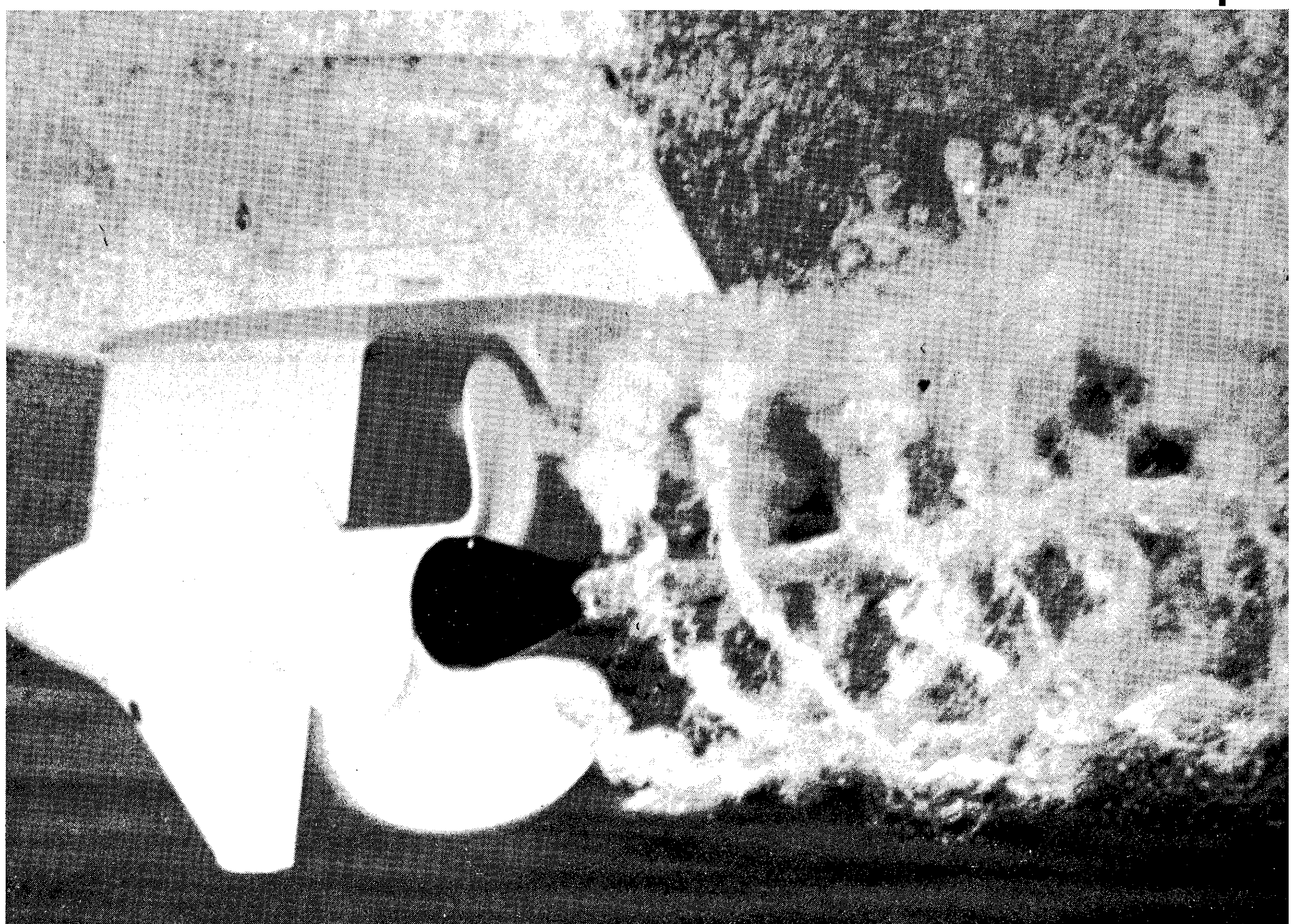
It tells you on boat installation whether or not the propeller selected is correct for the purpose – again by simply counting RPM at full throttle position for maximum performance. And again, should it fall short or over-revolutions it tells you which way to go on the propeller – down pitch or up, assuming the installation to be proper.

It's all a matter of RPM known by tachometer count. It's futile, wasted effort to attempt finalizing carburetor needle adjustments and/or tune-up unless tachometer indicated RPM falls within the factory recommended operating range for top performance. In either the tank or when boat installed, the tachometer is your key to best performance.

Service Promotion Bulletin No. 308 3/28/62

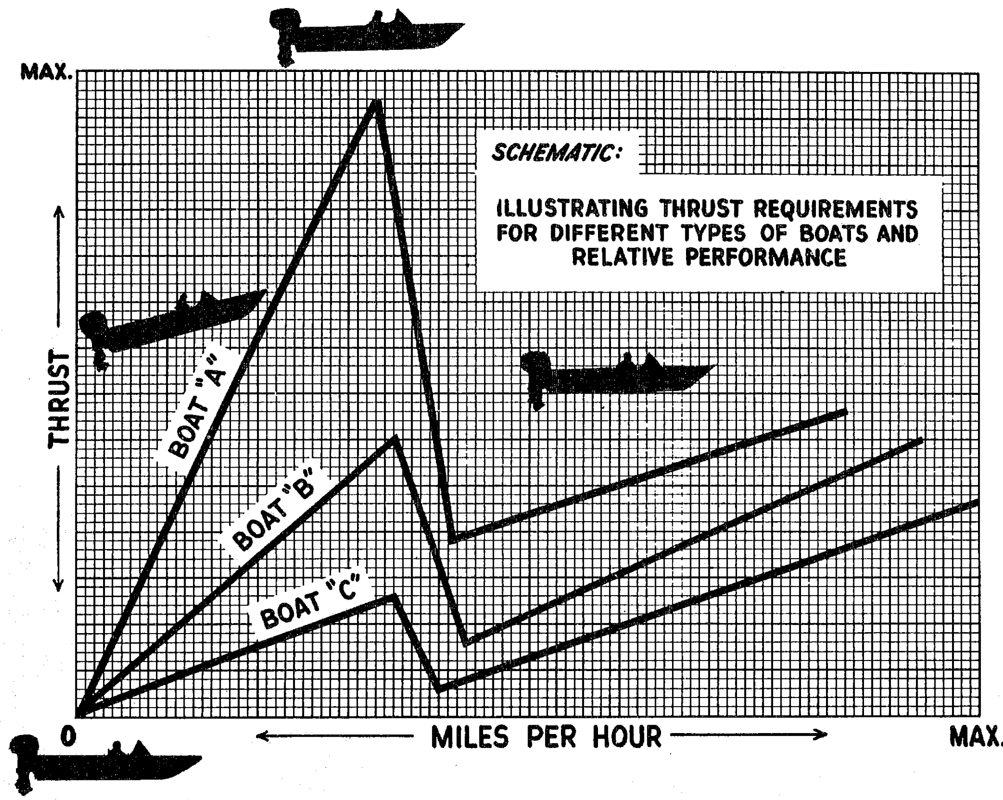
NOTES

Propellers RPM & Performance

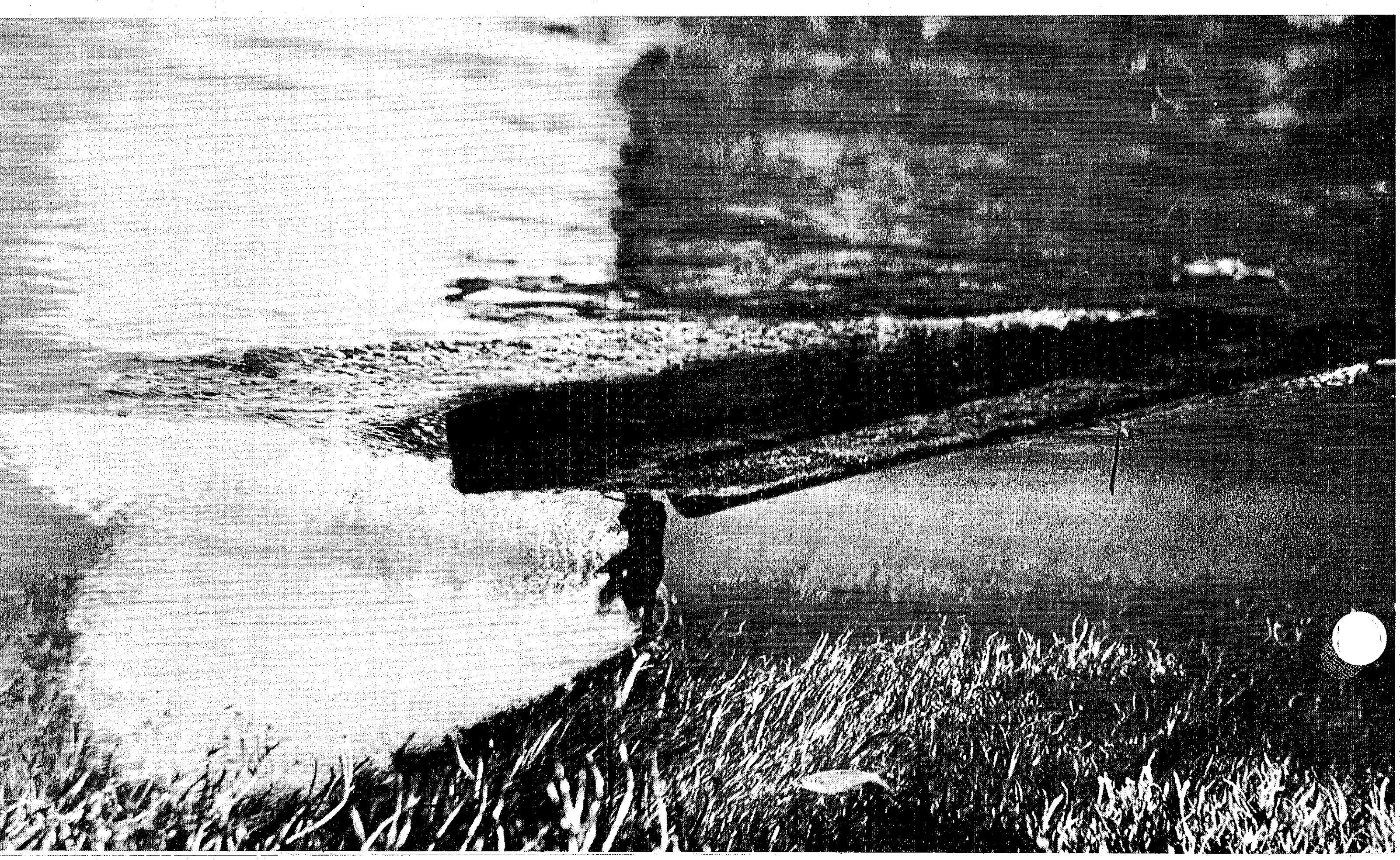


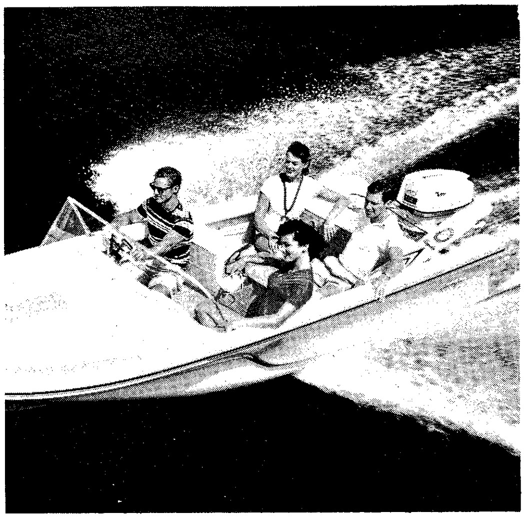
Johnson MOTORS

WAUKEGAN, ILLINOIS



Boat A – Large runabout, Boat B – Medium runabout,
Boat C – Light runabout.





FUNDAMENTALS RELATING TO OUTBOARD MOTOR PERFORMANCE AS AFFECTED BY THE PROPELLER INSTALLATION.

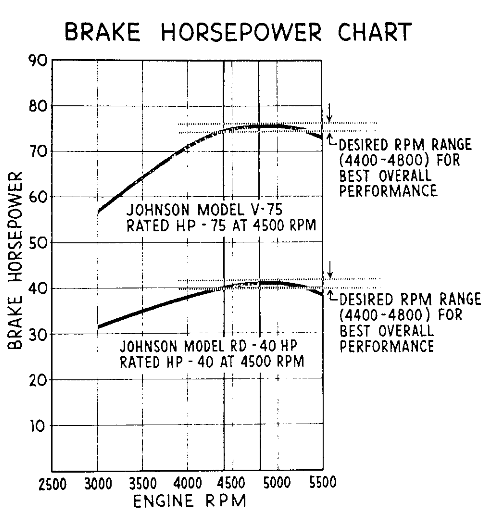
For a number of years, the propeller provided as standard equipment with Johnson Motors, in the 25 and 35 horsepower group particularly, performed quite effectively for average overall service and as such not to much thought was given the installation. But, with the advent of increased horsepower (RD, 40 h.p. and V-4, 50/75 h.p.) and the ever widening scope of outboard use from the light runabouts to the heavier loaded cruisers and water skiing, the proper selection of a propeller best suited for a specific unit and type of service becomes a predominant factor in realizing maximum capacity of the motor and over all performance.

Since load applied to the motor is largely governed by pitch and diameter of the propeller, specifications of the propeller selected for a given unit to achieve maximum performace ought to be of such as to permit its turning at full open throttle and under normal load to RPM falling within the peak range recommended for the model. RPM normally tends towards falling off with additional load and increasing with lessening of the load carried. Otherwise, excessive pitch for the installation acts to hold the motor RPM down - below that recommended. A propeller of less pitch than required acts conversely to permit excessive RPM - beyond that recommended.

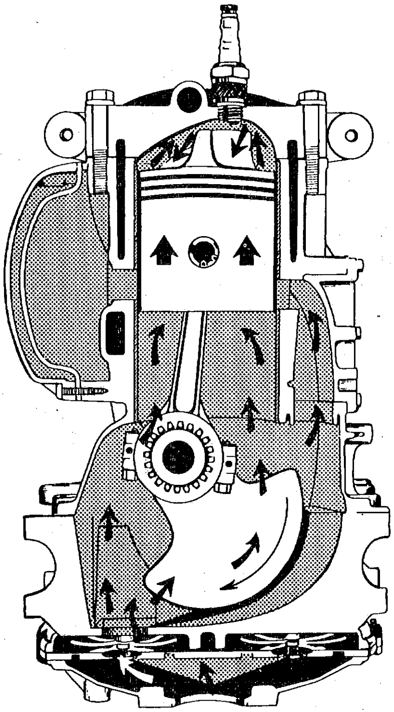
Recommended RPM range for peak performance model RD-40 4400 to 4800
Recommended RPM range for peak performance model V4-75 4400 to 4800

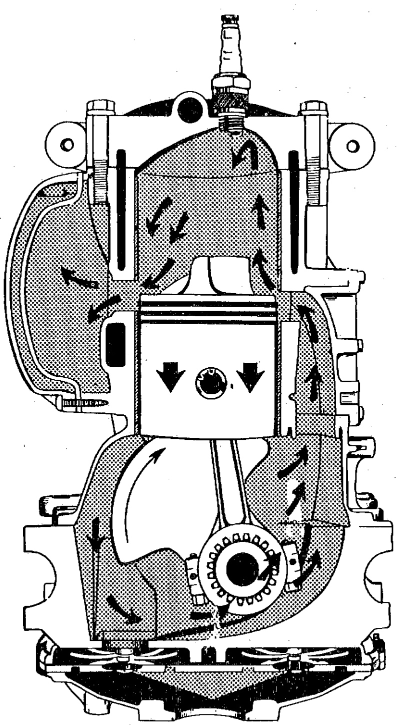
Of interest at the moment. On dynamometer test, it is found that the horse power developed by a reciprocating internal combustion engine progressively increases (tho not in direct proportion) with increasing RPM but, only so up to a certain critical point (known as peak horse power range) beyond which it commences to fall off rapidly as later explained.

It does not necessarily hold that an engine (motor) capable of developing say 40 H.P. at its established RPM range for best performance will develop 20 h.p. at half engine speed or 30 H.P. at three fourths engine speed - "fall off" in this respect is not directly proportionate to falling RPM. From this, the significance of maintaining as nearly as possible (by correct propeller installation) recommended RPM for the model should not be to difficult to understand.



Various conditions of operation, boats and boat loads enter the picture and come in for consideration.





Characteristically, a given engine develops zero horsepower at zero RPM but commences to deliver the instant it starts running and continues doing so progressively until its rated horsepower has been attained at a range (RPM) established by characteristics of its design and construction for best performance. This presents us with two questions, mamely -

1. What causes the engine to develop progressively more power with increased RPM and -

2. What causes the delivered power fall off when RPM have been extended beyond the critical period in RPM range.

In effect, increasing RPM is much like extending the length of a lever - the further distant from the fulcrum the greater the lifting power. For purpose of explanation, a single cylinder two (stroke) cycle engine delivers one power impluse (stroke) per each revolution. Now, if its stroke is 6" and the engine is operating at 1000 RPM, the piston on its combined power strokes has traveled five hundred feet per minute; when running at 2000 RPM, the piston mathematically has traveled a distance of 1000 feet to deliver power, thus increasing the leverage to subsequently result in greater lifting ability - simply a matter of more power impluses per minute. Basically, the greater the engine speed the greater the leverage or power developed - but, breathing and internal resistance are factors of mention affecting characteristics of engine performance.

Breathing when associated with reciprocating internal combustion engines is a term employed to describe the conduct of fuel vapor passing through the engine - from beginning to the end of the cycle or through induction (intake) compression, combustion (power) and exhaust.

To illustrate - volumetrically, a single cylinder engine of 19 cubic inch displacement should at cranking speeds with the carburetor shutter full open, draw or "take in" 10 cubic inches of fuel vapor for compression and combustion on each downward stroke of the piston. But, with starting and running under its own power, there is the matter of fuel vapor inertia and friction to overcome as RPM increase progresses. Normal tendency of matter is to remain motionless until energy is applied to move it and/or to continue in motion unless energy is applied to stop it - inertia.

Friction is known to exist between the incoming fuel vapor charge and the walls of the intake manifold, the cylinder and in the two (stroke) cycle engine, the transfer channels. Both fuel vapor inertia and friction as such exert their effects on engine performance since both require time and energy to over come. Time in this instance is controlled by the rate (RPM) at which the piston passes thru the cylinder wall port area on its up and downward strokes to uncover (open) and cover (close) the transfer ports. It becomes obvious then that the time element available for charging of the crankcase and fuel vapor transfer to the cylinder and combustion chamber is of duration commensurate with RPM at which the engine is running - correspondingly less with increasing RPM. The exhaust port is affected in like manner.

As long as the engine is able to "breath" effectively, power developed increases with increasing RPM. A period nevertheless is eventually reached when with further increasing RPM, resultant time available for overcoming fuel vapor inertia and friction to effectively charge the crankcase is not of sufficient duration to continue maintaining rated horsepower, consequently as "breathing" becomes restricted in effect by the element of time, power commences to fall off. The faster the engine is caused to run the less is the time available to fully complete the events of the cycle - intake, compression, combustion (power) and exhaust. *See further details on pages 9 & 10

Tho not ordinarily applied to outboards, some engines employ the use of manifold blowers or super chargers to build up fuel vapor flow thru the induction system to achieve improved breathing in the higher speed ranges for greater power out' put.

In addition to the engines breathing characteristics, internal counter resistance enters the picture to have its effect on performance.

Power is required to start and stop (accelerate and decelerate) the piston-rod assembly at each end of the stroke (twice per revolution). Energy is used to shear the oil film (lubrication). Energy is required to overcome resistance presented by the bearings. Energy is similarly consumed to overcome other internal resistance such as inducing, compressing and transfer of the fuel vapor charge prior to ignition. It takes power to operate the magneto and power to merely drive the gears in the gearcase, generator and alternator if installed. The faster the engine is caused to run, the greater the internal counter forces become to have their combined effects on ultimate power available for driving the boat. It follows then, that up to a certain critical point (RPM range for best performance), power developed as result of the rapidly expanding fuel vapor charges after compression and ignition, is sufficient to overcome the effects of internal resistance with energy to spare for propulsion of the boat. But, in time and with a further increase of RPM and eventual dimishing ability of the engines breathing capacity, the ever increasing effect of combined internal resistance as a consequence acts to further reduce power output.

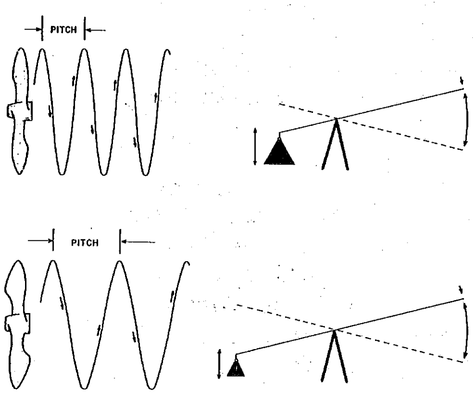
Beyond this critical point (RPM range for best performance), the force of counter resistance increases to the extent that it's now consuming considerably more energy for the engine to simply drive itself - less power available for driving the boat. Theoretically then, an engine running under "no load" conditions at full open throttle, reaches its maximum RPM when internal counter resistance and the force (energy) created by the running engine enter a state of equilibrium - that is, when the engine consumes all of the power it develpps to merely drive itself.

The above is merely pointed out to illustrate the effect of RPM on power output — power progressively increasing with increasing RPM then rapidly falling off with further increase. It is easily seen now that an engine turning over at excessively high RPM's is not necessarily indicative of great power output (RPM's in excess of RPM range established for maximum effective performance and safe operation). Conversely, but of considerable importance here, an engine (motor) turning at less than desired RPM does not develop its power for best performance.

It become a simple matter to understand the importance of the correct propeller installation to realize and achieve best optimum performance. Many factors, however, enter into the correct selection of a propeller in this respect. What will do for one motor/boat combination may not do for another. The details then to be taken into consideration are first of all, the type of boat, shape of hull, weight of the boat and motor less load, load normally carried (some boaters ordinarily run with heavier loads than others), distribution of load in the boat, angle of propeller drive, transom height of boat as it affects depth at which the propeller operates below surface of the water, speeds expected, etc. All are important and must be kept in mind when arranging a propeller installation best suited for the job. Total weight of the unit incidentally, is not always the criterion of performance - of most significance is the design of the hull and how it rides the water. The lightest boat may not always be the fastest or the best performing.

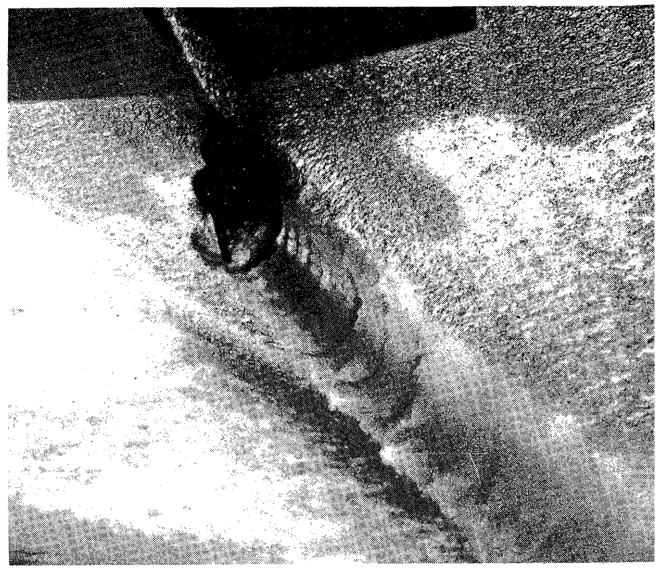
Keeping uppermost in mind, that since propeller specifications (pitch & diameter) determine the rate of motor RPM, the importance of the correct propeller selection and installation cannot be over estimated. The successful operation and performance of the unit depends upon it. And, the responsibility of correct propeller selection for best performance and owner satisfaction at this stage falls upon the installer (dealer).

Propeller specifications are given as (1) Diameter - the diameter of a circle described by the tips of the turning propeller blades and (2) Pitch - the "twist" or angle given the propeller blade with relation to direction of boat travel. Given in inches, it simply means that figuratively, a propeller of 6" pitch will advance 6" in one full turn - much like turning a nut down on the threaded end of a bolt. The propeller in reality, however, does not quite act in this manner principally because water is liquid and not a motionless solid. As a consequence, the revolving propeller in its effort to advance, draws in or pulls water from the front and discharges it to the rear to create what is known as the slip stream. During the process, some water of course slips or glides off the rapidly turning blades to have its effect, but for practical purposes, propulsion (of the boat) may be described as the effect of thrust developed by the propellers effort to advance and the resultant fast moving slip stream acting against the surrounding body of water.



PROPELLER PITCH-LEVERAGE

Light and lightly loaded planing boats present less resistance to forward motion which makes them naturally faster with a given motor and propeller installation while the heavy and heavier loaded displacement boats offer proportionately greater

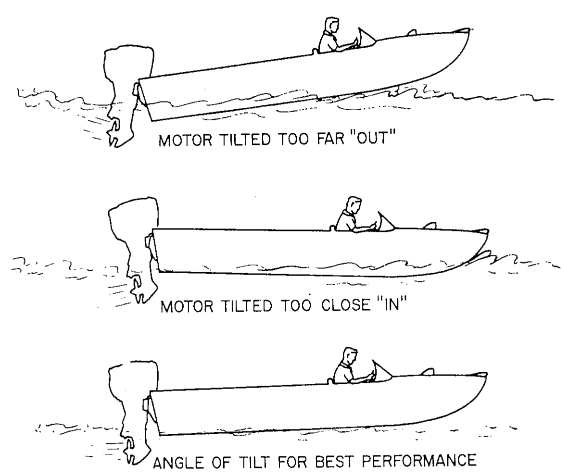


resistance to obviously result in slower boat speeds.

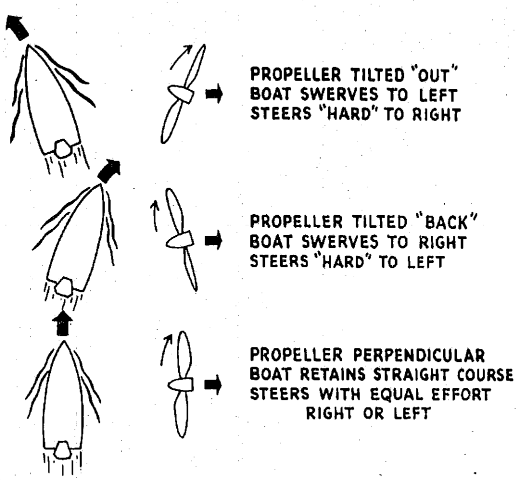
Propeller slippage and slip stream loss (depending upon the type of propeller and its performance characteristics), may often run as low as 10% for the light, lightly loaded planing hull, possibly 15% to 20% for the average planing runabout while as great as 40% for the heavier, heavily loaded, non-planing displacement boat (large runabout and heavy cruisers) with perhaps up towards 50% for barges, etc. From this, it can be seen that pitch and propeller blade area are the factors involved when seeking a selection for best results. Pitch in preference to blade area is given first consideration when planning for the light planing installation, while blade area (with less pitch) enters more prominently into propeller choice for the heavier, planing and displacement type of hulls (runabouts, cruisers, towing water skiers, etc.), since the force of driving effort must be applied against a greater area of water for maximum effect. This, nevertheless, is not meant to infer that pitch and blade area are to be considered independently of each other entirely. Pitch in either event is adjusted or selected to permit the motor turning within its desired RPM range when full capacity is attained; hence, greater pitch and correspondingly less blade area (2 blade propellers) for the lighter application, but greater blade area (3 blade) and proportionately less pitch for the progressively heavier installation to realize full power capacity.

Beyond certain basic mathematical calculations, the process of propeller manufacture and selection for light or heavy duty outboard performance is largely a matter of "cut" and "try" in view of the many variables involved; variations in hull design and constructions; variations in hull characteristics - load carrying characteristics; the nature of service and performace expected. Boats of the same general overall design manufactured by different builders often reveal different performance characteristics as frequently affected by water absorbtion (wood) or condition of individual hull bottom exposed to water, barnacles and/or moss, etc. The practical, ideal situation consequently is a propeller installation of such proportions (diameter, pitch blade area) as to permit the motor operating within its desireable RPM range to achieve the benefits of maximum motor capacity and of sufficient blade area commensurate with characteristics of the individual hull, nature of service, etc., for maximum average top speed performance.

Conditions for best performance eventually should be such as to permit the planing type of boat riding fairly "flat" on the water with possibly the rear (stern) 30% to 40% (of the linear length of the boat) actually in contact with the water. For best performance, observation at water level ought to reveal a slight tilt (up) at the bow - a slender and gradually tapering light streak between the keel and water line but, diminishing at a point of about 30 to 40% of the overall length of the boat from the stern - depending upon inherent characteristics of the particular boat, load carried and distribution of the load.



ILLUSTRATING THE EFFECT OF MOTOR TILT ANGLE ON PERFORMANCE



SCHEMATIC TO ILLUSTRATE EFFECT OF THRUST ADJUSTMENT

Ordinarilly, the least of the hull area in physical contact the surfact water, the greater the speed - all other details being equal.

The average displacement, non-planing boat should ride on a fairly level keel with a very slight tilt (up) at the bow.

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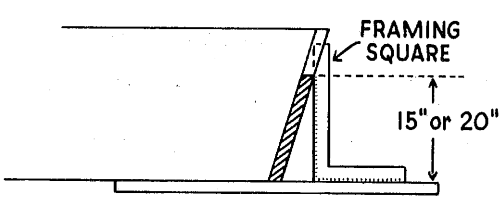
Here's a problem of interesting nature that perhaps you'd like to work out in conjunction with the above, to obtain a bit of forehand information as to about just what might be expected (mathematically) of a propeller of given pitch and turning at a known RPM. If you know the actual speed of the motor (by tachometer count) and pitch of a given propeller, it's not too difficult to determine possible mathematical boat speed by this simple equation.

$$\frac{\left(\dfrac{\text{Motor RPM's x Gear Ratio x Propeller Pitch in inches}}{12}\right)}{5280\ (\text{Ft. per mile})} \times 60 = \text{Mathematical or pitch miles per hr.}$$

Example - Motor RPM's - 4500
Gear Ratio - .572
Propeller Pitch - $12\frac{1}{2}$"

$$\frac{\left(\dfrac{4500 \times .572 \times 12.5''}{\cancel{12}}\right)}{5280\ (\text{ft. per mile})} \times \overset{5}{\cancel{60}} = 30.5 \text{ pitch miles per hour}$$

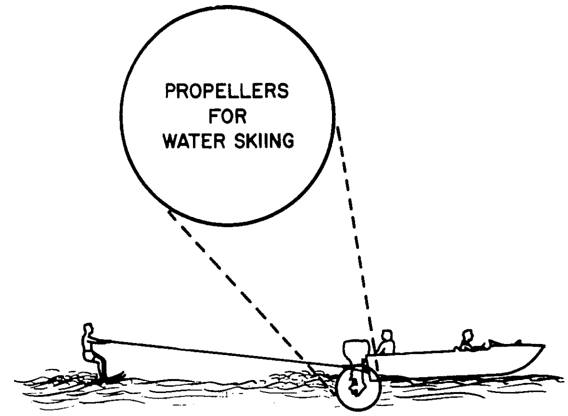
The above naturally does not take into consideration "slippage and Slip Stream", always present but in various degrees depending upon the nature of propeller and hull design, normal boat weight plus boat load, etc., So - if the average boat speed is known (clocked on an accurately measured straight line course), it's relatively easy to approximate loss to slippage and slip stream.



MEASURING TRANSOM HEIGHT

On the ideal side, say the unit clocked 28 m.p.h. (a good planing boat with a fair load); the difference between 28 miles accurately "clocked" and 30.5 pitch miles per hour is 2.5 miles of "slippage" per hour or $\frac{2.5}{30.5}$, 8% loss to slippage and at 26 m.p.h. $\frac{4.5}{30.5}$, a factor of 14.7% lost to slippage and slip stream.

The same details may be worked out with any combination of motor RPM, gear ratio and propeller pitch, but bear in mind the result will be mathematical not actual. Slippage and slip stream always enter into the system of final results - less slippage for the light, lightly loaded "planing" boat with progressively more for the heavier, heavily loaded planing boat (runabouts) and the heavier non-planing or displacement hulls.



Propellers for water skiing present a somewhat different situation. Usually the fairly light or medium type of runabouts are employed depending upon the size of the motor, weight and number of skiers, number of passengers in the runabout etc., (Regulations require two). In many instances where the skiing load is not particularly heavy, the propeller ordinarily provided or suggested for best optimum use will do nicely.

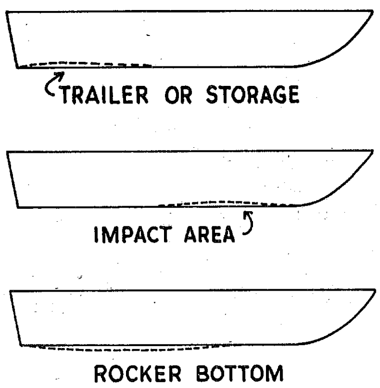
Propeller thrust requirements for water skiing otherwise are normally greater than necessarily demanded for average runabout use since the skier or skiers must be brought up to skiing position as quickly as possible and maintained at that position. Experience will reveal best suited propeller specifications for the individual conditions at hand.

The operator of a water skiing unit provided with a lower pitched propeller than required for ordinary runabout use should refrain from running at full open throttle when running "light" (no skiers) to guard against excessively high motor RPM.

Miscellaneous: Some operators riding alone or with but one passenger may prefer top speed performance at the expense of "quick get away" and ability to include additional passengers. In this event they'll want the higher pitched propeller. Others, with an identical unit may prefer quicker get away and the ability to include several extra passengers as the occasions arise but at the expense of higher top speed. A propeller of lower pitch (best suited for average performance) would be suggested here.

The unit with the normally lower pitched propeller installation naturally will arrive at Planing position in a shorter run and in less time than the unit with the higher pitched installation. However, after both have reached the planing position, the lighter loaded unit with the higher pitched installation will walk away from the former with the lower pitched propeller installation. On the other hand, the unit with the higher pitched propeller may fail entirely to attain planing position with the addition of two or more riders while a like number of passengers could be carried in the other with no appreciable falling off in over all performance.

In either of the above situations, both propellers should be "tailored" to their respective units and conditions of operation so as to permit the motors in each event turning as nearly as possible to within the RPM range established for best peak performance, Obviously, they'll not turn at identical RPM - varying perhaps as much as 100 to 150 RPM or so.



HULL CONDITIONS AFFECTING PERFORMANCE

For the heavier and heavier loaded runabouts, cruisers and displacement type of boats, propellers of pitch less than that suggested for lighter service are demanded. Reason - - correspondingly increasing resistance (water) to forward movement of the boat demands the greater "leverage" gained by the lower pitched installation to permit the motor or motors turning to within the RPM range recommended for best performance. In summation, it all settles down to a matter of RPM and the importance of maintaining recommended RPM under any and all conditions of operation for best optimum performance.

The following propellers are available for the Johnson Model RD series 40 H.P.

#378571 10 3/8" Dia. x 14" pitch - For light service.

#378579 10 3/8" Dia. x $13\frac{1}{4}$" " - For medium runabouts & Water Skiing

#378580 10 3/8" Dia. x $12\frac{1}{2}$" " - For heavier runabouts, light cruisers and/or water skiing.

#378581 10 3/8" Dia. x $11\frac{1}{2}$" " - For heavier cruisers or extra skiers.

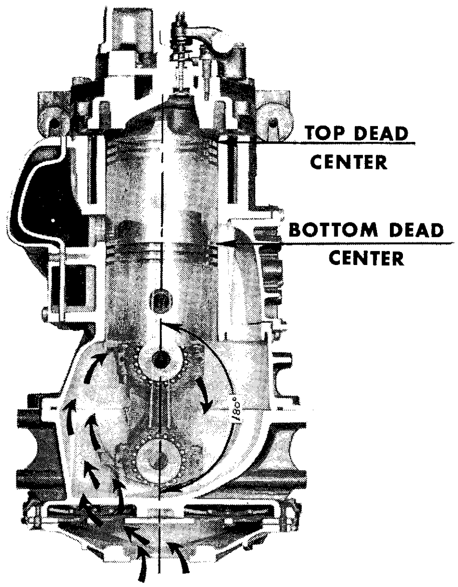
The following propellers are available for the Johnson Model V-4 series 75 H.P.

#377978 10" Dia. x 11" pitch - For average runabout use and/or water skiing.

#378039 10" " x 12" " - For light runabouts.

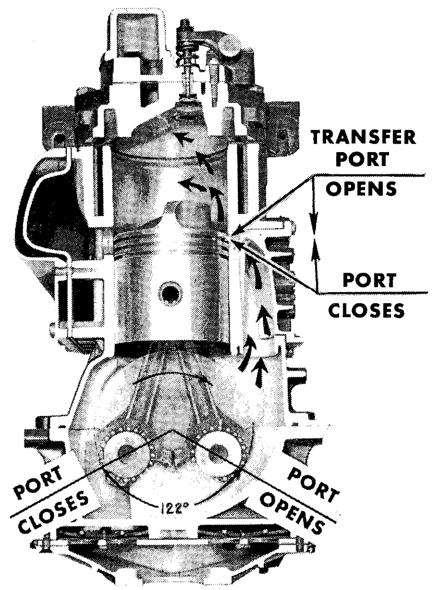
#378040 $10\frac{1}{4}$" " x 10" " - For large runabouts, cruisers and certain kinds of water skiing.

#593437 $9\frac{1}{2}$" " x 10" " - For large runabouts, cruisers and certain kinds of water skiing - heavy duty.



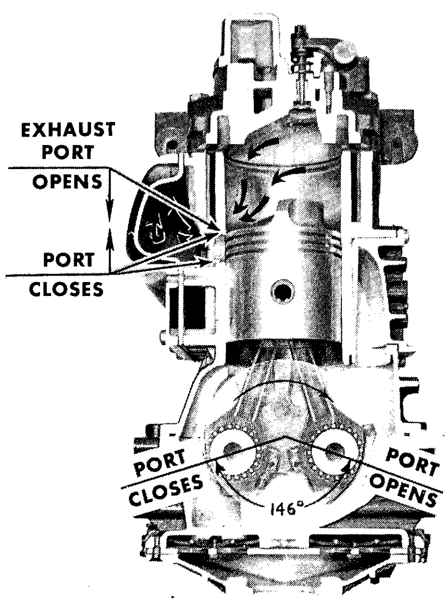
* To illustrate the effect of RPM on the engine's ability to breath - 4500 RPM in terms of seconds, reveals the engine to be turning at the rate of 75 revolutions per second (RPS) and at 5100 RPM at the rate of 85 RPS.

The automatic reed valve (intake to crankcase) is as its description implies - automatic in its performance as it is activated by existing conditions of crankcase pressure. The piston on its upward stroke creates a negative pressure or suction in the crankcase and in so doing, the reed plate is caused to lift from its seat in an effort to equalize atmospheric and crankcase pressures at the moment. During the process, fuel vapor is drawn in from the carburetor to charge the crankcase.

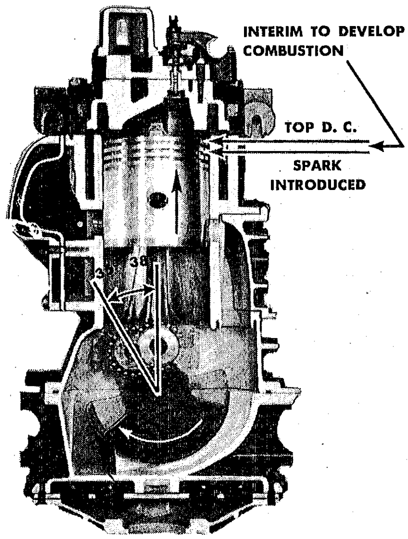


Being automatic in its action and because of the variables involved, it is difficult to determine precisely just when the reed actually starts to open and when it closes. But, for the sake of illustration it is reasonable to assume that opening commences somewhere in the region of bottom center position of the piston on its upward stroke and that closing occurs perhaps near the end of the stroke. It is not inconceiveable however, that reed valve closing might possibly occur some what later or after top center position of the piston due to enertia of the incoming fuel vapor charge at the moment. Predetermined tension in manufacture applied against the reed enters here also to have its affect on action of the reed.

On this assumption, it must be accepted that regardless of not knowing definitely just when the reed starts to open and how long it remains open, charging of the crankcase (induction) must occur sometime during the upward stroke of the piston - within the limits of the time required for the crankshaft to rotate 180 degrees (1/2 revolution). Thus, a simple calculation reveals that but 1/150 second is consumed to traverse this distance at 4500 engine RPM. At 5100 RPM, time consumed to cover the same distance is restricted to 1/170 second, indicating close to 13.3% less time at the higher RPM range to traverse the 180 degrees of crankshaft rotation alloted to charge the crankcase.



Since transfer port openings extends over 122 degrees of crankshaft rotation, actual time permitted fuel vapor transfer from the crankcase to the cylinder is 1/220 second at 4500 RPM. At 5100 RPM it reduces to 1/250 second, less by 13.3%.



Exhaust port opening is ordinarily confined to 146 degrees of crankshaft rotation consequently time permitted exhaust escape is limited to 1/185 second at 4500 RPM and to 1/210 second at 5100 RPM - less 13.3%.

It may now be observed that the time element 1), alloted to charge the crankcase 2), to transfer the charge to the cylinder and 3), to exhaust the spent fuel gases deminishes with increasing RPM to have its effect on over all performance.

Further and of interesting note - for best performance and efficiency of operation, the compressed fuel vapor charge must be ignited and fully developed for combustion by the time the piston has reached its top center position and as such involves an element of time. This obviously requires that ignition be introduced at a precise time or position of piston travel on its upward compression stroke.

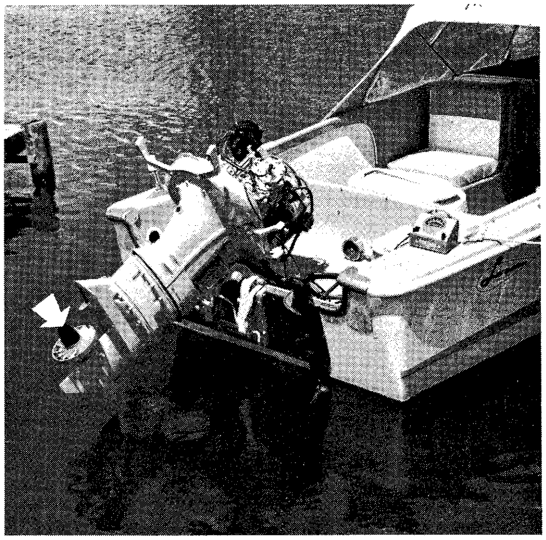
The desireable degree of ignition (spark) advance prior to top dead center position in this event as predetermined by engine design and performance characteristics, is commensurate with RPM. Fundamentally the higher RPM demand a greater degree of spark (ignition) advance while at lower RPM, a lesser degree to achieve fully developed combustion preceeding the power implues. Spark advance as lined to the carburetor shutter in outboards is manually controlled by the operator to function at partial advance at part throttle and full advance in full throttle.

At recommended operating RPM range, predetermined spark advance for best performance may be say 35 degrees at full open throttle - 35 degrees of piston travel upward to fully develop fuel vapor combustion. Spark advance in excess of this causes combustion to be developed too early - prior to top dead center during which time the piston is still proceeding on its upward stroke.

The resulting counter action causes engine knocking and power fall off. Spark or ignition advance of lesser degree at recommended RPM results in delayed development of combustion and likewise power fall off since combustion under the circumstance is delayed and not fully developed until the piston has passed its top center position and commenced its progress downward on the subsequent power stroke.

Depending upon performance characteristics of a given engine, combustion should be fully developed at or near piston top dead center position for maximum power and efficient operation at 35 degrees of spark advance. Time allowable to develop combustion is limited to 1/771 second when operating at 4500 RPM. At 5100 RPM the time element is calculated at 1/874 second, (less by 13.3%) which normally would require a slightly greater degree of spark advance.

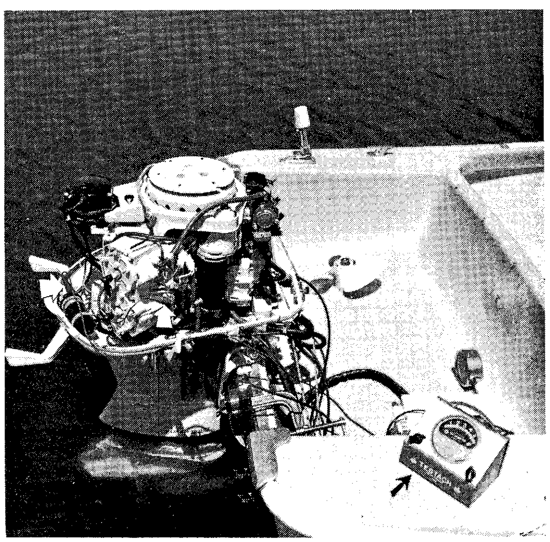
SUBJECT: WHY A TEST WHEEL FOR TANK AND DOCKSIDE TESTING.



The function of final testing and tuning of any outboard motor is best performed under actual conditions - on a boat in open water where all conditions of normal operation may be observed. But, it's not always possible or convenient to do so because of the time consumed and more often, inaccessability to water edge - thus, the propeller test wheel for tank use.

The use of test wheels however, need not necessarily be confined to the shop test tank. Quite often and under certain conditions it becomes advantageous to run a check of motor performance at dock side without removing the motor from the boat.

Should the occasion arise, anchor the boat firmly to the dock, making certain of ample water around and below the gearcase for test wheel running. Remove the propeller to install the test wheel. Attach the tachometer leads in the usual manner. Start and run motor to observe performance characteristics - keeping in mind desired operating rang (RPM) for the specific model.



Dock side test running in this manner provides an excellent opportunity to accomplish final adjustments and tuning - also, an opportunity to check remote control adjustments, over all rigging and the electric harness/junction box installation.

It is a known fact that propeller thrust, the force required to drive the boat, is greatest at full throttle between the time the boat starts to move and the instant at which it breaks over to assume planing position - point of greatest thrust. On having reached the planing position, propeller thrust for a moment falls off abruptly but commences to gradually build up again as boat speed accelerates and engine RPM approaches the range established for best performance - normal operation for the particular unit.

With this in mind, each of the available Johnson propeller test wheels, have been designed, constructed and calibrated for each specific model horse power range to simulate in the test tank, as nearly as possible, thrust and load condition approximating those encountered during normal over-all performance of the motor and at which time all final adjustments and tuning should be accomplished for maximum results.

Any attempt to check out or tune a motor laboring at low RPM in the shop test tank or at dockside because of the "regular" propeller installation is futile and wasted effort which serves no purpose. RPM must be "up" to correctly perform required adjustments - particularly so, the slow and high speed carburetor needle settings.

In view of the high speed needles having been removed from the 1961 RD and V4 series carburetors and replaced with fixed jets, test tank running within the desired RPM range becomes significantly important since the jets are calibrated accordingly for best performance.

See test wheel performance chart, Page 595, and the list of propeller test wheels appearing on Page 596.

Minimum desired RPM shown for each model is average minimum for test running with the properly designated test wheel installed at 600 feet above sea level (Waukegan, Illinois) in a tank 60" x 60"x 40" filled to approximately 565 gallons water capacity.

Several variables other than mechanical fitness however, enter the picture to affect testing performance such as,

1. The type and size of test tank and resultant turbulence created by the rapidly turning test wheel.
2. Dissipation or dispersion of exhaust gases from the tank.
3. Area elevation above sea level and,
4. Atmospheric conditions (barometric principally) at time of testing.

Using the chart as a guide, average tank performance (RPM) locally should not be too difficult to determine - simply by recording performance of several of each model as the occasions present themselves to establish an average of all recordings (of each model).

Keep in mind too that any internal combustion engine fundamentally develops its maximum horsepower at sea level where the air taken in with fuel vapor for combustions is denser than at higher than sea level elevations. Developed horsepower tapers progressively off at approximately 3% per each 1000 ft. of elevation up to 8,000 ft. or so.

Constantly changing atmospheric conditions (barometric and humidity) in a like sense have their effects on engine performance; increased RPM to a minor degree on a high barometer - lesser on a low barometer. Variations of 100 to 150 RPM may perhaps be noted when testing or during normal operation of the motor for that matter as result of changing atmospheric conditions.

Be guided by the test wheel chart when testing or tuning in the test tank or at dock-side while taking note of the above mentioned variables.

Write the following manufacturers for detailed information and price on Tachometers -

1. Mer-O-Tronic Instruments Corp.
   4553 Kidder Road
   Almont, Michigan

2. The Fox Valley Instrument Co.
   Cheboygan, Michigan

3. Herbrand Equip. Sales
   Fremont, Ohio

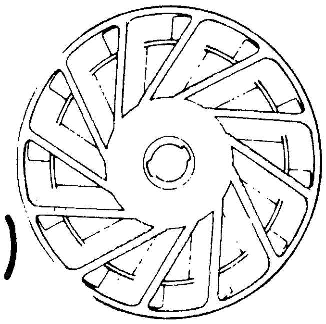
4. Snap-On-Tools Corp.
   Kenosha, Wisconsin

5. Seatronics, Inc.
   1030 York Road
   Towson 4, Maryland

Order #376734 Vibro-Tac from Outboard Marine Corporations, Parts Depot, Galesburg, Illinois - Price $27.50 net.

TEST WHEEL PERFORMANCE CHART

(Johnson Recommended Test Wheel)



MODEL	DESIRED MINIMUM RPM
JW - 3 H.P.	3850
JH - 3 "	3850
CD - 5½ "	4000
AD - 7½ "	4200
MQ - 9½ "	4400
QD - 10 "	4050
FD - 18 "	4500
RD - 25 "	4400
RX - 28 "	4400
RD - 30 "	4500
RD - 35 "	4500
RD - 40 "	4400
V-4 - 50 "	4400
V-4 - 60 "	4400
V-4 - 75 "	4400
V-4 - 90 "	4400

ABOVE BASED ON MOTOR OPERATION IN A TEST TANK 60"×60"×40" – ADEQUATELY VENTILATED – FILLED TO APPROX. 565 GAL. WATER CAPACITY @ 600 FT. ELEVATION

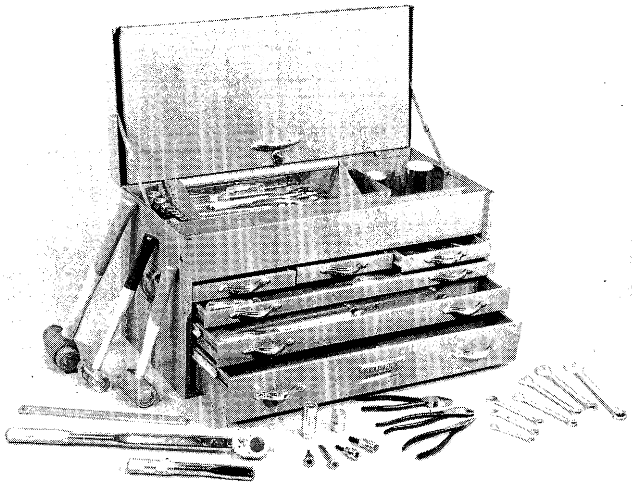
JOHNSON MOTORS · WAUKEGAN, ILL.

TEST WHEELS

Part No.	Used on:
203229	Model JW series
203466	Model AD series
277278	Models QD-10 through 18H, FD and FDE-10 through 10S
301973	Models TS, TD and TN
303592	Model CD series
375837	Models RD, RDE, RJE through 18 series, RX-10C
376913	Models FD and FDE-11, 12, FD-13, 14, 15, 16
377014	Models RJE-19; RD, RDE-19, 19C; RD-21; RDS-20, 21
377455	Models QD-19, 20, 21, 22, 23
378566	Models RD, RDS-22, 23
378566	Models RD, RDS-24M, RK-24

NOTES

A JOHNSON RECOMMENDED SHOP TOOL KIT (No. JM-100)



Illustrated here is a specially selected assortment of bench tools for the Johnson Service Technician – end wrenches, box wrenches, sockets with drivers, an impact driver set, torque wrenches, screwdrivers, pliers, punches, hammers, mallets, etc., as selected by Johnson to do any job on a Johnson Motor in conjunction with the necessary Johnson special tools.

All tools are of top quality, selected by Johnson for their proven ability to stand up under hard use, which come as a set with a tool chest of sturdy construction as shown for safe storage and security – manufactured and warranted by the Proto Tool Company.

No service operation can be expected to function efficiently or profitably without the tools to do the job. Top quality tools are an investment in economy of operation – too much costly time is wasted with other than quality tools and not having the right tool when needed.

Only those tools actually required for a Johnson Service operation have been included in the kit – see accompanying list.

Service Promotion Bulletin No. 279 5/10/61

JOHNSON MOTORS SERVICE TOOL SET NO. JM-100

ONE EACH OF THE FOLLOWING

Torque wrench, 1 to 150 ft.-lbs.
Torque wrench, 2 to 150 in.-lbs.
Combination wrench, 5/16″
Combination wrench, 3/8″
Combination wrench, 7/16″
Combination wrench, 1/2″
Combination wrench, 9/16″
Combination wrench, 5/8″
Combination wrench, 3/4″
Combination wrench, 13/16″
Socket, 3/8″ drive, 3/8″ opening
Socket, 3/8″ drive, 7/16″ opening
Socket, 3/8″ drive, 1/2″ opening
Socket, 3/8″ drive, 9/16″ opening
Socket, 3/8″ drive, 5/8″ opening
Socket, 3/8″ drive, 3/4″ opening
Socket, 3/8″ drive, 7/8″ opening
Socket, 3/8″ drive, 13/16″ opening (spark plug)
Speeder wrench, 3/8″ drive
Sliding T bar handle, 3/8″ drive
Extension, 3/8″ drive
Reversible ratchet, 3/8″ drive
Socket, 3/8″ drive screwdriver
Socket, 3/8″ drive, 3/16″ hexagon bit
Socket, 3/8″ drive, 7/32″ hexagon bit
Socket, 3/8″ drive, 5/16″ hexagon bit
Universal joint, 3/8″ drive
Sliding T bar handle, 1/2″ drive
Socket, 3/4″ drive, 1-5/16″ opening
Socket, 3/4″ drive, 1-11/16″ opening
Adaptor, 1/2″ F., 3/4″ M.
Adaptor, 1/2″ F., 3/8″ M.
Adaptor, 1/4″ F., 3/8″ M.
Impact driver, 3/8″ drive
Impact socket, 3/8″ drive, 7/16″ opening
Impact socket, 3/8″ drive, 9/16″ opening
Impact socket, 3/8″ drive, 1/2″ opening
Impact socket, Phillips bit No. 2
Impact socket, Phillips bit No. 3
Impact socket, screwdriver, 1/2″ bit

Adjustable wrench, 10″
Pliers, combination slip joint, 8″
Pliers, diagonal cutter, 7″
Pliers, battery, 8″
Pliers, power-track, 10″
Pliers, lever-wrench, 8″
Screwdriver, 3″ blade, 3/16″ bit
Screwdriver, 6″ blade, 5/16″ bit
Screwdriver, 12″ blade, 3/8″ bit
Screwdriver, Phillips No. 2
Screwdriver, Phillips No. 3
Screw starter, 9″
Punch, rivet or pin, 4-3/4″
Punch, rivet or pin, 5-5/8″
Punch, center, 5-1/4″
Chisel, cold, 5/8″ cut
Hammer, 4 oz., ball pein
Hammer, 12 oz., ball pein
Hammer, rawhide No. 3
Mallet, rawhide No. 3
Piston ring remover
Battery post and terminal cleaner
Flywheel turner
Tool chest, six drawer with tote-tray

NOTES

ACCESSORY THROTTLE CONTROL FOR TEST TANK USE

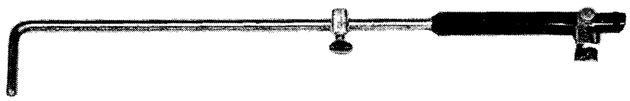


FIGURE A

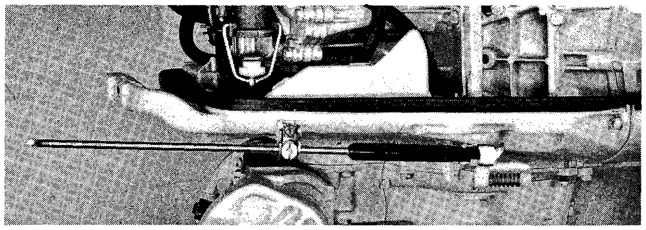


FIGURE B

The absence of a steering handle, due to the use of remote controls exclusively, has made test tank throttle operation a little awkward on electric starting engines.

Figure A illustrates a throttle control adaptable to the remote control fittings used on all our engines. This throttle control provides throttle operation as well as a positive throttle lock by means of a wing screw in the trunnion for engine break-in and warm-up before carburetor adjustment. This throttle control is also useful in engine testing on a boat as it eliminates the continuous running back and forth from the remote control box to the engine, or the necessity of a second man to perform this task.

Service Bulletin No. 891 2/19/62

BOTTOM FOULING AND BOAT PERFORMANCE

With the introduction of the higher horsepower engines, continuous maximum boat performance is expected by most of your customers. However, there is one contributing factor often overlooked by a large percentage of owners and dealers – the condition of the boat bottom.

You are all probably aware of the effect of salt water on hulls, but how many are aware of the reduction in performance that occurs in so-called fresh water. We recently conducted some tests that were eye-openers. One thing you must understand, is that these results will vary with water and air temperature and according to the foreign matter present in the water. However, though the time period changes, the final loss in speed can occur almost anywhere, much to the despair of owner and dealer alike.

In salt water the growth is usually barnacles and other forms of marine life. In fresh water the growth is not conspicuous in the early stages. It will first appear as a light film of scum which can be felt easier than it can be seen. However, even this early stage of fouling can result in obvious loss of performance.

A 16-foot boat was equipped with a 35 H.P. engine and performance was checked with various loads. It was then left in salt water and every week performance was checked again. At the end of 30 days the speed with one man had dropped almost 8 m.p.h. and with a six-man load, a loss of 10 m.p.h. was recorded and the boat would not plane.

This was not too surprising since salt water was involved. The next test in fresh water was quite surprising. The same sequence was followed and after 30 days the speed with two men had dropped almost 6 m.p.h. A six-man load showed a loss of almost 10 m.p.h. and planing was impossible. In each case when the hull was thoroughly cleaned, performance was restored.

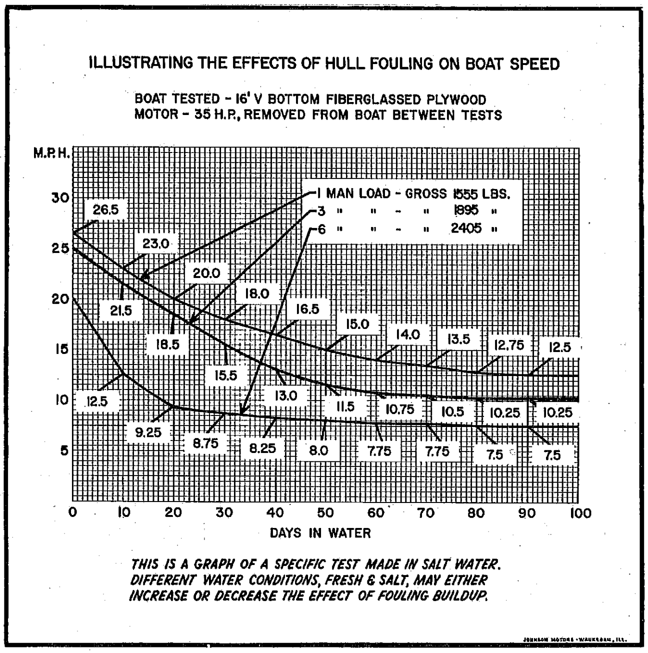
The significance is obvious. If boats are left at mooring, they should have antifouling bottom paint in order that maximum performance can be maintained. This is true for all types of boats – wood, aluminum and fiberglass. Good antifouling bottom paints are available from many sources and most boat manufacturers provide antifouling paint as an extra. Acquaint yourself with the antifouling paints best suited for your waters and encourage your customers to use them.

Whenever you have complaints on gradual speed losses over the course of a season, don't condemn the motor before you first check the condition of the boat bottom. Just a light film of scum can drastically affect performance; see chart on next page.

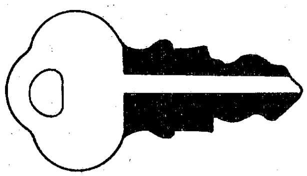
Obviously, boats kept on trailers or used for short periods of time, will not be affected by this condition. However, two or three weeks of continuous exposure during a vacation period can result in some growth build-up.

EDUCATE YOUR CUSTOMER TO CLEAN HIS BOAT OCCASIONALLY AND YOUR PERFORMANCE COMPLAINTS WILL BECOME MUCH MORE REALISTIC.

Service Bulletin No. 758 1/18/60



IGNITION KEY



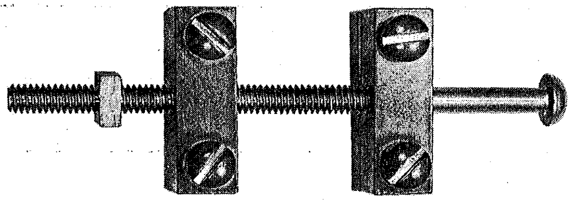
Our key switches, like any lock, are made up of lock tumblers which must operate freely to be functional. Due to their application in boats they are, of course, subject to moisture and resultant corrosion.

To prevent corrosion, these switches should be lubricated periodically. A good lubricant, such as used by automotive garages for the lock cylinders on automobiles, a form of light machine oil, or powdered graphite can be used. Also, in case where the lock freezes up completely, or the key cannot be removed, a couple of drops of oil or a little powdered graphite will almost always free them.

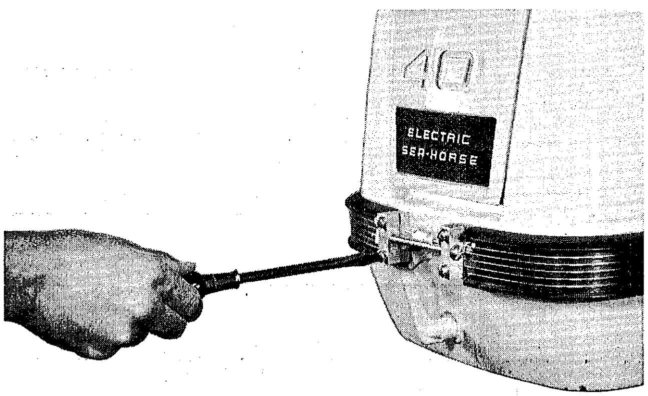
Service Bulletin No. 715 4/22/59

NOTES

SPECIAL TOOL – PART NO. 378482
For installing trim band;
40 h.p. Models RD through RDSL-23 (1961),
75 h.p. Models V4S-13 through V4A-13F (1961).

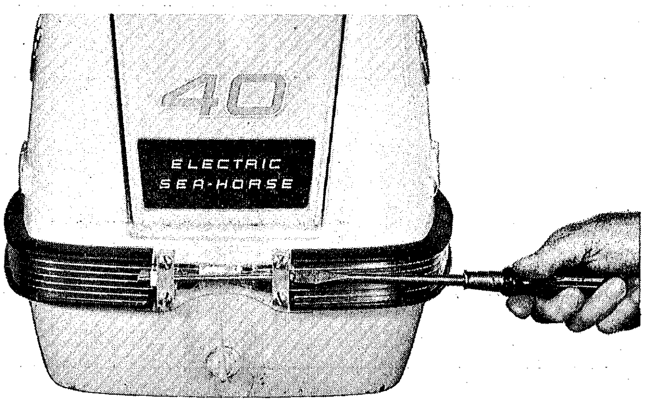


We suggest the use of a new special tool for installing the trim bands on engine covers of the above engines. It will considerably and efficiently reduce assembly time and is therefore a valuable asset in the service shop.

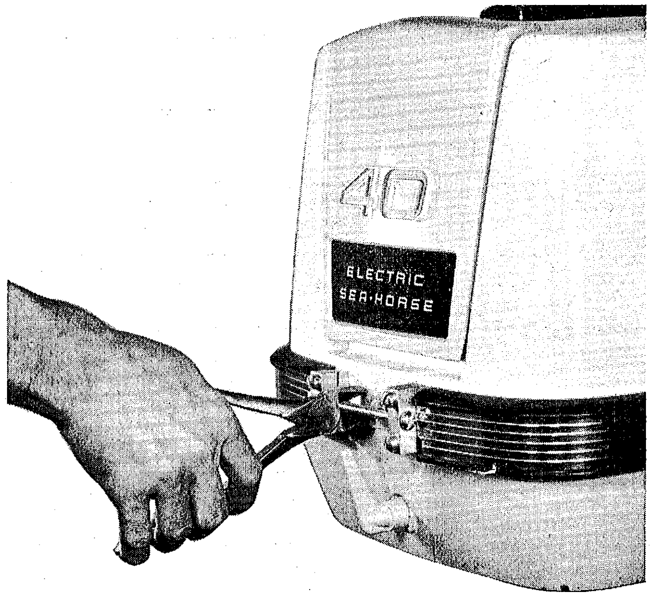


INSTRUCTIONS FOR USING TOOL:

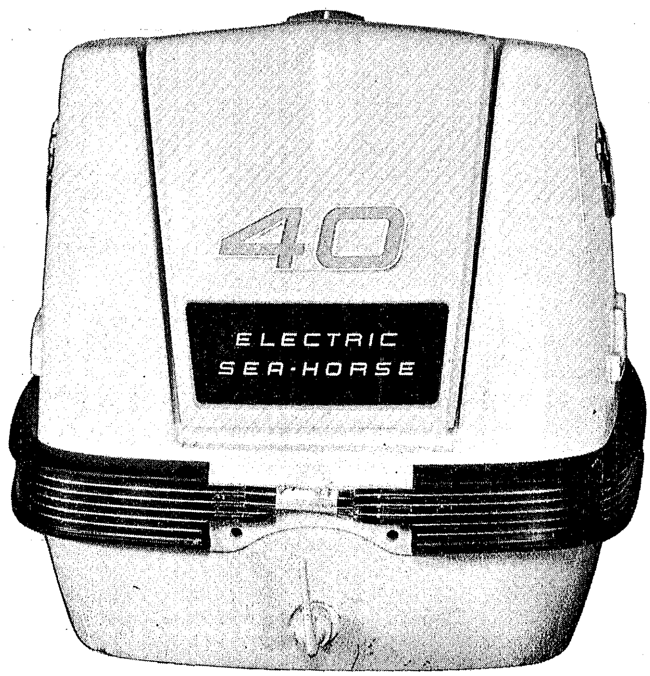
1. Cut $\frac{3}{4}''$ to $1''$ off each end of the trim band with tin shears prior to clamping tool on the band.
2. Clamp tool on one end of trim band. Place band in position over rubber molding strip around shroud, and clamp free end of band in tool.



3. Draw trim band snug. Check band frequently all around shroud while drawing trim band to be certain it is *between* the top and bottom beads of the rubber molding strip. Tighten band only as much as required to remove any bulges from trim band.



4. Place trim band clamp on the overlapped portion of band under the tool. Using a large sized dykes (side cutter), crimp the band clamp at both ends so it becomes slightly concave.



5. Remove trim band installation tool, and replace the trim band's cover.

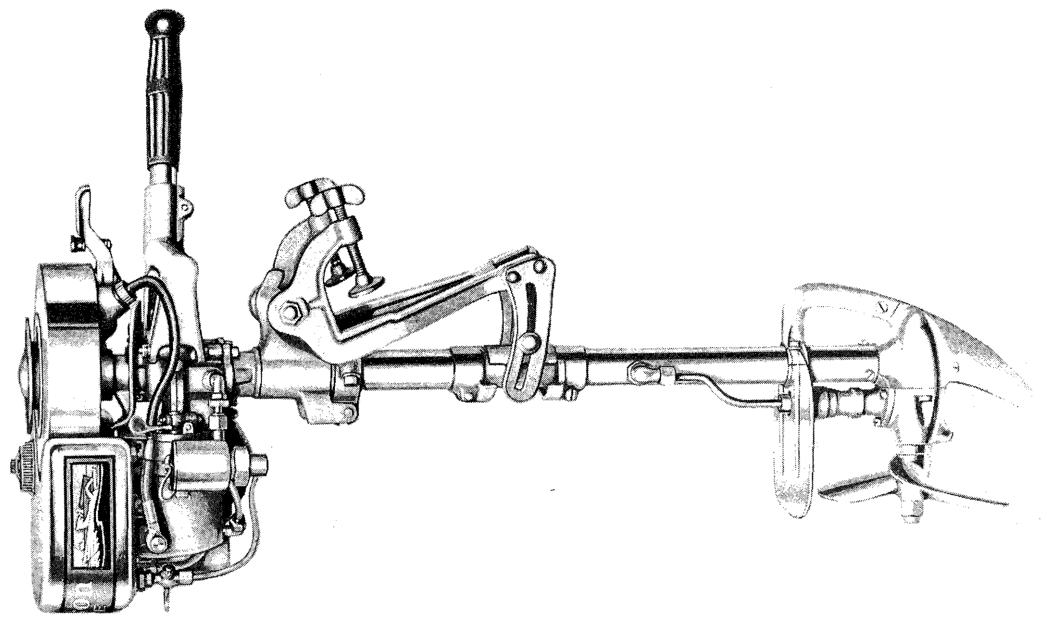
Service Bulletin No. 866 8/25/61

BASIC MODELS

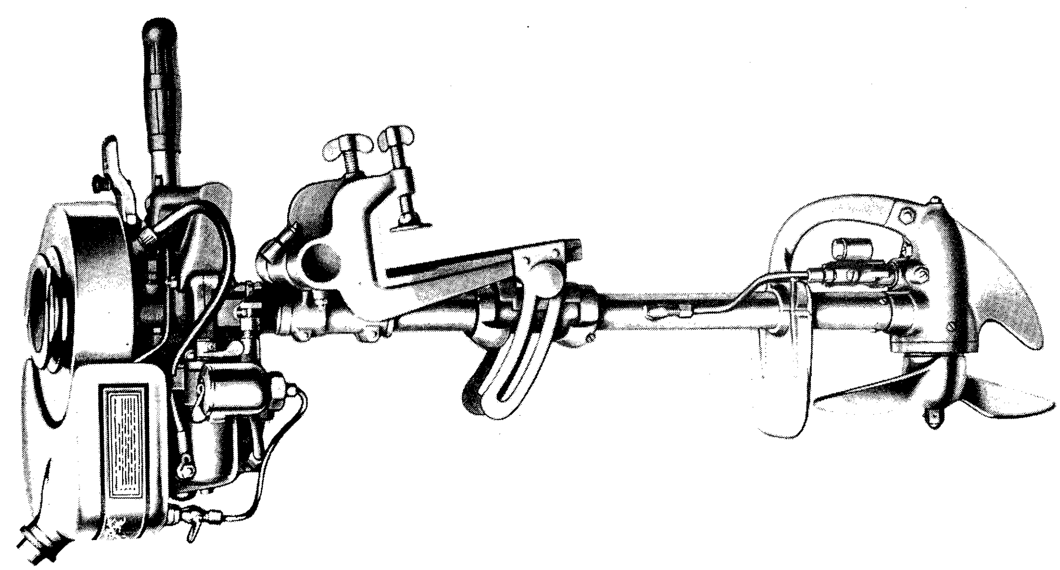
FOR SPECIFIC INFORMATION

Model Number
Year of Manufacture
Original List Price
Bore
Stroke
H.P.
R.P.M.
Gas Tank Capacity
Weight

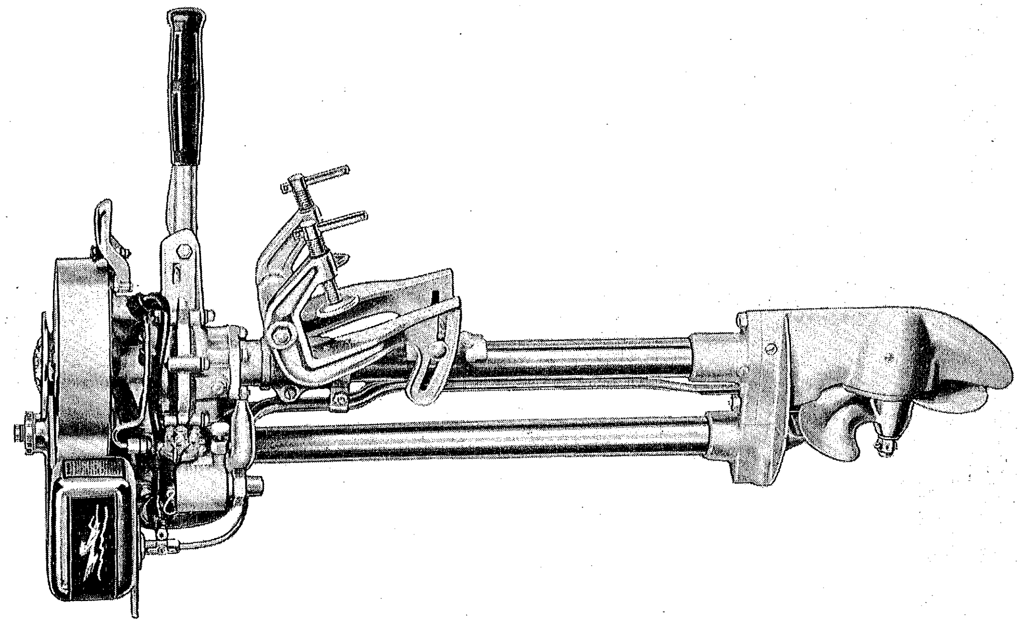
See pages 7 through 10.



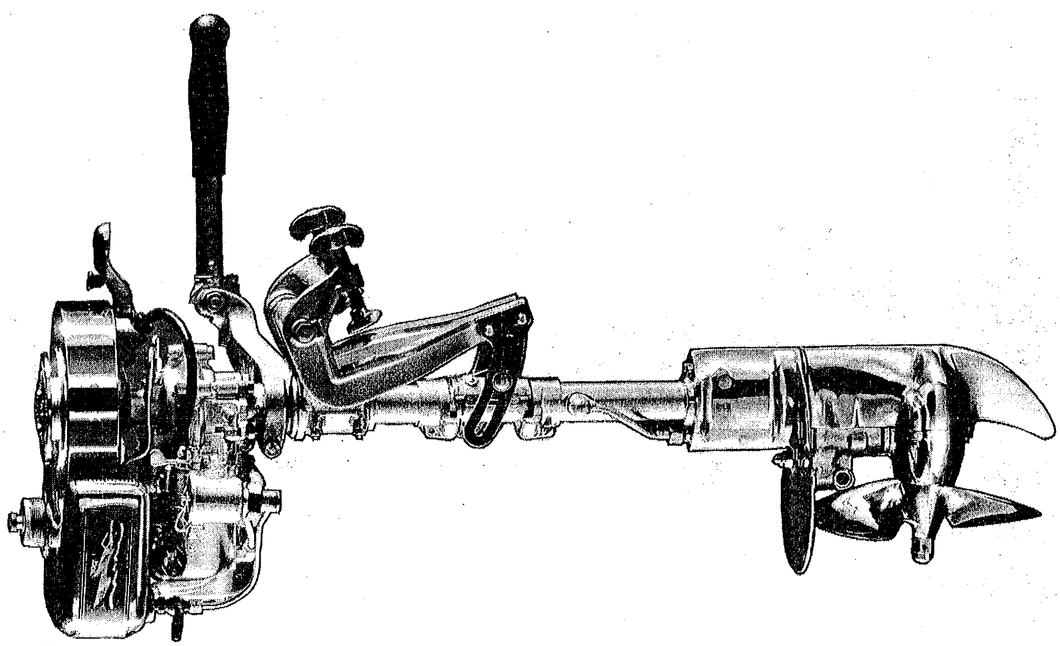
Model J-70



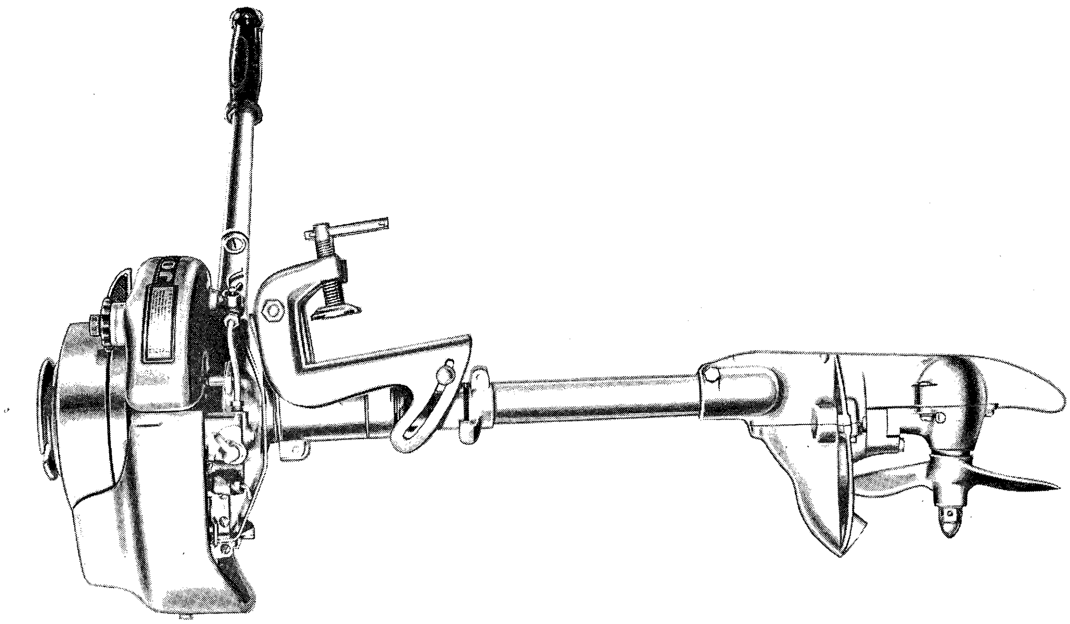
Model J-25



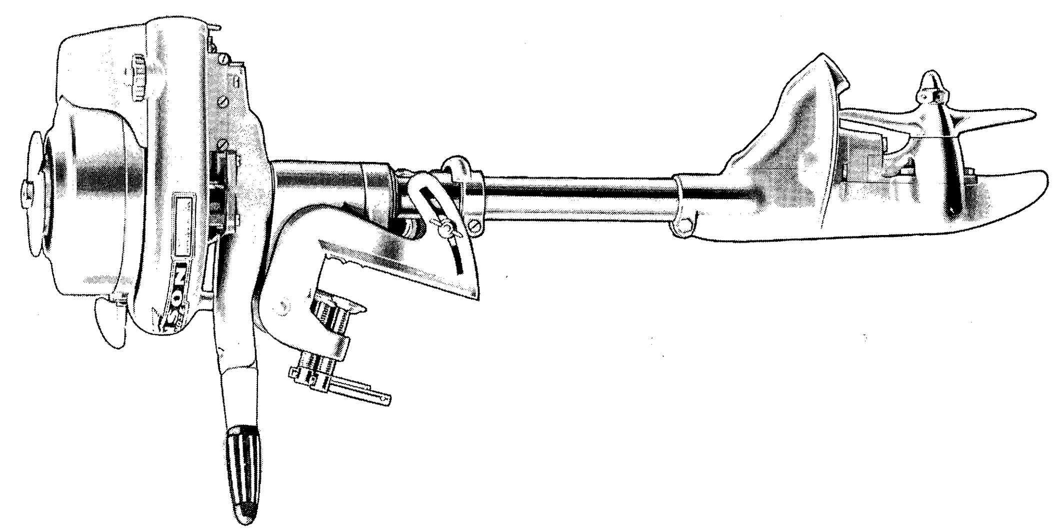
Models 100-110



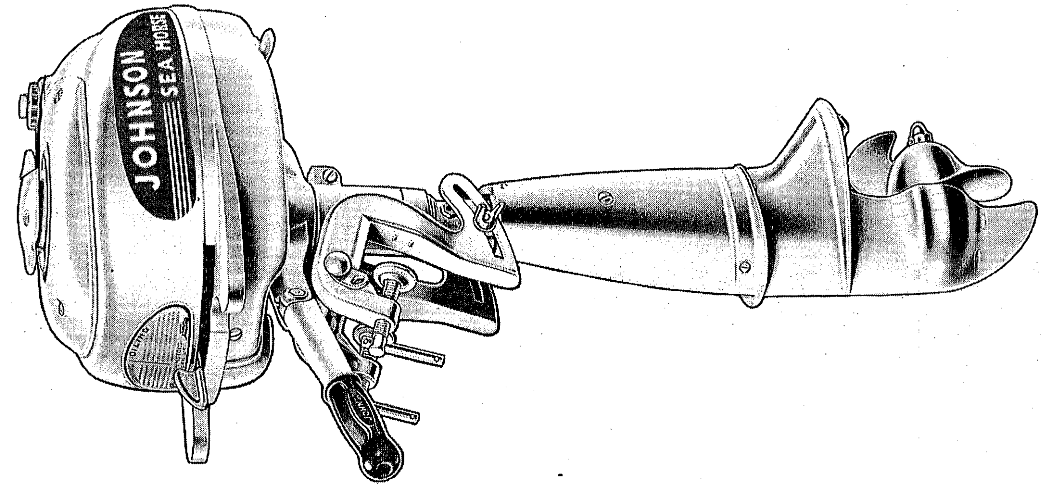
Model J-75



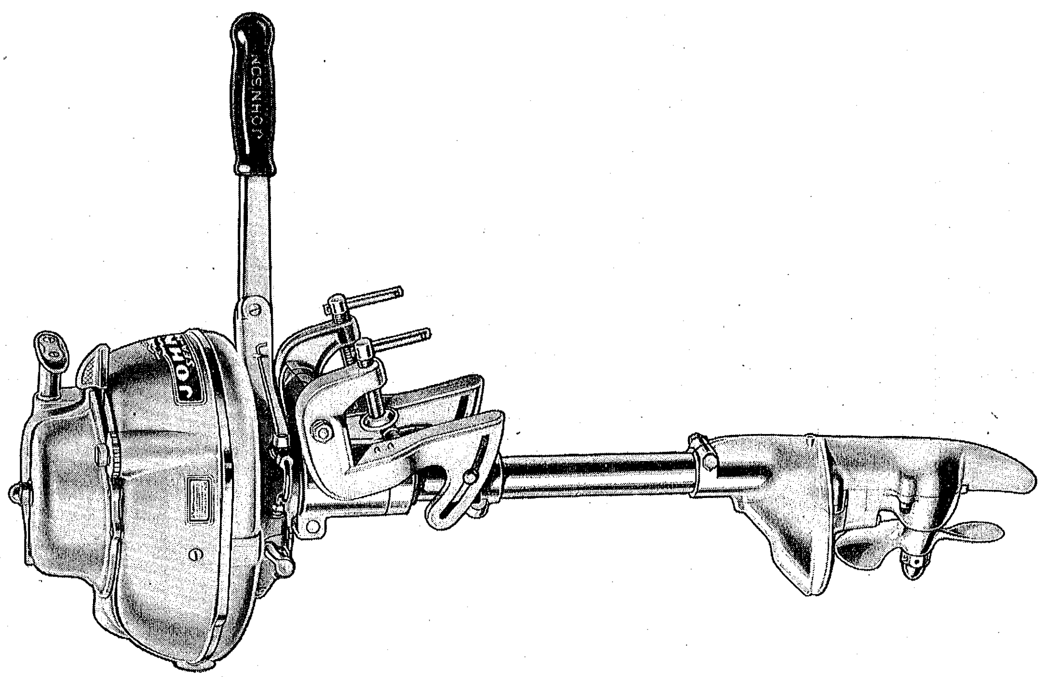
Model MS-15



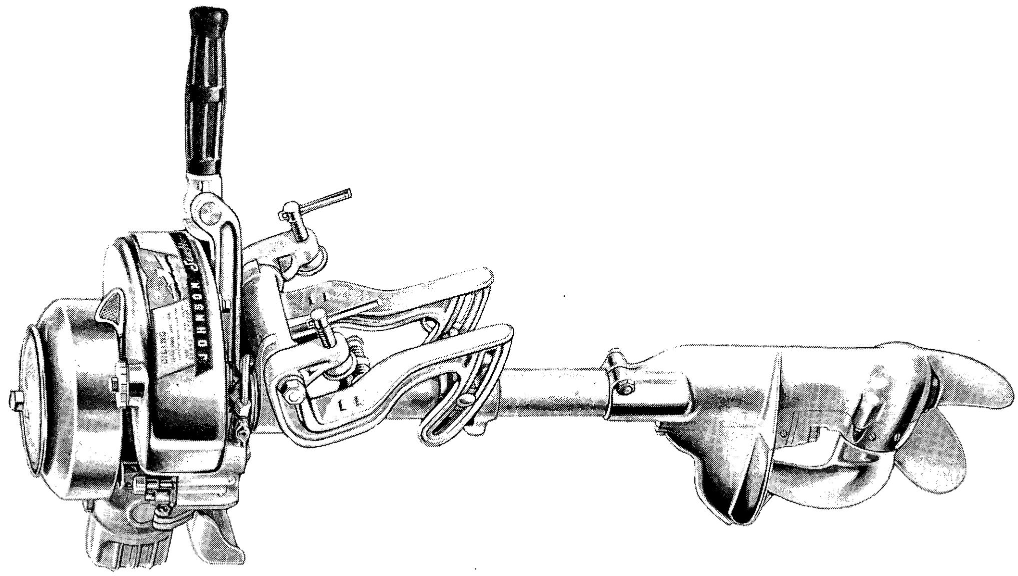
Models MS-38-39



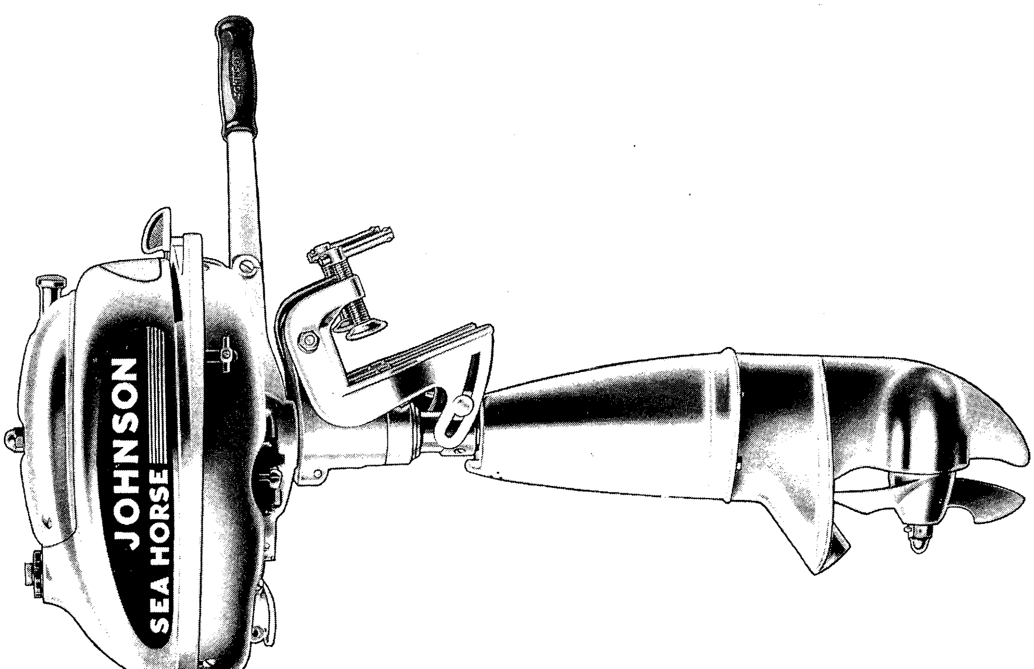
Model MS-20



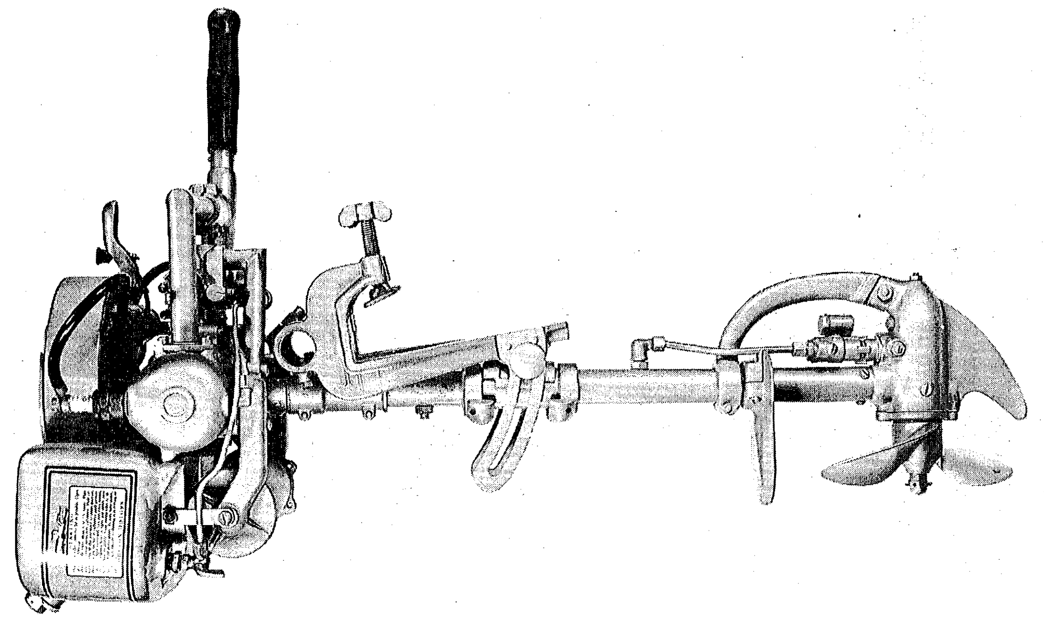
Model MD-38-38-39-15



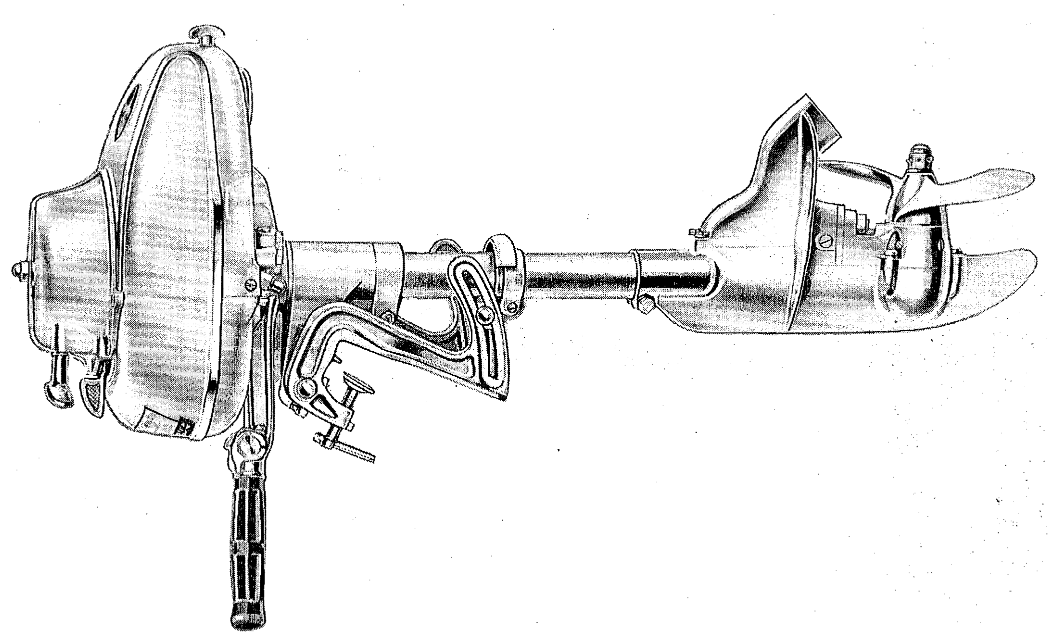
Models LS-37-38



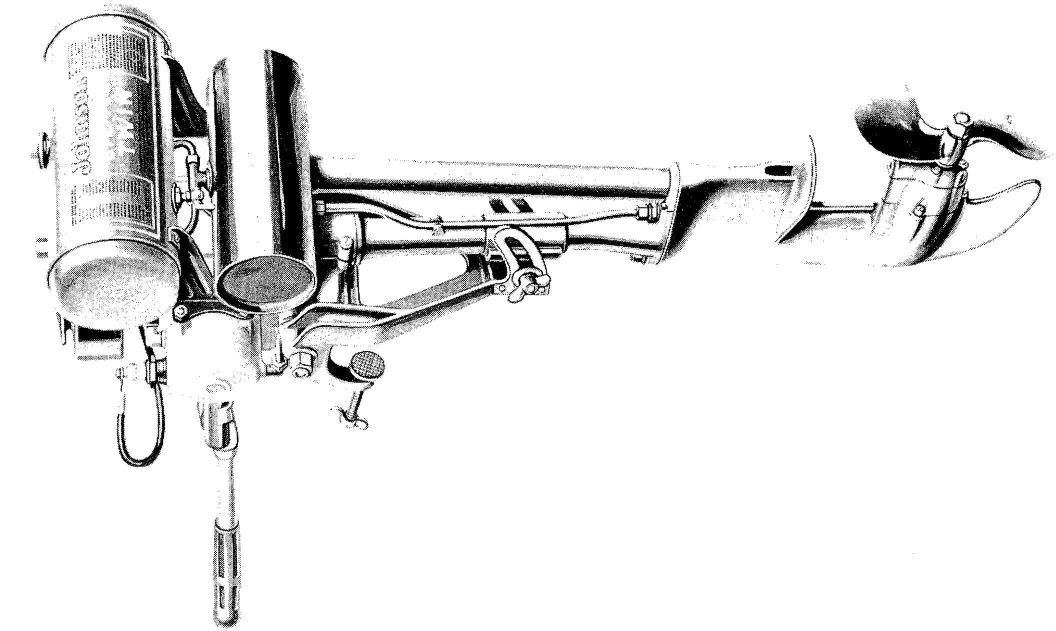
Model MD-20



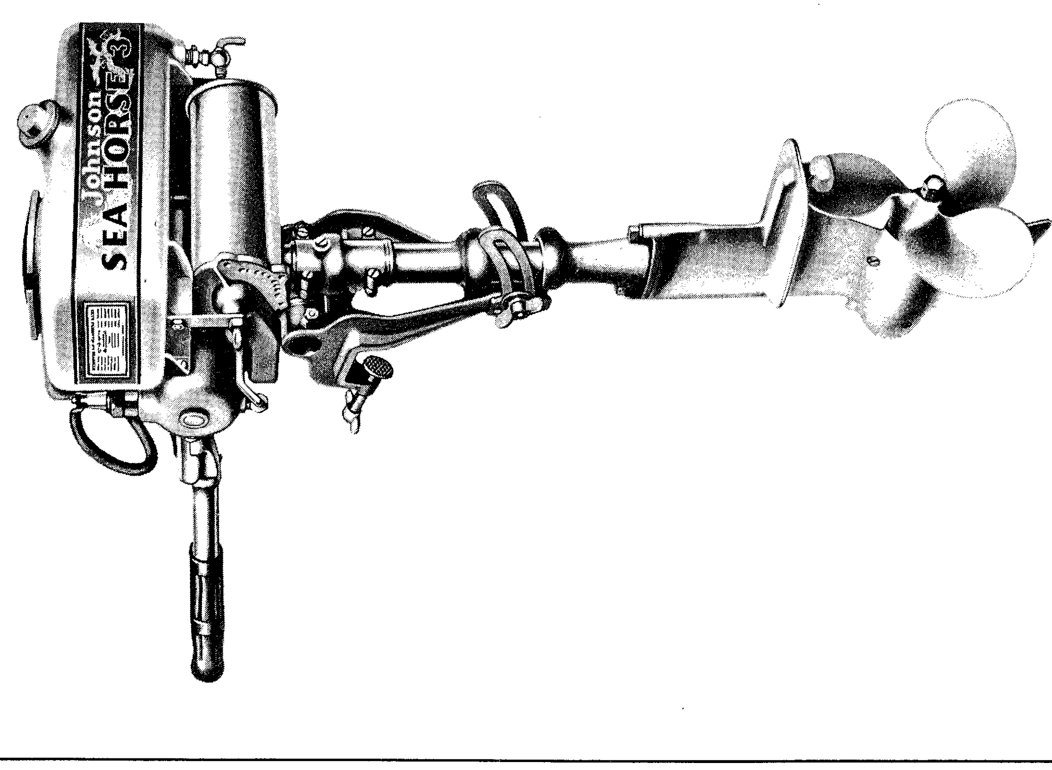
Models A, A-25



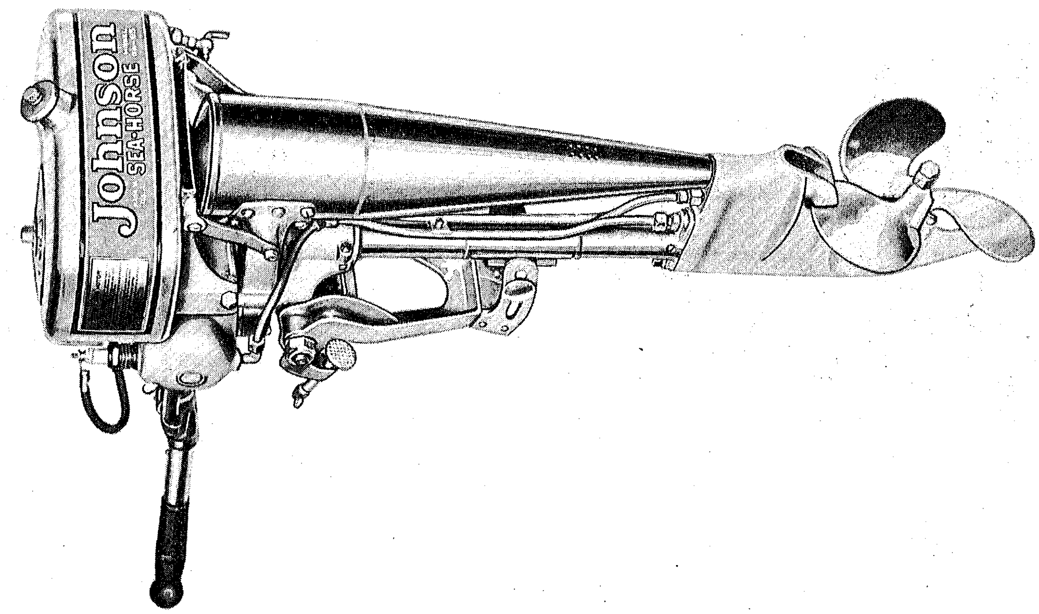
Models DS-37-38



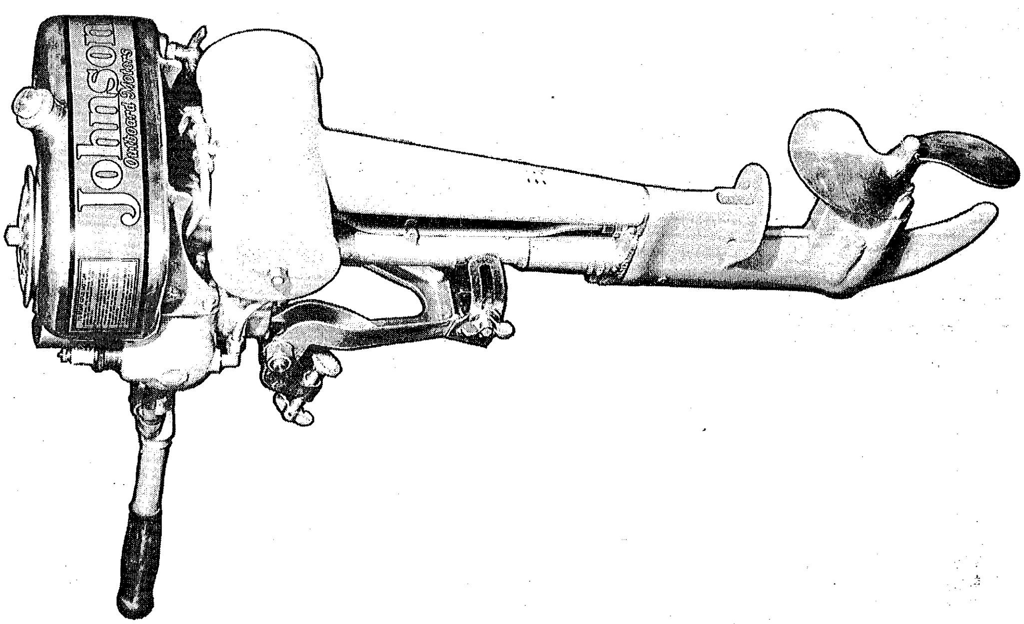
Model OA-55



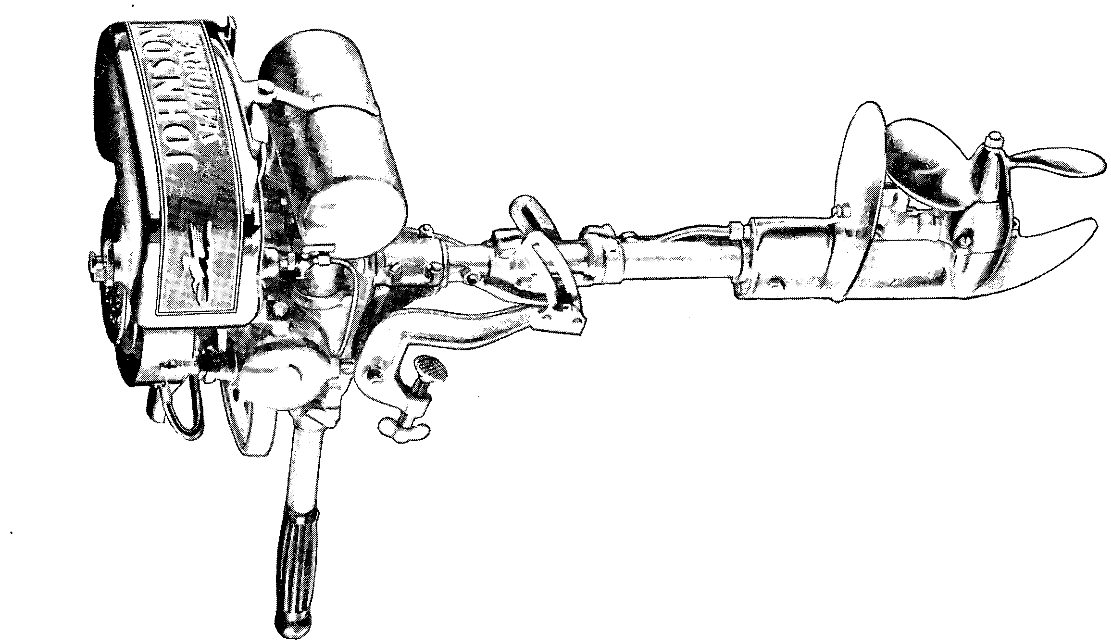
Models A-35-45



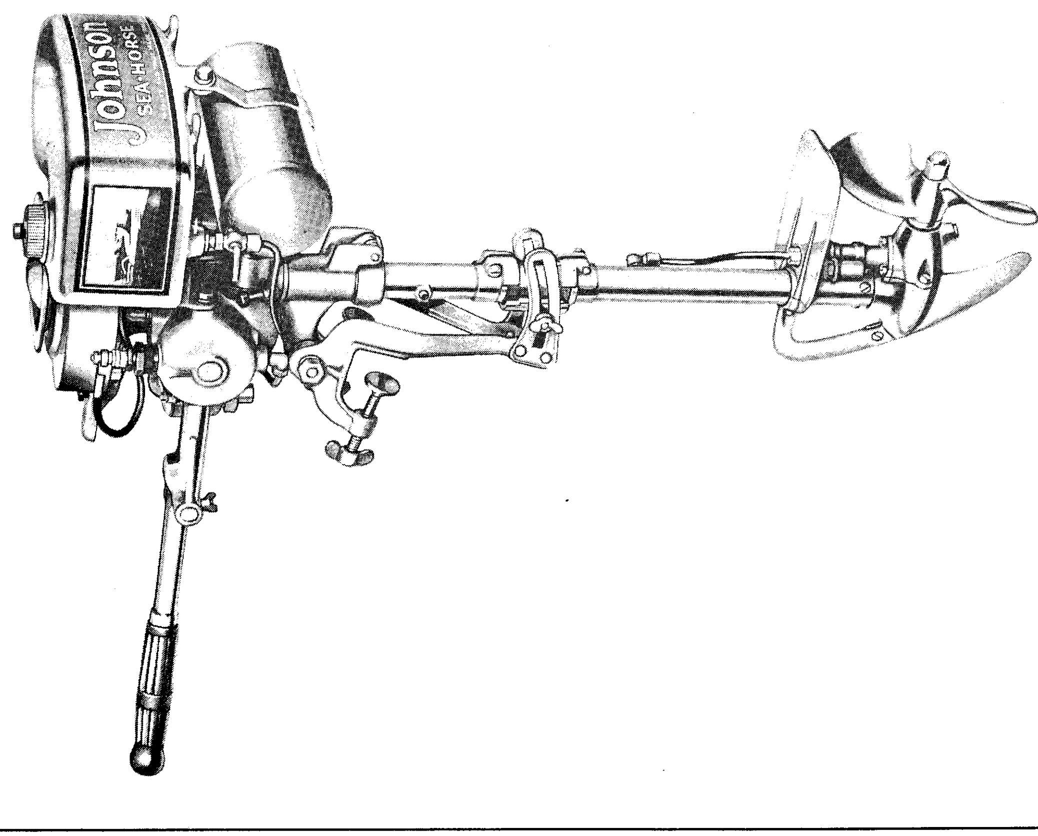
Model OA-65



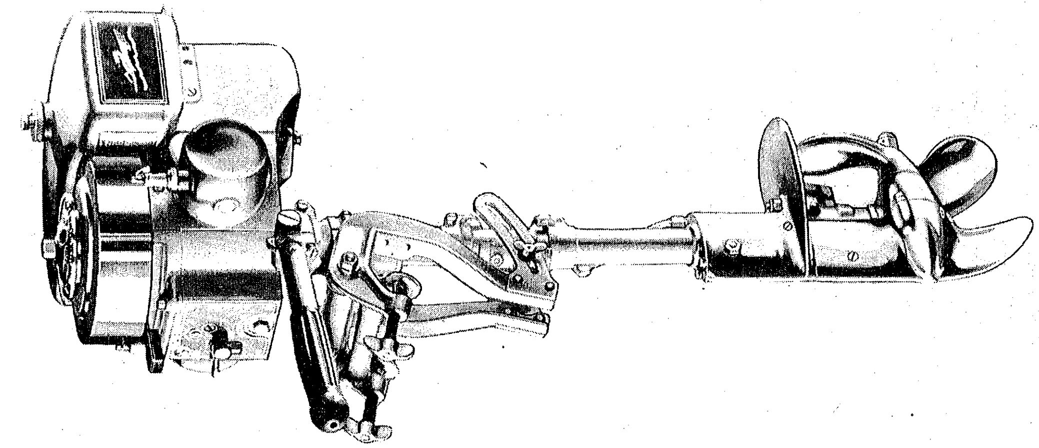
Model OA-60



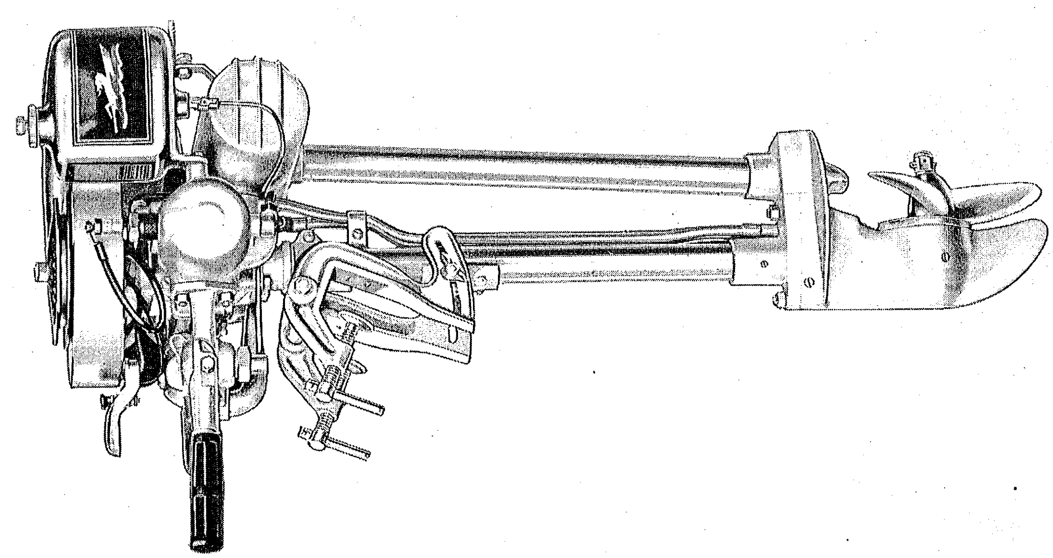
Model F-75



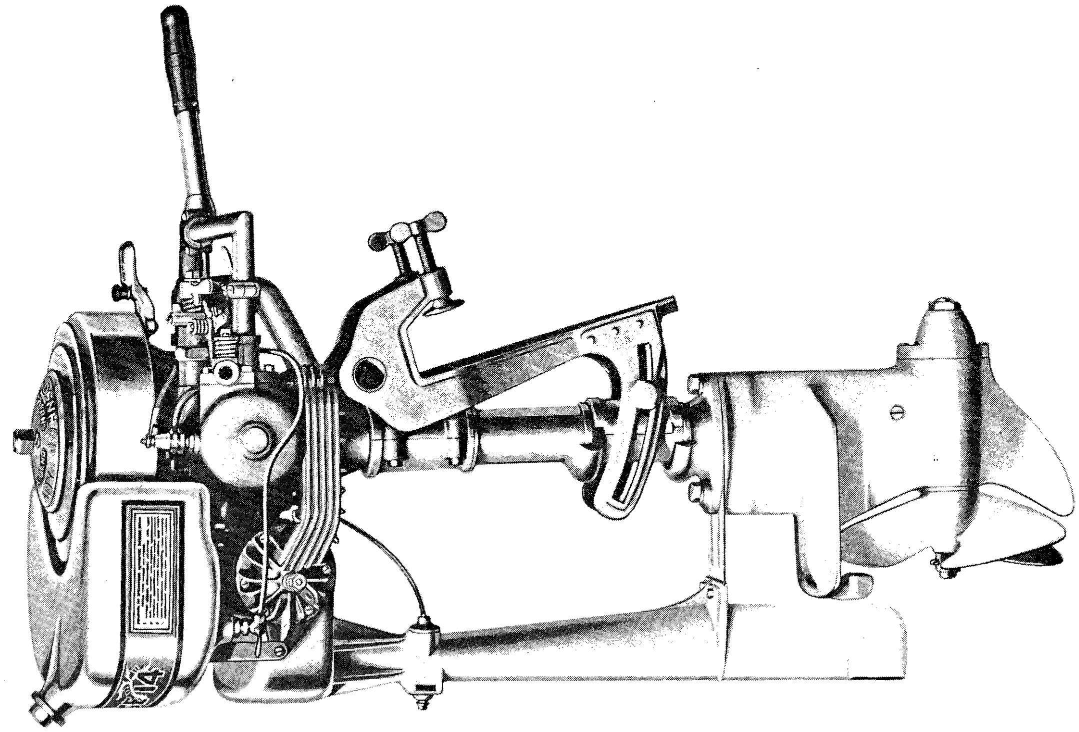
Model F-70



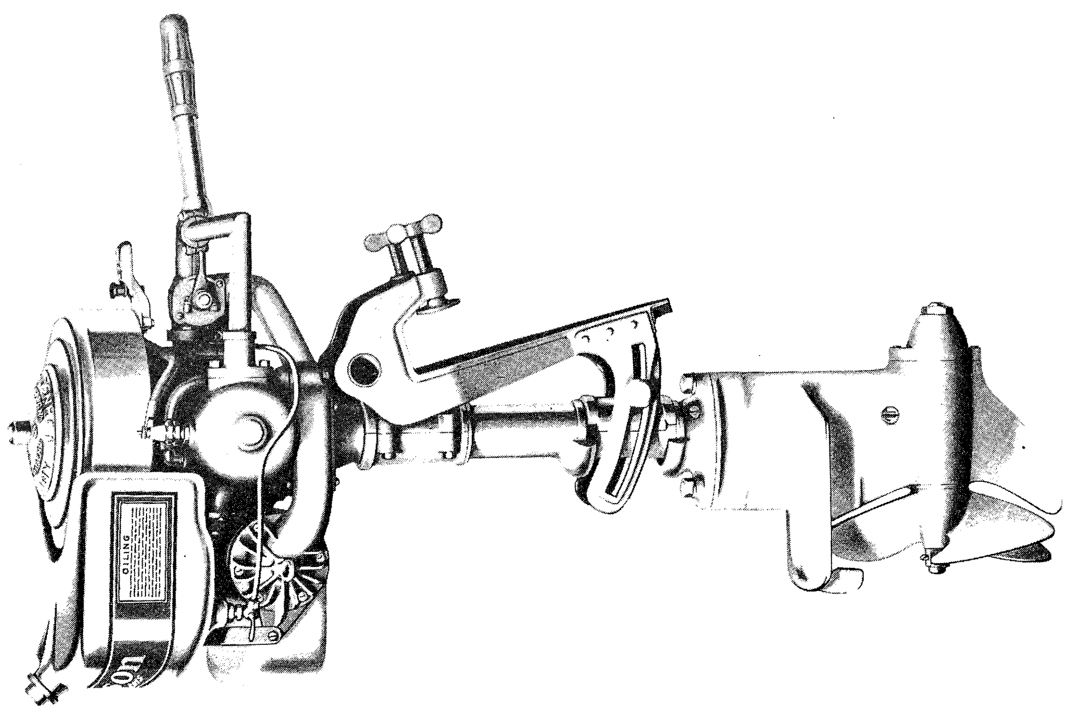
Model 300



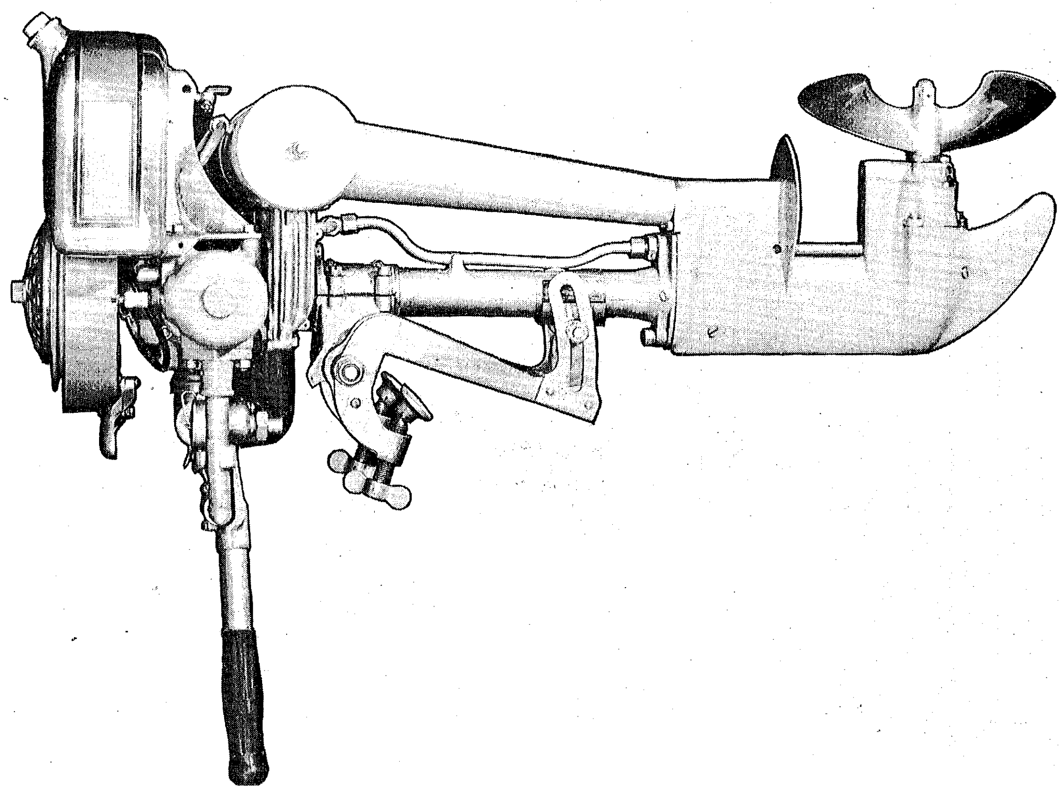
Models 200-210



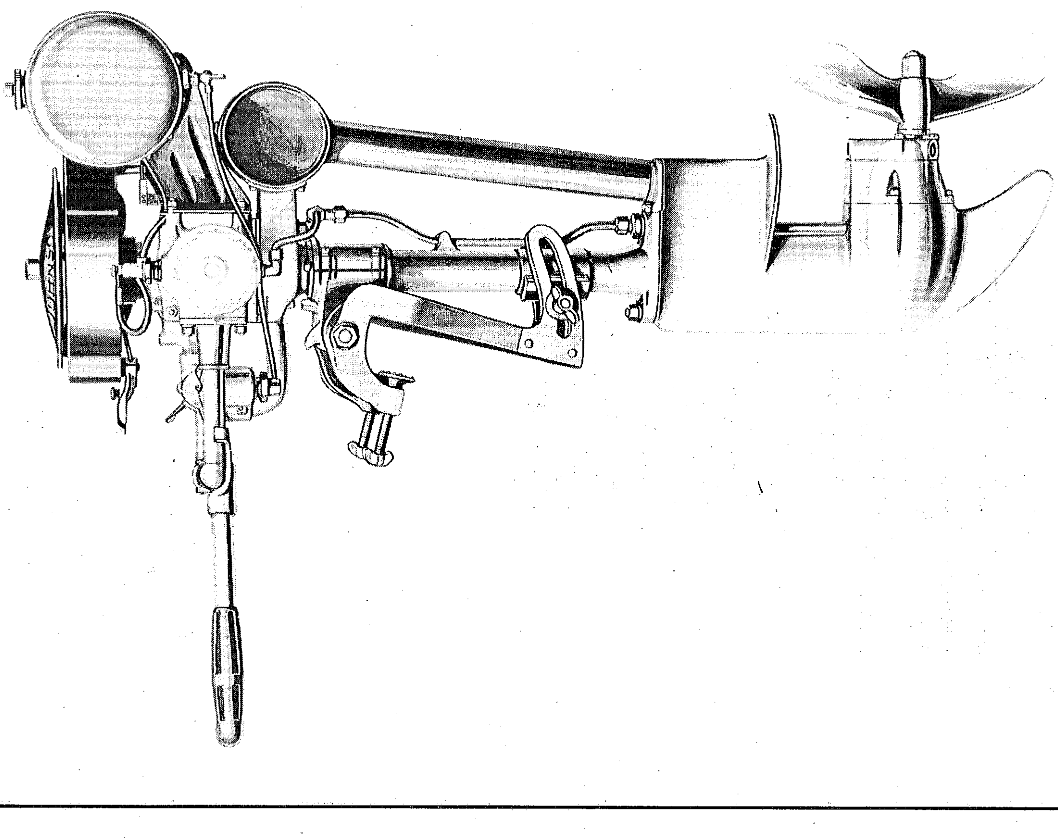
Models K-45, P-45



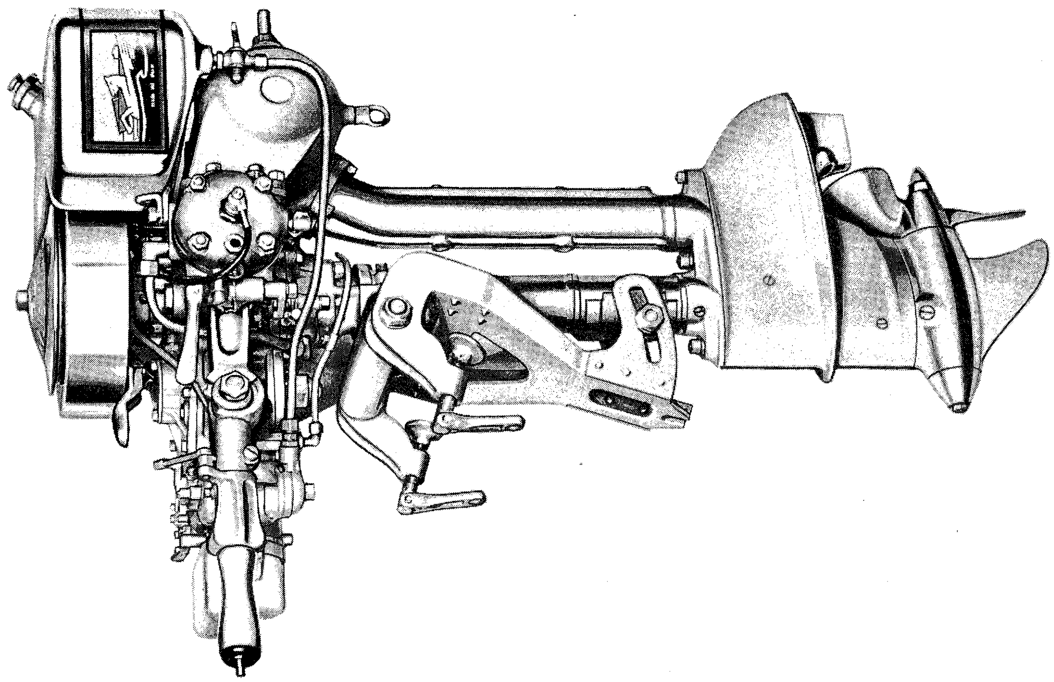
Models K-35-40, P-35-40



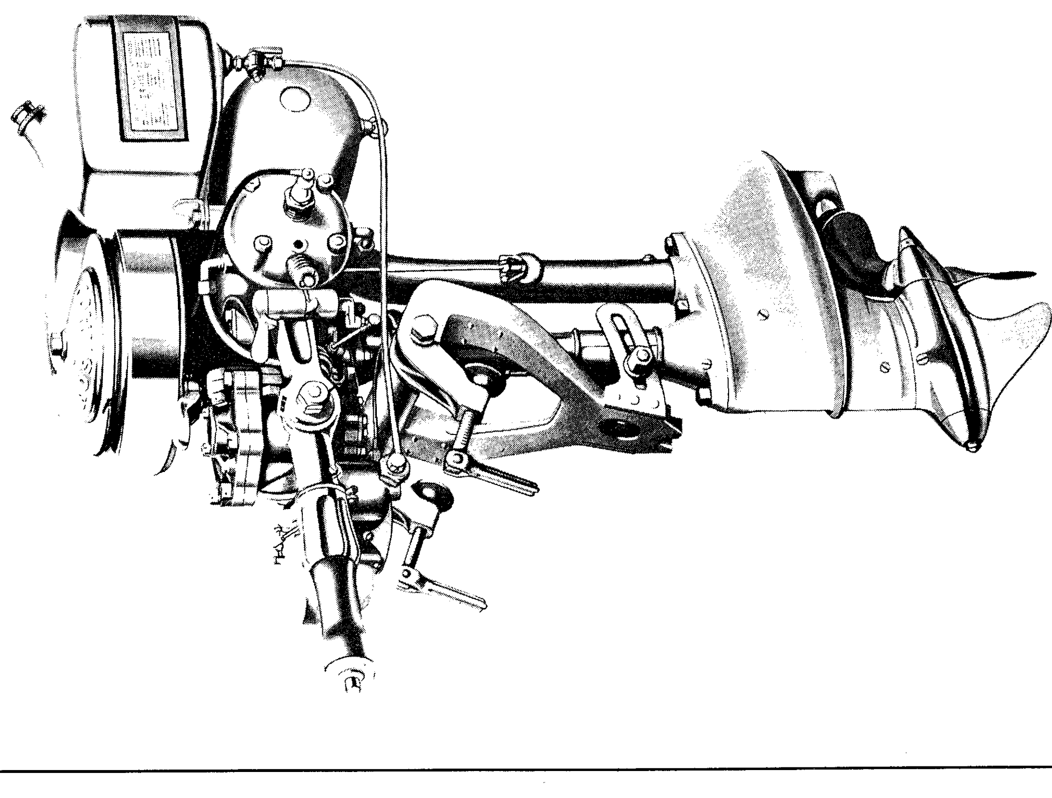
Models OK-60-75



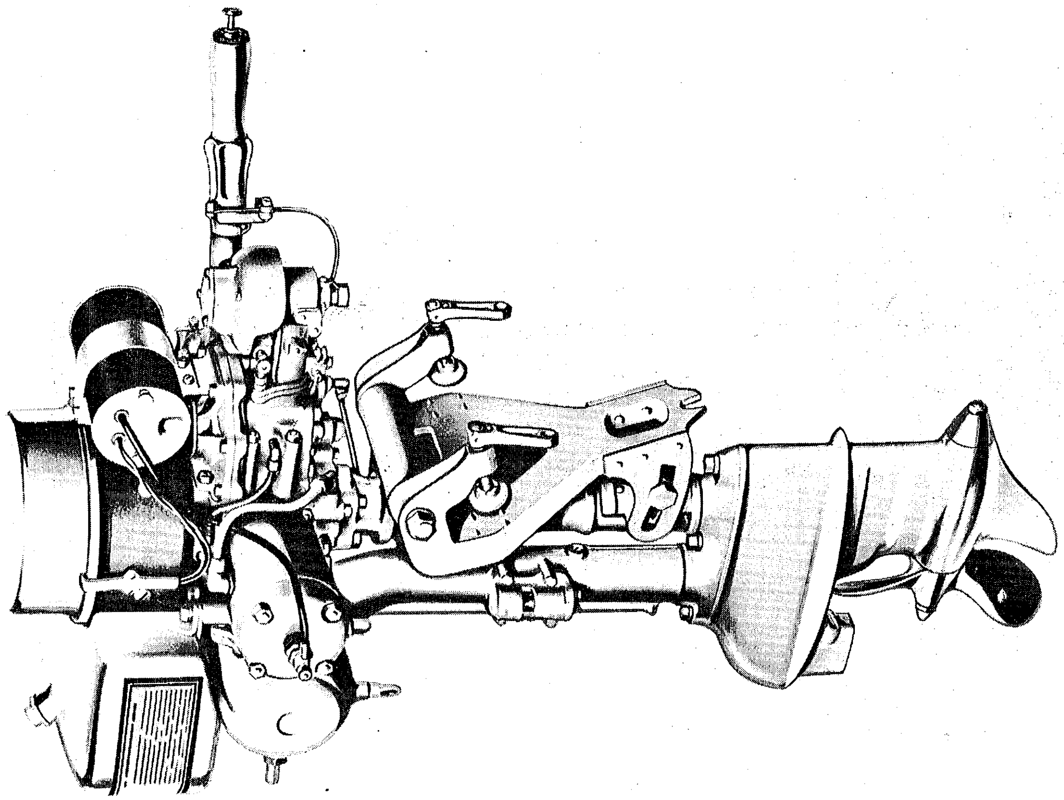
Model OK-55



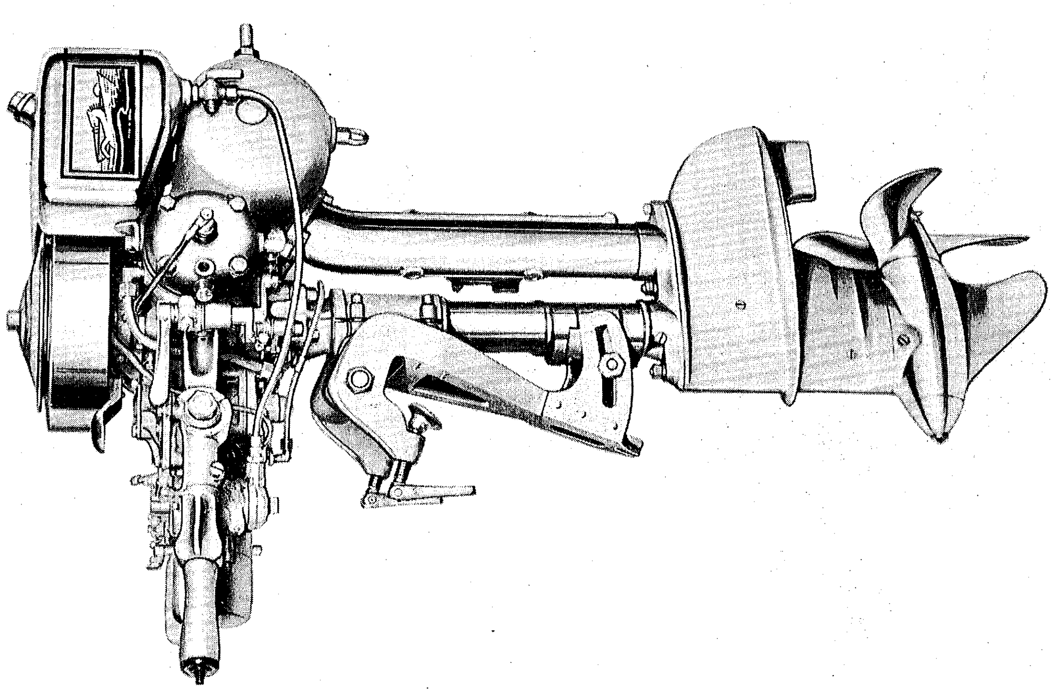
Models S-65-70



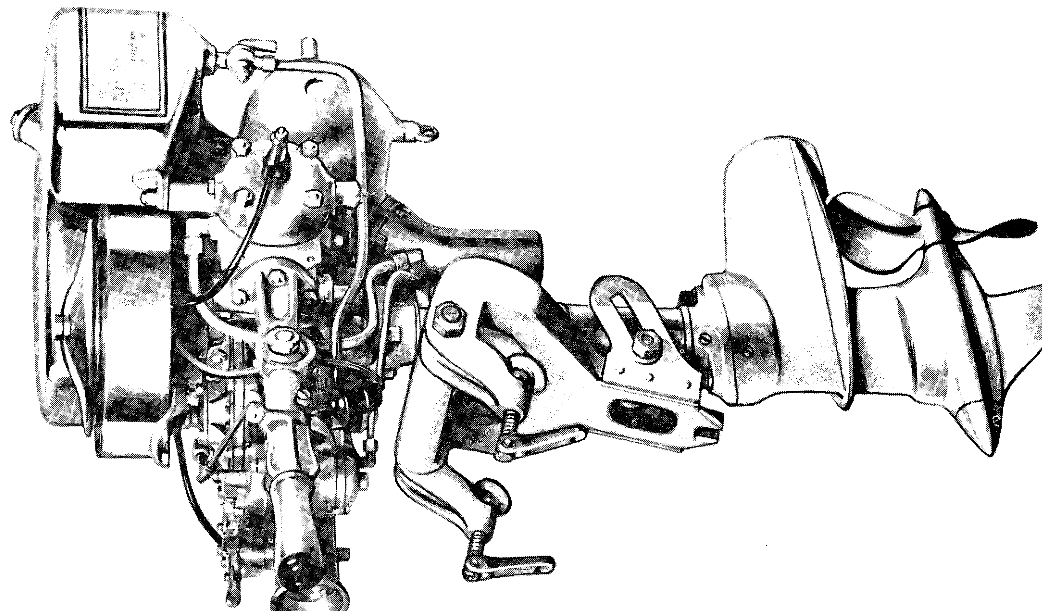
Model S-45



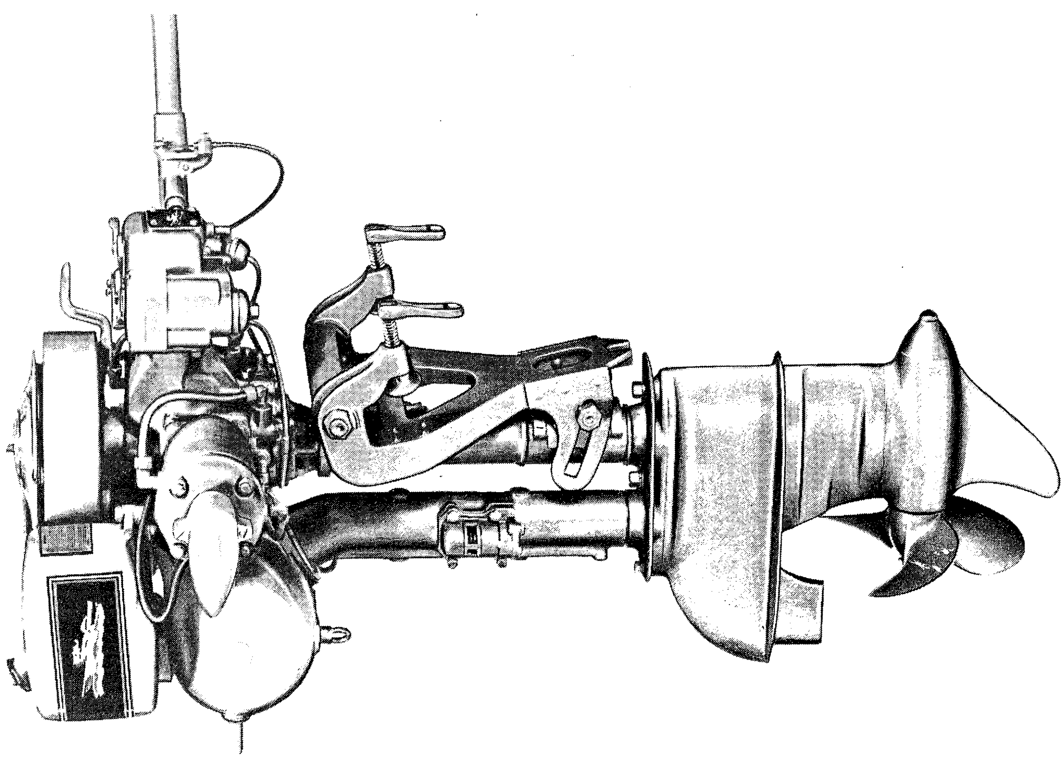
Models SE-50, PE-50



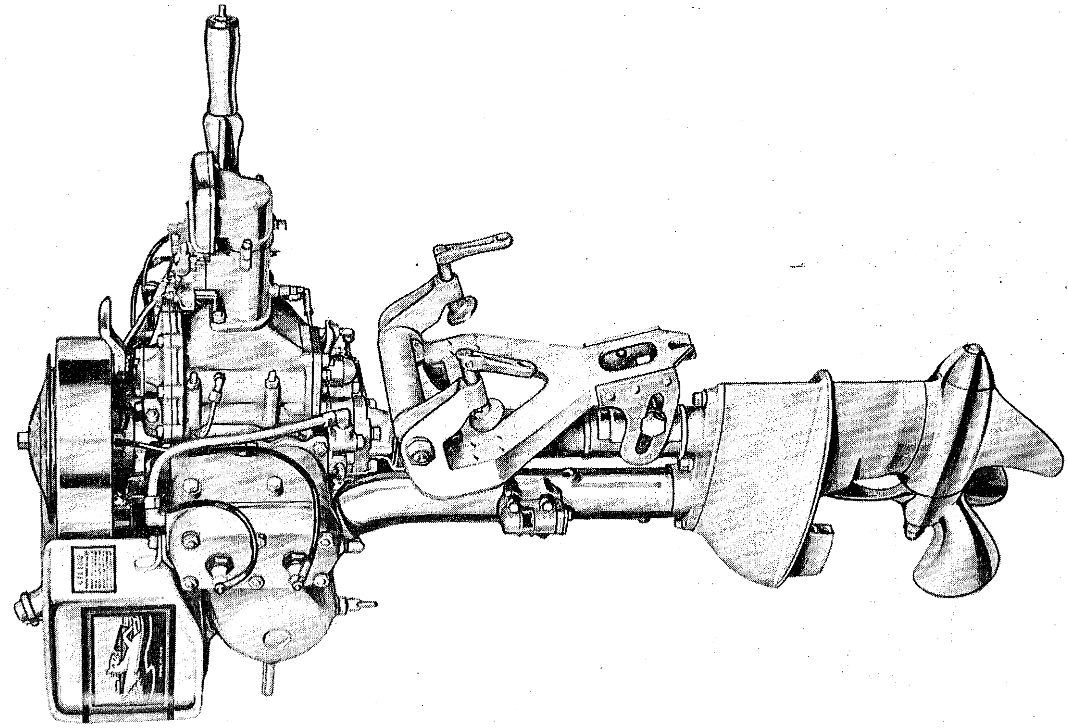
Models P-50-65-70



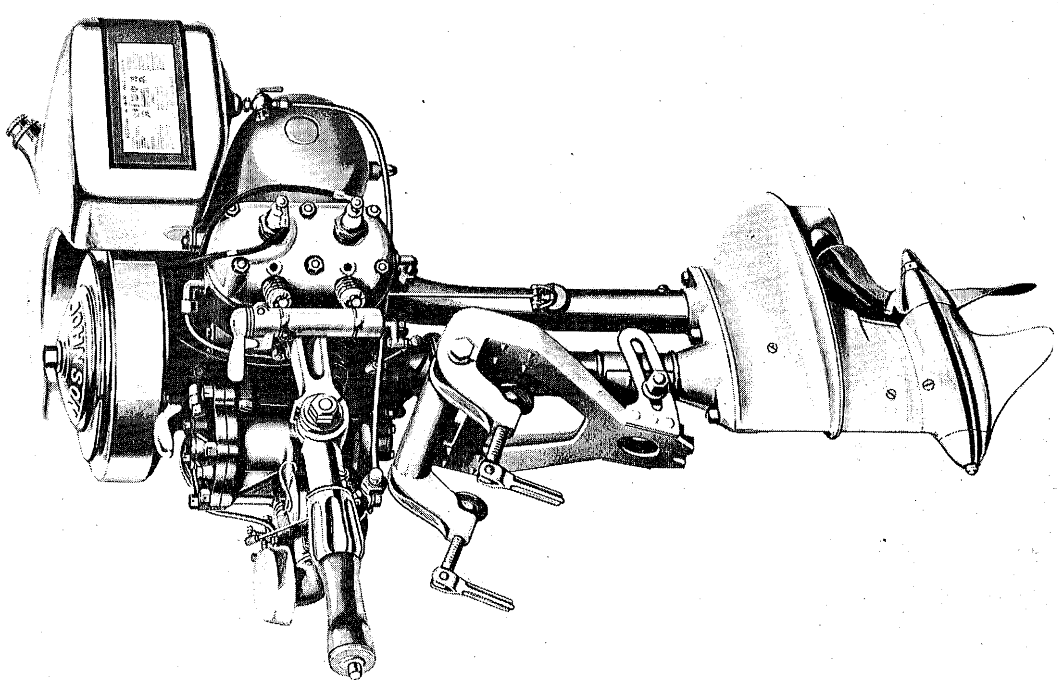
Models SR-PR (Racing)



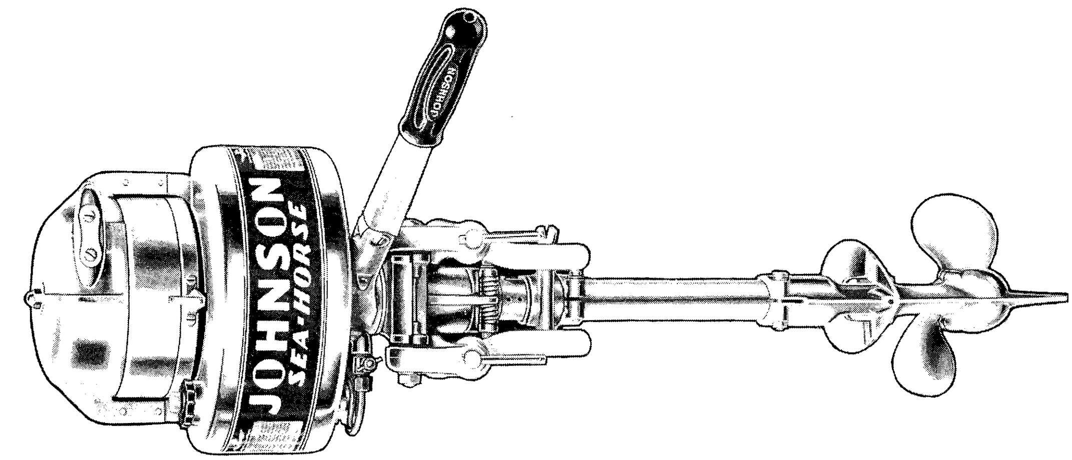
Models P-75, PO-15



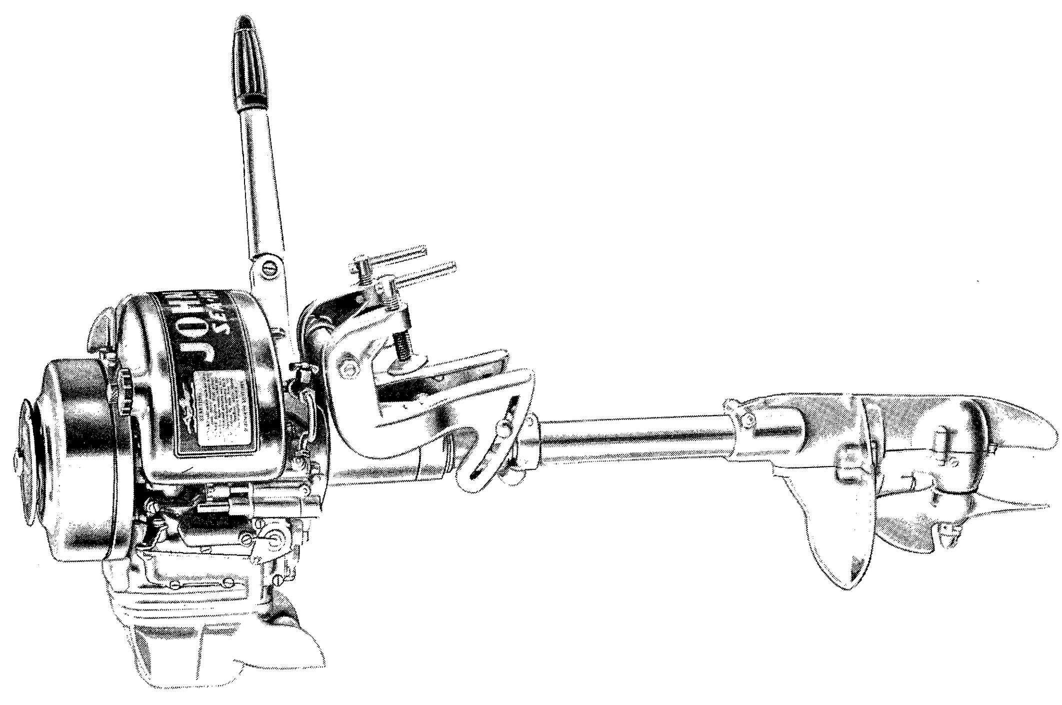
Models V-65-70



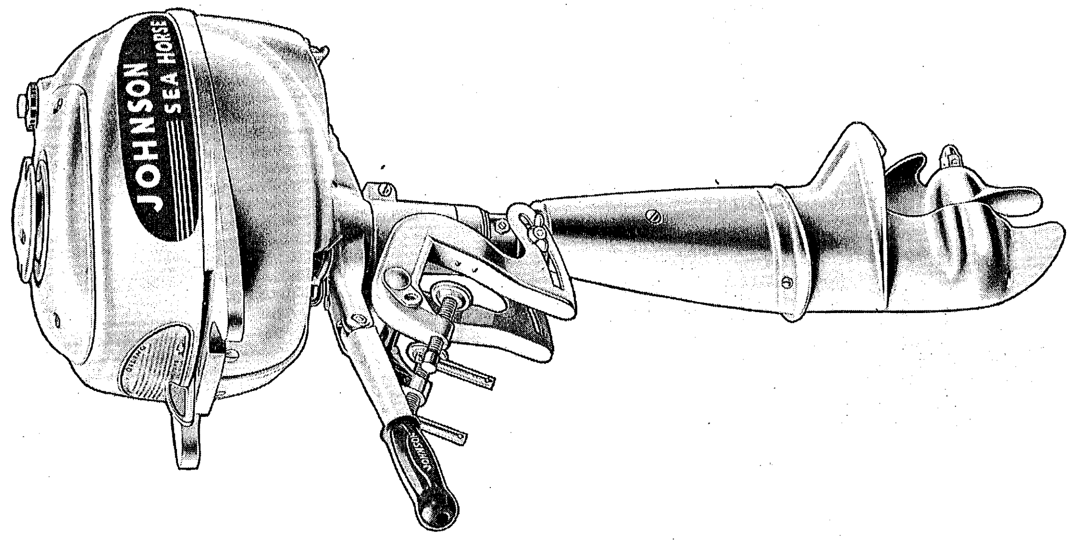
Model V-45



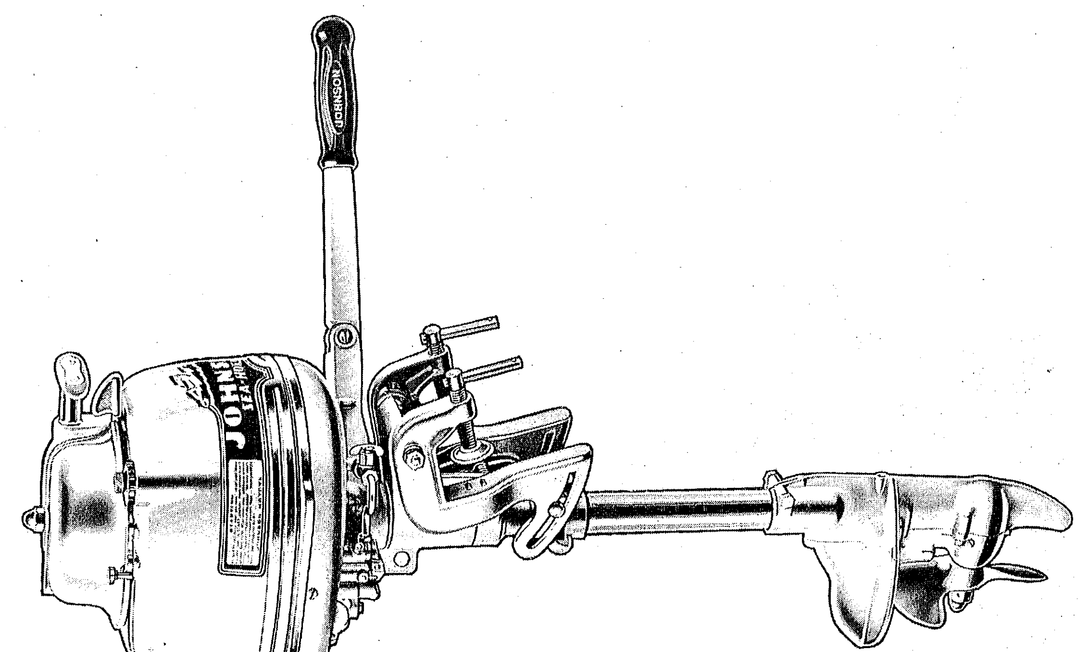
Model HA-39-10-15



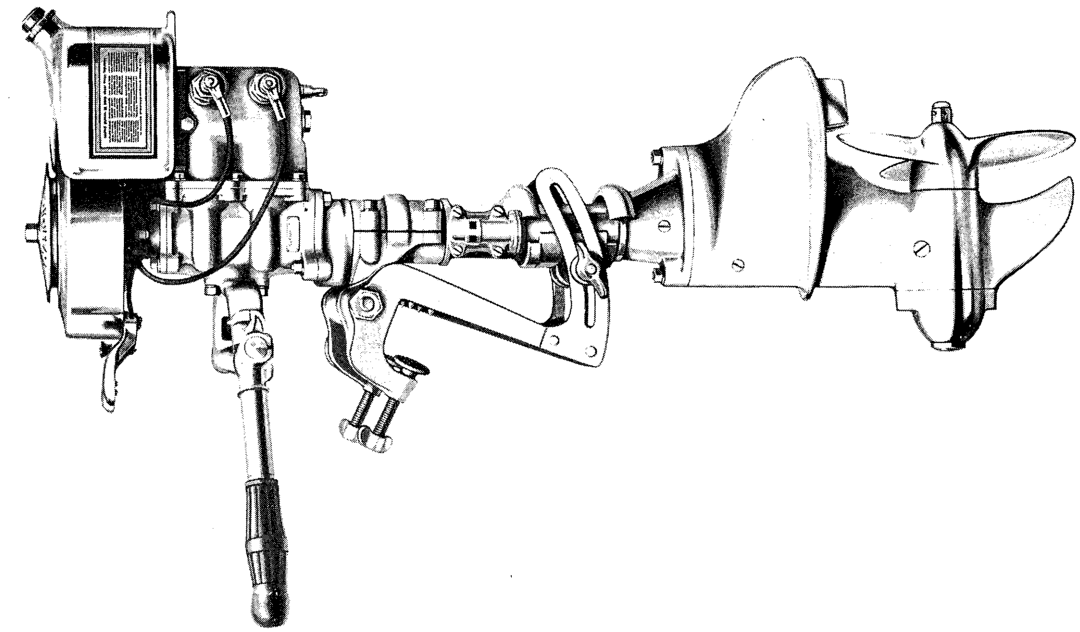
Model HS-39-10-15



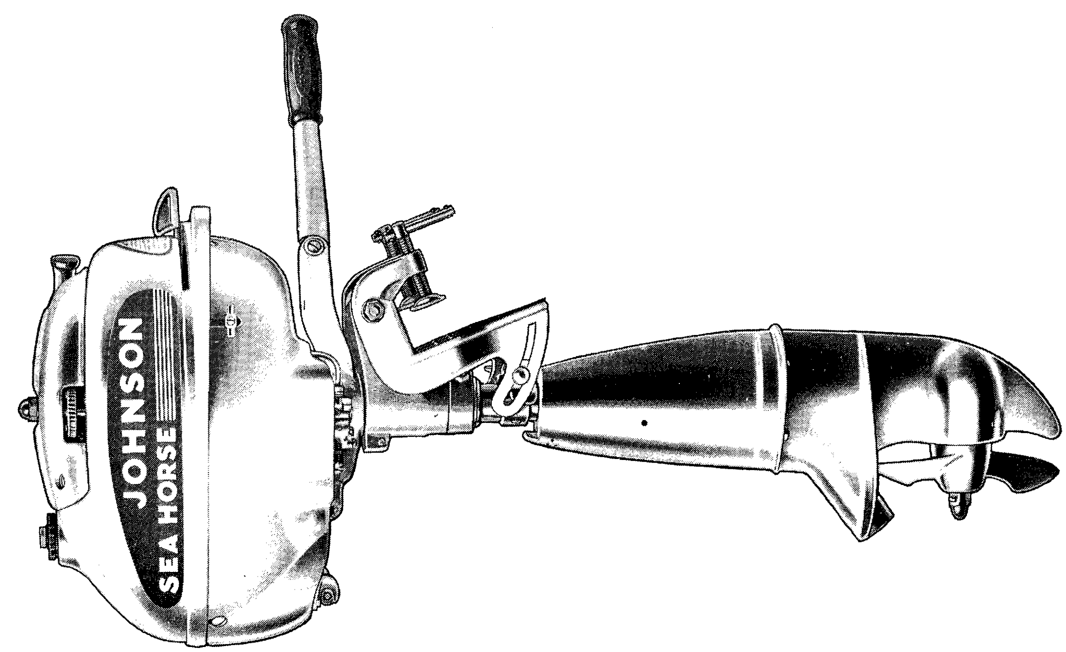
Model HS-20



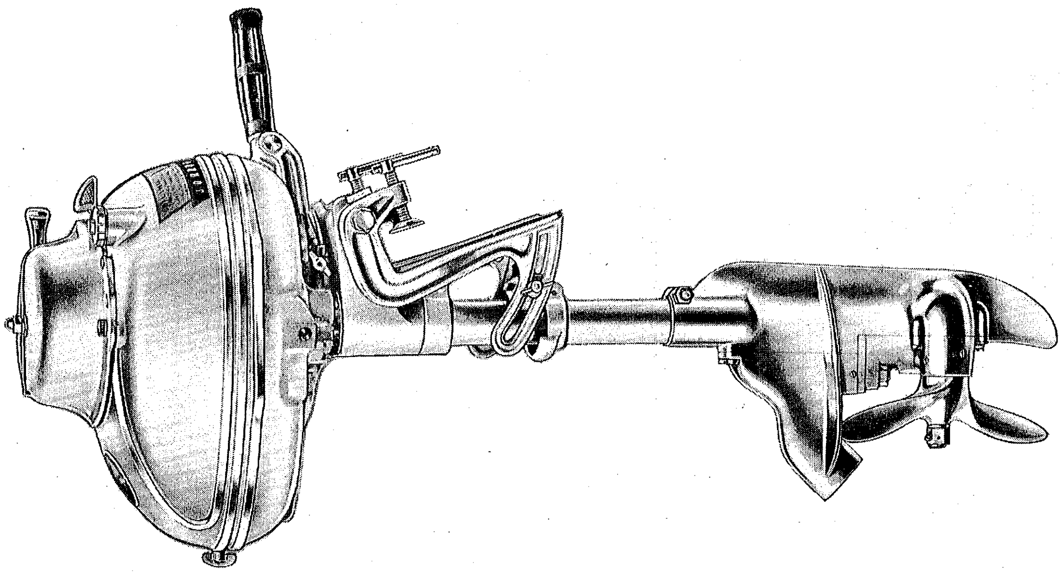
Model HD-39-10-15



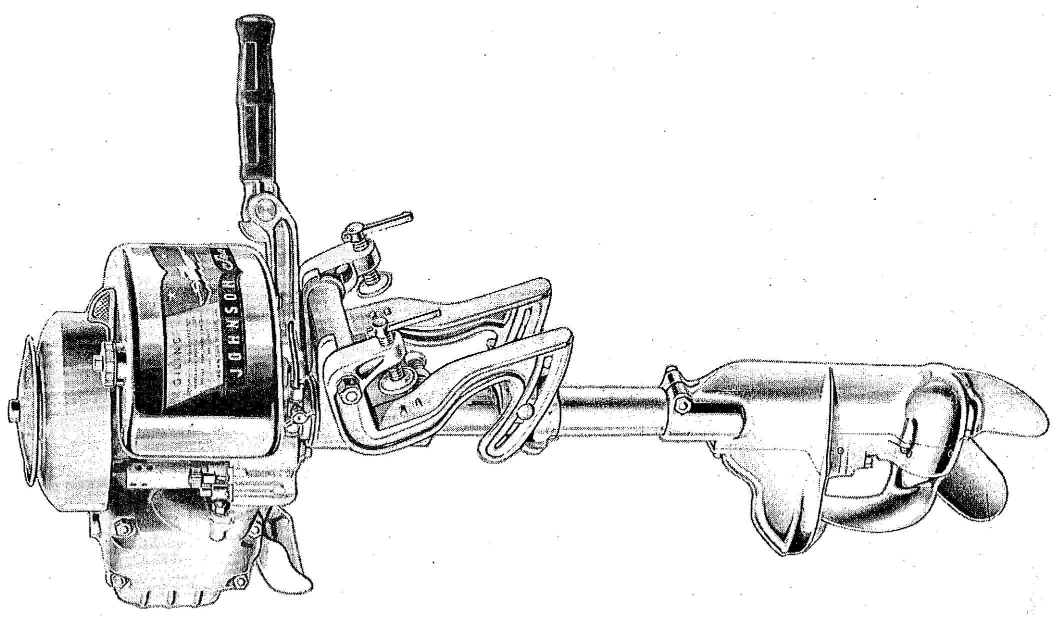
Models A-50-65-70—80, AA-37, K-50-65-70-80



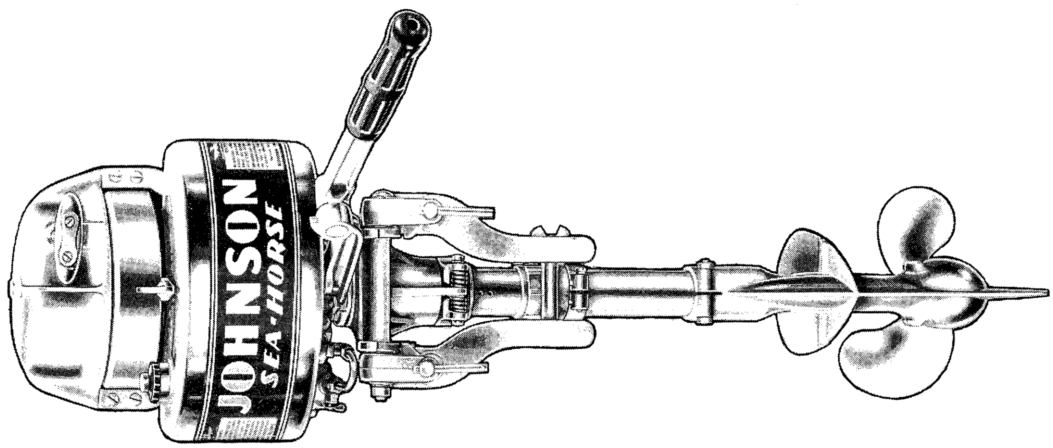
Models HD-20-25



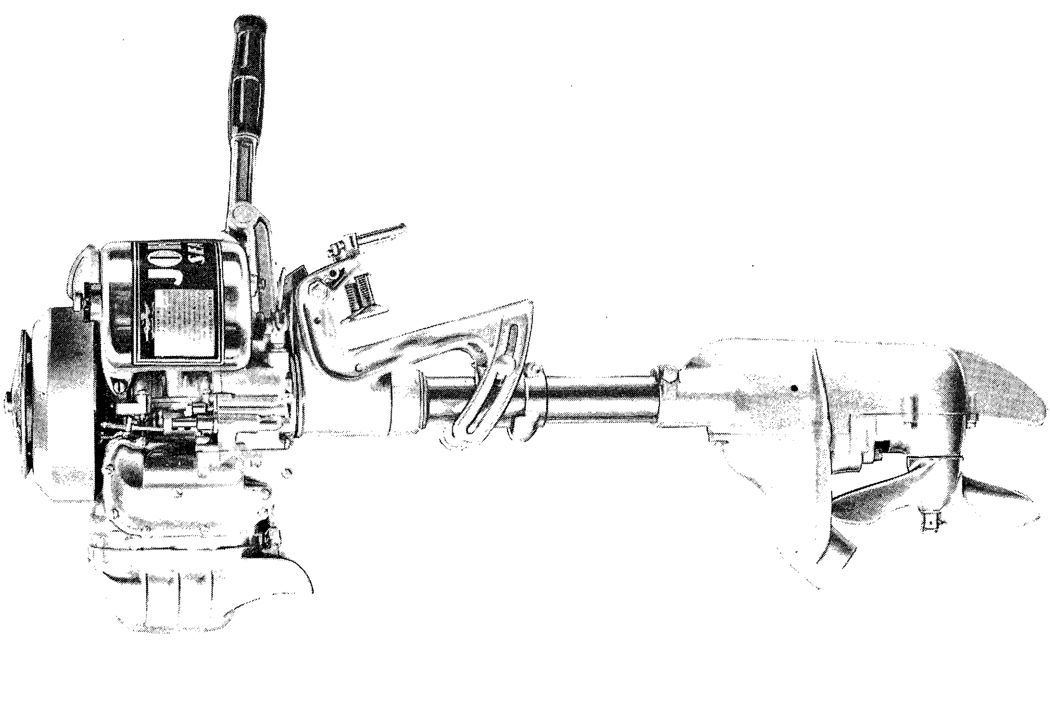
Models DT-37-38



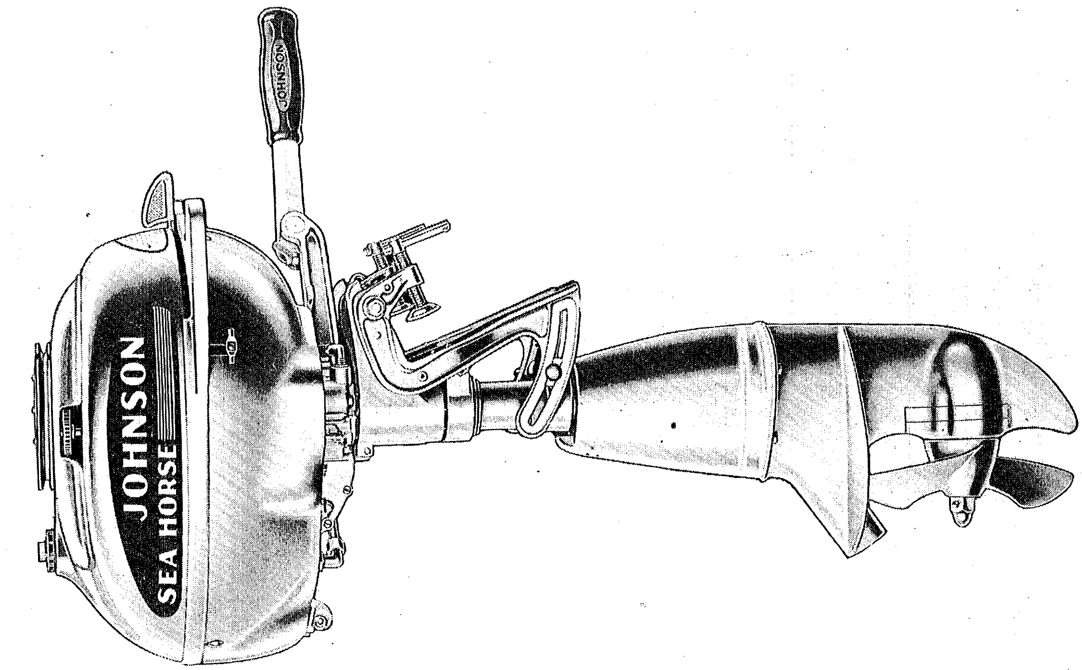
Models LT-37-38



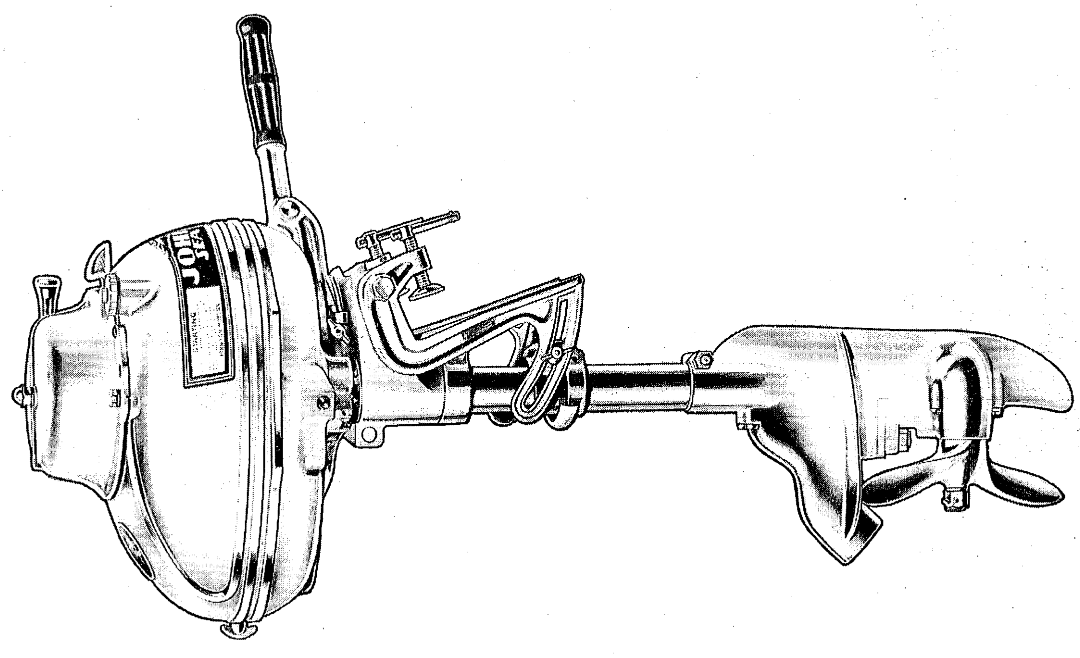
Models AT-39-10



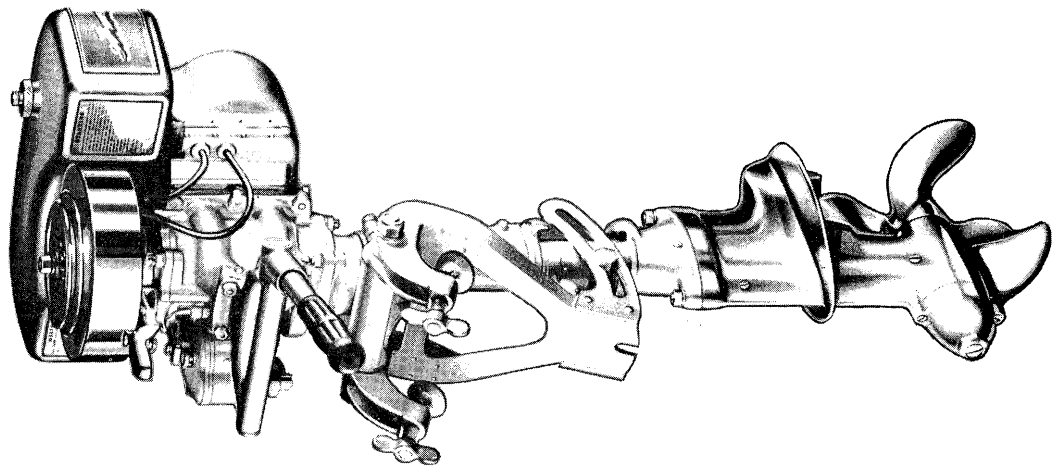
Models LT-39-10



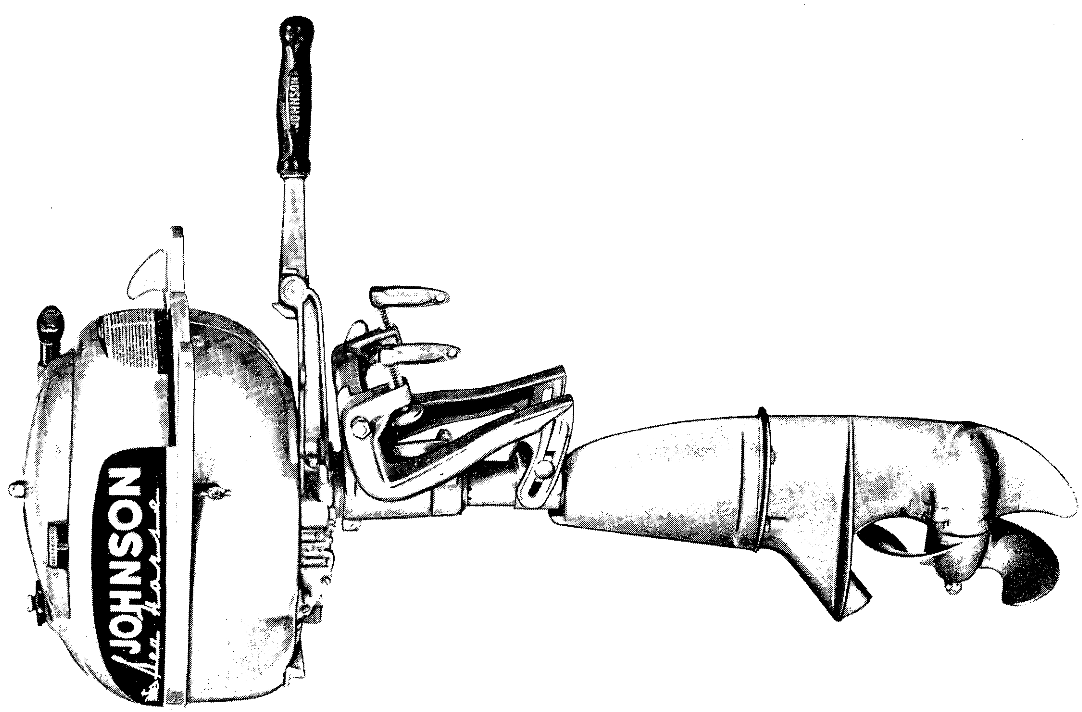
Models TS-15-20



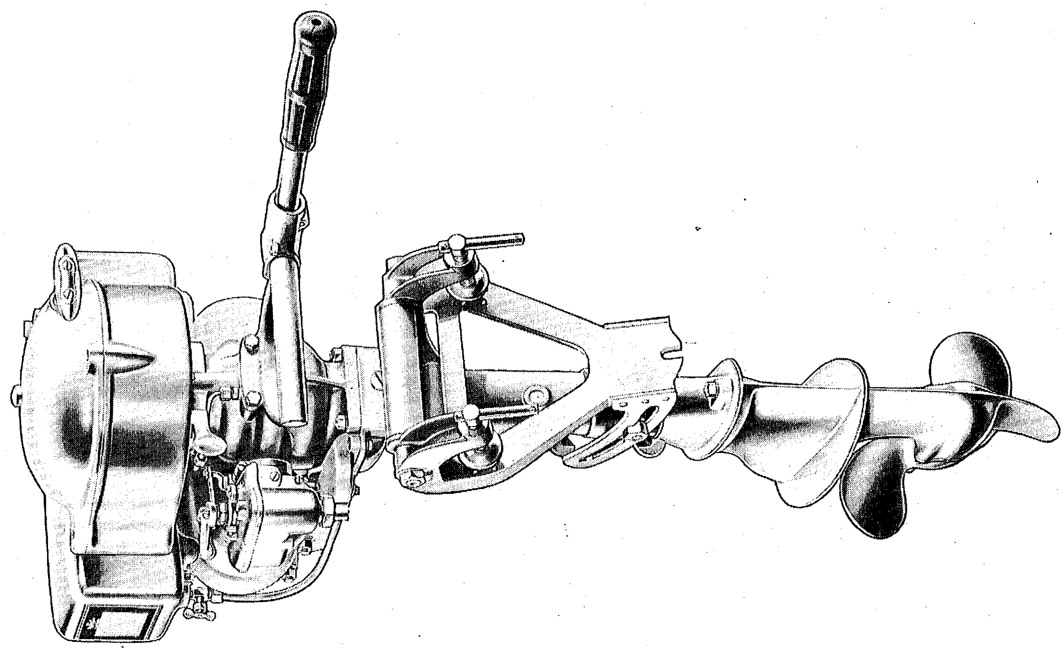
Models DT-39-10



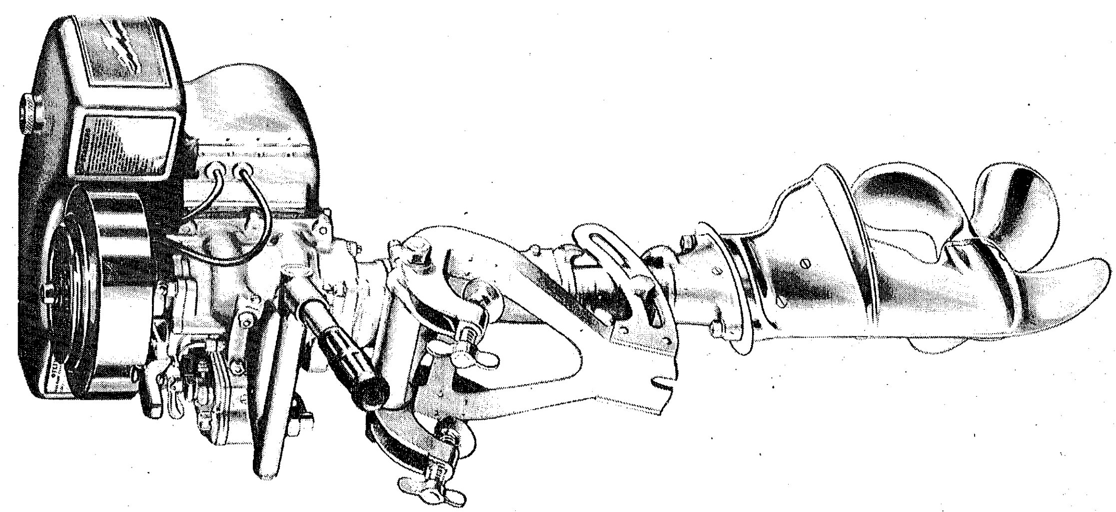
Models K-75, A-75



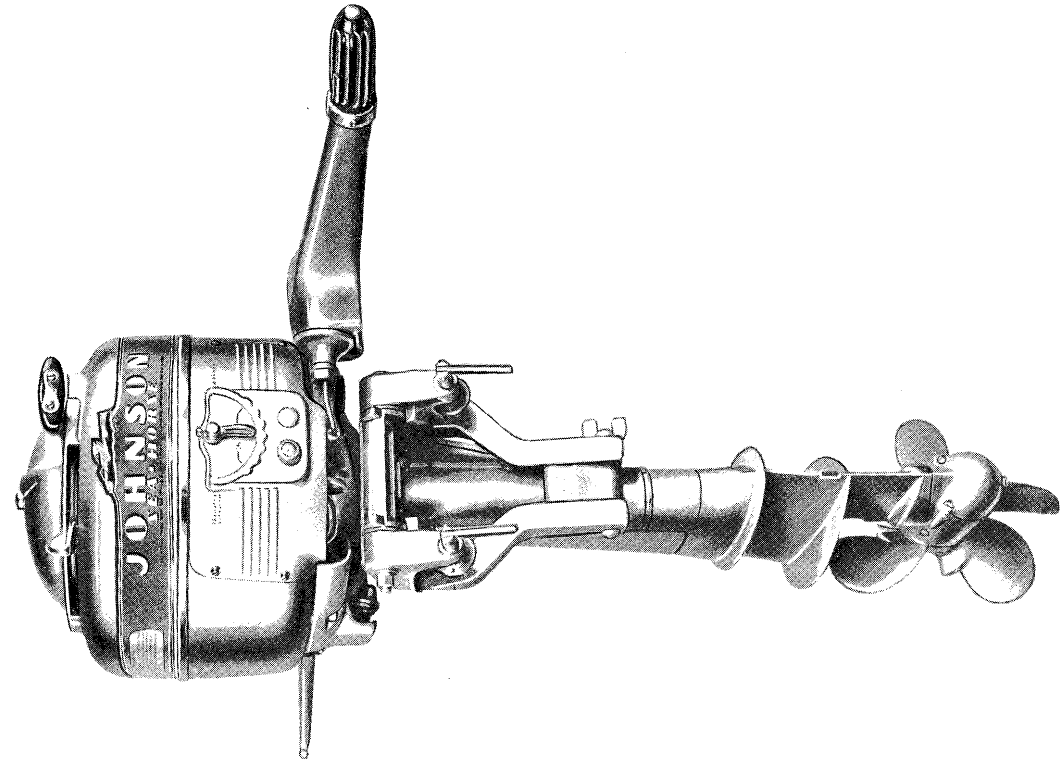
Models TD-15-20



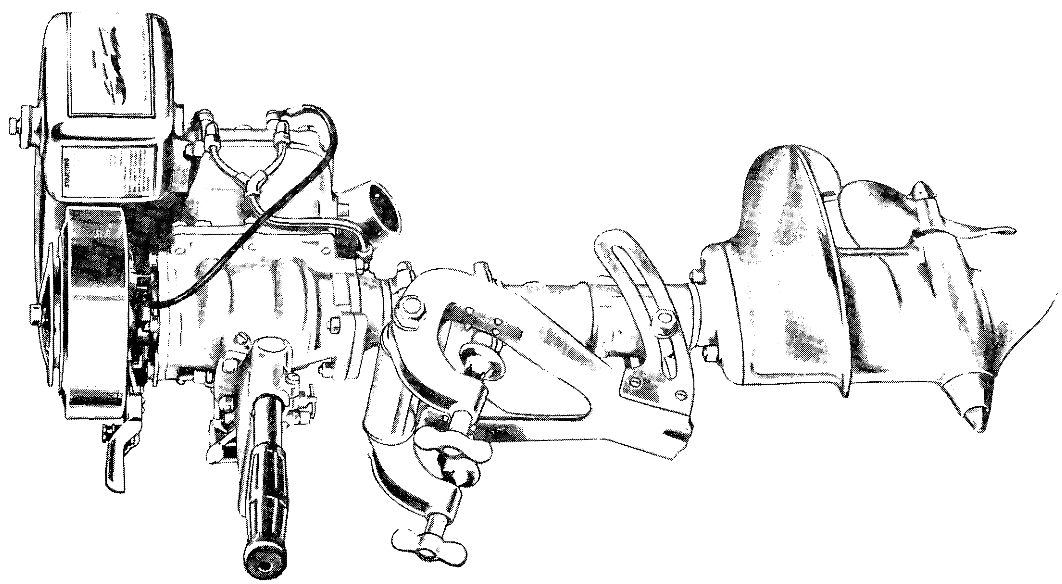
Model KD-15



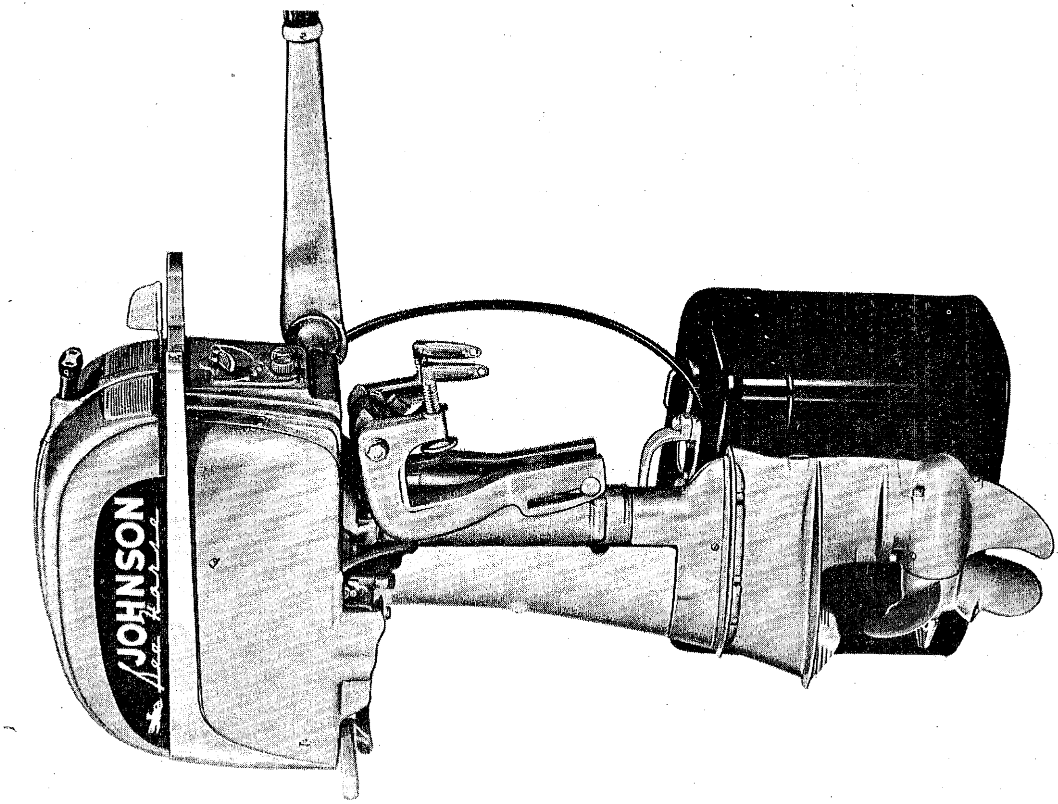
Models KA-37 to KS-15



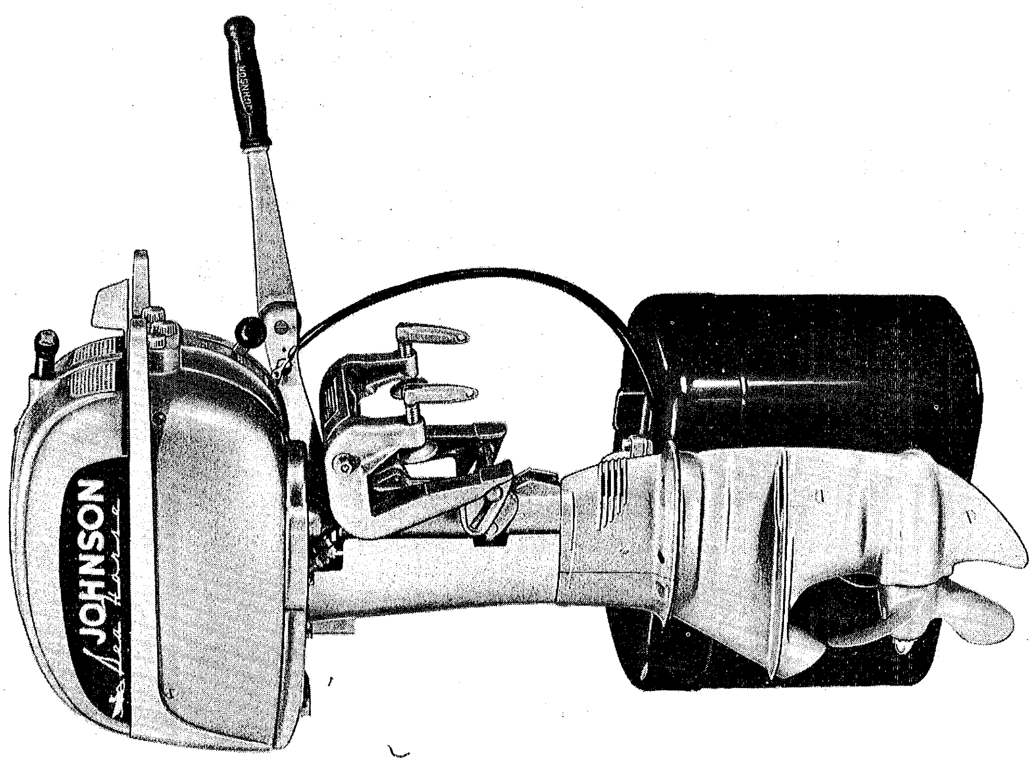
Models SD-10-15



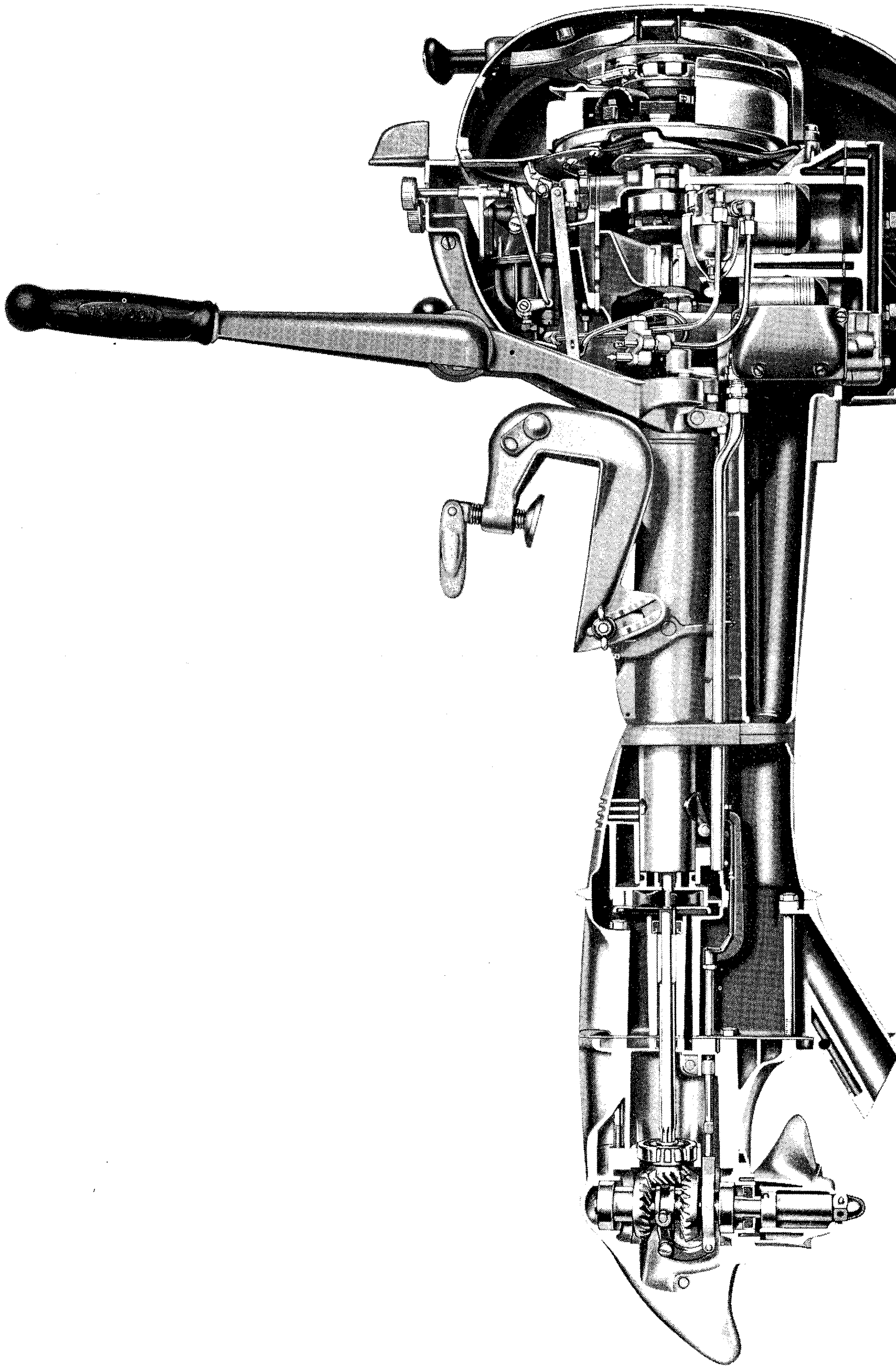
Model KR (Racing)



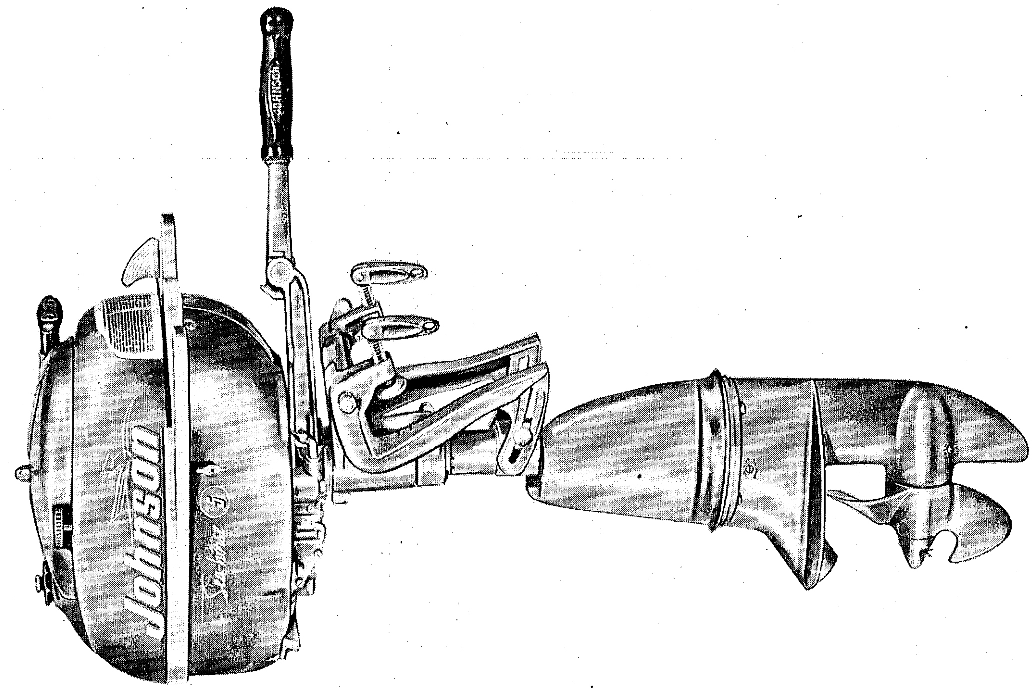
Model SD-20



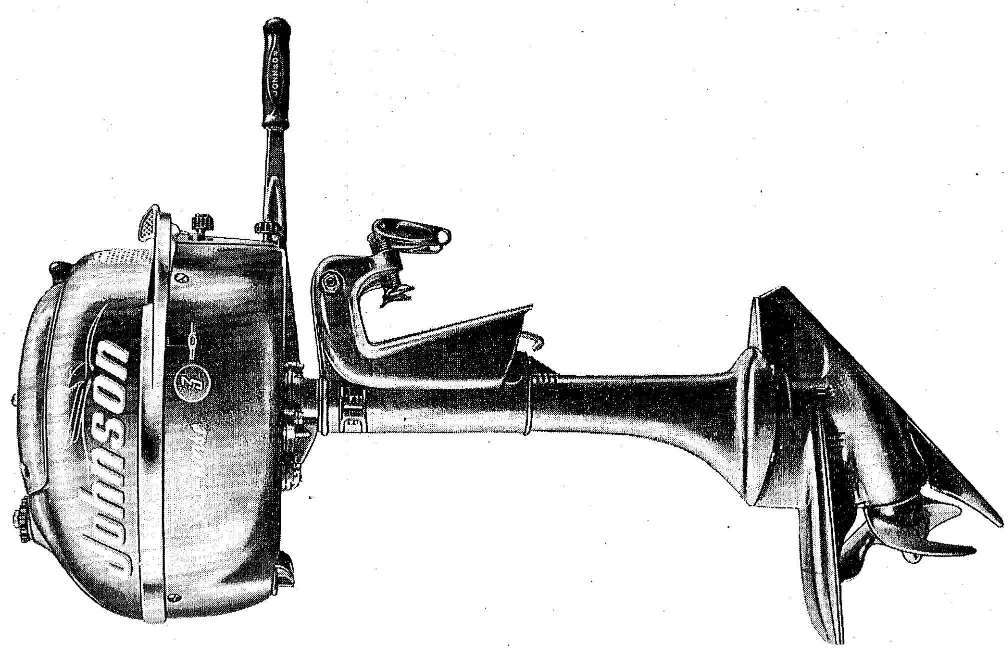
Model QD-10



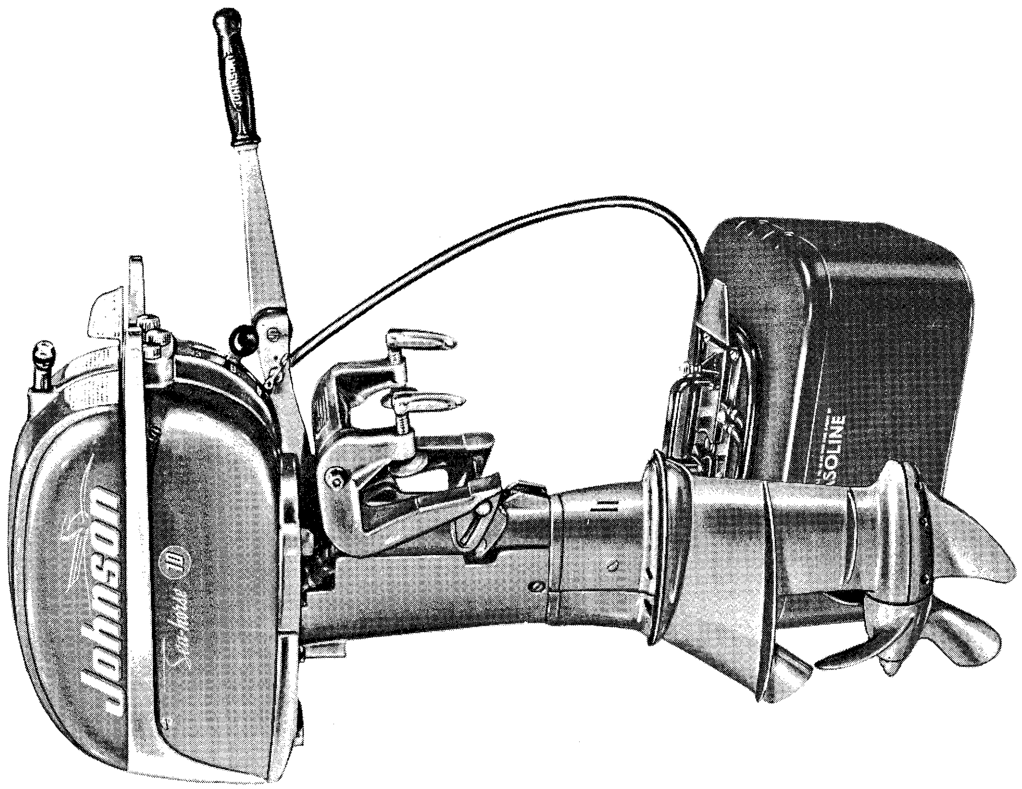
Model QD-10 (Sectionalized)



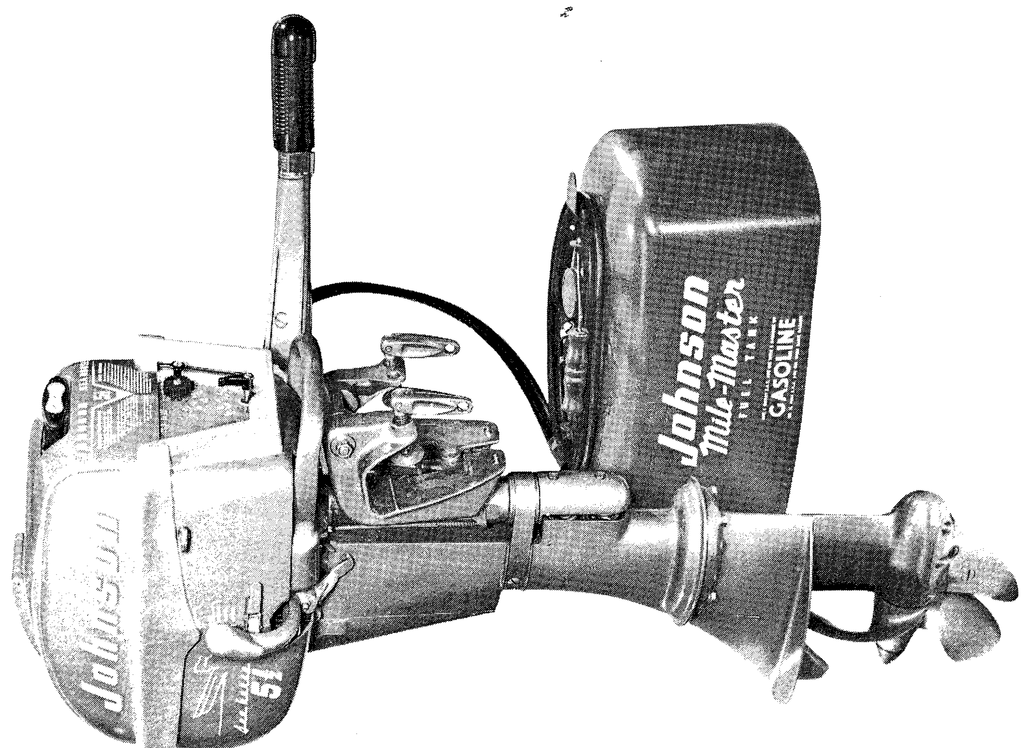
Model TN



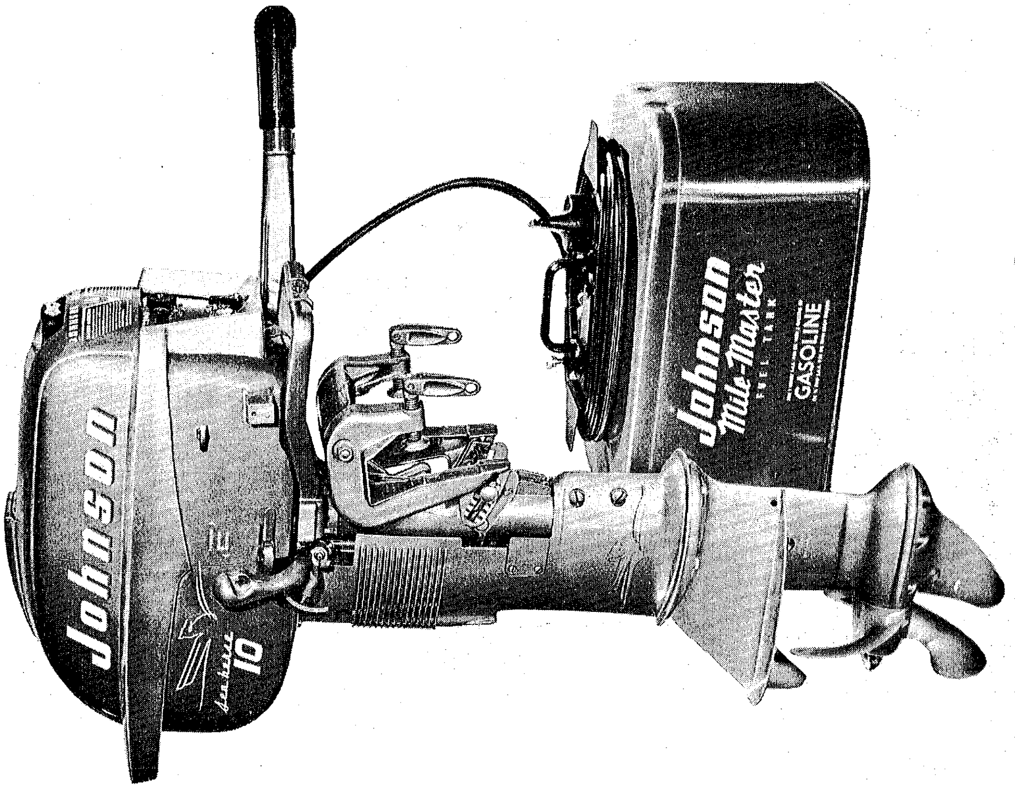
Model JW



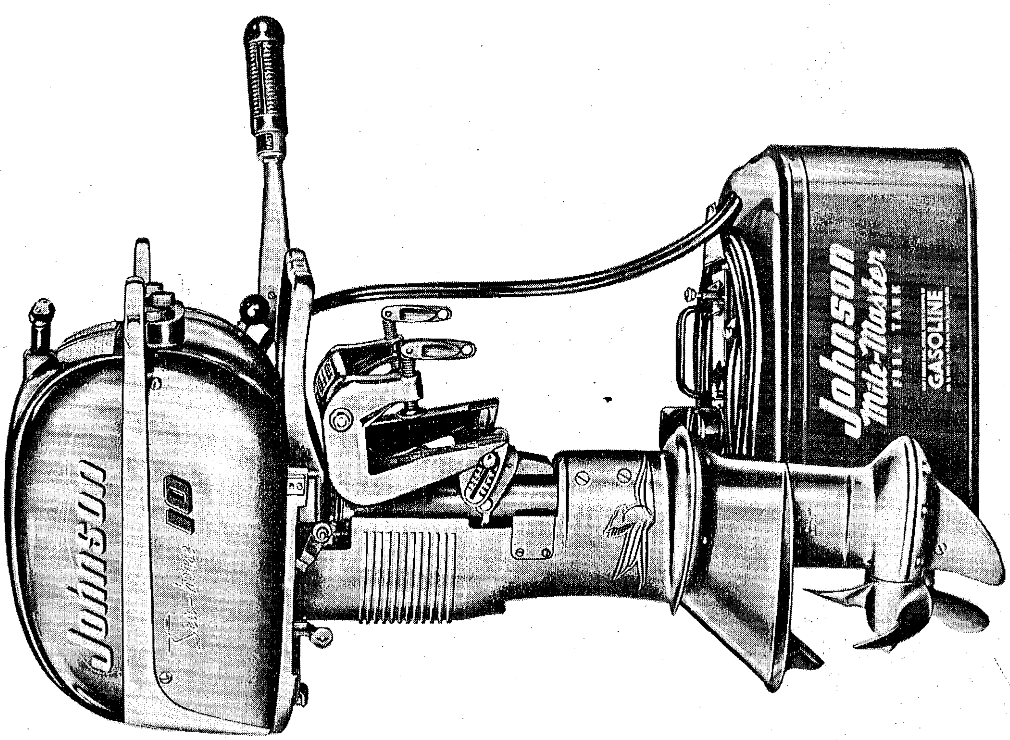
Model QD-12-13



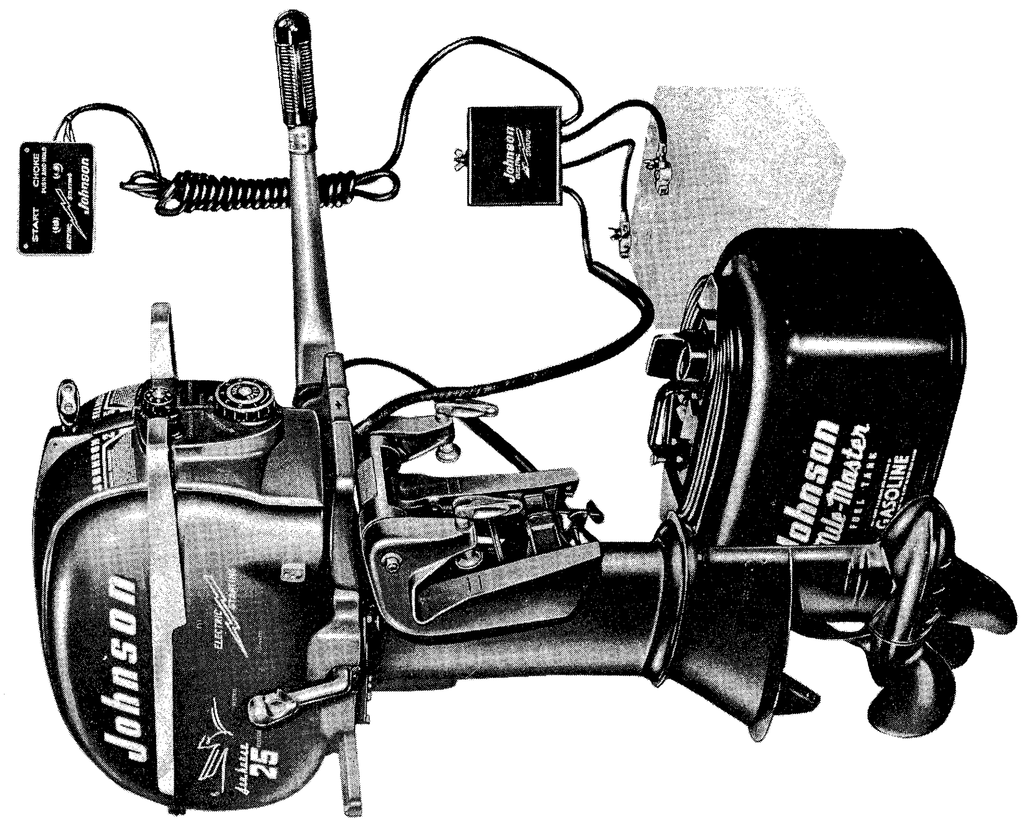
Model CD



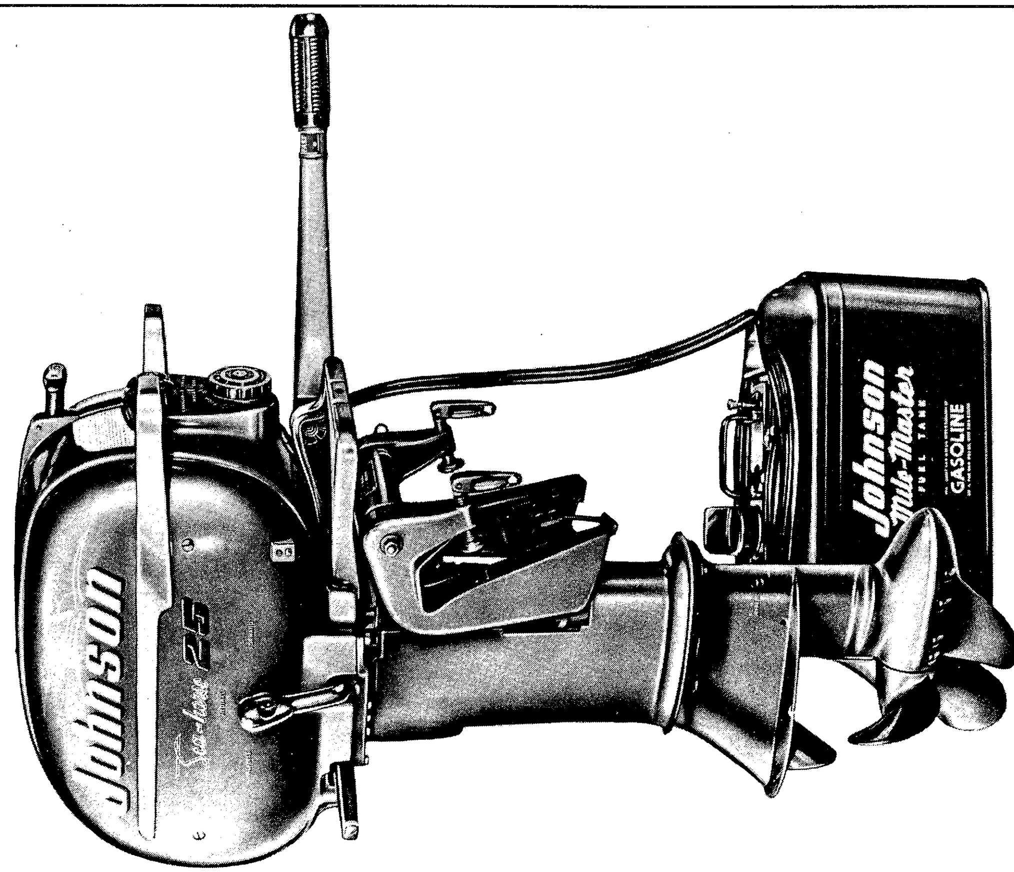
Model QD-15



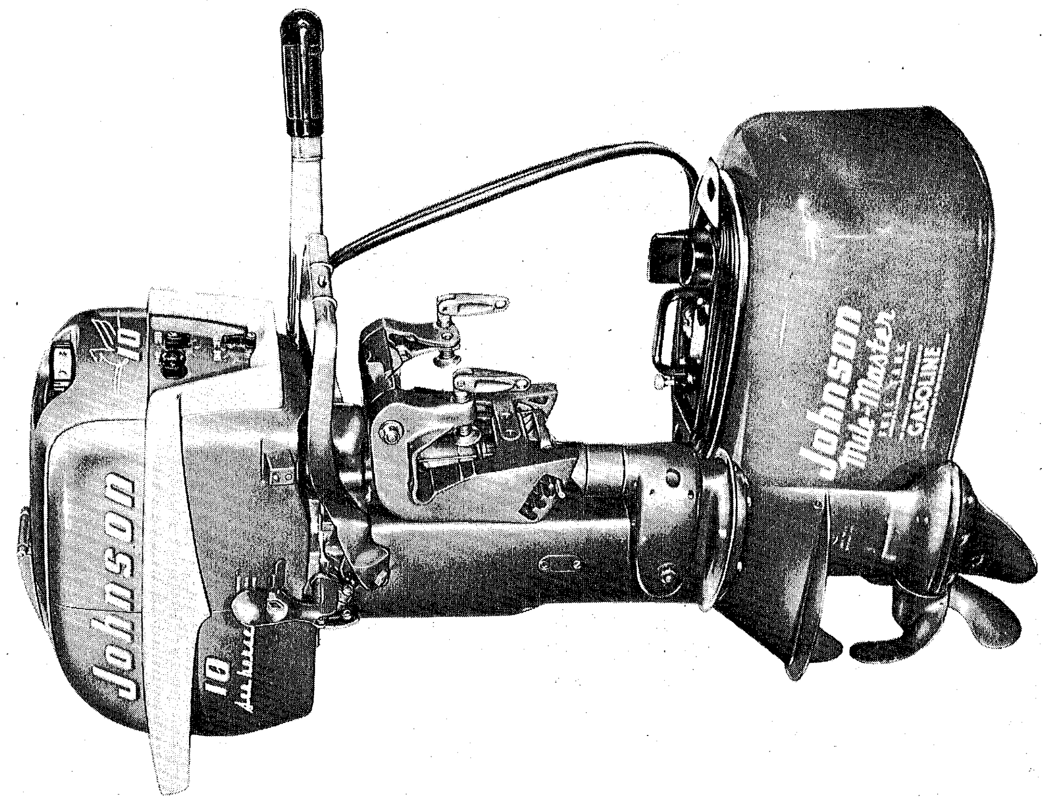
Model QD-14



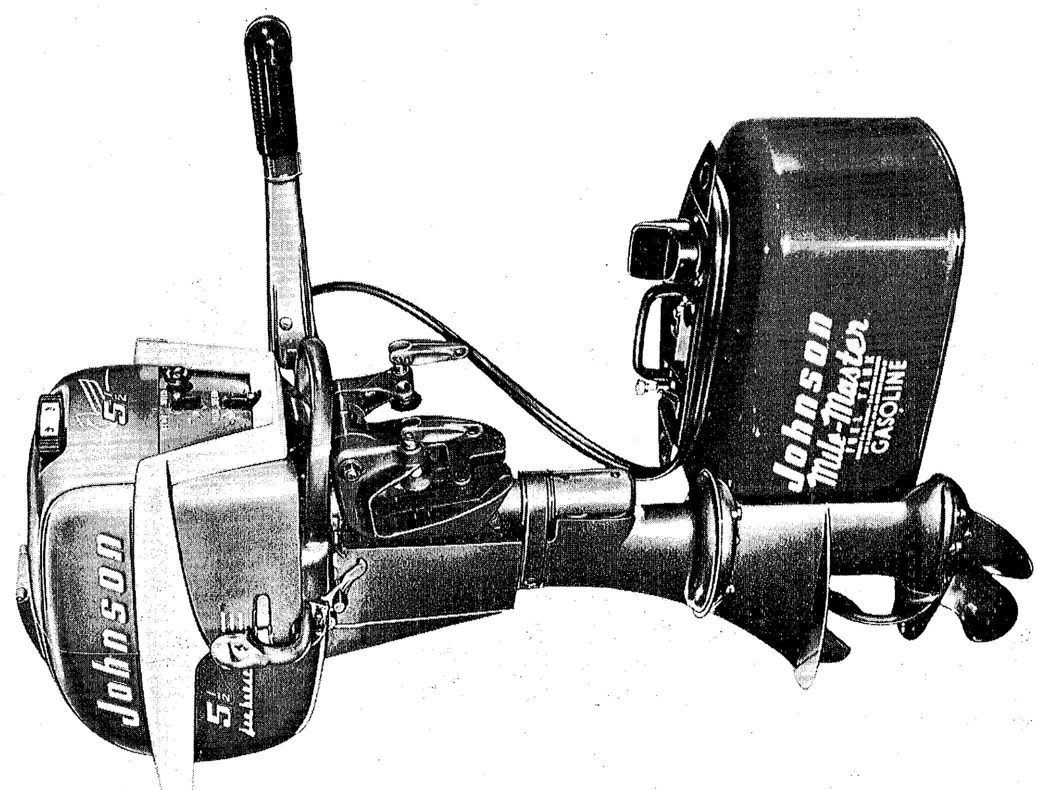
Model RDE



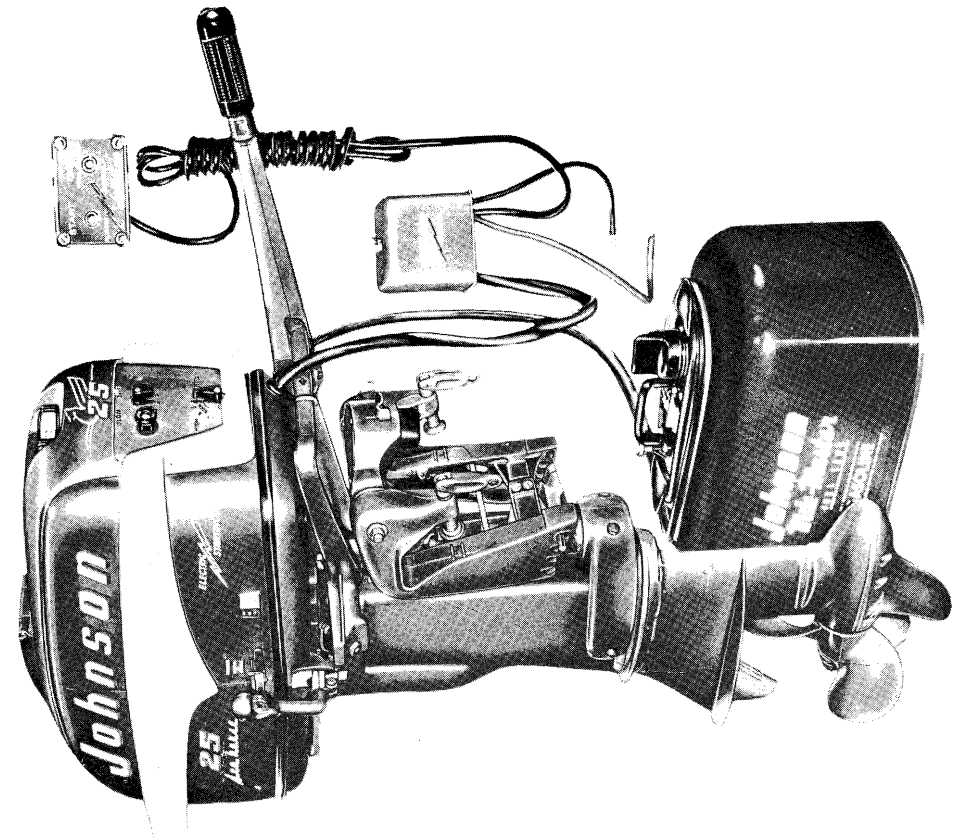
Model RD



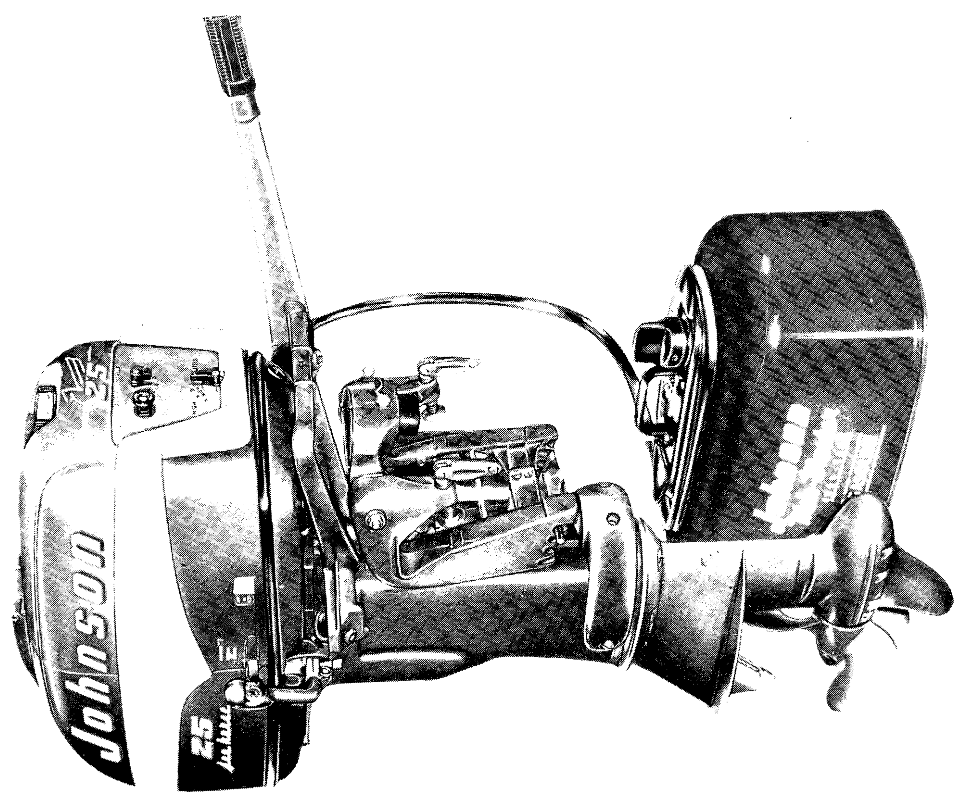
Model QD-16



Model CD-12



Model RDE-17



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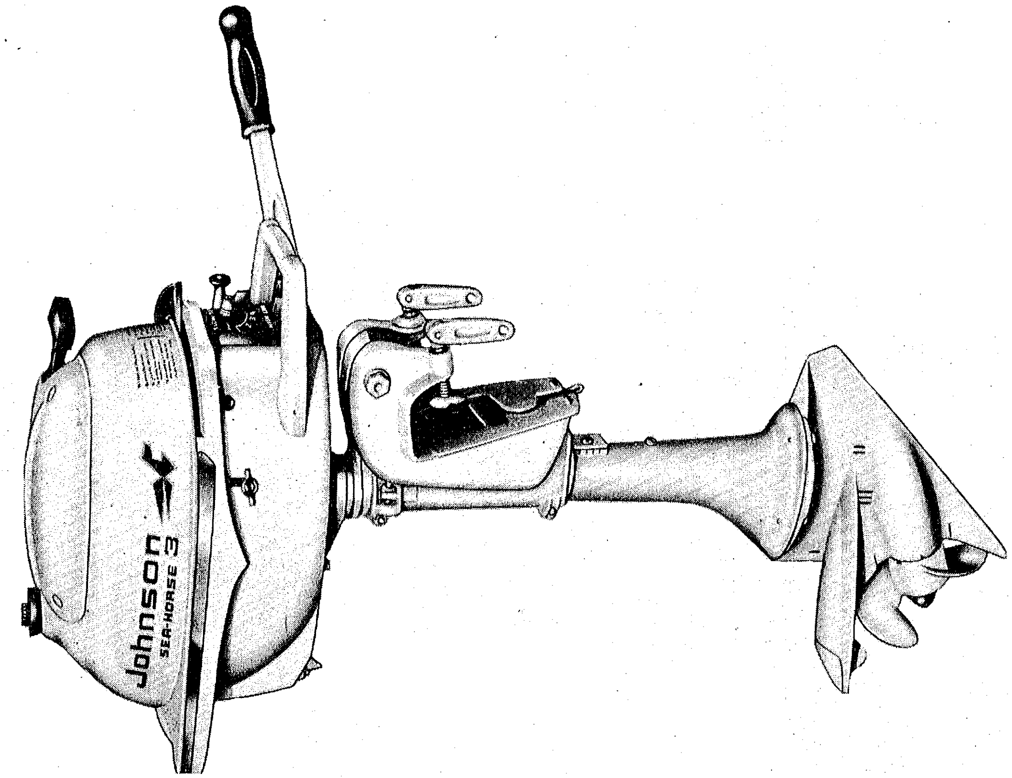

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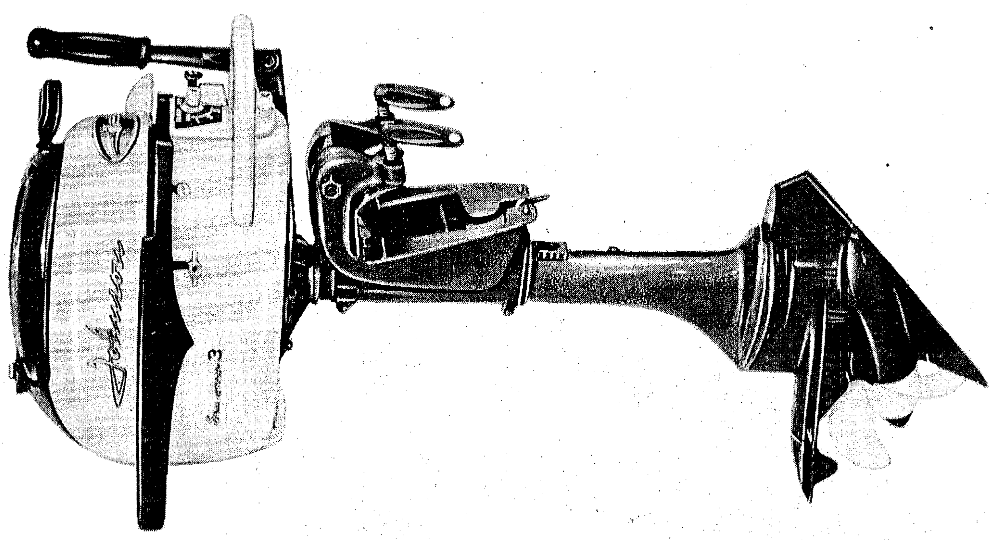

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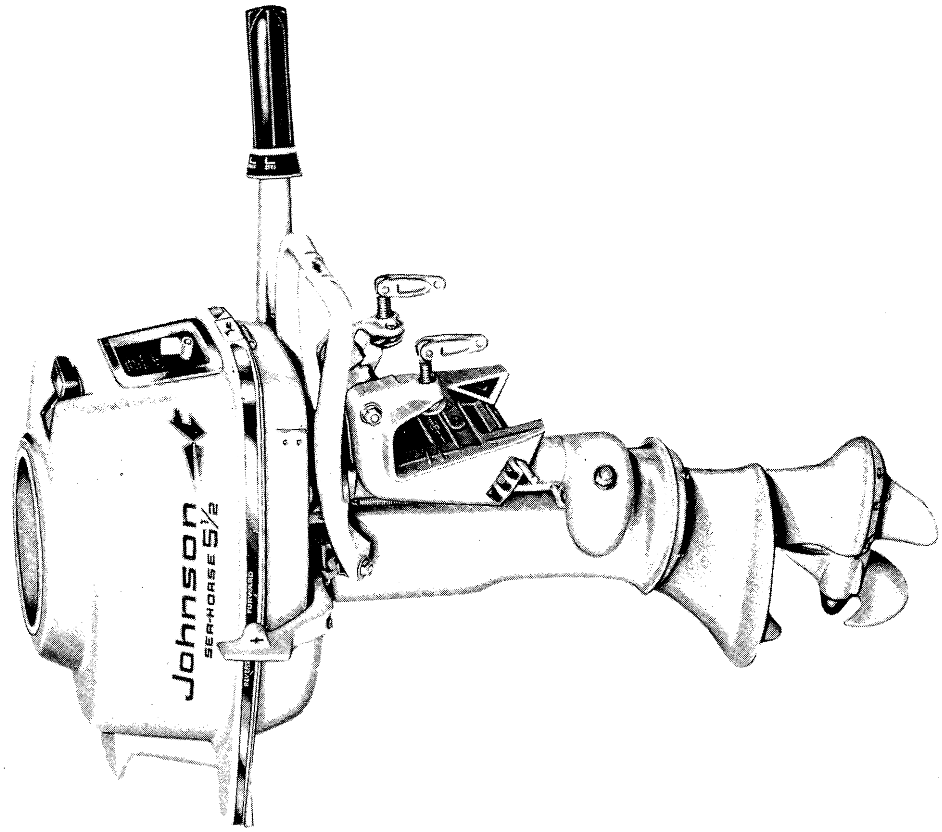

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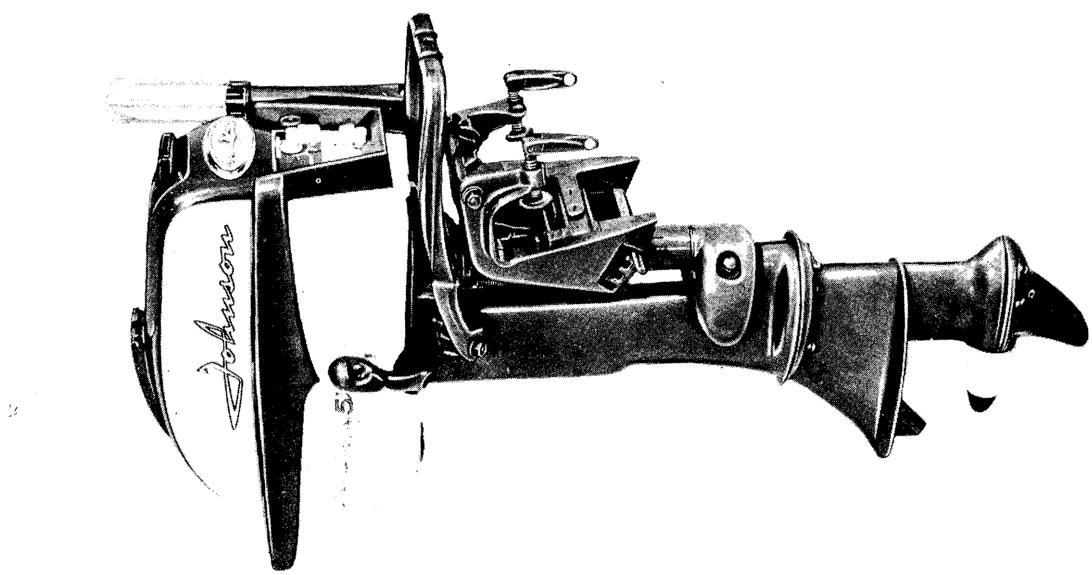

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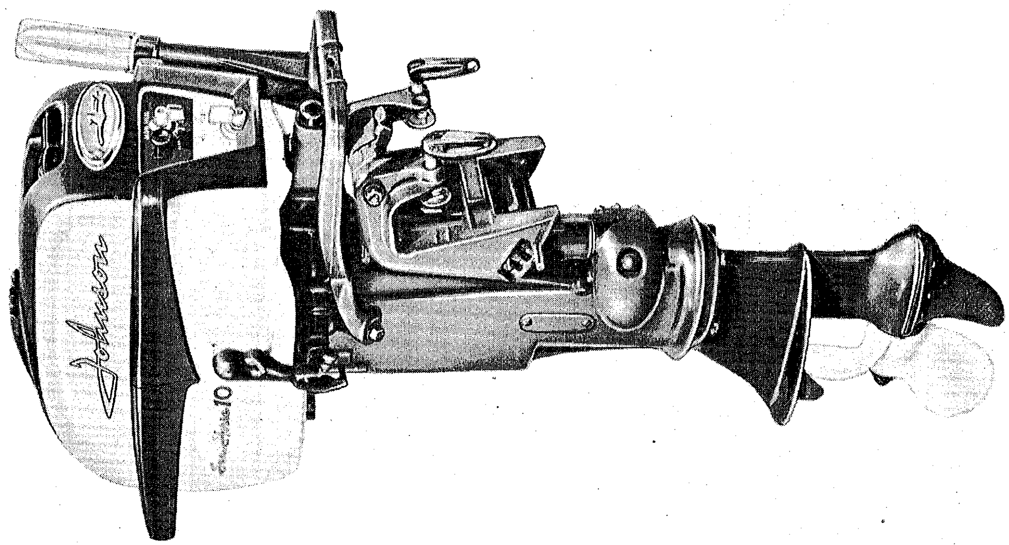

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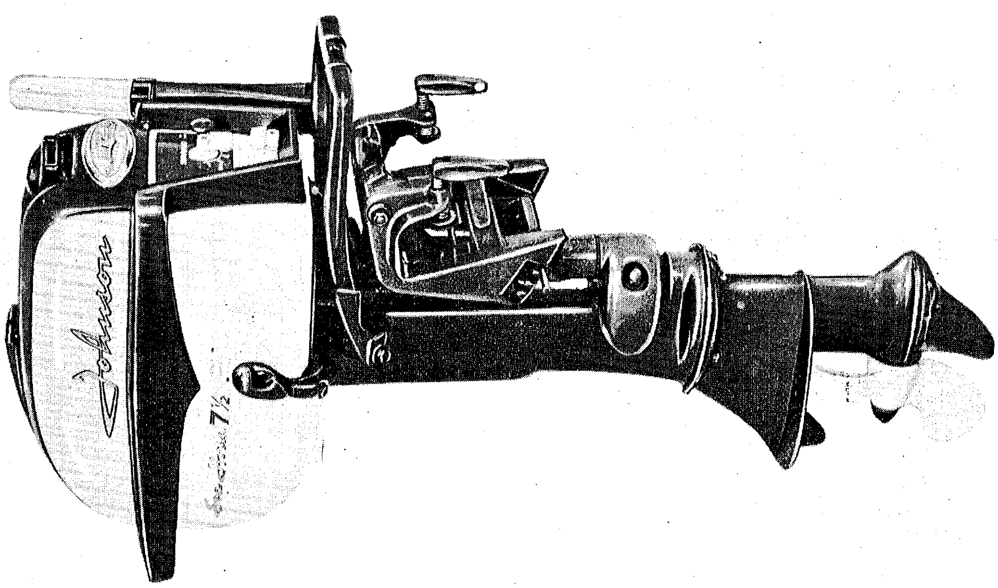
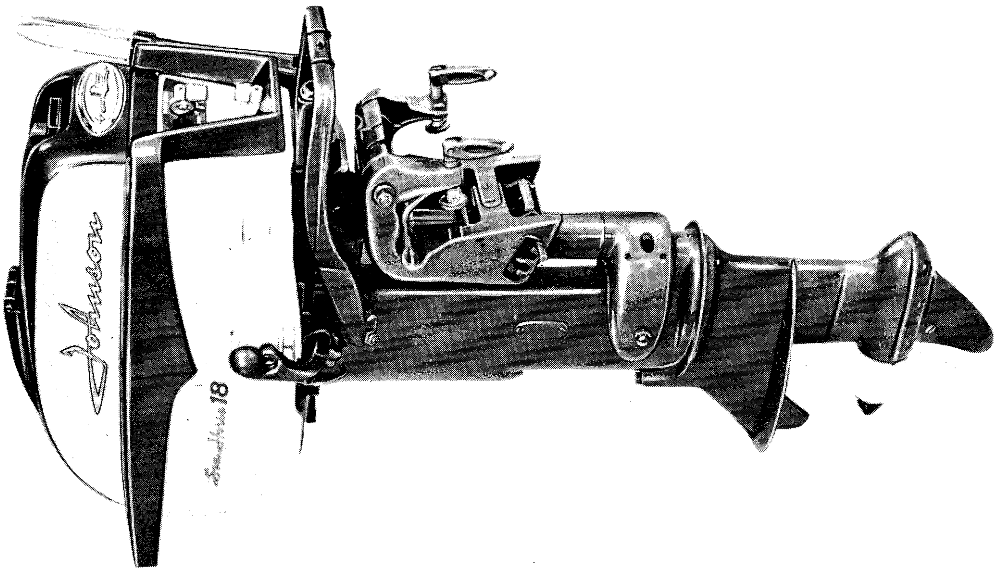
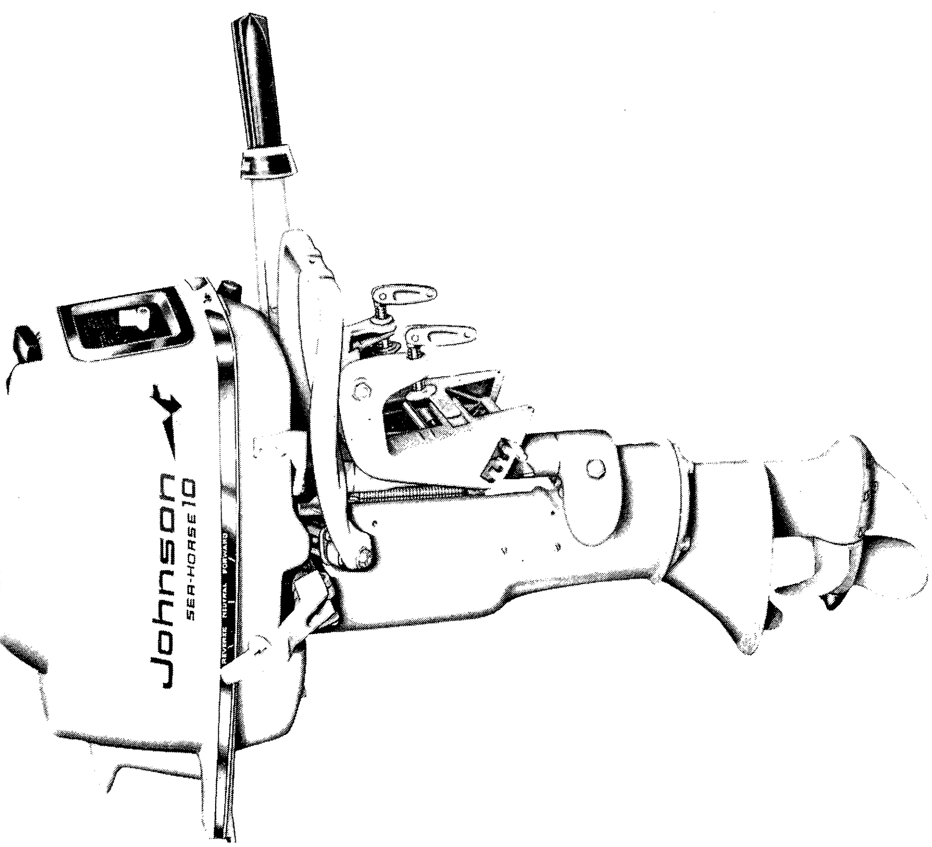


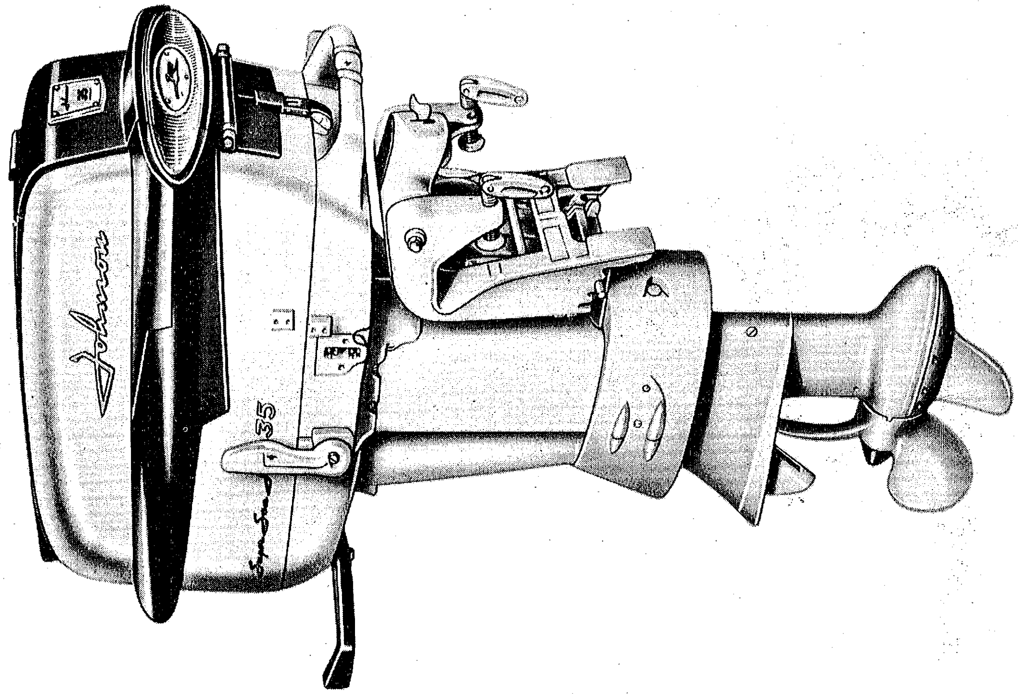
Model AD-12



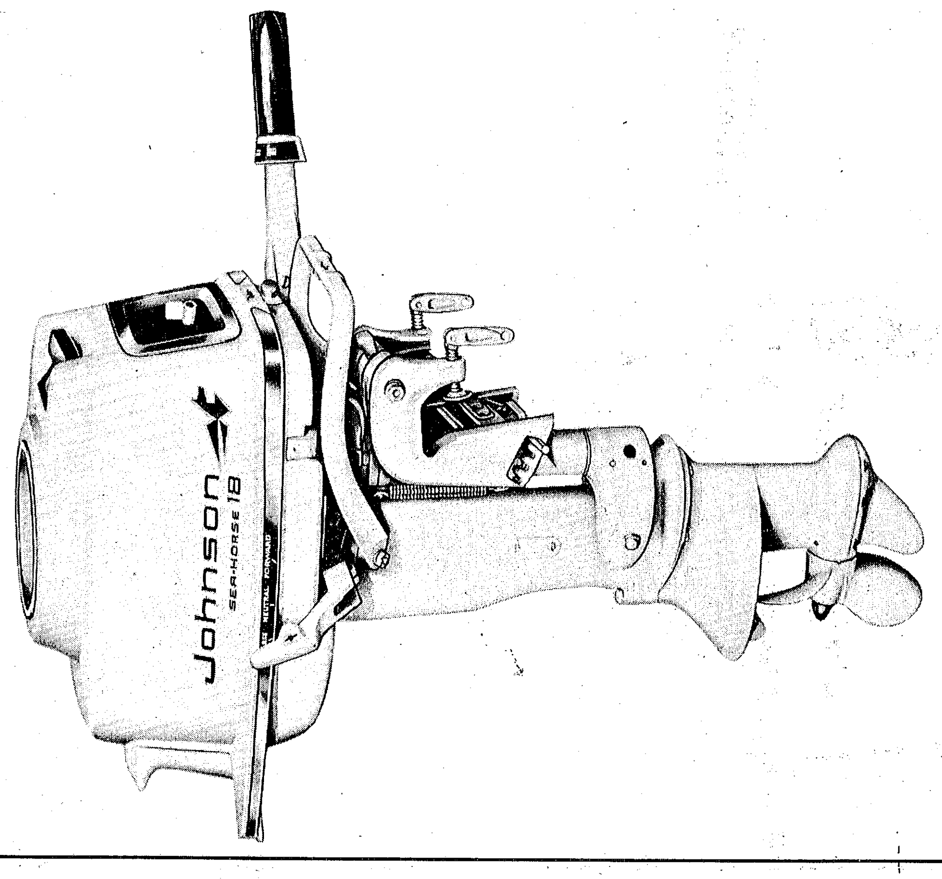
Model FD-12



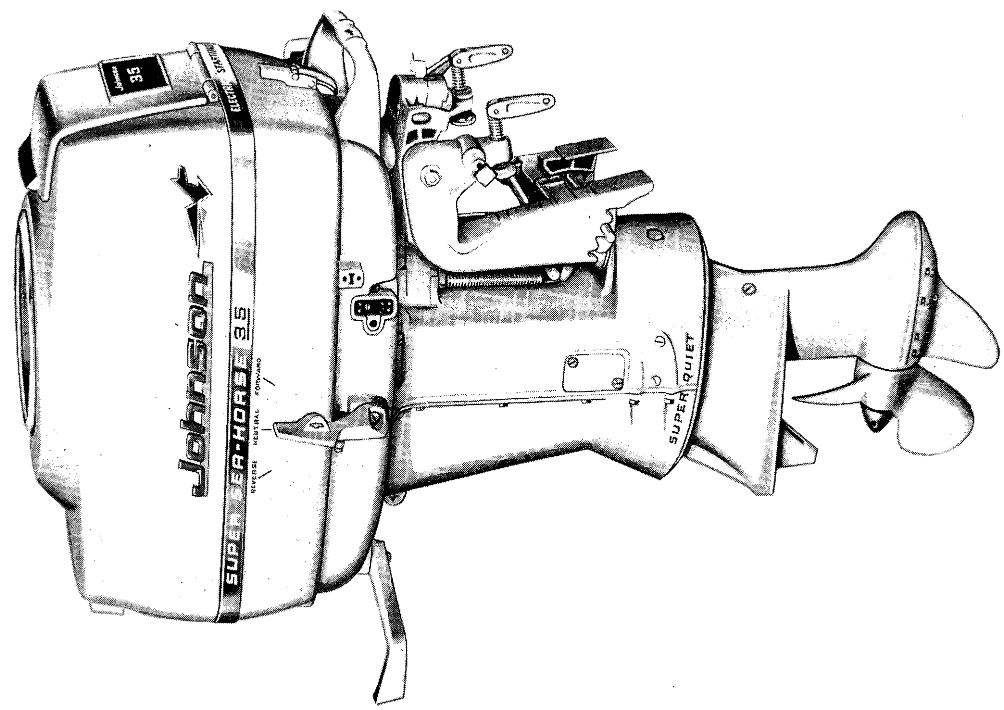
Model QD-20



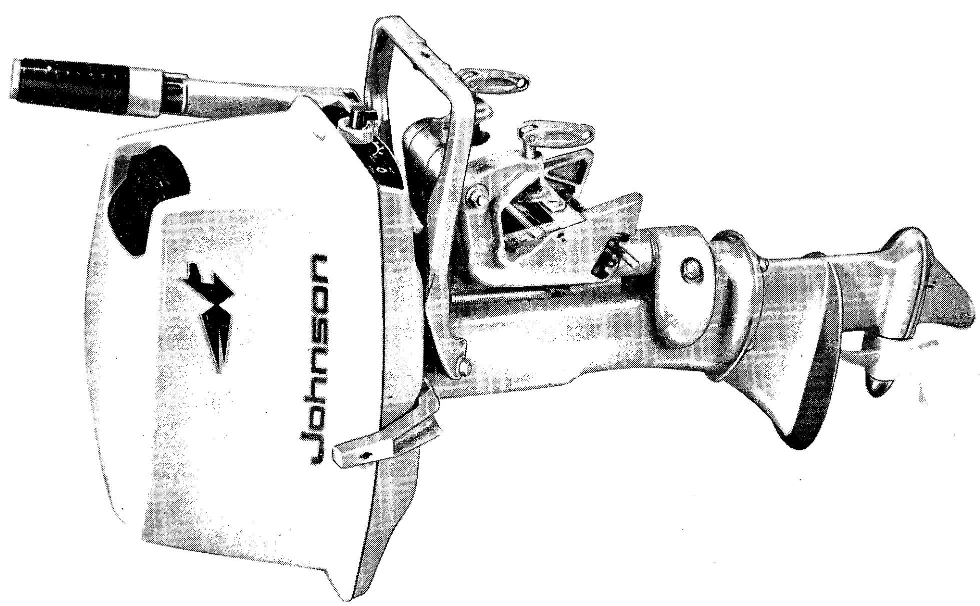
Model RD-19C



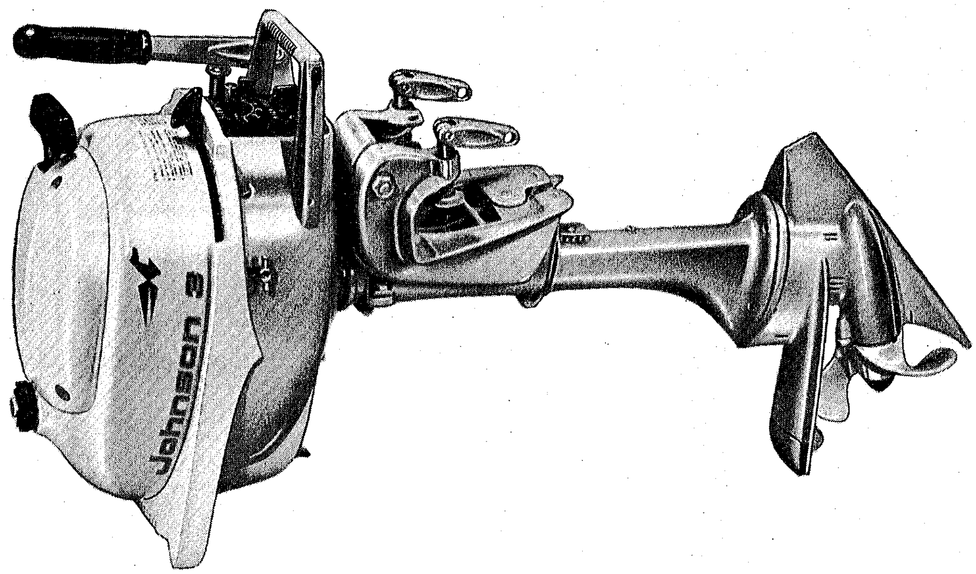
Model FD-13



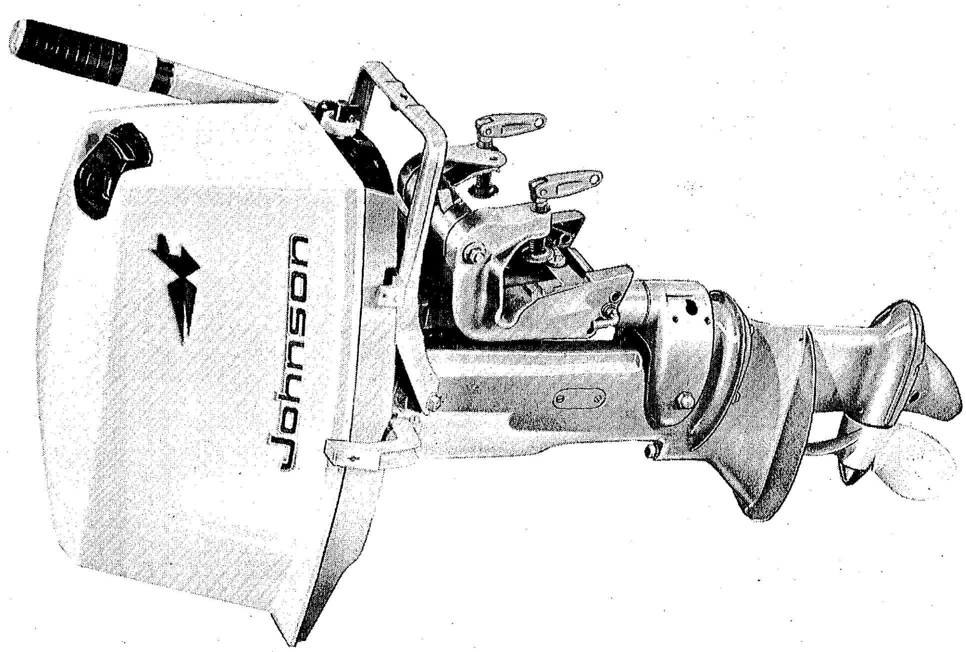
Model RDS-21



Model CD-19



Model JW-17



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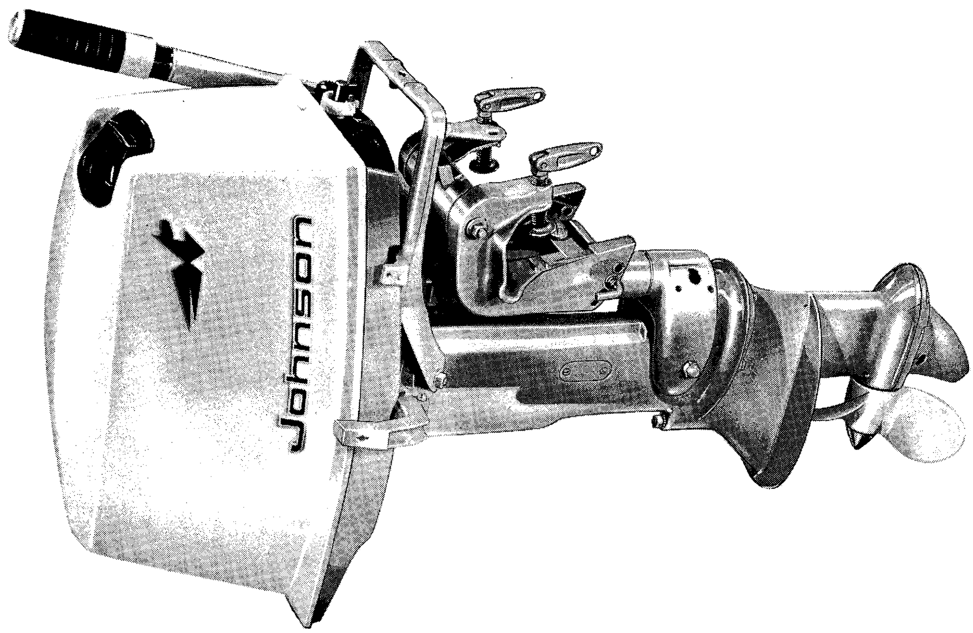

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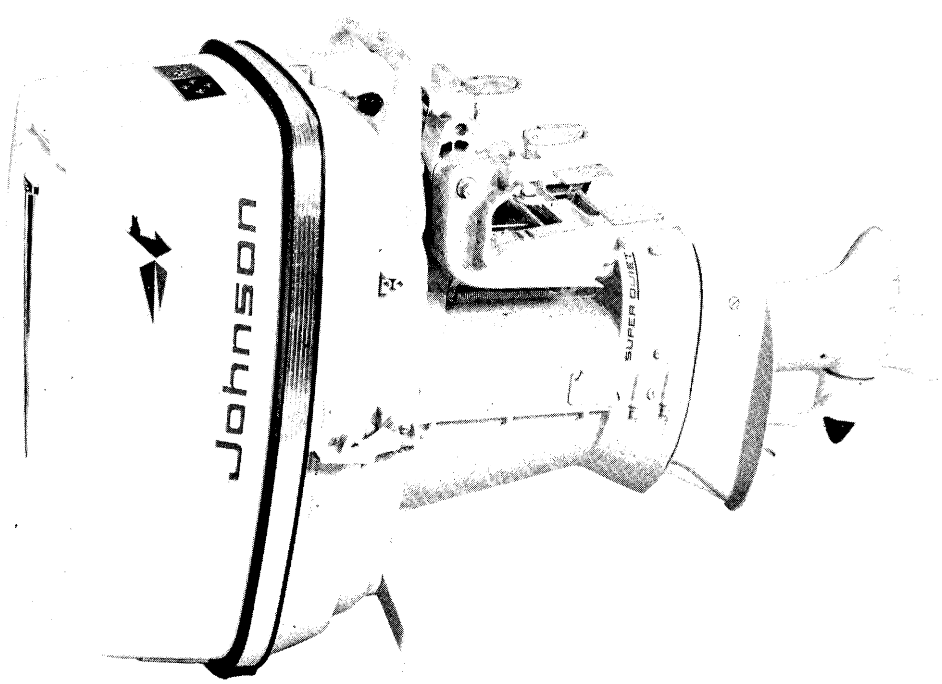
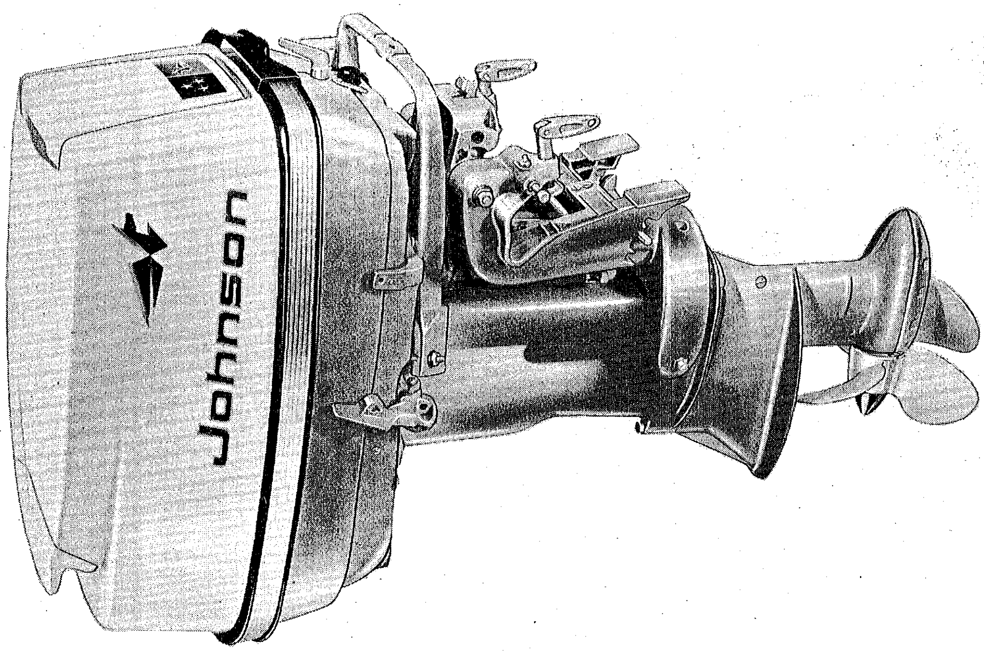
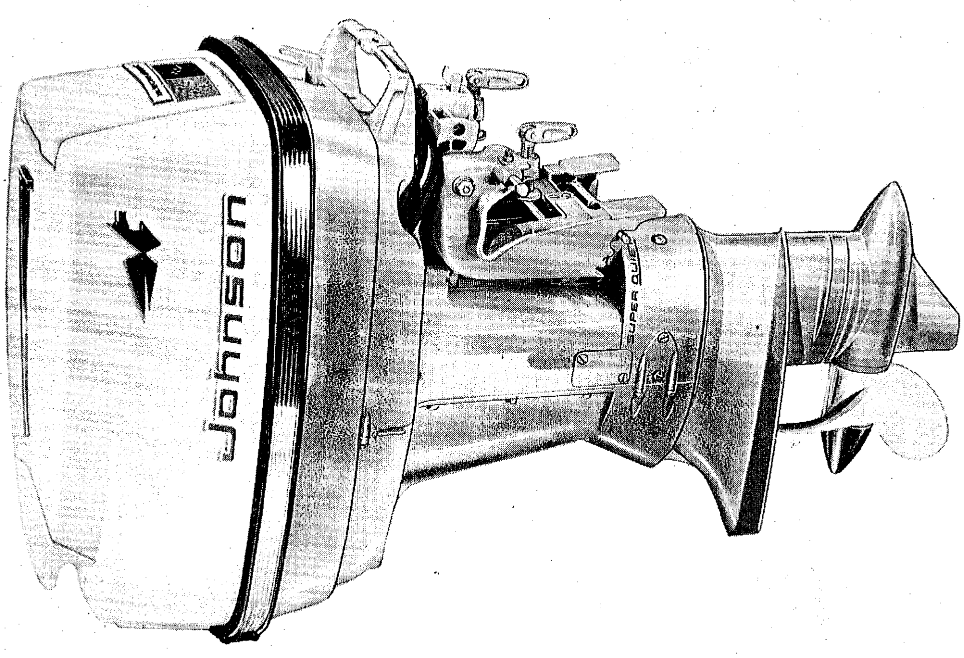


Model RDS-24



Model RX-10C



Model RK-24

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