JOHNSON

JOHNSON MOTORS
2600 Pershing Rd.
Waukegan, Illinois

CONDENSED SERVICE DATA

Series / Year Produced	V4-V4S	V4S-V4A
1958	10 & 10H	.....
1959	11	.....
1960	.....	12 & 12S
1961	.....	13
1962	.....	14
1963	.....	15
TUNE-UP		
Hp @ rpm	50 @ 4000	75 @ 4500
Bore—Inches	3	3⅜
Stroke—Inches	2½	
Number of Cylinders	4	
Displacement—Cu. In.	70.7	89.5
Spark Plug		
Champion	J4J	
AC	M42K	
Auto-Lite	A21X	
Electrode Gap	0.030	
Magneto Point Gap	0.020	
Magneto Timing	See Text	
Carburetor Make	Own	
Carburetor Adjustment	See Text	
Fuel-Oil Ratio	16:1	24:1
SIZES—CLEARANCES		
POWER HEAD		
Piston Rings		
End Gap	0.007-0.017	
Side Clearance	0.005-0.0065	0.006
Piston Skirt Clearance	0.003-0.0045	0.0045
Crankshaft Bearing Diameters		
Top Main Brng.	1.2653-1.2658	
Center Main Brng.	1.3748-1.3752	
Lower Main Brng.	1.1810-1.1815	
Crankpin	1.1812-1.1819	
Crankshaft Brng. Clearances	Needle & Roller Brngs.	
Drive Shaft Bearing		
Diametral Clearance	0.0013-0.0028	Roller Brng.
Pinion Shaft Bearing		
Diametral Clearance	Roller Bearing	
Propeller Shaft Bearing Diametral Clearance		
Propeller End	Ball Bearing	
Forward End	Ball Brng.	Tapered Roller
TIGHTENING TORQUES (All Values In Inch-Pounds)		
Connecting Rod	180-186	(See Note)
Crankcase Halves	60-72*	60-72*
Cylinder Head	168-192	168-192
Inlet Manifold	60-84	60-84
Exhaust Manifold	60-84	60-84
Reed Valve Plate	25-35	25-35
Flywheel	840-1020	840-1020
Spark Plug	240-246	240-246

Note: $\frac{9}{32}$-inch screws 216-222; $\frac{5}{16}$-inch screws 348-372.

*Except main bearing screws which are 162-168.

LUBRICATION

The power head is lubricated by oil mixed with the fuel. On motors produced before 1959, mix ½-pint outboard motor oil with each gallon of unleaded gasoline. On 1959 and later motors, use ⅓-pint oil with each gallon of fuel. If outboard motor oil is not available, use a good grade of regular "type MM" SAE 30 motor oil. Regular gasoline may be substituted for unleaded gasoline, however the anti-knock components may shorten spark plug life. Mix gasoline and oil thoroughly, using a separate container, before pouring mixture into fuel tank.

The lower unit gears and bearings are lubricated by oil contained in the gear case. Special "Outboard Marine Corporation, Type 'C' Lubricant" should be used. This lubricant is supplied in a tube, and filling procedures are as follows: Remove lower plug from gearcase and attach tube. Remove upper (vent) plug from case, and with motor in upright position, fill gearcase until lubricant reaches level of upper (vent) plug hole. Reinstall vent plug; then remove lubricant tube and reinstall lower plug. Tighten both plugs securely, using new gaskets if necessary, to produce a water tight seal. If OMC Type C Lubricant is not available, gear case may be temporarily filled with outboard motor oil through vent (upper) plug opening. If outboard oil is used, drain and refill with OMC Type C Lubricant as soon as possible. Lower gear lubricant should be maintained at level of vent plug, and drained and renewed after every 100 hours of operation.

FUEL SYSTEM

CARBURETOR. A two barrel, down draft type carburetor is used. Each barrel is provided with its own low and high speed adjustment needles and functions independently of the other barrel to mix fuel and air for the two cylinders on one side of the motor. Refer to Fig. J75 or J76. Normal initial setting for low speed mixture needles (IN) is 1½ turns open. Initial setting for high speed mixture adjustment needles (HN) is ⅝-turn open. Clockwise rotation of all needles leans the mixture. Idle mixture needle knobs (26) permit turning the needle only part of a turn for final adjustment. To make the initial adjustment (or a major adjustment) on early models, push knob down against pressure of spring (27—Fig. J75) until it clears hex head of needle; then turn needle with a screwdriver. On later models, remove the retaining screw and knob.

The two high speed mixture needles on all models so equipped are synchronized by gear on lever (49—Fig. J75 or J76) so that operating adjustment can be made simultaneously for both barrels. To make the initial adjustment or to synchronize the high speed mixture adjustment for the two barrels, refer to Fig. J77. Lift straight up on lever (L) until the gear clears needles and turn lever until pointer is directed forward as shown by broken lines. Pointer will now rest on cover flange and prevent the synchronizer gears from engaging. Use a blade screwdriver to adjust the needles (A) individually. After the initial adjustment, warm the motor to operating temperature and turn the idle mixture adjustment needles (I) alternately and a little at a time until smoothest engine operation is obtained. Speed lever must be at "Slow" for this adjustment. Shift motor to "Forward" and set speed lever to "Fast;" then adjust high speed mixture needles (A) alternately for best performance; then recheck idle mix-

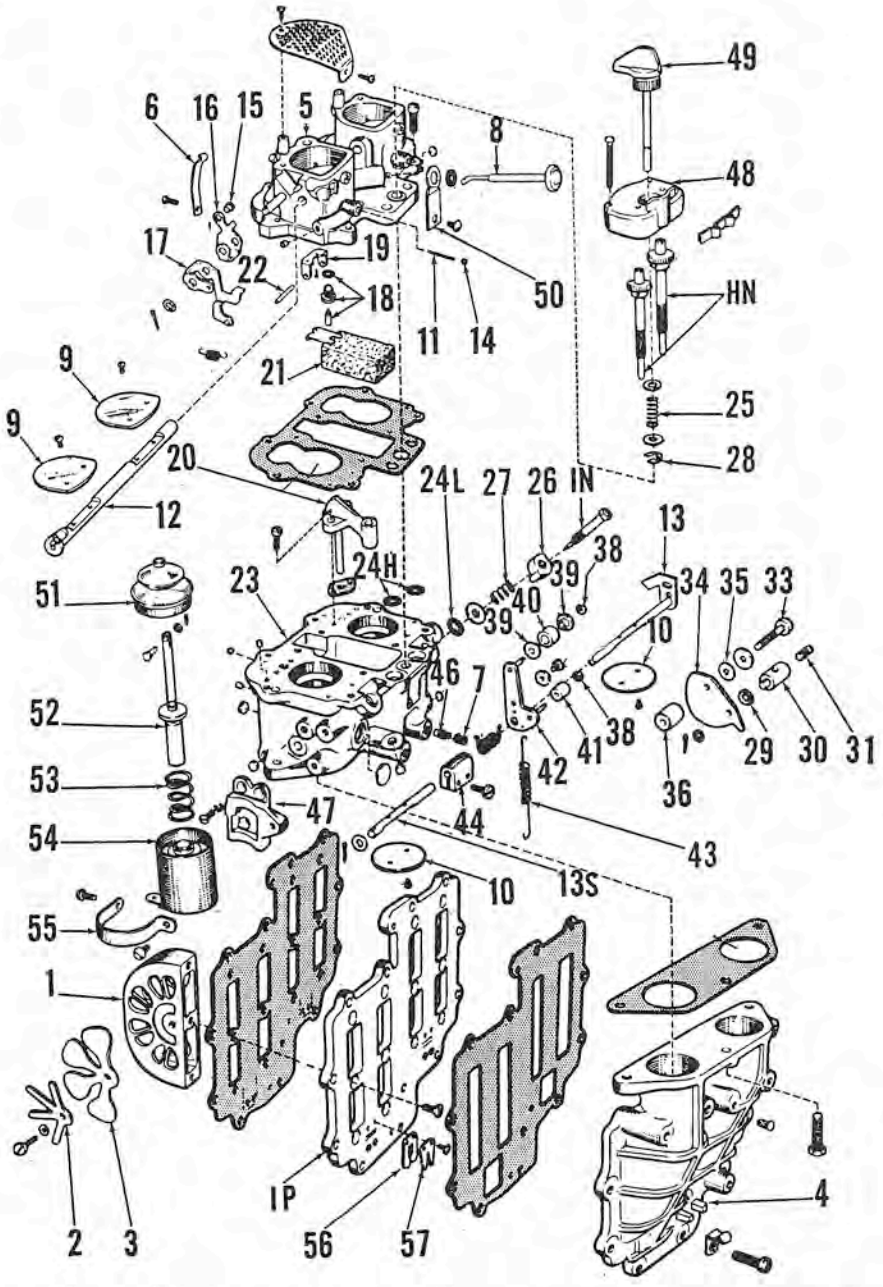


Fig. J75—Exploded view of carburetor, intake manifold and reed valves used on 50 hp models. Carburetor is equipped with solenoid operated electric choke.

IN. Slow speed needle
HN. High speed needle
IP. Inlet plate
1. Reed box
2. Reed stop
3. Reed petals
4. Intake manifold
5. Carburetor body
6. Leaf spring
7. Drain plug
8. Choke knob
9. Choke valve
10. Throttle valve
11. Wire
12. Choke shaft
13. Throttle shaft
13S. Throttle shaft
14. Lead shot
15. Bushing
16. Lever
17. Lever
18. Inlet needle & seat
19. Bracket
20. Nozzle
21. Fleat
22. Float shaft
23. Float chamber
24H. "O" ring
24L. "O" ring
25. Spring
26. Knob
27. Spring
28. Retainer
29. Washer
30. Pivot pin
31. Set screw
33. Cam screw
34. Throttle cam
35. Washer
36. Spacer
38. Retainer
39. Bushing
40. Cam roller
41. Sleeve
42. Cam follower
43. Spring
44. Connector
46. Plug
47. Bracket
48. Cover
49. Control gear
50. Bracket
51. Boot
52. Plunger
53. Spring
54. Housing
55. Clamp
56. Reed petals
57. Reed stop

ture. When adjustments have been made, re-engage or reinstall the idle knobs so that adjustment can be made approximately an equal amount in either direction. Lift up on high speed adjusting lever (L) and re-engage with pointer directed at "3" as shown. Be careful not to disturb the needle setting while installing the idle knobs or engaging the high speed adjustment lever.

High speed mixture on motors after 1960 is by means of fixed jets, and is not adjustable.

Throttle shutters (10—Fig. J75 or J76) can be synchronized to close at the same time. To make the adjustment, remove and invert the carburetor. Close throttle lever (13 or 13P), loosen screw in clamp (44). Hold both throttle plates closed and tighten clamp.

To set the carburetor float level, remove carburetor; then remove and invert the carburetor upper body. When in the inverted position, float should be parallel with gasket flange as shown in Fig. J78. If it is not, bend the float lever a slight amount, making sure float is not twisted.

IMPORTANT: High speed venturi (20) must be accurately centered in carburetor body and installation requires the use of a special locating fixture (OMC Tool No. 378014). Do not attempt to remove or renew the venturi unless tool is available.

1959 models are equipped with a solenoid operated electric choke. Solenoid is not adjustable, but should be checked for proper operation and faulty parts renewed.

Models after 1959 are equipped with an automatic choke (68 through 78—Fig. J76). The coiled (bimetal) thermal unit is contained in cover (74) and is only available in the assembly. A water jacket is built into housing (75) and water at engine temperature passes around thermal unit through hoses (66 & 76) to control the choke opening. Cover unit (68) also houses a diaphragm (72), the lower side of which is connected to manifold vacuum by means of hose (67). When the motor is not running, spring (71) operates through plunger on diaphragm to close the choke. As soon as engine is started, manifold vacuum moves the diaphragm downward against spring pressure which will allow the choke to partially open against the lighter pressure of the coiled, thermal unit spring. As motor warms up, the heat acts on the coiled thermal unit to relax spring tension and allow choke to fully open.

Very little trouble is normally encountered with the automatic choke assembly. In cases of malfunction, first check the temperature

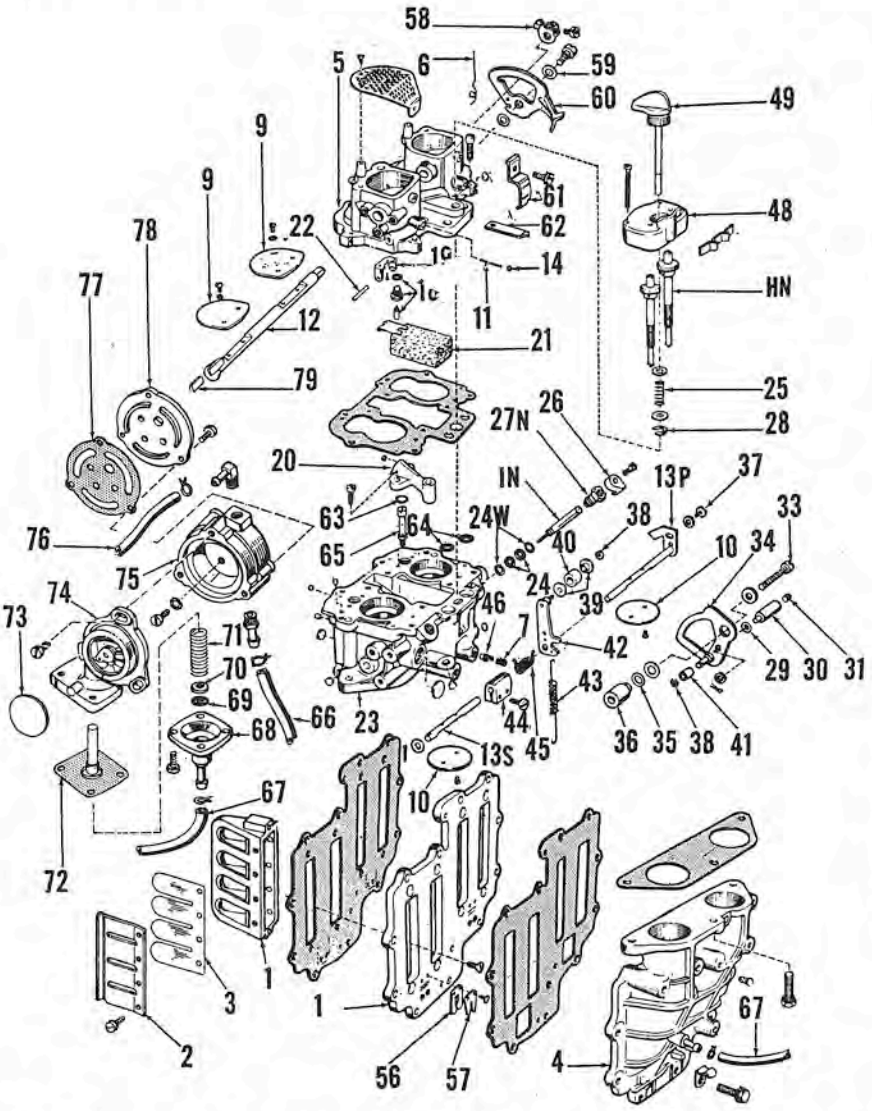


Fig. J76—Exploded view of carburetor and associated parts used on 1960 models. Later models are similar except that high speed jets are fixed and not adjustable. Refer to Fig. J75 for legend except for the following.

24. Washer
24W. Washer
27N. Nut
37. Lock screw
45. Spring
58. Lever
59. Washer
60. Lever
61. Panel
62. Spring
63. "O" ring
64. "O" ring
65. High speed tube
66. Hose
67. Hose
68. Diaphragm chamber
69. Valve seat
70. Valve
71. Spring
72. Diaphragm
73. Expansion plug
74. Cover
75. Housing
76. Hose
77. Gasket
78. Cover

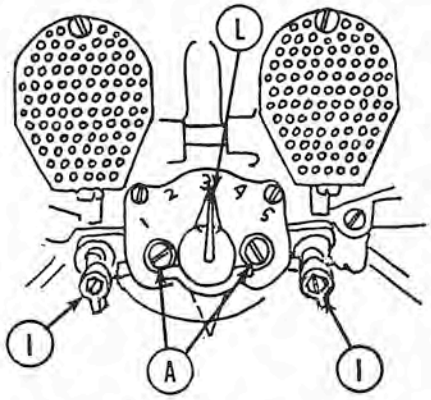


Fig. J77—To adjust the low speed needles, remove the knobs (I) and turn the needles in or out as required. Knob permits only a partial turn of needle, reinstall knobs to permit adjustment an equal amount either way. To adjust the high speed needles (A), lift up on the lever (L) and turn it 180 degrees to the position indicated by broken lines. Return the lever to "3" position as shown, being careful not to disturb the adjustment of needles (A). On early models, slow speed knobs (I) are spring loaded, needle can be adjusted by pressing down on knob, then turning needle.

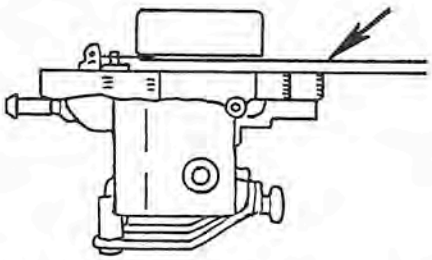


Fig. J78—Float adjustment is correct when float is parallel with inverted upper body as shown by arrow.

control for improper operation of cooling system thermostat or plugging of coolant hoses (66 or 76) or water passage in housing (75). A quick check which is usually effective, is to feel of choke housing (75) after engine has been running a few minutes. If housing is uncomfortably warm to the touch, temperature is probably satisfactory and remainder of choke system should be checked. Any condition which interferes with the vacuum balance of the choke unit will allow the diaphragm spring (71) to hold choke in closed position. Check for leaks in diaphragm (72), housing (68) or vacuum hose (67), or for kinks, collapse or plugging of the hose. Grasp port side of choke lever (58) and check for binding by turning lever. Shaft should turn freely 45° in either direction. If the above checks fail to correct the malfunction, disassemble the automatic choke unit and/or renew cover assembly (74).

To disassemble or adjust the automatic choke unit, first scribe a line on cover (74) and housing (75) and loosen or remove the three screws retaining cover to housing. If motor runs rich or floods when starting, turn cover slightly counter-clockwise; then retighten screws. If engine is hard to start because of insufficient choking, turn cover clockwise.

To check the operation of the automatic choke, start engine in normal manner, or by using the manual choke lever. With choke control in "Automatic" position, observe the action of port side of choke lever while engine warms up. When additional flow from water outlet indicates opening of thermostat, run engine at approximately half power for ten minutes to stabilize motor temperature. Move choke control lever to "Choke Off" position for a minute or so, then back to "Automatic." There should be no perceptible change in motor performance. Move speed control to "Slow" position and push choke lever (58) clockwise to full open position. Total movement of lever when measured at lever pin should not exceed ⅛-inch. If it does, "Lean" the choke adjustment slightly by turning cover (74) counter-clockwise, or overhaul the unit as outlined above.

SPEED CONTROL LINKAGE. The carburetor throttle valve is synchronized to open as the ignition timing is advanced. It is very important that ignition timing and throttle valve opening be correctly synchronized to obtain satisfactory operation. Fifty horsepower (1958 & 1959) models are also equipped with "Fuel Saver" linkage which allows throttle opening to be cut back slightly at high speed without affecting timing advance. To adjust the speed control linkage, proceed as follows:

Fifty HP (1958 & 1959) Models. First check to make sure magneto is properly timed. Move speed control lever until timing marks on magneto breaker point housing and bracket are aligned as shown at (S—Fig. J78A). At this time the aligning ridges on speed control lever and upper mounting bracket should be aligned as shown at (A—Fig. J79). If they are not, loosen the two adjusting screws in link (B) and shorten or lengthen link until alignment is made at (S—Fig. J78A) and (A—Fig. J79). Keep the link straight when tightening the screws. The above adjustment synchronizes the speed control lever with the magneto timing. To adjust the carburetor throttle, refer to Fig. J80. With the magneto timing marks aligned as previously outlined, the scribe line on throttle control cam should be aligned with follower roller as shown at (A), roller should be touching cam, and the throttle valve should be closed, but just ready to open. Any further movement of speed control lever away from slow position should cause throttle to open. To align the scribe line on cam, loosen the set screw in clamp (1) and move cam on link (L). To adjust follower roller on throttle valve loosen set screw (2) and move roller or throttle shaft. If adjustments are properly made, the lower projection on throttle cam will contact lower roller to slightly cut back throttle.

Seventy-Five HP (1930-1933) Models. First check to make sure magneto or distributor is properly timed. Move shift lever to "Forward" position and move speed control lever toward "Fast" position until control arm is parallel with the triangular "boss" on cylinder block as shown at (A—Fig. J81). With speed control lever in this position, loosen the two adjusting screws in

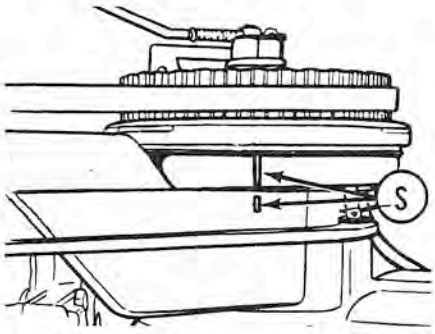


Fig. J78A — Magneto timing marks (S) aligned in preparing to adjust speed control linkage. Refer to text.

Fig. J79 — On 50 hp models, shorten or lengthen the magneto link (B) until synchronizing marks (A) are aligned. Refer to text.

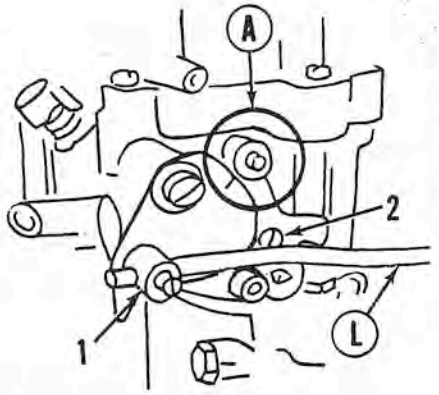


Fig. J80 — Loosen pivot clamp (1) and move cam and pivot on link (L) until scribe line is aligned with cam follower as shown at (A). Loosen screw (2) and move throttle shaft until cam follower just contacts cam and carburetor throttle valves are just ready to open. Refer to text.

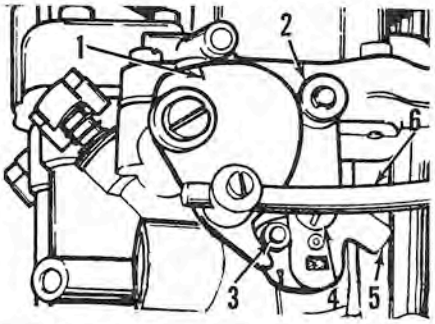


Fig. J80A — When adjustment is properly made, projection on cam will contact roller (3) to slightly cut back the throttle when full advance is passed.

1. Timing mark
2. Cam follower
3. Cam roller
4. Adjusting screw
5. Throttle shaft
6. Throttle link

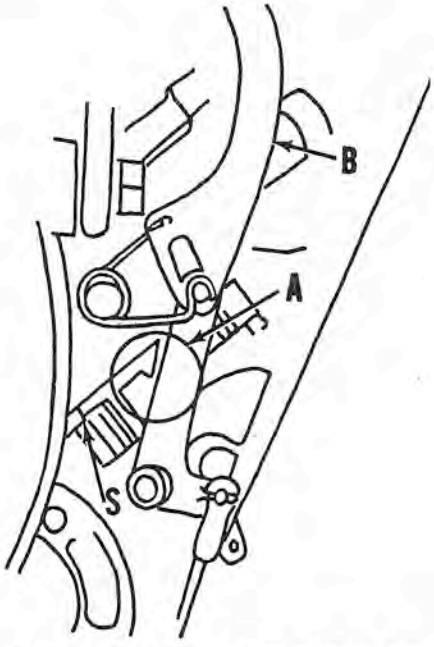


Fig. J81—On 75 hp models magneto linkage (B) should be adjusted so that magneto is fully advanced when speed control lever is aligned with block boss as shown at (A). Speed control lever contacts stop (S) in fully advanced "Fuel Saver" position.

link (B) and rotate magneto (or distributor) fully counter-clockwise as far as it will go. Retighten the clamp screws; then check to make sure magneto is fully advanced when speed control arm reaches position shown at (A). Move speed control lever back to slow position, slowly move toward fast, and note position at which cam (C—Fig. J82) contacts follower roller (F). Cam should contact roller at the position of the scribe line as shown at (1). If it does not, loosen screw (2) and reposition follower arm on throttle shaft. Insert a 0.020 feeler gage between speed control arm and stop in the position shown at (F—Fig. J83) and move speed control lever fully toward "Fast." With the feeler gage trapped by speed control arm, loosen set screw (A), and rotate cam (C) fully counter-clockwise. The purpose of the feeler gage is to allow for any slack in throttle linkage.

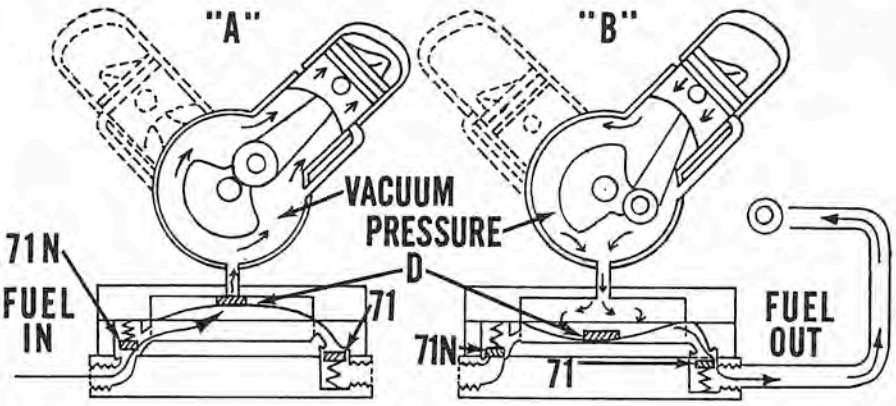


Fig. J84—Schematic diagram showing operation of the crankcase operated, diaphragm fuel pump. Pressure and vacuum pulsations pass from crankcase to rear of diaghragm (D) to induce a pumping action on fuel line as shown. Refer to Fig. J85 for legend and an exploded view of pump.

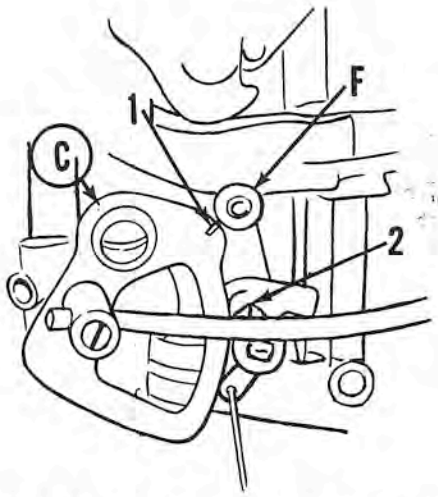


Fig. J82 — To synchronize the throttle on later models, move the cam (C) until scribe line (1) is aligned with cam follower (F), then loosen clamp screw (2) and position follower arm on throttle shaft until follower (F) contacts cam (C) and throttle valve just starts to open.

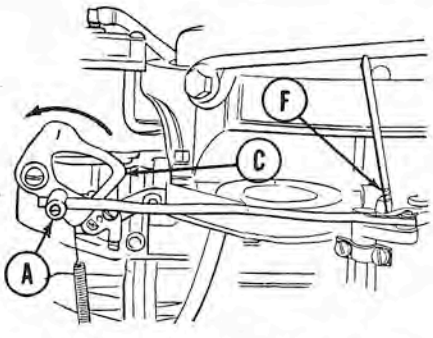


Fig. J83—Insert a 0.020 feeler gage (F) between speed control lever and stop then loosen set screw (A) and rotate cam (C) as far as possible in direction shown by arrow. Tighten clamp screw (A) in this position.

REED VALVES. Four sets of reed valves are used, one set for each cylinder. Refer to Figs. J75 and J76. On motors before 1960, a semi-circular inlet valve box was used as shown in Fig. J75. On 1960 and later motors a pyramidal valve box was used as shown in Fig. J76. On both types, reed valves should seat very lightly against inlet valve box (1) throughout their entire length with the least possible tension. Check reed petal seating visually. NOTE: Reed petals may stand out away from valve box a slight amount. Renew reed petals if broken, cracked, warped, rusted or bent. A broken reed petal is sometimes caused by a damaged or bent reed stop (2). Seating surface of valve box (1) should be smooth and flat.

FUEL PUMP. Motors after 1959 are equipped with a diaphragm fuel pump as shown in Fig. J84. Pressure and vacuum pulsations in the crankcase are directed through a passage in the cylinder to one side of the pump diaphragm (D). Vacuum in the crankcase draws the diaphragm in as shown in view "A". The diaphragm movement draws fuel from the tank past the inlet check valve (71N) as shown by arrow. As piston moves downward in cylinder (View "B"), pressure is introduced to back side of diaphragm forcing fuel out past the outlet check valve (71) as shown.

All defective or questionable parts should be renewed. Diaphragm (75—Fig. J85) should be renewed if air leaks or cracks are found, or if its condition is in any way questionable.

CRANKCASE BLEEDER VALVE. All models are equipped with a crankcase bleeder valve (56 & 57—Fig. J75 or J76), designed to remove any liquid fuel or oil which might build up in crankcase. One such valve is provided for each pair of cylinders. These reed type valves provide smoother operation at all speeds and lessen the possibility of spark plug fouling during slow speed operation. There is a small passage leading from each crankcase to a bleeder valve. Any condensed liquid accumulates in the bleeder pocket and passage until the piston travels its downward stroke. The crankcase pressure caused by the downward stroke of piston forces bleeder valve off its seats and blows the liquid out into the exhaust passage.

When motor is overhauled, bleeder passages should be blown out with compressed air and the valves examined. Valve reeds should exert a slight pressure against the plate. Seating surfaces should be smooth and flat. Valve reed should be renewed if broken, cracked, warped, rusted or bent.

IGNITION

All motors before 1961 are equipped with a belt driven, magneto ignition system. Motors after 1960 are available with either a belt driven magneto or with a battery ignition. Battery ignition models utilize a belt driven distributor with mounting identical to that of the magneto. Refer to the appropriate following paragraphs.

MAGNETO. Condenser capacity is 0.36-0.40 microfarad. Breaker point gap should be approximately 0.020 and can be adjusted

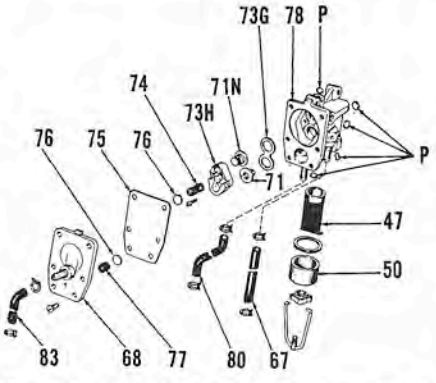


Fig. J85—Exploded view of fuel pump and strainer used on some motors.

P. Plug
47. Filter element
50. Bowl
67. Fuel line
68. Pump cover
71. Outlet valve
71N. Inlet valve
73G. Gasket
73H. Valve holder
74. Spring
75. Diaphragm
76. Support
77. Spring
78. Housing
80. Outlet hose
83. Hose

through inspection hole in pulley (2—Fig. J86) after cover (1) has been removed. The recommended procedure, however, is to set the gap using a light, so that points open at the correct time, and at the same relative time for all cylinders.

A timing light for setting the point gap can be made as shown in Fig. J87. Wire soldered to one end of battery should be fitted with a clip. Wire at other end should be attached to one terminal of a light bulb, with a wire leading from other terminal to a second clip. When properly constructed, bulb will light whenever circuit is closed or the two clips touched together.

To use the timing light, attach one clip to the primary lead and ground the other clip to the breaker plate as shown; thus, when either of the two sets of points are closed, the circuit will be closed and the bulb will light.

A spark is induced in the magneto high tension circuit the moment the points open and interrupt the primary current flow. Four sparks must be induced (each 90° apart) with each complete revolution of the magneto. The points should be timed to open the instant that the flywheel timing mark (A—Fig. J89) aligns with either of the timing marks (B) on breaker plate. Point opening for the other two cylinders is controlled by the shape of the breaker cam, and will be correct after adjusting each set of points.

To adjust the points, remove flywheel cover and magneto drive belt. Disconnect the primary lead and connect the timing light as shown in Fig. J87. With flywheel timing mark (A—Fig. J89) aligned with the first breaker plate timing mark, loosen the breaker point clamp screw slightly and turn the adjusting screw until the points close and lamp lights. Turn adjusting screw in opposite direction until the instant the lamp goes out; then tighten clamping screw. Turn flywheel until flywheel timing

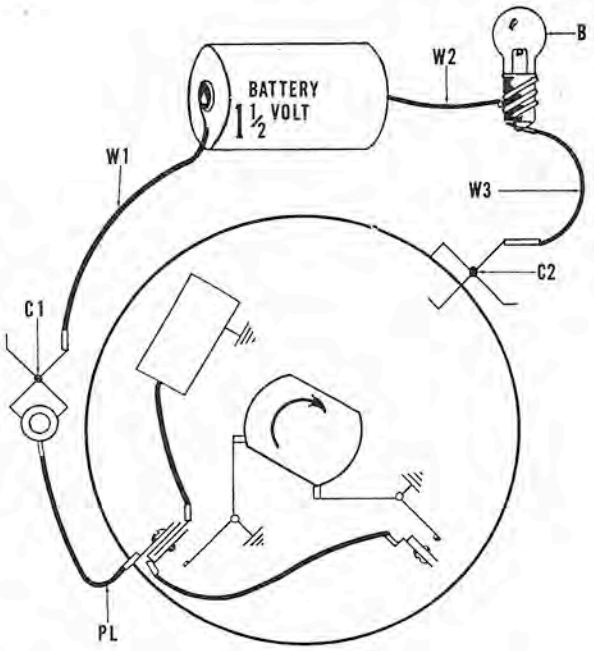


Fig. J87—Diagram showing method of constructing a timing light using flashlight battery, bulb, wires and clips. Refer to text.

B. Light bulb
C1. Spring clip
C2. Spring clip
PL. Primary lead
W1. Wire
W2. Wire
W3. Wire

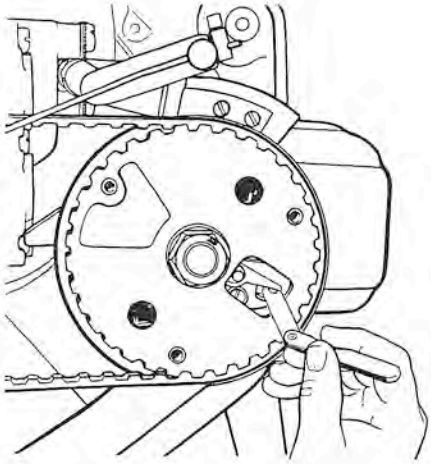
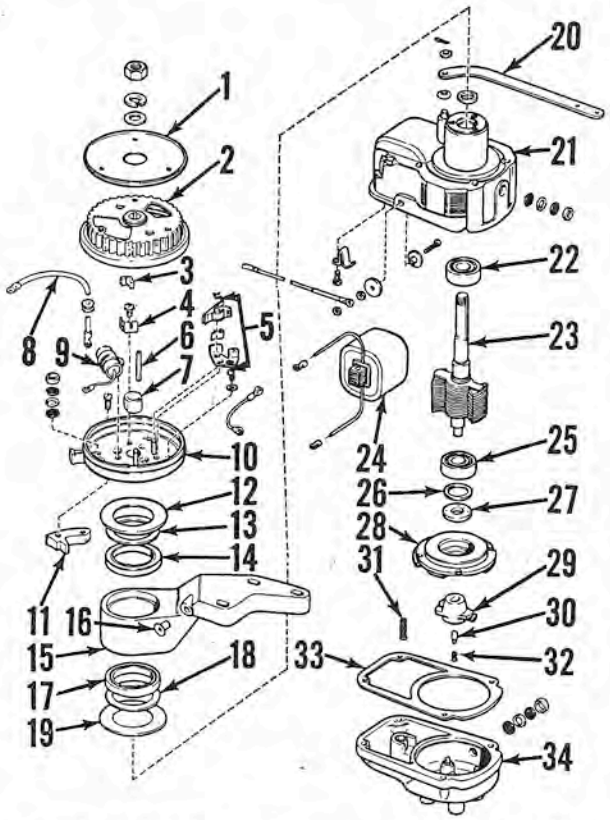


Fig. J88 — Pulley cover removed showing method of adjusting breaker points. Point gap is approximately 0.020 but the two sets of points must be synchronized using a timing light such as that shown in Fig. J87.



1. Pulley cover
2. Pulley
3. Oiler wick
4. Clip
5. Point set
6. Key
7. Cam
8. Lead wire
9. Condenser
10. Breaker plate
11. Stop
12. Washer
13. Washer
14. Bearing
15. Bracket
16. Bumper
17. Bearing
18. Washer
19. Washer
20. Link
21. Housing
22. Bearing
23. Shaft
24. Coil assembly
25. Bearing
26. Washer
27. Felt washer
28. Bearing support
29. Rotor
30. Brush
31. Spring
32. Spring
33. Gasket
34. Distributor cap

Fig. J86—Exploded view of magento of the type used. Magneto is belt driven from powerhead flywheel.

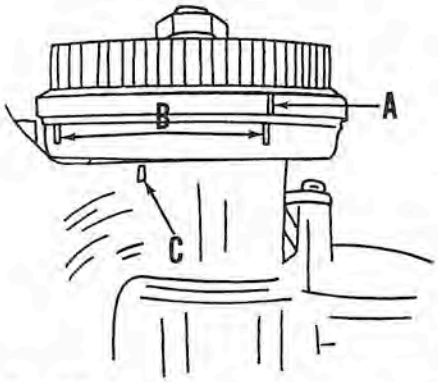


Fig. J89—Assembled magneto showing the three sets of timing marks. Refer to text for timing details.

A. Pulley timing mark
B. Magneto timing marks
C. Mounting bracket mark

mark aligns with the other breaker point timing mark (B), and repeat the adjustment with the second set of points. Recheck by turning the magneto pulley one complete turn in a clockwise direction to see that lamp goes out at the proper instant. Readjust, if required, by repeating the above procedure.

To time the magneto, remove the magneto pulley cover (C—Fig. J92) and loosen the magneto bracket screws (A); then slip belt off magneto pulley. Slowly turn the engine flywheel until timing mark on flywheel aligns with similar mark on block and manual starter housing as shown at (FT—Fig. J90); then turn magneto pulley until the timing marks are aligned as shown at (MT —Fig. J91). Slip belt over magneto pulley using care not to disturb the timing. Move magneto in or out to provide $\frac{5}{16}$ to $\frac{3}{8}$-inch belt deflection when measured midway between pulleys as shown in Fig. J92; then tighten the bracket screws (A).

Spark plug leads are provided with screw threads at magneto end. To remove or renew the leads push the nipple back and unscrew the lead.

BATTERY IGNITION. The ignition distributor used on battery ignition models is similar in construction and drive to the magneto used on other models.

To time the distributor, remove the distributor cap (1—Fig. J93) and align the marked tooth on drive pulley (12) with one of the timing marks (TM) on drive housing (18); then proceed as outlined in the previous MAGNETO paragraph.

To renew the drive belt, remove the distributor cap (1), rotor (3) and cam (8); then unbolt and lift off the breaker plate (9). When installing the breaker cam (8), make sure the wavy detent spring and Woodruff key are in place on shaft (15). Alternator stator must be removed from powerhead flywheel. Align the timing marks on flywheel and block, and the marked tooth on drive pulley (12) with timing mark (TM) on mounting bracket (26) and adjust belt to $\frac{5}{16}$-$\frac{3}{8}$-inch belt deflection as outlined for magneto models.

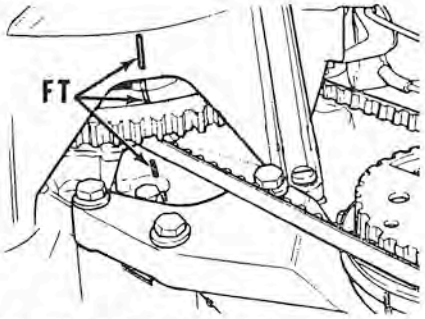


Fig. J90—Engine timing marks are located on starter housing, flywheel and engine block as shown at (FT).

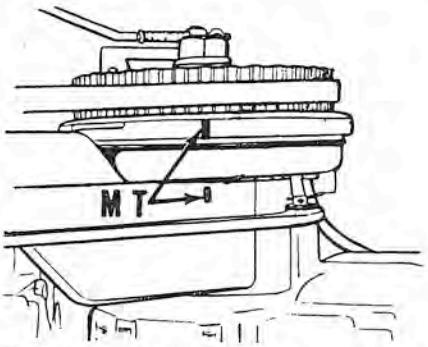


Fig. J91 — When installing magneto drive belt, first align flywheel timing marks as shown in Fig. J90, then install belt with magneto pulley and mounting bracket marks aligned as shown at (MT).

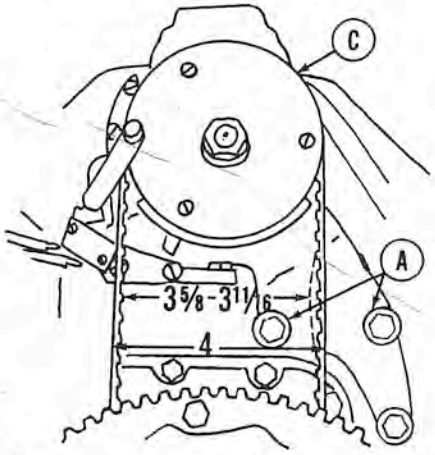


Fig. J92—Drive belt tension adjustment is correct when belt can be deflected 5/16 to 3/8 inch as shown. Adjust by loosening bracket attaching screws (A).

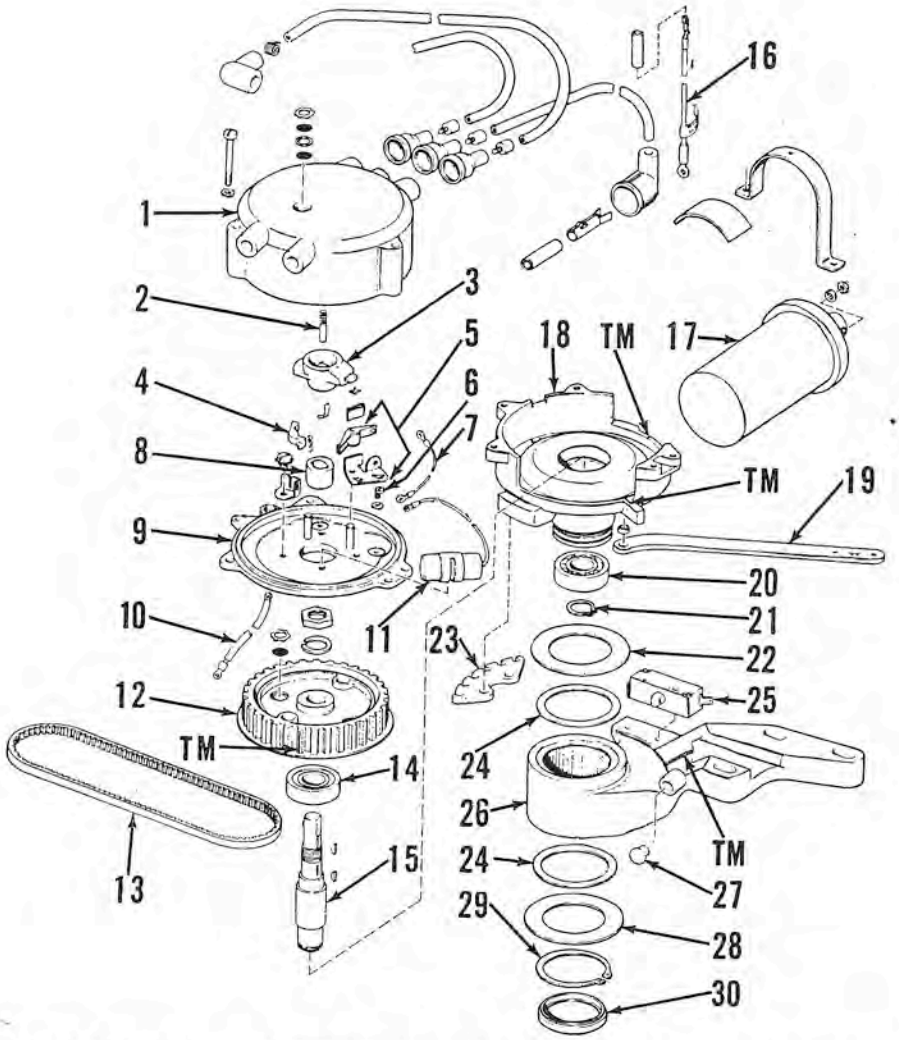


Fig. J93—Exploded view of battery ignition system used on some late models. Installation and timing is similar to that of magneto equipped motors.

TM. Timing marks
1. Distributor cap
2. Brush
3. Rotor
4. Oiler wick
5. Point set
6. Eccentric screw
7. Wire
8. Cam
9. Breaker plate
10. Wire
11. Condenser
12. Pulley
13. Drive belt
14. Bearing
15. Shaft
16. Primary wire
17. Ignition coil
18. Housing
19. Link
20. Bearing
21. Snap ring
22. Washer
23. Retainer
24. Washer
25. Safety switch
26. Bracket
27. Bumper
28. Washer
29. Snap ring
30. Housing cap

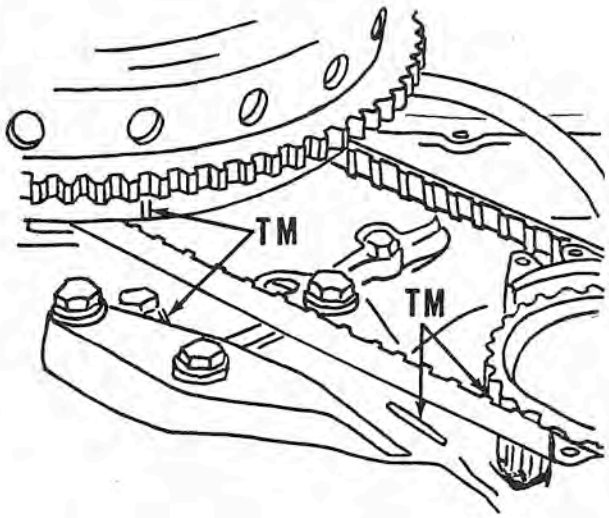


Fig. J94—To time the distributor, align the flywheel timing marks (TM), then align the marked pulley tooth with scribe line on mounting bracket as shown.

Primary wire (16) has a built-in one ohm resistance to protect the coil and condenser at slow idle speeds and another primary wire should not be substituted. Because of the alternator (AC generator) it is extremely important that battery leads are not reversed during assembly or installation. To do so may damage the rectifier diodes. Also, DO NOT polarize the alternator.

Condenser capacity is 0.35-0.41 mfds. Breaker point gap is approximately 0.020 but the two points must be synchronized.

COOLING SYSTEM

WATER PUMP. All models are equipped with a rubber impeller type water pump. Impeller is mounted on and driven by the drive shaft in the lower unit. Refer to Fig. J95.

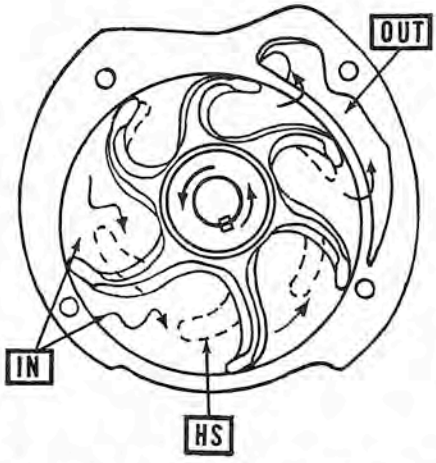


Fig. J95—The flexible rubber water pump impeller mounts on lower unit drive shaft and rotates in offset pump housing as shown. At slow speeds impeller blades follow outline of housing. Water is drawn into pump (IN) as area between blades increases, and is forced into power head (OUT) as area narrows. At high speeds, blades remain curved as shown by broken lines (HS) and pump operates by centrifugal action.

Water enters the lower unit through a water scoop which is located below the exhaust outlet, above and aft of the propeller. When cooling system problems are encountered, first check the water inlet (See Fig. J96) for plugging or partial stoppage; then if not corrected, detach the gear case from the drive shaft (exhaust) housing and check the condition of the water pump, water passages, gaskets and seals. Also check for pressure leaks into water jacket in the power head.

THERMOSTAT. A cooling system thermostat is used to maintain a coolant temperature of 130-150 degrees F. Thermostat should be renewed if expelled water temperature exceeds 170 degrees F. or if water remains below 130 degrees F. after a few minutes running. Water temperature can be checked with a thermometer inserted in the water discharge hole at rear of motor above water line.

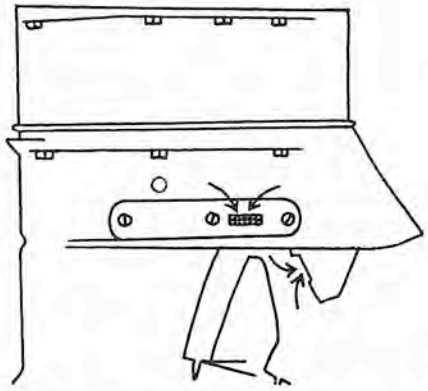


Fig. J96—Water pump inlet is located behind and above propeller as shown by arrows. The screen in side plate serves as inlet when motor is in reverse.

Thermostat is located at rear of powerhead to lower unit adapter plate and is shown exploded in Fig. J97. Most service can be performed without major disassembly after removing motor shroud. To renew any of the thermostat components, remove top cover (1), and the two springs (2 & 3). Check valve (5) is set to maintain one pound initial pressure in cooling system, and opens to return coolant water to intake side of water pump until engine warms up and thermostat valve (4) opens. Check seating surfaces of valves (4 and 5) and valve plate (7), and check springs for distortion or other damage. Renew all removed gaskets when thermostat unit is reassembled.

POWER HEAD

R&R AND DISASSEMBLE. To overhaul or service the power head, mount the motor on a suitable stand and remove the shroud.

All Models With Magneto Ignition. Remove the manual starter unit, magneto drive belt and magneto. Remove carburetor and intake manifold, electric starter and generator; then remove the flywheel, using a suitable puller. Remove thermostat hous-

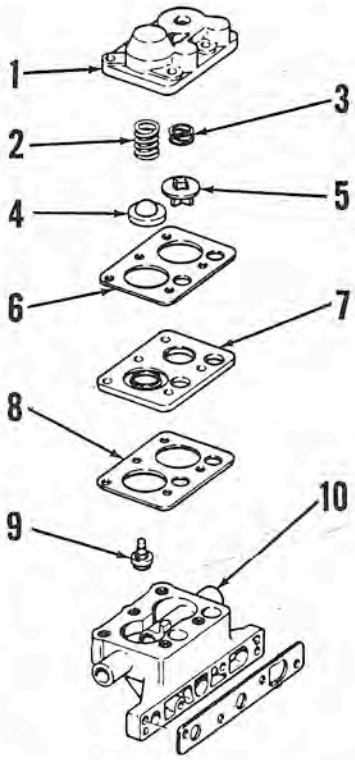


Fig. J97 — Exploded view of thermostat housing and related parts. Housing (10) mounts at rear of lower unit adapter plate.

1. Cover
2. Spring
3. Spring
4. Thermostat valve
5. Check valve
6. Gasket
7. Plate
8. Gasket
9. Thermostat
10. Housing

ing assembly and rear water jacket (exhaust) covers. Remove cylinder heads; then unbolt and remove power head from lower unit.

Models With Battery Ignition. Remove lifting (bail) cover assembly, starting pulley and flywheel; then disconnect and remove the alternator stator. Remove distributor cap, rotor, cam, breaker plate assembly and distributor drive belt; then unbolt and remove distributor. Remove carburetor and intake manifold, electric starter and thermostat housing. Remove rear water jacket (exhaust) covers, cylinder head covers and cylinder heads; then unbolt and remove power head from lower unit.

All Models. Refer to Figs. J98, J99 and J100. Remove the bolts retaining upper crankcase head (13—Fig. J99 or J100). Remove snap ring (30) from lower end of crankshaft, and remove carbon seal assembly (25 through 29). Remove the bolts (31) retaining lower crankcase head and loosen, but do not remove the thrust plate screws (32). Refer to Fig. J101. Drive out the tapered aligning dowels (23—Fig. J98) by driving from cylinder side; then unbolt and remove the forward crankcase half (21). Do not fail to remove the two center main bearing cap screws by reaching through intake ports, before attempting to separate the crankcase.

Pistons, rods and crankshaft are now accessible for removal and overhaul as outlined in the appropriate following paragraphs.

When reassembling, follow the procedure outlined in the following ASSEMBLY paragraph.

ASSEMBLY. Because of the two-cycle design, crankcase and intake manifold must be completely sealed against both vacuum and pressure. Exhaust manifold and cylinder head must be sealed against water leakage and pressure. Mating surfaces of water intake and exhaust areas between power head and lower unit must form a tight seal.

Whenever the power head is disassembled, it is recommended that all gasket surfaces and the mating surfaces of crankcase halves be carefully inspected for nicks, burrs and warped surfaces which might interfere with a tight seal. The cylinder head, head end of cylinder block, or mating surfaces of water jacket or manifold covers may be checked, and lapped, if necessary, to provide a smooth surface. For lapping, use a regular lapping block or a sufficiently large piece of smooth plate glass. Lay a sheet of No. 00 emery paper on the lapping block; then place surface to be lapped on emery paper. Apply very light pressure and use a figure-eight motion, checking frequently to determine progress. Do not remove any more metal than is absolutely necessary. Finish lap using lapping compound or a well worn emery paper surface. Thoroughly clean the parts with new oil on a clean, soft rag; then wash with soapsuds and clean rags. Mating surfaces of crankcase may be checked on the lapping block, and high spots or nicks removed, but surface must not be lowered. If extreme care is used, a slightly damaged crankcase can be salvaged in this manner. In case of doubt, renew the crankcase assembly.

The crankcase halves are positively located during assembly by the use of tapered

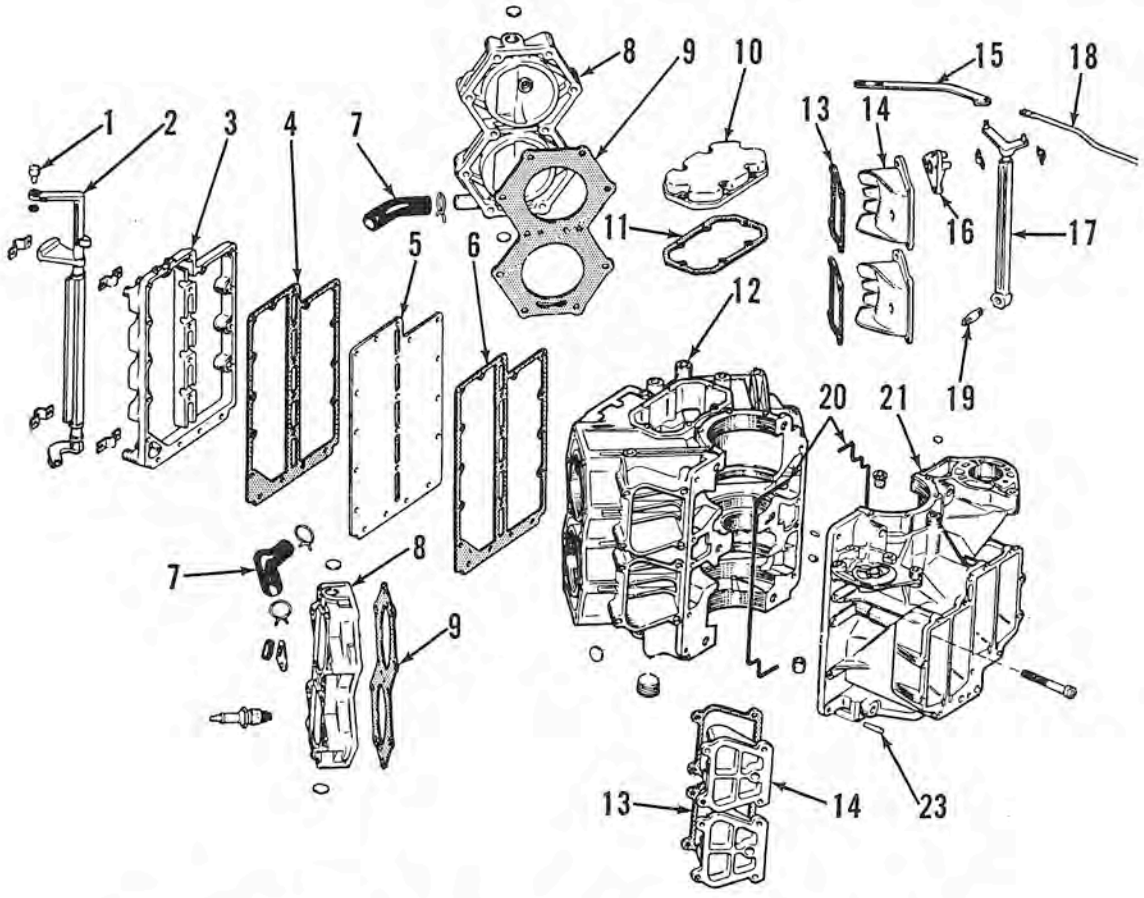


Fig. J98—Exploded view of power head cylinder block and associated parts.

1. Pivot pin
2. Shift lock lever
3. Exhaust cover
4. Gasket
5. Exhaust cover
6. Gasket
7. Hose
8. Cylinder head
9. Gasket
10. Cover
11. Gasket
12. Cylinder block
13. Gasket
14. By-pass cover
15. Link
16. Bracket
17. Speed control shaft
18. Rod
19. Pin
20. Seal strip
21. Crankcase front half
23. Taper pin

dowel pins. Check to make sure that the dowel pins are not bent, nicked or distorted, and that dowel pin holes are clean and true. When installing dowel pins, make sure they are fully seated but do not use excessive force.

The mating surfaces of crankcase halves are sealed by means of the sealing strips (20—Fig. J98) which fit in grooves in face of front crankcase half (21). When installing the sealing strips, first make sure the mating surfaces and sealing grooves are absolutely clean and free from old cement, nicks or other damage or foreign matter which might interfere with a perfect seal. Apply a small amount of hardening cement such as Sealer 1000 in grooves, and install the sealing strip so that ends extend an equal amount from ends of grooves. Seat the sealing strip carefully and evenly in grooves with the fingers by working AWAY from crankshaft bore; then trim ends to extend $\frac{1}{16}$-inch into bore to assure a good butt and seal. Coat mating surface of block thinly and evenly with a good hard-drying cement; then immediately install crankcase front half. Install and seat the tapered aligning dowels; then install and tighten the retaining cap screws. The suggested tightening torques are 60-84 inch-pounds for the small screws and 144-168 inch-pounds for the large bolts.

Use a non-hardening cement such as Perfect Seal No. 4 on all gasket surfaces when reassembling, and on the threads of all screws except connecting rod screws and

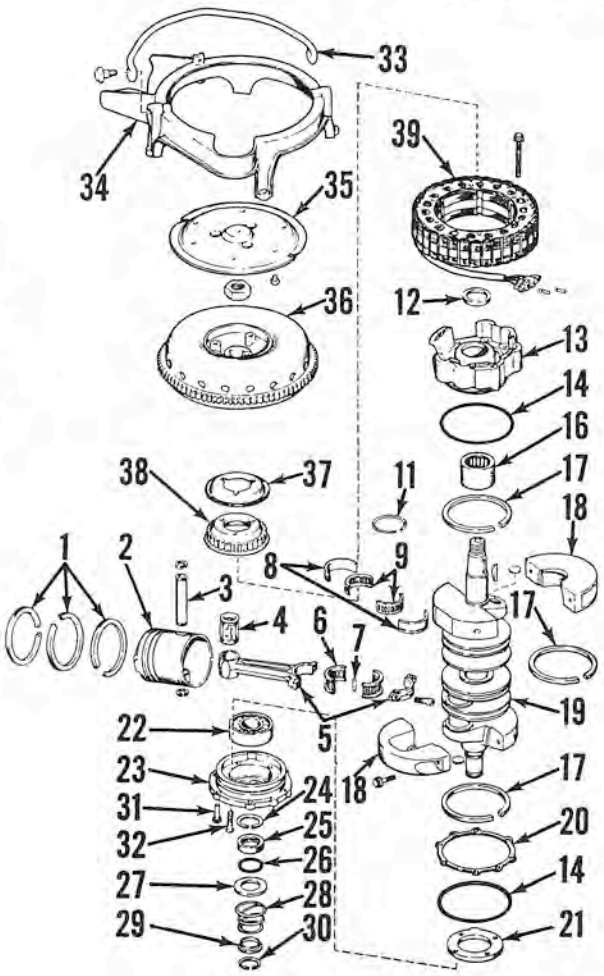
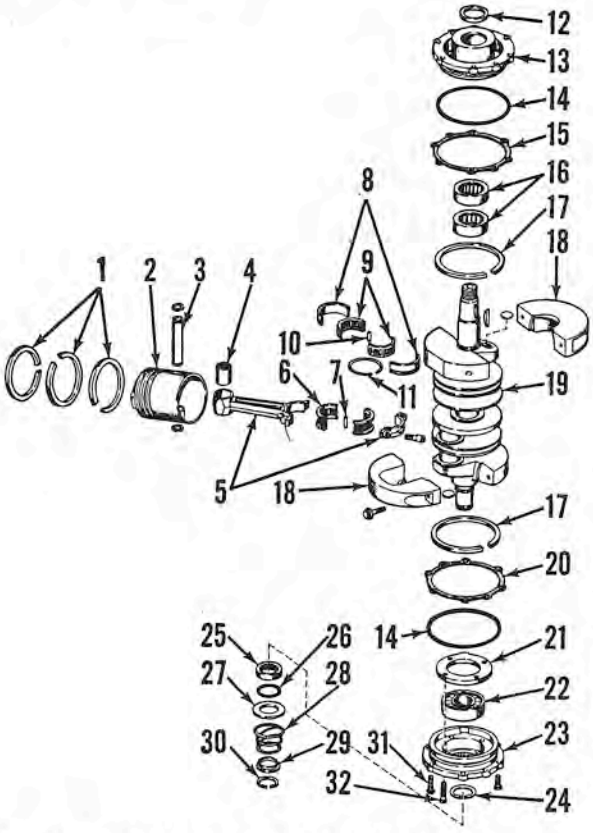


Fig. J100—Exploded view of crankshaft, bearings, piston, flywheel and alternator used on models so equipped. Refer to Fig. J99 for legend except for the following.

33. Ball
34. Starter housing
35. Starter pulley
36. Flywheel
37. Pulley cover
38. Ignition drive pulley
39. Stator



1. Piston rings
2. Piston
3. Piston pin
4. Bearing
5. Connecting rod
6. Bearing cage
7. Bearing roller
8. Outer race
9. Bearing cage
10. Bearing roller
11. Retaining ring
12. Seal
13. Crankcase head
14. "O" ring
15. Gasket
16. Bearings
17. Seal ring
18. Filler block
19. Crankshaft
20. Gasket
21. Plate
22. Bearing
23. Crankcase head
24. Snap ring
25. Seal
26. "O" ring
27. Retaining washer
28. Spring
29. Retainer
30. Snap ring
31. Screw
32. Screw

Fig. J99—Exploded view of crankshaft, bearings, pistons and associated parts used on magneto models.

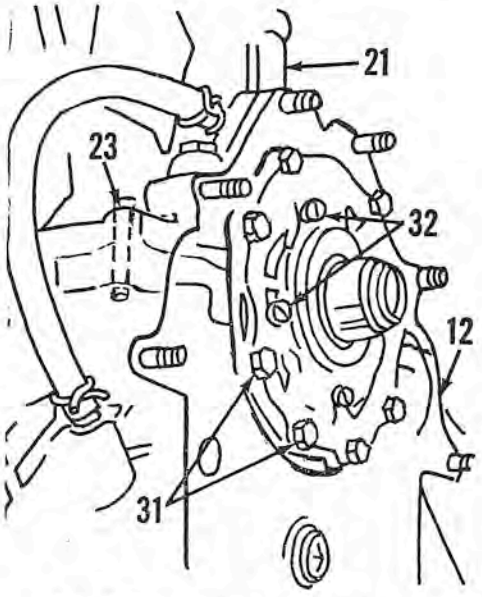


Fig. J101—Lower view of power head assembly. To disassemble, remove lower head cap screws (31) and loosen screws (32). Drive out the tapered pins (23) by working from cylinder side. Refer to Fig. J98 for legend.

those retaining upper crankcase head. Sealing the threads is especially important on motors operated in salt water, to prevent water damage to threads, and to make future disassembly easier.

When installing the flywheel, make sure that mating surfaces of flywheel and crankshaft are completely free from dirt, oil or grease. Outer edge of flywheel key must be parallel with center line of crankshaft as shown in Fig. J102 (not parallel with crankshaft taper). Tighten the flywheel retaining nut to a torque of 70-85 ft.-lbs.

PISTONS, PINS, RINGS AND CYLINDERS. Before detaching rods from crankshaft, be sure rod and cap are properly marked for correct assembly to each other and in the correct cylinder.

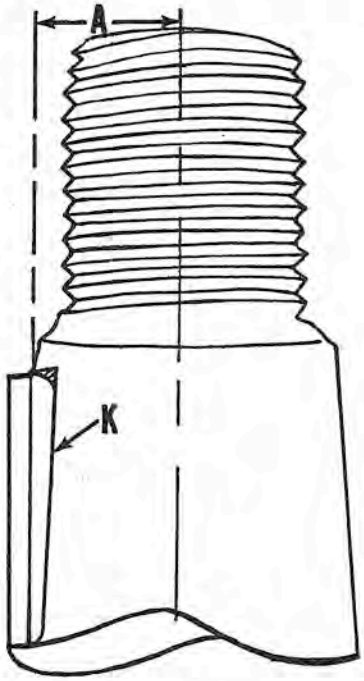


Fig. J102—When installing flywheel, make sure outer edge of key (K) is parallel with centerline of crankshaft as shown at (A).

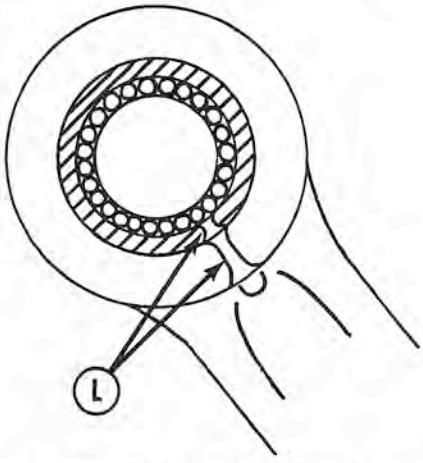


Fig. J103 — Install connecting rod upper bearing so that oil hole in bearing is aligned with hole in rod as shown at (L).

Each aluminum piston is fitted with three rings which are interchangeable and may be installed either side up. Pistons and rings are available in standard size and oversizes of 0.020 and 0.040. The recommended piston ring end gap is 0.007-0.017. Ring to groove clearance is 0.005-0.0065 for 50 hp motors and 0.006 for 75 hp motors. The recommended piston to cylinder wall clearance is 0.0035-0.0045 for 50 hp motors and 0.0045-0.006 for 75 hp motors. Renew piston, rings and/or cylinder assembly is clearances are excessive.

Piston pin is retained in piston by snap rings in each piston pin boss. Upper end of connecting rod is fitted with needle bearing. Check piston pin for wear or scoring in area contacted by connecting rod upper bearing.

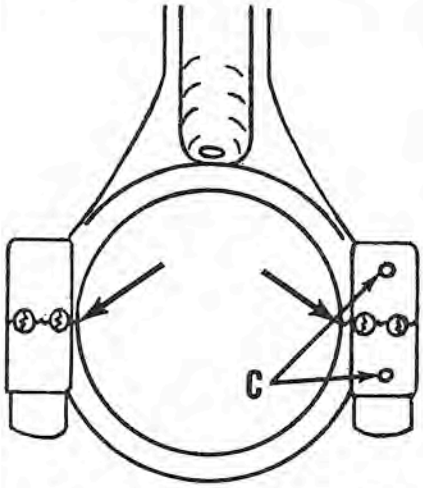


Fig. J104—Connecting rod is "fractured" at point of arrows. When installing cap, make sure correlation marks (C) are aligned then work cap back and forth a slight amount until fracture lines match.

When reassembling, piston should be installed with long, tapering side of piston head toward exhaust port side of cylinder (toward center of vee in the block). Thoroughly lubricate all friction surfaces when powerhead is assembled. Tighten the connecting rod cap screws according to the following schedule:

¼-inch, 28 thread.....180-186 inch-lbs.
$\frac{9}{32}$-inch, 28 thread.....216-222 inch-lbs.
$\frac{5}{16}$-inch, 24 thread.....348-372 inch-lbs.

CONNECTING RODS, BEARINGS AND CRANKSHAFT. Before detaching connecting rods from crankshaft, make sure rod and cap are properly marked for correct assembly to each other and in the correct cylinder.

Connecting rod rides in needle bearings at both the crankshaft and piston ends. The lower bearing consists of loose needles in a split cage as shown in Fig. J99 or J100. On models before 1960 the upper connecting rod bearing consists of a bearing and outer race assembly which must be pressed into connecting rod. When installing, make sure that the oil hole in outer race is aligned with oil hole in connecting rod as shown in Fig. J103. On later models, the upper connecting rod bearing uses the machined surfaces of connecting rod and piston pin as bearing races.

The connecting rod (crankpin end) is drilled and finished; then carefully fractured at points shown by arrows, Fig. J104. Parting line is not machined. When assembled, the uneven edges of parting line fit together to properly align rod and cap. When assembling, align the index marks (C); then move the cap back and forth slightly as rod screws are tightened, until uneven fracture lines mesh. Test the alignment by scratching fingernail across parting line, which should be barely noticeable.

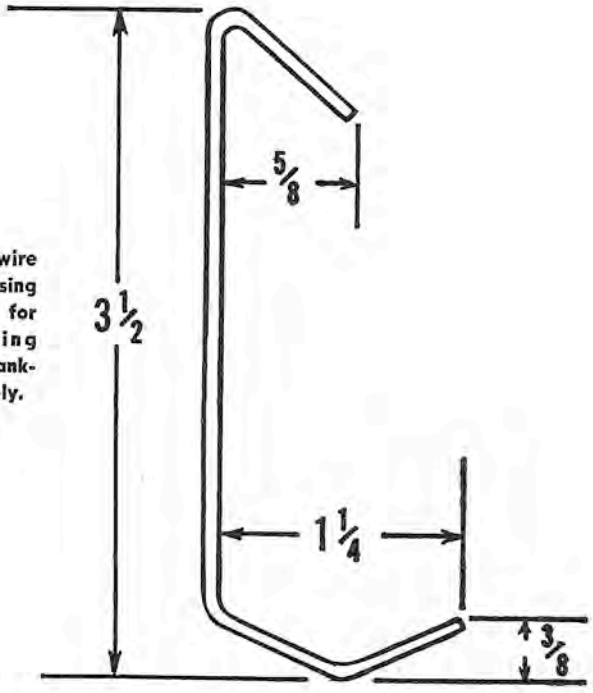


Fig. J105 — Four wire clips can be made using the pattern shown for holding the connecting rods away from crankshaft during assembly.

The two-piece crankpin bearing cage is indexed by score marks which must be aligned during assembly.

The crankshaft upper main bearing is a double roller bearing (16—Fig. J99 or J100), contained in the upper crankcase head (13). The center main bearing is a split cage needle bearing. The 20 bearing needles (10—Fig. J99) are loose in models before 1961, and are contained in the cage in later models. The two-piece outer race (8) is held together with retaining ring (11) and is positioned in cylinder block by a dowel. To remove the ball-type lower main bearing (22) after crankshaft and bearings assembly is removed from cylinder block, remove the four screws (32) which attach thrust plate (21) to lower crankcase head (23) and pull head from bearing and crankshaft. Use a suitable press or puller to remove bearing and thrust plate from crankshaft. When reassembling, the protruding lug on thrust plate (21) must be installed in the cavity provided in lower head (23). Thrust plate screws (32) must remain loose when installing the crankshaft assembly to prevent damage to gasket (20). When installing the crankshaft and bearings assembly, pull all pistons to bottom of cylinders and temporarily secure rods to outer flange of cylinder block. Wire clips can be constructed using the dimensions shown in Fig. J105 to hold the connecting rods away from crankshaft.

When assembling the power head, lubricate all friction surfaces as they are installed. Index marks on rod and cap, and on rod and center main bearing cages must be aligned during assembly. Loose needle bearings may be coated with a non-fibrous grease (such as gun or cup grease) to hold them in position during assembly. Center main bearing outer race must be positioned so that aligning dowel in crankcase slides into hole in bearing race.

Refer to the CONDENSED SERVICE DATA table for dimensional data and recommended torque values. If bearing surface of rod and cap is rough, scored, worn, or shows signs of overheating, renew the connecting rod and bearings. Inspect crankpin and main bearing journals. If scored, out-of-round, or worn, renew the crankshaft. Inspect the crankcase compression rings (17—Fig. J99 or J100) to see that they are free in crankshaft grooves, but not excessively loose or worn. These rings seal the crankcase into individual compartments for proper fuel induction. The two filler blocks (18) are attached to the crankshaft to fill out the upper and lower crankcase cavities and equalize the cavity size to assure equal fuel distribution.

MANUAL STARTER

Fig. J106 shows a starter typical of the one used. When installing a new starter cord or spring, invert the removed starter assembly in a vise and wind the spring by turning the starter pulley (11) counter-clockwise until spring is completely wound. Reverse the pulley approximately ½-turn until starter cord guide in housing (2) aligns with cord anchor in pulley. Thread the cord through pulley and housing and anchor in pulley with a suitable knot; then slowly allow spring to unwind. Pass cord through handle (8) and secure with anchor (9) so that all slack is taken up and handle is held against housing.

To adjust the manual starter lock, move the shift lever to FORWARD position. Loosen the set screw in collar (4—Fig. J107) and check to make sure that the spring on rod (2) moves latch in to rest on lower face of pulley. Move the collar (4) against pivot (3) and tighten set screw. Check the adjustment by moving shift lever to REVERSE position. Latch should again contact pulley to lock starter. Move shift lever to neutral position and make sure starter is free to operate.

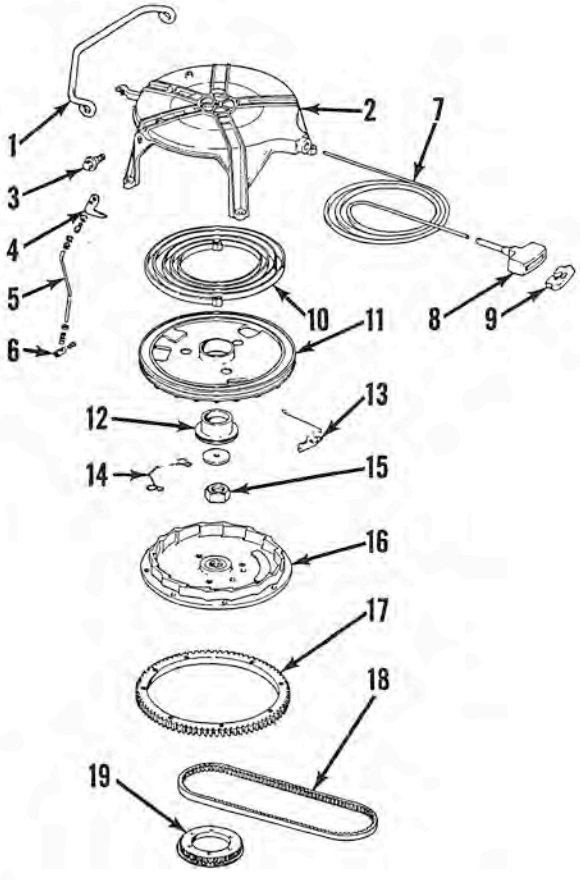


Fig. J106 — Exploded view of typical manual starter used on models not equipped with alternator.

1. Ball
2. Housing
3. Pivot screw
4. Lockout lever
5. Rod
6. Stop collar
7. Rope
8. Handle
9. Anchor
10. Spring
11. Starter pulley
12. Spindle
13. Pawl
14. Spring
15. Flywheel nut
16. Flywheel
17. Ring gear
18. Magneto drive belt
19. Drive pulley

LOWER UNIT

PROPELLER AND DRIVE PIN. Fifty hp (1958 & 1959) models use a $\frac{5}{16}$ x 1⅞-inch stainless steel drive pin, Johnson Part No. 305500. Seventy-five hp models use a $\frac{9}{32}$ x $2\frac{9}{32}$-inch stainless steel drive pin, Johnson Part. No. 307217.

All propellers are protected by a cushioning and slip clutch built into propeller hub. The gear ratio of lower unit was changed when horsepower was increased in 1960. Fifty horsepower models have a propeller shaft speed of approximately 2930 rpm at maximum recommended operating speed. In these models the propeller clutch should slip at an applied torque of 315-345 ft.-lbs. The standard propeller for these motors has a diameter of 12½ inches and a pitch of 14 inches.

Seventy-five horsepower motors have a propeller shaft speed of approximately 4350 rpm at maximum recommended operating speed. In these models the propeller clutch should slip at a torque of 240-290 ft.-lbs. Available propeller options are 9½ x 10, 10¼ x 10, 10 x 11 and 10 x 12, and propeller should be matched to boat and operating conditions.

REMOVE AND REINSTALL. Most service on the lower unit can be performed by detaching the gearcase housing from drive shaft and exhaust housing, or gearcase lower housing from gearcase. When servicing lower unit, pay particular attention to water pump and water tubes with respect to air or water leaks. Leaky connections may interfere with proper cooling and performance of motor.

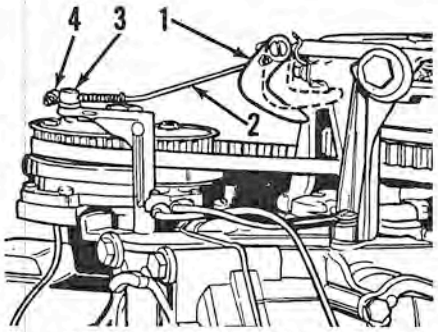
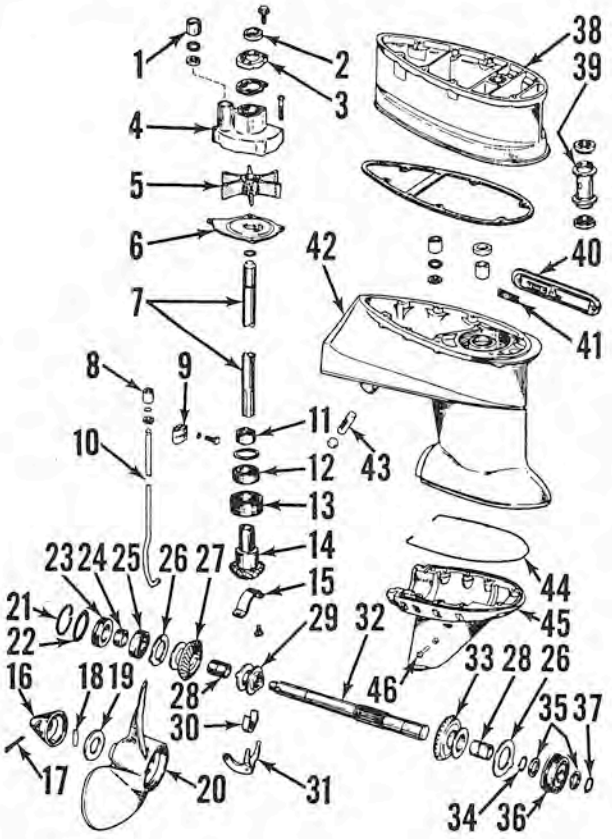


Fig. J107 — Schematic view of starter lock. Lockout lever (1) contacts starter pulley to prevent engine being started when shift lever is in gear. Refer to text for method of adjustment.



1. Bushing
2. Seal ring
3. Cover
4. Impeller housing
5. Impeller
6. Plate
7. Drive shaft
8. Bushing
9. Connector
10. Shift rod
11. Bearing
12. Bearing
13. Bearing
14. Drive pinion
15. Support
16. Retainer
17. Cotter pin
18. Drive pin
19. Thrust washer
20. Propeller
21. Retaining ring
22. "O" ring
23. Seal housing
24. Oil seal
25. Bearing
26. Thrust washer
27. Reverse gear
28. Bushing
29. Clutch dog
30. Cradle
31. Shift lever
32. Propeller shaft
33. Forward gear
34. Snap ring
35. Thrust washer
36. Bearing
37. Snap ring
38. Extension
39. Tube
40. Cover
41. Screen
42. Upper gearcase
43. Screen
44. Seal strip
45. Lower gearcase
46. Pivot screw

Fig. J108 — Exploded view of lower unit gearcase, water pump and associated parts used on 50 hp models. Items (38 & 39) are only used with "Long" models.

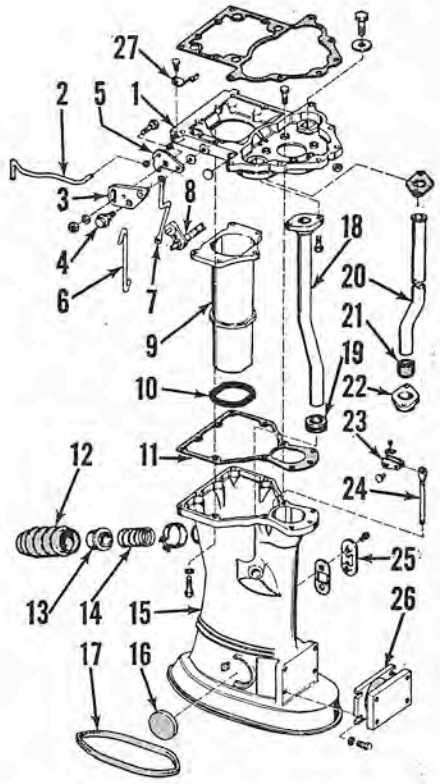


Fig. J109 — Exploded view of drive shaft housing, exhaust housing and associated parts used on 50 hp models.

1. Adapter plate
2. Rod
3. Adjustment plate
4. Pivot screw
5. Detent
6. Link
7. Link
8. Shifter shaft
9. Exhaust tube
10. Seal ring
11. Gasket
12. Boot
13. Retainer
14. Spring
15. Exhaust housing
16. Rubber mount
17. Seal ring
18. Water tube
19. Grommet
20. Water tube
21. Grommet
22. Coupling flange
23. Lever
24. Shift rod
25. Plate
26. Rubber mount

Use appropriate exploded views (Figs. J108 through J111) as a guide when overhauling the lower unit. All gasket surfaces must be smooth, free from nicks and burrs, and assembled using a non-hardening type sealer such as Permatex No. 1 or Perfect Seal No. 4. All joints without gaskets must be smooth and free from nicks, burrs and old cement, and sealed with a hardening sealer such as "Sealer 1000" available from Marprox Corporation, P. O. Box 955, Sheboygan, Wisconsin. Refer to CONDENSED SERVICE DATA table for repair specifications and recommended tightening torques.

1958 and 1959 Motors: The propeller shaft (32—Fig. J108), shaft gears and bearings can be removed after draining lubricant from gear compartment and removing shift lever pivot screw (46); then unbolting and removing lower housing (45). To remove drive pinion (14), it is first necessary to remove retainer strap (15).

To separate gear case from the exhaust and drive shaft housing, remove outer cover (5—Fig. J110) and inner cover (25—Fig. J109); then loosen the screw in shift rod clamp (9—Fig. J108). Remove the retaining cap screws and separate gear case (42) from exhaust housing.

Propeller shaft bearings (25 and 36) can be removed from shaft using a suitable press. When installing used bearings, make sure bearings are clean and dry then coat them thoroughly with Petrolatum No. 00. New bearings are factory lubricated. Renew gear bushings (28) or shaft (32) if excessive clearance or wear exists. Renew thrust washers (26) if worn or scored.

Gears (27 and 33) are interchangeable, as are bushings (28) and thrust washers (26). The bushings (28) float on propeller

1. Exhaust housing cover
2. Exhaust housing cover
3. Rubber mount
4. Pivot shaft
5. Cover plate
6. Friction pin
7. Stern bracket
8. Lock pin
9. Spring
10. Reverse lock lever
11. Washer
12. Bushing
13. Washer
14. Seal
15. Bearing
16. Swivel bracket
17. Stern bracket
18. Washer
19. Cable
20. Release arm
21. Bumper
22. Spool
23. Tilt spring
24. Spring
25. Lever
26. Spring
27. Pin
28. Link
29. Cable
30. Connector

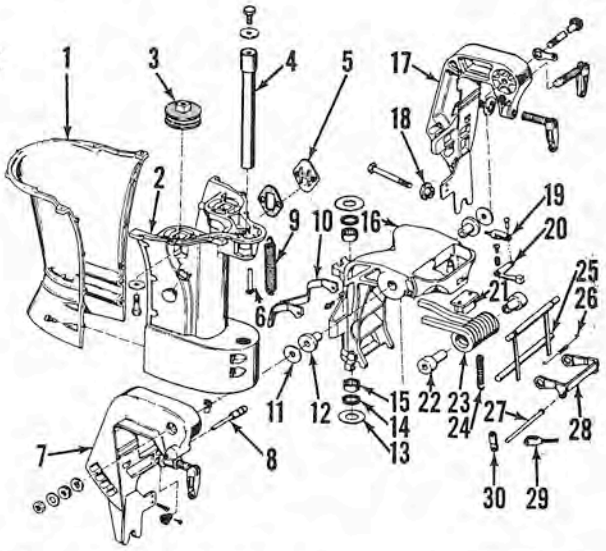


Fig. J110 — Exploded view of stern bracket, swivel bracket, exhaust housing and associated parts used on 75 hp models.

shaft (32) and in the gears. Recommended clearances are as follows:

Gear to bushing diametral clearance 0.0005-0.002

Rear bushing to propeller shaft diametral clearance 0.0012-0.0021

Front bushing to propeller shaft diametral clearance 0.0003-0.0012

Mesh position of drive shaft gear (14) and the two propeller shaft gears (27 and 33) is controlled by the thickness of shim above thrust bearing (12). Shims are available in thicknesses of 0.006, 0.008, 0.010, 0.012, 0.0135 and 0.015. Shims are matched to bearing (12) and serviced as an assembly. When renewing bearing, always use the shim provided with bearing.

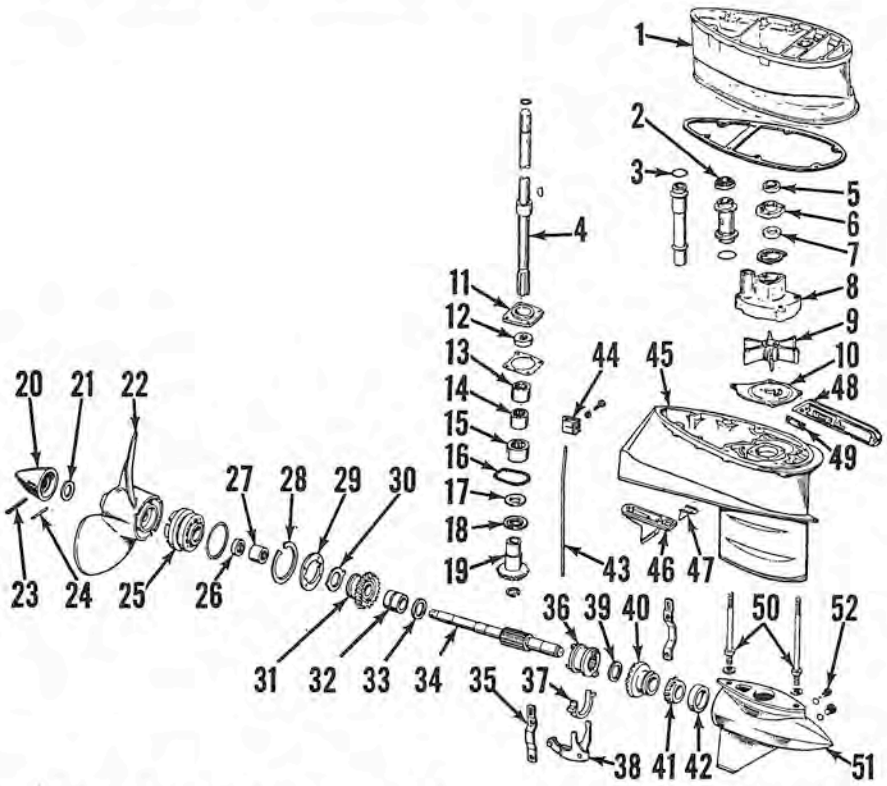


Fig. J111 — Exploded view of lower unit gearcase, water pump and associated parts used on 75 hp models. Items (1, 2 & 3) are used only on "Long" models.

1. Extension
2. Grommet
3. "O" ring
4. Drive shaft
5. Seal
6. Cover
7. Seal
8. Housing
9. Impeller
10. Plate
11. Cap
12. Seal
13. Bearing
14. Bearing
15. Bearing
16. Seal ring
17. Thrust washer
18. Thrust bearing
19. Drive pinion
20. Nut
21. Thrust washer
22. Propeller
23. Cotter pin
24. Drive pin
25. Gearcase head
26. Seal
27. Bearing
28. Snap ring
29. Retainer plate
30. Thrust washer
31. Reverse gear
32. Bushing
33. Thrust washer
34. Propeller shaft
35. Link
36. Clutch dog
37. Cradle
38. Shift lever
39. Thrust washer
40. Forward gear
41. Bearing cone
42. Bearing cup
43. Shift rod
44. Connector
45. Driveshaft housing
46. Exhaust outlet
47. Screen
48. Cover
49. Screen
50. Studs
51. Gearcase
52. Pivot screw

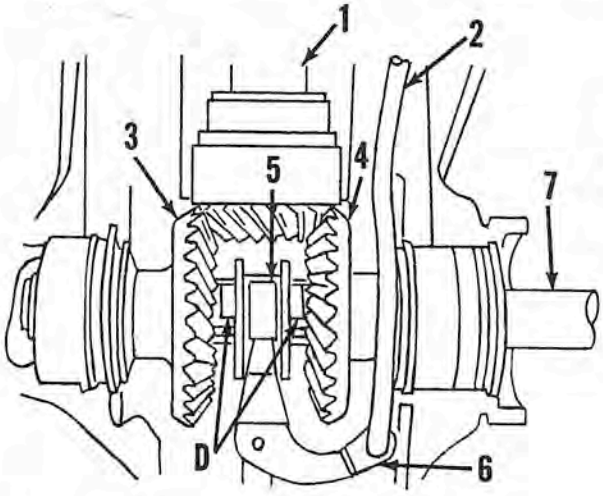


Fig. J112 — Schematic view of gearcase assembly showing shifting mechanism.

1. Pinion shaft
2. Shift rod
3. Forward gear
4. Reverse gear
5. Shift cradle
6. Shift lever
7. Propeller shaft
D. Clutch dogs

Housing seal (44) fits into a seal groove in lower gear housing (45). When installing the housing, press a new seal firmly into groove with the fingers; then trim the protruding ends to extend $\frac{1}{16}$-inch from end of groove to provide a good butt seal. Coat sealing surfaces lightly with a **hardening** type sealer such as "Sealer 1000." Tighten the retaining screws evenly and securely; then install the pivot screw (46), making sure it enters the hole in shifter lever (31). Adjust the shifter linkage as outlined in the following ADJUSTMENT paragraph of this section.

1960 and Later Motors (Except "Electramatic"): To remove the propeller shaft (34—Fig. J111) it is first necessary to detach pinion housing (45) from exhaust and drive shaft housing as follows: Remove covers (5—Fig. J110) and (25—Fig. J109) and loosen the screw in shift rod clamp (44—Fig. J111); then unbolt and remove the gear case from exhaust housing. Remove the two upper nuts from studs (50) and withdraw the gearcase (51) from pinion housing (45). To remove the propeller shaft and gears, first remove the propeller assembly, remove the screws retaining gearcase head (25) then remove the gearcase head using a suitable puller. Remove snap ring (28) and retainer plate (29). Remove the clamping screw from shifter yokes (35), remove the yokes and shifter rod (43), the shifter fork pivot screw (52); then withdraw the propeller shaft from housing. Forward gear (40) and bearing cone (41) will remain in housing as propeller shaft is withdrawn. Remove driving pinion (19); then remove forward gear (40) by tilting it to clear shifter pivot boss.

Assemble by reversing the disassembly procedure, using Fig. J111 as a guide. The following assembly notes will assist in efficient reassembly:

Tilt gearcase (51) on its forward point until centerline of propeller shaft bore is approximately 45 degrees from horizontal; then install bearing cone (41).

Use a lightweight grease to position

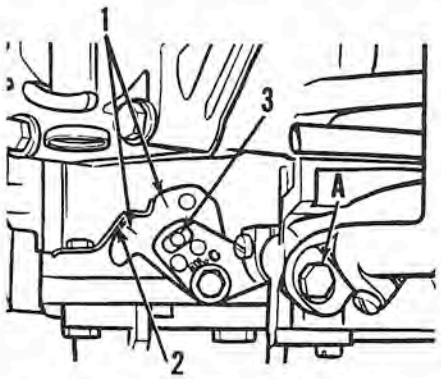


Fig. J113 — Shift lever should be adjusted so that detent spring rests in notch as shown, in neutral position. Clutch dogs should just start to engage gears when detent is aligned with either of the scribe lines (1). Detent is adjusted by loosening the nut on stud (3). Adjusting cap screw (A) properly positions the external lever as shown in Fig. J114.

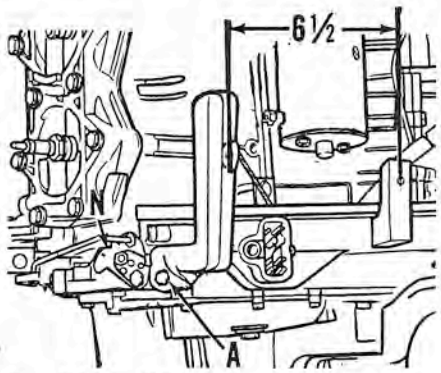


Fig. J114 — With detent spring resting in neutral notch as shown at (N), loosen cap screw (A) and move lever so that centerline is 6½ inches from centerline of shroud attaching boss as shown.

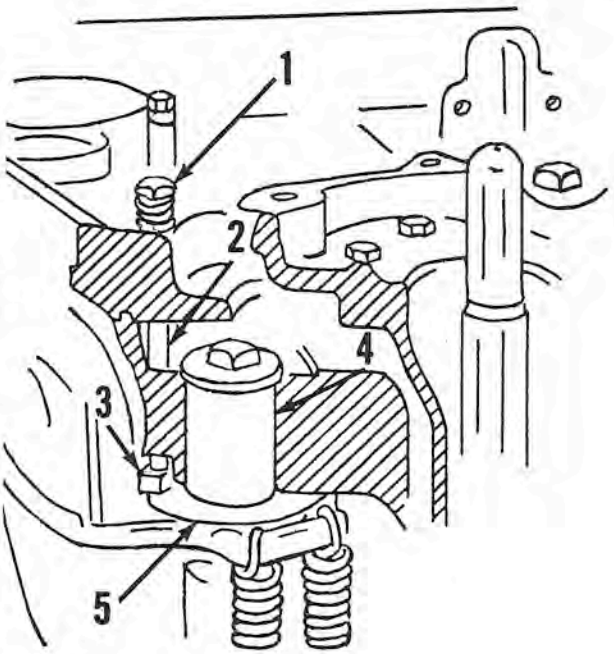


Fig. J115 — Cross sectional view of steering tension adjusting mechanism. See text for adjustment.

1. Adjusting screw
2. Plunger
3. Friction shoe
4. Pivot shaft
5. Friction washer

thrust washer (39) on forward drive pinion (40) and install pinion and washer in housing.

Install drive pinion (19); then assemble shifter collar (36), cradle (37) and shift lever (38) and place the assembly in housing while holding drive pinion (19) in approximate operating position.

Install thrust washer (33), bushing (32), gear (31), thrust washer (30) and retainer plate (29) in proper order on rear of propeller shaft (34); then insert the assembled shaft in open end of gearcase. Tilt gearcase up on forward point and arrange the previously inserted parts so that propeller shaft can be inserted. Make sure tabs of thrust washer seat in slots of retainer plate (29); then install snap ring (28).

Use two ¼-inch, 28 thread aligning studs when installing gearcase head (25), to make sure screw holes are properly aligned.

Reinstall gearcase to pinion housing, install lower unit, then adjust the shifter mechanism as outlined in the following ADJUSTMENT paragraph.

ADJUSTMENT. The lower unit drive pinion (1—Fig. J112) is coupled to the engine crankshaft. Forward gear (3) and reverse gear (4) are meshed with drive pinion and rotate constantly in opposite directions on propeller shaft (7). Drive collar is splined to the propeller shaft. Forward and reverse driving gears are obtained by shifting drive collar on propeller shaft until the dogs (D) engage similar lugs in either the forward gear (3) or reverse gear (4) to cause the propeller shaft to rotate. Neutral position is obtained when neither gear is coupled as shown in Fig. J112.

To adjust the shift linkage refer to Figs. J113 and J114. If linkage has been disassembled loosen the nut on stud (3—Fig. J113) and cap screw (A) and center both adjustments in the slotted holes. With motor not running, move the shift lever either way from the neutral position while turning propeller by hand. Clutch dogs on shifter collar should start to engage the gear as detent spring (2) aligns with one of the scribed lines (1). If it does not, loosen the nut on adjusting stud (3) and shift the detent plate until scribe line (1) is aligned; then retighten nut. Move shift lever through neutral and slowly into the other driving gear while turning propeller by hand. Check the position of detent (2) with the other scribe line (1) as gears engage. Equalize the error, if any, by loosening nut on stud (3) and slightly shifting the adjustment. Move the shift lever to neutral position. Loosen cap screw (A) if necessary, and move shift lever until lever is vertical and centerline is 6½ inches from centerline of cowl bracket as shown in Fig. J114.

Steering tension is controlled by a small shoe (3—Fig. J115) which is attached to plunger (2) and bears on thrust washer (5) located on swivel bracket. To adjust the tension, remove the motor shroud and tighten or loosen the spring loaded adjusting screw (1) which is located in the lower pan immediately below fuel filter.

Electramatic Models: The driving mechanism of "Electramatic" models consists of two driven gears which turn freely on the propeller shaft, two clutch coils, two clutch hubs splined to propeller shaft; and a forward drive and reverse drive electromagnet.

The clutch coils are anchored to their respective driven gears by three headless, Allen set screws, and the gear and clutch assembly secured to the splined clutch hub by a snap ring. Activation of either of the electromagnets attracts the free end of the clutch coil, causing it to drag on the splined hub. The resultant friction causes the coil to wrap around hub, gripping it firmly and locking propeller shaft to the selected driven gear. When the magnetic attraction is broken the grip of the coil on clutch hub is released, and both driven gears again turn independently of propeller shaft.

Malfunction of the unit could result in clutch slippage in one or both directions of travel; complete loss of ability to engage either or both of the gears; or complete lockup, in which drive shaft or propeller shaft could not be turned. Malfunction could be either electrical or mechanical in nature, and the cause should be determined before disassembly is attempted.

The electrical circuit consists of a hot wire leading from "A" terminal on starting switch to the remote control unit; the control switches; connecting wires leading from switches to the electromagnets; the electromagnets; and the ground circuit running back through the motor housings. Malfunction of an electrical nature usually results in failure of one or both of the clutch units to engage. Failure to disengage could be caused by malfunction of control switch. Similar malfunction could also be of a mechanical nature.

To check the electrical system, remove the motor cover and disconnect the shift cable leads at the quick disconnect terminals. NOTE: The shift wires are color-coded light green (reverse) and light blue (forward).

Attach one lead of an ohmmeter to a suitable ground and test the resistance of each lead of lower shift cable in turn. Resistance should be 7-8 ohms for each of the leads. A zero reading indicates a short circuit, while an infinity reading is an indication of an open circuit. An extremely high reading could indicate a broken wire or loose or corroded connections. In case of an unsatisfactory reading, the lower unit must be removed for further checking of the electrical components.

If a satisfactory reading was obtained in the tests and the remote control unit and battery are attached, use a voltmeter to

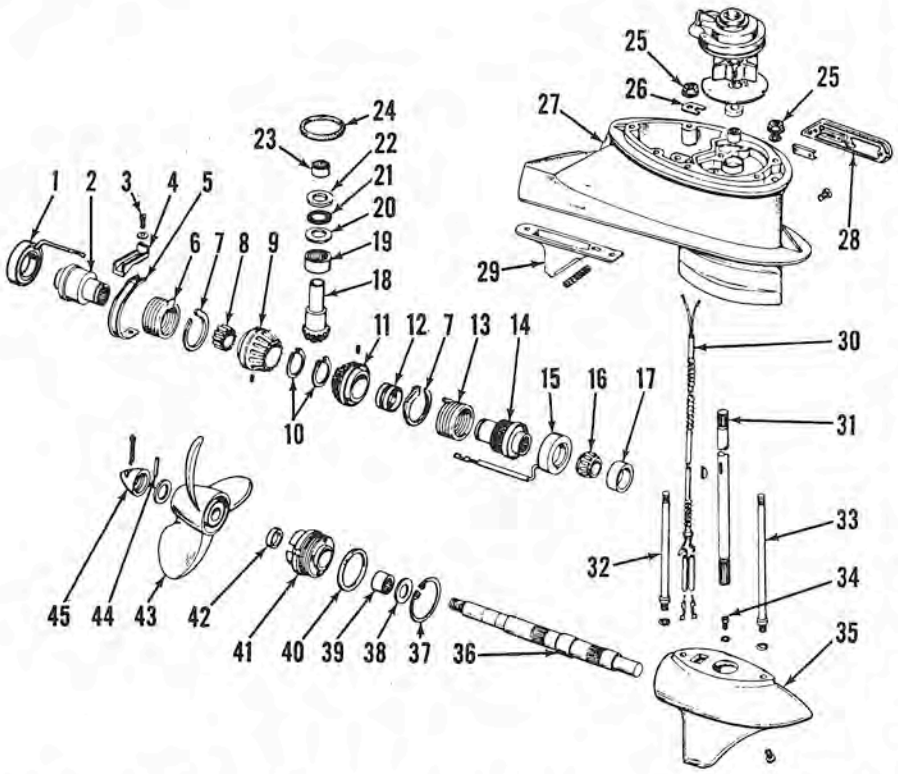


Fig. J116—Exploded view of gearcase and associated parts used on ELECTRAMATIC models.

1. Reverse electromagnet
2. Reverse hub
3. Screw
4. Retainer
5. Wire guard
6. Clutch coil
7. Spacer
8. Needle bearing
9. Reverse gear
10. Snap ring
11. Forward gear
12. Forward bushing
13. Clutch coil
14. Forward hub
15. Forward electromagnet
16. Bearing cone
17. Bearing cup
18. Drive pinion
19. Needle bearing
20. Washer
21. Thrust bearing
22. Washer
23. Needle bearing
24. "O" ring
25. Self-locking nut
26. Clip
27. Upper housing
28. Water inlet
29. Water inlet
30. Upper wiring
31. Drive shaft
32. Stud
33. Stud
34. Clamp screw
35. Lower gearcase
36. Propeller shaft
37. Snap ring
38. Thrust washer
39. Needle bearing
40. "O" ring
41. Gearcase head
42. Seal
43. Propeller
44. Drive pin
45. Propeller nut

about five inches apart. When long shaft unit is installed, engage cable support in upper set of ridges. Engage support in lower set of ridges on short shaft models, pulling slack into exhaust housing cover. The series of ridges form an exhaust gas seal.

To disassemble the gearcase, unbolt and remove the water pump and drive shaft, then remove and discard the two stud nuts (25—Fig. J116), retaining lower gearcase to upper housing. New self-locking nuts should be used when reassembling.

Invert the assembly and separate lower gearcase (35) from upper case (27). Tap lower gearcase lightly with a soft hammer, if necessary, to free lower case from its doweled position. Separate the housings 2-3 inches then disconnect the two coil leads from upper shift cable (30). The connectors are covered by an insulating rubber sleeve which must be pushed up the cable wires. After wiring is disconnected, the lower gearcase may be withdrawn.

Remove the four screws from rear surface of gearcase head (41). Thread puller legs into the threaded holes and pull the gearcase head, using a suitable puller. Remove snap ring (37), clamp screw (3) and coil wire retaining clamp (4). Insert a small punch into drive pin hole in propeller shaft and tap lightly on side of punch to pull propeller shaft slightly and dislodge the reverse electromagnet (1); then remove the electromagnet, being careful not to damage the coil lead.

Withdraw the propeller shaft (36) with reverse gear and hub assembly remaining on shaft. Tilt the pinion gear (18) toward the rear and withdraw through rear opening of gearcase; then tilt the gearcase and remove the forward gear and hub assembly.

check the current and continuity of the "Start" switch, remote control switches and remainder of wiring. Current should flow at battery voltage from the proper shift wire to a suitable ground on the motor when "START" switch is in "ON" position and the shift control lever is moved in the proper direction. There should be no continuity when "START" switch is in "OFF" position or when control lever is in neutral or the opposite directional setting.

To remove the lower unit, first remove engine cover and disconnect shift cable leads. Remove exhaust cover plate from side of motor, pull upper end of shift cable down, then unbolt and remove cable support from exhaust tube and cable. Be careful not to damage cable insulation. Lubricating the cable is an aid in disassembly and assembly.

After upper cable is free, remove propeller, then unbolt upper gearcase assembly from exhaust housing. Remove gearcase while feeding cable through support opening. When installing, note that two series of ridges are moulded into cable cover

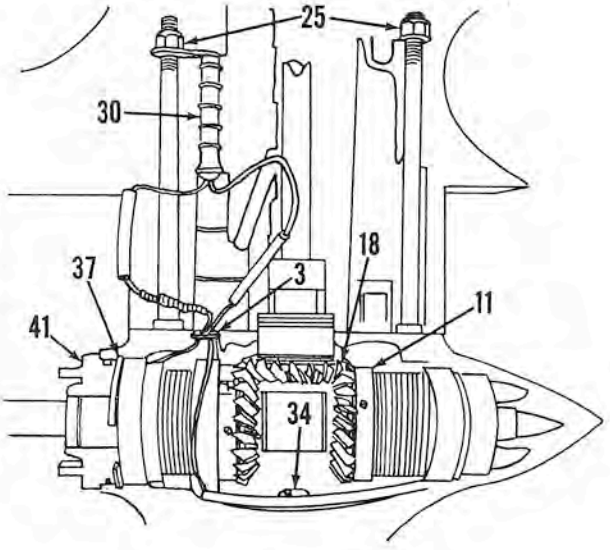


Fig. J117 — Cross section of the assembled ELECTRAMATIC gearcase. Refer to Fig. J116 for legend.

Reach down through drive pinion opening with a screwdriver and remove the screw (34) which retains the forward coil lead shield to bottom of gearcase. Refer to Fig. J117. After the screw is removed, insert an internal expanding gear puller into bearing cone (16—Fig. J116), and pull the bearing cone and forward electromagnet (15). Bearing cup (17) can be removed with an internal expanding puller and slide hammer, or by heating the gearcase (35) to approximately 200° F. and jarring cup from housing.

Forward and reverse drive gears (9 and 11) are identical, but should not be interchanged once they have been used. Clutch coils (6 and 13) and spacers (7) are also identical for forward and reverse drive units. The forward clutch hub (14) differs from the reverse hub (2) by being knurled on the friction surface. These two hubs must not be interchanged. The reverse driving gear (9) is fitted with a needle roller bearing (8), while forward gear contains a bushing (12). These must also be installed in the indicated positions.

The spacers (7) are wedge-shaped, and designed to fill up the space between the last winding of clutch coil and the pocket of the driving gear. The projecting lugs of coil and spacer are placed side by side to completely fill driving slot of gear. Apply one drop of Grade "D" LOCTITE to the threads of the retaining set screws and tighten the screws to a torque of 15-20 inch-pounds, using a torque wrench and suitable adapter. Forward bushing (12) should have a diametral clearance of 0.0003-0.0011 on the hub (14) and in the bore of gear (11). Because of the close clearances, extreme care must be used in assembly. Make sure parts are absolutely clean, and do not use force. Perfect alignment is required when assembling the gear and hub unit. Use a light oil as a lubricant when assembling the forward gear and bushing assembly; and needle bearing assembly grease or equivalent, when assembling the reverse gear. If clutch coil tends to bind, turn gear counter-clockwise while applying gentle pressure until gear is fully installed on hub. Install snap ring (10) with the sharp edge to the outside.

Assemble by reversing the disassembly procedure, making sure that the lead for forward electromagnet (15) properly fits in groove in bottom of gearcase and is secured with the retaining screw (34). Fit the guard (5) over tail of forward lead after gear units are installed. Use new self-locking stud nuts (25) and tighten to a torque of 18-20 ft.-lbs.

ELECTRICAL UNITS

Models with magneto ignition use a DC generator. Models with battery ignition use an alternator. Refer to Fig. J118 or J119 for wiring diagram, and to ELECTRICAL SYSTEM at end of JOHNSON section for overhaul data.

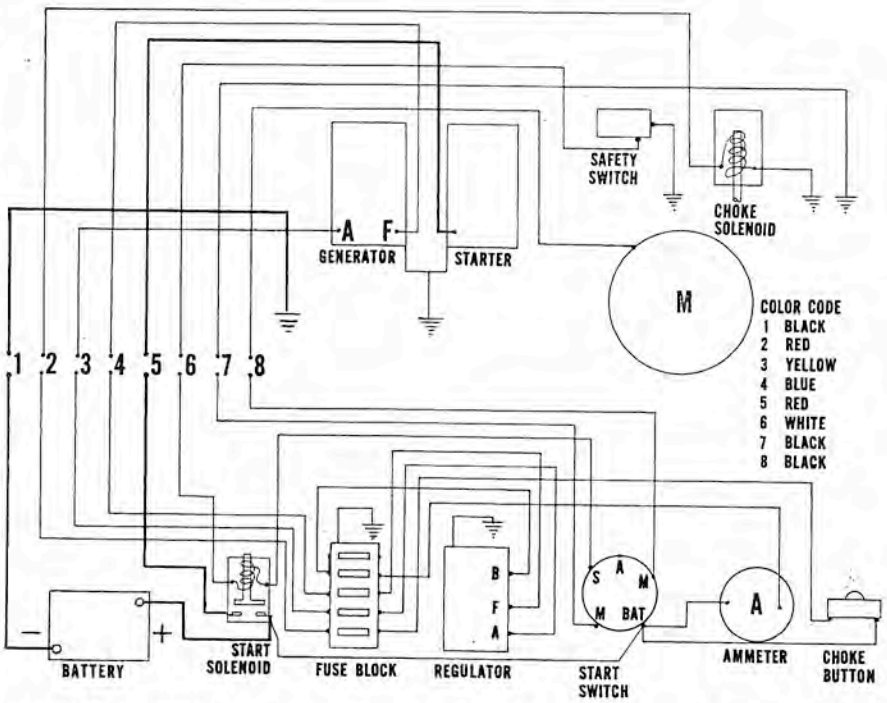


Fig. J118 — Wiring diagram used on V-4 models with magneto and DC generator.

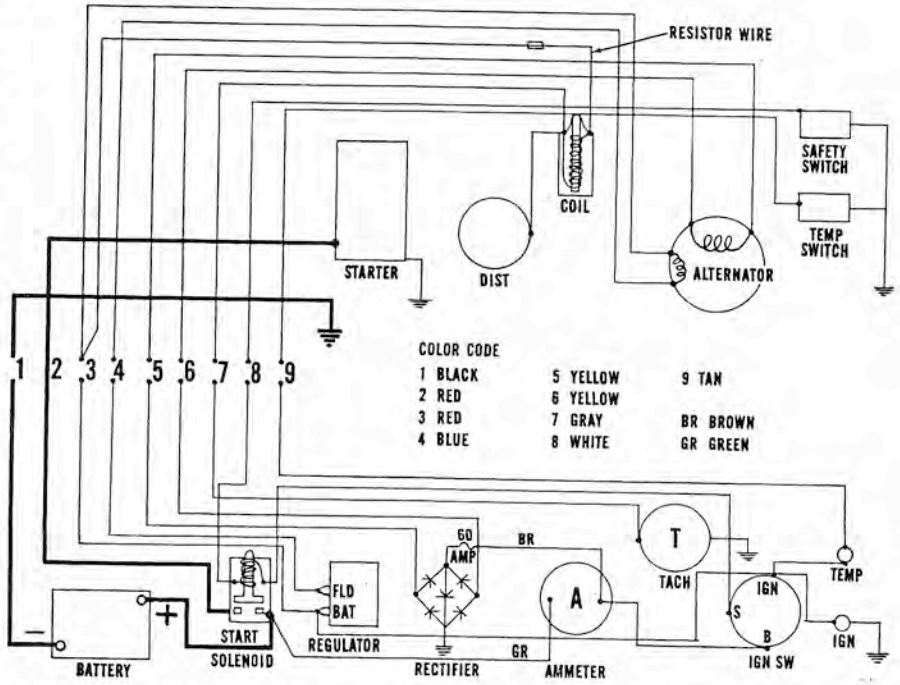


Fig. J119 — Wiring diagram used on four cylinder models with battery ignition and alternator.