

EVINRUDE

SERVICE • REPAIR HANDBOOK

1.5 to 35 hp • 1965-1978



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CHAPTER ONE

GENERAL INFORMATION

This service and repair handbook includes the latest service information for Evinrude 2-stroke outboard motors between 1.5 and 35 hp from 1965 through 1978.

MANUAL ORGANIZATION

Chapters One through Ten provide information for all 1.5 through 33 hp models through 1975. The Supplement at the end of this handbook covers all 1976-1978, 2-35 hp models (the 35 hp model was introduced in 1976). To service any late model motor, use the specifications in the supplement along with the step-by-step procedures in the pertinent chapters in the front of this book.

All procedures are given in the most practical sequence. Complex and lengthy operations are described step-by-step and are thoroughly illustrated. Installation and assembly procedures are given where they differ from removal and disassembly procedures. Notice is given at the head of each subsection requiring the use of special tools, and alternate methods or tools are identified where substitutes are possible. Italic notes of caution or operation emphasis appear throughout the text to ensure safety and working efficiency.

Each of the chapters gives detailed instructions for disassembly, inspection, reassembly, and operating adjustments of the components. These procedures will help you service a specific system, or overhaul the engine.

The exploded views illustrate the correct sequence of all parts as well as a listing of the parts needed for replacement. These can be of considerable help as a reference during disassembly and reassembly.

U.S. standards are used throughout and are accompanied by metric equivalents in parentheses where such reference might have practical value.

In many cases, measurement and performance specification ranges for assemblies, sub-assemblies, and parts overlap from model to model. Where possible, single values are given in the procedures that satisfy the specifications for all models. Specification ranges are tabulated for each specific model in the appropriate chapter.

MODELS

There are far too many models of Evinrude motors to list separate procedures for each. The various maintenance and overhaul functions are therefore referenced by engine horsepower output.

Usually the model number gives some clue as to the displacement of the engine and the year it was made. If in doubt about the year and model of your engine, refer any questions to a dealer. The horsepower for Johnson motors should be given somewhere on the motor cover or dealer plate.

Specifications and clearances are given in **Tables 1 through 8** at the end of the chapter.

SERVICE HINTS

The procedures used in this manual avoid the use of special tools and test equipment wherever possible. When necessary, special tools and test equipment are illustrated, either in actual use or alone. Special tools may be ordered and purchased through dealers. However, a well-equipped mechanic may find it possible to substitute similar tools or make new ones to fulfill a requirement.

Recommendations are occasionally made to refer a service task to a dealer or specialist in a particular field. In these cases, work will probably be done more quickly and economically than if the owner performs it personally.

When you order parts from the dealer or other parts distributor, always order by engine and chassis number. Write the numbers down and carry them in your wallet.

Throughout this manual, keep the following conventions in mind: "front" refers to the front of the boat, "left" and "right" or "port" and "starboard" refer to a person sitting in the boat facing forward. The abbreviation TDC means top-dead-center of a piston within a cylinder. BTDC means before top-dead-center; ATDC means after top-dead-center.

In procedural steps, the term "replace" means to discard a defective part and replace it with a new one. "Overhaul" means to remove, disassemble, inspect, measure, repair, or replace defective parts, reassemble, and install major systems and parts.

All dimensions and capacities are expressed in units familiar to an American mechanic. Metric measurements may also be given, as appropriate. Metric tools are not required to work on the various engines.

The terms **NOTE**, **CAUTION**, and **WARNING** have specific meaning in this book. A **NOTE** provides additional information to make a step or procedure easier or clearer. Disregarding a **NOTE** could cause inconvenience, but would not cause damage or personal injury.

A **CAUTION** emphasizes areas where equipment damage could result. Disregarding a **CAUTION** could cause permanent mechanical damage; however, personal injury is unlikely.

A **WARNING** emphasizes areas where personal injury or even death could result from negligence. Mechanical damage may also occur. **WARNINGS** are to be taken seriously. In some cases serious injury or death has been caused by mechanics disregarding similar warnings.

STANDARD PRACTICES

Experienced mechanics observe certain practices as a matter of course. Some of the following items are precautionary, others provide hints.

1. Disconnect battery positive (+) cable before repair operations in the vicinity of electrical connections, or those requiring electrical disconnections.
2. Be aware of flame or spark sources when working near a charging battery, or other areas involving volatile fluids, such as the fuel system.
3. Use the proper cleaning solution. External parts can be cleaned with solvent, unless they include rubber. Rubber parts can be cleaned with alcohol (or clean hydraulic brake fluid). Hot water and detergent is an excellent cleaning solution for the internal metal parts.
4. Tag all similar internal parts for location, and mark all mating parts for position. Record number and thickness of any shims upon disassembly.
5. Protect finished surfaces from physical damage and corrosion.
6. Frozen or very tight bolts and screws can often be loosened by soaking with penetrating oil then sharply striking the bolt head a few times with a hammer and punch (or screwdriver for screws). Use heat as a last resort, and be cautious of warping, removing temper, or melting any adjacent parts.

7. No parts, except those assembled with a "press fit," require unusual force during assembly. If you encounter difficulty in disassembling or assembling a part, determine the reason before proceeding. **Be patient.**

8. Cover all openings after removing parts or subassemblies to keep dirt, small tools and parts, etc., from falling in.

9. When assembling 2 parts, start all fasteners required, then tighten evenly.

10. If a part requires replacement, always take old parts to the dealer, when practical, for comparison to replacement part.

SAFETY HINTS

Professional mechanics can work for years and never sustain a serious injury. If you observe a few rules of common sense and safety, you can enjoy many safe hours servicing your own engine. You could hurt yourself or damage the motor if you ignore these rules.

1. Never use gasoline as a cleaning solvent.
2. Never smoke or use a torch in the vicinity of flammable liquids such as cleaning solvent in open containers.
3. Never smoke or use a torch in an area where batteries are being charged. Highly explosive hydrogen gas is formed during the charging process.
4. If welding or brazing is required on the engine, remove the fuel tank to a safe distance, at least 50 feet away. Welding on gas tanks requires special safety procedures and must be performed only by someone skilled in the process.
5. Use the proper sized wrenches to avoid damage to nuts and injury to yourself.
6. When loosening a tight or stuck nut, be guided by what would happen if the wrench should slip. Protect yourself accordingly.
7. Keep your work area clean and uncluttered.
8. Wear safety goggles during all operations involving drilling, grinding, or use of a cold chisel.
9. Never use worn tools.
10. Keep a fire extinguisher handy and be sure it is rated for gasoline and electrical fires.

TOOLS

Shop Tools

For proper servicing, you will need an assortment of ordinary handtools. As a minimum, these include:

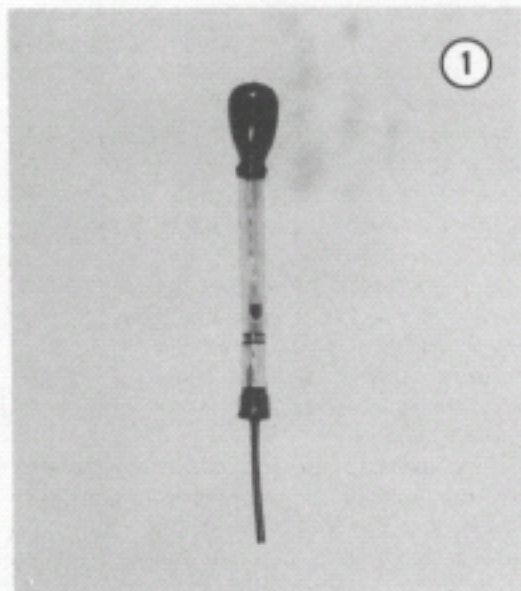
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| 1. Combination wrenches | 7. Phillips screwdrivers |
| 2. Sockets | 8. Slot (common) screwdrivers |
| 3. Plastic mallet | 9. Feeler gauges |
| 4. Small hammer | 10. Spark plug gauge |
| 5. Snap ring pliers | 11. Spark plug wrench |
| 6. Pliers | |

Special tools necessary are shown in the chapters covering the particular repair in which they are used.

Electrical system servicing requires a voltmeter, ohmmeter, or other device for determining continuity, and a hydrometer for battery equipped engines.

Advanced tune-up and troubleshooting procedures require a few more tools.

1. *Hydrometer (Figure 1)*. This instrument measures state of charge of the battery, and tells much about battery condition. Such an instrument is available at any auto parts store and through most larger mail order outlets. A satisfactory one costs less than \$3.



2. **Multimeter or VOM (Figure 2).** This instrument is invaluable for electrical system troubleshooting and service. A few of its functions may be duplicated by locally fabricated substitutes, but for the serious hobbyist, it is a must. Its uses are described in the applicable sections of this book. Prices start at around \$10 at electronics hobbyist stores and mail order outlets.

3. **Compression gauge (Figure 3).** An engine with low compression cannot be properly tuned and will not develop full power. A compression gauge measures engine compression. The one shown has a flexible stem, which enables it to reach cylinders where there is little clearance. Inexpensive ones start around \$3, available at auto accessory stores or by mail order from large catalog order firms.

4. **Impact driver (Figure 4).** This tool might have been designed with the mechanic in mind.

It makes removal of engine cover screws easy, and eliminates damaged screw slots. Good ones run about \$15 at larger hardware stores.

5. **Ignition gauge (Figure 5).** This tool measures point gap. It also has round wire gauges for measuring spark plug gap.

A few special tools may also be required for major engine service. They are available at the dealer.

EXPENDABLE SUPPLIES

Certain expendable supplies are also required. These include grease, oil, gasket cement, wiping rags, cleaning solvent, and distilled water. Ask your dealer for the special locking compounds and silicone lubricants which make maintenance simpler and easier. Solvent is available at most service stations and distilled water for the battery is available at most supermarkets.

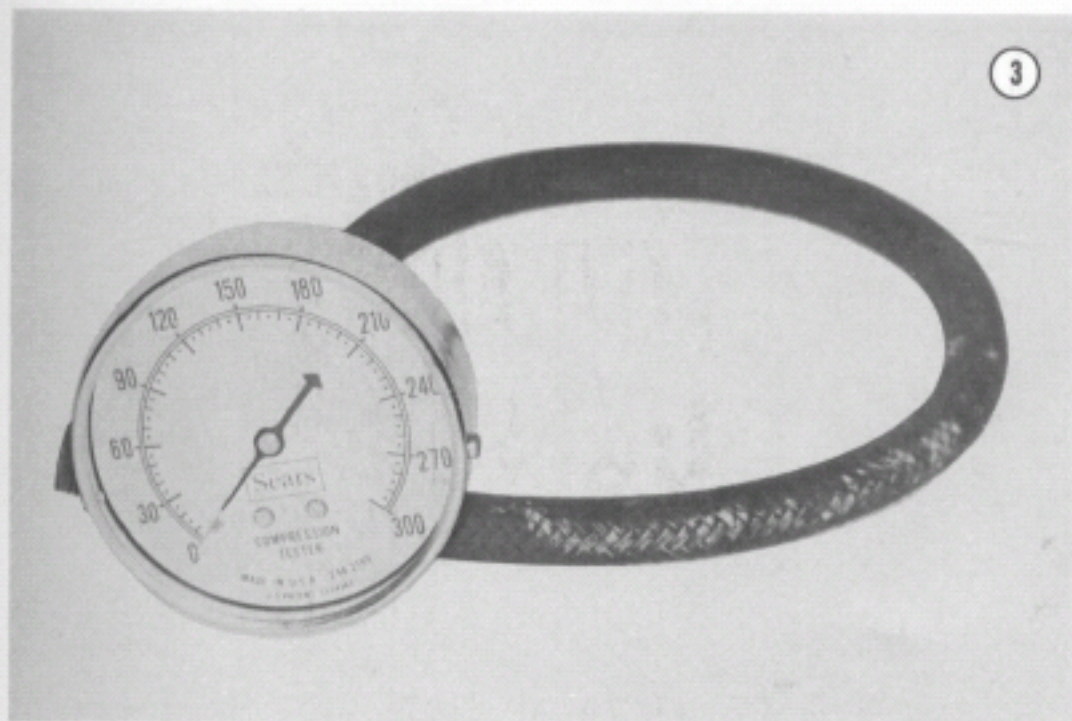
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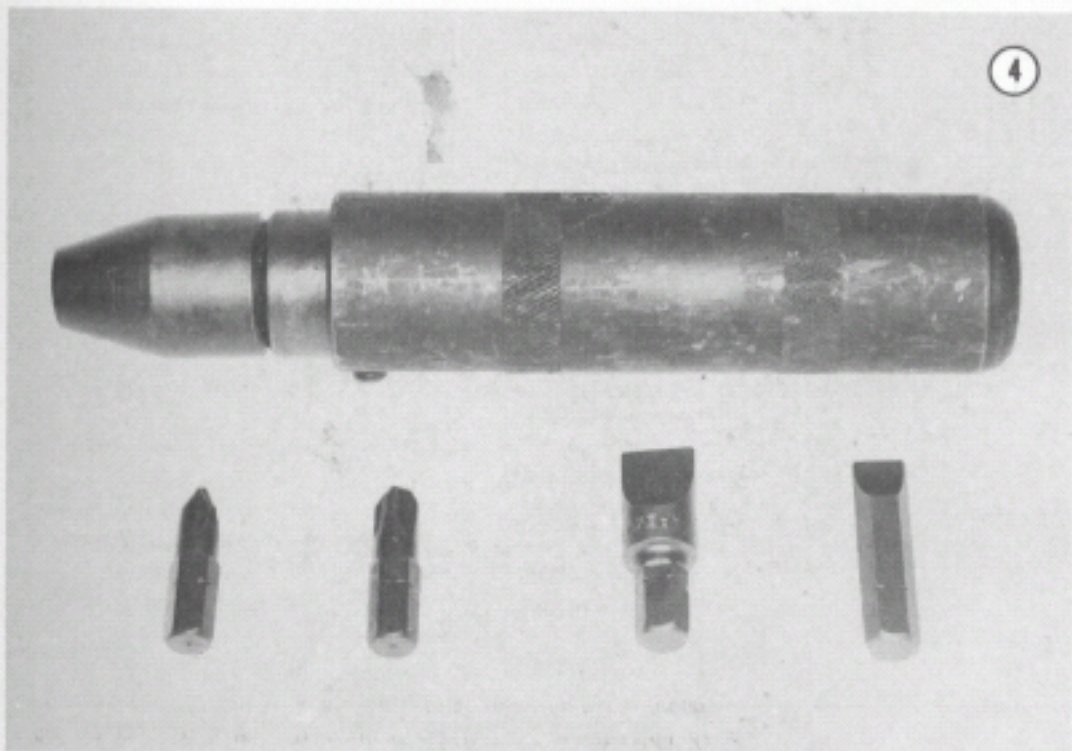
GENERAL INFORMATION

1

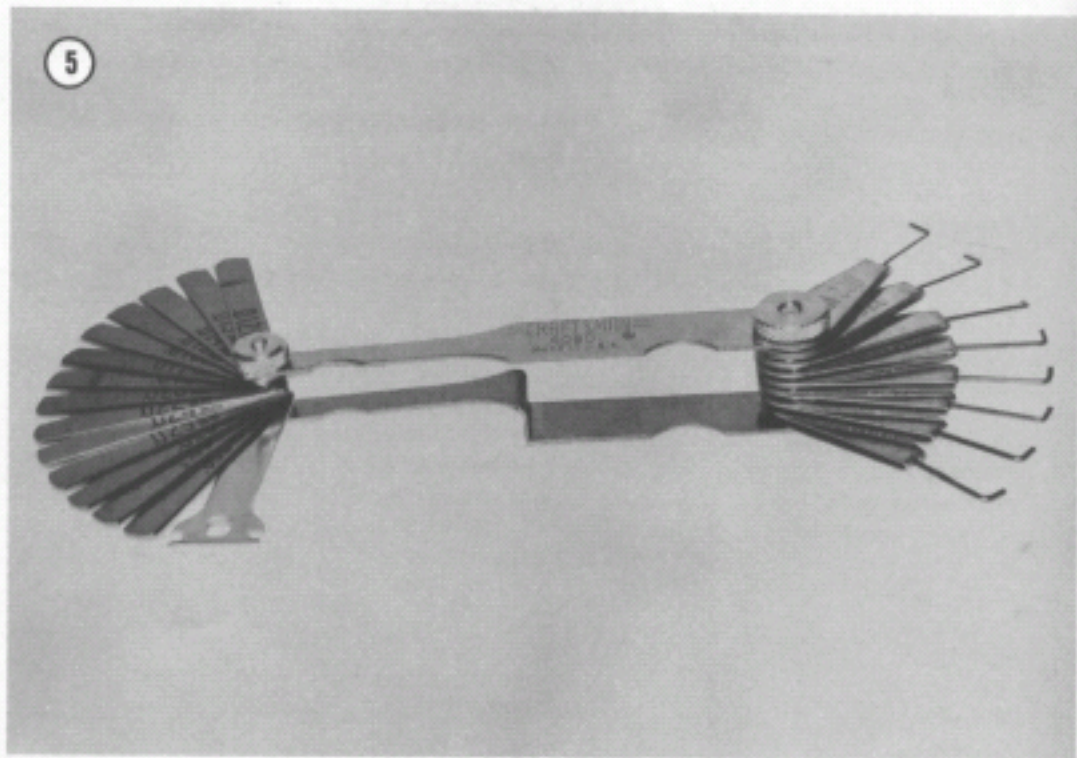
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GENERAL INFORMATION

Table 1 SPECIFICATIONS AND CLEARANCES — 1½ AND 2 HP

GENERAL

*Horsepower	1½ hp @ 4,000 rpm 2 hp at 4,500 rpm for 1971 and later
Operating range	3,500 to 4,500 rpm
Test tank	3,900 to 4,200 rpm
Engine type	Single cylinder, 2-cycle
Bore and stroke	1-9/16 in. bore x 1-3/8 in. stroke
Piston displacement	2.64 cu. in.
Crankshaft size	
Top journal	0.7502 - 0.7497 in.
Bottom journal	0.7502 - 0.7497 in.
Connecting rod crank pin	0.6690 - 0.6685 in.
Carburetion	Single barrel, float feed, high and low-speed adjustments
Float level setting	Flush with casting
Inlet needle seat	0.065 - 0.062 in. for 1968 0.050 - 0.053 in. Use a No. 55 drill as gauge
Cooling system	Centri-matic cooling
Propeller gear ratio	12:25
Propeller	7¼ x 4½ in.
Speed control	Single lever, synchronized throttle and spark
Starter	Manual
Ignition	Flywheel magneto
Spark plug	AC-M42K, Champion J4J, Auto-Lite A21X - 14mm (1½ hp)
Spark plug gap	0.030 in.
Spark plug torque	17½ - 20½ ft.-lb.
Breaker point gap	0.020 in.
Condenser	0.18 to 0.22 µfd.
Spark plug	AC-M44C, Champion J6J, 14mm (2 hp)

POWER HEAD

Piston ring gap	0.015 - 0.005 in.
Piston ring groove	0.0035 - 0.001 in., 0.0040 - 0.0020 in. for 1002 1970 and later
Cylinder and piston	0.0005 - 0.0043 in., 0.0025 - 0.0013 in. for 1802 1968 Roller
Crankshaft	
Upper	Needle bearing
Lower	Needle bearing
Connecting rod	
Piston end	0.0011 - 0.0004 in.
Crankshaft end	Needle bearing

(continued)

* Horsepower established at sea level. Allow 2% reduction per 1000' above sea level.

Table 1 SPECIFICATIONS AND CLEARANCES — 1½ AND 2 HP (continued)

LOWER UNIT

Drive shaft and bushing in gearcase	0.0025 - 0.0010 in., 0.0028 - 0.0010 in. for 1002 1970 and later
Gearcase head and propeller shaft	0.0020 - 0.0005 in., 0.0022 - 0.0007 in. for 1002 1970 and later
Propeller on shaft	0.0055 - 0.003 in., 0.0057 - 0.0032 in. for 1002 1970 and later
Bushing-to-propeller shaft	0.0022 - 0.007 in., 1970 and later

TORQUE CHART

POWER HEAD

Flywheel unit	22 - 25 ft.-lb.
Connecting rod screws	60 - 66 in.-lb.
Cylinder head screws	60 - 80 in.-lb.
Manifold to crankcase screws	60 - 80 in.-lb.
Bearing housing-to-cylinder screws	60 - 80 in.-lb.
Spark plug	17½ - 20½ ft.-lb.

LOWER UNIT

Pull required at propeller shaft to tilt up lower unit	11 - 14 lb.
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Note: See Table 9 for tightening torques of standard screws.

GENERAL INFORMATION

Table 2 SPECIFICATIONS AND CLEARANCES — 3 HP

GENERAL

*Horsepower	3 hp @ 4,000 rpm
Operating range	3,500 hp @ 4,500 rpm
Test tank	3,850 rpm
Engine type	2-cylinder, 2 cycle, 180° crank
Bore and stroke	1-9/16 in. bore x 1-3/8 in. stroke
Piston displacement	5.28 cu. in.
Crankshaft size	
All journals	0.6854 - 0.6849 in.
Connecting rod crank pin	0.6255 - 0.6250 in.
Carburetion	Single barrel, float feed, high and low-speed adjustments, manual choke
Float level	Flush with casting
Inlet needle seat	0.065 - 0.062 in. Use a No. 52 drill as gauge
Cooling system	Centri-matic (combination positive displacement and centrifugal pump)
Propeller gear ratio	17:28 Lightwin/Ducktwin 12:25 Yachtwin
Propeller	Yachtwins— Standard - 8 in. diameter x 5½ in. pitch, 3 blade Optional - 8 x 4½ in., 3 blade Lightwins— 6½ in. diameter x 6¼ in. pitch, 2 blades
Speed control	Single lever, synchronized throttle and spark
Starter	Manual, self-rewinding
Ignition	Flywheel magneto
Spark plug	AC-M42K, Champion J4J, 14mm
Spark plug gap	0.030 in.
Spark plug torque	17½ - 20½ ft.-lb.
Breaker point gap	0.020 in.
Condenser	0.18 to 0.22 µfd.

POWER HEAD

Piston ring gap	0.015 - 0.005 in.
Piston ring groove	0.0035 - 0.001 in.
Cylinder and piston	0.0025 - 0.0013 in.
Crankshaft	
Upper	0.0023 - 0.0013 in.
Center	0.0023 - 0.0013 in.
Lower	0.0023 - 0.0013 in.
Connecting rod	
Piston end	0.0011 - 0.0004 in.
Crankshaft end	0.0017 - 0.0007 in.

(continued)

*Horsepower established at sea level. Allow 2% reduction per 1000' above sea level.

Table 2 SPECIFICATIONS AND CLEARANCES — 3 HP (continued)

LOWER UNIT	Weedless Gearcase	Standard Gearcase
Drive shaft and bushing in gearcase	0.003 - 0.001 in.	0.0025 - 0.0010 in. 0.0018 - 0.005 in. 1966
Gear housing cap	0.0015 - 0.0005 in.	0.0020 - 0.0005 in. 0.0018 - 0.0005 in. 1966
Propeller on shaft	0.0043 (Hub) - 0.0023 in. 0.003 in.	0.0055 - 0.003 in. 0.0053 - 0.003 in. 1966

TORQUE CHART

POWER HEAD

Flywheel nut	30 - 40 ft.-lb.
Connecting rod screws	60 - 66 in.-lb.
Cylinder head screws	60 - 80 in.-lb.
Crankcase to cylinder screws— upper, center, lower	60 - 80 in.-lb.
Spark plug	17½ - 20½ ft.-lb.
Pull required at propeller shaft to tilt up lower unit	12 - 15 lb.
Starter housing	36 - 60 in.-lb. (3 - 5 ft.-lb.) 1966

Note: See Table 9 for tightening torques of standard screws.

GENERAL INFORMATION

Table 3 SPECIFICATIONS AND CLEARANCES — 4 HP

GENERAL

*Horsepower	4 hp @ 4,500 rpm
Operating range	4,000 to 5,000 rpm
Test tank	4,100 rpm 4,100 rpm. Part No. 316021 for 4506 4,550 rpm. Part No. 317738 for 4536
Engine type	2-cylinder, 2 cycle 180° crank
Bore and stroke	1-9/16 in. bore x 1-3/8 in. stroke
Piston displacement	5.28 cu. in.
Crankshaft size	
Top journal	0.7520 - 0.7515 in.
Center journal	0.6854 - 0.6849 in.
Bottom journal	0.6854 - 0.6849 in.
Connecting rod crank pin	0.6255 - 0.6250 in.
Carburetion	Single barrel, float feed, high and low-speed adjustments, manual choke
Float level setting	Flush with casting
Inlet needle seat	0.053 - 0.050 in. Use a No. 55 drill as gauge
Cooling system	Centri-matic (combination positive displacement and centrifugal pump)
Propeller gear ratio	17:28 Weedless 12:25 Standard
Propeller drive pin	Part No. 316558 1/8 x 1.234 in. stainless steel
Propeller	Standard 7 1/2 in. dia. x 6 in. pitch 3 blade LEXAN or 8 in. dia. x 5 1/2 in. pitch, 3 blade, 8 x 4 1/2 x 3 optional Weedless 6 1/4 in. dia. x 6 in. pitch, 2 blades LEXAN 6 1/4 x 5 1/2 x 3 optional
Speed control	Single lever, synchronized throttle and spark
Starter	Eas-A-Matic, self-rewinding
Ignition	Flywheel magneto
Spark plug	AC-M44C, Champion J6J, 14mm 1969 to 1970 ACM42K, J4J
Spark plug gap	0.030 in.
Spark plug torque	17 1/2 - 20 1/2 ft.-lb.
Breaker point gap	0.020 in.
Condenser	0.18 to 0.22 µfd.

(continued)

* Standard length lower unit.

Table 3 SPECIFICATIONS AND CLEARANCES — 4 HP (continued)

POWER HEAD

Piston ring gap	0.015 - 0.005 in.
Piston ring groove	0.0040 - 0.0020 in. 1969, 0.0035 - 0.0010
Cylinder and piston	0.0020 - 0.0008 in. 1969, 0.0049 - 0.0014
Crankshaft	
Upper	Needle bearings
Center	0.0023 - 0.0013 in.
Lower	0.0023 - 0.0013 in.
Connecting rod	
Piston end	0.0011 - 0.0004 in.
Crankshaft end	0.0017 - 0.0007 in.

LOWER UNIT

	Weedless	Standard
Standard		
Pinion and bushing in gearcase		0.0018 - 0.0005 in.
Weedless		
Drive shaft and bushing in gearcase	0.003 - 0.001 in.	
Gearcase head and bushing assembly	0.0015 - 0.0005 in.	0.0022 - 0.0007 in.
Propeller on shaft		
1970, 0.0065 - 0.0030	0.0053 - 0.0020 in.	0.0067 - 0.0022 in.
1971, 0.0065 - 0.0020	0.0043 - 0.0023 in. 1969	0.0055 - 0.003 in. 1969
Gearcase bushing to propeller shaft		0.0022 - 0.0007 in. 0.0020 - 0.0008 in. 1971

TORQUE CHART**POWER HEAD**

Flywheel nut	30 - 40 ft.-lb.
Connecting rod screws	60 - 66 in.-lb.
Cylinder head screws	60 - 80 in.-lb.
Crankcase to cylinder screws—	
upper, center lower	60 - 80 in.-lb.
Spark plugs	17½ - 20½ ft.-lb.
Pull required at propeller shaft to tilt up lower unit	12 - 15 ft.-lb.

Note: See Table 9 for tightening torques of standard screws.

Table 4 SPECIFICATIONS AND CLEARANCES — 5 AND 6 HP

GENERAL

		Model Nos.
*Horsepower	5 hp @ 4,000 rpm	5602-5803
	6 hp @ 4,500 rpm	6602-6805
Operating range	3,500 - 4,500 rpm	
Tank test	4,150 rpm	
Engine type	2-cylinder, 2-cycle 180° crank	
Bore and stroke	1-15/16 in. bore x 1-1/2 in. stroke	
Piston displacement	8.84 cu. in.	
Crankshaft size		
Top journal	0.8085 - 0.8080 in.	
Center journal	0.8080 - 0.8075 in.	
Bottom journal	0.8085 - 0.8080 in.	
Connecting rod crank pin	0.6690 - 0.6685 in.	
Carburetion	Single barrel, float feed, low-speed adjustment	
Float level setting	Flush with rim of casting	
Carburetor orifice plug	Hole size 0.041 in.	
Inlet needle seat	0.053 to 0.050 in. Use a No. 55 drill as gauge	
Cooling system	Centri-Matic (combination positive displacement and centrifugal pump)	
Propeller gear ratio	12:25	
Propeller	8 in. dia. x 7½ in. pitch, 3 blade	
Speed control	Single lever, synchronized throttle and spark	
Starter	Manual, self-rewinding	
Ignition	Flywheel magneto	
Spark plug	AC-M42K, Champions J4J	
Spark plug gap	0.030 in.	
Spark plug torque	17½ - 20½ ft.-lb.	
Breaker point gap	0.020 in.	
Condenser	0.18 - 0.22 µfd.	

POWER HEAD

Piston ring gap	0.015 - 0.005 in.
Piston ring groove clearance	0.0035 - 0.0010 in.
Cylinder and piston	0.003 - 0.0018 in.
Crankshaft bushings	
Upper	0.0020 - 0.0010 in.
Center	0.0025 - 0.0015 in.
Lower	0.0020 - 0.0010 in.
Crankshaft end-play	0.010 - 0.002 in., 1966 0.007 in. max.
Connecting rod bearings	
Piston end	0.0010 - 0.0003 in.
Crankshaft end	Needle bearing 1966 0.0010 - 0.0003 in., roller bearing

(continued)

* Standard length lower unit.

Table 4 SPECIFICATIONS AND CLEARANCES — 5 AND 6 HP (continued)

LOWER UNIT

Gearcase head and propeller shaft	0.0018 - 0.0005 in.
Driveshaft	0.0025 - 0.0010 in.
Propeller shaft bushing—front	0.0020 - 0.0005 in., 1966 0.0020 - 0.0008 in.
Propeller hub on shaft	0.0055 - 0.0025 in. 0.0033 - 0.0010 in., 1966

TORQUE CHART

POWER HEAD

Flywheel nut	40 - 45 ft.-lb.
Connecting rod screws	60 - 66 in.-lb.
Cylinder head screws	60 - 80 in.-lb.
Crankcase to cylinder screws	
Upper	60 - 80 in.-lb.
Center	60 - 80 in.-lb.
Lower	60 - 80 in.-lb.
Spark plugs	17½ - 20½ ft.-lb.

LOWER UNIT

Pull required at propeller shaft for tilt up lower units*	12 - 15 lb.
Slip clutch propeller	45 - 55 ft.-lb.

Note: See Table 9 for tightening torques on standard screws.

GENERAL INFORMATION

Table 5 SPECIFICATIONS AND CLEARANCES — 9.5 Hr

GENERAL

*Horsepower	9½ hp @ 4,500 rpm
Operating range	4,000 to 5,000 rpm
Tank test	4,400 rpm
	Part No. 379673
Engine type	2-cylinder, 2-cycle, 180° crank
Bore and stroke	2-5/16 in. bore x 1-13/16 in. stroke
Displacement	15.2 cu. in.
Crankshaft size	
Top journal	0.8125 - 0.8120 in.
Center journal	0.8132 - 0.8127 in., 0.8118 - 0.8113 in. 1966
Bottom journal	0.8125 - 0.8120 in.
Connecting rod crank pin	0.8132 - 0.8127 in.
	0.8118 - 0.8113 in., 1966
Cooling system	Centri-matic (combination positive displacement and centrifugal pump) thermostatically controlled
Carburetion	Float feed, low-speed adjustment, and manual choke
Float level setting	Parallel with face of casting
Carburetor orifice plug	Hole size 0.048 in. Use a No. 56 drill as gauge
Inlet needle seat	0.053 - 0.050 in. Use a No. 55 drill as a gauge
Propeller gear ratio	13:23
Propeller	3 blade, 8½ in. dia. x 8 in. pitch
Speed control	On steering handle, synchronized throttle and spark
Gear shift control	Forward, neutral and reverse
Starter	Manual self rewind
Ignition	Flywheel magneto
Spark plug	AC-M42K, Champion J4J - 14mm
Spark plug gap	0.030 in.
Spark plug torque	17½ - 20½ ft.-lb.
Breaker point gap	0.020 in.
Condenser	0.18 - 0.22 µfd

POWER HEAD

Piston and wrist pin—loose end	0.0005 - 0.0000 in.
Piston ring gap	0.017 - 0.007 in.
Piston ring groove clearance	0.0035 - 0.001 in.
Cylinder and piston	0.0050 - 0.0035 in.
	0.0045 - 0.003 in., 1966
Crankshaft bearings	
Upper	Needle bearing, roller bearing
Center	Needle bearing, roller bearing
Lower	Needle bearing, roller bearing

(continued)

* Standard length lower unit.

Table 5 SPECIFICATIONS AND CLEARANCES — 9.5 HP (continued)

POWER HEAD (continued)

Connecting rod bearings	
Piston end	Needle bearing, roller bearing
Crankshaft end	Needle bearing, roller bearing

LOWER UNIT

Gearcase head and propeller shaft	0.0020 - 0.0010 in.
Driveshaft—upper	0.0020 - 0.0003 in.
Driveshaft—lower	0.0030 - 0.0013 in.
Propeller on shaft	0.009 - 0.007 in.
Front gear to gearcase bearing	0.0022 - 0.0010 in.
Front gear to front bushing	Press fit
Front gear bushing to propeller shaft	0.0015 - 0.0005 in.
Rear reverse gear to rear bushing	0.0020 - 0.0005 in.
Rear gear bushing to propeller shaft	0.0015 - 0.0005 in.

TORQUE CHART

POWER HEAD

Flywheel nut	40 - 45 ft.-lb.
Connecting rod screws	90 - 100 in.-lb.
Cylinder head screws	96 - 120 in.-lb.
Crankcase to cylinder screws	
Upper	120 - 145 in.-lb.
Center	120 - 145 in.-lb.
Lower	120 - 145 in.-lb.
Spark plugs	17½ - 20½ ft.-lb.

LOWER UNIT

Side mounts nuts—	150 - 170 in.-lb.
upper and lower	(12 - 14 ft.-lb.)
Slip clutch propeller	70 ft.-lb.

Note: See Table 9 for tightening torques of standard screws.

Table 6 SPECIFICATIONS AND CLEARANCES — 9.9 AND 15 HP

GENERAL

Horsepower	9.9 hp @ 5,000 rpm
Operating range	4,500 to 5,500 rpm
Tank test	5,400 rpm
Engine type	2-cylinder, 2-cycle 180° crank
Bore and stroke	2.188 in. bore x 1.760 in. stroke
Piston displacement	13.20 cu. in.
Crankshaft size	
Top journal	0.8757 - 0.8752 in.
Center journal	0.8125 - 0.8120 in.
Bottom journal	0.8125 - 0.8120 in.
Connecting rod crank pin	1.06350 - 1.06300 in.
Carburetion	Single barrel, float feed, fixed high speed adjustable low-speed, manual choke
High speed orifice plug	Identification Number 51 Check with No. 0.051 dia. drill
Cooling system	Centri-matic (combination positive displacement and centrifugal pump) Thermostatically controlled
Propeller gear ratio	12:29
Propeller supplied with motor	3 blade, 9½ in. dia. x 10 in. pitch
Propeller options	3 blade, 10 in. dia. x 5 in. pitch 2 blade weedless 9 in. dia. x 10 in. pitch
Speed control	On steering handle Remote control available
Gear shift control	Forward, neutral and reverse
Electrical system (Electric start models only)	5 amp flywheel alternator
Starter	Manual self-winding Electric - 12 volt, and rope
Starter amperage draw while cranking	55 amps max.
Ignition	Low tension magneto
Spark plug	Champion LJ7, 14mm
Spark plug gap	0.030 in.
Spark plug torque	17½ - 20½ ft.-lb.
Breaker point	Gap 0.020 in.
Condenser	0.25 - 0.29 µfd
POWER HEAD	
Piston ring gap	0.015 - 0.005 in.
Piston ring groove clearance, lower	0.0035 - 0.0025 in.
Piston pin to piston — loose end	0.0005 - 0.0000 in.
Cylinder and piston	0.0053 - 0.0040 in.
Crankshaft end-play	Controlled by lower journal bearing

(continued)

Table 6 SPECIFICATIONS AND CLEARANCES — 9.9 AND 15 HP (continued)

LOWER UNIT

Propeller shaft in front gear bushing	0.0087 - 0.0002 in.
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TORQUE CHART

POWER HEAD

Flywheel nut	45 - 50 ft.-lb.
Connecting rod screw	48 - 60 in.-lb. (4 - 5 ft.-lb.)
Cylinder head screws	145 - 170 in.-lb. (12 - 14 ft.-lb.)
Crankcase to cylinder screws — upper, center and lower	145 - 170 in.-lb. (12 - 14 ft.-lb.)
Electric starter through bolts	30 - 40 in.-lb.
Electric starter pinion nut	150 - 170 in. lb.
Spark plug	17½ - 20½ ft.-lb.
Manual starter assembly screw	24 - 26 ft.-lb.

LOWER UNIT

Upper mounts	60 - 80 in.-lb. (5 - 7 ft.-lb.)
Pilot shaft to steering bracket screws	60 - 80 in.-lb. (5 - 7 ft.-lb.)
Slip clutch propeller	85 ft.-lb. min.
*Pull at propeller shaft for tilt up	30 - 40 lbs.
*Pull at propeller to overcome reverse lock	100 - 200 lbs.

Note: See Table 9 for tightening torques of standard screws.

* Standard length lower unit.

GENERAL INFORMATION

Table 7 SPECIFICATIONS AND CLEARANCES — 18 AND 25 HP

GENERAL

Horsepower	25 hp @ 5,500 rpm (18 hp @ 4,500 rpm)
Operating range	5,000 to 6,000 rpm (4,000 to 5,000 rpm)
Tank test	4,900 rpm
Engine type	2-cylinder, 2-cycle, 180° crank
Bore and stroke	2½ in. bore x 2¼ in. stroke
Piston displacement	22.0 cu. in.
Crankshaft size	
Top journal	1.0000 - 0.9995 in.
Center journal	1.0000 - 0.9995 in.
Bottom journal	1.0000 - 0.9995 in.
Connecting rod crank pin	1.0005 - 1.0000 in.
Carburetion	Single barrel, float feed, low-speed adjustment
Float level setting	Parallel to and 1/16 in. above gasket surface
Carburetor orifice plug	0.072 in. (0.068 for 18 hp)
Inlet needle seat	0.065 - 0.062 in. Use a No. 52 drill as a gauge
Cooling system	Centri-matic (combination positive displacement and centrifugal pump) thermostatically controlled by-pass system
Propeller gear ratio	12:21
Propeller drive pin	3/16 x 1 25/64 in., stainless steel
Propeller, supplied with motor	3 blade, 9 in. dia. x 10 in. pitch
Propeller, optional	3 blade, 9 in. dia. x 9 in. pitch
Propeller, optional	3 blade, 9 in. dia. x 10 in. pitch weedless
Speed control	Twist grip, synchronized throttle and spark
Gear shift control	Forward, neutral and reverse
Starter	12 volt electric key and automatic rewind rope, manual for 18 hp
Starter amperage draw when cranking	120 amperes maximum
Ignition	Low tension magneto
Spark plug	Champion UJ4J, - 14mm
Spark plug gap	0.030 in.
Spark plug torque	17½ - 20½ ft.-lb.
Breaker point gap	0.020 in.
Condenser	0.25 - 0.29 µfd
Driver coil resistance	0.80 ± 0.05 ohm

POWER HEAD

Piston and wrist pin — loose end	0.0005 - 0.0000 in.
Piston ring gap	0.017 - 0.07 in.
Piston ring groove clearance	0.0040 - 0.0020 in.
Cylinder and piston	0.0048 - 0.0033 in.
Crankshaft bearings	
Upper	Roller type
Center	Needle type
Lower	Roller type

(continued)

Table 7 SPECIFICATIONS AND CLEARANCES — 18 AND 25 HP (continued)

POWER HEAD (continued)

Crankshaft end-play	0.023 - 0.009 in.
Connecting rod bearings	
Piston end	Needle type
Crankshaft end	Needle type

POWER HEAD

Driveshaft — upper	Needle bearing
Propeller shaft in front gear bushing	0.0015 - 0.0005 in.
Gearcase head and propeller shaft	0.002 - 0.001 in.
Driveshaft pinion in gearcase	0.0025 - 0.0015 in.
Propeller shaft to reverse gear bushing	0.0015 - 0.0005 in.
Front gear to gearcase bearing	0.0060 - 0.0045 in.
Rear reverse gear to bushing	0.002 - 0.0005 in.

TORQUE CHART

POWER HEAD

Flywheel nut	40 - 45 ft.-lb.
Connecting rod screws	180 - 186 in.-lb.
Cylinder head screws	96 - 120 in.-lb.
Crankcase to cylinder screws	
Upper	110 - 130 in.-lb.
Center	120 - 130 in.-lb.
Lower	110 - 130 in.-lb.
Starter housing	96 - 120 in.-lb. (8 - 10 ft.-lb.)
Spark plug	17½ - 20½ ft.-lb.

LOWER UNIT

Lever to shift rod clamp screw	50 - 60 in.-lb. (5 - 7 ft.-lb.)
Side mounts, upper and lower nuts	150 - 170 in.-lb. (12 - 14 ft.-lb.)
Pilot shaft to steering bracket screws	84 - 108 in.-lb. (7 - 9 ft.-lb.)
Lower mount housing to pilot shaft screws	170 - 190 in.-lb. (14 - 16 ft.-lb.)
Slip clutch propeller	90 ft.-lb.
Lower motor cover mount nuts	72 - 96 in.-lb. (6 - 8 ft.-lb.)
*Pull at propeller shaft for tilt up lower units	30 - 35 lbs.
*Pull at propeller shaft to overcome reverse lock	200 - 240 lbs.

Note: See Table 9 for tightening torques of standard screws.

* Standard length lower unit.

GENERAL INFORMATION
Table 8 SPECIFICATIONS AND CLEARANCES — 33 HP
GENERAL

Horsepower	33 hp @ 4,500 rpm
Operating range	4,000 to 5,000 rpm
Tank test	4,400 rpm
Engine type	2-cylinder, 2-cycle, 180° crank
Bore and stroke	3 1/16 in. bore x 2 3/4 in. stroke
Piston displacement	40.5 cu. in.
Crankshaft size	
Top journal	1.2500 - 1.2495 in.
Center journal	1.000 - 0.9995 in.
Bottom journal	1.000 - 0.9995 in.
Connecting rod crank pin	1.1828 - 1.1823 in.
Carburetion	Single barrel, float feed, high and low-speed adjustments, manual or electric choke
Float level setting	Flush with rim of casting
Inlet needle seat	0.065 - 0.062 in. Use No. 52 drill as a gauge
Cooling system	Centri-matic (combination positive displacement and centrifugal pump)
Propeller gear ratio	12:21
Propeller	3 blade, 10 1/2 in. dia. x 12 in. pitch
Propeller options	3 blade, 10 3/8 in. dia. x 11 1/2 in. pitch 3 blade, 10 3/8 in. dia. x 14 in. pitch 3 blade, 10 3/8 in. dia. x 13 1/4 in. pitch
Speed control	Knob on steering bracket or remote control. Synchronized throttle and spark
Gear shift control	Forward, neutral, and reverse
Starter	Ski-Twin — Simplex self-winding spring Ski-Twin Electric — Electric
Ignition	Flywheel magneto
Spark plug	AC - M42K, Champion J4J, 14mm
Spark plug gap	0.030 in.
Spark plug torque	17 1/2 - 20 1/2 ft.-lb.
Breaker point gap	0.020 in.
Condenser	0.25 - 0.29 μ fd

POWER HEAD

Piston ring gap	0.017 - 0.007 in.
Piston ring groove clearance	0.007 - 0.0045 in.
Piston pin to piston — loose end	0.0006 - 0.0001 in.
Cylinder and piston	0.0045 - 0.0030 in.
Crankshaft end-play	0.011 - 0.003 in.

LOWER UNIT

Driveshaft — upper	Roller
Propeller shaft in front gear bushing	0.0020 - 0.0010 in.

(continued)

Table 8 SPECIFICATIONS AND CLEARANCES — 33 HP (CONTINUED)

LOWER UNIT (continued)	
Rear reverse gear to rear bushing	0.0020 - 0.0005 in.
Rear gear bearing to propeller shaft	0.0025 - 0.0005 in.
Propeller on shaft at drive pin hole	0.007 - 0.003 in.
Propeller on shaft — above the shoulder	0.0069 - 0.0034 in.

TORQUE CHART	
POWER HEAD	
Flywheel nut	100 - 105 ft.-lb.
Connecting rod screw	348 - 372 in.-lb. (29 - 31 ft.-lb.)
Cylinder head screws	168 - 192 in.-lb.
Crankcase to cylinder screws	
Upper and lower	150 - 170 in.-lb.
Center	162 - 168 in.-lb.
Spark plug	17½ - 20½ ft.-lb.
Starter housing screws	96 - 120 in.-lb. (8 - 10 ft.-lb.)
Side mounts — upper and lower nuts	150 - 170 in.-lb. (12 - 14 ft.-lb.)
Front mount — upper nut	240 - 320 in.-lb. (20 - 26 ft.-lb.)
Pilot shaft to steering bracket	120 - 140 in.-lb. (10 - 12 ft.-lb.)
Slip clutch propeller	185 - 255 ft.-lb.
*Pull at propeller shaft for tilt up lower units	30 - 40 lbs.
*Pull at propeller shaft to overcome reverse lock	260 - 310 lbs.

Note: See Table 9 for tightening torques of standard screws.

* Standard length lower unit.

Table 9 STANDARD SCREWS (TYPICAL TORQUE VALUE)

	Inch-Pounds	Foot-Pounds
No. 6	7 - 10	
No. 8	11 - 14	
No. 10	25 - 35	2 - 3
No. 12	35 - 40	3 - 4
¼ in.	60 - 80	5 - 7
5/16 in.	120 - 140	10 - 12
⅜ in.	220 - 240	18 - 20

<p>Never tighten a screw completely if it is on a part with 2 or more screws. The pressure on one side can cause distortion and leakage possibly resulting in damage. This is especially critical on the cylinder head and gear case.</p> <p>To avoid such warping, tighten each screw down in thirds until all are tight. In other</p>	<p>words, if the torque is 9 ft.-lb., then tighten each screw to 3 ft.-lb., then to 6 ft.-lb., and finally to 9 ft.-lb.</p> <p>Re-torque spark plugs, cylinder head and gear case screws after the first 15 minutes of running time.</p>
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CHAPTER TWO

LUBRICATION, PERIODIC MAINTENANCE, AND TUNE-UP

The 3 parts of this chapter present procedures necessary for maintaining maximum economy, performance, and dependability. Periodic performance of lubrication items will coincide with some maintenance periods; similarly, engine tune-up periods coincide with lubrication and maintenance periods. Ideally, all lubrication and maintenance items should be performed when it is time for engine tune-up.

Lubrication and maintenance intervals are identical for all models. See **Table 1** for lubrication points. Checks should include cleaning and tightening as well as inspection for unscheduled maintenance or repair. Manufacturer's recommended maintenance intervals for some items might possibly be performed less frequently if experience so indicates. It is suggested, however, that recommended intervals be followed until the effects of local environment and use indicate increased or reduced frequency.

The capacities shown for each model are typical. Minor improvements and changes in parts configurations have occasionally raised or lowered various capacities for a group of engines independent of model designation; therefore, fluid levels should always be confirmed by a visual check.

Tune-up specifications and torque values are presented at the end of Chapter One. Operating

principles of piston port 2-stroke engines are discussed in this chapter.

Engine Operation

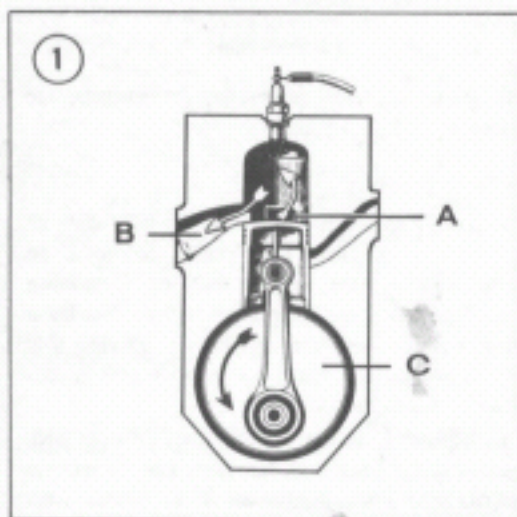
Figures 1 through 4 illustrate the operation of a piston-port engine. This engine is similar to a rotary-valve type, except that intake valving is accomplished by the piston rather than by a valve rotating with the crankshaft. During this discussion, assume that the crankshaft is rotating counterclockwise.

In **Figure 1**, as the piston travels downward, a scavenging port (A) between the crankcase and the cylinder is uncovered. The exhaust gases leave the cylinder through the exhaust port (B), which is also opened by the downward movement of the piston. A fresh fuel/air charge, which has previously been compressed slightly, travels from the crankcase (C) to the cylinder through the scavenging port (A) as the port opens. Since the incoming charge is under pressure, it rushes into the cylinder quickly and helps to expel the exhaust gases from the previous cycle.

Figure 2 illustrates the next phase of the cycle. As the crankshaft continues to rotate, the piston moves upward, closing the exhaust and scavenging ports. As the piston continues upward, the air/fuel mixture in the cylinder is

Table 1 LUBRICATION POINTS

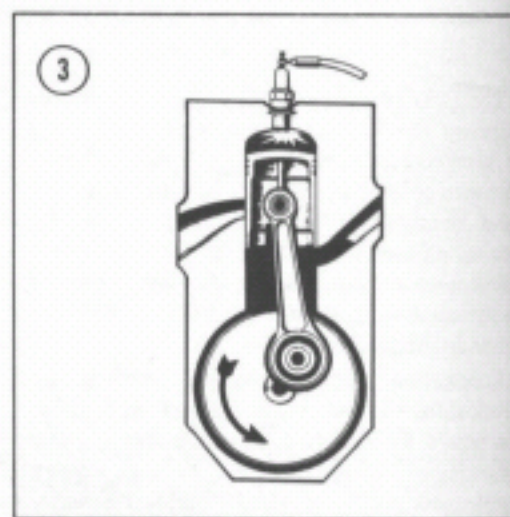
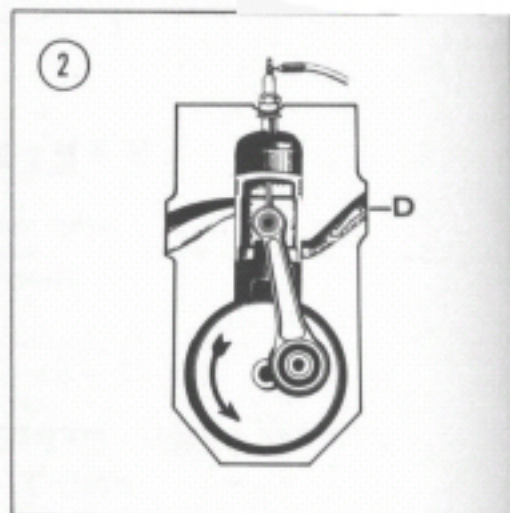
Part	Lubricant
Tilt reverse lock lever	OMC Sea-Lube anti-corrosion lube
Clamp screw threads	OMC Sea-Lube anti-corrosion lube
Throttle shaft gears	OMC Sea-Lube anti-corrosion lube
Idle speed adjuster	OMC Sea-Lube anti-corrosion lube
Magneto linkage	OMC Sea-Lube anti-corrosion lube
Manual starter spring	OMC Sea-Lube anti-corrosion lube
Choke	OMC Sea-Lube anti-corrosion lube
Carburetor linkage	OMC Sea-Lube anti-corrosion lube
Shift lever detent	OMC Sea-Lube anti-corrosion lube
Gearcase	OMC Sea-Lube gearcase lube (13.9 oz.)
Electric starter pinion shaft	Lubriplate 777
Motor cover latch lever	OMC Sea-Lube anti-corrosion lube
Swivel bracket	OMC Sea-Lube anti-corrosion lube



compressed. Notice also that a low pressure area is created in the crankcase at the same time. Further upward movement of the piston uncovers the intake port (D). A fresh fuel/air charge is then drawn into the crankcase through the intake port because of the low pressure created by the upward piston movement.

The third phase is shown in **Figure 3**. As the piston approaches top-dead-center, the spark plug fires, igniting the compressed mixture. The piston is then driven downward by the expanding gases.

When the top of the piston uncovers the exhaust port, the fourth phase begins, as shown



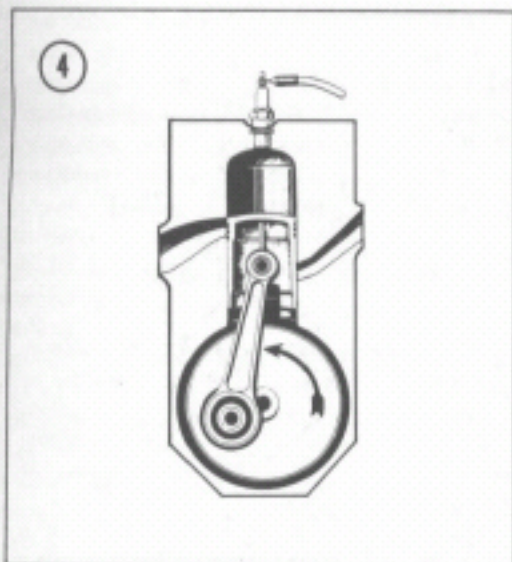
in **Figure 4**. The exhaust gases leave the cylinder through the exhaust port. As the piston continues downward, the intake port is closed and the mixture in the crankcase is compressed in preparation for the next cycle.

It can be seen from the foregoing discussion that every downward stroke of the piston is a power stroke.

LUBRICATION

Interval

The level of oil in the lower unit should be checked at the end of the first day of operation



or after 10 hours, whichever comes first, and after every 5 days or 50 hours thereafter. Drain the unit every 10 days, 100 hours, or every season, as use dictates. Add OMC Sea-Lube Premium blend lubricant (or equivalent) to the crankcase to bring the level up to vent or OIL LEVEL plug.

One-Cylinder Engines

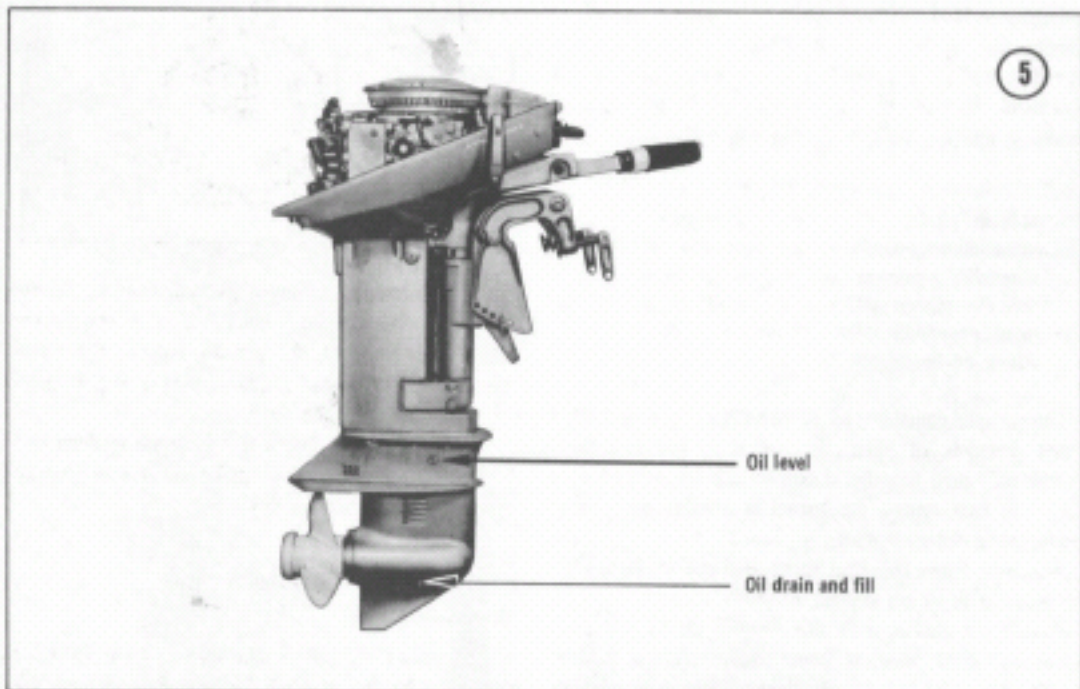
Remove the OIL DRAIN/FILL plug and gasket from the side of the gear case. Turn the engine onto its side and allow the oil to drain out. It's best to perform this operation while the engine is warm to eliminate all oil.

To refill, turn the engine rightside up and pump in oil through the OIL DRAIN/FILL hole. Bring the oil up to the level of the hole. Jiggle the engine slightly to release any trapped air and recheck oil level.

Two-Cylinder Engines

Remove the plugs and gaskets marked OIL DRAIN and OIL LEVEL from the side of the crankcase. See **Figure 5**. Position the engine with the propeller shaft in a horizontal position. Allow the oil to drain completely. It's best to warm the engine first so that all of the oil is thin enough to drain completely.

To refill, pump oil into the OIL DRAIN hole until it shows in the OIL LEVEL hole. Fill the case slowly to avoid creating any air pockets. Jiggle the engine after filling to eliminate any air pockets and top off.



ENGINE LUBRICATION

A conventional 2-stroke engine cannot receive its entire lubrication from an oil supply in the crankcase. Oil splash in the crankcase could be carried into the cylinder with the fuel/air charge, resulting in high oil consumption and spark plug fouling. These outboards use the following method for engine lubrication.

Fuel/Oil Mixture

In this system, lubricating oil is mixed with the fuel. The oil is then carried to the piston and cylinder with the fuel mixture as it is drawn into the engine. This system has an inherent disadvantage. Since sufficient oil must be mixed with the fuel to meet the maximum lubrication requirements of the engine, the engine will receive excess oil when lubrication requirements are minimal, such as at idling.

The only fuels recommended for outboard, 2-stroke motor use are marine, automotive white, and aircraft gasolines of 90 octane or greater. The engine is extremely sensitive to changes in oil or gasoline types. Optimum performance can only be realized through consistency.

Never use any more (or less) oil in the fuel mix than a 50:1 ratio of gas to oil. Too little oil results in insufficient lubrication, scoring of cylinder walls, overheating, and eventual destruction. Too much oil results in plug fouling, knocking, carbon buildup and poor performance.

CAUTION

Never use an oil which has detergent. The detergents are basically bits of metallic particles which can build-up on the piston and cause over-heating and pre-detonation. Never use additives or "boosters."

Never use gasoline which has been stored for great periods of time; it contains substances which will turn to gum if stored too long. These deposits can cause carburetion problems and spark plug deterioration.

Always drain the fuel tank and carburetor if the engine is to be stored.

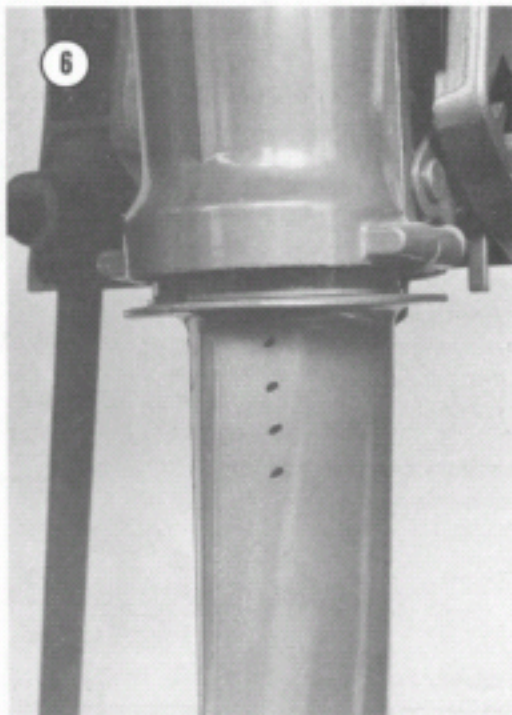
Don't be alarmed if the engine smokes excessively after having been stored for a few weeks, or even days, or after filling the tank

with fresh pre-mix. The oil tends to settle out of the gas or will remain on the bottom of the tank if not mixed properly. This could cause problems since, as the fuel is used, the mixture will "lean out" and not lubricate as well as it should. Drain the tank into a suitable container and discard if old or re-mix if still fresh.

WATER PUMP/COOLING SYSTEM

These engines rely on a variable volume pump and, in some instances, a thermostat to control and reduce engine heat. The system works in some degree to that of an automobile and should be treated with the same respect if long engine life is expected.

Proper functioning can be determined if a steady flow of water discharges from the idle relief holes near the water line while the engine is idling. See **Figure 6**. If there isn't any flow, stop the engine immediately and check for the problem. Don't restart the engine until the situation is rectified or permanent damage will result. Check and clean the discharge holes with a fine strand of wire.



MOVING PARTS LUBRICATION (EXTERNAL)

It would be ideal to be able to check oil and fluid levels and electrical equipment on a daily basis as operated. Such frequency is impractical, but every fuel stop should include at least the following checks for maximum reliability and performance: engine oil level, battery electrolyte level and evidence of leaking. In addition, the following points should be lubricated as indicated in Table 1: tilt reverse lock lever, idle speed adjustment, magneto linkage, starter drag spring, shift lever detent, carburetor linkage, choke, gearcase, starter pinion, swivel bracket, and motor cover latch.

The lubrication functions can be performed as infrequently as 60-day intervals in fresh water but salt water running increases this need to a maximum of 30 days. Experience and observation will indicate the frequency required by your operating conditions.

FUEL MIXING

The fuel of a 2-stroke engine is critical to performance and reliability since the fuel also carries lubrication to the power head. You should know the correct amounts of oil and gas to mix and the proper method.

Always start with fresh gasoline of 90 octane or higher. Pour this into a separate gas can (not the tank) through a fine mesh copper screen or cheese cloth to remove any impurities.

Pour $\frac{1}{2}$ of the gas to be used into the gas can and add oil to a 50:1 ratio of gas to oil. Replace the gas cap and tilt the can from side to side to thoroughly mix the two. See Figure 7. Add more gas and oil and repeat the mixing. A few simple tilting motions of the can will sufficiently mix the gas in warm weather above 32°F. Below 32°F, shake the can vigorously.



Portable tank

7

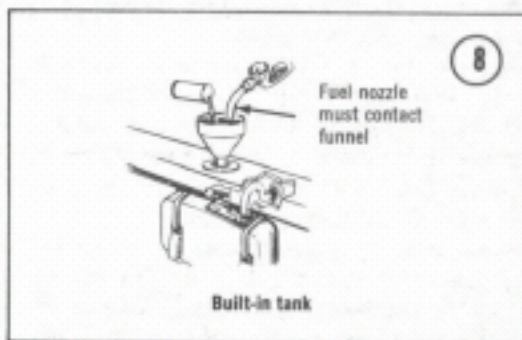
If the engine is not run for a few days, shake the fuel tank to mix any oil which may have settled to the bottom. Never use mix which has been stored for long periods or a mix of unknown ratio. Fuel and oil can be mixed at the pump on boats with built-in tanks. See Figure 8.

CAUTION

Never use additives to boost the gas or to otherwise enhance the fuel. Two-stroke engines could be damaged.

WARNING

Never store the gas in a living area. Never smoke near the container and avoid any sparks. Shut off the engine while refueling. Gasoline fumes in a confined area can be as damaging and dangerous as a bomb.



Built-in tank

TUNE-UP PROCEDURE

When a motor seems to be in need of a tune-up, the following guide will be helpful. Check the motor carefully and begin a systematic tune-up. Consult Chapter Three for troubleshooting any suspected malfunction.

Any thorough tune-up should also include a check of the power head and complete lubrication of moving parts. The first 4 steps of the following procedure may be skipped during a minor tune-up if the components listed are known to be in good shape from a previous overhaul. Complete, detailed procedures are included elsewhere in this manual.

1. Remove the exhaust cover and cylinder head.
2. Slowly rotate the flywheel and check for scored cylinder walls, cracked rings, carbon deposits, and excessive wear. Correct as necessary.

3. Clean carbon from the piston crown and cylinder head being careful not to deform the piston or alter its shape.
4. Surface the cylinder head.
5. Inspect, clean, and regap the spark plugs as needed.
6. Inspect the battery, condenser, points, coil, and all wiring.
7. Inspect the carburetor, especially the choke. For complete overhaul, see the *Fuel System* chapter (Chapter Four).
8. Inspect the fuel filter and shut-off valve.
9. Synchronize the carburetor linkage with the magneto.
10. Adjust the carburetor high- and low-speed needles and set idle.
11. Check the propeller for damage.
12. Drain and refill the gearcase and lubricate all moving parts.
13. Tighten all screws, nuts, and bolts to the torque value as specified.
14. Check operation of cooling system and operating temperature.

BATTERY

All models use the same 12-volt battery. Refer to **Figure 9** for battery construction. **Table 2** gives specifications.

Battery electrolyte level should be checked regularly, especially in hot weather.

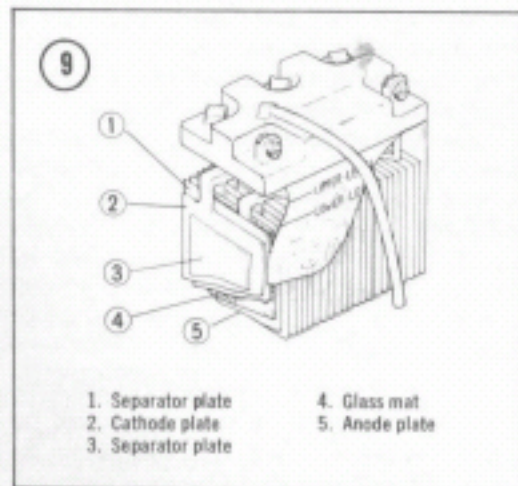


Table 2 BATTERY

Type	6N6-3B
Voltage	12V
Capacity	70Ah (at 10 hour rate)
Charging current	1.0A
Specific gravity of electrolyte when fully charged)	1.260-1.280 at 20°C(68°F)

Removal

1. Remove the retaining strap. Disconnect the ground, or negative (—) cable first, then the positive (+) cable.
2. Lift the battery from the mounting, noting the location of the terminal covers, mounting pads, and vent tube for reinstallation later.

Safety Precautions

When working with batteries, use extreme care to avoid spilling or splashing the electrolyte. This electrolyte is sulfuric acid, which can destroy clothing and cause serious chemical burns. If any electrolyte is spilled or splashed on clothing or body, it should immediately be neutralized with a solution of baking soda and water, then flushed with plenty of clean water.

WARNING

Electrolyte splashed into the eyes is extremely dangerous. Safety glasses should always be worn when working with batteries. If electrolyte is splashed into the eye, call a physician immediately, force the eye open, and flood with cool, clean water for about 5 minutes.

If electrolyte is spilled or splashed onto painted or unpainted surfaces, it should be neutralized immediately with baking soda and water solution and then rinsed with clean water.

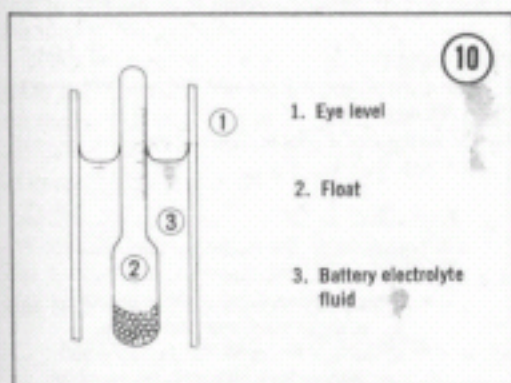
When batteries are being charged, highly explosive hydrogen gas forms in each cell. Some of this gas escapes through the filler openings and may form an explosive atmosphere around the battery. This explosive atmosphere may exist for several hours. Sparks, open flame, or a lighted

cigarette can ignite this gas, causing an internal explosion and possible serious personal injury. The following precautions should be taken to prevent an explosion.

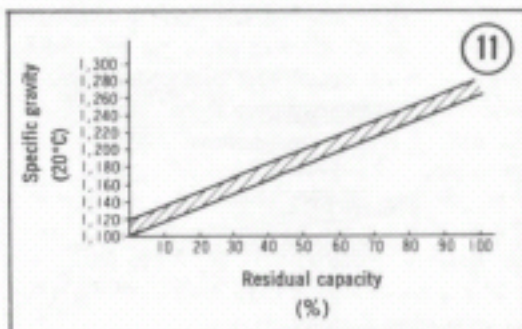
1. Do not smoke or permit any open flame near any battery being charged or which has been recently charged.
2. Do not disconnect live circuits at battery terminals, because a spark usually occurs where a live circuit is broken. Care must always be taken when connecting or disconnecting any battery charger; be sure its power switch is off before making or breaking connections. Poor connections are a common cause of electrical arcs which cause explosions.

Battery Inspection and Service

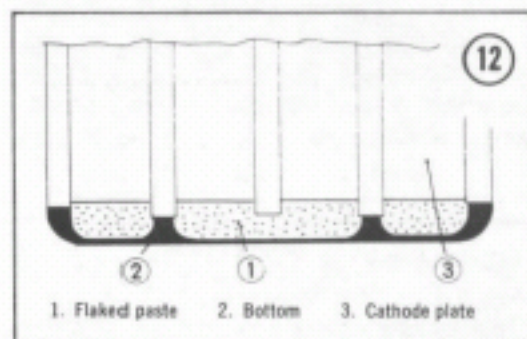
1. Measure the specific gravity of the battery electrolyte with a hydrometer.
2. The specific gravity is calibrated on the hydrometer float stem.
3. The reading is taken at the fluid surface level with the float buoyant in the fluid (Figure 10).



4. If the reading is less than 1.20 with the temperature corrected to 68°F, recharge the battery (see Figure 11).
5. If any cell electrolyte level is below the lower mark on the battery case, fill with distilled water to the upper mark.
6. Replace the battery if the case is cracked or damaged. Corrosion on the battery terminals causes leakage of current. Clean them with a wire brush or with a solution of baking soda and water.



7. Check the battery terminal connections. If corrosion is present, the connection is poor. Clean the terminal and connector and coat with Vaseline and reinstall.
8. Vibration causes the corrosion of the battery plates to flake off, forming a paste on the bottom (see Figure 12). Replace the battery when the paste builds up considerably.



Battery Charging

Batteries are not designed for high charge or discharge rates. For this reason, it is recommended that a battery be charged at a rate not exceeding 10 percent of its ampere-hour capacity. That is, do not exceed 0.5 ampere charging rate for a 5 ampere-hour battery, or 7.5 amperes for a 15 ampere-hour battery. This charge rate should continue for 10 hours if the battery is completely discharged, or until specific gravity of each cell is up to 1.260-1.280, corrected for temperature. If after prolonged charging, specific gravity of one or more cells does not come up to at least 1.230, the battery will not perform as well as it should, but it may continue to provide satisfactory service for a time.

Some temperature rise is normal as a battery is being charged. Do not allow the electrolyte temperature to exceed 110°F. Should temperature reach that figure, discontinue charging until the battery cools, then resume charging at a lower rate.

If possible, always slow-charge a battery. Quick-charging will shorten the battery service life. Refer to **Table 3**.

If a quick-charge is used, the rate should be no more than 2.0Ah.

1. Hook the battery to a charger by connecting the positive lead to the positive terminal on the battery and the negative lead to the negative terminal. To do otherwise could cause severe damage to the battery and could result in injury if the battery explodes.

2. The electrolyte will begin bubbling, signifying that explosive hydrogen gas is being released. Make sure the area is adequately ventilated and there are no open flames.

3. It will take at least 8 hours to bring the battery to full charge. Test the electrolyte periodically with a hydrometer to see if the specific gravity is within the standard range of 1.26

to 1.28. If the reading remains constant for more than an hour, the battery is charged. See **Table 3**.

Installation

1. Wash the battery with water to remove spilled electrolyte. Coat the terminals with Vaseline or light grease before installing.

2. When replacing the battery, be careful to route the vent tube so that it is not crimped. Connect the positive terminal first, then the negative one. Don't overtighten the clamps.

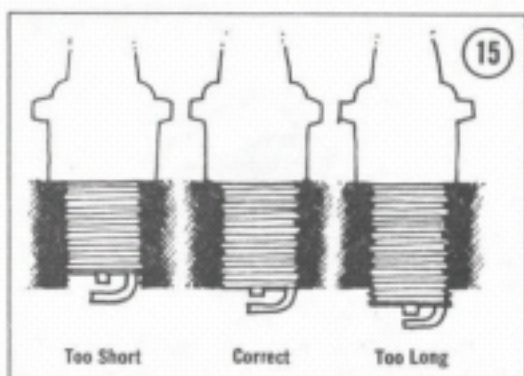
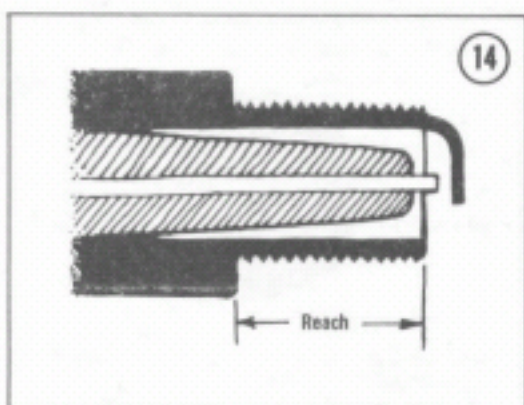
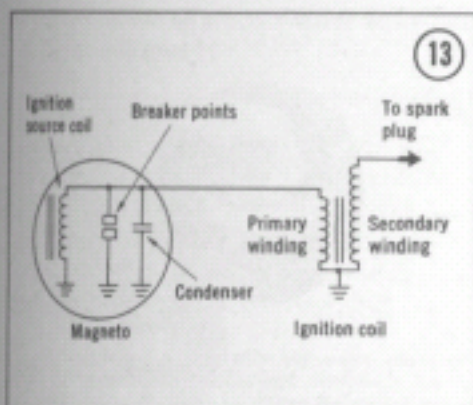
3. Remeasure the specific gravity of the electrolyte with a bulb hydrometer, reading it as shown.

Magneto Operation

Figure 13 illustrates a simplified magneto system of the type used on these motors. Magnets move past an ignition source coil, as the flywheel rotates, inducing current within the coil. Breaker points are opened by a cam, attached to the crankshaft, just as the piston reaches firing position. As the points open, energy is transferred from the source coil to the ignition coil, a form of transformer, where it is stepped up to

Table 3 BATTERY CHARGE

	Normal Charge	Rapid Charge
Charging Current Rate	0.6Ah	2.0Ah maximum
Checking for full charge	(1) Specific gravity: 1.260-1.280 (20°C, 68°F) maintained constant (2) 0.2Ah-0.6Ah (3) 7.5V-8.3V at terminals, checked with voltmeter	(1) Specific gravity: 1.260-1.280 maintained at 20°C (68°F) (2) Voltage: When large volume of gas is emitted from the battery (in about 2-3 hours for fully discharged battery) reduce charging rate to 0.2A (3) Battery is fully charged when a voltage of 7.5V is maintained
Charging duration	By this method, a battery with specific gravity of electrolyte below 1.220 at 20°C (68°F) will be fully charged in approximately 12-13 hours	By this method, battery with specific gravity of electrolyte below 1.220 at 20°C (68°F) will be fully charged in approximately 1-2 hours
Remarks		When required, the quick charging method may be used, however, the recommended charging current rate should be under 2.0A



the high voltage required to jump the spark plug gap for ignition. This process recurs once every revolution or as much as 9,000 times a minute. It is essential that all components are functioning properly and timing is correct for maximum engine efficiency at these speeds.

SPARK PLUGS

Spark plugs are available in various heat ranges hotter or colder than the plug originally installed at the factory.

Select plugs of a heat range designed for the loads and temperature conditions under which the engine will run. Use of incorrect heat ranges can cause seized pistons, scored cylinder walls, or damaged piston crowns.

In general, use a lower-numbered plug for low speeds, low loads, and low temperatures. Use a higher-numbered plug for high speeds, high engine loads, and high temperatures.

NOTE: Use the highest numbered plug that will not foul. In areas where seasonal temperature variations are great, the factory recommends a high-numbered plug for slower winter operation.

The reach (length) of a plug is also important. A longer than normal plug could interfere with the piston, causing permanent and severe damage. Refer to Figures 14 and 15.

Testing Plugs

A quick and simple test can be made to determine if the plug is correct for your type of use. Accelerate hard and maintain a high, steady

speed. Shut the throttle off, and kill the engine at the same time, allowing the boat to slow, out of gear. Don't allow the engine to slow the boat. Remove the plug and check the condition of the electrode area. A spark plug of the correct heat range, with the engine in a proper state of tune, will appear light tan. See Figure 16.

If the insulator is white or burned, the plug is too hot and should be replaced with a colder one. Also check the setting of the carburetor for it may be too lean.

A too-cold plug will have sooty deposits ranging in color from dark brown to black. Replace with a hotter plug and check for too-rich carburetion.

If any one plug is found unsatisfactory, discard the set.

Removal/Installation

Remove and clean the spark plugs frequently. Electrode gap should be measured with a round

16



Normal plug appearance noted by the brown to grayish-tan deposits and slight electrode wear. This plug indicates the correct plug heat range and proper air fuel ratio.



Red, brown, yellow, and white coatings caused by fuel and oil additives. Such additives should not be used or damage will result.



Carbon fouling distinguished by dry, fluffy black carbon deposits which may be caused by an over-rich air/fuel mixture, excessive hand choking, clogged air filter, or excessive idling.



Shiny yellow glaze insulator cone is caused when the powdery deposits from fuel and oil additives melt. Melting occurs during hard acceleration after prolonged idling. This glaze conducts electricity and shorts out the plug. Avoid the use of additives at all times.



Oil fouling indicated by wet, oily deposits caused by too much oil in the mix. A hotter plug temporarily reduces oil deposits, but a plug that is too hot leads to preignition and possible engine damage.



Overheated plug indicated by burned or blistered insulator tip and badly worn electrodes. This condition may be caused by preignition, cooling system defects, lean air/fuel ratios, low octane fuel, or over advanced ignition timing.

feeler gauge and set at 0.024-0.028 in. (6-7mm) as shown in **Figure 17**.



Often heat and corrosion can cause the plug to bind in the head making removal difficult. Don't use force; the head is easily damaged. Here is the proper way to replace a plug.

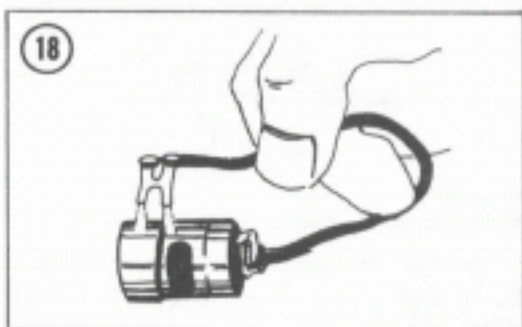
1. Blow out any debris which has collected in the spark plug wells. It could fall into the hole and cause severe damage.
2. Gently remove the spark plug leads by pulling up and out on the cap. Don't jerk the wires or pull on the wire itself.
3. Apply penetrating oil to the base of the plug and allow it to work into the threads.
4. Back out the plugs with a socket that has a rubber insert designed to grip the insulator. Be careful not to drop the plugs where they could become lodged.
5. Clean the seating area after removal and apply graphite to the threads to simplify future removal.
6. Clean the tips of the plugs with a sandblasting machine (some gas stations have them) or with a wire brush and solvent.
7. Always use a new gasket if old plugs are to be reused after cleaning.
8. Run the plug in finger-tight and tighten $\frac{1}{4}$ turn more with a wrench. Further tightening will flatten the gasket and cause binding.

NOTE: A short piece of fuel line can be used to install the plug initially in areas where space is a problem.

CONDENSER (CAPACITOR)

The condenser (capacitor) is a sealed unit and requires no maintenance. Be sure the connections are clean and tight.

The only possible proper test is to measure the resistance of the insulation with an ohmmeter. The value should be 5,000 ohms. A make-do test is to charge the capacitor by hooking the leads, or case and lead, to a battery. After a few seconds, touch the leads together, or lead to case, and check for a spark, as shown in **Figure 18**. A damaged capacitor won't store electricity or spark.

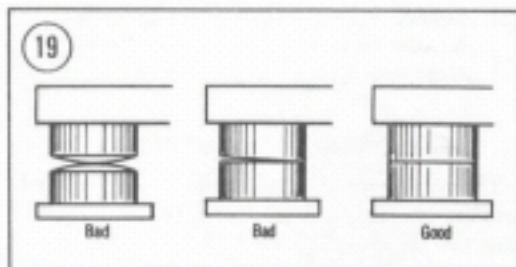


Most mechanics prefer to discard the condensers and replace them with new ones during engine tune-up.

BREAKER POINTS

Check that the insulation between the breaker contacts and the contact breaker base is not defective. A short-circuit will prevent the motor from running. To test for this condition, disconnect the wire or wires on the points, and with the points still blocked open, measure insulation resistance between the movable point and a good ground, using the highest range on the ohmmeter. If there is any indication at all on the ohmmeter, the points are shorted.

Contact surfaces may become pitted or worn from normal use. See **Figure 19**. If they are not too damaged, they can be dressed with a few strokes of a clean point file. Do not use sand-



paper, as particles may remain on the points and cause arcing and burning. If a few strokes of a file don't smooth the points completely, they will have to be replaced.

Oil or dirt may get on the points, resulting in premature failure. Common causes for this condition are defective crankshaft seals, improper lubrication of the rubbing block, or lack of care when the crankcase cover is removed and replaced.

If the point spring is weak or broken, the points will bounce, causing misfiring at high speeds.

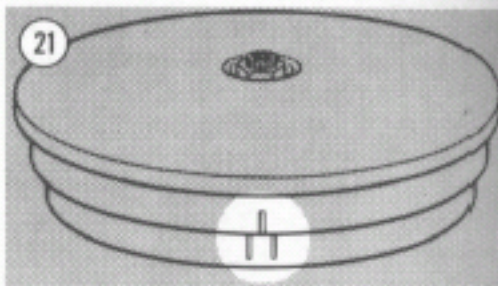
Adjustment—1.5-2 hp (Strobe Light Method)

1. The magneto must remain on the motor but the flywheel should be removed for proper adjustment.
2. Rotate the crankshaft by hand until the breaker arm rests on the high point of the cam (points full open). Rotate the crankshaft in a clockwise direction only to avoid damaging the water pump impeller.
3. Loosen the locking screw and turn the eccentric screw to produce a gap of 0.021 in. at the points as shown in **Figure 20**. Tighten the locking screw while holding the adjuster stable. Recheck the gap to make sure it hasn't shifted. New points should be gapped to 0.022 in. to provide for initial seating. Check the gap of new points after a few hours of running.
4. Check the flywheel and crankshaft tapers for nicks, burrs, or traces of oil. Clean these with solvent and blow dry if necessary. Don't allow solvent to enter the oiler wick.
5. Replace the flywheel and check for proper spark. Lay the spark plug against the engine case to provide a ground and keep the electrode



about $\frac{1}{4}$ in. away. Don't touch the plug wire with your bare hands while conducting the test. Rotate the engine and note if there is a fat, blue spark accompanied by a sharp cracking noise. If so, the system is good. If not, check as described in *Electrical* section of Chapter Three.

6. Screw the spark plug back into its hole and reconnect the high tension lead. Make sure the connection is firm. Check the *Spark Plug* section of this chapter for more details on spark plugs and their installation.
7. Start the motor and set the idle to 1,000 rpm. Hook up a timing light, follow instructions with that unit, and make sure that the flywheel timing mark lines up between the 2 marks on the armature plate. See **Figure 21**.



Adjustment—1.5-2 hp (Static Method)

1. The magneto must remain on the motor and the flywheel should be removed for proper adjustment.
2. Disconnect all leads from the breaker point assembly. Connect a meter or test light between the forward breaker point terminal and the breaker plate as shown in **Figure 22**. If a static timing light or meter is unavailable, proceed as outlined in the adjustment sequence using a



strobe light. Naturally a strobe won't be used but Steps 2 through 6 are applicable to this procedure. The strobe is used to double check the setting and to set the points more accurately.

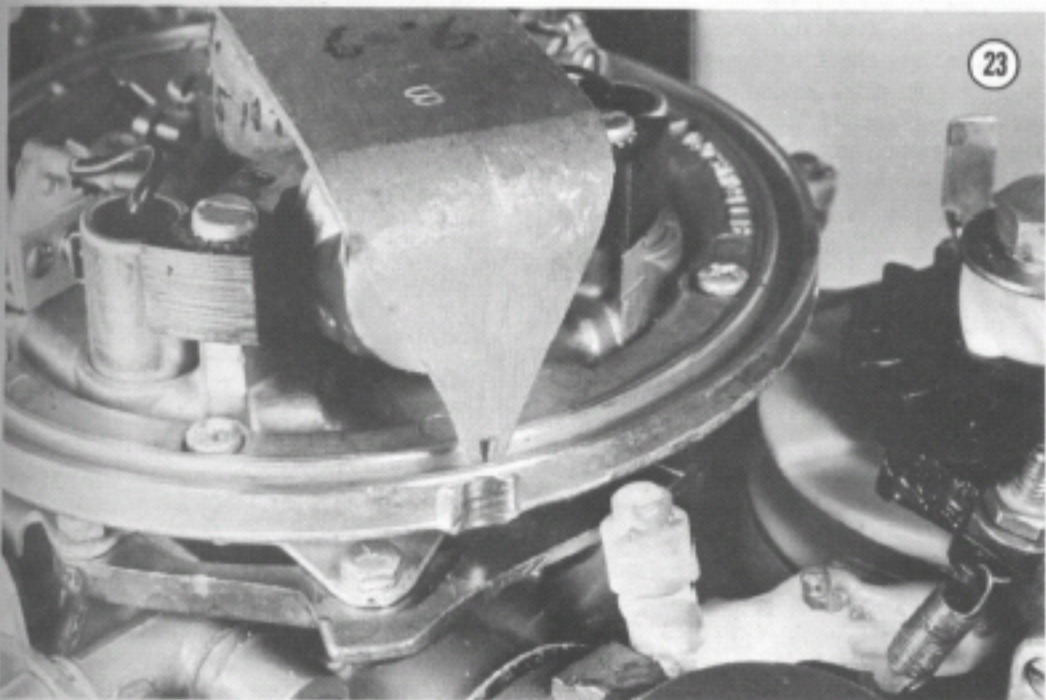
3. Connect special timing fixture No. 376969 onto the crankshaft as shown in **Figure 23**. Rotate the crank clockwise until the timing mark "T" is aligned with the first of 2 marks on the armature plate.

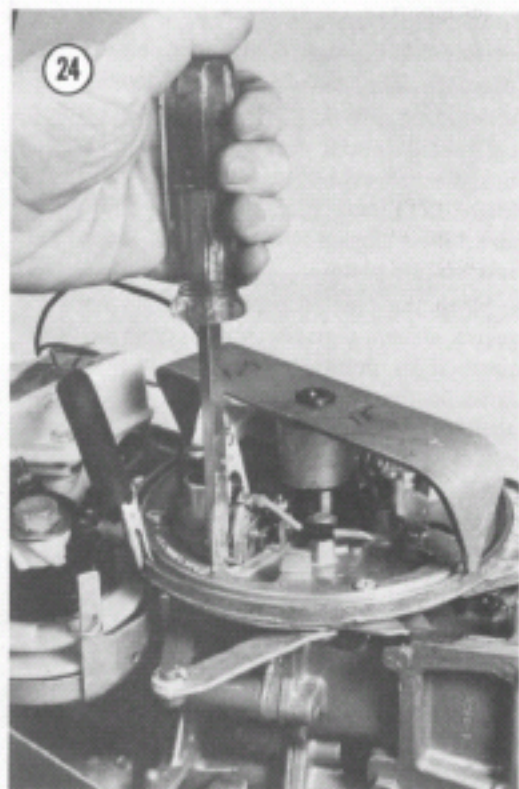
4. Move the pointer back and forth until the precise instant that the points open is determined. This point should be between the 2 marks on the armature plate and will be indicated by the light or meter. (Some mechanics now use "buzz boxes" to produce an audible tone instead of a light when the points open.)

5. Adjust the points until the timing is correct. See **Figure 24**. If new points are installed, set the timing for the points to open at the first mark to allow for initial seating and wear.

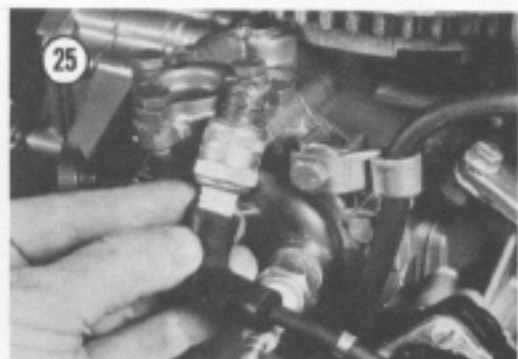
6. Recheck timing as previously described in Steps 3-5.

7. Check the flywheel and crankshaft tapers for nicks, burrs, or traces of oil. Clean with solvent if needed being careful to avoid the oiler wick.





8. Replace the flywheel, reconnect the wires to the points, and check for a proper spark. Lay the plug against the engine case to provide a ground. See **Figure 25**. Keep the electrode $\frac{3}{4}$ in. from the ground point. Don't touch the plug with your bare hands while conducting this test or you will receive a severe shock. Rotate the engine and note if there is a fat, blue spark and loud cracking noise. If not, check the *Electrical System* portion of Chapter Three.



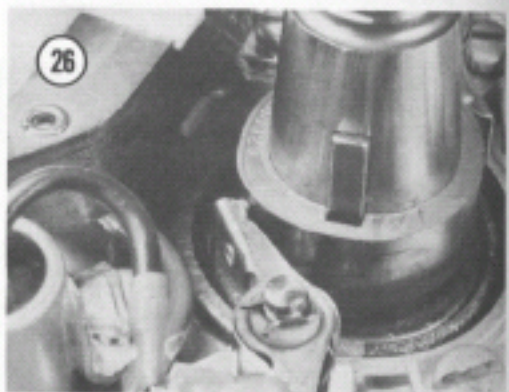
9. Screw the spark plug back into its hole and reconnect the high tension lead. Make sure the connection is firm. Check the *Spark Plug* section of this chapter for more detailed information on spark plugs.

Adjustment (3 through 33 hp Engines)

The static and strobe light breaker point adjustment procedures outlined previously for the 1.5-2 hp engines applies to the rest of the engines in the line. The only difference is that 2-cylinder engines have 2 sets of points, plugs, coil, etc. To time these engines, it is necessary to rotate the crank clockwise 180° and repeat the entire adjustment procedure.

When using a strobe light, wait until the second set of points have been set before starting the engine to check the timing.

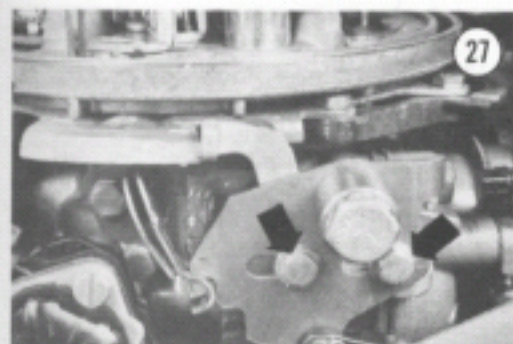
Some of the larger engines come equipped with a SET mark cast on the cam. This is to simplify the task of finding the spot where the rubbing block rests on the highest point on the cam. Place the rubbing block between the lines straddling SET mark. See **Figure 26**.



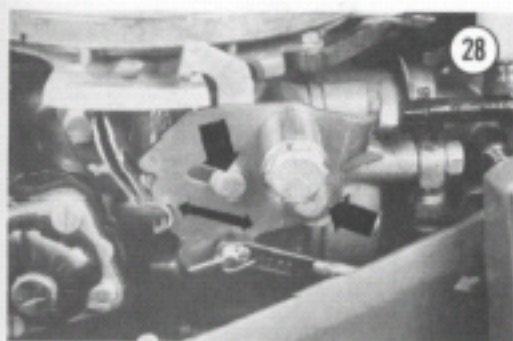
SHIFT LOCK STOP

Adjustment

1. The shift lock stop regulates the engine speed in neutral and reverse gear to avoid over-revving and possible engine damage. It is attached to the shift lock lever and hub assembly by 2 screws as shown in **Figure 27**.
2. Full power should be available in forward gear. High speed for neutral should be just



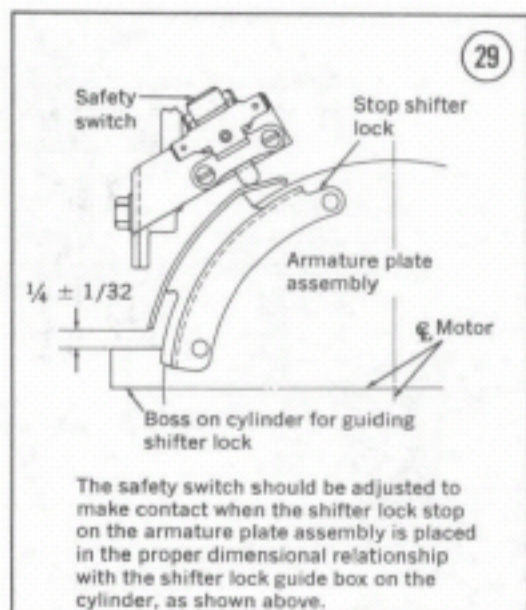
above 3,000 rpm and well below 4,000 rpm. The speed range for reverse should fall between 2,500 and 3,500 rpm. If adjustment is indicated, loosen the 2 screws shown in **Figure 28** and move the stop fore or aft until the specified speed is achieved. Tighten the screws and recheck rpm to make sure that it falls within accepted limits.



Safety Switches

If the motor is in neutral and the throttle is suddenly shut off, then the crankcase vacuum may become abnormally high. When this occurs, it will cause erratic carburetion and excessive rpm possibly damaging the engine. The safety switch can sense this sudden, irregular condition and will short out the plug until the speed decreases. Occasionally this switch will need adjustment as outlined below.

1. Hook an ohmmeter or test light to the switch leads.
2. Adjust the switch on its bracket so that the meter shows continuity, closed circuit, when the plunger is on the midpoint on the slope of the shifter lock stop as shown in **Figure 29**.



3. If the switch doesn't work, check the vacuum hose at the manifold for leaks. Also remove the hose and check the manifold hole with a No. 76 drill.
4. Connect a test light between the switch terminal and ground. Alternating vacuum and pressure will indicate that the switch is working properly.
5. If switch functioning is erratic, disassemble the unit and inspect the diaphragm and contacts. See **Figure 30**.
6. Repair or replace any parts as needed and reassemble.

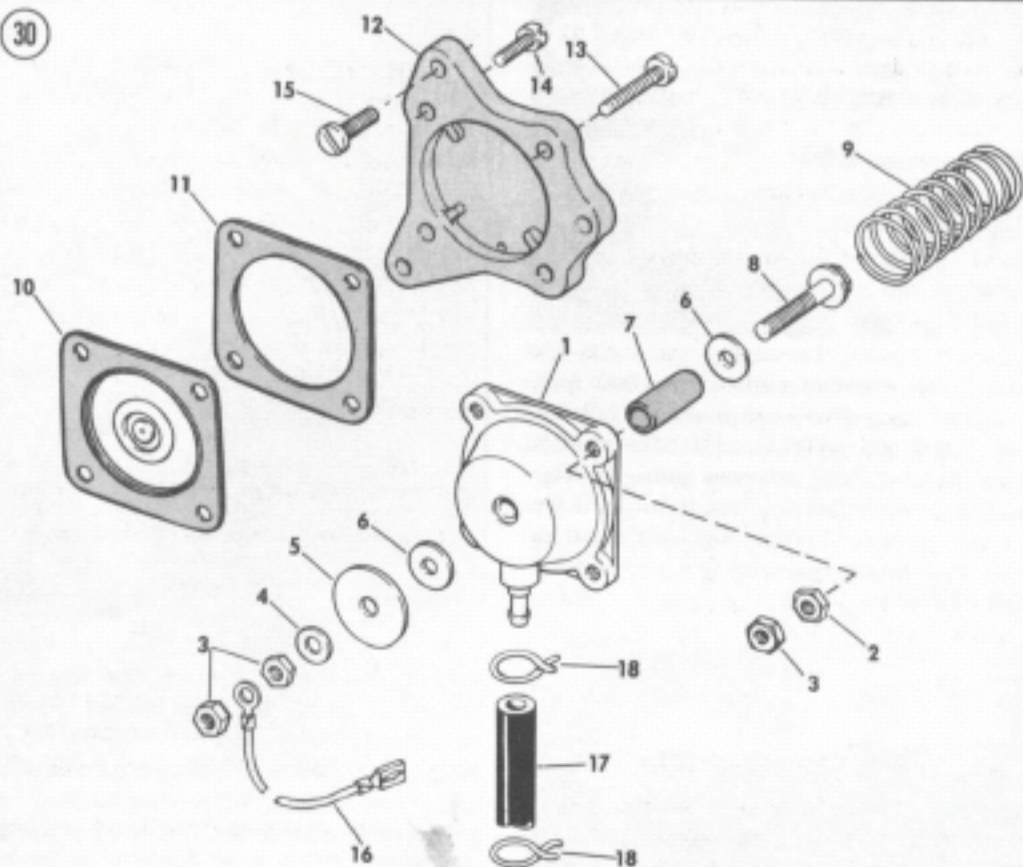
NEUTRAL START SWITCH (9.9-15 Horsepower)

Adjustment

The neutral start switch adjustment is possible only if the manual interlock cam, lockout lever, and hub adjustments are correct. If these have been disturbed, adjust. Then proceed to adjust switch as follows.

1. Shift into neutral. Disconnect red starter motor wire.
2. Connect a continuity light between the red starter motor wire and red battery cable.

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CUT-OUT SWITCH GROUP

- | | | |
|---------------------------|-------------------------|-----------|
| 1. Cutout body and nipple | 7. Tubing | 13. Screw |
| 2. Nut | 8. Screw | 14. Screw |
| 3. Locknut | 9. Spring | 15. Screw |
| 4. Washer | 10. Diaphragm and plate | 16. Lead |
| 5. Washer | 11. Gasket | 17. Hose |
| 6. Washer | 12. Adapter | 18. Clamp |

3. Press the starter button. The light should light with gears in neutral.

4. Shift to forward and reverse. The light should go out.

5. Remove and swing fuel pump out of the way. Loosen switch screws.

6. Center the plunger on the switch with the lobe on the lockout lever (gearshift in neutral) and raise the switch to depress the plunger between 0.090 to 0.150 in. (3/32-5/32 in.). Tighten screws. Press the starter button and the

continuity light should light. Shift into forward and reverse. The light should go out before engaging forward or reverse.

DECARBONIZATION

After an engine has been run for many hours it will probably require the removal of carbon from the piston crown and cylinder head. The best way to detect this need is if the engine has shown progressively worsening preignition or a

gradual loss of power. Several new products are now being marketed to allow the "lazy man's" approach to decarbonizing without the need of tearing the engine down. These products will not be as thorough, but can be used periodically. The procedure for their use is as follows.

1. Start and warm the engine to normal operating temperature.
2. Slowly pour 10 ounces of cleaner into the carburetor with the engine running at a fast idle of 1,500 rpm.
3. Slowly increase the speed of the engine and kill it by dumping in the remaining liquid.
4. Let the engine stand for ½ hour with the liquid still in the cylinder.
5. Start the engine and run it at full throttle, under load, for at least five minutes to clear out the system and remove the last traces of fluid. If this fails to completely decarbonize the cylinder then you will have to remove the head as outlined in Chapter Six.

WINTER STORAGE

If fuel is left in the engine during the winter it can become gummy and seriously hamper performance or cause expensive repair bills. Likewise, water left in the cooling system could cause excessive corrosion, or freeze and expand, cracking engine components. The following procedure should be followed for safe winter storage and fewer maintenance problems in the spring.

1. Check and replace the oil in the crankcase. Used oil could contain harmful acids.
2. Start and warm the engine. Run it at half throttle and stall with approximately 2 ounces of rust preventative oil injected in the carburetor. In spring, the plugs should be cleaned or replaced since they will have been fouled by oil.
3. Drain the fuel tank of any fuel mix and fill with a few ounces of engine oil. Swizzle the oil around to coat the tank walls and drain off the excess. In springtime this little oil will mix with the gas and be unnoticed but will prevent rust from forming during storage.
4. Drain the carburetors and fuel lines.

5. Drain the cooling system as previously described.

6. If the engine is to be stored on the boat, tilt it back so that the prop and any part of the engine is clear of the water.

7. Purchase or fabricate a cover to keep moisture and dust off. Never use plain plastic sheeting for this purpose. Plastic can't breathe and will trap moisture, promoting rust and mildew.

8. Disconnect the negative terminal of the battery and make arrangements to charge it at least once a month. If the battery is allowed to discharge completely, it will never hold a charge satisfactorily.

FUEL PUMP

Refer to Chapter Four for service procedures for the fuel pump.

FUEL FILTER

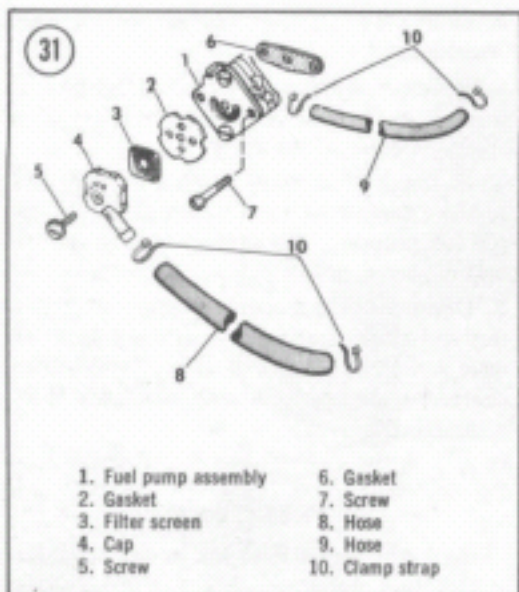
Even the most minute particle of dirt can cause carburetion problems if caught in one of the jet orifices. All engines are equipped with filters to trap dirt particles. This screen should be checked and cleaned periodically. The best time is at the beginning of each day's running. It should become a habitual part of other maintenance.

On one-cylinder engines, the filter is located inside the fuel tank and is a part of the connector. Below the filter is a fuel petcock.

On 2-cylinder engines, the filter is located on the fuel pump. Replace the gasket after cleaning to eliminate any chance of leakage. Refer to **Figure 31**.

DESALINIZATION (SALT WATER RUNNING MAINTENANCE)

Prolonged running in the ocean will eventually lead to a buildup of salt and minerals around the water jackets and in the cooling system passages. These deposits can build up to the point that cooling water is completely shut off. The result will be the destruction of the engine. The engines are treated to minimize rusting but total neglect negates this precaution. The following steps should be performed regularly to



protect the appearance and operation of the engine used in the ocean.

1. Flush the outside of the engine with fresh water washing with mild soap if necessary. Run fresh water through the engine to wash out minerals.

2. Spray the cylinder head and external parts with rust preventative.

3. Polish the finish with automotive cleaner/wax to remove oxidation and protect the paint.

4. Disconnect the negative battery terminal (ground strap) whenever the engine is stored or the boat docked for prolonged periods. There is enough leakage to completely drain a healthy battery.

5. Lubricate all moving parts frequently to prevent galling and corrosion. All iron or steel parts are particularly susceptible to corrosion when exposed to salt water or sea air.

6. Keep the motor in an upright position after flushing or normal use to facilitate drainage. Water could enter the cylinder through the exhaust ports or remain in passages causing corrosion.

MOTOR INSTALLATION

1. Refer to the section of this chapter which refers to lifting the motor. Place the motor so

that it is centered on the transom (rear) of the boat. Tighten the clamp screws by hand until snug, never use tools. After 15 minutes of running time, check the screws for tightness. See **Figure 32**.



2. A safety chain should be connected to keep from losing the motor overboard. Connect the chain to a transom plate (available as a dealer option for mounting on the boat).

Battery

See the section of this chapter that refers to battery care and charging prior to installation. If electrical accessories are to be installed, hook them directly to the battery terminals instead of to the charging system or damage will result. If the motor is to be run entirely without a battery then no extra equipment may be used. If the battery should quit functioning and it's necessary to move the boat, disconnect all of the accessories first.

Remote Control (Accessory)

Refer any such installation to a dealer. Accessory items aren't covered by this manual because of their complexity in installation and the vast number of items available.

Propeller

The propeller that comes on these engines is correct for most boats under most conditions. However, some boat/motor combinations could be improved upon by a different propeller.

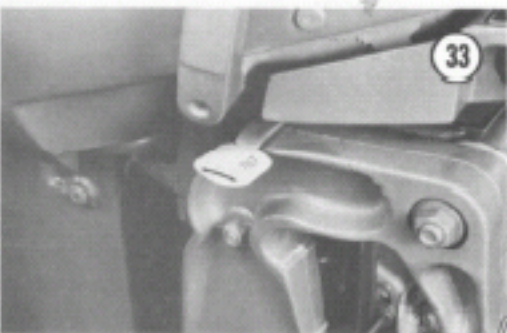
The engine rpm under full throttle with the motor properly trimmed is the best indicator. If the rpm is near the top limit, then the combination is correct. The best way to tell engine speed is with a tachometer. Consult your dealer for the ideal combination for your boat or refer to the specifications table in this manual. For more detail, see Chapter Seven.

Tilting

A tilt lever is provided on the starboard stern bracket to release the reverse lock and allow full or partial tilt.

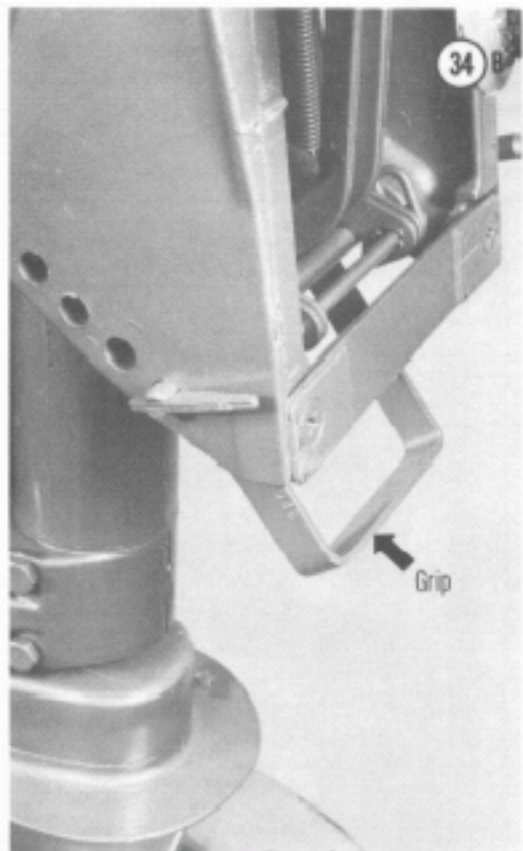
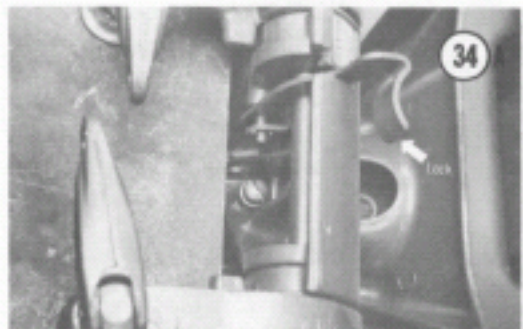
It's sometimes necessary to tilt the motor up while running to avoid bottoming in shallow water. While running in this mode, never attempt to run the engine at full or even partial throttle. The engine could easily overrev or overheat in the shallow, turbulent water.

1. Raise the lever to the TILT (up) position. See Figure 33.



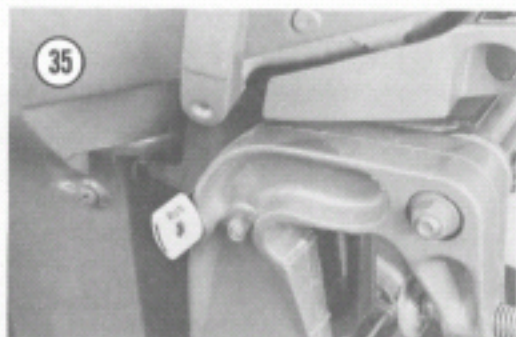
2. Raise the motor to the desired position using the motor cover grip. A shallow water bracket is used for partial tilt position but a lock engages

automatically when the motor is in full tilt position. See Figures 34A and 34B.



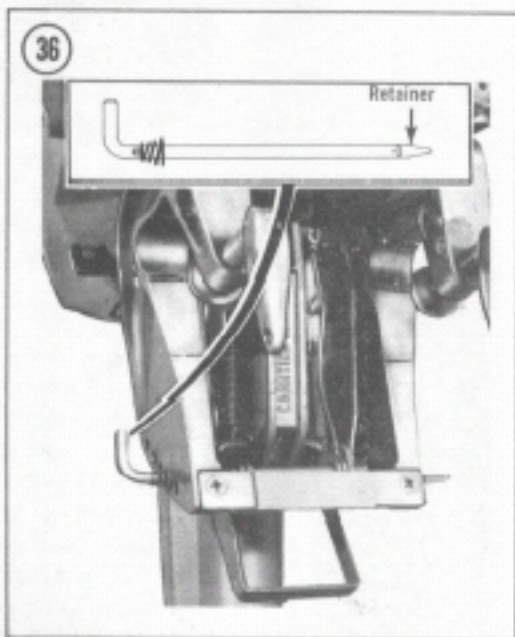
3. Move the tilt lever to the RUN (down) position to lower the motor. See Figure 35. It may be necessary to lift the motor slightly to disengage the tilt lock.

4. Lower the motor slowly until the motor is in running position and automatic lock engages.



Angle Adjustment

The stern bracket has provision for 5 adjustments to allow for transom angle and boat loading. The normal position for the angle adjusting rod will probably be in the second hole from the edge of the boat. See Figure 36. However, the angle should be set for optimum performance depending on the circumstances.



The motor should be perpendicular to the water while the throttle is set wide open and the boat running at full speed.

If the motor is tilted too far forward at the lower unit, the bow will plow and possibly take on water. If the lower unit is tilted too far aft, the boat will porpoise with a loss in steering.

See Figure 37. For best performance, the motor should be positioned so that the boat sits nearly level in the water when running. Position the load and passengers so that the boat maintains the same level attitude.

1. Turn off the motor.
2. Tilt the motor up into the full tilt position as outlined under *Tilting*, in this chapter.
3. Turn the adjusting rod up and press against the spring tension to place the retainer in the release position as shown in Figure 36.
4. Slide the rod out and reinstall in the desired position.
5. Press against the retainer rod spring tension and turn the rod handle down making sure that the retainer locks in position.
6. Replace the motor in the RUN position as outlined under *Tilting*.

MOTOR REMOVAL

1. Disconnect the battery cables on electric start models. Refer to the *Battery* section of this chapter for battery care.
2. Disconnect the safety chain and fuel line.
3. Lift the motor from the boat as described in this chapter under *Lifting Motor*.
4. Store or work on the motor with the power head higher than the lower unit. The lower unit may still have water trapped which could ruin the power head.

WARNING

Never run the engine out of water or with the propeller removed as it will result in overheating and damage to the water pump or total destruction.

TRAILERING

The motor should be placed in the full tilt position to prevent damage while trailering. Make sure that the tilt lock is secure to prevent the motor from falling while traveling over rough roads.

EMERGENCY STARTING

If an electric starter should fail, the motors are equipped with standard rope starters. This

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INCORRECT
Overload forward
causes boat
to "plow"

INCORRECT
Overload aft
causes boat
to "squat"

CORRECT
Balanced load
gives maximum
performance



INCORRECT
Causes boat
to "squat"

CORRECT
Gives maximum
performance

INCORRECT
Causes boat
to "plow"

unit is capable of starting the motor even if the battery is dead or missing since the starting power comes from special coils in the magneto.

In the unlikely event that the rope starter rope should break as well, or if it breaks on a standard start model, remove the motor cover. The broken end of the rope may be long enough to grasp and start as usual.

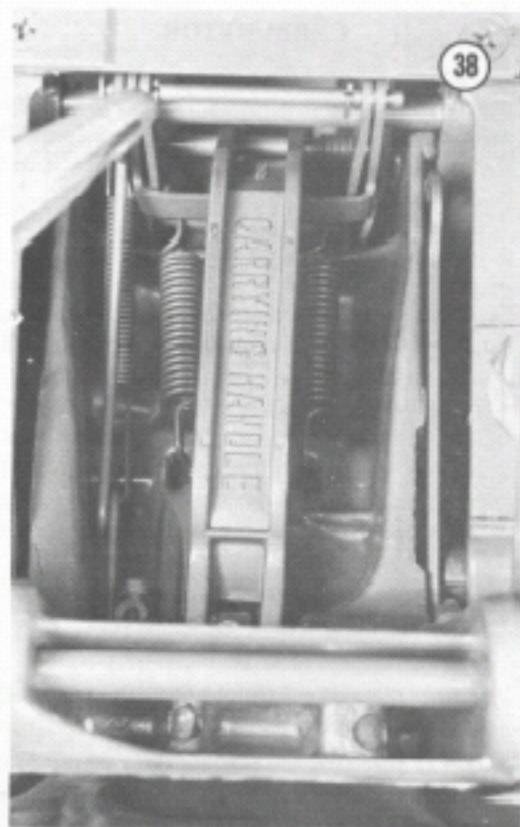
If the rope is too short, use a length of nylon cord or rope as a temporary substitute. Place a knot in the end of the rope and slip it into the flywheel notch and wrap the remainder around clockwise. Follow the normal procedure for manual starting.

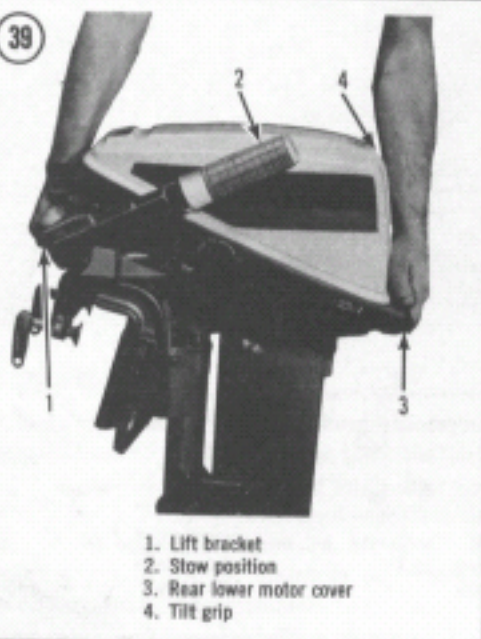
Never attempt to start an electric start model by using jumper cables. The electrical system is completely different from a car's and will be damaged.

LIFTING THE MOTOR

A gripping handle is placed at the balance point for each of the larger motors. Use this lift handle and the rear of the lower motor cover to lift or carry. Place the steering handle in the position as shown in **Figures 38 and 39**. Never use the tilt grip on the motor cover to lift or carry as damage will result.

38





1. Lift bracket
2. Stop position
3. Rear lower motor cover
4. Tilt grip

CARBURETOR

The carburetor comes from the factory set up for most boating conditions. It is assumed that the motor will be run at, or near, sea level. If the motor is run at higher altitudes, then it will be necessary to make adjustments.

Once the carburetor is set for a given altitude it should be left alone. Most home mechanics make the mistake of suspecting the carburetor and fiddling with it first when the most usual cause of problems is electrical. Never toy with the carburetor without following the sequence outlined below. Be sure to adjust the settings after any disassembly and at periodic intervals.

Most owners would be wise to perform a complete tune-up and overhaul at the beginning of each boating season and as often as needs dictate.

Adjustment (1.5-6 hp)

1. Set the control lever on the STOP position.
2. Move the control slowly until the cam just causes the throttle to open.
3. Make sure that the leading edge of the cam follower and the timing mark on the cam are aligned. See Figure 40.

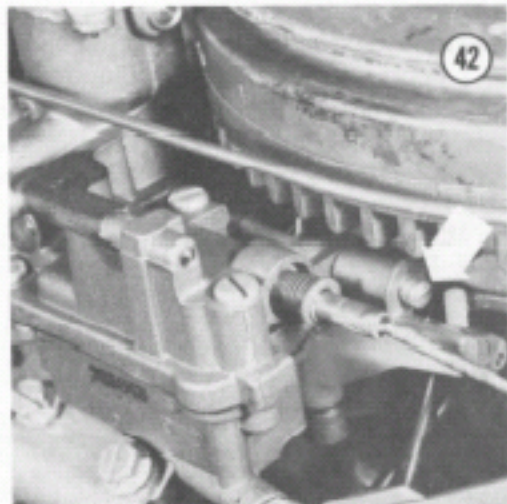
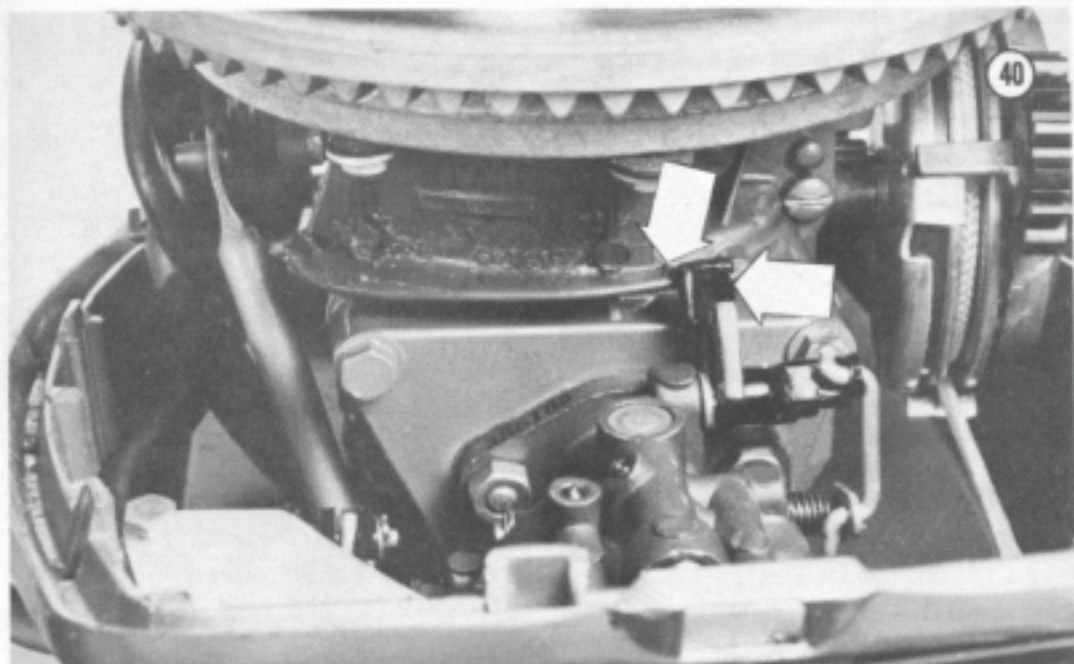
4. If the setting isn't correct, loosen the set screws and move the cam so that the throttle valve closes as the play is taken out of the linkage. The setting is correct when the rounded edge of the cam follower is aligned with the mark on throttle cam just as the throttle opens.

Needle Adjustment (1.5-6 hp)

1. Back out the low-speed needle from its seat by $1\frac{1}{4}$ turns. Never use force since the needles are easily damaged.
2. Run the high-speed needle into its seat and back out approximately $\frac{3}{4}$ turn.
3. Start the engine with the propeller set in a test tank or in the water. Run the engine at partial throttle until the engine warms up completely.
4. Adjust the high-speed needle until the rpm rises to its peak at that throttle setting. Allow 15 seconds for the rpm to stabilize.
5. Adjust the low-speed needle for the highest and smoothest rpm obtainable at the same throttle setting as the high-speed needle. Allow 15 seconds for the rpm to stabilize after setting.
6. Repeat the adjustment of the high-speed needle since it will be affected by Step 5.
7. Pull the low-speed knob off and carefully position it so that the pointer is facing down and reinstall. When the cam and needle valves are set correctly, the engine should idle at 600 rpm. Check with a tachometer to be sure.
8. The throttle tensioner is correct when rpm remains constant and the throttle lever retains its position. To adjust, set the tension screw as needed as shown in Figure 41. The throttle should never be set for "hands off" operation.

Adjustment (9.5-25 hp)

1. Loosen the adjustment screw for the cam follower as shown in Figure 42.
2. Move the follower until it makes contact with the throttle control cam. Turn the throttle on or rotate the magneto until the timing mark on the throttle and on the cam follower are aligned.
3. Check the throttle valve to be sure that it is closed and rotate the throttle lever roller until it rests against the follower.

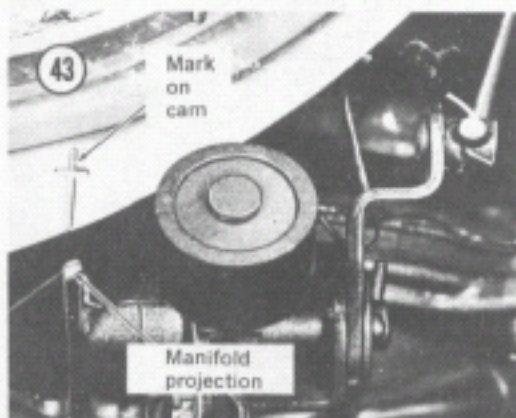


4. Tighten the throttle lever to the shaft to keep it from shifting. Make sure that the setting hasn't shifted while tightening. The throttle valve should start to open as the mark on the cam passes over the center of the roller.

5. Follow the procedure used for adjusting the low-speed needle on 1.5-6 hp engines except turn the needle out $\frac{1}{4}$ of a turn from its seat.

Adjustment (33 hp)

1. Turn the throttle on until the timing mark on the throttle cam is aligned with the projection on the intake manifold as shown in **Figure 43**.

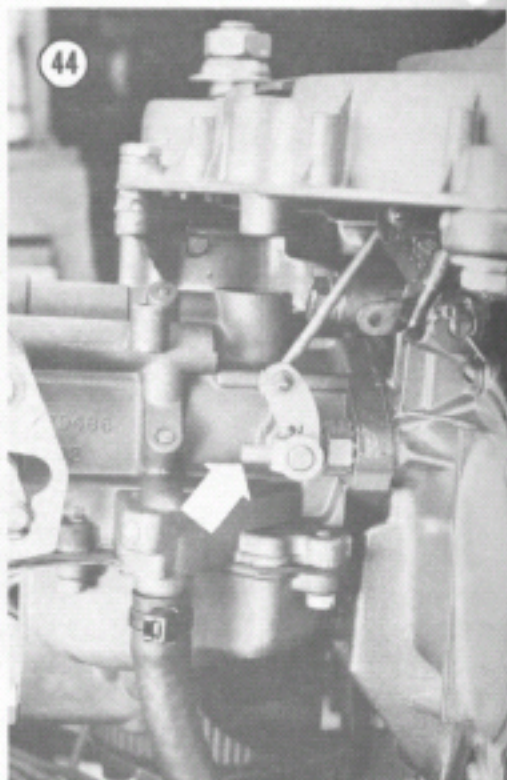


2. Check that the throttle valve is closed and that the cam follower is touching the cam. If not, proceed as follows.

3. Turn on the throttle until the armature plate cam and the raised projection on the intake manifold are aligned as shown in **Figure 43**.

4. Make sure that the throttle valve is closed and loosen the throttle arm clamp screw. Position the cam follower to touch the cam and tighten the screw. Make sure that the setting didn't change. See **Figure 44**.

5. Advance the throttle to make sure that the throttle valve opens as the timing mark on the cam passes the projection on the manifold plate. Readjust if necessary.



6. Set the high- and low-speed needles as outlined for the 1.5-6 hp engines except turn the high-speed needle out $\frac{3}{8}$ of a turn and the low-speed needle $1\frac{1}{4}$. Remove the knobs on the control panel and position to point up in this instance and reinstall. Be careful to not disturb the needle settings when reinstalling the knobs.

CHAPTER THREE

TROUBLESHOOTING

Troubleshooting mechanical problems can be relatively simple if you use orderly procedures and keep a few basic principles in mind.

The troubleshooting procedures in this chapter analyze typical symptoms, and show logical methods of isolating causes. These are not the only methods. There may be several ways to solve a problem, but only a systematic, methodical approach can guarantee success.

Never assume anything. Don't overlook the obvious. If you are running along and the engine suddenly quits, check the easiest, most accessible problem spots first. Is there gasoline in the tank? Is the gas petcock in the ON position? Has a spark plug wire fallen off? Check the ignition switch.

If nothing obvious turns up in a cursory check, look a little further. Learning to recognize and describe symptoms will make repairs easier for you or a mechanic at the shop. Describe problems accurately and fully. Saying that, "it won't run," isn't the same as saying, "it quit at high speed and wouldn't start," or that "it sat in my garage for 3 months and then wouldn't start."

Gather as many symptoms together as possible to aid in diagnosis. Note whether the engine lost power gradually or all at once, what color smoke (if any) came from the exhaust, and so

on. Remember that the more complicated an engine is, the easier it is to troubleshoot because symptoms point to specific problems.

After the symptoms are defined, areas which could cause the problems are tested and analyzed. Guessing at the cause of a problem may provide the solution, but it can easily lead to frustration, wasted time, and a series of expensive, unnecessary parts replacements.

You don't need fancy equipment or complicated test gear to determine whether repairs can be attempted at home. A few simple checks could save a large repair bill and time lost while the engine sits in a dealer's service department. On the other hand, be realistic and don't attempt repairs beyond your abilities. Service departments tend to charge heavily for putting together a disassembled engine that may have been abused. Some won't even take on such a job—so use common sense, don't get in over your head.

OPERATING REQUIREMENTS

An engine needs 3 basics to run properly: correct gas/air mixture, compression, and a spark at the right time. If one or more are missing, the engine won't run. The electrical system is the weakest link of the 3 basics. More problems result from electrical breakdowns than

system chapter for the specific carburetor circuits involved. Misfiring under heavy load, as when accelerating, is usually caused by a faulty spark plug.

FLAT SPOTS

If the engine seems to die momentarily when the throttle is opened and then recovers, check for a dirty main jet in the carburetor, water in the fuel, or an excessively lean mixture.

POWER LOSS

Poor condition of rings, piston, or cylinder will cause a lack of power and speed. Ignition timing should be checked.

OVERHEATING

If the engine seems to run too hot all the time, be sure you are not idling it for long periods. These engines are not designed to operate at a standstill for any length of time. A spark plug of the wrong heat range can burn a piston. An excessively lean gas mixture may cause overheating. Check ignition timing. Broken or worn rings may permit compression gases to leak past them, heating head and cylinder excessively. Check oil level and use the proper grade lubricants.

ENGINE NOISES

Experience is needed to diagnose accurately in this area. Noises are hard to differentiate and harder yet to describe. Deep knocking noises usually mean main bearing failure. A slapping noise generally comes from a loose piston. A light knocking noise during acceleration may be a bad connecting rod bearing. Pinging should be corrected immediately or damage to the piston will result. A compression leak at the head-cylinder joint will sound like a rapid on-and-off squeal.

PISTON SEIZURE

Piston seizure is caused by incorrect piston clearances when fitted, fitting rings with improper end gap, too thin an oil being used, incorrect spark plug heat range, or incorrect

ignition timing. Overheating from any cause may result in seizure.

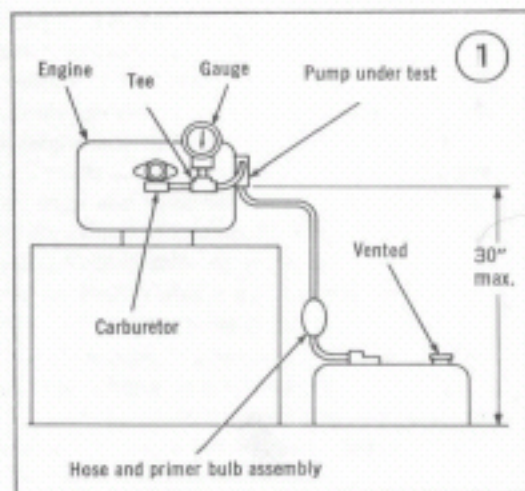
EXCESSIVE VIBRATION

Excessive vibration may be caused by loose motor mounts, worn bearings, or a generally poor running engine.

FUEL PUMP (3-33 hp)

Conduct test in a test tank or on the boat in the water.

1. Connect a fuel pressure gauge between the carburetor and fuel pump (see **Figure 1**).



2. Loosen fuel tank gas cap momentarily to release any pressure that may have built up.

3. Start motor and observe gauge. Pump pressures should read as in **Table 1**.

Table 1 FUEL PUMP PRESSURE

600 rpm	1 psi
2,500-3,000 rpm	1.5 psi
4,500 rpm	2.5 psi

ELECTRICAL PROBLEMS

A dead battery or one which discharges quickly may be caused by a faulty alternator or rectifier. Check for loose or corroded terminals. Shorted battery cells or broken terminals will keep a battery from charging. Low water level

TROUBLESHOOTING

will decrease a battery's capacity. A battery left uncharged after installation will sulphate, rendering it useless.

A majority of electrical problems are caused by loose or corroded ground connections. Check those first, and then substitute known good units for easier troubleshooting.

To determine accurately the condition of the components of the electrical system, an ignition analyzer should be used. Without the use of such test equipment, coils, condensers, or point assemblies may be replaced needlessly. Refer such work to a dealer. Simple checks can be performed with inexpensive equipment.

MAGNETO

Remove spark plug wires. Grasp the wire by the rubber boot and twist off counterclockwise.

Crank engine with starter or by rope. Hold the cap $\frac{1}{4}$ inch from the plug end using a cloth or other insulation to keep from getting a shock.

A strong, blue spark indicates that the magneto and coil are probably in good condition. Proceed with the next step if there is no spark.

Ignition Coil

1. Remove the ignition coil for testing with an ohmmeter or test light.
2. Check the primary coil black/white wire for continuity with a probe.

3. Check the secondary coil for continuity between bracket and high tension wire. If there is no continuity, replace the coil.

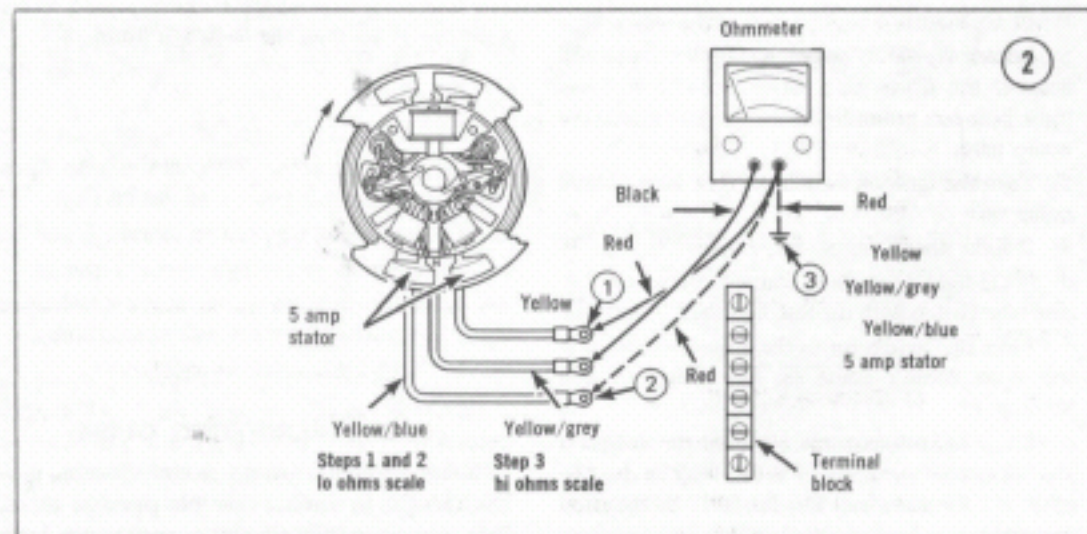
4. Check the condenser, as previously described. If the capacity or insulation resistance is less than specified, replace the coil.

Stator Test

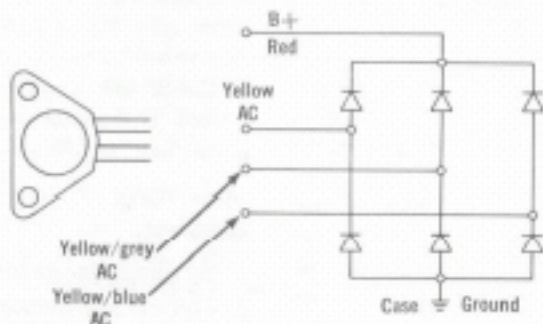
1. Set ohmmeter on lowest OHMS scale.
2. Connect the ohmmeter to the leads of the stator as shown in **Figure 2**. The reading should be 0.25-0.45 ohms.
3. Move the ohmmeter lead from the yellow stator lead, as shown at point 1 in **Figure 2**, and connect it to yellow/grey wire at point 2. This reading should also be 0.25-0.45 ohms.
4. Connect the black ohmmeter lead to point 2 and red to point 3 as in **Figure 2**. The ohmmeter should read infinity indicating an open circuit. If any other reading is indicated then the stator is shorting to ground.

Rectifier Test

1. Connect one lead of the ohmmeter to the yellow/grey lead of the rectifier and the other ohmmeter lead to the case (ground). Refer to **Figure 3** for a schematic of the rectifier.
2. Make note of the reading on the ohmmeter.



3



3. Reverse the ohmmeter leads or the polarity switch and again check the reading. If the reading was the same in both directions, the diode is faulty and should be replaced. A diode works like a one-way switch and only permits current to flow in one direction. A zero reading in one direction and infinity in the other is correct.

4. Repeat the preceding test for the yellow lead and ground; yellow/grey lead and ground; yellow/blue lead and ground; red and yellow leads; red and yellow/blue leads. Each of the wire pairs will have similar results and indicate a different portion of the rectifier.

Starter System

Check the remainder of the electrical system, including the battery, all connections and leads for worn insulation prior to testing the starter. Refer to **Figure 4** for the following steps.

1. Locate the safety switch at check point 1 and remove the white wire. Connect a 12-volt test light between ground (the engine case) and the white wire.

2. Turn the ignition switch on. The light should come on.

3. If light doesn't come on, proceed to Step 7.

4. If the light does glow, connect the white wire onto the switch with the test light still connected.

5. Turn the switch on to the START position. If the light doesn't come on this time, proceed to Step 16.

6. If the light does come on, then the switch is not connected properly or is faulty. The throttle may also be advanced too far for it to function properly.

NOTE: In the following steps turn key to OFF position prior to connecting or disconnecting the light to avoid getting a shock.

7. Connect the test light at check point 2. If the light comes on, the wire is not making contact between points 1 and 2.

8. If it doesn't light, proceed to Step 9.

9. Connect the test light at check point 3. If the light comes on then the solenoid switch is faulty.

10. If the light doesn't come on then proceed to the next step.

11. Connect the test light at check point 4. If the light comes on then the wire between points 3 and 4 is not connected.

12. If the light doesn't come on then proceed to the next step.

13. Connect the test light at check point 5. If the light comes on then the switch is faulty.

14. If there is no light then proceed to the next step.

15. Connect the test light at check point 6. If the light doesn't come on, check for an open circuit between the point and the battery.

16. Connect light between terminals A and B.

17. With switch off, the light should come on.

19. If the test light comes on with the switch in the START position then the solenoid is faulty.

TROUBLESHOOTING GUIDE

Table 2 summarizes the troubleshooting process. Use it to outline possible problem areas, then refer to specific chapter or section involved.

STARTER SYSTEM

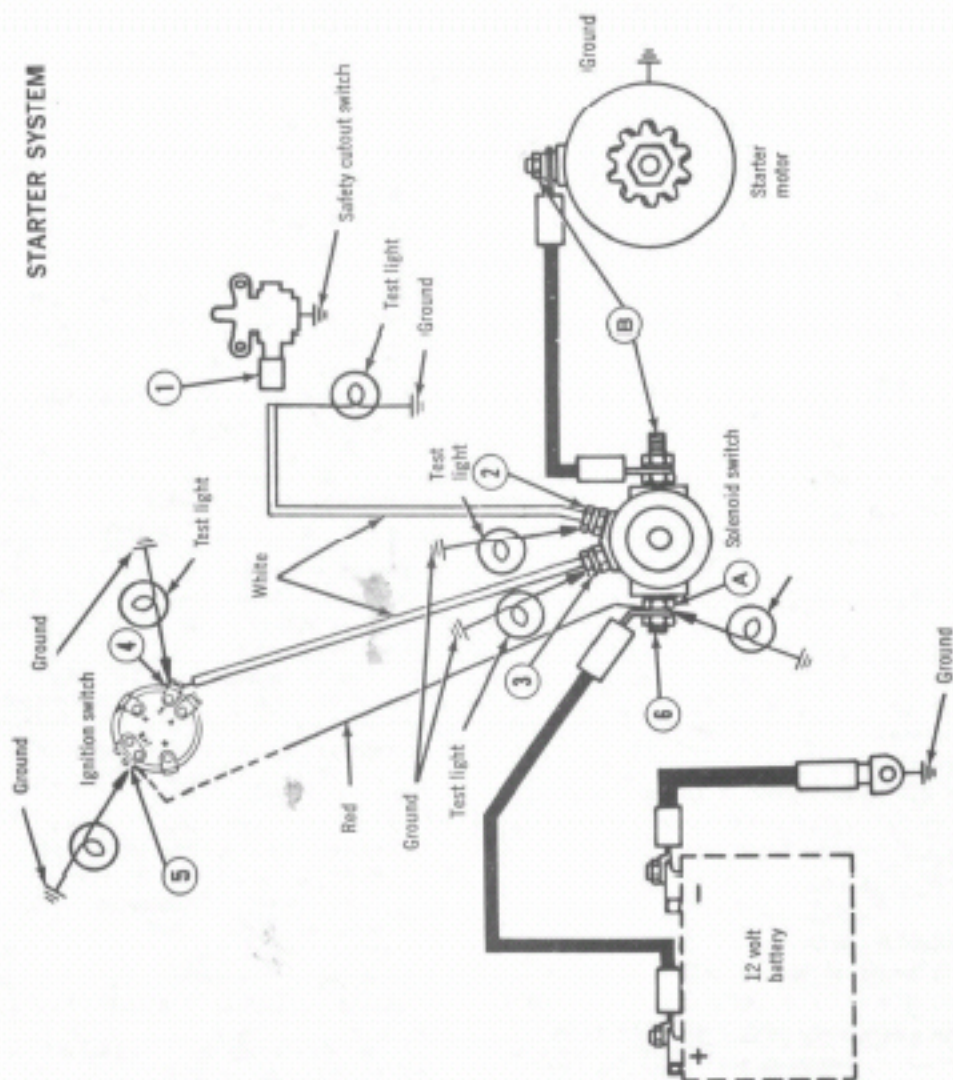


Table 2 TROUBLESHOOTING GUIDE

Item	Problem or Cause	Things to Check
Motor won't start	Fuel system	Fuel petcock closed Faulty fuel system Vent cap closed Fuel filter clogged Throttle closed Engine flooded Fuel deterioration from age
	Ignition system	Faulty system Improperly adjusted cam and/or linkage Flywheel key sheared Breaker cam inverted
Loss of power	Fuel tank	Petcock restricted Fuel line faulty Filter filled with dirt Vent closed
	Carburetor	Poor fuel mix (usually too much oil) Loss due to altitude and consequential carburetion change Adjustment (too rich—engine smokes; too lean—engine backfires) Choke malfunction Float setting incorrect Inlet needle worn or sticking Air leaks at manifold or gaskets
	Power head	Stuck piston rings Scored cylinder or piston Carburetor and magneto synchronization Poor compression (worn rings) Broken reed valves (backfiring) Excessive carbon on piston/cylinder head
	Overheating	Leakage at exhaust cover gasket Improper water tube installation Worn pump chamber Leaking head gasket (look for water in cylinder or a warped head) Poor ignition timing Carbon buildup on piston/cylinder head Water passages obstructed Air bleeder obstructed Damaged pump impeller Improperly installed power head or gasket
	Exhaust gas entering carburetor	Lower bearing housing screws loose Exhaust housing cracked Exhaust cover screws leaking Cover plate gasket damaged Exhaust relief opening obstructed
	Lower unit	Vibration (bent propeller) Clogged exhaust outlet

CHAPTER FOUR

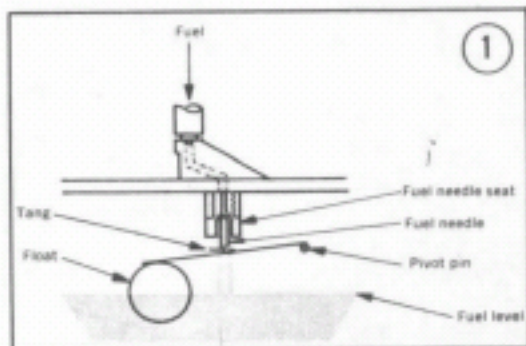
FUEL SYSTEM

For proper operation, a gasoline engine must be supplied with fuel and air mixed in the proper proportions by weight. A mixture in which there is excess fuel is said to be rich. A lean mixture is one which contains insufficient fuel. It is the function of the carburetors to supply the proper mixture to the engine under all operating conditions.

CARBURETOR OPERATION

The essential functional parts are a float and float valve mechanism for maintaining a constant fuel level in the float bowl, a system for supplying fuel at low speeds, a main fuel system which supplies the engine at medium and high speeds, and a choke system, which supplies the very rich mixture needed to start a cold engine. The operation of each system is discussed in the following paragraphs.

Figure 1 illustrates a typical float mechanism. Proper operation of the carburetor is dependent on maintaining a constant fuel level in the carburetor bowl. As fuel is drawn from the float bowl, the fuel level drops. When the float drops, the float valve moves away from its seat and allows fuel to flow past the valve and seat into the float bowl. As this occurs, the float is then raised, pressing the valve against its seat, thereby

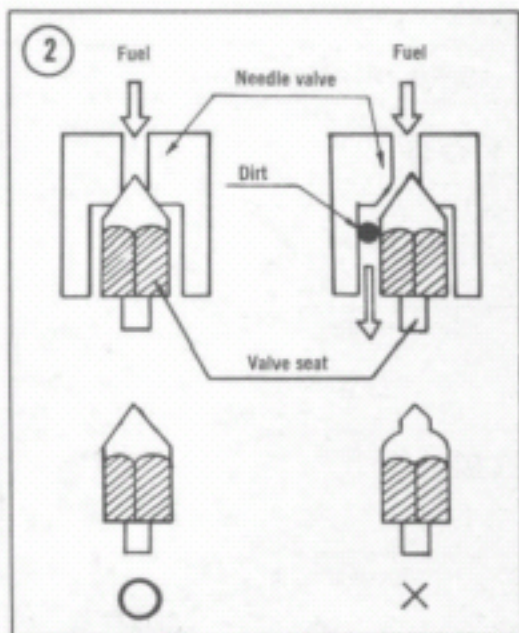


shutting off the flow of fuel. It can be seen from this discussion that a small piece of dirt can be trapped between the valve and seat, preventing the valve from closing and allowing fuel to rise beyond the normal level, resulting in flooding. **Figure 2** illustrates this condition.

On the upstroke of the piston a vacuum is created which causes fuel to be drawn into the throat of the carburetor.

The fuel is atomized by air rushing past the needles. The flow is determined by the size of the needle jet and is regulated to produce a mixture ratio of 12:1 at high speeds and 8:1 at lower idling speeds.

All engines are produced now with adjustable needle jets which automatically compensate for altitude changes over a limited range.



The throttle valve can cut down on the amount of air and gas entering the cylinder to control the rpm of the engine over its entire operating range from idle to high speed.

A choke valve is incorporated to produce a richer than normal mix of fuel and air until the motor warms up completely.

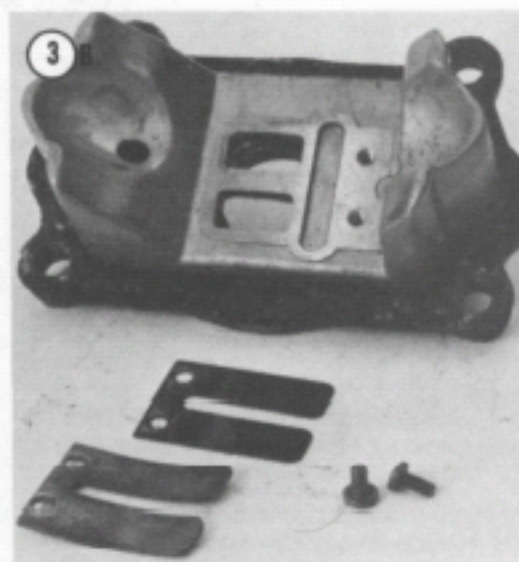
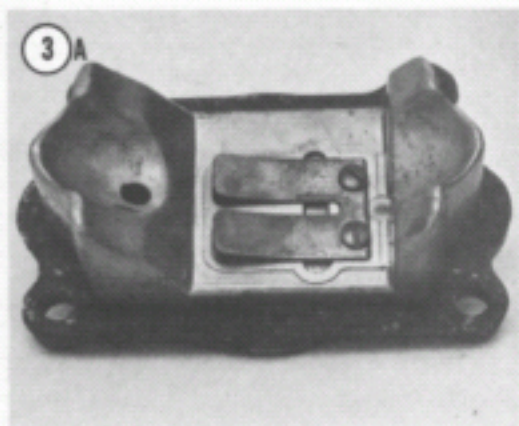
The throat of a carburetor is often called a "barrel." A single-barrel carburetor has only one throat. Two-barrel carburetors have 2 throats, 2 complete sets of metering devices, but only one float bowl and float.

The reed valves operate with the demands of the engine. As the throttle opens, a vacuum is created which causes the leaves, or reeds as they are often called, to open and allow in fuel and air. The design of the valves is such that they will only operate in one direction so that backfiring, and the inherent engine damage, is minimized. See Figures 3A and 3B for details of a typical reed valve.

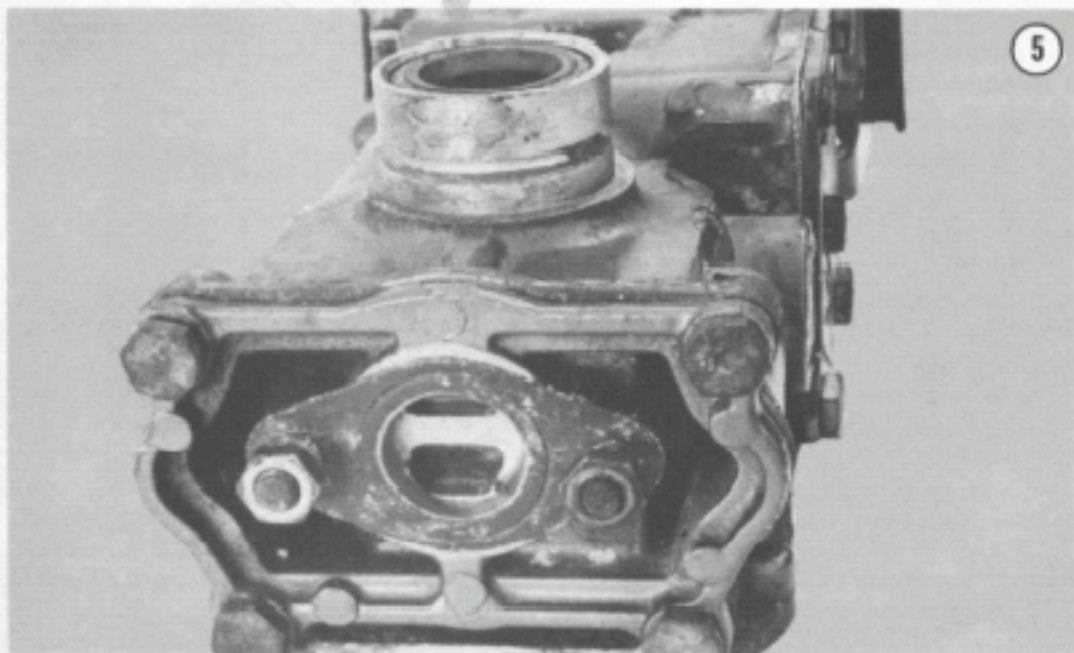
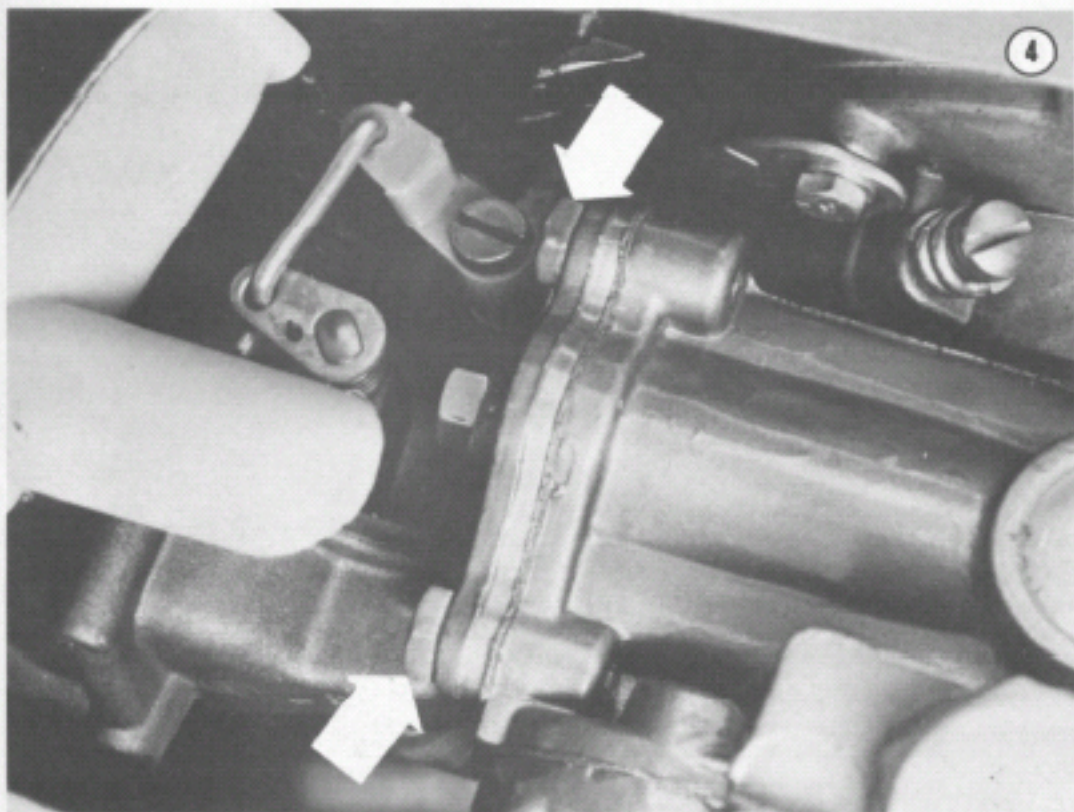
FUEL SYSTEM (GAS TANK, CARBURETOR, REED VALVES)

Removal/Installation (1.5-2 hp)

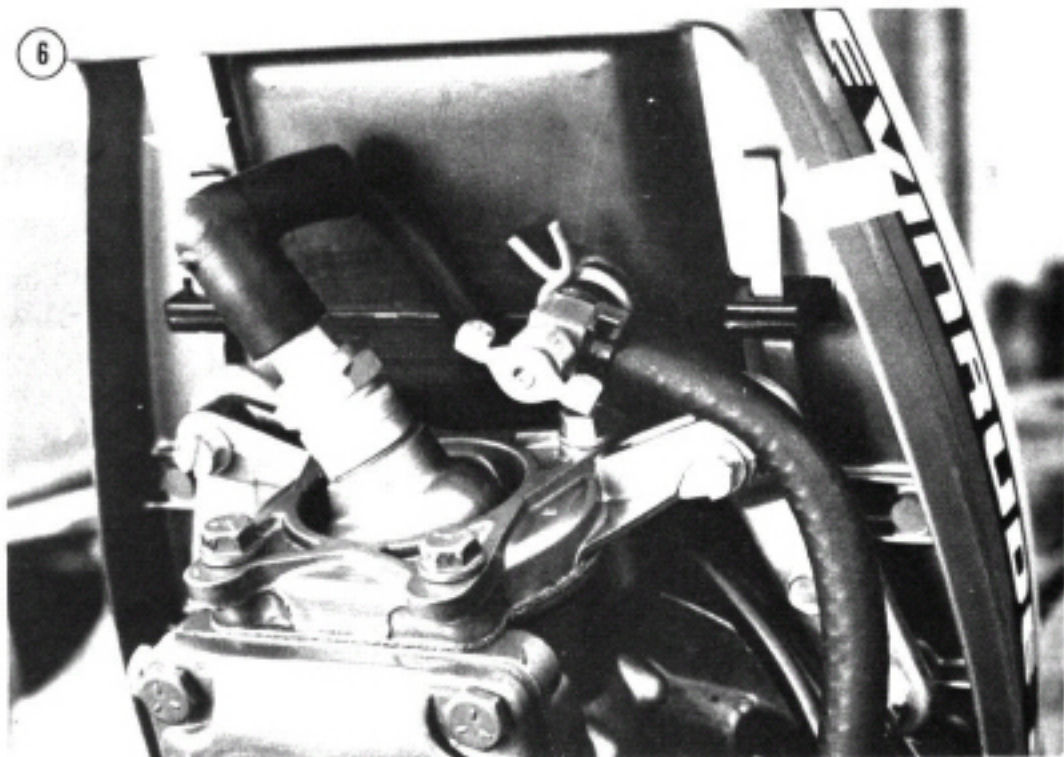
1. Shut off the fuel supply at the valve.
2. Remove the low-speed control knob.



3. Remove starter as outlined in Chapter Eight.
4. Disconnect the fuel line.
5. Remove carburetor control panel.
6. Remove fuel tank support bracket at the cylinder head.
7. Align the speed control lever with the slot in the support bracket and remove the air cleaner, fuel tank, and support bracket.
8. Remove the attaching nuts and carburetor as shown in Figure 4.
9. Remove the intake manifold, reed valves, and gaskets from the cylinder head. See Figure 5.
10. Pull out the 2 retainers and remove the fuel tank as shown in Figure 6.



6



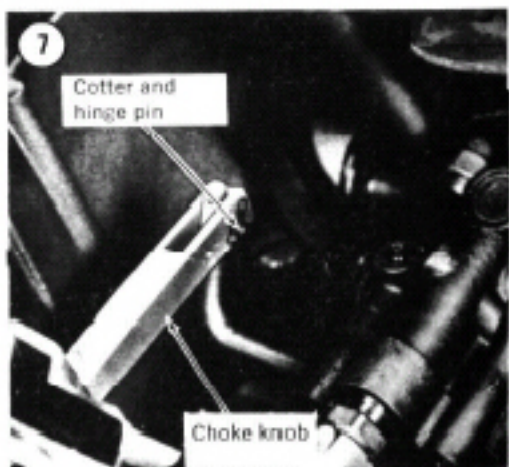
11. Reverse the preceding procedure to install being sure to clean all parts and use new gaskets where necessary.

Removal/Installation (3-6 hp Engines)

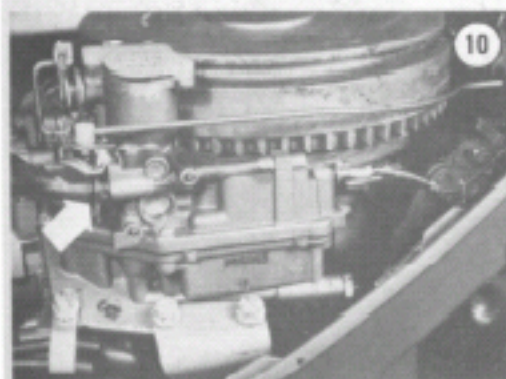
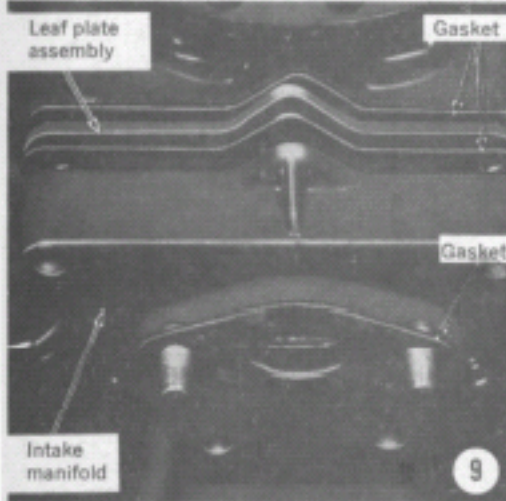
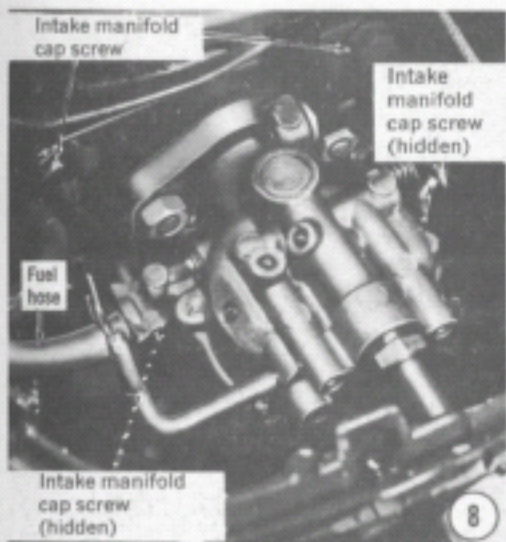
1. Shut off fuel at the valve.
2. Remove the motor cover.
3. Remove high- and low-speed knobs.
4. Remove the cotter pin and choke knob as shown in **Figure 7**.
5. Remove the cam follower spring from the manifold.
6. Disconnect the fuel hose. See **Figure 8**.
7. Remove the intake manifold, gaskets, and reed valve assembly from the power head as shown in **Figure 9**.
8. Reverse the procedure to install being sure to clean all parts and install fresh gaskets.

Removal/Installation (9.5 hp Engines)

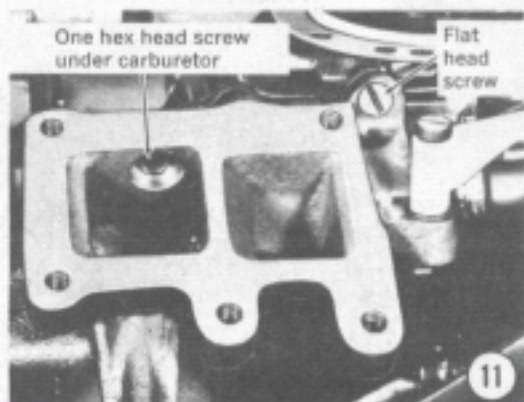
1. Disconnect the fuel line at the carburetor (**Figure 10**).



2. Lift the rod from the bellcrank to disconnect the choke.
3. Unhook the spring from the low-speed needle cable.
4. Remove low-speed knob and feed the end of the cable through the control panel.
5. Remove the carburetor from intake manifold.



6. Remove the intake manifold and reed valve plate from the crankcase as shown in **Figure 11**.

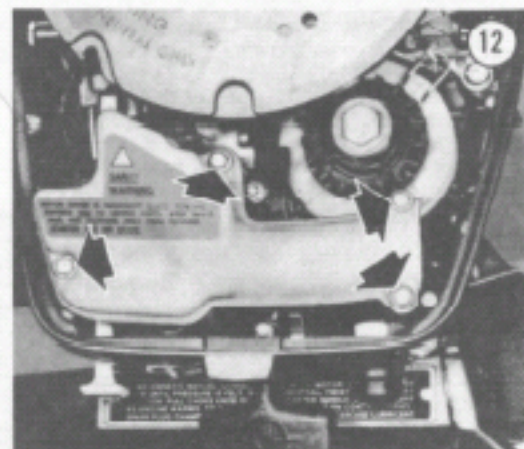


7. Reverse the procedure to install. Use new gaskets and clean all parts thoroughly. Tighten the flat-head screw prior to the hex-head screws when installing the carburetor to avoid warping the body. Do not install the low-speed knob until after the carburetor has been adjusted.

8. Refer to Chapter Two for carburetor adjustment and synchronization.

Removal/Installation (9.9-15 hp Engines)

1. Shut off the fuel at the valve.
2. Remove the low-speed knob from the cable.
3. Refer to **Figure 12** and remove the air silencer cover.



4. Remove the air silencer base from the carburetor. See **Figure 13**.

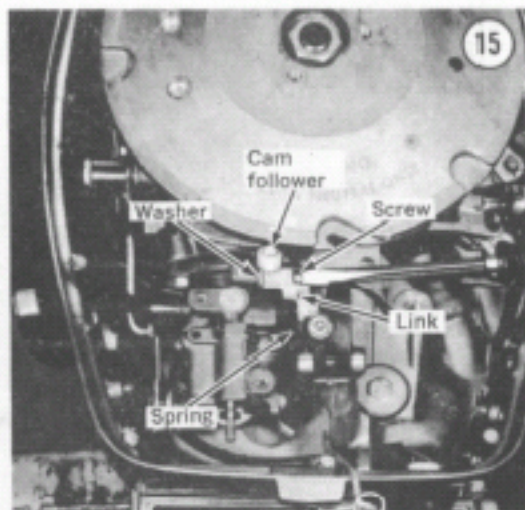


5. Remove choke detent as shown in **Figure 14**. Disconnect the choke lever and remove the shaft from the lower motor cover.

6. Remove the starter (see Chapter Eight).

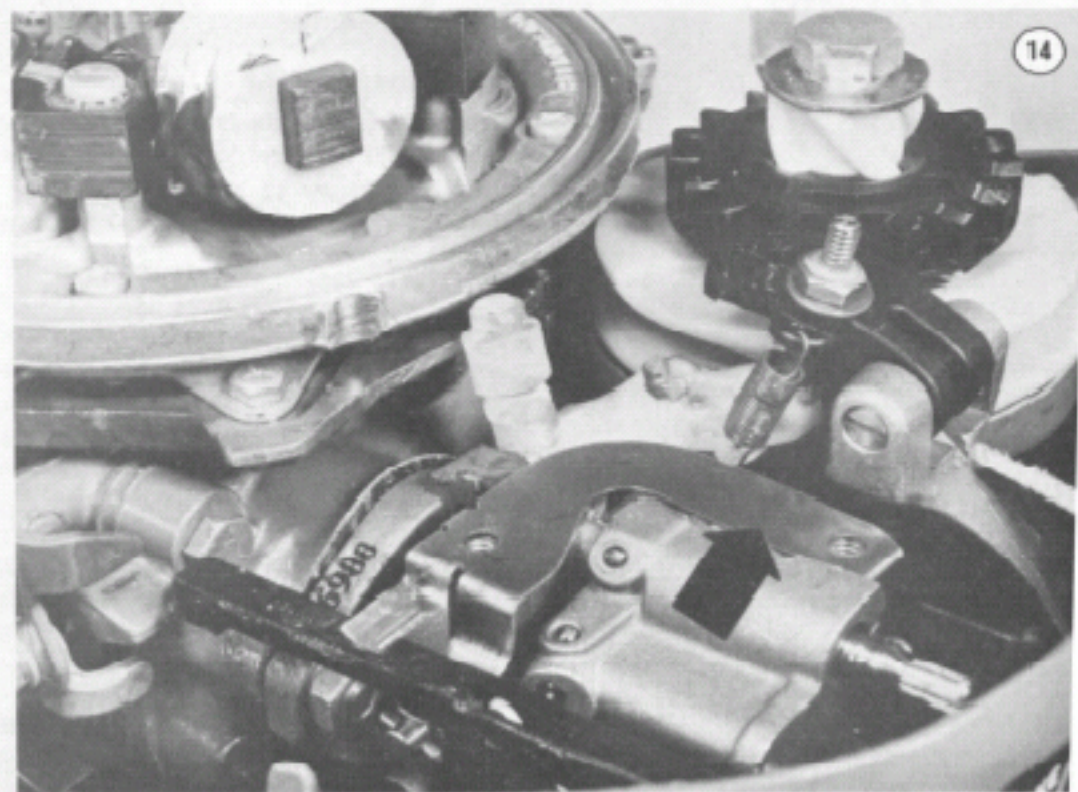
7. Disconnect the cam follower from the starter lock-out pawl spring. See **Figure 15**. Note the location of the link in the lever.

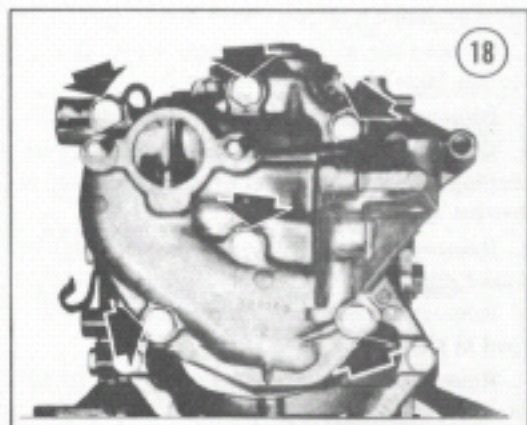
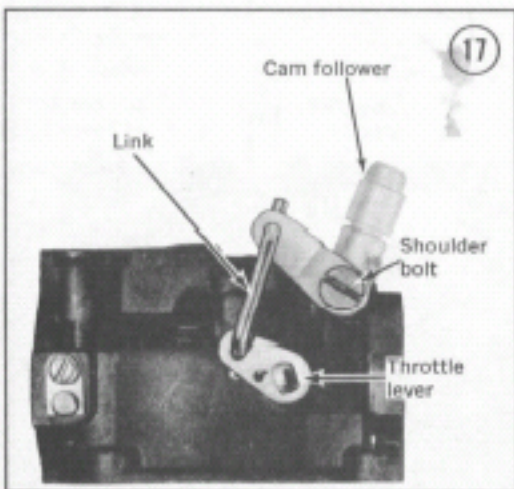
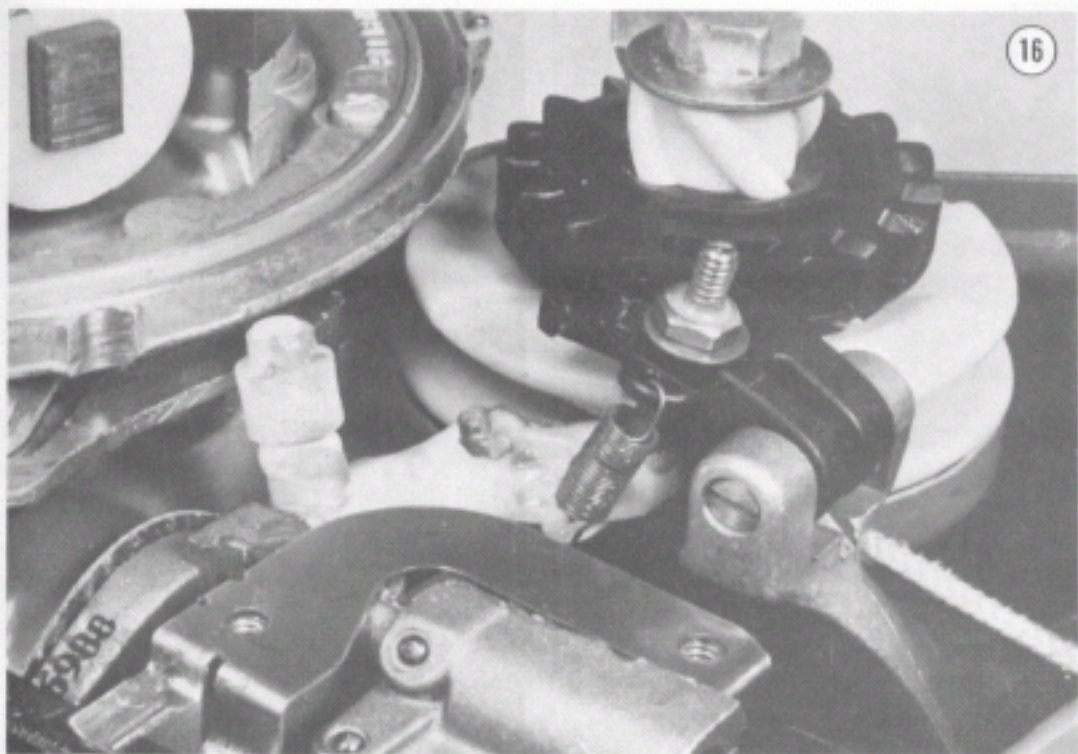
8. Remove the carburetor, gasket, and link from the manifold as an assembly. Note the location



of the link on the lever as shown in **Figures 16 and 17**. The link must be installed in the throttle lever first during assembly since the starter lock-out bracket interferes with its installation later.

9. Disconnect the fuel hose from the carburetor.





10. Remove the intake manifold as shown in Figure 18.

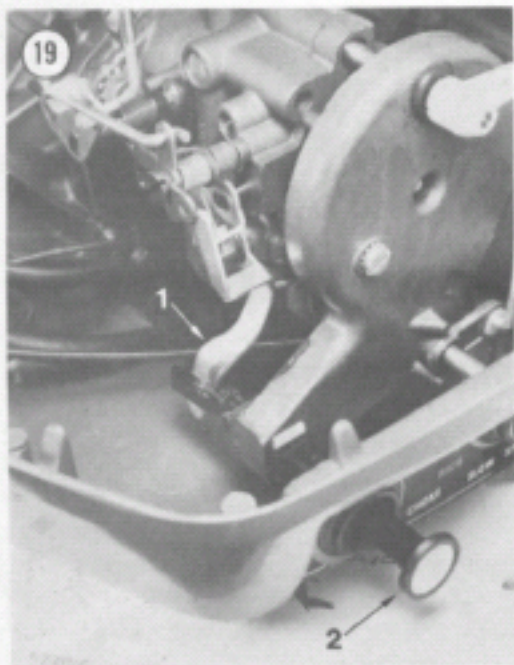
11. Remove the reed valve plate and gasket from the crankcase.

12. Reverse the removal procedure to install the carburetor, reed valves, and silencer. Be

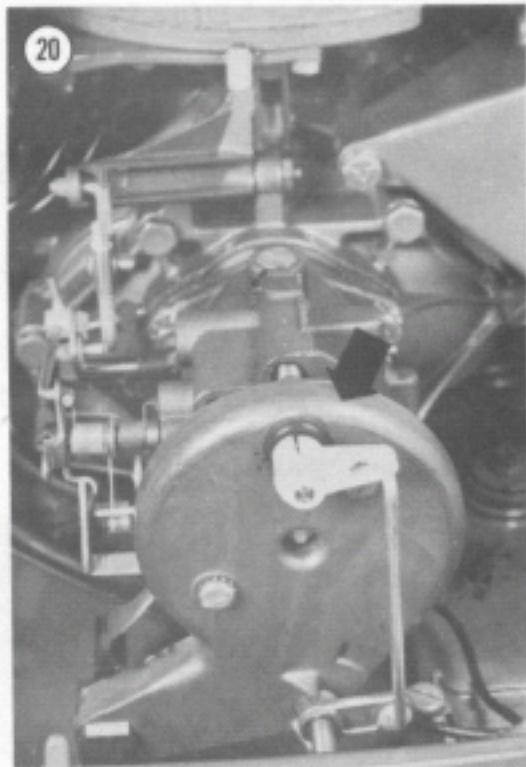
sure to use new gaskets during assembly and clean all parts carefully.

Removal/Installation (18-25 hp Engines)

1. Shut off fuel supply.
2. Remove choke lever. Lift up on the choke arm to remove the control knob from the carburetor. See Figure 19.



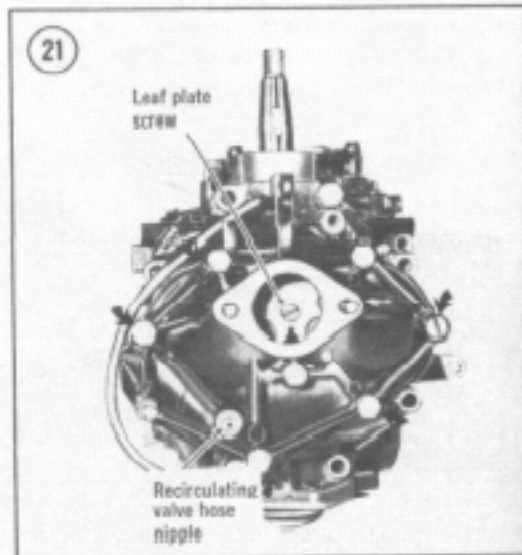
1. Choke arm
2. Control knob



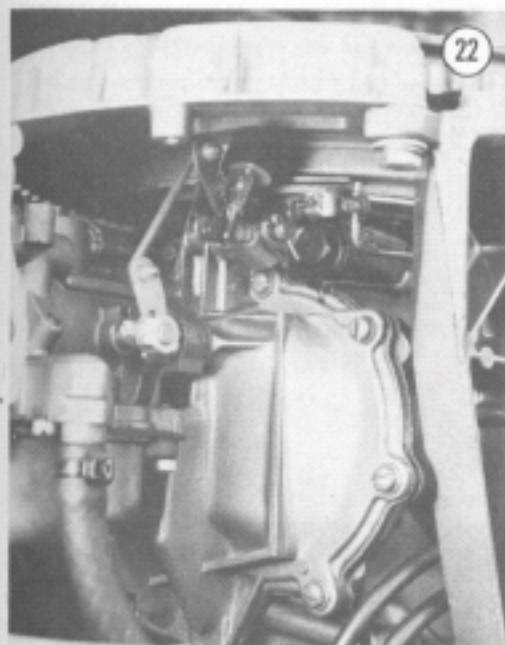
3. Remove the low-speed arm from the needle valve as shown in **Figure 20**.
4. Remove the air silencer cover from the carburetor body as shown in **Figure 20**.
5. Disconnect the cam follower-to-throttle link.
6. Disconnect the fuel line from the fuel pump keeping the free end above the float chamber to prevent spillage.
7. Remove the carburetor and gasket from the intake manifold.
8. Remove the intake manifold from the power head as shown in **Figure 21**.
9. Remove the reed valve assembly and gasket from the crankcase.
10. Reverse the removal procedure to install being sure to use new gaskets and clean parts. Adjust and synchronize the carburetor as outlined in Chapter Two of this manual.

Removal/Installation (33 hp Engine)

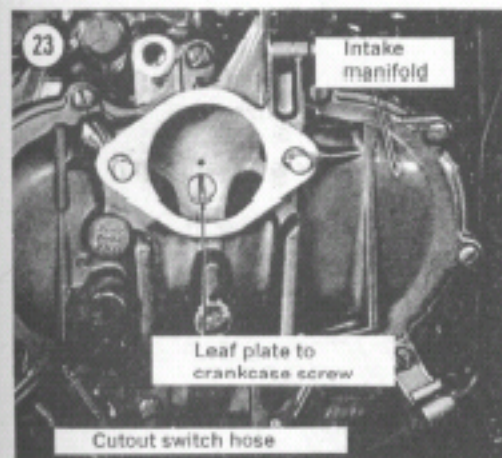
1. Shut off the fuel valve.
2. Disconnect the fuel line at the carburetor as shown in **Figure 22**.



3. Remove the lever pin at the throttle arm and remove the link.
4. Remove the electric starter as described in Chapter Five.



5. Disconnect the choke solenoid wire at the screw terminal and remove the carburetor with its gasket.
6. Remove the cotter pin from the lever lock-out rod and remove from the throttle lever.
7. Remove the cutout switch hose. Remove the intake manifold from the power head as shown in Figure 23.



8. Remove the reed valve assembly and gasket from the crankcase.

9. Reverse the removal procedure to install using new gaskets. Adjust and synchronize the carburetor as described in Chapter Two.

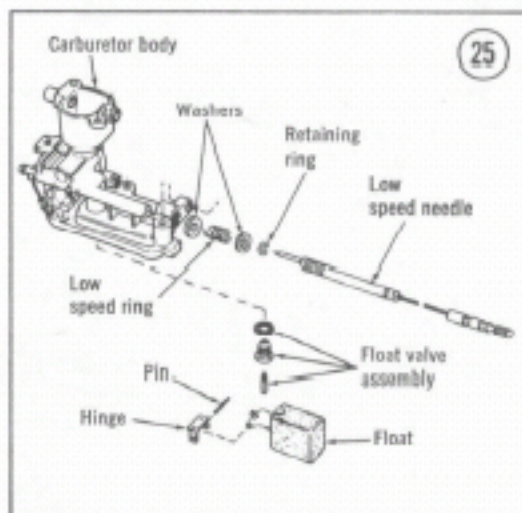
CARBURETOR

Disassembly (1.5-6 hp)

1. Drain the carburetor float bowl.
2. Remove the packing nut and the high-speed needle as shown in Figure 24.
3. Remove the float bowl from the chamber.
4. Remove low-speed valve and packing nut.
5. Remove hinge pin, float, float valve, valve seat, and gasket.
6. Refer to Figure 24 to remove the high-speed nozzle and boss gasket.
7. Clean all parts to free them of gum and varnish deposits. Replace any parts which are obviously defective. See the section titled *Cleaning and Repair* in this chapter.

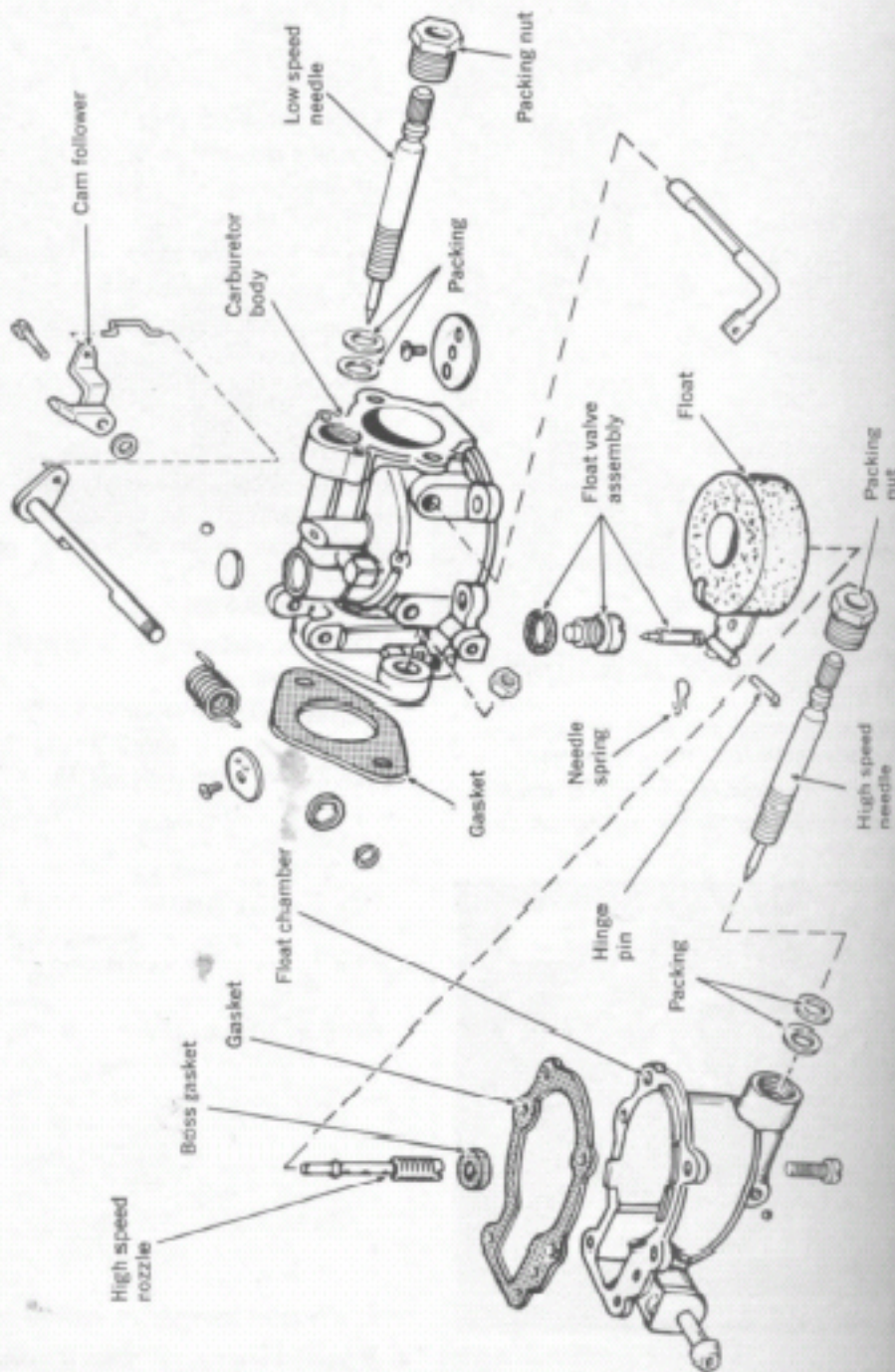
Disassembly (9.5 hp)

1. Drain the carburetor float bowl by removing the screw plug.
2. Remove the float bowl.
3. Remove the low-speed needle, 2 washers, and spring as shown in Figure 25.

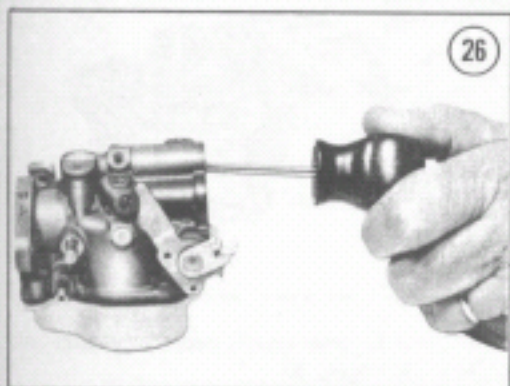


4. Remove the hinge pin, float, float valve, valve seat, and gasket.
5. Remove the air filtering screen.

CARBURETOR ASSEMBLY (1.5-6 HP)



- Use a special fixed-jet screwdriver, as shown in **Figure 26**, and remove the high-speed jet.
- Refer to the section titled *Cleaning and Repair* in this chapter to continue.

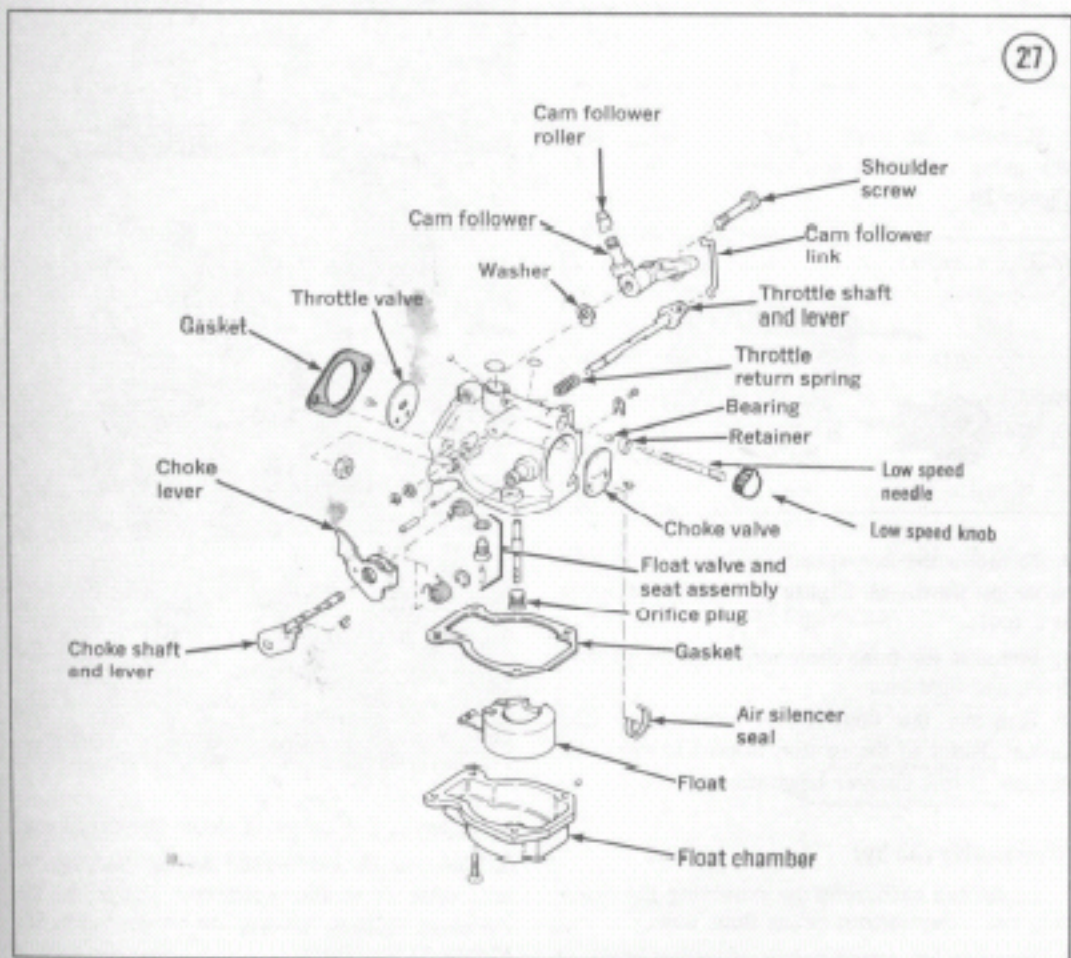


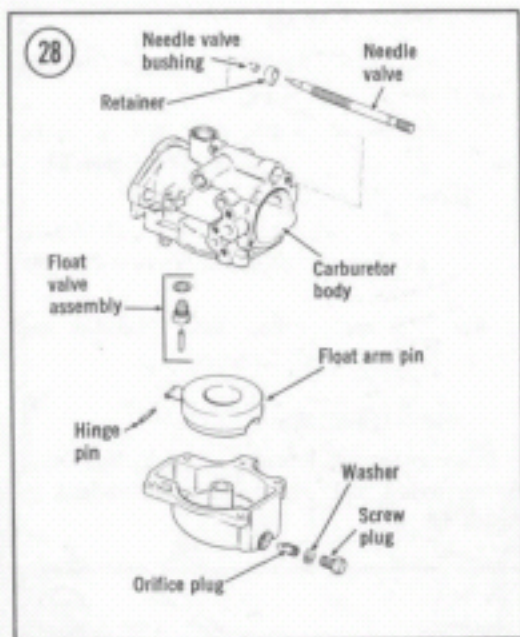
Disassembly (9.9-15 hp)

- Drain float bowl by removing the screw plug.
- Remove the float bowl.
- Remove the hinge pin, float, float valve assembly, valve seat, and gasket. See **Figure 27**.
- Remove orifice plug.
- Using the low-speed knob as a tool, remove the low-speed needle (Figure 27) in a counter-clockwise direction.
- Refer to the section titled *Cleaning and Repair* in this chapter to continue.

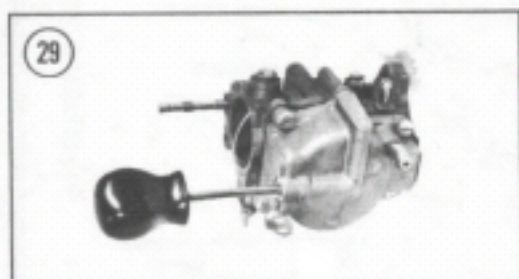
Disassembly (18-25 hp)

- Remove the fuel line and drain the float bowl by removing the screw plug as shown in **Figure 28**.





2. Remove the orifice plug (fixed high-speed jet) using a special screwdriver as shown in **Figure 29**.



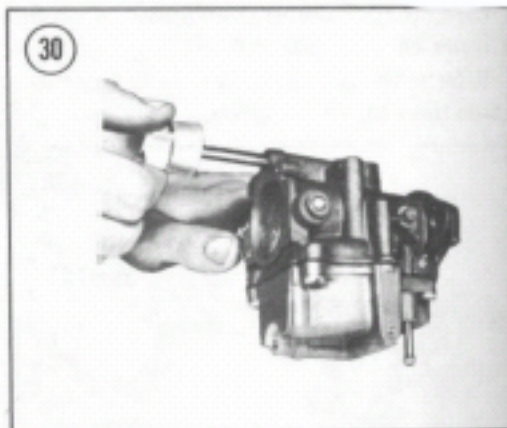
3. Remove the low-speed retainer and needle valve as shown in **Figure 30** using the knob as a tool.

4. Remove the float chamber, nylon hinge pin, float, and float arm.

5. Remove the float valve, valve seat, and gasket. Refer to the section titled *Cleaning and Repair* in this chapter to continue.

Disassembly (33 hp)

1. Drain the carburetor by removing the drain plug from the bottom of the float bowl.
2. Remove low-speed needle adjusting knob.

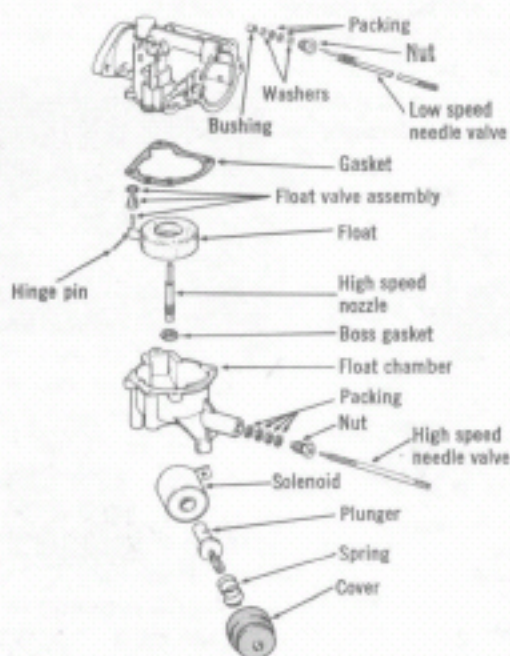


3. Remove the low-speed needle valve arm link as shown in **Figure 31**.



4. Remove control panel from the carburetor.
5. Remove the low-speed needle packing nut and valve from the carburetor body. Use the knobs as tools to extract the needle valve. See **Figure 32** for clarity.

32



6. Remove the needle valve gaskets and washers being careful to avoid damaging the threads.
7. Remove the choke solenoid and linkage on the electric starter models.
8. Remove the float bowl and gasket.
9. Remove the nylon hinge pin, float, and float arm.
10. Remove the float valve, valve seat, gasket, and high-speed nozzle.
11. See *Cleaning and Repair* to continue with overhaul.

3. Flush all passages of the carburetor body with solvent to remove gummy deposits.

Float and Needle Valve (All Models)

1. Inspect the float and arm for wear or damage. Install a new float if there is damage or oil-soaking.
2. Check the float arm wear in the hinge pin and needle valve contact areas.
3. Replace the float valve assembly if there is any evidence of grooves, nicks, or scratches on the inlet needle. See Figure 33.

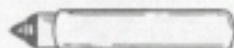
CLEANING AND REPAIR

Cleaning (All Models)

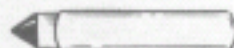
1. Clean all parts, except the float, in solvent and blow dry. Never dry parts with cloth or paper toweling. Lint or dust could enter the narrow passages of the carburetor and impede operation.
2. Remove any particles of gaskets from the sealing surfaces.

33

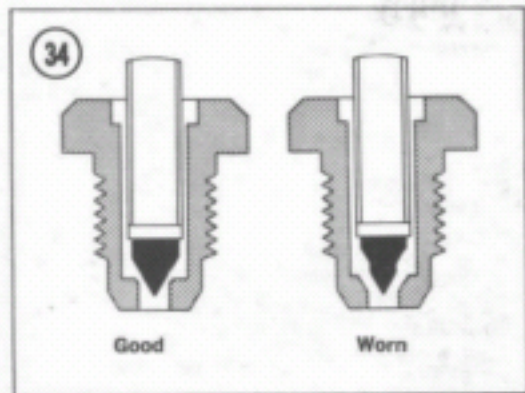
Worn



Good

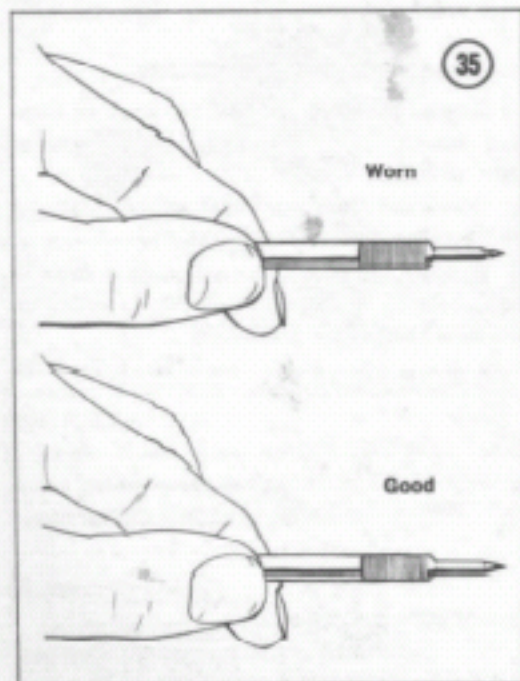


4. The needle valve seat can cause poor performance if it is nicked, scratched, or out-of-round. Check the seat carefully with a magnifying glass as shown in **Figure 34**. The seat and needle area are a matched set so both must be replaced at one time if either is damaged as described.



Needle Valves (All Models)

1. Check the needle valves at the tapered end, with a magnifying glass, for nicks, grooves, or scratches. Replace as needed if the needle looks like the worn example in **Figure 35**.



2. Do not attempt to alter the needle's shape or repair it in any way. Always replace the needle and seat as a pair.

Reed Valves (All Models)

The reed valves, recirculating check valves, and screens must be free of all varnish and gum deposits. Disassemble and clean if necessary. The reed valves must lay perfectly flat so that they form a perfect seal against the reed valve plate.

The clearance for the reed should be $\frac{1}{4}$ in. as shown in **Figure 36**. Never attempt to bend or repair a reed petal. Replace if the petal is damaged or not seating properly.

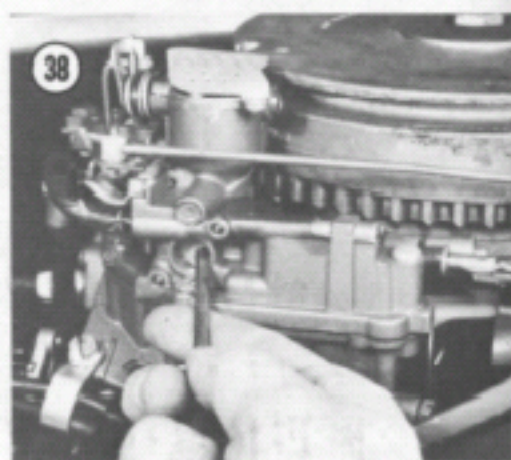
The reed petal stop plate may be bent as needed for proper clearance.

Core Plugs (All Models)

1. If the low-speed orifice becomes plugged, it may be necessary to remove the core plugs to clean them.

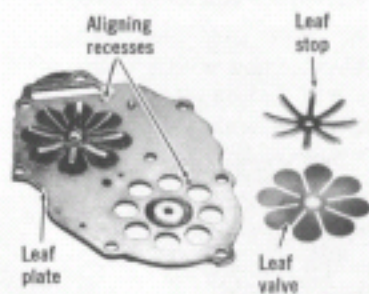
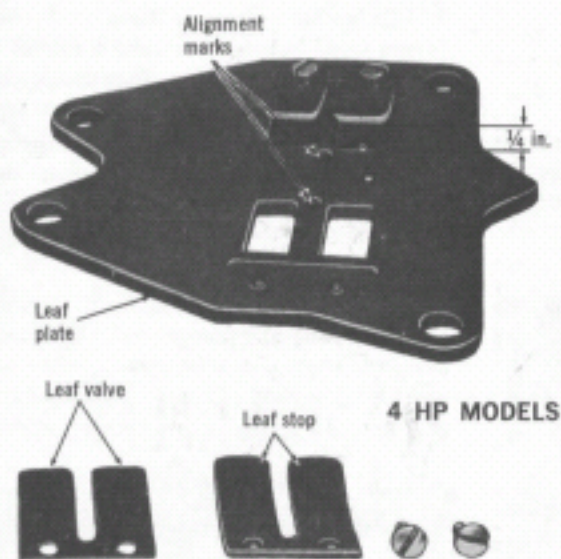
2. If leakage occurs from a core plug, it may be reseated using a flat-end punch and a light tap with a hammer as shown in **Figure 37**.

3. If leakage is persistent, remove the plug with a punch after drilling a $\frac{1}{8}$ in. diameter hole in the center as shown in **Figure 38**.



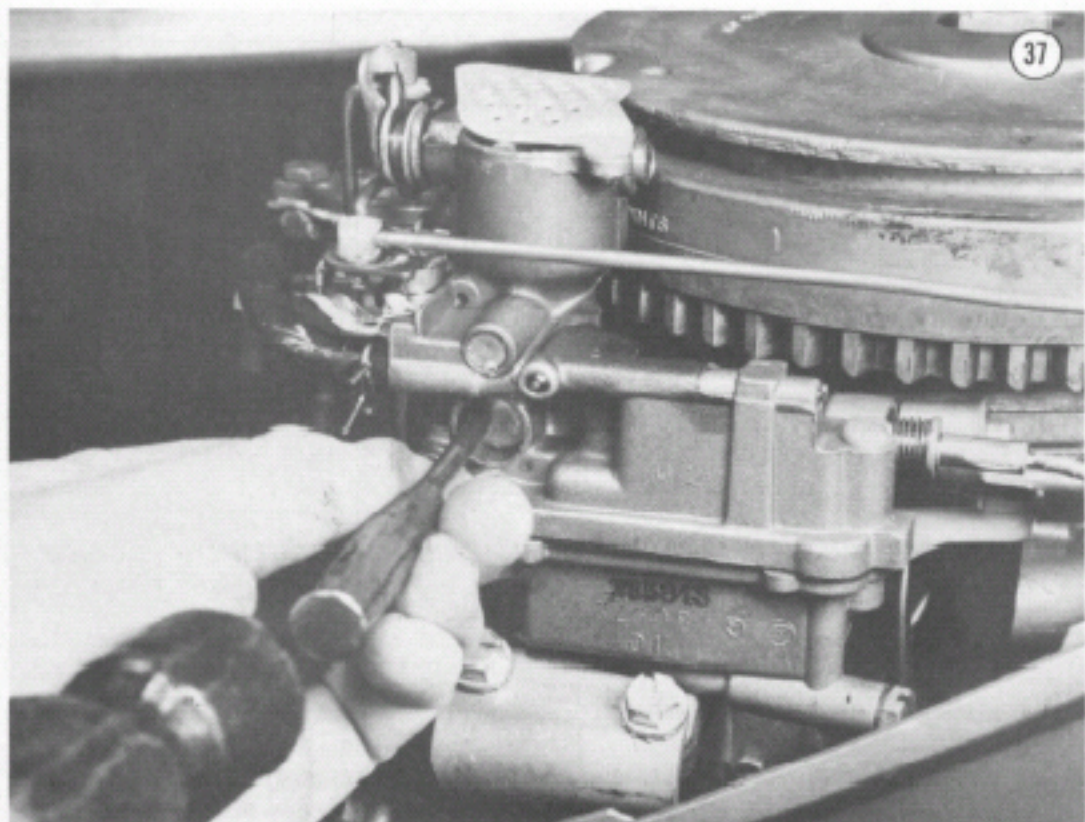
4. Inspect the contact area of the plug for nicks, scratches, or nonconcentricity.

5. Apply a bead of sealer to the edge of the new core plug and place it in the opening with the



18-25 HP MODELS

Items shown typical
Other models similar

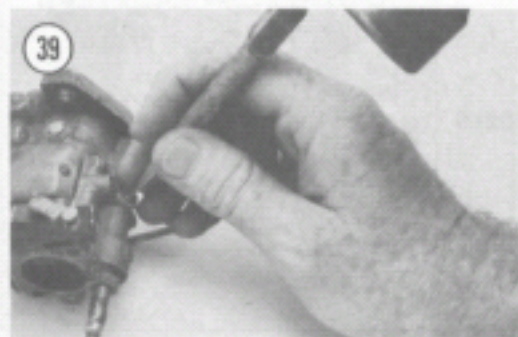


convex side up. Flatten it in place with a flat end punch and check for leakage.

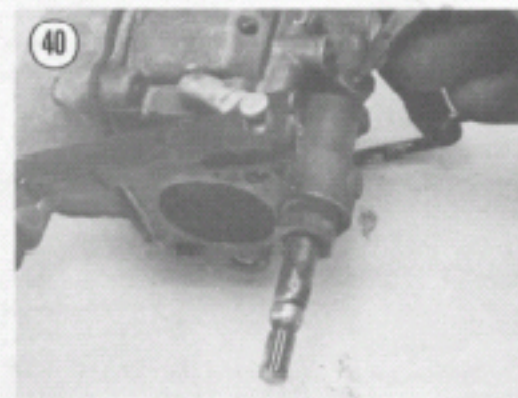
Lead Shots

(All Except 9.5 and 33 hp Engines)

1. The lead shot area of the carburetor shouldn't require service unless a leak has developed. If the leakage is slight, tap the lead shot in the center with a hammer and flat punch. See Figure 39.



2. If the leakage is severe and can't be corrected with a punch then remove the lead shot with a sharp object as shown in Figure 40.



3. Clean and inspect the carburetor body.
4. Install a new lead shot and seat with gentle taps from a hammer and flat punch.

Recirculating Valve (9.9-33 hp Engines)

The recirculating valve seldom needs service except at times when the engine is overhauled. Clean and inspect for damage.

Intake Manifold (33 hp Engine)

1. The cutout switch is actuated by vacuum from a small hole in the intake manifold. Clean out periodically with a No. 76 drill being careful not to damage or increase the size of opening.
2. Check the vacuum hose for clogging, pin holes, or kinking. If the hose appears weather checked, replace.

Choke Solenoid (33 hp Engine)

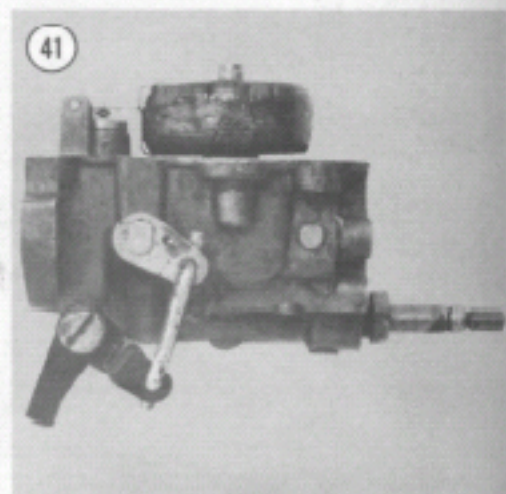
The solenoid should seldom, if ever, require attention. Keep the plunger free of corrosion by cleaning often. Coat the plunger with WD-40 to retard corrosion but don't use oil since it will only attract dust and cause sluggish movement.

CARBURETOR

Reassembly (1.5-6 hp Engines)

Reverse the sequence of disassembly in addition to the following.

1. Install new gaskets as a precaution against possible leakage.
2. After assembling the float, turn the carburetor upside down so that the weight of the float causes the needle to close. At this point, the float should be even with the body casting as shown in Figure 41.



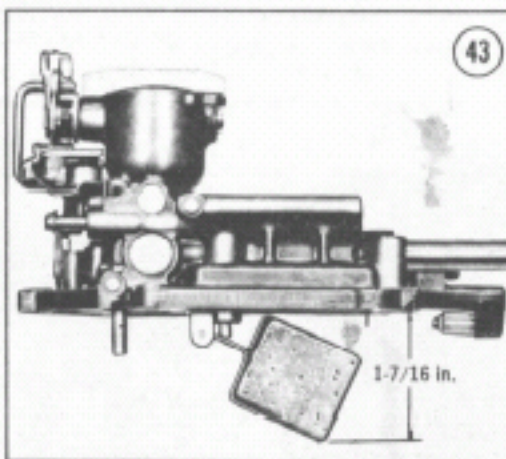
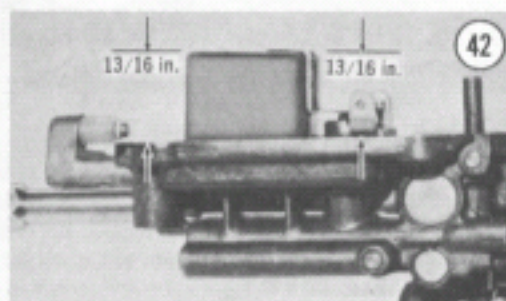
3. When installing the needles, be sure to seat them carefully to avoid damage. Follow the procedure in Chapter Two to adjust the carburetor.

FUEL SYSTEM

Reassembly (9.5 hp Engine)

Reverse the sequence of disassembly in addition to the following.

1. Install new gaskets to avoid leakage.
2. After assembling the float, turn the carburetor upside down so that the weight of the float closes the needle valve. The float should be parallel with the carburetor body and approximately $13/16$ in. away as shown in **Figure 42**. Turn the carburetor right-side up. The float drop is $1-7/16$ in. from the body as shown in **Figure 43**.



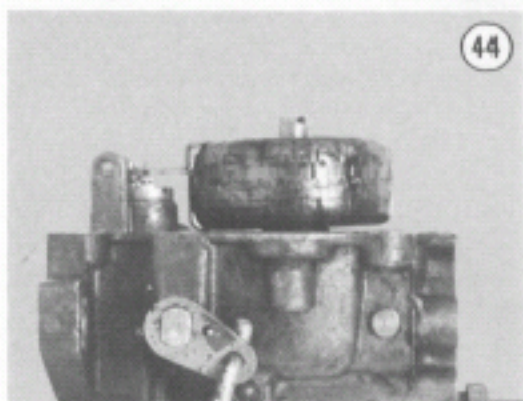
3. Install the needles gently and refer to the procedure on carburetor adjustment described in Chapter Two.

Reassembly (9.9-15 hp Engines)

Reverse the sequence of disassembly in addition to the following.

1. Install new gaskets to prevent any possible leakage.

2. After assembling the float, turn the carburetor upside down so that the weight of the float closes the needle inlet valve. The top of the float should be even with the body casting as shown in **Figure 44**.



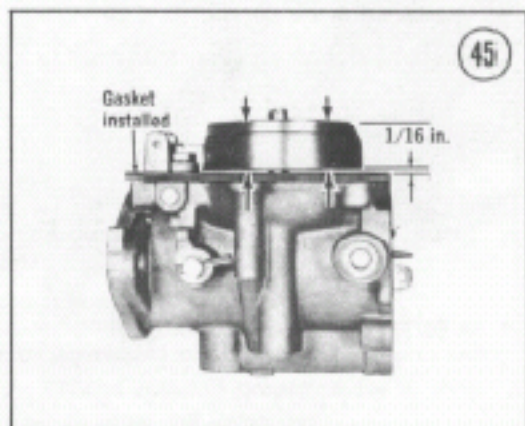
3. When installing the needles, handle them carefully to avoid damage and adjust as outlined in Chapter Two.

Reassembly (18-25 hp Engines)

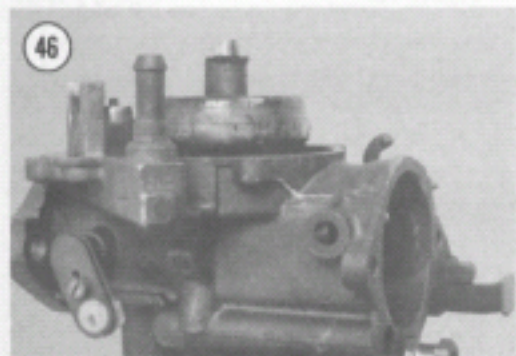
Reverse the procedure for disassembly in addition to the following.

1. Install new gaskets to prevent leakage.
2. After assembling the float, turn the carburetor upside down so that the weight of the float causes the inlet valve to close.

The top surface of the float should be parallel with the body casting and $1/16$ in. above as shown in **Figure 45**. Measure at the farthest point from the hinge.



3. The choke solenoid should operate freely and positively. The linkage should not have any free-play when the choke is in the OPEN position. See **Figure 46**.



4. Use extreme caution when installing the needles to avoid damage. Refer to Chapter Two for adjustment procedures.

Reassembly (33 hp Engine)

Reverse the disassembly sequence in addition to the following.

1. Install new gaskets to avoid possible leakage.

2. After assembling the float, turn the carburetor upside down so that the weight of the float closes the inlet valve. The top of the float should be even with the body casting as shown in **Figure 46**.

3. Check the choke valves for free operation and correct as needed to prevent binding.

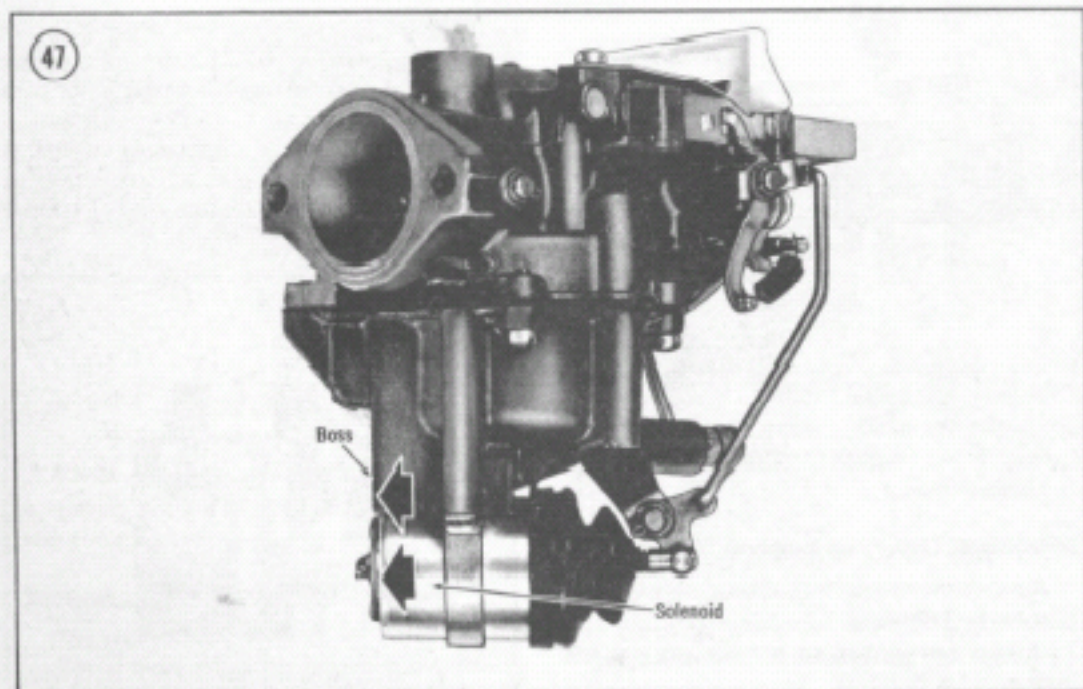
4. Pull out the manual choke completely and adjust the solenoid so that the plunger has approximately 1/16 in. of free-play. The closed end of the solenoid should be flush with the boss as shown in **Figure 47**.

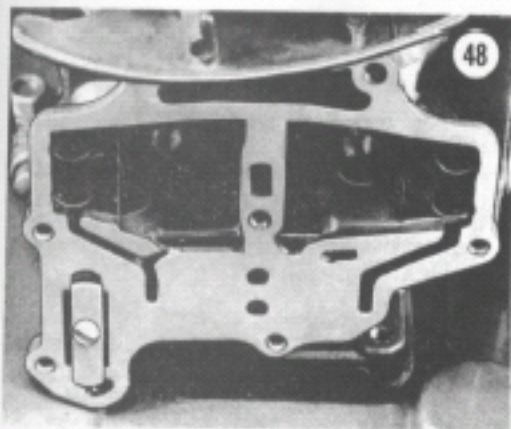
5. Use extreme caution when installing the needles. Refer to Chapter Two for adjustment procedures.

Oil Drain Valve

1. The oil drain valve should seldom, if ever, require attention. It is, however, a good idea to clean the valve and screens when servicing the rest of the motor.

2. Clean the drain valve and screens in solvent to remove gums and varnish caused by the fuel. See **Figure 48** for a typical valve.



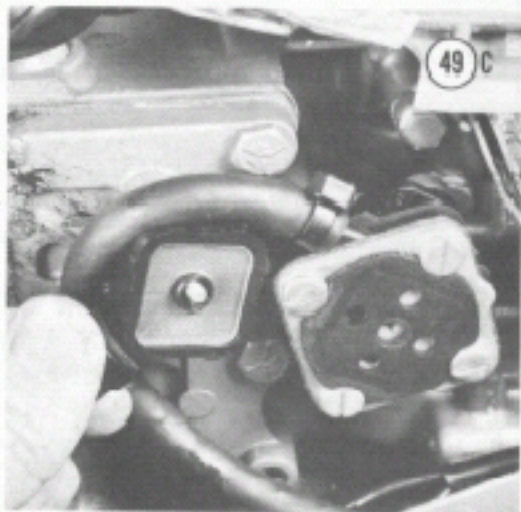
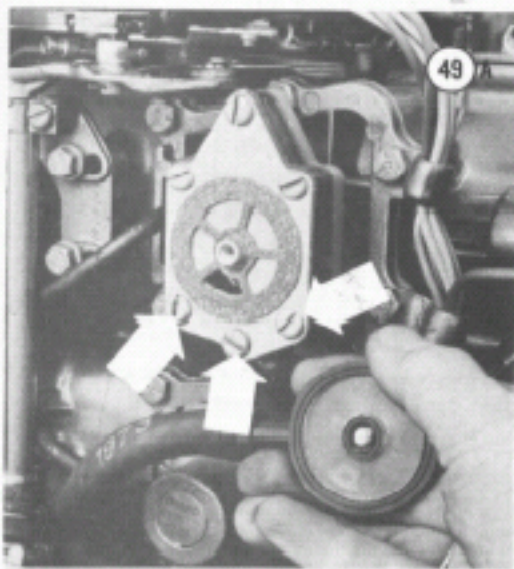
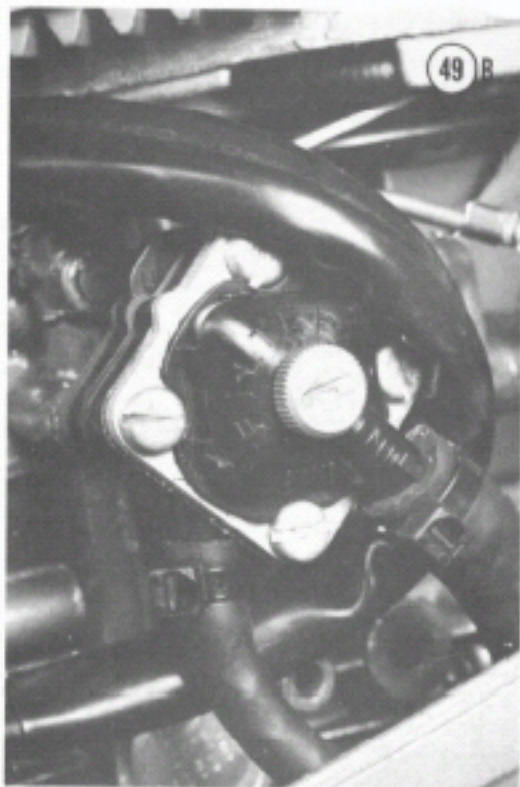


FUEL PUMP AND FILTER

Before servicing the fuel pump, make sure that the filter is clean and not damaged. Remove the fuel line and blow out any obstructions with compressed air. It may be that either of these was the cause of poor fuel delivery and the pump needn't be disassembled.

Removal/Installation (3-33 hp Engines)

1. Disconnect fuel lines. Mark for relocation.
2. Remove the screw and cover which secure the filter to the pump as shown in **Figures 49A, 49B, and 49C**. Remove the filter.

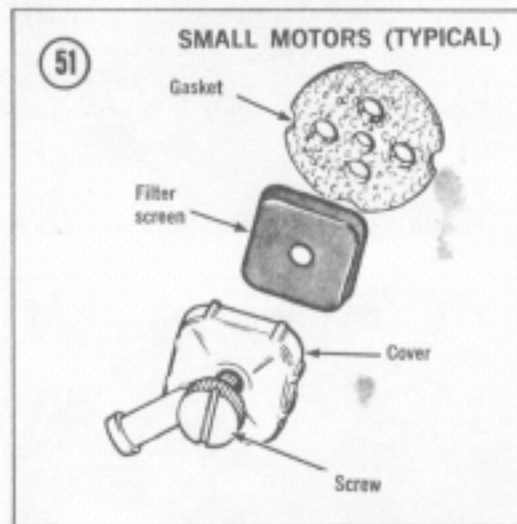
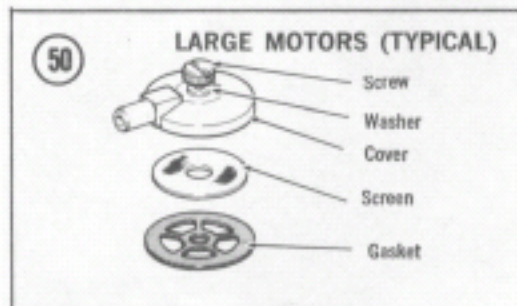


3. Remove the screws attaching the pump to the power head and remove the pump assembly.
4. Reverse removal procedure for installation after cleaning and inspection.

Cleaning, Inspection, and Repair

The fuel pump parts are not repaired separately. The unit must be replaced if not functioning properly.

1. Inspect the filter for dirt by removing the cap as shown in **Figures 50 and 51**.



2. Clean all parts in solvent and blow dry. Never use a cloth or paper since lint or dust can cause the unit to clog and cease functioning.
3. Replace the gasket to avoid possible leaks.

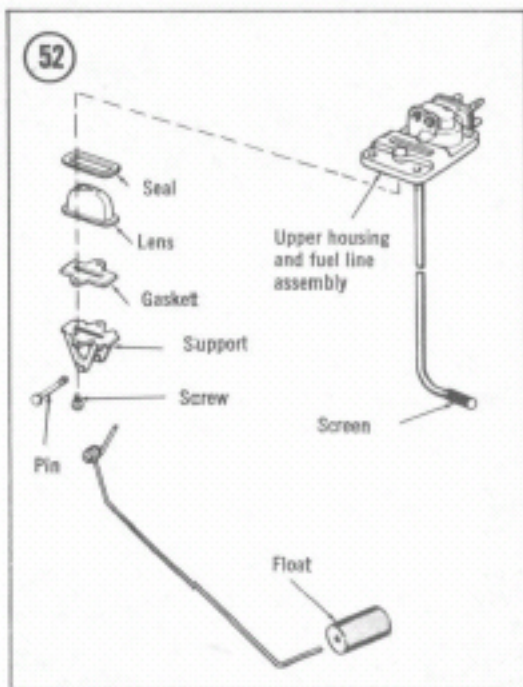
FUEL TANK

Fuel Mixture

Fuel ratios are extremely critical for optimum performance from a 2-stroke engine. Petroleum gums and varnish can result from a stale mixture and will clog small orifices and screens

consumption. For proper fuel mixtures, refer to Chapter Two.

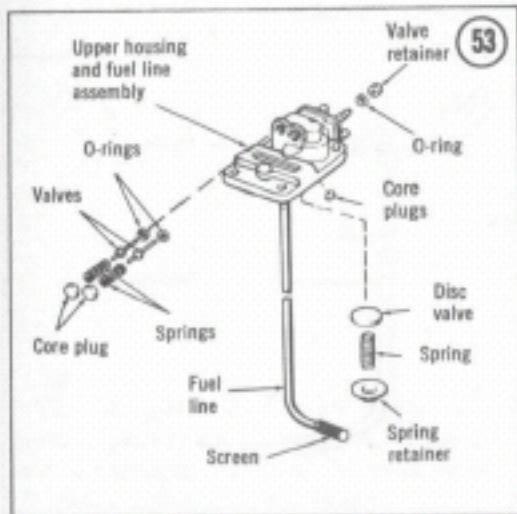
Clean the tank at least once a year or during a normal tune-up. A drain screw has been provided in the fuel tank upper housing as shown in **Figure 52** to simplify the task. Clean by flushing with fresh gasoline or solvent.



GAS GAUGE

1. The fuel level indicator is mounted to the fuel line assembly and the upper housing. Remove the attaching screws and carefully lift the assembly out to avoid damaging the indicator float or screen. See **Figure 52**.
2. Make sure that the float indicator is free to move on its hinge.
3. Remove the hinge pin from the indicator support by compressing the support ends.
4. Make sure that the float arm is not bent and that the float is not saturated or oil-soaked.
5. Remove the indicator support from the housing and remove the lens. Clean the lens with lacquer thinner to remove any substance which may be clouding the lens.

7. Check the release valves to make sure that they are seating properly. A small amount of dirt can cause severe leakage. The valves can only be cleaned by removing the core plugs.
8. Replace the O-rings to assure a tight seal as shown in **Figure 53**.
9. Reverse procedure to assemble and install.



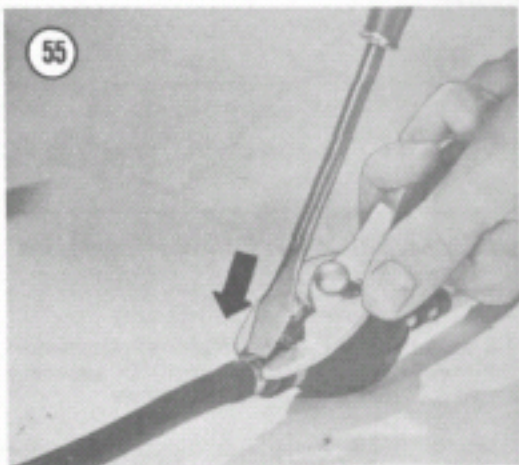
HOSE AND PRIMER BULB ASSEMBLY CLAMPS

Removal/Installation

1. Grip the clamp with pliers. Bend the overlapping hook backward to release the clamp. See **Figure 54**.

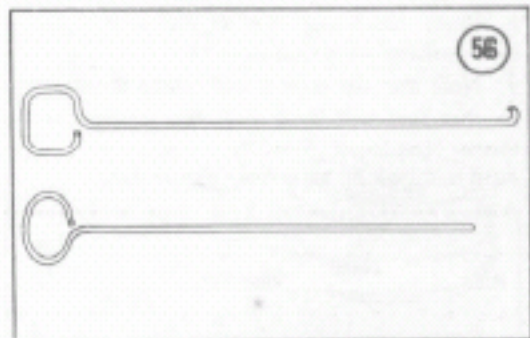


2. To assemble, grip the clamp firmly with pliers. Apply slight pressure to the hook on the top side with a screwdriver. Squeeze the clamp with pliers until the hooks interlock. See **Figure 55**.



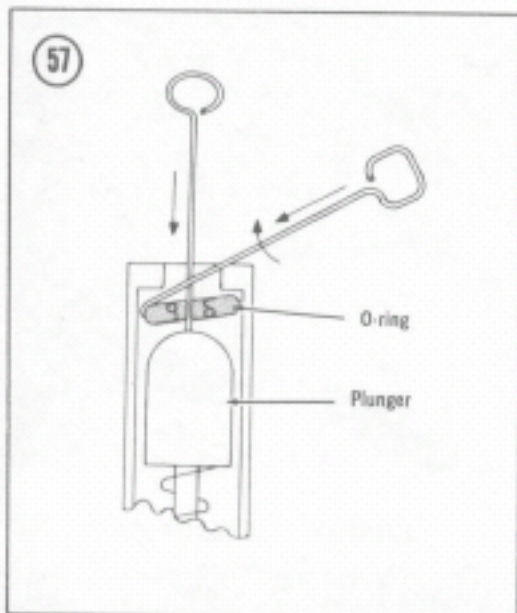
CONNECTOR HOUSINGS

Two tools are required to install the O-ring in the fuel hose connectors; one to hold the plunger down and one to remove the O-ring. Both are shown in **Figure 56**. Form a small hook of approximately 1/16 in. radius on the bottom end of the longer tool. Be certain the ends are rounded off to prevent scratching or damaging the O-ring seats or the plungers.

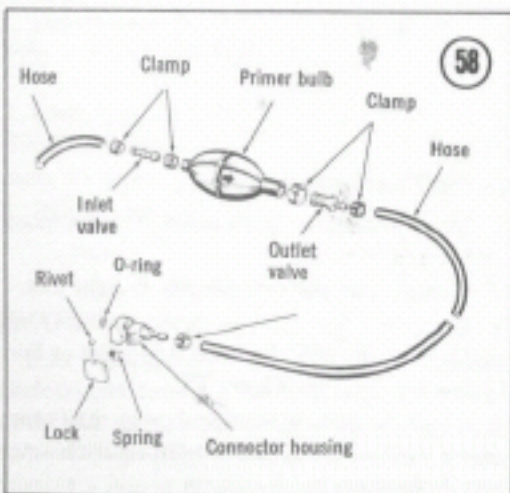


O-ring Removal/Installation

1. Place the connector between 2 wood blocks and clamp in a vise.
2. Depress the plunger with the straight tool.
3. Insert the hooked tool between the O-ring and its seat. Be sure the hook is in a flat or horizontal position. See **Figure 57**.
4. Twist the hook around and grasp the O-ring, then pull it out. Replace the O-ring with a new one if necessary.

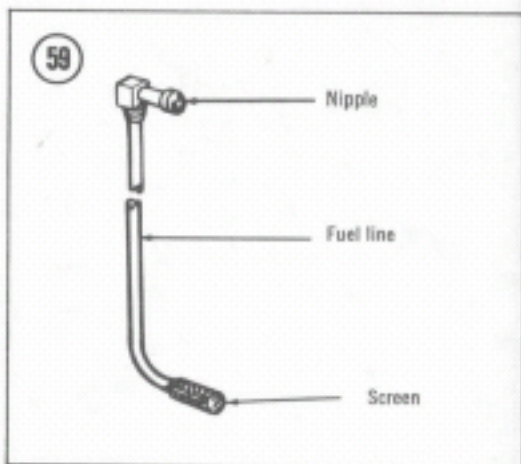


5. Place about one or two drops of oil on the O-ring.
6. Install O-ring on face of connector.
7. Depress the plunger with the straight tool. See Figure 57.
8. Pinch the O-ring together and gently push it into position with your fingers.
9. Note that the primer bulb must be attached so that fuel will flow from the shorter to the longer hose length. Fuel flow through the primer bulb is shown by an arrow (Figure 58).



FUEL LINE, SCREEN, AND NIPPLE ASSEMBLY

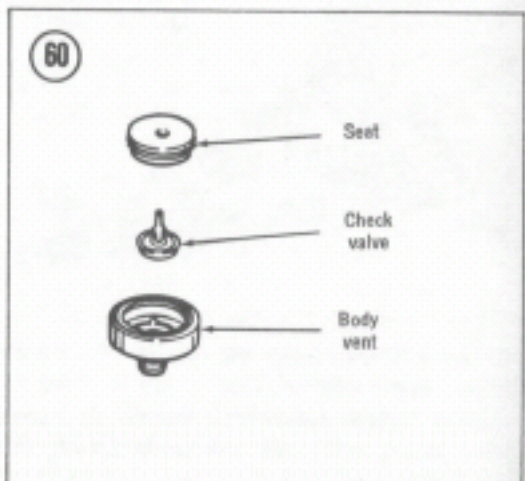
1. Refer to the previous section and remove the fuel hose and primer bulb.
2. Remove the fuel line, screen, and nipple assembly as shown in Figure 59.
3. Clean and inspect the parts. To assemble, reverse the procedure.



VENT

The vent is a one-way valve which can allow air into the tank for draining but won't allow air out in the form of fumes. An inoperative valve can cause fuel starvation and a loss of power.

Unscrew the valve from the tank for cleaning and servicing. See Figure 60.

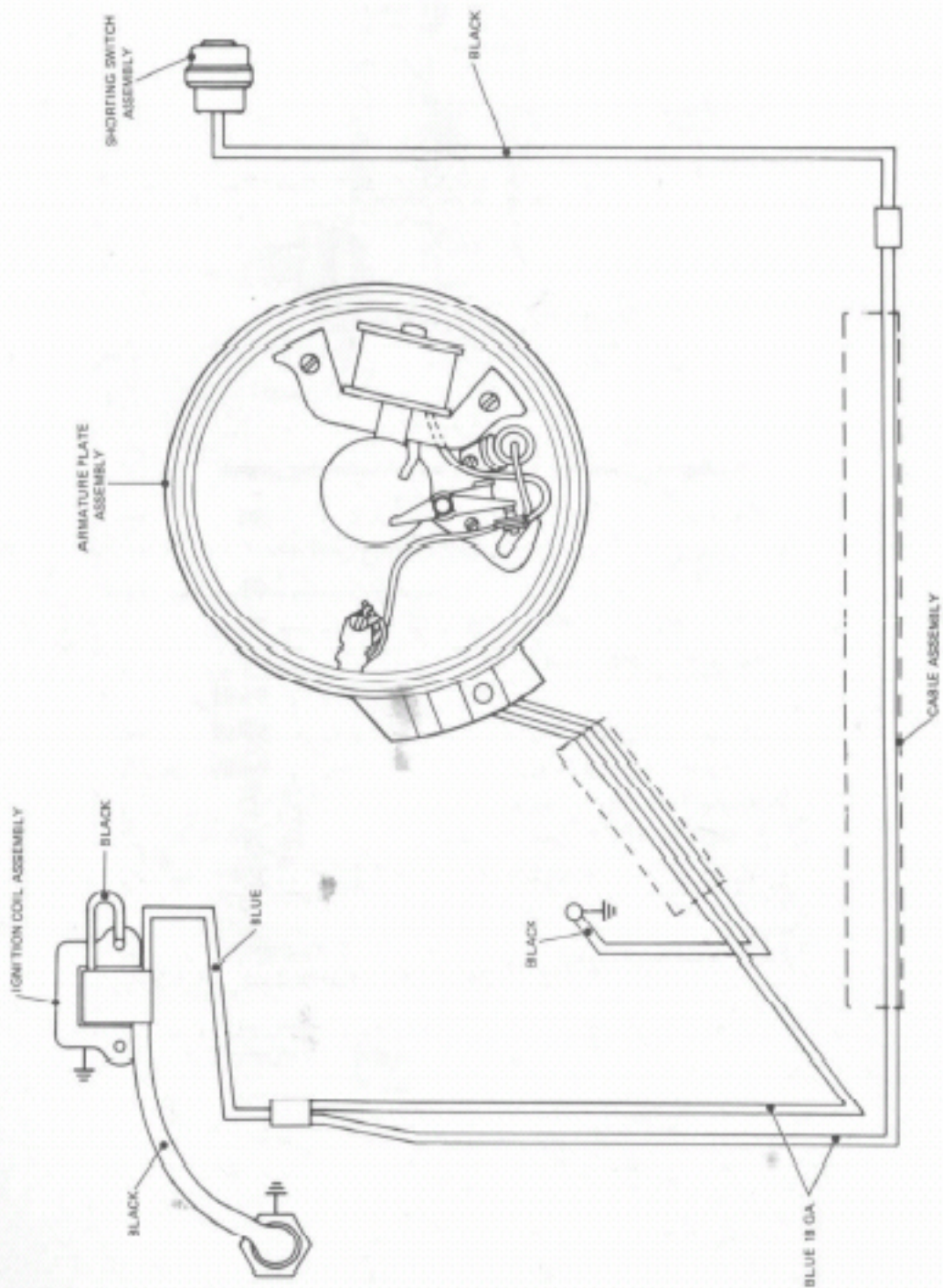


WIRING DIAGRAMS

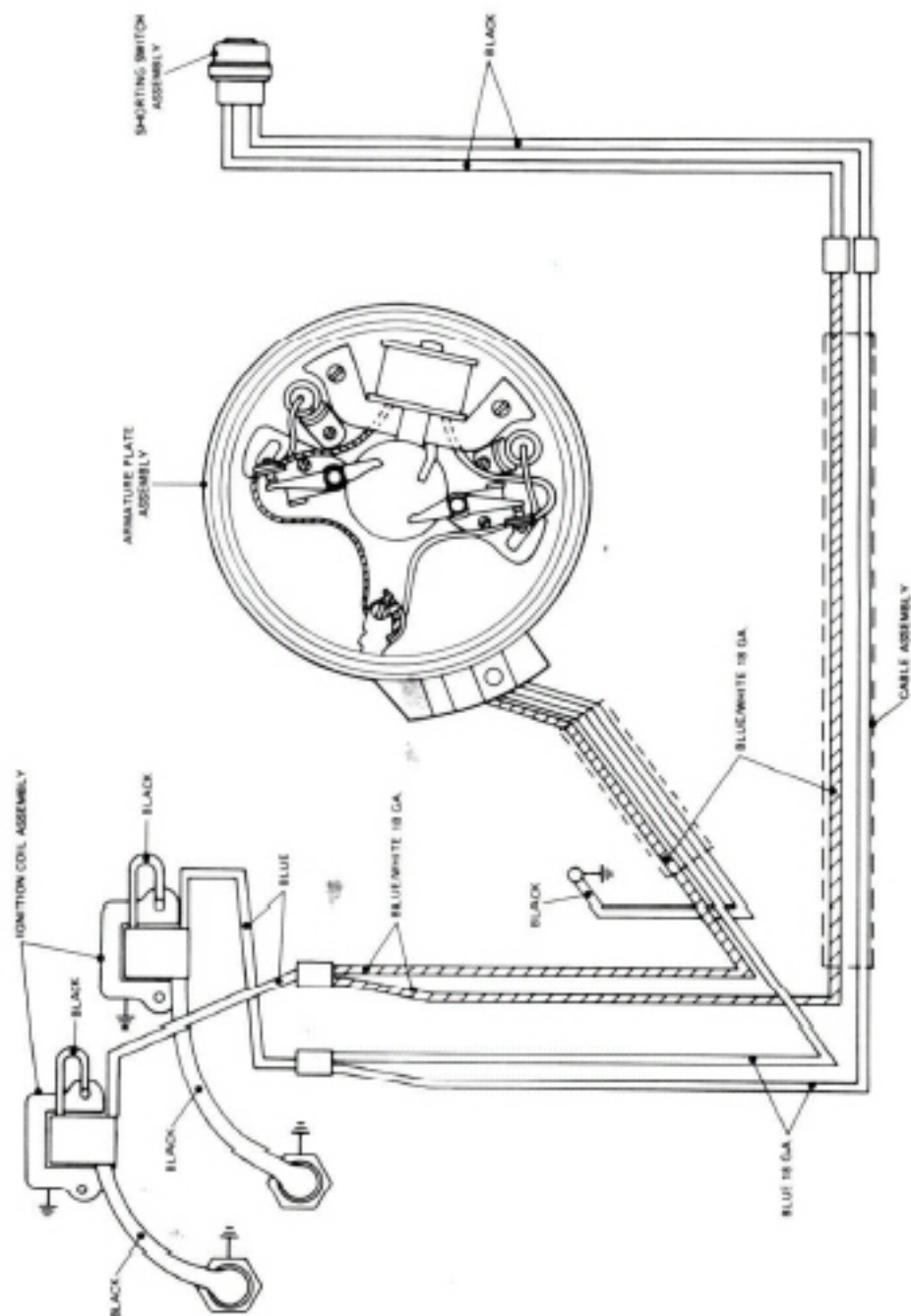
Wiring diagrams will be found on the following pages:

1.5-2 hp	90
9.9-15 hp with Manual Starter (3-9.5 hp Similar)	91
9.9-15 hp with Electric Starter	92
18-33 hp with Manual Starter	93
18-20 hp with Electric Starter	94-95
25 hp with Electric Starter	96-97
33 hp with Electric Starter	98-99
Wiring Harness — Typical (Models with Electric Starter)	100
Motor and Instrument Cables	101

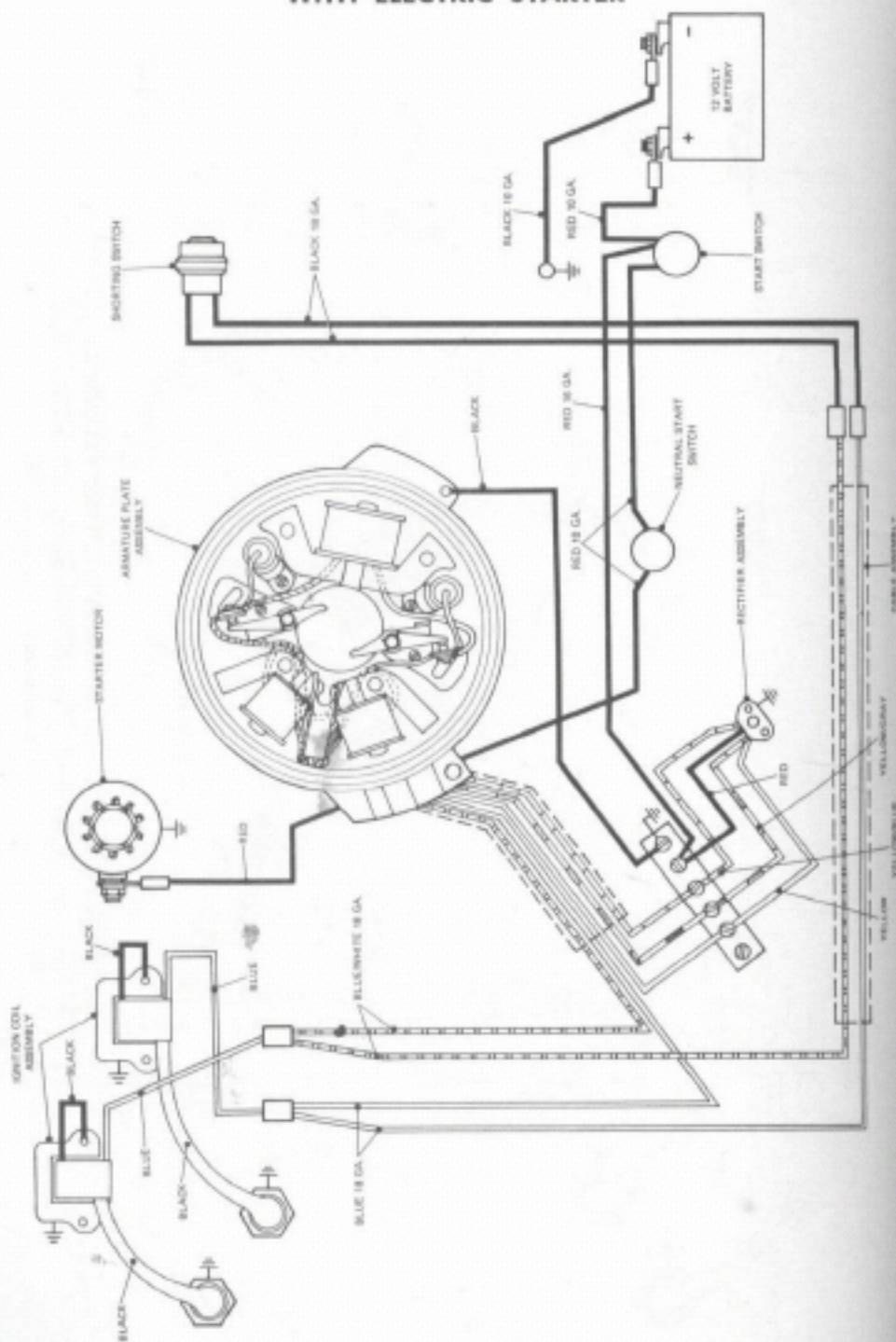
WIRING DIAGRAM — 1.5-2 HP



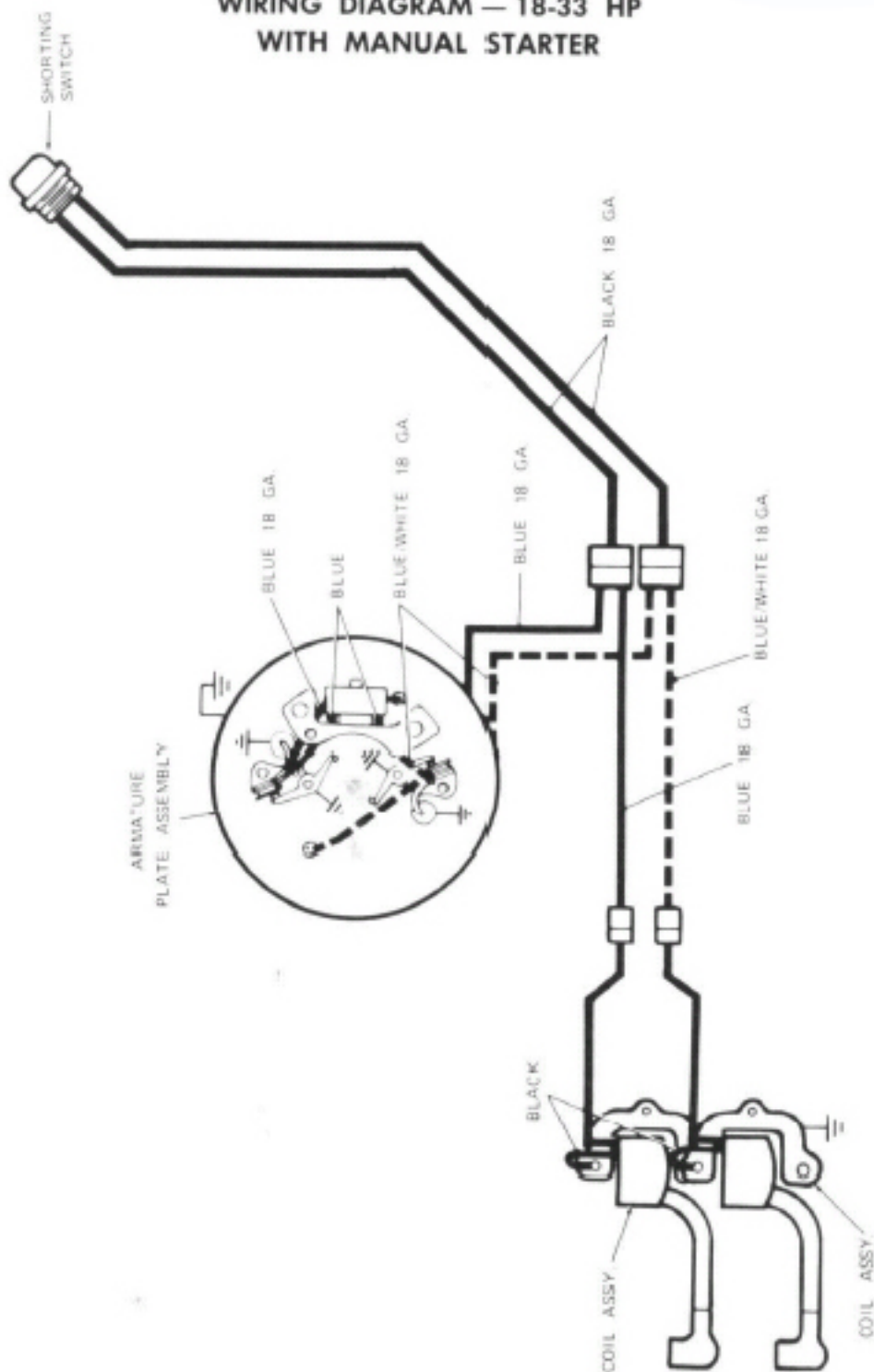
WIRING DIAGRAM — 9.9-15 HP WITH MANUAL STARTER
(3-9.5 HP Similar)



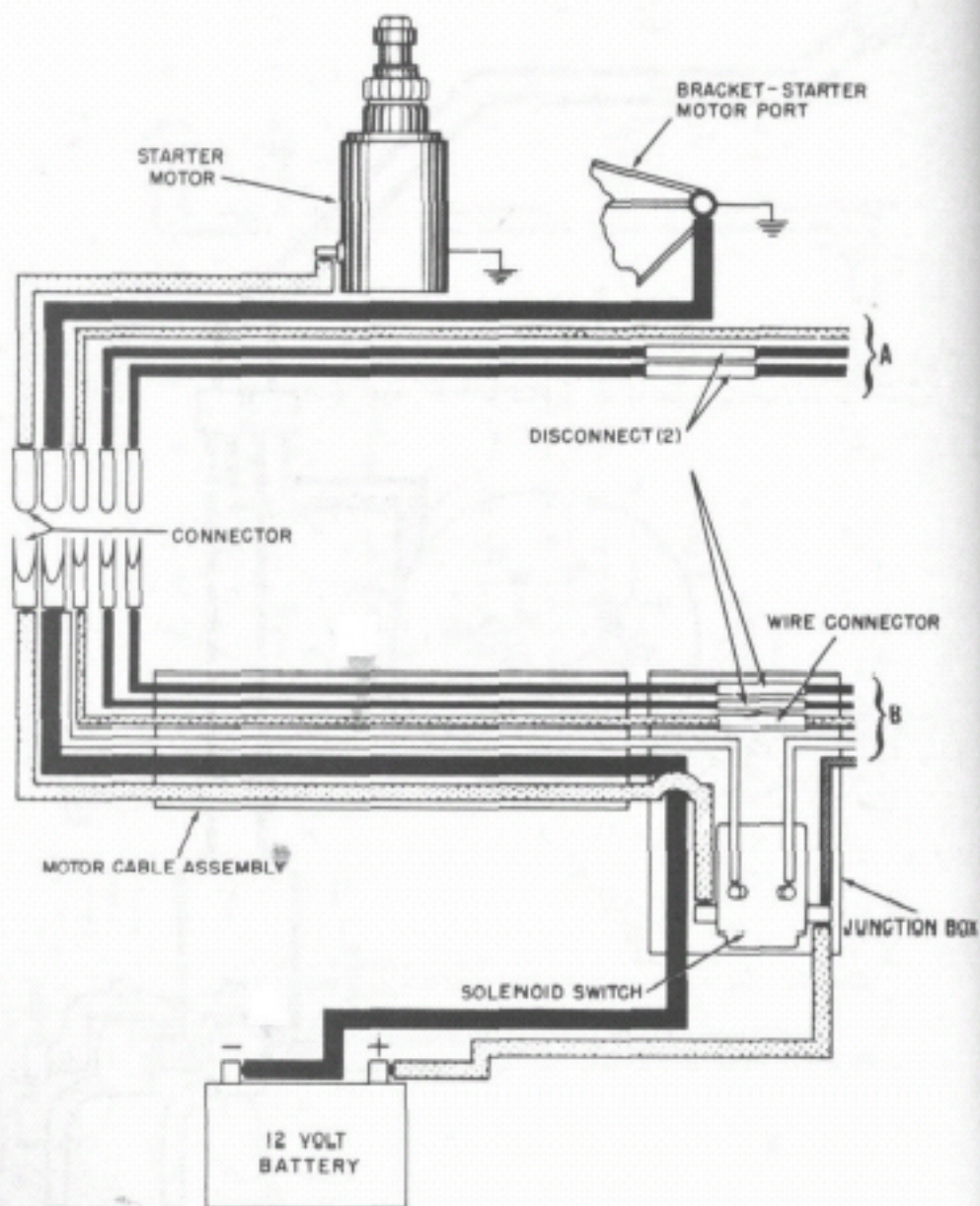
WIRING DIAGRAM — 9.9-15 HP WITH ELECTRIC STARTER

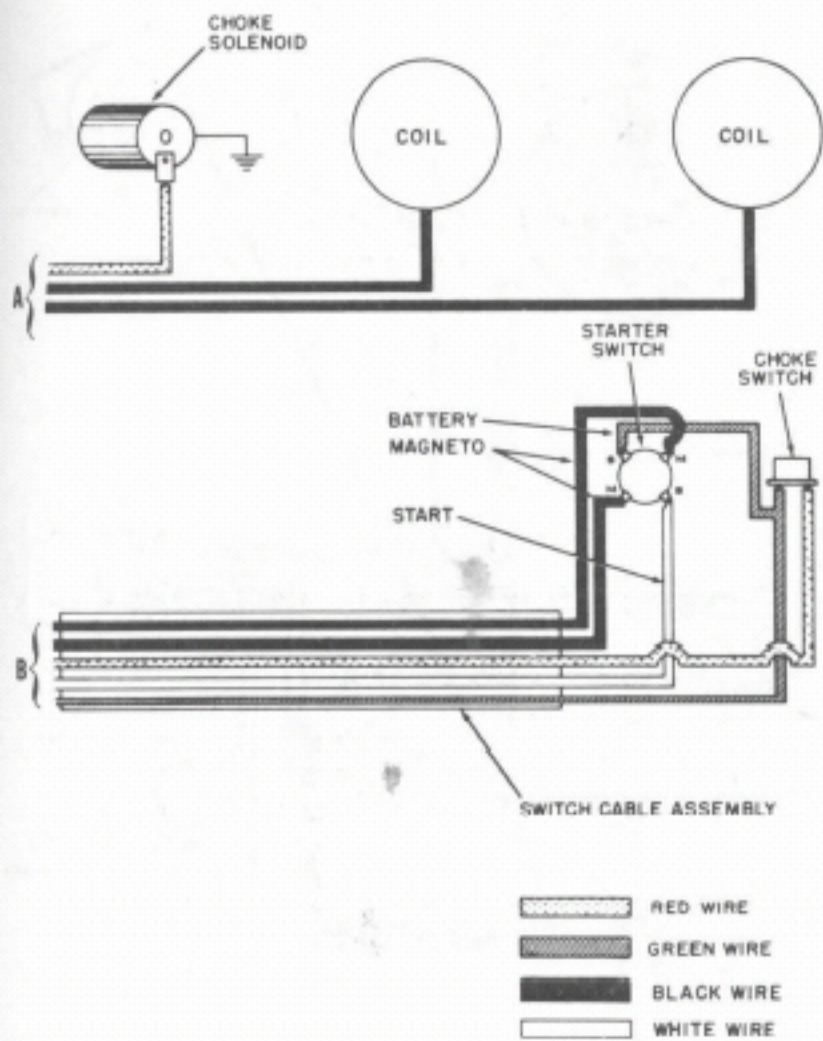


WIRING DIAGRAM — 18-33 HP
WITH MANUAL STARTER

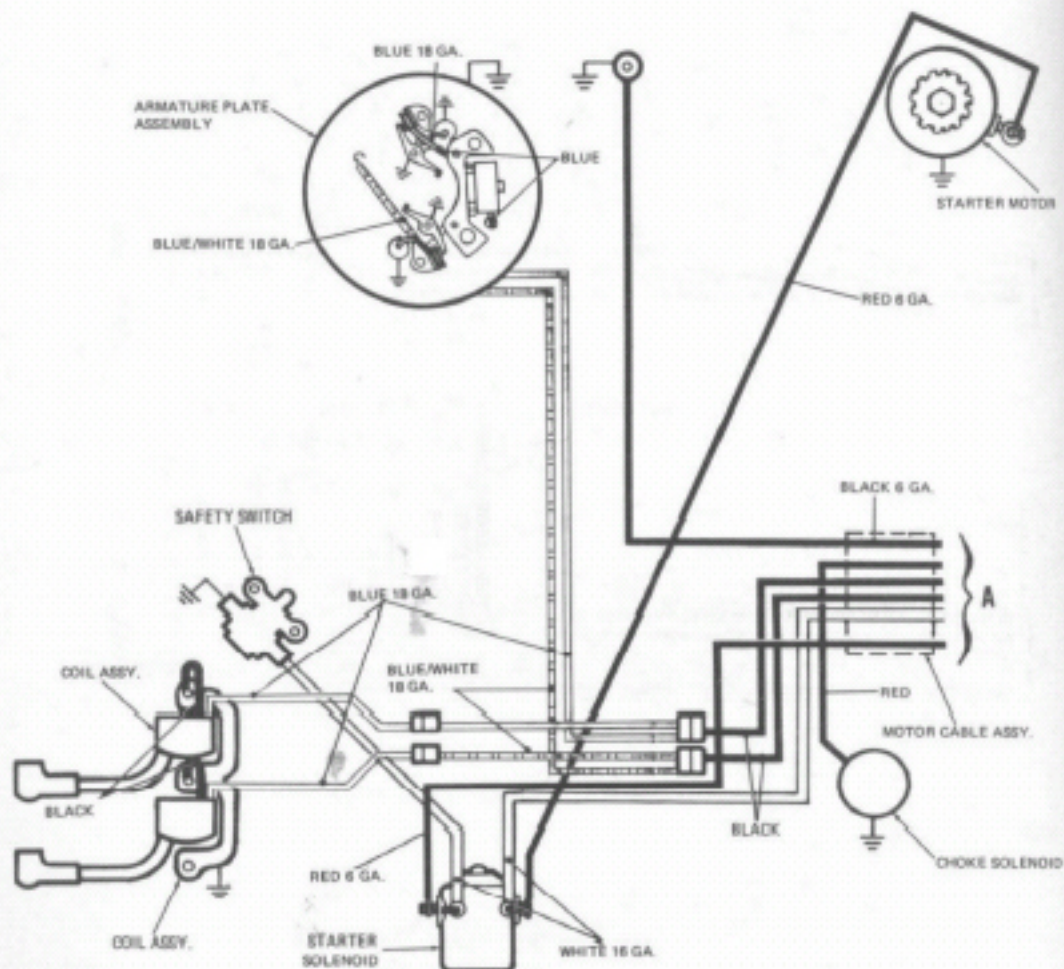


WIRING DIAGRAM — 18-20 HP WITH ELECTRIC STARTER

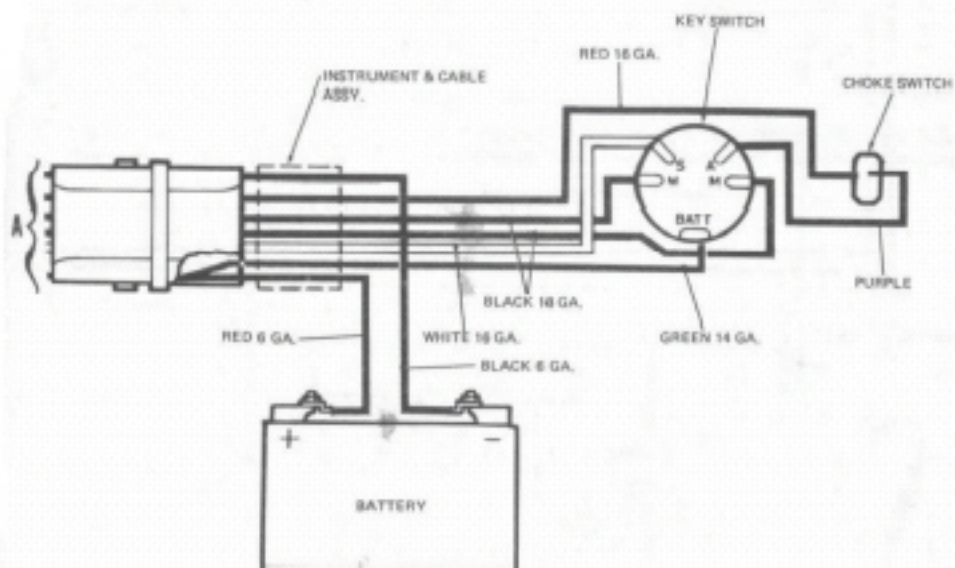




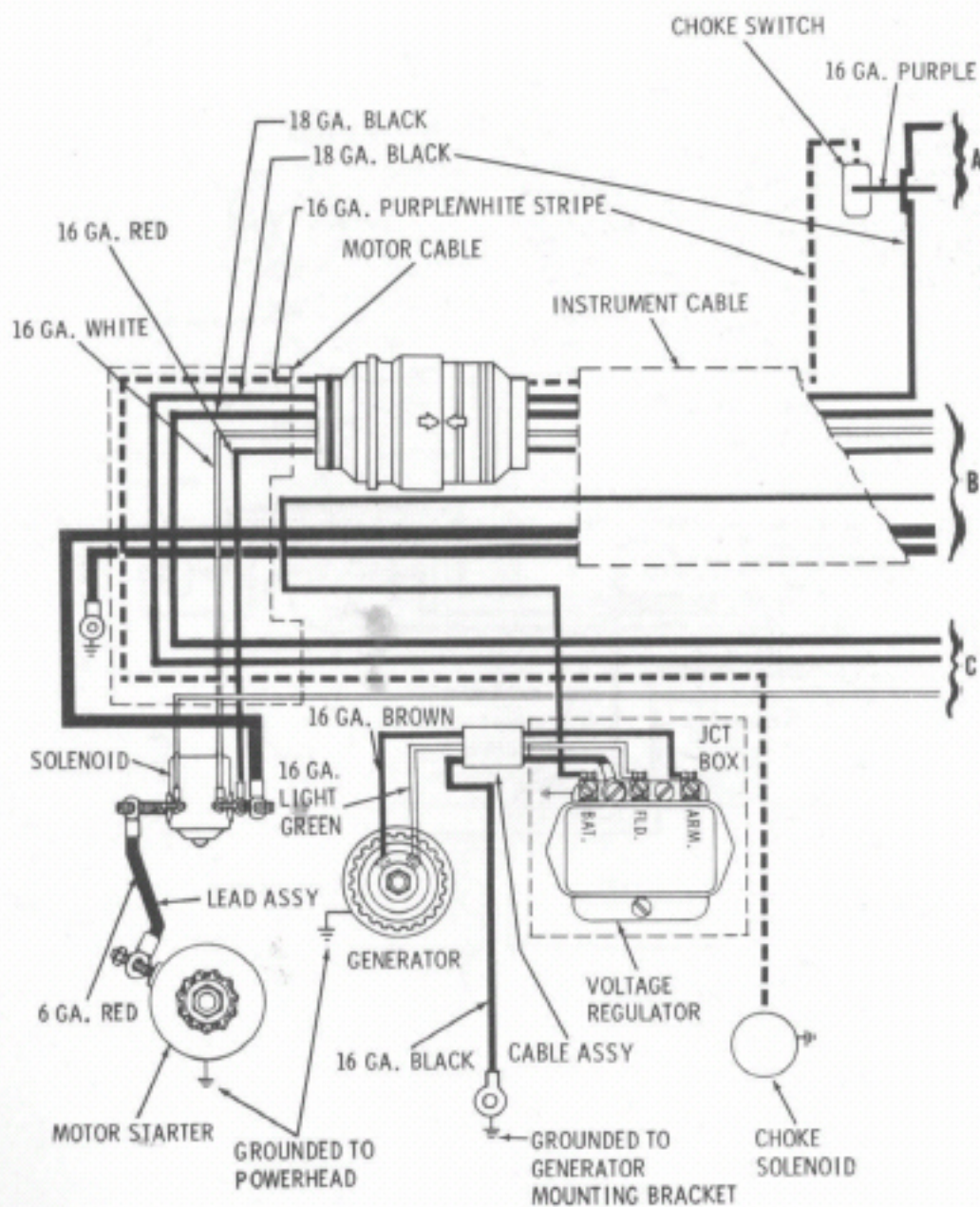
WIRING DIAGRAM — 25 HP WITH ELECTRIC STARTER



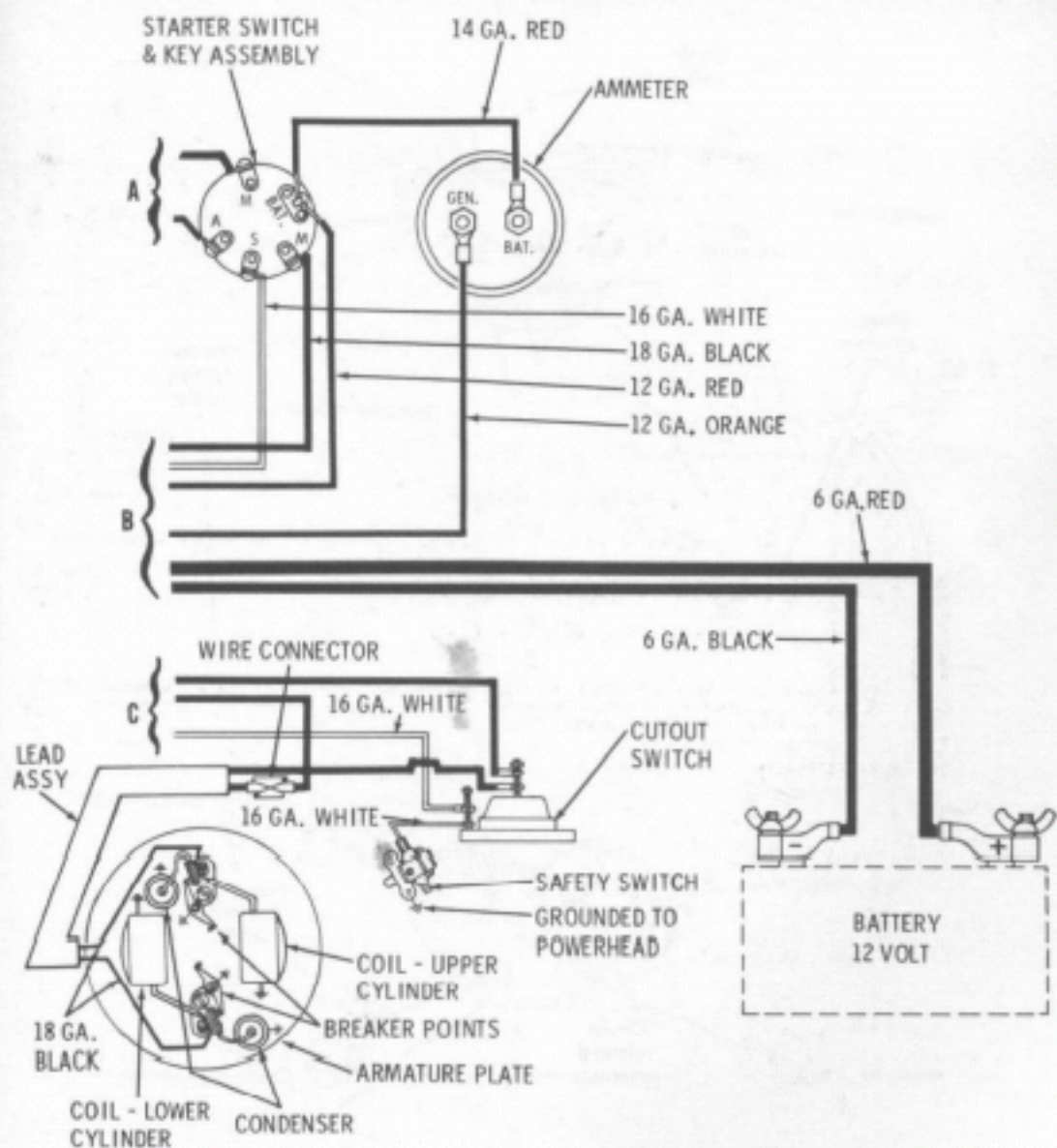
IGNITION SWITCH POSITIONS



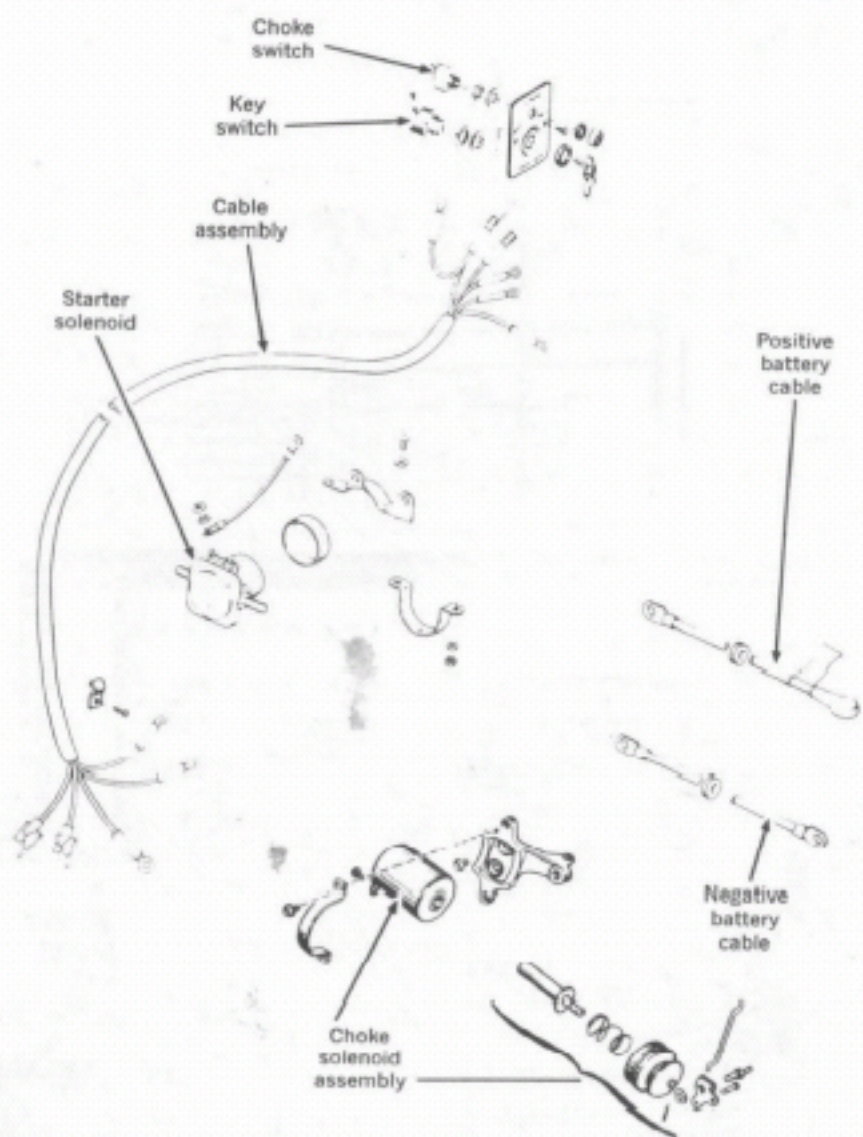
WIRING DIAGRAM — 33 HP WITH ELECTRIC STARTER



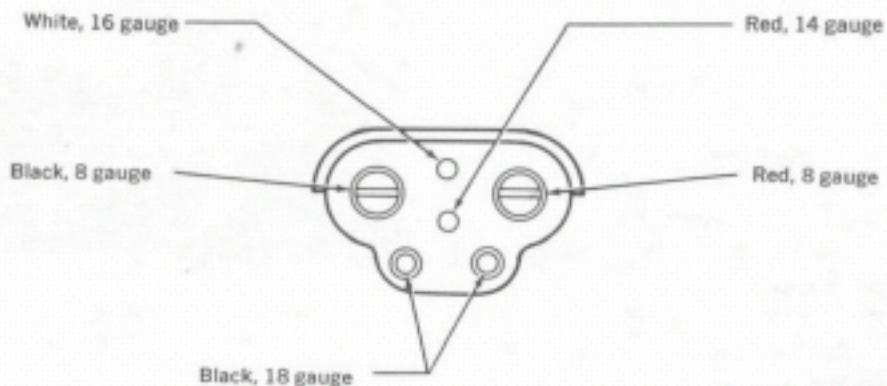
ELECTRICAL SYSTEM



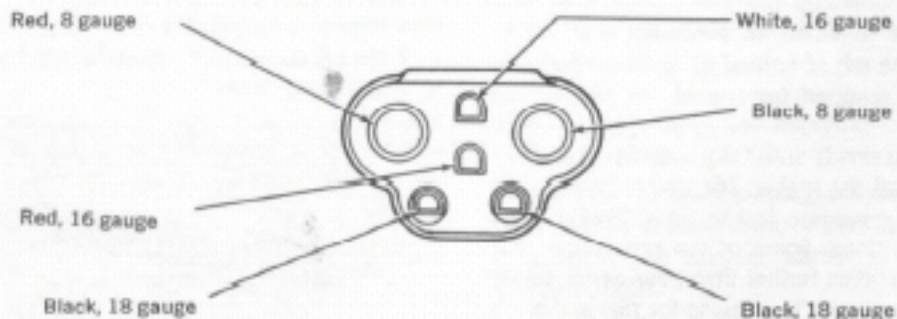
WIRING HARNESS—TYPICAL MODELS WITH ELECTRIC STARTER



MOTOR AND INSTRUMENT CABLES



MOTOR CABLE



INSTRUMENT CABLE

CHAPTER SIX

ENGINE REPAIR AND OVERHAUL

The outboard motor should require very little in the way of repair if periodic maintenance, such as lubrication and tune-ups, is performed to keep the engine in top running condition. Normally, the only engine work should be the decarbonizing of the power head to prevent preignition. The cost of some specialized tools and the expertise required for some jobs makes it more practical for a professional to do the work. It is for this reason that some of the more complicated procedures have been omitted.

Where possible, the procedures have been kept brief to eliminate confusion and redundancy. The use of normal hand tools should be all that's required for any of the jobs in this chapter.

Proceed slowly until fully acquainted with the chapter and the engine. It's always best to read an entire procedure first to get a "feel" for the job to be done. Some of the procedures may have been taken farther than your needs dictate to effect a repair. The reason for this is that it's usually better to carry a job one step further and be more thorough while the engine is already disassembled.

MOTOR TEMPERATURE

Proper operating temperature is extremely critical to engine performance and reliability.

The best time to check the temperature is after the engine has been run under normal conditions for 15 minutes or more. Most dealers have Thermomelt sticks which are similar in appearance to a crayon. The stick is designed to melt at temperatures exceeding 163°F. To check the motor, mark the starboard side of the cylinder with the stick. See **Figures 1A and 1B**. Do not mark the cylinder head since it will always be warmer and is not the best indicator. If the stick melts and appears glossy, the engine is running too hot. If the mark appears rough and chalky, the engine's cooling system is working well.

If the engine is overheating, check for clogging or a worn pump.



Power Head Removal (1.5-2 hp)

1. Remove the starter (see Chapter Eight).
2. Remove the fuel tank, carburetor, and manifold as described in Chapter Four.



3. Remove the spark plug, flywheel, magneto, armature plate, and wiring as described in Chapter Five.
4. Remove the power head from the exhaust housing. Refer to **Figure 2**. Disassemble as outlined later in this chapter.

Power Head Removal (3-4 hp)

1. Remove the carburetor, fuel tank fuel lines, reed valves, and manifold as described in Chapter Four.
2. Remove spark plugs, magneto, armature plate, and flywheel as described in Chapter Five.
3. Leave the starter attached to the crankcase unless it is in need of service. To repair, refer to Chapter Eight.
4. Remove the power head. Refer to **Figure 3**. The folding model has a pin through the drive shaft which must be removed. Rotate the crankshaft clockwise to align the adapter slot with the pin while lifting on the power head.

Separate the adapter and water tube from the power head while removing. Disassemble as outlined in this chapter.

Power Head Removal (5-6 hp)

1. Remove the starter (see Chapter Eight).
2. Remove the carburetor, reed valve assembly, fuel pump, and gas tank as described in Chapter Four.

3. Remove the flywheel, magneto, and armature plate as described in Chapter Five.
5. Remove the screws and nuts which hold the power head to the adapter. Refer to **Figure 4**.
6. Lift the power head off the lower unit exhaust housing.
7. Disassemble as outlined in this chapter.

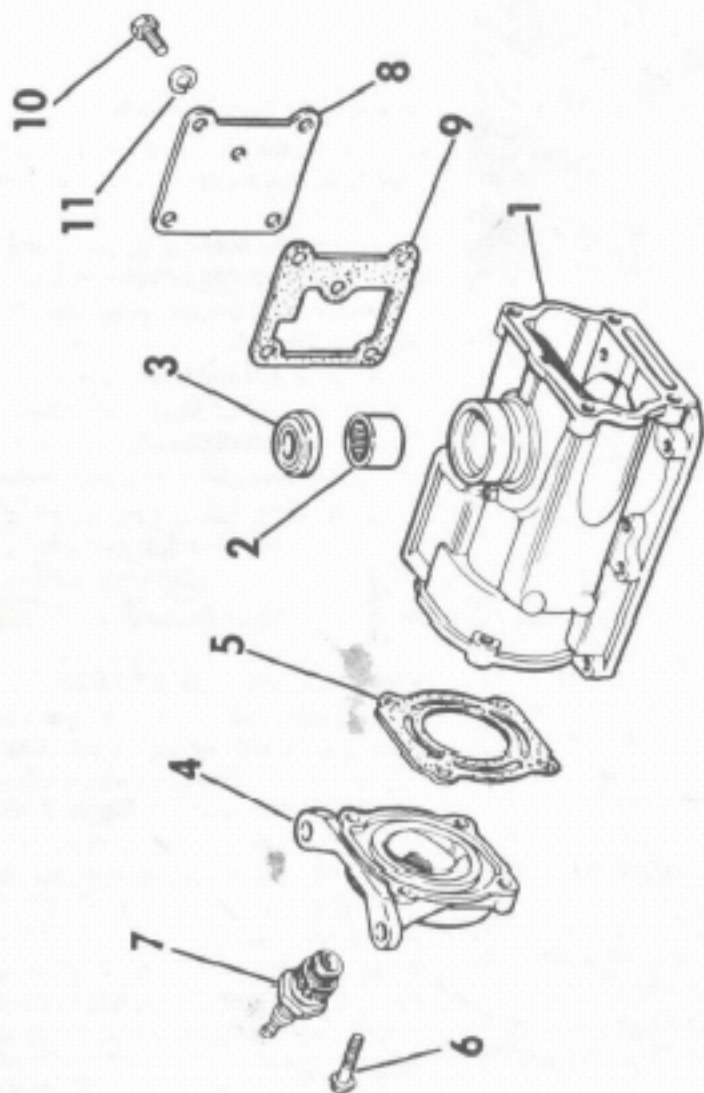
Power Head Removal (9.5 hp)

1. Remove the carburetor, reed valve assembly, fuel tank, fuel pump, and filter as described in Chapter Four.
2. Remove the flywheel, magneto, and armature plate as described in Chapter Five.
3. Remove the exhaust relief hose and clamp. Refer to **Figure 5**.
4. Remove shift rod lever and shaft.
5. Remove power head and exhaust housing from lower port motor cover.
6. Remove the upper starboard rubber mount.
7. Remove the cotter pins which attach the clevis to the shift rod link and rod.
8. Remove power head from exhaust housing.
9. Disassemble as described in this chapter.

Power Head Removal (9.9-15 hp)

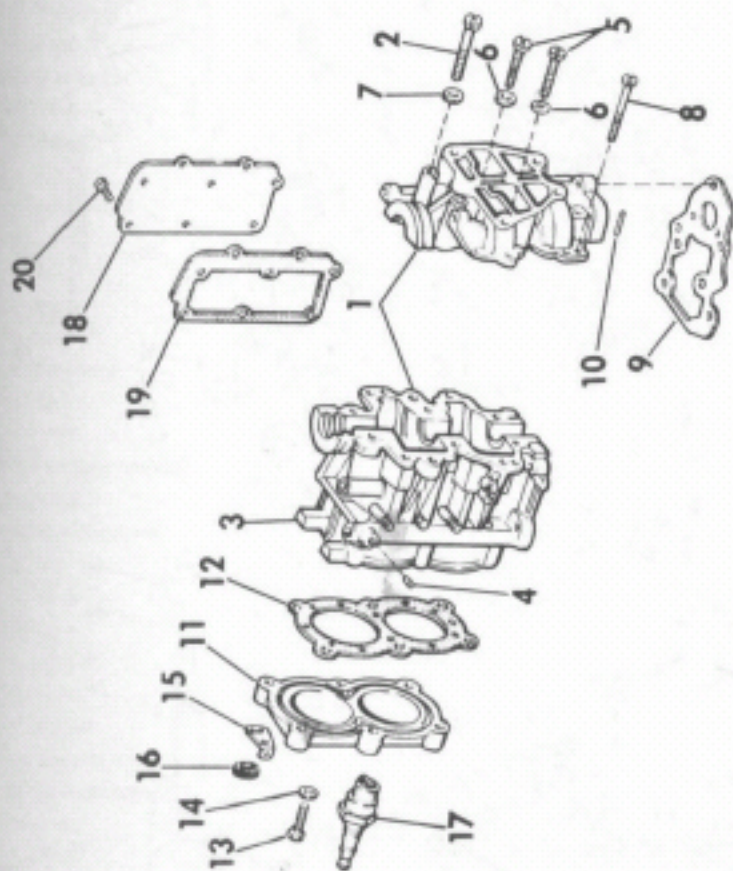
1. The upper seal can be removed and replaced without tearing the engine apart by following the steps in Chapter Five to remove the flywheel and armature plate. Refer to **Figure 6** in addition to Chapter Five.
2. Remove the carburetor, fuel tank, fuel lines, reed valve assembly, and manifold as described in Chapter Four.
3. Remove the spark plugs, magneto, armature plate, and flywheel as described in Chapter Five.
4. Remove the manual starter as shown in Chapter Eight.
5. Remove the electric starter as described in Chapter Five.
6. Remove the coils from the cylinder head and mark the location of the wires for reassembly.
7. Remove shift lock lever screw and swing the lever and rod out of the way.
8. Remove starter interlock cam screw.

2



CYLINDER AND HEAD (1.5-2 HP)

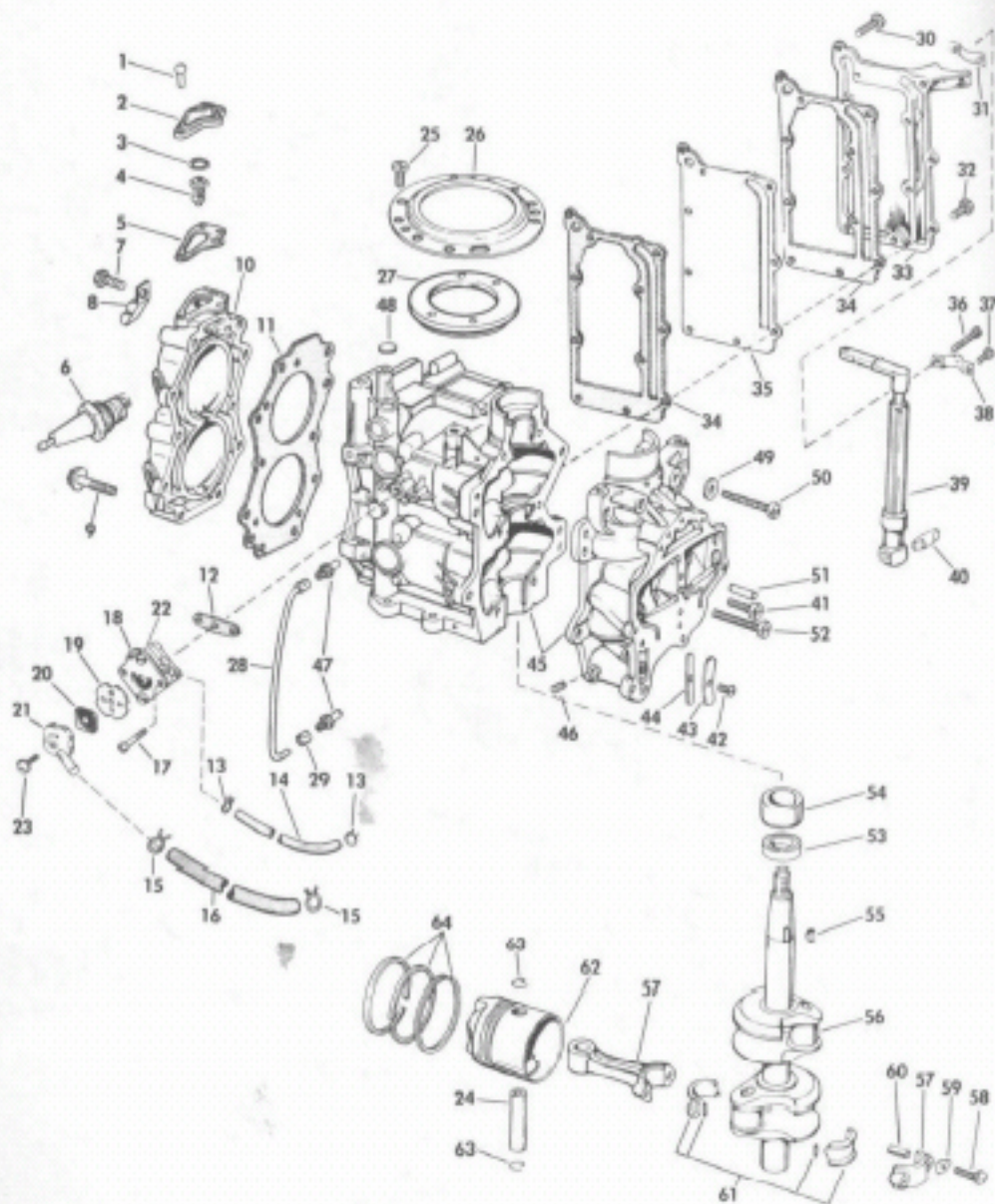
- | | | | |
|----|-------------------|-----|---------------------|
| 1. | Cylinder assembly | 7. | Spark plug |
| 2. | Needle bearing | 8. | Exhaust cover plate |
| 3. | Seal | 9. | Gasket |
| 4. | Cylinder head | 10. | Screw |
| 5. | Gasket | 11. | Washer |
| 6. | Screw | | |



POWER HEAD (3-4 HP)

- | | | |
|------------------------------------|-------------------|-------------------------|
| 1. Cylinder and crankcase assembly | 7. Washer | 14. Washer |
| 2. Screw | 8. Screw | 15. Anchor |
| 3. Plug | 9. Gasket | 16. Grommet |
| 4. Plug | 10. Taper pin | 17. Spark plug |
| 5. Screw | 11. Cylinder head | 18. Exhaust cover plate |
| 6. Washer | 12. Gasket | 19. Gasket |
| | 13. Screw | 20. Screw |

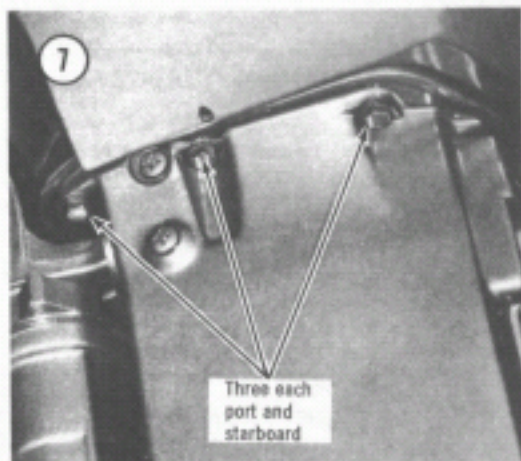
4



POWER HEAD (5-6 HP)

- | | |
|------------------------|--------------------------------------|
| 1. Screw | 34. Gasket |
| 2. Cap | 35. Exhaust cover |
| 3. Seal | 36. Screw |
| 4. Thermostat | 37. Screw |
| 5. Gasket | 38. Clamp |
| 6. Spark plug | 39. Lever |
| 7. Screw | 40. Pin |
| 8. Clamp | 41. Screw |
| 9. Screw | 42. Screw |
| 10. Cylinder head | 43. Plate |
| 11. Gasket | 44. Valve |
| 12. Gasket | 45. Cylinder and crank-case assembly |
| 13. Clamp | 46. Oil hole plug |
| 14. Hose | 47. Nipple |
| 15. Hose clamp | 48. Core plug |
| 16. Hose | 49. Washer |
| 17. Screw | 50. Screw |
| 18. Fuel pump assembly | 51. Taper pin |
| 19. Gasket | 52. Screw |
| 20. Fuel filter screen | 53. Oil seal |
| 21. Cap | 54. Magneto cam |
| 22. Screw | 55. Flywheel key |
| 23. Screw | 56. Crankshaft |
| 24. Wrist pin | 57. Connecting rod assembly |
| 25. Screw | 58. Screw |
| 26. Support | 59. Lockplate |
| 27. Retaining ring | 60. Dowel |
| 28. Oil return hose | 61. Liners and needles |
| 29. Clamp | 62. Piston |
| 30. Screw | 63. Retaining ring |
| 31. Clamp | 64. Ring set |
| 32. Screw | |
| 33. Exhaust cover | |

9. Remove the power head attaching screws. See Figure 7.



10. Remove the rubber mount screws and ground connection.

11. Lift the power head away from the exhaust housing.

12. Remove exhaust and water tubes. Disassemble as outlined in this chapter.

Power Head Removal (18-33 hp)

1. Remove the carburetor, gas tank, fuel lines, reed valve assembly, and manifold as described in Chapter Four.

2. Remove the manual starter as described in Chapter Eight.

3. Remove the flywheel, magneto, spark plugs, armature plate, and electric starter as described in Chapter Five.

4. Remove the starter mounting brackets from both sides of the motor.

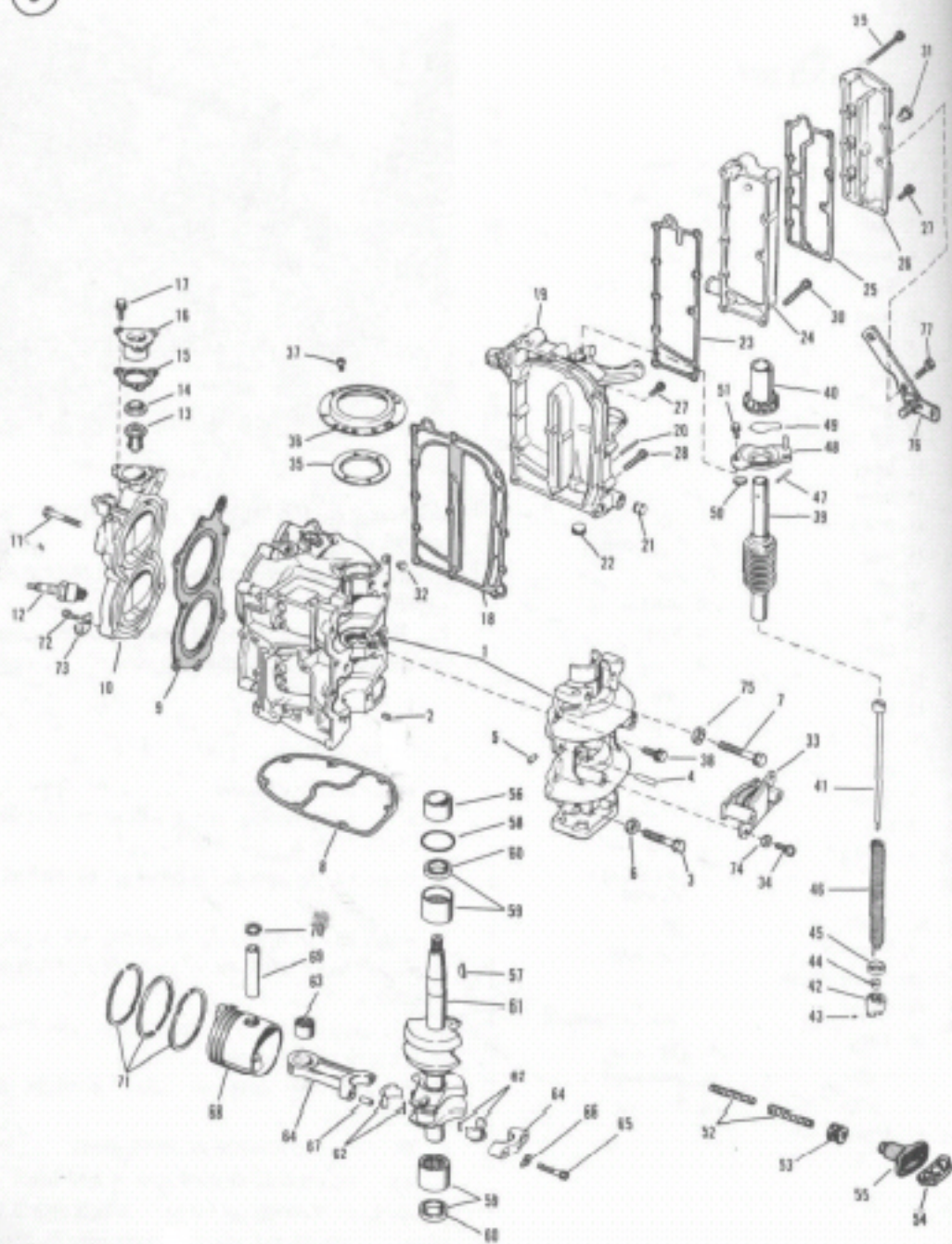
5. Remove the armature plate support and retainer ring.

6. Remove the throttle control lever.

7. Remove the shifter lock spring and lock.

8. Remove the nuts and screws which attach the power head to the exhaust housing. Refer to Figure 8.

9. Remove the power head and disassemble as described later in this chapter.



POWER HEAD AND STARTER (9.5 HP)

- | | |
|------------------------------------|-------------------------------|
| 1. Cylinder and crankcase assembly | 40. Pinion gear |
| 2. Dowel | 41. Spring retainer |
| 3. Screw | 42. Spring retainer |
| 4. Taper pin | 43. Set screw |
| 5. Plug | 44. Bushing |
| 6. Washer | 45. Bearing |
| 7. Screw | 46. Main spring |
| 8. Gasket | 47. Roll pin |
| 9. Gasket | 48. Bearing head |
| 10. Cylinder head | 49. Spring |
| 11. Screw | 50. Gasket |
| 12. Spark plug | 51. Screw |
| 13. Thermostat | 52. Rope |
| 14. Seal | 53. Eyelet |
| 15. Gasket | 54. Rope anchor |
| 16. Cap | 55. Starter handle |
| 17. Screw | 56. Magneto cam |
| 18. Gasket | 57. Crankshaft key |
| 19. Exhaust cover assembly | 58. O-ring |
| 20. Roll pin | 59. Needle bearing assembly |
| 21. Plug | 60. Seal |
| 22. Screw plug | 61. Crankshaft |
| 23. Gasket | 62. Needle and liner set |
| 24. Exhaust cover | 63. Bearing |
| 25. Gasket | 64. Connecting rod assembly |
| 26. Exhaust cover | 65. Screw |
| 27. Screw | 66. Lockplate |
| 28. Screw | 67. Dowel |
| 29. Screw | 68. Piston and dowel |
| 30. Screw | 69. Wrist pin |
| 31. Bumper | 70. Retaining ring |
| 32. Bumper | 71. Piston ring set |
| 33. Rubber mount | 72. Screw |
| 34. Screw | 73. Clamp |
| 35. Retaining ring | 74. Lockwasher |
| 36. Support | 75. Washer |
| 37. Screw | 76. Vibration damper assembly |
| 38. Screw | 77. Screw |
| 39. Spool and sleeve | |

Power Head Disassembly (1.5-2 hp)

1. Remove the cylinder head and gasket. Refer to Figure 2.
2. Remove the exhaust cover and its gasket.
3. Straighten lock tabs (7) and remove the connecting rod caps (16) as shown in Figure 9.
4. Remove the 30 needle bearings from the crankshaft.
5. Remove the lower main bearing and seal housing. If either the seal or bearing is damaged, the entire assembly will have to be replaced.
6. Remove the crankshaft from the bottom of the crankcase.
7. Temporarily install the connecting rod caps.
8. Continue to disassemble the power head as described elsewhere in this chapter. Refer next to the section on *Piston and Ring Removal*.

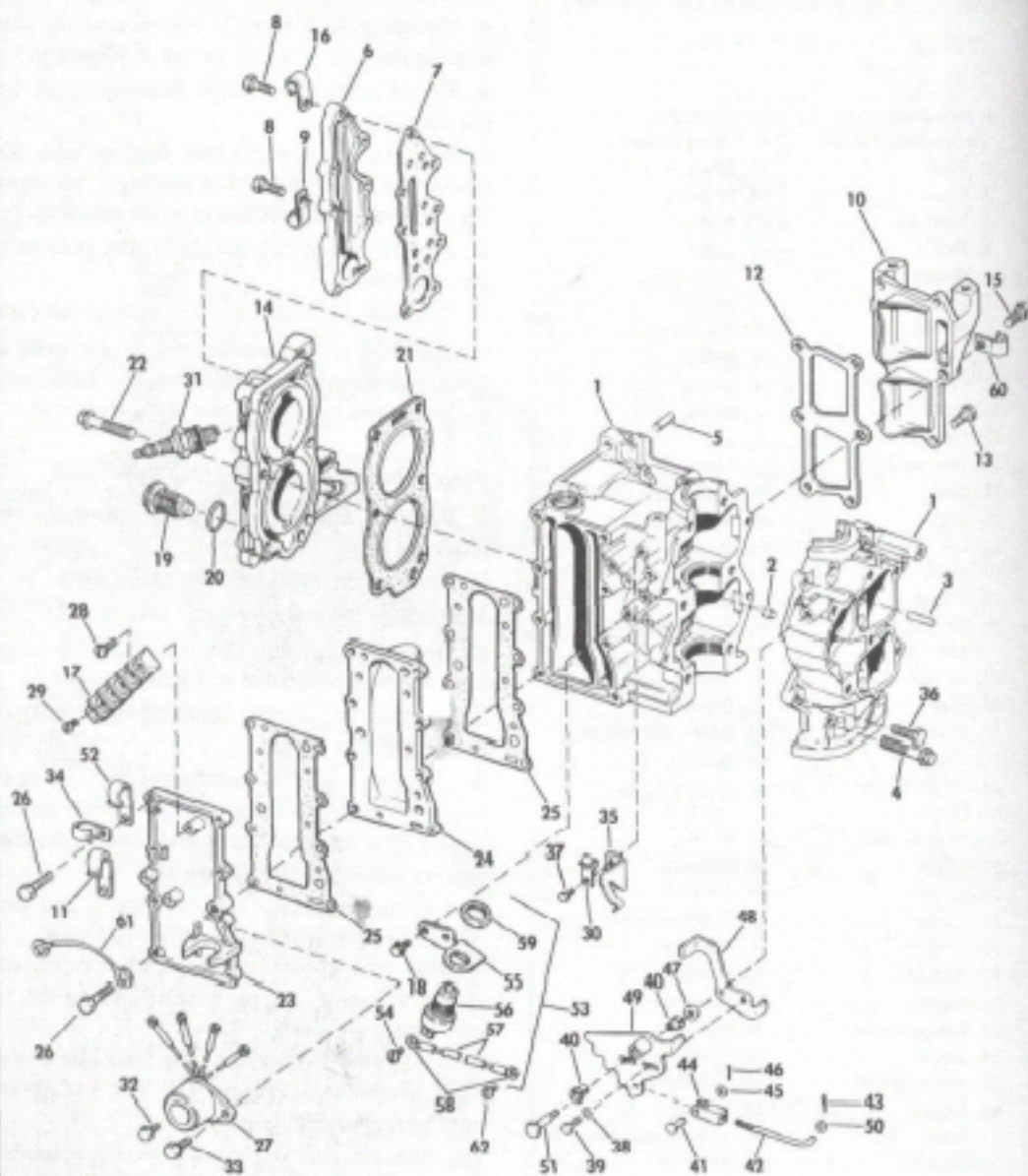
Power Head Disassembly (3-4 hp)

1. Remove the armature plate, washer, and retaining ring.
2. Remove the cylinder head and gasket.
3. Remove the exhaust cover and gasket.
4. Drive the taper pins (10) out of the crankcase from the back as shown in Figure 3.
5. Remove the screws attaching the crankcase to the cylinder block.
6. Separate the crankcase halves by tapping on the crankshaft with a plastic or rubber mallet.
7. Straighten the lock tabs and remove the connecting rod caps. See Figure 10.
8. Lift the crankshaft from the block and temporarily reinstall the connecting rod caps.
Mark each connecting rod, cap, bearing, and piston to assure correct mating during the re-assembly procedure.
9. Remove the magneto cam from the crankshaft as shown in Figure 11. The key should only be removed if damaged.
10. Remove seal and needle bearing assembly.
11. To continue disassembly, refer to *Piston and Ring Removal*.

Power Head Disassembly (5-6 hp)

1. Remove cylinder head and gasket. Refer to Figure 4.

6

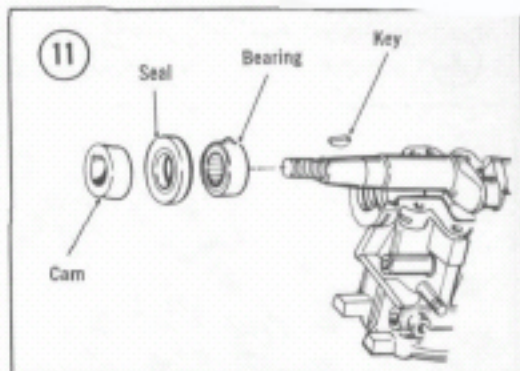


POWER HEAD (9.9-15 HP)

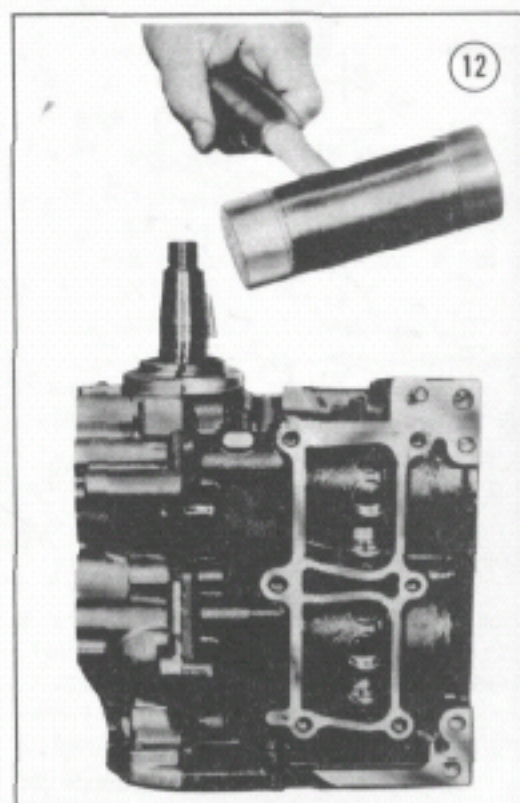
- | | |
|-----------------------------------|-------------------------------------|
| 1. Cylinder to crankcase assembly | **32. Screw |
| 2. Dowel | **33. Screw |
| 3. Taper pin | 34. Clamp |
| 4. Screw | 35. Detent |
| **5. Dowel pin | 36. Screw |
| 6. Cover | 37. Screw |
| 7. Gasket | 38. Lockwasher |
| 8. Screw | 39. Screw |
| 9. Clamp | 40. Bushing |
| **10. Bypass cover | 41. Pin |
| **10. Bypass cover | 42. Link |
| 11. Clamp | 43. Cotter pin |
| 12. Gasket | 44. Clevis |
| 13. Screw | 45. Washer |
| 14. Cylinder head assembly | 46. Cotter pin |
| **15. Screw | 47. Washer |
| *15. Screw | 48. Stop |
| 26. Clamp | 49. Lever and hub assembly |
| **17. Terminal block | 50. Washer |
| **18. Screw | 51. Screw |
| 19. Thermostat | 52. Clamp |
| 20. Seal | **53. Bracket and switch |
| 21. Gasket | **54. Screw |
| 22. Screw | **55. Bracket |
| 23. Exhaust cover | **56. Neutral start switch assembly |
| 24. Exhaust cover | **57. Lead assembly |
| 25. Gasket | **58. Terminal |
| 26. Screw | **59. Nut |
| **27. Housing | **60. Clamp |
| **28. Screw | 61. Ground wire |
| **29. Screw | **62. Screw |
| **30. Clamp | |
| 31. Spark plug | |

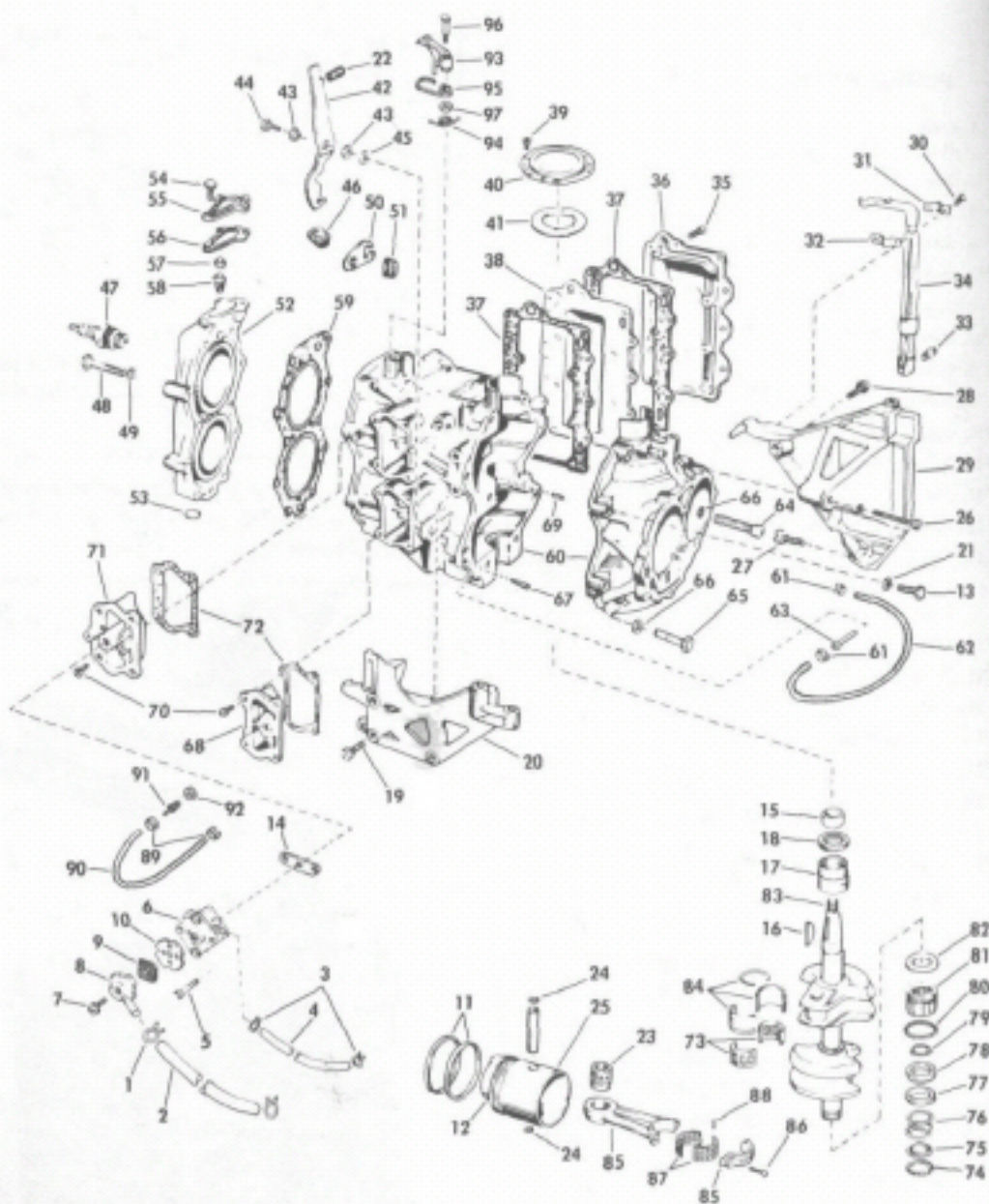
*Rope start models

**Electric start models



2. Remove exhaust covers and gaskets.
3. Remove the oil return hose.
4. Drive the taper pins out of the crankcase from the back. These must be installed from the same side during assembly.
5. Remove the crankcase attaching screws.
6. Tap on the crankshaft with a rubber or plastic mallet to separate the crankcase halves as shown in Figure 12.

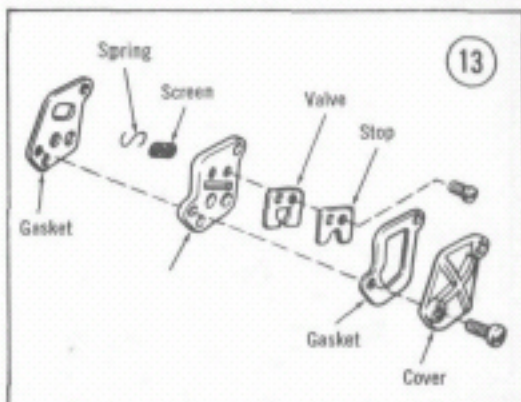




POWER HEAD (TYPICAL 18-33 HP)

- | | |
|--------------------------------------|-------------------------------------|
| 1. Hose clamp | 50. Anchor |
| 2. Hose | 51. Grommet |
| 3. Hose clamp | 52. Cylinder head assembly |
| 4. Hose | 53. Core plug |
| 5. Screw | 54. Screw |
| 6. Fuel pump and filter assembly | 55. Thermostat cap |
| 7. Screw | 56. Gasket |
| 8. Cap | 57. Seal |
| 9. Fuel filter screen | 58. Thermostat |
| 10. Gasket | 59. Gasket |
| 11. Piston ring set | 60. Cylinder and crankcase assembly |
| 12. Piston | 61. Hose clamp |
| 13. Screw | 62. Hose |
| 14. Gasket | 63. Nipple |
| 15. Magneto cam | 64. Screw |
| 16. Crankshaft key | 65. Screw |
| 17. Roller bearing and seal assembly | 66. Washer |
| 18. Seal | 67. Taper pin |
| 19. Screw | 68. Cover |
| 20. Bracket | 69. Dowel |
| 21. Washer | 70. Screw |
| 22. Spring | 71. Cover |
| 23. Needle bearing | 72. Gasket |
| 24. Retaining ring | 73. Retainer and needles |
| 25. Wrist pin | 74. Retaining ring |
| 26. Screw | 75. Washer |
| 27. Screw | 76. Spring |
| 28. Screw | 77. Washer |
| 29. Starter mounting bracket | 78. Seal |
| 30. Screw | 79. O-ring |
| 31. Clamp | 80. O-ring |
| 32. Clamp | 81. Roller bearing |
| 33. Pin | 82. Thrust washer |
| 34. Control lever | 83. Crankshaft assembly |
| 35. Screw | 84. Sleeve |
| 36. Exhaust cover | 85. Connecting rod assembly |
| 37. Gasket | 86. Screw |
| 38. Exhaust cover | 87. Retainer set |
| 39. Screw | 88. Needle set |
| 40. Support | 89. Clamp |
| 41. Retaining ring | 90. Oil line |
| 42. Shifter lock | 91. Nipple |
| 43. Bushing | 92. Washer |
| 44. Screw | 93. Lockout lever |
| 45. Washer | 94. Spring |
| 46. Grommet | 95. Spring |
| 47. Spark plug | 96. Shoulder |
| 48. Screw | 97. Washer |

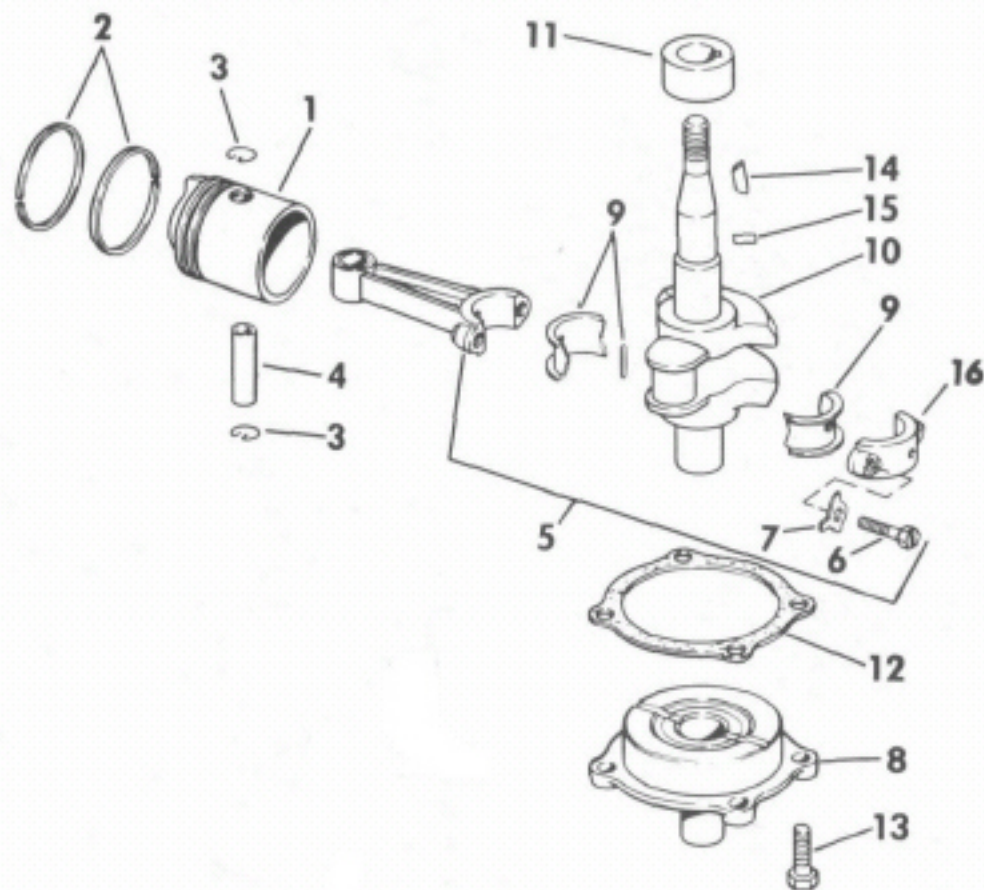
- Lift the crankcase from the cylinder block.
- Remove oil drain valve. Refer to **Figure 13**.



- Remove connecting rod caps and bearings.
- Mark each connecting rod, cap, bearing, and piston with the cylinder number to assure correct mating during reassembly.
- Lift the crankshaft from the case and temporarily reinstall the bearing caps.
- To continue disassembly, refer to the section on *Piston and Ring Removal*.

Power Head Disassembly (9.5 hp)

- Remove the upper front rubber motor mount. See **Figure 14**.
- Remove the 3 exhaust covers. Refer to **Figure 5**, items 19, 24, 26.
- Remove cylinder head and manifold.
- Drive taper pins out of the crankcase and cylinder from the rear.
- Remove crankcase screws and tap on the crankshaft with a rubber or plastic mallet to separate the case halves.
- Lift off the crankcase.
- Loosen locking tabs and remove the connecting rod caps and bearings.
- Lift the crankshaft from the case and temporarily reinstall the caps. Mark each connecting rod, cap, bearing, and piston to assure correct reassembly.
- Remove flywheel key and cam (**Figure 11**).
- Remove crankshaft roller bearings for cleaning and inspection.



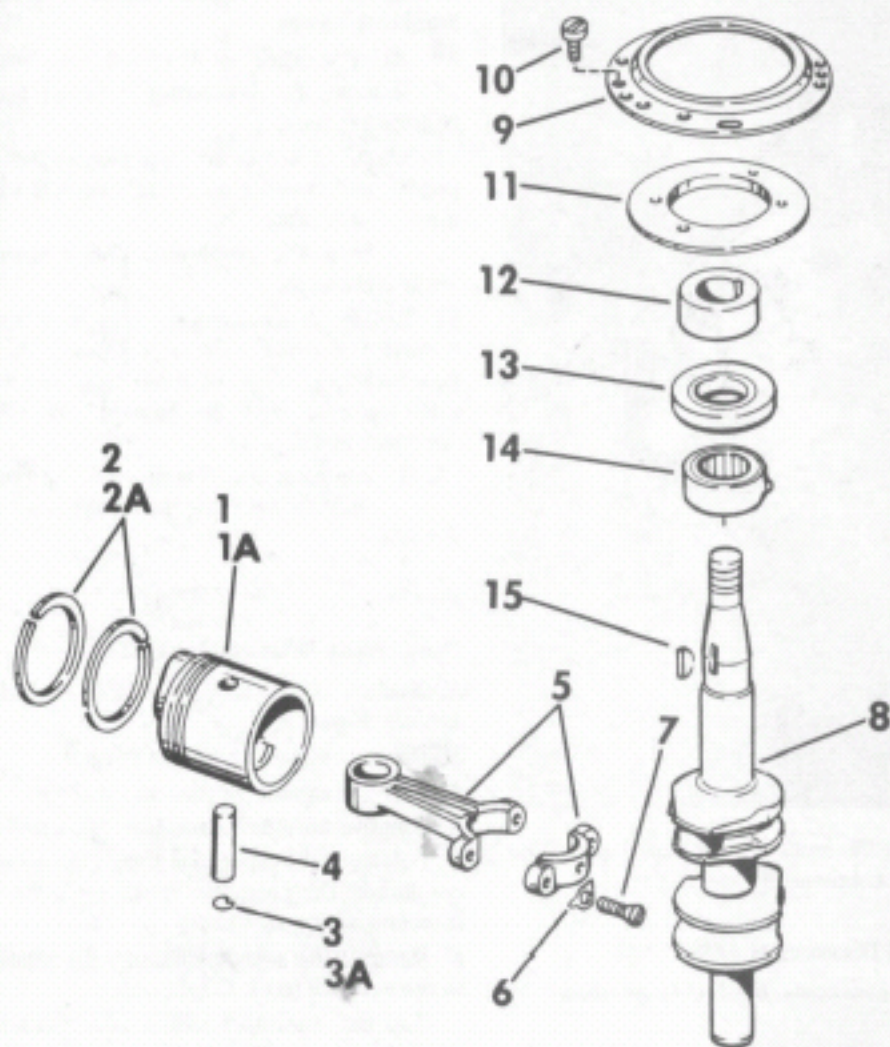
PISTON AND CRANKSHAFT (1.5-2 HP)

1. Piston assembly
2. Ring set
3. Retaining ring
4. Wrist pin

5. Connecting rod assembly
6. Screw
7. Lock tab
8. Bearing housing

9. Liners and needles
10. Crankshaft
11. Magneto cam
12. Gasket

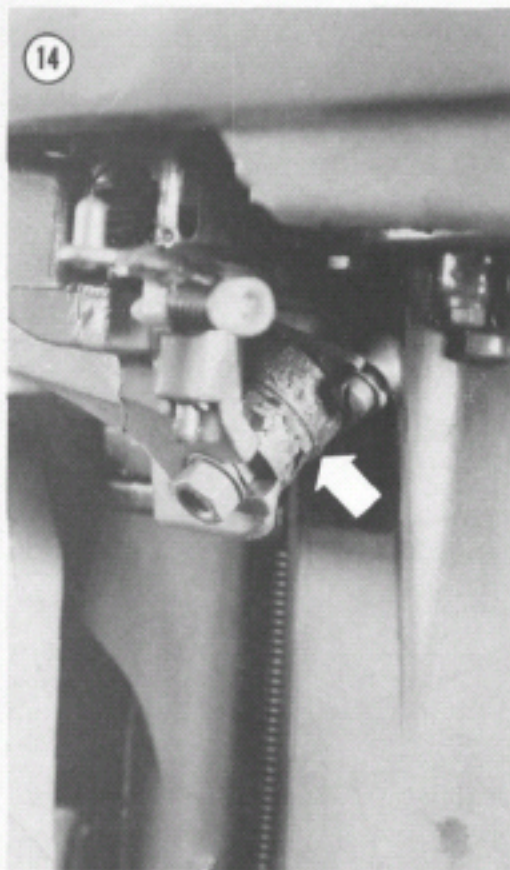
13. Screw
14. Flywheel key
15. Pin
16. Connecting rod caps



PISTON AND CRANKSHAFT (3-4 HP)

- | | | |
|--------------------|---------------|-----------------------------|
| 1. Piston assembly | 6. Lock tabs | 11. Retaining ring |
| 2. Ring set | 7. Screw | 12. Magneto cam |
| 3. Retaining ring | 8. Crankshaft | 13. Seal |
| 4. Wrist pin | 9. Support | 14. Needle bearing assembly |
| 5. Connecting rod | 10. Screw | 15. Flywheel key |

14



11. Refer to the section titled *Piston and Ring Removal* to continue disassembly.

Power Head Disassembly (9.9-15 hp)

1. Remove crankcase head (11) as shown in Figure 15.
2. Remove the exhaust covers and gaskets. See Figure 6.
3. Remove the cylinder head cover, gasket, and thermostat.
4. Remove cylinder head and gasket.
5. Remove the bypass cover and gasket.
6. Remove the intake manifold, reed valve assembly, and gaskets.
7. Drive out the taper pins from the rear of the crankcase. The taper pins must be driven in from the same direction during assembly because of the shape and direction of the internal taper of the crankcase.

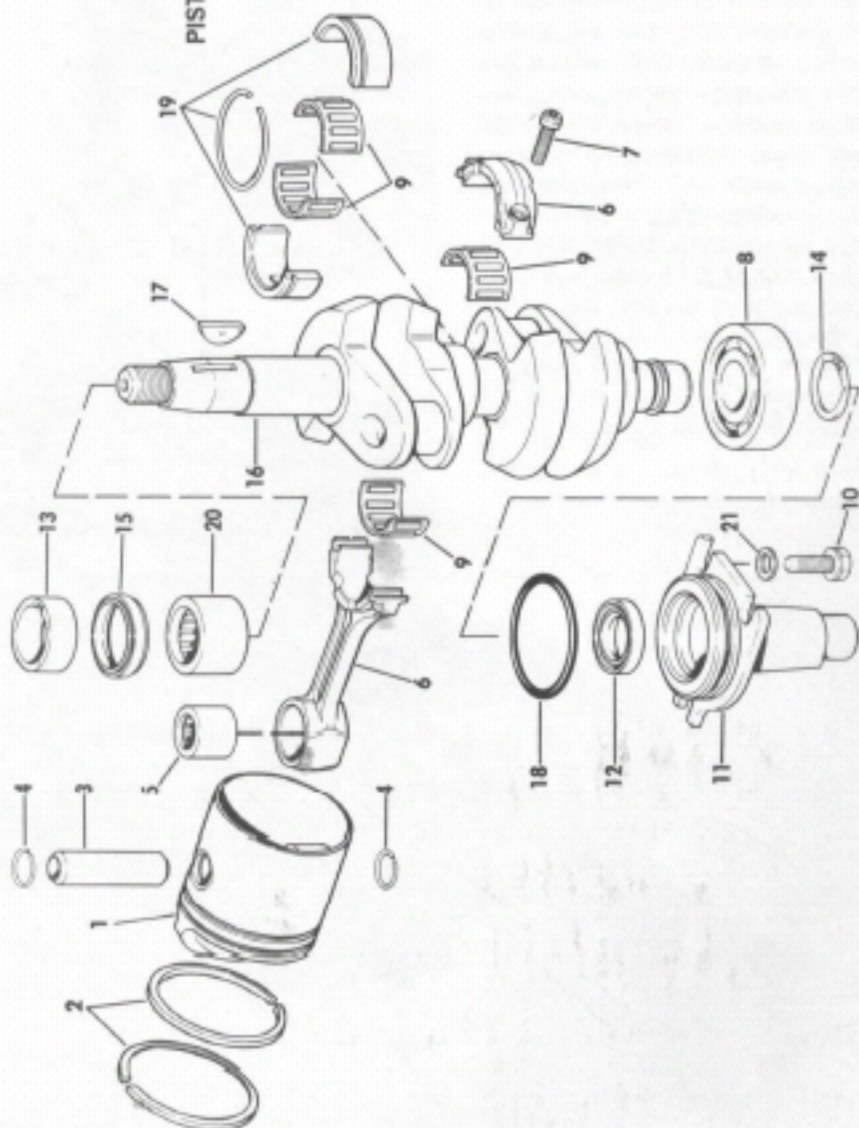
8. Remove the crankcase screws.
9. Tap on the crankshaft end to separate the crankcase halves.
10. Remove crankcase from cylinder block.
11. Remove the connecting rod caps and the bearing retainers.
12. Mark each cylinder, connecting rod, cap, piston, and bearing to ensure correct mating during reassembly.
13. Remove the crankshaft and temporarily replace the caps.
14. Lift the retaining ring out of its groove to remove the main crankshaft bearing. If it is necessary to remove the lower bearing, remove the snap ring. Pull the bearing out using a universal puller.
15. To continue disassembly, refer to the section in this chapter titled *Piston and Ring Removal*.

Power Head Disassembly (18-33 hp)

1. Remove lift bracket, cylinder head, and gasket. See Figure 8.
2. Remove bypass cover and gasket.
3. Remove exhaust covers and gaskets.
4. Remove oil return hose from the crankcase.
5. Drive out the taper pins from the rear of the crankcase. The pins must be driven in the same direction during assembly.
6. Remove the screws attaching the crankcase to the cylinder block (33 hp only).
7. Tap the crankshaft with a rubber mallet to separate the crankcase halves. Lift off the crankcase from the cylinder block.
8. Remove connecting rod caps and bearings.
9. Mark each cylinder, connecting rod, cap, and piston to assure correct mating during assembly.
10. If seal requires service, remove the retaining ring and pull out the carbon seal.
11. Lift out crankshaft and temporarily replace the connecting rod caps.
12. Lift retaining ring out of its groove and remove main bearing for cleaning and inspection.
13. Refer to the section of this chapter titled *Piston and Ring Removal* to continue overhaul.

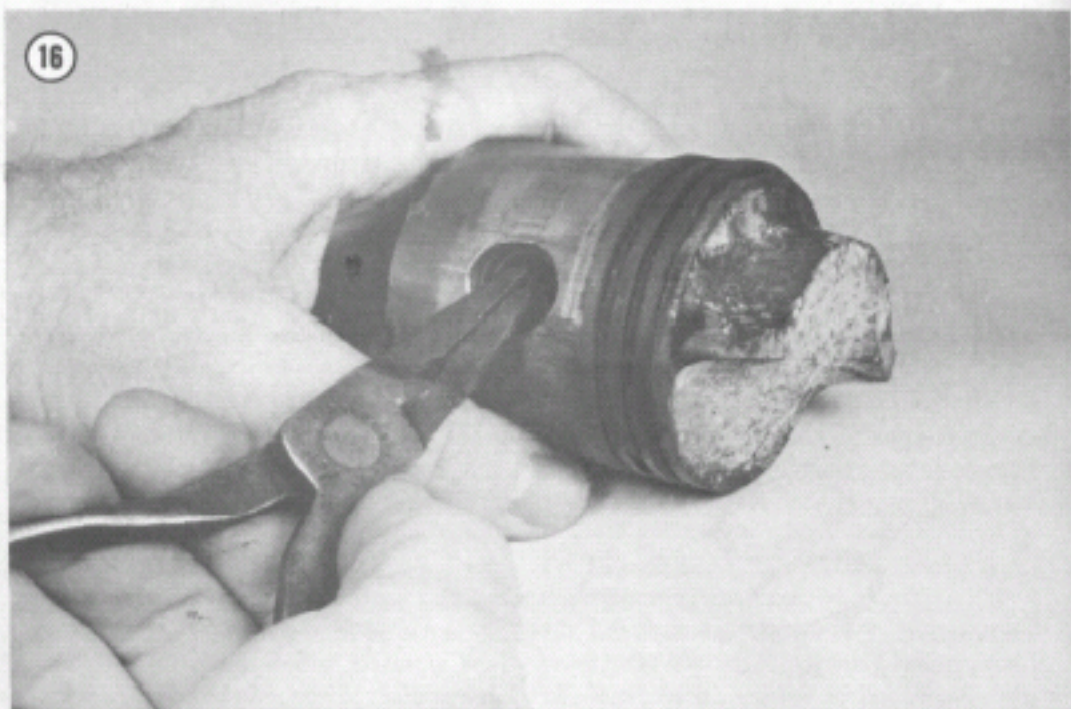
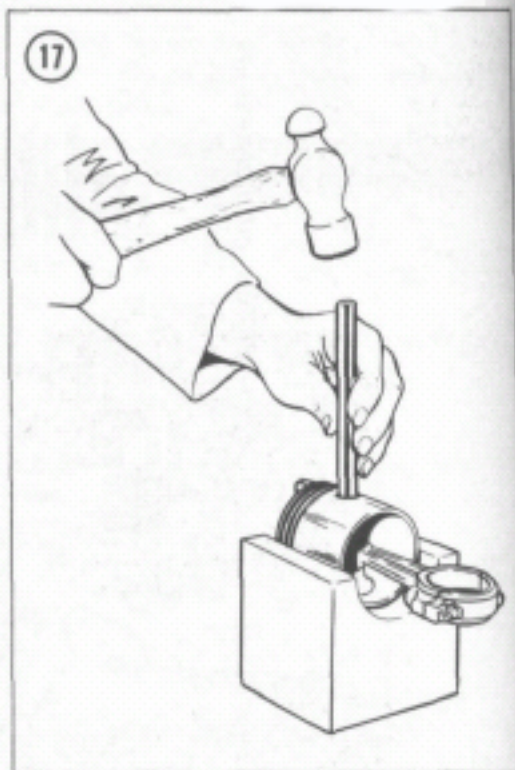
PISTON AND CRANKSHAFT (9.9-15 HP)

1. Piston
2. Ring set
3. Wrist pin
4. Retaining ring
5. Bearing
6. Connecting rod
7. Screw
8. Bearing assembly
9. Bearing set
10. Screw
11. Crankcase head
12. Seal
13. Magneto cam
14. Retaining ring
15. Seal
16. Crankshaft
17. Crankshaft key
18. O-ring
19. Split sleeve
20. Bearing
21. Washer

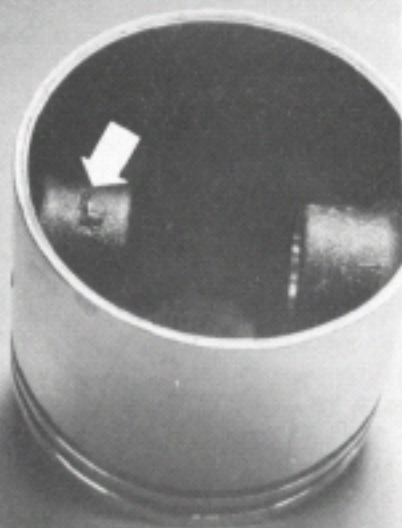


PISTON AND RING REMOVAL (1.5-33 hp)

1. Mark each piston as to the cylinder it was taken from and the direction it should face when reinstalled. Remove piston and rod.
2. Pry the ends of the rings away from the piston and break off. The rings should always be replaced even when they appear to be alright.
3. Check the wrist pin fit in the piston. If *any* movement can be felt, the pin should be replaced. Remove the retainer with a pair of snap ring pliers or pry out with a knife (**Figure 16**).
4. Remove the wrist pin. Special pullers are made for this purpose but a makeshift method is just as easy. Place a socket, with an outer diameter smaller than the wrist pin, against the wrist pin. Place a socket, with an internal diameter larger than the wrist pin, against the other side. Run a bolt through both sockets and the wrist pin. Place a nut on the bolt and tighten slowly until the pin is pulled into the larger socket. See **Figure 17** for removal using V-block. The pin should be driven through the piston side which is marked LOOSE or L. See **Figure 18**.



18



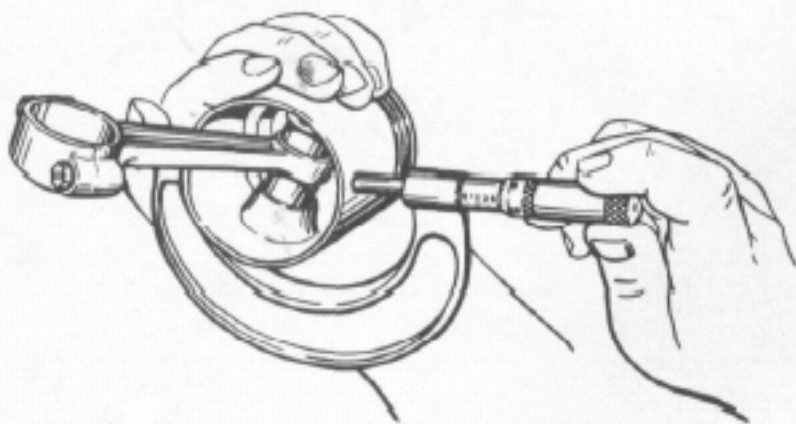
5. Check the piston to make sure that it hasn't been distorted during disassembly (Figure 19).

CLEANING AND INSPECTION

Cylinder and Crankcase

1. Check cylinder walls for excessive wear or scoring. Look for evidence of piston seizure at one time.
2. Check the cylinder ports for carbon buildup.
3. Check the cylinder walls for size and wall straightness using an inside micrometer. Refer to Chapter One for specifications regarding bore diameter. Wear or variance is acceptable up to 0.0025 in. Replace the cylinder block or have the cylinder bored to the next oversize piston diameter if beyond the limit.
4. Carefully scrape any carbon buildup off the ports and cylinder head with a blunt instrument such as a putty knife. A wire brush can be used in some spots but care must be exercised on aluminum parts.
5. If the cylinder and pistons check out against the specifications and can be reused, hone the cylinder to remove the glaze coat. Hones are sold at most automotive stores and come with instructions for their use.

19



Gaskets

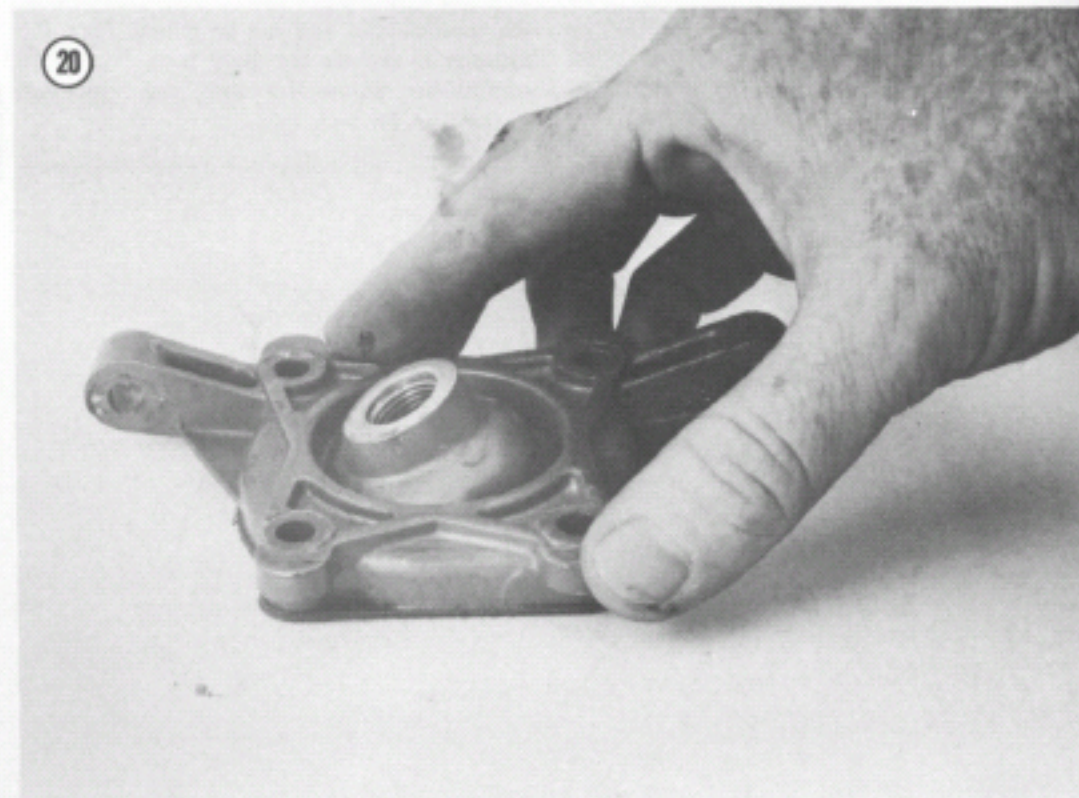
1. All gaskets should be discarded when an engine is disassembled. It is false economy to try saving a gasket.
2. Carefully remove the gaskets to minimize the cork left on the metal mating surface. A blunt instrument can be used for scraping but be very careful to avoid nicks or scrapes. Remove the old glue with trichlorethylene.
3. Check all gasket surfaces for flatness using a surface gauge or a piece of thick plate glass.
4. Gasket surfaces can be made flat using wet-or-dry emery cloth. Place the piece to be surfaced on No. 180 cloth which has been dampened with light machinist's oil. Rotate the piece in a figure 8 motion as shown in **Figure 20**. Continue until surface is uniform grey in color.

Pistons

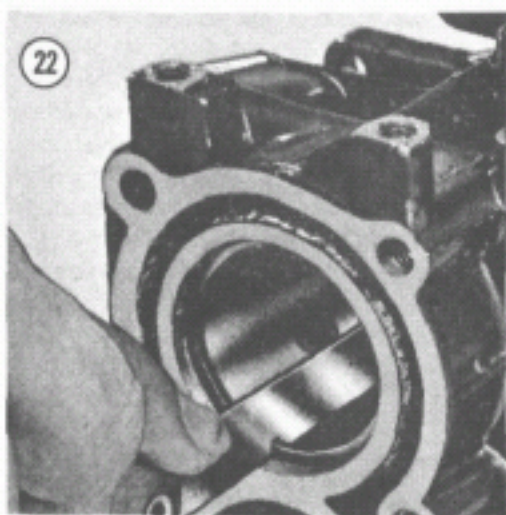
1. Check the pistons carefully for wear, scoring, and roundness. Measure the piston in several

spots for accuracy. See Chapter One for specifications.

2. Remove carbon deposits from the piston's crown, ring grooves, and inside of piston. A tool for cleaning the ring grooves can be made by sharpening the end of a broken ring. See **Figure 21**.



3. Refer to **Figure 22** to check for ring end gap. Place the piston in the cylinder without any



ings attached. Insert each of the rings and press them flush against the piston so that they are square in the cylinder. Measure the gap with a flat-bladed feeler gauge. Also check for ring groove clearance as shown in **Figure 23**. Chapter One has all specifications for overhaul of each engine.

Bearings

1. Clean the area around the bearings thoroughly to avoid contaminating bearing surfaces.
2. Place the bearings in a wire basket and soak in solvent. Shake the basket occasionally to loosen any debris.
3. Remove bearings from soaker tank and clean with fresh solvent. Turn the bearings gently while cleaning to get dirt from between the balls.
4. Blow the bearings dry with dry, filtered air. Don't allow the bearings to spin without lubricant.
5. Check the balls and races for discoloration, pitting, scoring, or excessive wear. Discard the old bearings if in doubt about their condition.

POWER HEAD ASSEMBLY (ALL MODELS)

Refer to the disassembly procedures in reverse for the assembly of each unit in addition to the following steps and information.

Work in a clean, dry area free of dust or dirt.



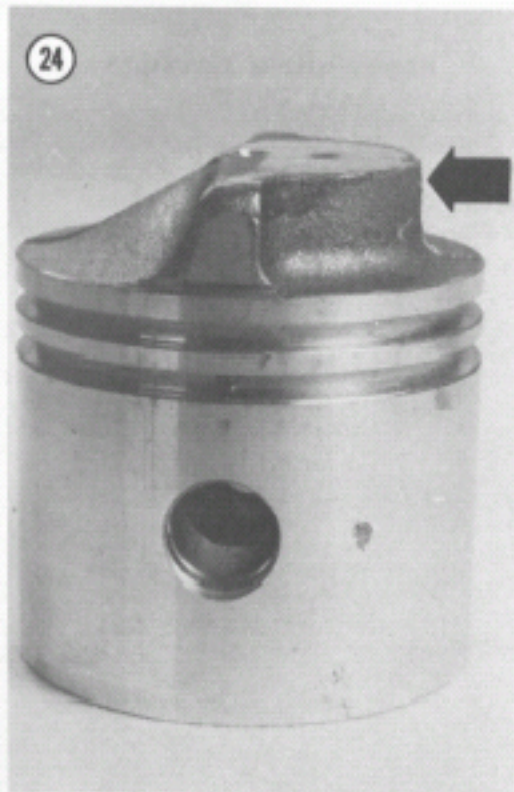
Make sure that all parts have been thoroughly cleaned prior to assembly.

Use new gaskets throughout to avoid any possible problems.

Never use force to assemble parts unless the procedure specifically calls for a press fit. Use lubricant of the correct type when joining parts that have been cleaned. A light coating of WD-40 on nonfunctioning, exposed surfaces will help retard oxidation.

Pistons

1. The direction of the piston crown is important. Install as shown in **Figure 24** with the rounded side of the crown toward the intake.



2. If the connecting rod is equipped with an oil hole, be sure that it faces up when installed.

3. Install wrist pin in the LOOSE or L side of the piston. Heat the piston slightly before inserting the pin all the way.

4. Replace the wrist pin retainer with a new part or a teflon button designed for this purpose. Make sure that the retainer is seated firmly to avoid possible future engine damage.

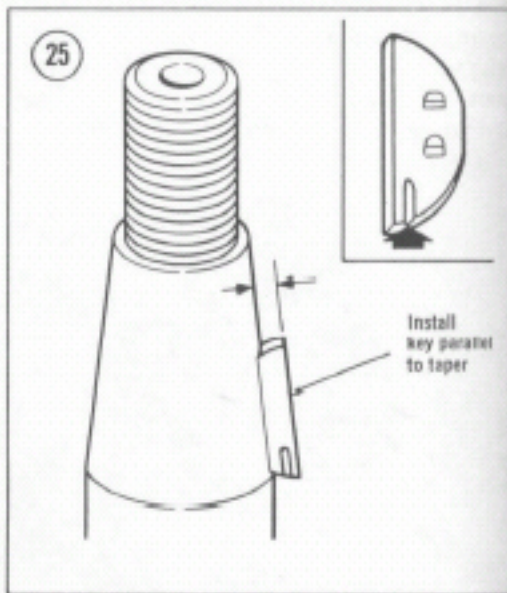
5. Use a piston ring expander to install the rings. Note the location and up or down attitude of each. If the ring is to face the top of the cylinder, it will so state on the ring near the gap.

6. Install the pistons by working one ring at a time into the cylinder by hand. A light coat of 2-stroke oil will simplify the installation and guarantee that the walls won't be scored in the first few minutes of running.

Crankshaft

1. Install the upper main bearing and seal.

2. Install flywheel key parallel to taper of the crankshaft as shown in **Figure 25**.

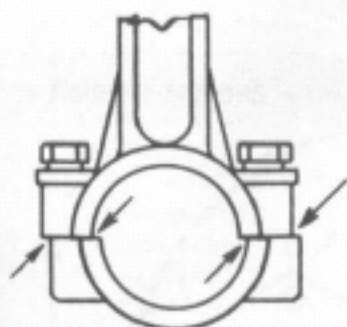


3. Install oil slinger on upper crankshaft.

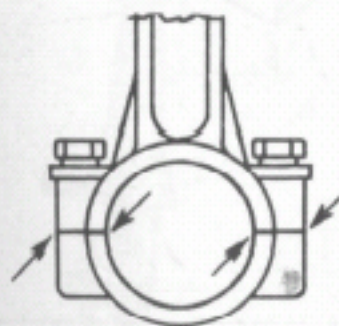
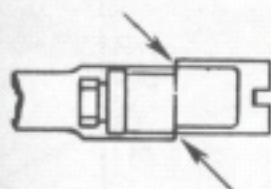
4. Remove connecting rod caps and place crankshaft on cylinder block making sure that the dowel aligns with the hole.

5. Rotate crank until the rod bearings are against the crankpins. Place needle bearings on the crankpins with grease and install the connecting rod caps. Refer to **Figure 26**. Tighten the screws to the torque specified in Chapter One.

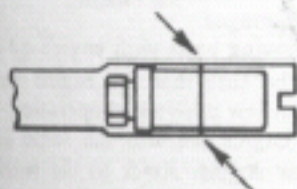
26



INCORRECT



CORRECT



6. Insert a wire through the connecting rod oil hole. If the correct number and size of bearings have been installed, it will be impossible to touch the crankpin with the wire.

7. Check the connecting rod for binding. If rod binds, check alignment as shown in Figure 26.

8. Bend the lock tabs up to prevent the connecting rod caps from backing out and causing engine destruction.

9. Install the remaining needle bearings with grease and install the liner.

10. Check the cylinder head for flatness using the method described previously under *Cleaning*.

Crankcase and Cylinder

1. Apply gasket cement sparingly to the crankcase face. Position the crankcase and install the taper pins from the rear.

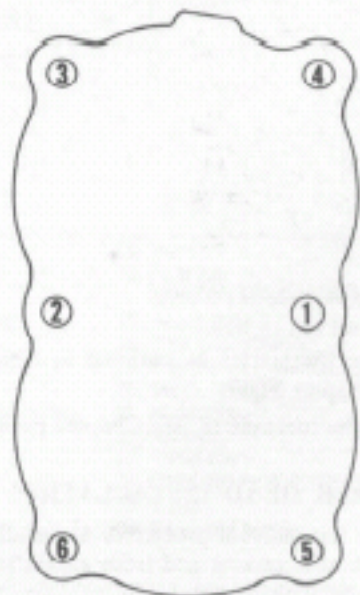
2. Install crankcase attaching screws and torque to the specs given in Chapter One.

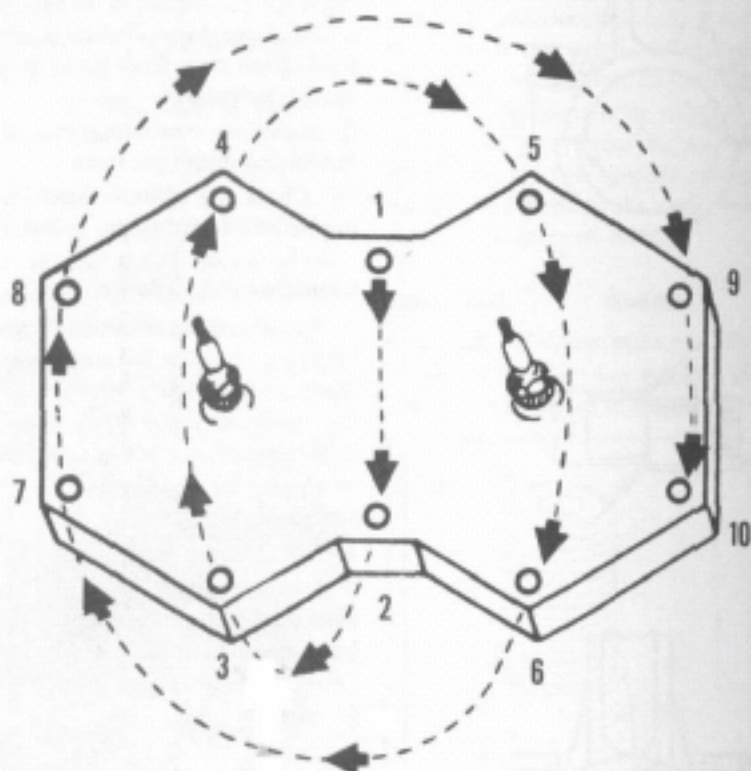
3. Check for binding between the crankshaft and bearings.

4. Install upper bearing seal.

5. Install cylinder head and gasket. Tighten bolts and screws alternately to specified torque following the sequence in Figure 27 or 28.

27





6. Install the exhaust covers.
7. Install oil return hose.
8. Replace the starter as outlined in Chapter Five or Chapter Eight.
9. Install the fuel system. See Chapter Four.

POWER HEAD INSTALLATION

Reverse the removal procedure to install. Be sure to use new gaskets and fresh gasket sealer on parts where it's required.

On some engines, the cylinder head will fit

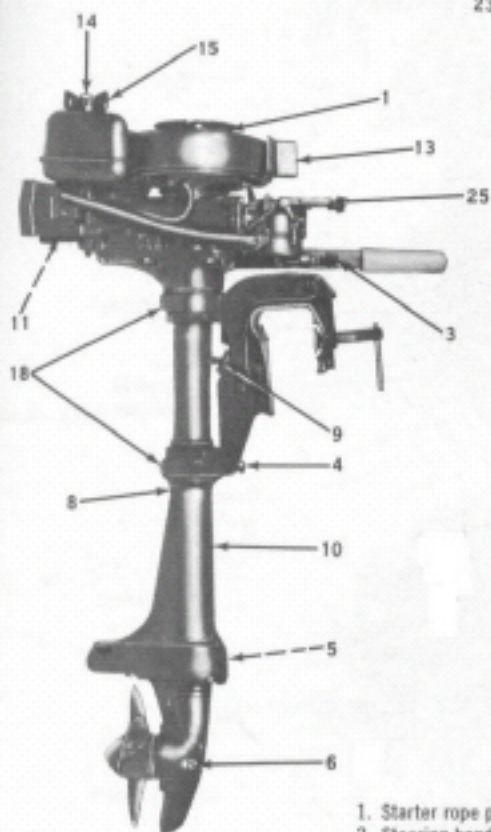
more easily if it is twisted slightly as it is fitted in place. Be careful that the splines on the crankshaft aren't damaged.

Coat all moving parts with engine oil during assembly to be sure that the engine isn't dry during the first few minutes of operation.

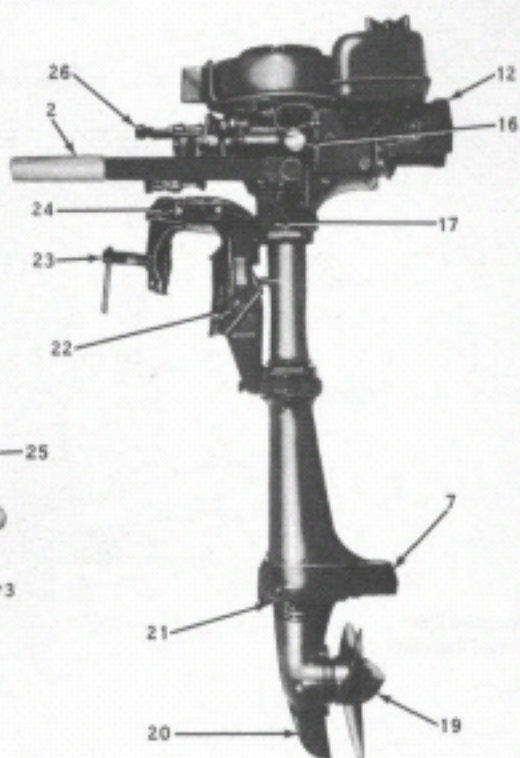
A rebuilt engine requires the same kind of care as a new engine. Refer to the section on break-in procedure in Chapter Two.

Install the electrical system as described in Chapter Five and give the engine a complete tune-up as outlined in Chapter Two.

1.5-2 HP MOTORS



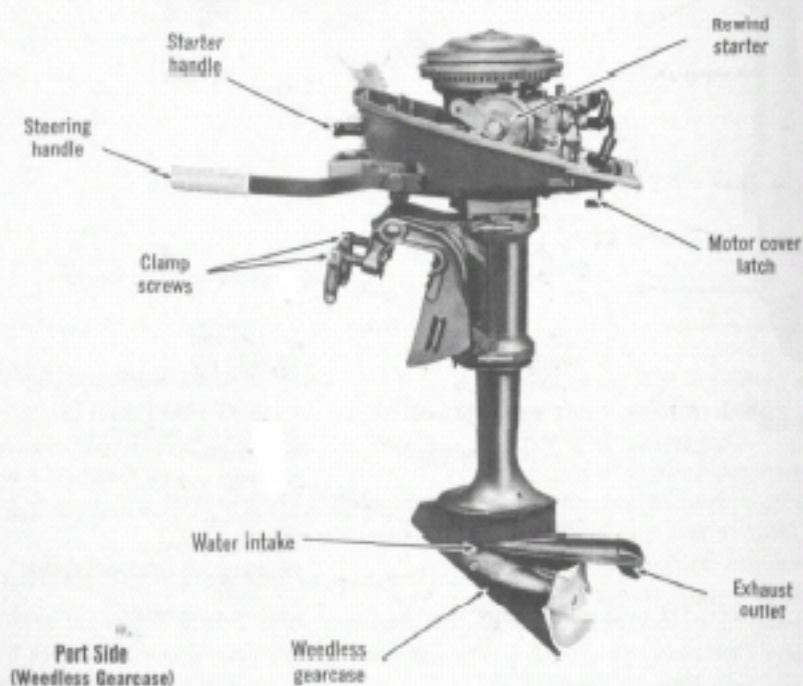
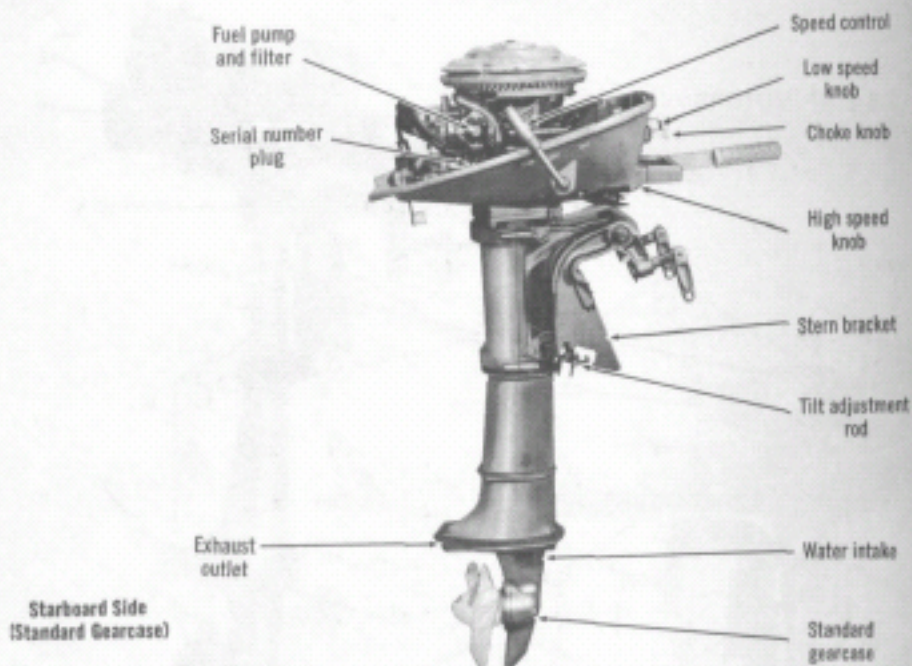
Starboard Side



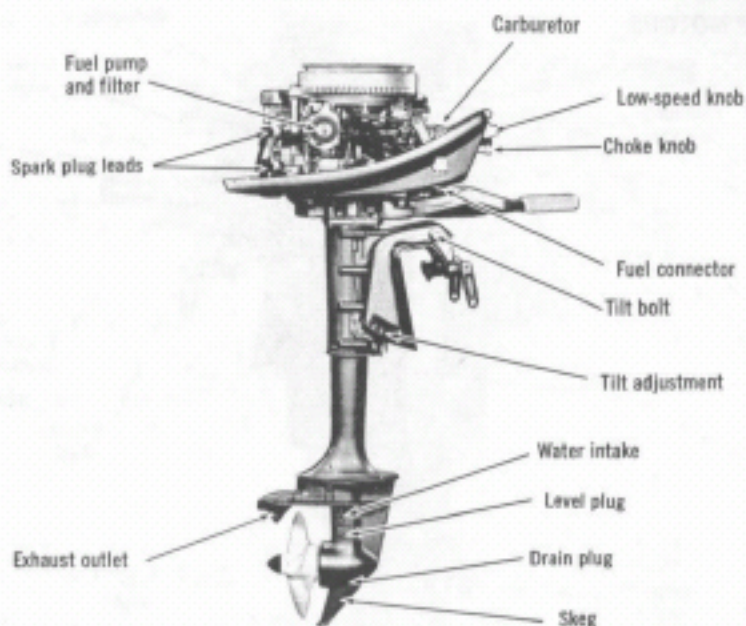
Port Side

- | | |
|------------------------------------|-----------------------------------|
| 1. Starter rope pulley | 14. Fuel vent |
| 2. Steering handle | 15. Filler cap |
| 3. High speed knob | 16. Model and serial number plug |
| 4. Steering friction screw | 17. Swivel bracket |
| 5. Water pump | 18. Pivot brg. retainers |
| 6. Oil drain and fill plug | 19. Propeller |
| 7. Exhaust outlet | 20. Skeg |
| 8. Exhaust relief and water outlet | 21. Water intake |
| 9. Reverse lock | 22. Tilt rod |
| 10. Exhaust housing | 23. Clamp screw |
| 11. Fuel valve | 24. Model and serial number plate |
| 12. Motor rest | 25. Choke |
| 13. Speed control | 26. Low speed needle |

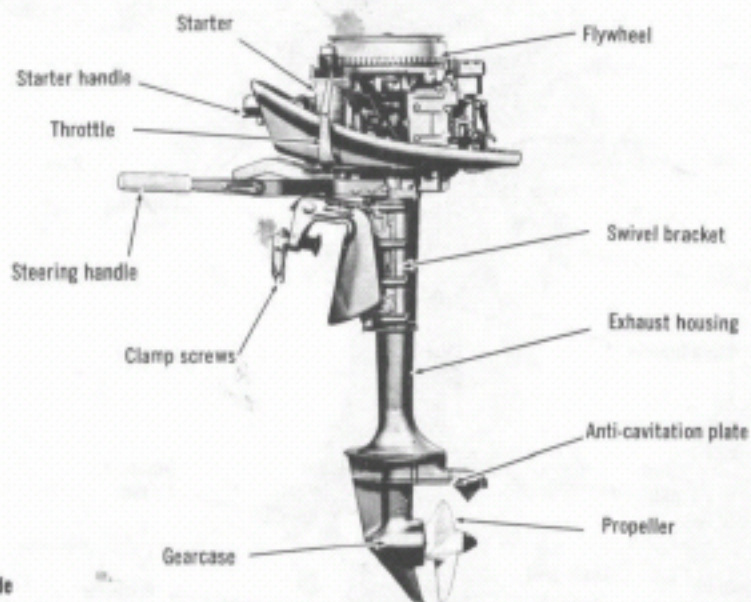
4 HP MOTORS



5 HP MOTORS

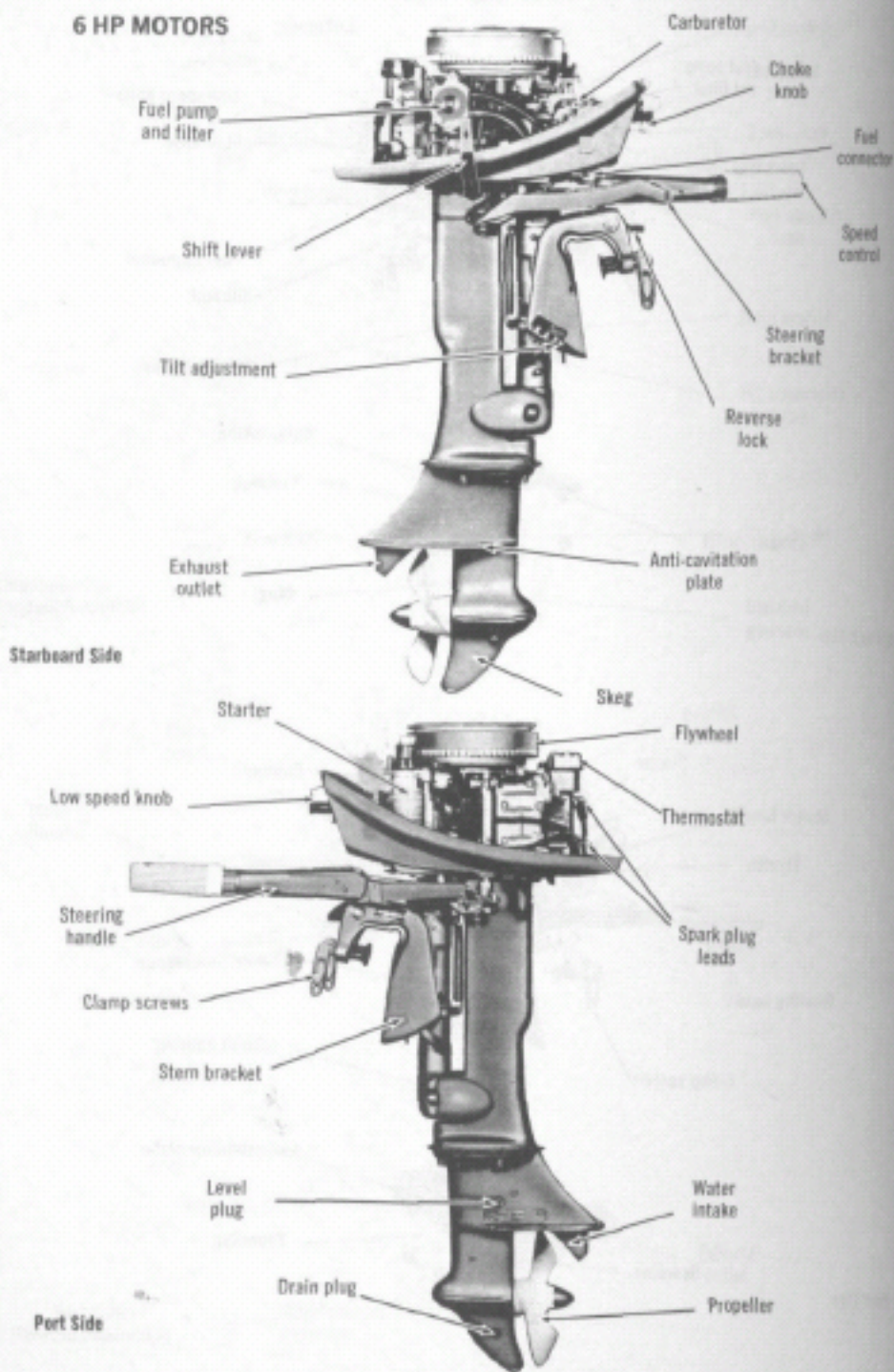


Starboard Side

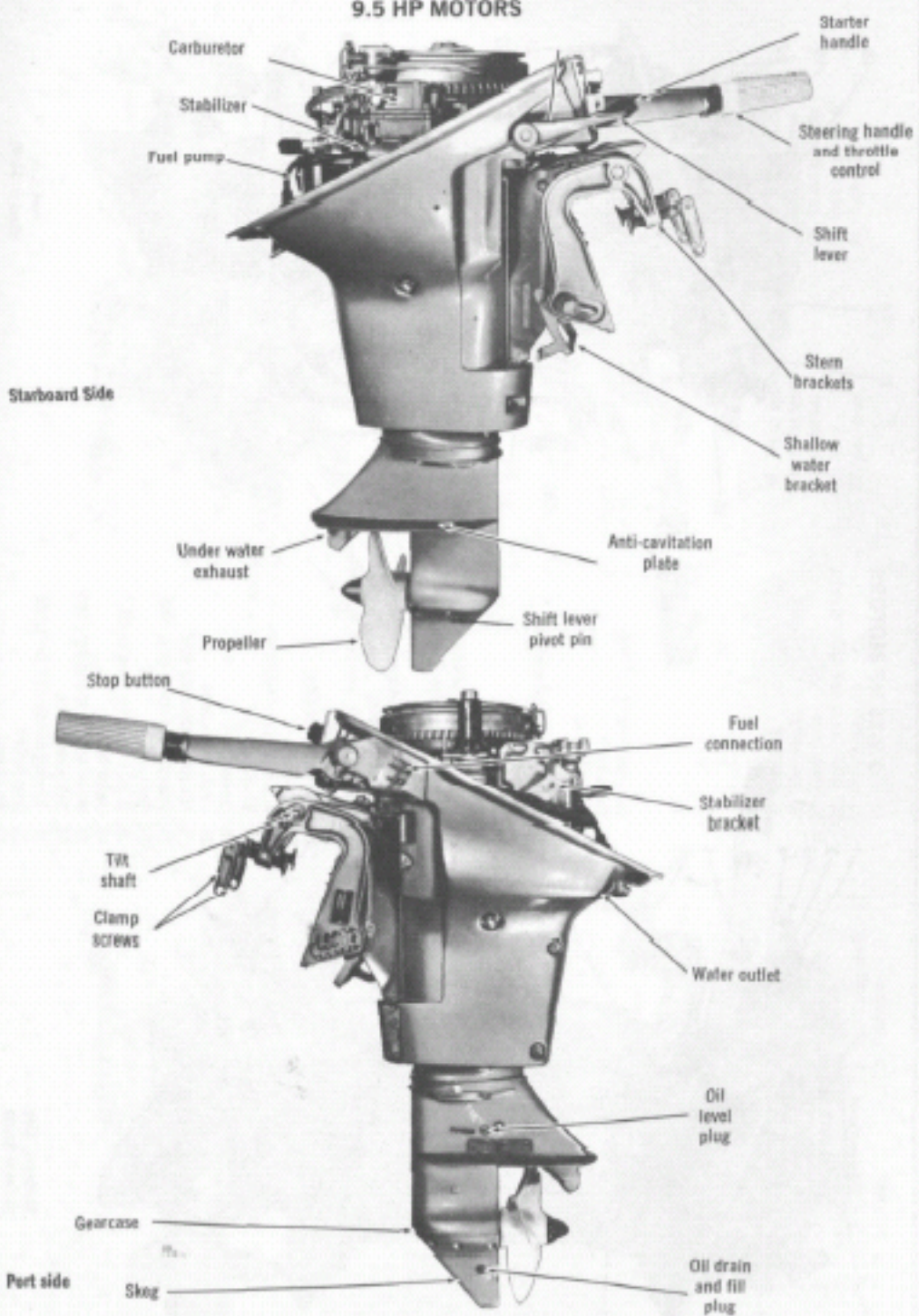


Port Side

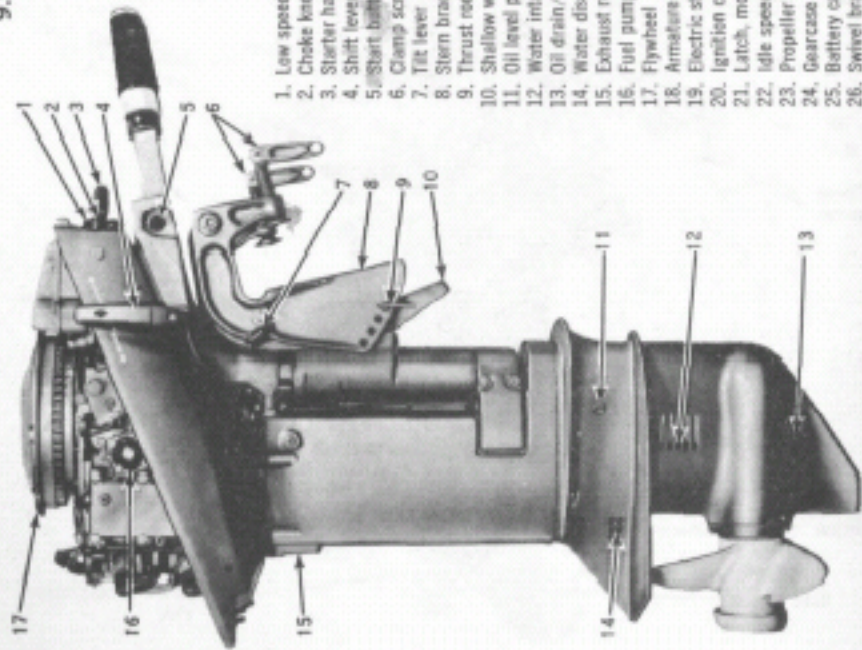
6 HP MOTORS



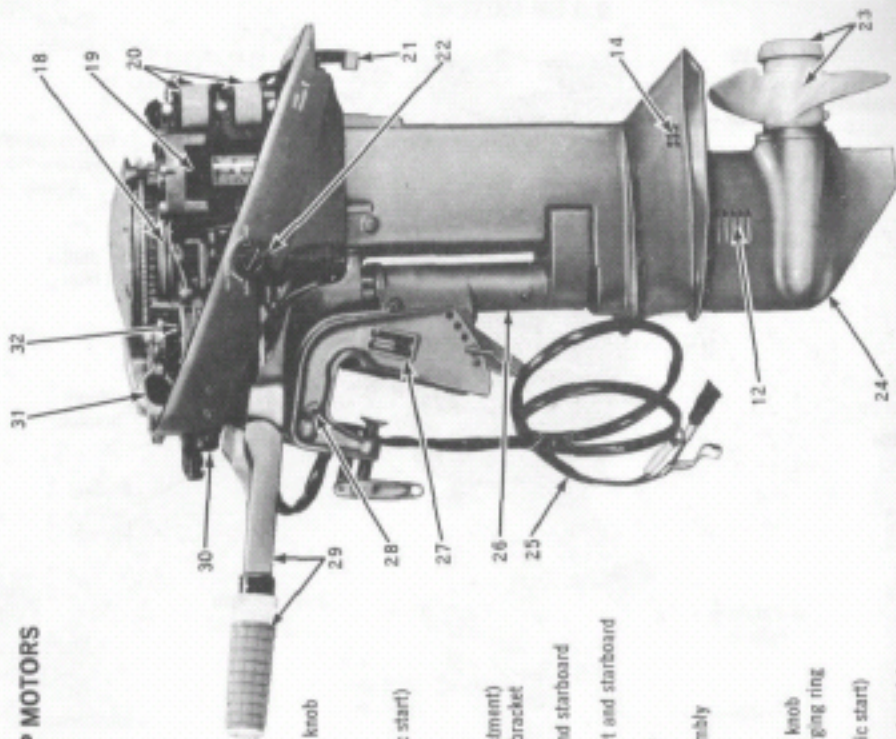
9.5 HP MOTORS



9.9-15 HP MOTORS



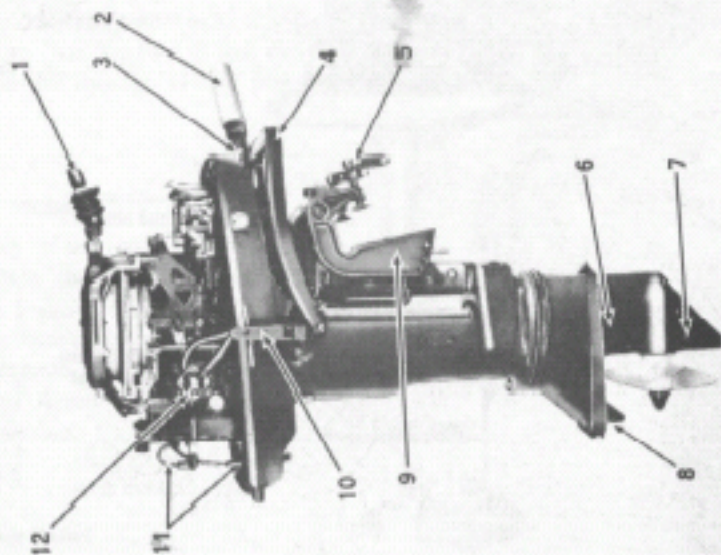
Starboard Side
(Manual Start)



Port Side
(Electric Start)

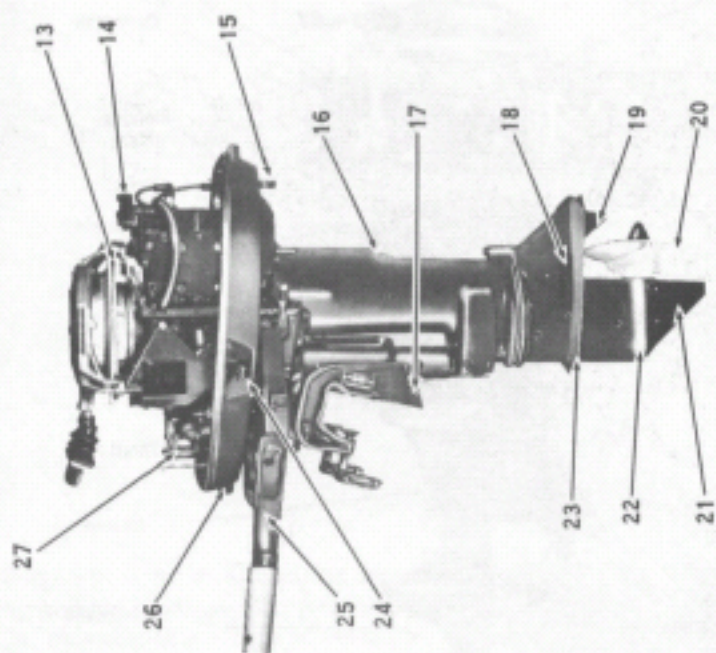
1. Low speed adjusting knob
2. Choke knob
3. Starter handle
4. Shift lever
5. Start button (electric start)
6. Clamp screws
7. Tilt lever
8. Stern brackets
9. Thrust rod (tilt adjustment)
10. Shallow water drive bracket
11. Oil level plug
12. Water intake, port and starboard
13. Oil drain/fill plug
14. Water discharge, port and starboard
15. Exhaust relief
16. Fuel pump and filter
17. Flywheel
18. Armature plate assembly
19. Electric starter
20. Ignition coils
21. Latch, motor cover
22. Idle speed adjusting knob
23. Propeller and converging ring
24. Gearcase
25. Battery cable (electric start)
26. Swivel bracket
27. Model and serial number plate
28. Safety chain link
29. Steering handle and twist grip
30. Stop button
31. Air silencer
32. Re-wind starter

18-25 HP MOTORS



Starboard Side

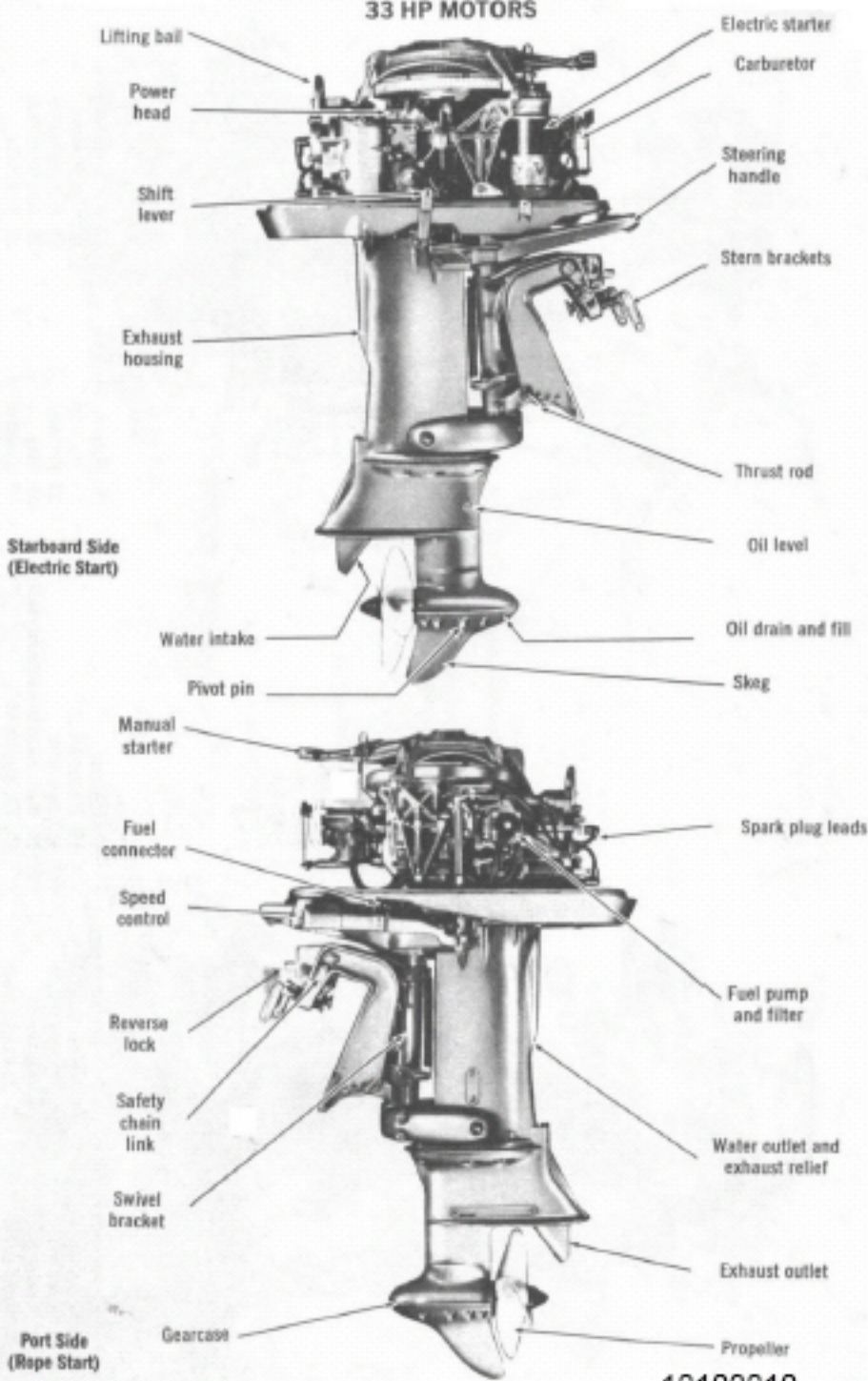
- 1. Starter handle
- 2. Speed control
- 3. Choke knob
- 4. Steering bracket
- 5. Clamp screws
- 6. Oil level plug
- 7. Oil drain and fill plug
- 8. Exhaust outlet
- 9. Stern bracket
- 10. Shift lever
- 11. Spark plug leads
- 12. Fuel pump



Port Side

- 13. Flywheel
- 14. Thermostat
- 15. Cover latch
- 16. Water outlet and exhaust relief
- 17. Tilt adjustment
- 18. Water bypass cover
- 19. Water intake
- 20. Propeller
- 21. Skag
- 22. Gearcase
- 23. Anti-cavitation plate
- 24. Fuel connector
- 25. Steering handle
- 26. Low-speed knob
- 27. Carburetor

33 HP MOTORS



10100010

CHAPTER SEVEN

LOWER UNIT

The lower unit is the most complex area of any motor because it contains the gearcase and drive unit. Servicing this system is impossible without the aid of test tanks, special jigs, and highly specialized and expensive tools.

The home mechanic will be forced to do nothing other than normal periodic maintenance and adjustments. If the lower unit is carefully and faithfully maintained, it should require very little else. The lower unit will continue to give good service through several power head overhauls.

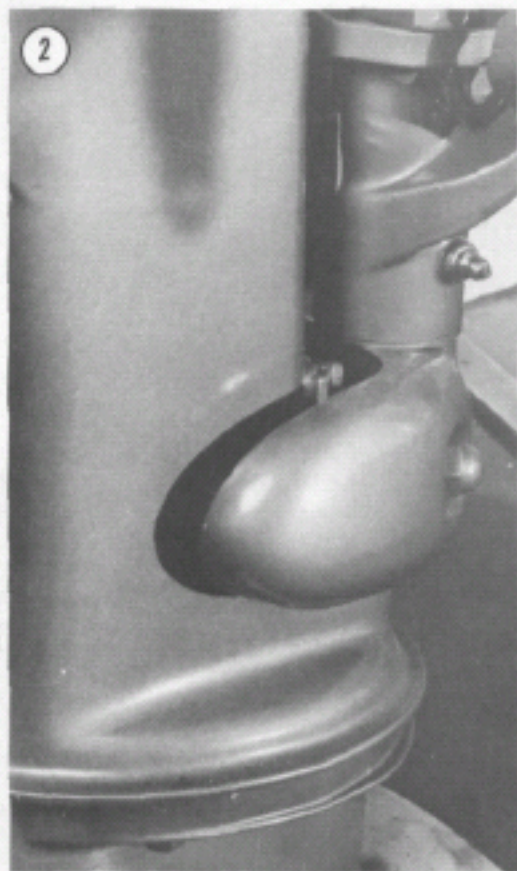
Motor Mounts

Many of the engines "float" on rubber pads to isolate the boat transom from vibration. **Figure 1** shows the location of typical mounts. Unless these pads are worn or cracked, the only maintenance is occasional lubrication with silicone or Armor-All to keep the rubber from deteriorating.

Exhaust Relief

Normally, when the engine is running, exhaust gases escape from the underwater outlet at the point shown in **Figure 2**.





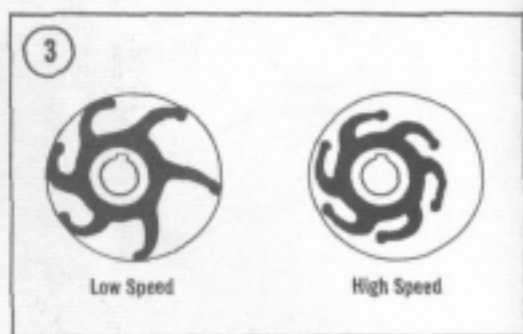
Upon starting, however, backpressure is created and the exhaust exits above the water line at the water outlet. Within moments the exhaust will exit from the underwater outlet as normal. If not, check the opening for any obstructions.

WATER PUMP

The water pump is essential to the long life and performance of any outboard engine. The engine would quickly overheat and seize without the cooling water. Maintenance, other than that outlined in Chapter Two, is impossible because of the location of the pump and its relation to the drivecase. The pump is simple to overhaul.

Cooling water is circulated by the water pump located at the top of the gearcase and driven by the crankshaft. This pump consists of rubber impeller blades keyed to the drive shaft and en-

cased off-center within a housing. The blades flex as they rotate, see **Figure 3**, varying the space between themselves and the housing wall.



At low speeds, the impeller works as a displacement pump. At high speeds, the blades are forced from contacting the housing by water resistance and pump acts as a centrifugal type.

Heavy-duty pumps are available from any dealer for use in muddy water. The pump has a stronger blade which resists the extra pressure of the dirty water.

Check the water outlet hole frequently to make sure that there is a steady stream of water. The engine could quickly overheat causing severe damage.

GEARSHIFT (ALL MODELS)

Forward, neutral, and reverse are provided by the mechanism located in the gearcase. See **Figures 4, 5, and 6** for a typical example. The drive shaft pinion gear rotates constantly and drives 2 bevel gears on the propeller shaft. In neutral, the shifter dog is located between the 2 and remains motionless.

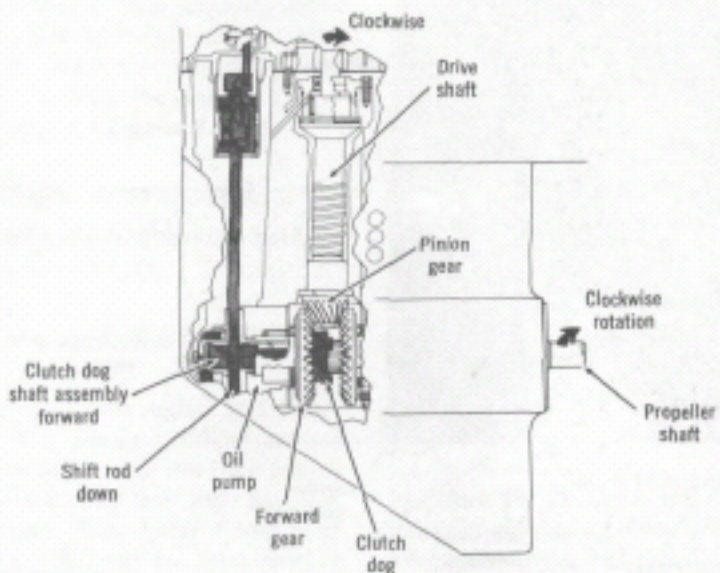
In forward or reverse, the shift lever causes the dog to engage the appropriate gear. Power is then transmitted from the pinion gear, through the shifter dog, and on to the propeller.

TILTING FRICTION

Swing the motor up as far as it will go and tighten the nut until the motor will just remain in this position. See **Figure 7**.

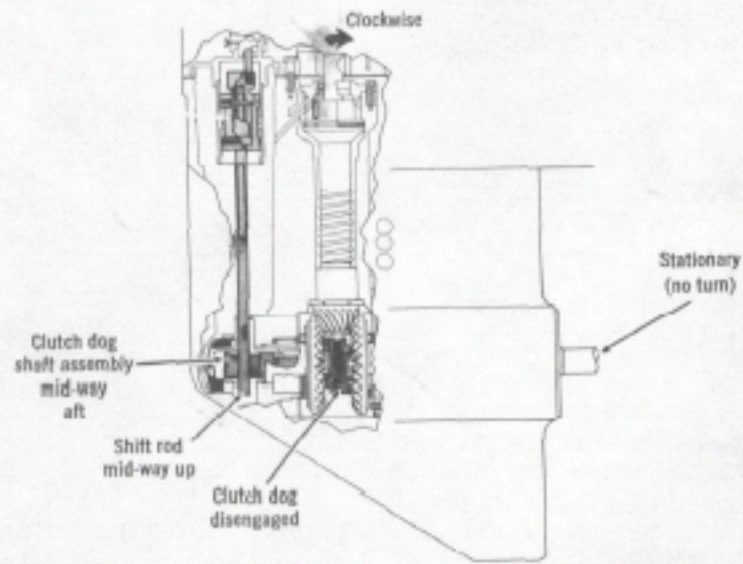
The tension is correct when the motor remains where set but can be returned to the original position with little effort.

4



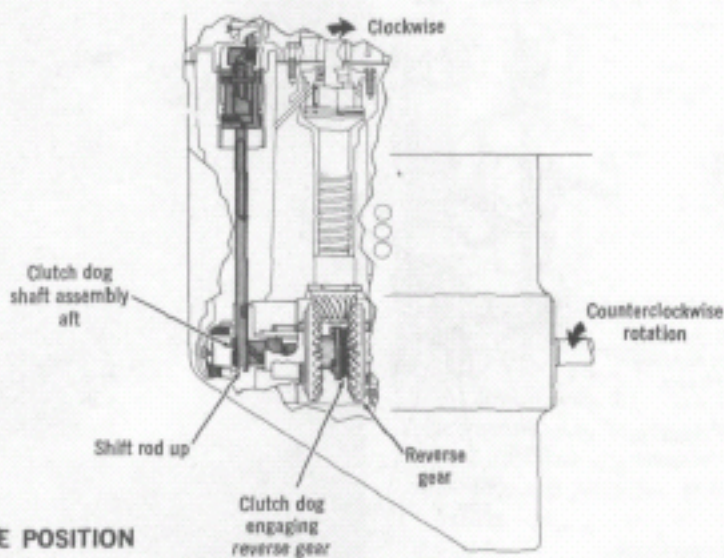
FORWARD POSITION

5

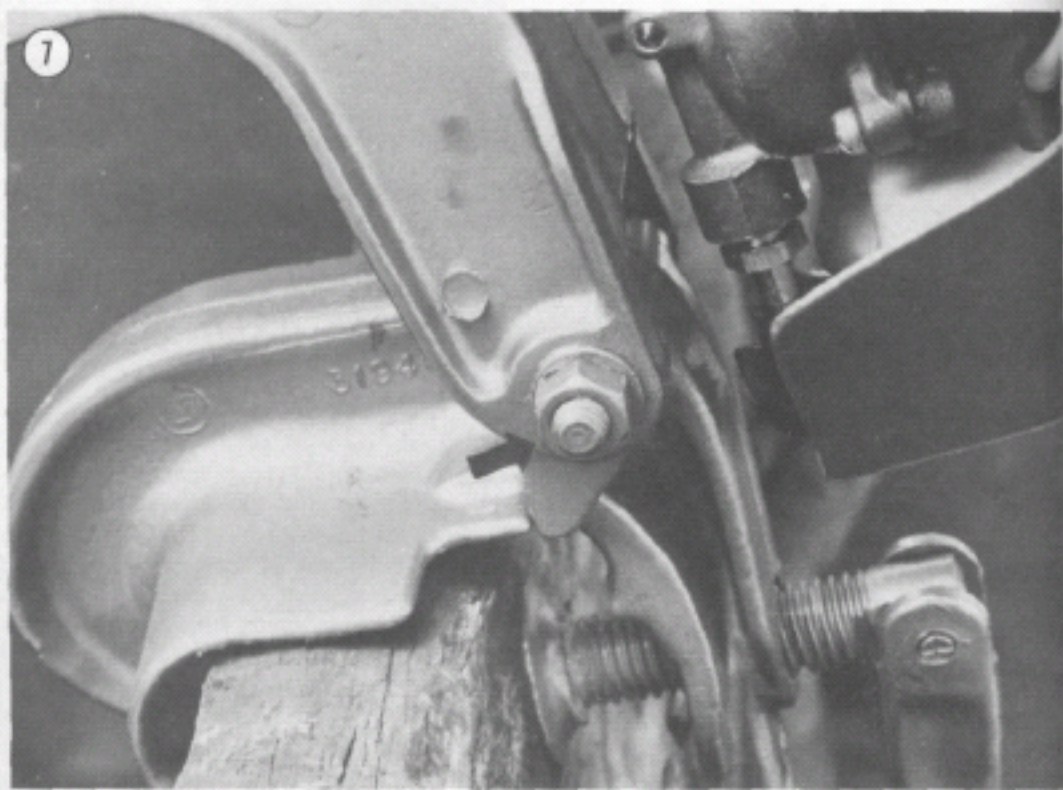


NEUTRAL POSITION

6



7



STEERING FRICTION

Tighten the steering friction adjusting screw until the motor steers easily but will remain in position when the handle is released. Never tighten the nut so much that the motor will allow "hands off" steering. See **Figures 8 and 9.**

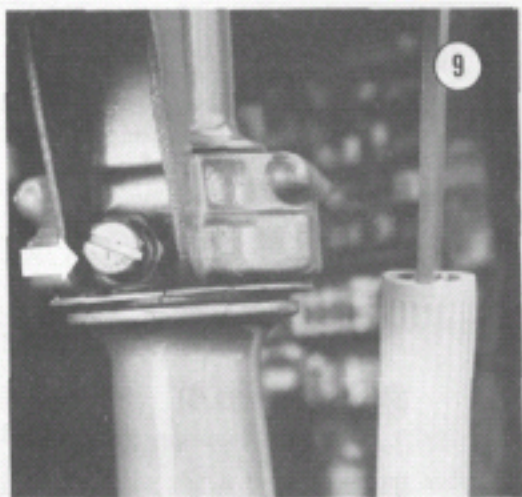
CLAMP SCREW SWIVEL PLATE

Inspect the plate make sure that it is not bent or loose. Replace if necessary.

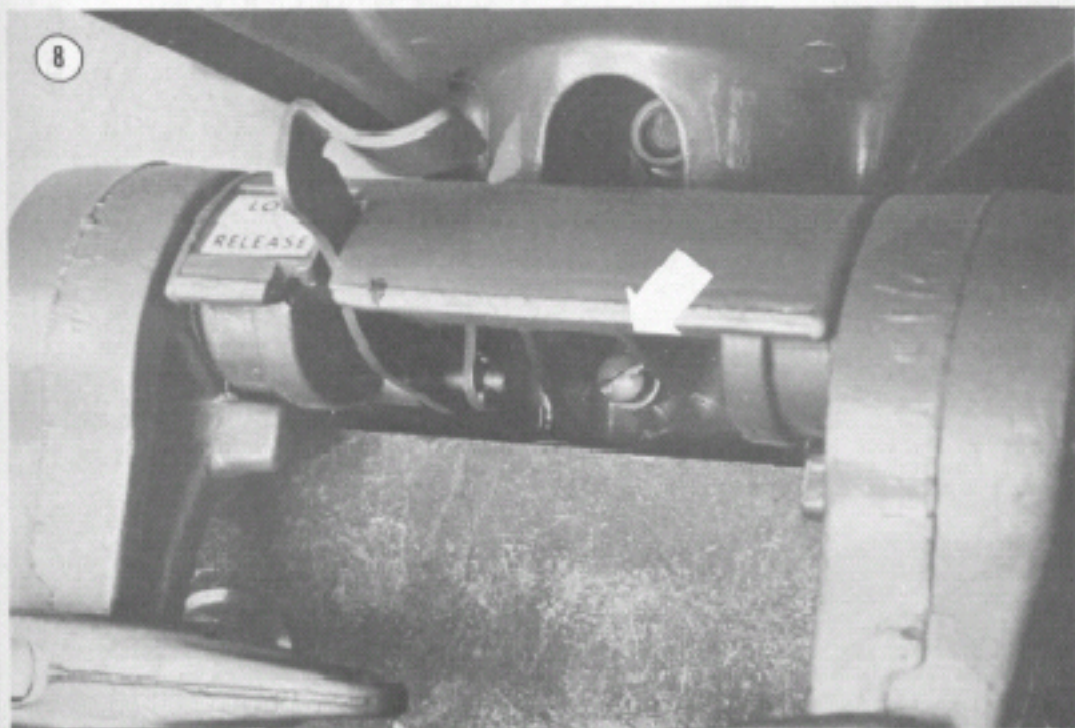
GEARCASE AND EXHAUST HOUSING

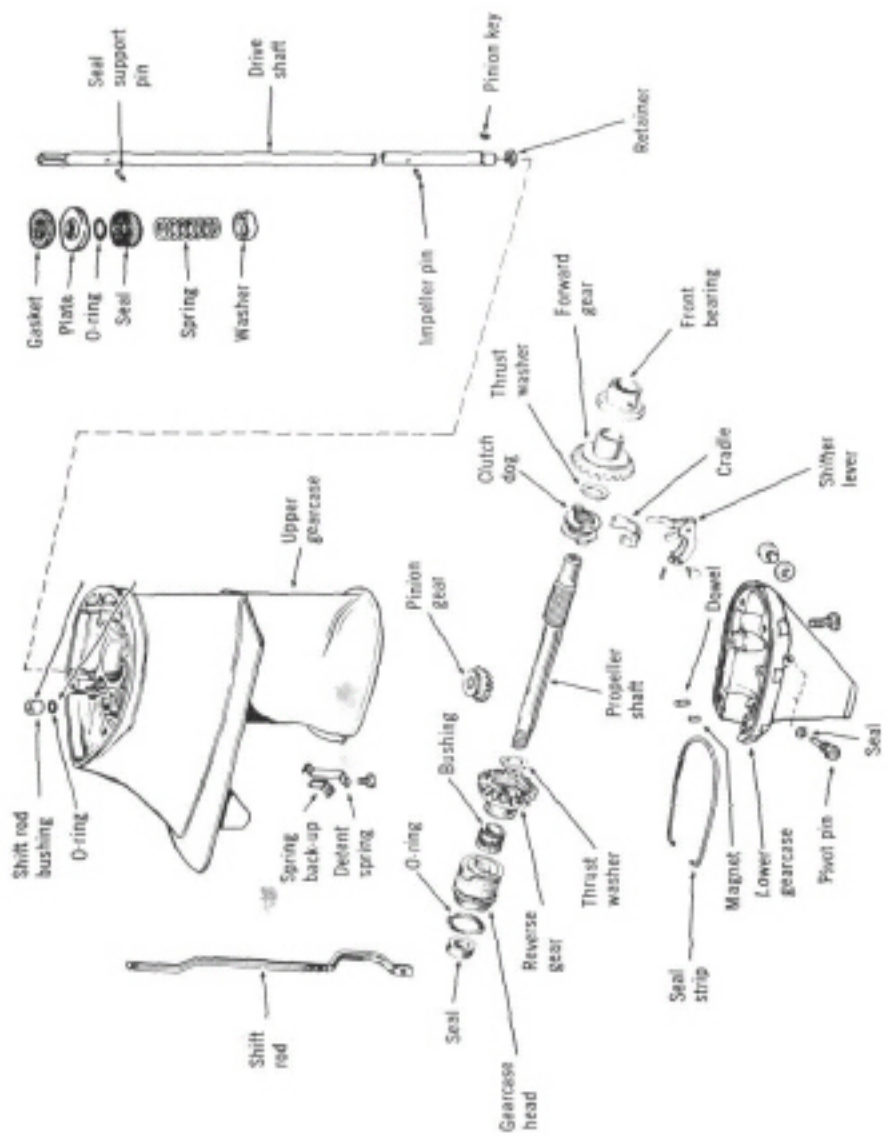
The smaller displacement engines (1.5-5 hp), have single speed gearboxes and no reverse function, therefore there is no need for adjustment or maintenance other than what has been described in Chapter Two. Later model 6 hp models have a reverse, but no adjustment is provided.

The larger engines have the functions of forward, neutral and reverse as provided by the mechanism in the lower gearcase and as shown



in **Figure 10.** The tools and skills required for removal and repair are far too extensive for the average home mechanic. Only the best equipped shops can handle such a job. Refer any such service to a dealer. Illustrations and a brief description on removal and installation are included for those who feel qualified to do the job.





GEARCASE (6 HP)

LOWER UNIT

Shifter Adjustment (9.5 hp)

1. Place the shift lever in reverse and loosen the screw which attaches the shift rod clevis to the shift shaft. See **Figure 11**. Move the shaft until the shift rod is fully engaged.
2. Adjust the shift lever so that the indicator is on **REVERSE** and tighten the screw.
3. Check the lever for proper detent in all 3 functions.

Shifter Adjustment (9.9-15 hp)

1. Remove the fuel pump. See Chapter Four.
2. Loosen the detent screws (**Figure 12**).
3. Remove shoulder bolt, lever and the hub assembly.
4. Remove the cotter pin, washer and clevis pin.
5. Rotate the lever and hub assembly clockwise until it comes to rest on the stop.
6. Hold the detent in the center notch and tighten the screws as shown in **Figure 12**.

7. Rotate the lever and hub to engage the neutral detent as shown in **Figure 13**.

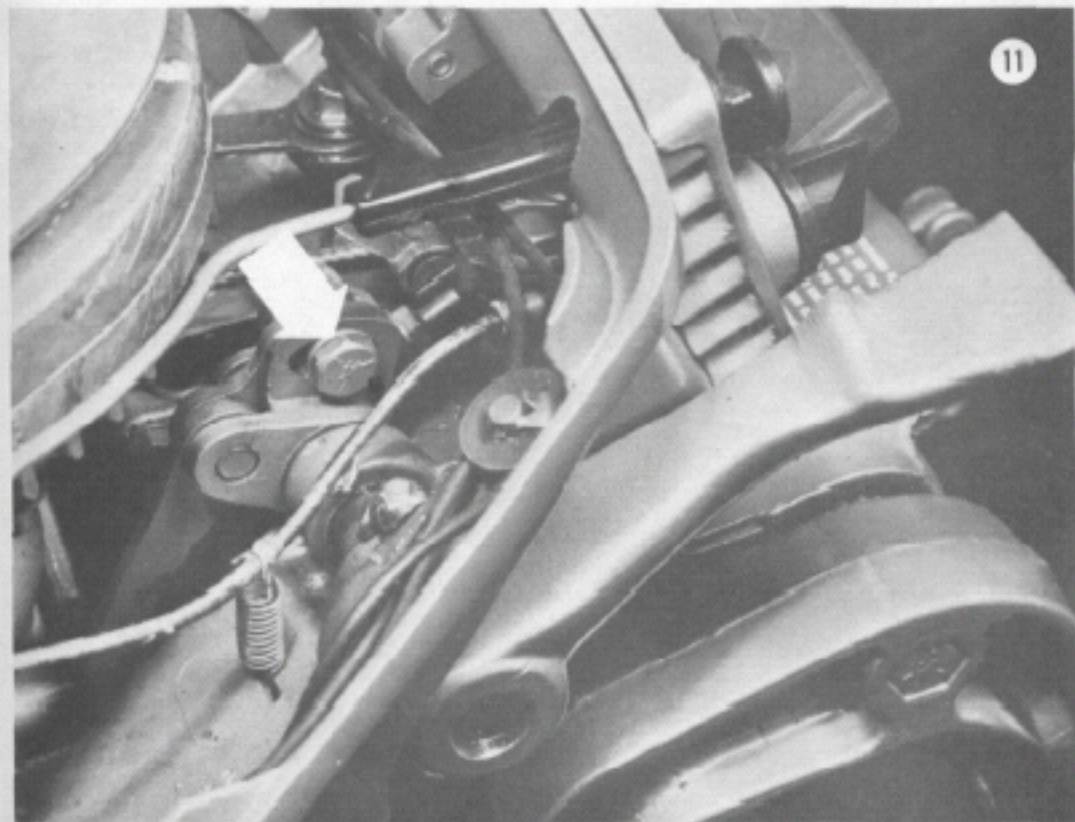
8. Push on the end of the propeller shaft to remove any end-play and position the shift handle in neutral. Adjust the clevis pin as necessary to slip into the holes provided for it in the lever and hub assembly. Refer to **Figure 13**. Reinstall the clevis pin in the same manner as it was removed.

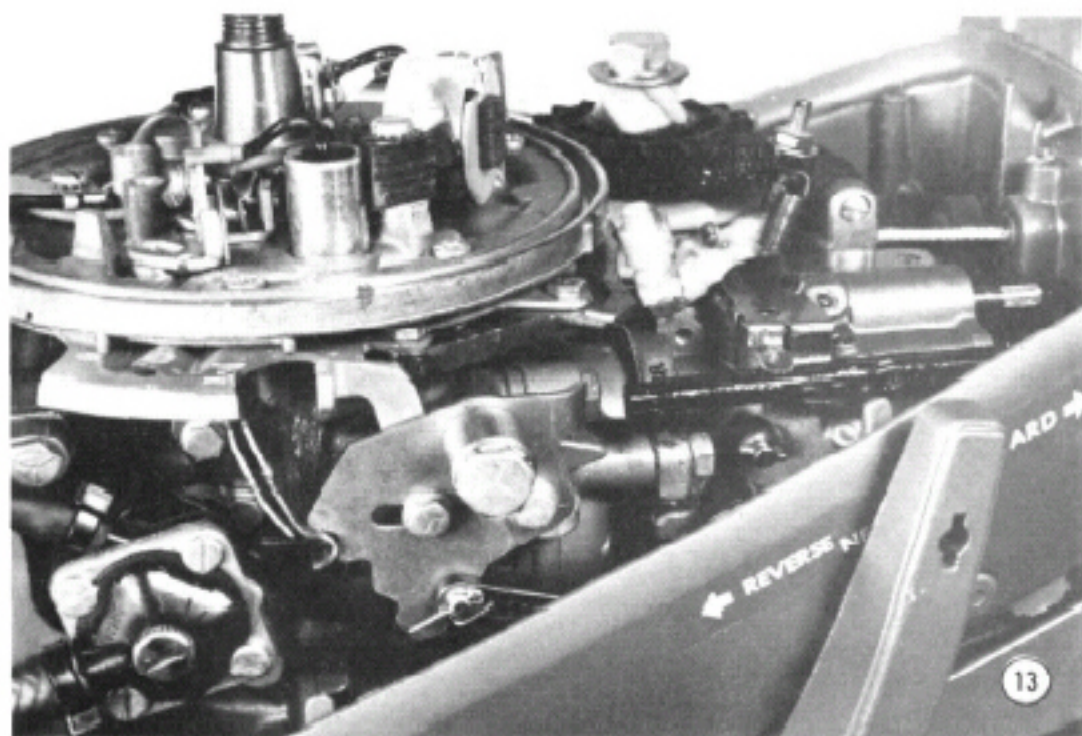
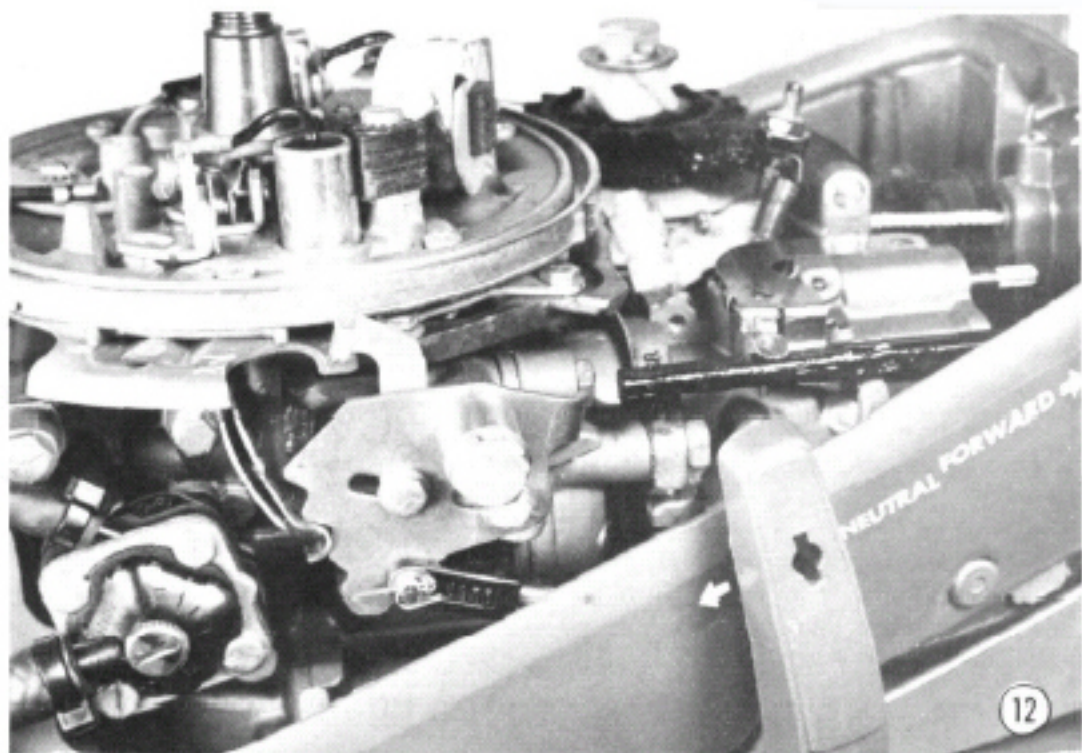
9. Adjust the starter pawl. See Chapter Two.

10. Adjust the neutral start switch as described in Chapter Five.

Shifter Adjustment (18-33 hp)

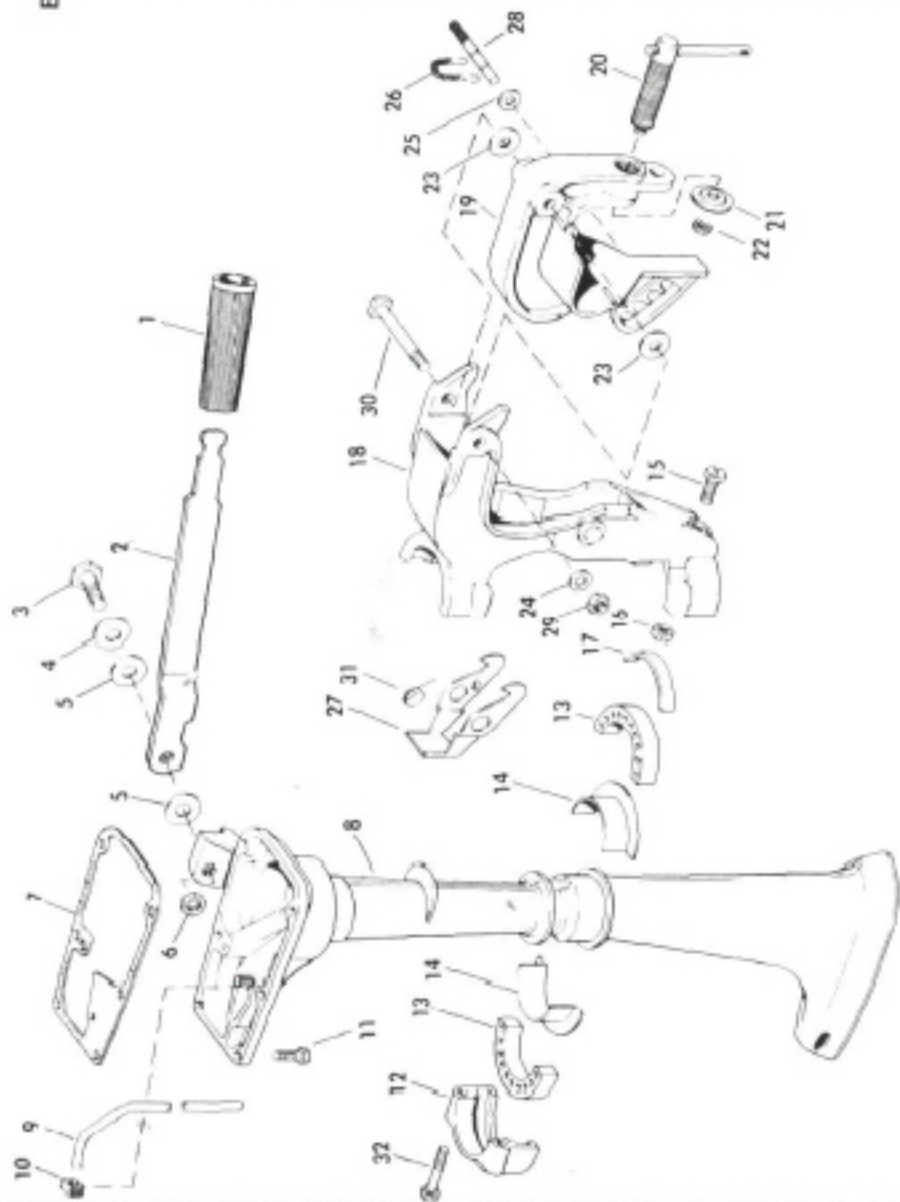
1. Place the shifter in neutral and make sure that the propeller rotates freely.
2. Move the shifter to forward gear. Rotate the propeller clockwise until it won't turn freely. Note the point where the gears first engage and where the shift pin is in the first detent.





EXHAUST HOUSING (1.5 - 2 HP)

1. Steering handle grip
2. Handle
3. Screw
4. Spring washer
5. Washer
6. Locknut
7. Gasket
8. Exhaust housing
9. Water tube
10. Water tube grommet
11. Screw
12. Retainer
13. Vibration dampener
14. Pivot bearing
15. Adjusting screw
16. Nut
17. Friction brake
18. Swivel bracket
19. Stern bracket and clamp screw assembly
20. Clamp screw and hand assembly
21. Swivel plate
22. Retainer
23. Washer
24. Washer
25. Washer
26. Spring
27. Lever
28. Tilt rod
29. Nut
30. Bolt
31. Spring
32. Screw



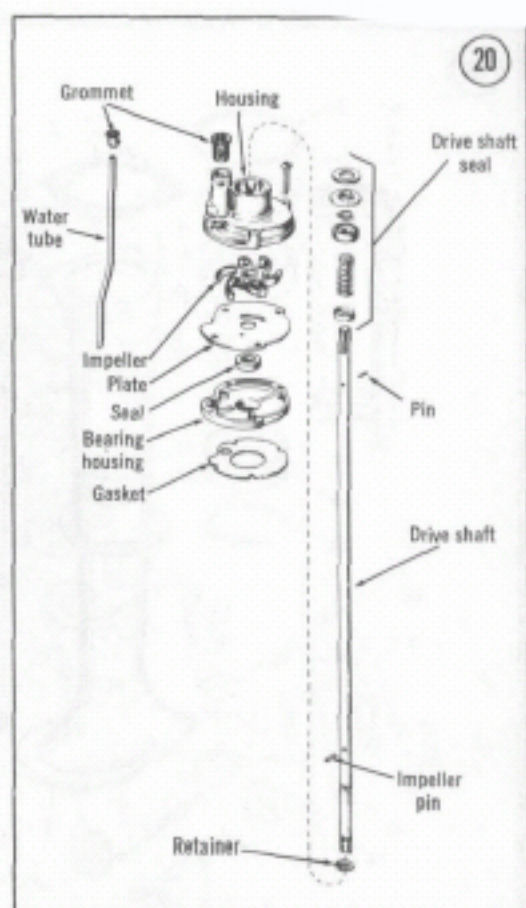
3. Remove the power head as described in Chapter Six.
4. Remove water tube and grommet from exhaust housing.
5. Remove rubber dampeners by stretching over the lower end housing.
6. Reverse the removal procedure to install, making sure to follow the section on *Cleaning, Inspection, and Repair*. Use all new parts during assembly if needed.

Removal/Installation (3-5 hp)

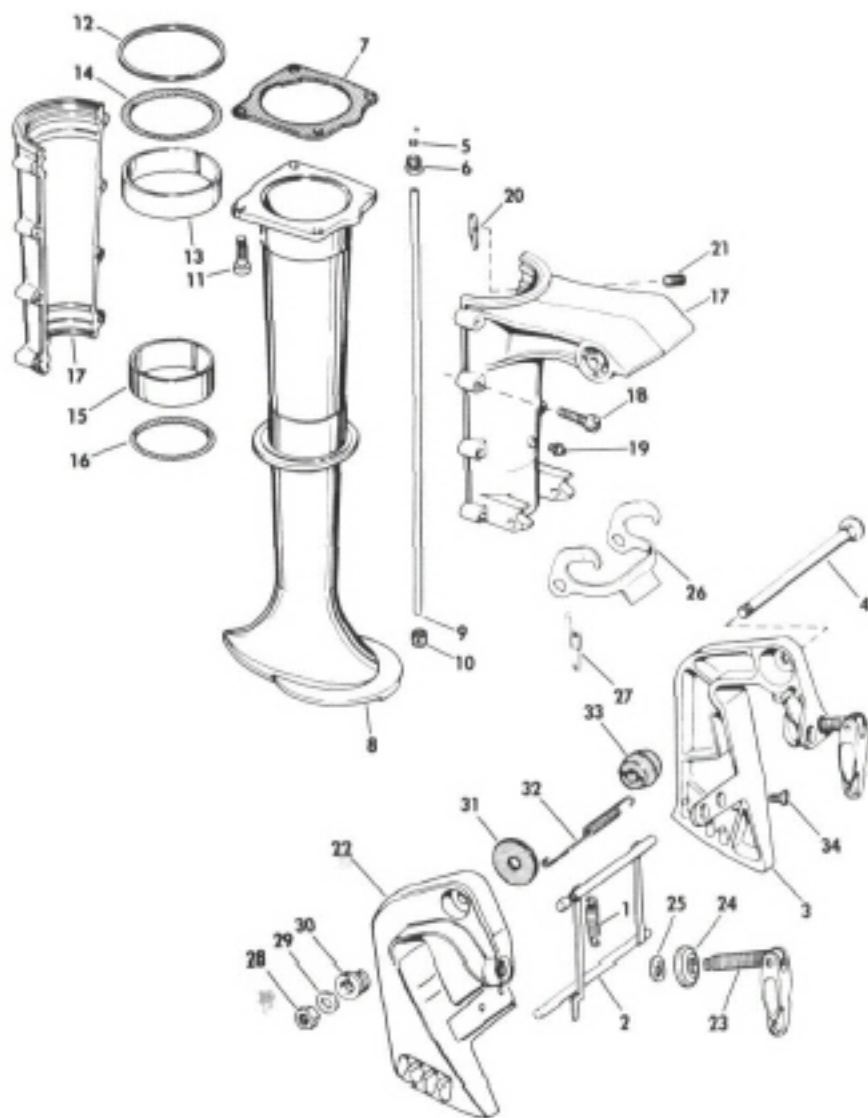
1. Remove the screws attaching the lower motor cover.
2. Lift the power head off the exhaust housing. Follow the procedure outlined in Chapter Six for power head repair.
3. Remove the inner exhaust housing. See **Figures 18 and 19** for details on the components.
4. The water tube is attached to the lower motor cover with a compression sleeve and nut. Remove the tube. See **Figure 20**.
5. Remove the screws attaching the gearcase to the exhaust housing.
6. Withdraw the gearcase carefully from the drive shaft to avoid damaging the splines. See **Figure 21**.
7. Drive the pin out of the drive shaft at the bottom end of the upper exhaust housing. Remove the drive shaft from the top of the exhaust housing.
8. Remove the grommets from the upper and lower exhaust housings.
9. Remove the nylon sleeve from the bushing at the bottom of the exhaust housing.
10. Reverse the removal procedure to install using the tips listed under the heading of *Cleaning, Inspection, and Repair* in this chapter. **Figures 22 and 23** will aid further disassembly.

Removal/Installation (6 hp)

1. Disconnect spark plug leads.
2. Remove upper motor cover.
3. Place shift lever in NEUTRAL first and then into FORWARD gear.

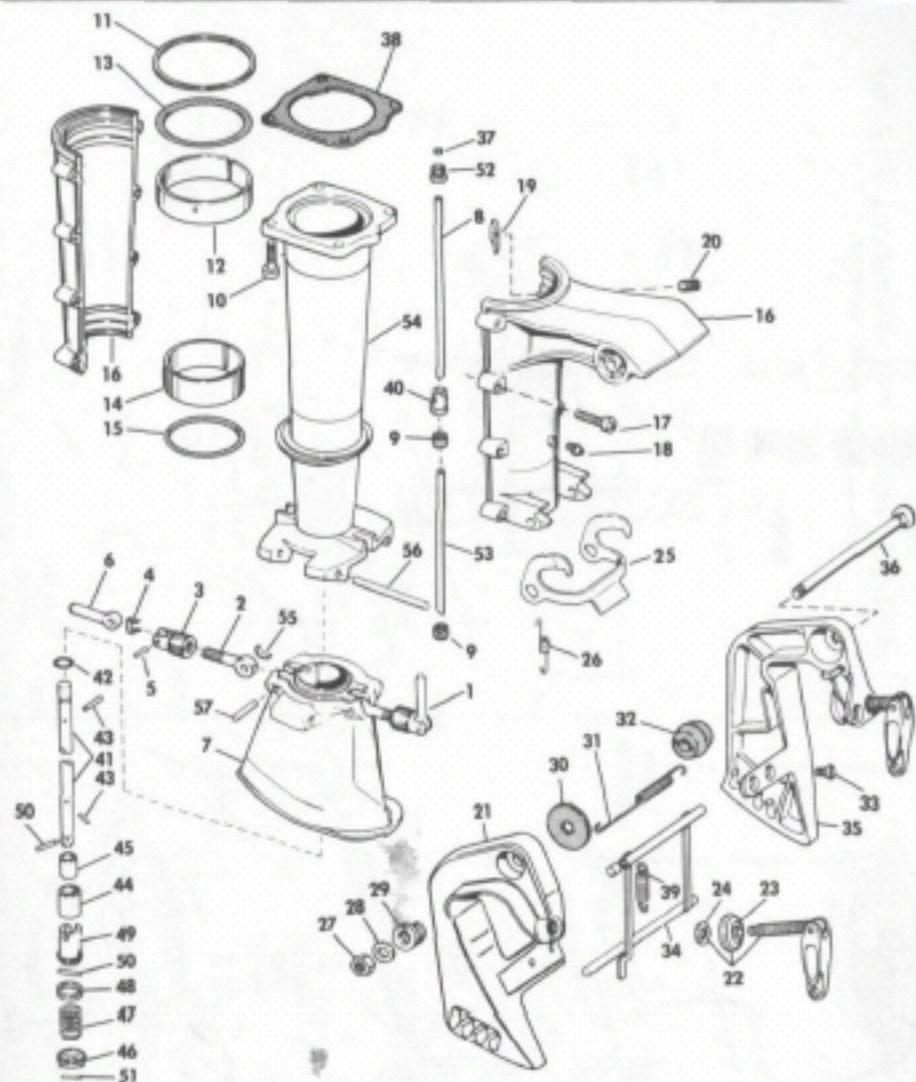


4. Remove the gearcase screws which attach this assembly to the gearcase extension. See **Figures 24 and 25** for location of components.
5. Rotate propeller by hand to align the drive shaft pin with the slot in the crankcase.
6. Remove the lower connector screw.
7. Remove upper and lower gearcase assembly from the extension.
8. Remove the power head as described in Chapter Six.
9. Remove lower motor cover.
10. Loosen the clamps and slide out the pilot shaft.
11. Loosen the nut and remove the front motor mount.
12. Lift the exhaust housing and pilot shaft from the steering bracket.
13. Pull out the water tube grommet.



LOWER UNIT (3 - 5 HP RIGID MODELS)

- | | | | |
|---------------------------|-----------------------------|--|--------------------|
| 1. Spring | 10. Grommet | 19. Lube fitting | 27. Spring |
| 2. Tilting lever | 11. Screw | 20. Friction block | 28. Nut |
| 3. Stern bracket assembly | 12. Thrust washer | 21. Screw | 29. Washer |
| 4. Bolt | 13. Lining | 22. Stern bracket and clamp screw assembly | 30. Spring |
| 5. Ball sleeve | 14. O-ring | 23. Clamp screw | 31. Washer |
| 6. Compression nut | 15. Lining | 24. Swivel plate | 32. Spring |
| 7. Gasket | 16. O-ring | 25. Retainer | 33. Conical washer |
| 8. Exhaust housing | 17. Swivel bracket assembly | 26. Reverse lock | 34. Screw |
| 9. Water tube | 18. Screw | | |



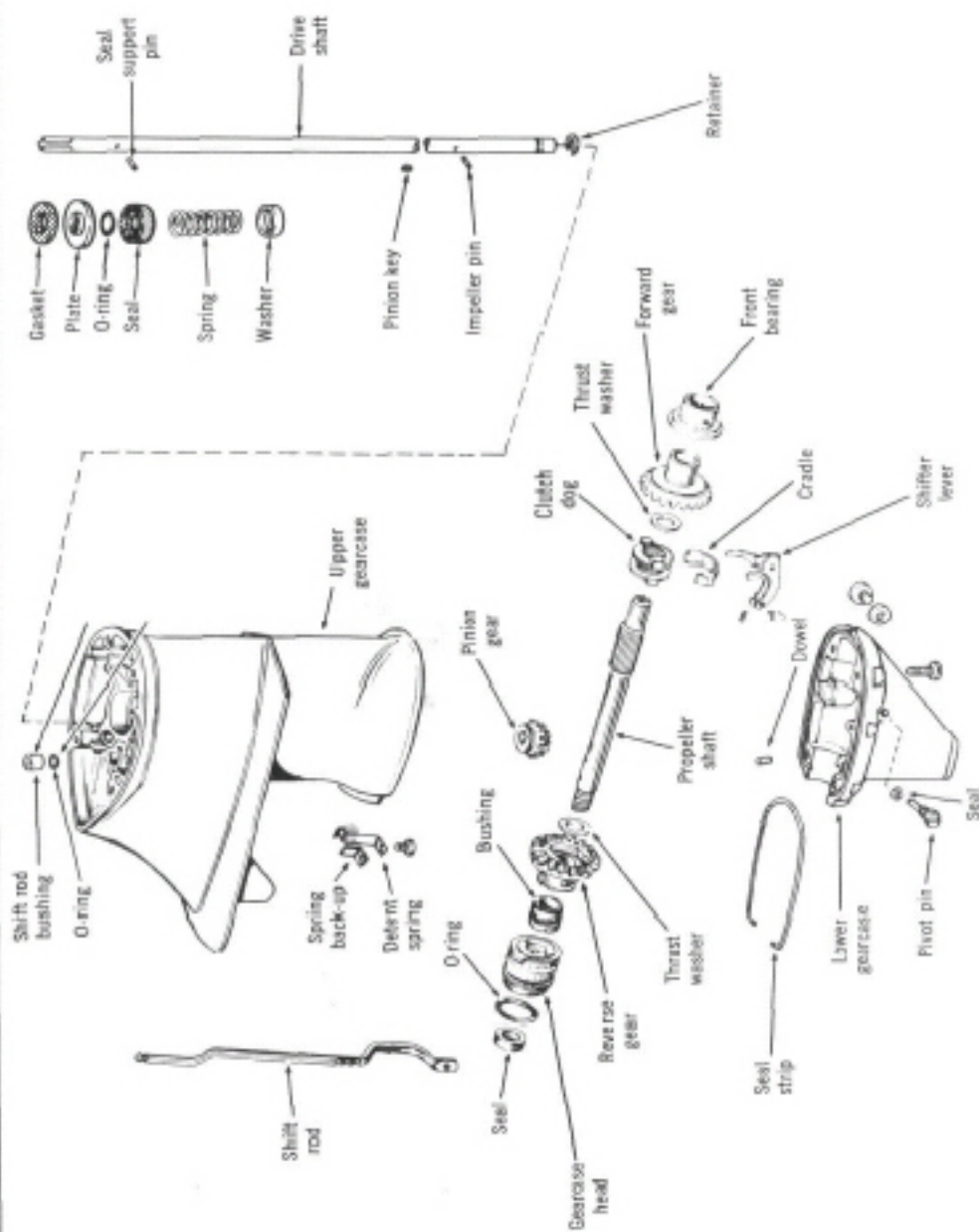
LOWER UNIT (3-5 HP FOLDING MODELS)

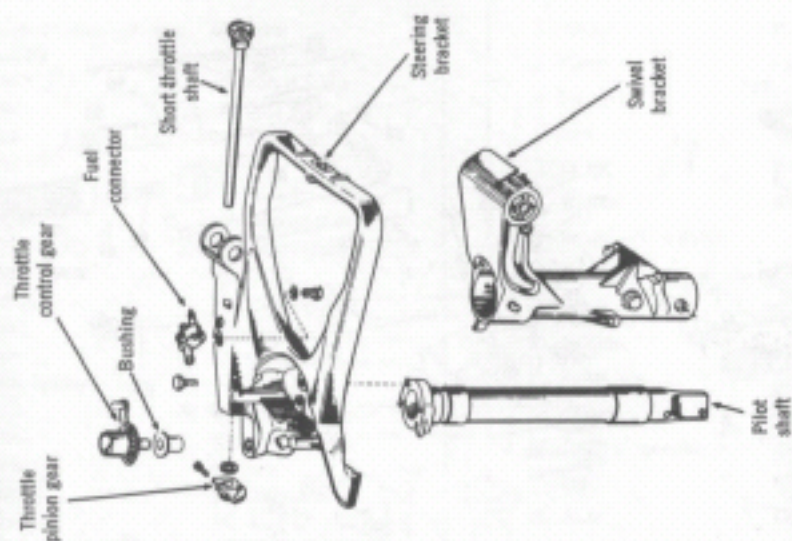
1. Clamp screw assembly
2. Clamp screw
3. Nut
4. Spring
5. Pin
6. Handle
7. Exhaust housing
8. Water tube
9. Water tube grommet
10. Screw
11. Thrust washer
12. Lining
13. O-ring
14. Lining

15. O-ring
16. Swivel bracket assembly
17. Screw
18. Tube fitting
19. Friction block
20. Screw
21. Stern bracket assembly
22. Clamp screw assembly
23. Swivel plate
24. Retainer
25. Reverse lock
26. Spring
27. Nut
28. Washer

29. Spring
30. Washer
31. Spring
32. Conical washer
33. Screw
34. Tilting lever
35. Stern bracket assembly
36. Bolt
37. Ball sleeve
38. Gasket
39. Spring
40. Grommet
41. Drive shaft
42. O-ring

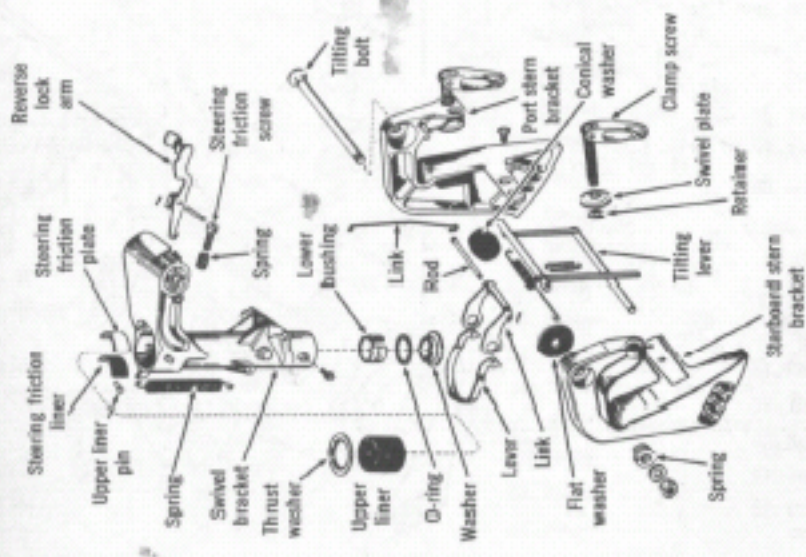
43. Pin
44. Sleeve
45. Bushing
46. Washer
47. Spring
48. Retaining washer
49. Coupler
50. Pin
51. Drive shaft pin
52. Compression nut
53. Water tube
54. Exhaust housing
55. Spring
56. Pin
57. Pin





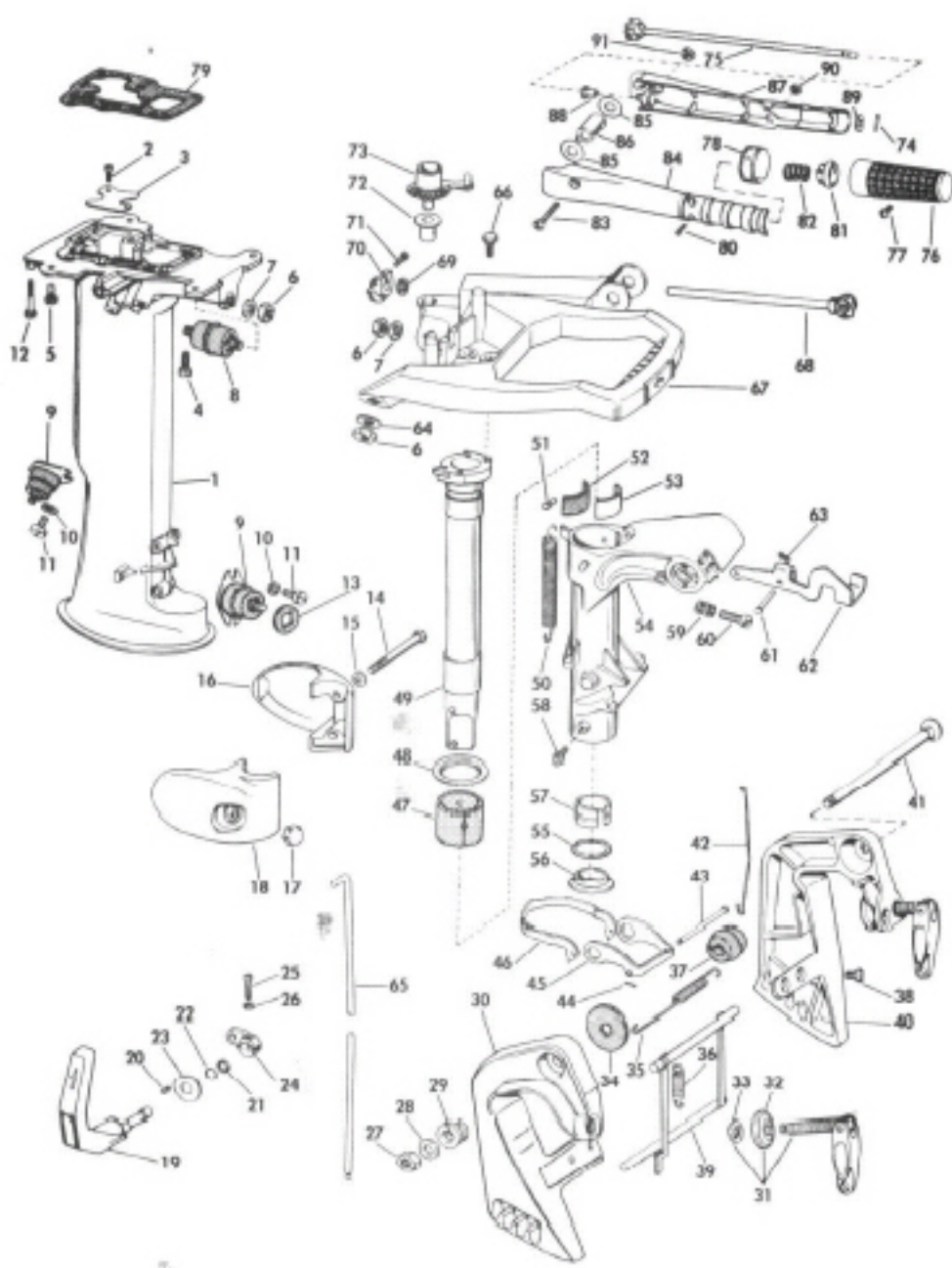
22

STEERING BRACKET AND PILOT SHAFT (3.5 HP)



23

STERN BRACKET AND SWIVEL BRACKET (3.5 HP)



LOWER UNIT (6 HP)

- | | |
|---|------------------------------|
| 1. Exhaust housing and cover assembly | 46. Lever |
| 2. Screw | 47. Liner |
| 3. Plate | 48. Thrust washer |
| 4. Screw | 49. Pilot shaft |
| 5. Screw | 50. Spring |
| 6. Nut | 51. Pin |
| 7. Washer | 52. Spacer |
| 8. Rubber mount | 53. Co-pilot plate |
| 9. Rubber mount | 54. Swivel bracket |
| 10. Washer | 55. O-ring |
| 11. Screw | 56. Thrust washer |
| 12. Screw | 57. Bushing |
| 13. Rubber gasket | 58. Lube fitting |
| 14. Screw | 59. Spring |
| 15. Washer | 60. Screw |
| 16. Housing | 61. Pivot shaft |
| 17. Acorn nut | 62. Arm |
| 18. Housing | 63. Cotter pin |
| 19. Shift lever and shaft | 64. Washer |
| 20. Spring | 65. Shift rod |
| 21. Washer | 66. Screw |
| 22. O-ring | 67. Steering bracket |
| 23. Washer | 68. Gear and shaft |
| 24. Lever | 69. Washer |
| 25. Screw | 70. Pinion |
| 26. Washer | 71. Pinion screw |
| 27. Nut | 72. Throttle control bushing |
| 28. Washer | 73. Throttle control gear |
| 29. Spring | 74. Pin |
| 30. Stern bracket assembly | 75. Gear |
| 31. Clamp screw, plate and retaining assembly | 76. Grip |
| 32. Swivel plate | 77. Screw |
| 33. Retainer | 78. Plate |
| 34. Washer | 79. Gasket |
| 35. Spring | 80. Screw |
| 36. Spring | 81. Block |
| 37. Conical washer | 82. Spring |
| 38. Screw | 83. Screw |
| 39. Tilting lever | 84. Handle |
| 40. Stern bracket assembly | 85. Washer |
| 41. Bolt | 86. Cover |
| 42. Link | 87. Handle |
| 43. Rod | 88. Bushing |
| 44. Cotter pin | 89. Washer |
| 45. Link | 90. Nut |
| | 91. Nut |

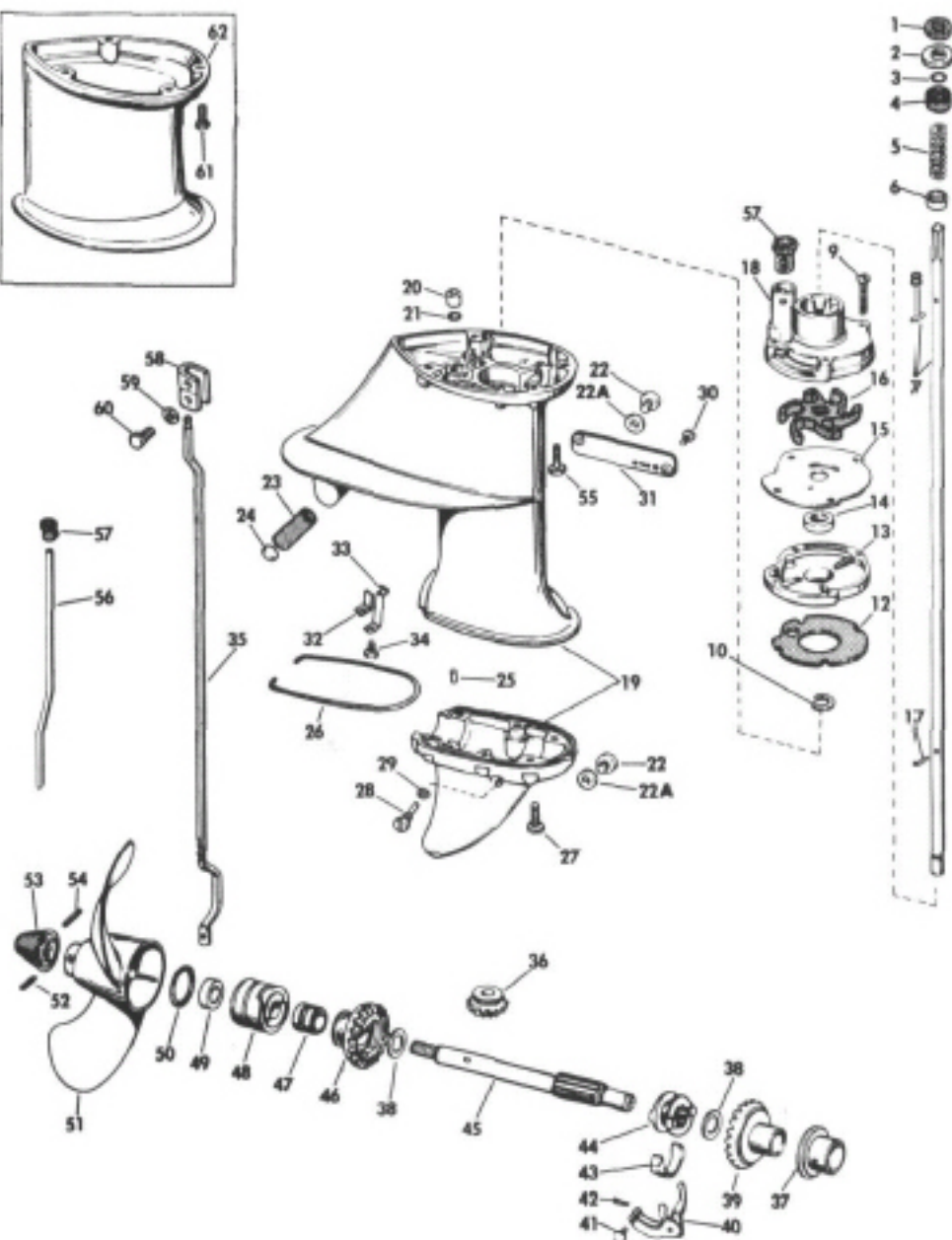
GEARCASE (6 HP)

(See Next Page)

- | | |
|--|-------------------------|
| 1. Gasket | 35. Shift rod |
| 2. Plate | 36. Drive shaft pinion |
| 3. O-ring | 37. Bearing |
| 4. Seal | 38. Thrust washer |
| 5. Spring | 39. Gear and bushing |
| 6. Washer | 40. Shift lever |
| 7. Drive shaft assembly | 41. Pin |
| 8. Pin | 42. Cotter pin |
| 9. Screw | 43. Cradle |
| 10. Retainer | 44. Clutch dog |
| 11. Pinion key | 45. Propeller shaft |
| 12. Gasket | 46. Reverse gear |
| 13. Housing assembly | 47. Bushing |
| 14. Seal | 48. Head and bearing |
| 15. Plate | 49. Oil retainer |
| 16. Impeller and pin assembly | 49. Seal |
| 17. Impeller pin | 50. O-ring |
| 18. Impeller housing | 51. Propeller |
| 19. Gearcase, bushing and pin assembly | 52. Cotter pin |
| 20. Bushing | 53. Nut |
| 21. O-ring | 54. Pin |
| 22. Plug assembly | 55. Screw |
| 22A. Washer | 56. Water tube |
| 23. Screen | 57. Water tube grommet |
| 24. Plug | 58. Rod connector |
| 25. Dowel | 59. Washer |
| 26. Gearcase seal | 60. Screw |
| 27. Screw | LONG UNIT |
| 28. Pivot pin | 7. Drive shaft assembly |
| 29. Seal | 8. Drive pin |
| 30. Screw | 56. Water tube |
| 31. Water bypass cover | 58. Connector |
| 32. Spring | 59. Washer |
| 33. Spring | 60. Screw |
| 34. Screw | 61. Screw |
| | 62. Extension shift rod |

GEARCASE (6 HP)

(See Key On Previous Page)



LOWER UNIT

- Remove the shift handle bushing and the shaft assembly.
- Reverse the procedure for installation. Other portions of this chapter will tell about cleaning, inspection, repair, and any further work which may be required prior to reassembly.

Removal/Installation (9.5 hp)

- Place shift lever in forward gear.
- Remove the screws attaching gearcase to the exhaust housing. See **Figures 26 and 27** for detailed views of lower unit and gearcase component location.
- Drop gearcase to expose shift rod connector.
- Remove lower connector screw.
- Remove the upper and lower gearcase assembly from the exhaust housing. Be careful to avoid damaging the drive shaft splines.
- Remove the complete power head, exhaust housing, and gearcase as outlined in Chapter Six.
- Remove the upper pivot shaft screws and cap and the lower pivot shaft nuts and screws.
- Reverse the procedure to install and assemble the unit. Refer to other sections of this chapter which outline procedures for cleaning and repair.

Removal/Installation (9.9-15 hp)

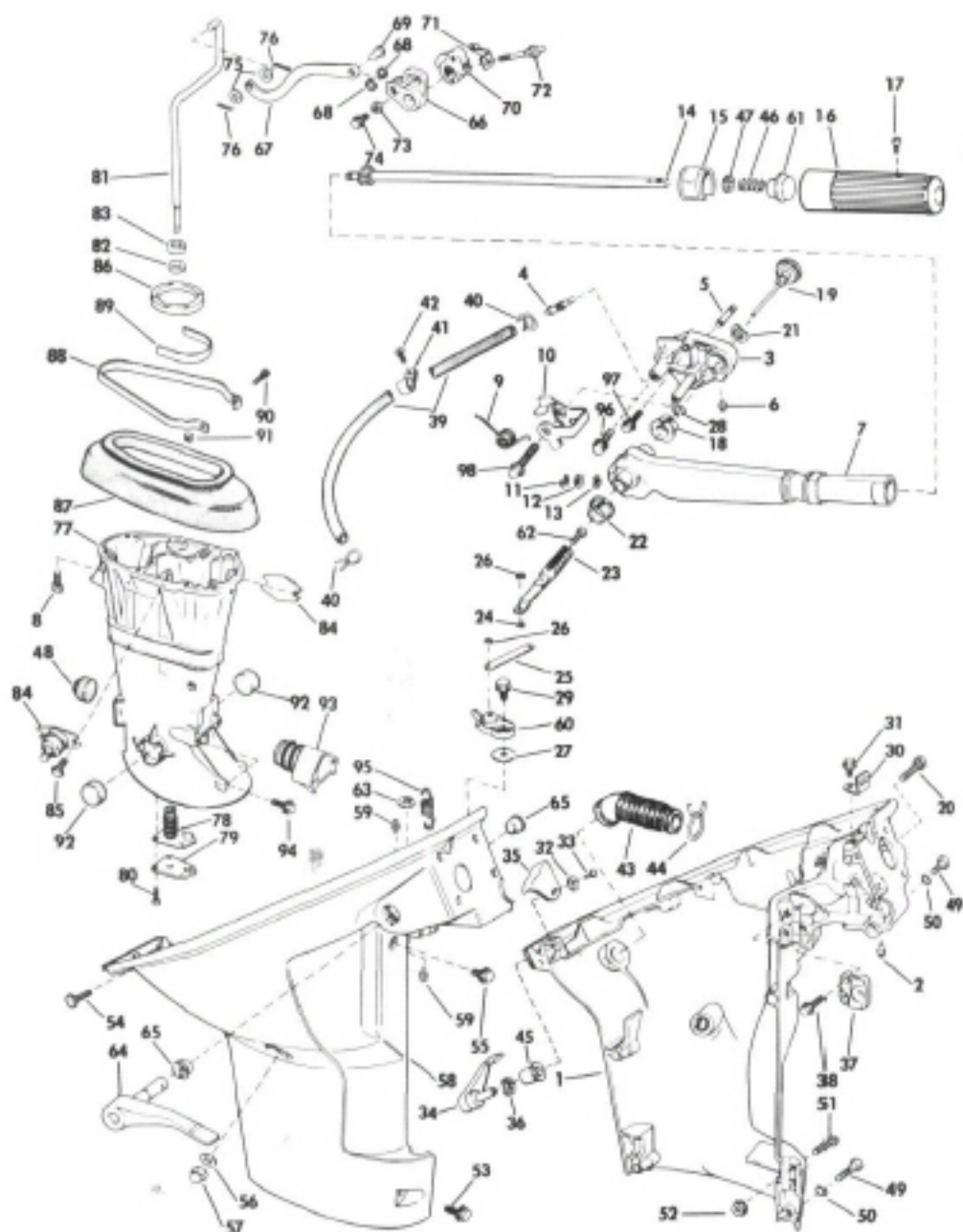
- Remove the power head as outlined in Chapter Six.
- Remove upper motor cover.
- Disconnect spark plug wires.
- Remove the screws attaching the gearcase to the exhaust housing. See **Figures 28, 29, and 30** for details of lower unit components.
- Drop gearcase enough to expose the shift rod connector (**Figure 31**).
- Remove upper connector screw.
- Remove gearcase assembly taking care to avoid damaging the drive shaft splines.
- Remove vertical shaft lever pin, control shaft gear, and inner gear.
- Remove upper shift rod cotter pin and clevis.
- Lift lower motor cover from the exhaust housing.
- Remove screws and mounting brackets.

LOWER UNIT (9.5 HP)

(See Next Page)

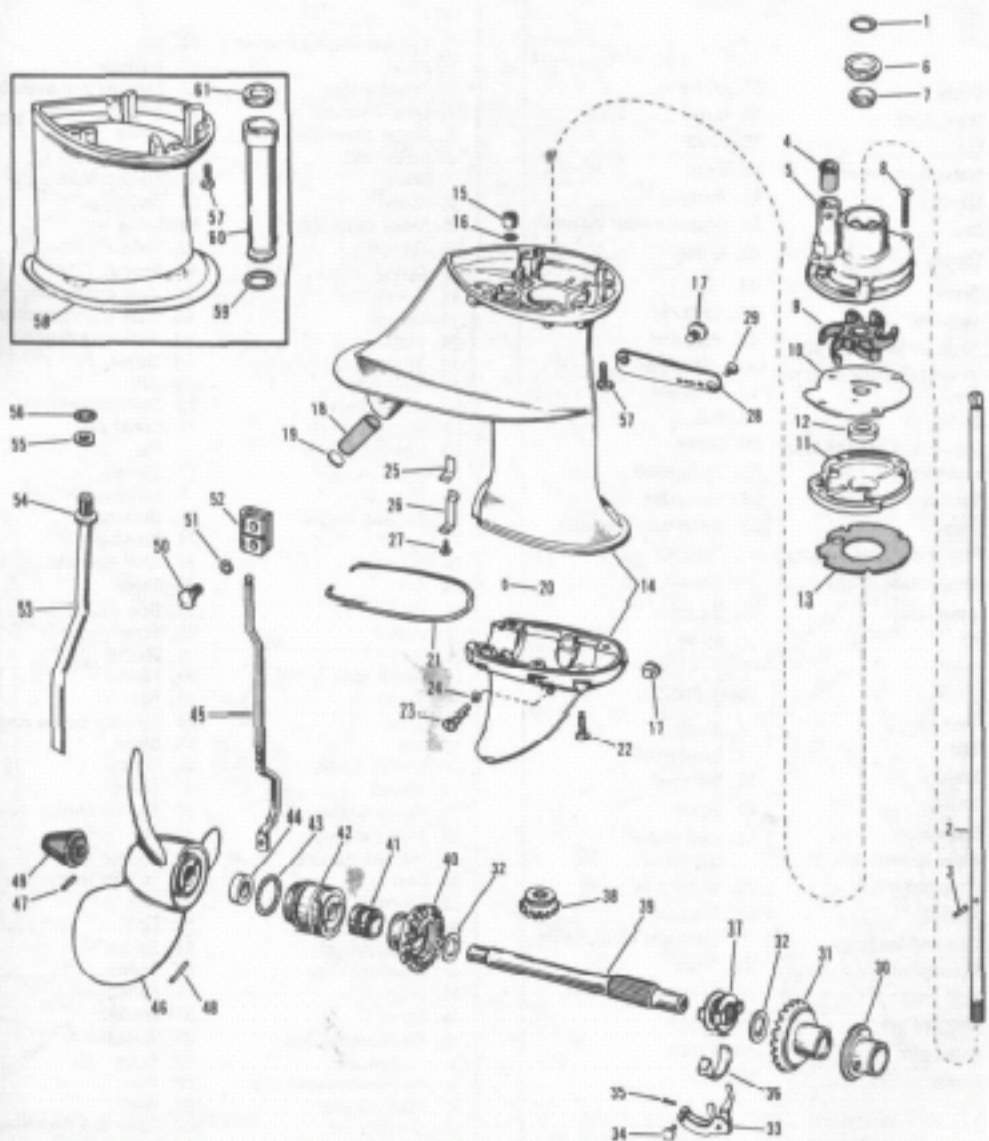
- | | |
|--|---|
| 1. Lower cover assembly | 51. Screw |
| 2. Lubrication fitting | 52. Nut |
| 3. Bracket and fuel connector assembly | 53. Screw |
| 4. Fuel connector nipple | 54. Screw |
| 5. Guide pin | 55. Screw |
| 6. Lubrication fitting | 56. Washer |
| 7. Steering handle assembly | 57. Nut |
| 8. Screw | 58. Lower motor cover and lube fitting assembly |
| 9. Spring | 59. Lube fitting |
| 10. Stop | 60. Interlock arm and pin |
| 11. Ring | 61. Friction block |
| 12. Washer | 62. Idle adjustment screw |
| 13. Bow washer | 63. Retainer |
| 14. Gear and shaft | 64. Shift lever and shaft |
| 15. Throttle control plate | 65. Bearing |
| 16. Grip | 66. Clevis |
| 17. Screw | 67. Link |
| 18. Bushing | 68. Bow washer |
| 19. Knob | 69. Pin |
| 20. Screw | 70. Bracket |
| 21. Bow washer | 71. Lever |
| 22. Bushing | 72. Detent screw |
| 23. Link | 73. Washer |
| 24. Bow washer | 74. Screw |
| 25. Link | 75. Washer |
| 26. E-ring | 76. Cotter pin |
| 27. Washer | 77. Exhaust housing, boot and plate assembly |
| 28. Retaining ring | 78. Shift rod boot |
| 29. Screw | 79. Plate |
| 30. Hook | 80. Plate screw |
| 31. Screw | 81. Shift rod |
| 32. Washer | 82. Guide |
| 33. Screw | 83. Seal |
| 34. Handle | 84. Rubber mount |
| 35. Hook | 85. Screw |
| 36. Bow washer | 86. Pilot ring |
| 37. Cap | 87. Exhaust housing seal |
| 38. Screw | 88. Clamp |
| 39. Fuel hose | 89. Retainer |
| 40. Hose clamp | 90. Screw |
| 41. Hose clamp | 91. Nut |
| 42. Screw | 92. Rubber mount |
| 43. Exhaust hose | 93. Rubber mount |
| 44. Hose clamp | 94. Screw |
| 45. Bushing | 95. Spring |
| 46. Spring | 96. Screw |
| 47. Washer | 97. Screw |
| 48. Rubber mount | 98. Screw |
| 49. Screw | |
| 50. Lockwasher | |

LOWER UNIT (9.5 HP)
(See Key On Previous Page)



GEARCASE (9.5 HP)
(See Key On Next Page)

27



GEARCASE (9.5 HP)

(See Previous Page)

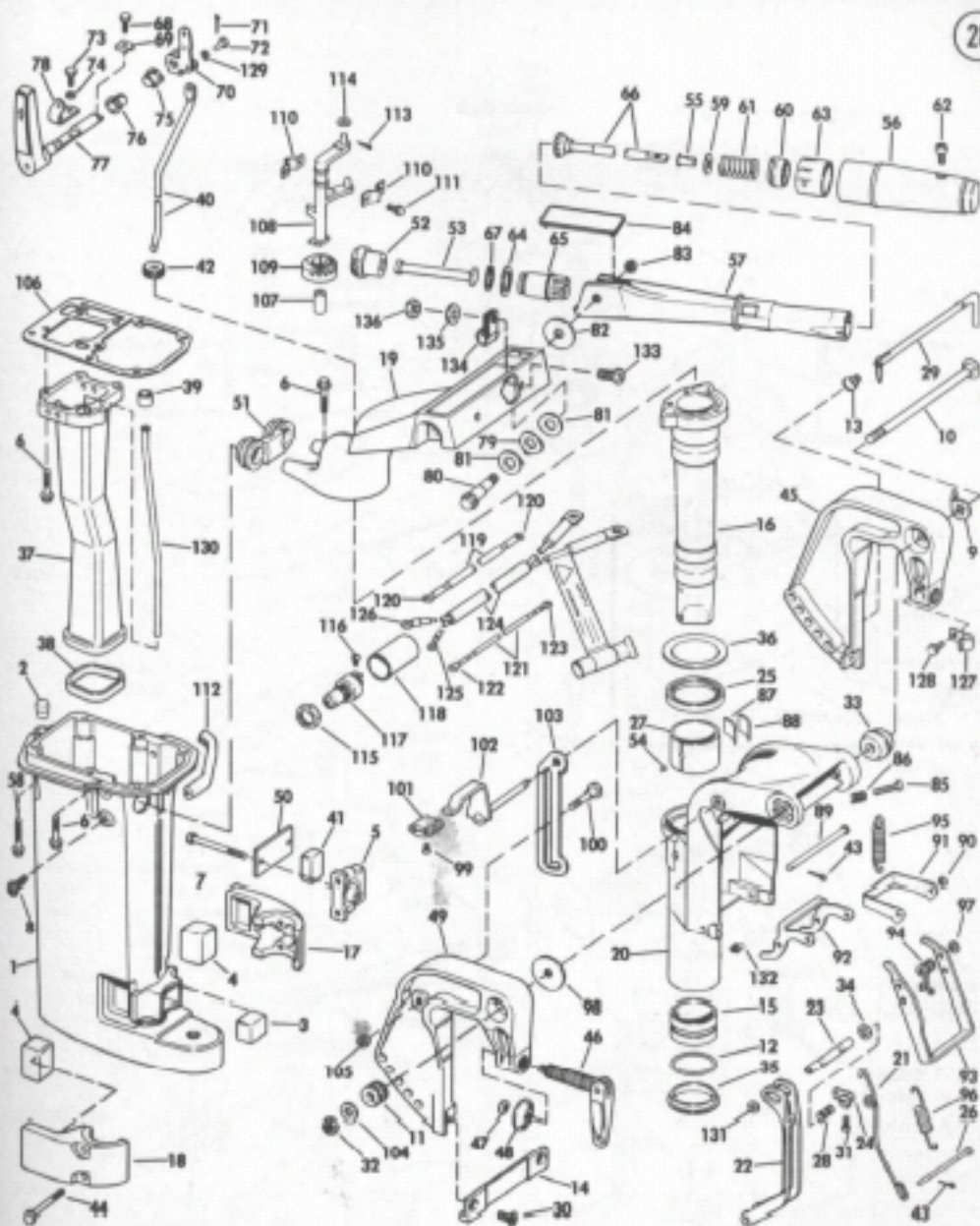
- | | |
|---------------------------------------|----------------------------|
| 1. O-ring | 37. Shifter |
| 2. Drive shaft | 38. Gear |
| 3. Pin | 39. Shaft |
| 4. Water tube grommet | 40. Gear |
| 5. Housing | 41. Bushing |
| 6. Seal | 42. Gearcase head assembly |
| 7. Washer | 43. O-ring |
| 8. Screw | 44. Seal |
| 9. Impeller | 45. Shift rod |
| 10. Impeller housing plate | 46. Propeller |
| 11. Bearing housing assembly | 47. Cotter pin |
| 12. Seal | 48. Drive pin |
| 13. Gasket | 49. Nut |
| 14. Gearcase upper and lower assembly | 50. Screw |
| 15. Bushing | 51. Lockwasher |
| 16. O-ring | 52. Connector |
| 17. Plug and washer assembly | 53. Water tube assembly |
| 18. Water intake screen | 54. Push nut |
| 19. Screen plug | 55. Washer |
| 20. Pin | 56. O-ring |
| 21. Seal | 57. Screw |
| 22. Screw | |
| 23. Pivot pin | |
| 24. Seal | |
| 25. Spring | |
| 26. Spring | |
| 27. Screw | |
| 28. Water bypass cover | |
| 29. Cover screw | |
| 30. Bearing | |
| 31. Gear and bushing | |
| 32. Thrust washer | |
| 33. Shift lever | |
| 34. Shift rod pin | |
| 35. Cotter pin | |
| 36. Cradle | |

LONG UNITS

- | |
|------------------------|
| 1. O-ring |
| 2. Drive shaft |
| 45. Shift rod |
| 50. Screw |
| 51. Lockwasher |
| Connector |
| 53. Water tube |
| 54. Push nut |
| Extension kit assembly |
| 57. Screw |
| 58. Gearcase extension |
| 59. O-ring |
| 60. Spacer |
| 61. Seal |

LOWER UNIT (9.9-15 HP)

- | | |
|----------------------------------|------------------------------------|
| 1. Exhaust housing assembly | 54. Pin |
| 2. Plug | 55. Bushing |
| 3. Thrust mount | 56. Steering grip assembly |
| 4. Lateral mount | 57. Steering handle |
| 5. Mount assembly | 58. Screw |
| 6. Screw | 59. Washer |
| 7. Screw | 60. Friction block |
| 8. Screw | 61. Spring |
| 9. Safety chain link | 62. Screw |
| 10. Tilt bolt | 63. Plate |
| 11. Spring | 64. Washer |
| 12. O-ring | 65. Gear and bushing assembly |
| 13. Spring | 66. Gear and shaft assembly |
| 14. Plate | 67. Retaining ring |
| 15. Bushing | 68. Screw |
| 16. Pivot tube | 69. Clip |
| 17. Mount bracket | 70. Shift rod bellcrank |
| 18. Mount bracket | 71. Cotter pin |
| 19. Steering bracket | 72. Pin |
| 20. Swivel bracket | 73. Screw |
| 21. Wire | 74. Lockwasher |
| 22. Carrying handle | 75. Bushing |
| 23. Bushing | 76. Bushing |
| 24. Bellcrank | 77. Shift lever and shaft assembly |
| 25. Seal | 78. Lever |
| 26. Pin | 79. Row washer |
| 27. Liner | 80. Screw |
| 28. Spring | 81. Washer |
| 29. Thrust rod assembly | 82. Washer |
| 30. Screw | 83. Nut |
| 31. Screw | 84. Steering handle cover |
| 32. Nut | 85. Screw |
| 33. Conical washer | 86. Spring |
| 34. Washer | 87. Spacer |
| 35. Thrust washer | 88. Friction block |
| 36. Thrust washer | 89. Pin |
| 37. Exhaust housing | 90. Washer |
| 38. Seal | 91. Locking lever |
| 39. Grommet | 92. Link |
| 40. Shift rod | 93. Link |
| 41. Thrust mount | 94. Spring |
| 42. Grommet | 95. Spring |
| 43. Cotter pin | 96. Spring |
| 44. Screw | 97. Washer |
| 45. Stern bracket and clampscrew | 98. Washer |
| 46. Clampscrew assembly | 99. Screw |
| 47. Plate retainer | 100. Pin |
| 48. Swivel plate | 101. Knob |
| 49. Stern bracket and clampscrew | 102. Lever and shaft assembly |
| 50. Link | 103. Tilt lock |
| 51. Seal | 104. Washer |
| 52. Control shaft inner gear | 105. Locknut |
| 53. Shaft | 106. Gasket |
| | 107. Pin |
| | 108. Vertical control shaft |

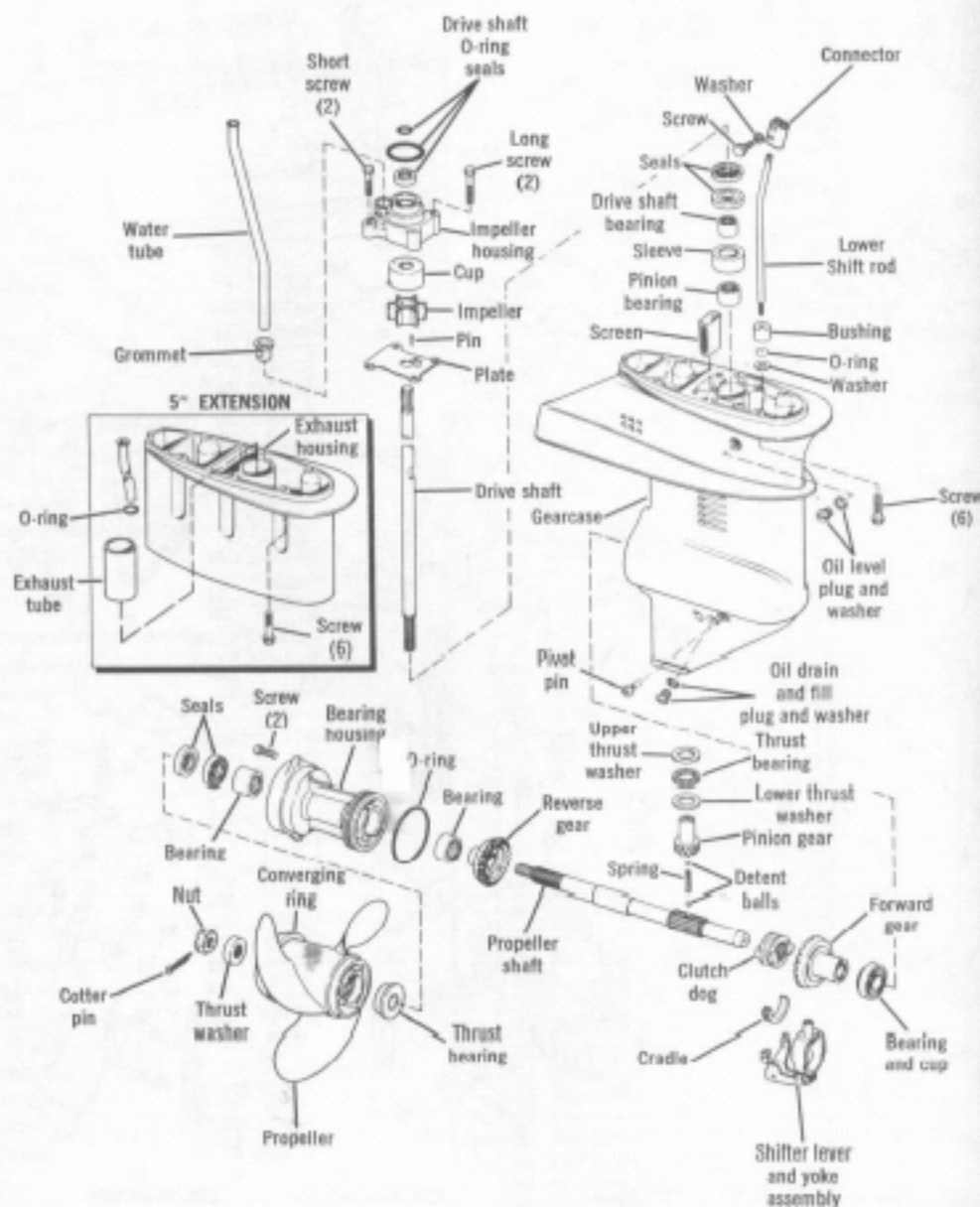


- 109. Vertical control shaft gear
- 110. Bearing clamp
- 111. Screw
- 112. Seal
- 113. Cotter pin
- 114. Washer
- 115. Nut

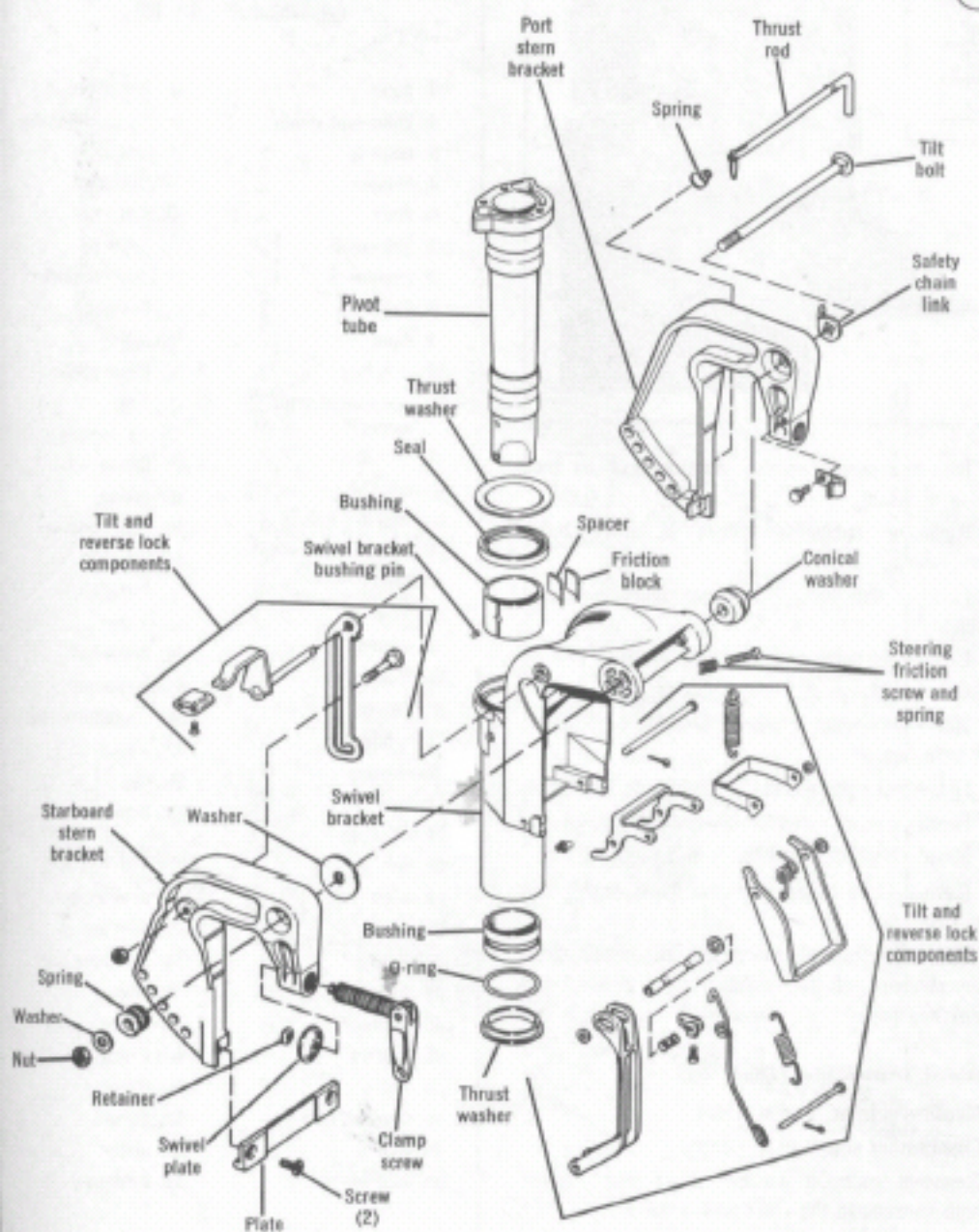
- 116. Screw
- 117. Switch assembly
- 118. Tubing
- 119. Lead assembly
- 120. Terminal
- 121. Lead assembly
- 122. Ring terminal

- 123. Ring terminal
- 124. Cable assembly
- 125. Ring terminal
- 126. Terminal
- 127. Clamp
- 128. Screw clamp
- 129. Washer

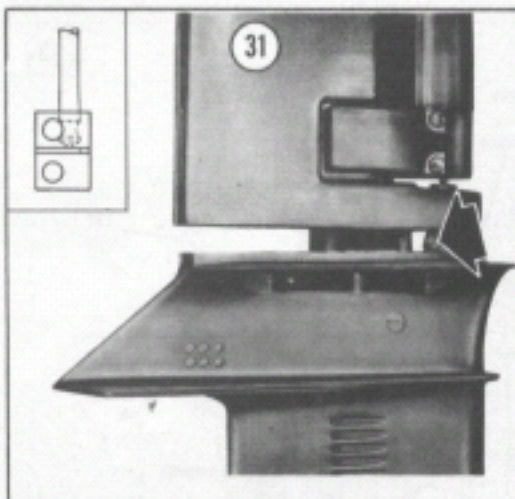
- 130. Water tube
- 131. Washer
- 132. Lubrication fitting
- 133. Screw
- 134. Battery cable clamp
- 135. Washer
- 136. Nut



GEARCASE (9.9-15 HP)



—STERN AND SWIVEL BRACKETS (9.9 - 15 HP)



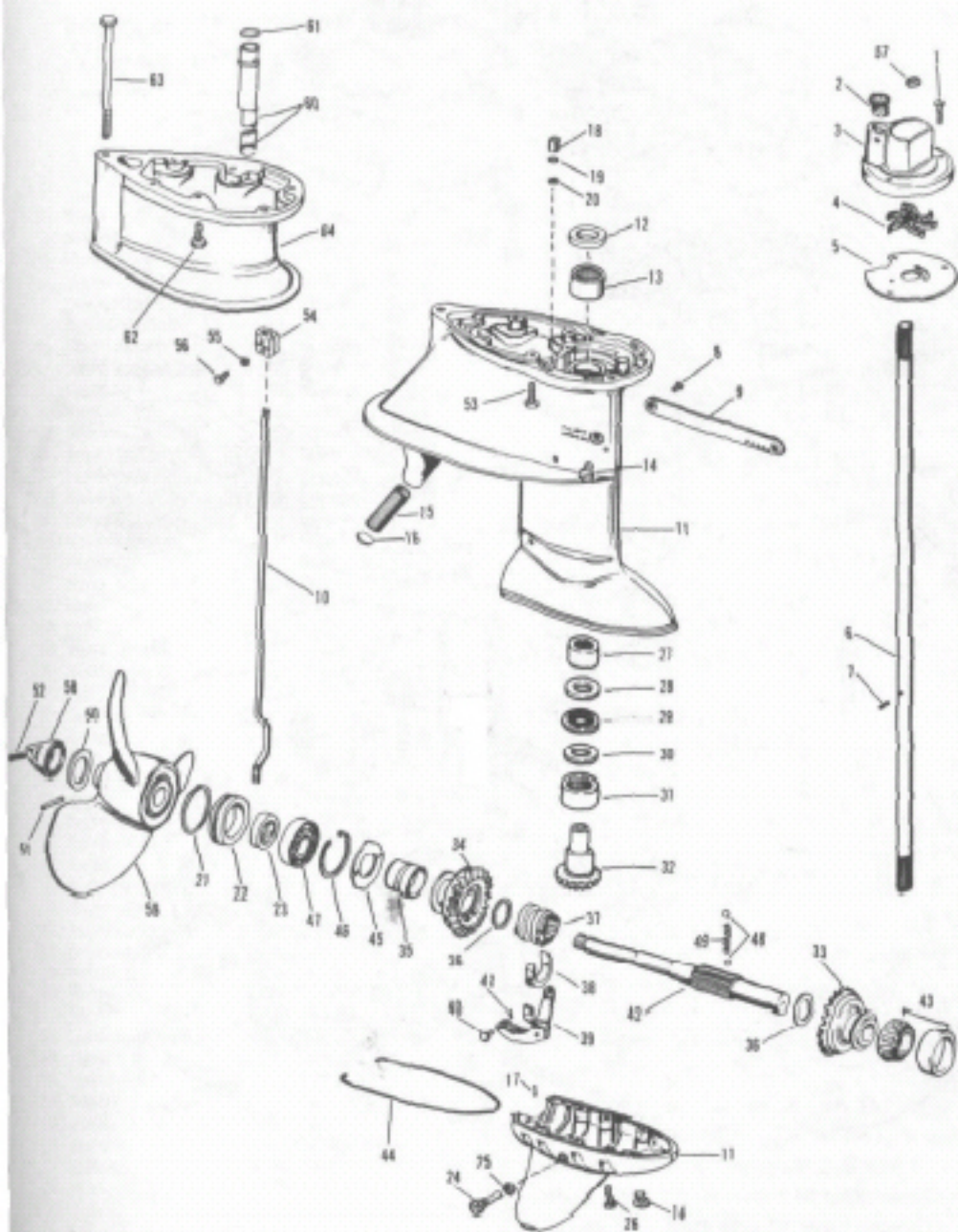
12. Remove upper motor mount link to free exhaust housing.
13. Remove rubber mounts if they have deteriorated.
14. Loosen the swivel bracket friction screw and spring.
15. Lift pivot tube and steering bracket out of swivel bracket.
16. Remove thrust washer, O-ring, and pivot tube bushing.
17. Drive out upper seal if it needs replacement.
18. Remove upper swivel bracket liner pin.
19. Remove spacer and friction block.
20. Remove the thrust rod and disassemble the stern bracket.
21. Reverse removal procedure for installation. Other sections of this chapter give procedures for further repair and cleaning.

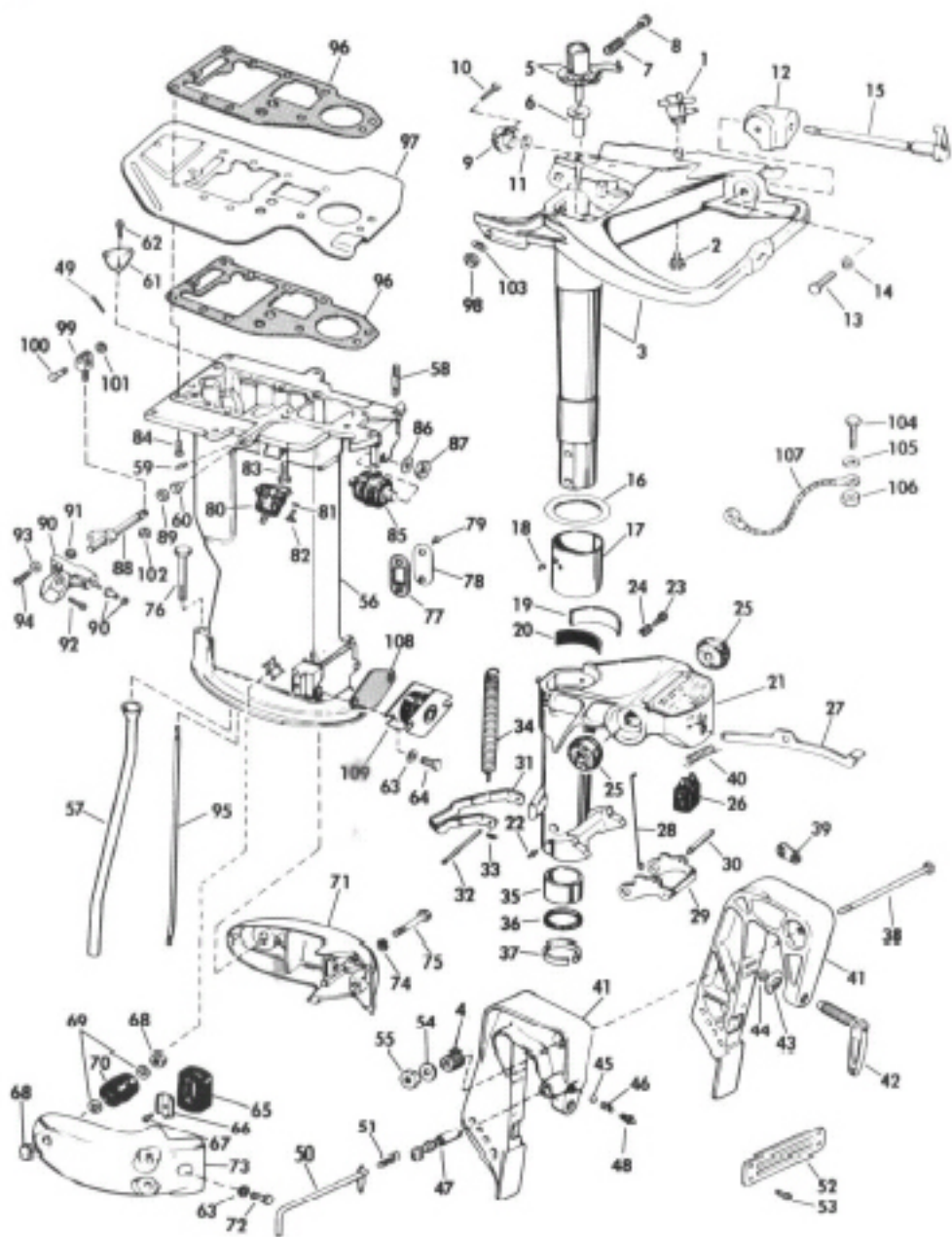
Removal/Installation (18-33 hp)

1. Remove upper motor cover.
2. Disconnect spark plug wires.
3. Remove exhaust cover plate and gasket enough to expose the shift rod connector.
4. Remove lower connector rod screw. Refer to **Figures 32 and 33** for details of the various units and components. The 33 hp engine is shown as a typical example.
5. Remove the screws which attach the gearcase to the exhaust housing.

GEARCASE (33 HP)

- | | |
|-----------------------------------|------------------------|
| 1. Screw | 36. Thrust washer |
| 2. Water tube grommet | 37. Shifter clutch dog |
| 3. Housing | 38. Cradle |
| 4. Impeller | 39. Shift lever |
| 5. Plate | 40. Pin |
| 6. Drive shaft | 41. Cotter pin |
| 7. Impeller pin | 42. Propeller shaft |
| 8. Screw | 43. Bearing |
| 9. Cover | 44. Seal |
| 10. Shift rod | 45. Thrust washer |
| 11. Gearcase and bearing assembly | 46. Ring |
| 12. Oil retainer | 47. Ball bearing |
| 13. Bearing | 48. Detent ball |
| 14. Plug and washer | 49. Spring |
| 15. Water intake screen | 50. Thrust washer |
| 16. Plug | 51. Drive pin |
| 17. Dowel | 52. Cotter pin |
| 18. Bushing | 53. Screw |
| 19. O-ring | 54. Connector |
| 20. Gasket | 55. Lockwasher |
| 21. O-ring | 56. Connector screw |
| 22. Housing | 57. O-ring |
| 23. Retainer | 58. Nut |
| 24. Pivot pin | 59. Propeller |
| 25. Seal | LONGER PARTS |
| 26. Screw | 6. Drive shaft |
| 27. Bearing | 10. Shift rod |
| 28. Washer | 54. Connector |
| 29. Thrust bearing | 55. Washer |
| 30. Washer | 56. Screw |
| 31. Bearing | 60. Adapter |
| 32. Pinion | 61. O-ring |
| 33. Gear and bushing | 62. Screw |
| 34. Gear | 63. Screw |
| 35. Bushing | 64. Extension |

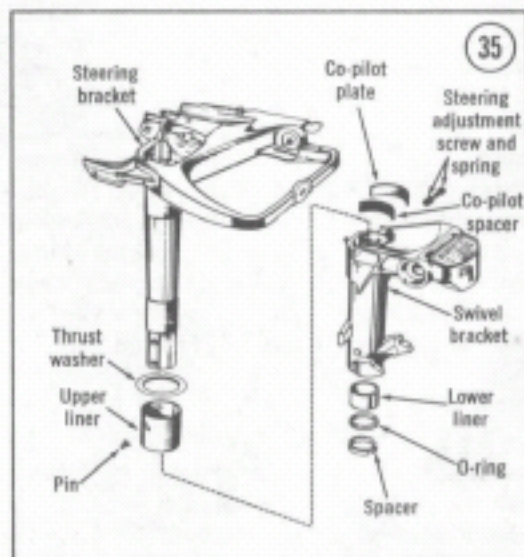




LOWER UNIT (33 HP)

- | | |
|-----------------------------|---------------------------------|
| 1. Connector | 56. Exhaust housing assembly |
| 2. Screw | 57. Water tube |
| 3. Steering bracket | 58. Stud |
| 4. Spring | 59. Lubrication fitting |
| 5. Gear | 60. Bushing |
| 6. Bushing | 61. Housing cover |
| 7. Spring | 62. Cover screw |
| 8. Screw | 63. Washer |
| 9. Pinion | 64. Screw |
| 10. Screw | 65. Bumper |
| 11. Washer | 66. Retainer |
| 12. Cover | 67. Screw |
| 13. Screw | 68. Acorn nut |
| 14. Lockwasher | 69. Gasket |
| 15. Knob and shaft | 70. Rubber mount |
| 16. Thrust washer | 71. Housing |
| 17. Swivel bracket liner | 72. Screw |
| 18. Pin | 73. Housing |
| 19. Co-pilot plate | 74. Lockwasher |
| 20. Spacer | 75. Screw |
| 21. Swivel bracket | 76. Screw |
| 22. Lubrication fitting | 77. Gasket |
| 23. Screw | 78. Exhaust housing cover plate |
| 24. Spring | 79. Screw |
| 25. Conical washer | 80. Rubber mount |
| 26. Bumper | 81. Washer |
| 27. Arm | 82. Screw |
| 28. Link | 83. Screw |
| 29. Link | 84. Screw |
| 30. Shaft | 85. Mount |
| 31. Locking lever | 86. Washer |
| 32. Rod | 87. Nut |
| 33. Cotter pin | 88. Bracket and shaft |
| 34. Spring | 89. O-ring |
| 35. Liner | 90. Bushing |
| 36. O-ring | 91. Lockwasher |
| 37. Spacer | 92. Screw |
| 38. Bolt | 93. Washer |
| 39. Safety chain | 94. Screw |
| 40. Spring | 95. Rod |
| 41. Stern brackets | 96. Gasket |
| 42. Clamp screw | 97. Powerhead plate |
| 43. Swivel plate | 98. Nut |
| 44. Retainer | 99. Clevis |
| 45. Detent ball | 100. Shift rod pin |
| 46. Spring | 101. Washer |
| 47. Pin | 102. Nut |
| 48. Lubrication fitting | 103. Washer |
| 49. Clevis | 104. Screw |
| 50. Thrust rod and retainer | 105. Washer |
| 51. Spring | 106. Nut |
| 52. Strap | 107. Ground lead |
| 53. Screw | 108. Gasket |
| 54. Washer | 109. Rubber mount |
| 55. Nut | |

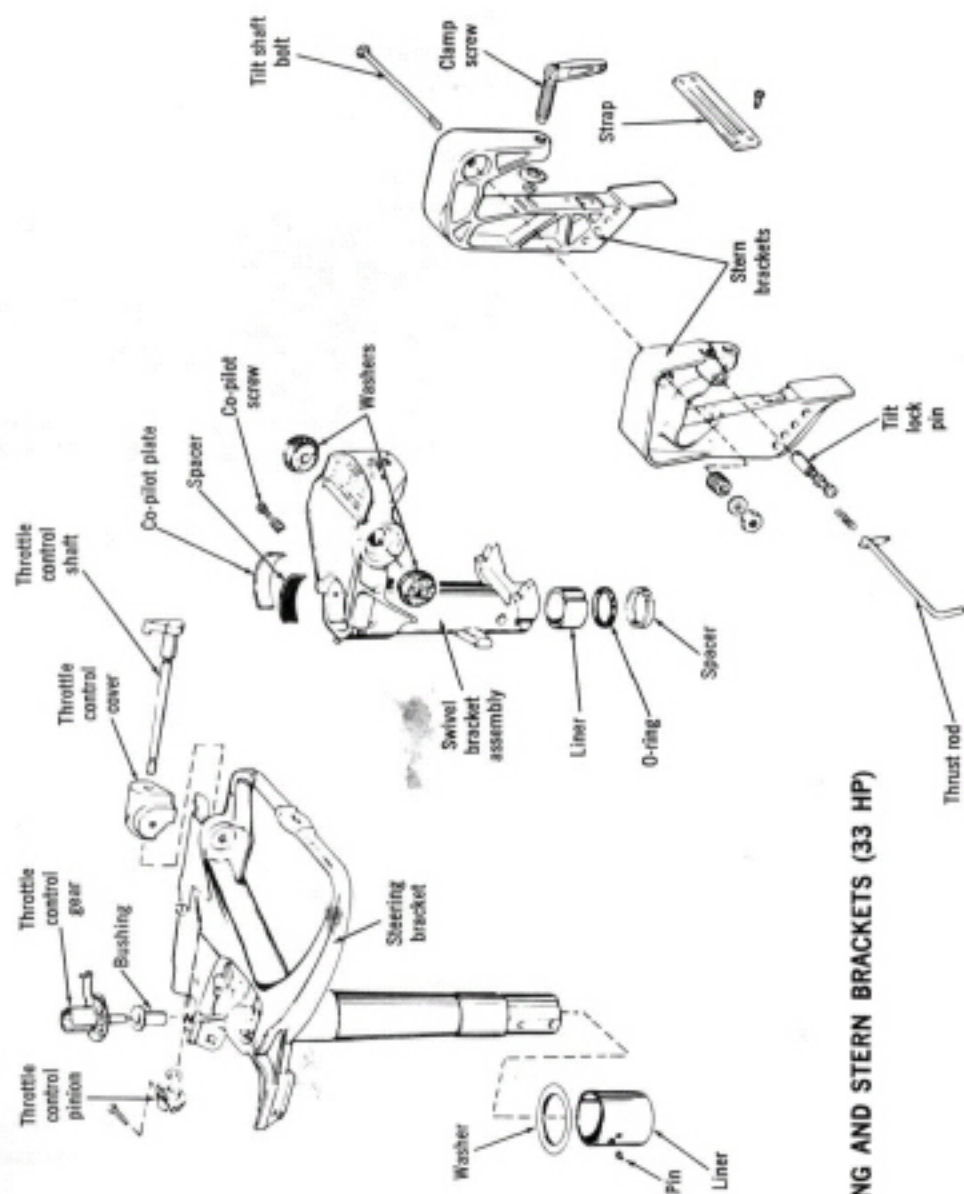
6. Remove gearcase from the exhaust housing taking care to avoid damaging drive shaft splines.
7. Remove the power head and attendant components as outlined in Chapter Six.
8. Remove throttle control pinion, shaft, and gear. See Figure 34.
9. Lift the steering bracket from swivel bracket assembly. See Figure 35.



10. Remove the nut from tilt shaft bolt and take off the stern bracket strap.
11. Reverse removal procedure for assembly after performing the cleaning and repair operations discussed elsewhere in this chapter.

Cleaning, Inspection, and Repair

1. Clean all parts with solvent and blow dry with compressed air or hand hair dryer set on low heat.
2. Discard all old seals, O-rings, and gaskets. These parts are inexpensive to replace while the engine is apart.
3. Check drive shaft splines for signs of wear or damage. Sometimes striking a submerged object can result in severe damage.
4. Inspect the gearcase for nicks on all machined mating surfaces. Repair any minor damage on a surface plate with No. 120 and No. 180 emery cloth. Check parallelism with a surface gauge and scriber.



STEERING AND STERN BRACKETS (33 HP)

5. Resurface and inspect the exhaust housing as described before for the gearcase.
6. Inspect water tubes for any damage which may restrict water flow.
7. Inspect water pump impeller for damage or excessive wear.
8. Inspect pump housing and impeller plate for scoring or pitting.
9. Check water intake screen and bypass holes for clogging.
10. Inspect drive gears, pinion gear, and thrust washers for wear.
11. Inspect rubber vibration mounts and replace if cracked, worn, or torn.
12. Inspect pilot shaft liner, bushing, and thrust washers for wear.
13. Inspect swivel bracket screw clamp assembly for loose plate or retainer.

Exhaust-to-Gearcase Alignment (All Models)

A broken drive shaft or excessive wear of spline or gears can result from misalignment of the exhaust housing-to-gearcase. Such misalignment is usually the result of striking a submerged object.

Inspect machined surfaces with a surface plate and dial indicator. Check for nicks and burrs and surface as described in the previous section of this chapter.

Both top and bottom surfaces must be parallel. If the housing is bent, it must be replaced or repaired by a competent shop. Such work is far beyond the scope of the home mechanic.

Gearcase Pressure Test (All Models)

1. Remove drain plug and insert pressure gauge.
2. Pump pressure up to 16-18 pounds.
3. Check for leaks at gasket mating surfaces and seals.
4. Pressure will gradually drop after a minute or so, which is normal.
5. If any one seal needs replacement, chances are that the others will soon follow. If one seal is replaced, do the whole set to eliminate repeating this same job at a later date.

PROPELLER

Of all the components of an outboard motor, the propeller is one of the most important. The wrong selection of size and pitch can cause poor performance or engine damage.

Most of the motors come from the factory with a blade well-suited for most applications. Varying conditions can dictate the need for a different propeller for increased performance. For instance, a boat used strictly for fishing will need an entirely different propeller than a boat used for water skiing.

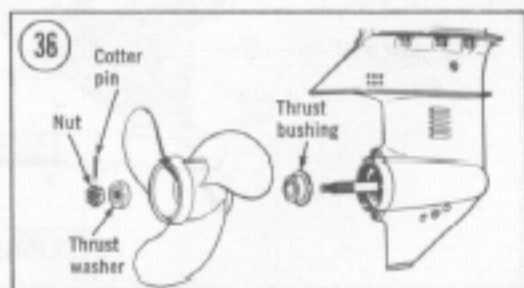
A tachometer will be needed to accurately evaluate the propellers to be used. Load the boat with the lightest load that it will likely carry and run the engine at full throttle. If the top rpm is near the upper operating range, then the propeller is correct and will probably be well-suited for most conditions. Under extreme conditions, or loads, it may be necessary to change propellers back and forth as needed.

Installation/Removal

All propellers are held in place with a shear pin designed to break before the drive train can be damaged. Most are also equipped with rubber shock absorbers to prevent the shear pin from breaking unless a hard object is hit. Extra drive and cotter pins should be carried at all times to prevent being stranded.

To replace a shear pin, pull the engine all the way forward and remove the rubber end cap from the propellers. Remove the shear pin; align the holes; insert a new pin and reinstall the rubber cap.

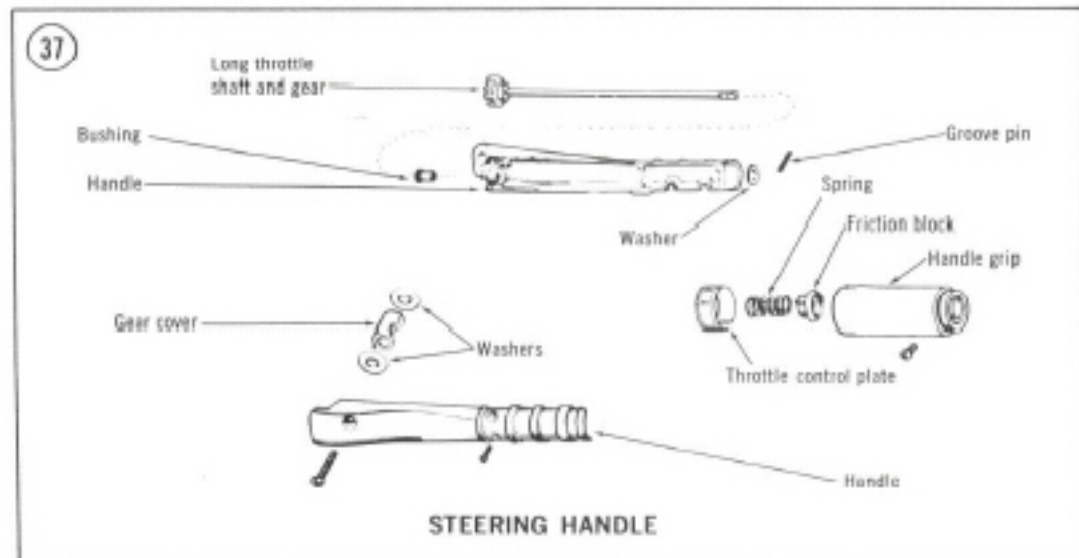
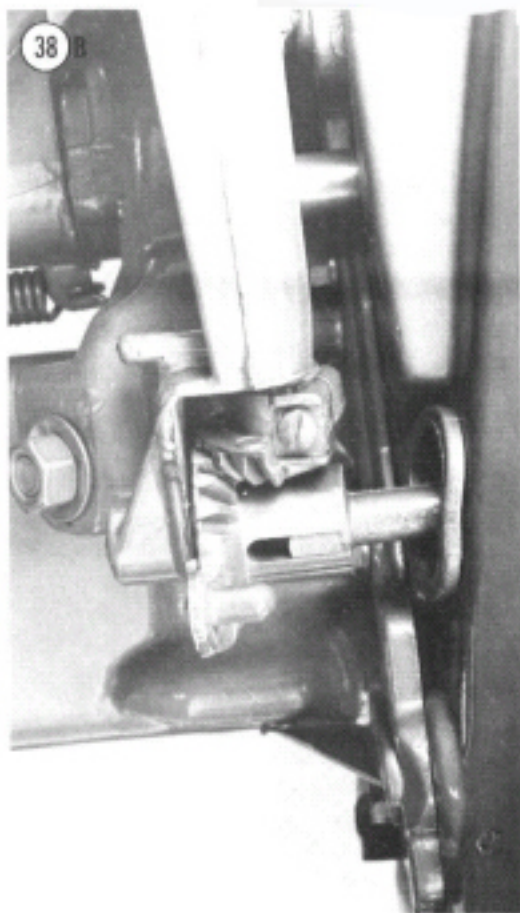
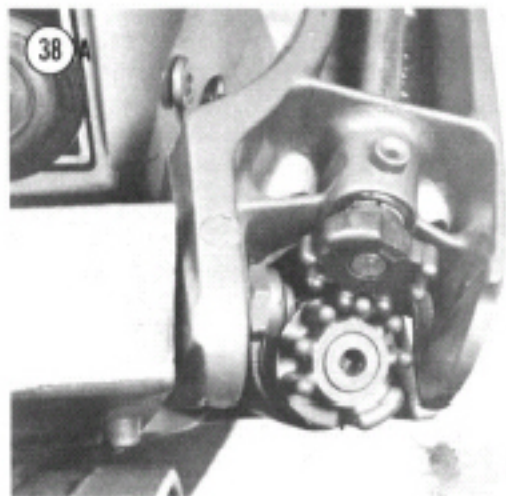
To replace the propeller, carry the previous steps farther by removing the nut and cotter pin shown in **Figure 36**. Slide the prop off the shaft and install the new prop.



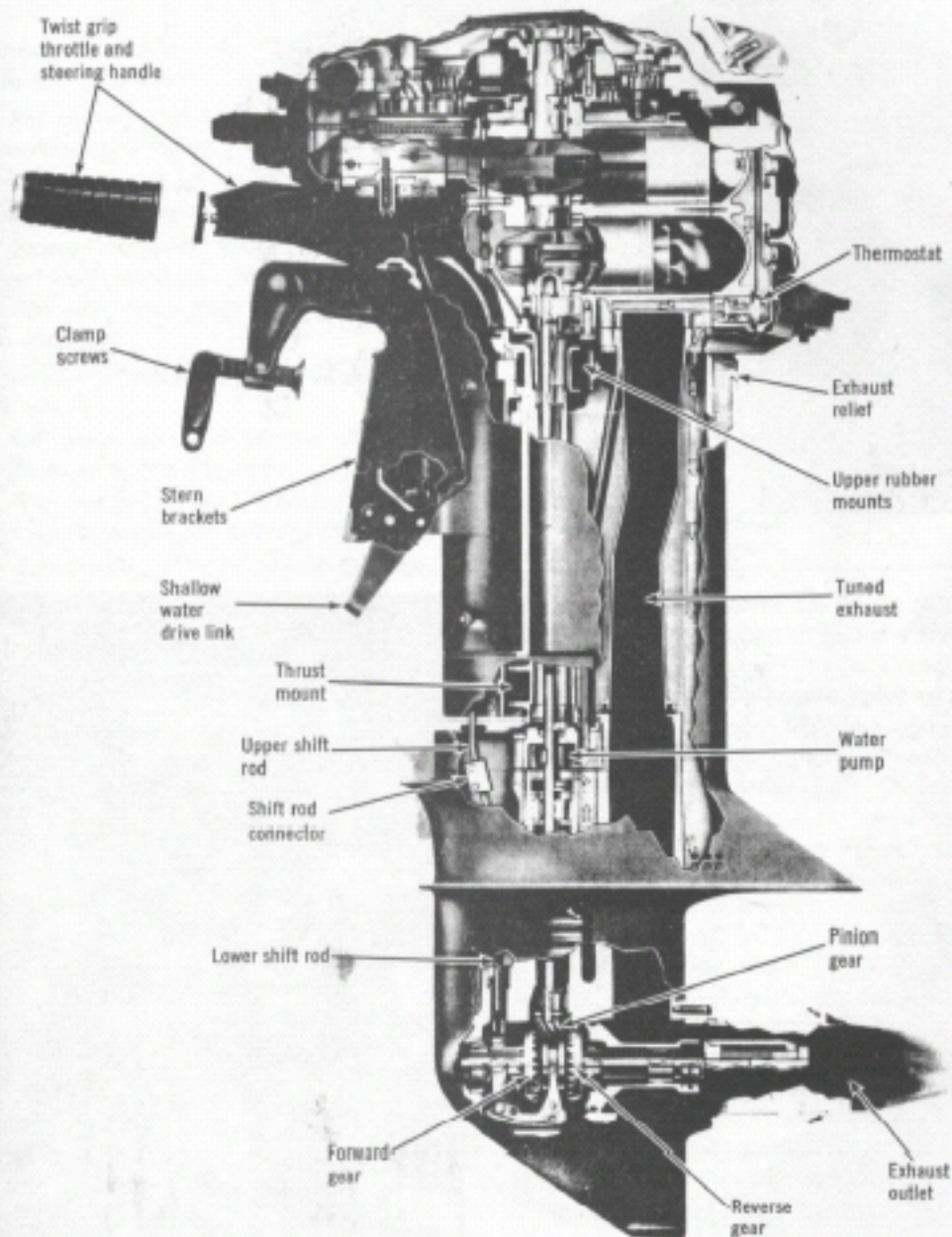
STEERING HANDLE

Removal/Installation

1. Remove the grip, friction block, spring and throttle control plate as shown in **Figure 37**.
2. Remove screws and separate handle halves.
3. Remove the long shaft and gear, retainer and washer.
4. Inspect all components for wear and clean in solvent prior to assembly.
5. Reverse the procedure to assemble, being careful to align the throttle shaft gears. Align as shown in **Figures 38A and 38B**.



LOWER UNIT



TYPICAL MOTOR

CHAPTER EIGHT

MANUAL STARTER

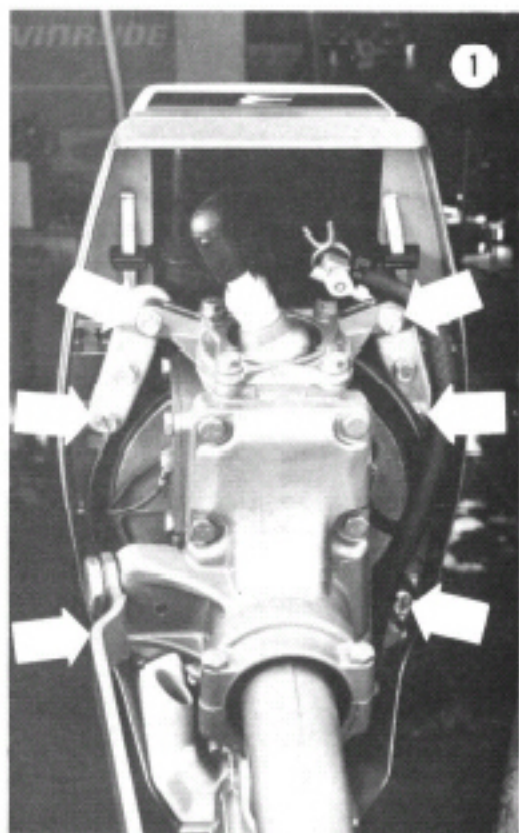
Almost all of the manual start models incorporate a spring to rewind the rope onto the starter pawl after an attempt is made at starting. This is far simpler than the old method of having to manually wind the rope around a drum. In their coiled position, the springs can be very hazardous. If the spring is allowed to unwind on its own it could snap out and cause severe eye damage. Always wear eye protection to avoid any such danger.

The complete overhaul of a manual starter requires the rewinding of the spring. This requires the use of a special tool and rewinding jig on all but the 1.5-4 hp motors. It's far simpler to take the disassembled unit to a dealer to have the unit rebuilt to the point where it can be installed on the motor.

Normally the starter shouldn't require a complete overhaul. The usual cause of problems is a broken or disengaged rope. The replacement of the rope is easy on all but a few models.

Removal/Installation (1.5-2 hp and 3 hp for 1966-1967)

1. Remove the fuel tank filler cap.
2. Remove the mounting screws and remove the starter from the power head. See Figure 1.



MANUAL STARTER

3. Reverse the procedure to install making sure that the detent spring is fitted under the front port side screw as shown in **Figure 2**.

Disassembly (1.5 hp and 3 hp for 1966-1967)

1. Pull the rope out part way and tie a knot in the middle. See **Figure 3**.

2. Untie the end of the rope to remove the handle and bumper as shown in **Figure 4**.

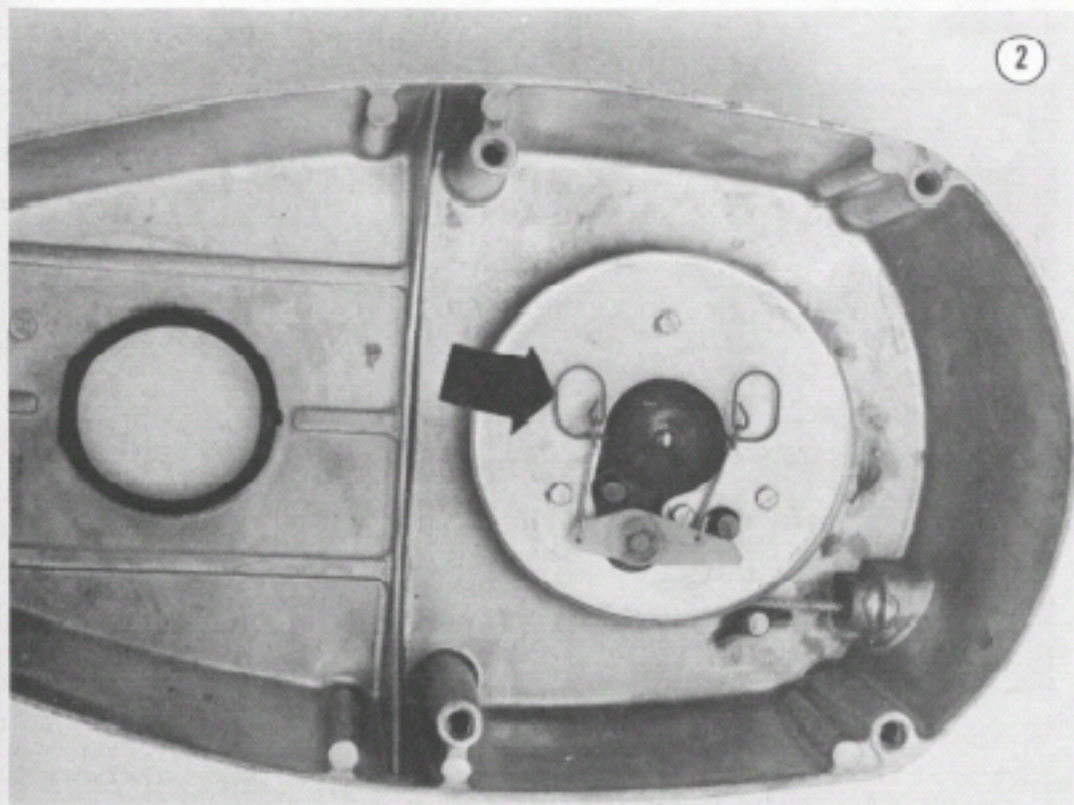
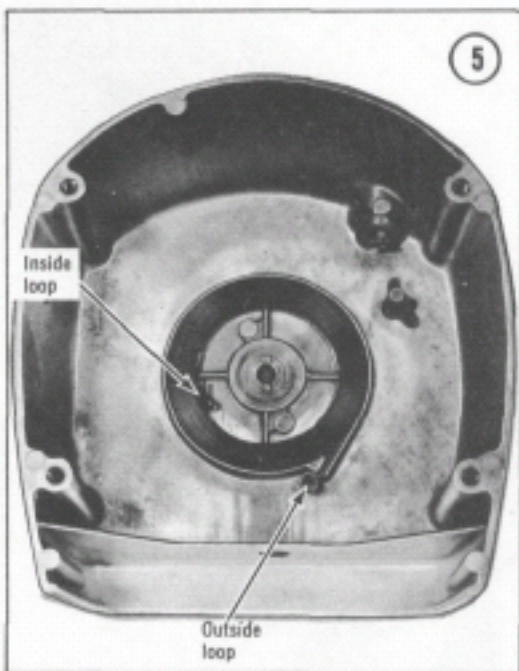
3. Release the middle knot in the rope and ease it back until the starter drum is rewound. Don't let the rope snap back or it could damage the starter.

4. Hold the pulley in the housing and lift out the spindle.

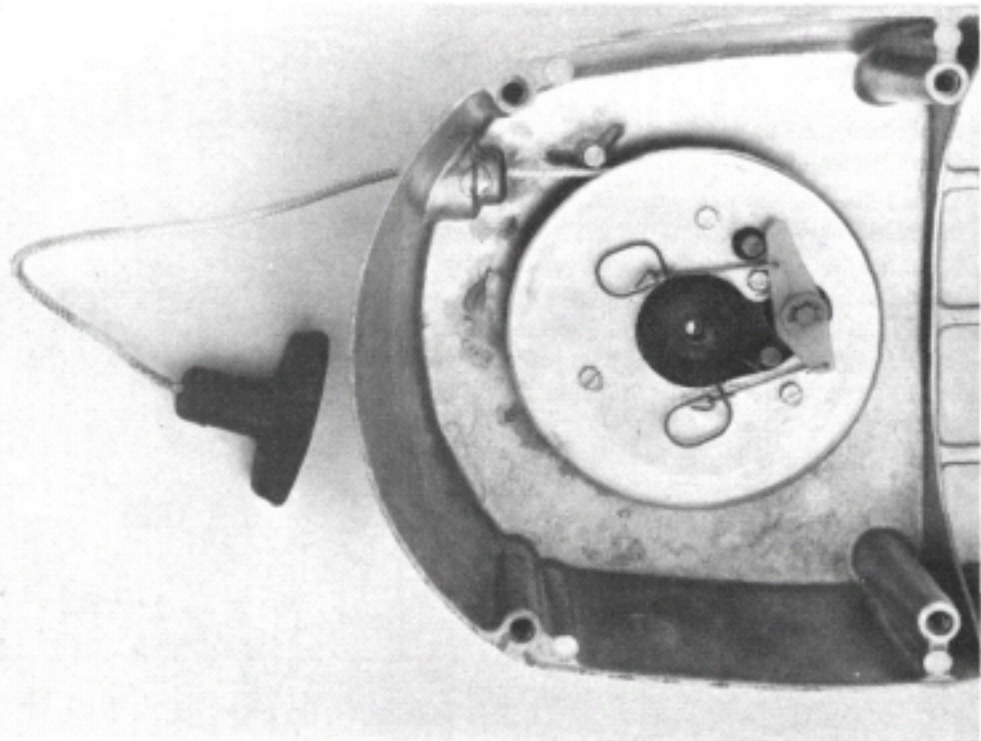
5. Lift the pulley off so that the spring remains in the housing. See **Figure 5**.

6. Turn the unit so that the bottom side is down and tap the housing to dislodge the spring.

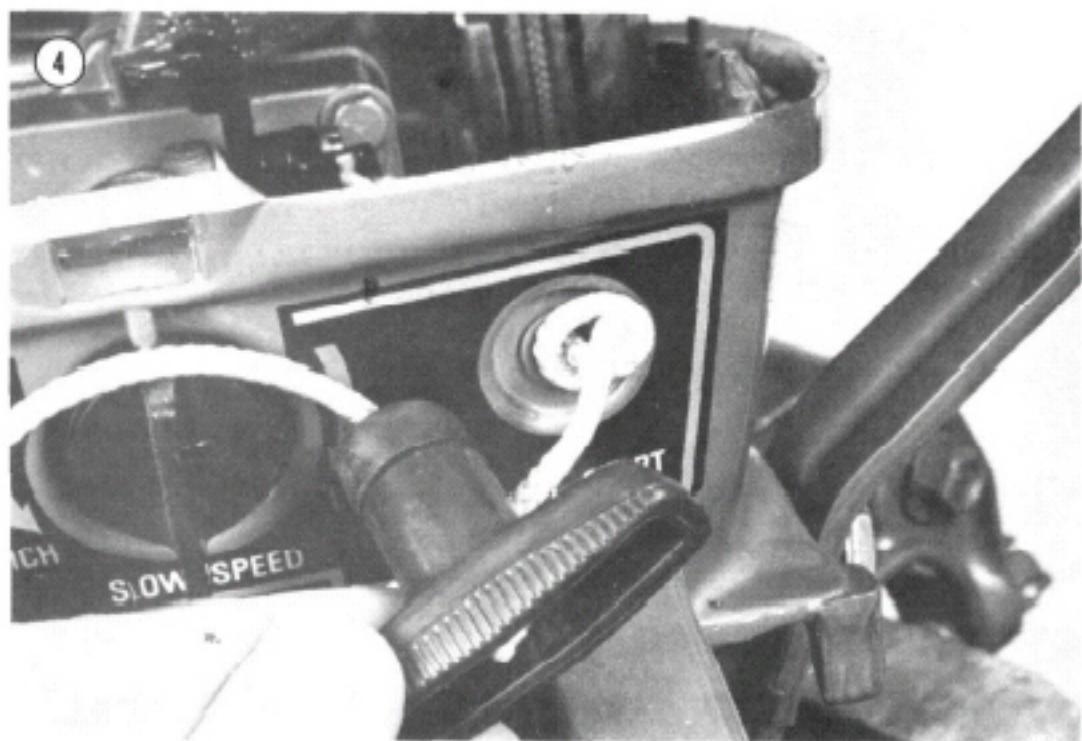
7. Remove the cover to remove the rope.



3



4



assembly (1.5-2 hp and 3 hp for 1966-1967)

3. Feed the spring through the hole in the starter housing.

4. Lubricate the spring and cavity.

5. Install the pulley so that the pin engages the spring loop.

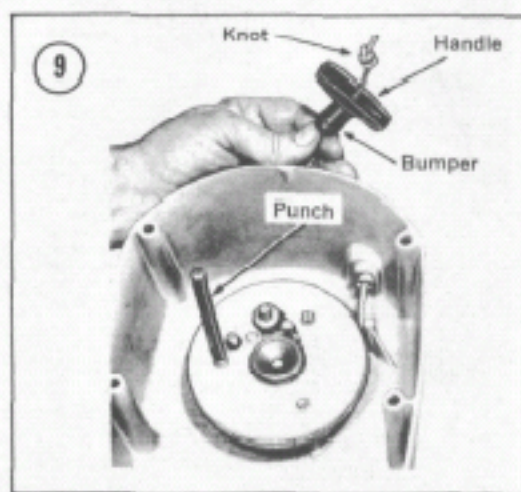
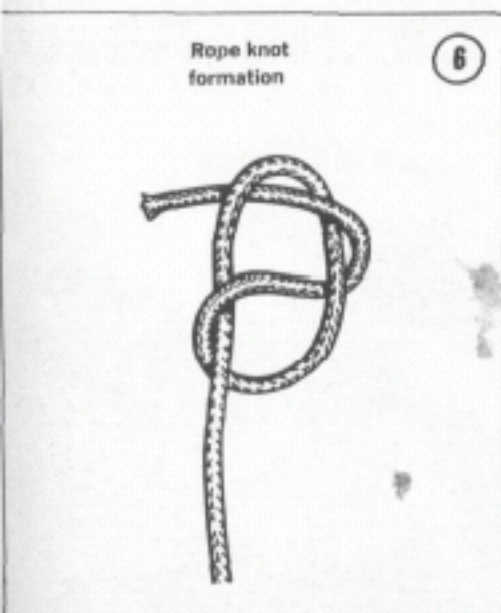
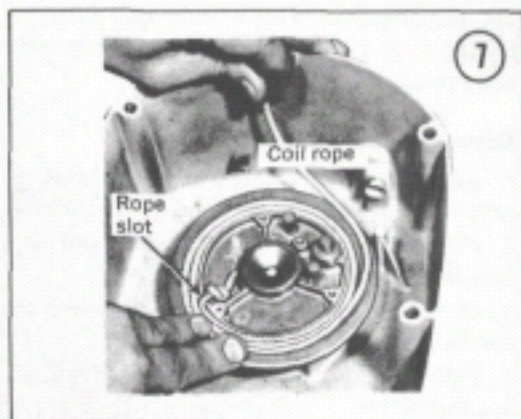
6. Lubricate the spindle and install so that the pulley engages the housing boss.

7. Wind the spring clockwise until the loop engages the outside face of the cavity.

8. It's best to install a new rope since the starter has already been disassembled this far. Cut the rope to 64 inches. Use only nylon rope designed for this purpose.

9. Fuse the ends of the rope with a match to prevent unraveling.

10. Knot the end of the rope (Figure 6).



9. Place the knot in the pulley slot and coil counterclockwise around the flange as shown in Figure 7.

10. Install pulley plate and pre-load the spring by winding $3\frac{1}{2}$ turns counterclockwise. See Figure 8.

Hold the pulley in position by inserting a rod through one of the screw holes in the pulley plate. See Figure 9.

11. Feed the free end of the rope through the starter housing and install on a handle. Knot the end to secure.

12. Install starter pawl, friction spring and retaining ring. Check the operation of the rope and starter.

Removal (3 hp 1968 and 4 hp)

1. Remove the spark plug wires by twisting the caps counterclockwise. Remove ground wires.
2. Pull the starter rope out part way and tie a knot in the middle.
3. Untie the end of the rope to remove the handle and bumper.
4. Pull the spring end out as far as it will go. See **Figure 10**.
5. Remove starter assembly from power head.

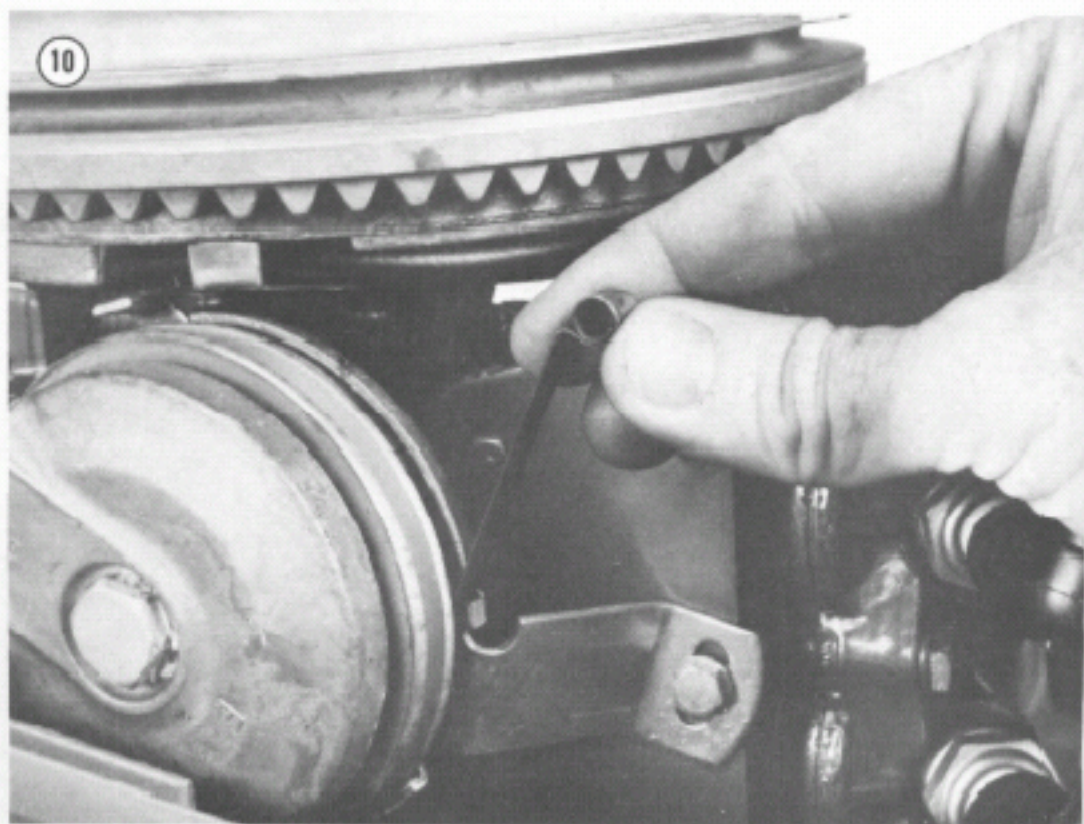
Disassembly (3 hp 1968 and 4 hp)

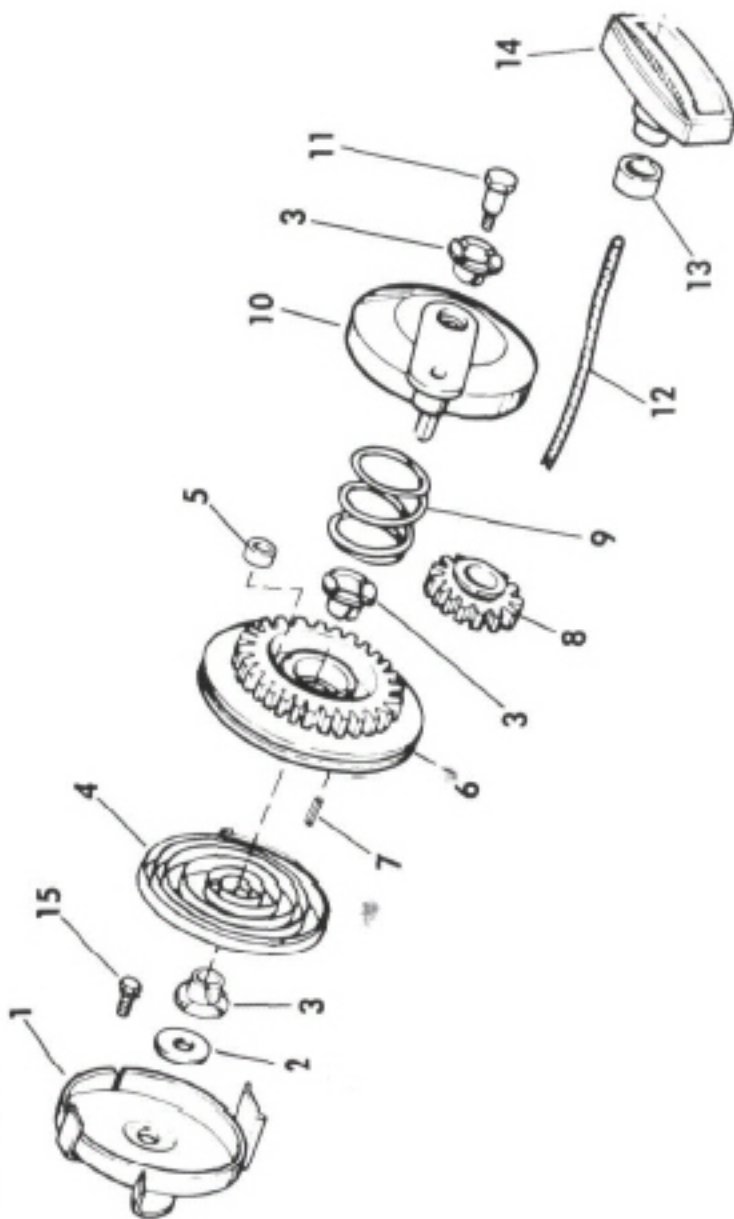
1. Lift out the idler gear, arm and spring as shown in **Figure 11**.
2. Lift pulley out of cup and unhook the spring.
3. Remove the rope from the pulley.

4. Remove the two idler bushings from pulley.
5. Clean all parts except the rope in solvent and blow dry. Check for any damage.

Assembly (3 hp 1968 and 4 hp)

1. It's always a good idea to replace the rope during an overhaul even if the original still looks good. The old rope can be kept in the boat for emergencies. Knot the end of a 64 inch piece of nylon rope and insert it in the rope hole of the pulley. Fuse the ends of the rope with a match to prevent fraying.
2. Pull the rope taut and wind it clockwise around the pulley.
3. Coat the bushings and install in the idler arm and pulley.
4. Assemble the idler gear, arm and spring to the pulley and cup making sure that the stops are aligned as shown in **Figure 12**.
5. Pre-load the spring $3\frac{1}{2}$ turns clockwise.

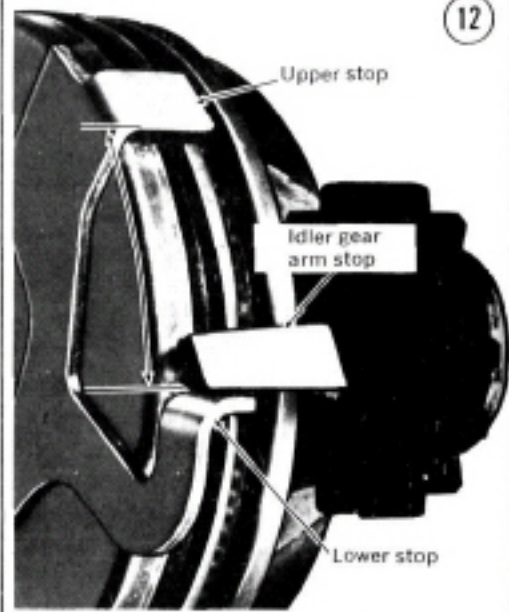




MANUAL STARTER (3 HP 1968 AND 4 HP)

- | | | |
|-----------------|---------------|--------------------|
| 1. Cap and stop | 6. Pulley | 11. Shoulder screw |
| 2. Washer | 7. Roll pin | 12. Rope |
| 3. Bushing | 8. Idler gear | 13. Bumper |
| 4. Spring | 9. Spring | 14. Handle |
| 5. Bushing | 10. Arm | 15. Screw |

12



6. Feed the free end of the rope through the housing and handle. Knot the end to secure. See Figure 6.

7. Install the starter on the power head.

8. Install the spark plug wires making sure that the cap makes a solid connection.

Rope Replacement (5-9.5 hp)

The procedure for replacing anything other than the starter rope on this series of engines is far too dangerous and requires too many specialized tools for the home mechanic.

Normally the only repair or maintenance required will be to replace the rope and lubricate the moving parts.

1. Remove the spark plug wires by twisting the caps counterclockwise. Ground the wires as shown in Figure 13.

2. Disconnect the ground connection at the terminal screw.

3. Pull the rope out all the way and allow it to return until the rope end is visible on the port side of the motor. Lock the starter by raising the pinion gear and holding it in place with a pair of pliers as shown in Figure 14.

4. Remove rope handle and rubber bumper.

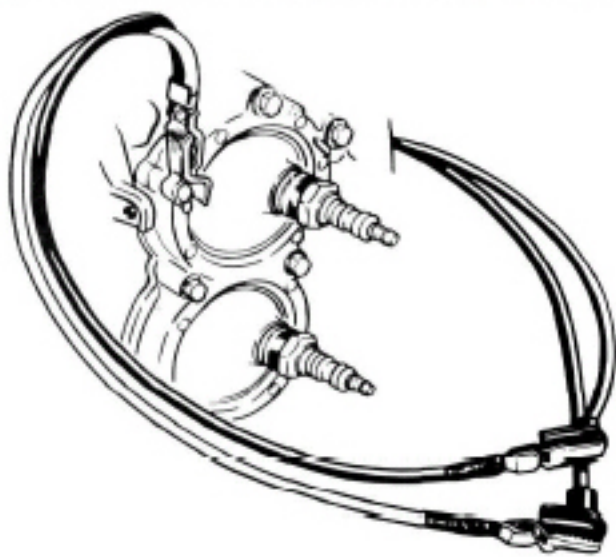
5. Pull the end of the rope out of the spool as shown in Figure 15.

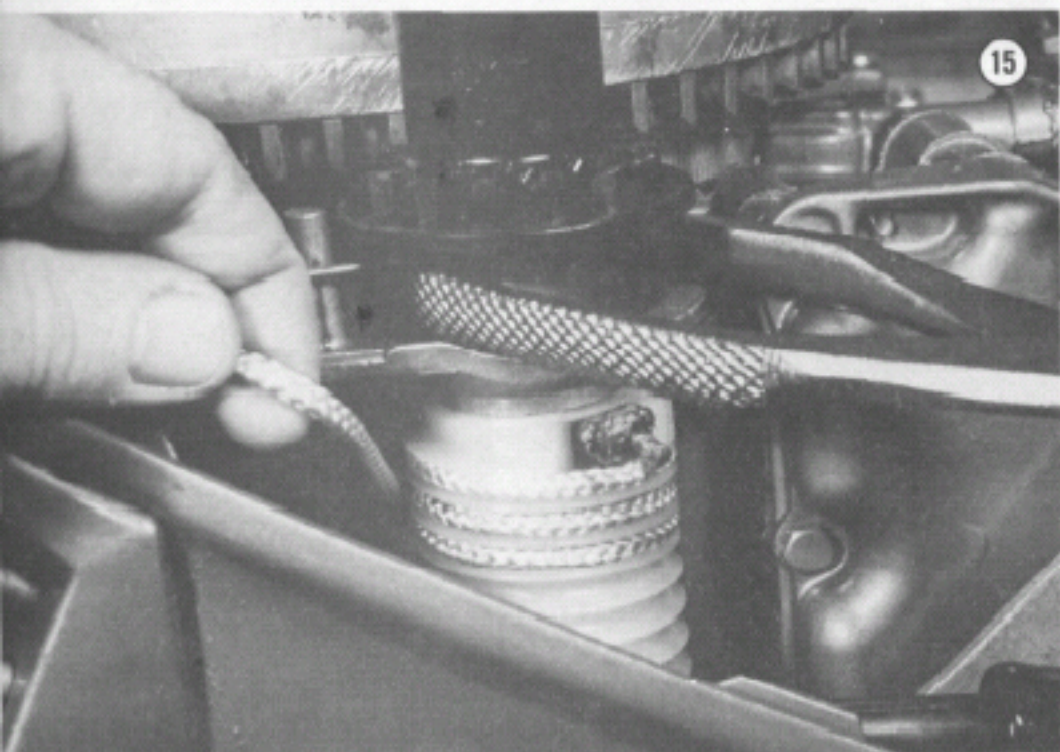
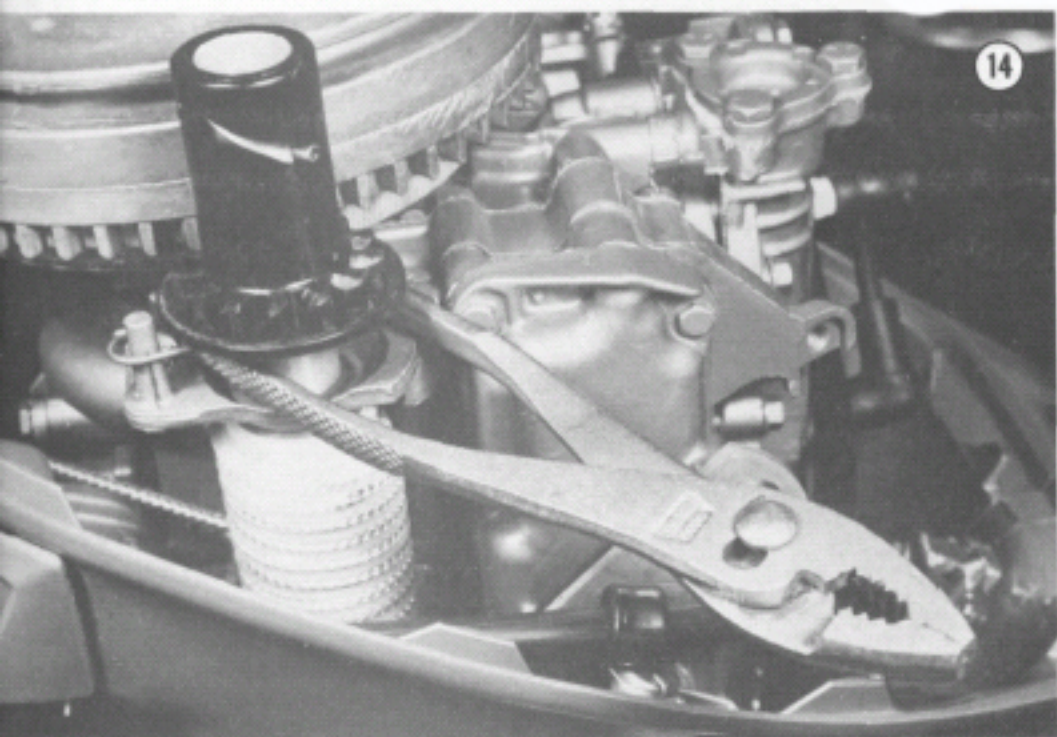
6. Cut a new rope to a length of 66¾ inches and fuse the strands together with a match.

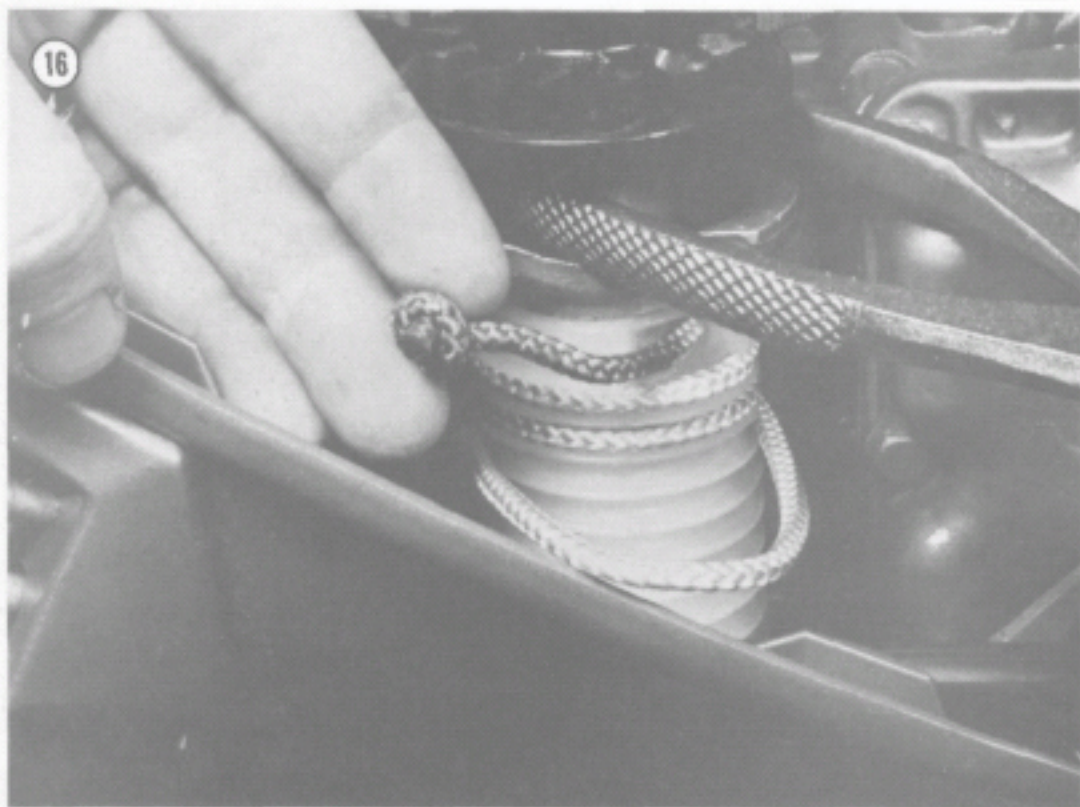
7. Thread the rope through the hole in the pulley as shown in Figure 16, and install the handle.

8. Hold the handle to keep the rope from re-winding too rapidly and pull the pliers out releasing the pinion gear.

13







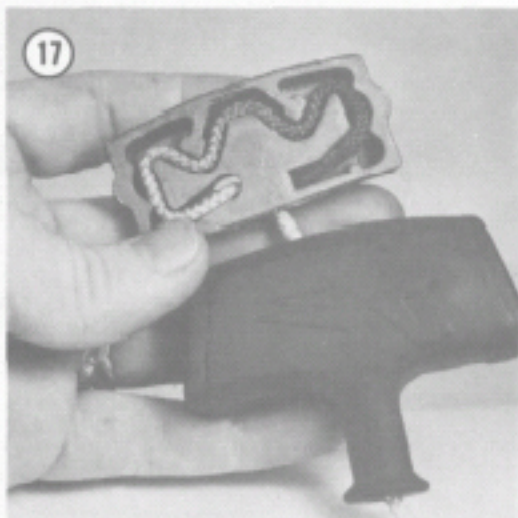
9. Pull the rope out a few times to make sure that it is operating smoothly and retracting fully. A new rope may be a little stiff for the first few uses.

Removal (9.9-15 hp)

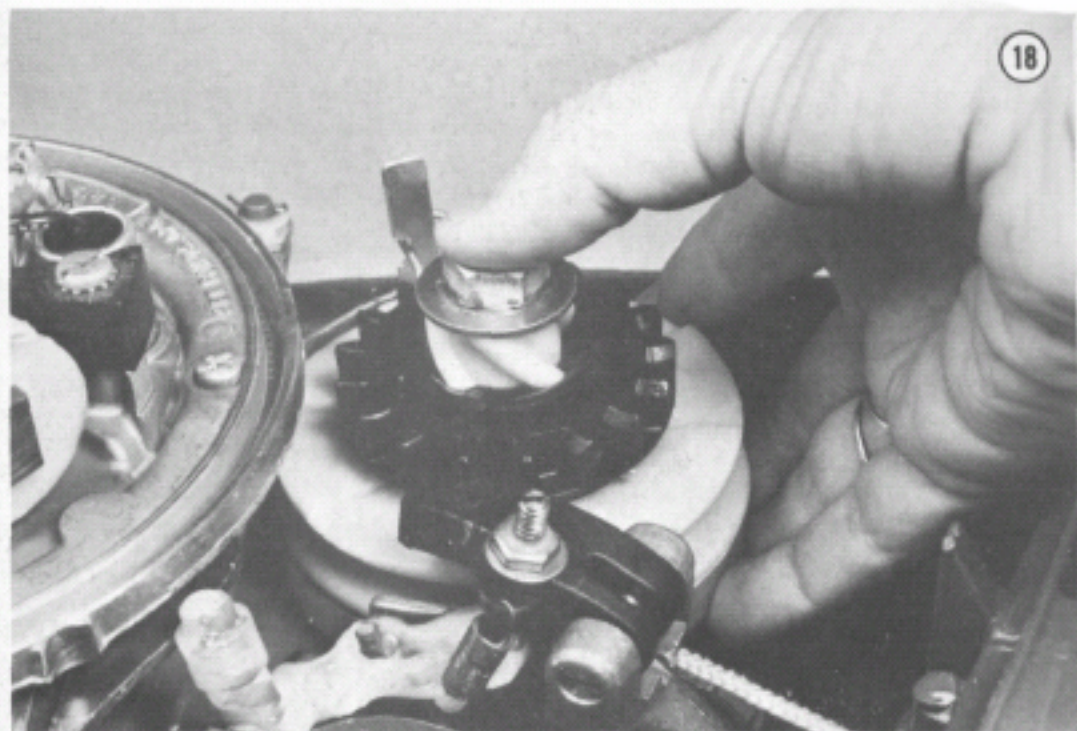
1. Relieve spring tension by pulling the starter rope out part way and tying a knot in the middle.
2. Remove starter handle and rope anchor as shown in **Figure 17**.
3. Hold the rope firmly and allow it to slowly rewind around the pulley.
4. Hold the cup and pulley together and remove the starter mounting screw. Thread a nut on the end of the screw to hold the unit together and take it to a dealer for service. The unit can later be installed in a like manner. See **Figure 18**.

Rope Replacement (9.9-15 hp)

Rope replacement requires the removal of the pulley without disturbing the spring. Extreme



caution is required and safety glasses must be worn. It is safer and easier for a dealer to perform this operation. You've already done the most difficult and expensive work.



Installation (9.9-15 hp)

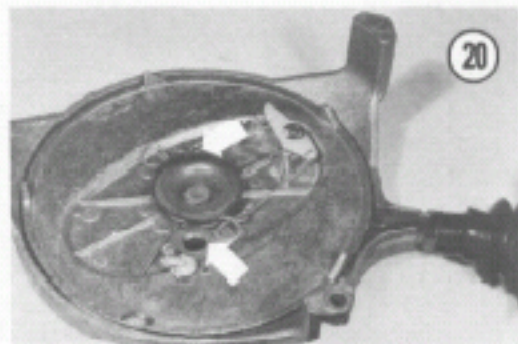
1. Remove the nut from the mounting screw while holding the pulley and cup firmly.
2. Install the pulley and cup. See **Figure 19**.
3. Feed the rope through the hole in the lower motor cover.
4. Extend the rope fully. The spring end should protrude from the housing $\frac{1}{2}$ inch or more to be correct. Adjust by unwinding the rope from the pulley enough to relieve tension.
5. Pull the rope out part way and tie a knot in the middle.
6. Feed the end of the rope into the handle and install the anchor as shown in **Figure 17**. Release the knot and let rope slowly unwind.

Removal (18-25 hp)

1. Remove motor cover.
2. Remove mounting screws and lift the starter from the power head.
3. Reverse to install. Take the entire assembly to a dealer if any service other than rope replacement or lubrication is needed.

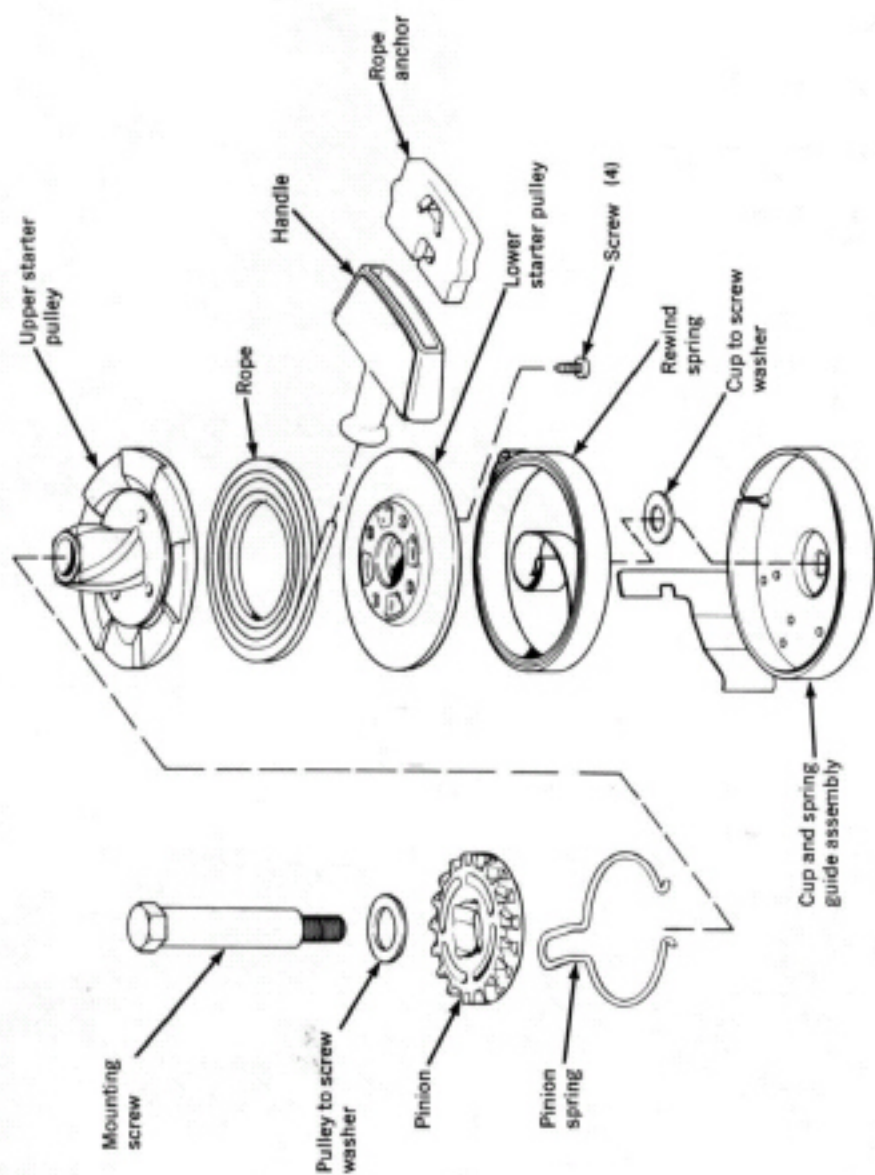
Rope Replacement (18-25 hp)

1. Pull the rope out completely to unwind it from the pulley. Lock the pulley in place by inserting a rod or screw in the small holes of the housing. See **Figure 20**.



2. Remove the rope anchor and rope from the handle as shown in **Figure 17**.
3. Pull the old rope out from the pulley end.
4. Cut a new nylon rope to $72\frac{3}{4}$ inches and fuse the ends with a match to keep the strands from unraveling.

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MANUAL STARTER (9.9 - 15 HP)

5. Tie a knot in one end of the rope and feed it into the pulley.
6. Thread the other rope end through the rope handle and position as shown in Figure 17. Insert the rope anchor.
7. Tug on the handle a few times to firmly seat the anchor.
8. Release the pin and allow the rope to unwind slowly onto the pulley.
9. Pull on the rope a few times and check the timing. Timing is correct if the arrow on the housing points within the limits of the box on the pulley as shown in **Figure 21**.

A new rope may not seat correctly at first and will throw timing off.

Starter Lockout Adjustment (18-25 hp)

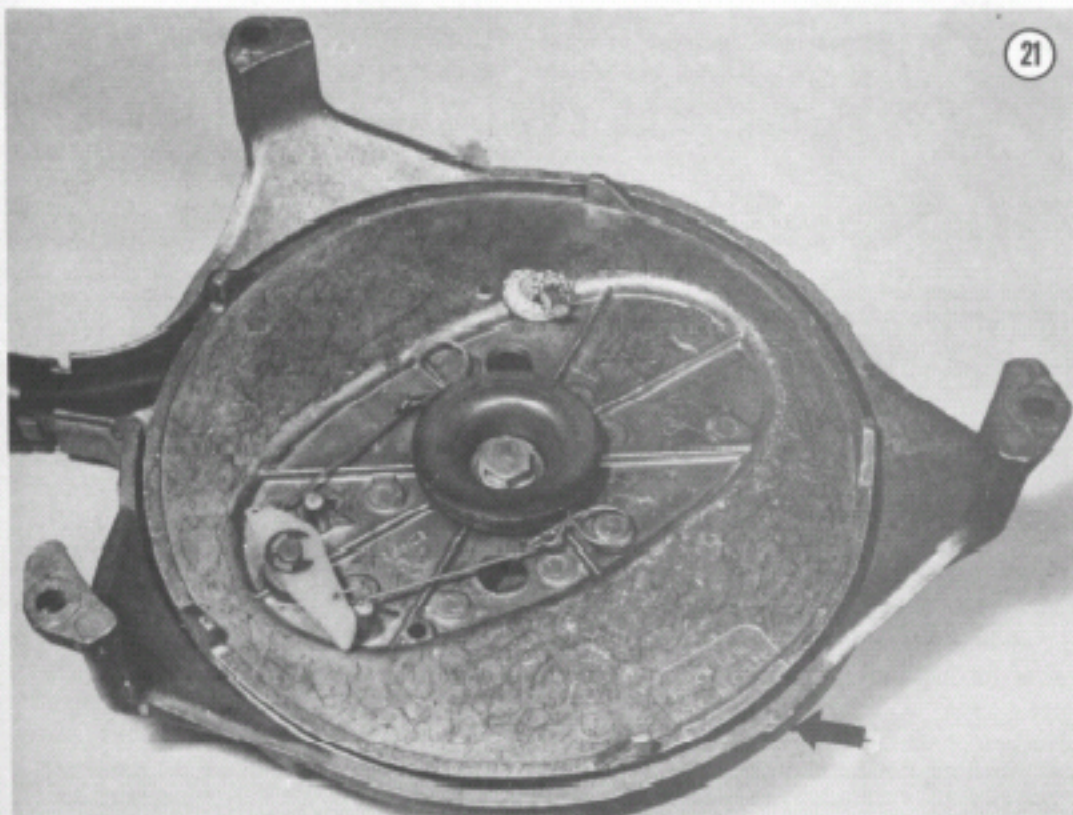
Set the shifter in neutral and set the screw so that the lockout lever clears the lugs on the pulley by 0.030-0.060 in. Lock the adjusting screw with the locknut.

Removal/Installation (33 hp)

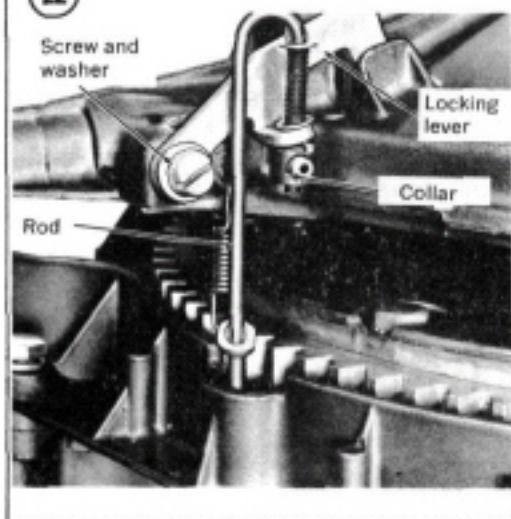
1. Remove motor cover.
2. Remove screw and washer to disconnect locking lever assembly. See **Figure 22**.
3. Remove mounting screws and lift starter from power head.
4. Reverse the procedure to assemble and install. Normally the starter spring won't require service but refer any such work to a dealer. The dangers of working with the spring and the tools needed for a satisfactory job make it an unreasonable and unprofitable task.

Rope Replacement (33 hp)

1. Pull the rope out far enough to tie a knot in the middle.
2. Remove rope anchor as shown in Figure 17.
3. Remove the handle, release the knot and ease the rope back until the pulley is unwound.



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4. Cut a new piece of nylon rope to $73\frac{3}{4}$ inches and fuse the ends with a match to keep the strands from unraveling.
5. Turn the pulley counterclockwise to make sure that it is completely wound and release

slightly until the pulley rope hole aligns with the hole in the housing.

6. Feed the rope through the pulley and housing holes. Tug on the rope to seat the knot.
7. Tie a slip knot in the middle of the rope to hold it in position while the handle is being installed.
8. Thread the rope into the handle.
9. Press the rope anchor in place and remove the knot in the middle of the rope to allow it to rewind.
10. Pull on the rope a few times to make sure that everything works properly.

Starter Lockout Adjustment (33 hp)

1. Set shifter in neutral.
2. Loosen collar screw.
3. Turn the throttle on until the magneto stop butts against the shifter lock.
4. Push the link collar against the lock lever enough to cause the end to clear the stop lugs of the pulley.
5. Tighten the set screw to hold the collar against the control rod.

CHAPTER NINE

ELECTRIC MOTORS

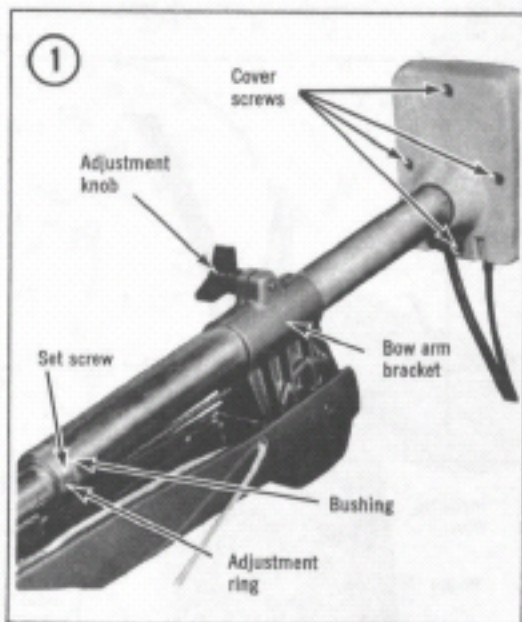
The electric models need the same care and maintenance as the gasoline powered models. Lubricate any moving parts frequently and keep the motor clean and waxed to avoid or retard corrosion.

The battery is the most important part of this system and requires the special care as outlined in Chapter Two and Chapter Five.

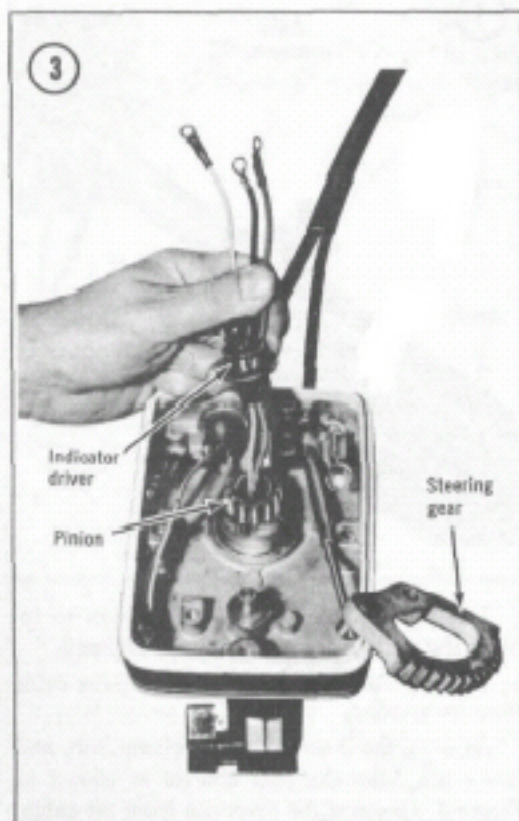
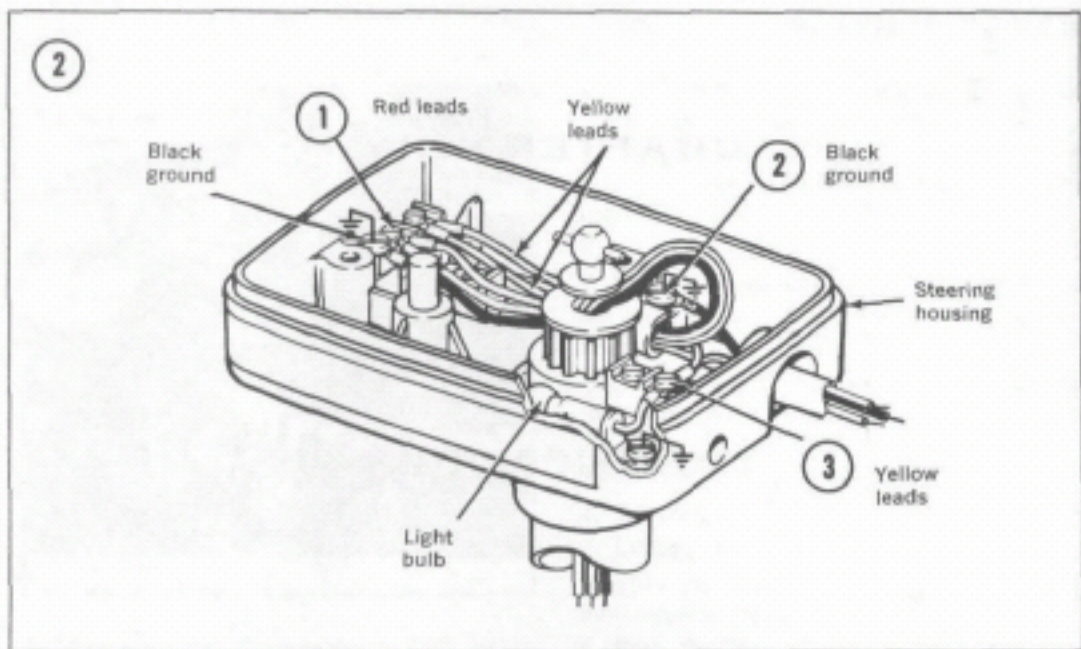
Most of the repair procedure on this motor requires the expert attention of a mechanic and many expensive and complicated pieces of test gear. We recommend that any such service be referred to an established dealer. The procedures for cable replacement and certain adjustments are included in this chapter. The exploded views at the end of the chapter are included for reference.

CABLE REPLACEMENT

1. Remove the steering housing cover as shown in **Figure 1**.
2. Remove bar and leads clamps.
3. Carefully cut the sleeve binding the cables together. Try to avoid nicking the wires.
4. Disconnect the black, yellow, and red wires as shown in **Figure 2**.



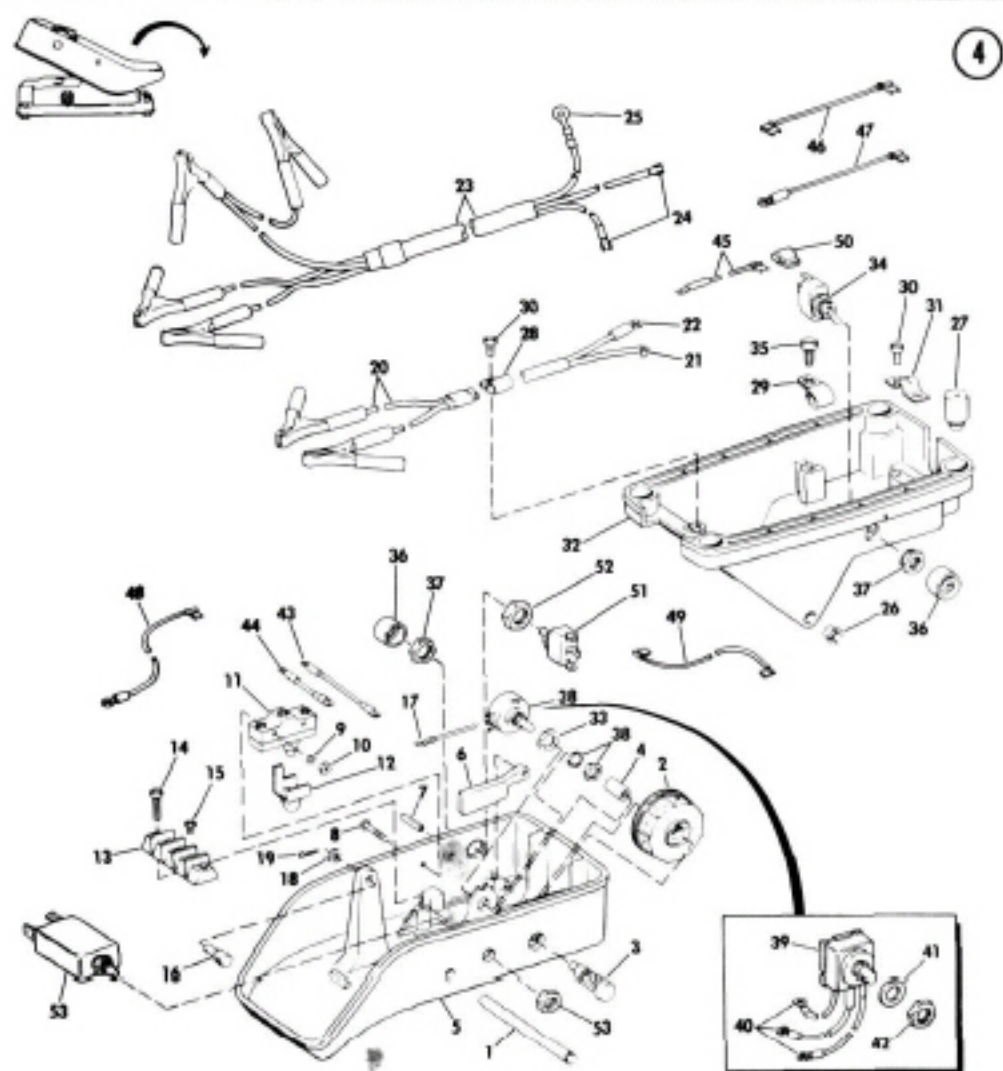
5. Lift the indicator drive high enough to remove the steering gear as shown in **Figure 3**.
6. Unscrew the steering gear and pull the cable from its housing.
7. Remove the 2 screws, cable clamp, nut, and cotter pin from the foot control as shown in **Figure 4**. Unscrew the pivot pin from the cable.



8. Clean the cable threads and apply Loctite.
9. Lubricate the pivot pin and insert in the steering gear.
10. Thread the pivot pin onto the cable.
11. Lubricate the steering gear pivot and teeth and align the arrows while installing the gear. See **Figure 5**.
12. Tighten steering cable set screw.
13. Press the indicator driver onto the gear with the rib facing starboard side of housing as illustrated in **Figure 5**.
14. Connect all wiring being sure to observe color coding.
15. Install steering cable in foot control.
16. Locate steering cable in clamp and attach with screws. See **Figure 4**.
17. Press the foot pedal down and thread the pivot pin onto cable. Align with the hole in the pedal.
18. Secure the pivot pin with a washer, cotter pin, and nut.

ADJUSTMENT

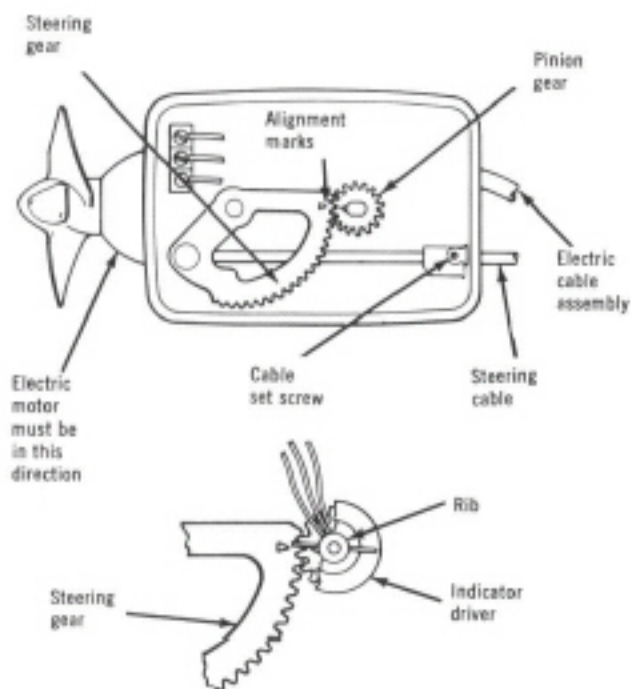
The motor tube must be perpendicular to the water for optimum performance. The adjustment for this is as follows.



CABLE AND PEDAL GROUP

- | | | | |
|------------------------|--------------------------|----------------------------|---------------------------|
| 1. Hinge pin | 14. Screw | 27. Bumper | 40. No. 8 ring terminal |
| 2. Wheel | 15. Screw | 28. Glamp | 41. Lockwasher |
| 3. Bearing shaft | 16. Pivot pin | 29. Clamp | 42. Nut |
| 4. Connector | 17. Lead assembly | 30. Screw | 43. Lead assembly |
| 5. Pedal assembly | 18. Washer | 31. Clamp | 44. Lead assembly |
| 6. On/off switch lever | 19. Cotter pin | 32. Base | 45. Lead assembly |
| 7. Roll pin | 20. Cable assembly | 33. Lockwasher | 46. Lead assembly |
| 8. Screw | 21. Spade terminal | 34. Master switch assembly | 47. Lead assembly |
| 9. Lockwasher | 22. No. 10 ring terminal | 35. Screw | 48. Lead assembly |
| 10. Nut | 23. Cable assembly | 36. Cover | 49. Lead assembly |
| 11. On/off switch | 24. Spade terminal | 37. Nut | 50. Insulator |
| 12. Boot | 25. No. 10 ring terminal | 38. Potentiometer assembly | 51. Speed selector switch |
| 13. Terminal block | 26. Bushing | 39. Rotary switch assembly | 52. Hex nut |
| | | | 53. Circuit breaker |

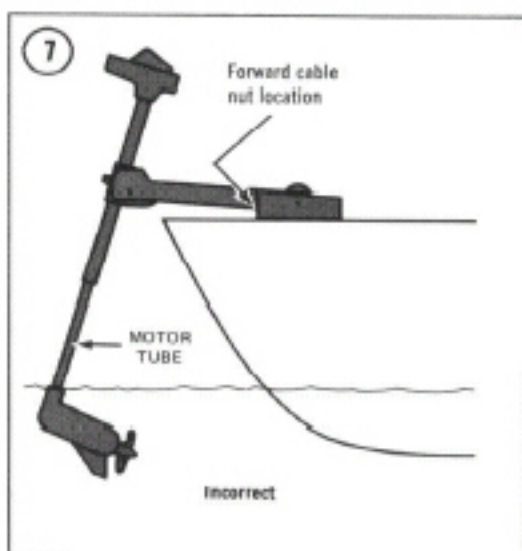
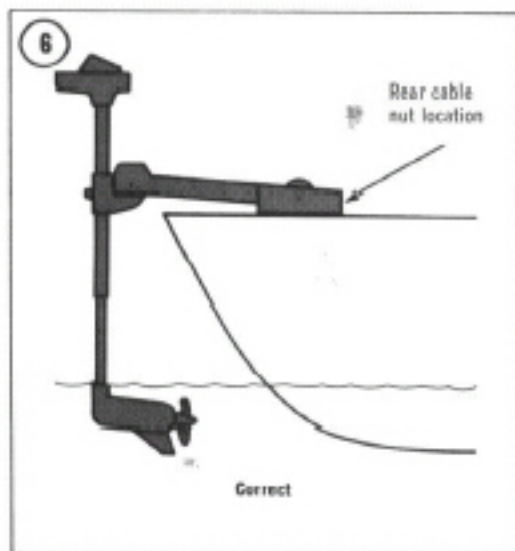
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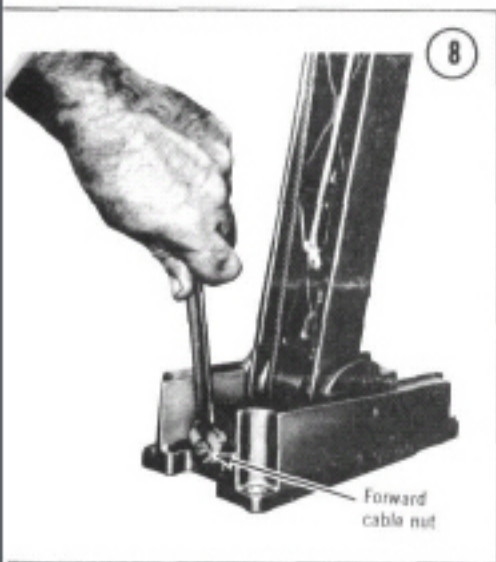


STEERING GEAR

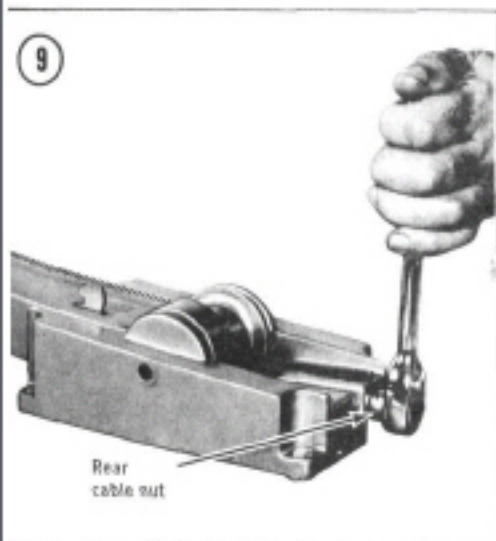
1. Refer to **Figure 6** for optimum position of motor tube with motor running.

2. If the motor is tilted forward, see **Figure 7**, loosen the nut as shown in **Figure 8**.

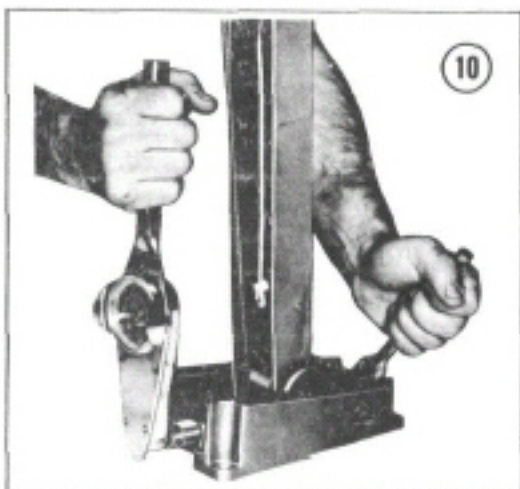




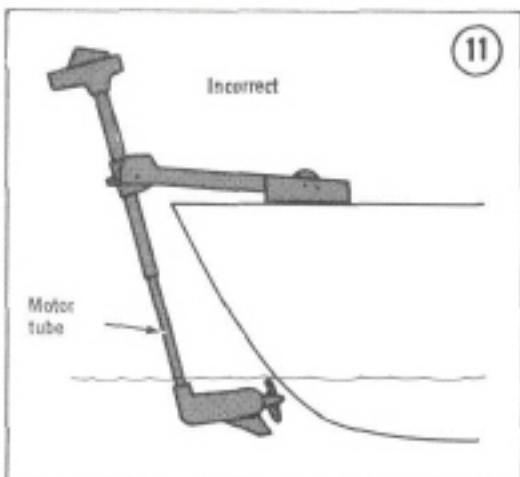
8. Tighten rear cable nut as shown in **Figure 9** until the motor tube position is correct.



4. Position a torque wrench on one nut and a regular wrench on the other as shown in **Figure 10** and tighten until the torque is 5 ft.-lb.



5. If the motor is tilted toward the rear as shown in **Figure 11**, loosen the rear nut and tighten the front nut. Proceed as previously outlined.



SUPPLEMENT

1976-1978 SERVICE INFORMATION

This supplement provides information and specifications for one- and two-cylinder motors manufactured from 1976 through 1978.

Use the data in the supplement, in conjunction with the procedures outlined in the various chapters in the main body of this manual, for these late model motors.

Refer to **Tables 1 through 5** for specifications for all late model motors. **Table 6** offers standard screw torque recommendations for all motors. **Tables 1 through 6** are found at the end of the chapter.

Wiring diagrams for all 1976 through 1978 models covered in this manual can be found at the back of this supplement.

CHAPTER TWO

LUBRICATION,
PERIODIC MAINTENANCE,
AND TUNE-UP

SPARK PLUGS

High-tension Leads

It is recommended that the high-tension lead wires be changed from their old location (Figure 1) to the location shown in Figure 2 on all 1969 through 1976 four horsepower motors. In addition, secure the high-tension leads to the fuel pump mounting boss with a tie strap (Figure 3). This will reduce the possibility of the leads getting caught on the motor cover during cover removal.

Spark Plug Recommendations

Refer to Table 7 for the latest spark plug recommendations for all 1965-1978 Evinrude outboard motors covered in this manual.

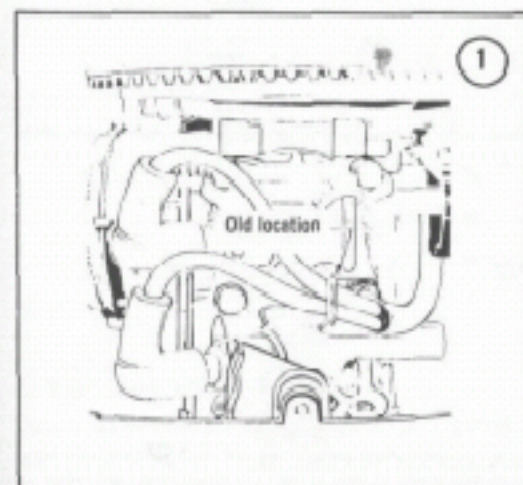
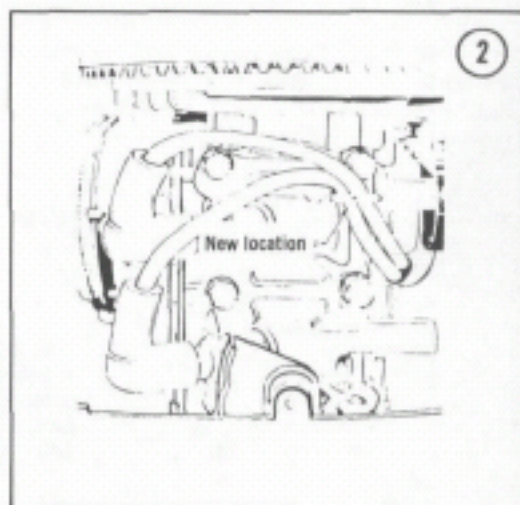


Table 7 SPARK PLUG RECOMMENDATIONS (ALL YEARS)

Hp	Year	Champion	AC	Gap
1.5	1968-1970	J6J	M44C	0.030
2	1971-1978	J6J	M44C	0.030
3	1952-1968	J6J	M44C	0.030
4	1969-1976	J6J	M44C	0.030
4	1977-1978	L77J4	M40FFX	0.040
5	1965-1968	J6J	M44C	0.030
5.5	1956-1964	J6J	M44C	0.030
6	1965-1976	J6J	M44C	0.030
6	1977	L77J4	M40FFX	0.040
6	1978	L78V	—	Surface gap
		L77J4 ³	M40FFX	0.040
7.5	1952-1958	J6J	M44C	0.030
9.5	1964-1973	J4J	M42K	0.030
9.9	1974-1976	UL81J ²	—	0.030
9.9	1977	L77J4	M40FFX	0.040
9.9	1978	L78V	—	Surface gap
		L77J4 ³	M40FFX	0.040
10	1952-1958	J6J	M44C	0.030
10	1959-1963	J4J	M42K	0.030
15	1974-1976	UL81J ²	—	0.030
15	1977	L77J4	M40FFX	0.040
15	1978	L78V	—	Surface gap
		L77J4 ³	M40FFX	0.040
15	1956	J6J	M44C	0.030
18	1957-1965	J4J	M42K	0.030
20	1966-1973	J4J	M42K	0.030
25	1952-1955	J4J	M42K	0.030
25	1969-1973	J4J	M42K	0.030
25	1974-1976	J4J	M42K	0.030
		UJ81J ¹	—	0.030
25	1977	L77J4	M40FFX	0.040
25	1978	L78V	—	Surface gap
		L77J4 ³	M40FFX	0.040
28	1962-1964	J4J	M42K	0.030
30	1956	J6J	M44C	0.030
35	1957-1958	J6J	M44C	0.030
35	1958-1959	J4J	M42K	0.030
35	1959	J4J	M42K	0.030
35	1976	UL81J ²	—	0.030
35	1977	L77J4	M40FFX	0.040
35	1978	L78V	—	Surface gap
		L77J4 ³	M40FFX	0.040

1. UJ81J OMC part number 388150.

2. UL81J OMC part number 387694.

3. For reduced radio interference, the following resistor/suppressor spark plugs may be used:

Regular	Suppressor	OMC Part Number
J4J	RJ4J	3876311
J6J	RJ6J	387627
L4J	RL4J	387631
L7J ₆	RL7J	387629
L76V	QL76V	388046
L77J4	QL77J4	387633
UL77V	QUL77V	387239

CHAPTER FOUR

FUEL SYSTEM

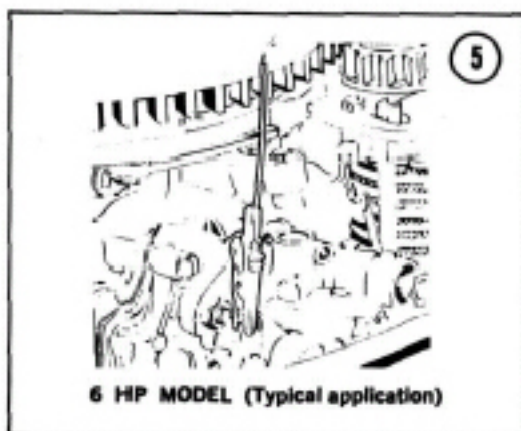
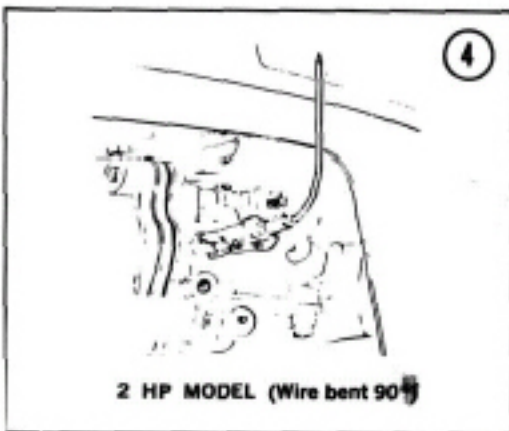
**Throttle Cam Adjustment
(all Models)**

It is important to properly set the throttle pickup on the throttle cam in order to obtain good overall performance and fuel economy. It is quite difficult to tell when the carburetor's throttle shaft begins to move. A simple tool can be made to exaggerate the throttle shaft movement (refer to **Figures 4 and 5**). All that is required is a piece of stiff wire and a common alligator clip (the only modification needed is to grind a bit of material from the large diameter on one side of the clip).

NOTE: When using this tool, attach it to the end of the throttle shaft opposite the cam follower. This will ensure a more accurate reading of the throttle cam movement.

Horsepower Restrictor Kit

If lake or boat restrictions require a motor with a maximum of 20 hp, an Evinrude Restrictor Kit can be installed on 1977 and earlier 25 hp models. This low cost kit is installed behind the carburetor and reduces both power and fuel consumption. The kit is available at your dealer.



CHAPTER FIVE

ELECTRICAL SYSTEM

Electric Connection Problems

Occasional electrical problems can sometimes be attributed to poor connections in the waterproof connectors. The pins and sockets

may be improperly seated in their connector halves, resulting in poor connections.

Figure 6 shows the proper dimensions of the pins and sockets seated in their connectors. If

the dimensions in your pins and sockets are incorrect, insert OMC tool No. 322697 to correct the dimensions. (Use alcohol to lubricate the connector before installing pins or sockets. Alcohol does not leave a residue which could contaminate any part of the connector.)

Voltage Regulator Kit (Outboards Equipped With 5, 6, 9, or 10 Amp Alternators)

Batteries are occasionally overcharged due to being used in conjunction with unregulated 5, 6, 9, or 10 amp alternators. This condition can be caused from using a battery which is defective or lower than the recommended capacity, or from running the boat for a long period of time without using any electrical accessories.

Check to be sure that the battery is not defective, and that it is of the proper capacity. Once this is determined, you can install a Voltage Regulator Kit to minimize the chance of overcharging.

Spark Plug Anti-fouling Kit (1974-1976 40 Hp Models)

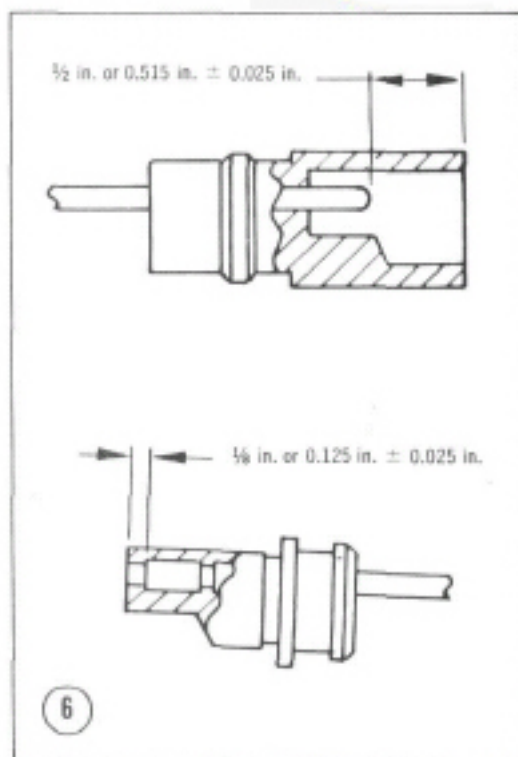
An accessory thermostat kit is available to owners of 1974-1976 40 hp motors, to eliminate excessive spark plug fouling. This kit maintains a higher operating temperature at trolling speed in cold water, through the use of a thermostat.

The thermostat kit also contains a new armature plate, support, and Delrin bearing to ensure proper breaker point function.

NOTE: On 1974-1975 electric start models, it is recommended that the original ignition driver coil (with white bobbin) be replaced with the newer driver coil (with blue bobbin) for maximum breaker point life. The driver coil is not included in the thermostat kit.

Armature Plate Improvement Kit (1973-1976 20 and 25 Hp Motors)

A new armature plate improvement kit is available to owners of 1973-1976 20 and 25 hp motors which reduces spark plug fouling when



the motor is used for trolling in cold water. The kit is shown in **Figure 7**.

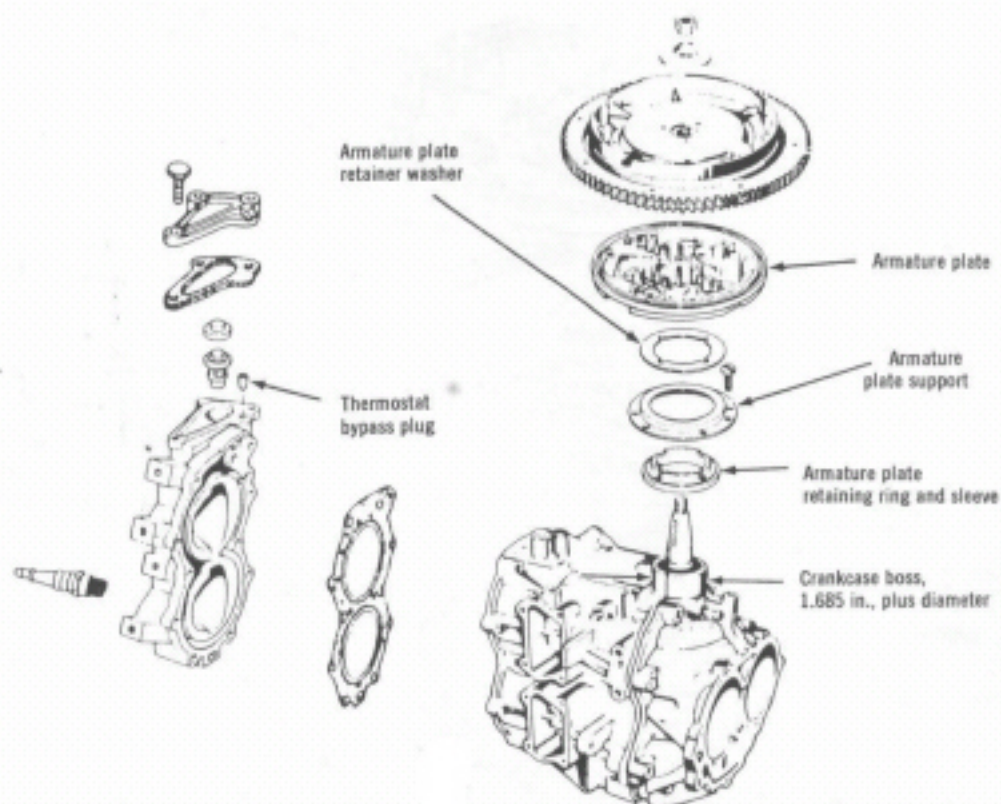
The thermostat plug raises the operating temperature for smoother running. The armature plate and armature plate retaining ring and associated parts provide smoother operation and reduced spark plug fouling through better support of the armature plate, which in turn provides more consistent breaker point operation.

NOTE: Do not use this kit on motors where the crankcase boss is worn to less than 1.6825 in. (42.8mm). Also, on 1973 motors, replace the ignition coils with Evinrude high output coils (not in kit).

Armature Plate Bearing Assembly and Lubrication (1974-1978 9/15 Hp Models; 1976-1978 35 Hp Models; and 1974-1976 40 Hp Models)

Improper lubrication of the armature plate bearing (Delrin ring) and the armature plate

7



**ARMATURE PLATE IMPROVEMENT KIT
(1973-1976 20 AND 25 HP MOTORS)**

pilot can lead to armature plate wobble, unstable timing, and damage to the armature plate and cylinder and crankcase assembly.

Apply Evinrude outboard motor lubricant (50:1 oil) to the bearing groove (inside diameter) only. Refer to Figure 6.

CAUTION

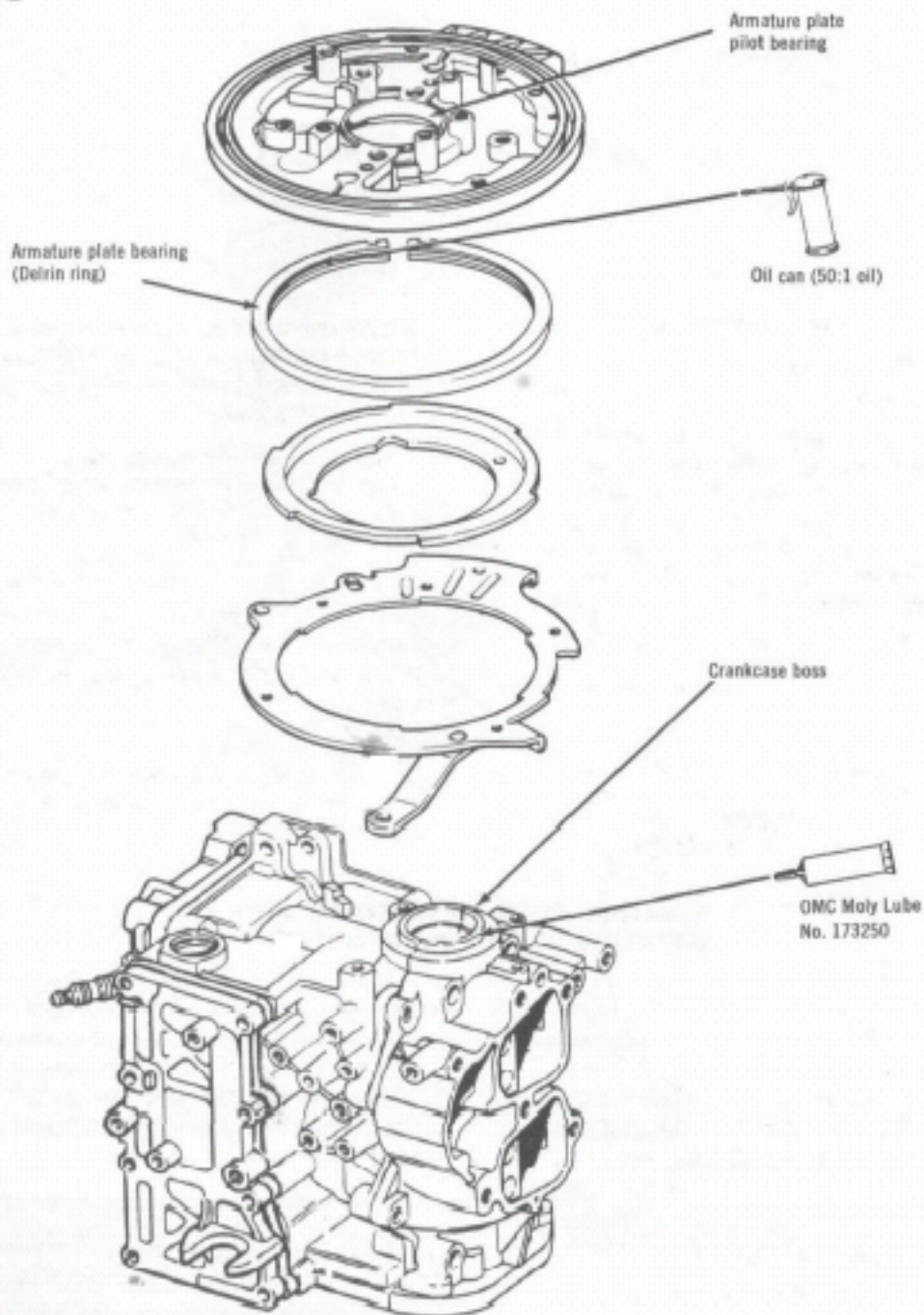
Do not lubricate the top, bottom, or outside of the bearing (Figure 8). The armature plate bearing is clamped be-

tween the armature plate and the retainer and link assembly, and should turn with them.

Earlier model (white or black) armature plate bearing parts should be replaced with late model parts (dark brown).

The proper armature plate pilot bearing (cast-in brass bearing) lubricant is OMC Moly Lube No. 173250, lightly spread on the crankcase boss mating surfaces.

8



CHAPTER SIX

ENGINE REPAIR AND OVERHAUL

POWER HEAD

**Motor Overheating
(35 Hp Models)**

If your 35 hp motor has overheated due to insufficient cooling water reaching the power head, it is a good idea to remove and inspect the inner exhaust cover for warpage. A warped exhaust cover plate can cause exhaust gases to enter the cooling system and create enough pressure to keep cooling water from reaching the power head.

1. Inspect the water tube guide and grommet (located on the front side of the inner exhaust tube). Also, be sure to inspect the plastic spacer above the water pump.

NOTE: Check the cylinder head for flatness. These parts are subject to distortion when there is a lack of cooling water.

2. Check the thermostat and replace the cylinder head gasket. Torque the cylinder head and cover to the specifications given in **Table 5**, this supplement.

CAUTION

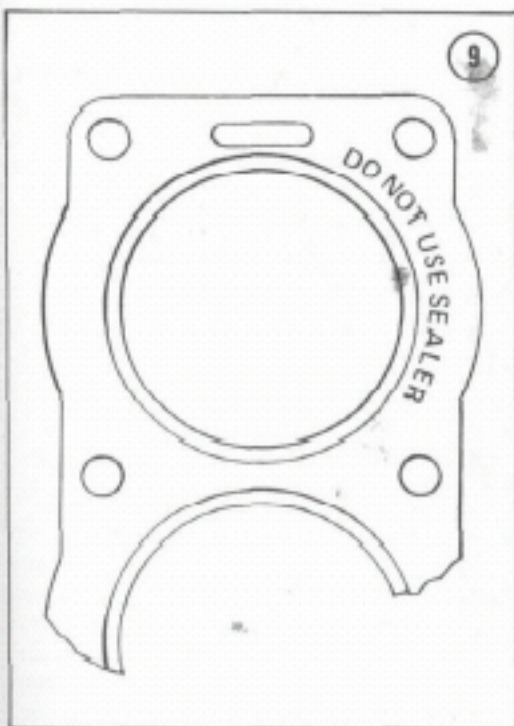
Never run the motor out of the water without cooling water from a fresh water flushing kit.

**Cylinder Head Gasket Coating
(9.9-35 Hp Models)**

Previous service information has recommended that both sides of the head gasket be coated with OMC Gasket Sealing Compound before installation. This is not necessary on late model replacement gaskets (these gaskets are stamped with "Do Not Use Sealer," as shown in **Figure 9**).

POWER HEAD ASSEMBLY**Cylinder-to-Piston Skirt Clearance
(All 1977-1978 Models)**

Refer to **Table 8** for the latest 1977-1978 cylinder-to-piston skirt clearance recommendations for all models.



Piston Rings (9.9 and 15 Hp Models)

When installing new piston rings in 9.9 and 15 hp motors, be certain that they fit into the ring groove so that they are flush to or below the surface of the piston (Figure 10). The factory reports that some piston rings were incorrectly machined so that they cannot properly fit into the grooves of the piston, in which case they protrude above the surface of the piston. While the piston can still be installed in the cylinder with the incorrectly machined piston rings in place, the pistons and cylinders could be damaged within a short period of time.

Refer to Figure 10, and to the following procedure to check the piston rings for correct machining.

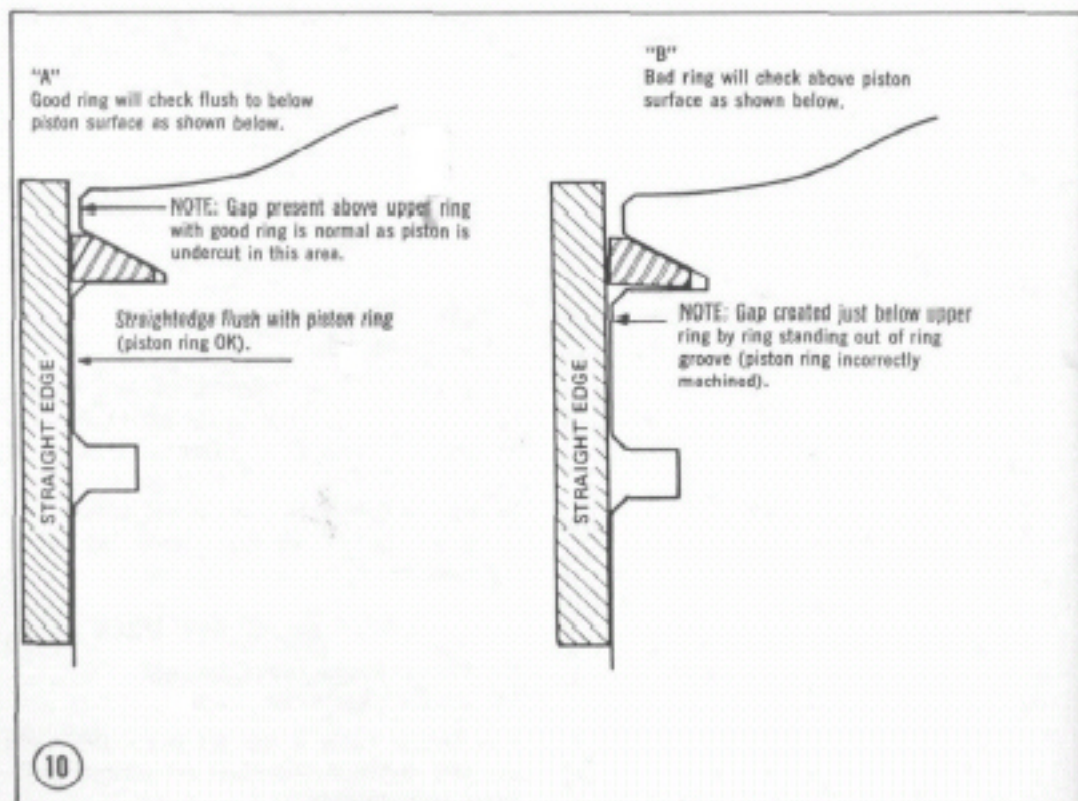
1. Insert the piston ring into the ring groove.
2. Lay a straightedge along the side of the piston (check several places around the circumference of the piston). A correctly machined piston ring will fit as shown in A, Figure 10;

an incorrectly machined ring will fit as shown in B, Figure 10.

Return any incorrectly machined piston rings to your dealer for replacement.

Table 8 CYLINDER-TO-PISTON SKIRT
CLEARANCE (1977-1978 MODELS)

Engine Model	Cylinder to Piston Skirt Clearance
2 hp	0.0055 in. max.-0.0043 in. min. (0.140-0.109 mm)
4 hp	0.0030 in. max.-0.0018 in. min. (0.076-0.046 mm)
6 hp	0.0030 in. max.-0.0018 in. min. (0.076-0.046 mm)
9.9 & 15 hp	0.0038 in. max.-0.0025 in. min. (0.097-0.064 mm)
25 & 35 hp	0.0065 in. max.-0.0035 in. min. (0.165-0.089 mm)



CHAPTER SEVEN

LOWER UNIT

**Water Pump Impeller Housing Failure
(All Models With Plastic Water Pump
Propeller Housings)**

Power head damage can result from plastic water pump impeller housings failing due to the gearcase not being placed in deep enough water before starting, or starting the motor out of the water (such as before launching and before turning on water when using flushing kits).

To prevent damage, the water level at the gearcase must be at least to the spray deflector plate located above the anti-ventilation plate. Refer to Chapter Seven, *Water Pump*, in the main part of this book.

**Water Pump Problems
(1978 35 Hp Models)**

Some 1978 35 hp motors have overheated after extended idling due to insufficient water pump output pressure at idle speed. The models affected are those built before the following serial numbers:

Model	Serial Number
35802	2463
35803	1926
35852	2453
35853	3501
35R78	4881847
35RL78	4886832
35E78	4890087
35EL78	4895278

The low output pressure has been traced to the impeller (No. 388702) being undersized on blade height; the impeller housing being warped; and gasket No. 323311 (impeller housing-to-plate) being assembled off center in relationship to the impeller cup (No. 323008), causing the gasket to be trapped between the cup and plate No. 323251, causing leakage. The

gasket should only be trapped between the impeller housing and the plate.

To correct, perform the following steps:

1. Replace the plastic impeller housing with new housing No. 390159.
2. Measure the impeller blade height at the tip where there is a flat surface, halfway down the blade; also measure at the hub. Replace the impeller if the blade height is less than 0.746 in. or more than 0.754 in.
3. Replace the gaskets (one on each side of the impeller plate). Be sure that the upper gasket (No. 323311) is not off center and trapped between cup No. 323008 and plate No. 323251.
4. Install washer No. 318452 under the heads of the water pump hold-down screws.

**Gearcase Replacement
(1976 35 Hp Models)**

Early 1976 35 hp motors ("S" model suffix) had an impeller housing which was attached with three screws. Current series 1976 and later 35 hp motors ("G" model suffix) use four attaching screws.

If it is necessary to replace the gearcase on an early series motor, install Impeller Housing Kit No. 388456 on the new gearcase. Refer to Chapter Seven, *Gearcase and Exhaust Housing*, in the main body of this book.

**Lower Mount System
(1976 and Later 35 Hp Models; and 1977
and Later 25 Hp Models)**

The lower mount assembly on 25 and 35 hp motors was changed in mid-1977 to limit the vertical travel of the rubber mounts. Earlier 25 and 35 hp motors can be modified by installing part No. 323107 (bumper); No. 323108 (port side lower mount housing); and No. 323109 (starboard side lower mount housing).

Table 1 SPECIFICATIONS — 2 HP, 1-CYLINDER (1976-1978)

GENERAL

Horsepower	2 hp @ 4,500 rpm
Rating at sea level. Allow 2% reduction per 1,000 ft. above sea level.	
Full throttle operating range	4,200-4,800 rpm
Engine type	1-cylinder, 2-cycle
Bore and stroke	1 $\frac{1}{8}$ in. x 1 $\frac{3}{8}$ in.
Piston displacement	2.64 cu.-in.
Crankshaft size	
Top journal	0.7502-0.7497 in.
Bottom journal	0.7502-0.7497 in.
Connecting rod crankpin	0.6690-0.6685 in.
Cooling system	Vari-volume pump
Propeller gear ratio	12:25
Speed control	Single lever, synchronized throttle, and spark
Propeller (standard)	7 $\frac{1}{4}$ x 4 $\frac{1}{2}$ in.
Starter	Manual self-winding
Ignition	Flywheel magneto
Spark plug	AC-M44C, Champion J6J (14mm)
Spark plug gap	0.030 in.
Breaker point gap	0.020 in.
Condenser capacity	0.18-0.22 mfd
Carburetion	Single barrel, float feed, with high and low speed adjustments
Float level setting	Flush with casing
Inlet needle seat	0.050-0.053 in. (use a No. 55 drill as gauge)

CLEARANCE

Power head	
Piston ring gap	0.025 in. maximum, 0.015 in. minimum
Piston ring groove	0.0040 in. maximum, 0.0020 in. minimum
Cylinder and piston	0.0055 in. maximum, 0.0043 in. minimum
Crankshaft	
Upper	Needle bearing
Lower	Needle bearing

(continued)

Table 1 SPECIFICATIONS — 2 HP, 1-CYLINDER (1976-1978) (continued)

CLEARANCE (continued)

Connecting rod	
Piston end	0.0011 in. maximum, 0.0004 in. minimum
Crankshaft end	Needle bearing
Lower unit	
Drive shaft and bushing in gearcase	0.0028 in. maximum, 0.0010 in. minimum
Gearcase head and propeller shaft	0.0022 in. maximum, 0.0007 in. minimum
Propeller on shaft	0.0057 in. maximum, 0.0032 in. minimum
Gearcase bushing to propeller shaft	0.0022 in. maximum, 0.0007 in. minimum

TORQUE

Power head	
Flywheel nut	22-25 ft.-lb.
Connecting rod screws	60-66 in.-lb.
Cylinder head screws	60-80 in.-lb.
Manifold to crankcase screws	60-80 in.-lb.
Bearing housing to cylinder screws	60-80 in.-lb.
Spark plug	17½-20½ ft.-lb.
Lower unit	
Pull at propeller shaft to tilt up lower unit	11-14 lb.

Table 2 SPECIFICATIONS — 4 HP, 2-CYLINDER (1976-1978)

GENERAL

Horsepower	4 hp @ 4,500 rpm
Rating at sea level. Allow 2% reduction per 1,000 ft. above sea level.	
Full throttle operating range	4,000-5,000 rpm
Engine type	2-cylinder, 2-cycle, alternate firing
Bore and stroke	1 $\frac{3}{4}$ in. x 1 $\frac{3}{8}$ in.
Piston displacement	5.28 cu.-in.
Crankshaft size	
Top journal	0.7520-0.7515 in.
Center journal	0.6854-0.6849 in.
Bottom journal	0.6854-0.6849 in.
Connecting rod crankpin	0.6255-0.6250 in.
Cooling system	Combination positive displacement and centrifugal pump
Propeller gear ratio	17:28, weedless; 12:25, standard
Speed control	Single lever, synchronized throttle and spark
Propeller	7 $\frac{1}{2}$ in. x 6 in. pitch, 3-blade plastic (standard); 6 $\frac{1}{4}$ in. x 6 in. pitch, 2-blade plastic (weedless)
Propeller drive pin	$\frac{1}{8}$ in. x 1.234 in., stainless steel
Starter	Automatic rewind (nylon rope)
Ignition	Flywheel magneto, breakerless CD ¹
Spark plug	AC-M40FFX; Champion L77J4 (14mm)
Spark plug gap	0.040 in.
Ignition coil	No. 1 cylinder, Part No. 581686; No. 2 cylinder, Part No. 581685
Carburetion	Single barrel, float feed, with high- and low-speed adjustments and manual choke
Float level setting	Flush with casting
inlet needle seat	0.053-0.050 in. (use a No. 55 drill as gauge)

CLEARANCE

Power head

Piston ring gap	0.015 in. maximum, 0.005 in. minimum
Piston ring groove	0.0040 in. maximum, 0.0020 in. minimum
Cylinder and piston	0.0020 in. maximum, 0.0008 in. minimum

(continued)

Table 2 SPECIFICATIONS — 4 HP, 2-CYLINDER (1976-1978) (continued)

CLEARANCE (continued)

Crankshaft	
Upper	Needle bearings
Middle	0.0023 in. maximum, 0.0013 in. minimum
Lower	0.0023 in. maximum, 0.0013 in. minimum
Connecting rod	
Piston end	0.0011 in. maximum, 0.0004 in. minimum
Crankshaft end	0.0017 in. maximum, 0.0007 in. minimum
Lower unit	
Pinion and bushing in gearcase (standard engine)	0.0018 in. maximum, 0.0005 in. minimum
Drive shaft and bushing in gearcase (weedless)	0.003 in. maximum, 0.001 in. minimum
Gearcase head and bushing assembly	
Standard	0.0022 in. maximum, 0.0007 in. minimum
Weedless	0.0015 in. maximum, 0.0005 in. minimum
Propeller on shaft	
Standard	0.0057 in. maximum, 0.0022 in. minimum
Weedless	0.0053 in. maximum, 0.0020 in. minimum
Gearcase bushing to propeller shaft	
Standard	0.0022 in. maximum, 0.0007 in. minimum
Weedless	Not applicable

TORQUE**Power head**

Flywheel nut	30-40 ft.-lb.
Connecting rod screws	60-66 in.-lb.
Cylinder head screws	60-80 in.-lb.
Crankcase to cylinder screws (upper, center, and lower)	60-80 in.-lb.
Spark plugs	17½-20½ ft.-lb.
Pull at propeller shaft to tilt up lower unit	12-15 lb.
Power packing mounting screws	3-4 ft.-lb.

1. MagFlash magneto CD on 1978 models.

Table 3 SPECIFICATIONS — 6 HP, 2-CYLINDER (1976-1978)

GENERAL

Horsepower	6 hp @ 4,500 rpm
Rating at sea level. Allow 2% reduction per 1,000 ft. above sea level.	
Full throttle operating range	4,000-5,000 rpm
Engine type	2-cylinder, 2-cycle, alternate firing
Bore and stroke	1 $\frac{1}{8}$ in. x 1 $\frac{1}{2}$ in.
Piston displacement	8.84 cu.-in.
Crankshaft size (top, center, and bottom journals)	0.8080-0.8075 in.
Connecting rod crankpin	0.6690-0.6685 in.
Cooling system	Combination positive displacement and centrifugal pump (thermostatically controlled)
Propeller gear ratio	12:25
Propeller drive pin	$\frac{3}{16}$ in. x 1 $\frac{3}{16}$ in., stainless steel
Propeller (standard)	8 in. dia. x 7 in. pitch, 3-blade
Speed control	Twist-grip, synchronized throttle and spark
Gearshift control	Forward, neutral, and reverse
Starter	Manual, self-winding
Ignition	Flywheel magneto, breakerless CD ¹
Spark plug	AC-M40FFX; Champion L77J4 (14mm)
Spark plug gap	0.040 in.
Ignition coil	Part No. 581686
Charge coil resistance	575 \pm 75 ohms
Carburetion	Single barrel, float feed, low-speed adjustment; fixed high-speed jet
Float level setting	Flush with rim of casting
Carburetion orifice plug	Hole size 0.052 in., Part No. 322249
Inlet needle seat	0.053-0.050 in. (use a No. 55 drill as gauge)

CLEARANCE

Power head	
Piston ring gap	0.015 in. maximum, 0.005 in. minimum
Piston ring groove clearance	0.0035 in. maximum, 0.0010 in. minimum
Cylinder and piston	0.003 in. maximum, 0.001 in. minimum

Table 3 SPECIFICATIONS — 6 HP, 2-CYLINDER (1976-1978) (continued)

CLEARANCE (continued)

Crankshaft bushings (all)	0.0025 in. maximum, 0.0015 in. minimum
Connecting rod bearings	
Piston end	0.0010 in. maximum, 0.0003 in. minimum
Crankshaft end	Needle bearing
Piston and wrist pin loose end	0.0007 in. maximum
Lower unit	
Gearcase head and propeller shaft	0.0020 in. maximum, 0.0010 in. minimum
Bearing housing bushing to drive shaft	0.0025 in. maximum, 0.0010 in. minimum
Propeller shaft in front gear bushing	0.0015 in. maximum, 0.0005 in. minimum
Propeller shaft to reverse gear bushing	0.0015 in. maximum, 0.0005 in. minimum
Front gear to gearcase bearing	0.0022 in. maximum, 0.0010 in. minimum
Rear reverse gear bushing	0.0025 in. maximum, 0.0005 in. minimum
Propeller hub on shaft	0.009 in. maximum, 0.007 in. minimum

TORQUE

Power head

Connecting rod screws	60-66 in.-lb.
Flywheel nut	40-45 ft.-lb.
Cylinder head screws	60-80 in.-lb.
Crankcase to cylinder screws (all)	60-80 in.-lb.
Spark plugs	17½-20½ ft.-lb.
Power pack mounting bolts	4-5 ft. lb.

Lower unit

Side mount nuts (upper and lower)	150-170 in.-lb. (12-14 ft.-lb.)
Lower mount housing to pilot shaft screws	72-96 in.-lb.
Pilot shaft to steering bracket screws	60-80 in.-lb.
Pull at propeller shaft for tilt-up lower units (standard length)	25-30 lb.
Pull at propeller shaft to overcome reverse lock (standard length)	120-140 lb.
Slip clutch propeller	60 ft.-lb.

1. MagFlash magneto CD on 1978 models.

Table 4 SPECIFICATIONS — 9.9 AND 15 HP, 2-CYLINDER (1976-1978)

GENERAL

Horsepower

Models 10R76, 10R77, 10R78, 10RL76, 10RL77, 10RL78, 10E76, 10E77, 10E78, 10EL76, 10EL77, 10EL78, 10SEL78¹ 9.9 hp @ 5,000 rpm

Models 15R76, 15R77, 15R78, 15RL76, 15RL77, 15RL78, 15E76, 15E77, 15E78, 15EL76, 15EL77, 15EL78 15 hp @ 6,000 rpm

Rating at sea level. Allow 2% reduction per 1,000 ft. above sea level.

Full throttle operating range

9.9 hp 4,500-5,500 rpm

15 hp 5,500-6,500 rpm

Engine type 2-cylinder, 2-cycle, alternate firing

Bore and stroke 2.188 in. x 1.760 in.

Piston displacement 13.20 cu.-in.

Crankshaft size

Top journal 0.8762-0.8757 in.

Center journal 0.8125-0.8120 in.

Bottom journal 0.8125-0.8120 in.

Connecting rod crankpin 1.0635-1.0630 in.

Cooling system Thermostatically controlled combination positive displacement and centrifugal pump

Propeller gear ratio 12:29

Propeller (standard) 9½ dia. x 10 in. pitch, 3-blade

Propeller (optional) 9¼ in. dia. x 8 in. pitch (3-blade); 10 in. dia. x 5 in. pitch (3-blade); 9 in. dia. x 10 in. pitch (2-blade)

Speed control On steering handle (remote control available)

Gearshift control Forward, neutral, reverse

Electrical system (electric start models only) 5 amp flywheel alternator

Starter

Manual Self-winding

Electric 12 volt (and rope)

Starter amp draw when cranking 55 amp maximum

Ignition Breakerless CD magneto

Spark plug Champion L77J4; AC-M40FFX (14mm)

Spark plug gap 0.040 in.

(continued)

Table 4 SPECIFICATIONS — 9.9 AND 15 HP, 2-CYLINDER (1976-1978) (continued)

GENERAL (continued)

Charge coil resistance	
Rope	575 ± 75 ohms
Electric	475 ± 75 ohms
Ignition coil	Part No. 581685
Carburetion	Single barrel, float feed, fixed high-speed; adjustable low-speed; manual choke
High speed orifice	9.9 hp, Part No. 322752, Identification No. 38; 15 hp, Part No. 322293, Identification No. 54
Float level setting	Flush with rim of casting
Inlet needle seat	0.065-0.062 in. (use No. 52 drill as gauge)

CLEARANCE

Power head

Piston ring gap	0.015 in. maximum, 0.005 in. minimum
Piston ring groove clearance (lower)	0.0035 in. maximum, 0.0025 in. minimum
Piston pin to piston (loose end)	0.0005 in. maximum
Cylinder and piston	0.0053 in. maximum, 0.0025 in. minimum
Crankshaft end play	Controlled by lower journal bearing

Lower unit

Propeller shaft in front gear bushing	0.0087 in. maximum, 0.0002 in. minimum
---------------------------------------	--

TORQUE

Power head

Flywheel nut	45-50 ft.-lb.
Connecting rod screw	48-60 in.-lb.
Cylinder head screws	145-170 in.-lb.
Crankcase to cylinder screws (all)	145-170 in.-lb.
Electric start through bolts	30-40 in.-lb.
Electric start pinion nut	150-170 in.-lb.
Spark plug	17½-20½ ft.-lb.
Power pack mounting bolts	4-8 ft.-lb.
Manual starter assembly screw	24-26 ft.-lb.

Lower unit

Upper mounts	60-80 in.-lb.
Pilot shaft to steering bracket screws	95-130 in.-lb. (8-10 ft.-lb.)
Slip clutch propeller	85 ft.-lb. minimum
Pull at propeller shaft for tilt-up (standard length)	30-40 lb.
Pull at propeller shaft to overcome reverse lock (standard length)	100-200 lb.

Table 5 SPECIFICATIONS — 25 AND 35 HP, 2-CYLINDER (1976-1978)

GENERAL

Horsepower	
Models 25R76, 25R77, 25R78, 25RL76, 25RL77, 25RL78, 25E76, 25E77, 25E78, 25EL76, 25EL77, 25EL78	25 hp @ 5,000 rpm
Models 35R76, 35R77, 35R78, 35E76, 35E77, 35E78, 35RL76, 35RL77, 35RL78, 35EL76, 35EL77, 35EL78	35 hp @ 5,500 rpm
Rating at sea level. Allow 2% reduction per 1,000 ft. above sea level.	
Full throttle operating range	
25 hp	4,500-5,500 rpm
35 hp	5,000-6,000 rpm
Engine type	2-cylinder, 2-cycle, alternate firing
Bore and stroke	3.000 in. x 2.250 in.
Piston and displacement	31.8 cu.-in.
Crankshaft size	
Top journal	1.2495-1.2500 in.
Center journal	0.9995-1.0000 in.
Bottom journal	0.9842-0.9846 in.
Connecting rod crankpin	1.1823-1.1828 in.
Cooling system	Combination positive displacement and centrifugal pump
Propeller gear ratio	12:21 (25 hp); 14:27 (35 hp)
Propeller (standard)	9¼ in. dia. x 11 in. pitch, 3-blade (25 hp); 10½ in. dia. x 11 in. pitch, 3-blade (35 hp)
Propeller (optional)	
25 hp	9½ in. dia. x 7 in. pitch (3-blade); 9 in. dia. x 9 in. pitch (3-blade); 9¼ in. dia. x 7 in. pitch, weedless (3-blade)
35 hp	11¼ in. dia. x 7 in. pitch, aluminum (3-blade); 11 in. dia. x 9 in. pitch, aluminum (3-blade); 10 in. dia. x 13 in. pitch, aluminum (3-blade); 10½ in. dia. x 11 in. pitch, SST (3-blade); 11 in. dia. x 9 in. pitch, SST (3-blade)
Speed control	On steering handle (manual start); remote control available on electric start
Gearshift control	Forward, neutral, reverse
Electrical system	5 amp flywheel alternator
Starter	
Manual	Self-winding
Electric	12-volt

(continued)

1976-1978 SERVICE INFORMATION

Table 5 SPECIFICATIONS — 25 AND 35 HP, 2-CYLINDER (1976-1978) (continued)

GENERAL (continued)

Starter amperage draw while cranking	100 amp maximum
Ignition	Magneto breakerless CD
Spark plug	Champion L77J4; AC-M40FFX
Spark plug gap	0.040 in.
Carburetion	Single barrel, float feed, fixed high-speed; adjustable low-speed (under motor cover), manual choke
High speed orifice plug	25 hp, Part No. 320921, Identification No. 55-D; 35 hp, Part No. 319831, Identification No. 59-D
Float level setting	Flush with rim of casting
Inlet needle seat	0.065-0.062 in. (use No. 53 drill as gauge)
Initial low-speed needle setting	1 1/4 turns open
Idle speed	650 rpm maximum
Maximum neutral rpm	4,500-6,000 rpm

CLEARANCE

Power head

Piston ring gap	0.017 in. maximum, 0.007 in. minimum
Piston ring groove clearance (lower)	0.0040 in. maximum, 0.0015 in. minimum
Cylinder and piston	0.0050 in. maximum, 0.0030 in. minimum
Crankshaft end play	0.011 in. maximum, 0.003 in. minimum

Lower unit

Propeller shaft in front gear bushing	0.0020 in. maximum, 0.0010 in. minimum
Rear reverse gear to rear bushing	0.0020 in. maximum, 0.0005 in. minimum
Reverse gear bushing to propeller shaft	0.0015 in. maximum, 0.0005 in. minimum

TORQUE

Power head

Flywheel nut	100-105 ft.-lb.
Connecting rod screw	348-372 in.-lb. (29-31 ft.-lb.)
Cylinder head screws	216-240 in.-lb. (18-20 ft.-lb.)
Crankcase to cylinder head screws (all)	145-170 in.-lb. (12-14 ft.-lb.)
Electric start through bolts	60-84 in.-lb.
Electric start pinion nut	240-300 in.-lb.
Spark plug	17 1/2 - 20 1/2 ft.-lb.
Manual starter assembly screw	8-10 ft.-lb.

Lower unit

Upper mounts	60-80 in.-lb. (5-7 ft.-lb.)
Pilot shaft to steering	120-144 in.-lb. (10-12 ft.-lb.)
Pull at propeller shaft for tilt-up (standard)	30-40 lb.
Pull at propeller shaft to overcome reverse lock (standard)	150-250 lb.

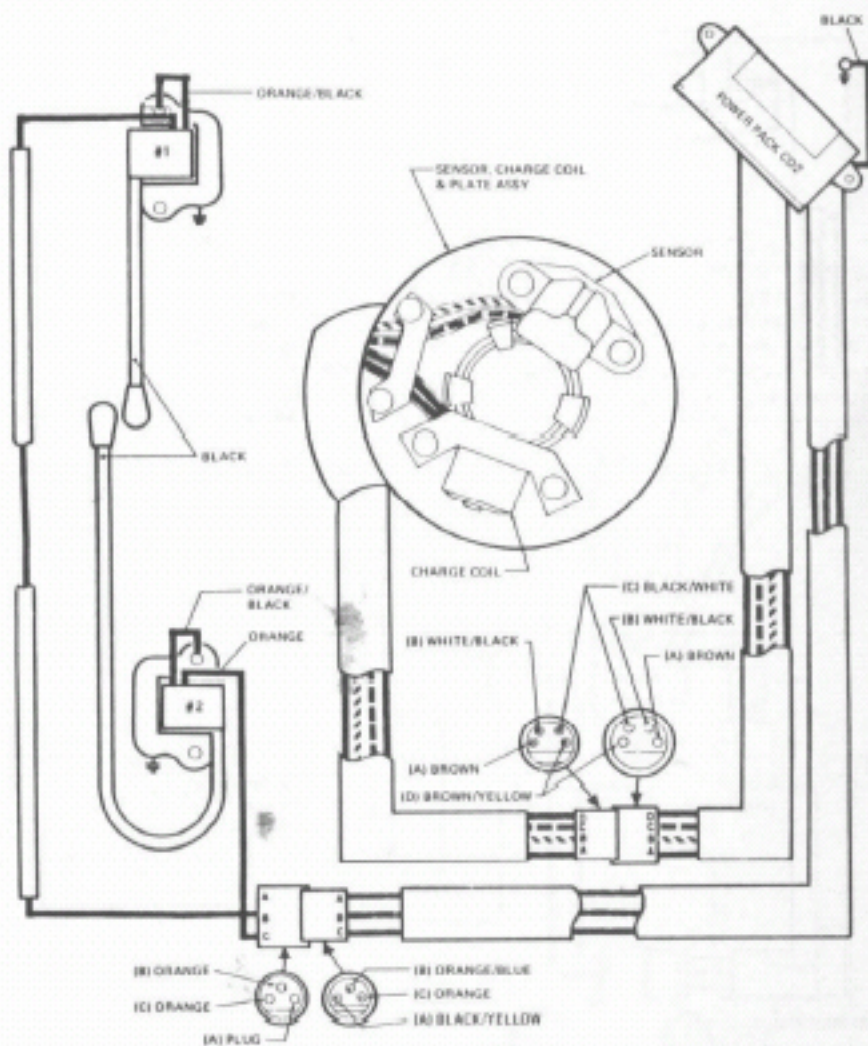
Table 6 STANDARD SCREW TORQUE — ALL MODELS

Torque should be used on the standard size screws listed, unless otherwise specified:		
Standard Screw Size	In.-lb.	Ft.-lb.
No. 6	7-10	—
No. 8	15-22	—
No. 10	25-35	2-3
No. 12	35-40	3-4
¼ in.	60-80	5-7
⅜ in.	120-140	10-12
½ in.	220-240	18-20

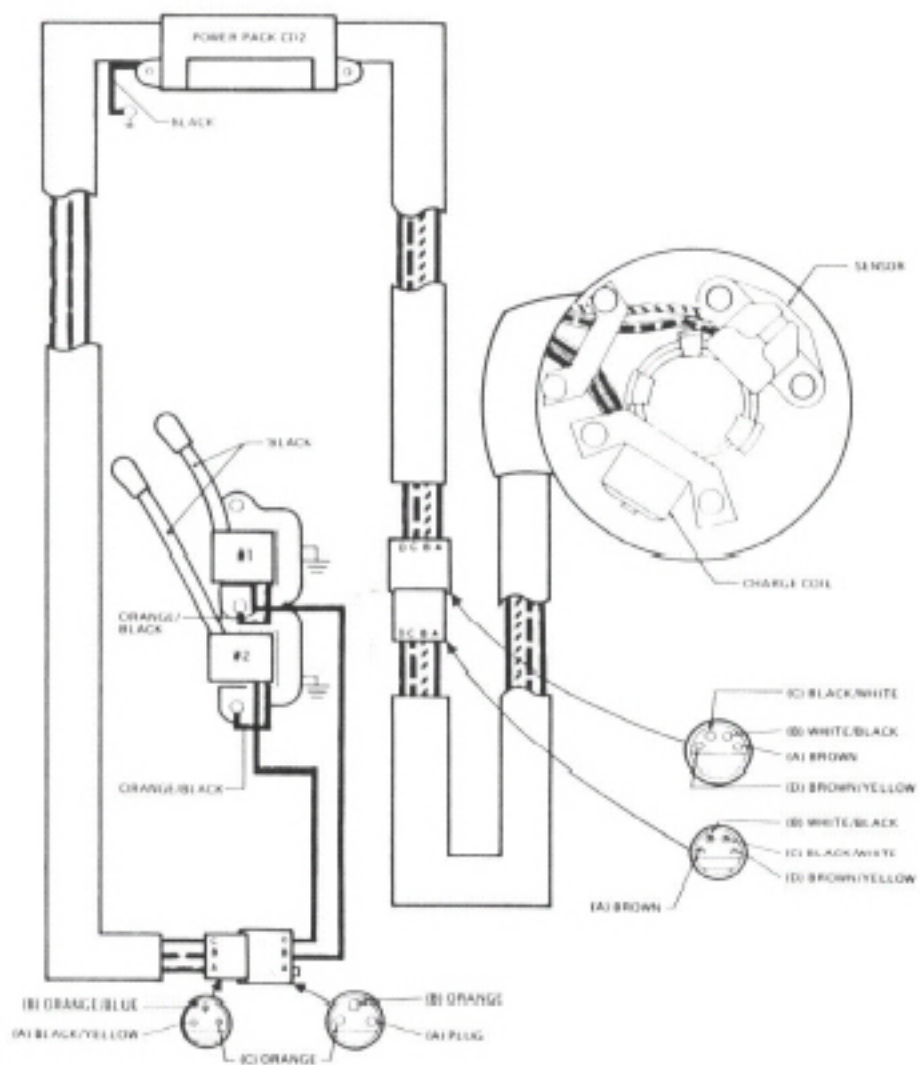
NOTE: When tightening 2 or more screws on the same part, do not tighten any screw completely at one time. First, tighten all screws to ½ of the specified torque, then to ⅔ of the specified torque. Finally, torque each screw to specified torque.

Run the engine for a short time to reach operating temperature, and let it cool until comfortable to the touch. The cylinder head screws and spark plugs should then be re-torqued.

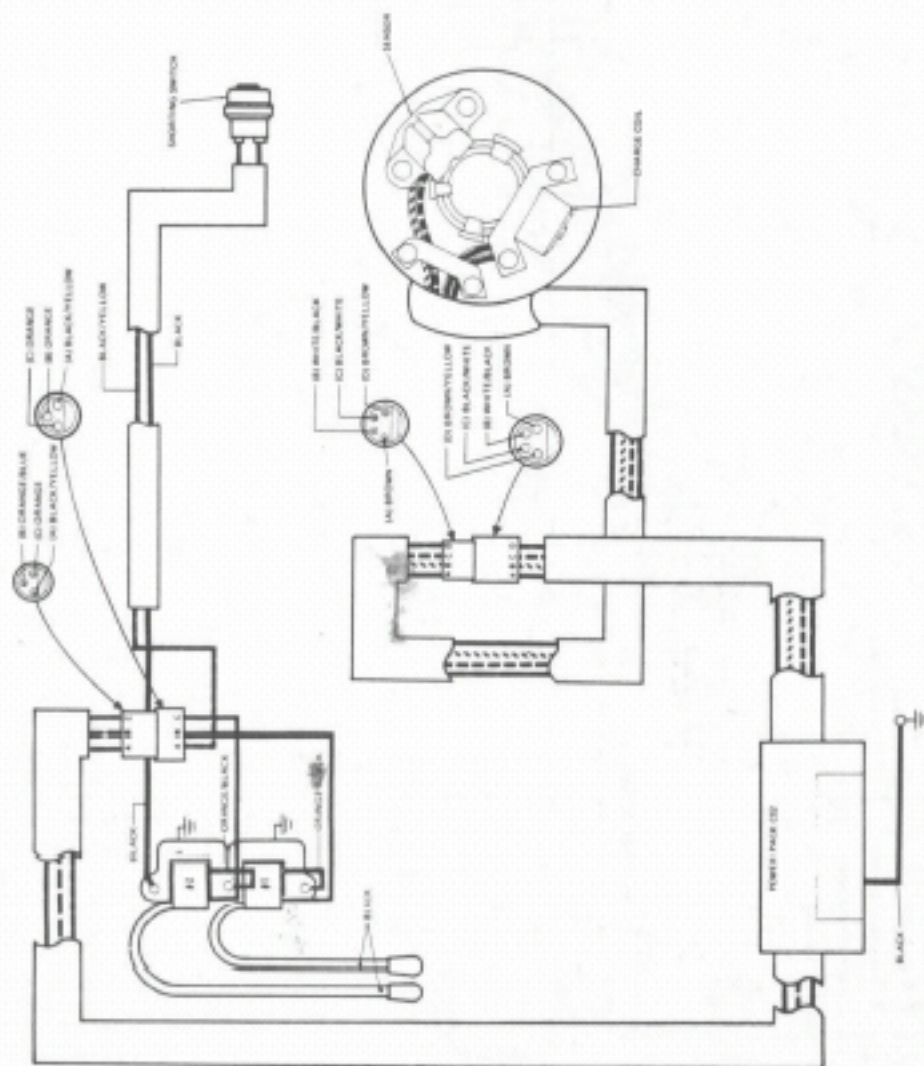
WIRING DIAGRAM — 4 HP



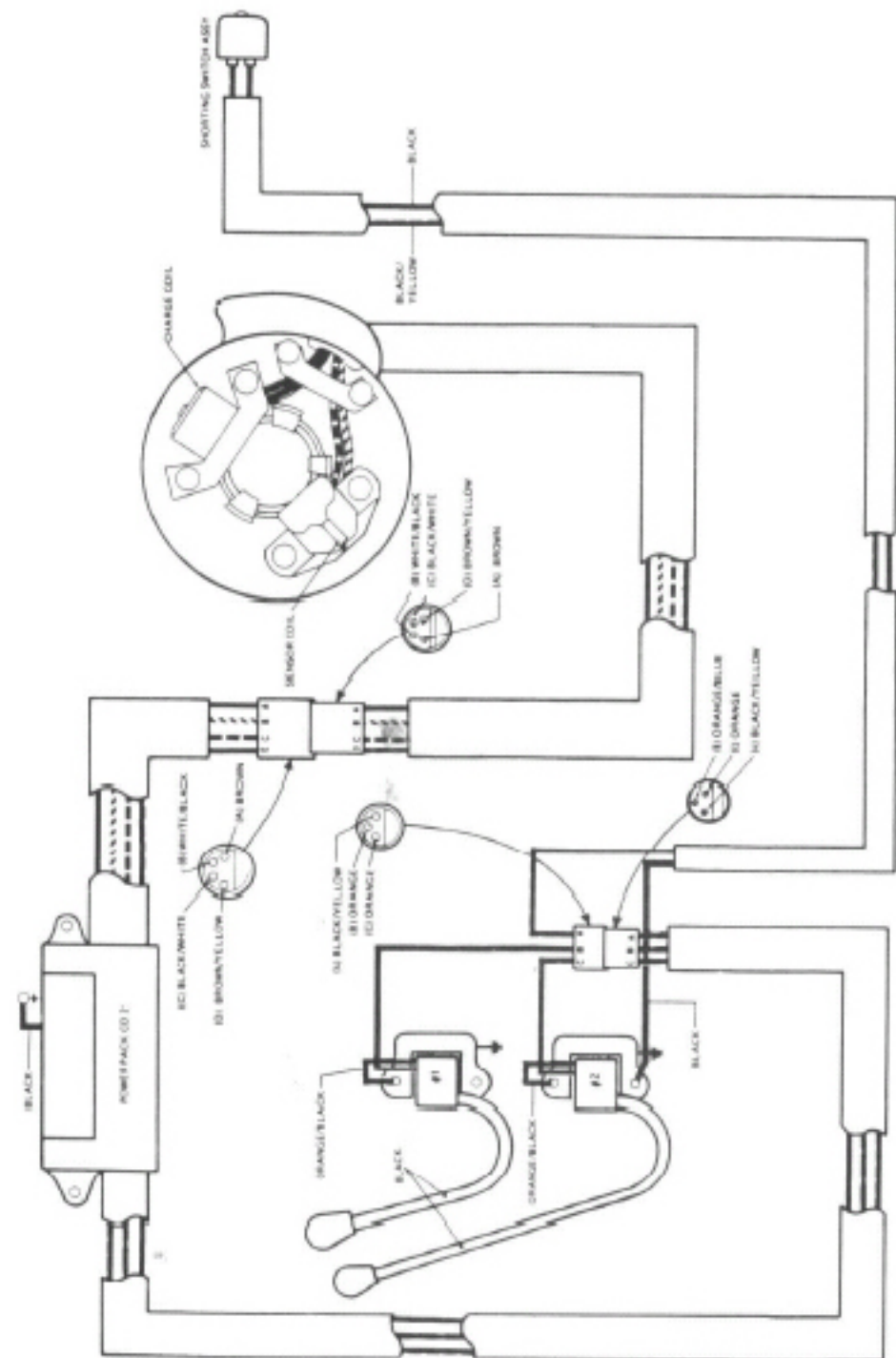
WIRING DIAGRAM — 6 HP



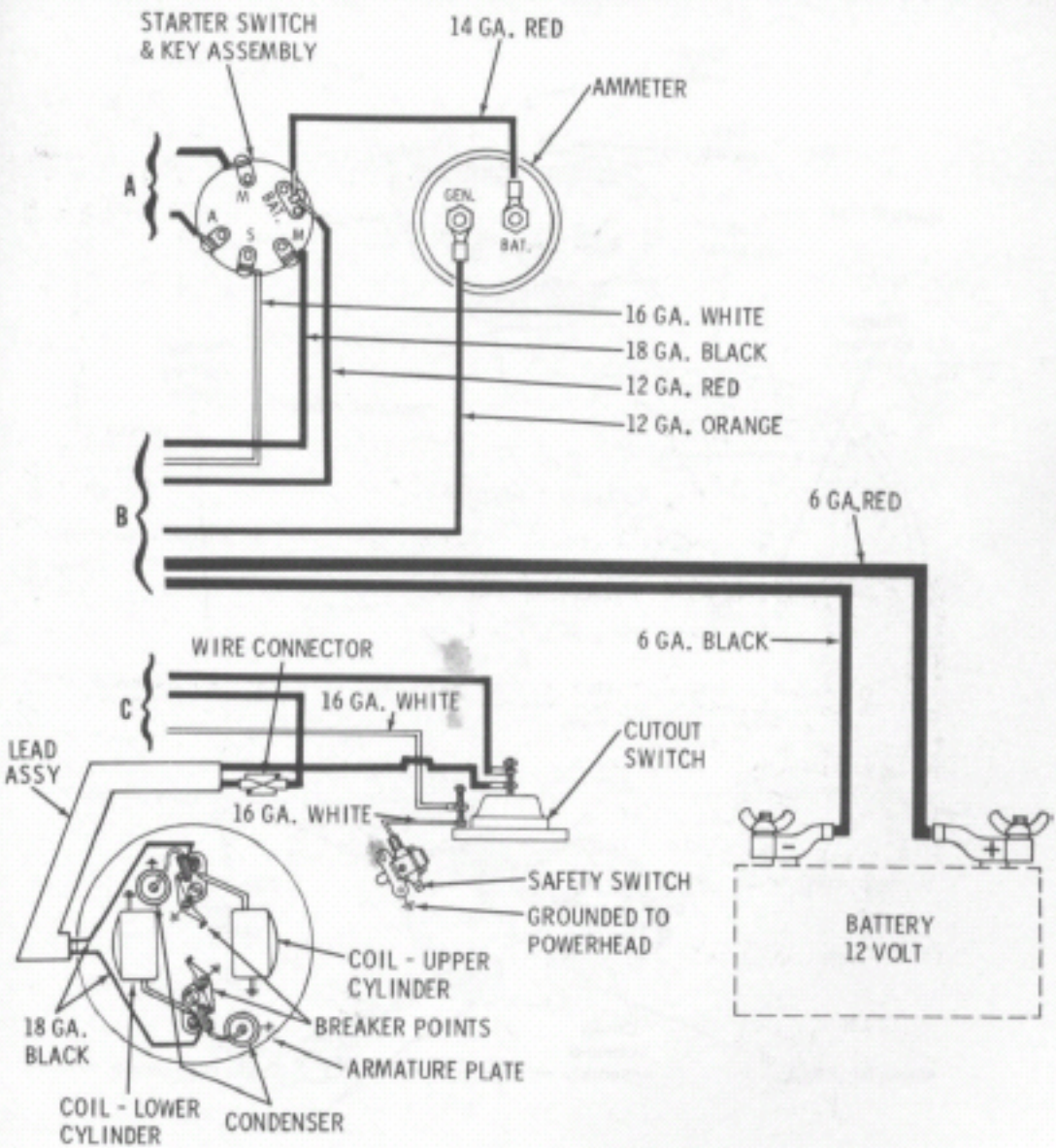
WIRING DIAGRAM — 10-15 HP WITH MANUAL START



WIRING DIAGRAM — 25-35 HP WITH MANUAL START



ELECTRICAL SYSTEM



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