Johnson OUTBOARDS

SERVICE MANUAL

70 HP model

70EL79

75 HP models

75ER79, 75ELR79

THE LOOK OF WORLD LEADERSHIP

ITE 4 NO. JM-7908

LITH

⚠ SAFETY WARNING

Proper service and repair is important for the safe, reliable operation of all mechanical products. The service procedures we recommend and describe in this service manual are effective methods for performing service operations. Some of these service operations require the use of tools specially designed for the purpose. These special tools should be used when and as recommended.

It is important to note that some warnings against the use of specific service methods that can damage the engine or render it unsafe are stated in this service manual. However, please remember that these warnings are not all inclusive. Since Johnson Outboards could not possibly know, evaluate and advise the service trade of all possible ways in which service might be done or of the possible hazardous consequences of each way, we have not undertaken any such broad evaluation. Accordingly, anyone who uses a service procedure or tool which is not recommended by Johnson Outboards must first thoroughly satisfy himself that neither his nor the engine's safety will be jeopardized by the service methods selected.

Housings and covers around the power head are machinery guards. Operation of the motor with these guards removed exposes the operator to additional hazards.

When replacing components having safety warnings attached, the safety warnings must be attached to the replacement parts.

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

⚠ **SAFETY WARNING**
Failure to obey a safety warning may result in injury to your or to others.

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

TABLE OF CONTENTS

NOTE

All photographs and illustrations may not necessarily depict actual models or equipment, but are intended for reference only and are based on the latest product information available at the time of publication.

NOTE

Before removing a motor equipped with tilt-assist shock absorbers from a boat, place the tilt lock lever in RUN position. Failure to do so will allow the stern brackets to swing out as the motor is removed.

If stern brackets swing out, it can be difficult to re-install motor on a stand, test tank, or boat. Considerable leverage is required to manually swing stern brackets into RUN position.

TABLE OF CONTENTS (CONT)

TABLE OF CONTENTS (CONT)

SECTION 1
INTRODUCTION

TABLE OF CONTENTS

NOTE

If removing engine from boat, see NOTE on Table of Contents page i.

FORWARD

Johnson® outboard motors are designed and built for dependable high performance. To assure continued peak operation, it is important that every Johnson owner be able to receive skilled and thorough service for his motor. Customer satisfaction and profitable service operation depend on service "know-how" and training.

Read this manual carefully so that you are familiar with the service procedures - then keep it readily available as a reference book in your service department.

Always remember, each service job is a chance for you to maintain motor performance that will keep your customer happy to be a Johnson owner.

PRODUCT REFERENCES & ILLUSTRATIONS

When reference is made in this handbook to a brand name, number, product or specific tool, an equivalent product may be used in place of the referred to product unless specifically stated otherwise. Equivalent products which are used must meet all current U.S. Coast Guard Safety Regulations and ABYC-BIA standards to avoid hazards.

All photographs and illustrations used in this manual may not necessarily depict actual models or equipment, but are intended for reference only.

Also, all photographs, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication.

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Always remember, each service job is a chance for you to maintain motor performance that will keep your customer happy to be a Johnson owner.

ARRANGEMENT OF MANUAL

This Service Manual includes the specific information you will need to service the Johnson motor. All general procedures are covered in abbreviated form, mostly by reference to procedural illustrations. The specific procedures which apply only, or primarily, to this motor are covered in fully-illustrated, detailed, step-by-step instructions.

The General Service Information section will help you diagnose a malfunctioning motor. It includes specifications, tune-up procedures, and a Trouble Check Chart. Clearances and torque values are also included for quick reference during servicing operations. Each of the following sections, Fuel System, Ignition System, Power Head and Lower Unit, gives detailed instructions for disassembly, inspection, reassembly, and operating adjustments of the components. These procedures will help you service a specific system, or completely overhaul the motor.

PARTS CATALOG

The Johnson Parts Catalog contains exploded views illustrating the correct sequence of all parts as well as a complete listing of the parts for replacement. This catalog can be of considerable help as a reference during disassembly and reassembly.

SERVICE POLICY

Whether within or following the warranty period, Johnson Outboards has a constant interest in its products.

It is Johnson's policy to assist dealers in building up their service knowledge and facilities so that they can give prompt, efficient service. Frequent Service Bulletins, and this Service Manual represents tangible efforts to give Johnson owners the best and most prompt service possible. This Service Manual covers all phases of servicing the motor. However, new situations sometimes arise in servicing a motor. If a service question does not appear to be answered in this manual, you are invited to write to the Service Department for additional help. Always be sure to give complete information, including motor model number and serial number. Be sure that you are familiar with the Johnson warranty.

REPLACEMENT PARTS AND PRODUCT REFERENCES

△ SAFETY WARNING

When replacement parts are required, use genuine OMC parts or parts with equivalent characteristics including type, strength, and material. Failure to do so may result in product malfunction and possible injury to the operator and/or passengers.

When reference is made in this manual to a recommended brand name product, an equivalent product may be used in place of the referred to product.

Individual purchasers of Service Manuals - See your local AUTHORIZED SERVICE DEALER.

SPECIAL SERVICE TOOLS

OMC has specially-designed tools to simplify some of the disassembly and reassembly operations. These tools are illustrated in this Service Manual, in many cases in actual use. Refer to the Special Service Tool Catalog for a description and ordering instructions for these tools. Purchasers of individual manuals must order Special Tools through an authorized dealer.

OUTBOARD MOTOR NOMENCLATURE

Sometimes the words "right" and "left" are very confusing when referring to the sides of an outboard motor. Therefore, the sides are referred to as STARBOARD or PORT sides. STARBOARD means on the right hand while facing the bow (FRONT) of the boat; PORT means left hand. See Figures 1-1 and 1-2.

Service required for the motor is generally one of three kinds . . .

1. NORMAL CARE AND MAINTENANCE, which includes putting a new motor into operation, storing motors, lubrication, and care under special operating conditions such as salt water and cold weather.
2. OPERATING MALFUNCTIONS due to improper motor mounting, propeller condition or size, boat condition, or the malfunction of some part of the motor. This includes motor tune-up procedures to keep the motor in prime operating condition.
3. COMPLETE DISASSEMBLY and overhaul, such as inspecting a motor that has been submerged or rebuilding trade-in units.

It is important to you as the service man to determine before disassembly just what the trouble is, and how to correct it quickly and with minimum expense to the owner. This section of the manual is designed to help you diagnose motor malfunctions and correct them.

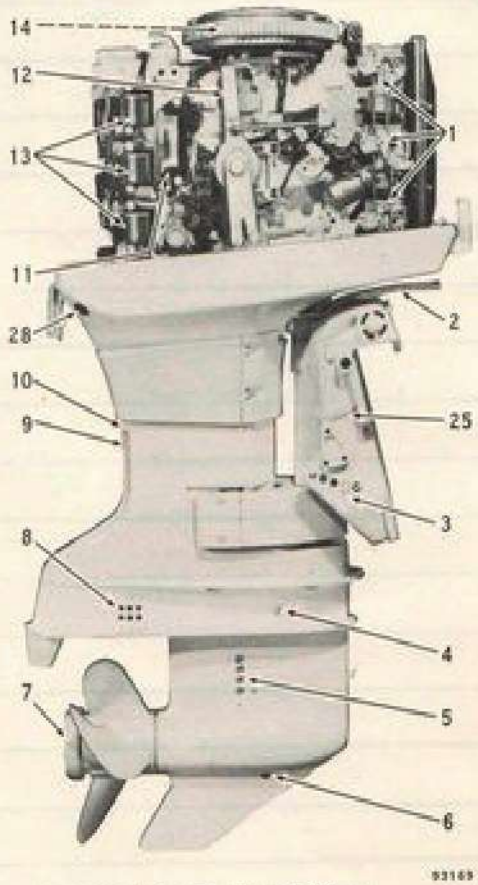


Figure 1-1. Starboard View (Standard)

1. Carburetors
2. Steering arm
3. Tilt adjustment rod
4. Oil level plug
5. Water intake
6. Oil drain and fill plug
7. Exhaust outlet
8. Water outlet
9. Exhaust housing
10. Exhaust relief
11. Power Pack III
12. Throttle lever
13. Ignition coils
14. Alternator
15. Tilt tube (long shaft only)
16. Fuel pump and filter
17. Exhaust covers
18. Tilt lock lever
19. Water outlet
20. Trim tab
21. Propeller
22. Skeg
23. Gearcase
24. Water intake
25. Stern bracket
26. Air silencer
27. Electric starter
28. Overboard water indicator

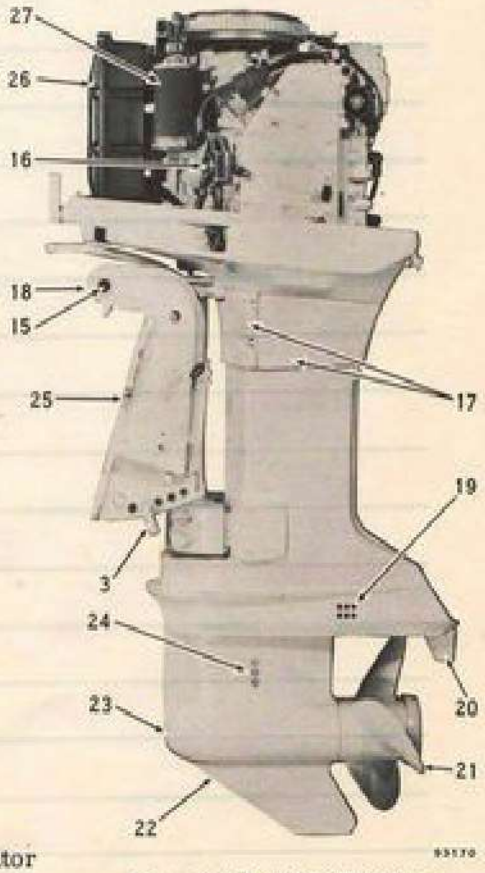


Figure 1-2. Port Side View (Long)

NOTES

SECTION 2
GENERAL SERVICE INFORMATION

TABLE OF CONTENTS

NOTE

If removing engine from boat, see NOTE on Table of Contents page i.

SAFETY WARNINGS

- To prevent possible eye injury always wear SAFETY GLASSES while servicing motor.
- The motor cover is a machinery guard. When testing or adjusting a running motor, do not allow anything to contact the spinning flywheel.
- Do not operate motor out of water. Do not operate motor in a test tank without the proper test wheel. Either will result in damage to water pump, overheating, too high rpm, and possible explosion of motor parts.
- To avoid possible operator injury be sure SAFETY DEVICES are installed and properly adjusted while servicing motor.
- Refer to solvent manufacturer's caution label regarding proper use and storage of solvent.

SPECIFICATIONS

	70 HP	75 HP STD	75 HP LONG
POWERHEAD			
Model numbers	70EL79	75ER79	75ELR79
Engine type	2 cycle, 3 cylinders in line	2 cycle, 3 cylinders in line	2 cycle, 3 cylinders in line
Bore and stroke	3" bore x 2-11/32" stroke (76.20 x 59.53 mm)	3" bore x 2-11/32" stroke (76.20 x 59.53 mm)	3" bore x 2-11/32" stroke (76.20 x 59.53 mm)
Piston displacement	49.7 in.^{3} (814 cm^3)	49.7 in.^{3} (814 cm^3)	49.7 in.^{3} (814 cm^3)
Full throttle operating range	4500 - 5500 rpm	5200 - 5800 rpm	5200 - 5800 rpm
Test wheel	Part No. 386665	Part No. 386950	Part No. 386665
Tank test with test wheel	5000 rpm	5200 rpm	5200 rpm
Idle speed			
Neutral	1000 - 1100 rpm	1000 - 1100 rpm	1000 - 1100 rpm
Forward	750 rpm	750 rpm	750 rpm
Pistons with rings			
Standard	Part No. 385877	Part No. 385877	Part No. 385877
0.020" oversize	Part No. 385878	Part No. 385878	Part No. 385878
0.030" oversize (without rings)	Part No. 385873	Part No. 385873	Part No. 385873
Piston ring sets (2 per set)			
Standard	Part No. 385807	Part No. 385807	Part No. 385807
0.020" oversize	Part No. 385808	Part No. 385808	Part No. 385808
0.030" oversize	Part No. 385809	Part No. 385809	Part No. 385809
Width of ring			
Upper	0.0900" - 0.0895" (2.286 - 2.273 mm)	0.0900" - 0.0895" (2.286 - 2.273 mm)	0.0900" - 0.0895" (2.286 - 2.273 mm)
Lower	0.0625" - 0.0615" (1.588 - 1.562 mm)	0.0625" - 0.0615" (1.588 - 1.562 mm)	0.0625" - 0.0615" (1.588 - 1.562 mm)
Crankshaft size			
Top journal	1.4979" - 1.4974" (38.047 - 38.034 mm)	1.4979" - 1.4974" (38.047 - 38.034 mm)	1.4979" - 1.4974" (38.047 - 38.034 mm)
Center journals	1.3752" - 1.3748" (34.930 - 34.920 mm)	1.3752" - 1.3748" (34.930 - 34.920 mm)	1.3752" - 1.3748" (34.930 - 34.920 mm)
Bottom journal	1.1815" - 1.1810" (30.010 - 29.997 mm)	1.1815" - 1.1810" (30.010 - 29.997 mm)	1.1815" - 1.1810" (30.010 - 29.997 mm)
Crank pin size	1.1828" - 1.1823" (30.043 - 30.030 mm)	1.1828" - 1.1823" (30.043 - 30.030 mm)	1.1828" - 1.1823" (30.043 - 30.030 mm)
FUEL SYSTEM			
Carburetion	3 carburetors, float feed with manual lever and remote control choke	3 carburetors, float feed with manual lever and remote control choke	3 carburetors, float feed with manual lever and remote control choke
Float level setting	Between steps on gauge no. 324891	Between steps on gauge no. 324891	Between steps on guage no. 324891
Carburetor orifice plugs			
Idle	Part No. 325859 Hole size 0.057" (1.45 mm)	Top & bottom carburetors Part No. 325837 Hole size 0.064" (1.63 mm) Middle carburetor Part No. 325836 Hole size 0.065" (1.65 mm)	Top & bottom carburetors Part No. 325837 Hole size 0.064" (1.63 mm) Middle carburetor Part No. 325836 Hole size 0.065" (1.65 mm)
Off idle	Part No. 318832 Hole size 0.035" (0.89 mm)	Part No. 323703 Hole size 0.036" (0.91 mm)	Part No. 323703 Hole size 0.036" (0.91 mm)
High speed	Part No. 321108 Hole size 0.052 (1.32 mm)	Part No. 320921 Hole size 0.055" (1.40 mm)	Part No. 320921 Hole size 0.055" (1.40 mm)
Inlet needle seat	Hole size 0.065" - 0.062" (1.65 - 1.57 mm) (Use a No. 52 drill as a gauge)	Hole size 0.065" - 0.062" (1.65 - 1.57 mm) (Use a No. 52 drill as a gauge)	Hole size 0.065" - 0.062" (1.65 - 1.57 mm) (Use a No. 52 drill as a gauge)
LOWER UNIT			
Propeller gear ratio	12:29	15:28	12:29
Propeller supplied with motor	(Aluminum) 3 blade, 13-1/4" dia. x 17" pitch	3 blade, 11-3/4" dia. x 17" pitch	3 blade, 13-1/4 dia. x 17" pitch
Optional propellers			
3 blade, aluminum	14" dia. x 9" pitch 14" dia. x 11" pitch 14" dia. x 13" pitch 13-3/4" dia. x 15" pitch 13" dia. x 19" pitch 12-3/4" dia. x 21" pitch 12-3/4" dia. x 23" pitch	13" dia. x 11" pitch 12-1/2" dia. x 13" pitch 12-1/4" dia. x 15" pitch 11-1/2" dia. x 19" pitch	14" dia. x 9" pitch 14" dia. x 11" pitch 14" dia. x 13" pitch 13-3/4" dia. x 15" pitch 13" dia. x 19" pitch 12-3/4" dia. x 21" pitch 12-3/4" dia. x 23" pitch
2 blade, bronze	13-3/4" dia. x 21" pitch 13-3/4" dia. x 23" pitch		13-3/4" dia. x 21" pitch 13-3/4" dia. x 23" pitch
3 blade, stainless steel	13-3/4" dia. x 15" pitch 13-1/4" dia. x 17" pitch 13" dia. x 19" pitch 12-3/4" dia. x 21" pitch 12-3/4" dia. x 23" pitch		13-3/4" dia. x 15" pitch 13-1/4" dia. x 17" pitch 13" dia. x 19" pitch 12-3/4" dia. x 21" pitch 12-3/4" dia. x 23" pitch

ELECTRICAL SYSTEM

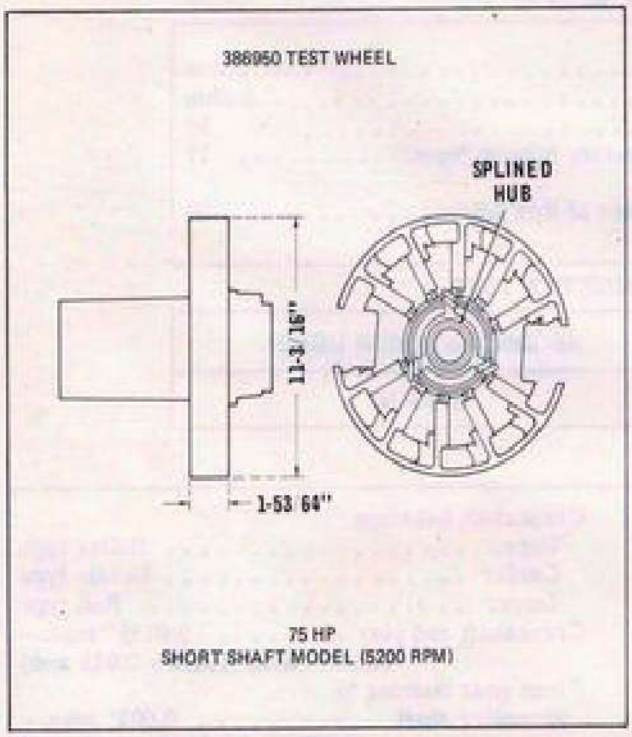
Generator	6 amp alternating current	6 amp alternating current	6 amp alternating current
Starter	Electric and emergency rope	Electric and emergency rope	Electric and emergency rope
Starter amp draw when cranking			
American Bosch	120 amp	120 amp	120 amp
Prestolite	135 amp	135 amp	135 amp

MISCELLANEOUS

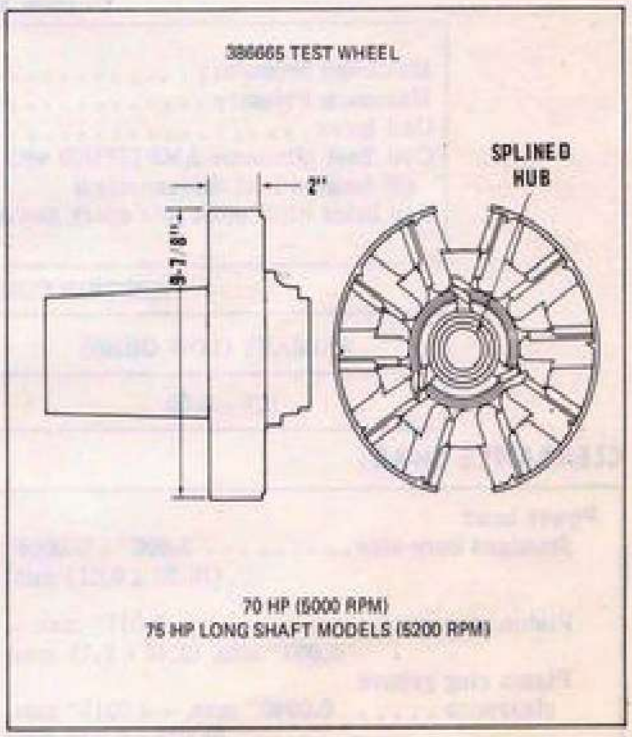
Cooling system	Pressure and thermostatically controlled system	Pressure and thermostatically controlled system	Pressure and thermostatically controlled system
Speed control	Remote control - synchronized throttle and spark	Remote control - synchronized throttle and spark	Remote control - synchronized throttle and spark
Gear shift control	Remote control - forward, neutral, reverse	Remote control - forward, neutral, reverse	Remote control - forward, neutral, reverse

IGNITION SYSTEM

Ignition	Magneto, breakerless C.D.	Magneto, breakerless C.D.	Magneto, breakerless C.D.
Timing	19° @ 4600 - 5000 rpm in gear	19° @ 4800 - 5200 rpm in gear	19° @ 4800 - 5000 rpm in gear
Spark plug	Champion L77J4, AC M40FFX	Champion L77J4, AC M40FFX	Champion L77J4, AC M40FFX
Spark plug torque	17-1/2 - 20-1/2 ft-lbs (24-27 N·m)	17-1/2 - 20-1/2 ft-lbs (24-27 N·m)	17-1/2 - 20-1/2 ft-lbs (24-27 N·m)
Coil	Part No. 581998	Part No. 581998	Part No. 581998



75 HP
SHORT SHAFT MODEL (5200 RPM)



70 HP (5000 RPM)
75 HP LONG SHAFT MODELS (5200 RPM)

IGNITION COIL TEST SPECIFICATION - See Section 4, Coil Test

Stevens Model ST-75	
Reversed Polarity (Switch Setting CD)	1.2

Stevens Model M.A.-75 of M.A.-80	
Switch	Index Adjustment
**A	20

** Use Model CD-1 Adapter Red test clip to orange/black
Black test clip to orange

Merc-O-Tronic with Capacitor Discharge Adapter Model 55-980

Operating Amperage	Primary Resistance	Secondary Continuity
1.4	0.1 Ohm or less	5 - 6 Approx. Red test clip to orange/black Black test clip to orange

Graham Tester Model 51

Maximum Secondary	1,000 ohms
Maximum Primary	.5 ohm
Coil Index	50
Coil Test Minimum AMPLIFIED with secondary circuit "open" (Hi tension lead disconnected)	17
Gap Index (Coil must fire spark gap on tester at this setting)	50

IGNITION COIL OHMMETER TEST

PRIMARY (LOW OHMS)	SECONDARY (HIGH OHMS)
0.1 ± 0.05	275 ± 50

CLEARANCE CHART

Power head
- Standard bore size . . . . . 3.000" ± 0.0005" (76.20 ± 0.013 mm)
- Piston ring gap . . . . . 0.017" max. - 0.007" min. (0.43 - 0.18 mm)
- Piston ring groove clearance . . . . . 0.0040" max. - 0.0015" min. (0.102 - 0.038 mm)
- Cylinder and piston at skirt . . . . . 0.0065" max. - 0.0045" min. (0.165 - 0.114 mm)

Crankshaft bearings
- Upper . . . . . Roller type
- Center . . . . . Needle type
- Lower . . . . . Ball type

Crankshaft end play . . . . . 0.0165" max. - 0.0006" min. (0.419 - 0.015 mm)

Front gear bushing to propeller shaft . . . . . 0.002" max. - 0.001" min. (0.05 - 0.03 mm)

Propeller on shaft . . . . . Spline

NOTE

When tightening two or more screws on the same part, DO NOT tighten screws completely, one at a time. To avoid distortion of the part, first tighten all screws together to one-third of specified torque, then to two-thirds of specified torque, then torque down completely. Re-torque cylinder head screws and spark plugs after motor has been run and has reached operating temperature, and has cooled comfortable to touch.

TORQUE CHART

SAFETY WARNING

Failure to comply with recommended torque values could result in operator injury or motor damage.

Power head
- Flywheel nut . . . . . 100-105 ft.-lbs. (135 - 140 N·m)
- Connecting rod screws . . . . . 348-372 in.-lbs. (29-31 ft.-lbs.) (40 - 42 N·m)

*Cylinder head screws . . . . . 216-240 in.-lbs. (18-20 ft.-lbs) (24-27 N·m)

Crankcase to cylinder main bearing screws and nuts
- Upper . . . . . 216-240 in.-lbs. (18-20 ft.-lbs.) (24 - 27 N·m)
- Center . . . . . 216-240 in.-lbs. (18-20 ft.-lbs.) (24 - 27 N·m)
- Lower . . . . . 216-240 in.-lbs. (18-20 ft.-lbs.) (24 - 27 N·m)

Spark plugs . . . . . 17-1/2-20-1/2 ft.-lbs. (24 - 27 N·m)

Stator screws . . . . . 48-60 in.-lbs. (5 - 7 N·m)

Lower journal bearing head screws . . . . . 96-120 in.-lbs. (11 - 14 N·m)

Pinion nut, driveshaft . . . . . 40-45 ft.-lbs. (54 - 60 N·m)

Starter through bolts - American Bosch . . . 95-110 in.-lbs. (11-12 N·m)

Pivot shaft nut (long shaft) . . . . . 130-150 ft.-lbs. (180-200 N·m)

Starter through bolts - Prestolite . . . . . 110-122 in.-lbs. (12 14 N·m)

Starter drive assembly locknut -
- Prestolite . . . . . 25-30 ft.-lbs. (34 - 40 N·m)
- Bosch . . . . . 20-25 ft.-lbs. (27 - 34 N·m)

Screw, Exhaust housing to powerhead . . . . . 18-20 ft.-lbs. (24-27 N·m)

Lower unit
- Pull at propeller shaft to overcome reverse lock (standard length) . . . 500-700 lbs. (227 - 318 kg)
- (long length) . . . . . 700-900 lbs. (318 - 408 kg)

Power pack & ignition coil mounting screws . . . . . 4 - 5 ft-lbs

*Retorque to 18-20 ft.-lbs. or 216-240 in.-lbs. (24-27 N·m) after motor test

Standard screws

	In.-Lbs. *	Ft.-Lbs. *	N·m
No. 6	7-10		0.8-1.2
No. 8	15-22		1.6-2.4
No. 10	25-35	2-3	2.8-4.0
No. 12	35-40	3-4	4.0-4.6
1/4"	60-80	5-7	7-9
5/16"	120-140	10-12	14-16
3/8"	220-240	18-20	24-27
7/16"	340-360	28-30	38-40

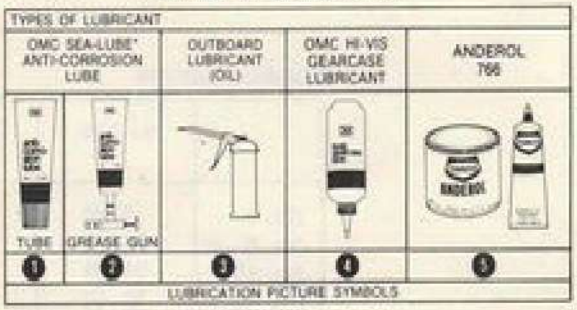
*These Torque Values apply unless otherwise specified.

LUBRICATION CHART

LUBRICATION POINT	LUBRICANT	FREQUENCY (PERIOD OF OPERATION) FRESH WATER	SALT WATER#
1. Gearcase Figure 2-1	OMC HI-VIS Gearcase Lube Standard Length Capacity 21.3 ozs. (630 mL) + Long Shaft 25.4 ozs. (751 mL) +	Change after first 20 hours of operation, check every 50 hours of operation thereafter. Add lubricant if necessary. Drain and refill every 100 hours of operation or once each season, whichever occurs first.	Same as Fresh Water Same as Fresh Water
2. Shift, Throttle, Carburetor, Choke Linkages and Springs; Front Cover Latch; Throttle Cam and Roller Shaft Figure 2-2 (Starboard Side)	OMC Anti-Corrosion Lube	60 days	30 days
3. Motor Cover Lever Shafts See Figure 2-3	OMC Anti-Corrosion Lube	60 days	30 days
4. Shift Lever Shaft See Figure 2-4 (Starboard Side)	OMC Anti-Corrosion Lube	60 days	30 days
5. Swivel Bracket, Tilt Lock Lever (Standard Length) See Figure 2-5 (Port Side)	OMC Anti-Corrosion Lube	60 days	30 days
6. Swivel Bracket and Tilt Lock (Long Shaft) See Figure 2-6	OMC Anti-Corrosion Lube	60 days	30 days
7. Tilt Tube and Tilt/Run Lever Shaft See Figure 2-7	OMC Anti-Corrosion Lube	60 days	30 days
8. Starter Pinion Gear Shaft Helix See Figure 2-8 (Port Side)	Anderol 766	60 days	30 days

Some areas may require more frequent lubrication.
+ 1 oz - 29.57 millilitres

TYPES OF LUBRICANT



NOTE

Recommended lubricants which have been formulated to protect against damage to bearings and gears must be used, as extensive damage can result from improper lubrication.

Figure 2-1. Gearcase

GEARCASE LUBRICATION

SAFETY WARNING

Disconnect charge coil connector between stator and power pack to avoid accidentally starting motor.

With motor in vertical position, remove oil drain/fill and oil level plugs from starboard side of gearcase. Allow lubricant to drain completely.

Refill OMC HI-VIS Gearcase Lubricant in drain/fill hole (Figure 2-1). If OMC HI-VIS Gearcase Lubricant is not available, OMC Premium Blend Gearcase Lube can be used as an alternate. Fill until lubricant appears at oil level hole.

Install oil level plug before removing lubricant tube from oil drain/fill hole. Drain/fill plug can then be installed without loss of lubricant. Tighten both plugs securely.

If the proper tube or filler type can is not available, install drain/fill plug. Slowly fill gearcase through oil level hole allowing trapped air to escape. Install oil level plug. Tighten both plugs securely.

NOTE

Recheck gearcase oil level after motor test has been completed.

LUBRICATION POINTS

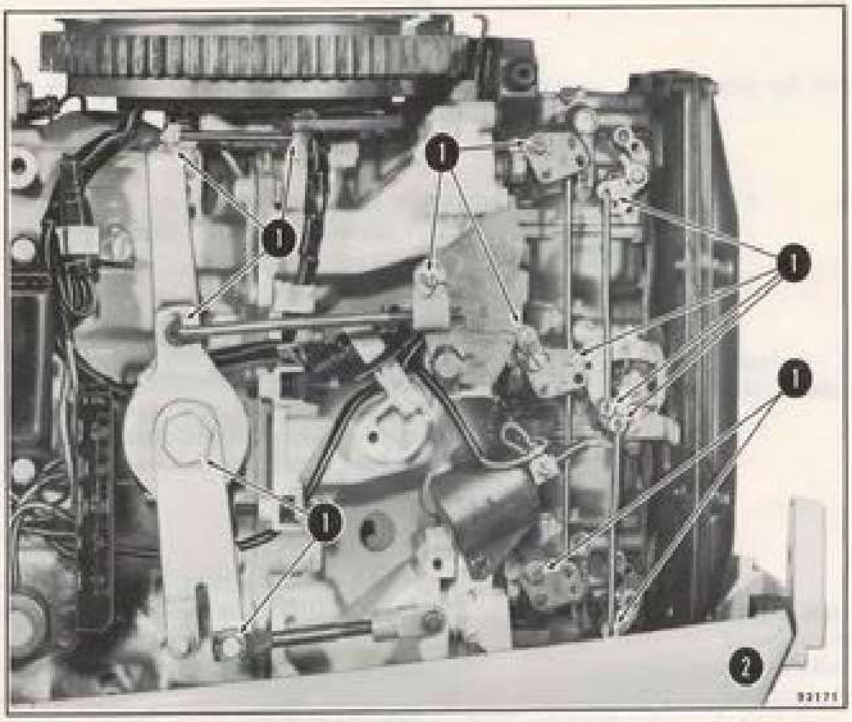


Figure 2-2. Shift, Throttle, Carburetor, Choke Linkages and Springs; Front Cover Latch; Throttle Cam and Roller Shaft (Starboard Side)

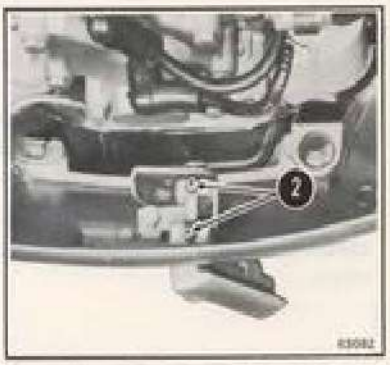


Figure 2-3. Motor Cover Lever Shaft

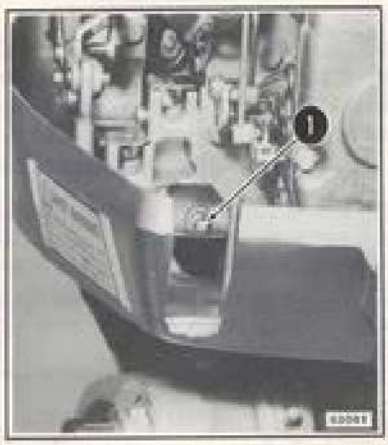


Figure 2-4. Shift Lever Shaft (Starboard Side)

Figure 2-5. Swivel Bracket and Tilt Lock Lever (Port Side)*

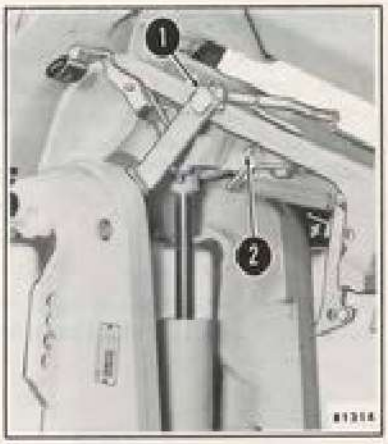


Figure 2-6. Swivel Bracket and Tilt Lock

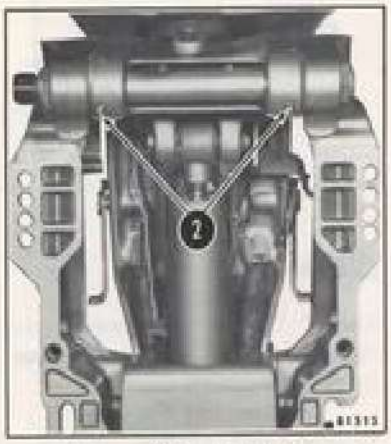


Figure 2-7. Tilt Tube

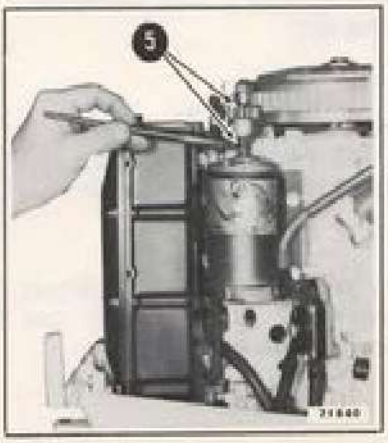


Figure 2-8. Starter Pinion Gear

*Standard Length Only

ENGINE FUEL AND LUBRICANT

TYPE OF GASOLINE. Use gasoline with the following minimum octane number.

PUMP POSTED OCTANE NUMBER	86
Research Octane Number Most Commonly Used in the Past	91

Automotive gasolines regular-leaded or lead-free meeting these minimum octane numbers may be used.

⚠ SAFETY WARNING

Gasoline is extremely flammable and highly explosive under certain conditions. Always stop engine, and do not smoke or allow open flames or spark near the boat when refueling or changing fuel tanks.

LUBRICANT. Use Johnson lubricant which is BIA certified for service TC-W (two-cycle, water cooled). It is formulated to give best engine performance with least combustion chamber deposits, least piston varnish, maximum spark plug life, and best lubrication. See inside back cover.

If Johnson lubricant is not available, another BIA certified TC-W lubricant may be used.

NOTE

Avoid the use of the following, as they will contribute to deterioration of your engine and shorten spark plug life:

- Automotive oils
- Premix fuel of unknown oil quality
- Premix fuel richer than 50:1 ratio

Some additives in 50:1 lubricant are subject to evaporation. Always cover partially used cans to prevent deterioration of lubricant.

FUEL MIXING INSTRUCTIONS

Always use fresh gasoline.

⚠ SAFETY WARNING

Gasoline is highly flammable. Always mix in well ventilated area.

1 part Lubricant to 50 parts Gasoline or:
6 Gal. Tank (22.7 litres) 1 pint (0.47 litres) lubricant to 6 gallons (22.7 litres) of gasoline

IMPORTANT: Additive compounds such as "tune-up" compounds, "tonics," "friction reducing" compounds, etc., are unnecessary and are not recommended. The use of OMC engine cleaner, OMC rust preventive oil and OMC 2 + 4 Fuel Conditioner is recommended.

Above 32° F (0°C)

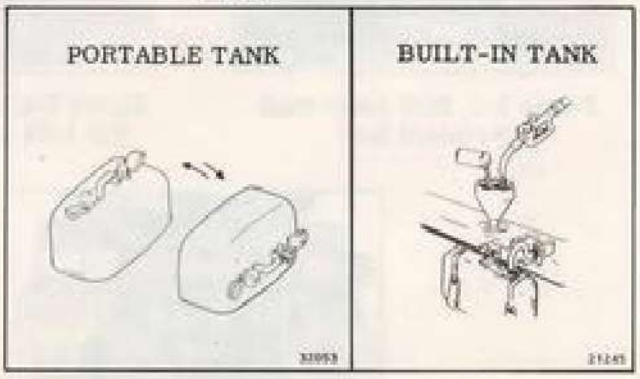
Portable Tank - Pour lubricant into tank, add fuel. Replace filler cap securely. To mix fuel, tip tank on side as shown below and back to upright position.

Built-in Tank - Use large metal filter funnel. Pour lubricant slowly with the fuel as tank is filled.

Below 32° F (0°C)

Portable Tank - Pour approximately one gallon (4 litres) gasoline into tank, add required lubricant. Replace filler cap securely. Thoroughly mix by shaking tank. Add balance of gasoline.

Built-in Tank - In separate container mix all lubricant needed with one gallon (4 litres) or more of gasoline. Use large metal filter funnel. Pour this mixture slowly with fuel as tank is filled.



BREAK-IN

The 50:1 mixture is used during break-in. Use only our 50:1 LUBRICANT or other BIA certified TC-W lubricants.

OPERATION (FIRST HOUR): For the first 5-10 minutes, operate engine at a fast idle. For remainder of first hour, do not operate engine over 3000 rpm or one-half throttle (approximate).

NOTE

With easy planing boats, bring the boat into planing position with full power and then immediately reduce the throttle setting to approximately 3000 rpm (one-half throttle). BE SURE boat maintains planing attitude at this throttle setting.

OPERATION (SECOND HOUR): Bring boat into planing attitude and reduce power to 4000 rpm or three-quarter throttle (approximate) while maintaining planing attitude. At intervals during the second hour, apply full power for periods of one to two minutes, returning throttle to original setting (4000 rpm three-quarter throttle) for a cooling period.

Avoid continuous full throttle operation for extended periods during the next eight hours.

TUNE-UP PROCEDURE

When an owner brings a motor to you for a tune-up or for some minor operating malfunction, the following procedure should be used as a guide to determine the cause of the malfunction. Write down the owner's comments. Keep an accurate card file on your service shop operation. Each service operation should be recorded along with:

OWNER'S NAME
DATE
MODEL NO.
SERIAL NO.
NATURE OF COMPLAINT
NATURE OF WORK PERFORMED
COST TO THE OWNER
WAS WORK PERFORMED UNDER WARRANTY?

After writing down the owner's comments, check the motor visually and begin a systematic tune-up procedure. Consult the Trouble Check Chart to find the causes of any malfunction discovered when tuning up the motor.

⚠ SAFETY WARNING

Key switch must be in off position before attempting any repairs on engine, except where otherwise specified.

1. Remove power head from exhaust housing. Remove exhaust covers and cylinder head. Slowly rotate flywheel and visually inspect pistons, rings, and cylinders for wear, freeness, and carbon deposits.

NOTE

Piston ring condition should be determined before continuing tune-up. Gum and varnish deposits on rings or pistons may be removed with an application of OMC Engine Cleaner.

If pistons and rings are in satisfactory condition for continued service, remove carbon and reinstall covers, using new gaskets.

2. Clean carbon from cylinder head and top of pistons. Replace upper bearing crankshaft seal. Surface and reinstall cylinder head, using new gasket.

3. Inspect spark plugs. Clean or replace as necessary.

4. Inspect and test sensor, coils, and ignition wires. (See Section 4 for test procedures.) Check for spark on each cylinder.

5. Inspect carburetors and electric choke.

6. Inspect fuel pump and lines. Replace filter element and gasket.

7. Synchronize carburetor linkage. (See Section 4.)

8. Check propeller for condition and correct pitch. (See Section 6.)

9. Drain and refill gearcase and thoroughly lubricate all components of the motor. (See Pages 2-6 and 2-7.)

10. Tighten all screws and nuts, etc., to specified torque. (See Page 2-5.)

11. Tank-test and check cooling system operation. Use a tachometer and test wheel for accurate rpm tests. Retorque cylinder head and exhaust cover screws after motor has cooled comfortable to touch.

12. Fog motor for storage, using OMC Rust Preventative Oil and fuel containing OMC 2 + 4 Fuel Conditioner.

13. Use OMC Gasket Sealing Compound Part Number 317201 on all screws, nuts, bolts, and pressed in seals in gearcase and on propeller shaft splines.

14. If fuel tank is not drained before storage, add OMC 2 + 4 Fuel Conditioner to stabilize the gasoline.

TROUBLE CHECK CHART

TROUBLE	POSSIBLE CAUSE
1. MOTOR WILL NOT START	A. FUEL SYSTEM - See Section 3 Fuel line improperly connected Slow speed orifice blocked Engine not primed Manual choke in "OFF" position Speed control not advanced (throttle closed) Engine flooded Old fuel Clogged fuel filter screen Electric choke not operating Choke spring broken or disconnected Fuel system faulty B. IGNITION SYSTEM - See Section 4 Timing, cam or linkage improperly adjusted Sheared flywheel key Loose wiring Ignition system faulty (key switch) Gear shift not in neutral Defective neutral start switch C. ELECTRICAL SYSTEM - See Section 7 Wrong rotation (Bosch starter), brushes in wrong Starter circuit faulty 20 ampere fuse open or fuse holder damaged Cranking speed too slow - 200 rpm min.
2. MOTOR WILL NOT STOP (Key turned off)	Key switch, wiring, or faulty Power Pack Incorrect wiring harness
3. LOSS OF POWER (Providing ignition is OK)	A. POWER HEAD - See Section 5 Carburetors and timer base not synchronized Throttle control lever (won't advance) Air leak at manifold gaskets - warped manifold (backfires) Broken leaf valves (backfires) Excessive carbon on pistons and cylinder head Stuck piston rings, or scored cylinder or piston B. CARBURETOR - See Section 3 Old fuel, too much lubricant, dirt in carburetor Ignition timing screw loose Electric choke not operating properly Inlet needles and seats worn or stuck Incorrect carburetor float setting Incorrect orifice plugs Altitude horsepower loss C. FUEL PUMP AND TANK - See Section 3 Faulty fuel hose (clamps or seals) (kinked) Fuel tank or pump filter plugged Fuel filter restricted Fuel and vent valves not opening Valves not operating Fuel hose passages restricted or wrong fuel hose Incorrect fuel pump Diaphragm leaking or damaged Antisiphon valves built in tanks incorrect or faulty D. EXHAUST GAS ENTERING CARBURETOR - See Section 6 Exhaust cover screws leaking Damaged exhaust housing seals Adapter gaskets leaking Cracked exhaust housing Exhaust adapter to cylinder screws loose or missing E. OVERHEATING POWER HEAD - See Section 5 Thermostat cover or gaskets damaged Pressure control valve damaged Exhaust cover gaskets leaking

TROUBLE CHECK CHART (CONT)

TROUBLE	POSSIBLE CAUSE
3. LOSS OF POWER (Providing ignition is OK) (Cont)	Head gaskets leaking (warped head) (water in cylinders) 3/16" diameter hole under heat sensor switch plugged Erratic or no flow from overboard water indicator Water intakes obstructed (overheating) Pump housing air bleed restricted (overheating) Water passages obstructed (overheating) Pump plate not sealing (bottom) Pump impeller damaged Pump housing distorted (overheated) Pump housing cover seal worn (driveshaft grooved) Water tube grommet damaged F. LOWER UNIT - See Section 6 Propeller hub slipping Bent or worn propeller, converging ring missing Bent gear housing or exhaust housing G. LOSS OF POWER, ENGINE OVERHEATING Thermostat damaged Water passages restricted
4. ENGINE MISFIRES (Providing fuel system and carburetor are OK)	A. SPARK PLUGS - See Section 4 Cover or inner terminal damaged (terminal point out of H.T. lead) Faulty leads or crossed leads Loose spark plugs (low torque) Defective spark plugs (cracked insulator) Incorrect spark plugs B. IGNITION - See Section 4 Incorrect timing Loose wiring Coils damaged Arcing around ignition coils Loose connections to sensor coils, charge coils, ignition coils, or on power pack ground lead Leads grounding out on sensor coils, charge coils, ignition coils, or key switch Sensor coils Charge coils Power pack Arcing in key switch
5. POOR PERFORMANCE ON BOAT	A. MOTOR ADJUSTMENT Incorrect propeller Mounts loose, loss of rubber bond Incorrect tilt angle Remote controls incorrectly adjusted Overheating B. CAVITATION OR VENTILATION Protruding hull attachments Keel too long Bent propeller (vibration) Transom too high C. BOAT Improper load distribution Marine growth on bottom Added weight (water absorption) Hook in bottom Catamaran (single engine) - venturi effect
6. SHIFT WILL NOT OPERATE	A. CONTROL BOX AND CABLE CONNECTIONS - See Section 8 Control box and/or power head connections

TROUBLE CHECK CHART (CONT)

TROUBLE	POSSIBLE CAUSE
6. SHIFT WILL NOT OPERATE (Cont)	B. LOWER UNIT - See Section 6 Incorrect lubricant (OMC HI-VIS Gearcase Lube only) Faulty adjustment Shifter dog damaged
7. ALTERNATOR WILL NOT OPERATE (Weak or under charged battery)	A. ALTERNATOR SYSTEM - See Section 7 Faulty wiring Rectifier diodes damaged Shorted or open stator windings
8. STARTER MOTOR WILL NOT OPERATE	A. STARTING CIRCUIT - See Section 7 Weak or shorted battery Loose or corroded battery connections Throttle advanced too far Gear shift not in neutral Defective neutral start switch Defective key switch Jammed starter drive Damaged starter drive parts Wrong rotation (Bosch), brushes in wrong Worn brushes Broken brush springs Open circuit in solenoid Burned commutator Broken field terminal Shorted or open windings - armature or field 20 amp fuse blown B. EXCESSIVE STARTER CURRENT DRAW - See Section 7 Worn or dry armature shaft bearings Excessive friction in engine Brushes not seating Dirty or corroded commutator Loose pole pieces Bearing heads buckled

SUBMERGED MOTORS

If a motor is lost overboard while running, it should always be disassembled before any attempt is made to start it. Often internal parts are damaged, and attempts at starting or running under these conditions can result in further damage.

A motor lost overboard in salt water should always be disassembled, rinsed in fresh water, cleaned, and dried before starting is attempted. Some materials used in modern engines are subject to very rapid corrosion in the presence of salt water, and should be inspected to determine if replacements are required.

A motor lost overboard in fresh water usually can be started safely if recovered within twelve hours, providing no sand or silt in present. Disconnect charge coil connector. Remove the spark plugs and carburetor orifice screws, and drain all fuel lines and tank. Spin the flywheel using emergency rope until all water present has been expelled. Squirt outboard lubricant into spark plug holes. Reassemble and start.

If sand has entered the engine, no attempt to start should be made.

If it is impossible to have the engine serviced immediately after it has been retrieved after extended submersion, it is advisable to submerge the power head in clean fresh water to prevent oxidation until it can be taken apart.

ENGINE SYNCHRONIZATION AND ADJUSTMENTS

PURPOSE

Reliable troubleshooting cannot be done if linkages and settings are out of adjustment in the first place. Start with this basic inspection and adjustment procedure before beginning troubleshooting, so as not to be misled by other unrelated troubles.

INSPECTION

General – Are there any loose screws or missing parts?

Lubrication – Does the motor look as if lubrication has been neglected?

Fuel supply – Is it clean, fresh, and the correct mixture?

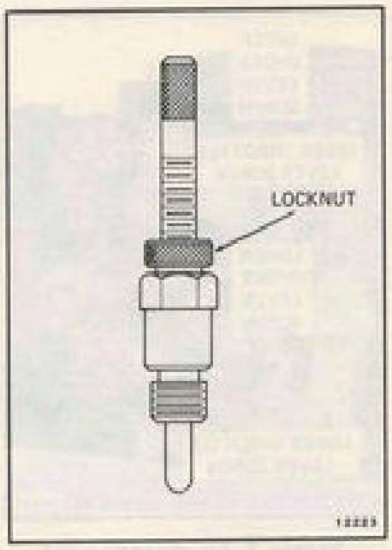


Figure 2-9. OMC Special Tool Tool No. 384887

ADJUSTMENTS

Following is the sequence of steps for basic engine set-up:

1. Set timing pointer.

a. Disconnect spark plug leads and remove spark plugs.

b. Install Piston Stop Assembly (Special Tool #384887, Figure 2-9) in upper cylinder (No. 1) spark plug hole.

c. Turn flywheel clockwise until the TDC mark is about 1-1/2" past the pointer. Bring piston stop against piston, and tighten locknut. With piston firmly against tool, mark rim of flywheel directly under pointer.

d. Rotate flywheel clockwise until piston again contacts tool. Mark flywheel rim directly under pointer.

e. Remove piston stop.

Using a scale, measure the mid-point between the two lines. Mark the mid-point line on the rim of the flywheel. If the mid-point line and the cast-in TDC mark on the flywheel are in agreement, the timing pointer alignment is correct. See Figure 2-10.

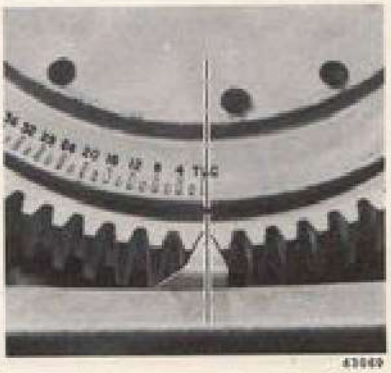


Figure 2-10. Top Dead Center Mark

If not, turn the flywheel to align the mid-point mark with pointer. Hold flywheel in this position. Loosen pointer adjustment screws and move pointer to align with cast-in TDC mark on flywheel. Tighten adjustment screws.

2. Adjust throttle cable.

The throttle cable must be adjusted just tight enough to insure that the engine throttle lever returns to its idle stop. If this cable is too loose, the engine idle speed will be high and inconsistent, causing difficulty shifting out of gear. If it is too tight, the control will feel stiff through the shifting range, and the warm-up lever will tend to move up when shifting to neutral.

a. Move remote control lever back slowly so that throttle lever is against idle stop screw.

b. If throttle lever will not go against the stop screw, turn throttle trunnion adjusting nut until the throttle lever contacts the idle stop screw with light pressure. See Figure 2-11.

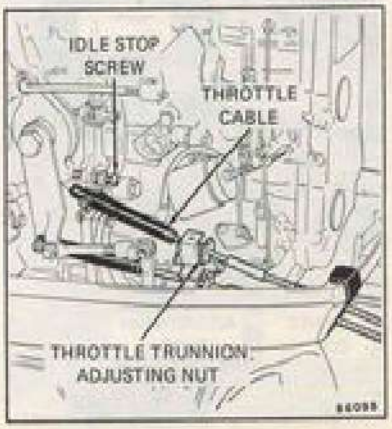


Figure 2-11. Throttle Cable Adjustment

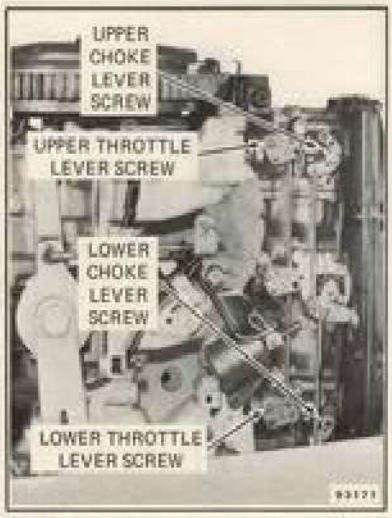


Figure 2-12. Throttle and Choke Lever Screws

3. Synchronize throttle valves.

a. Remove air silencer cover to observe throttle and choke valve action.

b. Retard throttle lever until throttle cam follower roller does not touch cam. See Figure 2-12. Loosen upper and lower carburetor lever adjusting screws to allow return spring on throttle shaft to close throttle valves. Rotate throttle shafts manually to make sure valves are closed. Press upward on tab on adjusting link to remove backlash. Tighten screw. Move cam follower, and check that both throttles start to rotate at the same time.

4. Adjust throttle pick-up point.

a. Embossed mark on throttle cam should align with the contact point of cam follower roller when throttles begin to open. See Figure 2-13.

b. With embossed mark on throttle cam aligned with contact point of cam follower roller, loosen center carburetor throttle arm screw. Allow spring to close throttle valves and retighten screws. See Figure 2-13. Recheck that throttles begin to open just as embossed mark contacts roller.

5. Adjust choke solenoid and choke linkage.

a. With manual choke lever in "OFF" position, shoulder on plunger should be 3/16" (5 mm) above surface of solenoid. See Figure 2-14.

b. If adjustment is incorrect, loosen two solenoid yoke screws, and move solenoid body to obtain correct adjustment.

c. To synchronize choke valves, loosen upper and lower choke lever retaining screws. Close choke valves. Tighten screws. See Figure 2-12.

6. Synchronize throttle and timer linkage.

a. Connect a timing light to No. 1 cylinder. Start engine and adjust the speed adjustment screw so TDC advance mark on flywheel grid aligns with timing pointer. See Figure 2-10.

b. Stop motor and adjust throttle cam yoke to align lower embossed mark on throttle cam with the contact point of throttle cam roller. See Figure 2-15. Rerun engine and check.

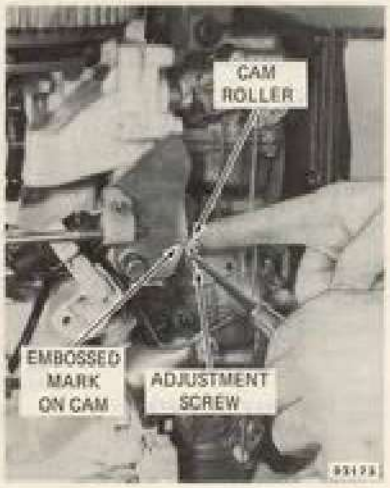


Figure 2-13. Adjusting Throttle Cam Roller

Figure 2-14. Solenoid Adjustment

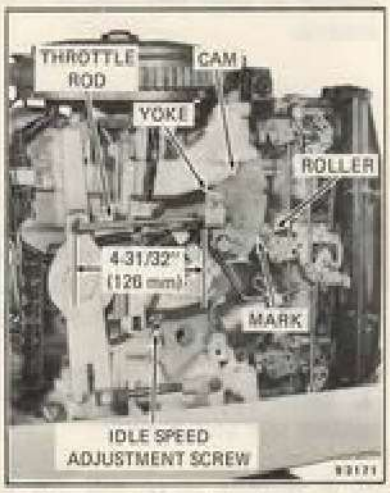


Figure 2-15. Synchronizing Throttle and Timer Linkage

7. Adjust maximum spark advance.

a. 70 hp - With the timing light connected to No. 1 cylinder, start the engine and set engine speed to 4600 to 5000 rpm (in gear). The 19° mark on the flywheel just aligns with the timing pointer. See Figure 2-16.

b. 75 hp - With the timing light connected to No. 1 cylinder, start the engine and set engine speed to 4800 to 5200 rpm (in gear). The 19° mark on the flywheel just aligns with the timing pointer.

c. If necessary, stop motor and move advance stop adjustment screw to obtain proper setting. See Figure 2-17. One turn clockwise retards timing about 1°. One turn counterclockwise advances timing about 1°.

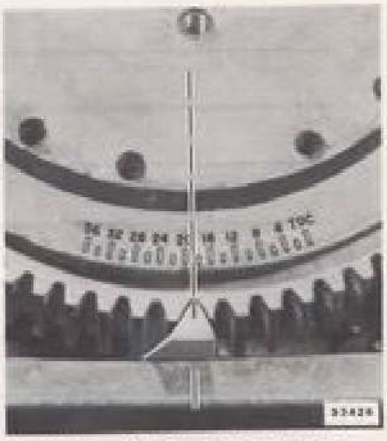


Figure 2-16. Full Throttle Timing

8. Adjust wide open throttle setting.

a. Move throttle lever to full advance position.

b. Adjust wide open throttle stop screw so that throttle valves go full open without strain on throttle shafts. See Figure 2-18.

9. Adjust idle speed.

Adjust idle stop screw so that engine idles at 750 rpm (maximum) in forward gear. See Figure 2-18.

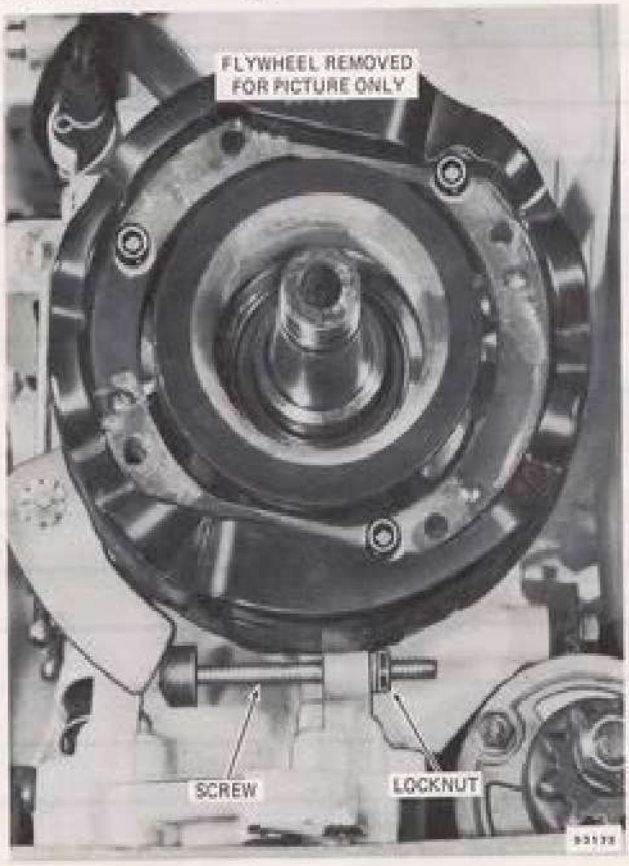


Figure 2-17. Full Spark Adjustment Screw

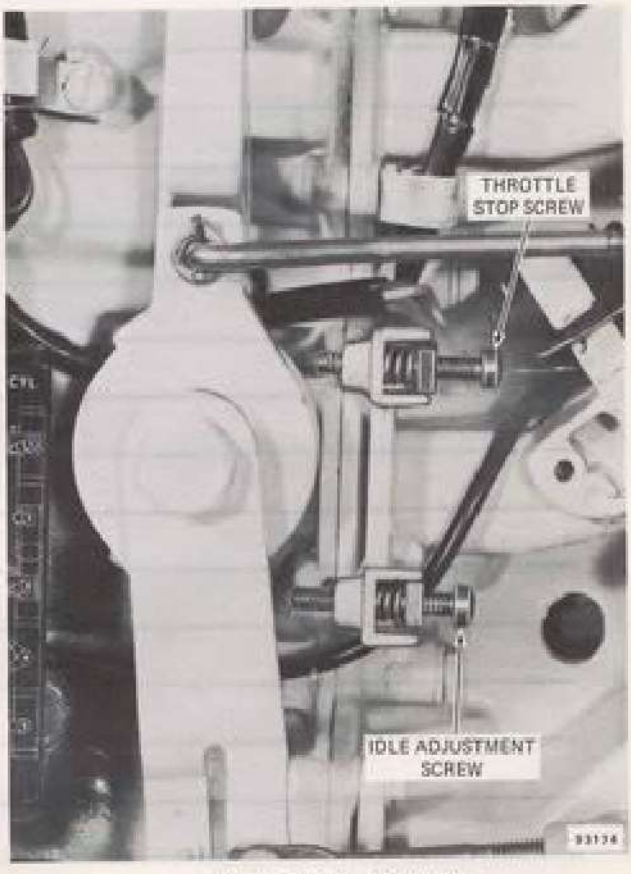


Figure 2-18. Throttle Adjustment Screws

NOTES

SECTION 3
FUEL SYSTEM

TABLE OF CONTENTS

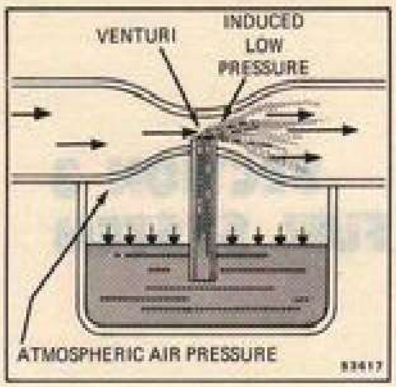
OMC SPECIAL TOOLS REQUIRED	
FIXED JET SCREWDRIVER	PART NUMBER 317002
FLOAT GAUGE	PART NUMBER 324891
TANK PRESSURE TEST ADAPTER	PART NUMBER 389945

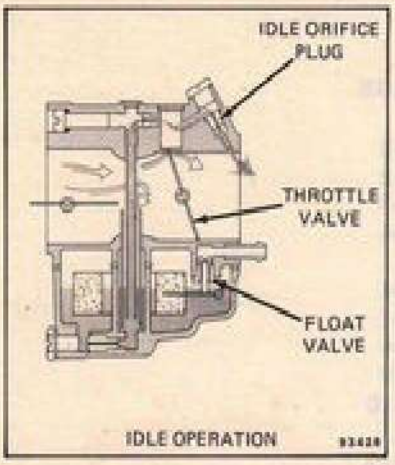
NOTE

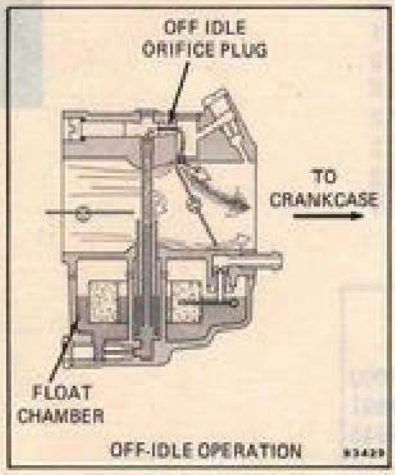
If removing engine from boat, see NOTE on Table of Contents page i.

SAFETY WARNING

Gasoline is extremely flammable and highly explosive under certain conditions. Insure good ventilation; do not smoke, nor allow open flames or sparks near fuel system while servicing.







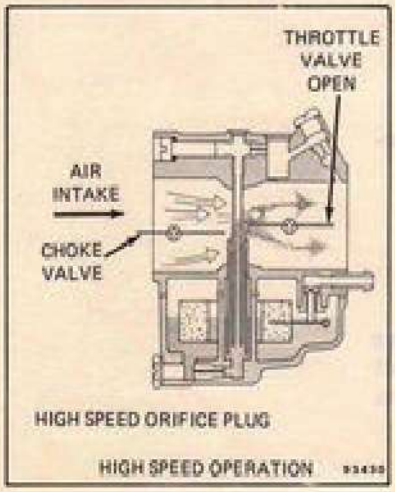


Figure 3-1. Carburetor Principle

DESCRIPTION

FUEL FLOW

The fuel system consists of a fuel tank, fuel pump, and three carburetors. The fuel tank is non-pressurized, suction operated. A diaphragm-displacement type fuel pump on the motor draws fuel from the tank and feeds it to the carburetors through a fuel filter.

CARBURETORS

Each carburetor is a single barrel, float feed type. The high speed, off idle, and idle jets are fixed. Throttle linkage is synchronized with the distributor by a cam.

THEORY OF OPERATION

The carburetor is a metering device for mixing fuel and air. At idle speed, an engine requires a mixture of about 8 parts air to 1 part fuel. High speed mixture is about 12:1.

A small chamber holds the fuel. A float valve admits fuel from the fuel tank to replace fuel as it is consumed by the engine. Metering jets in the carburetor throat extend down into the fuel chamber.

The upstroke of the piston in the cylinder creates a suction that draws air through the throat. A restriction in the throat, called a venturi, has the effect of reducing air pressure at this point by air velocity.

The differential pressure in throat and chamber causes the fuel to be pushed out of the metering jets and into the air stream. Here it mixes with the air to form a combustible mixture for burning in the engine cylinders.

In order to mix the fuel and air in just the right proportions for all engine speeds, the idle, off idle, and high speed jets have fixed orifices.

To regulate engine speeds, a throttle valve controls the volume of fuel-air mixture drawn into the engine. To compensate for the extra amount of fuel required to start a cold engine, a choke valve is placed ahead of the metering jets and venturi.

When the choke valve is closed, a very rich fuel mixture is drawn into the engine. As the engine starts and warms up, the choke is opened to restore the normal ratio required.

LEAF VALVES

The leaf valves time the injection of the fuel mixture into the crankcase by opening only when the pressure in the crankcase has dropped to a predetermined point on the compression stroke.

CHOKE AND CHOKE SOLENOID

The carburetor is fitted with an electric choke to reduce the ratio of air to fuel for cold starts.

The choke may be manually operated. With the choke lever in the "OFF" position, the choke valve is held in a fixed open position, allowing air to pass freely through the inlet. With the choke lever in the "ON" position, the valve is held in a closed position, restricting the flow of air to the carburetor.

With the choke lever in "OFF" position, if full choking is required, a choke switch in the ignition key switch can be operated to fully energize the choke solenoid.

NOTE

Turn key switch to "ON" position. Push key in to choke, then turn key to "START" position.

The choke solenoid operates the choke valves through a spring, allowing them to open partially as crankcase suction increases. See Figure 3-4.

FUEL PUMP

The fuel pump is of the diaphragm-displacement type, and is operated by changes in crankcase pressure. Alternate suction and pressure in the crankcase are transmitted to the pump diaphragm. Suction created on the upward stroke of the piston causes the diaphragm to displace and draw in fuel through the inlet valve. On the following downward stroke of the piston, crankcase pressure flexes the diaphragm in the opposite direction. The inlet valve is then seated, preventing the return of fuel to the tank, while the discharge valve is opened, allowing fuel to pass to the carburetor.

Fuel is drawn through a fine filter screen before entering the pump to remove impurities. See Figure 3-2.

FUEL TANK

The fuel tank is a non-pressurized, suction operated tank. Fuel is lifted from the tank to the carburetor by the fuel pump. Priming is achieved by squeezing the primer bulb (part of the fuel line) several times or until pressure required to squeeze the bulb increases. The connector nearest the primer bulb must be connected to the fuel tank. See Figure 3-3.

The tank air inlet and fuel outlet are sealed until the supply line connector is plugged into the tank. When the fuel line is attached, two valve plungers are depressed, forcing the valves off their "O" ring seats. This vents the tank to the atmosphere and opens the fuel outlet. "O" ring seals in the fuel connectors shut off fuel flow when the line is disconnected from the tank or motor. To facilitate draining and cleaning, a drain screw has been provided in the fuel tank upper housing.

REMOVAL OF CARBURETORS FROM MOTOR

a. Disconnect the carburetor to fuel pump hose from fuel pump.

b. Disconnect choke solenoid spring and choke and throttle linkages by pulling out of top and bottom carburetor lever retainers. See Figure 3-4.

c. Remove ten screws retaining air silencer cover. See Figure 3-4A.

d. Remove six screws retaining air silencer. Disconnect the drain hose, and remove air silencer. Discard six self-locking air silencer to carburetor screws, as new screws should be used on reassembly. See Figure 3-5.

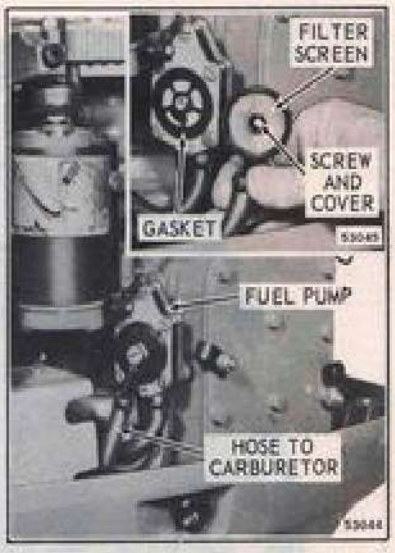


Figure 3-2. Fuel Pump, Filter, and Hoses

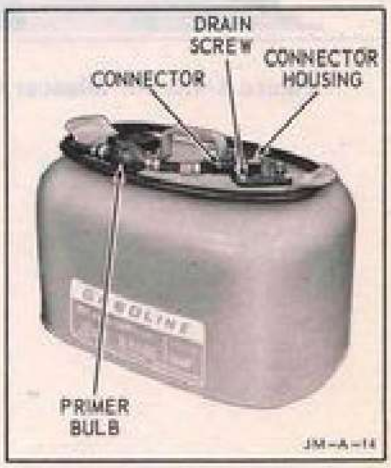


Figure 3-3. Fuel Tank, Primer Bulb, and Connector

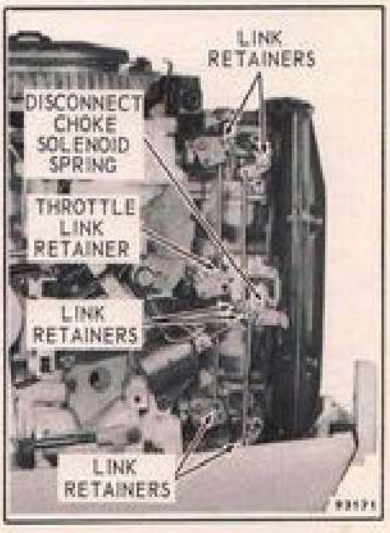


Figure 3-4. Choke Solenoid Spring, Throttle and Choke Links

Figure 3-4A. Air Silencer Cover Screws

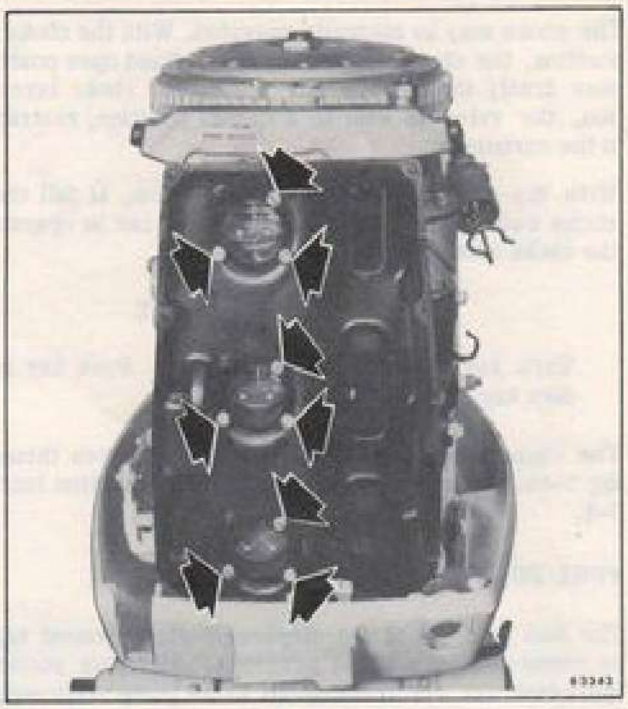


Figure 3-5. Air Silencer Screws

e. Disconnect fuel hoses between carburetors.

f. Remove carburetor nuts, lockwashers and carburetors. Discard gaskets. See Figure 3-6.

REMOVAL OF CHOKE SOLENOID

a. Disconnect lead at terminal board.

b. Remove two screws and clamp retaining solenoid. See Figure 3-19.

REMOVAL OF INTAKE MANIFOLD AND LEAF VALVES

a. Remove 17 screws retaining intake manifold and leaf valve assembly. See Figure 3-7.

b. Remove leaf plate and base assembly.

DISASSEMBLY OF CARBURETOR

a. Drain carburetor by removing screw plug from bottom of float chamber. See Figure 3-8.

b. Remove fixed high speed, off-idle and idle orifice plugs. If removal of idle speed plug is restricted, remove core plug and use a piece of stiff wire to apply pressure to plug while unscrewing with fixed jet screwdriver. To prevent damage to threads in float chamber assembly, use fixed jet screwdriver (Special Tool #317002). See Figures 3-9 and 3-10.

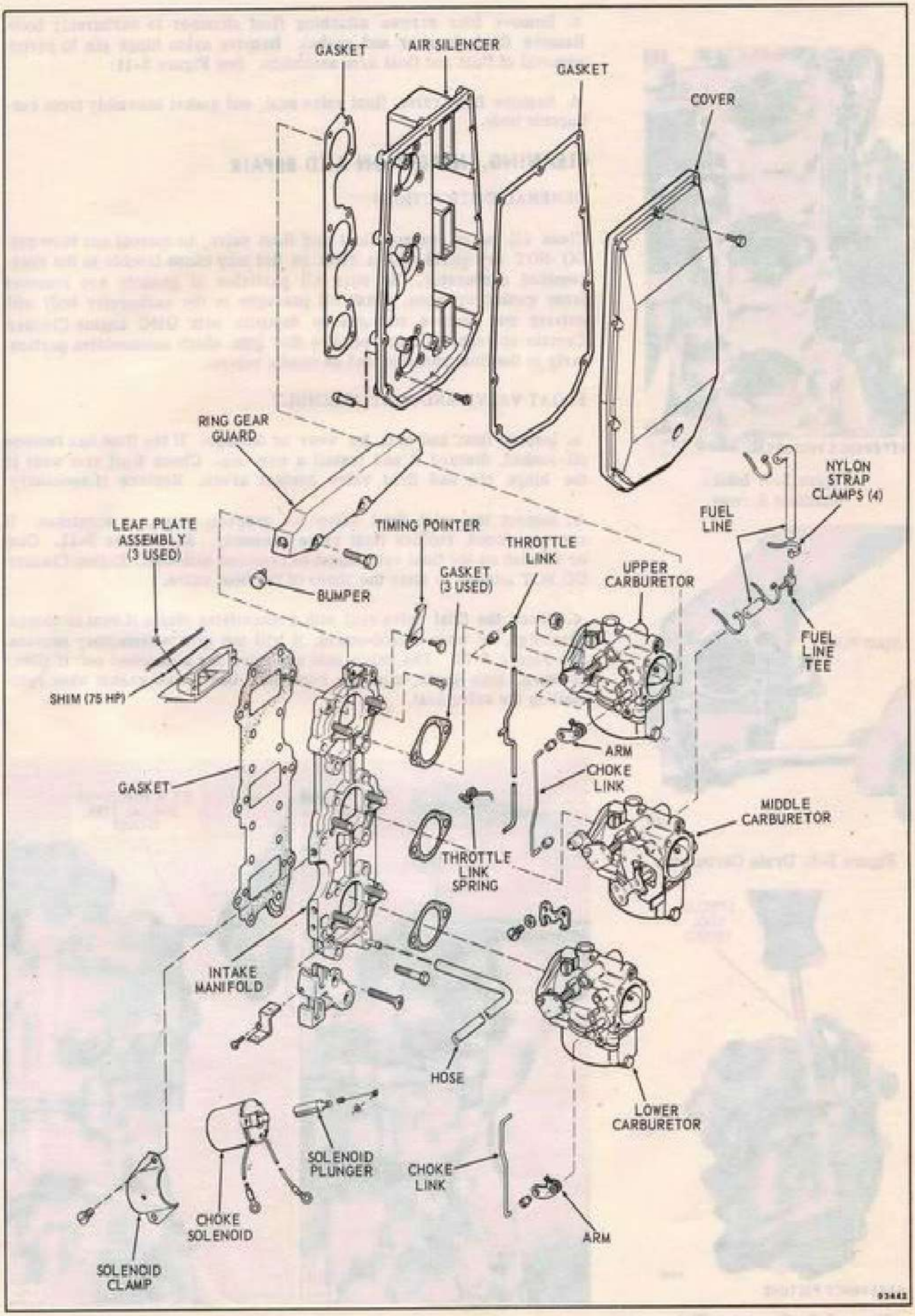


Figure 3-6. Air Silencer, Carburetors, Intake Manifold, and Leaf Valves

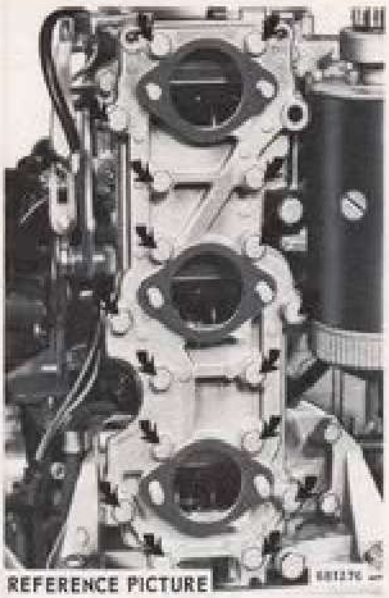


Figure 3-7. Intake Manifold Screws

Figure 3-8. Drain Carburetor

Figure 3-9. Removing High-Speed Jet

c. Remove four screws attaching float chamber to carburetor body. Remove float chamber and gasket. Remove nylon hinge pin to permit removal of float and float arm assembly. See Figure 3-11.

d. Remove float valve, float valve seat, and gasket assembly from carburetor body.

CLEANING, INSPECTION AND REPAIR

GENERAL INSTRUCTIONS

Clean all parts, except float and float valve, in solvent and blow dry. DO NOT dry parts with a cloth as lint may cause trouble in the reassembled carburetor. Be sure all particles of gaskets are removed from gasket surfaces. Flush all passages in the carburetor body with solvent and remove any gummy deposits with OMC Engine Cleaner. Certain solvents will not remove this gum which accumulates particularly in the float chamber and on needle valves.

FLOAT VALVE AND SEAT ASSEMBLY

a. Inspect float and arm for wear or damage. If the float has become oil-soaked, discard it and install a new one. Check float arm wear in the hinge pin and float valve contact areas. Replace if necessary.

b. Inspect the inlet float valve for grooves, nicks, or scratches. If any are found, replace float valve assembly. See Figure 3-12. Gum or varnish on the float valve must be removed with OMC Engine Cleaner. DO NOT attempt to alter the shape of the float valve.

c. Check the float valve seat with a magnifying glass; if seat is nicked, scratched, or worn out-of-round, it will not give satisfactory service. See Figure 3-13. The valve seat and valve are a matched set; if either is worn, both parts must be replaced. Use a new gasket when reinstalling the valve seat.

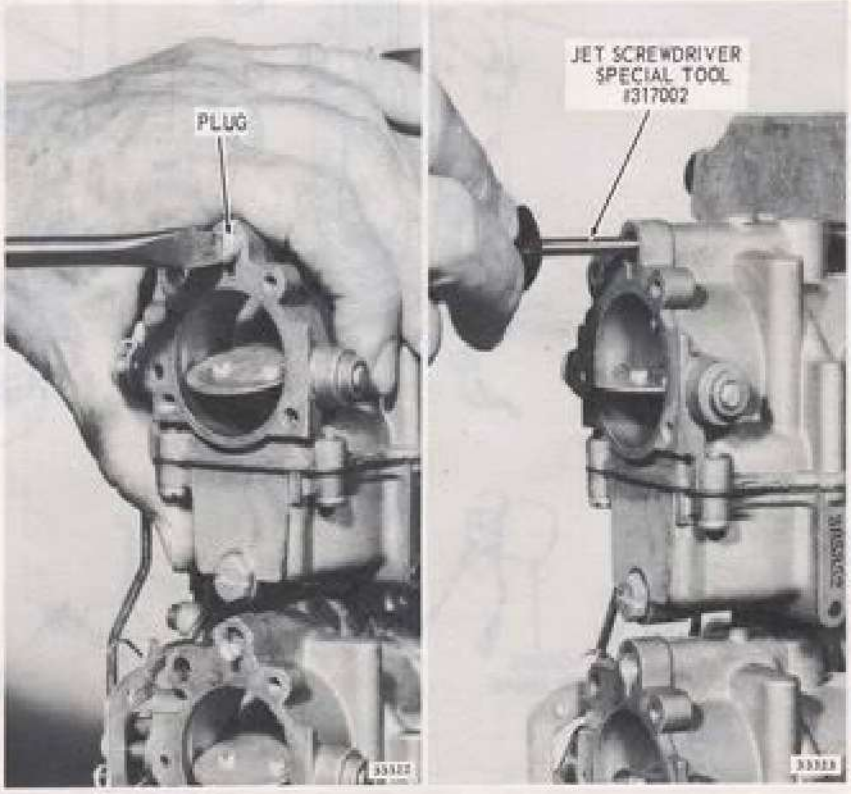
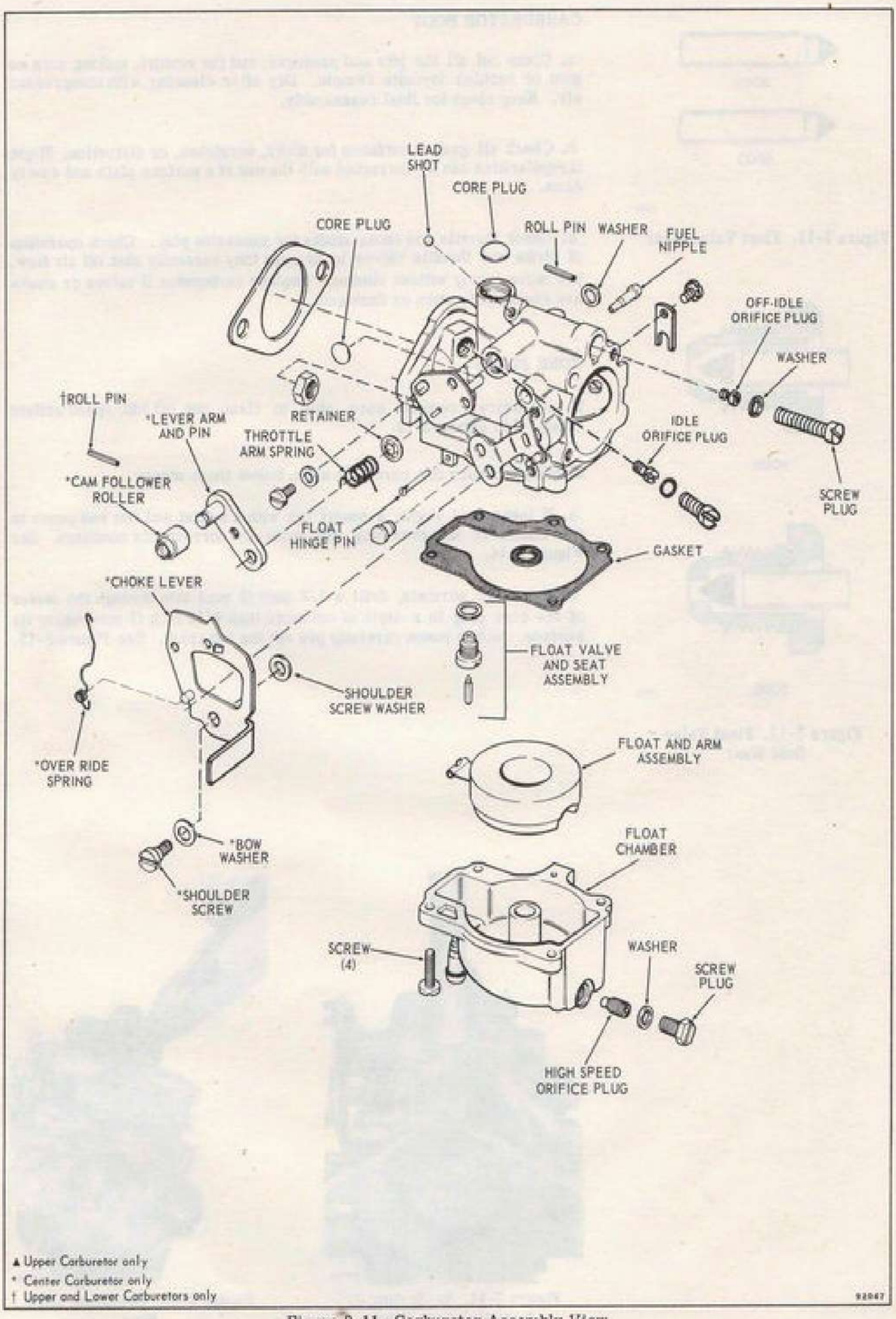


Figure 3-10. Removing Off Idle Speed Plug and Jet



▲ Upper Carburetor only
* Center Carburetor only
† Upper and Lower Carburetors only

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Figure 3-11. Carburetor Assembly View

Figure 3-12. Float Valve Wear

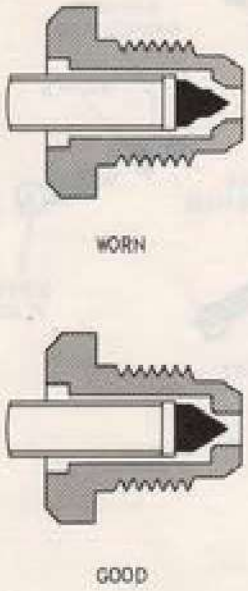


Figure 3-13. Float Valve Seat Wear

CARBURETOR BODY

a. Clean out all the jets and passages, and the venturi, making sure no gum or varnish deposits remain. Dry after cleaning with compressed air. Keep clean for final reassembly.

b. Check all gasket surfaces for nicks, scratches, or distortion. Slight irregularities can be corrected with the use of a surface plate and emery cloth.

c. Check throttle and choke shafts for excessive play. Check operation of choke and throttle valves to be sure they correctly shut off air flow, yet move freely without binding. Replace carburetor if valves or shafts are excessively worn or damaged.

CORE PLUGS

If necessary, remove core plug to clean out off idle speed orifice holes. See Figure 3-15.

If leakage occurs at a core plug area, follow these steps:

a. If leakage is slight, a smart tap with a mallet and flat end punch in the center of the core plug will normally correct this condition. See Figure 3-14.

b. If leakage persists, drill a 1/8 inch (3 mm) hole through the center of the core plug to a depth of not more than 1/16 inch (2 mm) below its surface. With a punch carefully pry out the core plug. See Figure 3-15.

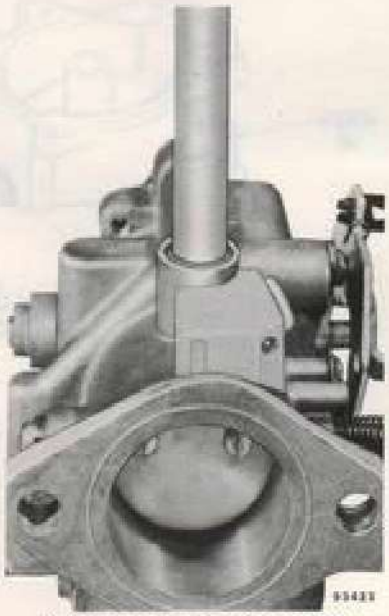


Figure 3-14. Re-Seating or Installing Core Plug

Figure 3-15. Removing Core Plug

c. Inspect and clean casting contact area; if nicks, scratches, or an out-of-round condition are observed, the casting must be replaced. If the casting opening is normal, apply a bead of OMC Adhesive "M" to the top edge of a new core plug, and place the new core plug in the casting opening, convex side up. Flatten to a tight fit with a flat end punch and mallet. Check for leakage.

LEAF VALVES

a. Inspect the leaf plate assembly and disassemble if necessary. The leaf valves must be free from all varnish and gum, and the leaves must be perfectly flat and without distortion so that they form a seal with the leaf plate base. See Figure 3-16.

b. DO NOT attempt to bend or repair a damaged leaf; replace the complete assembly if damaged. DO NOT under any circumstances bend or flex the leaves by hand.

c. Replace the leaf plate assembly if any leaves are broken.

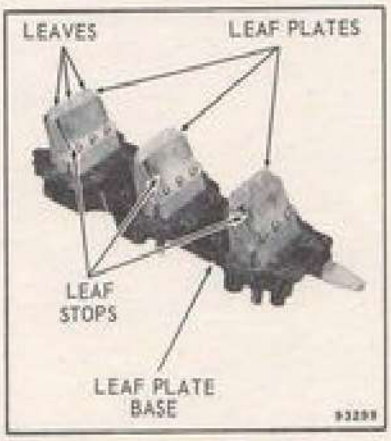


Figure 3-16. Leaf Valves

ELECTRIC CHOKE

For efficient operation, the solenoid plunger should be free from dirt and corrosion so that it can move freely in the housing. DO NOT lubricate the plunger, since the oil film will only attract dust and cause sluggish plunger movement.

Choke solenoid should test 2.0 ± 0.5 ohms between purple/white stripe lead and black ground lead. See Figure 3-17.

Figure 3-17. Testing Choke Solenoid

REASSEMBLY OF CARBURETOR

GENERAL INSTRUCTIONS

Reassemble the carburetor, paying particular attention to the following procedure. Keep all dust, dirt, and lint out of the carburetor during reassembly. Be sure that parts are clean and free from gum, varnish, and corrosion when reassembling them. Replace all gaskets and "O" rings. DO NOT attempt to use original gaskets and "O" rings because leaks may develop after the engine is back in use.

Check the Torque Chart in Section 2 for correct torque recommendations during reassembly.

FLOAT AND FLOAT CHAMBER

a. Install new carburetor bowl gasket. Replace float valve seat and gasket, float valve, float, and hinge pin.

b. Check for correct positioning of float. Turn carburetor body upside down so weight of float closes needle. Top of float should be between steps on gauge No. 324891. See Figure 3-18.

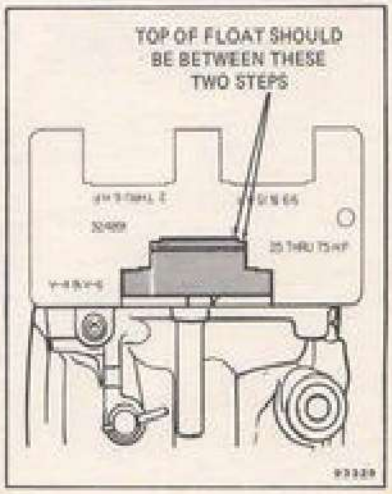


Figure 3-18. Float Level

c. Reassemble float chamber to carburetor body.

d. Replace the high speed, idle, and off-idle orifice plugs and screw plugs.

CHOKE

Check the choke for free operation. Choke valves must move freely, without binding.

LEAF VALVES

a. The importance of keeping the leaves in these valves free from distortion cannot be over-emphasized. Replace any leaf valve assembly which shows any indication of distortion or damage of leaf stop. Check leaf plate with scale for distortion.

b. The leaf is so designed that it maintains constant contact with the leaf block, and will spring away from the block when predetermined pressure is exerted against it. Leaf travel away from the block is limited by the leaf stop. When pressure is removed, the inherent spring action of the segments returns and holds them against the block. Attach the leaf segments and leaf stops to the leaf blocks, then examine each leaf carefully. Each leaf must lie flat against the block with no edges turned up or away from the block. See Figure 3-16.

c. Attach the leaf plate assemblies to the leaf plate base. Tighten screws and nuts to specified torque to avoid distortion of the leaf blocks.

INSTALLATION OF CHOKE SOLENOID

NOTE

If spring is removed from solenoid plunger, install by twisting on to plunger 2-1/2 to 3-1/2 turns.

a. Attach solenoid to intake manifold with clamp and two screws. For proper adjustment, see Section 2, "ENGINE SYNCHRONIZATION AND ADJUSTMENT."

b. Connect leads at solenoid.

INSTALLATION OF LEAF VALVES AND INTAKE MANIFOLD

a. Using new gasket, install leaf valve assemblies to intake manifold. Be sure new gasket matches all openings.

b. Tighten attaching screws to torque specified in Section 2.

REASSEMBLY OF CARBURETORS TO MOTOR

a. Place new gaskets in position on studs on manifold. Place carburetors on studs and fasten in place with nuts and lockwashers.

b. Connect fuel hoses between carburetors using new nylon hose straps. Connect choke and throttle linkages.

c. Connect choke solenoid spring and install ring gear guard.

d. Connect drain hose.

e. Install air silencer base using new self-locking screws and connect fuel hoses to fuel pump and filter using new nylon hose straps.

f. Install air silencer cover.

g. Attach throttle linkage.

h. For carburetor adjustment, see Section 2, "ENGINE SYNCHRONIZATION AND ADJUSTMENT."

FUEL PUMP AND FILTER

Before servicing or replacing fuel pump, remove the fuel filter screen and clean or replace it. See Figure 3-19. Also remove the fuel hose from the fuel tank and blow through all passages and lines with compressed air to be sure they are open. If clogged lines are the cause of the difficulty, this procedure would eliminate unnecessary servicing of the fuel pump. If this procedure does not correct the trouble, fuel pump is probably malfunctioning and should be replaced.

REMOVAL OF FUEL PUMP AND FILTER

a. Disconnect hoses from pump and filter assembly.

b. To remove fuel pump, remove two lower screws attaching pump and filter assembly to crankcase bracket, and remove pump and filter assembly. See Figure 3-19.

CLEANING, INSPECTION AND REPAIR

a. The fuel pump operating components are not serviced separately. If a malfunction occurs, replace the complete pump. See Fuel Pump Pressure Test.

b. Inspect the filter for accumulation of sediment by removing the filter cap screw and the filter cap. See Figure 3-19.

c. Clean all parts of the filter assembly and fuel connectors in solvent and blow dry. DO NOT dry parts with a cloth, as lint may stick to the parts and clog the passages or prevent the fuel pump valves from seating. Dissolve any gummy deposits with OMC Engine Cleaner (certain solvents will not dissolve these deposits).

NOTE

It is recommended that a new gasket be installed when servicing the filter and pump assembly.

REASSEMBLY OF FUEL PUMP AND FILTER

Reassemble the fuel filter to the pump in the reverse order of disassembly being sure lip of screen faces pump.

a. Attach fuel pump to crankcase bracket and connect hoses. Tighten filter and pump screws securely. Check for leaks by connecting fuel tank line to motor and squeezing primer bulb until definite pressure is felt in the bulb.

TESTING FUEL PUMP

Conduct this test on the motor in a test tank or on the boat.

1. Remove carburetor to fuel pump hose. Connect a fuel pressure gauge between the carburetor and fuel pump.

NOTE

Before testing, loosen fuel tank gas cap momentarily to release any pressure that may have built up. Fuel tank must not be more than 24 inches (61 cm) below fuel pump.

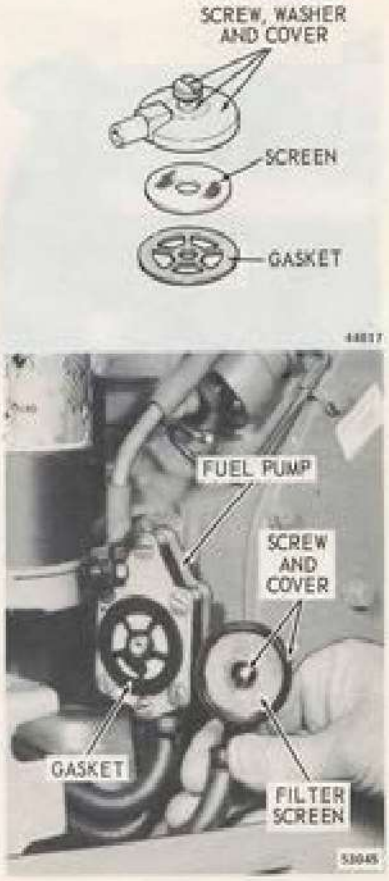


Figure 3-19. Fuel Filter and Pump

Figure 3-20. Fuel Tank Upper Housing

2. Start motor and observe gauge. Pump pressures shown below are minimums.

R.P.M.		
600	2500 to 3000	5000
1 psi (7 kPa)	1.5 psi (10 kPa)	2.5 psi (17 kPa)

FUEL TANK

FUEL MIXTURE

A motor in excellent mechanical and operating condition may give faulty performance because of an improper fuel mixture. Petroleum gum and varnish which precipitate from a stale mixture may clog the filter screen and any small orifices, interfering with starting and normal running. For proper fuel mixture, see inside front cover of Owner's Manual.

To assure that the fuel tank contains the proper mixture, drain and flush the tank at least once a year, and at every tune-up or major repair. To facilitate complete draining of the tank, a drain screw is provided in the fuel tank upper housing. See Figure 3-20. Clean the tank by flushing with clear gasoline or solvent.

DESCRIPTION

The fuel tank is of simple but rugged construction, with a capacity of 6 gallons (22.7 litres) of fuel mixture. It includes the bulb primer (for priming the fuel pump), fuel level gage, fuel hose and connectors, a bracket arrangement to hold the fuel line when not in use, and a carrying grip. The fuel tank upper housing, which provides the connection to the fuel hose, contains two release valves and a disc valve which prevent any escape of gasoline or fumes, minimizing the danger of explosion or fire.

CLEANING, INSPECTION AND REPAIR

If the tank or hose appears to be leaking fuel or fumes, pressure test tank and hose assembly before doing any disassembly. See TESTING AFTER REPAIR.

UPPER HOUSING AND FUEL LEVEL INDICATOR

The fuel indicator is mounted to the upper housing and fuel line assembly. The entire assembly may be removed by removing the four attaching screws. Lift the assembly from the tank carefully to avoid damaging the indicator float or the screen at the end of the pick-up tube. See Figure 3-21.

Check for free movement of the indicator on the indicator pin. Remove the pin from the indicator support by compressing the free end and pulling it out. Inspect the indicator to make sure that the float arm is not bent and that the float is not damaged or oil-soaked.

Remove the two screws attaching the indicator support to the upper housing. Lift the indicator lens out of the upper housing, and clean it with grease solvent or lacquer thinner to remove any foreign matter which may be clouding the lens. Inspect the lens seal for cracks or shrinkage which may allow leakage. When reassembling support to housing, torque 2 screws to 15-20 lb-in. (1.6-2.2 N·m). The release valves must seat tightly to prevent gasoline or fumes from leaking out,

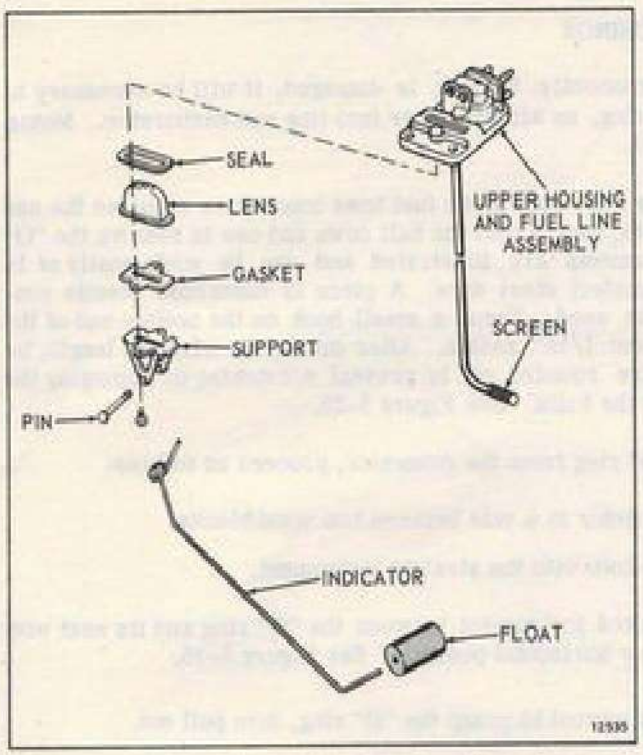


Figure 3-21. Fuel Tank Level

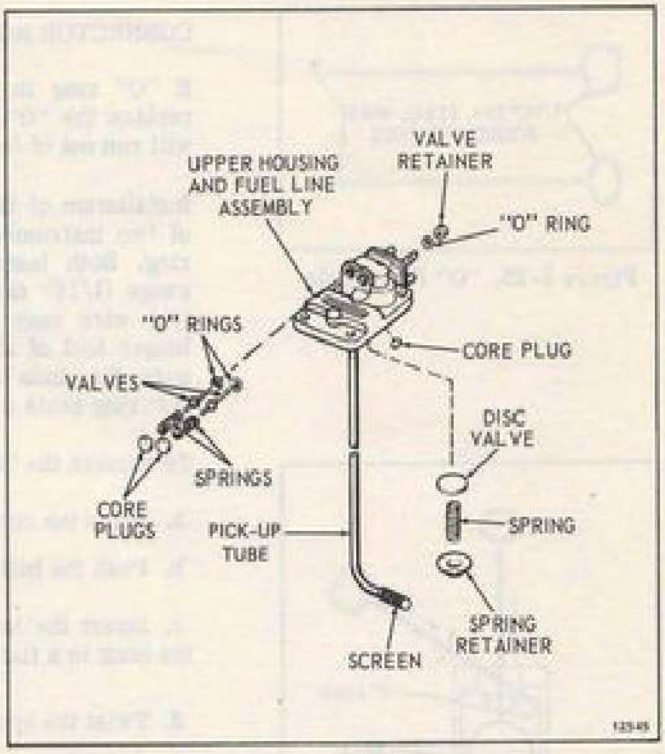


Figure 3-22. Fuel Tank Upper Housing and Valves

but must open a clear passage for air to enter the tank and for fuel to be drawn out when the fuel hose is connected. Dirt may keep the release valves from seating properly. The release valves are best cleaned by removing the core plugs and disassembling. Install new valve seats ("O" rings) to assure a tight seal. See Figure 3-22.

Install small ends of springs on valves and secure assembly in the housing using new core plugs staked in place. See Figure 3-22. This assembly must not leak. See "Testing After Repair."

The air inlet disc valve must seat tightly to prevent fumes from escaping the tank when the fuel hose is connected, but must allow air to enter the tank. The disc valve spring retainer is staked to the upper housing and may be removed by filing off the burrs if replacement is necessary. Restake with a small punch. Reassemble upper housing to fuel tank. Torque 4 screws to 25-35 lb-in. (2.8-4.0 N·m).

Figure 3-23. Removing Hose Clamps

SAFETY WARNING

Failure to follow reassembly procedure correctly could result in fuel leakage. Ignition of this leakage could result in fire or explosion.

HOSE AND PRIMER BULB ASSEMBLY

CLAMPS

To disassemble hose clamps, grip clamp with pliers. Bend overlapping hook backward (in direction of arrow) to release clamp. See Figure 3-23.

To assemble hose clamps, grip clamp firmly with pliers. Apply slight pressure to hook on top side with screwdriver. Squeeze clamp with pliers until hooks interlock. See Figure 3-24.

Figure 3-24. Attaching Hose Clamp

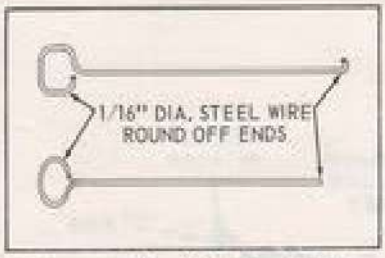


Figure 3-25. "O" Ring Tools

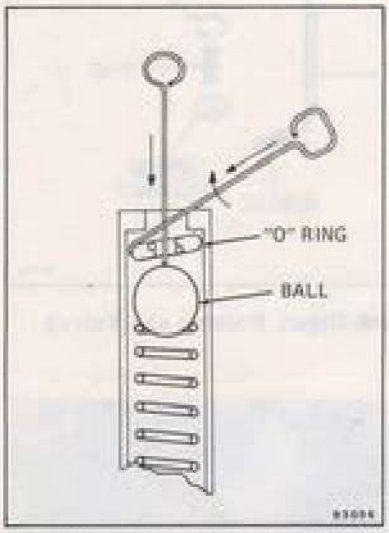


Figure 3-26. Removing "O" Rings

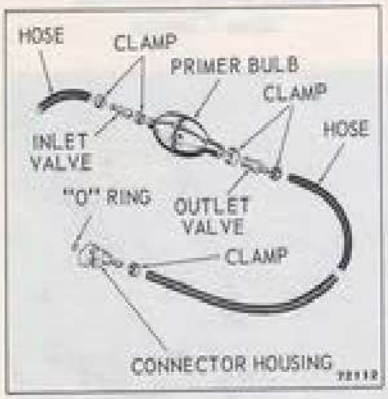


Figure 3-27. Primer Bulb and Hose Assembly

CONNECTOR HOUSINGS

If "O" ring in connector housing is damaged, it will be necessary to replace the "O" ring, as air will enter fuel line and carburetor. Motor will run out of fuel.

Installation of the "O" ring in the fuel hose connectors requires the use of two instruments, one to hold the ball down and one to remove the "O" ring. Both instruments are illustrated and can be made easily of 16 gauge (1/16" diameter) steel wire. A piece of discarded remote control wire may be used. Form a small hook on the bottom end of the longer tool of about 1/16" radius. After cutting the wires to length, be sure the ends are rounded off to prevent scratching or damaging the "O" ring seats or the balls. See Figure 3-25.

To remove the "O" ring from the connector, proceed as follows:

a. Place the connector in a vise between two wood blocks.

b. Push the ball down with the straight instrument.

c. Insert the hooked instrument between the "O" ring and its seat with the hook in a flat or horizontal position. See Figure 3-26.

d. Twist the hook around to grasp the "O" ring, then pull out.

To install the "O" ring in the connector, proceed as follows:

a. Place a drop or two of oil on the "O" ring.

b. Place the "O" ring on face of the connector.

c. Push the ball down with the straight instrument.

d. Pinch the "O" ring together and gently push into position with fingers.

When reassembling the fuel hose, check for cracks in the primer bulb or in the hose. The primer bulb must be attached so that fuel flow is from the shorter to the longer hose length. Fuel flow through the primer bulb is indicated by an arrow. See Figure 3-27.

TESTING AFTER REPAIR

SAFETY WARNING

Omitting the tank pressure test described below may result in your returning to service a fuel system which could leak liquid or vaporized fuel. Ignition of this leakage could result in fire or explosion.

Whenever a fuel tank or line have been serviced or have had parts disassembled, the unit must be tested to insure that the repaired or reassembled portion will not leak or emit fumes. Simply adding fuel to the tank and checking for leakage is not an adequate test, since leakage or fumes may occur only when the tank's contents have been pressurized. As examples, pressurization can occur when the tank is left in sunlight, or when the fuel is agitated, which might occur during transport.

Tools needed are Stevens Gearcase Pressure Tester Model S-34 and OMC Fuel Tank Pressure Test Adapter Part No. 389945. See Figure 3-28. A compressed air supply is also needed.

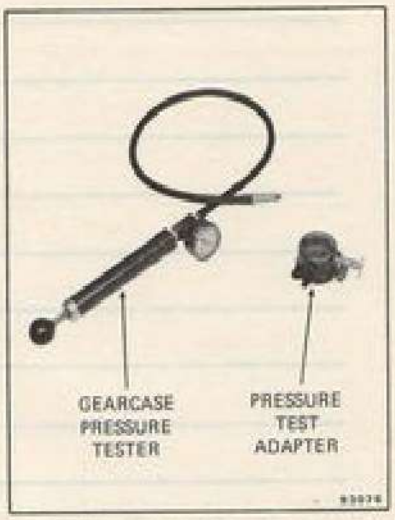


Figure 3-28. Pressure Test Equipment

BEFORE TESTING

SAFETY WARNING

Do not smoke during test, nor perform test in area where there are sparks or open flames. Once air pressure is applied to tank, gasoline traces may be expelled as a vapor or mist. Gasoline in this form is extremely flammable and highly explosive.

a. Remove fuel cap and disengage from tank. Remove anchor from fuel cap.

b. Empty fuel tank completely.

NOTE

If any fuel remains in the tank during testing, it could conceal the presence of leakage.

Figure 3-29. Adapter Installer

TEST PROCEDURE

a. Attach Pressure Test Adapter to fuel tank.

b. Install fuel cap (without anchor) onto adapter. See Figure 3-29.

c. Screw Stevens Pressure Tester into fitting on adapter.

d. Open air release valve on adapter.

e. Apply compressed air to valve stem on adapter in short bursts until gauge on pressure tester reads 10 psi (69 kPa).

NOTE

Short bursts of air will minimize the danger of overpressurizing. Overpressurizing can permanently damage tank.

f. Point end of fuel hose into a container below top of tank. Depress the ball in the fuel connector until any remaining fuel is expelled.

g. Add air to bring pressure back to 10 psi (69 kPa).

h. Close air release valve on acapter and remove Stevens Pressure Tester.

i. Submerge fuel tank in water, one portion at a time, in the same manner you would check a tire for air leaks. Any air bubbles indicate a leak point which must be repaired or replaced.

j. Disconnect hose from tank. With fuel connector housing submerged, check for leakage from fuel nipple and fuel valve pin. See Figure 3-30. Depress vent valve pin to check air vent disc valve for leakage.

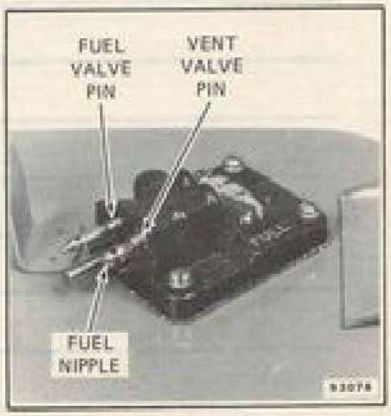


Figure 3-30. Fuel Connector Housing

k. After testing, open release valve on adapter to release tank pressure before removing cap.

NOTES

SECTION 4
IGNITION SYSTEM

TABLE OF CONTENTS

OMC SPECIAL TOOLS REQUIRED	
UNIVERSAL PULLER	PART NUMBER 378103
PISTON STOP	PART NUMBER 384887

TEST EQUIPMENT REQUIRED	
JUMPER WIRES (4)	NEON TESTER
SPARK TESTER	OR
OHMMETER	C.D. VOLTMETER TESTER
TIMING LIGHT	COIL TESTER

NOTE

If removing engine from boat, see NOTE on Table of Contents page i.

SAFETY WARNING

- Perform all ignition coil tests on a wooden or insulated bench top to prevent leakage or shock hazards.
- To avoid possible shock hazards, do not handle ignition coil or tester leads during output tests.

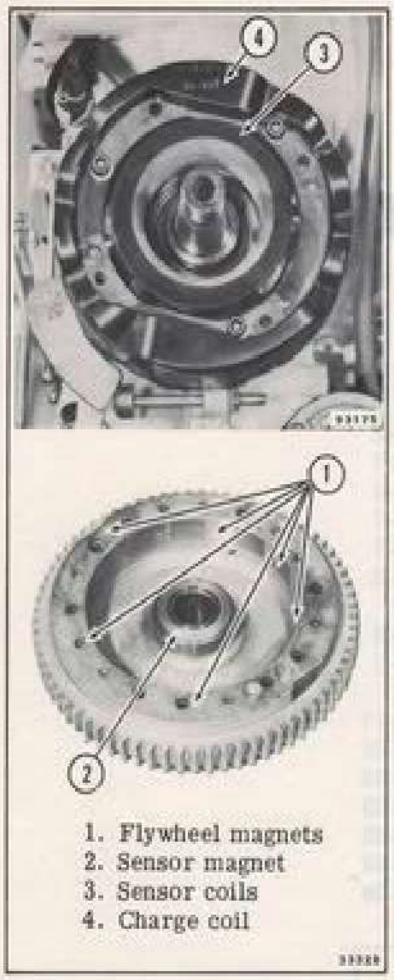


Figure 4-1. Flywheel and Stator Assembly

DESCRIPTION

The magneto capacitor discharge (CD) ignition system consists of five major components. They are:

1. Flywheel assembly, which contains six magnets cast into the flywheel 60° apart, and sensor magnets with two poles 180° apart located in the center hub. See Figure 4-1.

2. Stator and charge coil assembly, containing one charge coil for generating the alternating current feed to the power pack, and eight AC coils for battery charging.

3. Timer base and sensor coil assembly, containing three sensor coils 60° apart.

4. One power pack assembly containing the electronic circuits necessary to produce ignition at the proper time: capacitor charge circuit to store energy, and sensor circuit for triggering the capacitor discharge (CD) circuits.

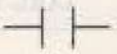
5. Ignition coils which generate the very high voltage required to ignite the fuel in each cylinder.

THEORY OF OPERATION

Simplified basic circuit illustrations support the theory of operation, and are intended for instructional use only. The theory of operation and schematics for the magneto capacitor discharge ignition system use the following three basic electronic components:

DIODE – A component in which current can flow only in one direction (as indicated by the arrow).

SILICON CONTROLLED RECTIFIER (SCR) – A component (such as a diode) in which current can flow through the SCR in one direction only (as indicated by the arrow), and in which the current can flow only when the GATE of the SCR receives a positive (+) input to trigger (or "turn-on") the SCR.



CAPACITOR – A component that stores voltage. One end of the capacitor is positive (+) and the other end is negative (-). The voltage is stored until the trigger circuit is activated.

CAPACITOR CHARGE CIRCUIT

When the magnet in the flywheel begins to pass the charge coil, the north pole of the magnet approaches the center lamination of the charge coil, creating magnetic lines of force to pass from the north pole through the coil and back to the south pole, inducing current flow from the charge coil. See Figure 4-2, part A.

Current flows from the charge coil through wire "a," which is positive (+), and enters the power pack, then flows through diode B, which applies a positive (+) charge to the ground side of the capacitor. Current flow is blocked by diodes A and C. On the return path, current flows from the capacitor to the charge coil through diode D and wire "b," part B. See Figure 4-2 part B.

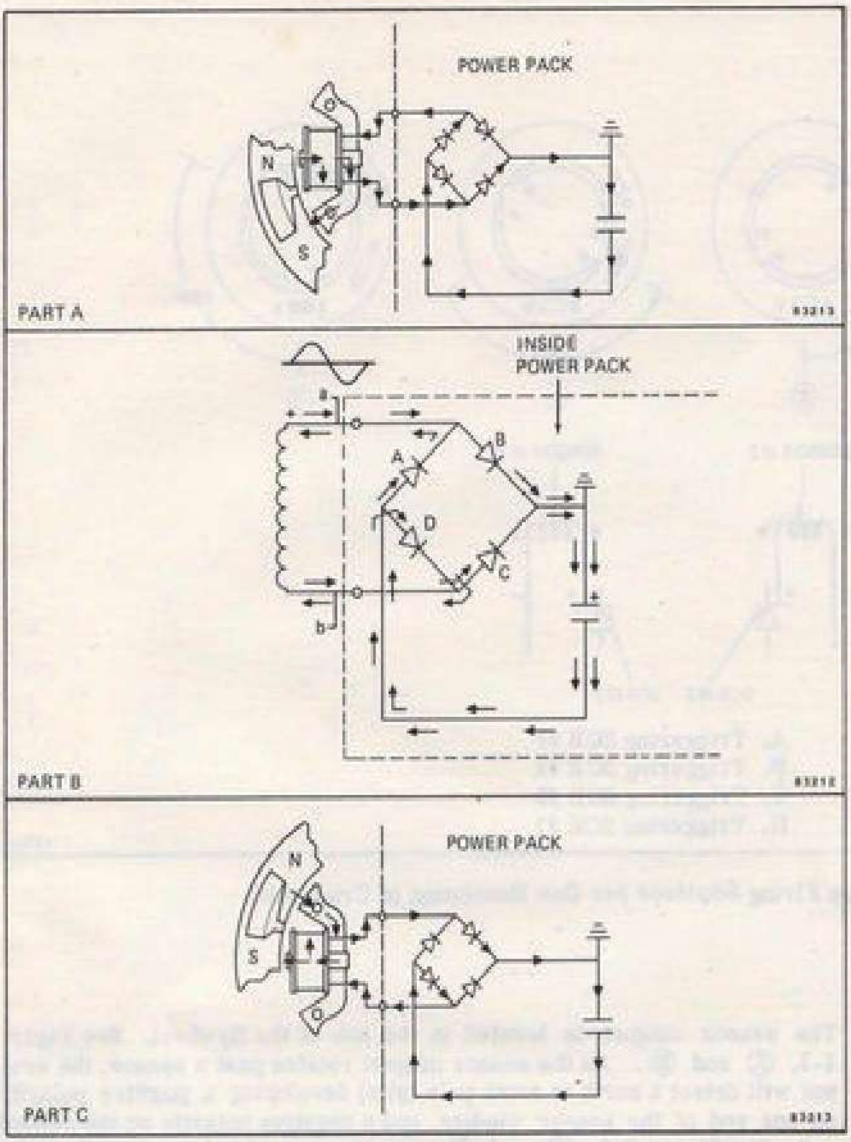


Figure 4-2. Capacitor Charge Circuit

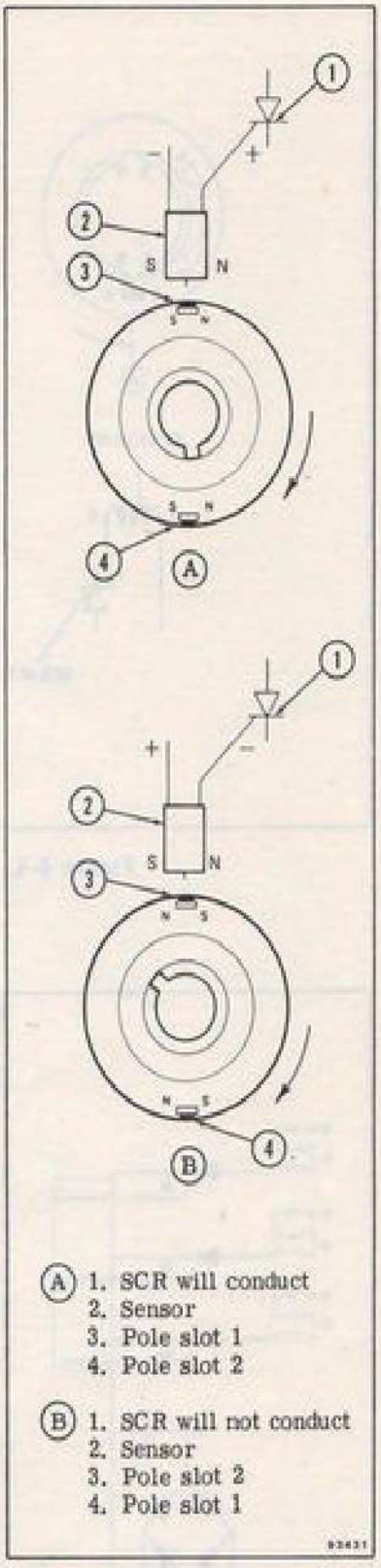


Figure 4-3. Sensor Magnet in Flywheel Hub

As the flywheel magnet moves further, the south pole of the magnet approaches the center laminations of the charge coil, causing the magnetic lines of force to reverse direction through the coil. The direction is from the north pole through the lamination to the south pole, inducing current flow from the charge coil in the opposite direction. See Figure 4-2, part C. Current flows from the charge coil through wire "b," which is positive (+), and enters the power pack, then flows through diode C, which applies a positive (+) charge to the ground side of the capacitor. Current flow is blocked by diodes D and B. On the return path, current flows from the capacitor to the charge coil through diode A and wire "a," shown in Figure 4-2, part B.

Alternating current from the charge coil has been changed (rectified) into direct current for capacitor charge by the four diodes. The diodes maintain a positive (+) charge on the ground side of the capacitor, regardless of the constantly changing charge coil output.

SENSOR CIRCUIT (TRIGGERING CIRCUIT) (See Figure 4-3)

The sensor circuit controls which SCR will turn on and allow the capacitor to discharge. The sensor coils, located under the flywheel, produce the signal necessary to turn on the SCR which controls the ignition timing.

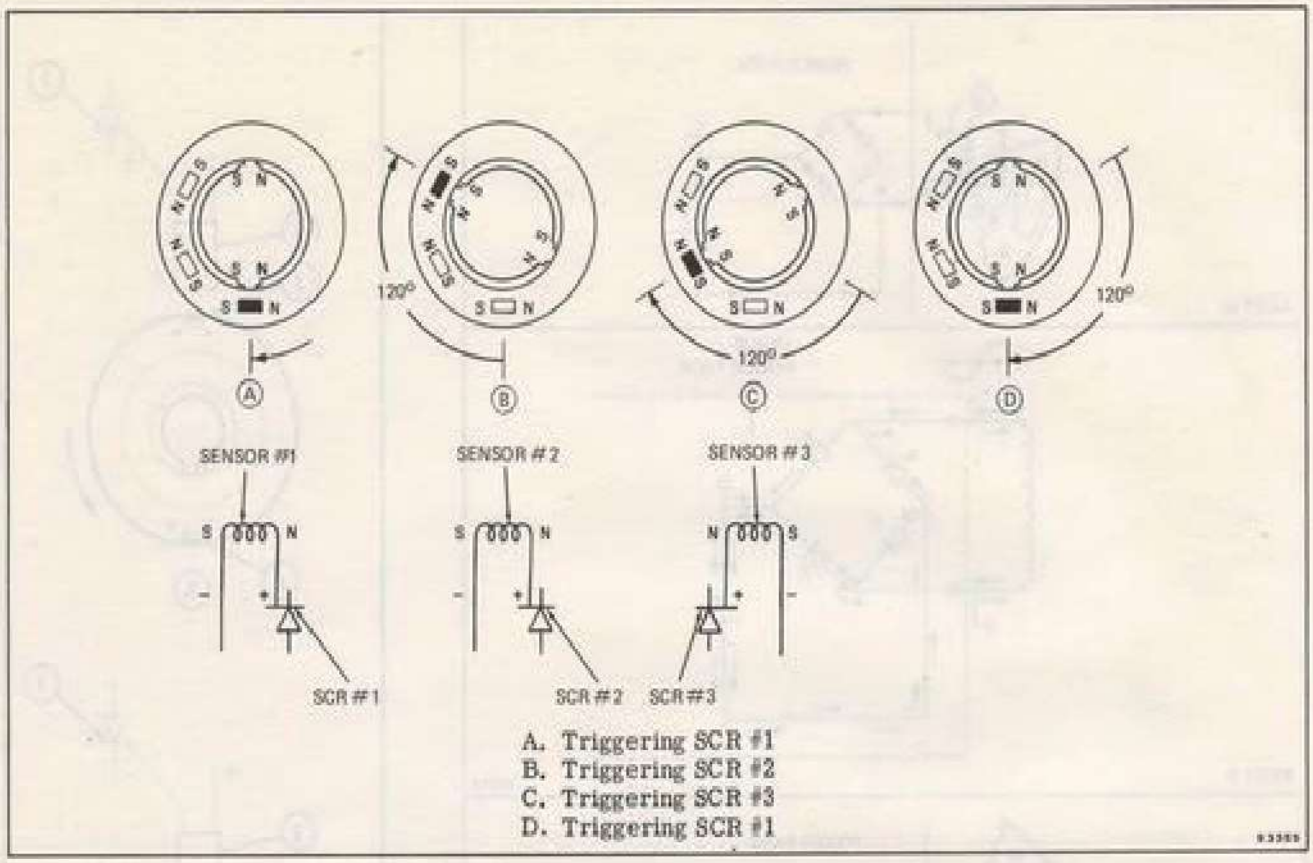


Figure 4-4. Ignition Firing Sequence per One Revolution of Crankshaft

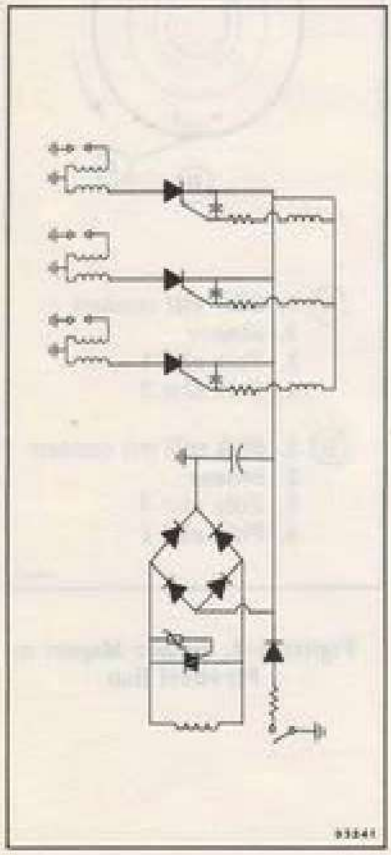


Figure 4-5. Ignition System Schematic

The sensor magnet is located in the hub of the flywheel. See Figure 4-3, Ⓐ and Ⓑ. As the sensor magnet rotates past a sensor, the sensor will detect a north to south pole (slot) developing a positive polarity on one end of the sensor winding, and a negative polarity on the second end. See Figure 4-3, Ⓐ and Ⓑ. As the magnet rotates 180° farther, the sensor will detect a south to north pole (slot) which develops a reverse polarity. The positive polarity is now on the second end and the negative on the one end. See Figure 4-4, Ⓑ. The SCR (Silicon Controlled Rectifier) located in the power pack will conduct only when the positive pulse is applied to its gate.

ENGINE BEGINS TO OPERATE (See Figures 4-4 Ⓐ and 4-4 Ⓑ)

As the magnet rotates, the first pole (slot) passes by #1 sensor coil, developing a positive electrical pulse which is applied to the gate of SCR #1. See Figure 4-4 Ⓐ.

The positive pulse turns on SCR #1 and the stored energy in the capacitor is discharged through the #1 ignition coil primary, through SCR #1 and back to the storage capacitor, inducing a high voltage into the ignition coil secondary, firing across the spark plug gap of cylinder #1. The firing SCR #1 then returns to its non-conducting state, and the storage capacitor is recharged.

The first pole (slot) of the magnet travels 120° from sensor #1, where it will pass sensor #2 developing a positive pulse to turn on SCR #2. See Figure 4-4 Ⓑ. The storage capacitor's energy is discharged through the #2 ignition coil primary, through SCR #2, and back to the capacitor, inducing a high voltage into the ignition coil secondary, firing across the spark plug gap of cylinder #2. SCR #2 returns to its non-conducting state, and the capacitor is recharged.

The second pole (slot) of the magnet, which is 180° away and of opposite polarity, travels 120° where it will pass sensor #3, Figure 4-4 Ⓒ, developing a positive pulse to turn on SCR #3. The storage capacitor's energy is discharged through the #3 ignition coil primary, through SCR #3, and back to the capacitor, inducing a high voltage into the ignition coil secondary, firing across the spark plug gap of cylinder #3. SCR #3 returns to its non-conducting state, and the capacitor is recharged.

All of this takes place on one revolution of the engine, and then the sequence begins all over again for the next revolution. See Figure 4-4Ⓓ.

CAPACITOR DISCHARGE (CD) CIRCUIT (See Figure 4-6)

When SCR #1 is triggered the positive (+) charge stored in the capacitor flows to engine ground, enters the #1 ignition coil through the grounded primary winding, and then flows through SCR #1 to the other side of the capacitor. See Figure 4-6.

During capacitor discharge, current flows through the ignition coil primary windings and SCR #1 until the capacitor is discharged and SCR #1 turns itself off. The capacitor can now be recharged as described in the capacitor charge circuit.

Current flowing through the #1 ignition coil primary winding produces a large magnetic field surrounding the secondary winding, and produces the high voltage to the spark plug, igniting the fuel in cylinder #1.

When SCR #2 is triggered, the same process fires cylinder #2. Then SCR #3 is triggered to fire cylinder #3 in the same manner.

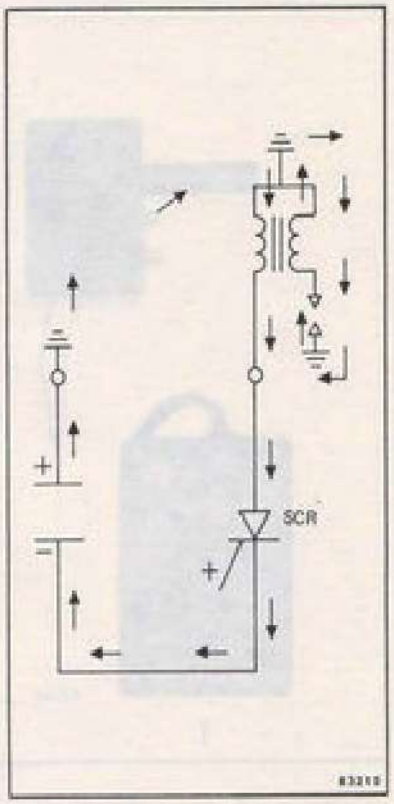


Figure 4-6. Capacitor Discharge

IGNITION STOP/KILL CIRCUIT (See Figure 4-7)

Since the capacitor is the "heart" of the ignition system, the key switch is used to prevent capacitor charge. One end of the capacitor is connected to engine ground. The key switch, when closed, will connect the other end of the capacitor to engine ground. When both ends of the capacitor are connected to engine ground, current flow from the charge coil will bypass the capacitor, as shown in Figure 4-7. When the capacitor is not "charged," ignition cannot occur.

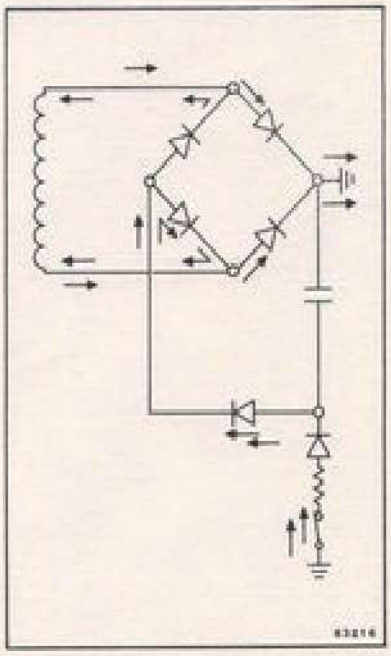


Figure 4-7. Ignition Kill Circuit

TROUBLESHOOTING THE CD SYSTEM

The magneto capacitor discharge ignition system is easy to troubleshoot. Remember these tips to obtain fast, accurate test results:

a. Visual Inspection — Check wiring for broken, pinched, or loose leads. Connectors should be securely fastened and free from moisture or water accumulation.

b. Test Equipment Condition — Be sure testers are in working order. Many hours can be wasted by replacing working components needlessly.

c. Follow Procedure — Troubleshooting can seem difficult if you vary your technique for each problem. Many times items in the system are overlooked because you "thought" you tested them. By following the same procedure each time you troubleshoot, all items in the ignition system are sure to be tested.

d. Test the Complete System — There may be occasions when more than one component is defective. If this condition is undetected, repeated ignition system failure may occur, or damage to replacement parts could result. Test everything.

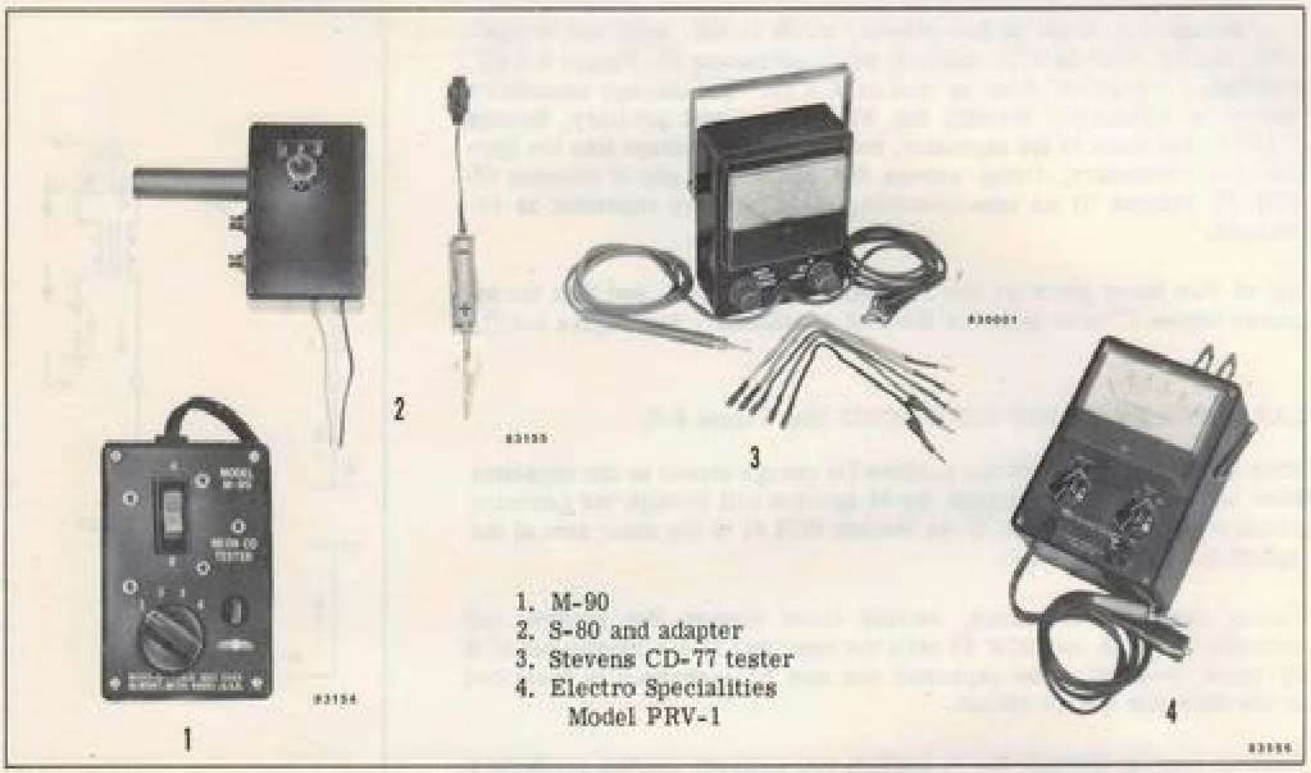


Figure 4-8. Ignition Testers

TEST EQUIPMENT REQUIRED

a. Spark tester with the air gap adjusted to 1/2" (12 mm).

b. Neon test light — Model M-80 or S-80 with 1-1/2 volt battery adapter, Model M-90 (no adapter required); CD-77 or PRV-1 voltmeter tester. See Figure 4-8.

c. Ohmmeter — capable of indicating low ohms (RX1) and high ohms (RX1,000).

d. Jumper wires (4 required). Jumper leads can be made as shown in Figure 4-9.

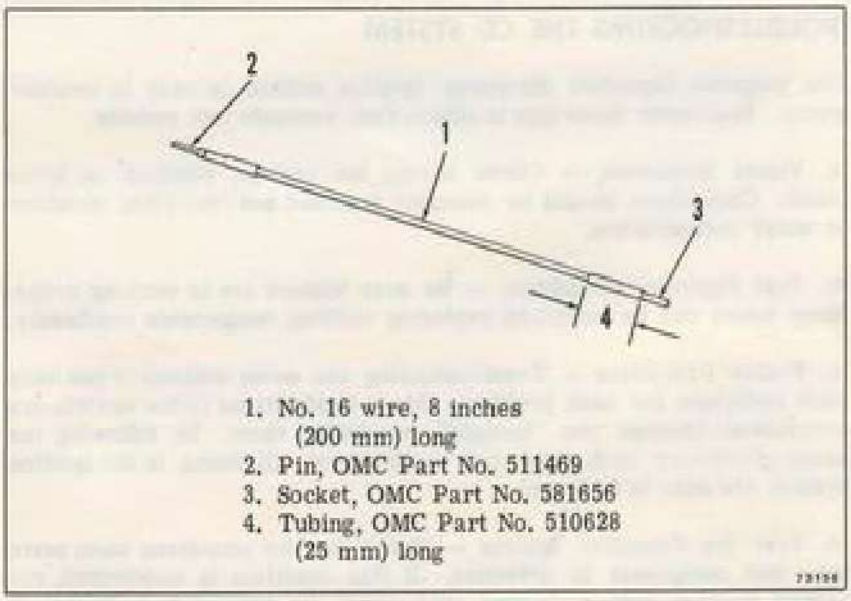
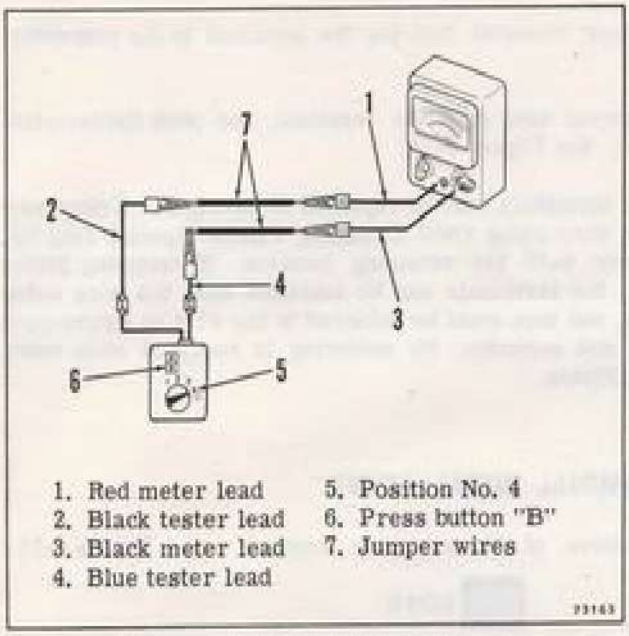
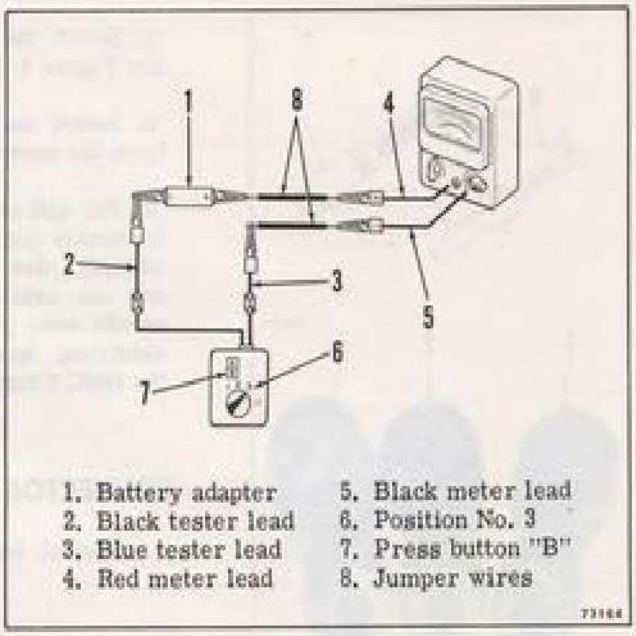


Figure 4-9. Jumper Wires



1. Red meter lead
2. Black tester lead
3. Black meter lead
4. Blue tester lead
5. Position No. 4
6. Press button "B"
7. Jumper wires

Figure 4-10. M-90 Neon Tester



1. Battery adapter
2. Black tester lead
3. Blue tester lead
4. Red meter lead
5. Black meter lead
6. Position No. 3
7. Press button "B"
8. Jumper wires

Figure 4-11. M-80 or S-80 Neon Tester

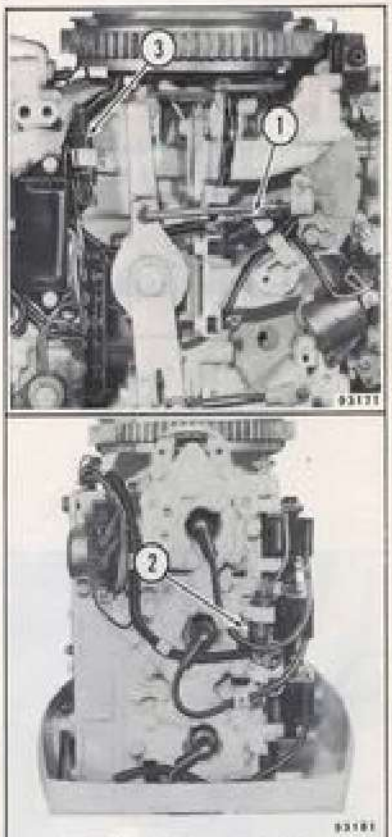
If using neon tester, check neon tester battery voltage as follows:

a. Model M-90 — Connect voltmeter as shown in Figure 4-10. Set switch to position 4, and press load button "B." Battery voltage should be a minimum of 2-1/2 volts.

b. Model M-80 or S-80 — Connect the 1-1/2 volt battery adapter to the neon tester black lead with negative (-) end toward the neon tester, and connect the voltmeter as shown in Figure 4-11. Set switch to position 3, and press load button "B." Battery voltage should be a minimum of 2-1/2 volts.

CONNECTOR PLUGS

Three waterproof connectors, male and female plug-in type, are utilized in the ignition system. A four-wire connector connects the sensor coil leads to the power pack. A four-wire connector connects the power pack leads to the ignition coils and kill switch. The two-wire connector connects the charge coil to the power pack. See Figure 4-12. Each connector is secured by a retainer. The retainer must be removed to unplug the connector.



1. Four-wire connector — sensor coils to power pack
2. Four-wire connector — power pack to ignition coils and kill switch
3. Two-wire connector — charge coils to power pack

Figure 4-12. Connector Plug Locations

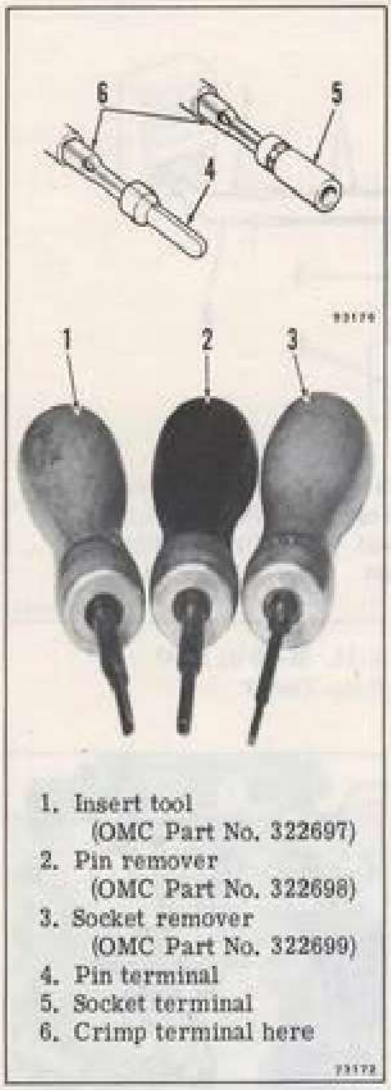
CONNECTOR TERMINAL REMOVAL

NOTE

Use the recommended lubricant for terminal removal. Substitutes may cause high resistance connections, short circuits between terminals, or have adverse effects on the connector material.

a. Apply isopropyl alcohol into the connector cavity at both ends to lubricate the terminal and connector.

b. Place the connector against the edge of a flat surface, and allow clearance for the terminal to be removed.



1. Insert tool (OMC Part No. 322697)
2. Pin remover (OMC Part No. 322698)
3. Socket remover (OMC Part No. 322699)
4. Pin terminal
5. Socket terminal
6. Crimp terminal here

Figure 4-13. Tools for Connector Terminals

c. Select the proper removal tool for the terminal in the connector. See Figure 4-13.

d. Insert the removal tool onto the terminal, and push the terminal from the connector. See Figure 4-14.

e. Pin and socket terminals may be replaced if damaged. Crimp new terminals onto the wire using OMC Crimping Pliers (Special Tool No. 322696). See Figure 4-13 for crimping location. If crimping pliers are not available, the terminals can be installed onto the wire using needle nose pliers, and then must be soldered to the wire to insure good electrical contact and security. No soldering is required when using the OMC Crimping Pliers.

CONNECTOR TERMINAL INSTALLATION

a. Connect both halves of the connector together. See Figure 4-15.

NOTE

Do not use grease or oil. Clean out any grease or oil that may be present in cavities.

b. Apply isopropyl alcohol into the connector cavity.

SAFETY WARNING

To avoid personal injury, securely hold insert tool against shoulder of terminal while installing terminals into connector cavity.

c. Position the insert tool against the shoulder of the terminal. See Figure 4-15.

d. Support the connector against a flat surface, and push the terminal into the connector until the shoulder on the insert tool is at the end of the connector. See Figure 4-16.

e. Reinstall wire retainer on connector.

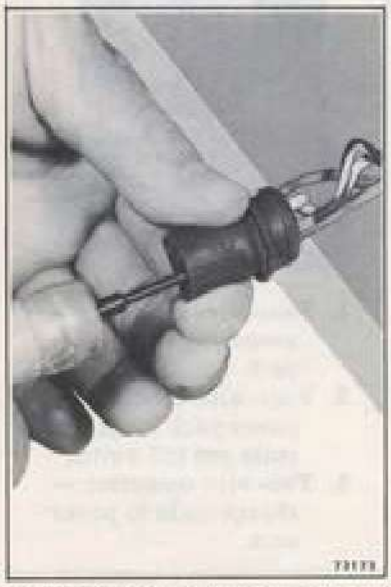


Figure 4-14. Removing Terminal from Connector

1. Insert tool
2. Shoulder on terminal
3. Joined connector

Figure 4-15. Insert Tool on Terminal

1. Shoulder on tool

Figure 4-16. Inserting Terminal

PRELIMINARY TROUBLESHOOTING THE CD IGNITION

A malfunction in the system will result in (1) engine miss, (2) engine surge, or (3) engine will not run.

1. Engine missing or surging may also be caused by insufficient, contaminated, or excessive fuel. After determining that this condition is not caused by carburetion, proceed (in order listed) to check the ignition system.

2. The spark plugs should be removed and examined. If the electrodes are worn, or if plug has a cracked insulator, or shows other signs of damage, it should be replaced. See Specifications, Section 2.

Connect the high tension lead wires to the spark plugs. Make sure that the spring clips in the spark plug lead covers make firm contact with the spark plug terminals. See Figure 4-17.

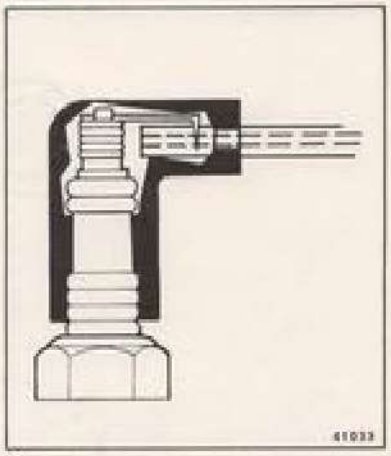


Figure 4-17. Correct Spark Plug Lead Installation

The cranking speed must be approx. 500 rpm.

SPARK TEST

a. Remove the high tension lead from each spark plug. To prevent damage to the spring terminal on the high tension lead, twist and pull on the cover. See Figure 4-17.

b. Adjust the air gap of the spark tester to 1/2" (12 mm), and connect the tester leads to the high tension leads. Secure the other end of the spark tester to a clean engine ground. See Figure 4-18.

NOTE

To prevent possible arcing of high voltage, position the tester leads at least 2" (50 mm) from any metal surface.

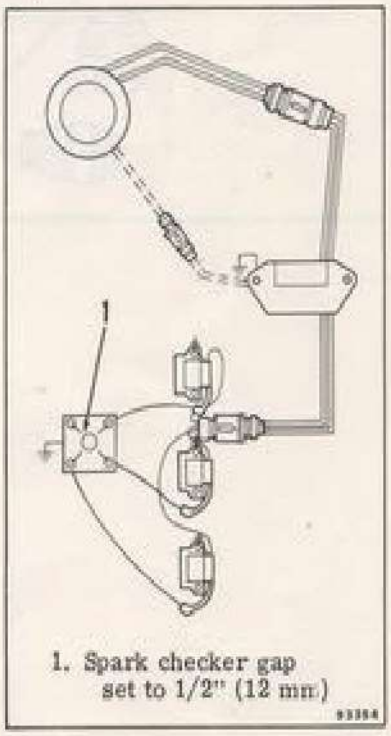
SAFETY WARNING

To avoid possible shock hazards, do not handle ignition coil or tester leads during this test.

c. Crank the engine and observe the results at the spark tester.

d. If a spark jumps at all gaps, alternately the ignition system is OK. Check the spark plugs and other engine systems.

e. If there is no spark, continue the troubleshooting procedure.



1. Spark checker gap set to 1/2" (12 mm)

Figure 4-18. Checking Spark

IGNITION TEST PROCEDURE

NOTE

Check the power pack ground wire to be sure it is clean and securely grounded before troubleshooting.

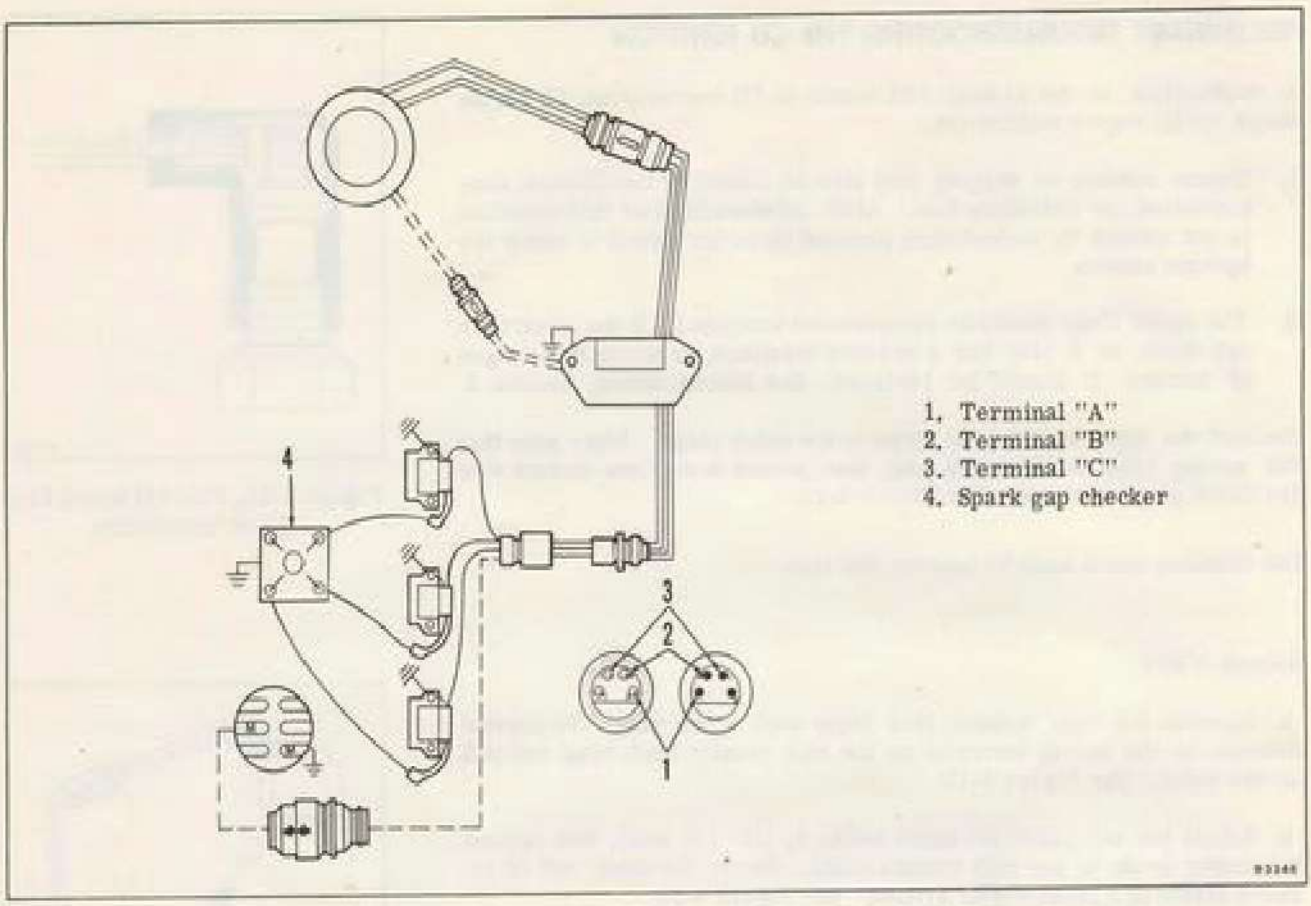


Figure 4-19. Key Switch Elimination Test

KEY SWITCH ELIMINATION TEST

a. Separate the four-wire connector that connects the power pack to the ignition coils and key switch. See Figure 4-19.

b. Insert a jumper wire between the "A" terminals of the four-wire connector. See Figure 4-19.

c. Insert a jumper wire between the "B" terminals of the four-wire connector. See Figure 4-19.

d. Insert a jumper wire between the "C" terminals of the four-wire connector. See Figure 4-19.

SAFETY WARNING

To avoid possible shock hazards, do not handle ignition coil or tester leads during this test.

e. Crank engine and observe the results at the spark tester.

f. If a spark jumps alternately at all gaps, the problem is in the key switch circuit. See "Key Switch Stop Circuit Test." If there is no spark, or a spark at only one gap, remove the jumper wires.

NOTE

Carefully align the connector halves during assembly to insure proper terminal contact.

g. Reconnect the four-wire connector and continue troubleshooting procedure.

OHMMETER TESTS

Ohmmeter tests are necessary to determine whether the sensor coil or charge coil have failed in a manner which could cause ignition failure.

NOTE

Resistance readings should be checked when the motor has completely cooled to ambient air temperature. The higher temperature, caused by running the motor, will increase the resistance reading and may result in unnecessary parts replacement.

SENSOR COIL TEST (OHMMETER)

a. Separate the four-wire connector between the timer base and power pack. See Figure 4-12.

b. Insert a jumper wire in "A" terminal of the timer base end. See Figure 4-20.

c. Insert a jumper wire in terminal "B" in the timer base end of the connector. See Figure 4-20.

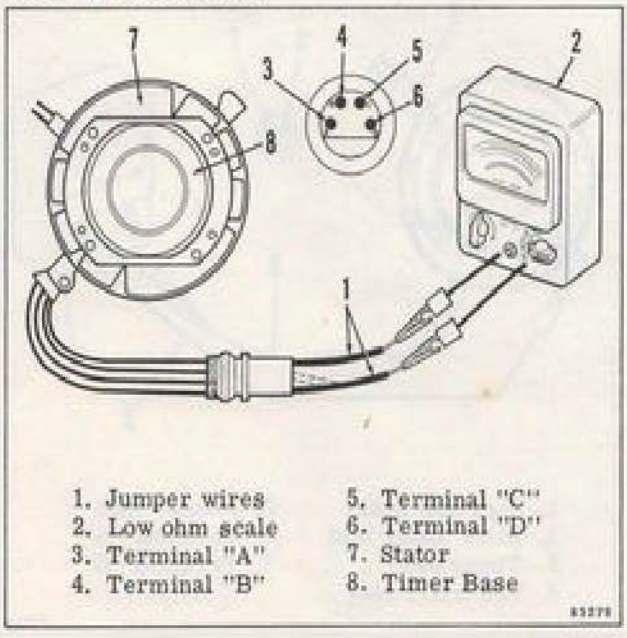
d. Insert a jumper into "C" terminal.

e. Insert a jumper into "D" terminal.

f. To test the resistance, connect an ohmmeter (calibrated on low ohm scale) between the "A" and "D" terminal jumper wires, then the "B" and "D" terminals. Then "C" and "D" terminals. The sensor coil resistance is good if the meter indicates 17 ± 5 ohms. Replace the sensor coil if the resistance reading is not within this range. See Figure 4-20.

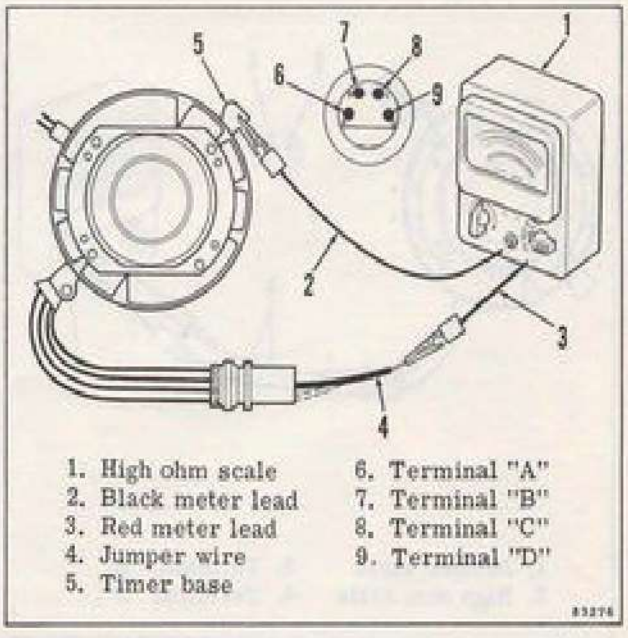
g. To test for shorts to ground, calibrate the ohmmeter to high ohm scale. Connect the black meter lead (-) to the timer base (ground). Attach the red meter lead (+) to the "A" terminal, then "B," then "C," then "D," jumper wire in the connector. See Figure 4-21. Any needle movement indicates the sensor coil or leads are shorted to ground. A shorted sensor must be replaced, or the grounded lead repaired to remove the shorted condition.

h. Remove the jumper wires from the connector and continue the troubleshooting procedure.



1. Jumper wires
2. Low ohm scale
3. Terminal "A"
4. Terminal "B"
5. Terminal "C"
6. Terminal "D"
7. Stator
8. Timer Base

Figure 4-20. Sensor Coil Resistance



1. High ohm scale
2. Black meter lead
3. Red meter lead
4. Jumper wire
5. Timer base
6. Terminal "A"
7. Terminal "B"
8. Terminal "C"
9. Terminal "D"

Figure 4-21. Sensor Coil Shorts to Ground

CHARGE COIL TEST (OHMMETER)

a. Separate two wire connector (CHARGE COIL).

b. Insert a jumper wire to terminal "A" in the stator end of the 2-wire connector. See Figure 4-22.

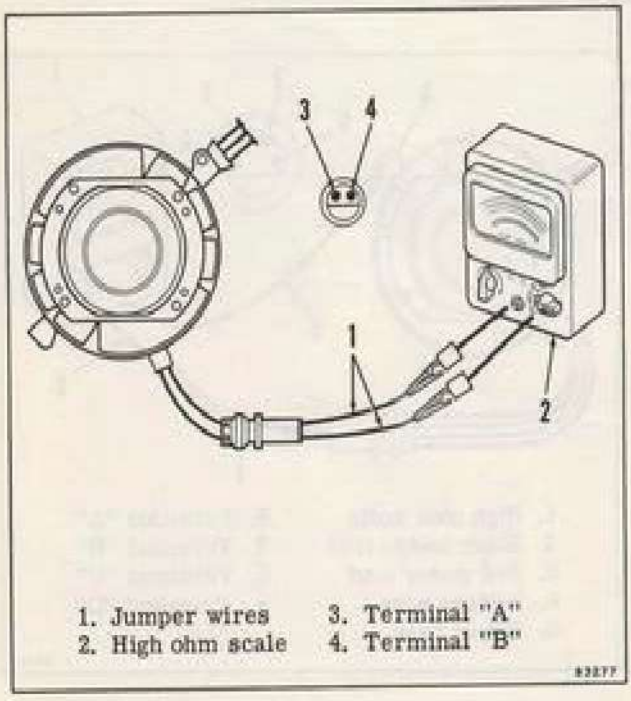
c. Insert a jumper wire to terminal "B" in the stator end of the connector. See Figure 4-22.

d. To test the resistance, connect an ohmmeter (calibrated to high ohm scale) between the two jumper wires. The charge coil resistance should be 550 ± 75 ohms.

e. To test for shorts to ground, calibrate the ohmmeter to high ohm scale. Connect the black meter lead (-) to the timer base (ground). Attach the red meter lead (+) to the "A" terminal jumper wire in the connector. See Figure 4-23. Observe the meter. Then move red lead to "B" terminal.

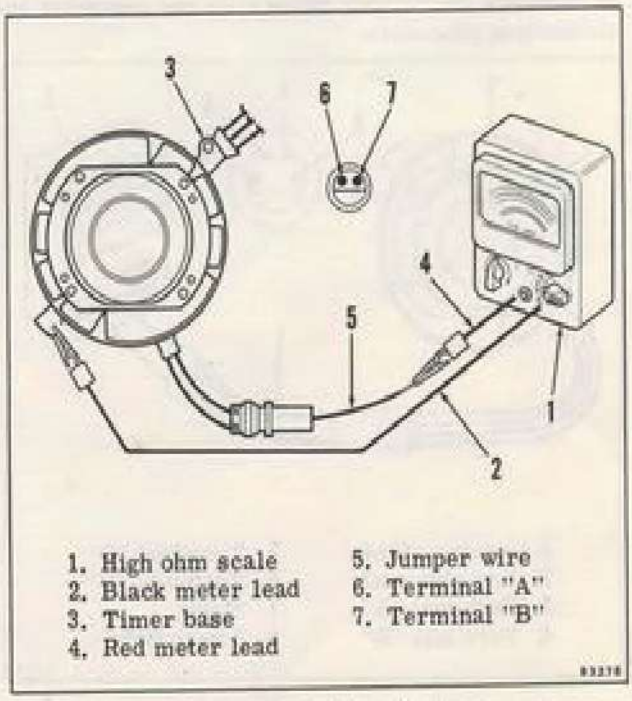
Any needle movement indicates the charge coil or leads are shorted to ground. A shorted charge coil must be replaced, or the grounded lead repaired to remove the shorted condition.

f. Do not remove the jumper wires from the connector, and continue the troubleshooting procedure.



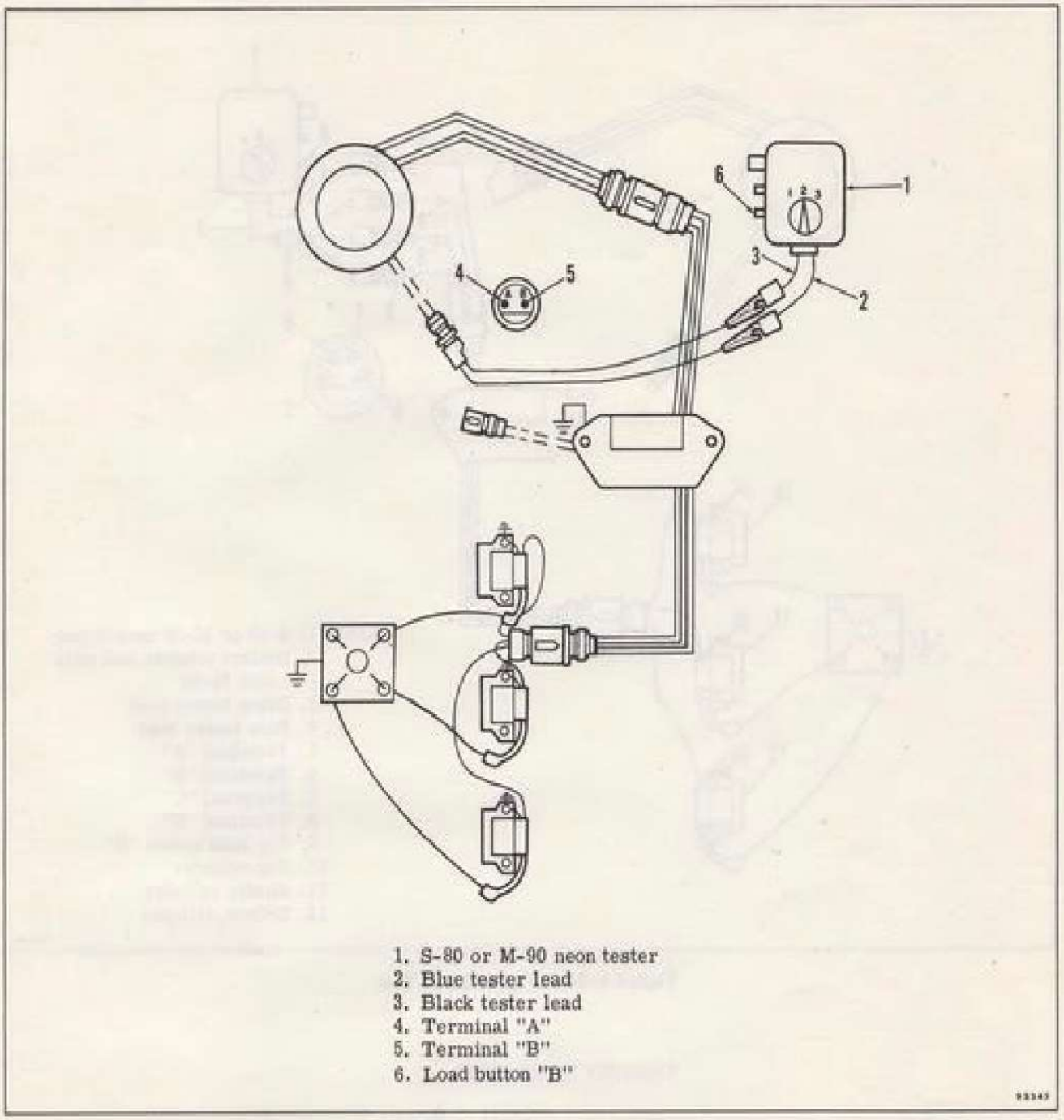
1. Jumper wires
2. High ohm scale
3. Terminal "A"
4. Terminal "B"

Figure 4-22. Charge Coil Resistance



1. High ohm scale
2. Black meter lead
3. Timer base
4. Red meter lead
5. Jumper wire
6. Terminal "A"
7. Terminal "B"

Figure 4-23. Charge Coil Shorts to Ground



1. S-80 or M-90 neon tester
2. Blue tester lead
3. Black tester lead
4. Terminal "A"
5. Terminal "B"
6. Load button "B"

Figure 4-24. Charge Coil Output Test

CHARGE COIL OUTPUT TEST

a. Insert a jumper wire to terminals "A" and "B" in the stator end of the two-wire connector. See Figure 4-25.

b. Connect the neon tester leads to the jumper wires as shown. See Figure 4-24.

c. Set neon tester switch to position number 2. Press load button "B".

d. Crank the engine and observe the light in neon tester. If the neon light flashes, the charge coil is good. If there is no light, replace the charge coil and repeat the charge coil output test.

e. Continue the troubleshooting procedure.

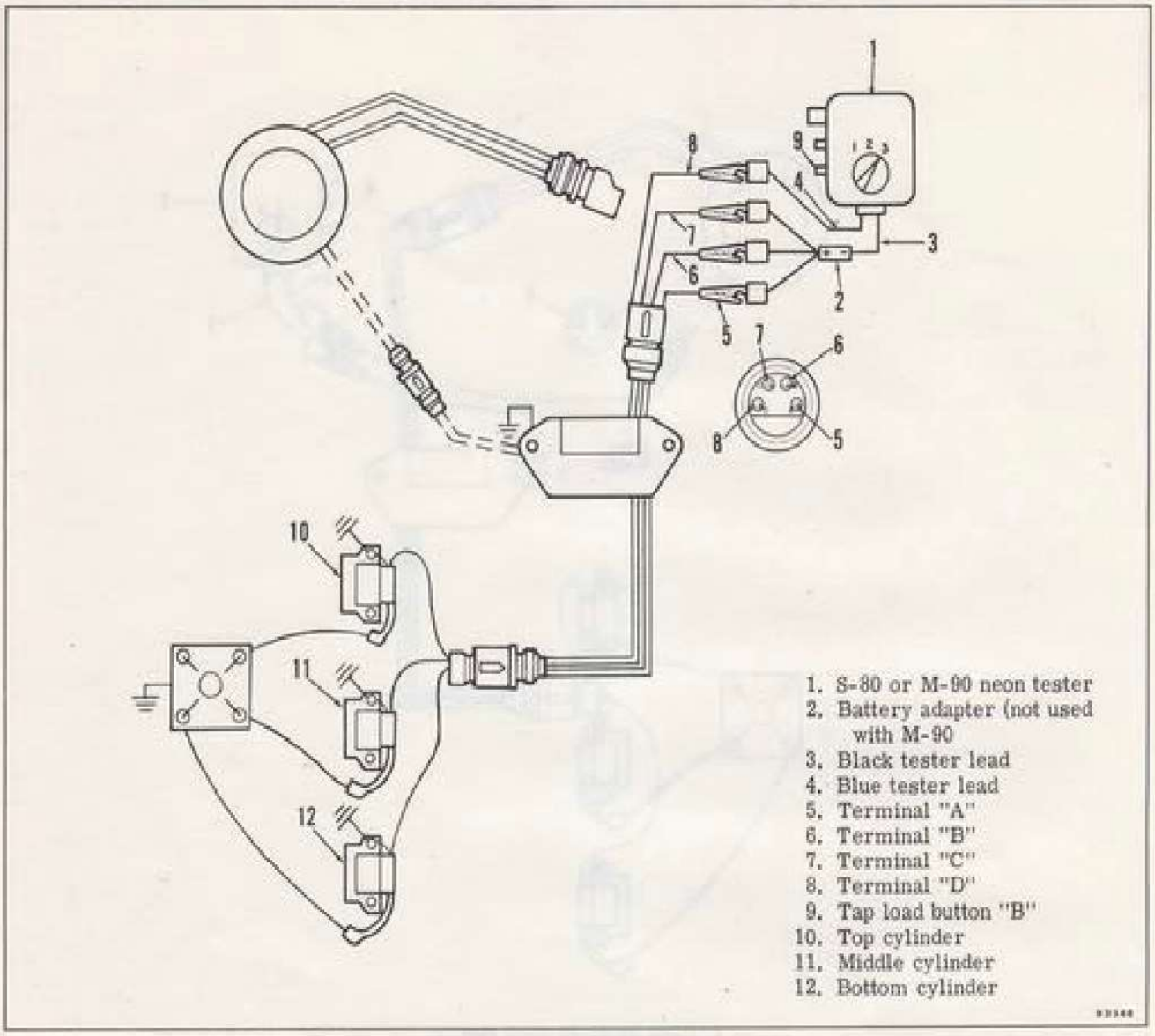


Figure 4-25. Trigger Input Test

TRIGGER INPUT TEST

SAFETY WARNING

To avoid possible shock hazards, do not touch the terminal ends of the jumper wires while making connections to the power pack, or when cranking the engine.

a. Reconnect charge coil connector.

b. Separate four-wire connector between time base and power pack.

c. Attach a jumper wire to the blue lead of the neon tester, then insert the jumper wire to terminal "D" in the power pack end of the four-wire connector. See Figure 4-25.

d. Connect a jumper wire to the positive (+) side of the battery adapter (on M-90 neon testers, connect the jumper wire directly to the black

lead of the tester), and insert the jumper wire to terminal "C" in the power pack end of the four-wire connectors. See Figure 4-25.

e. Set M-80 or S-80 neon tester switch to position number 3 or set M-90 neon tester switch to position number 4.

f. Crank the engine and tap load button "B." When load button "B" is pressed, spark should jump at the gap of the spark tester connected to button ignition coil only. See Figure 4-25. If a spark occurs at other gaps of the spark tester during this test, replace the power pack.

g. Remove the jumper wire from terminal "C" and put it on terminal "B" in the power pack end of the four-wire connector, and repeat step e. to fire middle ignition coil.

h. Remove the jumper wire from terminal "B" and put it on terminal "A" in the power pack end of the four-wire connector, and repeat step e. to fire top ignition coil.

i. If a spark occurred during each trigger input test, the sensor coil is defective. If there was no spark, or a spark occurred on one trigger input test but not the other, continue the troubleshooting procedure.

NOTE

Carefully align the connector halves during assembly to insure proper terminal contact. Isopropyl alcohol may be used as a lubricant to ease assembly of the connector.

j. Remove the jumper wires and reconnect the four-wire connector.

NOTE

Perform IGNITION COIL OHMMETER TEST prior to the POWER PACK OUTPUT TEST.

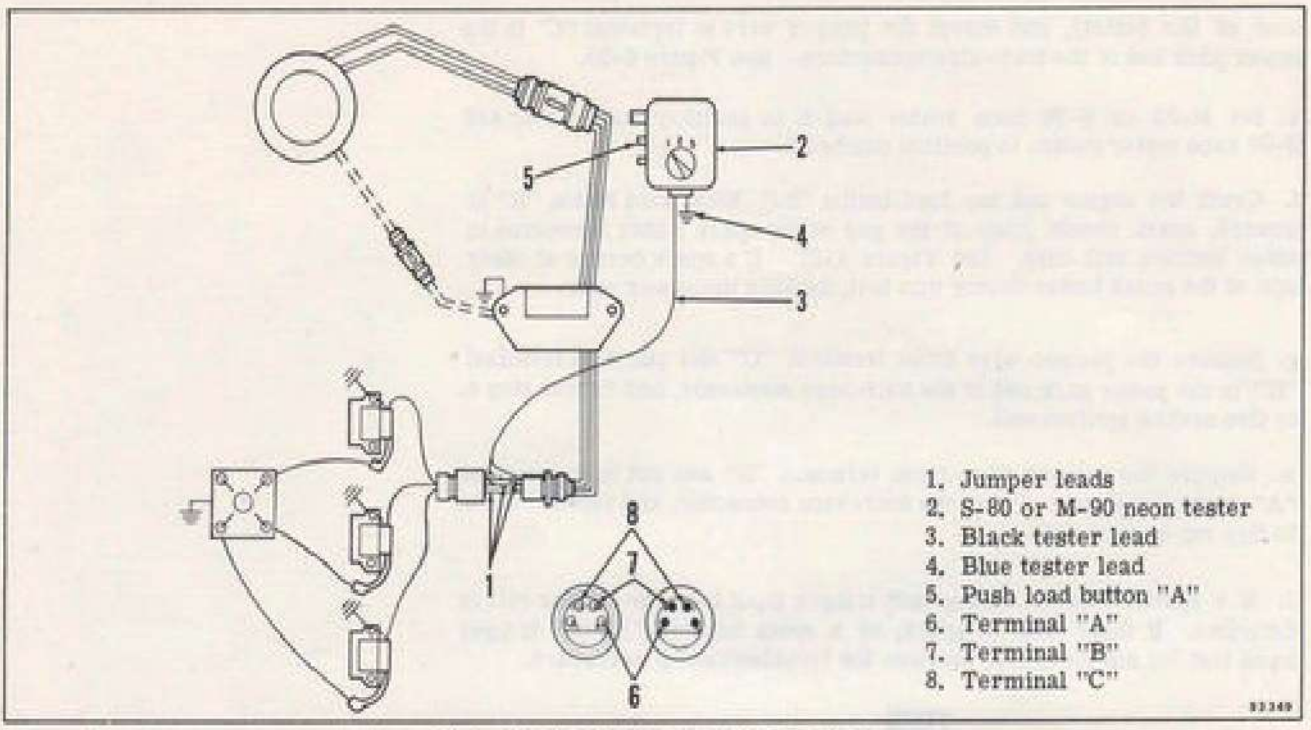


Figure 4-26. Power Pack Output Test

POWER PACK OUTPUT TEST

a. Separate the four-wire connector between the power pack and ignition coils.

b. Insert a jumper between the "B" terminals of both four-wire connectors. See Figure 4-26. Insert a jumper wire between the "C" terminals of both four-wire connectors.

c. Connect the neon tester blue lead to a clean engine ground.

d. Connect a jumper wire to the neon tester black lead, and insert the jumper wire to terminal "A" in the power pack end of the connector. See Figure 4-26.

e. Set the neon tester switch to position number 1.

f. While holding load button "A" depressed, crank engine and observe the light in the neon tester.

g. Remove jumper from between "B" terminals and remove tester black lead.

h. Insert jumper lead between "A" terminals of both connectors. Connect tester black lead to "B" terminal in power pack connector.

i. While holding load button "A" depressed, crank engine and observe the light in the neon tester.

j. Remove jumper from between "C" terminals and remove tester black lead.

k. Insert jumper lead between "B" terminals of both connectors. Connect tester black lead to "C" terminal in power pack connector.

l. While holding load button "A" depressed, crank engine and observe the light in the neon tester. If neon light flashes on each output test, the power pack is good. Check the ignition coils. If the neon light does not flash, or flashes on only one output test, replace the power pack, and repeat the power pack output test. The power pack can be substituted with a known good pack. (Be sure power pack ground lead is securely grounded to the power head.)

m. Check all wires and terminals for proper location, and secure the connectors with retaining clamps.

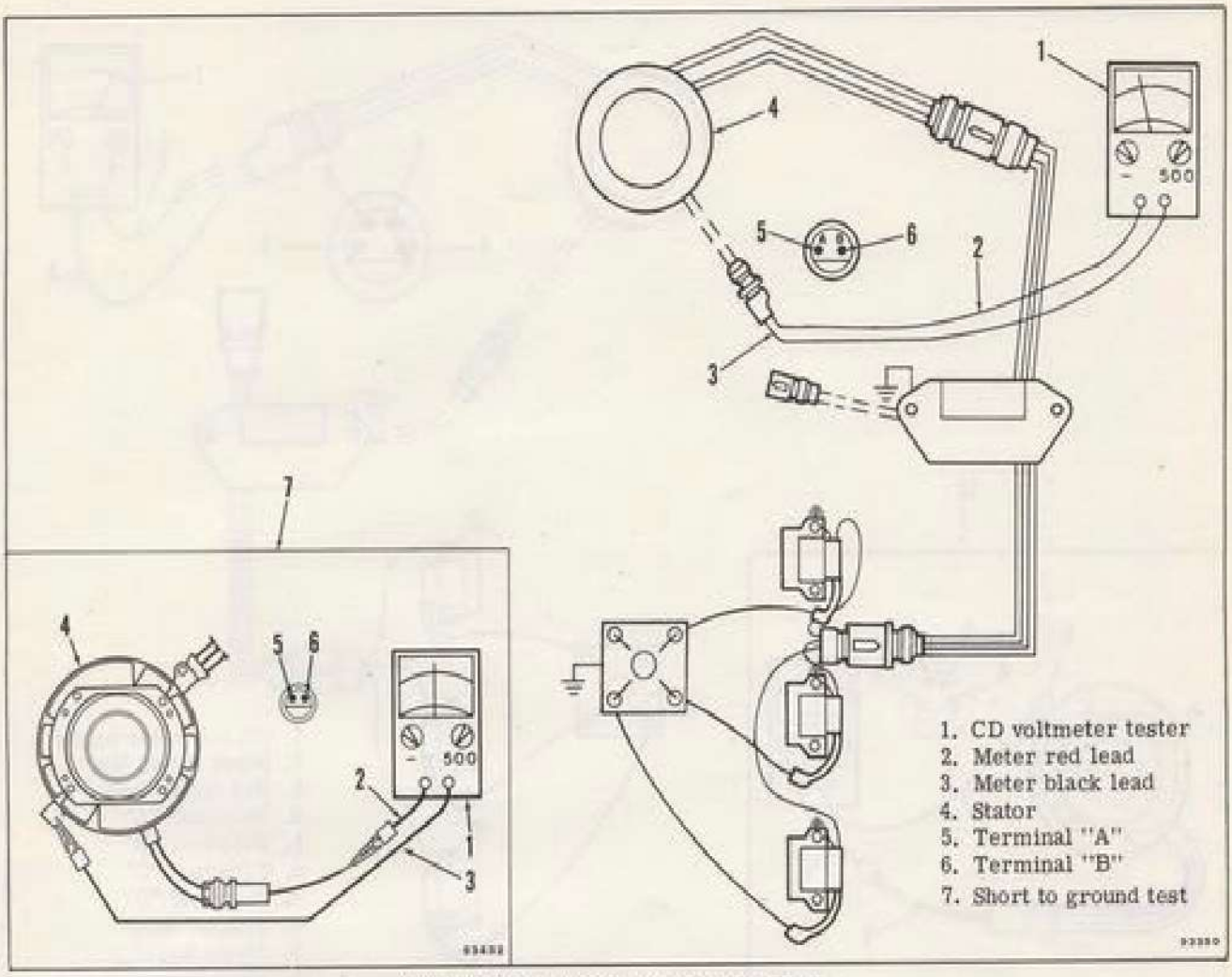


Figure 4-27. Charge Coil Output Test

IGNITION SYSTEM TESTS USING CD VOLTMETER TESTER

NOTE

Before conducting these tests be sure to do the Key Switch Elimination Test and the Ohmmeter Tests.

CHARGE COIL OUTPUT

a. Set meter switches to negative and 500.

b. Disconnect two-wire connector between stator and power pack.

c. To test for shorts to ground, set meter switches to (-) 500 scale. Connect the black meter lead (-) to the timer base (ground). Attach the red meter lead (+) to the "A" terminal jumper wire in the connector. See Figure 4-27. Observe the meter. Then move red lead to "B" terminal.

d. Any needle movement indicates the charge coil or leads are shorted to ground. A shorted charge coil must be replaced, or the grounded lead repaired to remove the shorted condition.

e. To check charge coil output, insert meter black lead probe into cavity "A" of connector from stator. Insert meter red lead probe into cavity "B" of connector. See Figure 4-27.

f. Crank engine and observe reading.

g. If meter reading is 220 or higher, go to Sensor Coil Output Test.

h. If low or no reading, check resistance of charge coil. If resistance does not meet specifications, replace charge coil.

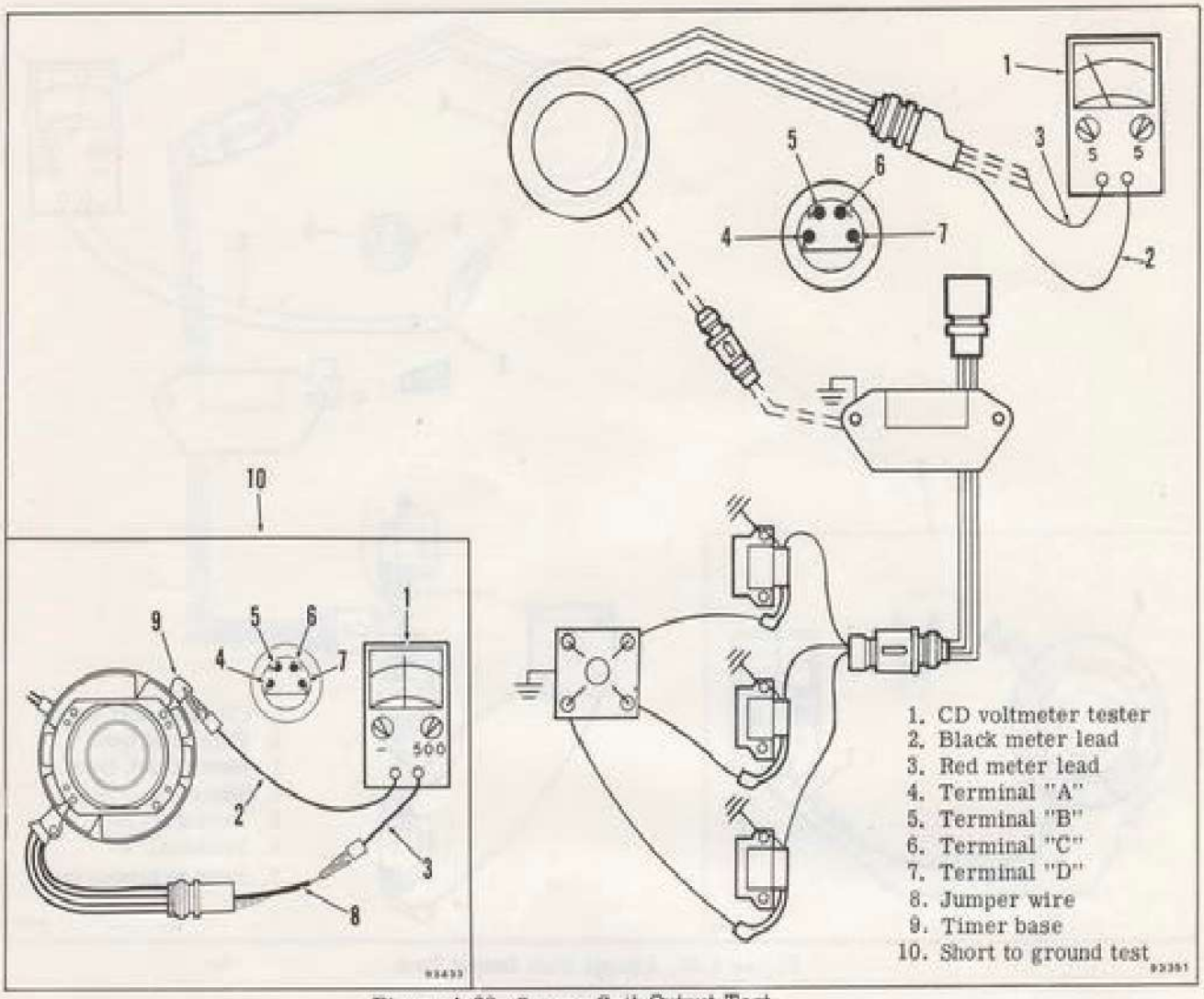


Figure 4-28. Sensor Coil Output Test.

SENSOR COIL OUTPUT TEST

a. Set meter switches to "S" and 5. Separate four-wire connector between timer base and power pack. To test for shorts to ground. Connect the black meter lead (-) to the timer base (ground). Attach the red meter lead (+) to the "A" terminal, then "B," then "C," then "D," jumper wire in the connector. See Figure 4-28. Any needle movement indicates the sensor coil or leads are shorted to ground. A shorted sensor must be replaced, or the grounded lead repaired to remove the shorted condition.

b. To test sensor coil output, insert meter black lead probe into cavity "D" of four-wire connector from timer base.

c. Insert meter red lead probe into cavity "A" of four-wire connector from timer base. See Figure 4-28.

d. Crank engine and observe meter reading.

e. Move meter red lead from cavity "A" to cavity "B" of the connector.

f. Crank engine and observe meter reading.

g. Move meter red lead from cavity "B" to cavity "C" of the connector.

h. Crank engine and observe meter reading.

i. Meter should read 0.4 or higher. If it does not, sensor coil maybe bad. Engine rpm may be too low or sensor magnet maybe weak.

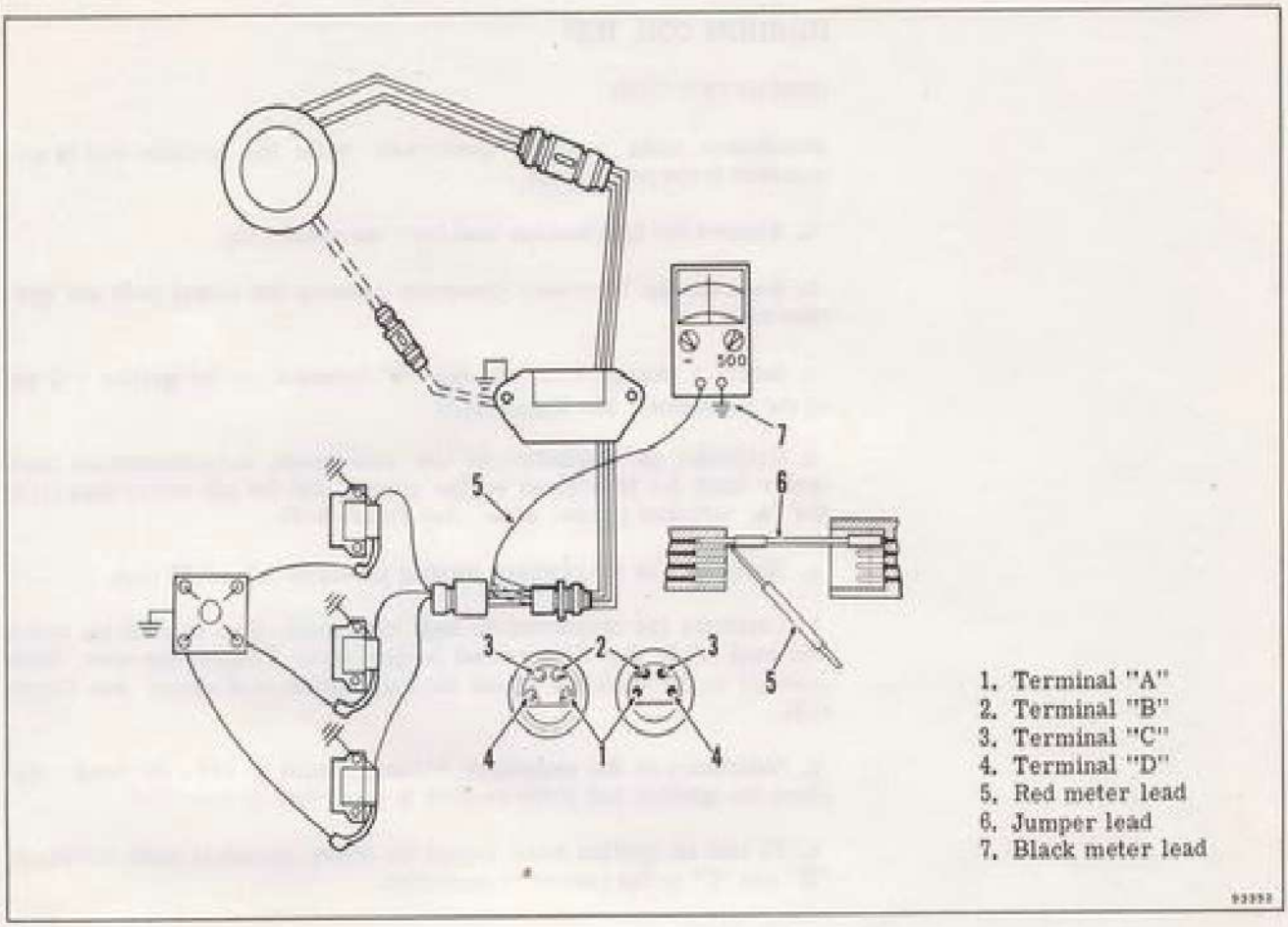


Figure 4-29. Power Pack Output Test

POWER PACK OUTPUT

a. Set meter switches to negative and 500.

b. Disconnect four-wire connector between power pack and ignition coils.

c. Insert jumper leads between "A" terminals of connectors. See Figure 4-29.

d. Insert jumper leads between "B" terminals of connectors.

e. Insert jumper leads between "C" terminals of connectors. Connect meter black lead to engine ground.

f. Connect meter red lead to metal part of jumper lead coming from power pack cavity "A." Crank engine. Observe meter reading.

g. Connect meter red lead to metal part of jumper lead coming from power pack cavity "B." Crank engine. Observe meter reading.

h. Connect meter red lead to metal part of jumper lead cavity "C." Crank engine. Observe meter reading.

i. If meter reads 260 or higher, check ignition coil or coils.

j. If meter does not read 260 or higher on one output, remove jumper lead from that cavity of connector from power pack. Insert meter red lead into that cavity. Crank engine. If meter reads 260 or higher, ignition coil is defective. If meter does not read 260 or higher, power pack is defective.

IGNITION COIL TEST

OHMMETER TEST

Resistance tests may be performed while the ignition coil is still mounted to the power head.

a. Remove the high tension lead from the spark plug.

b. Separate the four-wire connector between the power pack and ignition coils.

c. Insert a jumper wire into the "A" terminal on the ignition coil end of the connector. See Figure 4-30.

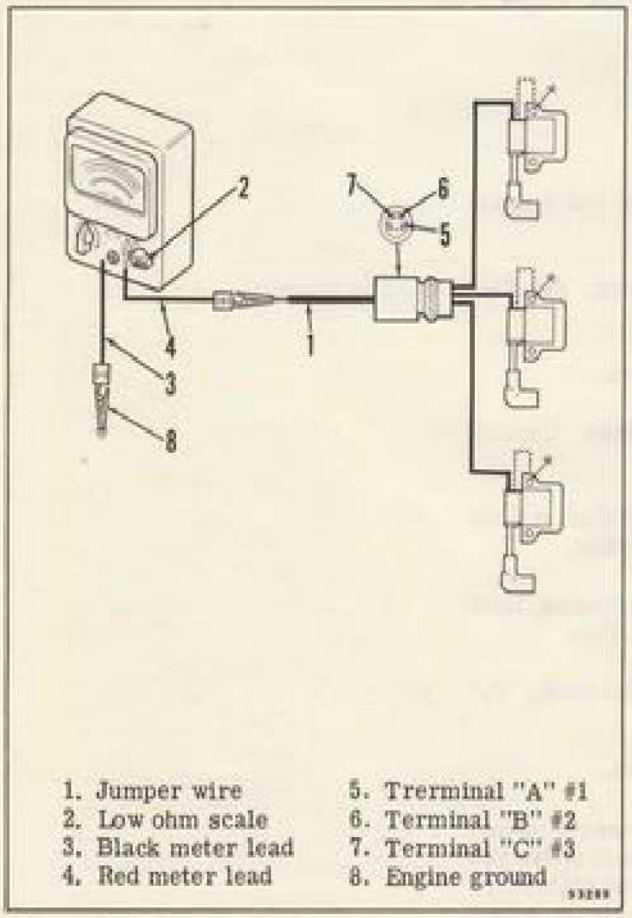
d. Calibrate an ohmmeter to low ohm scale, then connect the black meter lead (-) to a clean engine ground, and the red meter lead (+) to the "A" terminal jumper wire. See Figure 4-30.

e. Resistance of the primary winding should be 0.1 ± 0.05 ohm.

f. Calibrate the ohmmeter to high ohm scale, then connect the meter red lead (+) to the "A" terminal jumper wire. Connect the meter black lead (-) to the terminal inside the high tension lead cover. See Figure 4-31.

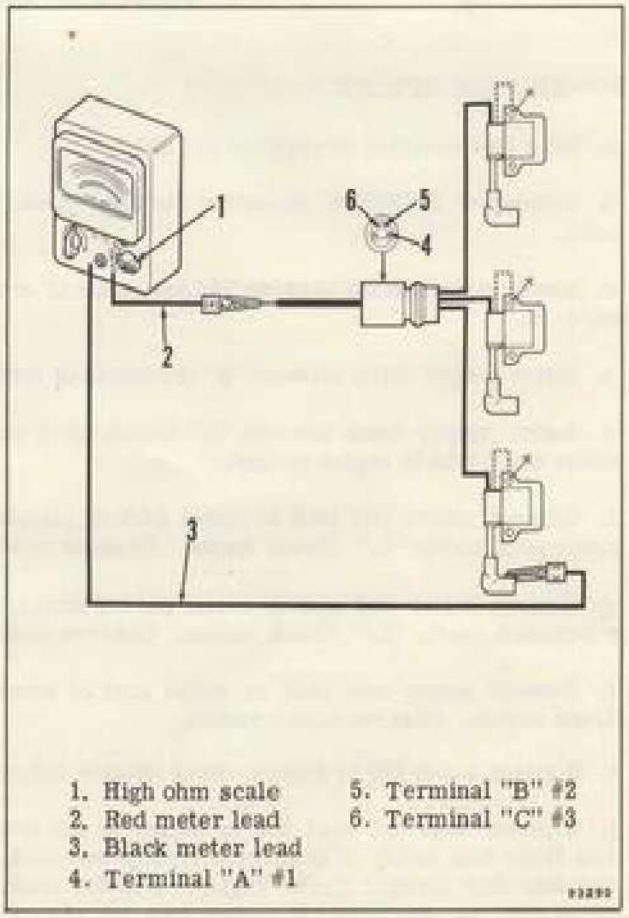
g. Resistance of the secondary winding should be 275 ± 50 ohms. Replace the ignition coil if the reading is other than as specified.

h. To test all ignition coils, repeat the above procedure using terminals "B" and "C" in the four-wire connector.



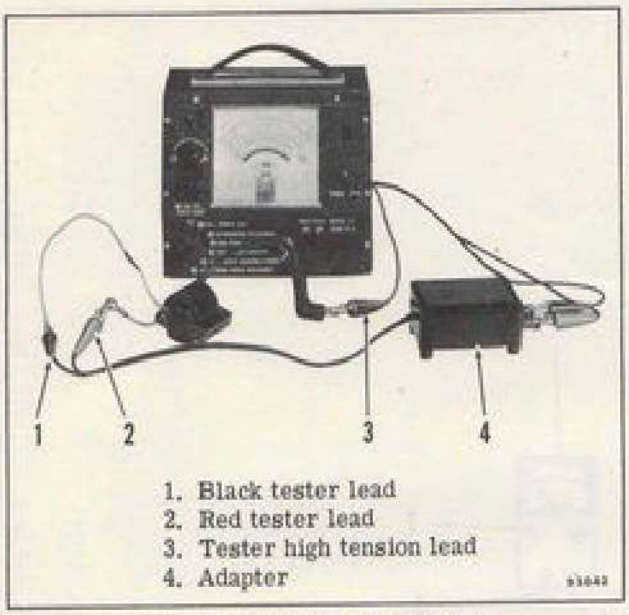
1. Jumper wire
2. Low ohm scale
3. Black meter lead
4. Red meter lead
5. Trerminal "A" #1
6. Terminal "B" #2
7. Terminal "C" #3
8. Engine ground

Figure 4-30. Primary Winding Resistance



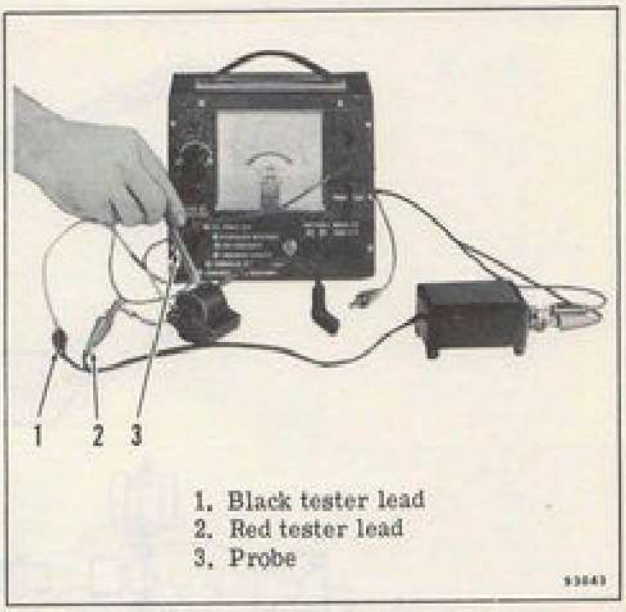
1. High ohm scale
2. Red meter lead
3. Black meter lead
4. Terminal "A" #1
5. Terminal "B" #2
6. Terminal "C" #3

Figure 4-31. Secondary Winding Resistance



1. Black tester lead
2. Red tester lead
3. Tester high tension lead
4. Adapter

Figure 4-32. Coil Power Test



1. Black tester lead
2. Red tester lead
3. Probe

Figure 4-33. Coil Leakage Test

POWER TEST

A wide variety of ignition testers is available from various manufacturers. In addition, some automotive testers having the proper specifications can be used. The use of the Graham, Merc-O-Tronic, or Stevens ignition tester is recommended.

Detailed instructions for the use of any tester are provided with the unit; therefore, only general information is given here. See Coil Specifications, Section 2.

IGNITION COIL TESTING (IGNITION COIL MUST BE REMOVED FROM POWER HEAD FOR POWER AND LEAKAGE TESTING.)

SAFETY WARNING

To avoid possible shock hazards and to prevent leakage, perform all tests to the coil on a wooden or insulated bench top.

If the ignition coil is good, the tester's meter will fall within the good area, with the primary circuit adjusted as specified. Connect the test leads from the ignition tester to the coil.

Connect the black lead of the tester to the orange lead of the ignition coil and the tester's red lead to the coils orange/black stripe ground lead. Connect the high tension lead of the tester to the high tension lead (secondary) of the ignition coil. With the tester set to coil index (or operating amperage — Merc-O-Tronic illustrated) adjusted as specified, note meter reading. See Figure 4-33. A low reading on the tester indicates a weak coil which must be replaced. A dead coil will show no reading.

LEAKAGE TEST

Ignition coil and high tension leads may be tested for leakage or insulation failures using the ignition analyzer. Leakage is caused by moisture, cracks in the coil housing, or carbon paths. Connect the coil to the ignition tester per manufacturer's instructions. Probe entire surface of the coil and high tension leads. Flashover will be apparent wherever insulation has broken down. Replace any coil which shows leakage. See Figure 4-34. (High tension lead must be disconnected from tester.)

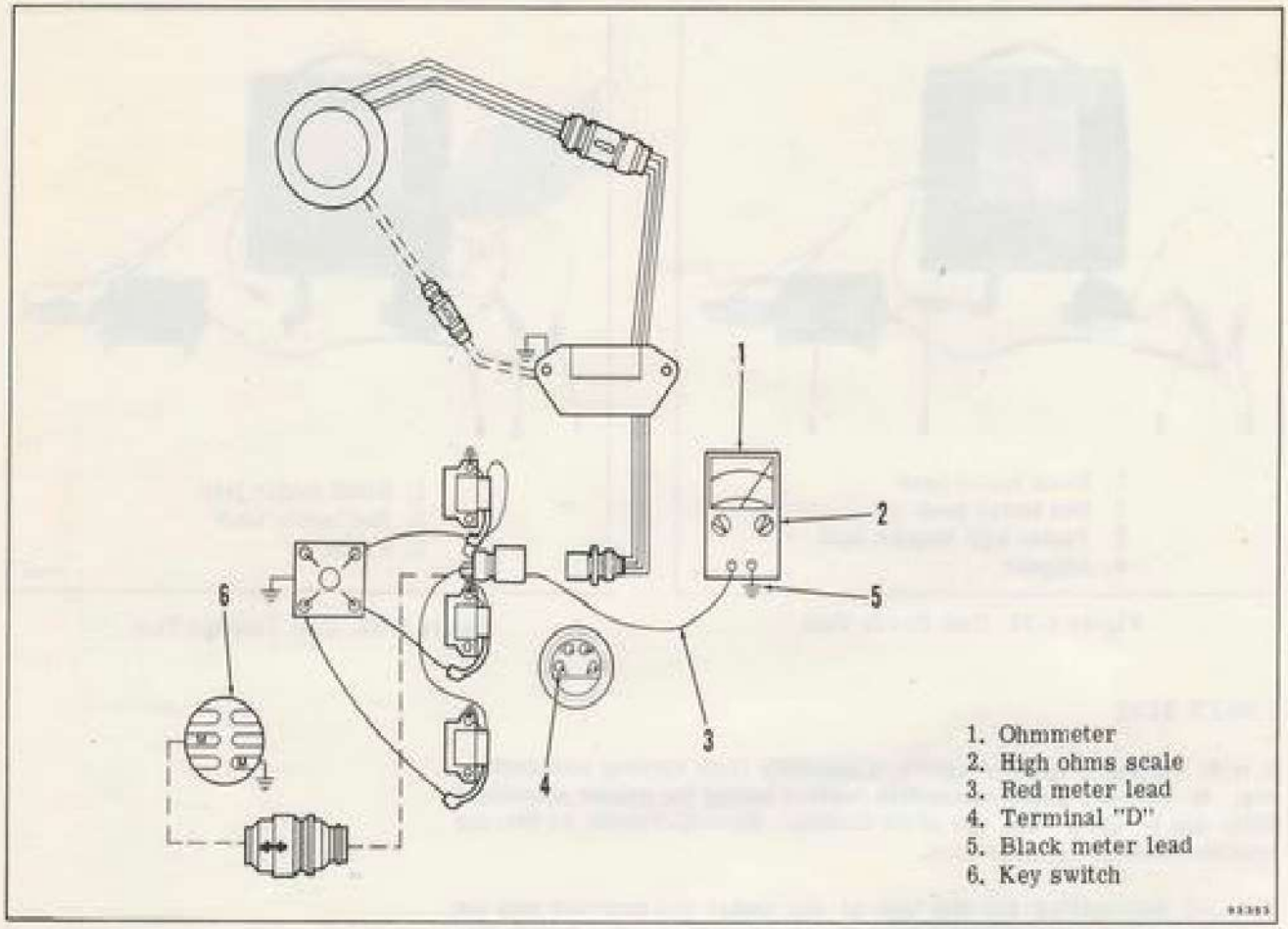


Figure 4-34. Key Switch Circuit Test

KEY SWITCH STOP CIRCUIT TEST

a. Separate the four-wire connector between the power pack and ignition coils.

b. Calibrate the ohmmeter to high ohms scale. Connect the meter red lead (+) to the "D" terminal in the ignition coil end of the connector, and black meter lead (-) to a clean engine ground. See Figure 4-35.

c. Turn the key switch to "ON."

d. The meter should indicate an open circuit (∞). If there is any needle movement, remove the black/yellow stripe wire from the key switch "M" terminal with the ohmmeter still connected as shown in Figure 4-34.

e. If the meter indicates an open circuit (∞) with the wire removed from the key switch, replace the switch. If a closed circuit (0) is indicated, repair the black/yellow stripe lead between the key switch and ignition coil end of the four-wire connector.

f. Turn key switch to "OFF" position. Meter should indicate a closed circuit.

g. If meter does not indicate closed circuit, check key switch, key switch ground lead and black/yellow stripe lead for open circuit. Repair circuit.

h. If engine does not stop when key switch is turned to "OFF" position, and stop circuit checks out ok, replace power pack.

IGNITION TIMING

It is possible for the ignition system to produce a good spark and yet the engine will not start. If the engine "pops" or "backfires" during starting attempts, the ignition timing could be off. Check the following:

a. Sensor Wire Positioning — On the four-wire connector between the timer base and power pack, be sure the correct color wires are in the correct positions on both halves of the connector. See Wiring Diagram at the end of manual.

b. Ignition Coil Wire Positioning — Check the four-wire connector to be sure the top ignition coil orange wire is in terminal "A" of connector, and that it mates with the orange/blue stripe wire from the power pack. The orange wire from the middle ignition coil must be in the "B" terminal mating with the orange power pack wire. The orange wire from the bottom ignition coil must be in the "C" terminal matching the orange/green wire from the power pack.

c. To check and adjust ignition timing, see "Engine Synchronization and Adjustment," Section 2.

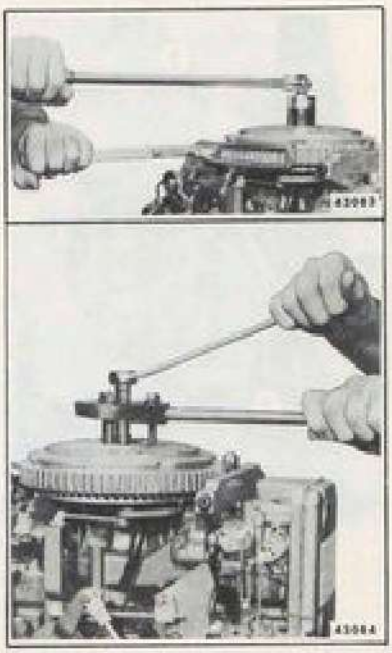


Figure 4-35. Removing Flywheel

STATOR AND TIMER ASSEMBLY REMOVAL

Remove flywheel nut using an appropriate flywheel holding fixture. See Figure 4-35. Remove flywheel, using puller (Special Tool No. 378103). See Figure 4-35.

Disconnect stator (connector) leads (yellow, yellow/gray) at terminal board, and charge coil leads from power pack. Remove four screws, and remove stator. See Figure 4-37.

The timer assembly is held in place by three retaining clips and screws. These clips engage a plastic ring (T-shaped, cross-section) which fits around the timer base. See Figure 4-37 and 4-38.

1. Stator screws

Figure 4-36. Stator

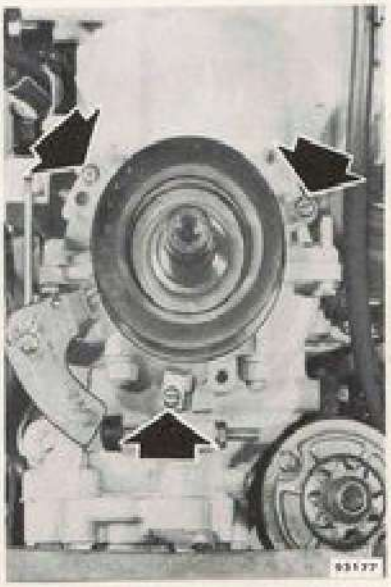
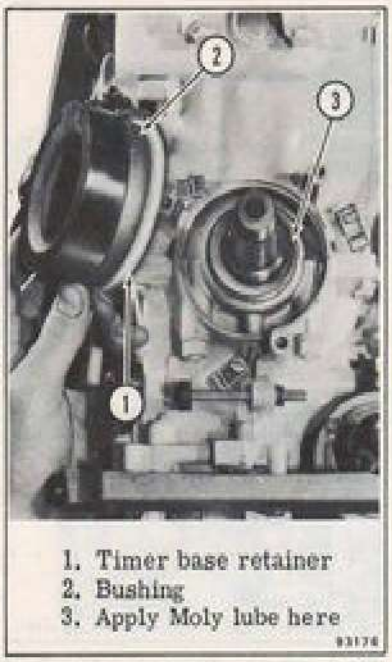


Figure 4-37. Sensor Coil and Timer Assembly Retaining Screws and Clips (Indicated by Arrows)



1. Timer base retainer
2. Bushing
3. Apply Moly lube here

93176

Figure 4-38. Timer Base Removed

TIMER BASE AND STATOR ASSEMBLY INSTALLATION

The timer base has a cast-in brass bushing which rotates, with very close tolerance, on the upper bearing and seal assembly as the spark is advanced or retarded. Check carefully for dirt, chips, or damage which may cause difficulty in rotating the timer base.

Apply OMC Moly Lube around crankcase upper bearing and seal assembly. See Figure 4-38.

Oil and assemble the timer base retainer to the timer base, and attach assembly to crankcase with four socket screws and washers. If flywheel key has been removed, reassemble to crankshaft with outer edge parallel to center line of crankshaft. See Figure 4-39.

Install stator and torque screws to specification.

Check crankshaft and flywheel tapers for any traces of oil. This assembly must be perfectly dry. Swab tapered surfaces with solvent and blow dry with compressed air. Inspect both tapers for burrs and nicks.

Replace flywheel and tighten nut to torque specifed in Section 2.

Check engine synchronization and timing. See Engine Synchronization and Adjustments," Section 2.

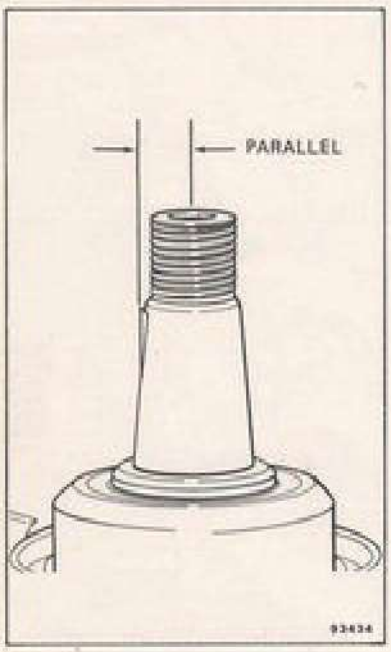


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Figure 4-39. Flywheel Key Position

SPARK PLUGS

Inspect plugs for cracked porcelain and excessively worn electrodes. If electrodes are worn, plug should be replaced. See Specifications for correct replacement of spark plug.

Poor motor performance and premature spark plug failure may result from improper spark plug installation.

Before installing the plug, be sure the plug seat in the cylinder head is clean and free from obstructions. Screw the plug in by hand, then tighten to the specified 17-1/2 to 20-1/2 foot-pounds (24-27 N·m).

SECTION 5
POWER HEAD

TABLE OF CONTENTS

OMC SPECIAL TOOLS REQUIRED

RING COMPRESSOR	PART NUMBER 308479
NO. 1 TRUARC PLIERS	PART NUMBER 303857
NO. 4 TRUARC PLIERS	PART NUMBER 307429
SEAL INSTALLER	PART NUMBER 318819
DRIVER	PART NUMBER 318599
CONE	PART NUMBER 318600

NOTE

If removing engine from boat, see NOTE on Table of Contents page i.

SAFETY WARNING

To prevent possible eye injury always wear SAFETY GLASSES while servicing motor.

5

DESCRIPTION

The power head consists of the cylinders, pistons, rods, crankshaft, and crankcase. The power head has three horizontally mounted cylinders. Alternate firing order is used so that each cylinder delivers one power impulse per crankshaft revolution. See pages 5-2 and 5-3 for two stroke theory.

THEORY OF OPERATION

Two stroke cycle engines used on outboard motors require only two piston strokes - one up, one down - to effect a crankshaft revolution and to complete the exhaust-intake-compression-ignition sequence that produces power. In a two stroke cycle engine, ignition of the fuel-air mixture occurs as the piston reaches the top of each stroke. The force of the fuel and air mixture burning drives the piston downward. Toward the end of the downward stroke, ports which lead to the exhaust system are uncovered. The exhaust gases flow into these ports, thus reducing the pressure in the cylinder. At almost the same time, intake ports are opened. These ports connect with the crankcase where a fuel and air mixture has been induced by carburetion. The downward motion of the piston compresses this mixture in the crankcase and forces it through the intake ports into the cylinder. The inrushing charge of the fuel-air mixture helps in ejecting the last of the exhaust gases from the cylinder. See Figure 5-1A, Fuel Intake and Exhaust.

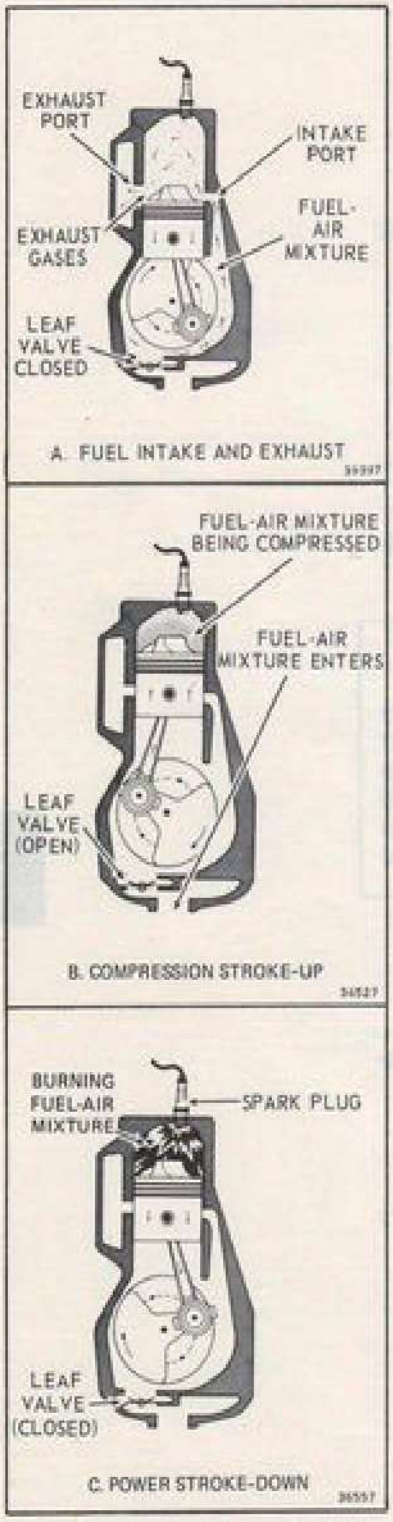


Figure 5-1. The Two Stroke Cycle with Cross-Flow Scavenging

As the piston begins its up stroke, it closes the intake and exhaust ports, and begins to compress the fuel and air mixture trapped in the cylinder. The upward travel of the piston also reduces the pressure in the crankcase compartment. The resulting reduced atmospheric pressure opens leaf valves which admit additional air and fuel from the carburetor into the crankcase, thus preparing the next cylinder charge. See Figure 5-1B, Compression Stroke.

At the top of the piston stroke, the compressed fuel-air mixture is ignited by a timed spark and the cycle begins anew. In an outboard motor engine running at full throttle, this cycle may be repeated 4000 or more times every minute. See Figure 5-1C, Power Stroke.

CROSS-FLOW AND LOOP SCAVENGING PRINCIPLES

Cross-flow means that the fresh fuel mixture enters the combustion chamber through the intake (transfer) ports and flows across the top of the piston and out the exhaust ports, pushing the burned gases ahead of it. In order to efficiently clear the combustion chamber of the burned gases, a deflector dome type piston is necessary to deflect the charge up and around the combustion chamber. See Figure 5-2.

This model is a loop-scavenged engine and incorporates an almost flat piston dome. Three intake ports are slanted upward and facing each other. This directional effect forces the three incoming charges to impinge on one another and flow upward and around the smooth dome shape in the combustion chamber, then down and out the exhaust ports on the adjacent side of the cylinder wall. The flow pattern of the incoming fresh fuel laden gases very effectively "drives" the burned exhaust gases from the cylinder. This results in a clean and powerful "charge" ready to be compressed and burned as the piston reaches the top of its stroke. See Figures 5-3 and 5-4.

Windows in the piston of this loop scavenged engine allow the fuel mixture to enter the cylinder from the crankcase through a smooth unbroken transfer passage, correctly designed for best efficiency.

CRANKCASE AND CYLINDERS

A split crankcase and cylinder assembly simplifies power head servicing. The cylinder heads are combined in one casting.

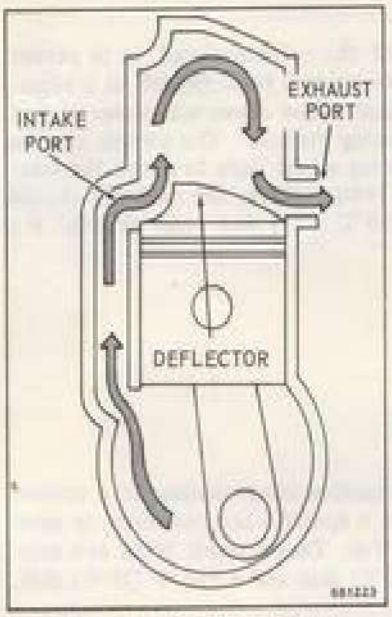


Figure 5-2. Cross-Flow Scavenging

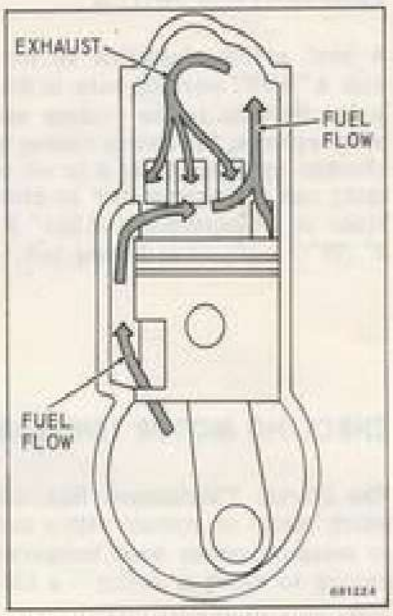


Figure 5-3. Loop Scavenging

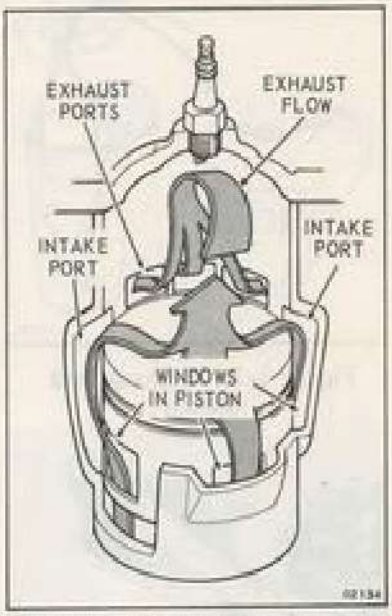


Figure 5-4. Loop Scavenged Cylinder

PISTONS

The pistons, with the piston rings, receive the force of combustion in the cylinder head, so it is necessary that both the pistons and piston rings be properly fitted to form a seal between the piston head and cylinder walls. To retain maximum power within the cylinder above the piston head, the cylinder must be perfectly round and the piston rings correctly seated in their grooves.

CONNECTING RODS

The connecting rods provide linkage between the piston and crankshaft. Connecting rod bearings include a roller bearing at the wrist pin, and a split cage roller bearing at the crankshaft. The crankshaft is of the three-throw type and is supported by four main bearings. A single row roller bearing is used at the upper journal. Split cage roller bearings at the center journals are aligned to the cylinder block by dowel pins. A ball bearing at the bottom journal absorbs the radial and vertical thrust loads of the crankshaft.

COOLING SYSTEM

Water for engine cooling is supplied by a two-stage pump containing a rubber impeller. At low speeds, the pump operates as a full displacement pump. At higher speeds, the impeller blades bend back under the increased water pressure, and the pump becomes a centrifugal action pump. See Figures 5-5 and 6-3.

COOLING SYSTEM OPERATION

The pressure and temperature controlled cooling system contains the pressure valves, springs, and the thermostat. The circulation of water through the cooling system by the water pump is controlled by the balanced action between the pressure control valves, water pump pressure and the thermostat. See Figure 5-6. See Water Flow Diagram at end of manual for water flow.

When the power head and cooling system temperatures reach approximately 145°F (63°C), the thermostat opens, allowing heated water to pass through the water discharge. As engine speed is increased, water pump pressure opens the relief valve. This by-passes the thermostat, allowing the engine to run cooler at higher speeds.

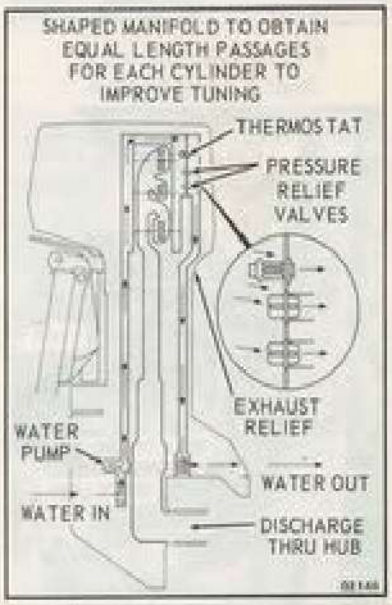


Figure 5-5. Cooling and Exhaust Systems

Figure 5-6. Thermostat

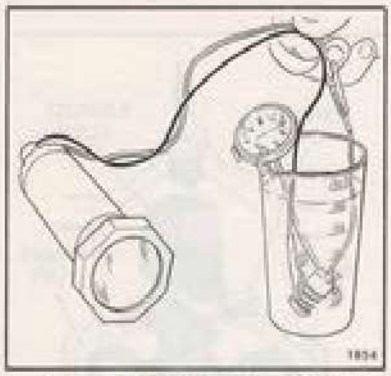


Figure 5-7. Checking Heat Switch

Figure 5-8. Checking Motor Temperature

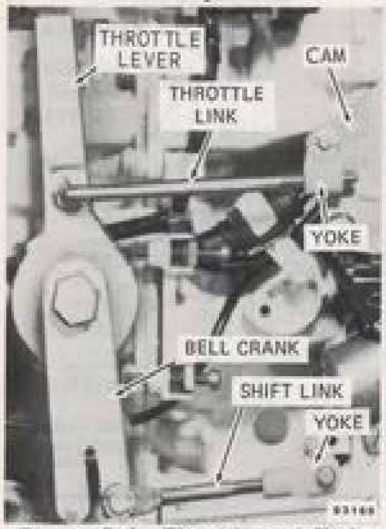


Figure 5-9. Throttle and Shift Control Levers and Cam

Figure 5-9A. Shift Rod Clevis to Shift Rod Screw

TEMPERATURE SWITCH

A heat switch, installed in the top of the cylinder head, is in series with a "HOT" warning horn in the remote control box. Should an irregularity develop in the cooling system and cause abnormal water jacket temperatures, the switch closes the warning circuit. The switch may be checked by submerging it in hot oil. Using a test light to check the contacts and a thermometer to check oil temperature, the contacts should close at a temperature of 211° F ± 6° (99°C ± 3°) and open at 175° F ± 7° (79°C ± 4°). See Figure 5-7.

CHECKING MOTOR TEMPERATURE

The Markal Thermomelt Stik, a heat sensitive stick similar to a crayon which melts on contact with a surface at a specific temperature, is used to measure power head temperature. Two Thermomelt Stiks are necessary to check a motor - a 125°F (52°C) Stik and a 163°F (73°C) Stik. Stik.

Hold a 125°F (53°C) and a 163°F (73°C) Thermomelt Stik on top of cylinder head with engine running 900-1000 rpm in forward. If 125°F (52°C) Thermomelt Stik melts and 163°F (73°C) Thermomelt Stik does not, the thermostat is functioning properly. If both melt, the engine is running too hot. If neither melts, the engine is running too cold. Run engine at 4000 rpm or more for several minutes and hold a 163°F (73°C) Thermomelt Stik on the top of the cylinder head. If 163°F (73°C) Thermomelt Stik melts, the engine is running too hot. See Figure 5-8.

REMOVAL OF POWER HEAD

a. Remove carburetor, leaf plate assembly, fuel pump and filter, and fuel hoses, as described in Section 3.

b. Remove flywheel and stator, as described in Section 4. Disconnect electric starter red cable lead and remove three screws and electric starter.

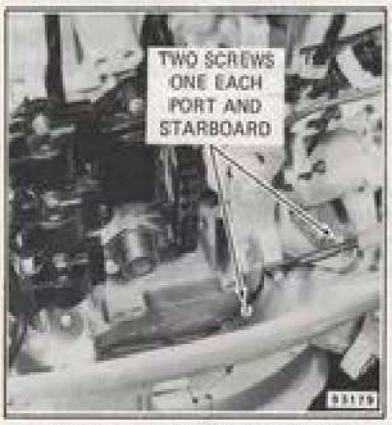


Figure 5-10. Power Head Bracket to Lower Motor Cover Screws

Figure 5-11. Front and Rear Exhaust Cover Removal

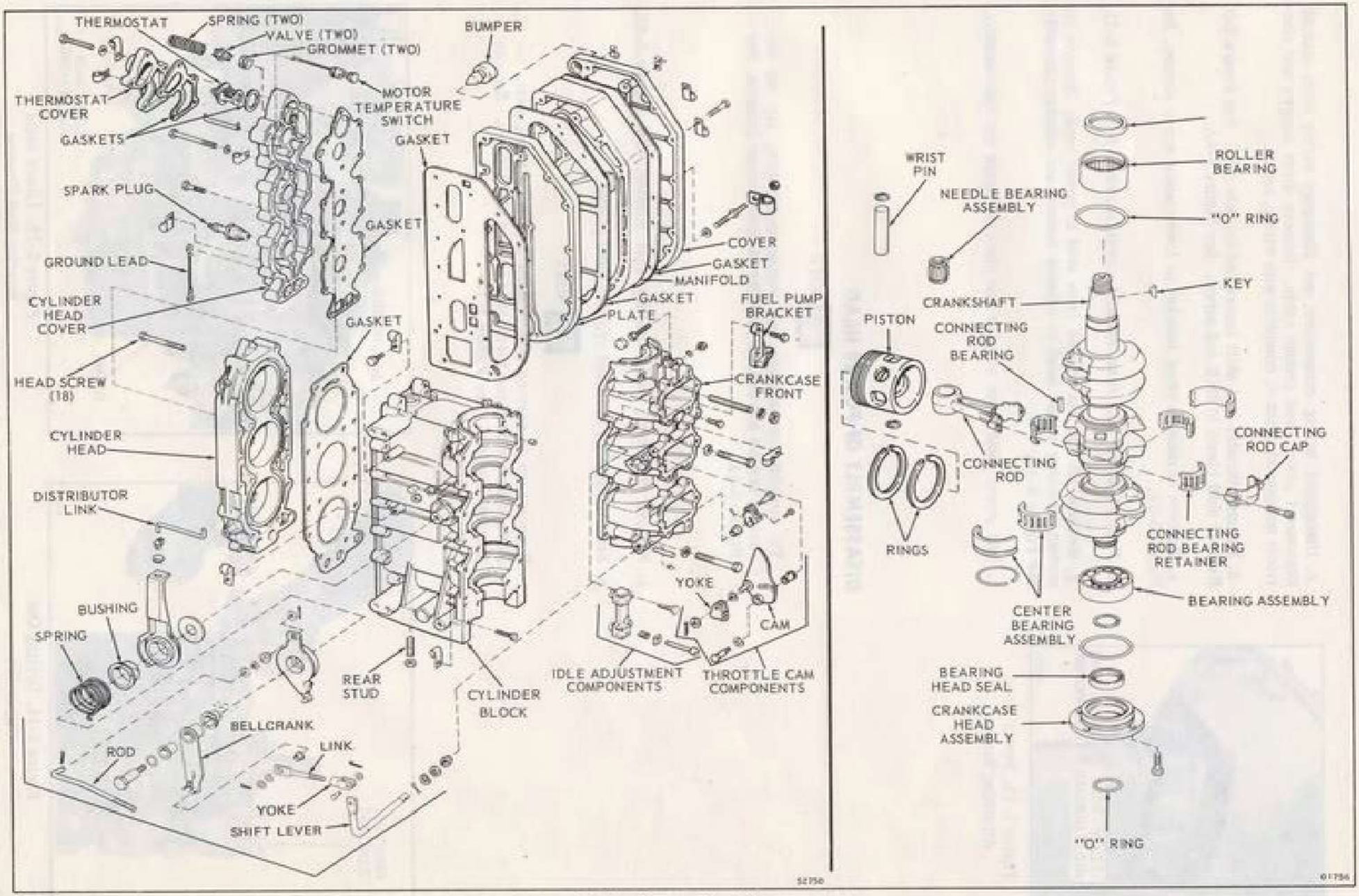


Figure 5-12. Power Head Components

Figure 5-13. Power Head Attaching Screws

c. Disconnect wiring connectors and disengage wiring from clamps. Disconnect power head ground cable. Remove three screws and electrical component bracket, complete with wiring, intact.

d. Remove throttle and shift levers and throttle cam. See Figure 5-9. Remove shift clevis to shift rod screw. See Figure 5-9A.

e. Remove crankcase front bracket to lower motor cover screws. See Figure 5-10.

f. Remove front and rear exhaust cover screws. See Figure 5-11.

g. Remove aft nut and washer from stud in power head. Remove six screws attaching power head to exhaust housing and adapter assembly. See Figure 5-13.

h. Lift power head from adapter and place on bench for disassembly.

DISASSEMBLY OF POWER HEAD

NOTE

To simplify reassembly and wiring installation, lay out the various screws and clamps in order of their proper location. See Figure 5-12.

a. Remove the lower main bearing seal housing. See Figure 5-15.

b. Remove cylinder head and cylinder head gasket.

NOTE

If necessary to service temperature switch or thermostat, remove cylinder head and thermostat covers and gaskets. Remove exhaust manifold. See Figure 5-12.

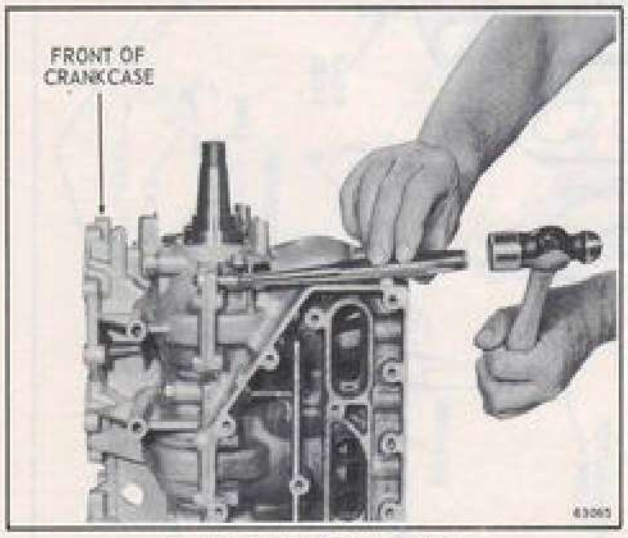


Figure 5-14. Driving Out Taper Pin

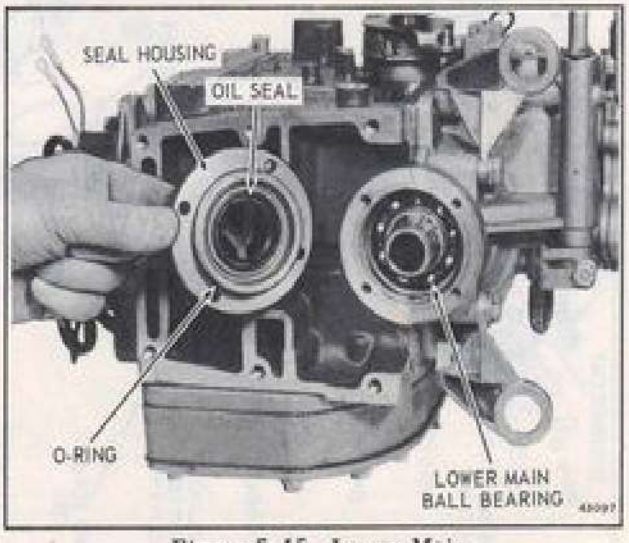


Figure 5-15. Lower Main Bearing Seal Housing

c. Drive out taper pin from back to front of crankcase. See Figure 5-14. Remove eight small and four large hex head screws and nuts attaching crankcase to cylinder block. See Figure 5-16.

SAFETY WARNING

Striking a steel tool with a steel hammer may produce chips which can cause serious damage to eyes. Safety glasses must be worn to prevent injury.

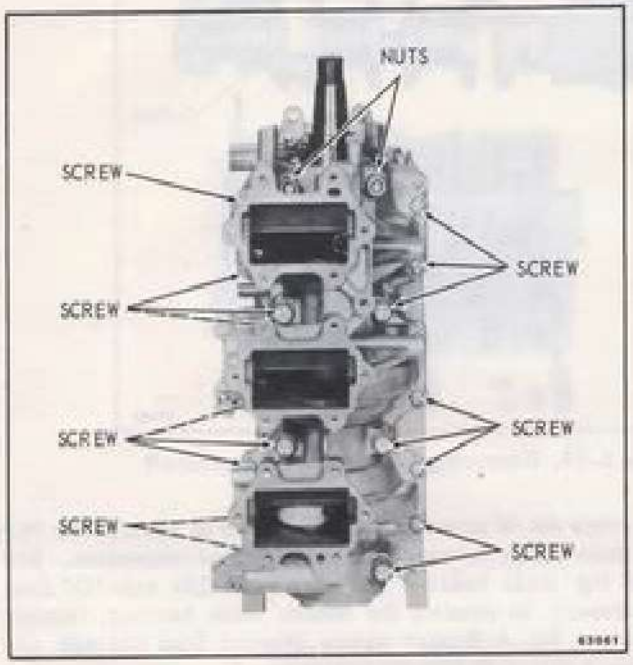


Figure 5-16. Crankcase Screws and Nuts

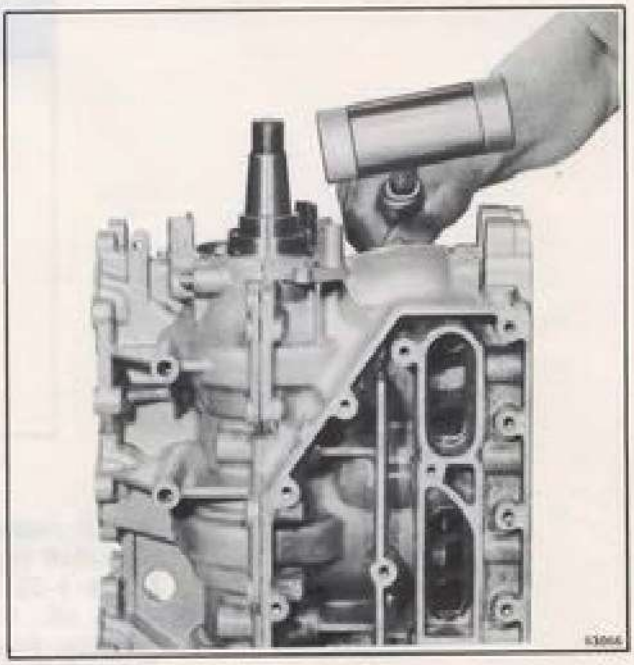


Figure 5-17. Separating Crankcase and Cylinder Block

d. Tap crankshaft with rawhide mallet to break seal between crankcase and cylinder. See Figure 5-17. Lift crankcase from cylinder block.

e. Use a 5/16 inch, 12 point socket to remove connecting rod screws. Remove rod caps and roller bearings. See Figure 5-18.

NOTE

Sixteen rollers are used at each rod bearing. Pistons, connecting rods, bearing retainers, bearings, and caps are matched parts and seat with the operation of the motor. Because of this it is essential to maintain their original positions at reassembly.

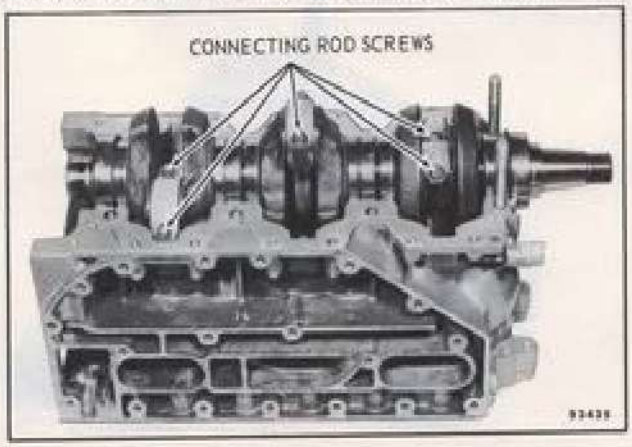


Figure 5-18. Connecting Rods Exposed

Mark each connecting rod and cap, piston, and bearing component to assure correct mating when they are reassembled. Also mark the cylinders from which they are removed.

e. Lift crankshaft from cylinder block. See Figure 5-19. Reinstall matched caps on connecting rods and remove pistons and rods from cylinders.

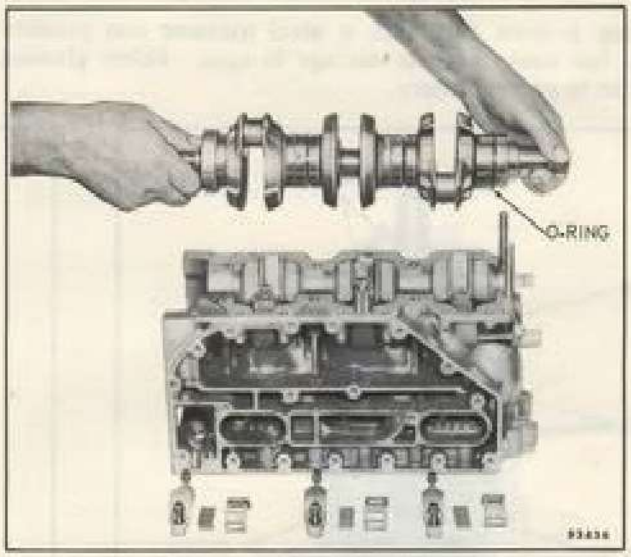


Figure 5-19. Removing or Installing Crankshaft

f. Lift retaining rings out of grooves and slide aside to remove the two crankshaft center main roller bearings for cleaning and inspection. See Figure 5-20. The top main bearing and seal assembly with "O" ring slides off. If necessary to remove the bottom main bearing, remove retaining ring using a No. 4 Truarc pliers (Special Tool #307429, see Figure 5-21) and use a puller to remove bearing.

SAFETY WARNING

Protect your eyes. Wear safety glasses when removing any retaining rings.

g. Remove the rings from the pistons by prying the ends loose enough to grip them with pliers and then breaking them away from the piston. DO NOT try to save the rings. Install a complete set of new rings on every power head service job.

h. If necessary to remove piston from connecting rod, remove wrist pin retaining ring, using small screwdriver. See Figure 5-22.

Figure 5-20. Crankshaft

Figure 5-21 Lower Bearing Removal

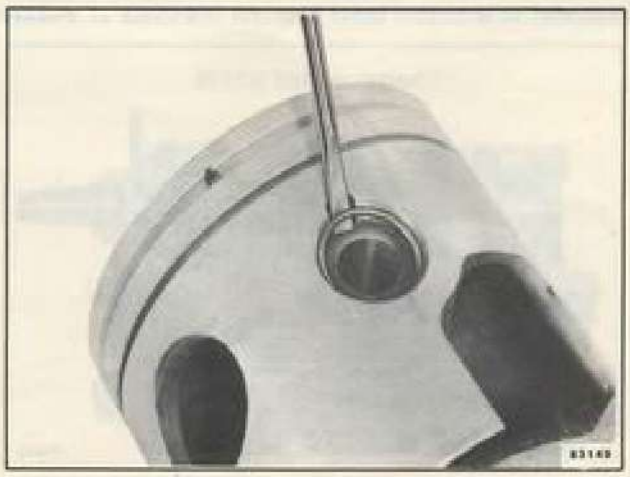


Figure 5-22. Removing Wrist Pin Retaining Rings

NOTE

One side of piston is marked "L" on inside. See Figure 5-23. When wrist pin is to be removed, "L" side of piston must be up, and arbor pressing tool must be applied to loose side. Always press from loose side to tight side, being careful not to distort piston. See Figure 5-24.

i. Drive wrist pin through to free piston from rod.

Figure 5-23. "L" Mark in Piston

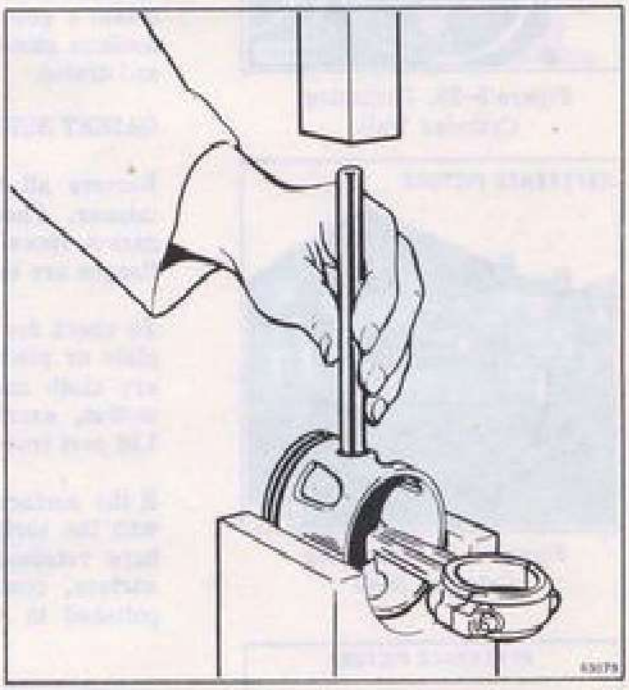


Figure 5-24. Driving Wrist Pin Out or In

CLEANING, INSPECTION AND REPAIR

CYLINDER BLOCK AND CRANKCASE

Check cylinder walls for excessive wear and check cylinder ports for carbon accumulation. Cylinder walls wear in various degrees, depending on lubrication and conditions under which the motor is operated. Major portion of wear is in the port area and the area covered by ring travel.

Check cylinder for size and wall straightness by using an inside micrometer. Refer to Section 2 for specified dimensions. Replace cylinder block, or rebore block for oversize pistons if wear is in excess of 0.030" (0.76 mm). Pistons and ring sets are available 0.020" and 0.030" oversize.

NOTE

If your shop is not equipped to rebore cylinder blocks, write our Service Department about reboring service.

Carbon accumulation in the exhaust ports restricts the flow of exhaust gases and has considerable effect on performance of the motor. Carefully scrape carbon from cylinder heads and exhaust ports with scraper or other blunt instrument. Exhaust ports and all exhaust passages must be free from carbon deposits to insure maximum performance.

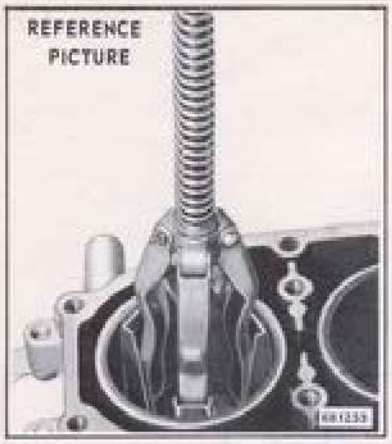


Figure 5-25. Deglazing Cylinder Wall

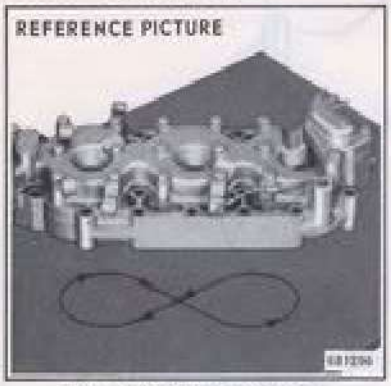


Figure 5-26. Surfacing Cylinder Head

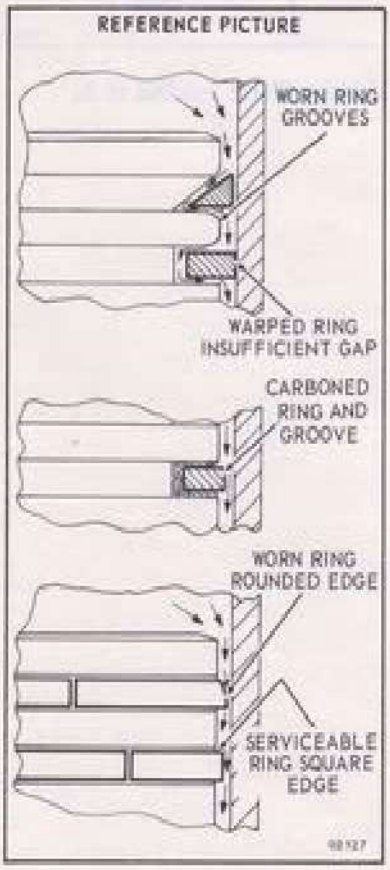


Figure 5-27. Piston and Ring Condition

NOTE

DO NOT scratch cylinder head gasket surface of cylinder. Use surface plate or plate glass to surface this area.

With continued operation of the motor, the cylinder walls will take on a glaze which reduces the effectiveness of the seal between the piston rings and the cylinder walls. The result will be reduced compression and a decrease in performance of the motor. Before reinstalling the pistons, break the glaze by using a fine cylinder hone to refinish cylinder walls. Use low rpm on drill with rapid up and down movement to obtain a good crosshatch pattern for good oil retention. Use hone with medium stone (220 grit). See Figure 5-25. Blow out all oil passages and drains.

GASKET SURFACES

Remove all traces of dried cement, using trichlorethylene or lacquer thinner. Check all gasket faces for flatness. Under certain conditions, gasket faces may warp or spring, particularly where thin sections or flanges are employed and are subect to temperature changes.

To check for flatness, lay a sheet of No. 120 emery cloth on a surface plate or piece of plate glass. Place the part to be surfaced on the emery cloth and move slowly back and forth several times in a figure 8 motion, exerting evenly distributed, light pressure. See Figure 5-26. Lift part from surface plate to observe results.

If the surface is actually warped or sprung, high spots making contact with the surface plate will take on a dull polish, while the low areas will have retained their original state. To insure flatness over the entire surface, continue surfacing until the entire gasket surface has been polished to a dull luster. Finish surfacing with No. 180 emery cloth.

CRANKSHAFT BEARINGS AND SEALS

a. All areas where the bearings are to be serviced should be kept free from accumulations of oil and dirt to avoid contaminating the bearings.

b. Place bearings in a wire basket and immerse in a solvent such as Solvasol. Tank should have a screened false bottom to prevent settlings from being stirred up into the bearings. Agitate basket frequently until grease, oil, and sludge are thoroughly loosened and can be flushed out. Bearings that contain especially heavy carbon deposits or hardened grease should be soaked in a separate container of solvent.

c. Using a spray gun with air filter and a clean solvent, flush each bearing until all dirt and residue are removed. Blow solvent out of bearings, using dry filtered air, being careful not to spin bearings by force of air.

d. Since dry bearings rust rapidly, lubricate them at once in light, clean oil. Rotate them a few times and, after draining the excess oil, place them in a covered container until assembly.

e. Discard bearings which show any of the following:

(1) Rusted rollers or raceways.

(2) Fractured ring. This may be caused by forcing a cocked bearing off a shaft, or by too heavy a press fit.

(3) Worn, galled, or abraded surfaces. These may be caused by too loose a fit, or bearing locked by dirt and turning on shaft or in housing.

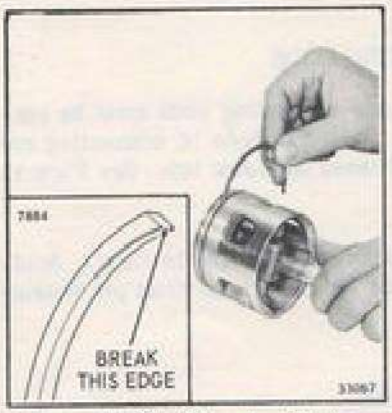


Figure 5-28. Cleaning Carbon from Ring Grooves

Figure 5-29. Check Piston Skirts for Roundness

Figure 5-30. Checking Ring Gap in Cylinder

(4) Badly discolored rollers and races. This is usually due to an inadequate supply of lubricant. Moderate discoloration is not a cause for discard.

f. Replace top crankcase bearing seal and "O" ring.

g. Using Seal Installer (Special Tool #318819), replace lower crankcase seal.

PISTONS

Check the pistons for roundness, excessive skirt wear, and scoring. See Figure 5-29. Carefully remove carbon deposits from inside piston head. Inspect the ring grooves from carbon accumulation, excessive wear, or damage to the ring seats. See Figure 5-27. Carefully scrape carbon from the ring grooves, making certain that carbon clinging to the bottom and sides of the grooves has been thoroughly removed without scratching or otherwise damaging the grooves. A tool for cleaning ring grooves can be made by breaking an old ring, grinding the edge and breaking the lower sharp edge. Care must be taken to prevent damage to lower ring land. See Figure 5-28. Check piston for size and roundness, using a micrometer. See Figure 5-29. Piston skirt must be perfectly round and not scratched. Correct sizes are given in Section 2.

Figure 5-31. Checking Fit of Ring in Lower Groove

Before installing new piston rings, check gap between ends of ring by placing ring in its respective cylinder bore, then pushing the ring down in the bore slightly with the bottom of the piston to square it up. Discard and replace with another new ring if gap is excessive. See Figure 5-30. Check lower ring in its ring groove for evidence of tightness or binding by rolling the ring around the piston ring groove. See Figure 5-31. Check for groove side clearance with feeler gage. See Figure 5-32. Correct gap and side clearances are given in Section 2.

Figure 5-32. Checking Groove Side Clearance

REASSEMBLY OF POWER HEAD

Proceed slowly. Make no forced assemblies unless press fits are called for and make no "dry" assemblies. Be sure all parts to be assembled are clean and free from dirt and grit. Perfectly good cylinder walls, pistons and rings can be ruined in a few minutes of operation unless all forms of grit are removed before assembly. Work in clean surroundings and with reasonably clean hands. Coat all bearing surfaces, cylinder walls, etc., with clean oil before assembly. Where the use of "oil" is specified, we recommend OMC Outboard Lubricant.

NOTE

Always use new gaskets and seals throughout when reassembling the power head. Apply OMC Gasket Sealing Compound Part Number 317201 to both sides of gaskets and to outside of metal cased seals. Do not use sealer if gasket is so marked. Also apply to O.D. of temperature switch grommet and wires between grommet and switch. Make certain all oil holes and passages are open.

PISTONS, WRIST PINS AND CONNECTING RODS

a. The relative positions of pistons and connecting rods must be considered when assembling pistons to rod. Oil hole in connecting rod must correspond with "UP" mark embossed on piston top. See Figures 5-33 and 5-34.

b. Apply coat of oil to wrist pin, making sure surface is clean. Apply OMC needle bearing grease to retain 10 rollers in wrist pin bearing retainer.

NOTE

One of the piston bosses is bored for a slip fit on the wrist pin and the other for a press fit. See Figure 5-23. When installing the wrist pin press from the side marked "L," using a fixture to guard against distortion or damage during the operation. See Figure 5-24.

Figure 5-33. Correct Piston Assembly

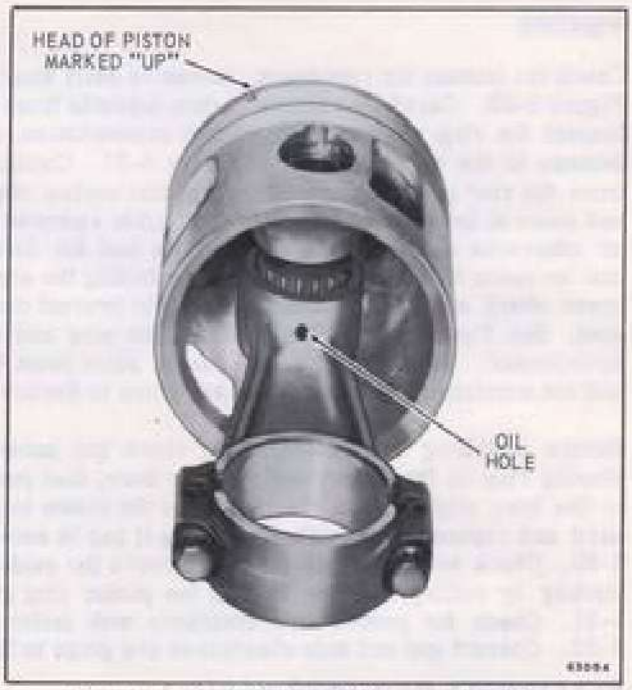


Figure 5-34. Oil Hole in Connecting Rod

c. Insert wrist pin through slip fit side of piston. Oil wrist pin bearing in connecting rod. Place connecting rod in position, then proceed to press the pin into piston. See Figure 5-24. This can be accomplished more easily if the piston is heated slightly, causing it to expand.

d. Replace retaining rings, making certain they come to rest securely in the groove provided for this purpose, using OMC Special Tools Cone Part #318600 and Driver #318599. See Figure 5-35.

e. Check piston with a micrometer to determine whether piston has been distorted during assembly. See Figure 5-29. Replace the piston if variation in diameter at the bottom of the piston skirt is greater than 0.004 inch (0.10 mm).

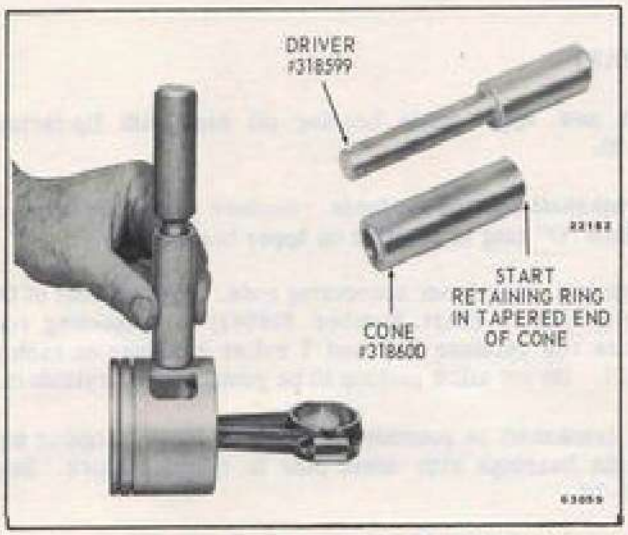


Figure 5-35. Installing Wrist Pin Retaining Rings

PISTON RINGS (UPPER RING IS A PRESSURE BACKED RING)

Install the piston rings on each piston. Spread each ring with a ring expander just enough to slip it over the head of the piston and down into place. Be sure the rings fit freely in the piston ring grooves. The ring grooves are pinned to secure the position of the rings, primarily to prevent ends of the rings from catching on the edges of the ports in the cylinders but also to assure staggering of the ring gaps.

PISTON AND CONNECTING ROD INSTALLATION

Coat pistons and cylinder bores with oil and install piston and connecting rod assemblies using a ring compressor, OMC Special Tool #308479. Be sure to match each assembly with the cylinder from which it was removed. The side marked UP on the top of the piston must face the top of the power head. See Figure 5-36. Make certain that the rings are correctly positioned in their grooves with respect to the groove pins. Damaged pistons and broken rings may result from imperfect alignment of the ring and piston dowel pin. The use of automotive type ring compressing tools should be avoided, as these frequently cause damaged pistons and broken piston rings through imperfect alignment of the ring gap and piston dowel pin. The use of (Special Tool #308479 for standard size rings and pistons only) is recommended. Using one hand to push the piston into the cylinder, use the free hand to guide the connecting rod into place and to align the rod with respect to the crankshaft.

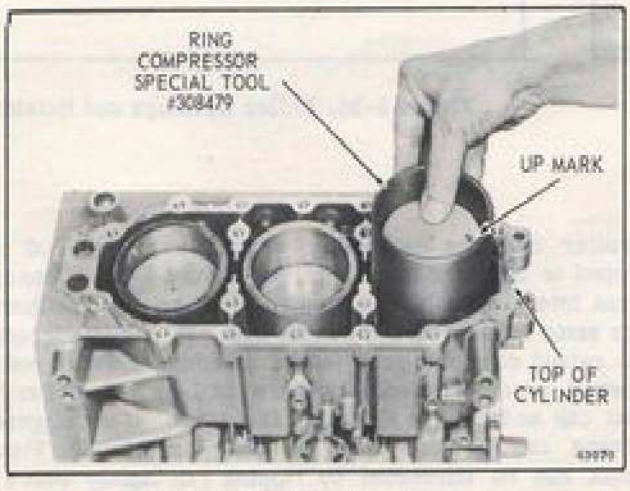


Figure 5-36. Installing Pistons

CRANKSHAFT

a. Install new upper main bearing oil seal with lip facing in. See Figure 5-20.

b. Oil crankshaft bearing surfaces. Replace journal bearings on crankshaft. Place "O" ring in position on upper bearing.

c. Remove rod caps from connecting rods. Apply a coat of OMC Needle Bearing Grease (Part Number 378642) to connecting rod bearing area. Place one retainer half and 7 roller bearings on each rod. See Figure 5-37. Do not allow pistons to be pushed out of cylinders.

d. Place crankshaft in position on cylinder block, aligning top and two center main bearings with dowel pins in cylinder block. See Figures 5-19 and 5-36.

e. Apply a coat of OMC Needle Bearing Grease to crankpins. Install 2 roller bearings and remaining retainer half on each crankpin. Place the remaining 7 roller bearings in each retainer. See Figure 5-38.

NOTE

16 rollers are used in each roller bearing.

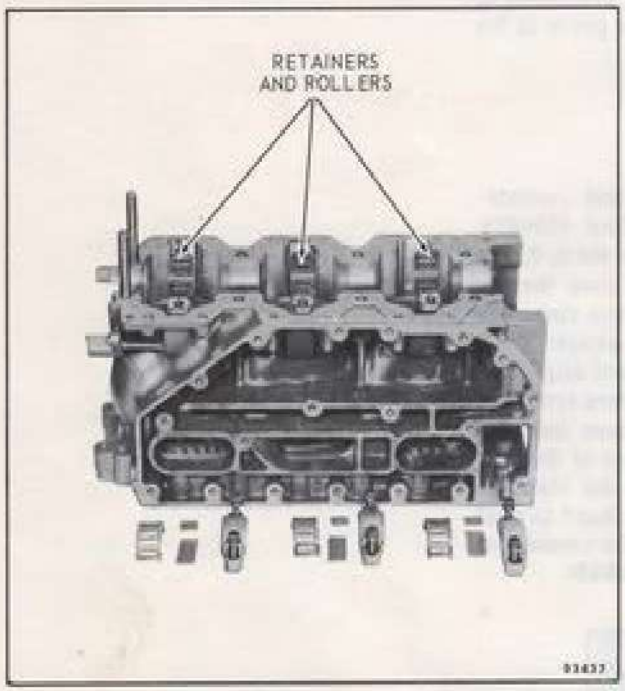


Figure 5-37. Installing Roller Bearings

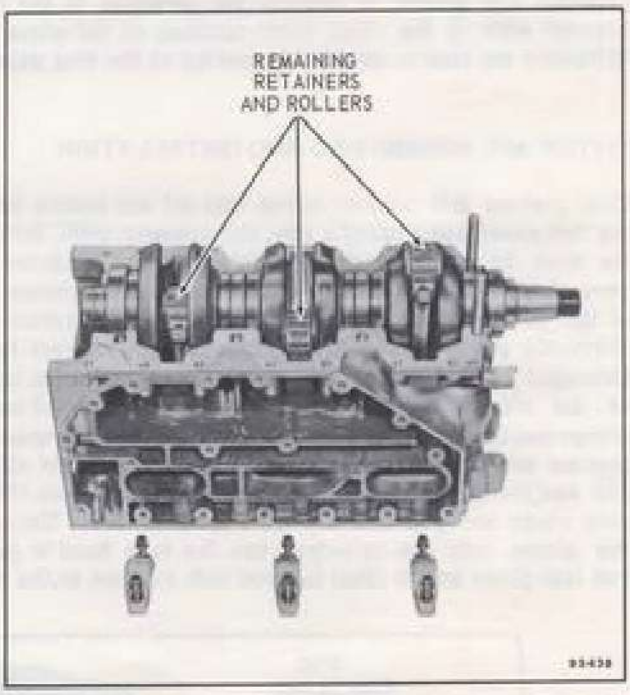


Figure 5-38. Roller Bearings and Retainers

f. With roller bearings in place, attach connecting rod caps with screws dipped in outboard lubricant. See Figure 5-39. Connecting rod caps are not interchangeable with those of other rods, neither may the caps of the same rods be turned end for end. To assist correct assembly, small raised dots are provided on matching sides of rod and cap. Draw a pencil over chamfered corners on both sides of rod to make certain that cap and rod are aligned at this point. If not aligned, chamfered corners can be felt with the pencil point. See Figure 5-40. Misalignment can be corrected by tapping cap lightly with a hammer and punch.

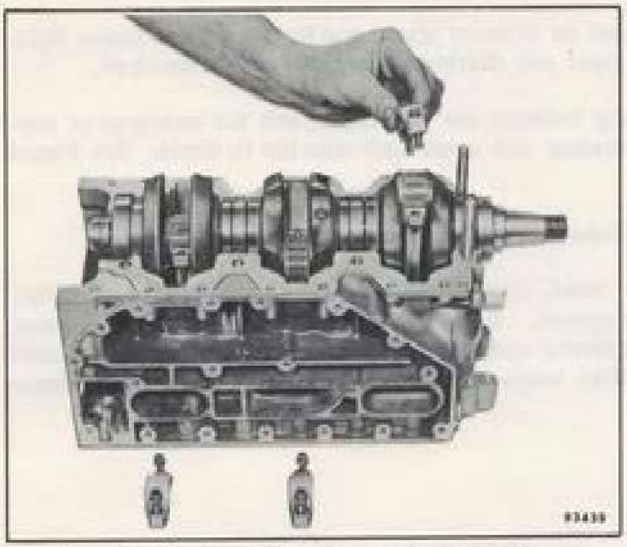


Figure 5-39. Installing Connecting Rod Caps

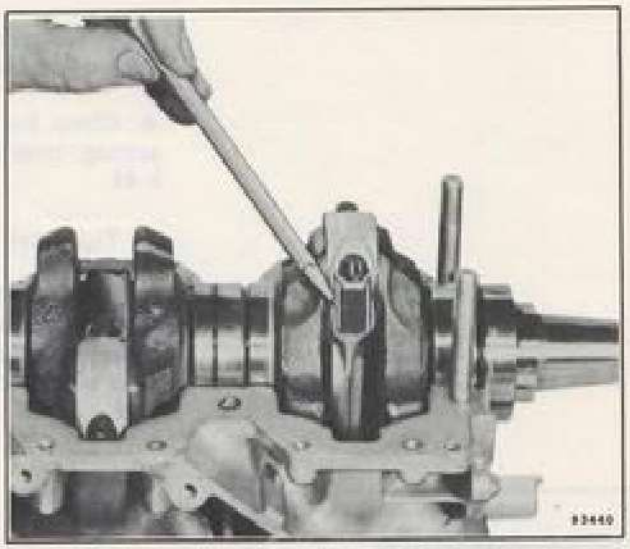


Figure 5-40. Rod and Cap Alignment

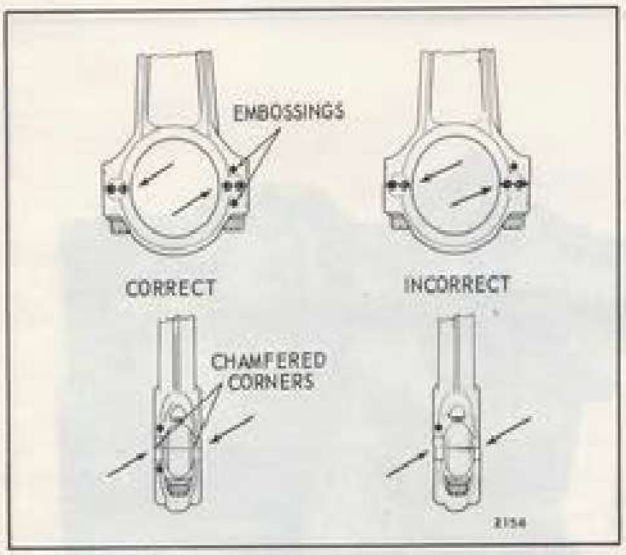


Figure 5-41. Correct and Incorrect Alignment

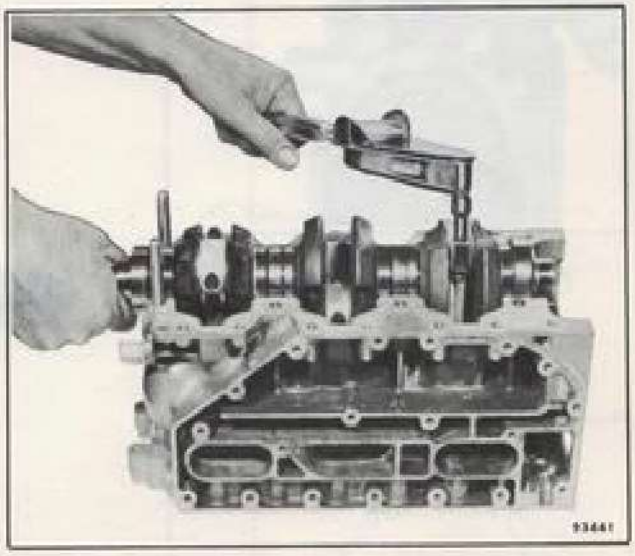


Figure 5-42. Torquing Connecting Rod Screws

g. Tighten connecting rod screws to torque specified in Section 2, using a torque wrench. See Figure 5-42. Rods and bearings should float on crankpins.

CRANKCASE AND CYLINDER

a. Clean the crankcase flange with OMC Locquic Primer (P/N 384884). Squeeze out a 1/4" (6 mm) ball of Gel Seal and dab it along one crankcase flange. Keep it 1/4" (6 mm) away from each labyrinth seal. See Figure 5-43. Treat the other crankcase flange the same way.

b. Position crankcase on cylinder block, and install screws finger tight. Replace crankcase taper pin, driving in carefully with a hammer.

c. Check for binding between the crankshaft and the bearings or connecting rods by rotating the crankshaft with the flywheel. See Figure 5-44.

d. Tighten all crankcase screws to torque specified in Section 2.

e. Install cylinder head, using a new gasket lightly coated with OMC Gasket Sealing Compound. Do not use sealer if gasket is so marked. Install temperature switch and thermostat if removed. Tighten cylinder head bolts to specified torque, following the sequence shown in Figure 5-45.

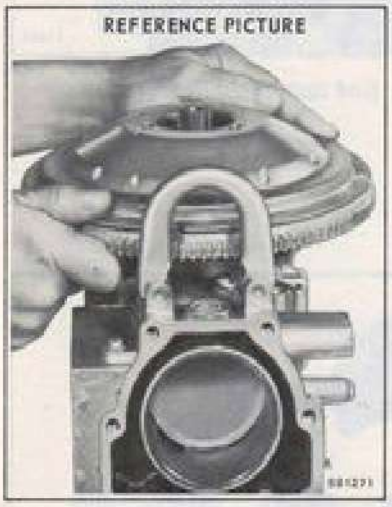


Figure 5-44. Check for Binding

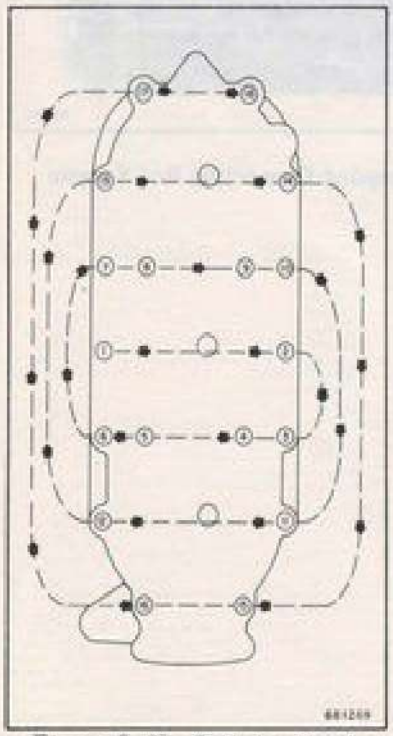


Figure 5-45. Cylinder Head Torque Pattern

NOTE

Re-torque cylinder head screws after motor test has been completed and motor has cooled comfortable to touch. See Section 2.

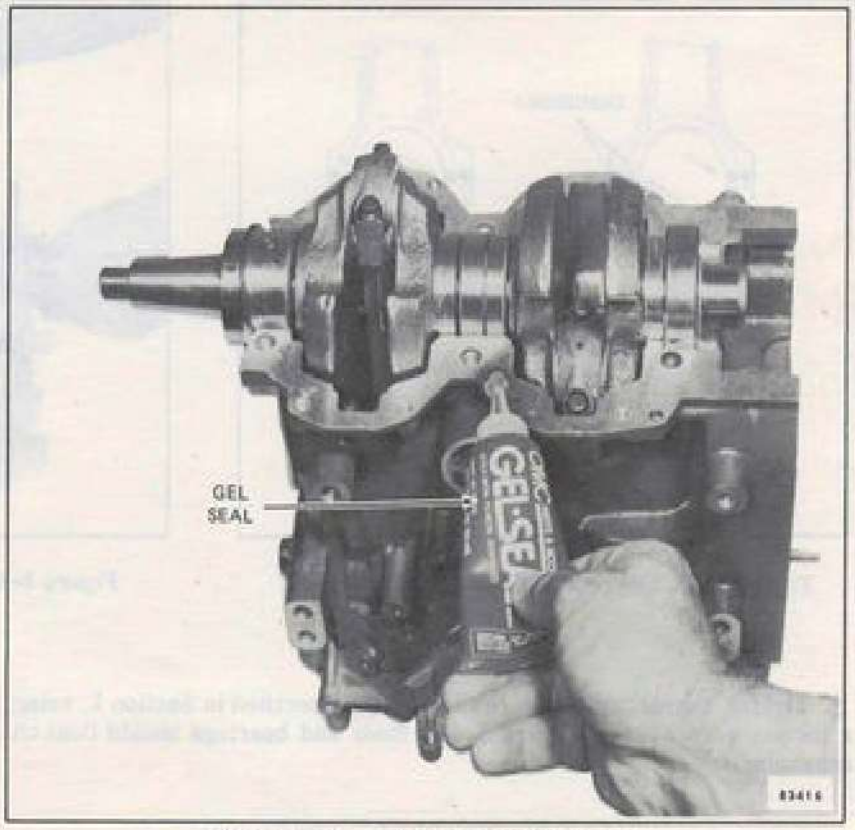


Figure 5-43. Applying OMC Gel Seal

f. If removed, reinstall cylinder head cover, using a new gasket.

g. Install exhaust covers, using new gaskets. Install all screws to torque specified in Section 2.

h. Install new seal in lower main bearing housing, and install in crankcase.

INSTALLATION OF POWER HEAD

a. Make sure that gasket surfaces of power head and adapter assembly are clean. Place new gasket in position. Coat driveshaft splines with OMC Moly Lube. Do not coat top surface of shaft as lubricant here may prevent seating of driveshaft in crankshaft.

b. Place power head on adapter, using care to avoid damaging the splines of the crankshaft and driveshaft. Rotating the power head slightly clockwise as it is lowered onto the exhaust housing will engage the splines. Align cylinder block stud with hole in adapter.

c. Replace six screws and nut and washer. Use OMC Screw Lock. Insert lower head bracket to lower motor cover screws. Tighten all screws to torque specified in Section 2.

d. Install front and rear exhaust covers.

e. Replace throttle control and shift levers and throttle cam.

f. Replace intake manifold, carburetor and other components of fuel system as described in Section 3.

g. Replace timer base and other components of ignition system, stator, and flywheel as described in Section 4.

h. Install electrical component board and connect all connectors. Connect power head ground wire. Install starter and connect cable.

BREAK-IN

Be sure that when an engine is returned to service after an overhaul, the owner is advised to follow break-in procedures exactly. See Break-In, Section 2.

NOTES

REFERENCE PICTURE

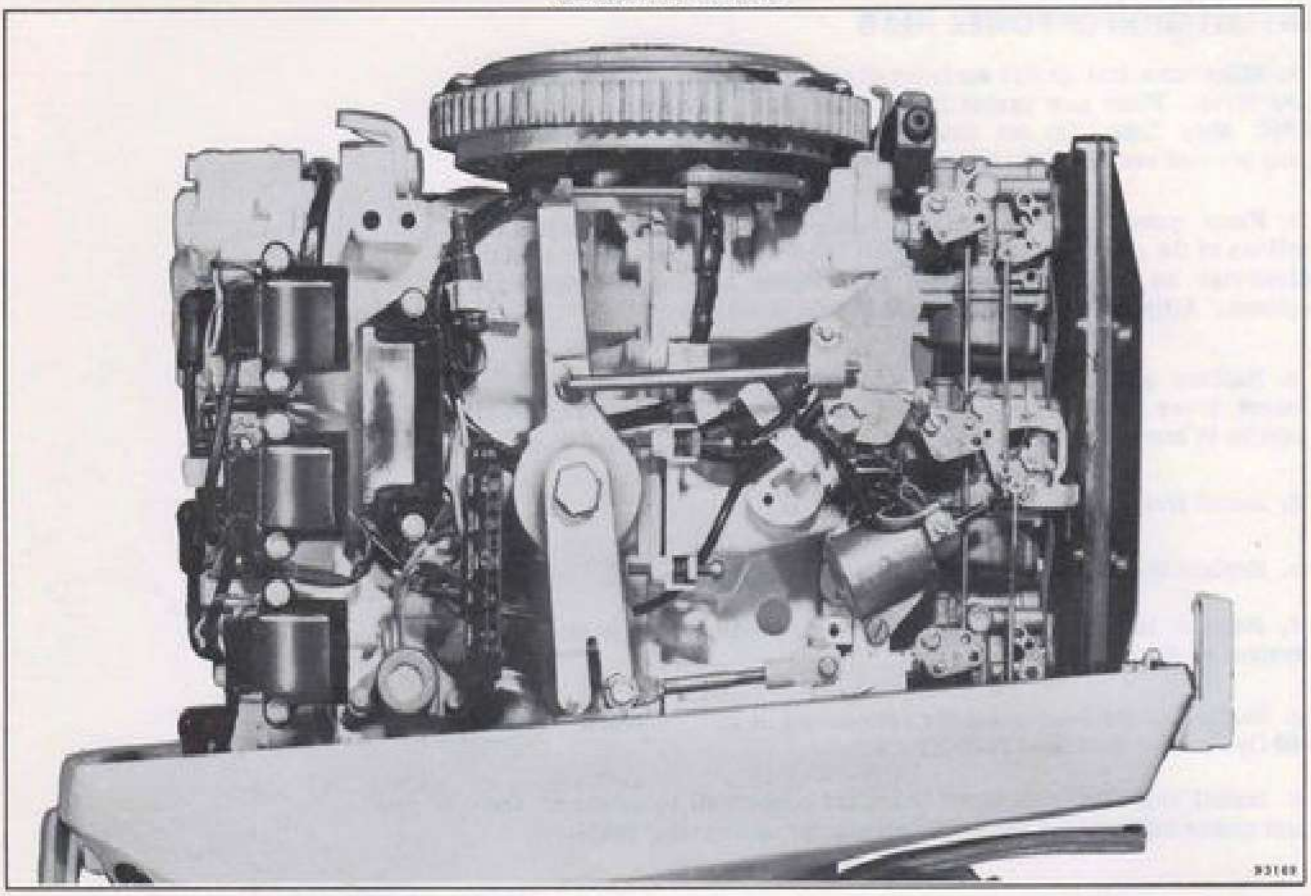


Figure 5-46. Starboard Wiring, Clamps and Linkage

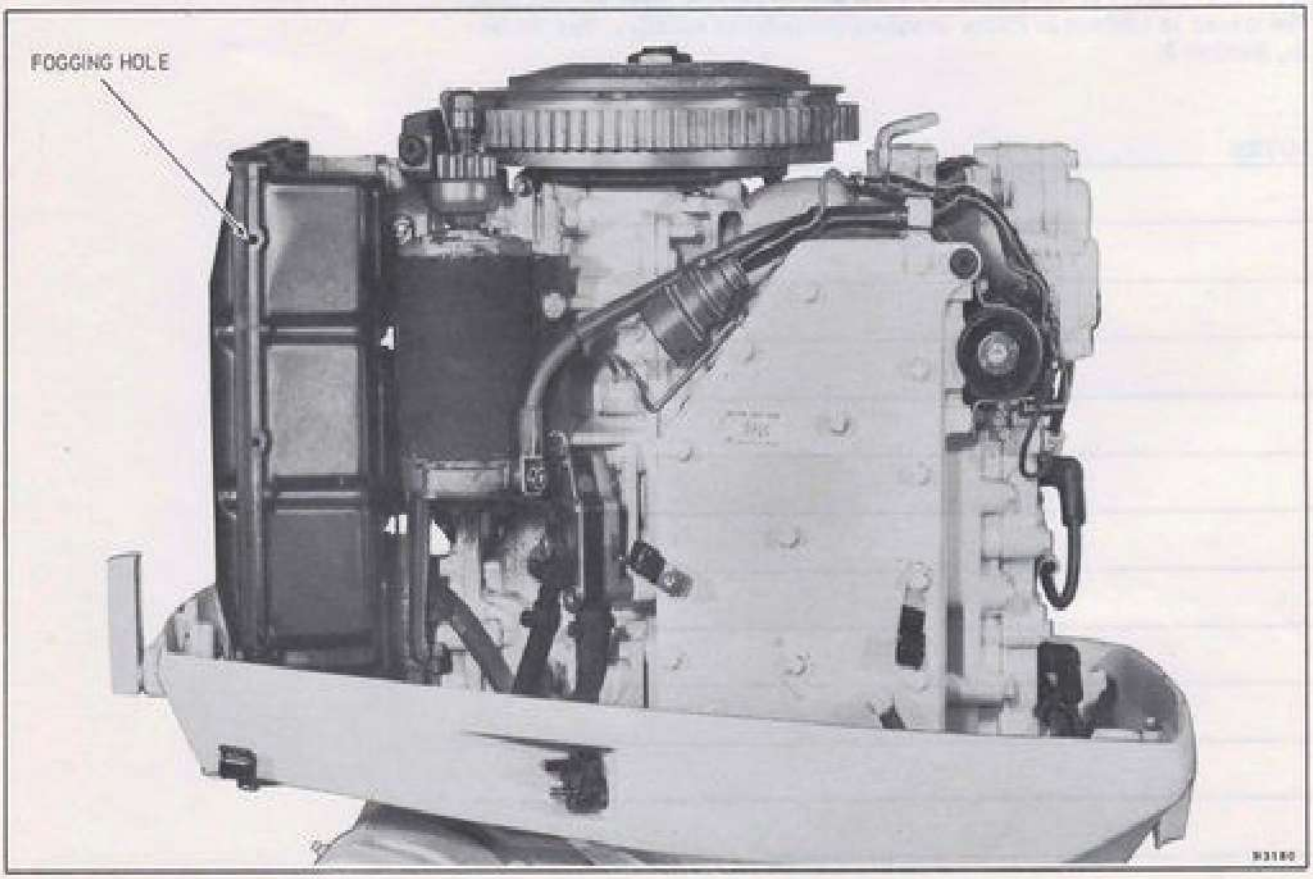


Figure 5-47. Port Side Wiring and Clamps

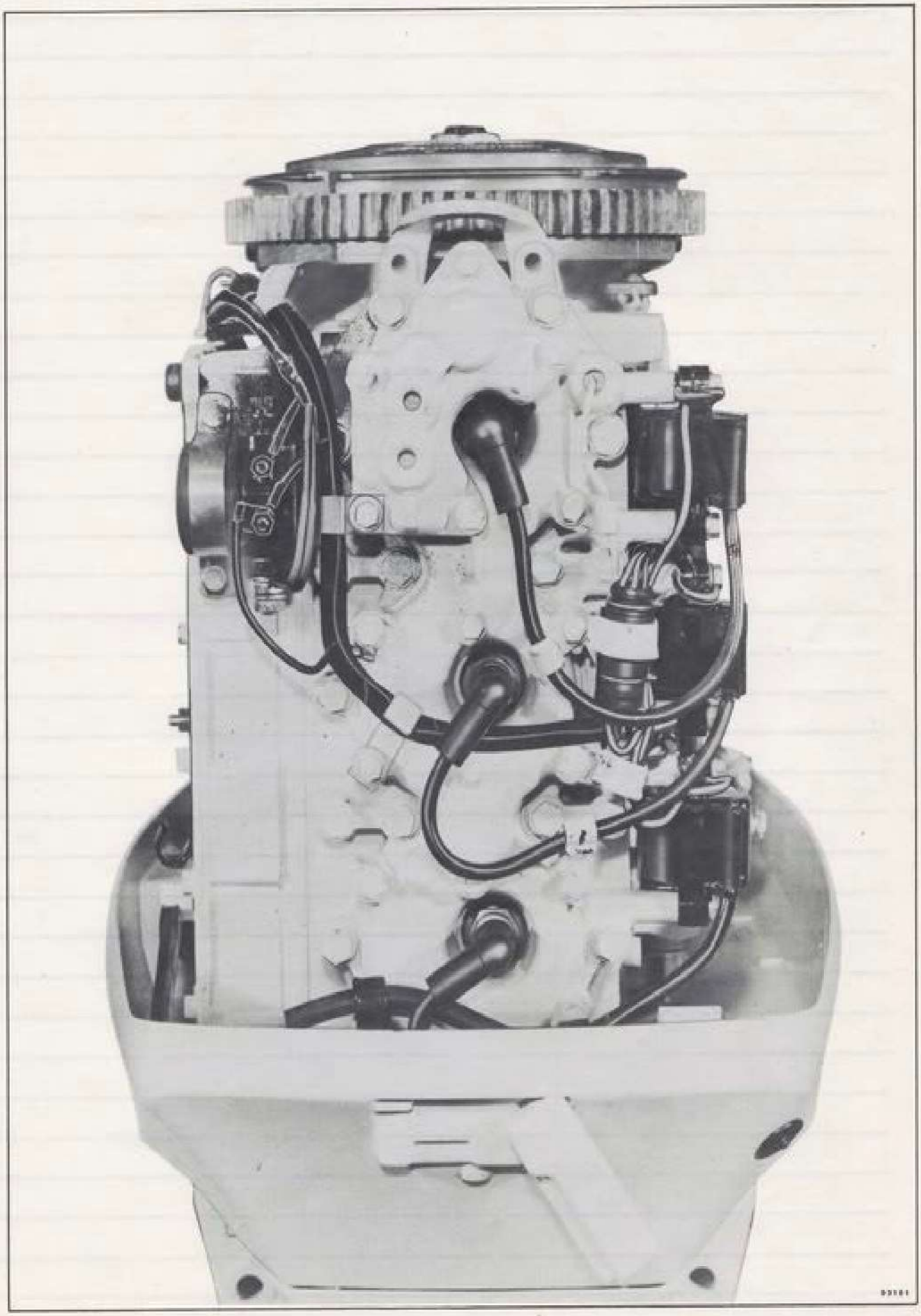


Figure 5-48. Aft View, Wiring and Clamps

NOTES

SECTION 6
LOWER UNIT

TABLE OF CONTENTS

OMC SPECIAL TOOLS REQUIRED

DRIVESHAFT HOLDING SOCKET	PART NUMBER 312752	PULLER LEGS	PART NUMBER 320737
SEAL PROTECTOR	PART NUMBER 312403	DRIVESHAFT REMOVER ASSEMBLY	PART NUMBER 387206
UNIVERSAL PULLER	PART NUMBER 378103	BEARING REMOVER	PART NUMBER 320672
TRUARC PLIERS #4	PART NUMBER 307429	BEARING REMOVER ASSEMBLY	PART NUMBER 387205
TRUARC PLIERS #7	PART NUMBER 311879	BEARING REMOVER	PART NUMBER 387131
PULLER SCREW	PART NUMBER 316982	OIL RETAINER INSTALLER	PART NUMBER 320668
BEARING INSTALLER	PART NUMBER 317061	BEARING INSTALLER	PART NUMBER 320669
BEARING INSTALLER	PART NUMBER 314641	BEARING INSTALLER	PART NUMBER 320738
SHIFT ROD GAUGE	PART NUMBER 324819	SEAL INSTALLER	PART NUMBER 314433
SEAL INSTALLER	PART NUMBER 311869	BEARING CUP INSTALLER	PART NUMBER 320670
SEAL INSTALLER	PART NUMBER 314640	BEARING INSTALLER	PART NUMBER 320673
SHIM GAUGE	PART NUMBER 315767	BEARING INSTALLER	PART NUMBER 320671
BEARING REMOVER AND INSTALLER	PART NUMBER 385546	SHIM GAUGE	PART NUMBER 320739
GUIDE PINS (2)	PART NUMBER 383175	PINION NUT HOLDER	PART NUMBER 320675
TRUARC PLIERS #21	PART NUMBER 277152	SLIDE HAMMER	PART NUMBER 311887
PRESSING PILOT	PART NUMBER 320898		

NOTE

If removing engine from boat, see NOTE on Table of Contents page i.

6

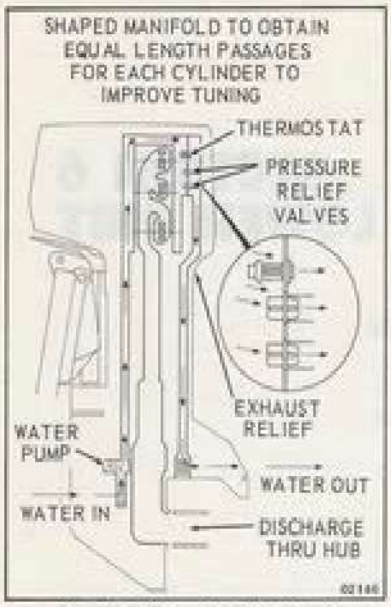


Figure 6-1. Cooling and Exhaust Systems

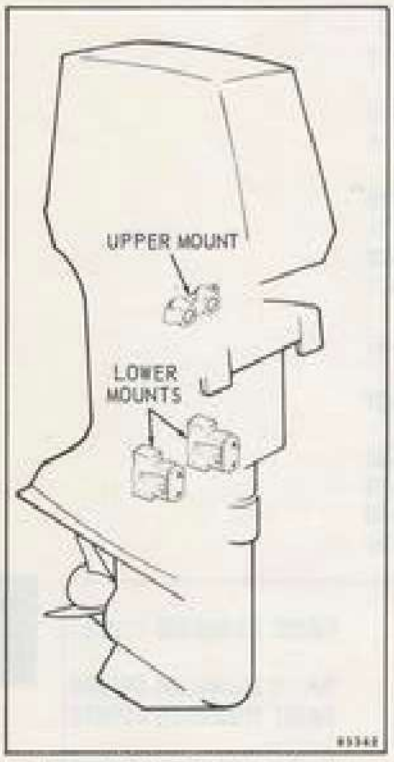


Figure 6-2. Isolation Mount Arrangement

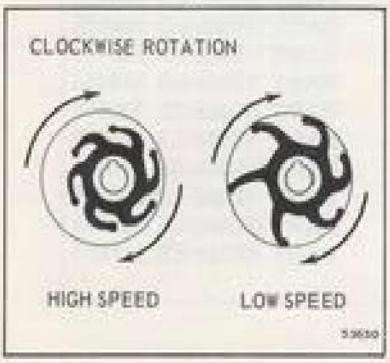


Figure 6-3. Impeller Positions

DESCRIPTION

EXHAUST HOUSINGS

This model features a "wet sleeve" exhaust system consisting of an inner and an outer housing with a water chamber in between. The water discharged from the engine cooling system fills the space between the exhaust housings and maintains a specified level when the engine is running. See Figure 6-1. The water drains out when the engine is stopped and tilted above the water line. This chamber of water serves as an effective silencer, quiets the exhaust relief, and cools the outer housing and lower rubber mounts.

Exhaust gases are discharged underwater through the propeller hub for efficient silencing and performance.

RUBBER MOUNTS

The outboard isolation system consists of five rubber mounts designed and located for efficiency. See Figure 6-2. In addition, the motor covers are rubber mount isolated from the power head and exhaust housing adapter.

EXHAUST RELIEF

Normally, exhaust gases are conducted down through the inner exhaust tube and out through the underwater exhaust outlet. However, in starting, water in the underwater outlet creates back pressure. This can cause hard starting. Exhaust relief is provided by an outlet above the waterline. Since no water is discharged until after the motor is started, the exhaust gases will initially be discharged through the exhaust relief outlet. See Figure 6-1.

WATER PUMP

Water for cooling the power head is circulated by the water pump, located at the top of the upper gearcase and driven directly by the driveshaft. The pump consists of a synthetic rubber impeller which is keyed to the driveshaft, and the pump housing which is offset from center with respect to the driveshaft. Because the housing is offset, the impeller blades flex as they rotate, varying the space between them. The pump inlet port, located in the stainless steel plate which forms the lower part of the pump housing, is open to the blades when the space between them is increasing. The pump outlet port, in the impeller housing, is open to the blades when the space between them is decreasing. Thus at low speeds the impeller works as a displacement pump. At higher speeds, water resistance keeps the blades from contact with the housing, and the pump acts as a centrifugal pump. For water circulation see Water Flow Diagram in back of manual. See Figure 6-3. Heavy duty water pumps are available for service in extremely sandy or silty waterways.

GEARCASE

The gearcase consists of:

1. The driveshaft and pinion gear;
2. The forward and reverse driving gears;
3. The propeller shaft;
4. The shifter detent, shift rod, shifter shaft, clutch dog, and shift lever;
5. The gearcase lubricant.

REMOVAL OF GEARCASE

The gearcase assembly may be removed from the exhaust housing and power head as follows:

a. Disconnect spark plug wires.

b. Drain lubricant from gearcase.

NOTE

Do not reinstall drain plug and magnet assembly if gearcase is to be disassembled as magnet may be broken off during disassembly and reassembly operations.

c. Remove fuel pump filter cover, screen and gasket. Lay aside. Remove shift rod screw. See Figure 6-4.

d. Scribe mark on gearcase and adjustable trim tab so it can be reinstalled in the same position. Remove screw and trim tab. See Figure 6-5.

e. Using a 1/2 inch socket and short extension, remove screw from inside of trim tab cavity (long shaft model only). See Figure 6-5.

f. Using a 5/8 inch thinwall socket, remove countersunk screw. See Figure 6-5.

g. Remove four 9/16" screws (2 each, port and starboard). See Figure 6-5.

h. Remove gearcase assembly from exhaust housing.

Figure 6-4. Remove Shift Rod Screw

Figure 6-5. Gearcase Screws

REMOVAL AND DISASSEMBLY OF EXHAUST HOUSING AND ADAPTER

a. Remove four screws from front exhaust cover and two aft inside of lower motor cover and remove rear exhaust cover. See Figure 6-11 or 6-12.

SAFETY WARNING

Long shaft models have a tilt assist shock absorber which exerts considerable upward pressure. Removing the exhaust housing while in the down position could allow a sudden release of parts which could cause serious injury. Place motor in tilt position to relieve pressure.

c. Remove two screws retaining lower motor cover to exhaust housing adapter. See Figure 6-6. Remove lower motor cover assembly.

d. Remove gearcase as described in "Removal of Gearcase."

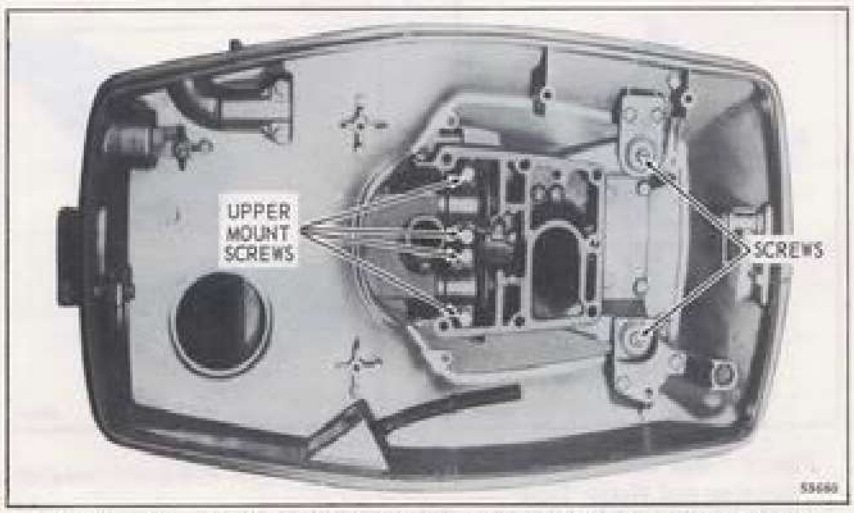


Figure 6-6. Lower Motor Cover Screws (Standard Length Shown)

Figure 6-7. Upper and Lower Rubber Mounts (Short Shaft)

e. The exhaust housing and adapter assembly, which carries the power head, is rubber mounted to the swivel bracket assembly. To release the exhaust housing on standard length models, remove port and starboard lower mount covers. See Figure 6-12. Remove rubber mount bolts, two each port and starboard. See Figure 6-7. Remove upper mount screws (see Figure 6-16), and remove exhaust housing and adapter assembly. On long shaft models, remove two upper screws and four lower screws. See Figure 6-7A.

f. Remove four screws and lift adapter, inner exhaust housing, and water tube assembly from exhaust housing. See Figure 6-8.

g. If necessary to remove water tube, remove four screws attaching inner exhaust housing to adapter. See Figure 6-8A. Water tube and grommet pulls out of inner exhaust housing. Plate can be removed from adapter by removal of four screws. See Figure 6-8B. Discard gasket.

DISASSEMBLY OF STERN AND SWIVEL BRACKETS (LONG SHAFT)

△ SAFETY WARNING

After removal of power head from long shaft models, place motor in tilt position to relieve pressure in tilt assist shock absorbers.

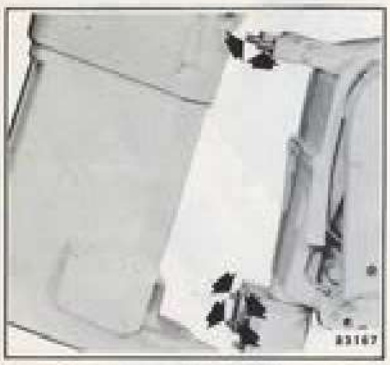


Figure 6-7A. Mount Screws (Long Shaft)

a. Remove 1-11/16" nut from bottom of pivot shaft. Remove pivot shaft, split keeper, and thrust washer. See Figures 6-9 and 6-10.

□ NOTE

On reassembly, tighten pivot shaft nut and torque to 130 to 150 ft-lbs (180 - 200 N·m). See Figure 6-11.

b. Upper and lower seals in swivel bracket may be driven out. Upper bronze bushing slides out. See Figure 6-9.

c. Remove the thrust rod and retainer, and the thrust rod spring from the stern bracket. Remove screws attaching tilt levers to stern bracket.

d. Remove four screws and plate fastening port and starboard stern brackets. Remove tilt tube bolt, nut and washers from top of stern brackets. Remove tilt assist shock absorber pivot pins, nut and lockwashers to remove shock absorbers and trailering lock arm components. See Figure 6-9. Tilt assist shock absorbers are serviced individually as an assembly.

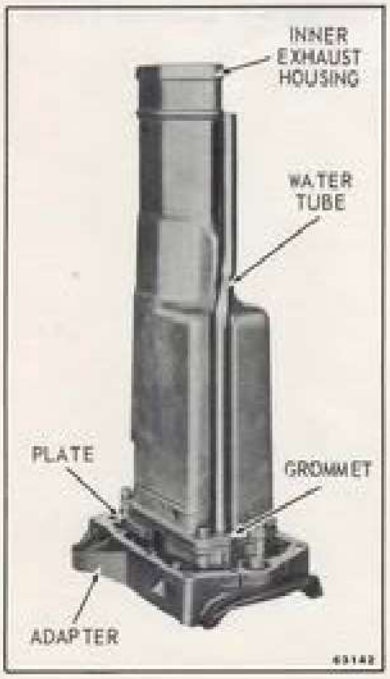


Figure 6-8. Inner Exhaust Tube, Water Tube and Plate Adapter

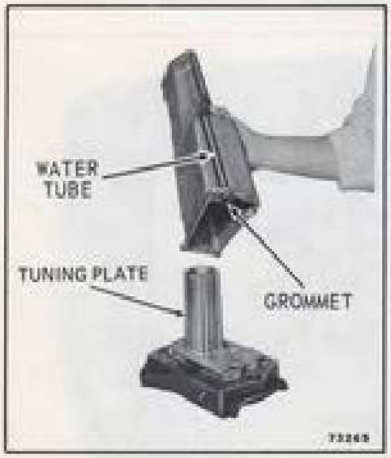


Figure 6-8A. Inner Exhaust Housing and Water Tube

Figure 6-8B. Plate and Adapter

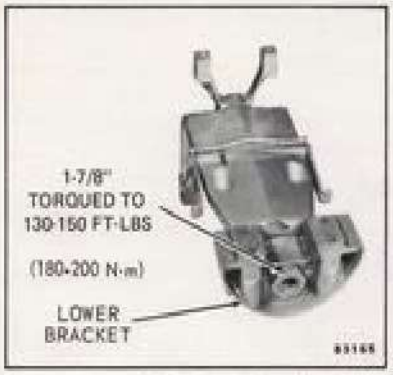


Figure 6-9. Pivot Shaft and Stern Bracket Assembly (Long Shaft)

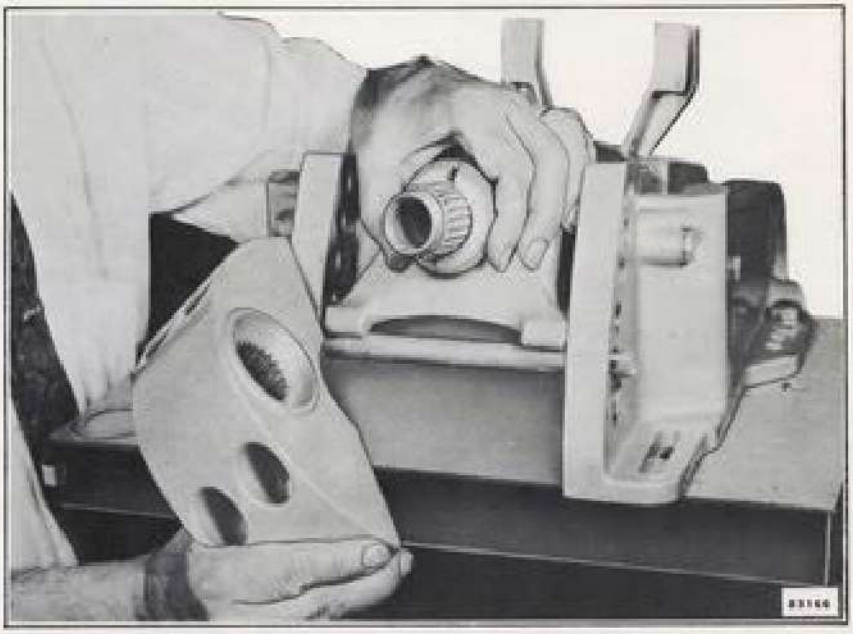


Figure 6-10. Pivot Shaft Splines (Long Shaft)

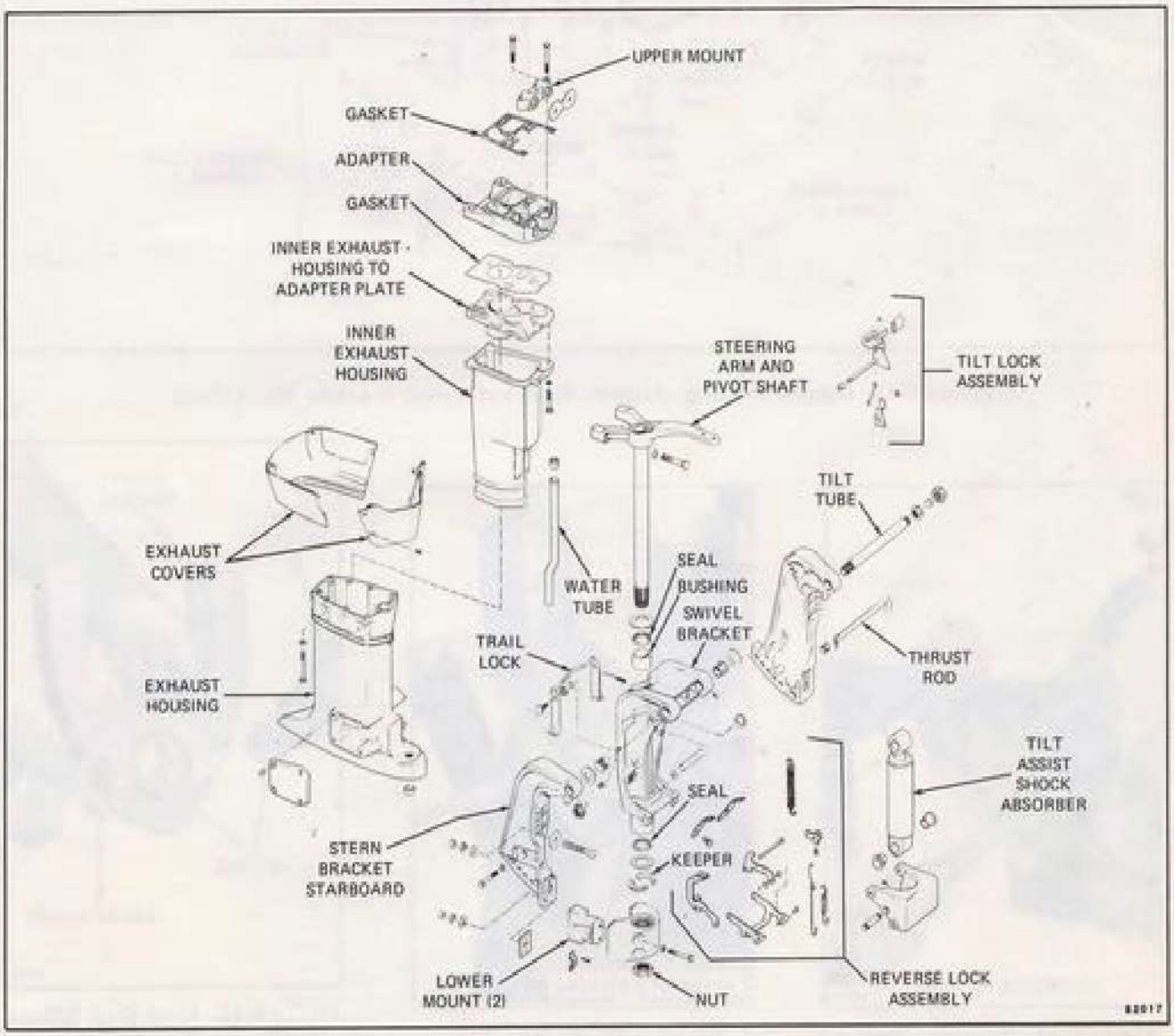


Figure 6-11. Exhaust Housing, Adapter, Stern and Swivel Brackets (70 HP Long Shaft)

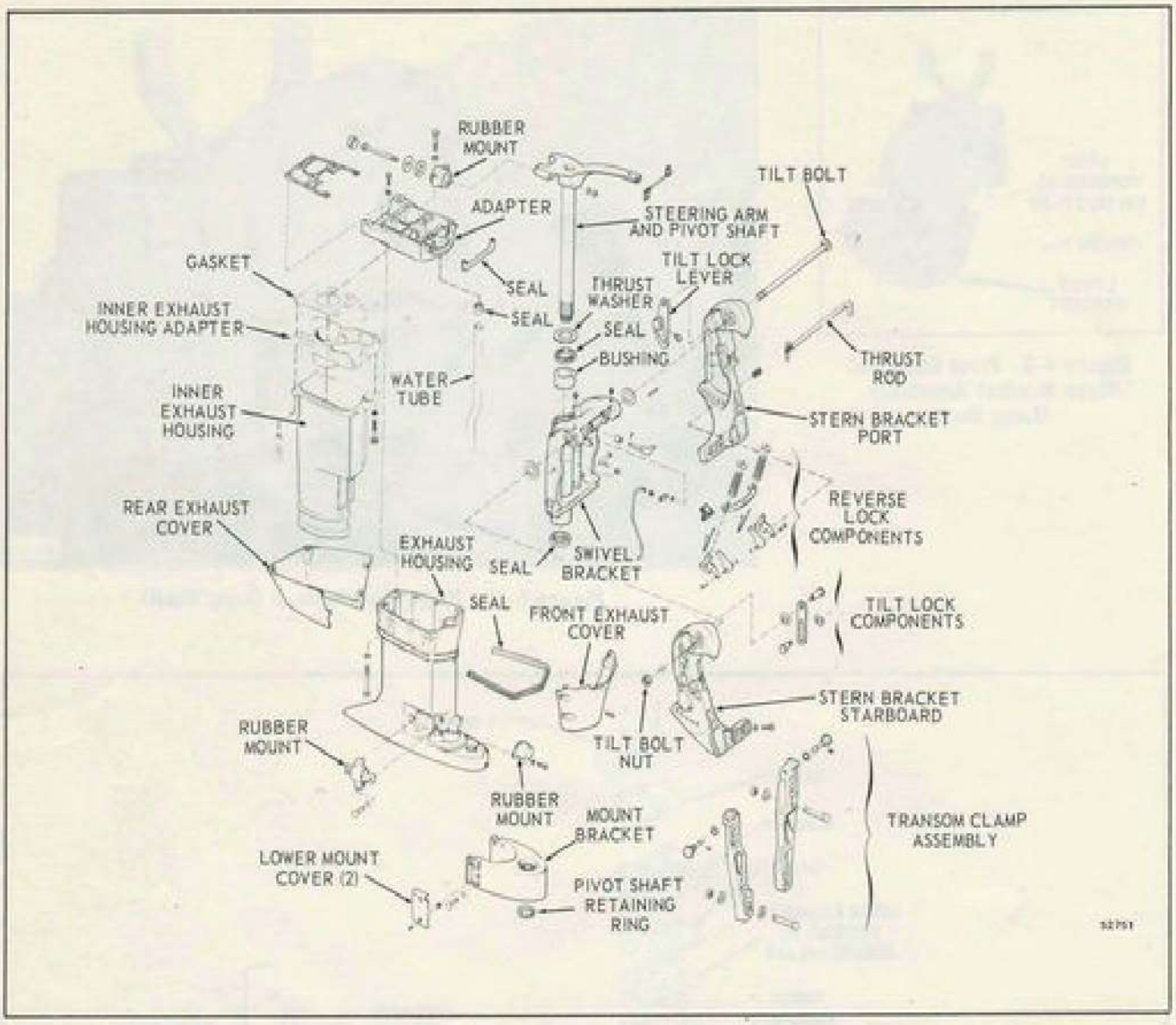


Figure 6-12. Exhaust Housing, Adapter, Stern and Swivel Brackets (Short Shaft)

Figure 6-13. Removing Truarc Ring (Standard Length)

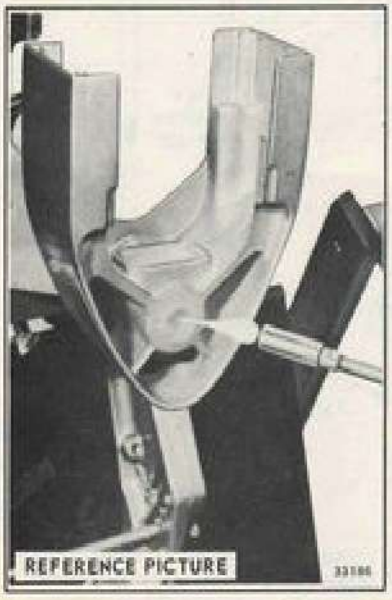


Figure 6-14. Heating Pivot Shaft Spline (Standard Length)

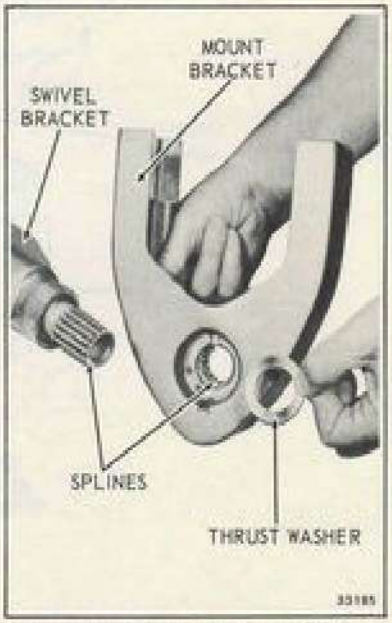


Figure 6-15. Pivot Shaft Splines and Lower Thrust Washer (Standard Length)

DISASSEMBLY OF STERN AND SWIVEL BRACKETS STANDARD LENGTH)

a. Using #4 Truarc pliers #307429, remove Truarc ring from bottom of pivot and steering shaft assembly. See Figure 6-13. Shaft is splined to bracket and secured with OMC Nut Lock. Heat spline and pivot shaft and remove mount bracket from pivot shaft. See Figures 6-14 and 6-15.

NOTE

On reassembly, coat spline with OMC Locquic Primer and OMC Nut Lock. See Figure 6-15.

b. Upper and lower seals in swivel bracket should be removed. Upper bushing slides out. See Figure 6-12.

DISASSEMBLY OF GEARCASE (STANDARD LENGTH)

a. Remove water tube guide. See Figure 6-35. Remove four screws and slide water pump impeller housing and impeller off of driveshaft. See Figure 6-16.

b. Remove impeller drive key and impeller plate.

c. Using a 5/16" thin wall deep socket wrench, remove the propeller shaft bearing housing screws. See Figure 6-17.

d. Using three puller legs (Special Tool #320737) and flywheel puller (Special Tool #378103), pull bearing housing from gearcase. See Figure 6-18.

e. Remove two Truarc rings using a #7 Truarc pliers. See Figure 6-19.

⚠ SAFETY WARNING

Retaining rings are under extreme pressures during removal and installation. Wear safety glasses and proceed with care to avoid unsnapping ring from pliers.

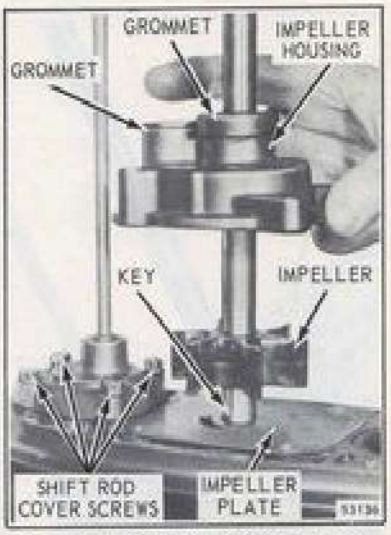


Figure 6-16. Removing Water Pump, Guide Removed

Figure 6-17. Removing Bearing Head Screws

Figure 6-18. Removing Bearing Housing

Figure 6-19. Removing Retaining Rings

Figure 6-20. Bearing and Shift Housing Rod Cover Screws

f. Remove retainer plate, thrust washer, thrust bearing, reverse gear from propeller shaft.

g. Remove four driveshaft bearing housing screws. See Figure 6-20. Pull up on shift rod placing clutch dog in forward gear. Remove the pinion lock nut from the bottom of the driveshaft by using Driveshaft Holding Socket (Special Tool #312752) (Figure 6-21).

h. Using a puller (Special Tool #387206), two 5/16" - 18 screws, and two smooth metal pads 1/8" x 2" x 4" (3 x 50 x 100 mm) to protect the gearcase, pull the driveshaft from the gearcase. See Figures 6-22 and 6-23. The seal housing, shim(s), bearing, and cone will come out with the driveshaft. Discard the seal housing "O" ring. The two back to back seals can be pressed out of the seal housing if worn. Push shift rod down into reverse gear position. Remove pinion gear from gearcase.

Figure 6-21. Remove Pinion Lock Nut

Figure 6-22. Driveshaft Puller

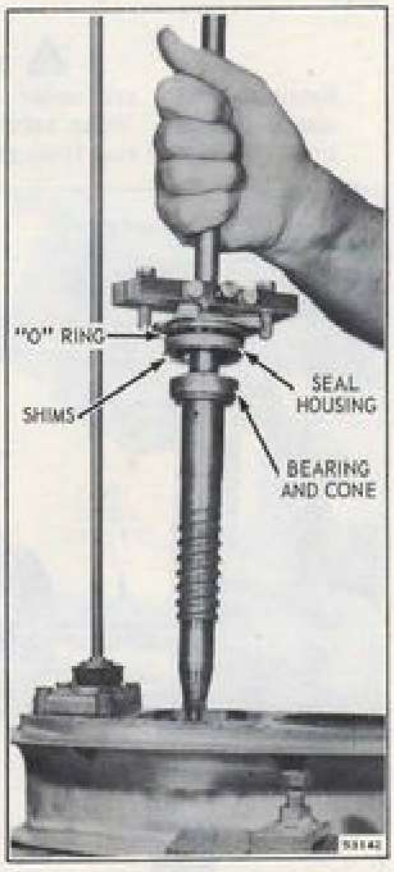


Figure 6-23. Driveshaft, Seal Housing, Shim(s) and Bearing

i. Remove four screws from shift rod cover assembly. See Figure 6-20. Unscrew shift rod from shifter detent in gearcase. Remove shift rod and cover assembly as an assembly.

j. Remove propeller shaft, forward gear and bearing housing from gearcase as an assembly. See Figure 6-24.

k. If necessary, remove lower driveshaft bearing. Using parts from Bearing Remover-Installer (Special Tool #385546, and remover Special Tool #320672). See Figure 6-25.

NOTE

Remove bearing setscrew from gearcase before attempting lower driveshaft bearing removal. See Figure 6-25 insert.

Place washer, bearing, plate, and guide sleeve on bolt as shown in Figure 6-25. Insert in gearcase. Screw remover #320672 onto screw thru gearcase cavity. Shoulder on tool must face lower bearing. Tighten screw with wrench to remove bearing.

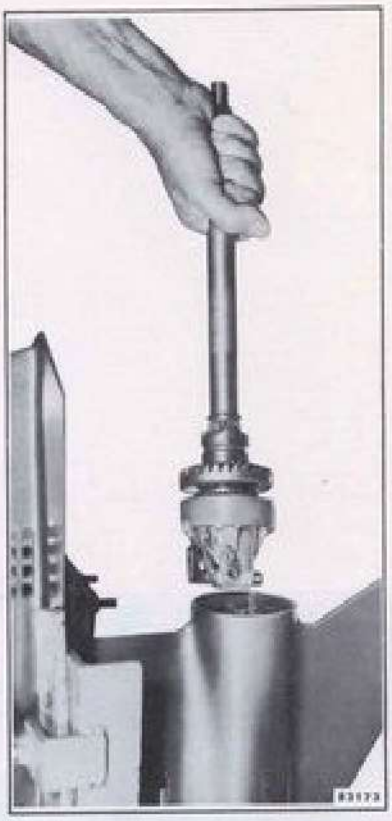


Figure 6-24. Removing Propeller Shaft

PROPELLER SHAFT BEARING HOUSING

Oil seals can be removed by driving them out. Bearings may be removed in the same manner, if necessary. All nut and screw threads that were coated with OMC Nut or Screw Lock must be thoroughly cleaned before reassembly.

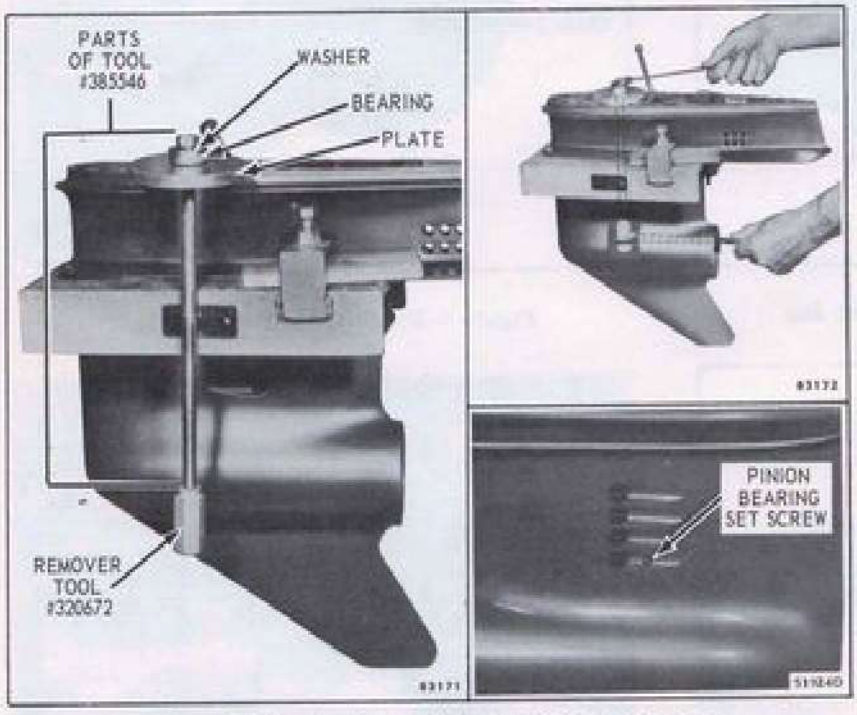


Figure 6-25. Removing Driveshaft Lower Bearing

DISASSEMBLY OF PROPELLER SHAFT, FORWARD GEAR AND SHIFT MECHANISM

a. Remove clutch dog pin retainer spring and discard it. Remove pin, clutch dog, and remove propeller shaft, forward gear and bearing, and bearing housing. See Figure 6-26.

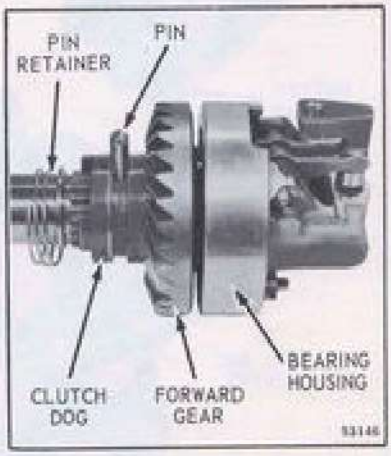


Figure 6-26. Removing Clutch Dog Pin

b. Remove shift lever pin. See Figure 6-27. Disengage shift lever from cradle in shifter shaft, and remove shifter shaft and cradle. See Figure 6-28. Remove shift lever.

c. Rotate shifter detent 180° to depress detent ball and spring. See Figure 6-29. Pull shifter detent from bearing housing being prepared to catch ball and spring.

SAFETY WARNING

Ball and spring can pop out with great force. Wear safety glasses for eye protection.

d. The forward bearing and cup are replaced as an assembly. If replacement is necessary, tap cup out of bearing housing. See Figure 6-28. Using a bearing remover (Special Tool #387205), pressing pilot #320898 and an arbor press, press bearing from gear. Tool lip must clamp under ends of rollers. Support tool with parallel bars on arbor press. See Figure 6-30.

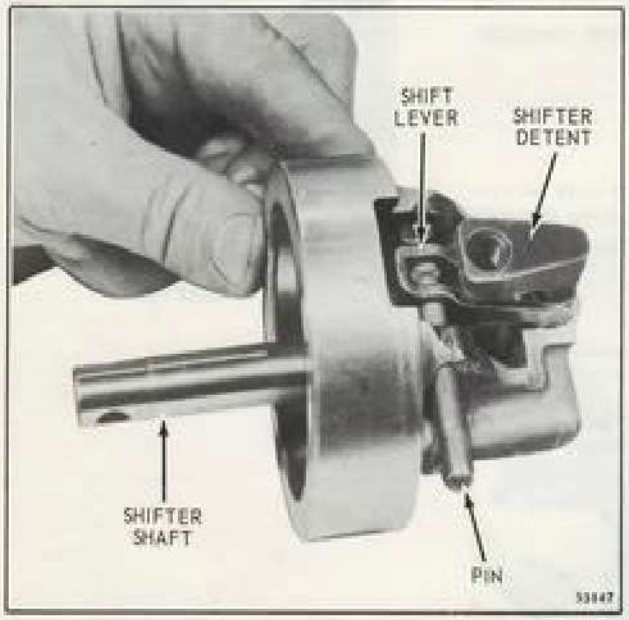


Figure 6-27. Removing Shift Lever Pin

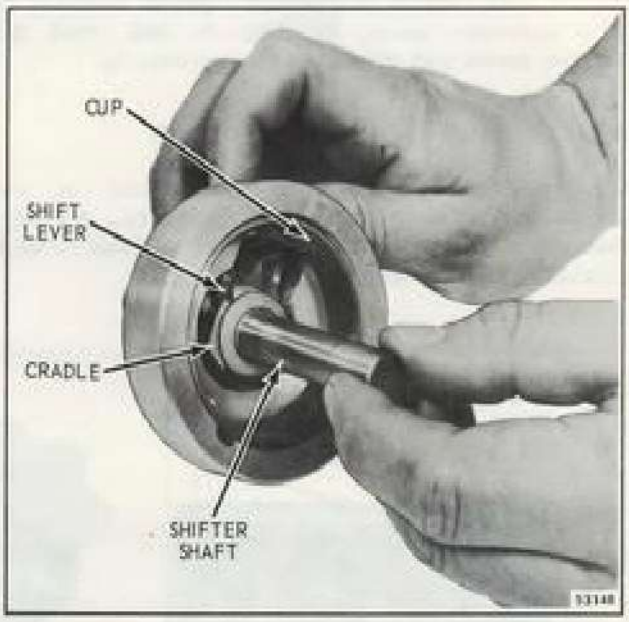


Figure 6-28. Shift Shaft and Cradle

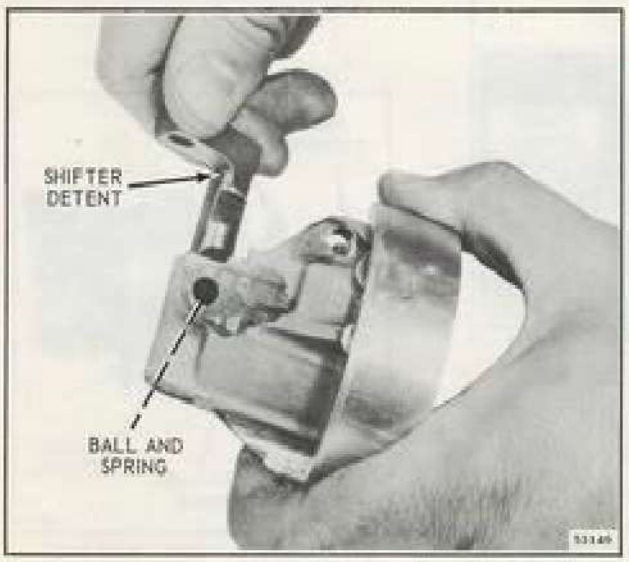


Figure 6-29. Removing Shifter Detent

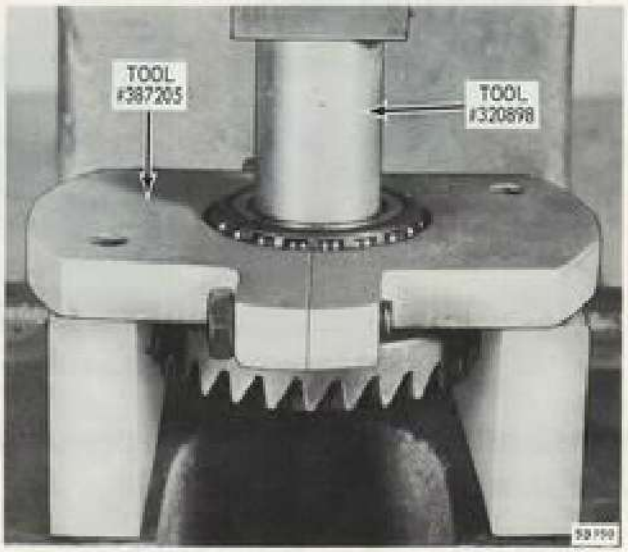


Figure 6-30. Removing Bearing

e. Driveshaft upper bearing and cone are replaced as an assembly. If replacement is necessary, use bearing remover (Special Tool #387131). Clamp tool below bearing and place in a deep throat pedestal type arbor press. Press shaft from bearing. See Figure 6-31. An alternate method is to clamp Special Tool #387206 to driveshaft just above shoulder. Invert driveshaft and place in arbor press with tool #387206 seated on press. Place a pipe over driveshaft and press against tool #387131 to remove bearing. See Figure 6-31, alternate method.

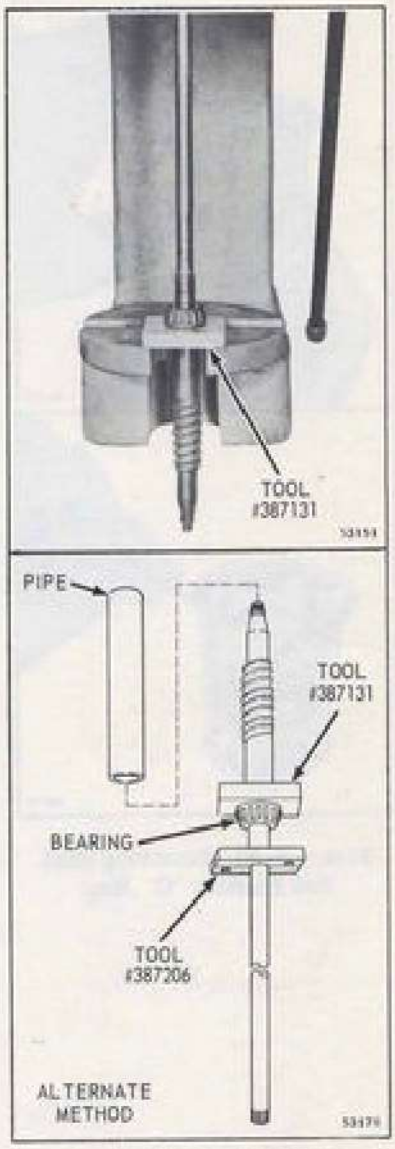


Figure 6-31. Removing Driveshaft Bearing

CLEANING, INSPECTION AND REPAIR

a. Clean all parts with cleaning solvent such as Solvasol, and dry with compressed air.

b. Discard all oil seals, "O" rings, and gaskets. Discard the lower driveshaft bearing and the propeller shaft housing bearings if these have been removed.

c. Inspect gearcase for nicks on the machined surfaces. Remove nicks and re-surface faces on a surface plate. Start with Number 120 emery cloth and finish with Number 180 emery cloth. Re-surface and inspect exhaust housing in like manner. Replace if bent. Check parallelism on plate with a surface gauge and scriber. A drill press table will also serve, using a spindle as a gauge. See Figure 6-32. DO NOT attempt to straighten if bent; replace it.

d. Inspect propeller for nicks, broken blades, and cracks. DO NOT attempt to weld cracked or broken propellers. Remove minor nicks with a file. Note that the aft side of the propeller is flat while the other side is rounded. File blades accordingly to retain shape. Replace badly worn, bent or broken propellers.

e. Inspect driveshaft splines for wear. A lower unit bent from striking a submerged obstruction can cause extensive damage to driveshaft splines. Replace shaft if worn.

NOTE

A bent exhaust housing may cause upper driveshaft splines to wear excessively, and may also damage crankshaft splines.

f. Inspect water tube for obstructions or kinks which may restrict water flow.

g. Inspect water pump impeller and replace if vanes are damaged or worn excessively. Inspect pump housing for distortion and replace if damaged. Inspect impeller housing plate and liner and replace if scored or pitted. Replace impeller housing gasket.

h. Check water intake screen and clean if plugged.

i. Inspect drive gears, pinion gear, thrust washers and bearings for wear. Replace if worn.

Figure 6-32. Checking Parallelism

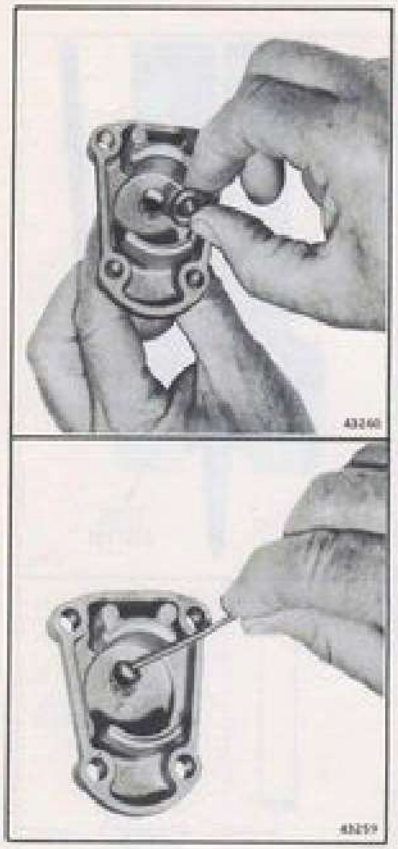


Figure 6-33. Removing Shift Rod Bushing "O" Ring

j. Wash needle and roller bearings in solvent. Oil bearings immediately with clean light spindle oil to prevent rusting. Inspect bearings and replace if damaged.

k. Inspect shift mechanism components. Replace if worn or damaged.

l. Inspect "O" ring and bushing in shift rod cover for wear. Replace "O" ring if worn, using a scribe or suitable tool for removal. If bushing is worn, replace shift rod cover assembly. See Figure 6-33.

REASSEMBLY OF GEARCASE (STANDARD LENGTH)

If not removed, remove drain plug and magnet assembly to prevent breakage of magnet. See exploded view Figure 6-35.

NOTE

Use OMC Gasket Sealing Compound Part #317201 on all pressed in seals in gear housing. The use of OMC Locquic Primer on the threads of nuts and screws requiring the use of OMC Nut lock or Screw Lock will reduce curing time. Make no "dry" assemblies. Where the use of oil is specified, OMC Premium Blend Gearcase lube is recommended.

a. DRIVESHAFT SEAL HOUSING. If removed, install two new seals back to back (lips facing away from each other) in driveshaft seal housing using installer (Special Tool #320668) and an arbor press. See Figures 6-34 and 6-35.

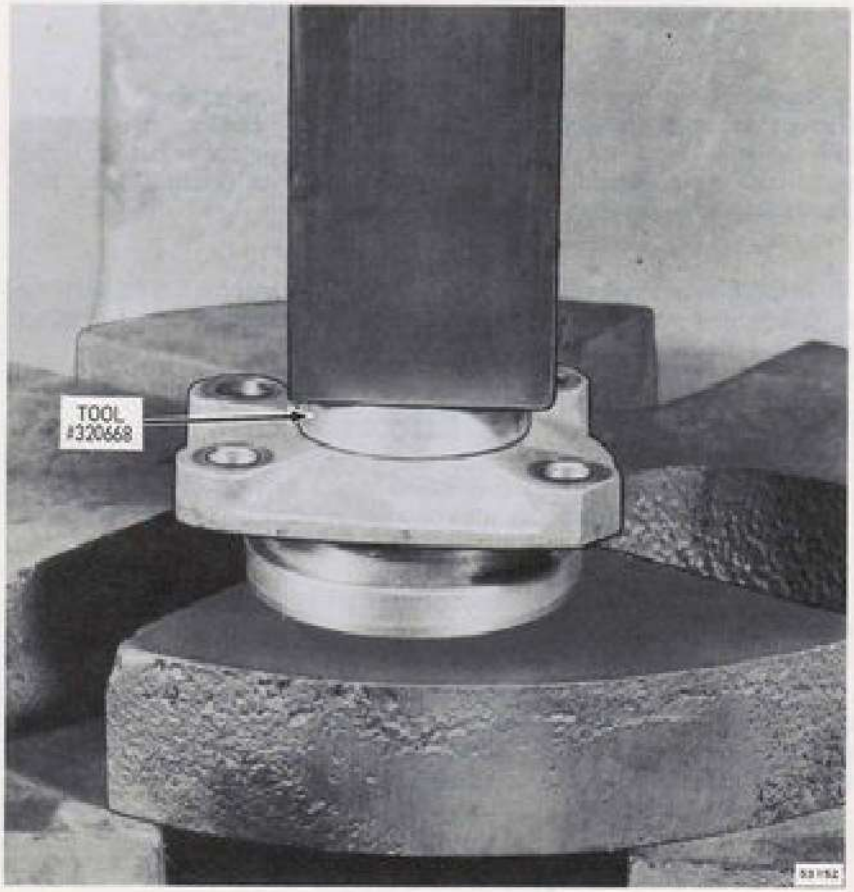


Figure 6-34. Installing Seals

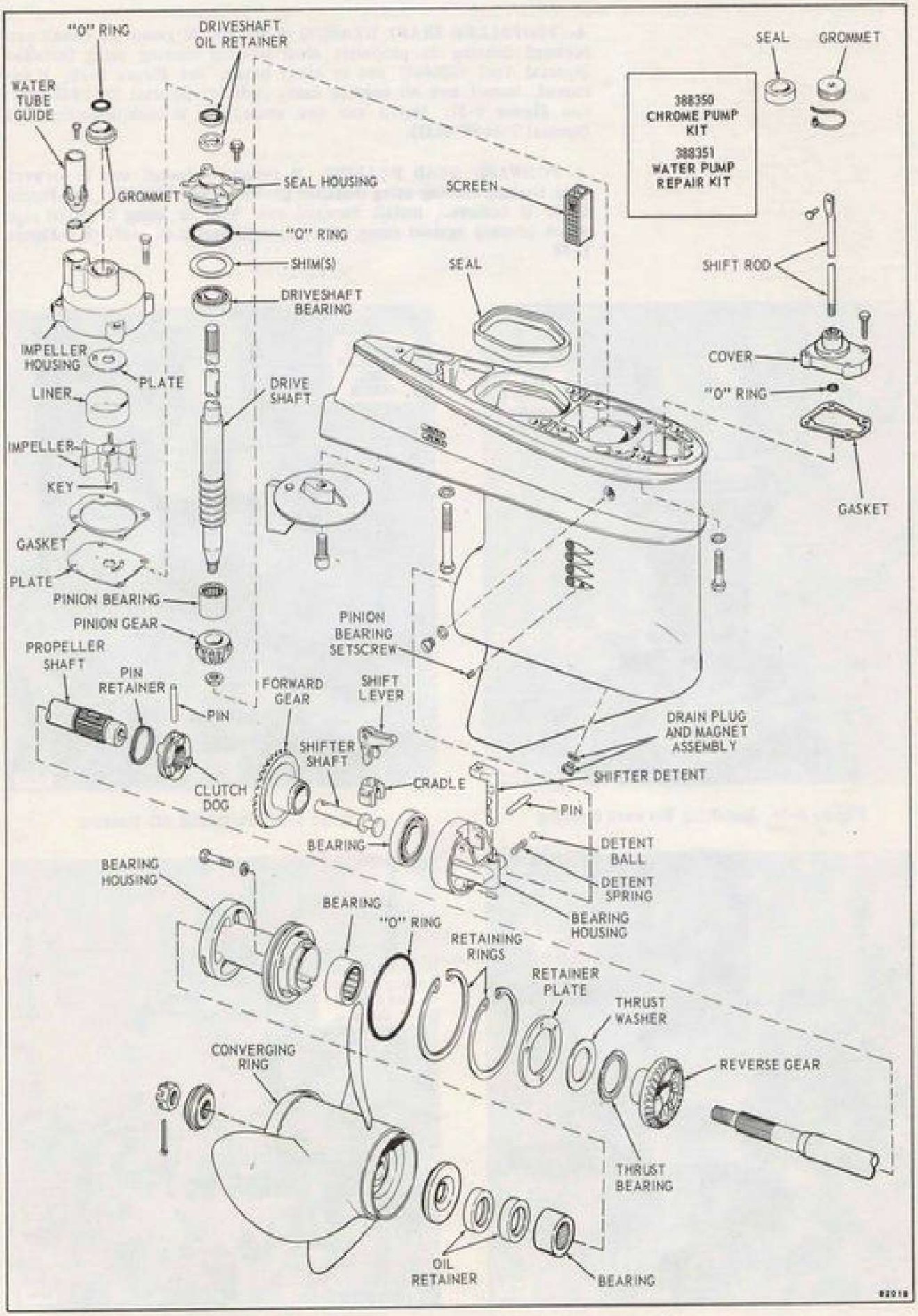


Figure 6-35. Gearcase Assembly Components (Standard Length)

b. PROPELLER SHAFT BEARING HOUSING. If removed, install new forward bearing in propeller shaft bearing housing using installer (Special Tool #320669) and an arbor press. See Figure 6-36. If removed, install new aft bearing using installer (Special Tool #320738). See Figure 6-37. Install two new seals back to back using installer (Special Tool #314433).

c. FORWARD GEAR BEARING. If removed, install cup in forward gear bearing housing using installer (Special Tool #320670). See Figure 6-38. If removed, install forward gear bearing using a tool or pipe which presses against inner race only until seated on gear. See Figure 6-39.

Figure 6-36. Installing Forward Bearing

Figure 6-37. Installing Aft Bearing

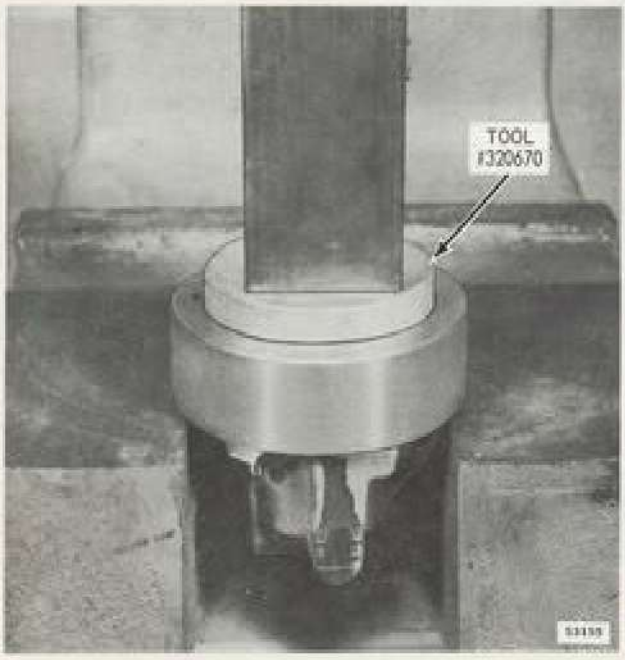


Figure 6-38. Installing Forward Bearing Cup

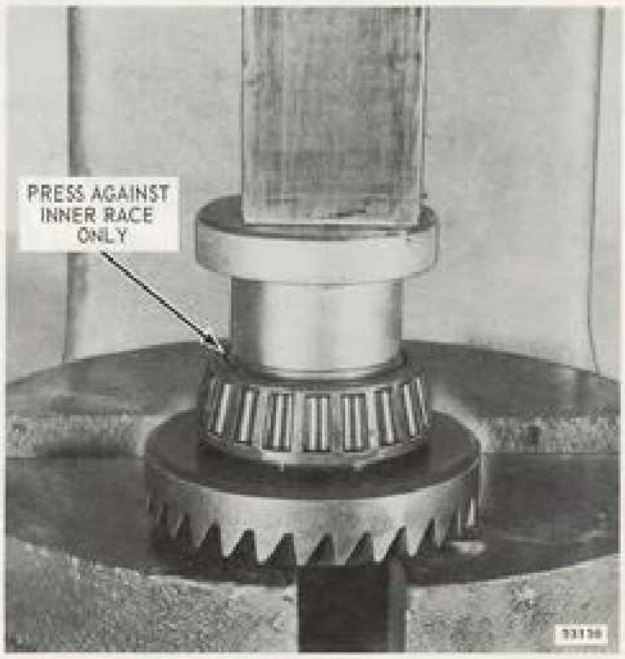


Figure 6-39. Installing Forward Gear Bearing

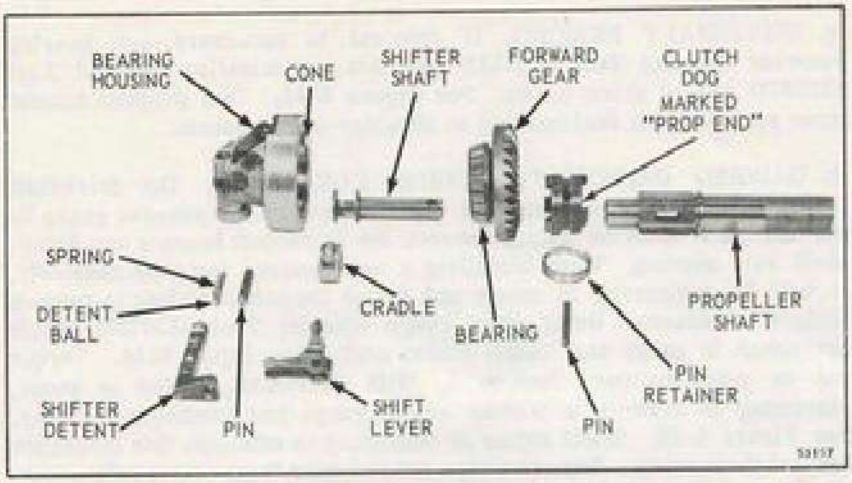


Figure 6-40. Shift Components

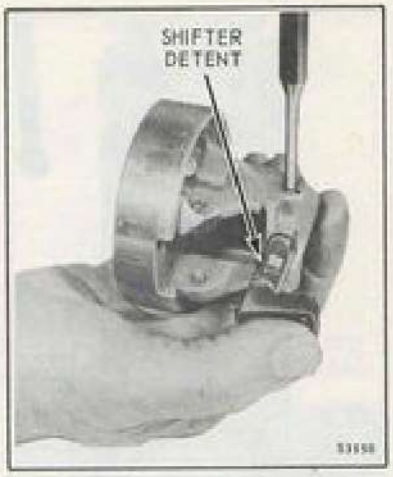


Figure 6-41. Assembling Detent

d. SHIFT MECHANISM. (See Figure 6-40.) Place a little Needle Bearing Grease (Part #378642) on end of detent spring and ball. Install spring and ball in forward bearing housing. With shifter detent facing forward, and a punch inserted in detent spring and ball hole, depress ball and spring while pressing shifter detent into housing. See Figure 6-41. Rotate shifter detent 180°. Oil and place cradle on shifter shaft, and position in forward bearing housing. Install shifter lever engaging cradle and shifter detent. Insert shifter lever pin. See Figure 6-42.

e. Oil and install clutch dog on propeller shaft with end marked "Prop End" facing propeller end of shaft and hole in dog aligned with slot in shaft. Oil and install forward gear on propeller shaft. Oil shifter shaft. Align hole in shifter shaft with hole in clutch dog. Assemble to propeller shaft and insert clutch dog pin. See Figure 6-43. Install new retaining spring making certain no coils overlap. See insert Figure 6-43. Press shifter detent down in reverse gear position for installation in gearcase.

f. PINION BEARING. If removed, install pinion bearing using parts of installer (Special Tool #385546) and installer (Special Tool #320673). Assemble plate and washer to installer using a 1/2"-13 screw. Place bearing on tool, lettered side against tool. Press bearing into gearcase. See Figure 6-44. Apply OMC Screw Lock to threads and install set screw in gearcase. See Figure 6-25 insert.

Figure 6-42. Inserting Pin

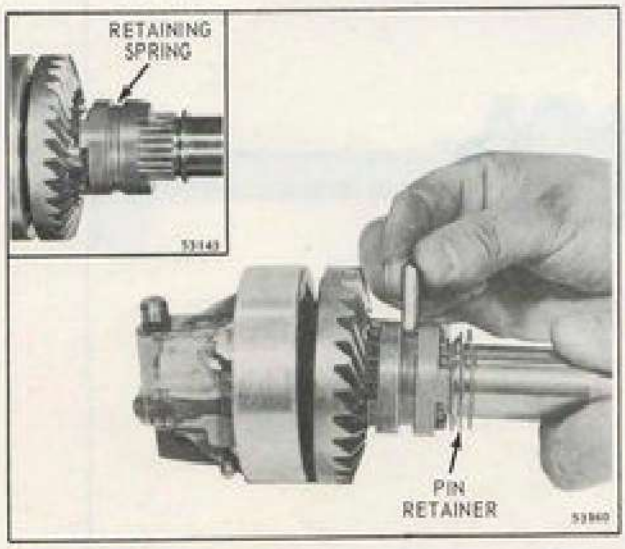


Figure 6-43. Assembling Propeller Shaft Components

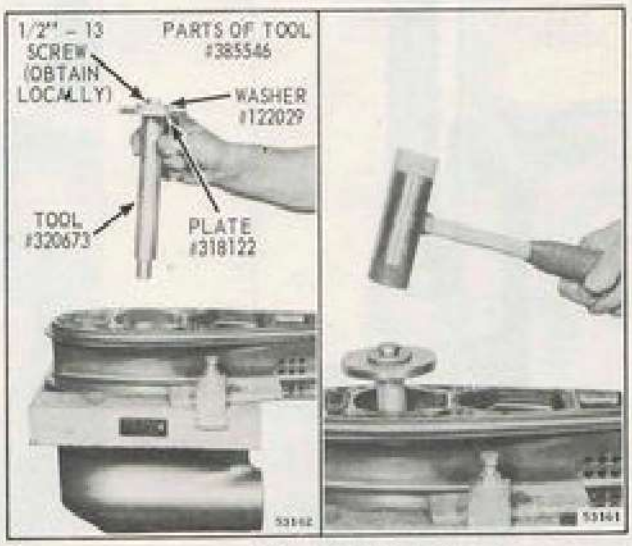


Figure 6-44. Installing Pinion Bearing

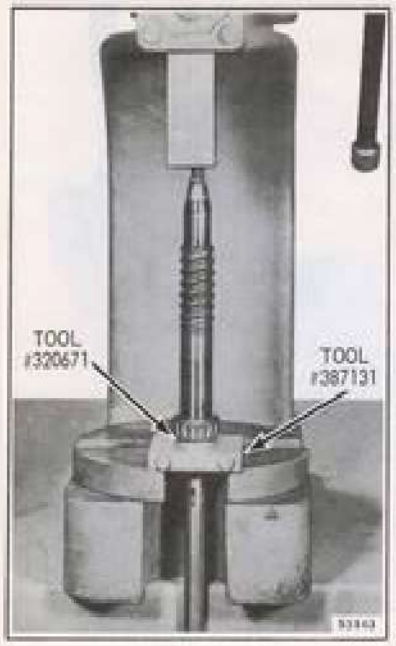


Figure 6-45. Installing Driveshaft Bearing

g. DRIVESHAFT BEARING. If removal is necessary, use bearing remover (Special Tool #387131) and bearing installer (Special Tool #320671) and an arbor press. See Figure 6-45. Tool presses against inner race and will seat bearing on shoulder on driveshaft.

h. GAUGING DRIVESHAFT BEARING CLEARANCE. The driveshaft pinion gear is precisely meshed with the forward and reverse gears by the use of a shim or shims between the driveshaft bearing and driveshaft seal housing. When installing a new bearing and cone assembly, it will be necessary to gauge and select the proper shims to restore factory clearance. Using shim gauge (Special Tool #320739) locate driveshaft in gauge and install pinion gear. See Figure 6-46. Torque nut to specifications, Section 2. With driveshaft seated in gauge, shimming is correct if bottom end of gauge just touches top of gear. See Figure 6-46. Select shims as necessary to establish this clearance and set them aside. Remove pinion nut and gear from driveshaft.

i. Lubricate bearing cone and cup and install propeller shaft, forward gear and shift mechanism in gearcase. Be sure alignment pin in forward bearing housing engages hole in gearcase. Also be sure shifter detent is pushed down in reverse gear position. See Figure 6-47.

NOTE

Be sure drain plug and magnet assembly is removed or magnet will be broken off when installing forward gear and bearing housing.

j. Apply OMC Gasket Sealing Compound to both sides of shift rod cover gasket and position on gearcase. Thread vertical shift rod and cover assembly into shifter detent as an assembly. Secure cover assembly screws to torque specified in Section 2.

Figure 6-46. Shim Gage

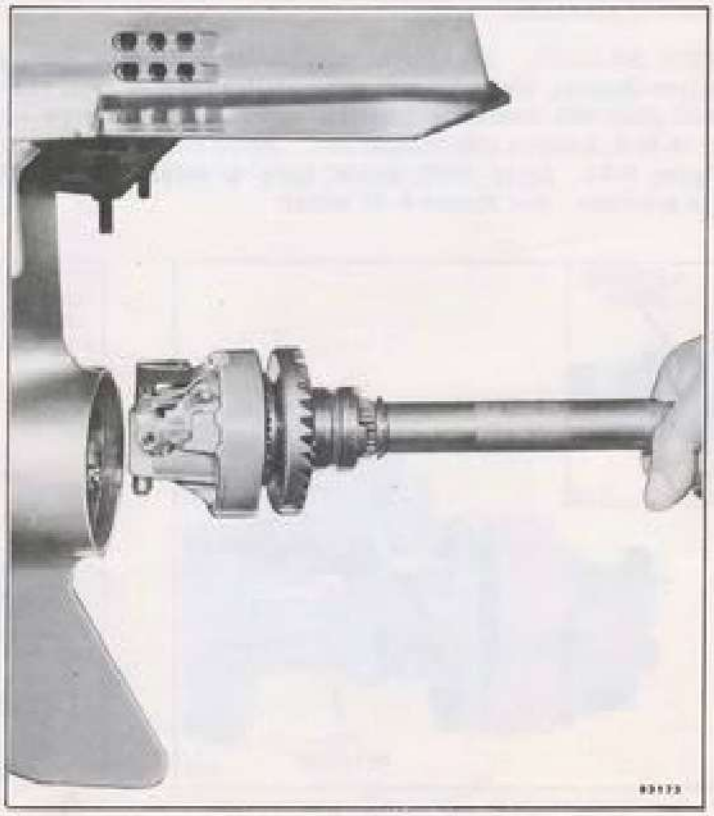


Figure 6-47. Installing Propeller Shaft

Turn vertical shift rod clockwise until it seats in shifter detent. Then back out as necessary until top end slants to port side. Shift into NEUTRAL. Using shift rod gauge (Special Tool #324819) align appropriate pin in gauge with hole in shift rod. Insert pin. Pin on gauge should enter hole in shift rod. The distance from the top of the gearcase to the center of the shift rod hole is 16.400" (416.56 mm) ± 1/2 turn. See Figure 6-48. Screw shift rod in or out of shifter detent to obtain specified dimension. Pull up on rod so clutch dog engages forward gear.

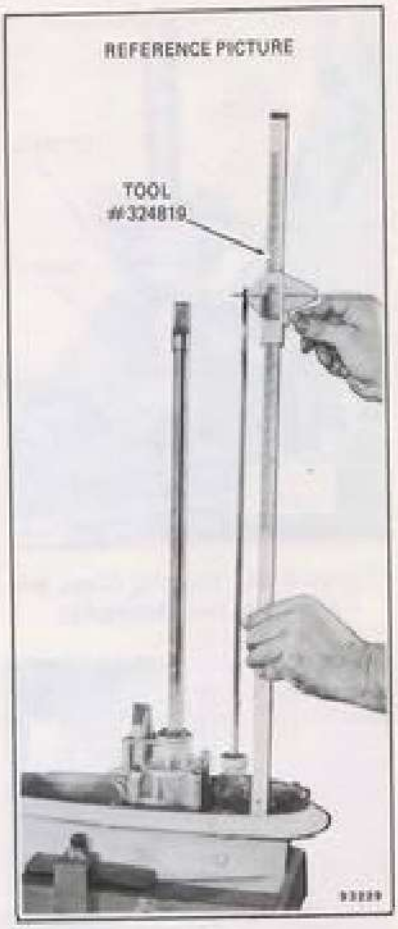


Figure 6-48. Shift Rod Adjustment

NOTE

After adjustment, vertical shift rod top end must slant towards port side. See Figure 6-48.

k. Oil and install driveshaft and pinion gear in gearcase. Start pinion nut on driveshaft using holding tool (Special Tool #320675). See Figure 6-49. Using driveshaft holding socket (Special Tool #312752) and an open end wrench on pinion nut, tighten and torque nut to Specifications, Section 2. See Figure 6-21.

l. Install thrust bearing and thrust washer on reverse gear. Slide reverse gear onto propeller shaft.

m. Install propeller shaft bearing housing retainer plate in gearcase. Insert two Truarc rings in gearcase using a #7 Truarc Pliers. See Figure 6-19.

SAFETY WARNING

Retaining rings are under extreme pressures during removal and installation. Wear safety glasses and proceed with care to avoid unsnapping ring from pliers.

n. Turn gearcase right side up. Thread guide pins 10" long by 1/4"-28 (Special Tool #383175) onto retainer plate. Install propeller shaft bearing housing in "UP" position (see Figures 6-50 and 6-73), and secure with screws dipped in OMC Gasket Sealing Compound. Be sure to install new "O" rings on screws. Tighten to torque specified in Section 2.

Figure 6-49. Starting Pinion Nut

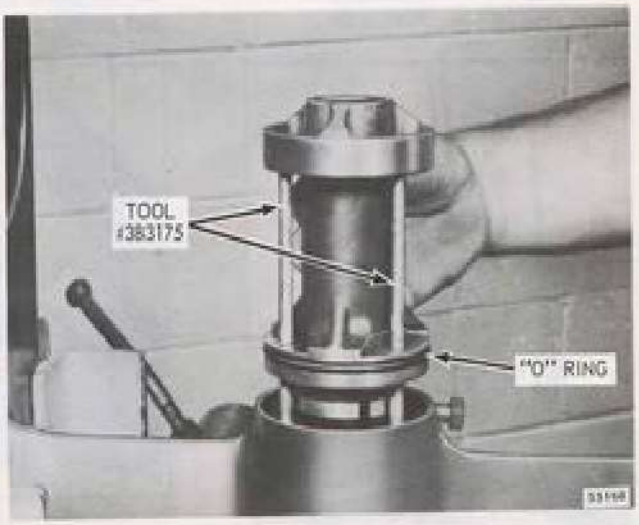


Figure 6-50. Installing Bearing Housing

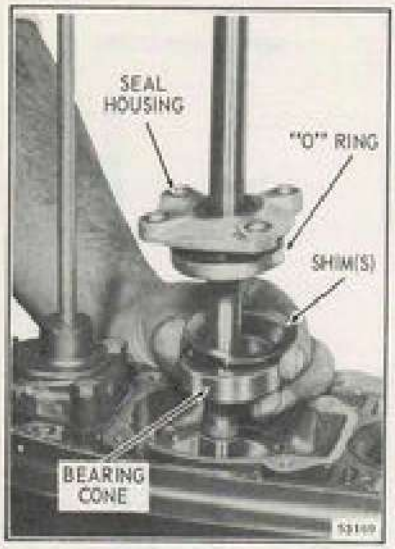


Figure 6-51. Bearing Cone, and Shim and Seal Assembly

Figure 6-52. Shift Rod Offset to Port Side

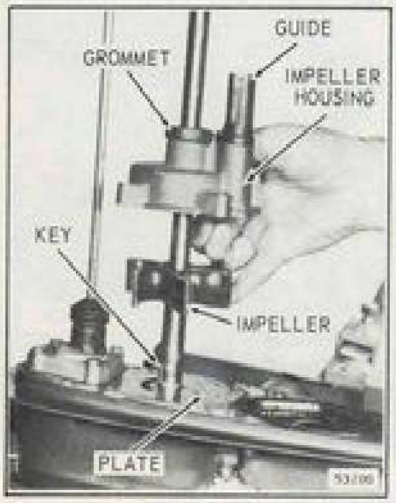


Figure 6-53. Water Pump

o. Oil and place a new "O" ring on driveshaft seal housing. Locate bearing cone squarely in hole in gearcase. Position shim(s) on top of cone. Place a seal protector (Special Tool #312403) over driveshaft splines and slide seal housing onto driveshaft. See Figure 6-51.

p. Dip screws in OMC Gasket Sealing Compound and tighten to torque specified in Section 2.

q. Install impeller plate. Insert impeller drive key in driveshaft.

r. Install impeller over key in driveshaft with either side up if installing new impeller.

s. Install new gasket onto pump housing. To hold gasket in place use OMC Gasket Sealing Compound (P/N 317201). Install new grommets in pump housing. Oil impeller blades. Install pump housing and rotate driveshaft clockwise while sliding housing over impeller. Secure pump housing and water tube guide with screws dipped in OMC Gasket Sealing Compound and tighten to torque specified in Section 2.

t. Perform gearcase pressure and vacuum tests.

DISASSEMBLY OF GEARCASE (LONG SHAFT)

NOTE

If not removed, remove drain plug and magnet assembly to avoid breaking off magnet during disassembly and reassembly operations.

Remove "O" ring from top of driveshaft. See Figure 6-52.

a. Remove four screws and slide water pump impeller housing and impeller off of driveshaft. See Figure 6-53. Remove water tube guide and grommets from impeller housing.

b. Remove impeller drive key and impeller plate.

c. Remove four propeller shaft bearing housing screws. Using two 8 inch 5/16"-18 bolts (Special Tool #316982) and flywheel puller (Special Tool #378103), pull bearing housing from gearcase. See Figure 6-54.

d. Remove two Truarc rings using a #7 Truarc pliers (Special Tool #311879). See Figure 6-19.

△ SAFETY WARNING

Retaining rings are under extreme pressures during removal and installation. Wear safety glasses and proceed with care to avoid unsnapping ring from pliers.

e. Remove retainer plate, thrust washer, thrust bearing, reverse gear and small thrust washer from propeller shaft. See Figure 6-55.

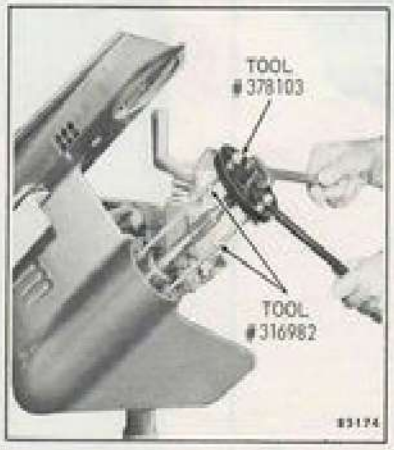


Figure 6-54. Removing Propeller Shaft Bearing Housing

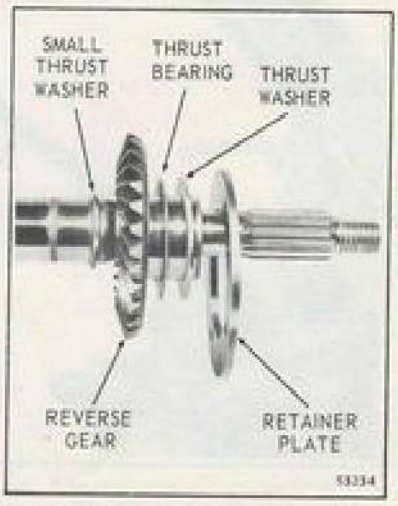


Figure 6-55

f. Remove four upper driveshaft bearing housing screws. Pull up on shift rod placing clutch dog in forward gear. Remove the pinion lock nut from the bottom of the driveshaft by using Driveshaft Holding Socket (Special Tool #312752) (Figure 6-21). With the lock nut removed, pull the driveshaft and bearing housing out of the gearcase and remove pinion gear. See Figure 6-56.

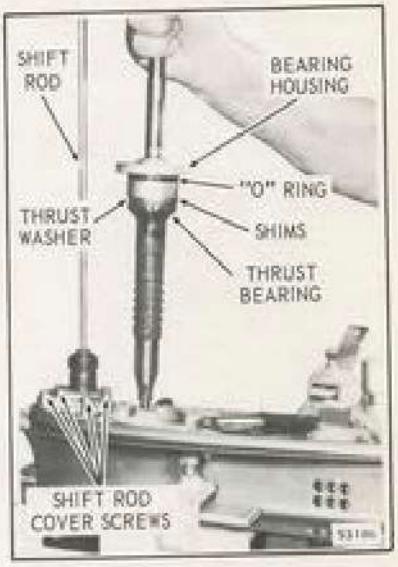


Figure 6-56

NOTE

If needle bearing in bearing housing is worn, bearing and bearing housing must be replaced as an assembly. See Figure 6-56.

g. Push shift rod down into reverse gear position.

NOTE

Shifter detent must be in reverse gear position to provide necessary clearance to remove propeller shaft.

h. Remove four screws from shift rod cover assembly. See Figure 6-56. Unscrew shift rod from shifter detent in gearcase. Remove shift rod and cover as an assembly. See Figure 6-57.

Figure 6-57. Removing Shift Rod and Cover

i. Remove propeller shaft, forward gear and bearing housing from gearcase as an assembly. See Figure 6-58.

j. If necessary, remove pinion bearing, using Bearing Remover-Installer (Special Tool #385546). See Figure 6-59.

NOTE

Remove bearing setscrew from gearcase before attempting pinion bearing removal. See Figure 6-59 insert.

Place washer, bearing, plate, and guide sleeve on bolt as shown in Figure 6-59. Insert in gearcase. Screw remover (#318125) portion of tool onto screw thru gearcase cavity. Shoulder on tool must face lower bearing. Tighten screw with wrench to remove bearing. See Figure 6-59.

Figure 6-58. Removing or Installing Propeller Shaft

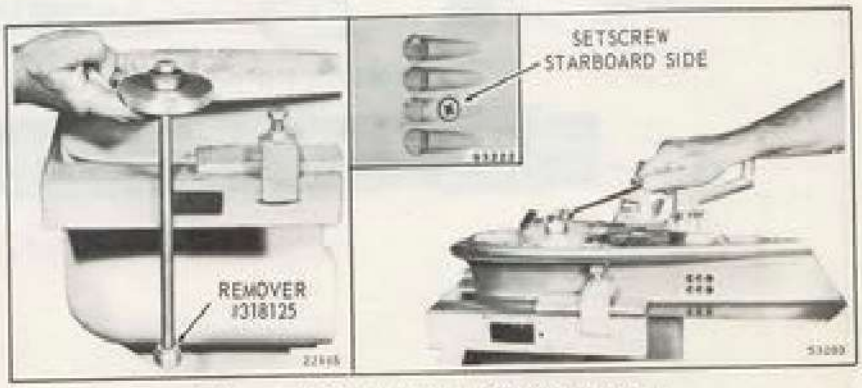


Figure 6-59. Removing Pinion Bearing

DISASSEMBLY OF PROPELLER SHAFT, FORWARD GEAR AND SHIFT MECHANISM

a. Remove clutch dog pin retainer spring and discard it. Remove pin, and remaining components from propeller shaft. See Figure 6-60.

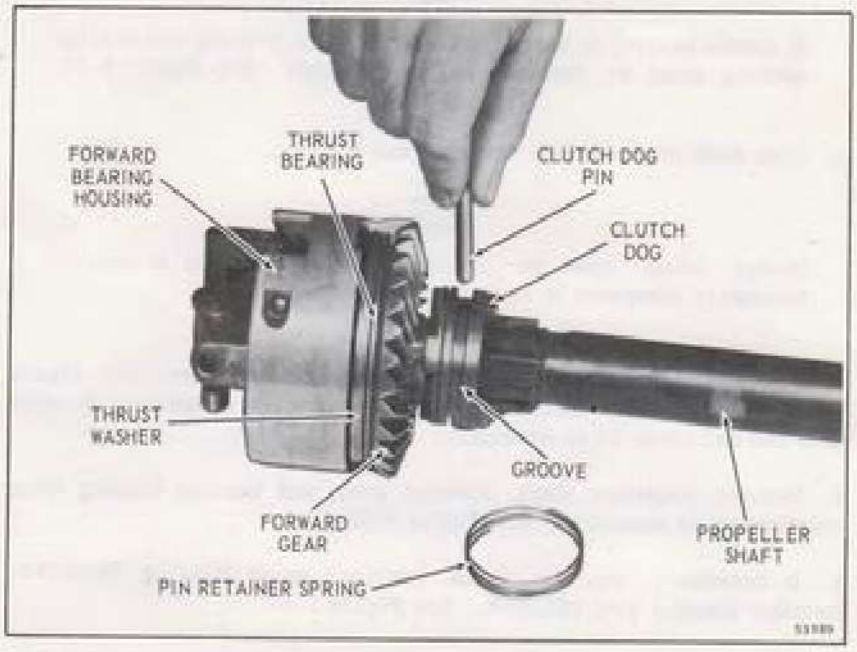


Figure 6-60. Removing or Installing Clutch Dog Pin

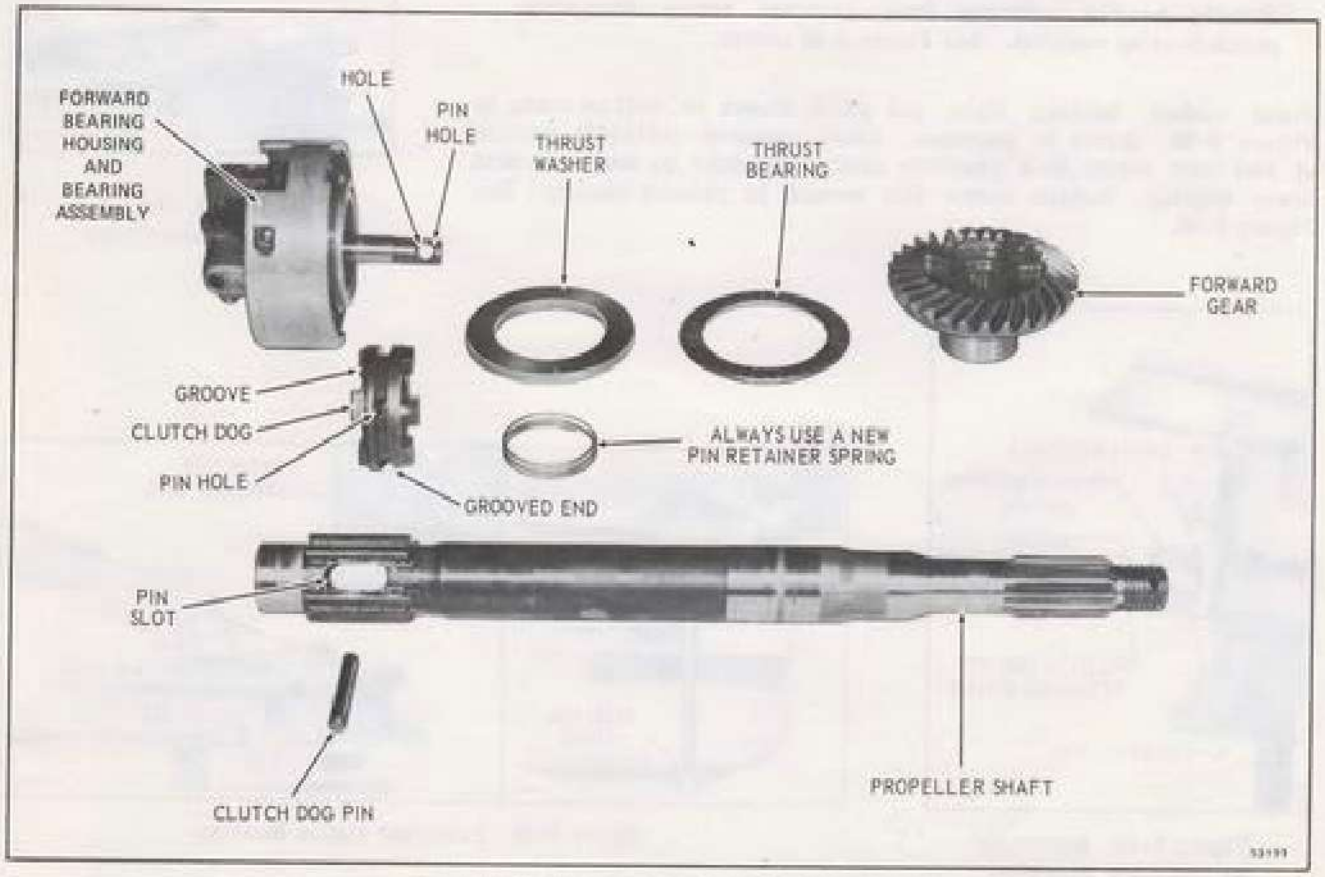


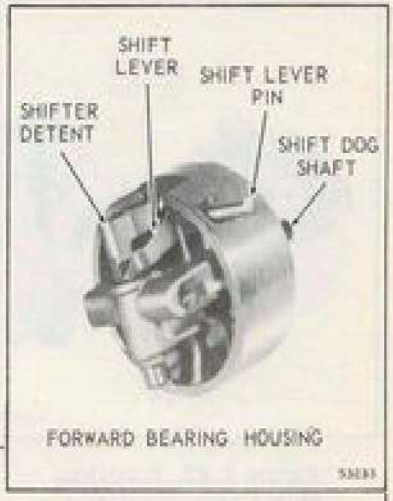
Figure 6-61. Propeller Shaft and Components

b. Remove two setscrews, springs and shifter detent balls from forward bearing housing. See Figure 6-62.

c. Remove shift lever pin. See Figure 6-62. Remove shift lever, shifter detent and shift dog shaft. See Figure 6-62 and insert.

PROPELLER SHAFT BEARING HOUSING

Oil seals can be removed by driving them out. Bearings may be removed in the same manner, if necessary. All nut and screw threads that were coated with OMC Nut or Screw Lock must be thoroughly cleaned before reassembly.



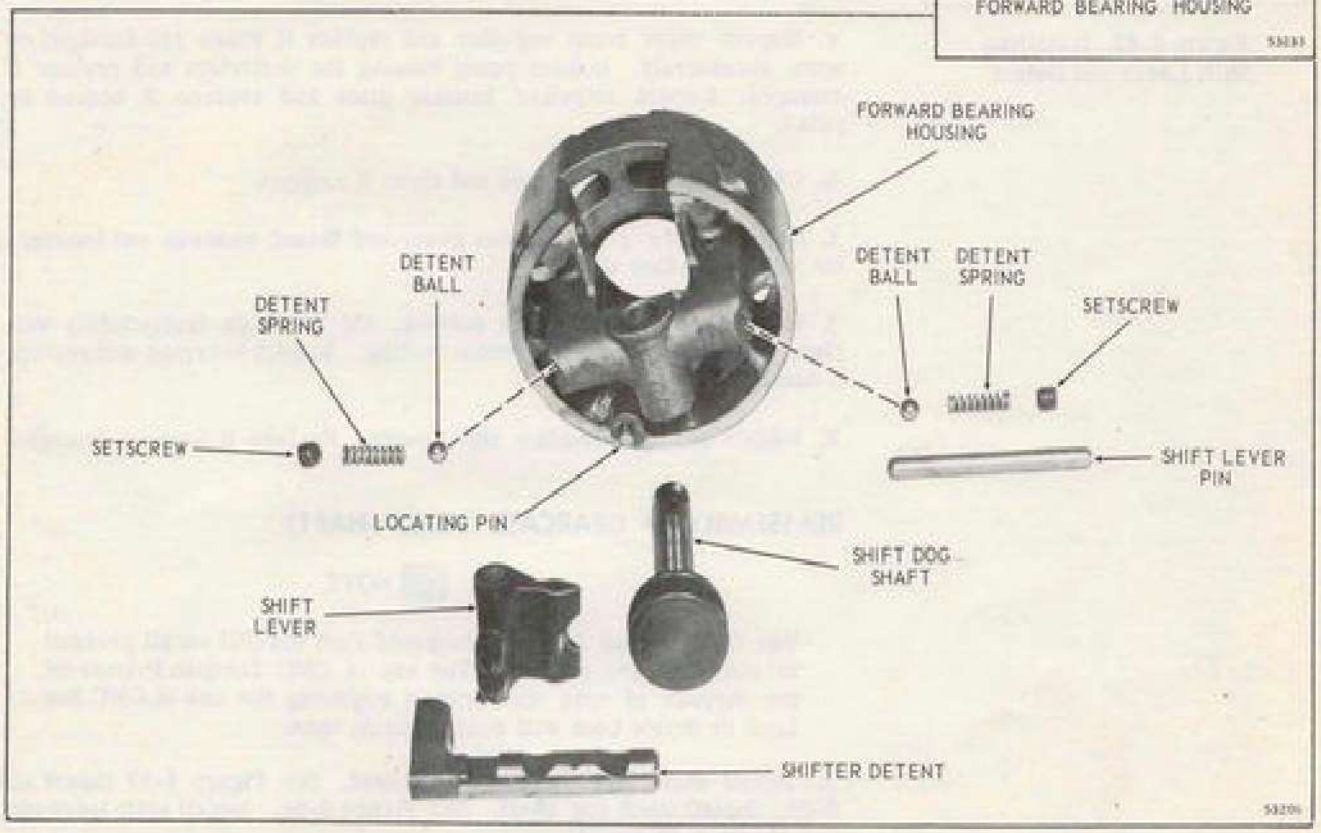


Figure 6-62. Bearing Housing Components

CLEANING, INSPECTION AND REPAIR

a. Clean all parts with cleaning solvent such as Solvasol, and dry with compressed air.

b. Discard all oil seals, "O" rings, and gaskets. Discard the lower driveshaft bearing and the propeller shaft housing bearings if these have been removed.

c. Inspect driveshaft splines for wear. A lower unit bent from striking a submerged obstruction can cause extensive damage to driveshaft splines. Replace shaft if worn. See NOTE, page 6-22, after paragraph e.

d. Inspect propeller for nicks, broken blades, and cracks. DO NOT attempt to weld cracked or broken propellers. Remove minor nicks with a file. Note that the aft side of the propeller is flat while the other side is rounded. File blades accordingly to retain shape. Replace badly worn, bent or broken propellers.

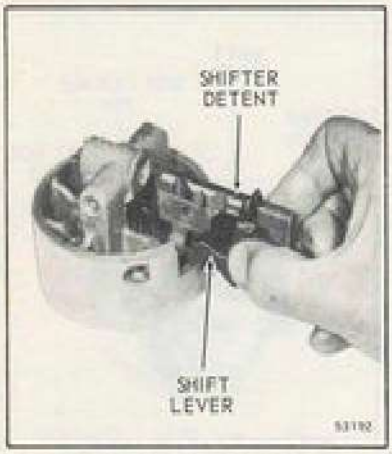


Figure 6-63. Installing Shift Lever and Detent

e. Inspect gearcase for nicks on the machined surfaces. Remove nicks and re-surface faces on a surface plate. Start with Number 120 emery cloth and finish with Number 180 emery cloth. Re-surface and inspect exhaust housing in like manner. Replace if bent. Check parallelism on plate with a surface gauge and scriber. A drill press table will also serve, using a spindle as a gauge. See Figure 6-32. DO NOT attempt to straighten if bent; replace it.

NOTE

A bent exhaust housing may cause upper driveshaft splines to wear excessively and may also damage crankshaft splines.

f. Inspect water tube for obstructions or kinks which may restrict water flow.

g. Inspect water pump impeller and replace if vanes are damaged or worn excessively. Inspect pump housing for distortion and replace if damaged. Inspect impeller housing plate and replace if scored or pitted.

h. Check water intake screen and clean if plugged.

i. Inspect drive gears, pinion gear, and thrust washers and bearings for wear. Replace if worn.

j. Wash needle bearings in solvent. Oil bearings immediately with clean light spindle oil to prevent rusting. Inspect bearings and replace if damaged.

k. Inspect shift mechanism components. Replace if worn or damaged.

REASSEMBLY OF GEARCASE (LONG SHAFT)

NOTE

Use OMC Gasket Sealing Compound Part #317201 on all pressed in seals in gear housing. The use of OMC Locquic Primer on the threads of nuts and screws requiring the use of OMC Nut Lock or Screw Lock will reduce curing time.

a. Install shift lever and shifter detent. See Figure 6-62 insert and 6-63. Install shift dog shaft. See Figure 6-64. Install shift lever pin. See Figure 6-62 insert.

b. Install detent balls and springs. Apply OMC Screw Lock to setscrew threads. Tighten setscrews until flush with bearing housing. See Figures 6-62 and 6-65A.

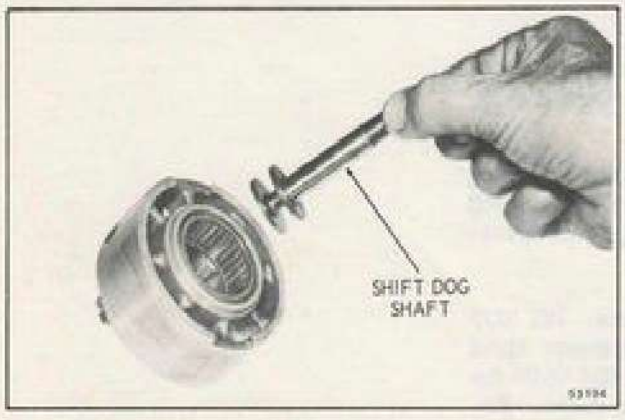


Figure 6-64. Installing Shift Dog Shaft

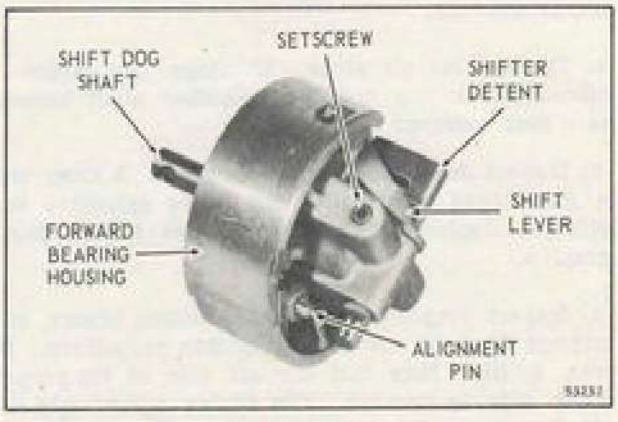


Figure 6-65A

c. Install thrust bearing on shoulder of forward gear. Install thrust washer on shoulder in bearing housing, and install forward gear in bearing housing. See Figure 6-65B.

d. Align holes in clutch dog and slot in propeller shaft. Install clutch dog on shaft, grooved end on dog facing forward end of shaft. See Figure 6-61.

e. Install propeller shaft in forward gear aligning slot in propeller shaft with hole in clutch dog shaft. Insert pin and install a new retainer spring on clutch dog to retain pin making certain no coils overlap. See Figure 6-58 or 6-43 insert. Press shifter detent down in reverse gear position.

f. Install driveshaft pinion bearing using Bearing Remover-Installer (Special Tool #385546). See Figure 6-66. Assemble washer, plate, guide sleeve and Remover-Installer portion of tool to screw. Shoulder on installer portion of tool must face down. Place bearing on tool, lettered side of case toward shoulder. Place bearing and tool in position in gearcase. Drive bearing in. Bearing will be properly seated when plate contacts top of gearcase. Apply OMC Screw Lock to threads, and install setscrew in gearcase. See Figure 6-59 insert.

⚠ SAFETY WARNING

Striking a steel tool with a steel hammer may produce chips which can cause serious damage to eyes. Safety glasses must be worn to prevent injury.

g. Insert propeller shaft, forward gear and bearing housing into gearcase. Be sure locating pin in bearing housing engages hole in gearcase. See Figure 6-58.

h. The driveshaft pinion gear is precisely meshed with the forward and reverse gears by the use of a shim or shims between the driveshaft thrust washer and driveshaft bearing housing. To select the proper shimming, assemble pinion gear to driveshaft and torque nut to 40-45 foot-pounds (54-60 N·m).

i. Remove thrust washer and bearing. Place shims removed during disassembly on driveshaft shoulder. Using shim gauge (Special Tool #315767) measure clearance between bottom of gauge and pinion gear. See Figure 6-67. If shimming is correct, bottom end of gauge should just touch top of pinion gear. Add or remove shims as necessary to make zero clearance. See Figure 6-67. Carefully set aside the correct shims selected and remove nut and pinion gear from driveshaft.

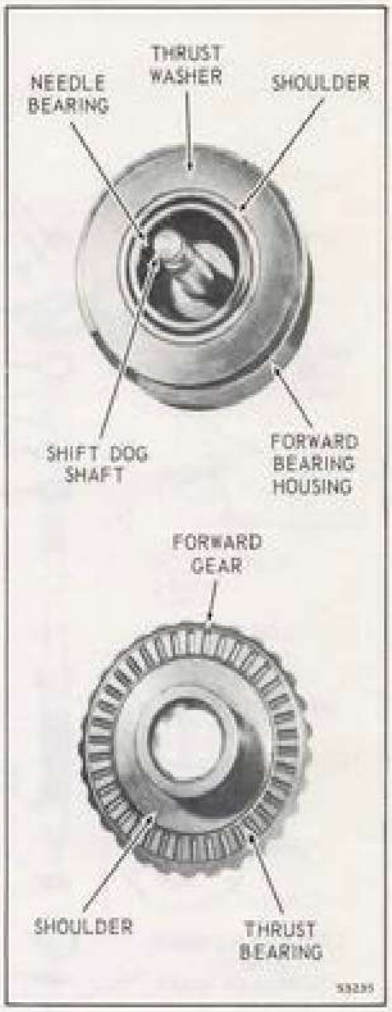


Figure 6-65B

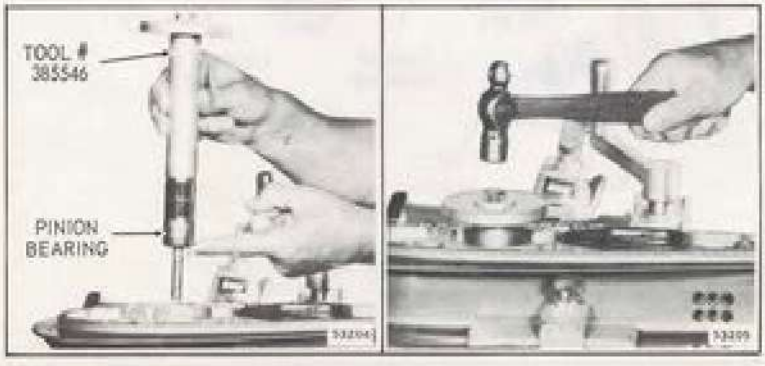


Figure 6-66. Installing Pinion Bearing

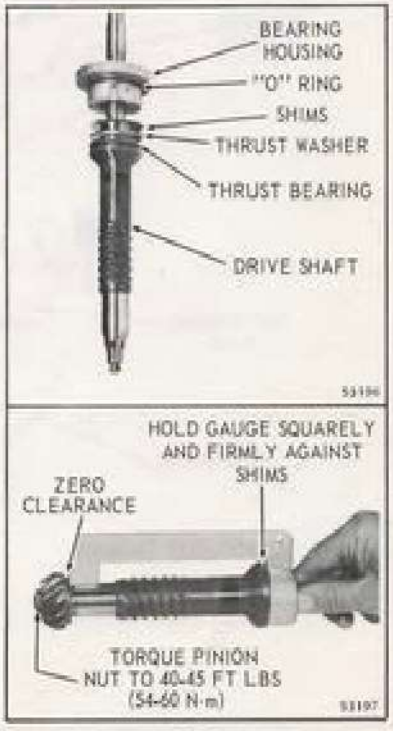


Figure 6-67. Gauging Thrust Bearing Shims

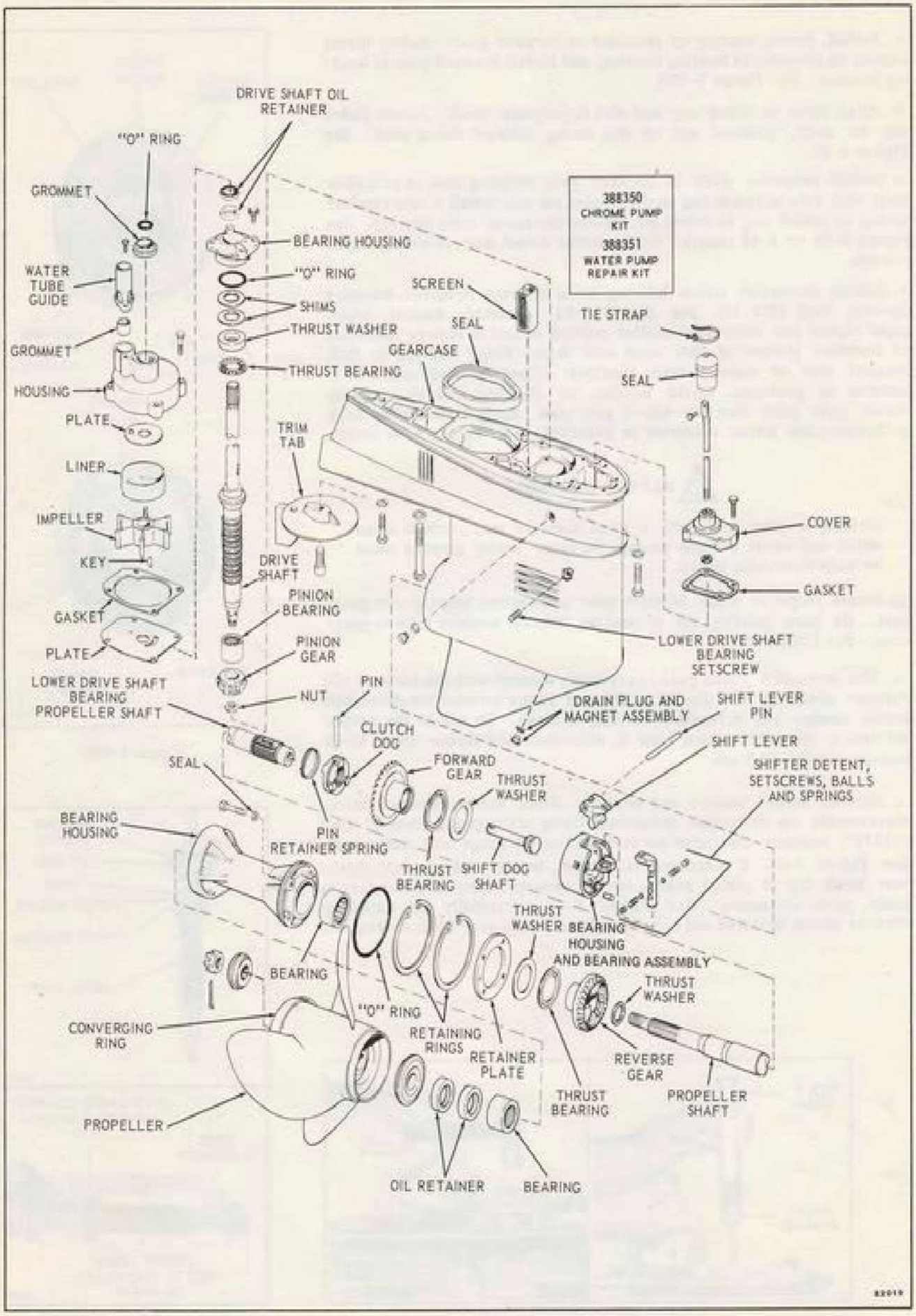


Figure 6-68. Long Shaft Gearcase Assembly Components

j. Replace shift rod cover "O" ring. See Figure 6-33. Apply OMC Gasket Sealing Compound to both sides of shift rod cover gasket and position on gearcase. Thread vertical shift rod and cover assembly into shifter detent as an assembly. Secure cover assembly screws to torque specified in Section 2. Apply OMC Anti-Corrosion Lube to shift rod about 3" (75 mm) above cover. See Figure 6-69 insert. Slide boot over end of rod end down onto shift rod cover. Secure with tie strap.

NOTE

Avoid getting lubricant on clamping area in boot or on cover. Lubricant here could cause boot to slip off.

k. Turn vertical shift rod clockwise until it seats in shifter detent. Then back out about three turns until top end offset faces port side. Shift into NEUTRAL. Using shift rod gauge (Special Tool #324819) pin on gauge should enter hole in shift rod. The distance from the top of the gearcase to the center of the shift rod hole is 21-23/32" ± 1/32" (542.52 ± 0.79 mm). See Figure 6-69. Screw shift rod in or out of shifter detent to obtain specified dimension. Pull up on rod so clutch dog engages forward gear. Using a long rod or screwdriver tap clutch dog fully into forward gear to provide clearance to install pinion gear.

NOTE

After adjustment, vertical shift rod top end must offset to port side of gearcase. See Figure 6-69.

l. Invert gearcase and slide pinion gear in place. See Figure 6-70.

m. Install driveshaft in gearcase and engage pinion gear. Start pinion nut on driveshaft using holding tool (Special Tool #320675). See Figure 6-49. Secure pinion gear to driveshaft with pinion nut using driveshaft holding socket (Special Tool #312752) and torque wrench. See Figure 6-21. Torque nut to 40-45 foot-pounds (54-60 N·m).

n. Install small thrust washer in reverse gear and install thrust bearing and thrust washer on reverse gear. Slide reverse gear into propeller shaft. See Figure 6-55.

o. Install propeller shaft bearing housing retainer plate in gearcase. Insert two Truarc rings in gearcase using a #7 Truarc Pliers (Special Tool #311879). See Figure 6-19.

⚠ SAFETY WARNING

Retaining rings are under extreme pressures during removal and installation. Wear safety glasses and proceed with care to avoid unsnapping ring from pliers.

Figure 6-69
Shift Rod Gauge

Figure 6-70. Install Pinion Gear

p. If removed, install new bearings in propeller shaft bearing housing. For forward bearing, use Special Tool #314641 (see Figure 6-71); for aft bearing, use Special Tool #417061. See Figure 6-72. Install oil seals back-to-back (one seal lip facing out and one seal lip facing in) using seal installer (Special Tool #311869). See Figure 6-72.

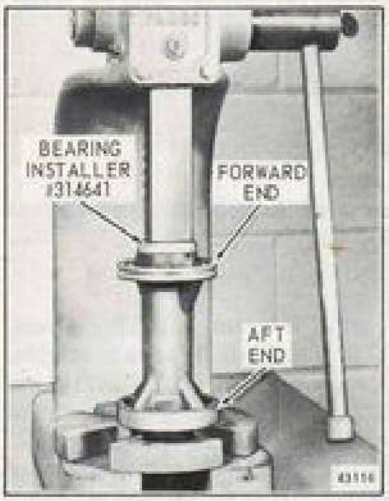


Figure 6-71. Installing Gearcase Head Forward Bearing

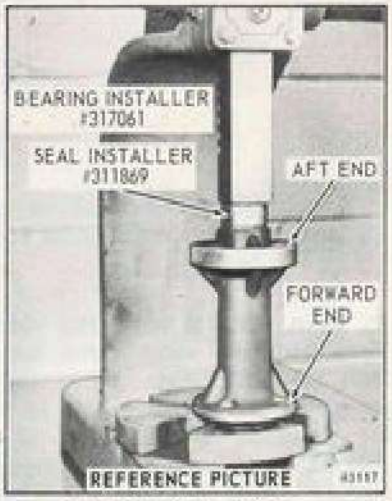


Figure 6-72. Installing Gearcase Head Aft Bearing and Seals

q. Turn gearcase right side up. Thread guide pins 10" (254 mm) long by 1/4"-28 (Special Tool #383175) into retainer plate. Install propeller shaft bearing housing with UP mark up (see Figures 6-50 and 6-73). Place new seals on bearing housing screws. Dip screws in OMC Gasket Sealing Compound and tighten to torque specified in Section 2.

r. Install new oil seals back-to-back (one seal lip facing out and one seal lip facing in) in driveshaft bearing housing, using seal driver (Special Tool #314640). Install new "O" ring on housing. Install thrust bearing, thrust washer and pre-selected shims on driveshaft.

s. Install driveshaft bearing housing using seal protector (Special Tool #312403). Dip screws in OMC Gasket Sealing Compound and tighten to torque specified in Section 2.

t. Install impeller plate. Insert impeller drive key in driveshaft.

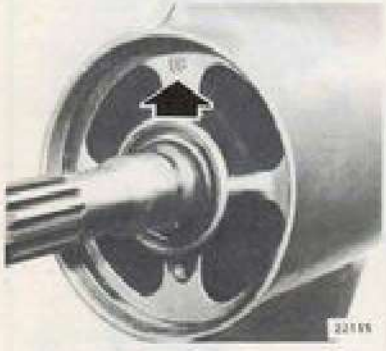


Figure 6-73. Up Mark in Bearing Head

u. Install impeller over key in driveshaft with either side up if installing a new impeller.

v. Install new grommets in pump housing. Install gasket to housing. Hold gasket in place with OMC Gasket Sealing Compound. Oil impeller blades. Install pump housing and rotate driveshaft clockwise while sliding housing over impeller. Secure pump housing and water tube guide with screws dipped in OMC Gasket Sealing Compound and tighten to torque specified in Section 2.

w. Perform gearcase pressure test. See Figure 6-74.

Figure 6-74. Pressure Testing Gearcase

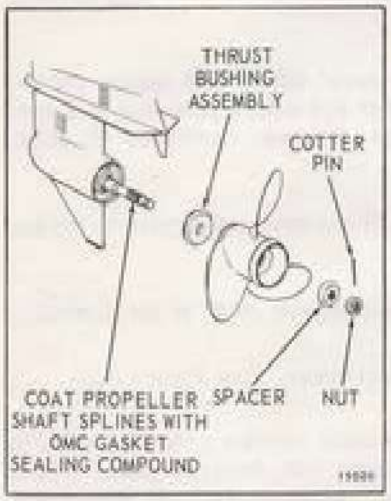


Figure 6-75. Propeller Installation

GEARCASE PRESSURE TEST

To test gearcase sealing, proceed as follows:

1. Remove drain plug and screw in a pressure test gauge. See Figure 6-74 (Stevens Experimental pressure test gauge illustrated).

2. Pump pressure up to 3-6 psi (21 - 42 kPa). If pressure gauge indicates leakage, submerge gearcase in water to determine source of leakage, as evidenced by bubbles. If gearcase pressure gauge does not indicate leakage, increase pressure to 16-18 psi (110 - 124 kPa). If pressure does not hold, submerge gearcase in water and check for source of leakage. Make necessary repairs and repeat test.

3. Screw in vacuum tester. Pump out to 3-5" of mercury and see if vacuum holds. Then pump out to 15" of mercury and check. If gearcase fails to hold on either test, put oil around suspected seal. If leak then stops or oil is drawn in, that seal is defective. When gearcase checks out ok, refill with lubricant. See Section 2 Lubrication Chart.

4. Coat propeller shaft splines with OMC Gasket Sealing Compound. Place thrust bushing in propeller and then slide assembly onto propeller shaft. Install thrust washer on shaft spline. Install and tighten propeller nut finger tight, and then tighten to align next cotter pin hole. The propeller shaft should turn freely (engine in neutral) after propeller is installed. Install cotter pin (use new pin if necessary), bending ends over nut.

NOTE

Use correct propeller thrust bushing. See Figure 6-75. Standard length gearcase uses a bushing measuring approximately 2-1/8" (54 mm) across largest outside diameter. Long shaft model uses a bushing measuring approximately 2-9/16" (65 mm) across largest outside diameter.

REASSEMBLY OF STERN AND SWIVEL BRACKETS (LONG SHAFT)

a. Install upper pivot shaft bushing and new seals, seal lip facing up.

b. Install lower seal, lip facing down.

c. Install isolation mounts if removed from exhaust housing. See Figure 6-7.

d. Install upper thrust washer. Assemble pivot shaft and steering arm to swivel bracket. Arm faces forward and lower mount bracket faces aft. Install keepers, lower mount bracket and nut and tighten to 130-150 foot-pounds (180 - 200 N·m) of torque. See Figures 6-9, 6-10 and 6-11.

e. Assemble stern bracket, tilt assist shock absorbers, and trailering lock arm components to swivel bracket. See Figure 6-11.

REASSEMBLY OF STERN AND SWIVEL BRACKETS (STANDARD LENGTH)

a. Install upper pivot shaft bushing and new seals, seal lip facing up.

b. Install lower seal, lip facing down.

c. Install isolation mounts if removed from exhaust housing. See Figure 6-7.

d. Install upper thrust washer. Assemble pivot shaft steering arm to swivel bracket. Coat spline with Locquic Primer and OMC Nut Lock. Arm faces forward and lower mount bracket faces aft. See Figure 6-12. Install retaining ring, using a #4 Truarc pliers (Special Tool #307429). See Figure 6-13.

e. Assemble stern bracket to swivel bracket. See Figure 6-12.

REASSEMBLY OF EXHAUST HOUSING AND ADAPTER

a. If removed, install water tube using new grommet. See Figure 6-8A. Be sure tube is aligned properly with water pump.

b. Apply OMC Gasket Sealing Compound to faces of plate and adapter. Using a new gasket, install adapter to plate with screws dipped in OMC Gasket Sealing Compound. Tighten to torque specified in Section 2. See Figure 6-8B.

c. Coat face of inner exhaust housing with OMC Gasket Sealing Compound and assemble to adapter with screws dipped in OMC Gasket Sealing Compound. Torque screws as specified in Section 2.

d. Install exhaust housing and adapter assembly to swivel bracket, and tighten all screws to torque specified in Section 2. See Figures 6-7 and 6-12.

e. Attach lower motor cover to adapter. See Figure 6-6.

f. Install power head as described in Section 5.

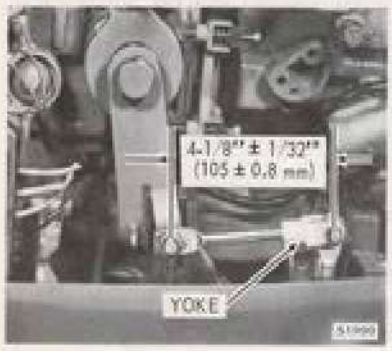


Figure 6-76. Shift Link Adjustment

INSTALLATION OF GEARCASE

a. Place "O" ring on driveshaft. Apply OMC Adhesive "M" to gearcase and exhaust housing surfaces. Coat driveshaft splines with OMC Moly lube. Do not coat top surface of shaft as lubricant here may prevent seating of driveshaft in crankshaft.

b. Carefully install gearcase making sure water tube guide guides water tube into pump grommet while shift rod enters grommet in lower motor cover. See Figure 6-4. Rotate flywheel clockwise to align driveshaft and crankshaft splines.

c. Dip screws in OMC Gasket Sealing Compound and tighten to torque specified in Section 2.

d. Install trim tab and align with scribe marks made at disassembly.

e. Connect shift rod. Reinstall fuel pump cover. See Figure 6-4.

f. Move shift lever into forward gear while rotating propeller shaft to ensure shifter clutch dog full engagement with forward gear. Check shift link adjustment as described in "Adjustments." If adjustment is necessary, remove clevis pin, and turn yoke as required to achieve proper dimension.

g. Touch up finish with spray enamel in a matching color.

Figure 6-77. Trim Tab Adjustment

ADJUSTMENTS

SHIFT LINK

Set yoke on shift link so that center distance of hole in link to holes in yoke is 4-1/8" ± 1/32" (105 ± 0.8 mm). See Figure 6-76.

TRIM TAB ADJUSTMENT

If replacing trim tab, a running adjustment may be required to achieve best steering results. If boat steers hard to starboard, adjust trim tab to port. If boat steers hard to port, adjust tab to starboard. See Figure 6-77.

PROPELLER SELECTION

GENERAL

Selection of the correct propeller is one of the most critical factors in achieving satisfactory performance of boat and motor. Propellers must be custom selected to match the motor to the boat, load or application. (SELECTION OF AN INCORRECT PROPELLER CAN CAUSE SERIOUS DAMAGE TO THE MOTOR.)

When shipped from the factory, the motor is equipped with a propeller that will give satisfactory performance under average conditions. However, since some boats have speed potentials that are quite high or low, it may be necessary to install a propeller having an increased or decreased pitch and diameter to achieve maximum performance. Optional propellers are available to replace the propeller furnished with the motor. See Specifications, Section 2, for Propeller Options.

SELECTING THE CORRECT PROPELLER

Since propeller pitch and diameter determine motor rpm at a given boat speed, the importance of correct propeller selection cannot be over emphasized. The operation and performance of the motor depend on it. A tachometer is required to check motor rpm. Select a propeller that will allow the motor to run at the top limit of its full throttle operating range with the lightest load that boat will carry. (See Specifications, Section 2, Full Throttle Operating Range.) By selecting a propeller in this manner, rpm loss at full throttle will not, in most cases, drop below the low limit of the operating range.

There are instances where the propeller selected cannot cover the complete range of boat applications, for example, from water skiing to high speed performance. In such cases it may be necessary to change propellers to suit each particular situation. (Light load, higher pitch propeller; heavy load, lower pitch propeller.) Remember, if the motor operates below the recommended full throttle rpm range, motor is laboring and power and efficiency are being lost. If the motor operates above the recommended full throttle rpm range, motor speed is excessive and additional power and efficiency are not being gained. In either case, serious engine damage may result.

NOTES

SECTION 7
ELECTRICAL SYSTEM

TABLE OF CONTENTS

NOTE

If removing engine from boat, see NOTE on Table of Contents page i.

DESCRIPTION

The complete electrical system is made up of the ignition system, the starter system, the alternator charging system, and the storage battery. Also included are the instrument and cable group. See wiring diagram at end of Section 8. This section will cover the starter system and the charging system, and battery maintenance.

TROUBLESHOOTING THE ELECTRICAL SYSTEM

Trouble in the electrical system often is first evidenced by failure of the starter to operate, and may be caused by failure of any one or more of the components covered in this section. If an ammeter does not indicate charging with the engine running, or if the battery fails to retain enough charge to consistently start the engine, the first things to check are the condition of the battery, polarity of the battery, and electrical connections throughout the circuit. A large percentage of electrical circuit as well as component failures are caused by loose or dirty electrical wiring connections, especially in the starter circuit. Battery maintenance and charging system troubleshooting are covered below. Starter system troubleshooting is included in the Trouble Check Chart in Section 2.

BATTERY SPECIFICATIONS

For best performance, we recommend a 12-volt battery with 360 amps cold cranking rating at 0°F (-18°C), and 115 minutes reserve capacity rating at 80°F (27°C) (70 amp hour reference).

The important thing to remember is that a customer's complaint about poor electric starting may be traceable to a battery with specifications not conforming to these recommended specifications.

SAFETY WARNING

Battery electrolyte is an acidic solution and should be handled with care. If electrolyte is spilled or splashed on any part of the body, immediately flush the exposed area with liberal amounts of water and obtain medical aid as soon as possible.

NOTE

Correct battery polarity is extremely important. The battery MUST be connected so its negative (-) post is connected to ground. If the positive (+) post is connected to ground, the rectifier diodes will be damaged.

BATTERY TESTING

A. Visual Inspection

The first step in determining the condition of a battery should be a visual inspection. Conditions such as broken, cracked or distorted container or cover, loose terminals or evidence of electrolyte seepage may indicate improper care, installation or application of the battery.

Look for excessive corrosion on the battery terminals, hold-down battery tray and battery cables. Check the battery cables for worn or frayed insulation. Replace cables if necessary.

Check the electrolyte level in each cell. If electrolyte level is below the plates, it is possible the battery is permanently damaged. Also look for dirt, oil or other contaminants floating in the electrolyte.

The sources of deficiencies noted in the visual inspection should be located and corrected before installation of a new battery.

B. Hydrometer

This test can only be used when there is sufficient electrolyte above the battery plates to fill the hydrometer tube. Do not, however, take readings immediately after refilling the cells with water.

Specific gravity will vary 4 points (0.004) with every 10°F (6°C) temperature change. For each 10°F (6°C) below 80°F (27°C), subtract 4 points from hydrometer reading. For each 10°F (6°C) above 80°F (27°C), add 4 points to hydrometer reading.

After correcting to 80°F (27°C), interpret readings as follows:

1. All cell readings uniform and above 1.225 specific gravity. Battery is serviceable. May require charging.

2. All cell readings uniform and below 1.225 specific gravity. Recharge to full charge and retest. See note.
3. Variation of more than 30 points (0.030) specific gravity between any two cells. Battery condition is questionable. Recharge and retest before making replacement.

NOTE

Disconnect positive cable when charging battery.

C. Capacity Test

Satisfactory capacity tests can be made only when the battery electrolyte equals or exceeds 1.225 specific gravity at 80°F (27°C).

D. Terminal Voltage Test

1. VARIABLE LOAD HIGH RATE DISCHARGE TESTER (RECOMMENDED). Connect tester to battery terminal posts. Discharge at a rate of three times battery ampere hour rating for 15 seconds. If the voltage is 9.6 volts or higher for 12-volt batteries at the end of 15 seconds, the battery has good output capacity.

2. FIXED RESISTANCE TESTER. This equipment has built-in load for high-rate discharge testing. Follow equipment manufacturer's instructions regarding test period and meter readings.

3. ENGINE LOAD FOR RESISTANCE. Disconnect charge coil connector. Connect a voltmeter across the battery. Crank engine for 15 seconds. If voltage is 9.6 volts or higher for 12-volt batteries at the end of 15 seconds, the battery has good output capacity.

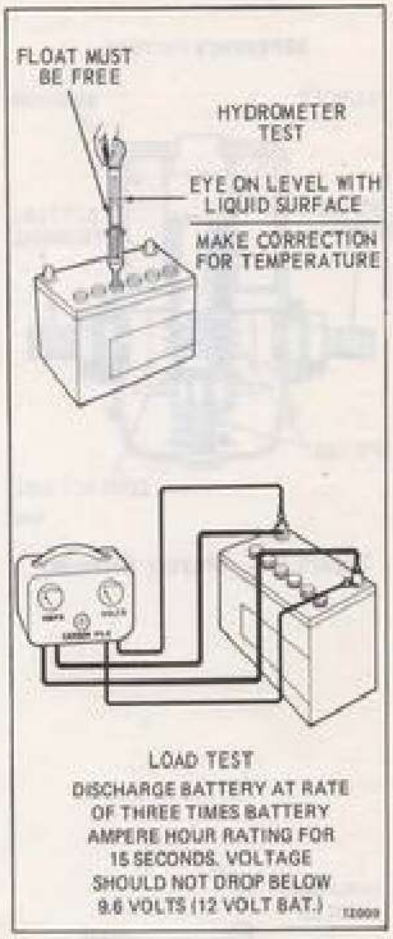


Figure 7-2. Battery Testing

BATTERY CHARGING

Boost charge 12-volt batteries at 50 amperes for 20 minutes (1000 ampere minutes). If the charger will not give this rate, charge for an equal number of ampere minutes at best rate available. DO NOT boost battery more than this amount for the "light load test".

If batteries are to be fully charged by means of a quick charger, the charge rate must be "tapered" (reduced to a safe limit) when the electrolyte temperature reaches 125°F (52°C), or when gassing becomes excessive. Failure to do so may harm the battery.

If the battery is to be slow charged, adjust electrolyte to proper level by adding water, then charge the battery at 5 amperes until fully charged. Full charge of the battery is indicated when all cell gravities do not increase when checked at three intervals of one hour and all cells are gassing freely. Plenty of time must be allowed for slow charging. Charge periods of 24 hours or more are often required.

BATTERY CARE

The battery should be kept charged at all times. The state of charge should be checked by making specific gravity readings with a battery hydrometer. It is suggested that specific gravity readings and checking for replacement of water be made every two weeks. If the battery has been standing for 30 days, it should be recharged before being placed into service to assure reliable starting. Charge battery up to the specific gravity recommended by the battery manufacturer.

The specific gravity of the battery electrolyte should be checked with a battery hydrometer, preferably one that has a built-in thermometer and correction chart. No other method should be used to determine the charge condition of a battery. Note also that a hydrometer reading is not accurate if water has been recently added, due to the fact that the water has not had a chance to mix with the electrolyte.

The proper water level should be maintained at all times. If water is added in freezing weather, the battery should be charged to full charge at once. Only pure distilled water or water approved for battery use should be added to the battery to replace water lost through evaporation. Never add acid except when acid has been lost by spilling.

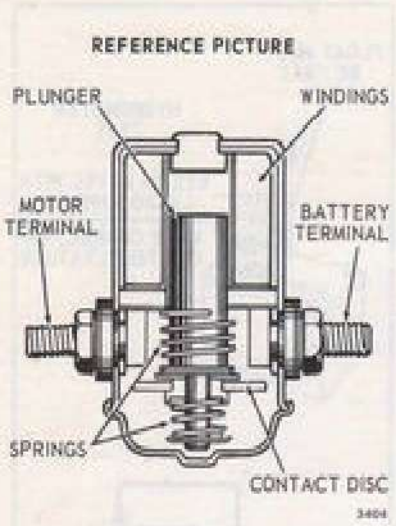


Figure 7-3. Starter Solenoid

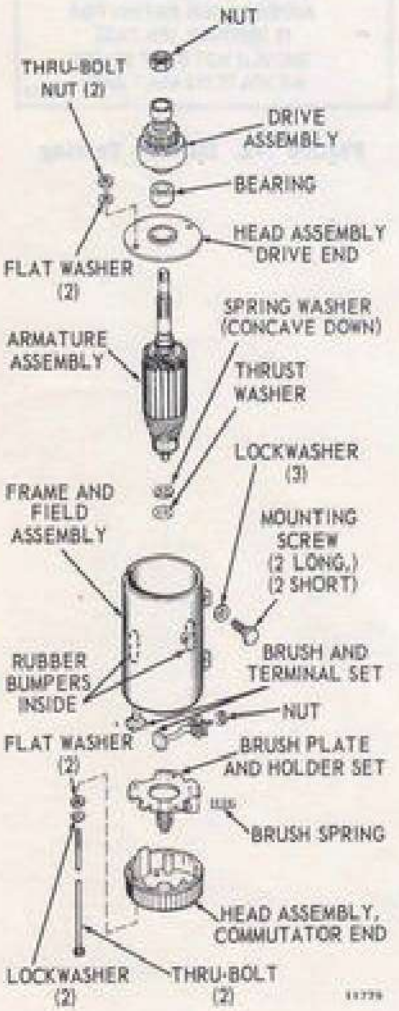


Figure 7-4A.
Starter Components (Prestolite)

Install the battery near the motor. For mounting the battery, use a Coast Guard approved battery box securely fastened to the boat. A loose battery may shift in the boat, damaging itself or other equipment. Tighten hold-down nuts evenly until battery is secure. If hold-down nuts are too tight, distortion and damage to battery case will result.

Connect battery cables, making sure clamps are tight on battery posts to insure good contact. Apply a coat of OMC Anti-Corrosion Lube to exposed areas of the battery posts and clamp connectors to retard corrosion.

NOTE

Correct battery polarity is extremely important. The battery MUST be connected so its negative post (-) is connected to ground. If the positive post is connected to ground, the rectifier diodes will be damaged.

STARTER SYSTEM

DESCRIPTION

The electric starting system consists of the starter motor, starter and choke switch, starter and choke solenoids, start in neutral switch, and the necessary cables and wires with their connectors. The starter motor supplies cranking power to the motor, converting electrical energy from the battery into mechanical power which is transmitted through the drive pinion gear and the flywheel ring gear. The starter switch controls the operation by activating the starter solenoid which makes and breaks the circuit between the battery and starter motor.

The starter solenoid closes the circuit through a movable contact disc which strikes two terminal contacts that are connected to the starter motor circuit. The solenoid winding contains many turns of wire which, when energized by the starter switch, exert a magnetic pull on the solenoid plunger, causing it to move the contact disc against the terminal contacts. See Figure 7-3.

The starter motor drive pinion is disengaged when at rest and is made to mesh with the flywheel ring gear by the rotation of the starter motor armature. After the engine has started, the starter pinion is driven faster than the starter motor shaft and moves down the screw shaft out of mesh with the flywheel.

The neutral start switch in the remote control opens the starter circuit, preventing accidental engaging of the starter motor, whenever the shift control lever is set beyond the neutral position.

Operation of the choke solenoid is discussed in detail in Section 3, Fuel System.

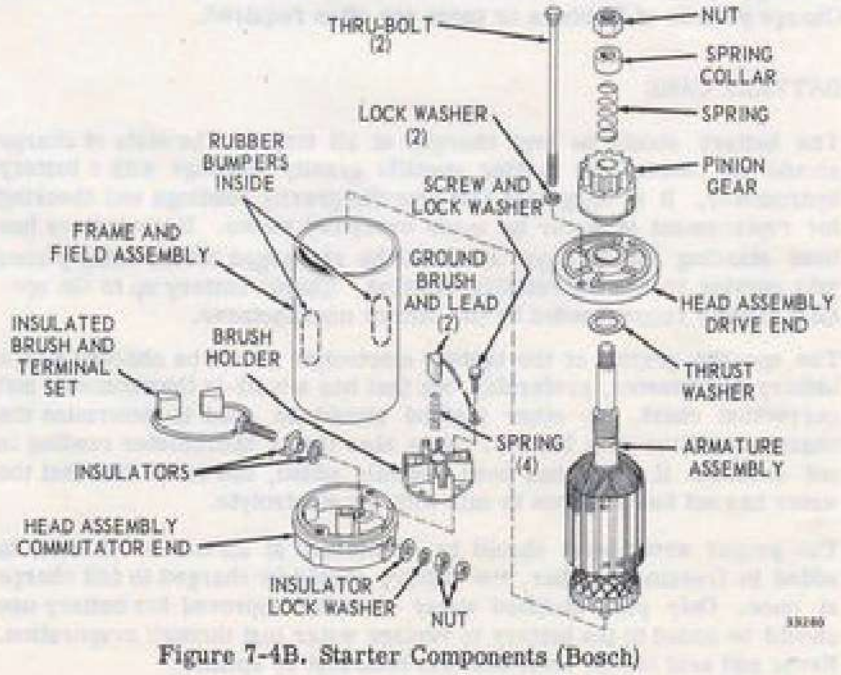


Figure 7-4B. Starter Components (Bosch)

REMOVAL OF STARTER

Due to the construction of the starter motor, maintenance operations are generally limited to periodic checking for looseness of mounting. Unless it is certain that the starter motor requires attention, do not remove it for overhaul. A thorough check should be made of the battery, cables, starting solenoid, and switch as outlined in the Trouble Check Chart in Section 2. Check the Prestolite starter motor by using the no load test. With 11 volts applied to the starter motor, maximum current should be 37 amperes and minimum speed should be 9000 rpm. Check Bosch starter no load test. With 12.0 to 12.4 volts applied, maximum current draw should be 32.0 amps, speed 5750 to 8000 rpm. See Figure 7-5. Remove starter motor for test as follows:

a. Disconnect lead from starter motor.

b. Remove air silencer as described in Section 3.

c. Remove three starter mounting screws. See Figure 7-6.

Figure 7-5. Starter Motor Test

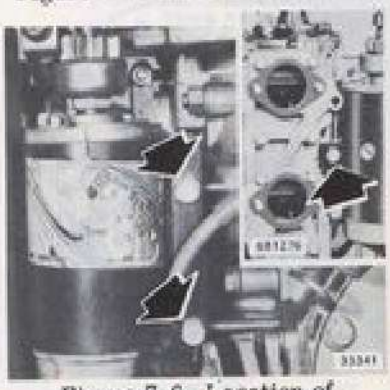


Figure 7-6. Location of Starter Screws

DISASSEMBLY OF STARTER (PRESTOLITE OR BOSCH)

a. Remove two thru-bolts from starter motor.

b. Carefully remove brush end head to avoid loss of brushes and springs.

c. Remove frame and field assembly. See Figure 7-4A or 7-4B.

d. Remove nut, retaining drive assembly.

e. Remove drive end head, taking care to avoid damaging bearing in head.

CLEANING, INSPECTION AND REPAIR

a. Inspect the brushes; replace if one-half worn, damaged, or cracked. Replace brush springs if weak.

b. Clean commutator with Grade 00 sandpaper. If commutator surface is unevenly worn or pitted, turn on a lathe. Remove any trace of oil from commutator.

c. Check the armature on a growler for shorted turns. See Figure 7-7A or 7-7B. Check armature for grounding by using a test light or meter. See Figure 7-8A or 7-8B. Inspect armature insulation for indications of overheating or damaged windings. Clean off any deposits of carbon or foreign matter which may contribute to later failure of the windings.

d. Using a test light, check field windings for continuity between field brush lead and frame of motor (ground). See Figure 7-9A. Check permanent magnets. See Figure 7-9B. Weak permanent magnets will cause excessive rpm on No Load Test.

e. DO NOT clean the starter drive assembly while the starter motor and drive are installed on the power head. The cleaning agent will drain into the starter motor, washing dirt from the drive into the starter bearings, commutator, etc. After disassembling the drive, clean each part with a grease solvent and inspect for wear or distortion.

Figure 7-7A. Checking for Shorted Turns

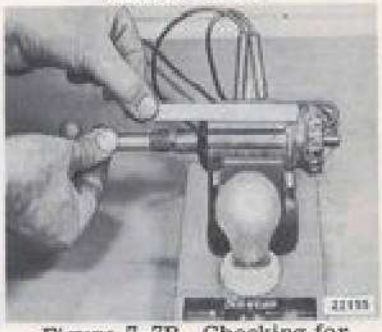


Figure 7-7B. Checking for Shorted Turns

Figure 7-8A. Checking for Grounding

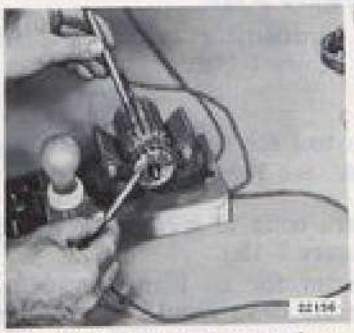


Figure 7-8B. Checking for Grounding

Figure 7-9A. Checking Field Continuity

Figure 7-9B. Checking Permanent Magnets

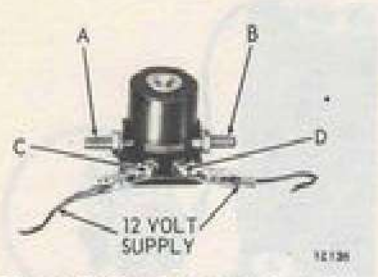


Figure 7-10. Testing Solenoid

Figure 7-11. Reassembling Starter (Prestolite)

Figure 7-11A.

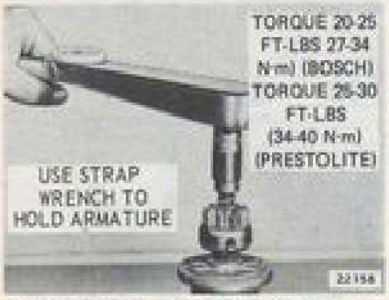


Figure 7-12. Torquing Starter Pinion Nut

Figure 7-13. Alignment Marks

f. If the pinion does not properly engage the flywheel, the pinion and screw shaft assembly may be worn, distorted, or dirty. Locate cause of binding and correct before completing assembly.

g. The starter solenoid is a sealed unit and is serviced only as an assembly. To test the solenoid, disconnect leads to solenoid terminals. Connect an ohmmeter set to low ohm scale between terminals A and B. Connect a 12 volt supply between terminals C and D. See Figure 7-10. Solenoid plunger should give an audible click and ohmmeter should read zero ohms. Remove 12 volt supply. Check resistance between C and D. Resistance should be 2.0 ± .75 ohms.

REASSEMBLY OF STARTER

PRESTOLITE

NOTE

Rubber pads are bonded to the inside of the frame assembly to prevent vibration of the thru-bolts. When aligning thru-bolts on reassembly, slight outward pressure on thru-bolts may be necessary to compress rubber pads.

a. Lubricate the armature shaft with one drop of SAE No. 10 oil. Lubricate the drive pinion helical threads on armature shaft with Anderol 766. Part number 325023. See Lubrication Chart, Section 2.

b. To facilitate reassembly of the starter motor, insert brushes and brush spring in holder and tie in place with fine wire or string. Assemble brush holder and armature to frame and field assembly, and remove string or wire. See Figure 7-11.

c. Replace commutator and drive end heads. Carefully insert thru-bolts to avoid damaging rubber bumpers inside field and frame assembly. See figure 7-4A. Secure with washers and nuts to complete starter motor assembly. (See Torque Specification, Section 2, and Figure 7-15.)

d. Check starter motor with no load test. With 11 volts applied to the motor terminals, maximum current draw should be 37.0 amperes and minimum speed should be 9000 rpm. See Figure 7-5.

e. Seal starter with Liquid Neoprene (GACO) at upper and lower end caps and around terminal. See Figure 7-11A.

BOSCH

a. Lubricate the armature shaft with one drop of SAE No. 10 oil. Lubricate pinion gear helix on armature shaft with Anderol 766. Part number 325023. See Lubrication Chart, Section 2.

b. Assemble drive end head, pinion gear, spring and cup to armature shaft. Torque nut to specifications. See Figure 7-12.

c. Assemble armature to frame and field assembly, aligning marks on end head and frame. See Figure 7-13.

d. Install insulated brush and terminal set in commutator end head with long lead in slot. See Figure 7-14 and 7-14A.

NOTE

Reversing these brushes will set motor to run backwards.

e. Install brush holder, brush springs, and ground brushes. Screws secure ground brush leads and holder. Insert insulated brushes in holder. See Figure 7-14B.

f. Assemble commutator end head to frame and field aligning notch and rib. See Figure 7-14C.

NOTE

A suitable tool for holding brushes in place can be made from a putty knife. See Figure 7-14C insert.

g. Torque thru-bolts to specifications. (See Specifications page, Section 2, and Figure 7-15.)

h. Check starter for no load test. With 12.0 to 12.4 volts applied, maximum current draw should be 32.0 amps, speed 5750 to 8000 rpm.

i. Seal starter with Liquid Neoprene (GACO) at upper and lower end caps. See Figure 7-15.

INSTALLATION OF STARTER

a. Place starter in position against crankcase, and attach three screws, tightening screw behind air silencer first. See Figure 7-6.

b. Reconnect starter motor lead.

c. Reinstall air silencer as described in Section 3.

6 AMPERE ALTERNATOR CHARGING SYSTEM

DESCRIPTION

The charging system consists of the alternator, the rectifier diodes which change the alternating current output of the alternator to direct current, and the battery itself.

The alternator is made up of two parts - the flywheel with cast-in magnets, and the stator assembly which is bolted to the crankcase. The stator assembly is made up of 8 coils wound over a laminated iron core. Around this assembly the flywheel turns, inducing alternating current in the coils.

The rectifier assembly converts the alternating current to direct current. The rectifier is mounted on the starboard side of the powerhead. See Figure 7-16.

TROUBLESHOOTING THE ALTERNATOR SYSTEM

Failure in the charging system will usually show up when the battery becomes undercharged. To determine the cause of trouble, check first the condition of the battery, and electrical connections throughout the circuit. A visual inspection may be all that is required to locate the trouble. Check the following before proceeding with electrical testing.

NOTE

Disconnect battery leads before tightening or changing connections on dash instruments or any part of the charging circuit.

a. Battery. See "Battery Testing," "Battery Care," and "Battery Maintenance" in this Section.

b. Wiring. Check for corroded or loose connections, and check and tighten all connections. Check for worn or frayed insulation.

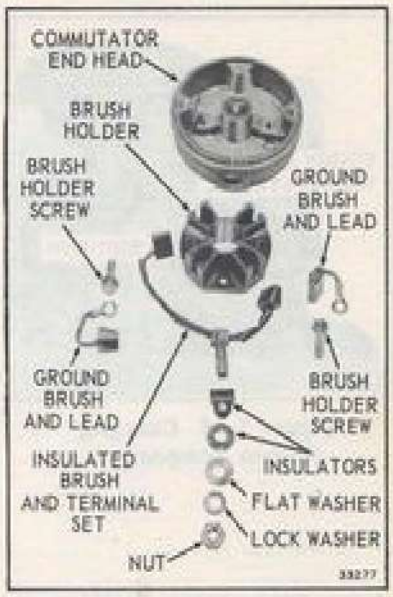


Figure 7-14. Commutator End Head Components

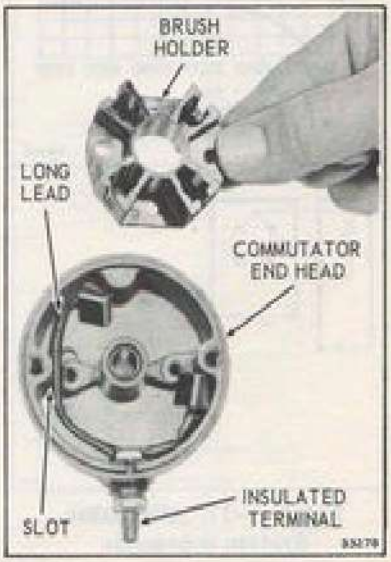


Figure 7-14A. Correct Insulated Lead and Brush Installation

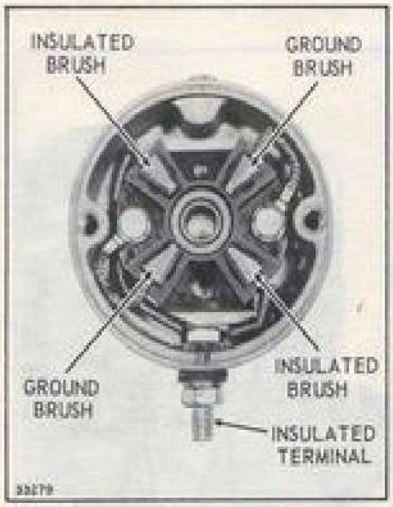


Figure 7-14B. Correct Commutator End Head Assembly

Figure 7-14C. Assembling Commutator End (Bosch)

Figure 7-15. Torquing Thru-Bolts (Bosch)

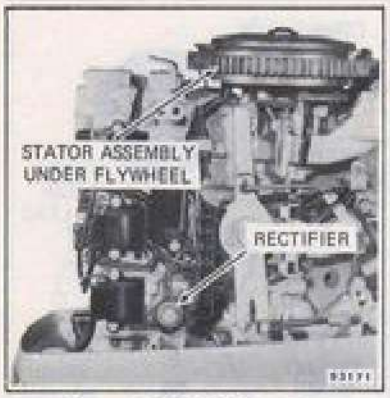


Figure 7-16. Charging System Components

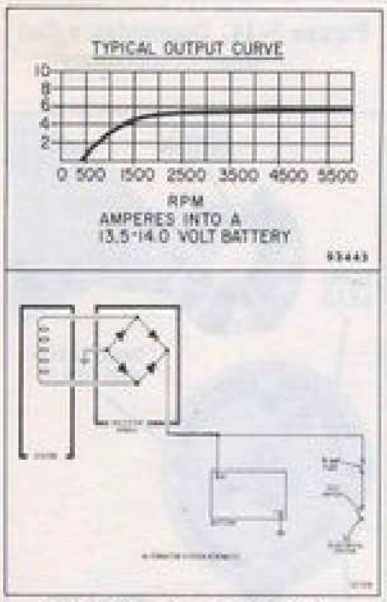


Figure 7-17. Alternator System Schematic

c. Check battery polarity. CHECK FOR DAMAGE TO RECTIFIER DIODES as described under "Checking Rectifier Diodes."

d. Electrical load. Excessive electrical load from too many accessories will run battery down.

If a visual inspection of the electrical system shows all components to be in good condition, an electrical inspection will be necessary to determine which component of the charging system is the cause of trouble. See Figure 7-17.

CHECKING RECTIFIER DIODES

To check the diodes, place test meter in the "HI" ohms position. This is basically a continuity test.

A test light may be used in place of a meter. Under no circumstances use any test meter or instrument with more than a 12-volt source. See Figure 7-18.

1. Disconnect rectifier leads from terminal block. Connect one ohmmeter (HI ohms scale) lead to either yellow or yellow/gray rectifier lead, and other meter lead to ground. Note meter reading.

2. Reverse test leads, or press polarity button if meter is so equipped, and again note meter reading. An infinite (very high) reading in both checks indicates the diode is open. A zero reading in both checks indicates the diode is shorted. A normal diode will show a reading in one direction and no reading in the other direction.

3. Repeat this procedure with other rectifier yellow lead.

4. Repeat test, connecting meter between rectifier yellow lead, yellow/gray lead and the rectifier red lead. See Figure 7-18A.

To check stator windings, disconnect the yellow lead (terminal) # 1 and yellow/gray (terminal 2) lead at the terminal block. Connect the red meter lead to either yellow lead and meter black lead to ground to check for shorts. An infinite reading on HI ohms scale indicates the windings are good.

Connect the ohmmeter (LO ohms scale) between the yellow and yellow/gray leads. A reading of 1.0 ohm ± 0.3 indicates the windings are good, and an infinite reading indicates the windings are open. See Figure 7-19.

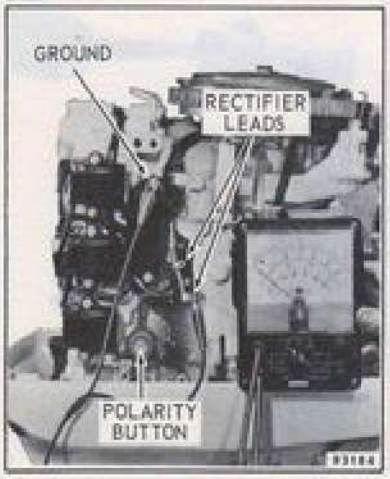


Figure 7-18. Checking Rectifier Diodes

Figure 7-18A. Checking Rectifier Diodes

Figure 7-19. Checking Alternator Stator

REPLACEMENT OF ALTERNATOR

If windings are found to have failed, the stator assembly must be replaced. Proceed as follows:

a. Remove flywheel, using flywheel puller (Special Tool #378103). See Section 5.

b. Disconnect stator leads at terminal board and charge coil connector to power pack. Remove three screws and lift stator from power head. See Figure 7-20.

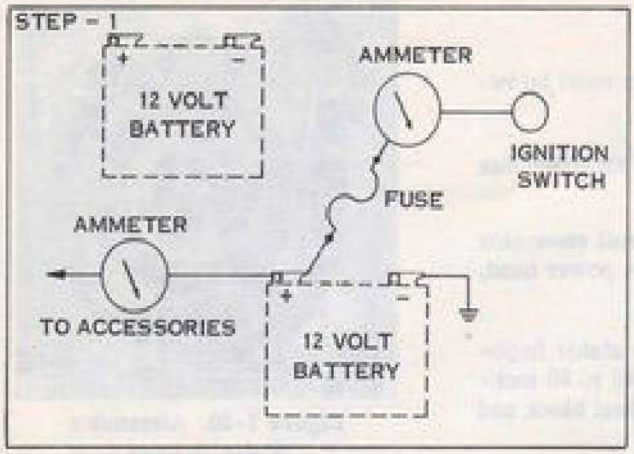
c. Apply OMC Screw Lock to stator screws. Place new stator in position and attach with screws. Tighten to a torque of 48 to 60 inch-pounds (5 to 7 N·m). Reconnect stator leads to terminal block and charge coil connector to power pack.

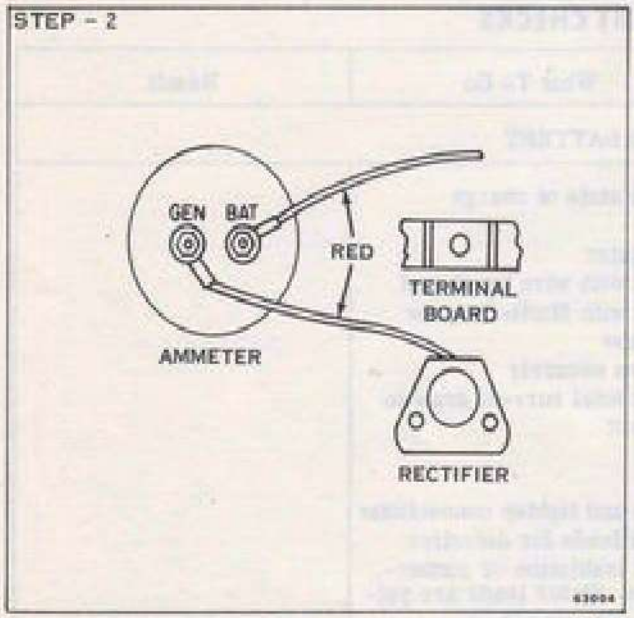
Figure 7-20. Alternator Stator Screws

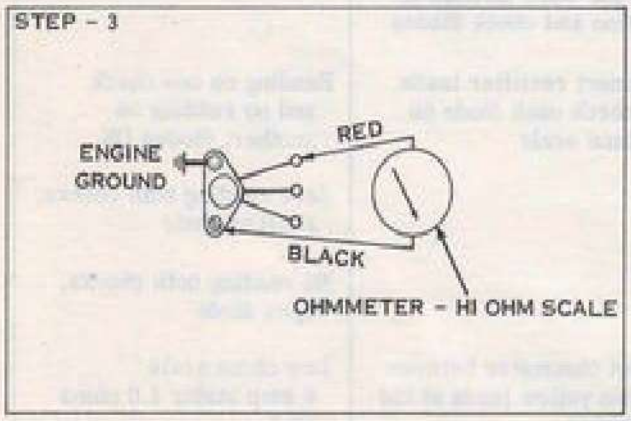
CHARGING CIRCUIT CHECKS

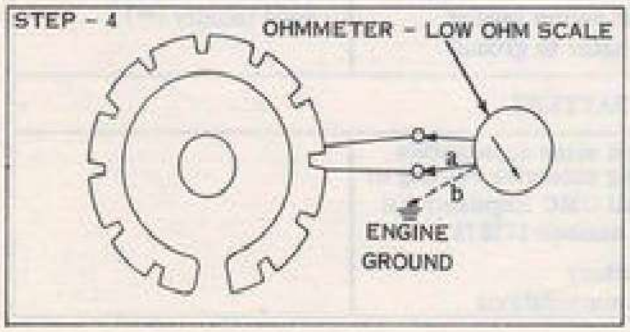
Where To Look	Cause	What To Do	Result
	UNDERCHARGED BATTERY		
BATTERY	1. Defective battery or worn out battery	Check state of charge	
	2. Low electrolyte level	Add water	
	3. Corroded terminal connections	Clean with wire brush and coat with Multi-Purpose Grease	
	4. Loose terminal connections	Tighten securely	
	5. Excessive electrical load	Check total current draw in circuit	
WIRING	1. Corroded or loose connections	Clean and tighten connections	
	2. Short or ground in leads to stator	Check leads for defective lead insulation or connections. Stator leads are yellow and yellow/gray.	
	3. Ground in other parts of circuit	Check for worn through insulation and check diodes	
RECTIFIER	Low output	Disconnect rectifier leads and check each diode on HI ohms scale	Reading on one check and no reading on another, diodes OK
			Zero reading both checks, shorted diode
			No reading both checks, open diode
ALTERNATOR	Defective stator winding	Connect ohmmeter between the two yellow leads at the alternator	Low ohms scale 6 amp stator 1.0 ohms ±0.3
		Connect ohmmeter from either yellow lead at alternator to ground	HI ohms scale should read infinity (∞).
	OVERCHARGED BATTERY		
ALTERNATOR	Extensive running without accessories	Turn on some accessories during extensive running or install OMC Regulator Kit part number 173573	
	Under capacity battery	See battery recommendations	

ALTERNATOR CIRCUIT TROUBLESHOOTING









UNDER CHARGED BATTERY

STEP - 1

a. Check condition of battery. See Specifications, Section 7.

b. Check all connections. They must be tight and clean.

c. Check electrical load on system. Total current draw from engine and accessories cannot be greater than 6 amps.

d. Inspect cables and leads for worn insulation.

ALTERNATOR OUTPUT CHECK

STEP - 2

a. Remove terminal board screw connecting rectifier and motor cable red leads.

b. Connect rectifier red lead to the generator (GEN) terminal of an OMC accessories 15 amp ammeter. Connect the other red lead to the ammeter battery terminal (BAT).

c. Start and run engine in its full throttle operating range. At this speed, the ammeter should indicate the rated output of the alternator as specified in Section 2.

d. If no change is indicated, test the alternator stator and the rectifier.

RECTIFIER CHECK

STEP - 3

a. CAUTION: Shut off engine and disconnect battery before checking rectifier. Use ohmmeter—HI ohm scale.

b. Disconnect rectifier leads.

c. Connect one ohmmeter probe to common engine ground, other probe to one yellow lead.

d. Note reading - reverse probes - note reading.

e. Reading on one check, no reading on other check - diode ok.

f. Repeat test using yellow/gray rectifier lead and same values.

g. If both readings on one yellow lead are high - diode open.

h. If both readings on one yellow lead are zero - diode shorted.

i. Repeat test procedures between rectifier red lead and to each yellow lead. Use same test values.

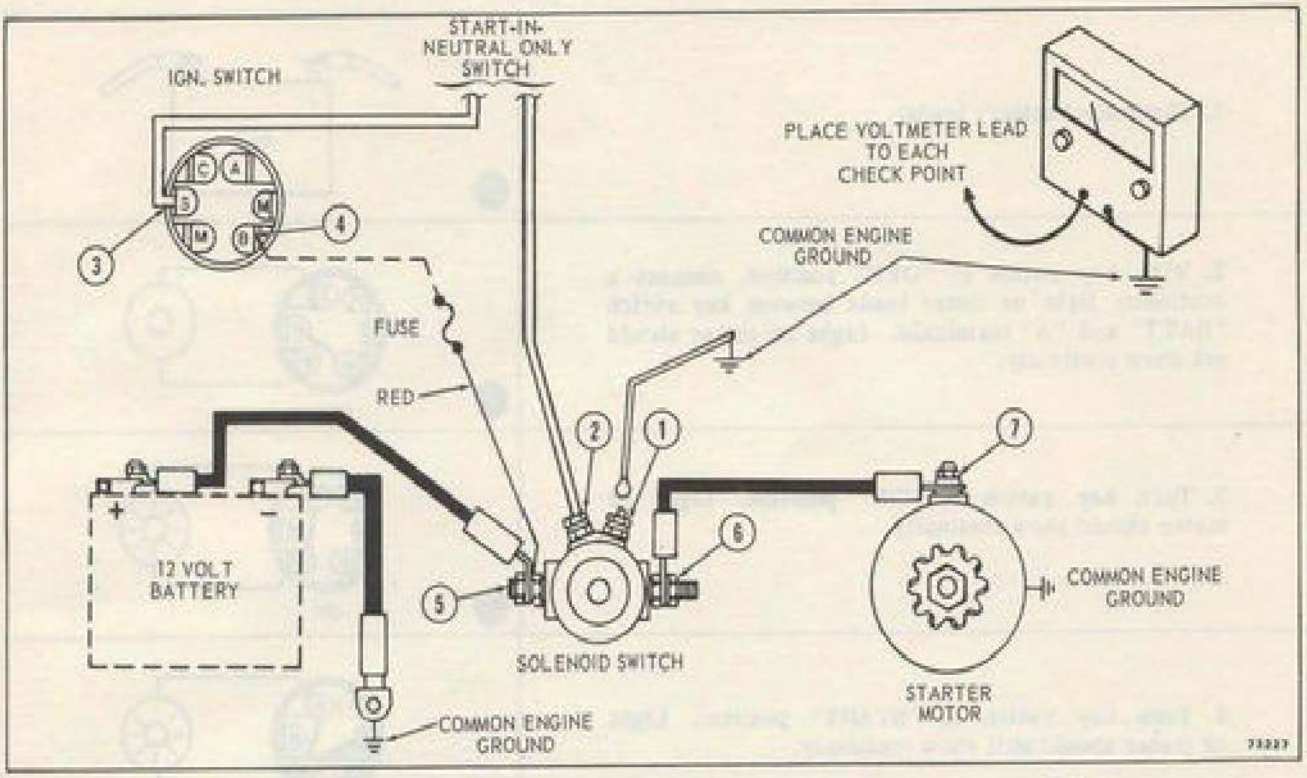
STATOR CHECK

STEP - 4

a. Disconnect stator leads. Connect ohmmeter, low ohms scale, between the two yellow leads. 6 amp stator - 1.0 ± 0.3 ohms, no reading - stator open.

b. Connect ohmmeter high ohm scale between common engine ground and one stator yellow lead. No reading (infinity) - stator ok. Any reading, stator shorting to ground.

STARTER CIRCUIT TROUBLESHOOTING



BEFORE TROUBLESHOOTING

NOTE

Remote control must be in neutral.

1. If engine does not turn over, check 20 amp fuse between starter solenoid and key switch; refer to diagram.
2. If fuse checks good, proceed in checking condition of battery, inspect cables and leads for worn insulation, and check all connections making sure they are tight and clean.

⚠ SAFETY WARNING

Steps 1 thru 6 - Remove starter to solenoid cable from check point 6 to prevent starter engagement while making checks.

STEP - 1 - Remove ground lead from solenoid switch at check point (1). Connect voltmeter between point (1) and common engine ground. Turn key switch to start position. Voltmeter should show 12 volts (battery voltage).

a. If meter does not read any voltage proceed to STEP - 2.
b. If meter reads 12 volts (battery voltage) check ground lead for open circuit (broken lead) with ohmmeter. Replace if open. Connect ground lead back on solenoid and proceed to STEP - 6.

NOTE

In steps 2 thru 6 turn key to "off" position before disconnecting and connecting meter. Turn key to "start" position after making connection where required.

STEP - 2 - Connect meter at (2). Turn key switch to "start" position.

a. If meter reads 12 volts (battery voltage), solenoid switch is faulty.
b. If no reading, proceed to STEP - 3.

STEP - 3 - Connect meter at (3). Turn key switch to "start" position.

a. If meter reads 12 volts (battery voltage), lead is open between (2) and (3), or neutral start switch is open.
b. If no reading proceed to STEP - 4.

STEP - 4 - Connect meter at (4).

a. If meter reads 12 volts (battery voltage), ignition switch is faulty.
b. If no reading, proceed to STEP - 5.

STEP - 5 - Connect meter at (5).

a. If meter reads 12 volts (battery voltage), check for open lead or faulty fuse between (4) and (5).
b. If no reading at (5) check for open lead between (5) and battery positive terminal.

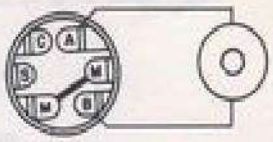
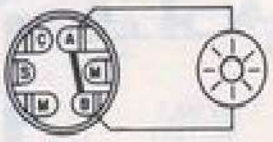
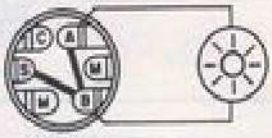
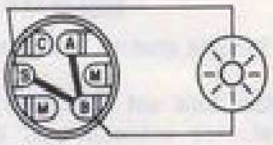
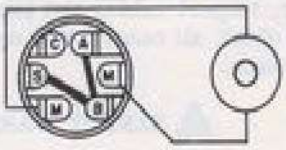
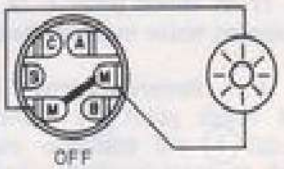
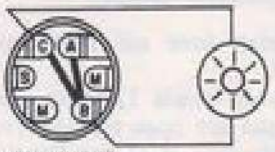
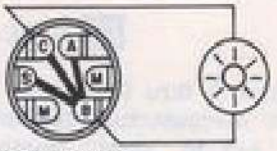
STEP - 6 - Connect voltmeter at point (6). Turn key to "start" position.

a. If no reading, solenoid is faulty.
b. If meter reads 12 volts (battery voltage - click should be heard in solenoid), proceed to STEP - 7.

STEP - 7 - Reconnect starter to solenoid cable at check point (6). Connect meter at point (7). Turn key to "start" position.

a. If meter reads 12 volts (battery voltage) and starter motor does not turn, check starter motor.
b. If no reading, check for broken cable or poor connection.

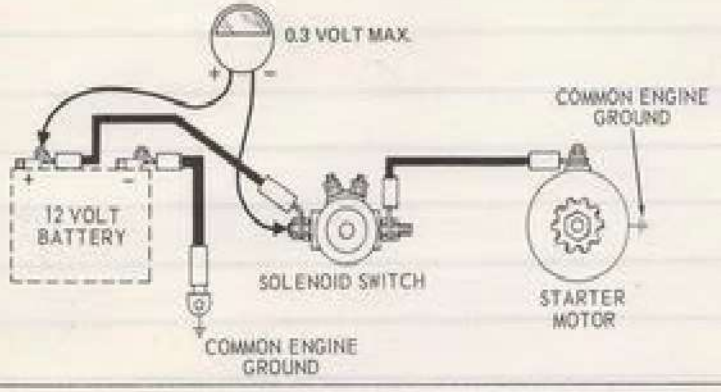
KEY SWITCH CHECK (with Test Light or Ohmmeter)

1. Disconnect battery leads.	 1
2. With key switch in "OFF" position, connect a continuity light or meter leads between key switch "BATT" and "A" terminals. Light or meter should not show continuity.	 2
3. Turn key switch to "ON" position. Light or meter should show continuity.	 3
4. Turn key switch to "START" position. Light or meter should still show continuity.	 4
5. With key held in "START" position, transfer lead from "A" terminal to "S" terminal. Light or meter should still show continuity.	 5
6. Transfer leads to "M" terminals. Light or meter should not show continuity in "START" or "ON" positions.	 6
7. Turn key switch to "OFF" position. Light or meter should show continuity.	 7
8. Transfer leads to "B" and "C" terminals. Turn key switch to "ON" position and push in key. Light or meter should show continuity when key is pushed in.	 8
9. Turn key switch to "START" position and push in key. Light or meter should show continuity when key is pushed in.	 9

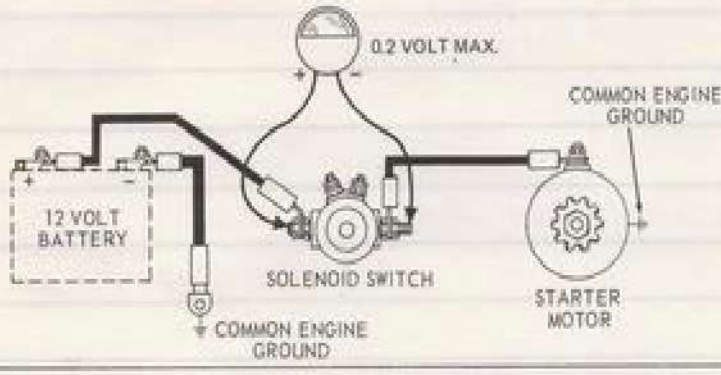
a. By making a systematic check from the positive battery terminal, through the starting circuit and back to the negative battery terminal, any component or electrical connection having excessive resistance, thus causing high voltage drop and subsequent hard starting, can be located. See below.

b. Ground spark plug high tension leads so that engine can be cranked without firing. Connect voltmeter and turn ignition switch to START to crank engine. NOTE: By placing voltmeter leads against battery, solenoid, and starter motor terminals rather than against connecting cable ends, each connection can be tested for high resistance along with component.

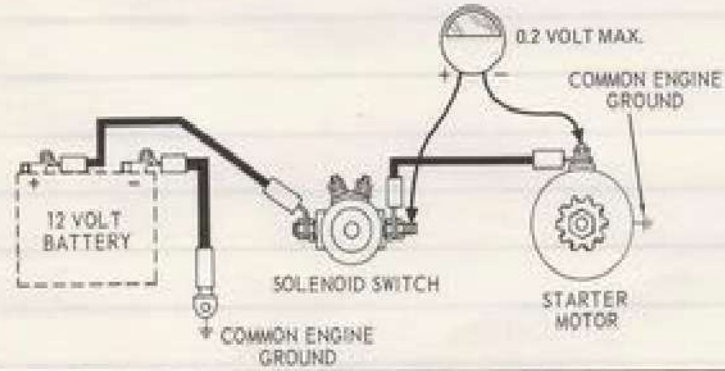
c. Clean and retighten, or replace, any connection, cable, or component having greater than specified voltage drop.



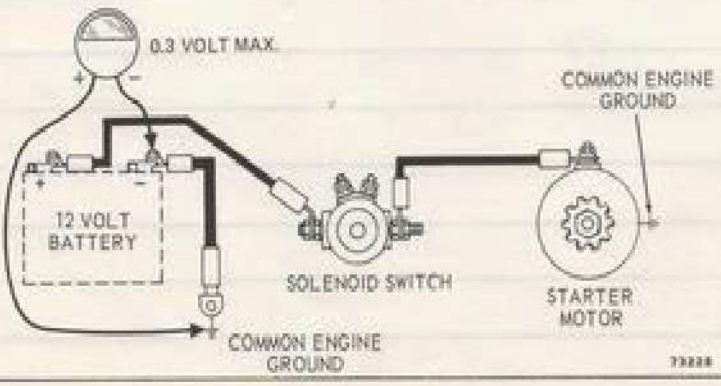
Connect voltmeter positive lead to battery positive post. Connect voltmeter negative lead to starter solenoid positive terminal. Turn key switch to start to crank engine. Voltage reading should not exceed 0.3 volt.



Connect voltmeter (only while engine is cranking) positive lead to starter solenoid positive terminal. Connect voltmeter negative lead to starter solenoid starter lead terminal. Turn key switch to start engine. Voltage reading should not exceed 0.2 volt.



Connect voltmeter positive lead to starter solenoid, starter lead terminal. Connect voltmeter negative lead to starter motor terminal. Turn key switch to start engine. Voltage reading should not exceed 0.20 volt.



Connect voltmeter positive lead to battery negative lead common power head ground screw. Connect voltmeter negative lead to battery negative post. Turn key switch to start engine. Voltage reading should not exceed 0.3 volt.

NOTES

SECTION 8
REMOTE CONTROL

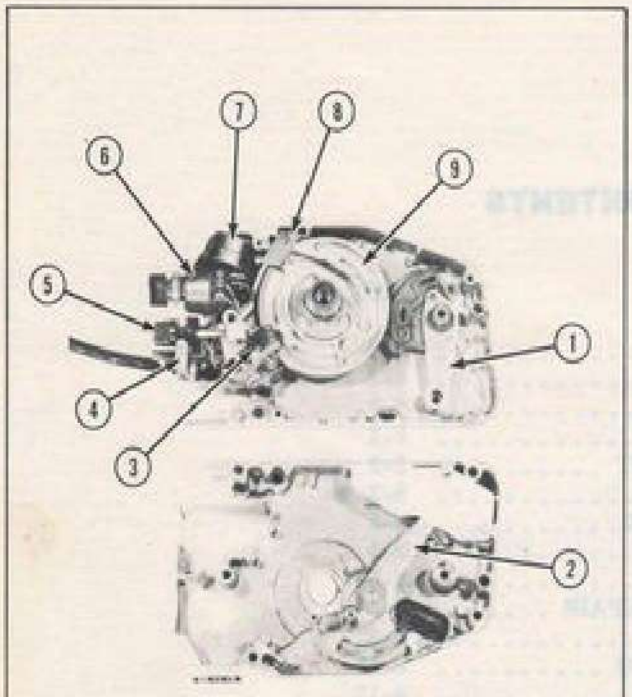
TABLE OF CONTENTS

DESCRIPTION

The remote control unit is comprised of a combination throttle and gearshift selection lever, warm-up speed control, ignition - choke - starter switch, neutral start switch, and a motor temperature warning horn. See Figure 8-1.

Control cables connected between the remote control lever and the gearshift and throttle controls at the engine open the throttle after the desired gear is engaged. A friction adjustment is provided to hold the gearshift and throttle lever in any given engine speed position.

The warm-up speed control lever opens the throttle sufficiently to start the engine and to control the fast idle speed for warm-up, after the engine has been started.



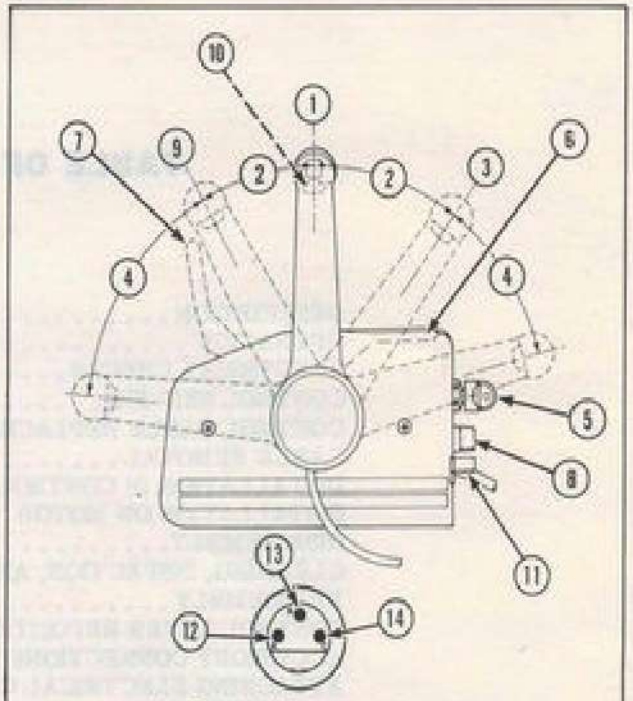
1. Shift control clevis
2. Throttle control clevis
3. Neutral start switch
4. Electric cable grommet
5. Friction adjustment knob
6. Key switch
7. Engine temperature warning horn
8. Throttle plate retainer
9. Shift and throttle plate

Figure 8-1. Remote Control Components

OPERATION

The neutral start switch in the control unit completes the starting circuit only when the control lever is in NEUTRAL position. The circuit is open when the control lever is in either FORWARD or REVERSE positions and the key switch is inactive (in the start position only). With the control lever in NEUTRAL position, the warm-up lever must be moved to START position. After starting and warm-up, the warm-up lever should be moved to RUN position. See Figure 8-2.

A lockout knob under the control lever handle must be depressed to allow movement of the control lever to forward or reverse. Approximately 32° of lever travel is required to complete shift into forward or reverse gear. Continuing to advance lever in forward or reverse direction increases engine speed. Control lever friction can be adjusted with the throttle friction adjustment knob located under the key switch. Only sufficient friction to prevent throttle creep is required.



1. Neutral
2. Shift range
3. Reverse
4. Speed range
5. Ignition, choke, and starter switch
6. Warm-up lever "run" position
7. Warm-up lever "start" position
8. Throttle friction adjustment
9. Forward
10. Lockout knob
11. Accessory plug
12. Terminal "A"
13. Terminal "B"
14. Terminal "C"

Figure 8-2. Starboard Installation

ELECTRICAL CHECKS

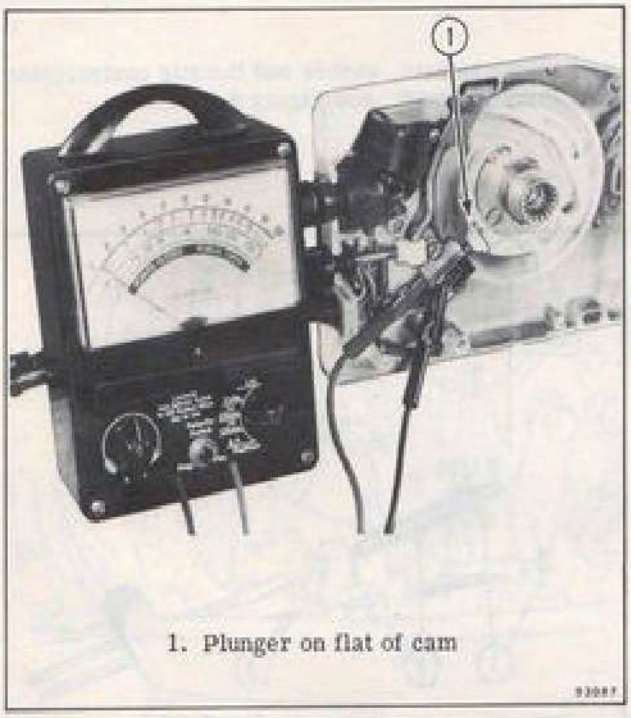
Before disconnecting battery, test electrical accessory plug on remote control. With key switch in on position, insert red voltmeter lead into "A" terminal and insert black lead into "C" terminal. See Figure 8-2. Meter should read battery voltage. To check tachometer circuit, engine must be running. Insert black voltmeter lead into terminal "C," and red lead into terminal "B." With engine running, voltmeter should show alternator output.

To test neutral start switch:

a. Disconnect battery.

b. Open control box. See Cable Removal.

c. Connect a test light or ohmmeter to neutral start switch. See Figure 8-3.



1. Plunger on flat of cam

Figure 8-3. Testing Neutral Start Switch

d. When control is in neutral, switch must show continuity. When control is out of neutral, switch must be open.

e. If switch is defective, replace.

CONTROL SERVICE

NOTE

Disconnect battery cables before attempting to work on remote control.

For control cable or other component replacement, control box must be unfastened from boat.

a. Place control lever in NEUTRAL. See Figure 8-2.

b. Remove screws and hardware attaching control to boat.

CONTROL CABLE REPLACEMENT

For satisfactory operation of your engine, we recommend OMC Snap-In Remote Control Cables or ones of equal quality. OMC Snap-In Remote Control Cables are completely assembled and ready to install with sealed cable ends and lifetime lubrication. If you do not select OMC Snap-In Remote Control Cables, make sure the cables used have all these important features.

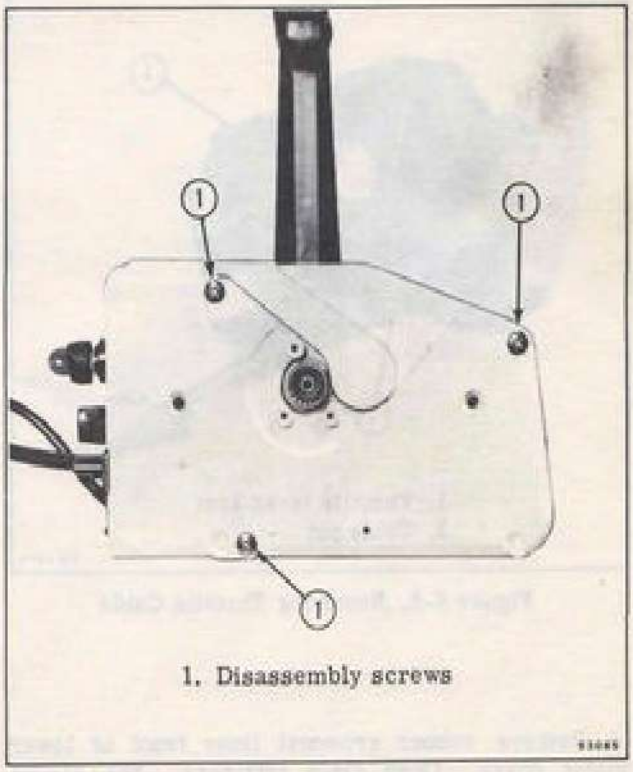
If you elect to use OMC Long-Life Cables (Type "O"), and Adapter Kit Part Number 173600 is available to adapt those cables to this remote control. Follow the instructions in the adapter kit.

NOTE

The following instructions apply to OMC Snap-In Cables.

CABLE REMOVAL

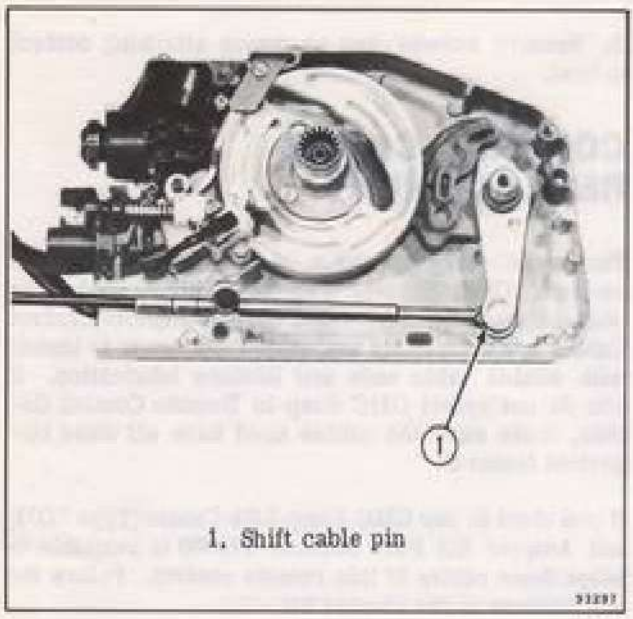
a. Remove three screws from control box and pull halves apart. See Figure 8-4.



1. Disassembly screws

Figure 8-4. Disassembly Screws

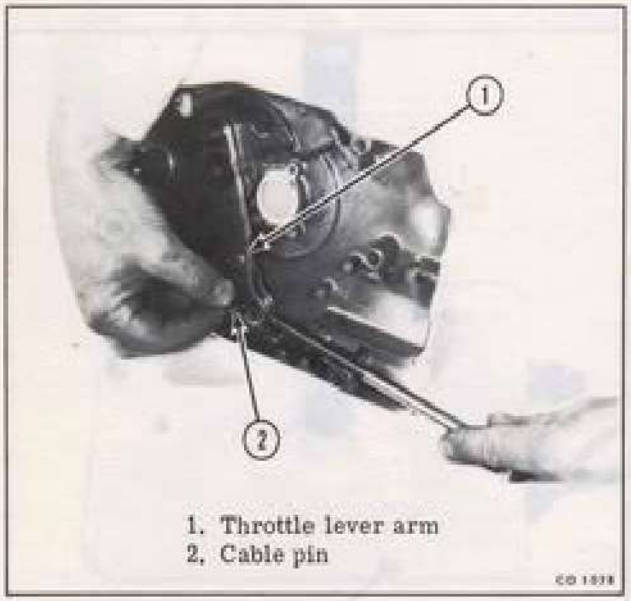
b. Remove shift cable pin from shift control clevis and disengage cable. See Figure 8-5.



1. Shift cable pin

Figure 8-5. Shift Cable

c. To remove throttle cable, lift throttle cable trunnion from pocket and bring cable rearward to expose cable pin. See Figure 8-6. Remove cable pin and cable.



1. Throttle lever arm
2. Cable pin

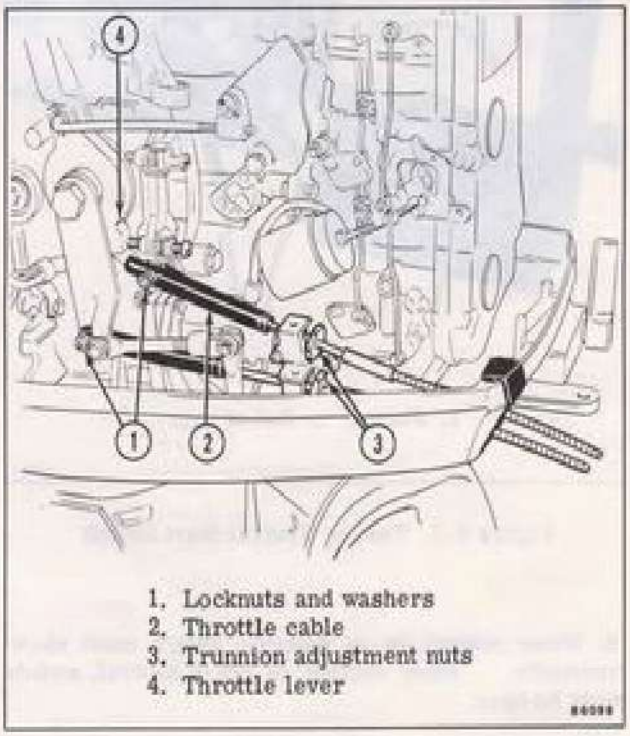
Figure 8-6. Removing Throttle Cable

d. Remove rubber grommet from front of lower motor cover. Open cable retainers. See Figure 8-7.

1. Rubber grommet
2. Cable retainer

Figure 8-7. Grommet and Retainers

e. Remove locknut, washer and throttle control cable from throttle lever. See Figure 8-8.

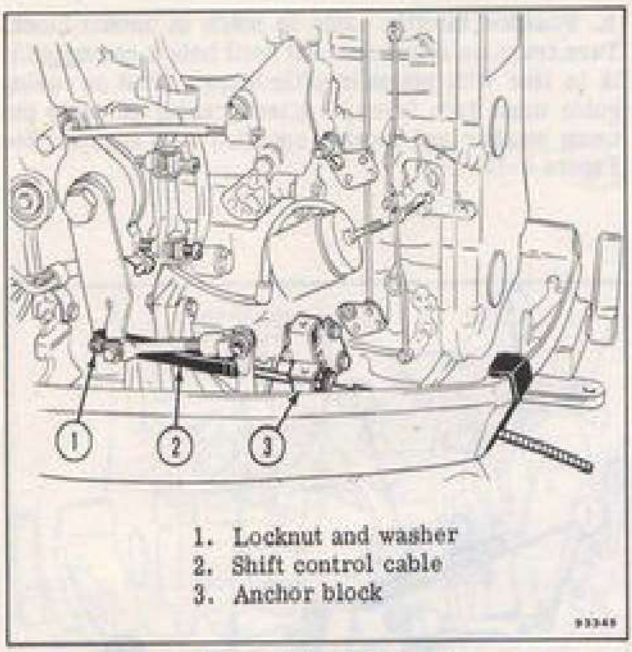


1. Locknuts and washers
2. Throttle cable
3. Trunnion adjustment nuts
4. Throttle lever

Figure 8-8 Throttle Cable

f. Remove nut and lockwasher and disconnect shift control cable from shift lever. See Figure 8-9.

g. Remove cable clamps attaching cable(s) to boat.



1. Locknut and washer
2. Shift control cable
3. Anchor block

Figure 8-9. Shift Cable

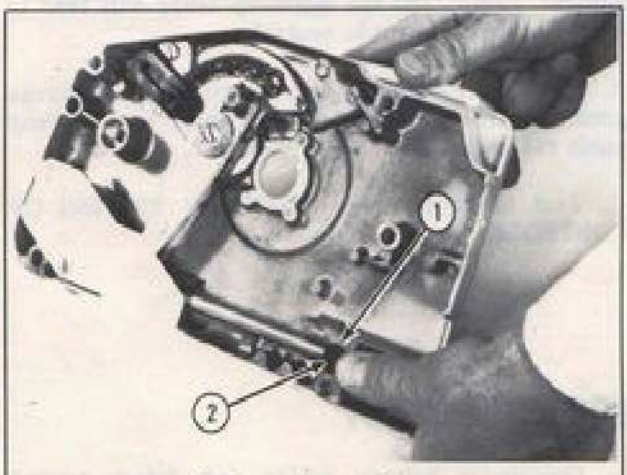
INSTALLATION IN CONTROL BOX

a. Place control lever in NEUTRAL position.

b. Lubricate cable ends with OMC Anti-Corrosion Lube.

c. Begin cable installation with housing half of control. Make certain warm-up lever is completely down. Move throttle lever arm from behind plastic plate to expose hole in lever arm. Place eyelet of throttle cable between the arms of the throttle lever in line with holes. Drop cable pin through upper lever arm, through eyelet, and into lower lever arm. See Figure 8-6.

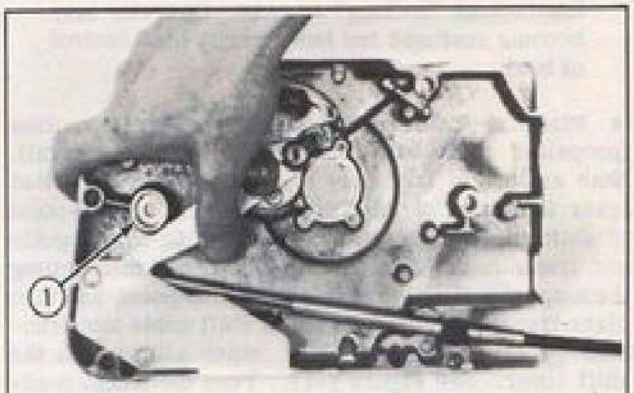
d. Insert cable trunnion into trunnion pocket in housing half as shown in Figure 8-10.



1. Trunnion pocket
2. Cable trunnion

Figure 8-10. Installing Throttle Cable

e. The throttle lever must be in the neutral position before reassembly. Move the throttle lever forward toward the front of the housing half until it contacts the stop. See Figure 8-11.



1. Throttle lever moved to neutral position against stop

Figure 8-11. Moving Throttle Lever Forward

f. Place eyelet of shift cable between the shift lever arms and press cable trunnion into trunnion pocket in cover half. Insert cable pin.

g. Reassemble two halves of control box, taking care to properly pilot the electrical cable grommet into the housing. Torque three cover screws 40 to 50 in. lbs. (4.6 to 5.5 N·m).

INSTALLATION ON MOTOR

a. Identify the throttle cable from the shift cable at the engine end of cables by lifting warm-up lever. The throttle cable will move.

b. Lubricate the shift and throttle cable ends with OMC Anti-Corrosion Lube, or equivalent.

⚠ SAFETY WARNING

To prevent accidental starting of engine always remove ignition key from start switch. Accidental starting of engine could cause possible injury to the installer and/or bystanders.

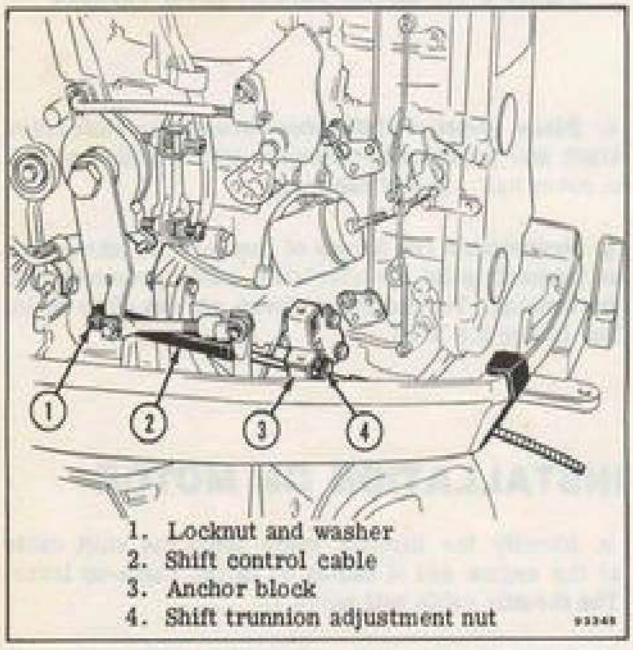
c. Remove rubber grommet from front of lower motor cover. Open cable retainers. See Figure 8-7.

d. Move control lever on remote control box to neutral position. Move warm-up lever down to "run" position.

SAFETY WARNING

Before connecting shift control cable to engine(s), insure that the remote control is in neutral and the engine shift lever is in neutral. Failure to make this adjustment can result in the engine starting in gear and/or the control "locking" in gear. Operator may become confused and temporarily lose control of boat.

e. Place shift lever on engine in neutral position (propeller shaft will turn freely when in neutral). Note amount of free play in shift lever and position lever in center of this travel. Determine mid-point of shift cable backlash by first pushing casing guide and trunnion nut toward each other, and then pulling them apart. Position backlash at mid-point, and then place trunnion adjustment nut of shift cable into trunnion pocket of anchor block which aligns with the shift lever. See Figure 8-12. Turn the trunnion adjustment nut until hole in casing guide is in line with pin on shift lever. (Flat on casing must face lever.) Attach casing guide to pin using washer and locknut supplied with engine.



1. Locknut and washer
2. Shift control cable
3. Anchor block
4. Shift trunnion adjustment nut

Figure 8-12. Installing Shift Cable

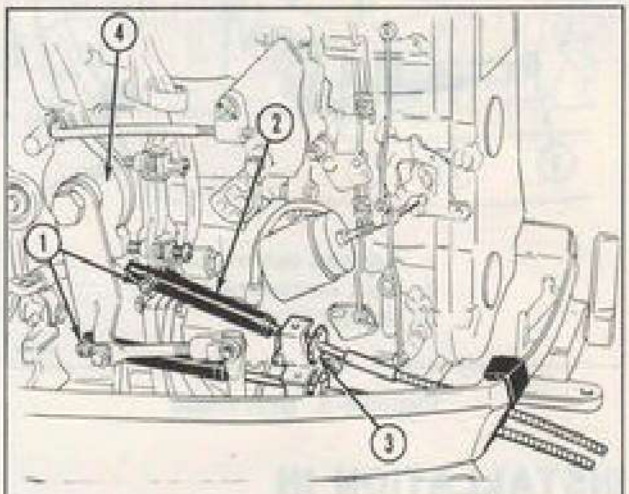
f. Move throttle lever on engine so that idle stop screw is against its stop.

g. Grasp throttle cable casing guide and trunnion nut. Pull firmly on casing guide while pushing on trunnion nut to remove backlash from cable and remote control.

NOTE

Unless backlash is removed (as in step "g" above) before adjusting and connecting throttle cable, engine may not return to a consistent idle speed.

h. Position throttle cable in notch in anchor block. Turn trunnion adjustment nut until hole in casing guide is in line with pin on throttle lever. (Flat on casing guide must face lever.) Attach casing guide to pin using washer and locknut supplied with engine. See Figure 8-13.



1. Locknut and washer
2. Throttle cable
3. Throttle trunnion adjustment nut
4. Throttle lever

Figure 8-13. Installing Throttle Cable

The throttle cable must be adjusted just tight enough to insure that the engine throttle lever returns to its idle stop. If this cable is too loose, the engine idle speed will be high and inconsistent, causing difficulty shifting out of gear.

If it is too tight, the control will feel stiff through the shifting range, and the warm-up lever will tend to move up when shifting to neutral.

i. Slip rubber grommet onto control cables and press grommet into groove in lower motor cover. Snap cable retainers shut. See Figure 8-7.

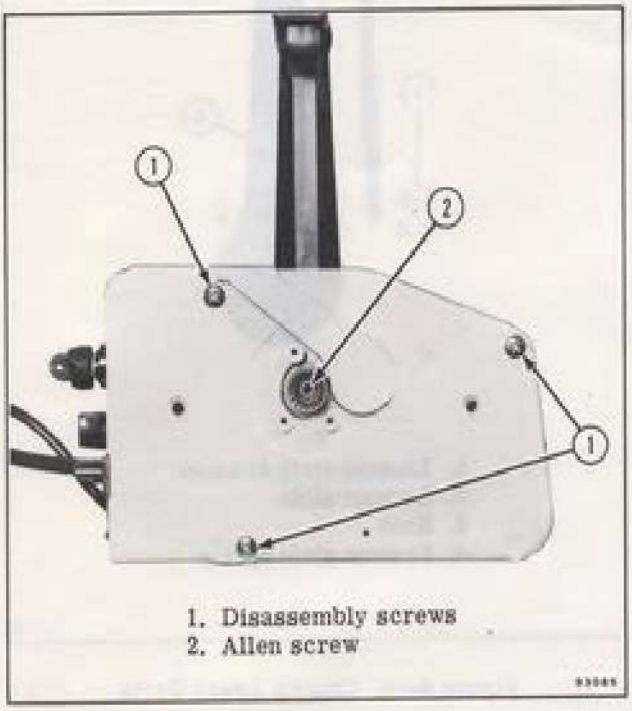
j. Test operation. See FUNCTION TESTING OF CONTROLS.

DISASSEMBLY

a. Disconnect battery cables and detach control from boat. See CONTROL SERVICE

b. To remove handle assembly, first loosen Allen head screw three complete turns. See Figure 8-14.

c. Support control on blocks to allow the handle to be driven off the control. Place small punch in head of Allen head screw and tap with plastic hammer to disengage the handle splines from the hub splines. Remove the Allen head screw and the handle. See Figure 8-15.



1. Disassembly screws
2. Allen screw

Figure 8-14. Disassembly Screws

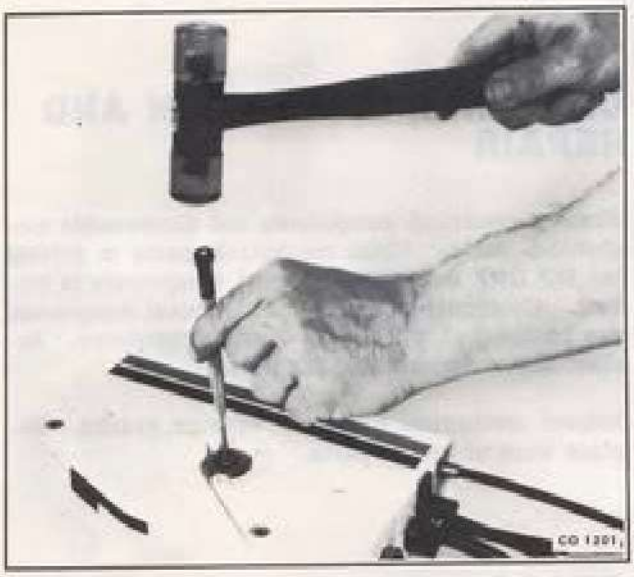


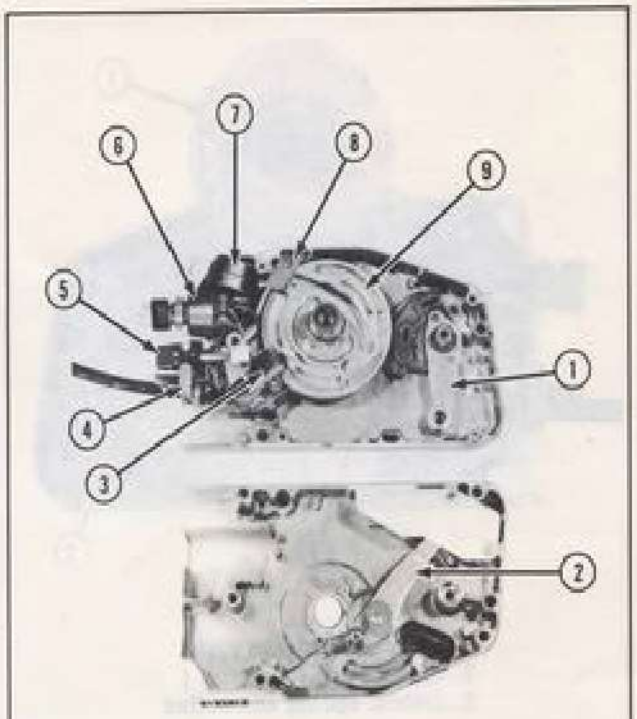
Figure 8-15. Loosening Control Handle

d. Remove three screws from control box and pull halves apart. See Figure 8-14.

e. Remove retainer screw and throttle plate retainer. See Figure 8-16.

f. Remove friction adjustment assembly.

g. Remove screws and neutral start switch and mounting plate.



1. Shift control clevis
2. Throttle control clevis
3. Neutral start switch
4. Electric cable grommet
5. Friction adjustment knob
6. Key switch
7. Motor temperature warning horn
8. Throttle plate retainer
9. Shift and throttle plate

Figure 8-16. Remote Control Components

h. Lift shift and throttle plate from housing. See Figure 8-17.

SAFETY WARNING

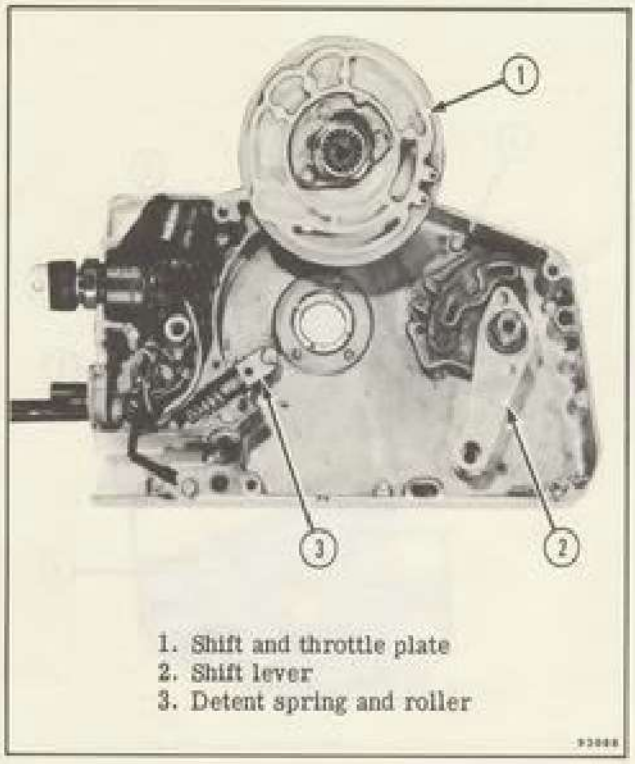
Use caution when removing mounting plate and shift and throttle plate as detent spring is highly compressed and may fly out causing personal injury. Wear safety glasses.

i. Remove detent spring and roller.

j. Lift out shift lever assembly.

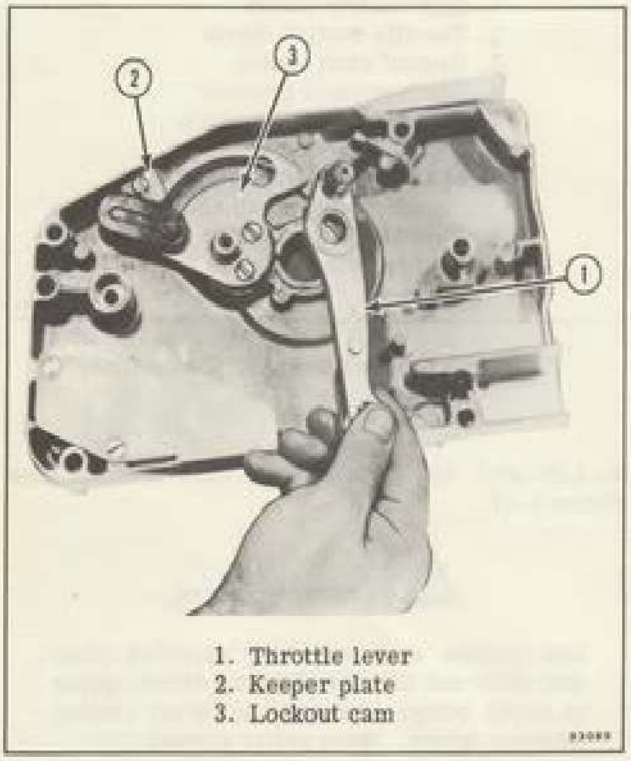
k. Remove flat head screw and countersunk washer and lift out throttle lever. See Figure 8-18.

l. To remove shift lockout cam, remove screw and keeper plate. See Figure 8-18. Remove screws and lockout cam.



1. Shift and throttle plate
2. Shift lever
3. Detent spring and roller

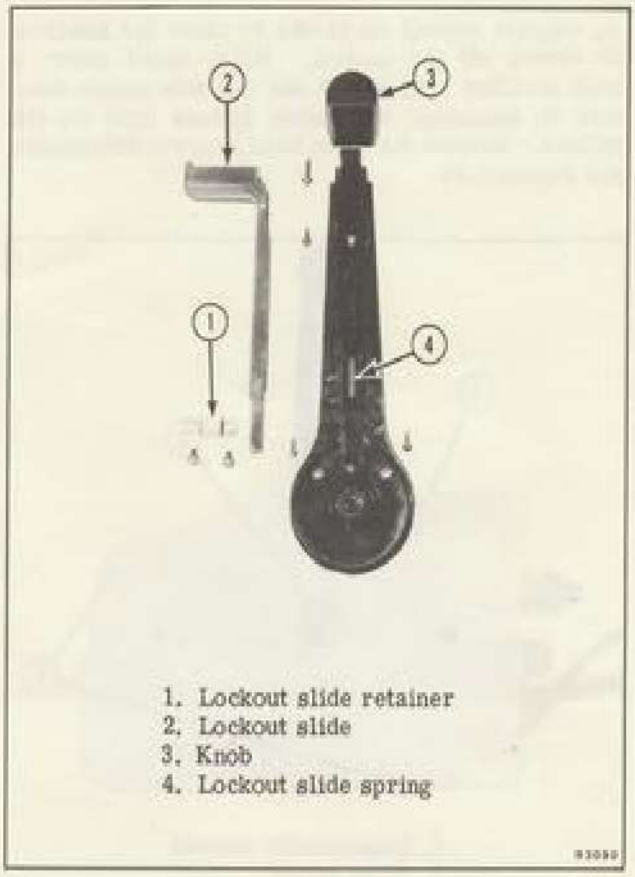
Figure 8-17. Shift and Throttle Plate Removed



1. Throttle lever
2. Keeper plate
3. Lockout cam

Figure 8-18. Removing Throttle Lever

m. To disassemble control lever, remove two screws and lockout slide retainer. See Figure 8-19. Lift out lockout slide. Remove one screw and control lever knob.



1. Lockout slide retainer
2. Lockout slide
3. Knob
4. Lockout slide spring

Figure 8-19. Control Lever Parts

CLEANING, INSPECTION AND REPAIR

Remove electrical components and disassemble mechanical parts. Clean mechanical parts in solvent but DO NOT immerse electrical components in solvent. Continuity of wiring and electrical components can be checked with a test light or ohmmeter. Replace any component that has failed.

Inspect mechanical parts for wear or cracks. Replace worn or broken parts.

REASSEMBLY

SAFETY WARNING

Failure to follow reassembly instructions could result in operator losing control of speed or direction of thrust. See Figure 8-22.

Lubricate friction points on mechanical parts with OMC Multi-Purpose Grease.

a. Insert spring into back side of slide and pivot control handle onto slide. Make certain spring is not pinched between slide and control handle. While holding slide against the control handle (to retain spring), replace slide retainer and secure with two slide retainer screws. Torque screws 25 to 35 in. lbs. (2.8 to 3.9 N·m).

b. Install shift lockout cam and lever and install screws. Torque screws 25 to 35 in. lbs. (2.8 to 3.9 N·m). See Figure 8-22.

c. Install keeper plate and screw. Torque screw 10 to 15 in. lbs. (1.2 to 1.6 N·m).

d. Place throttle lever on post. Install screw and washer. Washer must have tapered side outward. Use correct patch screw. Torque screw 25 to 35 in. lbs. (2.8 to 3.9 N·m). See Figure 8-22.

e. If removed, replace plastic separator. Torque screws 10 to 15 in. lbs. (1.2 to 1.6 N·m). See Figure 8-22.

f. Be sure gear teeth on shift lever assembly are free of dirt or grit. Install shift lever assembly.

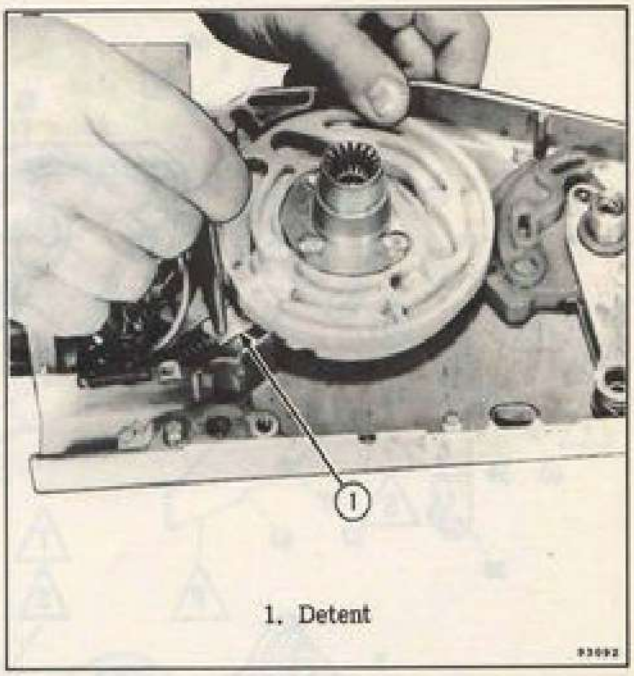
g. Install detent spring and plunger. See Figure 8-17.

SAFETY WARNING

To prevent possible eye injury from detent spring, wear safety glasses while installing shift and throttle plate.

h. Be sure shift and throttle plate is free of dirt or grit. Retract detent plunger and install shift and throttle plate. See Figure 8-20.

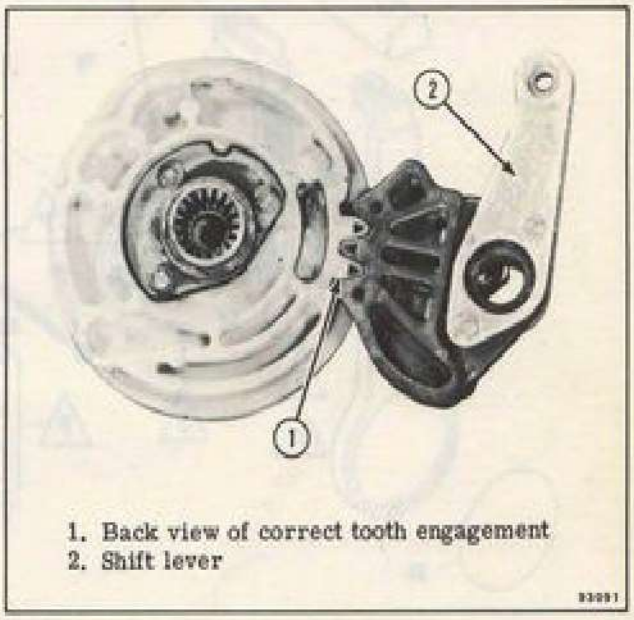
i. Rotate shift and throttle plate counterclockwise to engage gear teeth. See Figure 8-21. Orient parts in neutral position. See Figure 8-16.



1. Detent

Figure 8-20. Installing Shift and Throttle Plate

j. Place neutral start switch mounting plate in position and install friction adjustment assembly.

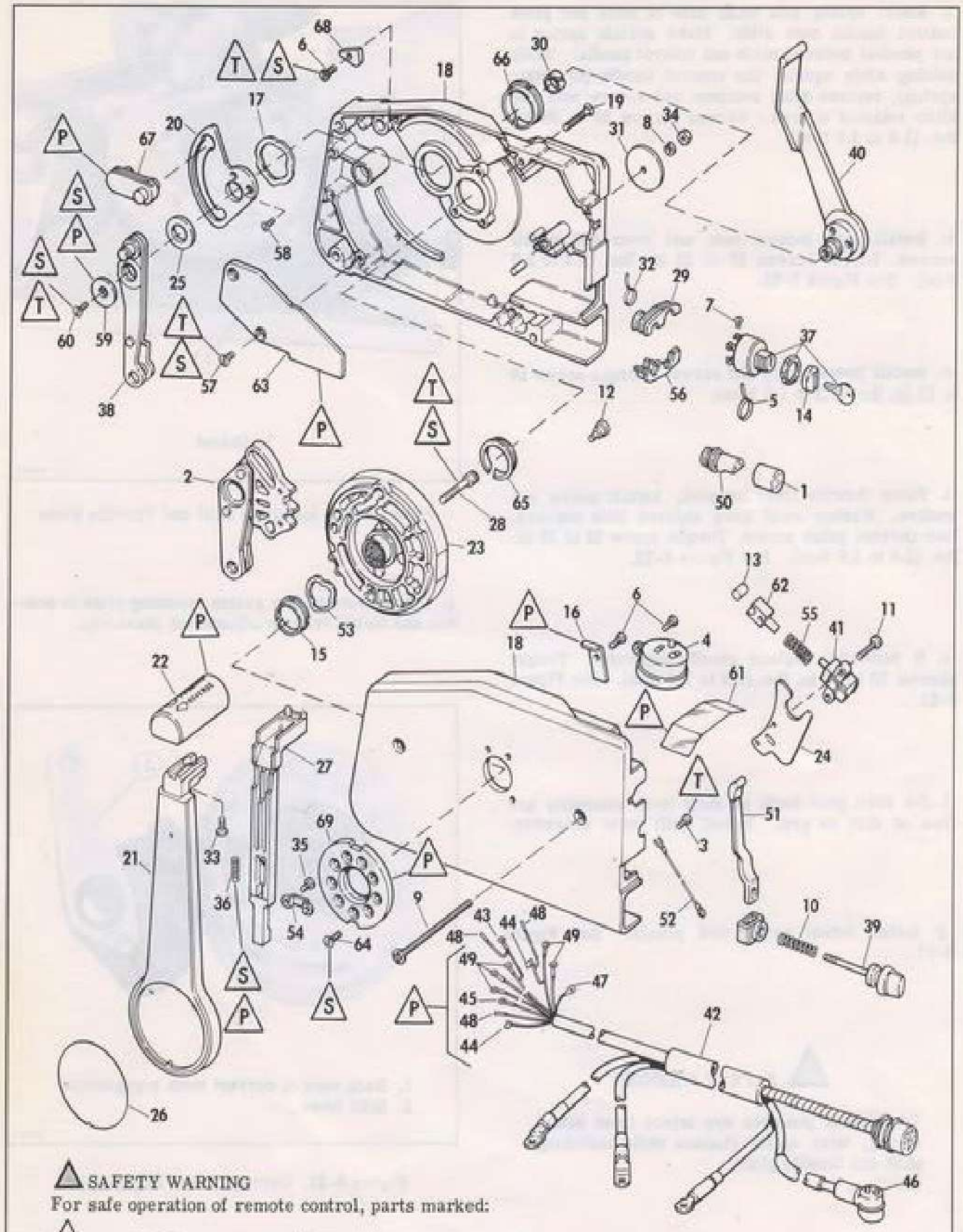


1. Back view of correct tooth engagement
2. Shift lever

Figure 8-21. Correct Lever Engagement

k. Install neutral start switch with two screws. Torque screws 25 to 35 in. lbs. (2.8 to 3.9 N·m).

l. Replace throttle plate retainer with one screw. Torque screw 25 to 35 in. lbs. (2.8 to 3.9 N·m).



⚠ SAFETY WARNING

For safe operation of remote control, parts marked:

P - must be in proper position

S - must not be substituted with other hardware

T - must be torqued to specifications

Failure to follow these procedures could result in operator losing control of speed or direction of thrust.

Figure 8-22. Remote Control Components

Key to Figure 8-22

1. 3-way connector cap
2. Shift lever assembly
3. Ground screw
4. Horn assembly
5. Tie strap
6. Horn and plate screw
7. Ignition switch screw
8. Control to boat lockwasher
9. Single control, portside mounting screw
10. Friction adjusting screw spring
11. Mounting bracket switch screw
12. Shift and throttle lever clevis pin
13. Detent, shift and throttle plate roller
14. Key push knob
15. Cam, hub cover bushing
16. Retainer plate
17. Cam to housing spring washer
18. Housing and cover assembly
19. Access cover to housing screw
20. Shift lockout cam
21. Remote control lever
22. Lever knob
23. Shift and throttle plate assembly
24. Neutral start switch mounting plate
25. Throttle lever to cam spacer
26. Lever applique
27. Neutral lock slide
28. Lever screw
29. Upper half grommet
30. Throttle lever bushing
31. Remote control to boat washer
32. Grommets tie straps
33. Knob to control lever screw
34. Mounting screw nut
35. Plate screw
36. Slide return spring
37. Ignition switch and key assembly
38. Throttle lever assembly
39. Knob and friction adjustment screw assembly
40. Warm-up lever
41. Neutral start switch assembly
42. Instrument cable assembly
43. Ring terminal
44. Slide on terminal
45. Ring terminal
46. Terminal cover
47. Terminal
48. Socket
49. Terminal
50. Plug
51. Friction adjustment lever
52. Ground lead assembly
53. Shift and throttle hub wave washer
54. Slide control lever plate
55. Detent spring
56. Lower grommet
57. Separator 10-24 x 1/2" screw
58. Shift lockout cam 10-24 x 3/8" screw
59. Warm-up lever washer
60. Warm-up lever 10-24 x 1/2" patch screw
61. Horn to cover insulator
62. Detent, shift and throttle plate shoe
63. Levers separator
64. Index plate 10-24 x 7/16" patch screw
65. Shift and throttle plate flanged bushing
66. Warm-up lever flanged bushing
67. Shift lockout lever
68. Keeper plate
69. Neutral lock index plate

m. Check to be sure no wires are being pinched.

Lubricate shift lever post and three assembly screws with OMC Anti-Corrosion Lube.

Reassemble two halves of control box, taking care to properly pilot the electrical cable grommet into the housing. Torque three cover screws 40 to 50 in. lbs. (4.6 to 5.5 N·m).

Pull up on the neutral lock slide, and install handle spline into spline of remote control so slide will engage notch of index plate. Install Allen head screw. Torque screw 70 to 80 in. lbs. (8 to 9 N·m).

SAFETY WARNING

Neutral lock slide in control lever must engage neutral notch in index plate when control is in neutral shift position, or control lever may lock in gear.

CONTROL LEVER REPOSITIONING

The control lever can be moved from the port to the starboard side of the remote control.

To do this:

a. Remove control lever as described in DISASSEMBLY.

b. Remove index plate. See Figure 8-22.

c. Install index plate on starboard side so that notch is pointing toward neutral position. Torque screws to 25-35 in. lbs. (2.8-4.0 N·m).

d. Reverse position of control knob to correctly orient lettering. See DISASSEMBLY and REASSEMBLY.

e. Install control lever. See REASSEMBLY.

The control lever can also be installed so that the neutral position is other than perpendicular to the control.

To do this:

a. Be sure control lever is in neutral.

b. Remove control lever as described in DISASSEMBLY.

c. Remove index plate. See Figure 8-22.

d. Rotate index plate so that either notch points to the desired neutral position, and three screw holes line up with three screw holes in control box.

e. Install screws and torque to 25-35 in. lbs. (2.8-4.0 N·m).

f. Pull up on the neutral lock slide, and install handle spline into spline of remote control so slide will engage notch of index plate. Install Allen head screw. Torque screw 70 to 80 in. lbs. (8 to 9 N·m).

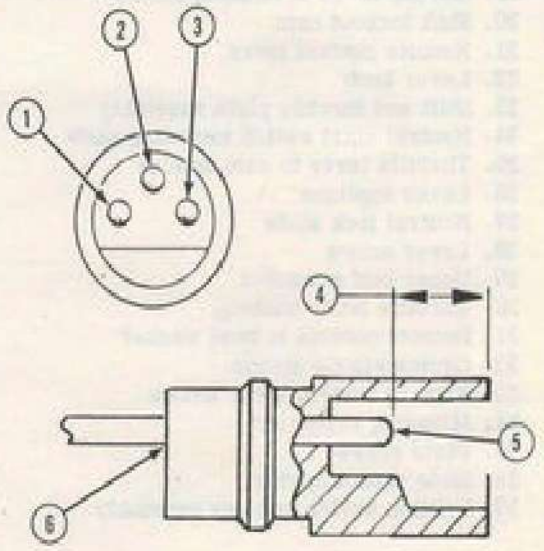
SAFETY WARNING

Neutral lock slide in control lever must engage neutral notch in index plate when control is in neutral shift position, or control lever may lock in gear.

ACCESSORY CONNECTIONS

A plug-in connector is provided at the rear of the control for hookup of accessory instruments.

The plug-in connector contains three contacts - a ground, a tachometer lead, and a lead to the accessary terminal of the key switch. See Figure 8-23. This accessory lead is for connecting low amperage instruments such as a trim gauge or fuel gauge. Maximum load for this connector is 5 amps.



1. Pin A switched B+ (purple) maximum 5 amp load
2. Pin B tachometer (gray)
3. Pin C ground (black)
4. Correct pin depth 1/2" or 0.515 ± 0.025
5. Pin contacts part number 511469
6. Use alcohol to lubricate when installing pins

Rubber connector part number 511465

Figure 8-23. Plug-In Connector

Two prewired kits are available with plug-in connector to quickly plug into your remote control. Instrument Wiring Kit - Plug-In with Fuse Block Part Number 173611 and Instrument Wiring Kit - Plug-In Connector Part Number 173602.

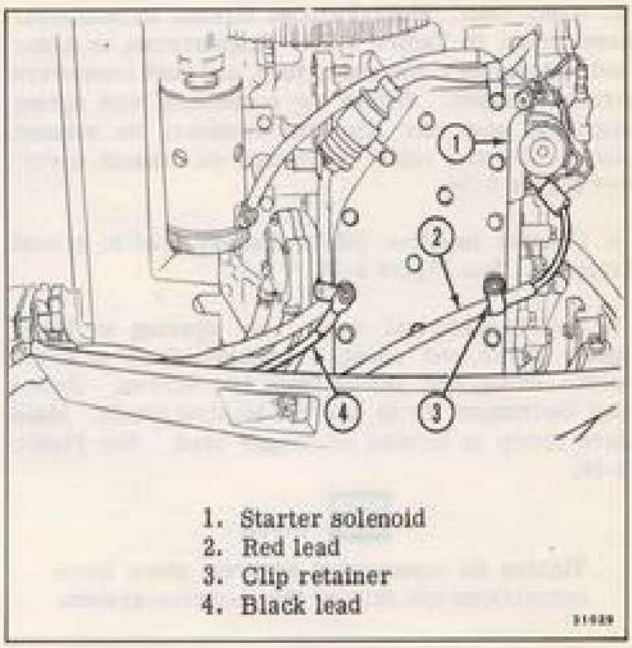
Follow the instructions contained in these kits for complete installation instructions.

If you choose to make up your own plug-in cable, use 16 gauge wire. Color code per Figure 8-27 to be consistent with engine wiring. For terminals use Rubber Connector Part Number 511465 and three Pin Contacts Part Number 511469.

Use Special Tool Part Number 322696, Crimping Pliers, or equivalent, to crimp the pin contacts and Special Insertion Tool, Part Number 322697 to install the pins in the rubber connector.

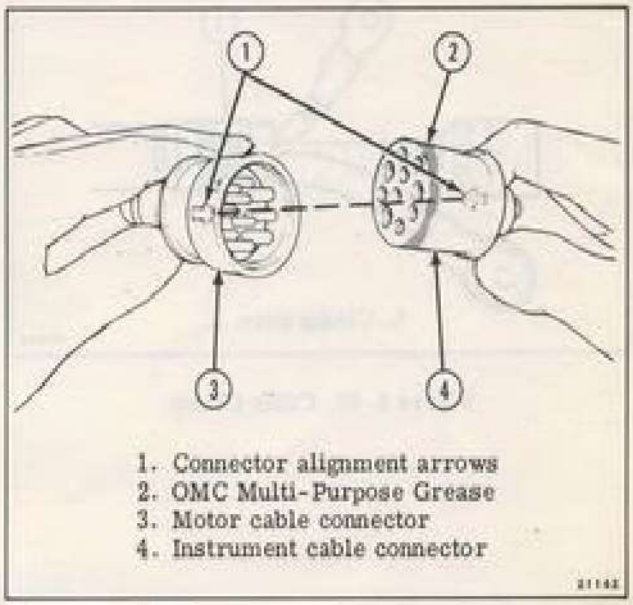
Use alcohol to lubricate the connector before installing the pins. See Figure 8-23.

When using the plug-in connection, a tie strap should be installed 3 inch to 4 inch from the end of the connector to hold the accessory leads to the control electrical harness.

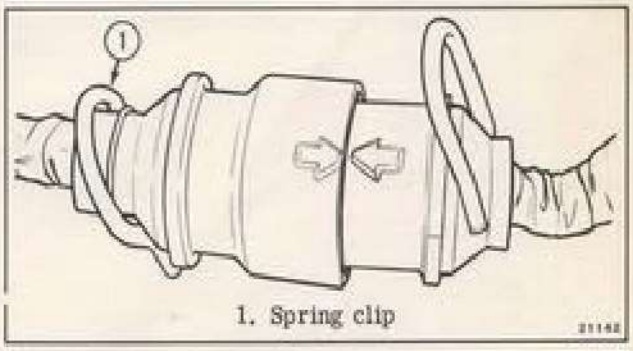


1. Starter solenoid
2. Red lead
3. Clip retainer
4. Black lead

Figure 8-24. Cable Connection



1. Connector alignment arrows
2. OMC Multi-Purpose Grease
3. Motor cable connector
4. Instrument cable connector



1. Spring clip

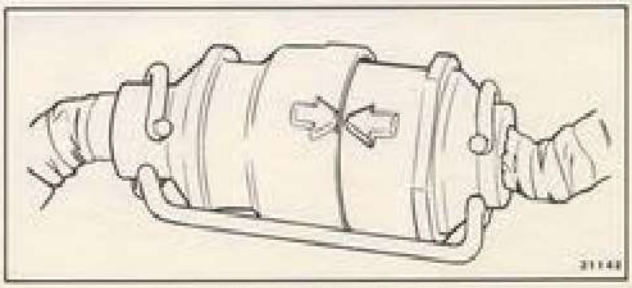


Figure 8-25. Cable Connector

ATTACHING ELECTRICAL CABLE AT MOTOR END

NOTE

Always disconnect battery cables when working on electrical connections.

Route the electrical cable assembly to the stern of the boat. It should be neatly fastened in an out of the way place. Four clamps and screws (not supplied) or the straps (supplied) are used for this purpose. The cable may be strung under the floorboards, if desired, since it resists possible damage by bilge water. Provide sufficient slack at motor end to permit steering and tilting of motor without binding.

a. Remove cable clamp from front of lower motor cover.

b. Route the positive (red) battery lead to starter solenoid using the decal on starter motor as your guide. The lead should be routed behind the starter motor. Cover terminal with rubber boot. See Figure 8-24.

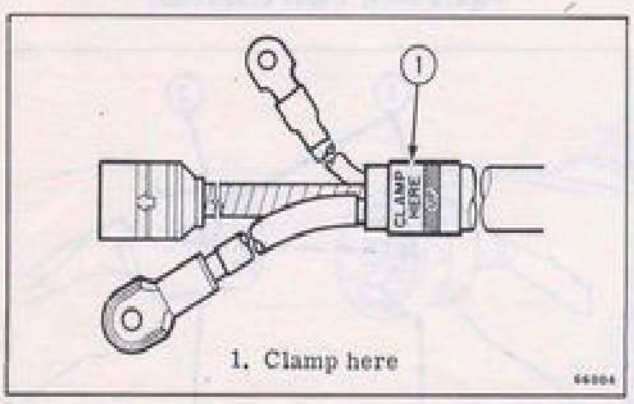
c. Apply OMC Multi-Purpose Grease to connector area shown in Figure 8-25. Align arrows on motor and instrument cable connectors, and push connectors firmly together. Secure the connection with spring clip and snap the clip into retainers on exhaust cover. Secure cable in clamps on exhaust cover. See Figure 8-24.

d. Connect negative (black) battery lead to ground terminal. See Figure 8-24.

e. Insert electrical cable into opening in lower motor cover and clamp. Position clamp in lower motor cover and secure with two screws. Notice that instrument cable has two locating bands. Make sure clamp is located on proper band. See Figure 8-26.

NOTE

Tighten all connections securely since loose connections can damage the electrical system.



1. Clamp here

Figure 8-26. Cable Clamp

FUNCTION TESTING OF CONTROLS

Test all remote control functions to insure operational safety.

a. Lift warm-up lever and observe motor linkage movement. Only the throttle lever must move. The shift lever must not move.

b. Put boat in water with lower unit submerged, and check neutral start switch. Motor must not crank when control is out of neutral.

NOTE

Do not start or run engine out of water even momentarily as the water pump will be damaged immediately and will lead to powerhead failure.

c. Check that control lever locks in neutral position and neutral lock slide must be pulled upward to shift into gear.

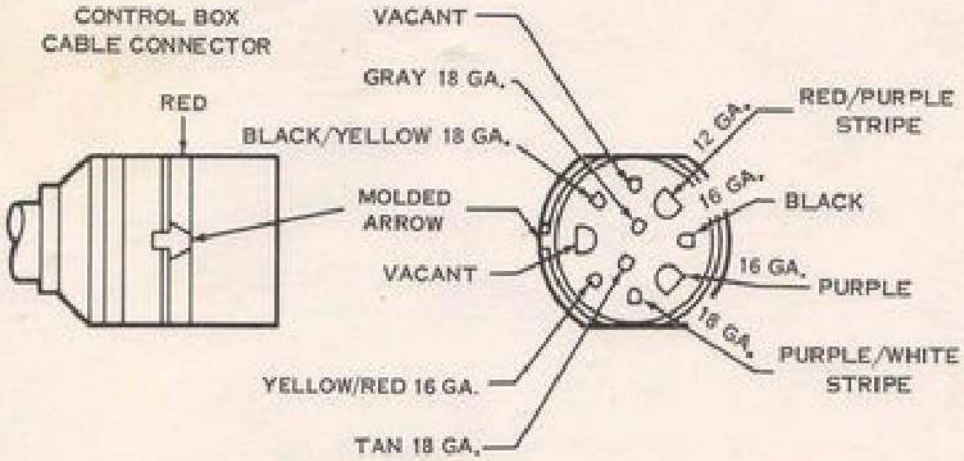
d. Check shift cable adjustment by moving the control handle very slowly from neutral toward forward with the engine running. Make a note of the handle position when the engine begins to make a ratcheting sound. Repeat this procedure in the reverse direction. The ratcheting sound should be heard an equal distance from the neutral detent in both forward and reverse. If not, adjust the shift cable trunnion nut until spacing is equal.

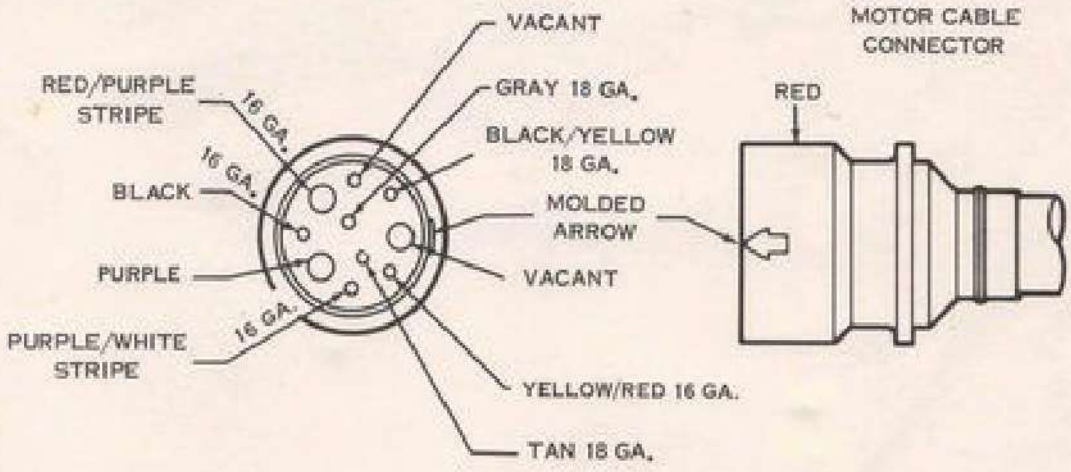
NOTE

In actual operation, the control handle should be moved quickly into the shift detents.

NOTES

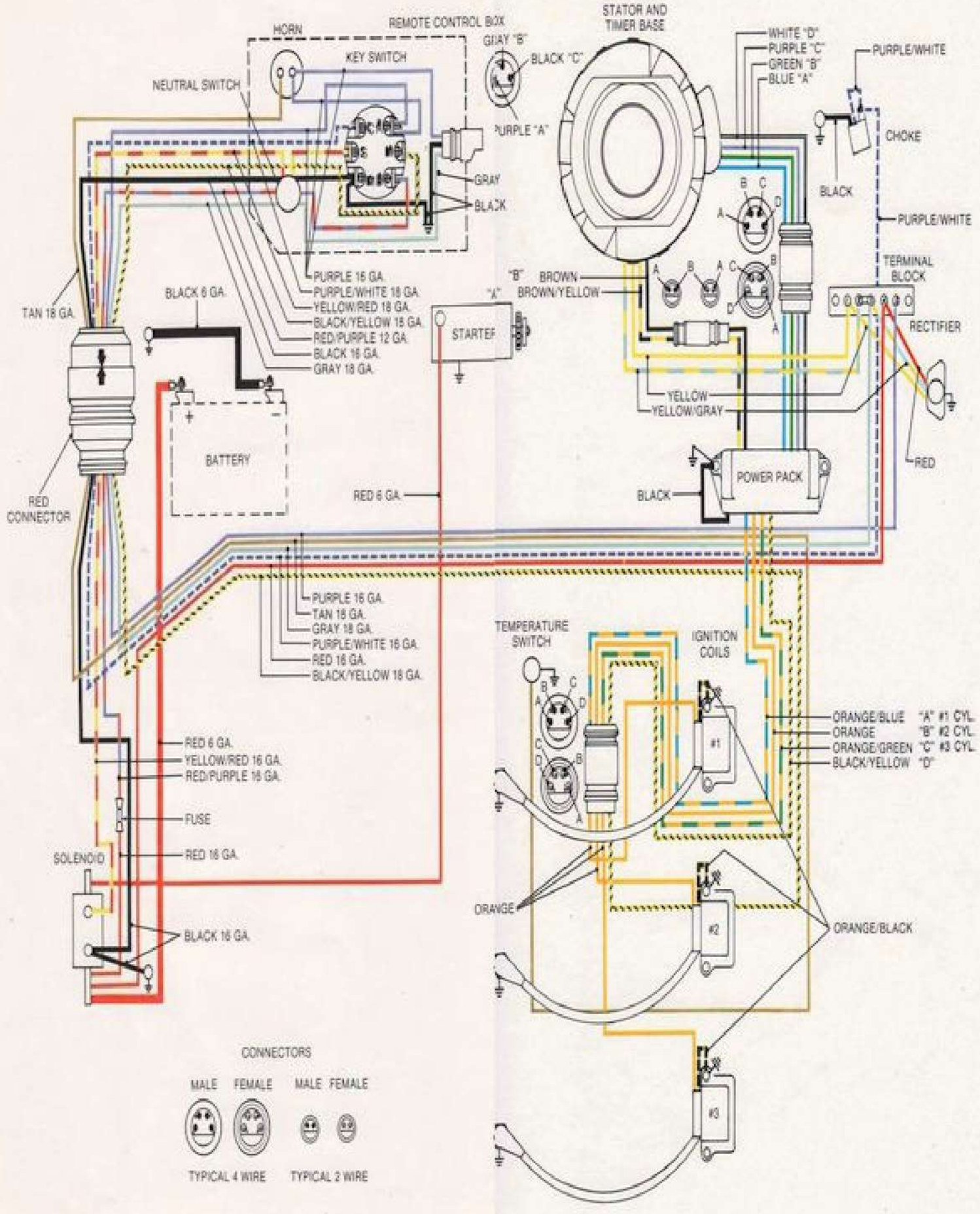
NOTES

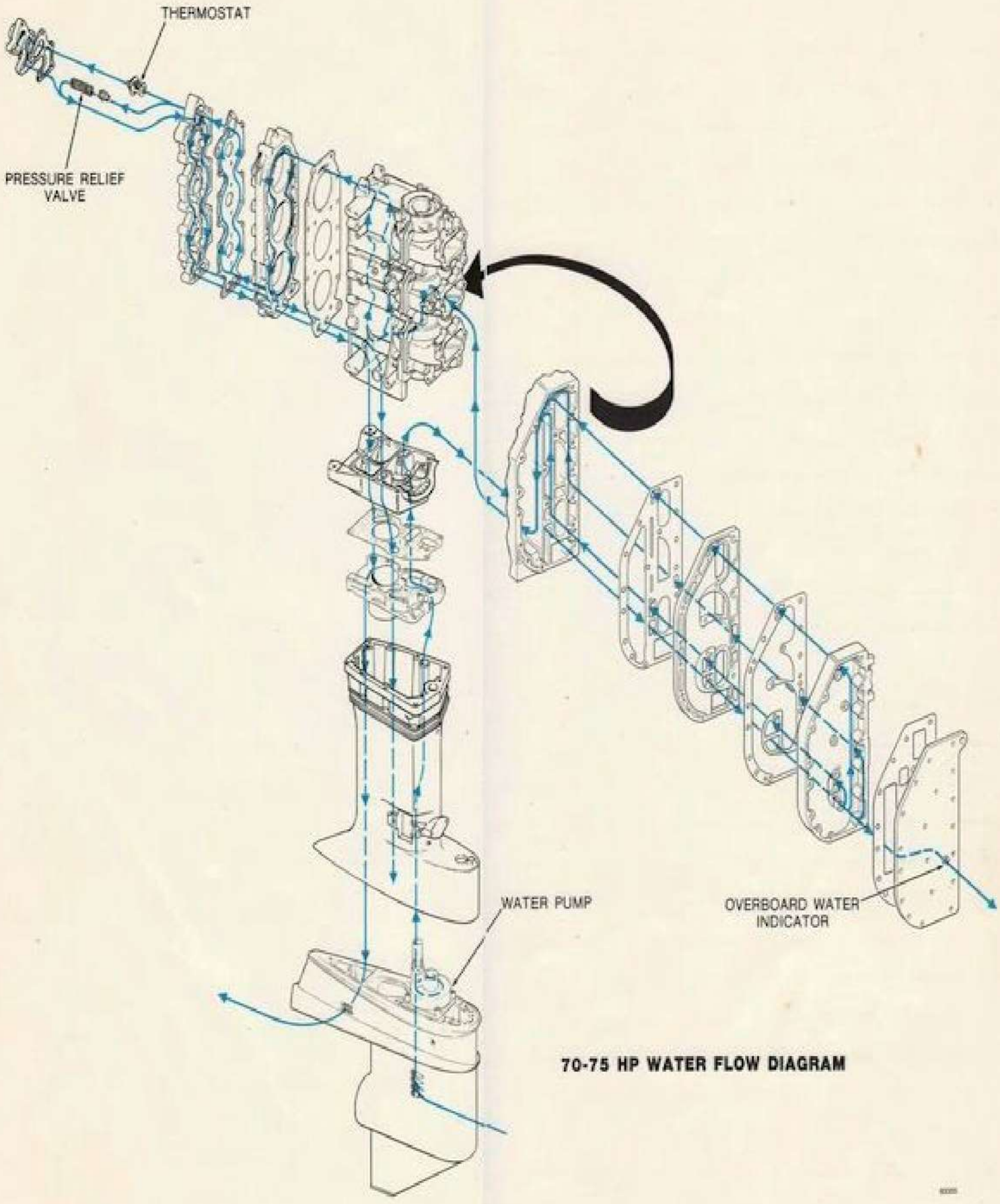

CONTROL BOX
CABLE CONNECTOR
RED
BLACK/YELLOW 18 GA.
MOLDED
ARROW
VACANT
YELLOW/RED 16 GA.
TAN 18 GA.
VACANT
GRAY 18 GA.
12 GA.
RED/PURPLE
STRIPE
16 GA.
BLACK
16 GA.
PURPLE
16 GA.
PURPLE/WHITE
STRIPE


VACANT
GRAY 18 GA.
BLACK/YELLOW
18 GA.
MOLDED
ARROW
VACANT
YELLOW/RED 16 GA.
TAN 18 GA.
RED/PURPLE
STRIPE
16 GA.
16 GA.
BLACK
PURPLE
16 GA.
PURPLE/WHITE
STRIPE
MOTOR CABLE
CONNECTOR
RED

63110

70/75 H.P.
WIRING DIAGRAM





70-75 HP WATER FLOW DIAGRAM

JOHNSON 50 TO 1 LUBRICANT

We recommend using JOHNSON 50/1 LUBRICANT.

JOHNSON 50/1 LUBRICANT is designed specifically for Johnson outboard motor use at a 50 to 1 gasoline to lubricant ratio for engine break in and after break in, new and older models. This improved lubrication is formulated to provide additional benefits such as: exceptional lubrication, less varnish and combustion chamber deposits, better spark plug life, good mixability with gasoline even in cold weather, and reduction of pre-ignition.

NOTE

If Johnson 50/1 Lubricant should not be available, see lubrication instructions Section 2.

USE ONLY THE RECOMMENDED OIL TO GASOLINE MIXTURE, REGARDLESS OF THE CLAIMS MADE FOR SOME OILS.

SAFETY WARNING

When replacement parts are required, use genuine OMC parts or parts with equivalent characteristics including type, strength, and material. Failure to do so may result in product malfunction and possible injury to the operator and/or passengers.

It is recommended that only genuine factory approved replacement parts and accessories be used. Replacement parts not manufactured nor approved by Johnson Outboards, should not be used.

Failure resulting from use of parts, or accessories other than those manufactured or approved by Johnson Outboards, will not be covered under warranty.

Johnson

OUTBOARDS

WAUKEGAN, ILLINOIS 60085