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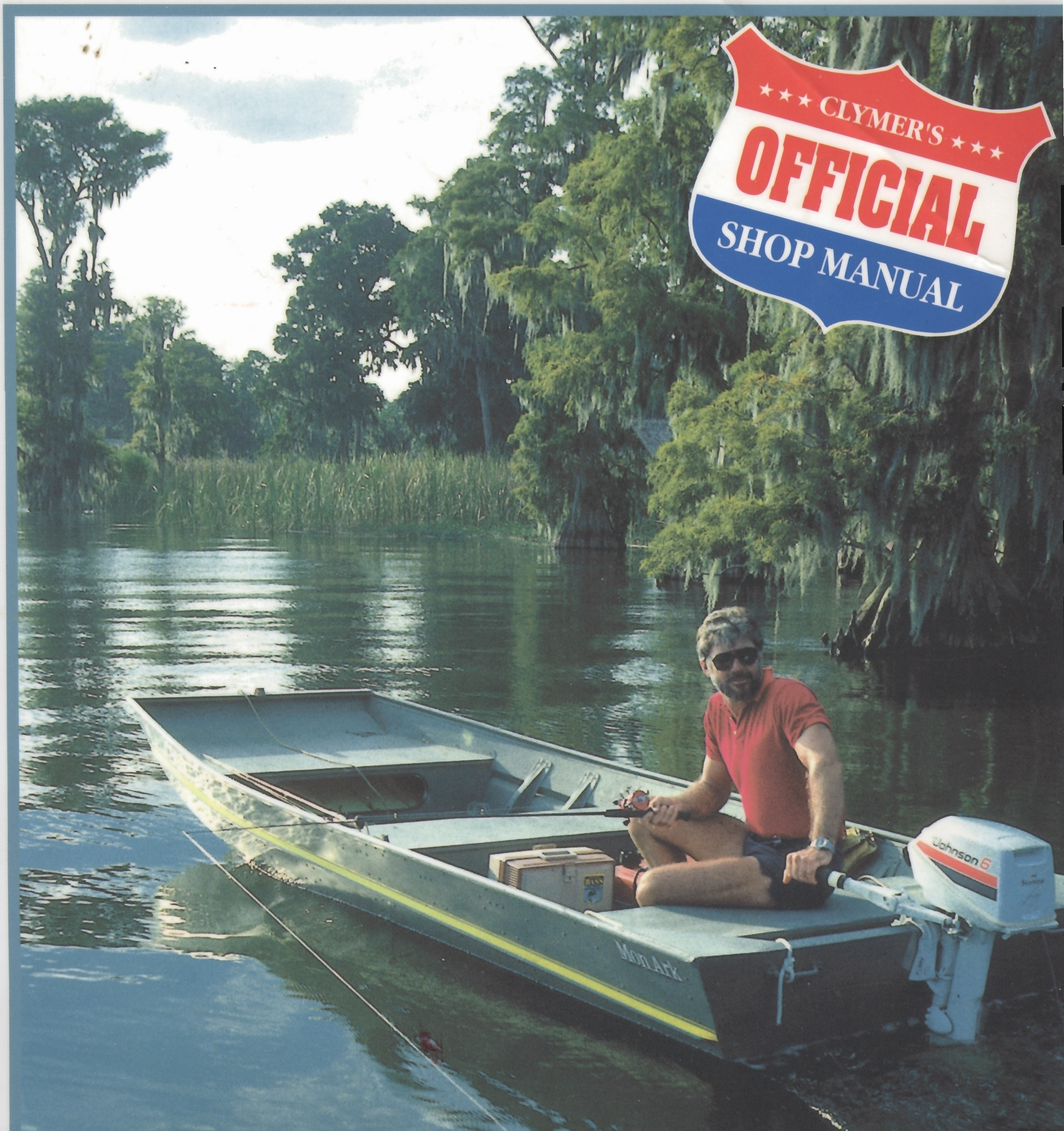
CLYMER®

EVINRUDE/JOHNSON

OUTBOARD SHOP MANUAL

2-40 HP • 1973-1990 (Includes Electric Motors)



FIRST EDITION
First Printing November, 1984

SECOND EDITION
Updated to include 1985-1986 models
First Printing August, 1986
Second Printing January, 1987

THIRD EDITION
Updated to include 1987 models
First Printing June, 1987
Second Printing March, 1988
Third Printing August, 1988

FOURTH EDITION
First Printing March, 1989
Second Printing June, 1989

FIFTH EDITION
Updated to include 1988-1989 models
First Printing January, 1990
Second Printing November, 1990

SIXTH EDITION
Updated to include 1990 models
First Printing October, 1991
Second Printing November, 1992
Third Printing December, 1993
Fourth Printing January, 1995
Fifth Printing January, 1996
Sixth Printing April, 1997
Seventh Printing May, 1998
Eighth Printing September, 1999
Ninth Printing December, 2000
Tenth Printing May, 2002
Eleventh Printing February, 2003

Printed in U.S.A.

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This book was printed at Von Hoffmann an ISO certifie~~d company~~.

ISBN: 0-89287-554-2

Library of Congress: 91-75700

TECHNICAL ILLUSTRATIONS: Steve Amos, Diana Kirkland and Carl Rohkar.

TECHNICAL ASSISTANCE: Tools shown in Chapter Two courtesy of Thorsen Tool, Dallas, Texas. Test equipment shown in Chapter Two courtesy of Dixson, Inc., Grand Junction, Colorado.

COVER: Photographed by Michael Brown Photographic Productions, Los Angeles, California.
- *Boat courtesy of Dave Lawless. Driver — Dubie.*
- *Photo boat courtesy of Cypress Gardens, Florida and drivey by Mike Monds do Oca.*
- *Special thanks to Jerry Imber for all his assistance.*

Quick Reference Data

TIGHTENING TORQUES

Fastener	in.-lb.	ft.-lb.
Ignition coil screws	60-80	
Power pack screw	48-60	
Starter motor through bolts		
9.9 and 15 hp	30-40	
18-35 hp (Prior to 1987)	60-84	
20-30 hp (After 1986)	95-110	
40 hp	95-110	
Standard bolts and nuts		
No. 6	7-10	
No. 8	15-22	
No. 10	25-35	
No. 12	35-40	
1/4 in		5-7
5/16 in.		10-12
3/8 in.		18-20
7/16 in.		28-30

TEST WHEEL RECOMMENDATIONS

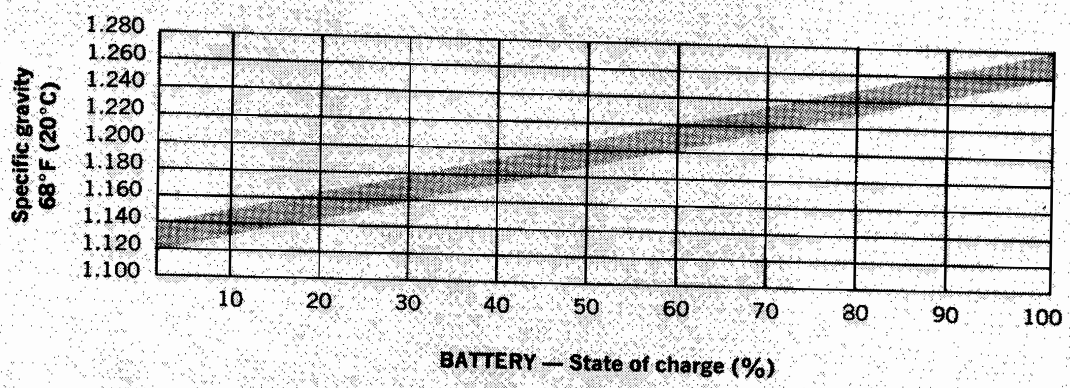
Model	Test wheel	Engine rpm
2 hp	316021	3,900
Colt, Junior	316021	3,900
2.5	317738	3,500
3, Ultra 4, Excel 4	317738	4,400
4 Weedless	316021	3,800
4 Standard		
1973	316960	4,100
1974-on	317738	4,550
4 Deluxe, 4.5 hp	390123	5,100
5 hp		
1985-1986	390239	4,900
1987-on	390239	4,500
6, 7.5 hp		
1973-1975	380757	4,000
1976-1979	379673	4,500
1982-1986	390239	4,900
1987-on	390239	4,800
8 hp		
1984-1986	390239	4,900
1987-on	390239	5,300
8SRL	390239	4,850
9.5 hp	379673	4,400
9.9 hp		
1974-1984	386537	5,400
1985-1986	386537	5,500
1987	386537	5,000
1988	386537	5,650
1989-1990	386537	5,400
9.9SEL		
1987	386537	4,200
1988	386537	4,800
1989-1990	386537	4,400

(continued)

TEST WHEEL RECOMMENDATIONS (continued)

Model	Test wheel	Engine rpm
15 hp		
1974-1986	386537	6,200
1987-1988	386537	6,650
1989-1990	386537	6,100
20 hp		
1973	376913	4,650
1980-1984	388880	4,650
1985-on	386891	4,550
25 hp		
1973-1976	376913	4,900
1977	388295	4,650
1978-1984	388880	5,200
1985-1986	394145	4,800
1987	394145	4,600
1988-on	394145	4,800
28 hp		
1987	396561	4,200
1988-on	398948	4,800
30 hp		
1984	386891	5,300
1985-1986	394145	5,400
1987	394145	5,200
1988-on	394145	5,400
35 hp		
1976-1984	386891	5,300
40 hp		
1973-1976	378566	4,500
1985-1986		
Manual	382861	4,900
Electric	387635	5,200
1987-1988	387635	4,900
1989-1990	432968	4,900

APPROXIMATE STATE OF CHARGE



RECOMMENDED SPARK PLUGS

Model	hp/cyl.	Champion plug type	Gap (in.)
2	2/1	J6C	0.030
Colt, Junior	2/1	RJ6C	0.030
2.5	2.5/2	QL77JC4	0.040
3	3/2	RL82C	0.030
Ultra 4, Excel 4	4/2	QL77JC4[2]	0.030
4 (1973-1976)	4/2	J6C	0.030
4 (1977-1980)	4/2	L77J4	0.040
4 (1981)	4/2	L7J	0.030
4 (1982-1987)	4/2	RL86C	0.030
4 (1988-1990)	4/2	RL82C	0.030
4 Deluxe	4/2	QL77JC4[2]	0.040
4.5	4.5/2	QL77J4[3]	0.040
5	5/2	QL77JC4[2]	0.040
6 (1973-1976)	6/2	J6C	0.030
6 (1977-on)	6/2	QL77JC4[2]	0.040
7.5	7.5/2	QL77J4	0.040
8	8/2	QL77JC4[2]	0.040
9.5	9.5/2	J6C[1]	0.030
9.9 (1974-1976)	9.9/2	UL81J	0.030
9.9 (1977-on)	9.9/2	QL77JC4[3]	0.040
15 (1974-1976)	15/2	UL81J	0.030
15 (1977-on)	15/2	QL77JC4[3]	0.040
18	18/2	UJ4J	0.030
20 (1973)	20/2	UJ4J	0.030
20 (1981-1982)	20/2	QL77J4	0.040
20 (1985-on)	20/2	QL77JC4[3]	0.040
25 (1973-1974)	25/2	UJ4J	0.030
25 (1975-1976)	25/2	J6C	0.030
25 (1977-on)	25/2	QL77JC4[3]	0.040
28	28/2	QL77JC4[3]	0.040
30	30/2	QL77JC4[3]	0.040
35 (1975-1976)	35/2	UL81J	0.030
35 (1977-1984)	35/2	QL77J4	0.040
40 (1973)	40/2	J6C	0.030
40 (1974)	40/2	UJ4J	0.030
40 (1975-1976)	40/2	UL81J	0.030
40 (1985-1988)	40/2	QL77JC4[3]	0.040
40 (1989-1990)	40/2	QL78C[2]	0.030

1. Use Champion J6J or AC M44C to prevent wet fouling if used primarily @ low speeds.
2. For sustained high speed operation, Champion QL16V (non-adjustable gap) is recommended.
3. For sustained high speed operation, Champion QL78V or L78V (non-adjustable gap) is recommended for 1985 and later models.

GEARCASE CLEARANCE SPECIFICATIONS

Bearing housing bushing to drive shaft	
6 hp	
1973	0.0015-0.0030 in.
1974-1979	0.0015-0.0025 in.
Drive shaft and bushing in gear case	
2 hp	0.0010-0.0028 in.
4 hp weedless	0.001-0.003 in.
Front gear to gearcase bushing	
6 hp (1973-1979)	0.0010-0.0022 in.
Gearcase bushing to propeller shaft	
2 hp	0.0007-0.0022 in.
4 hp (1973-1980)	0.0005-0.0020 in.
Gearcase head and propeller shaft	
2 hp	0.0007-0.0022 in.
6 hp (1973-1979)	0.0010-0.0020 in.
Gear head and bushing assembly	
4 hp	
1973	0.0005-0.0020 in.
1974-1980	0.0007-0.0022 in.
4 hp weedless	0.0005-0.0015 in.
Pinion and bushing in gearcase	
4 hp (1973-1980)	0.0005-0.0018 in.
Propeller on shaft	
2 hp	
1973	0.0022-0.0057 in.
1974-on	0.0022-0.0067 in.
4 hp	0.0030-0.0055 in.
4 hp weedless	
1973	0.0020-0.0063 in.
1974-on	0.0020-0.0053 in.
6 hp (1973-1979)	0.007-0.009 in.
Propeller shaft in front gear bushing	
6 hp (1973-1979)	0.0005-0.0015 in.
9.9 and 15 hp	0.0002-0.0087 in.
20-40 hp	0.0010-0.0020 in.
Propeller shaft to reverse gear bushing	
6 hp (1973-1979)	0.0005-0.0015 in.
20-40 hp	0.0005-0.0015 in.
Rear reverse gear bushing	
6 hp	
1973	0.0005-0.0020 in.
1974-1979	0.0005-0.0025 in.
20-40 hp	0.0005-0.0020 in.

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EVINRUDE/JOHNSON

OUTBOARD SHOP MANUAL

2-40 HP• 1973-1990 (Includes Electric Motors)

Chapter One

General Information

This detailed, comprehensive manual contains complete information covering maintenance, repair and overhaul. Hundreds of photos and drawings guide you throughout every procedure.

Troubleshooting, tune-up, maintenance and repair are not difficult if you know what tools and equipment to use and what to do. Anyone not afraid to get their hands dirty, of average intelligence and with some mechanical ability can perform most of the procedures in this manual. See Chapter Two for more information on tools and techniques.

A shop manual is a reference. You want to be able to find information quickly. Clymer books are designed with you in mind. All chapters are thumb tabbed and important items are indexed at the end of the manual. All procedures, tables, photos and instructions in this manual assume the reader may be working on the machine or using the manual for the first time.

Keep the manual in a handy place in your toolbox or boat. It will help you to better understand how your boat runs, lower repair and maintenance costs and generally increase your enjoyment of your boat.

MANUAL ORGANIZATION

This chapter provides general information useful to boat owners and marine mechanics.

Chapter Two discusses the tools and techniques for preventative maintenance, troubleshooting and repair.

Chapter Three provides troubleshooting and testing procedures for all systems and individual components.

Following chapters describe specific systems, providing disassembly, inspection, assembly and adjustment procedures in simple step-by-step form. Specifications concerning a specific system are included at the end of the appropriate chapter.

NOTES, CAUTIONS AND WARNINGS

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

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

A WARNING emphasizes areas where personal injury or even death could result from negligence. Mechanical damage may also occur. WARNINGS *must* be taken seriously. In some cases, serious injury or death has resulted from disregarding similar warnings.

TORQUE SPECIFICATIONS

Torque specifications throughout this manual are given in foot-pounds (ft.-lb.), inch-pounds (in.-lb.) and newton meters (N•m.). Newton meters are being adopted in place of meter-kilograms (mkg) in accordance with the International Modernized Metric System. Existing torque wrenches calibrated in meter-kilograms can be used by performing a simple conversion: move the decimal point one place to the right. For example, 4.7 mkg = 47 N•m. This conversion is accurate enough for most mechanical operations even though the exact mathematical conversion is 3.5 mkg = 34.3 N•m.

ENGINE OPERATION

All marine engines, whether two or four-stroke, gasoline or diesel, operate on the Otto cycle of intake, compression, power and exhaust phases.

Two-Stroke Cycle

A two-stroke engine requires one crankshaft revolution (two strokes of the piston) to complete the Otto cycle. All engines covered in this manual are a two-stroke design. **Figure 1** shows gasoline two-stroke engine operation.

Four-Stroke Cycle

A four-stroke engine requires two crankshaft revolutions (four strokes of the piston) to complete the Otto cycle. **Figure 2** shows gasoline four-stroke engine operation.

FASTENERS

The material and design of the various fasteners used on marine equipment are carefully thought out and designed. Fastener design determines the type of tool required to work with the fastener. Fastener material is carefully selected to decrease the possibility of physical failure or corrosion. See *Galvanic Corrosion* in this chapter for information on marine materials.

Nuts, bolts and screws are manufactured in a wide range of thread patterns. To join a nut and bolt, the diameter of the bolt and the diameter of the hole in the nut must be the same. It is just as important that the threads are compatible.

The easiest way to determine if fastener threads are compatible is to turn the nut on the bolt, or bolt into its threaded opening, using fingers only. Be sure both pieces are clean. If much force is required, check the thread condition on each fastener. If the thread condition is good but the fasteners jam, the threads are not compatible.

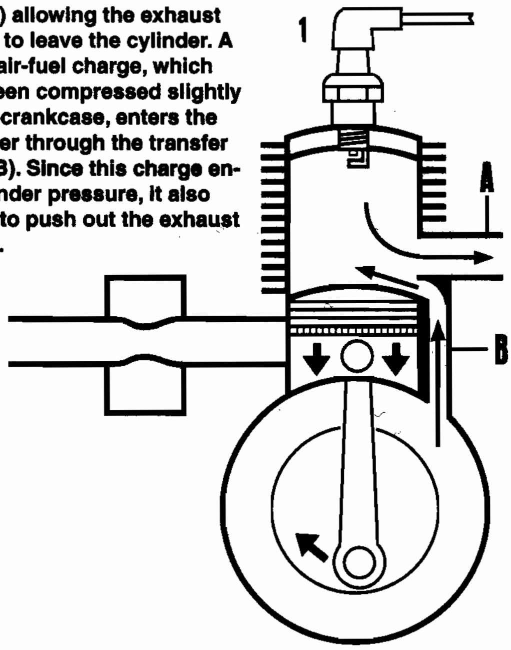
Four important specifications describe the thread:

1. Diameter.
2. Threads per inch.
3. Thread pattern.

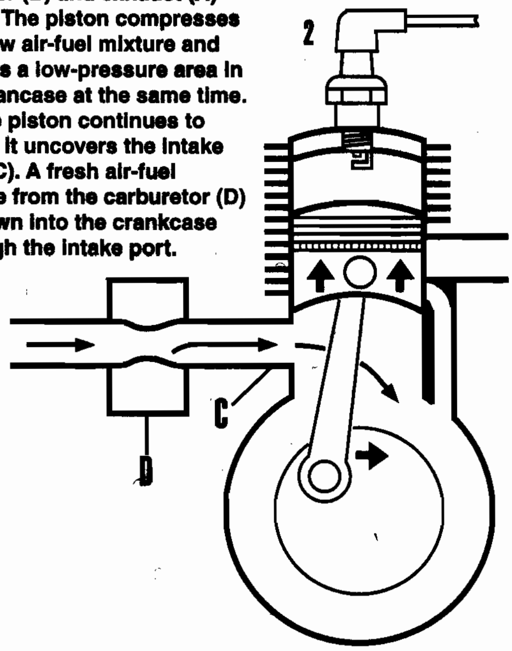
1

TWO-STROKE OPERATING PRINCIPLES

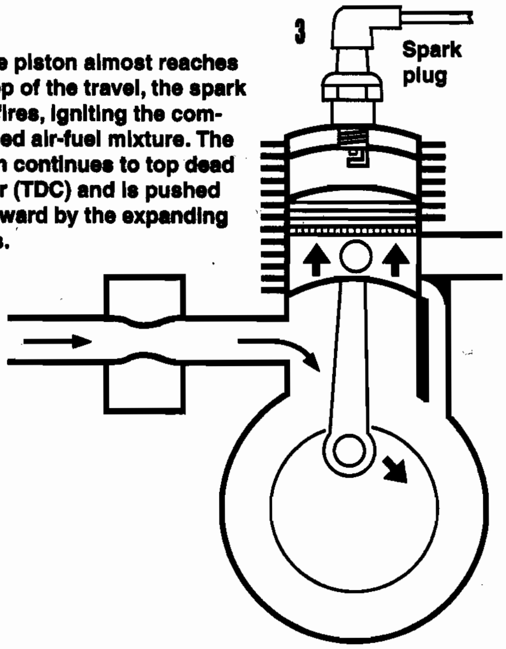
As the piston travels downward, it uncovers the exhaust pot (A) allowing the exhaust gases to leave the cylinder. A fresh air-fuel charge, which has been compressed slightly in the crankcase, enters the cylinder through the transfer port (B). Since this charge enters under pressure, it also helps to push out the exhaust gases.



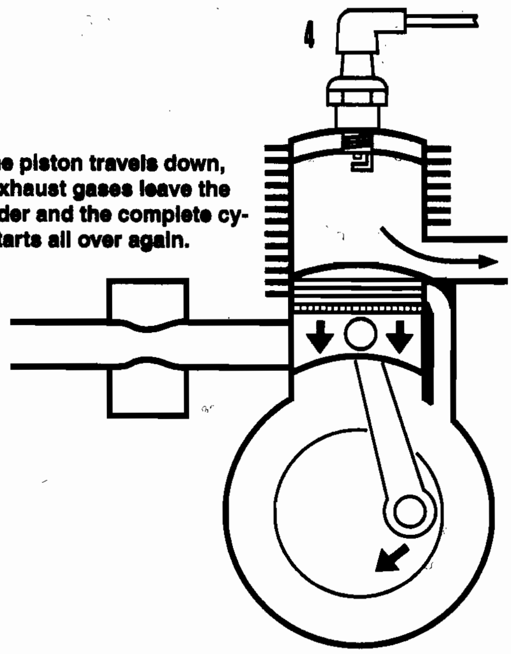
While the crankshaft continues to rotate, the piston moves upward, covering the transfer (B) and exhaust (A) ports. The piston compresses the new air-fuel mixture and creates a low-pressure area in the crancase at the same time. As the piston continues to travel, it uncovers the intake port (C). A fresh air-fuel charge from the carburetor (D) is drawn into the crankcase through the intake port.



As the piston almost reaches the top of the travel, the spark plug fires, igniting the compressed air-fuel mixture. The piston continues to top dead center (TDC) and is pushed downward by the expanding gases.



As the piston travels down, the exhaust gases leave the cylinder and the complete cycle starts all over again.



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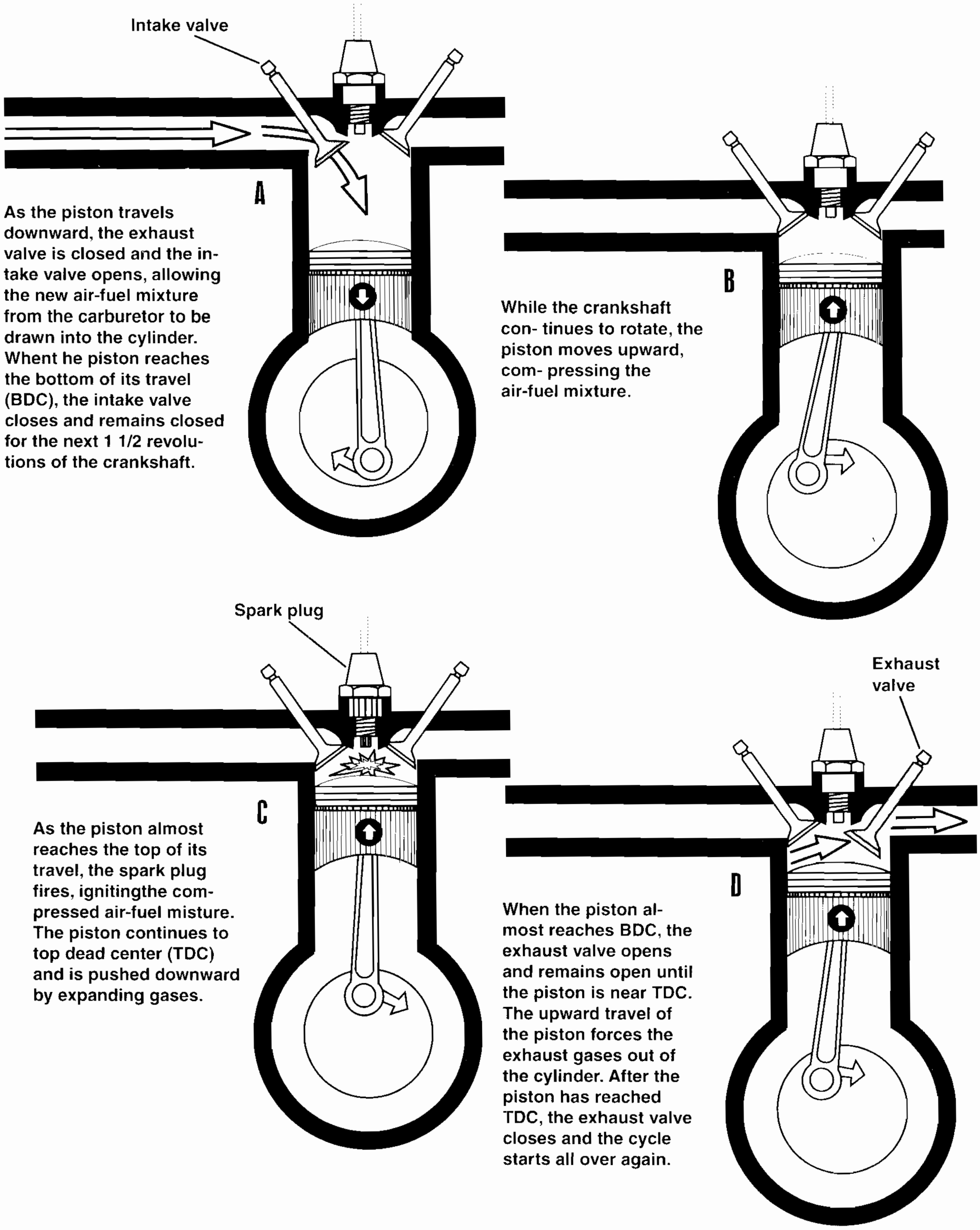
FOUR-STROKE GASOLINE OPERATING PRINCIPLES

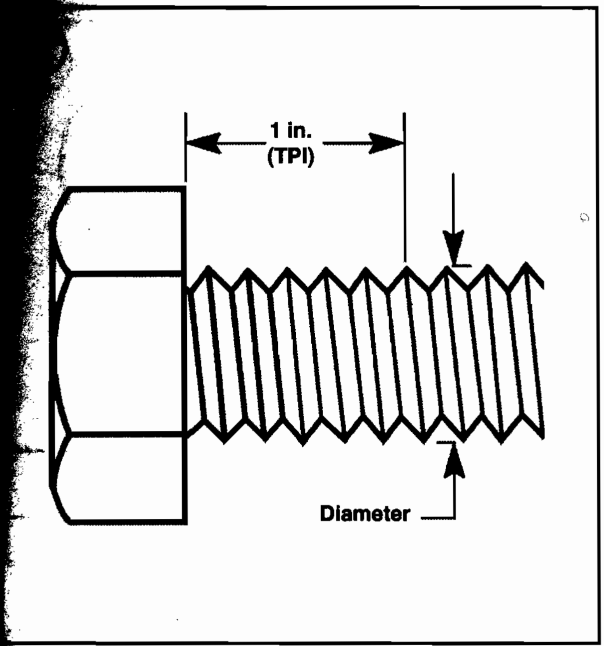


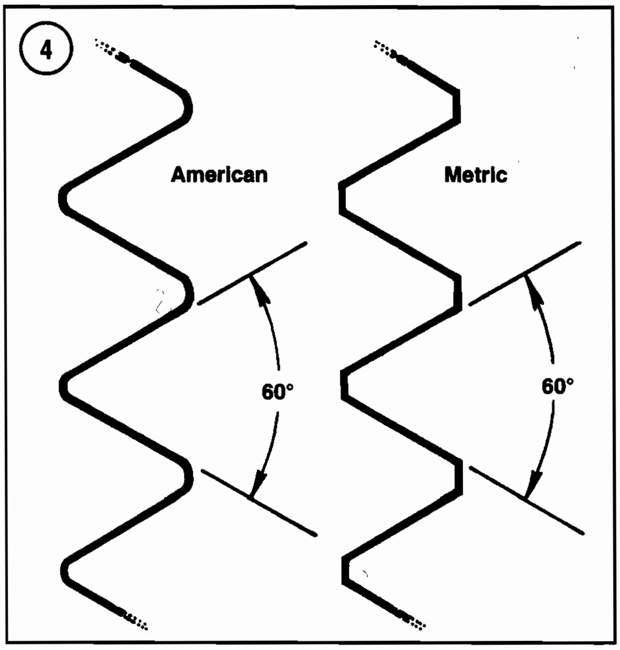
A. As the piston travels downward, the exhaust valve is closed and the intake valve opens, allowing the new air-fuel mixture from the carburetor to be drawn into the cylinder. Whent he piston reaches the bottom of its travel (BDC), the intake valve closes and remains closed for the next 1 1/2 revolutions of the crankshaft.

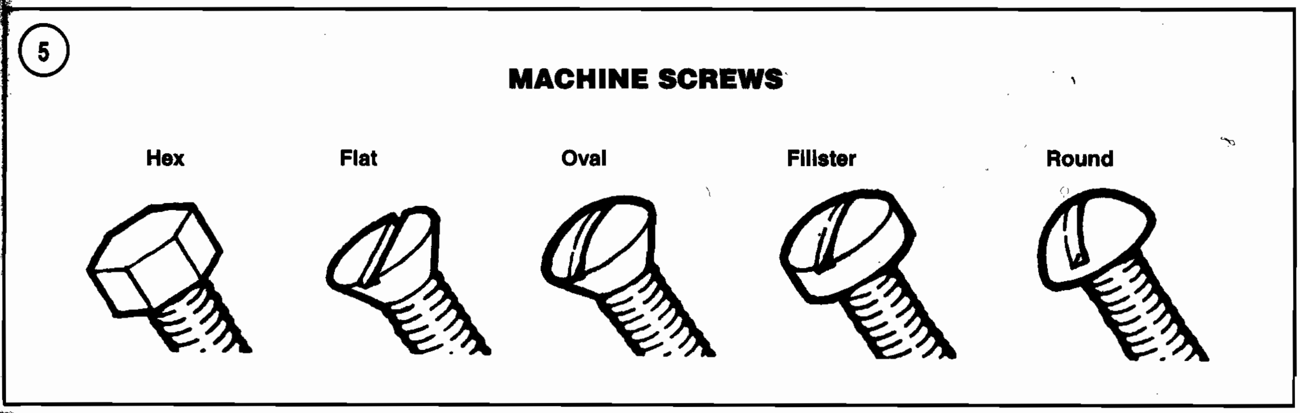
B. While the crankshaft con- tinues to rotate, the piston moves upward, com- pressing the air-fuel mixture.

C. As the piston almost reaches the top of its travel, the spark plug fires, ignitingthe compressed air-fuel misture. The piston continues to top dead center (TDC) and is pushed downward by expanding gases.

D. When the piston almost reaches BDC, the exhaust valve opens and remains open until the piston is near TDC. The upward travel of the piston forces the exhaust gases out of the cylinder. After the piston has reached TDC, the exhaust valve closes and the cycle starts all over again.







Thread direction

igure 3 shows the first two specifications. read pattern is more subtle. Italian and British ndards exist, but the most commonly used by rine equipment manufactures are American ndard and metric standard. The root and top the thread are cut differently as shown in **Fig- e 4.**

Most threads are cut so the fastener must be ned clockwise to tighten it. These are called ht-hand threads. Some fasteners have left-hand eads; they must be turned counterclockwise to hten. Left-hand threads are used in locations where normal rotation of the equipment would tend to loosen a right-hand threaded fastener. Assume all fasteners use right-hand threads unless the instructions specify otherwise.

Machine Screws

There are many different types of machine screws (**Figure 5**). Most are designed to protrude above the secured surface (rounded head) or be slightly recessed below the surface (flat head). In some applications the screw head is recessed well below the fastened sur-

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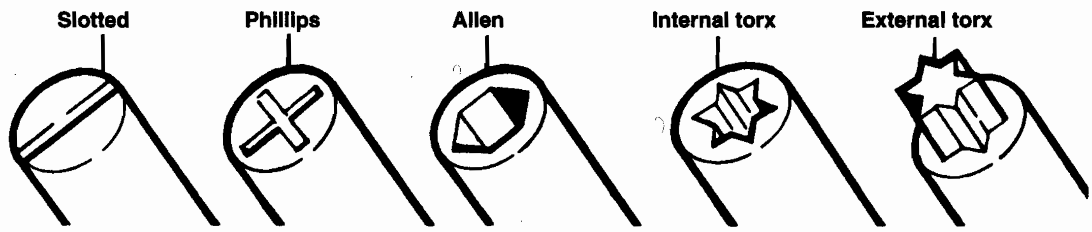
OPENINGS FOR TURNING TOOLS



face. **Figure 6** shows a number of screw heads requiring different types of turning tools.

Bolts

Commonly called bolts, the technical name for this fastener is cap screw. They are normally described by diameter, threads per inch and length. For example, 1/4-20 × 1 indicates a bolt 1/4 in. in diameter with 20 threads per inch, 1 in. long. The measurement across two flats of the bolt head indicates the proper wrench size required to turn the bolt.

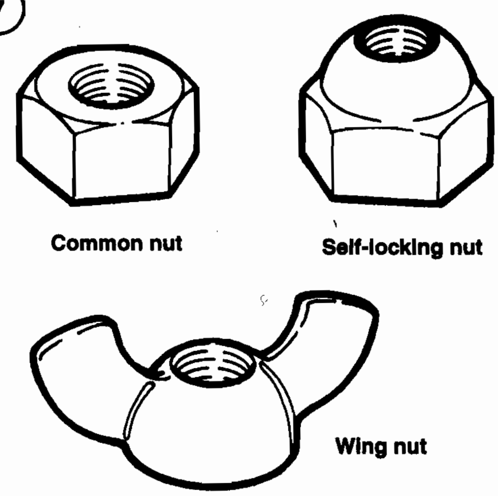
Nuts

Nuts are manufactured in a variety of types and sizes. Most are hexagonal (six-sides) and fit on bolts, screws and studs with the same diameter and threads per inch.

Figure 7 shows several types of nuts. The common nut is usually used with some type of lockwasher. Self-locking nuts have a nylon insert that helps prevent the nut from loosening; no lockwasher is required. Wing nuts are designed for fast removal by hand. Wing nuts are used for convenience in non-critical locations.

To indicate the size of a nut, manufactures specify the diameter of the opening and the threads per inch. This is similar to a bolt specification, but without the length dimension. The measurement across two flats of the nut indicates the wrench size required to turn the nut.

7



Washers

There are two basic types of washers: flat washers and lockwashers. A flat washer is a simple disc with a hole that fits the screw or bolt. Lockwashers are designed to prevent a fastener from working loose due to vibration, expansion and contraction. **Figure 8** shows several types of lockwashers. Note that flat washers are often

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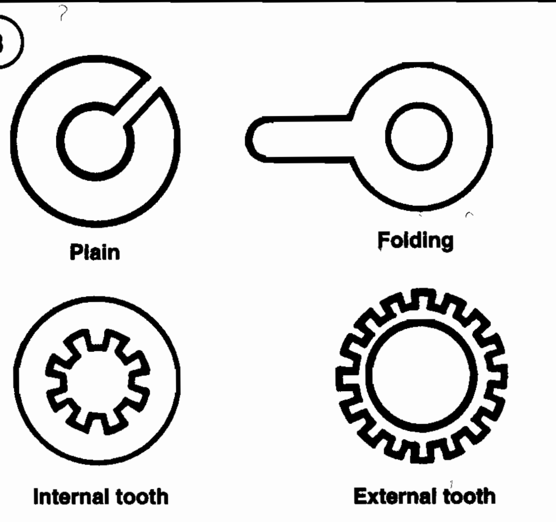

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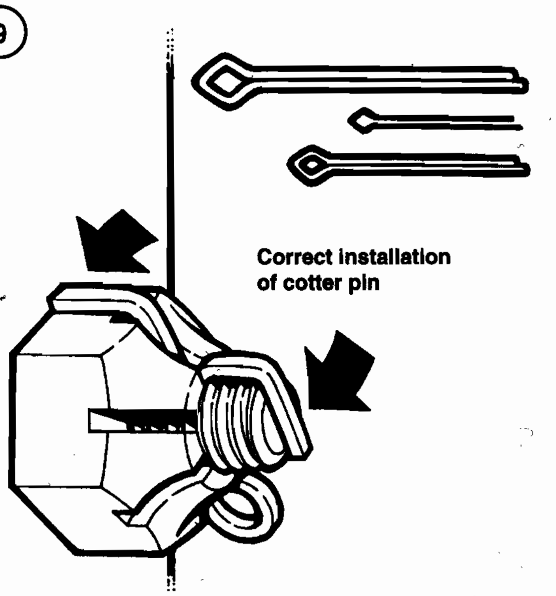

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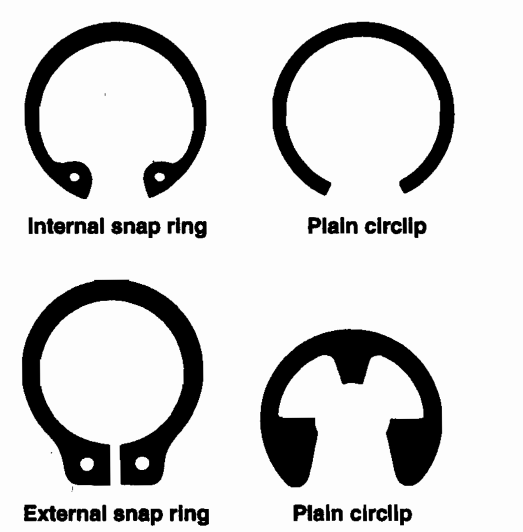

used between a lockwasher and a fastener to provide a smooth bearing surface. This allows the fastener to be turned easily with a tool.

Cotter Pins

In certain applications, a fastener must be secured so it cannot possibly loosen. The propeller nut on some marine drive systems is one such application. For this purpose, a cotter pin (**Figure 9**) and slotted or castellated nut is often used. To use a cotter pin, first make sure the pin fits snugly, but not too tight. Then, align a slot in the fastener with the hole in the bolt or axle. Insert the cotter pin through the nut and bolt or propeller shaft and bend the ends over to secure the cotter pin tightly. If the holes do not align, tighten the nut just enough to obtain the proper alignment. Unless specifically instructed to do so, never loosen the fastener to align the slot and hole. Because the cotter pin is weakened after installation and removal, never reuse a cotter pin. Cotter pins are available in several styles, lengths and diameters. Measure cotter pin length from the bottom of its head to the tip of its shortest prong.

Snap Rings

Snap rings (**Figure 10**) can be an internal or external design. They are used to retain components on shafts (external type) or inside openings (internal type). Snap rings can be reused if they are not distorted during removal. In some applications, snap rings of varying thickness (selective fit) can be selected to position or control end play of parts assemblies.

LUBRICANTS

Periodic lubrication helps ensure long service life for any type of equipment. It is especially important with marine equipment because it is exposed to salt, brackish or polluted water and other harsh environments. The type of lubricant used is just as important as the lubrication service itself, although in an emergency, the wrong type of lubricant is better than none at all. The following paragraphs describe the types of lubricants most often used on marine equipment. Be sure to follow the equipment manufacture's recommendations for the lubricant types.

Generally, all liquid lubricants are called *oil*. They may be mineral-based (including petroleum bases), natural-based (vegetable and animal bases), synthetic-based or emulsions (mixtures). *Grease* is lubricating oil that has a thickening compound added. The resulting material then usually enhanced with anticorrosion, antioxidant and extreme pressure (EP) additives. Grease is often classified by the type of thickener added; lithium and calcium soap are the most commonly used.

Two-stroke Engine Oil

Lubrication for a two-stroke engine is provided by oil mixed with the incoming air/fuel mixture. Some of the oil mist settles out in the crankcase, lubricating the crankshaft, bearings and lower end of the connecting rod. The rest of the oil enters the combustion chamber to lubricate the piston, rings and the cylinder wall. This oil is then burned along with the air/fuel mixture during the combustion process.

Engine oil must have several special qualities to work well in a two-stroke engine. It must mix easily and stay in suspension in gasoline. When burned, it cannot leave behind excessive deposits. It must also withstand the high operating temperature associated with two-stroke engines.

The National Marine Manufacturer's Association (NMMA) has set standards for oil used in two-stroke, water-cooled engines. This is the NMMA TC-W (two-cycle, water-cooled) grade. It indicates the oil's performance in the following areas:

1. Lubrication (preventing wear and scuffing).
2. Spark plug fouling.
3. Piston ring sticking.
4. Preignition.
5. Piston varnish.
6. General engine condition (including deposits).
7. Exhaust port blockage.
8. Rust prevention.
9. Mixing ability with gasoline.

In addition to oil grade, manufactures specify the ratio of gasoline and oil required during break-in and normal engine operation.

Gearcase Oil

Gearcase lubricants are assigned SAE viscosity numbers under the same system as four-stroke engine oil. Gearcase lubricant falls into the SAE 72-250 range. Some gearcase lubricants are multigrade. For example, SAE 80-90 is a common multigrade gear lubricant.

Three types of marine gearcase lubricants are generally available; SAE 90 hypoid gearcase lubricant is designed for older manual-shift units; type C gearcase lubricant contains additives designed for the electric shift mechanisms; high-viscosity gearcase lubricant is a heavier oil designed to withstand the shock loads of high performance engines or units subjected to severe duty use. Always use the gearcase lubricant specified by the manufacturer.

Grease

Greases are graded by the National Lubricating Grease Institute (NLGI). Greases are graded by number according to the consistency of the grease. These ratings range from No. 000 to No. 6, with No. 6 being the most solid. A typical multipurpose grease is NLGI No. 2. For specific applications, equipment manufactures may require grease with an additive such as molybdenum disulfide (MOS^2).

GASKET SEALANT

Gasket sealant is used instead of preformed gaskets on some applications, or as a gasket dressing on others. Three types of gasket sealant are commonly used: gasket sealing compound, room temperature vulcanizing (RTV) and anaerobic. Because these materials have different sealing properties, they cannot be used interchangeably.

Gasket Sealing Compound

This nonhardening liquid is used primarily as a gasket dressing. Gasket sealing compound is available in tubes or brush top containers. When exposed to air or heat it forms a rubber-like coating. The coating fills in small imperfections in gasket and sealing surfaces. Do not use gasket sealing compound that is old, has began to solidify or has darkened in color.

Applying Gasket Sealing Compound

Carefully scrape residual gasket material, corrosion deposits or paint from the mating surfaces. Use a blunt scraper and work carefully to avoid damaging the mating surfaces. Use quick drying solvent and a clean shop towel and wipe oil or other contaminants from the surfaces. Wipe or blow loose material or contaminants from the gasket. Brush a light coating on the mating surfaces and both sides of the gasket. Do not apply more compound than needed. Excess compound will be squeezed out as the surfaces mate and may contaminate other components. Do not allow compound into bolt or alignment pin holes

A hydraulic lock can occur as the bolt or pin compresses the compound, resulting in incorrect bolt torque.

RTV Sealant

This is a silicone gel supplied in tubes. Moisture in the air causes RTV to cure. Always place the cap on the tube as soon as possible if using RTV. RTV has a shelf life of approximately one year and will not cure properly after the shelf life expires. Check the expiration date on the tube and keep partially used tubes tightly sealed. RTV can generally fill gaps up to 1/4 in. (6.3 mm) and works well on slightly flexible surfaces.

Applying RTV Sealant

Carefully scrape all residual sealant and paint from the mating surfaces. Use a blunt scraper and work carefully to avoid damaging the mating surfaces. The mating surfaces must be absolutely free of gasket material, sealant, dirt, oil grease or other contamination. Lacquer thinner, acetone, isopropyl alcohol or similar solvents work well to clean the surfaces. Avoid using solvents with on oil, wax or petroleum base as they are not compatible with RTV compounds. Remove all sealant from bolt or alignment pin holes.

Apply RTV sealant in a continuous bead 0.08-0.12 in. (2-3 mm) thick. Circle all mounting bolt or alignment pin holes unless otherwise specified. Do not allow RTV sealant into bolt holes or other openings. A hydraulic lock can

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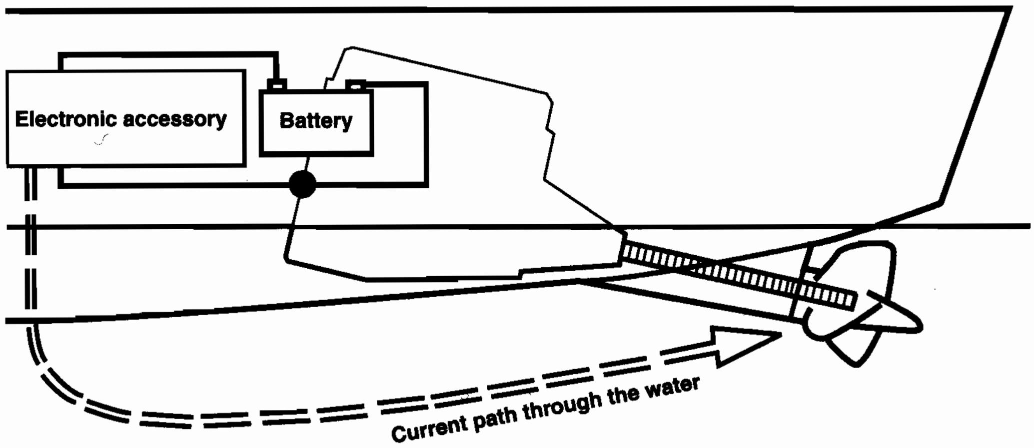

occur as the bolt or pin compresses the sealant, resulting in incorrect bolt torque. Tighten the mounting fasteners within 10 minutes after application.

Anaerobic Sealant

This is a gel supplied in tubes. It cures only in the absence of air, as when squeezed tightly between two machined mating surfaces. For this reason, it will not spoil if the cap is left off the tube. Do not use anaerobic sealant if one of the surfaces is flexible. Anaerobic sealant is able to fill gaps up to 0.030 in. (0.8 mm) and generally works best on rigid, machined flanges or surfaces.

Applying Anaerobic Sealant

Carefully scrape all residual sealant from the mating surfaces. Use a blunt scraper and work carefully to avoid damaging the mating surfaces. The mating surfaces must be absolutely free of gasket material, sealant, dirt, oil grease or other contamination. Lacquer thinner, acetone, isopropyl alcohol or similar solvents work well to clean the surfaces. Avoid using solvents with on oil, wax or petroleum base as they are not compatible with anaerobic compounds. Clean a sealant from the bolt or alignment pin holes. Apply anaerobic sealant in a 0.04 in. (1 mm) thick continuous bead onto one of the surfaces. Circle all bolt and alignment pin opening. Do not apply sealant into bolt holes or other openings. A hydraulic lock can occur as the bolt or pin compresses the sealant, resulting in incorrect bolt torque. Tighten the mounting fasteners within 10 minutes after application.

GALVANIC CORROSION

A chemical reaction occurs whenever two different types of metal are joined by an electrical conductor and immersed in an electrolytic solution such as water. Electrons transfer from one metal to the other through the electrolyte and return through the conductor.

The hardware on a boat is made of many different types of metal. The boat hull acts as a conductor between the metals. Even if the hull is wooden or fiberglass, the slightest film of water (electrolyte) on the hull provides conductivity. This combination creates a good environment for electron flow (**Figure 11**). Unfortunately, this electron flow results in galvanic corrosion of the metal involved, causing one of the metals to be corroded or eroded away. The amount of electron flow, and therefore the amount of corrosion, depends on several factors:

1. The types of metal involved.
2. The efficiency of the conductor.
3. The strength of the electrolyte.

Metals

The chemical composition of the metal used in marine equipment has a significant effect on the amount and speed of galvanic corrosion. Certain metals are more resistant to corrosion than others. These electrically negative metals are commonly called *noble*; they act as the cathode in any reaction. Metals that are more subject to corrosion are electrically positive; they act as the anode in a reaction. The more *noble* metals include titanium, 18-8 stainless steel and nickel. Less *noble* metals include zinc, aluminum and magnesium. Galvanic corrosion becomes more severe as the difference in electrical potential between the two metals increases.

In some cases, galvanic corrosion can occur within a single piece of metal. For example, brass is a mixture of zinc and copper, and, when immersed in an electrolyte, the zinc portion of the mixture will corrode away as a galvanic reaction occurs between the zinc and copper particles.

Conductors

The hull of the boat often acts as the conductor between different types of metal. Marine equipment, such as the drive unit can act as the conductor. Large masses of metal, firmly connected together, are more efficient conductors than water. Rubber mountings and vinyl-based paint can act as insulators between pieces of metal.

Electrolyte

The water in which a boat operates acts as the electrolyte for the corrosion process. The more efficient a conductor is, the more severe and rapid the corrosion will be.

Cold, clean freshwater is the poorest electrolyte. Pollutants increase conductivity; therefore, brackish or saltwater is an efficient electrolyte. This is one of the reasons that most manufacturers recommend a freshwater flush after operating in polluted, brackish or saltwater.

Protection From Galvanic Corrosion

Because of the environment in which marine equipment must operate, it is practically impossible to totally prevent galvanic corrosion. However, there are several ways in which the process can be slowed. After taking these precautions, the next step is to *fool* the process into occurring only where you want it to occur. This is the role of sacrificial anodes and impressed current systems.

Slowing Corrosion

Some simple precautions can help reduce the amount of corrosion taking place outside the hull. These precautions are not substitutes for the corrosion protection methods discussed under *Sacrificial Anodes* and *Impressed Current Systems* in this chapter, but they can help these methods reduce corrosion.

Use fasteners made of metal more noble than the parts they secure. If corrosion occurs, the parts they secure may suffer but the fasteners are protected. The larger secured parts are more able to withstand the loss of material. Also major problems could arise if the fasteners corrode to the point of failure.

Keep all painted surfaces in good condition. If paint is scraped off and bare metal exposed, corrosion rapidly increases. Use a vinyl- or plastic-based paint, which acts as an electrical insulator.

Be careful when applying metal-based antifouling paint to the boat. Do not apply antifouling paint to metal parts of the boat or the drive unit. If applied to metal surfaces, this type of paint reacts with the metal and results in corrosion between the metal and the layer of paint. Maintain a minimum 1 in. (25 mm) border between the painted surface and any metal parts. Organic-based paints are available for use on metal surfaces.

Where a corrosion protection device is used, remember that it must be immersed in the electrolyte along with the boat to provide any protection. If you raise the gearcase out of the water with the boat docked, any anodes on the gearcase may be removed from the corrosion process rendering them ineffective. Never paint or apply any coating to anodes or other protection devices. Paint or other coatings insulate them from the corrosion process.

Any change in the boat's equipment, such as the installation of a new stainless steel propeller, changes the electrical potential and may cause increased corrosion. Always consider this when adding equipment or changing exposed materials. Install additional anodes or other protection equipment as required ensuring the corrosion protection system is up to the task. The expense to repair corrosion damage usually far exceeds that of additional corrosion protection.

Sacrificial Anodes

Sacrificial anodes are specially designed to do nothing but corrode. Properly fastening such pieces to the boat causes them to act as the anode in any galvanic reaction that occurs; any other metal in the reaction acts as the cathode and is not damaged.

Anodes are usually made or zinc, a far from a noble material. Some anodes are manufactured of an aluminum and indium alloy. This alloy is less noble than the aluminum alloy in drive system components, providing the desired sacrificial properties. The aluminum and indium alloy is more resistant to oxide coating than zinc anodes. Oxide coating occurs as the anode material reacts with oxygen in the water. An oxide coating will insulate the anode, dramatically reducing corrosion protection.

Anodes must be used properly to be effective. Simply fastening anodes to the boat in random locations will not do the job.

First determine how much anode surface is required to adequately protect the equipment's surface area. A good starting point is provided by the Military Specification MIL-A-818001, which states that one square inch of new anode protects either:

1. 800 square inches of freshly painted steel.
2. 250 square inches of bare steel or bare aluminum alloy.
3. 100 square inches of copper or copper alloy.

This rule is valid for a boat at rest. If underway, additional anode area is required to protect the same surface area.

The anode must be in good electrical contact with the metal that it protects. If possible, attach an anode to all metal surfaces requiring protection.

Good quality anodes have inserts around the fastener holes that are made of a more noble material. Otherwise, the anode could erode away around the fastener hole, allowing the anode to loosen or possibly fall off, thereby loosing needed protection.

Impressed Current System

An impressed current system can be added to any boat. The system generally consists of the anode, controller and reference electrode. The anode in this system is coated with a very noble

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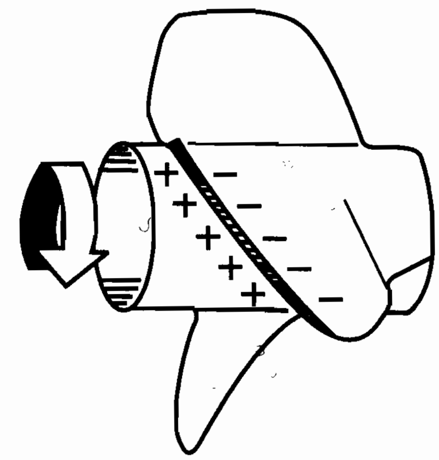


metal, such as platinum, so that it is almost corrosion-free and can last almost indefinitely. The reference electrode, under the boat's waterline, allows the control module to monitor the potential for corrosion. If the module senses that corrosion is occurring, it applies positive battery voltage to the anode. Current then flows from the anode to all other metal component, regardless of how noble or non-noble these components may be. Essentially, the electrical current from the battery counteracts the galvanic reaction to dramatically reduce corrosion damage.

Only a small amount of current is needed to counteract corrosion. Using input from the sensor, the control module provides only the amount of current needed to suppress galvanic corrosion. Most systems consume a maximum of 0.2 Ah at full demand. Under normal conditions, these systems can provide protection for 8-12 weeks without recharging the battery. Remember that this system must have constant connection to the battery. Often the battery supply to the system is connected to a battery switching device causing the operator to inadvertently shut off the system while docked.

An impressed current system is more expensive to install than sacrificial anodes but, considering it low maintenance requirements and the superior protection it provides, the long term cost may be lower.

PROPELLERS

The propeller is the final link between the boat's drive system and the water. A perfectly maintained engine and hull are useless if the propeller is the wrong type, is damaged or is deteriorated. Although propeller selection for a specific application is beyond the scope of this manual, the following provides the basic information needed to make an informed decision. The professional at a reputable marine dealership is the best source for a propeller recommendation.

How a Propeller Works

As the curved blades of a propeller rotate through the water, a high-pressure area forms on one side of the blade and a low-pressure area forms on the other side of the blade (**Figure 12**). The propeller moves toward the low-pressure area, carrying the boat with it.

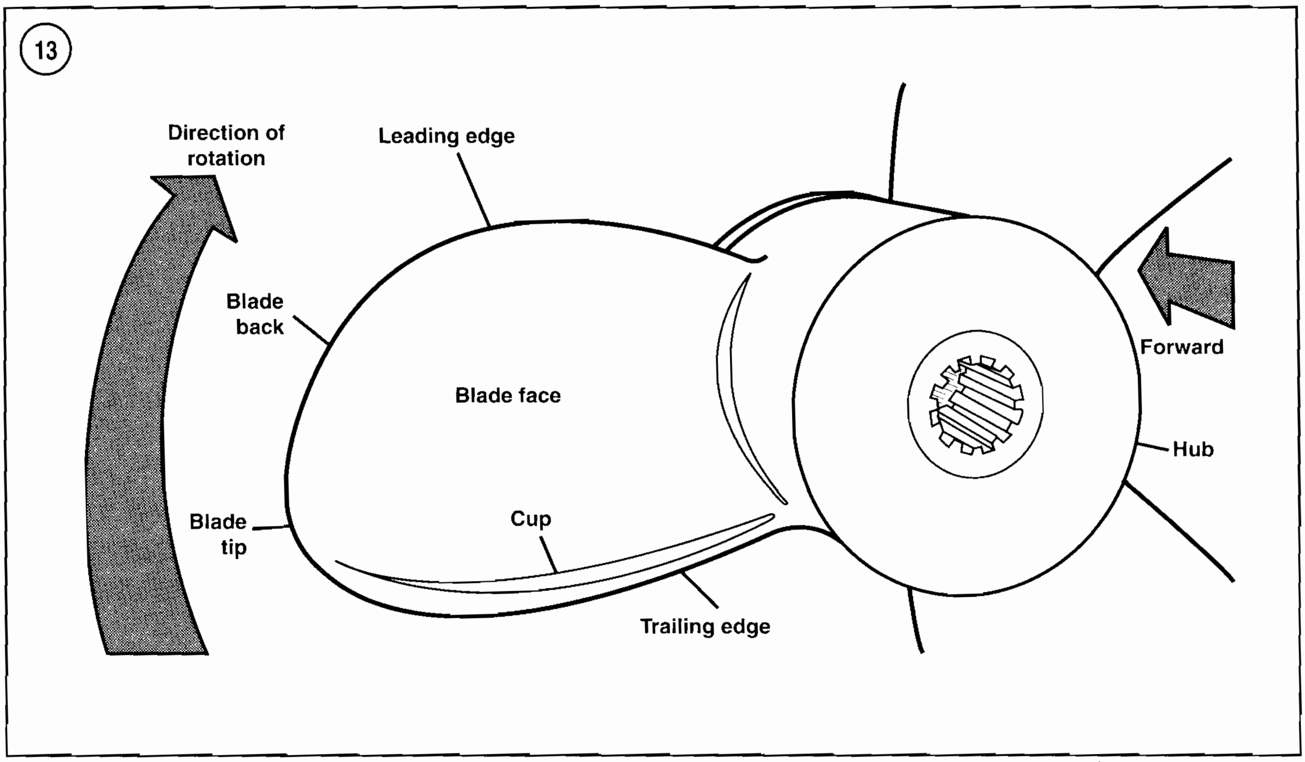
Propeller Parts

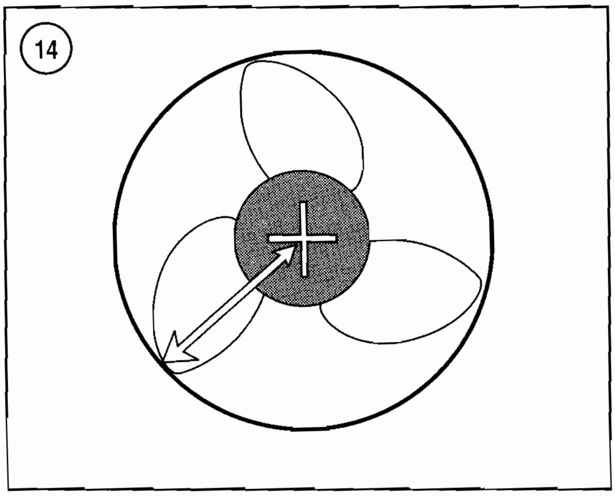
Although a propeller is usually a one-piece unit, it is made of several different parts (**Figure 13**). Variations in the design of these parts make different propellers suitable for different applications.

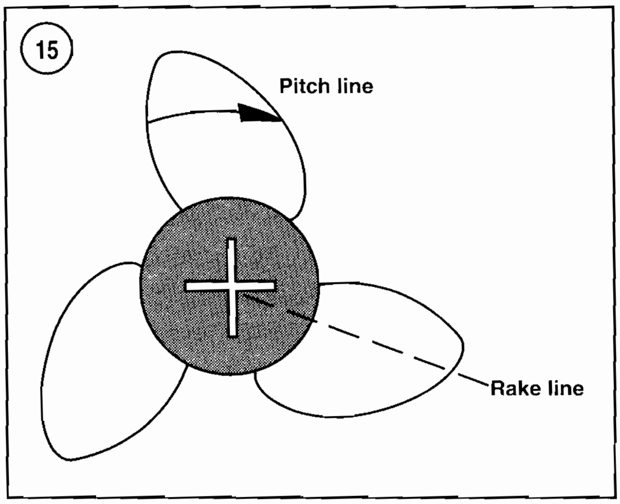
The blade tip is the point of the blade furthest from the center of the propeller hub or propeller shaft bore. The blade tip separates the leading edge from the trailing edge.

The leading edge is the edge of the blade nearest the boat. During forward operation, this is the area of the blade that first cuts through the water.

The trailing edge is the surface of the blade furthest from the boat. During reverse operation,







this is the area of the blade that first cuts through the water.

The blade face is the surface of the blade that faces away from the boat. During forward operation, high-pressure forms on this side of the blade.

The blade back is the surface of the blade that faces toward the boat. During forward gear operation, low-pressure forms on this side of the blade.

The cup is a small curve or lip on the trailing edge of the blade. Cupped propeller blades generally perform better than non-cupped propeller blades.

The hub is the center portion of the propeller. It connects the blades to the propeller shaft. On most drive systems, engine exhaust is routed through the hub; in this case, the hub is made up of an outer and inner portion, connected by ribs.

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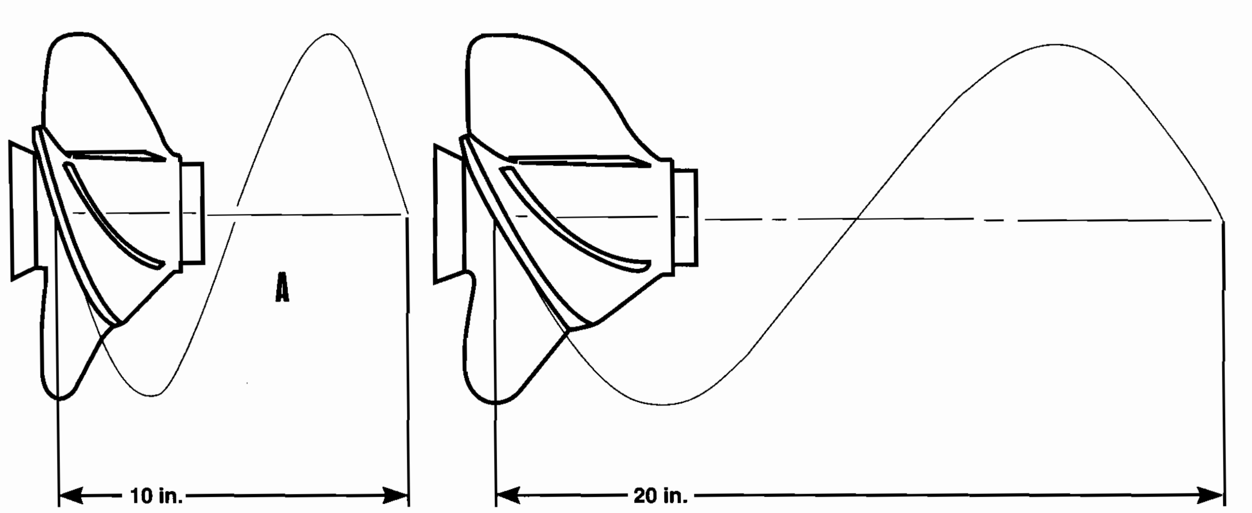


The diffuser ring is used on though- hub exhaust models to prevent exhaust gasses from entering the blade area.

Propeller Design

Changes in length, angle, thickness and material of propeller parts make different propellers suitable for different applications.

...meter

Propeller diameter is the distance from the center of the hub to the blade tip, multiplied by two. Essentially it is the diameter of the circle ...rmed by the blade tips during propeller rota... (**Figure 14**).

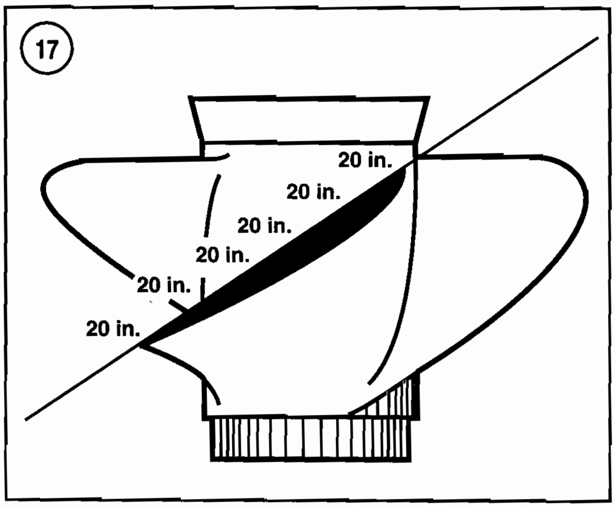
...and rake

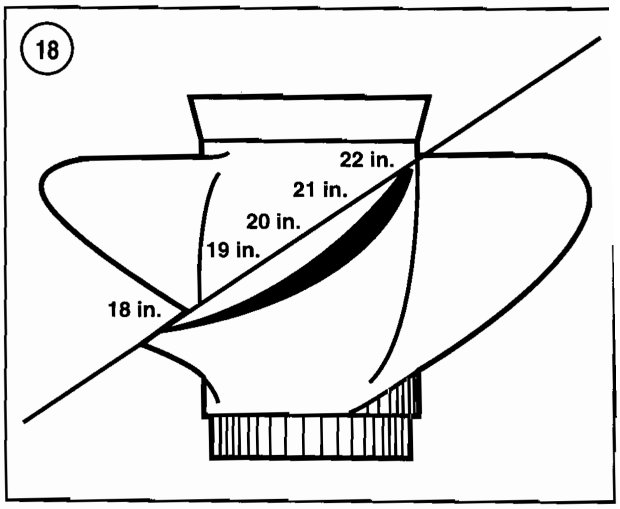
...eller pitch and rake describe the placement ...blades in relation to the hub (**Figure 15**).

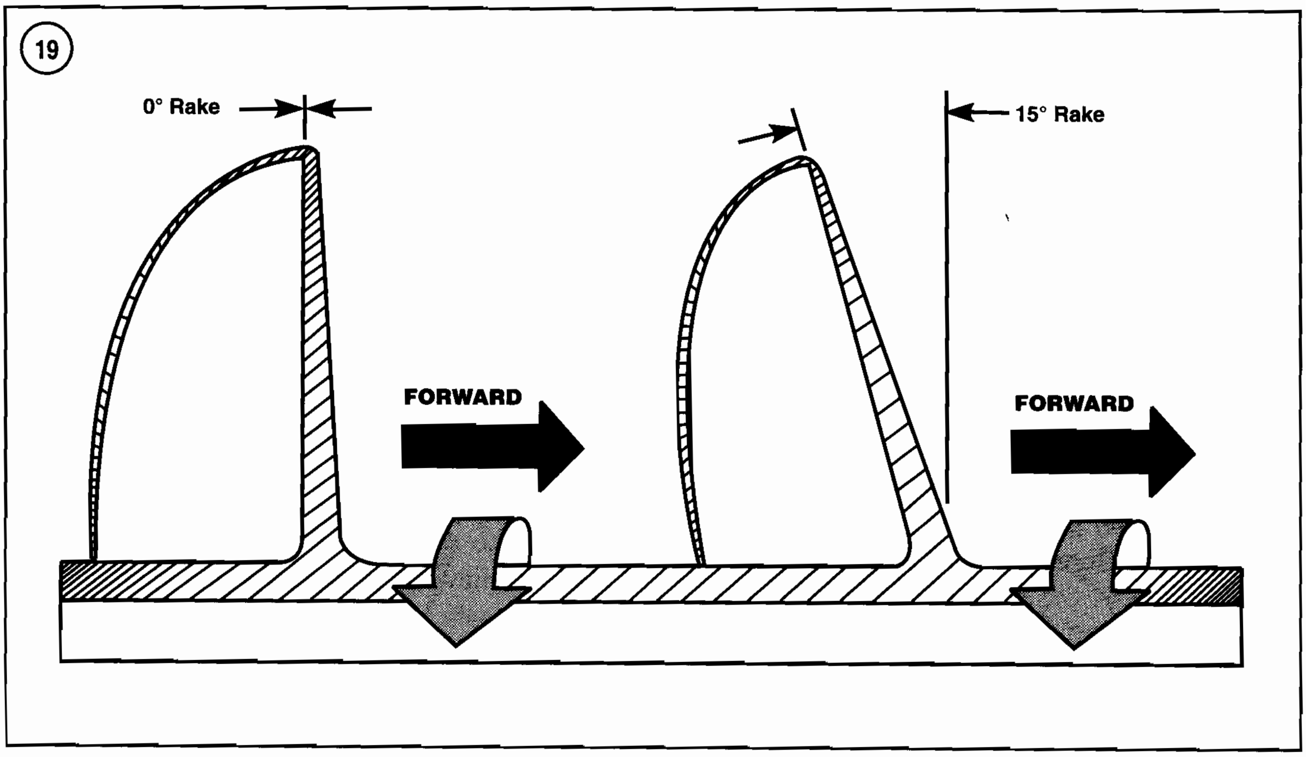
Pitch describes the theoretical distance the propeller would travel in one revolution. In A, **Figure 16**, the propeller would travel 10 inches in one revolution. In B, **Figure 16**, the propeller would travel 20 inches in one revolution. This distance is only theoretical; during operation, the propeller achieves only 75-85% of its pitch. Slip rate describes the difference in actual travel relative to the pitch. Lighter, faster boats typically achieve a lower slip rate than heavier, slower boats.

Propeller blades can be constructed with constant pitch (**Figure 17**) or progressive pitch (**Figure 18**). On a progressive propeller, the pitch starts low at the leading edge and increases toward the trailing edge. The propeller pitch specification is the average of the pitch across the entire blade. Propellers with progressive pitch usually provide better overall performance than constant pitch propellers.

Blade rake is specified in degrees and is measured along a line from the center of the hub to the blade tip. A blade that is perpendicular to the



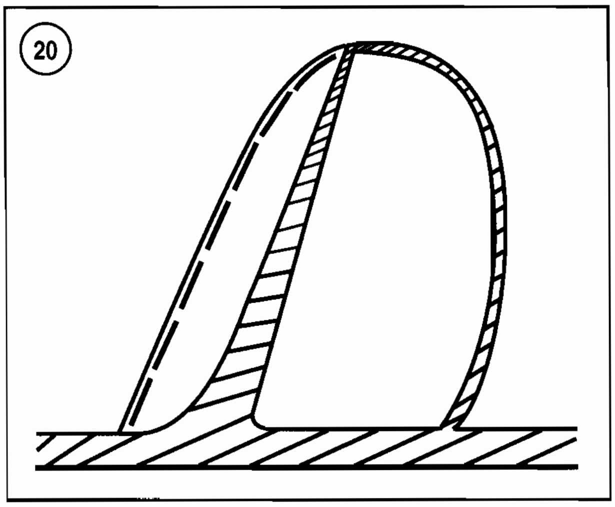


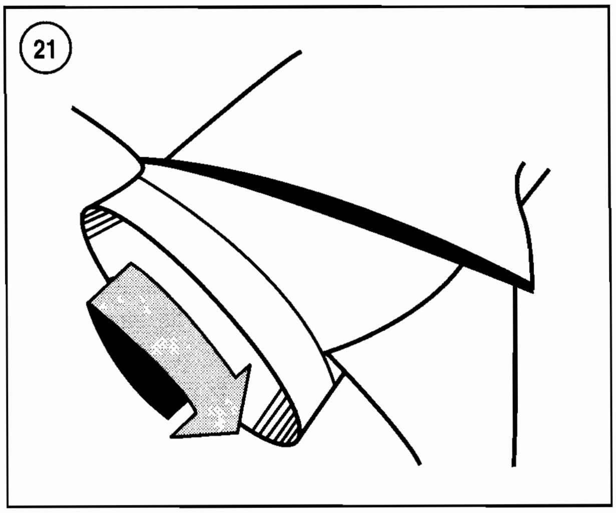


hub (**Figure 19**) has 0° rake. A blade that is angled from perpendicular (**Figure 19**) has a rake expressed by its difference from perpendicular. Most propellers have rakes ranging from 0-20°. Lighter faster boats generally perform better with propeller with a greater amount of rake. Heavier, slower boats generally perform better using a propeller with less rake.

Blade thickness

Blade thickness in not uniform at all points along the blade. For efficiency, blades are as thin a possible at all points while retaining enough strength to move the boat. Blades are thicker where they meet the hub and thinner at the blade tips (**Figure 20**). This is necessary to support the

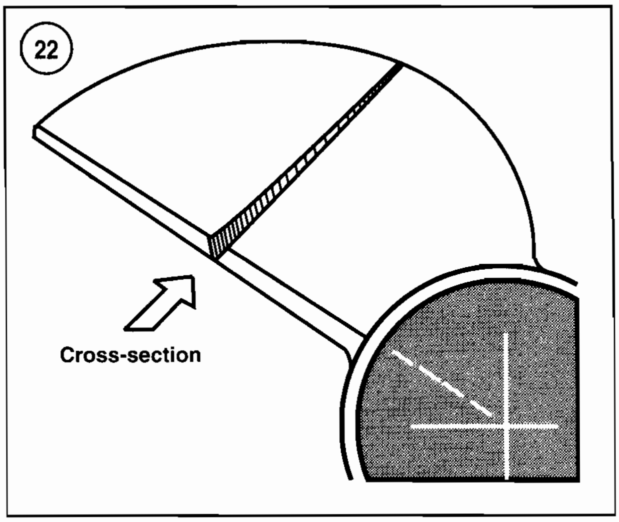




heavier loads at the hub section of the blade. Overall blade thickness is dependent on the strength of the material used.

When cut along a line from the leading edge to the trailing edge in the central portion of the blade (**Figure 21**), the propeller blade resembles and airplane wing. The blade face, where high-pressure exists during forward rotation, is almost flat. The blade back, where low-pressure exists during forward rotation, is curved, with the thinnest portions at the edges and the thickest portion at the center.

Propellers that run only partially submerged, as in racing applications, may have a wedge



shaped cross-section (**Figure 22**). The leading edge is very thin and the blade thickness increases toward the trailing edge, where it is thickest. If a propeller such as this is run totally submerged, it is very inefficient.

Number of blades

The number of blades used on a propeller is a compromise between efficiency and vibration. A one-bladed propeller would the most efficient, but it would create an unacceptable amount of vibration. As blades are added, efficiency decreases, but so does vibration. Most propellers have three or four blades, representing the most practical trade-off between efficiency and vibration.

Material

Propeller materials are chosen for strength, corrosion resistance and economy. Stainless steel, aluminum, plastic and bronze are the most commonly used materials. Bronze is quite strong but rather expensive. Stainless steel is more common than bronze because of its combination of strength and lower cost. Aluminum alloy and plastic materials are the least expensive

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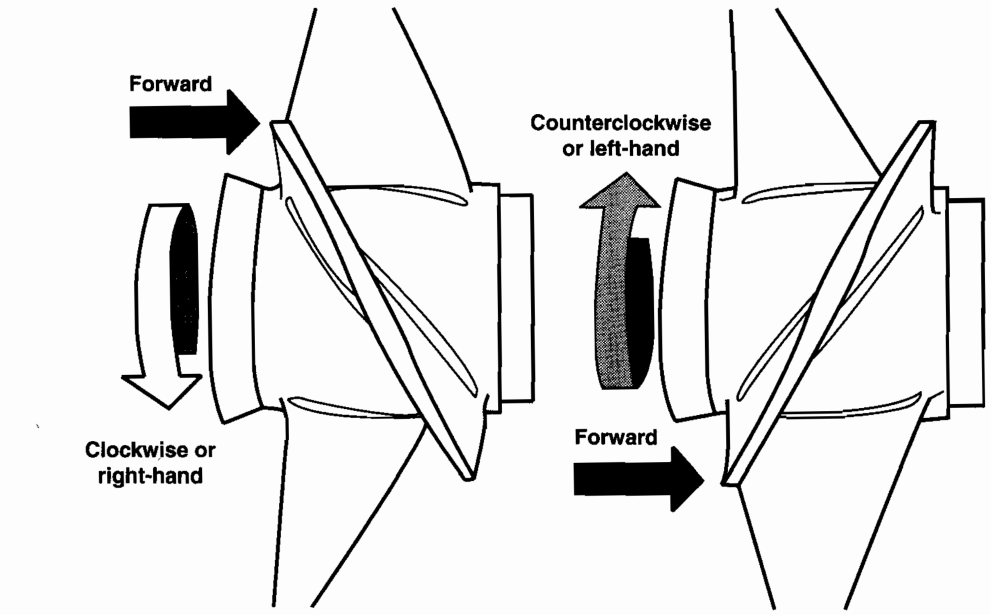


but usually lack the strength of stainless steel. Plastic propellers are more suited for lower horsepower applications.

Direction of rotation

Propellers are made for both right-hand and left hand rotations although right-hand is the most commonly used. As viewed from the rear of the boat while in forward gear, a right-hand propeller turns clockwise and a left-hand propeller turns counterclockwise. Off the boat, the direction of rotation is determined by observing the angle of the blades (**Figure 23**). A right-hand propeller's blade slant from the upper left to the lower right; a left-hand propeller's blades are opposite.

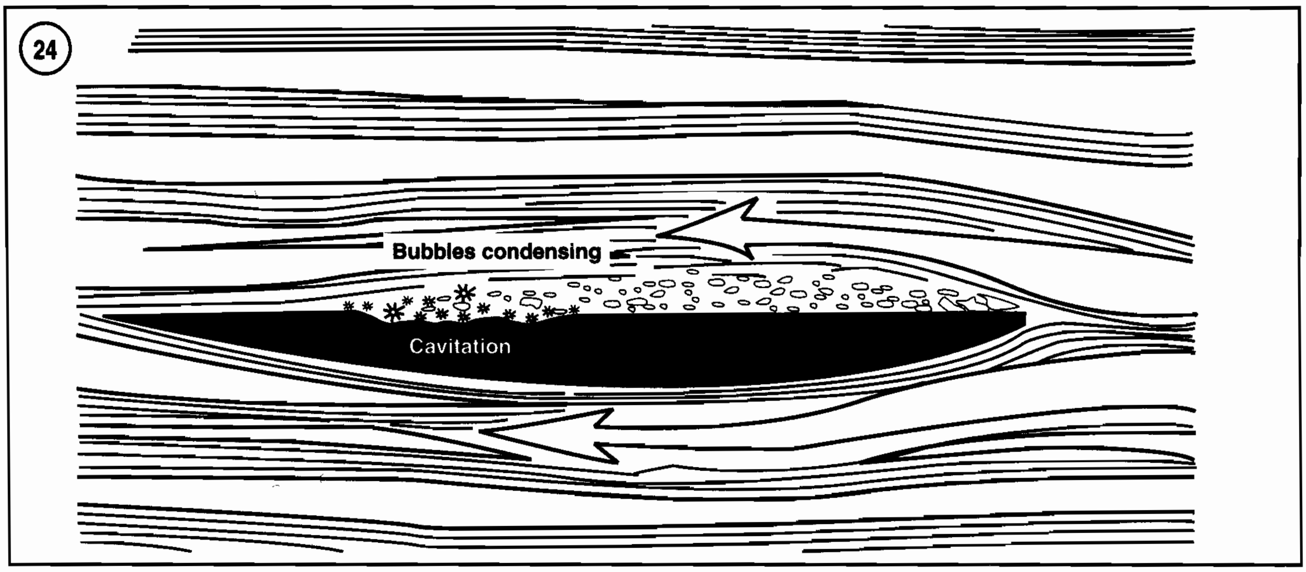
Cavitation and Ventilation

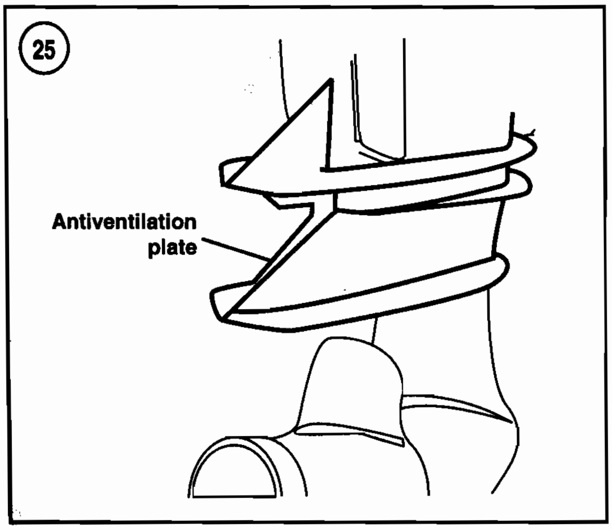
Cavitation and ventilation are *not* interchangeable terms; they refer to two distinct problems encountered during propeller operation.

To help understand cavitation, consider the relationship between pressure and the boiling point of water. At sea level, water boils at 212° F (100° C). As pressure increases, such as within an engine cooling system, the boiling point of the water increases—it boils at a temperature higher than 212° F (100° C). The opposite is also true. As pressure decreases, water boils at a temperature lower than 212° F (100° C). It the pressure drops low enough, water will boil at normal room temperature.

During normal propeller operation, low pressure forms on the blade back. Normally the pressure does not drop low enough for boiling to occur. However, poor propeller design, damaged blades or using the wrong propeller can cause unusually low pressure on the blade surface (**Figure 24**). If the pressure drops low enough, boiling occurs and bubbles form on the blade surfaces. As the boiling water moves to a higher pressure area of the blade, the boiling ceases and the bubbles collapse. The collapsing bubbles release energy that erodes the surface of the propeller blade.

Corroded surfaces, physical damage or even marine growth combined with high-speed operation can cause low pressure and cavitation on gearcase surfaces. In such cases, low pressure





forms as water flows over a protrusion or rough surface. The boiling water forms bubbles that collapse as they move to a higher pressure area toward the rear of the surface imperfection.

This entire process of pressure drop, boiling and bubble collapse is called *cavitation*. The ensuing damage is called *cavitation burn*. Cavitation is caused by a decrease in pressure, not an increase in temperature.

Ventilation is not as complex a process as cavitation. Ventilation refers to air entering the blade area, either from above the water surface or from a though-hub exhaust system. As the blades meet the air, the propeller momentarily looses it bite with the water and subsequently loses most of its thrust. An added complication is that the propeller and engine over-rev, causing very low pressure on the blade back and massive cavitation.

Most marine drive systems have a plate (**Figure 25**) above the propeller designed to prevent surface air from entering the blade area. This plate is correctly called an *anti-ventilation plate*, although it is often incorrectly called an *anticavitation plate*.

Most propellers have a flared section at the rear of the propeller called a diffuser ring. This feature forms a barrier, and extends the exhaust passage far enough aft to prevent the exhaust gases from ventilating the propeller.

A close fit of the propeller to the gearcase is necessary to keep exhaust gasses from exiting and ventilating the propeller. Using the wrong propeller attaching hardware can position the propeller too far aft, preventing a close fit. The wrong hardware can also allow the propeller to rub heavily against the gearcase, causing rapid wear to both components. Wear or damage to these surfaces will allow the propeller to ventilate.

Chapter Two

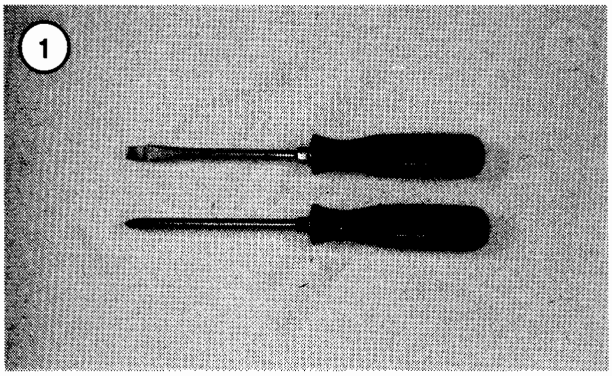
Tools and Techniques

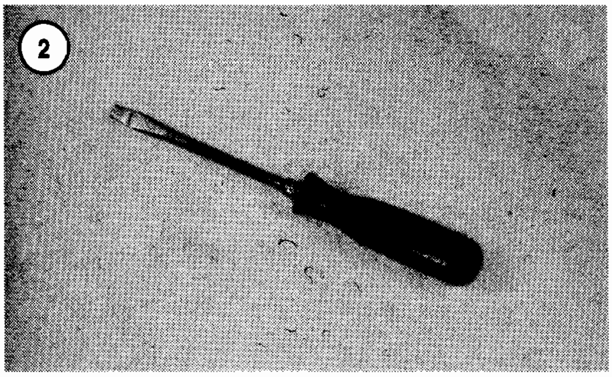
This chapter describes the common tools required for marine engine repair and troubleshooting. Techniques that make the work easier and more effective are also described. Some of the procedures in this book require special skills or expertise; it some cases it is better to entrust the job to a specialist or qualified dealership.

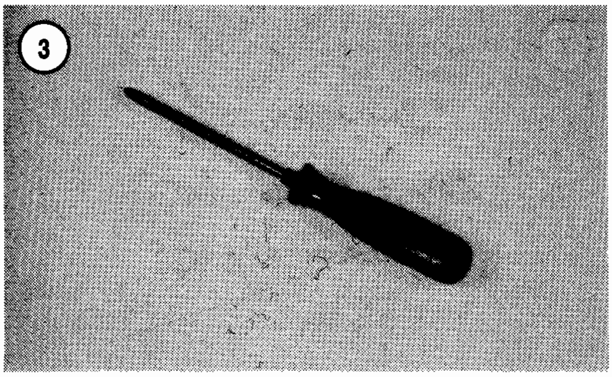
SAFETY FIRST

Professional mechanics can work for years and never suffer a serious injury. Avoiding injury is as simple as following a few rules and using common sense. Ignoring the rules can of often does lead to physical injury and/or damaged equipment.

1. Never use gasoline as a cleaning solvent.
2. Never smoke or use a torch near flammable liquids, such as cleaning solvent. Dirty or solvent soaked shop towels are extremely flammable. If working in a garage, remember that most home gas appliances have pilot lights.
3. Never smoke or use a torch in an area where a battery is being charged. Highly explosive hydrogen gas is formed during the charging process.
4. Use the proper size wrench to avoid damaged fasteners and bodily injury.
5. If loosening a tight or stuck fastener, consider what could happen if the wrench slips. Protect yourself accordingly.
6. Keep the work area clean, uncluttered and well lighted.
7. Wear safety goggles while using any type of tool. This is especially important when drilling, grinding or using a cold chisel.
8. Never use worn or damaged tools.
9. Keep a Coast Guard approved fire extinguisher handy. Ensure it is rated for gasoline (Class B) and electrical (Class C) fires.







BASIC HAND TOOLS

A number of tools are required to maintain and repair a marine engine. Most of these tools are also used for home and automobile repair. Some tools are made especially for working on marine engines; these tools can be purchased from a marine dealership. Having the required tools always makes the job easier and more effective.

Keep the tools clean and in a suitable box. Keep them organized with related tools stored together. After using a tool, wipe it clean using a shop towel.

The following tools are required to perform virtually any repair job. Each tool is described and the recommended size given for starting a tool collection. Additional tools and some duplication may be added as you become more familiar with the equipment. You may need all U.S. standard tools, all metric size tools or a mixture of both.

Screwdrivers

A screwdriver (**Figure 1**) is a very basic tool, but if used improperly can do more damage than good. The slot on a screw has a definite dimension and shape. Always select a screwdriver that conforms to the shape of the screw. Use a small screwdriver for small screws and a large one for large screws or the screw head are damaged.

Three types of screwdrivers are commonly required: a slotted (flat-blade) screwdriver (**Figure 2**), Phillips screwdriver (**Figure 3**) and Torx screwdriver (**Figure 4**).

Screwdrivers are available in sets, which often include an assortment of slotted Phillips and Torx blades. If you buy them individually, buy at least the following:

a. Slotted screwdriver—5/16 × 6 in. blade.
b. Slotted screwdriver—3/8 × 12 in. blade.
c. Phillips screwdriver—No. 2 tip, 6 in. blade.

d. Phillips screwdriver—No. 3 tip, 6 in. blade.
e. Torx screwdriver—T15 tip, 6 in. blade.
f. Torx screwdriver—T20 tip, 6 in. blade.
g. Torx screwdriver—T25 tip, 6 in. blade.

Use screwdrivers only for driving screws. Never use a screwdriver for prying or chiseling. Do not attempt to remove a Phillips, Torx or Allen head screw with a slotted screwdriver; you can damage the screw head so that even the proper tool is unable to remove it.

Keep the tip of a slotted screwdriver in good condition. Carefully grind the tip to the proper size and taper if it is worn or damaged. The sides of the blade must be parallel and the blade tip must be flat. Replace a Phillips or Torx screwdriver if its tip is worn or damaged.

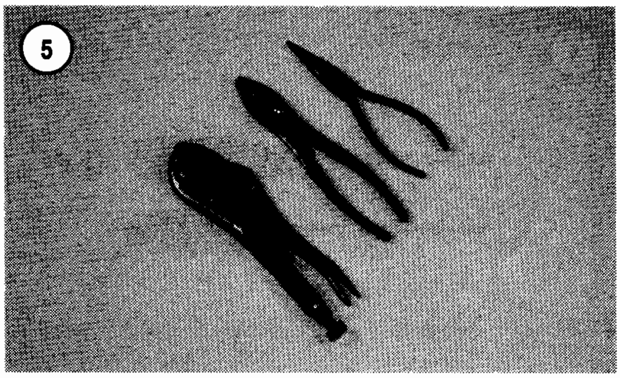
Pliers

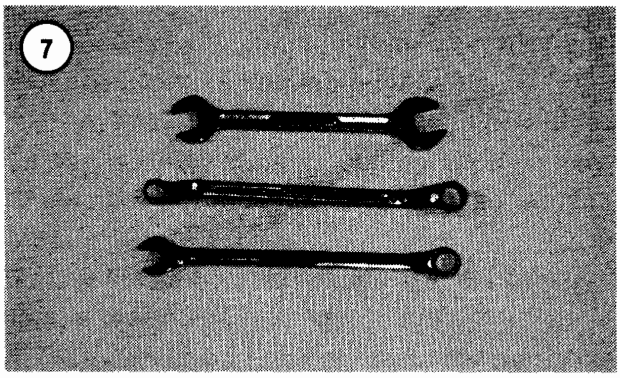
Pliers come in a wide range of types and sizes. Pliers are useful for cutting, gripping, bending and crimping. Never use pliers to cut hardened objects or turn bolts or nuts. **Figure 5** shows several types of pliers.

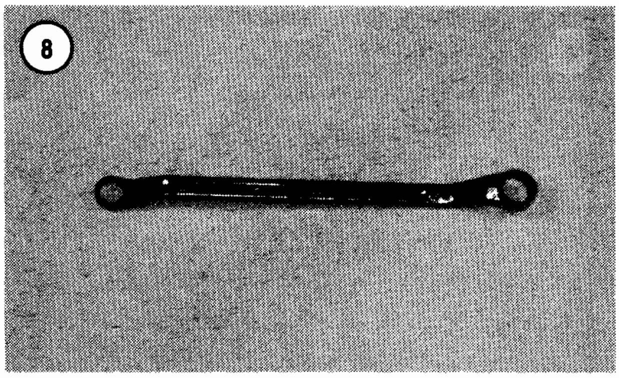
Each type of pliers has a specialized function. General-purpose pliers are mainly used for gripping and bending. Locking pliers are used for gripping objects very tightly, like a vise. Use needlenose pliers to grip or bend small objects. Adjustable or slip-joint pliers (**Figure 6**) can be adjusted to grip various sized objects; the jaws remain parallel for gripping objects such as pipe or tubing. There are many more types of pliers. The ones described here are the most common.

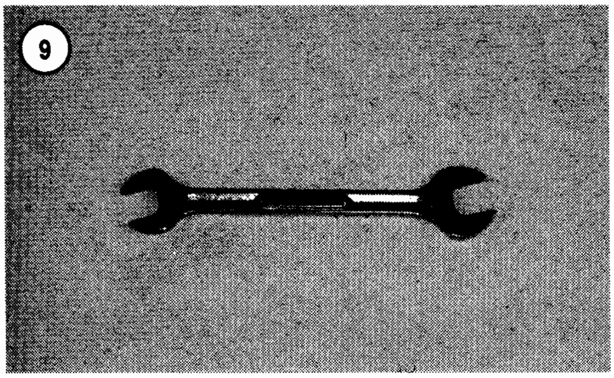
Box-end and Open-end Wrenches

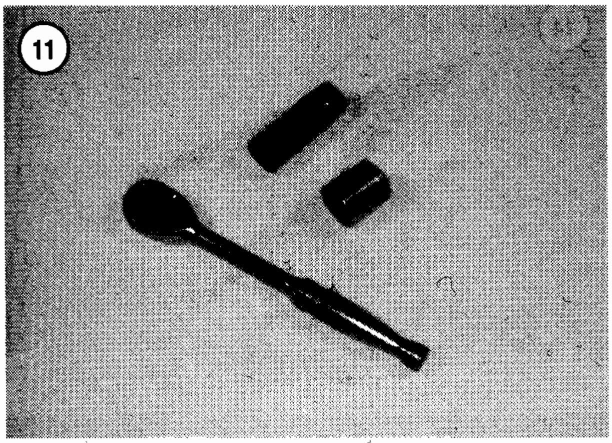
Box-end and open-end wrenches (**Figure 7**) are available in sets in a variety of sizes. The number stamped near the end of the wrench refers to the distance between two parallel flats on the hex head bolt or nut.











Box-end wrenches (**Figure 8**) provide a better grip on the nut and are stronger than open end wrenches. An open-end wrench (**Figure 9**) grips the nut on only two flats. Unless it fits well, it may slip and round off the points on the nut. A box-end wrench grips all six flats. Box-end wrenches are available with six-point or 12 point openings. The six-point opening provides superior holding power; the 12-point allow a shorter swing if working in tight quarters.

Use an open-end wrench if a box-end wrench cannot be positioned over the nut or bolt. To prevent damage to the fastener, avoid using and open-end wrench if a large amount of tightening or loosening toque is required.

A combination wrench has both a box-end and open- end. Both ends are the same size.

Adjustable Wrenches

An adjustable wrench (**Figure 10**) can be adjusted to fit virtually any nut or bolt head. However, it can loosen and slip from the nut or bolt, causing damage to the nut and possible physical injury. Use an adjustable wrench only if a proper size open-emd or box-end wrench in not available. Avoid using an adjustable wrench if a large amount of tightening or loosening torque is required.

Adjustable wrenches come in sized ranging from 4-18 in. overall length. A 6 or 8 in. size is recommended as an all-purpose wrench.

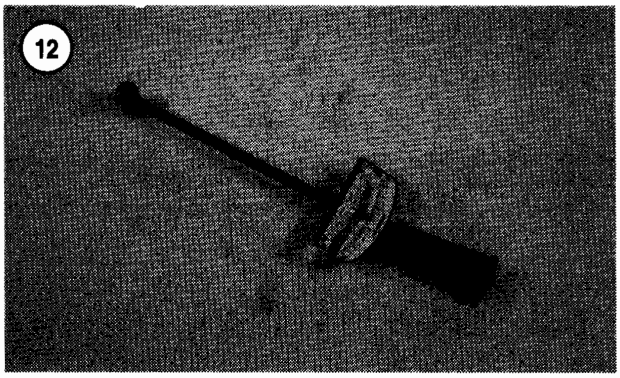
Socket Wrenches

A socket wrench (**Figure 11**) is generally faster, safer and more convenient to use than a common wrench. Sockets, which attach to a suitable handle, are available with six-point or 12-point openings and use 1/4, 3/8, and 1/2 in. drive sizes. The drive size corresponds to the square hole that mates with the ratchet or flex handle.

Torque Wrench

A torque wrench (**Figure 12**) is used with a socket to measure how tight a nut or bolt is installed. They come in a wide price range and in 1/4, 3/8, and 1/2 in. drive sizes. The drive size corresponds to the square hole that mates with the socket.

A typical 1/4 in. drive torque wrench measures in in.-lb. increments, and has a range of 20-150 in.-lb. (2.2-17 Nm,). A typical 3/8 or ½ in. torque measures in ft.-lb. increments, and has a range of 10-150 ft.-lb. (14-203 Nm.).



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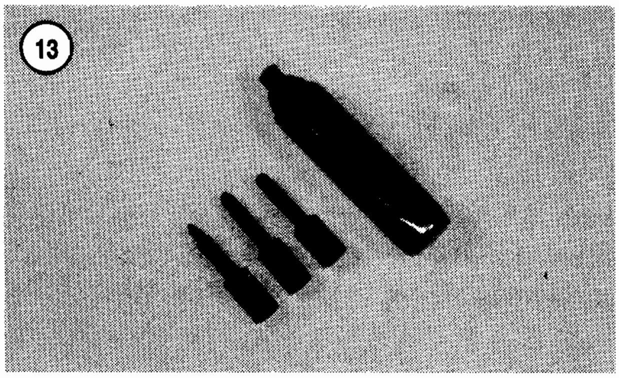
Impact Driver

An impact driver (**Figure 13**) makes removal of tight fasteners easy and reduces damage to bolts and screws. Interchangeable bits allow use on a variety of fasteners.



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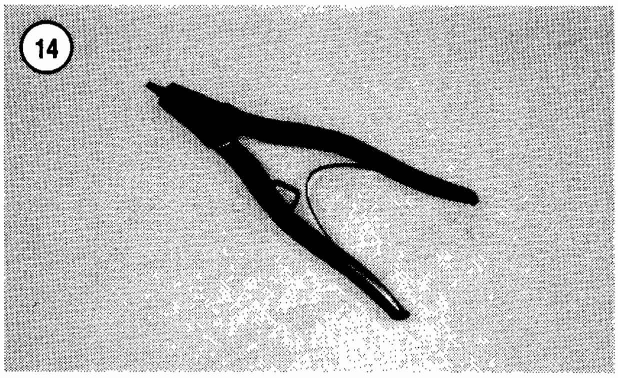
Circlip Pliers

Circlip (snap ring) pliers are required to remove circlips. Circlip pliers (**Figure 14**) usually come with different size tips; many designs can be switched to handle internal or external type circlips.



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Hammers

Various types of hammers (**Figure 15**) are available to accommodate a number of applications. Use a ball-peen hammer to strike another tool, such as a punch or chisel. Use a soft-face hammer to strike a metal object without damaging it.

Never use a metal-faced hammer on engine and drive system components as severe damage will occur. You can always produce the same amount of force with a soft-faced hammer.

Always wear eye protection when using hammers. Make sure the hammer is in good condition and that the handle is not cracked. Select the correct hammer for the job and always strike the object squarely. Do not use the handle or the side of the hammer head to stroke an object.

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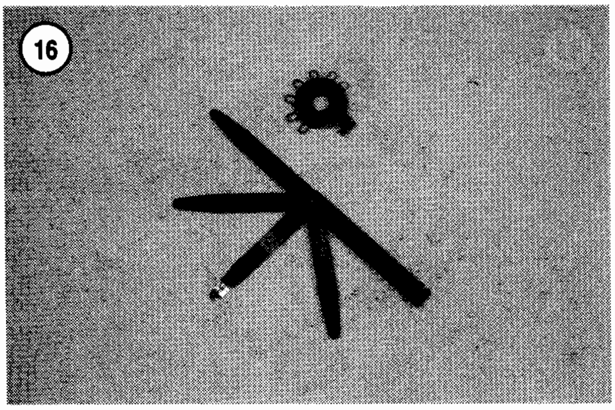
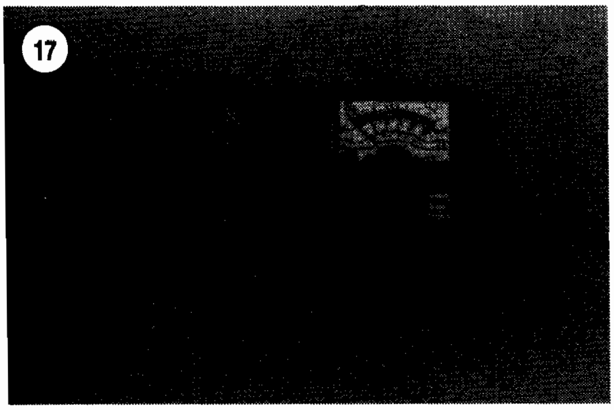
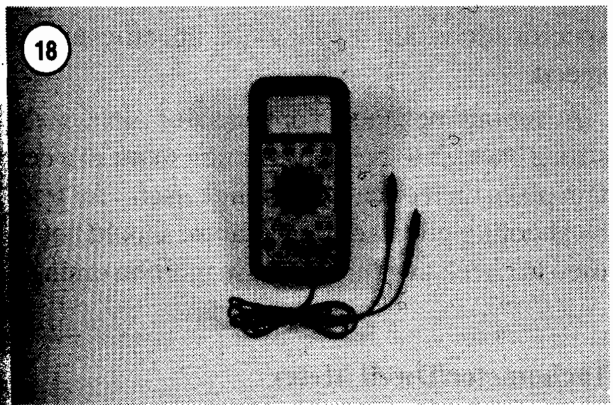






Feeler Gauges

This tool has either flat or wire measuring gauges (**Figure 16**). Use wire gauges to measure spark plug gap; use flat gauges for other measurements. A nonmagnetic (brass) gauge may be specified if working around magnetized components.

Other Special Tools

Many of the maintenance and repair procedures require special tools. Most of the necessary tools are available from a marine dealership or from tool suppliers. Instructions for their use and the manufacture's part number are included in the appropriate chapter.

Purchase the required tools from a local marine dealership or tool supplier. A qualified machinist, often at a lower price, can make some tools locally. Many marine dealerships and rental outlets will rent some of the required tools. Avoid using makeshift tools. Their use may result in damaged parts that cost far more than the recommended tool.

TEST EQUIPMENT

This section describes equipment used to perform testing, adjustments and measurements on marine engines. Most of these tools are available from a local marine dealership or automotive parts store.

Multimeter

This instrument is invaluable for electrical troubleshooting and service. It combines a voltmeter, ohmmeter and an ammeter in one unit. It is often called a VOM.

Two types of mutimeter are available, analog and digital. Analog meters (**Figure 17**) have a moving needle with marked bands on the meter face indicating the volt, ohm and amperage scales. An analog meter must be calibrated each time the scale is changed.

A digital meter (**Figure 18**) is ideally suited for electrical troubleshooting because it is easy to read and more accurate than an analog meter. Most models are auto-ranging, have automatic polarity compensation and internal overload protection circuits.

Either type of meter is suitable for most electrical testing described in this manual. An analog meter is better suited for testing pulsing voltage signals such as those produced by the ignition system. A digital meter is better suited for testing very low resistance or voltage reading (less than 1 volt or 1 ohm). The test procedure will indicate if a specific type of meter is required.

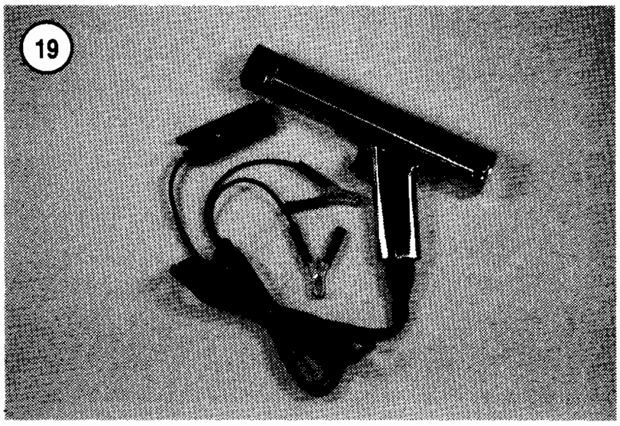
The ignition system produces electrical pulses that are too short in duration for accurate measurement with a using a conventional multimeter. Use a meter with peak-volt reading ca pability to test the ignition system. This type of meter captures the peak voltage reached during an electrical pulse.

Scale selection, meter specifications and test connections vary by the manufacturer and model of the meter. Thoroughly read the instructions supplied with the meter before performing any test. The meter and certain electrical components on the engine can be damaged if tested incorrectly. Have the test performed by a qualified professional if you are unfamiliar with the testing or general meter usage. The expense to replace damaged equipment can far exceed the cost of having the test performed by a professional.

Strobe Timing Light

This instrument is necessary for dynamic tuning (setting ignition timing while the engine is running). By flashing a light at the precise instant the spark plug fires, the position of the timing mark can be seen. The flashing light makes a moving mark appear to stand still next to a stationary mark.

Timing lights (**Figure 19**) range from inexpensive models with a neon bulb to expensive models with a xenon bulb, built in tachometer and timing advance compensator. A built in tachometer is very useful as most ignition timing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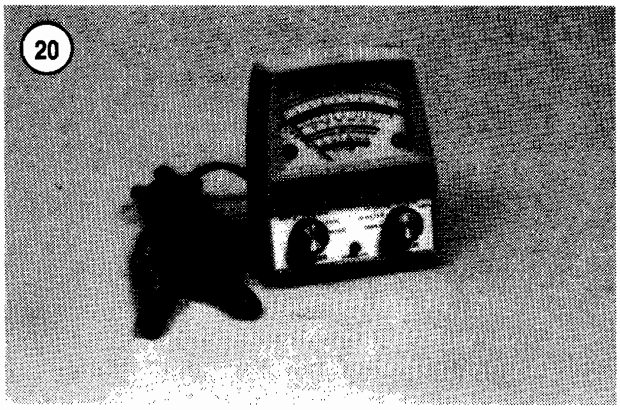
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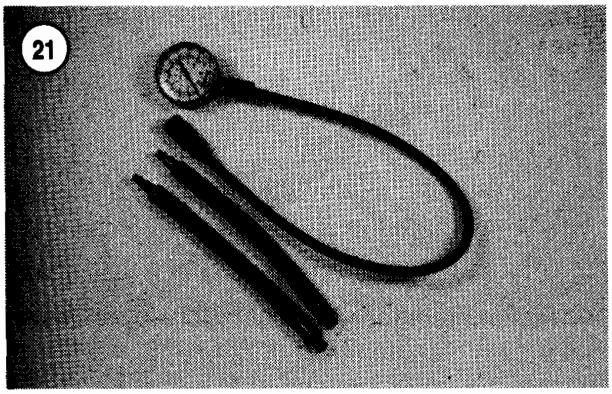
specifications are based on a specific engine speed.

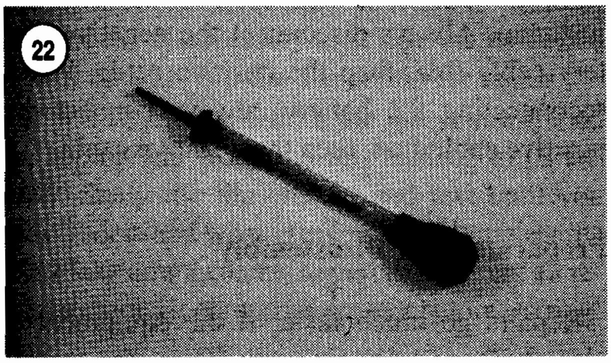
A timing advance compensator delays the strobe enough to bring the timing mark to a certain place on the scale. Although useful for troubleshooting purposes, this feature should not be used to check or adjust the base ignition timing.

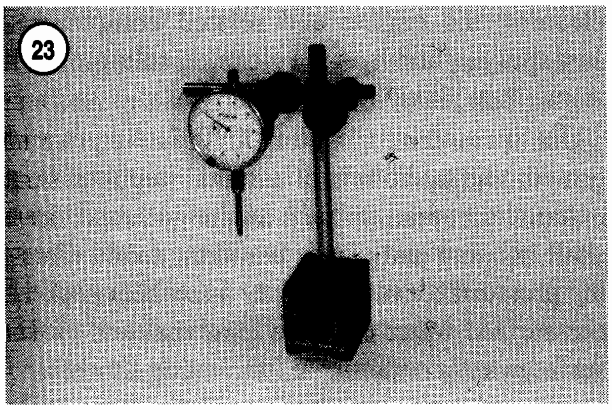
Tachometer/Dwell Meter

A portable tachometer (**Figure 20**) is needed to tune and test most marine engines. Ignition timing and carburetor adjustments must be performed at a specified engine speed. Tachometers are available with either an analog or digital display.

The fuel/air mixture must be adjusted with the engine running at idle speed. If using an analog







tachometer, choose one with a low range of 0-1000 rpm or 0-2000 rpm range and a high range of 0-6000 rpm. The high range setting is needed for testing purposes but lacks the accuracy needed at lower speeds. At lower speeds the meter must be capable of detecting changes of 25 rpm or less.

Digital tachometers are generally easier to use than most analog type tachometers. They provide accurate measurement at all speeds without the need to change the range or scale. Many of these use an inductive pickup to receive the signal from the ignition system.

A dwell meter is often incorporated into the tachometer to allow testing and/or adjustments to engines with a breaker point ignition system.

Compression Gauge

This tool (**Figure 21**) measures the amount of pressure created in the combustion chamber during the compression stroke. Compression indicates the general engine condition making it one of the most useful troubleshooting tools.

The easiest type to use has screw-in adapters that fit the spark plug holes. Rubber tipped, press-in type gauges are also available. This type must be held firmly in the spark plug hole to prevent leakage and inaccurate test results..

Hydrometer

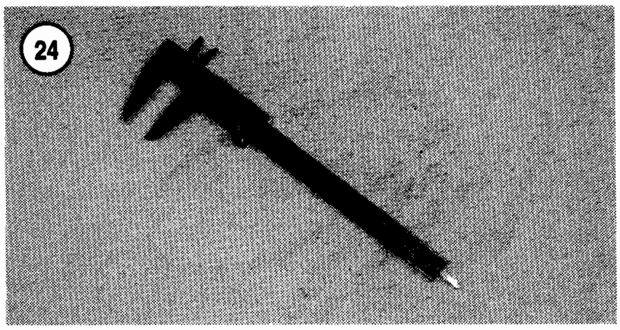
Use a hydrometer to measure specific gravity in the battery. Specific gravity is the density of the battery electrolyte as compared to pure water and indicates the battery's state of charge. Choose a hydrometer (**Figure 22**) with automatic temperature compensation; otherwise the electrolyte temperature must be measured during charging to determine the actual specific gravity.

Precision Measuring Tools

Various tools are required to make precision measurements. A dial indicator (**Figure 23**), for example, is used to determine piston position in the cylinder, runout and end play of shafts and assemblies. It is also used to measure free movement between the gear teeth (backlash) in the drive unit.

Venier calipers (**Figure 24**), micrometers (**Figure 25**) and other precision tools are used to measure the size of parts, such as the piston.

Precision measuring equipment must be stored, handled and used carefully or it will not remain accurate.



SERVICE HINTS

Most of the service procedures in this manual are straightforward and can be performed by anyone reasonably handy with tools. It is suggested, however, that you consider your skills and available tools and equipment before attempting a repair involving major disassembly of the engine or drive unit.

Some operations, for example, require the use of a press. Other operations require precision measurement. Have the procedure or measurements performed by a professional if you do not have access to the correct equipment or are unfamiliar with its use.

Special Battery Precautions

Disconnecting or connecting the battery can create a spike or surge of current throughout the electrical system. This spike or surge can damage certain components of the charging system. Always verify the ignition switch is in the OFF position before connecting or disconnecting the battery or changing the selection on a battery switch.

Always disconnect both battery cables and remove the battery from the boat for charging. If the battery cables are connected, the charger may induce a damaging spike or surge of current into the electrical system. During charging, batteries produce explosive and corrosive gasses. These gases can cause corrosion in the battery compartment and creates an extremely hazardous condition.

Disconnect the cables from the battery prior to testing, adjusting or repairing many of the systems or components on the engine. This is necessary for safety, to prevent damage to test equipment and to ensure accurate testing or adjustment. Always disconnect the negative battery cable first, then the positive cable. When reconnecting the battery, always connect the positive cable first, then the negative cable.

Preparation for Disassembly

Repairs go much faster if the equipment is clean before you begin work. There are special cleaners such as Gunk or Bel-Ray Degreaser, for cleaning the engine and related components. Just spray or brush on the cleaning solution, let it stand, then rinse with a garden hose.

Use pressurized water to remove marine growth and corrosion or mineral deposits from external components such as the gearcase, drive shaft housing and clamp brackets. Avoid directing pressurized water directly as seals or gaskets; pressurized water can flow past seal and gasket surfaces and contaminate lubricating fluids.

WARNING

Never use gasoline as a cleaning agent. It presents an extreme fire hazard. Always work in a well-ventilated area if using cleaning solvent. Keep a coast Guard approved fire extinguisher, rated for gasoline fires, readily accessible in the work area.

Much of the labor charged for a job performed at a dealership is usually for removal and disas-

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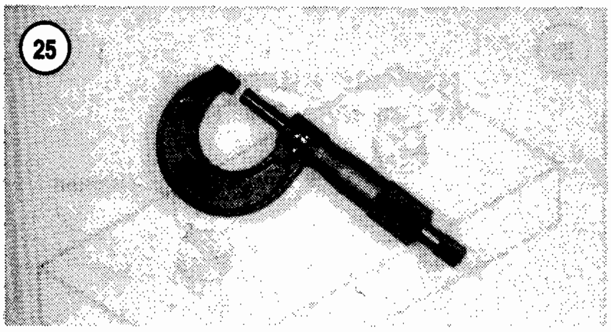

sembly of other parts to access defective parts or assemblies. It is frequently possible to perform most of the disassembly then take the defective part or assembly to the dealership for repair.

If you decide to perform the job yourself, read the appropriate section in this manual, in its entirety. Study the illustrations and text until you fully understand what is involved to complete the job. Make arrangements to purchase or rent all required special tools and equipment before starting.

Disassembly Precautions

During disassembly, keep a few general precautions in mind. Force is rarely needed to get things apart. If parts fit tightly, such as a bearing on a shaft, there is usually a tool designed to separate them. Never use a screwdriver to separate parts with a machined mating surface, such as the cylinder head or manifold). The surfaces will be damaged and leak.

Make diagrams or take instant photographs wherever similar-appearing parts are found. Often, disassembled parts are left for several days or longer before resuming work. You may not remember where everything came from, or carefully arranged parts may become disturbed.

Cover all openings after removing parts to keep contamination or other parts from entering.

Tag all similar internal parts for location and mounting direction. Reinstall all internal components in the same location and mounting direction as removed. Record the thickness and mounting location of any shims as they are removed. Place small bolts and parts in plastic sandwich bags. Seal and label the bags with masking tape.

Tag all wires, hoses and connections and make a sketch of the routing. Never rely on memory alone; it may be several days or longer before you resume work.

Protect all painted surfaces from physical damage. Never allow gasoline or cleaning solvent on these surfaces.

Assembly Precautions

No parts, except those assembled with a press fit, require unusual force during assembly. If a part is hard to remove or install, find out why before proceeding.

When assembling parts, start all fasteners, then tighten evenly in an alternating or crossing pattern unless a specific tightening sequence or procedure is given.

When assembling parts, be sure all shims, spacers and washers are installed in the same position and location as removed.

Whenever a rotating part butts against a stationary part, look for a shim or washer. Use new gaskets, seals and O-rings if there is any doubt about the conditions of the used ones. Unless otherwise specified, a thin coating of oil on gaskets may help them seal more effectively. Use heavy grease to hold small parts in place if they tend to fall out during assembly.

Use emery cloth and oil to remove high spots from piston surfaces. Use a dull screwdriver to remove carbon deposits from the cylinder head, ports and piston crown. *Do not* scratch or gouge these surfaces. Wipe the surfaces clean with a *clean* shop towel when finished.

If the carburetor must be repaired, completely disassemble it and soak all metal parts in a commercial carburetor cleaner. Never soak gaskets and rubber or plastic parts in these cleaners.

Clean rubber or plastic parts in warm soapy water. Never use a wire to clean jets and small passages because they are easily damaged. Use compressed air to blow debris from all passages in the carburetor body.

Take your time and do the job right. Break-in procedure for a newly rebuilt engine or drive is the same as for a new one. Use the recommended break-in oil and follow the instructions provided in the appropriate chapter.

SPECIAL TIPS

Because of the extreme demands placed on marine equipment, several points must be kept in mind when performing service and repair. The following are general suggestions that may improve the overall life of the machine and help avoid costly failure.

1. Unless otherwise specified, apply a threadlocking compound, such as Loctite Threadlocker, to all bolts and nuts, even if secured with a lockwasher. Use only the specified grade of threadlocking compound. A screw or bolt lost from an engine cover or bearing retainer could easily cause serious and expensive damage before the loss is noticed. When applying threadlocking compound, use only enough to lightly coat the threads. If too much is used, it can work its way down the threads and contaminate seals or bearings.
2. If self-locking fasteners are used, replace them with new ones. Do not install standard fasteners in place of self-locking ones.
3. Use caution when using air tools to remove stainless steel nuts or bolts. The heat generated during rapid spinning easily damages the threads of stainless steel fasteners. To prevent thread damage, apply penetrating oil as a cooling agent and loosen or tighten them slowly.
4. Use a wide chisel to straighten the tab of a fold-over type lockwasher. Such a tool provides a better contact surface than a screwdriver or pry bar, making straightening easier. During installation, use a new fold-over type lockwasher. If a new lockwasher is not available, fold over a tab on the washer that has not been previously used. Reusing the same tab may cause the washer to break, resulting in a loss of locking ability and a loose piece of metal adrift in the engine. When folding the tab into position, carefully pry it toward the flat on the bolt or nut. Use a pair or plies to bend the tab against the fastener. Do not use a punch and hammer to drive the tab into position. The resulting fold may be too sharp, weakening the washer and increasing its chance of failure.

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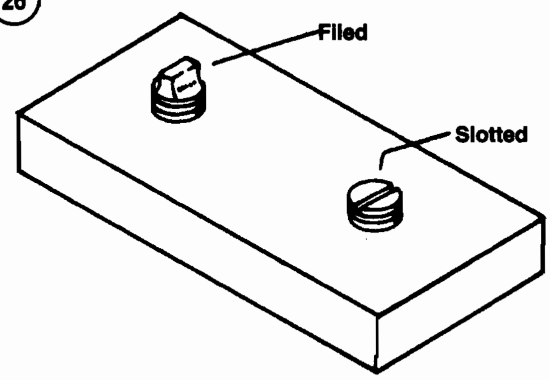
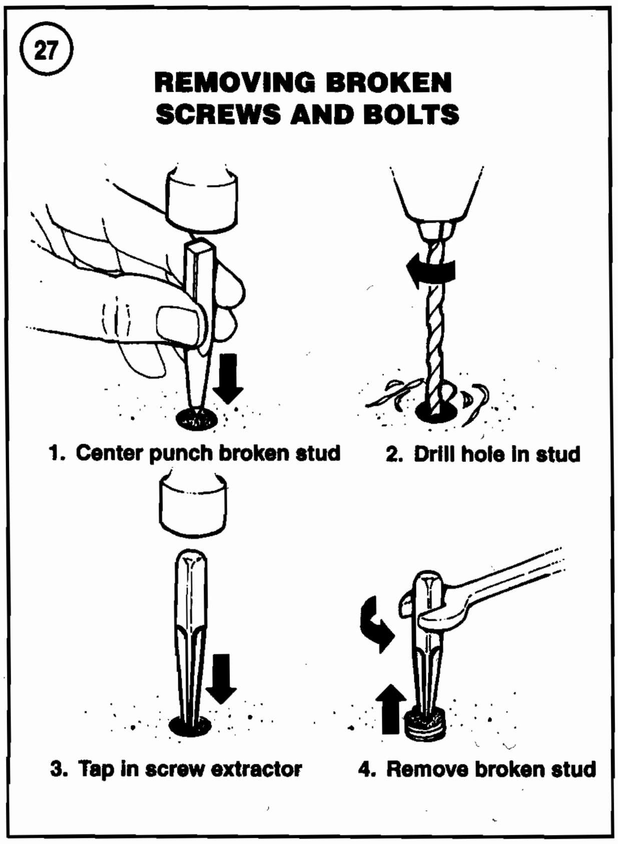


5. Use only the specified replacement parts if replacing a missing or damaged bolt, screw or nut. Many fasteners are specially hardened for the application.
6. Install only the specified gaskets. Unless specified otherwise, install them without sealant. Many gaskets are made with a material that swells when it contacts oil. Gasket sealer prevents them from swelling as intended and can result in oil leakage. Most gaskets must be a specific thickness. Installing a gasket that is too thin or too thick in a critical area could cause expensive damage.
7. Make sure all shims and washers are reinstalled in the same location and position. Whenever a rotating part contacts a stationary part, look for a shim or washer.



MECHANICS TECHNIQUES

Marine engines are subjected to conditions very different from most engines. They are repeatedly subjected to a corrosive environment followed by periods of non-use for weeks or longer. Such use invites corrosion damage to fasteners, causing difficulty or breakage during removal. This section provides information that is useful for removing stuck or broken fasteners and repairing damaged threads.

Removing Stuck Fasteners

When a nut or bolt corrodes and cannot be removed, several methods may be used to loosen it. First, apply penetrating oil, such as Liquid Wrench or WD-40. Apply it liberally to the threads and allow it to penetrate for 10-15 minutes. Tap the fastener several times with a small hammer; however, do not hit it hard enough to cause damage. Reapply the penetrating oil if necessary.

For stuck screws, apply penetrating oil as described, then insert a screwdriver in the slot. Tap the top of the screwdriver with a hammer. This looses the corrosion in the threads allowing it to turn. If the screw head is too damaged to use a screwdriver, grip the head with locking pliers and twist the screw from the assembly.

A Phillips, Allen or Torx screwdriver may start to slip in the screw during removal. If slippage occurs, stop immediately and apply a dab of course valve lapping compound onto the tip of the screwdriver. Valve lapping compound or a special screw removal compound is available from most hardware and automotive parts stores. Insert the driver into the screw and apply downward pressure while turning. The gritty material in the compound improves the grip on the screw, allowing more rotational force before slippage occurs. Keep the compound away from any other engine components. It is very abrasive and can cause rapid wear if applied onto moving or sliding surfaces.

Avoid applying heat unless specifically instructed because it may melt, warp or remove the temper from parts.

Removing Broken Bolts or Screws

The head of bolt or screw may unexpectedly twist off during removal. Several methods are available for removing the remaining portion of the bolt or screw.

If a large portion of the bolt or screw projects out, try gripping it with locking pliers. If the projecting portion is too small, file it to fit a wrench or cut a slot in it to fit a screwdriver (**Figure 26**). If the head breaks off flush or cannot be turned with a screwdriver or wrench, use a screw extractor (**Figure 27**). To do this, center punch the remaining portion of the screw or bolt. Select the proper size of extractor for the size of the fastener. Using the drill size specified on the extractor, drill a hole into the fastener. Do not drill deeper than the remaining fastener. Carefully tap the extractor into the hole and back the remnant out using a wrench on the extractor.

Remedying Stripped Threads

Occasionally, threads are stripped through carelessness or impact damage. Often the threads can be repaired by running a tap (for internal threads on nuts) or die (for external threads on bolts) through threads (**Figure 28**).

To clean or repair spark plug threads, use a spark plug tap. If an internal thread is damaged, it may be necessary to install a Helicoil or some other type of thread insert. Follow the manufacturer's instructions when installing their insert.

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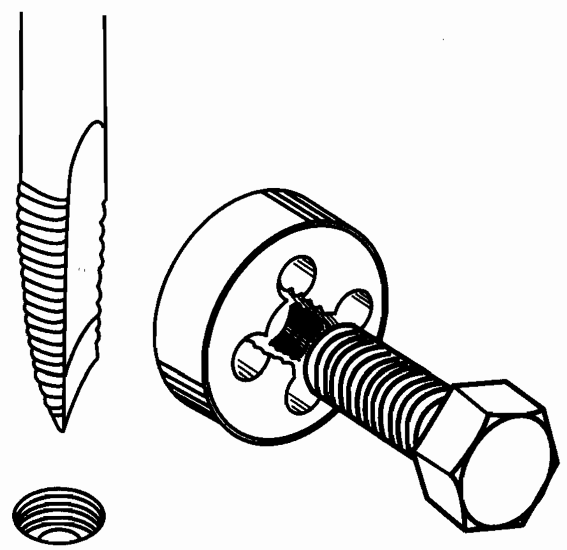

Chapter Three

Troubleshooting

NOTE
Troubleshooting procedures for electric outboard motors are in Chapter Eleven.

Troubleshooting is a relatively simple matter when it is done logically. The first step in any troubleshooting procedure is to define the symptoms as fully as possible and then localize the problem. Subsequent steps involve testing and analyzing those areas which could cause the symptoms. A haphazard approach may eventually solve the problem, but it can be very costly in terms of wasted time and unnecessary parts replacement.

Never assume anything. Don't overlook the obvious. If the engine suddenly quits when running, check the easiest and most accessible spots first. Make sure there is gasoline in the tank, the fuel petcock is in the ON position, the spark plug wires are properly connected and the wiring harnesses are properly connected.

If a quick visual check of the obvious does not turn up the cause of the problem, look a little further. Learning to recognize and describe symptoms accurately will make repairs easier for you or a mechanic at the shop. Saying that "it won't run" isn't the same as saying "it quit at high speed and wouldn't start."

Gather as many symptoms together as possible to aid in diagnosis. Note whether the engine lost power gradually or all at once, what color smoke (if any) came from the exhaust and so on. Remember—the more complicated an engine is, the easier it is to troubleshoot because symptoms point to specific problems.

After the symptoms are defined, areas which could cause the problems should be tested and analyzed. You don't need fancy or complicated test equipment to determine whether repairs can be attempted at home. A few simple checks can save a large repair bill and time lost while the engine sits in a shop's service department.

On the other hand, be realistic and don't attempt repairs beyond your abilities. Service departments tend to charge heavily for putting together a disassembled engine that may have been abused. Some won't even take on such a job—so use common sense and don't get in over your head.

Proper lubrication, maintenance and periodic tune-ups as described in Chapter Four will reduce the necessity for troubleshooting. Even with the best of care, however, an outboard motor is prone to problems which will eventually require troubleshooting.

This chapter contains brief descriptions of each operating system and troubleshooting procedures to be used. **Tables 1-3** at the end of the chapter present typical starting, ignition and fuel system problems with their probable causes and solutions.

OPERATING REQUIREMENTS

Every outboard motor requires 3 basic things to run properly: an uninterrupted supply of fuel and air in the correct proportions, proper ignition at the right time and adequate compression. If any of these are lacking, the motor will not run. The electrical system is the weakest link in the chain. More problems result from electrical malfunctions than from any other source. Keep this in mind before you blame the fuel system and start making unnecessary carburetor adjustments.

If a motor has been sitting for any length of time and refuses to start, check the condition of the battery first to make sure it has an adequate charge, then look to the fuel delivery system. This includes the gas tank, fuel pump, fuel lines and carburetor(s). Rust may have formed in the tank, obstructing fuel flow. Gasoline deposits may have gummed up carburetor jets and air passages. Gasoline tends to lose its potency after standing for long periods. Condensation may contaminate it with water. Drain the old gas and try starting with a fresh tankful. If the carburetor is getting a satisfactory supply of good fuel, turn to the starting system.

STARTING SYSTEM

Description

Johnson/Evinrude 9.5 hp and larger outboard motors may be equipped with an electric starter motor (**Figure 1**). The motor is mounted vertically on the engine. When battery current is supplied to the starter motor, its pinion gear is thrust upward to engage the teeth on the engine flywheel. Once the engine starts, the pinion gear disengages from the flywheel. This is similar to the method used in cranking an automotive engine.

The starting system requires a fully charged battery to provide the large amount of electrical current required to operate the starter motor. The battery may be charged externally or by an alternator stator and rectifier system which keeps the battery charged while the engine is running.

Starting Circuit (9.5, 9.9 and 15 hp)

The starting circuit on Johnson and Evinrude 9.5, 9.9 and 15 hp outboards equipped with an electric starting system consists of the battery, starter motor, ignition

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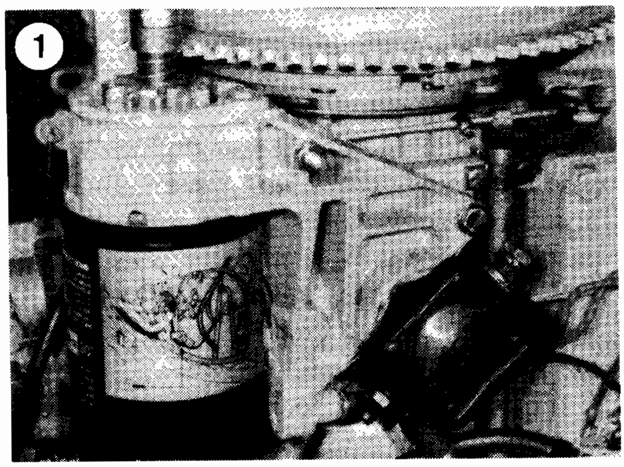

switch, neutral start switch and connecting wiring.

Turning the ignition switch to START completes the circuit between the battery and starter motor when the shift lever is in NEUTRAL. The neutral start switch prevents current flow if the shift control lever is not in NEUTRAL.

Starting Circuit (18-40 hp)

The starting circuit on 18-40 hp models consists of the battery, starter motor, starter and choke switches, starter and choke solenoids, ignition switch, neutral start switch, a fuse (on some models) and connecting wiring.

Turning the ignition switch to START allows current to flow through the solenoid coil. The solenoid contacts close and allow current to flow from the battery through the solenoid to the starter motor. The neutral start switch prevents current flow through the solenoid coil if the shift control lever is not in NEUTRAL. The choke solenoid operates in a similar manner to move the choke valve linkage and open the choke for starting.

General troubleshooting procedures are provided in **Table 1**.

CAUTION
Do not operate the starter motor continuously for more than 30 seconds. Allow the motor to cool for at least 2 minutes between attempts to start the engine.

Troubleshooting Preparation (All Models)

Before troubleshooting the starting circuit, make sure:

a. The battery is fully charged.
b. The control lever is in NEUTRAL.
c. All electrical connections are clean and tight.
d. The wiring harness is in good condition, with no worn or frayed insulation.
e. Battery cables are the proper size and length. Replace undersize cables or relocate battery to shorten distance between battery and starter solenoid.
f. The fuse installed in the red lead between ignition switch and solenoid is good, if so equipped.
g. The fuel system is filled with an adequate supply of fresh gasoline that has been properly mixed with Johnson or Evinrude 50/1 Lubricant. See Chapter Four.

3

Starting Difficulties With Older Engines

Many older 2-stroke engines are plagued by hard starting and generally poor running for which there seems to be no good cause. Carburetion and ignition are satisfactory and a compression test shows all is well in the engine's upper end.

What a compression test does not show is a lack of primary compression. The crankcase in a 2-stroke engine must be alternately under pressure and vacuum. After the piston closes the intake port, further downward movement of the piston causes the trapped mixture to be pressurized so it can rush quickly into the cylinder when the scavenging ports are opened. Upward piston movement creates a vacuum in the crankcase, enabling air-fuel mixture to be drawn in from the carburetor.

If the crankshaft seals or case gaskets leak, the crankcase cannot hold pressure or vacuum and proper engine operation becomes impossible. Any other source of leakage, such as defective cylinder base gaskets or porous or cracked crankcase castings, will result in the same conditions.

Older engines suffering from hard starting should be checked for pressure leaks with a small brush and soap suds solution. The following is a list of possible leakage points in the engine:

a. Crankshaft seals.
b. Spark plug threads.
c. Cylinder head joint.
d. Cylinder base joint.
e. Carburetor mounting flange(s).
f. Crankcase joint.

Troubleshooting (9.5-15 hp [Prior to 1985])

Refer to **Figure 2** for the following procedure.

1. Remove the fuel pump to permit access to the neutral start switch terminals. See Chapter Six.
2. Place the control box shift lever in NEUTRAL.
3. Connect the red voltmeter lead to point 1, **Figure 2**. Connect the black lead to a good engine ground. Depress the starter switch button. The voltmeter should indicate battery voltage (approximately 12 volts).
4. If no voltage is shown in Step 3, connect the red voltmeter lead to point 2. There should be no voltage reading. If there is, check the neutral start switch for continuity as described in this chapter.
5. Connect the red voltmeter lead to point 3 and depress the starter switch button. If voltage is indicated, the neutral start switch requires adjustment as described in this chapter. If no voltage is indicated, depress the neutral start switch manually. If voltage is now indicated, the neutral start switch requires adjustment as described in this chapter. If no voltage is indicated, replace the switch.
6. Connect the red voltmeter lead to point 4 and depress the starter switch button. There

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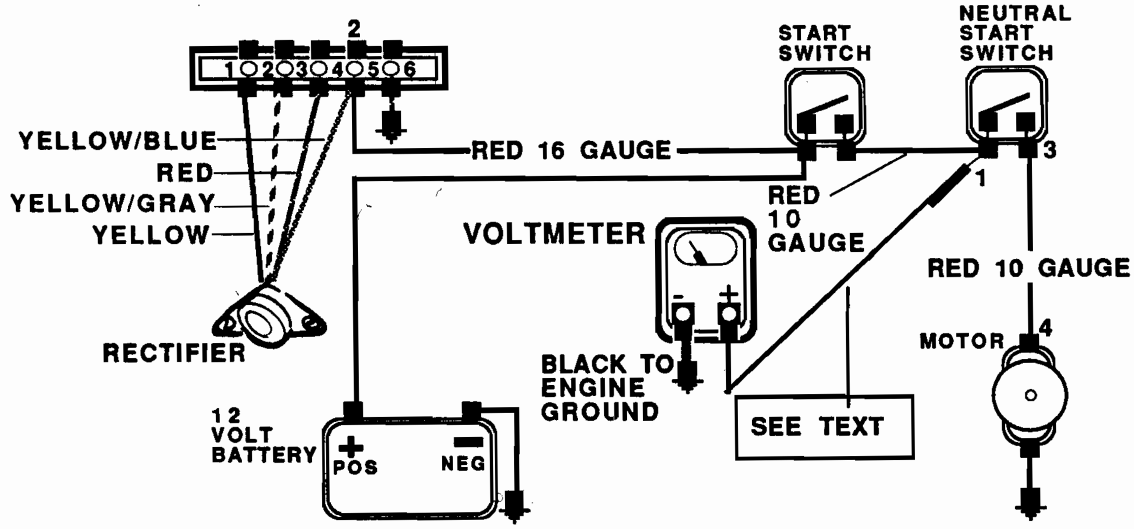
STARTER SYSTEM (9.5-15 HP [PRIOR TO 1985])



should be voltage. If not, there is an open in the wiring between point 3 and point 4.
7. If there is voltage in Step 6 but the starter motor will not turn over, replace the starter.

Troubleshooting
(9.9-15 hp [After 1984])

Refer to **Figure 3** for the following procedure.
1. Remove the engine cover.
2. Remove the fuel pump to permit access to the neutral start switch terminals. See Chapter Six.

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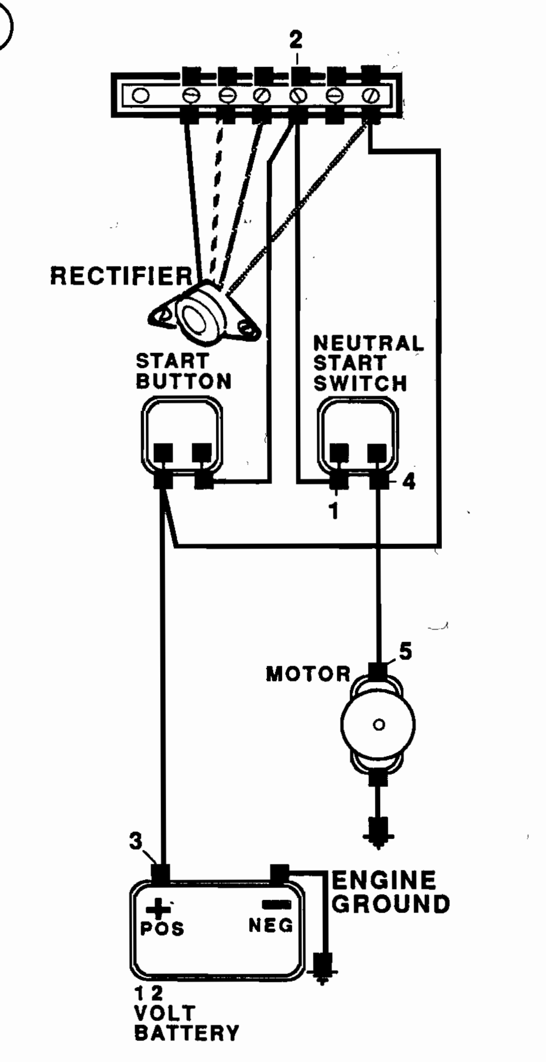

3. Place the control box shift lever in NEUTRAL, if so equipped.
4. 1985-1988—Disconnect the power pack-to-armature plate connector.
5. Connect the red voltmeter lead to point 1, **Figure 3**. Connect the black lead to a good engine ground. Depress the starter switch button. The voltmeter should indicate battery voltage (approximately 12 volts).
6. If no voltage is shown in Step 5, move the red voltmeter lead to point 2 and depress the button. If voltage is now shown, look for an open in the wiring between point 1 and point 2. If voltage is still not shown, disconnect the neutral start switch and check for continuity as described in this chapter.
7. Move the red voltmeter lead to point 4 and depress the button. If voltage is indicated, adjust the neutral start switch as described in this chapter. If no voltage is indicated, depress the neutral start switch manually. If voltage is now indicated, the neutral start switch requires adjustment.
8. Move the red voltmeter lead to point 5 and depress the starter switch button. There should be voltage. If not, there is an open in the wiring between point 4 and point 5.
9. If there is voltage in Step 8 but the starter motor will not turn over, replace the starter.

Troubleshooting
(18-40 hp with Remote Control)

Refer to **Figure 4** (1973-1982) or **Figure 5** (1983-on) for this procedure.
1A. 1973-1982—Locate the neutral start switch at point 1 (**Figure 4**) and remove the white wire. Connect a 12-volt test light between a good engine ground and the white wire.
1B. 1983-on—Disconnect the black ground lead at point 1 (**Figure 5**). Connect a 12-volt test light between the lead and a good engine ground.

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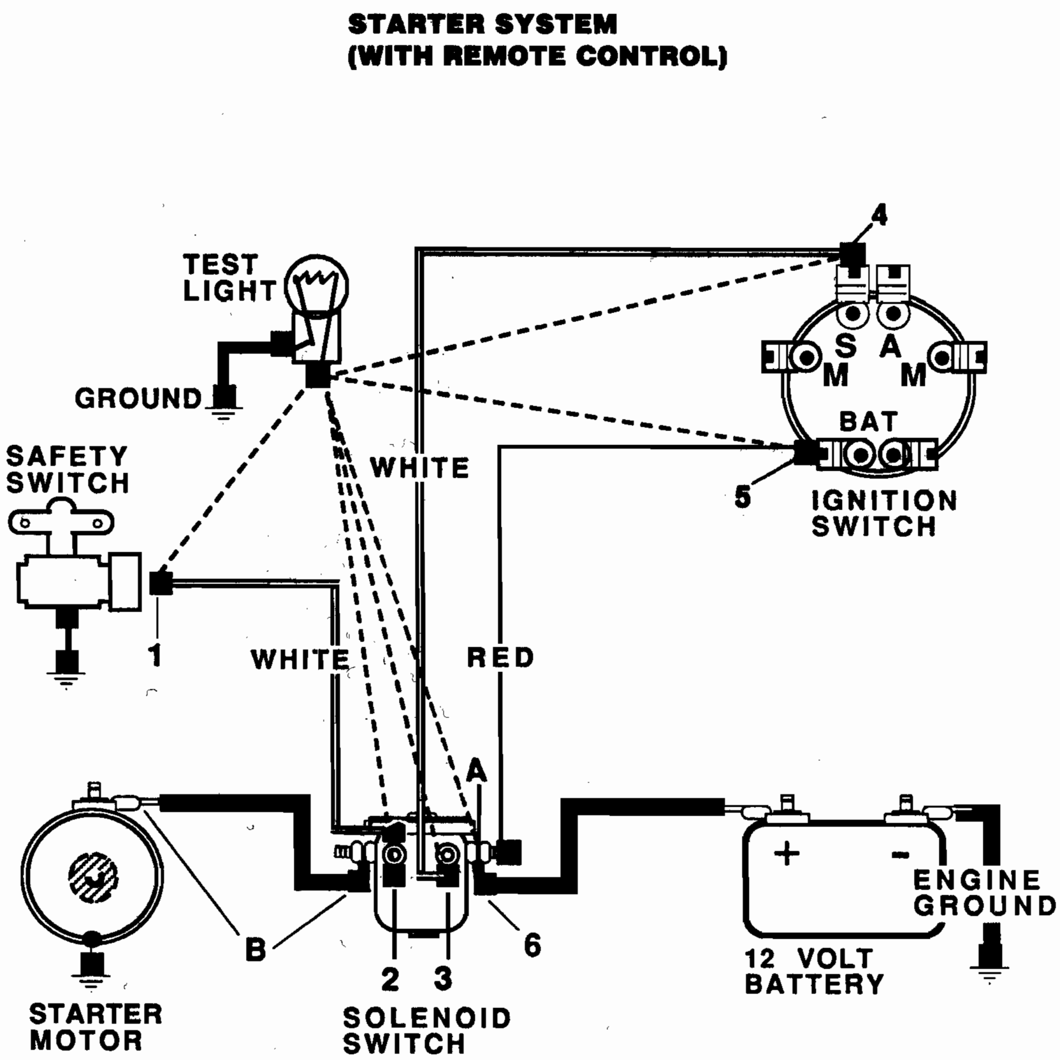
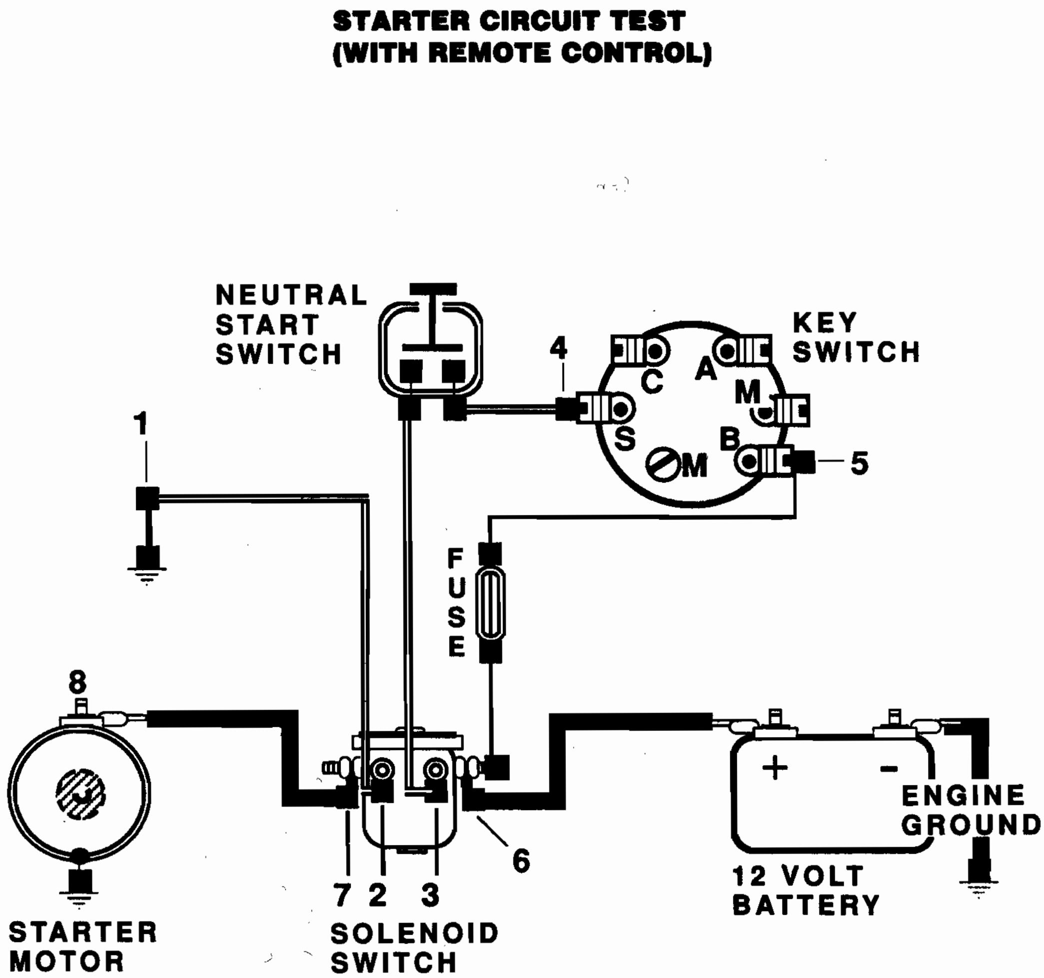

STARTER SYSTEM
(WITH REMOTE CONTROL)
TEST LIGHT
GROUND
SAFETY SWITCH
WHITE
WHITE
RED
1
4
5
S
A
M
M
BAT
IGNITION SWITCH
A
B
6
2
3
+
-
ENGINE GROUND
12 VOLT BATTERY
STARTER MOTOR
SOLENOID SWITCH

5


STARTER CIRCUIT TEST
(WITH REMOTE CONTROL)
NEUTRAL
START
SWITCH
KEY
SWITCH
4
C
A
M
S
B
M
5
1
F
U
S
E
8
+
-
ENGINE
GROUND
6
7 2 3
12 VOLT
BATTERY
STARTER
MOTOR
SOLENOID
SWITCH

2A. 1973-1982—Turn the ignition switch to START. If the light comes on, proceed with Step 3. If the light does not come on, proceed with Step 4.
2B. 1983-on—Turn the ignition switch to START. If the light comes on, proceed with Step 4. If the light does not come on, proceed with Step 9.
3. Connect the white wire to the switch with the test lamp still connected. Turn the switch to START. If the light does not come on, proceed with Step 9. If the light comes on, the switch is not properly connected or it is defective. The throttle may be advanced too far for it to function properly.

NOTE
Turn the key to OFF prior to connecting or disconnecting the light in the following steps. This will prevent the possibility of a shock.

4. Connect the test light between ground and point 2. If the light comes on, the wire is not making contact between point 1 and point 2.
5. If the light does not come on, connect the test light between ground and point 3. Turn the ignition switch to START. If the light comes on, the solenoid is defective.
6. If the light does not come on, connect the test light between ground and point 4. Turn the ignition switch to START. If the light comes on, the lead between point 3 and point 4 is loose, corroded or disconnected. On 1983 and later models, the neutral start switch may also be open or improperly adjusted.
7. If the light does not come on, connect the test light between ground and point 5. Leave the ignition switch OFF. If the light comes on, the switch is defective.
8. If the light does not come on, check for an open or burned fuse between point 5 and 6 and correct as required. Connect the test light between ground and point 6. Leave the ignition switch OFF. The light should light. If it does not, check for an open circuit between point 6 and the battery.
9. Connect the test light between ground and terminal A. Turn the ignition switch to START. The test light should come on and the solenoid should click. If the light does not come on, the solenoid is defective.
10. Connect the test light between ground and terminal B. Turn the ignition switch to START. If the light comes on but the starter motor will not turn over, replace the starter motor. If the light does not come on, check for a broken cable or a poor connection.

Troubleshooting
(18-40 hp with Push Button Start)

Refer to **Figure 6** for this procedure.

1. Locate the neutral start switch (A) at point 1 and remove the yellow/red lead. Connect a 12-volt test light between a good ground on the engine and the yellow/red lead.

2. Depress the push button (B). If the test light comes on, proceed to Step 3. If the test light does not come on, reconnect the yellow/red lead to the neutral start switch and proceed with Step 6.

3. Connect the test light between ground and point 2. Depress the push button (B). If the test light comes on, the lead is open between point 1 and point 2.

4. Connect the test light between ground and point 3. Depress the push button. If the test light comes on, the solenoid is defective.

5. Connect the test light between ground and point 4. If the test light comes on, check the push button. If the test light does not come on, look for an open between point 4 and the positive battery terminal.

6. Connect the test light between ground and point 5. Depress the push button. The test light should come on and the solenoid should click. If it does not, the solenoid is defective.

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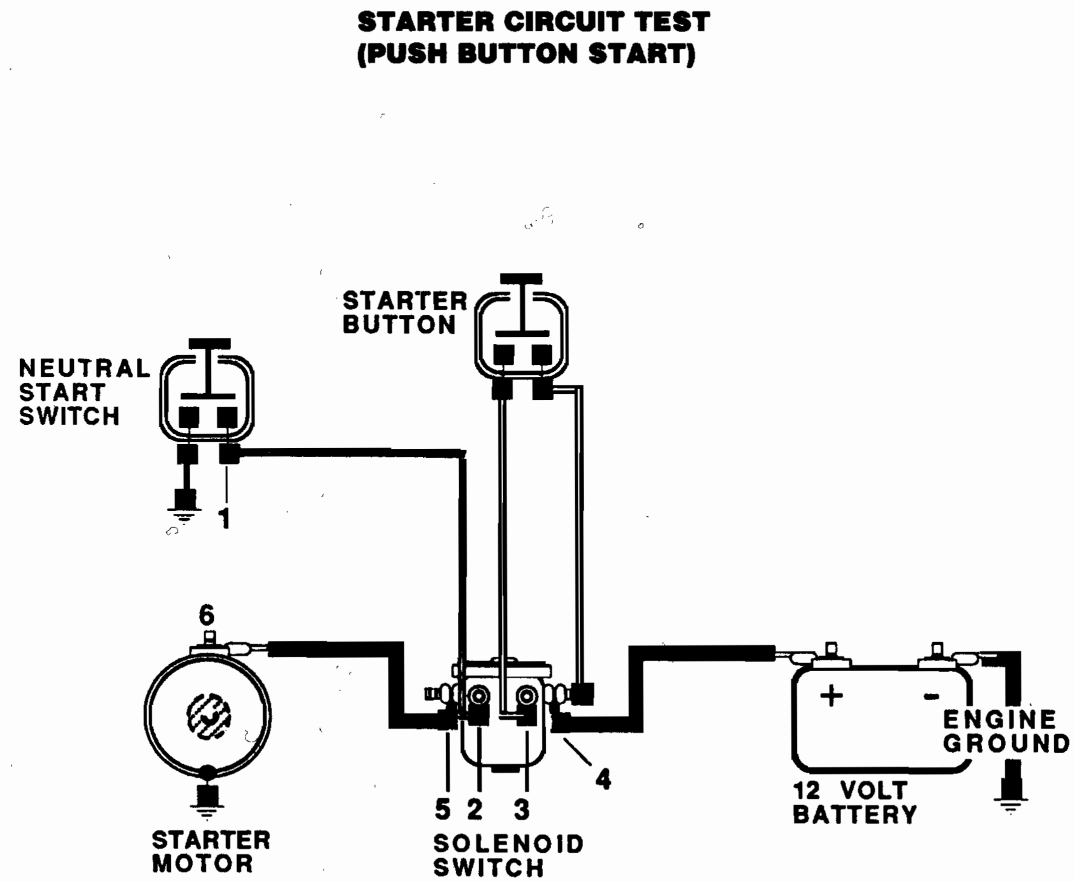
STARTER CIRCUIT TEST
(PUSH BUTTON START)
STARTER
BUTTON
NEUTRAL
START
SWITCH
1
6
4
5 2 3
STARTER
MOTOR
SOLENOID
SWITCH
+
-
ENGINE
GROUND
12 VOLT
BATTERY

7. Connect the test light between ground and point 6. Depress the push button. If the light comes on but the starter motor will not turn over, replace the starter motor. If the light does not come on, check for a broken cable or a poor connection.

CHARGING SYSTEM

Description

The charging system on 7.5-40 hp models consists of permanent magnets cast in the flywheel (**Figure 7**), a stator assembly (**Figure 8**), a rectifier (**Figure 9**), the battery and connecting wiring. Flywheel rotation past the stator coils produces alternating current (AC), which is sent to the rectifier for conversion to direct current (DC).

A malfunction in the battery charging system generally causes the battery to remain undercharged. Since the stator (**Figure 8**) is protected by its location underneath the flywheel (**Figure 7**), it is more likely that the battery, rectifier or connecting wiring will cause problems. The following conditions will cause rectifier damage:

a. Battery leads reversed.

b. Running the engine with the battery leads disconnected.

c. A broken wire or loose connection resulting in an open circuit.

Troubleshooting Preparation

Before troubleshooting the charging circuit, visually check the following.

1. Make sure the red cable is connected to the positive battery terminal. If polarity is reversed, check for a damaged rectifier.

NOTE
A damaged rectifier will generally be discolored or have a burned appearance.

2. Check for corroded or loose connections. Clean, tighten and insulate with OMC Black Neoprene Dip as required.

3. Check battery condition. Clean and recharge as required.

4. Check wiring harness between the armature plate and battery for damaged or deteriorated insulation and corroded, loose or

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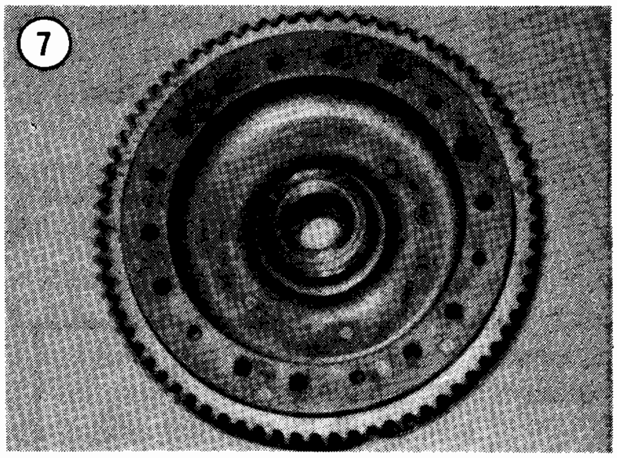

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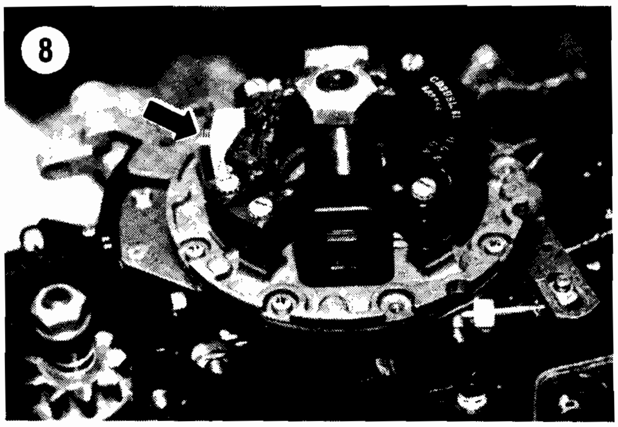

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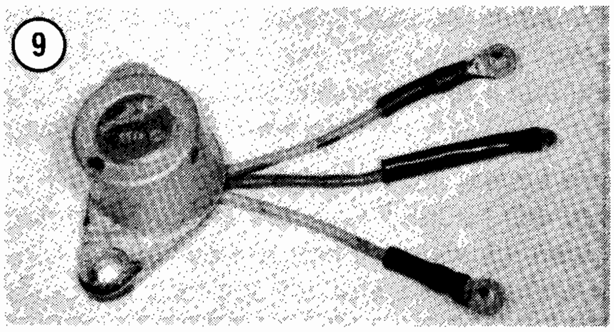
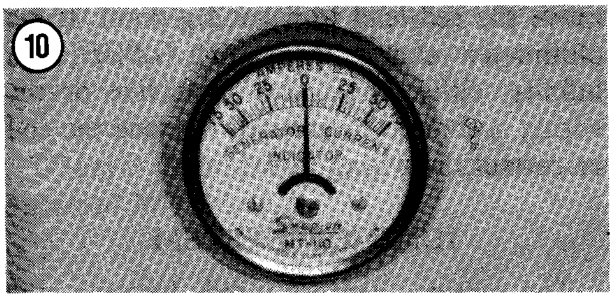
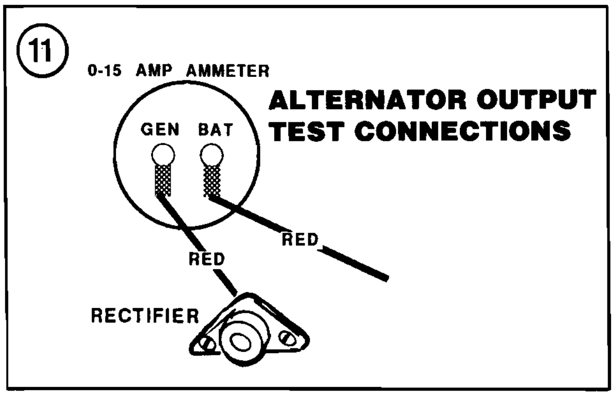


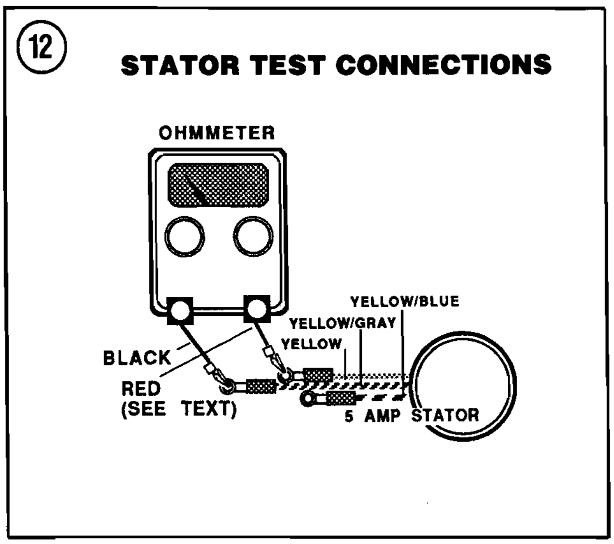
faulty connections. Repair or replace as required.

Alternator Output Quick Check

A quick check of the alternator output can be made with an induction ammeter (**Figure 10**). Fit the ammeter over the positive battery cable and run the motor at full throttle in a test tank or in the water. The induction ammeter will show the alternator output. The total electrical load on the system from the engine and accessories cannot exceed 5 amps (1973-1982) or 4 amps (1983-on).







Alternator Output Test

Perform this test for a more accurate reading of alternator output. Refer to **Figure 11** for this procedure.

1. Disconnect the red rectifier and starter motor leads at the terminal board.
2. Connect the rectifer lead to the negative terminal of a low-reading 15 amp ammeter. Connect the starter motor lead to the positive terminal on the ammeter.
3. With the engine in a test tank or in the water, start and run at full throttle. The ammeter should read approximately 5 amps (1973-1982) or 4 amps (1983-on).
4. If no charge is shown, test the stator and rectifier as described in this chapter.

Stator Test

Refer to **Figure 12** for this procedure.

1. Disconnect the yellow, yellow/grey and yellow/blue leads at the terminal block.
2. Set the ohmmeter on the low ohm scale.
3. Connect the black ohmmeter test lead to the yellow (1973-1982) or yellow/grey (1983-on) wire terminal.
4. Connect the red ohmmeter test lead to the yellow/grey (1973-1983) or yellow (1983-on) stator lead. The ohmmeter should read 0.25-0.45 ohms (1973-1982) or 0.22-0.32 ohms (1983-on).
5. Move the red ohmmeter test lead to the yellow/blue stator lead. The ohmmeter should read:
   a. 0.25-0.45 ohms (1973-1976).
   b. 0.45-0.65 ohms (1977-1982).
   c. 0.22-0.32 ohms (1983-on).
6. Move the red ohmmeter test lead to a good engine ground. It should read infinity,

indicating an open circuit. If any other reading is shown, the stator is shorted to ground.

Rectifier Test

Figure 13 is a schematic of the rectifier. Refer to **Figure 14** for typical location and test connections.

1. Ground one ohmmeter test lead at the rectifier case. Connect the other test lead to the yellow/grey rectifier lead. Note the ohmmeter reading.
2. Reverse the test leads and note the ohmmeter reading. The ohmmeter should read zero in one direction and infinity in the other. If the reading is the same in Step 1 and Step 2, the diode is defective and the rectifier should be replaced. High resistance indicates an open diode; low resistance indicates a shorted diode.
3. Repeat Step 1 and Step 2 to test the yellow and the yellow/blue rectifier leads.
4. Connect one ohmmeter test lead to the red rectifier lead. Connect the other test lead to the yellow/grey rectifier lead. Note the ohmmeter reading.
5. Reverse the test leads and note the ohmmeter reading. The ohmmeter should read zero in one direction and infinity in the other. If the reading is the same in Step 4 and Step 5, the rectifier is defective.
6. Repeat Step 4 and Step 5 to test the yellow rectifier lead, then the yellow/blue rectifier lead.
7. Replace the rectifier if the readings are not as specified.

AC Lighting Coil Test (Rope Start Models)

Rope start models have a lighting coil assembly mounted on the armature plate.

1. Disconnect the 3-wire connector at the armature plate.
2. With an ohmmeter on the low scale, insert the black probe in the connector yellow/grey lead socket and the red probe in the yellow lead socket. The ohmmeter should read 0.83-0.89 ohms.
3. Move the red probe to the yellow/blue lead socket. The ohmmeter should read 1.18-1.24 ohms.
4. Set the ohmmeter on the high scale and move the red lead to a good ground. If the ohmmeter shows a reading other than infinity, either the coil is defective or the wiring is shorted to ground. Replace the coil or correct the wiring as required.

IGNITION SYSTEM

The wiring harness used between the ignition switch and engine is adequate to handle the electrical needs of the outboard. It *will not* handle the electrical needs of accessories. Whenever an accessory is added, run new wiring between the battery and accessory, installing a separate fuse panel on the instrument panel.

If the ignition switch requires replacement, *never* install an automotive-type switch. A marine-type switch must always be used.

Description

Variations of three different ignition systems have been used on Johnson and

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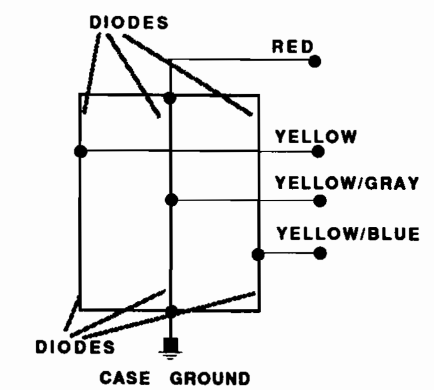


Evinrude outboards since 1973. See Chapter Seven for a full description. For the purposes of troubleshooting, the ignition systems can be divided into 3 basic types:

a. A flywheel magneto breaker-point ignition.
b. A flywheel magneto capacitor discharge (CD 2 [models prior to 1989 and 1989-1990 Ultra 4 and Excel 4]) breakerless ignition.
c. A flywheel magneto capacitor discharge (CD2UL [1989-1990 models except 1989-1990 Ultra 4 and Excel 4]) breakerless ignition.

General troubleshooting procedures are provided in **Table 2**.

roubleshooting Precautions

Several precautions should be strictly bserved to avoid damage to the ignition stem.

Do not reverse the battery connections. is reverses polarity and can damage the rging system rectifier or possibly damage ition components.

Do not "spark" the battery terminals with battery cable connections to check larity.

Do not disconnect the battery cables with engine running.

4. Do not crank engine if the power pack unit (CD 2 ignition) is not grounded to engine.
5. Do not touch or disconnect any ignition components when the engine is running, while the ignition switch is ON or while the battery cables are connected.
6. If you must run an engine equipped with a capacitor discharge ignition system without the battery connected to the harness, disconnect the charging system rectifier leads at the terminal board and tape them separately.

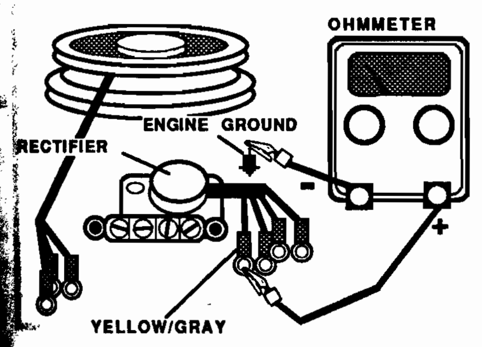
Troubleshooting Preparation (All Ignition Systems)

NOTE

To test the wiring harness for poor solder connections in Step 1, bend the molded rubber connector while checking each wire for resistance.

1. Check the wiring harness and all plug-in connections to make sure all terminals are free of corrosion, all connectors are tight and the wiring insulation is in good condition.
2. Check all electrical components that are grounded to the engine for a good ground.
3. Make sure that all ground wires are properly connected and the connections are clean and tight.
4. Check remainder of the wiring for disconnected wires and short or open circuits.
5. Make sure there is an adequate supply of fresh and properly mixed fuel available to the engine.
6. Check the battery condition on electric start models. Clean terminals and recharge battery, if necessary.
7. Check spark plug cable routing. Make sure the cables are properly connected to their spark plugs.
8. Remove all spark plugs, keeping them in order. Check the condition of each plug. See Chapter Four.

RECTIFIER TEST CONNECTIONS



9. Install a spark tester (**Figure 15**) between the plug wire and a good ground to check for spark at each cylinder. See **Figure 16**. Set the spark tester air gap to 7/16-1/2 in. Crank the engine over while watching the spark tester. If a spark jumps at each plug gap, the ignition system is good.
10. If a spark tester is not available, remove each spark plug and reconnect the proper plug cable to one plug. Lay the plug against the cylinder head so its base makes a good connection and turn the engine over. If there is no spark or only a weak one, check for loose connections at the coil and battery. Repeat the check with each remaining plug. If the connections are good, the problem is most likely in the ignition system.

BREAKER POINT IGNITION TROUBLESHOOTING

This procedure requires the use of a Stevens S-80 or Merc-O-Tronic M-80 neon test light. Refer to **Figure 17** (No. 1 ignition coil) and **Figure 18** (No. 2 ignition coil) for test connections.

1. Disconnect the No. 1 ignition coil-to-armature plate blue primary lead. Connect the neon tester blue lead to the armature plate end of the coil lead. Connect the neon tester black lead to a good engine ground. Set the tester switch to position No. 1.
2. Remove the spark plugs.
3. Crank the engine while watching the neon tester:
   a. If the tester light is bright and steady, remove the No. 1 ignition coil for further testing as described in this chapter.
   b. If the tester light is dim, the No. 1 condenser is open.
   c. If there is no tester light, check the breaker point gap(s) and condition. Regap or replace as required.
4. Disconnect the No. 2 ignition coil blue/white lead (**Figure 18**) and repeat Steps 1-3 on 2-cylinder engines.

Component Testing

An ignition analyzer must be used for accurate testing of the breaker points, condenser(s), driver and ignition coil(s). Johnson and Evinrude recommend the use of the Merc-O-Tronic, Stevens ST-75 or Stevens M.A.-75 or M.A.-80. These can be purchased through your local Johnson or Evinrude

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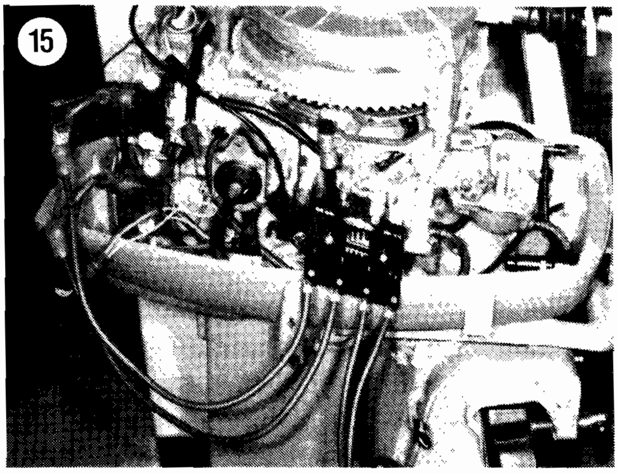

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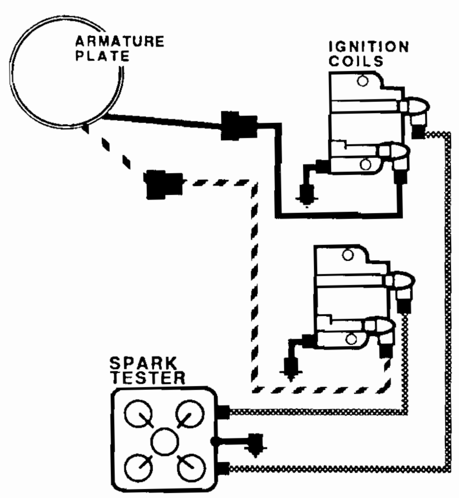
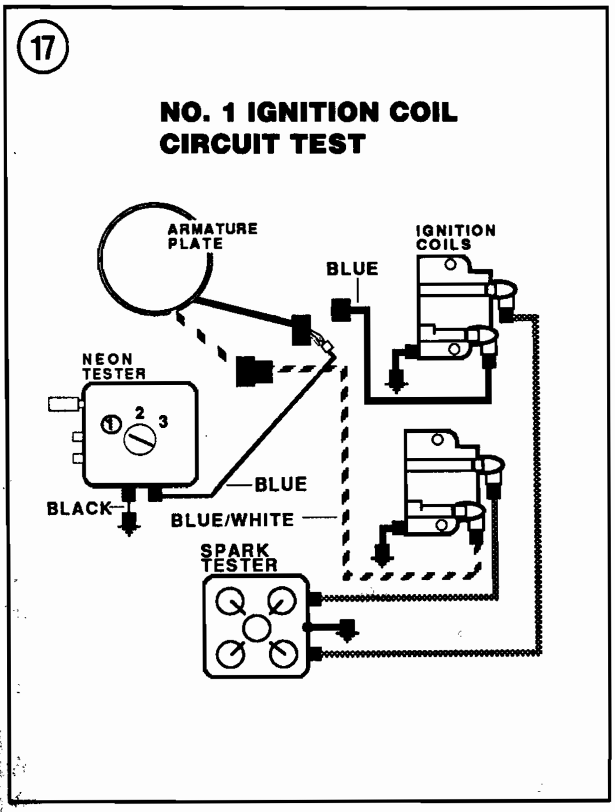
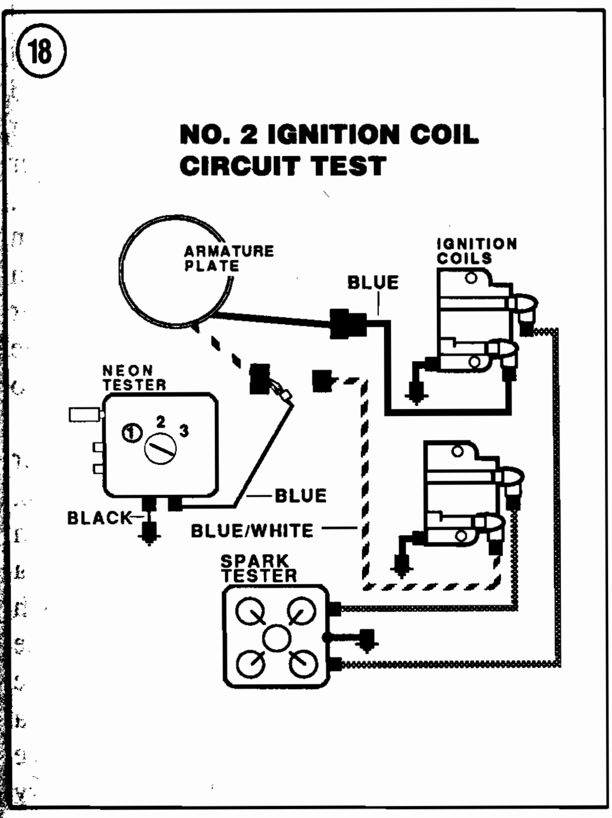
IGNITION SPARK TEST







dealer. Each analyzer includes detailed instructions for component testing as well as complete component specifications according to engine model and year of manufacture. The procedures given here are general in nature to acquaint you with component testing. Refer to the instructions provided with the particular analyzer to be used for the exact procedure.

Breaker Point Testing

1. Remove the flywheel. See Chapter Eight.
2. Disconnect the breaker point leads from the armature plate.
3. Connect one analyzer test lead to the breaker arm. Connect the other test lead to the breaker point screw terminal.
4. Set the analyzer controls according to manufacturer's instructions.
5. If the breaker points are good, the analyzer needle will rest in the "OK" segment (Merc-O-Tronic) or green segment (Stevens).
6. If the analyzer needle does not fall within the specified segment on the scale, clean the points with electrical contact cleaner and recheck the analyzer leads to make sure the connections are tight before discarding the points. The low current used in this test makes clean points and proper connections very important.

Condenser Testing

1. Remove the flywheel. See Chapter Eight.
2. Disconnect the condenser lead from the breaker point set.
3. Connect one analyzer test lead to the condenser lead. Connect the other test lead to the breaker plate.

WARNING
High voltage is involved in a condenser leakage test. Handle the analyzer leads carefully and turn the analyzer switch to DISCHARGE before disconnecting it from the condenser.

3

4. Set the analyzer controls according to manufacturer's instructions and check the condenser for leakage, resistance and capacity.
5. Compare the results in Step 4 with the specifications provided by the analyzer manufacturer. Replace the condenser if it fails any of the 3 tests.

Driver Coil Testing

1. Remove the flywheel. See Chapter Eight.
2. Disconnect the driver coil leads at the breaker points.
3. Connect an ohmmeter between the driver coil leads. Set the ohmmeter on the low ohms scale:
   a. Manual start models should show a resistance of 1.05-1.85 ohms (40 hp) 0.75-0.85 ohms (all others).
   b. Electric start models should show a resistance of 2.2-3.2 ohms.
4. Connect the ohmmeter between either driver coil lead and a good engine ground. Set the ohmmeter on the high ohms scale. If the ohmmeter does not read infinity, the driver coil or its leads are shorted to ground. Replace the driver coil. See Chapter Seven.

Ignition Coil Testing

WARNING
All coil tests should be performed on a wooden or insulated bench top to prevent shock hazards or leakage.

The ignition coil must be removed from the system before testing.
1. Remove the flywheel. See Chapter Eight.
2. Connect an ignition analyzer according to manufacturer's instructions.
3. Check the coil for continuity, power and leakage according to the analyzer manufacturer's instructions. Compare the results to the specifications provided with the analyzer. Replace the coil if it fails any of the 3 tests. See Chapter Seven.

CD 2 IGNITION TROUBLESHOOTING (EXCEPT 2.5 [1987-1988], ULTRA 4 AND EXCEL 4)

On models prior to 1985 the 4-wire connector plugs connect the charge and sensor coil leads to the power pack. The 3-wire connector plugs connect the power pack and ignition coils. On models after 1984 a 5-wire connector is used between the power pack and armature plate. No timing adjustments are required with a CD 2 ignition. Correct timing will be maintained as long as the wires are properly positioned in the connectors.

If the ignition system produces a satisfactory spark and the engine backfires but will not start, the ignition timing may be 180° off. On models prior to 1985, check to make sure the black/white wire in the 4-wire connector is positioned in connector terminal B. Also check to make sure the No. 1 coil (orange) wire is in the 3-wire connector B terminal and that it connects with the power pack (orange/blue) wire in the other connector B terminal. On models after 1984, check to make sure the black/white wire in the 5-wire connector is positioned in connector terminal B of both connector halves. Also check to make sure the orange/blue power pack lead is connected to the No. 1 ignition coil.

Jumper leads are required for troubleshooting. Fabricate 4 leads using 8 in. lengths of 16-gauge wire. Connect a pin (OMC part NO. 511469) at one end and a socket (OMC part No. 581656) with one inch of tubing (OMC part No. 519628) at the other. Ohmmeter readings should be made when the engine is cold. Readings taken on a hot engine will show increased resistance caused by heat and result in unnecessary parts replacement without solving the basic problem.

OMC states that output tests should be made with a Stevens CD-77 or Electro-Specialties PRV-1 voltmeter.

Stop Button Elimination Test

Prior To 1985

Refer to **Figure 19** for this procedure.

1. Connect a spark tester as shown in **Figure 19**. Set the tester air gap to 1/2 in.
2. Separate the power pack-to-ignition coil 3-wire connector. Insert a jumper wire between the connector B terminals. Insert a jumper wire between the connector C terminals.
3. Crank the engine with a starter rope while watching the spark tester. If there is no spark or a spark at only one gap, remove the jumper wires and reconnect the connector plugs. Perform the *Sensor Coil Resistance Test* as described in this chapter.
4. If a spark jumps both gaps alternately, the problem is in the stop button circuit or the emergency ignition cutoff switch.

Stop Button/Key Switch Elimination Test

After 1984

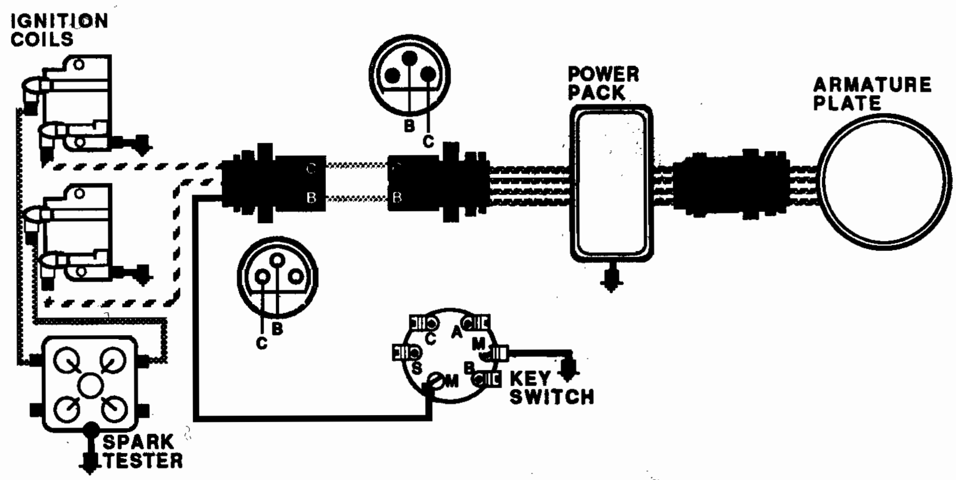
Refer to **Figure 20** for this procedure.

1. Connect a spark tester as shown in **Figure 20**. Set the tester air gap to 1/2 in.
2. Separate the power pack-to-armature plate 5-wire connector.
3. Insert jumper wires between the connector A, B, C and D terminals.
4. Crank the engine with a starter rope while watching the spark tester.
   a. If there is no spark at either gap, test the charge coil as described in this chapter.
   b. If there is a spark at only one gap, test the sensor coil as described in this chapter.
   c. If a spark jumps both gaps alternately, the problem is in the stop button circuit or the emergency ignition cutoff switch.

Sensor Coil Resistance Test

1. Separate the power pack-to-armature plate 4-wire connector. Insert jumper wires in terminals B and C of the armature plate end of the connector.

(19) **STOP BUTTON ELIMINATION TEST**



2. Connect an ohmmeter between the 2 jumper wires (**Figure 21**) and note the reading. If it is not 30-50 ohms, replace the sensor coil.
3. Set the ohmmeter on the high scale. Ground the black test lead at the armature plate and connect the red test lead to the C terminal jumper wire (**Figure 22**). The ohmmeter needle should not move. If it does, the sensor coil is grounded. Check for a grounded sensor coil lead before replacing the coil.
4. Remove the jumper wires and perform the *Charge Coil Resistance Test.*

Charge Coil Resistance Test

1. With the 4-terminal connector plug disconnected, insert jumper wires in terminals A and D of the armature plate end of the connector.
2. Connect an ohmmeter between the jumper wires (**Figure 23**) and note the reading. If it is not 500-600 ohms on models

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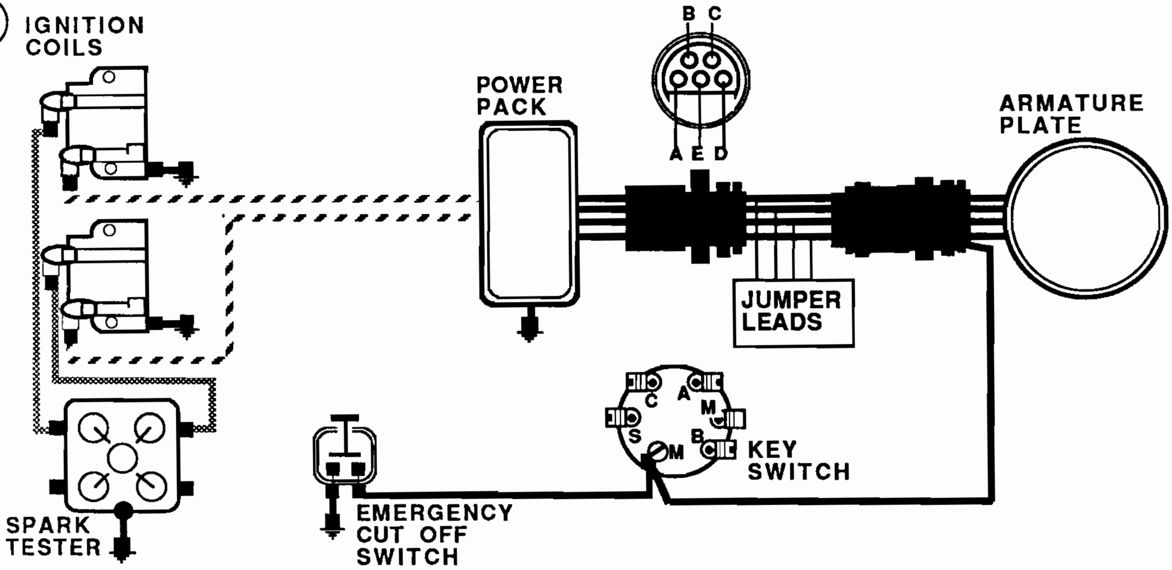

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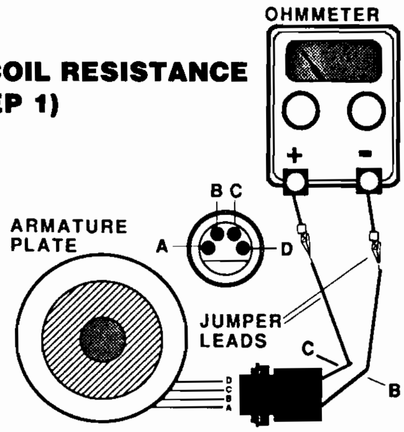
SENSOR COIL RESISTANCE TEST (STEP 1)



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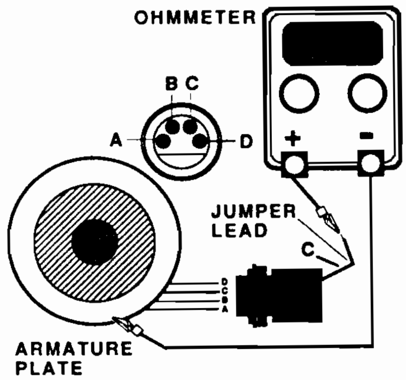
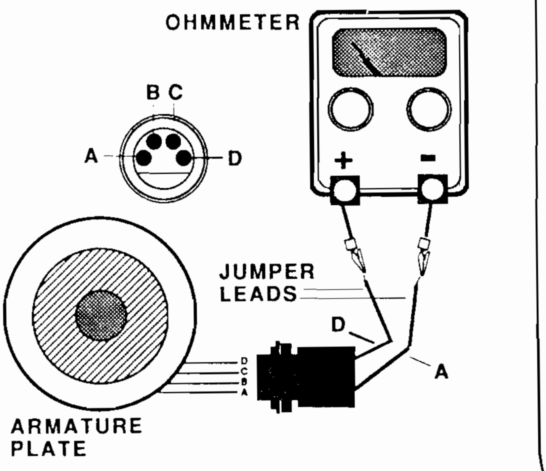
SENSOR COIL RESISTANCE TEST (STEP 2)



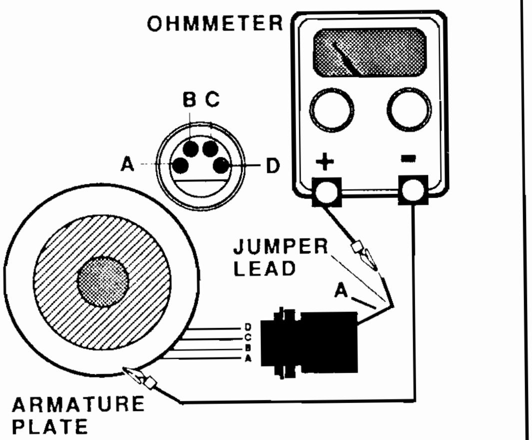
prior to 1985 (400-550 ohms for 1973-1982 electric start models) or 550-600 ohms on models after 1984, replace the charge coil.

3. Set the ohmmeter on the high scale. Ground the black test lead at the armature plate and connect the red test lead to the A terminal jumper wire (**Figure 24**). The ohmmeter needle should not move. If it does, the charge coil is grounded. Check for a grounded charge coil lead before replacing the coil.

(23) **CHARGE COIL RESISTANCE TEST (STEP 1)**



(24) **CHARGE COIL RESISTANCE TEST (STEP 2)**



Charge Coil Output Test

Refer to **Figure 23** for this procedure.

1. Disconnect the 4-wire connector. Set the CD voltmeter switches to NEGATIVE and 500. Insert the red test lead in cavity A of the armature plate end of the connector. Ground the black test lead at the armature plate. 3
2. Crank the engine and note the meter reading.
3. Move the red test lead to cavity D of the connector and crank the engine again. Note the meter reading.
4. There should be no meter reading in Step 2 or Step 3. If there is, the charge coil is grounded. Check for a grounded charge coil lead before replacing the coil.
5. Leave the red test lead in cavity D of the connector. Remove the black test lead from the armature plate and insert it in cavity A of the connector.
6. Crank the engine and note the meter reading. If it is less than 230 volts, replace the charge coil.

Sensor Coil Output Test

Refer to **Figure 25** for this procedure.

1. Disconnect the 4-wire connector on models prior to 1985 and the 5-wire connector on models after 1984. Set the CD voltmeter switches to S and 5. Insert the red test lead in cavity C of the armature plate end of the connector. Ground the black test lead at the armature plate.
2. Crank the engine and note the meter reading.
3. Move the red test lead to cavity B of the connector and crank the engine again. Note the meter reading.
4. There should be no meter reading in Step 2 or Step 3. If there is, the sensor coil is

grounded. Check for a grounded sensor coil lead before replacing the coil.

5. Leave the red test lead in cavity B of the connector. Remove the black test lead from the armature plate and insert it in cavity C of the connector.

6A. Prior to 1985—Crank the engine and note the meter reading. If it is less than 0.3 volts, replace the sensor coil.

6B. After 1984—Crank the engine and note the meter reading. If it is less than 2 volts, check the component wiring and connector. Repair or replace as required, then retest. If wiring and connector are satisfactory, replace the sensor coil.

Power Pack Output Test

Prior to 1985

Refer to **Figure 27** for this procedure.

1. Disconnect the 3-wire connector. Set the CD voltmeter switches to NEGATIVE and

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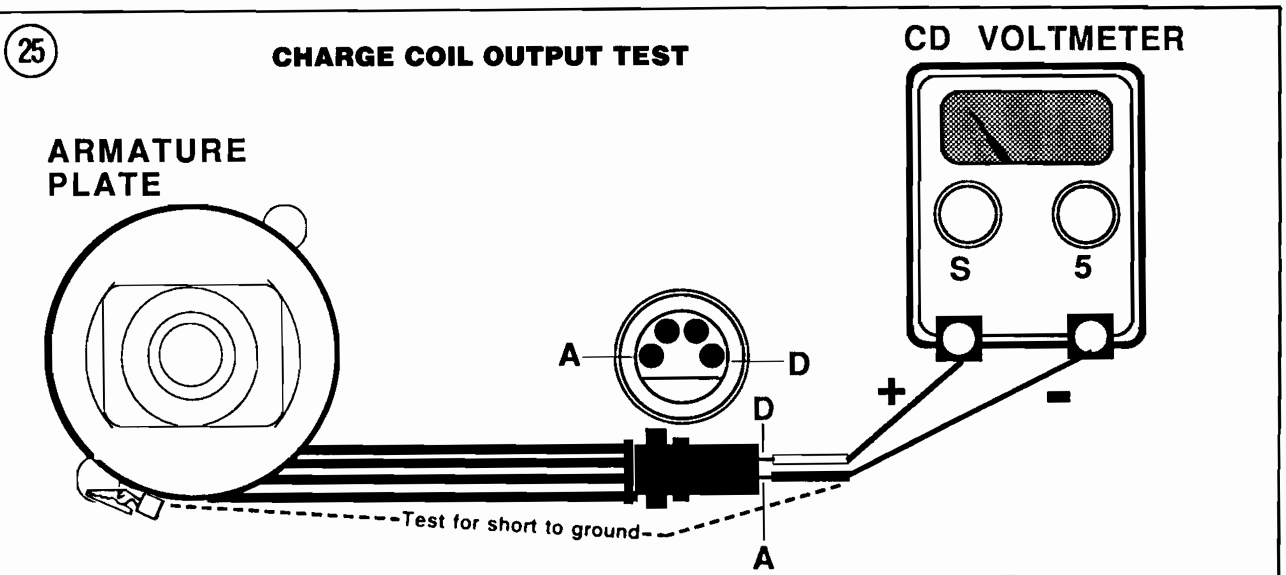
CHARGE COIL OUTPUT TEST



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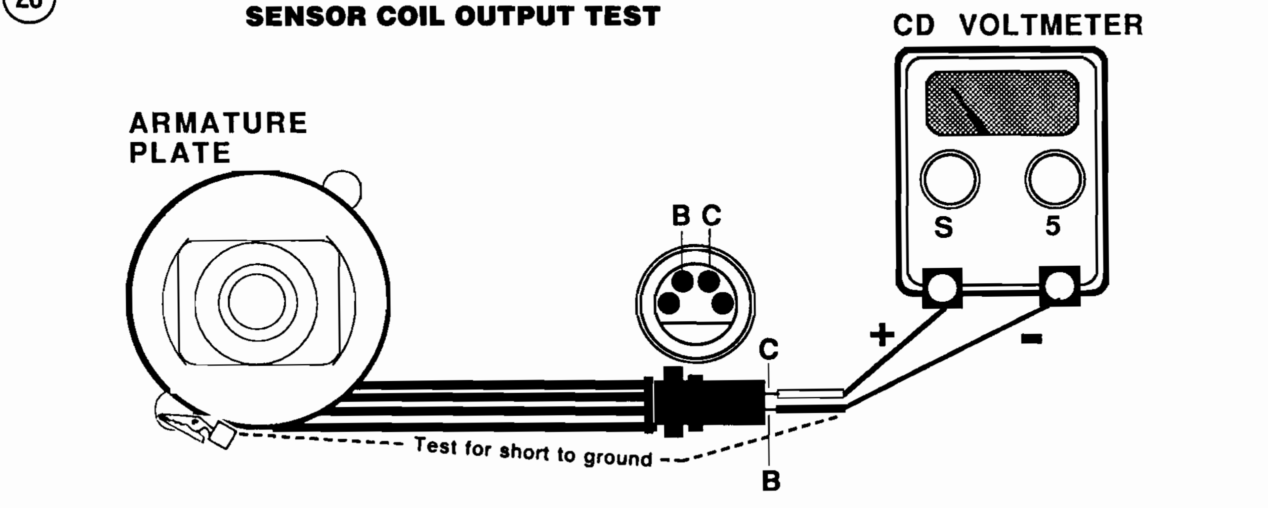
SENSOR COIL OUTPUT TEST



500. Insert jumper wires between terminals B and C of the connector.

2. Connect the red test lead to the jumper lead at terminal B and ground the black test lead.

3. Crank the engine and note the meter reading.

4. Move the red test lead to the jumper lead at terminal C. Crank the engine and note the meter reading.

5. If the meter reading is 180 volts or more in Step 3 or Step 4, check the ignition coil(s). If there is no reading, the power pack is probably defective. Substitute a known-good power pack and repeat the procedure.

After 1984

Refer to **Figure 28** for this procedure.

1. Set the CD voltmeter switches to NEGATIVE and 500.

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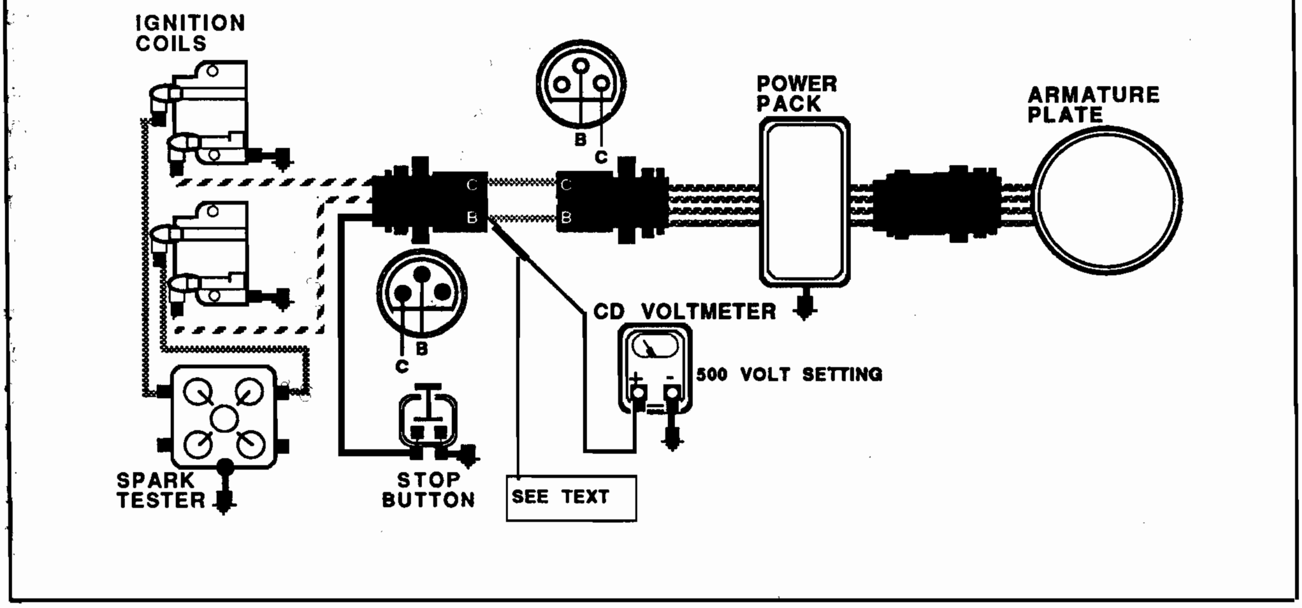
POWER PACK OUTPUT TEST



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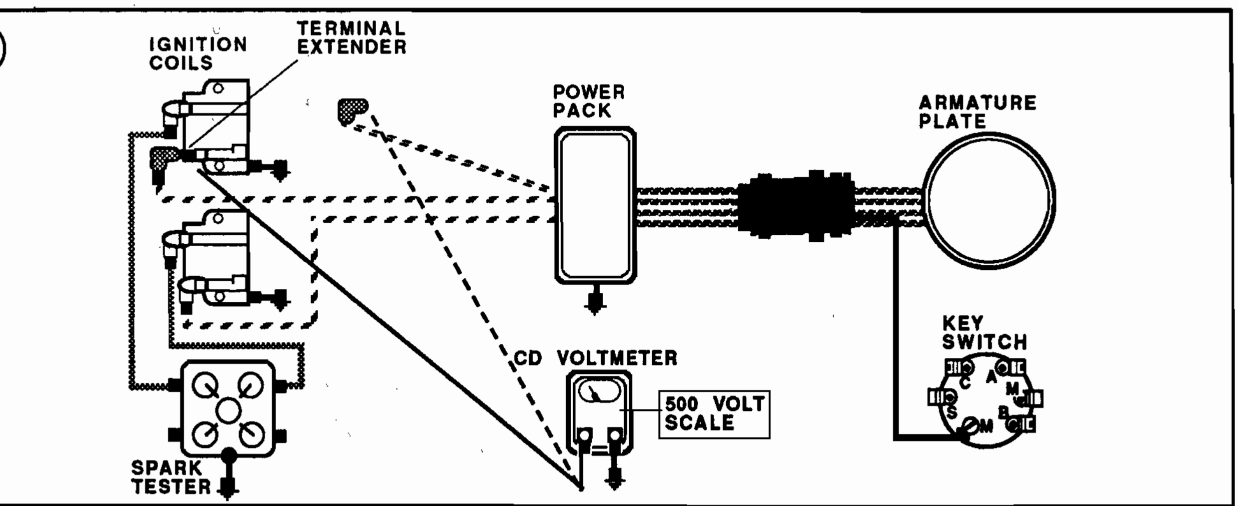


2. Disconnect the ignition coil primary leads. Install a terminal extender (**Figure 28**) on each coil terminal, then reconnect the primary leads.
3. Connect the black test lead to a good engine ground. Connect the red test lead to the metal portion of the No. 1 coil terminal extender. Crank the engine and note the meter reading.
4. The meter should read 200 volts or more in Step 3. If it does not, disconnect the coil primary lead from the terminal extender. Connect the red test lead directly to the spring clip in the primary lead boot. Crank the engine and note the meter reading.
   a. If the meter now reads at least 200 volts, test the ignition coil as described in this chapter.
   b. If the meter still reads less than 200 volts, check the spring clip and primary lead condition. Repair or replace as required, then retest. If condition is satisfactory, replace the power pack.
5. Repeat Step 3 with the red test lead on the metal portion of the No. 2 coil terminal extender. If the reading is less than 200 volts, repeat Step 4.
6. Disconnect the primary leads, remove the terminal extenders from the coil terminals and reconnect the primary leads. Make sure the orange/blue lead is connected to the No. 1 ignition coil.

Ignition Coil Resistance Test

Prior To 1985

1. Disconnect the high tension lead at the ignition coil.
2. Disconnect the 3-wire connector. Insert a jumper lead in terminal B of the ignition coil end of the connector.
3. Connect the ohmmeter red test lead to the B terminal jumper lead. Connect the black test lead to a good engine ground. The meter should read 0.1 ±0.05 ohms.
4. Set the ohmmeter on the high scale. Move the black test lead to the ignition coil high tension terminal. The meter should read 225-325 ohms.
5. If the readings are not as specified in Step 3 or Step 4, replace the No. 1 ignition coil.
6. Move the jumper lead from terminal B to terminal C and repeat the procedure to test the No. 2 ignition coil.

After 1984

1. Disconnect the primary and high tension (secondary) coil leads at the ignition coil to be tested.
2. With an ohmmeter set on the low scale, connect the red test lead to the coil primary terminal. Connect the black test lead to a good engine ground (if the coil is mounted) or the coil ground tab (if the coil is unmounted). The meter should read 0.1 ±0.05 ohms.
3. Set the ohmmeter on the high scale. Move the black test lead to the ignition coil high tension terminal. The meter should read 225-325 ohms for 1984 models and 250-300 ohms for models later than 1984.
4. If the readings are not as specified in Step 2 or Step 3, replace the ignition coil. See Chapter Seven.

CD 2 IGNITION TROUBLESHOOTING (2.5 [1987-1988], ULTRA 4 AND EXCEL 4)

Total Output Test

1. Disconnect the spark plug leads.
2. Connect a spark gap tester between the disconnected plug leads and a good engine ground. Set the tester gap to 3/8 in.
3. Crank the engine with the starter rope while watching the spark tester. A spark should jump each gap alternately. If there is no spark or a weak spark at either gap, continue testing.

Stop Button Elimination Test

1. Disconnect the black lead at the power pack.
2. Crank the engine with the spark tester installed.
   a. If there is no spark at either gap, test the sensor coil as described in this chapter.
   b. If there is a spark at only one gap, test the power pack as described in this chapter.
   c. If a spark jumps both gaps alternately, the problem is in the stop button circuit.

Stop Button Circuit Test

1. Disconnect the black lead at the power pack.
2. Connect an ohmmeter between the disconnected lead and a good engine ground.
3. Without depressing the button, the meter should show a very high reading. If the reading is very low, replace the stop button and harness.
4. Depress the stop button. If the meter does not show a very low reading, replace the stop button and harness.

Sensor Coil Ground Test

1. Disconnect the black wire (white tracer) and white wire (black tracer) at the power pack.
2. Set the CD voltmeter switches to S and 5. Connect the red test lead to one sensor lead and the black test lead to a good engine ground.
3. Crank the engine and note the meter. There should be no reading.
4. Move the red test lead to the other sensor lead and crank the engine. Again, there should be no reading.
5. If the voltmeter shows a reading at either sensor lead, check for a grounded sensor coil or lead. If found, correct. If the coil or lead is not grounded, replace the sensor coil.

Sensor Coil Output Test

1. Disconnect the black wire (white tracer) and white wire (black tracer) at the power pack.
2. Set the CD voltmeter switches to S and 5. Connect the red test lead to one sensor lead and the black test lead to the remaining sensor wire.
3. Crank the engine and note the meter reading.
4. Reverse the meter leads and repeat Step 3.
   a. If the meter reading is less than 4 volts on either test, check for a problem in the component wiring and/or connectors. If one is found, correct and retest. If a problem is not found, perform the *Sensor Coil Resistance Test* in this chapter.
   b. If the meter reading is 4 volts or more, test the power pack as described in this chapter.

Sensor Coil Resistance Test

1. Disconnect the black wire (white tracer) and white wire (black tracer) at the power pack.
2. Connect an ohmmeter between the disconnected wires. If the reading is not 85-115 ohms, replace the sensor coil.
3. Set the ohmmeter on the high scale. Connect the black test lead to a good ground. Alternately connect the red test lead to each disconnected sensor lead.
4. If the ohmmeter shows a reading at either sensor lead, check for a grounded sensor coil or lead. If found, correct. If the coil or lead is not grounded, replace the sensor coil.

Power Pack Output Test

1. Set the CD voltmeter switches to NEGATIVE and 500.

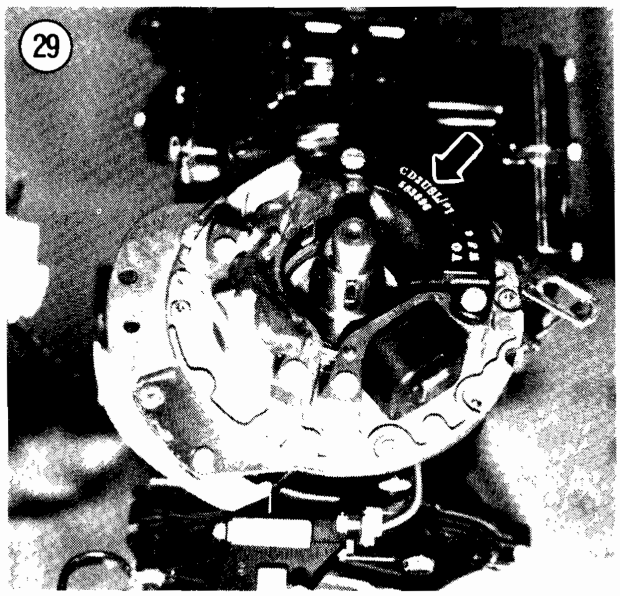
2. Disconnect the ignition coil primary leads. Install a terminal extender (**Figure 28**) on each coil terminal, then reconnect the primary leads.
3. Connect the black test lead to a good engine ground. Connect the red test lead to the metal portion of the No. 1 coil terminal extender. Crank the engine and note the meter reading.
4. The meter should read 125 volts or more in Step 3. If it does not, disconnect the coil primary lead from the terminal extender. Connect the red test lead directly to the spring clip in the primary lead boot. Crank the engine and note the meter reading.
   a. If the meter now reads at least 125 volts, test the ignition coil as described in this chapter.
   b. If the meter still reads less than 125 volts, check the spring clip and primary lead condition. Repair or replace as required, then retest. If condition is satisfactory, replace the power pack.
5. Repeat Step 3 with the red test lead on the metal portion of the No. 2 coil terminal extender. If the reading is less than 125 volts, repeat Step 4.
6. Disconnect the primary leads, remove the terminal extenders from the coil terminals and reconnect the primary leads. Make sure the orange/blue lead is connected to the No. 1 ignition coil.

CD2UL IGNITON TROUBLESHOOTING (1989-1990 4 DELUXE-40 HP MODELS)

The CD2UL ignition system is completely contained under the flywheel with the exception of the ignition coils. The breakdown of the CD2UL model number is as follows: CD-capacitor discharge; 2-two cylinders; U-under the flywheel; L-contains rpm rev. limiter. Some model numbers may also contain a "S" inserted between the "U" and the "L." The "S" means the system contains the S.L.O.W. (speed limiting overheat warning) mode. S.L.O.W. is available on 1989 20-40 hp models. Ignition system model number is printed on top of ignition module located beneath engine flywheel. The ignition module incorporates the power pack and the sensor coil into one assembly instead of two assemblies as on CD 2 ignition systems. See **Figure 29**.

Ignition System Output Test

1. Remove spark plug leads from spark plugs.
2. Mount a spark tester on the engine and connect a tester lead to each spark plug lead. Set the spark tester air gap to 1/2 in. See **Figure 30**.
3. Connect ignition system emergency cutoff clip and lanyard if so equipped.
4. Crank the engine over while watching the spark tester. If a spark jumps at each air gap, test the ignition system as outlined under *Running Output Test* in this chapter.
5. If a spark jumps at *only* one air gap, first make sure all connections are good, then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retest. If only one spark is noted, test ignition system as outlined under *Ignition Plate Output Test* in this chapter.

6. If *no* spark jumps at either spark tester air gap, first make sure all connections are good, then retest. If no spark is noted, test ignition system as outlined under *Stop Circuit Test* in this chapter.

Stop Circuit Test

1. Connect spark tester as outlined under *Ignition System Output Test*.

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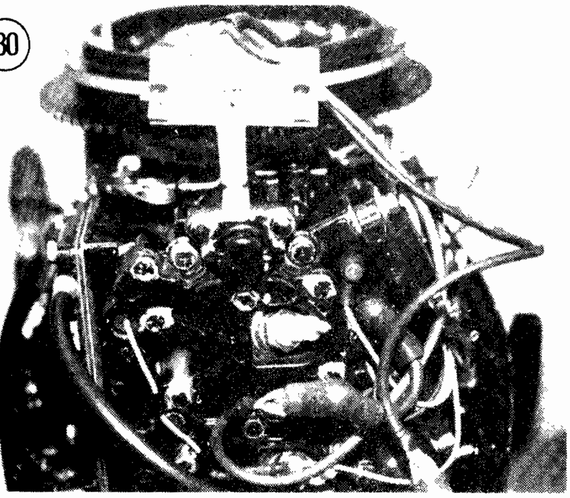

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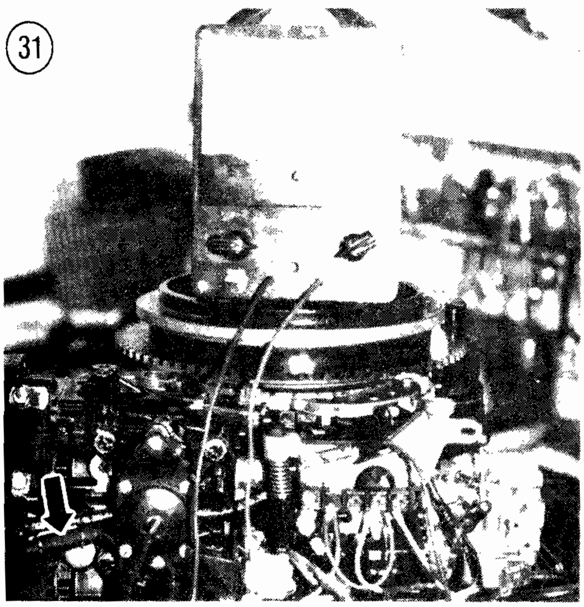

2. Disconnect stop circuit connector. See **Figure 31**.
3. Make sure ignition system emergency cutoff clip and lanyard are installed if so equipped.
4. Crank the engine over while watching the spark tester. If a spark jumps at each air gap, test the stop circuit using the following ohmmeter tests. If *no* spark jumps at either spark tester air gap, first make sure all connections are good, then retest. If no spark is noted, test ignition system as outlined under *Ignition Plate Output Test* in this chapter.
5. Calibrate an ohmmeter to Rx100 scale.
6. Connect one ohmmeter lead to the terminal end of stop circuit connector (**Figure 31**) which leads to tiller handle stop button.
7. Connect remaining ohmmeter lead to a good engine ground.
8. Note ohmmeter. No continuity or infinite resistance should be noted. If continuity is noted, look for a short in the wiring and if not found, replace stop button assembly.

9. Depress stop button or remove stop button clip and note ohmmeter. Continuity (near zero resistance) should be noted. If continuity is not noted, look for an open in the wiring and if not found, replace stop button assembly.

Ignition Plate Output Test

WARNING
Disconnect spark plug leads to prevent accidental starting.

1. Remove primary leads from ignition coils.
2. Connect No. 1 cylinder ignition coil primary lead to the red lead of Stevens load adapter No. PL-88 and the black lead of load adapter to a good engine ground. See **Figure 32**.

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3. Connect the red lead of a peak-reading voltmeter to the connector end of the red lead on Stevens load adapter No. PL-88. Connect the black lead of the peak-reading voltmeter to a good engine ground.
4. Set the peak-reading voltmeter on "POS" and "500."
5. Crank the engine over while noting the peak-reading voltmeter. The meter should show at least 175 volts.
6. Repeat Steps 2-5 for No. 2 cylinder ignition coil primary lead.
7. If both primary leads show at least 175 volts, then refer to *Ignition Coil Resistance Test* in this chapter.
8. If only one primary lead shows at least 175 volts, the ignition module must be replaced. Refer to Chapter Seven.
9. If neither primary lead shows sufficient output, then refer to *Charge Coil Resistance Test* in this chapter.

Charge Coil Resistance Test

WARNING
Disconnect spark plug leads to prevent accidental starting.

1. Remove automatic rewind starter, if so equipped, and engine flywheel. Refer to Chapter Eight.
2. Remove the two ignition module mounting screws.
3. Raise ignition module to expose the two bullet connectors. See **Figure 33**.
4. Disconnect the two bullet connectors.
5. Calibrate an ohmmeter to Rx100 scale.
6. Connect one ohmmeter lead to the terminal of the brown wire leading to the charge coil and connect the remaining ohmmeter lead to the terminal of the brown/yellow wire leading to the charge coil.
7. The ohmmeter should show between 535-585 ohms.
8. To test [illegible] ground, connect [illegible] good engine [illegible] the ohmmeter [illegible] of the brown and [illegible] leading from the charge coil.
9. No [illegible] should be [illegible]
10. [illegible] not within [illegible]
11. [illegible] the ignition [illegible]

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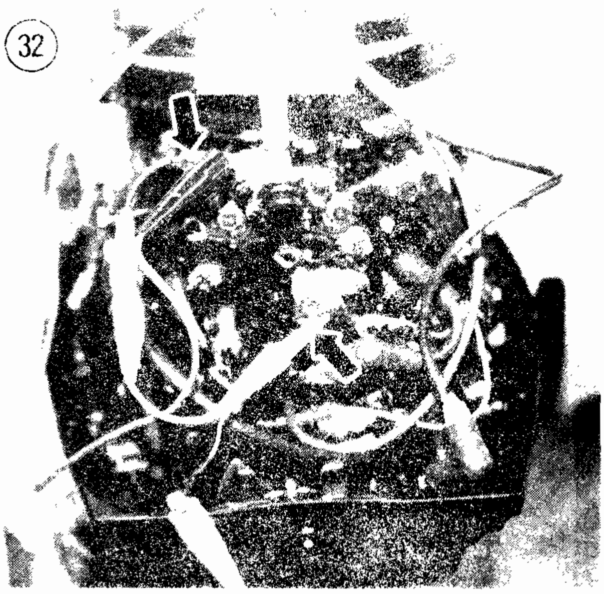

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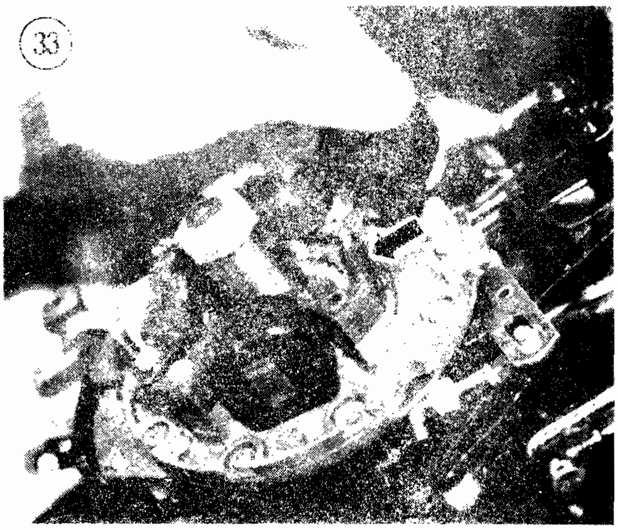

Running Output Test

1. Remove primary leads from ignition coils and connect Stevens terminal extenders No. TS-77 to ignition coil, then reconnect primary leads.
2. Connect the red lead of a peak-reading voltmeter to the No. 1 cylinder ignition coil terminal extender. Connect the black lead of the peak-reading voltmeter to a good engine ground.
3. Set the peak-reading voltmeter on "POS" and "500."
4. Make sure the outboard motor is mounted in a suitable test tank or testing fixture with a suitable loading device (test wheel or dynometer).
5. Start the engine and operate at the rpm ignition trouble is suspected.
6. The peak-reading voltmeter should show at least 200 volts.
7. Repeat Steps 2-6 to test No. 2 cylinder.
8. If either cylinder shows less than 200 volts, test charge coil as outlined under *Charge Coil Resistance Test* in this chapter.

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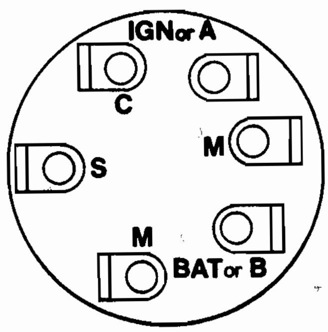
IGNITION SWITCH CONNECTORS



9. If charge coil test good, then replace ignition module. Refer to Chapter Seven.
10. Remove ignition coil terminal extenders, then reconnect primary leads.

Ignition Coil Resistance Test

1. Disconnect the primary and high tension (secondary) coil leads at the ignition coil to be tested.
2. With an ohmmeter set on the low scale, connect the red test lead to the coil primary terminal. Connect the black test lead to a good engine ground (if the coil is mounted) or the coil ground tab (if the coil is unmounted). The meter should read 0.1 ±0.05 ohms.
3. Set the ohmmeter on the high scale. Move the black test lead to the ignition coil high tension terminal. The meter should read 250-300 ohms.
4. If the readings are not as specified in Step 2 or Step 3, replace the ignition coil. See Chapter Seven.

IGNITION AND NEUTRAL START SWITCH

The ignition and neutral start switches can be tested with a self-powered test lamp or ohmmeter. If defective, replace the ignition switch with a marine switch. Do not use an automotive ignition switch.

Ignition Switch Test

Refer to **Figure 34** for this procedure.

1. Disconnect the negative battery lead. Disconnect the positive battery lead.
2. Connect a test lamp or ohmmeter leads between the BATT and A switch terminals. With the switch in the OFF position, there should be no continuity.
3. Turn the switch to the ON position. The test lamp should light or the meter show continuity.

4. Turn the switch to the START position. The test lamp should light or the meter show continuity.
5. Hold the switch key in the START position and move the test lead from terminal A to terminal S. The test lamp should light or the meter show continuity.
6. Turn the switch off. Move the test leads to the 2 terminals marked M. The test lamp should light or the meter show continuity.
7. Turn the switch first to the START, then to the ON position. There should be no continuity in either position.
8. Turn the switch OFF. Move the test leads to terminal B and terminal C. Turn the switch ON. There should be no continuity. If equipped with a choke primer system, push inward on the key and the test lamp should light or the meter show continuity.
9. Repeat Step 8 with the switch in the START position. The results should be the same.

NOTE
It is possible the switch may pass this test but still have an internal short. If the switch passes but does not function properly, have it leak-tested by a dealer.

10. Replace the switch if it fails any of the steps in this procedure.

Neutral Start Switch Test and Adjustment (9.9 and 15 hp)
Prior to 1985

Switch adjustment is possible only when the manual interlock cam and lockout lever/hub adjustments have not been disturbed. See *Shift Lever Adjustment*, Chapter Nine. Refer to **Figure 35** for this procedure.

1. Disconnect the negative battery cable.
2. Remove the engine cover.
3. Shift into NEUTRAL.
4. Disconnect the starter motor cable.
5. Connect one ohmmeter test lead to the starter motor cable. Connect the other test lead to a good engine ground.
6. Depress the starter button. The test lamp should light or the ohmmeter show continuity.
7. Shift into FORWARD. Depress the starter button. There should be no continuity.

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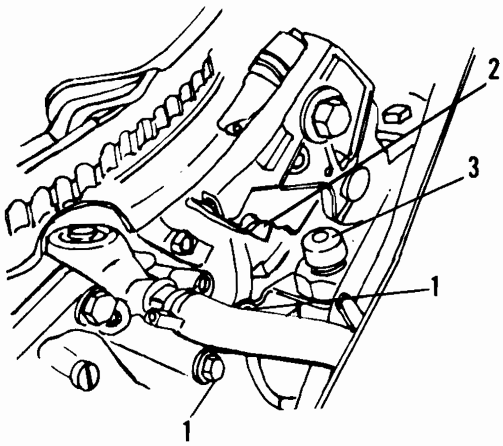
NEUTRAL START SWITCH (9.9-15 HP)



1. Adjusting screws
2. Lockout lever in neutral
3. Plunger

Repeat this step after shifting into REVERSE.

8. If continuity is shown in Step 7:
   a. Remove the fuel pump and move it out of the way. See Chapter Six.
   b. Loosen the neutral start switch screws.
   c. With the shift lever in NEUTRAL, center the plunger switch with its lobe on the lockout lever, then raise the switch to depress its plunger 3/32-5/32 in.
   d. Repeat Step 6 and Step 7 to check adjustment.
9. Reinstall fuel pump. Install engine cover. Connect the negative battery cable.

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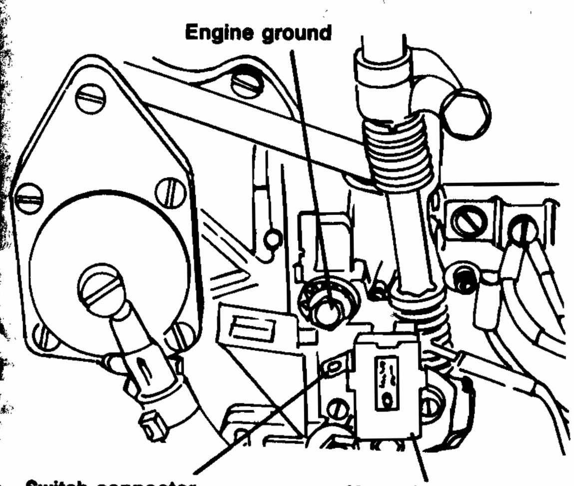
NEUTRAL START SWITCH (18-35 HP)



After 1984

Switch adjustment is possible only when the manual interlock cam and lockout lever/hub adjustments have not been disturbed. See *Shift Lever Adjustment*, Chapter Nine. Refer to **Figure 35** for this procedure.

1. Disconnect the negative battery cable.
2. Remove the engine cover.
3. Shift into NEUTRAL.
4. Disconnect the starter motor cable.
5. Connect one ohmmeter test lead to the starter motor cable. Connect the other test lead to the neutral start switch lead at the terminal board.
6. The test lamp should light or the ohmmeter show continuity.
7. Shift into FORWARD. There should be no continuity. Repeat this step after shifting into REVERSE.
8. If continuity is shown in Step 7:
   a. Remove the fuel pump and move it out of the way. See Chapter Six.
   b. Loosen the neutral start switch screws.
   c. With the shift lever in NEUTRAL, center the plunger switch with its lobe on the lockout lever, then raise the switch to depress its plunger 0.090-0.150 in.
   d. Repeat Step 6 and Step 7 to check adjustment.
9. Reinstall fuel pump. Install engine cover. Connect the negative battery cable.

Neutral Start Switch Test and Adjustment (25 and 30 hp TE Models)

Refer to **Figure 36** for this procedure.

1. Disconnect the negative battery cable.
2. Remove the engine cover.

3

3. Disconnect the yellow/red lead at the neutral start switch.
4. Connect an ohmmeter or test lamp between the switch and ground (**Figure 36**).
5. With the shift lever in NEUTRAL, the test lamp should light or the meter show continuity.
6. Shift into FORWARD and then REVERSE. There should be no continuity shown in either gear.
7. If continuity is shown in Step 6.
   a. Shift into NEUTRAL.
   b. Loosen the 2 neutral start switch screws and insert a 1/16 in. drill bit between the top of the plunger and bottom of the switch. Move the switch until the switch and plunger contact the drill bit, then tighten the screws securely.
   c. Shift into FORWARD and then REVERSE. If the light or meter shows continuity in either gear, replace the switch.

Neutral Start Switch Test and Adjustment (All Other 18-35 hp)

Refer to **Figure 36** for this procedure.
1. Disconnect the negative battery cable.
2. Remove the engine cover.
3. Disconnect the switch-to-solenoid lead at the switch.
4. Connect an ohmmeter or test lamp between the switch and ground (**Figure 36**).
5. With the shift lever in NEUTRAL, the test lamp should light or the meter show continuity.
6. Shift into FORWARD and then REVERSE. There should be no continuity shown in either gear.

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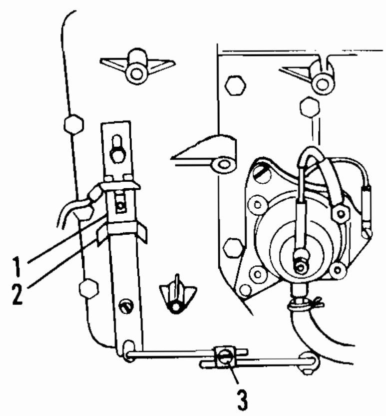
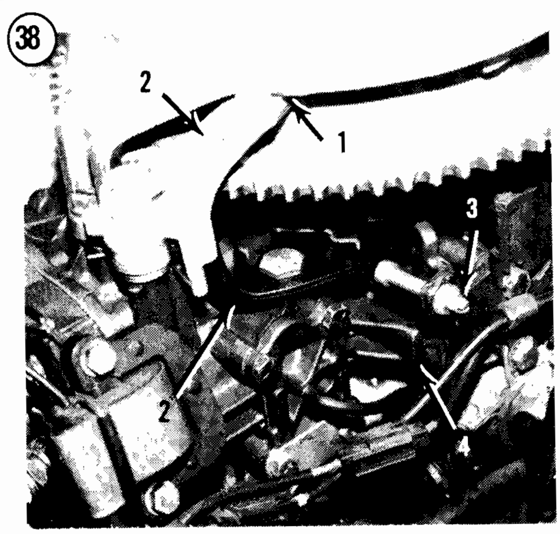
NEUTRAL SAFETY SWITCH ADJUSTMENT



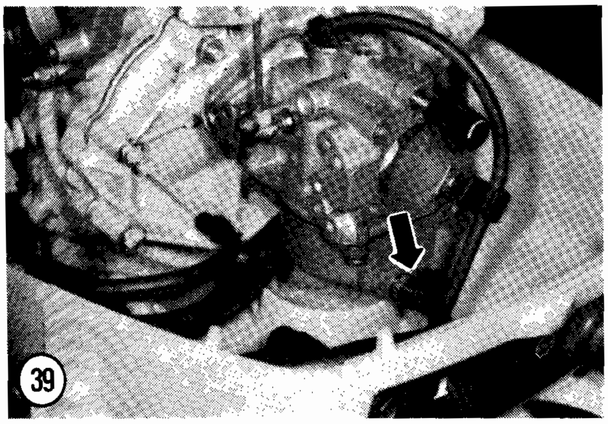
1. Neutral safety switch
2. Cam
3. Adjustment screw

7. If continuity is shown in Step 6:
   a. Shift into NEUTRAL.
   b. Loosen the switch locknut and turn the adjustment screw until the test light or meter shows continuity.
   c. Shift into FORWARD and then REVERSE. If the light or meter shows continuity in either gear, replace the switch.



NEUTRAL SAFETY SWITCH ADJUSTMENT

1. Starter pulley lug
2. Locking levers
3. Adjustment screw and nut
4. Shifter lock



Neutral Start Switch Test and Adjustment (40 hp Electric Start)

Refer to **Figure 37** for this procedure.

1. Remove the engine cover.
2. Place shift lever in NEUTRAL.
3. Check the lockout lever cam. It should be centered under the neutral switch plunger.
4. If adjustment is required, loosen the linkage screw and position the cam lever, then tighten the screw.

Neutral Start Switch Test and Adjustment (40 hp Manual Start)

Refer to **Figure 38** for this procedure.

1. Remove the engine cover.
2. Place shift lever in NEUTRAL.
3. Check clearance between lockout lever and starter pulley lugs. 3
4. If clearance is not 0.030-0.060 in., loosen the shifter locknut and adjust the screw to bring it within specifications, then tighten the locknut.

FUEL SYSTEM

Many outboard owners automatically assume the carburetor is at fault when the engine does not run properly. While fuel system problems are not uncommon, carburetor adjustment is seldom the answer. In many cases, adjusting the carburetor only compounds the problem by making the engine run worse.

Fuel system troubleshooting should start at the gas tank and work through the system, reserving the carburetor(s) as the final point. The majority of fuel system problems result from an empty fuel tank, sour fuel, a plugged fuel filter or a malfunctioning fuel pump. **Table 3** provides a series of symptoms and causes that can be useful in localizing fuel system problems.

Troubleshooting

As a first step, check the fuel flow. Remove the fuel tank cap and look into the tank. If there is fuel present, disconnect and ground the spark plug lead(s) as a safety precaution. Disconnect the fuel line at the carburetor (**Figure 39**, typical) and place it in a suitable container to catch any discharged fuel. See if gas flows freely from the line when the primer bulb is squeezed.

If there is no fuel flow from the line, the fuel petcock may be shut off or blocked by rust or foreign matter, the fuel line may be stopped up or kinked or a primer bulb check valve may be defective. If a good fuel flow is present, crank the engine 10-12 times to check fuel pump operation. A pump that is operating satisfactorily will deliver a good, constant flow of fuel from the line. If the amount of flow varies from pulse to pulse, the fuel pump is probably failing.

Carburetor chokes can also present problems. A choke that sticks open will show up as a hard starting problem; one that sticks closed will result in a flooding condition.

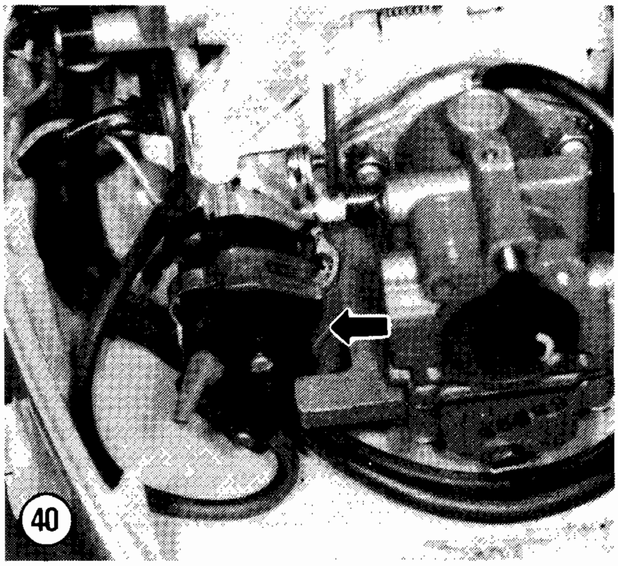
During a hot engine shut-down, the fuel bowl temperature can rise above 200°, causing the fuel inside to boil. While marine carburetors are vented to atmosphere to prevent this problem, there is a possibility some fuel will percolate over the high-speed nozzle.

A leaking inlet needle and seat or a defective float will allow an excessive amount of fuel into the intake manifold. Pressure in the fuel line after the engine is shut down forces fuel past the leaking needle and seat. This raises the fuel bowl level, allowing fuel to overflow into the manifold.

Excessive fuel consumption may not necessarily mean an engine or fuel system problem. Marine growth on the boat's hull, a bent or otherwise damaged propeller or a fuel line leak can cause an increase in fuel consumption. These areas should all be checked *before* blaming the carburetor.

Electric Primer System

A primer solenoid is used on 1984-on 20-40 hp electric models. See **Figure 40**. When the key is inserted in the ignition switch and depressed, the solenoid opens electrically and allows fuel to pass from the fuel pump into the carburetor in sufficient quantity to start the engine.

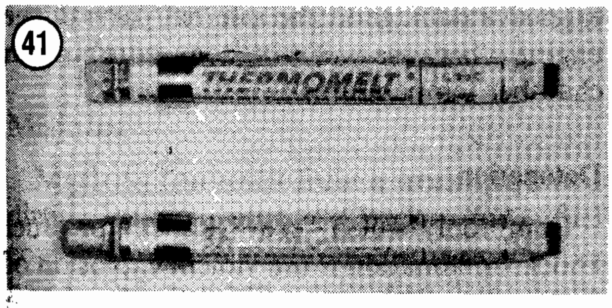


The primer solenoid operation can be checked by running the engine at approximately 2,000 rpm and depressing the ignition key. If the solenoid is functioning properly, the engine will run rich and drop about 1,000 rpm until the key is released. If the solenoid is suspected of not operating properly, shut the engines off and disconnect the purple/white wire at the terminal board. Connect an ohmmeter between the purple/white wire and the black primer solenoid ground lead. The ohmmeter should read 4-6 ohms. If the solenoid does not perform as described, remove and repair or replace it. See Chapter Six.

ENGINE TEMPERATURE AND OVERHEATING

Proper engine temperature is critical to good engine operation. An engine that runs too hot will be damaged internally. One that operates too cool will not run smoothly or efficiently.

A variety of problems can cause engine overheating. Some of the most commonly encountered are a defective thermostat, low



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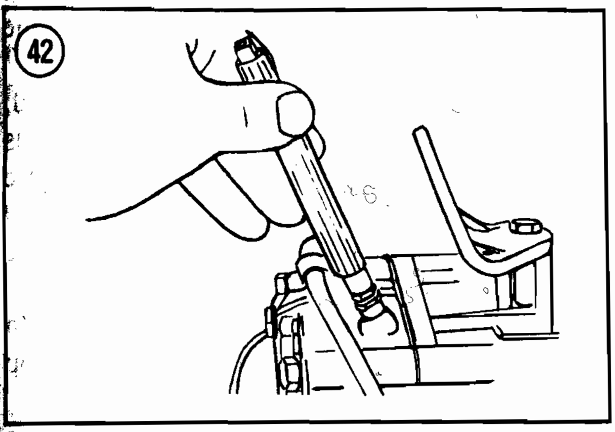
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output or defective water pump, damaged or mispositioned water passage restrictors or even engine flashing in the cylinder head casting water discharge passage that was not removed during manufacture.

The flashing problem is most common in 1976 and later 25-35 hp engines. It can be easily diagnosed by running the engine at 3,000 rpm in a test tank. If the water discharged by the pump indicator hose indicates that the water pump is satisfactory, check the water spray from the exhaust relief on the back of the exhaust housing. If there is little or none, remove the cylinder head water cover (see Chapter Eight) and check the water discharge passage at the bottom of the head for flashing. If found, it can be removed with a small punch or sharp knife.

Troubleshooting

Engine temperature can be checked with the use of Markal Thermomelt Stiks available at your Johnson or Evinrude dealer. This heat-sensitive stick looks like a large crayon (**Figure 41**) and will melt on contact with a metal surface at a specific temperature.

Three thermomelt sticks are required to properly check a Johnson or Evinrude outboard according to model: a 100° F (37° C) stick, a 125° F (52° C) stick and a 163° F (73° C) stick. The stick should not be applied to the center of the cylinder head, as this area is normally hotter than 163° F.

NOTE

Use the 100° F and 163° F stick(s) with 1984-on 8 hp and under models. Use the 125° F and 163° F stick(s) with all others.

The test is most efficient when carried out on a motor operating on a boat in the water. If necessary to perform the test using a test tank, run the engine at 3,000 rpm for a minimum of 5 minutes to bring it to operating temperature. Make sure inlet water temperature is below 80° F (26° C) and perform the test as follows.

1. Mark the cylinder water jacket with each stick (**Figure 42**). The mark will appear similar to a chalk mark. Make sure sufficient material is applied to the metal surface.
2. With the engine at operating temperature and running at idle in FORWARD gear, the 100° F (1984-on 8 hp and under) or 125° F (all others) stick mark should melt. If it does not melt on thermostat-equipped models (5-40 hp), the thermostat is stuck open and the engine is running cold.
3. With the engine at operating temperature and running at full throttle in FORWARD gear, the 163° F stick mark should not melt. If it does, the power head is overheating. Look for a defective water pump or clogged or leaking cooling system. On thermostat-equipped models, the thermostat may be stuck closed.

ENGINE

Engine problems are generally symptoms of something wrong in another system, such as ignition, fuel or starting. If properly maintained and serviced, the engine should experience no problems other than those caused by age and wear.

Overheating and Lack of Lubrication

Overheating and lack of lubrication cause the majority of engine mechanical problems. Outboard motors create a great deal of heat and are not designed to operate at a standstill for any length of time. Using a spark plug of the wrong heat range can burn a piston. Incorrect ignition timing, a defective water pump or thermostat, a propeller that is too large (over-propping) or an excessively lean fuel mixture can also cause the engine to overheat.

Preignition

Preignition is the premature burning of fuel and is caused by hot spots in the combustion chamber (**Figure 43**). The fuel actually ignites before it is supposed to. Glowing deposits in the combustion chamber, inadequate cooling or overheated spark plugs can all cause preignition. This is first noticed in the form of a power loss but will eventually result in extensive damage to the internal parts of the engine because of higher combustion chamber temperatures.

Detonation

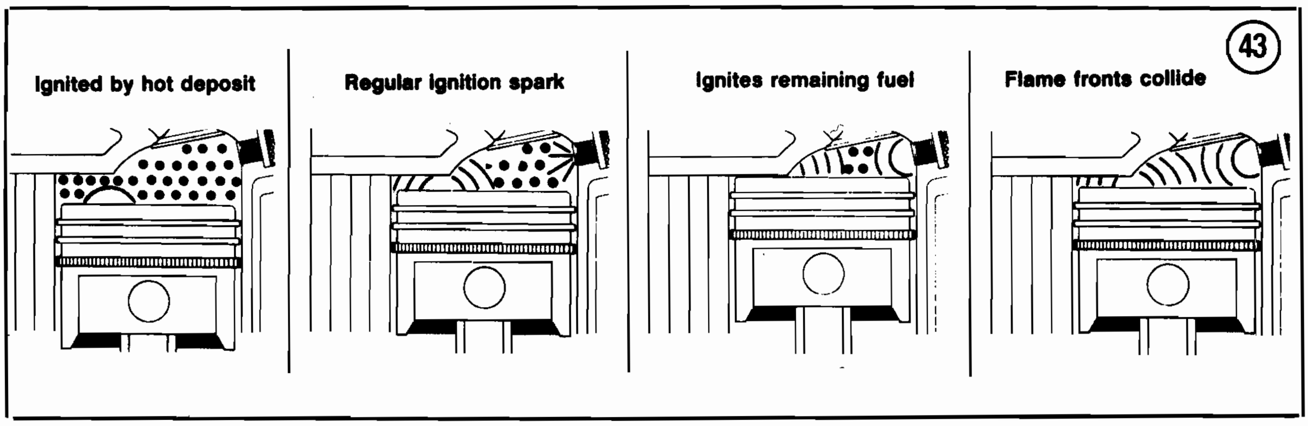
Commonly called "spark knock" or "fuel knock," detonation is the violent explosion of fuel in the combustion chamber prior to the proper time of combustion (**Figure 44**). Severe damage can result. Use of low octane gasoline is a common cause of detonation.

Even when high octane gasoline is used, detonation can still occur if the engine is improperly timed. Other causes are over-advanced ignition timing, lean fuel mixture at or near full throttle, inadequate engine cooling, cross-firing of spark plugs, excessive accumulation of deposits on piston and combustion chamber or the use of a prop that is too large (over-propping).

Since outboard motors are noisy, engine knock or detonation is likely to go unnoticed by owners, especially at high engine rpm when wind noise is also present. Such inaudible detonation, as it is called, is usually the cause when engine damage occurs for no apparent reason.

Poor Idling

A poor idle can be caused by improper carburetor adjustment, incorrect timing or



ignition system malfunctions. Check the gas cap vent for an obstruction.

Misfiring

Misfiring can result from a weak spark or a dirty spark plug. Check for fuel contamination. If misfiring occurs only under heavy load, as when accelerating, it is usually caused by a defective spark plug. Run the motor at night to check for spark leaks along the plug wire and under spark plug cap or use a spark leak tester.

WARNING
Do not run engine in a dark garage to check for spark leak. There is considerable danger of carbon monoxide poisoning.

Water Leakage in Cylinder

The fastest and easiest way to check for water leakage in a cylinder is to check the spark plugs. Water will clean a spark plug. If one of the 2 plugs on a multi-cylinder engine is clean and the other is dirty, there is most likely a water leak in the cylinder with the clean plug.

To remove all doubt, install a dirty plug in each cylinder. Run the engine in a test tank or in the boat in water for 5-10 minutes. Shut the engine off and remove the plugs. If one plug is clean and the other dirty (or if both plugs are clean), a water leak in the cylinder(s) is the problem.

Flat Spots

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

Power Loss

Several factors can cause a lack of power and speed. Look for air leaks in the fuel line or fuel pump, a clogged fuel filter or a choke/throttle valve that does not operate properly. Check ignition timing.

A piston or cylinder that is galling, incorrect piston clearance or a worn/sticky piston ring may be responsible. Look for loose bolts, defective gaskets or leaking machined mating surfaces on the cylinder head, cylinder or crankcase. Also check the crankcase oil seal; if worn, it can allow gas to leak between cylinders.

Piston Seizure

This is caused by one or more pistons with incorrect bore clearances, piston rings with an

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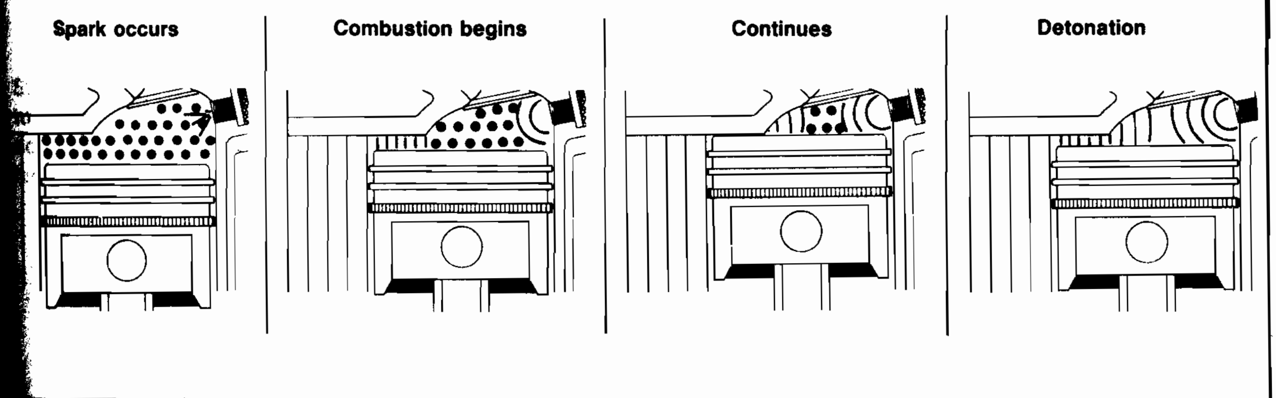


improper end gap, the use of an oil-fuel mixture containing less than 1 part oil to 50 parts of gasoline or an oil of poor quality, a spark plug of the wrong heat range or incorrect ignition timing. Overheating from any cause may result in piston seizure.

Excessive Vibration

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

Engine Noises

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

Table 1 STARTER TROUBLESHOOTING

Trouble	Cause	Remedy
Pinion does not move when starter is turned on	Blown fuse	Replace fuse.
	Pinion rusted to armature shaft	Remove, clean or replace as required.
	Series coil or shunt broken or shorted	Replace coil or shunt.
	Loose switch connections	Tighten connections.
	Rusted or dirty plunger	Clean plunger.
Pinion meshes with ring gear but starter does not run	Worn brushes or brush springs touching armature	Replace brushes or brush springs.
	Dirty or burned commutator	Clean or replace as required.
	Defective armature field coil	Replace armature.
	Worn or rusted armature shaft bearing	Replace bearing.
Starter motor runs at full speed before pinion meshes with ring gear	Worn pinion sleeve	Replace sleeve.
	Pinion does not stop in correct position	Replace pinion.
Pinion meshes with gear and motor starts but engine does not crank	Defective overrunning clutch	Replace overrunning clutch.

(continued)

Table 1 STARTER TROUBLESHOOTING (continued)

Trouble	Cause	Remedy
Starter motor does not stop when turned off after engine has started	Rusted or dirty plunger	Clean or replace plunger.
Starter motor speed low and high-current draw	Armature may be dragging on pole shoes from bent shaft, worn bearings or loose pole shoes	Replace shaft or bearings and/or tighten pole shoes.
	Tight or dirty bearings	Loosen or clean bearings.
High current draw with no armature rotation	A direct ground switch, at terminal or at brushes or field connections	Replace defective parts.
	Frozen shaft bearings which prevent armature from rotating	Loosen, clean or replace bearings.
Starter motor has grounded armature or field winding	Field and/or armature is burned or lead is thrown out of commutator due to excess leakage	Raise grounded brushes from commutator and insulate them with cardboard. Use an ignition analyzer and test points to check between insulated terminal or starter motor and starter motor frame (remove ground connection of shunt coils on motors with this feature). If analyzer shows resistance (meter needle moves to right), there is a ground. Raise other brushes from armature and check armature and fields separately to locate ground.
Starter motor has grounded armature or field winding	Current passes through armature first, then to ground field windings	Disconnect grounded leads, then locate any abnormal grounds in starter motor.
Starter motor fails to operate and draws no current and/or high resistance	Open circuit in fields or armature, at connections or brushes or between brushes and commutator	Repair or adjust broken or weak brush springs, worn brushes, high insulation between commutator bars or a dirty, gummy or oily commutator.

(continued)

Table 1 STARTER TROUBLESHOOTING (continued)

Trouble	Cause	Remedy
High resistance in starter motor	Low no-load speed and a low current draw and low developed torque	Closed "open" field winding on unit which has 2 or 3 circuits in starter motor (unit in which current divides as it enters, taking 2 or 3 parallel paths).
High free speed and high current draw	Shorted fields in starter motor	Install new fields and check for improved performance. (Fields normally have very low resistance, thus it is difficult to detect shorted fields, since difference in current draw between normal starter motor field windings would not be very great.)
Excessive voltage drop	Cables too small	Install larger cables to accomodate high current draw.
High circuit resistance	Dirty connections	Clean connections.
Starter does not operate	Run-down battery	Check battery with hydrometer. If reading is below 1.230, recharge or replace battery.
	Poor contact at terminals	Remove terminal clamps. Scrape terminals and clamps clean and tighten bolts securely.
	Wiring or key switch corroded	Install new switch or wiring. Coat with sealer to protect against further corrosion.
	Starter solenoid	Check for resistance between: (a) positive (+) terminal of battery and large input terminal of starter solenoid, (b) large wire at top of starter motor and negative (–) terminal of battery, and (c) small terminal of starter solenoid and positive battery terminal. Key switch must be in START position. Repair all defective parts.
	Starter motor	With a fully charged battery, connect a negative (–) jumper wire to upper terminal on side of starter motor and a positive jumper to large lower terminal of starter motor. If motor still does not operate, remove for overhaul or replacement.

(continued)

Table 1 STARTER TROUBLESHOOTING (continued)

Trouble	Cause	Remedy
Starter turns over too slowly	Low battery or poor contact at battery terminal	See "Starter does not operate".
	Poor contact at starter solenoid or starter motor	Check all terminals for looseness and tighten all nuts securely.
	Starter mechanism	Disconnect positive (+) battery terminal. Rotate pinion gear in disengaged position. Pinion gear and motor should run freely by hand. If motor does not turn over easily, clean starter and replace all defective parts.
Starter spins freely but does not engage engine	Low battery or poor contact at battery terminal	See "Starter does not operate."
	Poor contact at starter solenoid or or starter motor	See "Starter does not operate."
	Dirty or corroded pinion drive	Clean thoroughly and lubricate the spline underneath the pinion with Lubriplate 777
Starter does not engage freely	Pinion or flywheel gear	Inspect mating gears for excessive wear. Replace all defective parts.
	Small anti-drift spring	If drive pinion interferes with flywheel gear after engine has started, inspect anti-drift spring located under pinion gear. Replace all defective parts. NOTE: If drive pinion tends to stay engaged in flywheel gear when starter motor is in idle position, start motor @ 1/4 throttle to allow starter pinion gear to release flywheel ring gear instantly.
Starter keeps on spinning after key is turned ON	Key not fully returned	Check that key has returned to normal ON position from START position. Replace switch if key constantly stays in START position.
	Starter solenoid	Inspect starter solenoid to see if contacts have become stuck in closed position. If starter does not stop running with small yellow lead disconnected from starter solenoid, replace starter solenoid.

(continued)

Table 1 STARTER TROUBLESHOOTING (continued)

Trouble	Cause	Remedy
Wiring or key switch	Inspect all wires for defects	Open remote control box and inspect wiring @ switches. Repair or replace all defective parts.
Wires overheat	Battery terminals improperly connected	Check that negative marking on harness matches that of battery. If battery is connected improperly, red wire to rectifier will overheat.
	Short circuit in system	Inspect all wiring connections and wires for looseness or defects. Open remote control box and inspect wiring @ switches.
	Short circuit in choke solenoid	Repair or replace all defective parts. Check for high resistance. If blue choke wire heats rapidly when choke is used, choke solenoid may have internal short. Replace if defective.
	Short circuit in starter solenoid	If yellow starter solenoid lead overheats, there may be internal short (resistance) in starter solenoid. Replace if defective.
	Low battery voltage	Battery voltage is checked with an ampere-volt tester when battery is under a starting load. Battery must be recharged if it registers under 9.5 volts. If battery is below specified hydrometer reading of 1.230, it will not turn engine fast enough to start it.

Table 2 IGNITION TROUBLESHOOTING

Symptom	Probable cause
Engine won't start, but fuel and spark are good	Defective or dirty spark plugs. Spark plug gap set too wide. Improper spark timing. Shorted stop button. Air leaks into fuel pump. Broken piston ring(s). Cylinder head, crankcase or cylinder sealing faulty. Worn crankcase oil seal.

(continued)

Table 2 IGNITION TROUBLESHOOTING (continued)

Symptom	Probable cause
Engine misfires @ idle	Incorrect spark plug gap. Defective, dirty or loose spark plugs. Spark plugs of incorrect heat range. Leaking or broken high tension wires. Weak armature magnets. Defective coil or condenser. Defective ignition switch. Spark timing out of adjustment.
Engine misfires @ high speed	See "Engine misfires @ idle." Coil breaks down. Coil shorts through insulation. Spark plug gap too wide. Wrong type spark plugs. Too much spark advance.
Engine backfires	Cracked spark plug insulator. Improper timing. Crossed spark plug wires. Improper ignition timing.
Engine preignition	Spark advanced too far. Incorrect type spark plug. Burned spark plug electrodes.
Engine noises (knocking at power head)	Spark advanced too far.
Ignition coil fails	Extremely high voltage. Moisture formation. Excessive heat from engine.
Spark plugs burn and foul	Incorrect type plug. Fuel mixture too rich. Inferior grade of gasoline. Overheated engine. Excessive carbon in combustion chambers.
Ignition causing high fuel consumption	Incorrect spark timing. Leaking high tension wires. Incorrect spark plug gap. Fouled spark plugs. Incorrect spark advance. Weak ignition coil. Preignition.

3

Table 3 FUEL SYSTEM TROUBLESHOOTING

Symptom	Probable cause
No fuel @ carburetor	No gas in tank. Air vent in gas cap not open. Air vent in gas cap clogged. Fuel tank sitting on fuel line. Fuel line fittings not properly connected to engine or fuel tank.

(continued)

Table 3 FUEL SYSTEM TROUBLESHOOTING (continued)

Symptom	Probable cause
No fuel at carburetor (continued)	Air leak @ fuel connection. Fuel pickup clogged. Defective fuel pump.
Flooding @ carburetor	Choke out of adjustment. High float level. Float stuck. Excessive fuel pump pressure. Float saturated beyond buoyancy.
Rough operation	Dirt or water in fuel. Reed valve open or broken. Incorrect fuel level in carburetor bowl. Carburetor loose @ mounting flange. Throttle shutter not closing completely. Throttle shutter valve installed incorrectly.
Carburetor spit-back at idle	Chipped or broken reed valve(s).
Engine misfires @ high speed	Dirty carburetor. Lean carburetor adjustment. Restriction in fuel system. Low fuel pump pressure.
Engine backfires	Poor quality fuel. Air-fuel mixture too rich or too lean. Improperly adjusted carburetor.
Engine preignition	Excessive oil in fuel. Inferior grade of gasoline. Lean carburetor mixture.
Spark plugs burn and foul	Fuel mixture too rich. Inferior grade of gasoline.
High gas consumption:	
Flooding or leaking	Cracked carburetor casting. Leaks @ line connections. Defective carburetor bowl gasket. High float level. Plugged vent hole in cover. Loose needle and seat. Defective needle valve seat gasket. Worn needle valve and seat. Foreign matter clogging needle valve. Worn float pin or bracket. Float binding in bowl. High fuel pump pressure.
Overrich mixture	Choke lever stuck. High float level. High fuel pump pressure.
Abnormal speeds	Carburetor out of adjustment. Too much oil in fuel.

Chapter Four

Lubrication, Maintenance and Tune-up

The modern outboard motor delivers more power and performance than ever before, with higher compression ratios, new and improved electrical systems and other design advances. Proper lubrication, maintenance and tune-ups have thus become increasingly important as ways in which you can maintain a high level of performance, extend engine life and extract the maximum economy of operation.

You can do your own lubrication, maintenance and tune-ups if you follow the correct procedures and use common sense. The following information is based on recommendations from Johnson and Evinrude that will help you keep your outboard motor operating at its peak performance level.

Tables 1-4 are at the end of the chapter.

LUBRICATION

Proper Fuel Selection

Two-stroke engines are lubricated by mixing oil with the fuel. The various components of the engine are thus lubricated as the fuel-oil mixture passes through the crankcase and cylinders. Since two-stroke fuel serves the dual function of producing ignition and distributing the lubrication, the use of low octane marine white gasolines should be avoided. Such gasolines also have a tendency to cause ring sticking and port plugging.

Johnson and Evinrude have recommended the use of regular unleaded gasoline with a minimum posted pump octane rating of 86 in all 1973-1981 2-35 hp outboards. However, obtaining regular unleaded gasoline with an octane rating that high is becoming extremely difficult. Accordingly, factory engineering issued new fuel recommendations in March 1983 for 1977 and later models, dropping the octane rating to 67. No mention of a change was made for 1973-1976 models. While leaded regular or leaded premium can be used when necessary, lead-free or low lead regular gasolines are preferable, as they offer longer spark plug life.

Sour Fuel

Fuel should not be stored for more than 60 days (under ideal conditions). Gasoline forms gum and varnish deposits as it ages. Such fuel will cause starting problems. A fuel additive such as OMC 2+4 Fuel Conditioner should be used to prevent gum and varnish formation during storage or prolonged periods of non-use but it is always better to drain the tank in such cases. Always use fresh gasoline when mixing fuel for your outboard.

Gasohol

Some gasolines sold for marine use now contain alcohol, although this fact may not be advertised. A mixture of 10 percent ethyl alcohol and 90 percent unleaded gasoline is called gasohol. This is considered suitable for use in Johnson and Evinrude outboards. Some gasolines, however, contain methyl alcohol or methanol. This is *not* recommended for use.

Fuels with an alcohol content tend to slowly absorb moisture from the air. When the moisture content of the fuel reaches approximately one percent, it combines with the alcohol and separates from the fuel. This separation does not normally occur when gasohol is used in an automobile, as the tank is generally emptied within a few days after filling it.

The problem does occur in marine use, however, because boats often remain idle between start-ups for days or even weeks. This length of time permits separation to take place. The alcohol-water mixture settles at the bottom of the fuel tank. Since outboard motors will not run on this mixture, it is necessary to drain the fuel tank, flush out the fuel system with clean gasoline and then remove, clean and reinstall the spark plugs before the engine can be started.

Continued use of fuels containing methanol can cause deterioration of fuel system components. The major danger of using gasohol in an outboard motor is that a shot of the water-alcohol mix may be picked up and sent to one of the carburetors of a multicylinder engine. Since this mixture contains no oil, it will wash oil off the bore of any cylinder it enters. The other carburetor receiving good fuel-oil mixture will keep the engine running while the cylinder receiving the water-alcohol mixture can suffer internal damage.

The problem of unlabeled gasohol has become so prevalent around the United States that Miller Tools (32615 Park Lane, Garden City, MI 48135) now offers an Alcohol Detection Kit (part No. C-4846) so owners and mechanics can determine the quality of fuel being used.

The kit cannot differentiate between types of alcohol (ethanol, methanol, etc.) nor is it considered to be absolutely accurate from a scientific standpoint, but it is accurate enough to determine whether or not there is sufficient alcohol in the fuel that the user to should take precautions.

Recommended Fuel Mixture

NOTE

OMC issued a bulletin in September, 1988, recommending that a 50:1 fuel-oil mixture be used on all recreational outboard motors, which were previously recommended for a 100:1 fuel-oil mixture, when the motors are only used periodically and during the time of non-use the motor is stored in an area of high humidity or wide-scale temperature changes or if the motor is operated at a constant high rpm. A 100:1 fuel-oil mixture may be used on models so recommended after the engine is completely broken in and if the motor is used frequently, but not at a constant high rpm. For 1989, AccuMix and AccuMix R fuel-oil mixing systems have been changed to a 50:1 fuel-oil mixing ratio.

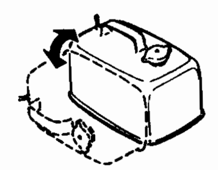
The use of reduced friction bearings in all 1985 and later 2-30 hp and 1985 and later 40 hp engines with tiller steering allows these nodels to be operated with a 100:1 fuel-oil nixture. The 1985 and later 40 hp remote lectric start models are equipped with ariable ratio oil (VRO) injection. AutoBlend l injection is standard on 1986 9.9-30 hp odels and 40 hp tiller steering models. ccuMix oil injection is standard on 1987 9-30 hp models and 40 hp tiller steering odels. AccuMix oil injection is offered as an cessory on 1988-1989 9.9-30 hp models, 1990 -30 hp models and 1988-1990 40 hp tiller teering models. A variation of the AutoBlend ystem and the AccuMix system for boats with uilt-in fuel tanks is optional with all 1986-on -30 hp models and 1987-1988 2.5 hp models. or all models prior to 1985, a 50:1 fuel-oil nixture is recommended.

If fuel-oil mixture must be premixed, use e specified gasoline for your Johnson or vinrude outboard and mix with Johnson or vinrude Outboard Lubricant in the llowing ratio:

CAUTION

Do not, under any circumstances, use multigrade or other high detergent automotive oils or oils containing metallic additives. Such oils are harmful to 2-stroke engines. Since they do not mix properly with gasoline, do not burn as 2-cycle oils do and leave an ash residue, their use may result in piston scoring, bearing failure or other engine damage.

a. *50:1 Fuel Mixture*—Thoroughly mix one pint (16 fluid ounces) of Johnson or Evinrude Outboard Lubricant with each 6 gallons of gasoline in your remote fuel tank. *100:1 Fuel Mixture* —Thoroughly mix 1/2 pint (8 fluid ounces) of Johnson or Evinrude Outboard Lubricant with each 6 gallons of gasoline in your remote fuel tank.
b. If Johnson or Evinrude Outboard Lubricant is not available, any high-quality 2-stroke oil intended for outboard use may be substituted provided the oil meets NMMA(BIA) rating TC-W (TC-WII, 1990 models), and specifies so on the container. Follow the manufacturer's mixing instructions on the container to obtain the recommended fuel-oil mixture.



Portable tank

Correct Fuel Mixing

WARNING

Gasoline is an extreme fire hazard. Never use gasoline near heat, sparks or flame. Do not smoke while mixing fuel.

Mix the fuel and oil outdoors or in a well-ventilated indoor location. Using less than the specified amount of oil can result in insufficient lubrication and serious engine damage. Using more oil than specified causes spark plug fouling, erratic carburetion, excessive smoking and rapid carbon accumulation.

Cleanliness is of prime importance. Even a very small particle of dirt can cause carburetion problems. Always use fresh gasoline. Gum and varnish deposits tend to form in gasoline stored in a tank for any length of time. Use of sour fuel can result in carburetor problems and spark plug fouling.

Above 32° F (0° C)

Measure the required amounts of gasoline and oil accurately. Pour the Outboard Lubricant into the portable tank and add the fuel. Install the tank filler cap and mix the fuel by tipping the tank on its side and back to an upright position several times. See **Figure 1**.

If a built-in tank is used, insert a large metal filter funnel in the tank filler neck. Slowly pour the Outboard Lubricant into the funnel at the same time the tank is being filled with gasoline. See **Figure 2**.

Below 32° F (0° C)

Measure the required amounts of gasoline and oil accurately. Pour about one gallon of gasoline in the tank and add the required amount of Outboard Lubricant. Install the tank filler cap and shake the tank to thoroughly mix the fuel and oil. Remove the cap and add the balance of the gasoline.

If a built-in tank is used, insert a large metal filter funnel in the tank filler neck. Mix the required amount of Outboard Lubricant with one gallon of gasoline in a separate container. Slowly pour the mixture into the funnel at the same time the tank is being filled with gasoline.

Consistent Fuel Mixtures

The carburetor idle adjustment is sensitive to fuel mixture variations which result from the use of different oils and gasolines or from inaccurate measuring and mixing. This may require readjustment of the idle needle. To prevent the necessity for constant readjustment of the carburetor from one batch of fuel to the next, always be consistent. Prepare each batch of fuel exactly the same as previous ones.

Pre-mixed fuels sold at some marinas are not recommended for use in Johnson or Evinrude outboards, since the quality and consistency of pre-mixed fuels can vary greatly. The possibility of engine damage resulting from use of an incorrect fuel mixture outweighs the convenience offered by pre-mixed fuel.

Lower Drive Unit Lubrication

Replace the lower drive unit lubricant after the first 20 hours of operation. Check every 50 hours of operation and top up if necessary. Drain and refill every 100 hours of operation or at least once a season. Use OMC HI-VIS gearcase lubricant.

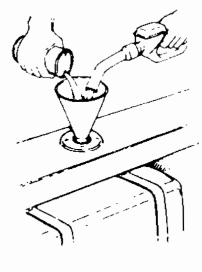
CAUTION

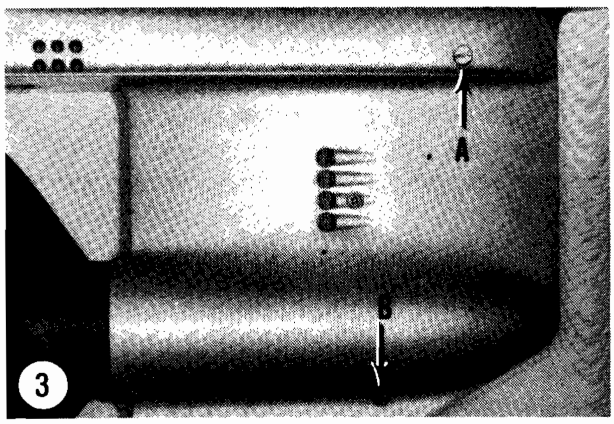
Do not use regular automotive grease in the lower drive unit. Its expansion and foam characteristics are not suitable for marine use.

2 and 4 hp models

1. Place a suitable container under the gearcase.
2. Remove the drain/fill plug from the starboard side of the gearcase.
3. Position the gearcase with the starboard side facing down and let the lubricant drain completely.

2





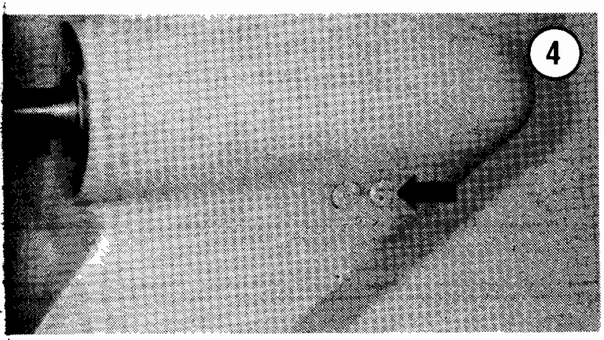
3

4. Reposition gearcase with drain/fill hole facing up. On all models except 1990 4 hp Deluxe, slowly fill with OMC HI-VIS gearcase lubricant until it appears at the hole. On 1990 4 hp Deluxe models, slowly fill with OMC Premium Blend gearcase lubricant until it appears at the hole.
5. On all models except 1990 3 and Ultra 4/Excel 4 models, install the drain/fill plug and tighten to 60-80 in.-lb. (7-9 N·m). On 1990 3 and Ultra 4/Excel 4 models, install the drain/fill plug and tighten to 40-50 in.-lb. (5-6 N·m).

4.5-40 hp models

1. Place a suitable container under the gearcase.

CAUTION
Never lubricate the gearcase without first removing the oil level screw, as the injected lubricant displaces air which must be allowed to escape. The gearcase cannot be completely filled otherwise.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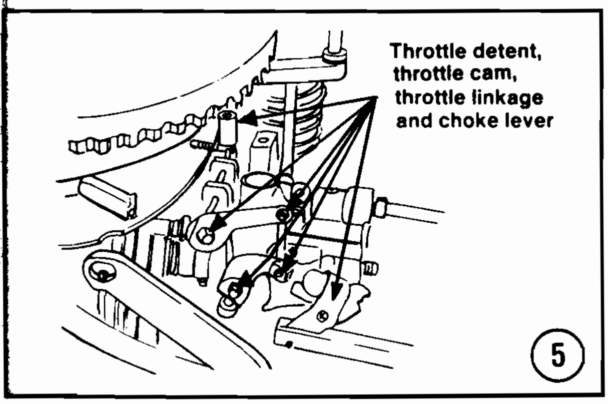


5

2. Locate and remove the oil level plug and washer (A, **Figure 3**, typical).

NOTE
*The gearcase on some models will have a Phillips head screw located beside the slotted drain/fill plug (**Figure 4**). The Phillips head screw secures the shift rod in place—do not remove it by mistake.*

3. Locate and remove the drain/fill plug and washer (B, **Figure 3**, typical).
4. Allow the lubricant to completely drain.
5. Inject OMC HI-VIS lubricant into the drain/fill plug hole until excess fluid flows out the oil level plug hole.
6. Drain about one fluid ounce of fluid to allow for lubricant expansion.
7. Install the oil level plug. Remove the lubricant tube or nozzle from drain/fill hole and install the drain/fill plug. Be sure the washers are in place under the head of each, so water will not leak past the threads into the housing. Tighten both plugs to 60-80 in.-lb. (7-9 N•m).

Other Lubrication Points

Refer to **Figures 5-12** (typical) and **Table 1** for other lubricant points, frequency of lubrication and lubricant to be used.

CAUTION
When lubricating the steering cable on models so equipped, make sure its core is fully retracted into the cable housing. Lubricating the cable while extended can cause a hydraulic lock to occur.

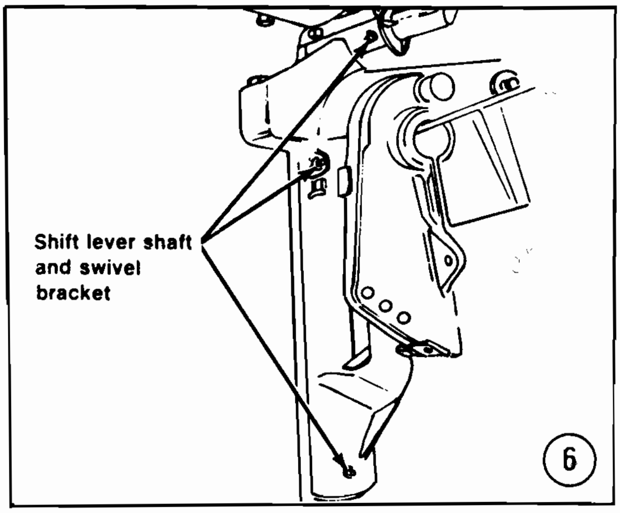
Salt Water Corrosion of Gear Housing Bearing Carrier/Nut

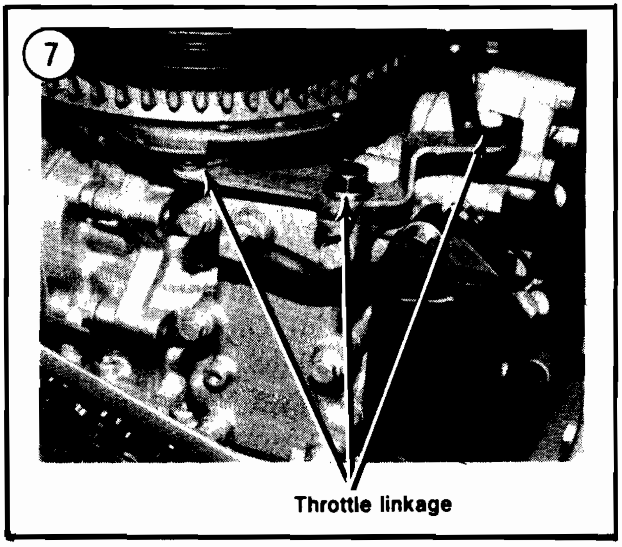
Salt water corrosion that is allowed to build up unchecked can eventually split the gear housing and destroy the lower unit. If the motor is used in salt water, remove the propeller assembly and bearing housing at least once a year after the initial 20-hour inspection. Clean all corrosive deposits and dried-up lubricant from each end of the housing (**Figure 13**). Lubricate the bearing housing, O-ring and screw threads with OMC Gasket Sealing Compound. Install bearing housing and tighten screws to specifications (Chapter Nine).

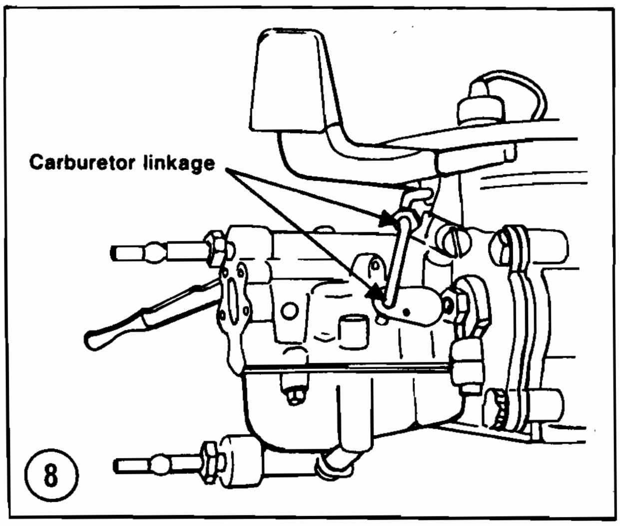
STORAGE

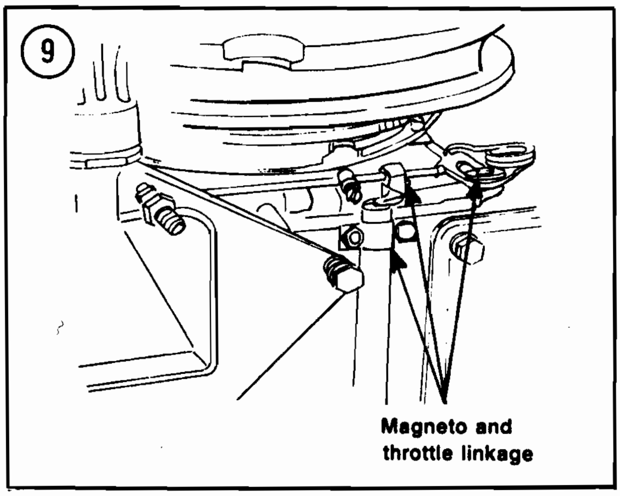
The major consideration in preparing an outboard motor for storage is to protect it from rust, corrosion and dirt. Johnson and Evinrude recommend the following procedure.

1. If boat is equipped with a built-in fuel tank, add one ounce of OMC 2+4 fuel conditioner to fuel tank for each gallon of fuel tank capacity. Top off fuel tank with recommended fuel shown in this chapter.
2. Operate the motor in a test tank with the proper test wheel or on the boat in the water. Start the engine and allow it to warm up while allowing the stabilized fuel to circulate.
3. Stop the engine after approximately five minutes.
4. In a portable six gallon fuel tank, prepare the following storage mixture:
   a. Add five gallons of recommended fuel.

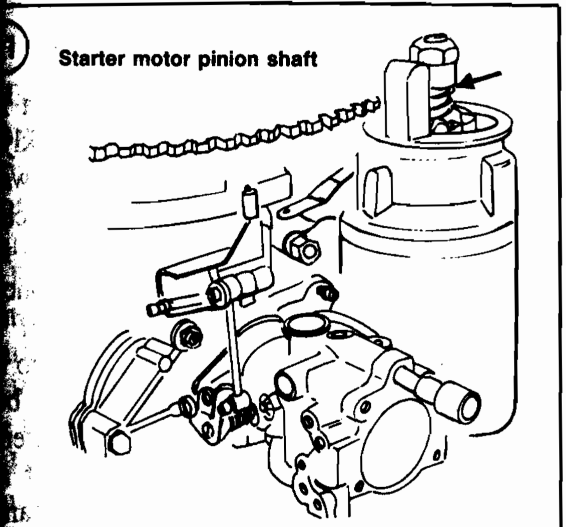




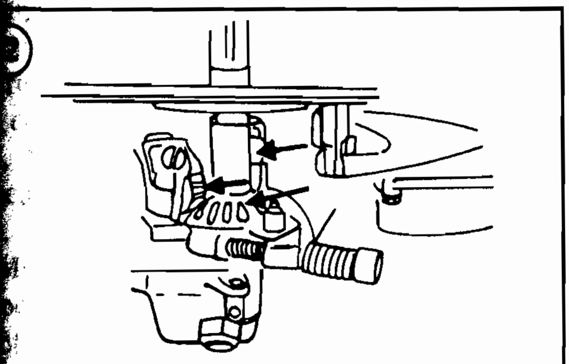




vel bracket, shift lever shaft and clamp screws



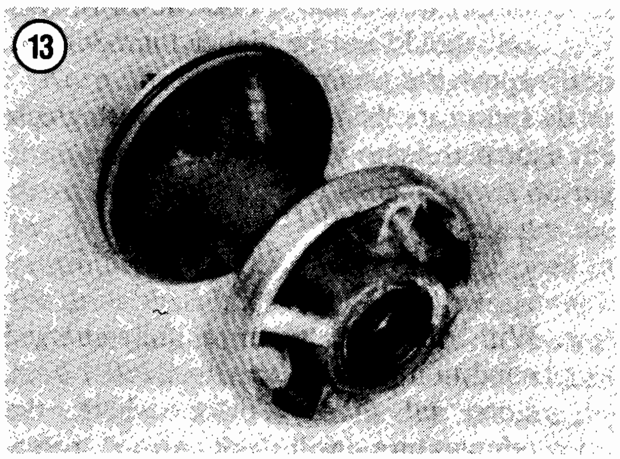
Starter motor pinion shaft



Vertical throttle shaft and gears

b. Add two quarts of OMC Storage Fogging Oil.
c. Add one pint of Evinrude or Johnson Outboard Lubricant.
d. Add one pint of OMC 2+4 fuel conditioner.

5. Thoroughly blend mixture in fuel tank.
6. Connect storage mixture to engine.
7. Operate the motor in a test tank with the proper test wheel or on the boat in the water. Start the engine and operate at approximately 1500 rpm for five minutes.
8. Stop the engine and disconnect the storage mixture.
9. Remove the engine cover.
10. Remove the spark plug(s) as described in this chapter.
11. Spray a liberal amount of OMC Storage Fogging Oil through spark plug hole(s) into each cylinder.
12. Rotate flywheel several rotations clockwise to distribute the OMC Storage Fogging Oil throughout the cylinder.
13. Remove the outboard motor from the test tank or water and rotate the flywheel several rotations clockwise to drain any water from the water pump.
14. Clean and regap or replace plugs. Leave spark plug leads disconnected.
15. If storage fuel mixture is not to be used on any other outboard motors, *safely* drain



and clean fuel tank. For regular use portable tank, stabilize fuel as recommended with OMC 2+4 fuel conditioner or drain and clean fuel tank. Store tank(s) in a well-ventilated area away from heat or open flame.

16. Drain and refill gearcase as described in this chapter. Check condition of level and drain/fill plug gaskets. Replace as required.
17. Refer to **Figures 5-12** and **Table 1** as appropriate and lubricate motor at all specified points.
18. Remove and check propeller condition. Remove any burring from drive pin hole and replace drive pin if worn or bent. Look for propeller shaft seal damage from fishing line. Clean and lubricate propeller shaft with OMC Triple-Guard grease. Reinstall propeller with a new cotter pin or tab lock washer.
19. Clean all external parts of the motor with OMC All-Purpose Marine Cleaner and apply a good quality marine polish.
20. Store the outboard motor in an upright position in a dry and well-ventilated area.
21. Service the battery as follows:
   a. Disconnect the negative battery cable, then the positive battery cable.
   b. Remove all grease, corrosion and dirt from the battery surface.
   c. Check the electrolyte level in each battery cell and top up with distilled water, if necessary. Fluid level in each cell should not be higher than 3/16 in. above the perforated baffles.
   d. Lubricate the terminal bolts with grease or petroleum jelly.

CAUTION
A discharged battery can be damaged by freezing.

   e. With the battery in a fully-charged condition (specific gravity 1.260-1.275), store in a dry place where the temperature will not drop below freezing. Do not store on a concrete surface.
   f. Recharge the battery every 45 days or whenever the specific gravity drops below 1.230. Before charging, cover the plates with distilled water, but not more than 3/16 in. above the perforated baffles. The charge rate should not exceed 6 amps. Discontinue charging when the specific gravity reaches 1.260 at 80° F (27° C).
   g. Before placing the battery back into service after winter storage, remove the excess grease from the terminals, leaving a small amount on. Install battery in a fully-charged state.

COMPLETE SUBMERSION

An outboard motor which has been lost overboard should be recovered as quickly as possible. If lost in salt water or fresh water containing sand or silt, disassemble and clean it immediately—any delay will result in rust and corrosion of internal components once it has been removed from the water. If the motor was running when it was lost, do not attempt to start it until it has been disassembled and checked. Internal components may be out of alignment and running the motor may cause permanent damage.

The following emergency steps should be accomplished immediately if the motor was lost in fresh water.

CAUTION
If it is not possible to disassemble and clean the motor immediately, resubmerge it in fresh water to prevent rust and corrosion formation until such time as it can be properly serviced.

1. Remove the engine cover.
2. Remove the spark plug(s) as described in this chapter.

3. Remove the carburetor float bowl drain screws if so equipped. See Chapter Six.
4. Disconnect the charge coil connectors.
5. Wash the outside of the motor with clean water to remove weeds, mud and other debris.

CAUTION
If there is a possibility sand or silt may have entered the power head or gearcase, do not try to start the motor or severe internal damage may occur.

CAUTION
Do not force the motor if it does not turn over freely when the rewind starter is operated in Step 6. This may be an indication of internal damage such as a bent connecting rod or broken piston.

6. Drain as much water as possible from the power head by placing the motor in a horizontal position. Use the starter rope to rotate the flywheel with the spark plug hole(s) facing downward.
7. Pour either Evinrude or Johnson Outboard Lubricant into cylinder(s) through spark plug holes.
8. Remove carburetor(s) and disassemble. See Chapter Six.
9. Disassemble electric starter motor, if so equipped, and disconnect all electrical connections. Wash with clean fresh water. Spray all electrical components and connections with a water displacing electrical spray and allow to dry. Reassemble electric starter motor, if so equipped, and reconnect all electrical connections.
10. Reinstall spark plug(s), carburetor(s) and electric starter motor if so equipped.
11. Blend a fresh fuel mixture following OMC's recommended engine break-in procedure. Try starting the motor. If the motor will start, let it run at least 30 minutes following OMC's recommended engine break-in procedure.
12. If motor will not start in Step 11, try to diagnose the cause as fuel, electrical or mechanical, then correct. If the engine cannot be started within three hours, disassemble, clean and oil all parts thoroughly as soon as possible.

ANTI-CORROSION MAINTENANCE

1. Flush the cooling system with fresh water as described in this chapter after each time motor is used in salt water. Wash exterior with fresh water.
2. Dry exterior of motor and apply primer over any paint nicks and scratches. Use only tin anti-fouling paint; do not use paints containing mercury or copper. Do not paint sacrificial anodes or trim tab.
3. Apply OMC Black Neoprene Dip to all exposed electrical connections except the positive terminal on the starter solenoid.
4. Check sacrificial anodes and replace any that are less than two-thirds their original size.
5. Lubricate more frequently than specified in **Table 1**. If used consistenly in salt water, reduce lubrication intervals by one-half.

ENGINE FLUSHING

Periodic engine flushing will prevent salt or silt deposits from accumulating in the water passageways. This procedure should also be performed whenever an outboard motor is operated in salt water or polluted water.

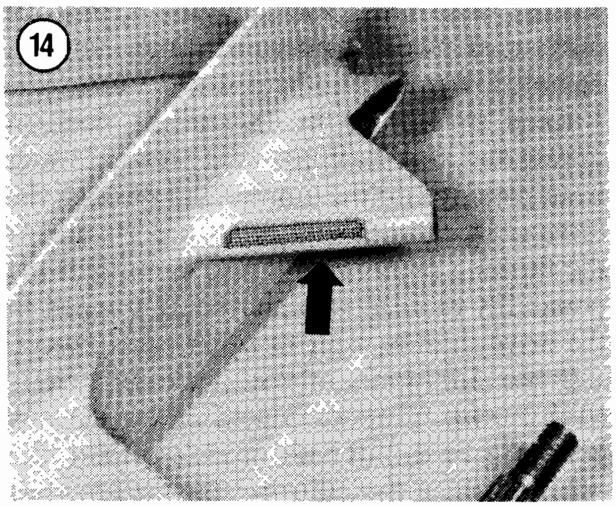
Keep the motor in an upright position during and after flushing. This prevents water from passing into the power head through the drive shaft housing and exhaust ports during the flushing procedure. It also eliminates the possibility of residual water being trapped in the drive shaft housing or other passageways.

Some Johnson and Evinrude outboards have the water intake located on the exhaust port (**Figure 14**). These models require the use of flushing devices other than a flush-test unit. See your Johnson or Evinrude dealer for the proper flushing device. Johnson and Evinrude recommend the outboard be run with a test wheel instead of the propeller when operated in a test tank or with a flush-test device. See **Figure 15** (typical). Test wheel recommendations are given in **Table 2.**

1. Remove the propeller and install the correct test wheel.
2. Attach the flushing device according to manufacturer's instructions. See **Figure 16** (typical).
3. Connect a garden hose between a water tap and the flushing device.
4. Open the water tap partially—do not use full pressure.
5. Shift into NEUTRAL, then start motor. Keep engine speed at approximately 1,500 rpm.
6. Adjust water flow so that there is a slight loss of water around the rubber cups of the flushing device.
7. Check the motor to make sure that water is being discharged from the "tell-tale" nozzle. If it is not, stop the motor immediately and determine the cause of the problem.

CAUTION
Flush the motor for at least 5 minutes if used in salt water.

14

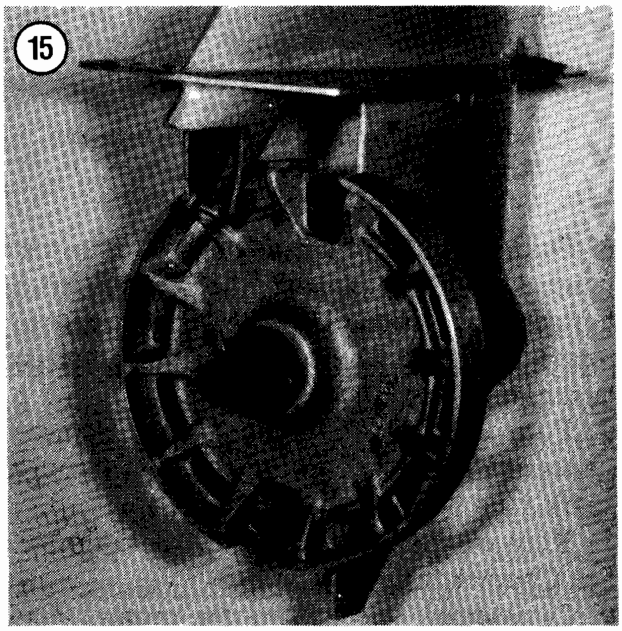


8. Flush motor until discharged water is clear. Stop motor.
9. Close water tap and remove flushing device from lower unit.
10. Remove test wheel and reinstall propeller.

TUNE-UP

A tune-up consists of a series of inspections, adjustments and parts replacements to compensate for normal wear

15



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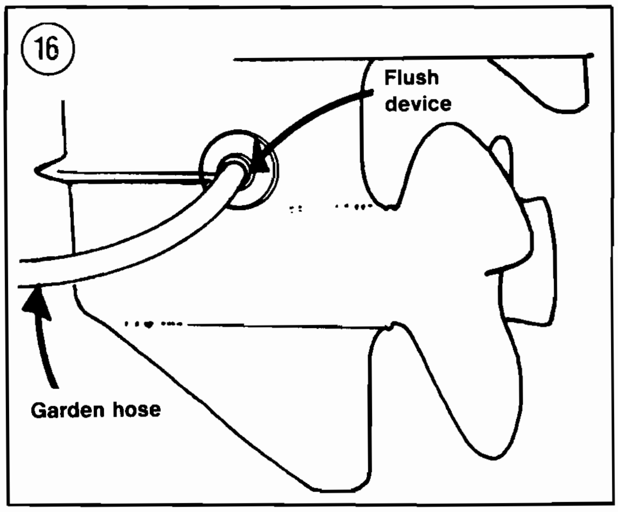


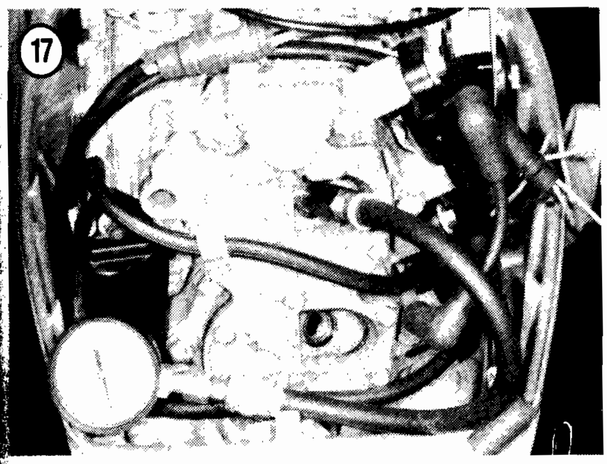
and deterioration of outboard motor components. Regular tune-ups are important for power, performance and economy. Johnson and Evinrude recommend their outboards be serviced every 6 months or 50 hours of operation. If subjected to limited use, the engine should be tuned at least once a year.

Since proper outboard motor operation depends upon a number of interrelated system functions, a tune-up consisting of only one or two corrections will seldom give lasting results. For best results, a thorough and systematic procedure of analysis and correction is necessary.

Prior to performing a tune-up, it is a good idea to flush the motor as described in this chapter and check for satisfactory water pump operation.

The tune-up sequence recommended by Johnson and Evinrude includes the following:

a. Compression check.
b. Spark plug service.
c. Lower unit and water pump check.
d. Fuel system service.
e. Ignition system service.
f. Battery, starter motor and solenoid check (if so equipped).
g. Internal wiring harness check.
h. Engine synchronization and adjustment (Chapter Five).



i. Performance test (on boat).

Any time the fuel or ignition systems are adjusted or defective parts replaced, the engine timing, synchronization and adjustment *must* be checked. These procedures are described in Chapter Five. Perform the timing, synchronization and adjustment procedure for your engine *before* running the performance test.

Compression Check

An accurate cylinder compression check gives a good idea of the condition of the basic working parts of the engine. It is also an important first step in any tune-up, as a motor with low or unequal compression between cylinders *cannot* be satisfactorily tuned. Any compression problem discovered during this check must be corrected before continuing with the tune-up procedure.

1. With the engine warm, disconnect the spark plug wire(s) and remove the plug(s) as described in this chapter.
2. Ground the spark plug wire(s) to the engine to disable the ignition system.
3. Connect the compression tester to the top spark plug hole according to manufacturer's instructions (**Figure 17**).
4. Make sure the throttle is held wide open and crank the engine through at least 4 compression strokes. Record the gauge reading.
5. Repeat Step 3 and Step 4 on 2-cylinder engines to test the other cylinder.

While minimum cylinder compression should not be less than 100 psi, the actual readings are not as important as the differences in readings when interpreting the results. A variation of more than 15 psi between 2 cylinders indicates a problem with the lower reading cylinder, such as worn or sticking piston rings and/or scored pistons or cylinders. In such cases, pour a tablespoon of engine oil into the suspect cylinder and repeat

Step 3 and Step 4. If the compression is raised significantly (by 10 psi in an old engine), the rings are worn and should be replaced.

If the power head shows signs of overheating (discolored or scorched paint) but the compression test turns up nothing abnormal, check the cylinder(s) visually through the transfer ports for possible scoring. A cylinder can be slightly scored and still deliver a relatively good compression reading. In such a case, it is also a good idea to double-check the water pump operation as a possible cause for overheating.

Spark Plugs

Johnson and Evinrude outboards are equipped with Champion, AC or NGK spark plugs selected for average use conditions. Under adverse use conditions, the recommended spark plug may foul or overheat. In such cases, check the ignition and carburetion systems to make sure they are operating correctly. If no defect is found, replace the spark plug with one of a hotter or colder heat range as required. **Table 3** gives the recommended spark plugs for all models covered in this book. **Table 4** contains a cross-reference for Champion, NGK, AC, Motorcraft and Autolite spark plugs.

All 1985-on 4 Deluxe through 40 hp engines use a surface gap spark plug for sustained high speed operation. The gap on this plug type is non-adjustable.

Spark Plug Removal

CAUTION

Whenever the spark plugs are removed, dirt around them can fall into the plug holes. This can cause engine damage that is expensive to repair.

1. Blow out any foreign matter from around the spark plugs with compressed air. Use a compressor if you have one. If you do not, use a can of compressed inert gas, available from photo stores.
2. Disconnect the spark plug wires (**Figure 18**, typical) by twisting the wire boot back and forth on the plug insulator while pulling outward. Pulling on the wire instead of the boot may cause internal damage to the wire.

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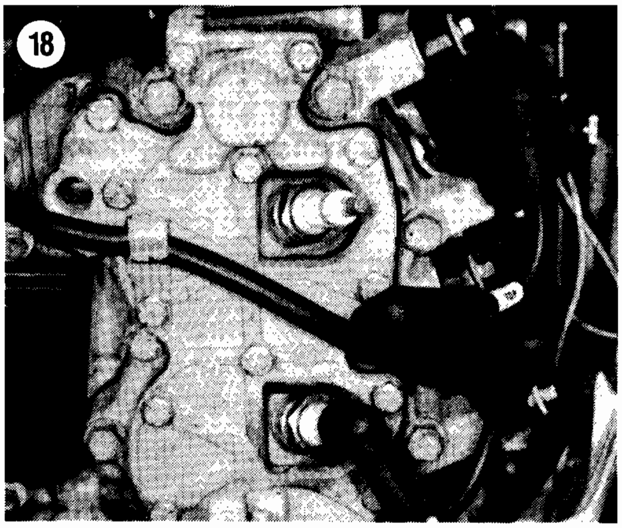

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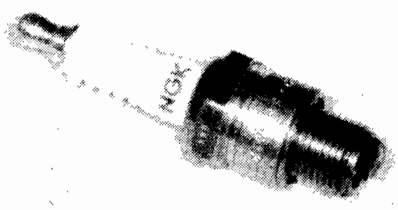

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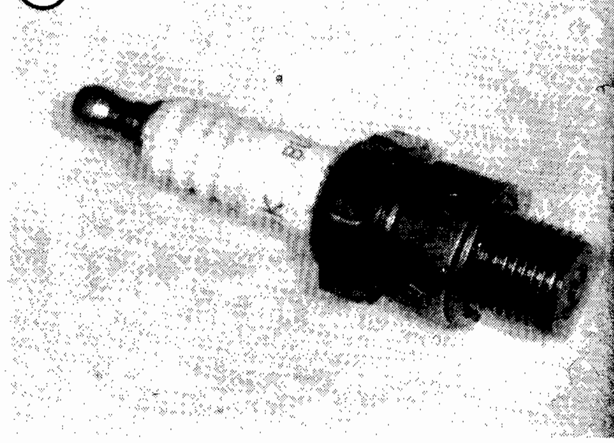

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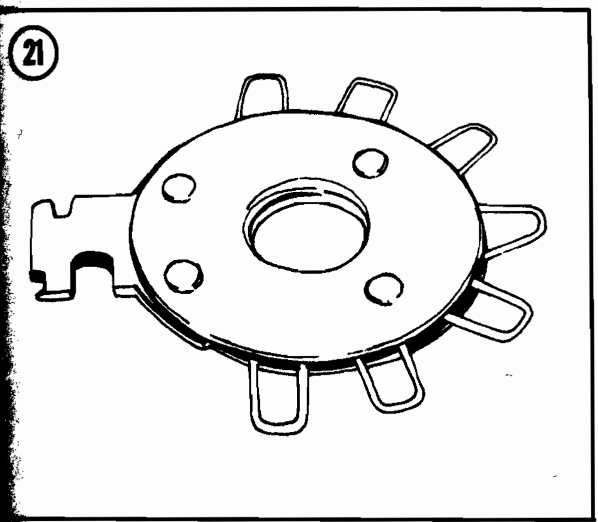

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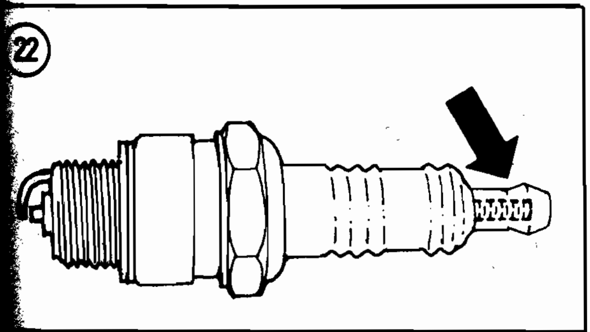

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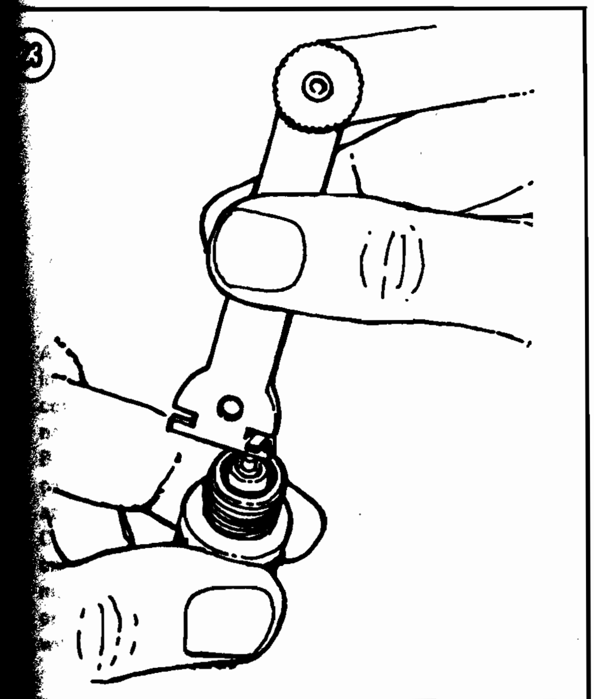


3. Remove the plugs with an appropriate size spark plug socket. Keep the plugs in order so you know which cylinder they came from.
4. Examine each spark plug. See **Figure 19A** for conventional gap plugs and **Figure 19B** for surface gap plugs. Compare plug condition with **Figure 20A** (conventional gap) or **Figure 20B** (surface gap). Spark plug condition indicates engine condition and can warn of developing trouble.
5. Check each plug for make and heat range. All should be of the same make and number or heat range.
6. Discard the plugs. Although they could be cleaned and reused if in good condition, they seldom last very long. New plugs are inexpensive and far more reliable.

Spark Plug Gapping (Conventional Gap Only)

New plugs should be carefully gapped to ensure a reliable, consistent spark. Use a special spark plug tool with a wire gauge. See **Figure 21** for one common type.

1. Remove the plugs and gaskets from the boxes. Install the gaskets.

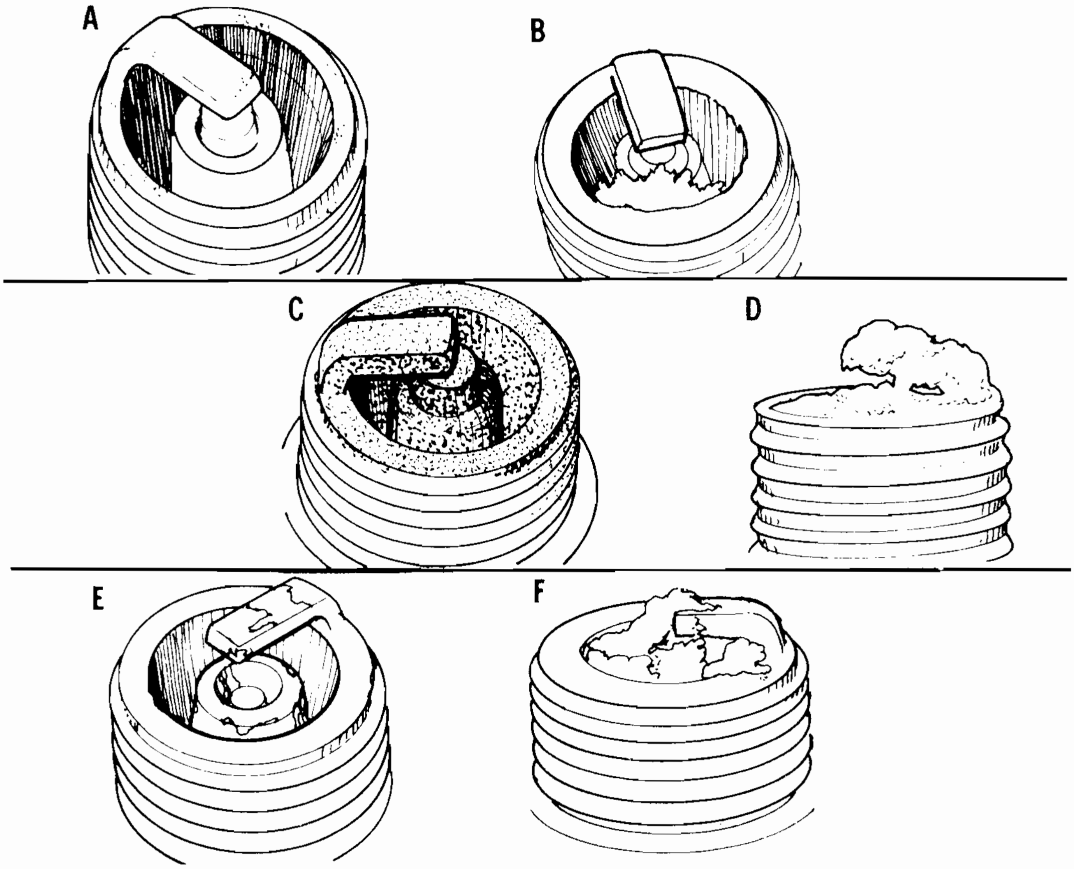
NOTE
*Some plug brands may have small end pieces that must be screwed on (**Figure 22**) before the plugs can be used.*

2. Insert an appropriate wire gauge (see **Table 3**) between the electrodes. If the gap is correct, there will be a slight drag as the wire is pulled through. If there is no drag or if the wire will not pull through, bend the side electrode with the gapping tool (**Figure 23**) to change the gap. Remeasure with the wire gauge.

CAUTION
Never try to close the electrode gap by tapping the spark plug on a solid surface. This can damage the plug internally. Always use the gapping and adjusting tool to open or close the gap.

20 A

SPARK PLUG ANALYSIS (CONVENTIONAL GAP SPARK PLUGS)



A. Normal—Light tan to gray color of insulator indicates correct heat range. Few deposits are present and the electrodes are not burned.

B. Core bridging—These defects are caused by excessive combustion chamber deposits striking and adhering to the firing end of the plug. In this case, they wedge or fuse between the electrode and core nose. They originate from the piston and cylinder head surfaces. Deposits are formed by one or more of the following:
  a. Excessive carbon in cylinder.
  b. Use of non-recommended oils.
  c. Immediate high-speed operation after prolonged trolling.
  d. Improper fuel-oil ratio.

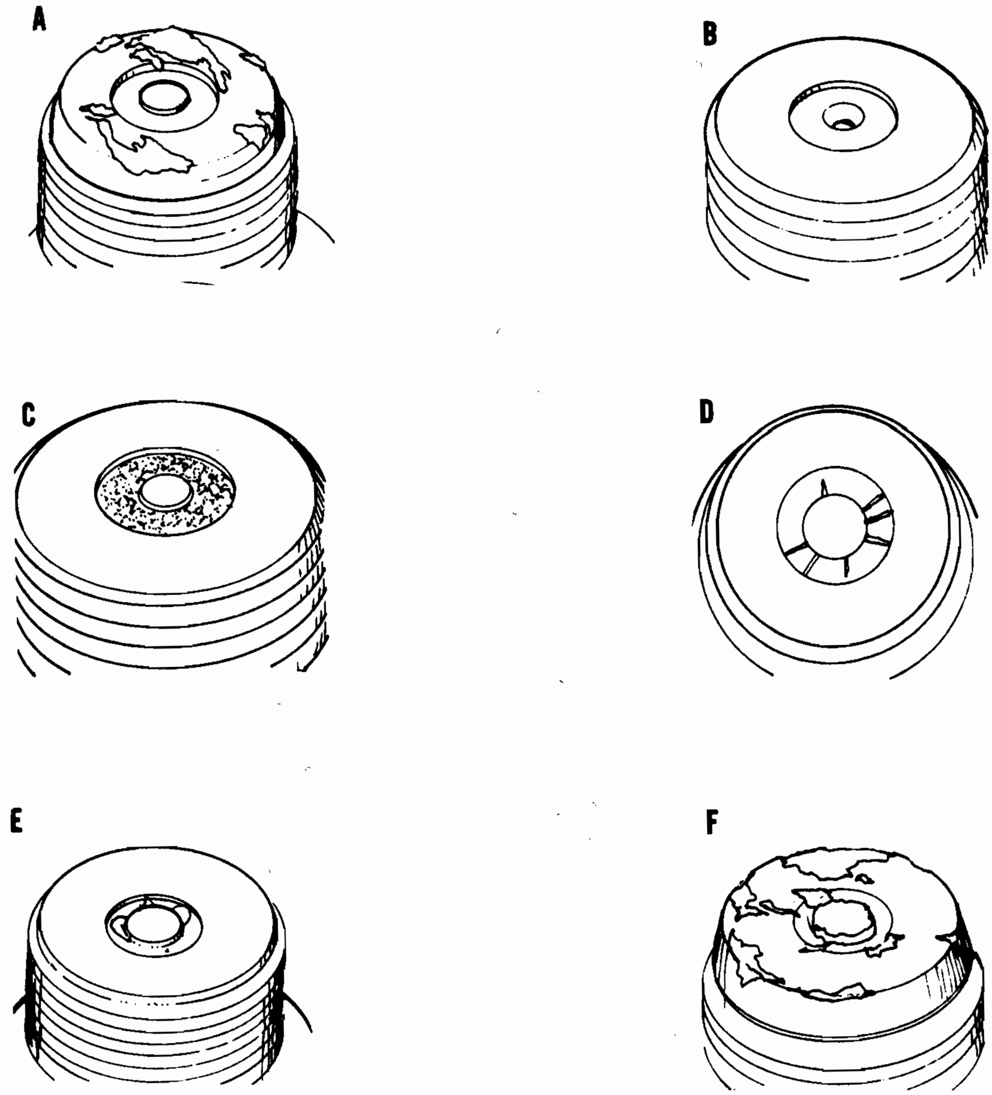
C. Wet fouling—Damp or wet, black carbon coating over entire firing end of plug. Forms sludge in some engines. Caused by one or more of the following:
  a. Spark plug heat range too cold.
  b. Prolonged trolling.
  c. Low-speed carburetor adjustment too rich.
  d. Improper fuel-oil ratio.
  e. Induction manifold bleed-off passage obstructed.
  f. Worn or defective breaker points.

D. Gap bridging—Similar to core bridging, except the combustion particles are wedged or fused between the electrodes. Causes are the same.

E. Overheating—Badly worn electrodes and premature gap wear are indicative of this problem, along with a gray or white "blistered" appearance on the insulator. Caused by one or more of the following:
  a. Spark plug heat range too hot.
  b. Incorrect propeller usage, causing engine to lug.
  c. Worn or defective water pump.
  d. Restricted water intake or restriction somewhere in the cooling system.

F. Ash deposits or lead fouling—Ash deposits are light brown to white in color and result from use of fuel or oil additives. Lead fouling produces a yellowish brown discoloration and can be avoided by using unleaded fuels.

0 B



SURFACE GAP
SPARK PLUG ANALYSIS

A. Normal—Light tan or gray colored deposits indicate that the engine/ignition system condition is good. Electrode wear indicates normal spark rotation.
B. Worn out—Excessive electrode wear can cause hard starting or a misfire during acceleration.
C. Cold fouled—Wet oil-fuel deposits are caused by "drowning" the plug with raw fuel mix during cranking, overrich carburetion or an improper fuel-oil ratio. Weak ignition will also contribute to this condition.
D. Carbon tracking—Electrically conductive deposits on the firing end provide a low-resistance path for the voltage. Carbon tracks form and can cause misfires.
E. Concentrated arc—Multi-colored appearance is normal. It is caused by electricity consistently following the same firing path. Arc path changes with deposit conductivity and gap erosion.
F. Aluminum throw-off—Caused by preignition. This is not a plug problem but the result of engine damage. Check engine to determine cause and extent of damage.

Spark Plug Installation

Improper installation of spark plugs is one of the most common causes of poor spark plug performance in outboard motors. The gasket on the plug must be fully compressed against a clean plug seat in order for heat transfer to take place effectively. This requires close attention to proper tightening during installation.

1. Inspect the spark plug hole threads and clean them with a thread chaser (**Figure 24**). Wipe the cylinder head seats clean before installing the new plugs.
2. Screw each plug in by hand until it seats. Very little effort is required. If force is necessary, the plug is cross-threaded. Unscrew it and try again.
3. Tighten the spark plugs. If you have a torque wrench, tighten to 17-20 ft.-lb. (24-27 N•m). If not, seat the plug finger-tight on the gasket, then tighten an additional 1/4 turn with a wrench.
4. Inspect each spark plug wire before reconnecting it to its cylinder. If insulation is damaged or deteriorated, install a new plug wire. Push wire boot onto plug terminal and make sure it seats fully.

Lower Unit and Water Pump Check

A faulty water pump or one that performs below specifications can result in extensive engine damage. Thus, it is a good idea to replace the water pump impeller, seals and gaskets once a year or whenever the lower unit is removed for service. See Chapter Nine.

Fuel System Service

The clearance between the carburetor and choke shutter should not be greater than 0.015 in. when the choke is closed or a hard starting condition will result. When changing from one brand of gasoline to another, it may be necessary to readjust the carburetor idle mixture needle slightly (1/4 turn) to accomodate the variations in volatility.

Fuel Lines

1. Visually check all fuel lines for kinks, leaks, deterioration or other damage.
2. Disconnect fuel lines and blow out with compressed air to dislodge any contamination or foreign material.
3. Coat fuel line fittings sparingly with OMC Gasket Sealing Compound and reconnect the lines.

Engine Fuel Filter

Three types of engine fuel filters are used: a petcock filter screen installed in the petcock between the fuel tank and carburetor on 2 hp models, and inline filter installed between the carburetor and fuel pump on 4 hp models prior to 1981 or a fuel pump filter screen (all other models).

Petcock Filter Screen (2 hp)

Refer to **Figure 25** for this procedure.

1. Unscrew and remove the fuel shut-off valve.
2. Remove the filter from the filter cup.
3. Clean filter in OMC Engine Cleaner and blow dry with compressed air.

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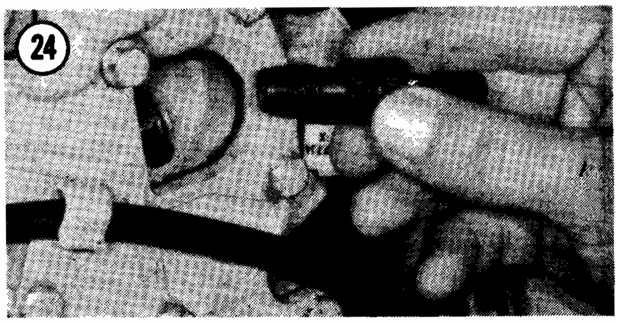

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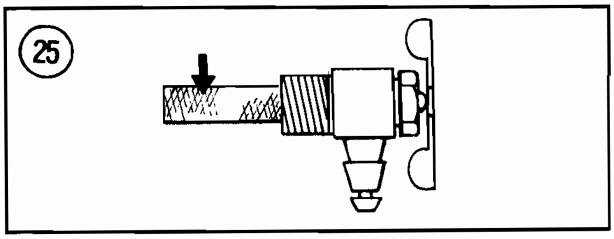
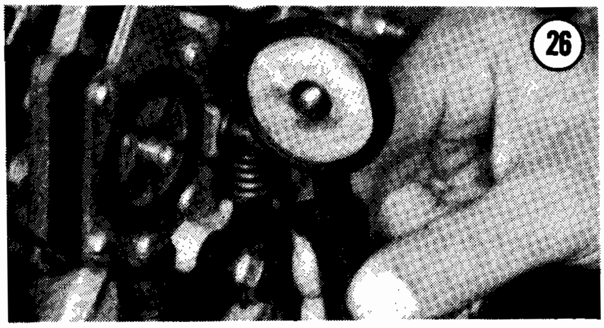
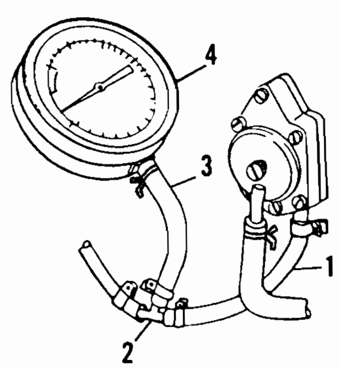


4. Installation is the reverse of removal. Use a drop of OMC Gasoila on the shut-off valve threads before installing valve in fuel tank.

Inline Filter (4 hp [Prior to 1981])

1. Remove the engine cover.
2. Compress the clamps holding the fuel lines to the filter with pliers and slide each clamp back on the hose about 1/2 inch.
3. Pull the filter from the lines. Discard the filter.
4. Connect the fuel lines to the new filter's nipples. Make sure the arrow embossed on the filter faces in the direction of fuel flow.
5. Compress each clamp with pliers and slide over the line until it touches the filter housing.
6. Check filter installation for leakage by priming fuel system with fuel line primer bulb.





27

1. Hose
2. Tee
3. Fabricated line
4. Pressure gauge

Fuel Pump Filter (All Other Models)

Refer to **Figure 26** for this procedure.

1. Remove the screw holding the filter cover to the fuel pump.
2. Remove the filter screen from the pump housing or filter cover.
3. Clean the screen in OMC Engine Cleaner. If screen is excessively dirty or plugged, discard it and install a new one.
4. Install the filter screen in the filter cover.
5. Reinstall the filter cover to the fuel pump and tighten the screw securely.
6. Check filter assembly for leakage by priming fuel system with fuel line primer bulb.

4

Fuel Pump

The fuel pump does not generally require service during a tune-up.

Fuel pump diaphragms are fragile and a defective one often produces symptoms which appear to be an ignition system problem. A common malfunction results from a tiny pinhole or crack in the diaphragm caused by an engine backfire. This defect allows gasoline to enter the crankcase and wet-foul the spark plug at idle speed, causing hard starting and engine stall at low rpm. The problem disappears at higher speeds, as fuel quantity is limited. Since the plug is not fouled by excess fuel at higher speeds, it fires normally.

Fuel Pump Pressure Test

Check fuel pump pressure by installing a pressure gauge at the end of the fuel line leading to the upper carburetor. See **Figure 27**. With the engine running in a test tank or on the boat in the water, fuel pump pressure must be at least 1 psi at 600 rpm, 1.5 psi at 2,500-3,000 rpm and 2.5 psi at 4,500 rpm. If not, rebuild the fuel pump with a new diaphragm, check valves and gaskets. See Chapter Six.

Breaker Point Ignition System Service

An ignition analyzer must be used for an accurate check of the breaker points. Johnson and Evinrude recommend the use of the Merc-O-Tronic, Stevens ST-75 or Stevens M.A.-75 or M.A.-80. These can be purchased through your local Johnson or Evinrude dealer.

Check the breaker points as described in *Breaker Point Testing*, Chapter Three. If they fail to perform as specified, clean the points with electrical contact cleaner—do not file. If they still do not deliver a satisfactory reading, replace the points as described in this chapter.

Breaker Point Replacement (1-cylinder Models)

1. Move the armature plate to the full advance position.
2. Disconnect the breaker point and condenser leads.
3. Remove the hairpin clip at the top of the breaker point pivot post.
4. Remove the adjusting and locking screws. Remove the breaker point set.
5. Remove the condenser attaching screw. Remove the condenser.
6. Assemble the movable side of a new breaker point set to the non-movable side by slipping it over the breaker point pivot post.
7. Install assembled point set to the armature plate. Install the adjusting and locking screws finger-tight.
8. Install the hairpin clip in the breaker point pivot post groove.

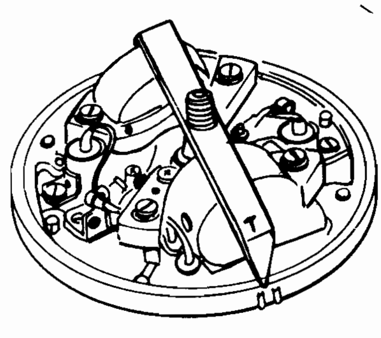
CAUTION
Do not rotate the crankshaft counterclockwise in Step 9 or the water pump impeller may be damaged.

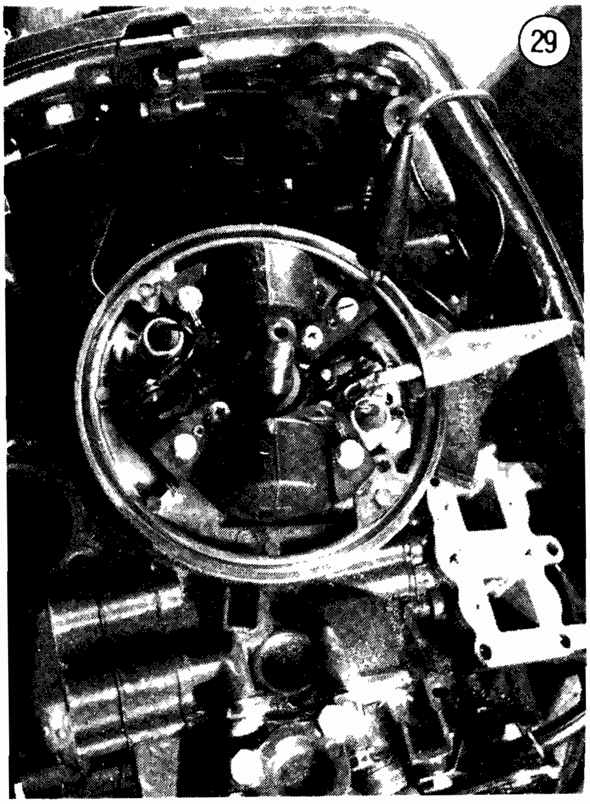
9. Rotate the crankshaft clockwise to position the breaker arm rubbing block on the high point of the cam.
10. Turn the adjusting screw to obtain a gap of 0.022 in. Measure gap with a flat feeler gauge.
11. Tighten the locking screw and recheck the point gap.
12. Install the new condenser and tighten the attaching screw securely.
13. Connect the breaker point and condenser leads.

Breaker Point Replacement (2-cylinder Models)

1. Move the armature plate to the full advance position.
2. Disconnect all breaker point and condenser leads.
3. Remove the hairpin clip at the top of each breaker point pivot post.

28





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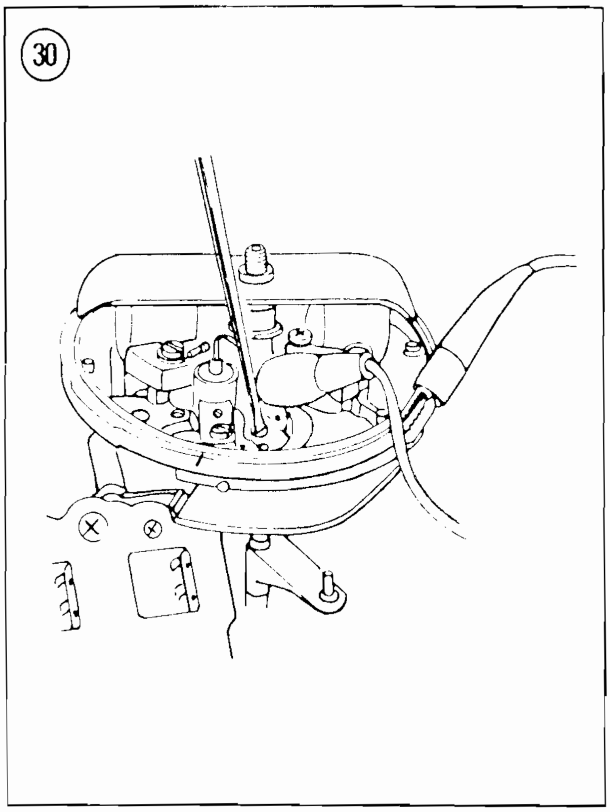

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4. Remove the adjusting and locking screws. Remove the breaker point sets.
5. Remove the condenser attaching screws. Remove the condensers.
6. Assemble the movable side of a new breaker point set to the non-movable side by slipping it over the breaker point pivot post.
7. Install each assembled point set to the armature plate. Install the adjusting and locking screws finger-tight.
8. Install the hairpin clip in each breaker point pivot post groove.
9. Install the correct timing fixture (**Figure 28**) on the crankshaft. Use part No. 383602 (6 and 25 hp), part No. 383603 (4 hp), part No. 386635 (35 and 40 hp) or part No. 386636 (9.5, 9.9 and 15 hp).
10. Connect an ohmmeter between the breaker plate and front breaker point set screw terminal. See **Figure 29**.

CAUTION
Do not rotate the crankshaft counterclockwise in Step 11 or the water pump impeller may be damaged.

11. Rotate the crankshaft clockwise until the side of the timing fixture marked "T" or "TOP" aligns with the front timing mark projection on the armature plate. See **Figure 28**.
12. Slowly move the timing fixture clockwise until the meter needle deflects (points open). This should happen when the timing plate aligns with the timing mark as in Step 11. If it does not, rotate the timing fixture another full turn and align the fixture with the marks, then adjust the point set (**Figure 30**) until the meter needle deflects. Tighten the locking screw.
13. Rotate the crankshaft 180° and repeat Steps 9-12 to adjust the rear breaker point set. Use the rear timing mark projection on the armature plate.

Battery and Starter Motor Check (Electric Start Models Only)

1. Check the battery's state of charge. See Chapter Seven.
2. Connect a voltmeter between the starter motor positive terminal (**Figure 31**) and ground.
3. Turn ignition switch to START and check voltmeter scale:
   a. If voltage exceeds 9.5 volts and the starter motor does not operate, replace the motor.
   b. If voltage is less than 9.5 volts, recheck battery and connections. Charge battery, if necessary, and repeat procedure.

Solenoid Check (Electric Start Models Only)

Any good volt-ohm-ammeter (VOA) can be used for this test.

1. Disconnect all leads from the starter solenoid. See **Figure 32**.
2. Connect the VOA meter leads to the soldered solenoid leads (1 and 2, **Figure 33**).
3. Set the meter to the R×1 scale. The meter should indicate continuity.
4. Set the meter to the R×1K scale. Connect the meter leads between the threaded terminals (3 and 4, **Figure 33**).
5. Connect a 12-volt battery between the soldered solenoid leads (1 and 2, **Figure 33**). The solenoid should click and the VOA meter should read zero ohms. If not, replace the solenoid.

Internal Wiring Harness Check

1. Check the wiring harness for signs of frayed or chafed insulation.
2. Check for loose connections between the wires and terminal ends.
3. Check the harness connector for bent electrical pins.
4. Check the harness connector and pin sockets for signs of corrosion and clean as required.
5. If the harness is suspected of contributing to electrical malfunctions, check all wires for continuity and resistance between harness connection and terminal end. Repair or replace as required.

Engine Synchronization and Adjustment

See Chapter Five.

Performance Test (On Boat)

Before performance testing the engine, make sure that the boat bottom is cleaned of all marine growth and that there is no evidence of a "hook" or "rocker" (**Figure 34**)

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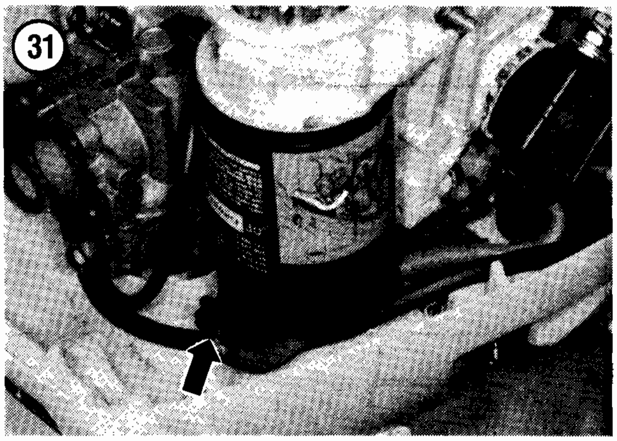

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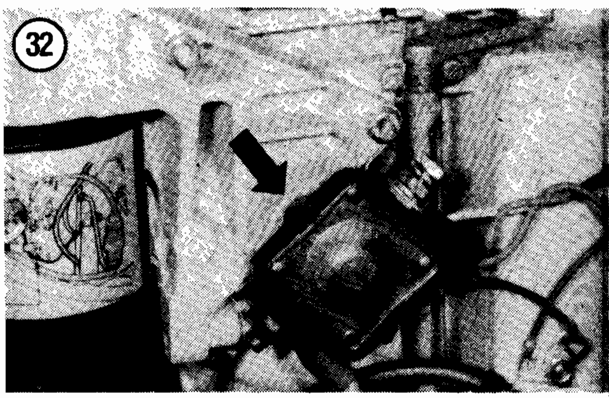

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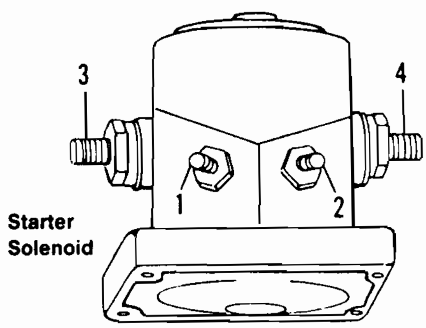
SOLENOID TEST POINTS



1. Soldered solenoid lead
2. Soldered solenoid lead
3. Threaded terminal
4. Threaded terminal

in the bottom. Any of these conditions will reduce performance considerably. The boat should be performance tested with an average load and with the motor tilted at an angle that will allow the boat to ride on an even keel. If equipped with an adjustable trim tab, it should be properly adjusted to allow the boat to steer in either direction with equal ease.

Check engine rpm at full throttle. If not within the maximum rpm range for the motor as specified in Chapter Five, check the propeller pitch. A high pitch propeller will reduce rpm while a lower pitch prop will increase it.

Readjust the idle mixture and speed under actual operating conditions as required to obtain the best low-speed engine performance.

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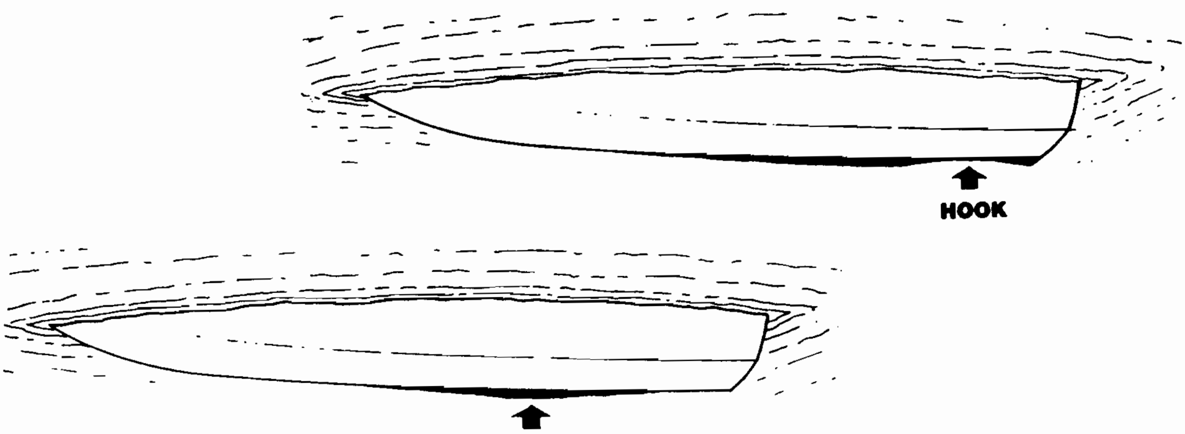

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Table 1 LUBRICATION & MAINTENANCE[1]

Lubrication points	Figure
Clamp screws, steering handle pivot and tilt/run lever	10
Throttle detent, cam, linkage and choke lever	5
Magneto and throttle linkage	7, 9
Shift lever fitting, reverse lock and swivel bracket	—
Fuel shut-off/choke shaft (integral tank)	—
Choke shaft (remote tank)	—
Choke linkage	8
Rear motor cover latch	—
Starter motor pinion shaft[2]	11
Vertical throttle shaft and gears	12

1. Complete list does not apply to all models. Perform only those tasks which apply to your model. Lubricate with OMC Triple-Guard Grease every 60 days (fresh water) or 30 days (salt water) as required.
2. Use Lubriplate 777.

Table 2 TEST WHEEL RECOMMENDATIONS

Model	Test wheel	Engine rpm
2 hp	316021	3,900
Colt, Junior	316021	3,900
2.5	317738	3,500
3, Ultra 4, Excel 4	317738	4,400
4 Weedless	316021	3,800
4 Standard		
1973	316960	4,100
1974-on	317738	4,550
4 Deluxe, 4.5 hp	390123	5,100
5 hp		
1985-1986	390239	4,900
1987-on	390239	4,500
6, 7.5 hp		
1973-1975	380757	4,000
1976-1979	379673	4,500
1982-1986	390239	4,900
1987-on	390239	4,800

(continued)

Table 2 TEST WHEEL RECOMMENDATIONS (continued)

Model	Test wheel	Engine rpm
8 hp		
1984-1986	390239	4,900
1987-on	390239	5,300
8SRL	390239	4,850
9.5 hp	379673	4,400
9.9 hp		
1974-1984	386537	5,400
1985-1986	386537	5,500
1987	386537	5,000
1988	386537	5,650
1989-1990	386537	5,400
9.9SEL		
1987	386537	4,200
1988	386537	4,800
1989-1990	386537	4,400
15 hp		
1974-1986	386537	6,200
1987-1988	386537	6,650
1989-1990	386537	6,100
20 hp		
1973	376913	4,650
1980-1984	388880	4,650
1985-on	386891	4,550
25 hp		
1973-1976	376913	4,900
1977	388295	4,650
1978-1984	388880	5,200
1985-1986	394145	4,800
1987	394145	4,600
1988-on	394145	4,800
28 hp		
1987	396561	4,200
1988-on	398948	4,800
30 hp		
1984	386891	5,300
1985-1986	394145	5,400
1987	394145	5,200
1988-on	394145	5,400
35 hp		
1976-1984	386891	5,300
40 hp		
1973-1976	378566	4,500
1985-1986		
Manual	382861	4,900
Electric	387635	5,200
1987-1988	387635	4,900
1989-1990	432968	4,900

Table 3 RECOMMENDED SPARK PLUGS

Model	hp/cyl.	Champion plug type	Gap (in.)
2	2/1	J6C	0.030
Colt, Junior	2/1	RJ6C	0.030
2.5	2.5/2	QL77JC4	0.040
3	3/2	RL82C	0.030
Ultra 4, Excel 4	4/2	QL77JC4[2]	0.030
4 (1973-1976)	4/2	J6C	0.030
4 (1977-1980)	4/2	L77J4	0.040
4 (1981)	4/2	L7J	0.030
4 (1982-1987)	4/2	RL86C	0.030
4 (1988-1990)	4/2	RL82C	0.030
4 Deluxe	4/2	QL77JC4[2]	0.040
4.5	4.5/2	QL77J4[3]	0.040
5	5/2	QL77JC4[2]	0.040
6 (1973-1976)	6/2	J6C	0.030
6 (1977-on)	6/2	QL77JC4[2]	0.040
7.5	7.5/2	QL77J4	0.040
8	8/2	QL77JC4[2]	0.040
9.5	9.5/2	J6C[1]	0.030
9.9 (1974-1976)	9.9/2	UL81J	0.030
9.9 (1977-on)	9.9/2	QL77JC4[3]	0.040
15 (1974-1976)	15/2	UL81J	0.030
15 (1977-on)	15/2	QL77JC4[3]	0.040
18	18/2	UJ4J	0.030
20 (1973)	20/2	UJ4J	0.030
20 (1981-1982)	20/2	QL77J4	0.040
20 (1985-on)	20/2	QL77JC4[3]	0.040
25 (1973-1974)	25/2	UJ4J	0.030
25 (1975-1976)	25/2	J6C	0.030
25 (1977-on)	25/2	QL77JC4[3]	0.040
28	28/2	QL77JC4[3]	0.040
30	30/2	QL77JC4[3]	0.040
35 (1975-1976)	35/2	UL81J	0.030
35 (1977-1984)	35/2	QL77J4	0.040
40 (1973)	40/2	J6C	0.030
40 (1974)	40/2	UJ4J	0.030
40 (1975-1976)	40/2	UL81J	0.030
40 (1985-1988)	40/2	QL77JC4[3]	0.040
40 (1989-1990)	40/2	QL78C[2]	0.030

1. Use Champion J6J or AC M44C to prevent wet fouling if used primarily @ low speeds.
2. For sustained high speed operation, Champion QL16V (non-adjustable gap) is recommended.
3. For sustained high speed operation, Champion QL78V or L78V (non-adjustable gap) is recommended for 1985 and later models.

Table 4 SPARK PLUG CROSS-REFERENCE CHART

NGK	Champion	AC	Autolite
B7S	J6C	B43	315
B6HS	L7J	44F	2636
B9HS-10	L77J4	M40FFX	2634
—	L78V	V40FFS	—
BR6S	RJ6C	CR43	303
BR7HS	RL82C	MR42FF	—
BR6HS	RL86C	R44F	—
—	QL77J4	—	—
—	QL77JC4	—	—
—	QL78V	VR40FFK	—
B8S	UJ4J	—	—
B7HS	UL81J	—	—

4

Chapter Five

Engine Synchronization and Linkage Adjustments

If an engine is to deliver its maximum efficiency and peak performance, the ignition must be timed and the carburetor operation synchronized with the ignition. This procedure is the final step of a tune-up. It must also be performed whenever the fuel or ignition systems are serviced or adjusted.

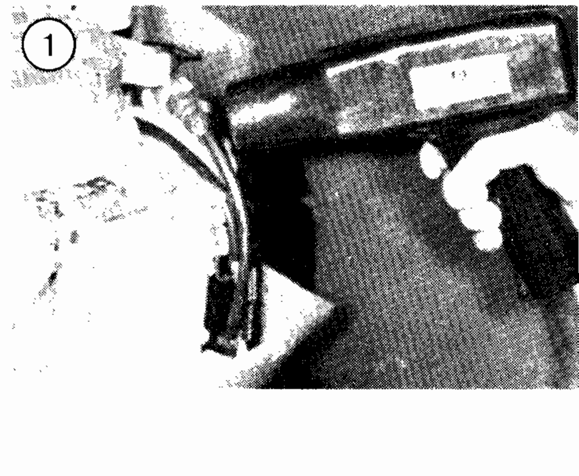
Procedures for engine synchronization and linkage adjustment on Johnson and Evinrude outboards differ according to model and ignition system. This chapter is divided into self-contained sections dealing with particular models/ignition systems for fast and easy reference. Each section specifies the appropriate procedure and sequence to be followed and provides the necessary tune-up data. Read the general information at the beginning of the chapter and then select the section pertaining to your outboard.

ENGINE TIMING

As engine rpm increases, the ignition system must fire the spark plug(s) more rapidly. Proper ignition timing synchroni: the spark plug firing with engine speed.

Timing is not adjustable on engines witl breaker point ignition. Ignition timing w this system depends upon correct init setting of the breaker point gap. Timing c be checked with a timing light (**Figure 1**). the timing marks on the flywheel a armature plate or timing pointer do not al properly, the breaker point gap must be res

On 2.5-15 hp Johnson and Evinru outboards with a CD ignition system, tim



adjustments are not required. If the wires are correctly positioned in the 3-wire, 4-wire and -wire connectors, proper ignition timing will be maintained, provided the linkage adjustments have been made correctly.

Ignition timing is adjustable on 20-40 hp models; a timing light is required to set the timing properly. The engine must be run at full throttle in forward gear. This requires the use of a test tank and test wheel, as timing an engine while speeding across open water is neither easy nor safe.

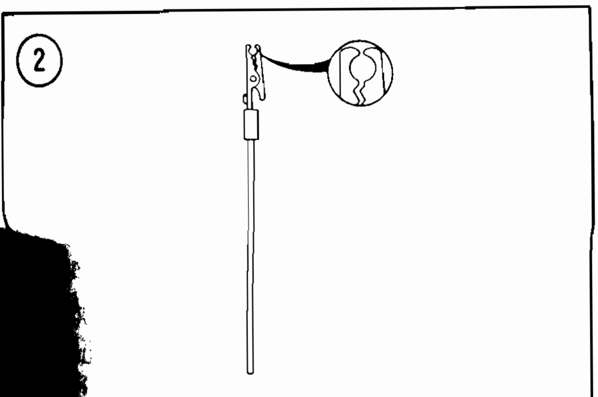
SYNCHRONIZING

As engine speed increases, the carburetor must provide an increased amount of fuel for combustion. Synchronizing is the process of timing the carburetor operation to the ignition (and thereby the engine speed).

Required Equipment

Static timing of an engine with a breaker point ignition requires the use of a test lamp or ohmmeter and a timing fixture to set the breaker point gap. A timing light is used to check timing mark alignment.

Dynamic engine timing uses a stroboscopic timing light connected to the No. 1 spark plug wire. See **Figure 1**. As the engine is cranked or operated, the light flashes each time the spark plug fires. When the light is pointed at the moving flywheel, the mark on the flywheel appears to stand still. The flywheel mark should align with the stationary timing pointer on the engine.



A simple tool called a throttle shaft amplifier can be made with an alligator clip and a length of stiff wire (a paper clip will do). This tool will exaggerate the movement of the carburetor throttle shaft and tell you that it's moving. The tool is especially useful on engines where the throttle cam and cam follower are partially hidden by the flywheel. To make the tool, enlarge the alligator clip's gripping surface by grinding out the front teeth on one side and secure the wire to the end of the clip. See **Figure 2**.

A tachometer connected to the engine is used to determine engine speed during idle and high-speed adjustments.

CAUTION
Never operate the engine without water circulating through the gearcase to the engine. This will damage the water pump and the gearcase and can cause engine damage.

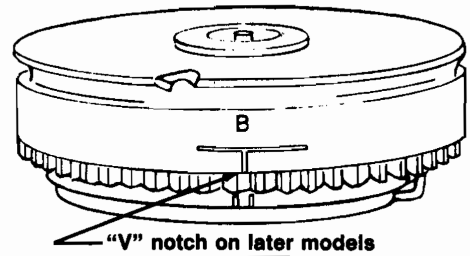
Some form of water supply is required whenever the engine is operated during the procedure. Using a test tank is the most convenient method, although the procedures may be carried out with the boat in the water.

CAUTION
Do not use a flushing device to provide water during synchronization and linkage adjustment. Without the exhaust backpressure of a submerged gearcase, the engine will run lean. The proper test wheel must be used to put a load on the propeller shaft or engine damage can result from excessive rpm.

JOHNSON/EVINRUDE 2HP, COLT AND JUNIOR (BREAKER POINT IGNITION)

The breaker points are mounted on a fixed base. Ignition timing on this model is non-adjustable. Correctly adjusted breaker points will align the flywheel timing mark between the 2 armature plate index marks when the engine is run at 1,000 rpm. See **Figure 3**. If the point gap is too large, timing will be retarded; a gap that is too small will advance timing.

3



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Throttle Cam Adjustment

1. Remove the engine cover.
2. Remove the rewind starter.
3. Remove the fuel tank support bracket.
4. Move the armature lever slowly until the cam follower starts to open the throttle. The center of the cam follower roller should be between the 2 marks on the throttle cam (**Figure 4**).

5A. 1973-1977—If the roller and throttle cam marks do not align in Step 4, loosen the throttle cam mounting screws. Adjust the cam position until the throttle valve is closed and there is no play in the linkage. The throttle cam mark should align with the flat edge of the cam follower as the two make contact. Retighten the cam screws.

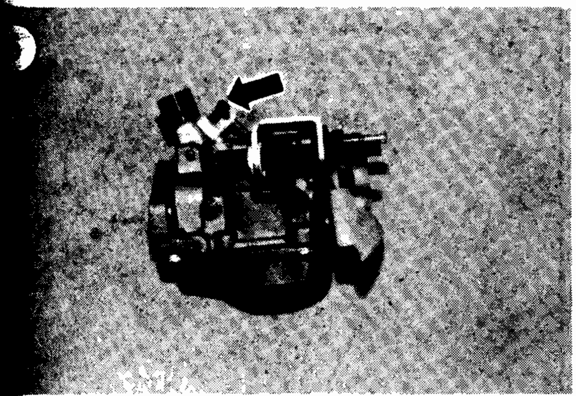
5B. 1978-on—If the roller and throttle cam marks do not align in Step 4, rotate cam follower adjustment screw (**Figure 5**, typical) out (counterclockwise) until the throttle valve is completely closed. Then rotate screw in (clockwise) until throttle valve (position amplifier tool on throttle shaft) just starts to move. On 1980-on models, a hex-head screw is used and requires special Ballhex Driver Tool part No. 327622 to rotate.

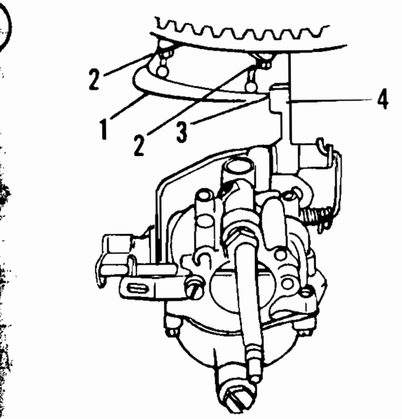
Needle Valve Adjustment

1. Install the engine in a test tank with the proper test wheel or on the boat in the water with the correct propeller.
2. If carburetor has been overhauled, temporarily install low- and high-speed knobs. If carburetor has not been overhauled, loosen high-speed needle packing nut.
3. Turn the carburetor high- and low-speed needles inward until they barely seat.
4. Back the high-speed needle out 3/4-1 turn; back the low-speed needle out 1 1/4-1 1/2 turns.
5. Remove the knob from each needle.
6. Start the engine and run at half throttle until the engine reaches operating temperature.
7. Connect a tachometer according to manufacturer's instructions. Run engine at full throttle and adjust the high-speed needle to obtain the highest consistent rpm.

NOTE
The engine requires approximately 15 seconds to respond to adjustment in Step 8.

8. Bring engine speed back to 700-800 rpm and adjust low-speed needle to produce the highest rpm and smoothest operation.





THROTTLE CAM ADJUSTMENT

1. Throttle cam
2. Cam mounting screws
3. Cam mark
4. Cam follower

nce low-speed mixture adjustment is actory, turn low-speed needle 1/8 turn terclockwise to prevent an excessively condition at idle.

Repeat Step 7. Once high-speed mixture ment is satisfactory, turn high-speed 1/8 turn counterclockwise to prevent cessively lean condition at wide-open le, then tighten needle packing nut ly.

Without changing needle position, install ed knob with pointer facing up and peed knob with pointer facing down.

12. Run the engine in FORWARD gear at idle and note the tachometer. If throttle cam and needle valve adjustments are correct, the engine will idle at 650 rpm in gear.
13. Shut the engine off, remove the test equipment and install the engine cover.

Ignition Timing Check

1. Connect a tachometer and timing light according to manufacturer's instructions.
2. Start the engine and run at 1,000 rpm.
3. Point the timing light at the armature plate index marks. If the flywheel timing mark does not align between the armature plate index marks, adjust the breaker point gap. See Chapter Four.

1973-1978 JOHNSON/EVINRUDE 4 (BREAKER POINT IGNITION)

The breaker points are mounted on a fixed base. Ignition timing on this model is non-adjustable. Correctly adjusted breaker points will align the flywheel timing mark between the 2 armature plate index marks when the engine is run at 1,000 rpm. See **Figure 3**. If the point gap is too large, timing will be retarded; a gap that is too small will advance timing.

Throttle Cam Adjustment

1. Remove the engine cover.
2. Set the throttle grip to the STOP position.
3. Slowly rotate the throttle grip toward the ADVANCE position until the cam follower starts to open the throttle. The timing mark on the throttle cam should align with the starboard edge of the cam follower. See **Figure 6**.
4. If the roller and throttle cam marks do not align in Step 3, loosen the throttle cam mounting screws. Adjust the cam position until the throttle valve is closed and there is no play in the linkage. The throttle cam mark

must be directly behind the round starboard edge of the cam follower as the two make contact. Retighten the cam screws.

Needle Valve Adjustment

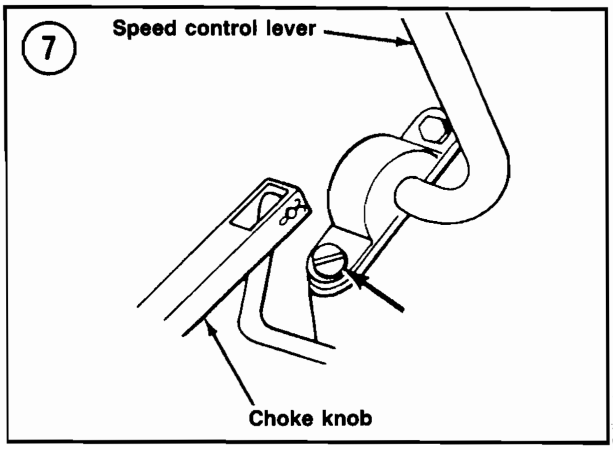
1. Install the engine in a test tank with the proper test wheel or on the boat in the water with the correct propeller.
2. Turn the carburetor high- and low-speed needles inward until they barely seat.
3. Back the high-speed needle out 3/4 turn; back the low-speed needle out 1 3/4 turns.
4. Remove the knob from each needle.
5. Start the engine and run at half throttle until the engine reaches operating temperature.
6. Connect a tachometer according to manufacturer's instructions. Run engine at full throttle and adjust the high-speed needle until the best high speed setting is obtained.

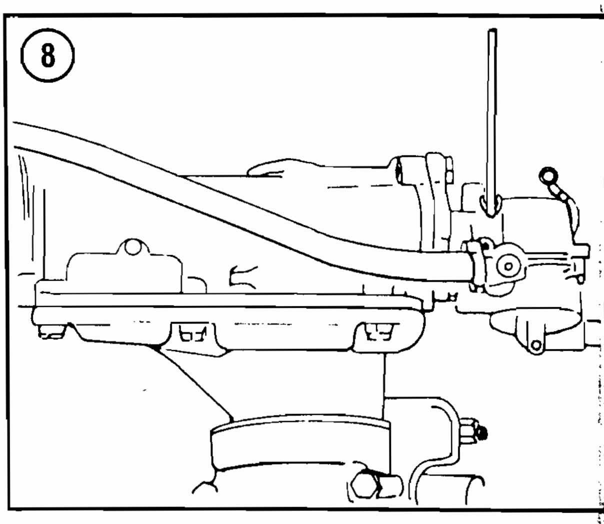
NOTE
The engine requires approximately 15 seconds to respond to adjustment in Step 7.

7. Bring engine speed back to 700-750 rpm and adjust low-speed needle to produce the highest rpm and smoothest operation.
8. Repeat Step 6 after the final low-speed adjustment has been made in Step 7.

NOTE
Do not disturb needle valve setting when reinstalling knobs in Step 9.

9. Install the high-speed needle knob with its pointer facing straight up. Install the low-speed needle with its pointer facing straight down.
10. Run the engine in FORWARD gear at idle and note the tachometer. If throttle cam and needle valve adjustments are correct, the engine will idle at 600 rpm in gear.
11. Shut the engine off, remove the test equipment and install the engine cover.





Throttle Tension Adjustment

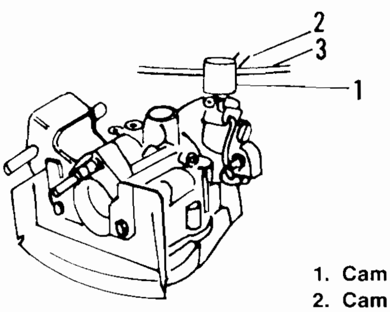
If the throttle tension is correctly adjusted, engine speed will remain constant and the throttle lever will remain in position. If tension is incorrect, adjust by tightening the throttle tension screw (**Figure** 7) as required.

Ignition Timing Check

1. Connect a tachometer and timing light according to manufacturer's instructions.
2. Start the engine and run at 1,000 rpm.
3. Point the timing light at the armature plate index marks. If the flywheel timing mark does not align between the armature plate index marks, adjust the breaker point gap. See Chapter Four.

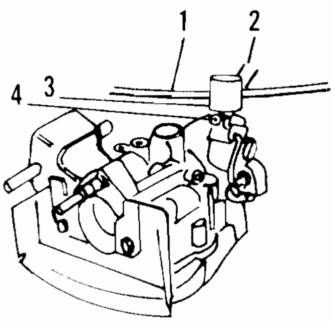
9

2.5, 3 HP, 4 STANDARD, EXCEL 4, ULTRA 4 AND 4 DELUXE TIMING MARK ALIGNMENT



1. Cam follower
2. Cam mark
3. Throttle cam

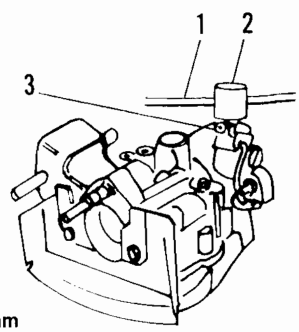
10



4.5-7.5 HP THROTTLE CAM ADJUSTMENT AND TIMING MARK ALIGNMENT

1. Throttle cam
2. Cam mark
3. Cam follower
4. Cam adjustment screw

2.5, 3 HP 4 STANDARD, EXCEL 4, ULTRA 4 AND 4 DELUXE



1. Throttle cam
2. Cam follower
3. Cam adjustment screw

11

JOHNSON/EVINRUDE 2.5, 3 HP, 4 STANDARD, EXCEL 4, ULTRA 4, 4 DELUXE, 4.5 AND 7.5 (CD 2 AND CD2UL IGNITION)

Timing adjustments are not required on these models. If the wires are correctly positioned in the 3-wire, 4-wire or 5-wire connectors, proper ignition timing will be maintained, provided the following adjustments are made correctly.

5

Throttle Cam Adjustment

1. Remove the engine cover.
2. Set the throttle grip to the STOP position.
3. Install the tool shown in **Figure 2** to the end of the throttle shaft opposite the cam follower linkage. Bend the tool wire 90° upward for easier viewing. See **Figure 8**.
4. Slowly rotate the throttle grip toward the ADVANCE position until the tool starts to move, indicating the cam follower is starting to open the throttle. The timing mark on the throttle cam should be centered under the cam follower roller. See **Figure 9** (Models 2.5, 3 hp, 4 Standard, Excel 4, Ultra 4 and 4 Deluxe) or **Figure 10** (Models 4.5 and 7.5).
5. Slowly back the cam adjusting screw out until the throttle valve has closed completely, then turn the screw in until the throttle shaft just starts to rotate. See **Figure 11** (Models 2.5, 3 hp, 4 Standard, Excel 4, Ultra 4 and 4 Deluxe) or **Figure 10** (Models 4.5 and 7.5) for adjusting screw location.

Needle Valve Adjustment

1. Install the engine in a test tank with the proper test wheel or on the boat in the water with the correct propeller.
2. Remove the knob from the low-speed needle.
3. Start the engine and run at half throttle until the engine reaches operating temperature.

4. Connect a tachometer according to manufacturer's instructions.

NOTE
The engine requires approximately 30 seconds to respond to adjustment in Step 5.

5. Bring engine speed back to 700-800 rpm and adjust low-speed needle to produce the highest rpm and smoothest operation.

NOTE
Do not disturb needle valve setting when reinstalling knob in Step 6.

6. Install the low-speed needle knob with its pointer facing down.
7. Run the engine in FORWARD gear at idle and note the tachometer. If throttle cam and needle valve adjustments are correct, the engine will idle at a minimum of 650 rpm in gear.

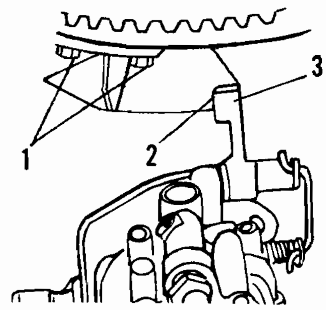
1973-1977 JOHNSON/EVINRUDE 6

The breaker points are mounted on a fixed base. Ignition timing on this model is non-adjustable. Correctly adjusted breaker points will align the flywheel timing mark between the 2 armature plate index marks when the engine is run at 1,000 rpm. See **Figure 3**. If the point gap is too large, timing will be retarded; a gap that is too small will advance timing.

Throttle Cam Adjustment

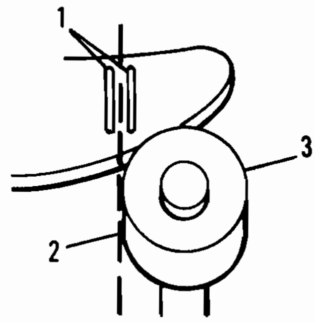
1. Remove the engine cover.
2. Set the throttle grip to the STOP position.
3. Slowly rotate the throttle grip toward the ADVANCE position until the starboard side of the cam follower roller is between the 2 index marks on the throttle cam. See **Figure 12**.

(12) **THROTTLE CAM ALIGNMENT**



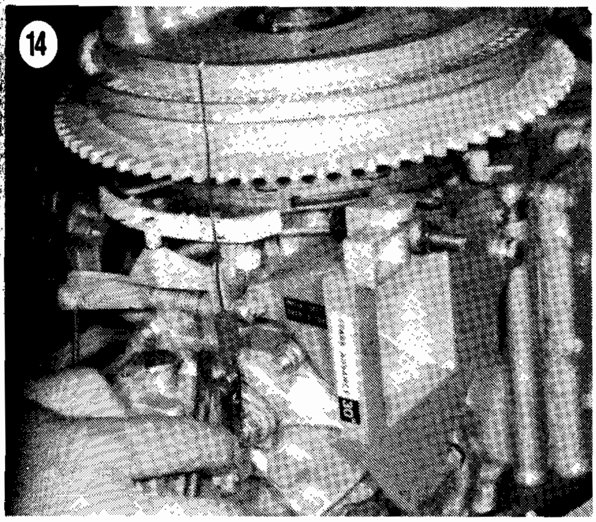
1. Mounting screws
2. Cam marks
3. Cam follower

(13) **THROTTLE CAM ALIGNMENT**



1. Cam marks
2. Leading (starboard) surface
3. Cam follower roller

4. If the throttle valve is not closed when the cam roller and throttle cam marks align in Step 3, rotate the throttle grip until the throttle cam marks are directly behind the starboard edge of the roller. See **Figure 13**.
5. Loosen the throttle cam mounting screws. Make sure the choke knob is pushed completely in and move the cam toward the rear of the motor, then pull it forward until it just touches the cam follower. Tighten the screws and recheck the throttle valve to make sure it is closed and there is no play in the linkage.
6. If the throttle valve is not closed after this adjustment, check for a weak return spring or binding linkage.



Needle Valve Adjustment

1. Install the engine in a test tank with the proper test wheel or on the boat in the water with the correct propeller.
2. Lightly seat the low-speed needle and back it out 1 1/2 turns. Remove the knob from the low-speed needle.
3. Start the engine and run at half throttle until the engine reaches operating temperature.
4. Connect a tachometer according to manufacturer's instructions.

> NOTE
> *The engine requires approximately 15 seconds to respond to adjustment in Step 5.*

5. Bring engine speed back to 700-750 rpm and adjust low-speed needle to produce the highest rpm and smoothest operation.

> NOTE
> *Do not disturb needle valve setting when reinstalling knob in Step 6.*

6. Install the low-speed needle knob with its pointer facing down.
7. Run the engine in FORWARD gear at idle and note the tachometer. If throttle cam and needle valve adjustments are correct, the engine will idle at 550 rpm in gear.
8. Shut the engine off, remove the test equipment and install the engine cover.

Ignition Timing Check

1. Connect a tachometer and timing light according to manufacturer's instructions.
2. Start the engine and run at 1,000 rpm.
3. Point the timing light at the armature plate index marks. If the flywheel timing mark does not align between the armature plate index marks, adjust the breaker point gap. See Chapter Four.

1978-1985 JOHNSON/EVINRUDE 5, 6 AND 8 (CD 2 IGNITION)

Timing adjustments are not required on these models. If the wires are correctly positioned in the 3-wire and 4-wire connectors, proper ignition timing will be maintained, provided the following adjustments are made correctly.

Throttle Cam Adjustment

1. Remove the engine cover.
3. Install the tool shown in **Figure 2** to the end of the throttle shaft opposite the cam follower linkage. See **Figure 14**.
4. Slowly rotate the throttle grip toward the ADVANCE position until the cam follower roller is centered between the throttle cam marks. See **Figure 15**. At this point, the tool installed in Step 3 should just start to move, indicating the throttle is starting to open.
5. If the roller and marks are not properly aligned when the tool starts to move, slowly back the cam follower adjustment screw (**Figure 16**) out until the throttle valve has closed completely, then turn the screw in until the throttle shaft just starts to rotate.

Needle Valve Adjustment

1. Install the engine in a test tank with the proper test wheel or on the boat in the water with the correct propeller.
2. Lightly seat the low-speed needle, then back it out 1-1 1/2 turns. Remove the knob from the low-speed needle.
3. Start the engine and run at half throttle until the engine reaches operating temperature.
4. Connect a tachometer according to manufacturer's instructions.

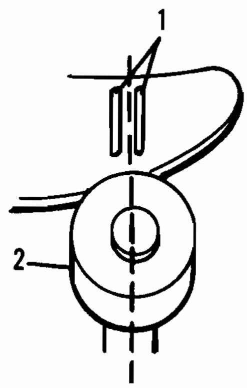
NOTE
The engine requires approximately 15 seconds to respond to adjustment in Step 5.

5. Bring engine speed back to 700-800 rpm and adjust low-speed needle to produce the highest rpm and smoothest operation.
6. Once low-speed mixture adjustment is satisfactory, turn low-speed needle 1/8 turn counterclockwise to prevent an excessively lean condition at idle.

NOTE
Do not disturb needle valve setting when reinstalling knob in Step 7.

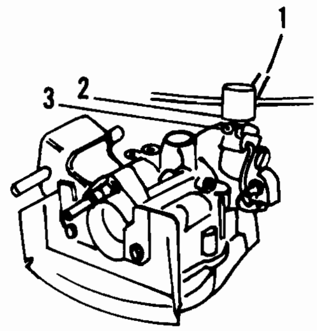
7. Install the low-speed needle knob in its normal running position.
8. Run the engine in FORWARD gear at idle and note the tachometer. If throttle cam and needle valve adjustments are correct, the engine will idle at approximately 650 rpm in gear.
9. 1978-1980—If engine does not idle at 550 rpm in gear with the throttle lever in the SLOW position, turn the idle speed adjustment needle clockwise (increase) or counterclockwise (decrease) as required to bring engine speed to specifications. See **Figure 17**.
10. Shut the engine off, remove the test equipment and install the engine cover.

15 **THROTTLE CAM ALIGNMENT**



1. Cam marks
2. Cam follower roller

16



1. Cam marks
2. Cam follower roller
3. Adjustment screw

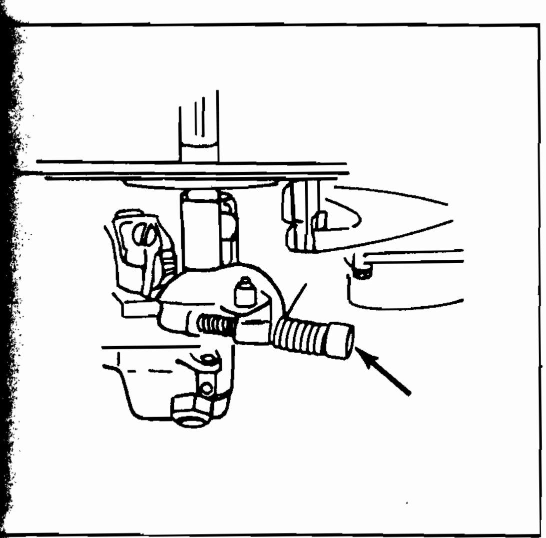
1986-1990 JOHNSON/EVINRUDE 6 AN 8 (CD 2 AND CD2UL IGNITION)

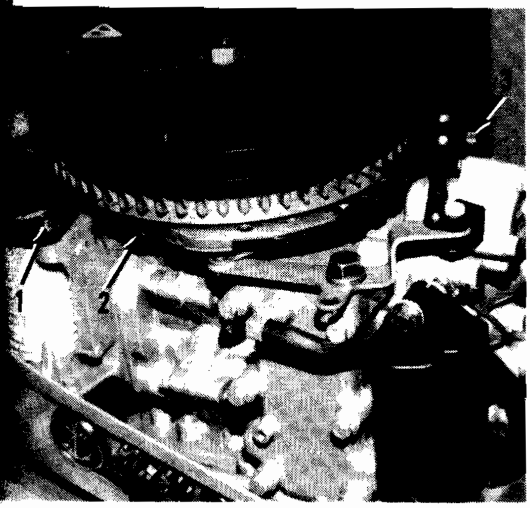
Idle timing is adjustable. Wide-op throttle timing is non-adjustable.

Timing Pointer Alignment

NOTE
*If the position of the timing pointer (1, **Figure 18**) is questioned, proceed as follows to check alignment.*

1. Remove both spark plug leads and plugs.





1. Timing pointer
2. Stop bracket
3. Throttle cable bracket

oosen timing pointer retaining screw (1, re 18) and center timing pointer in stment slot. Lightly tighten retaining w.

otate the flywheel clockwise until the C mark in the flywheel is approximately 1 in. past the timing pointer.

nstall OMC Piston Stop Tool part No. 887 into spark plug hole of No. 1 nder. Push tool's graduated stop rod into cylinder until rod end contacts piston top. Rotate tool's lock ring to retain stop rod position.

5. Place a mark on the flywheel adjacent to the timing pointer.
6. Rotate the flywheel clockwise until rod end of Piston Stop Tool contacts piston top again.
7. Place another mark on the flywheel adjacent to the timing pointer.
8. Use a suitable measuring device and measure the distance along the flywheel edge between the 2 marks placed on the flywheel.
9. Calculate the measured distance midpoint and place a mark on the flywheel edge at the midpoint.
10. The midpoint mark should align with the TDC mark in the flywheel.
11. Remove Piston Stop Tool from No. 1 cylinder spark plug hole.
12. If midpoint mark aligned with TDC mark in flywheel, securely tighten timing pointer retaining screw.
13. If midpoint mark did not align with TDC mark in flywheel, rotate flywheel clockwise to align midpoint mark with timing pointer. Secure position, then loosen timing pointer retaining screw and slide timing pointer in adjustment slot to align pointer with TDC mark in flywheel. Securely tighten timing pointer retaining screw.
14. Install spark plugs and reconnect spark plug leads.

5

Idle Timing Adjustment

1. Install the engine in a test tank with the proper test wheel or on the boat in the water with the correct propeller.
2. Rotate idle speed knob in tiller handle completely counterclockwise (slowest setting).
3. Remove screw retaining throttle cable bracket (3, **Figure 18**). Note flat washer located between throttle cable bracket and power head.

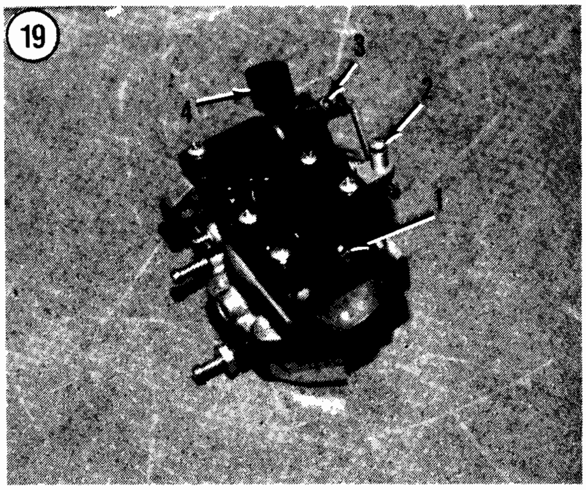
NOTE
Low-speed screw (1, ***Figure 19****) is located at front of carburetor on 1986-1987 models and on top, starboard side of carburetor on 1988-1990 models.*

4. Adjust low-speed screw (1, **Figure 19**) 2 1/2 turns out from a lightly seated position.
5. Rotate throttle cracking screw (2, **Figure 19**) counterclockwise until no contact is made with throttle valve link, then rotate cracking screw 4 complete turns clockwise after contact is made with throttle valve link.
6. Connect a timing light to No. 1 cylinder according to manufacturer's recommendation.
7. Start the engine and operate in NEUTRAL position with the throttle at idle position.
8. Idle timing should be 9° ± 1° ATDC.
9. To adjust idle timing, loosen and adjust stop bracket (2, **Figure 18**). Tighten retaining screw to secure stop bracket position.
10. Stop engine.
11. Adjust throttle cable bracket (3, **Figure 18**) so that bracket preloads throttle cable and linkage one complete turn toward the closed throttle position.
12. Install flat washer between throttle cable bracket and power head. Tighten throttle cable bracket retaining screw to secure adjustment.

Carburetor Mixture Adjustment

1. Install the engine in a test tank with the proper test wheel or on the boat in the water with the correct propeller.
2. Use OMC Ballhex Driver part No. 327622 and rotate throttle cam follower screw (3, **Figure 19**) counterclockwise until roller (4, **Figure 19**) does not touch the cam.
3. Connect a tachometer according to manufacturer's instructions.

19



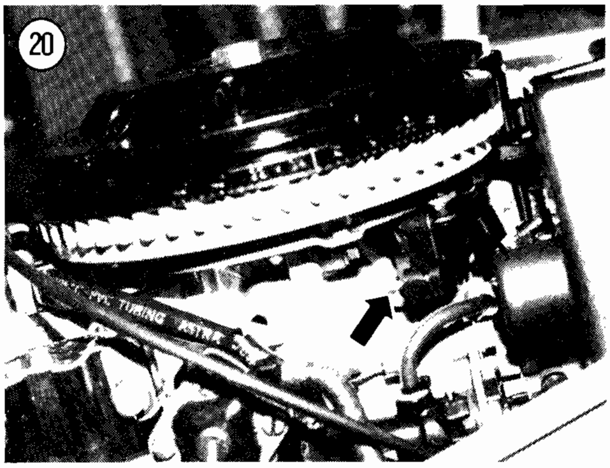
1. Low-speed screw
2. Cracking screw
3. Cam follower screw
4. Roller

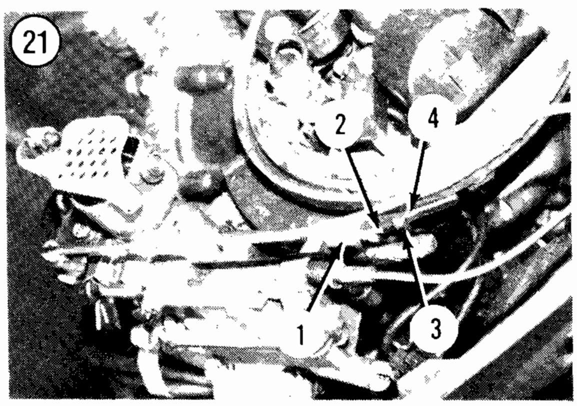
4. Start the engine and run at half throttle until the engine reaches operating temperature.

NOTE
Low-speed screw (1, ***Figure 19****) is located at front of carburetor on 1986-1987 models and on top, starboard side of carburetor on 1988-1990 models.*

NOTE
The engine requires approximately 15 seconds to respond to adjustment in Step 5.

5. Bring engine back to idle position and shift into FORWARD position. With the engine idling at approximately 700 rpm, adjust the low-speed screw to obtain the highest consistent rpm.
6. Once low-speed mixture adjustment is satisfactory, turn low-speed needle 1/8 turn counterclockwise to prevent an excessively lean condition at idle.
7. Adjust throttle cracking screw (2, **Figure 19**) to obtain an idle speed of 700 rpm in FORWARD gear position.
8. Stop the engine.





1. Throttle lever
2. Cam follower adjustment screw
3. Cam follower
4. Timing mark

9. With the throttle in the complete closed position, use OMC Ballhex Driver part No. 327622 and rotate throttle cam follower screw (3, **Figure 19**) clockwise until roller (4, **Figure 19**) just touches cam, then rotate counterclockwise 1/8 turn.

Wide Open Throttle Stop Adjustment

1. Stop the engine.
2. Rotate throttle to complete wide open position.
3. Use OMC Ballhex Driver part No. 327622 and rotate throttle cam screw (**Figure 20**) as needed to position roll pin in throttle shaft in a true vertical position.

JOHNSON/EVINRUDE 9.5 (BREAKER POINT IGNITION)

The breaker points are mounted on a fixed base. Ignition timing on this model is non-adjustable. Correctly adjusted breaker points will align the flywheel timing mark between the 2 armature plate index marks when the engine is run at 1,000 rpm. See **Figure 3**. If the point gap is too large, timing will be retarded; a gap that is too small will advance timing.

5

Throttle Cam Adjustment

1. Remove the engine cover.
2. Loosen the cam follower adjustment screw (**Figure 21**).
3. Move the cam follower until it just touches the throttle cam.
4. Slowly rotate the throttle grip until the cam follower aligns with the timing mark on the throttle cam. See **Figure 21**.
5. Make sure the throttle valve is completely closed. Hold the throttle shaft in that position and position the throttle lever roller against the cam follower. Tighten adjustment screw securely.

Needle Valve Adjustment

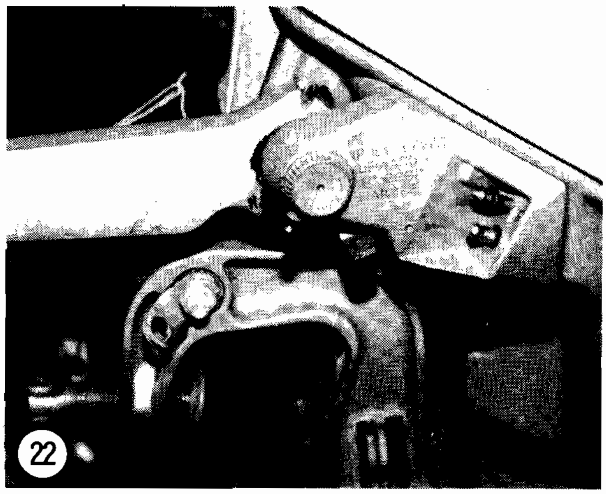
1. Install the engine in a test tank with the proper test wheel or on the boat in the water with the correct propeller.
2. Lightly seat the low-speed needle and back it out 3/4 turns. Remove the knob from the low-speed needle.
3. Start the engine and run at half throttle until the engine reaches operating temperature.
4. Connect a tachometer according to manufacturer's instructions.

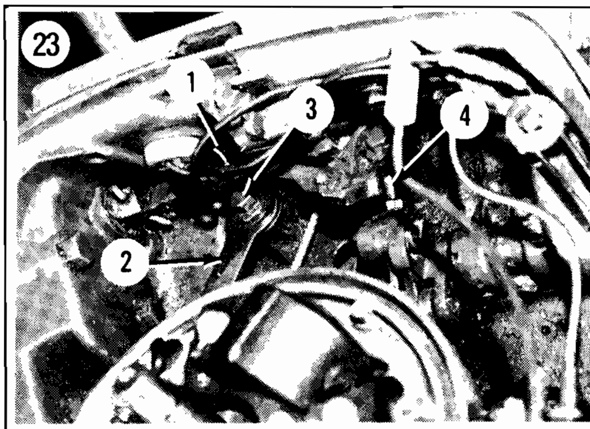
NOTE
The engine requires approximately 15 seconds to respond to adjustment in Step 5.

5. Briefly run the engine at full throttle to clear it out, then bring the engine speed back to 700-750 rpm (in gear).
6. Turn low-speed needle clockwise until the engine hesitates, then turn it counterclockwise until it reaches the fastest and smoothest running position.

NOTE
Do not disturb needle valve setting when reinstalling knob in Step 7.

7. Install the low-speed needle knob set mid-way between rich and lean.
8. Run the engine in FORWARD gear at idle and adjust the idle speed adjustment knob (**Figure 22**) until the engine idles at 550 rpm in gear.
9. Shift the engine into NEUTRAL and adjust the neutral stop screw to obtain an idle of 2,700-3,200 rpm. See **Figure 23** for neutral stop screw location (flywheel shown removed).
10. Shut the engine off, remove the test equipment and install the engine cover.





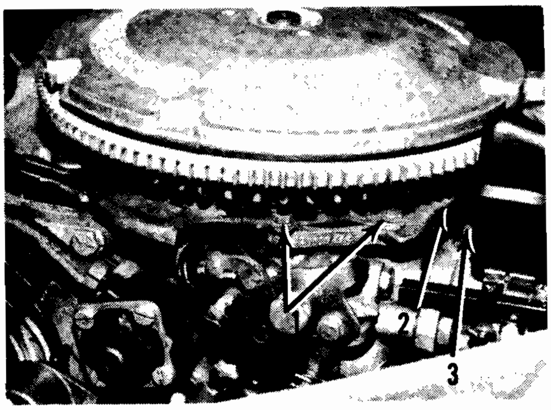
1. Circlip
2. Arm and link
3. Pivot and arm screw
4. Neutral stop screw

JOHNSON/EVINRUDE 9.9 AND 15 (BREAKER POINT IGNITION)

The breaker points are mounted on a fixed base. Ignition timing on these models is non-adjustable. Correctly adjusted breaker points will align the flywheel timing mark between the 2 armature plate index marks when the engine is run at 1,000 rpm. See **Figure 3**. If the point gap is too large, timing will be retarded; a gap that is too small will advance timing.

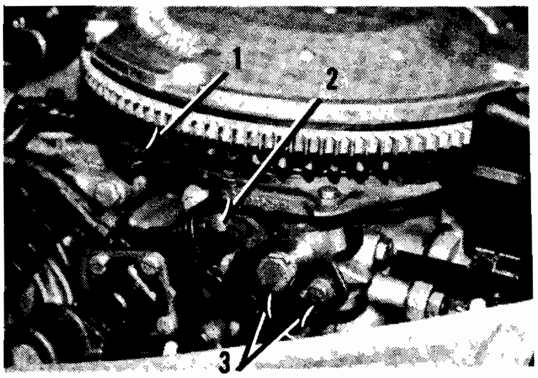
Throttle Cam Adjustment

1. Remove the engine cover.
2. Remove the air silencer cover and base.
3. Set the throttle grip to the STOP position.
4. Slowly rotate the throttle grip toward the ADVANCE position until the throttle cam timing mark intersects the cam follower roller. See **Figure 24**.
5. If the throttle valve is not closed when the cam roller and throttle cam mark align in Step 3, loosen the cam adjustment screws. Adjust cam back or forth as required and tighten screws.
6. Recheck adjustment by rotating the throttle grip while watching the throttle valve. The valve should start to open as the V-shaped cam mark passes the center of the roller.
7. Install the air silencer base and cover.



1. Cam adjustment screws
2. Cam mark
3. Cam follower roller

(24)



1. Armature retainer plate
2. Neutral speed stop (shift lock)
3. Adjustment screws

(25)

Needle Valve Adjustment

1. Install the engine in a test tank with the proper test wheel or on the boat in the water with the correct propeller.
2. Remove the knob from the low-speed needle.
3. Start the engine and run at half throttle until the engine reaches operating temperature.
4. Connect a tachometer according to manufacturer's instructions.

NOTE
The engine requires approximately 15 seconds to respond to adjustment in Step 5.

5. Bring engine speed back to 700-750 rpm and adjust low-speed needle to produce the highest rpm and smoothest operation.

NOTE
Do not disturb needle valve setting when reinstalling knob in Step 6.

6. Install the low-speed needle knob with its pointer facing down.
7. Run the engine in FORWARD gear at idle and note the tachometer. If throttle cam and needle valve adjustments are correct, the engine will idle at 600 rpm in gear.
8. Shift the engine into NEUTRAL and loosen the shift lock stop adjustment screws. Adjust shift lock stop to obtain an idle of 3,000-4,000 rpm, then tighten screws. See **Figure 25** for neutral speed stop location.
9. Shut the engine off, remove the test equipment and install the engine cover.

JOHNSON/EVINRUDE 9.9 AND 15 (CD 2 AND CD2UL IGNITION)

Timing adustments are not required on these models. If the wires are correctly positioned in the 3-wire, 4-wire or 5-wire connectors, proper ignition timing will be maintained, provided the following adjustments are made correctly.

Throttle Cam Adjustment

1. Remove the engine cover.
2. Remove the air silencer cover and base.
3. Set the throttle grip to the STOP position.
4. Install the tool shown in **Figure 2** to the end of the throttle shaft opposite the cam follower linkage. See **Figure 26**.
5. Slowly rotate the throttle grip toward the ADVANCE position until the cam follower

roller is centered between the raised marked area on the throttle cam. See **Figure 26**. At this point, the tool installed in Step 3 should just start to move, indicating the throttle is starting to open.

6A. 1977-1978—If the roller and marked area do not align properly when the tool starts to move, loosen the 2 cam adjustment screws (**Figure 26**) and adjust the cam position as required. Tighten screws and recheck alignment.

6B. 1979—If the roller and marked area do not align properly when the tool starts to move, use a screwdriver and turn throttle cam follower screw (3, **Figure 19**) (typical) counterclockwise until roller (4, **Figure 19**) does not touch the cam. Align roller and marked area, then rotate throttle cam follower screw clockwise until tool starts to move.

6C. 1980-on—Use OMC Ballhex Driver part No. 327622 and rotate throttle cam follower screw (3, **Figure 19**) (typical) counterclockwise until roller (4, **Figure 19**) does not touch the cam. Align roller and marked area, then rotate throttle cam follower screw clockwise until tool starts to move.

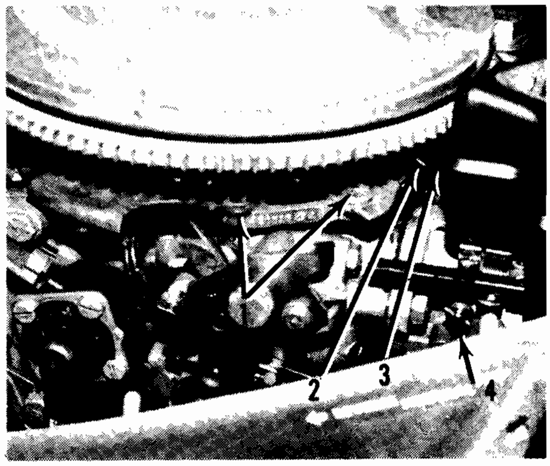
7. Install air silencer base and cover.

Needle Valve Adjustment

CAUTION
Needle valve on 1990 models is factory preset and should not require adjustment. If poor idle is noted, rotate needle valve only in small increments, allowing engine time to respond to adjustment and not varying far from factory preset. An engine adjusted too lean may result in engine damage.

1. Install the engine in a test tank with the proper test wheel or on the boat in the water with the correct propeller.

2. Remove the knob from the low-speed needle.



1. Cam adjustment screws
2. Cam mark
3. Cam follower roller
4. Attach tool here

(26)

3. Start the engine and run at half throttl until the engine reaches operatin temperature.

4. Connect a tachometer according t manufacturer's instructions.

NOTE
The engine requires approximately 15 seconds to respond to adjustment in Step 5.

5. Bring engine speed back to 700-800 rpm in gear and adjust the low-speed needle t produce the highest rpm and smoothes operation.

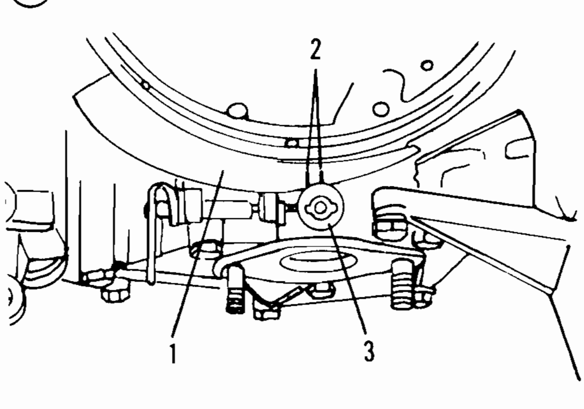
6. Once low-speed mixture adjustment i satisfactory, turn low-speed needle 1/8 tur counterclockwise to prevent an excessivel lean condition at idle.

NOTE
Do not disturb needle valve setting when reinstalling knob in Step 7.

7. Install the low-speed needle knob with it pointer facing down.

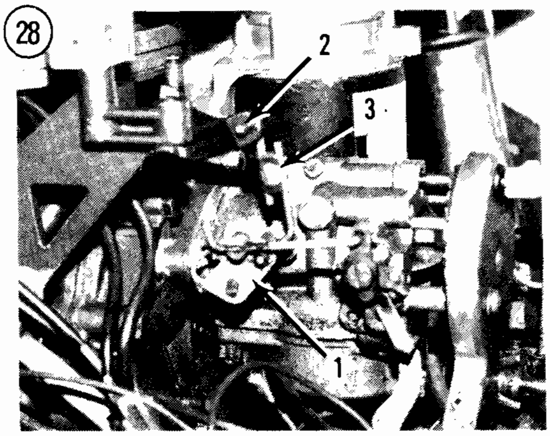
8. Run the engine in FORWARD gear at idl and note the tachometer. If throttle cam and

(27)



1. Throttle cam
2. Cam marks
3. Cam follower roller

(28)



1. Throttle shaft arm
2. Cam follower assembly
3. Linkage screw

needle valve adjustments are correct, the engine will idle at approximately 650 rpm in gear. Adjust idle speed if needed.

9. 1977-1978—Shift the engine into NEUTRAL and loosen the shift lock stop adjustment screws. Adjust shift lock stop to obtain an idle of 3,000-4,000 rpm, then tighten screws. See **Figure 25** for neutral speed stop location.

10. Shut the engine off, remove the test equipment and install the engine cover.

Wide Open Throttle Stop Adjustment

1988-1990

1. Stop the engine and shift into FORWARD position.
2. Rotate throttle to complete wide open position.
3. Use OMC Ballhex Driver part No. 327622 and rotate throttle cam screw (**Figure 20**) as needed to position roll pin in throttle shaft in a true vertical position. 5

JOHNSON/EVINRUDE 18, 20 AND 25 (BREAKER POINT IGNITION)

The breaker points are mounted on a fixed base. Ignition timing on these models is non-adjustable. Correctly adjusted breaker points will align the flywheel timing mark between the 2 armature plate index marks when the engine is run at 1,000 rpm. See **Figure 3**. If the point gap is too large, timing will be retarded; a gap that is too small will advance timing.

Throttle Cam Adjustment

1. Remove the engine cover.
2. Set the throttle grip to the STOP position.
3. Slowly rotate the throttle grip toward the ADVANCE position until the cam follower roller is centered between the 2 index marks on the throttle cam. See **Figure 27** (flywheel shown removed).
4. If the throttle valve is not closed when the cam roller and throttle cam marks align in Step 3, rotate the throttle grip until the cam follower roller and throttle cam index marks are positioned properly (Step 3).
5. Loosen the throttle shaft linkage screw (**Figure 28**). Hold the cam follower tightly against the cam and tighten the linkage screw.
6. Rotate the throttle grip from the STOP position toward ADVANCE. The throttle

valve should start to open after the roller edge passes the second cam mark.

7. If the throttle valve is not closed after the adjustment, check for a weak return spring or binding linkage.

Needle Valve Adjustment

1. Install the engine in a test tank with the proper test wheel or on the boat in the water with the correct propeller.
2. Lightly seat the low-speed needle and back it out one full turn. Remove the low-speed needle valve arm.
3. Start the engine and run at half throttle until the engine reaches operating temperature.
4. Connect a tachometer according to manufacturer's instructions.

NOTE
The engine requires approximately 15 seconds to respond to adjustment in Step 5.

5. Bring engine speed back to 700-750 rpm and adjust low-speed needle to produce the highest rpm and smoothest operation.

NOTE
Do not disturb needle valve setting when reinstalling the valve arm in Step 6.

6. Install the low-speed needle valve arm in the normal running position.
7. Run the engine in FORWARD gear at idle and adjust idle screw (if necessary) to bring the engine speed to 650 rpm in gear.
8. Shut the engine off, remove the test equipment and install the engine cover.

Ignition Timing Check

1. Connect a tachometer and timing light according to manufacturer's instructions.
2. Start the engine and run at 1,000 rpm.
3. Point the timing light at the armature plate index marks. If the flywheel timing mark does not align between the armature plate index marks, adjust the breaker point gap. See Chapter Four.

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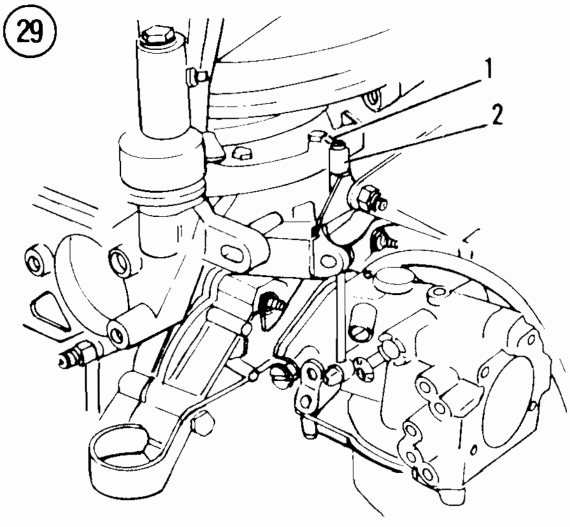


1. Cam marks 2. Cam follower roller

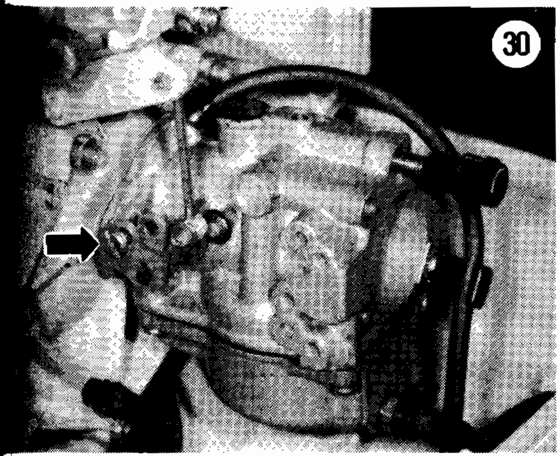
JOHNSON/EVINRUDE 20, 25, 28 AND 30 (CD 2 AND CD2UL IGNITION) JOHNSON/EVINRUDE 35 (ALL IGNITIONS)

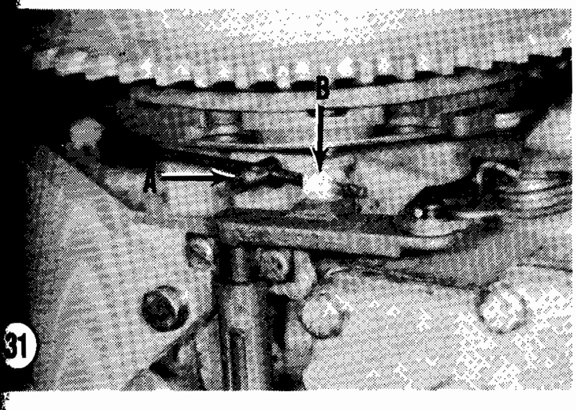
Timing adjustments are not required on models with a CD 2 ignition. If the wires are correctly positioned in the 3-wire and 4-wire connectors, proper ignition timing will be maintained, provided the following adjustments are made correctly.

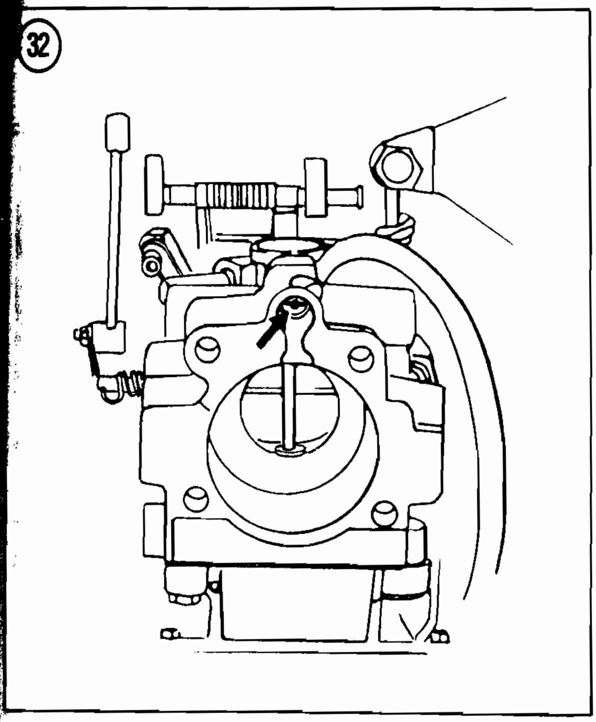
On Johnson/Evinrude models with a breaker point ignition, the breaker points are mounted on a fixed base. Ignition timing is non-adjustable. Correctly adjusted breaker points will align the flywheel timing mark between the 2 armature plate index marks when the engine is run at 1,000 rpm. See **Figure 3**. If the point gap is too large or too small, ignition timing will not be correct.

Throttle Cam Adjustment

1. Remove the engine cover.
2. Set the throttle grip to the STOP position.







3. Slowly rotate the throttle grip toward the ADVANCE position until the throttle cam timing marks align with the cam follower roller. On 1980-1982 25 hp models, the roller should align with the second cam mark; on all other models, the roller should be centered between the marks. See **Figure 29**.

4. If the throttle valve is not closed when the cam roller and throttle cam marks align in Step 3, loosen the cam adjustment screw (**Figure 30**). Adjust the cam up or down as required to align the marks and tighten the 5
screw.

Throttle Control Rod Adjustment

1. With the shift lever in FORWARD gear, the throttle lever should touch its stop.

2. If it does not, loosen the adjustment collar screw (A, **Figure 31**).

3. Push the throttle control rod to a full open position. Position collar in contact with the nylon pivot block (B, **Figure 31**) and tighten the collar screw.

Needle Valve Adjustment

1. Install the engine in a test tank with the proper test wheel or on the boat in the water with the correct propeller.

2. Start the engine and run at half throttle until the engine reaches operating temperature.

3. Connect a tachometer according to manufacturer's instructions.

NOTE

The engine requires approximately 15 seconds to respond to adjustment in Step 4.

4A. 1973-1988—Bring engine speed back to 700-750 rpm and adjust low-speed needle to produce the highest rpm and smoothest operation. See **Figure 32**.

NOTE
*A factory adjusted low-speed needle (**Figure 33**) is used on 1989-1990 models. If adjustment is required, initial settings of low-speed needle is 1 3/4 turns out from a lightly seated position.*

4B. 1989 and 1990—Bring engine speed back to 700-800 rpm and adjust low-speed needle to produce the highest rpm and smoothest operation. See **Figure 33**.

5. Once low-speed mixture adjustment is satisfactory, turn low-speed needle 1/8 turn counterclockwise to prevent an excessively lean condition at idle.

6. Run the engine in FORWARD gear at idle and note the tachometer. If idle speed is not 650 rpm, adjust idle speed knob or needle clockwise to increase or counterclockwise to decrease rpm. **Figure 34** shows idle speed needle used on some models.

7. Shut the engine off, remove the test equipment and install the engine cover.

Maximum Spark Advance

1. Install the engine in a test tank with the proper test wheel or on the boat in the water with the correct propeller.
2. Remove the engine cover.
3. Connect a tachometer and timing light according to manufacturer's instructions.
4. Start the engine and run at full throttle.
5. Point the timing light at the flywheel to align the flywheel and stationary marks as shown in **Figure 35** (manual start) or **Figure 36** (electric start).

The stationary mark must align with the 34 degree mark (± 1 degree) on 1977-1981 25 hp and 1976 35 hp models. It must align with the 30 degree mark (± 1 degree) on 20 hp, 1982 and later 25 hp, 28 hp, 30 hp and 1977 and later 35 hp models. Due to increasing variations in fuel quality, there may be some changes in 1983 and later specifications.

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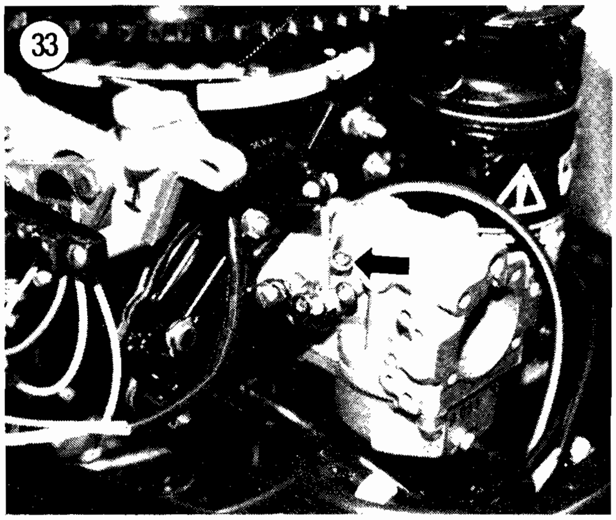

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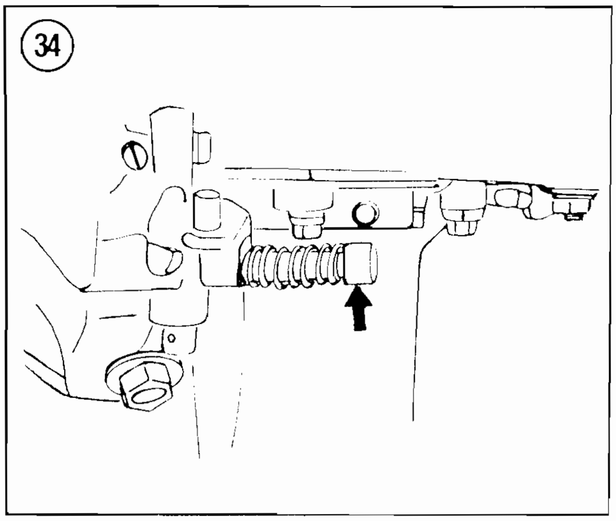

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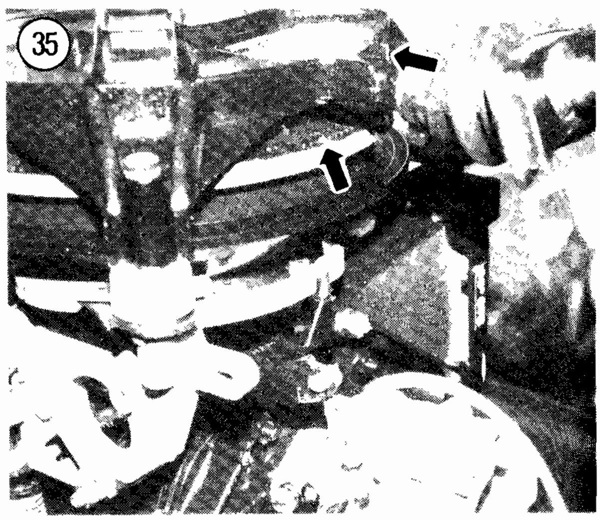

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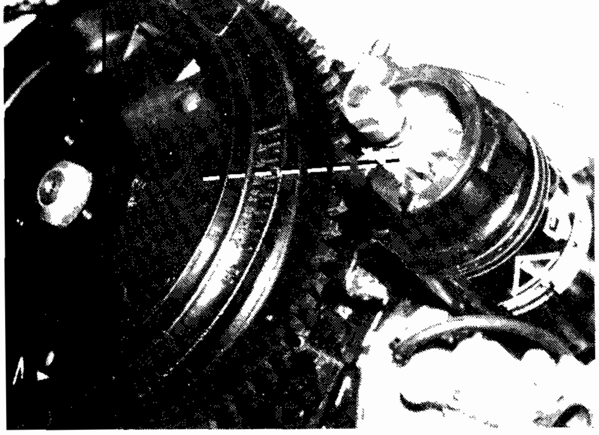

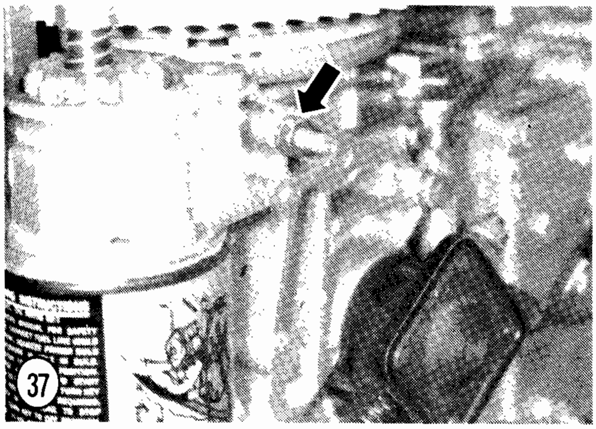

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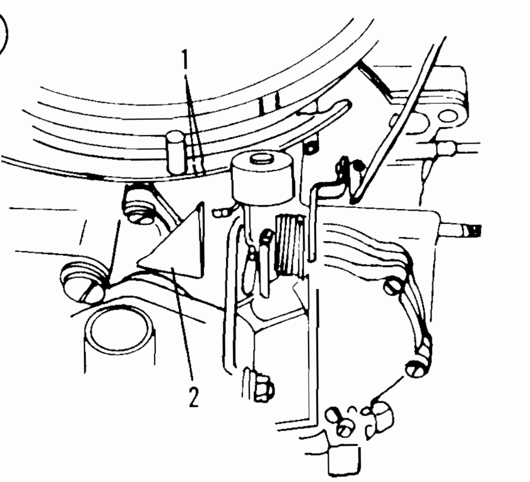

1. Cam mark
2. Manifold projection

Follow the timing specification on the engine decal if it differs from those given here.

WARNING
Do not attempt to make the adjustment in Step 6 with the engine running. The adjustment screw is close to the moving flywheel and serious personal injury could result.

6. If the timing is not correct, shut the engine off. Loosen the timing stop adjustment screw locknut (**Figure 37**) and turn the screw in or out as required to bring the timing within specifications. 5
7. Tighten the screw and start the engine. Recheck the timing.
8. Repeat Steps 5-7 until the timing is within specifications.

JOHNSON/EVINRUDE 40 (BREAKER POINT IGNITION)

The breaker points are mounted on a fixed base. Ignition timing is non-adjustable. Correctly adjusted breaker points will align the flywheel timing mark between the 2 armature plate index marks when the engine is run at 1,000 rpm. See **Figure 3**. If the point gap is too large, timing will be retarded; a gap that is too small will advance timing.

Throttle Cam Adjustment

1. Remove the engine cover.
2. Remove ring gear guard on electric start models.
3. Move the throttle control until the intake manifold projection is centered between the 2 throttle cam marks. See **Figure 38**.
4. If the throttle valve is not closed with the cam follower roller touching the cam, loosen the throttle arm clamp screw (**Figure 39**). Make sure the intake manifold projection

intersects the throttle cam marks, the throttle valve is closed and the cam roller touches the cam, then tighten the clamp screw.
5. Close the throttle with the throttle control, then slowly reopen it. The throttle valve should start to open after the first cam mark passes the intake manifold projection. If it does not, repeat Step 4.
6. Manually rotate armature base to full advance position. Adjust control rod collar to provide 1/32 in. clearance at the pivot pin. See **Figure 40**.

Needle Valve Adjustment

1. Install the engine in a test tank with the proper test wheel or on the boat in the water with the correct propeller.
2. Start the engine and run at half throttle until the engine reaches operating temperature.
3. Connect a tachometer according to manufacturer's instructions.

NOTE
The engine requires approximately 15 seconds to respond to adjustment in Step 4.

4. Bring engine speed back to 700-750 rpm and carefully remove the low-speed arm from the needle valve. Adjust the low-speed needle valve to produce the highest rpm and smoothest operation, then reinstall the low-speed arm without changing the needle valve position.
5. Run the engine in FORWARD gear at idle and note the tachometer. If idle speed is not 650 rpm, turn the idle adjustment screw on the throttle handle clockwise to increase or counterclockwise to decrease rpm.

1985-1988 JOHNSON/EVINRUDE 40 HP TILLER MODELS (CD 2 IGNITION)

Initial Throttle Cam Adjustment

1. Rotate the tiller handle idle speed adjustment knob counterclockwise to the slow speed position.
2. Rotate the twist grip to the full open position and check the throttle roller position in the throttle cam slot (**Figure 41**). It should be approximately 1/4 in. from the end of the slot.
3. Rotate the twist grip to the fully closed position and check the throttle roller position in the throttle cam slot (**Figure 42**). It shou

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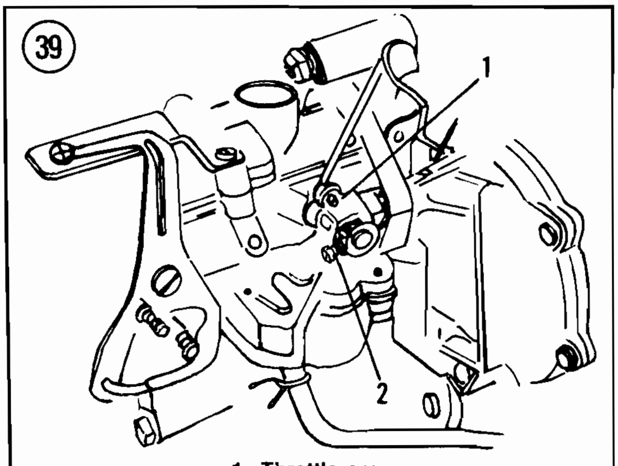

1. Throttle arm
2. Clamp screw

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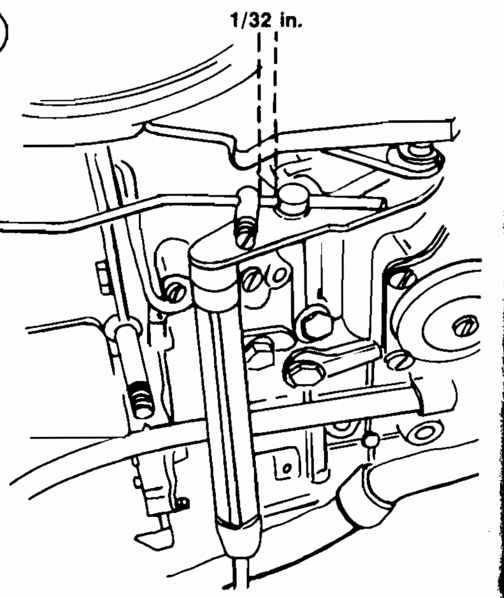
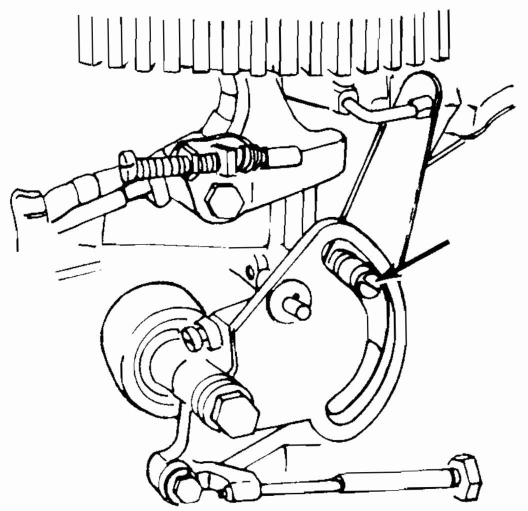


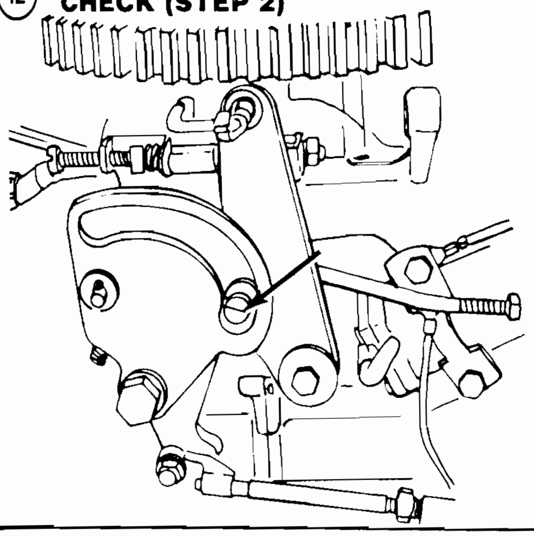
be approximately 1/4 in. from the end of the slot.

4. If the roller is not properly positioned in the cam slot in Step 2 or Step 3, loosen the throttle cable connector retaining screw. Rotate the cable connector until the roller comes to rest about 1/4 in. from each end of the cam slot as the twist grip is opened and closed. Tighten the retaining screw.

(41) THROTTLE CAM CLEARANCE CHECK (STEP 1)



(42) THROTTLE CAM CLEARANCE CHECK (STEP 2)



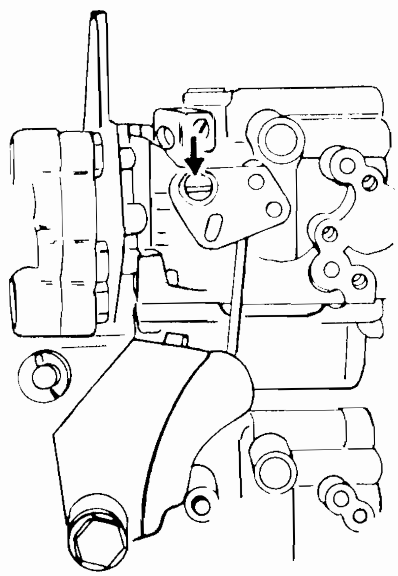
Throttle Valve Synchronization

1. Remove the engine cover.
2. Remove the air silencer cover.
3. Retard the throttle lever to a point where the throttle cam roller does not touch the cam.
4. Loosen the upper carburetor lever adjustment screw (**Figure 43**).
5. Rotate the throttle shaft partially open, then let it snap back to the closed position. Depress the adjusting link tab slightly to remove any backlash and tighten the adjustment screw.
6. Move the cam follower while watching the throttle valves. If the throttle valves do not start to move at the same time, repeat Steps 3-5.

Cam Follower Pickup Point Adjustment

1. Connect a throttle shaft amplifier tool (**Figure 2**) to the top carburetor throttle shaft.
2. Watching the amplifier tool, slowly rotate the throttle cam. As the end of the tool starts

(43) UPPER CARBURETOR LINKAGE ADJUSTMENT



to move, check the cam and cam follower alignment. The lower embossed mark on the cam (2, **Figure 44**) should align with the center of the cam follower (3, **Figure 44**).

3. If the cam follower and cam mark do not align in Step 2, loosen the cam follower screw (1, **Figure 44**) and let the throttle spring close the throttle valves. Align the cam mark and follower and press on the cam follower lever (4, **Figure 44**) to maintain the alignment while tightening the screw.

4. Repeat Step 2 to check the adjustment. If incorrect, repeat Step 3, then repeat Step 2 as required.

Cam Follower Pickup Timing

1. Install the engine in a test tank with the proper test wheel or on the boat in the water with the correct propeller.
2. Connect a timing light to the No. 1 cylinder according to manufacturer's instructions.
3. Slowly move the throttle lever until the tip of the amplifier tool starts to move. Remove the tool without disturbing the throttle lever position.
4. Start the engine and check the spark advance with the timing light, advancing the idle speed adjustment knob as required to keep the engine running. Spark advance should be 2-4° BTDC.
5. If the pickup timing is incorrect in Step 4, remove the throttle cam shoulder screw (1, **Figure 45**) or loosen the cam rod jam nut (1, **Figure 46**).
   a. Shoulder screw—Rotate the cam on the throttle lever link (2, **Figure 45**) clockwise to advance or counterclockwise to retard timing as required. One full turn of the cam will change timing approximately 2°. Install and tighten the shoulder screw.
   b. Jam nut—Turn the top of the thumbwheel (2, **Figure 46**) toward the engine to advance or away from the engine to retard timing as required. Tighten the jam nut to secure adjustment.
6. Repeat Step 3 and Step 4 to check the adjustment. If incorrect, repeat Step 5, then repeat Step 3 and Step 4 as required.

Maximum Spark Advance Adjustment

CAUTION
This procedure should be performed in a test tank with the proper test wheel

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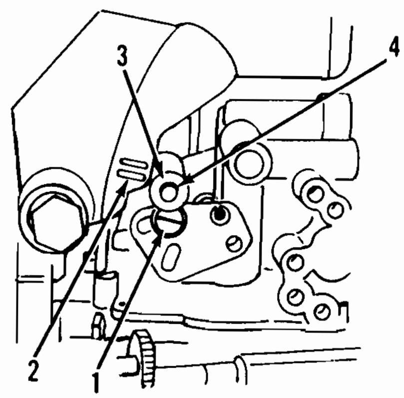
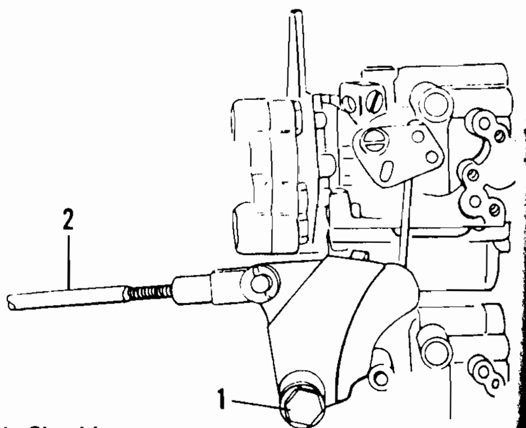
THROTTLE PICKUP POINT ADJUSTMENT



1. Adjustment screw
2. Lower cam mark
3. Cam follower roller
4. Depress here

THROTTLE CAM SYNCHRONIZATION



1. Shoulder screw
2. Throttle lever link

installed on the outboard motor. The use of the propeller and/or a flushing device can result in an incorrect setting and possible engine damage.

1. Connect a timing light to the No. 1 cylinder according to manufacturer's instructions.
2. Connect a tachometer according to manufacturer's instructions.
3. Start the engine and run in forward gear at a minimum of 3,500 rpm for 1985-1987 models and at a minimum of 5,000 rpm for 1988 models.

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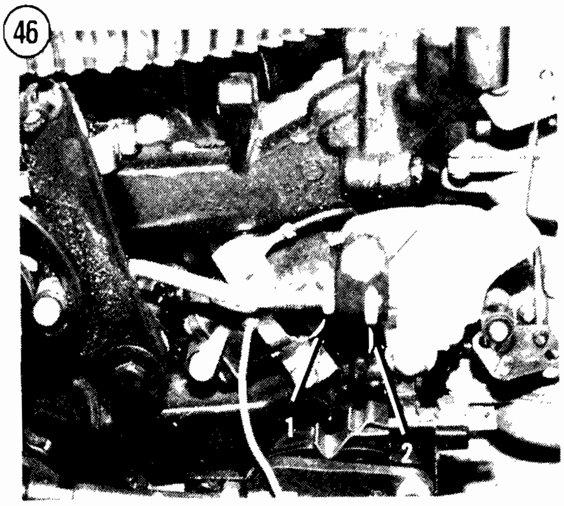

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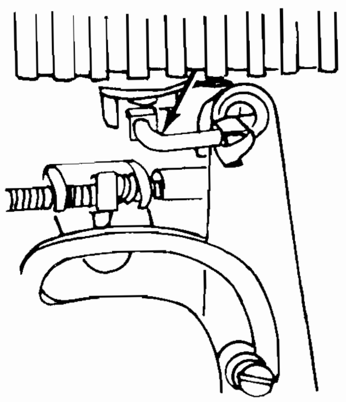
MAXIMUM SPARK ADVANCE ADJUSTMENT



4. Check the timing mark position with the timing light. The timing mark must align with the 19° ± 1° mark on the flywheel grid.
5. If the timing marks do not align as specified, shut the engine off. Remove the spark advance rod (**Figure 47**). Shorten the rod by bending its ends together to advance timing; lengthen it by expanding the ends to retard timing.
6. Reinstall the spark advance rod if adjustment was necessary and repeat Step 3 and Step 4. If timing mark alignment is still incorrect, repeat Step 5, then Step 3 and Step 4 as required. 5

Wide-open Throttle Stop Adjustment

1. Open the throttle to the full throttle position.
2. Note the position of the pin installed in each carburetor throttle shaft. The pins must be vertical.
3. If the pins are not correctly located in Step 2, loosen locknut (1, **Figure 48**). Turn wide-open stop screw (2, **Figure 48**) as required to locate the throttle shaft pins vertically, then tighten the locknut.

Shift Lever Detent Adjustment

1. Place the shift lever in NEUTRAL.
2. If the lower detent spring is not completely engaged in the shift lever detent notch (**Figure 49**), loosen the detent spring screw. Move the spring until it fully engages the notch, then tighten the screw snugly.

Idle Speed Adjustment

This procedure should be performed with the boat floating unrestrained in the water and the correct propeller installed.

1. Remove the engine cover.
2. Connect a tachometer according to manufacturer's instructions.
3. Start the engine and warm to normal operating temperature.

4. Shift the engine into FORWARD gear and note the idle speed on the tachometer. It should be 700-750 rpm.
5. If idle speed requires adjustment, shut the engine off as a safety precaution and rotate the idle speed screw (**Figure 50**) clockwise (to increase) or counterclockwise (to decrease) as required to bring idle speed within specifications.
6. Start the engine and recheck idle speed. If not within specifications, repeat Step 5 as required.
7. When idle speed is correct, shut the engine off. Remove the tachometer and install the engine cover.

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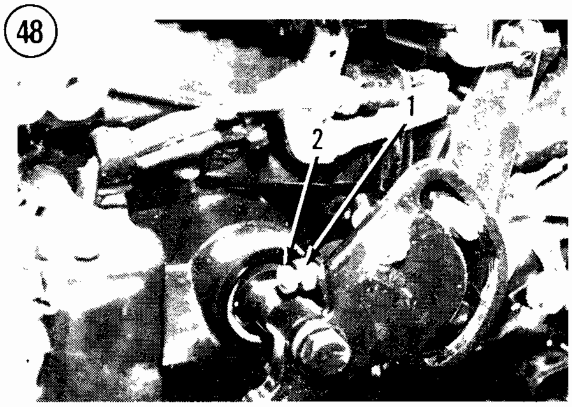
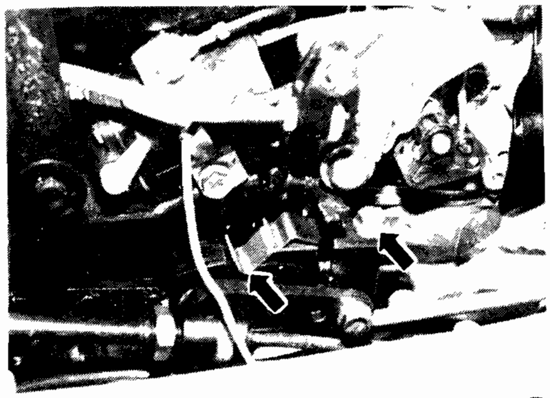


1. Locknut
2. Wide-open stop screw



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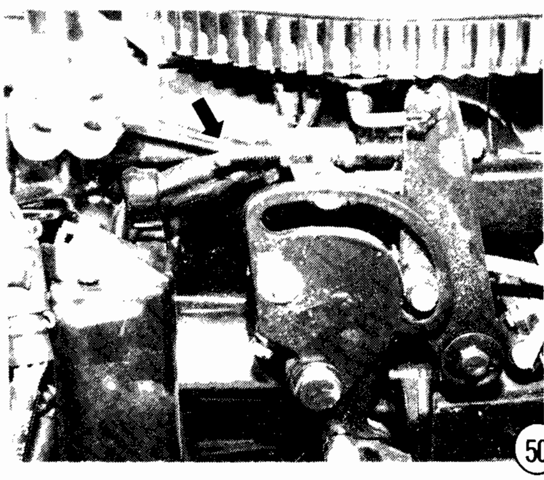

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1985-1988 JOHNSON/EVINRUDE 40 HP REMOTE CONTROL MODELS (CD 2 IGNITION)

Throttle Cable Adjustment

The throttle cable must be adjusted to allow the throttle lever to return to the idle stop. A cable that is too loose will cause a high and unstable idle, resulting in shifting difficulties. If too tight, shifting will feel stiff and the warm-up lever will move up during a shift into NEUTRAL.

1. Slowly move the control lever back until the idle stop screw contacts its stop (**Figure 51**).
2. If the idle stop screw does not contact the stop, adjust the trunnion nut (**Figure 52**) as required.

Throttle Valve Synchronization

1. Remove the engine cover.
2. Remove the air silencer cover.
3. Retard the throttle lever to a point where the throttle cam roller does not touch the cam.
4. Loosen the upper carburetor lever adjustment screw (**Figure 53**).

5. Rotate the throttle shaft partially open, then let it snap back to the closed position. Apply finger pressure to the adjusting lever (**Figure 53**) and tighten the adjustment screw.
6. Move the cam follower while watching the throttle valves. If the throttle valves do not start to move at the same time, repeat Steps 3-5.

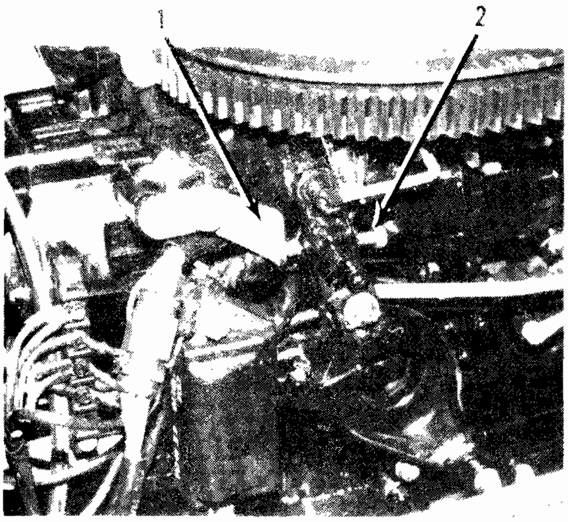
Throttle Cam Follower

Pickup Point and Timing

1. Connect a throttle shaft amplifier tool (**Figure 2**) to the top carburetor throttle shaft.
2. Watching the amplifier tool, slowly rotate the throttle cam. As the end of the tool starts to move, check the cam and cam follower alignment. The lower embossed mark on the cam (2, **Figure 54**) should align with the center of the cam follower (3, **Figure 54**).
3. If the cam follower and cam mark do not align in Step 2, loosen the throttle arm screw (1, **Figure 54**) and let the throttle spring close the throttle valves. Align the cam mark and follower and press on the cam follower roller (4, **Figure 54**) to maintain the alignment while tightening the screw.
4. Repeat Step 2 to check the adjustment. If incorrect, repeat Step 3, then repeat Step 2 as required.
5. When adjustment is correct, connect a timing light to the No. 1 cylinder according to manufacturer's instructions.
6. Slowly move the throttle lever until the tip of the amplifier tool starts to move. Remove the tool without disturbing the throttle lever position.
7. Start the engine and check the spark advance with the timing light, advancing the idle speed adjustment knob or throttle control lever (as equipped) as required to keep the engine running. Spark advance should be 2-4° BTDC.
8. If the pickup timing is incorrect in Step 7, loosen the throttle arm screw (1, **Figure 54**) or

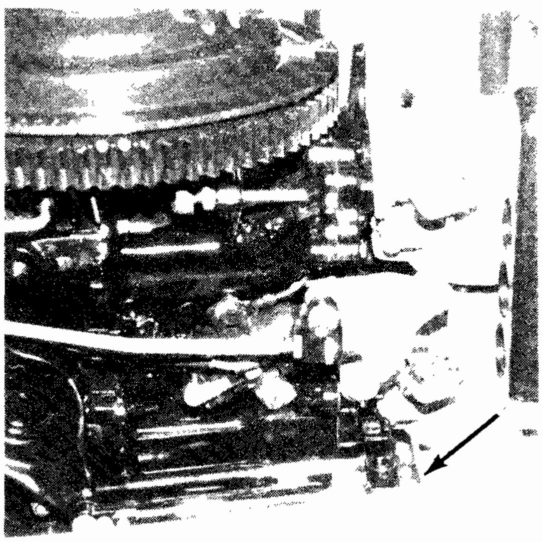
5

(51) **THROTTLE CABLE ADJUSTMENT**



1. Stop
2. Idle screw

(52) **TRUNNION ADJUSTMENT NUT**



the control lever jam nut (1, **Figure 46**) as equipped.

a. Shoulder screw—Align the throttle cam mark with center of the cam follower. Move the carburetor throttle arm until the throttle valves are closed. Depress the cam follower lever (4, **Figure 54**) to maintain the alignment and tighten the throttle arm screw.

b. Jam nut—Turn the top of the thumbwheel (2, **Figure 46**) toward the engine (to advance) or away (to retard) as required to bring pickup timing within specifications.

9. Repeat Step 6 and Step 7 to check the adjustment. If incorrect, repeat Step 8, then repeat Step 6 and Step 7 as required.

Wide-open Throttle Stop Adjustment

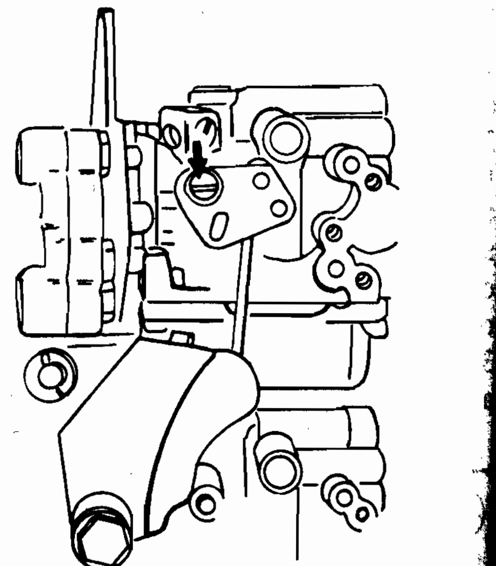
1. Move the throttle control to the full throttle position and hold the throttle linkage in that position.
2. Note the position of the pin installed in each carburetor throttle shaft. The pins must be vertical.
3. If the pins are not correctly located in Step 2, adjust the wide-open throttle stop screw (**Figure 55**) until the roll pins are vertical.

Maximum Spark Advance Adjustment

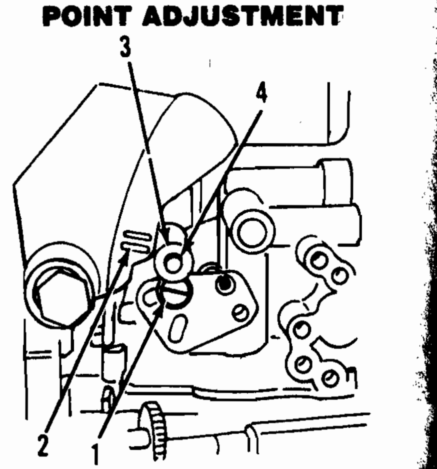
CAUTION
This procedure should be performed in a test tank with the proper test wheel installed on the engine. The use of the propeller and/or a flushing device can result in an incorrect setting and possible engine damage.

1. Connect a timing light to the No. 1 cylinder according to manufacturer's instructions.
2. Connect a tachometer according to manufacturer's instructions.
3. Start the engine and run in forward gear at a minimum of 3,500 rpm for 1985-1987 models and at a minimum of 5,000 rpm for 1988 models (timer base fully advanced).
4. Check the timing mark position with the timing light. The timing mark must align with the 19° ± 1° mark on the flywheel grid.

53 UPPER CARBURETOR LINKAGE ADJUSTMENT



54 THROTTLE PICKUP POINT ADJUSTMENT

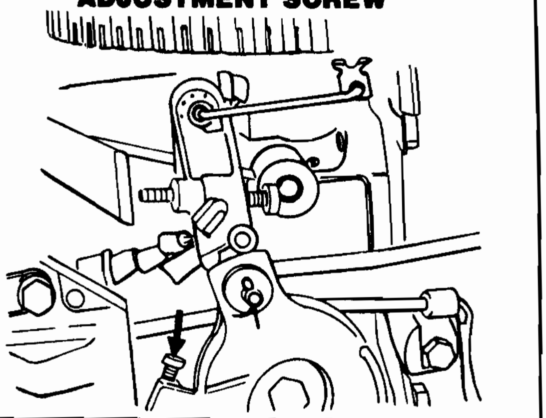


1. Adjustment screw
2. Lower cam mark
3. Cam follower roller
4. Depress here

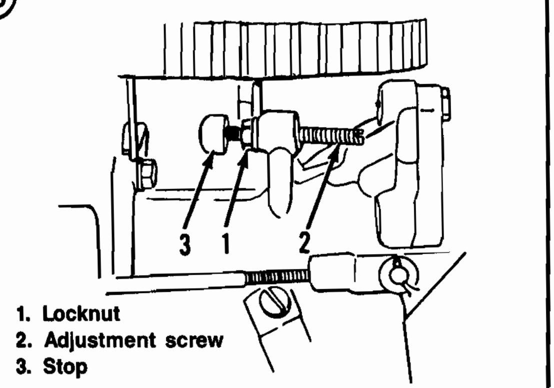
WARNING
Do not attempt to adjust the spark advance with the engine running in Step 5. The adjustment screw is located close to the moving flywheel and vibrates slightly when the engine is running. If the screwdriver slips out of the screw, serious personal injury can result.

If the timing marks do not align as cified, shut the engine off. Loosen the usting screw locknut (1, **Figure 56**). Adjust screw clockwise (to retard) or nterclockwise (to advance) as required, n tighten the locknut. One full turn in er direction changes timing roximately one degree.

55 **FULL THROTTLE STOP ADJUSTMENT SCREW**



56 **IGNITION TIMING**



1. Locknut
2. Adjustment screw
3. Stop

6. Restart the engine and repeat Step 4. If timing mark alignment is still incorrect, repeat Step 5, then Step 3 and Step 4 as required.
7. When the timing marks align as specified, shut the engine off.

Idle Speed Adjustment

This procedure should be performed with the boat floating unrestrained in the water and the correct propeller installed.

1. Remove the engine cover.
2. Connect a tachometer according to manufacturer's instructions.
3. Start the engine and warm to normal operating temperature.
4. Shift the engine into FORWARD gear and note the idle speed on the tachometer. It should be 700-750 rpm.
5. If idle speed requires adjustment, shut the engine off as a safety precaution and rotate the idle speed screw (**Figure 57**) clockwise (to increase) or counterclockwise (to decrease) as required to bring idle speed within specifications.
6. Start the engine and recheck idle speed. If not within specifications, repeat Step 5 as required.
7. When idle speed is correct, shut the engine off. Remove the tachometer and install the engine cover.

1989-1990 JOHNSON/EVINRUDE 40 HP MODELS (CD2UL IGNITION)

Throttle Valve Synchronization

1. Remove the engine cover.
2. Retard the throttle lever to a point where the throttle cam roller does not touch the cam.
3. Loosen the upper carburetor lever adjustment screw (1, **Figure 58**).
4. Rotate the throttle shaft partially open, then let it snap back to the closed position.

Apply finger pressure to the adjusting lever (1, **Figure 58**) and tighten the adjustment screw.
5. Move the cam follower while watching the throttle valves. If the throttle valves do not start to move at the same time, repeat Steps 3-5.

Throttle Cam Follower Pickup Point

1. Loosen cam follower roller adjustment screw (2, **Figure 58**).
2. Slowly rotate throttle cam (10, **Figure 58**) toward cam follower roller (7, **Figure 58**).
3. When pickup mark (3, **Figure 58**) on throttle cam intersects center of cam follower roller, the throttle cam and cam follower roller should just touch. Correctly adjust components, then tighten cam follower roller adjustment screw (2, **Figure 58**) to retain adjustment.
4. Move idle speed screw (4, **Figure 58**) against stop mounted on power head.
5. Spark lever cam follower (5, **Figure 58**) should be positioned between marks (6, **Figure 58**). If not, loosen locknut and adjust idle speed screw.
6. With linkage positioned as stated in Step 5, a 0.010 in. gap (8, **Figure 58**) between throttle cam and cam follower roller should be noted.
7. If gap is incorrect, pry control rod connector (9, **Figure 58**) from throttle cam ball socket and rotate connector as required to obtain 0.010 in. gap.

Wide-open Throttle Stop Adjustment

1. Move the throttle control to the full throttle position and hold the throttle linkage in that position.
2. Note the position of the pin installed in each carburetor throttle shaft. The pins must be vertical.
3. If the pins are not correctly located in Step 2, loosen locknut (1, **Figure 59**) and rotate wide-open throttle stop screw (2, **Figure 59**) until the roll pins are vertical.

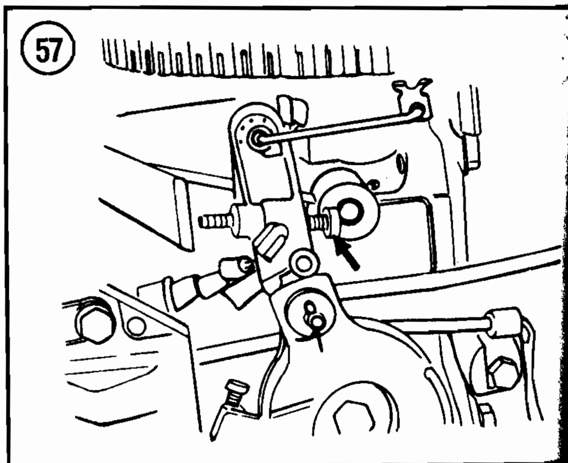
Maximum Spark Advance Adjustment

CAUTION
This procedure should be performed in a test tank with the proper test wheel installed on the engine. The use of the propeller and/or a flushing device can result in an incorrect setting and possible engine damage.

1. Connect a timing light to the No. 1 cylinder according to manufacturer's instructions.
2. Connect a tachometer according t manufacturer's instructions.
3. Start the engine and run in forward gear a a minimum of 5,000 rpm.
4. Check the timing mark position with th timing light. The timing mark must alig with the 19° ± 1° mark on the flywheel grid

WARNING
Do not attempt to adjust the spark advance with the engine running in Step 5. Attempting to do so could result in serious personal injury.

5. If the timing marks do not align specified, shut the engine off. Pry connect end of maximum spark advance control r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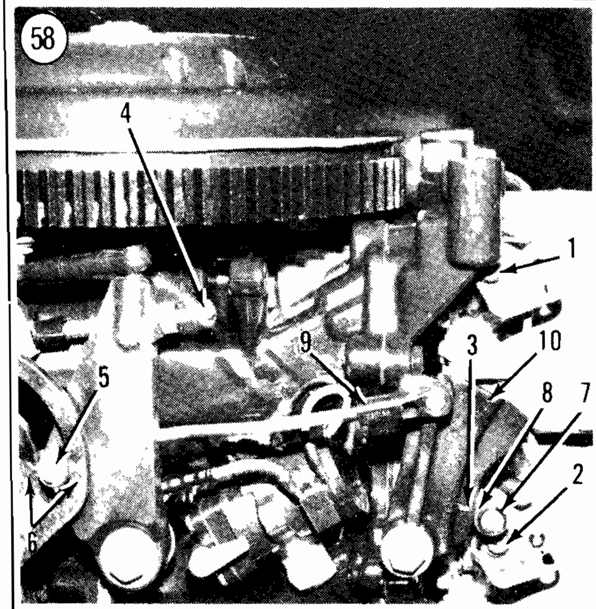
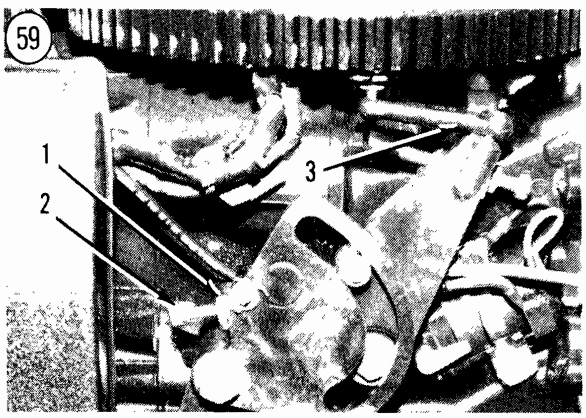


1. Adjustment screw
2. Adjustment screw
3. Pickup mark
4. Idle speed screw
5. Spark lever cam follower
6. Alignment marks
7. Cam follower roller
8. Gap (0.010 in.)
9. Control rod connector
10. Throttle cam



1. Locknut
2. Wide-open throttle stop screw
3. Maximum spark advance control rod

(3, **Figure 59**) from spark lever ball socket, then rotate connector end clockwise (to advance) or counterclockwise (to retard) as required. Reattach connector end to ball socket. Two full turns in either direction changes timing approximately one degree.

6. Restart the engine and repeat Step 4. If timing mark alignment is still incorrect, repeat Step 5, then Step 3 and Step 4 as required.
7. When the timing marks align as specified, shut the engine off. 5

Idle Speed Adjustment

This procedure should be performed with the boat floating unrestrained in the water and the correct propeller installed.

1. Remove the engine cover.
2. Connect a tachometer according to manufacturer's instructions.
3. Start the engine and warm to normal operating temperature.
4. Shift the engine into FORWARD gear and note the idle speed on the tachometer. It should be 725-775 rpm.
5. If idle speed requires adjustment, shut the engine off as a safety precaution. Loosen locknut and rotate the idle speed screw (4, **Figure 58**) clockwise (to increase) or counterclockwise (to decrease) as required to bring idle speed within specifications.
6. Start the engine and recheck idle speed. If not within specifications, repeat Step 5 as required.
7. When idle speed is correct, shut the engine off. Remove the tachometer.

NOTE

If idle speed is adjusted, cam follower pickup point must be rechecked and adjusted, if needed, as outlined in this chapter. With idle speed and cam follower pickup point correctly adjusted, idle timing should be 3° ± 2° ATDC with timing light properly connected to No. 1 cylinder.

Chapter Six

Fuel System

This chapter contains removal, overhaul, installation and adjustment procedures for fuel pumps, carburetors, fuel tanks and connecting lines used with the Johnson and Evinrude outboards covered in this book. **Table 1** is at the end of the chapter.

FUEL PUMP

Johnson and Evinrude outboards equipped with an integral fuel tank use a gravity flow fuel system and require no fuel pump.

The diaphragm-type fuel pump used on models with a remote fuel tank operates by crankcase pressure. Since this type of fuel pump cannot create sufficient pressure to draw fuel from the tank during cranking, fuel is transferred to the carburetor for starting by operating the primer bulb installed in the fuel line.

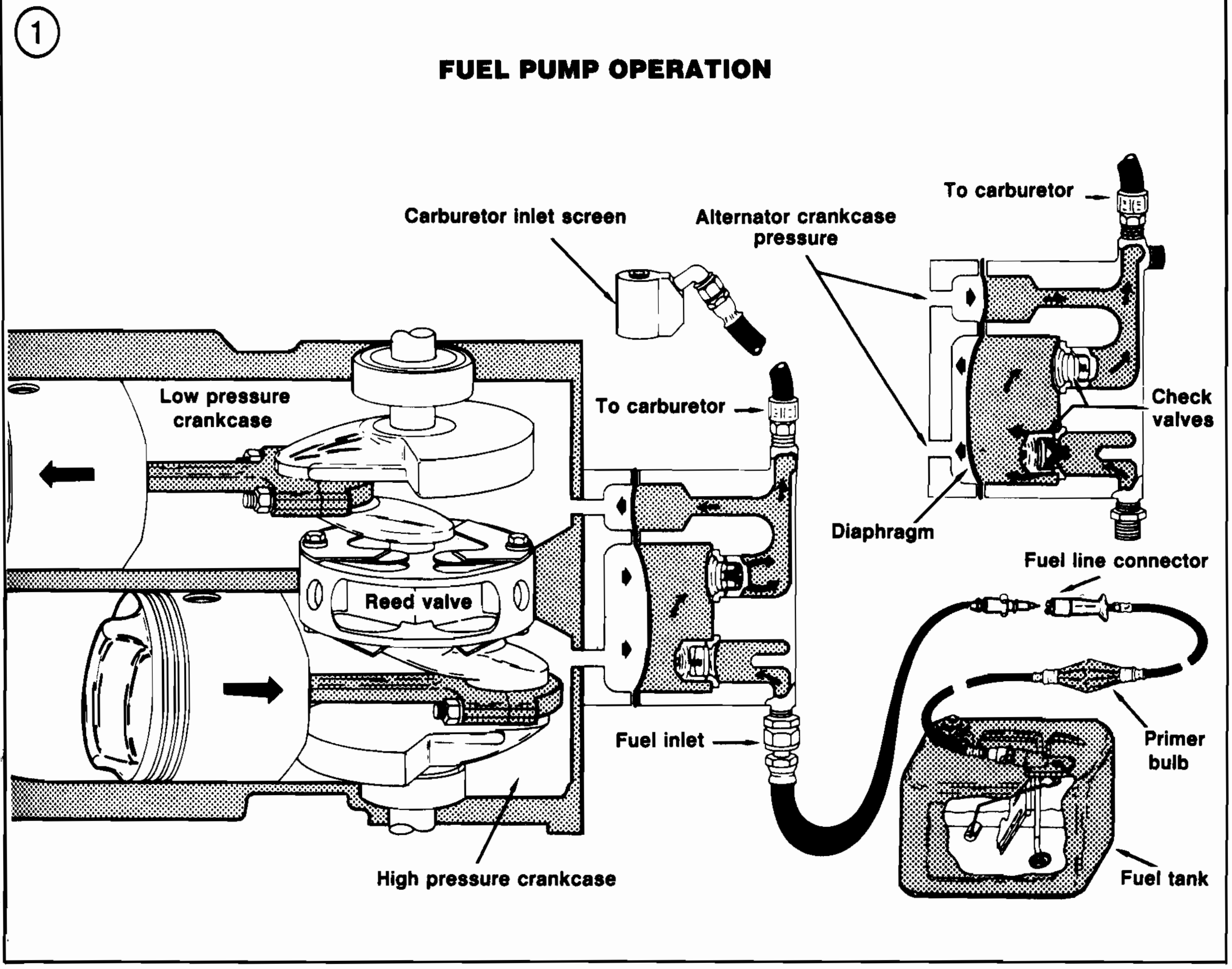
Pressure pulsations created by movement of the pistons reach the fuel pump through a passageway between the crankcase and pump.

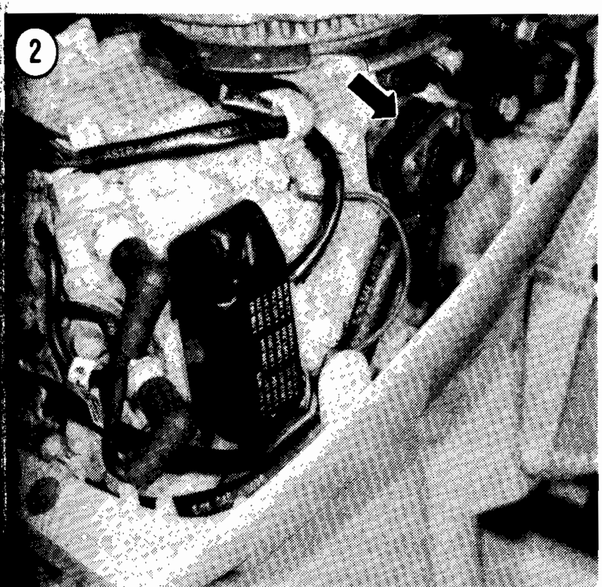
Upward piston motion creates a low pressure on the pump diaphragm. This low pressure opens the inlet check valve in the pump, drawing fuel from the line into the pump. At the same time, the low pressure draws the air-fuel mixture from the carburetor into the crankcase.

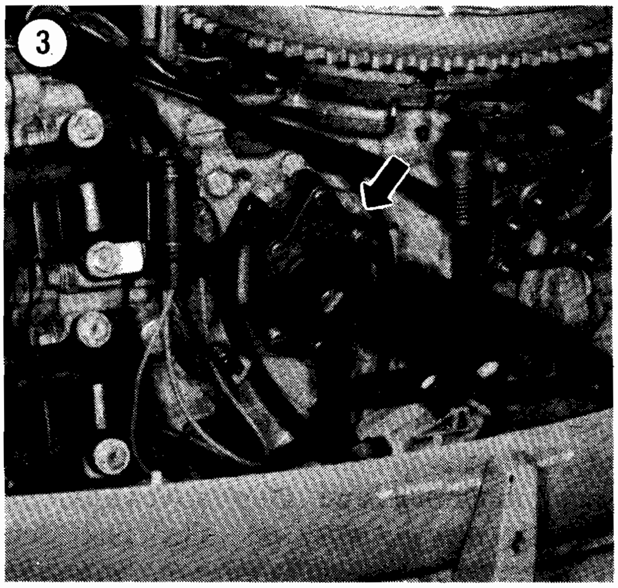
Downward piston motion creates a high pressure on the pump diaphragm. This pressure closes the inlet check valve and opens the outlet check valve, forcing the fuel into the carburetor and drawing the air-fuel mixture from the crankcase into the cylinder for combustion. **Figure 1** shows the operational sequence of a typical Johnson and Evinrude outboard fuel pump.

Johnson and Evinrude fuel pumps are self-contained, remote assemblies. Fuel pump shape and size differs according to engine size. The square pump shown in **Figure 2** is used on 4-15 hp engines. **Figure 3** shows the one used on 18 hp and larger models. The design of both pump styles is extremely simple and reliable in operation. Diaphragm

1


FUEL PUMP OPERATION
To carburetor
Carburetor inlet screen
Alternator crankcase pressure
Low pressure crankcase
To carburetor
Check valves
Diaphragm
Fuel line connector
Reed valve
Fuel inlet
Primer bulb
High pressure crankcase
Fuel tank





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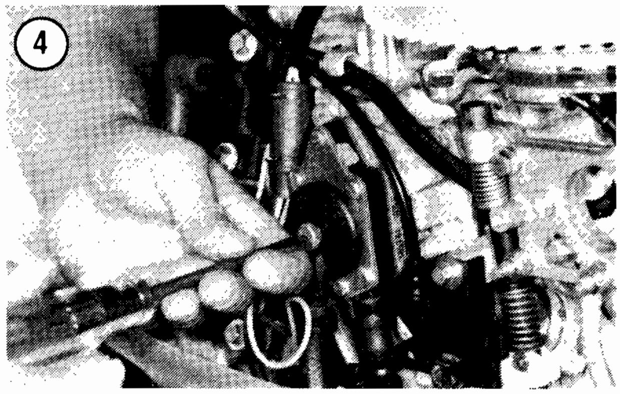
failures are the most common problem, although the use of dirty or improper fuel-oil mixtures can cause check valve problems. The fuel pump is serviced as an assembly; if defective, replace the entire unit.

NOTE
Some 1983 4-15 hp engines may stall after idling for a brief time but run satisfactorily at speeds above idle. The most likely cause is a fuel pump in which valve seat imperfections prevent the valves from seating. These pumps were installed on new motors at the factory and placed in replacement parts inventory. To test, position a portable fuel tank 24 inches below the pump and connected with a transparent hose. Run the engine at 700 rpm in gear. The pump is defective if it will not lift the fuel the entire 24 inches.

Removal/Installation

1. Unscrew and remove the filter cover and screen (**Figure 4**).
2. Remove the screws holding the pump assembly to the engine (**Figure 5**).
3. Remove and discard any straps holding the fuel lines to the fuel pump. Disconnect the lines at the pump.
4. Remove the pump and gasket from the engine. Discard the gasket.
5. Clean all gasket residue from the engine mounting pad. Work carefully to avoid gouging or damaging the mounting surface.
6. Clean the filter screen in OMC Engine Cleaner and blow dry with compressed air. If extremely dirty or damaged, install a new screen in Step 7.
7. Installation is the reverse of removal. Use new mounting and filter screen gaskets. Install new straps on the fuel line connections.

4



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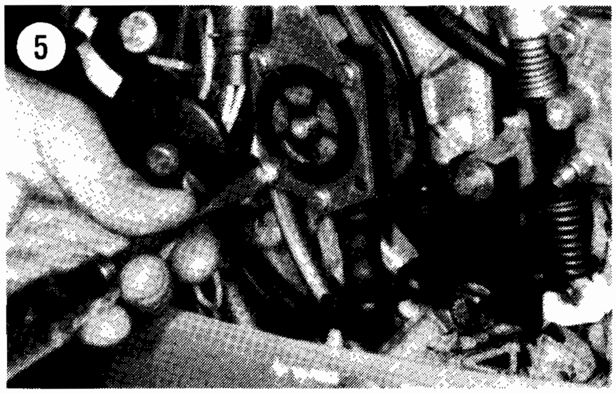


CARBURETORS

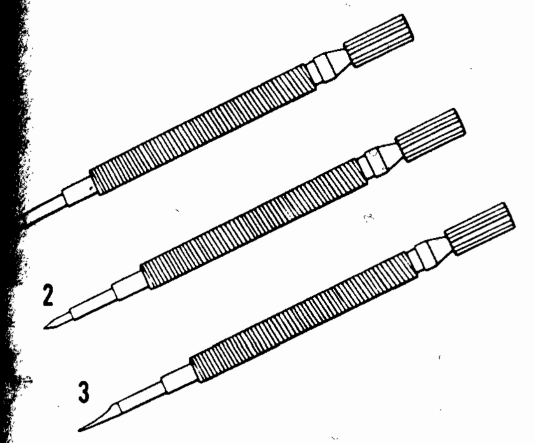
Many carburetors used on Johnson and Evinrude outboards have a fixed main jet orifice and require no high-speed adjustment.

Carburetors used on 1983 and earlier 6-35 hp models have a white Delrin needle valve retainer. Age and engine vibration can cause the retainer to lose its ability to prevent the low-speed needle from moving while the engine is running. An improved red retainer (part No. 315232) can be installed to correct the problem.

When removing and installing a carburetor, make sure the mounting nuts are securely tightened. A loose carburetor will cause a lean-running condition.

High Elevation Modifications

Table 1 contains orifice recommendations suggested by Johnson and Evinrude when a



3-1982 engine is used primarily at high ation areas. Rejetting for high elevation ration will recover only that engine power due to the improper air-fuel ratio caused the reduction in air density.

he propeller used must allow the engine un within the recommended engine speed ating range. The correct propeller should e full throttle engine rpm in the middle of recommended operating range. Changing prop for high elevation operation will over only that engine power lost by not rating within the proper rpm range.

Always rejet and prop the engine for the est elevation at which the boat will be rated to prevent the possibility of power d damage from a lean fuel mixture. If the t is to be used extensively at both high and elevations, you should have 2 sets of jets, rops and a fixed jet screwdriver (part No. 7002) for installation as required.

Your Johnson or Evinrude dealer can ply elevation modification stickers (part No. 393533) for application on the motor as a reminder of the original and elevation jet/prop sizes. Their use will assure that the correct information is always readily available.

Cleaning and Inspection

Before removing and disassembling any carburetor, be sure you have the proper overhaul kit, the proper tools and a sufficient quantity of fresh cleaning solvent. Work slowly and carefully, follow the disassembly procedures, refer to the exploded drawing of your carburetor when necessary and do not apply excessive force at any time.

It is not necessary to disassemble the carburetor linkage or remove the throttle cam or other external components. Wipe the carburetor casting and linkage with a cloth moistened in solvent to remove any contamination and operating film. Clean the carburetor castings with an aerosol type solvent and a brush. Do not submerge them in a hot tank or carburetor cleaner. A sealing compound is used around the metering tubes and on the casting to eliminate porosity problems. A hot tank or submersion in carburetor cleaner will remove this sealing compound.

Spray the cleaner on the casting and scrub off any gum or varnish with a small bristle brush. Spray the cleaner through the casting metering passages. Never clean passages with a wire or drill as you may enlarge the passage and change the carburetor calibration.

Blow castings dry with low-pressure (25 psi or less) compressed air. The use of higher pressures can damage the sealing compound.

Check the float for fuel absorption. Check the float arm for wear in the hinge pin and needle valve contact areas. Replace as required.

Check the needle valve tip for grooving, nicks or scratches. **Figure 6** shows a good

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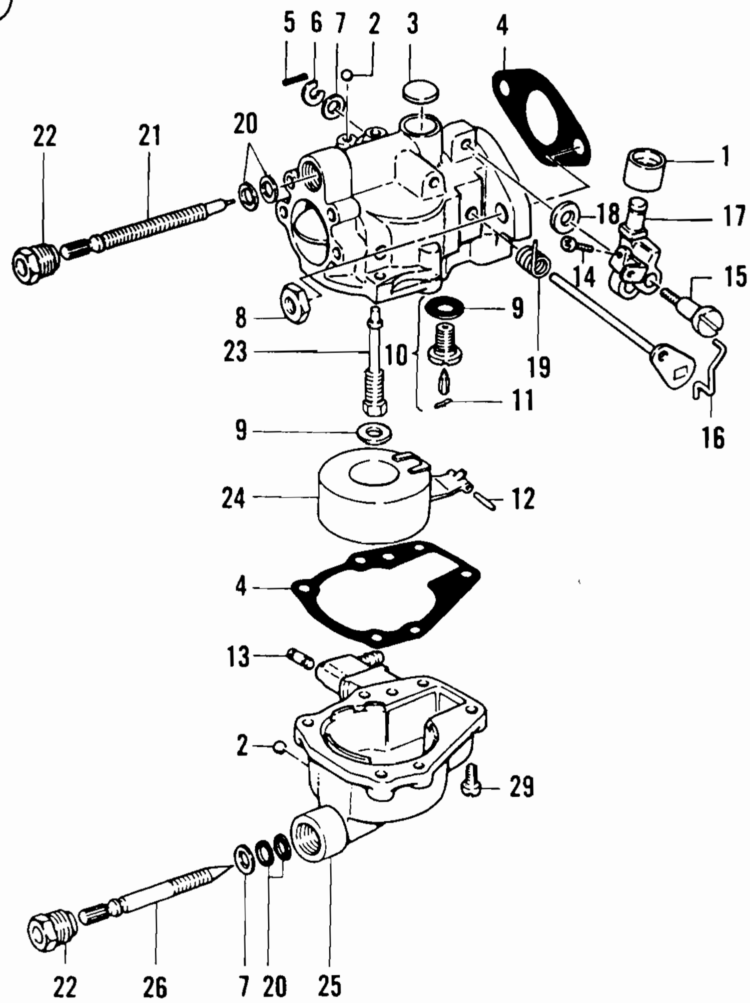


CARBURETOR (2 HP, COLT, JUNIOR AND 4 HP [1973-1977])

1. Cam follower roller
2. Lead shot
3. Welch plug
4. Gasket
5. Roll pin
6. Throttle shaft retainer
7. Washer
8. Mounting nut
9. Gasket
10. Inlet needle valve assembly
11. Retaining clip
12. Float hinge pin
13. Plug
14. Cam follower adjustment screw
15. Shoulder screw
16. Cam follower link
17. Cam follower
18. Shoulder screw washer
19. Throttle return spring
20. Low-speed needle valve packing
21. Low-speed needle valve
22. Needle valve nut
23. High-speed nozzle
24. Float assembly
25. Float chamber
26. High-speed needle valve
29. Screw

valve tip (1), a valve tip damaged from excessive pressure when seating (2) and one with wear on one side caused by vibration resulting from the use of a damaged propeller (3).

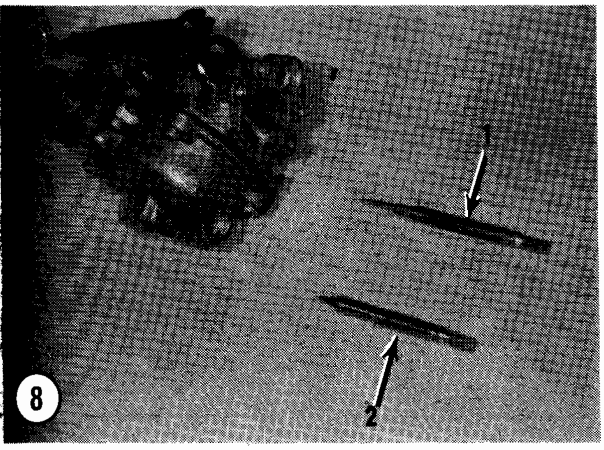
Check the throttle and choke shafts for excessive wear or play. The throttle and choke valves must move freely without binding. Replace the carburetor if any of these defects are noted.

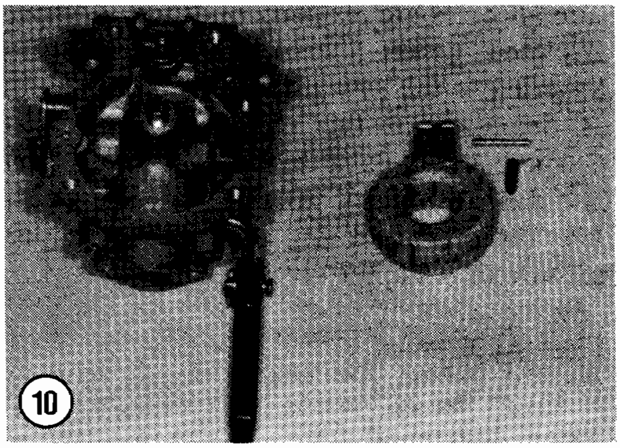
Clean all gasket residue from mating surfaces and remove any nicks, scratches or slight distortion with a surface plate and emery cloth.

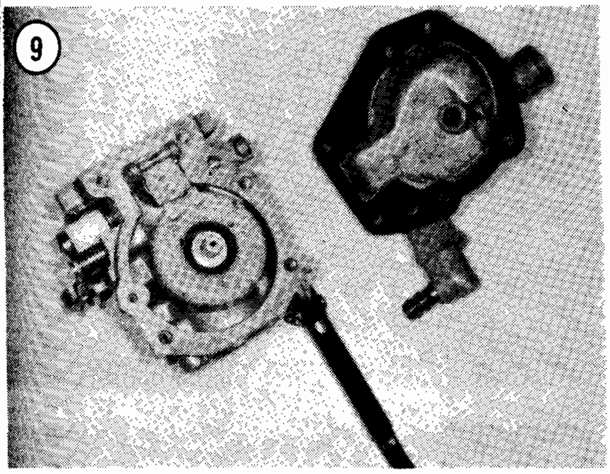
JOHNSON/EVINRUDE 2 HP, COLT, JUNIOR AND 4 HP (1973-1977)

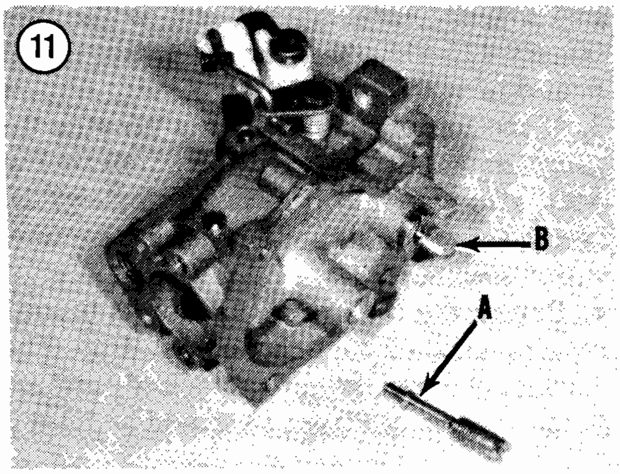
Removal/Installation

1. Remove the engine cover.
2. Shut the fuel supply valve off.
3. Remove the low-speed knob from the needle valve.
4. Remove the rewind starter.
5. Disconnect the fuel line at the carburetor.
6. Pull out the 2 support bracket retainers and remove the fuel tank.
7. Align the speed control with the support bracket slot. Remove the support bracket









screws. Remove the support bracket and air silencer.

8. Remove the carburetor mounting nuts. Remove the carburetor.
9. Remove and discard the gasket.
10. Clean all gasket residue from the manifold mounting surface.
11. Installation is the reverse of removal. Use a new gasket. Adjust throttle cam (Chapter Five) before reinstalling support bracket and air silencer. Adjust carburetor (Chapter Five).

Disassembly/Assembly

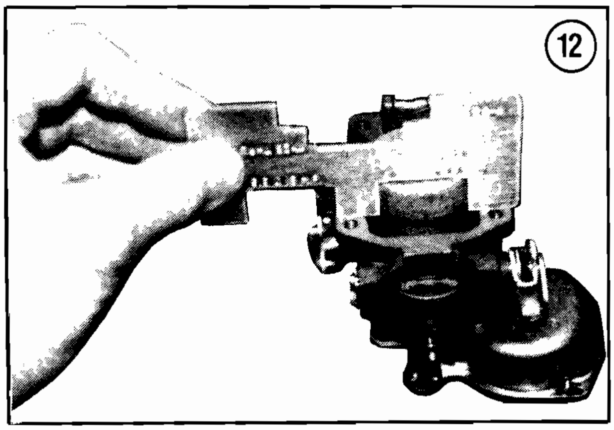
Refer to **Figure** 7 for this procedure.

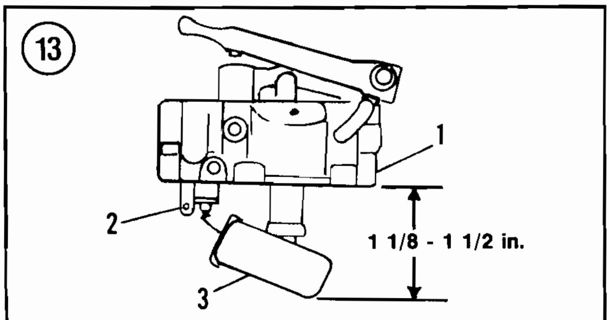
1. Remove the high- and low-speed needle nuts. Remove the high-speed needle valve (1, **Figure 8**). Remove the low-speed needle valve (2, **Figure 8**). Remove and discard the needle valve packings.
2. Drain the carburetor of any remaining fuel.
3. Remove the float chamber screws. Separate the float chamber from the main body (**Figure 9**). Discard the float chamber gasket.
4. Remove the float assembly hinge pin. Lift the float and needle valve from the float chamber. See **Figure 10**.
5. Remove the high-speed nozzle (A, **Figure 11**). Remove and discard the nozzle gasket.
6. Remove the needle valve seat (B, **Figure 11**) with a wide-blade screwdriver. Discard the seat gasket.
7. Assembly is the reverse of disassembly. Compare new gaskets to the old ones to make

sure all holes are properly punched. Remove any loose gasket fibers or stamping crumbs adhering to the new gaskets. Adjust the float as described in this chapter. Lightly seat needle valves. Back high-speed needle out one full turn. Back low-speed needle out 1 1/4 turns. Install on engine and adjust carburetor (Chapter Five).

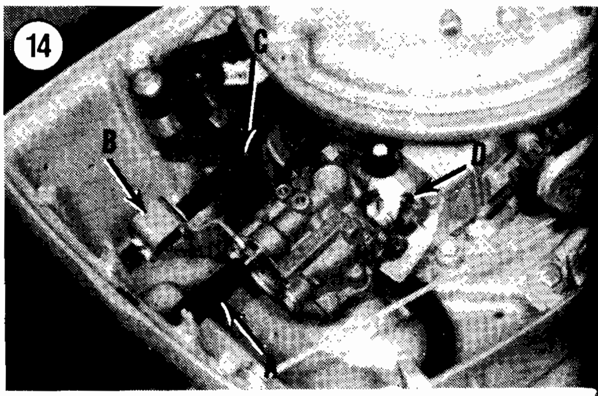
Float Adjustment

1. Invert the carburetor body with its gasket surface horizontal.
2. Place float gauge (part No. 324891) on the gasket surface and hold it next to the float (**Figure 12**). Do not let gauge pressure hold float down.
3. If the top of the float is not between the gauge notches (**Figure 12**), bend the metal float arm carefully (to avoid forcing the needle valve into its seat) and bring the level within specifications.
4. Return the carburetor body to its normal running position and check float drop. The distance between the carburetor body and the float as shown in **Figure 13** should be 1 1/8-1 1/2 in.
5. If the float drop is incorrect, carefully bend the tang (**Figure 13**) until it comes within specifications.





1. Carburetor body
2. Tang
3. Float



JOHNSON/EVINRUDE 2.5 HP, 3 HP, 4 HP (1978-ON), 4 HP DELUXE, EXCEL 4, ULTRA 4, 4.5 HP, 5 HP, 6 HP, 7.5 HP AND 8 HP

Johnson/Evinrude 2.5 hp, 3 hp, 4 hp (1978-on), 4 hp Deluxe, Excel 4 and Ultra 4 Removal/Installation

1. Remove the engine cover.
2. Remove the choke and low-speed adjustment knobs.
3. Disconnect the fuel line at the carburetor. Plug the line to prevent leakage.
4. Remove the 2 carburetor mounting nuts. Remove the carburetor and gasket. Discard the gasket.
5. Clean all gasket residue from the manifold mounting surface.
6. Installation is the reverse of removal. Use a new gasket. Adjust the carburetor (Chapter 5).

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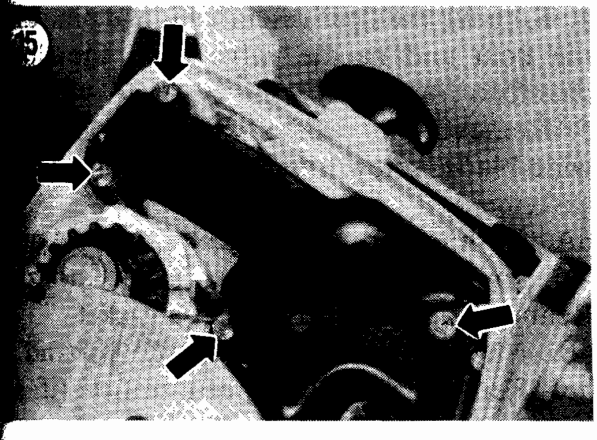

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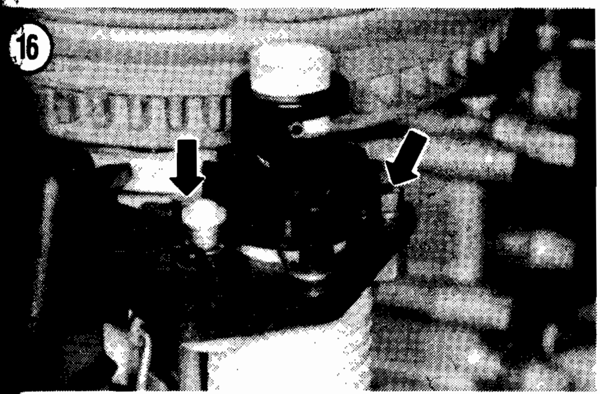

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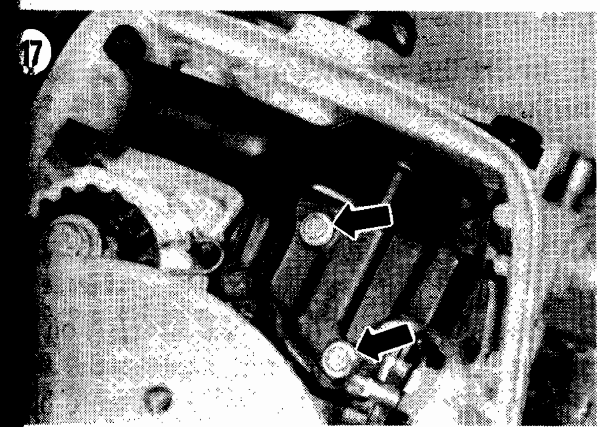

nson/Evinrude 4.5 hp moval/Installation

Remove the engine cover.

Remove the low-speed knob (A, **Figure**

Remove the choke knob retaining ring (B, **ure 14**). Disconnect the knob at the carburetor (C, **Figure 14**) and pull it out through the hole in the lower cover.

4. Remove the screw holding the cam follower and link (D, **Figure 14**). Move the cam follower out of the way to provide access to the mounting nut behind it.
5. Disconnect the fuel line at the carburetor. Plug the line to prevent leakage.
6. Remove the 2 carburetor mounting nuts. Remove the carburetor and gasket. Discard the gasket.
7. Clean all gasket residue from the manifold mounting surface.
8. Installation is the reverse of removal. Use a new gasket. Adjust the carburetor (Chapter Five).

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Johnson/Evinrude 7.5 hp and 5 hp, 6 hp and 8 hp (Prior to 1986) Removal/Installation

1. Remove the engine cover.
2. Remove the low-speed knob.
3. Remove the air silencer cover screws (**Figure 15**). Remove the cover.
4. Remove the manual starter. **Figure 16** shows one mounting screw; the second is located on the other side of the unit.
5. Remove the air silencer base screws (**Figure 17**). Remove the base.
6. Disconnect the choke lever at the carburetor and remove it from the engine.
7. Remove the screw holding the cam follower and link (D, **Figure 14**). Move the cam follower out of the way to provide access to the mounting nut behind it.
8. Disconnect the fuel line at the carburetor. Plug the line to prevent leakage.
9. Remove the 2 carburetor mounting nuts. Remove the carburetor and gasket. Discard the gasket.
10. Clean all gasket residue from the manifold mounting surface.
11. Installation is the reverse of removal. Use a new gasket. Adjust the carburetor (Chapter Five).

Johnson/Evinrude 5 hp, 6 hp and 8 hp (1986-on) Removal/Installation

1. Remove the engine cover.
2. Remove the air silencer cover and hose.
3. Remove the automatic rewind (manual) starter. See Chapter Ten.
4. Disconnect the cam follower and link at the carburetor.
5. Remove the carburetor mounting nuts. Remove the carburetor and gasket. Discard the gasket.
6. Disconnect the primer and fuel lines at the carburetor. Plug the lines to prevent leakage.
7. Installation is the reverse of removal. Use new carburetor and air silencer gaskets. Adjust the carburetor to idle at 850-900 rpm (6SL and 8SRL) or 650-700 rpm (all others) as described in Chapter Five. Squeeze primer bulb and check for fuel leaks.

Disassembly/Assembly (All Models Except 1986-on 5-8 hp)

Refer to **Figure 18** (2.5 hp, 3 hp, 4 hp [1978-on], Excel 4 and Ultra 4), **Figure 19** (4.5 hp), **Figure 20** (4 hp Deluxe, 5 hp, 6 hp and 8 hp) or **Figure 21** (7.5 hp) for this procedure.

1. Remove the float chamber screws. Separate the float chamber from the main body. Discard the float chamber gasket.
2. On 2.5 hp, 3 hp, 4 hp and 4.5 hp models equipped with an integral fuel tank, unscrew and remove the fuel pump nipple, filter, roll pin and fuel shut-off valve from the float chamber. Discard the shut-off valve O-rings.

3A. 2.5 hp, 3 hp, 4 hp, Excel 4, Ultra 4 and 4.5 hp—Remove the low-speed needle nut. Remove the low-speed needle valve. Remove and discard the needle valve packings.

3B. 4 hp Deluxe, 5 hp, 6 hp, 7.5 hp and 8 hp—Remove the low-speed needle valve. Insert a length of wire with a hooked end in the needle valve keyhole slot and remove the needle retainer.

4. Remove the float assembly hinge pin. Lift the float and needle valve from the float chamber.
5. Remove the needle valve seat with a wide-blade screwdriver. Discard the seat gasket.

6A. 2.5 hp, 3 hp, 4 hp, Excel 4, Ultra 4 and 4.5 hp—Remove the high speed nozzle. Remove and discard the nozzle gasket.

6B. 4 hp Deluxe, 5 hp, 6 hp, 7.5 hp and 8 hp—Remove the high-speed orifice (if so equipped) from the carburetor body.

7. Assembly is the reverse of disassembly. Compare new gaskets to the old ones to make sure all holes are properly punched. Remove any loose gasket fibers or stamping crumbs adhering to the new gaskets. Install needle valve retainer with a flat punch on models so equipped. Adjust the float as described in this chapter. Lightly seat needle valve. Back low speed needle out one full turn. Install on engine and adjust carburetor (Chapter Five).

Float Adjustment (All Models Except 1986-on 5-8 hp)

1. Invert the carburetor body with its gasket surface horizontal.

NOTE
Use the float gauge cutout marked "2 thru 6" for setting the 7.5 and 8 hp float in Step 2.

2. Place float gauge (part No. 324891) on the gasket surface and hold it next to the float (**Figure 12**). Do not let gauge pressure hold float down.
3. If the top of the float is not between the gauge notches (**Figure 12**), bend the metal float arm carefully (to avoid forcing the needle valve into its seat) and bring the level within specifications.
4. Return the carburetor body to its normal running position and check float drop. The distance between the carburetor body and the

oat as shown in **Figure 13** should be 1 1/8-1 /2 in.

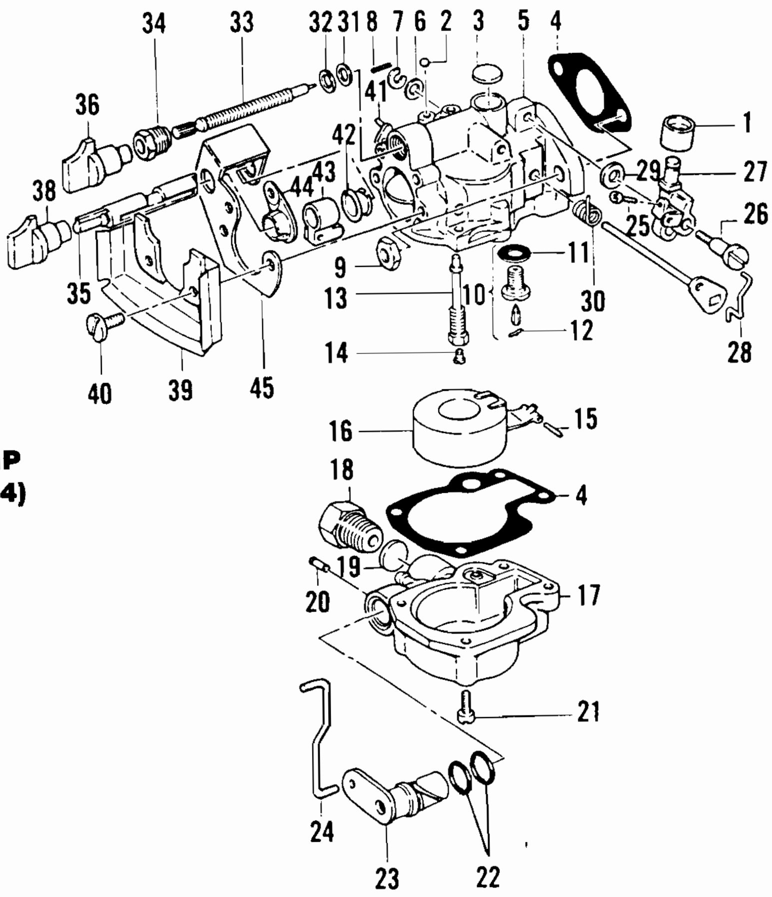
. If the float drop is incorrect, carefully bend e tang (**Figure 13**) until it comes within ecifications.

isassembly/Assembly 986-on 5-8 hp)

Refer to **Figure 22** for this procedure.

1. Unscrew and remove the low-speed needle.
2. Remove the cover and gasket. Discard the gasket.
3. Remove the float chamber and gasket. Discard the gasket and check the condition of the lower gasket in the float chamber.
4. Remove the float assembly hinge pin. Lift the float and needle valve from the carburetor body.

18

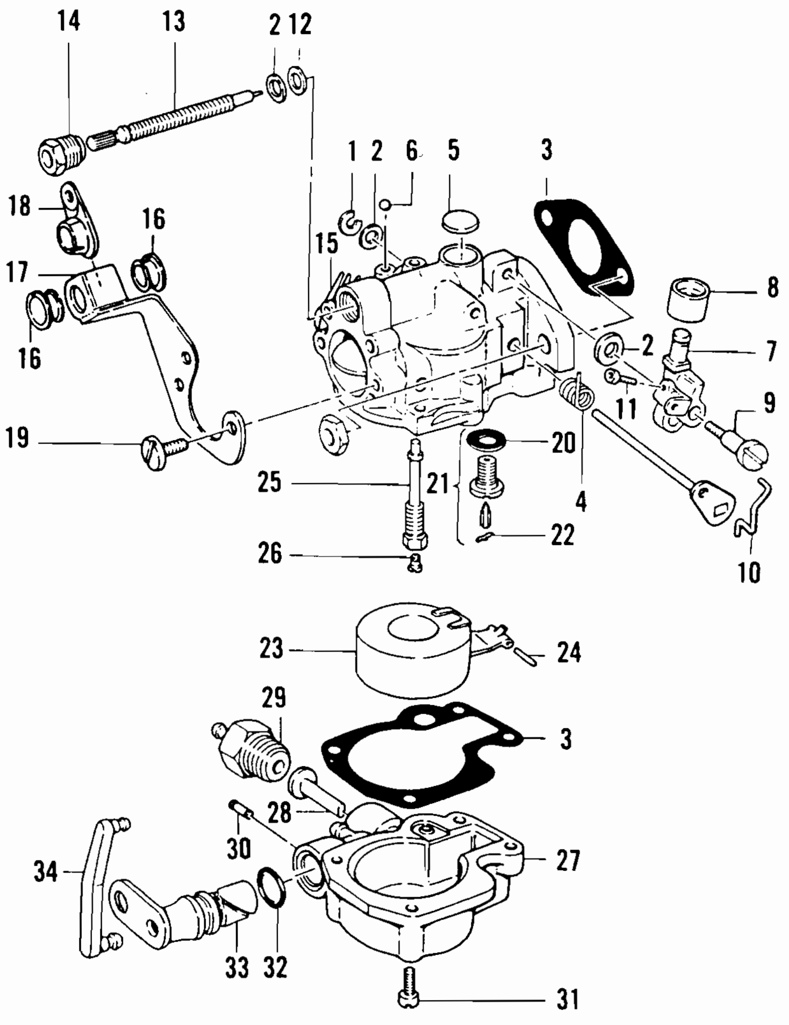


CARBURETOR (2.5 HP, 3 HP, 4 HP [1978-ON], EXCEL 4 AND ULTRA 4)

1. Cam follower
2. Lead shot
3. Welch plug
4. Gasket
5. Carburetor body
6. Throttle shaft washer
7. Throttle shaft retainer
8. Roll pin
9. Mounting nut
10. Inlet needle valve assembly
11. Gasket
12. Retaining clip
13. High-speed nozzle
14. High-speed orifice
15. Float hinge pin
16. Float assembly
17. Float chamber
18. Float chamber plug
19. Plug washer
20. Shut-off valve roll pin
21. Float chamber screw
22. O-rings
23. Shut-off valve
24. shut-off valve link
25. Cam follower screw
26. Shoulder screw
27. Cam follower
28. Cam follower link
29. Washer
30. Throttle return spring
31. Needle valve packing
32. Packing washer
33. Slow-speed needle valve
34. Needle valve nut
35. Choke and fuel shut-off shaft
36. Low-speed knob
38. Choke knob
39. Splash guard
40. Screw
41. Choke shaft lever
42. Bushing
43. Choke lever link
44. Choke knob lever
45. Choke knob and shaft support

5. Remove the needle valve seat with a wide-blade screwdriver. Discard the seat gasket.
6. Cut the flex tube from the 2 nipples to which it is connected. Discard the tube.
7. Remove the orifice plug from the float chamber. Remove the high-speed orifice with fixed jet screwdriver part No. 317002.
8. Remove the nozzle well and upper gasket. Discard the upper gasket.

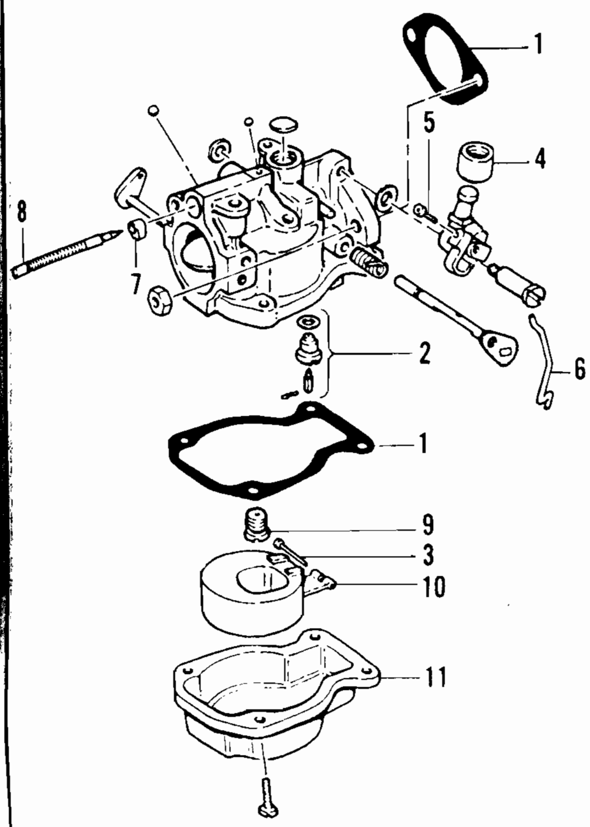
19



CARBURETOR (4.5 HP)

1. Throttle shaft retainer
2. Washer
3. Gasket
4. Throttle return spring
5. Welch plug
6. Lead shot
7. Cam follower
8. Cam follower roller
9. Shoulder screw
10. Cam follower link
11. Cam follower screw
12. Needle valve packing
13. Slow-speed needle valve
14. Needle valve nut
15. Choke shaft lever
16. Bushing
17. Choke plate adapter
18. Choke knob lever
19. Adapter screw
20. Gasket
21. Inlet needle valve assembly
22. Retaining clip
23. Float assembly
24. Float hinge pin
25. High-speed nozzle
26. High-speed orifice
27. Float chamber
28. Fuel pump bladder
29. Float chamber nipple
30. Shut-off valve roll pin
31. Float chamber screw
32. O-ring
33. Shut-off valve
34. Shut-off valve link

20



CARBURETOR (4 HP DELUXE AND 5 HP, 6 HP AND 8 HP [PRIOR TO 1986])

1. Gasket
2. Inlet needle valve assembly
3. Float hinge pin
4. Cam follower roller
5. Cam follower adjustment screw
6. Cam follower link
7. Packing
8. Low-speed needle valve
9. High-speed orifice
10. Float assembly
11. Float chamber

9. Assembly is the reverse of disassembly. Compare new gaskets to old ones to make sure all holes are properly punched. Remove any loose gasket fibers or stamping crumbs adhering to the new gaskets. Adjust the float as described in this chapter. Lightly seat low-speed needle, then back it out 2 1/2 turns. Install on engine and adjust carburetor (Chapter Five).

Float Adjustment (1986-on 5-8 hp)

1. Invert the carburetor body with its gasket surface horizontal, allowing the float weight to close the needle valve. 6
2. Place float gauge (part No. 324891) on the gasket surface and hold it next to the float (**Figure 23**). Use "9.9-15 hp" notch for this carburetor. Do not let gauge pressure hold float down.
3. If the top of the float is not between the gauge notches (**Figure 23**), bend the metal float arm carefully (to avoid forcing the needle valve into its seat) and bring the level within specifications.
4. Return the carburetor body to its normal running position and check float drop. The distance between the carburetor body and the float as shown in **Figure 24** should be 1-1 3/8 in.
5. If the float drop is incorrect, carefully bend the tang (**Figure 24**) until it comes within specifications.

JOHNSON/EVINRUDE 9.5 HP

Removal/Installation

1. Remove the engine cover.
2. Disconnect the fuel line at the carburetor. Plug the line to prevent leakage.
3. Lift the choke rod from the bellcrank.
4. Disconnect the cable-to-cover spring at the low-speed needle valve cable. Pull the low-speed knob from the cable and feed the cable through the control panel.

5. Remove the 5 screws holding the carburetor to the intake manifold. Swing the stabilizer bar to one side and remove the carburetor.
6. Clean all gasket residue from the manifold mounting surface.
7. Installation is the reverse of removal. Use a new gasket. Tighten flat head screw first to prevent carburetor distortion. Adjust the carburetor (Chapter Five).

Disassembly/Assembly

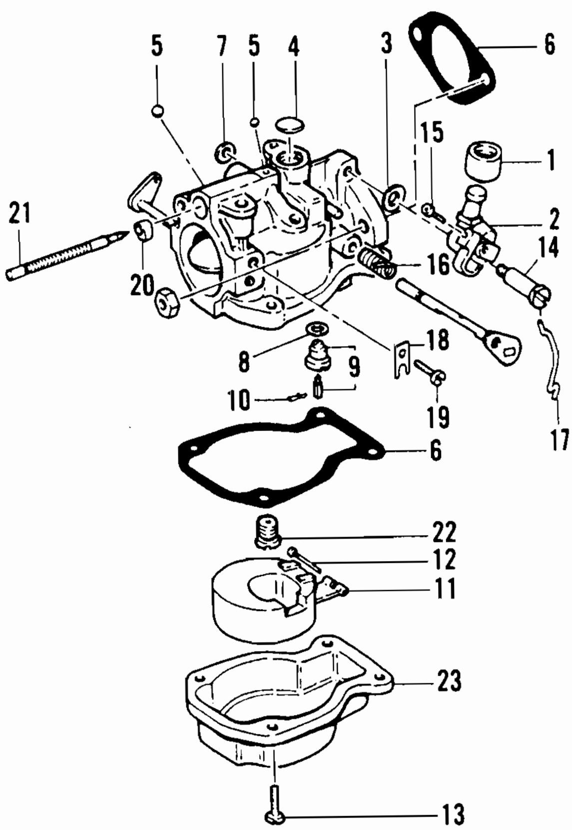
Refer to **Figure 25** for this procedure.

1. Remove the screw plug at the base of the float chamber and drain the fuel in the chamber into a container.
2. Remove the 4 screws holding the carburetor body to the float chamber.
3. Note the positioning of the washers and spring on the low-speed needle valve. Remove the needle valve, washers and spring.
4. Remove the float assembly hinge pin. Lift the float and needle valve from the float chamber.
5. Remove the needle valve seat with a wide-blade screwdriver. Discard the seat gasket.
6. Remove the high-speed jet from the float chamber with fixed jet screwdriver part No. 317002. See **Figure 26**.
7. Assembly is the reverse of disassembly. Compare new gaskets to the old ones to make sure all holes are properly punched. Remove any loose gasket fibers or stamping crumbs adhering to the new gaskets. Adjust the float as described in this chapter. Lightly seat needle valve. Back low-speed needle out 3/4 turn. Install on engine and adjust carburetor (Chapter Five).

Float Adjustment

1. Invert the carburetor body with its gasket surface horizontal, allowing the float weight to close the needle valve.

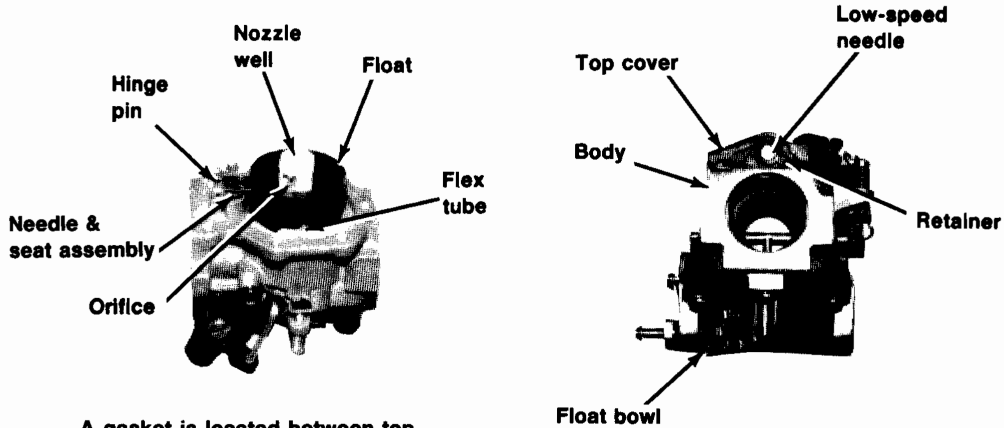
(21)



CARBURETOR (7.5 HP)

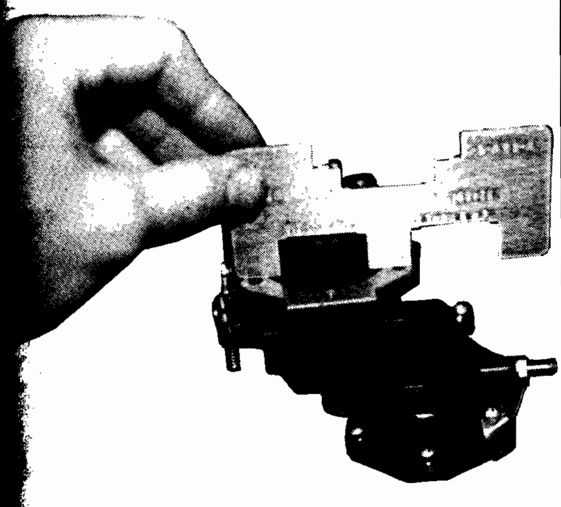
1. Cam follower roller
2. Cam follower
3. Washer
4. Welch plug
5. Lead shot
6. Gasket
7. Throttle shaft washer
8. Gasket
9. Inlet needle valve and needle assembly
10. Retaining clip
11. Float assembly
12. Float hinge pin
13. Float chamber screw
14. Shoulder screw
15. Cam follower adjustment screw
16. Throttle return spring
17. Cam follower link
18. Retaining clip
19. Screw
20. Needle valve retainer
21. Slow-speed needle valve
22. High-speed orifice plug
23. Float chamber

1986-ON 5-8 HP



A gasket is located between top cover and body, float bowl and body, and above and below nozzle well.

(22)



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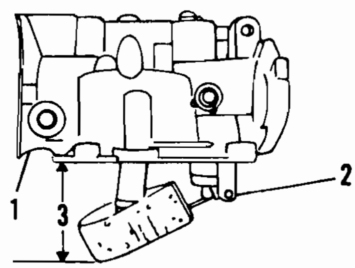


1. Carburetor casting
2. Adjustment tang
3. Float drop dimension

6

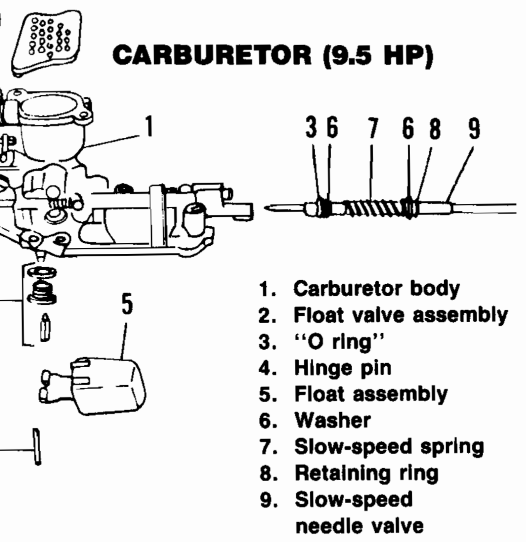
2. The float should be parallel with the casting face. Measure the distance between the casting and the top of the float. See **Figure 27**.
3. If the distance measured in Step 2 is not 13/16 in., bend the metal float arm carefully (to avoid forcing the needle valve into its seat) and bring the float within specifications.
4. Return the carburetor body to its normal running position and check float drop. The distance between the carburetor body and the float as shown in **Figure 28** should be 1 7/16 in. ± 1/16 in.
5. If the float drop is incorrect, carefully bend the float tang until the drop is within specifications.

JOHNSON/EVINRUDE 9.9 AND 15 HP

Removal/Installation

1. Remove the engine cover.
2. Remove the low-speed knob.
3. Remove the air silencer cover screws (**Figure 15**). Remove the cover.
4. Remove the air silencer base screws (**Figure 17**). Remove the base.
5. Remove the choke knob detent plate. Disconnect the choke lever from the choke

25



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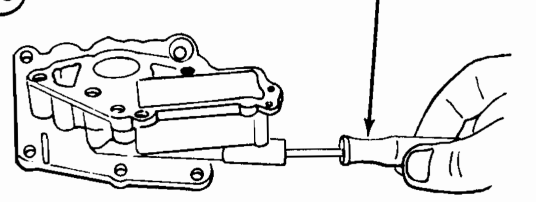

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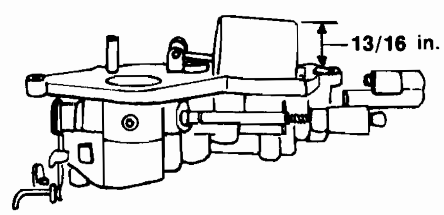

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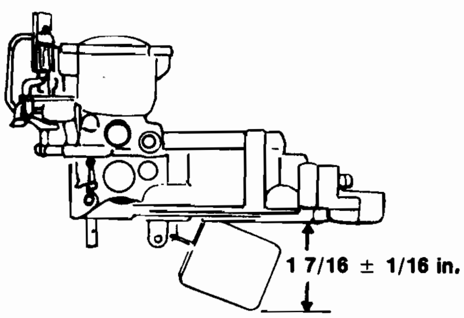

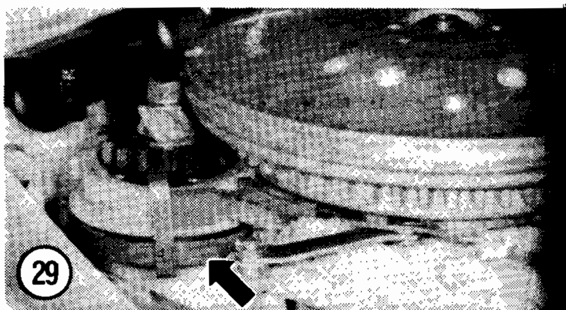

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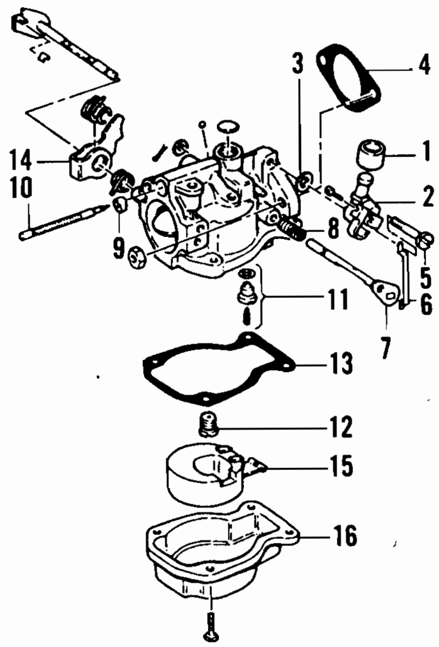
(30) **CARBURETOR (9.9 AND 15 HP)**



1. Cam follower roller
2. Cam follower
3. Washer
4. Gasket
5. Shoulder screw
6. Cam follower link
7. Throttle shaft and lever
8. Throttle return spring
9. Retainer
10. Low-speed needle valve
11. Inlet needle valve assembly
12. High-speed orifice plug
13. Gasket
14. Choke lever
15. Float assembly
16. Float chamber

shaft. Pull choke knob and shaft out of the lower motor cover.

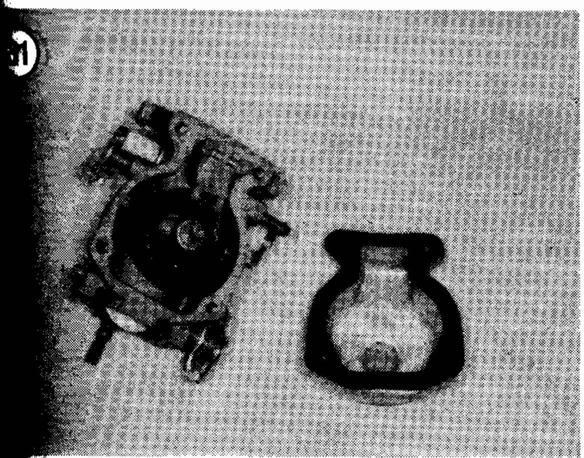
6. Remove the manual starter (**Figure 29**).
7. Remove the cam follower shoulder screw and washer (D, **Figure 14**). Disconnect lever from link and starter lockout pawl spring. Note position of link in cam follower.
8. Remove the 2 carburetor mounting nuts. Remove the carburetor, gasket and link. Note position of link on the throttle lever. Discard the gasket.
9. Disconnect the fuel line at the carburetor. Plug the line to prevent leakage.
10. Clean all gasket residue from the manifold mounting surface.
11. Installation is the reverse of removal. Use a new gasket. Connect link to throttle lever before mounting carburetor on intake manifold. Adjust the carburetor (Chapter Five).

Disassembly/Reassembly

Refer to **Figure 30** for this procedure.

1. Remove the float chamber screws. Separate the float chamber from the main body (**Figure 31**). Discard the float chamber gasket.
2. Remove the float assembly hinge pin. Remove the float. See A, **Figure 32**.
3. Remove the needle valve from the valve seat (B, **Figure 32**).

(31)



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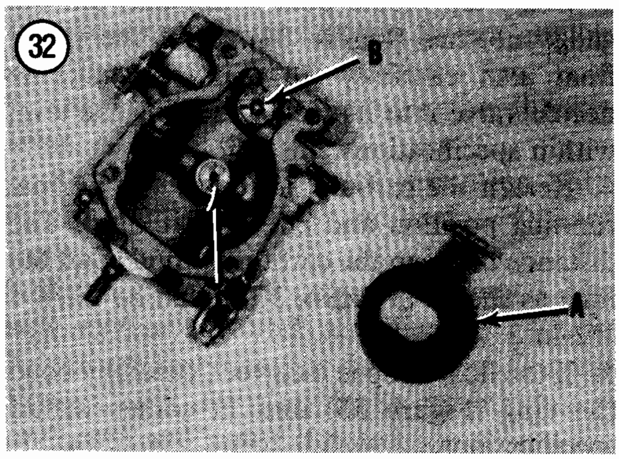


4. Remove the needle valve seat with a wide-blade screwdriver. Discard the seat gasket.
5. Remove the high-speed orifice plug (C, **Figure 32**).
6. Remove the low-speed needle valve (**Figure 33**). Insert a length of wire with a hooked end in the needle valve keyhole slot and remove the needle retainer.
7. Assembly is the reverse of disassembly. Compare new gaskets to the old ones to make sure all holes are properly punched. Remove any loose gasket fibers or stamping crumbs adhering to the new gaskets. Install needle valve retainer with a flat punch. Adjust the float as described in this chapter. Lightly seat needle valve. Back low-speed needle out one full turn (9.9 hp) or 7/8 turn (15 hp). Install on engine and adjust carburetor (Chapter Five).

Float Adjustment

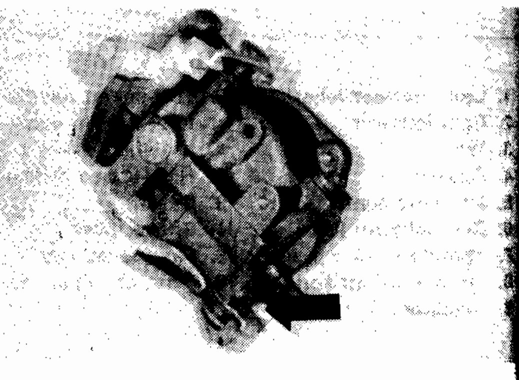
1. Invert the carburetor body with its gasket surface horizontal.
2. Place float gauge (part No. 324891) on the gasket surface and hold it next to the float (**Figure 34**). Do not let gauge pressure hold float down.
3. If the top of the float is not between the gauge notches (**Figure 34**), bend the metal float arm carefully (to avoid forcing the needle valve into its seat) and bring the level within specifications.
4. Return the carburetor body to its normal running position and check float drop. The distance between the carburetor body and the float as shown in **Figure 35** should be 1 1/8-1 1/2 in.
5. If the float drop is incorrect, carefully bend the tang (**Figure 35**) until it comes within specifications.

JOHNSON/EVINRUDE 20 HP, 25 HP, 28 HP, 30 HP, 35 HP AND 40 HP

Removal/Installation (All Models Prior to 1985)

1. Disconnect the carburetor fuel line at the fuel pump.
2A. 20-35 hp—Remove the screw holding the choke lever to the carburetor. Remove the wave washer and spacer, then disconnect the choke lever at the choke knob. Pull assembly from air silencer retainer.
2B. 40 hp—Disconnect low-speed arm and link from low-speed needle.
3. Remove the air silencer assembly.
4A. If equipped with a choke solenoid, remove the screw holding the solenoid and ground lead to the carburetor (A, **Figure 36**).
4B. If equipped with a primer solenoid, remove the solenoid screws and solenoid.

33



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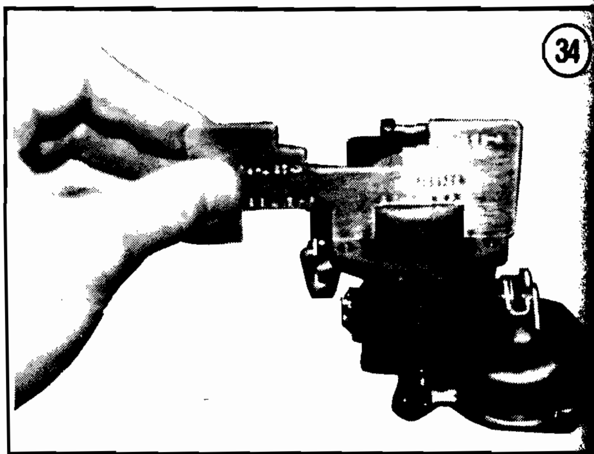

5. Disconnect the link between the throttle arm and cam follower (B, **Figure 36**).
6. Disconnect the oil recirculation line (C, **Figure 36**), if so equipped.
7. Remove the starter on electric start models if it interferes with carburetor removal. See Chapter Seven.
8. Remove the carburetor mounting nuts. Remove the carburetor and gasket. Discard the gasket.
9. Installation is the reverse of removal. Use a new gasket. Adjust the carburetor (Chapter Five).

Removal/Installation (1985-on 20-30 hp)

1. Remove the engine cover.
2. Disconnect the primer hose from the intake manifold and remove the screw holding the hose clamp to the carburetor.
3. If equipped with an electric starter, unbolt the starter bracket and place to one side.

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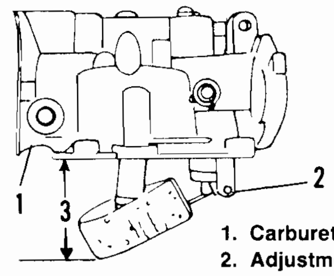
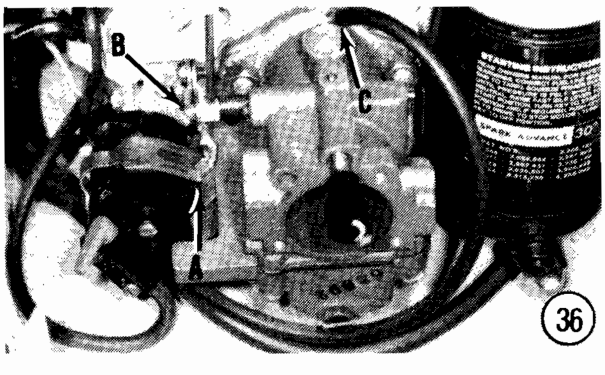


1. Carburetor casting
2. Adjustment tang
3. Float drop dimension



4. Disconnect throttle link from cam follower.
5. Unbolt the primer solenoid and place to one side.
6. Remove the carburetor mounting nuts. Remove the carburetor and gasket. Discard the gasket.
7. Disconnect the fuel line at the carburetor. Plug the line to prevent leakage.
8. Installation is the reverse of removal. Use a new gasket. Adjust the carburetor as described in Chapter Five. Squeeze primer bulb and check for leaks.

Removal/Installation (1985-on 40 hp)

1. Remove the engine cover.
2. Remove the air silencer cover and gasket. Discard the gasket.
3. Remove and discard the air silencer base attaching screws.

NOTE
Do not disconnect the hoses connected to the VRO pump in Step 4.

4. As required, remove the 2 screws holding the VRO pump bracket to the power head. Remove the VRO pump and bracket and place to one side.
5. Disconnect the drain hose at the air silencer base. Remove the base and gasket. Discard the gasket.
6. Disconnect the fuel line at the carburetor. Plug the line to prevent leakage.
7. Disconnect the linkage at the throttle lever.
8. Remove the carburetor mounting nuts. Remove the carburetor and gasket. Discard the gasket.
9. Installation is the reverse of removal. Use new carburetor and air silencer gaskets. Adjust the carburetor as described in Chapter Five. Check for fuel leaks during initial operation and repair if noted.

Disassembly/Assembly

Refer to **Figure 37** typical for this procedure.

1. Remove the float bowl plug. Drain the carburetor and remove the high speed orifice with fixed jet screwdriver part No. 317002. See **Figure 38.**

2A. 20-35 hp (Prior to 1989)—Remove the low speed needle valve **(Figure 39)**. Insert a length of wire with a hooked end in the needle valve keyhole slot and remove the needle retainer.

2B. 20-30 hp (1989-1990)—Remove the lo speed needle valve assembly (**Figure 40**).

2C. 40 hp—Remove the air intake screen low-speed needle valve, packing nut, packin and washers.

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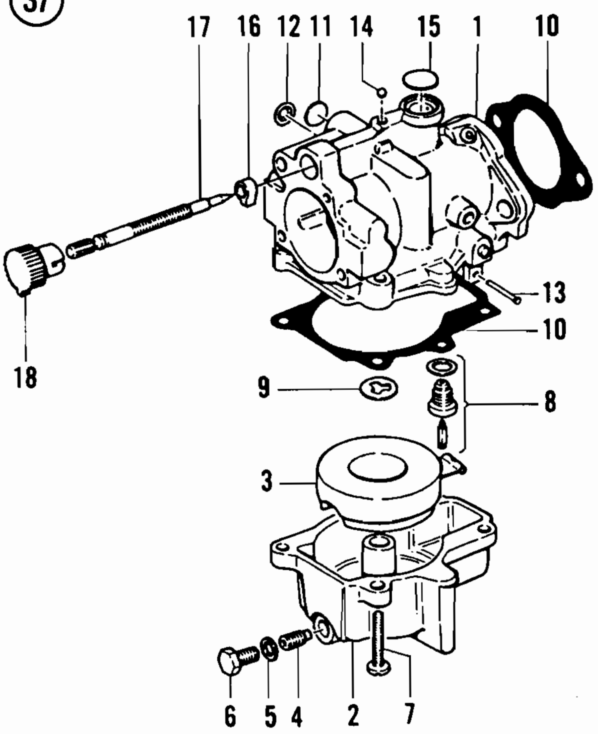

CARBURETOR (20-40 HP)

1. Carburetor body
2. Float chamber
3. Float assembly
4. Orifice plug
5. Screw plug washer
6. Screw plug
7. Float chamber screw
8. Inlet needle valve assembly
9. Nozzle gasket
10. Gasket
11. Welch plug
12. Retainer
13. Float hinge pin
14. Lead shot
15. Welch plug
16. Needle valve retainer
17. Slow-speed needle valve
18. Slow-speed adjustment knob

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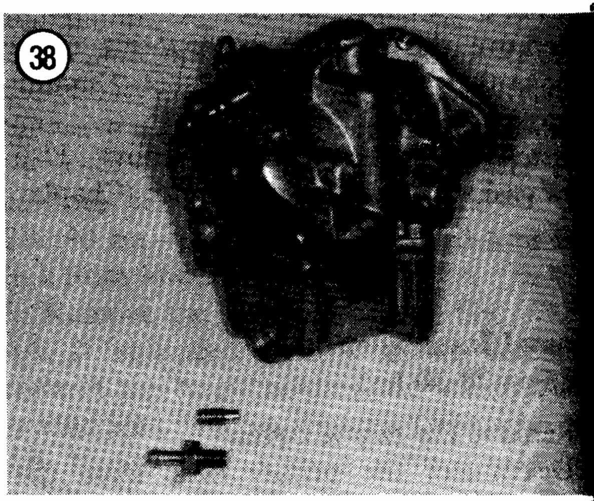

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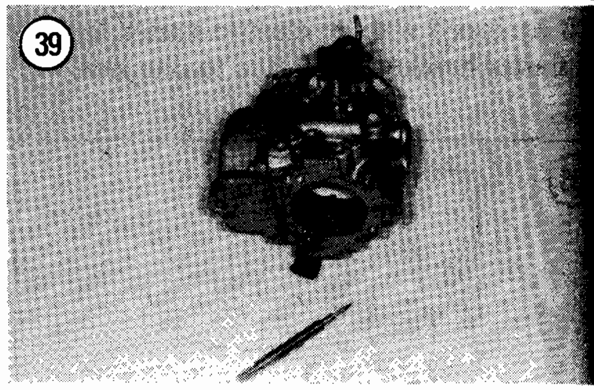

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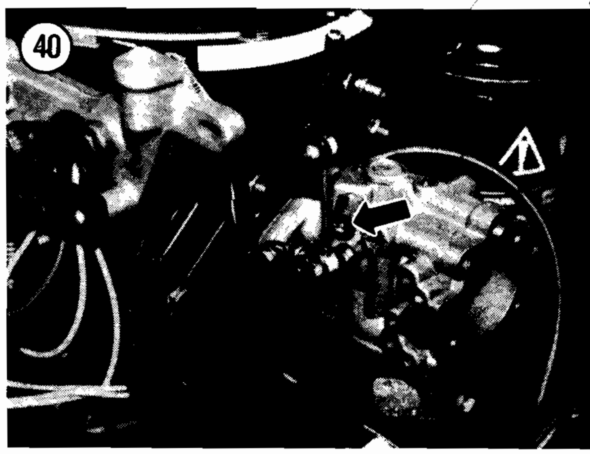

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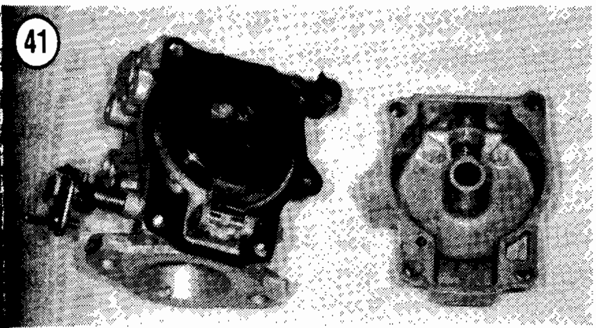

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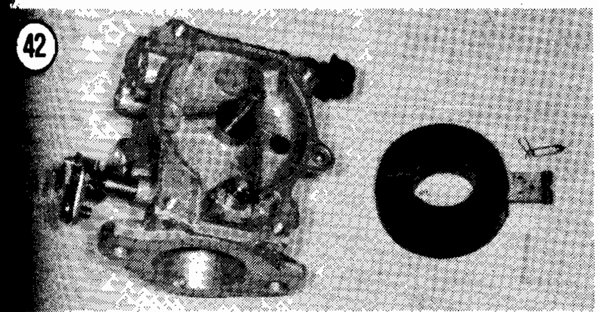

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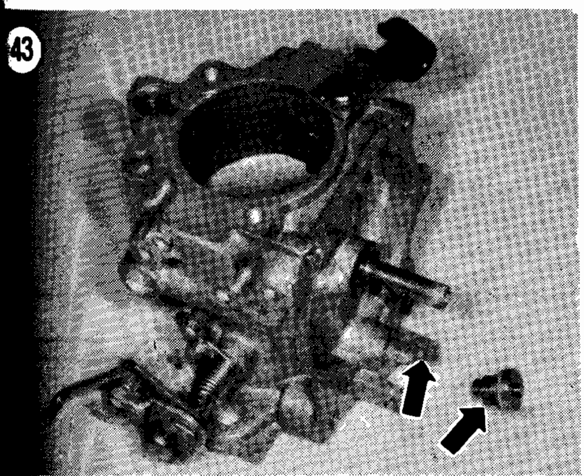
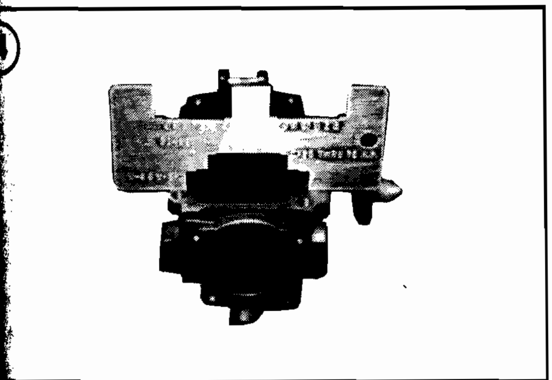




3. Remove the screws holding the float chamber to the main body. Remove the float chamber. Remove and discard the gasket. See **Figure 41**.
4. Remove the float assembly hinge pin. Lift the float and needle valve from the float chamber. See **Figure 42**.
5. Remove the needle valve seat (**Figure 43**) with a wide blade screwdriver. Discard the seat gasket.
6. 40 hp—Remove the high-speed nozzle and gasket. Discard the gasket.
7. Assembly is the reverse of disassembly. Compare new gaskets to the old ones to make sure all holes are properly punched. Remove any loose gasket fibers or stamping crumbs adhering to the new gaskets. On 20-35 hp models prior to 1989, install needle valve retainer with a flat punch. Adjust the float as described in this chapter. Install and lightly seat needle valve. Back low speed needle out 1 turn on 20-30 hp models prior to 1989, 1-3/4 turns on 1989-1990 20-30 hp models and 1-1/4 turns on 35 hp models. Reinstall on engine and adjust carburetor as described in Chapter Five.

Float Adjustment (20-35 hp)

1. Invert the carburetor body with its gasket surface horizontal.
2. Place float gauge (part No. 324891) on the gasket surface and hold it next to the float (**Figure 44**). Do not let gauge pressure hold float down.
3. If the top of the float is not between the gauge notches (**Figure 44**), bend the metal float arm carefully (to avoid forcing the needle valve into its seat) and bring the level within specifications.
4. Return the carburetor body to its normal running position and check float drop. The distance between the carburetor body and the

float as shown in **Figure 45** should be 1 1/8-1 5/8 in.

5. If the float drop is incorrect, carefully bend the tang (**Figure 45**) until it comes within specifications.

Float Adjustment (40 hp)

1. Invert the carburetor body with its gasket surface horizontal.
2. If the top of the float is not even with the gasket surface, bend the metal float arm carefully (to avoid forcing the needle valve into its seat) and bring the level within specifications.

CARBURETOR CORE PLUGS AND LEAD SHOT

Certain openings in the carburetor casting are covered with a core plug or have a lead shot installed. These usually require service only if the openings are leaking. **Figure 46** shows a carburetor with the core plug over the low-speed orifices removed (A) and a typical lead shot installed (B).

Core Plug Service

1. If leakage is noted, secure the carburetor in a vise with protective jaws.
2. Hold a flat end punch in the center of the core plug and tap sharply with a hammer to flatten the plug. Cover the plug area with OMC Adhesive M.

CAUTION
Do not drill more than 1/16 in. below the core plug in Step 3 or the casting will be damaged.

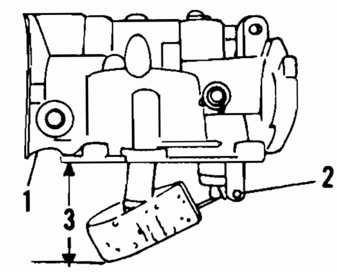
3. If this does not solve the leakage problem or if the low-speed orifices are completely plugged, carefully drill a 1/8 in. hole through the center of the plug and pry it from the casting with a punch.

4A. Clean all residue from the core plug hole in the casting. If the hole is out-of-round, replace the casting.

4B. If the low-speed orifices are plugged, clean with a brush and carburetor cleaner.

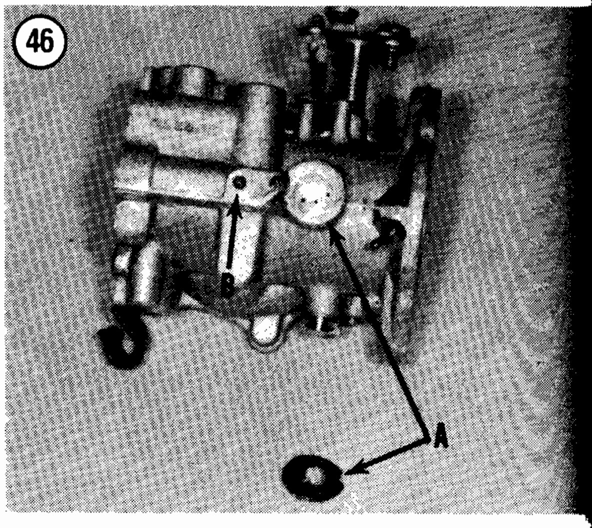
5. Coat the outer edge of a new core plug with OMC Adhesive M and position it in the casting opening with its convex side facing up.
6. Hold a flat end punch in the center of the core plug and tap sharply with a hammer to flatten the plug.

45



1. **Carburetor casting**
2. **Adjustment tang**
3. **Float drop dimension**

46

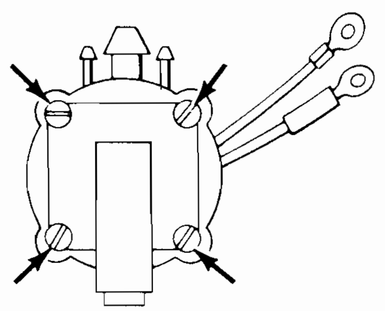


7. Coat the core plug with engine oil and blow compressed air (25 psi or less) through the casting passages to check for leakage.
8. Wipe the oil from the core plug and coat with OMC Adhesive M.

Lead Shot Service

1. If leakage is noted, secure the carburetor in a vise with protective jaws.
2. Tap the center of the lead shot sharply with a small hammer and appropriate size punch.

(47)



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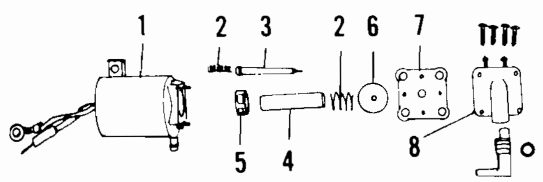


PRIMER SOLENOID COMPONENTS

1. Solenoid body
2. Spring
3. Plunger
4. Valve
5. Filter
6. Valve seat
7. Gasket
8. Solenoid

3. If leakage remains, carefully pry the lead shot from its opening with a suitable knife, awl or other sharp instrument.
4. Clean any residue from the lead shot opening in the casting.
5. Install a new lead shot in the opening and flatten out with a hammer and appropriate size punch.
6. Coat the core plug with engine oil and blow compressed air (25 psi or less) through the casting passages to check for leakage.
7. Clean the oil from the casting after pressure testing.

6

Carburetor Primer Solenoid Removal/Installation

1. Disconnect the solenoid purple/white lead at the terminal board.
2. Remove the 2 screws and clamp holding the solenoid. Remove the solenoid.
3. Installation is the reverse of removal. Be sure to reinstall the ground lead under the lower clamp screw. Coat the screw with OMC Black Neoprene Dip.

Testing

The solenoid plunger must be free of any dirt or corrosion that would prevent it from moving freely.

Connect an ohmmeter between the solenoid purple/white lead and the black ground lead. If the ohmmeter does not read 4-7 ohms, replace the solenoid.

Disassembly/Assembly

1. Remove the cover screws (**Figure 47**). Remove the cover and gasket. Discard the gasket.
2. Remove the valve seat, filter, valve, plunger and both springs. See **Figure 48**.

3. Clean or replace the filter as required.
4. Clean the plunger to remove any contamination or corrosion.
5. Assembly is the reverse of disassembly. Install a new valve seat and use a new cover gasket.

ANTI-SIPHON DEVICES

In accordance with industry safety standards, late-model boats equipped with a built-in fuel tank will have some form of anti-siphon device installed between the fuel tank outlet and the outboard fuel inlet. This device is designed to shut the fuel supply off in case the boat capsizes or is involved in an accident. Quite often, the malfunction of such devices leads the owner to replace a fuel pump in the belief that it is defective.

Anti-siphon devices can malfunction in one of the following ways:

a. Anti-siphon valve: orifice in valve is too small or clogs easily; valve sticks in closed or partially closed position; valve fluctuates between open and closed position; thread sealer, metal filings or dirt/debris clogs orifice or lodges in the relief spring.
b. Solenoid-operated fuel shut-off valve: solenoid fails with valve in closed position; solenoid malfunctions, leaving valve in partially closed position.
c. Manually-operated fuel shut-off valve: valve is left in completely closed position; valve is not fully opened.

The easiest way to determine if an anti-siphon valve is defective is to bypass it by operating the engine with a remote fuel supply. If a fuel system problem is suspected, check the fuel filter first. If the filter is not clogged or dirty, bypass the anti-siphon device. If the engine runs properly with the anti-siphon device bypassed, contact the boat manufacturer for replacement of the anti-siphon device.

FUEL TANK

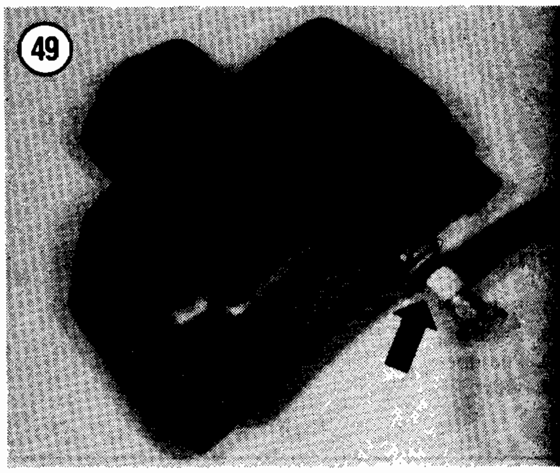
Integral Fuel Tank

All Johnson and Evinrude 2 hp, Colt and Junior models and some 4 and 4.5 hp models are fitted with an integral fuel tank. The integral tank on early 4 hp models so equipped is located in the engine cover. The integral tank on late 4 hp models so equipped is retained to the support bracket by 2 spring clips. The integral tank on 2 hp, Colt and Junior models and 4.5 hp models is located at the rear of the crankcase. The 2 hp tank is attached to a support bracket by 2 retainers or spring clips; the 4.5 hp tank is held in place by a clamp strap. Integral fuel tanks are equipped with a fuel shut-off valve and filter assembly in the tank inlet fitting. **Figure 4**[9] shows the 2 hp, Colt and Junior fuel tank and valve.

Portable Fuel Tank

Figure 50 shows the components of the portable fuel tank, including the primer bulb assembly.

When some oils are mixed with gasoline and stored in a warm place, a bacter[ia]



nce will form. This substance is clear in and covers the fuel pickup, restricting through the fuel system. Bacterial tion can be prevented by using OMC Fuel Conditioner on a regular basis. If t, it can be removed with OMC Engine r.

emove any dirt or water that may have the tank during refilling, clean the of the tank once each season by g with clean lead-free gasoline or ne.

k the inside and outside of the tank for rust, leakage or corrosion. Replace as d. Do not attempt to patch the tank utomotive fuel tank repair materials. le marine fuel tanks are subject to greater pressure and vacuum ions.

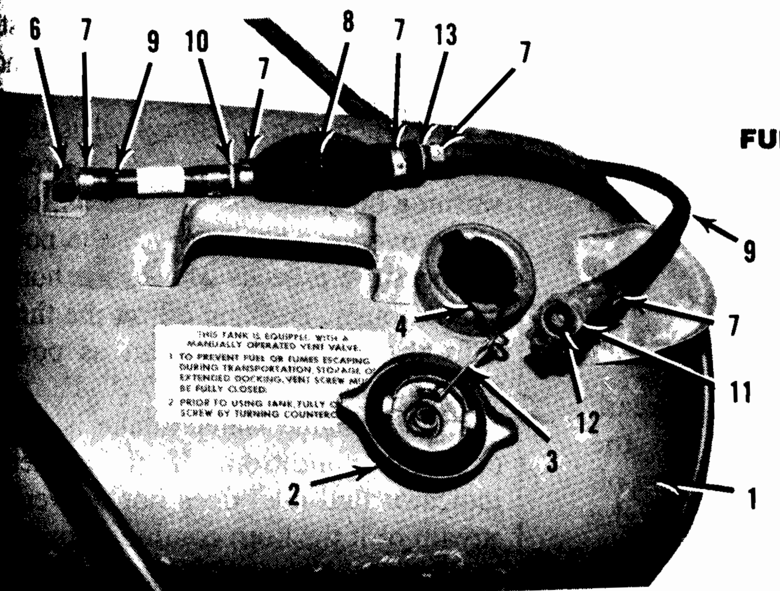
heck the fuel tank filter for possible ions, unscrew the fuel pickup nipple ithdraw the pickup tube and filter assembly from the tank. The filter on the end of the pickup tube can be cleaned with OMC Engine Cleaner.

Alcohol blended with gasoline may cause a gradual deteroriation of the indicator lens in portable fuel tanks. The use of a tank with an alcohol-resistant indicator lens is recommended if blended fuels are used with any frequency.

FUEL LINE AND PRIMER BULB

When priming the engine, the primer bulb should gradually become firm. If it does not become firm or if it stays firm even when disconnected, a check valve inside the primer bulb is malfunctioning.

The line should be checked periodically for cracks, breaks, restrictions and chafing. The bulb should be checked periodically for proper operation. Make sure all fuel line connections are tight and securely clamped.



FUEL TANK COMPONENTS

1. Fuel tank
2. Cap
3. Anchor link
4. Cap anchor
6. Elbow & fuel line
7. Clamp
8. Primer bulb
9. Short hose
10. Nipple and valve assembly
11. Fuel line connector
12. O-ring
13. Nipple and valve assembly

OIL INJECTION SYSTEM

The variable ratio oiling (VRO) system is a factory-installed standard feature on 1985 and later electric start 40 hp models. This system uses a self-contained pump on the power head instead of the conventional fuel pump. A remote mounted oil tank with pump and primer bulb and a warning horn complete the basic system.

One design uses a spark or flame arrestor installed in the pulse hose leading to the VRO pump and clamped in position to prevent it from moving and causing damage to the pump. An oil inlet filter is installed in the oil tank pickup unit and an inline filter is installed in the transparent oil inlet hose to the VRO pump on these models to protect the pump from contamination.

The other design has the arrestor installed in the pulse hose fitting. The arrestor should not be removed from the fitting; they are serviced as an assembly. These models have the oil inlet filter installed in the oil tank pickup unit and an inline filter canister (serviced as a complete assembly) installed in the fuel line on the power head.

A 2 version of the VRO pump was introduced in 1988. The new pump is designed to be alcohol resistant and to protect against damage from other harmful additives found in some gasoline blends.

Operation

The VRO system works on crankcase pressure in a manner similar to the conventional fuel pump, drawing fuel and oil from separate tanks and mixing them in the VRO pump at a ratio varying from 50:1 to 150:1 according to engine requirements. VRO-equipped models can also be run on a 50:1 fuel-oil mixture drawn from the fuel tank if the user premixes the fuel and oil as described in Chapter Four.

Break-in Procedure

All VRO models should be run on a 50:1 fuel-oil mixture form the fuel tank (see Chapter Four) *in addition to* the lubricant supplied by the VRO system. Mark the oil level on the translucent VRO remote oil tank and periodically check to make sure the system is working (oil level drops) before switching over to plain gasoline at the end of the 10-hour break-in period.

Warning Horn

A warning horn is installed in the accessory or remote control wiring harness. The horn has 2 functions on models prior to 1986 and 3 functions on 1986 and later models.

The sending unit in the remote oil tank is connected to the warning horn through the key switch and grounded to the engine. If the oil level in the tank drops below the 1/4 full point, the warning horn sounds for 1/2 second every 20 seconds to alert the user to a low oil level. A no-oil warning feature is incorporated in 1986 and later circuits. If the system runs completely out of oil or oil flow to the pump is obstructed, the warning horn sounds for 1/2 second every second.

A temperature sending unit is installed in the cylinder head and connected to the warning horn through the key switch to warn of an overheat condition. If the power head temperature exceeds 211° F, the horn sounds continuously. Backing off on the throttle will shut the horn off as soon as power head temperature reaches 175° F, unless a restricted engine water intake is causing the overheat condition. If the water pump indicator (tell-tale) does not deliver a steady stream or if the horn continues sounding after 2 minutes, the engine should be shut off immediately to prevent power head damage.

CAUTION

If the engine overheats and the warning horn sounds, retorque the cylinder head *after the engine cools to minimize the possibility of power head damage from a blown head gasket.*

Warning Horn Test

The warning horn should be tested periodically to make sure it is functioning properly.

1. Locate the electrical wire between the warning horn and temperature switch. Move the insulating sleeve back to provide access to the disconnect point in the wire.
2. Turn the key switch ON and ground the disconnect point to the engine.
3. If the horn does not sound, check the wiring and horn.
4. Reposition the insulating sleeve over the disconnect point in the wire.

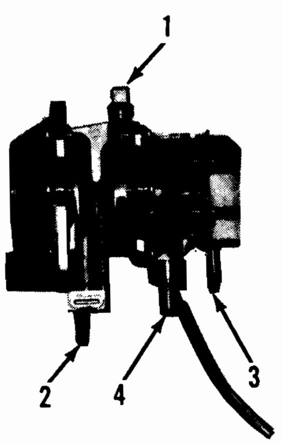
Troubleshooting

The VRO pump is sealed at the factory and is serviced by replacement if defective. Any attempt to disassemble the pump will void the factory warranty.

If the oil inlet hose is disconnected from the pump, it must be reinstalled with the same type of clamps as removed. The use of worm clamps will damage the vinyl hose while tie straps will not provide sufficient clamping pressure.

Refer to **Figure 51** for inlet and outlet identification.

(51)



1. Mixed fuel outlet
2. Crankcase (VRO pump) pulse line
3. Oul inlet
4. Fuel inlet

CAUTION

The pump nipples are plastic and can be broken if excess pressure is used when disconnecting or connecting the lines.

6

1. Disconnect the fuel outlet line. Install a tee to the end of the line and connect a 4 inch length of 5/16 in. ID hose to the tee.
2. Lubricate the pump outlet fitting with a drop of oil and connect the vinyl hose and tee assembly to the pump.
3. Connect a 0-15 psi pressure gauge to the tee.
4. Secure all hose connections with tie straps or hose clamps.

5A. 1985-1986 models—Start the engine and run at wide-open throttle in gear. The gauge should read between 3-15 psi and drop to 1-2 psi (accompanied by a clicking sound) each time the pump discharges oil.

5B. 1987-on models—Start the engine and run at approximately 800 rpm in gear. The gauge should read *no less than* 3 psi.

6. If no pressure is shown in Step 5:
   a. Check for fuel in the tank.
   b. Check for a pinched, kinked or restricted fuel line.
   c. Check for a pinched or leaking VRO pump pulse line (2, **Figure 51**).
7. If low pressure is shown in Step 5:
   a. Check fuel filter for restriction.
   b. Check for a pinched or leaking VRO pump pulse line (2, **Figure 51**).

c. Check for a pinched, kinked or restricted fuel line.
d. Squeeze the fuel primer bulb several times to remove any possible vapor lock condition in the line.

8. If no pressure or low pressure is shown in Step 5 and the items in Step 6 or Step 7 are satisfactory, replace the VRO pump.

Oil Flow Test

1. Make sure there is sufficient oil in the VRO tank. Add oil as needed.
2. Connect a remote fuel tank containing the 50:1 fuel/oil mixture to the engine.
3. With the engine in a test tank or on the boat in the water, start the engine and note the flow through the transparent hose at the VRO pump.
4. If a reduced flow or no flow is noted in Step 3, shut the engine off. Check the oil pickup filter as described in this chapter.

5A. If filter is not clogged or obstructed, proceed to Step 6.

5B. If filter required cleaning or replacement, repeat Step 3 to see if this service restored full oil flow. If it did not, continue with Step 6.

6. Disconnect the oil hose at the inlet fitting on the lower engine cover. Have an assistant hold the hose in a suitable clean container.
7. Loosen oil hose clamp at pickup unit. Grasp pickup unit firmly to prevent it from moving on its support rods and disconnect the hose. Blow the line out with low-pressure compressed air.
8. Remove the oil pickup mounting screws with a T-25 Torx driver. Remove the pickup unit from the tank and let it drain into a suitable clean container.
9. Insert a suitable plug in the end of the hose attached to the pickup unit. Install a clamp to hold the plug in place.
10. Connect a Stevens gearcase vacuum tester or a hand vacuum pump to the oil hose at the lower engine cover end and install a clamp to secure the connection.
11. Draw approximately 7 in. Hg vacuum. If the system does not hold the vacuum, check the oil hose for damage. If the hose is good, apply oil at each connection while drawing a vacuum to determine the point of leakage. Correct as required.
12. If the system holds vacuum in Step 10, replace the VRO pump assembly.

Excessive Engine Smoke

Check fuel system and filters for restrictions and VRO pump for malfunction or damage. The engine may smoke on a cold start. This is normal for cold starting a 2-cycle engine. It will also smoke if the oil hose primer bulb is squeezed prior to starting the engine. This priming is unnecessary and loads the carburetors with an excessively rich mixture.

Low Oil Warning Sounds at 20 Second Intervals

If the oil level in the tank is satisfactory, the pickup unit disc/contacts are either out of position or dirty. Remove the pickup unit from the tank and clean the float chamber in fresh solvent. If the float does not raise the disc clear of the contacts, replace the pickup unit.

Pickup Unit and Filter Service

Other than filter replacement, the oil pickup unit is serviced as an assembly if it does not function properly.

1. Remove the oil pickup mounting screws with a T-25 Torx driver. Remove the pickup unit from the tank and let it drain into a suitable clean container.
2. Note the position of the foam baffle (if so equipped) for reinstallation and remove from the pickup unit.

3. Pull the plastic filter assembly from the end of the pickup tube with needlenose pliers.
4. Clean filter in fresh solvent and blow dry with low-pressure compressed air, if available. Replace filter if damaged or badly clogged.
5. To reinstall filter, insert it in the plastic cap from a felt-tip marker. Marker cap should be large enough to hold filter but no larger than the outer diameter of the filter head.
6. Use the marker cap to press the filter into the pickup tube.
7. Reinstall the foam baffle (if so equipped) in the position noted in Step 2.
8. Reinstall pickup unit in oil tank and tighten the 4 retaining screws securely.

CAUTION
Failure to properly purge air from the system in Step 9 can result in serious engine damage caused by lack of proper lubrication.

9. Disconnect the oil hose at the inlet fitting on the lower engine cover. Hold the hose in a suitable clean container and squeeze the VRO primer bulb *50* times to purge any air from the line.
10. Reinstall the oil hose to the engine inlet fitting and tighten the clamp securely.

AUTOBLEND (TM) (1986) AND ACCUMIX (TM) (1987-ON) OIL INJECTION

This electro-mechanical oil injection system consists of a fuel pump activated oil metering pump built into a portable 6-gallon fuel tank (**Figure 52**). A similar metering pump design is available for boats with built-in fuel tanks. The 1-1/2 quart oil reservoir provides sufficient oil to blend a precise 100:1 mixture for 5 full tanks of gasoline. AutoBlend (TM) should *not* be used with 1985 or earlier outboards.

A revised version of AutoBlend (TM) called AccuMix (TM) (**Figure 53**) is standard equipment on all 1987 9.9-30 hp engines, and available as an option on 1987 2.5-8 hp engines and 1988-1990 2.5-30 hp engines. A similar metering pump design (AccuMix R [TM]) is available for boats with built-in fuel tanks. On 1987 and 1988 AccuMix (TM) models, fuel and oil is mixed at a 100:1 ratio. On 1989-1990 AccuMix (TM) models, fuel and oil is mixed at a 50:1 ratio and is indicated as so on the AccuMix (TM) tank.

NOTE
As a running change in 1988 and on 1989 models, the float was changed to cork material and is not mounted in a holding bracket.

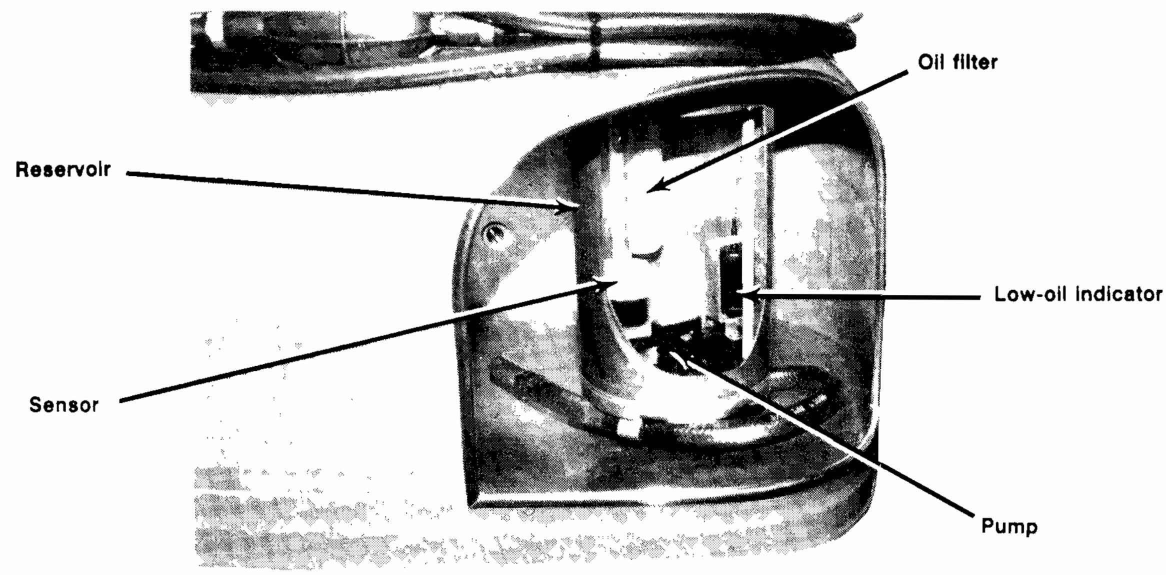
A low-oil warning indicator is triggered whenever the oil in the reservoir reaches the 1/2 quart level. This allows the use of one full tank of gasoline before the reservoir requires refilling. If the oil level should drop to a critical state, the sensor will automatically shut down the motor to prevent damage.

Owner service of the AutoBlend (TM) or AccuMix (TM) injection system is limited to draining and flushing of the fuel tank at each tune-up, or at least once per year. The AutoBlend (TM) and AccuMix (TM) units are serviced by replacement.

Removal/Installation

1. Remove the 8 screws holding the oil reservoir to the fuel tank. Lift the reservoir up and out of the tank. Remove and discard the reservoir gasket.
2. Remove the cover from the reservoir. Discard the cover seal.
3. Wash the oil reservoir components with a mild cleaner and blow dry with low-pressure compressed air.
4. Insert the pickup hose in the clip and position the reservoir on the fuel tank with a new gasket.

52


Oil filter
Reservoir
Low-oil indicator
Sensor
Pump

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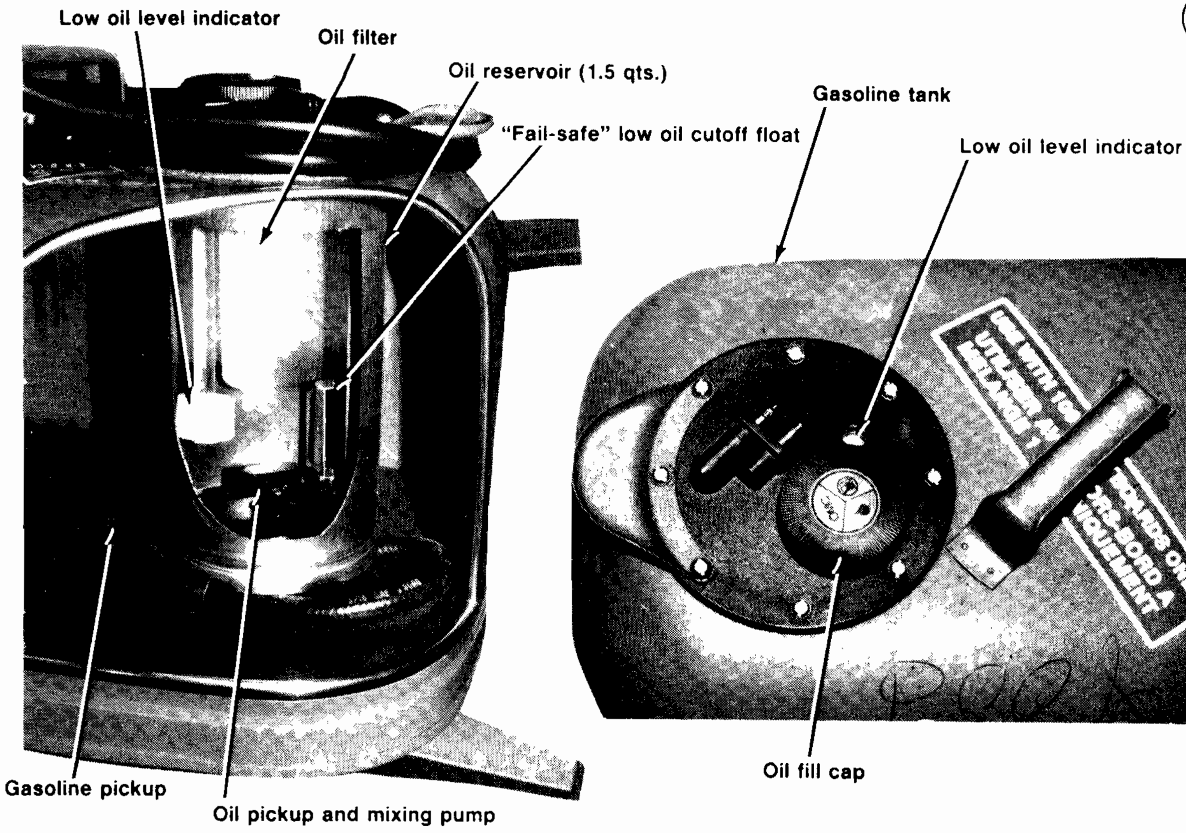

Low oil level indicator
Oil filter
Oil reservoir (1.5 qts.)
"Fail-safe" low oil cutoff float
Gasoline tank
Low oil level indicator
Gasoline pickup
Oil pickup and mixing pump
Oil fill cap

5. Fit a new cover seal in position and wipe the outer diameter of the fuel tube with a light coat of OMC Triple-Guard grease.
6. Fit the cover on the reservoir, making sure the fuel tube enters the cavity in the cover.
7. Insert the reservoir in the tank opening. Install the screws and washers, adding an extra washer under each tank bracket fastener. Tighten screws to 10-12 in.-lb. (1.1-1.3 N•m).

Table 1 CARBURETOR ALTITUDE ORIFICE CHART

1973-1979

Model/Year	Sea level	3,000 to 6,000 ft.	6,000 to 10,000 ft.
4/1973-1977	Adj.	Adj.	Adj.
4/1978			
Std. length	0.031	0.029	0.027
4/1978			
Long shaft	0.029	0.027	0.025
4/1979	0.031	0.029	0.027
6/1973-1975	44	42D	39D
6/1976	52D	49D	45D
6/1977-1979	42D	39D	38D
9.5/1973	49	45D	43D
9.9/1974-1975	51N	49N	46N
9.9/1976	40N	38N	36N
9.9/1977-1978	38N	36N	34N
9.9/1979	40N	38N	36N
15/1974	60N	58N	56N
15/1975-1976	58N	56N	54N
15/1977-1979	54N	52N	50N
25/1973-1976	72	69D	67D
25/1977	55D	54D	52D
25/1978-1979	49D	45D	45D
35/1976-1979	59D	53D	47D
40/1973-1976	670	64D	63D

1980-1982

Model/ Year	Sea level Low Speed	Sea level High Speed	3,000-6,000 ft. Low Speed	3,000-6,000 ft. High Speed	6,000-10,000 ft. Low Speed	6,000-10,000 ft. High Speed
4/All	Adj.	0.031*	Adj.	0.029*	Adj.	0.027*
4.5/All	Adj.	0.033*	Adj.	0.030*	Adj.	0.027*
7.5/All	Adj.	35N	Adj.	32N	Adj.	29N
9.9/All	Adj.	38N	Adj.	36N	Adj.	34N
15/1980	Adj.	54N	Adj.	51N	Adj.	48N
15/1981-1982	Adj.	56N	Adj.	53N	Adj.	50N
20/All	Adj.	49D	Adj.	43D	Adj.	37D
25/1980	Adj.	49D	Adj.	43D	Adj.	37D
25/1981-1982	Adj.	59D	Adj.	53D	Adj.	47D
35/All	Adj.	59D	Adj.	53D	Adj.	47D

* Idle style.

Chapter Seven

Electrical System

This chapter provides service procedures for the battery, starter motor (electric start models) and each ignition system used on Johnson and Evinrude outboard motors during the years covered by this manual. Wiring diagrams are included at the end of the book. **Tables 1-3** are at the end of the chapter.

BATTERY

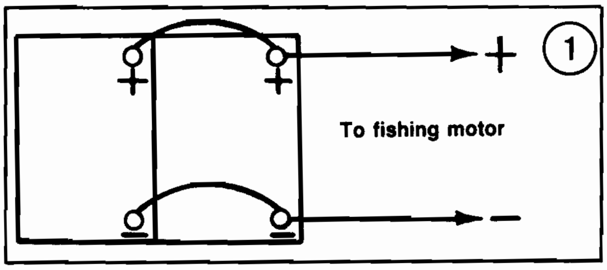
Since batteries used in marine applications endure far more rigorous treatment than those used in an automotive charging system, they are constructed differently. Marine batteries have a thicker exterior case to cushion the plates inside during tight turns and rough weather. Thicker plates are also used, with each one individually fastened within the case to prevent premature failure. Spill-proof caps on the battery cells prevent electrolyte from spilling into the bilges. Automotive batteries are not designed to be run down and recharged repeatedly. For this reason, they should *only* be used in an emergency situation when a suitable marine battery is not available.

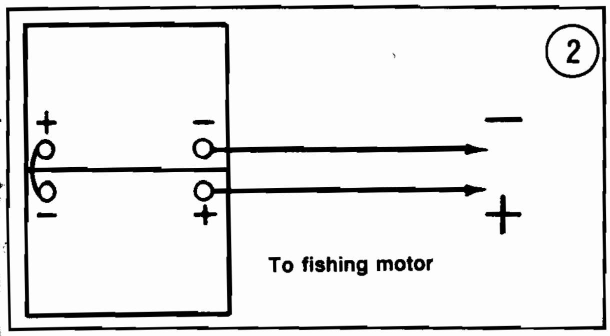
Johnson and Evinrude recommend that any battery used to crank an outboard motor have a cold cranking amperage of 350 amps and a reserve capacity of at least 100 minutes.

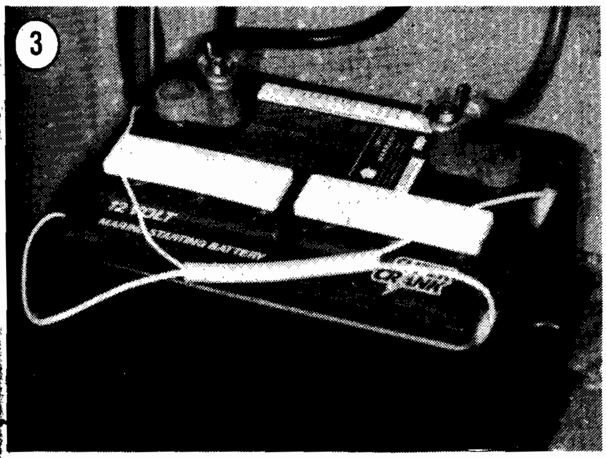
CAUTION

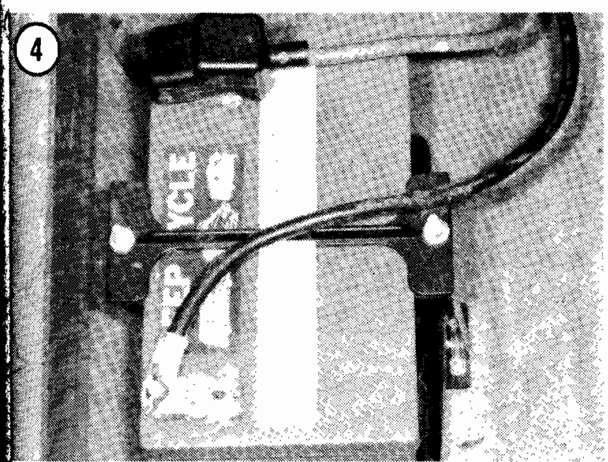
*Sealed or maintenance-free batteries are **not** recommended for use with the unregulated charging systems used on Johnson and Evinrude outboards. Excessive charging during continued high-speed operation will cause the electrolyte to boil, resulting in its loss. Since water cannot be added to such batteries, such overcharging will ruin the battery.*

Separate batteries may be used to provide power for any accessories such as lighting, fish finders, depth finder, etc. To determine the required capacity of such batteries, calculate the average discharge rate of the accessories and refer to **Table 1**. Batteries may be wired in parallel to double the ampere hour









capacity while maintaining a 12-volt system. See **Figure 1**. For accessories which require 24 volts, batteries may be wired in series (**Figure 2**) but only accessories specifically requiring 24 volts should be connected into the system. Whether wired in parallel or in series, charge the batteries individually.

Battery Installation in Aluminum Boats

If a battery is not properly secured and grounded when installed in an aluminum boat, it may contact the hull and short to ground. This will burn out remote control cables, tiller handle cables or wiring harnesses.

Johnson and Evinrude recommend the following preventive steps be taken when installing a battery in a metal boat. 7

1. Choose a location as far as practical from the fuel tank while providing access for maintenance.
2. Install the battery in a plastic battery box with cover and tie-down strap (**Figure 3**).
3. If a covered container is not used, cover the positive battery terminal with a non-conductive shield or boot (**Figure 4**).
4. Make sure the battery is secured inside the battery box and the box is fastened in position with the tie-down strap.

Care and Inspection

1. Remove the battery container cover (**Figure 3**) or hold-down (**Figure 4**).
2. Disconnect the negative battery cable. Disconnect the positive battery cable.

NOTE
*Some batteries have a built-in carry strap (**Figure 5**) for use in Step 3.*

3. Attach a battery carry strap to the terminal posts. Remove the battery from the battery tray or container.
4. Check the entire battery case for cracks.

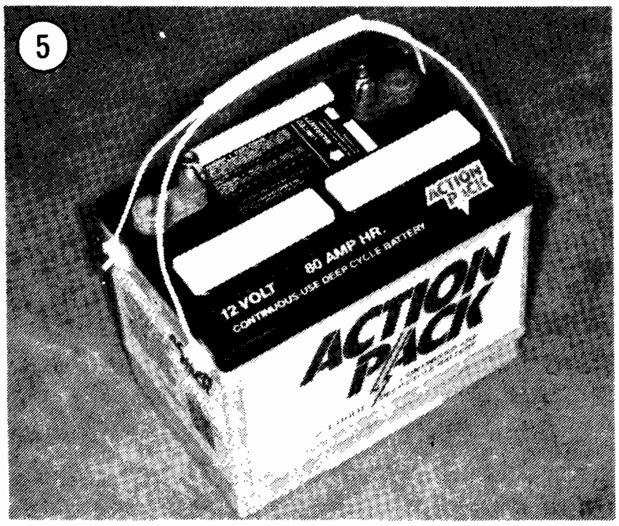
5. Inspect the battery tray or container for corrosion and clean if necessary with a solution of baking soda and water.

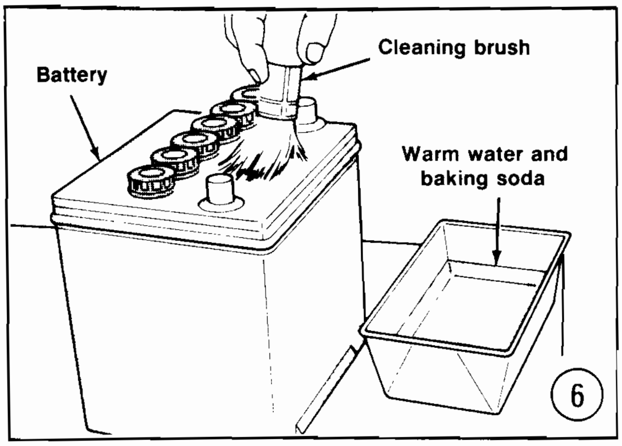
NOTE
Keep cleaning solution out of the battery cells in Step 6 or the electrolyte will be seriously weakened.

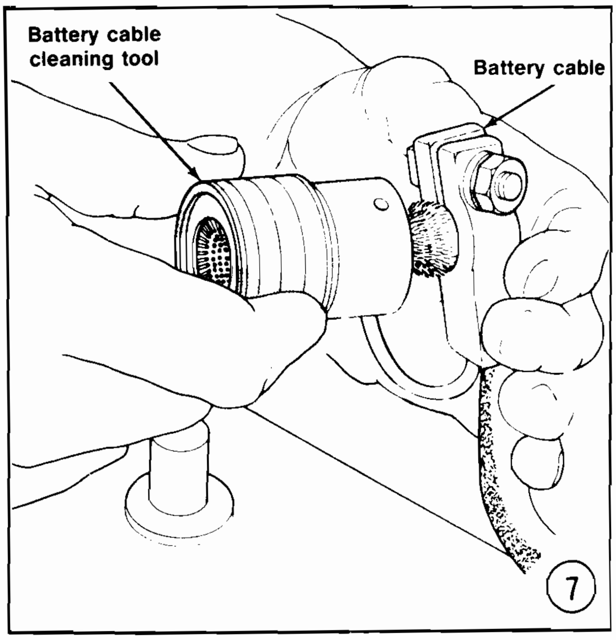
6. Clean the top of the battery with a stiff bristle brush using the baking soda and water solution (**Figure 6**). Rinse the battery case with clear water and wipe dry with a clean cloth or paper towel.
7. Position the battery in the battery tray or container.
8. Clean the battery cable clamps with a stiff wire brush or one of the many tools made for this purpose (**Figure 7**). The same tool is used for cleaning the battery posts. See **Figure 8**.
9. Reconnect the positive battery cable, then the negative cable.

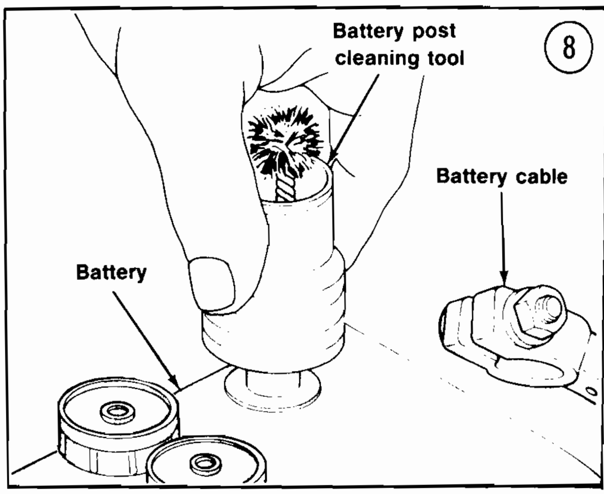
CAUTION
Be sure the battery cables are connected to their proper terminals. Connecting the battery backwards will reverse the polarity and damage the rectifier.

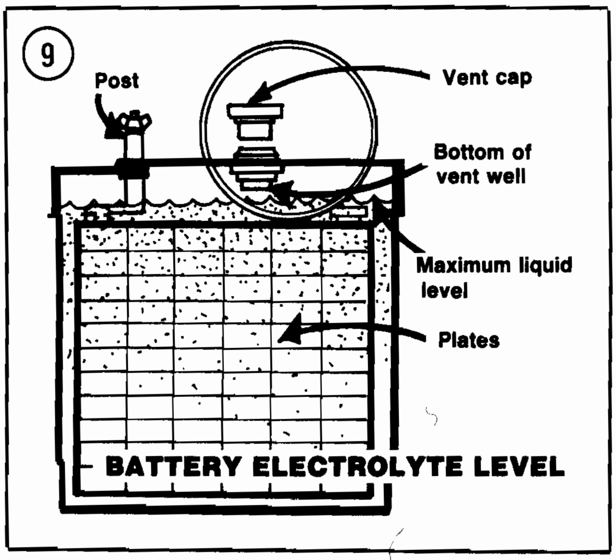
10. Tighten the battery connections and coat with a petroleum jelly such as Vaseline or a light mineral grease.

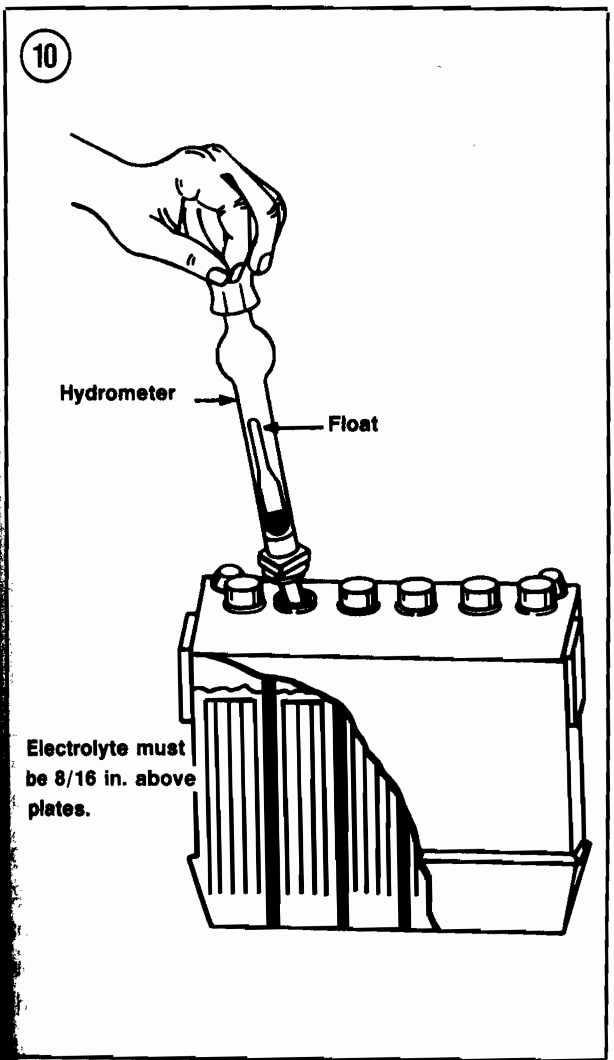












NOTE
Do not overfill the battery cells in Step 11. The electrolyte expands due to heat from charging and will overflow if the level is more than 3/16 in. above the battery plates.

11. Remove the filler caps and check the electrolyte level. Add distilled water, if necessary, to bring the level up to 3/16 in. above the plates in the battery case. See **Figure 9**.

Testing

Hydrometer testing is the best way to check battery condition. Use a hydrometer with numbered graduations from 1.100-1.300 rather than one with just color-coded bands. To use the hydrometer, squeeze the rubber ball, insert the tip in a cell and release the ball (**Figure 10**).

NOTE
Do not attempt to test a battery with a hydrometer immediately after adding water to the cells. Charge the battery for 15-20 minutes at a rate high enough to cause vigorous gassing and allow the water and electrolyte to mix thoroughly.

Draw enough electrolyte to float the weighted float inside the hydrometer. When using a temperature-compensated hydrometer, release the electrolyte and repeat this process several times to make sure the thermometer has adjusted to the electrolyte temperature before taking the reading.

Hold the hydrometer vertically and note the number in line with the surface of the electrolyte (**Figure 11**). This is the specific gravity for the cell. Return the electrolyte to the cell from which it came.

The specific gravity of the electrolyte in each battery cell is an excellent indicator of that cell's condition. A fully charged cell will read 1.260 or more at 68° F (20° C). A cell that is 75 percent charged will read from 1.230-1.250 while one with a 50 percent charge reads from 1.200-1.220. If the cell tests below 1.170, the battery must be recharged and one that reads 1.140 or below is dead. Charging is also necessary if the specific gravity varies more than 0.050 from cell to cell.

NOTE

If a temperature-compensated hydrometer is not used, add 0.004 to the specific gravity reading for every 10° above 80° F (25° C). For every 10° below 80° F (25° C), subtract 0.004.

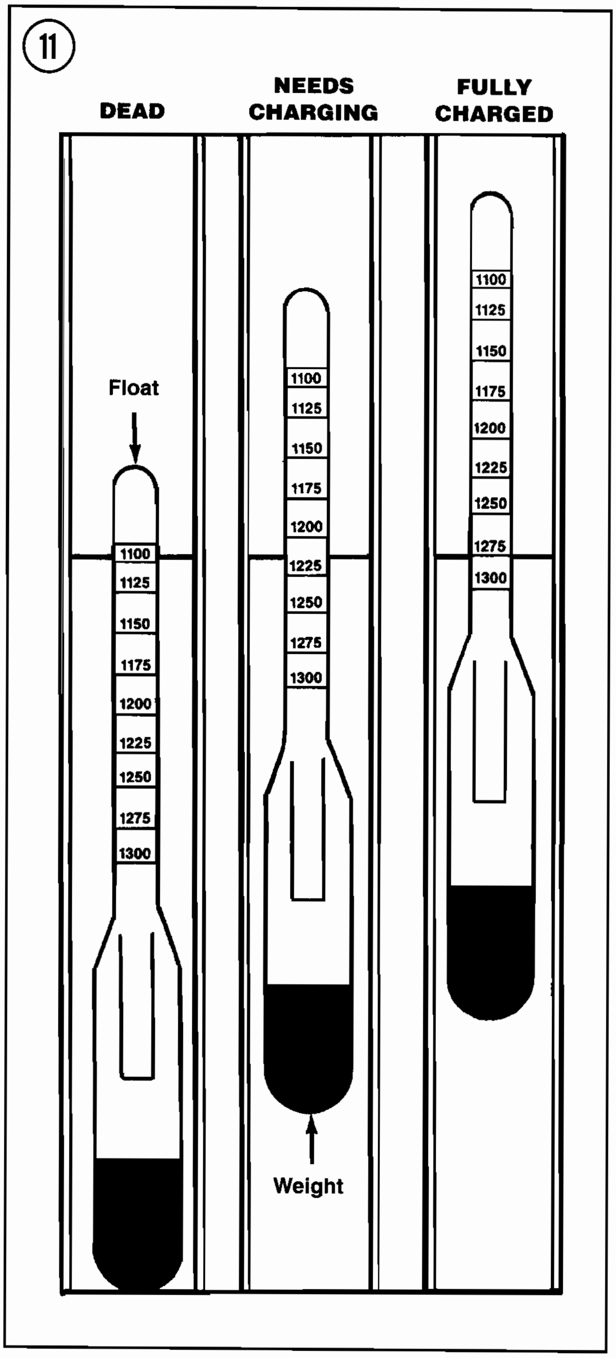
Charging A good state of charge should be maintained in batteries used for starting. Check the battery with a voltmeter as shown in **Figure 12.** Any battery that cannot deliver at least 9.6 volts under a starting load should be recharged. If recharging does not bring it up to strength or if it does not hold the charge, replace the battery.

The battery does not have to be removed from the boat for charging, but it is a recommended safety procedure since a charging battery gives off highly explosive hydrogen gas. In many boats, the area around the battery is not well ventilated and the gas may remain in the area for hours after the charging process has been completed. Sparks or flames occuring near the battery can cause it to explode, spraying battery acid over a wide area.

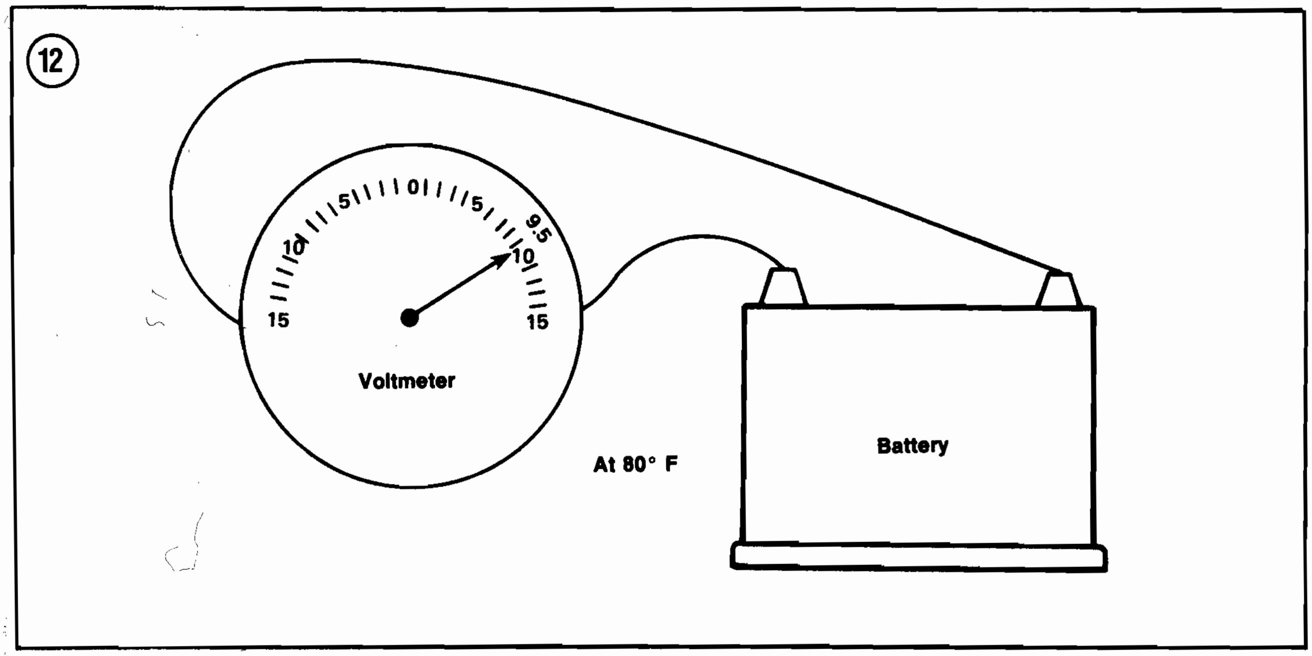
For this reason, it is important you observe the following precautions:

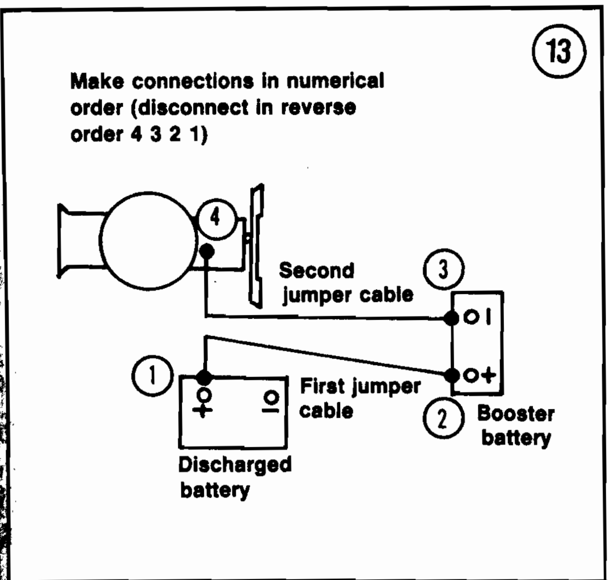
a. Do not smoke around batteries that are charging or have been recently charged.
b. Do not break a live circuit at the battery terminals and cause an electrical arc that can ignite the hydrogen gas.

Disconnect the negative battery cable first, then the positive cable. Make sure the electrolyte is fully topped up.



Connect the charger to battery—negative to negative, positive positive. If the charger output is varial select a 4 amp setting. Set the volti regulator to 12 volts and plug the charger If the battery is severely discharged, allov to charge for at least 8 hours. Batteries t are not as badly discharged require less





charging time. **Table 2** gives approximate charge rates for batteries used primarily for cranking. Check the charging progress with the hydrometer.

Jump Starting

If the battery becomes severely discharged, it is possible to start and run an engine by jump starting it from another battery. If the proper procedure is not followed, however, jump starting can be dangerous. Check the electrolyte level before jump starting any battery. If it is not visible or if it appears to be frozen, do not attempt to jump start the battery.

WARNING

Use extreme caution when connecting a booster battery to one that is discharged to avoid personal injury or damage to the system.

1. Connect the jumper cables in the order and sequence shown in **Figure 13**.

WARNING

An electrical arc may occur when the final connection is made. This could cause an explosion if it occurs near the battery. For this reason, the final connection should be made to a good ground away from the battery and not to the battery itself.

2. Check that all jumper cables are out of the way of moving engine parts.

3. Start the engine. Once it starts, run it at a moderate speed.

CAUTION
Running the engine at wide-open throttle may cause damage to the electrical system.

4. Remove the jumper cables in the exact reverse order shown in **Figure 13**. Remove the cables at point 4, then 3, 2 and 1.

BATTERY CHARGING SYSTEM

A battery charging system is standard on all electric start models.

The battery charging system on Johnson and Evinrude outboards consists of a flywheel with cast-in magnets, 2 stator coils on the armature plate, a rectifier and the battery.

Magneto breaker point, CD2 and CD2UL ignition systems all use a flywheel containing magnets (**Figure 14**). Standard manual start flywheels use 2 magnets for the ignition system. Electric start flywheels use an additional 2 magnets for the charging system. Rotation of the flywheel stator magnets past the armature plate stator coils (**Figure 15**, typical) creates alternating current. This current is sent to the rectifier (A, **Figure 16**, typical) where it is converted into direct current to charge the battery or power accessories.

A malfunction in the battery charging system will result in an undercharged battery. Perform the following visual inspection to determine the cause of the problem. If the visual inspection proves satisfactory, test the stator coils and rectifier. See Chapter Three.

1. Make sure that the battery cables are connected properly. The red cable must be connected to the positive battery terminal. If polarity is reversed, check for a damaged rectifier.
2. Inspect the battery terminals for loose or corroded connections. Tighten or clean as required.

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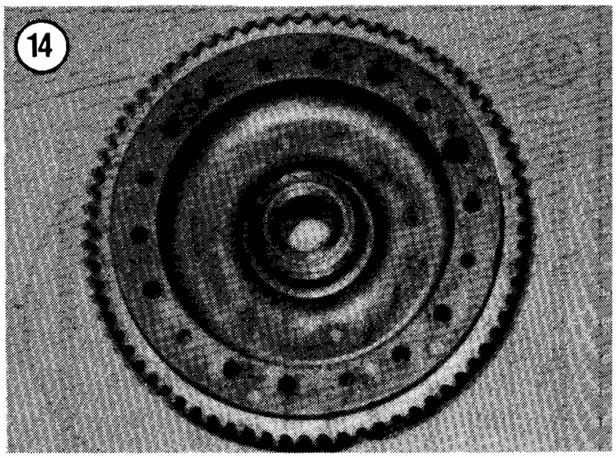

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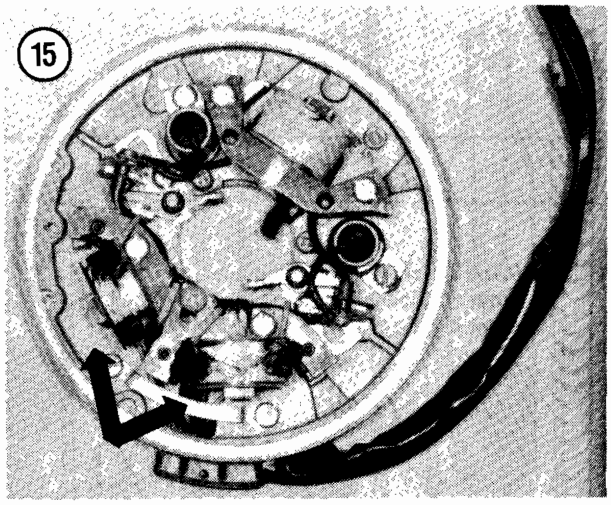
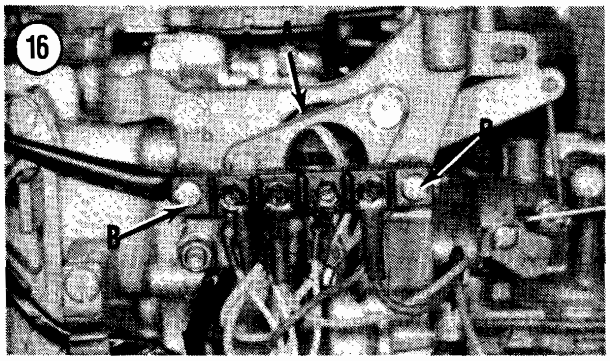


3. Inspect the physical condition of the battery. Look for bulges or cracks in the case, leaking electrolyte or corrosion build-up.
4. Carefully check the wiring between the stator coils and battery for signs of chafing, deterioration or other damage.
5. Check the circuit wiring for corroded, loose or open connections. Clean, tighten or connect as required.
6. Determine if the electrical load on the battery from accessories is greater than the battery capacity.

Stator Coil Replacement

See *Armature Plate Disassembly/Assembl[y]* in this chapter.



Rectifier Removal/Installation

1. Disconnect the red, yellow, yellow/grey and yellow/blue rectifier leads at the terminal board. See **Figure 16**.
2. Remove the 2 terminal board mounting screws (B, **Figure 16**) and move terminal board out of the way.
3. Remove the 2 rectifier mounting screws. Remove the rectifier.
4. Installation is the reverse of removal. Coat terminal board mounting screw threads with OMC Screw Lock. Coat rectifier lead connections with OMC Black Neoprene Dip.

ELECTRIC STARTING SYSTEM

Johnson and Evinrude outboards covered in this manual may use a rope-operated mechanical (rewind) starting system or an electric (starter motor) starting system. The electric starting system consists of the battery, starter solenoid, starter motor, neutral start switch, ignition switch and connecting wiring.

NOTE
The 9.5, 9.9 and 15 hp models have no separate starter solenoid. A heavy-duty start switch serves the solenoid function.

The starting system operation and troubleshooting is described in Chapter Three.

Marine starter motors are very similar in design and operation to those found on automotive engines. All Johnson and Evinrude starters use an inertia-type drive in which external spiral splines on the armature shaft mate with internal splines on the drive assembly.

The starter motor produces a very high torque but only for a brief period of time, due to heat buildup. Never operate the starter motor continuously for more than 30 seconds. Let the motor cool for at least 2 minutes before operating it again. If the starter motor does not turn over, check the battery and all connecting wiring for loose or corroded connections. If this does not solve the problem, refer to Chapter Three. Except for brush replacement, service to the starter motor by the amateur mechanic is limited to replacement with a new or rebuilt unit.

Starter Motor Removal/Installation (9.9 and 15 hp)

1. Disconnect the negative battery cable.
2. Remove the engine cover.
3. Remove the 2 screws holding the starter to the by-pass cover. Remove the starter.
4. Disconnect the starter lead at the bottom of the starter.
5. Installation is the reverse of removal. Tighten screws to 10-12 ft.-lb.

Starter Motor Removal/Installation (18-25 [1973-1976] and 40 hp)

1. Disconnect the negative battery cable.
2. Remove the engine cover.
3. Disconnect the starter cable.
4. 40 hp—Remove the flywheel guard if so equipped.
5. On early models, remove the 4 cap screws holding the starter and mounting brackets to the motor. On later models, remove the 3 cap screws holding the starter to the motor.

6. On early models, remove the starter and brackets from the bracket studs. On later models, remove the starter.
7. On early models, remove the 2 starter motor through bolts. Separate the starter motor from the bracket.
8. Installation is the reverse of removal. Wipe the through bolt threads with engine oil. Tighten fasteners to specifications (**Table 3**). Coat the starter cable connection with OMC Black Neoprene Dip.

Starter Motor Removal/Installation (20-25 [1977-on], 30 and 35 hp)

1. Disconnect the negative battery cable.
2. Remove the engine cover.
3. Disconnect all leads at the solenoid (**Figure 17**).
4. Remove the vertical throttle shaft clamp screws. Remove the clamp. See **Figure 18**.
5. Remove the air silencer assembly.
6. Remove the starter bracket front fastener (**Figure 19**).
7. Remove the upper and lower capscrews holding the starter bracket to the power head. Note that the lower capscrew is installed from the rear of the power head and has the starter ground lead attached.
8. Remove the starter motor with mounting bracket and solenoid attached.
9. Loosen the 2 solenoid clamp screws on the underside of the starter mounting bracket. Remove the solenoid.
10. Secure the mounting bracket in a vise with protective jaws.
11. Note alignment marks on starter case and bracket for reassembly reference. Remove the starter through-bolts. Separate the starter motor from its bracket.
12. Installation is the reverse of removal. Align starter and bracket marks. Wipe the through-bolt threads with engine oil. Install and tighten through-bolts to 60-84 in.-lb. Apply OMC Black Neoprene Dip to all electrical connections. Tighten bracket fasteners to specifications (**Table 3**).

Brush Replacement (9.5, 9.9 and 15 hp)

Always replace brushes in complete sets. Refer to **Figure 20** (typical) for this procedure.

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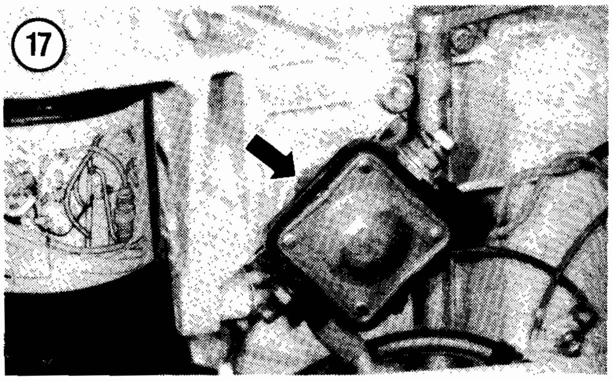

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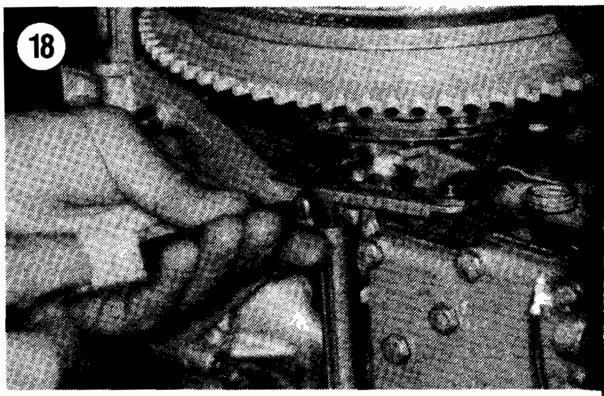

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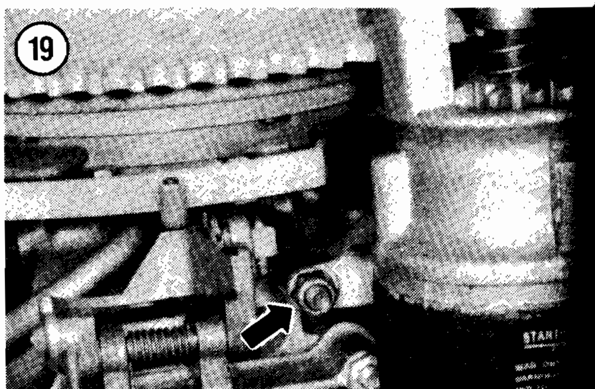
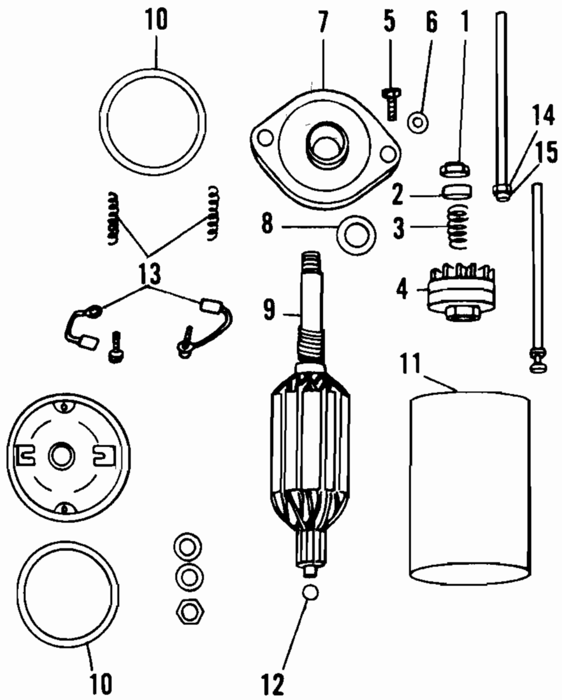


1. Remove the starter as described in this chapter.
2. Remove the 2 through-bolts and brush end cap from the starter.
3. Inspect the brushes. Replace them both if either are oil-soaked, pitted or worn to 3/8 in. or less.

(20)

STARTER (9.9-15 HP)



1. Pinion nut
2. Spacer
3. Pinion spring
4. Drive assembly
5. Bypass cover screw
6. Washer
7. Drive end cap
8. Armature shaft washer
9. Armature
10. O-ring
11. Starter frame
12. Thrust disc
13. Brush and spring assembly
14. Washer
15. Through bolt

4. Remove screw holding each old brush. Remove brush from end cap holder.
5. Insert new brush in end cap holder and attach terminal to cap with screw.
6. Align brush end cap and frame marks. Keep brushes recessed in the brush holder and install end cap to starter frame.
7. Wipe the through-bolt threads with engine oil. Install and tighten through-bolts to 30-40 in.-lb. Apply OMC Black Neoprene Dip around the end cap and frame joint.

Brush Replacement
(18-40 hp)

Always replace brushes in complete sets. Refer to **Figure 21** for this procedure.

1. Remove the starter and separate it from the mounting bracket as described in this chapter.
2. Carefully tap the commutator end cap from the starter frame.
3. Inspect the brushes in the brush holder on the commutator end of the armature. Replace all brushes if any are pitted, oil-soaked or worn to 3/8 in. or less.
4. Remove brushes and springs from brush holder. Remove brush holder from commutator end.
5. Check brush holder straightness. If brushes do not show full-face contact with commutator, holder is probably bent.
6. Install the insulated brush and terminal set in the commutator end cap as shown in **Figure 22.**
7. Install the brush holder in the commutator end cap. Install the brush springs in the holder. Insert the brushes and tighten the brush lead screws to the holder.
8. Fit the insulated brushes in the holder slots. **Figure 23** shows the reassembled brush holder and commutator end cap assembly.
9. Align the commutator end cap and starter frame marks. Hold the brushes in place and assemble the end cap to the frame. A putty

knife with a 1×1/2 in. slot cut in its end makes a suitable tool for keeping the brushes in place during this step.

10. Secure the starter mounting bracket in a vise with protective jaws. Align starter and bracket marks.

11. Wipe the through-bolt threads with engine oil. Install and tighten through-bolts to 60-84 in.-lb. Apply OMC Black Neoprene Dip around the end cap and frame joint.

MAGNETO BREAKER POINT IGNITION SERVICE

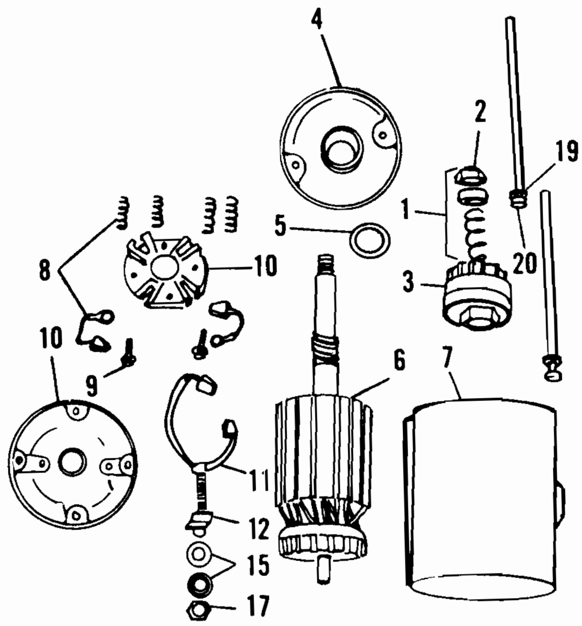
NOTE
See Chapter Three for troubleshooting and test procedures.

The 2 hp, Colt and Junior models use a magneto ignition with a combined primary/secondary ignition coil, a condenser and one set of breaker points mounted on an armature plate. The 1973 40 hp, 3 hp, 4 hp standard and 6 hp models are similar, with 2 combined ignition coils, 2 condensers and 2 sets of breaker points. The primary section of the coil connects to the stationary breaker point and is grounded to the armature plate. The secondary section of the coil connects to the spark plug and is also grounded to the armature plate.

All other models use a magneto ignition with 1 driver coil, 2 condensers and 2 sets of breaker points mounted on an armature plate. Electric start models also have 2 stator coils for the charging system. A combined primary/secondary ignition coil for each cylinder is mounted on the power head. The primary section of each ignition coil connects to the stationary breaker point set for its cylinder and is grounded to the armature plate. The secondary section of each ignition coil connects to the spark plug it fires and is also grounded to the armature plate.

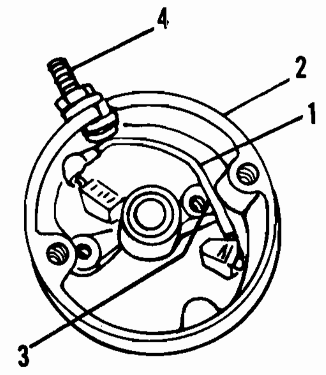
Figure 24 shows the location of the driver coil (A), breaker point sets (B), condensers (C) and stator coils (D) on the armature plate. The ignition coil on 2 hp, Colt and Junior models is identical in appearance and

21 BOSCH STARTER COMPONENTS



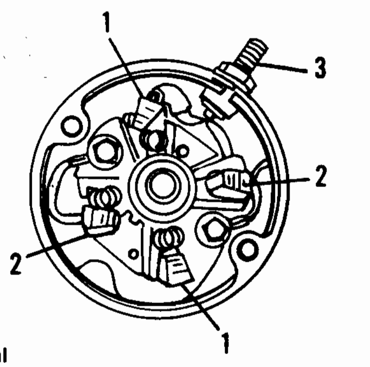
1. Pinion nut and spring assembly
2. Pinion nut
3. Pinion gear
4. End cap
5. Armature shaft washer
6. Armature
7. Starter frame
8. Negative brush and spring assembly
9. Screw
10. End cap and brush holder assembly
11. Positive brush assembly
12. Insulation bushing
15. Washer
17. Input stud nut
19. Washer
20. Center bolt

(22)



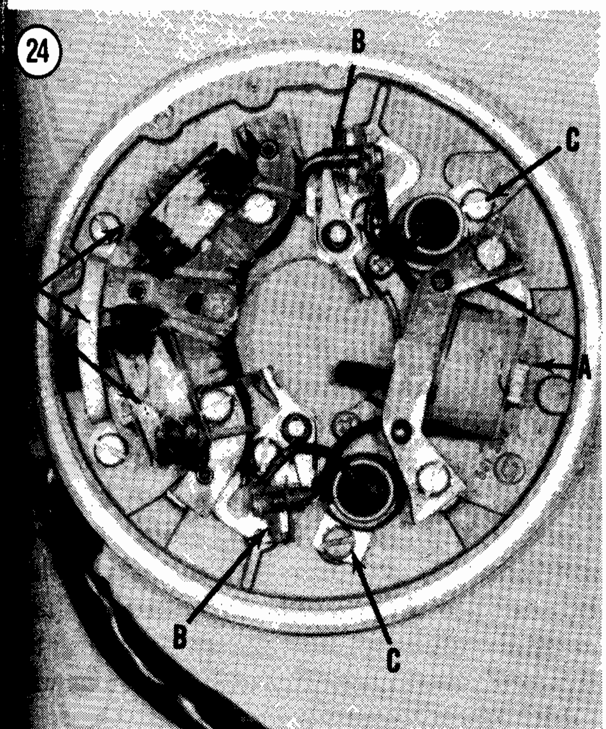
1. Long lead
2. Commutator end cap
3. Slot
4. Insulated terminal

(23)



1. Insulated brush
2. Ground brush
3. Insulated terminal

(24)



location to the driver coil shown in **Figure 24**. Two armature plate mounted ignition coils are used on 1973 40 hp, 3 hp, 4 hp standard and 6 hp models. The ignition coils on models with coil mounted on each cylinder are shown in **Figure 25**.

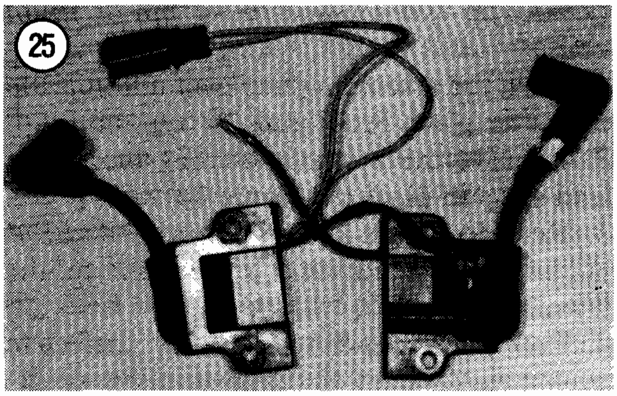
Operation

As the flywheel rotates, magnets around its inner diameter create current through the closed breaker points and back to the driver coil. When the cam opens the No. 1 point set, voltage rises quickly across the No. 1 ignition coil primary and the condenser absorbs excess current. The No. 1 ignition coil steps up the voltage to the secondary side and fires the No. 1 spark plug. The breaker points close and the flywheel continues to rotate, duplicating the sequence for the No. 2 point set and ignition coil to fire the No. 2 spark plug.

Armature Plate Removal/Installation

1. Remove the rewind starter, if so equipped. See Chapter Ten.
2. Remove the flywheel. See Chapter Eight.
3. On 2 hp, Colt and Junior models:
   a. Disconnect the high tension lead at the spark plug.

(25)



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b. Disconnect the armature plate ground lead and plate screw located under the armature plate base.
c. Remove the plate from the power head.

4. On all other models:
   a. Disconnect the spark plug leads.
   b. Disconnect the armature plate lead connectors.
   c. Remove the ignition coils from the power head.
   d. Disconnect the stop switch connector.
   e. On 18-40 hp models, disconnect armature link at throttle shaft arm.
   f. On electric start models, disconnect the yellow, yellow/gray, yellow/blue and armature plate ground lead at the terminal board.
   g. Remove the armature plate retaining screws. Remove armature plate and cable assembly from the power head. It is not necessary to remove the retainer and support plates from models so equipped.

5. Installation is the reverse of removal. Coat all electrical connections with OMC Black Neoprene Dip.

Armature Plate Disassembly/Assembly (Manual Start)

This procedure is used to replace the ignition coil (2 hp, Colt, Junior, 3 hp, 4 hp standard, 6 hp and 1973 40 hp), driver coil (9.9-35 hp and 1974-1976 40 hp) or stator coils.

1. Turn the armature plate over and remove the cover plate. See **Figure 26** (typical).
2. Remove the 2 screws holding the wiring lead strap in place (E, **Figure 24**).
3. Refer to **Figure 24** and remove the screws holding the defective component(s) to the armature plate.
4. Pull the lead(s) of the defective component(s) from the insulation sleeve.

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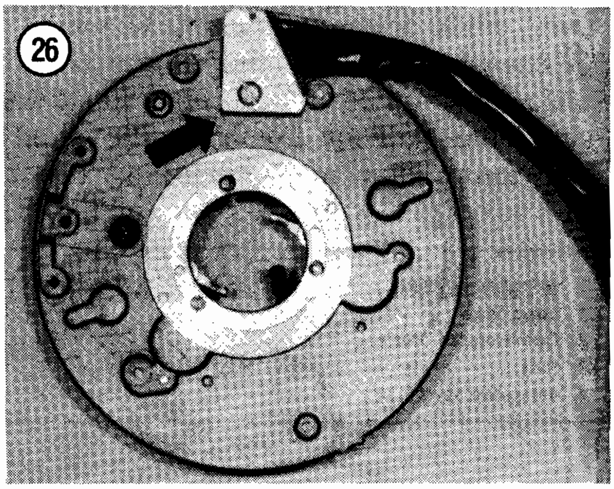

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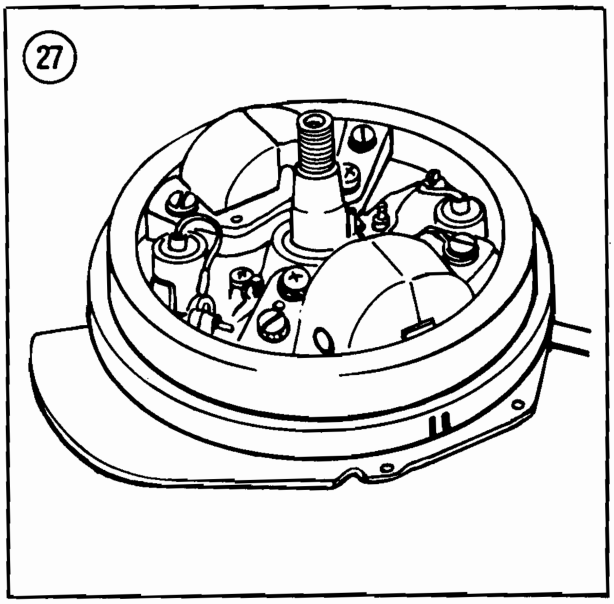
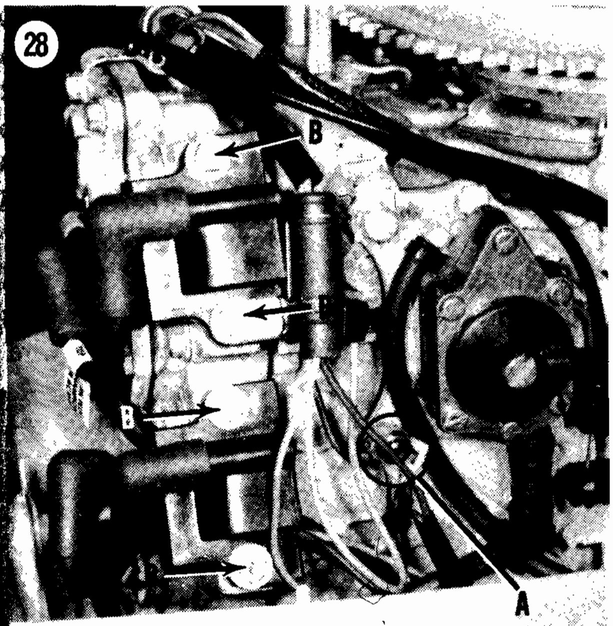
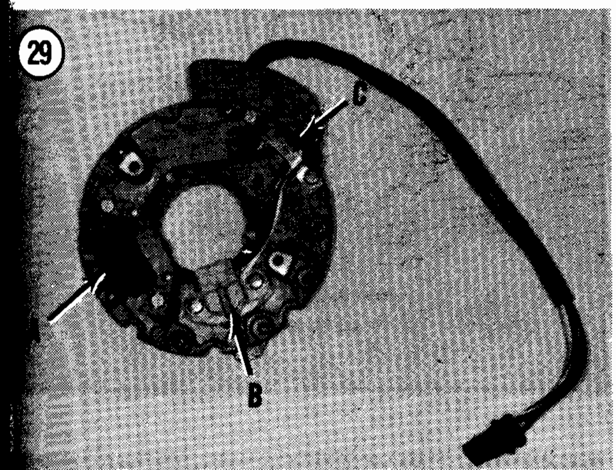


5. Remove the defective component(s) and lead(s) from the armature plate.
6. Assembly is the reverse of disassembly. If the driver coil is removed, replace the oiler wick underneath it and make sure the coil is properly aligned when reinstalled. Johnson and Evinrude recommend the use of a coil locating ring (part No. 317001) which is machined to fit over the armature plate bosses. See **Figure 27**. Position all leads carefully so they will not rub against the flywheel. Coat all electrical connections with OMC Black Neoprene Dip.





rmature Plate isassembly/Assembly lectric Start)

. Turn the armature plate over and remove he cover plate. See **Figure 26** (typical).
. Remove the wiring lead clamp on the top f the armature plate.
. Remove the stator retaining screws. emove the stator from the armature plate.
. Assembly is the reverse of disassembly.

Secondary Ignition Coil Replacement (Cylinder Mounted Coils)

1. Remove the engine cover.
2. Disconnect the spark plug lead of the coil to be replaced.
3. Disconnect the blue (No. 1 coil) or blue/white (No. 2 coil) primary lead from the armature plate connector.
4. Disconnect the coil ground lead (A, **Figure 28**).
5. Remove the attaching bolts and washers (B, **Figure 28**). Remove the coil from the power head.
6. Installation is the reverse of removal.

Secondary Ignition Coil Replacement (Armature Plate Mounted Coils)

The secondary coil is combined with the primary coil on these models. To replace the coil, refer to *Armature Plate Disassembly/ Assembly* in this chapter.

CD 2 IGNITION SYSTEM

NOTE
See Chapter Three for troubleshooting and test procedures.

The major components of the CD 2 ignition system on all models include the flywheel, charge coil, sensor coil, power pack, ignition coils, spark plugs and connecting wiring. The charge coil is located under the flywheel on the armature plate (A, **Figure 29**). The flywheel is fitted with permanent magnets inside its outer rim. As the crankshaft and flywheel rotate, the flywheel magnets pass the stationary charge coil. This creates an alternating current that is sent to the power pack where it is stored in a capacitor for release.

A sensor coil is also mounted under the flywheel on the armature plate (B, **Figure 29**). As the flywheel magnets pass the stationary sensor coil, an alternating current is created and sent to the No. 1 SCR (switch) in the power pack. The power pack contains the electronic circuitry required to produce ignition at the proper time. The No. 1 SCR discharges the capacitor into the No. 1 ignition coil at the proper time. While this is happening, the capacitor is recharging in preparation for discharge through the No. 2 SCR.

Armature Plate Removal/Installation

1. Remove the rewind starter, if so equipped. See Chapter Ten.
2. Remove the flywheel. See Chapter Eight.
3. Disconnect the armature plate lead connectors.
4. Remove the 5 armature plate retaining screws (**Figure 30**). Remove armature plate assembly from the power head.
5. Installation is the reverse of removal. Install OMC Nut Lock on threads of armature plate retaining screws. Tighten fasteners to specification (**Table 3**).

Charge Coil, Sensor Coil or Stator Coil Replacement

The charge and sensor coils can be replaced individually on manual start models and 1984-on electric start models. On all earlier electric start models, the charge, sensor, and stator coils are enclosed in a potted ring and are replaced as an assembly.

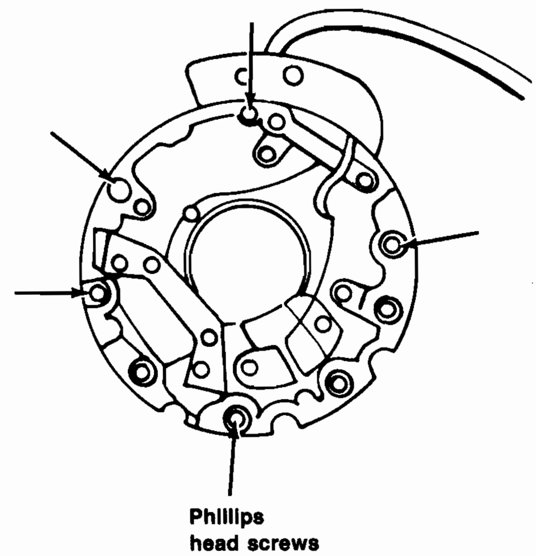
1. Turn the armature plate over and remove the cover plate. See **Figure 31** (typical).
2. Remove the 2 screws holding the wiring lead strap in place (C, **Figure 29**).
3. Refer to **Figure 29** (manual start models and 1984-on electric start models) and remove the screws holding the defective component(s) to the armature plate. On all earlier electric start models, remove the 3 screws to remove the potted ring.

4A. Charge coil—Remove the A and D wire terminals from the 4-wire connector. See *Connector Terminal Removal/Installation* in this chapter.

4B. Sensor coil—Remove the B and C wire terminals from the 4-wire connector. See *Connector Terminal Removal/Installation* in this chapter.

4C. 1973-1983 electric start models—Remove all 4 wire terminals from the 4-wire

(30) **ARMATURE PLATE REMOVAL**



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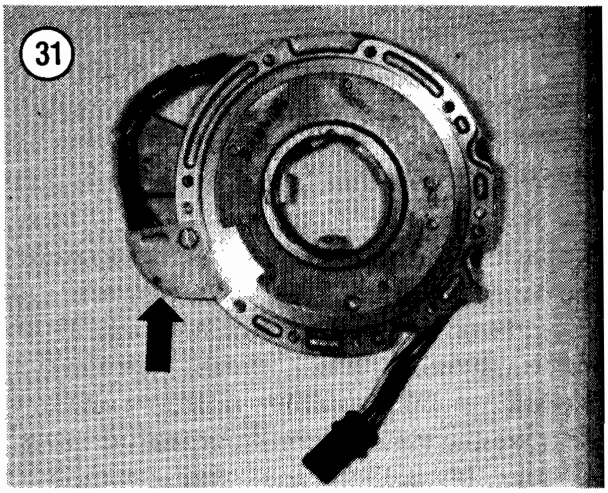

connector. See *Connector Terminal Removal/Installation* in this chapter.

5. Pull the lead(s) of the defective component(s) from the insulation sleeve.
6. Remove the defective component(s) and lead(s) from the armature plate.
7. Assembly is the reverse of disassembly. Each coil must be properly aligned when reinstalled to prevent contact with the flywheel magnets and to produce maximum output. Johnson and Evinrude recommend the use of a coil locating ring (part No. 317001) which is machined to fit over the armature plate bosses. See **Figure 27**. Position all leads carefully so they will not rub against the flywheel. Coat all electrical connections (except connector plugs) with OMC Black Neoprene Dip.

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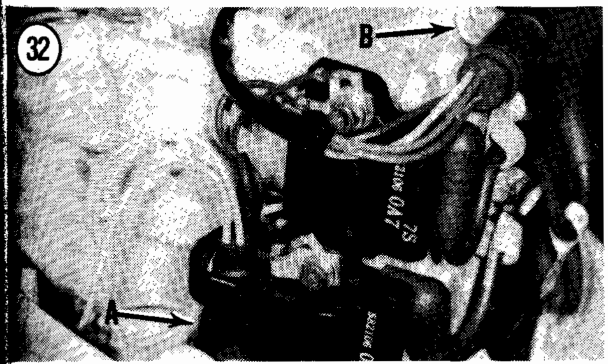

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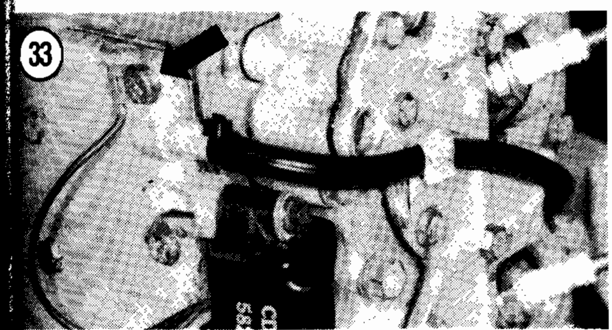

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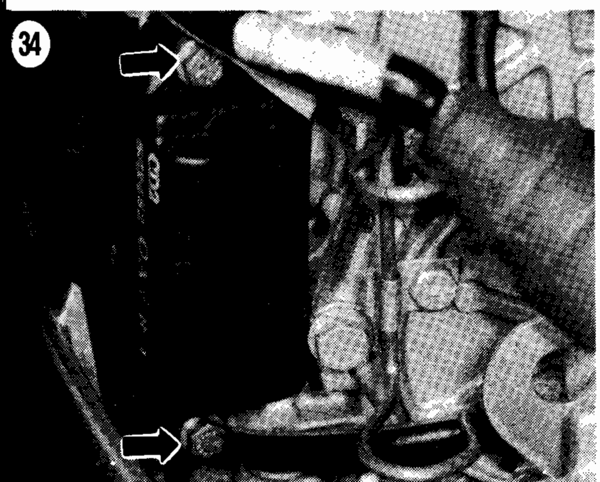

Power Pack Replacement

The power pack electrical circuits are encased in a potting material and can be serviced only by replacement.

1. Disconnect the negative battery cable.
2. Remove the engine cowling.
3. Separate the 3-wire and 4-wire connectors between the power pack and the ignition coils/armature plate. See **Figure 32** (typical).

NOTE
On some engines, the ground lead is attached to one of the power pack mounting screws and is removed in Step 5.

4. Remove the screw holding the power pack ground lead (**Figure 33**).
5. Remove the power pack mounting bolts. See **Figure 34** (typical). Remove the power pack.
6. Installation is the reverse of removal. Position the lockwasher on the engine side of the ground wire connector to assure a good ground. Make sure there is sufficient slack in the ground wire; if too tight, it can cause an ignition failure. Tighten the mounting bolts to 48-60 in.-lb.

Secondary Ignition Coil Replacement

See *Secondary Ignition Coil Replacement (Cylinder Mounted Coils)* in this chapter.

7

Connector Terminal Removal/Installation

Water-proof plug-in connectors are used in the CD 2 ignition system (**Figure 32**). If the connector halves are secured by a retaining clamp, it must be removed before they can be separated.

Whenever a component is replaced in the CD 2 system, the wires and their plug terminals must be removed from the connector. A set of 3 special tools is available for quick and easy terminal removal/installation: insert tool part No. 32697, pin remover tool part No. 322698 and socket remover tool part No. 322699. Each tool has the appropriate tip for its intended use.

Connector terminals should be removed and installed according to this procedure. Use of tools or lubricant other than specified can result in high resistance connections, short circuits between terminals or connector material damage.

1. Lubricate the terminal pin or socket to be removed with rubbing alcohol at both ends of the connector cavity.
2. Hold the connector against the edge of a flat surface, allowing sufficient clearance for terminal/socket removal.
3. Insert the proper removal tool in the connector end of the plug and carefully push the terminal or socket from the plug. See **Figure 35**.
4. If the pin or socket requires replacement, install a new one on the end of the wire. Make sure the insulation is stripped back far enough to allow the new pin or socket to make complete contact with the wire.
5. Crimp the new terminal onto the wire with crimping pliers (part No. 322696) or equivalent. If crimping pliers are not available, solder the wire in the pin or socket.
6. Lubricate the connector cavity with rubbing alcohol.
7. Place the insert tool against the pin or socket shoulder. Carefully guide the pin or socket into the rear of the connector plug cavity and press it in place until the insert tool shoulder rests against the connector plug. Withdraw the insert tool.
8. Reconnect connector plug halves and install the retaining clamp, if used.

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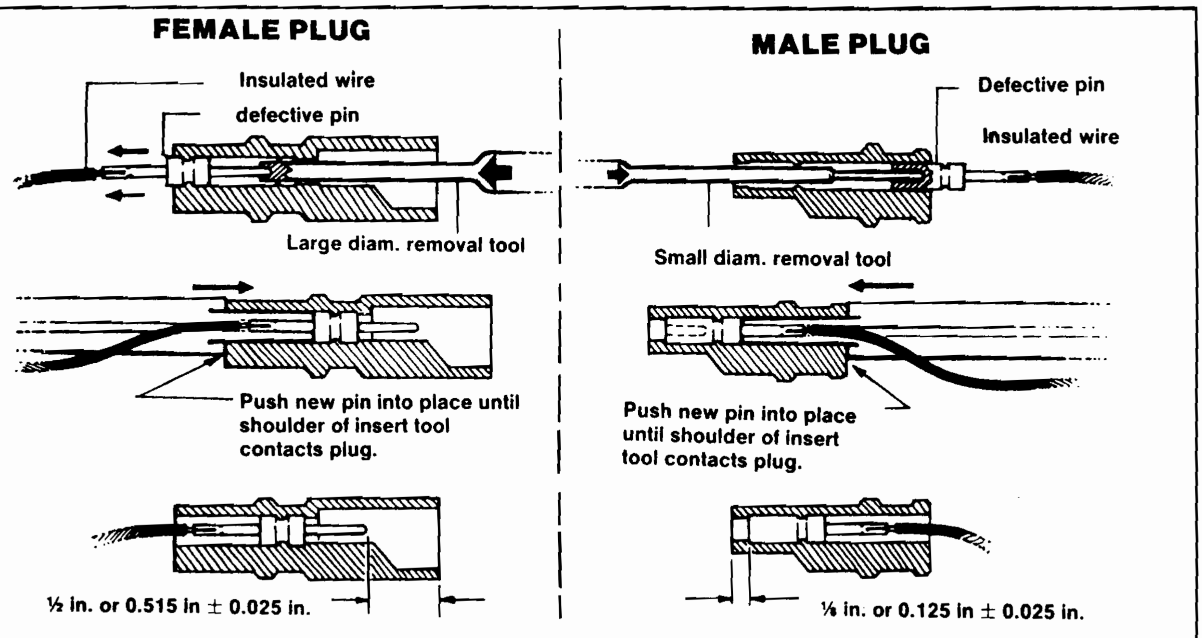

CD2UL IGNITION SYSTEM

NOTE
See Chapter Three for troubleshooting and test procedures.

The CD2UL ignition system is completely contained under the flywheel with the exception of the ignition coils. The breakdown of the CD2UL model number is as follows: CD-capacitor discharge; 2-two cylinders; U-under the flywheel; L-contains rpm rev. limiter. Some model numbers may also contain a "S" inserted between the "U" and the "L." The "S" means the system contains the S.L.O.W. (speed limiting overheat warning) mode. S.L.O.W. is available on 1989 and 1990 20-40 hp models. Ignition system model number is printed on top of ignition module located beneath engine flywheel. The ignition module incorporates the power pack and the sensor coil into one assembly instead of two assemblies as on CD 2 ignition systems. See A, **Figure 36**.

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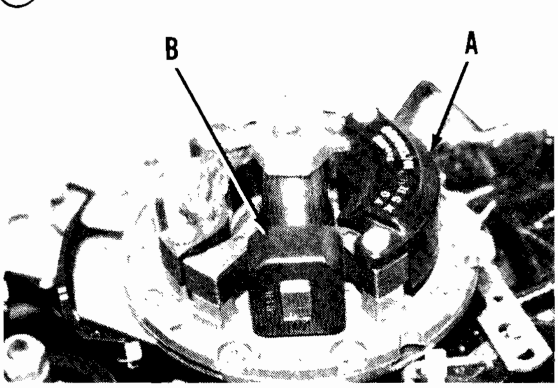

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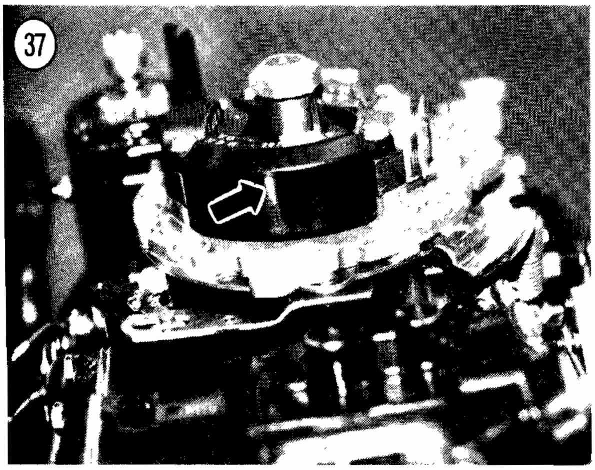


The major components of the CD2UL ignition system on all models include the flywheel, charge coil, ignition module, ignition coils, spark plugs and connecting wiring. The charge coil is located under the flywheel on the armature plate (B, **Figure 36**). The flywheel is fitted with permanent magnets inside its outer rim. As the crankshaft and flywheel rotate, the flywheel magnets pass the stationary charge coil. This creates an alternating current that is sent to the ignition module where it is stored in a capacitor for release. As the flywheel magnets pass the sensor coil (**Figure 37**) located in the ignition module, an alternating current is created and sent to the No. 1 SCR (switch) in the ignition module. The No. 1 SCR discharges the capacitor into the No. 1 ignition coil at the proper time. While this is happening, the capacitor is recharging in preparation for discharge through the No. 2 SCR.

Armature Plate Removal/Installation

1. Remove the rewind starter, if so equipped. See Chapter Ten.
2. Remove the flywheel. See Chapter Eight.
3. Disconnect the armature plate lead connectors.
4. Remove the 5 armature plate retaining screws. Remove armature plate assembly from the power head.
5. Installation is the reverse of removal. Apply OMC Nut Lock on threads of armature plate retaining screws. Tighten fasteners to specification (**Table 3**).

Charge Coil, Ignition Module or Stator Coil Replacement.

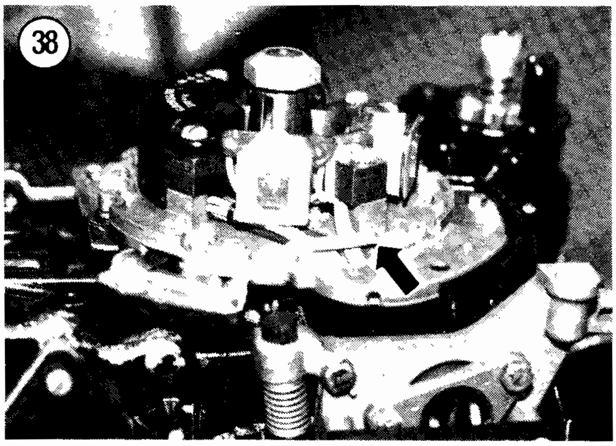
1. Remove the armature plate as previously outlined in this chapter.
2. Turn the armature plate over and remove the cover plate. See **Figure 31** (typical).
3. Remove the 2 screws holding the wiring lead strap in place (**Figure 38**).
4. Refer to **Figure 39** and remove the respective retaining screws to replace a defective ignition module (A), charge coil (B) or stator coil (C).
5. Pull the lead(s) of the defective component(s) from the insulation sleeve. See *Connector Terminal Removal/Installation* in this chapter.
6. Remove the defective component(s) and lead(s) from the armature plate.
7. Assembly is the reverse of disassembly. Each coil must be properly aligned when reinstalled to prevent contact with the flywheel magnets and to produce maximum output. Johnson and Evinrude recommend the use of a coil locating ring (part No. 334994) which is machined to fit over the armature plate bosses. See D, **Figure 39**. Position all leads carefully so they will not rub against the flywheel. Apply OMC Ultra Lock on threads of component retaining screws and install. Hold the component(s) against the locating ring and tighten the retaining screws to specification (**Table 3**).

Secondary Ignition Coil Replacement

See *Secondary Ignition Coil Replacement (Cylinder Mounted Coils)* in this chapter.

Connector Terminal Removal/Installation

See *Connector Terminal Removal/Installation* under CD 2 ignition systems in this chapter.



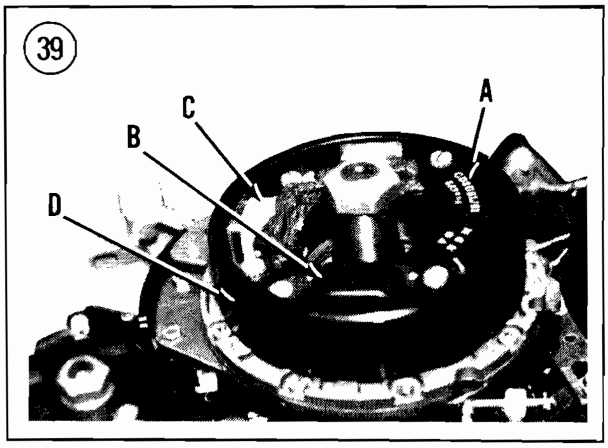


Table 1 BATTERY CAPACITY (HOURS)

Accessory draw	80 Amp-hour battery provides continuous power for	Approximate recharge time
5 amps	13.5 hours	16 hours
15 amps	3.5 hours	13 hours
25 amps	1.8 hours	12 hours
Accessory draw	**105 Amp-hour battery provides continuous power for**	**Approximate recharge time**
5 amps	15.8 hours	16 hours
15 amps	4.2 hours	13 hours
25 amps	2.4 hours	12 hours

Table 2 APPROXIMATE CHARGE RATE

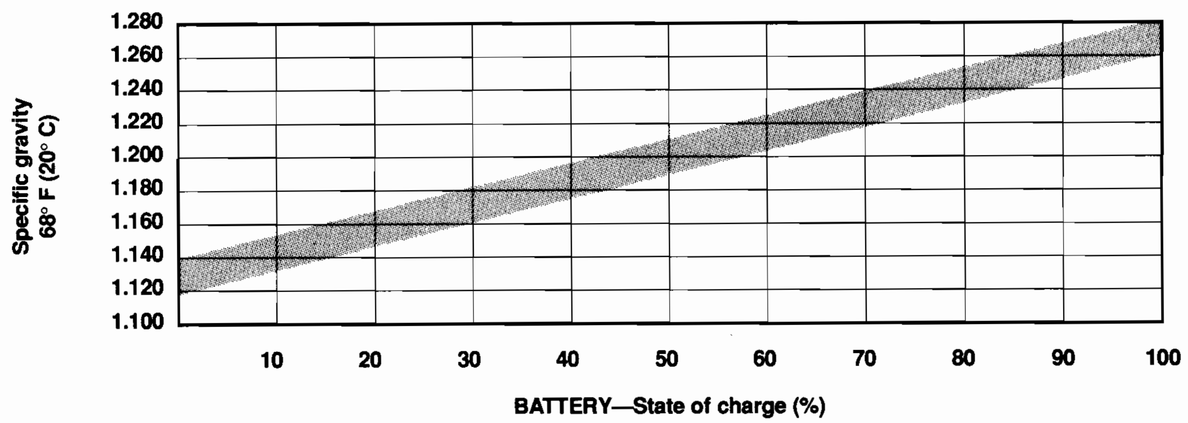


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Table 3 TIGHTENING TORQUES

Fastener	in.-lb.	ft.-lb.
Armature plate	25-35[1]	
Charge coil screws	30-40[2]	
Ignition coil screws	60-84	
Ignition module screws	30-40[2]	
Power pack screws	60-84	
Starter motor through bolts		
9.9 and 15 hp	30-40	
18-35 hp	95-110	
40 hp	95-110	
Stator coil screws	30-40[2]	

(continued)

Chapter Eight

Power Head

Basic repair of Johnson and Evinrude outboard power heads is similar from model to model, with minor differences. Some procedures require the use of special tools, which can be purchased from a dealer. Certain tools may be fabricated by a machinist, often at substantial savings. Power head stands are available from specialty shops such as Bob Kerr's Marine Tool Co. (P.O. Box 1135, Winter Garden, FL 32787).

Work on the power head requires considerable mechanical ability. You should carefully consider your own capabilities before attempting any operation involving major disassembly of the engine.

Much of the labor charge for dealer repairs involves the removal and disassembly of other parts to reach the defective component. Even if you decide not to tackle the entire power head overhaul after studying the text and illustrations in this chapter, it can be cheaper to perform the preliminary operations yourself and then take the power head to your dealer. Since many marine dealers have lengthy waiting lists for service (especially during the spring and summer season), this practice can reduce the time your unit is in the shop. If you have done much of the preliminary work, your repairs can be scheduled and performed much quicker.

Repairs go much faster and easier if your motor is clean before you begin work. There are special cleaners for washing the motor and related parts. Just spray or brush on the cleaning solution, let it stand, then rinse it away with a garden hose. Clean all oily or greasy parts with fresh solvent as you remove them.

WARNING

Never use gasoline as a cleaning agent. It presents an extreme fire hazard. Be sure to work in a well-ventilated area when using cleaning solvents. Keep a fire extinguisher rated for gasoline and oil fires nearby in case of emergency.

Once you have decided to do the job yourself, read this chapter thoroughly until you have a good idea of what is involved in completing the overhaul satisfactorily. Make arrangements to buy or rent any special tools necessary and obtain replacement parts before you start. It is frustrating and time-consuming to start an overhaul and then be unable to complete it because the necessary tools or parts are not at hand.

A limited number of new motors are assembled every year with cylinders that have been bored larger than standard. Such motors are identified by the letters "OS" stamped on the power head serial number welch plug. Cylinder reboring on these motors is not possible; a new cylinder and crankcase is required. If you have one of these engines, contact your Johnson or Evinrude dealer if cylinder repair becomes necessary. OMC has established a policy of absorbing certain costs for repair of these motors even if the motor is out of warranty.

Before beginning the job, re-read Chapter Two of this manual. You will do a better job with this information fresh in your mind.

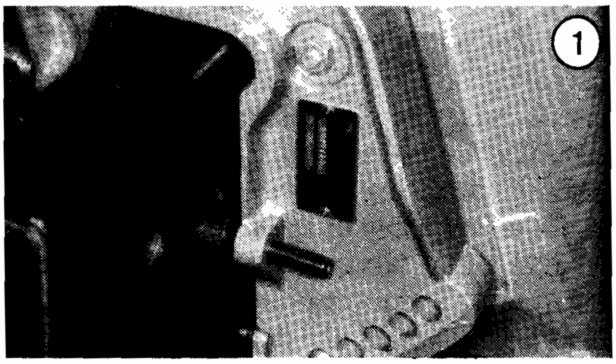
Since this chapter covers a large range of models over a lengthy time period, the procedures are somewhat generalized to accommodate all models. Where individual differences occur, they are specifically pointed out. The power heads shown in the accompanying pictures are current designs. While it is possible that the components shown in the pictures may not be identical with those being serviced, the step-by-step procedures may be used with all models covered in this manual.

NOTE

OMC issued a bulletin in September, 1988, recommending that a 50:1 fuel-oil mixture be used on all recreational outboard motors, which were previously recommended for a 100:1 fuel-oil mixture, when the motors are only used periodically and during the time of non-use the motor is stored in an area of high humidity or wide-scale temperature changes or if the motor is operated at a constant high rpm. A 100:1 fuel-oil mixture may be used on models so recommended after the engine is completely broken in and if the motor is used frequently, but not at a constant high rpm. Starting in 1989, AccuMix and AccuMix R fuel-oil mixing systems were changed to a 50:1 fuel-oil mixing ratio.

CAUTION

Whenever a power head is rebuilt, it should be treated as a new engine. Use a 25:1 fuel-oil mixture (non-VRO and non-auxiliary oil tank models) when recommended fuel-oil mixing ratio after break-in is 50:1. Use a 50:1



fuel-oil mixture (non-VRO and non-auxiliary oil tank models) when recommended fuel-oil mixing ratio after break-in is 100:1. Use a 50:1 fuel-oil mixture (VRO models), in addition to VRO lubrication, for 1985 models. Use a 100:1 mixture (VRO or auxiliary oil tank equipped models), in addition to VRO or auxiliary oil tank lubrication, for 1986-1990 models. Recommended oil is Evinrude or Johnson Outboard Lubricant. A 10 hour break-in period is recommended, during which time keep maximum engine speed under 3/4 throttle. Before switching to straight fuel on VRO and auxiliary oil tank models, make sure oil level has dropped in holding tank to ensure fuel and oil is being mixed.

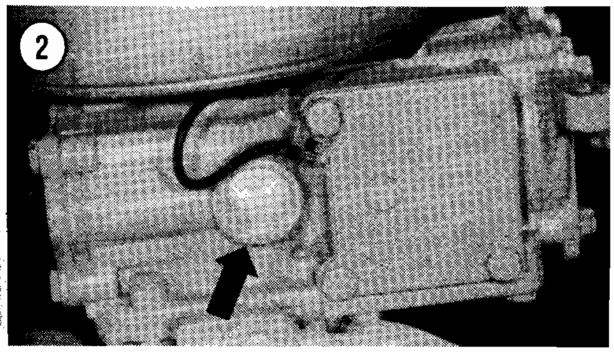
Tables 1-3 are at the end of the chapter.

ENGINE SERIAL NUMBER

Johnson and Evinrude outboards are identified by engine serial number. This number is stamped on a plate riveted to the transom clamp (**Figure 1**). It is also stamped on a welch plug installed on the power head (**Figure 2**). Exact location of the transom clamp plate and welch plug varies according to model.

This information identifies the outboard and indicates if there are unique parts or if internal changes have been made during the model run. The serial number should be used when ordering any replacement parts for your outboard.

2



Starting with the 1980 model year, the model year designation is coded. The last 2 letters of the model code indicate the model year. To determine the year of a given model (1980-on), write the word INTRODUCES. Below the word, number the letters 1-0. Match these numbers to the last 2 letters of the model code. As an example, J25TELCT is a 1983 model. The "C" represents 8 and the "T" represents 3.

FASTENERS AND TORQUE

Always replace a worn or damaged fastener with one of the same size, type and torque requirement.

Power head tightening torques are given in **Table 1**. Where a specification is not provided for a given bolt, use the standard bolt and nut torque according to fastener size.

Where specified, clean fastener threads with OMC Locquic Primer and then apply OMC Nut Lock or Screw Lock as required.

Power head fasteners should be tightened in 2 steps. Tighten to 50 percent of the torque value in the first step, then to 100 percent in the second step.

Retighten the cylinder head bolts after the engine has been run and warmed up.

To retighten the power head mounting fasteners properly, back them out one turn and then tighten to specifications.

When spark plugs are reinstalled after an overhaul, tighten to the specified torque. Warm the engine to normal operating temperature, let it cool down and retorque the plugs.

GASKETS AND SEALANTS

Three types of sealant materials are recommended: OMC Gasket Sealing

Compound, Adhesive M and OMC Gel Seal II. Unless otherwise specified, OMC Gasket Sealing Compound is used with gaskets on older engines. Adhesive M is used primarily with crankcase spaghetti seals (gasket strips). Gel Seal II replaces the original Gel Seal and is used instead of a crankcase gasket with newer engines. Be sure to use the appropriate sealant specified for your engine.

FLYWHEEL

Removal/Installation

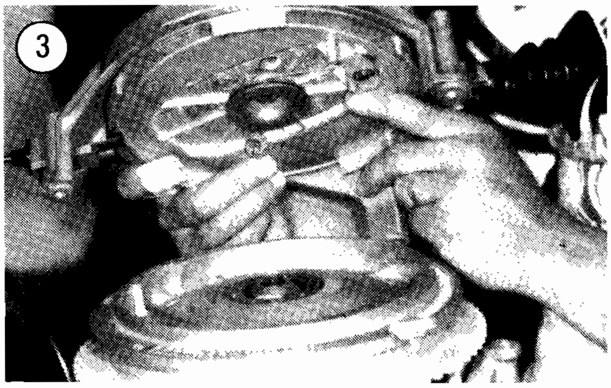
A strap wrench is used to hold the flywheel on manual start models. Use a flywheel holding tool on electric start models. The OMC universal puller kit (special part No. 378103) or equivalent is recommended for flywheel removal.

1. Remove the rewind starter assembly on 18-40 hp engines (**Figure 3**).
2. Remove the flywheel nut with an appropriate size socket and flywheel holding tool (**Figure 4**).
3. Install puller on flywheel with its flat side facing up.
4. Hold puller body with puller handle and tighten center screw. See **Figure 5**. If flywheel does not pop from the crankshaft taper, pry up on the rim of the flywheel with a large screwdriver while tapping the puller center screw with a brass hammer.
5. Remove puller from flywheel. Remove flywheel from crankshaft (**Figure 6**).
6. Remove the Woodruff key from the crankshaft key slot.
7. Remove the cam. On 2 hp, Colt and Junior models, remove cam drive pin.
8. Clean the crankshaft and flywheel tapers with OMC Cleaning Solvent.

NOTE
If the Woodruff key is installed incorrectly, cam position and ignition timing will be affected on magneto ignition models.

9. Install Woodruff key with its outer edge parallel to the crankshaft taper on 9.9 and 15 hp models and parallel to the crankshaft centerline on all other models. On 4 hp (standard models) through 40 hp models, the single upset mark on the side of the key must face downward. See **Figure 7**.
10. Install cam with side marked "TOP" facing up, if removed. On 2 hp, Colt and Junior models, reinstall cam drive pin.

3



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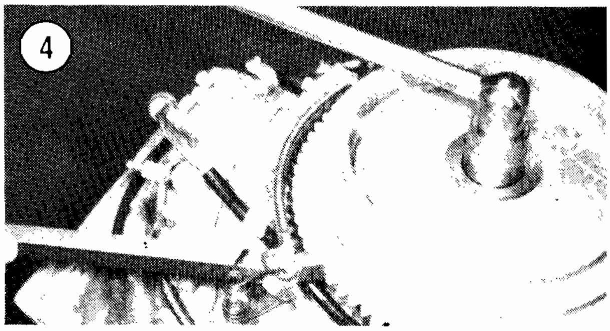

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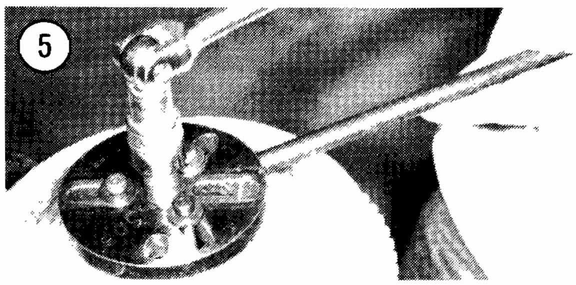

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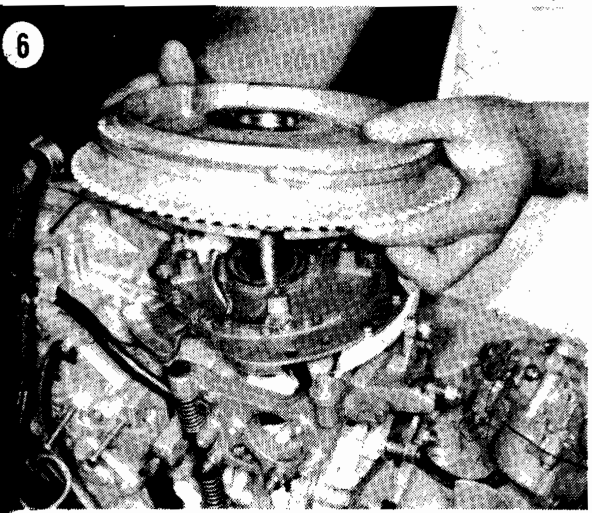

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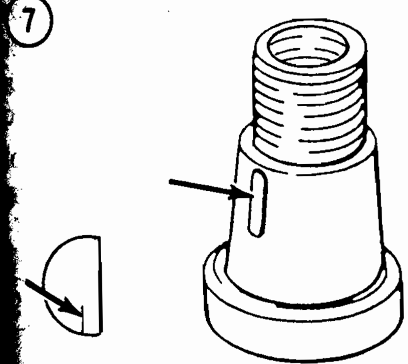
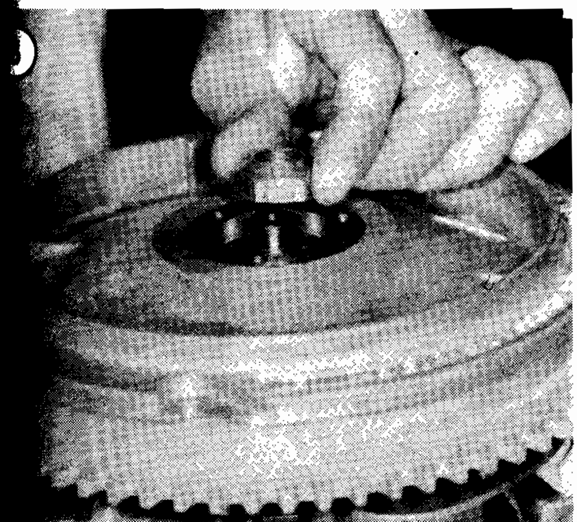


Install key parallel to taper or crankshaft centerline as noted in text. Key must face downward on models with a single mark on key side.



11. Install the flywheel and flywheel nut (**Figure 8**). Hold flywheel with the holding tool and tighten flywheel nut to specifications (**Table 2**).

MAGNETO ARMATURE PLATE

Removal/Installation

1. Remove the flywheel as described in this chapter.
2. Disconnect armature link and control lever.
3. Disconnect the magneto armature plate leads. Disconnect the ground lead and stop switch connector.
4. On electric start models, disconnect the yellow, yellow/blue and yellow/grey leads at the terminal board.
5. Remove the screws holding the magneto armature plate to the retainer plate.
6. Remove the magneto armature plate and cable assembly from power head.
7. Remove the armature plate bearing (Delrin ring).
8. Disconnect any support plate linkage (varies with model). Note exact sequence of washers and bushings used for reassembly reference.
9. Remove the screws holding the armature support and retaining ring to the power head. Remove the support and retaining ring.
10. Installation is the reverse of removal. Coat crankcase boss with OMC Moly Lube and Delrin ring with Evinrude or Johnson Outboard Lubricant. Squeeze ends of Delrin ring together with needlenose pliers and make sure it fits properly into armature plate boss. Complete engine synchronization and linkage adjustments. See Chapter Five.

CD 2 AND CD2UL ARMATURE PLATE

Removal/Installation

1. Remove the flywheel as described in this chapter.

2. Remove all J-clamps holding armature plate leads in position.
3. Disconnect the 3-wire and 4-wire connectors.
4. On electric start models, disconnect the armature plate stator leads at the terminal board (**Figure 9**).
5. Remove the screws holding the armature plate to the retainer plate. Remove the armature plate from the power head. See **Figure 10** (typical).
6. Remove the armature plate bearing (Delrin ring).
7. Disconnect any support plate linkage (varies with model). Note exact sequence of washers and bushings used for reassembly reference.
8. Remove the screws holding the armature support and retainer plate to the power head. Remove the support and retaining ring (**Figure 11**).

NOTE
A replacement armature plate and pilot kit is available for 1977-on 9.9-35 hp motors with an excessively worn crankcase pilot bearing (Delrin ring) or armature plate. Use of this kit (part No. 392610) can eliminate the need for cylinder/crankcase replacement.

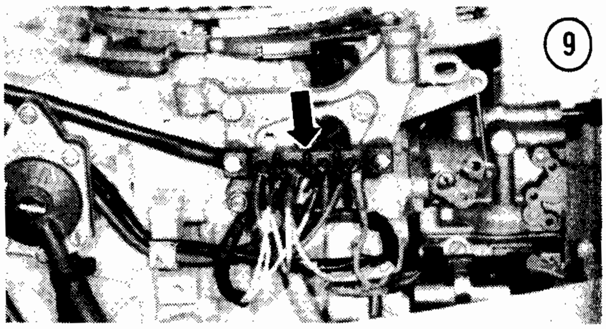
9. Installation is the reverse of removal. Coat crankcase boss with OMC Moly Lube and Delrin ring with Evinrude or Johnson Outboard Lubricant. Squeeze ends of Delrin ring together with needlenose pliers and make sure it fits properly into armature plate boss. See **Figure 12** (typical). Complete engine synchronization and linkage adjustments. See Chapter Five.

POWER HEAD

When removing any power head, it is a good idea to make a sketch or take an instant picture of the location, routing and positioning of wires and J-clamps for reassembly reference. Take notes as you remove wires, washers and engine grounds so they may be reinstalled in their correct position. Unless specified otherwise, install lockwashers on the engine side of the electrical lead to assure a good ground.

Removal/Installation (2 hp, Colt and Junior)

1. Disconnect the spark plug lead and remove the spark plug.
2. Remove the fuel tank filler cap. Remove the 4 engine cover mounting screws. Lift engine cover with starter assembly from power head. Note position of throttle detent spring under front port side screw. Reinstall filler cap.
3. Make sure the fuel supply valve is off. Disconnect the fuel line at the valve. Remove



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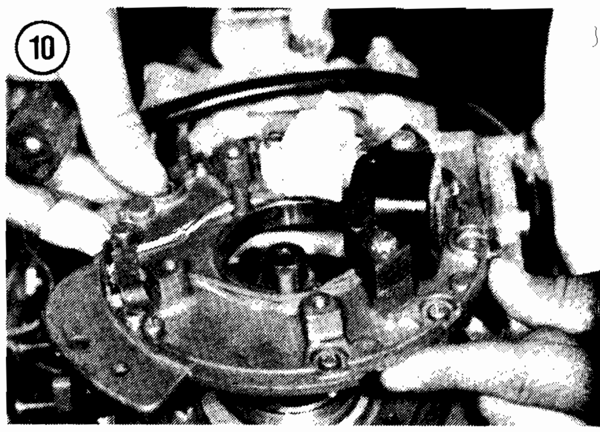


10

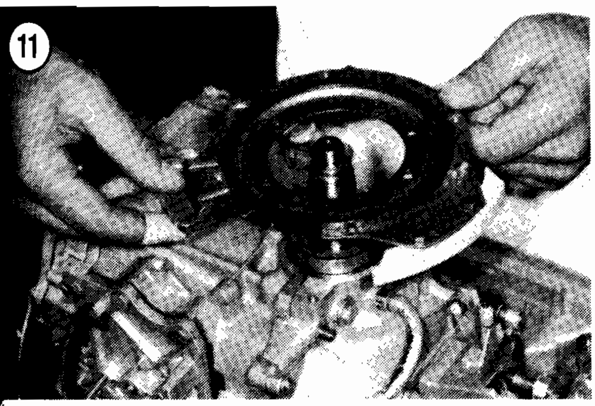
the 2 retainers holding the tank to its mounting bracket. Remove the tank.

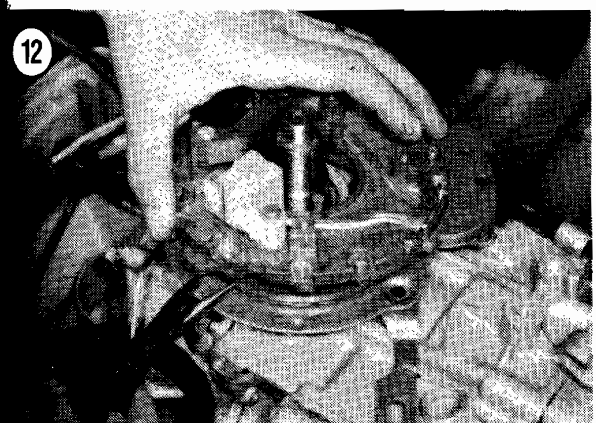
4. Remove the choke lever and low-speed adjustment knob.

5. Remove the 2 front screws holding the mounting bracket to the carburetor. Remove the 2 rear screws holding the bracket to the power head. Align the speed control lever with the mounting bracket slot and remove the bracket and air silencer assembly.

6. Remove the 6 bolts holding the power head to the exhaust housing. Remove the power head and discard the gasket.

7. Installation is the reverse of removal. Lubricate drive shaft splines with OMC Moly Lube. Coat a new power head-to-exhaust housing gasket with OMC Gasket Sealing Compound. Tighten fasteners to specifications (**Table 1**). Connect fuel line, open fuel valve and check for leakage. Complete engine synchronization and linkage adjustments. See Chapter Five.





Removal/Installation (2.5 hp, Excel 4 and Ultra 4)

1. Remove engine covers.
2. Disconnect the spark plug leads. Remove the spark plugs.
3. Remove the rewind starter. See Chapter Ten.
4. Disconnect fuel supply line from fuel pump.
5. Remove the carburetor assembly. See Chapter Six.
6. Disconnect stop switch electrical connections.
7. Remove the 5 screws holding the power head to the exhaust housing. Lift the power head straight up and off the drive shaft. Remove and discard the power head gasket. 8
8. Installation is the reverse of removal. Lubricate drive shaft splines with OMC Moly Lube. Install a new power head-to-exhaust housing gasket. Apply OMC Gasket Sealing Compound on threads of 5 power head mounting screws. Tighten fasteners to specifications (**Table 1**). Complete engine synchronization and linkage adjustments. See Chapter Five.

Removal/Installation (3 hp and 4 hp Standard)

1. Remove the choke knob. Remove the low speed adjustment knob, if so equipped.
2. Loosen the front and rear lower motor cover screws. Disengage and spread cover open sufficiently to remove from the power head.
3. Disconnect the spark plug leads. Remove the spark plugs.
4. Remove the 5 screws holding the power head to the exhaust housing. Lift the power

head straight up and off the drive shaft. Remove and discard the power head gasket.
5. Install power head on holding fixture part No. 303605 if further service is necessary.
6. Installation is the reverse of removal. Lubricate drive shaft splines with OMC Moly Lube. Coat both sides of a new power head-to-exhaust housing gasket with OMC Gasket Sealing Compound. Tighten fasteners to specifications (**Table 1**). Complete engine synchronization and linkage adjustments. See Chapter Five.

Removal/Installation (4 Deluxe and 4.5 hp)

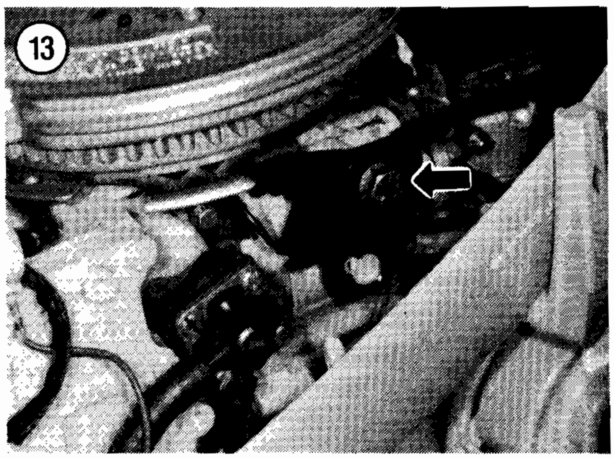
1. Remove the engine cover.
2. Remove the fuel tank.
3. Disconnect the throttle linkage and remove the carburetor. See Chapter Six.
4. Remove the intake manifold and reed valve assembly.
5. Disconnect the 3-wire and 4-wire connectors.
6. Disconnect the spark plug leads and remove the spark plugs.
7. Remove the flywheel as described in this chapter.
8. Remove the armature plate as described in this chapter.
9. Remove the power pack.
10. Leave starter on crankcase unless it requires service. Tie a knot in the starter rope inside the lower motor cover and remove the rope handle.
11. Remove the bolts holding the power head to the exhaust housing. Remove the power head.
12. Place the power head on a clean workbench and remove the inner exhaust housing. Remove and discard the gasket.
13. Install power head on holding fixture part No. 303605 if further service is necessary.
14. Remove gearcase from exhaust housing. See Chapter Nine.
15. Install water tube in position in the inner exhaust housing.
16. Install inner exhaust housing and adapter to power head with a new gasket.

NOTE
Use a rubber band to hold water tube to exhaust tube. This will simplify proper positioning of the water tube.

17. Lubricate end of water tube with liquid soap. Install power head to exhaust housing and tighten fasteners to specifications (**Table 1**).
18. The remainder of installation is the reverse of removal. Lubricate drive shaft splines with OMC Moly Lube. Install gearcase to exhaust housing and make sure water tube enters water pump grommet. Complete engine synchronization and linkage adjustments. See Chapter Five.

Removal/Installation (5, 6, 7.5 and 8 hp)

NOTE
The upper main bearing oil seal can be replaced on this model without power head removal or disassembly. With flywheel and armature plate removed, remove old seal with tool part No. 382944 and install new seal with tool part No. 314901.



1. Remove the engine cover.
2. Disconnect the spark plug leads and remove the spark plugs.
3. Remove the air silencer assembly.
4. Disconnect the throttle control screw and nut. Remove the throttle control.
5. Remove the water pump indicator hose.
6. Remove the flywheel as described in this chapter.
7. Disconnect and remove the armature plate as described in this chapter.
8. Remove the ignition coils.
9. Remove the power pack, if so equipped.
10. Remove the manual starter. See Chapter Ten.
11. Disconnect the fuel line and remove the carburetor and fuel pump as an assembly. See Chapter Six.
12. Working from underneath the inner exhaust housing, remove the power head attaching bolts.
13. Remove the power head and gasket. Discard the gasket.
14. Install power head on holding fixture part No. 303605 if further service is necessary.
15. Installation is the reverse of removal. Position water tube in inner exhaust housing. Install inner exhaust housing and adapter to power head with a new gasket. Lubricate drive shaft splines with OMC Moly Lube. Rotate power head slightly while lowering it to align crankshaft and drive shaft splines. Tighten fasteners to specifications (**Table 1**). Complete engine synchronization and linkage adjustments. See Chapter Five.

Removal/Installation (9.5-15 hp)

NOTE
The upper main bearing oil seal can be replaced on this model without power head removal or disassembly. With flywheel and armature plate removed, remove old seal with tool part No. 386629 (1972-1979) or part No. 391060 (1980-on). Install new seal with tool part No. 319872 (1973-1979) or part No. 391060 (1980-on).

1. Remove the flywheel as described in this chapter.
2. Remove the armature plate as described in this chapter.
3. Disconnect the fuel line and remove the carburetor and fuel pump as an assembly. See Chapter Six.

NOTE
*A metal shift lock lever is used on older models; newer engines use the plastic lever shown in **Figure 13**.*

4. Remove the shift lock lever screw (**Figure 13**). Swing lever and rod out of the way, then remove starter interlock screw.

5A. On electric start models, remove the starter. See Chapter Seven.

5B. On manual start models, remove the starter. See Chapter Ten. 8

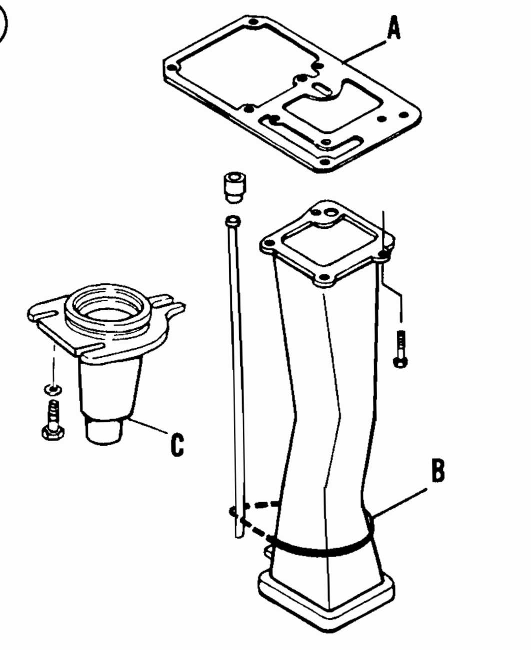
6. Remove the ignition coils. See Chapter Seven. Note that the stop switch ground lead is installed under a coil screw.
7. On CD 2 models, use pin removal tool part No. 322698 to remove the stop switch lead from the A cavity of the 4-wire connector or the E cavity of the 5-wire connector. On CD2UL models, disconnect the one pin stop switch connector.
8. From underneath the exhaust housing, remove the 3 power head attaching bolts on each side of the unit. Note that the 2 rear bolts are longer. Some models may use a ground lead under one of the front bolts.
9. From inside the lower motor cover, remove the 3 rubber mount screws and washers. Note that a power head ground lead is installed under the starboard mount screw. Additional washers are installed under the rubber mount sleeves.
10. Lift the power head straight up and out of the exhaust housing.
11. Place the power head on a clean workbench and remove the exhaust and

water tube assembly. Remove and discard the gasket.
12. Install power head on holding fixture part No. 303605 if further service is necessary.
13. Remove gearcase from exhaust housing. See Chapter Nine.
14. If rubber mount sleeves were removed from power head mounting brackets, reinstall with OMC Adhesive M. Coat the washers with OMC Adhesive M. Position a large washer over each lower motor cover rubber sleeve mounting hole, then place small washers over the large ones.
15A. 1973-1986—Coat a new power head-to-exhaust housing gasket with OMC Gasket Sealing Compound and install on power head (A, **Figure 14**).
15B. 1987-on—Install a new power head-to-exhaust housing gasket on power head (A, **Figure 14**). Install gasket dry, use *no* sealer.

NOTE
The 9.5 and 9.9 hp uses a single water tube and grommet in Step 15; the 15 hp model has 2 water tubes and grommets.

16. Make sure the grommet(s) are properly located in the exhaust tube, then install the exhaust and water tube assembly to the power head. Use a rubber band to hold the long water tube to the exhaust tube (B, **Figure 14**).
17. Coat the outer mating diameter of the crankcase head with Permatex No. 2. See C, **Figure 14**.
18. Lubricate drive shaft splines with OMC Moly Lube.
19. Holding the power head over the exhaust housing, guide the long water tube into the water tube opening in the exhaust housing. On 15 hp models, guide the small water tube into the opening at the rear of the exhaust housing. Guide the vertical control shaft into the shaft gear.

14



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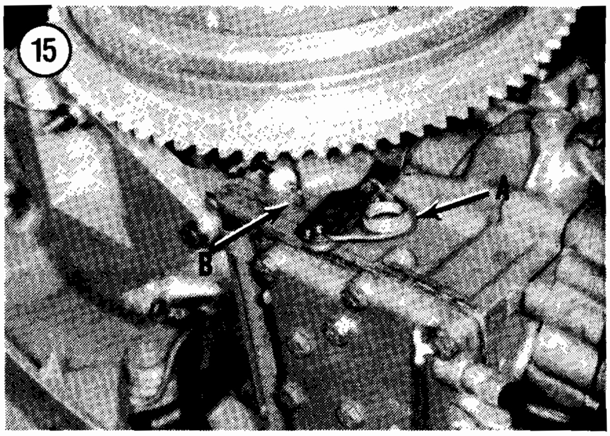
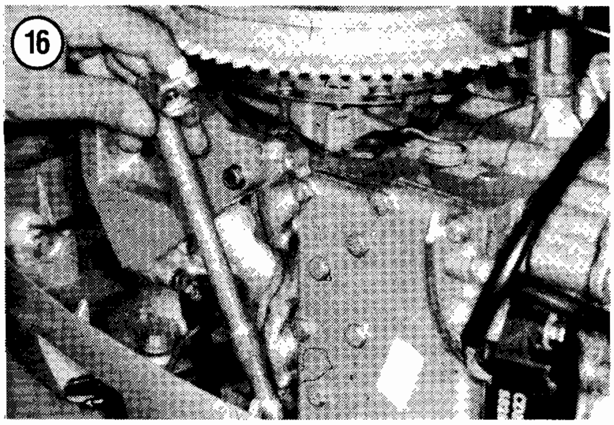
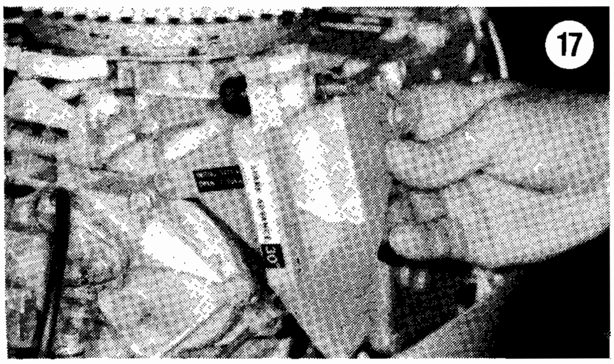
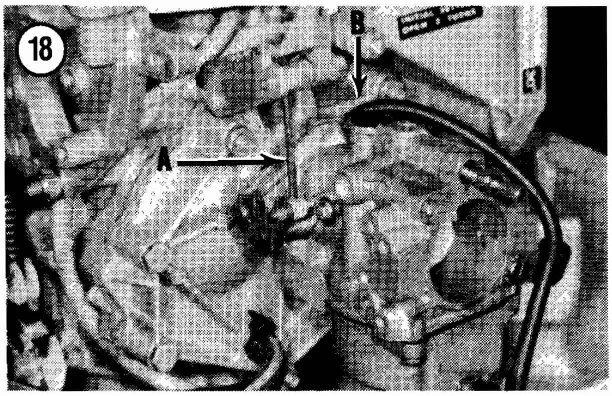


20. Use an awl to align the rubber mount sleeves and washers with the lower motor cover mounting holes, if necessary. Install the mounting screws with the power head ground lead under the rear screw. Tighten the screws securely.
21. Wipe the exhaust housing-to-power head screw threads with OMC Gasket Sealing Compound. Install the 2 longer screws in the rear mounting holes, then install the remaining 4 screws. Make sure the ground lead is installed on the front screw, if so







equipped. Tighten the bolts to specifications (**Table 1**).

22. Install the gearcase. See Chapter Nine.
23. Reverse Steps 1-7 to complete installation. On CD 2 equipped models, use pin insert tool part No. 322697 to install stop switch lead in A or E cavity of connector. Complete engine synchronization and linkage adjustments. See Chapter Five.

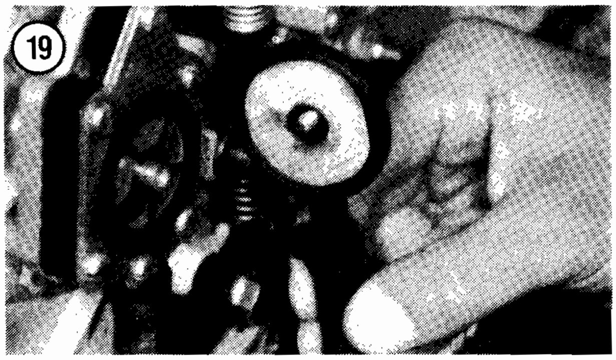
Removal/Installation (18-40 hp)

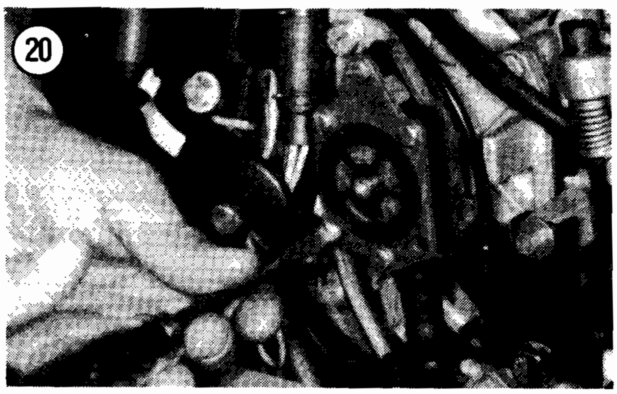
NOTE
The upper main bearing oil seal can be replaced on this model without power head removal or disassembly. With flywheel and armature plate removed, remove old seal with tool part No. 387780. Wipe new seal casing with OMC Gasket Sealing Compound and install with tool part No. 321539.

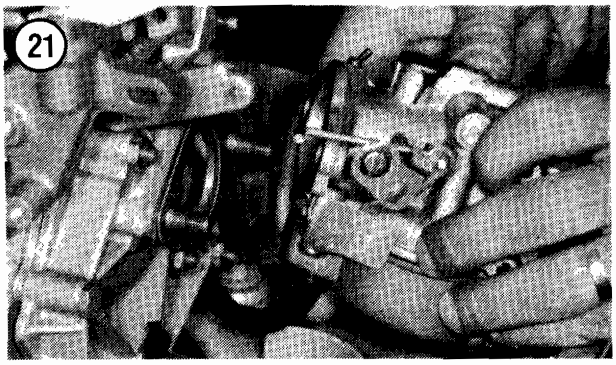
1. Remove the engine cover.
2. Disconnect the battery on electric start models.
3. Disconnect the spark plug leads.
4. Disengage the throttle arm spring (A, **Figure 15**) from the throttle arm. Remove pin from end of throttle control rod (B, **Figure 15**). Separate armature plate link from throttle control lever.
5. Remove the screws and clamp holding the vertical throttle shaft. Lift the shaft from the throttle gear (**Figure 16**).
6. Remove the rewind starter. See Chapter Ten. Remove the starter lockout lever if positioned over the flywheel.
7. On electric models, remove the starter motor and solenoid. See Chapter Seven. On manual models, remove the bracket (**Figure 17**). Note that a ground lead is attached to the bottom rear fastener on both electric and manual start models.
8. Remove the air silencer, if so equipped.
9. Disconnect the throttle cam to cam follower link (A, **Figure 18**). Disconnect the recirculation line (B, **Figure 18**), if so equipped.
10. Remove the fuel filter (**Figure 19**), then remove the fuel pump attaching screws (**Figure 20**). Place the fuel pump and filter assembly to one side.
11. Remove the 2 carburetor mounting nuts. Pull carburetor, gasket and choke bracket (if so equipped) from intake manifold studs

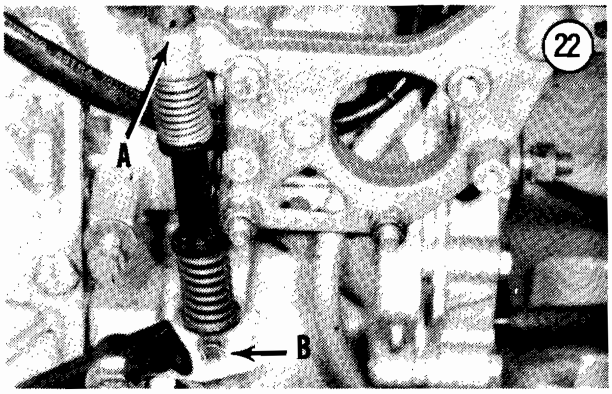
(**Figure 21**) while disengaging choke shaft from carburetor choke lever. Remove with fuel pump assembly attached. Discard the gasket.

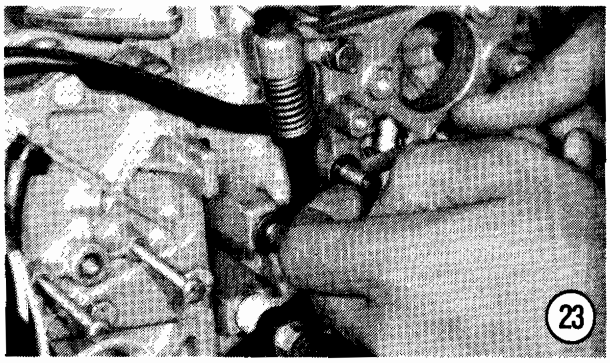
12. Remove the flywheel as described in this chapter.
13. On electric start models, disconnect all leads at the terminal board. Remove the terminal board.
14. On manual start models equipped with an actuator cam, install a piece of wire through the hole in the top of the shaft (A, **Figure 22**) to keep the shaft from coming out of the bracket. Remove the cotter pin and washer holding the cam link to the cam (B, **Figure 22**).
15. Remove the cam bolt and the 2 bracket nuts. Remove the assembly (**Figure 23**).
16. Disconnect the outboard water indicator hose from the exhaust cover nipple (**Figure 24**). Slide the hose through the J-clamp and remove from the motor.

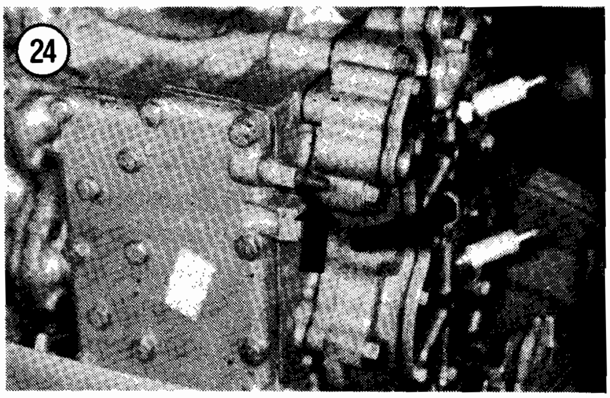


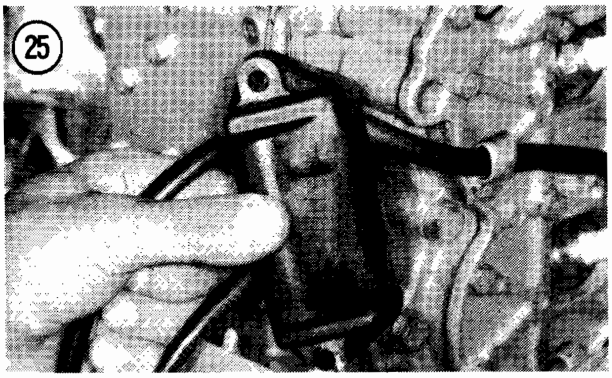


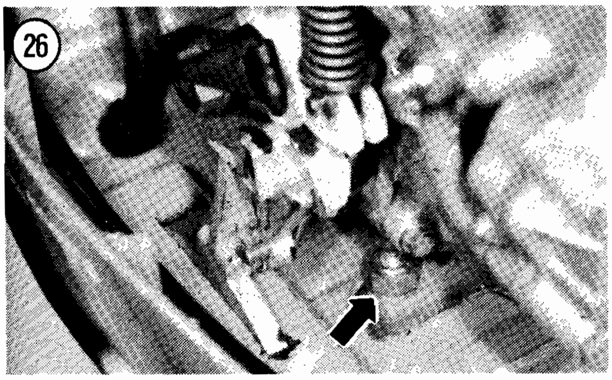


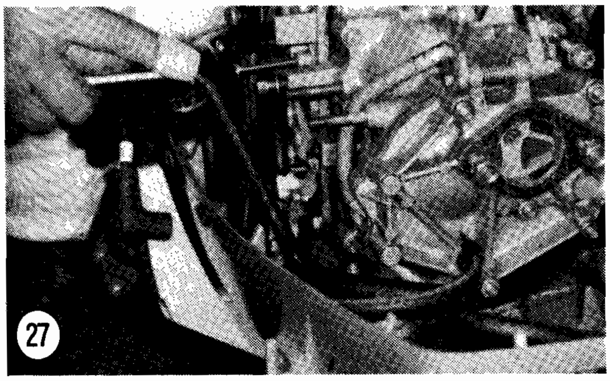


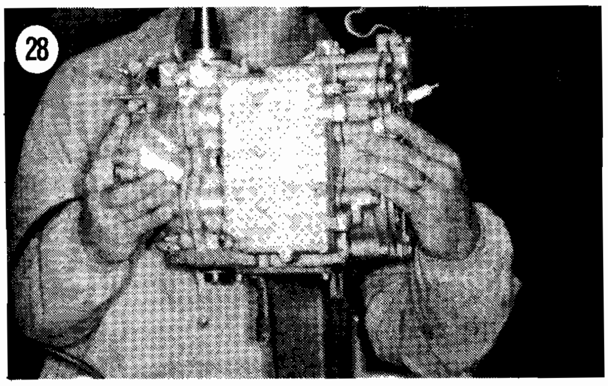












17. Remove the ignition coils. Note that the stop switch ground lead is attached to one of the coil mounting screws.
18. On CD 2 models, use pin removal tool part No. 322698 to remove the stop switch lead from the A cavity of the 4-wire connector on models prior to 1985 and from the E cavity of the 5-wire connector on 1985-1988 models. On CD2UL models, disconnect the one pin stop switch connector.
19. Remove the armature plate as described in this chapter.
20. On CD 2 models, remove the power pack (**Figure 25**). Note the location of the power pack ground lead.

NOTE

At this point, there should be no hoses, wires or linkages connecting the power head to the exhaust housing. Recheck this to make sure nothing will hamper power head removal.

8

21. From underneath the exhaust housing, remove the 4 bolts holding the power head.
22. Locate the port and starboard power head retaining nuts and washers (**Figure 26**). Remove the nuts with OMC tool part No. 322700 or an offset 1/2 in. box wrench (**Figure 27**).
23. Rock the power head from side to side to break the gasket seal. Carefully lift the power head from the exhaust housing (**Figure 28**) and place on a clean workbench.
24. Remove the inner exhaust tube attaching screws. Tap the end of the tube with a soft hammer (**Figure 29**) to break it loose.

Remove the tube. Remove and discard the gasket.

25. Depress water tube guide tab and pull guide from tube. Remove and discard the exhaust tube rubber grommet.

26. Install power head on holding fixture part No. 303605 if further service is necessary.

27. Installation is the reverse of removal. Lubricate drive shaft splines with OMC Moly Lube. Make sure the O-ring is in the end of the crankshaft. Apply Permatex No. 2 on both sides of power head-to-exhaust housing gasket in area of inner exhaust housing mounting surface. Lubricate top of water tube with liquid soap. Rotate power head as required to align crankshaft and drive shaft splines. Apply OMC Nut Lock to port and starboard exhaust housing studs. Tighten fasteners to specifications (**Table 1**). Use pin insert tool part No. 322697 to install stop switch lead in A cavity of the 4-wire connector on models prior to 1985 and in E cavity of the 5-wire connector on 1985-1988 models. Complete engine synchronization and linkage adjustments. See Chapter Five.

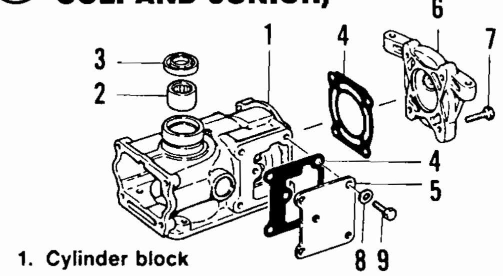
Disassembly (2 hp, Colt and Junior)

Refer to **Figure 30** for this procedure.

1. Remove the cylinder head bolts. Remove the cylinder head and gasket. Discard the gasket.
2. Remove the exhaust cover bolts. Remove the exhaust cover and gasket. Discard the gasket.
3. Remove the intake manifold and reed valve assembly.
4. Remove the connecting rod cap and 30 needle bearings.

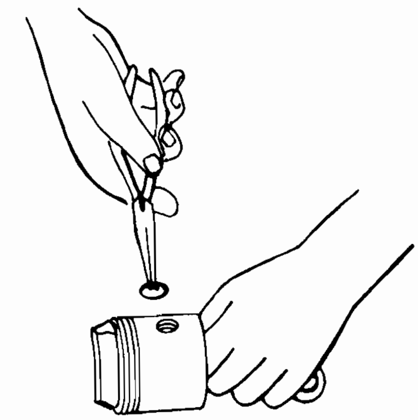
NOTE
Main bearing and seal housing are serviced as an assembly. If bearing or seal requires replacement, install a new bearing and seal housing.

(30) **CRANKCASE AND CYLINDER (2 HP, COLT AND JUNIOR)**



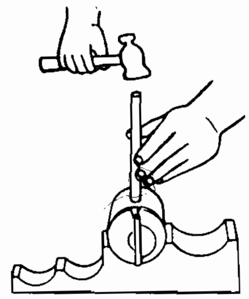
1. Cylinder block
2. Needle bearing
3. Seal
4. Gasket
5. Exhaust cover plate
6. Cylinder head
7. Head screw
8. Washer
9. Exhaust cover screw

(31)

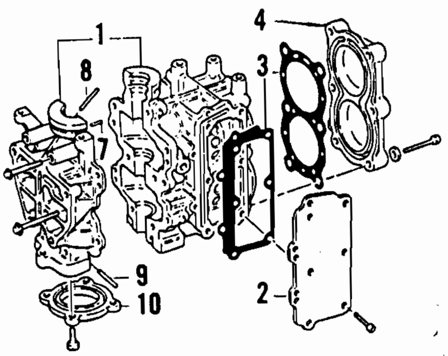


5. Remove the 4 lower main bearing housing bolts. Remove the bearing housing and 28 needle bearings.
6. Remove the crankshaft through the bottom of the crankcase.
7. Reinstall connecting rod cap on connecting rod. Push the piston toward the cylinder head end of the crankcase until the piston rings can be seen.
8. Remove and discard the piston rings with a ring expander tool.
9. Remove the piston and connecting rod through the carburetor end of the crankcase.
10. Support crankcase and push upper main bearing and seal out with a suitable tool.
11. If the piston is to be removed from the connecting rod, remove the piston pin

(32)

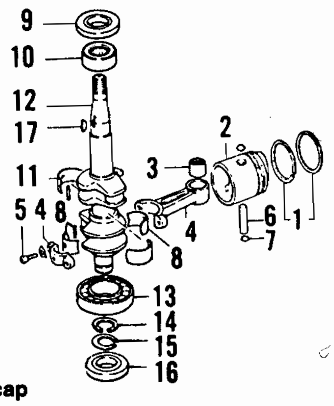


CYLINDER AND CRANKCASE (2.5 HP, 3 HP, 4 HP, 4 HP STANDARD, EXCEL 4 AND ULTRA 4)



1. Cylinder and crankcase assembly
2. Exhaust cover plate
3. Gasket
4. Cylinder head
7. Taper pin
8. Upper drain tube
9. Lower drain tube
10. Inner flange

TYPICAL CRANKSHAFT AND PISTON COMPONENTS



1. Piston rings
2. Piston
3. Needle bearing
4. Connecting rod and cap
5. Cap screw
6. Piston pin
7. Retaining ring
8. Needle bearings and liners
9. Seal
10. Needle bearing
11. Center bearing and liners
12. Crankshaft
13. Ball bearing
14. Bearing snap ring
15. Crankshaft snap ring
16. Lower seal

(33)

retaining rings with needlenose pliers. See **Figure 31**.

12. Place piston in cradle part No. 326572 with "L" mark on inside of piston boss facing upward. This positions the driver on the loose end of the piston pin. Drive piston pin through piston with a tool part No. 326624 or a suitable driver. See **Figure 32**.

13. If connecting rod piston pin bearing requires replacement, remove with tool part No. 327637.

Disassembly (2.5-8 hp)

Refer to **Figure 33** (2.5 hp, 3 hp, 4 hp Standard, Excel 4 and Ultra 4), **Figure 34** (4 Deluxe and 4.5 hp) and **Figure 35** (5, 6, 7.5 and 8 hp) for this procedure.

1. 5-8 hp—Remove the thermostat cap, gasket and components from cylinder head. Discard the seal and gasket.
2. Remove the cylinder head and gasket. Discard the gasket.

NOTE
Check inner exhaust cover (5-8 hp) for signs of pitting. If found, discard the cover.

3. Remove the exhaust cover and gasket. On 5-8 hp, remove the inner exhaust cover and gasket. Discard the gaskets.
4. 2.5 hp, 3 hp, 4 hp Standard, Excel 4 and Ultra 4—Remove the inner flange.
5. Remove and discard any crankcase hose clamps. Remove hose from crankcase.

NOTE
Some engines use 2 taper pins. Inspect yours carefully before proceeding with Step 6. Remove both pins, if so fitted, before attempting to separate the crankcase and cylinder in Step 8.

6. With crankcase and cylinder block on a solid surface, drive the taper pins from the back to the front of the crankcase.

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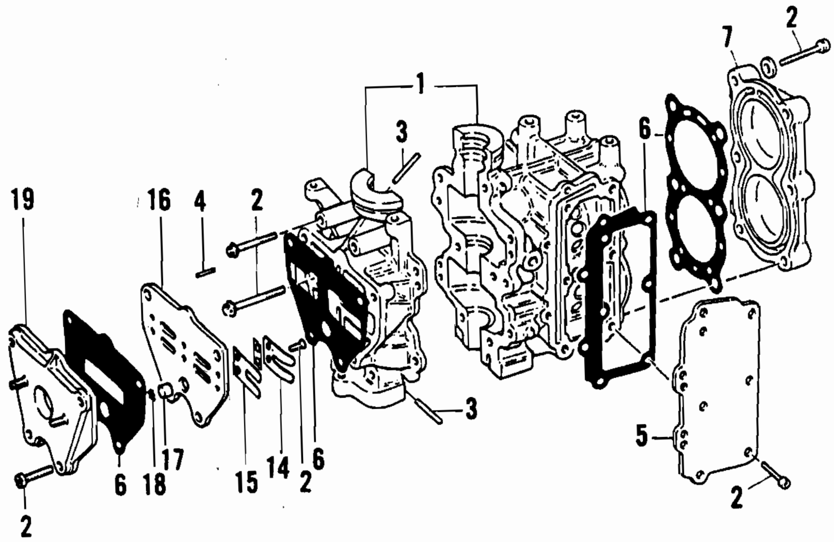
CYLINDER AND CRANKCASE (4 DELUXE AND 4.5 HP)



1. Cylinder and crankcase assembly
2. Screw
3. Crankcase
4. Taper pin
5. Exhaust cover plate
6. Gasket
7. Cylinder head
14. Leaf backup plate
15. Leaf valve
16. Leaf plate
17. Check valve
18. Check valve screen
19. Intake manifold

7. Remove the crankcase-to-cylinder block bolts.
8. Tap the top of the crankshaft with a plastic mallet to separate the cylinder and crankcase halves.

NOTE
The main bearing and connecting rod caps must be removed before the crankshaft can be removed from the cylinder block.

9. Remove the center main bearing liner and needle bearings. Place in a clean container.

NOTE
The 30 connecting rod bearings are larger than the 30 center main bearings.

10. Mark the connecting rod and cap. Remove each connecting rod cap and needle bearings. Place in a clean container.
11. Remove the crankshaft from the cylinder block.
12. Remove the remaining connecting rod and main bearing needle bearings and place in their respective container.
13. Remove the flywheel Woodruff key, if not removed when the flywheel was removed. Remove the upper seal and upper main bearing assembly.
14. If lower main bearing requires removal, remove snap ring and remove bearing with an appropriate puller.
15. Reinstall the rod cap to its respective connecting rod. Remove each piston and

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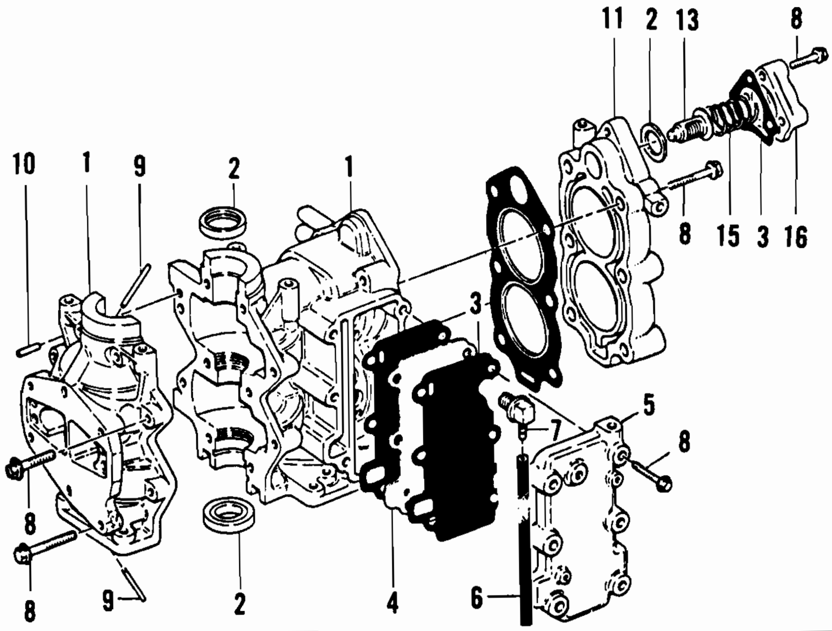
CYLINDER AND CRANKCASE (5-8 HP)

1. Cylinder and crankcase assembly
2. Seal
3. Gasket
4. Inner exhaust cover
5. Outer exhaust cover
6. Water indicator hose
7. Indicator elbow
8. Screw
9. Crankcase drain tube
10. Taper pin
11. Cylinder head
13. Thermostat
15. Spring
16. Thermostat cover



nnecting rod assembly from its cylinder. ark the cylinder number on the top of the ston with a felt-tipped pen.

. Pry each ring far enough from the piston grip it with pliers, then break the rings off e piston and discard.

. If the piston is to be removed from the nnecting rod, remove the piston pin aining rings with tool part No. 325937. See **ure 31.**

A. 1973-1978—Place piston in cradle part o. 326572 (4 hp) or part No. 326573 (6 hp) th "L" mark on inside of piston boss facing ward. This positions the driver on the loose d of the piston pin.

B. 1979-on—Place piston in cradle part o. 326572 (2.5-4.5 hp) or part No. 326573 -8 hp) with "L" mark on inside of piston ss facing downward. This positions the iver on the tight end of the piston pin.

. Drive piston pin through piston with tool rt No. 326624 (2.5-4.5 hp), part No. 6573 (5-8 hp) or another suitable driver. e **Figure 32.**

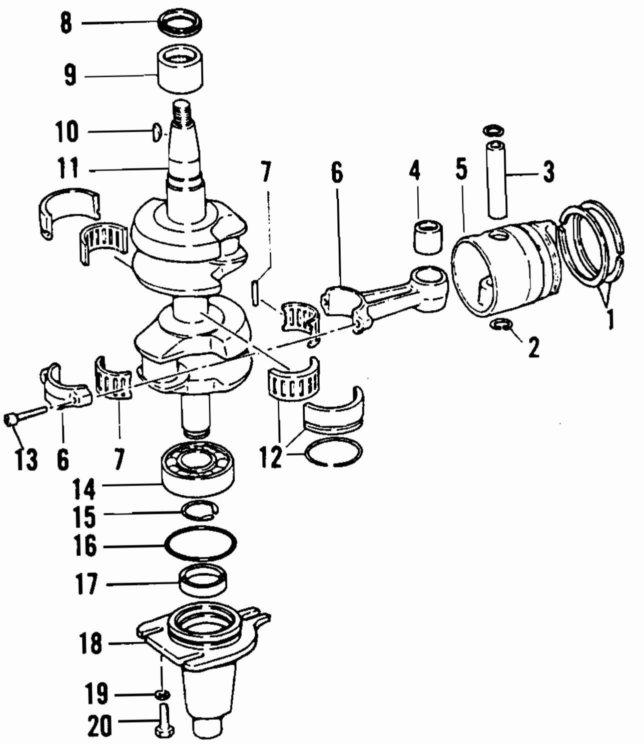
. If connecting rod piston pin bearing quires replacement, remove with tool part No. 327637 (2.5-4.5 hp) or part No. 327645 (5-8 hp).

Disassembly (9.5-15 hp)

Refer to **Figure 36** for this procedure.

1. Remove the crankcase head and discard the O-ring.
2. Remove the cylinder head cover. Remove the thermostat, seal and cover gasket. Discard the seal and gasket.
3. Remove the cylinder head and gasket. Discard the gasket.
4. Remove the bypass cover and gasket. Discard the gasket.
5. Remove the intake manifold, reed valve assembly and gasket. Discard the gasket.
6. With crankcase and cylinder block on a solid surface, drive the taper pin from the back to the front of the crankcase.
7. Remove the crankcase-to-cylinder block bolts.
8. Tap the top of the crankshaft with a plastic mallet to separate the cylinder and crankcase halves.

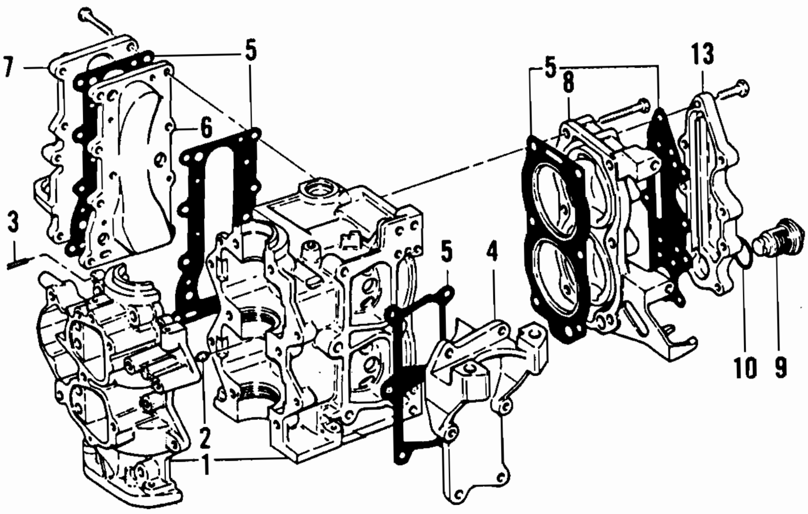
36



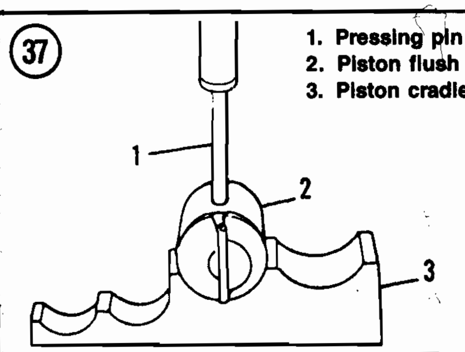
TYPICAL CRANKSHAFT AND PISTON COMPONENTS

1. Piston ring
2. Retaining ring
3. Piston pin
4. Needle bearing
5. Piston
6. Connecting rod and cap assembly
7. Bearing assembly
8. Seal
9. Needle bearing
10. Flywheel key
11. Crankshaft
12. Center bearing assembly
13. Rod cap screw
14. Ball bearing
15. Snap ring
16. O-ring
17. Seal
18. Crankcase head
19. Washer
20. Screw

CYLINDER AND CRANKCASE (9.5-15 HP)



1. Cylinder and crankcase assembly
2. Bearing dowel pin
3. Taper pin
4. Bypass cover
5. Gasket
6. Inner exhaust cover
7. Outer exhaust cover
8. Cylinder head
9. Thermostat
10. Thermostat seal
13. Water cover



37

1. Pressing pin
2. Piston flush with cradle
3. Piston cradle

NOTE

The connecting rod caps must be removed before the crankshaft can be removed from the cylinder block. Note that one side of rod and cap has raised dots and that the corners are chamfered for proper rod/cap alignment. Caps are not interchangeable and cannot be turned.

9. Mark the connecting rod and cap. Remove each connecting rod cap and bearing retainer. Place in a clean container.
10. Remove the crankshaft from the cylinder block.
11. Remove the remaining connecting rod bearing retainer and place in its respective container.
12. Reinstall each rod cap to its respective connecting rod. Remove the piston and rod assemblies from their cylinder. Mark the cylinder number on the top of each piston with a felt-tipped pen.
13. Carefully pry the crankshaft center main bearing retaining ring from its groove. Slide the retaining ring to one side and remove the roller bearing assembly. Place the 23 rollers in a clean container.
14. Slide the top main bearing off the crankshaft.
15. If lower main bearing requires removal, remove snap ring and remove bearing with an appropriate puller.
16. Pry each ring far enough from the piston to grip it with pliers, then break the rings off the piston and discard.

NOTE

When replacing the piston and piston pin on 1976-1980 models, install piston, piston pin and bearing assembly part No. 391526 as a replacement. This assembly supercedes part No. 387660 and contains a larger piston pin/bearing surface for increased durability.

17. If the piston is to be removed from the connecting rod, remove the piston pin retaining rings with tool part No. 325937. See **Figure 31**.

18A. 1973-1981—Place piston in cradle part No. 319919 with "L" mark on inside of piston boss facing upward. This positions the driver on the loose end of the piston pin. The piston skirt should be flush with the cradle. See **Figure 37**.

18B. 1982-on—Place piston in cradle part No. 326573. The piston skirt should be flush with the cradle. See **Figure 37**.

19. Heat the piston to 200-400° F with a heat lamp, then drive the piston pin through the piston with tool part No. 319920 (1973-1981) or part No. 392511 (1982-on) and an arbor press.
20. Remove piston from connecting rod along with the 23 needle bearings and 2 washers. Place bearings and washers in a clean container.

Disassembly (18-40 hp)

Refer to **Figure 38** for this procedure.

1. Remove the lower main bearing seal housing (**Figure 39**). Remove and discard the seal housing O-rings and the O-ring inside the crankshaft. Drive the seal from the housing with an appropriate size punch.
2. Remove the cylinder head cover and gasket (**Figure 40**). Discard the gasket.
3. Remove the thermostat spring, thermostat and seal (**Figure 41**). Discard the seal.

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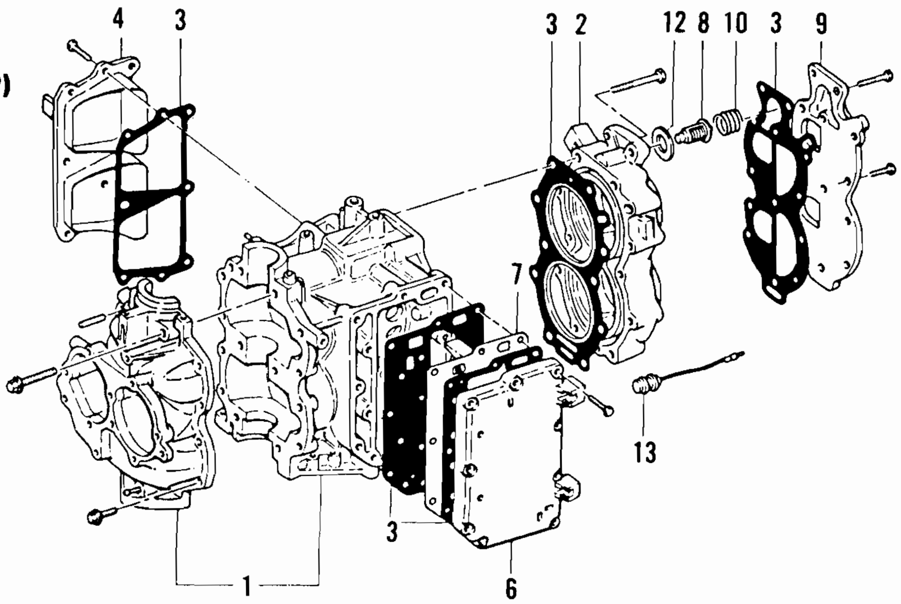
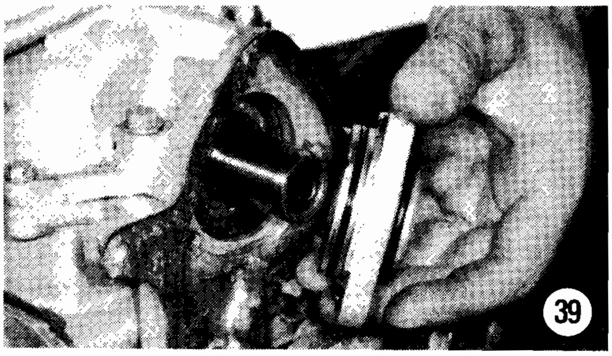
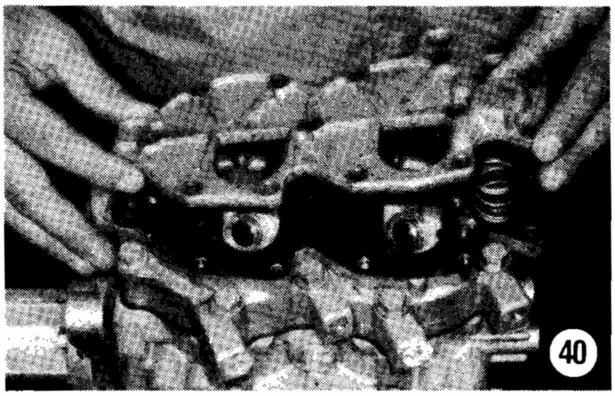
CYLINDER AND CRANKCASE (18-40 HP)

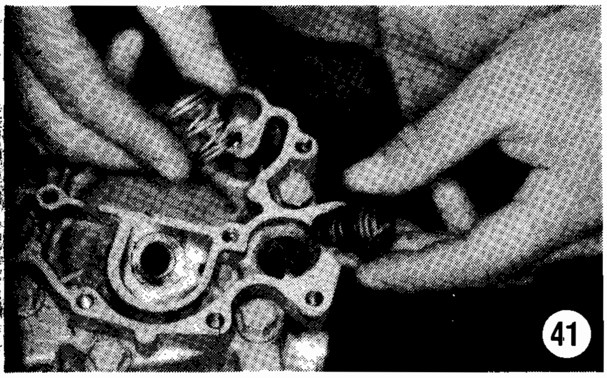
1. Cylinder and crankcase assembly
2. Cylinder head
3. Gasket
4. Bypass cover
6. Outer exhaust cover
7. Inner exhaust cover
8. Thermostat
9. Water cover
10. Spring
12. Thermostat seal
13. Temperature switch

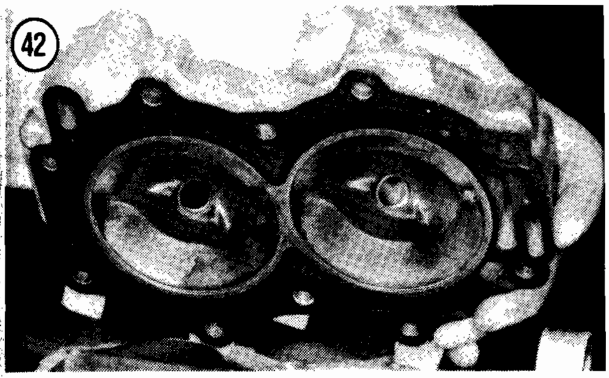


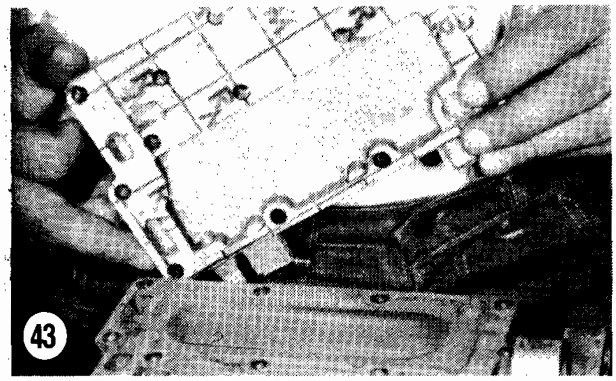


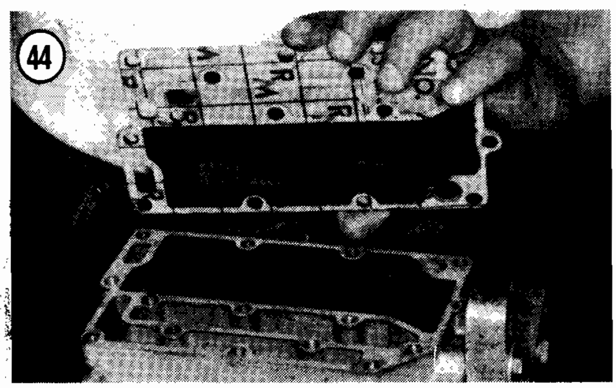


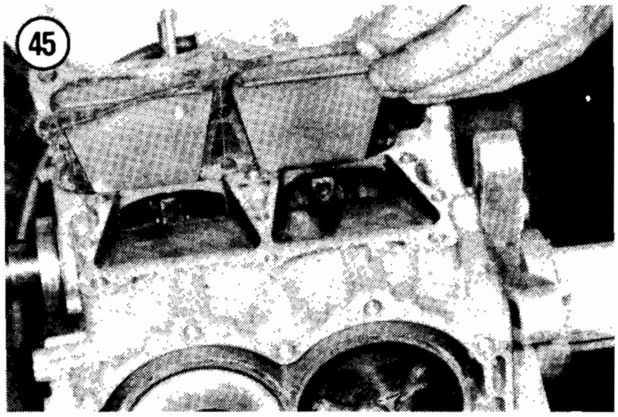
4. Remove the cylinder head and gasket (**Figure 42**). Discard the gasket.
5. Remove the exhaust cover screws. Tap cover if necessary to break the seal. Remove the outer cover and gasket (**Figure 43**). Discard the gasket.
6. Remove the inner exhaust cover and gasket (**Figure 44**). Discard the gasket.
7. Remove the intake bypass covers and gaskets (**Figure 45**). Discard the gaskets.
8. Remove the crankcase taper pin with a punch (**Figure 46**). Drive taper pin from front to back of crankcase.
9. Remove the crankcase-to-cylinder block bolts. Note that 2 are inside the openings and 4 are hidden. See **Figure 47**.
10. Remove the intake manifold and gasket (**Figure 48**). Discard the gasket.
11. Remove the single screw holding the reed valve assembly. Remove the reed valve assembly (**Figure 49**).
12. Tap the side of the crankshaft with a soft mallet to break the gasket seal, then remove the cylinder half from the crankcase. See **Figure 50**.

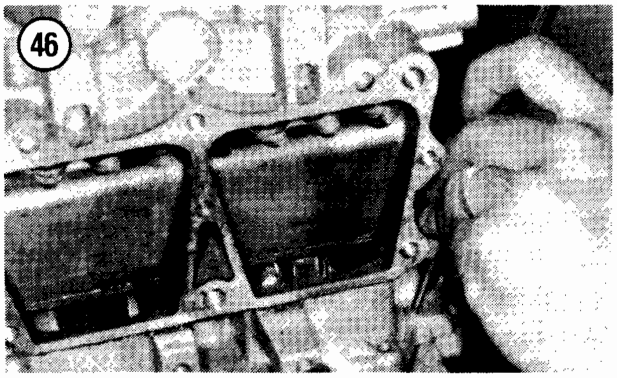












NOTE

The center main bearing and connecting rod caps must be removed before the crankshaft can be removed from the cylinder block. Note that one side of rod and cap has raised dots and the corners are chamfered for proper rod/cap alignment. Caps are not interchangeable and cannot be turned.

13. Remove the center main bearing lower sleeve and the cage/roller assembly. See **Figure 51**.
14. Check connecting rod and cap alignment with a pencil point or dental pick (**Figure 52**). Alignment must be correct at 3 of the 4 corners. Record alignment points of each cap for reassembly reference.
15. Remove each connecting rod cap and bearing retainer. See **Figure 53**. Place in a clean container.
16. Remove the crankshaft from the cylinder block (**Figure 54**).

17. Remove the remaining connecting rod bearing and center main bearing retainers and needle bearings (**Figure 55**). Place bearings and retainer in their respective containers.
18. Orient each rod cap to its respective connecting rod and reinstall cap screws finger-tight.
19. Remove the piston and rod assemblies from their cylinder. Mark the cylinder number on the top of each piston with a felt-tipped pen.
20. Remove the flywheel Woodruff key, if not removed when the flywheel was removed. Slide the upper seal and main bearing assembly off the crankshaft.
21. If lower main bearing requires removal, remove snap ring then remove bearing with an appropriate puller.
22. Remove and discard O-ring from inside of lower main bearing journal.
23. Pry each ring far enough from the piston to grip it with pliers, then break the rings off the piston and discard.
24. If the piston is to be removed from the connecting rod, remove the piston pin retaining rings with tool part No. 325937. See **Figure 56**.

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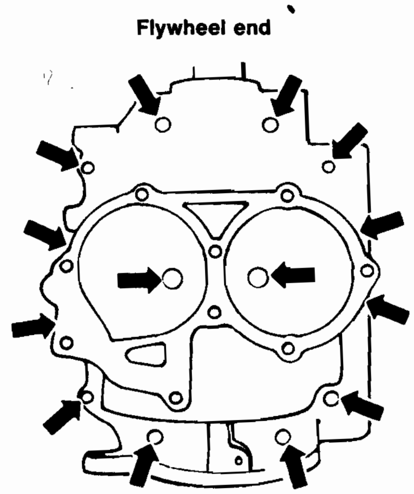

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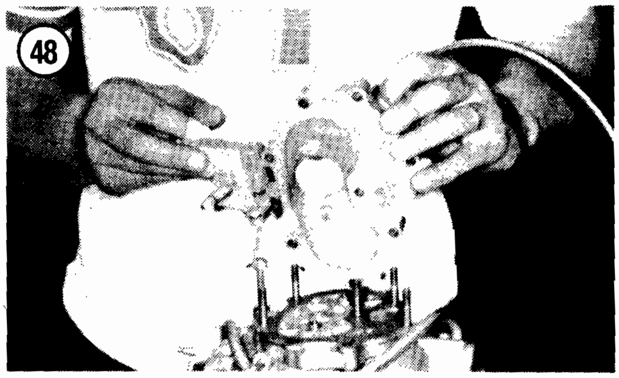

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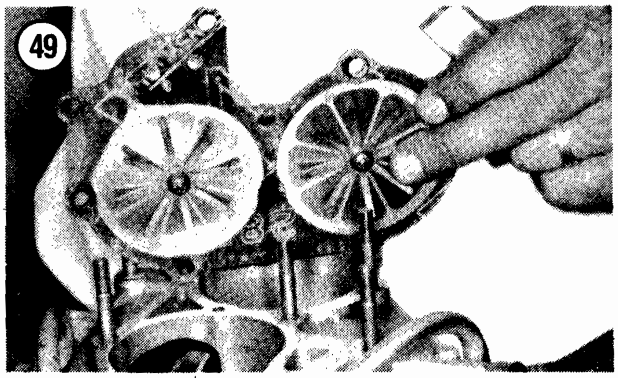

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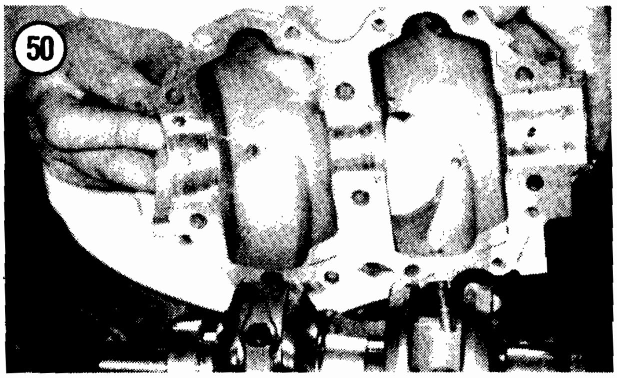

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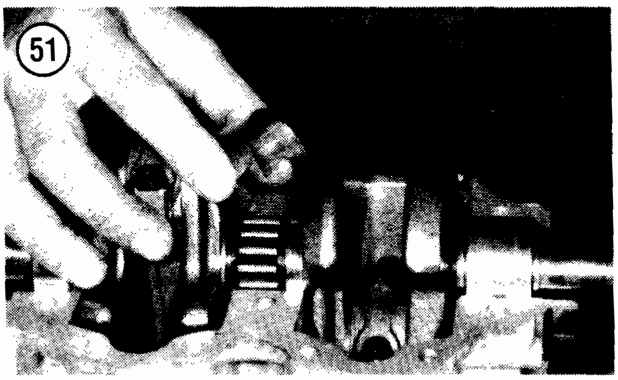
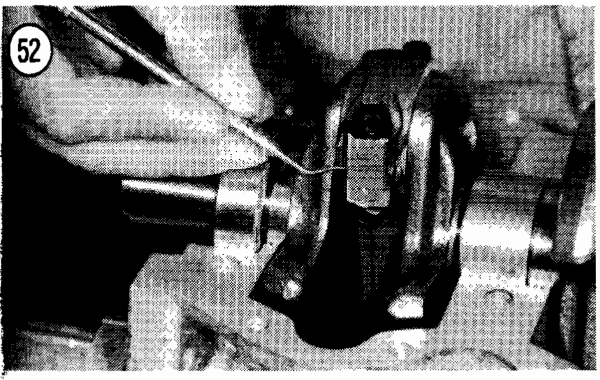
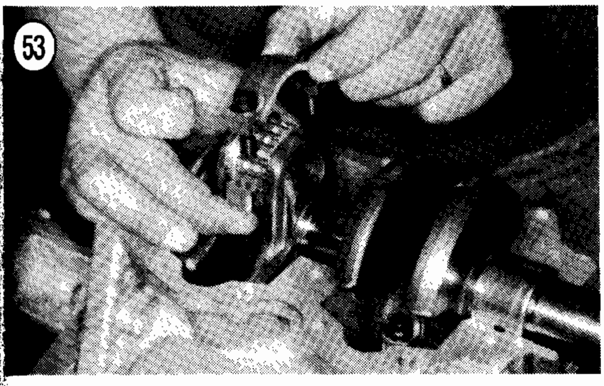
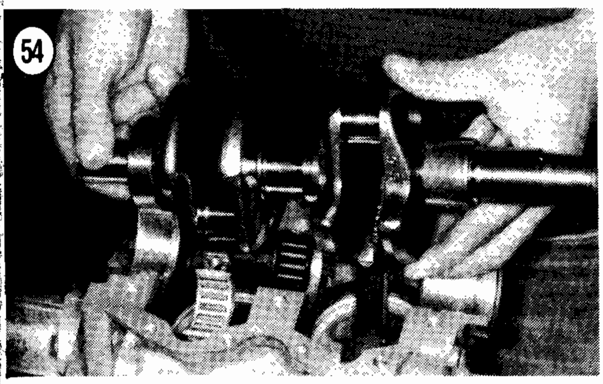
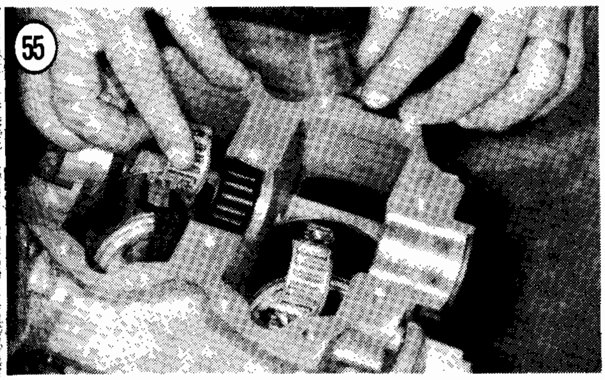










25A. 1973-1977—Place piston in cradle part No. 321432 with "LOOSE" mark on inside of piston boss facing upward. This positions the driver on the loose end of the piston pin. The piston skirt should be flush with the cradle. See **Figure 37**.

25B. 1978-1979—Place piston in cradle part No. 321432. The piston skirt should be flush with the cradle. See **Figure 37**.

25C. 1980-on—Place piston in cradle part No. 326573. The piston skirt should be flush with the cradle. See **Figure 37**.

26. Press the piston pin through the piston with tool part No. 321434 (1973-1984) or part No. 326356 (1985-on).

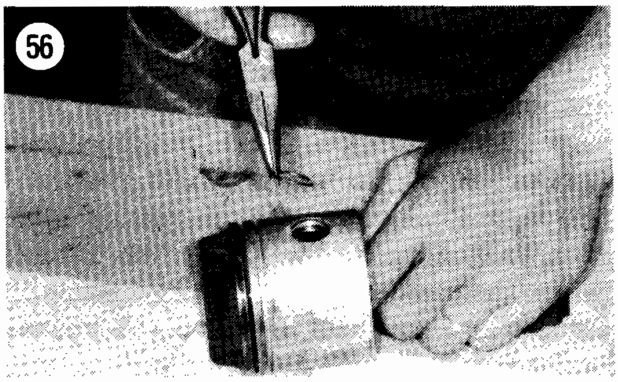
27A. 1973-1984—Remove piston from connecting rod along with the caged bearing retainer. Slide bearing retainer from connecting rod (**Figure 57**) and place in a clean container.

27B. 1985-on—Remove piston from connecting rod along with the 2 thrust washers. Withdraw the 28 loose needle bearing rollers from the connecting rod and place in a clean labeled container.

8

Cylinder Block and Crankcase Cleaning and Inspection (All Engines)

Johnson and Evinrude outboard cylinder blocks and crankcase covers are matched and line-bored assemblies. For this reason, you



should not attempt to assemble an engine with parts salvaged from other blocks. If inspection indicates that either the block or cover requires replacement, replace both.

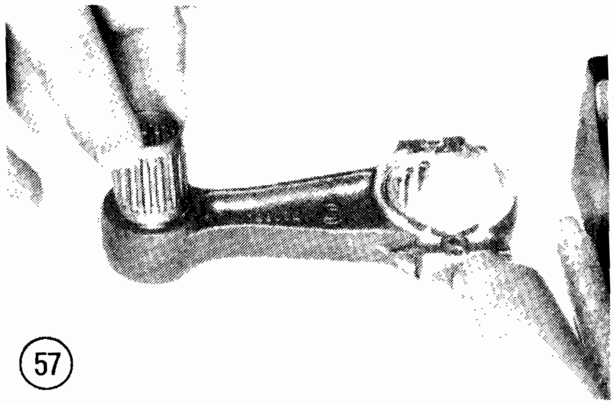
WARNING
Remove any jewelry from your from your hands and wrists and wear hand and eye protection when working with Gel Seal and Gasket Remover. The substance is powerful enough to etch holes in a watch crystal or badly irritate any cut in the skin.

Carefully remove all gasket and sealant residue from the cylinder block and crankcase cover mating surfaces. Gel Seal or Gel Seal II should be cleaned from mating parts with OMC Gel Seal and Gasket Remover. After spraying the area to be cleaned, allow the solvent to stand for 5-10 minutes before cleaning off the old Gel Seal and the remover. Since Gel Seal is bright red in color, a visual inspection will quickly tell you when it has been completely removed.

Clean the aluminum surfaces carefully to avoid nicking them. A dull putty knife can be used, but a piece of Lucite with one edge ground to a 45 degree angle is more efficient and will also reduce the possibility of damage to the surfaces. Once the area is clean, apply OMC Cleaning Solvent to remove all traces of the Gel Seal and Gasket Remover.

When sealing the crankcase cover and cylinder block, both mating surfaces must be free of all sealant residue, dirt and oil or leaks will develop.

Once the gasket surfaces are cleaned, place the mating surface of each component on a large pane of glass. Apply uniform downward pressure on the component and check for warpage. Replace each component if more than a slight degree of warpage exists. In cases where there is a slight amount of warpage, it can often be eliminated by placing the mating surface of each component on a large sheet of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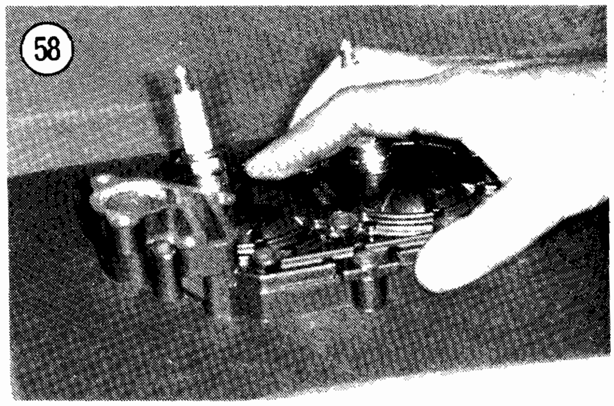
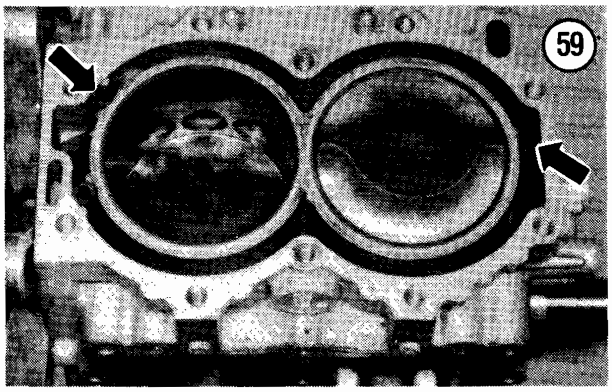
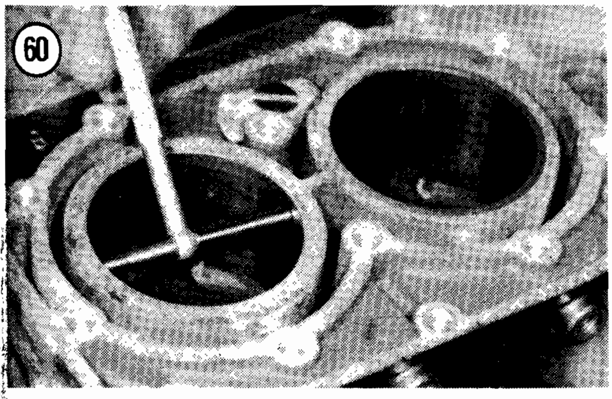

58

120 emery cloth. Apply a slight amount of pressure and move the component in a figure-8 pattern. See **Figure 58**. Remove the component and emery cloth and recheck surface flatness on the pane of glass.

If warpage exists, the high spots will be dull while low areas will remain unchanged in appearance. It may be necessary to repeat this procedure 2-3 times until the entire mating surface has been polished to a dull luster. Do not remove more than a total 0.010 in. from the cylinder block and head. Finish the resurfacing with 180 emery cloth.

1. Clean the cylinder block and crankcase cover thoroughly with solvent and a brush.
2. Carefully remove all gasket and sealant residue from the cylinder block and crankcase cover mating surfaces.
3. Check the cylinder heads and exhaust ports for excessive carbon deposits or varnish.





Remove with a scraper or other blunt instrument.

4. Check the block, cylinder head and cover for cracks, fractures, stripped bolt or spark plug holes or other defects.

5. Check the gasket mating surfaces for nicks, grooves, cracks or excessive distortion. Any of these defects will cause a compression leak. Replace as required.

6. Check all oil and water passages in the block and cover for obstructions. Make sure any plugs installed are properly tightened.

7. Make sure all water passage restrictors (**Figure 59**) are in good condition and properly installed. Damaged, loose or missing restrictors will interfere with cooling water circulation and result in possible engine overheating.

8. Check crankcase recirculation orifice, if so equipped, and clean with tool part No. 326623.

NOTE
With older engines, it is a good idea to have the cylinder walls lightly honed with a medium stone even if they are in good condition. This will break up any glaze that might reduce compression.

9. Check each cylinder bore for signs of aluminum transfer from the pistons to the cylinder walls. If scoring is present but not excessive, have the cylinders honed by a dealer or qualified machine shop.

10. Check each cylinder bore for size and taper in the port area with an inside micrometer or bore gauge. See **Figure 60**. If bore is tapered by 0.002 in. or more or out-of-round or worn by 0.003 in. or more, have the cylinder(s) honed or rebored by a dealer or qualified machine shop.

CAUTION
If cylinders are rebored for oversize pistons, be sure to allow 0.003-0.005 in. clearance between the new bore diameter and the oversize piston on 1973-1984 models. For 1985-on models, no manufacturer recommended piston-to-cylinder clearance is provided. When an Evinrude or Johnson replacement piston (provided by OMC) is used, a built-in clearance is maintained by boring the cylinder to the oversize diameter determined by adding the oversize dimension of the piston to the standard bore.

Crankshaft and Connecting Rod Bearings Cleaning and Inspection (All Engines)

Bearings can be reused if they are in good condition. To be on the safe side, however, it is a good idea to discard all bearings and install new ones whenever the engine is disassembled. New bearings are inexpensive compared to the cost of another overhaul caused by the use of marginal bearings.

1. Place ball bearings in a wire basket and submerge in a suitable container of fresh solvent. The bottom of the basket should not touch the bottom of the container.
2. Agitate basket containing bearings to loosen all grease, sludge and other contamination.
3. Dry ball bearings with dry filtered compressed air. Be careful not to spin the bearings.
4. Lubricate the dry bearings with a light coat of Evinrude or Johnson Outboard Lubricant and inspect for rust, wear, scuffed surfaces, heat discoloration or other defects. Replace as required.
5. If needle bearings are to be reused, repeat Steps 1-4, cleaning one set at a time to prevent any possible mixup. Check bearings for flat spots. If one needle bearing is defective, replace the set with new bearings and liners.
6. Repeat Step 5 to check caged piston pin bearings. If bearing is defective, replace the bearing and its corresponding piston pin.

Piston Cleaning and Inspection (All Engines)

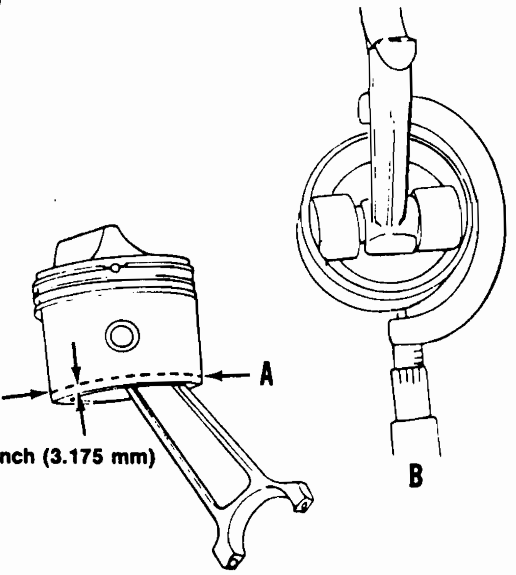
1. Check the piston(s) for signs of scoring, cracking, cracked or worn piston pin bosses or metal damage. Replace piston and pin as a set if any of these defects are noted.
2. Check piston ring grooves for distortion, loose ring locating pins or excessive wear. If the flexing action of the rings has not kept the lower surface of the ring grooves free of carbon, clean with a bristle brush and solvent.

NOTE
Do not use an automotive ring groove cleaning tool in Step 3 as it can damage the piston ring locating pin.

3. Clean the piston skirt, ring grooves and dome with the recessed end of a broken ring to remove any carbon deposits.
4. Immerse pistons in a carbon removal solution to remove any carbon deposits not removed in Step 3. If the solution does not remove all of the carbon, carefully use a fine wire brush; avoid burring or rounding of the machined edges. Clean the piston skirt with crocus cloth.

5A. Check 1982-1984 25, 30 and 35 hp pistons for size and roundness:
   a. Measure the piston at a point 1/8 in. above the bottom edge of the skirt (A, **Figure 61**) and 90° to the piston pin hole (B, **Figure 61**).

61



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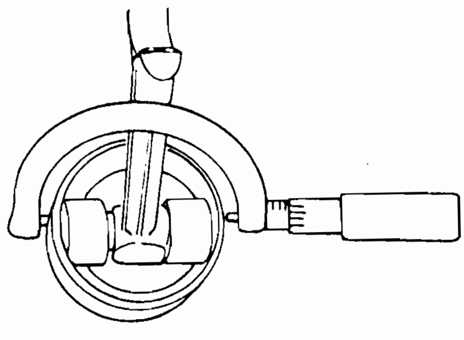
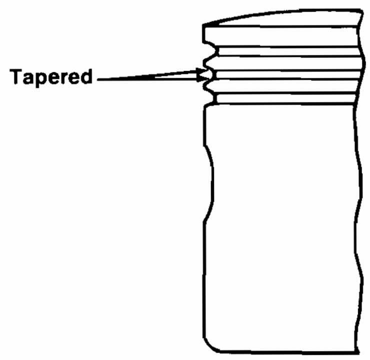


b. Repeat the measurement at a point parallel to the piston pin hole. See **Figure 62**.
c. Subtract the second measurement from the first one. If the difference is more than 0.0045 in., replace the piston.
d. Subtract the first measurement from that obtained in Step 10 of *Cylinder Block and Crankcase Cleaning and Inspection* to determine the piston-to-cylinder clearance. If clearance exceeds 0.0034 ±0.001 in., have the cylinder rebored and install an oversize piston.
e. If the piston side grooves are worn in a pattern similar to that shown in **Figure 63**, replace the piston.

63



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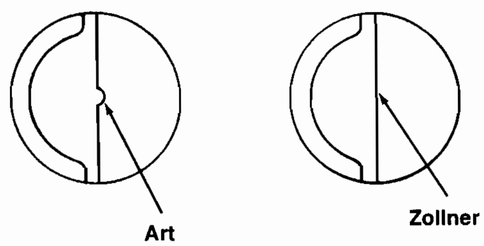
PISTON CROWNS



5B. Check 1985-1988 20-30 hp pistons for size and roundness:
a. Measure the piston at a point 1/8 in. above the bottom edge of the skirt (A, **Figure 61**) and 90° to the piston pin hole (B, **Figure 61**).
b. Repeat the measurement at a point parallel to the piston pin hole. See **Figure 62**.
c. Subtract the second measurement from the first one. If the difference is more than 0.004 in., replace the piston.
d. If piston skirt grooves are worn smooth in area 90° to piston pin hole, replace the piston.
e. If the piston side grooves are worn in a pattern similar to that shown in **Figure 63**, replace the piston.

5C. Check 1985-on 40 hp pistons for size and roundness:
a. Measure the piston at a point 1/8 in. above the bottom edge of the skirt (A, **Figure 61**) and 90° to the piston pin hole (B, **Figure 61**).
b. Repeat the measurement at a point parallel to the piston pin hole. See **Figure 62**.
c. Subtract the second measurement from the first one. If the difference is less than 0.004 in., replace the piston.
d. If piston skirt grooves are worn smooth in area 90° to piston pin hole, replace the piston.
e. If the piston side grooves are worn in a pattern similar to that shown in **Figure 63**, replace the piston.

5D. Check 1989 and 1990 20-30 hp pistons for size and roundness:

NOTE
*Two piston types are used. The piston crown on the Zollner type has a straight side adjacent to the sloped side. The piston crown on the Art type has a half-circle in the straight side adjacent to the sloped side. See **Figure 64**.*

a. Measure the piston at a point 1/8 in. above the bottom edge of the skirt (A, **Figure 61**) and 90° to the piston pin hole (B, **Figure 61**).
b. Repeat the measurement at a point parallel to the piston pin hole. See **Figure 62**.
c. Subtract the second measurement from the first one. The difference should be 0.006 in. ±0.001 in. on Zollner type pistons or 0.002 in. ±0.0005 in. on Art type pistons. If not, replace the piston.
d. If piston skirt grooves are worn smooth in area 90° to piston pin hole, replace the piston.
e. If the piston side grooves are worn in a pattern similar to that shown in **Figure 63**, replace the piston.

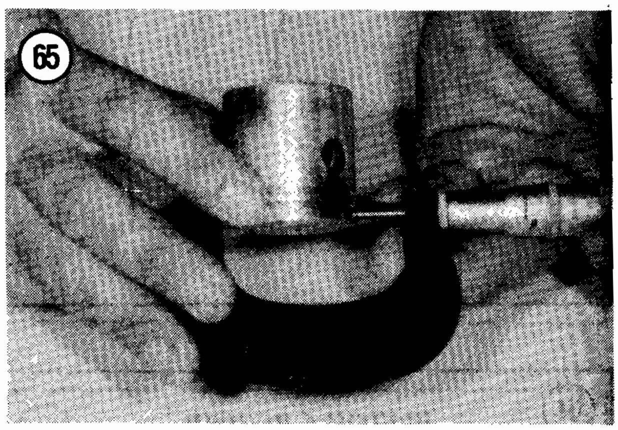
5E. Check all other pistons with a micrometer approximately 1/8-1/4 in. from piston skirt bottom and at piston top. See **Figures 61, 62** and **65**. Measure at a point 90° to the piston pin and at a point parallel with the piston pin bosses. Compare the 2 top and skirt measurements to determine if piston is out-of-round. Replace piston and pin as a set if piston is out-of-round by more than 0.002 in. for all models.

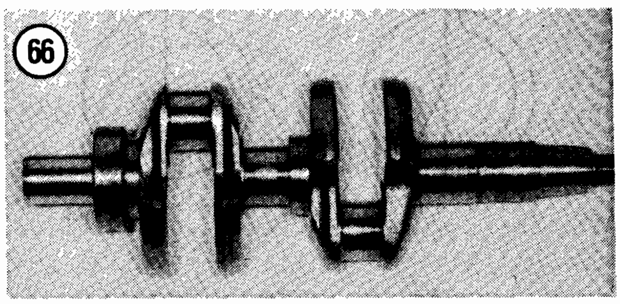
Crankshaft Cleaning and Inspection (All Engines)

1. Clean the crankshaft thoroughly with solvent and a brush. Blow dry with dry filtered compressed air, if available, and lubricate with a light coat of Evinrude or Johnson Outboard Lubricant.
2. Check the crankshaft journals and crankpins for scratches, heat discoloration or other defects. See **Figure 66**.
3. Measure the journals and crankpins with a micrometer and compare to **Table 3**. If journals or crankpins are not within specifications, replace the crankshaft.
4. Check drive shaft splines and flywheel taper threads for wear or damage. Replace crankshaft as required.
5. If lower crankshaft ball bearing has not been removed, grasp inner race and try to work it back and forth. Replace bearing if excessive play is noted.
6. Lubricate ball bearing with Evinrude or Johnson Outboard Lubricant and rotate outer race. Replace bearing if it sounds or feels rough or if it does not rotate smoothly.

Piston and Connecting Rod Assembly (All Engines)

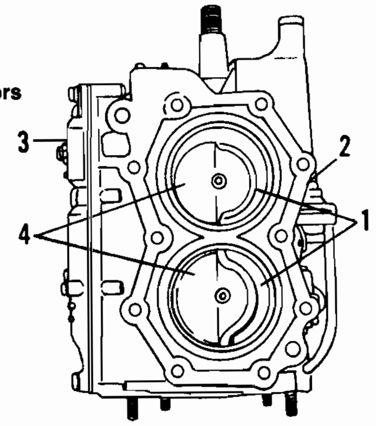
If the pistons were removed from the connecting rods, they must be correctly oriented when reassembling. The exhaust or slanted side of the piston dome must face the exhaust ports when installed (**Figure 67**). The connecting rod oil hole on models with hole





CORRECT PISTON INSTALLATION

1. Intake side of piston deflectors
2. Intake side of cylinders
3. Exhaust side of cylinders
4. Exhaust side of piston deflectors



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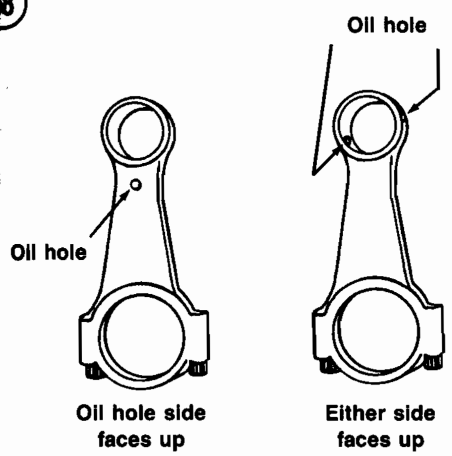

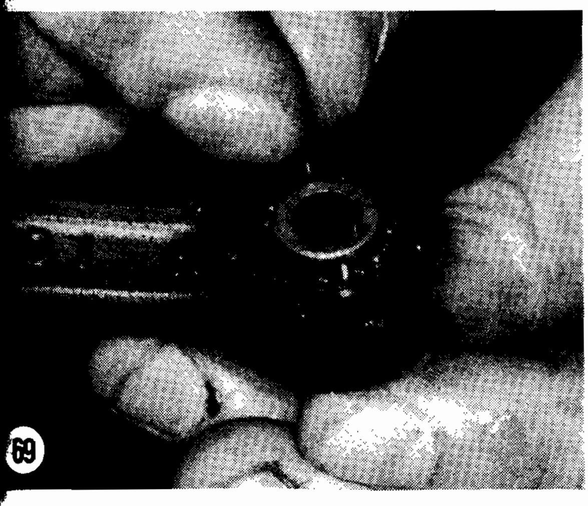

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in center of connecting rod must face toward the flywheel end of the engine. The connecting rod on models with 2 oil holes in side of connecting rod small end can be installed with either side toward the flywheel end of the engine. See **Figure 68**. Double-check rod and piston orientation before installing the piston pin.

1A. If a caged bearing was removed from the connecting rod piston pin end:

a. Reinstall the bearing with an arbor press.
b. Fit piston over connecting rod piston pin end with the exhaust (slanted) side of dome facing the starboard side of the connecting rod (oil hole facing up on single hole models, **Figure 68**).

1B. If needle bearings were removed from the connecting rod piston pin end:

a. Position connecting rod with oil hole facing up on single hole models. See **Figure 68**.
b. Wipe inside of piston pin bore with OMC Needle Bearing grease.
c. Install a suitable bushing to act as a spacer and insert needle bearings individually. See **Figure 69**.
d. When all bearings are in place, fit washers at top and bottom of bearing assembly.
e. Hold piston with exhaust (slanted) side of dome facing the starboard side of the connecting rod and carefully fit on rod to prevent disturbing the bearings.

2. Lightly coat wrist pin and lubricate each piston pin hole with a drop or two of Evinrude or Johnson Outboard Lubricant.

NOTE
Position piston in Step 3 to drive piston pin in place from the "L" or "LOOSE" side of the piston. See piston pin boss inside piston skirt for marking.

3. Insert piston pin through piston pin hole and engage connecting rod. Make sure piston

8

dome and connecting rod oil hole (single hole models) are properly oriented. Position piston on the same cradle used to disassemble it and press piston pin in place with the same piston pin tool used to remove it. See **Figure 37**.

4. Install new piston pin retaining rings on each side of the piston using piston pin driver and appropriate cone. See **Figure 70**. Make sure rings fit into grooves in piston pin bore and ring openings face downward.

5. Measure the bottom of 2-15 hp piston skirts at a point parallel with the piston pin and 90° from the piston pin. Compare the measurements. If measurements vary more than 0.002 in., the piston was distorted during assembly and should be replaced.

6. Check end gap of new rings before installing on piston. Place ring in cylinder bore, then square it up by inserting the bottom of an old piston. Do not push ring into bore more than 3/8-1/2 in. Measure the gap with a feeler gauge (**Figure 71**) and compare to specifications (**Table 3**).

7. If ring gap is excessive in Step 5, repeat the step with the ring in the other cylinder. If gap is also excessive in that cylinder, discard and replace with another new ring.

8. If ring gap is insufficient in Step 5, the ends of the ring can be filed slightly. Clean ring thoroughly and recheck gap as in Step 5.

NOTE

The upper ring is a pressure-back type and has a tapered groove which cannot be checked following procedure in Step 9. To check pressure-back ring-to-piston groove fit, install ring on piston. Place a straightedge across the ring groove. See ***Figure 72****. The straightedge should touch on both sides of the ring groove and not touch the ring face. If straightedge does not touch on both sides or touches the ring face, remove ring and clean ring groove.*

9. Once the ring gaps are correctly established, roll the lower ring around the

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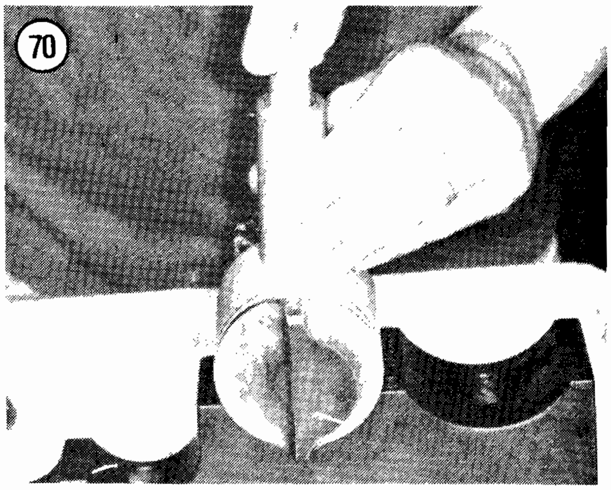

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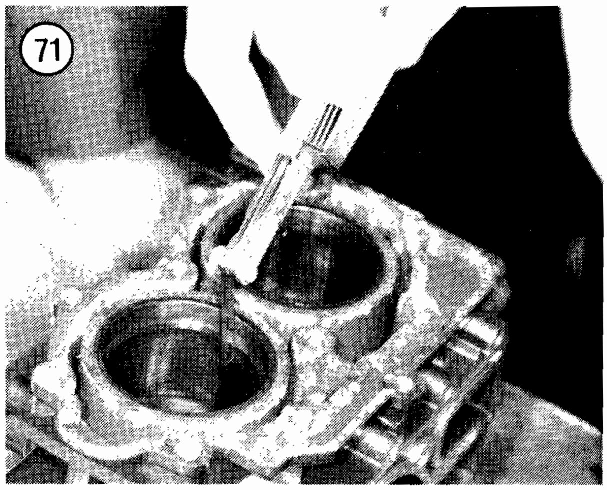

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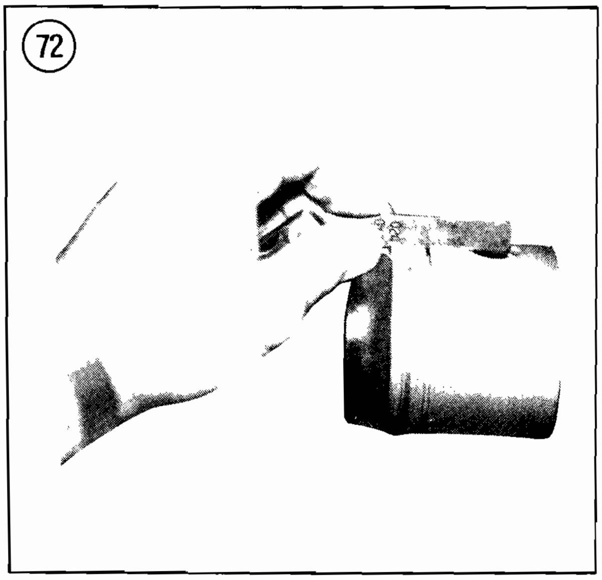

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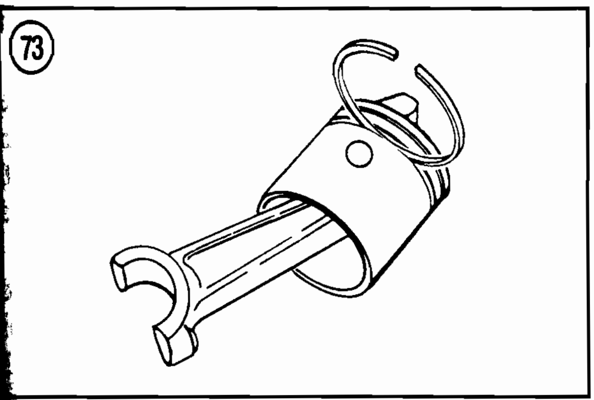

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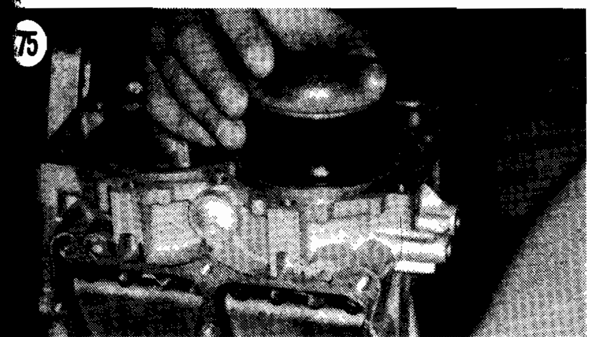

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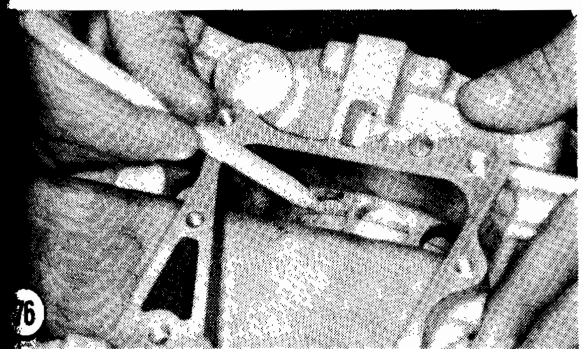


piston ring groove to check for binding or tightness. See **Figure 73**.

10. Install the lower ring on the piston with a ring expander. Spread the ring just enough to fit it over the piston head and into position. See **Figure 74**.

11. Repeat Step 10 to install the upper ring.

12. Position each ring so the piston groove locating pin fits in the ring gap. Proper ring positioning is necessary to minimize compression loss and prevent the ring ends from catching on the cylinder ports.

13. Coat the piston and cylinder bore with Evinrude or Johnson Outboard Lubricant.

   a. Check the piston dome number made during disassembly and match piston with its correct cylinder.
   b. Orient exhaust side of piston to exhaust port side of cylinder block.
   c. Make sure connecting rod oil hole (single hole models) faces flywheel end of engine.
   d. Insert piston into cylinder bore. Recheck ring gap and groove locating pin alignment.
   e. Install ring compressor tool part No. 327017 for 2-4 hp models, part No. 326589 for 5-8 hp models, part No. 326590 for 9.9-15 hp models, part No. 326591 for 20-35 hp models and part No. 326592 for 40 hp models over piston dome and rings.
   f. Hold connecting rod end with one hand to prevent it from scraping or scratching the cylinder bore and slowly push piston into cylinder. See **Figure 75**.

14. Remove the ring installer tool and repeat Step 13 to install the other piston on 2-cylinder engines.

15. Reach through exhaust port and lightly depress each ring with a pencil point or small screwdriver blade. See **Figure 76**. The ring should snap back when pressure is released. If it does not, the ring was broken during piston installation and will have to be replaced.

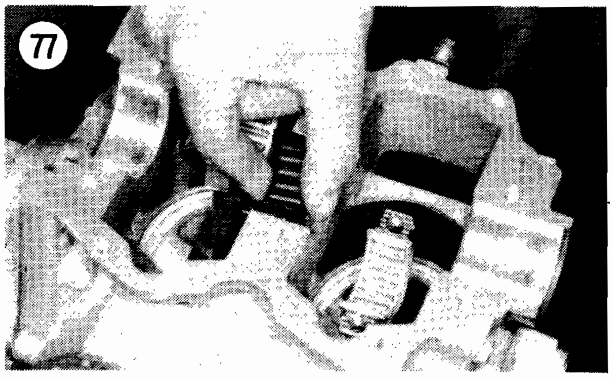
8

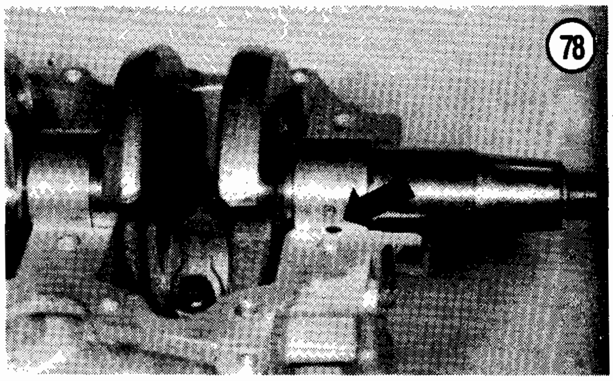
Connecting Rod and Crankshaft Assembly (All Engines)

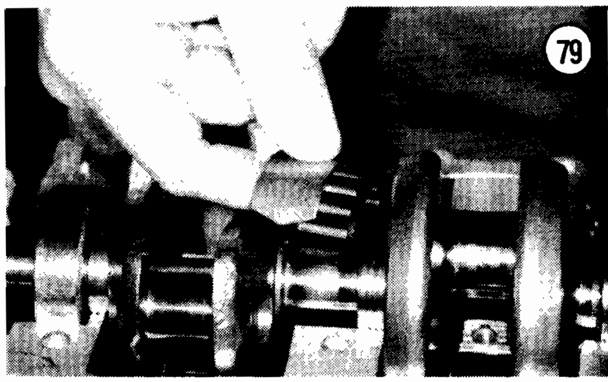
1. On 2 hp, Colt and Junior models, install new upper main bearing (lettered side up) through the bottom of the crankcase. Work carefully to prevent losing the bearing needles and press the bearing case until it is recessed 1/16 in. below the crankcase finish thrust surface.
2. Reinstall upper and lower main ball bearings on crankshaft, if removed. Reinstall upper oil seal.
3. Remove connecting rod caps. Coat connecting rod bearing surfaces with OMC Needle Bearing grease. Install a bearing retainer half and needle bearings in the rod.
4A. If crankshaft center main bearing line uses a sleeve retainer ring, install bearing cages and bearings, fit sleeves in position and install retainer ring.
4B. If center main bearing does not use a sleeve retainer ring, install the center main bearing liner in the block with its pointed end facing the intake side. The locating flange should engage the locating pocket. Install the bearing cage and roller assembly on the liner. See **Figure 77**.
5. Coat outer edge of top crankcase seal with OMC Gasket Sealing Compound.

NOTE
Location of upper and lower bearing holes and dowel pins varies according to model. Determine which is in the block and align the bearings accordingly so pin and hole will mate when crankshaft is installed in Step 6.

6. Lubricate the crankshaft assembly with Evinrude or Johnson Outboard Lubricant and install in cylinder block. Align upper and lower main bearing dowel and pin hole. See **Figure 78** (typical). On crankshafts with a center main bearing sleeve retainer ring, align hole in sleeve with dowel pin in block. Seat crankshaft in place.
7. If crankshaft does not use a retainer sleeve ring, coat the main bearing journal with OMC Needle Bearing grease and install remaining retainer half, needle bearings and sleeve. See **Figure 79**.
8. Draw connecting rod(s) up around crankshaft crankpin journal. Coat crankpins with OMC Needle Bearing grease and install

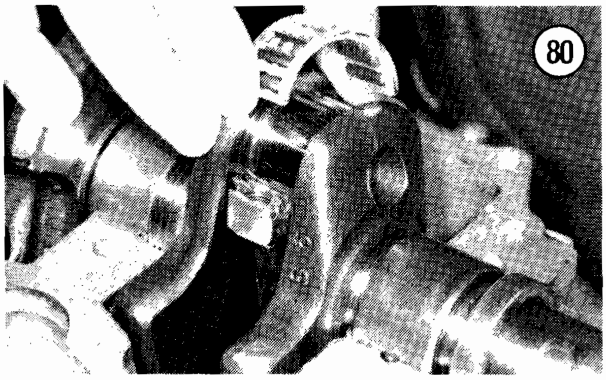






remaining retainer halves and needle bearings on each crankpin (**Figure 80**).

9. Orient the connecting rod cap according to the small raised dots and marks made during disassembly. Install the caps finger-tight.



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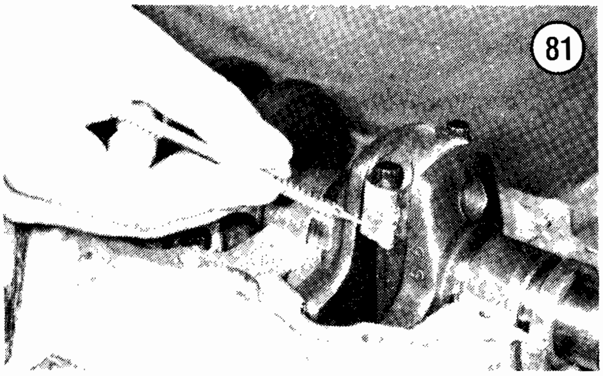

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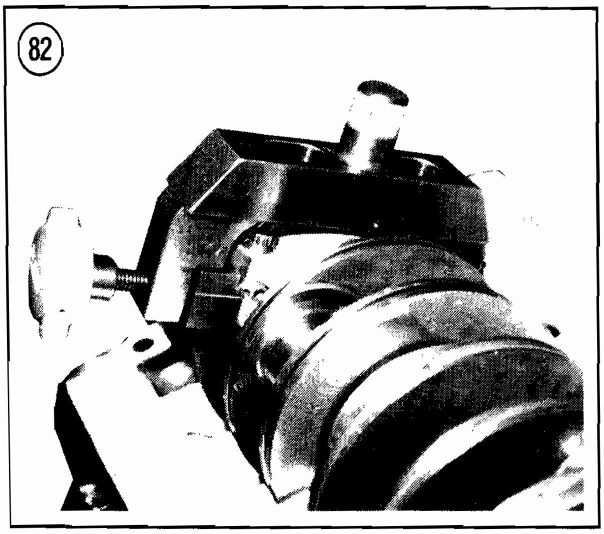

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CAUTION

The procedure detailed in Steps 10A and 10B is very important to proper engine operation as it affects bearing action. If not done properly, major engine damage can result. It can also be a time-consuming and frustrating process. Work slowly and with patience. If alignment was satisfactory when checked during disassembly, it should be possible to achieve a similar alignment on reassembly.

10A. Proceed as follows for all models except 1986-on 20-40 hp models:

NOTE

Some 1985 models are equipped with precision-ground connecting rods. If so equipped, refer to Step 10B.

a. Run a pencil point or dental pick over the rod and cap chamfers to check alignment (**Figure 81**). Refer to notes made during disassembly. Rod and cap must be aligned so that the pencil point or dental pick will pass smoothly across the break line on at least 3 of the 4 corners.
b. If rod and cap alignment is not satisfactory, gently tap cap in direction required with a soft-faced mallet and recheck alignment. Repeat this procedure as many times as necessary to achieve alignment of at least 3 corners.
c. If satisfactory alignment cannot be achieved, the connecting rod and cap should be replaced.
d. Once rod and cap alignment is correct, carefully torque rod caps to specifications (**Table 1**).

10B. Proceed as follows for 1986-on 20-40 hp models:

NOTE

Precision-ground connecting rods are used and require the use of a special alignment fixture to correctly align.

a. Assemble OMC Rod Cap Alignment Fixture part No. 396749 on connecting rod (**Figure 82**, typical) following directions provided with special tool.
b. Once rod and cap alignment is correct, use special torque socket part No. 331638 and a suitable torque wrench and extension and carefully torque rod cap screws to specification (**Table 1**).

11. On 2 hp, Colt and Junior models, install lower bearing housing with a new gasket and tighten to specifications (**Table 1**).
12. Rotate the crankshaft to check for binding. If the crankshaft does not float freely over the full length of the crankpin(s), loosen the rod caps and repeat Step 10A or 10B.

Cylinder Block and Crankcase Assembly (General Procedures)

The cylinder head gasket on some models is impregnated with sealant during manufacture and requires no additional sealer when installed. Check the gasket package to determine if it is this type.

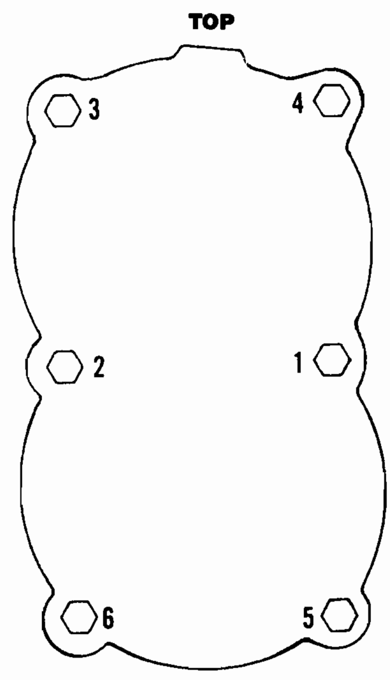
All gaskets which have not been impregnated with sealant should be lightly coated on both sides with OMC Gasket Sealing Compound. The outer diameter of the crankshaft upper seal should also be coated with OMC Gasket Sealing Compound.

The crankcase face on some models is grooved for the use of a spaghetti or rubber seal. The new seal should be fully seated in the grooves and then cut 1/2 in. longer at each end to assure a good butt seal against both crankcase bearings. Run a thin bead of OMC Adhesive M in the groove before installing the seal. Force the seal into the groove and let it set 15-20 minutes. Trim the ends of the seal with a sharp knife, leaving about 1/32 in. of the seal end to butt against the bearings. Apply another thin bead of OMC Adhesive M to the crankcase face. Use care not to apply an excessive amount, as it can squeeze over when the parts are mated and may block oil or water passages.

A motor reassembled with Gel Seal II should set overnight before it is started and run. If the motor must be run the same day, spray the surface opposite to the one coated with Gel Seal II with OMC Locquic Primer and allow several hours for the Gel Seal II to cure.

Gel Seal II starts to cure as soon as the parts are mated. The process is shortened when OMC Locquic Primer has also been used. For this reason, it is important that you install and torque all fasteners as soon as possible. If Gel Seal II starts to set up before the fasteners are torqued, it can act as a shim and result in bearing misalignment, mislocation or tight armature plate bearings.

CYLINDER HEAD
TORQUE SEQUENCE (2.5-8 HP)



83

ylinder Block and Crankcase Assembly
hp, Colt and Junior)

. Install the cylinder head with a new sket.

Install the intake manifold and reed valve sembly with a new gasket.

Install the exhaust cover with a new sket.

Tighten all fasteners to specifications able 1).

Install the magneto cam drive pin and m. Cam side marked "TOP" must face the wheel.

Install the power head as described in this apter.

ylinder Block and Crankcase Assembly
.5-8 hp)

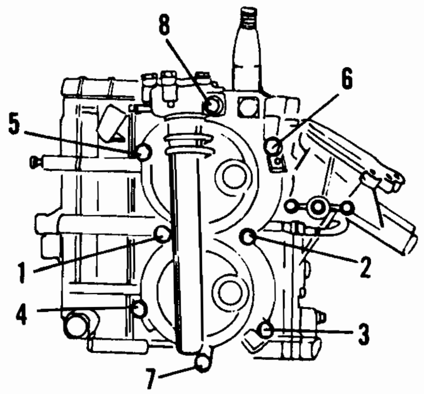
Squeeze a 5/16 in. ball of Gel Seal II on ch crankcase flange. Spread sealant along nge and inside all bolt holes but keep it at st 1/4 in. from seals.

Install crankcase to cylinder block. Install lts finger-tight, then install crankcase taper n(s) with a mallet and punch. Tighten bolts specifications (**Table 1**).

Install lower bearing snap ring (beveled ge facing out) in crankcase.

Install lower crankshaft seal (lip facing t) until it bottoms on the snap ring.

CYLINDER HEAD TORQUE SEQUENCE (9.5 HP)



5. Rotate the crankshaft several turns to check for binding. If crankshaft does not turn easily, disassemble and correct the interference.
6. Install cylinder head with a new gasket. Tighten bolts to specifications (**Table 1**) following the sequence shown in **Figure 83**.
7. 5-8 hp models—Install thermostat with a new seal. Install retainer, spring, new gasket and thermostat cover. Tighten fasteners to specifications (**Table 1**).
8. Reinstall inner exhaust cover with a new gasket, if so equipped. Install outer exhaust cover with a new gasket. Tighten all fasteners finger-tight, then torque to specifications (**Table 1**).
9. Reinstall crankcase hose with new clamps.
10. 2.5 hp, 3 hp, 4 hp Standard, Excel 4 and Ultra 4 models—Install inner flange and tighten screws to specifications (**Table 1**).
11. Install the power head as described in this chapter.

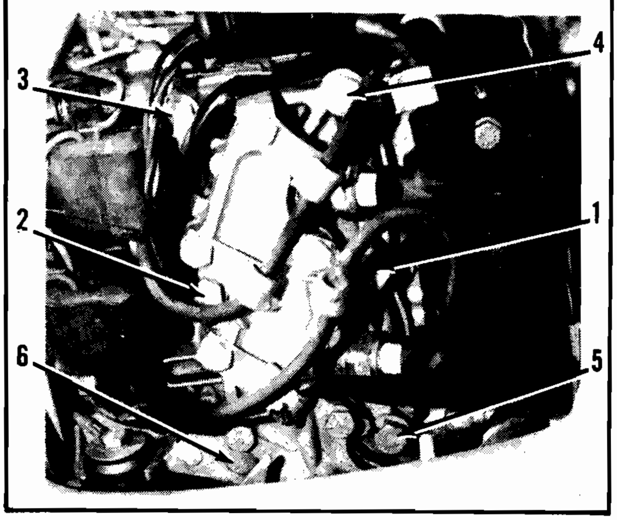
8

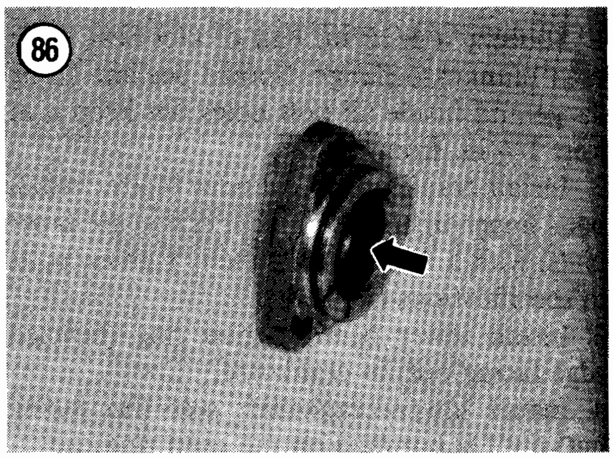
Cylinder Block and Crankcase Assembly (9.5-15 hp)

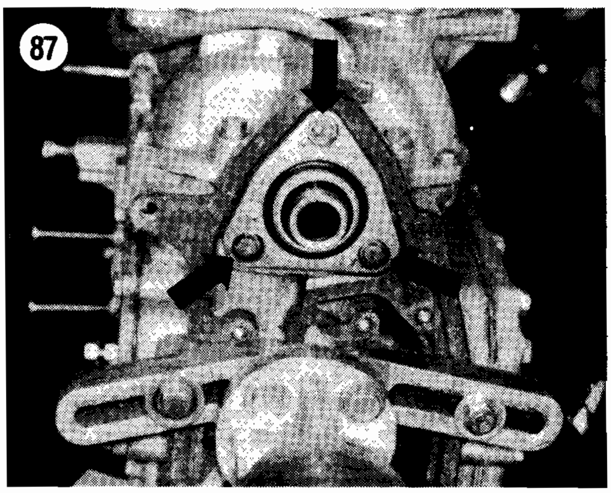
1. Squeeze a 5/16 in. ball of Gel Seal II on each crankcase flange. Spread sealant along flange and inside all bolt holes but keep it at least 1/4 in. from seals.
2. Tap crankshaft toward flywheel end to seat lower bearing.
3. Install crankcase to cylinder block. Wipe the 2 center main bolt threads with Gel Seal II. Install and tighten all fasteners finger-tight.
4. Install crankcase taper pin(s) with a mallet and punch.
5. Rotate the crankshaft several turns to check for binding. If crankshaft does not turn easily, disassemble and correct the interference.
6. Tighten crankcase bolts to specifications (**Table 1**). Start in the center and work outward following a spiral pattern.

7. Wipe the outer diameter of a new upper main bearing seal with OMC Gasket Sealing Compound and install with tool part No. 319872 (1973-1979) or part No. 391060 (1980-on).
8. Wipe the outer diameter of 2 new crankcase head seals with OMC Gasket Sealing Compound. Fit the smaller diameter seal on tool part No. 330251 with its lip facing the large end of the tool. Install the seal in the crankcase head cover until tool touches cover. Remove the tool and repeat the step with the larger diameter seal (lip facing away from tool). When properly installed, the seal lips will face each other.
9. Lubricate a new O-ring with Evinrude or Johnson Outboard Lubricant and install on crankcase head.
10. Install crankcase head and tighten fasteners to specifications (**Table 1**).
11. Install the cylinder head with a new gasket. Tighten fasteners following the sequence shown in **Figure 84** (9.5 hp) or **Figure 85** (9.9-15 hp).
12. Install thermostat with a new seal. Install the thermostat spring.
13. Install the cylinder head cover with a new gasket. Tighten fasteners to specifications (**Table 1**).
14. Install inner and outer exhaust covers with new gaskets. Tighten fasteners to specifications (**Table 1**).
15. Install bypass cover and intake manifold/reed valve assembly with new gaskets. Tighten fasteners to specifications (**Table 1**).
16. Install the power head as described in this chapter.

(85) **CYLINDER HEAD TORQUE SEQUENCE (9.9-15 HP)**

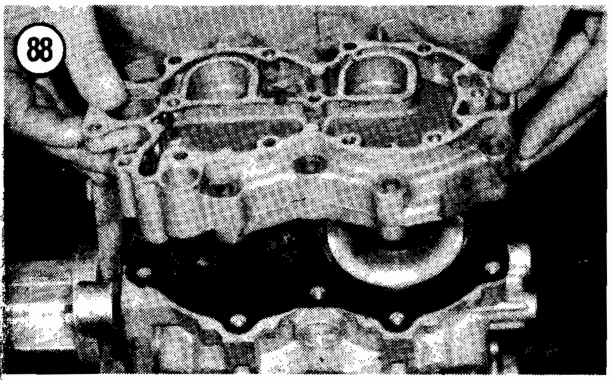






Cylinder Block and Crankcase Assembly (18-40 hp)

1A. Grooved crankcase flange—Install a new spaghetti seal with OMC Adhesive M as described in this chapter.



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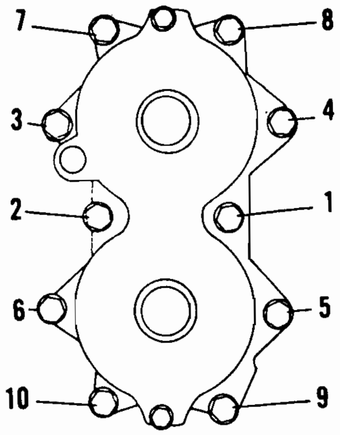
89 **CYLINDER HEAD TORQUE SEQUENCE (18-40 HP)**



. Flat crankcase flange—Squeeze a 5/16 ball of Gel Seal II on each crankcase nge. Spread sealant along flange and inside bolt holes but keep it at least 1/4 in. from ls.

Install crankcase to cylinder block. Install lts finger-tight, then install crankcase taper (s) with a mallet and punch.

Tap the bottom of the crankshaft with a let to seat the lower main bearing. Wipe threads of all bolts which enter crankcase ity through holes with Adhesive M or Gel II as required, then tighten to cifications (**Table 1**). Start with the center ts and work outwards in a clockwise ction.

4. Drive the old seal from the crankcase head (**Figure 86**) with a punch and mallet. Clean the seal bore and wipe the outer diameter of a new seal with OMC Gasket Sealing Compound. Fit seal on tool part No. 321515 with its lip facing the tool. Press seal into crankcase head until tool bottoms against head.
5. Lubricate 2 new O-rings with Evinrude or Johnson Outboard Lubricant and install on crankcase head.
6. Install the lower crankcase head with OMC Gasket Sealing Compound on the screw threads. See **Figure 87**. Tighten to specifications (**Table 1**).

NOTE
If cylinders have been honed, crankshaft will be more difficult to turn by hand in Step 7. In this case, temporarily install flywheel and crankshaft should turn with a minimal effort.

7. Rotate the crankshaft several turns to check for binding. If crankshaft does not turn easily, disassemble and correct the interference.
8. Install the cylinder head with a new gasket (**Figure 88**). Tighten bolts to specifications (**Table 1**) following the sequence shown in **Figure 89**.
9. Install the thermostat with a new seal in the cylinder head cavity. Place the spring on top of the thermostat and install the water cover with a new gasket. See **Figure 90**. Tighten the screws to specifications (**Table 1**). The long screw should be installed below the thermostat.
10. Install the inner and outer exhaust covers with new gaskets. See **Figure 91**. Tighten fasteners to specifications (**Table 1**).
11. Install the bypass cover with a new gasket (**Figure 92**). Tighten fasteners to specifications (**Table 1**).

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12. Install a new reed valve gasket, then install the reed valve. See **Figure 93**. Wipe attaching screw threads with Permatex No. 2 and tighten screw securely.
13. Install the intake manifold with a new gasket (**Figure 94**). Tighten fasteners to specifications (**Table 1**).
14. Connect intake crankcase oil return or recirculation hoses.
15. Install the power head as described in this chapter.

Reed Block Service

The reed block or leaf valve assembly is located behind the intake manifold. **Figure 95** (9.5-15 hp) or **Figure 96** (18-40 hp) show typical reed block assemblies.

The reeds remain in constant contact with the leaf plate until a predetermined crankcase pressure is exerted on them. A reed stop limits the amount of travel from the plate.

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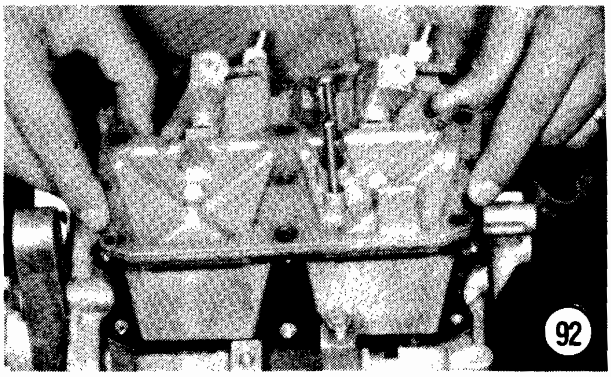

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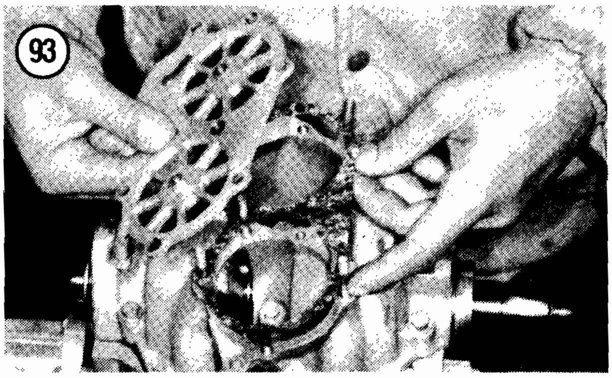

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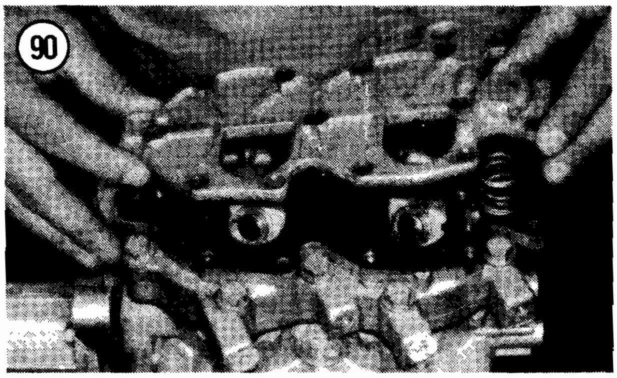

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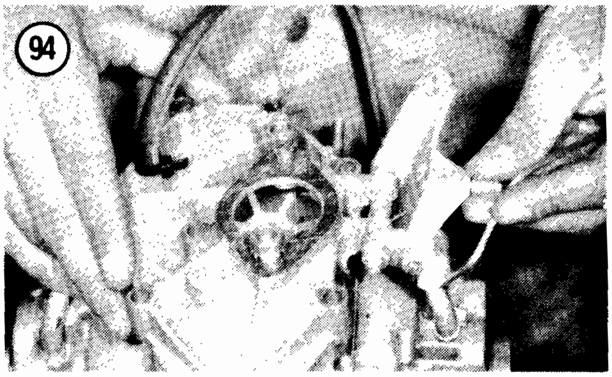

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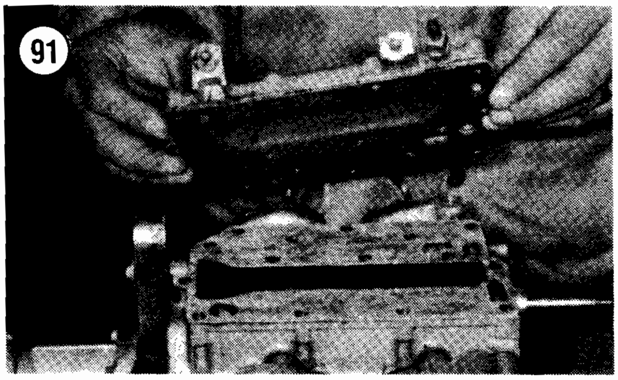
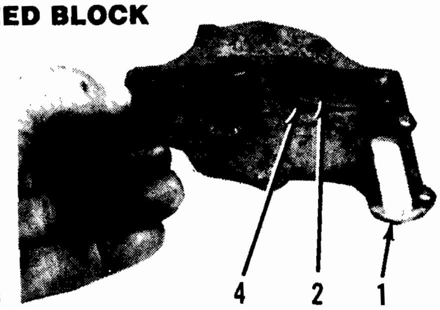
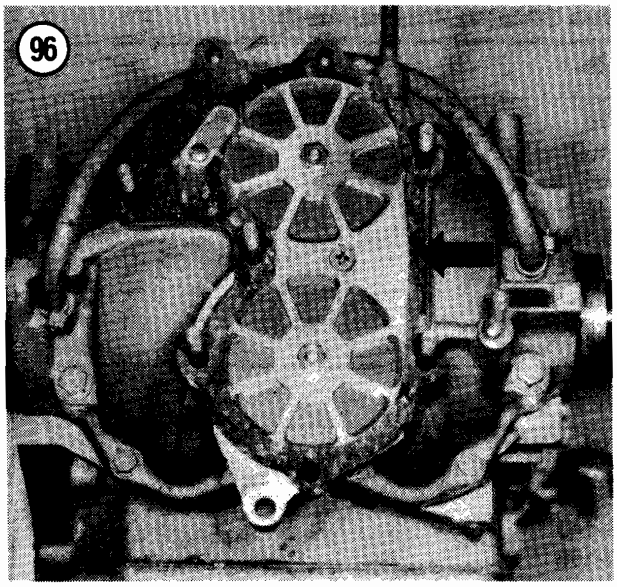


95 **REED BLOCK**



1. Leaf plate
2. Leaf stops
4. Leaf valves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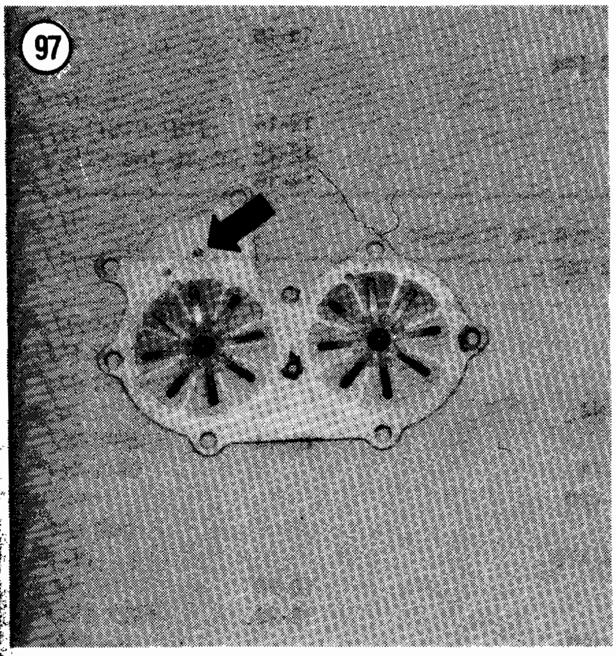
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Once the crankcase pressure is removed, the reed returns to contact the plate.

Reeds and reed stops can be disassembled from the plate for cleaning. Do not attempt to bend or flex the reeds if they are distorted or do not contact the plate as designed. If the reeds or reed stops are defective, replace the entire assembly. Whenever the intake manifold is removed, inspect the reed block for signs of gum and varnish, and broken, chipped or distorted reeds. If gum or varnish is present, remove the screws holding the reed stops and reeds to the plate. Carefully clean all components in OMC Engine Cleaner and reinstall.

Some reed blocks contain a recirculation valve hole and reed; others use a recirculation valve and screen assembly. **Figure 97** shows the recirculation valve hole; **Figure 98** shows the recirculation valve reed on the other side of the plate. These require no service beyond an occasional cleaning in OMC Engine Cleaner to remove any gum or varnish.

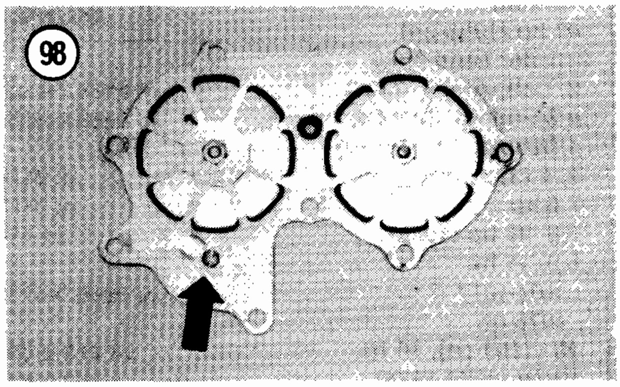
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Table 1 POWER HEAD TIGHTENING TORQUES

Fastener	in.-lb.	ft.-lb.
Bearing housing-to-cylinder		
2 hp, Colt, Junior	60-84	
Connecting rod screws		
2, Colt, Junior, 2.5, 3, 4 Standard, Excel 4, Ultra 4, 4 Deluxe, 4.5, 5, 6, 8 hp	60-70	

(continued)

Table 1 POWER HEAD TIGHTENING TORQUES (continued)

Fastener	in.-lb.	ft.-lb.
7.5 hp	60-70	
9.5 hp	90-100	
9.9, 15 hp (Prior to 1986)	48-60	
9.9, 15 hp (After 1985)	60-70	
20 hp (1973)	180-186	
25 hp (1973-1975)	180-186	
20 (1985-on), 25 (1976-on), 30, 35, 40 hp		30-32
Crankcase-to-block bolts (Main bearing bolts)		
2.5, 3, 4 Standard, Excel 4, Ultra 4, 4 Deluxe, 4.5, 6 (1973), 7.5 hp	60-84	
5, 6 (1981-on), 7.5 (1981-on), 8 hp		12-14
9.5 hp	120-145	
9.9, 15 hp	144-168	
20, 25 hp (1973)		
Upper and lower	110-130	
Center	120-130	
20 (1985-on), 30 hp		14-16
25 hp (1974)	120-144	
25, 35 hp		
1976		12-14
1977-1978		18-20
1979-on		14-16
40 hp (1973-1976)		
Upper and lower	150-170	
Center	162-168	
40 hp (1985-on)		18-20
Cylinder head bolts		
2, Colt, Junior, 2.5, 3, 4 Standard, Excel 4, Ultra 4, 4 Deluxe, 6 hp (1973)	60-84	
5, 6 (1981-on), 8 hp		12-14
7.5 hp	12-14	
9.5, 20 hp (1973)	96-120	
9.9, 15 hp		
1974-1977	145-170	
1978-on		18-20
20 (1985-on), 30 hp		18-20
25 hp (1973-1975)	96-120	
25, 35 hp		
1976		14-16
1977-on		18-20
40 hp (1973-1976)		14-16
40 hp (1985-on)		18-20
Intake manifold bolts	60-84	
Power head-to-exhaust housing		
2-15 hp	60-84	
20 hp (1985-on), 25, 30, 35 hp		16-18
40 hp (1985-on)		18-20
Spark plug		18-20

(continued)

Table 1 POWER HEAD TIGHTENING TORQUES (continued)

Fastener	in.-lb.	ft.-lb.
Standard bolts and nuts		
No. 6	7-10	
No. 8	15-22	
No. 10	25-35	2-3
No. 12	35-40	3-4
1/4 in.	60-80	5-7
5/16 in.	120-140	10-12
3/8 in.	220-240	18-20

Table 2 FLYWHEEL NUT TORQUE

	ft.-lb.
2 hp, Colt, Junior	22-25
2.5, 3 hp, 4 Standard, Excel 4, Ultra 4, 4 Deluxe	30-40
6 (1973), 9.5 hp	40-45
5, 6 (1981-on), 8 hp	40-50
9.9, 15 hp	45-50
20 hp	
1973	40-45
1985-on	100-105
25 hp (1973-1976)	40-45
25 (1977-on), 30, 35, 40 hp	100-105

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Table 3 POWER HEAD SPECIFICATIONS

2 HP, COLT, JUNIOR		
Standard bore size		
1973-1990	1.5668-1.5675 in.	
1989-1990	1.5643-1.5650 in.	
Bore		
1973-1988	1.5625 in.	
1989-1990	1.5650 in.	
Stroke	1.375 in.	
Piston ring		
Width	0.0615-0.0625 in.	
Gap		
1973-1975	0.005-0.015 in.	
1976-on	0.015-0.025 in.	
Side clearance	0.0020-0.0040 in.	
Piston-to-cylinder clearance (1973-1974)	0.0043-0.0055 in.	
Crankshaft bearing clearance		
Upper and lower	Needle bearing	
Crankshaft journal diameter		
Top (1973-1990)	0.7497-0.7502 in.	
Bottom (1973-1988)	0.7497-0.7502 in.	
Bottom (1989-1990)	0.6691-0.6695 in.	
Connecting rod		
Piston end clearance	0.0004-0.0011 in.	
Crankshaft end	Needle bearing	
Crankpin diameter	0.6695-0.6700 in.	(continued)

Table 3 POWER HEAD SPECIFICATIONS (continued)

2.5, 3, 4 STANDARD, EXCEL 4, ULTRA 4, 4 DELUXE AND 4.5 HP	
Standard bore size	1.5643-1.5650 in.
Bore	
1973-1984	1.5625 in.
1985-on	1.565 in.
Stroke	1.375 in.
Piston ring	
Width	0.0615-0.0625 in.
Gap	0.005-0.015 in.
Side clearance	0.0020-0.0040 in.
Piston-to-cylinder clearance	
1973-1978	0.0008-0.0020 in.
1979-1984	0.0018-0.0030 in.
Crankshaft bearing clearance	
Upper	Needle bearing
Center and lower	0.0013-0.0023 in.
Crankshaft journal diameter	
1973-1978	
Top	0.7515-0.7520 in.
Center	0.6849-0.6854 in.
Bottom	0.6849-0.6854 in.
1979-1988	
Top	0.7506-0.7510 in.
Center	0.6685-0.6690 in.
Bottom	0.7498-0.7502 in.
1989-1990	
Top	0.7515-0.7520 in.
Center	0.6685-0.6690 in.
Bottom	0.6691-0.6695 in.
Connecting rod	
Piston end clearance	0.0004-0.0011 in.
Crankshaft end clearance	0.0007-0.0017 in.
Crankpin diameter	
1973-1978	0.6250-0.6255 in.
1979-on	0.6695-0.6700 in.
5, 6, 7.5 AND 8 HP	
Standard bore size	1.9373-1.9380 in.
Bore	1.9375 in.
Stroke	1.700 in.
Piston ring	
Width	0.0615-0.0625 in.
Gap	0.005-0.015 in.
Side clearance	
1973-1979	0.0020-0.0040 in.
1980-1984	0.0020-0.0035 in.
1985-on	0.004 in. max.
Piston-to-cylinder clearance (1973-1984)	0.0018-0.0030 in.
Crankshaft bearing clearance	0.0015-0.0025 in.
Crankshaft journal diameter	
1973-1979	0.8075-0.8080 in.
1980-1987	
Top	0.87225-0.87725 in.
Center	0.8104-0.81545 in.
Bottom	0.7498-0.7562 in.

(continued)

Table 3 POWER HEAD SPECIFICATIONS (continued)

5, 6, 7.5 AND 8 HP (continued)	
Standard bore size	2.3120-2.3130 in.
1989-1990	
Top	0.8762-0.8767 in.
Center	0.8127-0.8132 in.
Bottom	0.6691-0.6695 in.
Connecting rod	
Piston end clearance	0.0003-0.0010 in.
Crankshaft end clearance	Needle bearing
Crankpin diameter	0.6695-0.6700 in.
9.5 HP	
Standard bore size	2.3120-2.3130 in.
Bore	2.3125 in.
Stroke	1.8125 in.
Piston ring	
Width	0.0925-0.0935 in.
Gap	0.007-0.017 in.
Side clearance	0.001-0.0035 in.
Piston-to-cylinder clearance	0.0035-0.0050 in.
Crankshaft bearing clearance	Needle bearings
Crankshaft journal diameter	
Top and bottom	0.8120-0.8125 in.
Center	0.8127-0.8132 in.
Connecting rod	
Piston end	Needle bearing
Crankshaft end	Needle bearing
Crankpin diameter	0.8127-0.8132 in.
9.9 AND 15 HP	
Standard bore size	2.1875-2.1883 in.
Bore	2.188 in.
Stroke	1.760 in.
Piston ring	
Width	
Upper	0.0695-0.0700 in.
Lower	0.0615-0.0625 in.
Gap	0.005-0.015 in.
Side clearance	
1974-1984	0.0025-0.0035 in.
1985-on	0.004 in. max.
Piston-to-cylinder clearance	
1974-1975	0.0040-0.0053 in.
1976-1978	0.0025-0.0053 in.
1979-1984	0.0025-0.0038 in.
Crankshaft bearings	Needle bearing
Crankshaft journal diameter	
1974	
Top, center and bottom	0.8120-0.8125 in.
1975	
Top	0.8752-0.8757 in.
Center and bottom	0.8120-0.8125 in.

(continued)

8

Table 3 POWER HEAD SPECIFICATIONS (continued)

9.9 AND 15 HP (continued)	
1976-1984	
Top	0.8757-0.8762 in.
Center and bottom	0.8120-0.8125 in.
1985-on	
Top	0.8757-0.8762 in.
Center	0.8120-0.8125 in.
Bottom	0.7870-0.7874 in.
Connecting rod	
Piston end clearance	0.0000-0.0005 in.
Crankpin diameter	
1974-1979, 1982	1.6300-1.6350 in.
1980, 1981, 1983, 1985-on	0.8120-0.8125 in.
1984	0.7870-0.7874 in.
20 AND 25 HP (1973-1976)	
Standard bore size	2.45-2.55 in.
Bore	2.50 in.
Stroke	2.25 in.
Piston ring	
Width	
Upper	0.0895-0.0900 in.
Lower	0.0615-0.0625 in.
Gap	0.007-0.017 in.
Side clearance	0.0020-0.0040 in.
Piston-to-cylinder clearance	0.0033-0.0048 in.
Crankshaft bearings	
Upper and lower	Roller bearing
Center	Needle bearings
Crankshaft journal diameter	0.9995-1.0000 in.
Connecting rod	
Piston end	Needle bearing
Crankshaft end	Needle bearing
Crankpin diameter	1.0000-1.0005 in.
20 HP (1982-ON), 25 HP (1976-ON), 28 HP (1987-ON) 30 HP (1984-ON) AND 35 HP (1977-ON)	
Standard bore size	2.9995-3.0005 in.
Bore	3.00 in.
Stroke	2.25 in.
Piston ring	
Width	
Upper	0.0895-0.0900 in.
Lower	0.0615-0.0625 in.
Gap	0.007-0.017 in.
Side clearance	0.0015-0.0040 in.
Piston-to-cylinder clearance	
1975-1978	0.0030-0.0050 in.
1979-1982	0.0035-0.0065 in.
1983-1984	0.001-0.0034 in.
Crankshaft bearings	
Upper and lower	Roller bearing
Center	Needle bearings

(continued)

Table 3 POWER HEAD SPECIFICATIONS (continued)

20 HP (1982-ON), 25 HP (1976-ON), 28 HP (1987-ON) 30 HP (1984-ON) AND 35 HP (1977-ON) (continued)	
Crankshaft journal diameter	
Top	
1975-1977	1.2495-1.2500 in.
1978-on	1.2510-1.2515 in.
Center	
1975-1977	0.9995-1.0000 in.
1978-1982	1.1810-1.1815 in.
1983-on	1.1833-1.1838 in.
Bottom	0.9842-0.9846 in.
Connecting rod	
Piston end	Needle bearing
Crankshaft end	Needle bearing
Crankpin diameter	1.1823-1.1828 in.
40 HP (1973-1976)	
Standard bore size	3.1860-3.1875 in.
Bore	3.1875 in.
Stroke	2.75 in
Piston ring	
Width	
Upper	0.0895-0.0900 in.
Lower	0.0615-0.06525 in.
Gap	0.007-0.017 in.
Side clearance	0.0015-0.0040 in.
Piston-to-cylinder clearance	0.0030-0.0050 in.
Crankshaft bearings	
Upper and center	Needle bearing
Lower	Roller bearing
Crankshaft journal diameter	
Top	1.4974-1.4979 in.
Center	1.3748-1.3752 in.
Bottom	1.1810-1.1815 in.
Connecting rod	
Piston end	Needle bearing
Crankshaft end	Needle bearing
Crankpin diameter	1.1823-1.1828 in.
40 HP (1985-ON)	
Standard bore size	3.1870-3.1880 in.
Bore	3.1875 in.
Stroke	2.820 in.
Piston ring	
End gap	0.007-0.017 in.
Groove side clearance (lower)	0.004 in. max.
Crankshaft	
Journal diameter	
Top	1.4974-1.4979 in.
Center	1.3748-1.3752 in.
Bottom	1.1810-1.1815 in.
Crankpin diameter	1.1823-1.1828 in.

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Chapter Nine

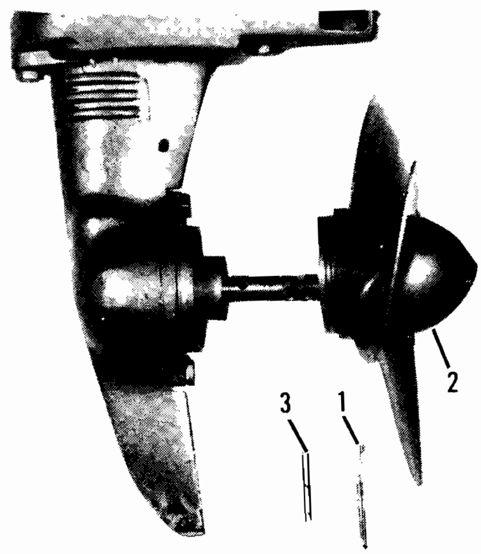
Gearcase

Torque is transferred from the engine crankshaft to the gearcase by a drive shaft. A pinion gear on the drive shaft meshes with a drive gear in the gearcase to change the vertical power flow into a horizontal flow through the propeller shaft. On Johnson and Evinrude outboards with a shift capability, a sliding clutch engages a forward or reverse gear in the gearcase. This creates a direct coupling that transfers the power flow from the pinion to the propeller shaft.

The gearcase can be removed without removing the entire outboard from the boat. This chapter contains removal, overhaul and installation procedures for the propeller, gearcase and water pump. **Table 1** (specifications) and **Table 2** (tightening torques) are at the end of the chapter.

The gearcases covered in this chapter differ somewhat in design and construction and thus require slightly different service procedures. The chapter is arranged in a normal disassembly/assembly sequence.

PROPELLER COMPONENTS



1. Cotter pin
2. Propeller
3. Drive pin

1

When only a partial repair is required, follow the procedure(s) for your gearcase to the point where the faulty parts can be replaced, then reassemble the unit.

Since this chapter covers a wide range of models, the gearcases shown in the accompanying pictures are the most common ones. While it is possible that the components shown in the pictures may not be identical with those being serviced, the step-by-step procedures may be used with all models covered in this manual.

PROPELLER

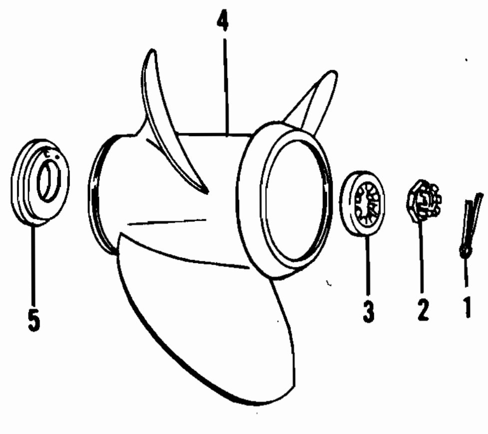
Johnson and Evinrude outboards use variations of 2 propeller attachment designs. Smaller gearcases use a drive pin that engages a slot in the propeller hub, which is retained by a cotter pin (**Figure 1**). On some models, the cotter pin passes through a cone-type nut that is separate from the propeller.

In this design, a metal pin installed in the propeller shaft engages a recessed slot in the propeller hub. As the shaft rotates, the pin rotates the propeller. The drive pin is designed to break if the propeller hits an obstruction in the water. This design has 2 advantages. The pin absorbs the impact to prevent possible propeller damage. It also alerts the user to the fact that something is wrong, since the engine speed will increase if the pin breaks.

Propellers on the larger gearcases ride on thrust bearings and are retained by a castellated nut and cotter pin (**Figure 2**). An underwater impact is absorbed by the propeller hub.

(2)

PROPELLER COMPONENTS



1. Cotter pin
2. Castellated nut
3. Thrust washer
4. Propeller
5. Thrust bearing

Removal/Installation

1. To remove the propeller on smaller units:
   a. Remove and discard the cotter pin.
   b. Pull the propeller or propeller and nut off the propeller shaft.
   c. Remove and discard the drive pin from the propeller shaft. Inspect the pin engagement slot in the propeller hub for wear or damage.
   d. Installation is the reverse of removal. Lubricate the propeller shaft with OMC Triple-Guard grease. Use a new drive pin and cotter pin.
2. To remove the propeller on larger units:
   a. Remove and discard the cotter pin.
   b. Remove the castellated nut.
   c. Remove the thrust washer, propeller and thrust bearing assembly from the propeller shaft.
   d. Installation is the reverse of removal. Lubricate propeller shaft with OMC Triple-Guard grease and use a new cotter pin.

WATER PUMP

Johnson and Evinrude outboards use a volume-type or a pressure-type water pump. The 2 can be distinguished by the size and shape of the impeller. Volume-type water pumps use a thin impeller with long vanes;

pressure-type pumps have a thick impeller with short vanes. Both types are serviced in essentially the same manner. An optional chrome water pump available for some models is recommended for use in areas where the water contains considerable sand or silt.

The water pump impeller is secured to the drive shaft by a key that fits between a flat area on the drive shaft and a similar cutout in the impeller hub. As the drive shaft rotates, the impeller rotates with it. Water between the impeller blades and pump housing is pumped up to the power head through the water tube.

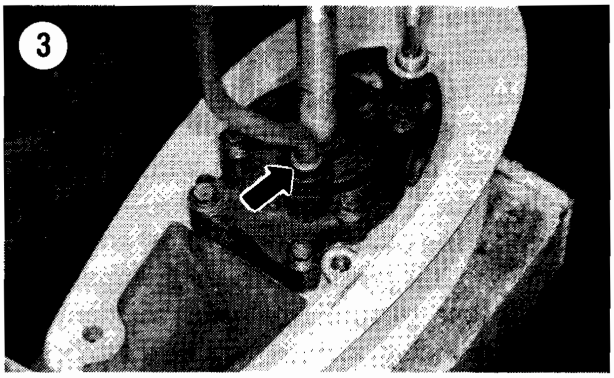
All seals and gaskets should be replaced whenever the water pump is removed. Since proper water pump operation is critical to outboard operation, it is also a good idea to install a new impeller at the same time.

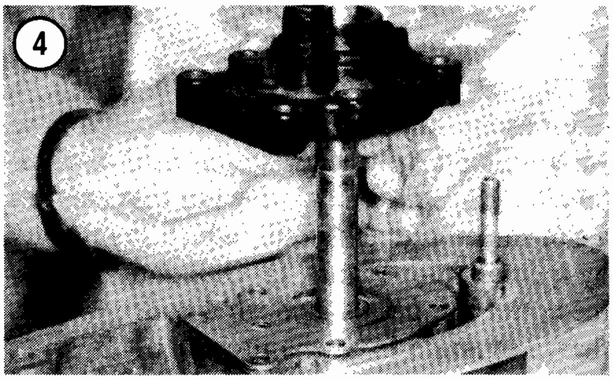
Do not turn a used impeller over and reuse it. The impeller rotates clockwise with the drive shaft and the vanes gradually take a "set" in one direction. Turning the impeller over will cause the vanes to move in a direction opposite to that which caused the "set." This will result in premature impeller failure and can damage a power head extensively.

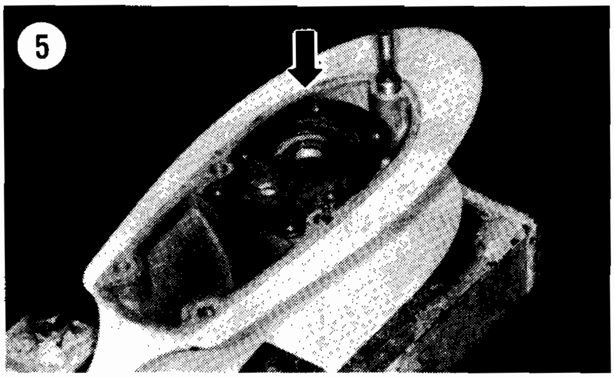
Removal and Disassembly

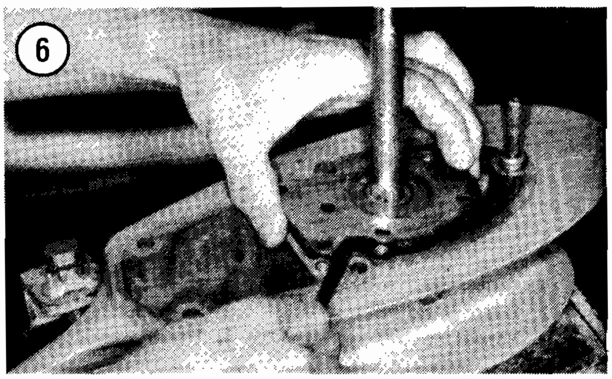
1. Secure the gearcase in a holding fixture or a vise with protective jaws. If protective jaws are not available, position the gearcase upright in the vise with the skeg between wooden blocks.
2. Remove the water tube from the pump housing. See **Figure 3**.

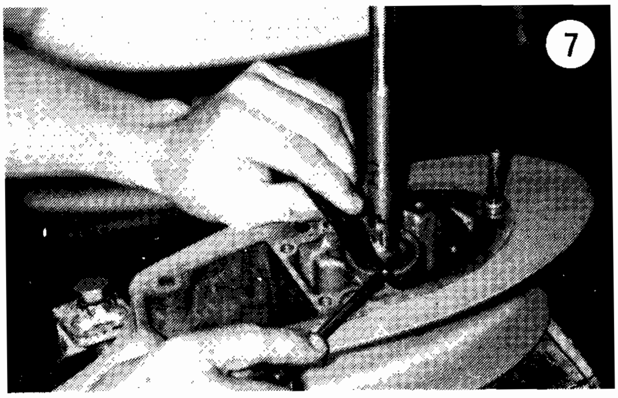
NOTE
Hold the drive shaft in place on 2 hp gearcases during Step 3 to prevent it from moving up enough to dislodge the pinion gear.

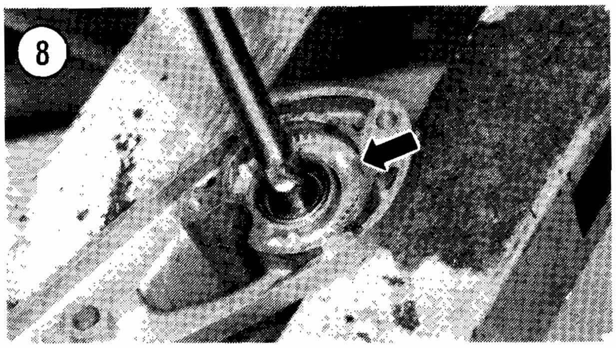


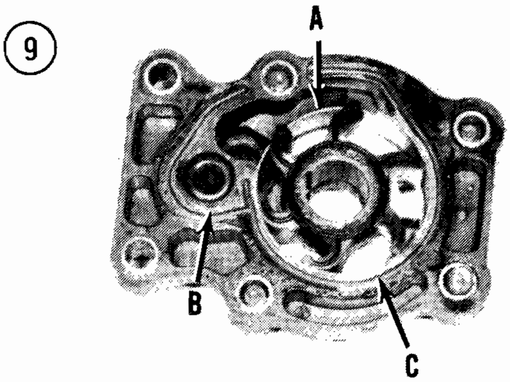


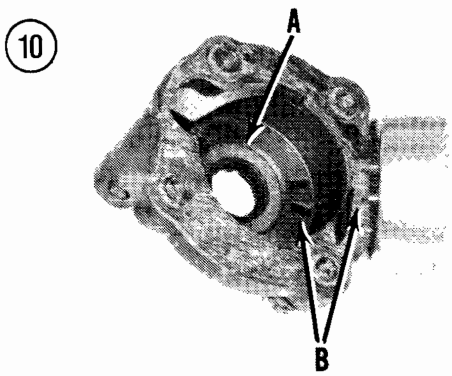












3. Remove the impeller housing screws and washers. Insert screwdrivers at the fore and aft ends of the impeller housing and pry it loose.

NOTE
In extreme cases, the impeller hub may have to be split with a hammer and chisel to remove it in Step 4.

4. Slide the impeller housing up and off the drive shaft **(Figure 4)**.
5A. 2 hp, Colt and Junior gearcase—Remove the impeller from the gearcase cavity. This completes water pump disassembly on this model.
5B. All others—If the impeller did not come off with the impeller housing, carefully pry the impeller up and off the shaft. Remove the drive key.
6. Remove and discard the top impeller plate gasket, if loose. See **Figure 5**. If it is not loose, remove in Step 7 with impeller plate.
7. Carefully pry the impeller plate loose with a screwdriver (**Figure 6**), then slide the plate and gasket (if used) up and off the drive shaft. Discard the gasket.
8. If the bottom impeller plate gasket did not come free with the impeller plate, carefully loosen with a screwdriver tip and scrape off the housing. See **Figure 7**.
9. Remove the nylon water intake screen from the gearcase cavity (**Figure 8**), if so equipped.

Cleaning and Inspection

When removing seals from impeller housing, note and record the direction in which the lip of each seal faces for proper reinstallation.
1. Invert the impeller housing and remove the impeller and impeller cup (A, **Figure 9**).
2. Remove and discard the O-ring or drive shaft seal under the impeller cup. The seal is shown in A, **Figure 10**.

3. Remove and discard the shift rod O-ring and bushing (B, **Figure 9**) and spaghetti seal (C, **Figure 9**), if so equipped.

4. Turn the housing right side up and remove and discard the water tube grommet (**Figure 11**). Remove and discard the O-ring, if used.

5. Check the housing for cracks, distortion or melting. Replace as required.

6. Clean all metal parts in solvent and blow dry with compressed air, if available.

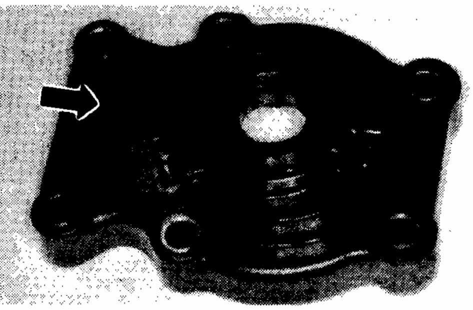
7. Carefully remove all gasket residue from the mating surfaces.

8. Check impeller plate and cup for grooving or rough surfaces. Replace if any defects are found.

9. If original impeller is to be reused, check bonding to hub. Check side seal surfaces and vane ends for cracks, tears, wear or a glazed or melted appearance. See **Figure 12**. If any of these defects are noted, do *not* reuse impeller.

10. Check nylon water intake screen for blockage, distortion or other defects. Replace as required.

11



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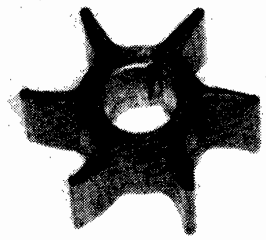

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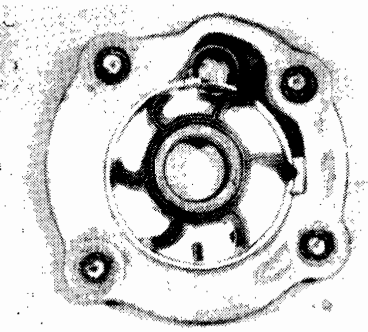


Assembly and Installation

When a new seal is installed in the impeller housing, its lips should face in the direction recorded during disassembly. After installation, wipe the seal lips with OMC Triple-Guard grease.

1A. If impeller housing uses a drive shaft seal, wipe the seal casing with OMC Gasket Sealing Compound and install with a suitable driver.

1B. If impeller housing uses an O-ring, install a new one in the housing groove.

2. Lubricate a new shift rod bushing and O-ring (if used) with OMC HI-VIS Gearcase Lubricant and install in impeller housing.

3. 2 hp, Colt and Junior gearcase—Install a new water tube seal in the impeller housing and proceed to Step 10.

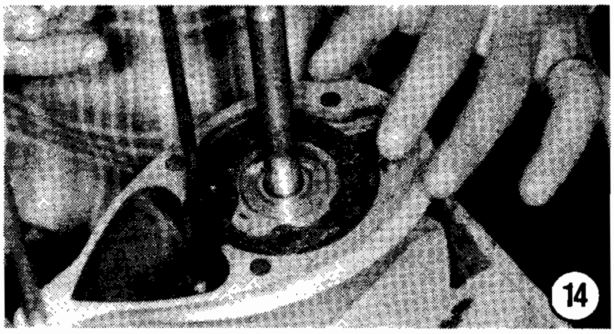
NOTE

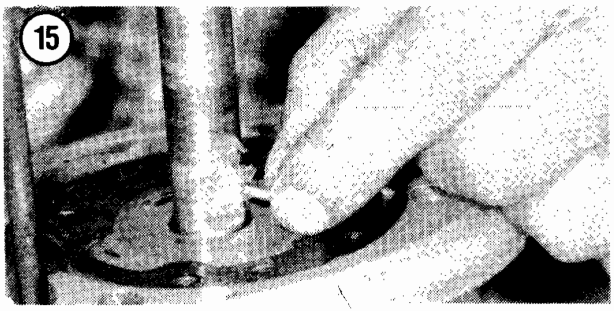
Always install a new impeller cup when the impeller is replaced.

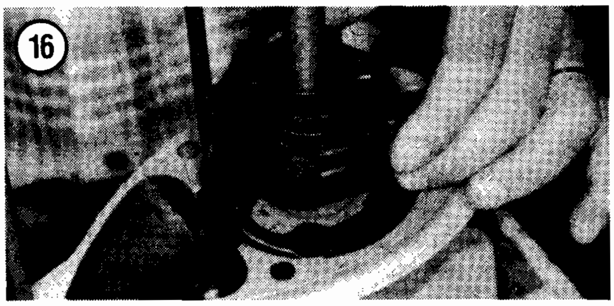
4. Align the impeller cup tabs with the housing cutouts (B, **Figure 10**) and install the cup.

CAUTION

*If the original impeller is to be reused, install it in the same rotational direction as removed to avoid premature failure. The curl of the blades should be positioned as shown in **Figure 13**.*







5. Lubricate the inside diameter of the impeller cup with a light coat of OMC HI-VIS Gearcase Lubricant and install the impeller with a downward rotating motion.
6. Coat the outside diameter of a new water tube grommet with OMC Adhesive M. Install grommet so its bosses will fit into the holes in the impeller housing.
7. If impeller housing uses a spaghetti seal (C, **Figure 9**), apply a thin coat of OMC Adhesive M to seal groove, then install the new seal.
8. Install nylon water intake screen in gearcase cavity, if used. See **Figure 8**.
9A. 9.9 and 15 hp—Run a thin bead of OMC Adhesive M on the machined surface of the gearcase that mates with the impeller plate, then install the plate.
9B. All others—Coat both sides of a new impeller plate gasket with OMC Gasket Sealing Compound and install on the gearcase. Install impeller plate. Coat both sides of a second gasket and install. Align gasket and impeller plate holes with those in the gearcase. See **Figure 14**.
10. Coat the drive shaft key flat with OMC Needle Bearing Grease and install the drive key (**Figure 15**).
11. 2 hp, Colt and Junior gearcase—Coat bottom surface of impeller housing with OMC Adhesive M.
12. Lightly lubricate the drive shaft splines with OMC HI-VIS Gearcase Lubricant and slide the impeller housing and impeller over the drive shaft.
13. Rotate the drive shaft as required to align the drive key with the impeller groove. Press the impeller housing down with a smooth, even motion so impeller hub groove will ride over drive key. See **Figure 16**.

CAUTION
Housing fastener torque is important in Step 14. Excessive torque can cause the pump to crack during operation; insufficient torque may result in leakage and exhaust induction which will cause overheating.

14. Wipe all impeller housing fastener threads with OMC Gasket Sealing Compound and install with washers (if used). See **Figure 17**. Tighten fasteners to specifications (**Table 2**).

GEARCASE

Removal/Installation (2 hp, Colt, Junior, 2.5 hp, 3 hp, Excel 4, Ultra 4 and 4 hp)

1. Disconnect the spark plug lead as a safety precaution to prevent any accidental starting of the engine during lower unit removal.

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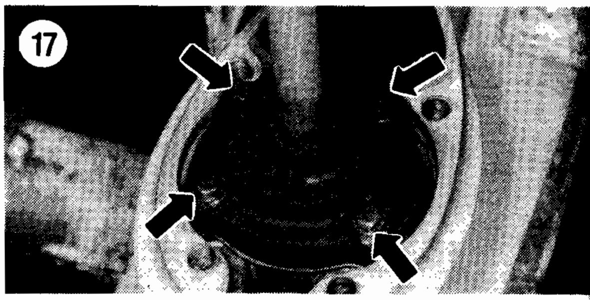
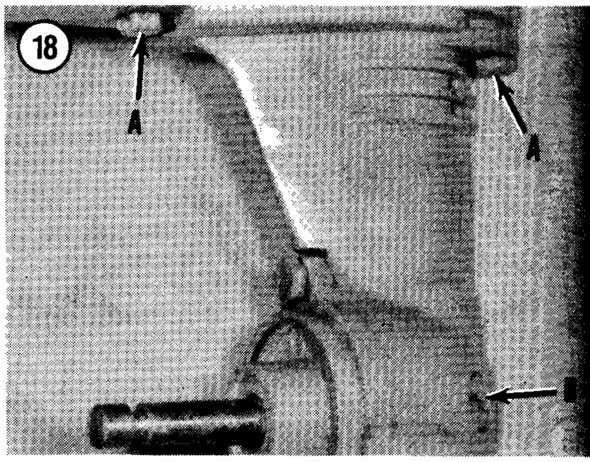
2. Remove the propeller as described in this chapter.
3. Remove the 4 screws (4 hp weedless) or the 2 screws (all other models) holding the gearcase to the exhaust housing. See A, **Figure 18** for all models except 4 hp weedless.
4. Carefully separate the gearcase from the exhaust housing to prevent damage to the water tube and drive shaft, then remove gearcase.
5. Remove the fill/drain plug(s). The 2 hp, Colt, Junior, 4 hp weedless and 1973-1980 4 hp models use a single plug (B, **Figure 18**); the 2.5 hp, 3 hp, Excel 4, Ultra 4 and 1981-on 4 hp models have separate fill and drain plugs. Hold the gearcase over a container. Drain the lubricant from the unit.

NOTE
If the lubricant is creamy in color or metallic particles are found in Step 6, the gearcase must be completely disassembled to determine and correct the cause of the problem.

6. Wipe a small amount of lubricant on a finger and rub the finger and thumb together. Check for the presence of metallic particles in the lubricant. Note the color of the lubricant. A white or creamy color indicates water in the lubricant. Check the drain container for signs of water separation from the lubricant.
7. If the water tube remained in the exhaust housing, remove it from the grommet.
8. On 2.5 hp, 3 hp, Excel 4, Ultra 4 and 4 hp models, remove and discard the drive shaft O-ring.
9. Mount the gearcase in a suitable holding fixture.
10. To reinstall the gearcase, lubricate the exhaust housing water tube grommet with liquid soap.
11. On 2.5 hp, 3 hp, Excel 4, Ultra 4 and 4 hp models, install a new drive shaft O-ring.



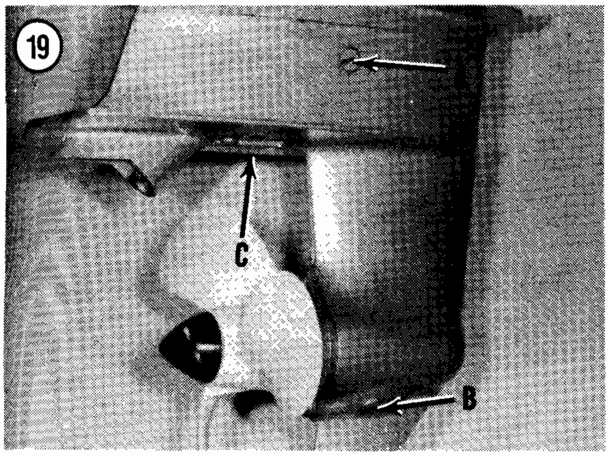


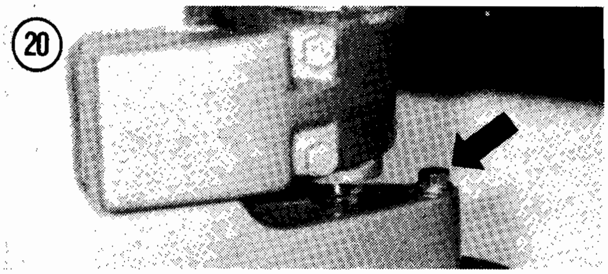
CAUTION
Do not grease the top of the drive shaft in Step 12. This may excessively preload the drive shaft and crankshaft when the mounting bolts are tightened and cause a premature failure of the power head or gearcase.

12. Lightly lubricate the drive shaft splin with OMC Moly Lube.

CAUTION
Do not rotate the flywheel counterclockwise in Step 13. This can damage the water pump impeller.

13. Position gearcase under exhaust housin and align water tube with grommet and driv shaft splines with the crankshaft. On Excel 4 Ultra 4 and 1981-on 4 hp models, also alig the shift rod to engage the shift rod bushin Push the gearcase into place, rotating th flywheel clockwise as required to let the driv shaft and crankshaft engage.





14. Wipe gearcase screw threads with OMC Gasket Sealing Compound. Install screws and tighten to specifications (**Table 2**).
15. Install the propeller as described in this chapter.
16. Reconnect the spark plug lead and refill the gearcase with the proper type and quantity of lubricant. See Chapter Four.

Removal/Installation (4 Deluxe, 4.5, 5, 6 1982-on, 7.5 and 8 hp)

1. Disconnect the spark plug leads as a safety precaution to prevent any accidental starting of the engine during lower unit removal.
2. Place a container under the gearcase. Remove the oil level plug (A, **Figure 19**), then remove the drain/fill plug (B, **Figure 19**). Drain the lubricant from the unit.

NOTE
If the lubricant is creamy in color or metallic particles are found in Step 3, the gearcase must be completely disassembled to determine and correct the cause of the problem.

3. Wipe a small amount of lubricant on a finger and rub the finger and thumb together. Check for the presence of metallic particles in the lubricant. Note the color of the lubricant. A white or creamy color indicates water in the lubricant. Check the drain container for signs of water separation from the lubricant.
4. Remove the propeller as described in this chapter.
5. Move the shift lever into FORWARD. If necessary, rotate the propeller shaft slightly to help unit engage.
6. Remove the gearcase screw just below the lower steering pivot point (**Figure 20**).
7. Remove the 2 gearcase attaching screws at the rear of the zinc anode cavity (C, **Figure 19**).
8. Separate the gearcase from the exhaust housing and remove from the unit.
9. Remove and discard the drive shaft O-ring.
10. Mount the gearcase in a suitable holding fixture.
11. To reinstall the gearcase, lubricate the exhaust housing water pump grommet with liquid soap.
12. Install a new drive shaft O-ring.
13. Make sure the shift lever is in FORWARD gear.

CAUTION
Do not grease the top of the drive shaft in Step 14. This may excessively preload the drive shaft and crankshaft when the mounting bolts are tightened and cause a premature failure of the power head or gearcase.

14. Lightly lubricate the drive shaft splines with OMC Moly Lube.

CAUTION
Do not rotate the flywheel counterclockwise in Step 15. This can damage the water pump impeller.

15. Position gearcase under exhaust housing. Align water tube with grommet, drive shaft with crankshaft splines and the shift rod with the shift rod bushing. Push the gearcase into place, rotating the flywheel clockwise as required to let the drive shaft and crankshaft engage.
16. Install gearcase screws and tighten to specifications (**Table 2**).
17. Install the propeller as described in this chapter.
18. Reconnect the spark plug leads and refill the gearcase with the proper type and quantity of lubricant. See Chapter Four.

Removal/Installation (1973-1979 6; All 9.5, 9.9, 15 and 40 hp)

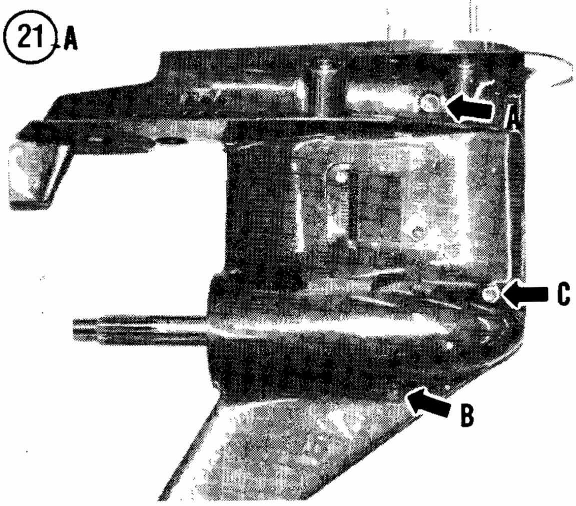
1. Disconnect the spark plug leads as a safety precaution to prevent any accidental starting of the engine during lower unit removal.

NOTE
Figure 21 *shows the plugs on the starboard side. On some earlier models, they are located on the port side.*

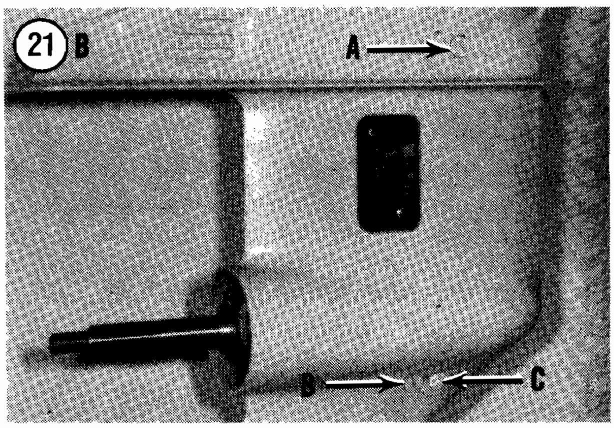
2A. 1989 and 1990 40 hp—Place a container under the gearcase. Remove the oil level plug (A, **Figure 21A**), then remove the slotted head drain/fill plug (B, **Figure 21A**). Do *not* remove the Phillips head pivot pin (C, **Figure 21A**). Drain the lubricant from the unit.
2B. All other models—Place a container under the gearcase. Remove the oil level plug (A, **Figure 21B**), then remove the slotted head drain/fill plug (B, **Figure 21B**). Do *not* remove the Phillips head pivot pin (C, **Figure 21B**). Drain the lubricant from the unit.

NOTE
If the lubricant is creamy in color or metallic particles are found in Step 3, the gearcase must be completely disassembled to determine and correct the cause of the problem.

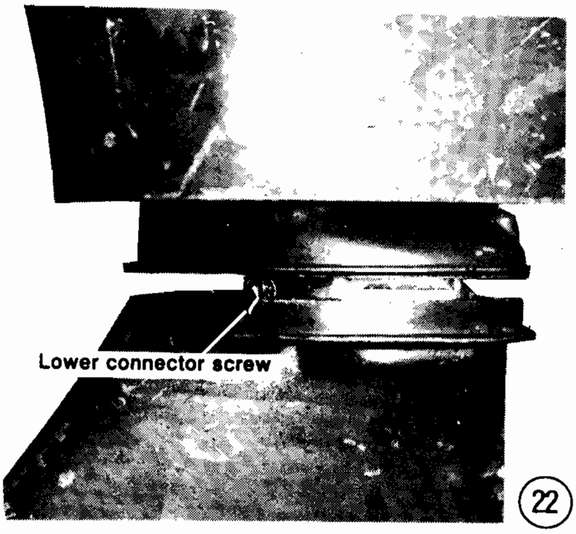
21A



21B



3. Wipe a small amount of lubricant on a finger and rub the finger and thumb together. Check for the presence of metallic particles in the lubricant. Note the color of the lubricant. A white or creamy color indicates water in the lubricant. Check the drain container for signs of water separation from the lubricant.
4. Remove the propeller as described in this chapter.
5A. 1985-on 40 hp—Remove shift rod retaining screw from shift cam located in bottom of engine pan.
5B. All other models—Move the shift lever into FORWARD. If necessary, rotate the propeller shaft slightly to help unit engage.
6. Remove the 4 or 6 screws holding the gearcase to the exhaust housing. If equipped



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with an extension housing, remove the extension-to-exhaust housing screws.
7. All models except 1985-on 40 hp—Separate the gearcase or gearcase extension from the exhaust housing enough to expose the shift rod connector. Remove the lower connector screw. See **Figure 22.**
8. Remove the gearcase or gearcase and extension from the exhaust housing.
9. If so equipped, remove and discard the drive shaft O-ring.
10. Mount the gearcase in a suitable holding fixture. On models with a gearcase extension, remove the extension from the gearcase.
11. To reinstall the gearcase, install the extension, if so equipped, and make sure the extension exhaust seal is in place.
12. If so equipped, install a new drive shaft O-ring.
13. All models except 1985-on 40 hp—Pull up on the shift rod to engage REVERSE gear. Make sure the shift lever on the motor is in the REVERSE position.

CAUTION
Do not grease the top of the drive shaft in Step 14. This may excessively preload the drive shaft and crankshaft when the mounting bolts are tightened and cause a premature failure of the power head or gearcase.

14. Lightly lubricate the drive shaft splines with OMC Moly Lube. Apply a thin bead of OMC Adhesive M to the machined area of the gearcase directly to the rear of the water pump.

CAUTION
Do not rotate the flywheel counter-clockwise in Step 15. This can damage the water pump impeller.

NOTE
If drive shaft has a pin installed in its end, the pin must be aligned with the pin slot in the exhaust housing in Step 15.

15. Position gearcase under exhaust housing. Align extension housing water tube with impeller housing grommet, drive shaft with crankshaft splines and the shift rod with the shift rod connector or cam. Push the gearcase into position until the shift rod connector or cam screw can be installed, rotating the flywheel clockwise as required to let the drive shaft and crankshaft engage. 9
16A. 1985-on 40 hp—Install shift rod retaining screw in shift cam located in bottom of engine pan and securely tighten.
16B. All other models—Install and tighten the shift rod connector screw securely. See **Figure 22.** Seat the gearcase against the exhaust housing.
17. Wipe gearcase or extension screw threads with OMC Gasket Sealing Compound. Install screws and tighten to specifications (**Table 2**).
18. Install the propeller as described in this chapter.
19. Reconnect the spark plug leads and refill the gearcase with the proper type and quantity of lubricant. See Chapter Four.

Removal/Installation (18, 20, 25, 28 and 35 hp)

1. Disconnect the spark plug leads as a safety precaution to prevent any accidental starting of the engine during lower unit removal.
2. Place a container under the gearcase. Remove the oil level plug, then remove the slotted head drain/fill plug. Do *not* remove the Phillips head pivot pin. Drain the lubricant from the unit.

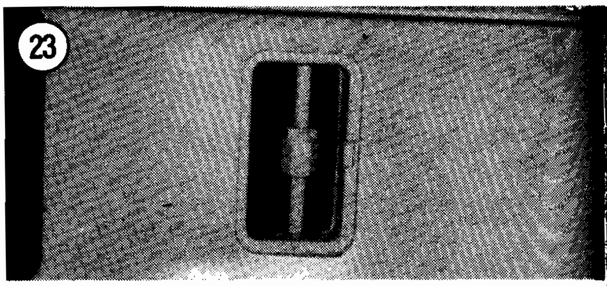
NOTE
If the lubricant is creamy in color or metallic particles are found in Step 3, the gearcase must be completely disassembled to determine and correct the cause of the problem.

3. Wipe a small amount of lubricant on a finger and rub the finger and thumb together. Check for the presence of metallic particles in the lubricant. Note the color of the lubricant. A white or creamy color indicates water in the lubricant. Check the drain container for signs of water separation from the lubricant.
4. Remove the propeller as described in this chapter.
5. Move the shift lever into FORWARD. If necessary, rotate the propeller shaft slightly to help unit engage.

6A. 1985-on 20 and 25 hp, 30 hp and 1982-on 35 hp—Remove the water intake screen on both sides of the gearcase to provide access to the shift rod connector (**Figure 23**). Hold the lower connector with a 1/2 in. open-end wrench and turn the upper connector with a second wrench. When the shift rod disengages, remove and keep the plastic keeper between the connectors.

6B. All others—Remove the exhaust housing cover plate and gasket to provide access to the shift rod connector screw. See **Figure 24**. Remove the lower connector screw.

7. Remove the fasteners holding the gearcase to the exhaust housing. Some models use a nut and 2 screws on each side (**Figure 25**) while others use 5 screws. If equipped with an extension housing, remove the extension-to-exhaust housing fasteners.
8. Carefully withdraw the gearcase or gearcase extension from the exhaust housing. If the impeller housing spacer (arrow, **Figure 26**) does not come out with the gearcase, remove it from the extension housing and discard the O-rings.
9. Mount the gearcase in a holding fixture. On models with a gearcase extension, remove the extension from the gearcase.



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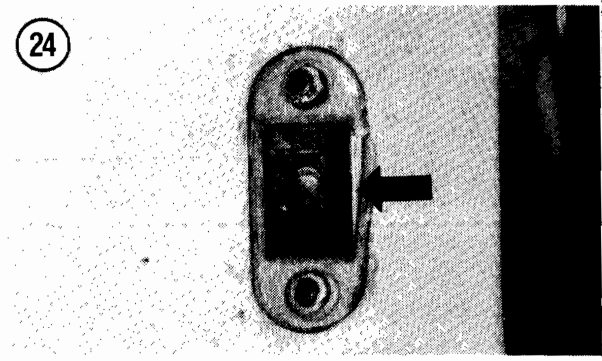

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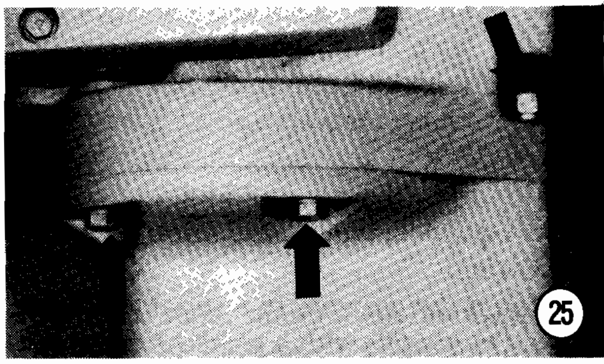

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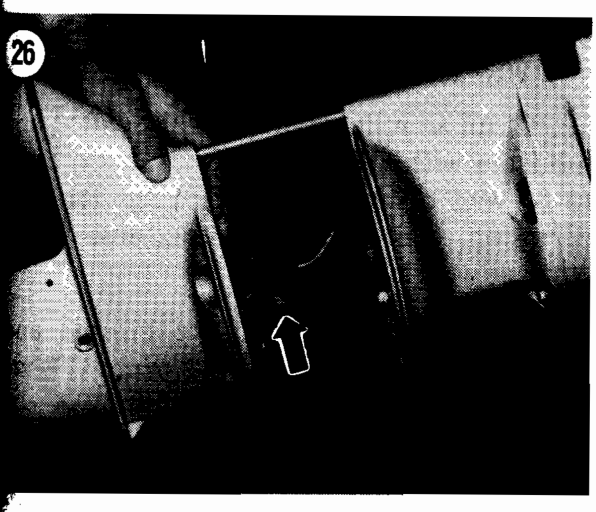

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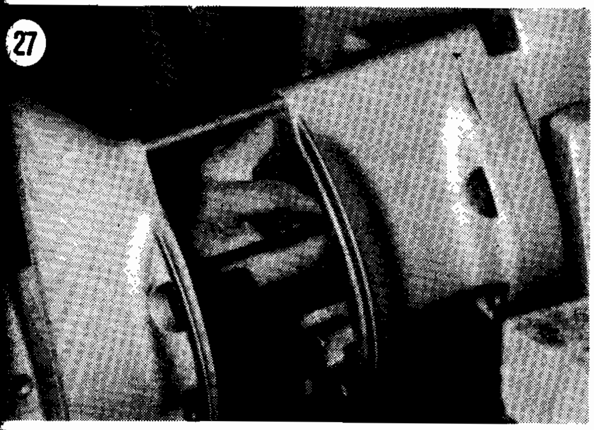

0. To reinstall the gearcase, install the xtension, if so equipped, and make sure the xtension exhaust seal is in place.

1. Shift the gearcase into FORWARD gear. Make sure the shift lever on the motor is in e FORWARD position.

2. Make sure impeller housing spacer is roperly positioned at the base of the riveshaft and the water tube is installed in e inner exhaust tube.

CAUTION
Do not grease the top of the drive shaft in Step 13. This may excessively preload the drive shaft and crankshaft when the mounting bolts are tightened and cause a premature failure of the power head or gearcase.

13. Lightly lubricate the drive shaft splines with OMC Moly Lube.

CAUTION
Do not rotate the flywheel counterclockwise in Step 14. This can damage the water pump impeller.

14. Position gearcase under exhaust housing. Align extension housing water tube with water pump grommet, drive shaft with crankshaft splines and the shift rod with the shift rod connector (**Figure 27**). Rotate the flywheel clockwise as required to let the drive shaft and crankshaft engage.

15. Wipe gearcase or extension screw/stud threads with OMC Gasket Sealing Compound. Install screws/nut and tighten to specifications (**Table 2**).

16A. 1985-on 20 and 25 hp, 30 hp and 1982-on 35 hp—Install the plastic keeper on the upper shift rod. Move the shift lever on the motor until the upper shift rod engages the lower shift rod connector. Hold the lower connector with a 1/2 in. open-end wrench and tighten the upper connector with a second wrench. Install the water intake screens.

16B. All others—Align lower shift rod groove with connector screw hole. Install screw with washer and tighten to 10-12 ft.-lb. Install exhaust housing cover plate with a new gasket coated with OMC Adhesive M. Tighten securely.

17. Install the propeller as described in this chapter.

18. Move shift lever on motor to NEUTRAL position. The propeller should rotate freely. Loosen both shift lever screws. Move shift actuator cam until lockout lever detents into cam notch. Tighten shift lever screws to 60-84 in.-lb.

19. Reconnect the spark plug leads and refill the gearcase with the proper type and quantity of lubricant. See Chapter Four.

Cleaning and Inspection (All Models)

1. Clean all parts in fresh solvent. Blow dry with compressed air, if available.
2. Clean all nut and screw threads thoroughly if OMC Screw Lock or OMC Nut Lock has been used. Soak nuts and screws in solvent and use a fine wire brush to remove residue.
3. Remove and discard all O-rings, gaskets and seals. Clean all residue from gasket mating surfaces.
4. Check drive shaft splines for wear or damage. If gearcase has struck a submerged object, the drive shaft and propeller shaft may suffer severe damage. Replace drive shaft as required and check crankshaft splines for similar wear or damage.
5. Check propeller shaft splines and threads for wear, rust or corrosion. See A, **Figure 28**. Replace shaft as necessary.
6. Install V-blocks under the drive shaft bearing surfaces at each end of the shaft. Slowly rotate the shaft while watching the crankshaft end. Replace the shaft if any signs of wobble are noted.
7. Repeat Step 6 with the propeller shaft. Also check the shaft surfaces where oil seal lips make contact. Replace the shaft as required.
8. Check bearing housing and needle bearing for wear or damage. See **Figure 29**. Replace as required.
9. Check bearing housing contact points on the propeller shaft (B, **Figure 28**). If shaft shows signs of pitting, grooving, scoring, heat discoloration or embedded metallic particles, replace shaft and bearings.
10. Check water pump as described in this chapter. Check and clean water intake screen as required.
11. Check all shift components for wear or damage. Look for excessive wear on the shift lever, cradle (A, **Figure 30**), shifter shaft and clutch dog engagement surfaces (B, **Figure 30**). Replace as required.
12. Clean all roller bearings with solvent and lubricate with OMC HI-VIS Gearcase Lube to prevent rusting. Check bearings for rust, corrosion, flat spots or excessive wear. Replace as required.
13. Check pinion gear needle bearing and thrust washers for wear or damage (**Figure 31**). Replace as required.
14. Check the forward, reverse and pinion gear for wear or damage. See A, **Figure 32** (typical). Check clutch engagement dogs (B, **Figure 32**). If clutch dogs or teeth are pitted, chipped, broken or excessively worn, replace the gear.
15. Check gearcase upper drive shaft bearing and pinion bearing for wear or damage.

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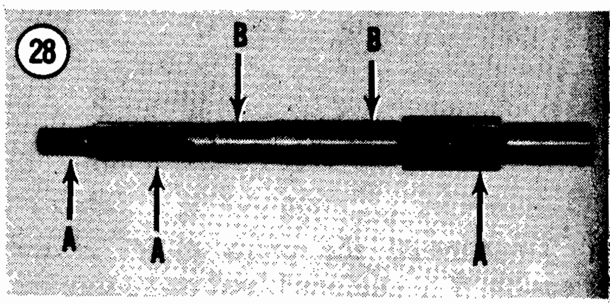

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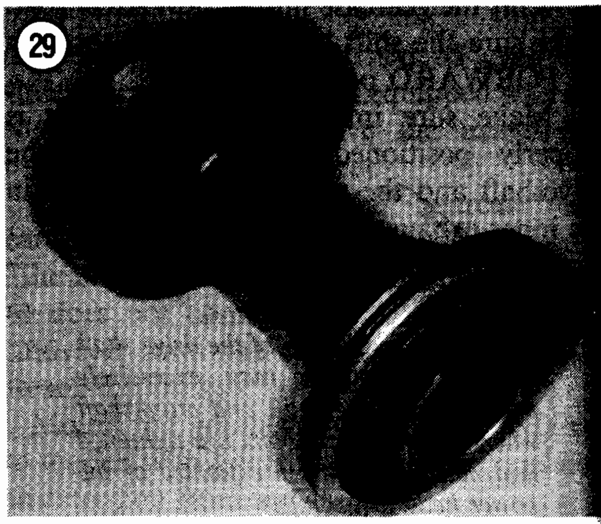

Replace pinion bearing as required. If upper drive shaft bearing requires replacement, replace the bearing and housing as an assembly.

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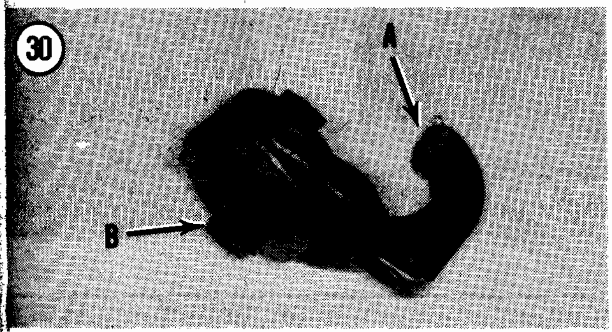

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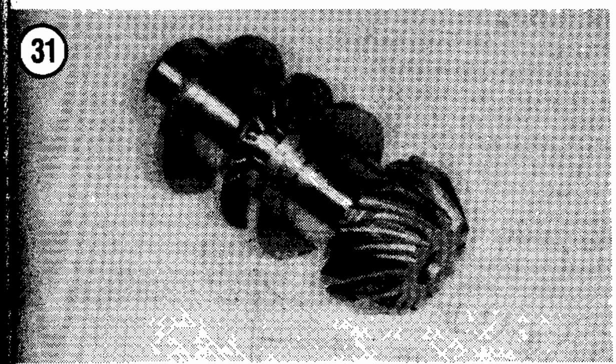

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16. Check the propeller for nicks, cracks or damaged blades. Minor nicks can be removed with a file, taking care to retain the shape of the propeller. Replace any propeller with bent, cracked or badly chipped blades.

Disassembly/Assembly
(2 hp, Colt, Junior and 1973-1980 4 hp)

Refer to **Figure 33** for this procedure.

1. Remove the gearcase as described in this chapter.
2. Secure the gearcase in a holding fixture or a vise with protective jaws. If protective jaws are not available, position the gearcase upright with the skeg between wooden blocks.
3. Remove the water pump attaching screws. Pull the drive shaft and impeller housing assembly up and out of the gearcase. Remove the impeller housing from the drive shaft.
4. Remove the impeller from the gearcase cavity.
5. Remove the 2 gearcase head screws. Tap the gearcase head ears with a mallet to break the seal (**Figure 34**), then rotate the head off the propeller shaft and gear assembly.
6. Remove and discard the gearcase head O-ring.
7. Remove and discard the gearcase head seal.
8. Remove the propeller shaft and gear assembly.

9A. Standard gearcase—Reach inside the gearcase housing and remove the pinion gear.

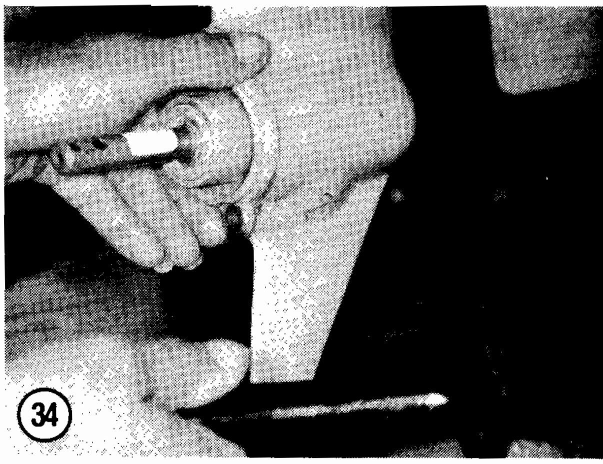
9B. Weedless gearcase—Reinsert drive shaft and tap on its end to dislodge the thrust bearing holding the pinion gear. Remove the bearing, pinion gear and drive shaft.

10. Remove the drive shaft seal with universal seal remover part No. 391259.
11. Clean and inspect all parts as described in this chapter. Check drive shaft bushing in gearcase. If worn or damaged, replace the gearcase housing.

12. Coat the metal case of a new gearcase head seal with OMC Gasket Sealing Compound. Install seal in gearcase head (lip facing inward) with installer part No. 330219.

13. Repeat Step 12 to install the drive shaft seal (lip facing downward) with installer part No. 330219.

14. Lubricate a new gearcase head O-ring with OMC HI-VIS Gearcase Lubricant. Install O-ring on gearcase head.



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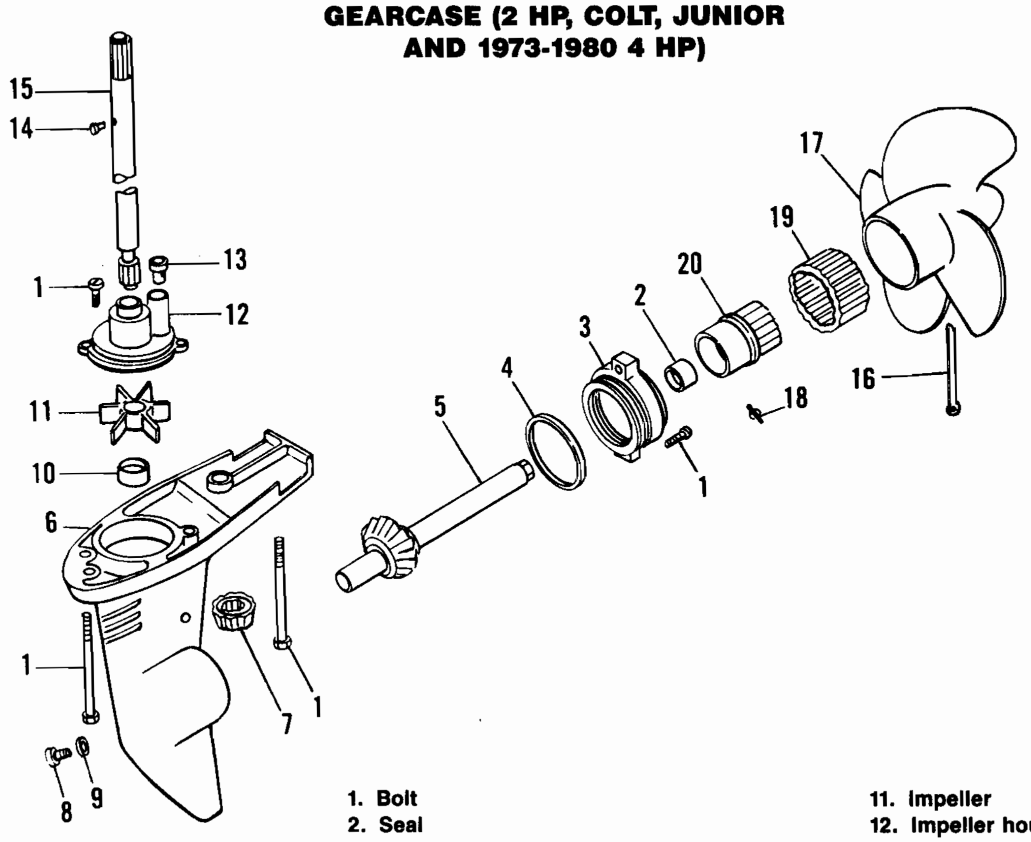
GEARCASE (2 HP, COLT, JUNIOR AND 1973-1980 4 HP)



1. Bolt
2. Seal
3. Gearcase head and bushing assembly
4. O-ring
5. Propeller shaft and gear assembly
6. Gearcase housing
7. Pinion gear
8. Fill/drain plug
9. Plug washer
10. Seal
11. Impeller
12. Impeller housing
13. Water tube grommet
14. Impeller drive pin
15. Drive shaft
16. Cotter pin
17. Propeller
18. Propeller drive pin
19. Propeller clutch ring
20. Propeller clutch hub

5. Slant the gearcase in the holding fixture the pinion gear can be installed and will main in place:

a. Standard gearcase—Insert pinion gear.
b. Weedless gearcase—Insert pinion gear and thrust bearing. The boss on the bearing must engage the 2 bosses in the gearcase.

. Install the propeller shaft and gear sembly to engage the pinion gear.

. Install the drive shaft in the gearcase. otate drive shaft to engage pinion gear, hold propeller gear from turning and turn drive shaft until it is fully seated in the pinion gear.

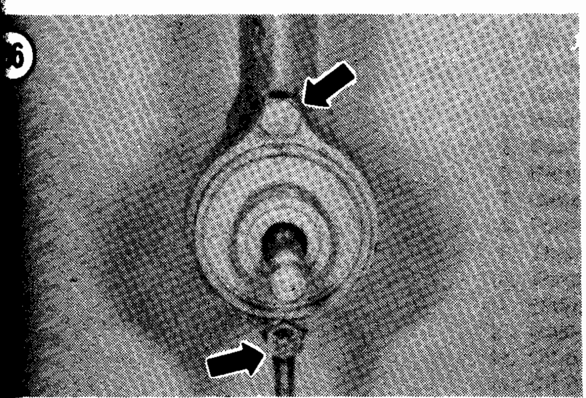
18. Coat gearcase head screw threads with OMC Gasket Sealing Compound. Install standard gearcase head with the flat on the sealing surface facing the upper screw hole in the gearcase. Align gearcase head and gearcase match marks on weedless model. Tighten screws to specifications (**Table 2**).

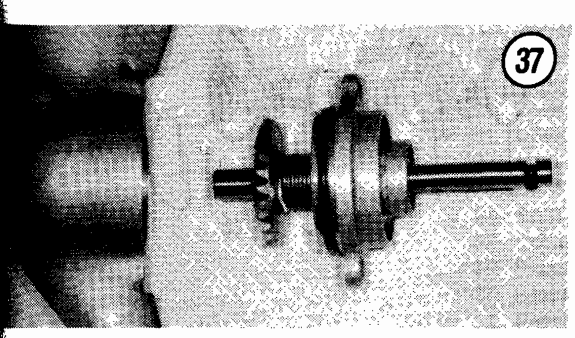
19. Pressure and vacuum test the gearcase as described in this chapter.

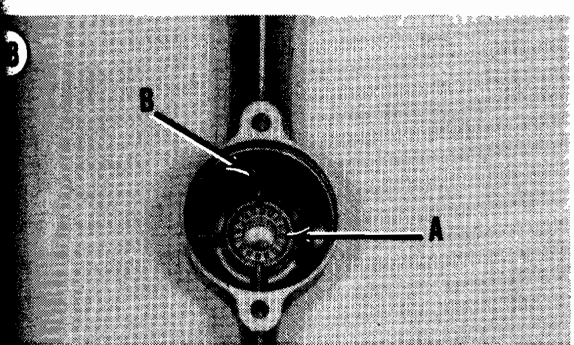
20. Install the water pump assembly as described in this chapter.

21. Install the gearcase as described in this chapter. Fill with the recommended type and quantity of lubricant. See Chapter Four.

22. Check gearcase lubricant level after engine has been run. Change the lubricant after 10 hours of operation (break-in period). See Chapter Four.







Disassembly/Assembly (2.5 hp, 3 hp, Excel 4, Ultra 4 and 1981-on 4 hp)

Refer to **Figure 35** (following page) for this procedure.

1. Remove the gearcase as described in this chapter.
2. Secure the gearcase in a holding fixture or a vise with protective jaws. If protective jaws are not available, position the gearcase upright with the skeg between wooden blocks.
3. Remove the water pump as described in this chapter.
4. Pull the drive shaft out of the gearcase.
5. Remove the 2 gearcase head screws (**Figure 36**).
6. Tap the gearcase head ears with a mallet to break the seal, then rotate the head free of the gearcase and remove with the propeller shaft and gear assembly. See **Figure 37**.
7. If the forward gear thrust washer and bearing assembly did not come out with the propeller shaft assembly, remove them from the gearcase. See A, **Figure 38**.

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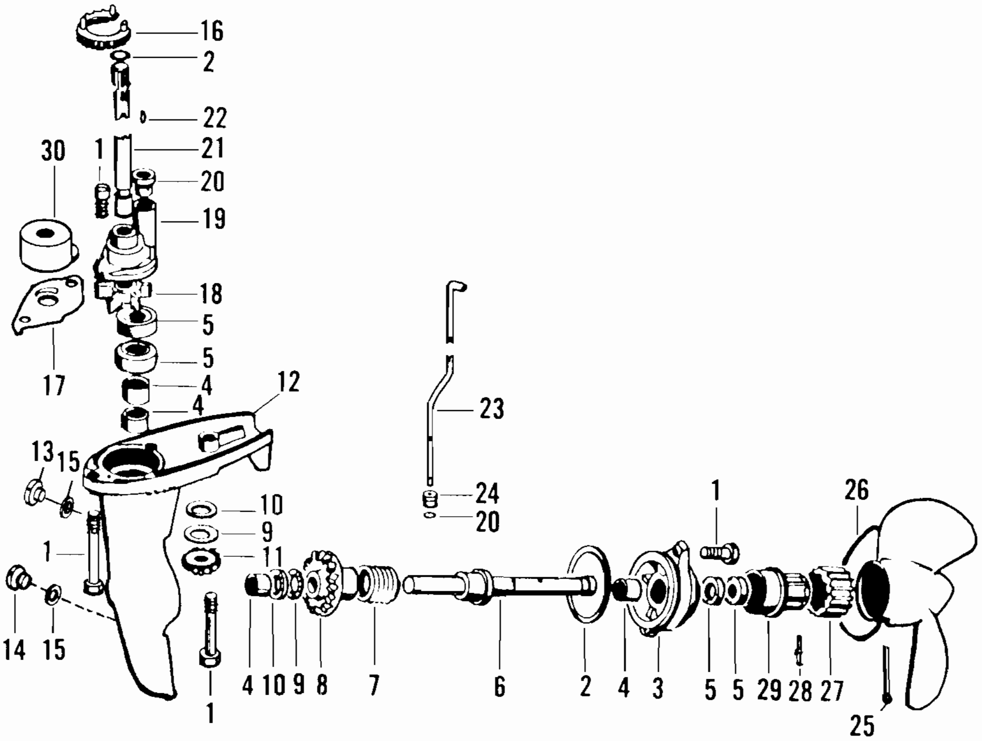
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GEARCASE
(2.5 HP, 3 HP, EXCEL 4,
ULTRA 4 AND 1981-ON 4 HP)

1. Bolt
2. O-ring
3. Gearcase head
4. Bearing
5. Seal
6. Propeller shaft
7. Clutch spring
8. Forward gear
9. Thrust bearing
10. Thrust washer
11. Pinion gear
12. Gearcase housing
13. Oil level plug
14. Oil drain plug
15. Plug washer
16. Water inlet screen
17. Impeller housing plate
18. Impeller
19. Impeller housing
20. Water tube grommet
21. Drive shaft
22. Impeller drive pin
23. Shift rod
24. Shift rod bushing
25. Cotter pin
26. Propeller
27. Propeller clutch ring
28. Propeller drive pin
29. Propeller clutch hub
30. Impeller housing liner

8. Remove the pinion gear (B, **Figure 38**) and thrust washer/bearing assembly from the gearcase. Place the washer/bearing assembly in a separate container to prevent it from being mixed up with the forward gear washer/bearing assembly.
9. Inspect the propeller shaft, clutch spring and forward gear assembly. Do not disassemble unless necessary:
   a. If further disassembly is indicated by your inspection, insert an appropriate size punch in the propeller shaft drive pin hole.
   b. Hold the forward gear from moving and rotate the propeller shaft in a counterclockwise direction while pulling outward on it. The shaft and gear will separate (**Figure 39**).
   c. Carefully remove the spring to prevent distorting its coils. If the coils do not touch each other at all points, replace the spring.
   d. Reassemble the propeller shaft components by reversing steps a-c. The tanged end of the spring should face the gear.
   e. Install the forward gear thrust bearing and thrust washer on the propeller shaft in that order.
10. Remove and discard the gearcase head seals (**Figure 40**).
11. Place the gearcase head on a flat surface and remove the needle bearing (A, **Figure 41**) with a suitable driver. Remove and discard the O-ring (B, **Figure 41**).
12. Clean and inspect all parts as described in this chapter.
13. Coat the metal case of 2 new gearcase head seals with OMC Gasket Sealing Compound. Install the inner seal (lip facing inward) with installer part No. 327572, then install the outer seal (lip facing outward) with the same tool.
14. Pack the cavity between the 2 new seals with OMC Triple-Guard grease.

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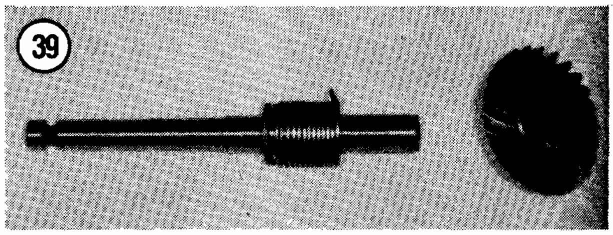

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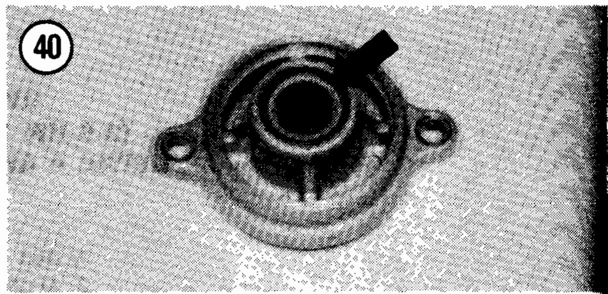

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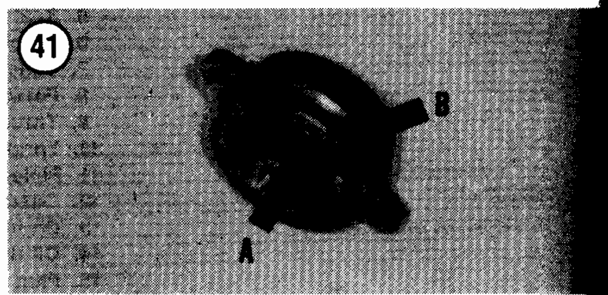

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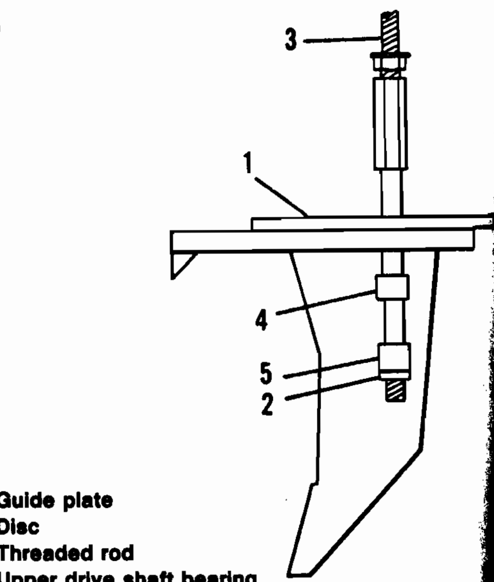
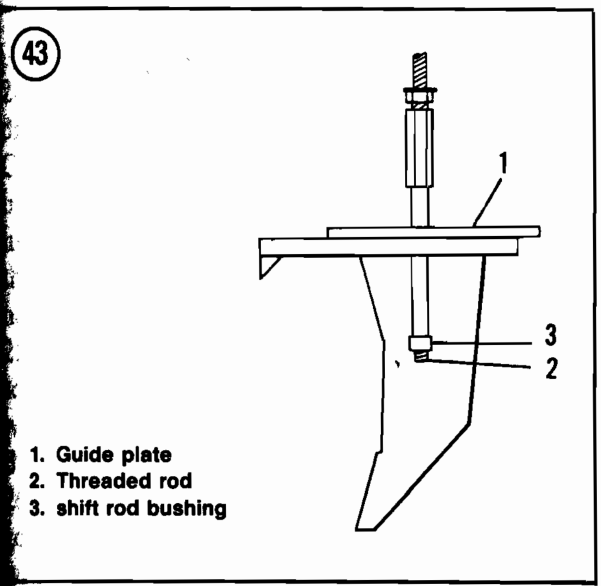
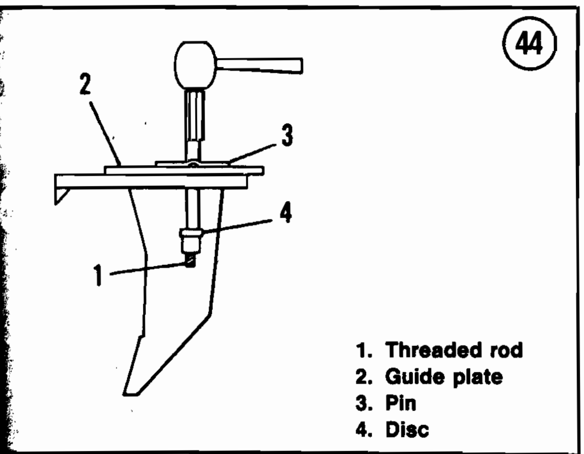


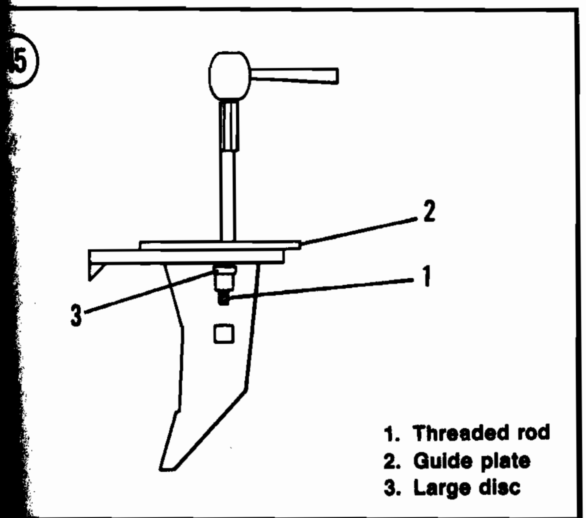
1. Guide plate
2. Disc
3. Threaded rod
4. Upper drive shaft bearing
5. Lower drive shaft bearing



1. Guide plate
2. Threaded rod
3. shift rod bushing



1. Threaded rod
2. Guide plate
3. Pin
4. Disc



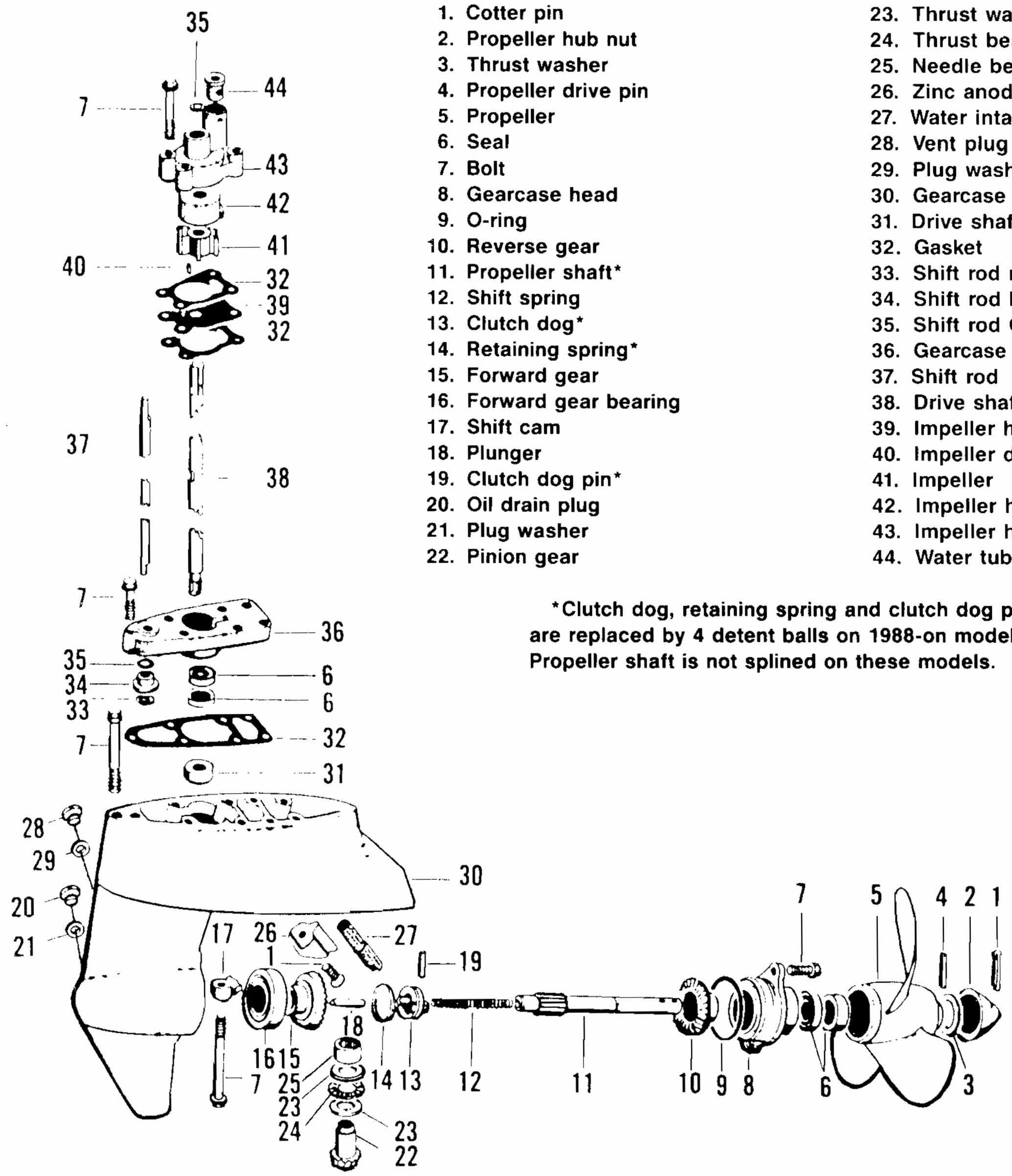
1. Threaded rod
2. Guide plate
3. Large disc

15. Lubricate a new O-ring with OMC HI-VIS Gearcase Lubricant and install on gearcase head.
16. Turn the gearcase head over and install a new bearing with tool part No. 392091. Lettered side of bearing must face tool to prevent bearing damage.
17. Remove the 2 drive shaft seals from the gearcase with tool part No. 391259.
18. If the upper and lower drive shaft bearings require removal, assemble the components of tool part No. 392092 as shown in **Figure 42**. Attach a slide hammer and remove the 2 bearings.
19. If the shift rod bushing requires removal, assemble the guide plate and rod from tool part No. 392092 as shown in **Figure 43**. Thread rod into bushing, attach a slide hammer and remove the bushing and O-ring.
20. If the forward gearcase bearing requires removal, assemble tool part No. 391259 with puller jaws in a vertical position and remove the bearing.
21. If shift rod bushing was removed, assemble tool part No. 392092 installer and rod. Fit a new bushing on the installer (O-ring facing down) and coat outside of bushing with OMC Adhesive M. Drive bushing into gearcase with a mallet until fully seated.
22. If forward gearcase bearing was removed, support the gearcase nose on a block of wood. Install a new bearing with tool part No. 392091 and a mallet. Lettered side of bearing should face tool to prevent bearing damage.
23. If upper and lower drive shaft bearings were removed, reinstall as follows:

a. Lower bearing—Assemble tool part No. 392092 components as shown in **Figure 44**. With the lettered side of the bearing facing the tool, drive it in place until the pin touches the guide plate.
b. Upper bearing—Assemble tool part No. 392092 components as shown in **Figure 45**. With the lettered side of the bearing

(46)

GEARCASE (4 DELUXE, 4.5-8 HP)



1. Cotter pin
2. Propeller hub nut
3. Thrust washer
4. Propeller drive pin
5. Propeller
6. Seal
7. Bolt
8. Gearcase head
9. O-ring
10. Reverse gear
11. Propeller shaft*
12. Shift spring
13. Clutch dog*
14. Retaining spring*
15. Forward gear
16. Forward gear bearing
17. Shift cam
18. Plunger
19. Clutch dog pin*
20. Oil drain plug
21. Plug washer
22. Pinion gear
23. Thrust washer
24. Thrust bearing
25. Needle bearing
26. Zinc anode
27. Water intake screen
28. Vent plug
29. Plug washer
30. Gearcase houging
31. Drive shaft bearing
32. Gasket
33. Shift rod retaining ring
34. Shift rod bushing
35. Shift rod O-ring
36. Gearcase cover
37. Shift rod
38. Drive shaft
39. Impeller housing plate
40. Impeller drive pin
41. Impeller
42. Impeller housing liner
43. Impeller housing
44. Water tube grommet

*Clutch dog, retaining spring and clutch dog pin are replaced by 4 detent balls on 1988-on models. Propeller shaft is not splined on these models.

facing the tool, drive it in place until firmly seated.

24. Coat the metal case of 2 new gearcase drive shaft seals with OMC Gasket Sealing Compound. Install the inner seal (lip facing inward) with installer part No. 327431, then install the outer seal (lip facing outward) with the same tool. Pack the cavity between the 2 new seals with OMC Triple-Guard grease.
25. Slant the gearcase in the holding fixture so that the pinion gear can be installed and will remain in place. Install the thrust washer, thrust bearing and pinion gear in that order.
26. Lubricate the drive shaft from the pinion gear end to the water pump drive key flat with OMC HI-VIS Gearcase Lubricant. Install drive shaft in gearcase and rotate it until it is secured to the pinion gear.
27. Install the water pump as described in this chapter.

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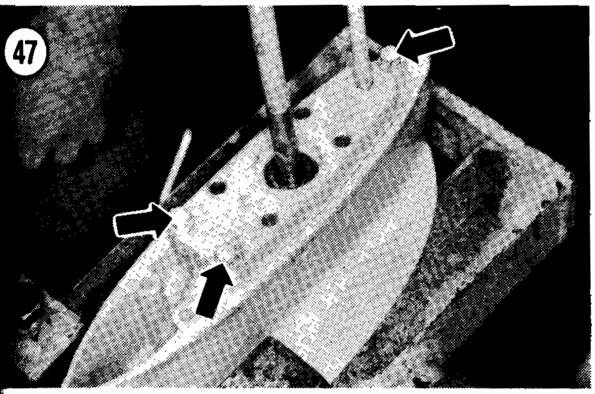

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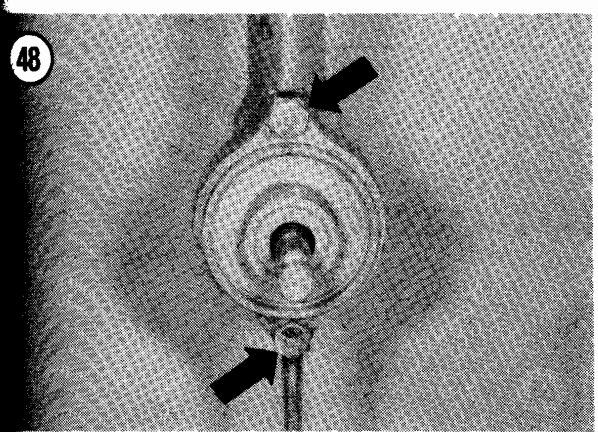


28. Install the propeller shaft and forward gear/bearing assembly in the gearcase.
29. Cover the groove in the propeller shaft with a single layer of cellophane tape to prevent it from damaging the gearcase head seals.
30. Lubricate the gearcase head O-ring with OMC HI-VIS Gearcase Lubricant. Install gearcase head over propeller shaft and seat in the gearcase. Remove the cellophane tape from the shaft groove.
31. Coat the gearcase head screw threads with OMC Gasket Sealing Compound. Install and tighten screws to specifications (**Table 2**).
32. Pressure and vacuum test the gearcase as described in this chapter.
33. Install the gearcase as described in this chapter. Fill with the recommended type and quantity of lubricant. See Chapter Four.
34. Check gearcase lubricant level after engine has been run. Change the lubricant after 10 hours of operation (break-in period). See Chapter Four.

9

Disassembly/Assembly (4 Deluxe, 4.5, 5, 6, 7.5 and 8 hp)

Refer to **Figure 46** for this procedure.

1. Remove the gearcase as described in this chapter.
2. Secure the gearcase in a holding fixture or a vise with protective jaws. If protective jaws are not available, position the gearcase upright with the skeg between wooden blocks.
3. Remove the water pump as described in this chapter.
4. Remove the 3 gearcase cover screws (**Figure 47**). Lift the cover up and slide it off the drive shaft and shift rod. Remove and discard the gasket.
5. Pull the drive shaft and shift rod from the gearcase.
6. Remove the 2 gearcase head screws (**Figure 48**).

7. Tap the gearcase head ears with a mallet to turn the cover about 15°, then drive the head rearward by alternately tapping on the ears until the O-ring comes out of the gearcase. Remove the gearcase head and propeller shaft as an assembly. See **Figure 49**.

8A. 1980-1987—Separate the gearcase head and reverse gear/thrust washer from the propeller shaft. Remove the plunger from the front of the shaft.

8B. 1988-on—Separate the gearcase head, reverse gear and thrust washer from the propeller shaft. Remove plunger, spring and 4 detent balls from propeller shaft (**Figure 50**).

9. 1980-1987—Carefully lift one end of the clutch dog retaining spring and insert a screwdriver blade under it as shown in **Figure 51**. Holding the screwdriver in one position, rotate the propeller shaft to unwind the spring.

10. 1980-1987—Insert tool part No. 390766 in the propeller shaft end to compress the shifter spring. See **Figure 52**.

11. 1980-1987—Compress the spring and remove the clutch dog pin. Remove the tool and slide the clutch dog off the shaft. The shifter spring will protrude from the shaft. **Figure 53** shows the components of the disassembled propeller shaft.

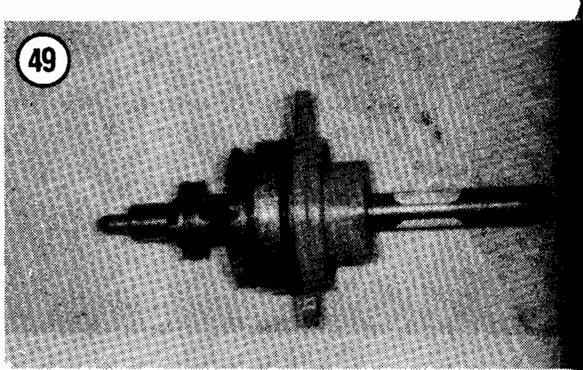
12A. 1980-1987—Reinsert the disassembled propeller shaft in the gearcase and engage the forward gear. Slap the end of the shaft upward with the palm of your hand to pop the forward gear loose. Remove the shaft, reach inside the housing and remove the forward gear.

12B. 1988-on—Reach inside the housing and rotate the forward gear beneath the pinion gear to remove.

13. With the forward gear removed, reach inside the housing again and tilt the gearcase until the shift cam falls into your hand. Remove the shift cam from the housing.

14. Move the gearcase back to a vertical position while holding one hand under the pinion gear. The gear, 2 thrust washers and thrust bearing will drop into your hand (**Figure 54**).

15. If the forward gear bearing race requires replacement, remove with puller part No. 391012 on 1980-1987 models and puller part No. 432131 on 1988-on models and a slide hammer. Make sure puller jaws fit into the grooves in the gearcase casting behind the bearing race.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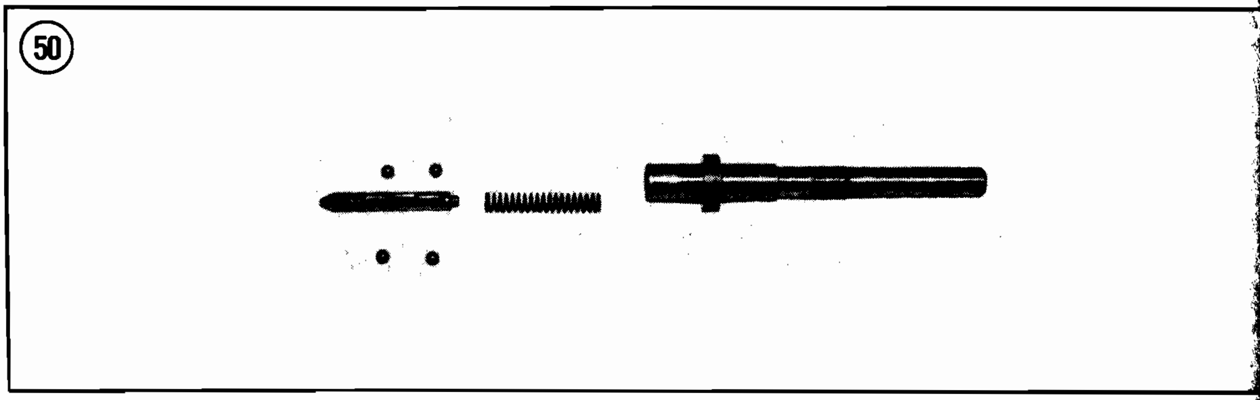
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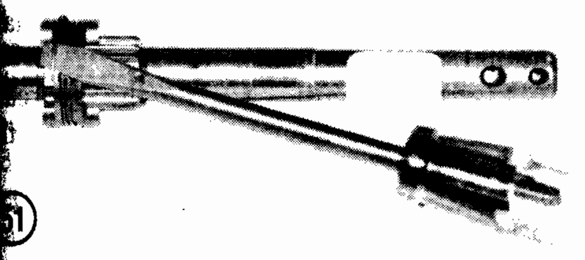
. If the upper drive shaft bearing and eve assembly requires replacement, nove the seals with an appropriate puller, n reverse the jaws of puller part No. 391012 so that their tips face inward. Stretch a stiff rubber band over the jaws to hold them in place. Remove the bearing and sleeve assembly with the puller and a slide hammer.



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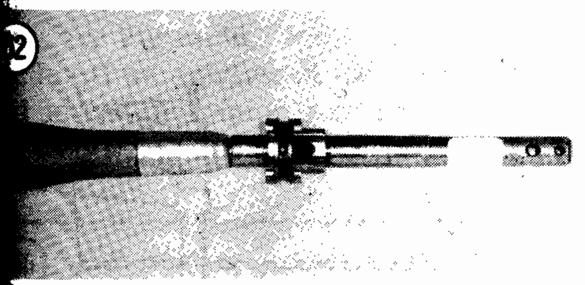

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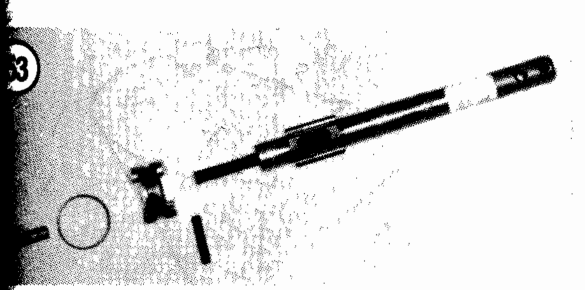

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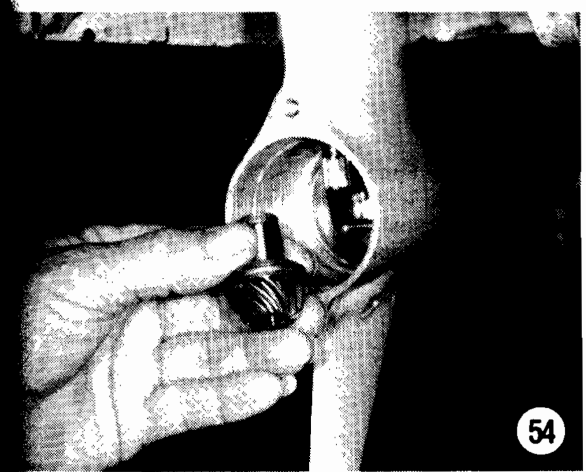

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17. If the pinion bearing requires replacement, put a clean shop cloth inside the gearcase housing under the pinion bearing. Insert remover part No. 319880 through the top of the gearcase and drive the pinion bearing out. Remove the shop cloth and bearing.
18. Check the water intake screen on the gearcase. If clogged, damaged or otherwise defective, carefully depress the tab and slide the screen from its cavity. If the tab breaks off during screen removal, install a new screen.
19. Check the zinc anode fastened to the bottom of the anti-ventilation plate. If less than two-thirds of the anode remains, remove the attaching screw and install a new anode.
20. Remove the O-ring from the gearcase head. Temporarily reinstall the head in the gearcase with both screws. Install an appropriate puller and slide hammer and remove the 2 seals.
21. Remove the gearcase cover seals with tool part No. 391259.
22. Use the shift rod to pry the shift rod bushing from the gearcase cover. Remove and discard the O-ring.
23. Clean and inspect all components as described in this chapter.
24. Coat the metal case of 2 new gearcase head seals with OMC Gasket Sealing Compound. Install the narrow seal (lip facing inward) with installer part No. 326548, then install the wide seal (lip facing outward) with the same tool. Pack the cavity between the 2 new seals with OMC Triple-Guard grease.
25. Coat the metal case of 2 new gearcase cover seals with OMC Gasket Sealing Compound. Install the seals back-to-back with installer part No. 326547. Pack the cavity between the 2 new seals with OMC Triple-Guard grease.

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26. Lubricate a new shift rod O-ring with OMC Triple-Guard grease and install it in the gearcase cover cavity.
27. Run a thin bead of OMC Adhesive M on a new shift rod bushing. Install bushing in gearcase cover and allow Adhesive M to dry.
28A. 1980-1987—If the pinion and upper drive shaft bearings were removed, refer to **Figure 55**:

a. Assemble components of tool part No. 383173 with spacer part No. 383174.
b. Install upper drive shaft bearing (lettered side up) under the spacer.
c. Install pinion bearing (lettered side down) on installer part No. 319878.
d. Insert bearing/installer through propeller bore and thread on installer rod.
e. Tighten the nut at the top of the rod until both bearings are fully seated.
f. If only one of these bearings was removed, the new one can be installed with the same tools and procedure, omitting the use of the tools for the other bearing.

28B. 1988-on—Install upper drive shaft bearing using tool part No. 326575. Use a mallet and tap driver to install bearing into gearcase bore until properly seated. Pinion bearing must be installed by pulling bearing into position from propeller shaft opening of housing. Position bearing through propeller shaft opening of housing and engage pinion bearing bore. Slide a 6-1/2×3/8 in. course bolt with a wide washer through upper drive shaft bearing and pinion bearing. Thread pinion bearing installer part No. 319878 onto bolt end. Rotate bolt to pull pinion bearing into properly seated position.

NOTE
If either the forward gear bearing or bearing race requires replacement, install a new bearing/race assembly.

29. If the forward bearing race was removed, install with tool part No. 326025 and a mallet until fully seated.
30. If the forward gear or bearing requires replacement, separate the two with a universal puller and arbor press. Install the bearing to the gear with an appropriate mandrel and arbor press.
31. Insert the shift cam in the gearcase housing with the flat on the cam facing the

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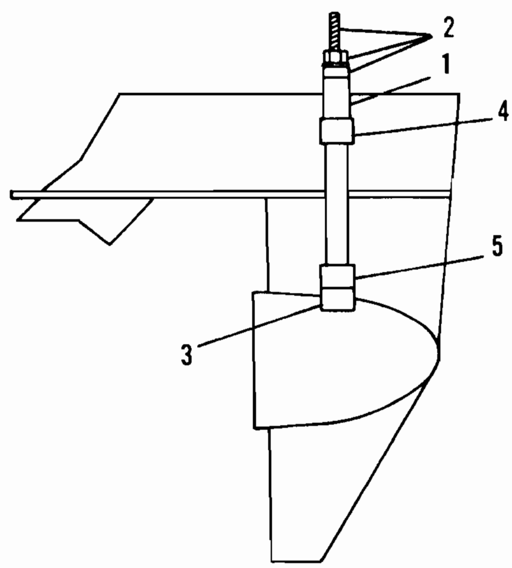

1. Spacer
2. Threaded rod and nut assembly
3. Installer
4. Upper drive shaft bearing
5. Pinion bearing

port side of the housing or on later models with "UP" facing toward top of gearcase. Hold cam in that position and slide shift rod (retaining ring end first) into the gearcase, rotating it to engage the cam.

32. Coat both side of a new gearcase cover gasket with OMC Adhesive M. Install the cover and gasket. Wipe the screw threads with OMC Screw Lock and tighten to specifications (**Table 2**).

33. Sandwich the pinion gear bearing between the 2 thrust washers. The thrust washer with the inside chamfer must rest against the pinion shoulder. The chamfered edge of the other thrust washer must face away. See **Figure 56**.

34. Invert the gearcase in the holding fixture and install the pinion gear/bearing/washer assembly.

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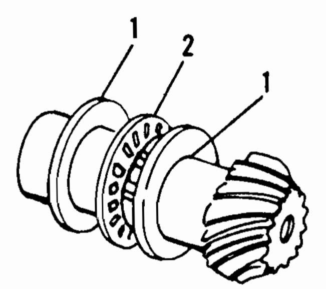

1. Chamfered edge 2. Thrust bearing

35. Insert the forward gear in the gearcase, then install the propeller shaft in the gear and pull up sharply on the shaft to snap the gear in its proper position. This will hold the pinion gear in place. See **Figure 57**. Remove the propeller shaft and return the gearcase to an upright position.

36. 1980-1987—Insert shifter spring in propeller shaft. Install clutch dog with end marked "PROP" facing the rear of the shaft. Align hole in clutch dog with shaft hole, then insert tool part No. 390766 to compress the shifter spring and install the clutch dog pin. See **Figure 52**.

37. 1980-1987—Reinstall one end of the clutch dog retaining spring over the clutch dog, then rotate the propeller shaft to wind the spring back in place.

38. 1980-1987—Coat the square end of the shift plunger with OMC Needle Bearing grease and insert it in the end of the propeller shaft.

39. 1988-on—Install reverse gear thrust washer onto propeller shaft with outer beveled side toward the propeller shaft shoulder. Slide reverse gear onto propeller shaft up to detent ball openings.

40. 1988-on—Install spring and plunger into end of propeller shaft.

41. 1988-on—Apply OMC Needle Bearing grease onto 2 detent balls. Depress plunger to align ramps in plunger with openings in propeller shaft. Install 2 detent balls in openings adjacent to reverse gear. Slide reverse gear over detent balls to retain balls and plunger in propeller shaft.

42. 1988-on—Apply OMC Needle Bearing grease onto 2 remaining detent balls. Hold reverse gear in position and install detent balls in forward gear openings of propeller shaft.

43. 1988-on—Install the propeller shaft assembly in the forward gear. See **Figure 58**.

44. 1980-1987—Install the propeller shaft in the forward gear.

45. 1980-1987—Insert the reverse gear thrust washer in the gear recess and slide the gear on the propeller shaft, rotating as required until it engages the pinion.
46. Apply OMC Gasket Sealing Compound to the gearcase head O-ring and flange. Install the gearcase head and tighten the screws to specifications (**Table 2**).
47. Install the drive shaft with a rotating motion to engage the pinion gear splines.
48. Install the water pump as described in this chapter.
49. Pressure and vacuum test the gearcase as described in this chapter.
50. Install the gearcase as described in this chapter. Fill with the recommended type and quantity of lubricant. See Chapter Four.
51. Check gearcase lubricant level after engine has been run. Change the lubricant after 10 hours of operation (break-in period). See Chapter Four.

Disassembly/Assembly (9.9 and 15 hp)

Refer to **Figure 59** for this procedure.
1. Remove the gearcase as described in this chapter.
2. Secure the gearcase in a holding fixture or a vise with protective jaws. If protective jaws are not available, position the gearcase upright with the skeg between wooden blocks.
3. Remove the water pump as described in this chapter.
4. Remove the 2 propeller shaft bearing housing screws.
5. Install puller part No. 386631 using the propeller nut to hold the puller on the propeller shaft. Turn nut until puller loosens bearing housing in gearcase, then remove the puller. Slide the bearing housing off the propeller shaft and remove it from the gearcase.
6. Remove the propeller shaft and reverse gear assembly with 2 detent balls and a spring.
7. Remove the Phillips head pivot pin screw at the base of the gearcase housing.
8. Pull the drive shaft up and out of the gearcase.
9. Unscrew the shift rod and remove from the gearcase.
10. Reach into the propeller bore with a pair of needlenose pliers and remove the clutch dog.
11. Remove the pinion gear and thrust bearing/washer assembly.
12. Reach into the propeller housing with a pair of needlenose pliers and grasp the shift lever. Move the lever back and forth and remove it with the forward gear and clutch dog yoke.
13. Slant the gearcase enough to remove the forward tapered roller bearing. If one or both detent balls failed to come out in Step 6, it will come out at this time.
14. To remove the shift rod bushing:

a. Position remover tool and handle part No. 327693 under the bushing.
b. Insert a slide hammer adaptor through the bushing and thread it into the remover tool.

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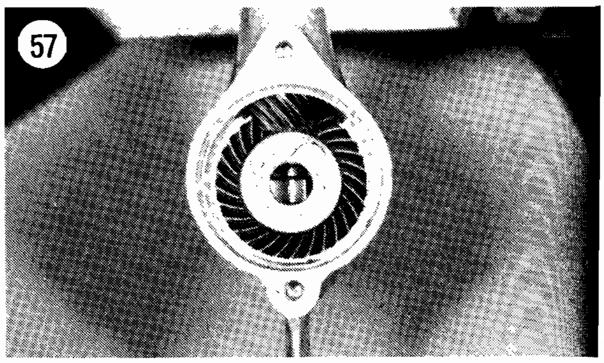

c. Remove the handle from the remover tool and pull the bushing out with the slide hammer.
d. Remove and discard bushing O-ring. Examine bushing for wear or damage and replace as required.

15. Attach a slide hammer to a narrow 2-jaw puller (part No. 391010). Insert puller jaws behind the drive shaft seals and remove the seals.
16. Drive the upper drive shaft bearing from its sleeve with remover tool part No. 319880 and a mallet.
17. Attach a slide hammer to a wide 2-jaw puller (part No. 390012). Insert puller jaws in the gearcase recesses behind the forward bearing cup and remove the cup.
18. If the lower pinion bearing requires removal, assemble the components of tool part No. 391257 as shown in **Figure 60**. Insert the assembled tool in the gearcase and drive the pinion bearing out.
19. Remove and discard the gearcase bearing housing O-ring.

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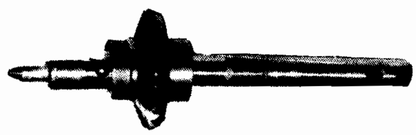

20. Secure the bearing housing in a vise with protective jaws and remove the 2 bearings and the seals with tool part No. 391259 or a slide hammer and narrow 2-jaw puller.
21. Clean and inspect all components as described in this chapter.
22. Install a new large bearing (lettered side facing tool) in the gearcase bearing housing with installer part No. 319876.
23. Install a new small bearing (lettered side facing tool) in the gearcase bearing housing with installer part No. 319875.
24. Coat the metal case of 2 new gearcase head seals with OMC Gasket Sealing Compound. Install the inner seal (lip facing inward) with installer part No. 326553, then install the outer seal (lip facing outward) with the same tool. Pack the cavity between the 2 new seals with OMC Triple-Guard grease.
25. Install a new O-ring on the bearing housing and lubricate with OMC HI-VIS Gearcase Lube.

9

NOTE
If either the forward gear bearing or bearing cup requires replacement, install a new bearing/cup assembly.

26. If the forward gear bearing cup was removed, remove the gearcase from the holding fixture. Place nose of gearcase on a block of wood and drive the bearing in place with installer tool part No. 319929, handle part No. 311880 and a mallet, rotating the tool during installation.
27. If the lower pinion bearing was removed, assemble the components of tool part No. 391257 as shown in **Figure 61**. Use OMC Needle Bearing Grease to hold the bearing on the tool (lettered side facing up). Insert the tool and bearing in the gearcase and press the bearing into the gearcase until the washer on the tool touches the spacer.

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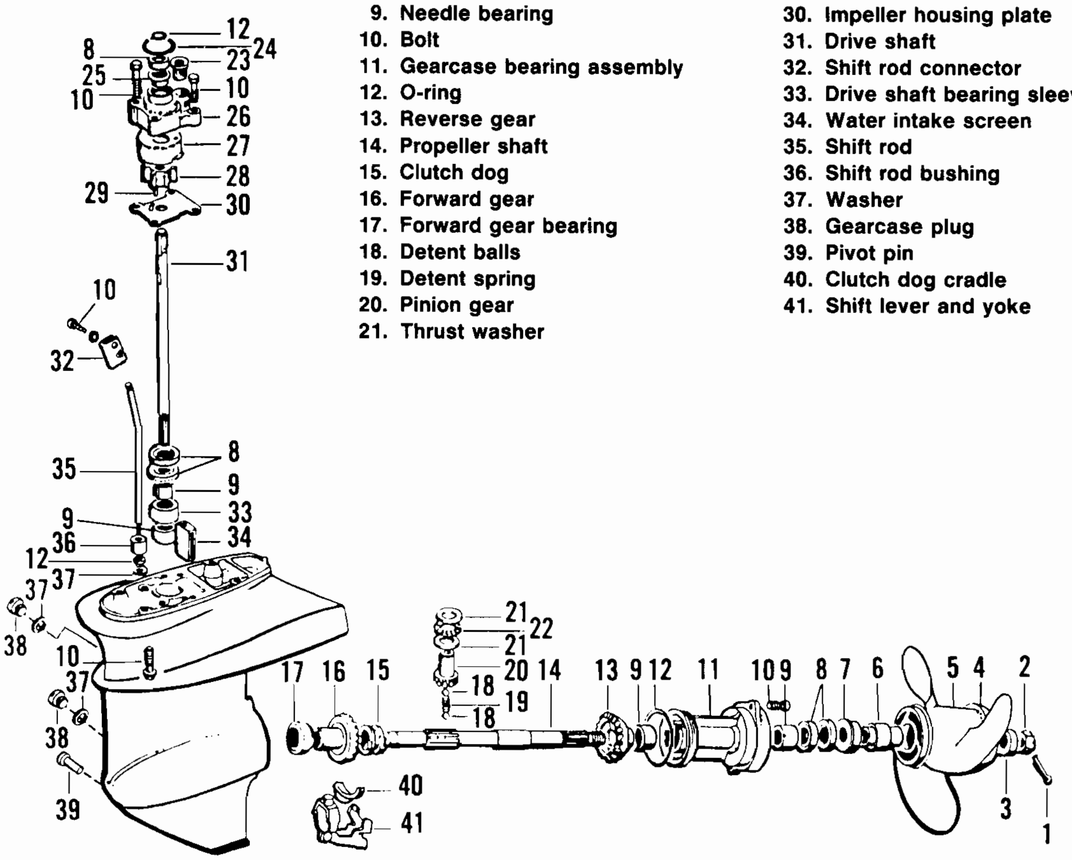
GEARCASE (9.9 AND 15 HP)

1. Cotter pin
2. Castellated nut
3. Thrust washer
4. Propeller converging
5. Propeller
6. Propeller bushing
7. Thrust bushing
8. Seal
9. Needle bearing
10. Bolt
11. Gearcase bearing assembly
12. O-ring
13. Reverse gear
14. Propeller shaft
15. Clutch dog
16. Forward gear
17. Forward gear bearing
18. Detent balls
19. Detent spring
20. Pinion gear
21. Thrust washer
22. Needle thrust bearing
23. Water tube grommet
24. Impeller housing seal
25. Water restrictor
26. Impeller housing
27. Impeller housing
28. Impeller
29. Impeller drive pin
30. Impeller housing plate
31. Drive shaft
32. Shift rod connector
33. Drive shaft bearing sleeve
34. Water intake screen
35. Shift rod
36. Shift rod bushing
37. Washer
38. Gearcase plug
39. Pivot pin
40. Clutch dog cradle
41. Shift lever and yoke



28. If the drive shaft bearing was removed, install bearing (lettered side up) in the bearing sleeve with an arbor press and installer part No. 319931 or part No. 326566.
29. Install the bearing and sleeve (lettered side up) in the gearcase with installer part No. 319931 and handle part No. 311880.
30. Coat the metal case of 2 new drive shaft seals with OMC Gasket Sealing Compound. Install the inner seal (lip facing toward gearcase) with installer part No. 326554, then install the outer seal (lip facing away from gearcase) with the same tool. Pack the cavity between the 2 new seals with OMC Triple-Guard grease.

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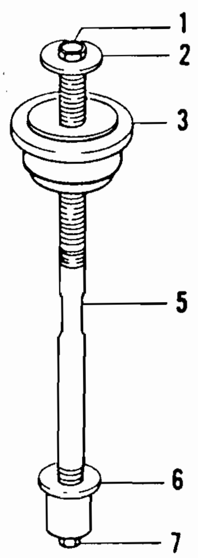

1. Nut
2. Washer
3. Pilot plate
5. Threaded rod
6. Installer/remover
7. Screw

31. Lubricate a new shift rod bushing O-ring with OMC HI-VIS Gearcase Lube. Install O-ring on bushing. Fit the bushing and a new washer on tool part No. 304515. Wipe outer diameter of bushing with OMC Gasket Sealing Compound and drive bushing into the gearcase with a mallet.
32. Lubricate the forward gear bearing with OMC HI-VIS Gearcase Lube and install in the forward gear bearing cup.
33. Thread tool part No. 319991 through the shift rod bushing and into the shifter yoke. Pull on the tool and guide the yoke/lever/forward gear assembly into the gearcase. When properly located, the gear will rest against the forward bearing and the shift lever will fit in the gearcase slot.
34. Sandwich the pinion gear bearing between the 2 thrust washers. The thrust washer with the inside chamfer must rest against the pinion shoulder. The chamfered edge of the other thrust washer must face away. See **Figure 56**.

NOTE

If pinion binding occurs in Step 35, temporarily install drive shaft to align pinion. If this does not relieve the binding condition, the forward bearing cup is not fully seated.

35. Guide the pinion gear in place in the gearcase while pushing on the top of the forward gear with a long screwdriver.
36. Position the clutch dog with its grooves facing the forward gear and install in the cradle with needlenose pliers.
37. Coat the propeller shaft spring and 2 detent balls with OMC Needle Bearing Grease. Install the spring and balls in the propeller shaft.
38. Install the propeller shaft in the clutch dog, forward gear and forward bearing. Align

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the detent balls with the clutch dog lugs and slide the reverse gear on the propeller shaft.
39. Install the bearing housing in the gearcase. Wipe the screw threads with OMC Gasket Sealing Compound and tighten to specifications (**Table 2**).

NOTE
If the pivot pin seal condition is doubtful, install a new pin in Step 40.

40. Locate the shift yoke pin hole by probing through the pivot pin hole in the gearcase with an awl. Align the yoke and gearcase holes. Coat the pivot pin threads with OMC Gasket Sealing Compound and tighten the screw to specifications (**Table 2**).
41. Install the drive shaft with a rotating motion to engage the pinion gear splines.
42. Lubricate the shift rod threads with OMC HI-VIS Gearcase Lube. Slide shift rod through the shift rod bushing and thread it into the yoke.

NOTE
On models equipped with a gearcase extension, make the adjustment in Step 43 after installing the extension.

43. Shift the gearcase into NEUTRAL. Measure the distance between the top of the gearcase and the top of the shift rod connector. Rotate shift rod until measurement is 13/32-7/16 in. with the flat surface of the connector facing the drive shaft.
44. Install the water pump as described in this chapter.
45. Pressure and vacuum test the gearcase as described in this chapter.
46. Install the gearcase as described in this chapter. Fill with the recommended type and quantity of lubricant. See Chapter Four.
47. Check gearcase lubricant level after engine has been run. Change the lubricant after 10 hours of operation (break-in period). See Chapter Four.

Disassembly/Assembly (1973-1979 6 hp, 9.5 hp, 1973-1984 20 and 25 hp, 28 hp and 1973-1976 40 hp)

Refer to **Figure 62** for this procedure.
1. Remove the gearcase as described in this chapter.
2. Secure the gearcase in a holding fixture or a vise with protective jaws. If protective jaws are not available, position the gearcase upright with the skeg between wooden blocks.
3. Remove the water pump as described in this chapter.
4. Remove the drive shaft from the gearcase.
5. Invert the gearcase in the holding fixture. Remove the Phillips head pivot pin. Remove and discard the O-ring.
6. Remove the 6 screws holding the lower half of the gearcase to the upper half. Tap the skeg with a soft hammer to break the seal and

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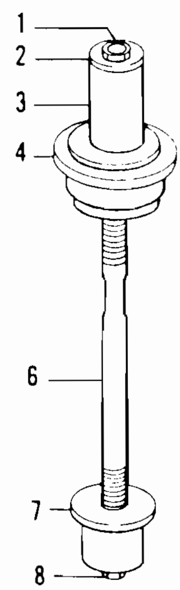

1. Nut
2. Washer
3. Spacer
4. Pilot plate
6. Threaded rod
7. Installer/remover
8. Screw

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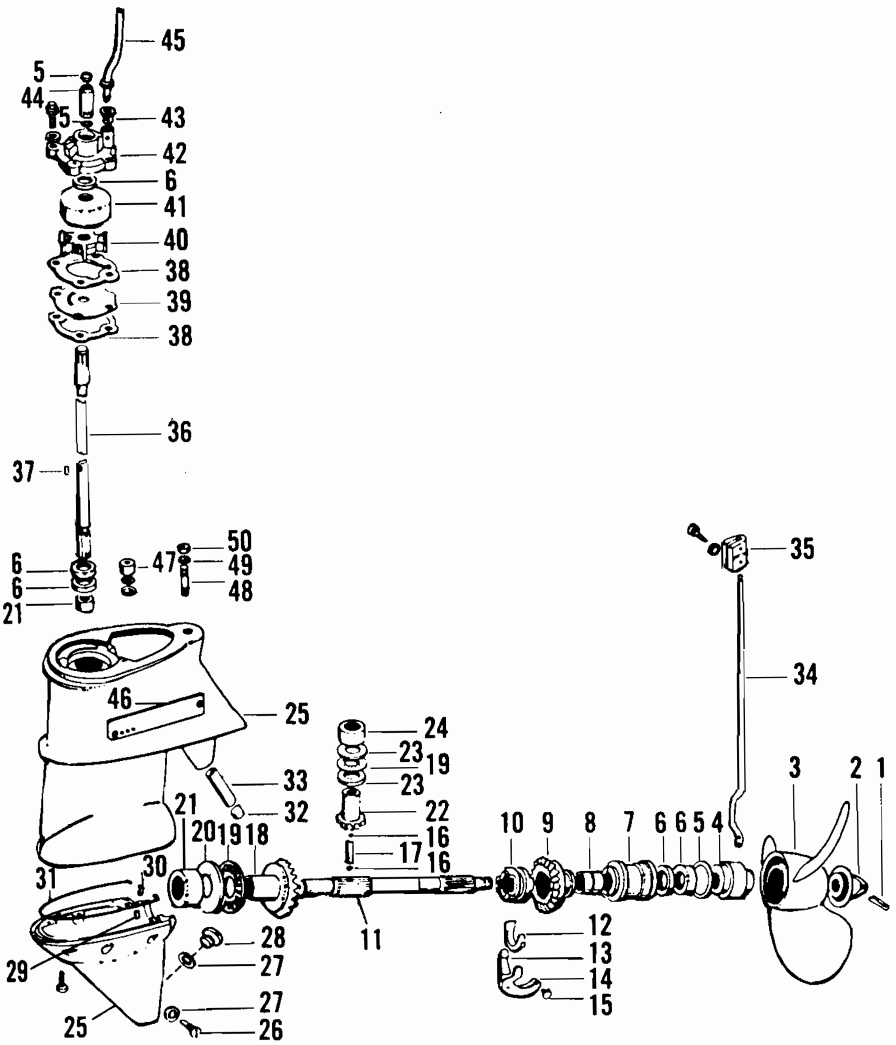
GEARCASE (1973-1979 6 HP, 9.5 HP, 1973-1984 20 AND 25 HP, 28 HP AND 1973-1976 40 HP)



1. Cotter pin
2. Propeller nut
3. Propeller
4. Propeller bushing
5. O-ring
6. Seal
7. Gearcase head assembly
8. Reverse gear bushing
9. Reverse gear
10. Clutch dog
11. Propeller shaft
12. Cradle
13. Shift lever
14. Shift rod cotter pin
15. Shift rod pin
16. Detent balls
17. Detent spring
18. Forward gear
19. Thrust bearing
20. Thrust washer
21. Front bearing
22. Pinion gear
23. Thrust washer
24. Pinion bearing
25. Gearcase halves
26. Pivot pin
27. Washer
28. Drain/fill plug
29. Bearing dowel
30. Gearcase magnet
31. Spaghetti seal
32. Intake screen plug
33. Intake screen
34. Shift rod
35. Shift rod connector
36. Drive shaft
37. Impeller drive pin
38. Gasket
39. Impeller housing plate
40. Impeller
41. Impeller housing liner
42. Impeller housing
43. Water tube grommet
44. Impeller housing spacer
45. Water tube
46. Water bypass cover
47. Shift rod bushing
48. Stud
49. Washer
50. Nut

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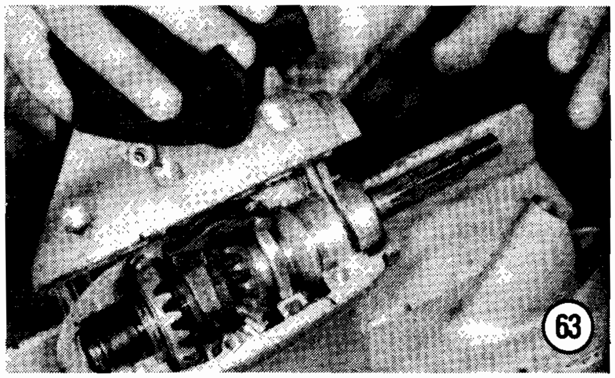
remove the lower half (**Figure 63**). Remove and discard the spaghetti seal (**Figure 64**).

7. Pivot the shifter lever to the rear and remove the cradle (**Figure 65**).
8. Slide the propeller shaft assembly straight up and to the side, then remove it from the gearcase. See **Figure 66**.
9. Remove the pinion gear/bearing/washer assembly from the gearcase (**Figure 67**).
10. Examine the upper end of the shift rod for burrs and remove with No. 400 grit sandpaper, if found. Slide the shift rod out of the gearcase.
11. To check, clean or replace the water intake screen:
    a. Remove the 2 screws holding the cover plate in the side of the gearcase. Remove the cover plate and check for blocked water passages.
    b. If the water intake screen requires replacement, drill a 5/32 in. hole in the plug and remove with a No. 3 Easy-out.
    c. Slide the screen from the gearcase and check for damage, blockage or metallic chips. Replace as required.
    d. Slide the screen back into the gearcase.
    e. Coat a new plug with OMC Adhesive M and drive it into the gearcase until it just touches the screen.
    f. Reinstall the cover plate and tighten the screws snugly.
12. Slide all components except the clutch dog from the propeller shaft.
13. With a hand cupped over the clutch dog, slowly slide it to the front of the propeller shaft, catching the spring and 2 detent balls as the clutch dog uncovers them.
14. Remove the gearcase head seals with remover part No. 391259. Remove and discard the O-ring. See **Figure 68**.
15. Soak the gearcase head in solvent to remove the dried sealant from the seal bore.
16. Coat the metal case of 2 new gearcase head seals with OMC Gasket Sealing Compound. Install the seals back-to-back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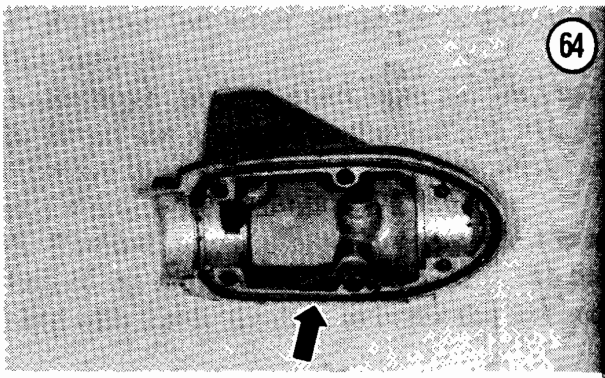
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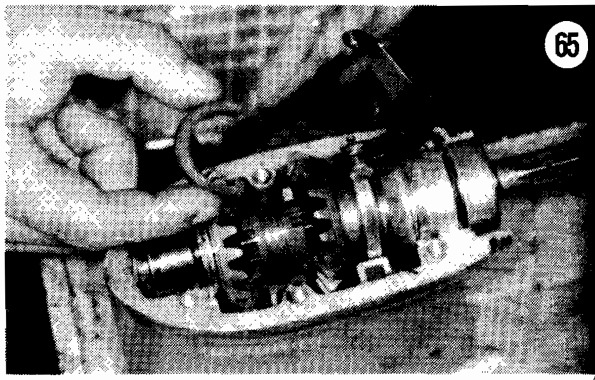
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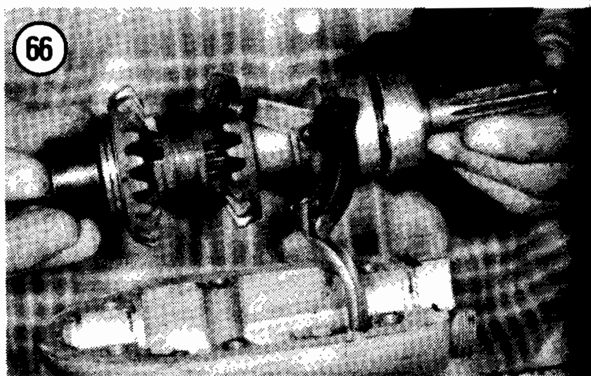
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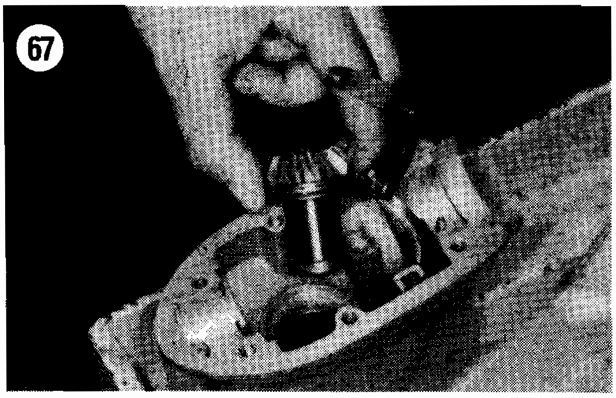
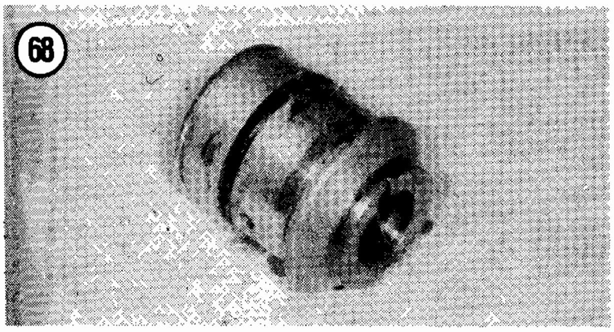
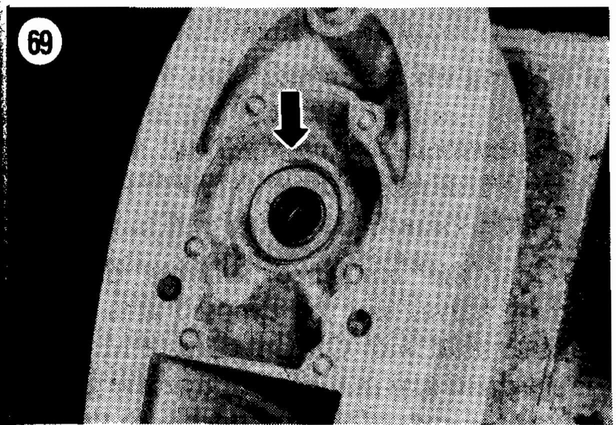






with installer part No. 326691. Pack the cavity between the 2 new seals with OMC Triple-Guard grease.

17. Lubricate a new O-ring with OMC HI-VIS Gearcase Lube and install on gearcase head.

18. Drive the upper drive shaft seals and bearing (**Figure 69**) from the gearcase with tool part No. 326570 (6-28 hp) or part No. 20018 (40 hp) and a mallet.

19. Lubricate a new bearing with OMC HI-VIS Gearcase Lube and install in the gearcase (lettered side up) with tool part No. 326564 (6-28 hp) or part No. 319926 (40 hp).

20. Coat the metal case of 2 new gearcase head seals with OMC Gasket Sealing Compound. Install the inner seal (lip facing toward gearcase) and the outer seal (lip facing away from gearcase) at the same time with installer part No. 330655 (6-28 hp) or part No. 3119927 (40 hp) and drive handle part No. 378737. Pack the cavity between the 2 new seals with OMC Triple-Guard grease.

21A. 6-28 hp—Remove the pinion bearing with remover part No. 326571 and remover part No. 326570. Install remover part No. 326571 with its slide ring behind the bearing cage, then drive the bearing out with remover part No. 326570 and a mallet.

21B. 40 hp—Remove the pinion bearing with puller part No. 379445 and puller jaws part No. 308093.

22A. 6-28 hp—Lubricate a new pinion bearing with OMC HI-VIS Gearcase Lube and install (lettered side up) in gearcase with tool part No. 326565 until tool seats against gearcase flange.

22B. 40 hp—Lubricate thrust washers and bearing with Johnson or Evinrude Outboard Lubricant. Install washer with large hole, bearing and washer with small hole in that order, then install new pinion bearing (lettered side up) in gearcase with tool part No. 378098 and driver part No. 378737.

23. Drive the shift rod bushing from the gearcase with tool part No. 304514 and a mallet.

24. Fit a new shift rod bushing on the end of tool part No. 304515. Lubricate a new O-ring with OMC HI-VIS Gearcase Lube and install on the end of the bushing along with a new bushing gasket. Position the tool and bushing assembly in the gearcase and drive in place until the bushing is fully seated.

25. Insert the spring in the propeller shaft. Position a detent ball on each side of the spring and hold in place while sliding the clutch dog in place. Chamfered and grooved lugs of the shift dog should face the front of the shaft.

26. Lubricate the remaining propeller shaft components with OMC HI-VIS Gearcase Lube. Install the roller bearing (lettered end facing forward), thrust washer, thrust bearing and gear in that order.

27. Turn the shaft around and install the reverse gear, bushing and gearcase head in that order.

28. Lubricate the end of the shift rod with OMC HI-VIS Gearcase Lube. Insert rod through shift rod bushing.

29. Sandwich the pinion gear bearing between the 2 thrust washers. The thrust washer with the inside chamfer must rest against the pinion shoulder. The chamfered edge of the other thrust washer must face away. See **Figure 56**.

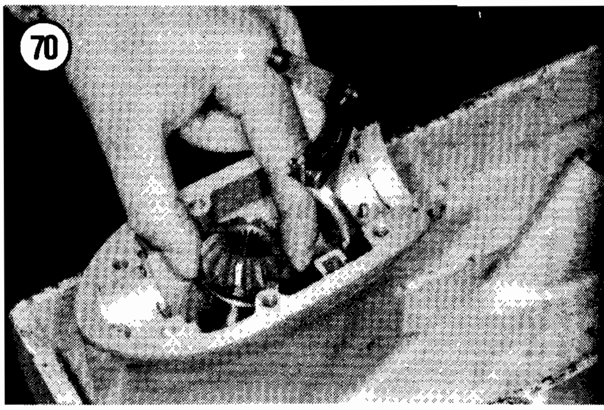
30. Install the pinion gear/bearing/washer assembly in the gearcase **(Figure 70)**.

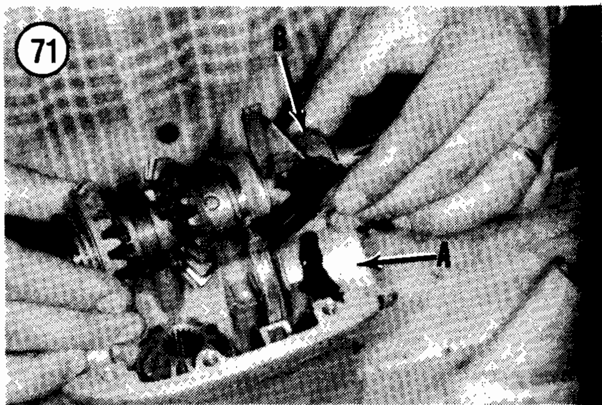
31. Run a bead of OMC Adhesive M on the upper gearcase at point A, **Figure 71**.

32. Install the cradle on the shift lever (B, **Figure 71**).

33. Install the propeller shaft assembly in the upper gearcase **(Figure 71)**. Make sure the hole in the gearcase head engages the locating pin in the gearcase. Pry the clutch dog forward into gear with a flat-blade screwdriver while rotating the propeller shaft, then position the shift cradle.

34. 6-28 hp—Install alignment tool part No. 390880 on propeller shaft **(Figure 72)** to seat the forward gear and thrust bearing against the gearcase and prevent them from cocking. Leave the tool in place until the other half of the gearcase is installed.





NOTE
Spaghetti seal is sold in bulk rolls. Obtain at least 13 inches for use in Step 35.

35. Coat the machined surfaces of bo gearcase halves and the exposed area of t gearcase head with OMC Adhesive M. Pla the spaghetti seal in the lower gearcase groo and cut the ends of the seal flush with the e of the groove using a sharp knife. App OMC RTV Adhesive Sealant on each end the seal for a distance of 1/2 inch.

36. Coat the gearcase screw threads w OMC Gasket Sealing Compound. Install t lower gearcase half with the 2 front and 2 r screws. Tighten the 4 screws alternately a evenly until finger-tight to draw the hal together.

37. Install the remaining screws finger-ti then tighten all screws to specifications (Ta

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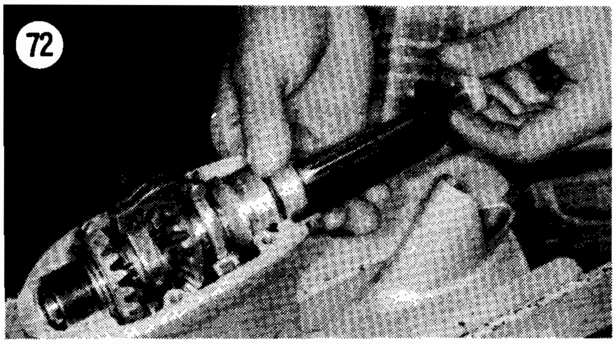

2), working from side-to-side and front-to-rear. Remove the alignment tool.
38. Locate the shift yoke pin hole by probing through the pivot pin hole in the gearcase with an awl. Align the yoke and gearcase holes. Install a new O-ring on the pivot pin. Coat the pin threads and O-ring with OMC Gasket Sealing Compound and tighten the screw to specifications (**Table 2**).
39. Install the drive shaft with a rotating motion to engage the pinion gear splines.
40. Install the water pump as described in this chapter.
41. Pressure and vacuum test the gearcase as described in this chapter.
42. Install the gearcase as described in this chapter. Fill with the recommended type and quantity of lubricant. See Chapter Four.
43. Check gearcase lubricant level after engine has been run. Change the lubricant after 10 hours of operation (break-in period). See Chapter Four.

Disassembly/Assembly
(1985-on 20 and 25 hp, 30 hp and 35 hp)

Refer to **Figure 73** for this procedure.
1. Remove the gearcase as described in this chapter.
2. Secure the gearcase in a holding fixture or a vise with protective jaws. If protective jaws are not available, position the gearcase upright with the skeg between wooden blocks.
3. Remove the water pump fasteners. Pull up on the drive shaft and remove it from the gearcase with the water pump attached. Disassemble the water pump as described in this chapter.
4. Remove the 2 screws holding the bearing housing in the propeller bore. Use a long screwdriver or a screwdriver tip socket and extension to reach the screws. See **Figure 74.**
5. Install puller part No. 378103 components as shown in **Figure 75** and remove the bearing housing from the gearcase.
6. Remove the large snap ring from the gearcase with snap ring pliers part No. 303859 or equivalent.
7. Holding one hand around the propeller shaft, tilt the gearcase in the holding fixture and catch the retainer plate as it drops out.
8. Turn the lower shift rod counterclockwise with an open-end wrench and remove the rod from the shift yoke.
9. Reach into the gearcase with needlenose pliers and remove the shift yoke (**Figure 76**).
10. Remove the Phillips head pivot pin from the outside of the gearcase. Remove and discard the pivot pin O-ring.
11. Start to pull the propeller shaft out carefully and slowly. Two clutch dog detent balls will dislodge and drop into the gearcase bore. Tilt the gearcase and catch the clutch dog and shift cradle, reverse gear and the detent spring and balls.
12. Remove the forward gear and bearing assembly. Remove the pinion gear/bearing/washer assembly with a right angle rod, if necessary. See **Figure** 77.
13. Attach a slide hammer to a narrow 2-jaw puller (part No. 391010). Insert the puller jaws in the grooves at each side of the gearcase behind the forward gear bearing cup and remove the cup.
14. Lubricate the forward bearing cup with OMC HI-VIS Gearcase Lube and install with tool part No. 319929 and handle part No. 311880. Make sure cup is completely seated in the gearcase.

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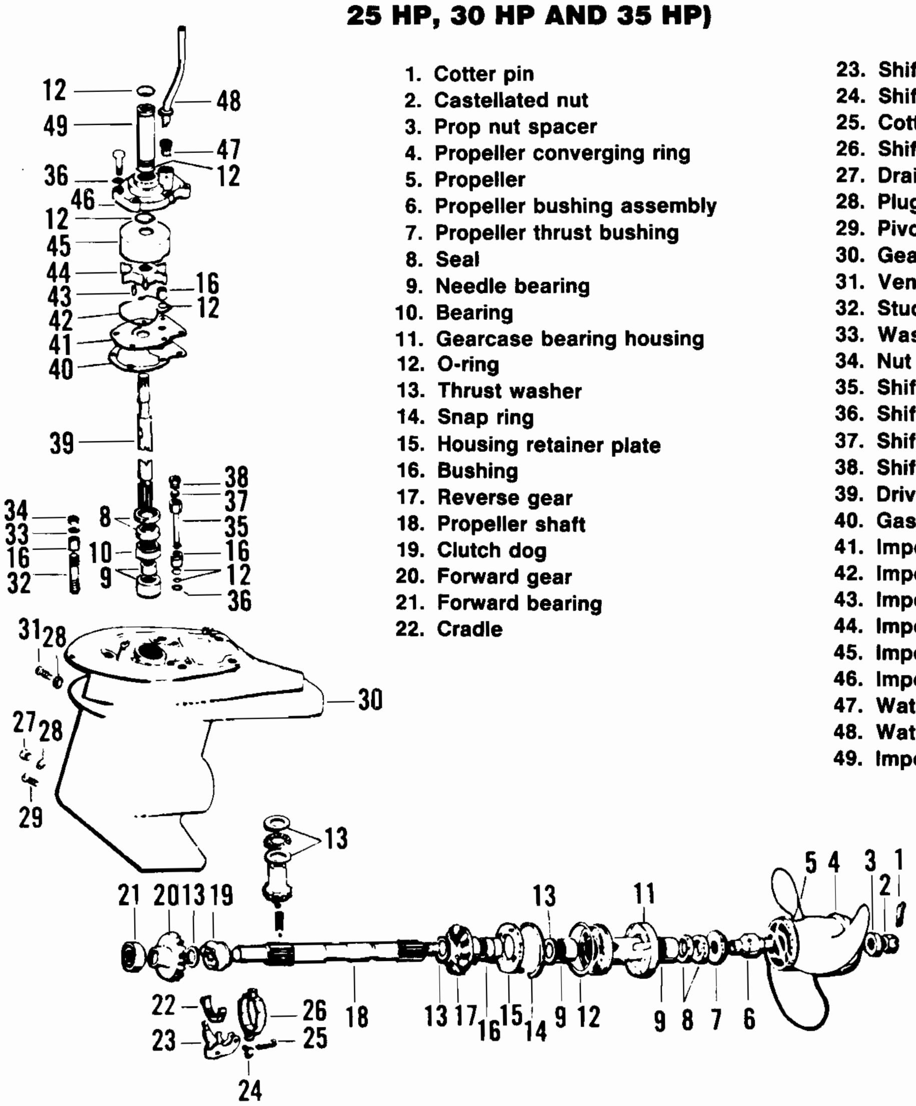
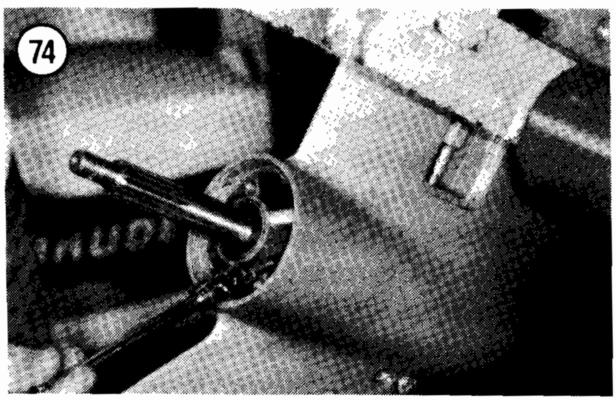
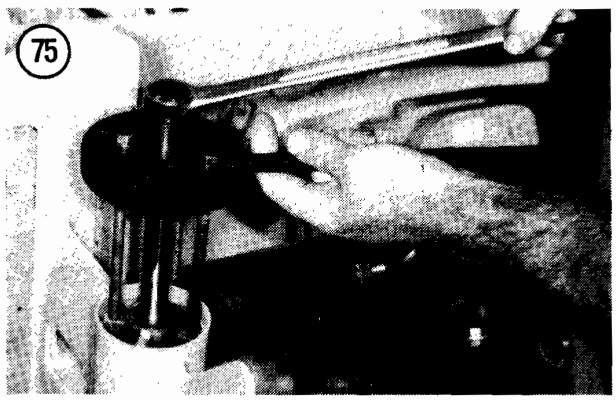
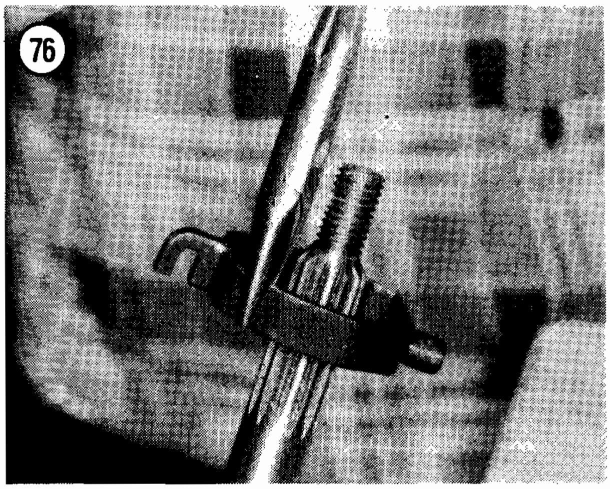
GEARCASE (1985-ON 20 AND 25 HP, 30 HP AND 35 HP)

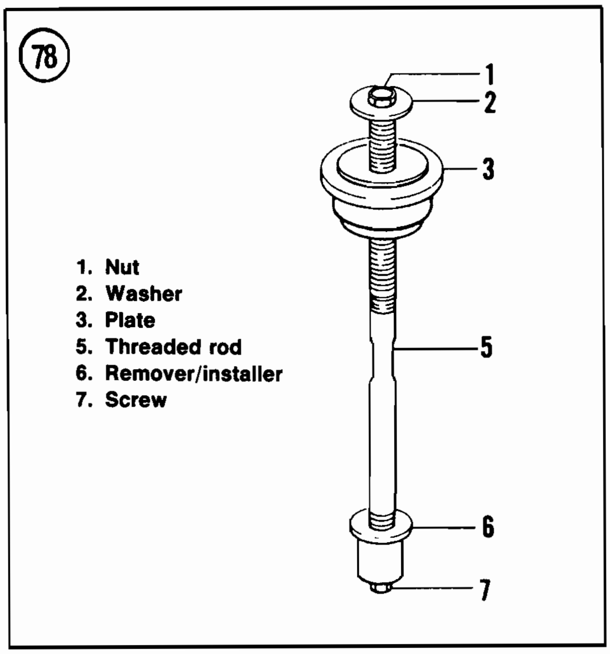


1. Cotter pin
2. Castellated nut
3. Prop nut spacer
4. Propeller converging ring
5. Propeller
6. Propeller bushing assembly
7. Propeller thrust bushing
8. Seal
9. Needle bearing
10. Bearing
11. Gearcase bearing housing
12. O-ring
13. Thrust washer
14. Snap ring
15. Housing retainer plate
16. Bushing
17. Reverse gear
18. Propeller shaft
19. Clutch dog
20. Forward gear
21. Forward bearing
22. Cradle
23. Shift lever
24. Shift lever pin
25. Cotter pin
26. Shift yoke and connector
27. Drain/fill plug
28. Plug washer
29. Pivot pin and O-ring
30. Gearcase housing
31. Vent plug
32. Stud
33. Washer
34. Nut
35. Shift rod
36. Shift rod bushing
37. Shift rod nylon keeper
38. Shift rod connector
39. Drive shaft
40. Gasket
41. Impeller housing plate
42. Impeller housing seal
43. Impeller drive pin
44. Impeller
45. Impeller housing liner
46. Impeller housing
47. Water tube grommet
48. Water tube
49. Impeller housing spacer









15. Remove the drive shaft seals with remover tool part No. 391259. Remove the upper drive shaft bearing and bearing housing assembly with the same tool. If the bearing is worn or damaged, press it from the housing and discard it.
16. Lubricate a new drive shaft bearing with OMC HI-VIS Gearcase Lube and install in bearing housing (lettered side up) with tool part No. 322923. Use the same tool to install the drive shaft bearing housing (lettered side up) in the gearcase.
17. Coat the metal case of 2 new drive shaft seals with OMC Gasket Sealing Compound. Install seals back-to-back with installer part No. 326554. Pack the cavity between the seals with OMC Triple-Guard grease.

NOTE
Pinion bearings cannot be serviced separately. If one requires removal, both must be removed.

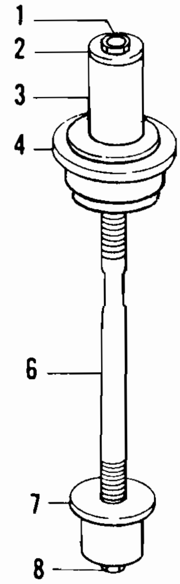
18. To remove the pinion bearings, assemble the components of tool part No. 391257 as shown in **Figure 78**. Install the assembled tool in the gearcase and drive the pinion bearings into the propeller shaft bore.
19. To install the pinion bearings, assemble the components of tool part No. 391257 and spacers part No. 330067 and part No. 330068 (spacers are not included with tool part No. 391257) as shown in **Figure 79**. Use OMC Needle Bearing Grease to hold the bearing on the tool (lettered side facing up). Insert the tool and bearing in the gearcase and tighten the tool screw until the washer on the tool touches the spacer.
20. To remove the shift rod bushing:
   a. Position remover tool and handle part No. 327693 under the bushing.
   b. Insert a slide hammer adaptor through the bushing and thread it into the remover tool.

c. Remove the handle from the remover tool and pull the bushing out with the slide hammer.
d. Remove and discard bushing O-ring. Examine bushing for wear or damage and replace as required.

21. To install the shift rod bushing, lubricate 2 new O-rings with OMC HI-VIS Gearcase Lube and install on bushing. Coat outside of bushing with OMC Adhesive M. Install bushing and washer with tool part No. 304515.
22. Remove and discard the bearing housing O-ring. Remove and discard the bearing housing seals and bearings with tool part No. 391259.
23. Clean and inspect all components as described in this chapter.
24. Lubricate a new bearing with OMC HI-VIS Gearcase Lube and install (lettered side against tool) in the rear of the bearing housing with tool part No. 321429. Repeat this step to install front bearing with tool part No. 321428.
25. Coat the metal case of 2 new bearing housing seals with OMC Gasket Sealing Compound. Install the seals back-to-back with installer part No. 326546. Pack the cavity between the 2 new seals with OMC Triple-Guard grease.
26. Lubricate a new bearing housing O-ring with OMC HI-VIS Gearcase Lube and install on the housing.
27. Lubricate the forward gear bearing with OMC HI-VIS Gearcase Lube and install in bearing cup.
28. Sandwich the pinion gear bearing between the 2 thrust washers. The thrust washer with the inside chamfer must rest against the pinion shoulder. The chamfered edge of the other thrust washer must face away. See **Figure 56**. Install the assembly in the gearcase with a right angle rod. See **Figure 77**.
29. Install the forward gear in the gearcase.

(79)

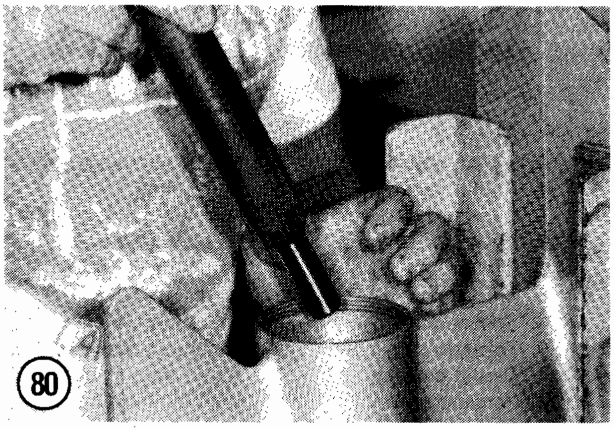
1. Nut
2. Washer
3. Spacer
4. Plate
6. Threaded rod
7. Installer/remover
8. Screw



30. Coat clutch shifter and clutch dog with OMC Needle Bearing Grease. Assemble clutch dog (grooved end facing forward gear) to shifter and install in gearcase with needlenose pliers.
31. Align gearcase and shifter holes with an awl, then install pivot pin with a new O-ring. Tighten pin to specifications (**Table 2**).
32. Coat detent balls with OMC Needle Bearing Grease. Install detent spring in propeller shaft hole and set one ball on one side of the spring. Slide detent sleeve part No. 328081 over shaft.

WARNING
Detent balls are under considerable pressure in Step 33. Wear safety glasses for eye protection in case the ball flies out during installation.

33. Align detent sleeve groove with remaining hole in shaft and put second detent ball in tool groove. Depress detent ball and



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pull tool back until detent ball engages shaft hole. Leave tool in place.

NOTE
Work slowly and carefully in Step 34. Detent balls and spring will not engage clutch dog if tool legs and clutch dog ramps are misaligned.

34. Holding detent tool on propeller shaft (**Figure 80**), insert shaft in gearcase and engage forward gear. Push shaft forward, aligning tool legs with clutch dog ramps until detent balls and spring enter the clutch dog. Remove the detent tool.
35. Lubricate reverse gear and reverse gear bushing with OMC HI-VIS Gearcase Lubricant. Install reverse gear, then install the bushing in the gear.
36. Grasp shifter yoke with needlenose pliers. Install the yoke in the gearcase bore, engaging its top in the upper gearcase cavity and locating its bottom hook on the shift lever clevis pin at the bottom of the gearcase cavity.
37. Lubricate the lower shift rod with OMC HI-VIS Gearcase Lubricant. Install rod through the water intake opening until it engages the shifter yoke. Thread rod into yoke until it bottoms.
38. Position the retainer plate on the propeller shaft with its tab facing the skeg and slide plate in position.
39. Install the large snap ring with snap ring pliers part No. 303869. Sharp outside edge of ring should face to the rear and the rings should face the skeg.
40. Thread guide pins (part No. 383175) into the retainer plate holes.
41. Lubricate the bearing housing thrust washer and O-ring with OMC HI-VIS Gearcase Lubricant. Install thrust washer in bearing housing recess. Position bearing housing on guide pins with the word "UP" facing the top of the gearcase. Slide housing into gearcase cavity and seat by tapping in place with a brass punch and mallet.
42. Install new O-rings on the bearing housing screws. Coat screw threads with OMC Gasket Sealing Compound. Remove one guide pin and install the screw with a long screwdriver or a screwdriver tip socket and extension. See **Figure 74**. Remove the other guide pin and install the second screw. Tighten both screws to specifications (**Table 2**). 9
43. Lightly lubricate drive shaft pinion splines with OMC HI-VIS Gearcase Lubricant. Install the drive shaft with a rotating motion to engage the pinion gear splines.
44. Install the water pump as described in this chapter.
45. Pressure and vacuum test the gearcase as described in this chapter.
46. Install the gearcase as described in this chapter. Fill with the recommended type and quantity of lubricant. See Chapter Four.
47. Check gearcase lubricant level after engine has been run. Change the lubricant after 10 hours of operation (break-in period). See Chapter Four.

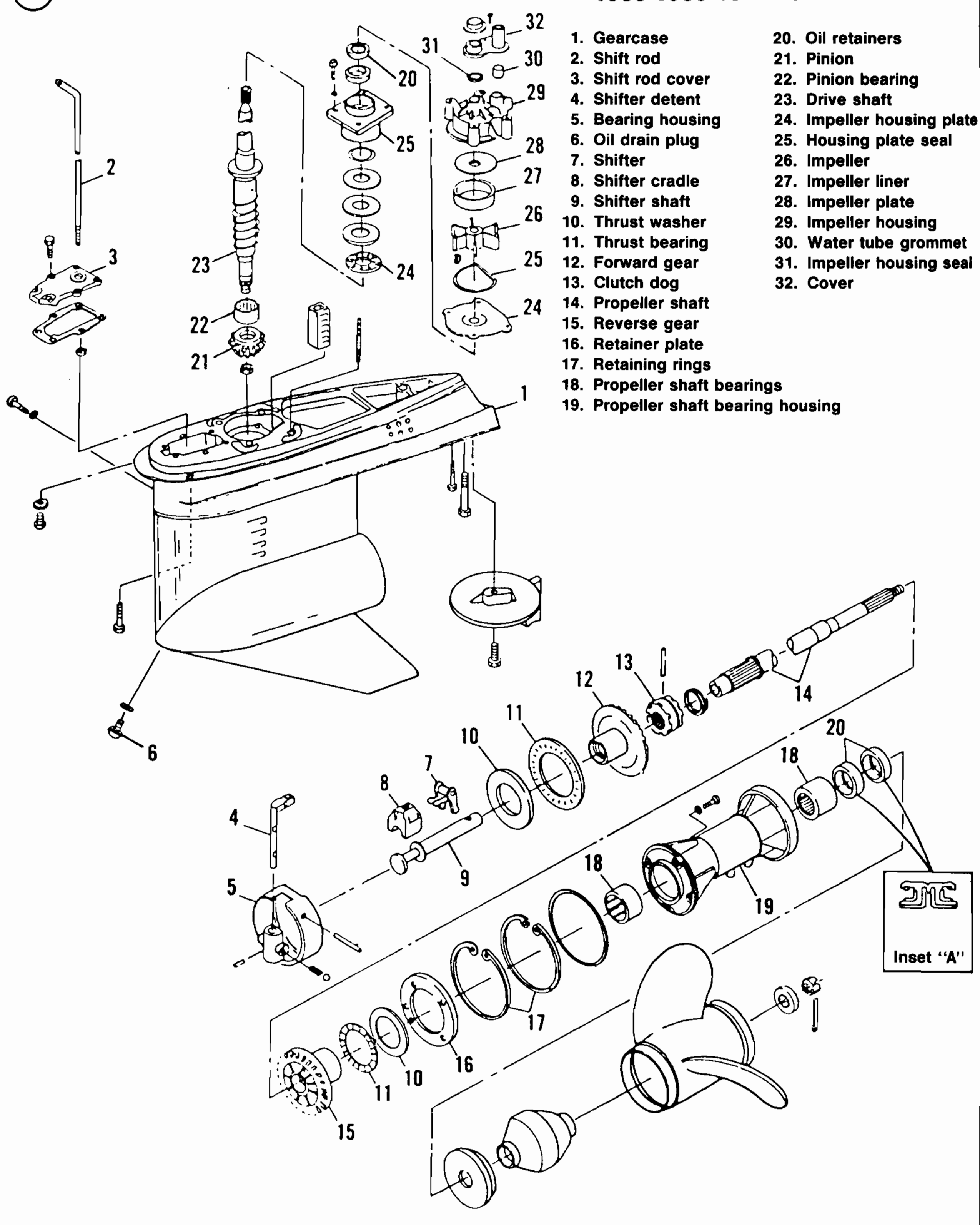
Disassembly
(1985-1988 40 hp)

Refer to **Figure 81** (typical) for this procedure.

81

1985-1988 40 HP GEARCASE

1. Gearcase
2. Shift rod
3. Shift rod cover
4. Shifter detent
5. Bearing housing
6. Oil drain plug
7. Shifter
8. Shifter cradle
9. Shifter shaft
10. Thrust washer
11. Thrust bearing
12. Forward gear
13. Clutch dog
14. Propeller shaft
15. Reverse gear
16. Retainer plate
17. Retaining rings
18. Propeller shaft bearings
19. Propeller shaft bearing housing
20. Oil retainers
21. Pinion
22. Pinion bearing
23. Drive shaft
24. Impeller housing plate
25. Housing plate seal
26. Impeller
27. Impeller liner
28. Impeller plate
29. Impeller housing
30. Water tube grommet
31. Impeller housing seal
32. Cover



Secure the gearcase in a holding fixture or vise with protective jaws. If protective jaws e not available, position the gearcase right with the skeg between wooden blocks.
Remove and discard the O-ring on the top the driveshaft.
Remove the 4 screws holding the water mp housing to the gearcase. Slide the water mp off the drive shaft and retrieve the peller drive pin. Remove the impeller plate om the gearcase.
Remove the propeller bearing housing ews with a thin wall 5/16 in. deep socket. iscard the O-rings on the screws.
Assemble flywheel puller (part No. 8103) with 3 puller legs (part No. 320737). t puller legs around bearing housing flange s. Tighten puller nut until the bearing using comes loose.
Remove the puller assembly from the aring housing. Remove the bearing housing om the gearcase. Remove and discard the aring housing O-ring.

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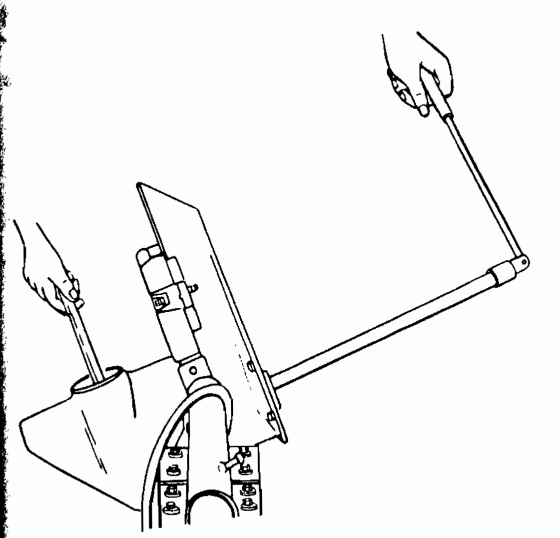
PINION LOCKNUT REMOVAL



7. Use snap ring pliers part No. 311879 and carefully remove the 2 large snap rings in the gearcase propeller bore.
8. Remove the retainer plate, thrust washer, thrust bearing and reverse gear from the propeller shaft.
9. Remove the 4 screws holding the driveshaft seal housing.
10. Pull up on the shift rod to shift the clutch dog into FORWARD gear.
11. Install drive shaft holding socket part No. 316612 on drive shaft splines and connect a breaker bar.
12. Hold pinion locknut with a socket and flex handle. Pad the gearcase where the flex handle will hit with shop cloths to prevent housing damage.
13. Hold the pinion nut from moving and turn the drive shaft to break the pinion locknut loose. See **Figure 82**. Remove the pinion locknut and drive shaft holding tool.
14. Remove the pinion locknut and pinion gear from the gearcase.
15. Pull the drive shaft and seal housing from the gearcase. Remove the thrust washer, bearing and shims from the drive shaft.
16. Push the shift rod down to engage REVERSE gear. Unthread the shift rod from the shifter detent. Remove the cover screws. Tap cover with a soft mallet to break gasket seal and slide it upward on the shift rod away from the gearcase.
17. Disengage the shift rod and remove from the gearcase with the shift rod cover. Discard the cover gasket and O-ring.

NOTE
The shift detent must be in REVERSE to provide necessary clearance for propeller shaft removal in Step 18.

18. Remove the propeller shaft, forward gear and bearing housing as an assembly from the gearcase.
19. If lower drive shaft (pinion) bearing requires replacement, remove the bearing

9

retaining screw from the gearcase. Remove and discard the O-ring on the screw.

20. Assemble bearing remover/installer tool (part No. 391257) as shown in **Figure 83** and tighten screw to pull bearing from gearcase.

21. Drive oil seals and bearings from each end of bearing housing with a suitable punch and mallet.

22. Carefully lift one end of the clutch dog retaining spring and insert a screwdriver blade or the tip of an awl under it. Holding the screwdriver or awl in a stationary position, rotate the propeller shaft to unwind the spring.

23. Remove the clutch dog retainer pin (**Figure 84**) and separate the bearing housing, forward gear, thrust washer and bearing assembly and clutch dog from the propeller shaft.

24. Remove the shift lever pin from the bearing housing with a suitable punch.

25. Disconnect the shift lever from the shifter shaft cradle, then remove the shaft, cradle and lever. See **Figure 85**.

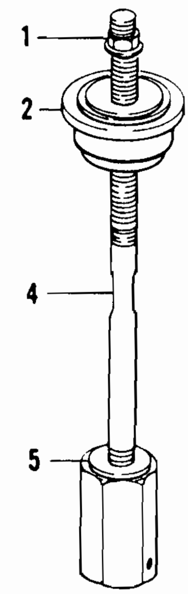
26. Depress the detent ball and spring by rotating the shifter detent 180°. Catch ball and spring as detent is removed from bearing housing. See **Figure 86**.

Assembly
(1985-1988 40 hp)

NOTE
The forward gear bearing and bearing housing are serviced as an assembly. Replace the assembly if either is worn or damaged.

Refer to **Figure 81** (typical) for this procedure.

1. Reassemble the bearing housing as follows:
   a. Coat end of forward bearing housing detent spring and ball with OMC Needle Bearing Grease. Insert spring and ball in forward bearing housing.



1. **Flange nut (part No. 326586)**
2. **Plate and bearing (part No. 391260)**
4. **Rod (part No. 326582)**
5. **Remover (part No. 326581)**

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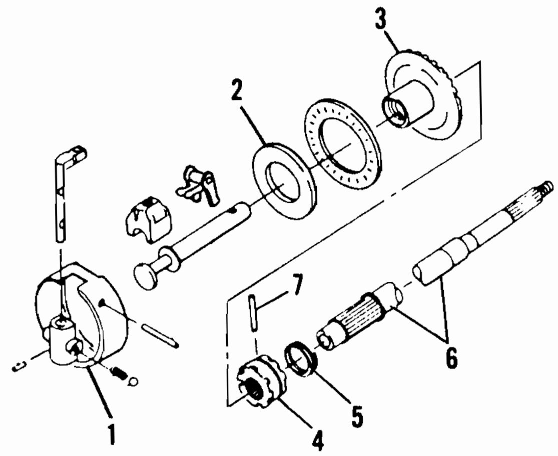

1. **Bearing housing**
2. **Thrust washer**
3. **Forward gear**
4. **Clutch dog**
5. **Pin retainer**
6. **Propeller shaft**
7. **Clutch dog pin**

b. Install shifter detent in forward bearing housing. Depress ball and spring with a suitable punch and push detent into housing.
c. Coat shifter cradle with OMC HI-VIS Gearcase Lubricant and install on shift shaft. Rotate shifter detent 180°, then insert cradle and shaft in housing.
d. Insert the shift lever to engage the cradle and shifter detent, then install retaining pin.

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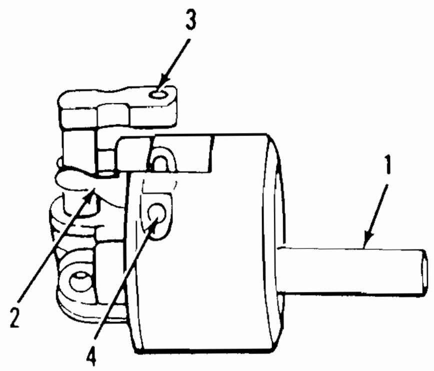

1. Shifter shaft
2. Shift lever
3. Shifter detent
4. Pin

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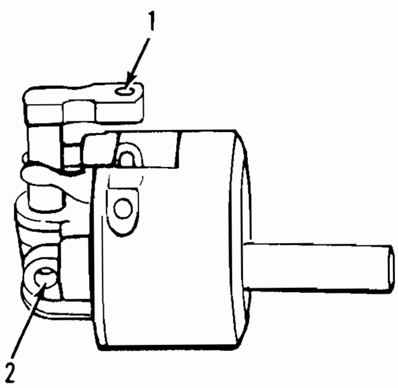

1. Shifter detent
2. Ball and spring

2. Position the clutch dog with the end stamped "PROP" facing the propeller end of the shaft. Align the clutch dog holes and propeller shaft slot, then install clutch dog on shaft.
3. Place thrust bearing on forward gear shoulder. Place thrust washer on bearing housing shoulder. Install forward gear in bearing housing.
4. Install the propeller shaft over the shift shaft and align the clutch dog and shift shaft holes. Insert the retaining pin.
5. Install one end of a new clutch dog retaining spring over the clutch dog, then rotate the propeller shaft to wind the spring back in place.
6. Push shifter detent into REVERSE position, then install bearing housing, forward gear and propeller shaft assembly in the gearcase. The locating pin on the bearing housing must engage the locating hole in the gearcase. 9
7. If lower drive shaft (pinion) bearing was removed, lubricate a new bearing with OMC Needle Bearing Grease. Assemble bearing remover/installer tool part No. 391257. Position new bearing on tool with lettered side facing tool shoulder. Insert assembly into gearcase and drive the bearing in until the tool washer touches the tool spacer. Remove the tool.
8. Wipe a new bearing setscrew O-ring with OMC Gasket Sealing Compound and install setscrew in gearcase. Tighten to specifications (**Table 2**).
9. If drive shaft tapered roller bearing requires replacement, remove and install the bearing with an arbor press and universal bearing plate.

10. Install pinion gear on drive shaft and tighten locknut to specifications (**Table 2**).
11. Measure and record the thickness of the shims removed during disassembly. Install 0.020 in. shimming on drive shaft shoulder, then install the drive shaft in shim gauge part No. 320739. See **Figure 87**.
12. Measure the clearance between the shim gauge and pinion gear. If the same pinion and forward gear assembly is being reinstalled, check the gearcase trim tab pocket.

   a. If there is an "S" stamped inside the pocket, adjust the thickness of the shim(s) removed during disassembly to match the feeler gauge reading.
   b. If there is no stamping in the gearcase trim tab pocket, subtract 0.007 in. from the feeler gauge reading, then adjust the thickness of the shim(s) removed during disassembly to match that reading.

13. If a new pinion and forward gear assembly is being installed, adjust the thickness of the shim(s) removed during disassembly to match the feeler gauge reading.
14. Remove the drive shaft from the shim gauge. Remove the 0.020 in. shim. Remove the pinion gear from the drive shaft.
15. Coat the outside diameter of 2 new drive shaft bearing housing seals with OMC Gasket Sealing Compound. Install the seals back-to-back in the housing (one lip facing in and the other facing out). Pack the cavity between the seals with OMC Triple-Guard grease.
16. Install a new bearing housing O-ring and lubricate it with OMC Triple-Guard grease.
17. Install the drive shaft thrust bearing, thrust washer and shim pack on the drive shaft.
18. Coat both sides of a new drive shaft seal housing gasket with OMC Gasket Sealing Compound. Install gasket to seal housing.
19. Wrap drive shaft splines with one thickness of masking tape and carefully slide seal housing and gasket over drive shaft.
20. Wipe the seal housing screw threads with OMC Gasket Sealing Compound and install the screws. Tighten screws to specifications (**Table 2**).
21. Remove the masking tape from the drive shaft splines and clean splines as required.
22. Coat both sides of a new shift cover gasket with OMC Gasket Sealing Compound and install on gearcase.
23. Insert shift rod through shift rod cover bushing and thread it into the shifter detent until it stops, then back it out enough to position offset on top of rod with the port side of the gearcase. Tighten shift rod cover screws to specifications (**Table 2**).

NOTE
After adjustment in Step 24, shift rod offset should face drive shaft.

24. Place shift rod in NEUTRAL. Position a universal shift rod gauge (part No. 389997) on the gearcase beside the vertical shift rod and align gauge and shift rod holes. Insert

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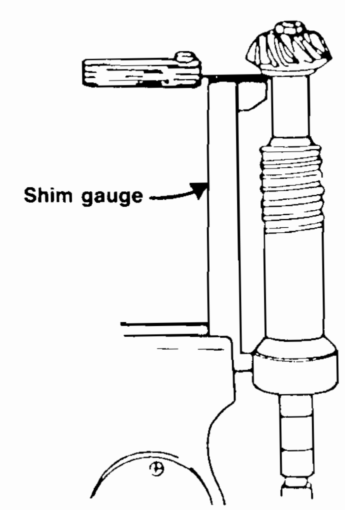

gauge pin in gauge hole. See **Figure 88**. Screw the shift rod in or out of the shifter detent to obtain a dimension of 15-29/32 ±1/32 in. (standard shaft) or 20-29/32 ±1/32 in. (long shaft), then pull up on the shift rod to engage clutch dog with forward gear.

25. Install pinion gear in gearcase propeller shaft bore and mesh with forward gear teeth.

26. Install drive shaft to engage pinion gear and install locknut.

27. Install drive shaft holding socket part No. 316612 on drive shaft splines and connect a breaker bar.

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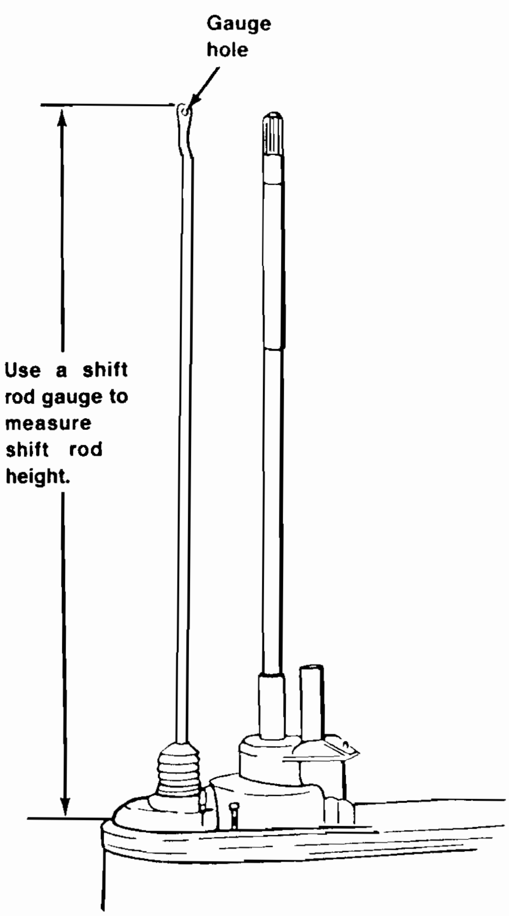

28. Hold pinion locknut with a socket and flex handle. Pad the gearcase where the flex handle will hit with shop cloths to prevent housing damage.

29. Hold the pinion nut from moving and turn the drive shaft to tighten the pinion locknut to specifications (**Table 2**). See **Figure 82**. Remove the pinion locknut and drive shaft holding tools.

30. Install the thrust bearing and thrust washer on reverse gear. Install reverse gear assembly with retainer plate on propeller shaft.

31. Slip one snap ring (flat side facing out) over the propeller shaft and install with snap ring pliers part No. 311879. Repeat this step to install the other snap ring.

32. If the bearing was removed from the propeller shaft bearing housing, install a new one with a suitable mandrel.

33. Wipe the outer diameter of 2 new propeller bearing housing seals with OMC Gasket Sealing Compound. Install the seals back-to-back (one lip facing in, the other facing out) with a suitable seal installer. Pack the cavity between the seals with OMC Triple-Guard grease. 9

34. Install a new O-ring on the bearing housing and lubricate with OMC Triple-Guard grease. Install new O-rings on the housing screws and wipe the screw threads with OMC Gasket Sealing Compound.

35. Install the guide pins used for bearing housing removal. Position the housing on the guide pins with drain slot facing downward or "UP" mark facing upward and slide the housing into the gearcase. Tighten screws to specifications (**Table 2**).

36. Install the water pump assembly using new gaskets. Tighten housing screws to specifications (**Table 2**).

37. Pressure and vacuum test the gearcase as outlined in this chapter.

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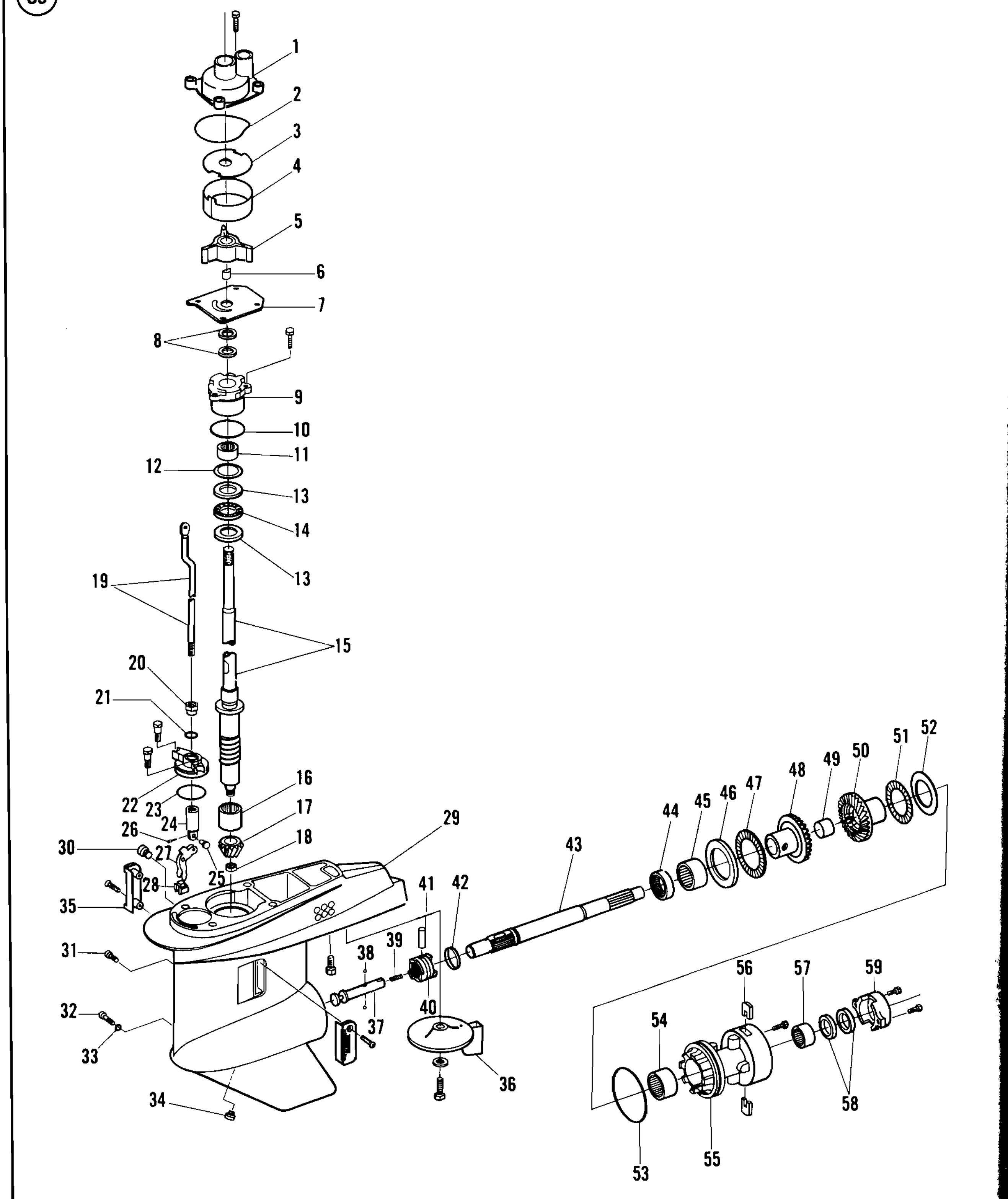

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1989-1990 40 HP GEARCASE

1. Impeller housing
2. Housing plate seal
3. Impeller plate
4. Impeller liner
5. Impeller
6. Impeller drive key
7. Impeller housing plate
8. Seals
9. Drive shaft bearing housing
10. O-ring
11. Bearing
12. Shim(s)
13. Thrust washers
14. Thrust bearing
15. Drive shaft
16. Bearing
17. Pinion gear
18. Nut
19. Shift rod
20. Bushing
21. O-ring
22. Shift rod cover
23. O-ring
24. Connector
25. Pin
26. Cotter pin
27. Shift lever
28. Cradle
29. Gearcase
30. Oil level plug
31. Bearing retaining screw
32. Shift lever pivot pin
33. O-ring
34. Drain/fill plug
35. Water intake screen
36. Trim tab
37. Shift shaft
38. Detent ball (3)
39. Spring
40. Clutch dog
41. Pin
42. Spring
43. Propeller shaft
44. Bearing (short)
45. Bearing (long)
46. Thrust washer
47. Thrust bearing
48. Forward gear
49. Bushing
50. Reverse gear
51. Thrust bearing
52. Thurst washer
53. O-ring
54. Bearing
55. Propeller shaft bearing housing
56. Retainer (2)
57. Bearing
58. Seals
59. Anode

Disassembly (1989-1990 40 hp)

Refer to **Figure 89** for this procedure.

1. Secure the gearcase in a holding fixture or a vise with protective jaws. If protective jaws are not available, position the gearcase upright with the skeg between wooden blocks.
2. Remove the propeller, if not previously removed, and inspect for damage.
3. Remove the propeller shaft bearing housing anode retaining screws and remove the anode.
4. Remove the propeller shaft bearing housing retaining screws and retainers. See **Figure 90**.
5. Assemble flywheel puller (part No. 378103) with two 1/4-20 × 8 in. cap screws and flat washers or a suitable length of 1/4-20 threaded rod, nuts and flat washers. Screw the cap screws or threaded rod into the threaded holes for the retaining screws in the propeller shaft bearing housing. Tighten the puller jackscrew until the bearing housing comes loose.
6. Remove the puller assembly from the bearing housing. Remove the bearing housing from the gearcase. Remove and discard the bearing housing O-ring. See **Figure 91**.
7. Remove thrust washer (A, **Figure 92**) from the bearing housing end.
8. Tilt the gearcase housing with the propeller shaft angled down and slide reverse gear (C, **Figure 92**) and thrust bearing (B, **Figure 92**) off the propeller shaft. Reposition gearcase housing with anti-ventilation plate level.

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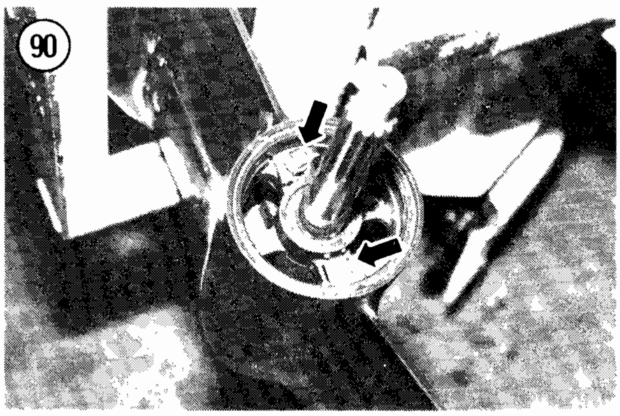
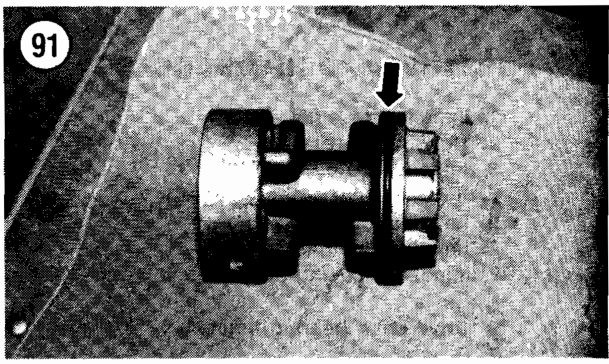
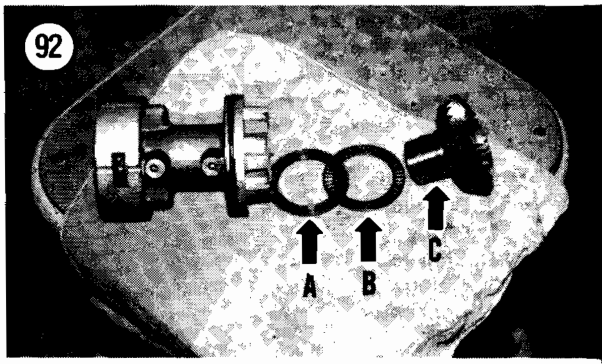


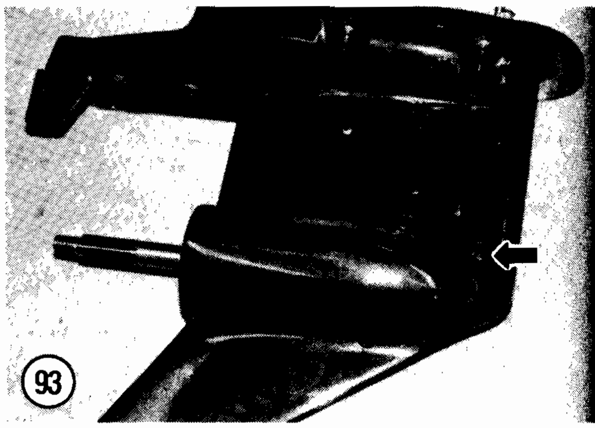
9. Remove shift lever pivot pin. See **Figure 93**. Remove and discard the screw O-ring.
10. Remove 2 shift rod cover retaining screws. See **Figure 94**.
11. Grasp shift rod and lift assembly from gearcase.
12. Disassemble shift rod and discard 2 O-rings. See **Figure 95**.
13. Remove the propeller shaft assembly (B, **Figure 96**) and cradle (A, **Figure 96**) from the gearcase.
14. Carefully lift one end of the clutch dog retaining spring and insert a screwdriver blade or the tip of an awl under it. Holding the screwdriver or awl in a stationary position, rotate the propeller shaft to unwind the spring.
15. Remove the clutch dog retainer pin, then slide the clutch dog off of the propeller shaft.

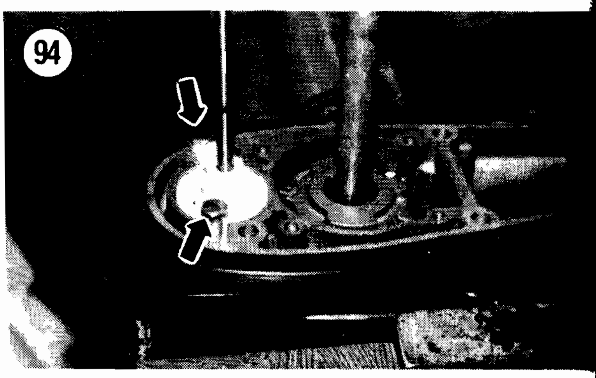
WARNING
To prevent possible personal injury, eye protection is recommended prior to disassembly of shift detent.

16. Remove the shift shaft, 3 detent balls and spring from the propeller shaft. See **Figure 97**.
17. Remove the 3 cap screws holding the drive shaft bearing housing.
18. Install drive shaft holding socket, part No. 316612, on drive shaft splines and connect a breaker bar.
19. Hold pinion nut with a 11/16 in. wrench. Pad the gearcase, where the wrench will hit, with shop cloths to prevent housing damage.
20. Hold the pinion nut from moving and turn the drive shaft to break the nut loose. Remove the pinion nut and drive shaft holding tool.
21. Remove the pinion nut and gear from the gearcase.
22. Pull the drive shaft and bearing housing from the gearcase.
23. Separate the bearing housing, shim(s), thrust washers and thrust bearing from the drive shaft. See **Figure 98**.
24. Remove the forward gear, thrust washer and thrust bearing from the gearcase.









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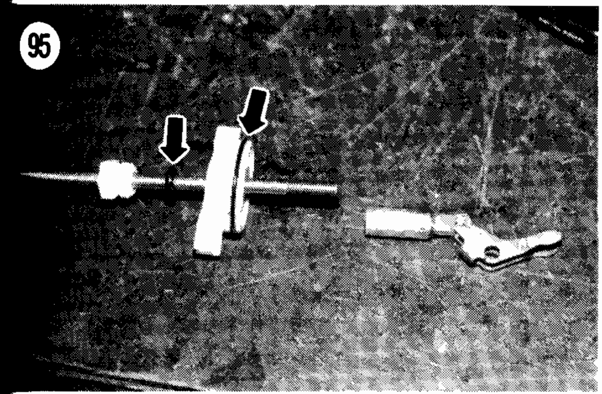

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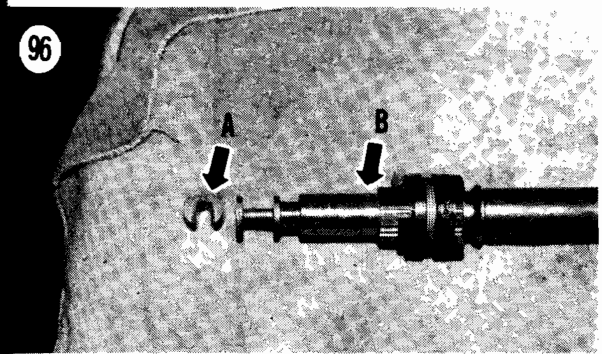

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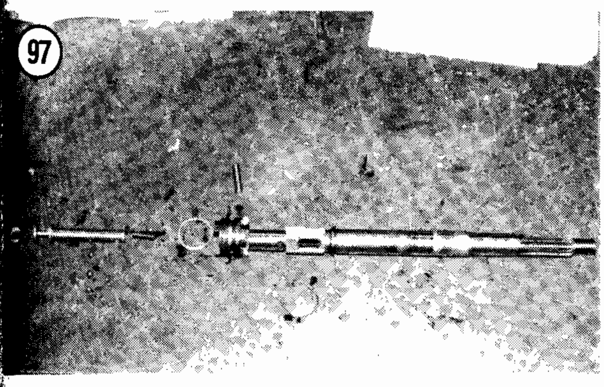

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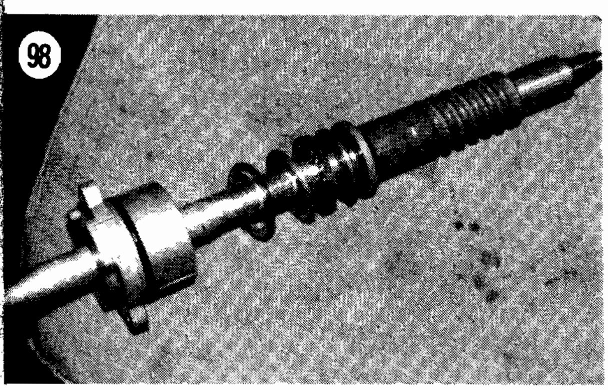


25. If lower drive shaft (pinion) bearing requires replacement, remove the bearing retaining screw (**Figure 99**) from the gearcase. Remove and discard the O-ring on the screw.

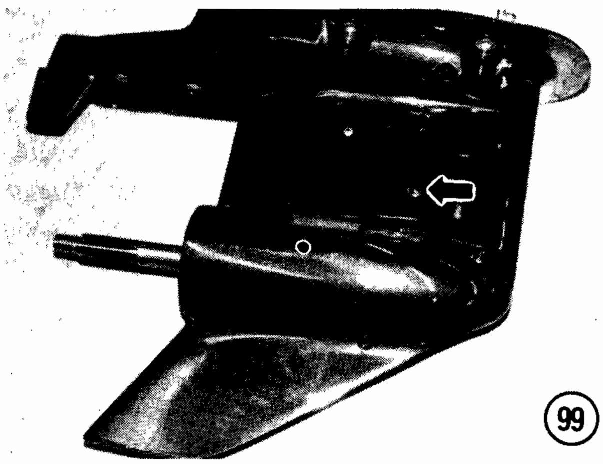
26. Assemble rod (part No. 326582 from tool part No. 391257), remover/installer (part No. 326575 from tool part No. 391257), guide plate (part No. 334987 from tool part No. 433033), 1/4-20 × 1-1/4 in. hex head screw, 1 inch O.D. flat washer and 1/4-20 × 1/2 in. hex head screw. Install assembled tool into top of gearcase and drive the lower drive shaft bearing into the propeller shaft cavity using a suitable mallet.

27. If the two forward gear bearings are to be replaced, assemble forward bearing service kit (part No. 433034) and extract the bearings from the gearcase bore.

28. Use bearing puller (part No. 432130) and a suitable slide hammer to extract the bearings and oil seals from the propeller shaft bearing housing if replacement is required.

29. Drive oil seals from drive shaft bearing housing using a suitable punch and mallet. Remove and discard the bearing housing outer O-ring. 9

NOTE
Bearing in drive shaft bearing housing is only replaceable as a complete assembly with the drive shaft bearing housing.



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Assembly (1989-1990 40 hp)

CAUTION
Bearings must always be replaced after removal. Never reuse a bearing.

Refer to **Figure 89** for this procedure.

1. Reassemble the propeller shaft bearing housing as follows:
   a. Use bearing installer (part No. 334997) and drive *new* fore and aft bearings into the bearing housing, with the lettered side of the bearing facing outward, until tool contacts bearing housing.
   b. Position the oil seals back-to-back (open sides facing away from each other). Apply OMC Gasket Sealing Compound onto the metal outer surfaces of the seals. Using seal installer (part No. 910585 or part No. 326556), drive the seals into the aft end of the bearing housing. Apply OMC Triple-Guard Grease onto the seal lips after installation.
   c. Apply OMC Triple-Guard Grease onto the bearing housing outer O-ring and install onto housing. See **Figure 91**.
2. Reassemble the drive shaft bearing housing as follows:

NOTE
Bearing in drive shaft bearing housing is only replaceable as a complete assembly with the drive shaft bearing housing.

   a. Position the oil seals back-to-back (open sides facing away from each other). Apply OMC Gasket Sealing Compound onto the metal outer surfaces of the seals. Using seal installer (part No. 335823), drive the seals into the bearing housing. Apply OMC Triple-Guard Grease onto the seal lips after installation. See **Figure 100**.
   b. Apply OMC Triple-Guard Grease onto the bearing housing outer O-ring and install onto housing.
3. If lower drive shaft (pinion) bearing was removed, install as follows:
   a. Assemble rod (part No. 326582 from tool part No. 391257), remover/installer (part No. 326575 from tool part No. 391257), guide plate (part No. 334987 from tool part No. 433033), 1/4-20 × 1-1/4 in. hex head screw, 1 inch O.D. flat washer, spacer (part No. 334986 from tool part No. 433033) and 1/4-20 × 1/2 in. hex head screw. Apply OMC Needle Bearing Assembly Grease onto *new* bearing to retain bearing on

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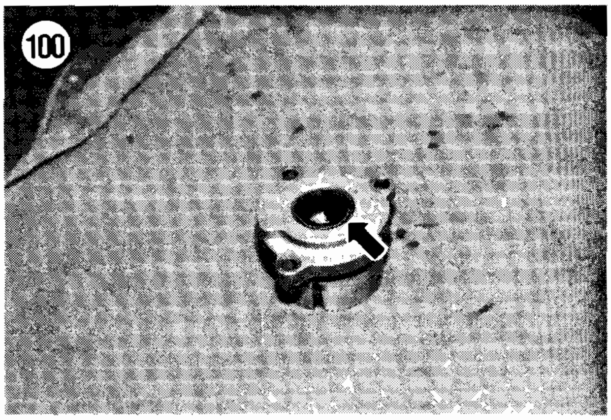

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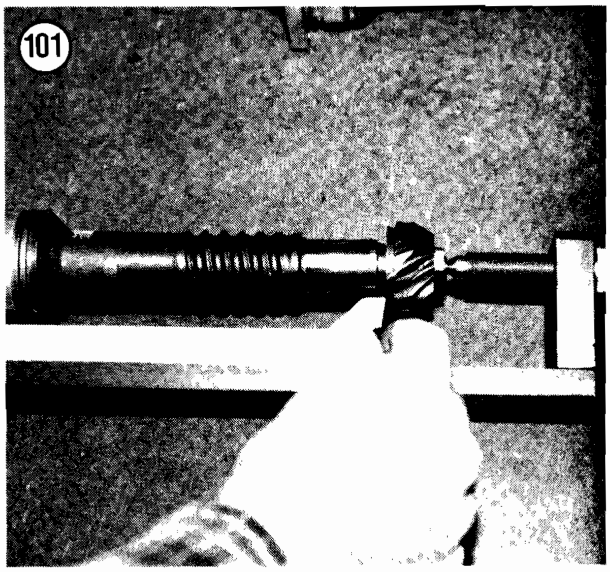


installer (part No. 326575). Position bearing on installer with lettered side of bearing facing toward tool assembly (facing top of gearcase after installation). Install assembled tool into top of gearcase and drive the lower drive shaft bearing into bearing bore, using a suitable mallet, until correctly positioned (tool's flat washer contacts top of spacer).

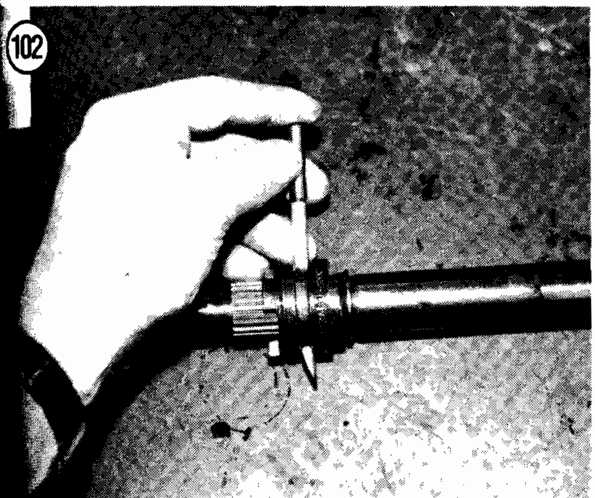
b. Install a new O-ring on the bearing retaining screw. Apply OMC Nut Lock on the screw threads, then install screw (**Figure 99**) and tighten to specification (**Table 2**).

4. If the two forward gear bearings were removed, install as follows:

a. Assemble forward bearing service kit (part No. 433034) and drive handle (part No.311880).

b. Support the nose of the gearcase with a suitable thickness of wood and position the propeller shaft cavity in a vertical direction on a solid surface.

c. First, install the short bearing into the gearcase with the lettered side of the bearing facing toward the installer tool. Drive the bearing into the gearcase, using a suitable mallet, until the installer tool contacts the gearcase. Then install the long bearing following same procedure. Note that one side of the installer tool is used to install the short bearing and the other side is used to install the long bearing.



5. Use universal pinion thrust bearing shim gauge (part No. 393185) and service kit (part No. 433032) to determine proper drive shaft shim thickness. See **Figure 101**. Follow directions provided with tool for correct setup and measuring procedures in determining correct shim thickness. Use fewest number of shims possible to obtain desired thickness.

6. Position the clutch dog with the end stamped "PROP END" facing the propeller end of the shaft. Align the clutch dog holes and propeller shaft slot, then install clutch dog on shaft.

WARNING

To prevent possible personal injury, eye protection is recommended prior to assembly of shift detent.

7. Install the 3 detent balls and spring into the shift shaft. While preventing the detent balls from falling free, align the shift shaft holes and propeller shaft slot then carefully slide the shift shaft into the propeller shaft. 9

8. Using a tool similar to that shown in **Figure 102** to align components, slide clutch dog retainer pin into position while pushing aligning tool from components.

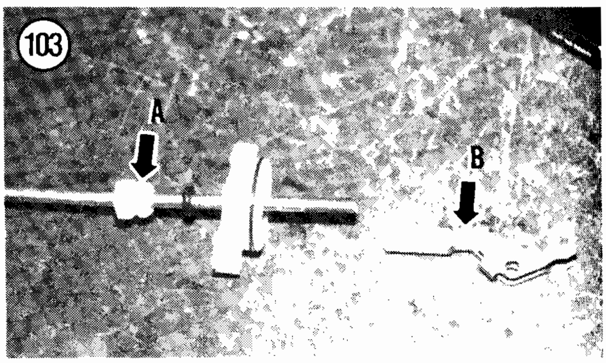
9. Install one end of a new clutch dog retaining spring over the clutch dog, then rotate the propeller shaft to wind the spring back in place. Make sure no coils overlap.

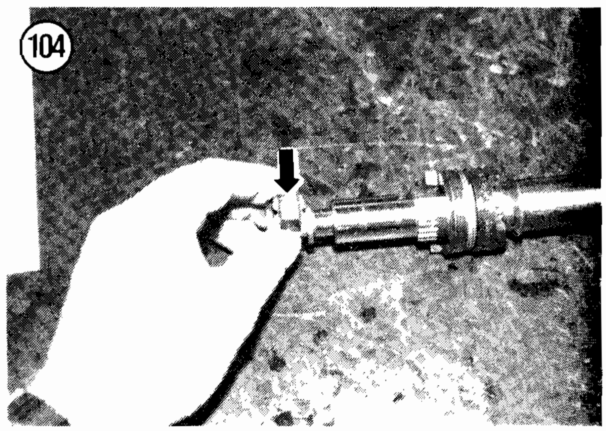
10. Install forward gear thrust washer into the gearcase with the chamfered side facing toward the gearcase nose.

11. Apply OMC Needle Bearing Assembly Grease onto the forward gear thrust bearing and assemble the bearing onto the forward gear. Install the forward gear and thrust bearing assembly into the gearcase.

12. Assemble thrust washers and thrust bearing onto drive shaft. See **Figure 98**. Install the bottom thrust washer with the chamfered side facing down and the top thrust washer with the chamfered side facing up.

13. Lightly coat the drive shaft shim(s) with OMC Needle Bearing Assembly Grease and position them in the drive shaft bearing housing.
14. Slide drive shaft bearing housing onto drive shaft.
15. Apply a light coat of OMC Gasket Sealing Compound onto the gearcase area where the drive shaft bearing housing mounting flange contacts.
16. Install drive shaft and bearing housing assembly into gearcase.
17. Install the pinion gear and nut onto the drive shaft.
18. Install drive shaft holding socket, part No. 316612, onto drive shaft splines and connect a torque wrench.
19. Hold pinion nut with a 11/16 in. wrench. Pad the gearcase, where the wrench will hit, with shop cloths to prevent housing damage.
20. Hold the pinion nut from moving and turn the drive shaft until the specified torque is obtained. See **Table 2**.
21. Apply OMC Gasket Sealing Compound onto the threads of the drive shaft bearing housing retaining screws and tighten to specification. See **Table 2**.
22. Apply OMC Triple-Guard Grease onto the 2 shift rod cover O-rings. See **Figure 95**. Install the larger, thinner O-ring onto the cover and the smaller, thicker O-ring onto the shift rod.
23. Apply OMC Adhesive M onto the threads of shift rod cover bushing. See A, **Figure 103**. Screw bushing into cover and tighten to 48-60 in.-lb.
24. Screw the shift lever and connector assembly (B, **Figure 103**) *nine* turns onto the shift rod.
25. Apply OMC Needle Bearing Assemble Grease onto shift shaft cradle and position cradle onto shift shaft with part number facing upward. See **Figure 104**.
26. Tilt gearcase nose down and slide propeller shaft assembly into gearcase with shift shaft cradle facing upward.
27. Install shift rod assembly into gearcase. Shift lever tangs must engage slots in shift shaft cradle.
28. Install a new O-ring on the shift lever pivot pin. Apply OMC Nut Lock on the pin threads, then install pin (**Figure 93**) and tighten to 60-84 in.-lb.
29. Apply OMC Gasket Sealing Compound onto the threads of the shift rod cover retaining screws, then install and tighten the screws (**Figure 94**) to specification. See **Table 2**.
30. Apply OMC Needle Bearing Assembly Grease onto the reverse gear thrust bearing and assemble the bearing onto the reverse gear. Install the reverse gear and thrust bearing assembly into the gearcase.
31. Apply a light coat of OMC Gasket Sealing Compound onto the O-ring flange and rear support flange on the propeller shaft bearing housing.
32. Apply OMC Needle Bearing Assembly Grease onto the reverse gear thrust washer and position the washer onto the propeller shaft bearing housing. See **Figure 105**.





33. Position the propeller shaft bearing housing with mounting screw holes in a vertical position and the drain slot on the bottom. Then slide the propeller shaft bearing housing into the gearcase.
34. Install propeller shaft bearing housing retainers and screws (**Figure 90**), then tighten to specification. See **Table 2**.
35. Install propeller shaft bearing housing anode and secure with retaining screws. Tighten to specification shown in **Table 2**.

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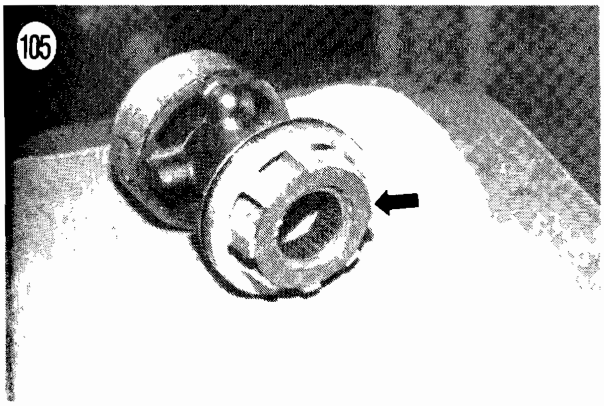

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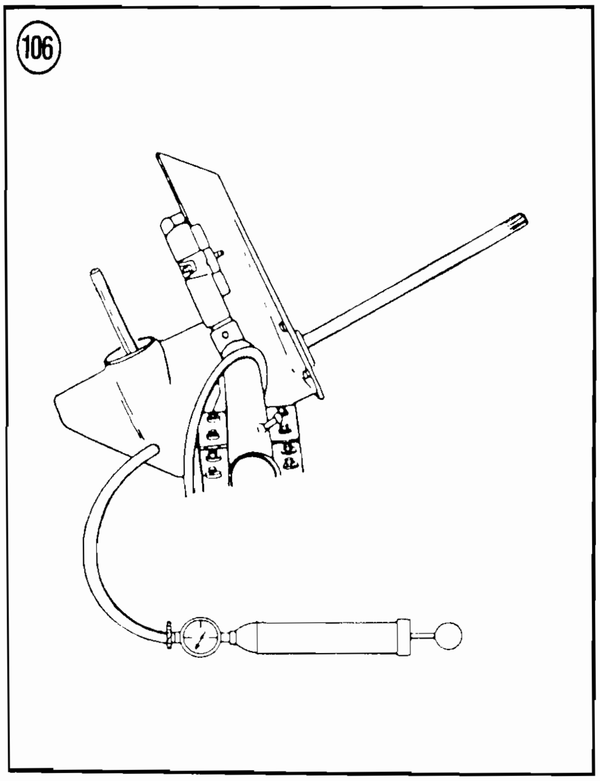


36. Place shift rod in NEUTRAL. Position a universal shift rod gauge (part No. 389997) on the gearcase beside the vertical shift rod and align gauge and shift rod holes. Insert gauge pin in gauge hole. See **Figure 88**, typical. Screw the shift rod in or out of the connector to obtain a dimension of 16-15/16 ± 1/32 in. (standard shaft) or 21-15/16 ± 1/32 in. (long shaft).
37. Install the water pump as described in this chapter.
38. Pressure and vacuum test the gearcase as described in this chapter.
39. Install the gearcase as described in this chapter. Fill with 16.4 oz. of OMC HI-VIS Gearcase Lube as outlined in Chapter Four. Tighten oil level plug and drain/fill plug to specification. See **Table 2**.
40. Check gearcase lubricant level after engine has been run. See Chapter Four.

Pressure and Vacuum Test 9

Whenever a gearcase is overhauled, it should be pressure and vacuum tested before refilling it with lubricant. If the gearcase fails either the pressure or vacuum test, it must be disassembled and the source of the problem located and corrected. Failure to perform a pressure and vacuum test or ignoring the results and running a gearcase which failed one or both portions of the test will result in major gearcase damage.

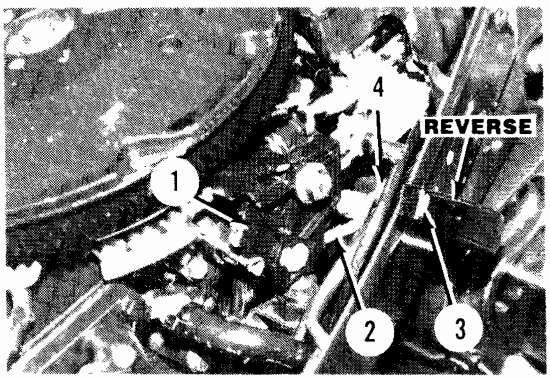
1. Install a new seal on the oil level plug.
2. Thread a pressure test gauge into the fill/drain plug hole. See **Figure 106** (typical).
3. Pump the pressure to 3-6 psi. If pressure holds, increase it to 16-18 psi. If it does not hold, submerge the gearcase in water and check for the presence of air bubbles to indicate the source of the leak.
4. If pressure holds at 16-18 psi, release the pressure and remove the pressure tester. If pressure does not hold at this level, submerge the gearcase in water and check for the

presence of air bubbles to indicate the source of the leak.
5. Thread a vacuum test gauge into the fill/drain plug hole. See **Figure 106** (typical).
6. Draw 3-5 in. Hg vacuum. If vacuum holds, increase it to 15 in. Hg. If vacuum does not hold at this level, coat suspected seal with lubricant to see if the leak stops or the lubricant is sucked in.
7. If vacuum holds at 15 in. Hg, release the vacuum and remove the tester. If vacuum does not hold, coat the suspected seal with lubricant to see if the leak stops or the lubricant is sucked in.
8. If the source of a pressure or vacuum leak cannot be determined visually, disassemble the gearcase and locate it.
9. If gearcase passes the pressure and vacuum test, fill it with the required type and quantity of lubricant. See Chapter Four.

SHIFT LEVER

Adjustment (9.9-15 hp)

Refer to **Figure 107** for this procedure.
1. Disconnect the fuel line at the carburetor.



1. Hub assembly
2. Link
3. Shift lever postition in reverse
4. Shift lever

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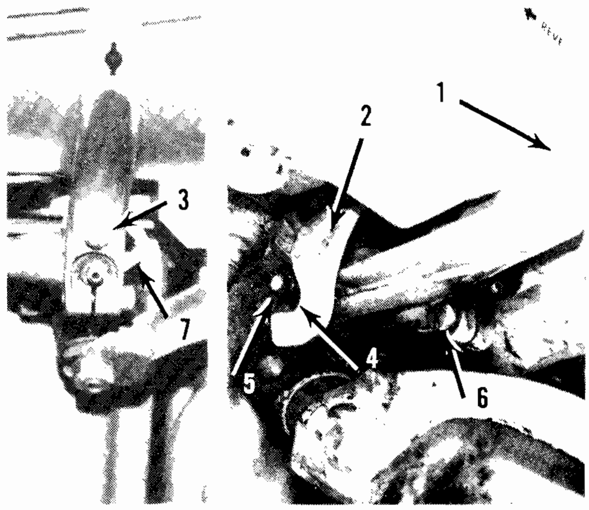
2. Remove the cotter pin and washer from the shift lever link.
3. Move shift lever and hub assembly to REVERSE.
4. Adjust the link to align with the shift lever hole without moving shift lever.
5. When link aligns with shift lever hole, shorten it one turn. Apply a slight pressure to the shift lever and reinstall the link.
6. Install washer and a new cotter pin, then reconnect the carburetor fuel line.
7. Check and adjust neutral start switch. See Chapter Three.

Adjustment (1973-1982 20-35 hp)

Refer to **Figure 108** for this procedure.
1. Move shift lever to REVERSE.
2. Loosen adjustment and clamp screws.
3. Rotate adjustment lever counterclockwise until full engagement of clutch dog is felt in reverse gear.



1. Shift lever
2. Shifter lock
3. Adjustment screw
4. Reverse detent
5. Shift lever bushing
6. Clamp screw
7. Adjusting lever

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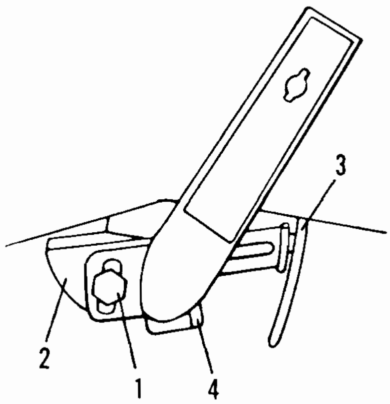
(109)

SHIFT LOCK ADJUSTMENT



1. Adjustment screw
2. Bracket and shaft
3. Shifter lock
4. Clamp screw

4. Rotate shift lever counterclockwise until the lever roller contacts the end of the shifter lock reverse detent.
5. Tighten adjustment and clamp screws to 5-7 ft.lb.

Adjustment (1973-1976 40 hp)

Refer to **Figure 109** for this procedure.

1. Move the shift handle to FORWARD while rotating the propeller clockwise to engage the clutch dog with forward gear.
2. Note the point at which engagement takes place and the point at which the shift lever pin rides in the shifter lock forward detent.
3. Move the shift handle from FORWARD through NEUTRAL and into REVERSE. Note the points of engagement and the points at which the shift lever pin rides in the shifter lock neutral and reverse detents.
4. If the shifter lever pin does not fully engage the forward and reverse detents and return to the neutral detent when the shift lever is placed in NEUTRAL, loosen the shift handle clamp and adjustment screws.
5. Position handle as required and tighten the screws. Repeat procedure to check adjustment.

Tables are on the following pages.

Table 1 GEARCASE CLEARANCE SPECIFICATIONS

Bearing housing bushing to drive shaft	
6 hp	
1973	0.0015-0.0030 in.
1974-1979	0.0015-0.0025 in.
Drive shaft and bushing in gear case	
2 hp	0.0010-0.0028 in.
4 hp weedless	0.001-0.003 in.
Front gear to gearcase bushing	
6 hp (1973-1979)	0.0010-0.0022 in.
Gearcase bushing to propeller shaft	
2 hp	0.0007-0.0022 in.
4 hp (1973-1980)	0.0005-0.0020 in.
Gearcase head and propeller shaft	
2 hp	0.0007-0.0022 in.
6 hp (1973-1979)	0.0010-0.0020 in.
Gear head and bushing assembly	
4 hp	
1973	0.0005-0.0020 in.
1974-1980	0.0007-0.0022 in.
4 hp weedless	0.0005-0.0015 in.
Pinion and bushing in gearcase	
4 hp (1973-1980)	0.0005-0.0018 in.
Propeller on shaft	
2 hp	
1973	0.0022-0.0057 in.
1974-on	0.0022-0.0067 in.
4 hp	0.0030-0.0055 in.
4 hp weedless	
1973	0.0020-0.0063 in.
1974-on	0.0020-0.0053 in.
6 hp (1973-1979)	0.0070-0.009 in.
Propeller shaft in front gear bushing	
6 hp (1973-1979)	0.0005-0.0015 in.
9.9 and 15 hp	0.0002-0.0087 in.
20-40 hp	0.0010-0.0020 in.
Propeller shaft to reverse gear bushing	
6 hp (1973-1979)	0.0005-0.0015 in.
20-40 hp	0.0005-0.0015 in.
Rear reverse gear bushing	
6 hp	
1973	0.0005-0.0020 in.
1974-1979	0.0005-0.0025 in.
20-40 hp	0.0005-0.0020 in.

Table 2 GEARCASE TIGHTENING TORQUE

Fastener	in.-lb.	ft.-lb.
Bearing housing anode screws (1989-1990)	108-132	
Bearing housing screws		
40 hp (1986-1988)		8-10
40 hp (1989-1990)		10-12
All Others	60-84	
Drain/fill/oil level plugs	60-84	
Drive shaft bearing housing		
screws (1985-on 40 hp)		8-10
Gearcase cover screws	60-80	
Gearcase head screws		
2, Colt, Junior, 2.5, 3, 4,		
Excel 4, Ultra 4	60-84	
4 Deluxe-8 hp	60-80	
Gearcase mounting screws		
2, Colt, Junior, 2.5, 3, 4,		
Excel 4, Ultra 4	60-84	
4 Deluxe-8 hp		
Front		10-12
Rear	60-84	
9.9-15 hp		8-10
6 (1973-1979), 9.5,		
20-40 hp (1973-1984)		10-12
20-30 hp (1985-on)		16-18
40 hp (1985-on)		
3/8 in. bolt		18-20
7/16 in. bolt		28-30
Lower-to-upper gearcase screws	60-80	
Pinion bearing retaining		
setscrew (1985-on 40 hp)	48-80	
Pinion nut (1985-on 40 hp)		40-45
Shift cradle pivot pin	48-84	
Shift rod cover (1985-on 40 hp)	60-84	
Trim tab		18-20
Upper shift rod connector	60-84	
Water pump fasteners		
2, Colt, Junior, 2.5, 3, 4,		
Excel 4, Ultra 4	25-35	
All Others	60-84	
Zinc anode screw	60-84	

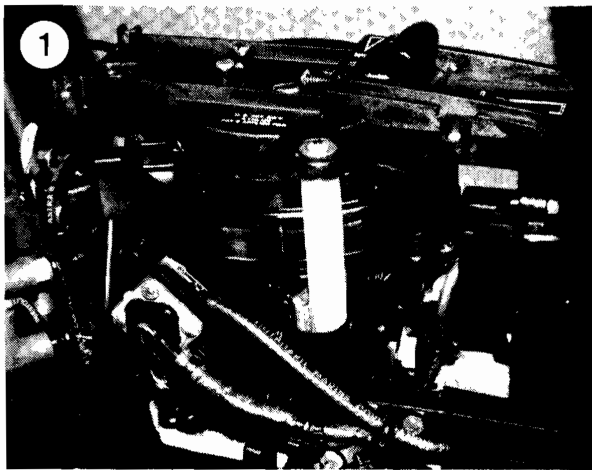
Chapter Ten

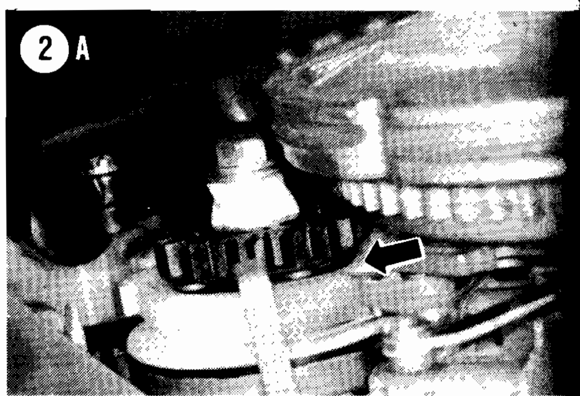
Automatic Rewind Starters

All models are equipped with a rope-operated rewind starter. The starter assembly may be mounted in the engine cover (2-3 hp and 1979-on 4 hp [Standard Models]), beside the flywheel (1973-1978 4 hp [Standard Models] and 4 hp Deluxe-15 hp) or above the flywheel (2.5 hp, Excel 4, Ultra 4 and 18-40 hp). See **Figures 1-4** (typical). Pulling the rope handle causes the starter spindle shaft to rotate against spring tension, moving the drive pawl or pinion to engage the flywheel and turn the engine over. When the rope handle is released, the spring inside the assembly reverses direction of the spindle shaft and winds the rope around the pulley.

All 5 hp and larger outboards are equipped with a starter interlock feature. This prevents operation of the rewind starter whenever the throttle is advanced beyond the START position.

Automatic rewind starters are relatively trouble-free, with a broken or frayed rope the most common malfunction. This chapter covers rewind starter and rope/spring service.





ENGINE COVER STARTER

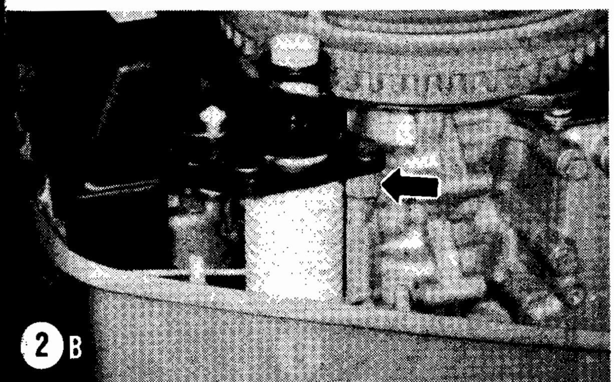
This starter type is used on 2-3 hp and 1979-on 4 hp (Standard Models) outboard motors.

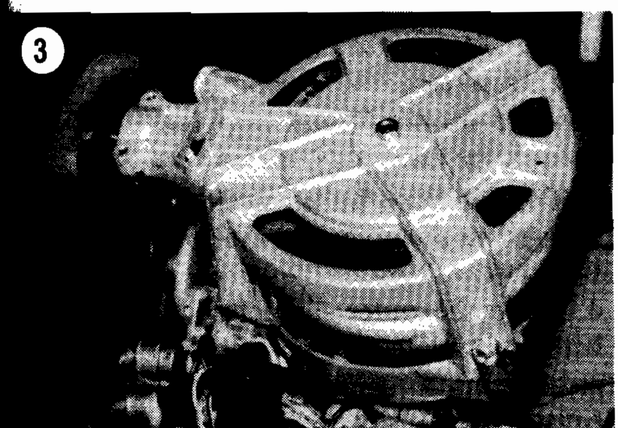
Removal/Installation

1. Disconnect the spark plug lead to prevent the engine from accidentally starting.
2. Remove the fuel tank cap. Remove the engine cover. Reinstall the cap on the fuel tank.
3. Installation is the reverse of removal. Tighten cover screws to 60-80 in.-lb.

Starter Rope Replacement

1. Place the engine cover upright on a flat surface.
2. Pull the starter rope out as far as it will go and tie a slip knot in the rope near the cover.





3. Untie the knot in the handle end of the rope and remove the handle assembly.
4. Invert the engine cover and pull the rope out enough to release the slip knot tied in Step 2.

NOTE
Some models use a pulley plate installed over the pulley. This plate must be removed before the rope can be disconnected from the pulley in Step 6.

5. If equipped with a pulley plate, remove the plate screws and plate.
6. Hold the pulley firmly and pull knotted end of rope from pulley. Slowly allow pulley to rotate until it is completely unwound.
7. Tie a knot in the end of a new rope.
8. Rotate the pulley 3 1/2 turns counterclockwise to tension the spring and hold in that position.
9. Insert the unknotted end of the rope in the pulley hole. If pulley uses a plate, reinstall plate and tighten screws. Thread the rope around the pulley and out the starter housing hole, then pull the rope until the knot bottoms in the pulley.
10. Holding the free end of the rope, carefully release pressure on the pulley and allow it to slip slowly. Wind all but approximately 12 in. of the rope on the pulley in this manner.
11. Tie a slip knot in the rope to hold it in place and install the handle assembly. Tie a knot in the end of the rope and seat the knot in the handle.
12. Release the slip knot and allow the starter pulley to rewind the remaining rope.

Disassembly

WARNING
Disassembling this starter mechanism without holding the spring in place can result in the spring unwinding violently, causing serious personal injury. Wear safety glasses and gloves during this procedure.

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Refer to **Figure 4** for this procedure.

1. Remove the starter rope as described in this chapter.
2. Remove the circlip holding the starter pawl in place. Lift the pawl off its shaft and disengage the friction spring and links. Remove the pawl and spring/link assembly.
3. Place the engine cover on its side. Hold the pulley and spindle in place with one hand and remove the starter spindle screw from the top of cover.
4. Invert the engine cover and remove the spindle while holding the pulley in place.
5. Slowly lift the pulley straight up and out of the starter housing in the engine cover. The spring should remain in the housing.
6. Position the cover right-side up on the workbench or floor and rap it sharply. The spring will fly out of the engine cover starter housing and be contained inside the cover.

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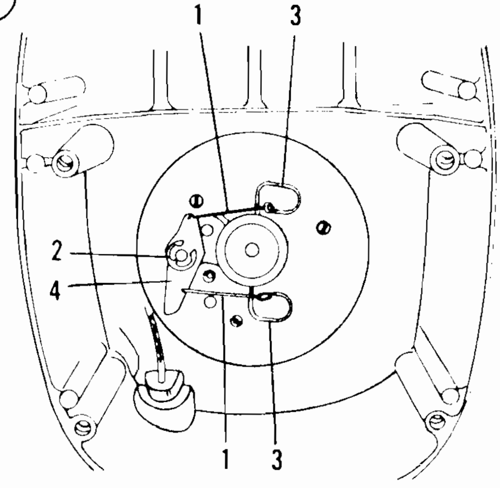
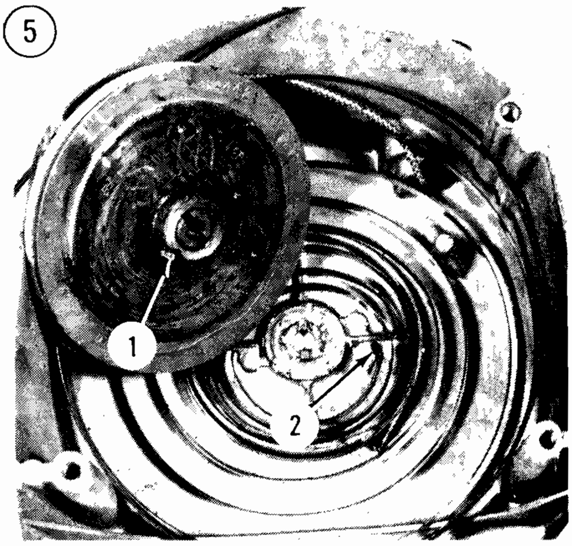


1. Link
2. Retaining ring
3. Friction spring
4. Starter pawl

5



1. Pulley pin
2. Spring loop

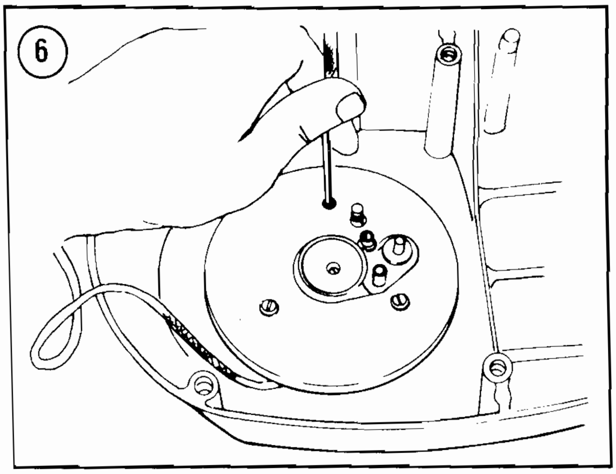
Cleaning and Inspection

1. Wash all metal parts in solvent and blow dry with compressed air.
2. Check spring for wear or broken end loops. Replace as required.
3. Check pawl, friction spring and spindle for wear.
4. Remove any sharp edges or rough surfaces from pulley and housing that might fray the rope.
5. Check rope for fraying. Replace as required.

Assembly (Models With Pulley Plate)

1. Lubricate the spring and housing spring cavity with Lubriplate 777 or OMC Triple-Guard grease.
2. Loosely coil the spring and insert it in the engine cover. Locate the inside coil in the housing slot with its loop facing the center of the spring cavity.
3. Position rope pulley over the spring and engage the pulley pin in the spring loop. See **Figure 5**.
4. Wipe the outer diameter of the spindle with Lubriplate 777 or OMC Triple-Guard grease. Insert spindle through pulley and engage spindle slot with housing rib.

6



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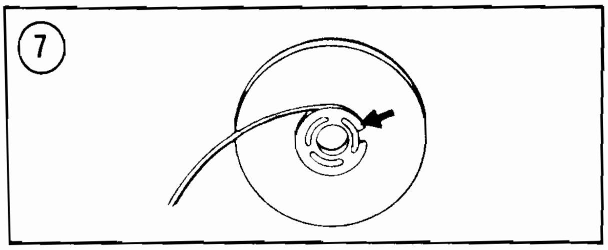

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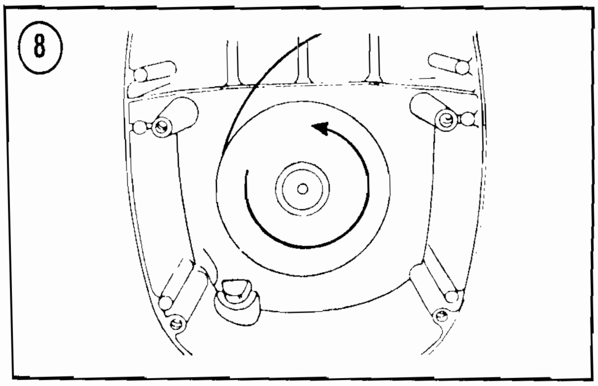


5. Dip spindle screw threads in OMC Screw Lock and install screw.
6. Rotate pulley counterclockwise to wind spring into housing until the outer spring loop engages the outer face of the spring cavity.
7. Insert knotted end of rope in pulley slot. Wrap the rope counterclockwise around the pulley flange.
8. Install pulley plate with 3 screws and tighten securely. Wind pulley counterclockwise 3 1/2 turns to preload the spring, then insert a punch through the remaining screw hole (**Figure 6**) and engage one of the starter housing ribs to hold the pulley against spring tension.
9. Feed the rope through the starter housing hole and install the handle assembly. Tie a knot in the end of the rope.
10. Remove the punch and install the remaining plate screw.
11. Install the starter pawl, friction spring assembly and secure the pawl in place with the circlip.
12. Test the starter action by pulling the rope handle. The pawl should extend when the rope is pulled and retract when released.

Assembly
(Models Without Pulley Plate)

1. Lubricate the spring and housing spring cavity with Lubriplate 777 or OMC Triple-Guard grease.
2. Wipe the outer diameter of the spindle with Lubriplate 777 or OMC Triple-Guard grease.
3. Install spring on pulley as shown in **Figure 7**. 10
4. Install pulley in housing with spring passing through the spring cavity gate. The rib in the center of the housing should engage the spindle slot.
5. Clean the spindle screw threads of all old adhesive. Spray threads with OMC Locquic Primer. Install lockwasher on screw and wipe screw threads with OMC Screw Lock. Install and tighten screw.
6. Rotate pulley counterclockwise until outer spring loop engages outer face of spring cavity (**Figure 8**).
7. Install the starter pawl and friction spring assembly and secure the pawl in place with the circlip.
8. Install rope as described in this chapter.
9. Test the starter action by pulling the rope handle. The pawl should extend when the rope is pulled and retract when released.

SWING ARM GEAR DRIVE STARTER

This starter type is used on 1973-1978 4 hp (Standard Models), 4 hp Deluxe and 4.5 hp outboard motors. It must be partially disassembled to replace the rope.

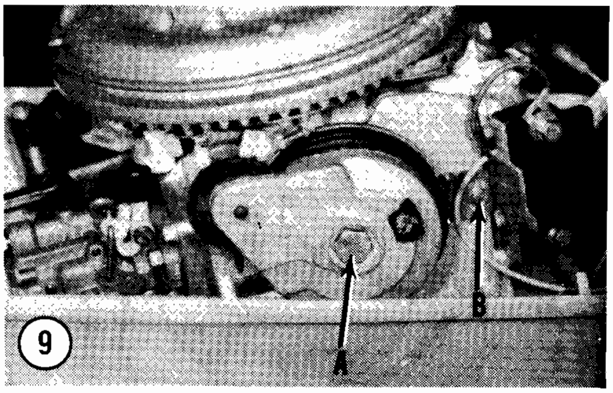
Removal/Installation

1. Disconnect the armature plate-to-power pack connector to prevent the engine from accidentally starting.
2. Pull the starter rope out enough to tie a slip knot behind the handle. Untie the knot holding the rope in the handle and remove the handle assembly.
3. Release the slip knot made in Step 2 and gradually allow the starter to unwind while holding the pulley.
4. Disconnect the starter spring at the cup and stop assembly and pull it out as far as possible to relieve spring tension.

NOTE
On some models, removal of the ignition coil will increase access for screw removal and subsequent starter assembly removal.

5. Remove the shoulder screw (A, **Figure 9**) and the adjustment screw (B, **Figure 9**). Remove the starter assembly from the power head.
6. Clean threads of the 2 screws to remove all old adhesive. Spray the threads with OMC Locquic Primer.
7. Wipe the shoulder screw threads with OMC Screw Lock. Make sure the idler gear arm is located between the 2 tabs of the cup and stop assembly. Position the starter assembly to the power head and install the shoulder and adjustment screws finger-tight.
8. Coat starter spring with a light coat of Lubriplate 777 or OMC Triple-Guard grease.
9. Install OMC tool part No. 383967 in lower motor cover groove at side of idler arm.

9



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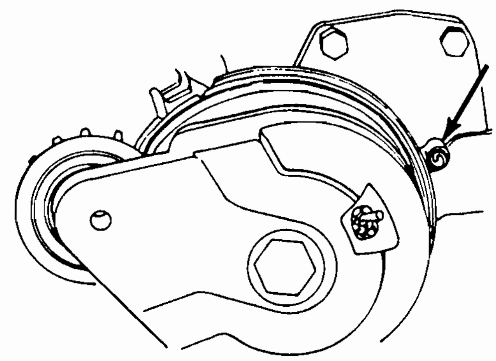

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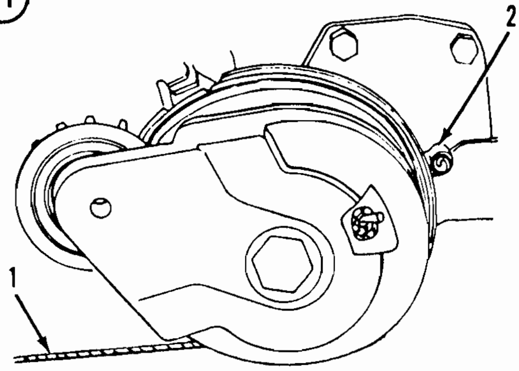
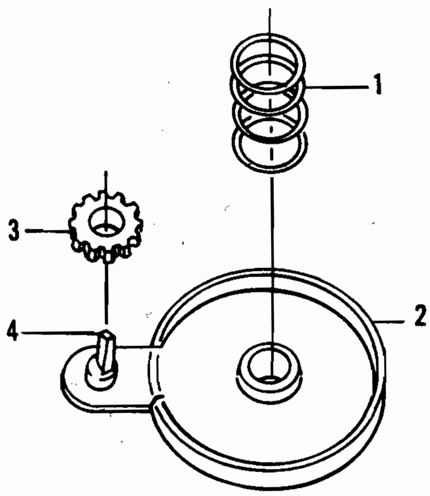


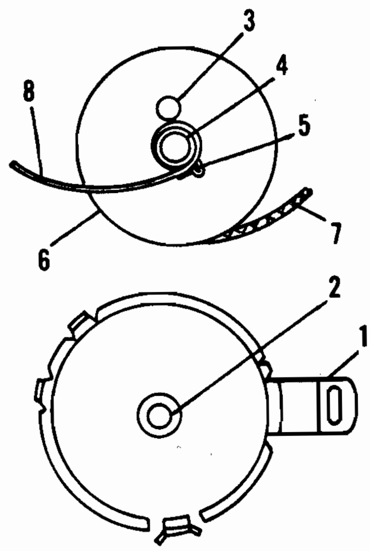
1. Pull rope out fully
2. Extend spring

12



1. Spring
2. Idler gear arm
3. Idler gear
4. Stop

13



and stop assembly
sher
bushing
hing
5. Roll pin
6. Pulley
7. Rope
8. Spring

Rotate tool thumbscrew as required to position it in the idler arm hole.

10. Make sure idler gear engages flywheel, then turn flywheel clockwise and wind starter spring into cup and stop assembly until the spring loop touches the pulley slot. See **Figure 10.**

11. Hold pulley from turning and remove tool, then let pulley rotate slowly until spring tension is relieved.

12. Reinstall tool part No. 383967 and turn flywheel clockwise enough to rotate starter pulley 1 1/2 turns to preload the spring. Hold pulley and remove tool.

13. Release the end of the rope and feed it through the lower motor cover hole, pulling it out as far as possible. Hold rope fully extended and grasp the spring end loop. Pull spring from cup and stop assembly. See **Figure 11**. If spring can be pulled out 8-18 in., preload is satisfactory. If not, repeat Steps 10-13.

14. Install rope handle assembly and tie a knot in the end of the rope.

15. Hold the idler gear arm stop against the cup stop. Make sure the idler gear teeth engage the flywheel properly, then tighten the adjustment screw.

16. Tighten the shoulder screw to 10-12 ft.-lb.

17. Install the ignition coil, if removed.

18. Reconnect the 4-wire connector.

Disassembly

1. Remove the idler gear arm, gear and gear arm spring from the starter assembly. See **Figure 12.**

2. Separate the pulley from the cup and stop assembly. Note spring loop position and disconnect the spring from the pulley roll pin. See **Figure 13.**

3. Remove the rope from the pulley, then remove the rope bushing.

4. Remove the idler gear arm bushing. Remove the bushing from each side of the pulley.

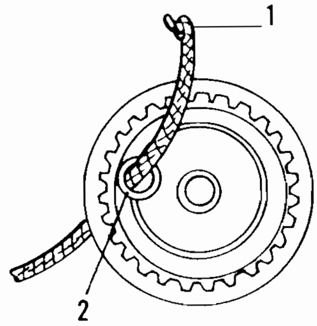
Cleaning and Inspection

1. Wash all metal parts in solvent and blow dry with compressed air.
2. Check metal parts for corrosion. Remove corrosion, if found, and wipe parts with an oil-dampened cloth.
3. Check spring for wear or broken end loops. Replace as required.
4. Check rope for fraying. Replace as required.

Assembly

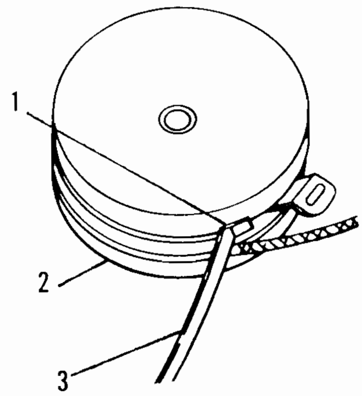
1. Insert pulley bushing.
2. Tie a knot in one end of the rope. Insert the other end through the bushing rope hole. See **Figure 14**.
3. Pull the rope through until the knot seats in the pulley bushing. Hold the pulley with the knot facing you, then wind the pulley clockwise. Tape or install a rubber band to hold rope in pulley.
4. Wipe bushings with Lubriplate 777 or OMC Triple-Guard grease and insert in pulley and idler gear arm.
5. Install washer in cup and pulley assembly, hooking spring end loop to pulley roll pin. See **Figure 13**.
6. Sandwich pulley and spring to cup and stop assembly. The spring should extend through the cup slot. See **Figure 15**.
7. Assemble idler gear with shoulder resting against gear arm, then install arm and spring to pulley and cup. Locate the idler gear shaft stop between the cup and stop assembly tabs without turning pulley and disengaging spring end. See **Figure 16**.
8. Install starter mechanism to power head as described in this chapter.

14



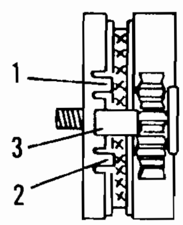
1. Knot
2. Bushing

15

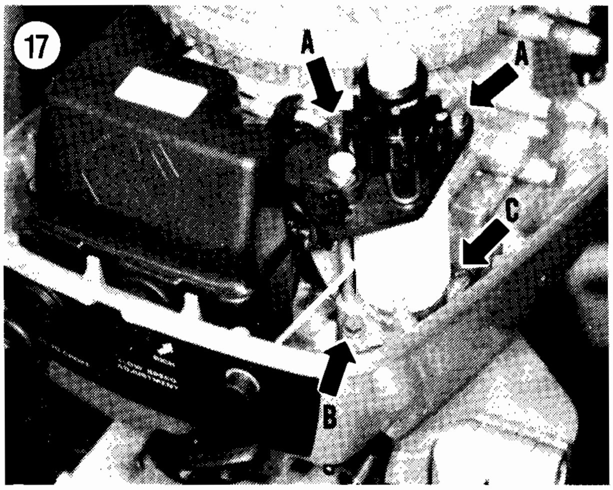


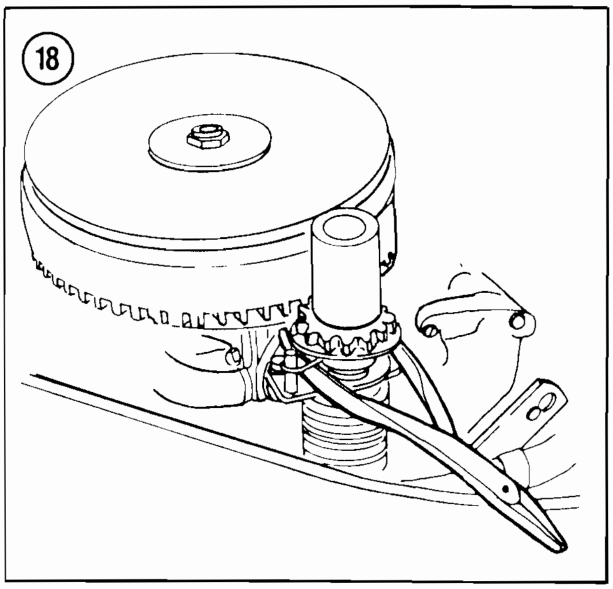
1. Cup slot
2. Pulley
3. Spring

16



1. Upper stop
2. Lower stop
3. Idler gear arm stop





SIDE-MOUNTED PINION GEAR STARTER

This starter type operates in a manner similar to an automotive starter. The nylon pinion slides up to engage the flywheel as the rope is pulled, then disengages when the engine starts.

Removal/Installation (5-9.5 hp)

1. Disconnect the armature plate-to-power pack connector to prevent the engine from accidentally starting.
2. Pull the starter rope out enough to tie a slip knot behind the handle. Untie the knot holding the rope in the handle and remove the handle assembly.

NOTE
The version used on the 9.5 hp engine has no lower retainer plate fasteners.

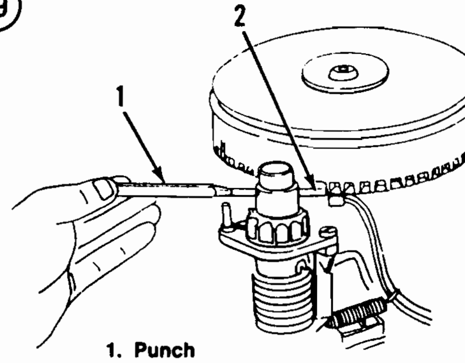
3. Remove the 2 top starter screws (A, **Figure 17**). Remove the front spring retainer plate screw (B, **Figure 17**).
4. Loosen the rear retainer plate screw (C, **Figure 17**). Let the plate drop enough to release the starter spring hook.
5. Remove the starter and main spring from the power head.
6. Lubricate the lower retainer bushing with several drops of Evinrude or Johnson Outboard Lubricant.
7. Fit the external tang of the starter assembly main spring into the lower retainer plate slot. Tighten both lower retainer plate screws.
8. Install the starter spool assembly so that the spool slot engages the internal rewind spring tang. Install and tighten the top starter screws to 60-84 in.-lb.
9. Disengage the cam follower and insert a flat-blade screwdriver in the lever arm slot. Install an O-ring or rubber band above the pinion teeth to prevent engagement with the flywheel.
10. Rotate the spool counterclockwise 12 1/2-14 turns (except 9.5 hp) or 20 1/2 turns (9.5 hp) using a speeder or ratchet wrench and a flat tip driver which fits into the inner slot of the spool.
11. With 9.5 hp models, raise pinion gear to engage flywheel and lock in place by sliding plier handles under the gear. See **Figure 18**.
12. With all others, insert a pin punch in the pinion gear roll pin hole to prevent the spool from unwinding. See **Figure 19**.
13. Insert the knot end of the starter rope through the spool slot. Hold the rope and

remove the pliers or pin punch. Let the starter slowly wind the rope up.
14. Insert the rope through the lower motor cover eyelet and tie a slip knot. Install the handle assembly and tie a knot in the end of the rope to fit into the handle.
15. Release the slip knot and remove the screwdriver and O-ring or rubber band. Pull the starter handle several times to make sure it engages with the flywheel.
16. Make sure the starter interlock functions properly. The starter should lock when the throttle is opened beyond the START position.
17. Reconnect the 4-wire connector.

Starter Rope Replacement (5-9.5 hp)

1. Disconnect the armature plate-to-power pack connector to prevent the engine from accidentally starting.
2. Pull the starter rope out until it is fully extended. On 9.5 hp models, raise the pinion gear to engage the flywheel and lock in place by inserting plier handles under the gear. See **Figure 18**. On all others, insert a small punch in the roll pinhole to lock the starter in the extended position. See **Figure 19**.
3. Untie the knot holding the rope in the handle and remove the handle assembly. Pull the rope from the spool.
4. If the rope has broken while in service, rotate the spool counterclockwise 20 1/2 turns (9.5 hp) or 12 1/2-14 turns (all others) using a speeder or ratchet wrench and a flat tip driver which fits into the inner slot of the spool.
5. Tie a knot in the new rope about 1/2 in. from the end, then feed the rope through the pulley slot until the knot rests snugly against the pulley.
6. Feed the rope counterclockwise around the pulley once and between the spool and guide.

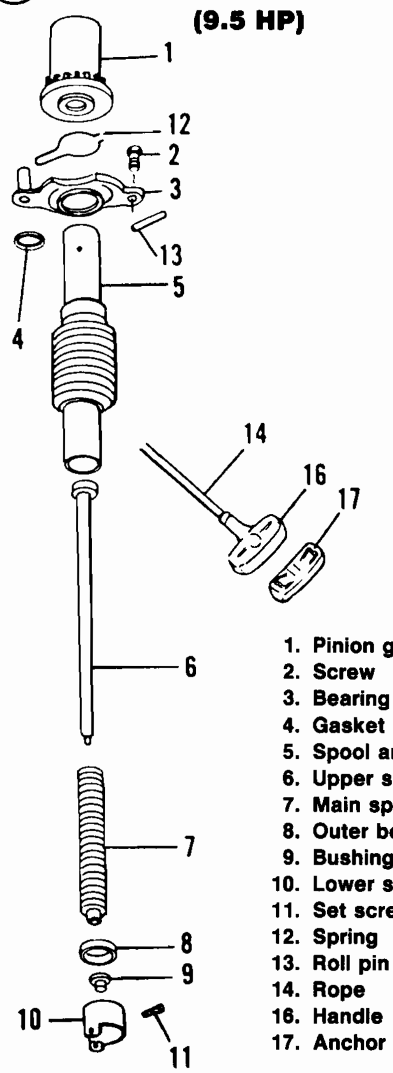
19



1. Punch
2. Roll pin

20

STARTER COMPONENTS (9.5 HP)



1. Pinion gear
2. Screw
3. Bearing head
4. Gasket
5. Spool and sleeve
6. Upper spring retainer
7. Main spring
8. Outer bearing
9. Bushing
10. Lower spring retainer
11. Set screw
12. Spring
13. Roll pin
14. Rope
16. Handle
17. Anchor

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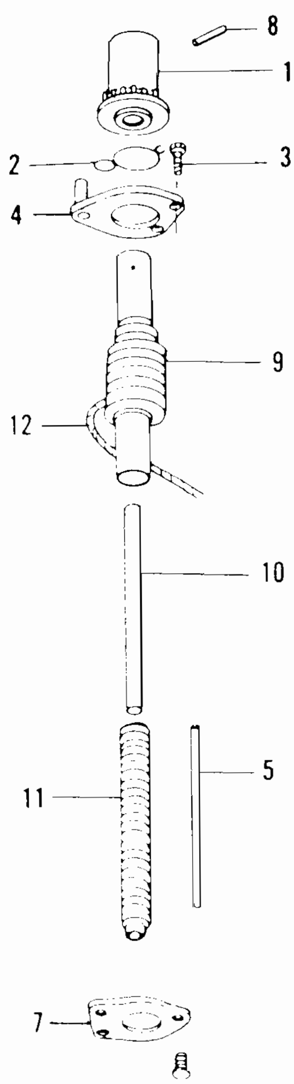
STARTER COMPONENTS (ALL OTHERS)



1. Pinion gear
2. Spring
3. Screw
4. Bearing nut
5. Guide
7. Spring retainer plate and bushing
8. Roll pin
9. Sleeve
10. Slot
11. Main spring
12. Rope

7. Insert the rope through the lower motor cover and install the handle assembly.
8. Hold rope handle securely and remove pliers or punch holding starter pinion gear. Let starter rope rewind slowly.

Disassembly/Assembly (5-9.5 hp)

Starter disassembly should only be necessary if the pinion gear is damaged. Refer to **Figure 20** (9.5 hp) or **Figure 21** (all others) for this procedure.

1. Remove the roll pin with a pin punch.
2. Remove the pinion. Release the cam follower and slide the bearing head off the starter spool.
3. Remove the main spring from the spool assembly.
4. On 9.5 hp models, remove the lower spring retainer set screw. Remove retainer, bushing and outer bearing.
5. To assemble, install outer bearing, bushing and retainer on 9.5 hp models. Tighten setscrew.
6. Install the pinion spring. Position bearing head and pinion gear on starter spool. Spring loop must fit over bearing head post.
7. Align pinion slot with spool holes. Install roll pin with split seam facing to the side to prevent dragging against the pinion gear slot.
8. Install main spring in spool assembly.

Cleaning and Inspection (5-9.5 hp)

1. Wash all parts in solvent and blow dry with compressed air.
2. Check all parts for excessive wear or damage. Replace as required.
3. Check rope for fraying. Replace as required.

10

Removal/Installation (9.9 and 15 hp)

1. Disconnect the armature plate-to-power pack connector to prevent the engine from accidentally starting.
2. Pull the starter rope out enough to tie a slip knot behind the handle. Untie the knot holding the rope in the handle and remove the handle assembly.
3. Release the slip knot made in Step 2 and gradually allow the pulley to slowly rewind the rope.
4. Remove the air silencer assembly.
5. Loosen the starter mounting screw. Hold pulley and cup together to keep the spring in the cup and remove the mounting screw.
6. If starter does not require disassembly, install a 3/8 in.×16 nut on the mounting screw and finger-tighten to prevent the cup and pulley from coming apart.
7. Installation is the reverse of removal.

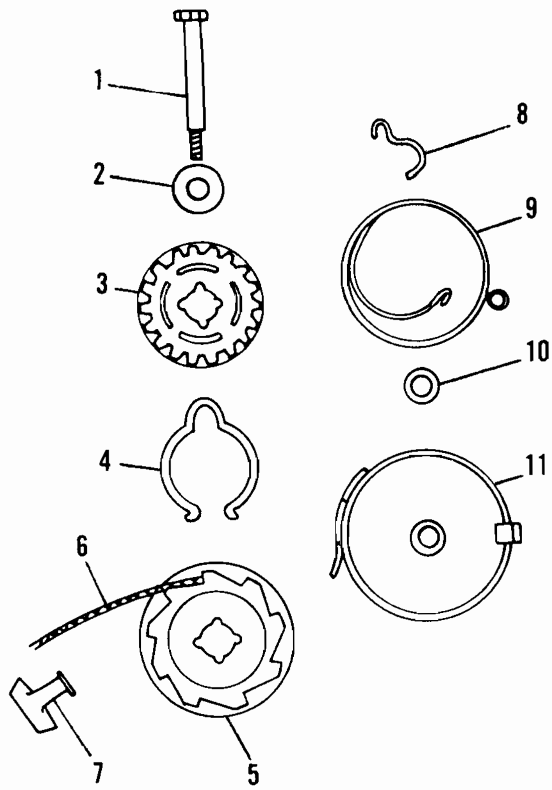
Starter Rope Replacement (9.9 and 15 hp)

WARNING
Disassembling this starter mechanism without holding the spring in place can result in the spring unwinding violently, causing serious personal injury. Wear safety glasses and gloves during this procedure.

Refer to **Figure 22** for this procedure.

1. Remove the starter as described in this chapter.
2. Carefully secure the starter housing horizontally in a vise with protective jaws.
3. Remove the mounting screw and washer.
4. Unclip the pinion spring and remove from the starter pulley with the pinion gear.
5. Insert a putty knife or similar instrument between the pulley and cup to hold the spring in place. Remove the pulley from the cup.
6. Remove the rope from the pulley.
7. Thread the new rope through the hole in the pulley. Tie a knot in the end of the rope

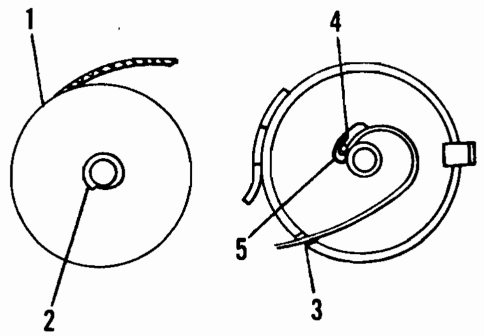
(22)



STARTER COMPONENTS 9.9-15

1. Mounting screw
2. Washer
3. Pinion
4. Pinion spring
5. Pulley
6. Rope
7. Handle and bushing
8. Spring retainer
9. Spring
10. Washer
11. Cup and spring guide assembly

(23)



1. Pulley
2. Spring loop anchor
3. Slot
4. Spring loop
5. Spring retainer

and wind the rope onto the pulley in a counterclockwise direction.

8. Fit the pulley to the cup so that the spring loop will engage the pulley shaft cutout.

9. Install the pinion and pinion spring on the pulley.

10. Lubricate the mounting screw and washer with Evinrude or Johnson Outboard Lubricant. Install screw through pulley, cup washer and cup.

11. If starter is not to be immediately installed on manifold, thread a 3/8 in.×16 nut on the mounting screw and finger-tighten to keep the assembly together.

Starter Disassembly (9.9 and 15 hp)

1. Remove the starter from the manifold and install a nut on the mounting screw as described in this chapter.

2. Carefully secure the starter assembly vertically in a vise with protective jaws.

WARNING
Wear safety glasses and gloves during Step 3.

3. Slip a flat screwdriver blade through the exposed spring loop and withdraw the spring from the cup.
4. Remove the starter from the vise. Remove the nut, mounting screw and washer.
5. Unclip the pinion spring and remove from the starter pulley with the pinion gear.
6. Remove the pulley, spring, cup washer and spring retainer from the cup assembly.
7. Remove the rope from the pulley, if required.

Cleaning and Inspection (9.9 and 15 hp)

1. Clean all metal and plastic parts in solvent. Blow dry with compressed air.
2. Check spring for wear or broken end loops. Replace as required.
3. Check pinion and pulley for excessive wear and chipped or broken teeth.
4. Check cup for corrosion or damage. Clean or replace as required.
5. Check rope for fraying. Replace as required.

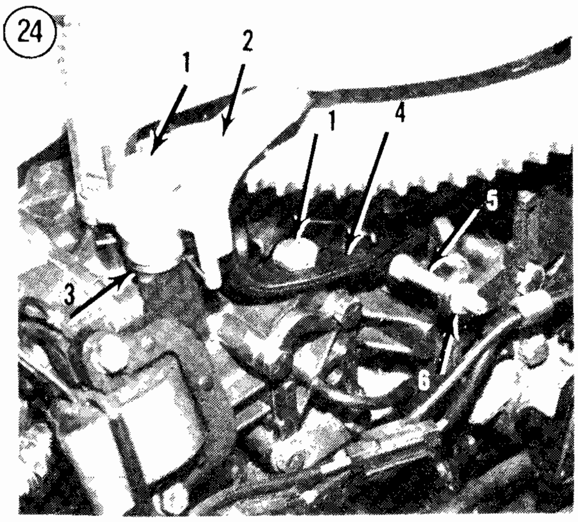
Assembly (9.9 and 15 hp)

Refer to **Figure 22** for this procedure.

1. Install starter rope as described in this chapter.
2. Lubricate spring surface in cup with Lubriplate 777 or OMC Triple-Guard grease.
3. Install spring and retainer in cup as shown in **Figure 23**.
4. Position cup washer and install pulley with spring loop engaging the pulley loop anchor (**Figure 23**).
5. Place pinion on pulley. Wipe mounting screw threads with Evinrude or Johnson

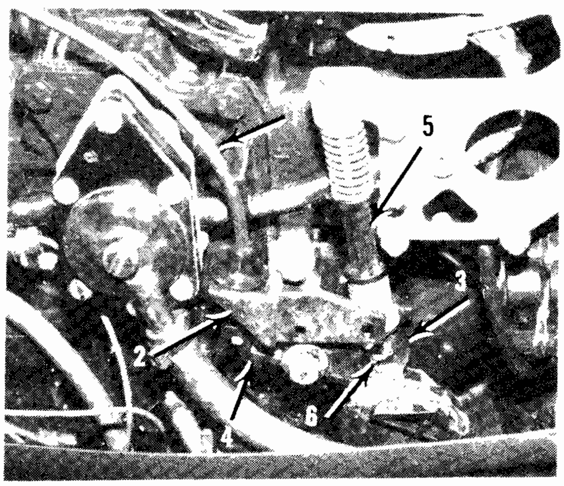
Outboard Lubricant and install screw with washer through pulley, cup washer and cup.
6. Install a 3/8 in.×16 nut on the mounting screw finger-tight.
7. Hold cup in one hand and wind spring into cup by turning pulley counterclockwise (as seen from top of pulley). As spring is wound and resistance felt, feed the spring into the cup through the slot to relieve tension.
8. When spring is completely wound into cup with outer loop drawn up against the cup, wind the rope counterclockwise around the pulley and install pinion spring.
9. Install starter on manifold as described in this chapter.
10. Pull the rope out as far as possible, then pull out the spring loop end. It should extend at least 1/2 in. from the cup.
11. Make sure the starter interlock functions properly. The starter should lock when the throttle is opened beyond the START position.
12. Reconnect the 4-wire connector.

24



LOCKOUT LEVERS

1. Shoulder screws
2. Upper lockout lever
3. Spring
4. Lower lockout lever
5. Adjustment screw
6. Locknut



STARTER INTERLOCK COMPONENTS

1. Neutral lockout cable
2. Cable bracket
3. Neutral shift lockout lever
4. Starter lockout lever
5. Neutral start plunger
6. Actuator cam link

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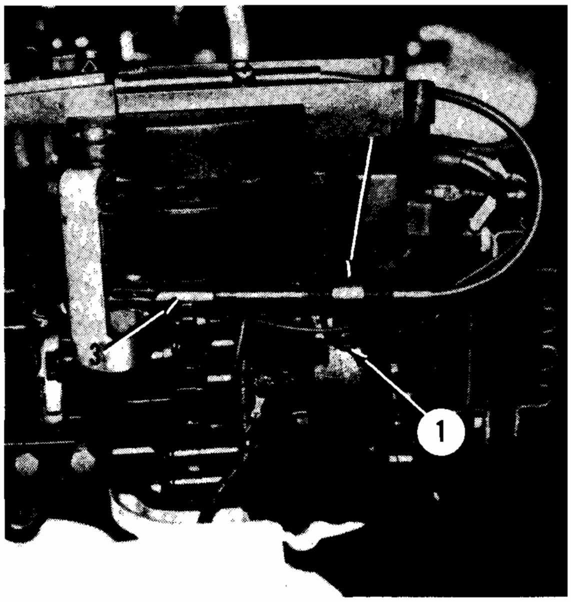
FLYWHEEL MOUNTED STARTER

This starter type is used on 2.5 hp, Excel 4, Ultra 4 and 18-40 hp outboard motors. On 18-40 hp models, a locking plunger connected to the gear shift lockout lever prevents starter engagement if the motor is in gear. **Figure 24** shows the older type lockout system; **Figure 25** shows the late model system. The starter must be disassembled to replace the rope.

Removal/Installation (2.5 hp, Excel 4 and Ultra 4)

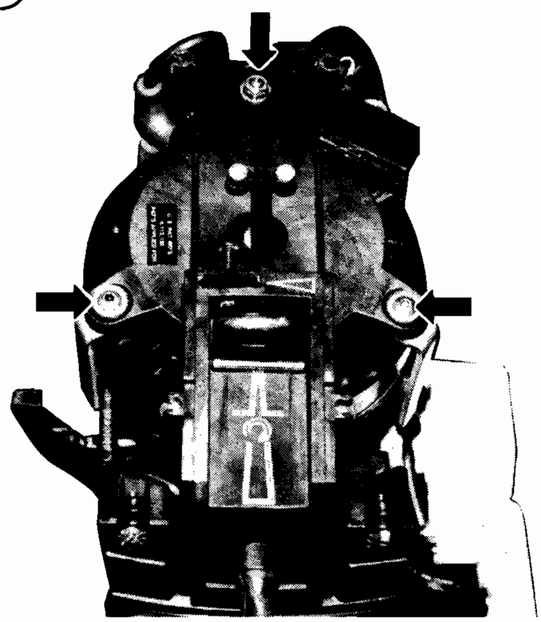
1. Remove engine covers.
2. Disconnect the spark plug leads from the spark plugs to prevent the engine from accidentally starting.



1. Screw
2. Trunnion
3. Throttle cable

26

27



3. Remove screw (1, **Figure 26**) retaining throttle cable trunnion (2, **Figure 26**).
4. Disconnect throttle cable (3, **Figure 26**) from armature plate.
5. Remove two screws and one nut retaining starter assembly (**Figure 27**) and withdraw assembly.
6. Install starter assembly in reverse of removal while noting the following.
7. Apply OMC Screw Lock on the threads of the two starter retaining screws and one nut.
8. Tighten fasteners to 60-80 in.-lb.
9. Adjust throttle cable as outlined in Chapter Five.

Disassembly (2.5 hp, Excel 4 and Ultra 4)

Figure 28 shows components typical to type used.

1. Remove throttle cable assembly from starter housing.

WARNING
Disassembling this starter mechanism without holding the spring in place can result in the spring unwinding violently, causing serious personal injury. Wear safety glasses and gloves during this procedure.

2. Pull the starter rope out enough to tie a slip knot behind the handle. Pry the rope anchor from the handle.
3. Remove the handle, untie the slip knot and gradually allow the starter to unwind while holding the pulley.
4. Remove the circlip holding the starter pawl in place (**Figure 30**).
5. Lift the pawl off its shaft and disengage the friction spring and links. Remove the pawl and spring/link assembly.
6. Remove the screw located beneath the throttle cable.
7. Remove the spindle and hold pulley in housing.

8. Carefully extract pulley from housing. Use care not to allow the rewind spring to unwind uncontrolled.
9. Carefully extract rewind spring if replacement is required.

Cleaning and Inspection (2.5 hp, Excel 4 and Ultra 4)

1. Wash all metal parts in solvent and blow dry with compressed air.
2. Check rewind spring for wear or broken end loops. Replace as required.
3. Check pawl, friction spring and spindle for wear.
4. Check rope for fraying. Replace as required.

Assembly (2.5 hp, Excel 4 and Ultra 4)

WARNING
During starter mechanism assembly, the spring may unwind violently causing serious personal injury. Wear safety glasses and gloves during this procedure.

Figure 28 shows components typical to type used.

1. Lubricate the spindle and rewind spring area of starter housing with Lubriplate 777 or OMC Triple-Guard grease.
2. Install starter rope into pulley, then wrap starter rope around pulley in a clockwise direction as viewed from the top side.
3. Insert one rewind spring loop over the pin in the housing.
4. Carefully coil the spring into the housing.
5. Install pulley in housing, making sure that pin on pulley engages the inner spring loop.
6. Install spindle in housing. Install screw through opening in top of housing and thread into spindle. Hold spindle and securely tighten screw.
7. Rotate the pulley counterclockwise as needed to preload rewind spring and to align

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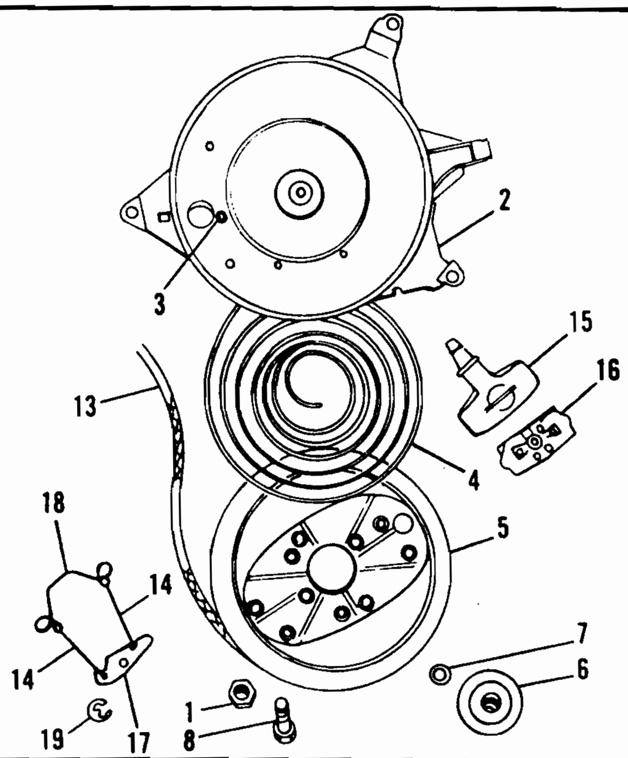
FLYWHEEL MOUNTED STARTER COMPONENTS

1. Spindle screw nut
2. Rewind starter assembly
3. Guide pin
4. Spring
5. Pulley
6. Starter spindle
7. Spindle washer
8. Screw
13. Rope
14. Pawl link spring
15. Handle
16. Handle anchor
17. Starter pawl
18. Friction spring
19. Circlip



starter rope end with rope guide in starter housing.
8. Feed enough starter rope through rope guide in starter housing to allow a slip knot to be tied and still have enough rope remaining to install handle.
9. Install handle and secure with anchor, then release slip knot and allow starter rope to slowly wind onto pulley.

CAUTION
With the starter rope fully extended, the pulley should be able to be rotated an additional one-half turn. If pulley cannot be rotated an additional one-half turn, excessive tension is being applied on rewind spring which may result in spring breakage.

10. Lightly lubricate the pawl pin with Lubriplate 777 or OMC Triple-Guard grease. Install pawl and link assembly. Install circlip.
11. Pull starter rope out and check pawl operation. Pawl should extend when rope is pulled out and retract when rope is released.
12. Reinstall throttle cable assembly on starter housing.

Removal/Installation (1984-on 40 hp)

1. Remove the engine cover. Disconnect the power pack-to-armature plate 4- or 5-wire connector.

NOTE
Disconnect the starter lockout cable at the power head in Step 2 if the power head is to be removed.

2. Remove the screw holding the starter lockout cable clamp on the starter housing. Remove the lockout slide from the housing.
3. Remove the 3 housing attaching screws with lockwashers and washers.
4. Remove the 2 screws holding the starter handle bracket to the power head. Remove the starter from the power head.
5. Installation is the reverse of removal, plus the following:
   a. Make sure the washers are installed between the rubber starter mounts and power head.
   b. Tighten bracket screws to 60-84 in.-lb. (7-9 N•m) and housing attaching screws to 10-12 ft.-lb. (14-16 N•m).
   c. Lubricate lockout slide area on housing with OMC Triple-Guard grease or Lubriplate 777.
   d. Shift engine into NEUTRAL and adjust lockout cable to center lockout slide on lockout lever. Tighten cable clamp screw snugly.

Disassembly (1984-on 40 hp)

WARNING
Disassembling this starter mechanism without holding the spring in place can result in the spring unwinding violently, causing serious personal injury. Wear safety glasses and gloves during this procedure.

1. Pull the starter rope out enough to tie a slip knot behind the handle. Pry the rope anchor from the handle.
2. Remove the handle, untie the slip knot and gradually allow the starter to unwind while holding the pulley.
3. With the starter housing placed upright on a clean workbench, remove the lockout lever shoulder screw. Remove the lockout lever, spring and washer from the housing.
4. Remove the nut from the center of the housing holding the pawl retaining screw.
5. Carefully invert the starter housing and remove the pawl retaining screw, washer, pawl plate and return spring.

6. Remove the spring from the pawl screw cavity. Remove the pawl and spring washer.
7. Carefully open the pulley lockring with a screwdriver and remove it from the housing.
8. Remove the friction plate and spring washer.
9. Hold pulley in housing while turning the housing upright (legs downward) on the workbench or floor.
10. Release the pulley and rap the housing sharply to dislodge the pulley and spring. The spring should uncoil within the starter housing legs.
11. Lift the housing up and remove the spring and pulley.
12. Remove the bushing from the pulley. If necessary, remove the rope guide shoulder screw and guide from the housing.

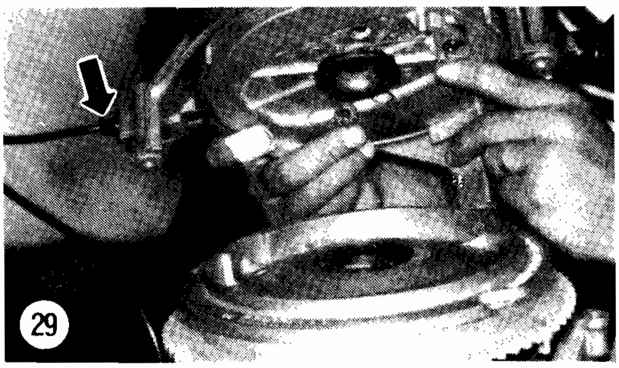
Cleaning and Inspection (1984-on 40 hp)

1. Wash all metal parts in solvent and blow dry with compressed air.
2. Check spring for wear or broken end loops. Replace as required.
3. Check pawl and related components for wear.
4. Remove any sharp edges or rough surfaces from pulley and housing that might fray the rope.
5. Check rope for fraying. Replace as required.
6. Check starter interlock components for wear or damage. Replace as required.

Assembly (1984-on 40 hp)

WARNING
During starter mechanism assembly, the spring may unwind violently, causing serious personal injury. Wear safety glasses and gloves during this procedure.

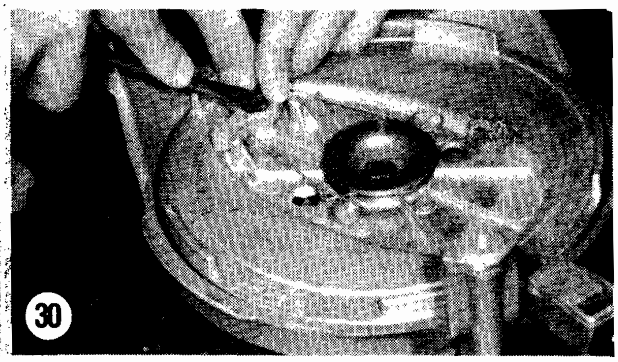
1. Lubricate the pulley bushing with Lubriplate 777 or OMC Triple-Guard grease.
2. Position the spring shield in the starter housing.
3. Inserting the open loop of the spring first, carefully coil the spring into the housing cutout.
4. Install the pulley bushing in the pulley and position the pulley shim on the pulley.
5. Install the pulley in the starter housing, making sure the outer loop of the spring engages the pin in the housing.
6. Position the friction plate spring washer and plate on the pulley hub, then install the lockring.
7. Coat the starter pawl boss with Lubriplate 777 or OMC Triple-Guard grease. Position spring washer on pawl boss and install pawl in pulley.
8. Install the spring in the retaining screw cavity.
9. Install the return spring on the pawl plate, press the other end of the spring on the pulley boss and position the pawl plate on the pulley.
10. Install the pawl plate retaining screw and washer. Tighten screw to 10-12 ft.-lb. (14-16 N•m).
11. With starter housing upright on workbench, spray the threads of the retaining screw and nut with OMC Locquic Primer. Coat nut threads with OMC Screw Lock. Install and tighten nut securely.



12. If rope guide shoulder screw and guide were removed, reinstall and tighten screw snugly.

13. Tie a knot in the end of a new rope. Invert starter housing on workbench and wind pulley counterclockwise as far as possible. Back off the rewind spring until the pulley rope cavity aligns with the rope guide.

14. Insert new rope through pulley, rope guide and handle bracket outlet. Feed the rope until it comes out the side of the housing. Pull the rope through the pulley until the knot seats against it, then tie a slip knot in the rope to hold it in position.
15. Lubricate the handle end of the rope with Lubriplate 777 or OMC Triple-Guard grease. Thread rope through handle using Johnson or Evinrude tool part No. 378774.
16. Press rope into channel in rope anchor with end of rope butted tightly against channel. Install anchor in handle.
17. Pull on the end of the rope to make sure the knot seats against the pulley, then untie the slip knot and slowly let rope wind onto pulley.
18. Pull starter rope out and check pawl operation. Pawl should extend when rope is pulled out and retract when rope is release.
19. Pull the rope out and release it several times, then check to make sure the housing arrow aligns with the pulley mark. If not properly aligned, pull rope out and release several more times. A new rope must lose some of its stiffness before the marks will properly align.
20. Position the starter lockout lever, spring and washer on the starter housing. Install the shoulder screw and tighten snugly.


30

Removal/Installation (All Other Models)

1. Remove the 3 housing screws.
2. Remove the starter housing from the power head (**Figure 29**).

NOTE
The starter lockout cable should be disconnected at the power head in Step 3 if power head is to be removed.

3. Disconnect the lockout cable connector (arrow, **Figure 29**) from the starter housing with a screwdriver, if so equipped.
4. Installation is the reverse of removal.

Disassembly (All Other Models)

WARNING
Disassembling this starter mechanism without holding the spring in place can result in the spring unwinding violently, causing serious personal injury. Wear safety glasses and gloves during this procedure.

Refer to **Figure 28** (typical) for this procedure.
1. Pull the starter rope out enough to tie a slip knot behind the handle. Pry the rope anchor from the handle.
2. Remove the handle, untie the slip knot gradually allow the starter to unwind while holding the pulley.
3. Remove the circlip holding the starter pawl in place (**Figure 30**).
4. Lift the pawl off its shaft and disengage the friction spring and links. Remove the pawl and spring/link assembly. See **Figure 31**.

10

5. Remove the screw and washer from the spindle (**Figure 32**). It may be necessary to hold the nut on the top of the starter housing with a wrench while loosening the screw.
6. Remove the spindle (**Figure 33**) and hold pulley in housing while turning it over (legs downward) on the workbench or floor.
7. Release the pulley and rap the housing sharply to dislodge the pulley and spring. The spring should uncoil within the starter housing legs.
8. Lift the housing up and remove the spring and pulley.

Cleaning and Inspection (All Other Models)

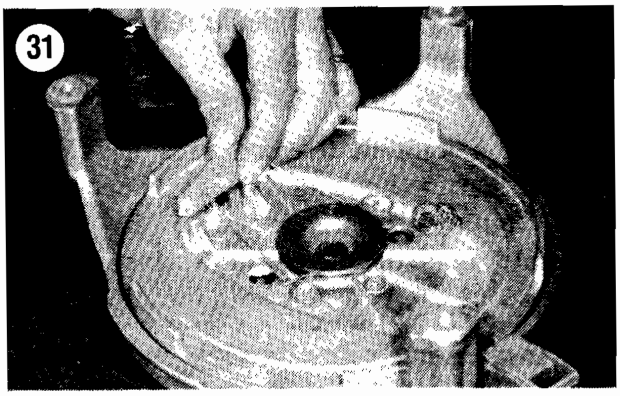
1. Wash all metal parts in solvent and blow dry with compressed air.
2. Check spring for wear or broken end loops. Replace as required.

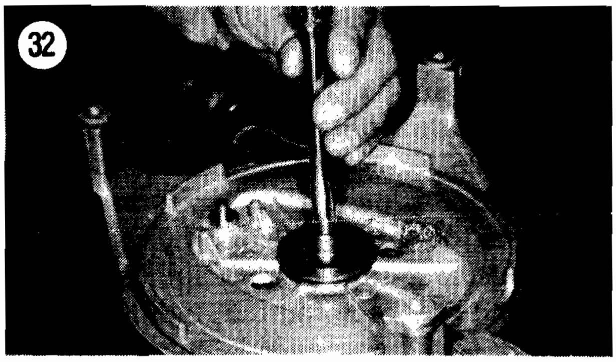
NOTE
If starter pawl is replaced on 1973-1978 models, use part No. 324755. This redesigned pawl is used on 1979 and later models and can be fitted to previous models.

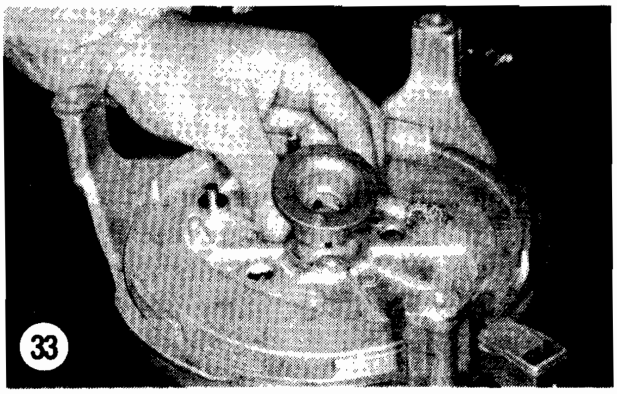
3. Check pawl, friction spring and spindle for wear.
4. Remove any sharp edges or rough surfaces from pulley and housing that might fray the rope.
5. Check rope for fraying. Replace as required.
6. Check starter interlock components for wear or damage. Replace as required.

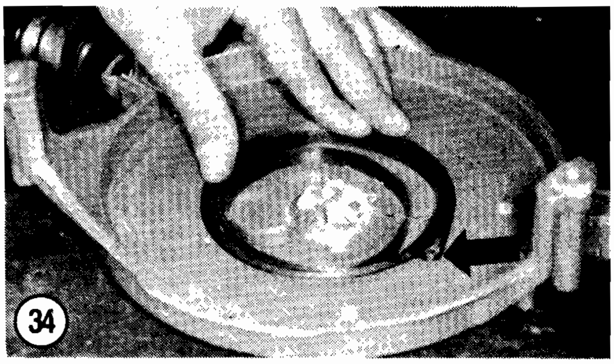
Assembly (All Other Models)

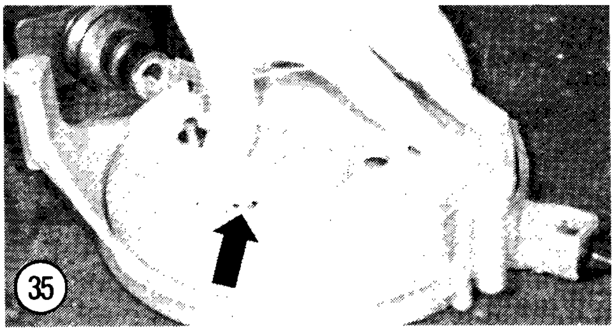
WARNING
During starter mechanism assembly the spring may unwind violently, causing serious personal injury. Wear safety glasses and gloves during this procedure.











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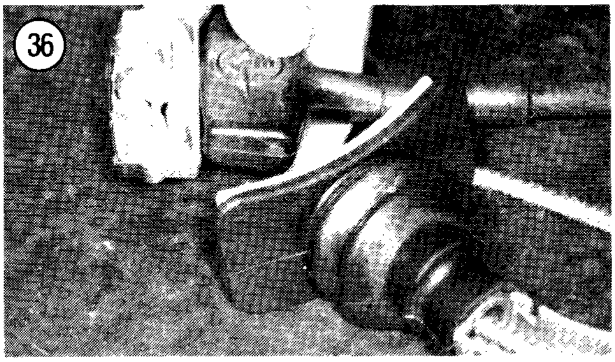

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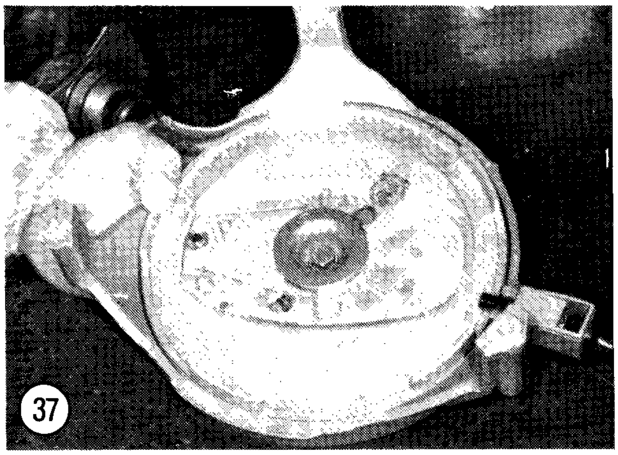

37

Refer to **Figure 28** for this procedure.

1. Lubricate the spindle and housing spindle area with Lubriplate 777 or OMC Triple-Guard grease.
2. Insert one spring loop over the pin in the housing cutout (**Figure 34**).
3. Carefully coil the spring into the housing. See **Figure 34**.
4. Install pulley in housing, making sure that pin on pulley engages the inner spring loop.
5. Install spindle in housing. Install spindle screw with washer. Thread nut on screw as it protrudes through the top of the housing. Hold nut with one wrench and tighten the spindle screw with a second wrench.
6. Wind pulley counterclockwise until spring is tight, then back pulley off 1/2-1 turn and align the pulley and housing holes (arrow, **Figure 35**). Insert a nail, punch or drill in holes to lock pulley in place.
7. Tie a knot in the end of a new rope. Insert the opposite end of the rope in the pulley hole and feed the rope until it comes out the side of the housing. Pull the rope through the pulley until the knot rests against it.
8. Lubricate the handle end of the rope with Lubriplate 777 or OMC Triple-Guard grease. Thread rope through handle using Johnson or Evinrude tool part No. 378774.
9. Press rope into channel in rope anchor with end of rope butted tightly against channel. See **Figure 36**. Install anchor in handle.
10. Pull on the end of the rope to make sure **10**
the knot seats against the pulley, then remove the locking nail, punch or drill and slowly let rope wind onto pulley.
11. Lightly lubricate the pawl pin with Lubriplate 777 or OMC Triple-Guard grease. Install pawl and link assembly. Install circlip. **Figure 37** shows the finished assembly.
12. Pull starter rope out and check pawl operation. Pawl should extend when rope is pulled out and retract when rope is released.
13. Pull the rope out and release it several times, then check to make sure the housing arrow aligns with the pulley mark. If not aligned properly, pull rope out and release several more times. A new rope must lose some of its stiffness before the marks will properly align.

Index

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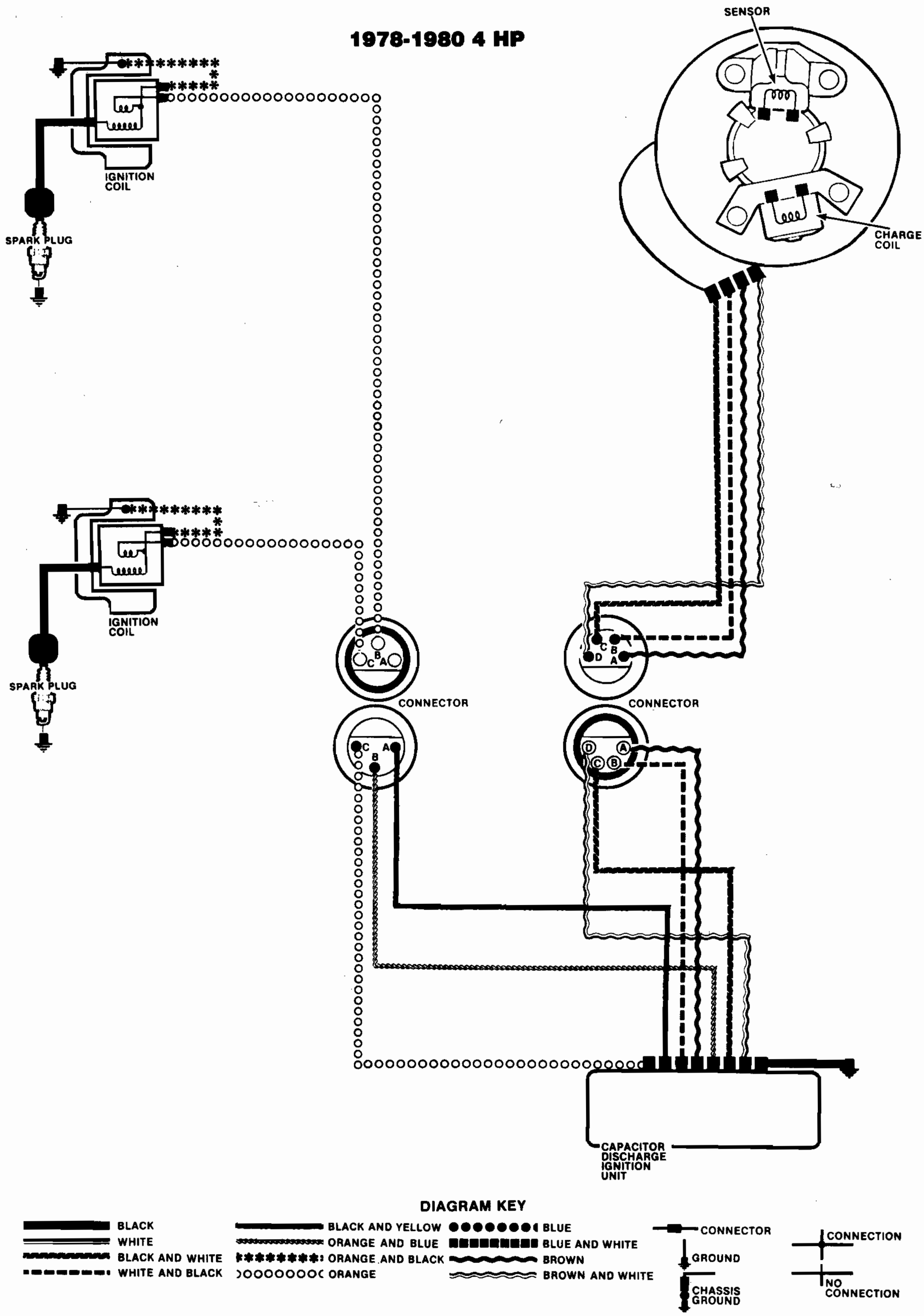
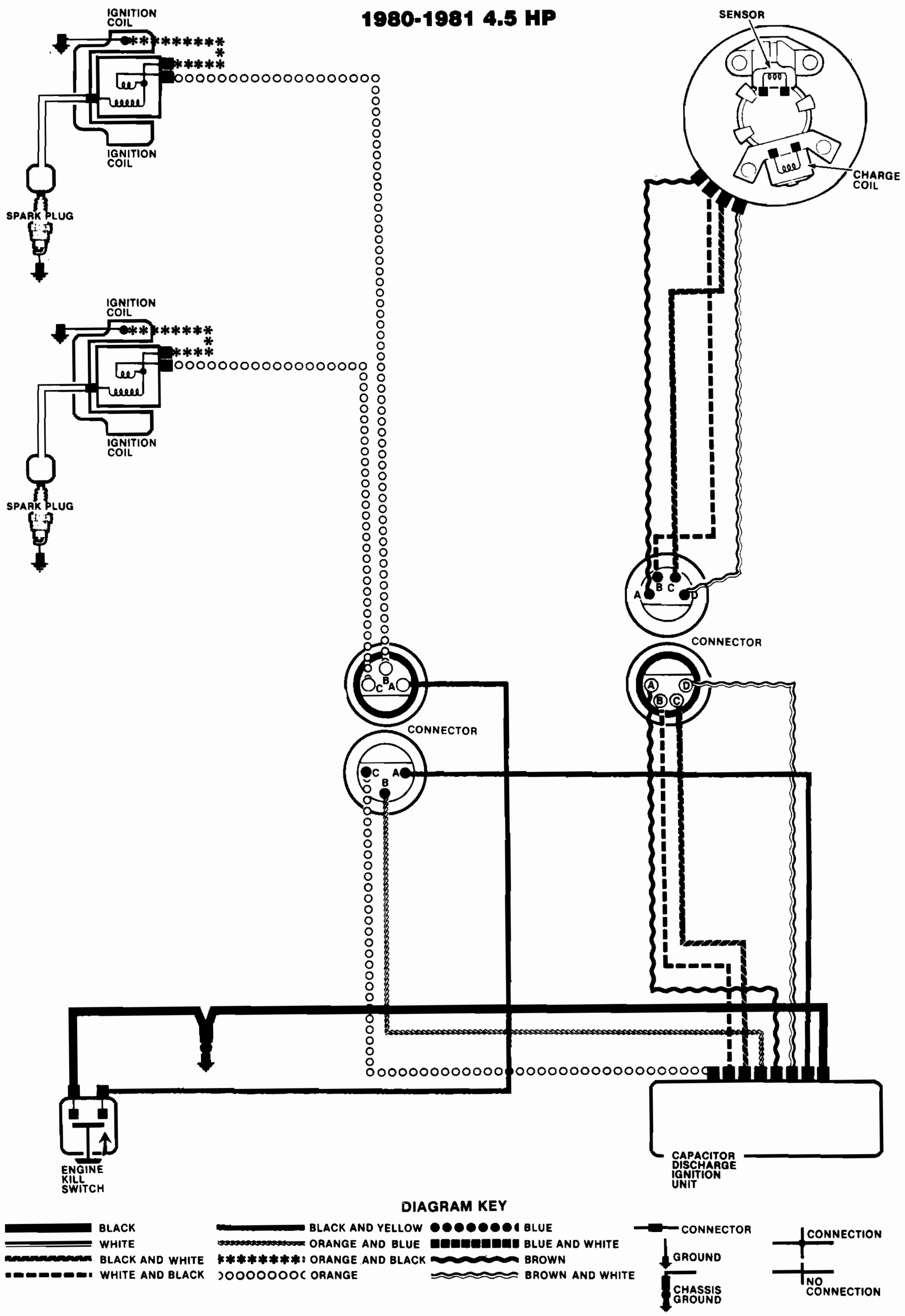
1978-1980 4 HP





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IGNITION COIL
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A
B
C
D
CONNECTOR
A
B
C
D
C
B
A
CONNECTOR
C
A
B
ENGINE KILL SWITCH
CAPACITOR DISCHARGE IGNITION UNIT
DIAGRAM KEY
BLACK
WHITE
BLACK AND WHITE
WHITE AND BLACK
BLACK AND YELLOW
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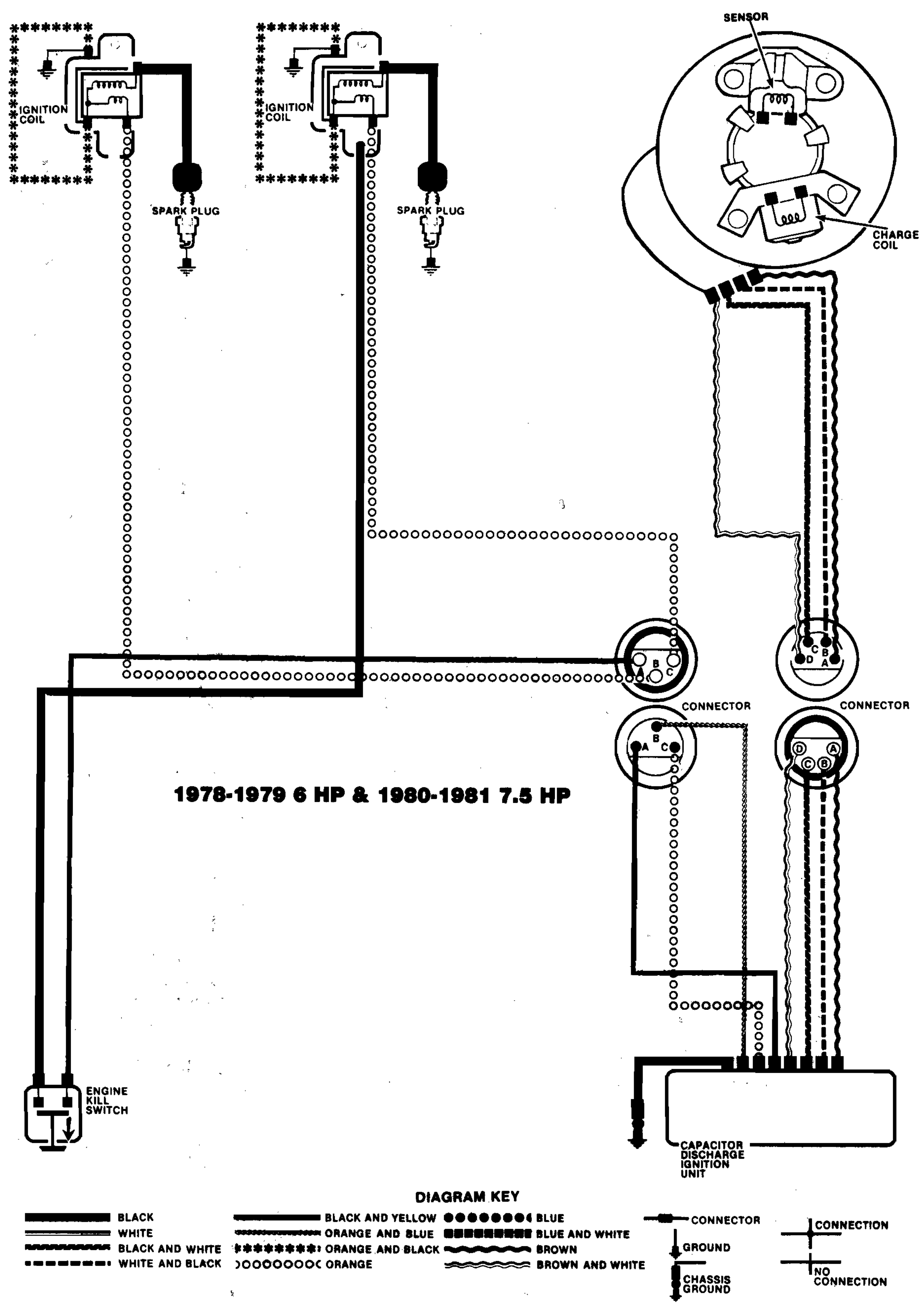
GROUND
CHASSIS GROUND
CONNECTION
NO CONNECTION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CHARGE COIL
CONNECTOR
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ENGINE KILL SWITCH
CAPACITOR DISCHARGE IGNITION UNIT
DIAGRAM KEY
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WHITE
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BLACK AND YELLOW
ORANGE AND BLUE
ORANGE AND BLACK
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CONNECTOR
GROUND
CHASSIS GROUND
CONNECTION
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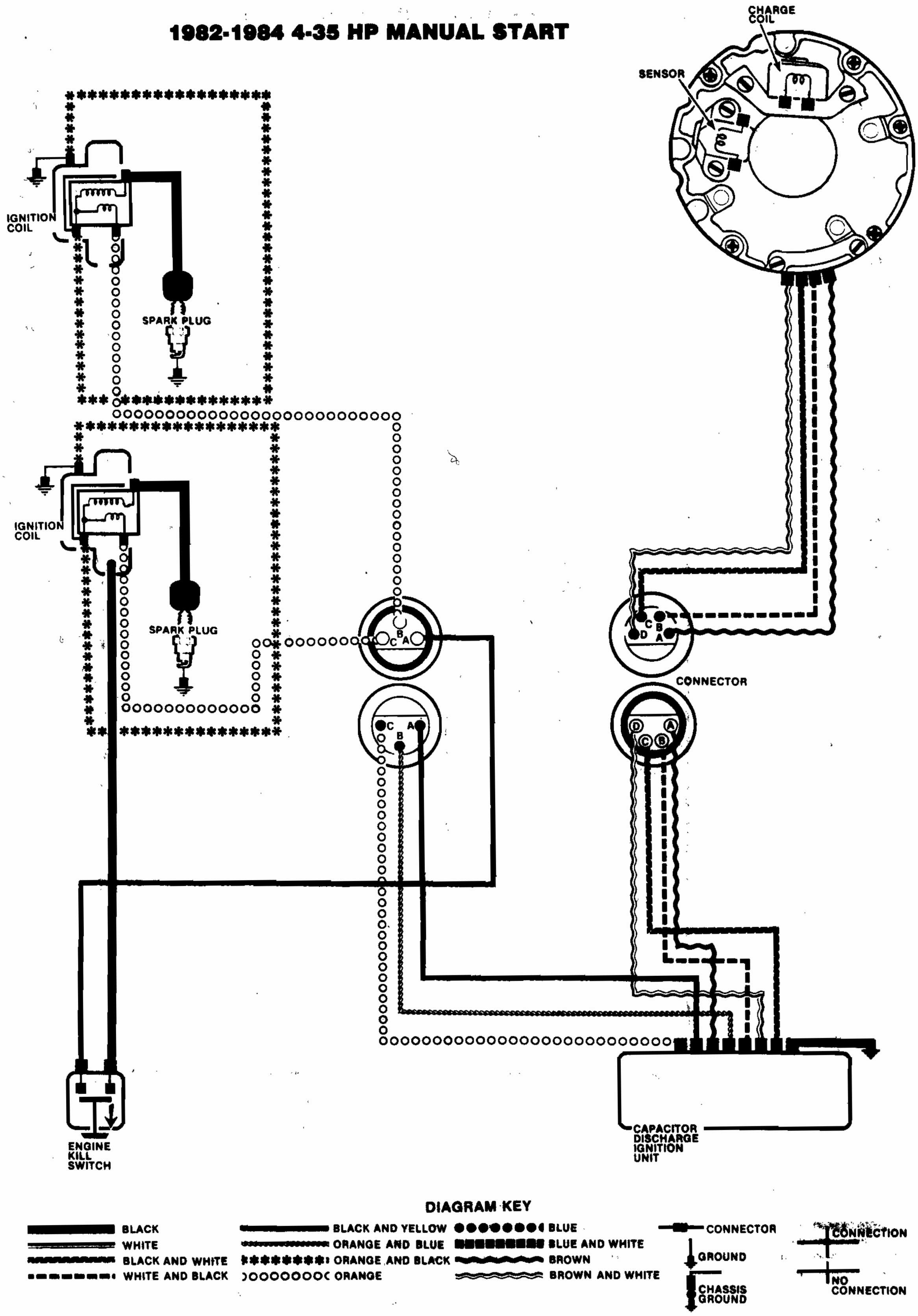
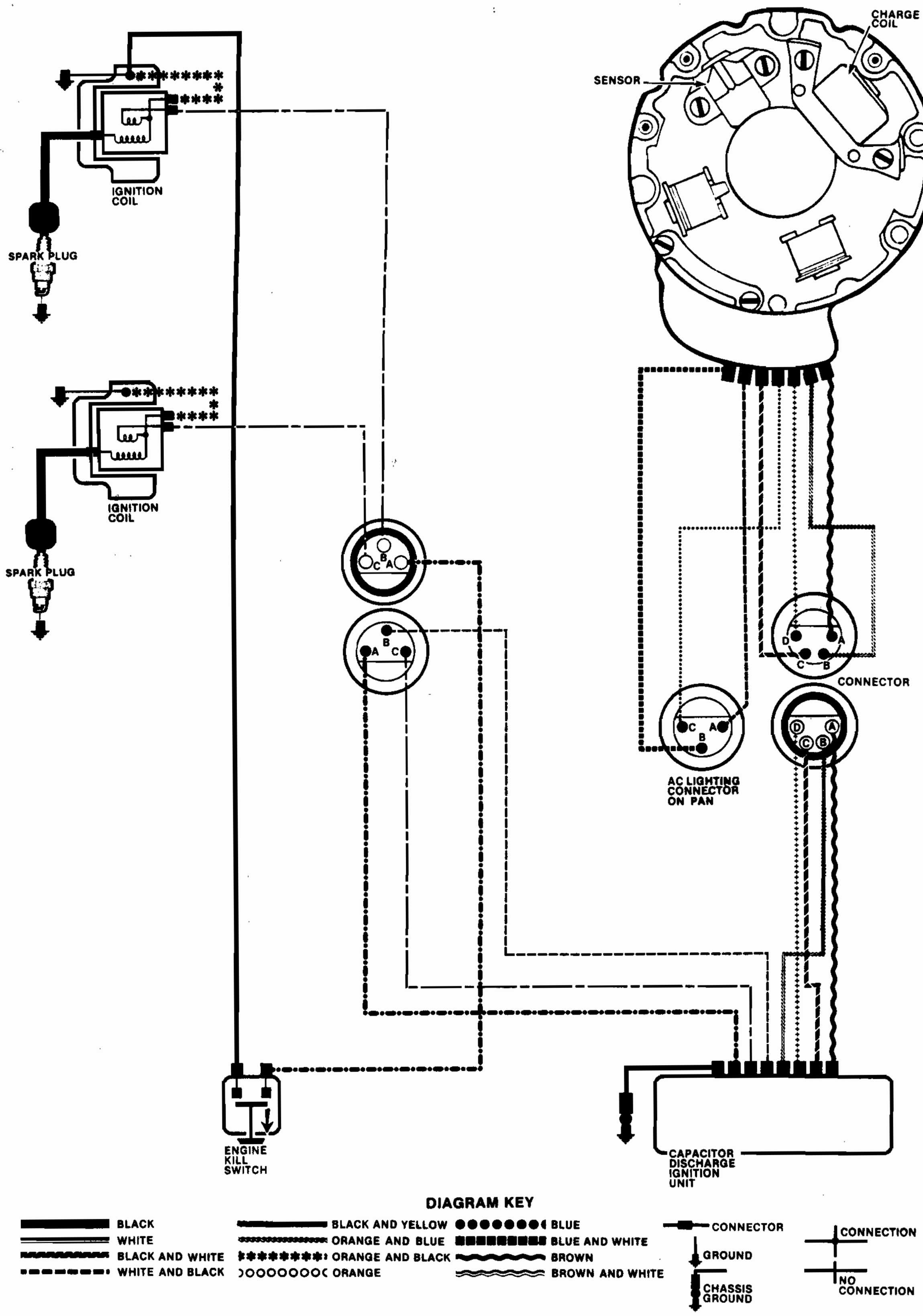
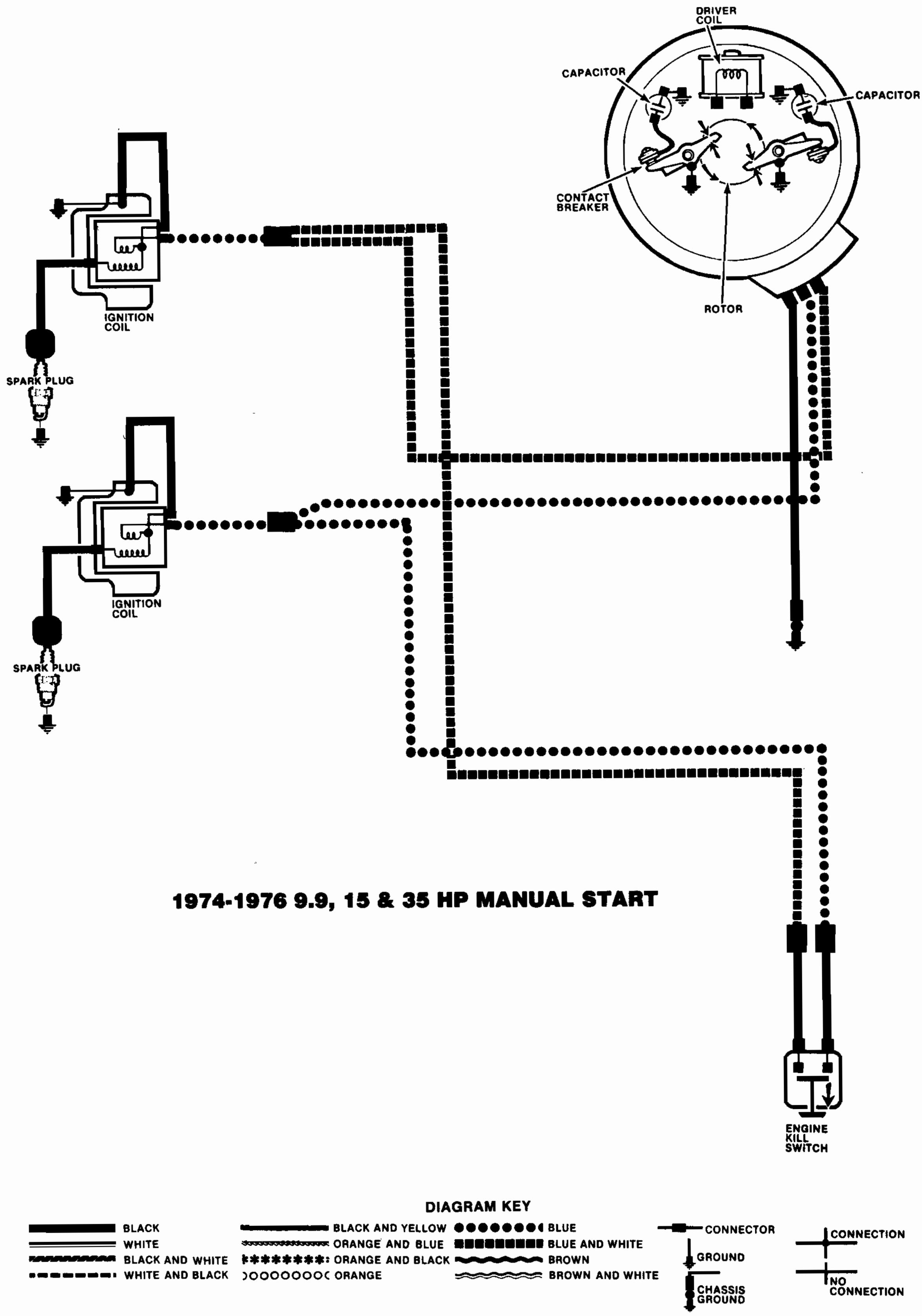
1982-1984 4-35 HP MANUAL START



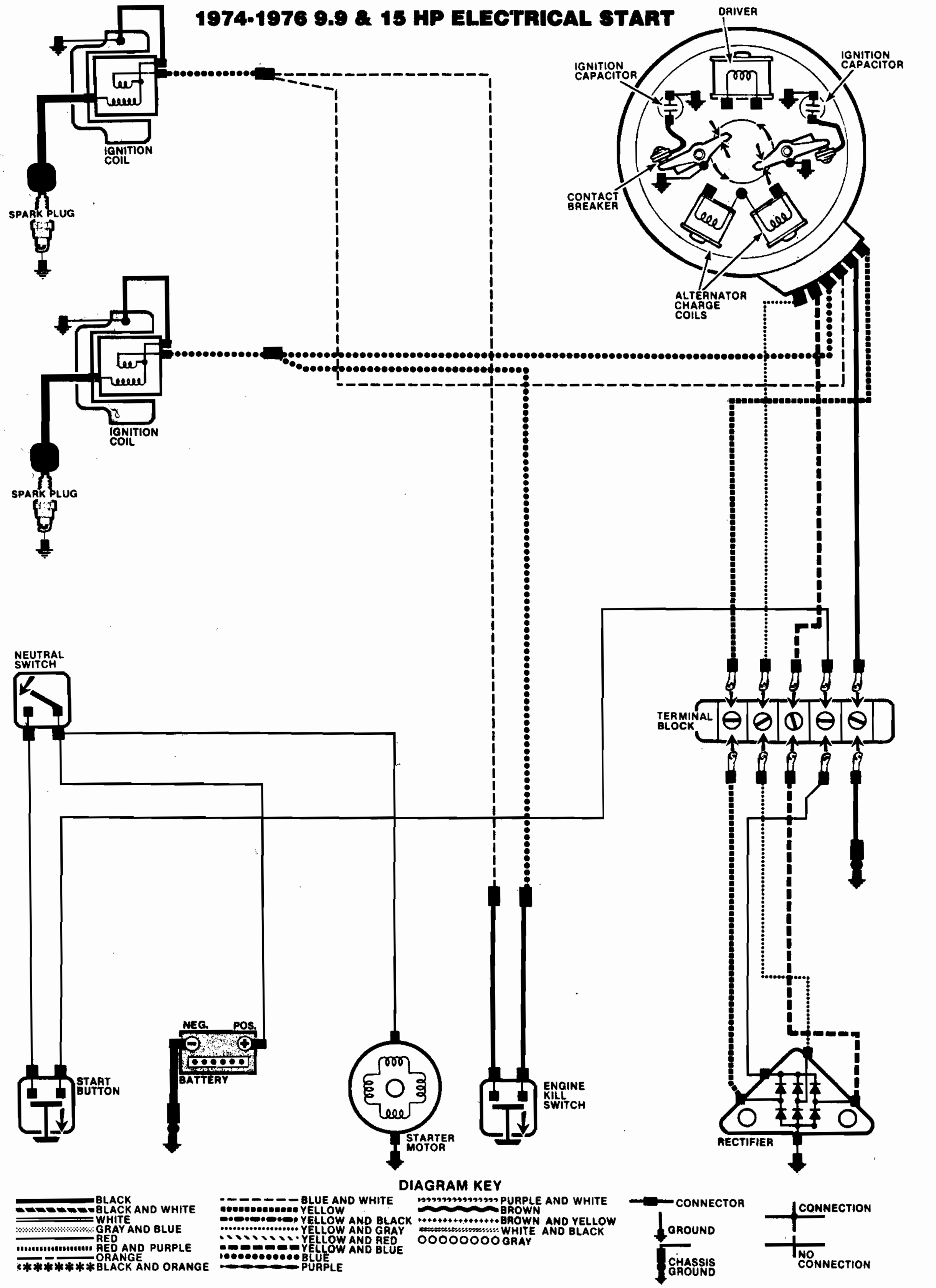
1984 5-35 HP MANUAL START/AC LIGHTING





1974-1976 9.9, 15 & 35 HP MANUAL START

13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ALTERNATOR CHARGE COILS
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IGNITION COIL
SPARK PLUG
NEUTRAL SWITCH
TERMINAL BLOCK
NEG.
POS.
BATTERY
START BUTTON
STARTER MOTOR
ENGINE KILL SWITCH
RECTIFIER
DIAGRAM KEY
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BLACK AND WHITE
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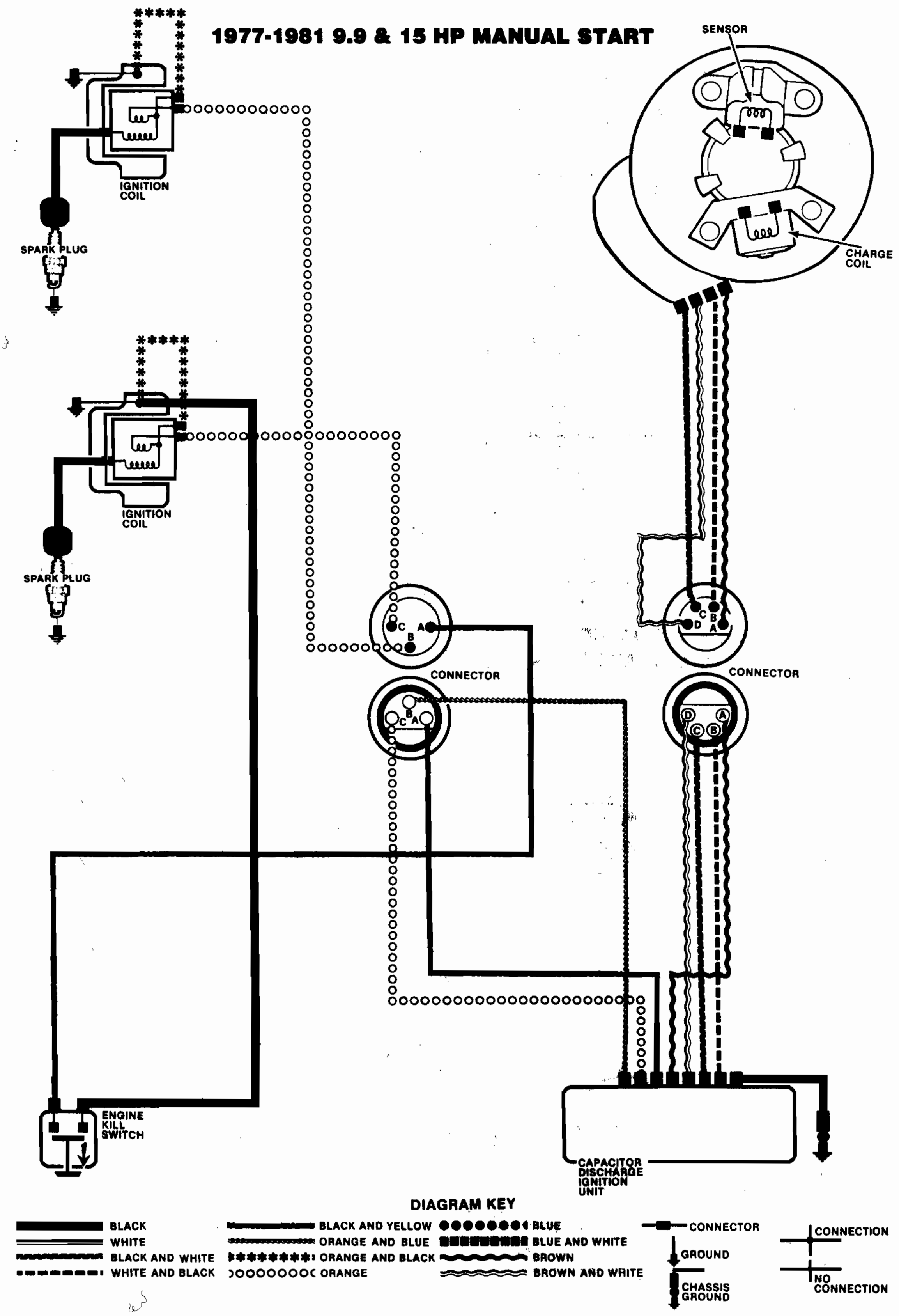
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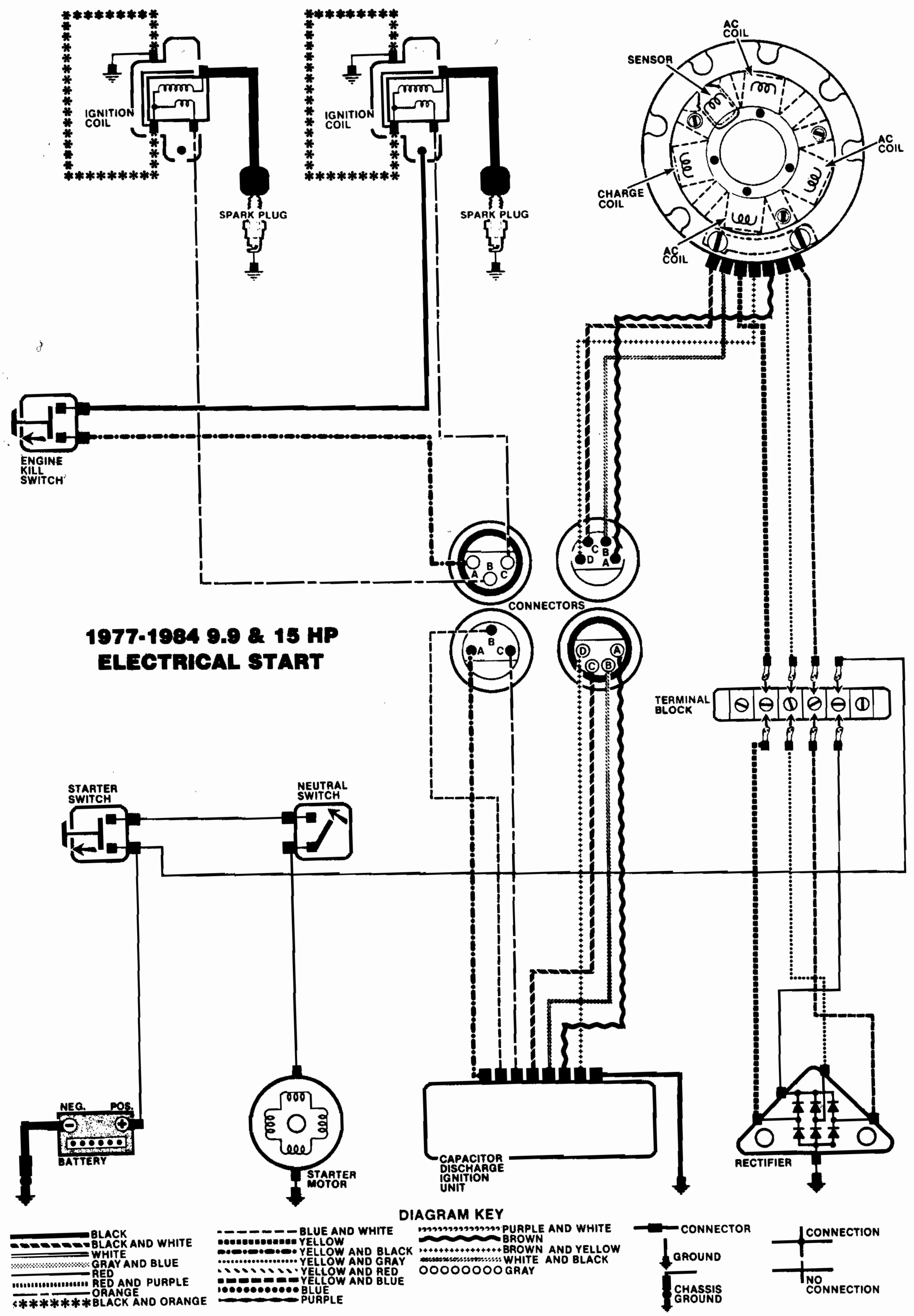

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1977-1984 9.9 & 15 HP
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NEG.
POS.
BATTERY
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CAPACITOR DISCHARGE IGNITION UNIT
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CONNECTION
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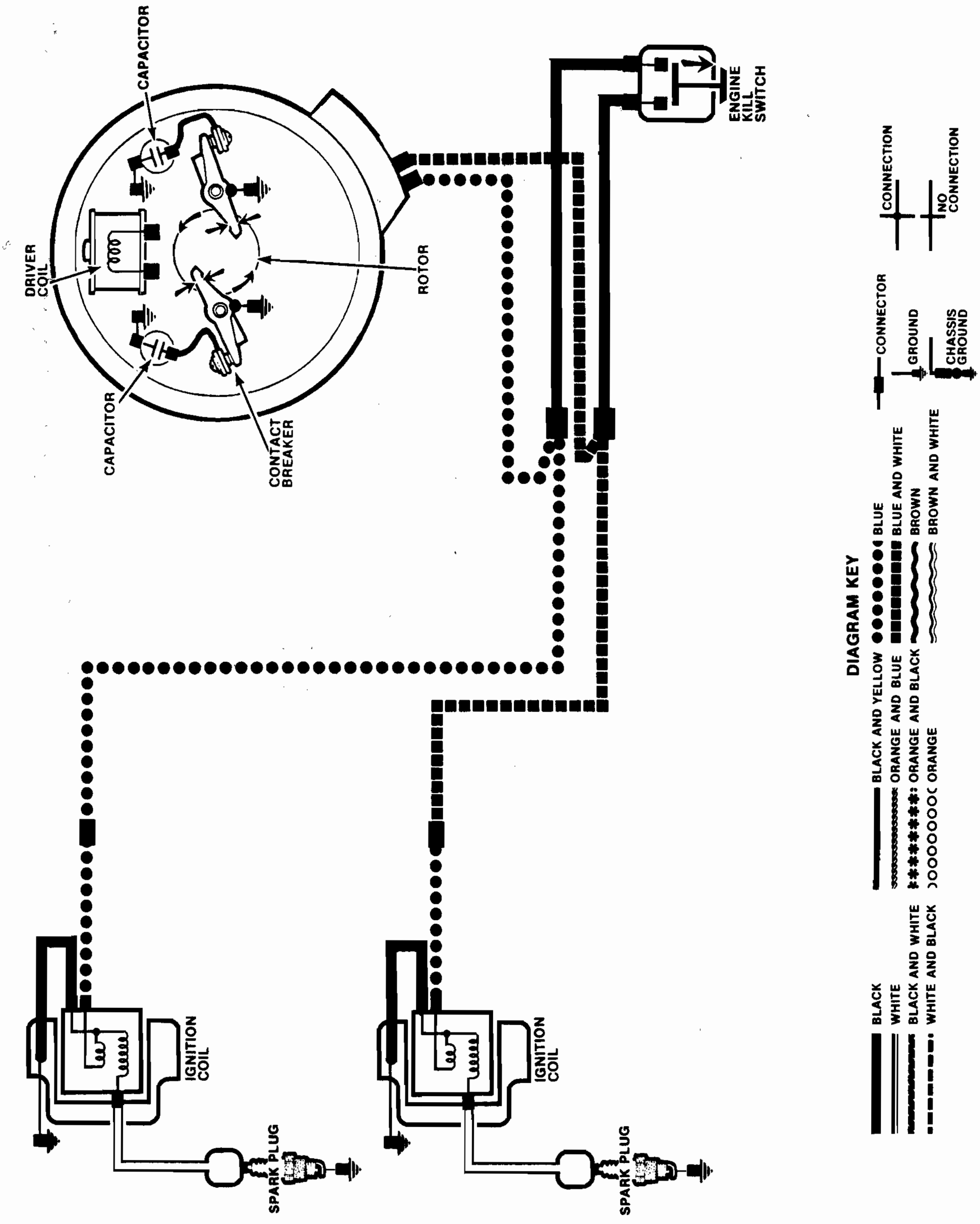
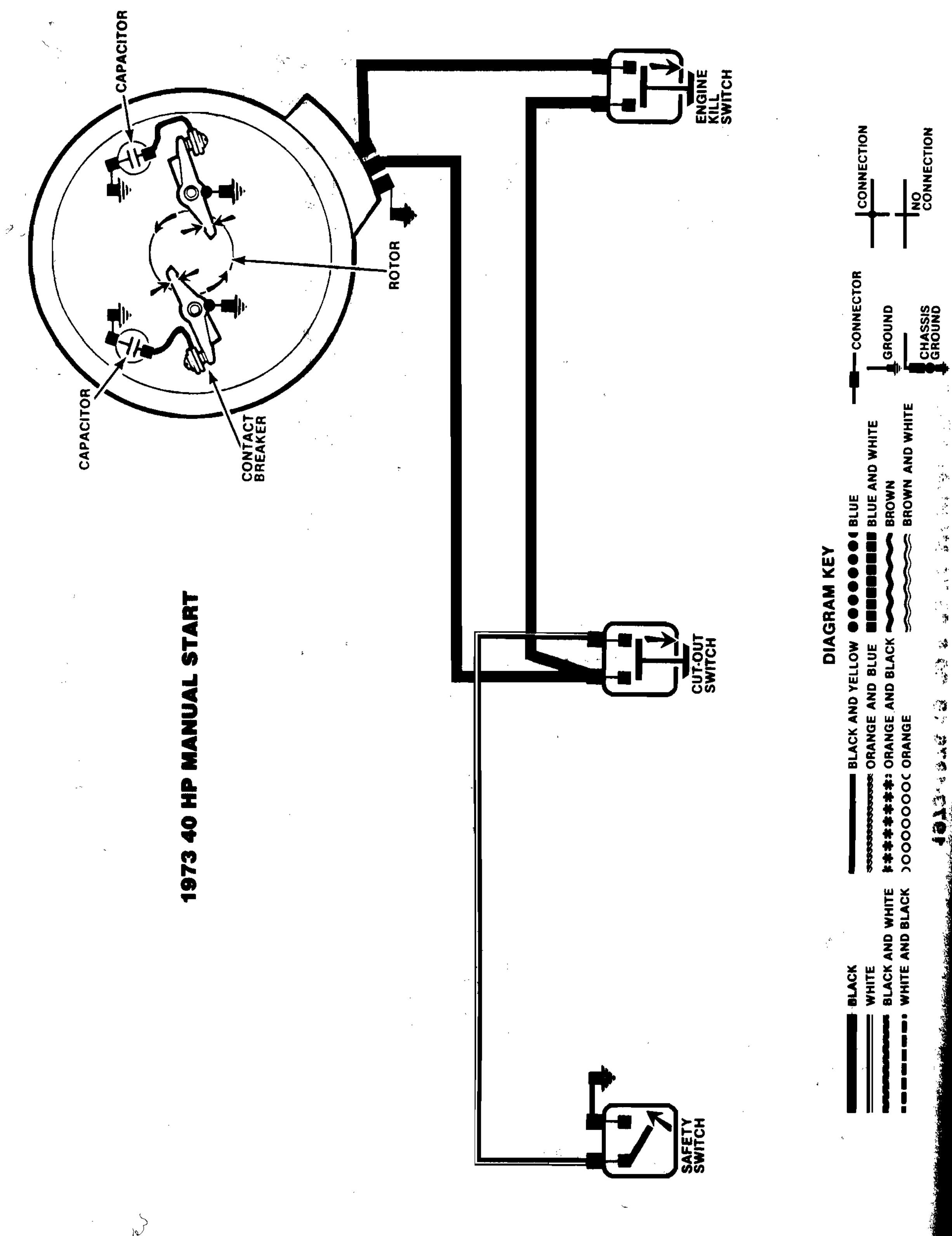
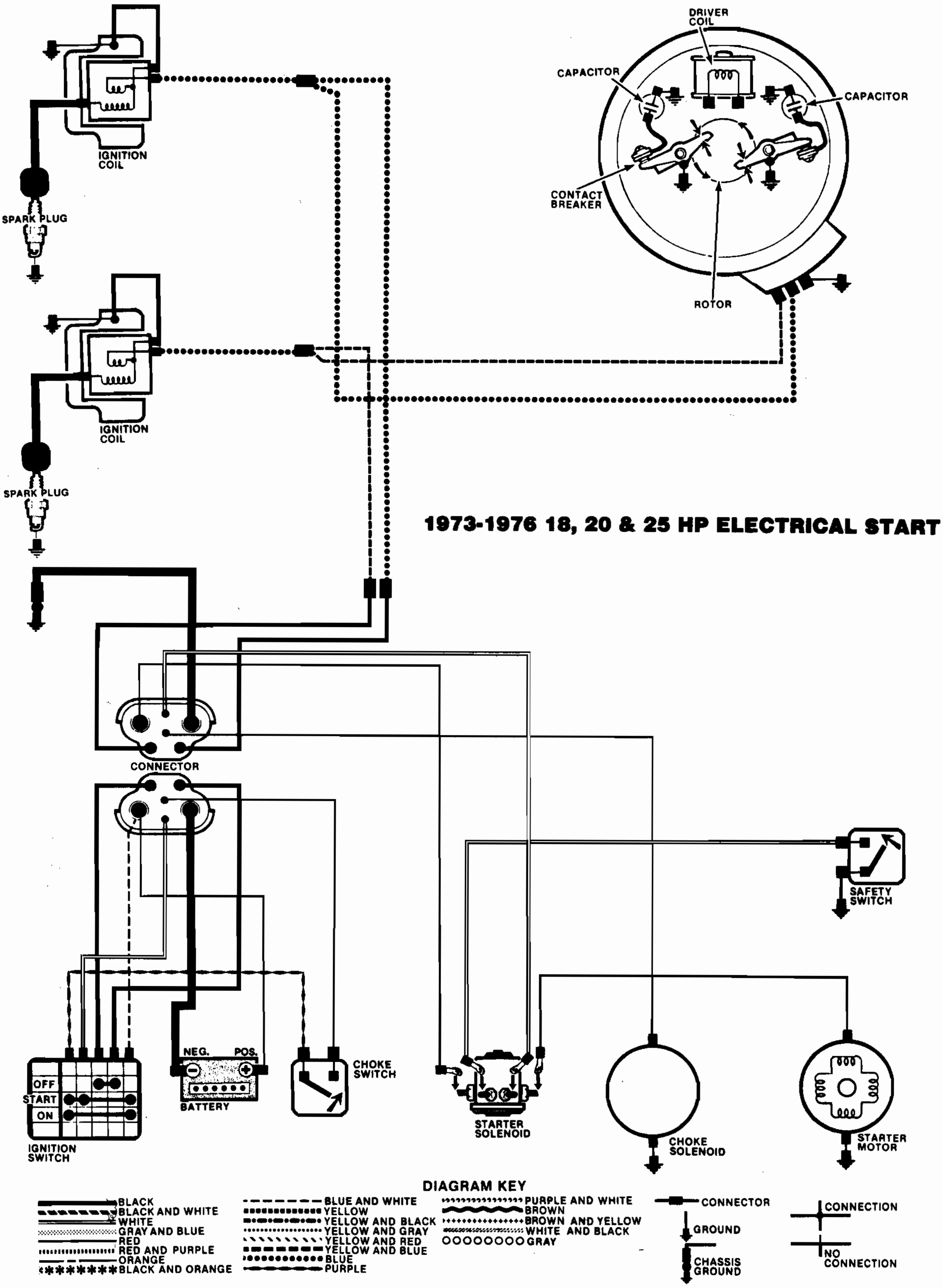
1973-1976 18, 20 & 25 HP MANUAL START

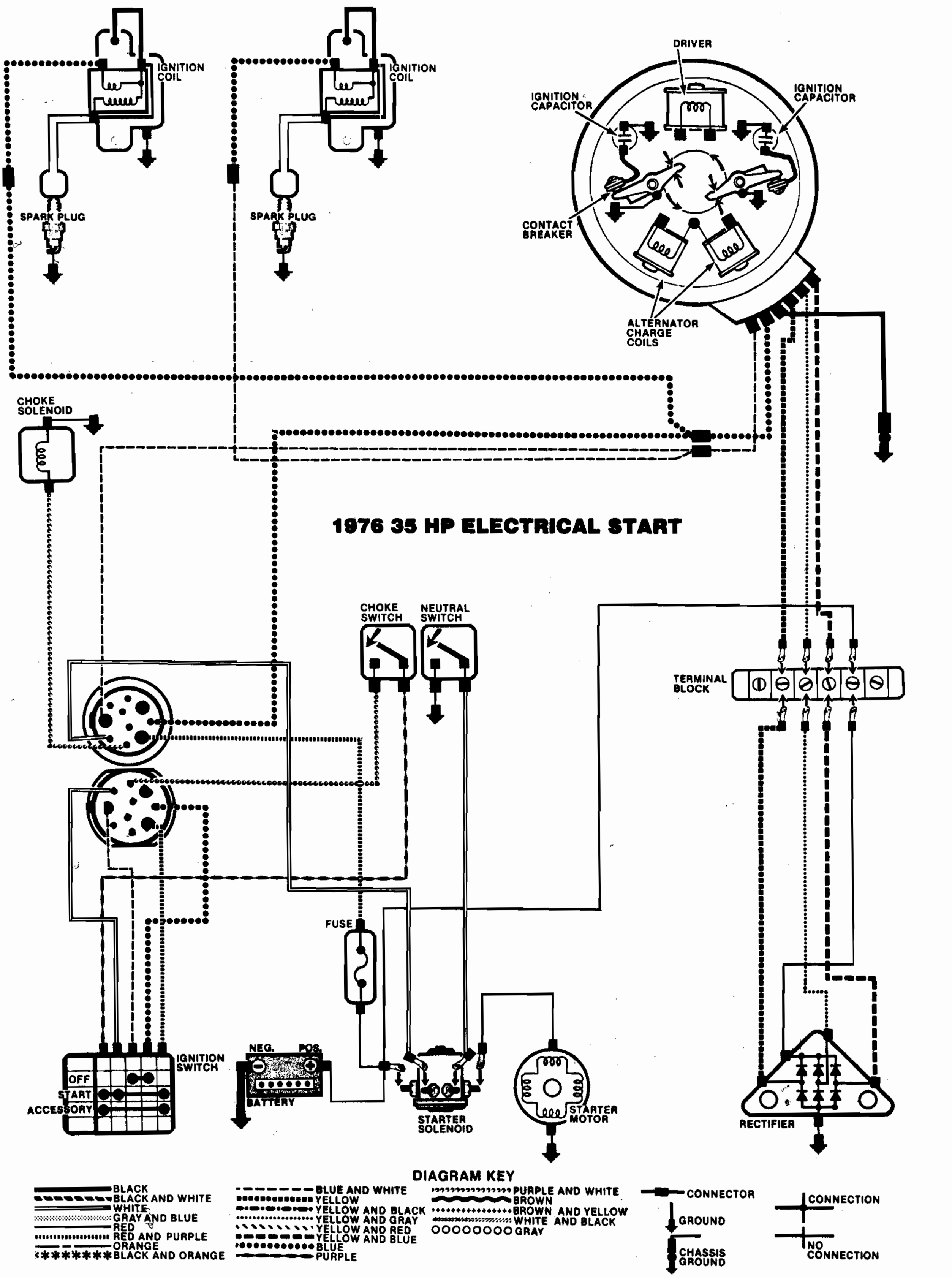


1973 40 HP MANUAL START





1973-1976 18, 20 & 25 HP ELECTRICAL START



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1976 35 HP ELECTRICAL START
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CONNECTION
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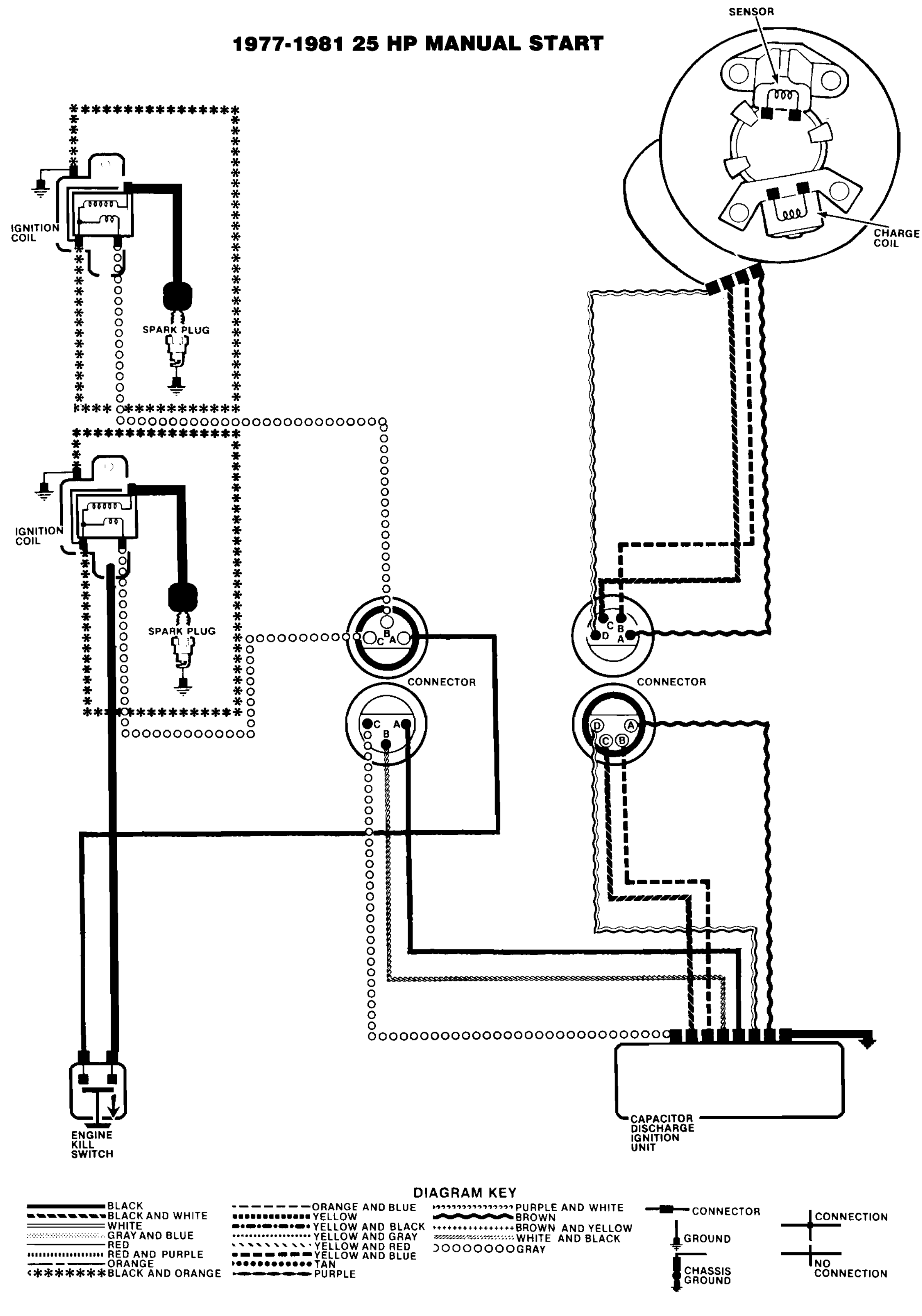
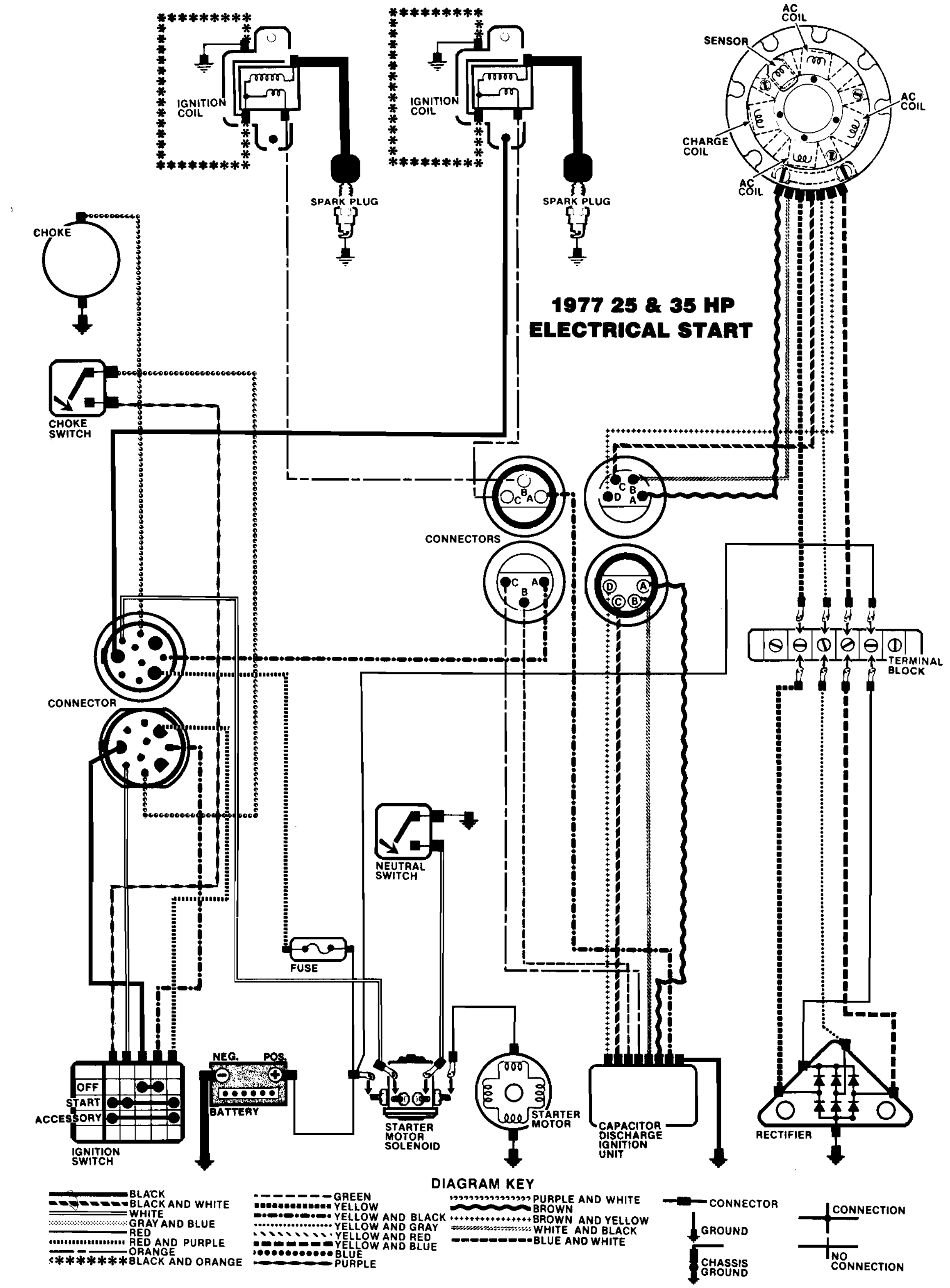
1977-1981 25 HP MANUAL START




1977 25 & 35 HP
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CHARGE COIL
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CHOKE
CHOKE SWITCH
CONNECTORS
TERMINAL BLOCK
CONNECTOR
NEUTRAL SWITCH
FUSE
NEG.
POS.
BATTERY
OFF
START
ACCESSORY
IGNITION SWITCH
STARTER MOTOR SOLENOID
STARTER MOTOR
CAPACITOR DISCHARGE IGNITION UNIT
RECTIFIER
DIAGRAM KEY
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CONNECTION
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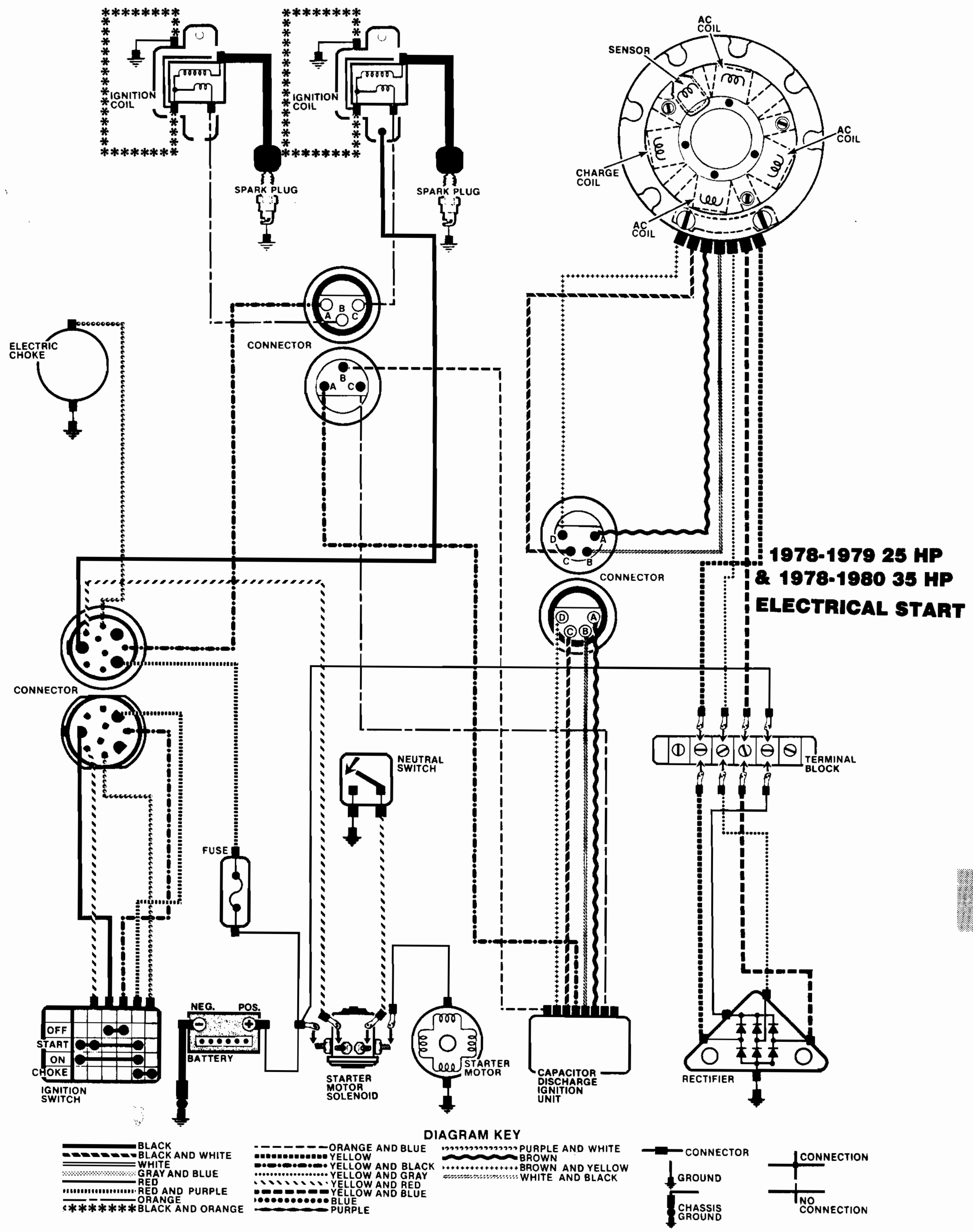
1978-1979 25 HP & 1978-1980 35 HP ELECTRICAL START
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SPARK PLUG
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SENSOR
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CHARGE COIL
AC COIL
ELECTRIC CHOKE
CONNECTOR
CONNECTOR
CONNECTOR
CONNECTOR
NEUTRAL SWITCH
TERMINAL BLOCK
FUSE
OFF
START
ON
CHOKE
IGNITION SWITCH
NEG.
POS.
BATTERY
STARTER MOTOR SOLENOID
STARTER MOTOR
CAPACITOR DISCHARGE IGNITION UNIT
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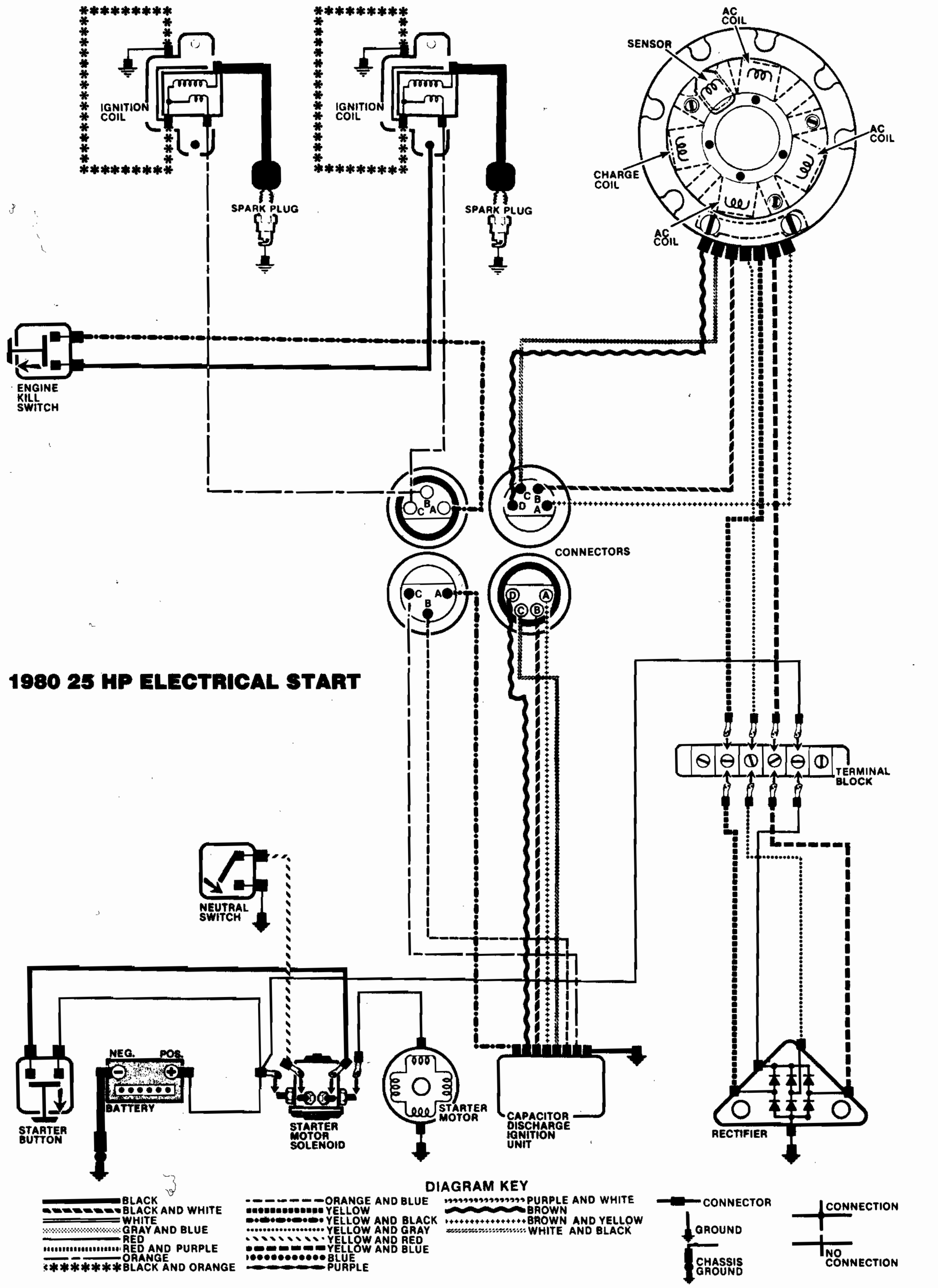
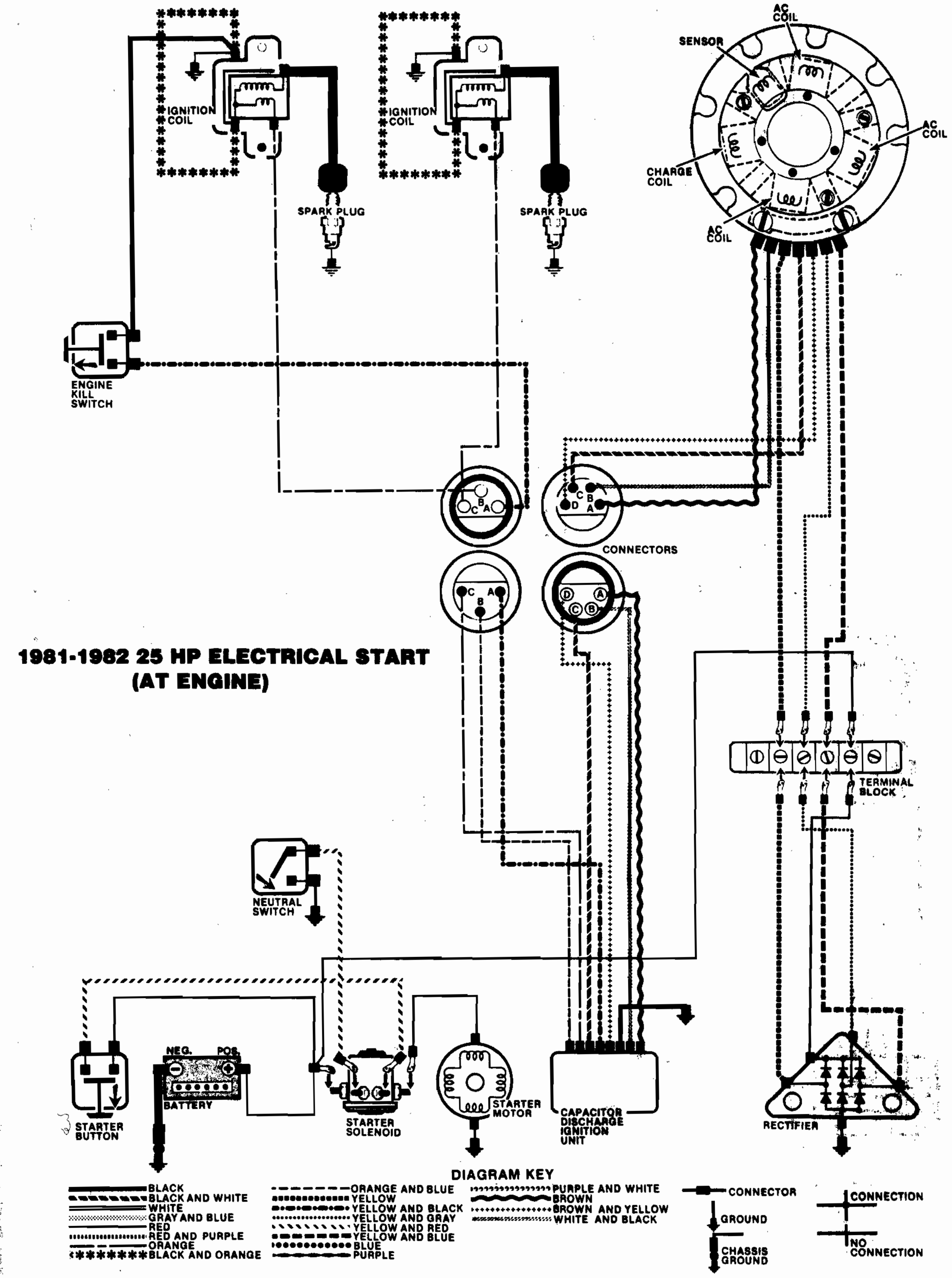
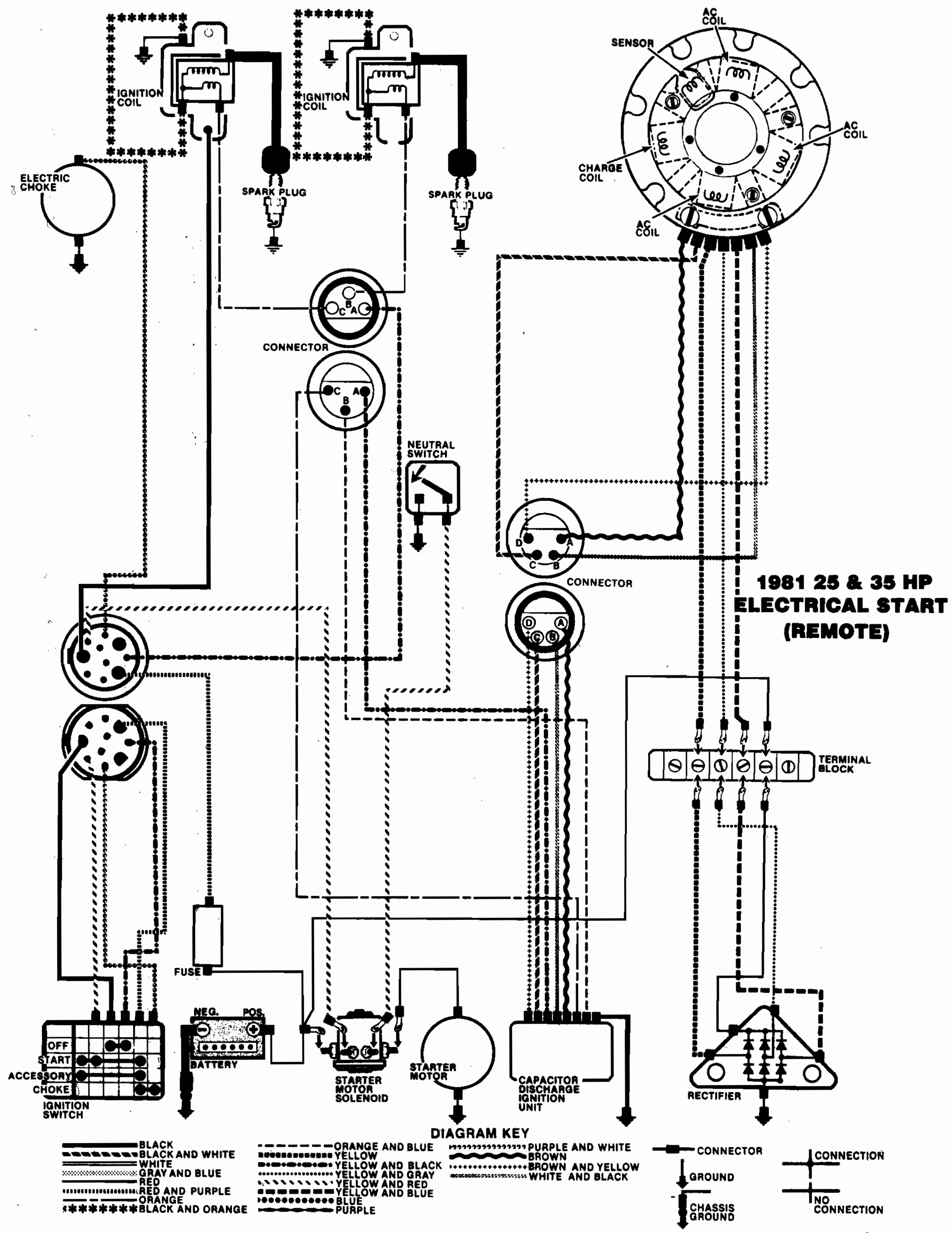


1980 25 HP ELECTRICAL START



1981-1982 25 HP ELECTRICAL START (AT ENGINE)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AC COIL
AC COIL
CHARGE COIL
AC COIL
CONNECTOR
NEUTRAL SWITCH
CONNECTOR
1981 25 & 35 HP ELECTRICAL START (REMOTE)
TERMINAL BLOCK
FUSE
OFF
START
ACCESSORY
CHOKE
IGNITION SWITCH
NEG.
POS.
BATTERY
STARTER MOTOR SOLENOID
STARTER MOTOR
CAPACITOR DISCHARGE IGNITION UNIT
RECTIFIER
DIAGRAM KEY
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CONNECTOR
GROUND
CHASSIS GROUND
CONNECTION
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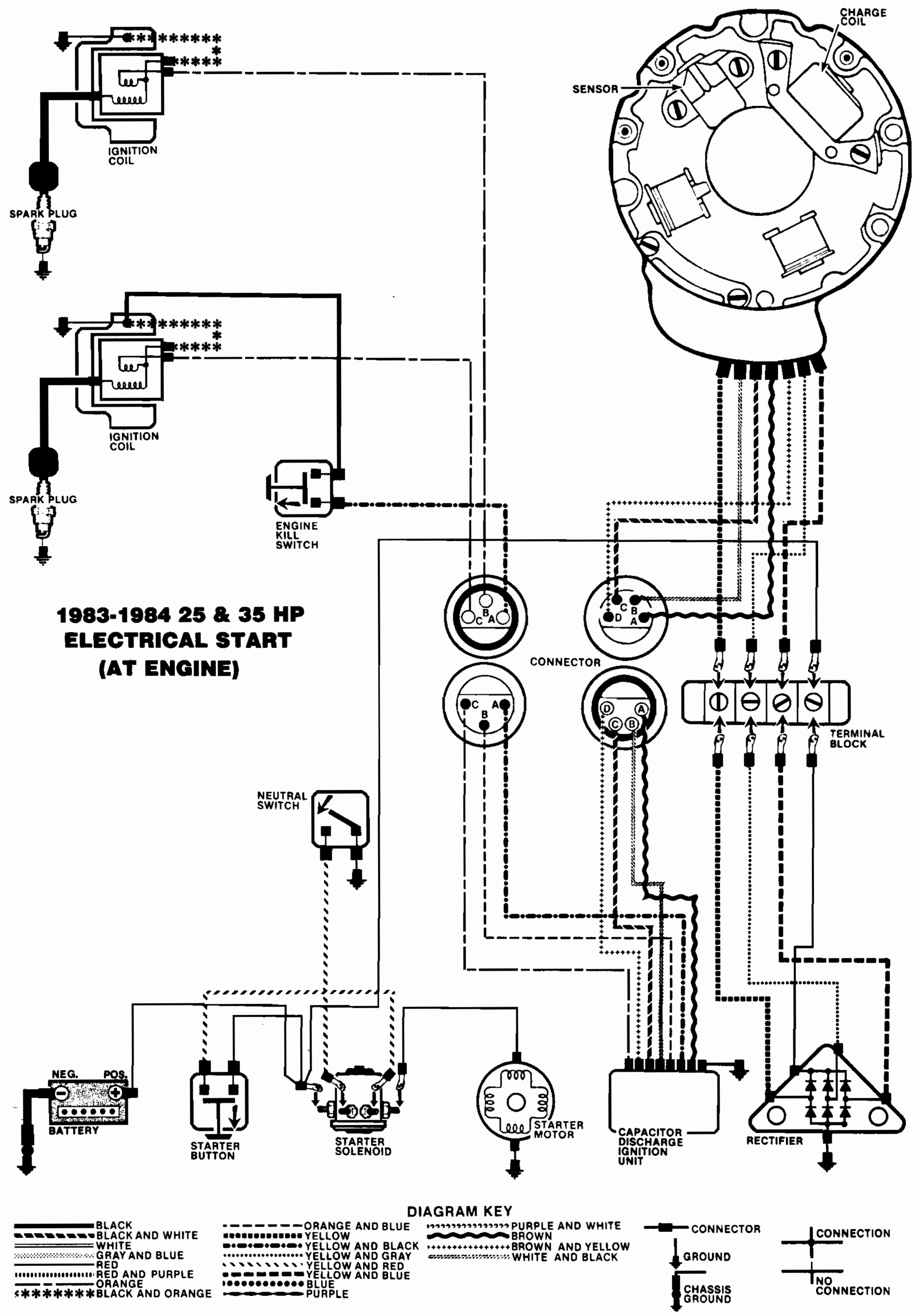
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SPARK PLUG
ENGINE KILL SWITCH
1983-1984 25 & 35 HP
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(AT ENGINE)
CONNECTOR
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NEG.
POS.
BATTERY
STARTER BUTTON
STARTER SOLENOID
STARTER MOTOR
CAPACITOR DISCHARGE IGNITION UNIT
RECTIFIER
DIAGRAM KEY
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CONNECTION
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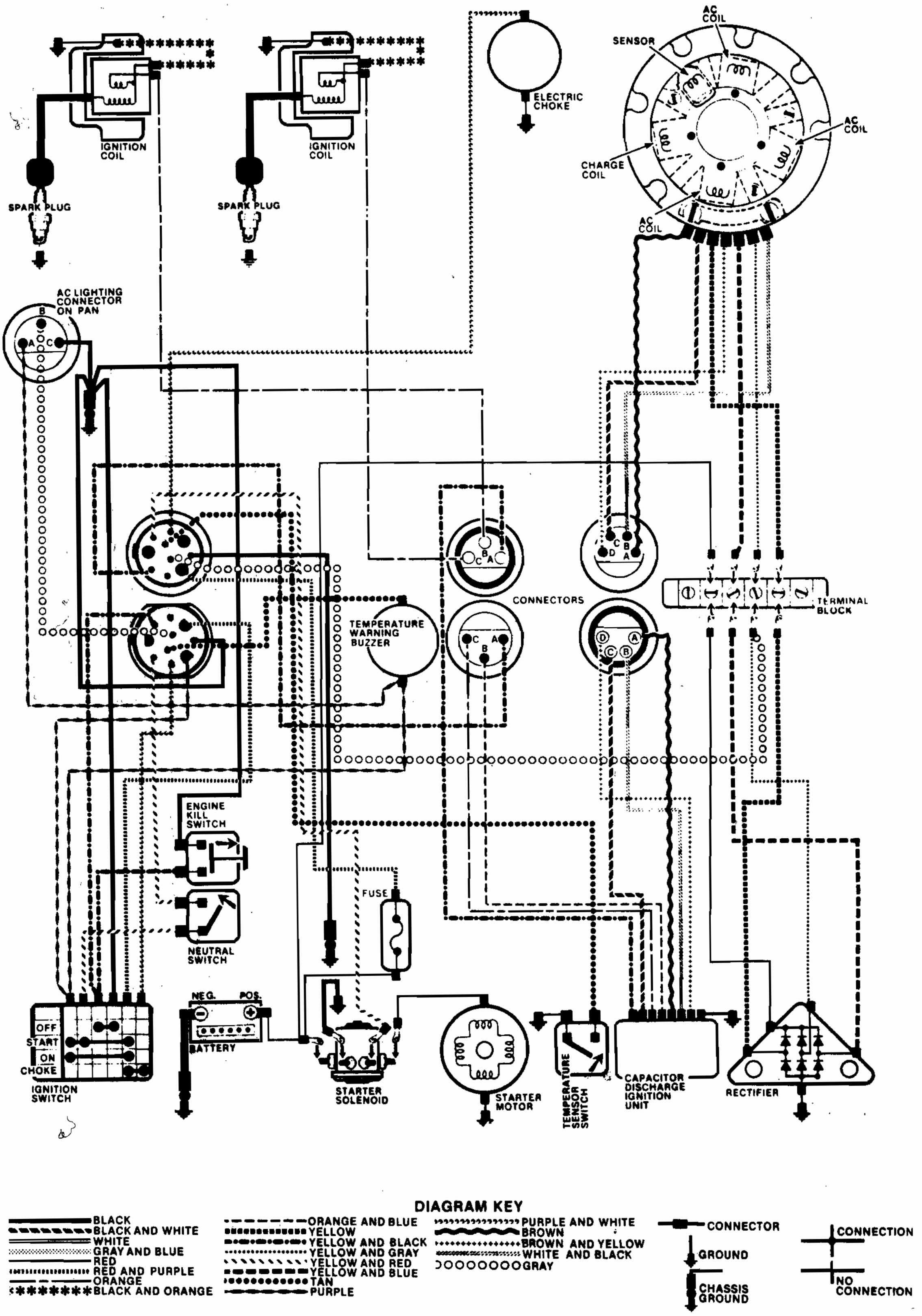
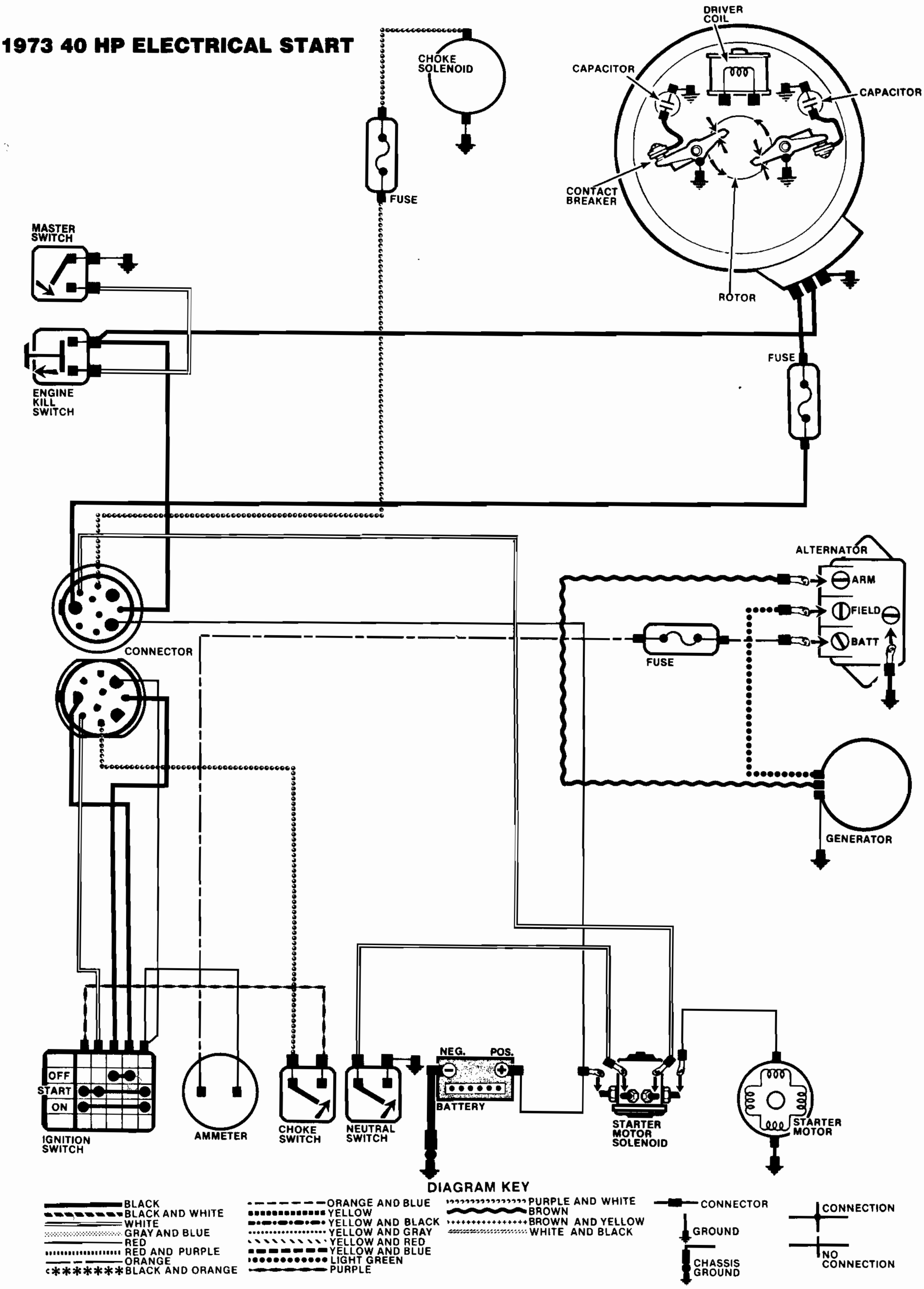
1982-1984 20, 25 & 35 HP ELECTRICAL START (REMOTE)



1973 40 HP ELECTRICAL START



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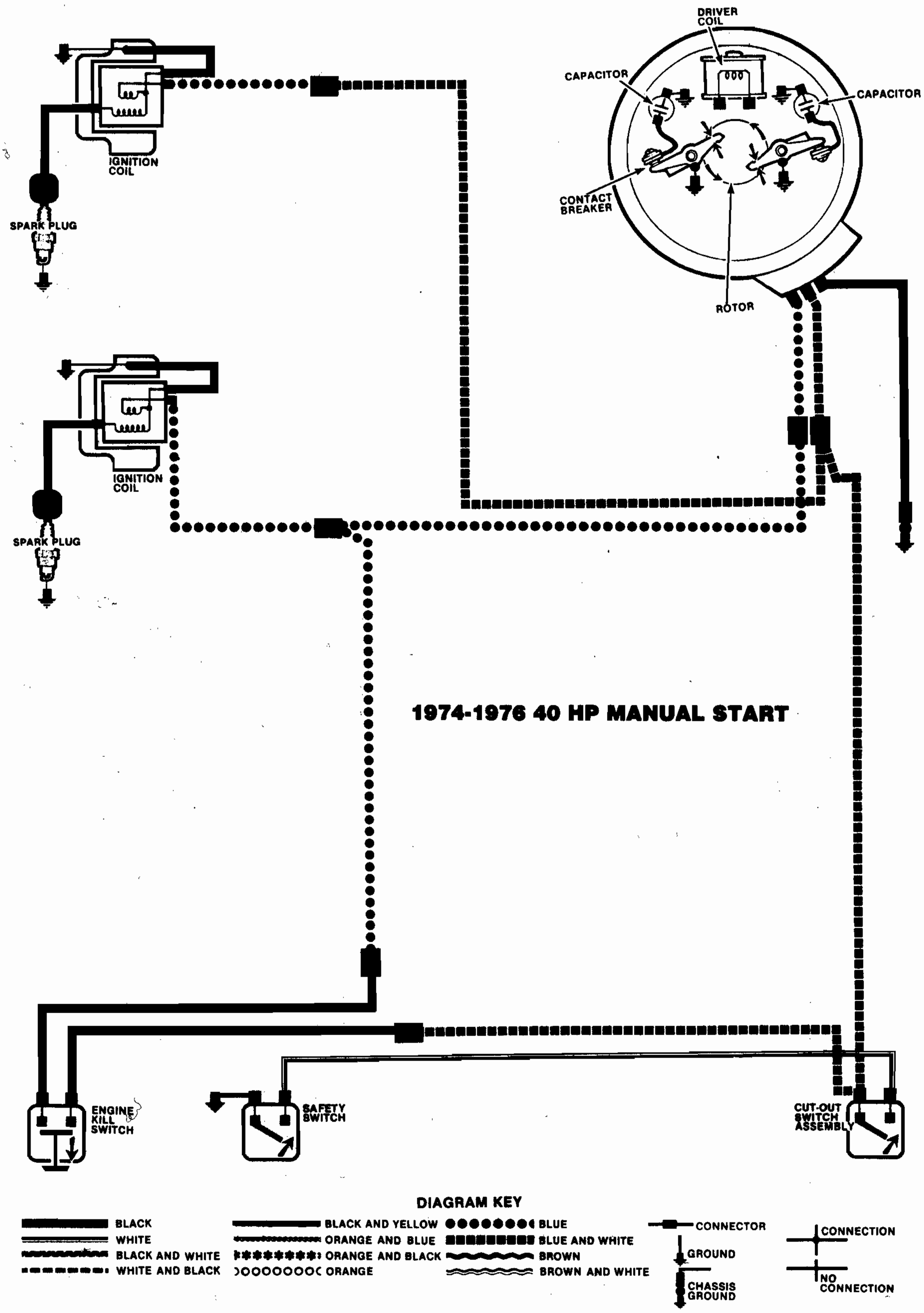

DRIVER COIL
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CAPACITOR
CONTACT BREAKER
ROTOR
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IGNITION COIL
SPARK PLUG
1974-1976 40 HP MANUAL START
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SAFETY SWITCH
CUT-OUT SWITCH ASSEMBLY
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CHASSIS GROUND
CONNECTION
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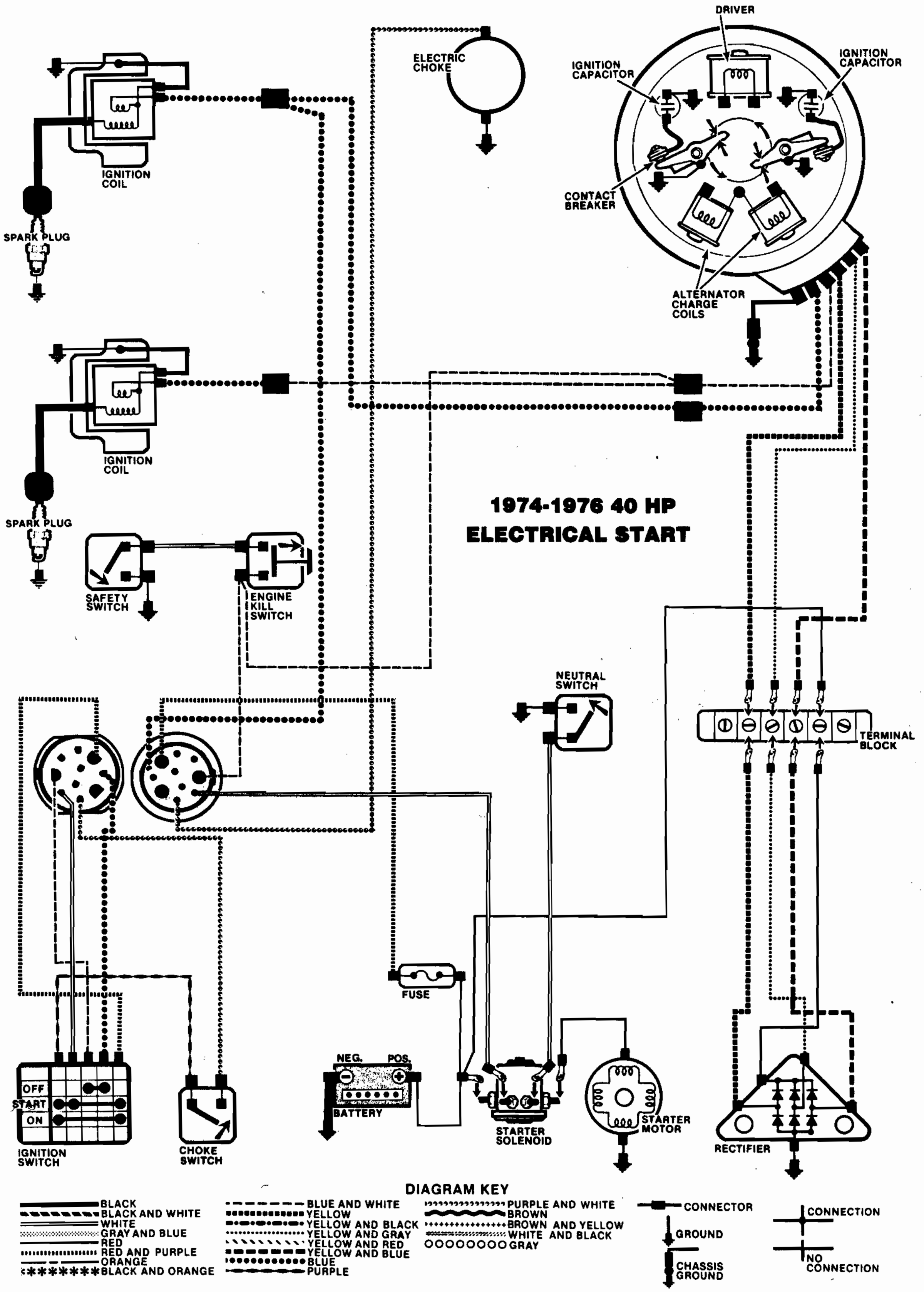
1974-1976 40 HP
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IGNITION CAPACITOR
ELECTRIC CHOKE
CONTACT BREAKER
ALTERNATOR CHARGE COILS
IGNITION COIL
SPARK PLUG
IGNITION COIL
SPARK PLUG
SAFETY SWITCH
ENGINE KILL SWITCH
NEUTRAL SWITCH
TERMINAL BLOCK
FUSE
NEG.
POS.
BATTERY
STARTER SOLENOID
STARTER MOTOR
RECTIFIER
OFF
START
ON
IGNITION SWITCH
CHOKE SWITCH
DIAGRAM KEY
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BLACK AND WHITE
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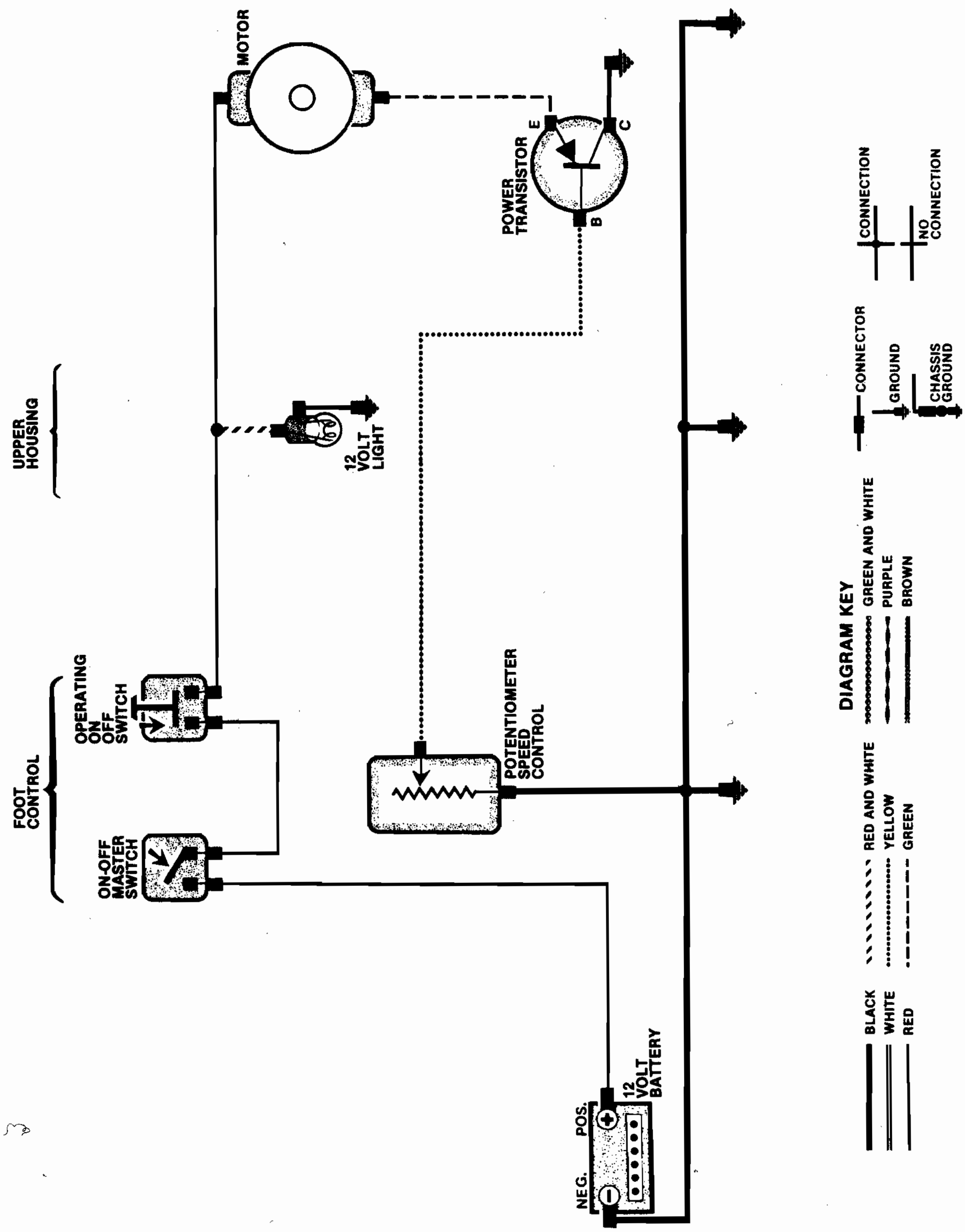
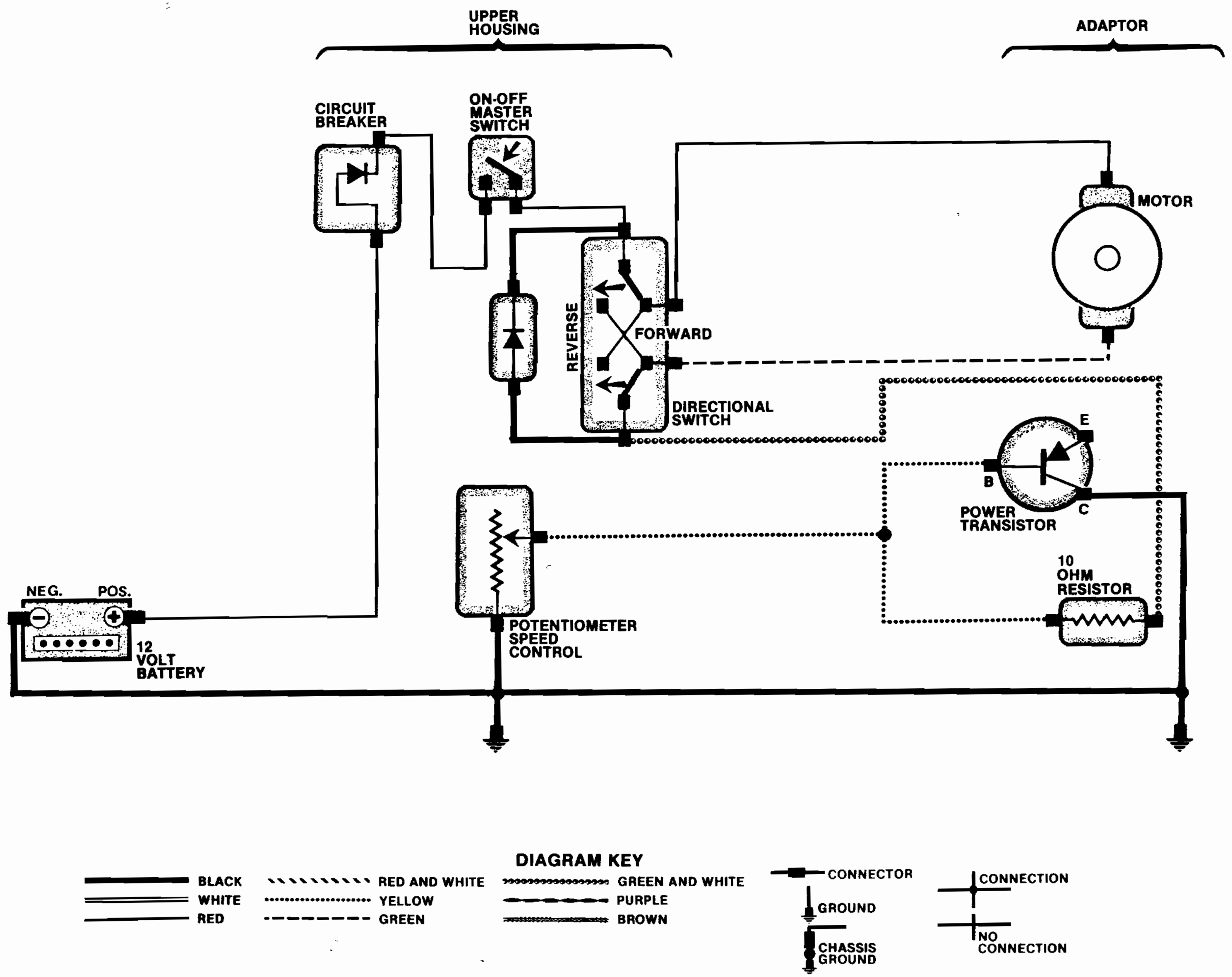
RED
RED AND PURPLE
ORANGE
BLACK AND ORANGE
BLUE AND WHITE
YELLOW
YELLOW AND BLACK
YELLOW AND GRAY
YELLOW AND RED
YELLOW AND BLUE
BLUE
PURPLE
PURPLE AND WHITE
BROWN
BROWN AND YELLOW
WHITE AND BLACK
GRAY
CONNECTOR
GROUND
CHASSIS GROUND
CONNECTION
NO CONNECTION

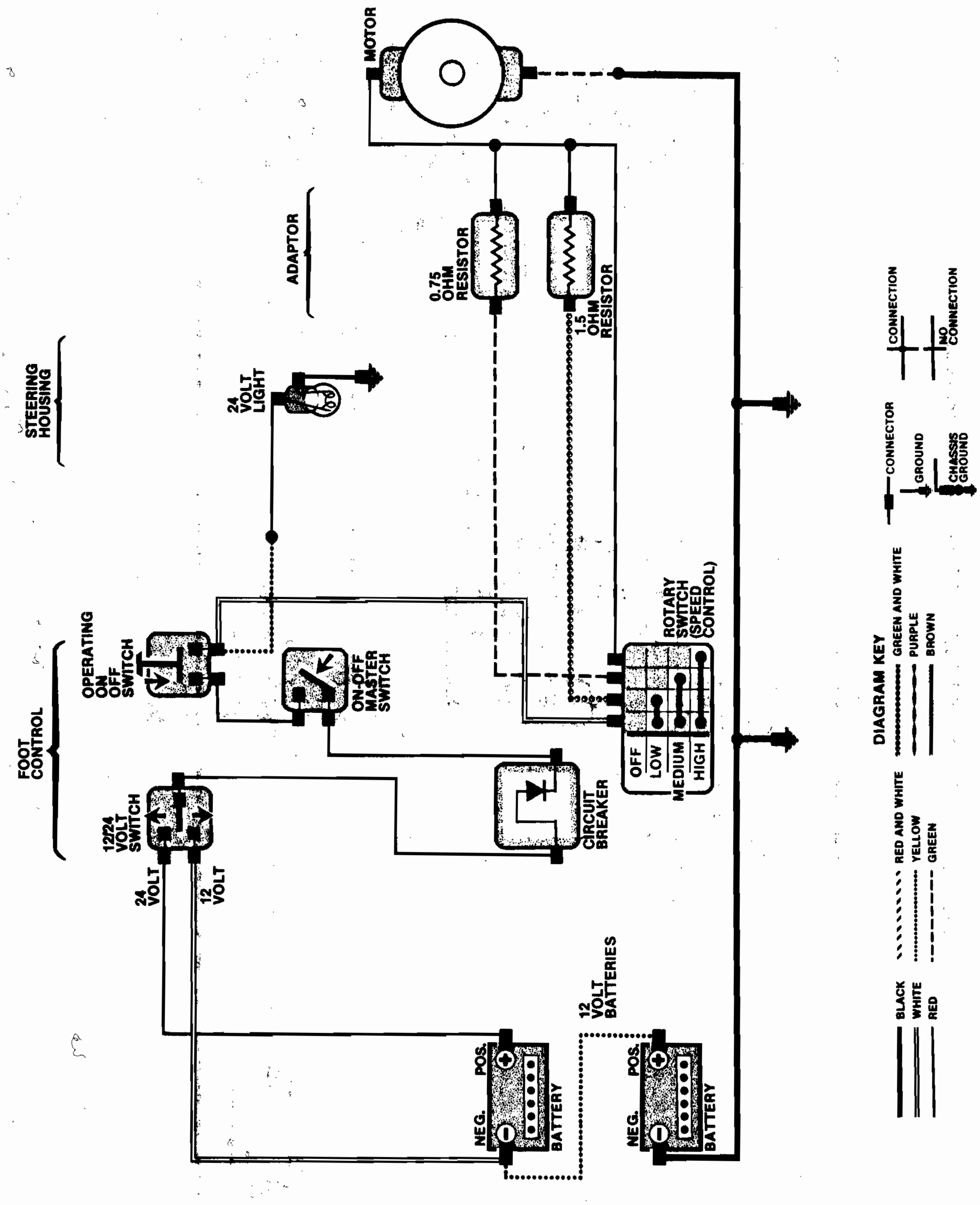
1975-1976 12V ELECTRICAL MOTOR (BOW-MOUNT)



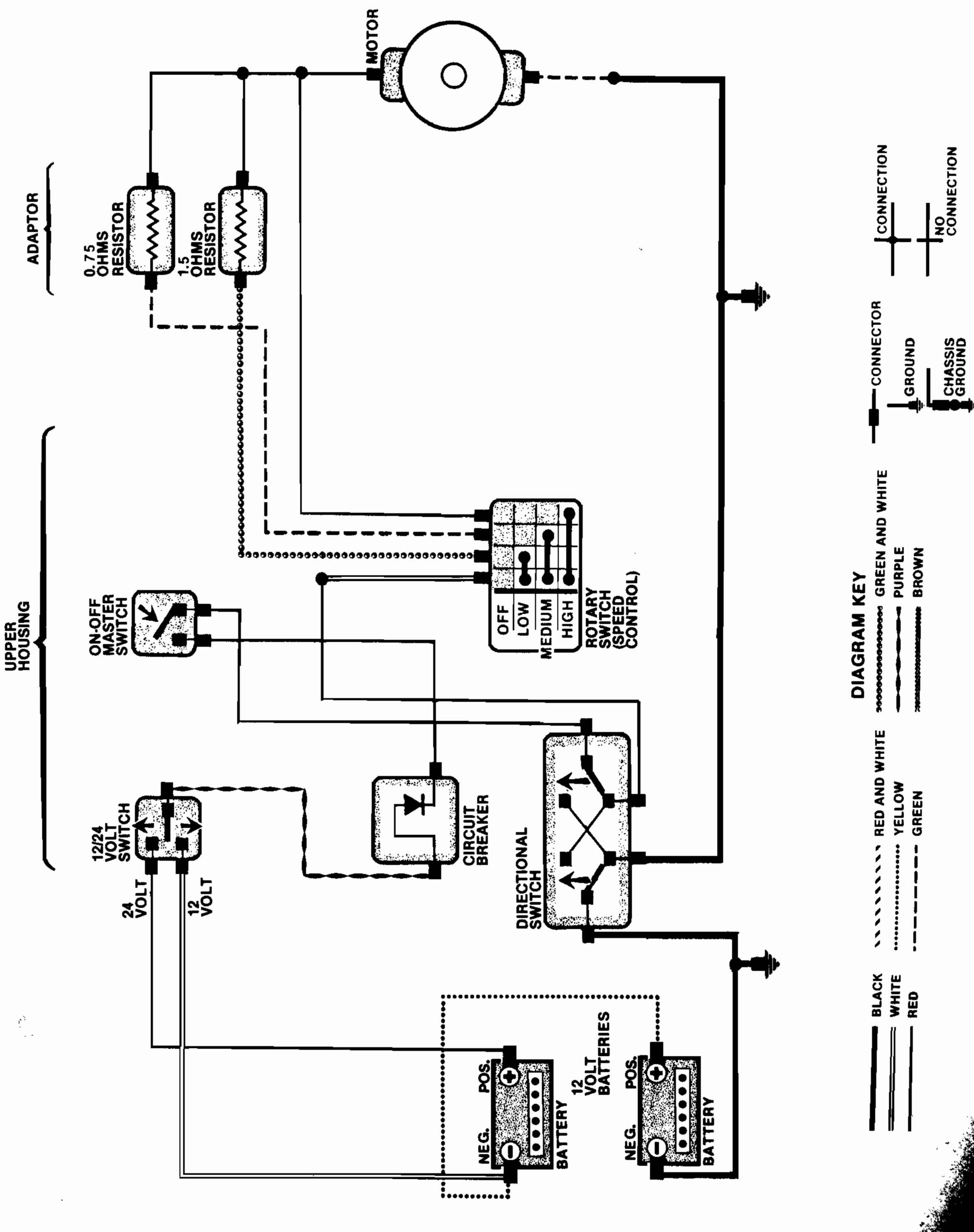
1975-1976 12V ELECTRICAL MOTOR (TRANSOM MOUNT)



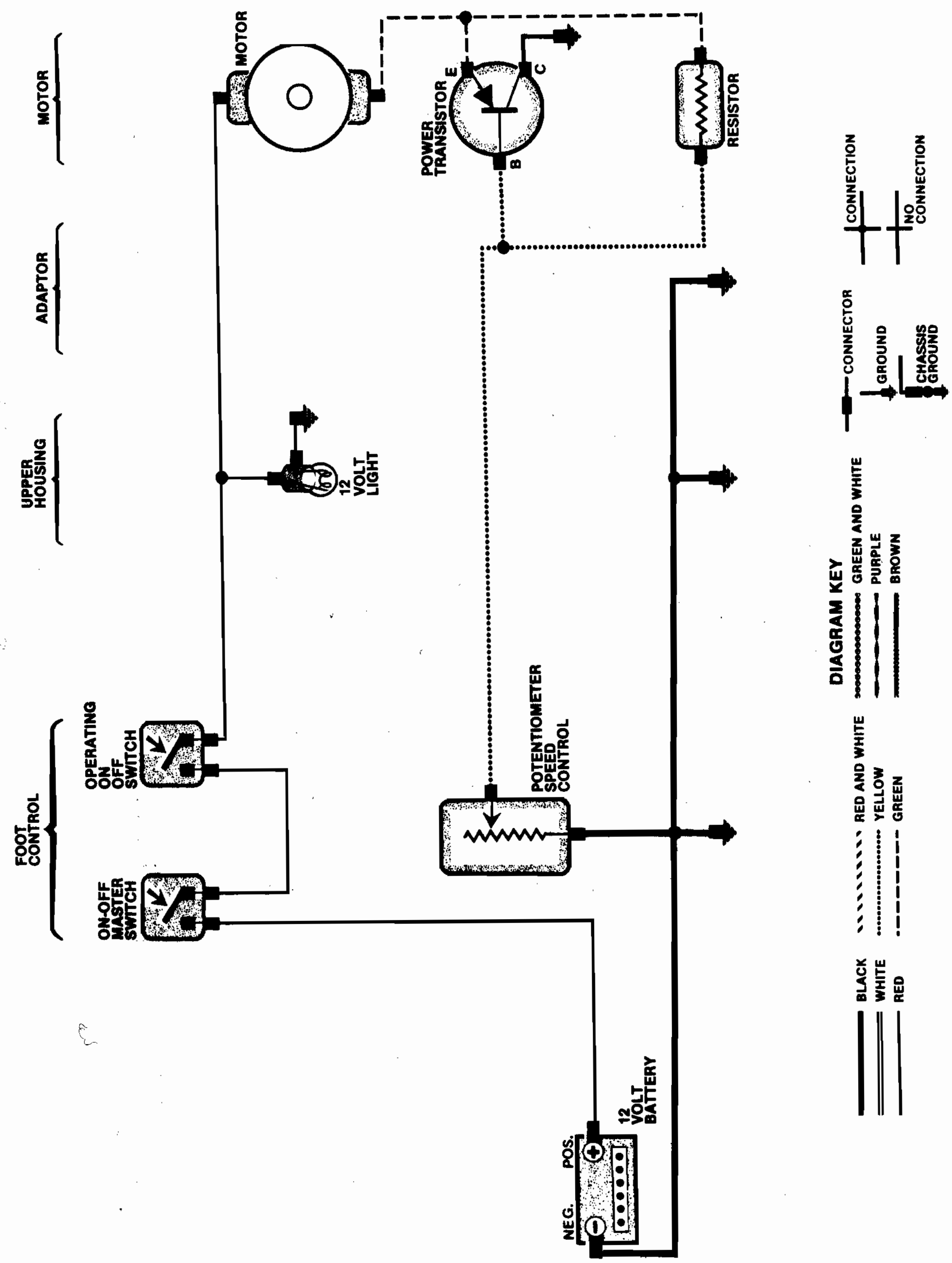
1975-1976 24V ELECTRICAL MOTOR (BOW-MOUNT)



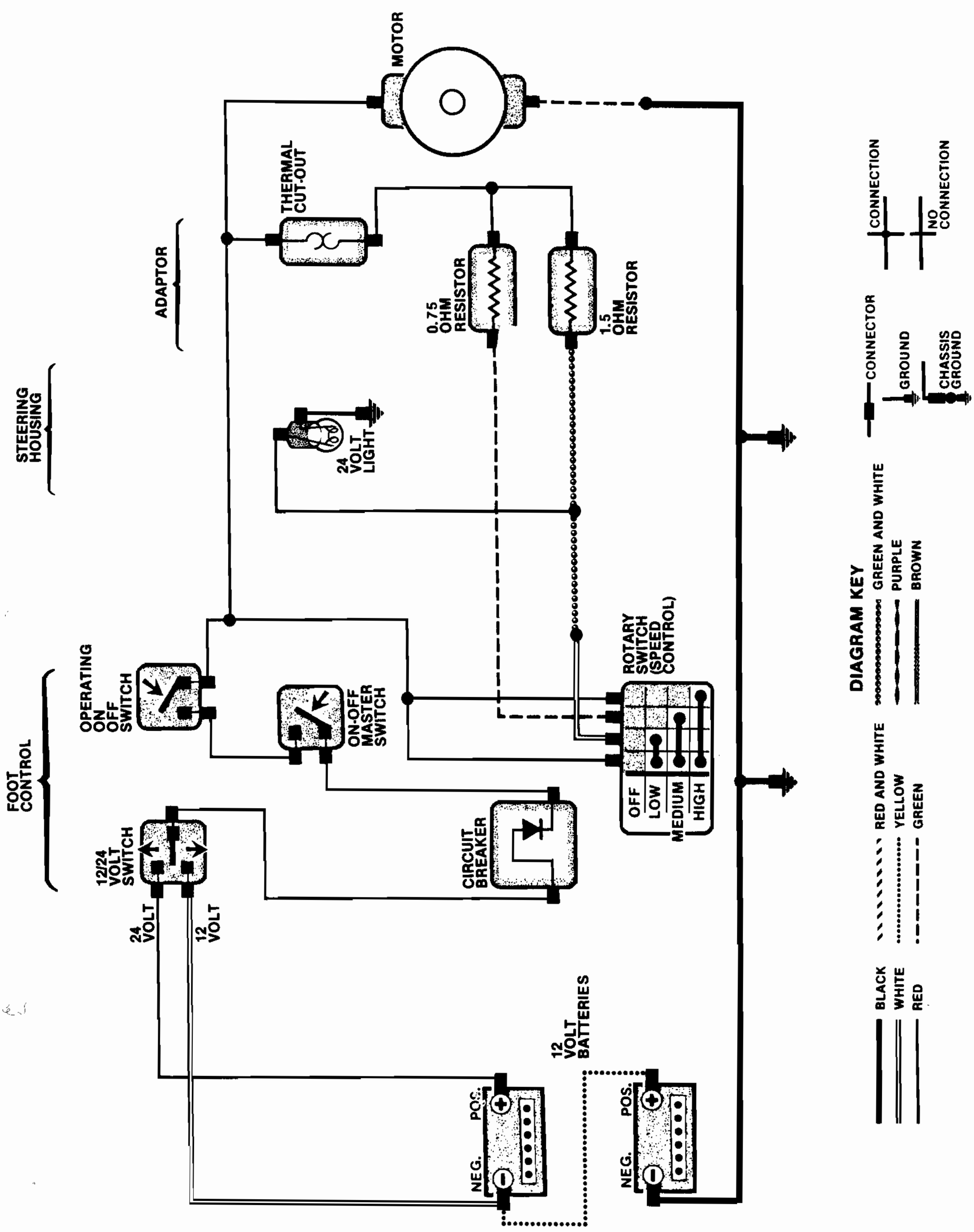
1975-1976 24V ELECTRICAL MOTOR (TRANSOM MOUNT)



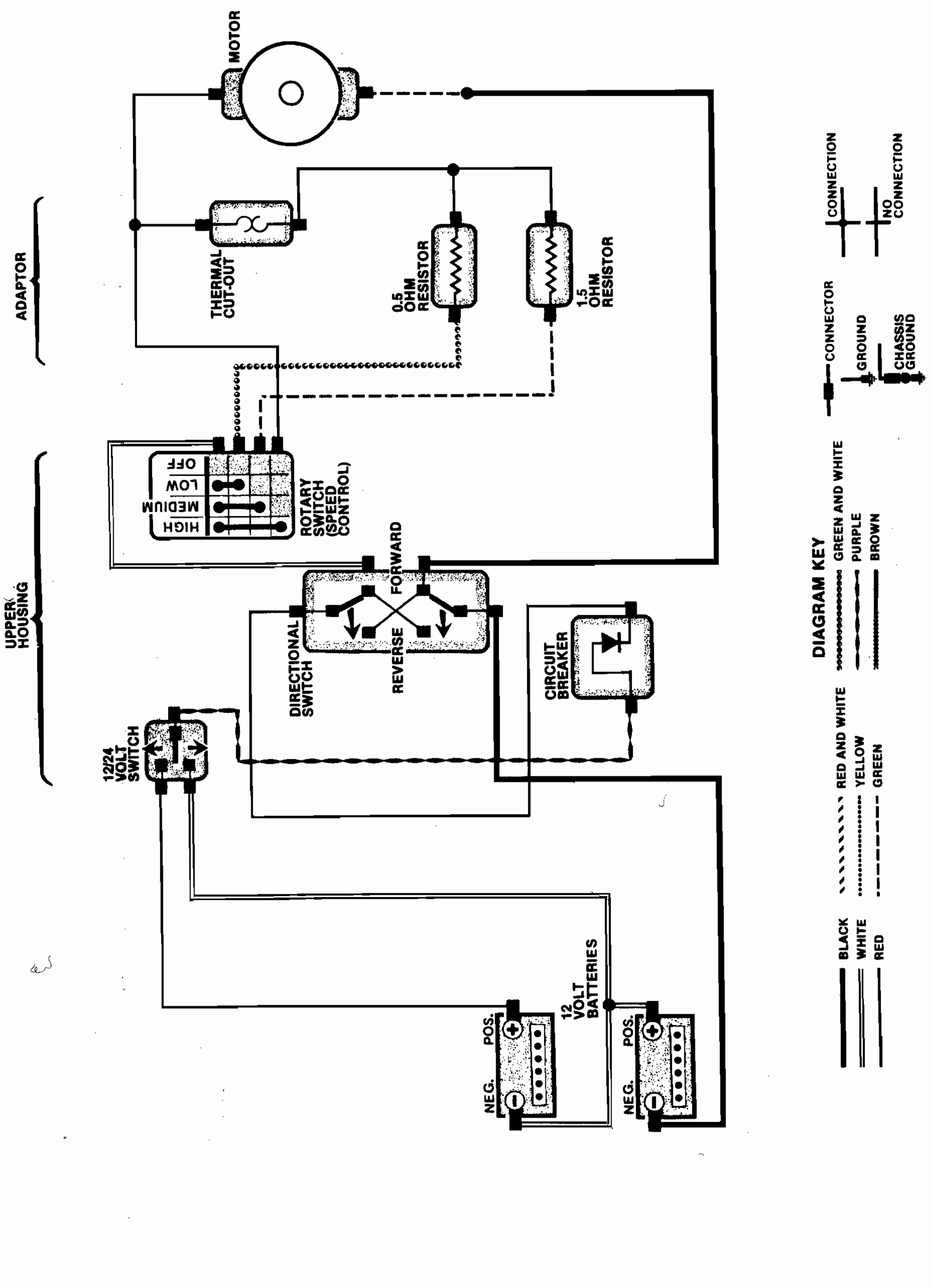
1977-1981 12V ELECTRICAL MOTOR (SPEED-FOOT CONTROLLED)



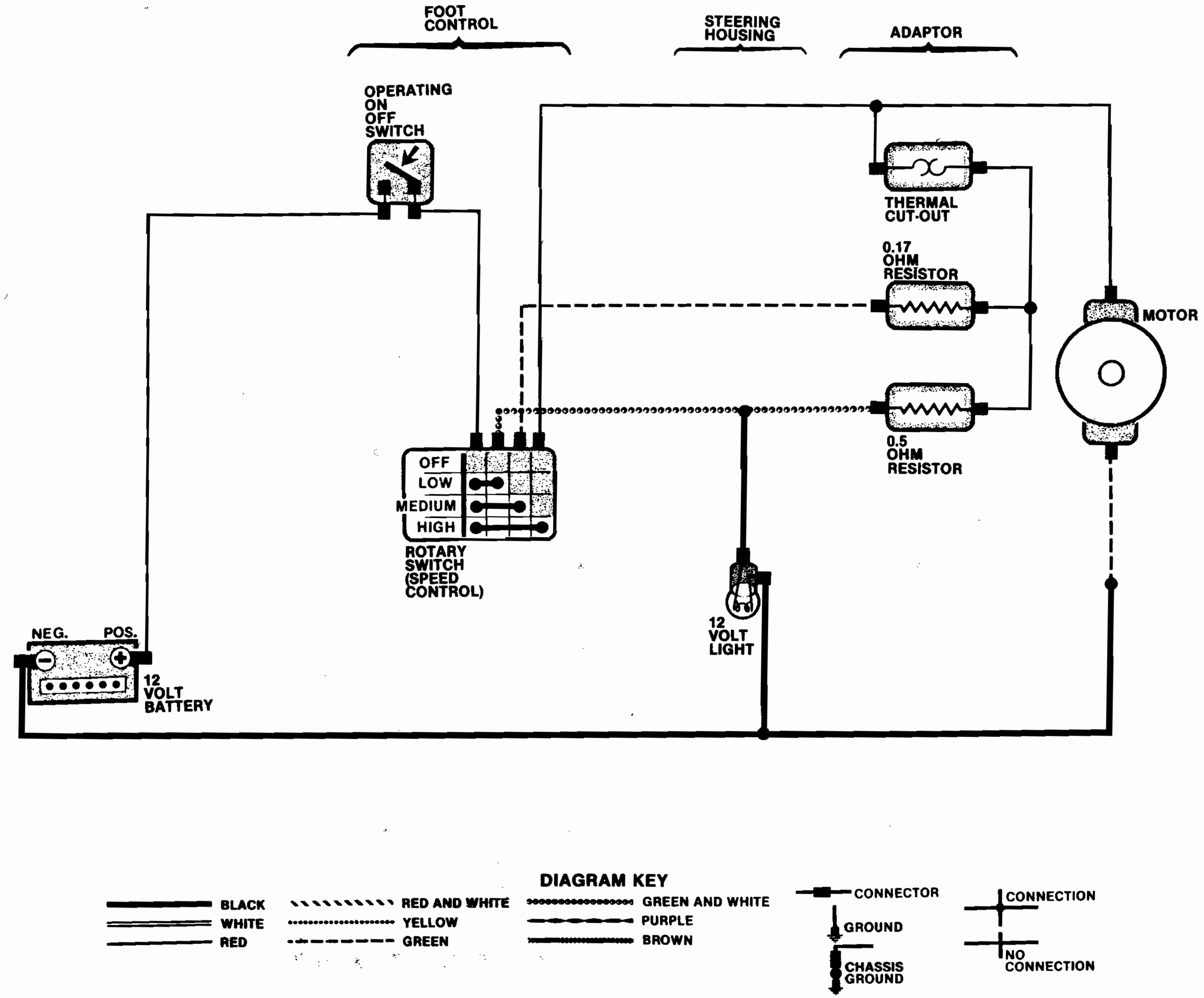
1977-1981 24V ELECTRICAL MOTOR (SPEED-FOOT CONTROLLED)



1980-1981 24V ELECTRICAL MOTOR (SPEED-FOOT CONTROLLED)



1982-ON 12V ELECTRICAL MOTOR (SPEED-FOOT/HAND CONTROLLED)



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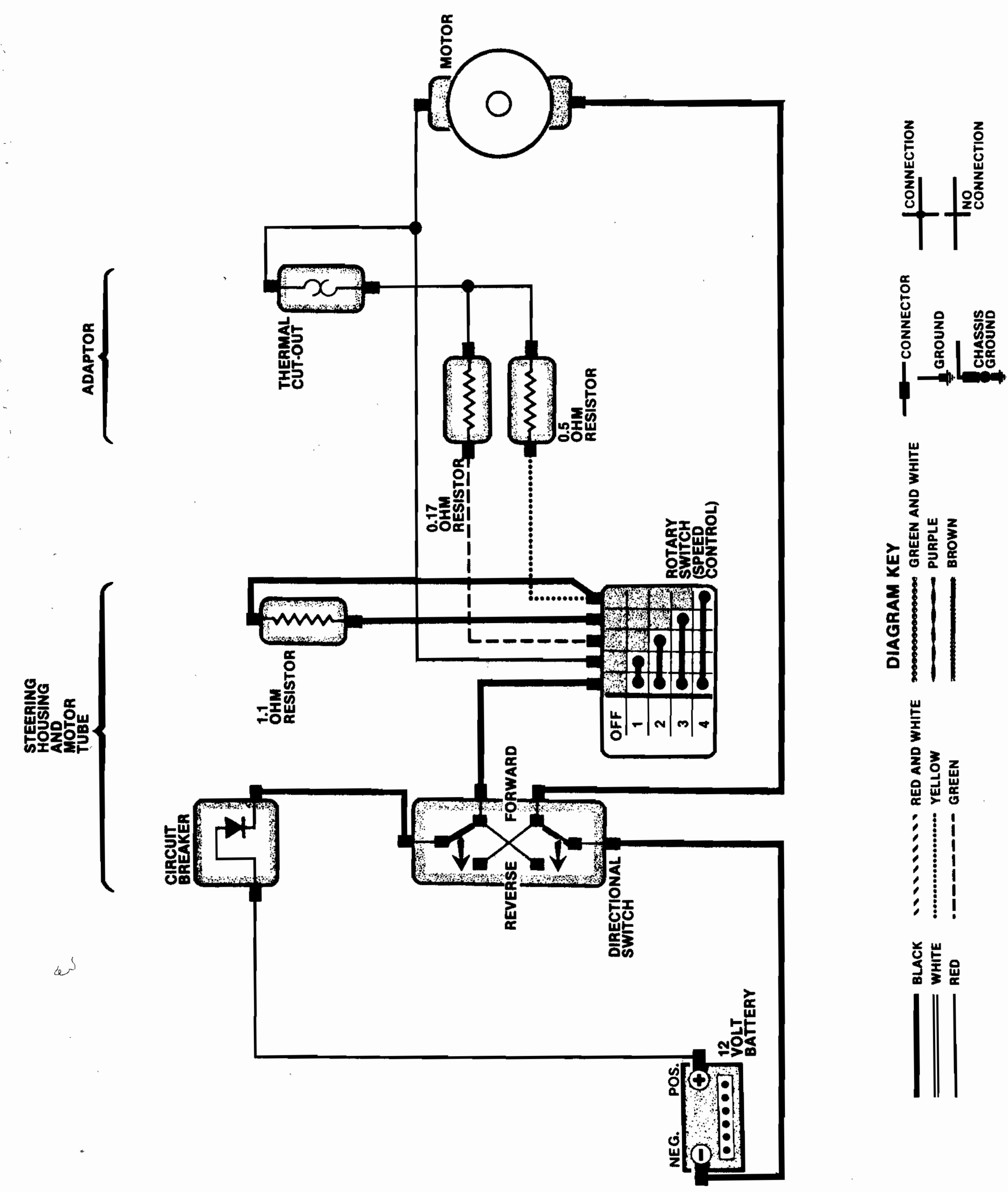
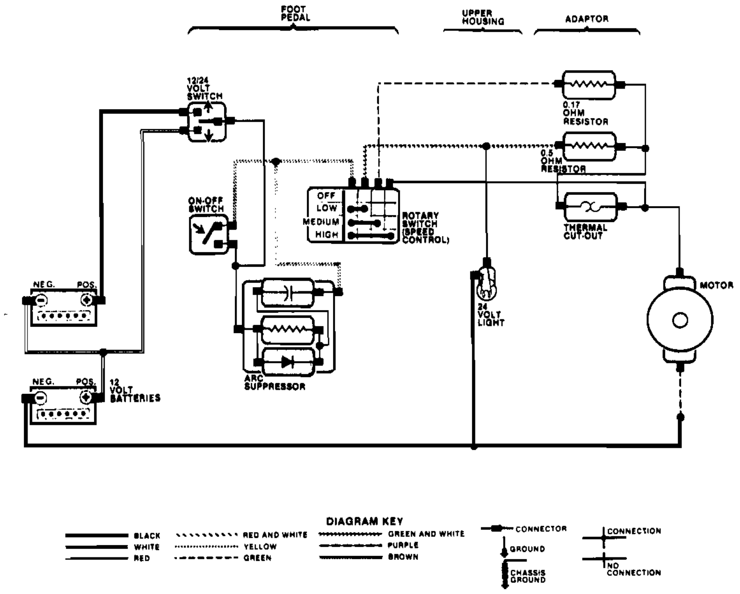
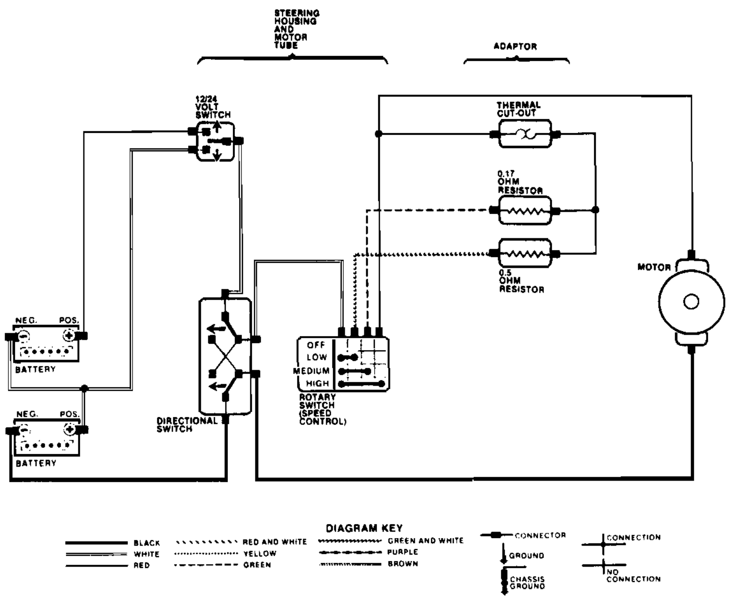
1982-ON 12V ELECTRICAL MOTOR (TRANSOM MOUNT)



1982-ON 12/24V ELECTRICAL MOTOR (SPEED-FOOT CONTROLLED)



1982-ON 12/24V ELECTRICAL MOTOR (SPEED-HAND CONTROLLED)



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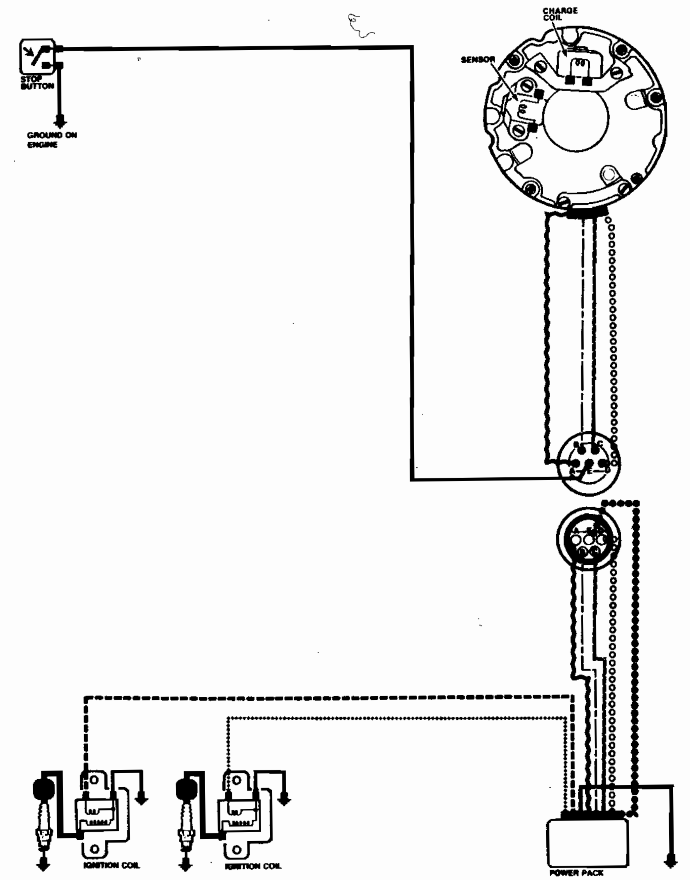
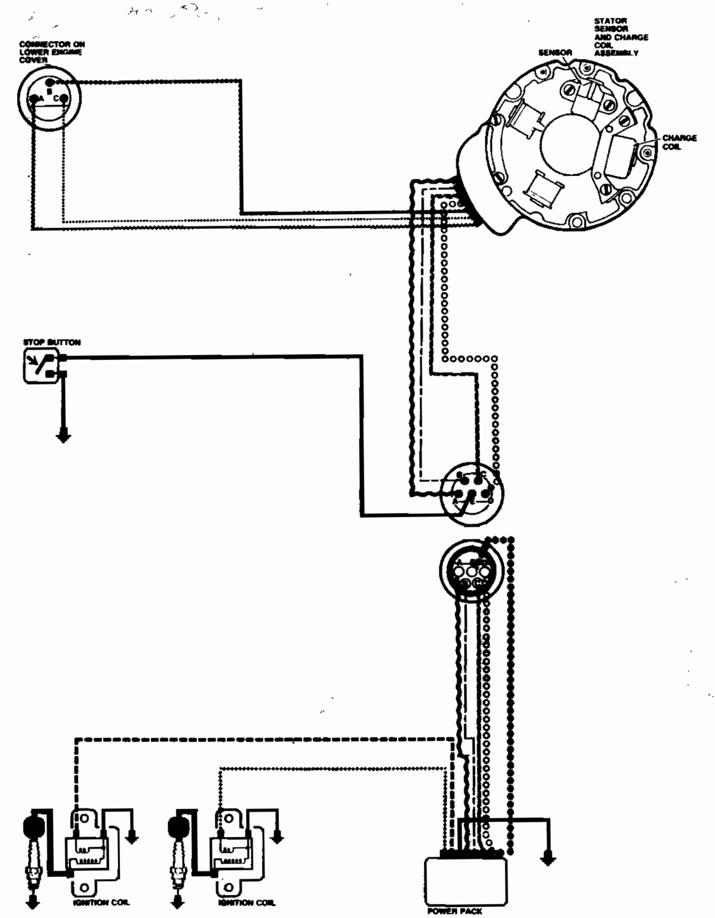
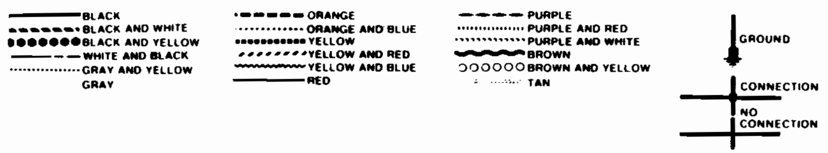


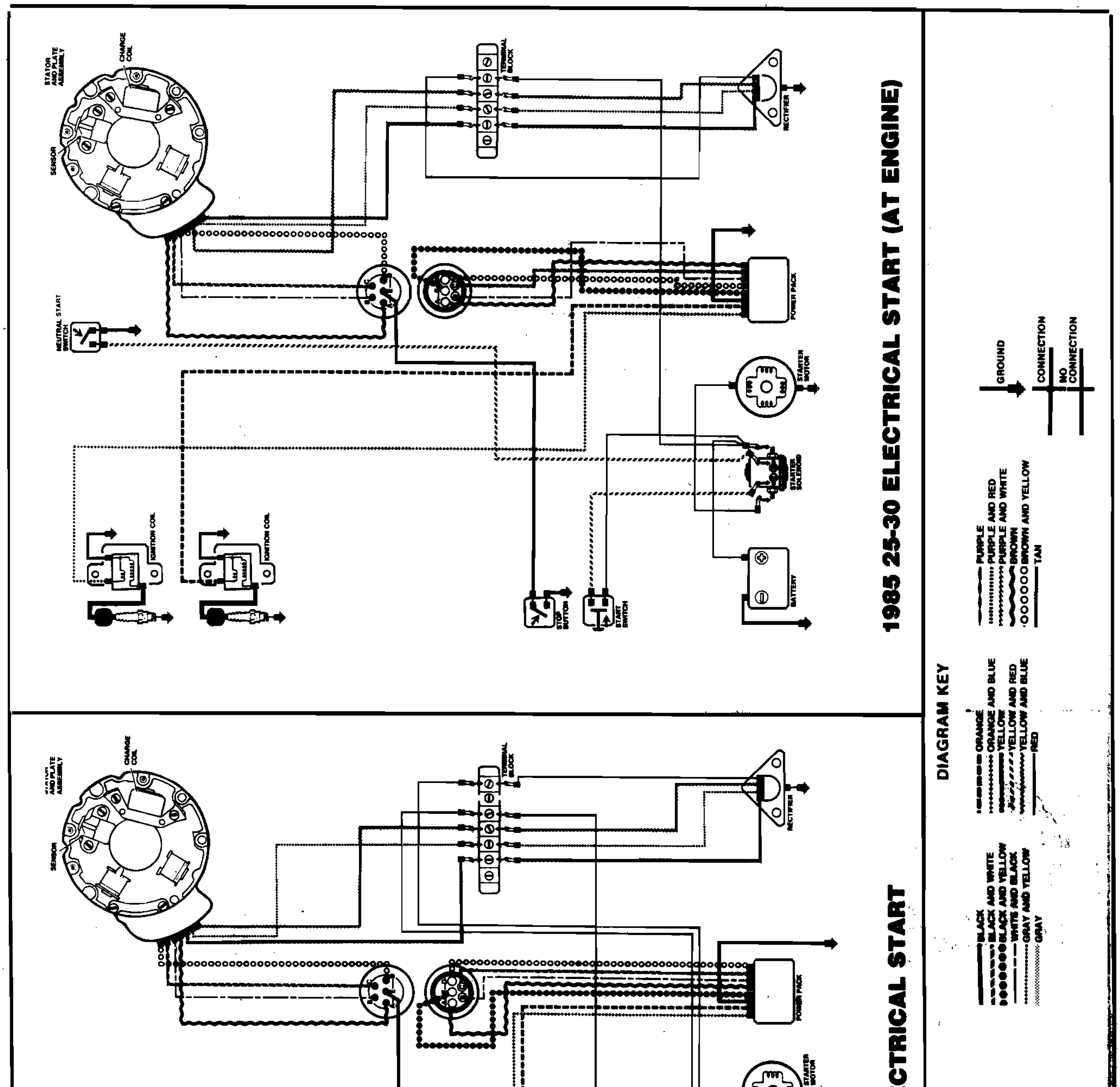
1985 4 DELUXE 40HP MANUAL START

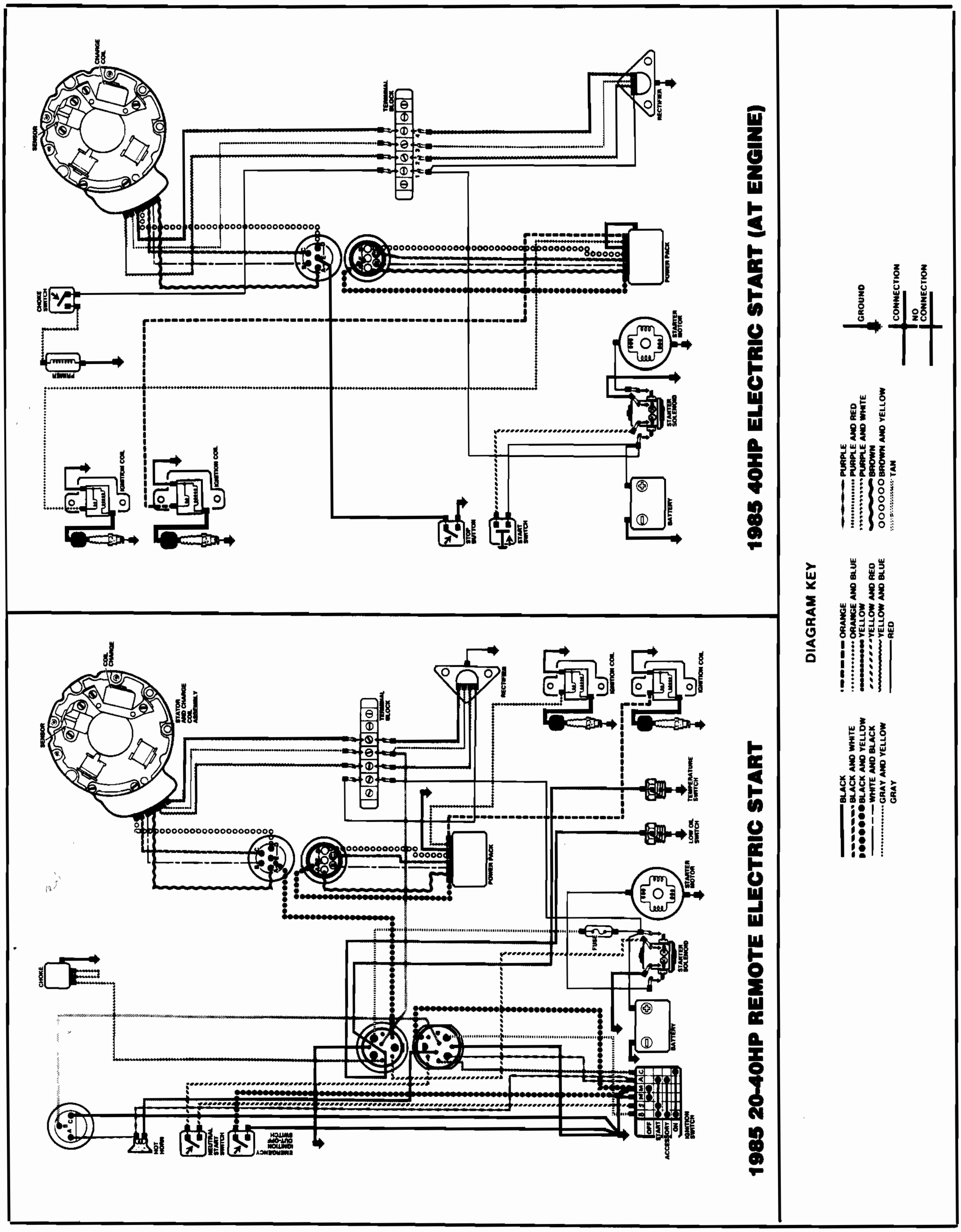


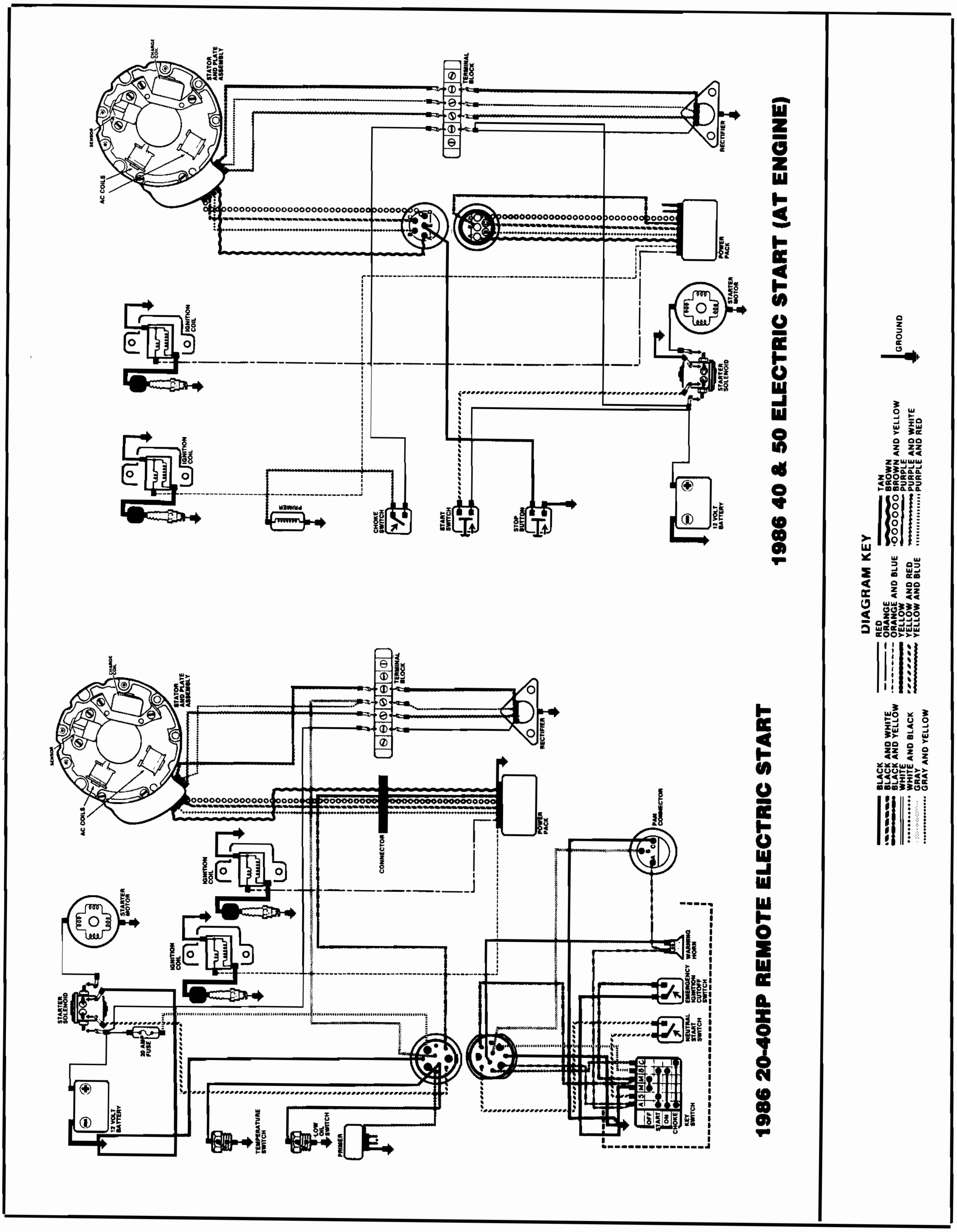
1985 5-40HP MANUAL START W/AC LIGHTING

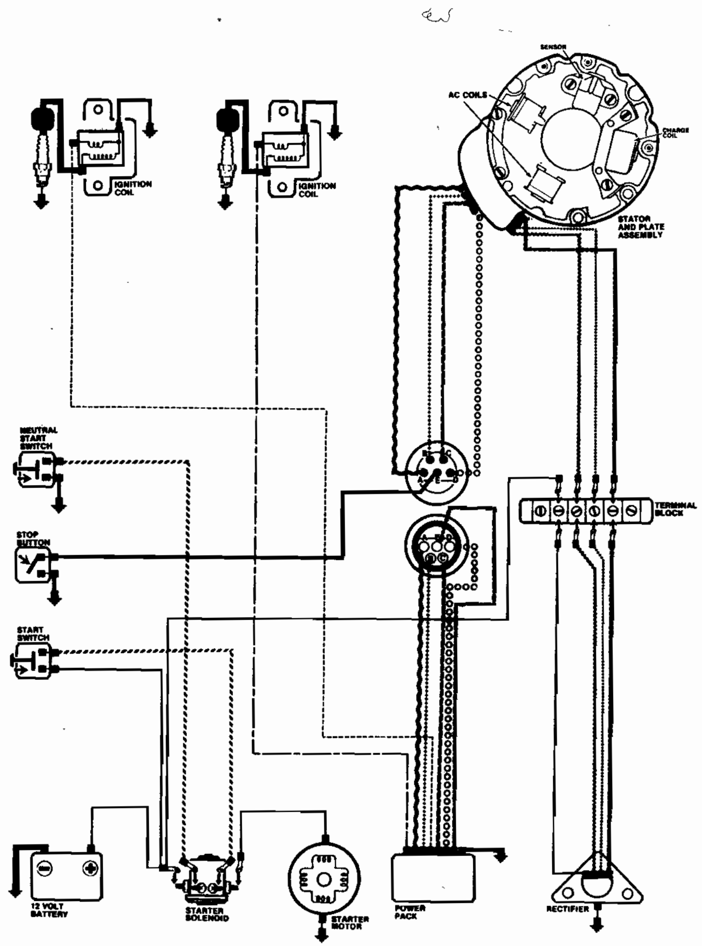
DIAGRAM KEY



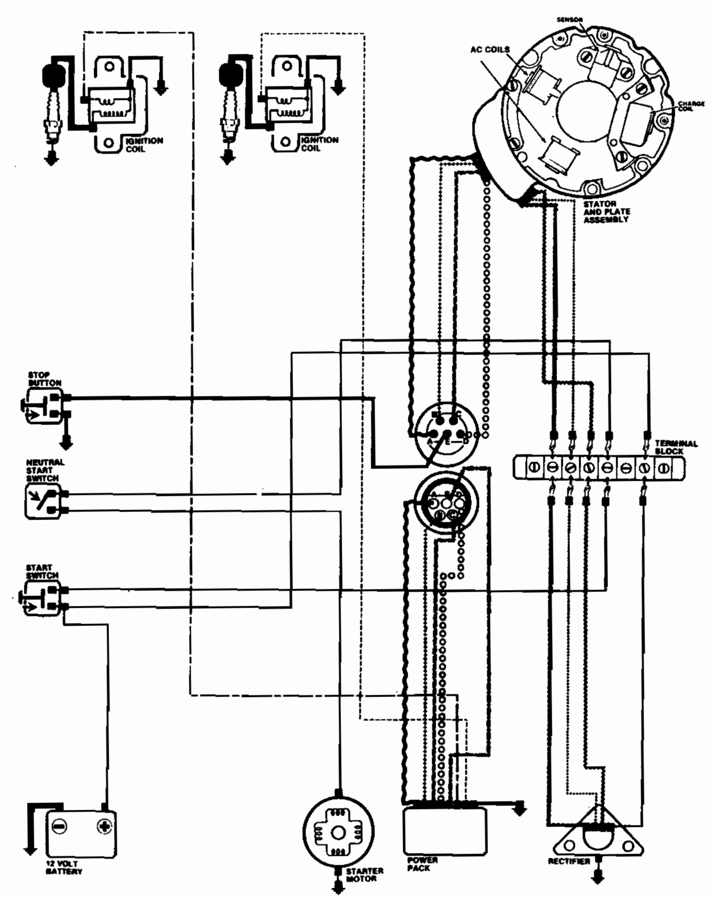

1985 25-30 ELECTRICAL START (AT ENGINE)
STATOR AND PLATE ASSEMBLY
CHARGE COIL
SENSOR
TERMINAL BLOCK
RECTIFIER
NEUTRAL START SWITCH
POWER PACK
STARTER MOTOR
STARTER SOLENOID
IGNITION COIL
BATTERY
STOP BUTTON
START SWITCH
1985 9.9-15 ELECTRICAL START
STATOR AND PLATE ASSEMBLY
CHARGE COIL
SENSOR
TERMINAL BLOCK
RECTIFIER
POWER PACK
STARTER MOTOR
START SWITCH
IGNITION COIL
BATTERY
STOP BUTTON
NEUTRAL START SWITCH
DIAGRAM KEY
BLACK
BLACK AND WHITE
BLACK AND YELLOW
WHITE AND BLACK
GRAY AND YELLOW
GRAY
ORANGE
ORANGE AND BLUE
YELLOW AND RED
YELLOW AND BLUE
RED
PURPLE
PURPLE AND RED
PURPLE AND WHITE
BROWN
BROWN AND YELLOW
TAN
GROUND
CONNECTION
NO CONNECTION


1985 40HP ELECTRIC START (AT ENGINE)
1985 20-40HP REMOTE ELECTRIC START
DIAGRAM KEY
BLACK
BLACK AND WHITE
BLACK AND YELLOW
WHITE AND BLACK
GRAY AND YELLOW
GRAY
ORANGE
ORANGE AND BLUE
YELLOW
YELLOW AND RED
YELLOW AND BLUE
RED
PURPLE
PURPLE AND RED
PURPLE AND WHITE
BROWN
BROWN AND YELLOW
TAN
GROUND
CONNECTION
NO CONNECTION
SENSOR
CHARGE COIL
TERMINAL BLOCK
RECTIFIER
POWER PACK
STARTER MOTOR
STARTER SOLENOID
BATTERY
IGNITION COIL
STOP BUTTON
START SWITCH
CHOKE SWITCH
PRIMER
STATOR AND CHARGE COIL ASSEMBLY
TEMPERATURE SWITCH
LOW OIL SWITCH
FUSE
CHOKE
IGNITION SWITCH
HOT HORN
NEUTRAL START SWITCH
EMERGENCY IGNITION CUT-OFF SWITCH


1986 40 & 50 ELECTRIC START (AT ENGINE)
STATOR AND PLATE ASSEMBLY
CHARGE COIL
SENSOR
AC COILS
TERMINAL BLOCK
RECTIFIER
POWER PACK
STARTER MOTOR
STARTER SOLENOID
IGNITION COIL
PRIMER
CHOKE SWITCH
START SWITCH
STOP BUTTON
12 VOLT BATTERY
1986 20-40HP REMOTE ELECTRIC START
CONNECTOR
TEMPERATURE SWITCH
LOW OIL SWITCH
20 AMP FUSE
WARNING HORN
EMERGENCY IGNITION CUTOFF SWITCH
NEUTRAL START SWITCH
KEY SWITCH
OFF
START
ON
CHOKE
DIAGRAM KEY
BLACK
BLACK AND WHITE
BLACK AND YELLOW
WHITE
WHITE AND BLACK
GRAY
GRAY AND YELLOW
RED
ORANGE
ORANGE AND BLUE
YELLOW
YELLOW AND RED
YELLOW AND BLUE
TAN
BROWN
BROWN AND YELLOW
PURPLE
PURPLE AND WHITE
PURPLE AND RED
GROUND

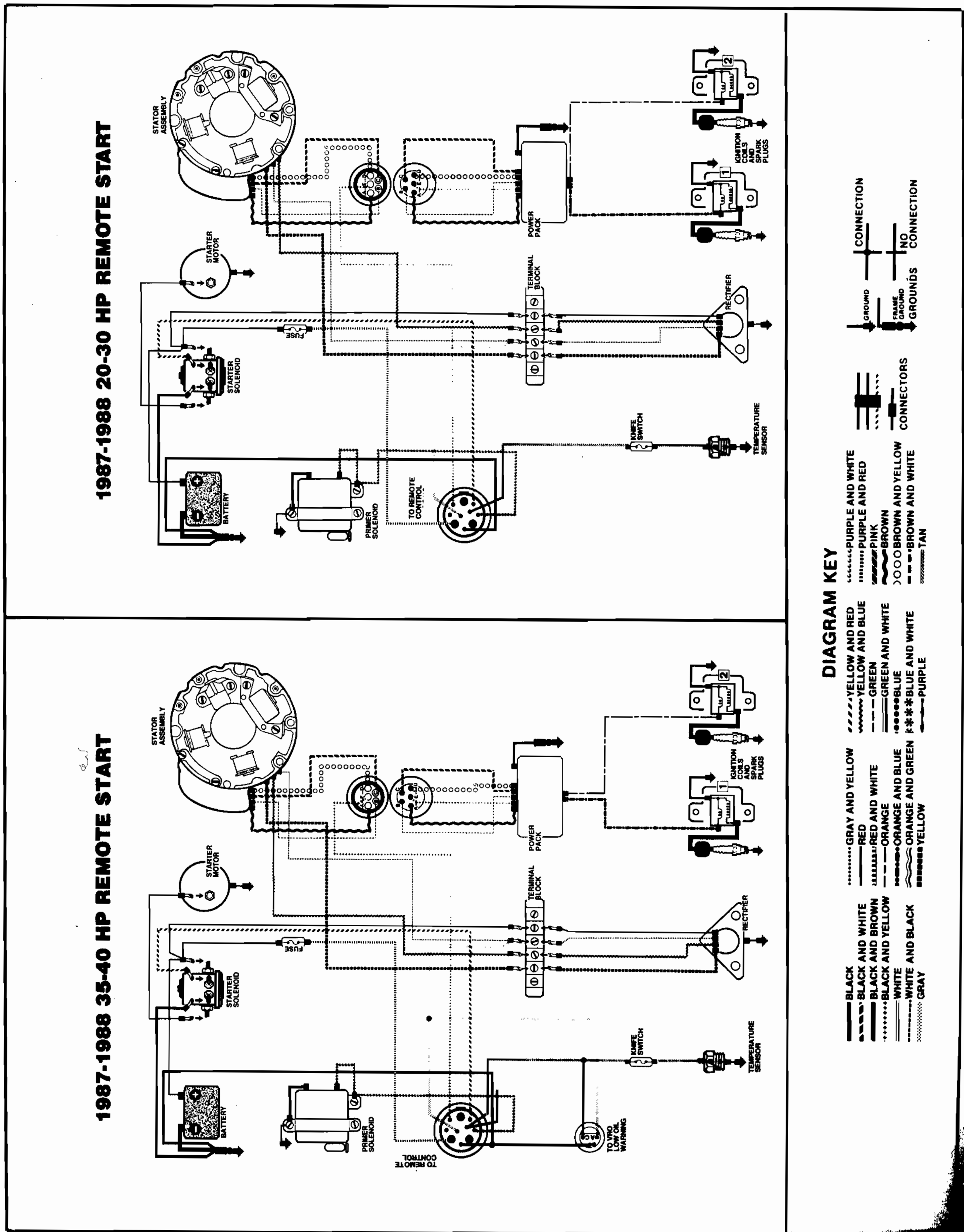


1986 25 & 30 ELECTRIC START (AT ENGINE)

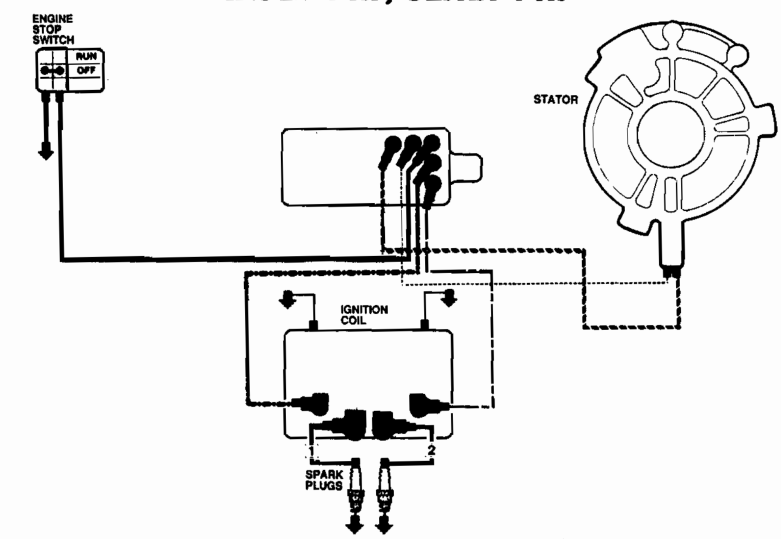


1986 9.9 & 15 ELECTRIC START

DIAGRAM KEY


1987-1988 20-30 HP REMOTE START
STATOR ASSEMBLY
STARTER MOTOR
FUSE
STARTER SOLENOID
BATTERY
PRIMER SOLENOID
TO REMOTE CONTROL
TERMINAL BLOCK
POWER PACK
RECTIFIER
KNIFE SWITCH
TEMPERATURE SENSOR
IGNITION COILS AND SPARK PLUGS
1987-1988 35-40 HP REMOTE START
STATOR ASSEMBLY
STARTER MOTOR
FUSE
STARTER SOLENOID
BATTERY
PRIMER SOLENOID
TO REMOTE CONTROL
TO VRO LOW OIL WARNING
TERMINAL BLOCK
POWER PACK
RECTIFIER
KNIFE SWITCH
TEMPERATURE SENSOR
IGNITION COILS AND SPARK PLUGS
DIAGRAM KEY
BLACK
BLACK AND WHITE
BLACK AND BROWN
BLACK AND YELLOW
WHITE
WHITE AND BLACK
GRAY
GRAY AND YELLOW
RED
RED AND WHITE
ORANGE
ORANGE AND BLUE
ORANGE AND GREEN
YELLOW
YELLOW AND RED
YELLOW AND BLUE
GREEN
GREEN AND WHITE
BLUE
BLUE AND WHITE
PURPLE
PURPLE AND WHITE
PURPLE AND RED
PINK
BROWN
BROWN AND YELLOW
BROWN AND WHITE
TAN
CONNECTORS
GROUND
FRAME GROUND
GROUNDS
CONNECTION
NO CONNECTION

1987-1990 2.5 HP, 3 HP, EXCEL 4 HP, ULTRA 4 HP



1987-1990 REMOTE CONTROL

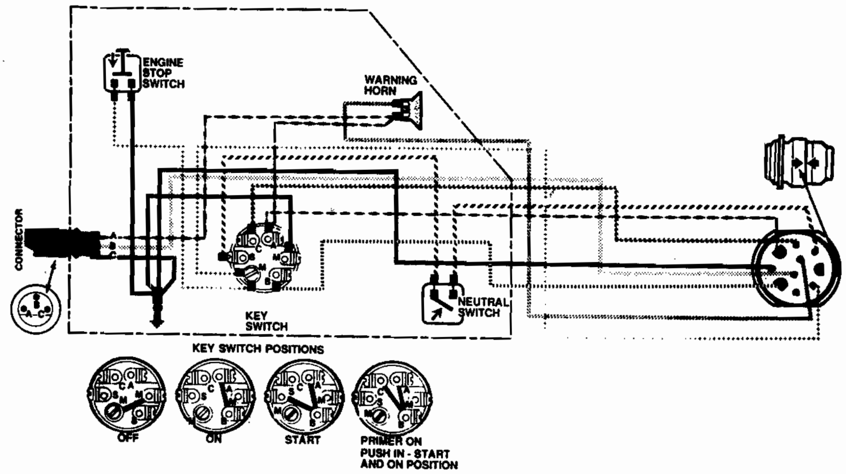


DIAGRAM KEY

- BLACK
- BLACK AND WHITE
- BLACK AND BROWN
- BLACK AND YELLOW
- WHITE
- WHITE AND BLACK
- GRAY
- GRAY AND YELLOW
- RED
- RED AND WHITE
- ORANGE
- ORANGE AND BLUE
- ORANGE AND GREEN
- YELLOW
- YELLOW AND RED
- YELLOW AND BLUE
- GREEN
- GREEN AND WHITE
- BLUE
- BLUE AND WHITE
- PURPLE
- PURPLE AND WHITE
- PURPLE AND RED
- PINK
- BROWN
- BROWN AND YELLOW
- BROWN AND WHITE
- TAN
- CONNECTORS
- GROUND
- FRAME GROUND
- GROUNDS
- CONNECTION
- NO CONNECTION

1987-1988 4 HP DELUXE — 40 HP MANUAL START

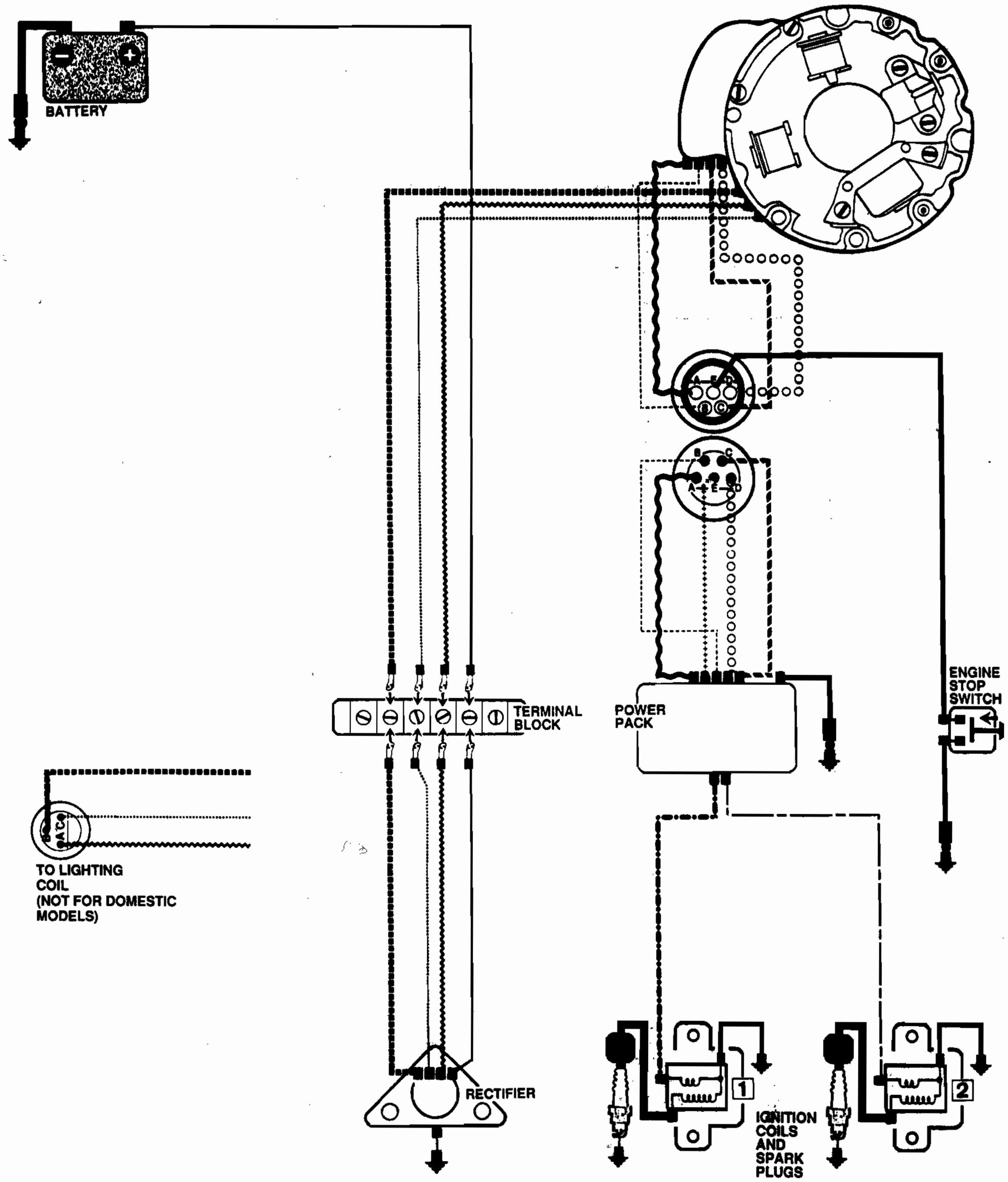
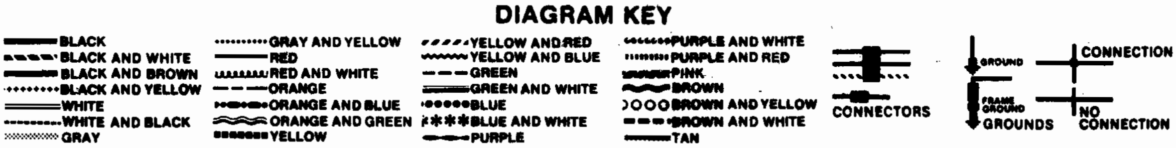
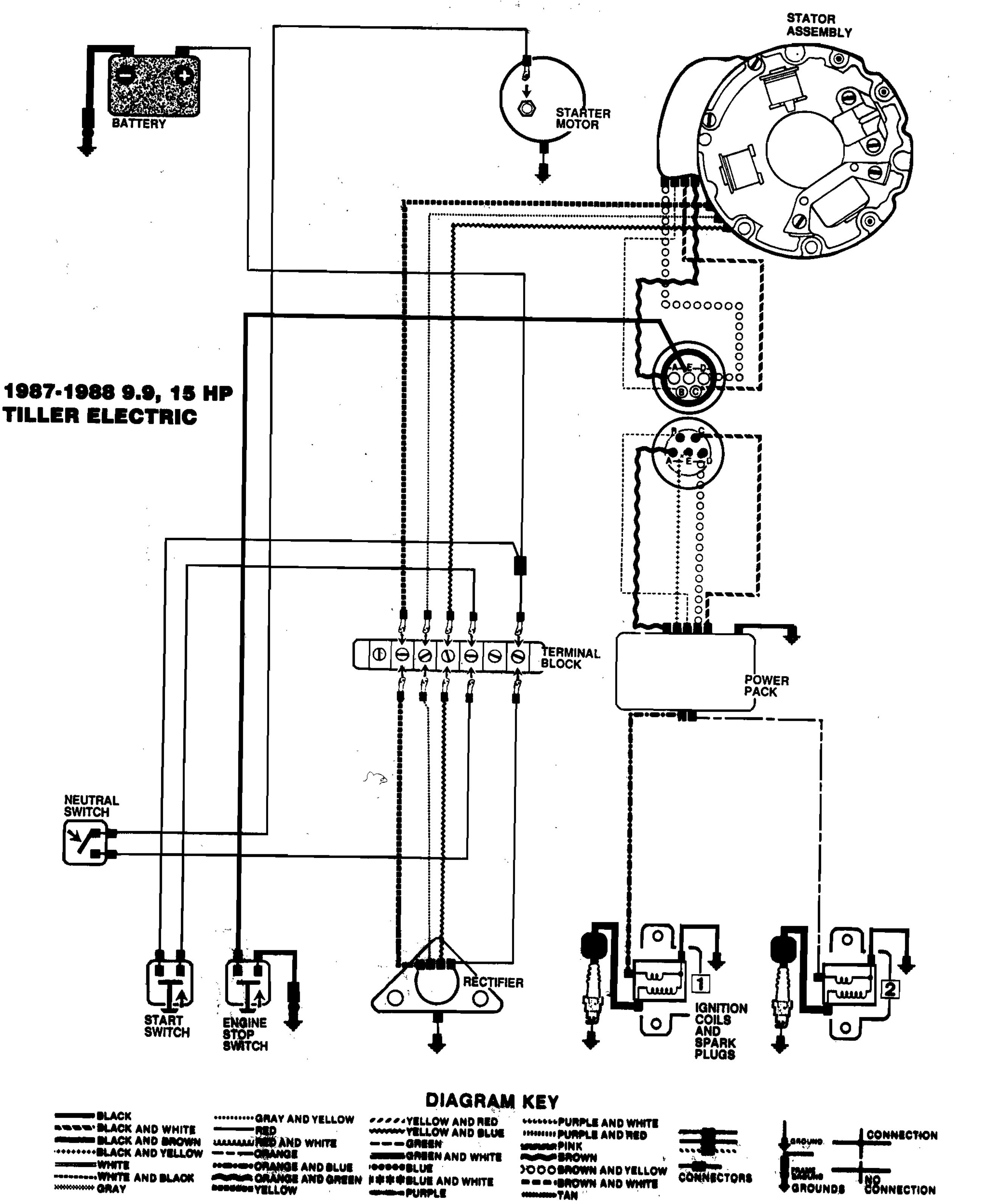
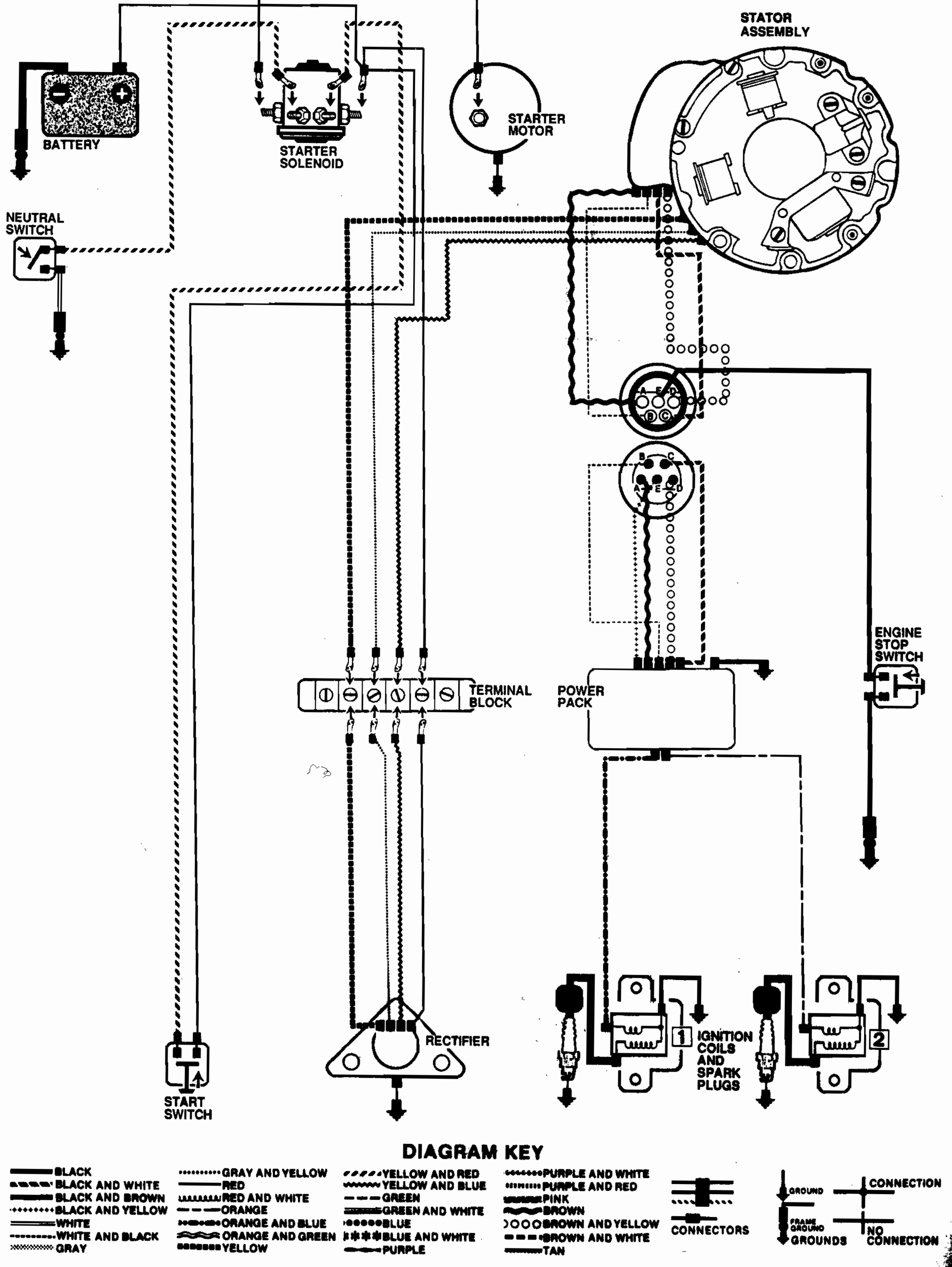


DIAGRAM KEY

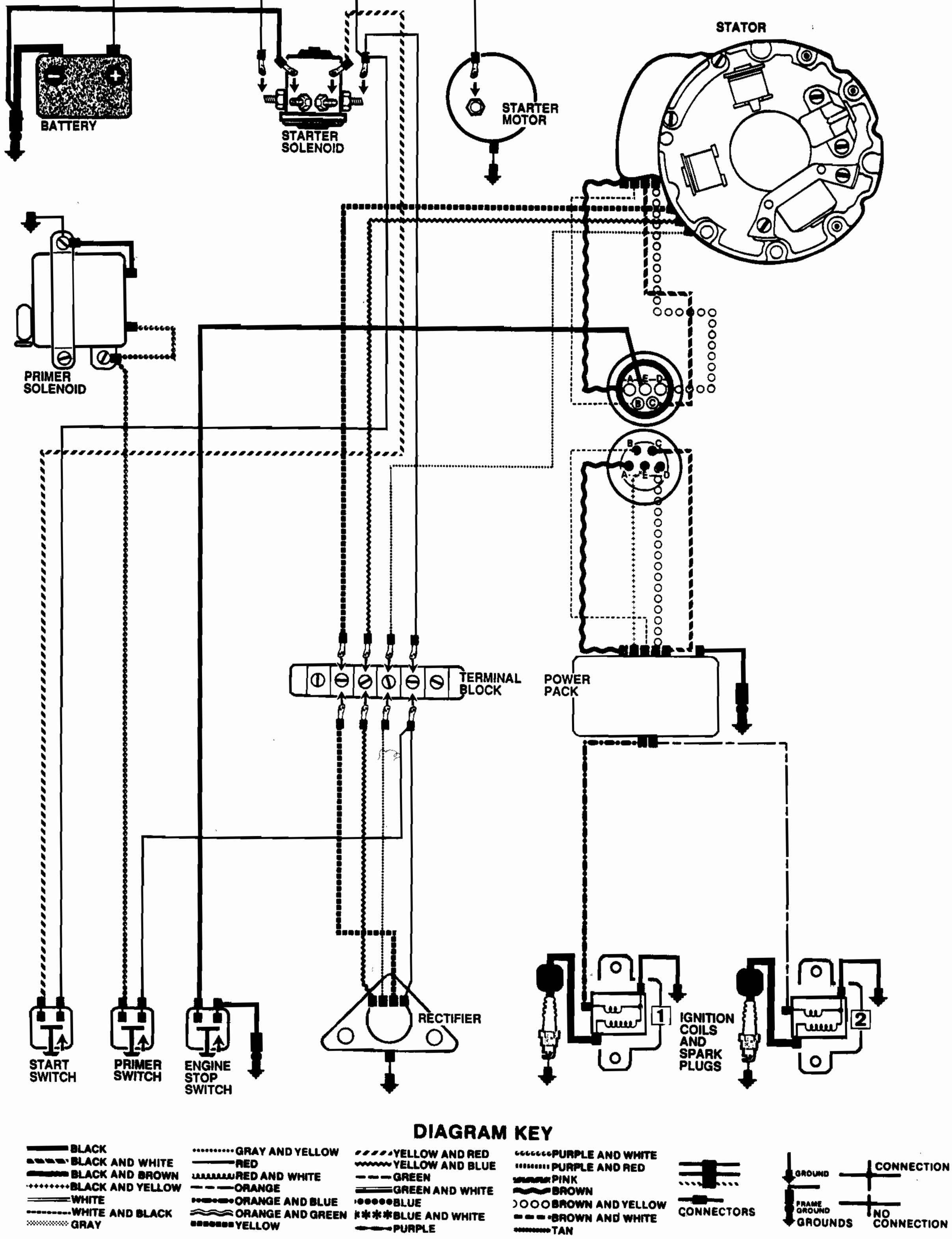



STATOR ASSEMBLY
STARTER MOTOR
BATTERY
1987-1988 9.9, 15 HP TILLER ELECTRIC
TERMINAL BLOCK
POWER PACK
NEUTRAL SWITCH
START SWITCH
ENGINE STOP SWITCH
RECTIFIER
IGNITION COILS AND SPARK PLUGS
1
2
DIAGRAM KEY
BLACK
BLACK AND WHITE
BLACK AND BROWN
BLACK AND YELLOW
WHITE
WHITE AND BLACK
GRAY
GRAY AND YELLOW
RED
RED AND WHITE
ORANGE
ORANGE AND BLUE
ORANGE AND GREEN
YELLOW
YELLOW AND RED
YELLOW AND BLUE
GREEN
GREEN AND WHITE
BLUE
BLUE AND WHITE
PURPLE
PURPLE AND WHITE
PURPLE AND RED
PINK
BROWN
BROWN AND YELLOW
BROWN AND WHITE
TAN
CONNECTORS
GROUND
FRAME GROUND
GROUNDS
CONNECTION
NO CONNECTION

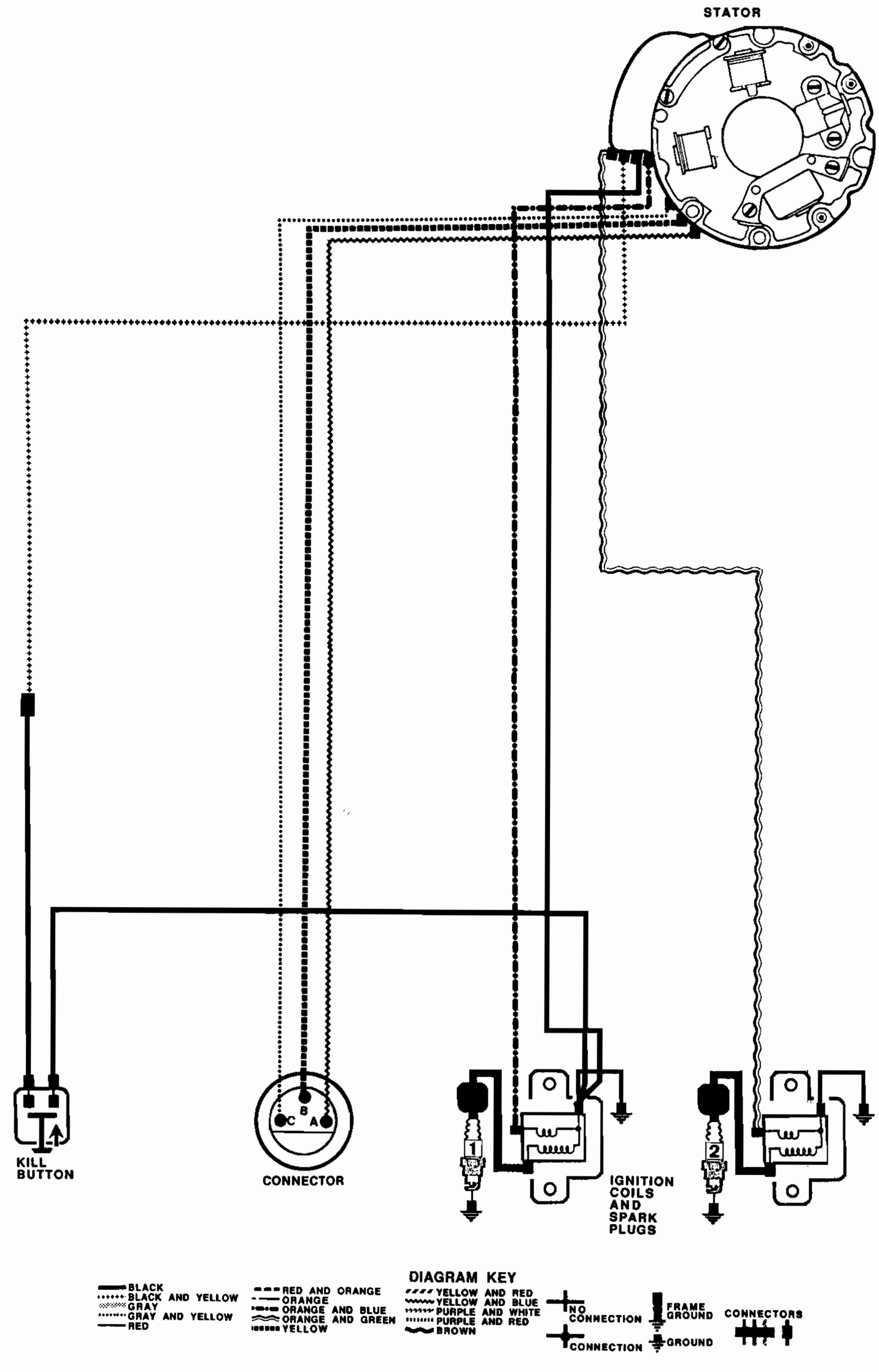
1987-1988 20-30 HP TILLER ELECTRIC



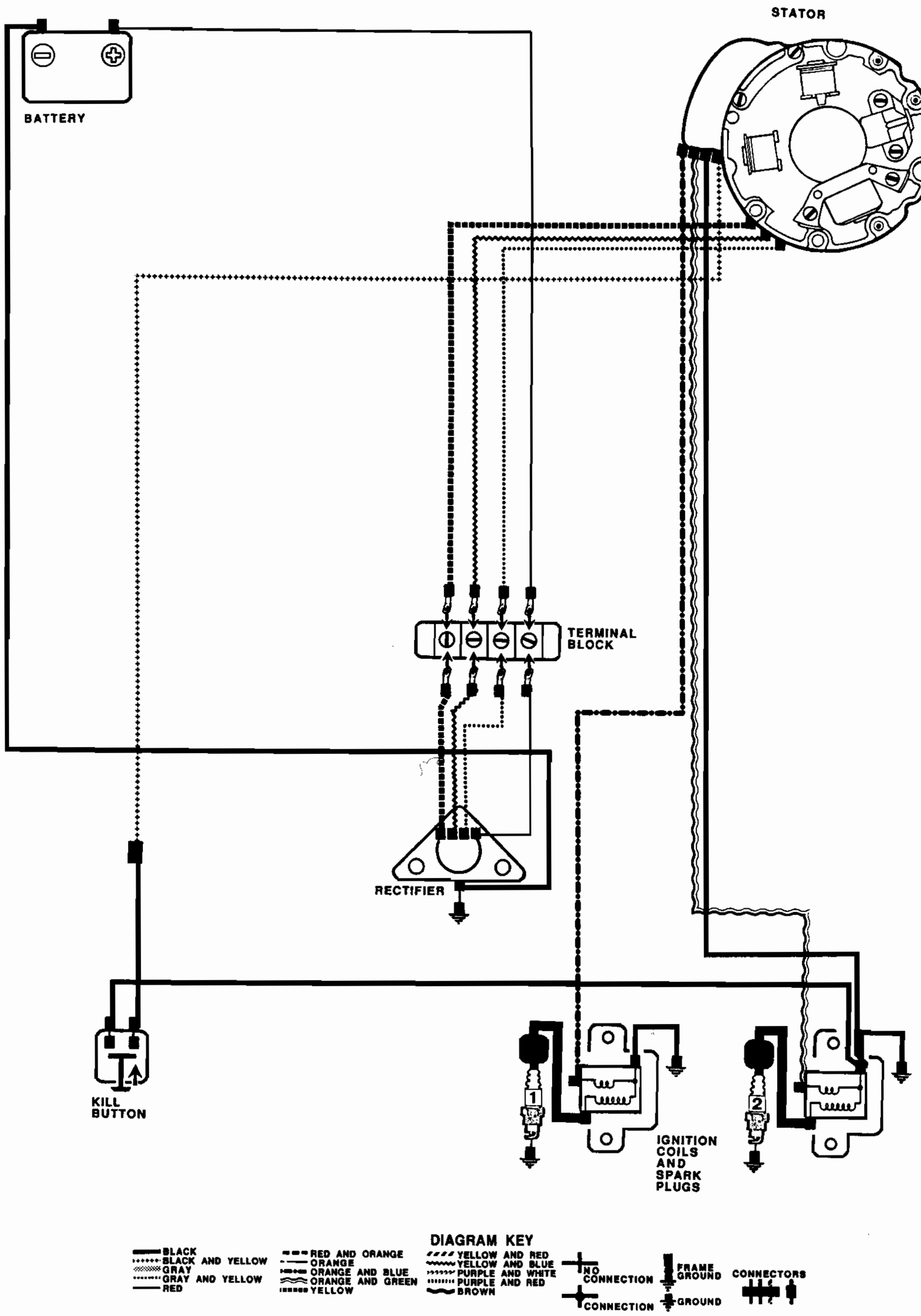
1987-1988 40 HP TILLER ELECTRIC



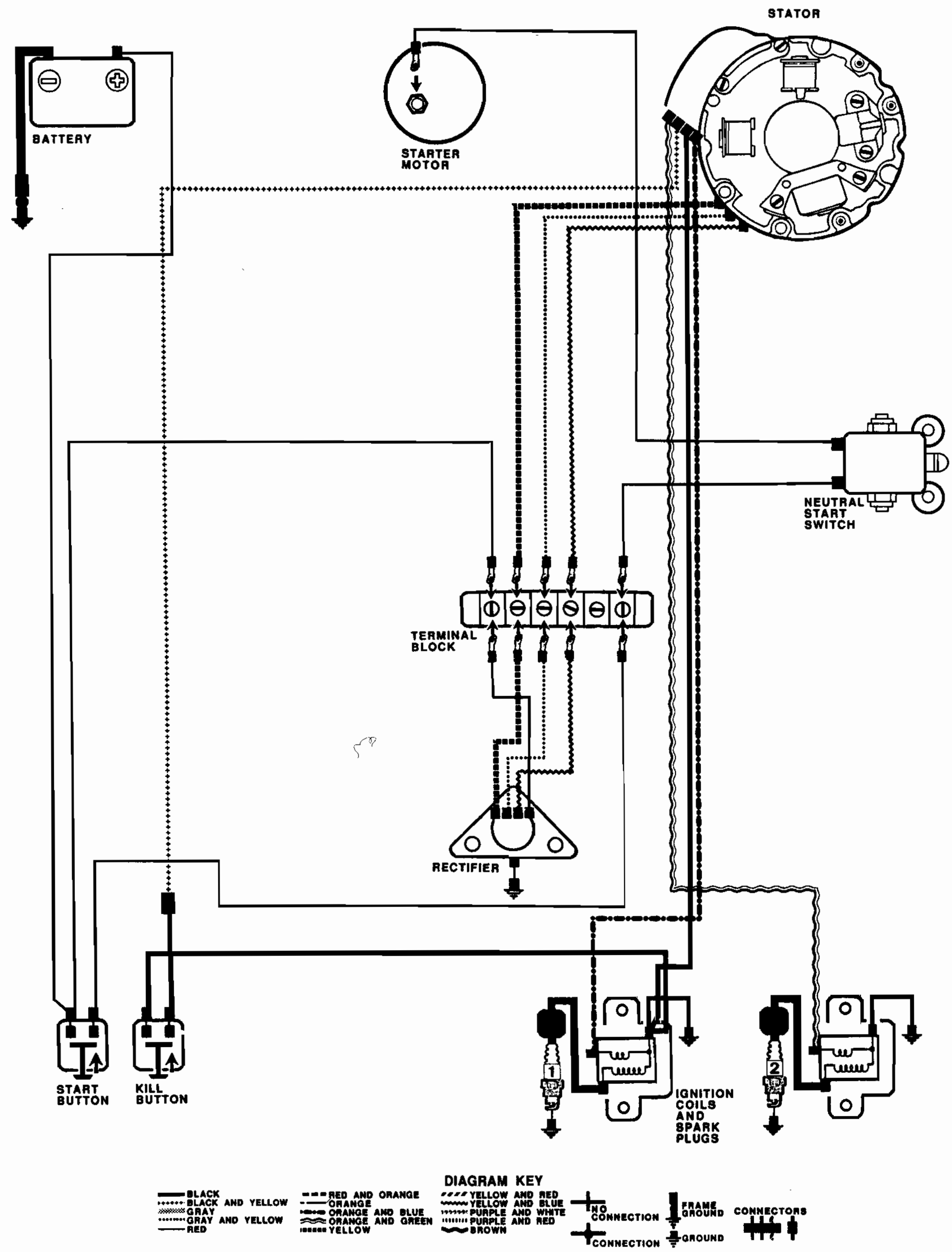
1989-1990 MANUAL START WITH AC LIGHTING CONNECTOR



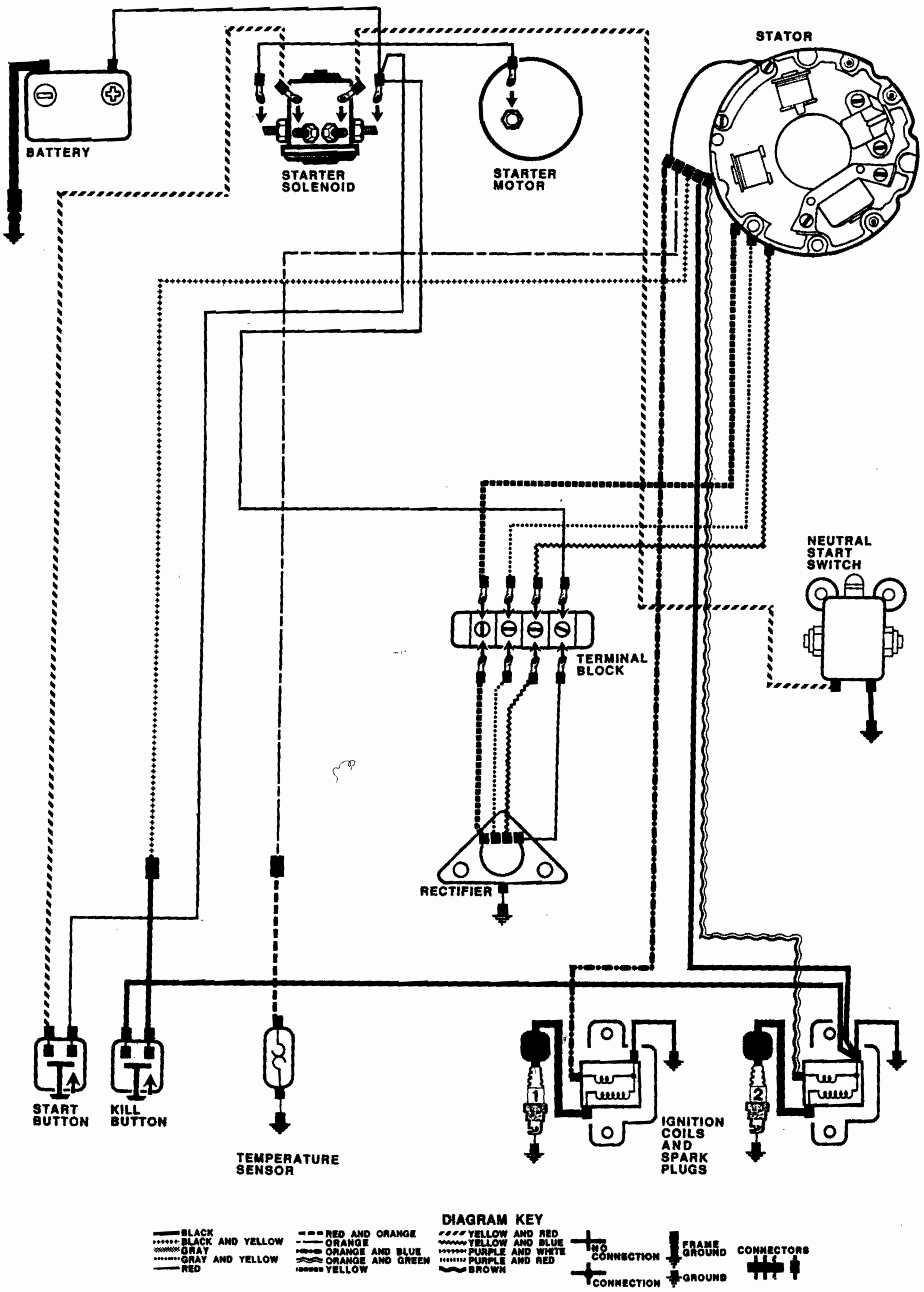
1989-1990 4 DELUXE — 8 HP



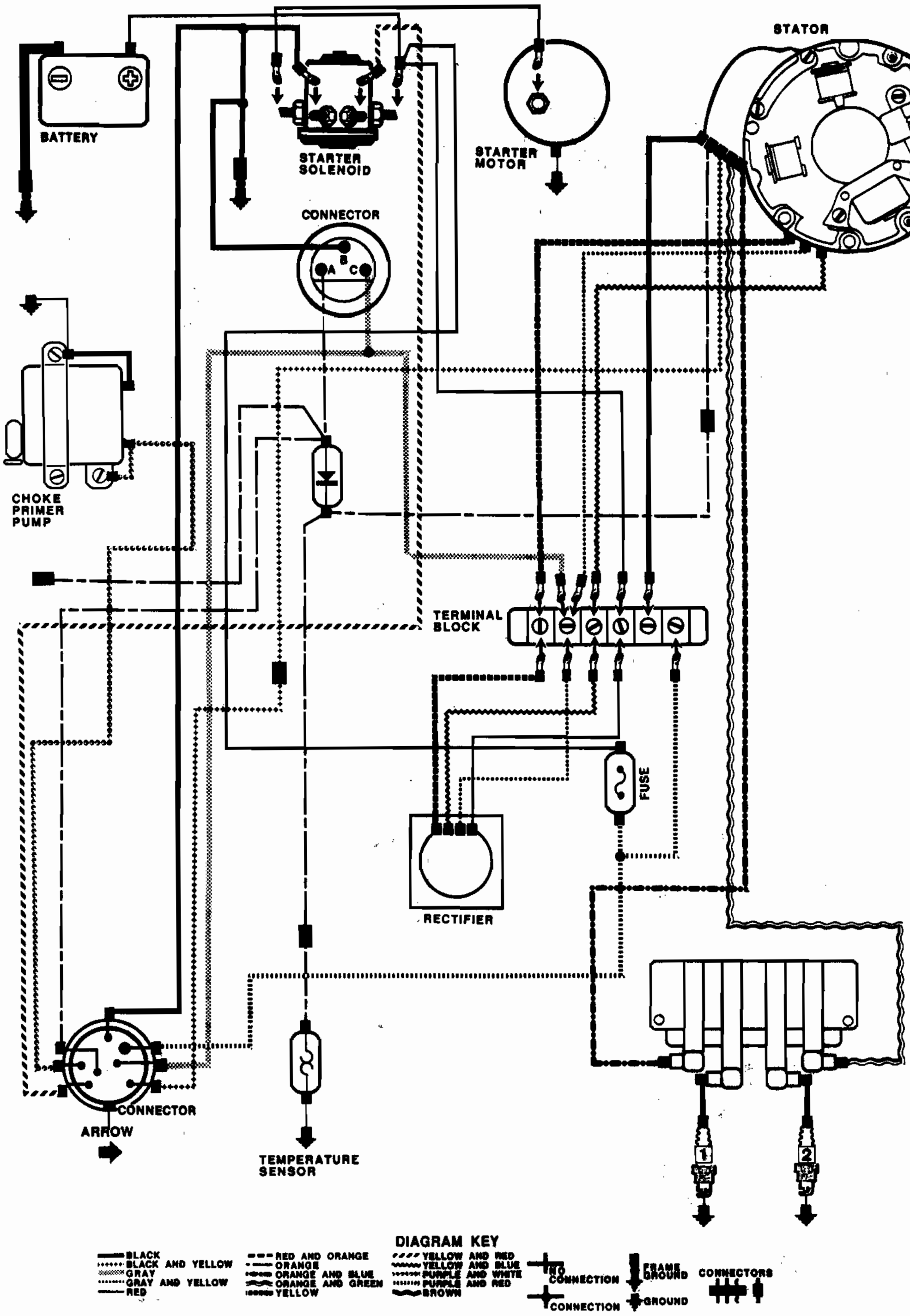
1989-1990 9.9-15 HP REMOTE START



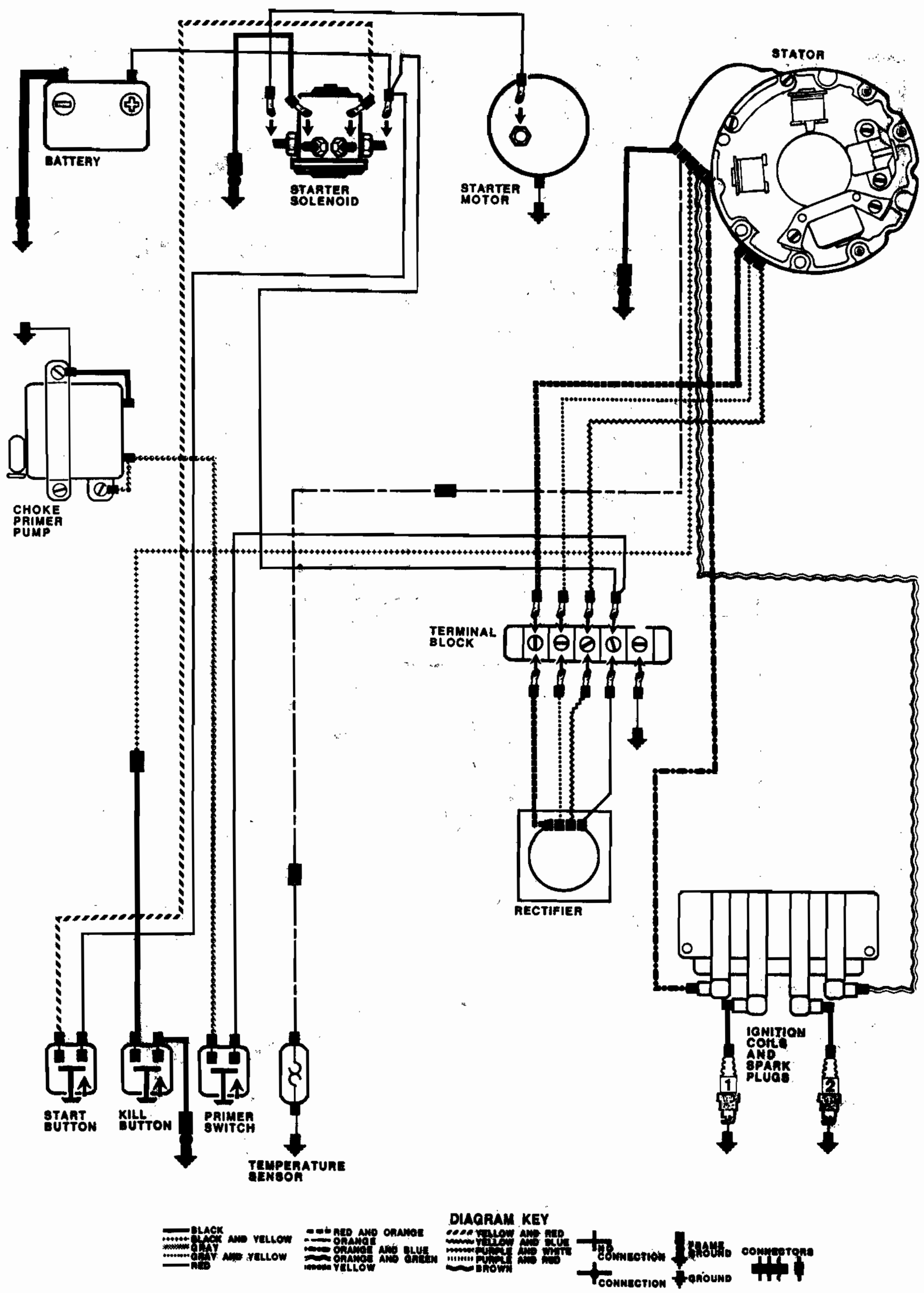
1989-1990 20-30 HP TILLER ELECTRIC



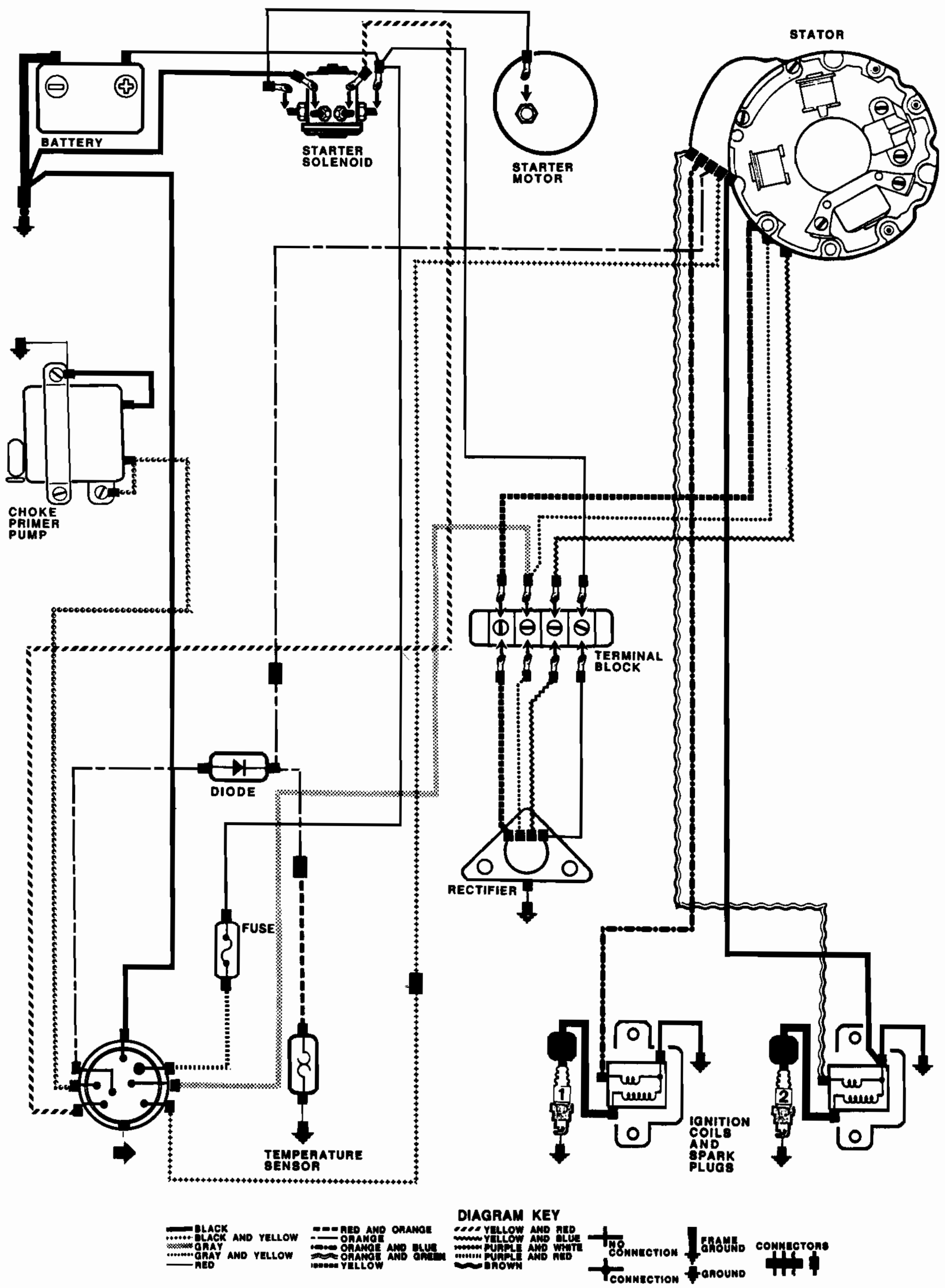
1989-1990 20-30 HP REMOTE START



1989-1990 40 HP TILLER ELECTRIC



1989-1990 HP REMOTE START



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OUTBOARD SHOP

2-40 HP • 1973-1990 (Includes Electric Motors)

2 hp	Ultra 4	7.5 hp	18 hp	35 hp
2.5 hp	4 hp Deluxe	8 hp	20 hp	40 hp
3 hp	4.5 hp	9.5 hp	25 hp	Electrics
4 hp	5 hp	9.9 hp	28 hp	
Excel 4	6 hp	15 hp	30 hp	

This easy-to-use manual can save you money in maintenance and repair bills. Step-by-step procedures and detailed illustrations guide you through every job. Inside, you'll find:

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Frequently used specifications on specially marked pages.

General Information
Manual organization, lubricant types, corrosion prevention, and propeller design.

Tools and Techniques
Common tools, test equipment, shop safety and mechanic's tips.

Troubleshooting
Easy-to-follow text and charts guide you from symptoms to solutions.

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All the tasks required for safety and top performance.

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Electrical System
Testing, adjustment and replacement procedures for starting, charging, magneto ignition and CDI systems.

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Complete overhaul procedures for your engine.

Gearcase
Water pump overhaul; gearcase overhaul for all gasoline powered models; pressure and vacuum testing; shift linkage adjustment.

Automatic Rewind Starters
Rewind starter overhaul for engine cover, swing arm, flywheel and side-mount models; rope replacement.

Electric Motors
Lubrication and maintenance procedures; electrical troubleshooting, testing and replacement; lower unit overhaul.

Index
References and cross-reference to all major sections of the manual.

Wiring Diagrams
Complete schematics for all models.

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