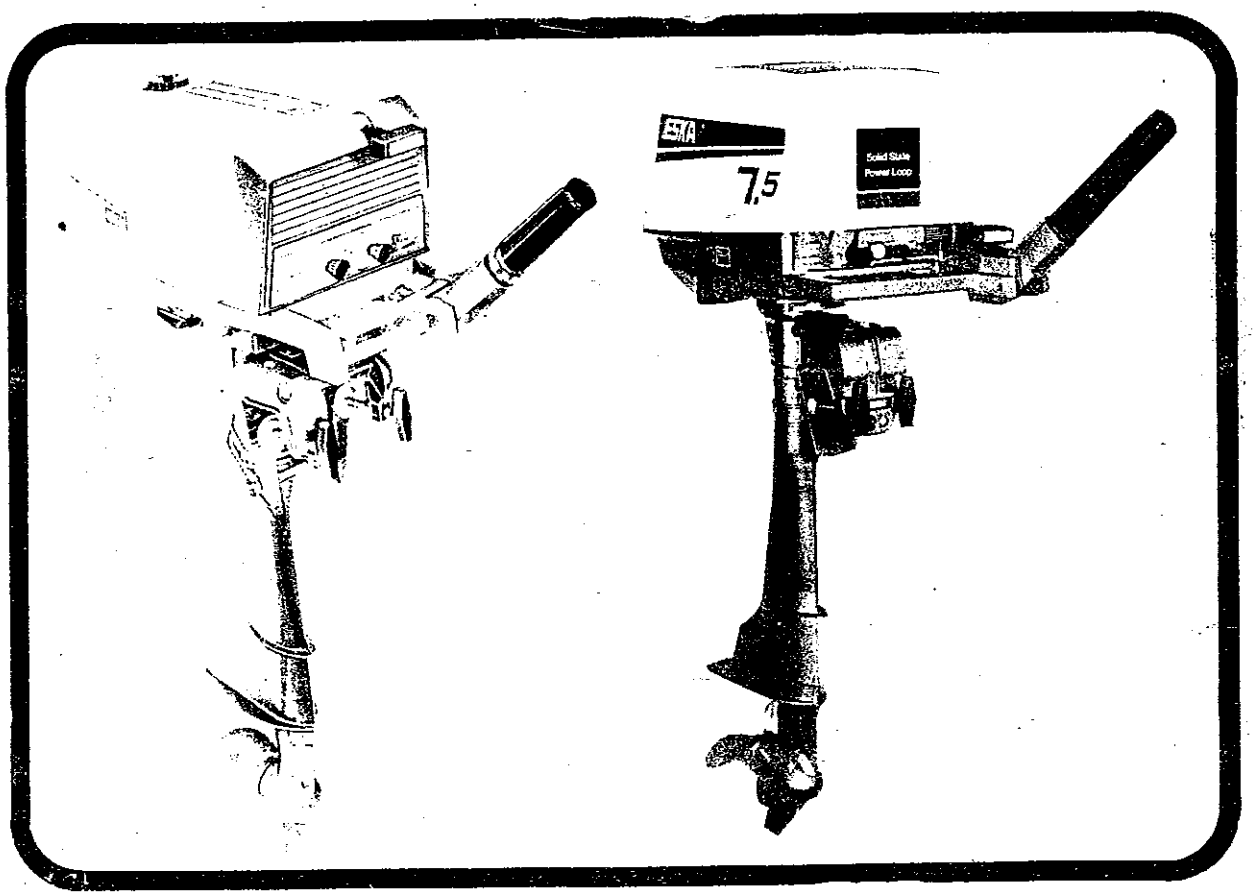
ESKA

FILE IN	:	DIV. 2
Section	:	6
Page	:	2-F-1
Issued	:	Oct, 1978

MECHANIC'S MANUAL

3.0 - 7.5 H.P., Air-Cooled, Single Cylinder Outboard Motors



ESKA a TALLEY INDUSTRIES Company

2400 Kerper Boulevard • Dubuque, Iowa 52001

Publication No. 96960
(Supercedes Printings Mar, 1971 & Mar, 1976)

Printed in U.S.A.

FILE IN : DIV. 2
Section : 6
Page : 1-1
Issued : Oct, 1978

ESKA COMPANY DUBUQUE, IOWA

TABLE OF CONTENTS

Printed in U.S.A.

TABLE OF CONTENTS —Continued

PART I GENERAL

1. INTRODUCTION

The purpose of this manual is to provide service information which can assist servicing dealers. This manual covers Single-Cylinder, 3.0 H.P. to 7.5 H.P., Air-Cooled, Two-Cycle, Outboard Motors which have engines manufactured by Tecumseh Products Company.

2. MODEL IDENTIFICATION

The identification plate for the complete outboard is located on the swivel bracket beneath the engine, the underside of the engine, or on the transom mounting bracket, depending on the model and year of the outboard as shown in Figure 1. If for some reason the identification plate must be removed, always replace when assembling. Always list model and serial numbers when corresponding.

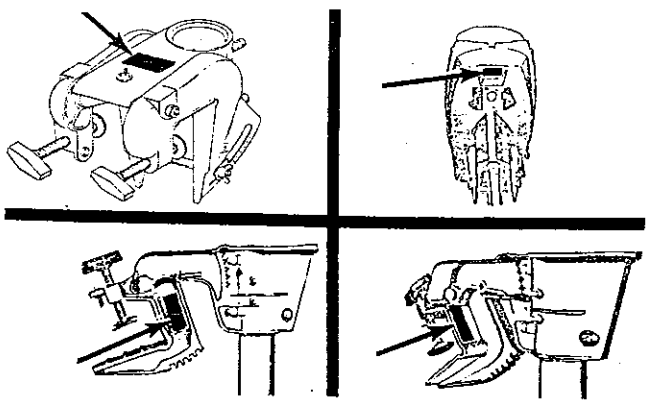


Figure 1. Views showing typical locations of the identification plate.

3. ENGINE IDENTIFICATION

A. The identification of an **ESKA** single-cylinder engine will be found on a tag shown in Figure 2. Refer to Figure 3 for the different tags used and explanation of the build date code. The TYPE NUMBER must be included in any parts orders to assure the delivery of correct parts. Always refer to TYPE NUMBER in correspondence concerning the engine.

B. When repairing an engine by using a short-block, be sure that the original engine tag is installed in a similar position on the shortblock. All identification tags on shortblock should remain to identify the shortblock.

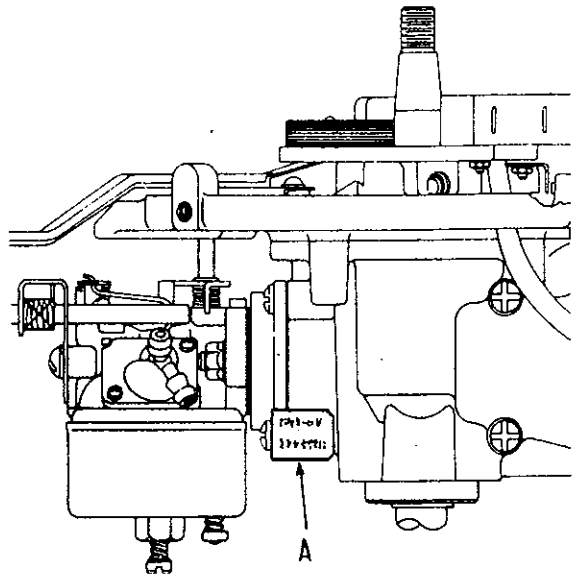


Figure 2. Proper location of engine identification tag (A).

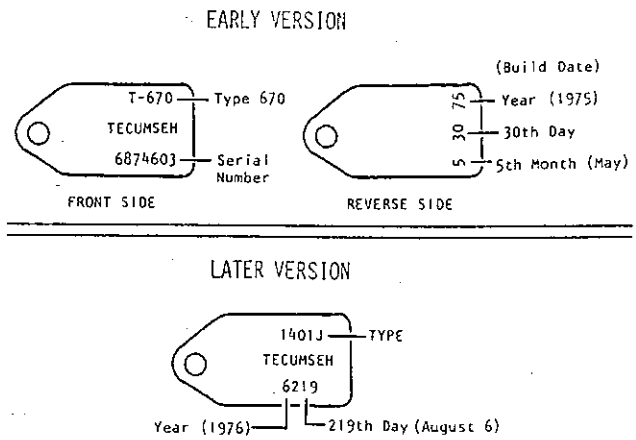


Figure 3. Typical Identification Tag.

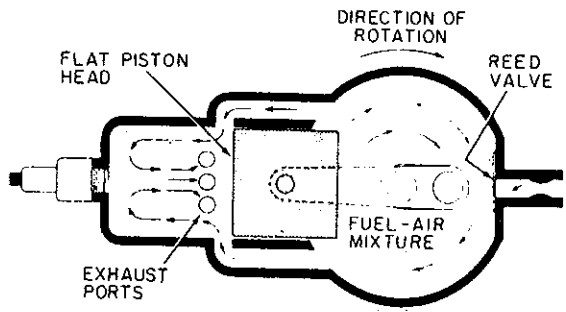


Figure 4. Loop scavenge engine with reed valve.

4. ENGINE DESIGN

A. Figure 4 illustrates the loop scavenge design

and uses the vacuum-pressure-activated reed valve. The ports are located on three sides of the cylinder; the intake ports are on two sides opposite each other and the exhaust ports are illustrated by the three holes just above the head of the piston.

B. The flat piston is used in this design. As the fuel/air mixture shoots into the combustion chamber through the two sets of intake ports, it collides and is directed to the top of the combustion chamber looping when it strikes the cylinder head, is fired and then forces all spent gases out through the open exhaust ports before it.

C. The following terms are commonly used to describe two-cycle engine theory:

(1) **EXHAUST OR SCAVENGE PHASE.** The burned gases must be cleared out of the combustion chamber and replaced by a fresh charge of fuel-air mixture. The exhaust passes out through the exhaust ports into the outside air.

(2) **EXHAUST PORTS.** These precisely positioned openings in the cylinder allow the burned gases to pass out of the combustion chamber.

(3) **PORTS.** Small openings in the cylinder allow gases to pass into and out of the combustion chamber. The ports are opened and closed by the movement of the piston.

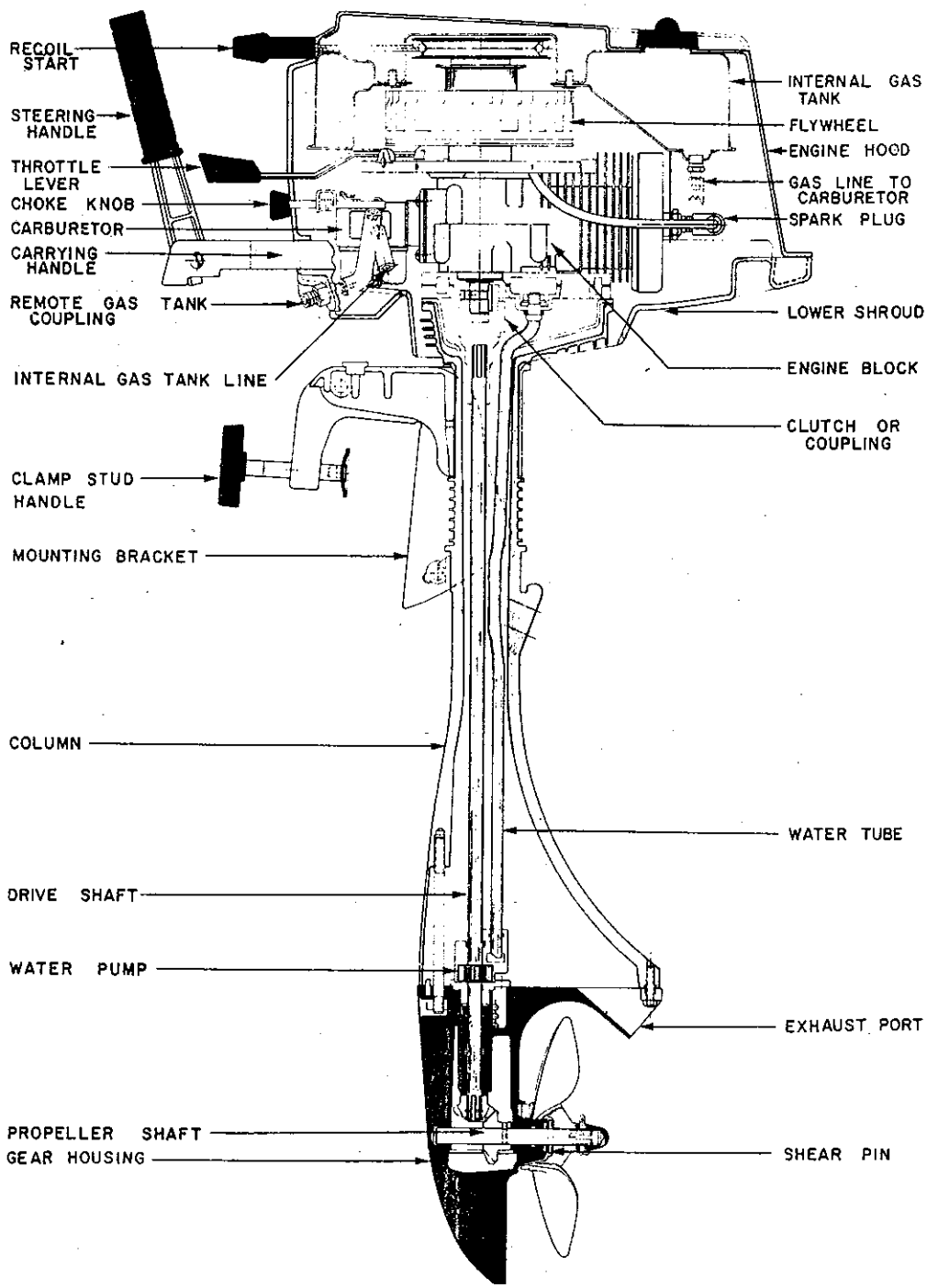
(4) **REED VALVE.** A flap or flutter valve that is activated by crankcase pressure. A reduction in crankcase pressure opens the valve, allowing the fuel, air and oil mixture to enter the crankcase. Increased crankcase pressure closes the valve, prohibiting escape of the fuel, air and oil mixture back through the carburetor.

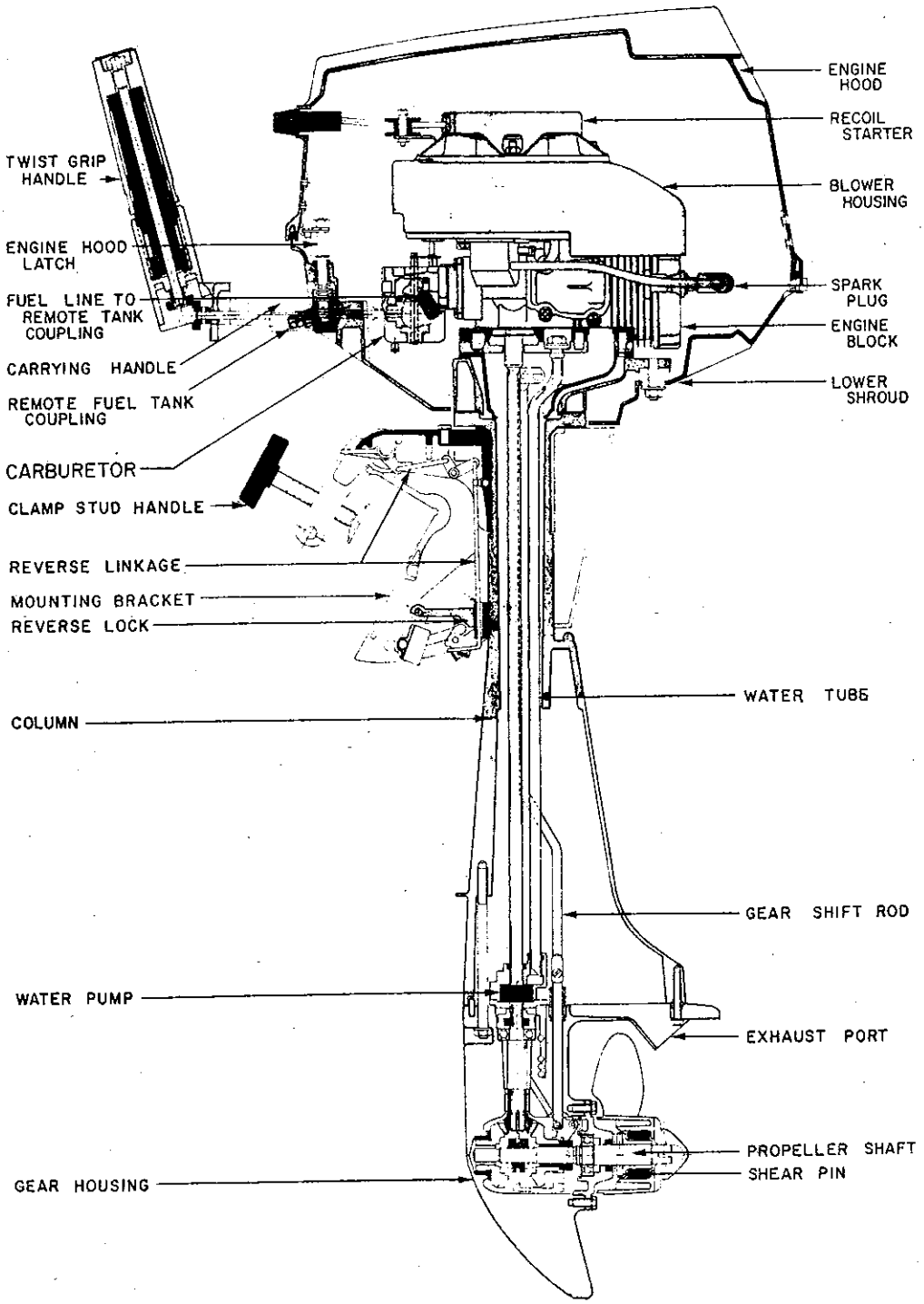
(5) **LUBRICATION.** The two-cycle engines used in **ESKA** outboard motors utilize an oil-mist lubrication. The correct quantity of oil is mixed with the fuel and enters the crankcase through the carburetor with the fuel-air mixture. The oil then clings to the moving parts and lubricates the bearing surfaces.

5. ENGINE APPLICATION

Refer to **ESKA** Outboard Motor Identification Data for specific model application.

ESKA COMPANY DUBUQUE, IOWA




ENGINE HOOD
RECOIL STARTER
BLOWER HOUSING
SPARK PLUG
ENGINE BLOCK
LOWER SHROUD
TWIST GRIP HANDLE
ENGINE HOOD LATCH
FUEL LINE TO REMOTE TANK COUPLING
CARRYING HANDLE
REMOTE FUEL TANK COUPLING
CARBURETOR
CLAMP STUD HANDLE
REVERSE LINKAGE
MOUNTING BRACKET
REVERSE LOCK
WATER TUBE
COLUMN
GEAR SHIFT ROD
WATER PUMP
EXHAUST PORT
PROPELLER SHAFT
SHEAR PIN
GEAR HOUSING

PART II OPERATION

1. ENGINE FUEL MIX

16:1 Mixture

Gasoline	Oil	
1 gallon	1/2 pint	8 oz.
3 gallons	1½ pints	24 oz.
5 gallons	2½ pints	40 oz.
6 gallons	3 pints	48 oz.
1 liter	0.60 liter	63 cc
5 liters	0.31 liter	313 cc
10 liters	0.63 liter	625 cc
20 liters	1.25 liters	1250 cc

24:1 Mixture

Gasoline	Oil	
1 gallon	1/3 pint	5.3 oz.
3 gallons	1 pint	16 oz.
5 gallons	1⅔ pints	26.5 oz.
6 gallons	2 pints	32 oz.
1 liter	0.40 liter	42 cc
5 liters	0.21 liter	208 cc
10 liters	0.42 liter	417 cc
20 liters	0.83 liter	833 cc

32:1 Mixture

Gasoline	Oil	
1 gallon	1/4 pint	4 oz.
3 gallons	3/4 pint	12 oz.
5 gallons	1¼ pints	20 oz.
6 gallons	1½ pints	24 oz.
1 liter	0.30 liter	31 cc
5 liters	0.16 liter	156 cc
10 liters	0.31 liter	312 cc
20 liters	0.63 liter	625 cc

50:1 Mixture

Gasoline	Oil	
1 gallon	1/6 pint	3 oz.
3 gallons	1/2 pint	9 oz.
5 gallons	13/16 pint	15 oz.
6 gallons	1 pint	18 oz.
1 liter	0.02 liter	20 cc
5 liters	0.10 liter	100 cc
10 liters	0.20 liter	200 cc
20 liters	0.40 liter	400 cc

Cleanliness of fuel and oil is essential for proper engine operation. Make sure that gasoline and oil are stored in clean, covered, rust-free containers. Dirt in fuel can clog small ports and passages of the carburetor, causing engine failure. Use regular grade gasoline, if not available, a no-lead or low-lead gasoline is an acceptable alternative. Gasoline, standing for long periods of time, develops a gum that will result in fouled spark plugs, clogged fuel lines, carburetors and fuel screens. Dirty oil causes engine wear. When servicing engines showing indications of dirty gasoline or oil, report the condition to the engine owner, cautioning him against continued use of contaminated fuels or lubricants.

2. CONTROLS

The operating controls on **ESKA** outboard motors are clearly marked. Models with clutch or gear shift have control lever located on starboard (right) side.

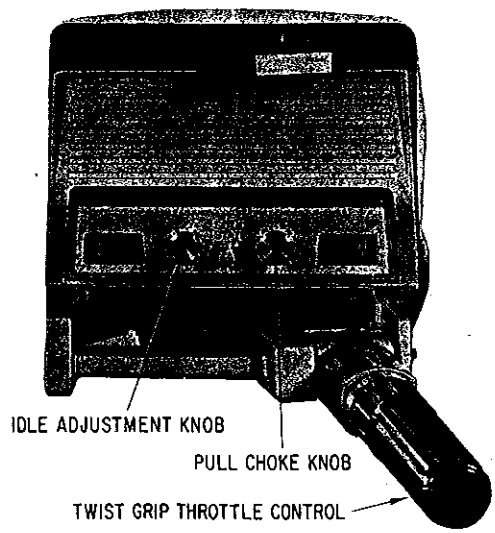


Figure 1. View of typical front panel.

3. STARTING PROCEDURE

A. Operation using integral fuel tank:

(1) Open fuel shut-off valve.

(2) The filler cap on engine tank is equipped with a polyethylene cap plug protecting the two entrenched air vents that automatically supply air through the cap passages and escape out the rubber umbrella check valve into the tank. The rubber umbrella's check valve will also seal off gasoline from escaping out through the filler cap when outboard motor is being transported. Gasoline pressurizes the umbrella to prevent fuel from escaping. (See Figure 3).

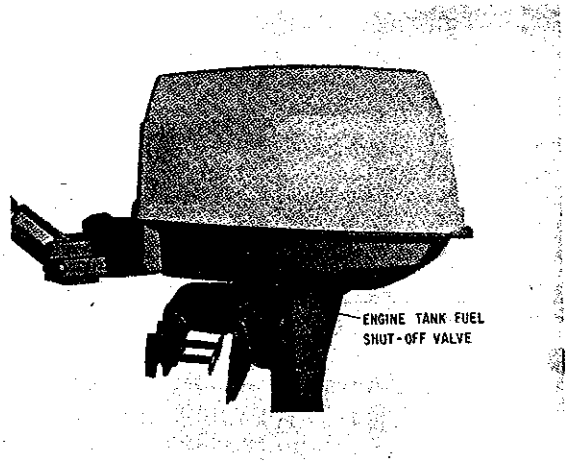


Figure 2. Engine fuel tank shut-off valve is located on post side of engine.

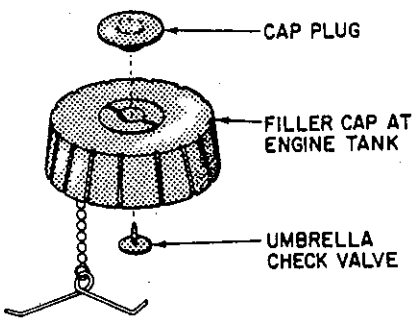


Figure 3. Integral fuel tank cap has umbrella type check valve.

CAUTION

If outboard continues to stall or not run, take filler cap off and see if motor will run. If motor runs without filler cap, replace filler cap.

B. Operation using remote fuel tank:

(1) Clean remote fuel tank coupling and connector at engine before joining. Slide collar back on coupling to connect coupling to connector. Rotate coupling several times to be sure coupling is well seated to the connector. (See Figure 4).

(2) Close engine fuel tank shut-off valve if also equipped with engine mounted fuel tank. (See Figure 2).

(3) Before starting, be sure that fuel tank has a sufficient amount of properly mixed fuel. Open the air vent screw on the filler cap at remote fuel tank. (See Figure 5).

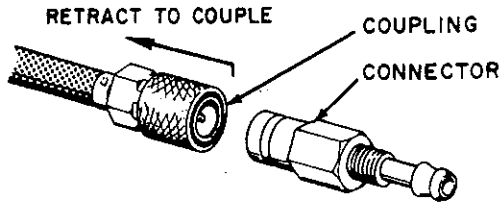


Figure 4. View of remote fuel tank connection.

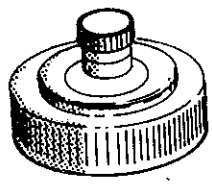


Figure 5. Remote fuel tank cap has screw type air vent.

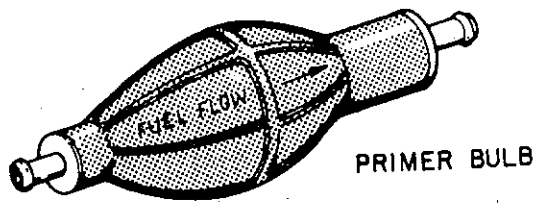


Figure 6. Primer bulb permits fuel to flow only one direction.

(4) Squeeze primer bulb by hand until firm to force fuel into the carburetor. (See Figure 6).

C. Turn twist grip handle to "Start" position. Do not try to advance beyond "Start" position. On modles with clutch or gear shift, the automatic lockout feature engages when shift lever handle is in "Neutral" position. (See Figures 7 and 9).

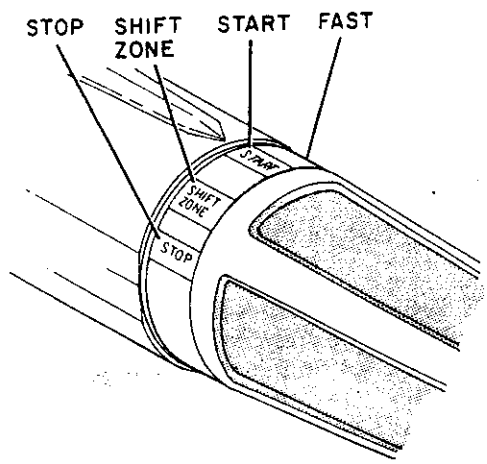


Figure 7. View of typical twist grip throttle.

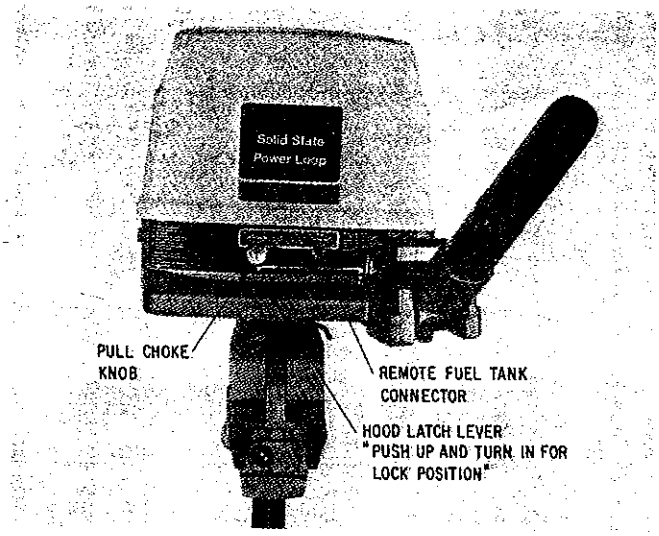


Figure 8. View of a typical choke knob and remote fuel connection.

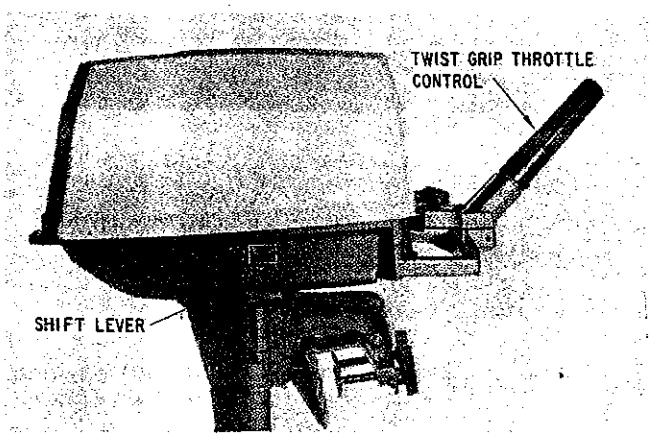


Figure 9. Shift control lever is on starboard side of outboard motor.

WARNING

When starting be sure shift lever handle is in "Neutral" position and twist grip is in "Start" position so as to not lose your balance with a fast start. Do not smoke when opening air vent screw to prevent explosion or fire from gas fumes escaping from tank.

D. Pull out choke knob to "Full" choke position. If engine has been running recently, choking may not be necessary. (See Figure 8.)

E. Pull starter handle slowly until you feel starter engage, then pull with rapid motion and allow starter cord to retract slowly.

F. When engine starts:

(1) Push choke knob to "Half In" position and leave at this position until engine warms up, then push choke knob to "Full In" position.

(2) Forward Drive—Position motor with steering handle forward. Turn twist grip handle to "Shift" position, place shift lever handle in "Drive" or "Forward" position, then turn twist grip to desired speed.

(3) Reverse Drive—If outboard motor has a reverse gear feature, turn twist grip handle to "Shift" position, move shift lever to "Reverse" position, then turn twist grip to desired speed.

(4) On models without reverse gear, slow engine speed to near idle, be sure column is against thrust bracket, then pivot motor 180 degrees in counter-clockwise direction.

(5) If motor stops in "Drive" or "Forward" position—Before attempting to start motor turn twist grip to "Stop" position, then move shift lever to "Neutral." Turn twist grip to "Start" position, then resume normal restart procedure.

4. FLOODING

To clear engine of excess fuel, move choke knob to "Off" position, move shift lever handle to "Neutral" position, and turn twist grip throttle to "Start" position. Pull recoil starter handle until engine starts and continues to run.

5. STOPPING PROCEDURE

A. To stop engine, turn twist grip handle to "Shift" position, move shift lever handle to "Neutral" position, and then turn twist grip handle to full "Stop" position.

WARNING

In case of an Emergency, the engine can be stopped by pulling the Choke Knob to Full Choke Position.

If the motor will not be operated for a period of time, or if it is to be tilted up, we recommend the following practice to prevent spillage of inflammable fuels from the carburetor throat and bowl:

1. Close fuel shut-off valve and/or air vent screw on filler cap at remote fuel tank and disconnect remote fuel tank.

PART X FN GEAR HOUSING

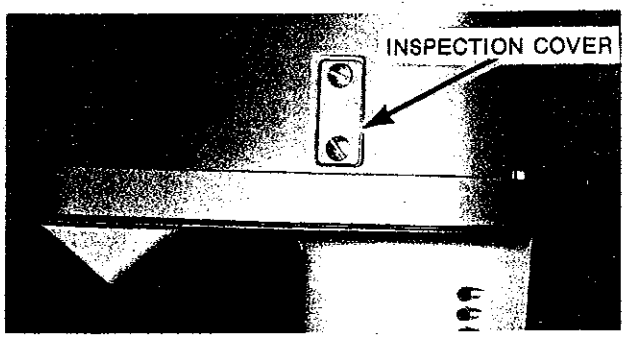


Figure 1. Remove inspection cover.

1. GENERAL

The gear housing is attached to the lower portion of the column. The pinion gear and bevel gear are in constant mesh. Power is transmitted from the bevel gear to the propeller shaft through a dog clutch. The dog clutch is keyed to the propeller shaft but slides on the propeller shaft to contact the bevel gear when propeller rotation is desired.

2. REMOVE GEAR HOUSING FROM COLUMN

A. Use a flat tip screwdriver to remove the two flat-head screws holding the inspection cover. Remove cover (Figure 1).

B. Loosen the hex head machine screw connecting the column link rod and the shift rod (Figure 2). Do not remove at this point.

C. Hook a piece of wire around screw to prevent dropping screw into gear housing and remove screw.

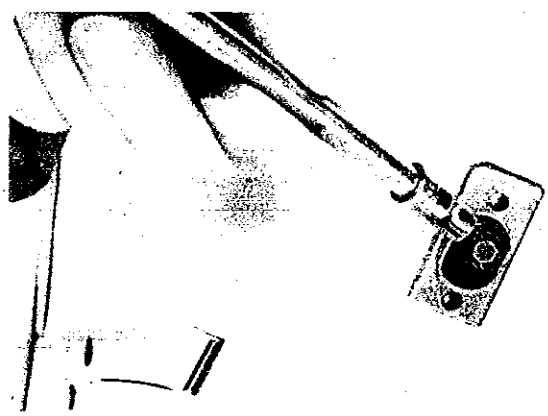


Figure 2. Loosen connecting screw.

D. Remove screw and washer adjacent to exhaust outlet (Figure 3).

E. Use a 1/2-inch open end wrench and remove column stud nut and lockwasher (Figure 4).

NOTE

The gear housing may have to be separated slightly from the column in order to remove the column stud nut and lockwasher.

F. Pull gear housing from column and remove pilot bushing.

3. DISASSEMBLY GEAR HOUSING [Figure 5]

A. Remove water pump; see Part IX-paragraph 3A.

B. Remove cotter pin in propeller nut.

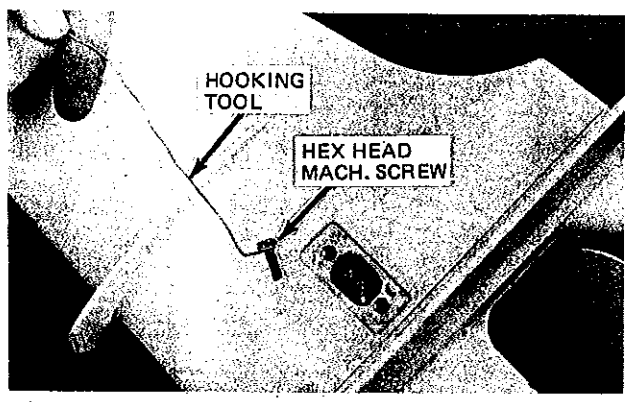


Figure 3. Hold screw with hooking tool.

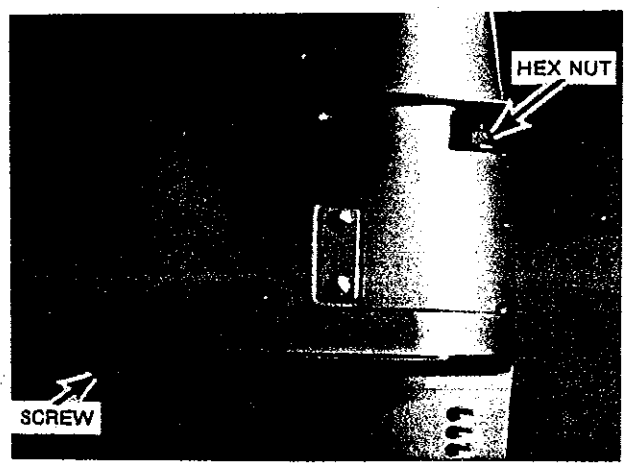


Figure 4. Unscrew stud hex nut.

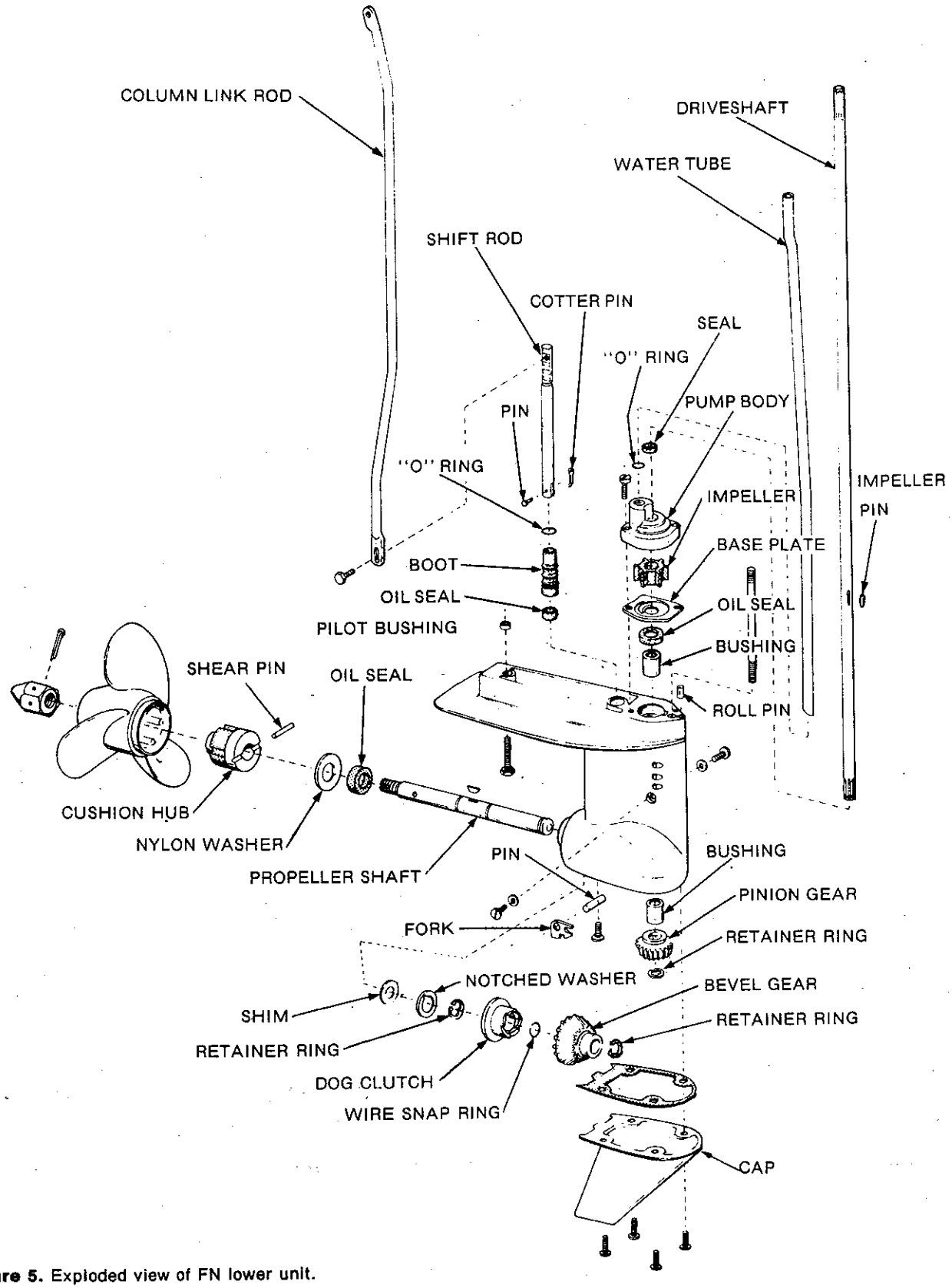


Figure 5. Exploded view of FN lower unit.

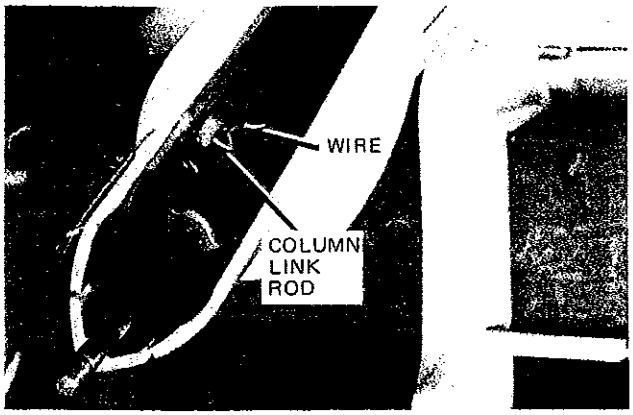


Figure 33. Hold column link rod in place with wire.

CC. Check that the shift rod is properly engaged with the fork lever by operating the shift rod up and down and checking for forward, neutral and reverse operation by turning the drive shaft and observing the propeller shaft.

DD. Use a 3/8-inch socket wrench to install and tighten the two hex washer-head cap screws.

EE. Install the nylon washer, shear pin and propeller assembly on the propeller shaft.

FF. Install the propeller nut until it is finger-tight and then use a 1-11/16-inch wrench or channel lock pliers to tighten the propeller nut to the nearest cotter pin hole.

GG. Install the cotter pin.

6. REASSEMBLE GEAR HOUSING TO COLUMN

To locate and position certain parts, a flashlight and a piece of wire are required. Reassemble the gear housing to the column as follows:

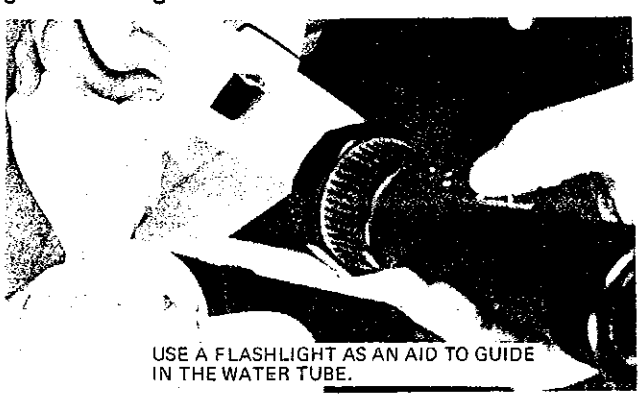


Figure 34. Guide water tube in place.

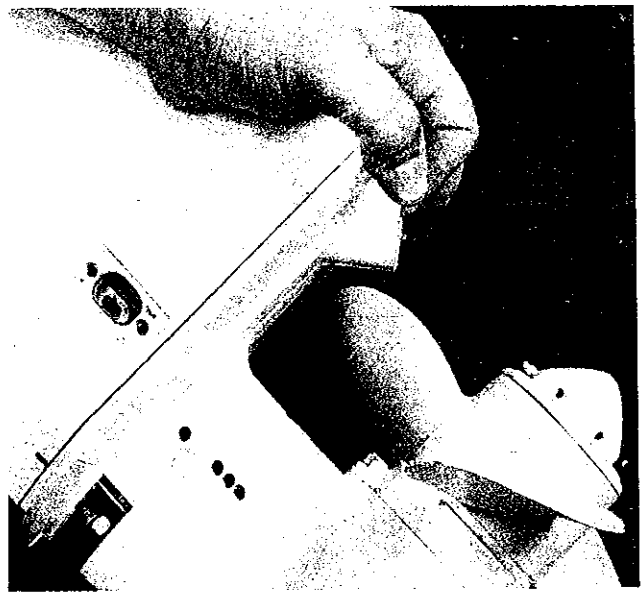


Figure 35. Mate gear housing and column.

A. Use a piece of wire to tie back the column link rod (Figure 33).

B. Lubricate the end of the water tube with petroleum jelly.

C. Clean and lubricate the drive shaft splines with Lithium grease.

D. Replace the pilot bushing into the gear housing.

E. Assemble the gear housing to the column by inserting the drive shaft into the column. Engage the drive shaft into the column. Engage drive shaft and engine crankshaft splines and guide the water tube into the water pump (Figure 34).

NOTE

It may be necessary to rotate the crankshaft to engage the drive shaft splines.

F. Push the gear housing up to within 1/4-inch of the column and start the lock washer and hex nut on the stud; then push the gear housing up so that it is flush to the column (Figure 35).

G. Replace the hex-head machine screw and the column stud hex nut and medium split-lock washer (Figure 5).

H. Use a 3/8-inch socket wrench to tighten the hex-head machine screw, and a 1/2-inch wrench to tighten the column stud hex nut.

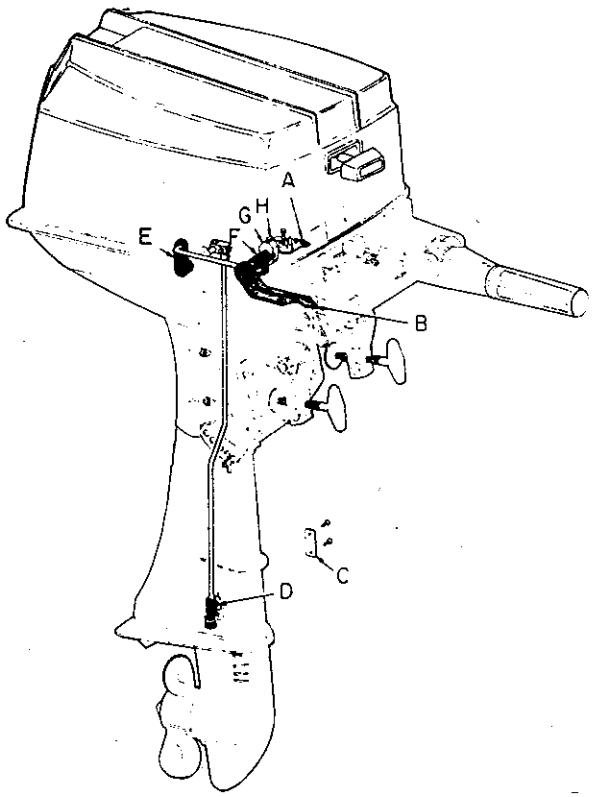


Figure 36. Adjust shift linkage.

I. Replace the cavity clip.

J. Release the wire holding the column link rod and align the column link rod and shift rod.

K. Use the hooking tool (or split screwdriver) to install the machine pan-head screw. Tighten with a flat-tip screwdriver.

L. Adjust the shift linkage as outlined in paragraph 7.

M. Replace the inspection cover and cover gasket. Lubricate the flat-head screws and replace. Tighten with a flat-tip screwdriver.

7. SHIFT LINKAGE ADJUSTMENTS (Figure 36)

If the outboard does not shift fully into gear or is hard to shift, follow this procedure to adjust the shift linkage. Remove the outboard hood, if not already removed.

A. **Loosen the two fillister-head machine screws (A) holding the flat spring.**

B. **Place the shift lever (B) in neutral and rotate the propeller to check.**

NOTE

You should be able to feel the shifter bracket in the gear housing click into the neutral position. There are three noticeable click positions; the middle click is neutral. The propeller should rotate freely.

C. Remove the inspection cover (C) located at the lower end of the column.

D. Loosen the screw (d) connecting the column link rod and the shift rod.

NOTE

Do not remove the shift rod screw.

E. Rotate the center control lever (E) so that the arm is in a vertical position.

F. Tighten the shift rod screw (D), making sure that the flat spring (H) is in the half moon of the cam (G).

G. Rock the cam (G) back and forth to find the midtravel point and tighten the flat spring screws (A).

H. All linkage should be properly adjusted. If not, repeat the procedure.

8. PROPELLER

Always use correct propeller listed in parts list. Propellers are power-matched to the outboard to provide optimum performance. The propeller used on FNR models has a rubber cushion inside the hub. When a replacement propeller is ordered for this model, the propeller will come as an assembly with the hub cushion in place. The hub cushion may be ordered separately and replaced. To replace a shear pin, proceed as follows:

A. If outboard is equipped with FN gear housing, FNR gear housing or spring clutch, make sure shift lever is in engaged position.

B. Remove cotter pin and propeller nut.

C. Rmove propeller and broken shear pin.

D. Apply lithium grease to propeller shaft before reassembly.

E. Install new shear pin and replace propeller, propeller nut and cotter.

PART III TROUBLE SHOOTING

1. PRELIMINARY PROCEDURE

A. The accompanying list of problems is provided as a guide to help detect and remedy some common difficulties.

B. A quick check of the list can save valuable time diagnosing faults.

ENGINE FAILS TO START OR STARTS WITH DIFFICULTY

Cause	Remedy
No fuel in tank	Fill tank with clean, fresh fuel.
Fuel shut-off valve	For operation using integral fuel tank on models so equipped, open valve by turning counter-clockwise. For operation using remote fuel tank on models also equipped with integral fuel tank, valve must be closed by turning valve clockwise. On all models with remote fuel tank, be sure hose is connected to coupling firmly, is seated and line is primed by squeezing primer bulb until it is firm.
Obstructed fuel line	Clean fuel screen and line. If necessary, remove and clean carburetor.
Tank cap vent obstructed	Open vent in fuel tank cap, or replace cap.
Water in fuel	Drain tank. Clean carburetor and fuel lines. Dry spark plug electrodes. Fill tank with clean, fresh fuel.
Engine over-choked	Close fuel shut-off and pull starter until engine starts. Reopen fuel shut-off for normal fuel flow immediately after engine starts.
Improper carburetor adjustment	Adjust carburetor.
Dirty carburetor	Disassemble and clean carburetor.
Loose or defective magneto wiring	Check magneto wiring for shorts or grounds; repair if necessary.
Faulty magneto	Check timing, point gap and, if necessary, overhaul magneto.
Spark plug fouled	Install new spark plug of correct type.
Spark plug wire wet or dirty	Dry or clean and dry spark plug high tension wire.
Spark plug porcelain cracked	Install new spark plug.
Crankcase leaking	Find leak and repair as required.
Poor compression	Overhaul engine.
Carbon in combustion chamber	Remove cylinder head or cylinder and clean carbon from head and piston.

ENGINE FAILS TO START OR STARTS WITH DIFFICULTY—Continued

Cause	Remedy
Loose or worn connecting rod	Overhaul engine.
Loose flywheel	Check flywheel key and keyway; replace parts if necessary. Tighten flywheel nut to 18-25 ft. lbs. (2.0-2.8 N.m) torque.
Worn cylinder	Overhaul engine.
Improper magneto timing	Time magneto.

ENGINE MISSES UNDER LOAD

Cause	Remedy
Spark plug fouled	Install new spark plug of correct type.
Spark plug porcelain cracked	Install new spark plug of correct type.
Improper spark plug gap	Regap spark plug.
Pitted magneto breaker points	Install new breaker points.
Magneto breaker arm sluggish	Clean and lubricate breaker point arm.
Faulty condenser	Install new condenser.
Improper carburetor adjustment	Adjust carburetor.
Reed bent or chipped	Install new reed/reed plate.

ENGINE LACKS POWER

Cause	Remedy
Choke partially closed	Open choke.
Improper carburetor adjustment	Adjust carburetor.
Magneto improperly timed	Time magneto.
Worn piston or rings	Overhaul engine.
Propeller bound by foreign objects (fishing lines, weeds, etc.)	Remove foreign objects.
Reed bent or chipped	Install new reed/reed plate.
Improper amount of oil in fuel mixture	Drain tank; fill with correct mixture.
Engine properly timed Engine improperly timed	Time engine.
Exhaust ports clogged	Clean ports and caution to use correct type and amount of oil in fuel.

ENGINE OVERHEATS

Cause	Remedy
Engine improperly timed	Time engine.
Carburetor improperly adjusted	Adjust carburetor.
Excessive load on engine	Check heavy boat or excessive loading of boat.
Damaged water pump	Check and repair as necessary.
Carbon in combustion chamber	Remove cylinder head or cylinder and clean carbon from head and piston.
Improper amount of oil in fuel mixture	Drain tank; fill with correct mixture.

ENGINES SURGES OR RUNS UNEVENLY

Cause	Remedy
Fuel tank cap vent hole clogged	Open vent hole.
Carburetor out of adjustment	Adjust carburetor.

ENGINE VIBRATES EXCESSIVELY

Cause	Remedy
Engine not securely mounted	Tighten loose mounting bolts.
Driven equipment out of balance	Recheck driven equipment. (Flywheel, prop, etc.)

2. POINTS TO CHECK FOR CARBURETOR MALFUNCTION

Cause	Remedy
Carburetor out of adjustment	C-I-J-K
Engine will not start	A-B-C-D-E-F-I-J-K-L-P
Engine will not accelerate	B-C-I-J
Engine hunts (at idle or high speed)	C-G-H-I-J-Q
Engine will not idle	C-G-I-J-Q-R

POINTS TO CHECK FOR CARBURETOR MALFUNCTION—Continued

Cause	Remedy
Engine lacks power at high speed	B-E-G-I-J-Q
Carburetor floods	C-F-N-Q-R
Carburetor leaks	E-F-H-O-S
Idle speed is excessive	G-K-L-O
Choke does not open fully	G-L
Engine starves for fuel at high speed (leans out)	A-C-E-I-L-N-P-Q
Carburetor runs rich with main adjustment needle shut off	F-N-O-P-Q

POINTS TO CHECK

A. Open fuel shut-off valve at fuel tank—fill tank with fuel.

B. Check ignition and spark plug.

C. Dirt or restriction in fuel system—clean tank and fuel strainers; check for kinks or sharp bends.

D. Check for stale fuel or water in fuel—fill with fresh fuel.

E. Examine fuel line and fuel pick-up in tank for sealing at fittings.

F. Check and clean atmospheric vent holes.

G. Examine throttle and choke shafts for binding or excessive play—remove all dirt or paint, replace shaft.

H. Examine idle and main mixture adjustment screws and "O" rings for cracks or damage.

I. Adjust main mixture adjustment screw if so equipped.

J. Adjust idle mixture adjustment screw. Check to see that it is the correct screw.

K. Check position of choke and throttle plates.

L. Adjust control cable or linkage to assure full choke and carburetor control.

M. Clean carburetor after removing all non-metallic parts that are serviceable. Blow out all passages.

N. Check inlet needle and seat for condition and proper installation. Replace if necessary.

O. Check sealing of welch plugs, cups, plugs and gaskets.

P. Check fuel pump operation—pump element, inner and outer one-way valves.

Q. Adjust float setting.

R. Check float shaft for wear and float for leaks or dents.

S. Check seal for fuel drain or bowl gasket.

TROUBLESHOOTING OF COLUMN AND GEAR BOX ASSEMBLY

Problem	Solution
Water coming out of adaptor plates between power head and leg.	Check the six mounting screws to make sure they are tight. If screws are tight, remove leg from power head and check adapter plates for warpage and condition of gaskets. If mounting plates are warped, always replace with new gaskets.
Excessive vibration of lower column.	Check for tightness of mounting screws. Inspect propeller for damage. If the above are in good order, check splines on drive shaft, if worn, replace drive shaft or coupling. Check condition of gears in gear box, if damaged, replace with new gears, bearings, and seals.
Propeller drive shaft worn excessively.	Check oil level in gear box. Check tightness of oil seals and bearings. Replace with propeller drive shaft, bearings and seals. Make sure seals are properly sealing. If gears are worn, replace.
Oil leaking from gear box.	Check gear housing gasket, if defective, replace. Inspect for cracks on gear housing. If cracks or porosity are visible, replace with new gear housing. Make sure vent and drain plugs and seals are tight. Check for wear of drive shaft and bearings. Check lubrication.
Loose propeller.	Check propeller nut to make sure it has a snug fit and shear and cotter pin are in place.
Engine runs but propeller does not turn.	Check shear pin, if broken, replace. If propeller and shear pin are in order, check the coupling between the engine and drive shaft, or clutch on respective models. Check gears and gear drive pin.
Very little friction when steering outboard and will not maintain true course direction.	Tighten spring tension screws on transom bracket to proper tension. If screws and springs are missing, replace. Outboard should turn freely but with some resistance to hold in position. Grease swivel bracket at grease fitting.
Steering unduly tight or seized up.	Remove spring tension screws and then transom bracket from leg. Clean up and lubricate.
Broken or chipped gears.	Check for foreign material in gear box and alignment of gears. If defective, replace. check drive shaft and bearing wear, check lubrication.

CLUTCH PROBLEMS [Models with spring clutch]

Cause	Remedy
Clutch sticks, will not go into neutral.	If slightly rusted, will usually break free. If tip end of spring is broken where it contacts outer shell, install new clutch.
Clutch not engaging.	When spring breaks internally or when clutch is excessively worn, install new clutch. Again, if rusted will usually break free.
Control action stiff.	Lubricate shift rod pivot and linkages with SAE 30 oil.

3. PRE-OVERHAUL CHECK

A. A complete check of the engine before overhaul will often pin-point cause of improper operation and assure correction of fault.

B. Check compression. Disconnect spark plug lead to insure that engine will not start; crank engine by hand in direction of normal rotation (clockwise). This should be done when engine is cold. There should be considerable resistance to turning as piston approaches top dead center. Hold piston against compression for several seconds. If resistance to pull decreases rapidly, it indicates poor compression. Poor compression is usually the result of worn piston rings, worn cylinder bore, or rings trapped by carbon in grooves.

C. Check crankcase seals. Remove magneto from engine and engine from lower unit. Check seals at ends of crankshaft for evidence of leakage indicating faulty seal. Also check for leaking gaskets and cracks. Crankcase leakage will result in hard starting, faulty fuel metering (carburetion) and general erratic operation.

D. Check reed plate. Remove carburetor and check reeds and reed plate. Reeds should not be open more than 0.010 inch (0.25 mm), should not be warped, bent, chipped or cracked.

PART IV OUTBOARD DISASSEMBLY & REASSEMBLY

1. GENERAL

This section covers disassembly and reassembly of outboard assemblies excluding the power head and gear housing. Refer to Parts V, VI, VII and VIII for servicing of power head components. Refer to Parts IX, X and XI for gear housing service.

2. REMOVE POWER HEAD PARTS (All Models Except Deluxe Mfg. During 1978 And Later)

Removal of power head parts includes removal of hood, control panel, controls and linkage, fuel lines, carrying handle, engine and engine to column adaptor plates. Due to design variation from model to model, detailed disassembly instructions are not given for items whose removal or disassembly is obvious upon inspection of the outboard. Sufficient detailed instructions are given to enable the technician to completely disassemble, repair and reassemble the power head on all models except outboards equipped with FWD/NEUTRAL/REV drive. (See paragraph 4 for FNR models, paragraphs 5 and 6 for Deluxe models manufactured in 1978 and later.

A. Remove hood.

B. Remove fuel lines.

C. Remove control knobs and disconnect linkage as necessary (Figure 1).

D. If equipped with control panel, proceed as follows:

(1) Pull the starter rope out far enough to tie a slip knot at the rewind mechanism (Figure 2).
(2) Pry the metal channel from the starter handle, untie the knot, and remove the handle and channel from the starter rope (Figure 3).
(3) Remove instrument panel by removing the four screws securing the panel to the carrier handle.

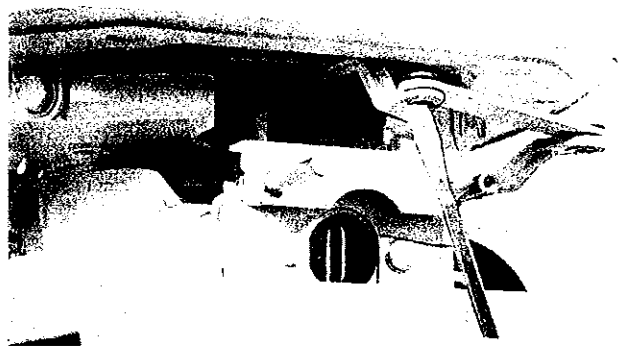


Figure 1

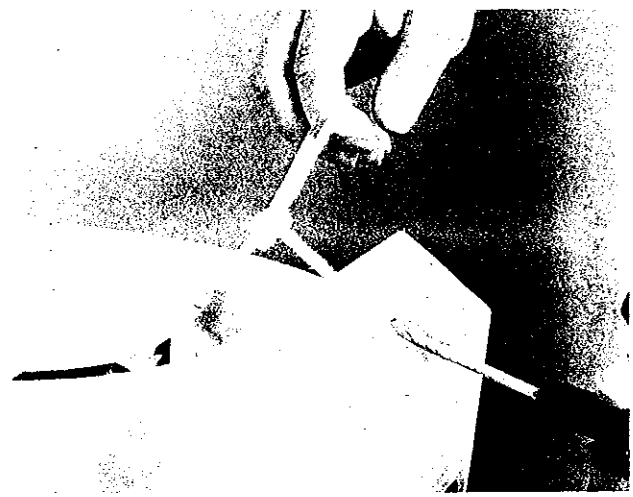


Figure 2

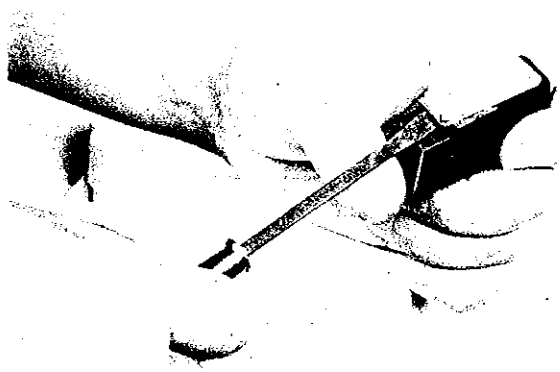


Figure 3

E. Separate the engine assembly from the column assembly by removing the six fillister head screws (outboards manufactured in 1976 use four hex nuts and two pan head screws) securing the upper adaptor plate to the column (Figure 4).

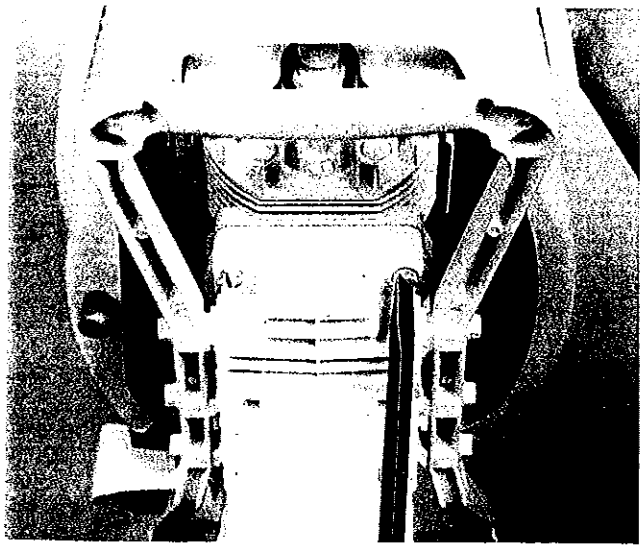


Figure 4

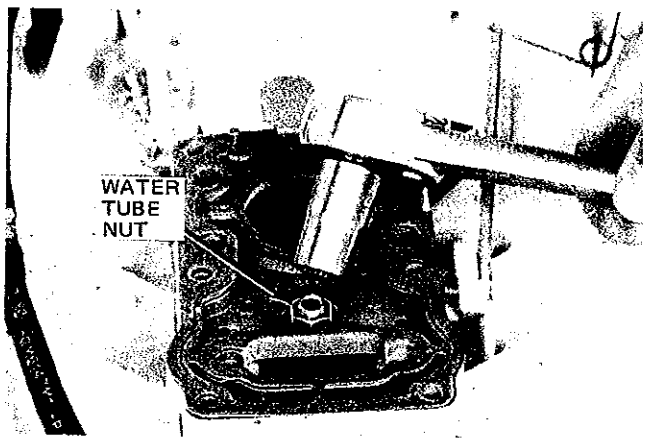


Figure 5

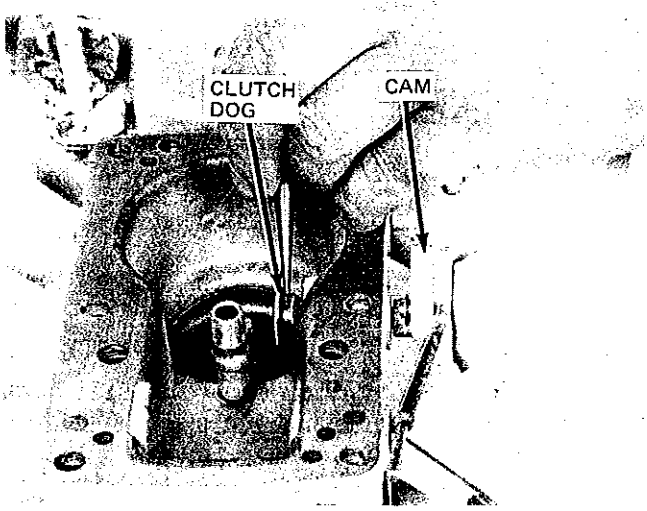


Figure 6

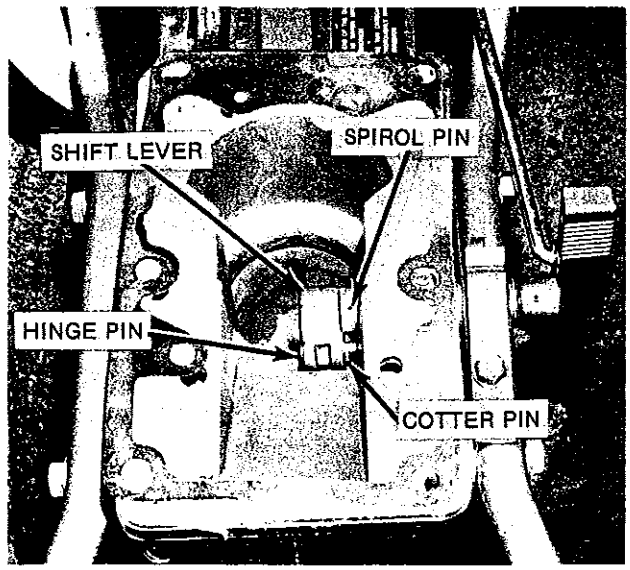


Figure 7

F. Models equipped with a clutch, remove the clutch shift mechanism as follows:

(1) Remove the hex nut, flat washer and Viton seal from the water tube (Figure 5).
(2) Remove lower adaptor plate.
(3) Drive out the spirol pins in the clutch dog and cam (Figure 6).
(4) Remove the shift rod and knob.
(5) Remove exhaust deflector and gasket.
(6) To remove the knob from the shift rod, drive out the spirol pin.

G. To disassemble FN shift mechanism, proceed as follows:

(1) Remove cotter pin and hinge pin (Figure 7).
(2) Drive out spirol pin and remove shift lever and washer.
(3) Remove flat spring and shift rod cam (Figure 8).
(4) Remove shift handle, shaft and lockout rod.
(5) Remove nyliner flange bushing in carrier handle.
(6) To remove bushing and "O" ring in column housing, remove carrier handle so bushing
(6) To remove bushing and "O" ring in column housing, remove four screws securing carrier handle to column and move carrier handle so bushing and "O" ring are accessible.

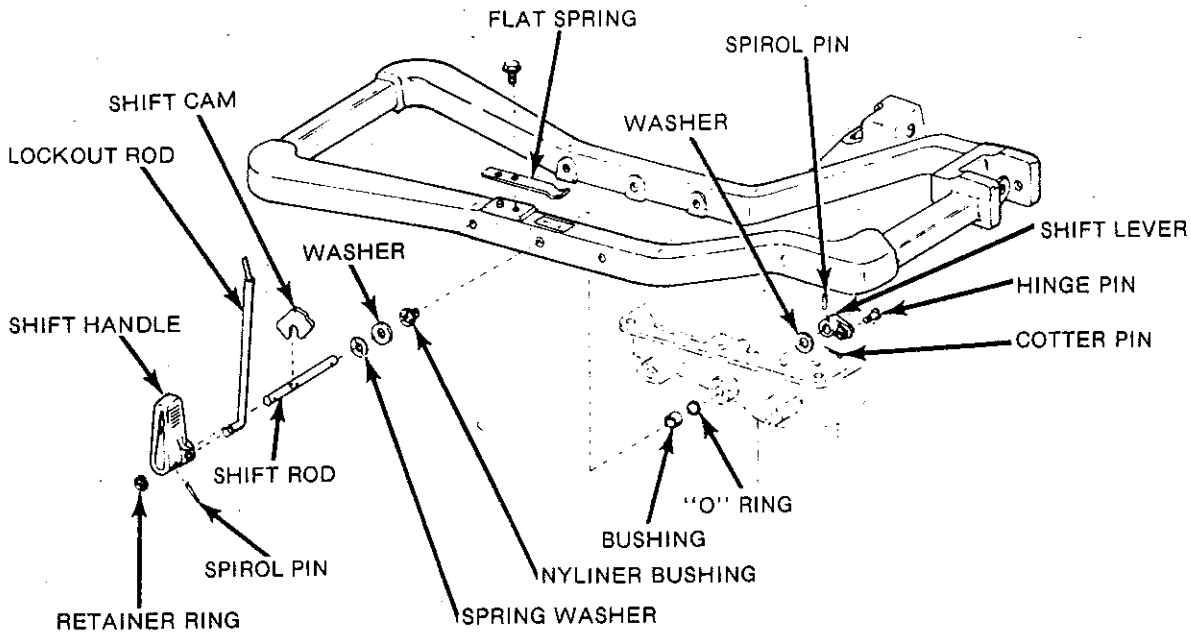


Figure 8

H. Outboards manufactured prior to 1976, perform the following:

(1) Remove water tube nut, washer and seat (Figure 9).
(2) Remove lower adaptor plate and gasket.
(3) Remove exhaust deflector and gasket.
(4) Remove upper adaptor plate from engine by removing the six screws.

I. Outboards manufactured after 1975, perform the following:

(1) Remove column gasket.
(2) Remove six screws securing the exhaust plate and top plate to engine.
(3) Remove water tube "O" ring from exhaust plate.

J. Remove steering handle or carrying handle, if so equipped (Figure 10).

3. **REASSEMBLE POWER HEAD PARTS (All Models Except Deluxe Mfg. During 1978 And Later)**

A. Install steering handle or carrying handle, if used, except on FN models.

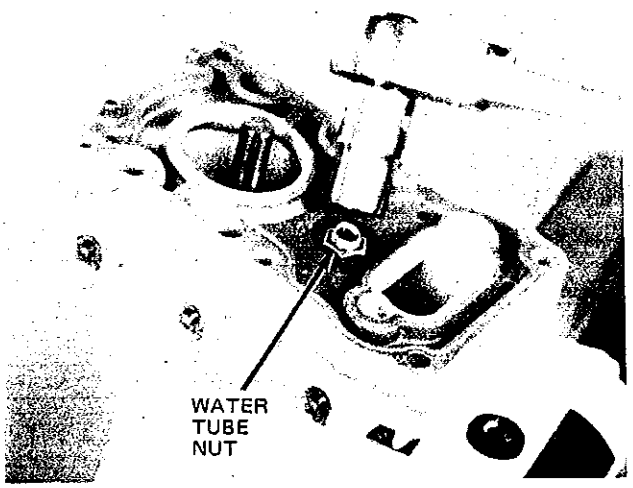


Figure 9

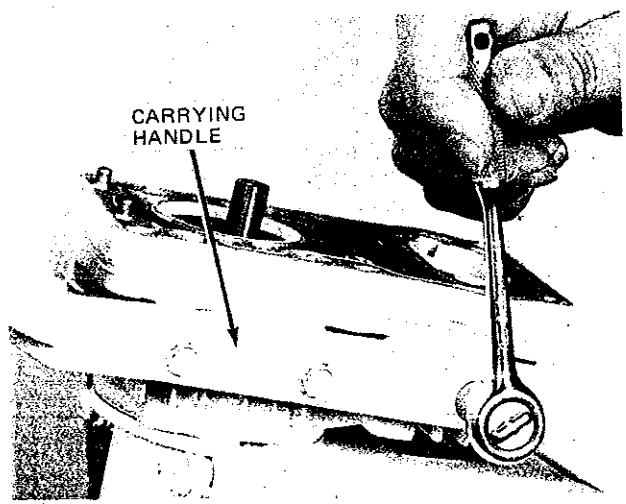


Figure 10

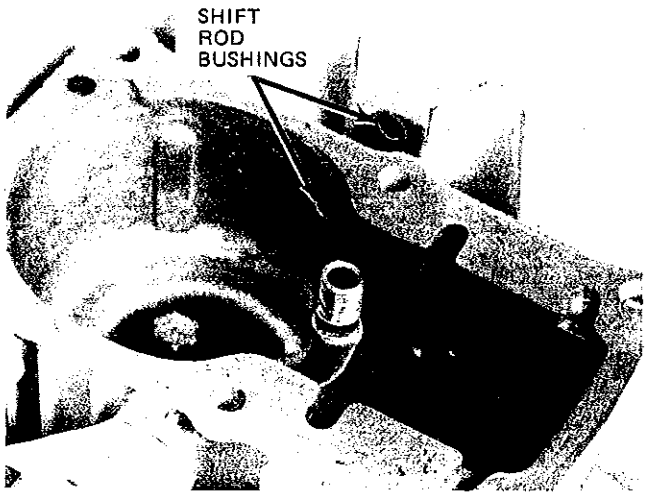


Figure 11

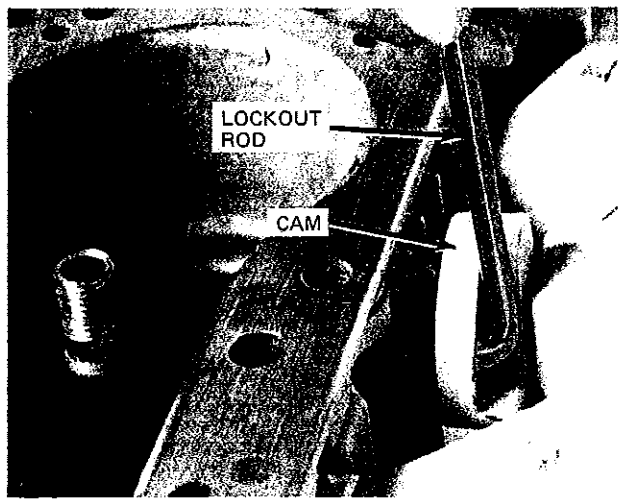


Figure 14

NOTE

Clean all gasket surfaces prior to reassembly. Whenever gaskets are removed, a new gasket should be installed.

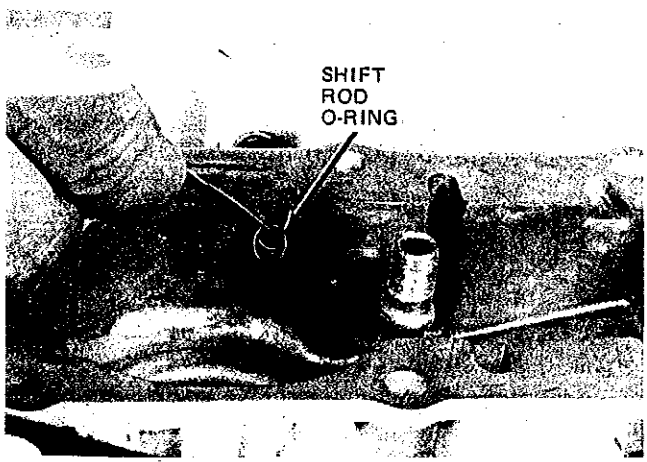


Figure 12

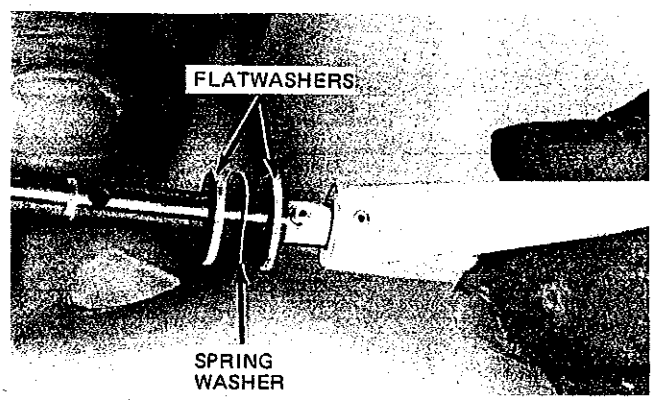


Figure 13

B. Models equipped with a clutch, perform the following:
   (1) Inspect the shift rod bushings in the carrier handle and column housing. Replace if worn or damaged (Figure 11).
   (2) Install a new shift rod "O" ring in the column housing (Figure 12).
   (3) Install column top gasket and exhaust deflector on column housing.
   (4) Assemble shift rod, knob, flat washers and spring washers as shown in Figure 13.
   (5) Assemble lockout rod to cam. Secure with retaining ring.
   (6) Assemble cam and shift rod into carrier handle and column (Figure 14).
   (7) Line up holes in cam and shift rod and install spirol pin.
   (8) Install clutch dog and flat washer on shift rod as shown in Figure 15.

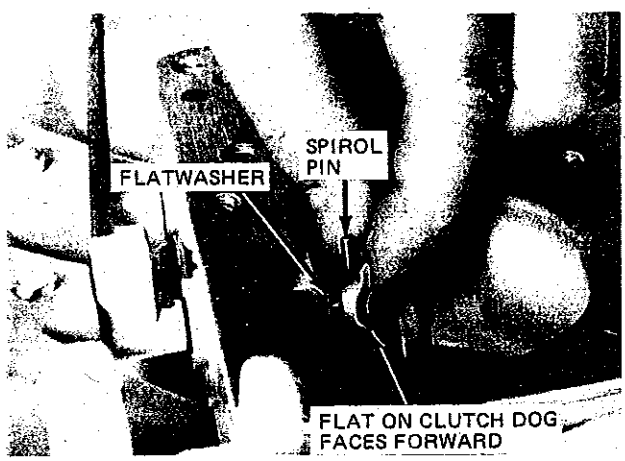


Figure 15

(9) Install upper adaptor plate and gasket on engine block and secure with 4 twelve point screws and 2 slotted fillister head screws.
(10) Install woodruff key in crankshaft.
(11) Install clutch assembly on crankshaft and tighten setscrew.
(12) Install a new "O" ring in the splined end of the clutch.

C. Install shift mechanism on FN models as follows:

(1) Install "O" ring and sleeve bushing in column (Figure 8).
(2) Install carrying handle.
(3) Install nyliner bushing in carrying handle.
(4) Install shift handle on shift rod and retain with spirol pin.
(5) Install lockout rod on shift handle and retain with retaining ring.
(6) Install spring washer and flat washer on shift rod and insert shift rod in carrying handle and column.
(7) Place flat washer and then shift lever on shift rod.
(8) With shift handle and shift lever in positions shown in Figure 7, drive spirol pin into shift lever and rod.
(9) Connect column link rod with shift lever and install hinge pin and cotter pin.
(10) Install shift cam on shift rod with cam positioned as shown in Figure 16.
(11) Install flat spring.

D. Outboards manufactured prior to 1976, perform the following:

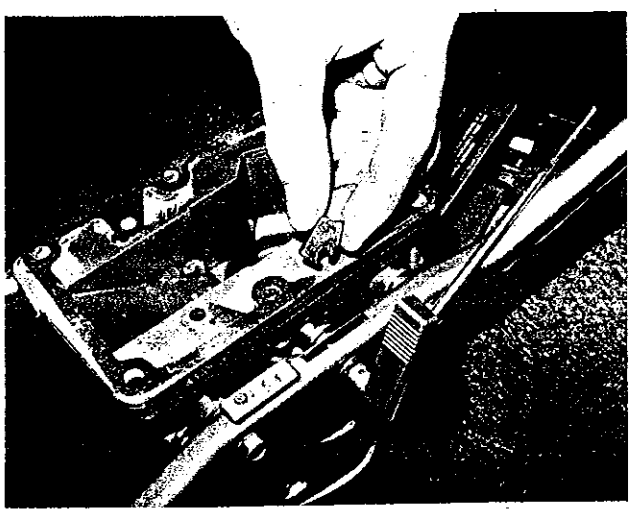


Figure 16

(1) Attach the upper adaptor plate and gaskets to the engine with six screws.
(2) Place the column top gasket, exhaust deflector and gasket, and lower adaptor plate and gasket on the column assembly.
(3) Install water tube seal, flat washer and nut.

E. Outboards manufactured after 1975 perform the following:

(1) Install the top plate and gaskets, and the exhaust plate and gaskets to the engine with six screws.
(2) Install water tube "O" ring in exhaust plate.
(3) Install column top gasket on column.

F. Clean and lubricate drive shaft splines with Lithium grease.

G. Install engine assembly on the column. If equipped with a clutch or FN perform the following:

(1) Move the shift lever to drive position.
(2) Lower the engine onto the column while guiding the lockout rod and spring, if used, into position (Figure 17).
(3) Rotate the propeller or engine crankshaft to make sure the clutch or crankshaft splines and drive shaft splines are properly engaged.

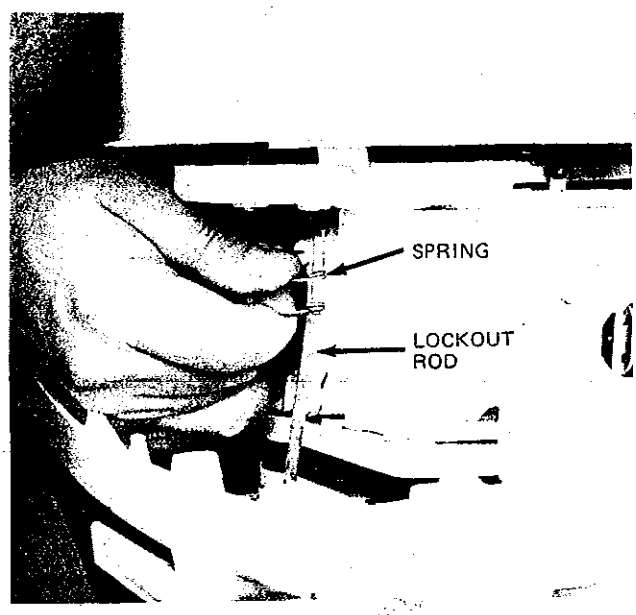


Figure 17

H. If equipped with a control panel, proceed as follows:

(1) Install control panel with four slotted fillister head screws.
(2) Install starter rope through hole in control panel and attach starter handle.
(3) Release slip knot in starter rope during disassembly.

I. Install control knobs and reconnect linkage.

J. Connect fuel lines.

K. Replace hood.

4. REMOVE POWER HEAD PARTS (MODELS EQUIPPED WITH FNR DRIVE)

A. Remove the hood as follows:

(1) Pull the starter rope out so that a slip knot can be tied in the rope approximately 18 inches (46 cm) from the handle.
(2) Release the rope until it stops.
(3) Pry out the metal channel from the starter handle and untie the knot in the end of the starter rope. Remove the handle and channel from the rope.
(4) Pull out on the hood release latch and lift off the hood.

B. ENGINE REMOVAL.

(1) Remove retaining ring, spring washer and hinge pin from throttle link lever and engine throttle arm (Figure 18).
(2) Refer to Figure 19 and disconnect the choke as follows:
a. Drive out the spirol pin that secures the choke lever to the choke control rod.
b. Remove the cotter pin from the choke control rod and remove the choke control rod, flat washer and spring.

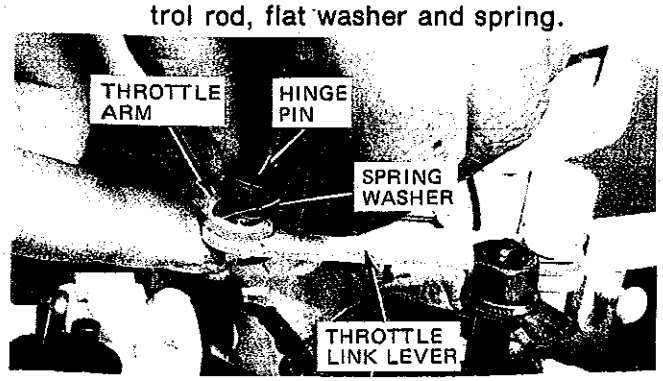


Figure 18

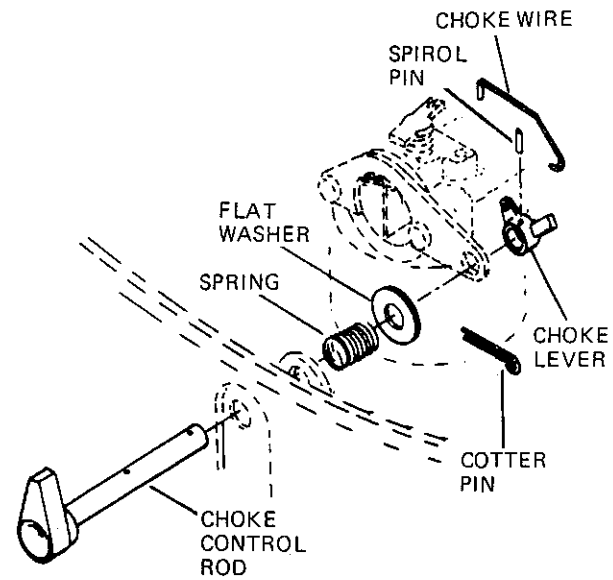


Figure 19

c. Disconnect the choke wire from the carburetor.
(3) Disconnect the fuel line from the carburetor.
(4) Disconnect ground wires from stop switch. (Stop switch not used in models manufactured after 1975.)
(5) Remove the four flange nuts and two washer head screws that secure the top adaptor plate to the lower adaptor plate (Figure 20).
(6) Lift the engine and top adaptor plate off the column.
(7) Remove the four 12-point screws and two slotted head screws to remove the top adaptor plate from the engine.

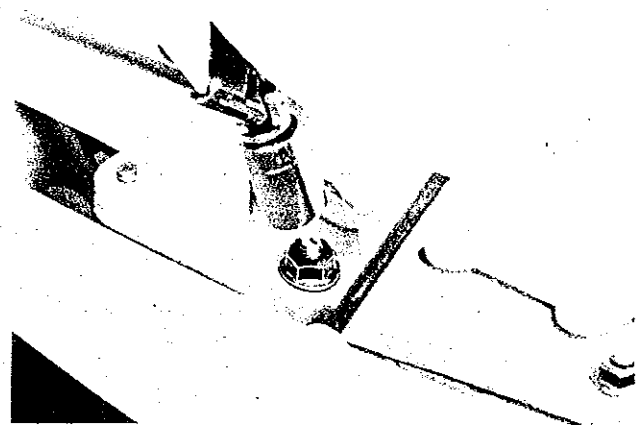


Figure 20

C. CARRIER HANDLE AND ADAPTOR HOUSING REMOVAL

(1) Remove the engine assembly (Para. 4B).
(2) Remove the swivel bracket assembly (Para. 12).
(3) Remove the nut, washer and Viton seal from the water tube.
(4) Remove the lower adaptor plate and gasket from the exhaust deflector.
(5) Remove the hitch pin from the link rod at the shift lever cam (Figure 21).
(6) Remove the screw from the shift linkage lever and slide the shift linkage lever off the center shift rod (Figure 22).
(7) Remove the column from the adaptor housing by removing the six socket head screws (Figure 23).
(8) Separate the carrier handle and adaptor housing by removing the three flange nuts and flat washers.

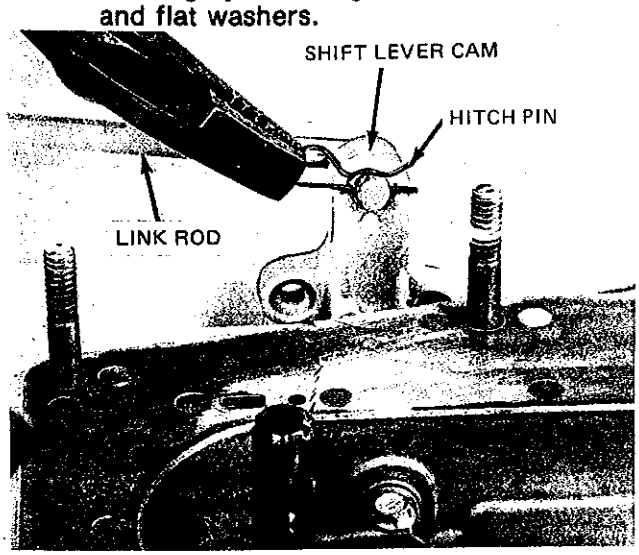


Figure 21

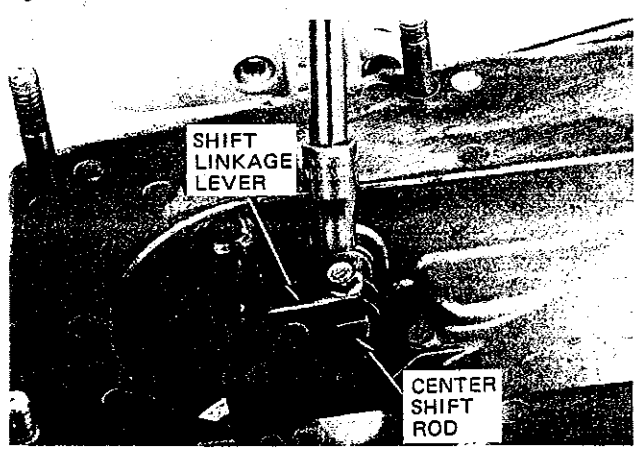


Figure 22

Figure 23

(9) Pull the center shift rod out of the adaptor housing.
(10) Remove the exhaust deflector from the adaptor housing.

D. HANDLE LATCH LEVER (Figure 24). This mechanism is located in the center of the control panel.

(1) Using a 1/2-inch wrench, remove the hex nut, lockwasher, and hood lock cam.

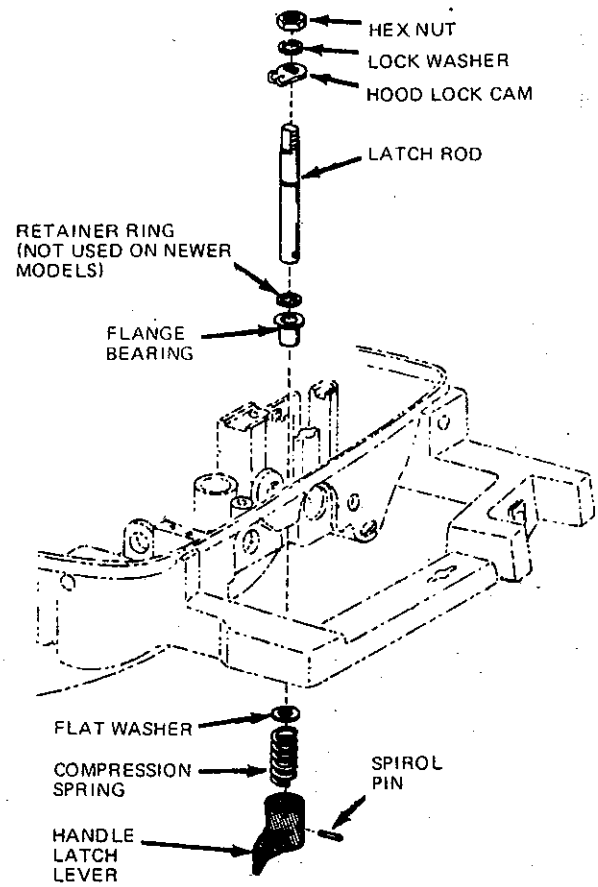


Figure 24

(2) Push up on the bottom of the handle latch lever, and with long nose pliers remove the retainer ring. (Retainer ring is replaced by a spacer on models after 1975.)
(3) Withdraw the handle latch lever, compression spring, flat washer, and latch rod as a unit, and finally the flange bearing.
(4) To separate the latch rod from the handle latch lever, place it in a vise with soft jaws and use a pin punch and hammer to drive out the spirol pin.
(5) Clean all parts with solvent and inspect. Replace any damaged parts. Lubricate latch rod and hood lock cam with lithium grease.
(6) To replace the latch rod in the handle latch lever, place the latch rod in a vise with soft jaws and install the handle latch lever. Use a hammer to drive the spirol pin into the positioning holes.
(7) Place the flange bearing into position and hold it in place while installing the latch rod, flat washer, compression spring, and handle latch lever as a unit.
(8) Push up on the bottom of the handle latch lever and install the retainer ring (if used) in the groove using pliers. Install spacer on models after 1975.
(9) Replace the hood lock cam, split lockwasher, and hex nut. Secure with a 1/2-inch wrench.

E. REASSEMBLE CARRIER HANDLE AND ADAPTOR HOUSING

NOTE

Clean all gasket surfaces prior to reassembly. Whenever gaskets are removed a new gasket should be installed.

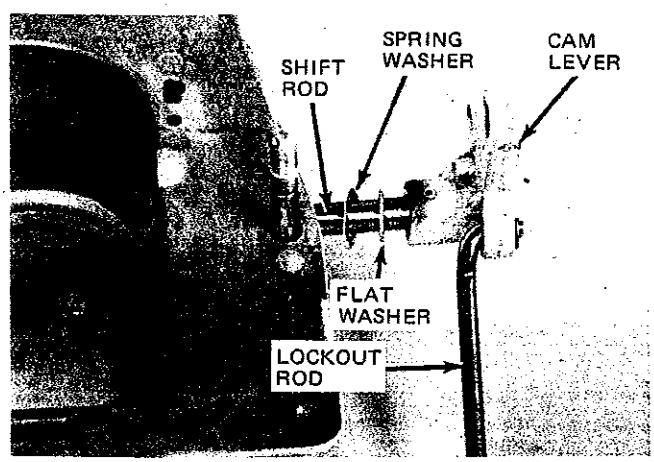


Figure 25

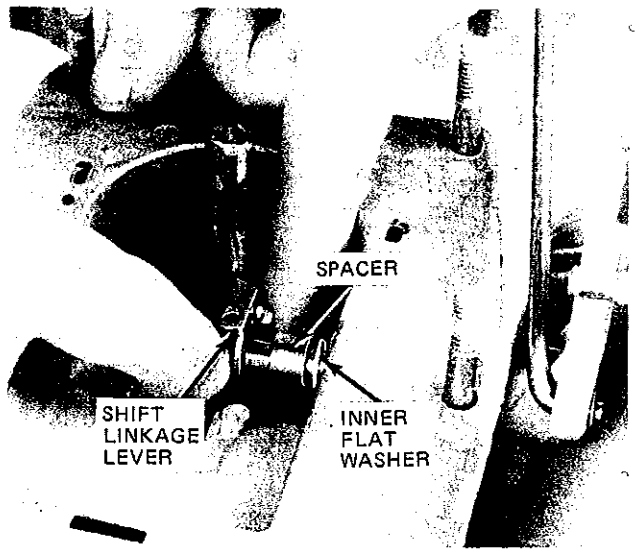


Figure 26

(1) Inspect center shift rod bearing in adaptor housing for damage or wear, replace if necessary.
(2) Install a new center shift rod "O" ring in the adaptor housing.
(3) Install exhaust deflector and gasket on adaptor housing.
(4) Assemble shift rod, cam lever, lock-out rod, flat washer and spring washer, and install in adaptor housing (Figure 25).
(5) Install the rubber mounts in the carrier handle.
(6) Install the adaptor housing in the carrier housing and secure with three flat washers and flange nuts.
(7) Install a new gasket on the column and assemble the adaptor housing and carrier handle to the column with six socket head screws.
(8) Install swivel bracket assembly (Para. 13).
(9) Install the inner flat washer, spacer and shift linkage lever on the center shift rod. Install and tighten the screw in the shift linkage lever (Figure 26).
(10) Install the lower adaptor plate and gasket on the exhaust deflector.
(11) Install the water tube packing, flat washer and hex nut.
(12) Assemble the link rod and hitch pin to the shift lever cam.

F. ENGINE INSTALLATION.

(1) Install a new gasket and top adaptor plate on the engine and secure with four 12-point screws and two slotted head screws.

(2) Install a new gaket on the lower adaptor plate.
(3) Place the gear selector in "F" position and lower the engine onto the mounting studs while guiding the lockout rod into the flywheel housing.
(4) Rotate the propeller or engine crankshaft to make sure the crankshaft splines and drive shaft splines are properly engaged.
(5) Secure the engine to the column with four flange nuts and two hex head screws.
(6) Connect the fuel line to the carburetor.
(7) Connect the magneto wires to the stop switch (if used).
(8) Attach the choke wire to the carburetor choke arm and the choke lever.
(9) Insert the choke rod and knob assembly into the carrier handle and assemble the nyliner, spring, flat washer and choke lever on the rod (Figure 27).

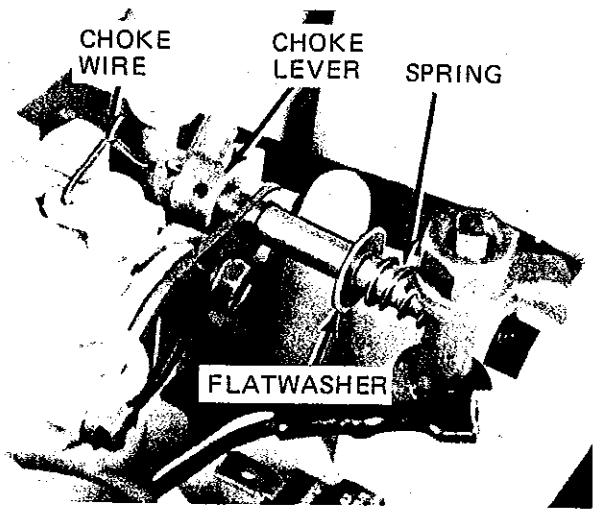


Figure 27

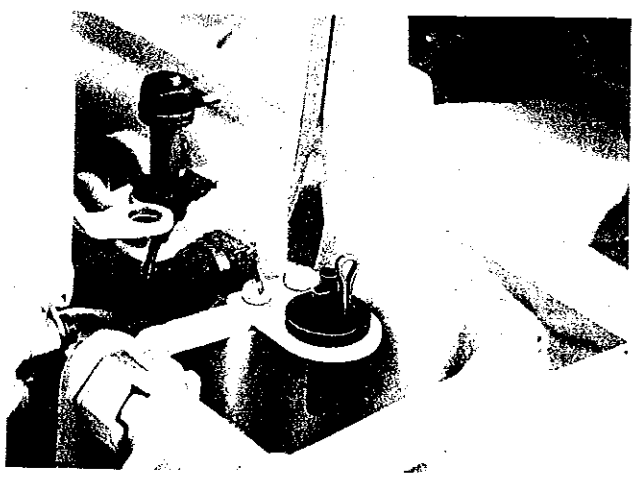


Figure 28

(10) Compress the spring and install the cotter pin with the flat washer between the spring and cotter pin.
(11) Align the holes in the choke lever and choke rod and drive in the spirol pin.
(12) Connect the throttle lever link to the throttle lever on the engine and install the hinge pin, spring washer, sleeve bearing and retainer ring.

G. SHIFT LEVER PARTS.

(1) Place shift lever in neutral.
(2) Remove the shear pin holder and flat spring by removing the two fillister head screws (Figure 28).
(3) Disconnect the link rod from the shifter bracket.
(4) Remove the shifter bracket and cam by driving out the spirol pin in the shifter bracket.
(5) Remove the handle from the rod by driving out the spirol pin in the handle.
(6) Inspect the flange bushings for damage or wear and replace if necessary.
(7) Inspect the shifter bracket and cam for elongated holes and worn down cam lobes. Replace if necessary.
(8) Fasten the handle to the rod with a spirol pin.
(9) Assemble the rod and handle, shifter bracket, and cam into the carrier handle.
(10) Fasten the shifter bracket to the rod with a spirol pin.
(11) Connect the link rod to the shifter bracket and secure with the hitch pin.
(12) Install the shear pin holder and flat spring and secure with two fillister head screws.

5. REMOVE POWER HEAD PARTS (Deluxe Models Manufactured During 1978 And Later)

A. Remove hood.

B. Remove fuel lines.

C. Pull starter rope out of starter housing and tie a knot in rope to prevent rope entering starter housing.

D. Pry metal channel from starter handle, untie knot and remove handle and channel from starter rope (Figure 3).

E. Disconnect choke rod.

F. Disconnect throttle rod.

G. Separate the engine assembly from the column assembly by removing six screws securing the upper adaptor plate to the column.

H. Remove column gasket.

I. Remove six screws securing the exhaust plate and top plate to engine.

J. Remove water tube "O" ring from exhaust plate.

K. To remove carrier handle, remove flange nut on front underside and two flange nuts located on inside and to rear of carrier handle.

L. Refer to paragraph 4D to remove and assemble handle latch lever.

M. To remove shift components, refer to Figure 29 and proceed as follows:

(1) Disconnect column shift rod from shift lever by removing cotter pin and hinge pin.
(2) Drive out spirol pin in shift lever.
(3) Remove flat spring.
(4) Catch shift lever and washer while removing shift handle and rod.
(5) Drive out spirol pin and remove cam.
(6) Drive out hinge pin and remove shift handle.
(7) If necessary, drive out bushings in column and remove "O" ring.

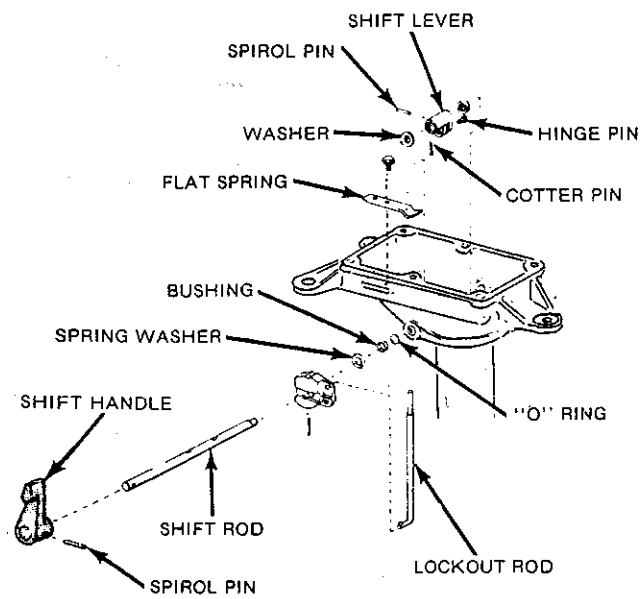


Figure 29

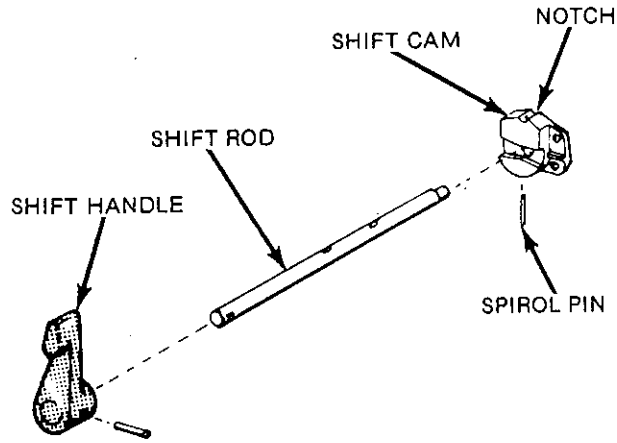


Figure 30

6. **REASSEMBLE POWER HEAD PARTS (Deluxe Models Manufactured During 1978 And Later)**

NOTE

Clean all gasket surfaces prior to reassembly. Whenever gaskets are removed a new gasket should be installed.

A. Proceed as follows to install shift components:
(1) Install "O" ring in shift rod bore in column nearest flat spring location.
(2) Install sleeve bushings.
(3) Install shift handle on shift rod and retain with spirol pin.
(4) Install shift cam on shift rod so notch aligns with shift handle as shown in Figure 30. Retain shift cam with spirol pin.
(5) Install lockout rod on shift cam.
(6) Place spring washer on shift rod and insert shift rod in column.
(7) Install washer and then shift lever on shift rod as shift rod enters drive shaft bore of column.
(8) Position shift lever on shift rod so arms on shift lever are pointing downward while shift handle is vertical. Drive spirol pin into shift lever and shift rod.
(9) Install flat spring.

B. Install carrier handle.

C. Install the top plate and gaskets, and the exhaust plate and gaskets to the engine with six screws.

D. Install water tube "O" ring in exhaust plate.

E. Install column top gasket on column.

F. Clean and lubricate drive shaft splines with lithium grease.

G. Install engine assembly on column while guiding lockout rod into position.

H. Connect throttle rod.

I. Connect choke rod.

J. Thread starter rope through carrier handle and attach channel and starter handle.

K. Connect fuel lines.

L. Install hood.

7. REMOVE AND REPLACE TWIST GRIP ASSEMBLY PARTS

A. GENERAL. This section outlines procedures for removal and replacement of the parts and assemblies which comprise the twist grip. It is recommended that at the time this system is serviced, the twist grip decal be replaced. If you do not intend to replace the decal, mark the position of each gear as you disassemble the unit. When replacing the gear, put it in the same position. If this is done properly, the decal should be properly positioned with reference to the pointer on the hub.

B. HANDLE HUB AND (TWIST) HANDLE GRIP. The handle hub and (twist) handle grip is located in the right hand corner of the carrier handle. It operates the throttle linkage and is the steering control. Refer to following sections for disassembly.

(1) On models manufactured prior to 1976 proceed as follows (see Figure 32):

a. Pry off the handle grip cap and use a 7/16-inch socket wrench to remove the flange nut and flat washer.

b. Pull off the handle grip, remove the slotted flat washer, and pull out the handle (Figure 33).

c. With the handle hub at 90 degrees to the carrier handle, push down the handle rod and remove the pin from the handle rod gear (Figure 31).

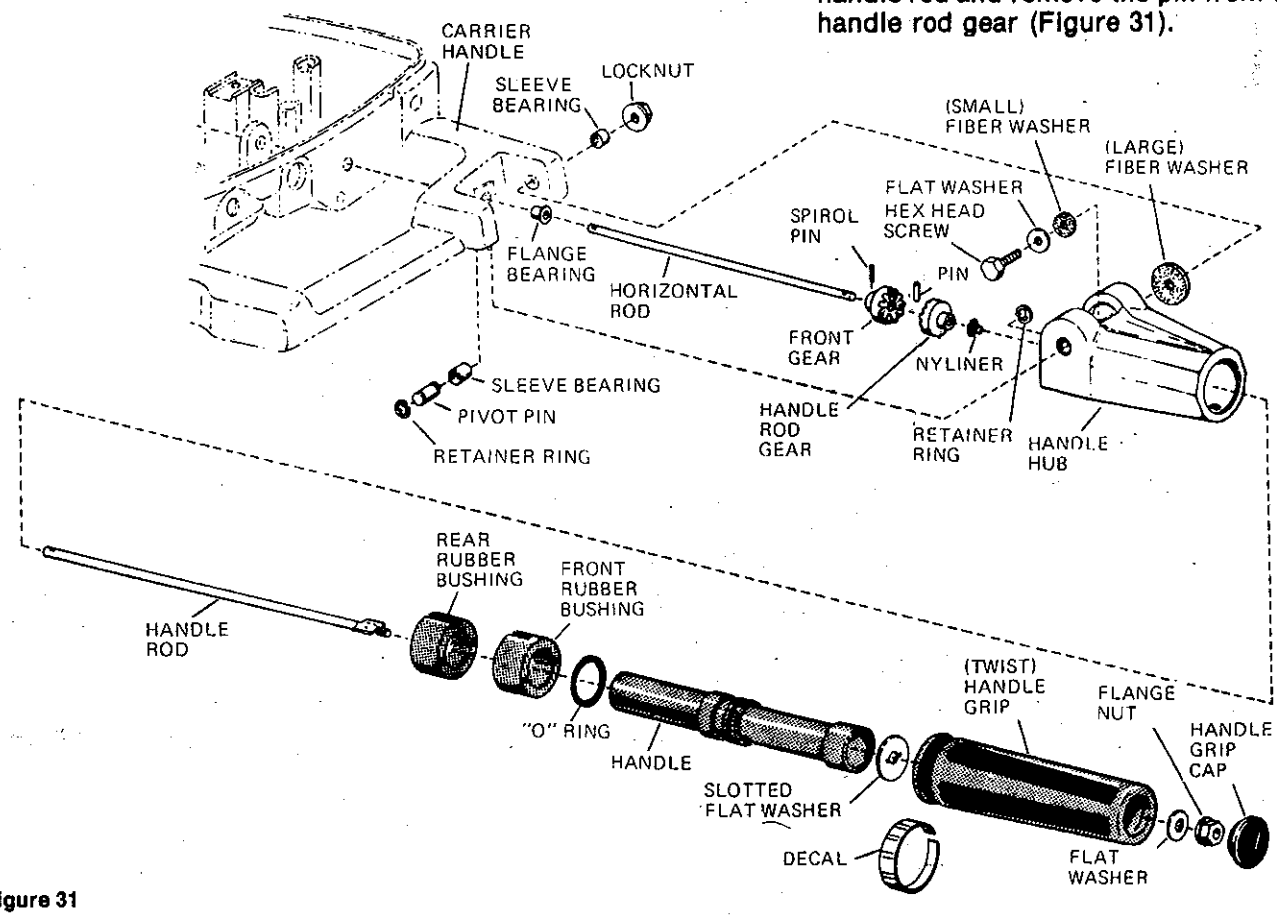


Figure 31

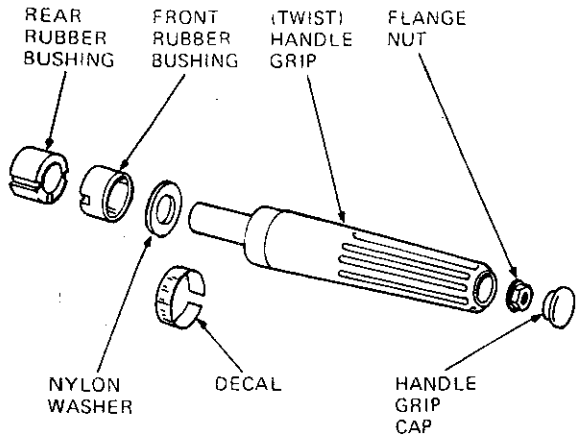


Figure 32

d. Withdraw the handle rod, and remove the handle rod gear and nyliner (Figure 34).
e. Pry loose and pull out the (front) and (rear) rubber bushings (Figure 35).
f. Use a pin punch and hammer to drive out the spirol pin in the front gear. Remove the front gear and flange bearing (Figure 31).
g. Use a 1/2-inch socket wrench and a 1/2-inch open end wrench to remove the hex head screw, flat washer, (small) fiber washer, and lock nut.
h. Remove the retainer ring and slide out the pivot pin.

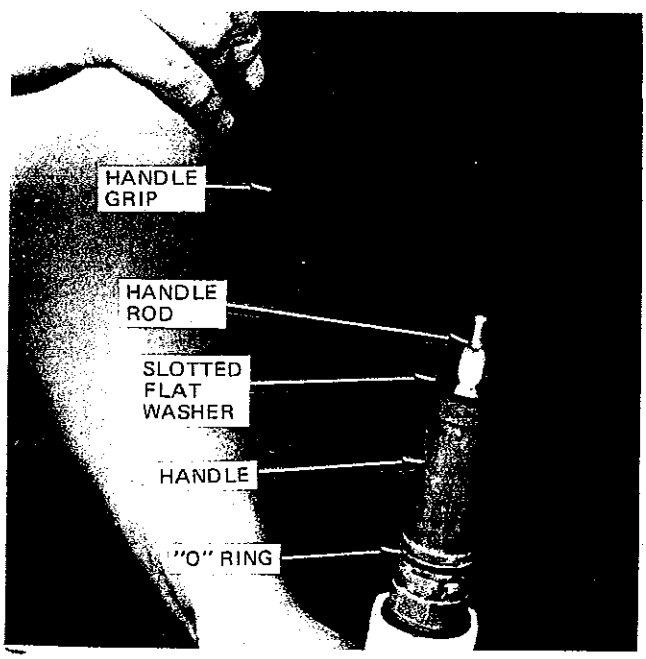


Figure 33

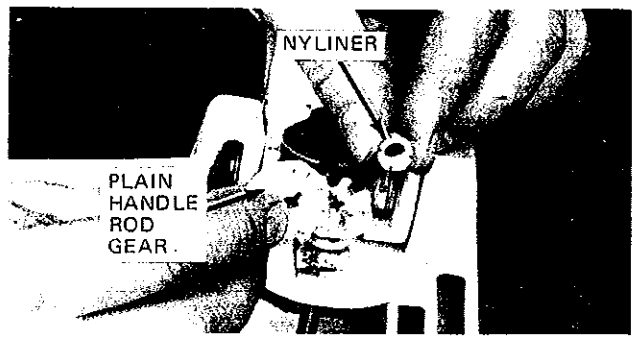


Figure 34

i. The sleeve bearings are a slip fit and should come out easily. If necessary, use a punch and hammer to tap them out.
j. Remove the handle hub and (large) fiber washer (Figure 31).

(2) On models manufactured in 1976 proceed as follows (see Figure 32):
   a. Pry off the handle grip cap and use a 7/16-inch socket wrench to remove the flange nut.
   b. Pull off the handle grip and remove the nylon washer.
   c. Follow steps (1)-c through (1)-j for models prior to 1976.

(3) On models manufactured after 1976 except Deluxe models manufactured during 1978 and later, proceed as follows (see Figure 36):

   a. Remove flat spring.
   b. Remove spring retainer and drive out pins on both sides of hub (Figure 37).
   c. Remove twist grip assembly.
   d. Remove wire retainer and drive out spirol pin in twist grip drive gear.

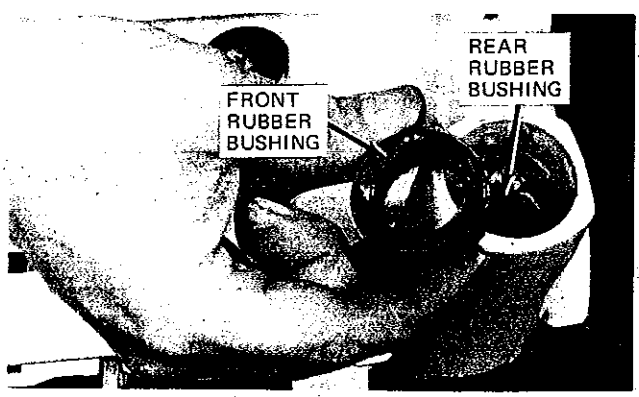


Figure 35

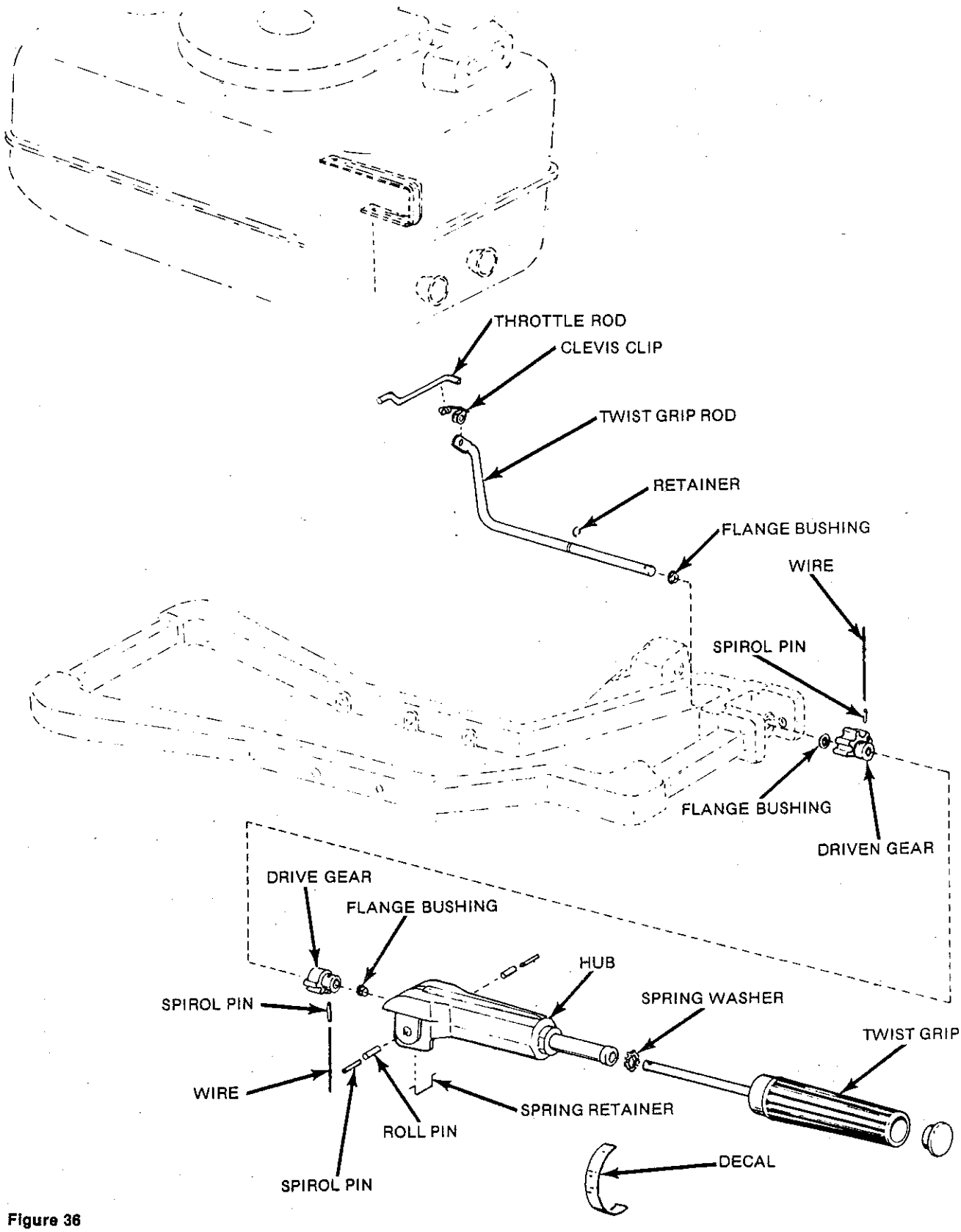

THROTTLE ROD
CLEVIS CLIP
TWIST GRIP ROD
RETAINER
FLANGE BUSHING
WIRE
SPIROL PIN
FLANGE BUSHING
DRIVEN GEAR
DRIVE GEAR
FLANGE BUSHING
HUB
SPIROL PIN
SPRING WASHER
TWIST GRIP
WIRE
SPRING RETAINER
ROLL PIN
SPIROL PIN
DECAL

Figure 36

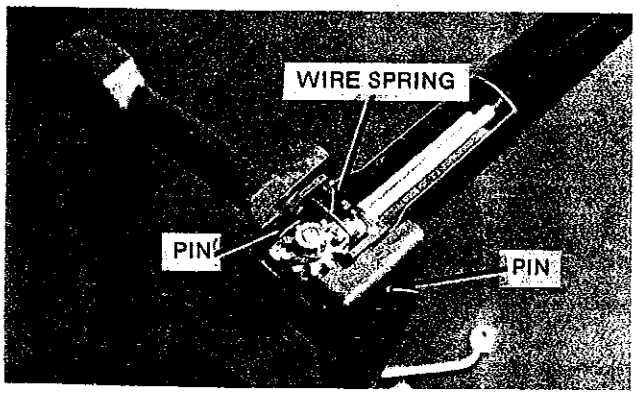


Figure 37

e. Remove drive gear and withdraw twist grip. Nyliner may now be removed from twist grip hub.

(4) On Deluxe models manufactured during 1978 and later, proceed as follows:

a. Remove hood and disconnect throttle rod.
b. Remove flat spring.
c. Remove driven gear wire retainer and drive out spirol pin in driven gear (Figure 38).
d. Remove driven gear.
e. Unscrew set screw and remove handle hub pivot screw.
f. Remove hinge pin retainer ring.
g. Drive out hinge pin.
h. Remove twist grip assembly by moving downward while pushing twist grip rod in to clear twist grip drive gear.
i. Pry off handle grip cap and remove flange nut.
j. Pull off handle grip and remove nylon washer.
k. Pry loose and pull out rubber bushings (Figure 35).

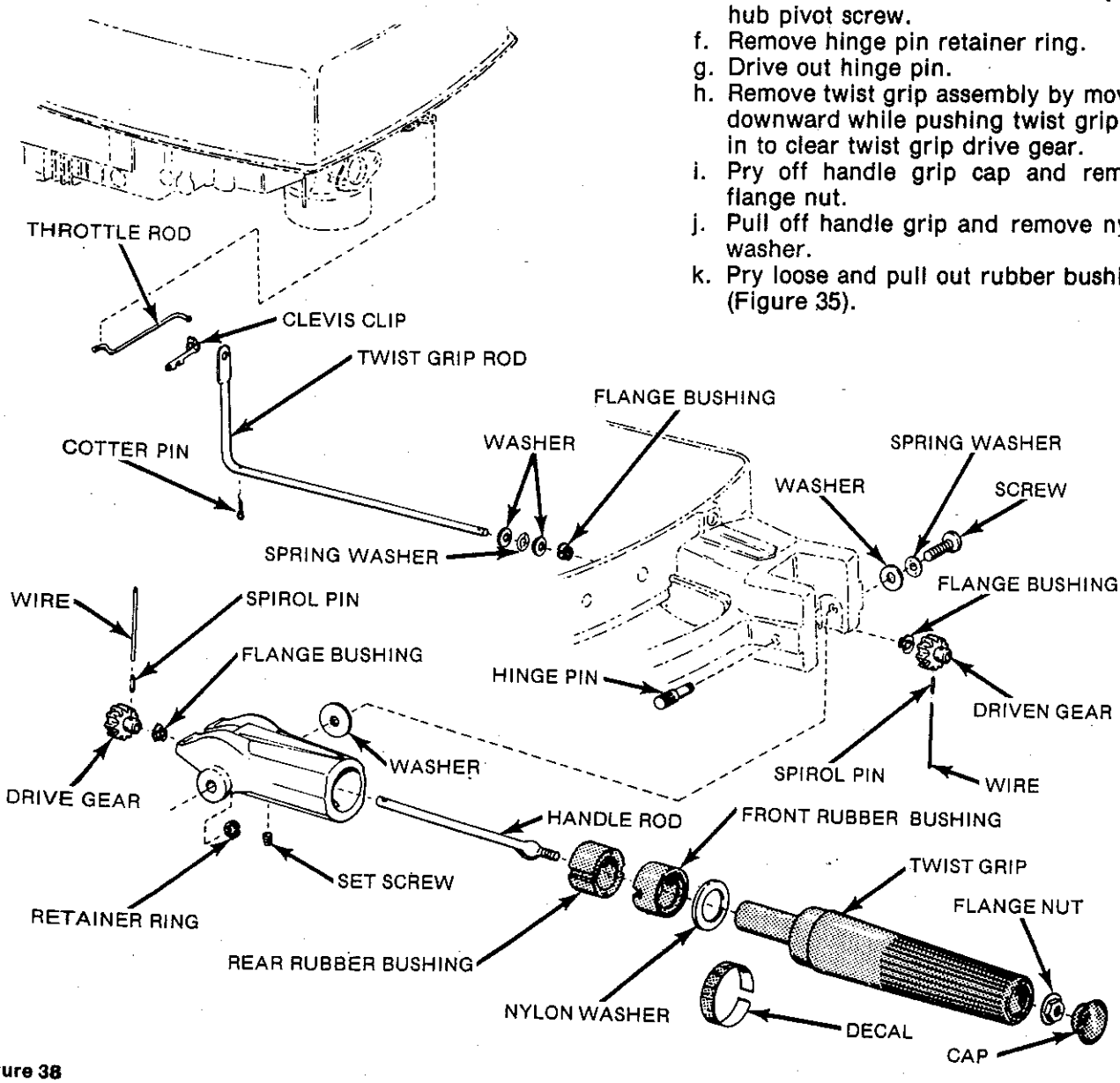


Figure 38

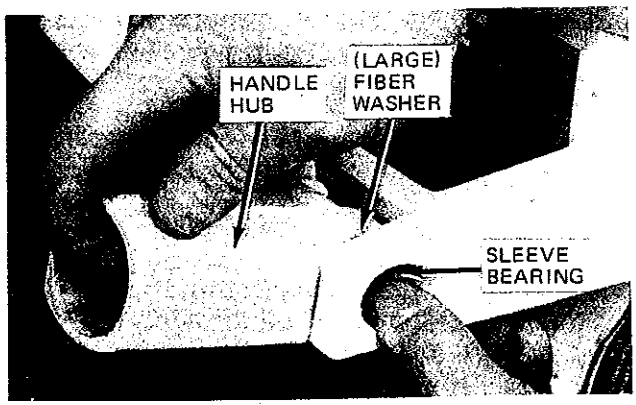


Figure 39

l. Drive out spirol pin and remove drive gear and flange bushing.
m. Remove twist pin rod.

C. Clean and inspect all parts; replace damaged parts. Lubricate the gears with lithium grease. Lubricate "O" ring in handle of models prior to 1977 with lithium grease. Lubricate the sleeve bearings on models prior to 1977.

D. To reassemble handle hub and twist grip on models prior to 1977, proceed as follows:
(1) Place the handle hub and (large) fiber washer in position and insert the sleeve bearings into the carrier handle (Figure 39).
(2) Install the pivot pin and replace the retainer ring.
(3) Install the hex head screw, flat washer, and (small) fiber washer. Fasten with lock nut and tighten with a 1/2-inch socket wrench and a 1/2-inch open end wrench. Use Loctite "A", or equivalent on the nut.
(4) Install the flange bearing and front gear. Replace the spirol pin using a hammer and punch.
(5) Insert the (front) and (rear) rubber bushings; check for proper alignment and fit.
(6) With the handle hub turned to a 90-degree angle to the carrier handle, install the nyliner and position the handle rod gear as shown in Figure 31.
(7) Push the handle rod down through the handle hub, nyliner, and handle rod gear. Install the (gear) pin and pull the rod up through the handle hub.
(8) Turn the hub handle back down to a position in line with the carrier handle and push in the handle. Install the slotted flat washer onto the handle rod and push on the handle grip.

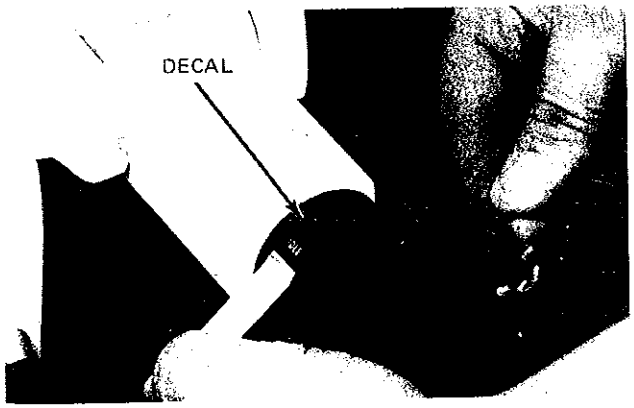


Figure 40

(9) (Models manufactured in 1976.) Install nylon washer on twist grip handle and push the handle shank into the handle hub.
(10) Replace the flat washer and flange nut. Tighten the nut to provide suitable twist-grip operation of the throttle linkage. Replace the handle grip cap at the end of the handle grip.
(11) Following reassembly of the twist grip, place the gear selector in neutral and turn the twist grip counter-clockwise to the stop. Locate the new decal so that the word "Start" aligns with the pointer on the hub (Figure 40).

E. To reassemble handle hub and twist grip on models after 1976 except Deluxe models manufactured during 1978 and later, reverse disassembly procedure in step B (3). Following reassembly of twist grip, install new decal so "Stop" on decal is aligned with pointer when twist grip is turned clockwise against stop (Figure 41).

F. To reassemble handle hub and twist grip on Deluxe models manufactured during 1978 and later, proceed as follows:
(1) Insert front and rear rubber bushings; check for proper alignment and fit.
(2) Install nyliner bushing.
(3) Insert handle rod in hub and attach gear with pin to handle rod. Install wire retainer through pin and around gear.

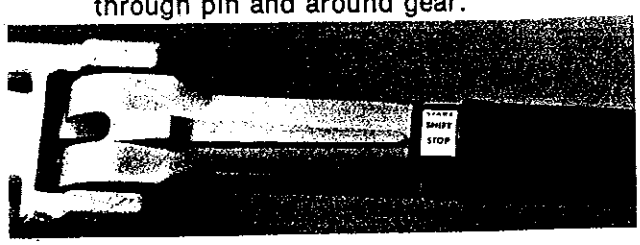


Figure 41

(4) Install nylon washer on twist grip and push twist grip into hub.
(5) Replace flange nut. Tighten nut to provide suitable twist grip operation.
(6) Install flange bushings and twist grip rod.
(7) Install twist grip assembly in carrier handle.
(8) Install hinge pin and retainer ring.
(9) Install hinge screw and set screw.
(10) Install driven gear on twist grip rod and drive spirol pin into gear and rod.
(11) Install wire retainer through spirol pin and around gear hub.
(12) Install flat spring.
(13) Connect throttle rod.
(14) Install hood.

8. REMOVE AND REPLACE THROTTLE LINKAGE PARTS (Twist grip models prior to 1977) (Figure 42)

A. Remove engine hood and control panel as necessary to gain access to the throttle linkage parts.
B. Disconnect the throttle control linkage from the engine throttle control arm by removing the retainer ring, hinge pin and spring washer.
C. Remove throttle control linkage, hub bracket, support bracket and vertical rod by removing hex head screw in support bracket.
D. To remove the vertical rod gear proceed as follows:

NOTE

Mark the vertical rod gear and rear horizontal rod gear before disassembly so that the gears can be reinstalled in the same position as before disassembly.

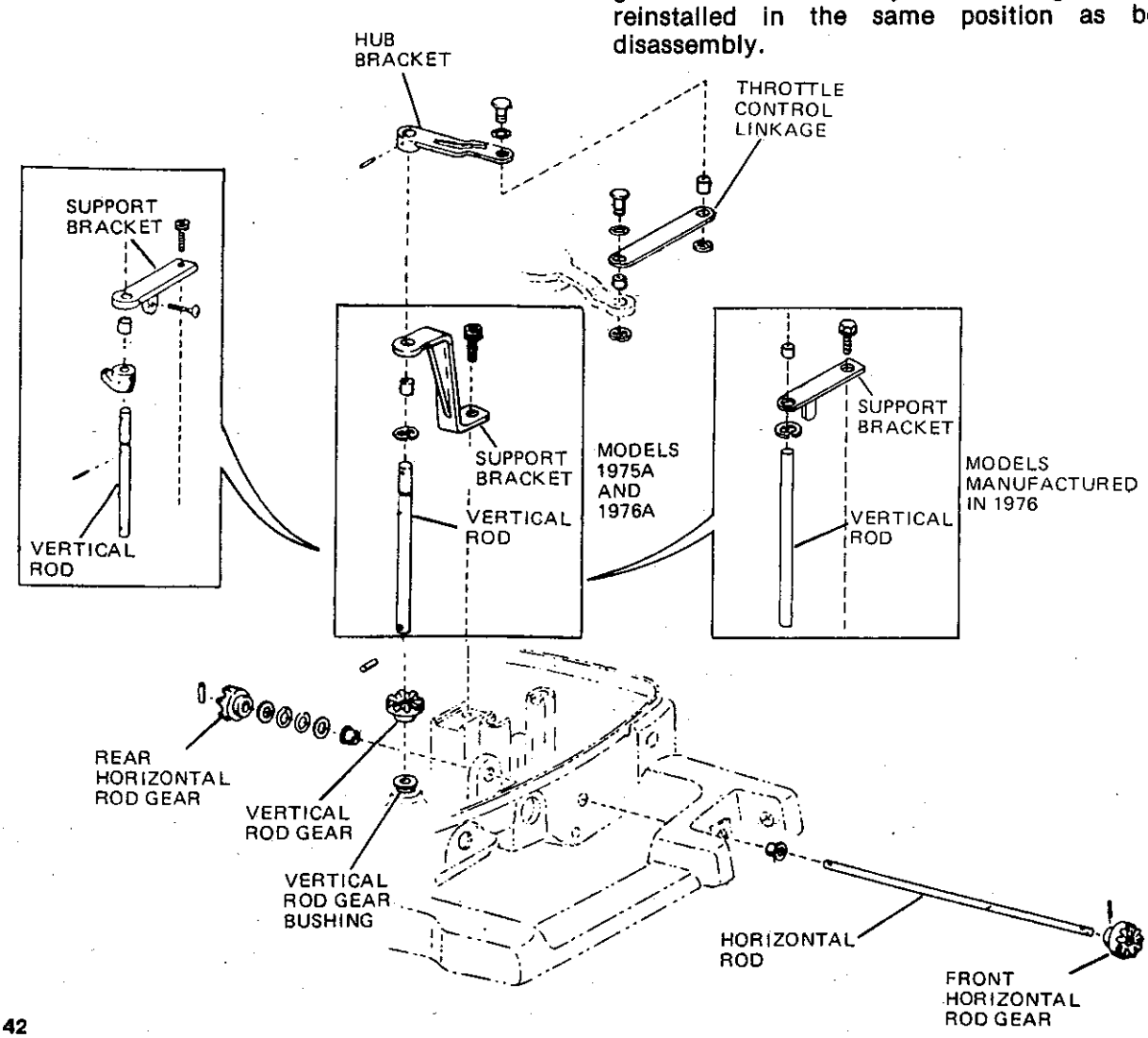


Figure 42

(1) Drive out the spirol pin from the front horizontal rod gear.
(2) Slide the rod rearward to remove the needle roller from the rear horizontal rod gear.
(3) Tilt the twist grip handle straight up.
(4) Slide the horizontal rod forward until the rear horizontal rod gear can be removed.
(5) Remove the vertical rod gear from the bushing.
(6) Inspect the vertical rod gear bushing.

NOTE

If replacement of the vertical rod gear bushing is required the engine assembly will have to be removed to provide room for a tap or expanding jaw slide hammer to be used on the bushing.

E. Install the vertical rod gear as follows:
(1) Lubricate the vertical rod gear with lithium grease and install in the bushing.
(2) Position the rear horizontal rod gear on the vertical rod gear with the marks made before disassembly lined up.
(3) Slide the horizontal rod rearward until the needle roller can be installed, then slide the horizontal rod forward to engage the needle roller in the gear slot.
(4) Line up the holes in the front gear and horizontal rod and drive in the spirol pin.

F. Inspect the throttle control linkage, hub bracket, vertical rod and support bracket for damage, misalignment or wear.

G. Assemble the throttle control linkage, hub bracket, vertical rod and support bracket.

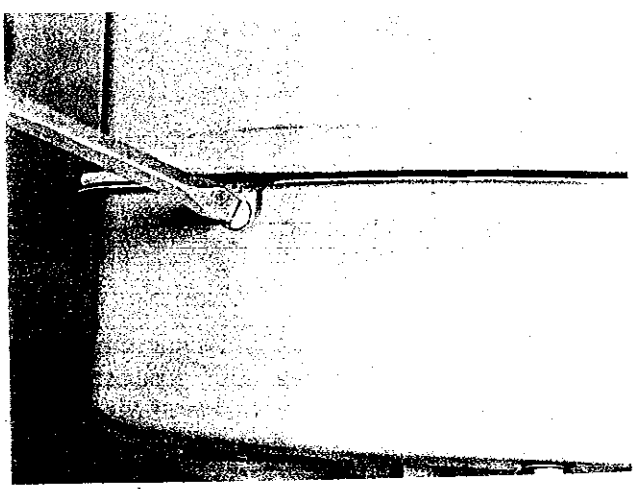


Figure 43

H. Insert the needle roller in the vertical rod and install the throttle control assembly.

I. Line up the needle roller in the vertical shaft with the slot in the vertical shaft gear.

J. Fasten the support bracket to the carrier handle with the hex washer head screw.

K. Fasten the throttle linkage to the throttle control arm on the engine with hinge pin, spring washer and retainer ring.

L. Install control panel and hood.

9. REMOVE THROTTLE LINKAGE PARTS (Twist grip models after 1976 See Figure 36.)

A. Remove four pan head screws from lower shroud. (See Figure 43.)

B. Drop lower shroud, moving to the left side to allow maximum space in which to work.

C. Remove rod and clevis clip.

D. At this point, other parts areas will be free to work.

10. REMOVE SWIVEL BRACKET AND MOUNTING BRACKETS

A. Lay the outboard on a bench so that no weight is on the swivel bracket.

B. Remove the four fillister head screws and springs from the swivel bracket cap.

C. Remove the swivel bracket and cap from the column.

D. Remove the liners and thrust collars.

E. Remove the nut, flat washer and carriage bolt that fasten the mounting brackets to the swivel bracket.

F. Remove the wing nuts, lock washers, flat washers and pawls to remove the thrust bracket.

G. To remove the stud and handle assembly from the mounting brackets, drive out the spirol pin that fastens the clamp pad stud to the stud and handle assembly.

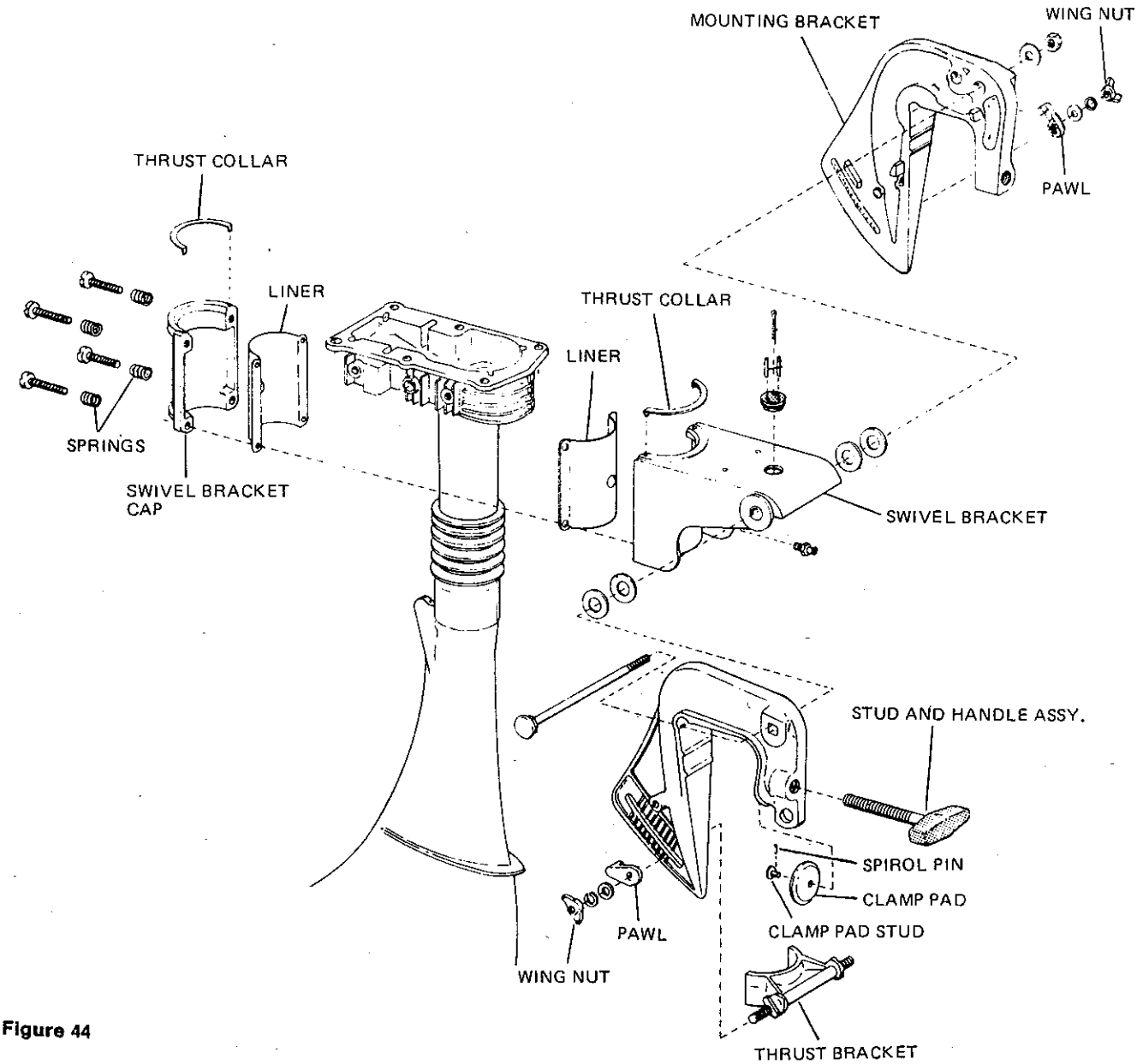


Figure 44

H. Remove the clamp pad and unscrew the stud and handle assembly from the mounting bracket.

11. REASSEMBLY OF SWIVEL BRACKET AND MOUNTING BRACKET

A. Lubricate the threads on the stud and handle assembly with lithium grease and screw them into the mounting brackets.

B. Assemble the clamp pad and clamp pad stud to the stud and handle and secure with the spirol pin.

C. Install the carriage bolt in the right hand mounting bracket.

D. Assemble the nylon washers, flat washers and swivel bracket onto the carriage bolt (Figure 45).

E. Attach the thrust bracket assembly to the right hand mounting bracket and assemble the pawl, flat washer, lock washer and wing nut to the thrust bracket stud (Figure 46).

F. Assemble the left hand mounting bracket to the swivel bracket and thrust bracket and sec-

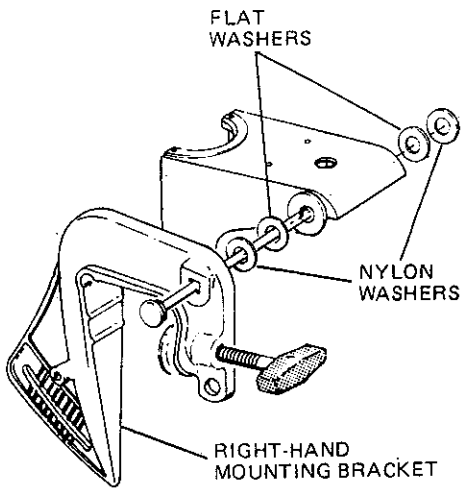


Figure 45. Install washers.

ure with the carriage bolt lock washer and nut, and the thrust bracket pawl, flat washer, lock washer and wing nut.

G. Install the liners and thrust collars in the swivel bracket and cap.

H. Clean the liners and thrust collars and coat with lithium grease.

I. Assemble the swivel bracket and swivel bracket cap to the column and install the springs and fillister head screws. Tighten the screws until the desired turning resistance in the column is obtained.

12. REMOVE SWIVEL BRACKET PARTS

A. Place the outboard on a workbench so that there is no weight on the swivel bracket.

B. Remove the springs from the column lock plate.

C. Remove the two steering adjustment tension screws and springs from the swivel bracket cover.

D. Remove the four self-locking nuts and flat washers from the swivel bracket cover.

E. Remove the swivel bracket cover, rubber cushion blocks and column lock bracket cap and liner.

F. Remove the swivel bracket cap, liners and thrust collars.

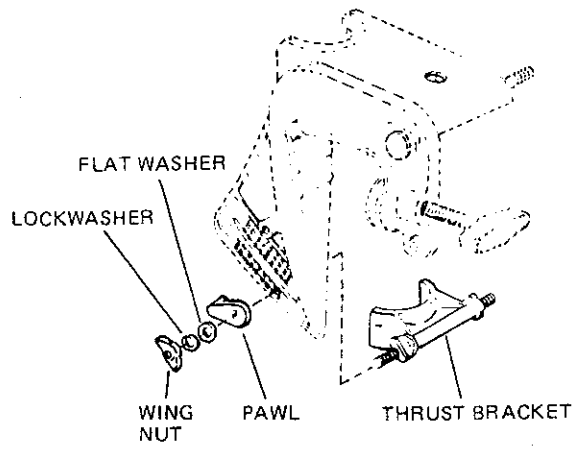


Figure 46. Install thrust bracket and pawl.

G. Remove the column lock and linkage as follows:

(1) Disconnect the linkage rod from the column release lever.
(2) Remove the linkage bell crank and spacers by removing the hinge pin from the swivel bracket.
(3) Remove the lock plate and release plate from the column lock bracket by removing the two truss head screws.
(4) Remove the hinge pin from the lock plate and release plate.

H. Remove the wing nuts, washers and pawls from the thrust bracket.

I. Remove the nut and flat washer from the carriage bolt in the mounting bracket.

J. Remove the left mounting bracket from the swivel bracket.

K. Pull out the carriage bolt to remove the column release lever and bushing, right mounting bracket, and rubber bushings from the swivel bracket.

L. Remove the tilt lock pin from the left mounting bracket by driving the spirol pin out of the tilt lock knob.

M. Remove the tilt brace plat from the right mounting bracket by driving out the spirol pin in the knob.

N. Remove the clamp stud and handle from the mounting brackets by driving out the spirol pin securing the clamp pad to the clamp stud.

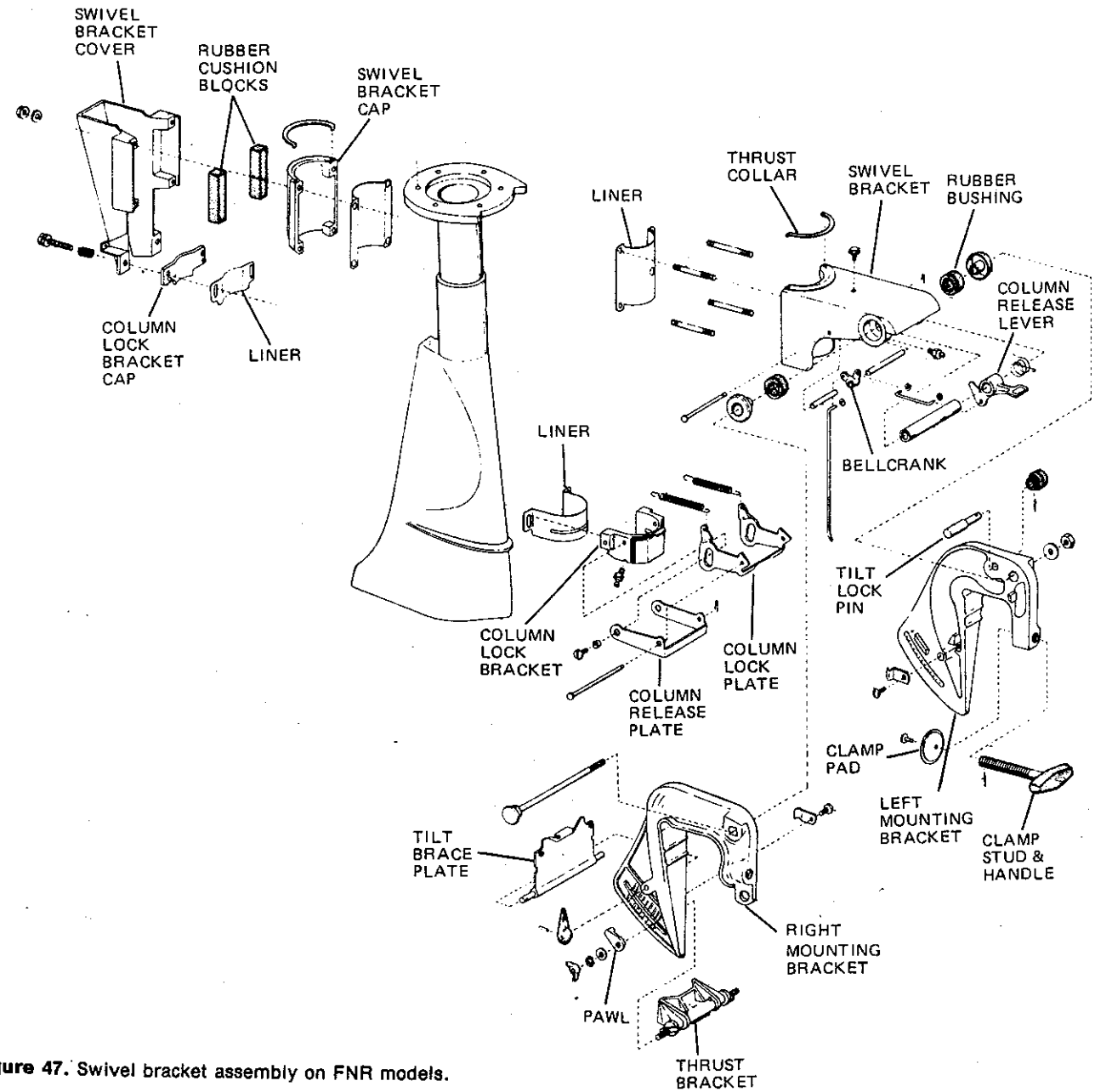


Figure 47. Swivel bracket assembly on FNR models.

13. REASSEMBLE SWIVEL BRACKET PARTS

A. Lubricate the clamp studs with lithium grease and screw them into the mounting bracket.

B. Assemble the clamp pads and clamp pad studs to the clamp studs and secure with the spirol pins.

C. Install the tilt lock pin and knob in the left mounting bracket and secure with the spirol pin.

D. Install the rubber bushing and cupped sleeves in the swivel bracket.

E. Position the column release lever and spring in the swivel bracket and insert the spacer sleeve (Figure 48).

F. Assemble the bell crank, long spacer, short spacer and hinge rod to the swivel bracket (Figure 49).

G. Insert hitch pin in hinge rod.

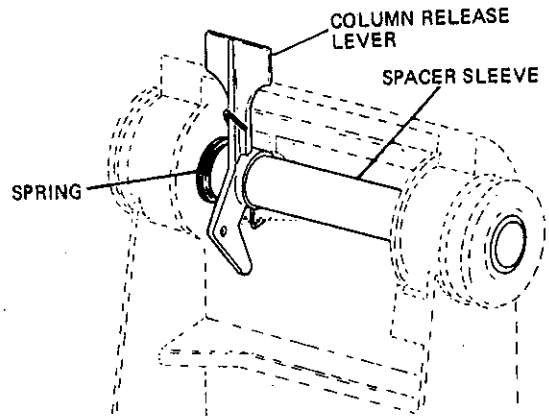


Figure 48. Pictorial view of column release lever.

H. Install linkage rod between column release lever and bell crank. Secure with two push nuts.

I. Install tilt brace in right mounting bracket and assemble knob to shaft with the spirol pin.

J. Install the carriage bolt and flat washer in the right mounting bracket.

K. Assemble thrust plate, pawl, flat washer, lock washer and wing nut to the right mounting bracket.

L. Install the swivel bracket to the right mounting bracket.

M. Place the flat washer on the carriage bolt and assemble the left mounting bracket to the swivel bracket.

N. Install the flat washer and nut on the carriage bolt and tighten the nut.

O. Install the hinge pin in the column lock plate and release plate, and secure with hitch pin.

P. Attach the lock plate and release plate to the column lock bracket with two truss head screws.

Q. Install the liners and thrust collars on the swivel bracket and swivel bracket cap.

R. Assemble the swivel bracket and cap to the column.

S. Install the rubber cushion blocks into the swivel bracket cover.

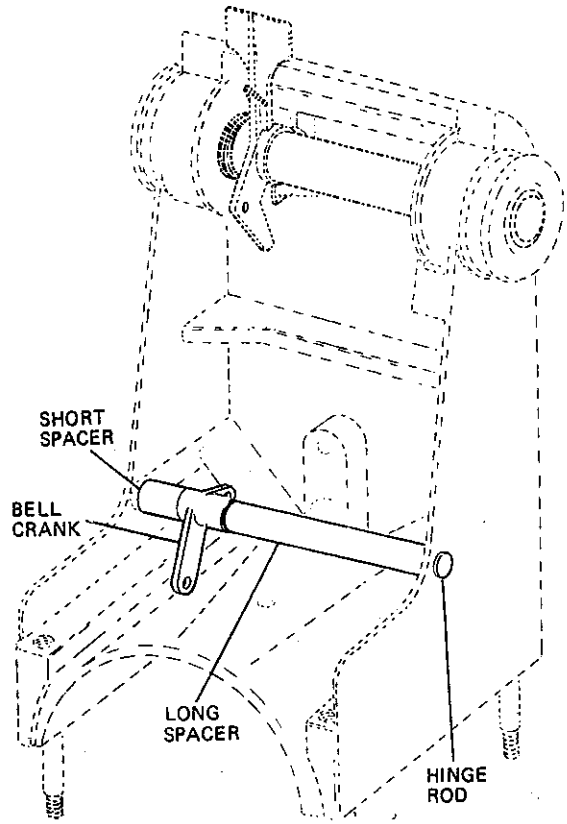


Figure 49. Pictorial view of bell crank and spacers.

T. Assemble the swivel bracket cover, column lock bracket cap and liner to the column and secure with four flat washers and self-lock nuts.

U. Push the lower column release rod through the hole in the column lock bracket cushion and attach the top of the rod to the bell crank with a push nut.

V. Insert the liner in the column lock bracket and attach the bracket to the column with the two slotted head screws and springs. Tighten the screws until the desired turning resistance in the column is obtained.

W. Connect the two springs between the column lock plate and the swivel bracket cover.

X. Lubricate the swivel bracket and column lock bracket with lithium grease through the two pressure fittings.

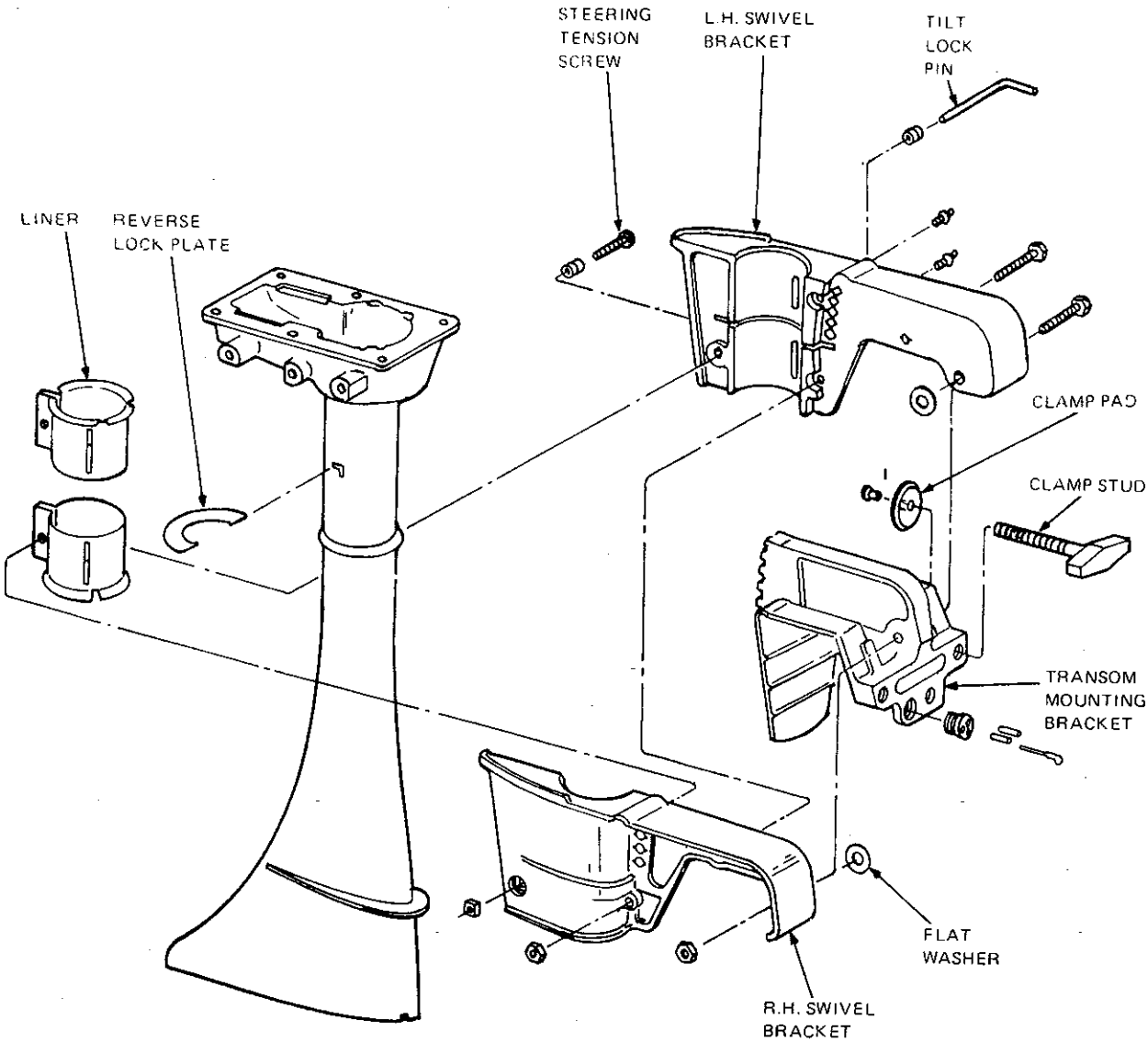


Figure 50. Swivel bracket assembly on models after 1975 except FNR.

14. REMOVE SWIVEL BRACKET PARTS

A. Lay the outboard on a bench so that no weight is on the swivel bracket.

B. Remove the nut and bolt securing the transom mounting bracket to the swivel bracket.

C. Remove the transom mounting bracket from the swivel bracket.

D. Remove tilt lock pin and spring.

E. Remove steering tension screw, nut and spring.

F. Separate the swivel bracket halves by removing the two remaining bolts and nuts.

G. Remove the swivel bracket liners from the column.

H. Remove the reverse lock plate from the column.

I. The clamp pads can be removed from the clamp studs by driving out the spirol pins in the clamp studs. This will also allow the clamp studs to be removed from the transom mounting bracket.

15. REASSEMBLY SWIVEL BRACKET PARTS

A. Lubricate the clamp studs with lithium grease and screw them into the transom mounting bracket.

B. Attach the clamp pads to the clamp studs with the clamp pad studs and spirol pins.

C. Install the reverse lock plate in the column.

D. Clean and coat the swivel bracket liners with lithium grease and install them on the column.

E. Install the swivel bracket halves on the column making sure that the liners are properly positioned between the swivel bracket and column.

NOTE

The hole in the flat of the lower liner must line up with the steering tension screw holes in the swivel brackets.

F. Install the two hex head screws and nuts in the swivel brackets. Do not tighten screws.

G. Install the steering tension screw, spring and nut. Do not tighten screw.

H. Assemble transom mounting bracket and flat washer to the swivel bracket and install the nut and bolt. Do not over-tighten this bolt; to do so could prevent the outboard from tilting on the mounting bracket.

I. Tighten the swivel bracket screws and nuts.

J. Tighten the steering tension screw until the desired steering tension is obtained.

K. Install the tilt lock pin and spring.

ESKA COMPANY DUBUQUE, IOWA

PART V ENGINE SERVICE

1. INTRODUCTION

A. **ESKA** outboard motors use an efficient, two-cycle engine of the uniblock, loop-scavenge design. The loop-scavenge system uses a flat or evenly crowned piston for better cooling and better performance. Uniblock describes the crankcase and cylinder constructed as one piece which permits great power as well as compact size. Crankcase volume is small causing greater differential pressure resulting in more efficient movement of the oil-gasoline-air mixture.

B. While all of the engines used are similar and incorporate many of the same advanced features, it is important to identify the engine by type number before servicing. Refer to the first section, GENERAL AND SPECIFICATIONS and the motor for identification if necessary before servicing.

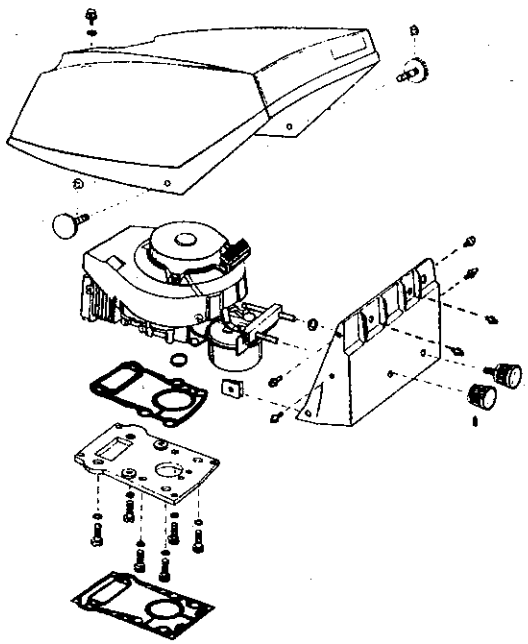


Figure 1

2. ENGINE REPAIR NOT REQUIRING REMOVAL

Many engine repairs can be successfully accomplished without removing the engine from the lower unit. It will, however, be necessary to remove the engine to service the crankshaft, crankcase lower seal, or uniblock. Easy access to the engine and components is possible with outboard mounted on a stand or a 2 x 4 (inch block) secured in a vise.

3. ENGINE DISASSEMBLY

A. Test ignition, compression, etc. prior to disassembly, then remove parts necessary to accomplish repair using the following typical complete disassembly list.

(1) Remove the 4 screws that secure blower housing or combination air shroud-fuel tank to base. (See Figure 3).

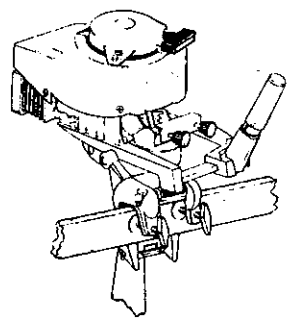


Figure 2

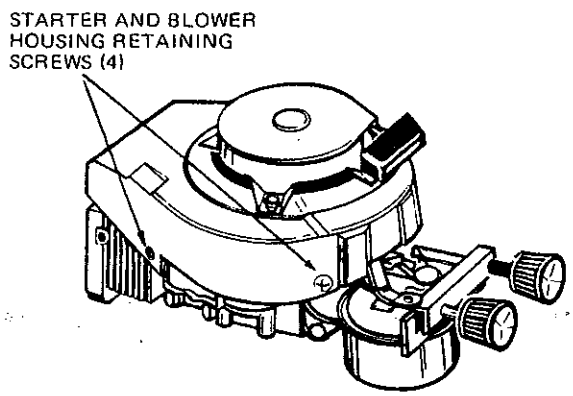


Figure 3

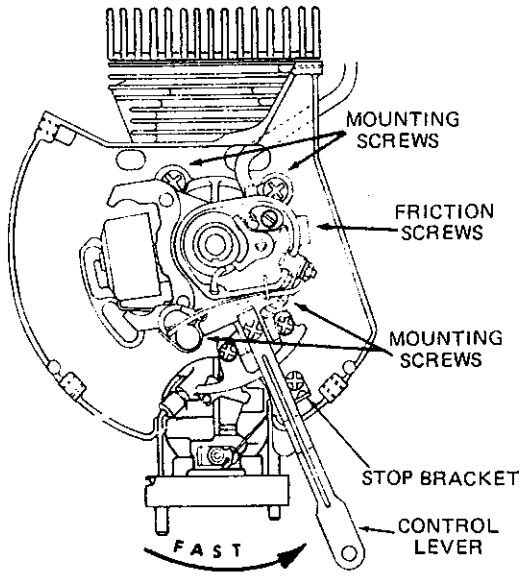


Figure 4

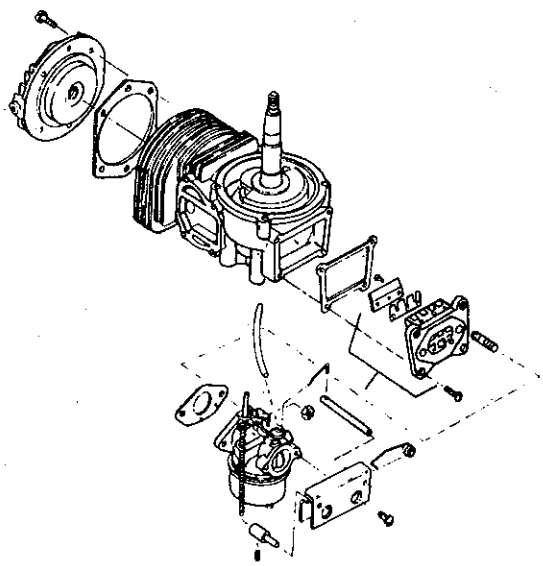


Figure 5

(2) Remove flywheel retaining nut, starter cup and flywheel.

(3) Remove the blower housing, loosen the friction screw securing magneto to base assembly. Disconnect wire from magneto to transformer on units with solid state ignition. On all models, remove the magneto assembly. (See Figure 4).

(4) Remove 6 cylinder head screws, cylinder head and gasket. Be careful not to damage fins if it is necessary to pry head from cylinder.

(5) Unbolt and remove carburetor from the reed plate assembly. Remove the 4 screws mounting reed plate, then remove reed plate assembly.

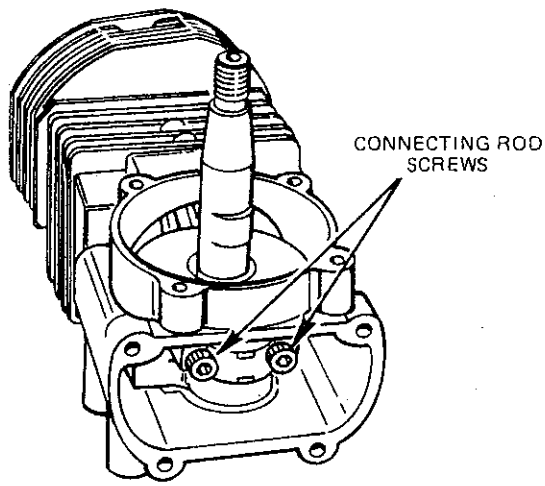


Figure 6

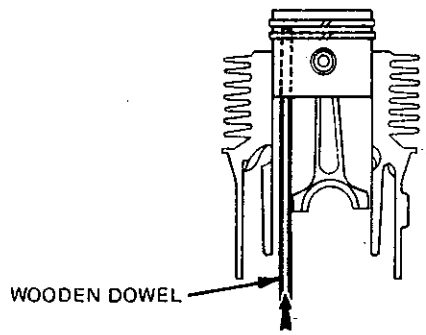


Figure 7

(6) Notice the location of the connecting rod match marks before disassembly. (See Figure 14 or 15). Match marks should be down toward P.T.O. end. Remove connecting rod screws. (See Figure 6). Carefully remove the connecting rod cap, bearing needles and bearing liners.

(7) Remove carbon ridge from top of cylinder if necessary, then push piston and connecting rod out through cylinder bore. If necessary to use force to remove piston and rod, use wooden dowel as shown in Figure 7. Be careful not to damage crankshaft or rod bearing surface.

(8) Clean and lubricate P.T.O. end of crankshaft to facilitate removal of crankshaft.

(9) Remove magneto and fan housing base assembly by removing the 4 mounting screws, then carefully lifting from crankcase.

(10) Remove crankshaft assembly.

a. On type 642 and 643 engines with ball type upper main bearing, the base assembly, top main bearing and crank-

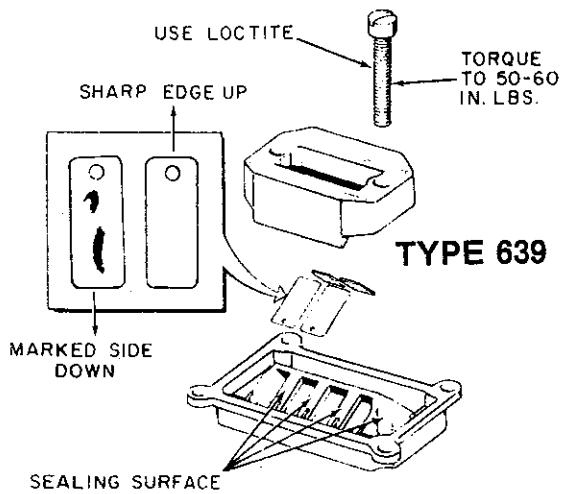


Figure 8

TYPE 640

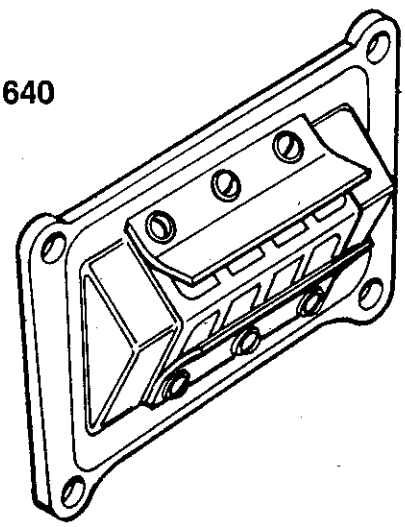


Figure 9

TYPE 642 & 643

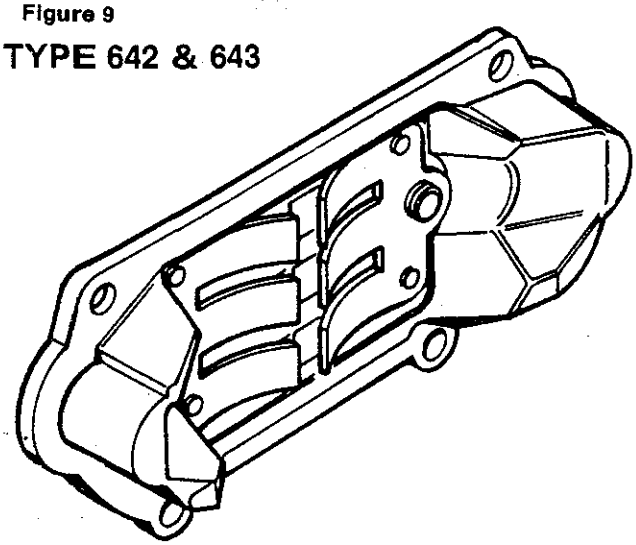


Figure 10

shaft will be withdrawn together. (See Figure 13).

b. On models with ball type lower (P.T.O.) main bearing, it will be necessary to bump crankshaft out of lower main bearing using a soft faced mallet.

c. On models with needle type lower (P.T.O.) main bearing, be careful not to lose the needle rollers from bearing as crankshaft is withdrawn.

B. Observe the following and refer to Figures 8, 9, and 10 when servicing the reed plate assembly.

(1) The reed plate assemblies used on type 639 and 640 engines have replaceable reed pedals. Be careful to assemble reed pedals with correct side toward sealing surface as shown in Figure 8. The rough (cut) edge of reed should face away from sealing surface. Screws securing reed pedal stops on type 639 should be coated with Loctite, then torqued to 50-60 inch pounds (5.6-6.8 Nm). Torque the reed stop retaining screws on type 640 engines to 6-9 inch pounds (0.68-1.02 Nm) after coating threads with Loctite.

(2) On type 642 and 643 engines, the reeds are riveted to plate and should not be removed. (See Figure 10.)

C. Refer to the following when servicing crankcase seals.

(1) Discard all seals removed from crankcase, since new seals should be installed each time crankshaft is removed. Check condition of seal retainers and retainer springs.

(2) Use an awl or similar sharp pointed tool to remove seals. Insert tool between retainer spring and groove so that point of tool is near gap in spring. Carefully pry retainer spring out of spring groove, then remove retainer and seal. (See Figures 11 and 12.)

CAUTION

Use care when removing retainer spring from crankcase groove. Excessive pressure could damage crankcase, especially at magneto end. Do not scratch or nick crankshaft where seal makes contact.

(3) Install magneto end seal with open side of seal down toward inside of engine. (See Figure 11.) Install the P.T.O. end seal with open side of seal down toward outside (lower unit) as shown in Figure 12.

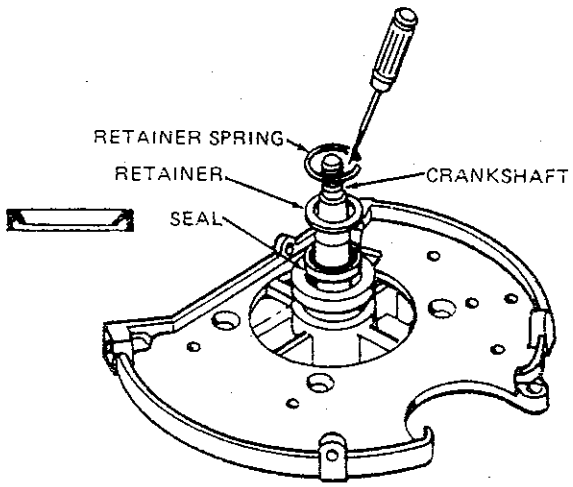


Figure 11

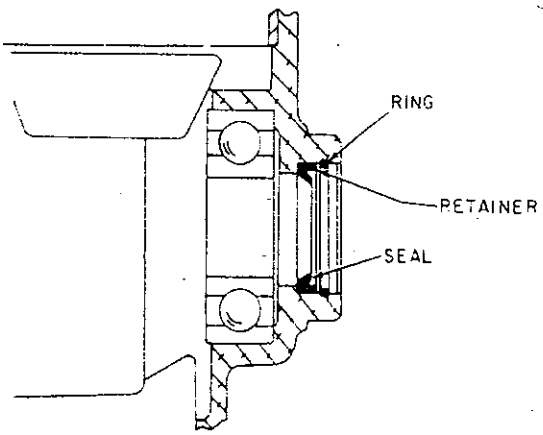


Figure 12

D. Refer to the following for connecting rod service.
   (1) Connecting rod is removed with piston attached and can be separated from piston by removing the piston pin.
   (2) Account for all of the bearing needle rollers to be sure that none are stuck inside engine when reassembling.
   (3) Check connecting rod and cap for cracks or distortion. Check bearing surfaces for wear or scoring. Check bearing needle diameters against the values listed in the "TABLE OF SPECIFICATIONS." Install new bearing assemblies if condition is questionable.

E. Check crankshaft carefully.
   (1) All bearing journals must be within limits listed in the TABLE OF SPECIFICATIONS. Undersize bearings are not available.

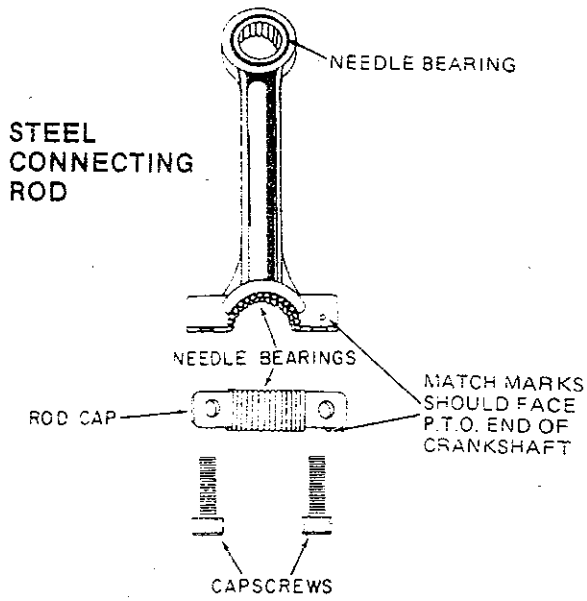


Figure 13

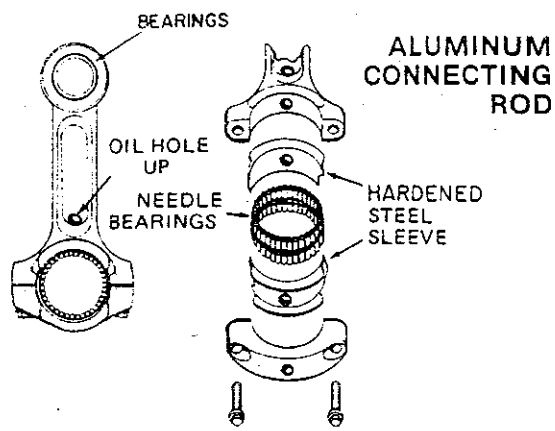


Figure 14

   (2) Inspect oil seal contact surfaces for any nicks or scratches which could cause premature wear to oil seals.

F. Do not remove bearing from bore in cylinder block or fan housing base assembly unless new bearings are going to be installed.
   (1) Check operation of ball bearings by rotating the inner race by hand and check for roughness, binding or other signs of unsatisfactory operation. Install new bearings if damaged.
   (2) To remove ball type main bearings, it is necessary to heat cylinder block or fan housing base assembly to expand bore. DO NOT attempt to remove without heating, DO NOT heat parts using an open flame

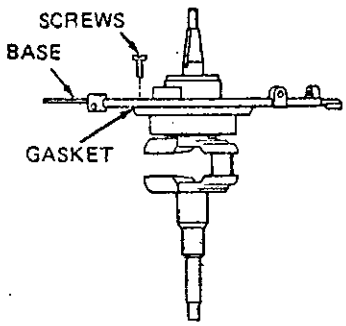


Figure 15. Types 642 and 643 base assembly and crankshaft are removed together from the cylinder.

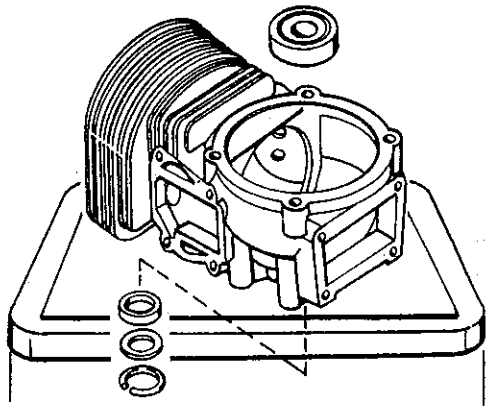


Figure 16

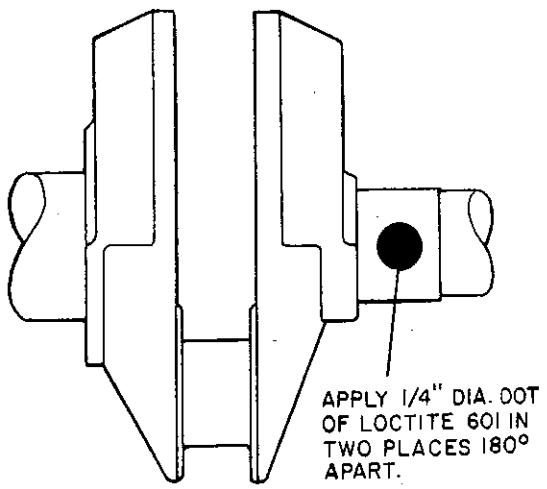


Figure 17

and DO NOT heat to more than 400 F. (204 degrees C.)

a. On models with ball type lower (P.T.O.) main bearing, remove crankshaft lower seal and heat the cylinder block. At about 400 degrees F. (204 degrees C.) the bearing may drop out of bore, if not, tap case lightly to assist removal.

b. On models with ball-type upper (magneto end) main bearing, the magneto and fan housing base assembly must be heated to remove crankshaft and upper bearing. When base assembly reaches nearly 400 degrees F. (204 degrees C.), the crankshaft and bearing should slide easily from bore. To remove bearing from crankshaft, remove retaining ring, heat bearing with torch, then carefully press bearing from crankshaft. Be careful not to damage crankshaft and do not attempt to re-use bearing. (See Figure 15).

c. One suggested method of heating cylinder block and base housing assembly to 400 degrees F. (204 degrees C.) is as follows:

Place 1/8 inch thick steel or asbestos plate on electric hot plate, then position cylinder block or base housing on heated steel or asbestos plate. (See Figure 16.)

(3) Special procedures are required for installing ball type main bearings without damage.

a. For installation in lower (P.T.O.) main bearing position, heat cylinder block to about 400 degrees F. (204 degrees C.), then quickly install new bearing which is at room temperature. Be sure bearing is seated to maximum depth of bearing bore. Apply a 1/4 inch (6mm) diameter spot of Loctite in two places 180 degrees apart on crankshaft lower bearing journal, before installing crankshaft. (See Figure 17.) Carefully press crankshaft into bearing being careful not to get Loctite on bearing balls.

b. For installation in upper (magneto end) main bearing position, suspend bearing in container of SAE 30 motor oil. Heat oil in container until oil begins to smoke, then quickly install heated bearing onto top main journal of crankshaft which has remained at room temperature. Be sure that bearing is fully on to journal and install retaining ring. Allow crankshaft and main bearing assembly to cool and heat the magneto and fan base housing to approximately

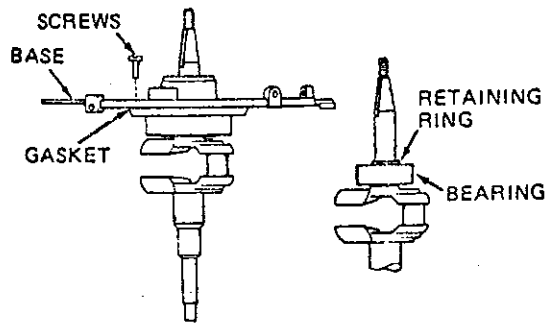


Figure 18. Remove retaining ring and bearing after crankshaft is removed from shroud base of types 642 and 643.

400 degrees F. (204 degrees C.). Position bearing fully into bore of base housing after bearing has cooled to room temperature and base has been heated. Allow all parts to cool before assembly. (See Figure 18.)

(4) Roller type main bearing needles may fall from the bearing cage with very little effort. The bearing cage can be removed and installed after heating cylinder block or magneto and fan base housing to 400 degrees F. (204 degrees C.). Use grease to hold bearing needles in position while installing crankshaft. (See Figure 19).

(5) Bushing type bearings can not be removed. If bushings are worn excessively, new cylinder block must be installed.

G. Check cylinder, piston, pin and rings carefully.

(1) Make sure that all carbon is cleaned from piston, then visually inspect piston for scoring or other obvious damage. Measure piston diameter at right angles to pin, between pin bore and bottom ring groove and cylinder bore diameter, then compare measurements with dimentions listed in table of ENGINE SIZES AND CLEARANCES. Piston can be considered satisfactory if not scored and if piston to cylinder clearance is not more than 0.007 inch (0.178 mm).

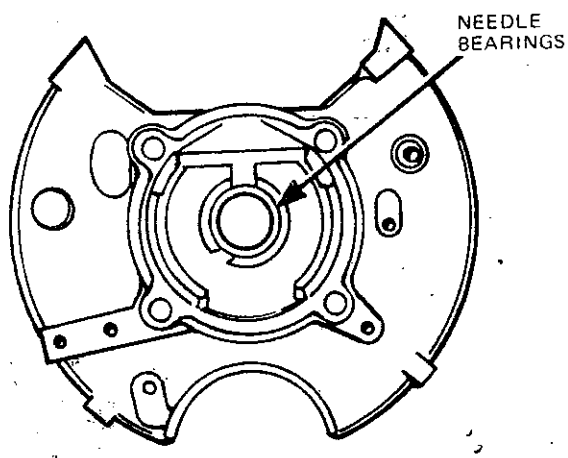


Figure 19

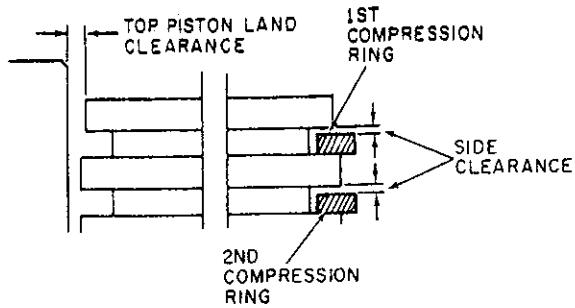


Figure 20

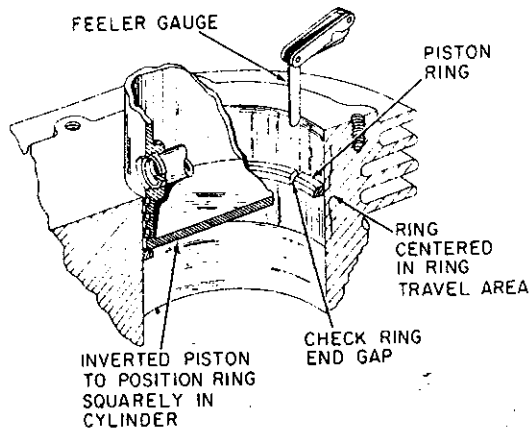


Figure 21

(2) Check piston ring side clearance in groove using new piston ring in clean groove. (See Figure 20.) Compare measured clearance with recommended dimensions listed in ENGINE SIZES AND CLEARANCE table.

(3) Check piston rings for wear visually and by inserting rings squarely in cylinder bore about 1/2 inch (12.7 mm) from top, then measuring end gap. (See Figure 21). Install new rings if end gap is more than maximum listed in table of ENGINE SIZES AND CLEARANCES.

(4) Check cylinder bore wear by directly measuring maximum worn dimension or by measuring end gap of new piston ring positioned squarely at various distances from top of cylinder bore.

H. Some pistons have pin bore offset slightly to balance piston movement.

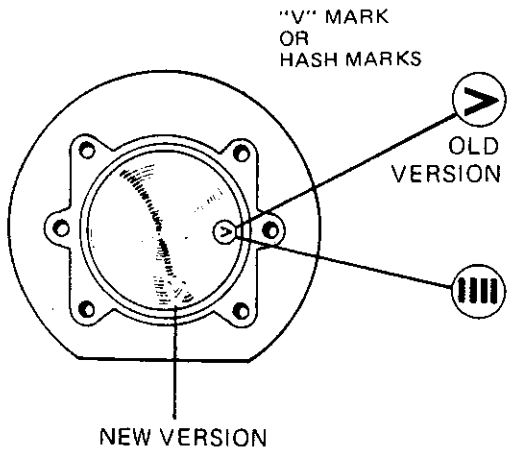


Figure 22

(1) Offset pistons can be identified by "V" mark or hash marks as shown in Figure 22. Unmarked pistons are not offset and can be installed either way.

(2) Incorrect installation of offset piston can cause a disturbing engine knock.

I. To assemble piston to connecting rod proceed as follows:

(1) Install one piston pin retaining ring in piston as shown in Figure 23. If offset piston is not used, retaining ring can be installed in either groove.
(2) Fill a quart can 3/4 full of SAE 30 motor oil.
(3) Completely submerge the piston in the oil but **DO NOT** let the piston touch the bottom of the can. Use a heavy wire and bend a hook in each end to suspend the piston in the oil. (See Figure 24).
(4) Gradually heat the oil using a hot plate or torch until the oil begins to smoke.
(5) When the oil smokes, remove the piston from the oil and install the piston to the rod by quickly pushing the piston pin through both the piston and rod until the pin bottoms on the retaining ring. Use a flat face punch to position and guide the piston pin into the piston and rod. (See Figure 25).

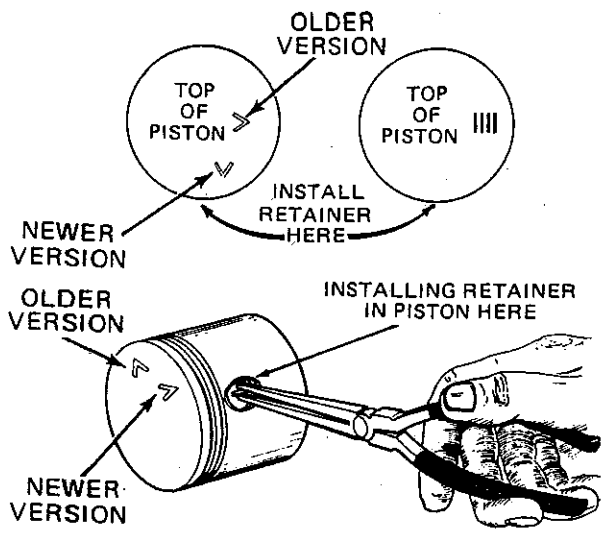


Figure 23

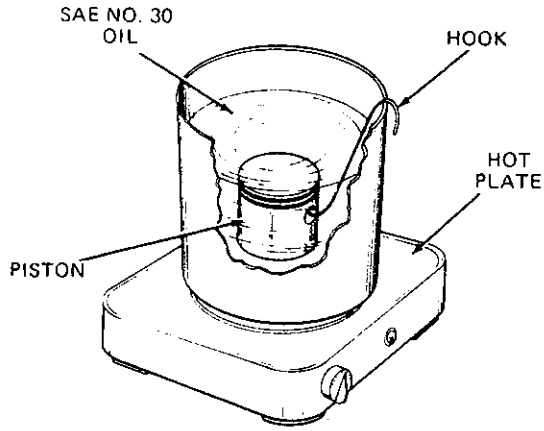


Figure 24

CAUTION

It is important to assemble offset piston to connecting rod correctly with marks on piston as shown in Figure 19 and the match marks on connecting rod (Figure 25) down. Piston pin with closed end should be toward exhaust side (down).

(6) Install remaining piston pin retaining ring. Check both retaining rings and turn so that gaps are at open end of piston.

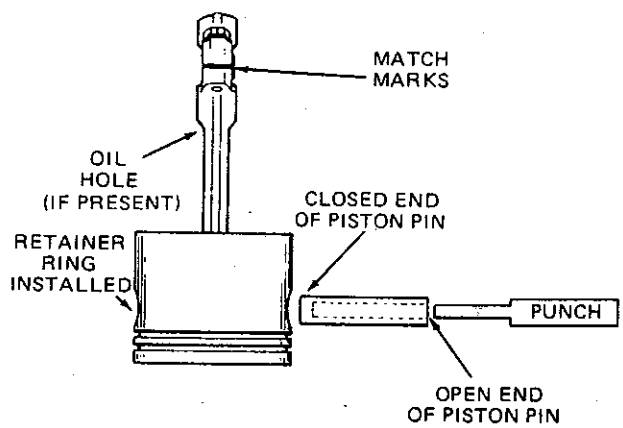


Figure 25

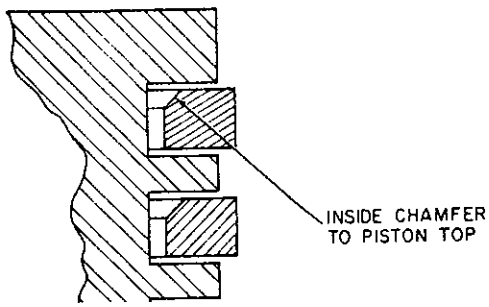


Figure 26

(7) Allow piston to cool before installing rings on piston and piston and rod assembly in the cylinder.

J. Some piston rings may be chrome plated or beveled, but not all engines have beveled or CHROME RINGS.

(1) If used, chrome plated piston should be located in top groove (nearest closed end of piston).

(2) If used, beveled edge of ring should be toward top of piston. (See Figure 26).

K. Use a ring compressor to insert piston, rings and connecting rod assembly into cylinder bore. Do not force because damage to rings or piston are sure to occur. Check marks on piston and connecting rod to be sure of correct installation in cylinder. (See Figures 23 and 25).

L. Engine types 640, 642 and 643 have aluminum connecting rod with hardened steel liners at crankshaft bearing end. The liners should be fitted with oil hole in insert aligned with hole in connecting rod cap. The oil hole in rod should be up (toward top of engine(if present, but later models have only hole in cap. (See Figure 27.)

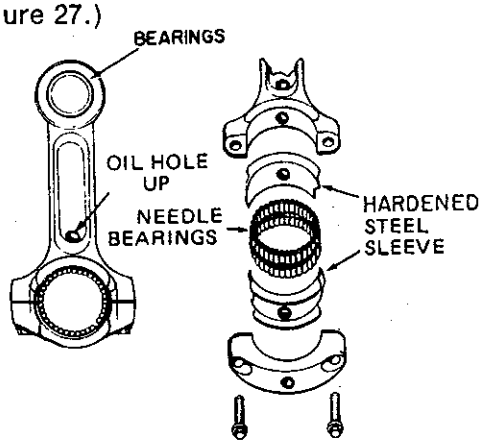


Figure 27

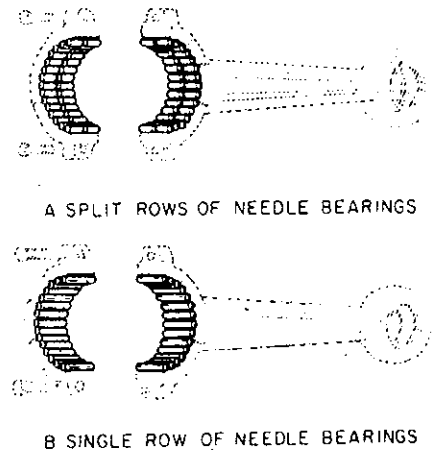


Figure 28

M. Connecting rod crankshaft bearing needles may be single row of needles or two (split) rows as shown in Figure 28.

(1) Install new needle rollers as follows:

a. Clean crankshaft journal and connecting rod thoroughly. Hands and work area must also be free of oil and dirt.

b. Place bearings with beeswax onto cool metallic surface to stiffen beeswax. Hand temperatures will melt wax, so avoid prolonged handling.

c. Remove paper backing from bearings and wrap needles around crankshaft journal. Beeswax will hold needles onto journal. Needles must be positioned uniformly onto the crank pin. (See Figure 29.)

d. Split needles are to be installed with blunt ends together and tapered ends towards the outer end of the journal. (See Figure 30.) Wrap each row of needles around journal and try to seal together with gentle but firm pressure to keep bearings from unwinding.

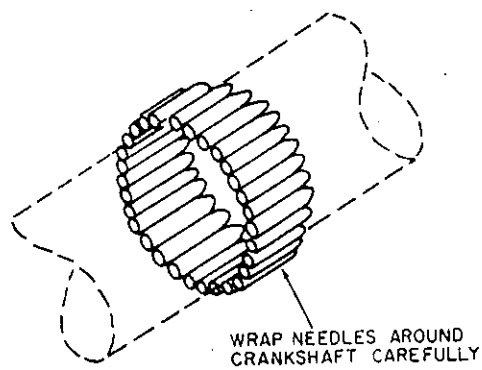


Figure 29

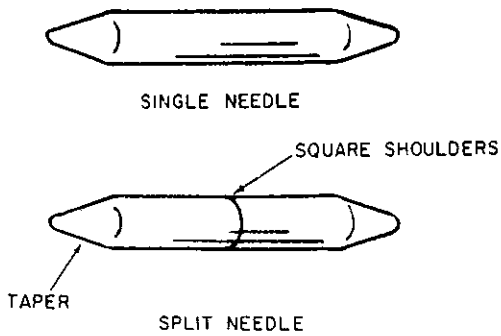


Figure 30

e: Place connecting rod onto journal, position rod and cap with match marks toward P.T.O. end, then secure with capscrews. (See Figure 31.) Torque to specifications listed in ENGINE TORQUE LIMIT table.

f. Force solvent (lacquer thinner) into needles just installed to remove all beeswax then lubricate bearing needles with B1A certified TC-W oil.

(2) Old needle rollers have worn into the races and should not be mixed or wear will be exaggerated. To reassemble rollers of used bearing be sure to account for each bearing then proceed as follows:

a. Clean crankshaft journal and connecting rod thoroughly. Hands and work area must also be free of oil and dirt.

b. Coat crankshaft journal with grease, then position connecting rod near journal. Install each cleaned dry roller on crankshaft journal grease, pushing them between connecting rod and crankshaft.

c. When bearing needles begin to exit opposite side of connecting rod, position remaining rollers around exposed half of crankshaft journal.

d. Blunt ends of split rollers are installed together toward center of crankshaft journal. (See Figure 30.)

e. Check to be sure that all bearing rollers are installed, then install connecting rod cap with match marks aligned and toward P.T.O. end. Tighten cap retaining cap screws to specification listed on ENGINE TORQUE LIMIT table.

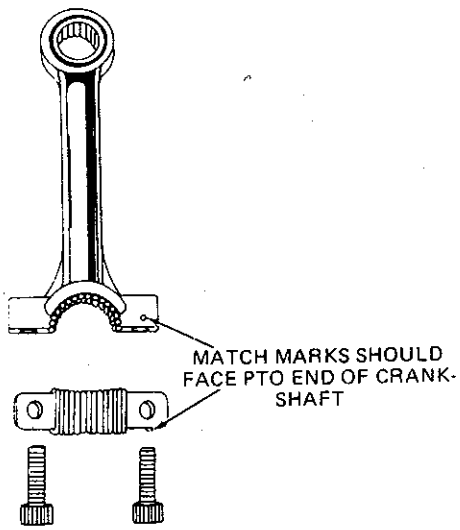


Figure 31

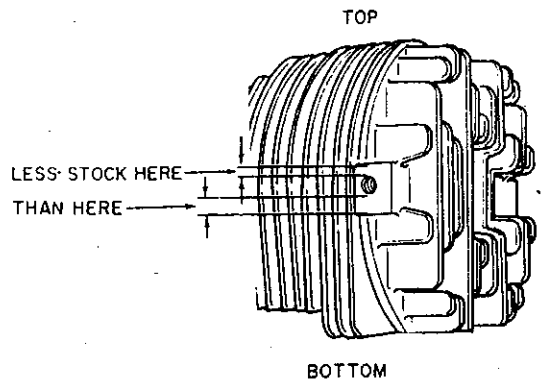


Figure 32

f. Force lacquer thinner solvent or similar solvent into bearing just installed to clean assembly grease from bearing, then lubricate with B1A certified TC-W oil.

N. The cylinder head on some early models can be installed in a way which appears correct but is wrong. The head may be like either shown, i.e., two flats around the circumference, or one. Important in any case is that the fuel tank bracket-mounting hole must have less stock on the boss toward the top of the engine when correctly assembled. (See Figure 32.) This is necessary so that the tank bracket-positioning slots allow alignment between the tank bracket and boss-mounting holes.

ENGINE SIZES AND CLEARANCES

ENGINE MODEL	AV750	AV817	AV520	AV600
ENGINE TYPE	639	640	642	643
Bore-Inches	2.3750 2.3765	2.4370 2.4385	2.0930 2.0945	2.0930 2.0945
Stroke-Inches	1.68	1.75	1.50	1.76
Displacement-Cubic Inch	7.50	8.17	5.2	6.0
Point Gap-Inch	.020	Solid State	.020	.020
Timing Before Top Dead Center (BTDC)-Inch	.095	.115	.075	.085
Spark Plug Gap-Inch	.035	.035	.035	.035
Piston Ring End Gap-Inch Both	.005 .013	.007 .017	.006 .016	.006 .016
Piston Diameter*-Inch	2.3700 2.3695	2.4315 2.4310	2.0880 2.0875	2.0880 2.0875
Piston Ring Groove Width-Inch Top	.066	.066	.066	.066
Bot.	.065	.065	.065	.065
Piston Ring Width-Inch Both	.0615 .0625	.0615 .0625	.0615 .0625	.0615 .0625
Piston Pin Diameter-Inch	.4997 .4999	.4997 .4999	.4997 .4999	.4997 .4999
Crankshaft Rod Needle Diameter-Inch	.0655 .0653	.0781 .0780	.0781 .0780	.0781 .0780
Crank Pin Journal Diameter-Inch	6368 6258	.6929 .6919	.8452 .8442	.8452 .8442
Crankshaft P.T.O. End Main Bearing Dia.-Inch	.6697 .6687	.6697 .6687	1.0005 .9995	1.0005 .9995
Crankshaft Magneto End Main Bearing Dia.-Inch	.7505 .7495	.8755 .8745	.7505 .7495	.7505 .7495
Crankshaft End Play-Inch	0	0	.005 .022	.005 .022

*Measure piston diameter 90 degrees to pin, between pin bore and bottom ring groove.

ESKA COMPANY DUBUQUE, IOWA

ENGINE TORQUE LIMITS

CARBURETOR & REED PLATES		
Carburetor fuel bowl nut		50-60 in-lbs (5.6-6.8 Nm)
Reed plate to Uniblock	10-24 x 1/2	35 in-lbs (4.0 Nm)
CRANKCASE & CYLINDER		
Mounting carburetor to reed plate studs	1/4-20; 1/4-28	60-75 in-lbs (6.8-8.5 Nm)
Cylinder head to cylinder	1/4-20	80-100 in-lbs (9.0-11.3 Nm)
Spark plug		16-22 ft-lbs (1.8-2.5 Nm)
CRANKSHAFT & CONNECTING ROD		
Aluminum rods to rod cap	10-24 x 3/4	50-57 in-lbs (5.6-6.4 Nm)
Steel rod to rod cap	10-32 x 9/16 and 5/8	70-80 in-lbs (7.9-9.0 Nm)
Steel hub flywheel on iron shaft	7/16-20	18-25 ft-lbs (2.0-2.8 Nm)
OUTBOARD BEARING ADAPTERS		
Outboard bearing adapter to crankcase screw	1/4-20 x 3/4	75-100 in-lbs (8.5-11.3 Nm)
Outboard bearing adapter to crankcase screw	5/16-18 x 7/8	105-120 in-lbs (11.9-13.6 Nm)
MAGNETOS		
Stator friction screw for outboard with twist grip, throttle control		3-9 in-lbs (.3-1.0 Nm)
Stator friction screw for outboard with manual throttle lever		20-25 in-lbs (2.3-2.8 Nm)
REWIND STARTERS		
Starter to shroud	1/4-28 x 7/16	50-70 in-lbs (5.6-7.9 Nm)
SHROUD		
Shroud to base	1/4-20 x 5/8	80-100 in-lbs (9.0-11.3 Nm)
Shroud base to cylinder	1/4-20 x 5/8	70-80 in-lbs (7.9-9.0 Nm)
Shroud to bracket	1/4-20 x 5/8	55-65 in-lbs (6.2-7.3 Nm)
Shroud to mounting bracket	1/4-20 x 3/8	45-55 in-lbs (5.1-6.2 Nm)
PANEL CONTROLS		
Panel control to carburetor	10-32 x 3/8	30-40 in-lbs (3.4-4.5 Nm)
Idle control setscrew	6-32 x 3/16	6-7 in-lbs (.7-1.0 Nm)
CAP SCREWS - NUTS		
Cap screws	4-40	6-8 in-lbs (.7-.9 Nm)
Cap screws	6-32	10-15 in-lbs (1.1-1.7 Nm)
Cap screws	8-32	20-30 in-lbs (2.3-3.4 Nm)
Cap screws	10-24	30-40 in-lbs (3.4-4.5 Nm)
Cap screws	10-32	35-40 in-lbs (4.0-4.5 Nm)
Cap screws	1/4-20 fil hex hd	50-60 in-lbs (5.6-6.8 Nm)
Cap screws	1/4-20 flex hd	70-80 in-lbs (7.9-9.0 Nm)
Cap screws	1/4-28	70-75 in-lbs (7.9-8.5 Nm)
Cap screws	5/16-18	105-115 in-lbs (11.9-13.0 Nm
Nuts	8-32	20-25 in-lbs (2.3-2.8 Nm)
Nuts	1/4-20, 1/4-28	70-75 in-lbs (7.9-8.5 Nm)

PART VI FUEL SYSTEMS

1. IDENTIFICATION

A. When servicing the fuel system and especially the carburetor, first locate the identification code stamped on the carburetor body. (See Figure 1.)

B. The first part of the carburetor identification code is the manufacturing model number. The manufacturing code is not the part number. Refer to the appropriate "Master Parts Manual" or "Microfiche" for cross reference of manufacturing model number and part number. In some cases the manufacturing model number may be preceeded by the numbers "0234."

C. The last part of the carburetor identification code indicates date of manufacture. The example shown in Figure 1 would have been manufactured in 1976 as indicated by the "6"; in February as indicated by "B"; on the third day of the month as indicated by the last digit.

2. CARBURETOR OPERATION

A. The carburetor is designed to provide the correct fuel mixture to the engine at any operating speed.

B. In the CHOKE or start position (see Figure 2) the choke shutter is closed, and the only air entering the engine enters through openings around the shutter. As the starting device is operated to start the engine, the air pressure in the carburetor is reduced as air is drawn into the engine. Since the air passage is blocked by the choke shutter, fuel is drawn from the main nozzle and from both idle fuel discharge ports and mixes with the air that passes through the throttle shutter. This makes a very rich fuel mixture which is needed to start a cold engine.

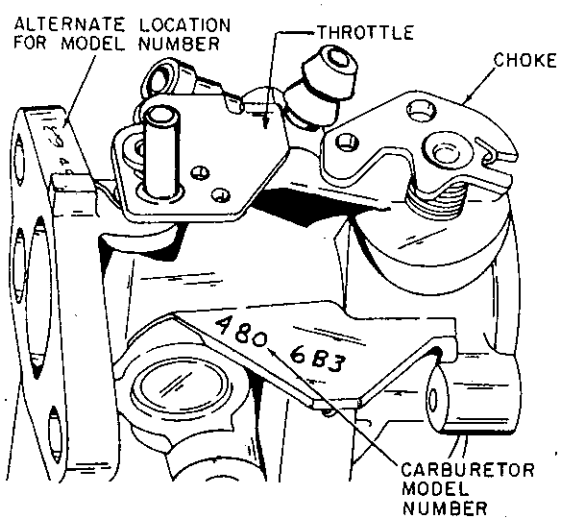


Figure 1

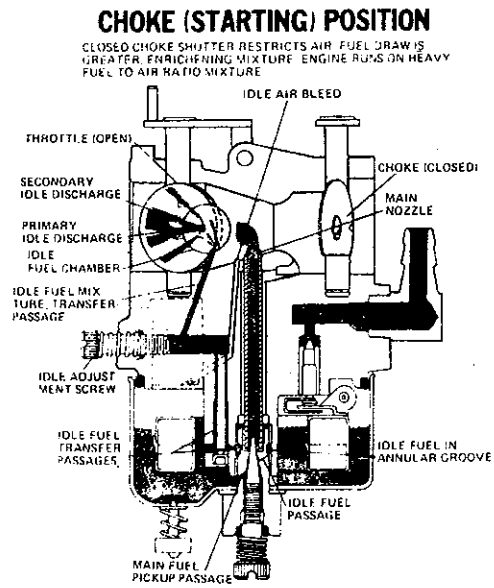


Figure 2

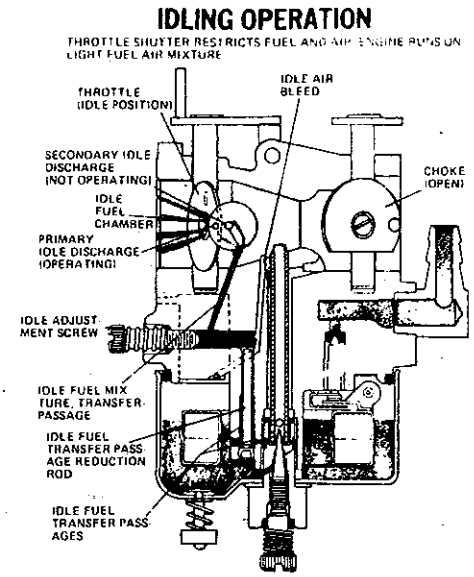


Figure 3

C. At IDLE, (See Figure 3) a relatively small amount of fuel is required to perate the engine. The throttle is almost closed, shutting off the fuel supply from all except the one idle fuel discharge orifice so that the suction created by the engine draws fuel only from that orifice.

D. During INTERMEDIATE operation (see Figure 4) a second orifice is uncovered as the throttle shutter opens, and more fuel is allowed to mix with the air flowing into the engine.

E. During HIGH SPEED operation (see Figure 5) the throttle shutter is fully opened. Air flows through the carburetor at high speed. The venturi, which decreases the size of the air passage through the carburetor, further accelerates the air flow. This high-speed movement of the air decreases the air pressure and fuel is drawn into the air stream through the main nozzle that opens into the venturi, mixing with the air in the air passage. As the engine load increases, air is automatically bled into the main nozzle through the air-bleed tube located in the air horn. This allows liquid fuel to be metered freely from the main nozzle.

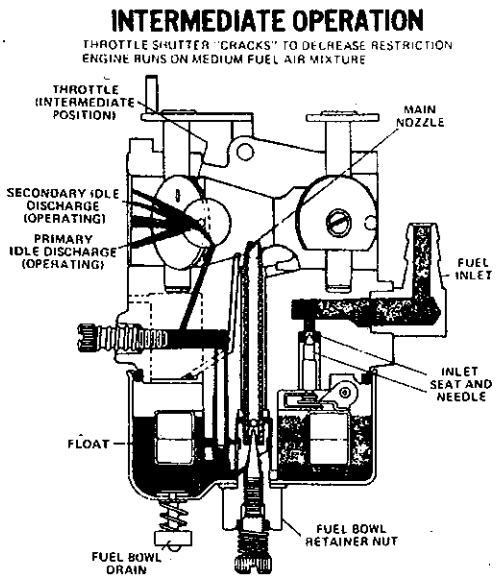


Figure 4

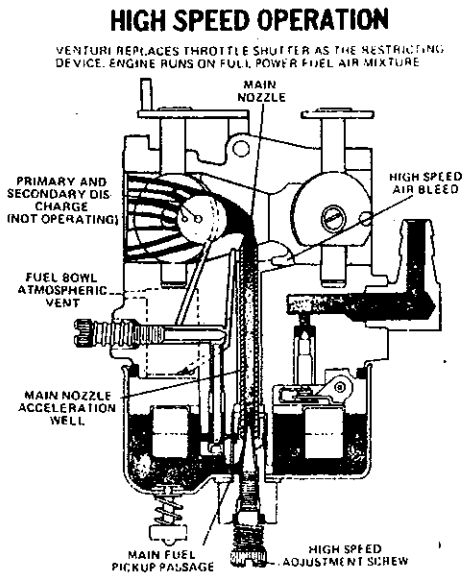


Figure 5

3. CARBURETOR DISASSEMBLY AND SERVICE

A. It is sometimes easier to remove the carburetor and reed plate as an assembly. Disconnect the fuel line and unbolt carburetor from reed plate.

B. The following instructions are in a sequence to be followed for complete overhaul of this carburetor. If it is necessary to service only a portion of the carburetor, follow the instructions pertaining to that service.

(1) THROTTLE. Examine the throttle lever and plate prior to disassembly. Replace any worn parts.

a. Remove the screw in the center of the throttle plate and pull out the throttle shaft lever assembly (Figure 6).

b. When reassembling, it is important that the lines on the throttle plate (Figure 6) are facing out when in the closed position. Position throttle plate as before disassembly. The throttle shaft must be held in tight to the bottom bearing to

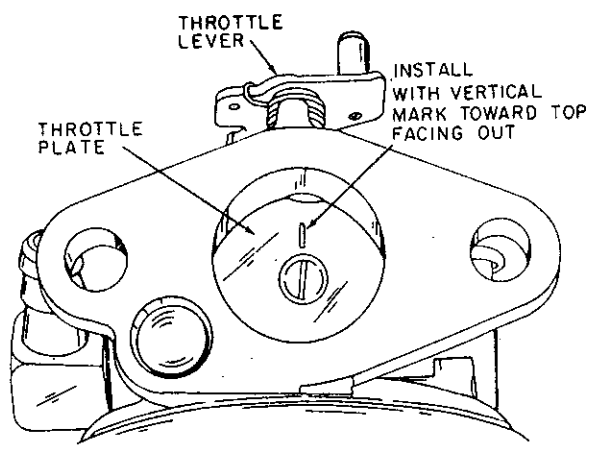


Figure 6

prevent the throttle plate from riding on throttle bore of the body, causing excessive throttle plate wear.

(2) CHOKE. Examine the choke lever and shaft at the bearing points and holes into which the linkage is fastened (Figure 7), and replace if worn. The choke plate is inserted into the air horn of the carburetor in such a position that the flat surface of the choke is as shown in Figure 7. Hold the choke shaft securely into the bearing bore when replacing the choke plate. This will prevent binding and excessive choke plate wear.

(3) IDLE ADJUSTING SCREW. Remove the idle screw from the carburetor body and examine the point for damage to seating surface on the taper. If damaged, replace the idle adjusting screw.

(4) MAIN ADJUSTING SCREW. Some carburetors may not have a main (high speed) adjusting screw, but may instead have an orifice of a specific size called a main or high speed jet. The main adjusting screw must be removed, from models so equipped before inspecting.

a. Examine the taper of the main adjusting screw (Figure 8). Install a new screw and fuel bowl retainer nut as an assembly if the taper (point) area of needle is damaged.

b. The fuel bowl retainer nut contains the seat for the screw. Examine the sealing "O" ring, the high-speed adjusting screw. Replace if it indicates wear or cuts.

c. During reassembly, position the coil spring on the adjusting screw, followed by the small brass washer and the "O" ring sesal.

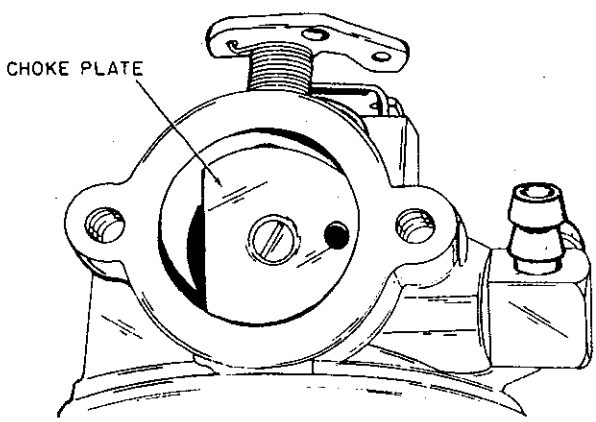


Figure 7

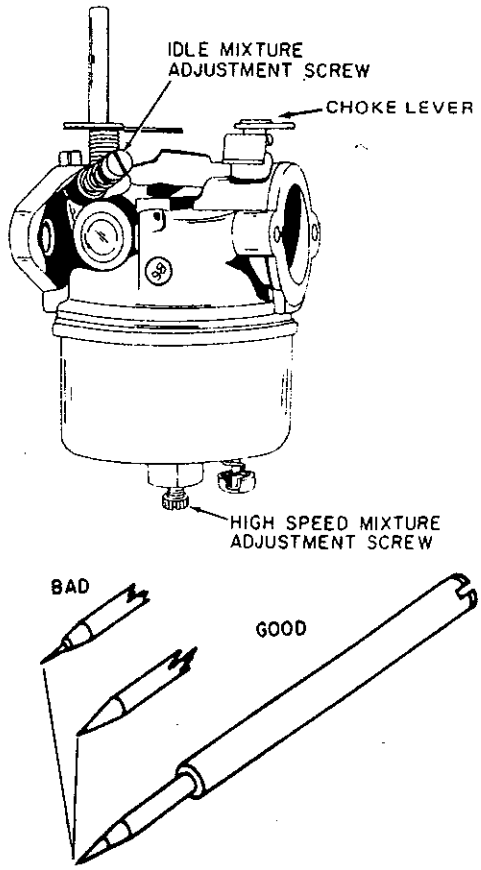


Figure 8

(5) FUEL BOWL RETAINING NUT. Remove the fuel bowl retaining nut and fiber washer. (Figure 9.) Replace the washer, if cracked or worn.

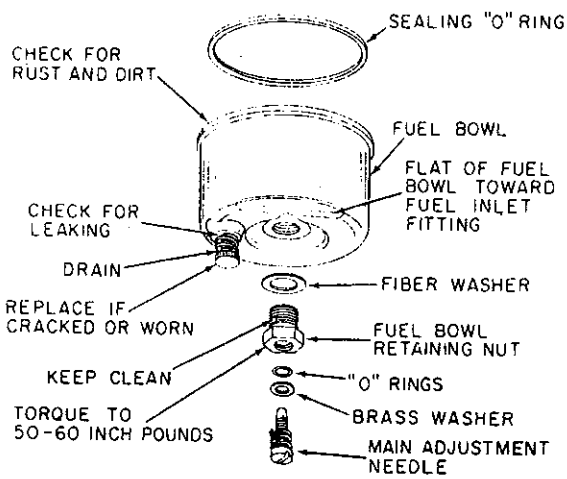


Figure 9

a. The retaining nut contains the transfer passage through which fuel is delivered to the high-speed and idle fuel system of the carburetor. It is the larger hole closest to the hex nut end of the fitting. If a problem occurs with the idle system of the carburetor, examine the small fuel passage in the annular groove in the retaining nut. This passage must be clean for the proper transfer of fuel into the idle metering system.
b. When replacing, torque the fuel bowl nut to 50-60 in.-lbs. (5.6-6.8 Nm).

(6) FUEL BOWL. Fuel bowl should be examined for rust, dirt and corrosion, (Figure 9.) Thoroughly clean before replacing. If it is impossible to properly clean the fuel bowl, replace it.
a. Check fuel bowl drain for leaking. Replace the rubber gasket on the inside of the drain valve.
b. The large "O" rings (Figure 9 and 10) sealing the fuel bowl to the carburetor body must be in good condition to prevent leakage. Examine the "O" ring for swelling or cuts. Moisten the "O" ring seal with either water or a very small amount of fuel or oil to allow the fuel bowl to slide onto the "O" ring properly. Hold the carburetor body in an inverted position and place the "O" ring on the carburetor body and then position the fuel bowl.

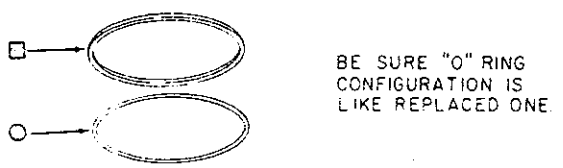


Figure 10

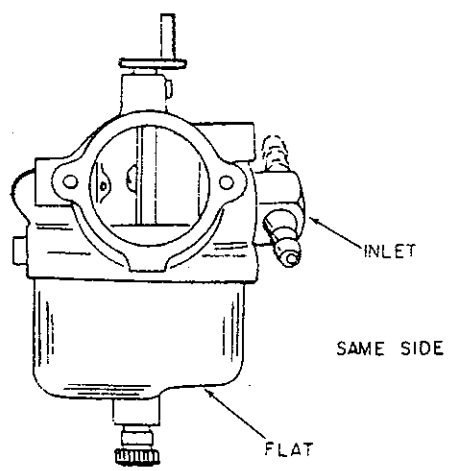


Figure 11

CAUTION

The fuel bowl flat surface is usually positioned on the same side of the carburetor as the fuel inlet fitting, (Figure 11). On some applications, the location of the bowl drain is dictated by the position of some adjacent parts.

(7) FLOAT. Be careful when removing the float from the carburetor body. On some models, the inlet needle is attached to the float with an anchoring clip and will be lifted off the seat as float is removed. Remove the float (Figure 12) from the carburetor main body by pulling out the float axle with a pair of needle-nosed pliers. Examine the float hinge (Figure 12) bearing surfaces through which the float axle passes and replace if worn. Excessive wear on the tab of the float hinge that contacts the inlet needle will require replacement of the float to assure proper fuel metering within the carburetor.
a. The correct float setting from the rim of the carburetor body to the float is 0.185-0.235 inch (4.70-5.97 mm). Use special tool number 670253 to check float setting as shown in Figure 13.
b. Remove the float to make adjustments. Bend the tab on the float hinge to correct setting. Do not direct compressed air into the fuel inlet fitting when the carburetor is assembled; this will collapse the float.

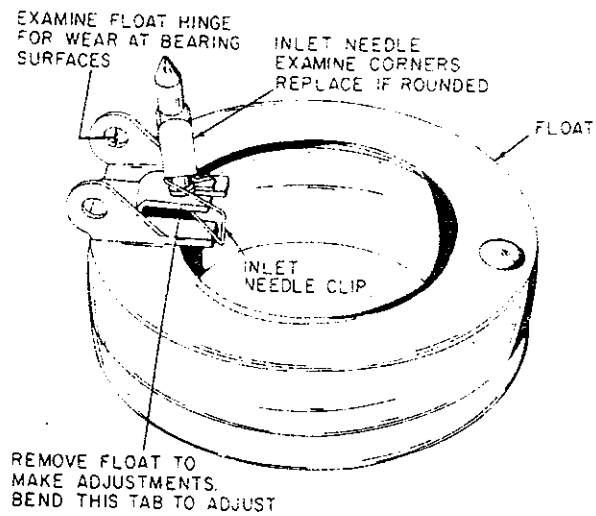


Figure 12

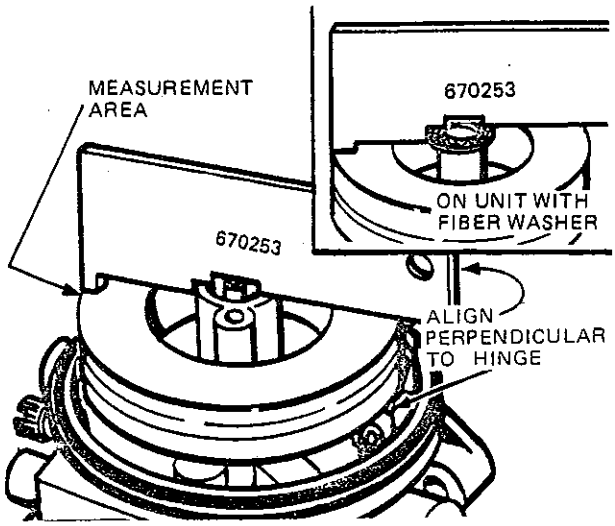


Figure 13

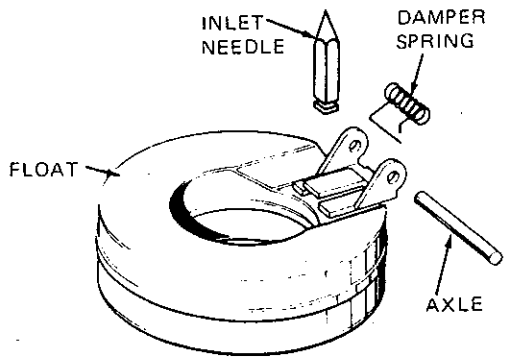


Figure 14

c. If compressed air is used, disassemble carburetor by removing float, then always direct low-pressure air through the system opposite normal fuel flow to dislodge foreign matter toward reverse taper of any restricting passages.

d. A float damper spring is used on some outboard carburetors. (See Figure 14.) The carburetor does not have an inlet needle clip. The damper spring stabilizes the float and prevents unnecessary bouncing when the engine is operated in rough water.

e. To assemble the float and spring, position carburetor as shown in Figure 15. Start the axle, hook the long end of the damper spring under the float tab, facing the choke end of the carburetor; put tension on the other end of the spring either with thumb or index finger. Push the axle through the hinge and spring, release the end of the spring and it will anchor on the carburetor casting as shown in Figure 16.

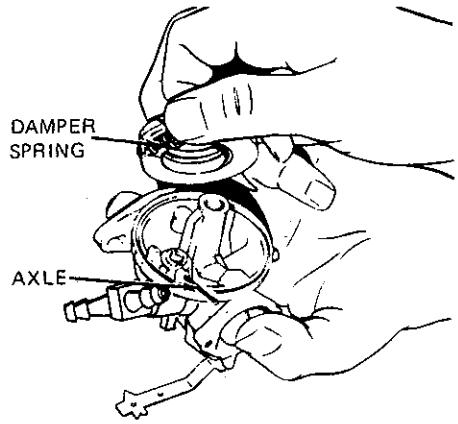


Figure 15

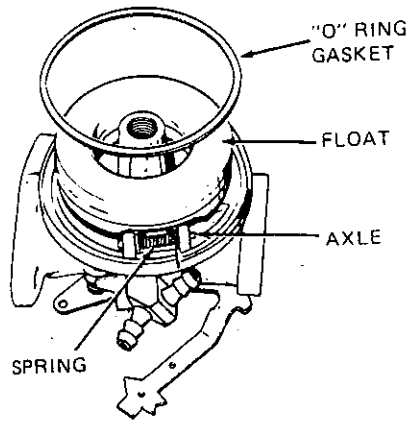


Figure 16

NOTE

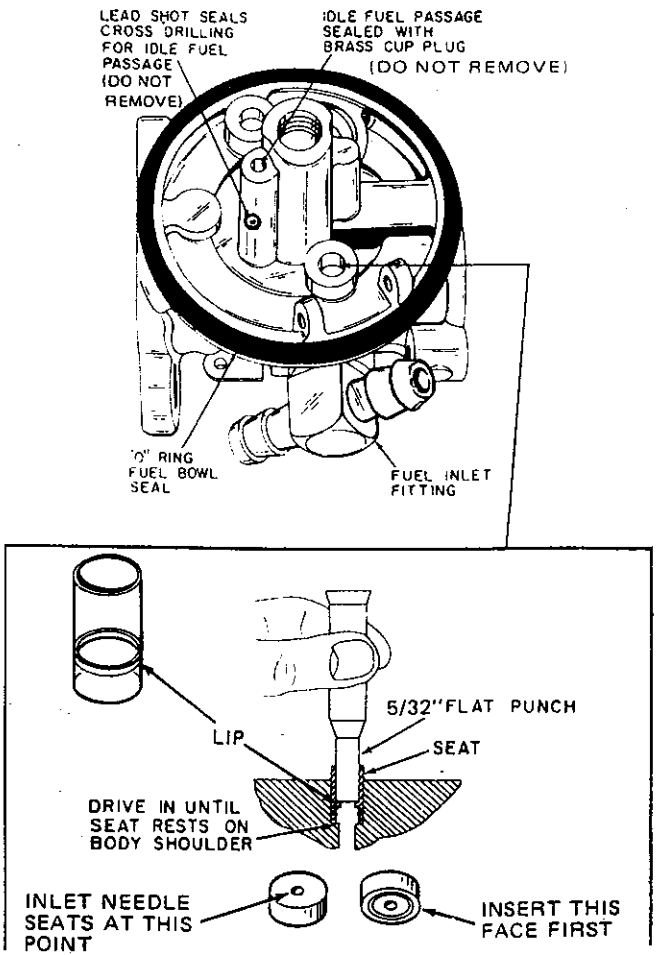
The long end of the spring that hooks on the float tab must point toward the choke end of the carburetor.

f. The gasket fits over the float spring as shown in Figure 16 to avoid cutting by the spring during bowl assembly.

(8) INLET NEEDLE AND SEAT. Several different types of needles and seats have been used. Some use a resilient Viton seat with a hard needle, while others use a rigid hard seat with a resilient Viton tip on the needle. Correct service procedure is important and different depending upon type of needle and seat.

CAUTION

Do not subject Viton parts to harsh carburetor cleaning solvents and be sure to install correct parts when reassembling.



INSTALLATION OF VITON SEAT

Figure 17

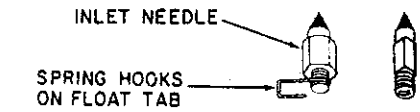
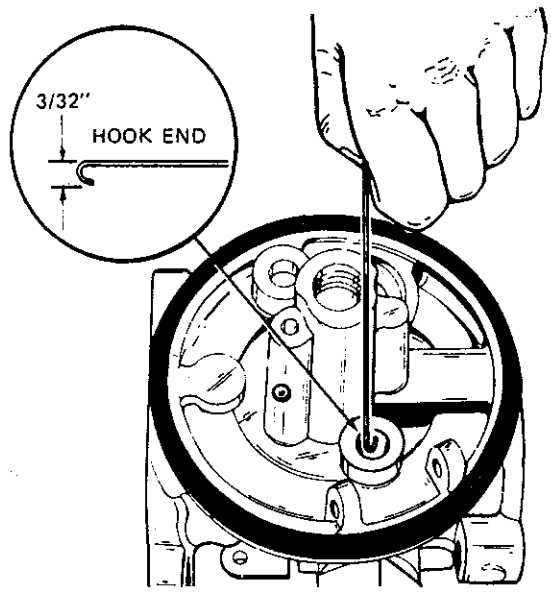


Figure 18



REMOVAL OF VITON SEAT

Figure 19

a. The inlet needle is anchored to the float tab by a clip, (Figure 18) to assure proper movement of the inlet needle off of the seat when the float drops. The inlet needle clip must be positioned as shown in Figure 12 during reassembly. Examine inlet needle carefully and install new needle if any evidence of wear or damage is noticed.

b. Be sure to remove Viton seat, if so equipped, before subjecting carburetor body to harsh carburetor cleaners. Do not attempt to remove the brass cup containing the Viton seat. If the seat is to be replaced, use the bent end of a paper clip or wire with about a 3/32 inch (2 mm) hook. Push the hook through the Viton seat hole as shown in Figure 19, then pull Viton seat out of brass cup. Replace with a new seat. The clip must be properly bent so that hook will not catch on edge of brass cup.

Thoroughly clean the cavity and moisten the Viton seat with oil. Position the seat over the bore in carburetor body with the smooth side of the seat facing the flat on the punch, grooved side down. (See Figure 17.) Push the Viton seat squarely into bore using a 5/32 inch (3.5 mm) diameter flat punch. Be sure that seat passes over the lip at base of brass cup. (Figure 17.)

(9) CARBURETOR BODY. Examine the carburetor body for wear and damage.

a. It may be necessary to remove the large welch plug (Figure 20 and 21) if excessive dirt has accumulated in the atmospheric vent cavity, or it may be possible to clean this cavity with carburetor cleaner or compressed air without removing the welch plug.

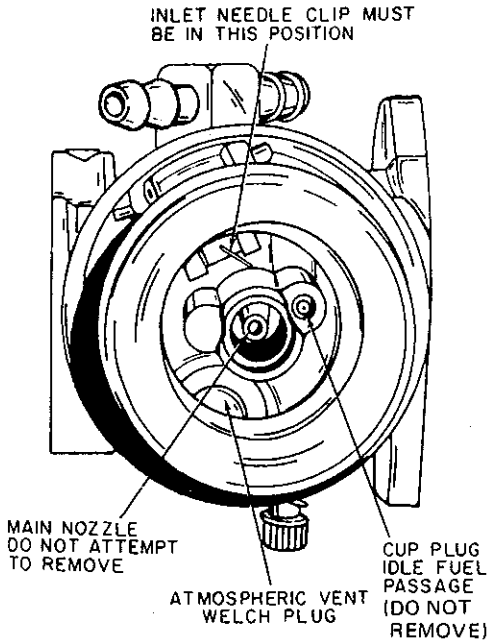


Figure 20

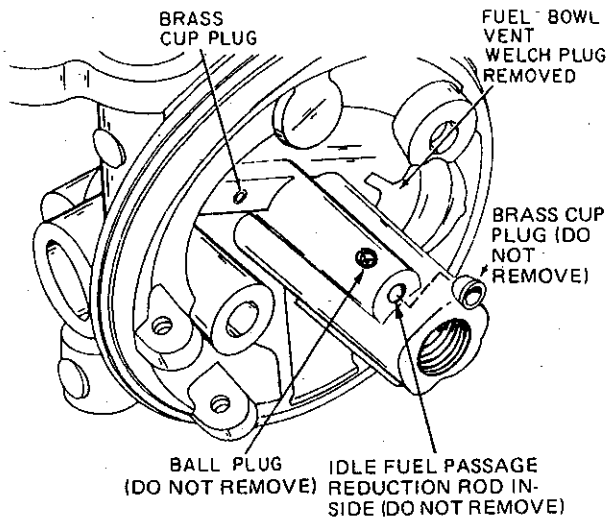


Figure 21

There are two approved methods of removing Welch plugs. The first is to carefully punch hole in plug, then pry plug from cavity. (See Figure 22.) Extreme care must be exercised using this method to avoid damage to parts under Welch plug. The second method requires the use of a flat punch about half the diameter of plug. Drive the punch against center of plug. The plug will release its grip on carburetor body and

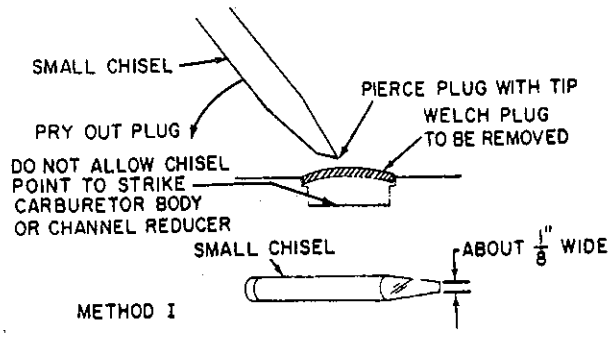


Figure 22

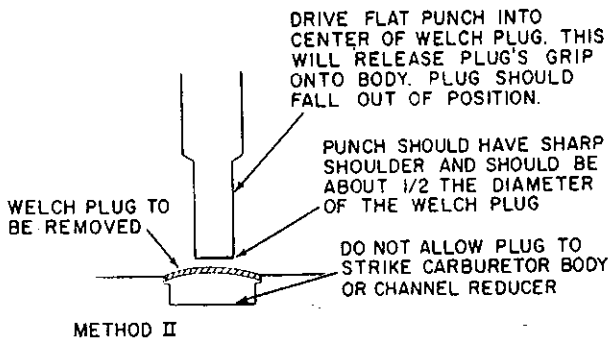


Figure 23

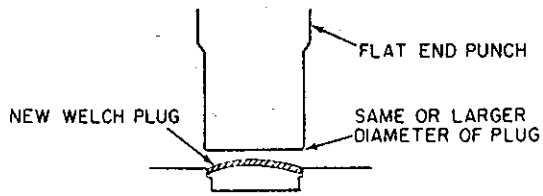


Figure 24

should fall freely from bore. (See Figure 23.)

Clean the receptacle in carburetor body thoroughly, then position new Welch plug into receptacle with raised (convex) side up. Flatten plug while in receptacle using a hammer and a flat punch that is equal to or greater than the diameter of the plug. Merely flatten Welch plug. Do not drive center of plug below surface of carburetor. (See Figure 24.)

b. The carburetor body contains a main nozzle tube (Figure 20) pressed into the carburetor body to a predetermined depth and positioning within the venturi of the carburetor. Do not attempt to re-

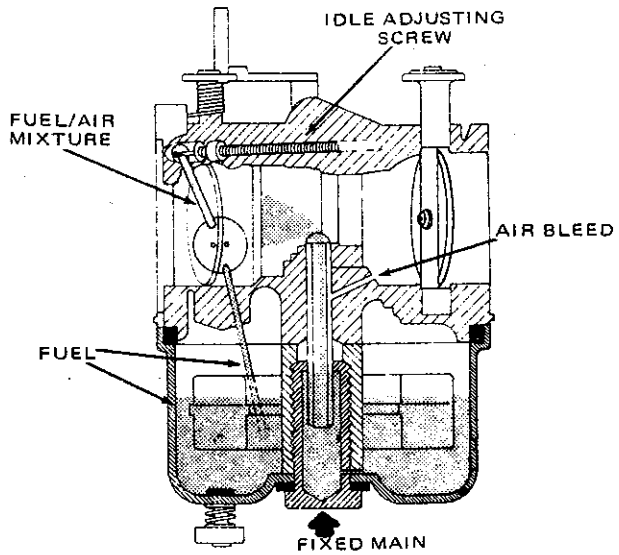


Figure 25

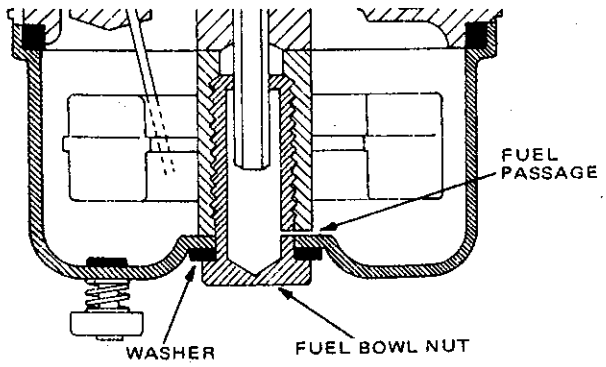


Figure 26

move this main nozzle. Any movement of this nozzle will seriously affect the metering characteristics of the carburetor and will require replacement of the entire carburetor.

c. Clean the accelerating well surrounding the main nozzle with compressed air and carburetor cleaning solvents. With the choke plate and shaft removed, compressed air may be blown in through the high-speed air bleed (located just behind the lower choke shaft bearing and immediately in front of the venturi or on the side of carburetors manufactured since 1973) to remove any dirt that may have accumulated.

d. A welch plug on the side of the carburetor body, just below the Idle Adjusting Screw, seals the Idle Fuel Chamber. This welch plug may be removed for thorough cleaning of the idle fuel mixture passage and the Primary and

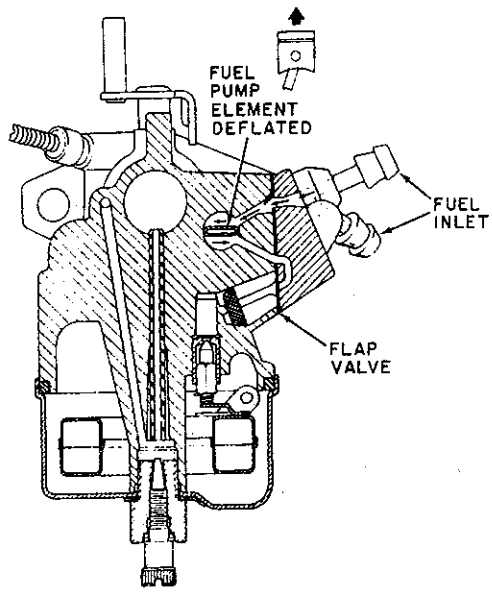


Figure 27

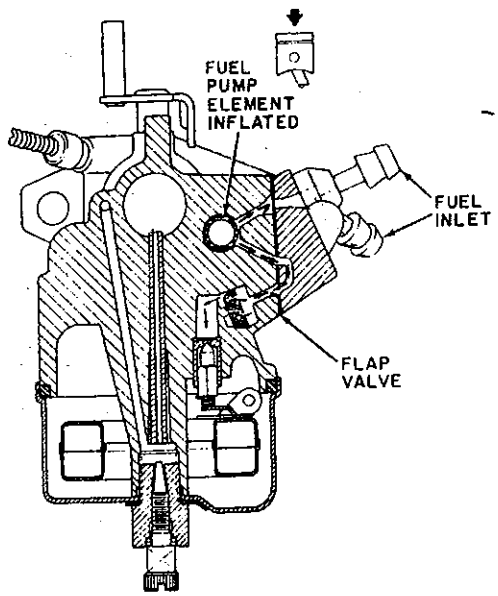


Figure 28

Secondary Idle Fuel discharge ports. Clean with solvent and compressed air. DO NOT use any tools that may change the size of the discharge ports.

e. Carburetors with fixed main jet are serviced in much the same manner as models with a main adjustment screw. The fixed main orifice (passage) is located in the bowl nut. (See Figures 25 and 26.) Install new bowl nut and washer if damaged.

4. CARBURETOR FUEL PUMP

A. The fuel pump built into carburetor of some models uses a bladder type pumping element and two flap valves to control the direction of fuel flow. The pump element should be inserted into the opening in the mounting flange end of the carburetor body, with the slot opening at a 45° angle (Figure 29). A gasket fits between mounting flange of carburetor and cylinder. The hole of gasket must be directly over the pump element to allow the crankcase pulsations to operate the pump element.

NOTE

Be careful to place hole of gasket directly over pump element.

The engine piston, moving out of the crankcase area, creates a partial vacuum which collapses the fuel pump element in the carburetor. On the outside of the element, suction opens the inlet flap, allowing a supply of fuel to flow from the tank and lines into the cavity created by deflating pump element. Suction pulls the outlet flap closed, sealing the outlet port so that fuel isn't pulled from the area of the inlet needle and seat. (See Figure 27.)

With the piston downward stroke, crankcase pressure enlarges the pump element forcing fuel out of its cavity. This pressurized fuel acts against the outlet flap valve, opening it, to allow a head of pressurized fuel to be transmitted to the inlet needle and seat port. The inlet valve is pressed against the inlet port sealing it so that pressurized fuel does not escape back into the fuel tank and lines. (See Figure 28.)

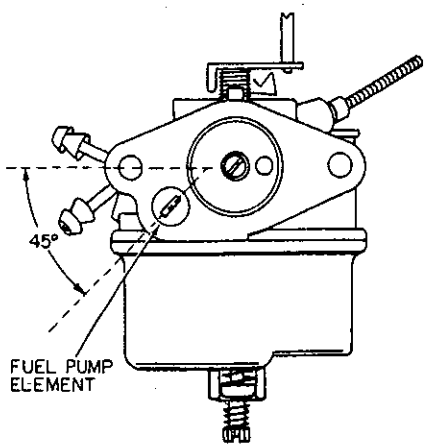


Figure 29

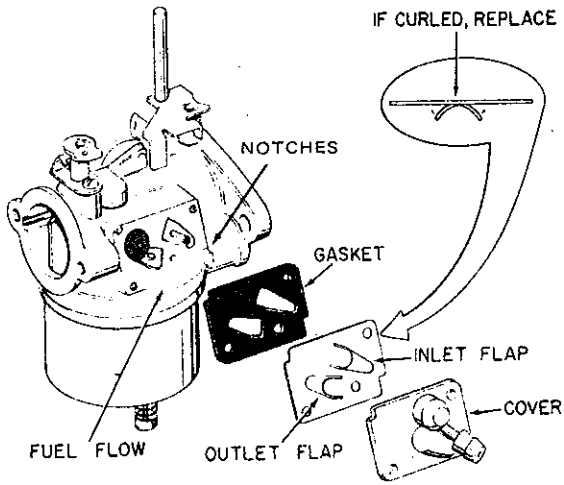


Figure 30

The valve cover assembly contains the two fuel inlets from the fuel supply.

The flap valve goes between the cover and gasket. (See Figure 30.) Notches on the carburetor body insure that the gasket, valve and cover can only be fit to the body correctly. Cover retaining screws should be tightened to 6-8 in.-lbs. (0.68-0.90 Nm) torque.

Clean or replace the strainer periodically. (See Figure 31.)

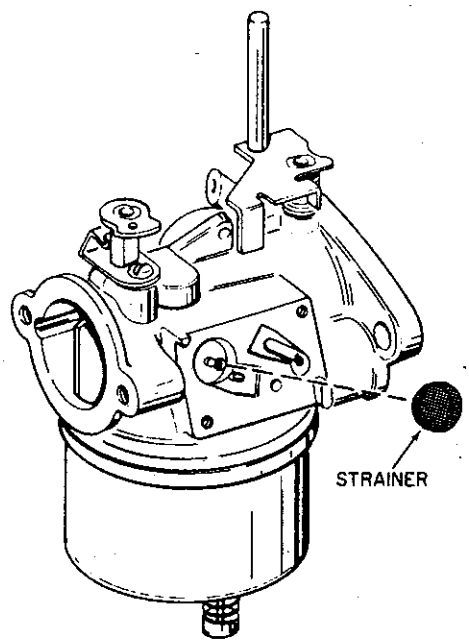


Figure 31

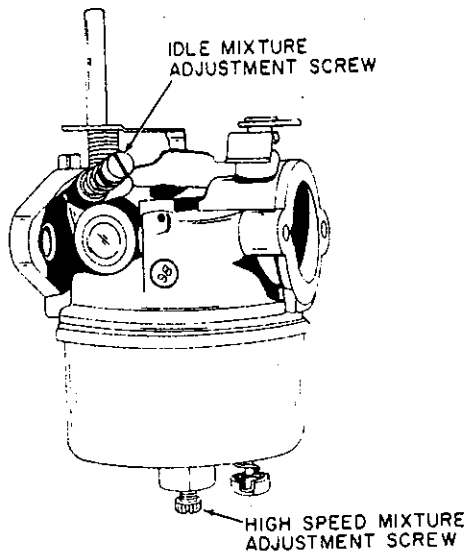


Figure 32

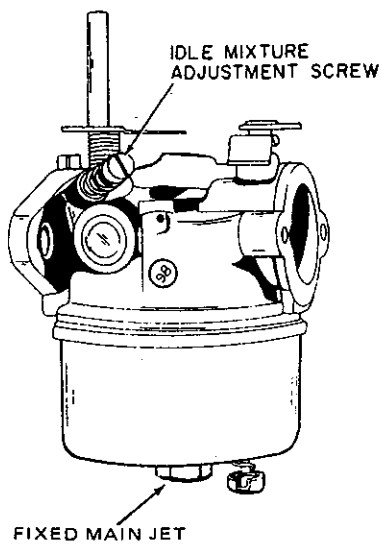


Figure 33

B. If engine is not running properly, make normal idle and main fuel mixture adjustments and the fuel supply tank, lines screens, vents and connections. Even small leaks between engine and remote fuel tank will allow air to be pumped instead of fuel.

C. Check condition of the pump element and check valves if fuel starvation is suspected and other problem is not found.

(1) Remove carburetor to check for pulsation passage alignment. (See Figure 29.)
(2) Check condition of pump element.
(3) Check for air leaks at gasket surface.
(4) If flaps are curled (Figure 30), install new flap valve and gasket.

CAUTION

Check seating of flap valves using mouth suction and pressure only. Do not use compressed air.

(5) Check strainer located in carburetor body for restriction. (See Figure 31.)

5. CARBURETOR REINSTALLATION

A. Secure carburetor and reed valve to engine.

B. Install shrouding or control panels. Connect choke and throttle controls.

C. Position control panel to carburetor. Connect carburetor fuel lines.

D. Adjust carburetor as described in following paragraph 6. Adjust carburetor linkage for control panel-operated carburetors.

CAUTION

Do not run the outboard out of water and only run outboard in a small test tank long enough to test unit.

NOTE

Outboard motor should only be operated in test tank if test propeller is available. The correct test propeller part number can be found in the ESKA Outboard Motor Identification Data. An outboard tested in a test tank with a test propeller must be fine-tuned on boat. This is due to difference in boats and difference between the test tank and normal boat operation.

6. CARBURETOR ADJUSTMENT

A. Correct adjustment may not be possible if carburetor is damaged, if wrong fuel-oil mixture is used, reed valve is damaged, ignition system is faulty or if some other problem exists.

B. Preset the main and idle adjustment screws. Turn the adjustment screw on carburetor IN until lightly seated, then back out one full turn. (See Figure 32.) Some carburetor models have a fixed main jet. The absence of the adjustment screw and receptacle indicate fixed jet. (See Figure 33.)

C. Start engine and allow to warm up to normal operating temperature with the throttle in the

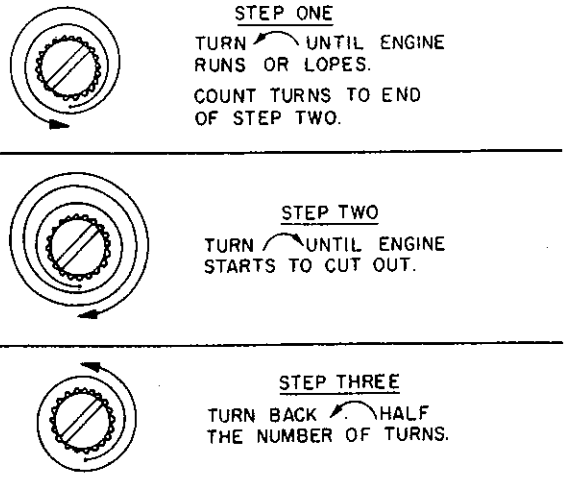


Figure 34

wide open position, back the main adjustment screw out counter-clockwise slowly until rich drop-off engine speed is reached. Turn main adjustment screw (Figure 32) in clockwise until lean drop-off speed is reached. (Engine will miss and run erratically due to lack of fuel.) Back main adjustment out midway between rich and lean drop-off. (See Figure 34.)

D. Bring the throttle control to low speed position with outboard in gear and follow the procedure in preceding paragraph C for adjusting the idle system (See Figure 33.) Later carburetors are similar to earlier carburetors with a few exceptions. The idle air adjustment screw has been relocated to facilitate adjustment of both air and fuel in the idle section. The early carburetor controls only the AIR bleed by the idle adjustment screw.

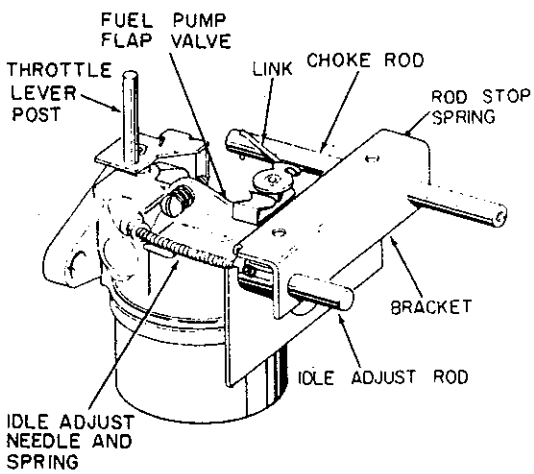


Figure 35

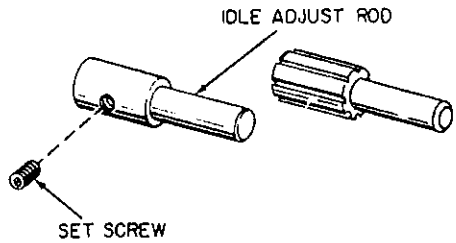


Figure 36

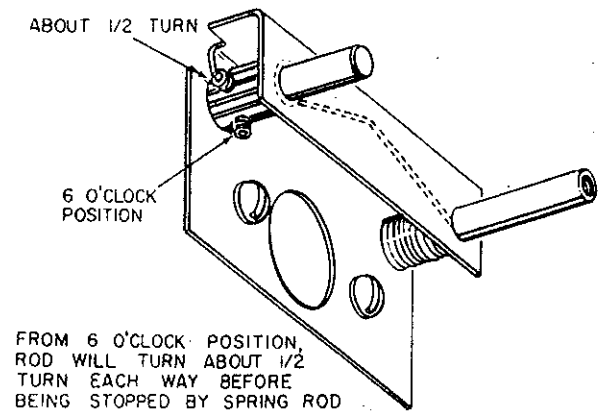


Figure 37

7. CARBURETOR CONTROL PANEL

A. Install idle adjustment rod into bracket, then screw setscrew into the rod a few turns (Figures 35 and 36).

B. Position the choke rod spring extended end on the idle adjustment rod and align the springs with the choke rod holes in the bracket. Press the choke rod through the bracket and spring with link attaching hole toward the carburetor side (Figure 35).

C. Install the choke shaft link in the rod, then install the other end in the choke lever.

D. On the other side, bend the idle adjustment coil into the rod, making sure that the setscrew is down (6 o'clock position). (See Figure 37.)

E. Install the control bracket to the carburetor, but do not tighten screw completely.

F. Tighten the setscrew to secure the rod to the coil. The rod should turn each way about half a turn before contacting the choke spring extended end.

G. It is important to remember that the idle adjustment screw be set one full turn open from lightly seated and that the rod setscrew be down when connecting the rod and coil.

H. Tighten the control bracket screw. Pull the choke rod to see that the choke closes.

PART VII IGNITION SYSTEMS

1. PRINCIPAL PARTS

A. The magneto ignition consists of a stator assembly mounted to the engine and a magnet cast into the rotating flywheel.

B. The stator assembly consists of a stator plate, laminations, ignition coil, contact points and condenser. (See Figure 1.) Stator laminations concentrate the magnetic lines of force for the primary circuit. (See Figure 1.)

D. The condenser acts as an electrical shock absorber to prevent arcing between the contact points as they open. Arcing would lower voltage output at the spark plug as well as burn and pit contact points, shortening point life. (Figure 1.)

E. The ignition coil consists of two coil windings that are hermetically sealed within a plasticlike casing. (See Figure 2.)

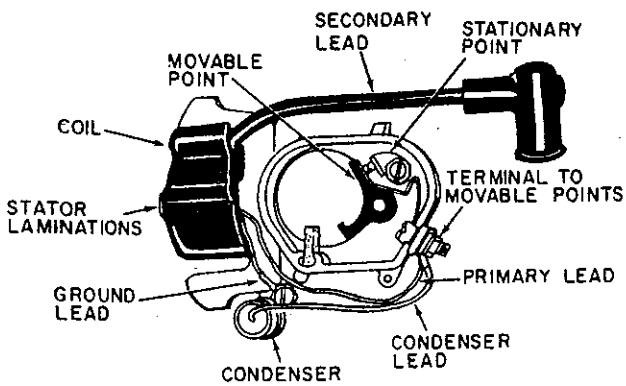


Figure 1

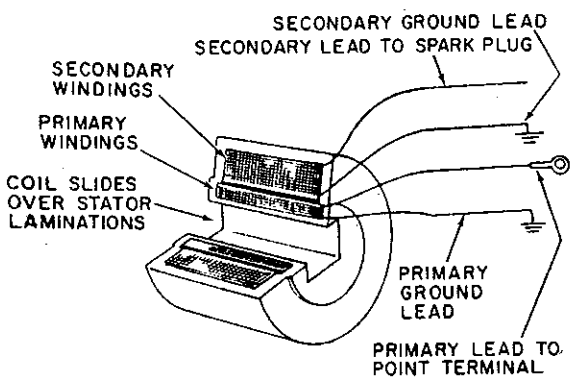


Figure 2

(1) The primary winding consists of a few turns (about 50) of comparatively heavy-gauge wire wrapped around the center receptacle hole for the stator laminations. One lead is connected to the insulated movable contact point terminal and the other lead is grounded to the stator body. The primary circuit is the low-voltage (300-400 volts) circuit that is used as a transformer to increase the voltage in the secondary or high-voltage circuit (10,000-20,000 volts).

(2) The secondary winding is of extremely fine wire with many turns (about 10,000) wrapped over the primary windings. One lead connects the spark plug and the other is grounded to the stator body. (See Figure 3.) The ground (also known as the "common") provides the return path to complete each circuit.

2. HOW A MAGNETO IGNITION WORKS

A. Bar magnets in the flywheel revolve around the magneto laminated legs. As the north pole of the first magnet passes over the center leg, a magnetic force field is set up down through the first leg, since the south pole of the second magnet is directly above the first leg. The circuit is completed in the iron flywheel rim. As the field passes from the top to bottom of the center leg, it cuts the windings in the coil.

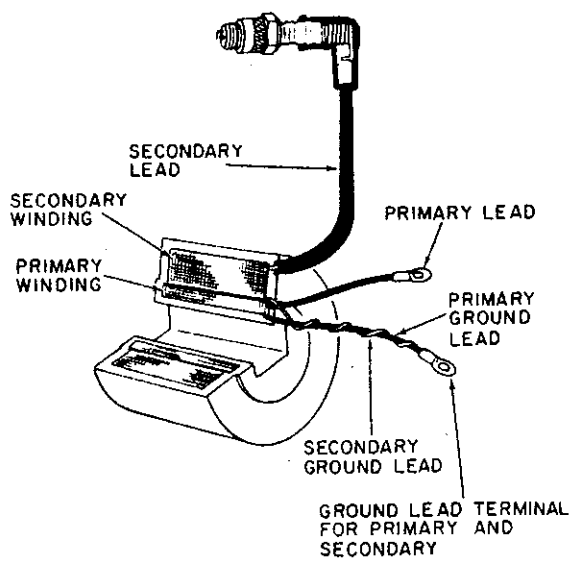


Figure 3

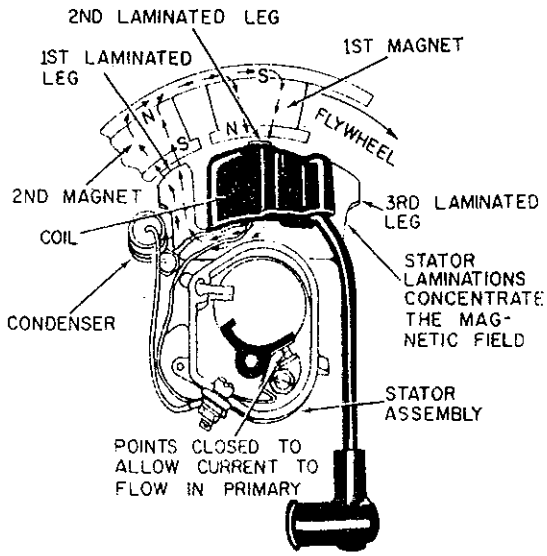


Figure 4

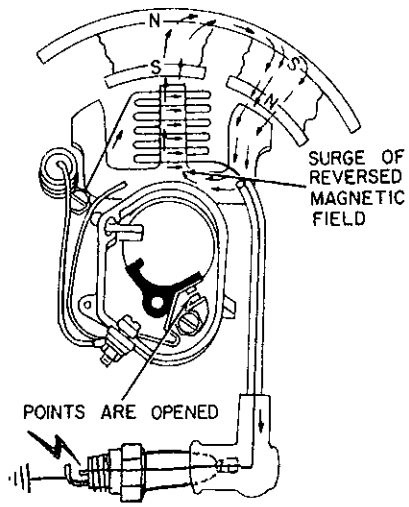


Figure 6

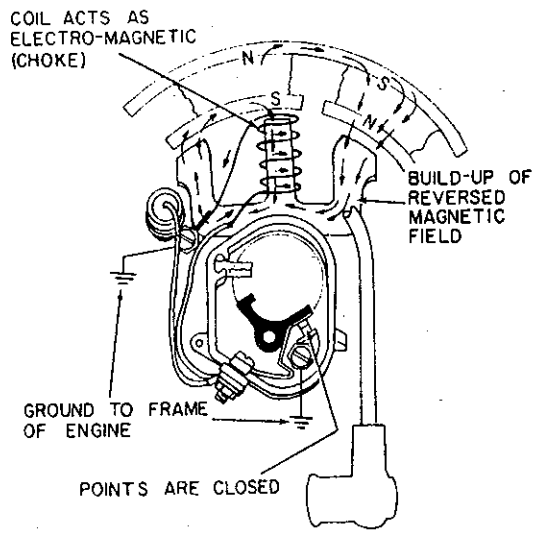


Figure 5

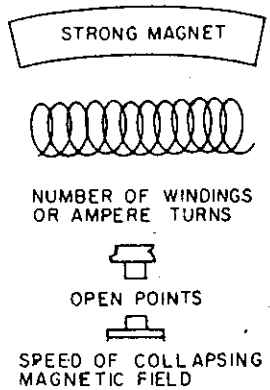


Figure 7

With the points closed (complete circuit), the coil generates a small amount of charge. (See Figure 4.)

B. As the flywheel continues to rotate, the first magnet now appears over the third leg and the second magnet comes directly over the center leg. Now the magnetic field passes from the top of the third leg down and attempts to go up the center leg. However, in step one, the coil had become an electro-magnet and opposes any change in magnetic flow. (See Figure 5.)

C. At the precise instant the magnetic field reversal build-up is at its peak, the points are opened. This breaks the circuit and the coil no no longer acts as an electro-magnet, causing a tremendous surge of reversed magnetic field. This sudden reversal of magnetic field generates an enormous voltage in the secondary coil. It travels to ground by arcing the air gap in the spark plug. (See Figure 6.)

D. The points then reclose to repeat the cycle sequence. High secondary voltage depends on the amount of conductor turns in the primary and secondary windings, the strength of the magnetic field within the magnet and primary circuit, and the speed at which the collapsing magnetic lines of force are cut by the secondary windings. (See Figure 7.)

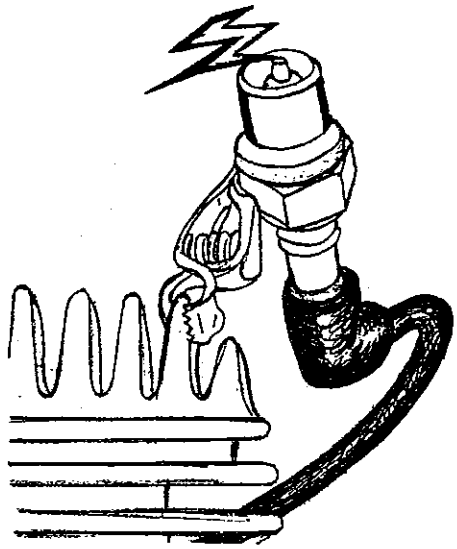


Figure 8

3. CHECKING OPERATION OF IGNITION SYSTEM

A. Disconnect the high tension lead from spark plug and attach to test plug which is securely grounded to the cylinder or cylinder head. (See Figure 8.)

B. Crank engine and check for spark between center electrode and test plug case.

C. If bright, hot spark jumps gap, magneto is operating correctly; however, the spark plug which is installed in engine may be fouled or otherwise faulty. Be sure to remove and check condition of spark plug.

D. Electrical current will take the path which is easiest to follow. Check the spark plug connector, spark plug high tension lead, coil, etc., for dirt, oil, moisture or anything else that could create a path for the current to follow more easily than jumping the spark plug electrode gap.

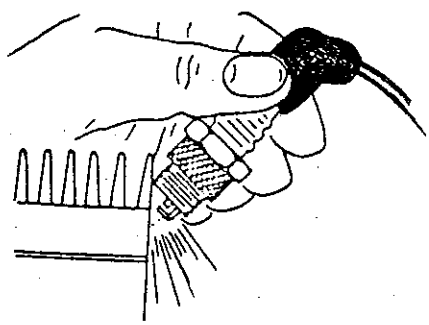


Figure 9

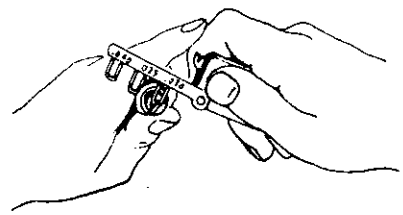


Figure 10

4. SPARK PLUG SERVICE

Spark plugs should be removed, cleaned and adjusted periodically. Check gap with wire feeler gauge and adjust gap if necessary. Install new spark plug if condition is questionable or if ignition problem is suspected. Refer to "Master Parts Manual" or "Microfiche" for correct replacement number. Apply a little graphite grease to the threads to prevent sticking. Be sure cleaned plugs are free of all foreign material. (See Figure 10.)

5. CONDITIONS CAUSING FREQUENT SPARK PLUG FOULING.

If spark plugs foul frequently, check for the following conditions:

A. Carburetor setting too rich.

B. Partially closed choke valve.

C. Poor grade of gasoline.

D. Clogged exhaust system.

E. Incorrect spark plug.

F. Too much oil in 2-cycle engine fuel mixture.

G. Loose carbon in cylinder, carbon flakes off when engine cools down.

6. FLYWHEEL REMOVAL

A. Remove screws, engine shroud and rewind starter. Place a socket wrench and handle on flywheel nut and use flywheel tool part number 670217 to hold flywheel. Remove nut by turning in counter-clockwise direction. (See Figure 11.)

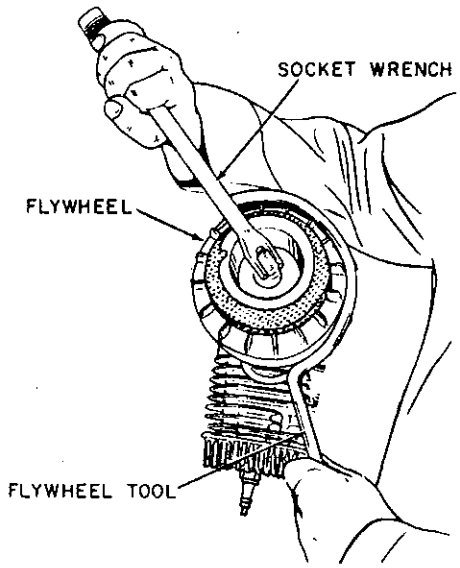


Figure 11

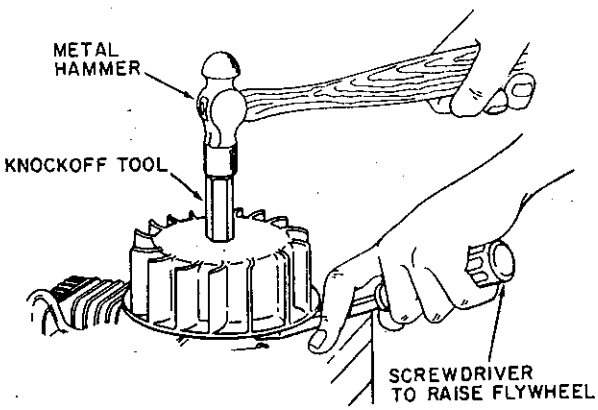


Figure 12

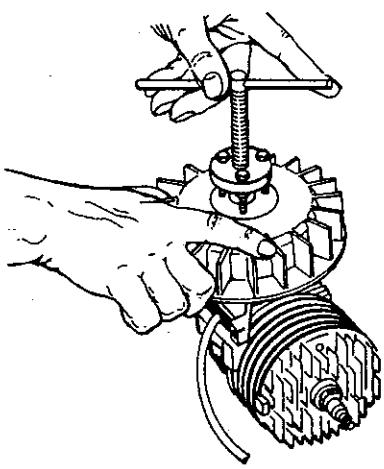


Figure 13

B. Remove flywheel by using appropriate puller or special knockoff tool.

(1) Remove flywheel nut and starter cup. Turn correct knockoff tools onto crankshaft, to within 1/16 inch (1 mm) of flywheel. Hold flywheel firmly and rap top of knockoff sharply with a hammer to jar flywheel loose. Remove knockoff and flywheel. (See Figure 12.)

(2) On flywheels that have cored holes, use flywheel puller number 670215. A set of 3 self-tapping screws are included with the puller. (See Figure 13.)

7. REPLACING MAGNETO BREAKER POINTS

A. Remove nut that holds electrical leads to the screw on the movable breaker point spring. Remove the movable breaker point from stud.

B. Remove the screw and stationary breaker point. Put a new stationary breaker point on breaker plate; install the screw, but do not tighten.

C. Position a new movable breaker point on the post. Reconnect leads and tighten nut.

D. Adjust breaker point gap at high side of cam and tighten screw. Refer to the table of specifications for correct gap, if not shown on dust cover. (See Figure 14.)

E. Check new point contact and remove all grease, fingerprints and dirt from points.

8. MAGNETO REMOVAL

If magneto fails to produce a proper spark after adjusting or replacing breaker points, remove and test coil and condenser.

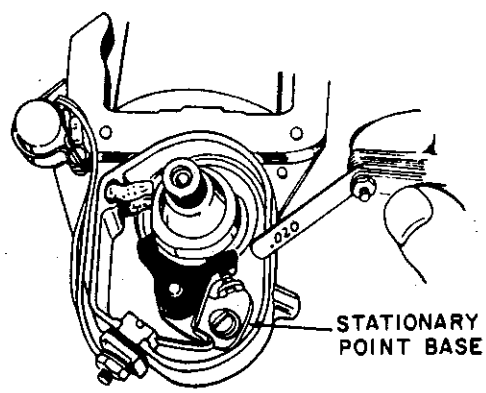


Figure 14

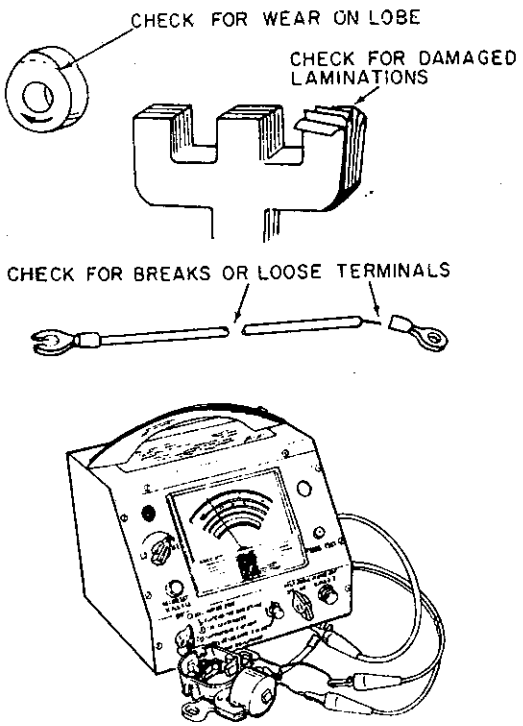


Figure 15

9. CHECKING MAGNETO PARTS

A. Inspect coil assembly for cracks in insulation, evidence of overheating or other damage. Make sure electrical leads are intact, especially where they enter the coil. With coil assembly installed on core assembly, check operation of coil on approved coil tester. (See Figure 15.)

B. Inspect condenser for visible damage. Look especially for damaged terminal lead, dents or gouges in can, or broken mounting clip. Check condenser on a good quality tester. Follow test equipment manufacturer's instructions to check for breakdown capacity and series resistance. Replace condenser if condition is in doubt.

C. The Alnico magnets cast into the flywheel rarely lose their magnetic strength; however, if magnets are suspected faulty, place flywheel upside-down on a wooden surface. Hold a screwdriver by the extreme end of handle with point down. Move blade to within one inch (2.5 cm) of magnets at which time magnets should attract screwdriver blade against magnet. (See Figure 16.)

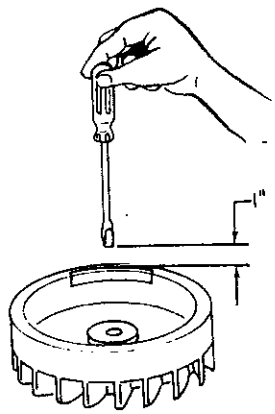


Figure 16

CAUTION

Alnico magnets cannot be recharged on a conventional charger. Never stack flywheels with magnets holding stack together. It may dissipate the magnetic strength of the magnets.

D. (See Figure 15.) Replace breaker cam showing excessive wear, scoring or other damage. Replace core assembly showing bent laminations, distortion or other damage. Replace all electrical leads showing wear, insulation breaks, insecure terminals or other damage.

10. REASSEMBLY AND INSTALLATION OF MAGNETO

If coil was removed, reinstall carefully, supporting center of core to prevent distorting lamination. Time the magneto using the following table to determine the correct timing procedure.

11. TYPE NUMBER CROSS REFERENCE (Timing procedure for all engine types.)

Engine Type	Timing Procedure
639	A
639A	B
639B	C
639-02	A
639-02A	A
639-02B	A
639-02C	C
639-02D	C
639-03	A
639-03A	B
639-04	A
639-04A	B
639-05	C
639-06	B

Engine Type	Timing Procedure
639-07	C
639-07A	C
639-07B	C
639-08	C
639-08A	C
639-10	C
639-10A	C
639-11	C
639-12	C
639-13	C
639-13A	C
640-02	D
640-03	D
640-03A	D
640-04	D
640-05	D
640-05A	D
640-06	D
640-06A	D
640-06B	D
640-07	D
640-07A	D
640-08	D
640-09	D
640-10	D
640-11	D
640-12	B
640-13	D
640-14	B
640-14A	B
640-15	D
640-16	D
640-17	D
640-18	D
642	A
642A	B
642B	B
642-01	A
642-01A	A
642-02	A
642-02A	A
642-02B	A
642-02C	B
642-02D	B
642-02E	B
642-03	A
642-03A	A
642-03B	A
642-04	A
642-04A	B
642-04B	B
642-04C	B
642-05	A
642-05A	A
642-05B	A
642-06	B
642-06A	B
642-07	B
642-07A	B
642-07B	B
642-07C	B
642-08	B
642-08A	B
642-08B	B
642-08C	B
642-09	A
642-10	A
642-11	B
642-13	B
642-13A	B
642-14	B
642-14A	B
642-15	B
642-16	B
642-17	B
642-17A	B
642-17B	B
642-17C	B
642-18	B
642-18A	B
642-19	B
642-20	B
642-21	B
642-22	B
642-23	B
642-24	B
642-25	B
642-26	B
642-27	B
642-28	B
643	A
643A	B
643B	B
643-01	A
643-01A	A
643-02	A
643-03	A
643-03A	B
643-03B	B
643-04	B
643-04A	B
643-05	B
643-05A	B
643-05B	B
643-06	A
643-07	A
643-08	A
643-09	B

Engine Type	Timing Procedure
643-11	B
643-12	B
643-13	C
643-14	B
643-14A	B
643-15	B
643-15A	B
643-16	B
643-17	B
643-18	B
643-19	B
643-20	B
643-20A	B
643-20B	B
643-21	B
643-22	B
643-23	B
643-24	B
643-24A	B
643-25	B
643-26	B
643-27	B
643-28	B

12. IGNITION TIMING AND THROTTLE CAM ADJUSTMENT, TYPE A TIMING PROCEDURE

A. Apply a small amount of E.P. lithium grease to the contact area of the friction screw. Do not turn the screw into the radius of the stator collar. (See Figure 17.)

B. Install the stator with operating handle pointed in the direction of the carburetor. Be sure the throttle post is NOT INSIDE the area of the throttle actuating cam. (See Figure 18.)

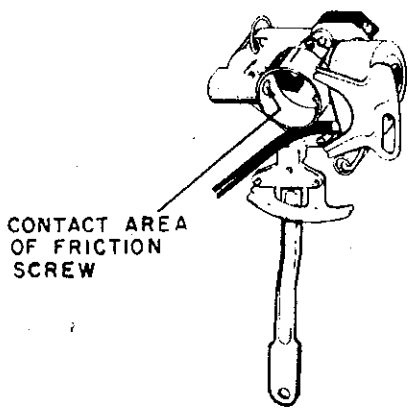


Figure 17

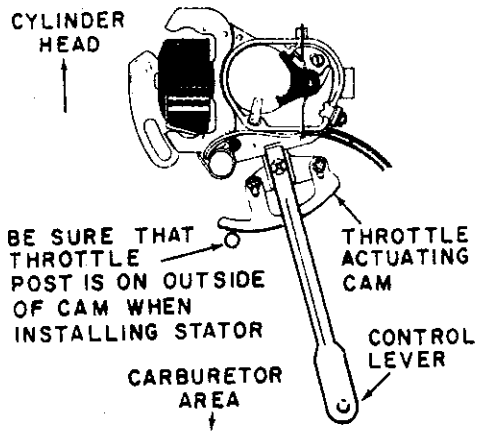


Figure 18

C. Tighten the friction screw to 5-8 in.-lbs. (0.56-0.90 Nm) **torque** for twist grip models; 12-15 in.-lbs. (1.36-1.69 Nm) torque for other models. (See Figure 19.)

D. Install the points, if necessary. Adjust the point stationary base for a .020-inch (0.51 mm) point gap on high side of cam, then close points and clean. Use a squarely cut piece of bond paper. (See Figure 20.)

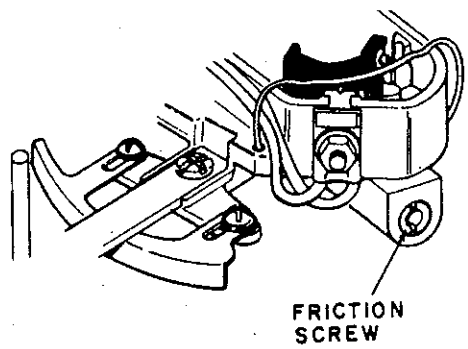


Figure 19

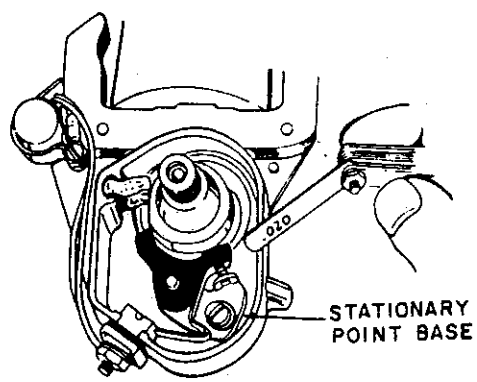


Figure 20

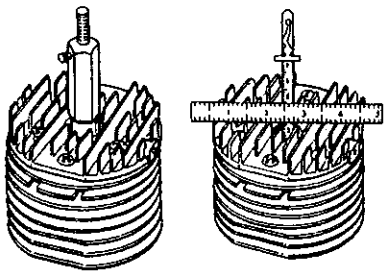


Figure 21

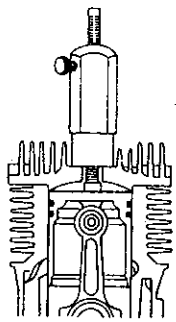


Figure 22

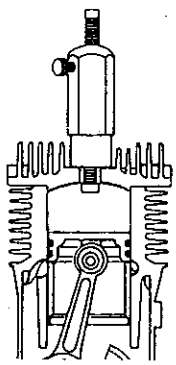


Figure 23

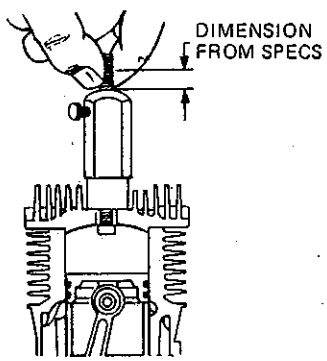


Figure 24

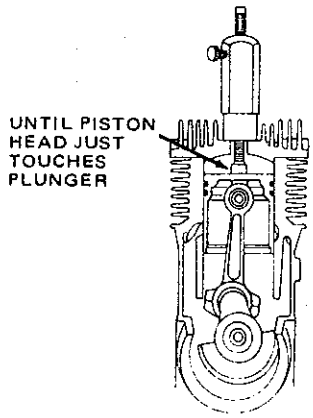


Figure 25

E. Install the timing gauge number 670124; or use a straight edge and narrow machinist's rule; or use a dial indicator through the spark plug hole. (See Figure 21.)

F. Find Top Dead Center (TDC) while rotating the crankshaft. (See Figure 22.)

G. If tool number 670124 is used, tighten the set screw to lock the plunger, then back off TDC opposite normal rotation (turn counter-clockwise). If the rule and straight edge or dial indicator is used, leave the piston at TDC. (See Figure 23.)

H. Find the correct Before Top Dead Center (BTDC) dimension in the specifications located in the General Information section of this manual.

I. Apply the correct dimension to the engine. (See Figure 24.)

   (1) If tool number 670124 is used, carefully find dimension on the calibrated plunger. Hold that dimension carefully, then loosen the set screw and move the plunger into the barrel. Re-tighten the set screw. NOTE: Calibrations on plunger are 1/32 inch or .031 inch.
   (2) If dial indicator or straight edge and rule are used, move piston down until correct dimension is registered.

J. When using tool number 670124, bring piston up on normal rotation until it contacts plunger. (See Figure 25.)

K. Position the operating lever as shown in Figure 26 to set the idle location of the throttle cam.

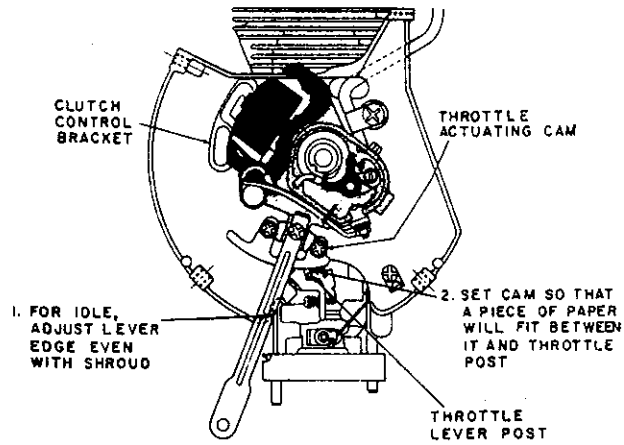


Figure 26

L. Install leads of some continuity reading device on the point terminal and to ground. (See Figure 27.)

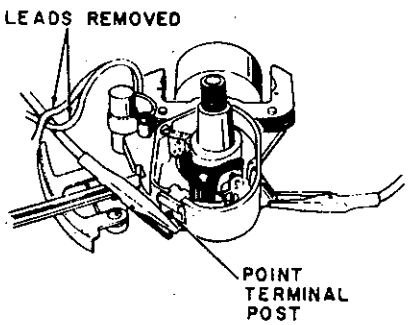


Figure 27

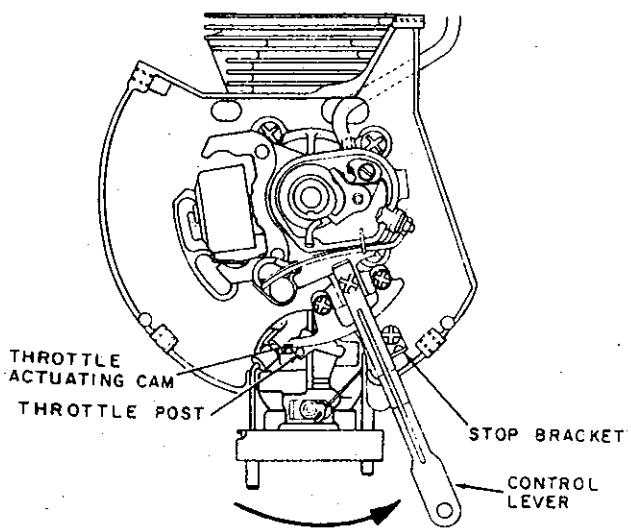


Figure 28

M. Move the stator counter-clockwise, advancing the timing until the continuity reading breaks and reads zero. Tighten the stop bracket so that the stator won't move any further counter-clockwise. (See Figure 28.)

N. Adjust the throttle cam for full throttle. Recheck to see that the idle position wasn't changed (see step K). Be sure the cam is contacting correctly at both ends of the operating lever travel before tightening cam screw.

O. Install gasket, cover and retaining clip. Reassemble key and flywheel, starter and other accessories.

13. IGNITION TIMING AND THROTTLE CAM ADJUSTMENT, TYPE B TIMING PROCEDURE

A. Perform steps A thru J as described in paragraph 12.

B. Install leads of some continuity reading device on the point terminal and to ground. (See Figure 29.)

C. Move the stator counter-clockwise, advancing the timing until the continuity reading breaks and reads zero. Tighten the stop bracket so that the stator won't move any further counter-clockwise. (See Figure 30.)

D. Loosen the cam locking screws just enough to allow adjustment of the cam. Move the cam to open the throttle completely WITHOUT causing any binding with the throttle post.

E. To determine the idle-speed throttle cam pickup point, proceed as follows: (See Figure 31.)

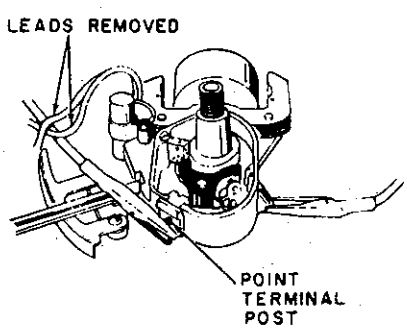


Figure 29

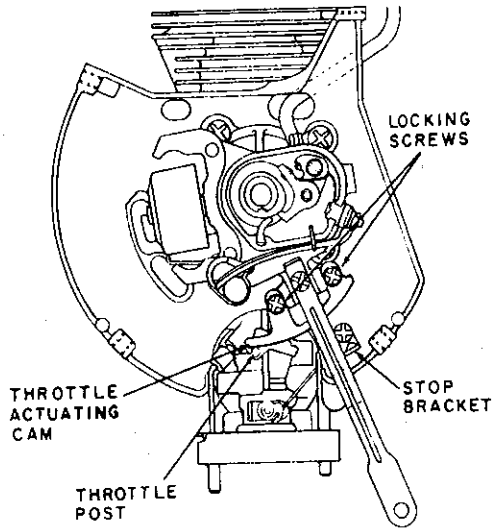


Figure 30

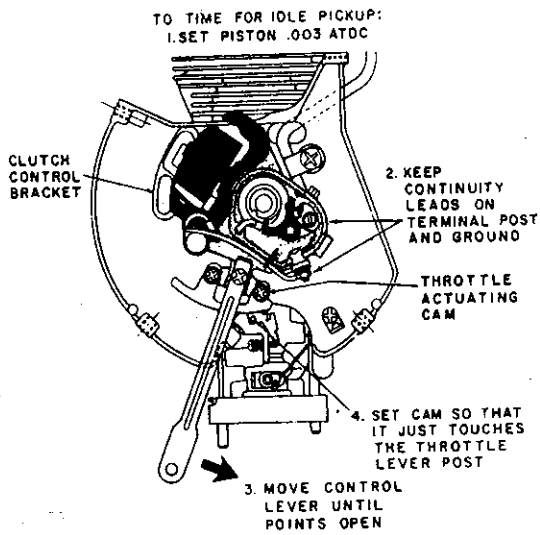


Figure 31

(1) If a dial indicator is used, find the 0.003 inch (0.08 mm) After Top Dead Center piston position, then proceed to step 3 below.

(2) If a timing gauge is used, set as follows:
   a. Turn the gauge into the spark plug threads until it is finger tight, then back out (unthread) the gauge 1/10 to 1/8 of a turn.
   b. From that position, find TDC (Top Dead Center), then lock the plunger with the set screw.
   c. Advance the crankshaft so that the timing gauge can be tightened finger tight. Do NOT loosen the set screw to move the plunger only. Tighten the timing gauge in the spark plug hole.
   d. Back up the crankshaft so that the piston just contacts the gauge plunger.

(3) With a continuity indicating device connected to the point terminal post and ground, retard the timing (move operating lever clockwise) until the points close and continuity is established. The operating lever should be at full-run position to start. Find the point where continuity breaks, then hold the magneto position.

(4) Move the throttle actuating cam (see Figure 30) right side so that the cam just touches the throttle post without moving it. Tighten the retaining screw slightly to hold that position.

(5) Leave the continuity device attached, but move the operating lever back to the full-run position. Usually, the cam left slot may be readjusted. Work carefully.

(6) Recheck idle (using continuity device), then full-run position alternately until the operating lever can be moved from one position to the other without having to make some minor adjustment to the cam position.

F. Install gasket, cover and retaining clip. Reassemble key and flywheel, starter and other accessories.

14. SOLID-STATE IGNITION.

The solid-state ignition system has no friction-producing (hence, wearing) parts. The only moving part of the system is the flywheel with the charging magnets.

A. Description of operation. Numbers in parentheses refer to Figure 32. As the (1-A) flywheel magnet passes the (2) input coil, a low-voltage A.C. current is induced into that coil. The current passes through a (3) rectifier, converting this current to D.C. It then travels to the (4) capacitor where it is stored. The flywheel rotates approximately 180° and as the (1-B) magnet passes the (5) trigger coil, it induces a very small electric charge into that coil. The charge passes through the (6) resistor and turns on the (7) silicon-controlled rectifier (solid-state switch). With the (7) silicon-controlled rectifier closed, the low voltage stored in the (4) capacitor travels to the (8) pulse transformer. Here the voltage is stepped up instantaneously and it is discharged across the

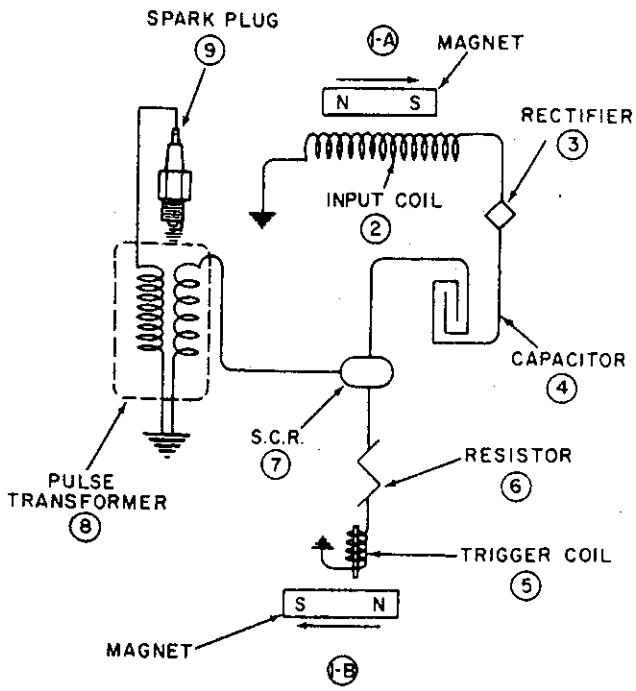


Figure 32

electrodes of the (9) spark plug, firing before top dead center. Some units are equipped with an advance and retard feature. This is accomplished through the use of a second (5) trigger coil and (6) resistor set to turn on the (7) S.C.R., at a lower R.P.M., to fire the spark plug at top dead center.

B. The only check which can be made to determine whether the solid state ignition system is working is to separate the high-tension lead from the spark plug and check for spark. A spark indicates that the unit is all right—that the spark plug should be replaced. No spark indicates that some other part needs replacement. Check as follows (Figures 33 and 34).

(1) Inspect high-tension lead for cracks or indications of arcing. Replace the transformer if questionable lead is found.
(2) Check all low-tension leads for shorts. Check ignition cut-off lead to see that unit is not grounded out. Repair leads, if possible, or replace.
(3) Before replacing pulse transformer unit, attach leads to a new transformer, ground the unit and test for spark. If a spark occurs now but didn't previously, replace the unit with a good one.

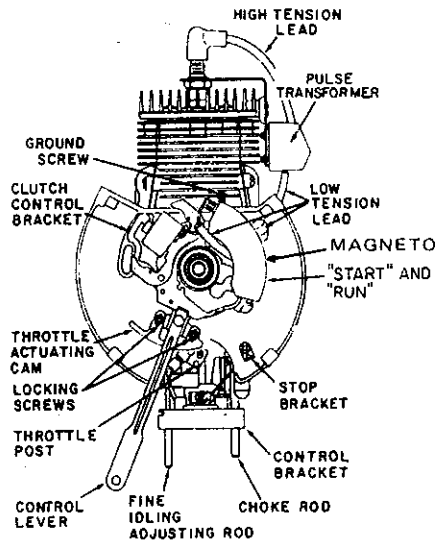


Figure 33

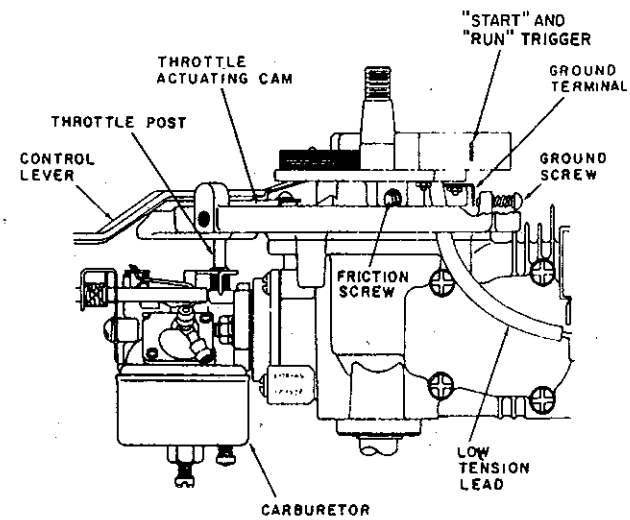


Figure 34

(4) Replace magneto and test for spark. Time the magneto using the table in paragraph 11 to determine the correct timing procedure.
(5) Check flywheel magnets for strength. Check key and keyway. Be sure that key locks flywheel to crankshaft.

15. SOLID-STATE IGNITION—TIMING AND THROTTLE ADJUSTMENT FOR TYPE C TIMING PROCEDURE

A. Install the magneto or carburetor as necessary.

CAUTION

Be sure that the throttle post is not bound behind the throttle actuating cam. See steps A, B, and C in paragraph 12.

B. The ground screw (ignition cut-out) should be adjusted to contact the ground terminal on the ignition unit when the control lever is in the full retard position. (See Figure 34.)

C. Set the piston at correct position BTDC (Before Top Dead Center) according to table in Figure 35.

NOTE

The key should be in its normal position on the crankshaft keyway. Do not disturb the piston position once it has been properly set.

Install tool 670236A on the crankshaft; be careful not to distort key register area. (See Figure 36.)

D. Without disturbing the BTDC piston position set in step C, move the control lever counter-clockwise until the "START" and "RUN" trigger aligns with the timing tool (670236A) notch marked "No. 1." Hold this position.

NOTE

Current solid state ignition has only one trigger!

E. Adjust the stop bracket (Figure 37) to prevent the control lever from moving any further counter-clockwise. Tighten the stop bracket screw securely.

F. Loosen the actuating cam lock screw enough to allow adjustment of the cam. Position the end of the cam (contacting the throttle post) so that it opens the throttle completely—however, be sure that the cam doesn't cause a binding with the post.

G. When properly adjusted, there should be perceptible play in the throttle post (1/16 inch or 1 mm) at open throttle. If this is not present, the cam is probably causing binding at the post and subsequent readjustment and parts replacement may soon follow.

H. When the correct position is attained, tighten the lock screw on the "high" end to hold the cam in place.

I. Move the control lever to align the "START" and "RUN" trigger of the ignition unit with

OUTBOARD ENGINE TYPE	PISTON POS. BTDC	PICKUP POS. # ON TOOL
639	.095	2
640	.115	1
642	.075	4
643	.085	

Figure 35

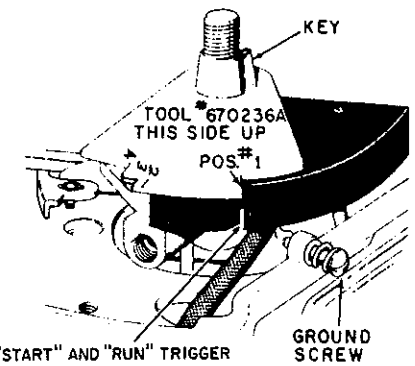


Figure 36

the tool at the proper position pointed out in Figure 36, depending upon engine type. Hold this position. (Figure 38 shows example of type 639.)

J. Adjust the cam to touch the post without moving it. Tighten the lock screw on the "high" end to hold the cam in place.

K. Recheck to ensure that the high-speed point hasn't changed or that binding will not occur. Readjust from high to pickup point as necessary.

L. When assured that cam position is correct at "FULL RUN" and "IDLE" positions, torque the lock screw to 10-15 in.-lbs. (1.13-1.69 Nm).

M. Install the remaining magneto parts, shroud and starter and other removed accessories.

16. SOLID-STATE IGNITION—TIMING AND THROTTLE ADJUSTMENT FOR TYPE D TIMING PROCEDURE

A. Install the magneto or carburetor as necessary.

CAUTION

Be sure that the throttle post is not bound behind the throttle actuating cam. See steps A, B and C in paragraph 12.

B. The ground screw (ignition cut-out) should be

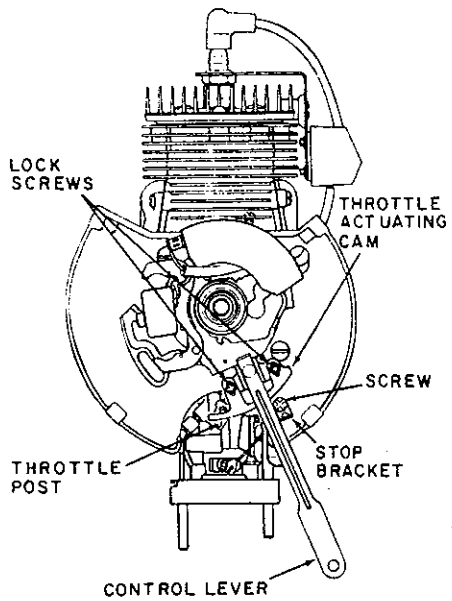


Figure 37

adjusted to contact the ground terminal on the ignition unit when the control lever is in the full retard position. (See Figure 34.)

C. Set the BTDC (Before Top Dead Center) piston position to 0.115 inch (2.92 mm).

NOTE

The key should be in its normal position on the crankshaft keyway. Do not disturb the piston position once it has been properly set.

Install tool number 670238A on the crankshaft; be careful not to distort key register area.

D. Without disturbing the BTDC piston position set in step C, move the control lever counter-clockwise until the "START" and "RUN" trigger aligns with the timing tool (670238A) notch marked "No. 1." Hold this position. (See Figure 39.)

E. Adjust the stop bracket (Figure 37) to prevent the control lever from moving any further counter-clockwise. Tighten the stop bracket screw securely.

F. Loosen the actuating cam lock screw enough to allow adjustment of the cam. Position the end of the cam (contacting the throttle post) so that it opens the throttle completely—however, be sure that the cam doesn't cause a binding with the post.

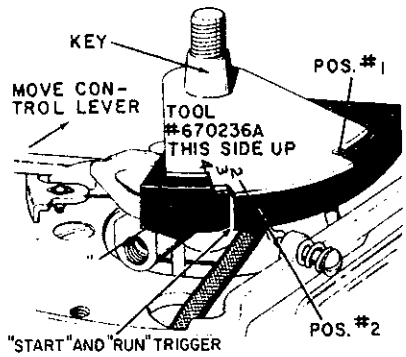


Figure 38

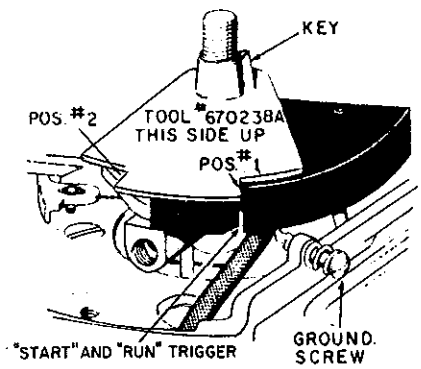


Figure 39

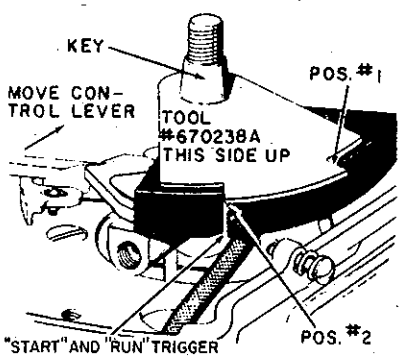


Figure 40

G. When properly adjusted, there should be perceptible play in the throttle post (about 1/16 inch or 1 mm) at open throttle. If this is not present, the cam is probably causing binding at the post and subsequent readjustment and parts replacement may soon follow.

H. When the correct position is attained, tighten the lock screw on the "high" end to hold the cam in place.

I. Move the control lever to align the "START" and "RUN" trigger of the ignition unit with

the tool at the proper position pointed out in Figure 40. Hold this position.

J. Adjust the cam to touch the post without moving it. Tighten the lock screw to hold the cam in place.

K. Recheck to ensure that the high-speed point hasn't changed or that binding will not occur. Readjust from high to pickup point as necessary.

L. When assured that cam position is correct at "FULL RUN" and "IDLE" position, torque the lock screw at 10-15 in. lbs. (1.13-1.69 Nm).

M. Install the remaining magneto parts, shroud and starter and other removed accessories.

PART VIII STARTER SYSTEMS

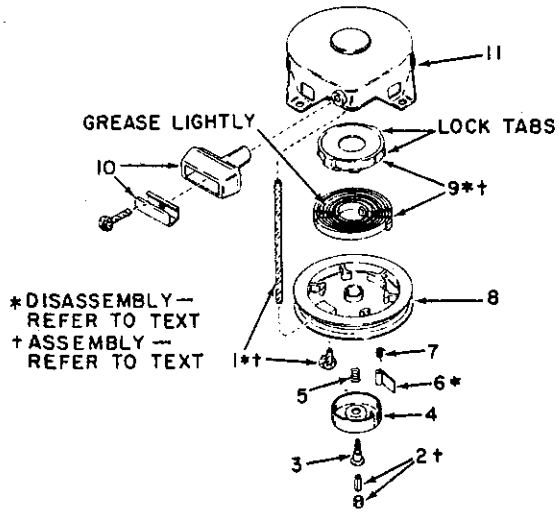


Figure 1

1. OPERATION.

Pulling the starter rope rotates the pulley and cams the starter dogs into engagement with the starter hub, transmitting the energy to turn the engine over. Releasing the starter rope on rewind starters moves the starter dog out of mesh with the starter hub. The powerful clock-type spring recoils the pulley in reverse direction to rewind the rope.

2. DOG TYPE REWIND STARTER.

Several variations have been used, but service is similar for all.

A. Follow number sequence shown in Figure 1 to disassemble starter. Release spring tension before disassembly. Hold pulley (8) with thumb firmly, remove handle (10), then release pulley slowly until spring is unwound. (See Figure 2.) Remove and install spring and keeper (9) as an assembly. Grease spring lightly.

B. Assemble starter dog (6), brake spring (5) and return spring (7) as shown in Figure 3. Tighten retainer screw (3) to 45-55 in. lbs. (5.08-6.21 Nm). If starter dogs do not emerge immediately from cup (4) when rope is pulled, retainer screw (3) may be loose or brake spring (5) damaged. Be sure to preload spring by turning pulley before inserting rope through housing (11) and attaching handle (10).

C. Be sure to attach pulley housing to engine so that handle is correctly positioned for starting.

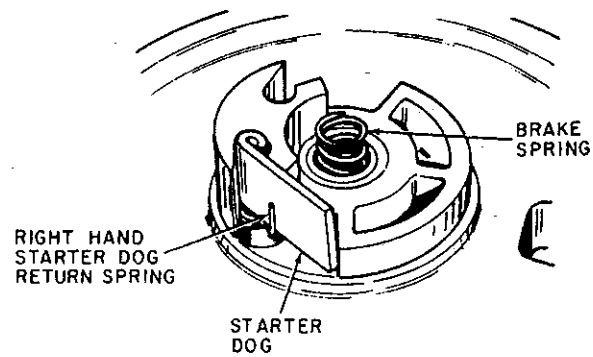


Figure 3

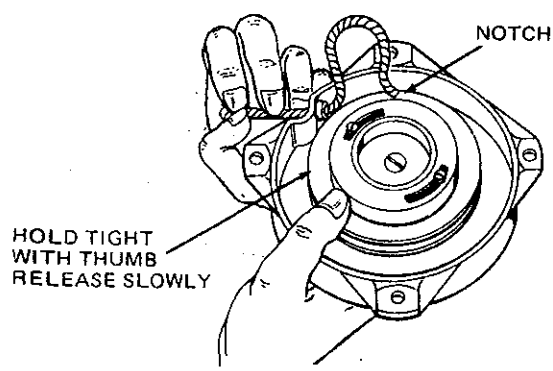


Figure 2

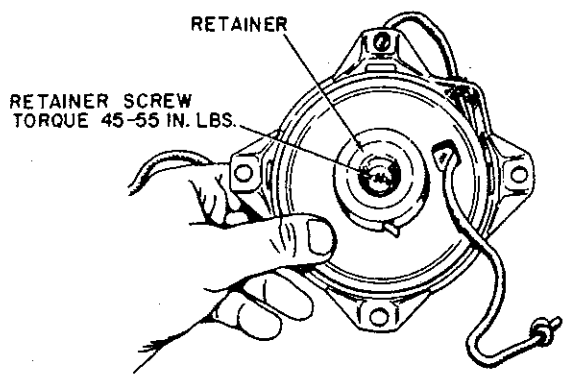


Figure 4

PART IX FNR GEAR HOUSING

1. GENERAL

The gear housing is attached to the lower portion of the column. FNR models contain a gear box which is connected to the shifter control to provide forward, neutral and reverse gear selection. Most models contain a water pump driven by the drive shaft. The gear housing also serves as a water inlet and outlet for cooling the column, and exhaust outlet for the engine. It also acts as a rudder and an anti-cavitation device. Disassemble only as far as necessary to effect the needed repairs.

2. REMOVE GEAR HOUSING FROM COLUMN

A. Use a flat-tip screwdriver to remove the two flat-head screws holding the inspection cover. Remove the cover (Figure 1).

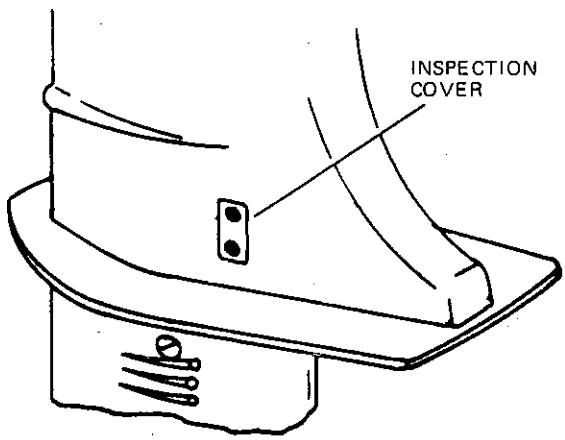


Figure 1. Remove inspection cover.

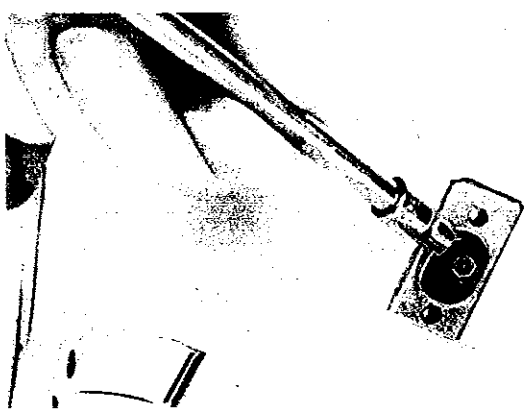


Figure 2. Loosen connecting screw.

B. Loosen the hex head machine screw connecting the column link rod and the shift rod (Figure 2). Do not remove at this point.

C. Hook a piece of wire around screw to prevent dropping screw into gear housing and remove screw.

D. Remove screw and washer adjacent to exhaust outlet (Figure 4).

E. Pry off the cavity clip; use a 1/2-inch open end wrench to remove the column and stud hex nut and lock washer.

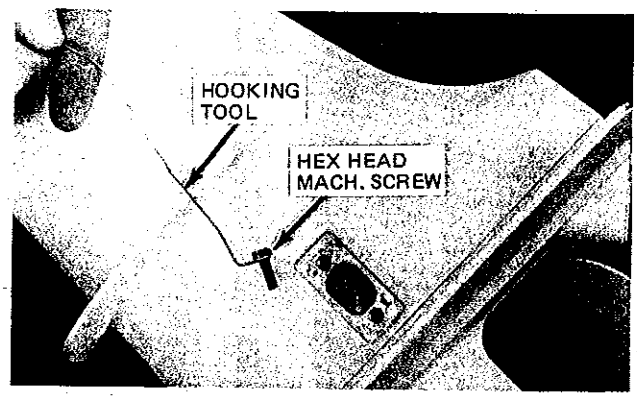


Figure 3. Hold screw with tool.

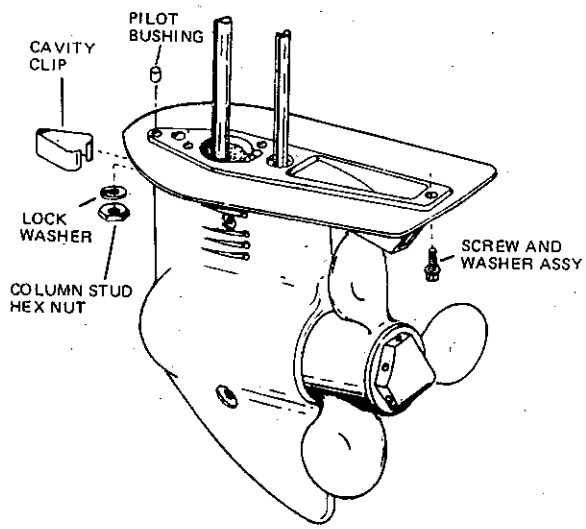


Figure 4. Remove stud hex nut and rear screw.

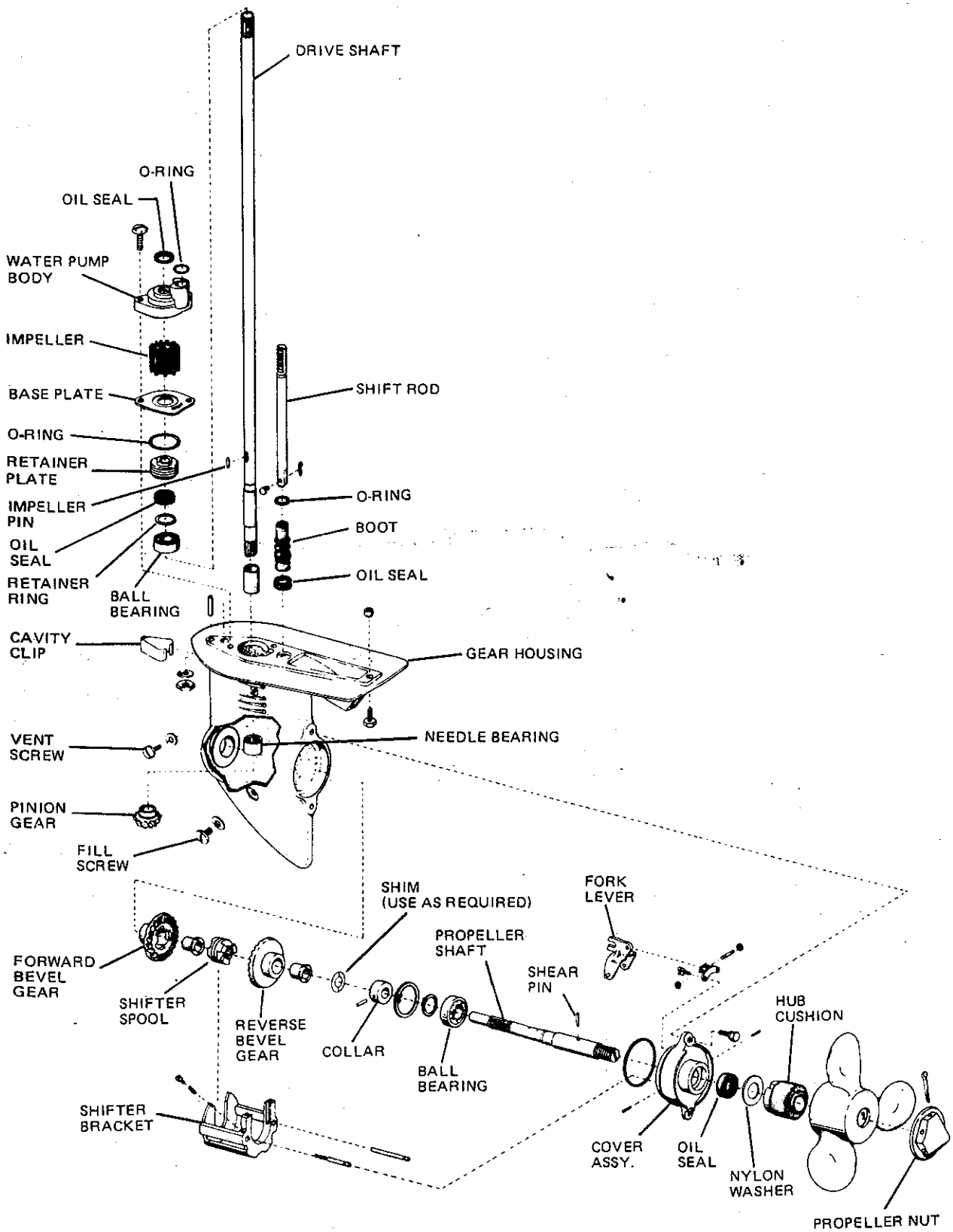


Figure 5. Exploded view of FNR lower unit.

NOTE

The gear housing may have to be separated slightly from the column in order to remove the column stud hex nut and lock washer.

F. Pull gear housing from the rest of the column assembly and remove the pilot bushing.

3. DISASSEMBLY GEAR HOUSING [Figure 5]

A. Remove the water pump as follows:

(1) Use a flat-tip screwdriver or impact wrench to remove the two fillister head machine screws holding the water pump body to the gear housing.

(2) Slide the pump body off the drive shaft (it may be necessary to clean the shaft); the impeller may stick inside the pump body. If it does stick, be prepared to catch the impeller when it falls out.
(3) If the impeller did not separate from the drive shaft in (2) above, remove the impeller pin when it falls out.
(4) Pry off the base plate.
(5) To remove the oil seal, pry it out with a flat-tip screwdriver.
(6) Use a piece of wire or small flat-tip screwdriver to lift out the "O" ring.

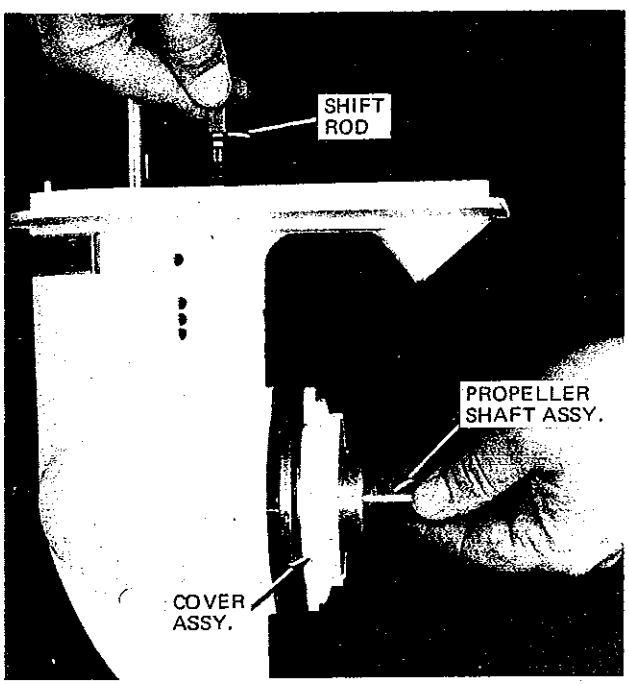


Figure 6. Pry cover out.

(7) Wrap a rag around upper end of drive shaft and remove vent screw.
(8) Carefully inject compressed air into vent screw hole and "pop" retainer plate and seal assembly out of gear housing. If compressed air is not available, pry retainer plate out of housing. Retainer plate and seals will be damaged and must be replaced if prying is required.

B. Remove the cotter pin in the propeller nut.

C. Use a 1-11/16-inch wrench or channel-lock pliers to remove the propeller nut.

D. Remove the propeller assembly, shear pin and nylon washer.

NOTE

If the oil in the lower housing has not been drained, do so before proceeding.

E. Use a 3/8-inch socket wrench to remove the two hex washer-head cap screws that secure the cover assembly into the gear housing assembly, and then pry out the cover assembly approximately 1/2 inch (Figure 6).

F. Pull the shift rod up and pull out the cover assembly.

G. Pull the shifter bracket assembly and cover assembly apart while holding a thumb or finger over the detent hole to retain the detent and detent spring (Figure 7).

H. Lift out the reverse bevel gear assembly, shim washer (if used) and shifter spool of the shifter bracket assembly.

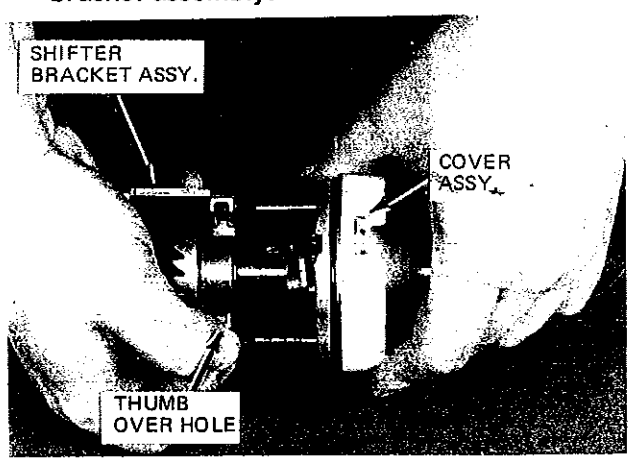


Figure 7. Pull shifter bracket away from cover.

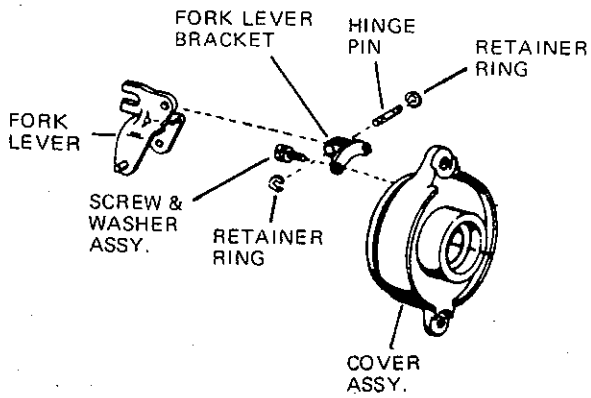


Figure 8. Exploded view of shift fork assembly.

I. Use a flat-tip screwdriver to remove the two screw and washer assemblies holding the fork lever to the cover assembly and remove the fork lever to the cover assembly and remove fork lever (Figure 8). If it is necessary to disassemble the fork lever, remove one pin retainer ring and slide out the hinge pin.

J. Use snap-ring pliers to remove large bearing retainer ring from the cover assembly (Figure 9).

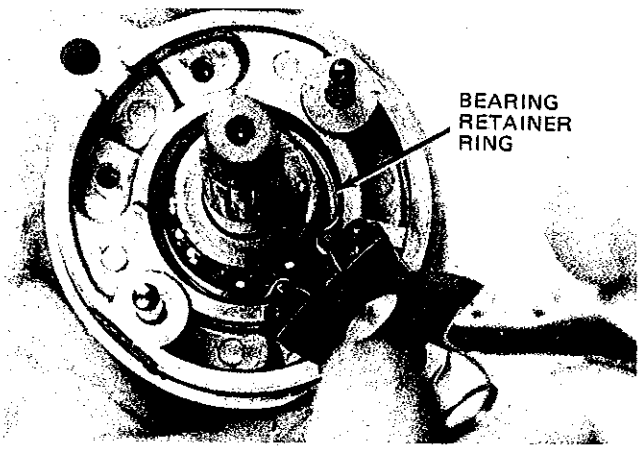


Figure 9. Remove bearing retainer ring.

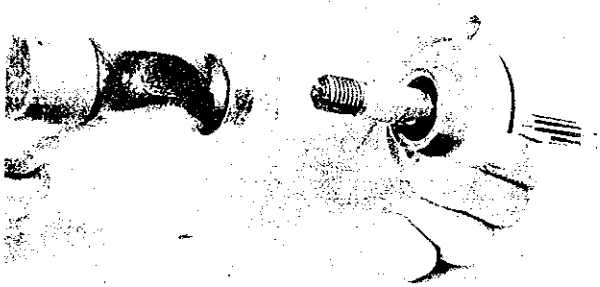


Figure 10. Tap out propeller shaft.

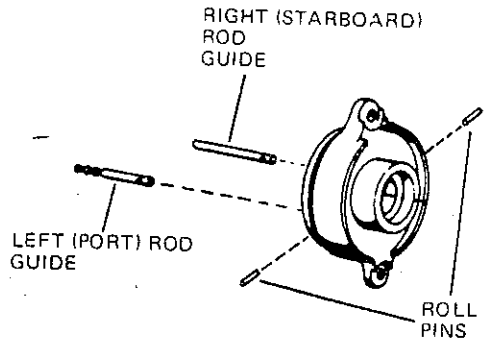


Figure 11. Remove roll pins and rod guides.

K. While holding the cover assembly, use a soft hammer to tap out the propeller shaft assembly (Figure 10).

L. To remove the shifter-bracket left and right rod guides from the cover assembly, tap out the roll pins (Figure 11).

M. Place the propeller shaft if a vise (holding it by the collar) and use a pin punch and hammer to drive out roll pin retaining collar (Figure 12).

N. Remove the propeller shaft assembly and collar from the vise. Slide the collar off the propeller shaft.

O. Use snap-ring pliers to remove the small snap ring on propeller shaft.

P. Place the propeller shaft in a vise so that the vise jaws support the inner race of the ball bearing, but do not touch the propeller shaft. Tap out the propeller shaft with a soft hammer (Figure 13).

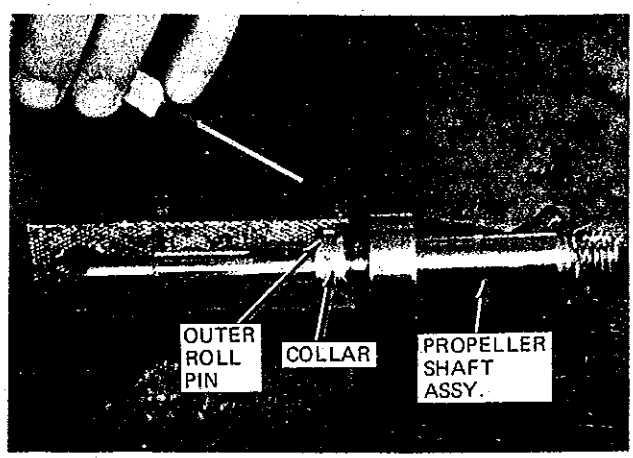


Figure 12. Drive out roll pin.

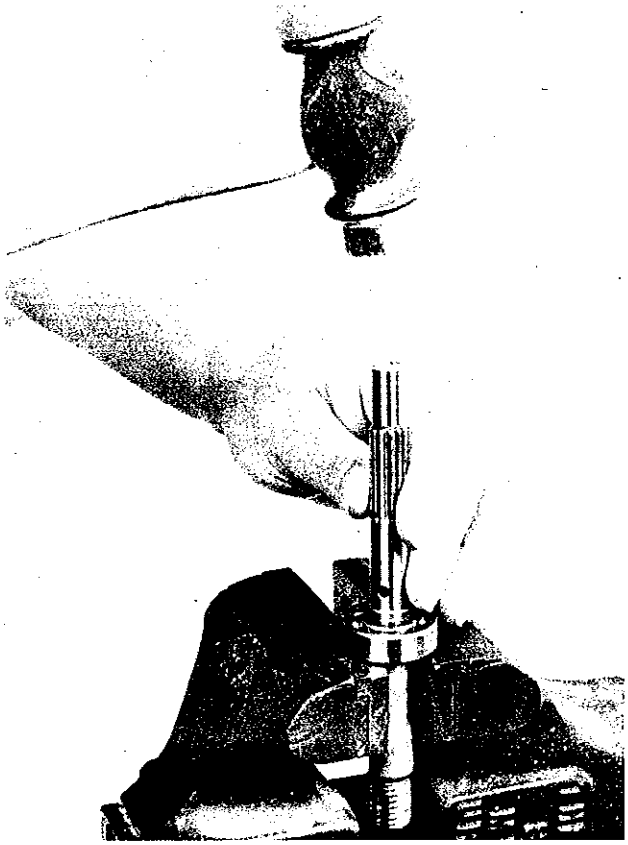


Figure 13. Tap propeller shaft out of bearing.

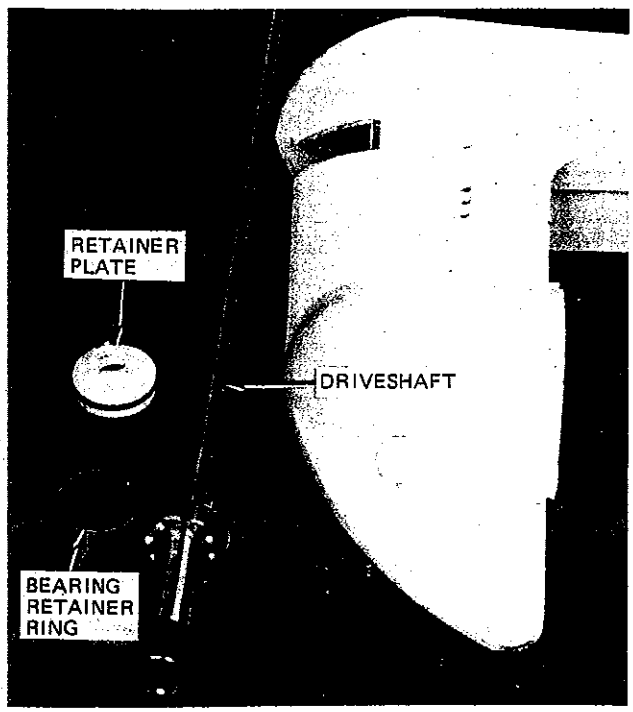


Figure 14. Remove retainer ring and plate.

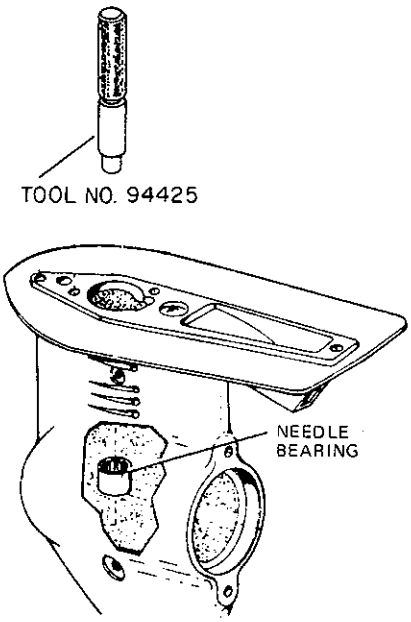


Figure 15. Use tool no. 94425 to remove bearing.

Q. Use snap-ring pliers to remove bearing retainer ring securing drive shaft bearing in gear housing (Figure 14).

R. Hold the drive shaft and tap the gear housing with a soft hammer to remove the drive shaft.

S. Remove the pinion gear and forward bevel gear assembly.

CAUTION

Special tools are required to remove the drive shaft needle bearing and the bevel gear flange bushing from the gear housing. The use of any other tool is not recommended and may result in damage to gear housing parts.

T. To remove the drive shaft needle bearing from the gear housing assembly, bearing removal and installation tool number 94425 should be used. Insert the tool, without the "C" clip, in the drive shaft needle bearing and drive out the bearing (Figure 15).

U. To remove the bevel gear flange bushing from the gear housing, a tool should be used similar to the one shown in Figure 16. (See lower unit tools section for sizes of component tools.) To use the tool, screw the tap firmly into the bushing and attach a slide hammer or screw-type puller to the extension shaft.

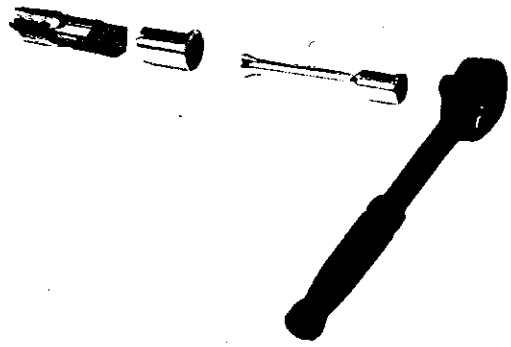


Figure 16. Use tools shown to remove gear bushing from gear housing.

V. To remove the flange bushing from either the forward bevel gear or the reverse bevel gear, press it out with an arbor press.

W. To remove the shift rod, remove the cotter pin and shift rod pin and pull out the shift rod (Figure 17).

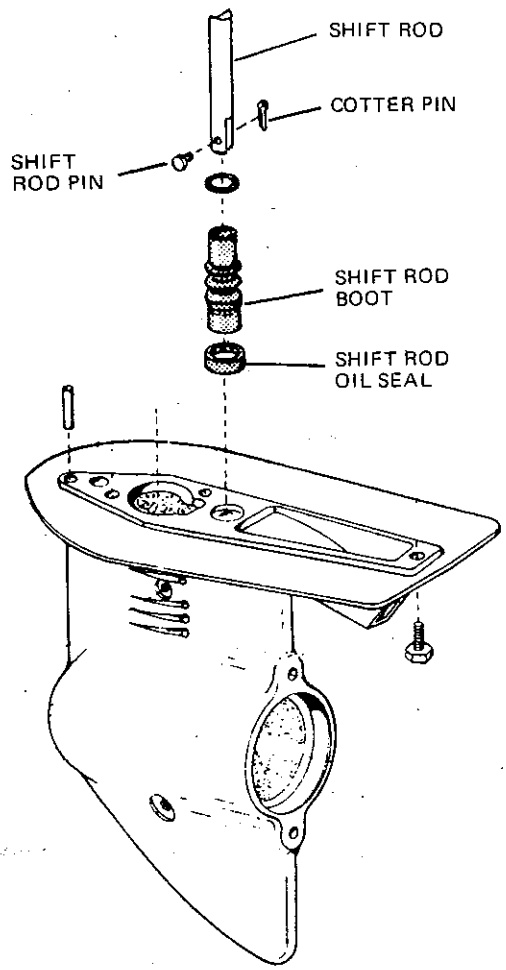


Figure 17. View of shift rod, boot and seal.

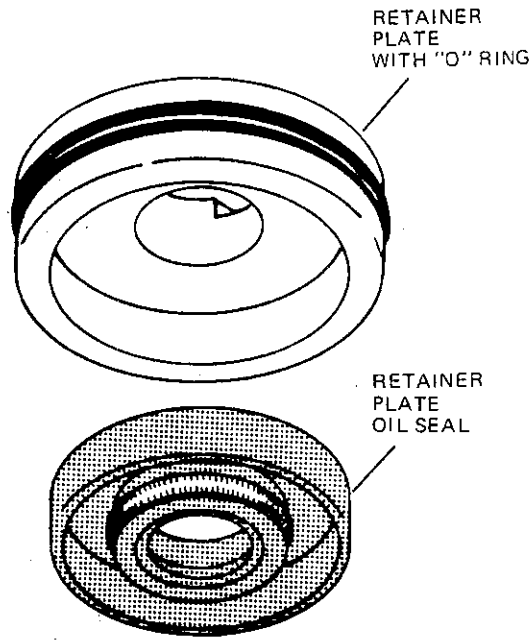


Figure 18. View of retainer plate and oil seal.

X. Use a flat-tip screwdriver to remove the retainer plate oil seal from the retainer plate (Figure 18).

4. INSTALL DRIVE SHAFT BALL BEARING ON DRIVE SHAFT

CAUTION

Use extreme care when holding the drive shaft ball bearing, as the outer race can snap off of the bearing cage, which will allow the bearing cage,

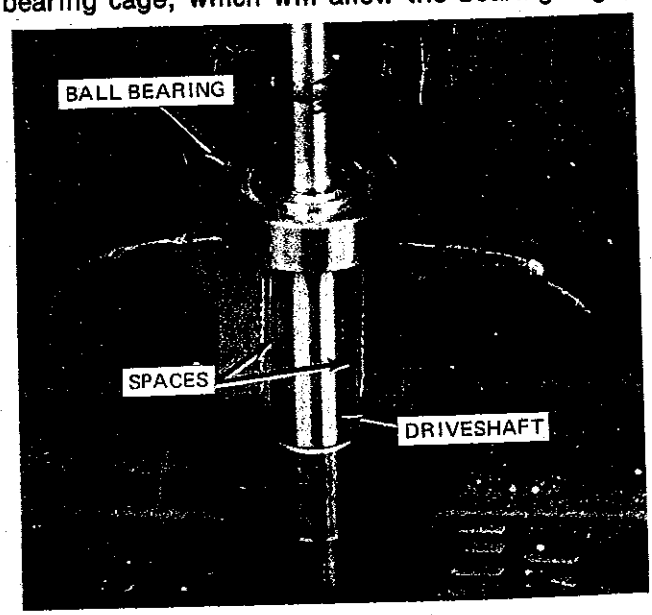


Figure 19. Install bearing on drive shaft.

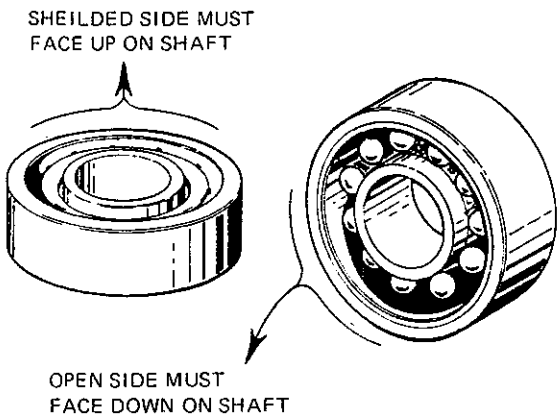


Figure 20. Install bearing as shown.

balls and inner race to become separated. Remove the drive shaft ball bearing as follows:

A. Place the drive shaft in a vise so that the jaws support the ball bearing inner race, but do not touch the shaft. Juse a soft hammer or block of wood and a hammer to tap the drive shaft out of the ball bearing (Figure 19).

NOTE

The ball bearing must be installed with open side towards gear end of drive shaft (Figure 20).

B. To install the drive shaft ball bearing, place the ball bearing on the jaws of a vise and slip the drive shaft through the ball bearing. Adjust the vise jaws so that the jaws support the ball bearing inner race, but do not touch the drive shaft. Use a soft hammer or block of wood and a hammer to tap the drive shaft into position (Figure 21).

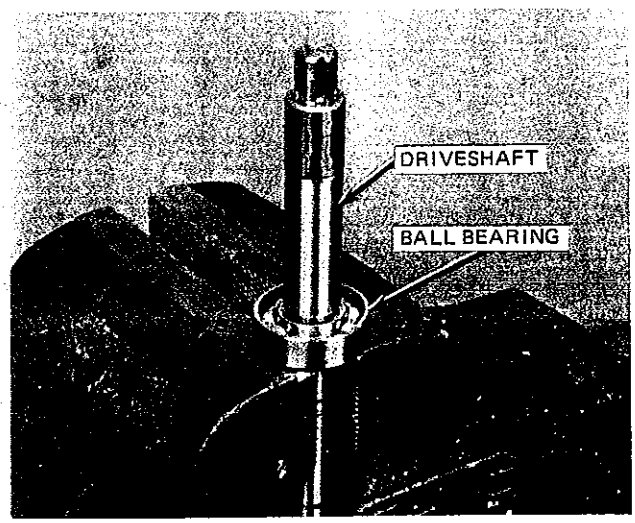


Figure 21. Tap shaft into bearing.

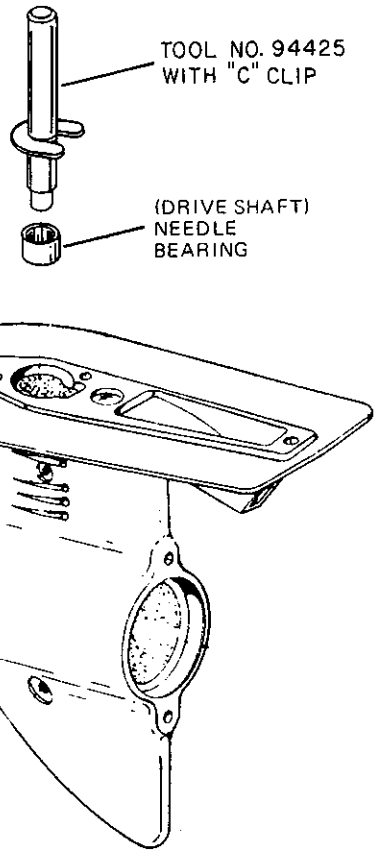


Figure 22. Use tool no. 94425 with "C" clip to install bearing.

5. REASSEMBLE GEAR HOUSING (Figure 5)

Clean and inspect all parts and replace any damaged parts before reassembly. After reassembly, fill the gear housing with SAE 90 lubricant. To reassemble the gear housing:

A. Press a new retainer plate oil seal into the retainer plate with the lips of the seal facing out, as shown in Figure 18.

B. Press a new oil seal into the cover assembly with the lip of the seal facing in.

C. Press a new shift-rod oil seal into the shift rod guide with the lip of the seal facing in.

D. Press the shift rod boot into the shift rod guide with a flat-tip screwdriver (Figure 5).

E. Slide a new boot "O" ring onto the shift rod.

F. Insert the shift rod; install the shift rod pin and cotter pin.

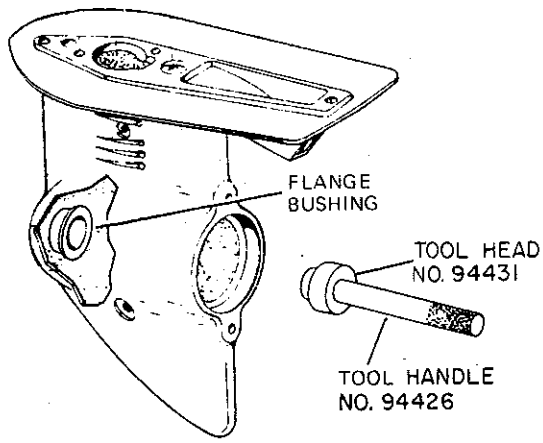


Figure 23. Use tool shown to install flange bushing.

CAUTION

To replace the gear-housing needle bearing and bronze bushings, special tools are needed. The use of any other tool may result in damage to gear housing parts.

NOTE

The drive shaft needle bearing should be installed only one way. The needle bearing has two ends, one rounded and one flat. The flat end of the needle bearing should be placed against the driving section of tool. Never drive on round end of bearing.

G. To install the drive shaft needle bearing, use tool number 94425 with addition of the "C" clip (Figure 22). Place the needle bearing on the tool and insert the tool in the gear housing. Press the needle bearing in until the "C" clip is seated against the gear housing.

H. To install the front bevel gear flange bushing into the case, use tool handle number 94426 and tool head number 94431 (Figure 23). Place the flange bushing on the tool and insert the tool in the gear housing; drive in the flange bushing until the tool is seated against the gear housing.

I. To install either the forward bevel gear flange bushing or the reverse bevel gear flange bushing, press them into the gears with an arbor press (Figure 5).

J. Position the forward bevel gear assembly into the gear housing.

K. Position the pinion gear into the gear housing assembly. Install the drive shaft into the pinion gear. Use a punch and hammer to tap on the outer race of the drive shaft ball bearing (Figure 24).

L. Use snap-ring pliers to replace the bearing retainer ring on the drive shaft. The beveled side of the bearing retainer ring must be up.

NOTE

The notches in the retainer plate must be properly positioned before the retainer plate is seated; otherwise, the water pump base plate cannot be installed.

M. Apply petroleum jelly to the retainer plate "O" ring and install, but do not seat, the retainer plate. Place the base plate on the retainer plate with notches engaged. Turn base plate until screw holes are properly lined up, then remove the base plate and tap retainer plate firmly against its seat. A punch and hammer may be needed to seat the plate.

N. Replace the water pump as follows:

(1) Install a new oil seal in the pump body assembly with the lip of the seal facing out.
(2) Install a new "O" ring; a small screwdriver may be needed.
(3) Replace the base plate (Figure 25).
(4) Put grease in the pin notch of the drive shaft to maintain pin in position and install the impeller pin (Figure 26).
(5) Slip the impeller over the drive shaft and the impeller pin.

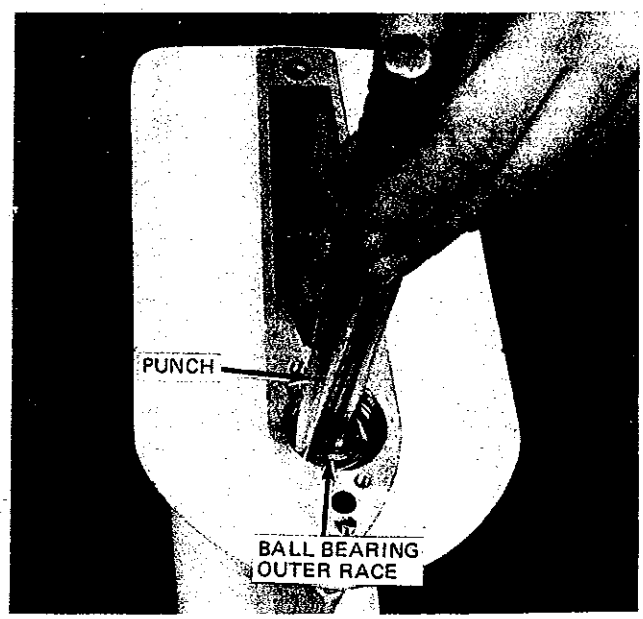


Figure 24. Tap on bearing outer race.

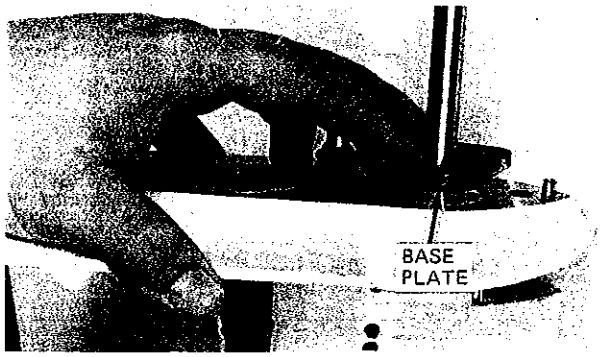


Figure 25. Install base plate.

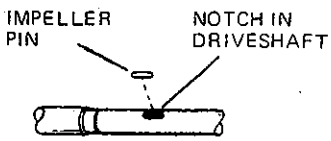


Figure 26. Place impeller pin in notch in drive shaft.

(6) Lubricate the inside of the pump body with white grease or petroleum jelly.
(7) Install the pump body assembly, turning drive shaft as you push it down over the impeller. Be sure the impeller vanes are not pinched at the pump base plate.
(8) Use a flat-tip screwdriver to install the two fillister-head machine screws.

O. Place the propeller shaft ball bearing on a vise and install the propeller shaft. Adjust the vise jaws so that the jaws support the ball bearing inner race, but do not touch the propeller shaft (Figure 27).

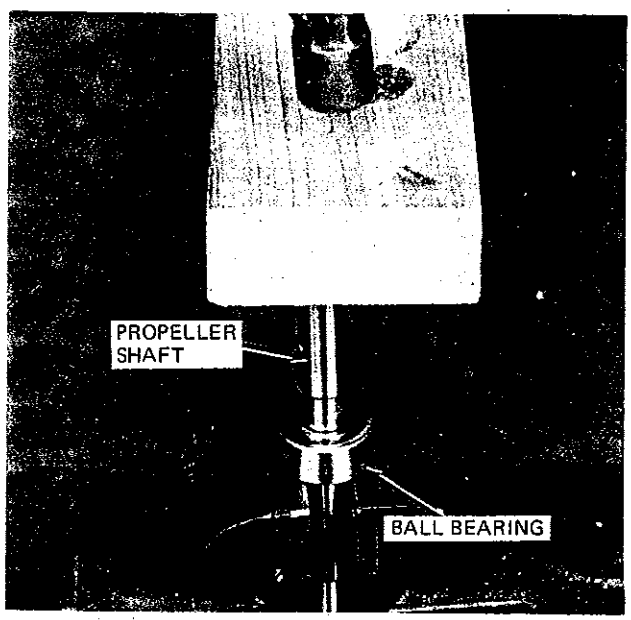


Figure 27. Tap propeller shaft into bearing.

P. Use snap-ring pliers to install the small bearing retainer ring on the propeller shaft (Figure 5).

Q. Place the propeller shaft collar in a vise, slide in the propeller shaft, install the outer roll pin with a hammer (Figure 28).

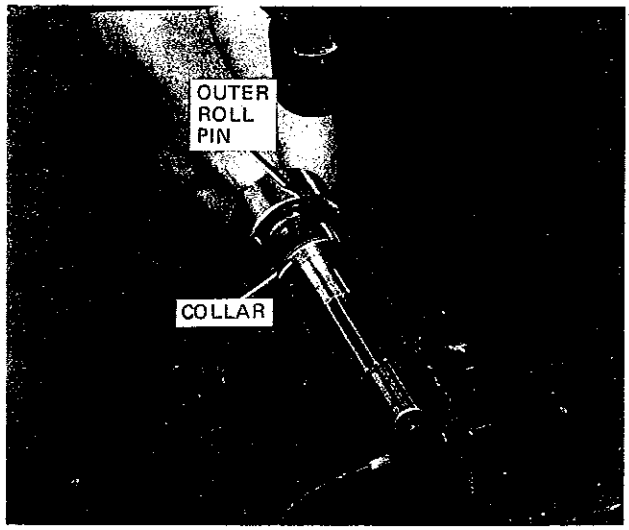


Figure 28. Tap roll pin into collar and shaft.

R. To replace the shifter-bracket right rod guide and left rod guide in the cover assembly, drive in the roll pins (Figure 5).

S. Hold the cover assembly and tap in the propeller shaft (Figure 29).

T. Use snap-ring pliers to install the large bearing retainer ring with the beveled edge of the retainer ring facing away from the bearing (Figure 5).

U. To assemble the fork lever and fork lever bracket, slide in the hinge pin and replace the pin retainer ring (Figure 8).

V. Attach the fork-lever assembly to the cover assembly with the two screw and washer assemblies using a flat-tip screwdriver.

W. Replace the shifter spool, reverse bevel-gear assembly and shim washer (if used) in the shifter-bracket assembly.

X. Push the shifter-bracket assembly and cover

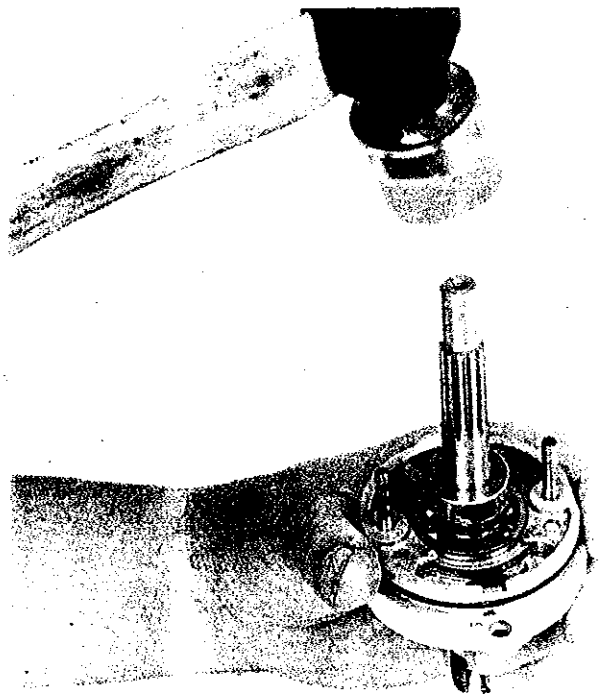


Figure 29. Tap propeller shaft into cover.

assembly together using a small punch to depress the detent (Figure 30).

Y. For ease of assembly and to keep the cover assembly "O" ring from twisting, apply petroleum jelly to the "O" ring.

Z. Adjust the shifter bracket to center on the neutral detent position. Install cover "O" ring (Figure 5).

NOTE

The shift rod should be properly positioned so that the flat side is facing left when viewed from the rear of the gear housing.

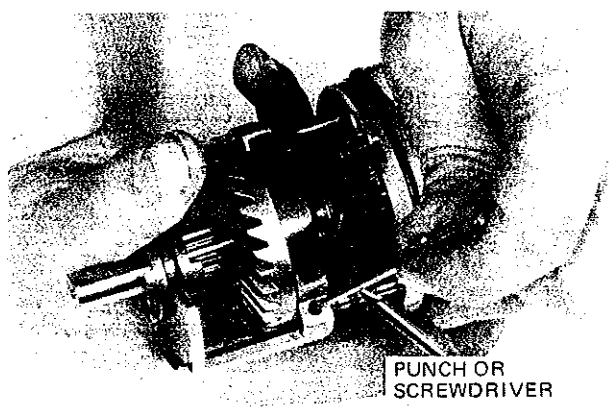


Figure 30. Depress detent.

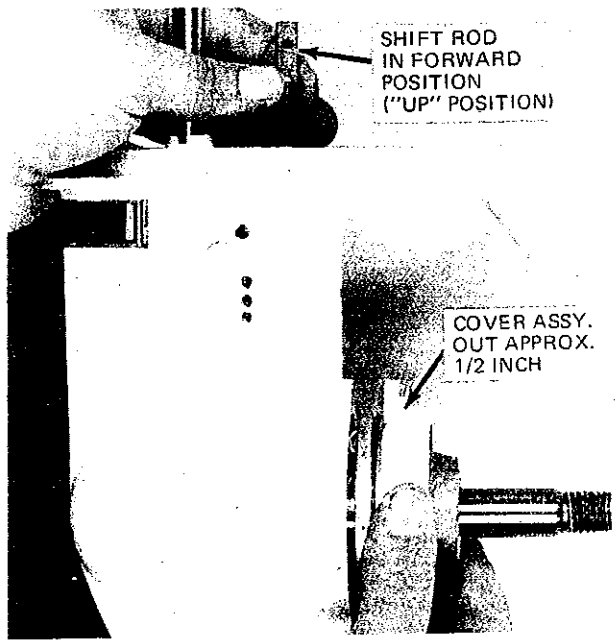


Figure 31. Hold shift rod in forward (up) position.

AA. Pull the shift rod up into the forward position and slide in the cover assembly so that the fork lever is up and to the point where the cover assembly is approximately 1/2 inch from the gear housing (Figure 31).

BB. Push down the shift rod to the neutral position and slide the cover assembly in the rest of the way (Figure 32).

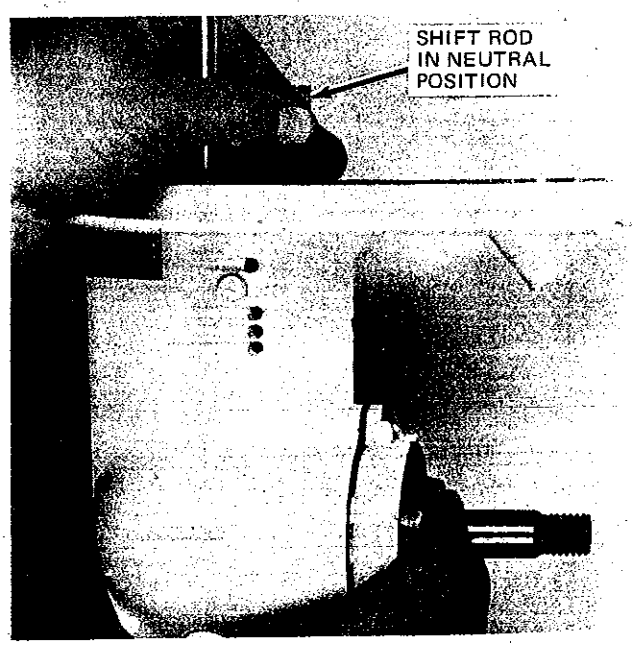


Figure 32. Push shift rod down and move in cover.

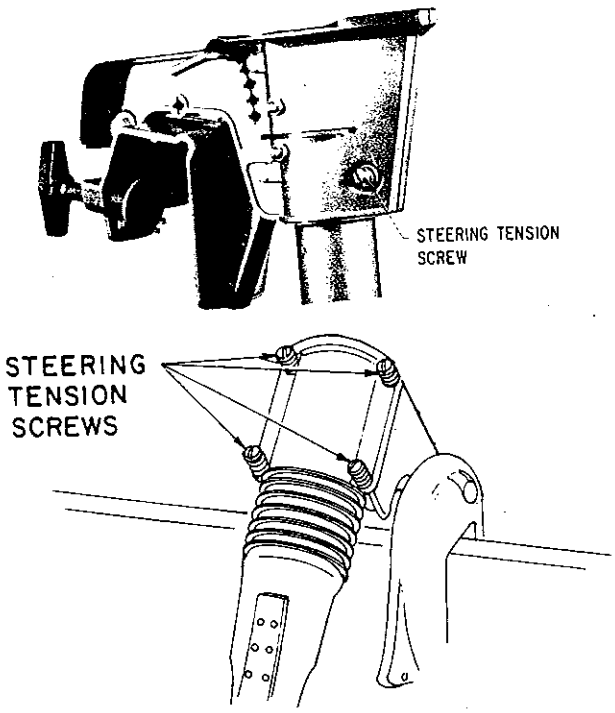


Figure 14. Steering tension may have one or four adjusting screws.

B. If twist grip becomes too loose and will not hold engine speed, remove cap and tighten locknut until desired drag is obtained.

9. STEERING ADJUSTMENT

The amount of steering tension is controlled by the spring tension screw(s) located on swivel bracket cover. (See Figure 14.) Some models have one adjustment screw, while others have four. Turn adjusting screw(s) clockwise to increase tension and counter-clockwise to decrease tension. It is possible to lose screw or nut plate if screw is backed out too far. If loosening screw does not reduce tension, stiffness may be caused by lack of lubrication. Lubricate the grease fitting(s) on swivel bracket as required.

10. COOLING SYSTEM

A. The water pump is provided to cool and condense exhaust gases. This pump is located in the column just above the gear housing and the water inlet holes are on each side of the gear housing just below the cavitation plate. (See Figure 15.)

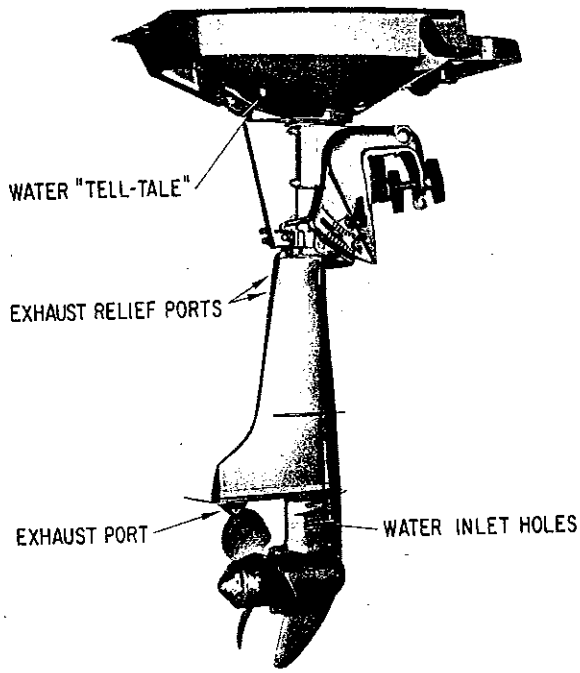


Figure 15. View showing typical locations for checking cooling system operation.

B. A warm spray of water will come out at exhaust relief port holes on the rear of column when the pump is working properly.

NOTE

On models with clutch, water pump does not operate in neutral.

C. If the water inlet holes plug or pump fails, the engine should be stopped at once and the problem corrected. If water spray is so hot that you cannot hold your hand under the spray, turn off motor and check for weeds or other foreign materials blocking water inlet holes. If these are clear and water spray is still hot, turn motor off. This indicates cooling system failure.

CAUTION

The water pump has a rubber impeller which can be damaged by operation in excessively silty or sandy water. Operation of motor with inoperative water pump or obstruction in cooling system will cause severe damage due to overheating.

11. PROPELLER SHEAR PIN

A. The Shear Pin is used for the purpose of protecting the Drive Train and Gears. The Shear

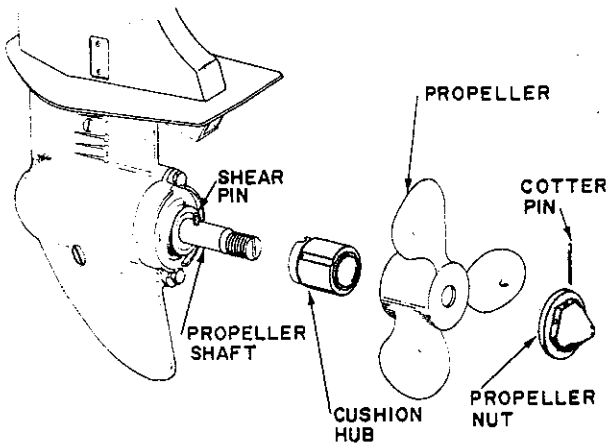


Figure 16. View showing propeller and shear pin typical of all models.

Pin will not prevent the propeller from becoming damaged when striking an underwater object. When shear pin is broken, the engine will continue to run, however, the propeller will not be rotating.

CAUTION

Stop engine immediately after shearing pin to avoid possible damage to the engine.

B. To repair, shut off motor, remove propeller cotter pin and nut. Slip off propeller and replace with new shear pin. (See Figure 16.)

12. SALT WATER OPERATION

A. Even though the interior surfaces of the outboard motor are designed to resist corrosion, there still is a possibility of mechanical build-up of salt and silt deposits. To materially increase the life of all exposed parts and decorative finishes, follow the steps indicated below:

(1) Wipe exterior completely with fresh water cloth and then apply light coating of oil.
(2) Lubricate propeller shaft occasionally with a waterproof type of lubricant (Lithium Grease), thus enabling the propeller to be removed easily.
(3) It is good practice when operating in salt water to inspect motor daily and to apply a light coating of grease to any part or area that shows evidence of corrosion or rust.
(4) Always remove motor from boat vertically, allowing water to drain from colum before tilting the motor.

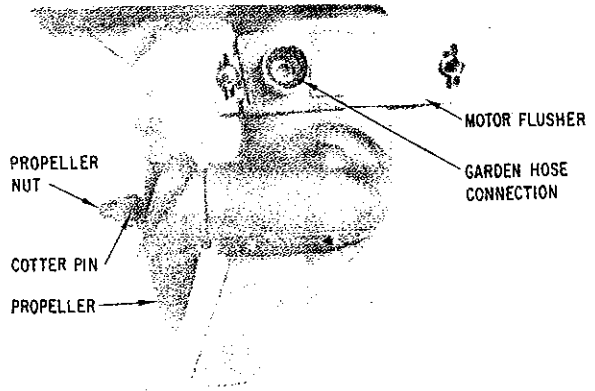


Figure 17. Motor flusher should be used to remove salt deposits.

(5) After every salt water use, run the outboard motor in fresh water for approximately five (5) minutes using the available MOTOR FLUSHER to flush out salt deposit and to prevent possible corrosion following the steps below. (See Figure 17.)

Be sure motor is mounted securely.
Remove cotter pin, propeller nut, propeller, and shear pin to prevent body injury while running.
Fasten motor flusher over water intake on lower unit.
Fasten garden hose to motor flusher.
Important: If motor is so equipped, place shift lever in the forward position so water will circulate throughout water areas of unit.
Turn on water faucet to medium pressure. There is no need for full pressure and pump to gear housing seal may be damaged by excessive pressure.
Start motor and run at IDLING SPEED. Do not race motor. Now adjust flow of water so there is water being discharged out of the water outlets on the column.
After five (5) minutes of running, stop motor, remove motor flusher and replace shear pin, propeller, propeller nut, and cotter pin.

CAUTION

Do not run outboard motor out of water without using motor flusher because it will damage the cooling system and engine. Run motor in a well ventilated area or outside.

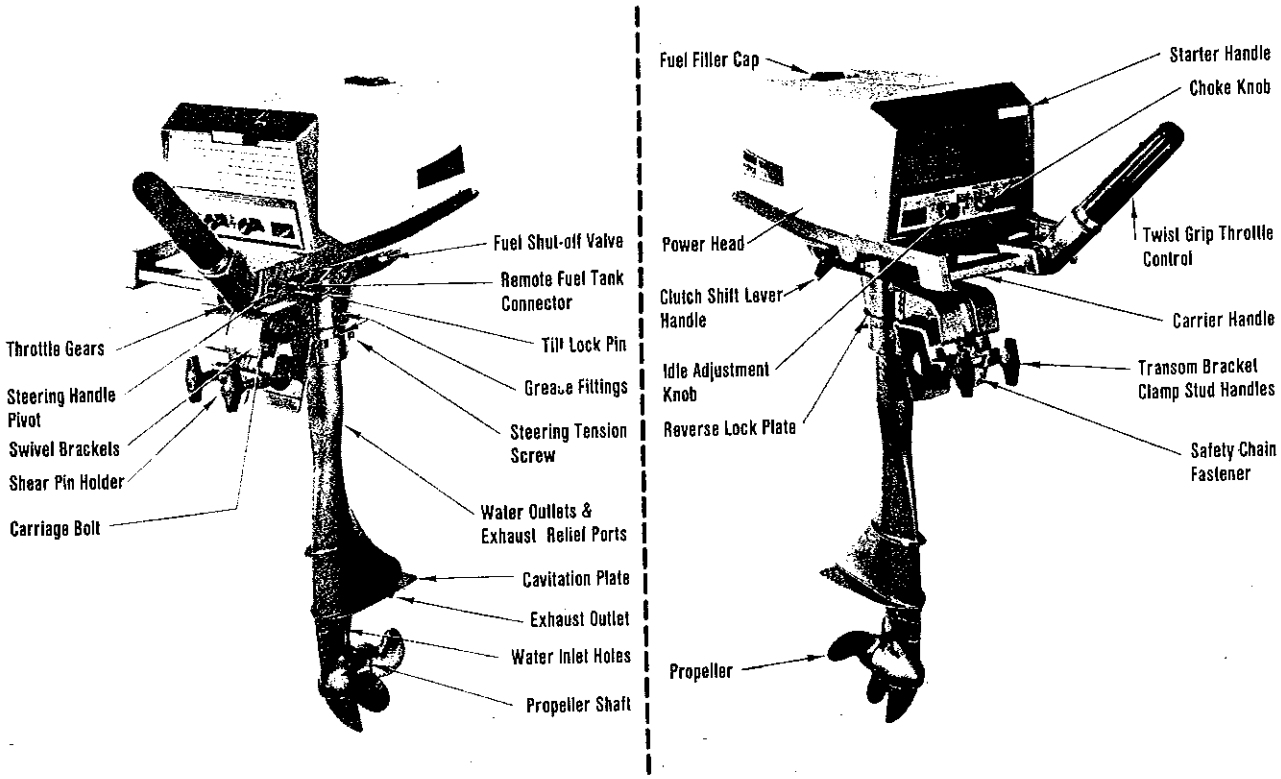


Figure 10. Port and starboard views of typical outboard motor.

2. Allow motor to run at idling speed until it stops of its own accord, indicating the carburetor has run dry.

B. Also, when ready to remove motor from boat, and running engine on remote fuel tank, disconnect remote fuel coupling.

6. LUBRICATION

A. For best results, lubricate every 60 days in fresh water and every 30 days when using outboard motor in salt water operation.

B. Use Lithium Grease on Parts Names listed below. (See Figure 10.)

(1) Propeller Shaft.
(2) Grease Fittings.
(3) Steering Tension Screw.
(4) Throttle Gears.
(5) Transom Clamp Screws.

C. Use outboard lubricating oil on Part Names listed below. (See Figure 10.)

(1) Steering Handle Pivot.
(2) Carriage Bolt.
(3) Shift Lever Rod.

D. Use S.A.E. 90 EP Outboard Gear Lubricant in gear housing. Gear Housing lubricant level should be checked at least every twenty hours of operation. Drain old oil from gear housing and fill with new oil at the end of the outboard motor season. Draining and filling with new oil will remove water and may prevent corrosion to internal parts. Check, drain or fill gear housing as follows:

(1) Place outboard in upright position and remove the lower (fill) plug and washer.
(2) To drain lubricant, remove upper (vent) plug and allow lubricant to drain from lower opening.
(3) To check level, insert nozzle of gear lubricant tube into lower (fill) opening, then remove the upper (vent) plug.

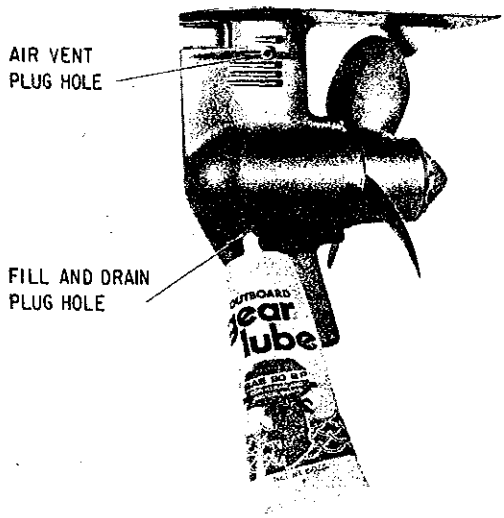


Figure 11. Gear lube is installed through lower hole.

(4) To fill gear housing, insert nozzle of gear lubricant tube into the lower (fill) opening.
(5) Squeeze tube until lubricant begins to run out of the upper (vent) plug hole, then reinstall upper vent plug and washer. Remove lubricant tube and install the lower (fill) plug and washer.

7. CARBURETOR ADJUSTMENTS

A. The idle mixture can be adjusted on all models; main (high speed) mixture and idle speed can be adjusted on many models. To adjust, refer to Figure 12 and proceed as follows:

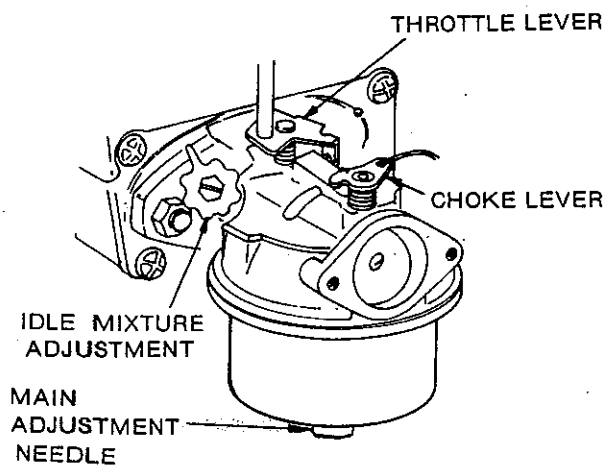


Figure 12. View of typical carburetor adjustment points.

(1) Start and run motor on boat or in test tank until it reaches normal operating temperature.
(2) Turn twist grip to slowest speed position that will permit engine to run.
(3) Turn idle mixture needle on carburetor out (counter-clockwise) until motor runs roughly because of rich mixture, then turn needle in (clockwise) until motor runs smoothly. Normal setting is one (1) turn out from lightly seated position.
(4) Turn twist grip to slowest speed position, then turn idle speed stop screw on carburetor to change slow speed. Turning stop screw in (clockwise) increases speed; turning screw out (counter-clockwise) lowers speed.
(5) With engine operating in wide open position, turn the main adjustment needle out (counter-clockwise) slowly until engine speed drops off. Count the turn while turning mixture needle in (clockwise) until engine speed drops off, then back needle out about midway between rich and lean drop off settings.
(6) The motor should start easily and run smoothly at slowest speed and should accelerate rapidly to maximum speed. It may be necessary to readjust or clean carburetor if operation is not smooth.

8. TWIST GRIP ADJUSTMENT

A. If twist grip handle becomes too stiff; pry off cap and remove self-locking nut (see Figure 13), then remove handle. On models prior to 1977, apply grease to the "O" ring and on 1977 and later models apply grease to the shank of the handle using a good all-purpose grease. Reverse the steps to assemble, using the nut to adjust tension on the handle.

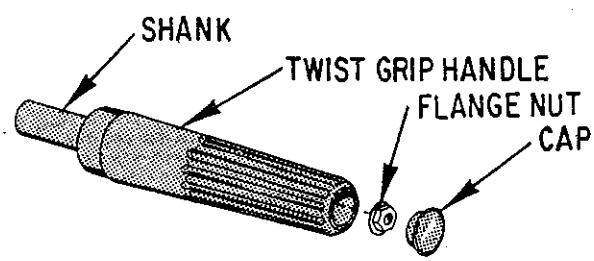


Figure 13. View of twist grip throttle.

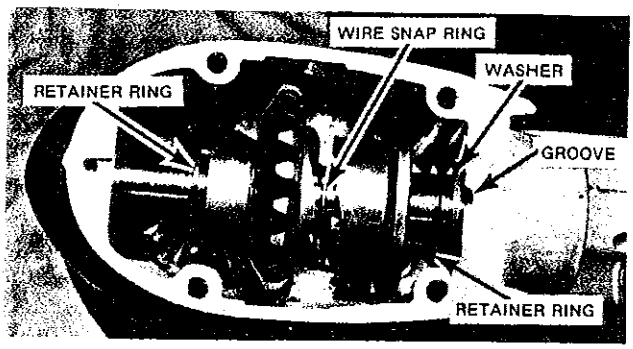


Figure 6. View of gear case.

C. Use a suitable wrench and unscrew propeller nut.

D. Remove propeller assembly, shear pin and nylon washer.

E. Place container under gear housing to catch grease. Remove the four screws, then tap cap with a plastic or rubber hammer to break the gasket seal allowing the grease to run out.

F. Remove rear retaining ring from groove using "Tru-Arc" pliers (#L152) and move snap ring forward on propeller shaft (Figure 6).

G. Remove front retainer ring from groove using "Tru-Arc" pliers (#L152) and move snap ring forward on propeller shaft.

H. Slide propeller shaft and dog clutch rearward so wire snap ring is exposed and remove snap ring from propeller shaft (Figure 6).

I. Remove snap ring from gearcase to prevent binding in gears.

J. Pull propeller shaft rearward while working retainer rings forward until dog clutch key is exposed.

K. Turn propeller shaft so key is aligned with groove shown in Figure 6.

L. Rotate washer so notch aligns with key and continue to pull propeller shaft rearward.

NOTE

It may be necessary to rotate shaft slightly to align key with groove in case. Do not use excessive force on shaft. Shaft should slide rearward with a small amount of force.

M. Remove retainer rings, gear, dog clutch and washer as shaft is withdrawn.

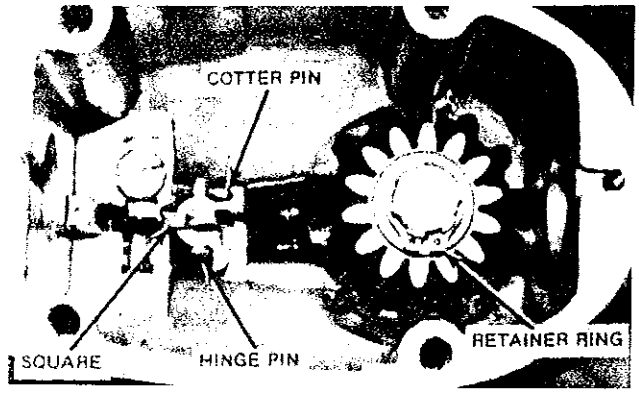


Figure 7. Remove gear retainer ring.

N. Propeller shaft seal must be replaced as key will damage seal when shaft is removed.

O. Remove retainer ring securing pinion gear and remove gear (Figure 7).

P. Withdraw drive shaft.

Q. Inspect drive shaft bushing. If replacement is required, remove bushing using a suitable puller or press. Do not attempt to drive bushings out with a hammer and punch.

R. Remove cotter pin and shift rod pin shown in Figure 7.

S. Withdraw shift rod.

T. Remove screw, fork lever and fork lever hinge pin.

U. Inspect all components and replace any components excessively worn or damaged.

4. REASSEMBLE GEAR HOUSING

A. Install new drive shaft, propeller shaft and shift rod seals using a suitable driver. Seal lip should be in towards gear cavity.

B. Install shift rod boot into shift rod guide.

C. Install fork lever, fork lever hinge pin and slotted screw so square slot of fork lever will point towards dog clutch (Figure 7).

D. Slide a new "O" ring on shift rod.

E. Insert shift rod and install shift rod pin and cotter pin.

F. Insert drive shaft and attach pinion gear and retainer ring to drive shaft.

G. Remove dog clutch key from propeller shaft if not removed earlier.

H. Insert propeller shaft into gearcase and as shaft enters gear cavity install washer and retainer ring.

I. Simultaneously install dog clutch in fork lever and on propeller shaft.

J. Install bevel gear and retainer ring on propeller shaft.

K. Install dog clutch key in propeller shaft keyway.

L. Install wire snap ring in round groove in propeller shaft.

M. Insert propeller shaft fully and seat retainer rings in their propeller shaft grooves.

N. Install water pump; see Part II-paragraph 5N.

O. Install gear housing to cap gasket.

P. Install gear housing cap on gear housing and secure with screws.

5. REASSEMBLE GEAR HOUSING TO COLUMN

A. Use a piece of wire to tie back the column link rod (Figure 8).

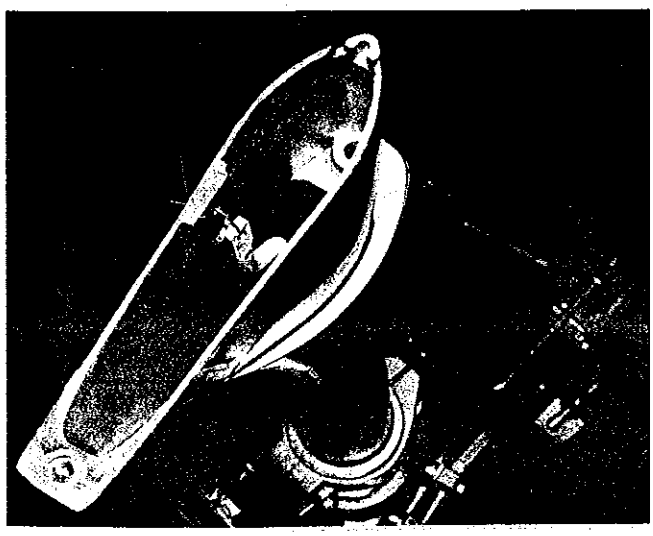


Figure 8. Tie back column link rod.

B. Lubricate end of water tube with petroleum jelly.

C. Clean drive shaft splines and lubricate with lithium grease.

D. Replace the pilot bushing in gear housing.

E. Assemble the gear housing to the column by inserting the drive shaft into the column. Engage the drive shaft and engine crankshaft splines and guide the water tube into the water pump.

NOTE

It may be necessary to rotate the crankshaft to engage the drive shaft splines.

F. Push the gear housing up to within 1/4-inch of the column and start the lockwasher and hex nut on the stud; then push the gear housing up so that it is flush to the column.

G. Install rear machine screw adjacent to exhaust outlet.

H. Tighten rear machine screw and hex nut on the stud.

I. Remove wire used to tie back column link rod and align link rod and gear housing shift rod.

J. Install machine screw securing link rod to shift rod.

K. Adjust shift linkage as outlined in paragraph 6.

L. Replace inspection cover and gasket. Lubricate screws and install.

6. SHIFT LINKAGE ADJUSTMENT

If the outboard does not shift fully into gear or is hard to shift, follow this procedure to adjust shift linkage.

A. Remove top cover from 1978 and later Deluxe models.

B. Loosen screws(s) securing flat spring (Figure 9).

C. Remove inspection cover located at lower end of column.

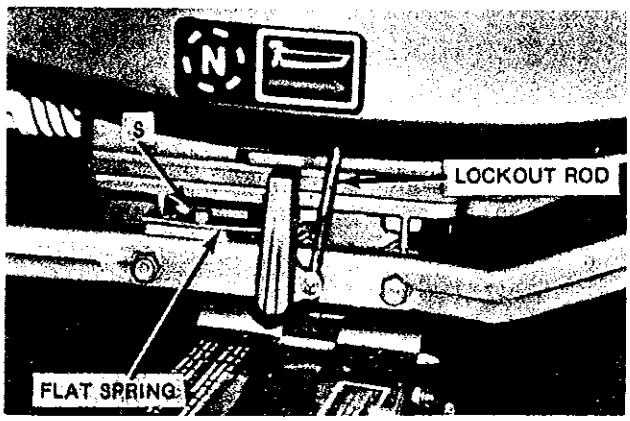


Figure 9. Unscrew screw(s) securing flat spring.

D. Loosen but do not remove screw connecting column link rod and shift rod.

E. Push shift rod down until contacting stop boss in gear housing to position dog clutch in neutral.

F. Place shift lever in vertical (Neutral) position.

G. Place flat spring in half moon on cam and tighten screw.

H. Tighten screw connecting column link rod and shift rod.

I. Check that vertical lockout rod restricts throttle travel in neutral position and no restriction in forward position.

J. If throttle lockout does not function as cited in preceding step, repeat all steps, except in step E rotate shift lever either way from vertical for proper throttle lockout cited instep H.

7. PROPELLER

Always use correct propeller listed in parts catalog. Propellers are power-matched to the outboard to provide optimum performance. The propeller used has a rubber cushion inside the hub. When a replacement propeller is ordered for this model, the propeller will come as an assembly with the hub cushion in place. The hub cushion may be ordered separately and replaced.

To replace a shear pin, proceed as follows:

A. If outboard is equipped with transmission or clutch, make sure shift lever is in engaged position.

B. Remove cotter pin and propeller nut.

C. Remove propeller and broken shear pin.

D. Apply lithium grease to propeller shaft before reassembly.

E. Install new shear pin and replace propeller, propeller nut and cotter pin.

ESKA COMPANY DUBUQUE, IOWA

PART XI STANDARD GEAR HOUSING

1. GENERAL

The gear housing is attached to the lower portion of the column. These models all have constant mesh gears in the gear housing and some models have a clutch attached to the engine's crankshaft.

2 REMOVE GEAR HOUSING FROM COLUMN

NOTE

On models using a water inlet tube (Figures 2 and 3) it may be necessary to disassemble the gear housing in order to remove the gear housing from the column.

A. Use a 3/8-inch socket wrench to remove the screw and washer assembly (Figure 1).

B. Pry off the cavity clip; use a 1/2-inch open-end wrench to remove the column stud hex nut and lock washer.

C. Pull gear housing from the rest of the column assembly and remove the pilot bushing.

3. DISASSEMBLE GEAR HOUSING [Figures 2 and 3]

A. Remove water pump (if so equipped), see Part IX-paragraph 3A.

B. Remove cotter pin and propeller nut.

C. Remove propeller assembly, shear pin and nylon washer.

D. Loosen the four fillister-head screws securing cap to gear housing.

E. Place a container under gear housing to catch grease. Tap the cap with a plastic or rubber hammer to break the gasket seal, allowing the grease to run out.

F. Remove fillister-head screws and cap from gear housing.

G. Remove gear housing to cap gasket.

H. Using a 1/8-inch pin punch, drive the roll pins out of the bevel gear (Figure 2).

I. Remove the propeller shaft (Figure 5).

J. Remove bevel gear and shaft spacer (if used) from gear housing.

K. Remove pinion gear and drive shaft from gear housing (Figure 5).

L. Use snap-ring pliers to remove pinion gear retaining ring from drive shaft (Figure 7.)

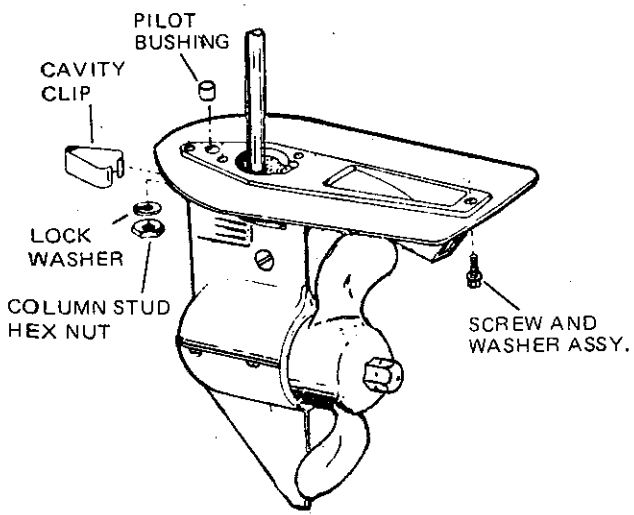


Figure 1. Unscrew stud hex nut.

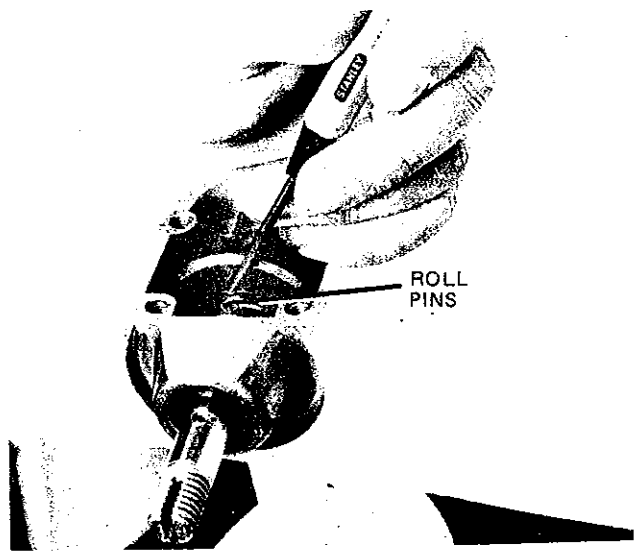


Figure 2. Remove roll pins.

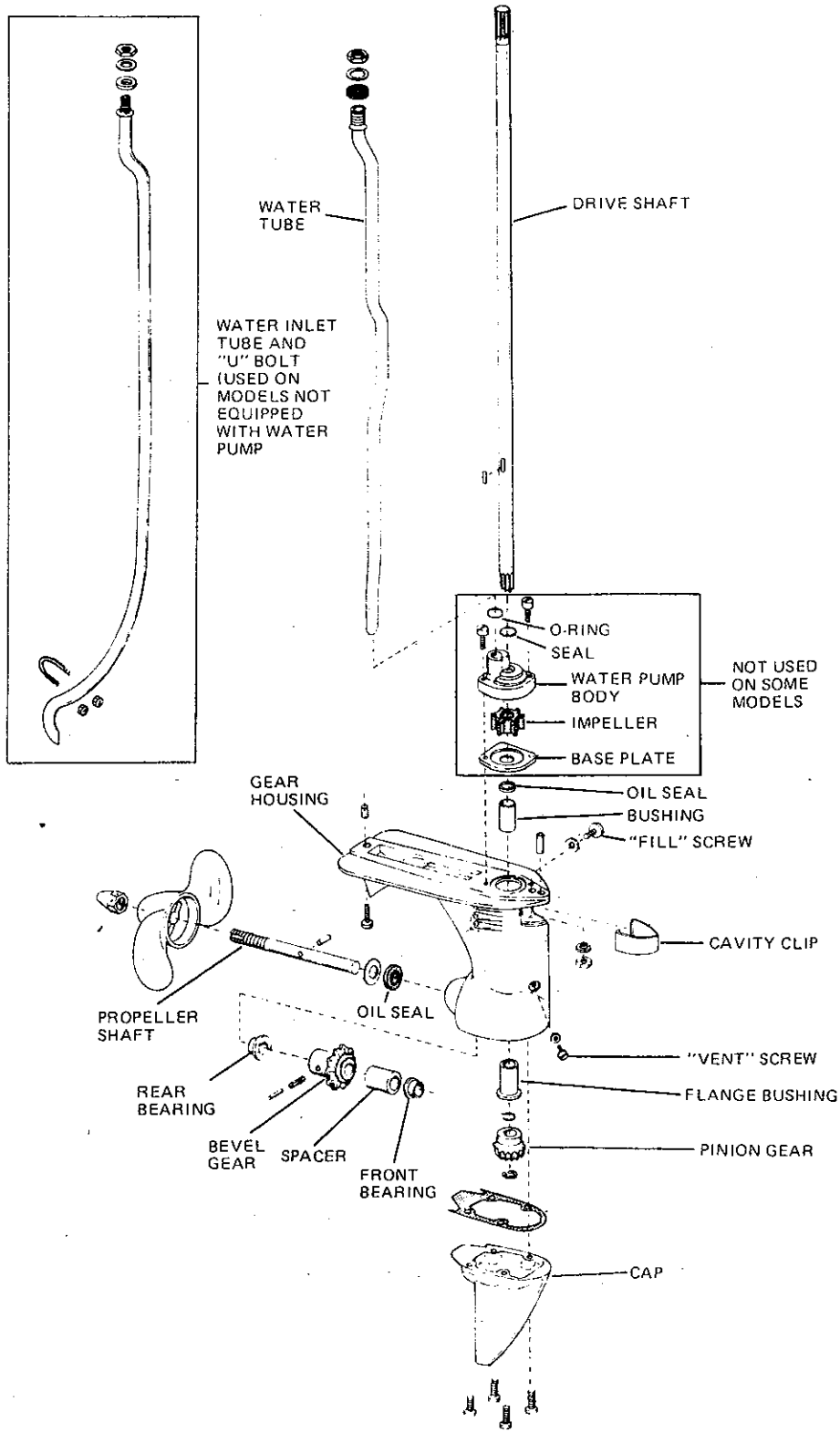


Figure 3. Exploded view of gear housing used on models manufactured prior to 1976.

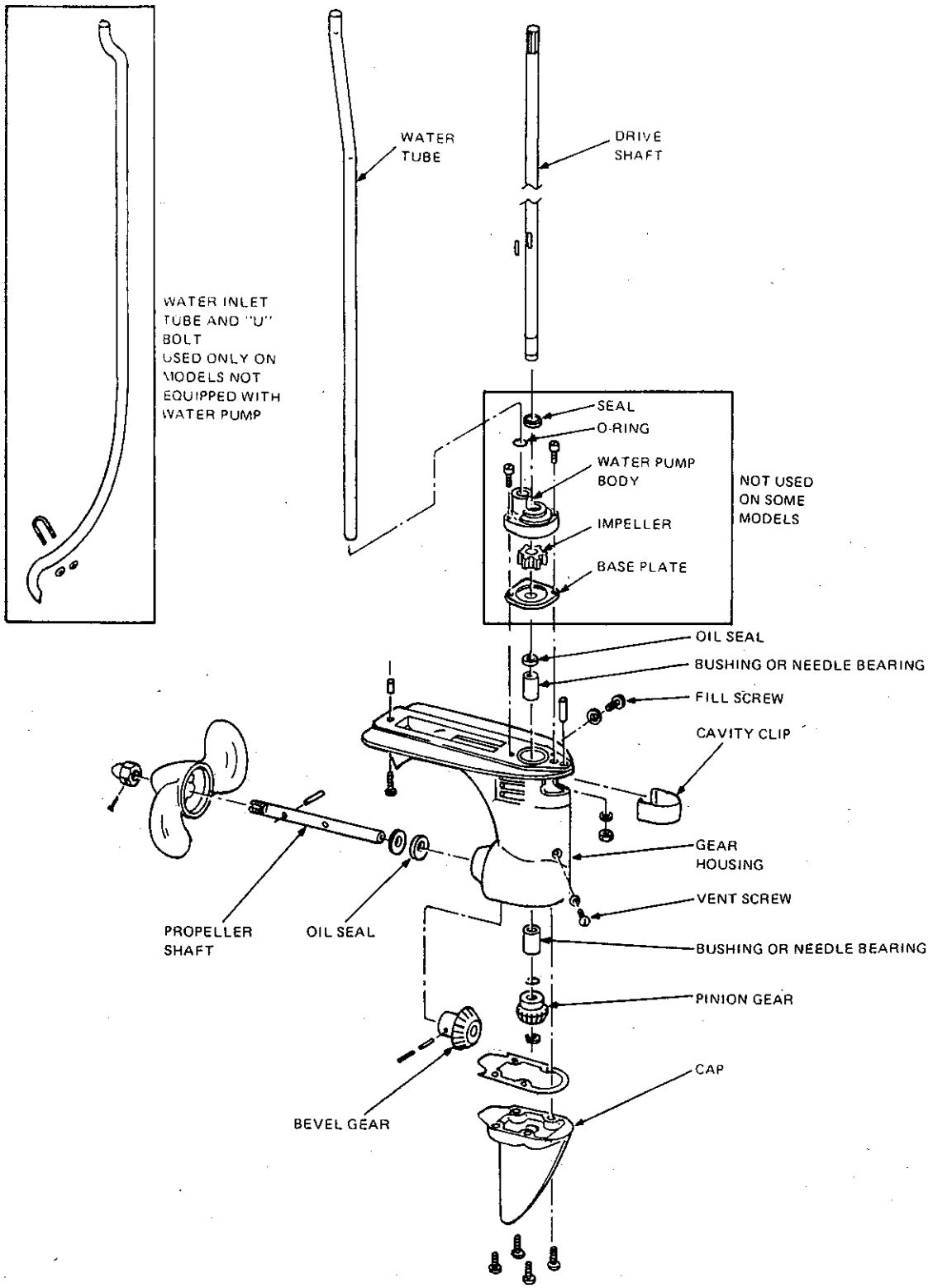


Figure 4. Exploded view of gear housing used on models manufactured after 1975.

Figure 5. Withdraw propeller shaft.

M. Remove pinion gear from drive shaft.

N. Remove wire snap ring from drive shaft.

O. Remove drive shaft seal and propeller shaft seal.

P. Inspect drive shaft bushings (or needle bearings) and propeller shaft bushings (if used) for wear. If replacement is required, remove the bushings (or needle bearings) using a suitable puller or press. If proper equipment is not available, have the bushings or needle bearings) replaced by a shop equipped to perform this operation. Do not attempt to drive the bushings (or needle bearings) out with a hammer and punch. Use tool number 94427 to remove the propeller shaft front flange bushing.

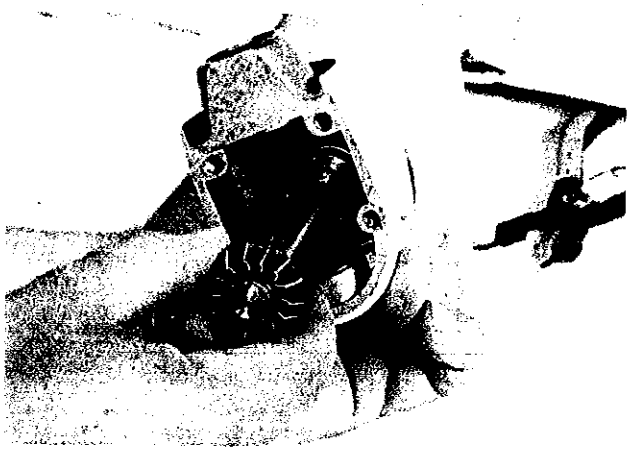


Figure 6. Remove gear and shaft.

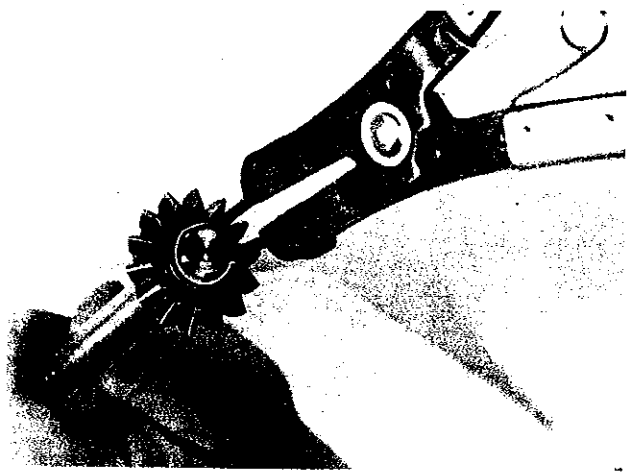


Figure 7. Remove retainer ring.

4. REASSEMBLE GEAR HOUSING

A. Install new drive shaft seal in gear housing, using a proper size seal driver. Install seal with open side against bushing (prt number facing out) (Figure 8).

B. Install new propeller shaft seal in gear housing using a proper size seal driver. Install seal with open side against bushings (part number facing out) (Figure 9).

C. Install wire snap ring and pionion gear on drive shaft. Secure with retaining ring.

D. Lubricate drive shaft splines with lithium grease and install drive shaft in gear housing.

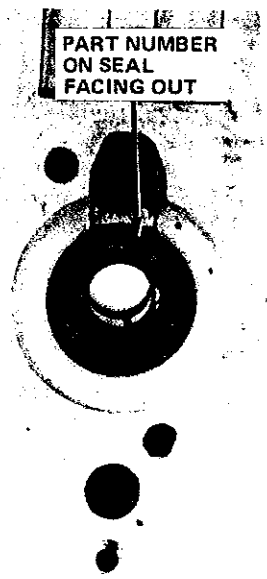


Figure 8. Part number on seal must face out.

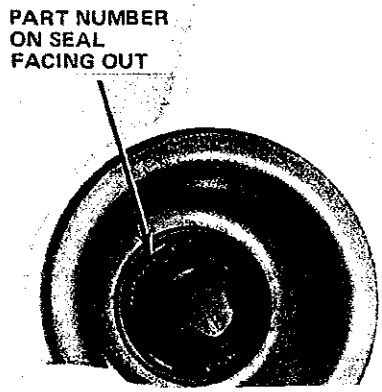


Figure 9. Part number on seal must face out.

E. Install water pump (if so equipped); see Part IX-paragraph 5N.

F. Install bevel gear, shaft spacer (if used) and propeller shaft in gear housing (Figure 10).

G. Line up holes in bevel gear with holes in propeller shaft. Drive in roll pins until they are centered in the bevel gear.

NOTE

Slots in roll pins should be approximately 180 degrees apart.

H. Install gear housing to cap gasket.

I. Install gear housing cap on gear housing and secure with four fillister-head screws.

5. REASSEMBLE GEAR HOUSING TO COLUMN

A. Lubricate end of water tube with petroleum jelly.

B. Clean drive shaft splines and lubricate with lithium grease.

C. Replace pilot bushing in gear housing (Figure 2).

D. Assemble gear housing to column, engaging drive shaft splines and water tube while pushing gear housing up to column.

E. When gear housing is within 1/4-inch of column, start lock washer and hex nut on the stud;then push gear housing up so that it is flush to column.

F. Secure gear housing with stud and hex-head machine screw.

G. Replace cavity clip.

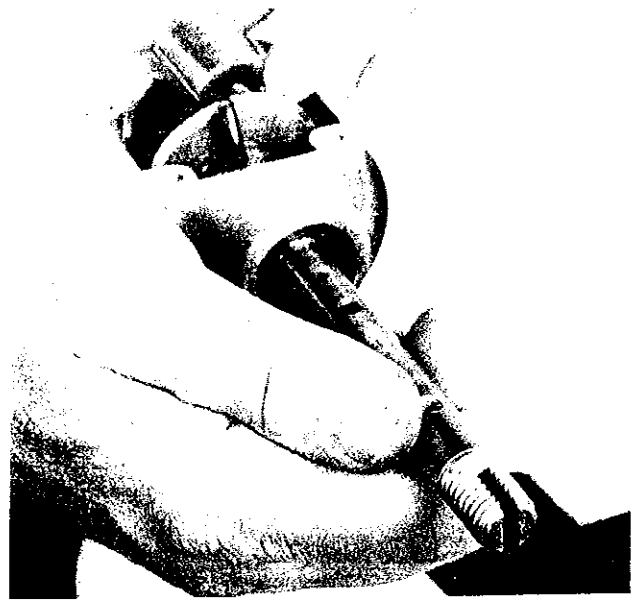


Figure 10. Install propeller shaft.

H. Assemble nylon weasher, shear pin and propeller on propeller shaft.

I. Install propeller nut finger tight; then use a wrench to tighten nut to nearest cotter pin hole.

J. Install cotter pin.

6. PROPELLER

Always use correct propeller listed in parts catalog. Propellers are pwer-matched to the outboard to provide optimum performance. The propeller has a rubber cushion inside the hub. When a replacement propeller is ordered for this model, the propeller will come as an assembly with the hub cushion in place. The hub cushion may be ordered separately and replaced.

To replace a shear pin, proceed as follows:

A. If outboard is equipped with transmission or clutch, make sure shift lever is in engaged position.

B. Remove cotter pin and propeller nut.

C. Rmove propeller and broken shear pin.

D. Apply lithium grease to propeller shaft before assembly.

E. Install new shear pin and replace propeller, propeller nut and cotter pin.