



# *Troubleshooting & Repair Manual* *Gasoline and Electric* **OUTBOARDS**



## **FORWARD**

This manual was written to assist technicians and service personnel with the repair and maintenance procedures for Briggs & Stratton electric- and gasoline-powered outboards. It assumes that persons using this manual have been properly trained in and are familiar with the servicing procedures for these products, including the proper use of required tools and safety equipment and the application of appropriate safety practices. Persons untrained or unfamiliar with these procedures or products should not attempt to perform such work.

Proper maintenance and repair is important to safe, reliable operation of all equipment. The troubleshooting, testing, maintenance, and repair procedures described in this manual are appropriate for the Briggs & Stratton products described herein. Alternative methods or procedures may pose risk to personal safety and the safety and/or reliability of the product and are not endorsed or recommended by Briggs & Stratton.

All information, illustrations, and specifications contained in this manual were based on the data available at the time of publication. Briggs & Stratton Corporation reserves the right to change, alter, or otherwise improve the product or the product manuals at any time without prior notice.

Briggs & Stratton offers two complementary publications to enhance understanding of engine technology, maintenance, and repair. (Neither publication, however, is a substitution for a recognized technician training program.) For consumers, Small Engine Care & Repair (p/n 274041) provides a comprehensive overview of how small air-cooled engines work, basic troubleshooting, and step-by-step maintenance procedures. For engine technicians and consumers alike, an in-depth study of engine theory and operation can be found in the textbook Small Engines (p/n CE8020). Both publications can be purchased at **[www.BRIGGSandSTRATTON.com](http://www.BRIGGSandSTRATTON.com)** or through a local Authorized Briggs & Stratton Service Dealer.

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# Section 1

# INTRODUCTION

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## DESIGNED FOR FRESH WATER

**CAUTION:** Salt water is extremely corrosive to outboard components. Failure or damage related to salt water corrosion is **NOT** covered under the BRIGGS & STRATTON Warranty.



### WARNING

Rotating parts can contact or entangle hands, feet, hair, clothing, or accessories.

Traumatic amputation or severe laceration can result.

- Avoid contact with propeller. Keep people and pets away from propeller while the engine is running.
- DO NOT run the outboard out of the water.
- Operate equipment with guards in place.
- Keep hands and feet away from rotating parts.
- Tie up long hair and remove jewelry.
- DO NOT wear loose-fitting clothing, dangling drawstrings or items that could become caught.
- Keep lines, rigging and other equipment inside the boat.



### WARNING

Starting engine creates sparking. Sparking can ignite nearby flammable gasses.

Explosion and fire could result, causing serious injury or death.

- If there is a natural or LP gas leak in the area, do not start engine.
- Do not use pressurized starting fluids because vapors are flammable.



### WARNING

Fuel and its vapors are extremely flammable and explosive.

Fire or explosion can cause severe burns or death.

## ADDING FUEL

- Fill fuel tank outdoors or in well ventilated area.
- Do not fill portable fuel tank while it is in the boat or inside a vehicle. Always place tank on the ground when filling with gasoline.
- Do not overfill tank. Fill tank to approximately 1-1/2 inches below top of neck to allow for fuel expansion.
- Keep all fuel away from sparks, open flames, pilot lights, heat, and other ignition sources.
- Do not smoke when refueling.
- Check fuel lines, tank, cap and fittings frequently for cracks or leaks. Replace if necessary.
- Locate the fuel tank in a position that keeps the vent higher than the fuel level.

## STARTING ENGINE

- Make sure spark plug, muffler and fuel cap are in place.
- Line from fuel tank is correctly connected to the engine.
- Do not crank engine with spark plug removed.
- If fuel spills, wait until it evaporates before starting engine.
- If engine floods, set choke to RUN position (choke open), place throttle in FAST position and crank until engine starts.

## TRANSPORTING EQUIPMENT

- Transport outboard with transport valve in the OFF position.

## STORING EQUIPMENT

- Store away from furnaces, stoves, water heaters, clothes dryer or other appliances that have pilot light or other ignition source because they can ignite fuel vapors.



## HAZARD SYMBOLS AND MEANINGS



Fire



Explosion



Moving Parts



Toxic Fumes



Hot Surface



Kickback



Electrocution



Unstable Condition



Pressure



Chemical Burns



Eye Protection Required



### DANGER



Storage batteries give off explosive hydrogen gas during recharging.

Hydrogen gas stays around battery for a long time after battery has been charged.



Slightest spark will ignite hydrogen and cause explosion.

You can be blinded or severely injured.

Battery electrolyte fluid contains acid and is extremely caustic.

Contact with battery fluid will cause severe chemical burns.

- Do not allow any open flame, spark, heat, or lit cigarette around battery during, and for several minutes after charging.

- Wear protective goggles, rubber apron, and rubber gloves.



## WARNING:



The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.



### WARNING



Rapid retraction of starter cord (kickback) will pull hand and arm toward engine faster than you can let go.

Broken bones, fractures, bruises or sprains could result.

- Be sure the shift selector is in NEUTRAL position before attempting to start the outboard.
- When starting engine, pull cord slowly until resistance is felt, then pull rapidly.
- Allow the cord to retract slowly.



### WARNING



Running engines produce heat. Temperature of muffler and nearby areas can reach or exceed 150°F (65°C).

Severe burns can occur.

- Do not touch hot surfaces.
- Allow equipment to cool before touching.



### WARNING

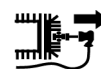


Unintentional sparking can result in fire or electric shock.

Unintentional start-up can result in entanglement, traumatic amputation, or laceration.

### BEFORE PERFORMING ADJUSTMENTS OR REPAIRS

- Disconnect spark plug wire and keep it away from spark plug.




### WHEN TESTING FOR SPARK

- Use approved BRIGGS & STRATTON spark plug tester Part No. 19368.
- Do not check for spark with spark plug removed.

## IN THE INTEREST OF SAFETY

### Safety Alert Symbols

1

The safety alert symbol () is used to identify safety information about hazards that can result in personal injury.

A signal word (**DANGER**, **WARNING**, or **CAUTION**) is used with the alert symbol to indicate the potential severity of injury. In addition, a hazard symbol may be used to represent the type of hazard.



**DANGER:** indicates a hazard which, if not avoided, **will result in death or serious injury**.





**WARNING:** indicates a hazard which, if not avoided, **could result in death or serious injury**.



**CAUTION:** indicates a hazard which, if not avoided, **might result in death or serious injury**.

**CAUTION:** When used **without** the alert symbol, indicates a situation that **could result in damage to equipment**.

**NOTE:** This notation is used to inform you of a method, reference or procedure that could assist with specific operations or decisions.

	 <b>CAUTION</b> <b>Before attempting to service this equipment, read the entire owner's manual and operating instructions.</b>
<ul style="list-style-type: none"><li>•Death, personal injury and/or property damage may occur unless service instructions are followed carefully.</li><li>•<b>Failure to follow the warnings listed below could result in death, serious injury (including paralysis) or property damage.</b></li></ul>	

- DO NOT** run engine in an enclosed area. (Exhaust gases contain carbon monoxide, an odorless and deadly poison.)
- DO NOT** place hands or feet near moving or rotating parts.
- DO NOT** operate engine if gasoline is spilled or when smell of gasoline is present or other

explosive conditions exist. (Move equipment away from spill and avoid any ignition until gasoline has evaporated.)

- DO NOT** tamper with links or other parts to increase engine speed. (This engine uses a non-adjustable, electronic engine speed limiter.)
- DO NOT** run engine without the blower housing or with other safety shields removed when doing repairs.
- DO NOT** crank engine with spark plug removed. (If engine is flooded, place throttle in the **FAST** position and crank until engine starts.)
- DO NOT** operate engine without a muffler. (Inspect periodically and replace if worn or leaking. If engine is equipped with muffler deflector, inspect periodically and replace if necessary. Replacement parts must be same as on original equipment.)
- DO NOT** run the outboard unless the propeller is either removed from the outboard or in water. Remove the spark plug lead and select **NEUTRAL** when servicing the outboard. Remove the propeller whenever it is necessary to test run the outboard.
- PRIOR TO WORK**, read and understand the section(s) of this manual that pertain to the job. Follow all safety warnings.
- PULL STARTER CORD SLOWLY** until resistance is felt. Then pull cord rapidly to avoid kickback and prevent hand or arm injury.
- WEAR** suitable eye protection (safety glasses, goggles or face shield) when performing repair procedures.
- PREVENT ACCIDENTAL STARTING** by removing spark plug wire from spark plug when servicing engine or equipment.
- USE** fresh gasoline. Stale fuel can gum carburetor and cause leakage.
- CHECK** fuel lines and fittings frequently for cracks or leaks. Replace if necessary.
- USE** Genuine Briggs & Stratton Parts or their equivalent **ONLY**. The use of replacement parts, which are not of equivalent quality, may damage the engine.



## FUEL RECOMMENDATIONS

### Gasoline

Use clean, fresh, unleaded gasoline. Leaded gasoline may be used if unleaded is not available. A minimum of 85 octane is recommended. The use of unleaded gasoline results in fewer combustion deposits and longer valve life.

**NOTE:** We do not recommend the use of gasoline that contains alcohol, such as gasohol. However, if used, it must not contain more than 10 percent Ethanol and must be removed from the engine during storage. Do not use gasoline that contains Methanol.

Only purchase a 30-day supply of gasoline. Fresh gasoline minimizes gum deposits and also will ensure fuel volatility tailored for the season in which the engine will be operated.

**NOTE:** The use of a fuel additive, such as Briggs & Stratton Gasoline Additive (#5041) or equivalent, will minimize the formation of fuel gum deposits during storage. Such an additive may be added to the fuel tank or storage container.

## OIL RECOMMENDATIONS

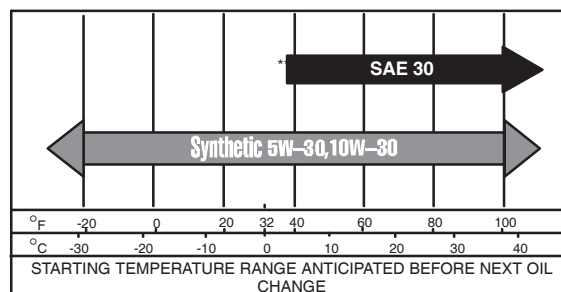
### Lubrication System

Oil has four purposes. It cools, it cleans, it seals, and it lubricates. This engine is lubricated with an oil slinger. During normal operation, small particles of dust, metal from the cylinder walls, pistons, bearings, and combustion deposits will gradually contaminate the oil. If the oil is not changed regularly, these foreign particles can cause increased friction and an abrasive action, which shortens the life of the engine. Fresh oil also assists in cooling. Old oil gradually becomes thick and loses its cooling ability and lubricating qualities.

### Engine Oil

Use a high quality detergent oil classified "For Service SF, SG, SH, SJ" or higher. Briggs & Stratton strongly recommends the use of synthetic oil such as Briggs & Stratton (#100030C) or equivalent. If not available, SAE 30 weight oil is an acceptable substitute. No special additives should be used with recommended oils.

Do not mix oil with gasoline.



Air-cooled engines run hotter than automotive engines. The use of multi-viscosity oils, (10W-30 etc.) in ambient temperatures above 40°F (4°C), will result in high oil consumption. If multi-viscosity oil is used, check oil level more frequently to prevent any possible engine damage due to lack of lubrication.

SAE 30 oil, if used in ambient temperatures below 40°F (4°C), will result in hard starting and possible engine damage due to inadequate lubrication.

Synthetic oil meeting ILSACGF-2, API certification mark and API service symbol with "SJ/CF ENERGY CONSERVING" rating or higher, is acceptable oil at all temperatures.

**NOTE:** Use of synthetic oil does not alter the required oil change intervals.

### OIL DRAIN PLUG, OIL FILL AND DIPSTICK

1. Change oil every 25 hours.
2. Position the engine vertically to check or change the oil.
3. Remove oil drain plug (Figure 1) ①. Drain oil while engine is still warm.



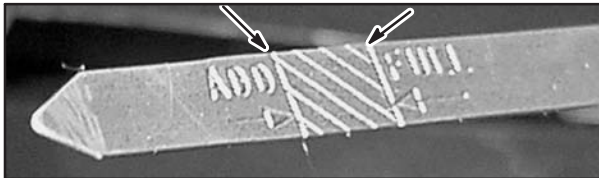
Fig. 1 – Oil Drain Plug

4. Install drain plug. Torque to 10 ft. lbs. (14 Nm).
5. Remove dipstick (Figure 2) ②. Refill slowly with 24 oz. (0.75 qt., 0.7 L) of new oil with the proper service classification and viscosity grade. Do not overfill.



**Fig. 2 – Dipstick**

6. Install the dipstick.
7. Start and run engine at idle to check for oil leaks.
8. Check the oil level. The oil level should be between the ADD and FULL marks on the dipstick. Add new oil if required (Figure 3).

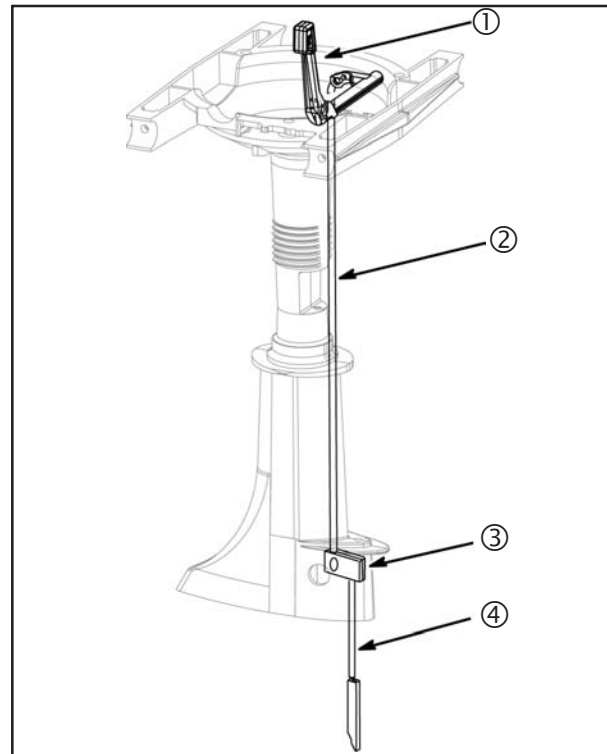


**Fig. 3 – Dipstick Markings**

## GEAR SELECTOR

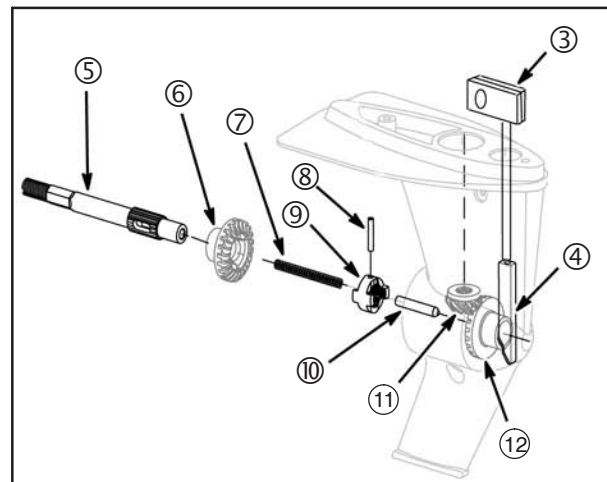
### Operation

The outboard operator selects gears with the shift lever handle (Figure 4) ① on the starboard (right) side of the outboard which acts on the shift cam/rod assembly ④. The shift lever is connected to the shift cam/rod by an upper rod ②. The rods are connected with a clamp ③ that also provides for NEUTRAL adjustment.



**Fig. 4 – Gear Selector Operation**

The forward gear (Figure 5) ⑫ and reverse gear ⑥ are driven simultaneously by the pinion gear ⑪ and spin freely on the propeller shaft ⑤. The spring ⑦ inside the propeller shaft applies forward pressure on the roll pin ⑧, sliding clutch ⑨ and shift cam follower ⑩. The shift cam/rod ④ is stepped to control the location of the sliding clutch through the shifter pin. The sliding clutch is splined to the propeller shaft.



**Fig. 5 – Forward Gear**

## Reverse

When the shifter is moved to the REVERSE position, the shift cam (Figure 6) ⑨ is pressed down to its lowest position in the gear case. The highest surface of the cam presses the cam follower ⑥ rearward, engaging the sliding clutch ⑤ to the REVERSE gear ②.

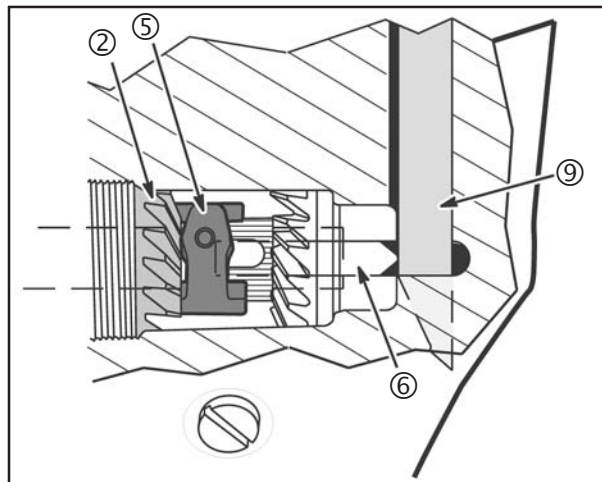


Fig. 6 – Reverse

## Neutral

When the shifter is in the NEUTRAL position the shift cam (Figure 7) ⑨ is in the middle position. The cam-follower ⑥ is on the middle detent of the shifter cam. The sliding clutch ⑤ is not engaged to either the FORWARD or the REVERSE gears.

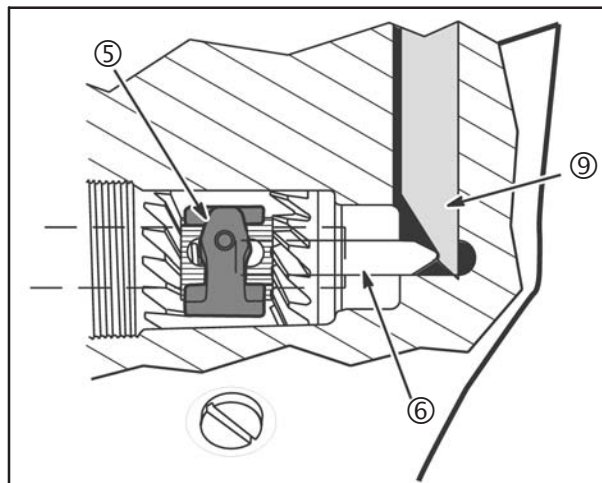


Fig. 7 – Neutral

## Forward

When the shifter is set to the FORWARD position, the shift cam (Figure 8) ⑨ is pulled to its highest

position in the gear case. The spring ③ inside the propeller shaft pushes the sliding clutch ⑤ and cam follower ⑥ forward, engaging the sliding clutch to the FORWARD gear ⑧.

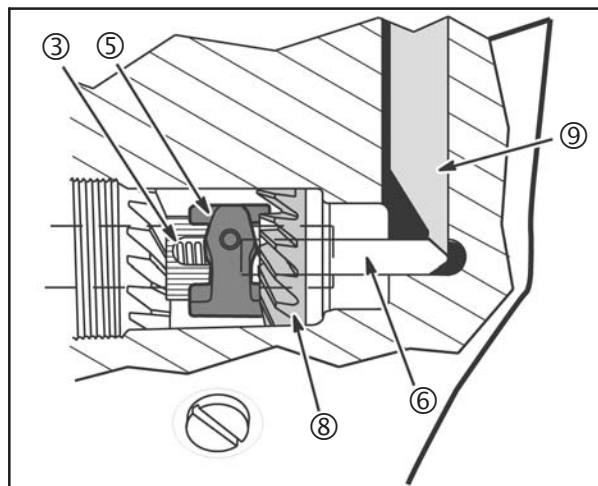


Fig. 8 – Forward

## CHANGING GEAR CASE OIL

1. Remove oil drain/fill plug (Figure 9) ② and vent plug ①.

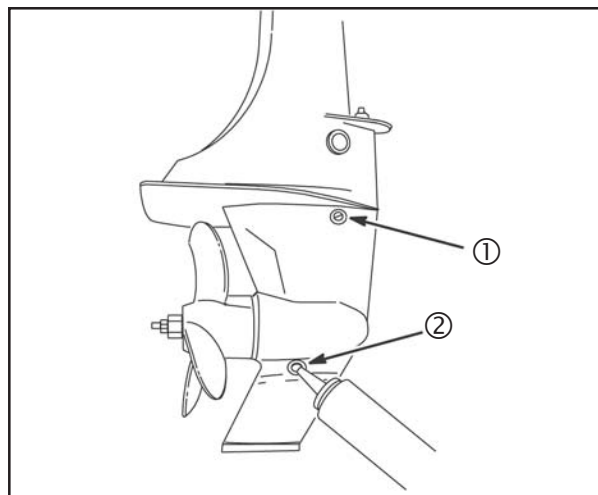


Fig. 9 – Gear Case Oil

2. Drain the gear lube into an approved container.
3. Fill gear case with 4 oz. of 80-90W gear oil.

Insert the tip of the oil bottle into the oil fill (lower) hole. Squeeze the bottle until the oil is just to the point of overflowing at the vent (upper) hole.

4. Install vent plug in top hole. Torque to:  
20 in. lbs. (2 Nm).
5. Install oil drain/fill plug in lower hole. Torque to:  
45 in. lbs. (5 Nm).

## ELECTRIC OUTBOARD

1

### GENERAL INFORMATION

The power ratings for an individual electric outboard model are initially developed by starting with those provisions of SAE (Society of Automotive Engineers) Surface Vehicle Standard J1228 (Small Craft – Marine Propulsion Engine and Systems – Power Measurements and Declarations) (Revision Nov. 1991) that are relevant to electrically powered outboard units, such as sections defining measurement of declared (rated) power (3.2), and establishing manufacturing tolerance (4.1.1 & 8). The source of electrical power is a fully charged battery pack, similar to and representative of that typically used in the application; high current cabling is per ABYC guidelines. Electrical measurements are performed by generally accepted means. Thrust tests are direct force measurements, taken at stall, on open water. Peak thrust is quoted instead of peak power; the intent of the design is to maximize thrust and efficiency at displacement speeds. The “3150” designation means that the nominal full-charge continuous power rating is 3 hp, and the nominal peak developed thrust is 150 lb<sub>f</sub>. Actual “on site” power and/or thrust developed may differ from the nominal rated values, due to several factors: Selection of and state-of-charge of the propulsion batteries; changes in temperature; individual unit-to-unit variation; mode of operation — acceleration or cruise; mass, type, and length of craft to which the outboard is fitted; the presence of wind, weeds, and water currents; as well as any other factors which may reasonably be inferred to influence the performance of the unit.

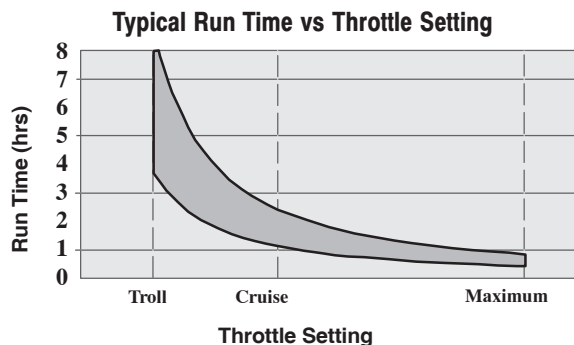
To complete the installation of your outboard, you will need the following items. Your Briggs & Stratton Dealer has kits available to aid installation. See an Authorized Briggs & Stratton Dealer for available Power Supply Harness kits, which include the battery harness and fuse supplies. **Line Fuse, fuse block & cable caps.** Connect fuse as shown under **Battery Installation**. Use appropriate cable caps to protect the fuse block terminals.

- **Battery Harness.** 6 gauge wire or larger, terminating in an Anderson SB120 (or equivalent) connector, to connect the batteries to the outboard.
- **Deep cycle marine batteries.** Briggs & Stratton recommends using four 12 Volt batteries. Refer to a marine battery manufacturer or dealer for specific information.
- **U.S. Coast Guard approved battery boxes.**
- **6 gauge wire battery cable inter-connects.**

### BATTERY RECOMMENDATION

The outboard requires a 48 volt power source. For best results, use marine group 31 deep cycle batteries with at least 100 ampere hour rating. The outboard can draw 70 amps continuously with the throttle set at MAX POWER, and as much as 100 amps for short periods of time. The actual ampere draw is subject to your particular environmental and operating conditions.

Refer to a marine battery manufacturer or dealer for specific information.



**NOTE:** Run time and speed will vary based on battery size, boat hull size, type and loading, and water conditions.

Cycling batteries are designed to have good life performance in deep cycle service. The major cause of battery failure in deep cycle service is poor maintenance:

- Dirt and corrosion on battery tops or terminals
- Incorrect battery water level
- Lack of charging
- Excessive discharge

Maintain battery pack at full charge. Proper care will significantly improve the battery life. Failure to properly recharge batteries (within 12-24 hours) may cause reduced battery performance or premature battery failure. For best results, use a variable rate charger.

Refer to the battery charger manufacturer for specific information on how to charge the battery pack.

### BATTERY INSTALLATION

Batteries must be connected in series to obtain 48 volts with 100 ampere rating.





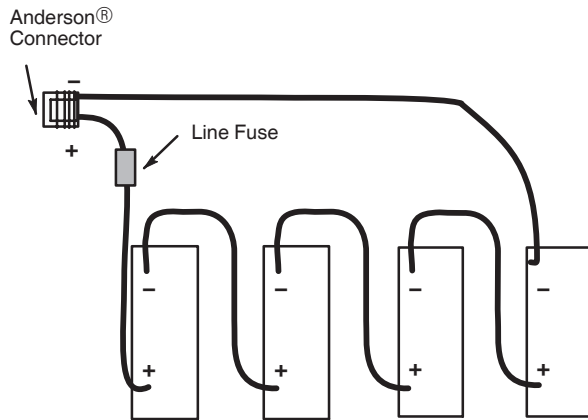
Risk of Electrical Shock. **DO NOT** touch un-insulated battery terminals, connectors, or wires.

Prior to wiring the batteries, ensure that the battery harness is unplugged from the outboard.

The batteries must be wired in series to provide 48 volts. **Improper wiring of batteries could cause batteries to explode.**

Use 6 gauge wire or larger for battery harness and all wiring between batteries.

Keep wire connections to the batteries tight, maintaining good contact with the battery terminals.



**NOTE:** The battery connection diagram is for reference ONLY. It depicts four 12 volt batteries wired in a series to produce a total of 48 volts. While the connections will follow the pattern as shown, the actual position of the batteries may vary depending upon how and where the batteries are located within your boat.

## OUTBOARD CONTROLS

### ON / OFF/ BATTERY TEST SWITCH

The outboard switch is used for the following:

- | - Turns motor on.
- O - Turns motor off.

**BATTERY** – Press-to-test battery switch.

Once the battery harness is connected to the outboard power receptacle, the voltage may be tested. Press and hold the battery test of the ON/OFF/BATTERY TEST switch. Allow the battery gauge to read the state of charge of the battery pack.

## BATTERY GAUGE

When the needle moves fully to the right **I**, the battery pack is fully charged to **48 volts or higher**. As the battery pack is discharged, the needle will only rise to the level of charge remaining in the battery pack.

When the battery gauge needle reaches the far left or red circle, the battery pack is discharged to **45 volts or less**. Head to shore and recharge the battery pack.

**NOTE:** Meter will not display a reading if battery voltage is below 45 volts.

## LOW VOLTAGE WARNING SOUND

A beeper will sound when the battery pack voltage drops to **32 volts**. This will indicate that the battery pack has been discharged to a level which may not power the outboard. Upon beeper activation, it is recommended to reduce power (if applicable), head immediately to shore, and charge the battery pack.

## FORWARD / REVERSE SWITCH



**WARNING**  
ALWAYS use the slowest practical speed when operating the boat in reverse. Using high power in REVERSE may force water over the transom into the boat.

**FORWARD (FWD)** – To move the boat forward, press the switch to the FORWARD position.

**REVERSE (REV)** – To move the boat in reverse, press the switch to the REVERSE position.

## SPEED CONTROL

The speed control has various positions:

**STOP / RESET**

**CRUISE**

**MAX POWER**

Twist SPEED CONTROL smoothly to increase speed.

The MAX POWER setting generally benefits the boater by offering high thrust at low speeds and is not intended for cruising. On average, operation at MAX POWER for long periods of time will only increase boat speed by about 1 mph, while greatly reducing run time and range.

## SAFETY / MOTOR STOP SWITCH

The outboard motor will stop when the stop switch clip is pulled from the SAFETY/MOTOR STOP switch.



The snap of the safety lanyard **MUST** be attached to the operator of the boat to reduce the possibility of injury in case the operator falls overboard.

## BEFORE STARTING OUTBOARD

1. Before attaching the power harness to the power receptacle on the outboard, ensure the ON/OFF/BATT. switch is in the OFF position
2. Attach the safety lanyard to the SAFETY/MOTOR STOP switch.
3. Attach the safety lanyard snap to the operator.

## START / OPERATE MOTOR

1. Twist the SPEED CONTROL to the STOP/RESET position.
2. Toggle the ON/OFF switch to the ON position. Motor will start.
3. Toggle the FORWARD/REVERSE switch to the direction desired.
4. Rotate the SPEED CONTROL until desired speed is reached.

**NOTE:** SPEED CONTROL must be in the STOP/RESET position for the motor to start.

## MOTOR RESET

During normal use, the outboard may sense an abnormal condition, stopping the propeller from rotating. If the propeller fails to rotate, twist the SPEED CONTROL to the STOP/RESET position, then return to operation as normal.

If this fails to reset the outboard, cycle the ON/OFF/BATTERY TEST switch from OFF to ON, then operate as normal.

Situations that will cause a reset condition include, but are not limited to:

- Obstructed propeller.
- Automatic return to OFF due to lack of use for 30 seconds.



Before clearing obstructed propeller, disconnect the battery harness from the power receptacle, and the safety lanyard from the SAFETY/MOTOR STOP switch to prevent unintentional sparking or start up.

### Automatic return to OFF will occur when:

The safety lanyard is clipped to the SAFETY/MOTOR STOP switch, and...

- The ON/OFF/BATTERY TEST switch is in the ON position, and...
- The SPEED CONTROL is in the STOP/RESET position for 30 seconds or longer.



# Section 2

## TROUBLESHOOTING

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## TROUBLESHOOTING



Most complaints concerning engine operation can be classified as one or a combination of the following:

- No Start
- Hard Start
- Lack of Power
- Vibration
- Overheating
- High Oil Consumption

When the cause of a malfunction is not readily apparent, perform a check of the compression, ignition, carburetion and cooling systems. This check-up, performed in a systematic manner, can usually be done in a matter of minutes. It is the quickest and surest method of determining the cause of failure. This check-up will point out potential future failures, which can be corrected in advance. The basic check-up procedure is the same for all engine models.

### Check Lower Unit

What appears to be a problem with engine operation, such as hard starting, vibration, etc., may be the fault of the lower unit rather than the engine itself. Listed are the most common effects of problems and probable causes.

	<p style="text-align: center;"> <b>WARNING</b></p> <p>To prevent accidental starting, the spark plug wire must be removed from the spark plug and grounded after removing boot. Failure to do so can cause personal injury. If the propeller or propeller shaft is turned with the outboard in gear it is possible that the engine will crank over and start. Remove the spark plug lead and select NEUTRAL when servicing the outboard. To prevent serious injury from contact with a rotating propeller, do not run the outboard unless the propeller is either removed from the outboard or the unit is in water. Remove the propeller whenever it is necessary to test run the outboard.</p>
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### No Start – Hard Start

1. Check remote control assembly for proper adjustment.
2. Check neutral safety system for shorted wires, loose or corroded connections, or defective modules or switches.

### Vibration

1. Mounting bolts loose – tighten.
2. Check for lower unit damage.

### Power Loss

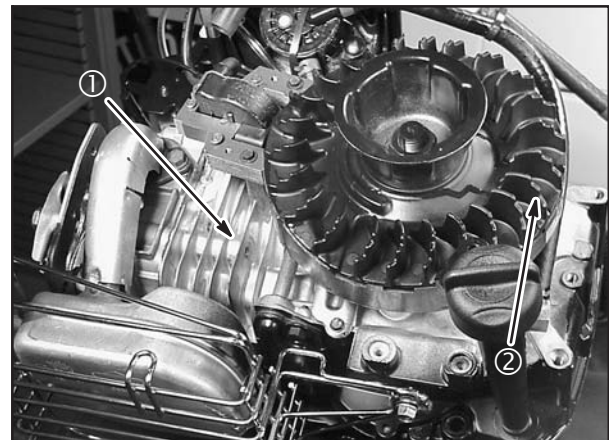
1. Bind or drag in unit – place engine in NEUTRAL. Operate lower unit manually to check for binding.
2. No lubrication in lower unit.

### Noise

1. No lubricant in lower unit.
2. Worn bearings or gears.

## COOLING

Chaff or dirt can clog the cooling system, especially after prolonged service in very dusty conditions. Continued operation with a clogged cooling system can cause severe overheating and possible engine damage. Periodically inspect the cylinder fins (Figure 10) ① and fan ②. Clean as required. Clean and inspect more often when dust or when airborne debris is present.



**Fig. 10 – Cooling Fins**

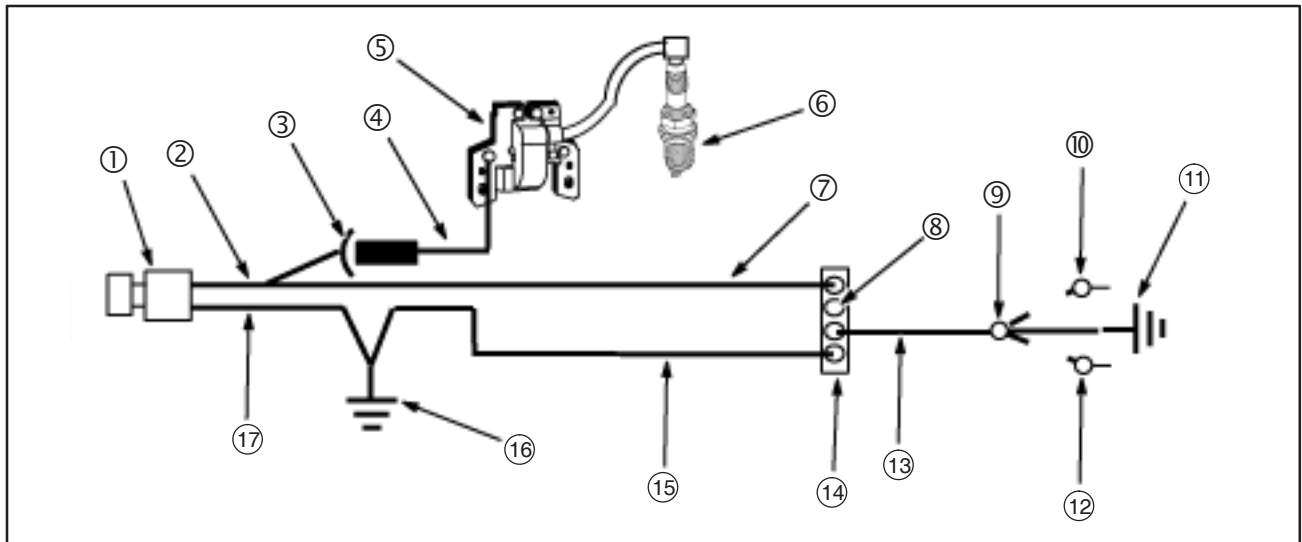


Fig. 11 – Ignition Schematic

1. Safety/Engine Stop Switch
2. BLACK Wire  
– to Safety/Engine Stop Switch
3. Connector
4. BLACK Wire  
– Armature Ground
5. Armature
6. Spark Plug
7. BLACK Wire  
– to Speed Limiter
8. Not Used
9. Neutral Switch
10. FORWARD Position
11. NEUTRAL Position
12. REVERSE Position
13. BLACK Wire
14. Wiring Harness Connector  
– to Engine Speed Limiter
15. WHITE Wire
16. Engine Ground
17. RED Wire

## CHECK IGNITION

	<p style="text-align: center;"> <b>WARNING</b></p> <p>Be sure there is no fuel or fuel vapor present, which might be ignited by the spark and cause a fire or explosion. Do not remove spark plug for this test.</p>
--	---

Attach Tester (#19368) to the spark plug wire and ground the tester to the engine block. Spin the flywheel with the engine starter. If spark jumps the tester gap, the ignition system is performing satisfactorily. If spark does not occur, look for:

- Incorrect ignition armature air gap
- Shorted stop switch wire
- Shorted safety/engine stop switch
- Ignition armature failure
- Defective Speed Limiter

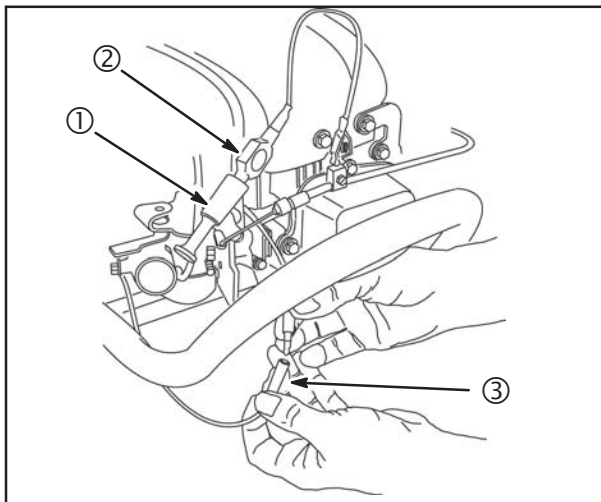
**NOTE:** If engine runs but misses during operation, a quick check to determine if ignition is faulty can be made by inserting the spark plug tester between the ignition cable and the spark plug. A spark miss will be noticeable in the window of the tester.

## ARMATURE TEST

2

	<p><b>WARNING</b></p> <p>Do not remove spark plug when checking ignition. A fire or explosion may occur. Always use an approved spark tester.</p>
---	---

1. Disconnect the ground lead (Figure 12) ③ to the armature.



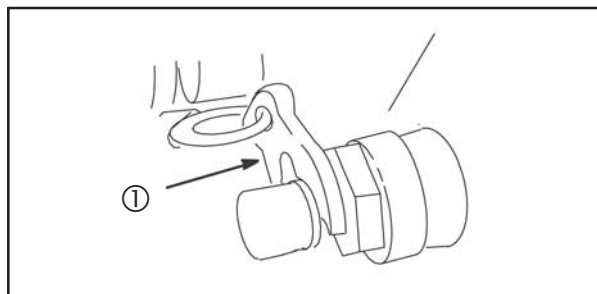
**Fig. 12 – Armature Test**

2. Connect spark plug wire ① to long terminal of Spark Tester ② (#19368) and ground tester to engine.
3. Pull the starter rope and observe the spark gap in the tester. If the spark jumps the tester gap, the armature is good.
4. If there is no spark, check the ground lead for pinching, worn insulation or damage. Test the lead for continuity. If the ground lead is undamaged and has continuity, replace the armature.

## TESTS FOR NO SPARK

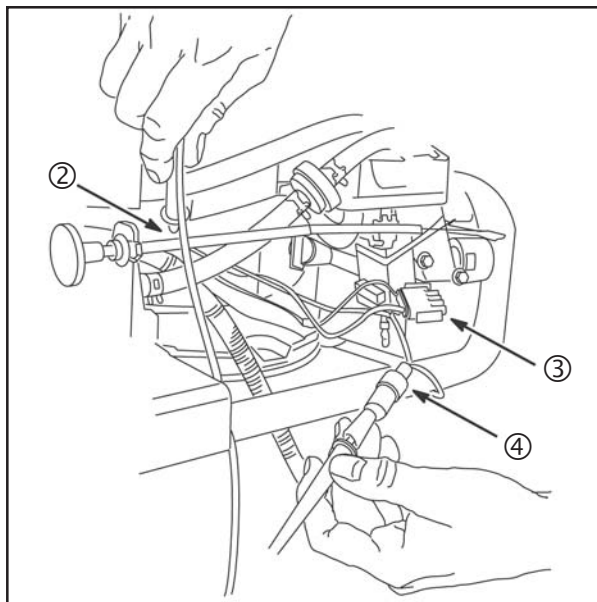
**NOTE:** Perform these tests if the armature is good and there is still no spark.

1. Remove the cowl from the power head.
2. Disconnect the armature ground lead.
3. Remove safety/engine stop switch clip (Figure 13) ①.



**Fig. 13 – Safety Stop Switch Clip**

4. Disconnect the wiring harness connector (Figure 14) ③ from the engine speed limiter.



**Fig. 14 – Disconnect Speed Limiter**

5. Insert the test probe to the wire harness side of the armature ground wire connector ④.
6. Test the switch for continuity at the engine ground ②.

There should be continuity.

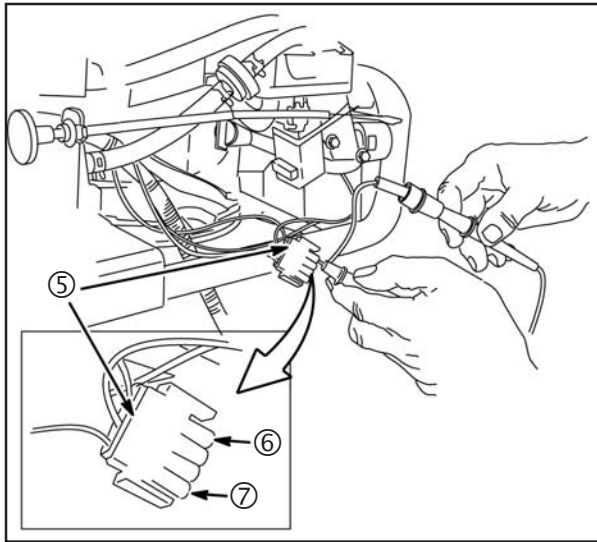
7. Insert clip to safety/engine stop switch (Figure 13) ① and retest the switch for continuity.

There should be no continuity.

Use steps 6 and 7 to verify a working safety/engine stop switch and wires.

**NOTE:** Leave the test probe connected to the armature ground wire connector (step 5) for the following steps.

8. Test the black wire (Figure 15) ⑥ for continuity at the connector ⑤ to the engine speed limiter.



**Fig. 15 – Continuity Test**

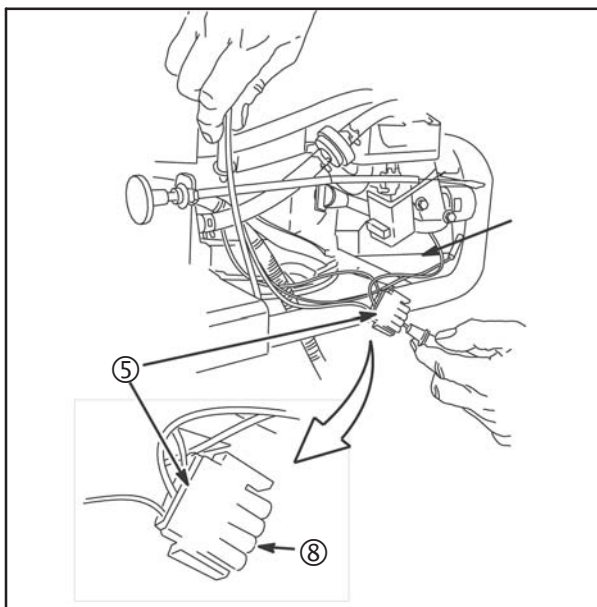
There should be continuity.

9. Test the white wire ⑦ for continuity at the connector to the engine speed limiter. There should be no continuity.
10. Depress the safety/engine stop switch. There should be continuity only when the switch is depressed.

If there is still no spark replace the engine speed limiter.

## NEUTRAL SWITCH TEST

1. Disconnect the wiring harness connector (Figure 16) ⑤ from the engine speed limiter.

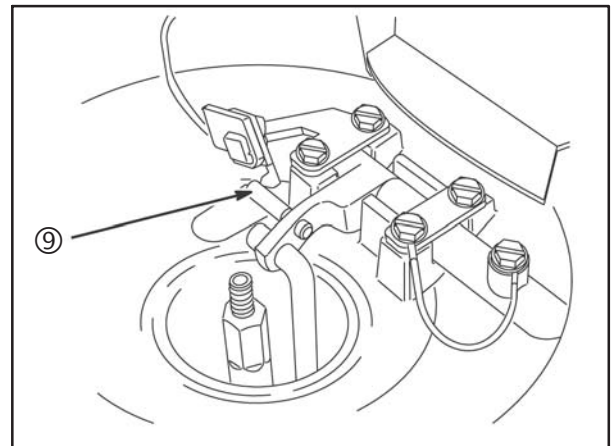


**Fig. 16 – Neutral Switch Test**

2. Place the shift lever to NEUTRAL. Test for continuity between the wiring harness connector ⑧ and the engine ground.
3. Repeat the test with the shift lever in the FORWARD and REVERSE positions.

There should be continuity with the shift lever NEUTRAL, and no continuity in the FORWARD and REVERSE positions.

4. Remove the power head (See Section 3).
5. Make sure the wire to the switch was not pinched or damaged.
6. Make sure the actuating pin of the shift lever actuates the switch in the NEUTRAL position, and does not actuate the switch when shifted to FORWARD or REVERSE.
7. Check for continuity from the actuating pin on the shift lever (Figure 17) ⑨ to the wire harness connector. There should be continuity with the shift lever in NEUTRAL only.



**Fig. 17 – Shift Lever Continuity Test**

**NOTE:** Local laws may require the use of a resistor spark plug to suppress ignition signals. If an engine was originally equipped with a resistor spark plug, be sure to use a resistor spark plug for replacement.

## CHECK COMPRESSION

If compression is poor, look for:

- Loose Spark Plug
- Loose cylinder head bolts
- Blown cylinder head gasket
- Burned valves or valve seats
- Insufficient valve clearance
- Warped or worn valve stems and guides
- Worn bore and/or piston rings
- Broken connecting rod



## Cylinder Leak Down Test

1. Run engine for 5 minutes, allowing engine to reach operating temperature.

**NOTE:** If the engine is cold or cannot be started, air flow may be higher (gauge readings lower) because compression components are not at normal operating temperatures.

2. Remove spark plug from engine. Disconnect crankcase breather tube.
3. Rotate crankshaft in direction of operation until piston is at top dead center (TDC) of compression stroke.
4. Hold flywheel nut with 15/16" socket and 1/2" breaker bar (Figure 18).

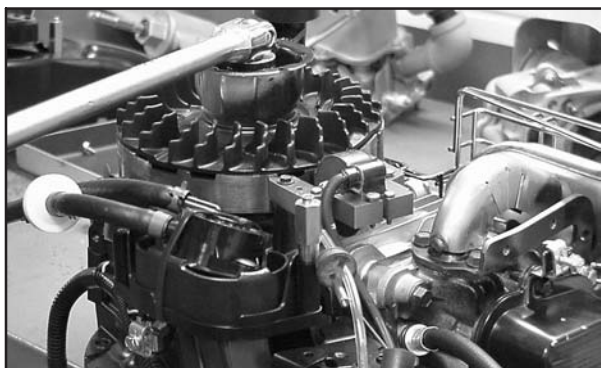



Fig. 18 – Holding The Flywheel



**CAUTION**

Injury may occur if the crankshaft is allowed to rotate. The crankshaft must be held with the piston at top dead center to eliminate any chance of rotation.

5. Connect tester (#19545) to a shop air source with minimum air pressure of 70 psi (480 KPA).
6. Install outlet hose into spark plug hole of cylinder being tested. Insure O-ring is seated to prevent air leak at spark plug hole. Connect other end to tester.
7. While securely holding the flywheel nut with the breaker bar and socket, pull the knob lock out in the direction of the arrow. Slowly turn the regulator adjustment knob (Figure 19) ① clockwise until tester's needle is on the set point. Push in regulator adjustment knob.

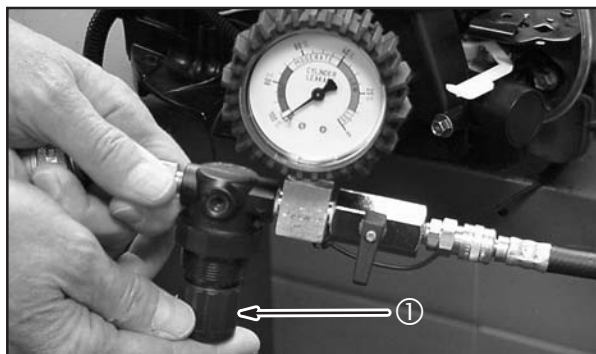


Fig. 19 – Adjusting Compression Tester

8. Slowly open the valve and note the reading on the gauge.
9. Listen for air leaking from cylinder head gasket, carburetor, exhaust system and either crankcase breather or high oil fill dipstick tube.

**NOTE:** If a high flow of air is leaking from exhaust and carburetor, make sure that piston is at TDC on compression stroke.

Reading is Green	Good Condition
Reading is Yellow, small leak at cylinder head gasket.	Replace gasket and retest.
Reading is Yellow/Red, minimal leakage from one component.	Look for a problem with that component.
Reading is Red, air is leaking from several components.	Check that piston is at TDC on compression stroke. If reading does not change, look for problems beginning with component that appeared to leak the most air. Re-test after repair.

- Air flowing between cylinder and cylinder head indicates that cylinder head gasket is leaking.
  - Air flowing from carburetor indicates air is leaking past intake valve and seat.
  - Air flowing from exhaust system indicates air is leaking past exhaust valve and seat.
  - Air flowing from crankcase breather tube or high oil fill dipstick tube indicates air is leaking past piston rings.
10. When test is complete, close the valve. Push the regulator lock nut IN and turn counterclockwise as far as it will go to release pressure in combustion chamber.
  11. Disconnect outlet hose from tester before removing from spark plug hole.



## CHECK CARBURETION

Before making a carburetion check, fill the fuel tank with fresh, clean gasoline. Be sure that the shut-off valve is OPEN. Check to see that the choke closes completely. If engine will not start, remove and inspect the spark plug.

If plug is wet, look for:

- Over choking
- Excessively rich fuel mixture
- Water in fuel
- Inlet needle stuck open
- Fouled spark plug

If plug is dry, look for:

- Leaking carburetor mounting gaskets
- Dirt or gum deposits in carburetor, fuel filter, fuel lines, transport valve or fuel tank
- Inlet needle stuck shut
- Inoperative fuel pump

A simple check to determine if the fuel is getting to the combustion chamber through the carburetor is to remove the spark plug and pour a small quantity of gasoline through the spark plug hole. Replace the plug. If the engine fires a few times and then stops, look for the same conditions as for a dry plug.

## STEERING TENSION

1. Steering tension is adjusted with a set screw (Figure 20) ① on the left side of the mid-section that applies pressure to a friction pad. Tighten the steering (increase steering effort) by turning the set screw clockwise; loosen (reduce steering effort) by turning the screw counterclockwise.

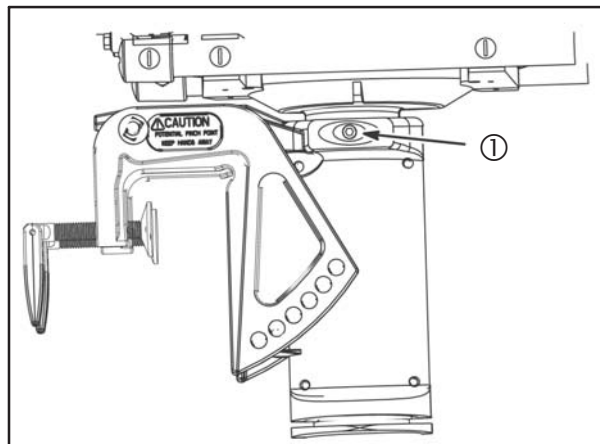


Fig. 20 – Steering Tension Adjustment

## PROPELLER SERVICE

1. Remove the stainless steel lock nut (Figure 21) ①, stainless steel washer ③ and the propeller ② from the propeller shaft.

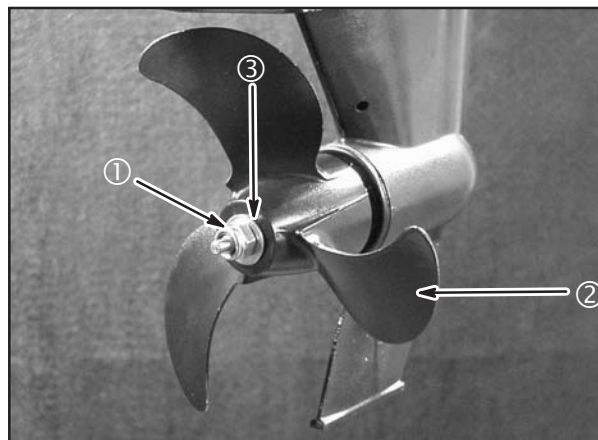


Fig. 21

2. Press the coupling assembly out of the propeller.
3. Inspect the coupling components (Figure 22) ① for wear and damage. If either the inner or outer coupling show wear or damage, replace the coupling.

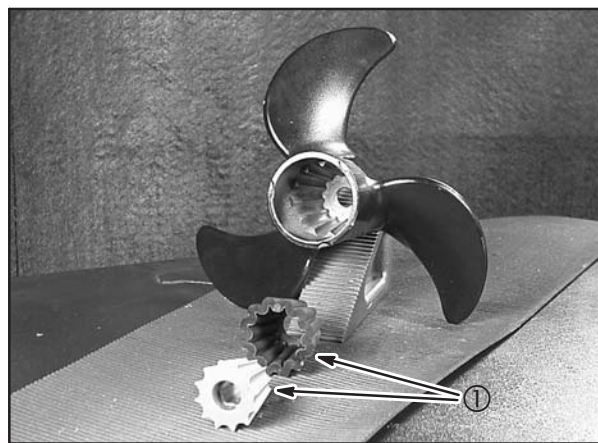
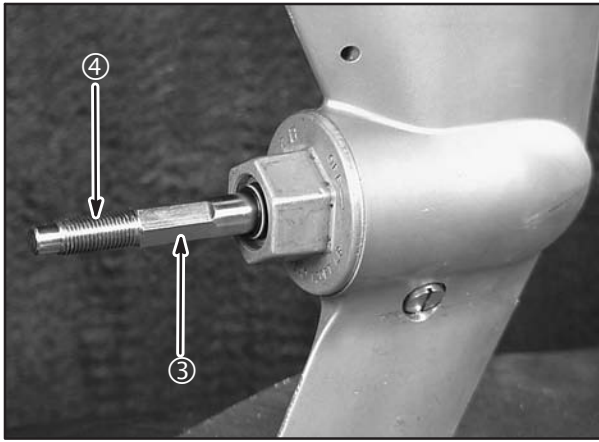


Fig. 22 – Propeller Mounting Hardware

4. Inspect the exposed end of the propeller shaft for wear or damage. If the threads (Figure 23) ④ or hex portion ③ show wear or damage replace the shaft.



**Fig. 23 – Propeller Drive Couplings**

5. Inspect the propeller (Figure 21) ② for broken or damaged blades, and for wear or damage to the hub. Replace or repair the propeller as required.
6. Install the coupling to the propeller.
7. Apply anti-seize to the propeller shaft. Install the propeller, stainless steel washer and stainless steel lock nut to the propeller shaft. Torque to 90 in. lbs. (10 Nm).

## ELECTRIC OUTBOARD

### Troubleshooting

Most complaints concerning motor operation can be classified as one or a combination of the following:

1. Motor will not run
2. Motor lacks power
3. Vibration
4. Noise

### Motor Will Not Run

The motor is equipped with a time out feature that shuts off power to the controller to prevent battery drain when the motor has been idle for approximately 30 seconds. To reactivate power to the motor, cycle the ON/OFF switch or rotate throttle to the STOP/RESTART position.

**NOTE:** Throttle must be in the STOP/RESTART position for the motor to run.

If the motor will not run, check the following components in the order shown.

The motor controller is equipped with an LED which displays a flash code which may be used to identify certain conditions or problems in the electrical system or components. See fault code chart on page 8.

### Check Battery And Wiring

1. Make sure that safety lanyard is properly connected, switch is in ON position and throttle is in STOP/RESTART position.
2. Depress battery charge indicator switch and note reading on gauge.
  - a. Meter will not display a reading if battery voltage is below 45 volts.
3. Check fuse in battery harness.
4. Make sure battery cables and connections are clean and tight.
5. Check battery voltage between positive and negative terminals at harness connector.

A fully charged battery pack will be 48 to 52 volts.

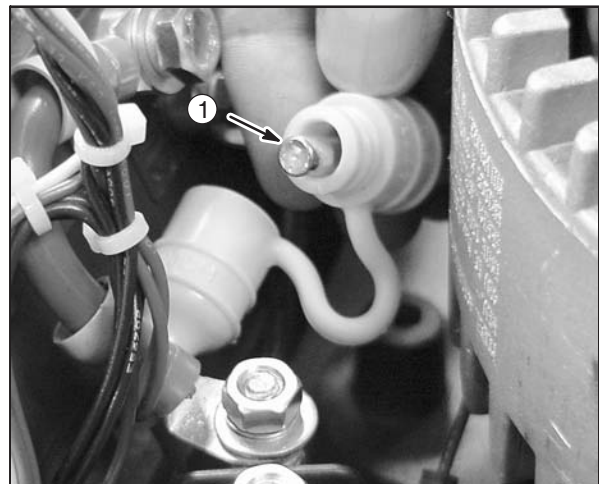
**NOTE:** When battery voltage drops to 32 volts a beeper will sound indicating that approximately 5 to 15 minutes of usable power remains. Available power will decrease as battery voltage drops. Motor will not run if battery voltage is below 15 volts.

### Check Motor Wiring And Fuse

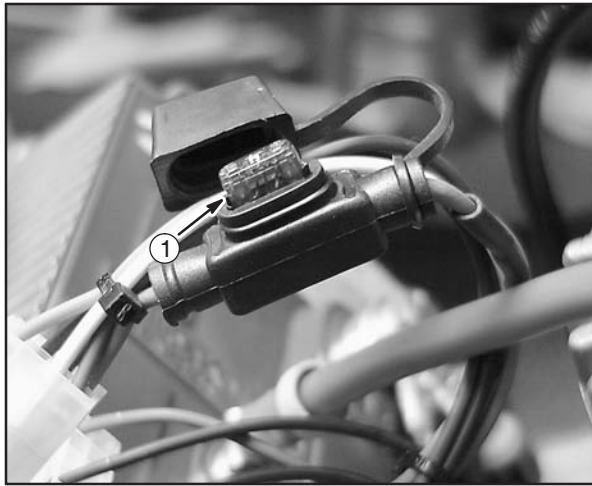
Disconnect battery harness connector from motor.

Remove 4 screws and cover.

1. Check 4 amp inline fuse (1) in motor harness.
  - a. Early style fuse holder is shown in Fig. 24.
  - b. Current style fuse holder is shown in Fig. 25.



**Fig. 24**



**Fig. 25**


2. Check for loose connections.
3. Check for burnt, loose or broken wires.

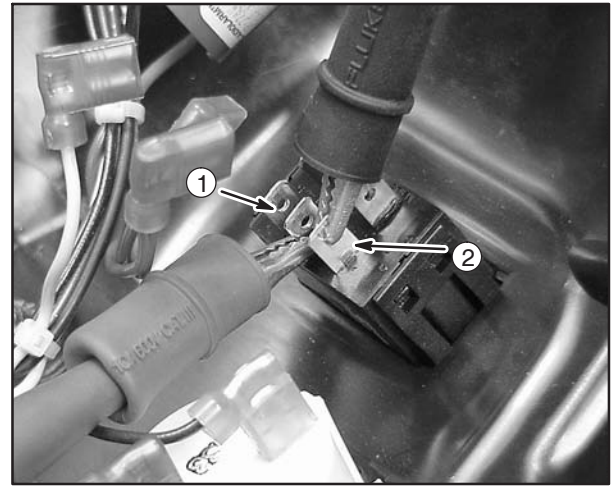
If fuse is OK and no damaged wires or loose connections are found, further testing is required. Test the following components in the order shown.

### Check On/Off/Battery Switch

The digital multimeter, Tool #19464 is recommended for the following tests.

Disconnect wires from switch taking note of their position and color. Note that only the terminals closest to the battery gauge are used.

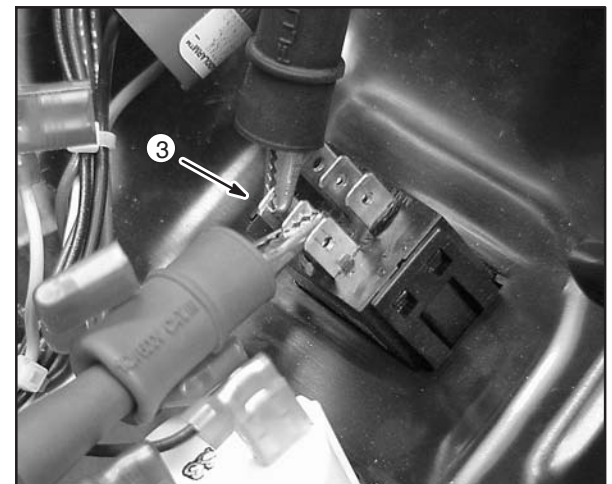
1. Insert RED test lead into receptacle in meter.
2. Insert BLACK test lead into receptacle in meter.
3. Rotate selector to  (Diode Test) position.
4. Attach either test lead from meter to center terminal (1) on switch (single red wire). Leave lead attached for remainder of test.
5. Attach other test lead to bottom terminal (2) on switch (double red wire), Fig. 26.
6. Meter should display "OL".
7. Move switch to ON position.
8. Meter should make a continuous tone indicating continuity.



**Fig. 26**

9. Move switch to OFF position.
10. Attach test lead to top terminal on switch (3) (yellow wire), Fig. 27.
11. Meter should display "OL".
12. Move switch to "Battery" position.
13. Meter should make a continuous tone indicating continuity.

Replace switch if test results are not as shown above.



**Fig. 27**

### Check Forward Reverse Switch

Disconnect wires from switch taking note of their position and color.

1. Move switch to "Reverse" position.
2. Attach either test lead from meter to center terminal (1) on switch (brown wire). Leave lead attached through step 10.
3. Attach other test lead to bottom terminal (2) on switch (black wire), Fig. 28.



4. Meter should display "OL".
5. Move switch to "Forward" position.
6. Meter should make a continuous tone indicating continuity.

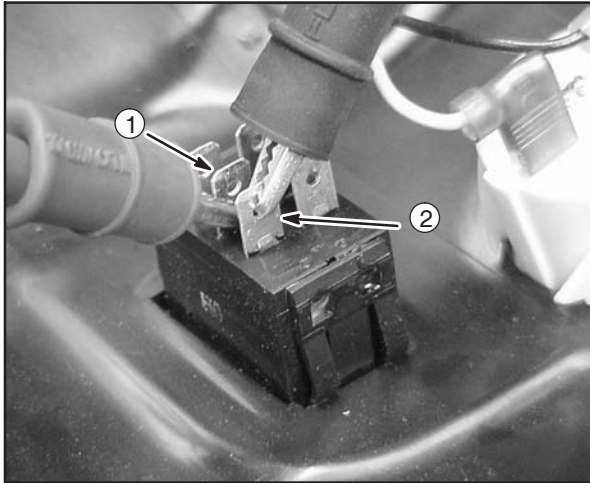


Fig. 28

7. Now attach test lead to top terminal (3) on switch (blue wire), Fig. 29.
8. Meter should display "OL".
9. Move switch to "Reverse" position.
10. Meter should make a continuous tone indicating continuity.

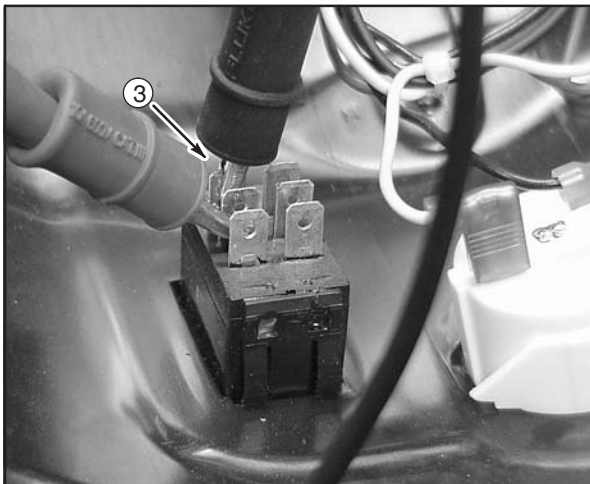


Fig. 29

11. Now move and attach test lead to other center terminal (4) on switch (double black wire). Leave attached through remainder of test.
12. Attach other test lead to bottom terminal (5) on switch (green wire), Fig. 30.
13. Meter should display "OL".
14. Move switch to "Forward" position.

15. Meter should make a continuous tone indicating continuity.

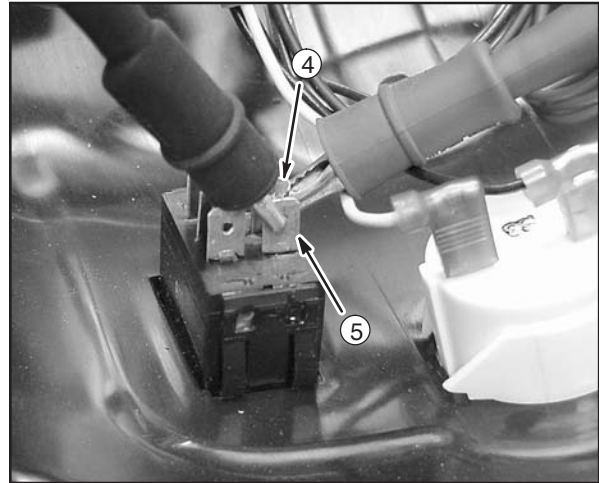


Fig. 30

16. Move test lead to top terminal (6) on switch (white wire), Fig. 31.
17. Meter should display "OL".
18. Move switch to "Reverse" position.
19. Meter should make a continuous tone indicating continuity.

Replace switch if test results are not as shown above.

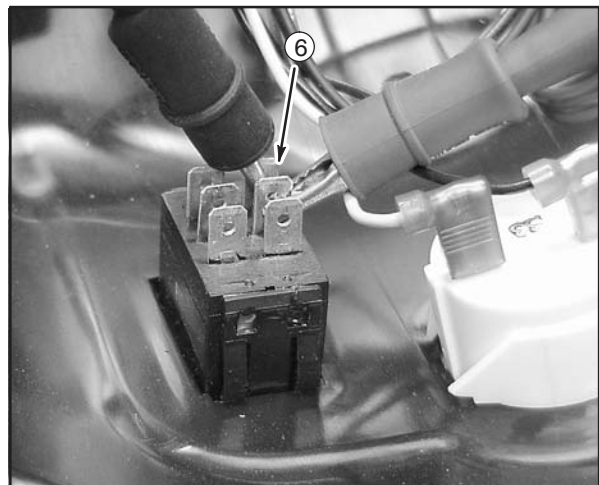


Fig. 31

### Check Primary Contacts

1. Disconnect battery harness from motor.
2. Set multimeter to read ohms/resistance.
3. Attach Red meter test lead (1) to to contactor post (1).
4. Attach Black meter test lead (3) to contactor post (2), Fig. 32.
5. Meter should display "OL".

6. If meter displays any resistance, including "0", replace the contactor.

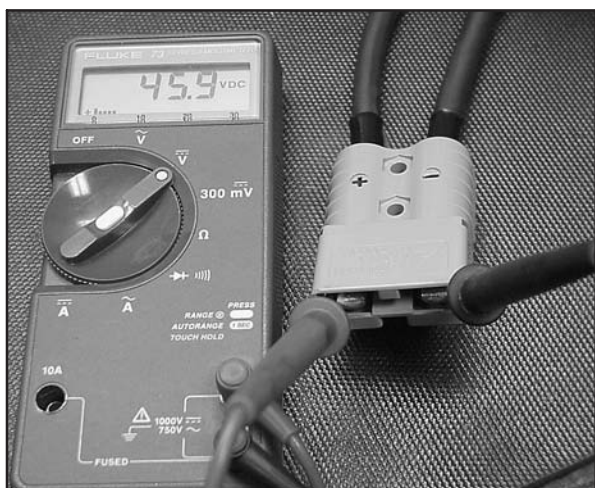


**Fig. 32**

### Check Contactor Primary Circuit

A known good battery pack is required.

1. Set multimeter to DC volts position and check and note battery voltage at battery harness connector, Fig. 33.



**Fig. 33**

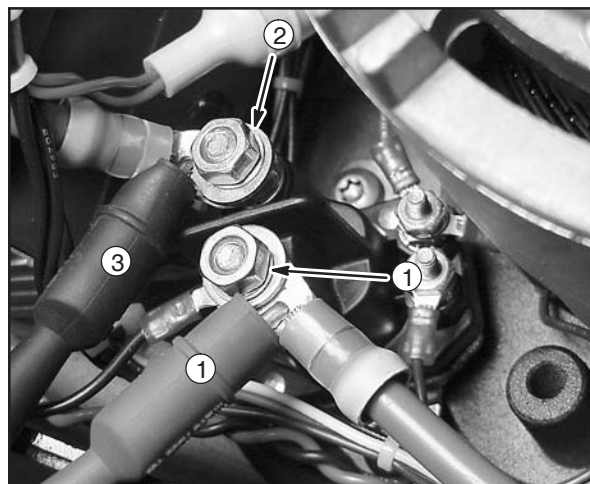
**NOTE:** Before plugging battery in to motor make sure motor switch is in "OFF" position, throttle is in STOP/RESTART position and safety lanyard is properly installed.

Then proceed as follows:

2. Attach Red meter test lead (1) to to contactor post (1).
3. Attach Black meter test lead (3) to contactor post (2), Fig. 34.
4. Insert battery harness connector into motor.
5. Turn ON/OFF switch to "ON" position.

6. After approximately one second (but less than 30 seconds) the meter should display no battery voltage.

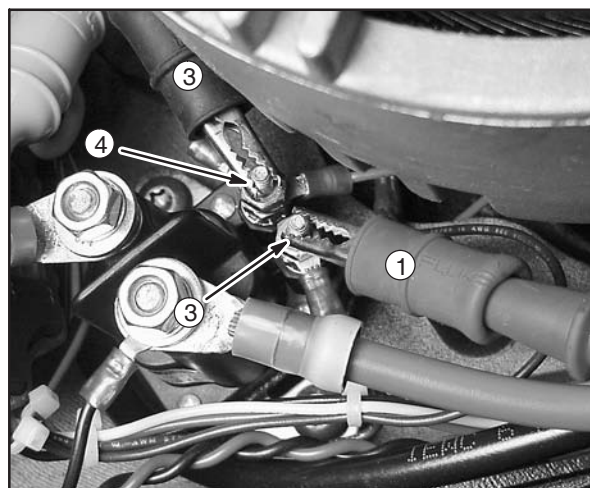
If meter displays any voltage, replace the contactor.



**Fig. 34**

### Check Contactor Coil Winding

1. Disconnect battery harness from motor.
  2. Set multimeter to read ohms/resistance.
  3. Attach Red meter test lead (1) to to contactor post (3).
  4. Attach Black meter test lead (3) to contactor post (4), Fig. 35.
  5. Resistance reading should be 60 ohms  $\pm$  10%.
- Replace contactor if not within specifications.



**Fig. 35**

### Replace Contactor

Remove wires from contactor posts noting color and position of wires as shown, Fig. 36.

1. Red wire (1) to battery harness connector.

2. Black wire (2) to safety switch harness.
3. Red wire (3) to B+ terminal on controller.
4. Red wire (4) to fuse holder.
5. Red wire (5) to reverse solenoid.
6. Blue wire (6) to reverse solenoid.

When assembling contactor to lower cowl, torque screws to 60 in. lbs. (7 Nm).

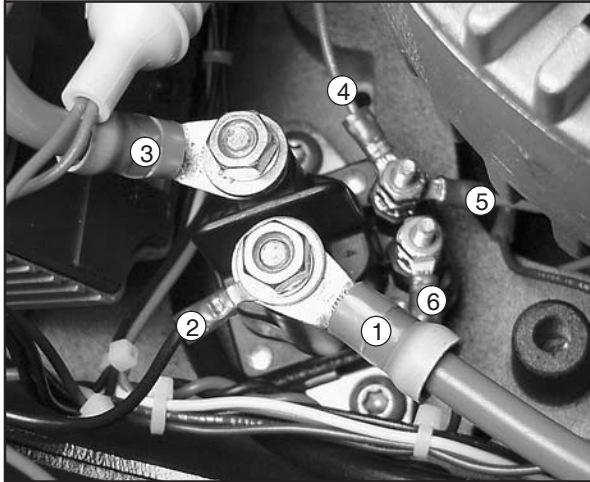



Fig. 36

#### Check Safety Switch (Lanyard)

Disconnect battery harness from motor and assemble safety lanyard to switch.

Disconnect 6 pin switch harness from motor cover.

1. Rotate selector to  (Diode Test) position.
2. Insert either meter lead into #2 pin receptacle (red wire) (1) in motor harness as shown.

**NOTE:** #2 pin receptacle is next to #1 pin receptacle; green wire (2).

3. Attach other meter lead to #1 contactor post (3), Fig. 37.
4. Meter should make a continuous tone indicating continuity.
  - a. If meter displays "OL", switch is defective. Replace.
5. Now remove safety lanyard from switch.
6. Meter should display "OL".

7. If meter makes a continuous tone switch is defective. Replace.

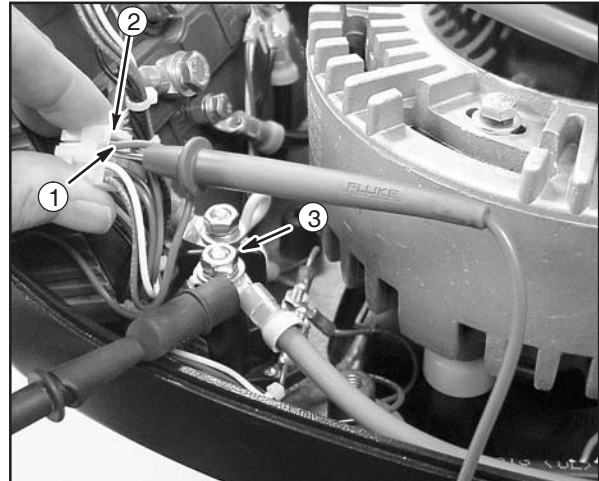


Fig. 37

#### Motor Lacks Power

Make sure battery pack is fully charged and all connections are clean and tight. Be sure battery electrolyte level is not low. Make sure battery harness plug terminals are clean.

Periodically lubricate battery harness plug terminals with a quality dielectric grease.

If the motor lacks power check the easy and obvious things first. For instance, weeds fouled around the propellor or lower unit will effect motor performance and may cause the motor or controller to overheat.

**NOTE:** When the motor controller temperature exceeds 195° F, current to the motor is interrupted. Current is restored when the controller temperature drops below 165 ° F.

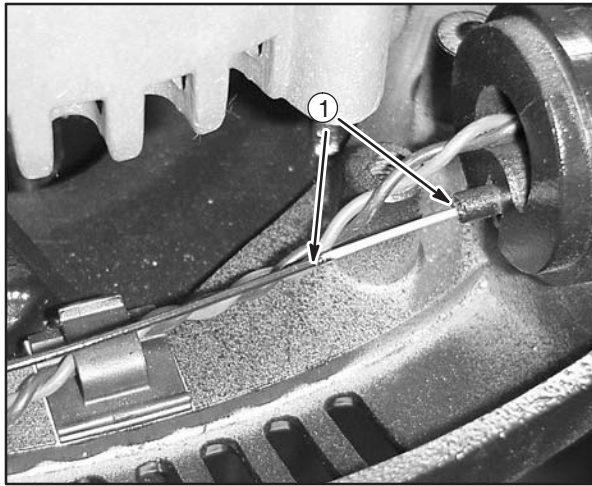
Check the propellor for damaged or bent blades. Check the rubber clutch drive in propellor hub for wear or damage. Also, see Vibration.

#### Check Throttle Control Wire

If motor performance is erratic, such as a variation in speed when the throttle is held in a fixed position, check the throttle control wire for kinks and bends.

Throttle control wire travel should be no less than 1-1/16" (1), Fig. 38.





**Fig. 38**

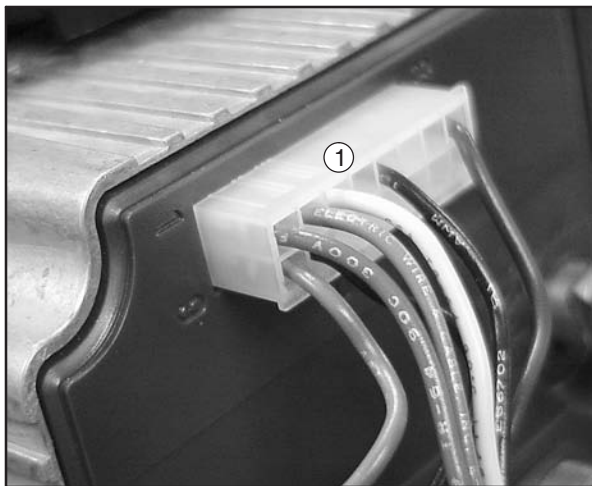
If control wire travel is less than specified, or wire is kinked and cannot be straightened the throttle control wire must be replaced.

A faulty throttle potentiometer can also cause erratic motor performance.

### Check Throttle Potentiometer

Disconnect battery harness from motor. Rotate throttle clockwise to STOP/RESTART position.

1. Disconnect 16 pin harness connector (1) from controller, Fig. 39.



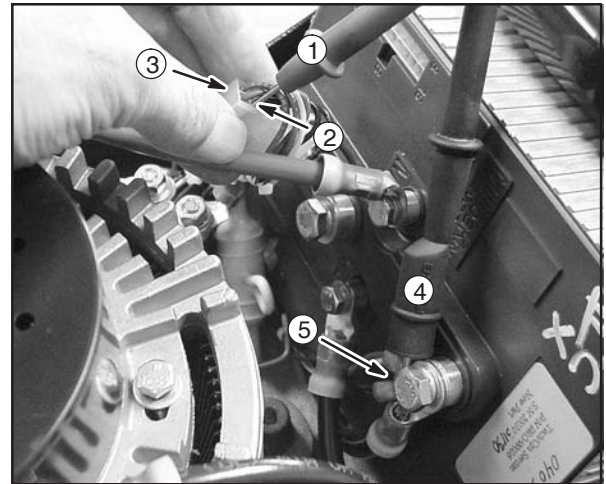
**Fig. 39**

2. Set multimeter to read ohms/resistance.
3. Insert Red meter test lead (1) into to #10 pin (2) in harness connector (black wire).

**NOTE:** #10 pin receptacle is next to #9 pin receptacle; brown wire (3).

4. Attach Black meter test (4) lead to B- terminal (5) on controller, Fig. 40.
5. Resistance reading should be 500 ohms or less.
6. Rotate throttle counter-clockwise to Fast (Max Power) position.
7. Resistance reading should increase to approximately 5000 ( $\pm 30\%$ ) ohms.

Replace throttle potentiometer if not within specifications.



**Fig. 40**

### Check Brushes

Disconnect battery harness from motor.

1. Remove red (1) and black (2) wires at brush box terminals, Fig. 41.
  2. Remove 3 screws (3), cover and brush box assembly.
  3. Check brushes for wear or damage.
    - a. Minimum brush length is 1/4".
- The brush box is replaced as assembly.
4. Check motor commutator for wear or damage.

**NOTE:** If commutator is worn or damaged the motor must be replaced.

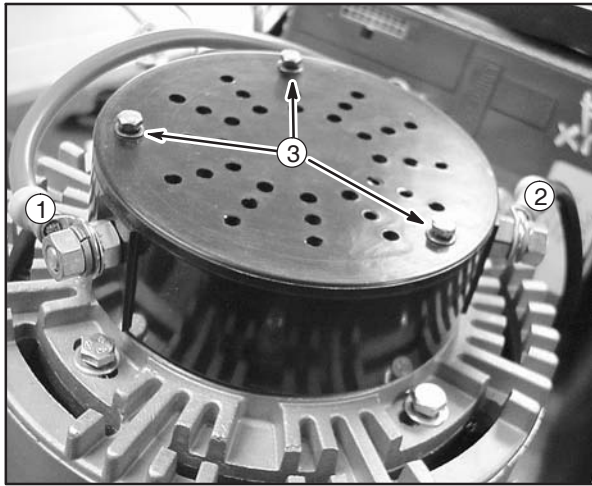


Fig. 41

### Replace Brush Box

1. Assemble brush box to motor, Fig. 42.

**NOTE:** Brush box and cover can only be assembled to motor in one position. Torque screws to 15 in. lbs.

2. Install red (1) and black (2) wires at brush box terminals.
3. Torque nuts to 60 in. lbs. (7Nm).

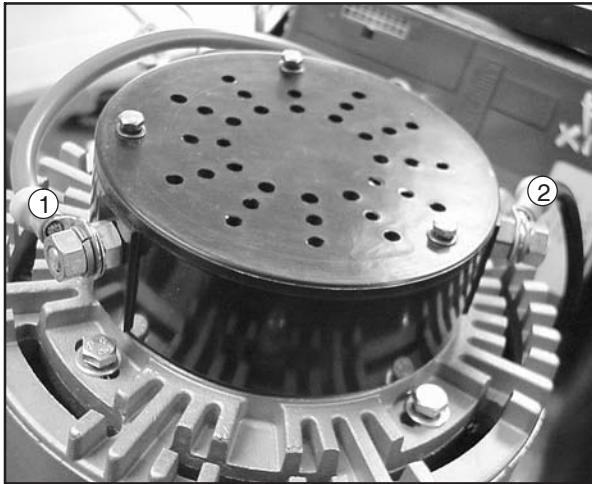


Fig. 42

### Testing Reverse Lock Solenoid

The outboard motor is equipped with a reverse lock that prevents the lower unit from pivoting out of the water when the motor is operating in reverse. The reverse lock is activated when the motor is switched into reverse and the throttle is rotated from the STOP/RESTART position.

1. Disconnect 16 pin connector at motor controller.
2. Connect battery harness to motor.
3. Place motor switch in ON position.
4. Place forward/reverse switch in REVERSE position.

**CAUTION:** Test must be performed with switch in REVERSE position only.

5. Set multimeter to read ohms/resistance.
6. Insert Red meter test lead (1) into to #1 pin (2) in harness connector (red wire), Fig. 43.
7. Insert Black meter test (3) lead into #9 pin (4) in harness connector (brown wire).
8. Resistance reading should be 30 ohms  $\pm$  10%.

Replace reverse lock solenoid if not within specifications.

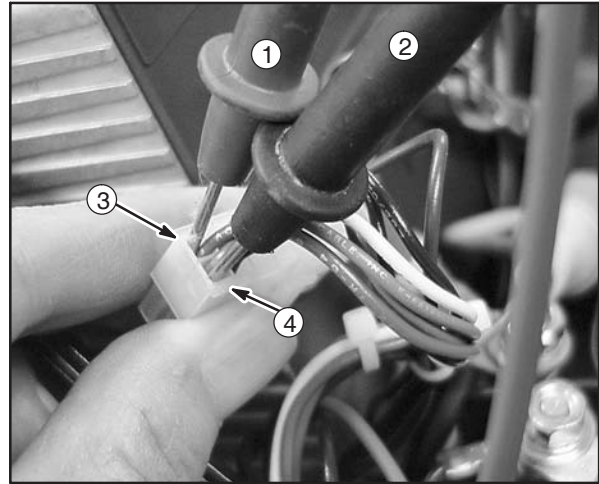


Fig. 43

### Vibration

1. Make sure transom clamp brackets are properly tightened.
2. Check propellor for damaged or bent blades.
3. Check rubber clutch drive in propellor hub for wear or damage.
4. Check for worn swivel brackets or isolator rings.

### Noise

1. No lubricant in lower unit.
2. Worn bearings or gears (lower unit).
3. Worn or damaged commutator (motor).

**MOTOR CONTROLLER FAULT CODE CHART**

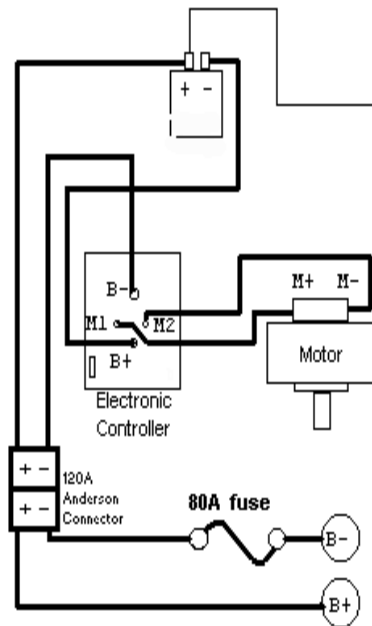
<b>LED Code</b>	<b>Test Condition</b>	<b>Explanation</b>	<b>Corrective Action</b>	<b>Action To Clear Fault Code</b>
OFF	Power is properly connected. Lanyard properly connected. Switch ON.	No output from motor controller	Check battery voltage Check for proper controller grounding	Replace controller
ON (continuous)	Power is properly connected. Lanyard properly connected. Switch ON.	Controller ready for normal operation	None	None
1 Flash	Power properly connected. Lanyard properly connected. Switch ON.	Processor problem in motor controller	Controller requires reprogramming	Replace controller
2 Flash	Power properly connected. Lanyard properly connected. Switch ON.	Automatic return to OFF due to lack of use for 30 seconds.	Rotate throttle clockwise to STOP/RESTART position.	Cycle ON/OFF switch or safety switch
3 Flash	Power properly connected. Lanyard properly connected. Switch ON.	Short circuit in controller or terminals	Check for debris or corrosion at controller terminals	Replace controller
4 Flash	Power properly connected. Lanyard properly connected. Switch ON.	Short, open or welded contacts in contactor terminals	Check for debris or corrosion at contactor terminals Test contactor	Replace contactor
6 Flash	Power properly connected. Lanyard properly connected. Switch ON.	Throttle not in STOP/RESTART position. Faulty potentiometer	Rotate throttle clockwise to STOP/RESTART position. Test potentiometer	Replace potentiometer
7 Flash	Power properly connected. Lanyard properly connected. Switch ON.	Battery voltage below 30 volts.	Charge batteries	Battery voltage returned to 48 volts $\pm 10\%$

## MOTOR CONTROLLER FAULT CODE CHART

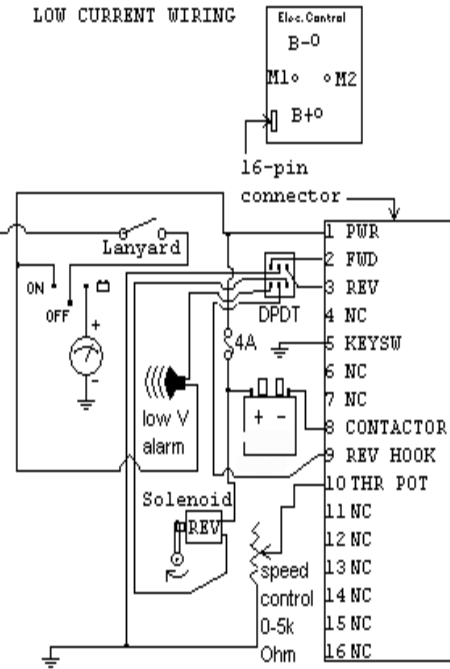
LED Code	Test Condition	Explanation	Corrective Action	Action To Clear Fault Code
7 Flash	Power properly connected. Lanyard properly connected. Switch ON.	Battery voltage above 57 volts.	Check batteries Battery harness plugged into motor during battery charging	Battery voltage returned to 48 volts $\pm 10\%$
8 Flash	Power properly connected. Lanyard properly connected. Switch ON.	Overheated motor controller	Check for cause of overheating. (propellor fouled with weeds or debris)	Condition corrected upon cool down Cycle ON/OFF switch or safety switch
9 Flash	Power properly connected. Lanyard properly connected. Switch ON.	Motor stalled	Check for propellor obstruction or lower unit damage	Cycle ON/OFF switch or safety switch

# Electric Outboard Wiring Diagram

## HIGH CURRENT WIRING



## LOW CURRENT WIRING



NOTE:  $\oplus$  denotes controller B - (neg) rather than actual earth ground

Schematic is split into two circuits for clarity.

Some components are shown twice, as a result.





# Section 3

## DISASSEMBLY

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## COOLING SHROUD

**NOTE:** The cooling shroud must be removed to access the power head, wiring harness and other serviceable components.

### Removal

1. Remove the top cover.
2. Remove the dipstick.
3. Remove safety/engine stop switch clip and the switch (Figure 24) ①.

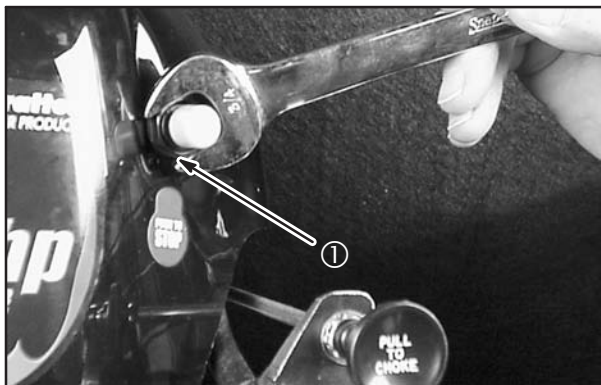


Fig. 44 – Engine Stop Switch

4. Remove cowl.

**NOTE:** Do not lose the nylon spacers from the standoffs.

5. Remove starter handle and insert.

**NOTE:** Pull starter rope out approximately 18" and tie a temporary knot (Figure 25) ④ in the starter rope. Remove handle insert ② from handle ③ and pull the knot ① from the handle insert. Untie knot, remove insert and handle from rope.

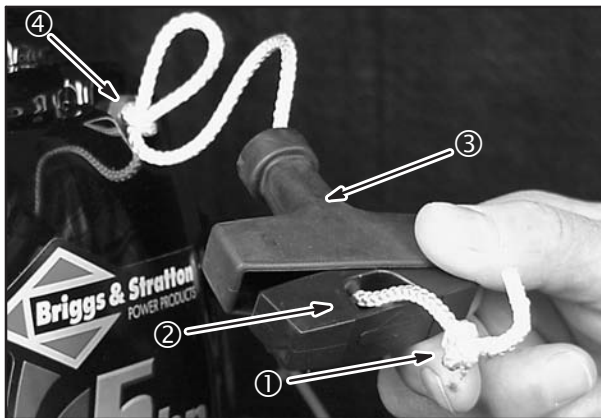


Fig. 45 – Temporary Knot

6. Remove the starter rope from the shroud. Remove the shroud from the engine.

## POWER HEAD

1. Cut wire ties holding the throttle cable to the starboard (right) side of the rear handle.
2. Remove nuts (Figure 26) ①, washers and bolts.

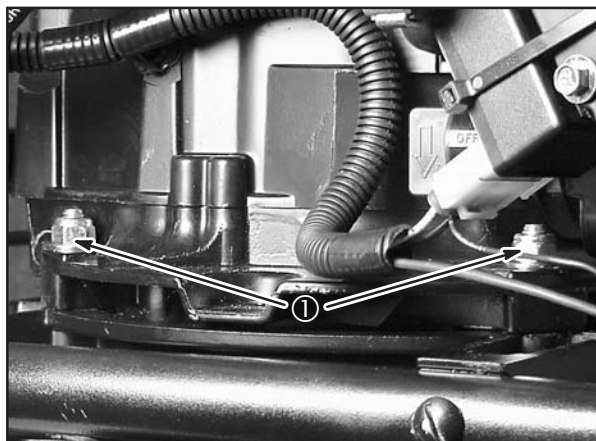


Fig. 46 – Power Head Mount Bolts

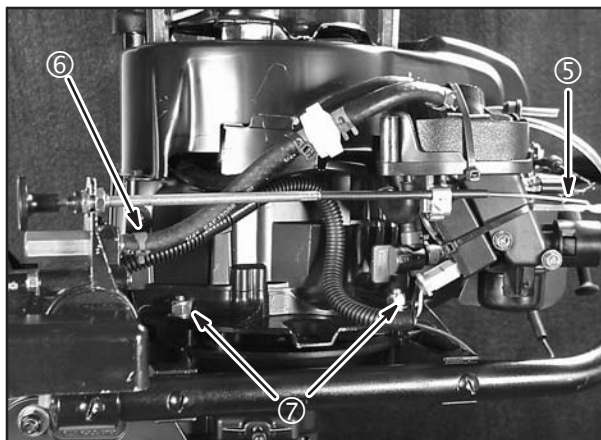
**NOTE:** The bolt on the starboard side of the engine is longer than the bolts on the port (left) side. Do not interchange bolts from side-to-side.

3. Remove the throttle cable clamp (Figure 27) ④.



Fig. 47 – Throttle Cable Clamp

4. Disconnect the throttle cable from the carburetor.
5. Disconnect the choke control rod (Figure 28) ⑤ from the choke lever.

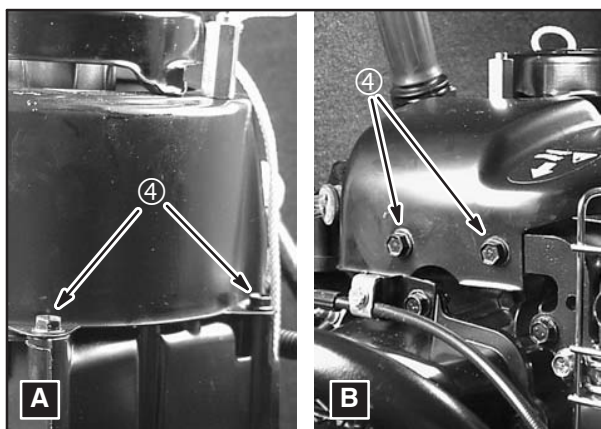


**Fig. 48 – Port Side Components**

6. Disconnect the fuel line ⑥ at the fuel fitting.
7. Remove two nuts ⑦, washers and bolts.
8. Lift the power head from the midsection. Disconnect the neutral switch wires from the wiring harness.
9. Remove the power head.

## BLOWER HOUSING

1. Remove four screws (Figure 29A and B) ④, two from front and two from rear of blower housing as shown.



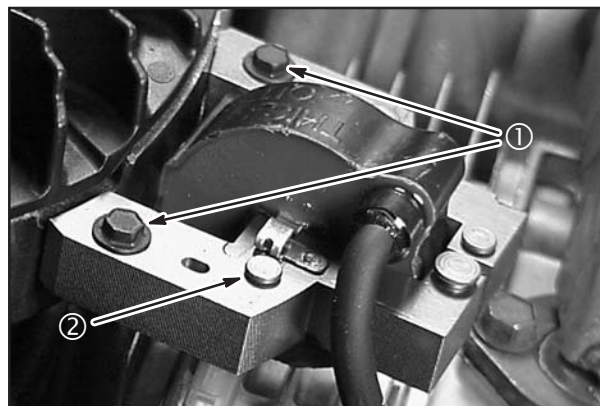
**Fig. 49 – Blower Housing Removal**

## MAGNETRON® IGNITION

**NOTE:** The flywheel does not need to be removed to service Magnetron® ignition except to check the keyway, flywheel key and oil seal. Replace any damaged parts.

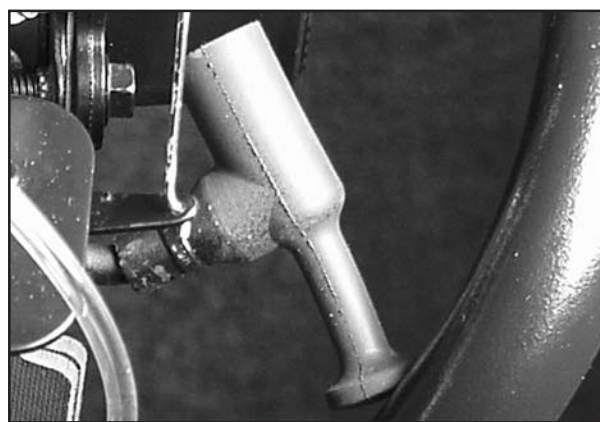
1. Remove blower housing.
2. Remove the spark plug wire from the spark plug.

3. Remove armature mounting screws (Figure 30) ①, disconnect stop wire ②. Lift off armature.



**Fig. 50 – Armature Removal**

**NOTE:** Elbow (Figure 31) does not need to be removed except to be replaced if damaged.



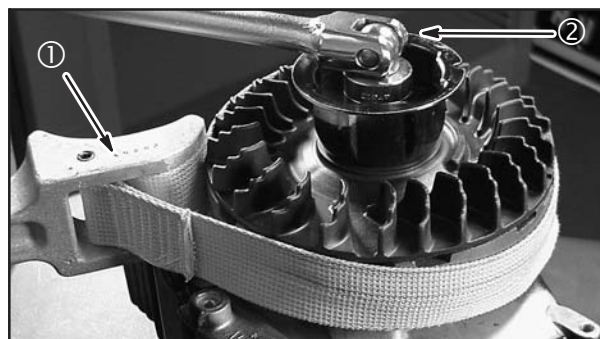
**Fig. 51 – Plug Elbow**

## FLYWHEEL

Remove the blower housing and rewind assembly to access the flywheel.

**CAUTION:** Do not strike flywheel to remove.

1. Use the correct flywheel holder (Figure 32) ① to prevent the flywheel from turning.



**Fig. 52 – Holding The Flywheel**



2. Use socket and breaker bar ② to remove flywheel nut.
3. To remove flywheel, use Tool (#19203), Flywheel Puller (Figure 33).

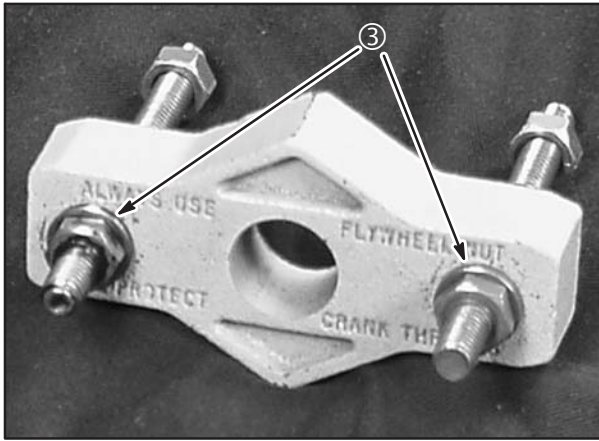


Fig. 53 – Flywheel Puller (#19203)

**NOTE:** Positioning retainer nuts (Figure 33) ③ on the puller screws is necessary to prevent damage to the flywheel.

4. Thread flywheel nut onto crankshaft until top of nut is flush with end of crankshaft threads.
5. Install the flywheel puller to the flywheel.
6. Turn puller screws into flywheel puller holes until screws bottom or puller contacts flywheel nut (Figure 34) ④.

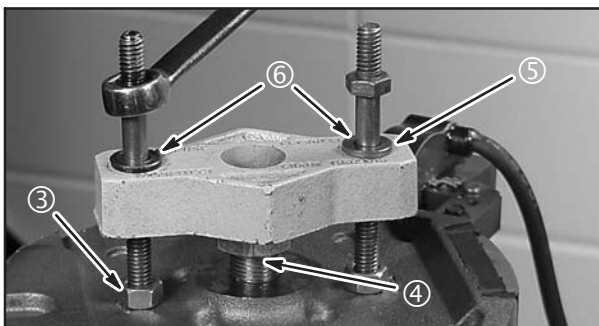


Fig. 54 – Remove Flywheel

7. Tighten puller nuts ⑤ or screws ⑥ equally until flywheel loosens.

**NOTE:** If the screws ⑥ on Flywheel Puller Tool are too short, use two cylinder head bolts (#94622), or two cylinder head studs (#94776), and two flat washers (#225137) in place of original screws.

## INSPECT FLYWHEEL KEY, KEYWAY, FLYWHEEL AND CRANKSHAFT

Replace the flywheel key (Figure 35) ① if inspection reveals any shearing ②. Flywheel should be inspected for cracks, burrs on taper or keyway, and distortion of keyway. Check taper of crankshaft for burrs, rust, or other damage. Check fan or flywheel for broken fins. Replace any damaged components with new parts.

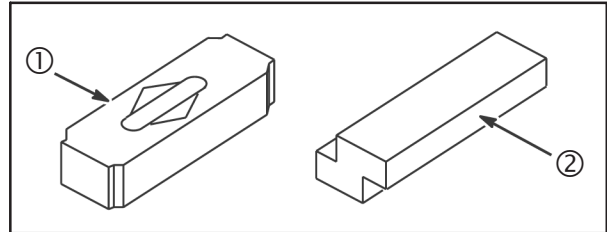


Fig. 55 – Flywheel Key

## CARBURETOR

1. Turn the fuel shutoff valve to the OFF position and drain the carburetor.

**NOTE:** Do not use a bolt or screw in the fuel hose to stop fuel leakage. Screw threads will loosen rubber particles which will get into the fuel system.

2. Disconnect choke (Figure 36) ② and throttle ③ linkages.

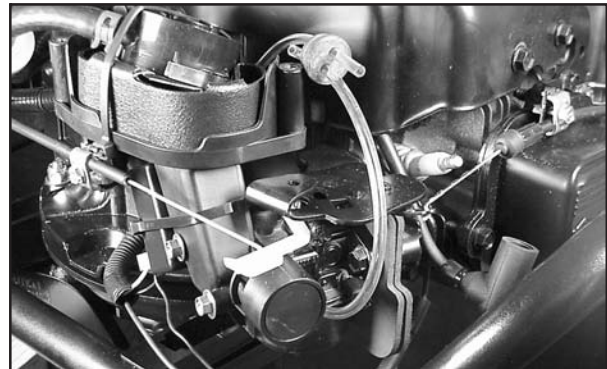
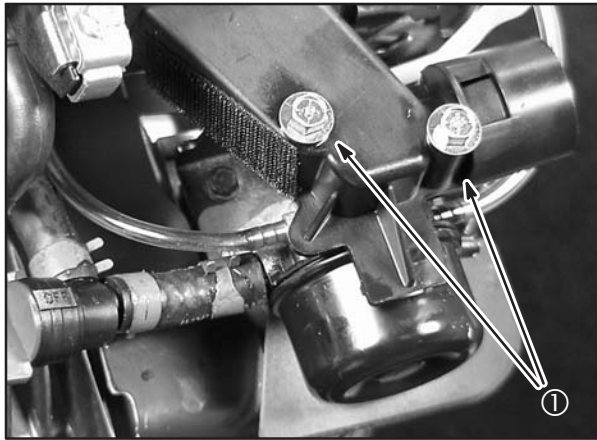


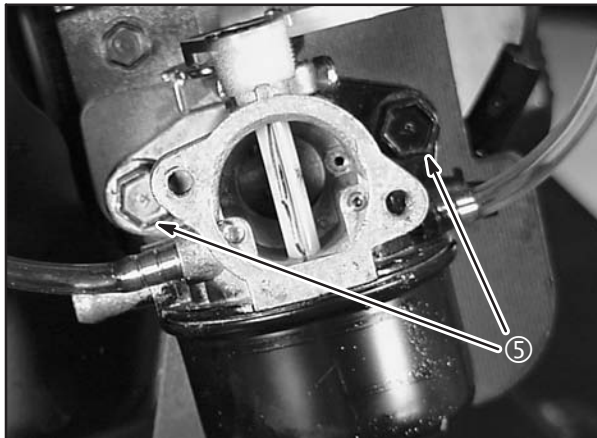
Fig. 56 – Remove Carburetor Components

3. Remove fuel pump retaining strap ①.
4. Remove speed limiter retaining strap.
5. Remove screws, (Figure 37) ①. Set aside air horn and gasket. Disconnect breather tube.
6. Disconnect fuel line at carburetor.



**Fig. 57 – Air Horn Removal**

7. Remove screws (Figure 38) ⑤, carburetor and control bracket.

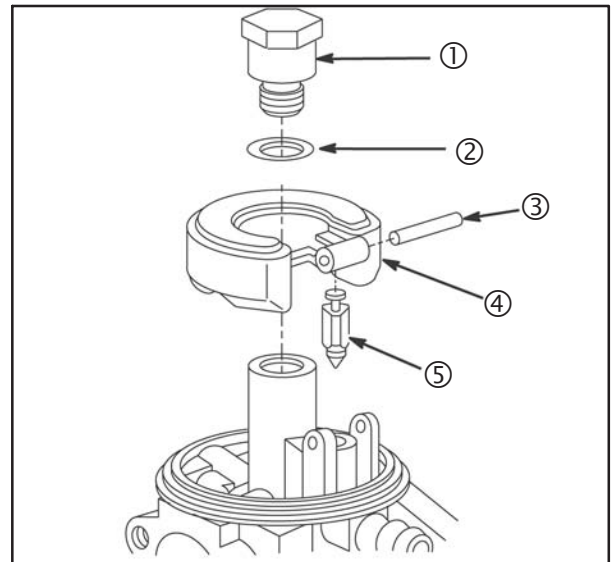


**Fig. 58 – Carburetor Mounting Screws**

8. Disconnect throttle link from carburetor.

### Disassemble Carburetor

1. Remove bowl screw/fixed main jet (Figure 39) ① with fiber washer ②.



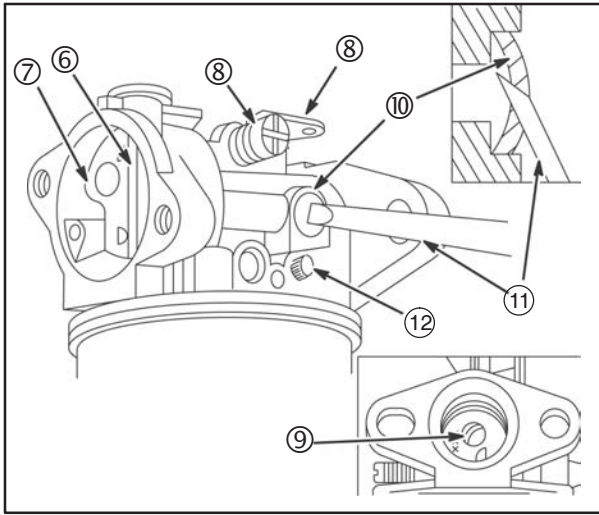
**Fig. 59 – Carburetor Float Components**

2. Remove float bowl and bowl gasket from carburetor.
3. Remove float hinge pin ③, float ④ and inlet needle ⑤.

**NOTE:** Inlet seat is not replaceable.

4. Remove idle speed screw with spring (Figure 40) ⑧, when used.
5. Remove the limiter cap from the mixture screw. Remove mixture screw and spring ⑫.
6. Rotate throttle shaft to closed position. Remove throttle plate screw ⑨.
7. Remove throttle plate and throttle shaft with foam seal.
8. Grasp choke plate ⑥ and remove from choke shaft ⑦.
9. Remove choke shaft and foam washer.
10. With a modified 5/32" pin punch ⑪, remove welch plug ⑩ from carburetor body.





**Fig. 60 – Remove Welch Plug**

## Carburetor Cleaning

1. Disassemble carburetor.
2. Remove all old gaskets, seals and sealing material.
3. Use commercial carburetor cleaning solvents such as Briggs & Stratton Spray Cleaner (#100041 or #100042), to clean carburetor parts and body.
4. Do not leave non-metallic parts (plastic, nylon, minlon, etc.) in commercial carburetor cleaner bath more than 15 minutes.

**NOTE:** Parts containing rubber, such as seals, O-rings or pump diaphragms should never be placed in commercial carburetor cleaner bath.

5. Use only compressed air (blowing in both directions) to clean out all openings and passages.
6. Do not use wires, drills or any other devices to clean out metering holes or passages.

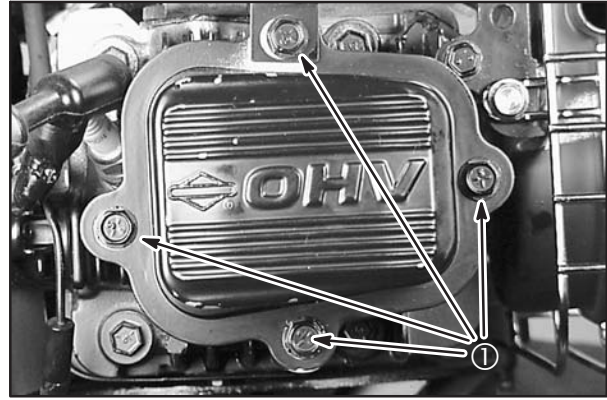
## CYLINDER HEAD

### Prepare Cylinder Head for Removal

Before cylinder head can be removed, muffler guard and muffler must be removed.

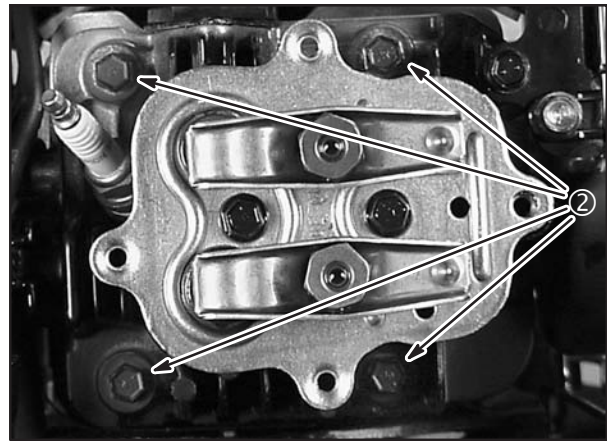
### Remove Valve Cover

1. Remove four screws (Figure 41) ① from valve cover.



**Fig. 61 – Valve Cover**

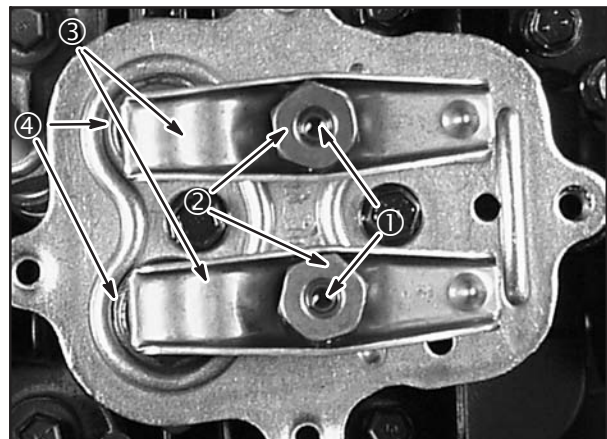
2. Remove valve cover and gasket.
3. Remove four cylinder head bolts (Figure 42) ②.
4. Remove the cylinder head.



**Fig. 62 – Cylinder Head Bolts**

### Disassemble Cylinder Head

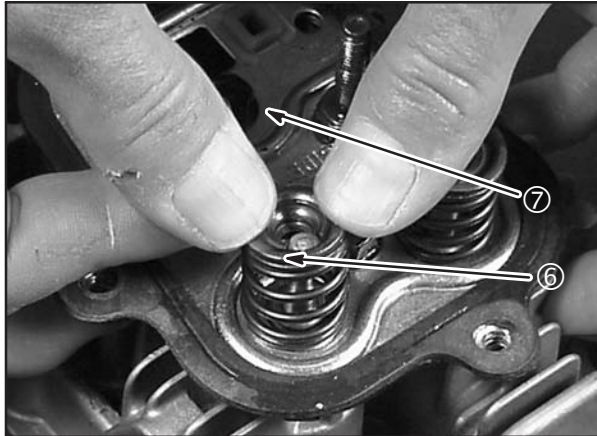
1. Loosen rocker arm adjusting nut set screws (Figure 43) ①. Remove rocker arm adjusting nuts ② and rocker arms ③.



**Fig. 63 – Rocker Assembly**

2. Pull the push rods from the push rod guides. Label the push rods for correct assembly.

3. Remove cylinder head plate with rocker arm studs.
4. Remove valve caps ④.
5. Place cylinder head on work surface.
6. Press down on spring retainer (Figure 44) ⑥ with thumbs to compress valve spring. Compress spring until large end of slot in retainer can be lined up with end of valve stem.



**Fig. 64 – Valve Spring Retainers**

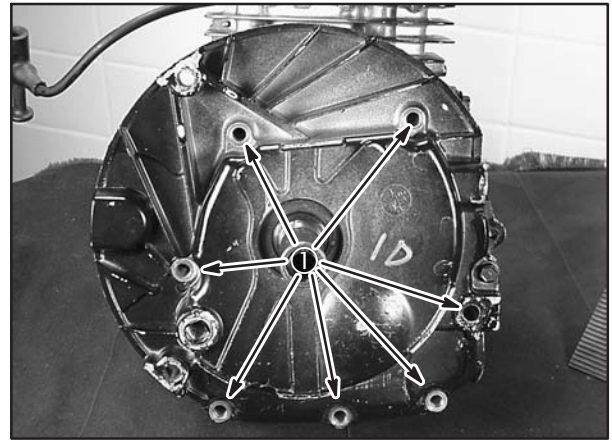
7. Slowly relieve tension on spring and retainer.
8. Remove retainer, spring, valve and valve stem seal (intake only). Discard valve stem seal.
9. Repeat for exhaust valve.

**NOTE:** If push rod guides (Figure 44) ⑦ are worn, replace before installing cylinder head plate.

## CRANKSHAFT & CAMSHAFT

Before removing the crankshaft from the engine, remove rust, paint, or burrs from the PTO end of crankshaft. This will reduce the chance of damaging the oil seal, sump or sump bearing.

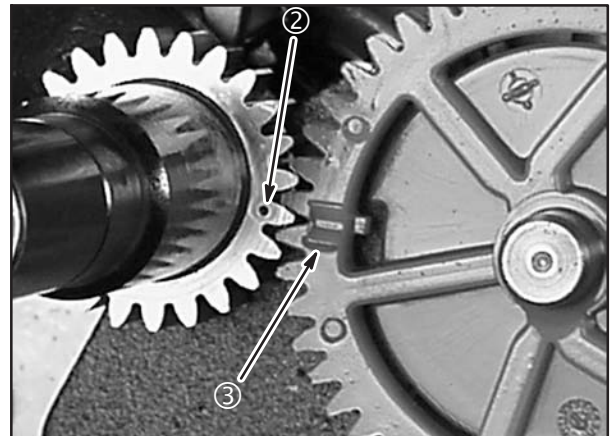
1. Drain oil from crankcase.
2. Remove seven screws (Figure 45) ①, to remove crankcase sump. If the sump sticks, tap lightly with a soft hammer on alternate sides near dowel pins.



**Fig. 65 – Remove Sump Cover**

**NOTE:** It is not necessary to remove dowel pins.

3. Tip engine over onto flywheel side of crankcase.
4. Support engine to prevent end of crankshaft from resting on workbench.
5. Rotate crankshaft until timing mark on crankshaft (Figure 46) ② aligns with timing mark on camshaft ③.



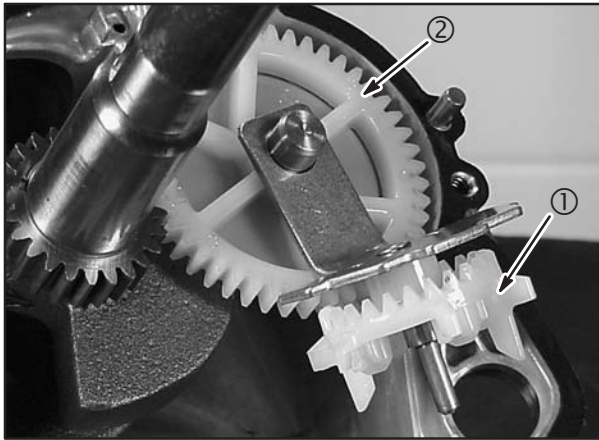
**Fig. 66 – Engine Timing Marks**

6. With camshaft in this position, the valve tappets will remain clear of cam lobes. Lift out camshaft.
7. Remove tappets.

## OIL SLINGER LUBRICATION

The oil slinger (Figure 47) ① is driven by the cam-gear ②. The oil slinger lubricates the valve tappets, connecting rod, cylinder, piston and rings.



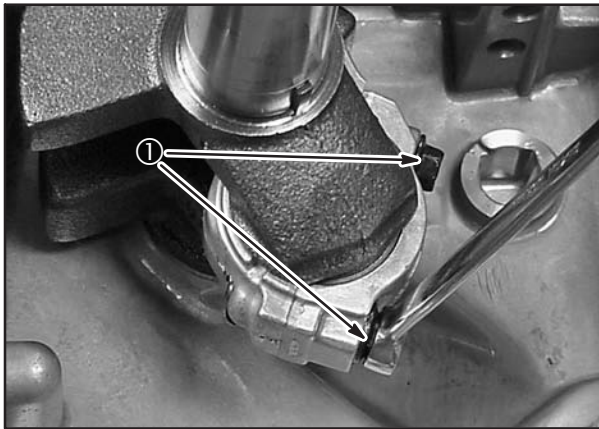


**Fig. 67 – Oil Slinger Assembly**

1. Remove the sump to access the oil slinger.
2. Inspect the slinger gear teeth for wear, broken teeth, broken slinger paddles, or burrs on teeth. Replace if worn or damaged.

## PISTON AND CONNECTING ROD

1. Remove any carbon or ridge at top of cylinder bore to prevent ring breakage.
2. Remove connecting rod cap bolts (Figure 48) ① and cap.

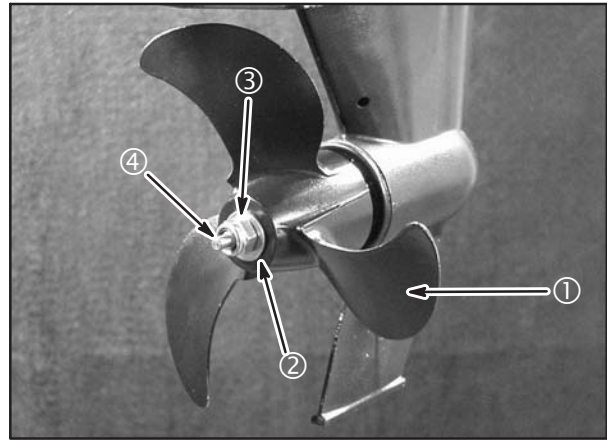


**Fig. 68 – Connecting Rod Cap Bolts**

3. Push piston and rod out through top of cylinder.
4. Remove crankshaft.

## GEAR CASE DISASSEMBLY

1. Drain the gear case.
2. Remove the stainless steel lock nut (Figure 49) ③, stainless steel washer ② and propeller ① from the propeller shaft ④.



**Fig. 69 – Propeller Assembly**

3. Use Briggs & Stratton Socket (#19557), to loosen the propeller shaft carrier (Figure 50).



**Fig. 70 – Removing Propeller Shaft Carrier**

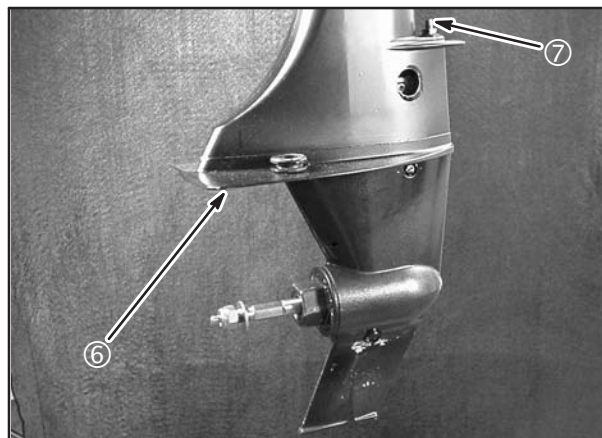
**NOTE:** Always loosen the shaft carrier with the gear case attached to the midsection. The shaft carrier is LEFT-HAND THREAD.

4. Remove the drive shaft housing plug. Loosen (do not remove) the shift rod clamp set screw (Figure 51) ⑥.



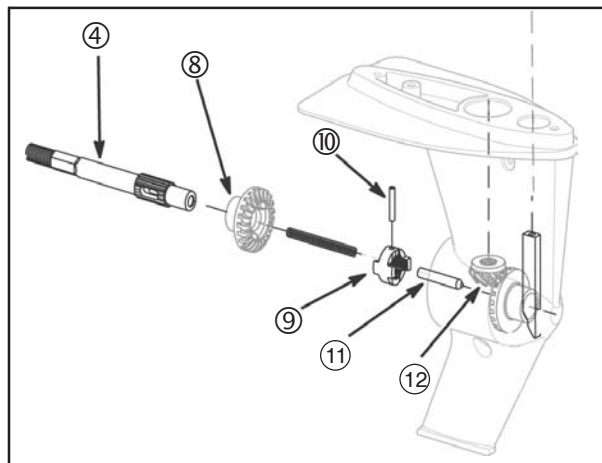
**Fig. 71 – Drive Shaft Housing Plug**

5. Remove the nut (Figure 52) ⑦ and screw ⑥. Remove the gear case from the midsection.



**Fig. 72 – Remove Gear Case**

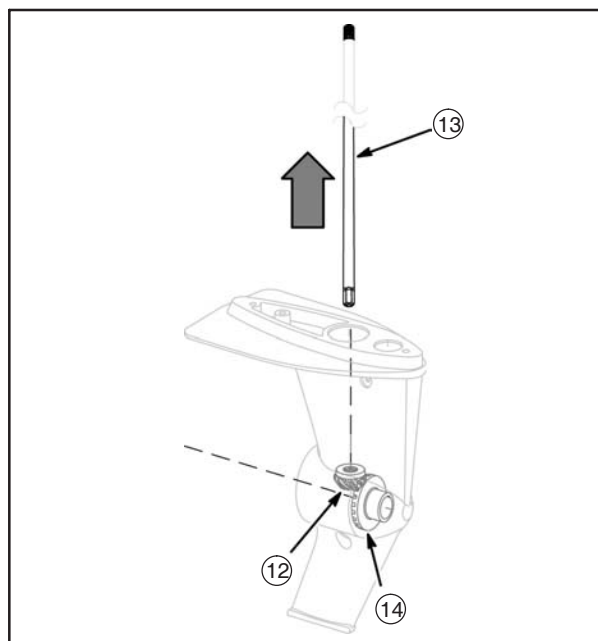
6. Remove the propeller shaft assembly (Figure 53) ④ from the gear case.



**Fig. 73 – Gear Case Components**

**NOTE:** Reverse gear ⑧, sliding clutch ⑨, rollpin ⑩ and spring ⑪ are removed as part of the prop shaft assembly.

7. Pull the drive shaft (Figure 54) ⑬ out (arrow) from the pinion gear ⑫. Remove the pinion gear and the forward gear/bearing assembly ⑭ from the gear case.

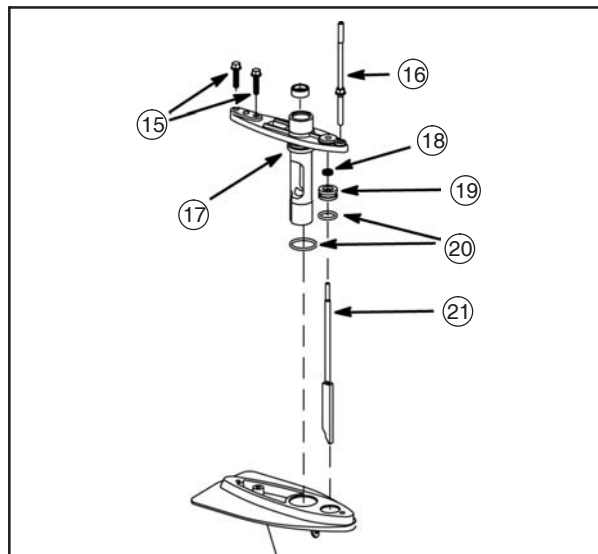


**Fig. 74 – Drive Shaft Components**

Inspect all gears for wear or damage. Inspect the seal for the shift shaft. If any gear is worn or damaged replace all gears as a set. Inspect the bearing on the forward gear. If the bearing shows wear or damage inspect the bearing race inside the gear case. If the bearing race is worn or damaged replace the gear case. If the bearing is damaged replace the gear set.

Replace the drive shaft if it is bent, damaged or worn.

8. Remove two stainless steel screws (Figure 55) ⑮ and stud ⑯ from the input shaft carrier ⑰. Remove the input shaft carrier assembly from the gear case.



**Fig. 75 – Shifting Components**

Inspect shaft bushings inside the gear case. Inspect the seal ⑮ and the support ⑯ for the gear selector

shaft ②①. Inspect the seal for the drive shaft. Inspect all lower unit parts for visual evidence of wear or damage. Replace O-rings ②①. Replace any worn or damaged parts.

## SLIDING CLUTCH

1. Install the propeller shaft to Briggs & Stratton Tool (#19555), Insert the tool knob (Figure 56) ② through the tool body and into the shaft to secure the shaft to the tool.
2. Insert the pin ① through the tool into the knob to secure the knob to the tool.
3. With the shaft properly installed to the tool, remove and discard the roll pin (Figure 56) ③ from the sliding clutch. Disassemble the tool and the propeller shaft/sliding clutch assembly.

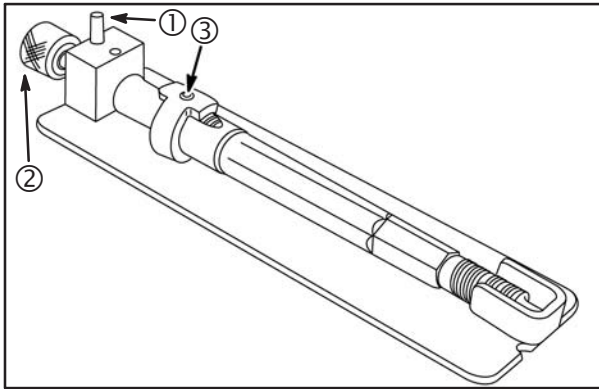


Fig. 76 – Tool (#19555)

	<p><b>WARNING</b></p> <p>The spring is under pressure. Use caution when removing or installing the tool handle and the spring. Always wear eye protection.</p>
--	--

Replace the shaft if it is bent or if the clutch splines are worn. Replace the roll pin. Inspect the sliding clutch and spring. Replace worn or damaged components.

**CAUTION:** Replace the roll pin whenever it has been removed from the propeller shaft. Damage to gear case components could result from a missing or mis-installed roll pin.

4. Install the shaft, spring and sliding clutch to the tool. Assemble the shaft in reverse order.

## MIDSECTION

### Disassembly

1. Remove the nut from the opposite side of the transom bracket bolt (Figure 57) ①. Remove the transom brackets.

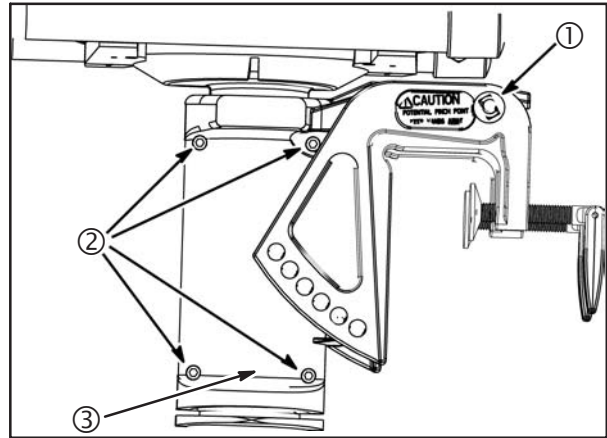


Fig. 77 – Remove Transom Brackets

2. Remove four socket head screws ②.
3. Separate and remove the tilt brackets (Figure 58) ③ from the midsection.

**NOTE:** The port side tilt bracket has the friction brake shoe for the steering. Do not lose the brake shoe. The reverse hook ⑤ may come off with either tilt bracket.

4. Inspect the steering brake shoe and the reverse hook actuator (Figure 58) ④. Replace if worn or damaged.

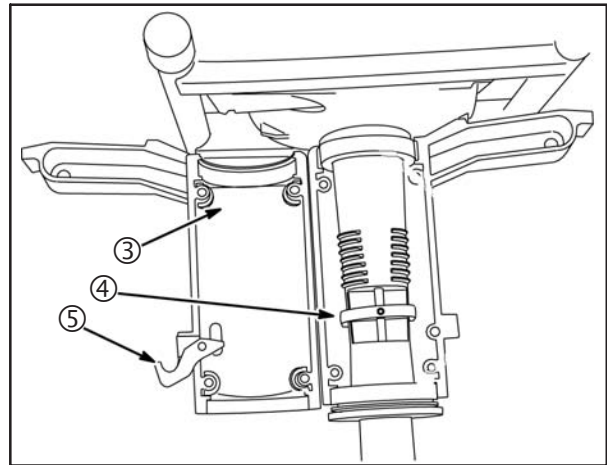
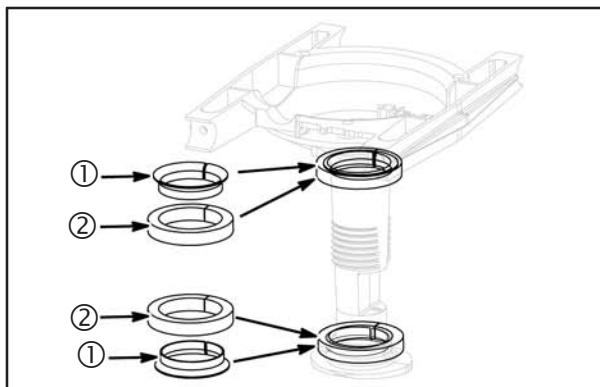


Fig. 78 – Remove Tilt Bracket

5. Remove and inspect the sleeves and rubber bushings (Figure 59) ① & ②. Replace if worn or damaged.





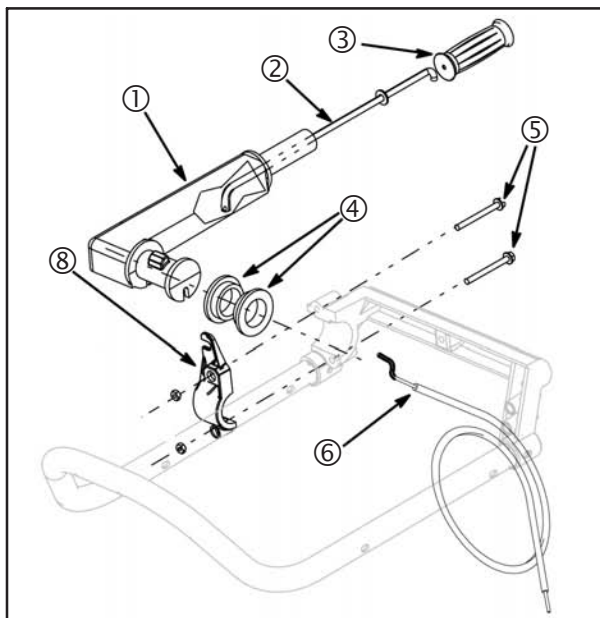
**Fig. 79 – Inspect Steering Bushings**

**NOTE:** Be aware of the “stack-up” of bushing and sleeves.

## THROTTLE CABLE

### Replacement

1. Pull the rubber grip (Figure 60) ③ from the tiller handle ①.
2. Remove the cap screws ⑤ from the retainer ⑧. Remove the tiller assembly from the front handle.



**Fig. 80 – Throttle Cable Assembly**

3. Remove the isolators ④ from the tiller handle.
4. Remove the throttle cable ⑥ from the rod ② in the tiller handle. Pull the cable from the handle and out of the isolators.

**NOTE:** Grease the throttle rod support bracket inside the tiller handle whenever the tiller assembly is serviced.

5. Installation is the reverse of removal. Torque cap screws to 45 in. lbs. (5 Nm).

## REWIND STARTER

**NOTE:** Rewind starters used on these model series engines are riveted to the blower housing. Replacement starters are supplied with screws and nuts to replace the rivets, when mounting new assemblies.

### Remove Rope



1. Pull starter rope out as far as it will go.
2. While holding pulley and starter housing, pull pulley end of rope out and untie knot at end of rope.
3. Remove rope and handle from starter.
4. Slowly release pulley to release spring tension.

### Inspect Rope

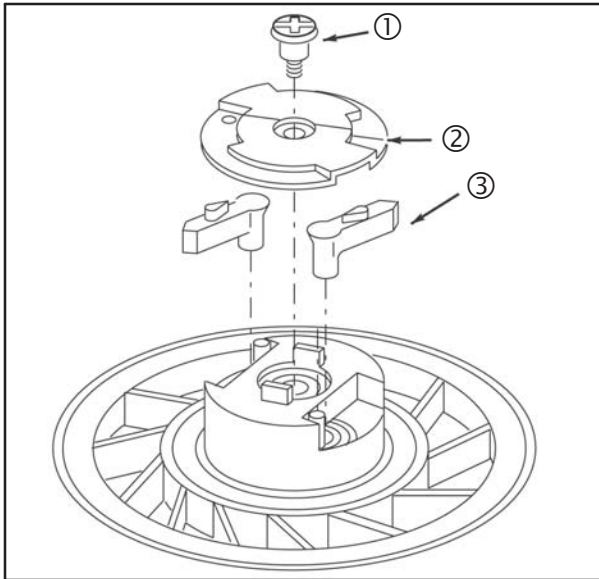
1. Inspect rope. Replace if frayed or broken strands are found.
2. If re-using old rope, burn each end of rope with an open flame and wipe rope ends with waste cloth while still hot, to prevent swelling and un-raveling.

**NOTE:** When installing a new rope, check parts list to be sure correct diameter and length is used. The service replacement rope is cut to length as required.

### Remove Pulley and Spring

 	<p><b>WARNING</b></p> <p>Wear eye protection when installing or removing starter pulley and spring. The starter spring is still under tension when the rope has been removed and the pulley has been unwound.</p>
---	---

1. Remove shoulder screw (Figure 61) ① and retainer ②.



**Fig. 81 – Rewind Starter Pulley**

2. Lift out pawls (Figure 61) ③.
3. Rotate pulley until pulley feels free.
4. Carefully lift out pulley with spring (Figure 62).

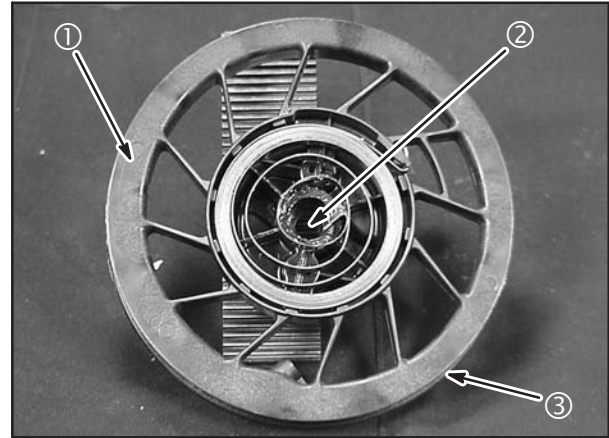


**Fig. 82 – Pulley With Spring**

### Inspect Spring, Starter Housing and Pulley

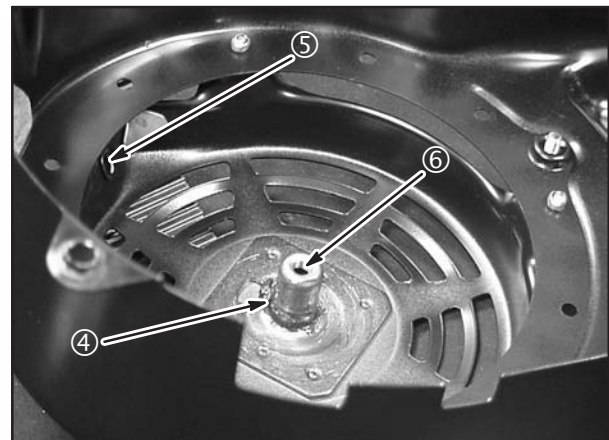
1. Inspect pulley for wear, cracks, rough edges (Figure 63) ① or burrs in pulley groove ② and wear on center hole ③.

2. Replace pulley if damaged or worn.



**Fig. 83 – Starter Pulley Spring**

3. Inspect spring for broken ends, kinks and burrs. Replace assembly if any of the above conditions exist.
4. Inspect starter housing for wear or sharp edges at rope eyelet (Figure 64) ⑤, center pivot post ⑥, and inner spring anchor tab ④.



**Fig. 84 – Starter Housing**

5. Replace assembly if worn or damaged.

**CAUTION:** Pulley and spring is serviced as an assembly. Do not remove spring from pulley.

# Section 4

## OVERHAUL

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## MAGNETRON® IGNITION

### Remove Armature

The best means of testing Magnetron® armatures is on the engine. Before replacing the armature, be sure that the problem is not in the wiring, the safety/engine stop switch, the neutral switch or speed limiter.

### INSPECT VALVE SPRINGS

Replace broken, distorted or worn valve springs.

### INSPECT VALVE GUIDES

1. Check valve guides for wear using Reject Gauge Tool (#19122).
2. If flat end of gauge can enter guide for 1/4" (6.35mm) or more, valve guide is worn. Replace the cylinder head.
3. If plug gauge is not available, replace the cylinder head if the valve guide exceeds .267" (6.78mm).

### FINISH REAM VALVE GUIDES

**NOTE:** The following procedure is recommended to assure that the entire guide is clean and free of foreign material.

1. Use Finish Reamer Tool (#19096) and Reamer Pilot Guide Tool (#19191) to remove foreign material or burrs from guide.
2. Use Stanisol® or kerosene to lubricate reamer.
3. Ream through entire guide.
4. Keep turning reamer clockwise when removing reamer.
5. Flush out all reaming chips.

### REFACE VALVES AND SEATS

Valve faces can be resurfaced using a commercially available valve grinding tool. Briggs & Stratton does not recommend this practice as a high quality repair procedure. Valve replacement is recommended for damaged or worn valves.

Valve seats (Figure 65B) ② are cut to 45° using Tool (#19237) or (#19343), "Neway® Valve Seat Cutter Kit". Valve and seat are lapped in using Valve Lapping Tool (#19258) and Valve Lapping Compound (#94150) to assure a good seal between the valve face and the seat.

1. Thoroughly clean lapping compound from valve seat and valve face.
2. Valve seat width should be as shown (Figure 65B).
3. If seat is wider, a narrowing cutter should be used. If valve face is badly burned, the burned valve should be replaced.
4. Replace valve if margin (Figure 65A) ① is less than 1/32" or is damaged.

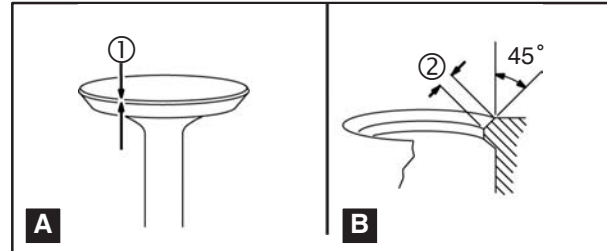


Fig. 85 – Valve & Seat Specifications

5. Valve seat width ② should be 3/64 – 1/16". If the seat width is not within specification, or if the seats are burned or damaged, replace cylinder head.

### REMOVE PISTON RINGS

Remove piston rings using Piston Ring Expander (#19340) as shown (Figure 66).

**NOTE:** Some oil control rings consist of two thin steel rails and a spring expander. The steel rails cannot be removed with the piston ring expander.

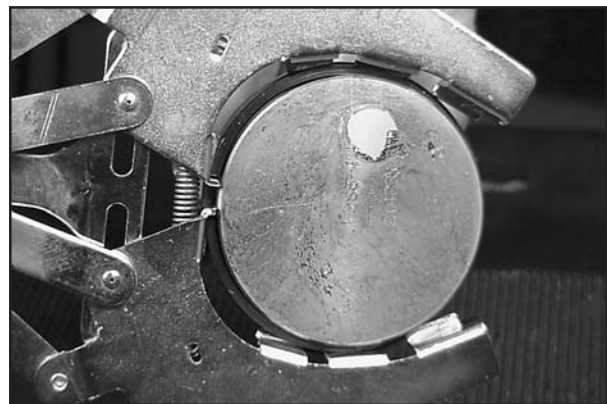


Fig. 86 – Ring Expander

1. Grasp one end of the steel rail and wind the rail from the oil ring groove into the next ring groove.
2. Repeat into the top ring groove and then off the piston.



## CHECK PISTON RING GROOVE WEAR

1. Clean carbon from top ring groove.
2. Place a new ring (Figure 67) ② in groove and measure space between ring and ring land. If the measurement is .007" (.18mm) or greater, reject the piston.

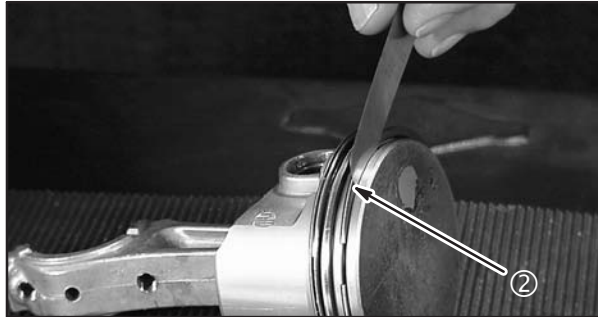


Fig. 87 – Measuring Ring Groove Wear

## CHECK PISTON RING END GAP

1. Clean all carbon from the end of the rings, and from the cylinder bore.
2. Insert old rings (Figure 68) ③ one at a time one inch down into the cylinder.

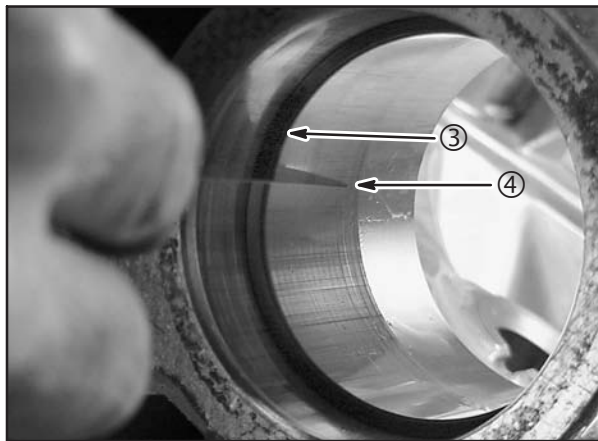


Fig. 88 – Ring End Gap

3. Check end gap with feeler gauge ④.
4. Replace the piston ring if the ring end gap is greater than:

<b>Top Compression Ring</b>	.020 in. (.51mm)
<b>Center Compression Ring</b>	.030 in. (.76mm)
<b>Oil Control Ring</b>	.035 in. (.89mm)

## CHECK CONNECTING ROD

If the crankpin bearing is scored, the rod must be replaced. Reject size of the crankpin bearing (Figure 69) ① is 1.102 in. (27.99mm) or greater. Reject size

of the piston pin bearing ② is .627 in. (15.93mm) or greater.



Fig. 89 – Connecting Rod Bearings

## UNDERSIZED CONNECTING RODS

Undersized connecting rods .020" (.51mm) are available if crankpin is scored or worn below reject. Check illustrated parts list for part number availability.

1. Grind crankpin (Figure 70) to the following dimensions:

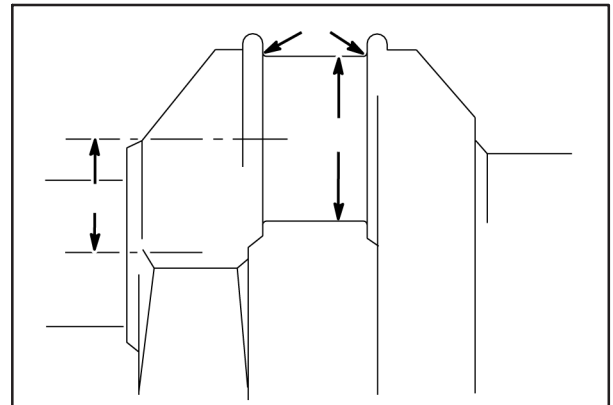


Fig. 90 – Crankpin Dimensions

Crankpin diameter	(A)	1.078 – 1.079 in. (27.39 – 27.41mm)
Fillet Radius	(R)	.069 – .079 in. (1.75 – 2.01mm)
Crankshaft Throw	(T)	1.020 in. (25.91mm)

## CHECK PISTON PIN AND PISTON PIN BORE

If piston pin is worn .001" (.03mm) out of round, or if it is under .624 in. (15.85mm), it should be replaced. Oversize piston pins are available for some models. Check the illustrated parts list for part number availability.



Replace the piston if the piston pin bore (Figure 71) ③ is .627 in. (15.93mm) or greater.

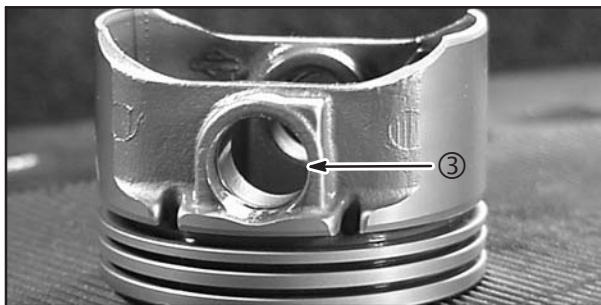


Fig. 91 – Piston Pin Bore

## 4

### INSPECT CRANKSHAFT

**CAUTION:** Always replace a bent crankshaft.

- Figure 72 shows wear points to be checked on crankshaft. Discard crankshaft if worn smaller than the following minimum diameter specifications. Mag journal (Figure 72) ① .873 in. (22.17mm) PTO journal ⑤ 1.060 in. (26.92mm).

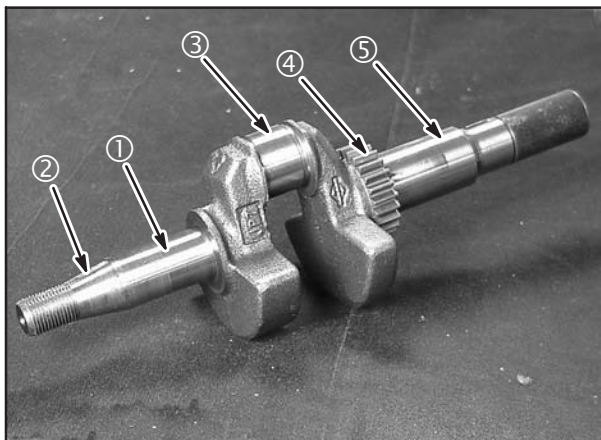


Fig. 92 – Crankshaft Wear Points

- Resize the crankpin journal if worn smaller than the following minimum diameter. Crankpin journal ③ 1.097 in. (27.86mm).
- Inspect keyway ②. Replace the crankshaft if the keyways show wear or spreading. Remove burrs from keyway edges to prevent bearing damage.
- Check timing gear ④ for chipped or cracked teeth. Check the gear keyway for wear. Replace gear if damaged.

### INSPECT CAMSHAFT

- Inspect gear teeth (Figure 73) ①. Replace the camshaft if the teeth are worn or nicked.

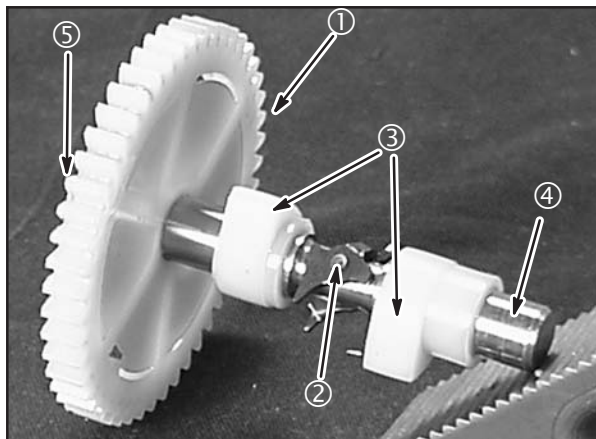


Fig. 93 – Camshaft

- Measure PTO journal ⑤, and mag journal ④. Replace the camshaft if either journal is worn smaller than the reject dimensions below.

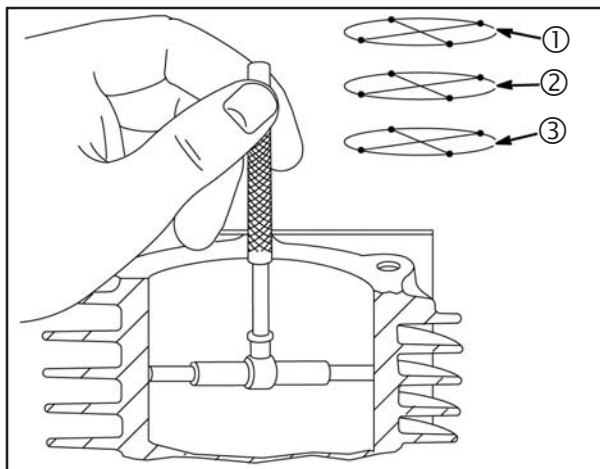
**Mag Journal ④** .498 in. (12.65mm)

**PTO Journal ⑤** .498 in. (12.65mm)

- Inspect the camshaft lobes ③. Replace the camshaft if the lobes are worn or galled.
- Replace camshaft if compression release ② binds, pivot pin is worn, or return spring is broken.

### CHECK CYLINDER

Inspect cylinder whenever engine has been disassembled. Inspect for cracks, stripped boltholes, broken fins or cylinder wall damage. Use a Telescoping Gauge (#19485) with a Dial Caliper (#19199) to determine size of cylinder bore. Measure the cylinder bore at right angles, at the top (Figure 74) ①, middle ② and bottom ③ areas of the piston ring travel. Standard cylinder bore is 2.688" (68.28mm). If the cylinder bore is more than .003" (.08mm) oversize, or .0015" (.04mm) out of round, it must be resized.



**Fig. 94 – Cylinder Measurements**

**NOTE:** New piston rings may be installed if the cylinder bore is within specification and shows no sign of scoring or other damage. When installing new piston rings the cylinder bore should be reconditioned using a rigid hone with finishing stones to restore the proper cross hatch angle in the cylinder bore.

## CYLINDER RESIZING

Always resize bore to exactly .010", .020", or .030" (.25mm, .50mm or .76mm) over standard size. If this is done accurately, the stock oversize rings and pistons will fit correctly, maintaining proper clearances. Cylinders can be quickly resized with a good quality hone set such as Briggs & Stratton Tool (#19205). Contact your Briggs & Stratton source of supply. Use stones and lubrication recommended by hone manufacturers to produce correct cylinder wall finish. Honing can be done with a portable variable speed 1/2" electric drill.

## Set Up For Honing

Check cylinder bores at top and bottom for burrs. Remove burrs to prevent damage to hone. Fasten cylinder to a honing fixture such as a 2" X 6" (51mm X 152mm) piece of wood approximately 16" (406mm) long. Clamp the cylinder and honing fixture in a vise at a convenient working height.

## Hone Cylinder

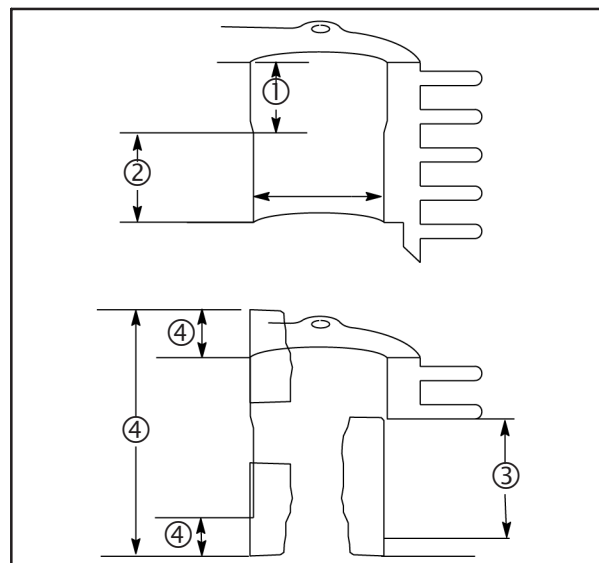
1. Place hone in middle of cylinder bore. Tighten adjusting knob with finger or small screwdriver until stones fit snugly against cylinder wall. Do not force.
2. Install drive shaft to drill chuck. Connect drive shaft to hone. Be sure that cylinder and hone are

centered and aligned with drive shaft and drill spindle.

3. Lubricate honing stones and cylinder bore with honing oil or automatic transmission fluid.

Recommended drill speed is 300-700 RPM maximum and 40-60 strokes per minute. Lubricate hone frequently to prevent build-up on stones. The cylinder will show the most wear in the ring travel area (Figure 75) ①. The cylinder does not wear oversize or out-of-round below the ring travel area ② and will guide the hone to straighten cylinder bore.

4. Start the drill and, as the hone spins, move it up and down limiting the travel to the bottom of the cylinder (Figure 75) ③.



**Fig. 95 – Cylinder Honing Details**

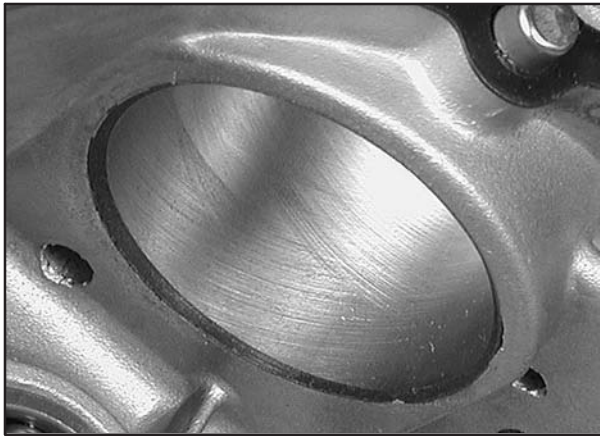
5. As the bottom of the cylinder increases in diameter, gradually increase the length of the strokes until hone travels full length of bore and extends past the cylinder bore ends ④.

Do not extend hone more than 3/4 – 1" (19mm – 25mm) at either end of cylinder bore ④.

6. As cutting tension decreases, stop hone and tighten adjusting knob.
7. Check cylinder bore frequently with an accurate micrometer.

## CYLINDER FINISH ("CROSS HATCH")

The finishing stones are used after the cylinder bore has been resized to within .0015" (.04mm) of the desired size or when reconditioning a cylinder bore. The finishing stones produce the correct cross hatch necessary for proper lubrication. Correct cross hatch angle is approximately 45 degrees (Figure 76).



**Fig. 96 – Cylinder Finish**

**4**

It is recommended that the cylinder bore be reconditioned to restore the cross hatch when new piston rings are to be installed to a cylinder that is within specification. Do not hone oversize or it will be necessary to resize the cylinder.

**NOTE:** To produce the proper cross hatch finish use a drill speed of approximately 200 RPM and 40-60 strokes per minute. Lubricate hone liberally to prevent build-up on finishing stones.

## CYLINDER CLEANING

It is most important that the entire cylinder and crankcase be thoroughly cleaned after honing.

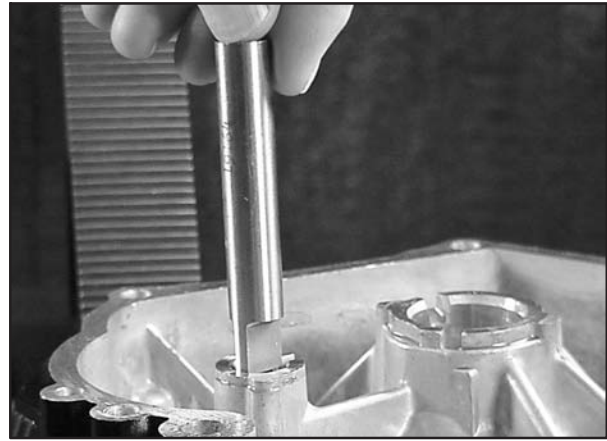
First, wash the cylinder and crankcase carefully in solvent such as kerosene or commercial solvent. Then thoroughly wash cylinder and crankcase using a stiff brush with soap and hot water. Rinse thoroughly with hot running water. Continue washing and rinsing until all traces of honing grit are gone. Honing grit is highly abrasive and will cause rapid wear to all internal components of the engine unless it is completely removed.

**NOTE:** When the cylinder and crankcase have been thoroughly cleaned, use a clean white rag or napkin and wipe the cylinder bore. If honing grit is present it will appear as gray residue on the rag. If any honing grit is evident, re-wash and rinse the entire cylinder and crankcase, and check again. When there is NO trace of honing grit on the rag the cylinder is properly cleaned.

## CHECK CAMSHAFT BEARINGS

Replace cylinder or sump if cam gear bearings are worn more than specification. Replace cylinder or

sump if Plug Gauge (#19164) can be inserted in bearing 1/4" (6.35mm) or more (Figure 77).

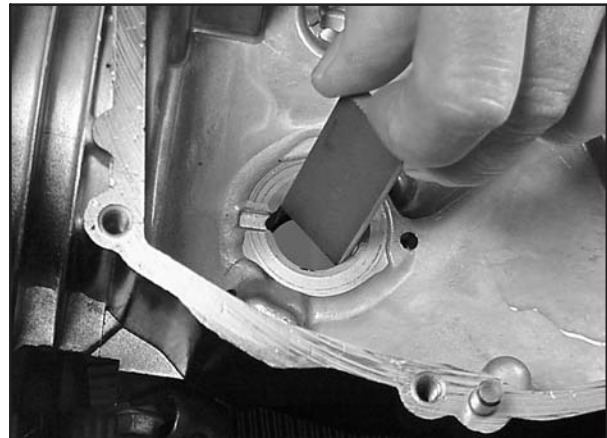


**Fig. 97 – Plug Gauge (#19164)**

If gauge is not available, replace cylinder or sump if bearings are worn over .503" (12.78mm).

## CHECK CRANKSHAFT BEARINGS

Check the crankshaft bearings in the cylinder and sump whenever the engine is apart. Gauge or measure at several locations in bearing. Check the Mag bearing with Plug Gauge (#19166) as shown (Figure 78).



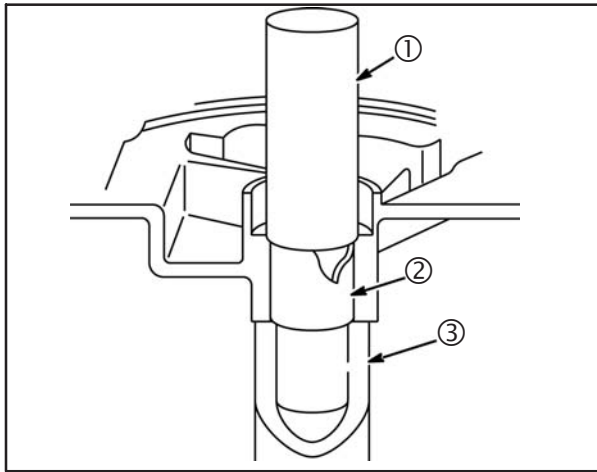
**Fig. 98 – Check Crankshaft Bearing**

If no plug gauge is available, use .877" (22.28mm) as the reject dimension. Replace the bearing if it exceeds the reject dimension. Check the PTO bearing with Plug Gauge (#19375). If no plug gauge is available use 1.0655" (27.06mm) as the reject dimension. Replace the sump if it exceeds the reject dimension.

## REMOVE DU® MAGNETO BEARING

1. Place Briggs & Stratton Cylinder Support Tool (#19123) (Figure 79) ③ under magneto bearing
- ②. Place Briggs & Stratton Bushing Driver (#19124) ① down through worn bearing.

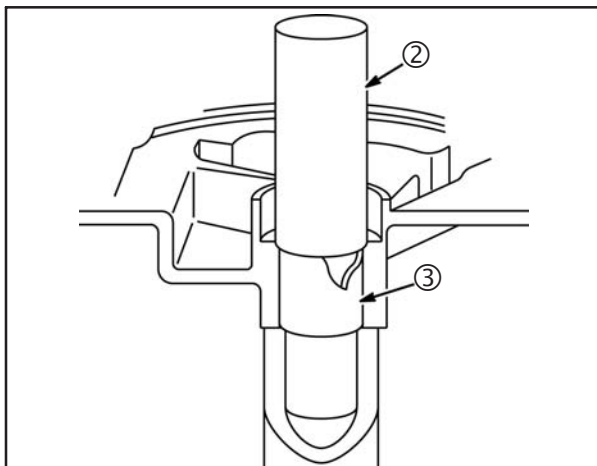
2. Press bearing out of cylinder.



**Fig. 99 – Remove DU® Magneto Bearing**

### INSTALL DU® MAGNETO BEARING

1. Place DU® bearing on cylinder with bearing oil hole in line with oil hole in cylinder.
2. Use Briggs & Stratton Bushing Driver Tool (#19124) (Figure 80) ② to press bearing ③ to a depth of .080" (2.03mm). Measure from thrust face side of cylinder.



**Fig. 100 – Install DU® Magneto Bearing**

3. Stake bearing to cylinder as shown (Figure 81).



**Fig. 101 – Stake Cylinder Bearing**

**4**

### OIL SEALS

Install new oil seals whenever engine is disassembled. When installing crankcase cover or sump, always use the correct seal protector to prevent damaging oil seal.





# Section 5

## ASSEMBLY

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## PISTON AND CONNECTING ROD

The piston pin is a slip fit in both the piston and connecting rod.

1. Oil the piston pin. Assemble the piston to the connecting rod as shown in.



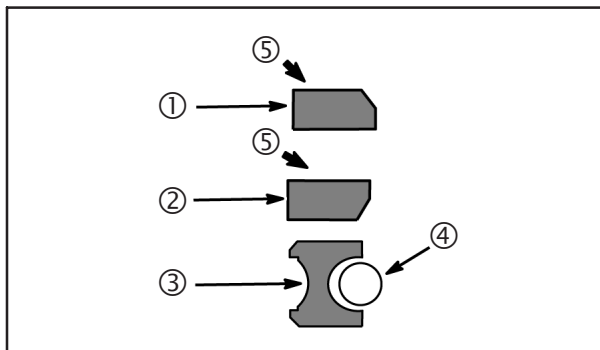
**Fig. 102 – Piston & Rod Assemblies**

**NOTE:** The word MAG cast in the flywheel side of the connecting rod must face the same direction as the arrow (Figure 82) ① on top of the piston.

2. Insert the piston pin from the piston pin lock side of the piston pin bore ② until the pin stops against the shoulder.
3. Install the piston pin lock. Be sure lock is firmly set in groove.

## PISTON RINGS

Correct piston ring positions are shown.



**Fig. 103 – Piston Rings**

1. Install the expander (Figure 83) ④ and oil control ring ③ first, followed by the center ring ② and top ring ①.
2. Install the center and top rings with the ID mark ⑤ facing the top of the piston.

## Compress Piston Rings

1. Oil the piston rings and piston skirt.

2. Compress the piston rings with Ring Compressor (#19230) (Figure 84).



**Fig. 104 – Ring Compressor**

3. Place piston and compressor upside down on bench and push piston down until head of piston is even with edge of compressor.
4. Tighten compressor until piston cannot be turned.
5. Loosen compressor until piston can be turned with slight resistance (Figure 85).



**Fig. 105 – Piston Assembly Ready To Install**

**NOTE:** Do not attempt to install piston and ring assembly without ring compressor.

## CRANKSHAFT INSTALLATION

1. Select a seal protector based on size of crankshaft mag journal.
2. Insert protector into mag side oil seal.
3. Install crankshaft to cylinder.
4. Install slip fit timing gear (if removed) with timing mark out.

## INSTALL CONNECTING ROD & PISTON

1. Lubricate cylinder bore and crankpin.
2. Rotate crankshaft until crankpin journal is at bottom of stroke.

**NOTE:** This permits the compressed rings, piston and rod assembly to be pushed into the cylinder.

3. Install piston with arrow (Figure 86) ① toward flywheel side of engine. Take care not to damage crankpin journal or connecting rod journal.

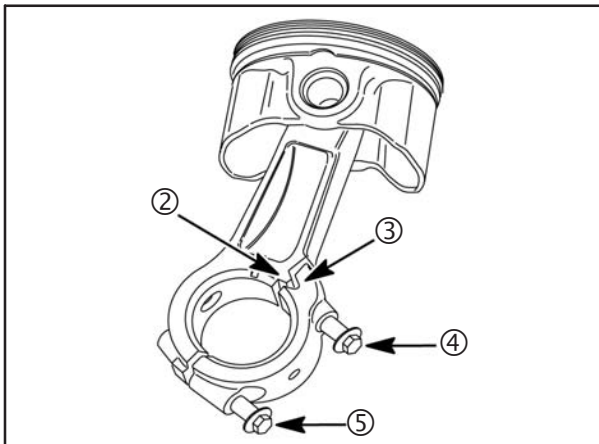


**Fig. 106 – Install Piston Assembly**

4. Pull connecting rod against crankpin.
5. Install connecting rod cap with notch in rod cap aligned with tab in connecting rod.

**NOTE:** The notch in the connecting rod cap (Figure 87) ③ must engage the tab on the connecting rod ②.

6. Install connecting rod cap screws.

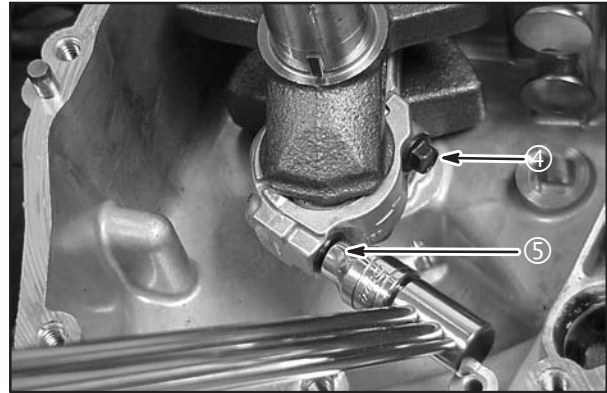


**Fig. 107 – Connecting Rod Cap**

**CAUTION:** Failure to use a torque wrench can result in loose rods (causing breakage) or over-tightened rods (causing scoring).

**NOTE:** Torque the screw closest to the piston (Figure 88) ④ first. Torque the screw farthest

from piston second ⑤. The connecting rod screws must be torqued in this sequence.



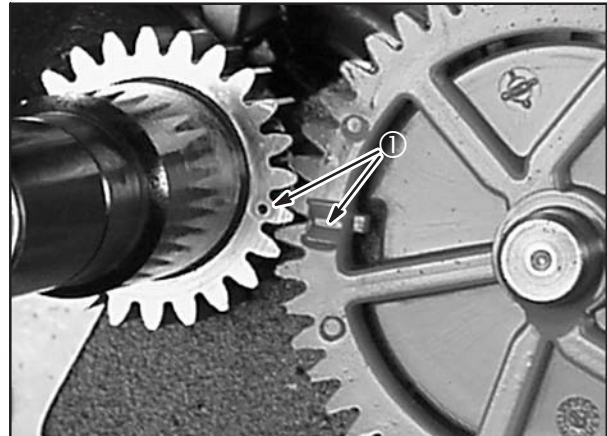
**Fig. 108 – Torque Connecting Rod Cap**

7. Use Torque Wrench (#19393) to torque connecting rod cap screws to 100 in. lbs. (11 Nm).
8. Rotate crankshaft two revolutions to make sure crankpin and rod are not binding during rotation.
9. Move connecting rod sideways to be sure rod slides from side-to-side.

## INSTALL CAMSHAFT

1. Install tappets. Be sure tappets clear cam lobes.
2. Install camshaft.

Timing marks (Figure 89) ① must be aligned. Typical alignment is shown.



**Fig. 109 – Camshaft Timing Marks**

3. Assemble oil slinger to camshaft.

## INSTALL SUMP

1. Install sump using seal protector. Do not force sump.
2. Install screws, torque in sequence as shown (Figure 90). Torque to 110 in. lbs. (12 Nm).



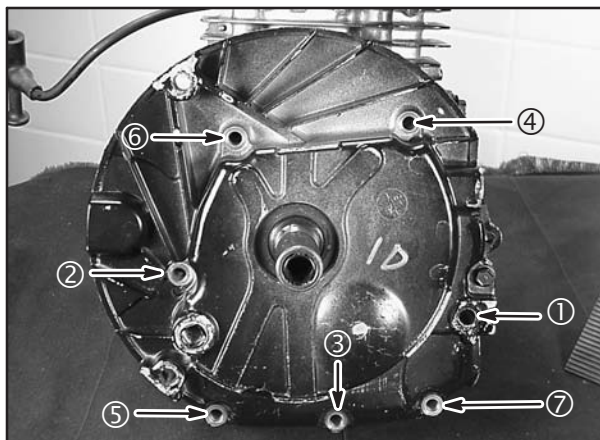


Fig. 110 – Torque Sump Cover

## CRANKSHAFT END PLAY

When sump is installed with a standard gasket, end play should be .002–.028 in. (.05–.71mm). Always measure end play with a standard gasket in place. If end-play is more than specification, replace crankcase cover or sump, or use (#220624) shim (Figure 91) ① on magneto end of crankshaft. If end play is less than specification use additional gasket(s) (Figure 92) ③ between the sump ② and the cylinder ④ to get proper end play.

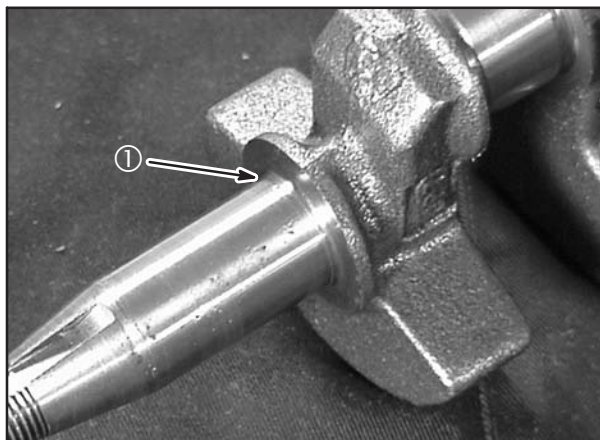


Fig. 111 – Crankshaft End Play

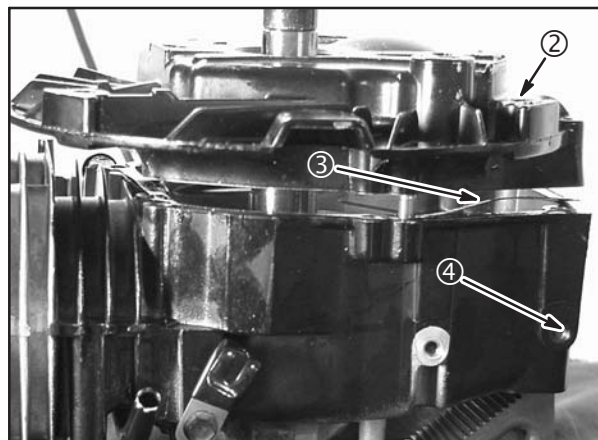


Fig. 112 – Shimming The Crankcase Cover

## INSTALL FLYWHEEL

**WARNING:** Do not use impact wrenches to install flywheel.

1. Clean flywheel taper and crankshaft taper, removing all oil, dirt or grease.
2. Install flywheel key to slot before installing flywheel.
3. Slide flywheel onto crankshaft.
4. Torque flywheel nut to 60 ft. lbs. (80 Nm).

## INSTALL ARMATURE

1. Install stop switch wire to armature.
2. Turn flywheel so magnet (Figure 93) ① is away from coil. Install armature assembly on engine.

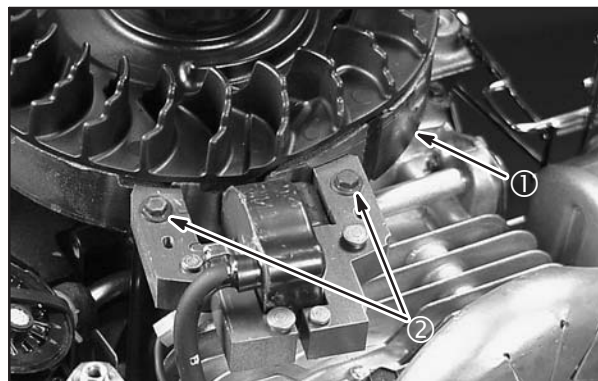


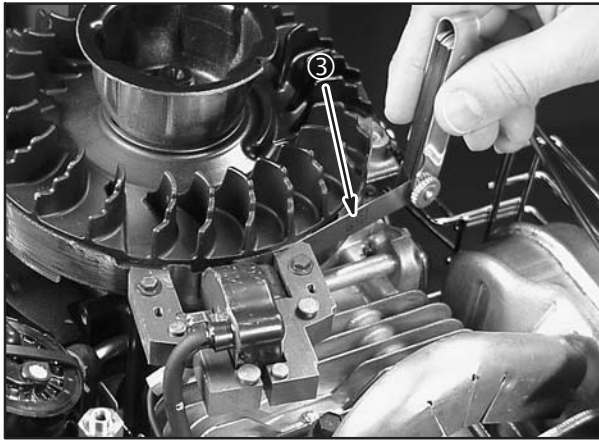
Fig. 113 – Armature

3. Install coil mounting screws ② finger tight.

## ARMATURE AIR GAP

1. Pull left side of armature away from flywheel and tighten left screw.

2. Rotate flywheel until magnet is under armature laminations.
3. Place thickness gauge blade (Figure 94) ③ between magnet and armature.



**Fig. 114 – Setting Armature Air Gap**

**NOTE:** Use a .010–.014" (.25–.36mm) gauge.

4. Loosen left armature screw and let magnet pull armature down onto flywheel magnet. Torque screws to 25 in. lbs. (3 Nm).

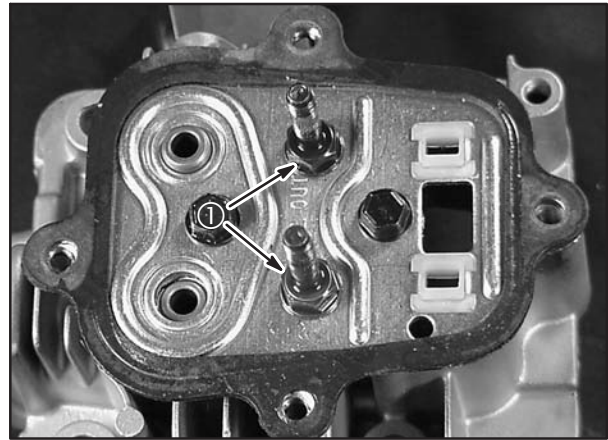
## CYLINDER HEAD ASSEMBLY

### Install Cylinder Head Plate and Rocker Arm Studs

1. Place new cylinder head plate gasket and cylinder head plate on cylinder head.

**NOTE:** The cylinder plate is labeled for correct installation.

2. Install two rocker arm studs (Figure 95) ①. Torque to 80 in. lbs. (9 Nm).

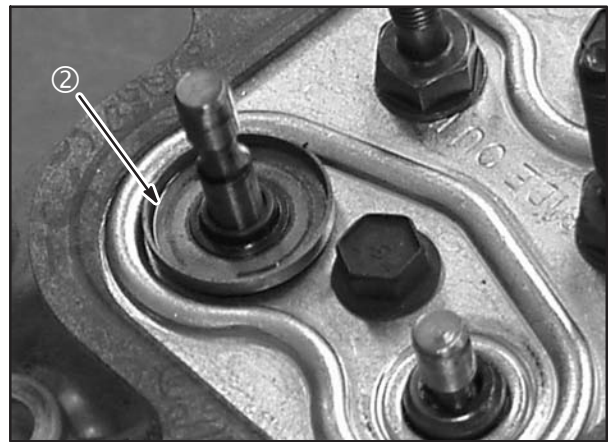


**Fig. 115 – Cylinder Head Plate**

## INSTALL VALVES

**NOTE:** A valve stem seal (Figure 96) ② is used on the intake valve.

1. Valve sticking will occur and valve stem seals will be damaged if the stems and guides are not free of foreign material and burrs.
2. Lightly coat valve stems with Valve Guide Lubricant (#93963) and install in valve guides.
3. Oil the inside diameter of the valve stem seal with engine oil and install on the valve stem.
4. Slide seal down against head plate.



**Fig. 116 – Valve Stem Seals**

**NOTE:** Be sure Valve Guide Lubricant is not on valve face, valve seat or exposed end of valve stem.

## INSTALL VALVE SPRINGS AND RETAINERS

1. Place a shop rag or wood blocks on work surface to support valves. Place cylinder head on rag or blocks and install valve spring over valve stem.
2. Place retainer (Figure 97) ① on spring. Depress retainer with thumbs to compress spring.



Fig. 117 – Valve Spring Retainers

3. Compress spring until valve stem extends through large end of retainer slot. Continue to press until small end of slot can slide into groove on valve stem. Be sure retainer is fully engaged to valve stem groove.

## INSTALL CYLINDER HEAD

**NOTE:** Do not use sealer on gaskets.

1. Coat threads of cylinder head screws with Valve Guide Lubricant (#93963).
2. Place new cylinder head gasket on dowel pins and then install cylinder head and cylinder head screws.
3. Torque screws in sequence as numbered on cylinder head, or as shown (Figure 98). Tighten the cylinder head in three steps:

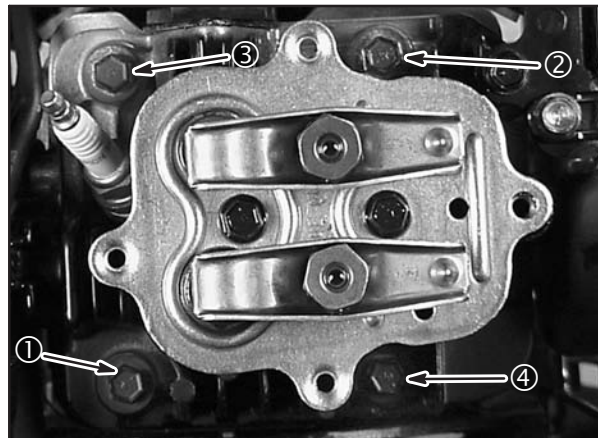


Fig. 118 – Torque Cylinder Head Bolts

**NOTE:** Do not tighten any screw to the final torque before all screws have been tightened to the second step. Uneven tightening may cause a warped cylinder head.

First step:	70 in. lbs. (8 Nm)
Second step:	140 in. lbs. (16 Nm)
Final step:	210 in. lbs. (24 Nm)

## INSTALL ROCKER ARMS

1. Install push rods (Figure 99) ① through push rod guide making sure push rods are in valve tappets ②.

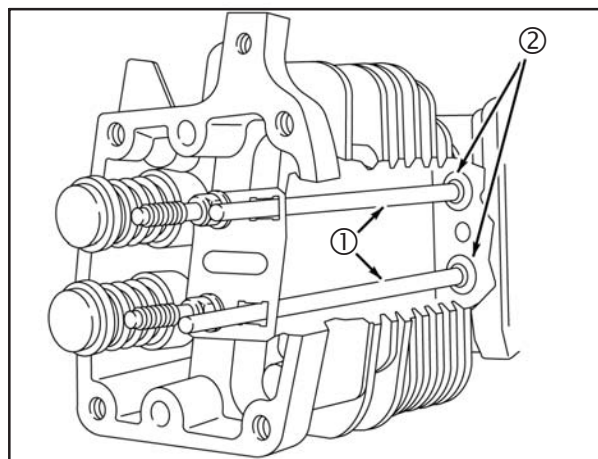
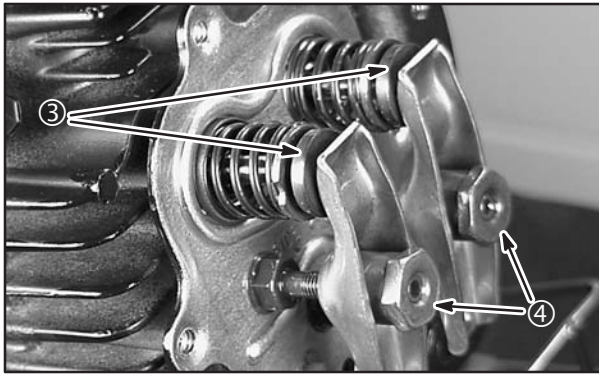


Fig. 119 – Install Rocker Arms

2. Remove all lubricant from end of valve stems.
3. Place valve caps (Figure 100) ③ on end of valve stems. Do not use lubricant on the valve caps.





**Fig. 120 – Valve Caps & Adjusting Nuts**

4. Place rocker arms on studs and install rocker arm adjusting nuts ④ and set screws while holding rocker arm against valve cap and pushrod until nut is finger tight.
5. Rotate crankshaft at least two revolutions to be sure push rods operate rocker arms.

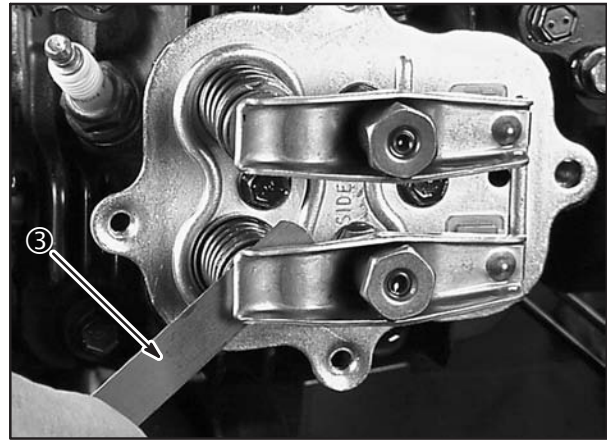
## ADJUST VALVE CLEARANCE

Check valve clearance while engine is cold.

1. Turn crankshaft until piston is at TDC of the compression stroke.
2. Insert a narrow screwdriver or small rod into spark plug hole against the piston. The screwdriver or rod is used to gauge piston movement.

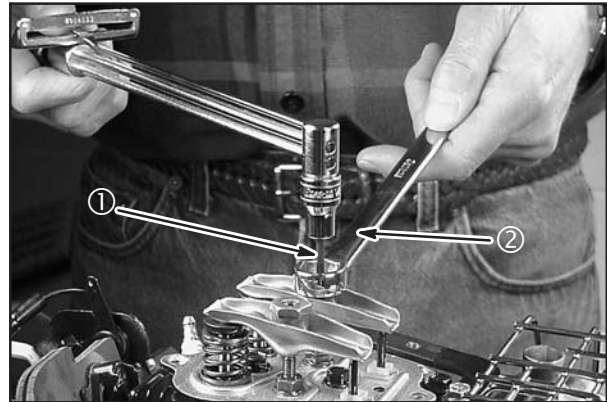
**NOTE:** Correct positioning of crankshaft is required to prevent compression release from holding valves open.

3. While watching screwdriver or rod, turn crankshaft clockwise (flywheel end) past TDC until piston is 1/4" (6.35mm) down.
4. Using feeler gauges (Figure 101) ③, check valve clearance. Clearance should be .004 – .008" (.10 – .20mm) for intake and exhaust valves.



**Fig. 121 – Checking Valve Clearance**

5. To adjust, loosen set screw (Figure 102) ①. Turn rocker nut ② until valve clearance is correct.
6. When valves are adjusted, hold rocker nut. Tighten set screw to 35 in. lbs. (4 Nm).



**Fig. 122 – Adjusting Valve Clearance**

7. Recheck clearance and adjust, if required.

## INSTALL VALVE COVER

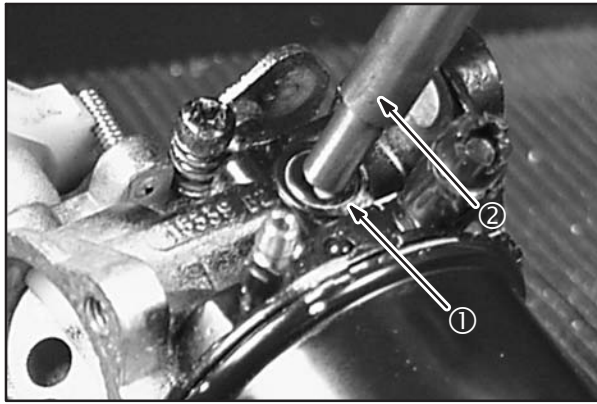
1. Install valve cover with new gasket. Install four screws. Torque screws to 85 in. lbs. (10 Nm).
2. Install muffler, exhaust manifold, air guides, shields and other parts removed from cylinder head.
3. Torque muffler screw to 85 in. lbs. (10 Nm).

## CARBURETOR ASSEMBLY

### Install Welch Plug

1. Install welch plug (Figure 103) ① with a pin punch ② slightly smaller than the outside diameter of the plug.



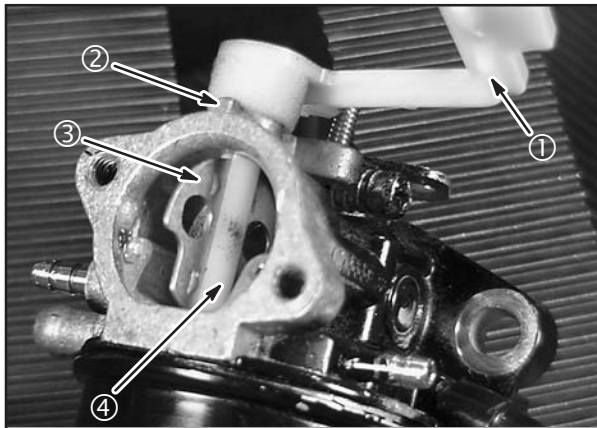


**Fig. 123 – Install Welch Plug**

2. Press in until plug is flat. Do not cave in plug.
3. After plug is installed, seal outside edge of plug with fingernail polish or non-hardening sealant.

### Install Choke Shaft

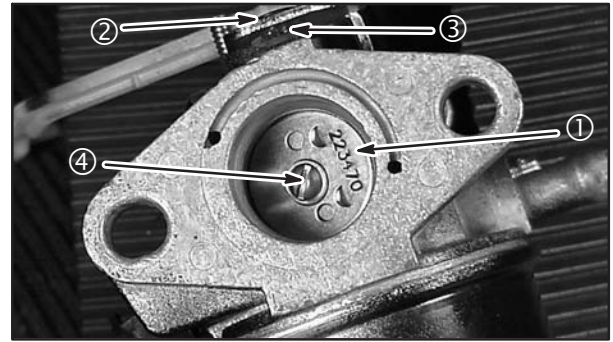
1. Install choke shaft (Figure 104) (1) and felt washer (2). Rotate choke shaft until lever is as shown.
2. Insert and center choke plate (3) in slot of choke shaft, with dimples (4) as shown.



**Fig. 124 – Choke Shaft**

### Install Throttle Shaft

1. Install throttle shaft (Figure 105) (2) and foam washer (3).
2. Turn shaft until flat is facing out.
3. Lay throttle plate on shaft with numbers (1) facing out and install screw (4).

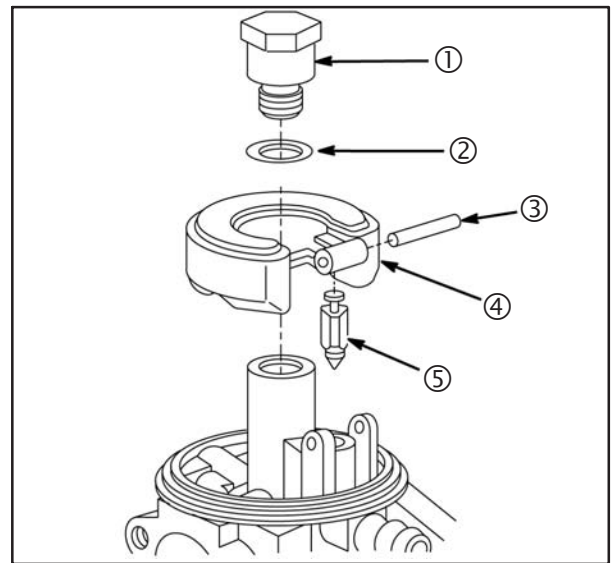


**Fig. 125 – Throttle Shaft**

### Install Inlet Needle and Float

1. Install inlet needle (Figure 106) (5) to float (4) and install assembly to carburetor body.
2. Insert float hinge pin (3) and center pin between float pin bosses. Float height is non-adjustable.
3. Install rubber gasket on carburetor and lay float bowl on body.

**5**

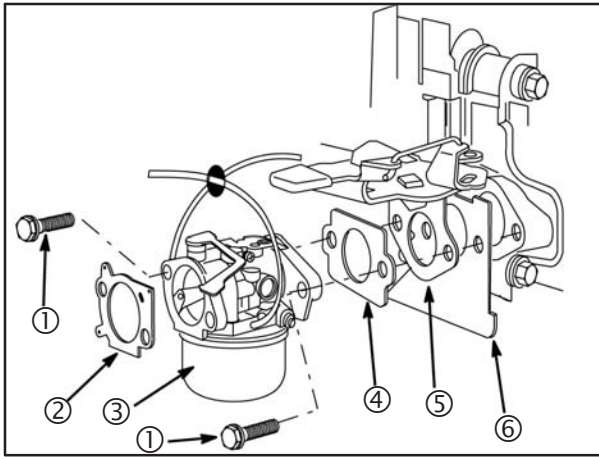


**Fig. 126 – Assemble Carburetor**

4. Place fiber washer (2) over main jet (1) and install main jet. Torque nut to 50 in. lbs. (6 Nm).

### INSTALL CARBURETOR

1. Place a new intake gasket (Figure 107) (6) between the control bracket (5) and the cylinder head.



**Fig. 127 – Carburetor Installation**

2. Place a new intake gasket ④ between the control bracket ⑤ and the carburetor ③.
3. Using carburetor mounting screws ① to align parts, place carburetor and gasket on control bracket.
4. Install carburetor assembly to the cylinder head with two mounting screws ①. Torque screws to 90 in. lbs. (10 Nm).

**NOTE:** Use new screws or Loctite sealant to prevent screws from vibrating loose.

5. Install a new air horn gasket ② and the air horn to the carburetor.
6. Install fuel pump and connect fuel lines.
7. Install speed limiter.

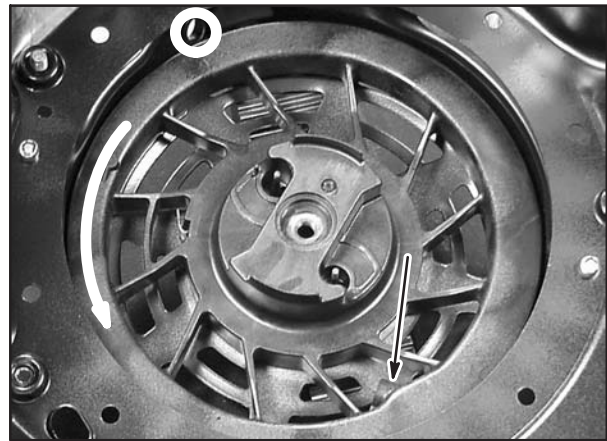
## INSTALL PULLEY AND SPRING

1. Lay starter housing on workbench.
2. Assemble starter pulley (Figure 108) ① to center pivot post ② in housing.



**Fig. 128 – Starter Pulley**

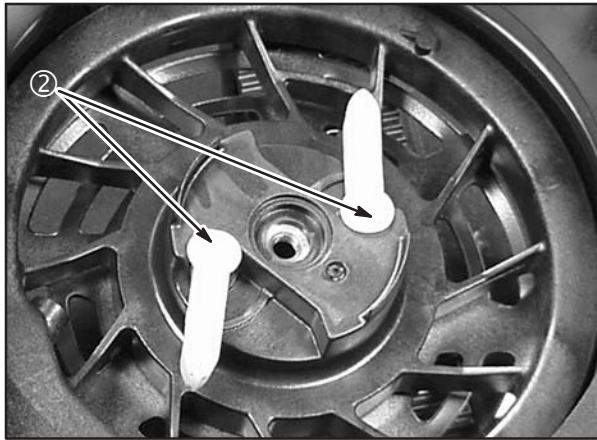
3. Rotate pulley counterclockwise until slight resistance is felt, indicating that spring is engaged in spring tab (Figure 109).



**Fig. 129 – Engage Pulley Spring**

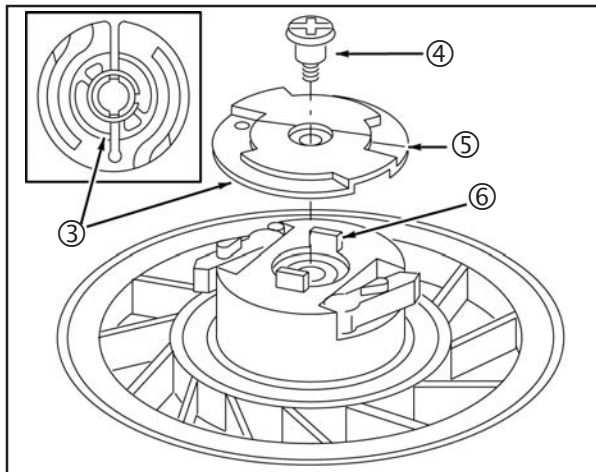
## INSTALL PAWLS, PAWL SPRINGS & RETAINER ASSEMBLY

1. Install pawls (Figure 110) ②.



**Fig. 130 – Install Pawls**

2. Install retainer (Figure 111) ⑤ making sure that slots ③ in retainer engage tabs ⑥ on pulley.



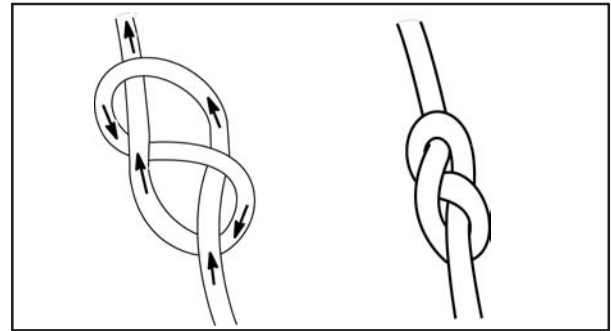
**Fig. 131 – Rewind Assembly**

3. Hold retainer down, compressing pawl springs and install retainer screw. Torque screw ④ to 70 in. lbs. (8 Nm).
4. While holding retainer, rotate pulley to extend and retract pawls. If the pawls do not extend and retract, remove retainer and reinstall.

## WIND SPRING & INSTALL ROPE

1. Tie knot on one end of the rope.

**NOTE:** Knot must be the original “Figure 8” style, (Figure 112) so it will not pull through pulley or rope handle hole.



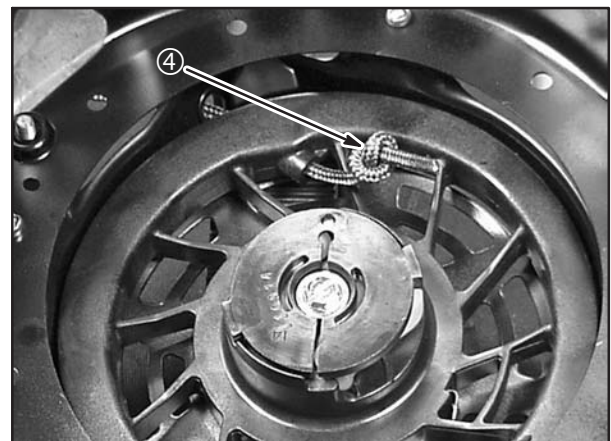
**Fig. 132 – Rope Knot**

2. Turn pulley counterclockwise until spring is wound tight.
3. Rotate pulley clockwise until rope hole (Figure 113) ① in pulley is in line with starter housing eyelet ② and hold pulley.



**Fig. 133 – Rope Installation**

4. Insert unknotted end of rope through rope hole in pulley, then through eyelet in housing.
5. Pull rope until knot rests against pulley.



**Fig. 134 – Securing Rope**

6. Tie a temporary knot (Figure 114) ④ in the rope to prevent the rope from retracting into the pulley.



7. Let pulley and spring slowly retract rope against temporary knot.

## INSTALL BLOWER HOUSING

1. Install blower housing (Figure 115).

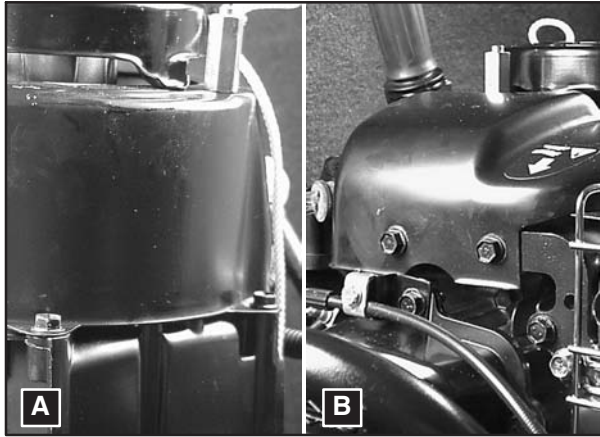


Fig. 135 – Blower Housing

2. Torque screws to 85 in. lbs. (10 Nm).

## GEAR CASE ASSEMBLY

1. Install the shift cam/rod (Figure 116) ⑤ to the gear case ⑥.
2. Install the shift shaft support ③ with seal ② and the O-rings ④ to the input shaft carrier.
3. Install the input shaft carrier ⑦ to the gear case. Torque stainless steel screws ⑧ and stud ① to 55 in. lbs. (6 Nm).

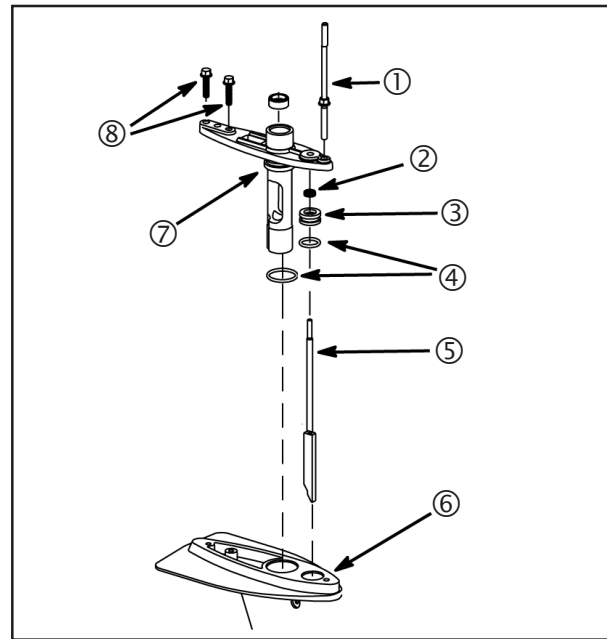


Fig. 136 – Gear Case

4. Install the forward gear and bearing assembly (Figure 117) ⑩ to the housing.
5. Install the pinion gear ⑪ to the recess in the gear case.

**NOTE:** The shift cam ⑤ must be in the FORWARD position when assembling the propeller shaft assembly to the gear case (inset).

6. Install the shift cam follower ⑫ to the propeller shaft assembly ⑬. Install the propeller shaft assembly and cam follower to the gear case.

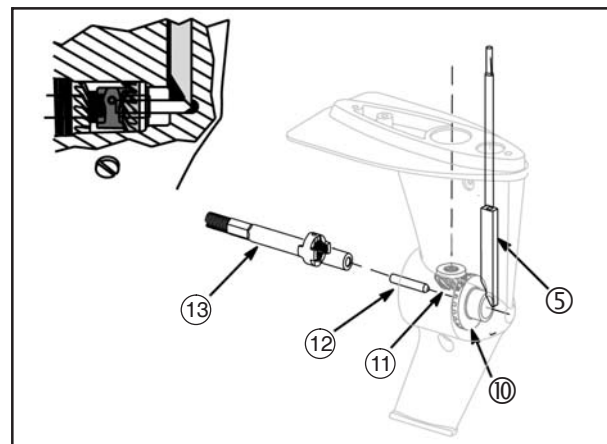
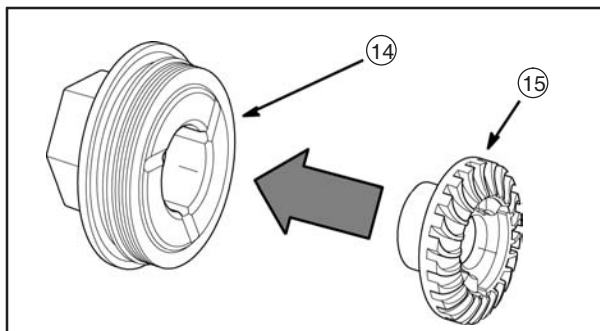


Fig. 137 – Install Forward Gear

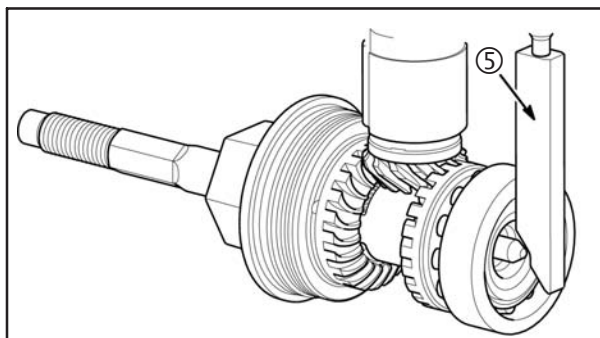
7. Assemble reverse gear (Figure 118) ⑮ to the carrier ⑭.





**Fig. 138 – Assemble REVERSE Gear**

8. Apply Anti-Seize to the carrier threads.
9. Install the carrier assembly to the gear case and align all gears. Hand tighten the carrier until the flange contacts the face of the gear case. Do not torque the carrier at this time.



**Fig. 139 – Install Carrier Assembly**

The carrier is Left-Hand-Thread.

**NOTE:** It may be necessary to turn the drive shaft and/or the propeller shaft to mesh gears.

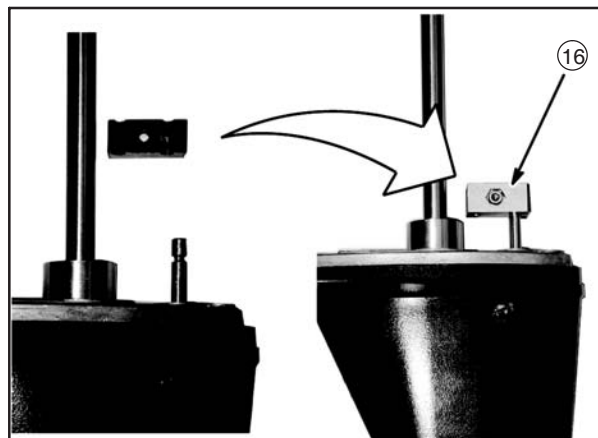
10. Install the drive shaft through the top plate into the pinion gear.
11. Depress the shift cam/rod (Figure 119) ⑤ approximately 5/16" (8mm) to select NEUTRAL.

**NOTE:** Turn the drive shaft and/or the propeller shaft to verify NEUTRAL.

12. Install the clamp (Figure 120) ⑩ to the shift cam/rod. Tighten the clamp just enough to locate the clamp to the rod.

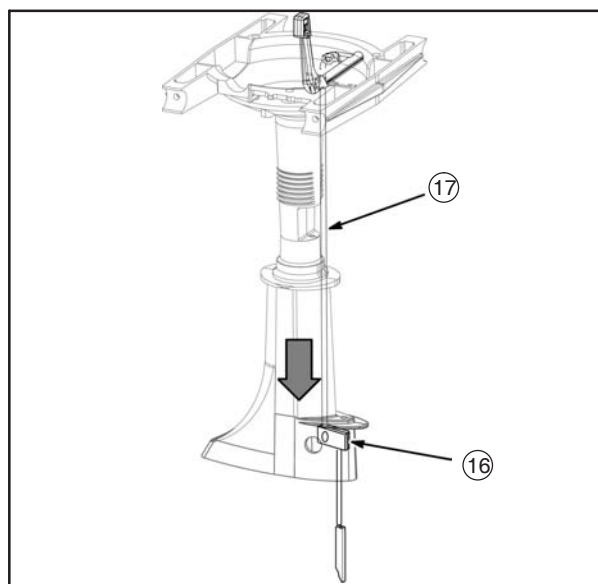
**IMPORTANT:** The locating ridges of the clamp must engage the slot in the rod.

13. Place the shift selector in NEUTRAL.



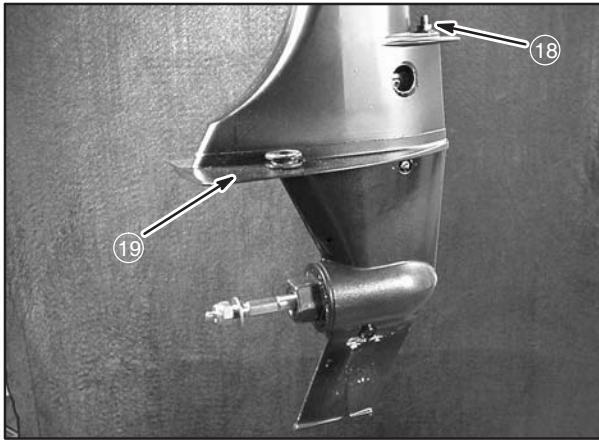
**Fig. 140 – Shift Clamp**

14. Slide the upper shift rod (Figure 121) ⑪ into the clamp ⑩ as you place the gear case onto the midsection.



**Fig. 141 – Shift Rod Assembly**

15. Install the gear case assembly to the midsection. Torque the screw (Figure 122) ⑫ to 60 in. lbs. (7 Nm). Torque the nut ⑬ to 80 in. lbs. (9 Nm).



**Fig. 142 – Install Gear Case**

16. Verify that the gear lever and gear case are both in NEUTRAL, and that the shift rod and shift cam/rod are both engaged to the clamp. Tighten the clamp through the hole in the gear case (Figure 123). Torque the clamp screw to 35 in. lbs. (4 Nm). Again verify NEUTRAL.



**Fig. 143 – Tighten Shift Clamp**

17. Use Briggs & Stratton Socket (#19557), to torque the carrier to the gear case. Torque the carrier to 120 ft. lbs. (160 Nm).

**NOTE:** Always torque the carrier with the gear case attached to the midsection (Figure 124).

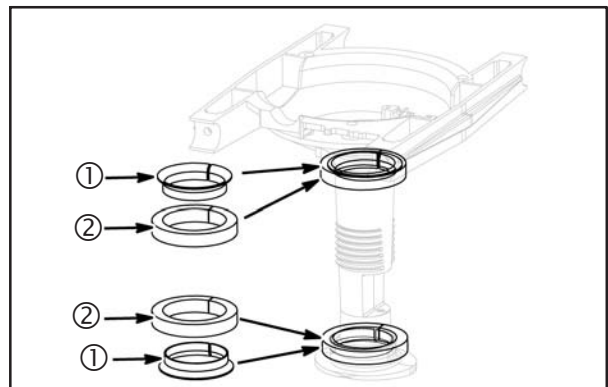


**Fig. 144 – Torque Carrier**

18. Apply Anti-Seize to the propeller shaft threads. Install the propeller, stainless steel washer and stainless steel lock nut to the propeller shaft. Torque the lock nut to 90 in. lbs. (10 Nm).

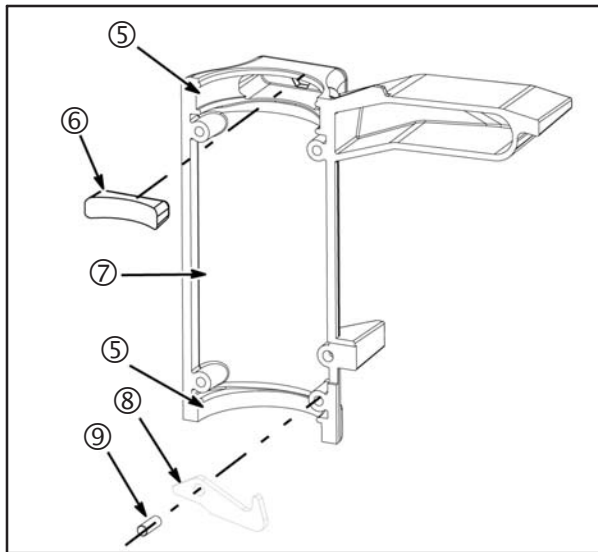
### Mid Section Assembly

1. Apply Anti-Seize to the mounting surfaces of the sleeves (Figure 125) ①. Place the sleeves and rubber bushings ② together on the midsection.



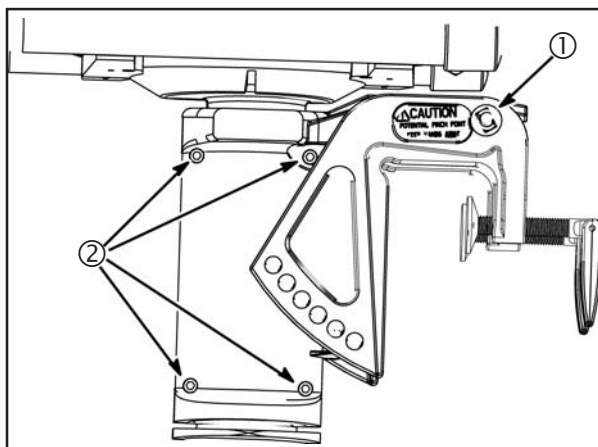
**Fig. 145 – Sleeves & Bushings**

2. Insert brake shoe (Figure 126) ⑥ to port side tilt bracket ⑦.
3. Locate reverse hook ⑧ to port side tilt bracket with pin ⑨.



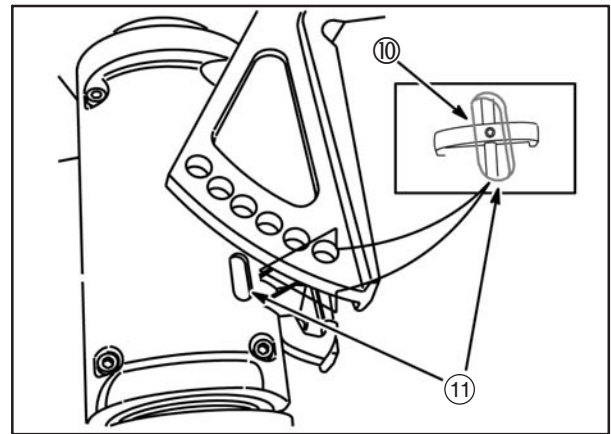
**Fig. 146 – Brake Shoe**

4. Place the tilt bracket with the reverse hook onto the midsection. Align the bushings already in position on the mid section (Figure 125) with the grooves in the tilt brackets (Figure 126) ⑤.
5. Place the remaining tilt bracket onto the midsection.
6. Secure the tilt brackets with four (Figure 127) ② screws. Torque screws to 55 in. lbs. (6 Nm).
7. Install the transom brackets to the tilt brackets. Apply Anti-Seize to the transom bracket bolt. Torque the transom bracket nut (Figure 127) ① to 190 in. lbs. (21 Nm).



**Fig. 147 – Transom Bracket**

8. The reverse hook actuator (Figure 128) ⑩ is adjusted with a setscrew that is accessed through an opening ⑪ in the starboard tilt bracket. Adjust the actuator so that it just touches the reverse hook when NEUTRAL is selected. Tighten by turning the set screw clockwise. Verify correct adjustment.

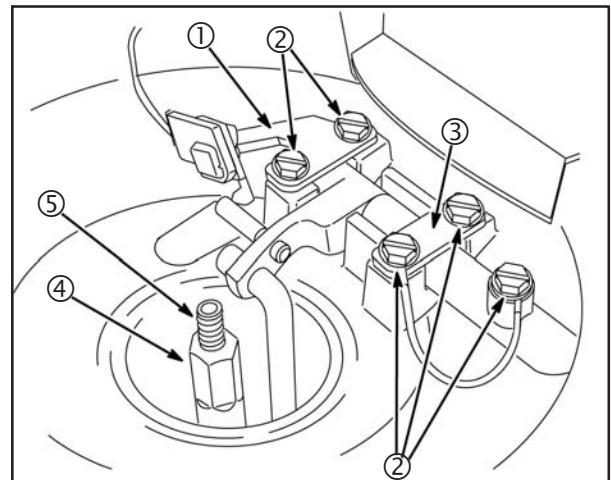


**Fig. 148 – Reverse Hook**

**NOTE:** When correctly adjusted the bottom edge of the reverse hook is at a right angle to the edge of the swivel bracket castings when REVERSE is selected.

## Install Power Head

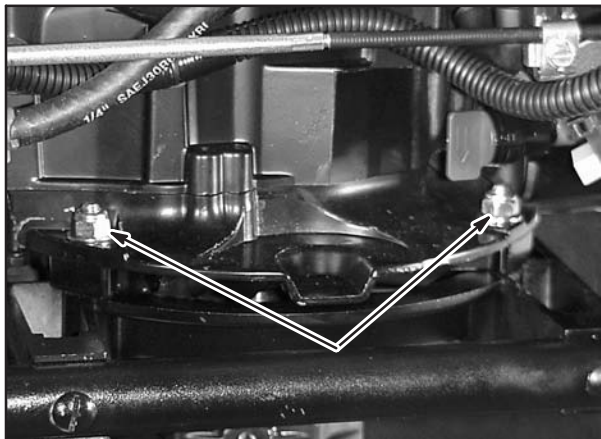
1. Grease the shift lever pockets under the neutral switch (Figure 129) ① and the shift lever retaining plate ③. Grease the hex end of drive shaft ④ and spring ⑤ as shown.



**Fig. 149 – Install Power Head**

2. Torque screws ② to 35 in. lbs. (4 Nm).
3. Connect the neutral switch wire to the wiring harness. Lower the power head onto the midsection. Align the hex socket in the crankshaft adapter to the hex end of the drive shaft ④. Be certain that the wire for the neutral switch is not pinched between the power head and the midsection.
4. Secure the power head to the midsection with two bolts on the port side and one bolt on the starboard side of the power unit (Figure 130). Apply Anti-Seize compound to the threads of the

bolts. Install the bolts thread-end up through the midsection and power unit. Install the washers and nuts to the bolts. Torque the nuts to 210 in. lbs. (24 Nm).



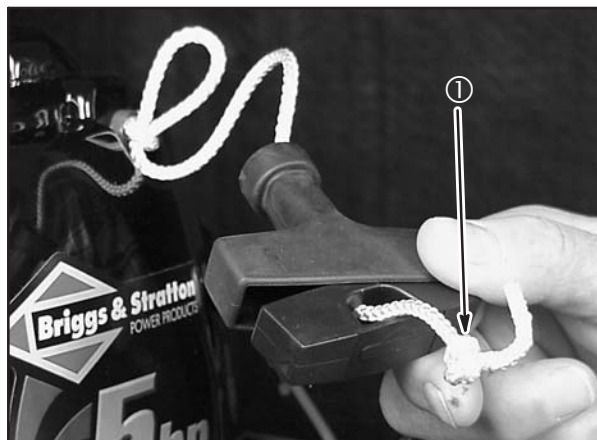
**Fig. 150 – Secure Power Head**

**NOTE:** The bolts must be installed from the bottom, with the threaded end up. The washers and lock nuts are installed from the top.

5. Connect the throttle cable to the carburetor. Secure in position with the throttle cable clamp. Replace the wire ties that hold the throttle cable to the rear handle.
6. Connect the choke control rod to the choke lever.

## COOLING SHROUD INSTALLATION

1. Insert the starter rope through the opening in the shroud.
2. Pull the rope through the openings in the handle and handle insert.
3. Knot the end of the rope with a figure 8 knot (Figure 131) ① as shown.

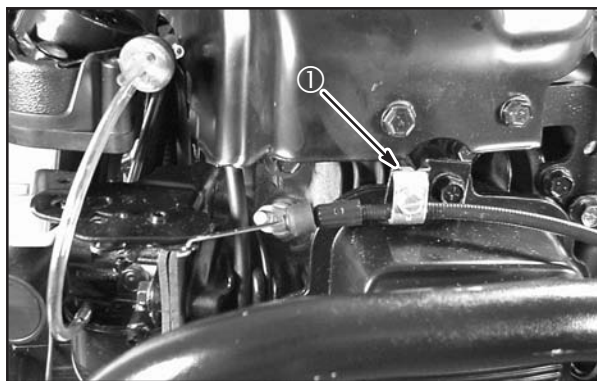


**Fig. 151 – Pull Handle Assembly**

4. Pull the handle out and hold.
5. Remove temporary knot.
6. Install the shroud, safety/engine stop switch, dipstick and top cover.

## ADJUST THROTTLE CABLE

1. With throttle control in the IDLE position, loosen casing clamp screw (Figure 132) ① at the back of the outboard.



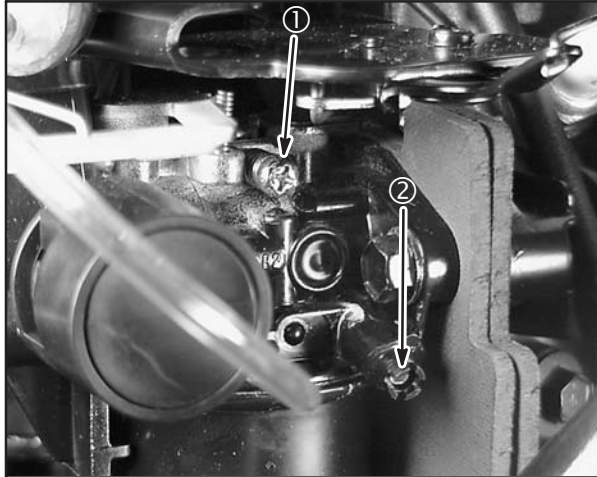
**Fig. 152 – Adjust Throttle Cable**

2. Push the throttle cable toward the carburetor control bracket to move the throttle to the idle stop.
3. Press on the throttle to ensure that it is seated firmly against the idle adjusting screw.
4. Snug the casing clamp screw. Observe the range of throttle motion when the hand grip is moved from IDLE to HIGH SPEED stops.



## IDLE ADJUSTMENT

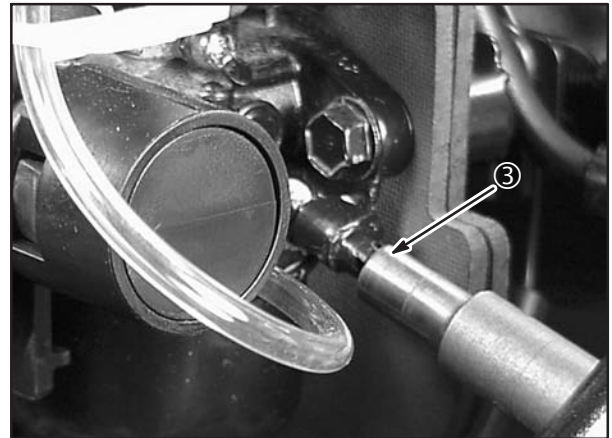
1. Start and run the engine at half throttle to warm engine to operating temperature.
2. Rotate throttle lever counterclockwise to the IDLE position and hold against throttle stop while adjusting idle speed adjusting screw (Figure 133) ① to obtain 1900 RPM (1400 RPM in FORWARD gear, with the propeller in water).



**Fig. 153 – Idle Adjustment**

3. Move throttle control to FAST position. Engine should accelerate smoothly.

4. Turn the idle mixture screw ② clockwise slowly until the engine just begins to slow, and note or mark the position of the screw.
5. Then turn the screw counterclockwise until the engine just begins to slow. Again note or mark the position of the screw.
6. Turn the idle mixture screw to the midpoint between the two positions.
7. Install the limiting cap (Figure 134) ③ to the idle mixture screw.



**Fig. 154 – Limiting Cap**

8. Move throttle control to FAST position. Engine should accelerate smoothly. If the engine does not accelerate smoothly, open the idle mixture screw 1/8 turn.



# Section 6

## APPENDIX

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## OUTBOARD ENGINE FASTENER SPECIFICATIONS

Blower Housing	3/8"	85 in. lbs. (10 Nm)
Carburetor	3/8"	80 in. lbs. (9 Nm)
Connecting Rod	5/16"	100 in. lbs. (11 Nm)
Cylinder Head Bolt	3/8"	210 in. lbs. (24 Nm)
Muffler (to Cylinder Head)	3/8"	85 in. lbs. (10 Nm)
Flywheel	15/16"	60 ft. lbs. (80 Nm)
Ignition Armature	1/4"	25 in. lbs. (3 Nm)
Intake Air Horn	5/16"	45 in. lbs. (5 Nm)
Oil Drain Plug	3/8" Square Drive (internal)	125 in. lbs. (14 Nm)
Rocker Arm Ball Set Screw	1/8" Hex Drive (internal)	60 in. lbs. (7 Nm)
Spark Plugs	5/8"	180 in. lbs. (20 Nm)
Sump	1/2"	110 in. lbs. (12 Nm)
Throttle Plate Retaining Screw	2	45 in. lbs. (5 Nm)
Valve Cover	3/8"	85 in. lbs. (10 Nm)

## 6

## LOWER UNIT FASTENER SPECIFICATIONS

Casing Clamp (Cylinder)	1	35 in. lbs. (4 Nm)
Choke Nut	1	30 in. lbs. (3 Nm)
Clamp Bracket Screw	2	35 in. lbs. (4 Nm)
Cowl Mounting Screw (10-32)	4	25 in. lbs. (3 Nm)
Cowl Screw Standoff	4	35 in. lbs. (4 Nm)
Cowl Cover Screw (10-24)	4	25 in. lbs. (3 Nm)
Engine Mounting Bolts	3	210 in. lbs. (24 Nm) *
Front Handle Casing Clamp Screw	1	35 in. lbs. (4 Nm)
Front Handle Screw	1	55 in. lbs. (6 Nm)
Front Handle Tiller Housing Pivot Cap	2	45 in. lbs. (5 Nm)
Rear Case/Midsection Nut	1	80 in. lbs. (9 Nm)
Gear Case/Midsection Self-Tapping Screw	1	60 in. lbs. (7 Nm)
Ground Wire Screw	1	90 in. lbs. (10 Nm)
Handle Screw	4	55 in. lbs. (6 Nm)
Hook Actuator Set Screw	1	35 in. lbs. (4 Nm)
Input Shaft Carrier-to-Gear Case Screw	2	55 in. lbs. (6 Nm)
Oil Drain/Fill Plug	1	45 in. lbs. (5 Nm)
Oil Vent Plug	1	20 in. lbs. (2 Nm)
Output Shaft Nut	1	130 in. lbs. (15 Nm)
Propeller Nut	1	90 in. lbs. (10 Nm) *
Reed-Switch Screw	1	35 in. lbs. (4 Nm)
Safety/Engine Stop Switch	1	20 in. lbs. (2 Nm)
Shift Lever Screws	4	35 in. lbs. (4 Nm)

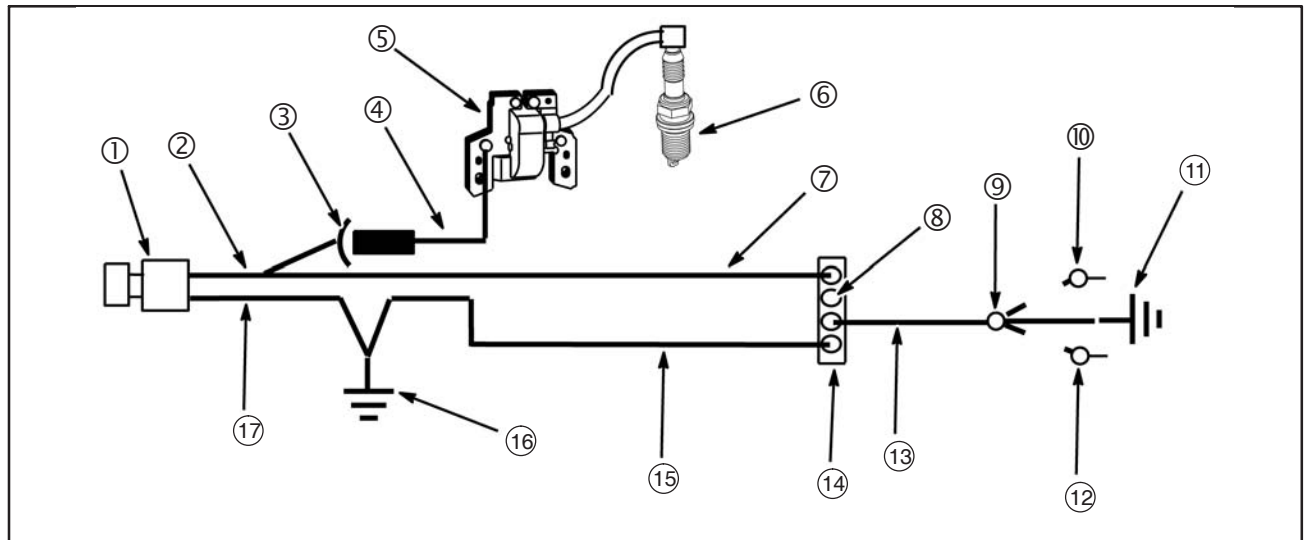


Shift Rod Clamp Screw	1	35 in. lbs. (4 Nm)
Shift Rod to Shift Cam Screw	1	20 in. lbs. (1 Nm)
Stud Mount Screw-to-Gear Case	1	55 in. lbs. (6 Nm)
Tilt Bracket Screws	4	55 in. lbs. (6 Nm)
Transom Thru-Bolt Clamp Nut	1	190 in. lbs. (21 Nm) *

\* Apply Anti-Seize compound to threads of these fasteners.

Always use Anti-Seize compound on any external screws and nuts that are stainless-to-stainless.

## IGNITION SYSTEM WIRING DIAGRAM



**Fig. 155 – Ignition System**

- |  |  |
|--|--|
| 1. Safety/Engine Stop Switch                 | 10. FORWARD Position                                   |
| 2. BLACK Wire – to Safety/Engine Stop Switch | 11. NEUTRAL Position                                   |
| 3. Connector                                 | 12. REVERSE Position                                   |
| 4. BLACK Wire – Armature Ground              | 13. BLACK Wire   |
| 5. Armature                                  | 14. Wiring Harness Connector – to Engine Speed Limiter |
| 6. Spark Plug                                | 15. WHITE Wire   |
| 7. BLACK Wire – to Speed Limiter             | 16. Engine Ground                                      |
| 8. Not Used                                  | 17. RED Wire   |
| 9. Neutral Switch                            |  |

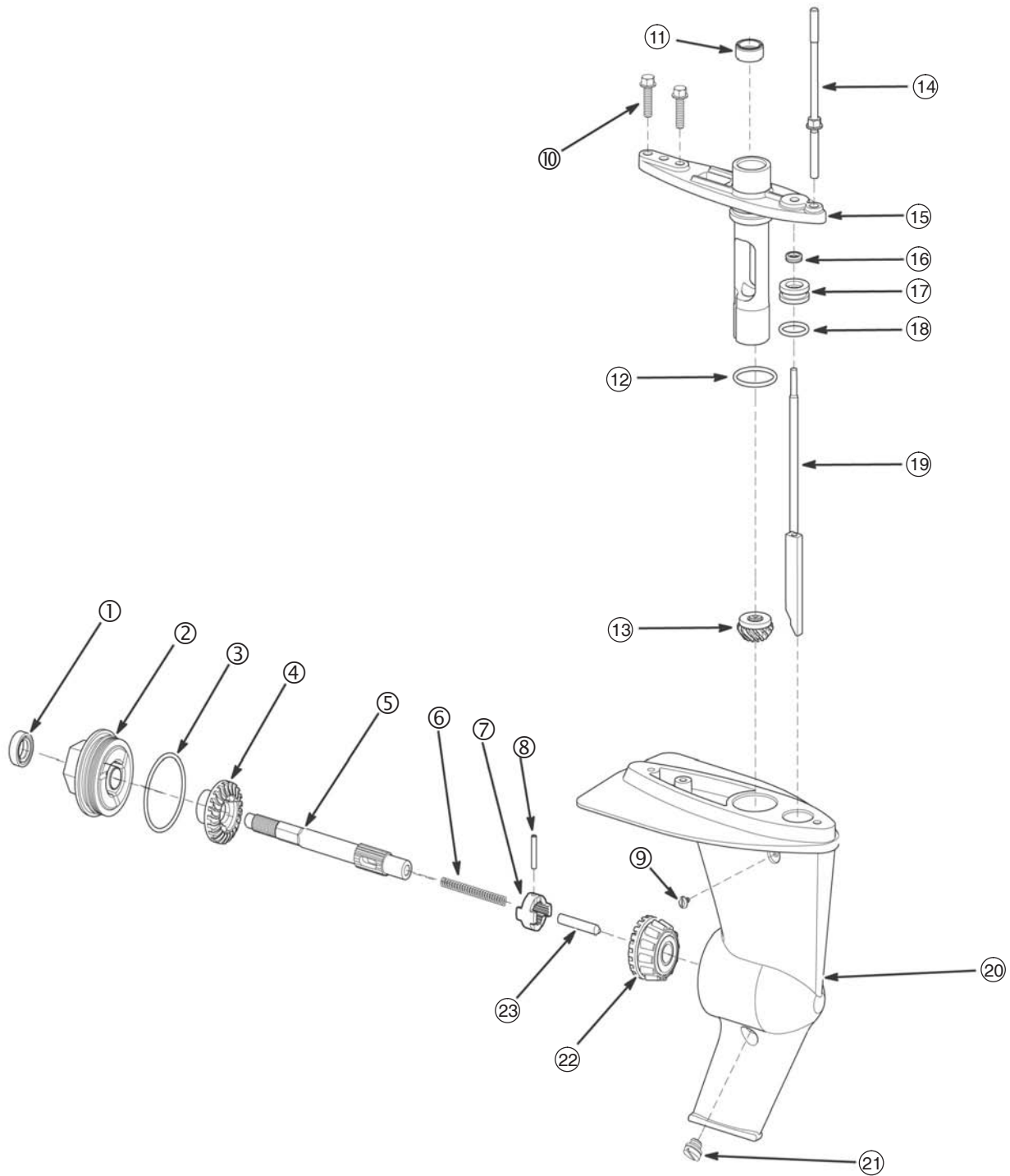


Fig. 156 – Component Location – Gear Case

## COMPONENT LOCATION – GEAR CASE

1. Seal
2. Propeller Shaft Carrier  
(LH Thread)
3. O-Ring
4. Reverse Gear
5. Propeller Shaft
6. Spring
7. Sliding Clutch
8. Roll Pin
9. Vent Plug
10. Screw (2, SS)
11. Seal
12. O-Ring
13. Pinion Gear
14. Stud
15. Input Shaft Carrier
16. Quad Ring Seal
17. Seal
18. O-Ring
19. Shift Cam/Rod
20. Gear Case
21. Oil Drain/Fill Plug
22. Forward Gear/Bearing Assembly
23. Shift Cam Follower

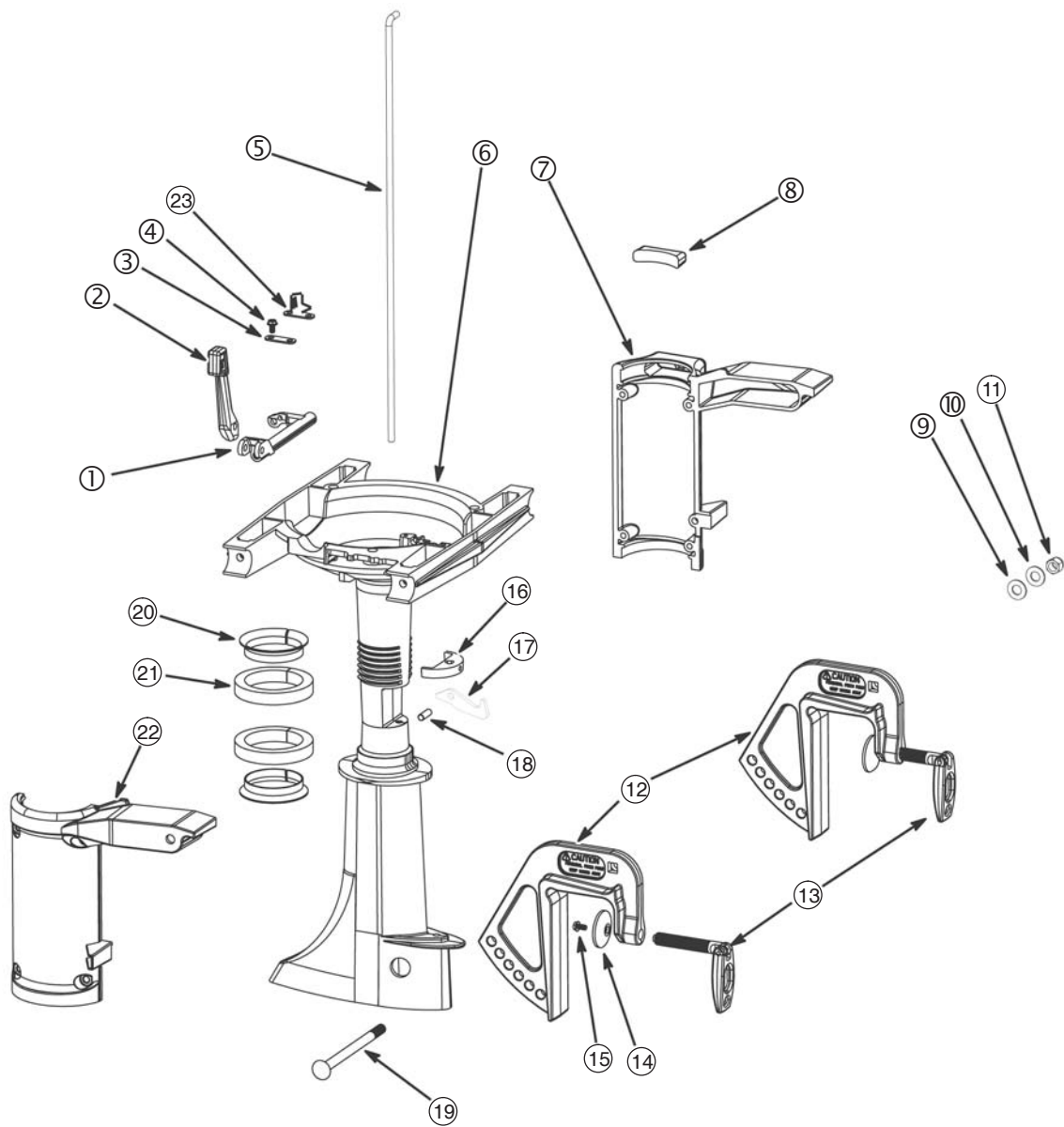


Fig. 157 – Component Location – Midsection



## COMPONENT LOCATION – MIDSECTION

1. Shift Lever
2. Shift Lever Handle
3. Plate
4. Screw (5 used)
5. Upper Shift Rod
6. Housing
7. Tilt Bracket  
(LH – Port)
8. Brake Shoe
9. Washer
10. Washer
11. Lock Nut
12. Transom Bracket
13. Clamp/Handle
14. Washer
15. Screw
16. Actuator
17. Reverse Hook
18. Pin
19. Bolt
20. Sleeve
21. Bushing
22. Tilt Bracket  
(RH – Starboard)
23. Neutral Switch



***Look for these other repair manuals from  
the Briggs & Stratton Power Products line:***

***86262GS Portable Generators Familiarization  
& Troubleshooting Guide***

***B3277GS Pressure Washer Familiarization  
& Troubleshooting Guide***

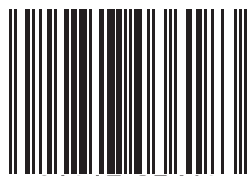
***190275GS Hand-Held Generator Familiarization  
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