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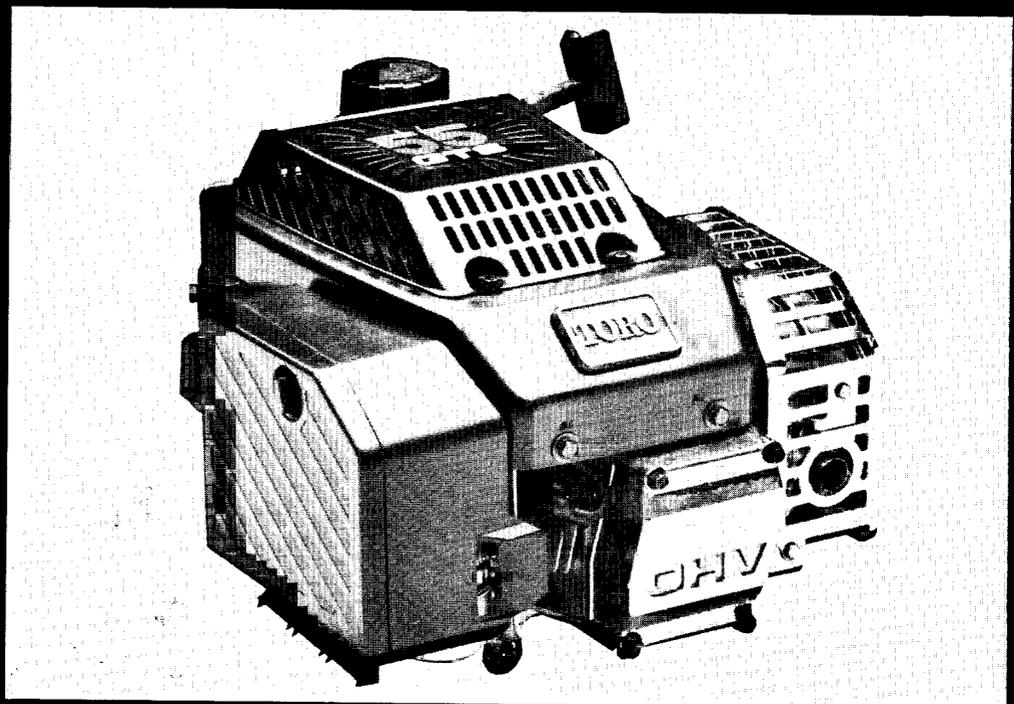
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GTS 150
**SERVICE
MANUAL**



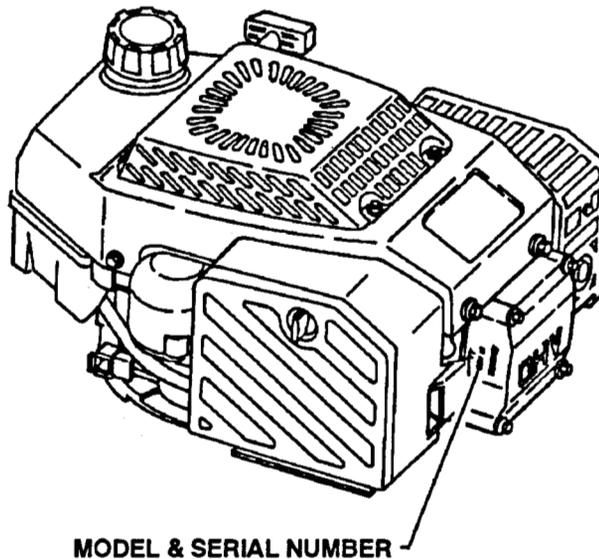
PREFACE

This Service and Overhaul Manual was written expressly for the following GTS 150 Overhead Valve Engines:

Model 97777 Type 0111-01

Model 97772 Type 0110-01

Model 97777 Type 3110-01



MODEL & SERIAL NUMBER

The Toro Company has made every effort to make this service manual a useful and lasting addition to every service facility. To assure proper and effective service, and to provide optimum performance for the life of the engine, you are urged to read this manual carefully.

It is not the purpose of this manual to teach component theory, but rather to provide the mechanic with a working guideline of maintenance, troubleshooting, test, repair and overhaul procedures.

The Toro Company reserves the right to change product specifications or this manual without notice.

The Toro Company gratefully acknowledges the assistance of the Briggs & Stratton Corporation and Ferris State University in the production of this manual.

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The Toro Company - 1991

Minneapolis, MN 55420 - U.S.A.

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SAFETY INFORMATION



This safety symbol means WARNING or CAUTION, PERSONAL SAFETY INSTRUCTION - Read the instruction because it has to do with safety. Failure to comply with the

instruction may result in personal injury or death.

This manual is intended as a service and repair manual only. The safety instructions provided in this manual are for the troubleshooting and service of the engine only. The individual Operator's Manual will contain safety information on the operation of the complete product powered by the GTS 150 engine. Operator's manuals with complete operational safety instructions are available through:

The Toro Company
Publications Department
8111 Lyndale Avenue South
Minneapolis, MN 55430 U.S.A.

SAFETY TIPS

Avoid lacerations and amputations...

Stay clear of all moving parts whenever the engine is running. Treat all normally moving parts as if they were moving whenever the engine is running or has the potential to start.

Avoid burns...

Do not touch the engine while running or shortly after running.

Avoid falls....

Do not operate the mower on slippery surfaces or if footing is questionable.

Avoid fires and falls...

Wipe up any spilled fuel or oil.

Avoid asphyxiation....

Never operate an engine in a confined area without proper ventilation.

Avoid eye injuries....

Wear eye protection when working with springs or cables and when running engine.

Avoid unexpected starting of engine...

Always turn off key and disconnect spark plug wire before attempting any cleaning, adjustment or repair.

Avoid fires and explosions...

Use a container designed for gasoline. Avoid spilling gasoline and never smoke while working around gasoline.

Avoid accidental misuse of fuel...

Always store fuel in a properly labeled container that is designed for gasoline.

Avoid injury due to inferior parts...

Use only Toro original parts to insure that important safety criteria are met.

Avoid injury to bystanders...

Always clear the area of bystanders before starting or testing a lawn mower.

Avoid injury due to projectiles...

Always clear the area to be mowed of sticks, rocks and other debris that could be picked up and thrown by the mower.

SPECIFICATIONS

GTS 150 Engine Specification

Item	Specification
Type	air cooled, 4-stroke overhead valve
Bore	2.562" (65.07 mm)
Stroke	1.780" (45.21 mm)
Displacement	9.18 cu. in. (150.46 cc)
Valve Lash (cold setting)	.005 - .007" (.13 - .18 mm)
Valve Seat Angle (factory)	44 degrees
Valve Seat Angle (resurface)	45 degrees
Valve Face Angle (factory)	44.75 degrees
Valve Face Angle (resurface)	45 degrees
Compression	90 - 110 psi (6.5 - 7.8 kg/cm ²) See "Compression Measurement" on page 37
Engine Rotation	counterclockwise as viewed from PTO
Carburetor	float type with fixed main jet
Fuel	unleaded regular
Fuel Tank	44 ounces (1.3 liters)
Ignition System	solid state magneto type
Ignition Timing	22 degrees BTDC
Ignition Coil Resistance	primary .2 - .4 Ohms, secondary 2400 - 5000 Ohms
Spark Plug and Gap	Champion RC12YC, gap .030" (.76 mm)
Starting System	rewind (12 volt on some models)
Alternator Output	.5 amperes (unregulated)
Lubrication	gerotor pump and splash
Oil Capacity	25 ounces (.74 liters)
Recommended Oil	detergent SAE 10W-30 or 30, SF, SG
Governor	centrifugal, mechanical
Governed Engine Speed	3000 +/- 100 RPM
Idle Speed	1400 +/- 100 RPM
Air Cleaner	two stage foam type with optional paper element
Choke	manual, snap over design
Fuel Filter	in tank, washable, 75 micron
Piston	aluminum alloy, permanent mold
Piston Rings	two compression, one, 3 piece oil control

SPECIFICATIONS (cont'd)

GTS 150 Carburetor Specifications

Item	Specification
Type	Walbro float type
Main Jet (std)	#30 - .0295" (.75 mm)
Main Jet (High Alt)	#28 - .0280" (.71 mm)
Pilot Jet	.0360" (.91 mm) tube, no jet
Seat Material	viton
Inlet Needle Material	stainless steel
Inlet Needle Pop "off" Pressure	5 psi (.7 Kg/cm ²)

GTS 150 Fastener Torques

Item	Torque
Spark Plug	170 in lbs (19 Nm)
Cylinder Head Bolts	160 in lbs (18 Nm)
Flywheel Nut	60 ft lbs (81 Nm)
Connecting Rod Nuts	100 in lbs (11 Nm)
Rewind Starter Pulley Screw	70 in lbs (8 Nm)
Rewind Starter Mounting Screws	40 in lbs (5 Nm)
Air Cleaner Screws	35 in lbs (4 Nm)
Carburetor to Intake Fasteners	60 in lbs (7 Nm)
Crankcase Screws	85 in lbs (10 Nm)
Shroud Fasteners	50 in lbs (5.5 Nm)
Oil Pump Screws	85 in lbs (10 Nm)
Muffler Nuts	85 in lbs (10 Nm)
Electric Starter Screws	85 in lbs (10 Nm)
Flywheel Brake Screws	85 in lbs (10 Nm)
Rocker Arm Studs	110 in lbs (12 Nm)
Rocker Bell Locking Screws	45 in lbs (5 Nm)
Governor Lever Lock Nut	35 in lbs (4 Nm)

TOOL REQUIREMENTS

Description	Specification	Comments
Open End / Box	7/16"	connecting rod, flywheel puller
Open End / Box	10 mm	valve adjusting nut
Hex Key	3 mm	valve adjusting jam screw
Socket (3/8" Drive)	5/16"	(Nut driver acceptable)
	3/8 "	
	7/16"	
	1/2 "	
	16mm / 5/8"	deep well for spark plug
Socket Adapter	3/8" to 1/4" Drive	
Extension	3", 3/8" Drive	
Feeler Gauges	SAE and Metric	
Flywheel Holder		B & S part number 19372
Flywheel Puller		B & S part number 19069
Oil Seal Protector		B & S part number 19334
Piston Ring Compressor		B & S part number 19070
Piston Ring Expander		B & S part number 19340

TROUBLESHOOTING

Engine Does Not Start When "Cold"

Possible Causes	Remedy
fuel tank empty	fill tank with clean fresh unleaded fuel
bad fuel	drain tank and float bowl, fill tank with clean fresh unleaded fuel
fuel filter plugged	replace filter
air cleaner plugged	wash and re-oil air cleaner element
carburetor is fouled	clean the carburetor
no spark at plug	see "Engine Does Not Produce Spark"
incorrect ignition timing	check for sheared flywheel key
low compression	see "Engine has Low Compression"
engine flooded with fuel	see "Engine Flooded with Fuel"
valve stuck shut	free valve
push rod bent	replace push rod, free stuck valve

Engine Will Start "Cold", but will Not Start "Hot"

Possible Causes	Remedy
engine flooded	See "Engine Flooded" section
excessive alcohol in fuel	use no more than 10% ethanol blend
inadequate valve clearance	readjust valves to .005 - .007" (.12 - .17 mm), measured when engine is cold
engine overheated	see "Engine Overheated" section

Engine Does Not Produce Spark

Possible Causes	Remedy
engine control in "off" position	move control to the "run" position
spark plug wire disconnected	reconnect spark plug wire
spark plug wire damaged	replace ignition coil
spark plug fouled or damaged	replace with a new plug
coil kill wire grounded	locate and eliminate the ground
ignition coil failed	replace the ignition coil
flywheel magnets failed	replace flywheel

TROUBLESHOOTING (cont'd)

Engine has Low Compression

Possible Causes	Remedy
incorrect valve clearance	readjust valves to .005 - .007" (.15 - .17 mm) measured with engine cold
worn piston rings	replace piston rings
piston rings stuck in groove	replace piston and rings
head gasket leaking	replace gasket and torque head bolts (look for overheating as cause)
valves do not seal	replace or reseal valves
valve stuck open	free and/or replace valve

Engine Flooded with Fuel

Possible Cause	Remedy
over use of "choke" position	take throttle control off "choke"
throttle cable mis-adjusted	adjust throttle cable
choke over center spring broken	repair spring
air cleaner plugged	wash and re-oil air cleaner element
fouled spark plug	replace spark plug
carburetor float stuck open	clean carburetor, replace failed parts

Engine Lacks Power

Possible Cause	Remedy
dull blade	sharpen or replace blade
housing choked with grass	clean mower housing
low or no crankcase oil	maintain correct oil level
flywheel key sheared	replace flywheel key
incorrect valve adjustment	adjust valves .005 - .007" (.15 - .17 mm)
carburetor fouled	clean carburetor
intake manifold air leak	repair or replace failed components
restricted exhaust	clean exhaust port or muffler
low compression	see "Low Compression"

TROUBLESHOOTING (cont'd)

Bent Push Rod

Possible Cause	Remedy
sticky valve guides	free valves
carbon build up	decarbon engine

Engine Surging

Possible Cause	Remedy
fouled carburetor pilot jet	clean carburetor and jet
worn throttle linkage	replace linkage

Engine Back Fires

Possible Cause	Remedy
flywheel key sheared	replace key
intake valve not closing	adjust valves

Engine After Fires

Possible Cause	Remedy
stopping engine from high RPM	idle before shutting off ignition
carbon build up in muffler	decarbon muffler
hot spot in exhaust path	remove hot spot
air leak in muffler	replace muffler

Engine Overheats

Possible Cause	Remedy
obstructed recoil start screen	clean screen
low engine oil level	change or bring oil level to normal
restricted main carburetor jet	clean carburetor
clogged cooling fins	clean cooling fins

Engine Vibrates Excessively

Possible Cause	Remedy
out of balance blade	balance or replace blade
bent blade	replace blade
bent crankshaft	replace crankshaft
loose engine mounting bolts	torque mounting bolts
out of balance BBC flywheel	replace flywheel

TROUBLESHOOTING (cont'd)

Engine Crankshaft Will Not Turn

Possible Cause	Remedy
blade is jammed in housing	inspect and repair
crankshaft seized in its bearings	inspect and repair
camshaft seized in its bearings	inspect and repair
piston seized in its cylinder	inspect and repair
engine brake engaged	disengage brake or inspect and repair

Engine Produces Mechanical Knocking Sound

Possible Cause	Remedy
loose blade	inspect and replace or tighten fastener to the correct torque
loose BBC flywheel	inspect and replace or tighten fastener to the correct torque
pre-ignition	see "Pre-Ignition" section
loose rod cap	inspect and repair

Pre-Ignition

Possible Cause	Remedy
sheared flywheel key	inspect and repair
low quality fuel	replace with fresh unleaded regular fuel
carbon build up in engine	decarbon engine
excessive alcohol in fuel	replace with fresh unleaded regular fuel with no more than 10% ethanol

Engine Smokes Excessively

Possible Cause	Remedy
engine over filled with oil	correct the oil level
air cleaner element clogged	clean or replace
engine run on two-stroke fuel	use fresh fuel (no oil)
breather inoperative	repair or replace
crankcase air leak	find and repair leak
worn rings and/or cylinder	rebuild engine or short block

TROUBLESHOOTING (cont'd)

Engine Stalls

Possible Cause	Remedy
engine out of fuel	refill with fresh fuel
engine overloaded	unload engine and restart
spark plug fouled	see "Spark Plug Fouled" section
gas cap vent plugged	replace gas cap
no lubricating oil	inspect, repair and fill to correct oil level
ignition grounded	inspect and repair

Spark Plug Fouled

Possible Cause	Remedy
incorrect spark plug	use correct spark plug
clogged air cleaner	clean or replace element
crankcase overfilled	maintain correct oil level
overuse of choke	readjust or move control off choke
weak ignition system	repair or replace
worn rings and/or cylinder	rebuild engine or short block
use of leaded fuel	replace with fresh unleaded regular gasoline

GTS 150 MAINTENANCE

Servicing Air Cleaner

Normally, clean the air cleaner after every 25 operating hours. More frequent cleaning is required when the mower is operated in dusty or dirty conditions.

1. Stop the engine, allow it to cool and disconnect the spark plug wire. Remove the key from the key switch on electric start models.
2. Rotate the knob securing the air cleaner cover to the engine until the cover can be removed. Clean the cover thoroughly. See Figure 1.

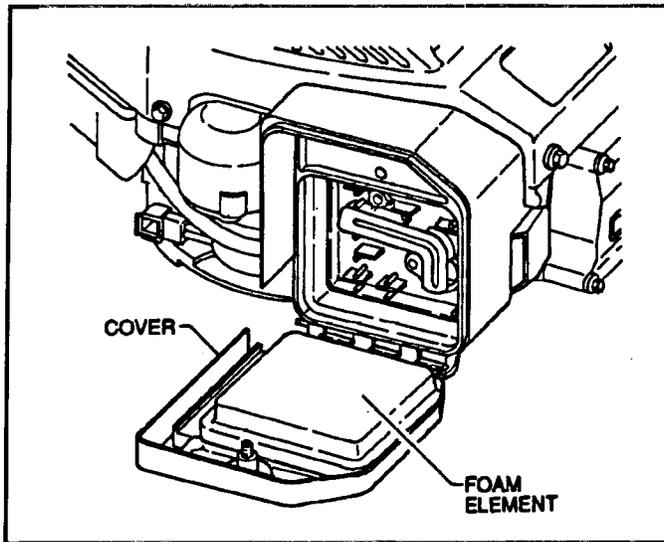


Figure 1

3. If the outside of the foam element is dirty, remove it from the air cleaner body and clean it thoroughly. See Figure 1.
 - A. Wash the foam element in a solution of liquid soap and warm water. Squeeze the element to remove dirt, but do not twist as the foam may tear. Rinse thoroughly in clear water.
 - B. Dry the element by wrapping it in a clean rag. Squeeze the rag and foam element to dry.
 - C. Saturate the element with 5 teaspoons (25 ml) of SAE 10W 30 engine oil. Squeeze the element to remove excess oil and to distribute the oil thoroughly. A damp element is desirable.
4. Reinstall the foam element and air cleaner cover. Do not operate the engine without the air cleaner element as extreme engine wear and damage will likely result.
 - A. Paper elements are available for use in extremely dirty conditions. Toro part number 77-9010.

Replacing the Spark Plug

Use a Champion RC12YC spark plug or equivalent. The correct air gap is .030" (.76 mm). Remove the plug after every 25 operating hours and check its condition.

1. Stop the engine, allow it to cool and disconnect the spark plug wire. See Figure 2. Remove the key from the switch on electric start models.

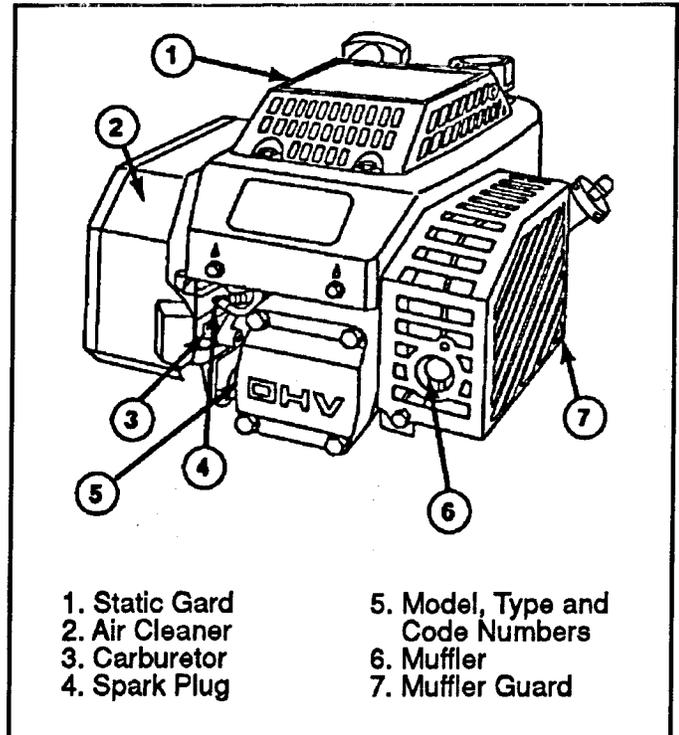


Figure 2

2. Clean around the spark plug and use a 5/8" socket to remove the plug from the cylinder head. Replace a cracked, fouled, or dirty spark plug. Do not sand blast, scrape, or clean electrodes as engine damage could result from grit entering the cylinder.
3. Set the air gap at .030" (0.76 mm). See Figure 3. Install the correctly gapped spark plug and gasket seal. Tighten the plug to 14 ft lbs (19 N•m).

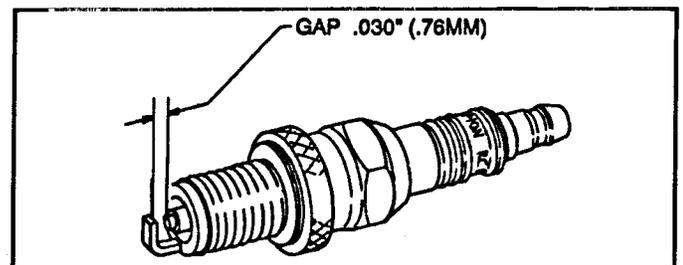


Figure 3

Removing Gasoline from the Fuel Tank

1. Stop the engine, allow it to cool and disconnect the spark plug wire. Remove the key switch on electric start models.
2. Remove the cap from the fuel tank and use a pump type siphon to transfer fuel into a clean gas can or container designed to hold gasoline. Note: this is the only fuel removal procedure that should be used for general maintenance.

Changing Crankcase Oil

Change the oil after the first 2 operating hours and after every 25 hours. Since warm oil will drain better and carry more contaminants than cold oil, run the engine for a 5 minute period before draining the oil.

1. Stop the engine, allow it to cool and disconnect the spark plug wire. See Figure 4.

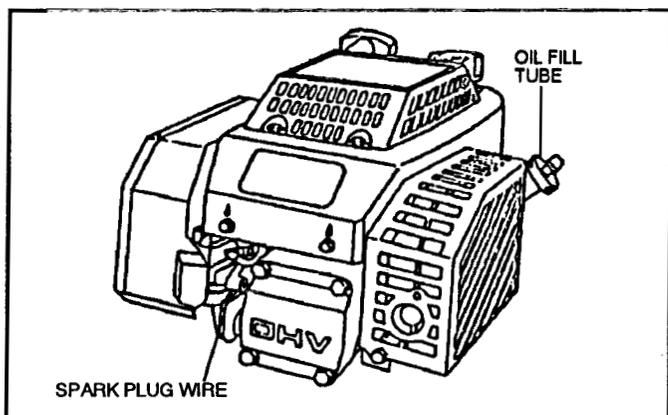


Figure 4

2. Remove the gasoline from the fuel tank: refer to "Removing Gasoline" on page 23.
3. Remove the dipstick from the oil fill tube and place a drain pan next to the left side of the mower.
4. Tip the mower on its left side, allowing the oil to drain into the drain pan. See Figure 5.

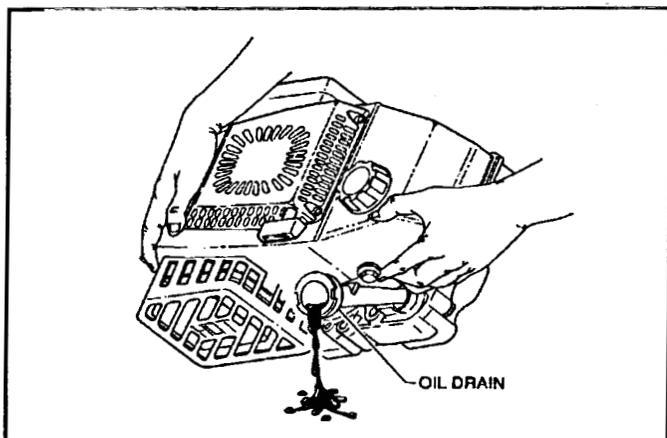


Figure 5

5. When the oil is drained, return the mower to its upright position and add fresh oil to the engine. Refer to "Filling the Crankcase with Oil" on page xx. The crankcase capacity is 25 oz (.74 liters). When changing oil, the crankcase may retain a small amount of oil, reducing the amount required to bring the oil level back to normal.

Carburetor - Adjustment

1. Turn the idle mixture screw clockwise until it seats. DO NOT FORCE.
2. Turn the idle mixture screw counterclockwise 1-1/2 turns. This will permit the engine to start and final adjustment can be made with the engine running.
3. Start the engine and allow it to warm up.
4. While the engine is running, move the speed control lever to the fast position until the hole "A" in the throttle lever aligns with the hole in the throttle control bracket. See Figure 6. Use a 1/8" (3 mm) diameter pin to hold the holes in position.

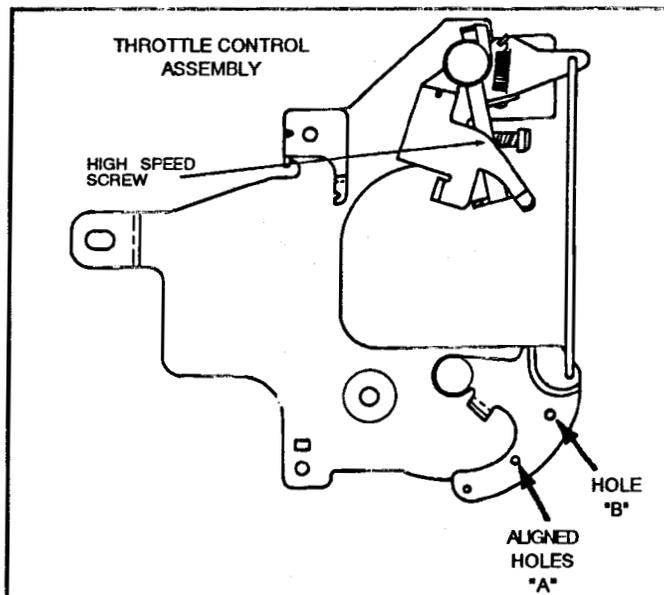


Figure 6

5. Adjust the high speed screw on the throttle control bracket to obtain 3000, +/- 100 RPM.
6. Remove the pin and move the speed control lever to the slow or idle position, until hole "B" in the throttle control lever aligns with the hole in the throttle control bracket. Use a 1/8" (3 mm) diameter pin to hold the holes in alignment.
7. Adjust the idle speed stop screw to 1700, +/- 100. See Figure 7.

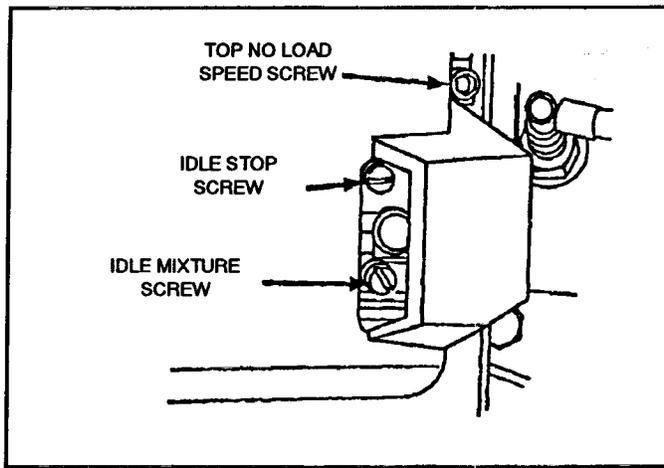


Figure 7

8. Turn the idle mixture screw slowly, clockwise (lean mixture) until the speed just begins to slow down. Then, turn the idle mixture screw slowly counterclockwise (rich mixture) until the engine increases in speed and then just starts to slow down. Turn the screw to a midpoint position between rich and lean. Note: if the speed exceeds 1900 RPM during this adjustment, repeat step 7 and 8. If the engine does not accelerate properly, re-adjust the idle mixture screw approximately 1/8 of a turn counterclockwise to richen the mixture.
9. Remove the aligning pin and re-adjust the idle speed stop screw to 1400 +/- 100 RPM.
10. Re-check the high speed setting.

Compression - Measurement

Engine compression can vary depending on the technique and compression gauge used to make the measurement. The compression values given in the specification section are a reference point only. We recommend the individual dealer establish compression values based on new product using his or her own technique and compression gauge.

1. Remove the spark plug and install a compression gauge that threads into the spark plug opening.
2. Pull the starter rope rapidly to achieve a momentary engine speed of over 500 RPM. This will cause the compression release mechanism to allow the intake valve to completely close.
3. Pull the starter rope repeatedly until there is no further rise in the compression value.

Throttle - Adjustment

Throttle control adjustment may be required if the engine does not start, stop or run at the correct speed. Whenever a new throttle control cable is installed, the throttle must be adjusted.

1. Stop the engine, allow it to cool and disconnect the spark plug wire. Remove the key on electric start models.
2. Move the throttle control to the "Fast" position.
3. Loosen the cable clamp screw until the throttle cable sheath can slide in its clamp.
4. Move the throttle cable left or right until holes in the throttle lever and throttle bracket align. See Figure 8.

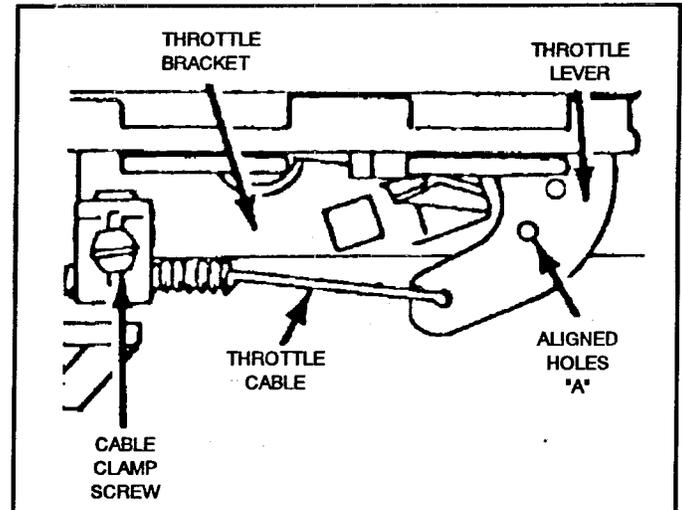


Figure 8

5. Insert a 1/8" (3 mm) pin in the aligned holes to hold the throttle lever in position.
6. Pull the throttle cable slightly to remove any slack and tighten the cable clamp screw to lock the adjustment in place.
7. Remove the 1/8" (3 mm) pin and bring the throttle control back to the off position.
8. Connect the spark plug wire.

Clean the Engine and Recoil Starter

Accumulated yard debris and dirt can cause overheating and malfunction of control linkages. Before every mowing, the muffler area, throttle linkage and air intake screens should be cleaned of debris.

1. Stop the engine, allow it to cool and disconnect the spark plug wire. Remove the key on electric start models.
2. Remove dirt and debris with a cloth, brush or low pressure (30 psi, 200 kPa or less) air. When using compressed air be sure to wear safety glasses to prevent eye injury from airborne debris.
3. A forceful stream of water is not recommended as it could cause contamination of the fuel system.

Clean the Cooling System

Every 25 hours, or every cutting season, the engine blower housing must be removed and the cooling fins cleaned. Failure to clean the cooling system may lead to engine overheating and severe engine damage.

1. Stop the engine, allow it to cool and disconnect the spark plug wire. Remove the key on electric start models.
2. Remove the four 3/8" hex, washer head screws that retain the blower housing to the engine.
3. Remove the gas cap and lift the blower housing and recoil starter assembly away from the engine to expose the cooling fins. Replace the gas cap.
4. Remove dirt and debris with a cloth, brush or low pressure, 30 psi (200 kPa) or less, air. When using compressed air be sure to wear safety glasses to prevent eye injury from airborne debris. See Figure 9.

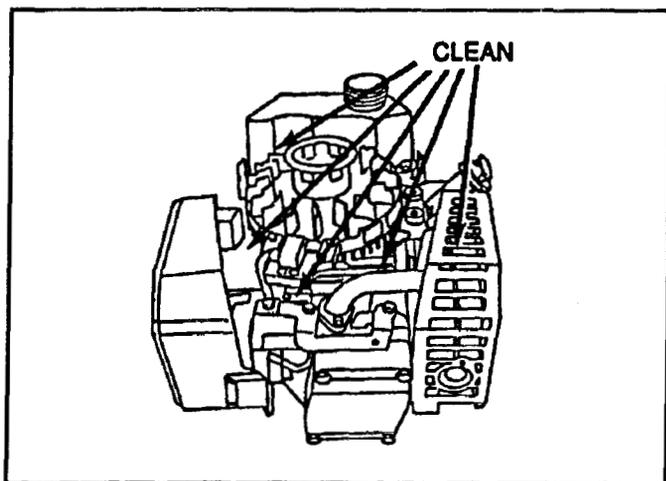


Figure 9

5. Remove the gas cap and install the blower housing. Replace the gas cap. Install the four 3/8" hex, washer head screws that retain the blower housing. Tighten the screws to 50 in lbs (5.6 Nm).

Preparing the Engine for Storage

For long term storage, either remove gasoline from the fuel tank and carburetor as described on page 16 or add a fuel stabilizer to the gasoline. If the gasoline has been removed from the fuel tank, start the engine and allow it to idle until all the fuel is consumed and the engine stops. Repeat the starting procedure two more times to assure all the gasoline is removed from the engine. If gasoline is not removed from the carburetor in this manner, gum-like varnish deposits will form and cause starting problems and/or poor engine operation.

Fuel can be left in the fuel tank only if a fuel additive such as Toro's Stabilizer/Conditioner is added to the gasoline and run through the engine before storage.

Toro's Stabilizer/Conditioner is petroleum distillate based. The Toro Company does not recommend stabilizers with an alcohol base, such as ethanol, methanol or isopropyl alcohol.

Under normal conditions, all fuel additives remain effective in fuel for 6-8 months.

1. Remove the spark plug and pour two tablespoons (30 ml) of SAE 30 oil into the spark plug hole in the cylinder. Pull the starter rope slowly to coat the inside of the cylinder. Install the spark plug and tighten to 14 ft lb (19 Nm). Do not connect the spark plug wire.
2. Clean dirt and chaff from the cylinder, cylinder head fins, and blower housing. Also remove grass clippings, dirt and grime from the external parts of the engine, shrouding and top of the mower housing.
3. Clean the air cleaner: refer to the Maintenance Section on Servicing the Air Cleaner on page 15.
4. Change the engine oil: refer to the Maintenance Section on Changing the Engine Oil on page 16.
5. Tighten all nuts, bolts and fasteners.
6. Store the engine in a clean, dry place. Cover the engine to keep it clean and protected.

SECTION 1 CARBURETOR

Carburetor Description

The carburetor used on the GTS 150 is a dual circuit (pilot and main), float bowl design with fixed main jet, fixed nonremovable pilot jet and an adjustable pilot circuit mixture screw. The carburetor is fitted with a standard number 30 (.0295") main jet. A high altitude main jet number 28 (.0280") is also available. The carburetor is fitted with a stainless steel inlet needle and a replaceable inlet seat. The throttle and choke shaft are equipped with dust seals.

Carburetor Theory and Operation

The carburetor receives fuel from the tank and mixes it with air in the right proportions to provide a highly combustible mixture to the engine.

As the piston moves down on the intake stroke, a partial vacuum is created within the cylinder, causing the greater atmospheric pressure to force air to flow through the carburetor into the cylinder. The velocity of the air increases as it flows through the carburetor venturi and the air pressure is reduced at this point to less than atmospheric pressure. The differences of pressure in the venturi of the carburetor causes atmospheric pressure to push raw fuel from the float bowl into the air stream where it breaks up into a fine spray, or becomes atomized, and mixes with the air stream. See Figure 10.

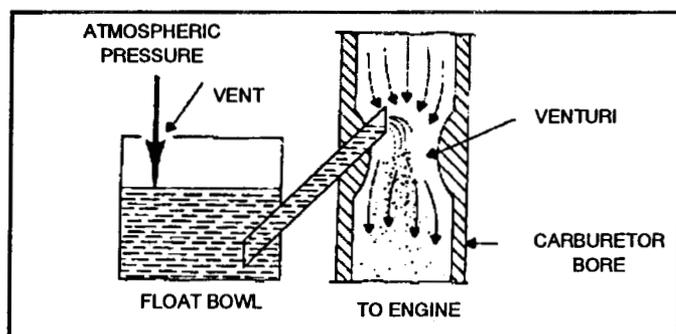


Figure 10

When starting the engine, an extra rich mixture is required. The choke plate is closed by the operator to provide an approximate 8:1 (approximately six times richer than normal) ratio of fuel to air for this rich mixture. Closing the choke plate further reduces the air pressure area in the venturi to increase the fuel drawn into the carburetor bore. In this condition, fuel is drawn from the float bowl through the pilot system ports as well as the main discharge tube to achieve the proper starting mixture. See Figure 11.

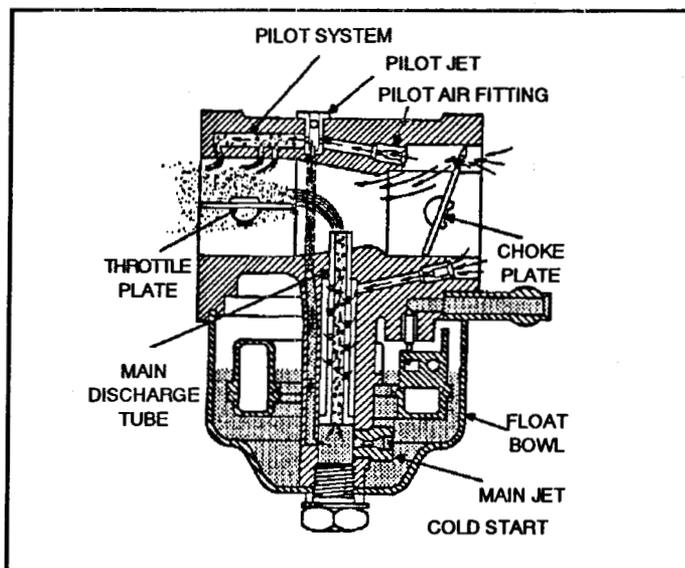


Figure 11

Fuel atomization becomes more efficient due to heat, once the engine has reached normal operating temperature. As a result, the engine does not require the rich mixture it did for starting and the choke plate must be moved to the open position. The engine speed is now regulated by the throttle plate. In no load condition, a small portion of the fuel may be drawn from the main discharge tube, however the primary fuel supply is drawn from the pilot circuit. Air passing through the pilot jet from the pilot air fitting draws fuel out of the pilot jet orifice from the float bowl. This fuel pre-mixes with the incoming air and is discharged into the carburetor bore where the fuel becomes atomized. See Figure 12.

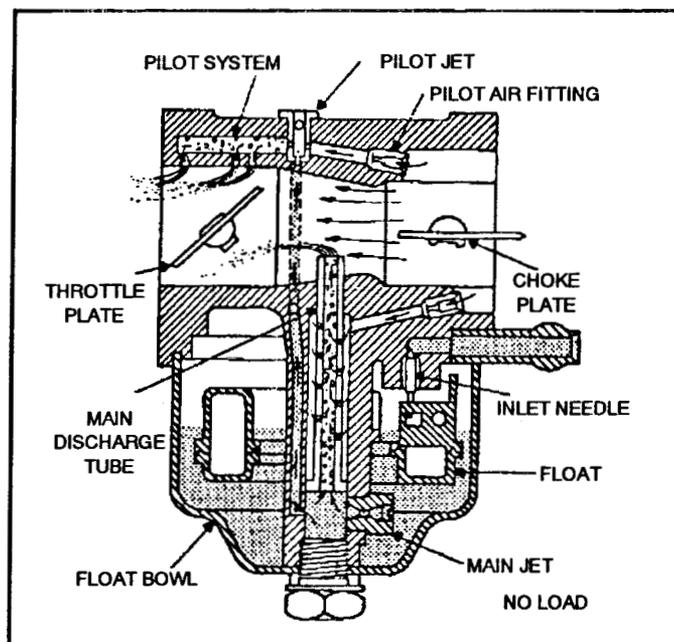


Figure 12

As the throttle plate is opened to compensate for engine load, the main discharge tube becomes the main source of fuel. Opening the throttle plate increases the flow of air through the venturi and strengthens the low pressure area at the main discharge tube. Fuel discharge increases at the main discharge tube as it decreases from the pilot system. Air is drawn from the air correction jet, through holes along the length of the main discharge tube. This pre-mixes air with the fuel before it enters the carburetor bore for more efficient atomizing of the fuel. See Figure 13.

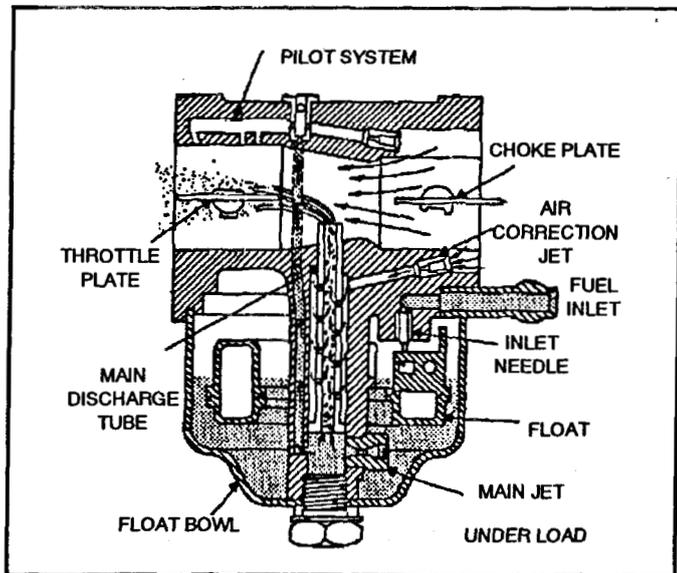


Figure 13

Carburetor - Removal

1. Remove the fuel from the tank as described in the Maintenance Section on page 16.
2. Remove the three 5/16" hex, washer head shoulder screws retaining the air cleaner to the carburetor. Take care not to lose the cork gasket that seals between the air cleaner body and the carburetor. See Figure 14.

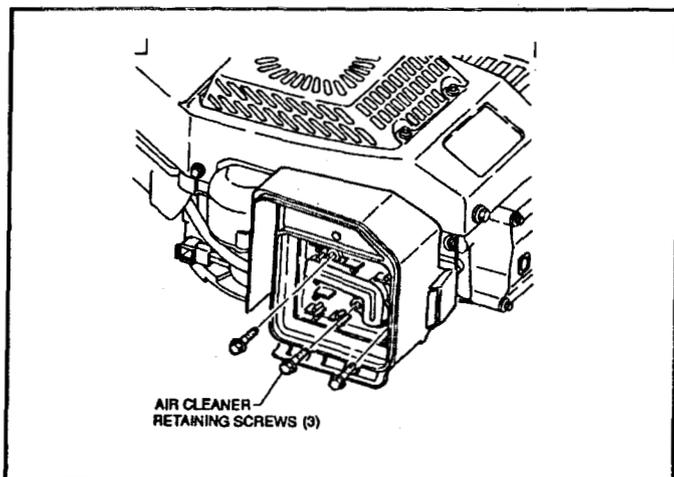


Figure 14

3. Disconnect the choke over-center spring. Note the position of the spring for correct assembly. See Figure 15.

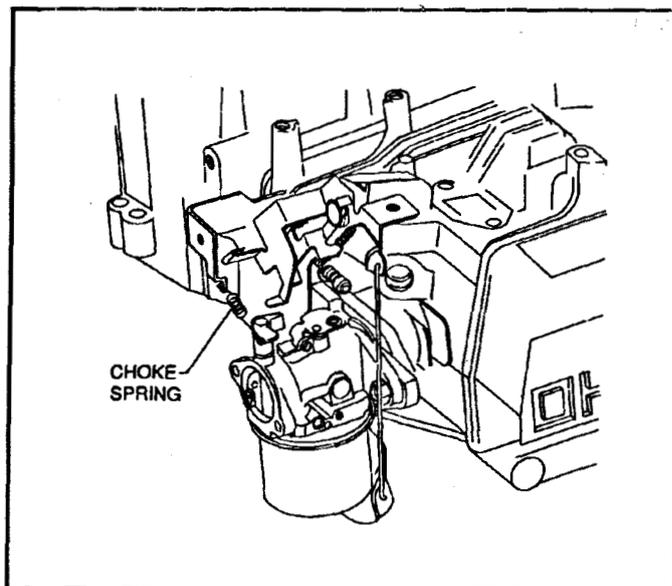


Figure 15

4. Remove the two 3/8" hex, washer head screws that retain the carburetor, the insulator gasket, and engine block. See Figure 16.

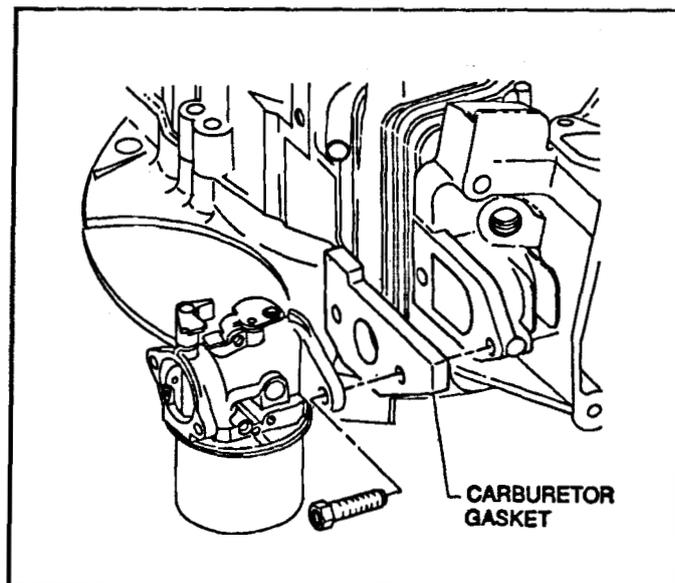


Figure 16

5. Have a rag ready to absorb a small amount of spilled gasoline. Pull the carburetor away from the engine. Twist the carburetor to unhook the carburetor from the governor link rod. As the carburetor is tilted, fuel that is in the fuel bowl may leak out the bowl vent tube.
6. Hold the carburetor over a drain pan and use a 1/2" wrench to loosen the bowl nut. Allow the remaining fuel in the bowl to drain into the pan. Tighten the bowl nut.

Carburetor - Pressure Testing

1. Turn the carburetor upside down.
2. Connect a pressure tester to the inlet fitting on the carburetor. See Figure 17.

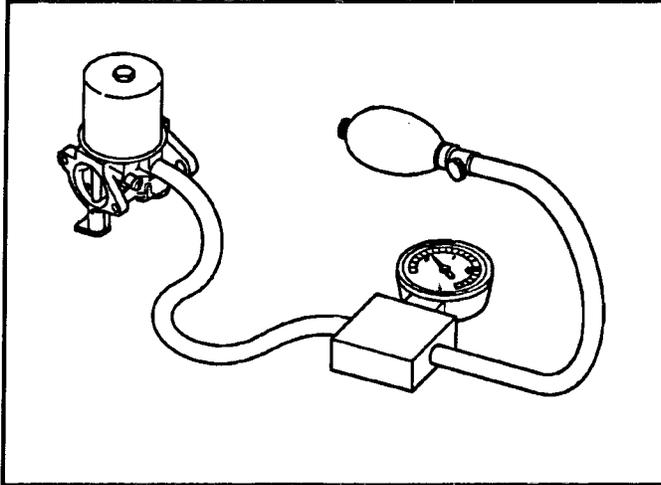


Figure 17

3. Pump the pressure to the inlet needle "pop off" pressure, 5 psi (.3 kg/cm²).
4. The inlet needle should seal. If the pressure leaks down to zero, the inlet needle is not seating indicating that carburetor service is required.

Carburetor - Disassembly

1. Remove the bowl nut, bowl and gasket.
2. Use a 9/16" wrench to remove the main jet and float stop disc. See Figure 18.

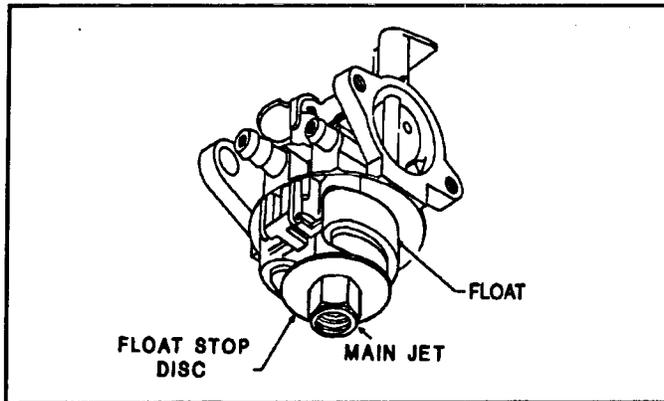


Figure 18

3. Remove the float hinge pin, float and inlet needle.
4. Remove the idle mixture screw and spring and the idle stop screw and spring. See Figure 19.

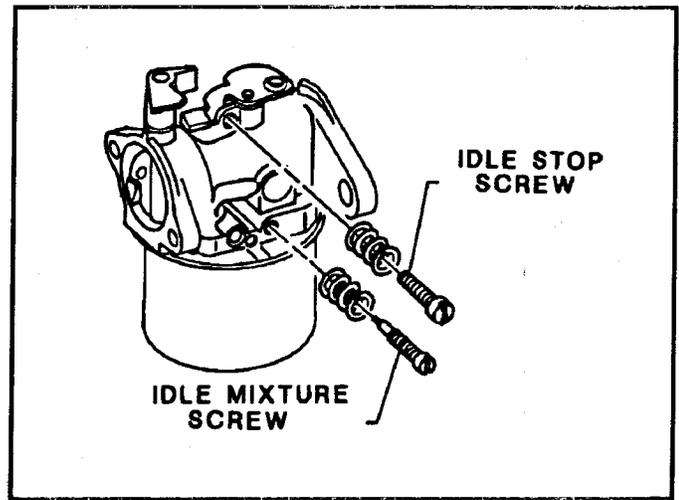


Figure 19

5. The throttle plate is retained with one screw. When the plate is removed the throttle shaft may be withdrawn from the body of the carburetor.
6. The choke plate is retained in a slot in the choke shaft with an interference fit. The plate may be removed by pulling it out of the slot with a pair of pliers. The choke shaft may then be removed from the body of the carburetor.
7. If the carburetor vent passage is open it is not necessary to remove the welch plug that covers the vent opening in the bowl of the carburetor. This is a vent area that does not have a filter screen or other cleanable device.
8. Remove the pilot circuit welch plug from the side of the carburetor. Pierce the plug with a small chisel or pointed device and pry the plug out of the body of the carburetor.
9. The viton, fuel inlet seat may be removed by pulling the seat out of the body of the carburetor with a number 5 crochet hook.

Carburetor - Cleaning and Service

1. **CAUTION:**  Wear gloves that are suitable for use with chemicals and wear eye protection when working with carburetor cleaning materials. Work only in well ventilated areas free from sparks or flames. Make sure you follow all manufacturers recommendations on the use of their cleaning products.
2. The carburetor body and components may be soaked in carburetor cleaner, however; after the soak, each passage and component in the carburetor should be washed with a pressurized carburetor cleaning agent. Soak tanks may not be clean and the pressurized cleaner will remove any residue.
3. Direct the pressurized cleaner through all openings and passages in the opposite direction of normal fuel or air flow.

4. Use extreme care with mechanical cleaning devices: i.e. wires, probes, tip cleaners, etc. Mechanical cleaning may damage or enlarge critically sized carburetor components and passages.

Carburetor - Assembly

1. Install a new welch plug in the pilot circuit opening on the body of the carburetor. Use a 1/8" (3 mm) pin punch to dimple and seal the welch plug in the body of the carburetor.
2. Install the throttle shaft dust seal and throttle shaft in the body of the carburetor.
3. Use red, number 271 Loctite™ on the throttle plate screw and install the throttle plate. Allow the specified amount of time for the Loctite to cure before operating the engine.
4. Place a dust seal on the choke shaft and insert the choke shaft in the body of the carburetor.
5. While looking at the choke end of the carburetor, position the choke shaft with the over-center spring slot toward the right side of the carburetor.
6. Insert the choke plate so the plate is captured in the slot of the choke shaft. The choke should fully close with a 90 degree clockwise turn of the shaft.
7. Install the idle stop screw. Adjustment of the screw should be performed when the engine is running. Idle speed should be set to 1700 RPM. See page 16 for the carburetor adjustment procedure.
8. Install the idle mixture screw; nominally set at 1 to 1-1/2 turns open. See Figure 20.

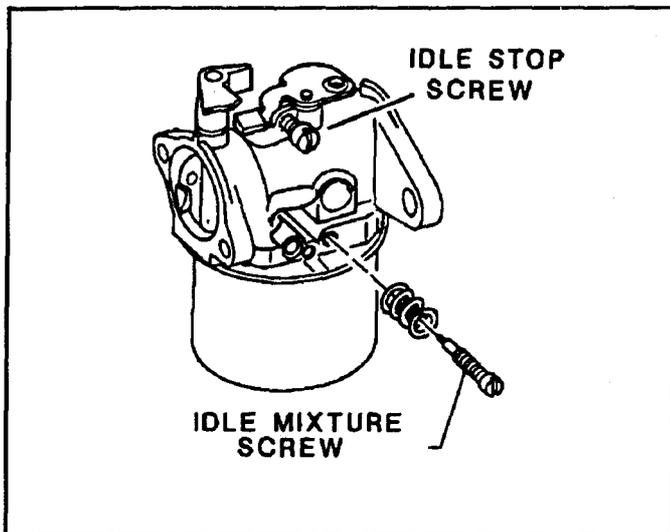


Figure 20

9. Install a new viton seat. Insert the seat with a 1/8" (3 mm) pin punch. The flat end of the inlet needle will also work to push the seat in place. Take care not to damage the point end of the needle.

10. Install the needle on the float. Put the float and needle in position and insert the hinge pin.
11. Install the float stop disc and the main jet.
12. Install the bowl gasket and the fuel bowl.
13. Install the bowl nut.

Carburetor - Adjustment

See "Carburetor - Adjustment" in the Maintenance Section on page 16.

SECTION 2 FUEL SYSTEM

FUEL TANK

Fuel Tank - Operation

The GTS 150 uses a 1.6 quart (1.5 liters) plastic fuel tank with a non-replaceable 75 micron in-tank filter screen. The filter is welded in the bottom of the tank over a sediment reservoir. The tank is mounted above the level of the carburetor and uses gravity to supply fuel through a .25" I.D. (6.35 mm) rubber hose to the carburetor. The fuel tank is vented through an opening in the fuel cap. The fuel hose is retained to the tank and the carburetor with spring type hose clamps. The fuel opening on the tank is 1.75" (45 mm) in diameter and is opposite the fuel outlet helping to prevent damage to the filter screen by funnels and gasoline filler spouts. The placement of the cap also prevents interference with the starting rope in Zone Start applications.

Fuel Tank - Removal

1. Crimp the fuel hose with a pair of locking pliers to prevent fuel flow.
2. Remove the hose clamp on the carburetor end of the hose.
3. **CAUTION:**  Avoid fire and explosion. Store fuel in a container designed for gasoline and never smoke while working around gasoline. Release the clamping pliers and drain the fuel into a container designed to receive gasoline.
4. Remove the four 3/8" hex, washer head screws that retain the blower housing to the engine. It is not necessary to remove the recoil starter.
5. Remove the gasoline tank cap and remove the blower housing.
6. Remove the two 3/8" hex, washer head screws that retain the fuel tank to the fuel tank bracket.

Fuel Tank and Filter - Cleaning

1. Wash the tank in clean solvent designed for cleaning engine parts.
2. Back wash the filter screen by directing cleaning solvent, under pressure, through the sediment reservoir and screen, opposite fuel flow direction.
3. Wash the tank again with clean solvent.
4. Clean or replace the fuel hose.

Fuel Cap - Operation

The fuel cap is a three piece design with an inner sealing disc that is vented to a baffle assembly in the body of the cap. The baffle assembly acts to allow expansion in the tank without loss of fuel. Atmospheric pressure is allowed

into the tank from an opening in the cap to allow gravity to feed fuel to the carburetor.

Fuel Cap - Service

1. The fuel cap may not be disassembled, however, the vent opening on the cap and inner sealing disc should be kept free of debris.
2. The ventilating ability of the cap may be tested by filling the cap with water and observing the flow of water out of the vent opening in the side of the cap. If water does not drain, the vent opening may be plugged or restricted.
3. If the cap will not vent properly, it should be replaced.

Fuel Hose - Removal

1. **CAUTION:**  Avoid fire and explosions. Store fuel in a container designed for gasoline and never smoke while working around gasoline.
2. Remove the air cleaner cover and foam element.
3. Remove the three 5/16" hex, washer head shoulder screws that retain the air cleaner body to the engine.
4. Pull the air cleaner body away from the engine. Take care not to lose the cork gasket between the air cleaner and the carburetor. Take note of the position of the breather hose on the back of the air cleaner and the location of its' connection to the breather vent tube.
5. Disconnect the fuel hose from the carburetor by squeezing the spring type hose clamp with a pair of pliers.
6. Drain the fuel into a container designed for gasoline.
7. Remove the fuel hose from the fitting on the bottom of the gasoline tank.

Fuel Hose - Installation

1. Make certain the fuel hose is clean. Even if the fuel hose is new, run clean solvent through the inside of the hose prior to installation.
2. Install a spring type hose clamp 2" (5 cm) from each end of the fuel hose. Install the hose on the outlet pipe of the fuel tank. Secure the fuel hose with the hose clamp.
3. Install the other end of the fuel hose to the inlet pipe on the carburetor and secure it with the remaining hose clamp.
4. Install the body of the air cleaner.

IMPORTANT: Take care that the breather vent hose on the back of the air cleaner body mates with the

breather vent tube. Leakage in this area will allow dirt to enter the air cleaner on the carburetor side of the filter element.

5. Make sure the cork gasket is between the air cleaner body and the carburetor. Install the three 5/16" hex, washer head shoulder screws.
6. Make sure the air cleaner element is properly cleaned and oiled, see Maintenance Section on page 15 and install the element.
7. Install the air cleaner cover and tighten the thumb screw.

SECTION 3 IGNITION

Operation

The firing of the spark plug at the proper time is the culmination of a number of components working together. These components on the GTS 150 are:

Flywheel
Ignition armature coil
Spark plug
Armature coil wiring

The following describes the function of each of the above components.

Ignition Operation - Flywheel

The flywheel is connected directly to the crankshaft and turns at the same speed as the crankshaft. Imbedded in the flywheel are three magnets. These magnets rotate past the coil to generate electricity.

Imbedded in the opposite side of the flywheel are steel counterweights which offset the weight of the three magnets. These counterweights are not magnetic.

Ignition Operation - Ignition Armature Coil

The ignition armature coil is actually a transformer. It is positioned close to the flywheel to allow the magnetic field of the flywheel magnets to cut through the wire coils of the armature coil to generate electricity. See Figure 21.

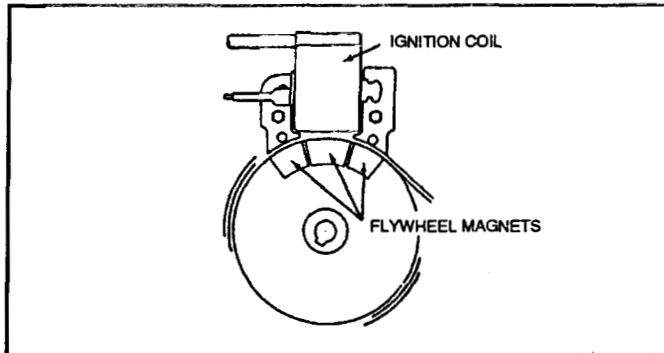


Figure 21

Complete operation of the ignition circuit is described with reference to Figure 22.

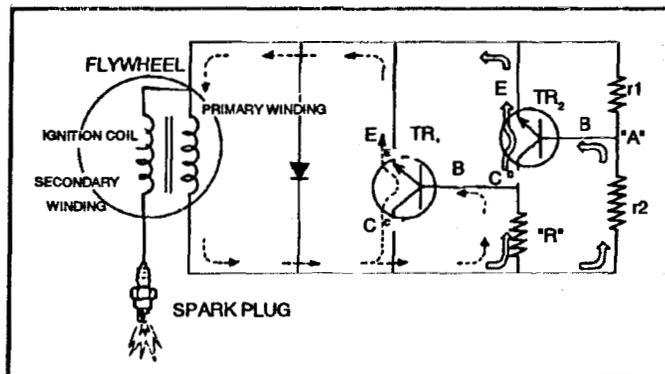


Figure 22

Low voltage is produced in the primary coil of the armature coil which causes a very small current to flow through resistor "R" to the base of transistor TR1. This small base current will cause the transistor to "turn on" creating a low resistance path through the collector, emitter circuit of the transistor as shown by the dotted line.

As the magnets continue to cut through the coils of the primary winding the primary voltage will increase. This voltage also develops across the voltage divider network created by resistors R1, R2. At a precisely timed moment, the voltage at point "A" turns TR2 "on" creating a low resistance path for the base current flowing through resistor "R". In fact, when this occurs, it is easier for the current to flow through the collector, emitter circuit of TR2 than it is through the base, emitter circuit of TR1.

With the base current for TR1 diverted, TR1 turns "off", opening the armature coil primary circuit. Remember, the current flowing through resistor "R" and TR2 is extremely small and can not support the magnetic field created in the primary winding. When the circuit through TR1 opens, the magnetic field in the primary winding collapses, generating an extremely high voltage in the secondary winding, enough voltage to cause a spark at the spark plug.

Ignition Operation - Spark Plug

The spark plug is used to ignite the air-fuel mixture by producing a spark just before the piston reaches top dead center. A spark plug is typically constructed as shown in Figure 23.

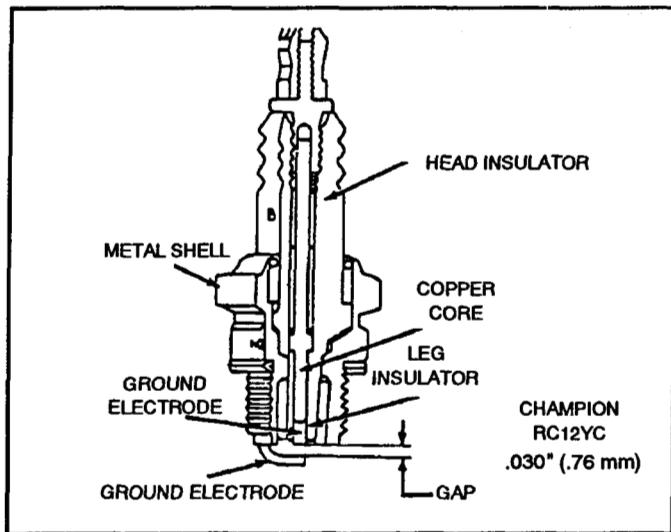


Figure 23

There are two critical areas important to proper spark plug function. The first is that the electrodes are properly gapped and are clean. This ensures that a strong spark will be present and that it occurs at the proper time. Excessive gap or fouling can delay firing enough to cause a loss of power or stalling. Correct gap is .030" (.76 mm).

The other important area is the insulator. The insulator prevents arcing from taking place in another area of the plug, away from the electrodes. Because of the extremely high voltage present, even a slight crack or fouling of the head insulator can result in arcing and a malfunction of the plug.

Armature Coil Wiring - Operation

The armature coil has two external wires. One wire is the high voltage spark plug wire and the other wire is the primary grounding or engine kill wire. The free end of the kill wire is terminated at the throttle bracket kill terminal.

There are two ground terminals that connect to the frame of the armature coil and through the armature coil frame to the block of the engine.

Air Gap - Adjustment

1. Remove the gas cap.

CAUTION: Use extreme care if there is fuel in the gas tank. Do not smoke or allow open flames around gasoline. Gasoline fumes are explosive.

2. Remove the four 3/8" hex, washer head screws that retain the blower housing.
3. Remove the blower housing and replace the gas cap on the fuel tank.
4. Loosen the two screws that retain the ignition armature coil. Use a feeler gauge to set the air gap between the flywheel and ignition armature coil to .008 - .012" (.20 - .30 mm)

5. Tighten the 5/16" hex, washer head screws retaining the armature coil to 45 in lbs (5 Nm).
6. Remove the gas cap and replace the blower shroud. The blower shroud fasteners are tightened to 50 in lbs (5.6 Nm).
7. Install the gas cap.

Ignition Armature Coil - Removal

1. Remove the gas cap.

CAUTION: Use extreme care if there is fuel in the gas tank. Do not smoke or allow open flames around gasoline. Gasoline fumes are explosive.

2. Remove the four 3/8" hex, washer head screws that retain the blower housing.
3. Remove the blower housing and replace the gas cap on the fuel tank.
4. Disconnect the armature coil secondary ground wire (ignition kill wire) from the grounding terminal on the throttle control bracket.
5. Unplug the spark plug wire.
6. Remove the two 5/16" hex, washer head screws that retain the armature coil. The armature coil may now be removed from the engine.

Ignition Armature Coil - Testing

Use an approved tester to test armature coils. Coil specifications are supplied by the tester manufacturer or can be found in Briggs and Stratton form MS-7862, "Instruction Book for Testing Briggs & Stratton Ignition Coils."

1. The primary coil should have .2 to .4 ohms of resistance. The secondary coil should have 2400 to 5000 ohms of resistance.
2. Primary resistance is measured between the kill wire and ground. Because the primary resistance is so small the resistance measurement will more realistically be used for disclosing either short circuits or, more likely, open circuits in the primary winding.
3. Secondary resistance is measured between the spark plug wire and ground.

Ignition Armature Coil - Installation

1. Lightly tighten the two screws that retain the ignition armature coil. Use a feeler gauge to set the air gap between the flywheel and ignition armature coil to .008 - .012" (.20 - .30 mm)
2. Tighten the 5/16" hex, washer head screws retaining the armature coil to 45 in lbs (5 Nm).
3. Remove the gas cap and install the blower shroud. The blower shroud fasteners are tightened to 50 in lbs (5.6 Nm).
4. Install the gas cap.

SECTION 4 REWIND STARTER

Rewind Starter - Operation

The rewind starter operates through a retainer/friction disc that causes two engagement dogs to extend from the center of the rewind starter and engage the inside of the starter cup on the flywheel. The engagement dogs move into contact with the starter cup when the rewind rope is pulled. When the engine starts, the speed of the engine exceeds the speed of the rewind starter and forces the starter dogs back into the center of the rewind mechanism, disengaging them from the starter cup.

Rewind Starter - Disassembly

1. Remove the four 5/16" hex, washer head screws that retain the rewind starter assembly to the engine.
2. Remove the alignment pin from the Phillips head screw in the center of the rewind mechanism. See Figure 24.

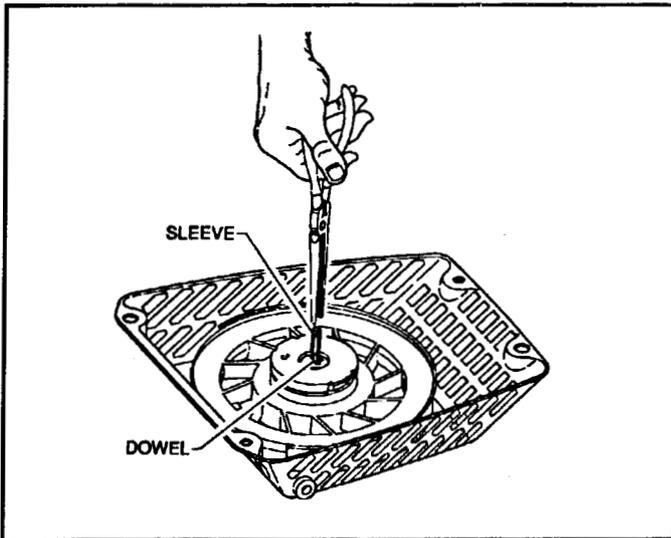


Figure 24

3. Remove the Phillips head screw from the center of the rewind mechanism and lift the friction plate from the starter. See Figure 25.

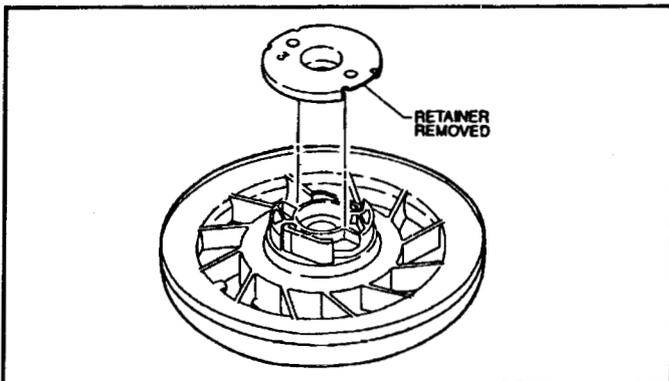


Figure 25

4. Remove the two ratchet dogs and springs. Take note of the positioning of the springs for correct installation. See Figure 26.

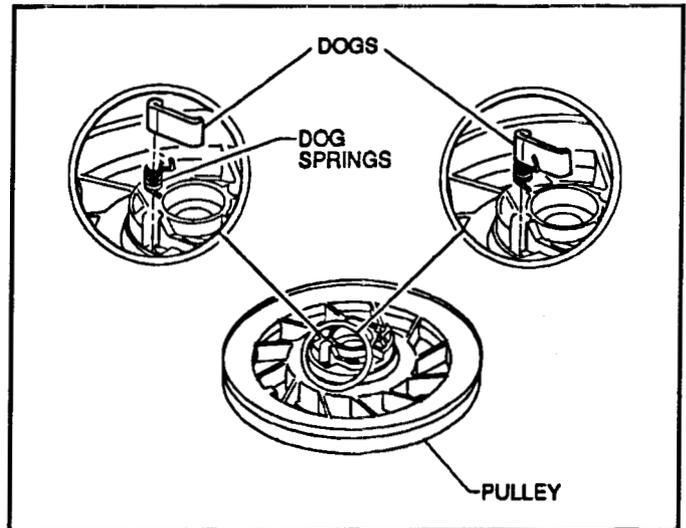


Figure 26

5. Completely extend the rewind rope and hold the reel in place. Untie the knot in the end of the rope, withdraw the rope and slowly allow the reel to unwind to a relaxed state.
6. Remove the reel from the rewind housing. The rewind spring is captured in the reel and will not fall out or be suddenly released. The rewind spring is not serviceable. If the spring has failed, an entire spring and reel assembly must be used for repair. See Figure 27.

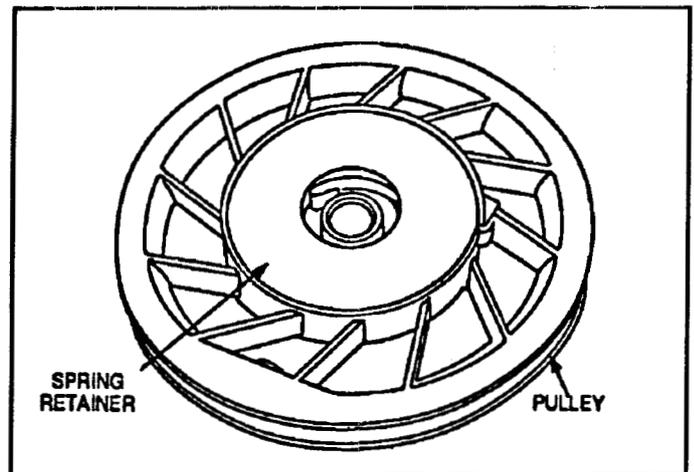


Figure 27

Rewind Starter - Assembly

1. Lubricate the center post of the rewind starter with a small amount of general purpose grease.
2. Place the reel assembly on the center post of the rewind starter and turn the reel counterclockwise until the hook on the reel spring engages the spring retainer on the center post of the starter. See Figure 28.

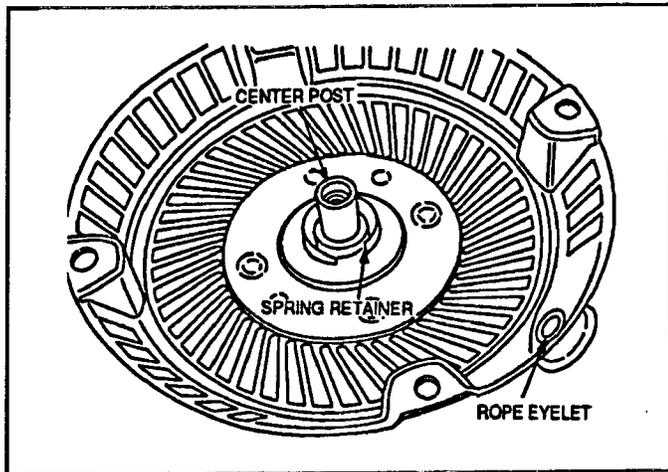


Figure 28

3. Install the dog springs and the brake spring as shown in Figure 29.

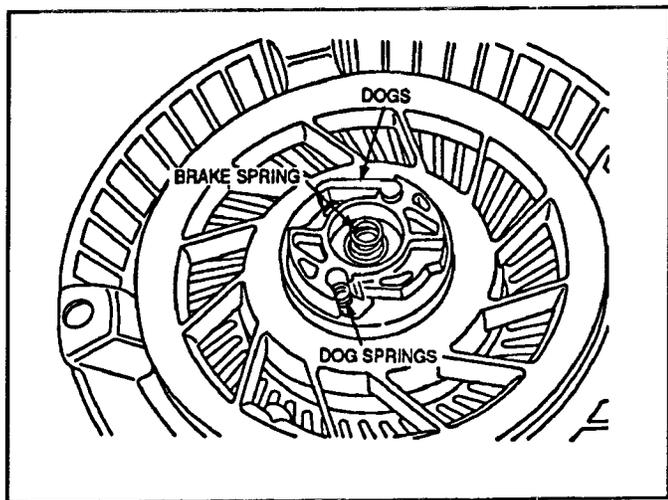


Figure 29

4. Install the friction disc retainer and retaining screw. See Figure 30.

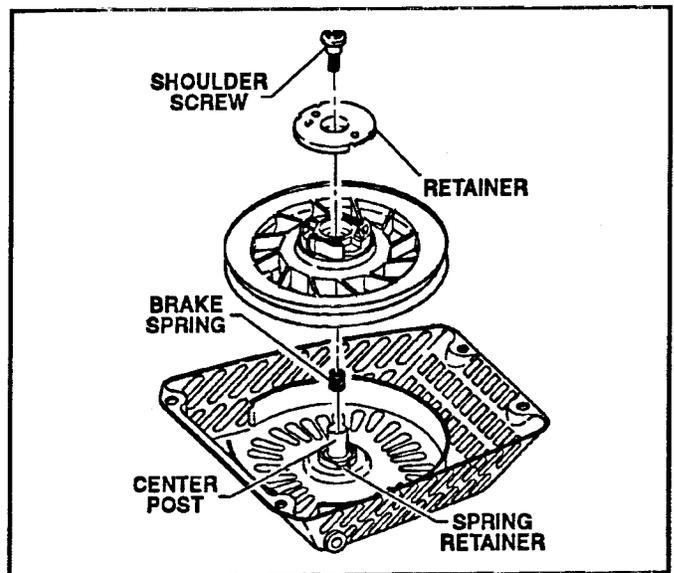


Figure 30

5. Drive the aligning roll pin into the center of the retaining screw and slide the plastic sleeve over the pin. See Figure 31.

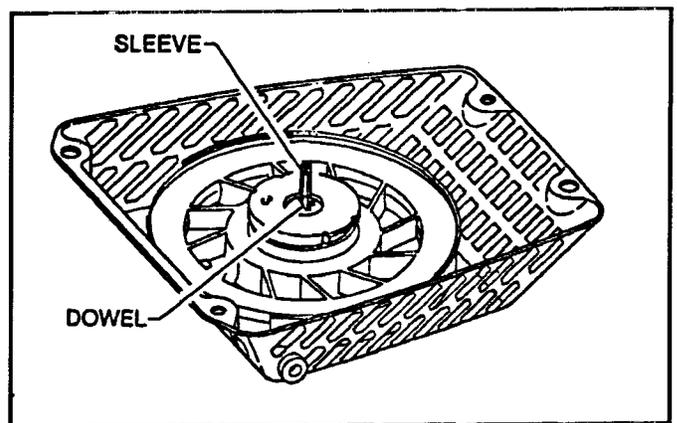


Figure 31

Rewind Starter - Installation

1. Install the rewind starter on the blower housing, centering the aligning pin in the opening in the end of the crankshaft.
2. Install the four 5/16" hex, washer head retaining screws and tighten to 40 in lbs (4.5 Nm).

SECTION 5 ENGINE

Engine - Operation

Intake Stroke

The GTS 150 is a four stroke cycle, over head valve engine. The running engine begins with the first of four strokes being the intake stroke. The piston moves from Top Dead Center (TDC) to Bottom Dead Center (BDC) with the intake valve opening as the piston leaves TDC and closing as the piston reaches BDC. While the piston is moving toward BDC with the intake valve open, a partial vacuum is created in the cylinder. Air and fuel will enter the cylinder under atmospheric pressure as long as the intake valve is open and the piston is moving toward BDC. See Figure 32.

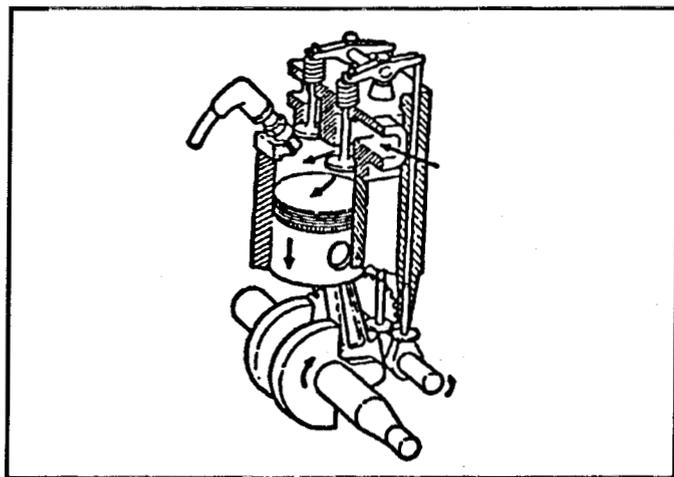


Figure 32

Compression Stroke

The second stroke (compression) begins as the piston leaves BDC and moves toward TDC. Both the intake and exhaust valves are closed at this time. As the piston moves, the air/fuel mixture is compressed in the cylinder. See Figure 33.

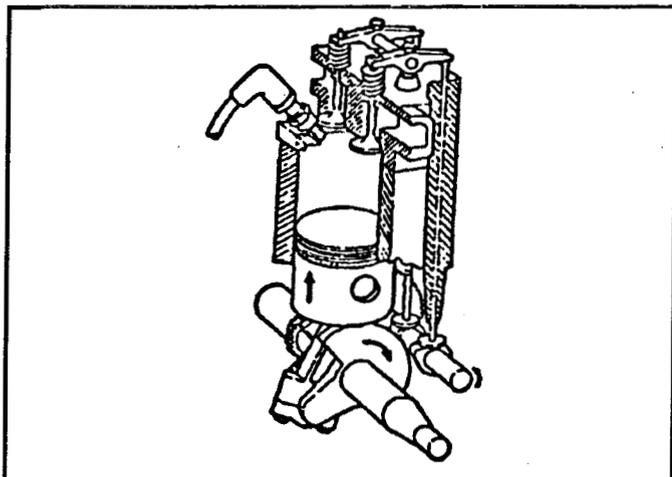


Figure 33

Power Stroke

When the piston comes close to TDC the mixture is ignited by the spark plug and the third stroke begins. The expanding combustion gases push the piston down in the cylinder creating the power stroke, both the intake and exhaust valves are still closed at this time. See Figure 34.

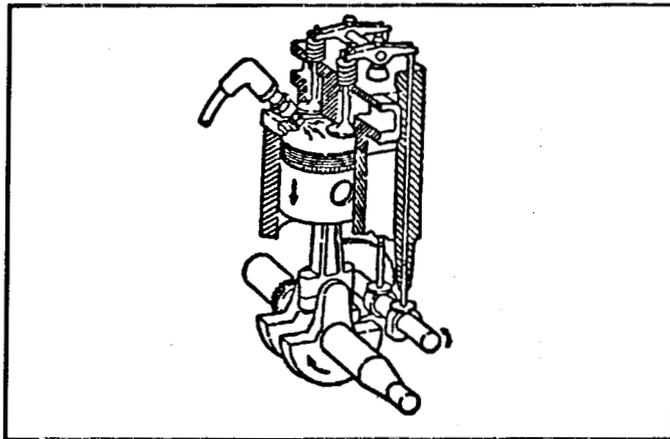


Figure 34

Exhaust Stroke

The fourth stroke (exhaust) begins as the piston reached BDC and the exhaust valve opens. As the piston moves toward TDC the piston forces the exhaust gases from the engine. See Figure 35.

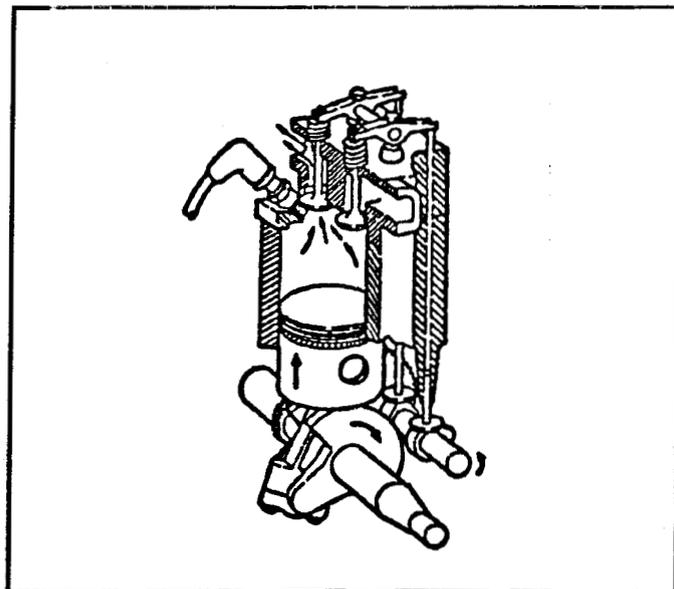


Figure 35

Engine Dissassembly

Air Cleaner - Operation

Combustion air comes from the fan blades on the flywheel (the flywheel also provides cooling air for the engine). Air moves into the air cleaner body through an opening in the blower housing and an opening in the upper body of the air cleaner. The air has to make a right angle turn down and then another right angle turn through plastic ribs to enter the oiled foam element. Heavier particles will not be able to make the turn into the foam element and will fall, or will be blown out the opening in the bottom of the air cleaner. Note that an optional paper air cleaner element is available for this engine.

Air Cleaner - Removal

1. Loosen (counterclockwise rotation) the thumb screw retaining the air cleaner cover, and remove the cover from the body of the air cleaner. See Figure 36.

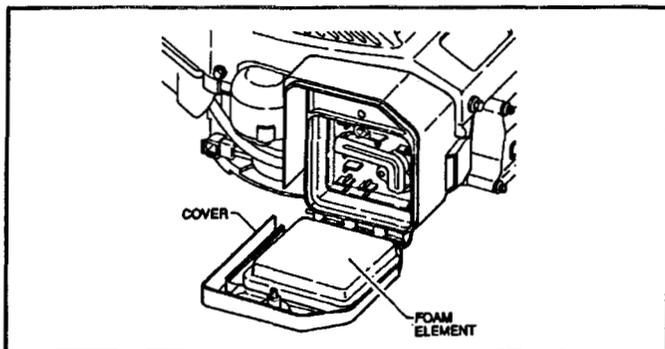


Figure 36

2. Remove the foam filter element. See Figure 36.
3. Remove the three 5/16" hex, washer head shoulder screws retaining the air cleaner body to the carburetor and throttle bracket.
4. Pull the air cleaner body away from the engine and at the same time pull the breather hose off the breather vent tube. Do not lose the cork gasket between the air cleaner body and the carburetor. See Figure 37.

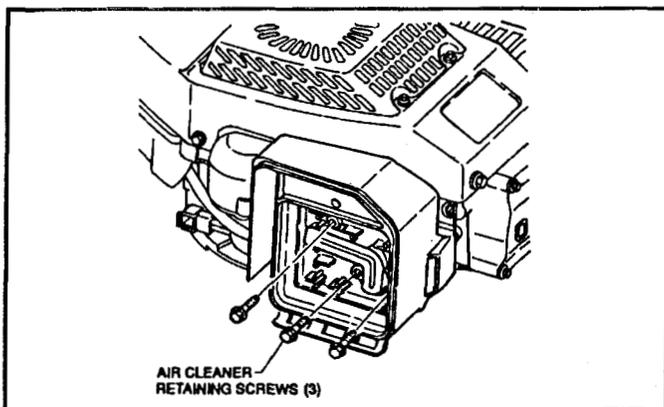


Figure 37

Rewind Starter - Operation

See Section 4 Rewind Starter on page 27.

Rewind Starter - Removal

1. Remove the four 5/16" hex, washer head screws retaining the recoil starter to the blower housing. See Figure 38.

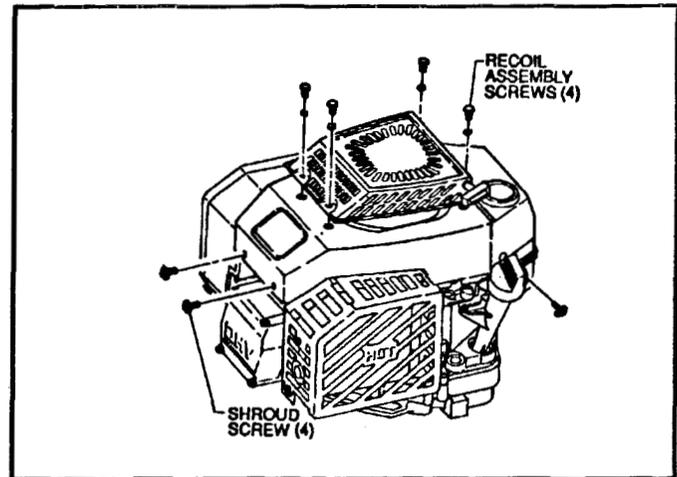


Figure 38

2. Lift the starter away from the blower shroud.

Blower Shroud - Removal

1. Remove the four 3/8" hex, washer head cap screws retaining the blower shroud.
2. Lift the blower shroud off the engine. See Figure 38.

Muffler Shroud - Removal

1. Remove two 3/8" hex, washer head cap screws from the back of the muffler shroud.
2. Remove two 5/16" hex, cap screws from the front of the muffler shroud. See Figure 39.

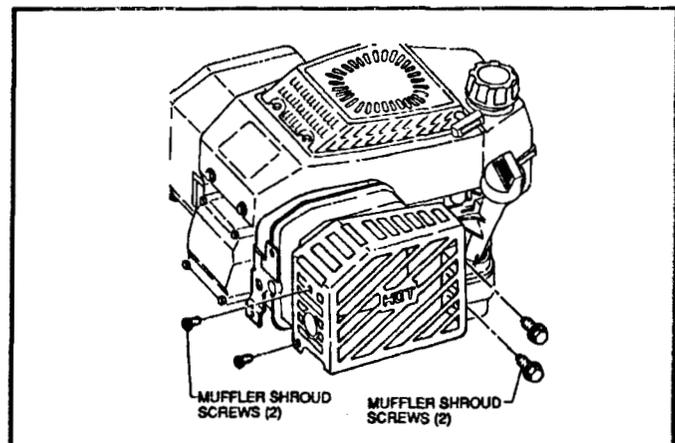


Figure 39

Flywheel Brake - Operation (If Installed)

Zone start mowers are fitted with a flywheel brake that kills the ignition and stops the rotation of the engine. The brake is a spring loaded lever that when released causes a brake shoe to rub against the flywheel in a self energizing manner. An arm on the brake lever at the same time touches a contact point that is part of the ignition kill wire terminal. This will ground the kill wire to prevent spark. To start the engine, the brake cable is pulled to both open electrical contact and pull the brake shoe away from the flywheel.

Flywheel Brake - Removal (If Installed)

1. Unload the spring with a spring hook.
2. Remove the cable.
3. Disconnect the ignition kill wire.
4. Remove the two 5/16" hex, washer head screws that retain the brake assembly to the block of the engine. See Figure 40.

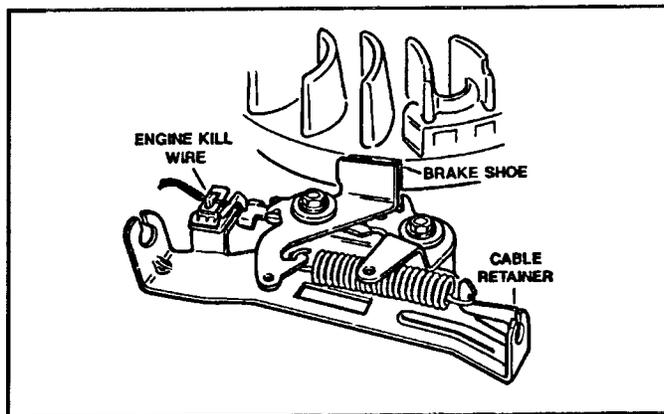


Figure 40

Fuel Tank - Operation

See Section 2 on Fuel System, page 23.

Fuel Tank - Removal

1. Crimp the fuel hose with a pair of locking pliers.
2. Remove the hose clamp on the carburetor end of the hose.
CAUTION:  Avoid fire and explosion, store fuel in a container designed for gasoline and never smoke while working around gasoline.
3. Release the clamping pliers and drain the fuel into a container designed to receive gasoline.
4. Remove the two 3/8" hex, washer head screws (1-1/4" long) retaining the fuel tank to the engine.
5. The 75 micron fuel filter screen is an integral part of the fuel tank and is not removable.

Muffler - Operation

The muffler quiets exhaust noise by slowing the escape of combustion gases while at the same time preventing excessive back pressure. The muffler is of a dual chamber design with the exhaust being discharged into the first chamber and then through a series of holes into the second chamber where the exhaust is discharged to the atmosphere.

Muffler - Removal

1. Remove the two 3/8" hex, washer head cap screws that retain the exhaust pipe to the engine.
2. Remove the single 3/8" hex, washer head cap screw that retains the muffler bracket to the block of the engine. See Figure 41.

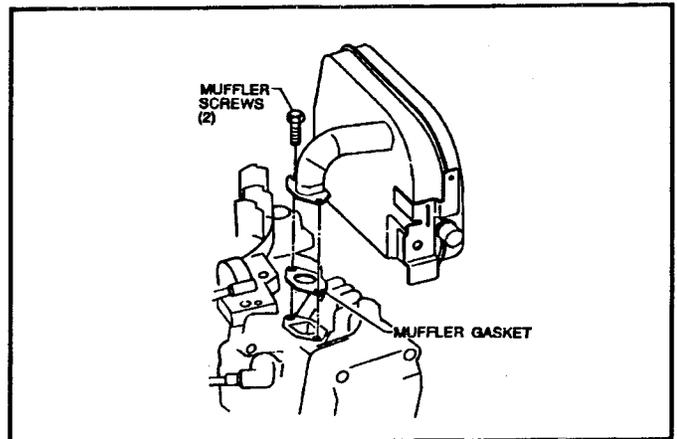


Figure 41

3. Remove and discard the gasket between the exhaust pipe and the engine.

Dipstick and Oil Fill Tube - Removal

1. Remove the two 3/8" hex, washer head screws that retain the dipstick tube.
2. Withdraw the tube from the block of the engine. The tube is sealed with an "O" ring. See Figure 42.

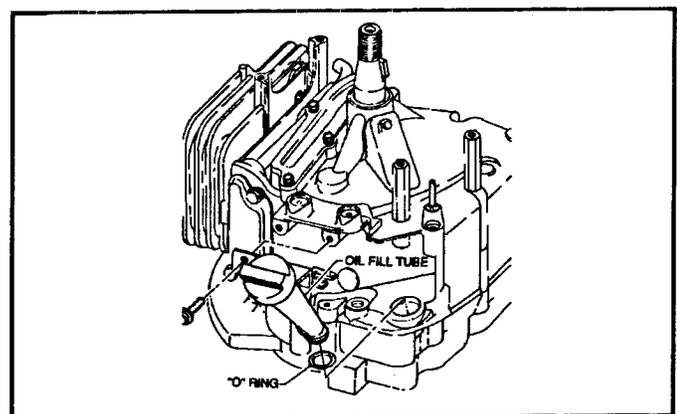


Figure 42

Carburetor - Operation

See Section 1 - Carburetor, page 19.

Carburetor - Removal

1. Note the position of the choke over-center spring before removal. This will aid proper reinstallation. The long hook end of the spring is attached to the carburetor shaft. Unhook the choke over-center spring. See Figure 43.

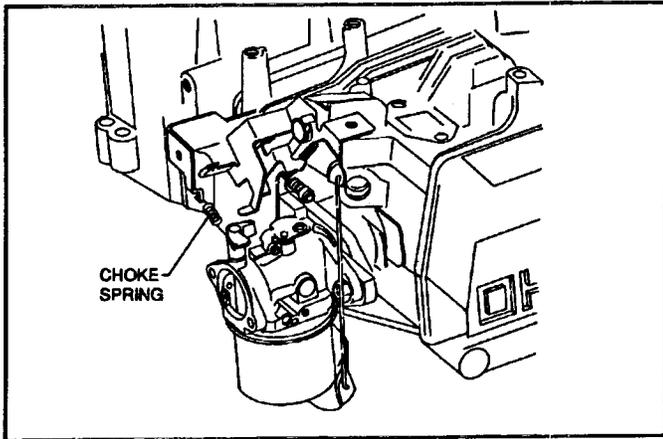


Figure 43

2. Remove the two 3/8" hex, washer head shoulder screws that retain the carburetor. See Figure 44.

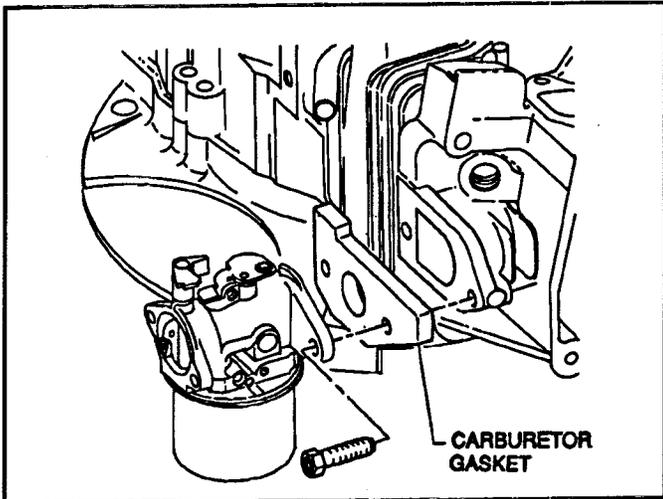


Figure 44

3. During removal, rotate the body of the carburetor and unhook the throttle lever from the governor control rod.
4. The insulator/gasket may now be removed.

Ignition Coil - Operation

See Section 3 - Ignition, page 25.

Ignition Coil - Removal

1. Note the routing of the ignition ground (kill) wire, this will make reinstallation easier. Disconnect the ignition ground wire from the terminal on the back of the throttle bracket. See Figure 45.

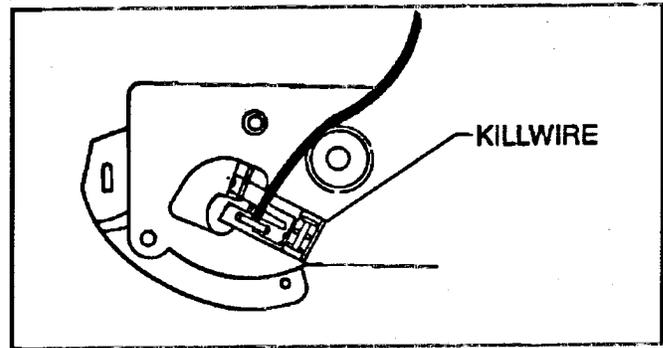


Figure 45

2. Disconnect the ignition coil high tension wire from the spark plug.
3. Remove the two 5/16" hex head screws retaining the ignition coil. The coil may now be lifted away from the engine. See Figure 46.

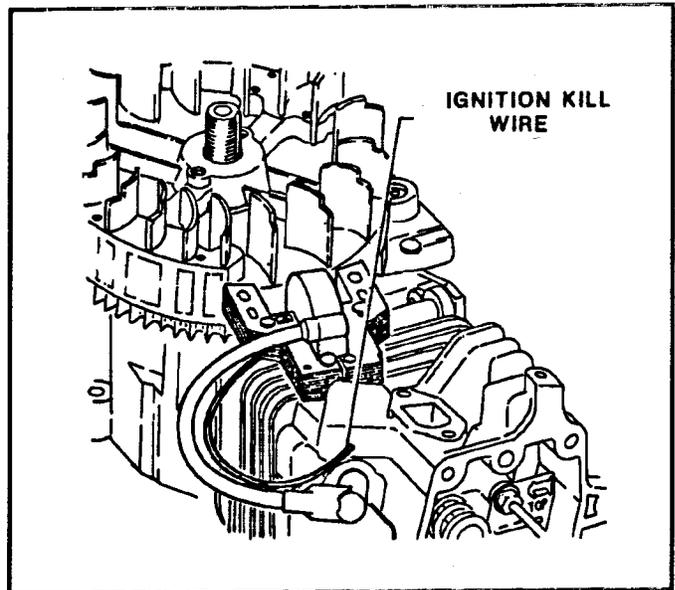


Figure 46

Throttle Bracket - Removal

1. Remove the two 3/8" hex, washer head screws that retain the front blower shroud bracket.
2. Remove the two 3/8" hex, washer head screws that retain the throttle bracket to the engine block. See Figure 47.

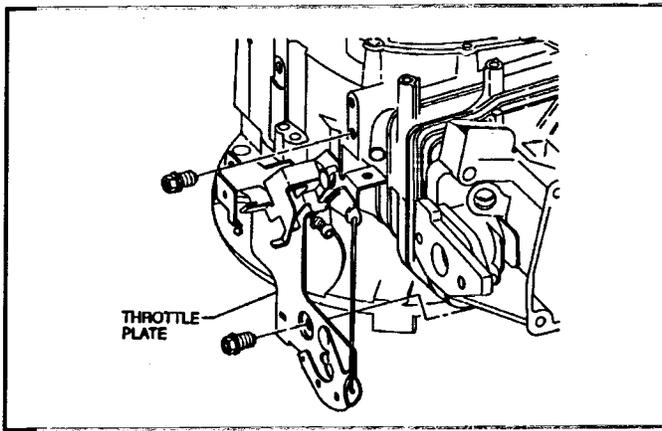


Figure 47

Alternator - Operation

The alternator is a single coil employing 1/2 wave rectification through the use of a diode built into the body of the alternator. The alternator also uses a capacitor in parallel with the output for electrical filtration. The diode can be checked with a ohmmeter by alternately placing the positive and negative leads on the connections to the diode. See Figure 48. The diode should conduct in one direction and block in the other.

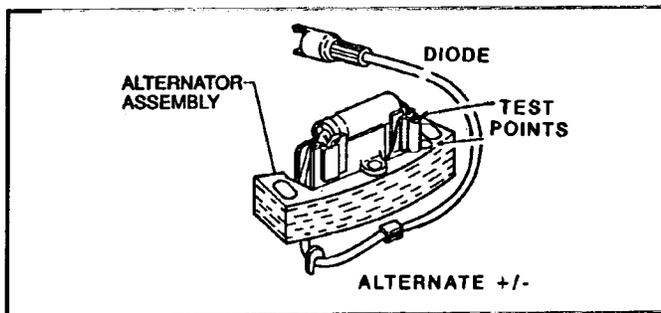


Figure 48

Alternator - Removal (if installed)

1. Remove the two 5/16" hex, washer head cap screws retaining the alternator. See Figure 49.

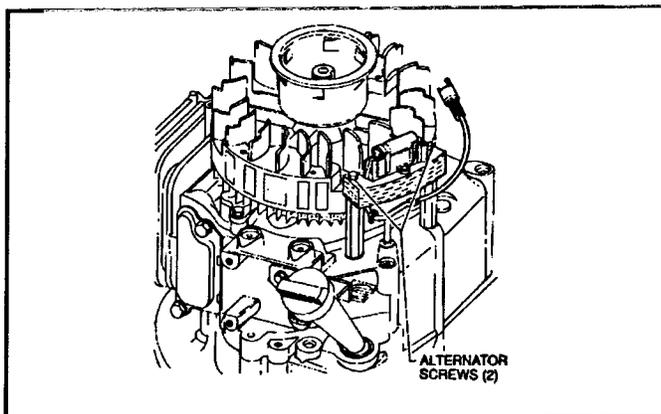


Figure 49

2. Remove the alternator.

Flywheel - Removal

1. Remove the 15/16" hex nut retaining the flywheel starter cup. See Figure 50.

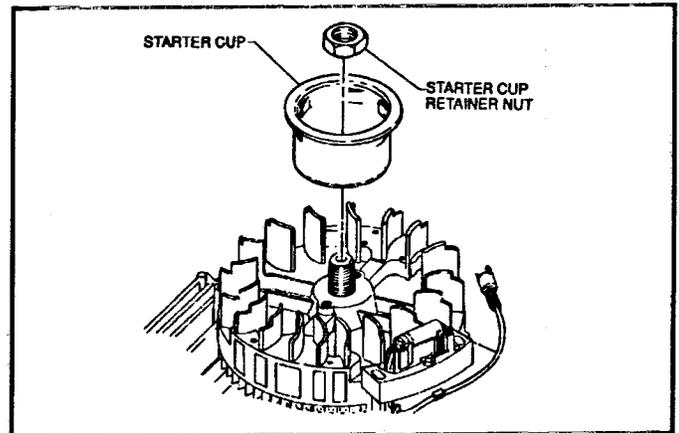


Figure 50

2. Remove the starter cup and reinstall the flywheel nut to protect the threads on the end of the crankshaft.
3. Install Briggs and Stratton flywheel puller 19203 as shown in Figure 51 and remove the flywheel. The holes in the flywheel are not tapped and require the use of the self tapping screws included with the flywheel puller. Alternately tighten the screws on the puller until the flywheel breaks loose.

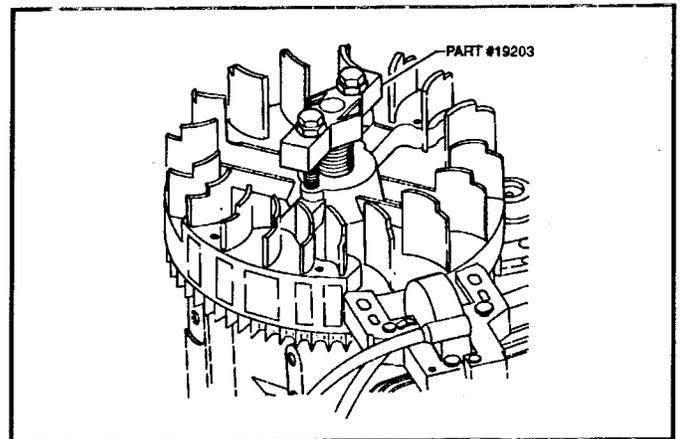


Figure 51

4. Remove the flywheel and examine the condition of the flywheel key. Replace the key if necessary.

Electric Starter - Operation

The electric starter is a 12 volt DC universal motor using a 14:1 gear reduction to drive a composite spur (pinion) gear through a helical drive shaft. When the motor is started the rotation of the helical shaft causes the pinion gear, through inertia, to engage the ring gear on the

flywheel. When the engine starts, the speed of the flywheel will exceed the speed of the starter motor helical shaft and will cause the pinion gear to move down the shaft disengaging from the flywheel ring gear.

Electric Starter - Removal (If Installed)

1. Remove the two 3/8" hex, washer head cap screws retaining the starter. See Figure 52.

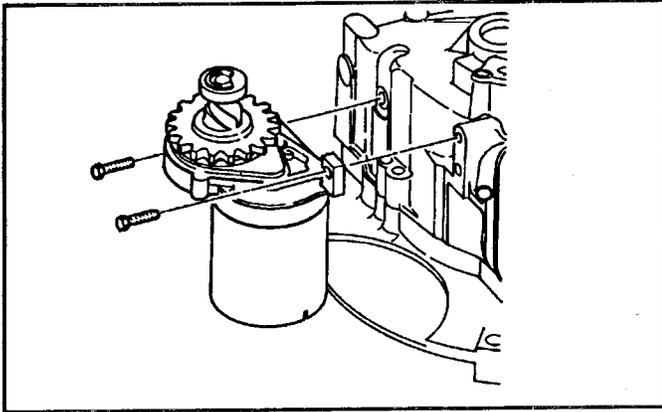


Figure 52

Throttle Control Lever and Link Rod - Removal

1. Loosen the 3/8" nut retaining the throttle control lever to the governor shaft. See Figure 53.

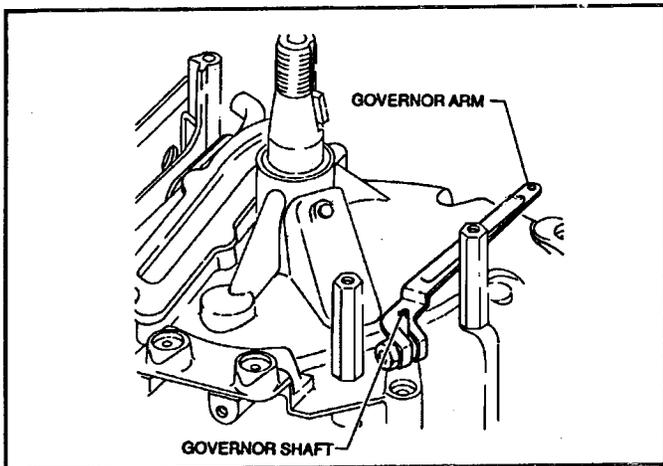


Figure 53

2. Use a screwdriver to open the split end of the throttle control lever (governor arm) and slip the lever off the governor shaft.

Valve Cover - Removal

1. Remove the four 5/16" washer head cap screws that retain the valve cover.
2. Remove the cover and gasket. See Figure 54.

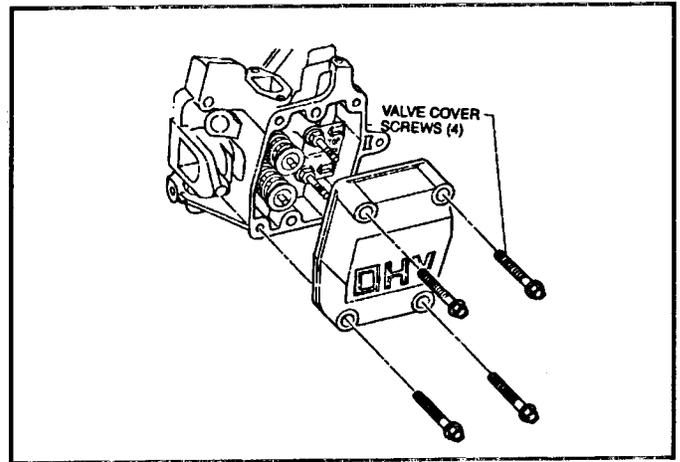


Figure 54

Head Assembly - Removal

1. Remove the four 1/2" hex, flange head cap screws that retain the head. It is not necessary to remove the rocker arms at this time.
2. Remove the head and push rods from the engine. See Figure 55. The push rods are the same on intake and exhaust, and can be used to operate either valve.

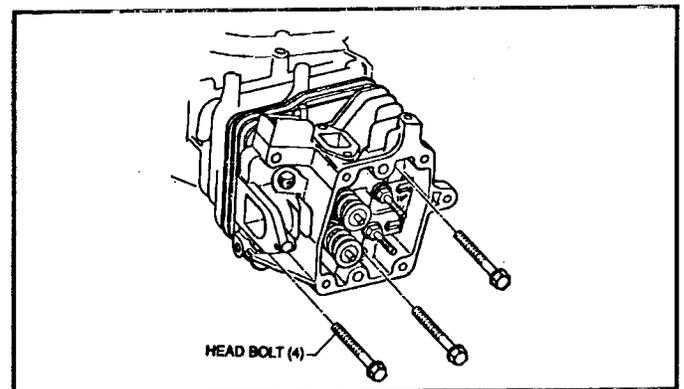


Figure 55

3. Remove the gasket from the head or block. Note the position of the alignment pins. See Figure 56.

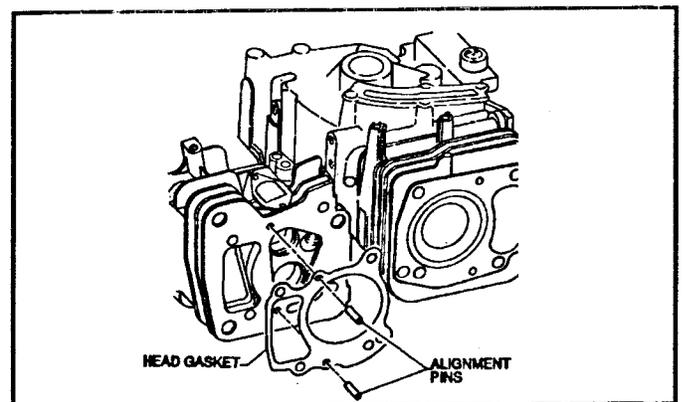


Figure 56

Head - Disassembly

1. Hold the rocker arm adjusting nut with a 10 mm wrench and loosen the socket head jam screw with a 3 mm hex key. See Figure 57.

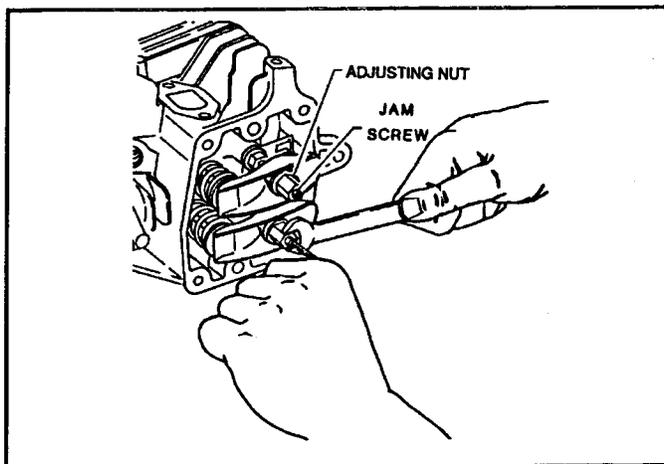


Figure 57

2. Remove the adjusting nuts and rocker arms.
3. The spring rate on the valve springs allows removal without the aid of a spring compressor. Remove the springs and keepers as shown in Figure 58. The intake and exhaust springs and keepers are the same and can be used on either valve.

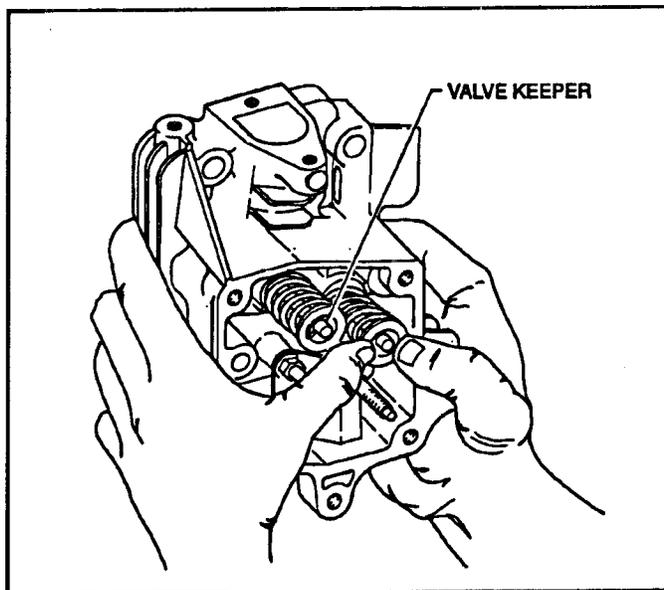


Figure 58

4. Note the seal and washer that is used on the intake valve. See Figure 59. The seal will help prevent oil from entering the combustion chamber through the intake valve guide.

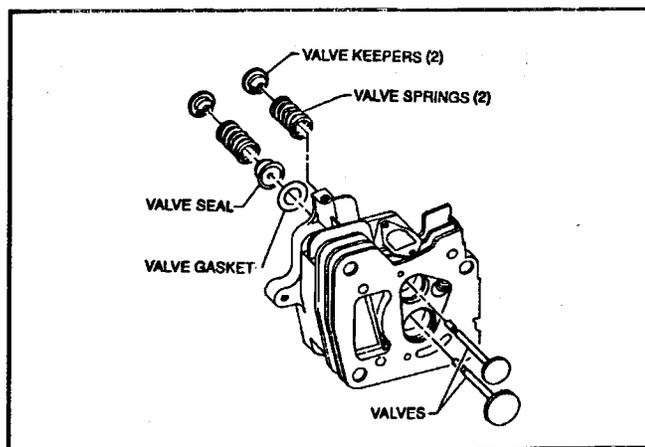


Figure 59

Valves and Seats - Reconditioning

The intake and exhaust valve seats on the GTS 150 are factory cut to 44 degrees. The intake and exhaust valves are factory ground to 44.75 degrees. When reconditioning, the seats should be cut to 45 degrees and the valves should be ground to 45 degrees. The valves are then lapped into the seat for a proper seal.

1. Use Briggs & Stratton valve lapping tool #19258 and lapping compound #94150 for lapping valves and seats.
2. The lapped valve seat width should be $3/64 - 1/16$ " (1.2 - 1.6 mm). If the seat is wider than this dimension a narrowing stone or cutter should be used to bring the dimension into specification. See Figure 60.

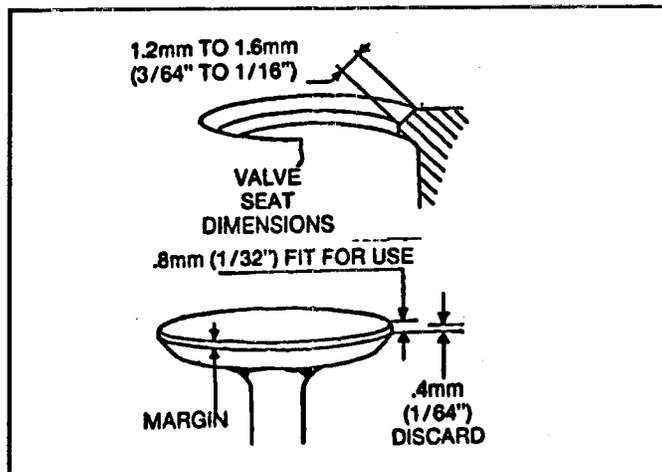


Figure 60

3. The valve margin should be at least $1/64$ " (.4 mm) after regrinding to 45 degrees. Replace the valve if the margin is less than the specification after regrinding. Refer to Figure 60.
4. If the valve seats are burned or damaged the cylinder head must be replaced.

Breather - Operation

The crankcase is ventilated through an opening in the top (magneto) side of the block. The opening is under the flywheel and connects to a passage with a sheet metal cover that in turn ventilates to the breather in the side of the engine.

The breather uses a valve to prevent air entering the crankcase when the piston is moving toward TDC. The valve allows pressure to escape, or vent back to the clean side of the air cleaner when the piston is moving toward BDC. Ventilation to the air cleaner occurs through a tube that connects the breather to the air cleaner body. Any oil that collects in the bottom of the breather will drain back to the sump through a small drilled passage in the bottom of the breather cavity in the block.

Breather - Removal

1. Remove the four 1/4" hex, washer head cap screws that retain the breather passage cover as shown in Figure 61.

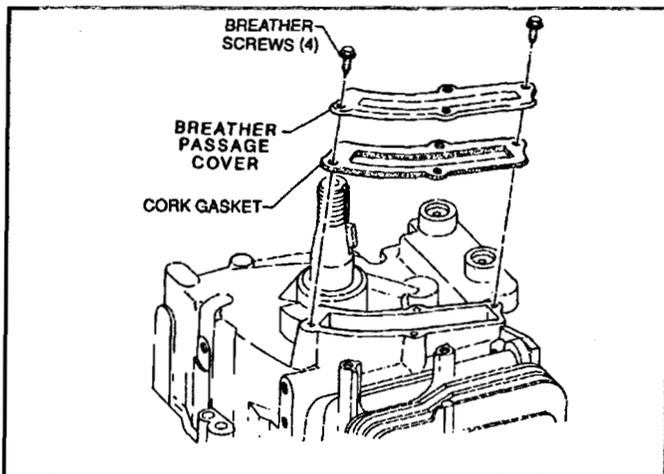


Figure 61

2. Remove the two 3/8" hex, washer head cap screws that retain the breather assembly in the side of the engine.

Oil Pump - Operation

The GTS 150 uses a gerotor style, positive displacement oil pump. The pump is driven by a cross pin in the end of the cam shaft. Oil is drawn into the expanding cavities in the gerotor pump set and is squeezed out through collapsing cavities opposite the intake opening. Oil is discharged through the center of the camshaft to a drilled passage from the upper camshaft bearing to the upper crankshaft bearing. The oil is then discharged through another drilled passage in the bottom of the upper main bearing. From there the oil splashes down over the rest of the engine components.

The counterweight and connecting rod throw oil to a passage that leads to the head assembly. There is a hole in the sump side of the engine that allows oil to drain back from the head.

Oil Pump - Removal

1. Turn the engine over and remove the three 3/8" hex, flange head cap screws that retain the oil pump cover. See Figure 62.

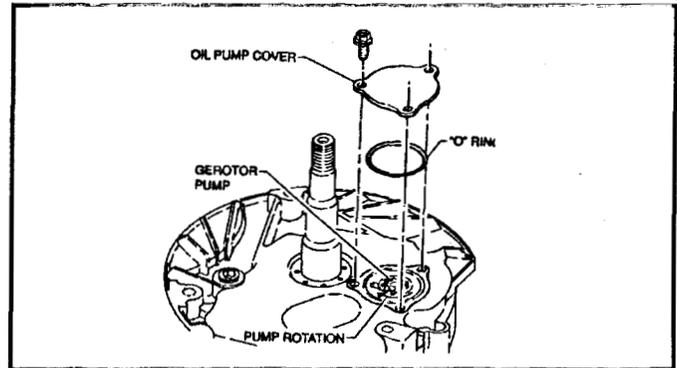


Figure 62

2. Use a magnet to remove the gerotor set. The tolerances of these parts do not require that they be kept in the same relationship for assembly. See Figure 63.

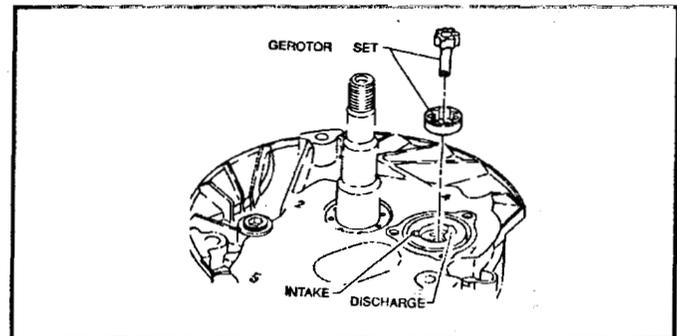


Figure 63

Sump - Removal

1. Remove the seven 3/8" hex, washer head cap screws that retain the sump to the block of the engine. See Figure 64.

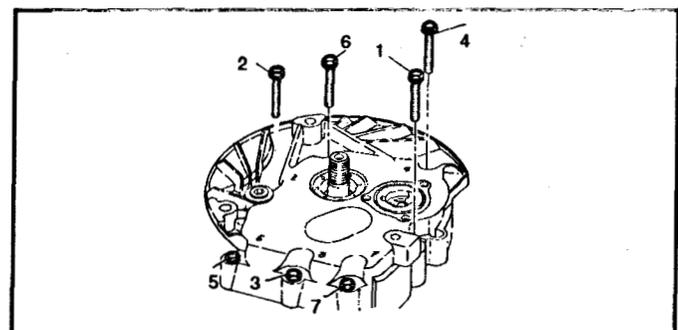


Figure 64

2. Clean the crankshaft of debris and any imperfections that could damage the sump crankshaft seal. It is recommended that a seal protector be put over the crankshaft or tape wrapped over the shaft to prevent damage to the seal.
3. Pull the sump off the engine.

Governor and Splasher - Operation

The governor and splasher are a combined unit driven by the camshaft. As the engine speed increases the flyweights on the governor will open through centrifugal force causing the governor plunger to act on the governor arm. The faster the engine runs, the greater the force applied to the governor arm to close the throttle plate.

The paddles on the splasher mechanism provide immediate lubrication to all internal components of the engine, including the upper main bearing. Upper main bearing lubrication occurs through a drilled passage designed to receive oil from the splasher.

Governor and Splasher - Removal

1. With the sump off the engine the governor/splasher may be removed from the end of the camshaft. See Figure 65.

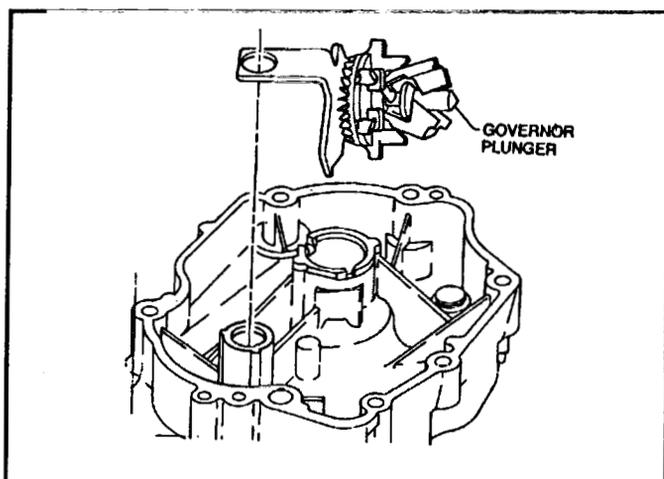


Figure 65

2. The governor/splasher is serviceable only as an assembly.

Camshaft - Operation

The camshaft is made of a composite material and driven by the crankshaft. The camshaft is timed with the crankshaft to cause the intake and exhaust valves to open and close at the correct time. The camshaft is also responsible for driving the oil pump and is hollow to accommodate the flow of lubricating oil.

Camshaft - Removal

1. Note the timing marks on the crankshaft drive gear and camshaft driven gear for proper assembly.
2. Turn the crankshaft so the connecting rod cap is out of the way of the camshaft.
3. Make sure the cam followers are pushed out of the way of the cam lobes and pull the camshaft out of the block. See Figure 66.

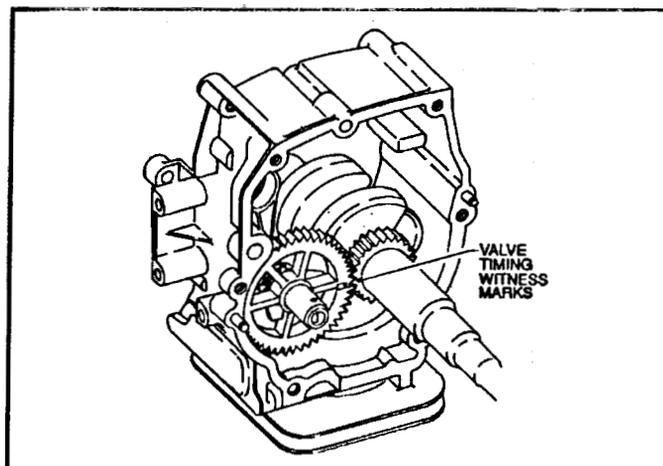


Figure 66

4. Remove the cam followers. The cam followers are identical, however; if the engine has been run and the followers are going to be reused, make sure you install the followers in their original position to maintain established wear patterns. See Figure 67.

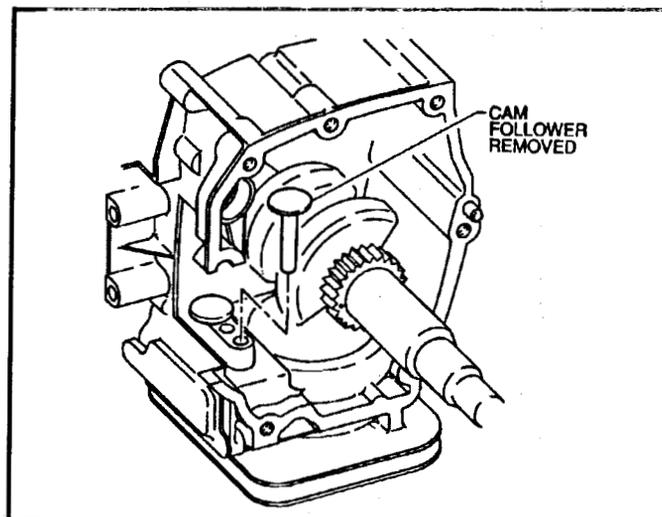


Figure 67

Compression Release - Operation

The compression release operates through centrifugal force. At starting speeds the end of the compression release arm rises slightly above the intake lobe on the

camshaft which prevents the intake valve from fully seating. This, in turn, eases starting resistance. At operating speeds, centrifugal force will cause the arm to move out of the way of the cam lobe and will allow the intake valve to fully close.

Compression Release - Removal

1. If disassembly is necessary, take note of how the compression release lever and spring is installed, and drive the pivot pin out of the camshaft with a pin punch.
2. Note that the pin can be removed only from one direction. See Figure 68.

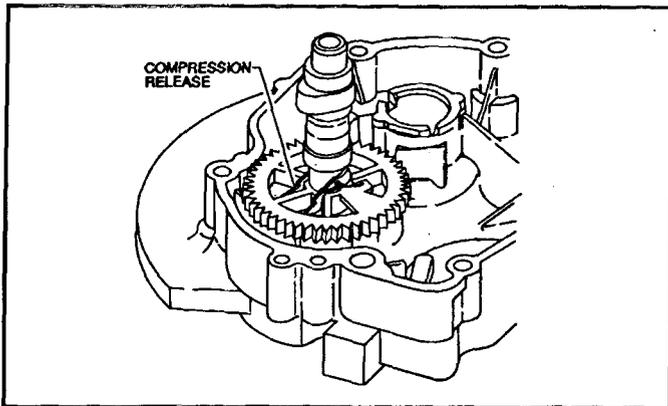


Figure 68

Crankshaft - Removal

1. Remove the two 7/16" hex, cap screws retaining the rod cap. Note the orientation of the rod cap for proper reinstallation. See Figure 69.

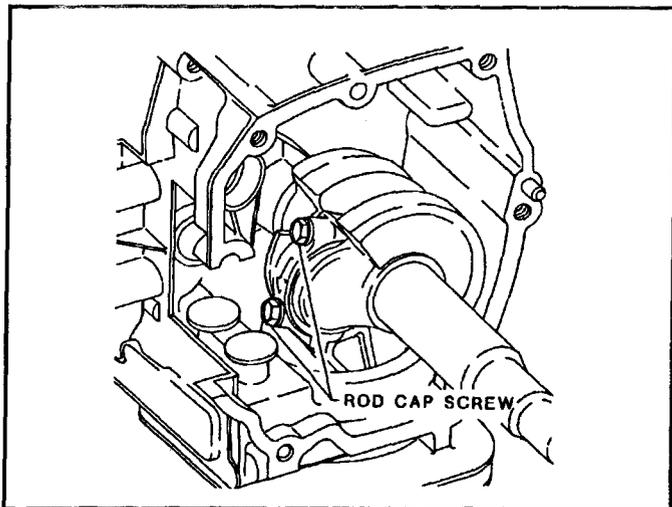


Figure 69

2. Pull the rod cap off the crankshaft connecting rod journal and push the piston and connecting rod out of the way of the crankshaft. See Figure 70.

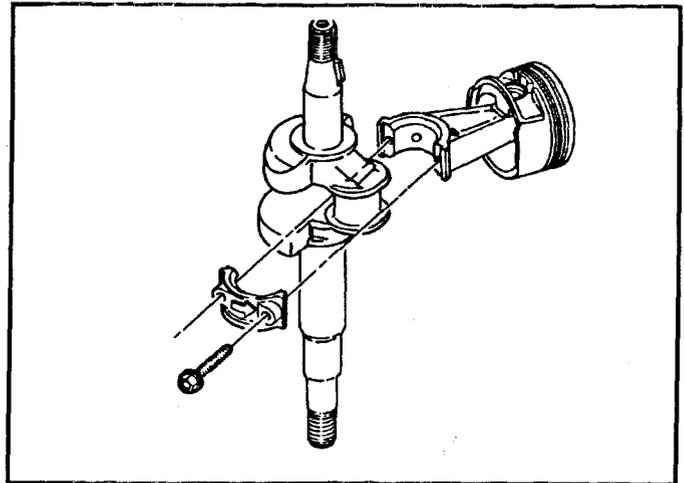


Figure 70

3. The crankshaft may now be withdrawn from the engine. Place a sleeve or tape over the crankshaft to prevent the crankshaft keyway from cutting the seal.
4. The camshaft drive gear is keyed to the crankshaft and may be removed. Take care to note the side of the gear with the timing mark for correct installation. See Figure 71.

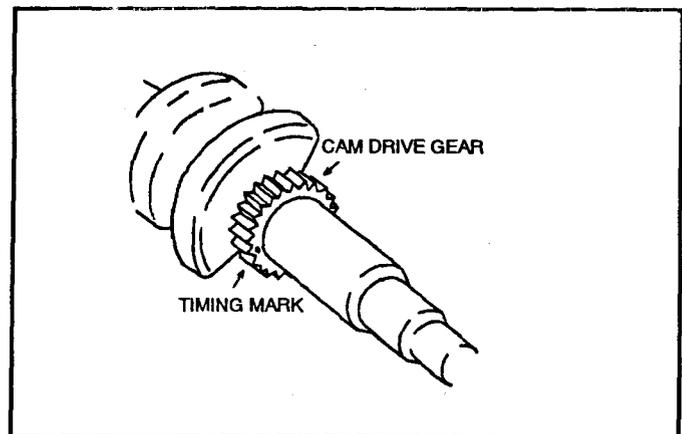


Figure 71

Piston and Connecting Rod - Operation

The piston is of a special casting and tapered machining design with a dished face. The casting and machining provide for quiet operation and excellent cooling.

The piston and connecting rod are both marked for proper assembly. The arrow on the face of the piston should be on the push rod side of the engine. The arrow on the connecting rod should point toward the push rods. The connecting rod also uses the word "mag" on the side that should be toward the magnet.

Piston and Connecting Rod - Removal

1. Note the orientation of the piston and connecting rod prior to removal for proper reinstallation. There are matching arrows on the connecting rod and rod cap that point toward the push rods on assembly. See Figure 72. The word "Mag" is also written on the side of the connecting rod that should point toward the magneto side of the engine.

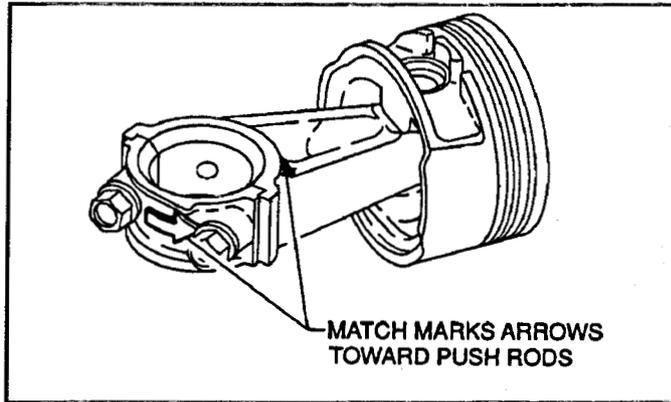


Figure 72

2. If the piston is to be removed from the connecting rod and reinstalled in the engine at a later time, note the piston orientation in order to maintain the established wear patterns. See Figure 73.

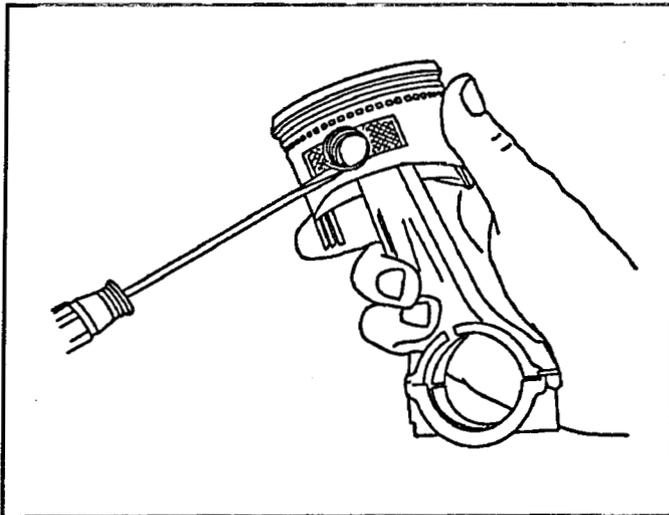


Figure 73

Piston Rings - Removal

1. Note the orientation of the piston rings prior to removal. Use a piston ring expander to remove the piston rings.
2. Remove the top compression ring, second compression ring and the three piece oil control ring. See Figure 74.

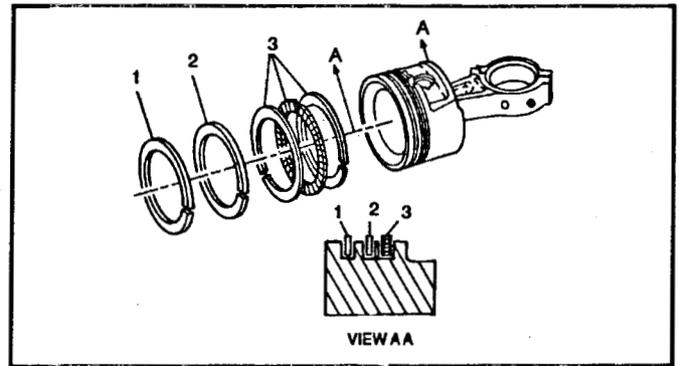


Figure 74

3. The top ring has no top or bottom orientation, however; if it is to be reused, install the ring using the original positioning to maintain the established wear patterns.
4. The second ring has a step that must face the bottom of the piston.
5. The three piece oil control ring assembly uses scraper rings above and below a ring expander.

Piston Pin - Removal

1. Note the relationship of the connecting rod to the piston for correct assembly. The arrow on the connecting rod and the arrow on the face of the piston must be on the same side.
2. Remove one of the retaining rings on the side of the piston and push out the piston pin.

Governor Arm - Removal

1. The governor arm is retained with a pushnut on the outside of the block and an upset on the shaft on the inside.
2. The block does not use a seal on the governor shaft.
3. To remove the shaft, pry the pushnut off the outside of the shaft and withdraw the shaft. Take care to remove burrs on the shaft prior to removal. The burrs will damage the bore in the block of the engine. See Figure 75.

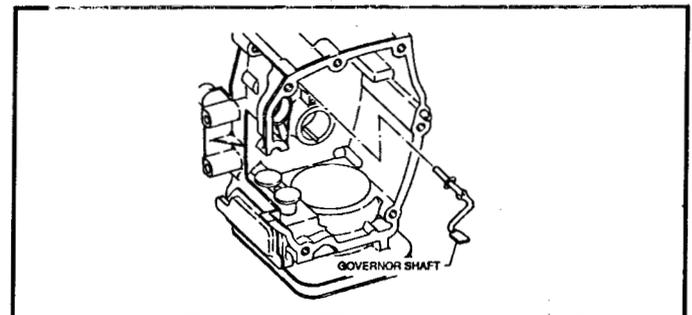


Figure 75

Engine disassembly is now complete.

Engine Assembly

Thoroughly inspect and clean all engine parts prior to assembly. All moving parts and "O" rings should be lubricated with SAE 30 engine oil on installation. No sealant is required on head, valve cover, breather, muffler, carburetor or sump gaskets.

Piston Pin - Installation

1. Install one retaining ring in one side of the piston.
2. Make certain the arrow on the big end of the connecting rod and the arrow on the face of the piston are on the same side.
3. Lubricate the piston pin with SAE 30 engine oil and slide the piston pin through the piston and connecting rod.
4. Install the second retaining ring.

Piston Ring - Installation

1. Install the oil scraper ring expander. This will not require a piston ring expander.
2. Install one scraper ring above and one scraper ring below the oil scraper ring expander.
3. Install the second and top compression rings.

Piston - Installation

1. Tighten a ring compressor around the piston. Piston ring groove alignment is not a concern as the rings are free to rotate during the operation of the engine.
2. Lubricate the cylinder walls with SAE 30 engine oil.
3. Push the piston out of the ring compressor and into the cylinder. See Figure 76.

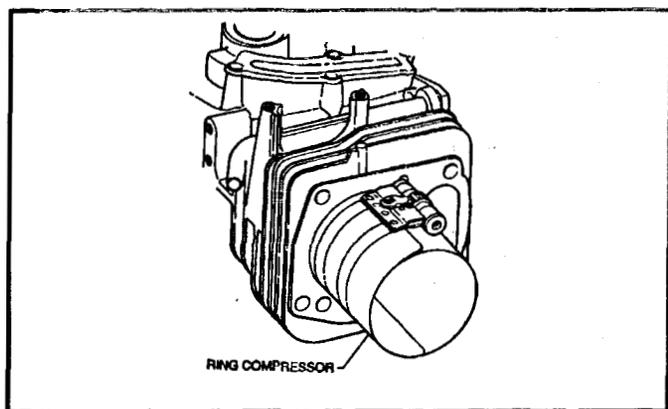


Figure 76

4. Make sure the piston is in the cylinder with the arrow on the face of the piston toward the push rod side of the engine. The word "MAG" on the connecting rod should face the magneto side of the engine. See Figure 77.

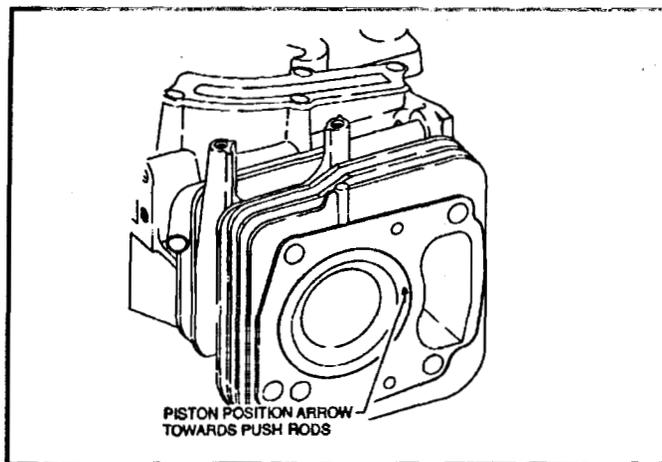


Figure 77

5. Push the piston the rest of the way into the cylinder of the engine.

Crankshaft - Installation

1. Make sure the cam drive gear and key are installed on the crankshaft with the timing marks on the gear visible.
2. Place a protective sleeve around the crankshaft and insert the magneto (flywheel end) of the crankshaft through the seal in the magneto end of the engine. The connecting rod will have to be pushed to one side and the counterweight turned to provide installation clearance.
3. Install the rod cap with the arrow facing the push rod side of the engine. See Figure 78.

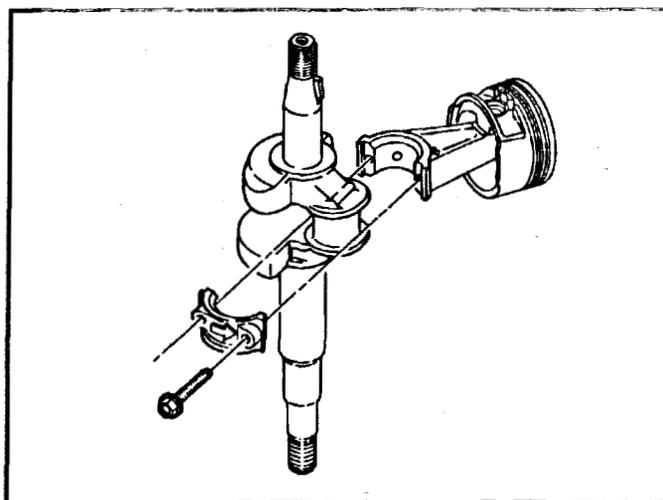


Figure 78

4. Torque the rod cap bolts to 100 in lbs (11.5 Nm).
5. Rotate the crankshaft two complete revolutions to disclose any binding or interference.

Governor Shaft - Installation

1. Place a flat washer on the governor shaft, against the upset on the shaft. See Figure 79.
2. Lubricate the governor shaft with SAE 30 engine oil.
3. Insert the shaft in the block of the engine. See Figure 79.

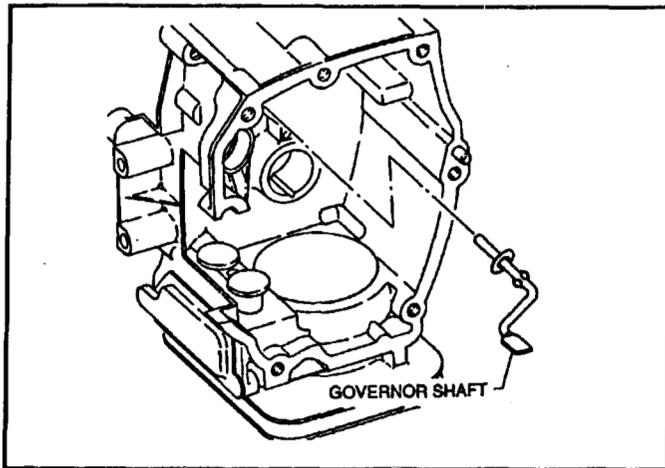


Figure 79

4. Install a pushnut retainer on the shaft to retain it in the block.

Cam Followers - Installation

1. The cam followers are both the same and may be used in either the intake or exhaust position. However, if the engine has been run and the cam followers are being reused, they should be installed in their original positions to maintain existing wear patterns. Lubricate the cam followers with SAE 30 engine oil prior to assembly. See Figure 80.

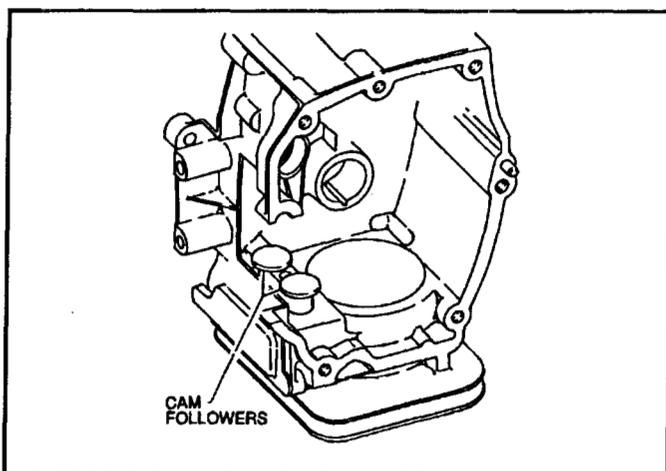


Figure 80

Camshaft - Installation

1. Match the timing mark on the camshaft with the timing mark on the camshaft drive gear on the crankshaft. See Figure 81.

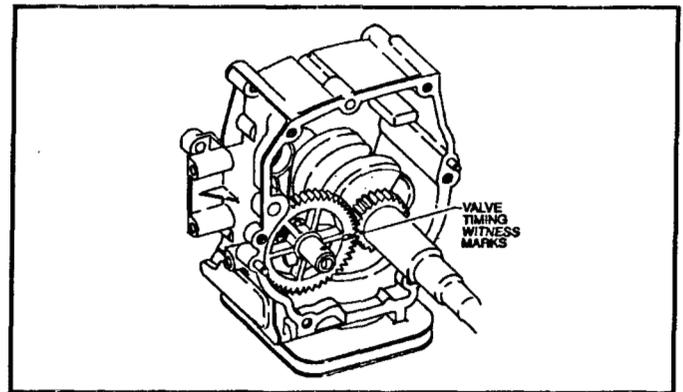


Figure 81

2. Lubricate the end of the camshaft with SAE 30 engine oil and install the camshaft.

Governor/Splasher - Installation

1. Install the governor as shown in Figure 82. Make sure the governor plunger is positioned against the governor arm and that the flyweights are free to move.

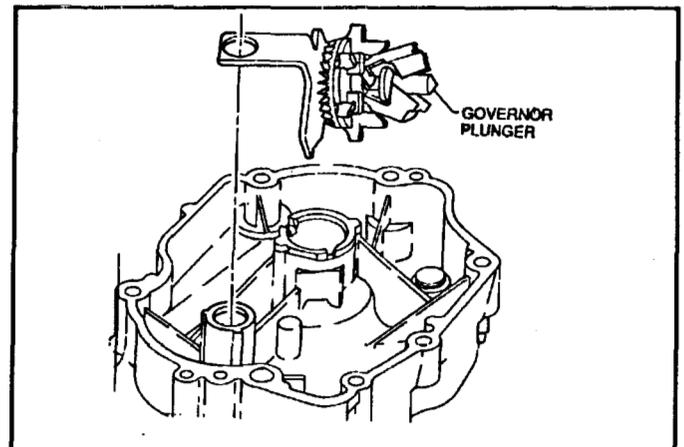


Figure 82

2. Turn the engine through two complete revolutions to make sure all parts are free to turn.

Sump - Installation

1. Install a new sump gasket.
2. Lubricate the crankshaft with SAE 30 engine oil and install a seal protector on the end of the crankshaft.
3. Slide the sump onto the crankcase of the engine.
4. Install the retaining screws and tighten them to 85 in lbs (9.5 Nm) as shown in Figure 83.

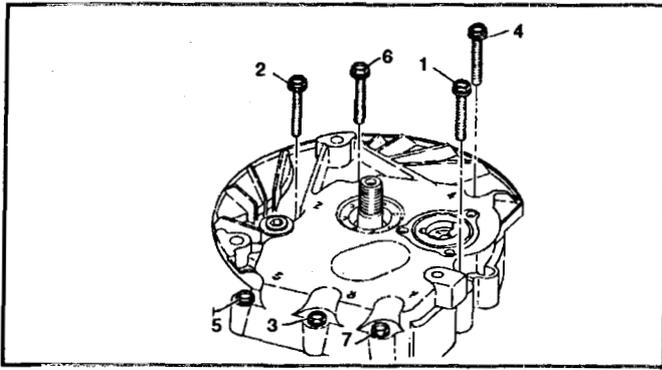


Figure 83

Oil Pump - Installation

1. Separate the gerotor set and insert the pump drive assembly so the slot in the shaft engages the drive pin in the end of the camshaft. See Figure 84.

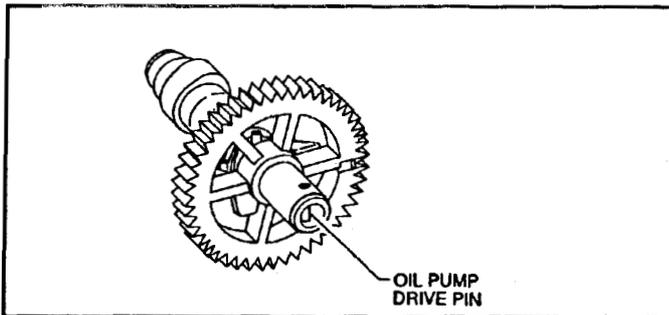


Figure 84

2. Install the pump driven assembly. Matching of the drive and driven assemblies is not necessary.
3. Install the cover plate and torque the screws to 85 in lbs (9.5 Nm).

Breather - Installation

1. Install the gasket cover and four screws that retain the breather passage cover. See Figure 85.

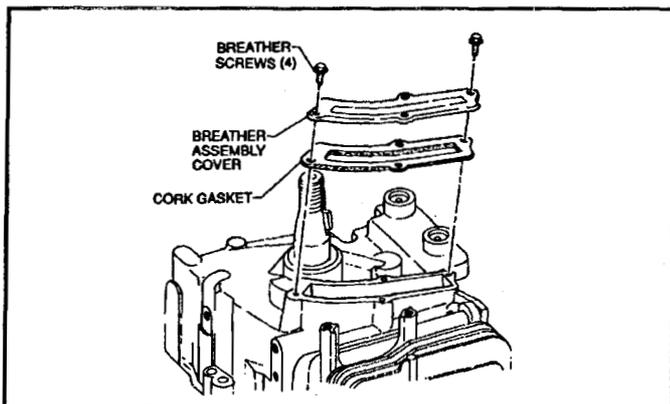


Figure 85

2. Install the gasket, breather assembly and its retaining screws.

Head - Assembly

1. Lubricate the intake and exhaust valve stems with SAE 30 engine oil.
2. Install the intake and exhaust valves. The intake valve is the larger of the two valves.
3. Install the washer and valve seal on the stem of the intake valve. See Figure 86.

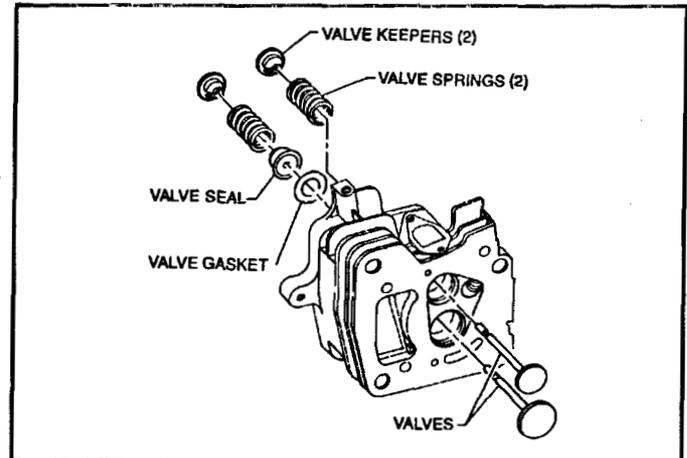


Figure 86

4. Install the springs and valve keepers on each valve. The springs are identical and can be used on either valve.
5. Install the cap on the stem of each valve. The rocker arms and adjusting nuts may now be installed.

Push Rods - Installation

1. Stand the engine up and install the two push rods against the cam followers. It is easiest to do this before the head is installed.
2. The push rods are the same and can be used in the intake or exhaust position.

Head - Installation

1. Make sure the alignment pins are installed in the block of the engine.
2. Install a new head gasket. Do not use sealant of any type on the head gasket.
3. Install the head over the push rods. Guide the push rods into the rocker arm guides as the head is installed.
4. Install the four head bolts and torque in the sequence embossed on the head to 160 in lbs (18 Nm).

Valve Clearance - Adjustment

The engine should be cool when adjusting the valve clearance.

1. Bring the engine up to top dead center with both valves closed (compression stroke).
2. Turn the adjusting nut with a 10 mm wrench until you have achieved a clearance of .005" to .007" (.13 mm to .18 mm). See Figure 87.

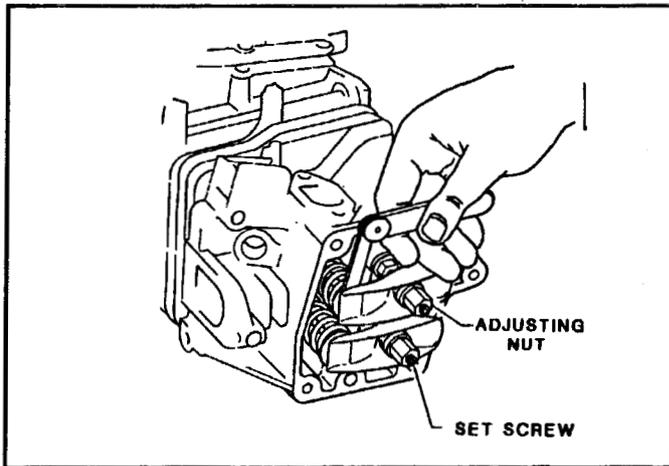


Figure 87

3. When the proper clearance has been achieved, tighten the set screw in the top of the adjusting nut with a 3 mm hex key to 45 in lbs (5 Nm). See Figure 88.

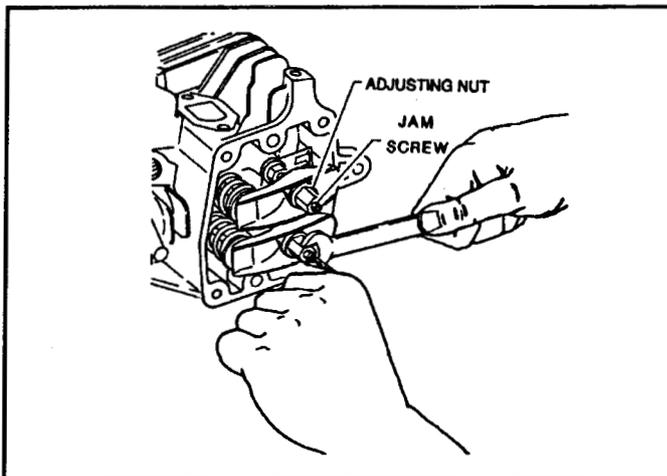


Figure 88

Valve Cover - Installation

1. Mount a new valve cover gasket.
2. Install the valve cover. See Figure 89.

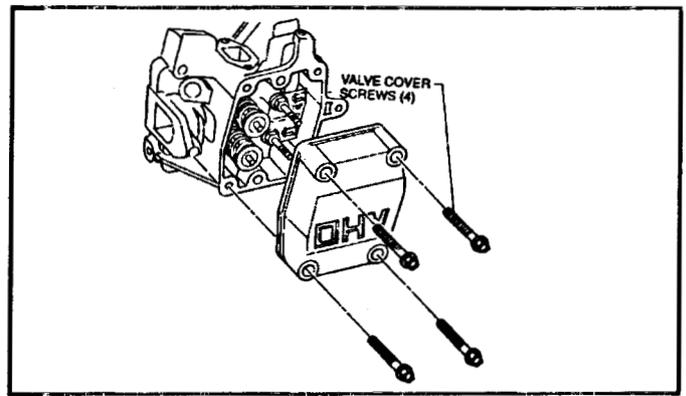


Figure 89

3. Tighten the valve cover screws in a diagonal sequence to 45 in lbs (5 Nm).

Throttle Bracket - Installation

1. Install the two 3/8" hex, washer head screws that retain the throttle bracket to the engine block. Torque the screws to 85 in lbs (9.5 Nm) See Figure 90.

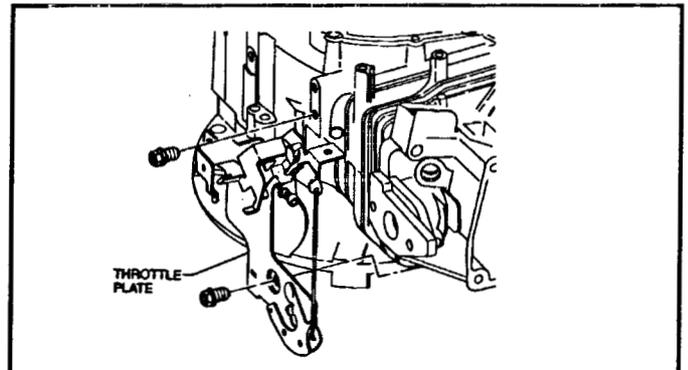


Figure 90

2. Install the front blower shroud bracket with two 3/8" hex, washer head screws. Torque the screws to 85 in lbs (9.5 Nm)

Governor Control Lever and Link Rod - Installation

1. Install the link rod with the Z bend from the bottom of the governor lever. See Figure 91.

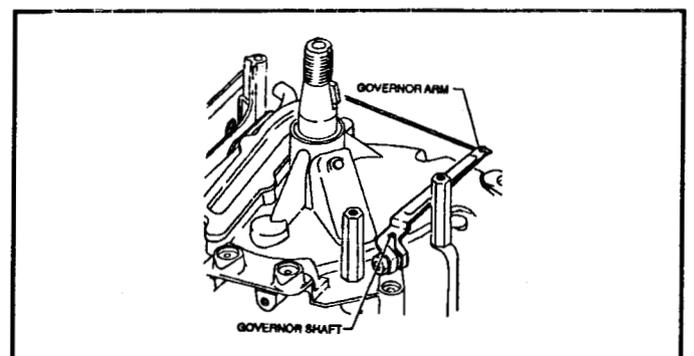


Figure 91

2. Install the governor lever on the governor shaft, leave the lever loose at this time. See Figure 92.

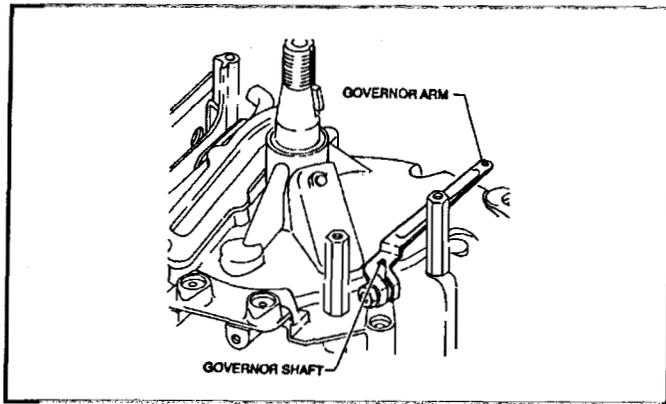


Figure 92

4. Install the choke over center spring. See Figure 95.

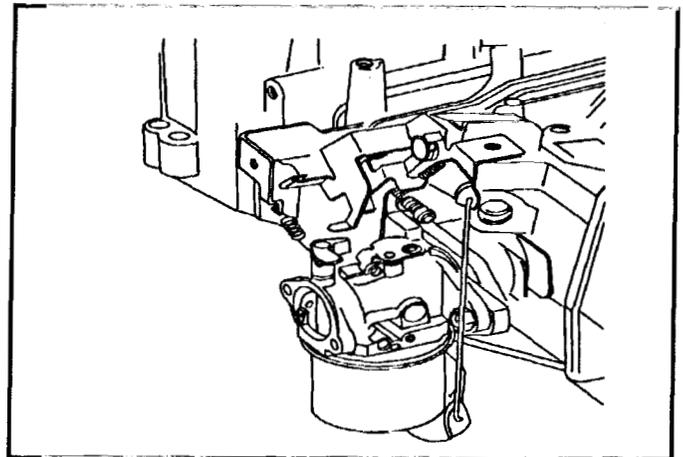


Figure 95

Carburetor - Installation

1. Install the carburetor throttle arm on the "Z" bend of the governor link rod. The "Z" bend is installed from the top through the bushing in the arm on the top of the throttle shaft.
2. Install the carburetor gasket/insulator and carburetor on the block of the engine. Torque the screws to 60 in lbs (6.8 Nm). See Figure 93

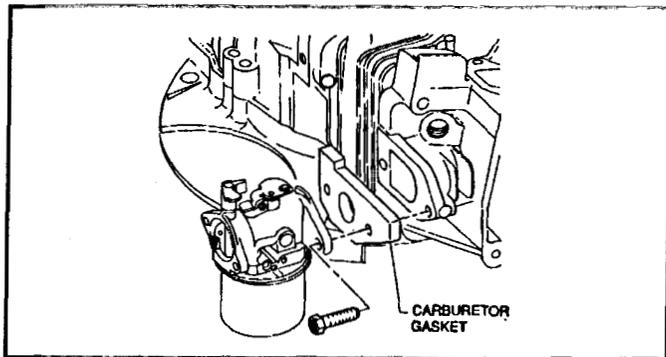


Figure 93

Governor - Adjustment

1. To adjust the governor the following sequence of component installation must be followed:
 - a. Install the link rod on the governor arm and carburetor.
 - b. Install the governor lever on the governor shaft - leave it loose.
 - c. Install the carburetor on the engine.
 - d. Attach the link rod spring.
2. Rotate the carburetor throttle shaft to the full throttle position.
3. Rotate the governor shaft fully counterclockwise and tighten the governor lever locking nut to 35 in lbs (4 Nm).

3. Hook the governor link spring on the throttle bracket assembly. See Figure 94.

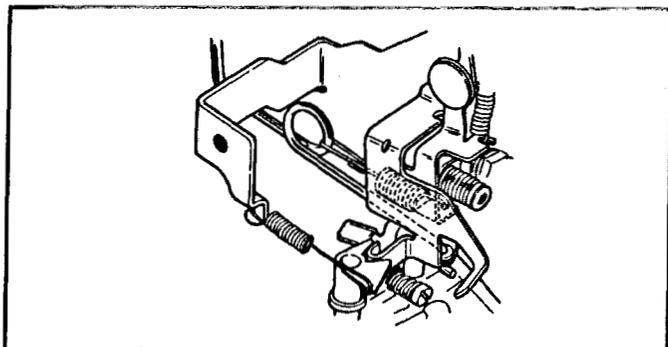


Figure 94

Electric Starter - Installation

1. Install the electric starter (if equipped) with two 3/8" hex washer head screws. Torque the screws to 85 in lbs (9.5 Nm). See Figure 96.

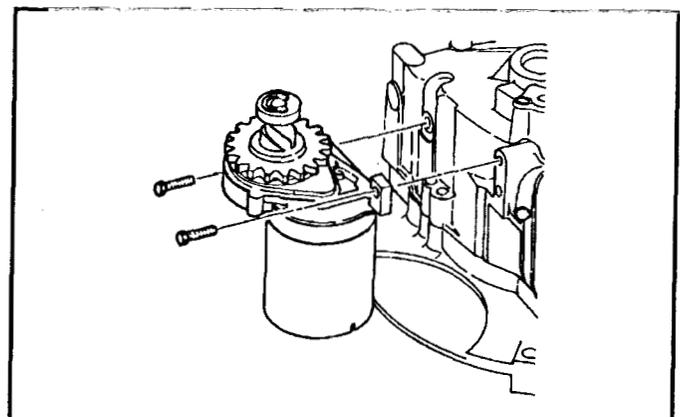


Figure 96

Flywheel - Installation

1. Install the flywheel key.
2. Make certain the crankshaft taper and flywheel taper are free of burrs or defects.
3. Install the flywheel, starter cup and flywheel nut. Torque the nut to 60 ft lbs (82 Nm).

Alternator - Installation

1. If an alternator is used on the engine, begin installation by routing the output wire underneath the bracket that retains the blower shroud.
2. Install the alternator on its mounting posts. See Figure 97.

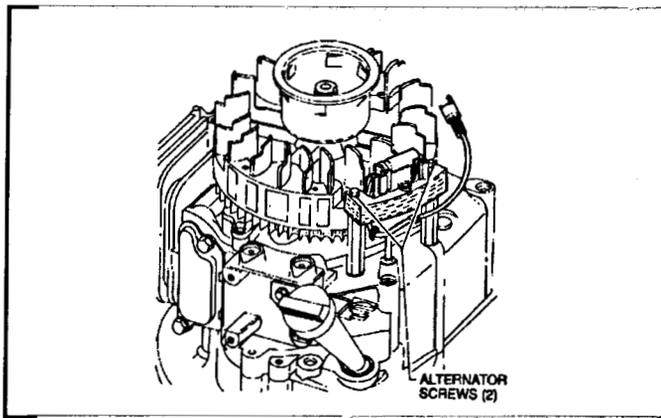


Figure 97

3. The alternator air gap (the space between the flywheel and the alternator) should be set to .008 - .012" (.20 - .30 mm).
4. Tighten the alternator mounting screws to 45 in lbs (5 Nm).

Ignition Armature Coil - Installation

1. Install the ignition coil on its mounting bosses.
2. Route the ignition kill wire behind the throttle bracket and connect the kill wire to the grounding terminal on the bottom of the throttle bracket. See Figure 98.

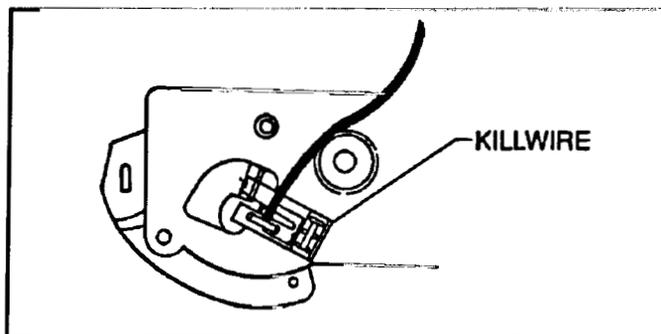


Figure 98

3. Set the ignition coil air gap (the space between the flywheel and ignition coil) to .008 - .012" (.20 - .30 mm).
4. Torque the ignition coil screws to 45 in lbs (5 Nm).
5. Route the spark plug wire through the slot in the front shroud bracket to help retain the wire in place.

Flywheel Brake - Installation (if required)

1. Mount the brake assembly to the block with two 5/16" hex, washer head screws. Torque to 35 in lbs (4 Nm). See Figure 99.

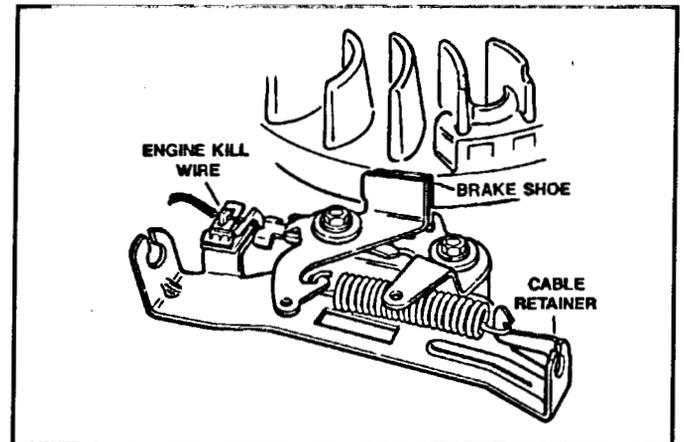


Figure 99

2. Connect the brake cable.
3. Connect the ignition kill wire.
4. Install the brake spring.

Muffler - Installation

1. Install a new muffler gasket.
2. Install the muffler with two 3/8" hex, washer head cap screws. Torque the screws to 85 in lbs (9.5 Nm) See Figure 100.

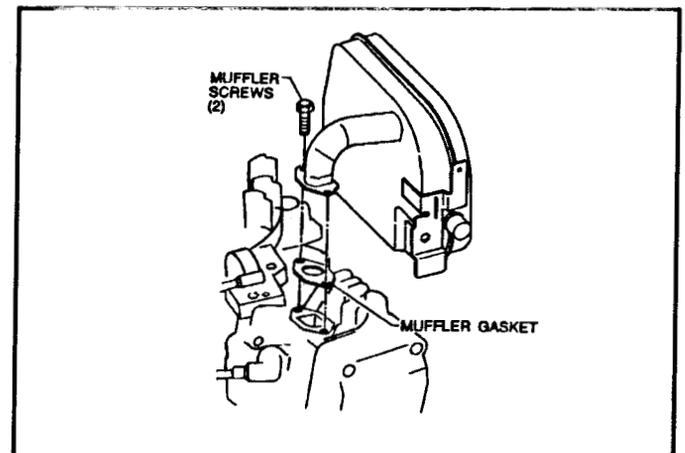


Figure 100

3. Install a single 3/8" hex, washer head cap screw in the front mounting bracket of the muffler. Torque the screw to 85 in lbs (9.5 Nm)

Muffler Shroud - Installation

1. Install the shroud with two 3/8" hex, washer head screws in the rear of the shroud. Torque the screws to 50 in lbs (5.5 Nm).
2. Install two 5/16" hex, cap screws in the front of the muffler shroud. Torque the screws to 35 in lbs (4 Nm). See Figure 101.

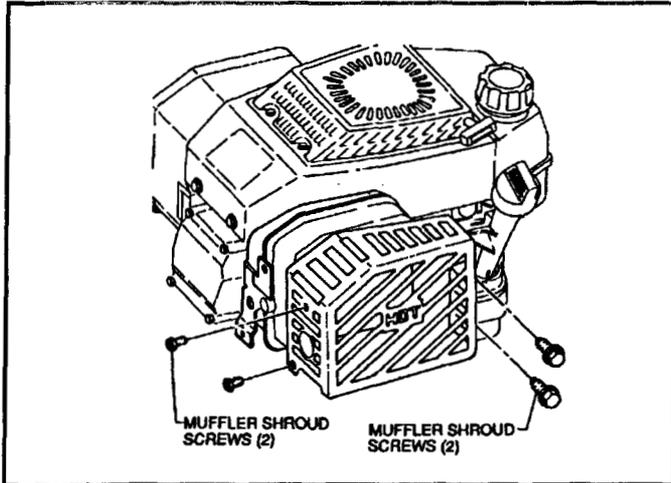


Figure 101

Dipstick Tube - Installation

1. Lubricate the "O" ring on the sealing end of the tube.
2. Install the tube in the block.
3. Mount the tube with two 3/8" hex, washer head cap screws. Torque the screws to 35 in lbs (4 Nm). See Figure 102 and 103.

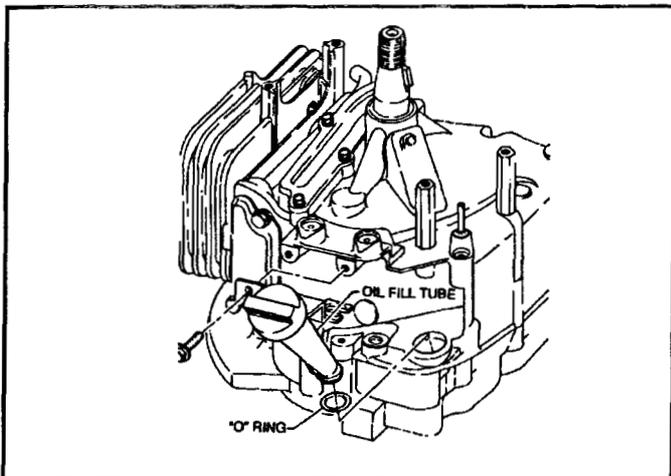


Figure 102

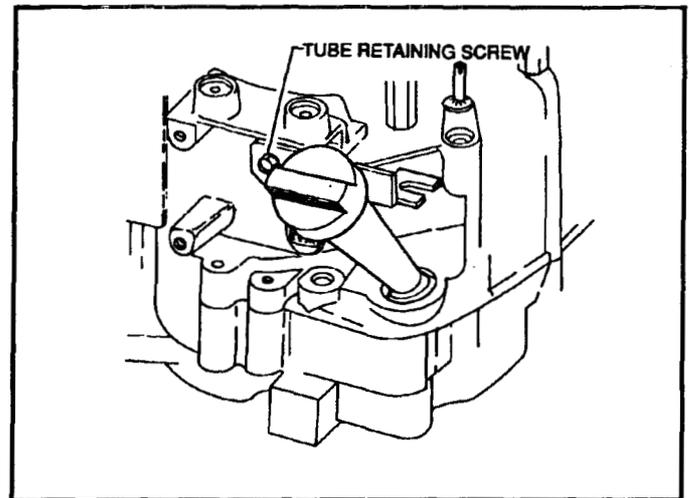


Figure 103

Fuel Tank - Installation

1. Mount the fuel tank with two 3/8" hex, washer head cap screws. Torque the screws to 45 in lbs (5 Nm).
2. Install the fuel hose. With electric start models, route the fuel hose around the electric starter.
3. Install a hose clamp on the fuel tank and carburetor ends of the fuel hose.

Blower Shroud - Installation

1. Install the blower shroud and secure it with four 3/8" hex, washer head cap screws. Torque the screws to 50 in lbs (5.8 Nm). See Figure 104.

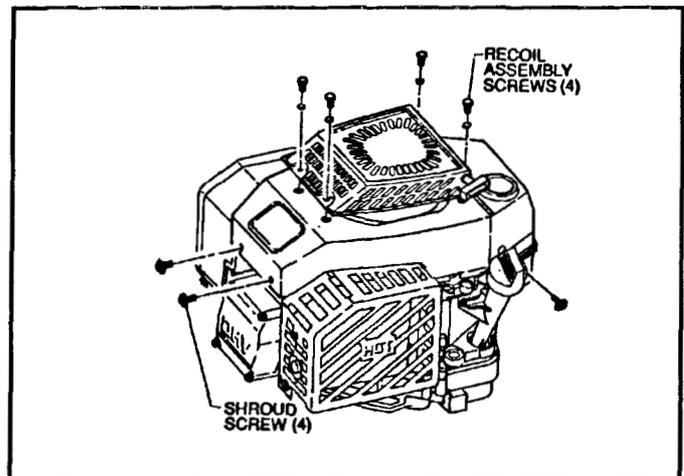


Figure 104

Rewind Starter - Installation

1. Make sure the alignment pin is installed in the drilled hole in the rewind starter mounting screw. See Figure 105.

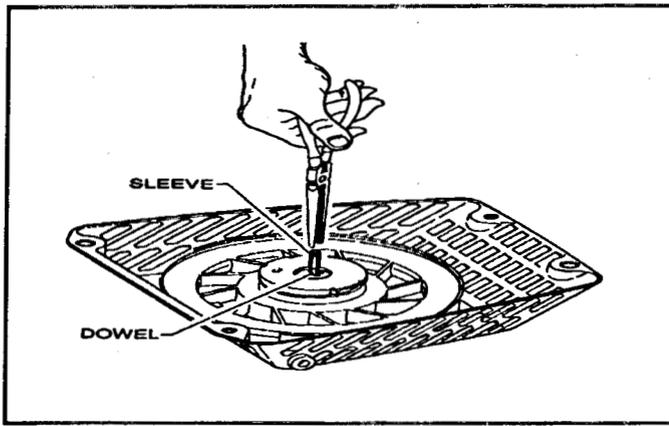


Figure 105

2. Install the recoil starter with four 5/16" hex, cap screws. Make sure there is a flat washer on each screw. Torque the screws to 40 in lbs (5 Nm) See Figure 106.

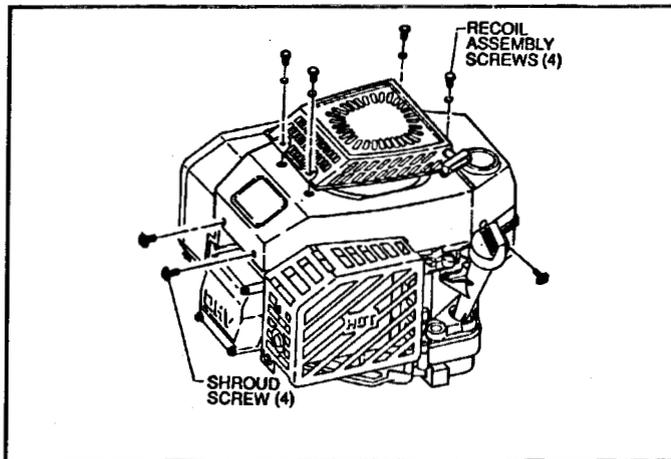


Figure 106

Air Cleaner - Installation

1. Make sure the cork gasket is installed between the body of the air cleaner and the carburetor.
2. Make certain the breather hose is installed and sealed on the back of the air cleaner. The breather vents into the clean side of the air cleaner element.

IMPORTANT: Failure to connect this hose properly will result in engine failure due to dirt ingestion.

3. Mount the air cleaner body to the engine making certain the breather hose is installed on the breather tube.
4. Secure the air cleaner body with three 5/16" hex, washer head shoulder screws. See Figure 107. Torque the screws to 35 in lbs (4 Nm).

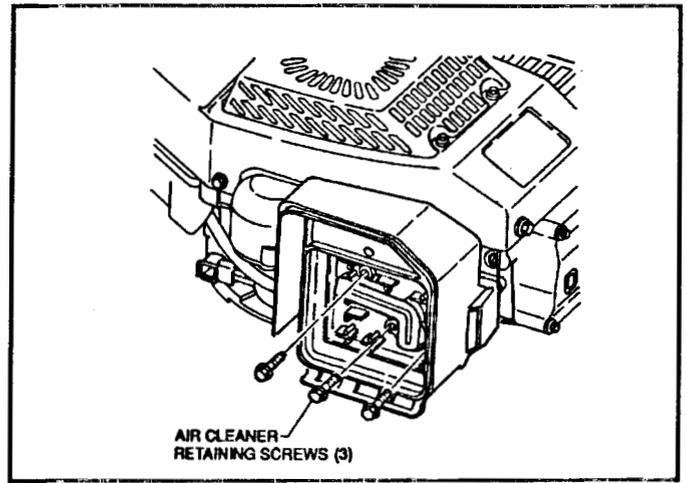


Figure 107

5. Make sure the foam element has been properly cleaned and oiled. See Maintenance Section on page 15, and install the element.
6. Install the air cleaner cover and tighten the thumb screw.

Spark Plug - Installation

1. The correct spark plug is a Champion RC12YC.
2. Gap the plug to .030" (.76 mm).
3. Torque the spark plug to 170 in lbs (19 Nm).

Engine assembly is complete.

ACKNOWLEDGEMENT

The Toro Company wishes to extend its gratitude and appreciation to the students in Steven M. Last's Technical Illustration class in the School of Technology at Ferris State University in Big Rapids, Michigan.

The students identified in the photograph completed 93 of the illustrations used in this service manual.



Students: left to right in photograph.

Top row: Karen Becker, Scott Cooley, Kevin Lubien, Amada Lopez, Dan Backus.

Second row: Scott Thomas, Dave Dekarske, Ben Beltman, Roger Scholz, Rich Tyndall, Steve Stewart, Matt Vink, Sandi Hutchinson, Wendy Skaja, Rachel Wisner.

Front row: Jim Pleshokov, Scott Geyer.