



Briggs and Stratton Engine
Model 190707 and 220707
Service Manual No. 9-50262

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JI Case
A Tenneco Company



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SECTION 1

SPECIFICATIONS

ENGINE MODEL NUMBER		190707	220707
ARMATURE AIR GAP		.010" to .014" (0.26 to 0.35 mm)	.010" to .014" (0.26 to 0.35 mm)
CARBURETOR ADJUSTMENT (INITIAL TURNS OPEN FROM SEAT)	NEEDLE VALVE	1-1/8	1-1/8
	IDLE VALVE	1-1/8	1-1/8
CONDENSER CAPACITY		.18 to .24 MFD	.18 to .24 MFD
CONTACT POINT GAP		0.20" (0.51 mm)	.020" (0.51 mm)
CRANKSHAFT END PLAY		.002" to .008" (0.05 to 0.20 mm)	.002" to .008" (0.05 to 0.20 mm)
CRANKSHAFT REJECT SIZE	MAG. JOURNAL	.9975" (25.336 mm)	1.376" (34.950 mm)
	CRANKPIN	1.122" (28.50 mm)	1.247" (31.67 mm)
	P.T.O. JOURNAL	1.179" (29.95 mm)	1.376" (34.95 mm)
CYLINDER BORE STD †		3.000" to 2.999" (76.20 to 76.17 mm)	3.4375" to 3.4365" (87.313 to 87.287 mm)
IDLE SPEED		1750 RPM	1750 RPM
MAIN BEARING REJECT GAGE		19178	
RING GAP REJECT SIZES	COMPRESSION RINGS	.035" (0.88 mm)	.035" (0.88 mm)
	OIL RINGS	.045" (1.14 mm)	.045" (1.14 mm)
SPARK PLUG GAP		.030" (0.76 mm)	.030" (0.76 mm)
TOP GOVERNED SPEED		3600 RPM	3600 RPM
TORQUE SPECIFICATIONS	FLYWHEEL NUT	65 lb. ft. (88 Nm)	65 lb. ft. (88 Nm)
	CYLINDER HEAD	165 lb. in. (19 Nm)	165 lb. in. (19 Nm)
	CONNECTING ROD	165 lb. in. (19 Nm)	190 lb. in. (21 Nm)
VALVE CLEARANCE	INTAKE	.005" to .007" (0.13 to 0.17 mm)	.005" to .007" (0.13 to 0.17 mm)
	EXHAUST	.009" to .011" (0.23 to 0.27 mm)	.009" to .011" (0.23 to 0.27 mm)
VALVE GUIDE REJECT GAGE		19151	19151

CYLINDER RESIZING

Resize if .003" (0.076 mm) or more wear or .0025" (0.064 mm) out of round.

Resize to .010", .020" or .030" (0.254, 0.508 or 0.762 mm) over Standard.

GENERAL INFORMATION

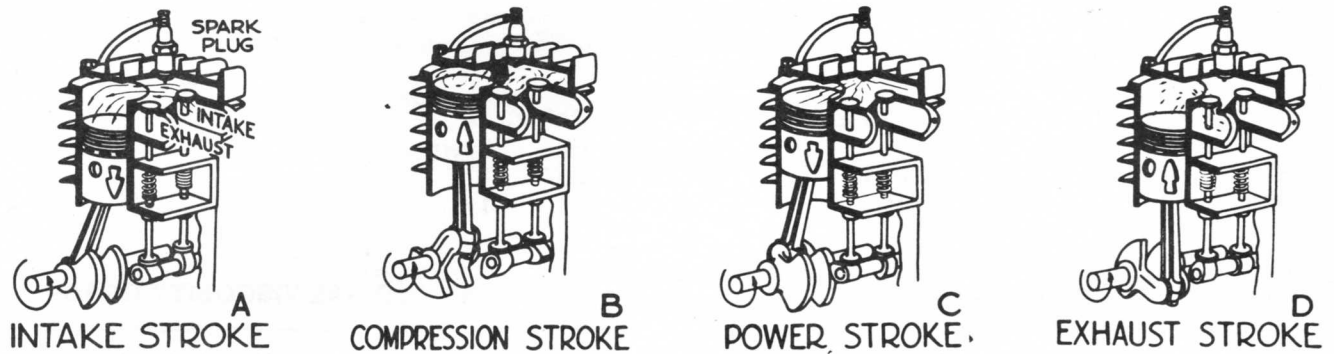


FIGURE 2-1

These engines are of the same basic 4 stroke cycle design used in larger machines or as the name indicates, there are four strokes to one complete power cycle:

A. INTAKE STROKE

The piston goes down and causes a vacuum in the cylinder. The vacuum pulls gasoline through the open intake valve and into the space above the piston.

B. COMPRESSION STROKE

Both valves close. The piston comes up and compresses the gasoline in the space between the piston and cylinder head.

C. POWER STROKE

At this point the magneto sends high tension current to the spark plug. An explosion occurs and moves the piston down.

D. EXHAUST STROKE

The exhaust valve opens. The piston moves up and pushes out all of the exhaust gas.

This completes the power cycle.

USE CLEAN GASOLINE

IMPORTANT: A clean, new, regular grade or regular grade with lead added gasoline is recommended. Do not use a gasoline with a large content of lead. Engine life will be shorter.

IMPORTANT: Fill the crankcase with the correct oil before you start the engine. Keep the oil level between the marks on the dipstick.

CAUTION: Handle gasoline with care — it is highly flammable.



- a. Use approved gasoline container.
- b. Never remove the cap of the fuel tank or add gasoline to a running or hot engine, or fill the fuel tank indoors. Wipe up spilled gasoline.
- c. Open doors if the engine is run in the garage — exhaust fumes are dangerous. Do not run the engine (motor) indoors.

CORRECT LUBRICATION IS IMPORTANT

Any detergent oil having high quality and having the service classification SC, SD or MS can be used. Detergent oils keep the engine cleaner.

OIL CAPACITY CHART

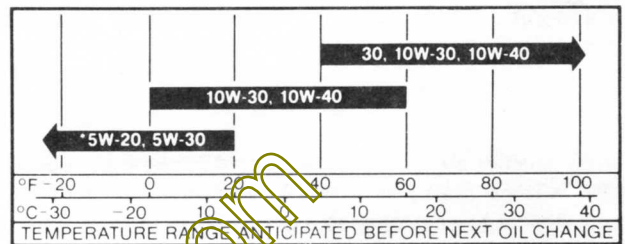
MODEL	CAPACITY	
	Pints	Liters
80-108	2-1/4	1.1
110	3	1.4

Do not use any special additives.

Change the oil after each 25 hours of engine operation. If the operating conditions are severe or dusty, change the oil at shorter intervals. See section 6 of this manual.

Service the air cleaner every 25 hours of engine operation. If the operating conditions are severe or dusty, service the air cleaner at shorter intervals. See section 3 of this manual.

RECOMMENDED SAE VISCOSITY GRADES



*If not available, a synthetic oil may be used having 5W-20, 5W-30 or 5W-40 viscosity.

CLEAN THE COOLING SYSTEM

Debris can cause an obstruction of the air cooling system. The engine can become too hot and damage will occur. The figure below shows the engine with the blower housing removed and the area to be cleaned. Clean this area at regular intervals.

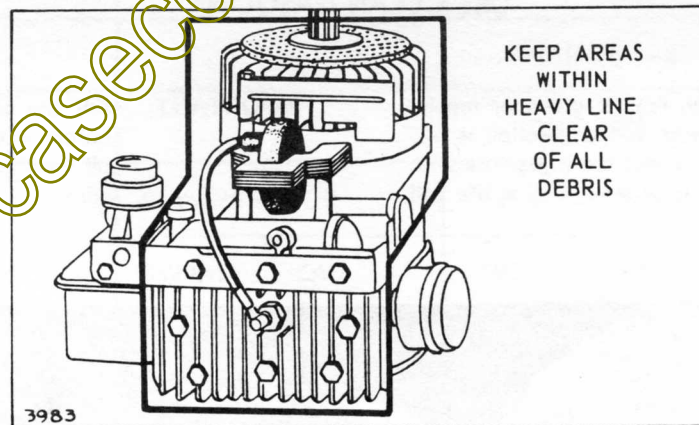


FIGURE 2-2

TUNE-UP PROCEDURE

Use this procedure on newer engines with minor problems. By using these steps you will either:

1. Make sure the engine function is correct.
2. You will know if major repairs are needed.

These steps are also included in the Overhaul Procedure section of this manual. They are a part of the complete overhaul procedure.

1. Remove the air cleaner, check for correct service.
2. Check the oil level. Drain the oil and gasoline. Clean the fuel tank and lines.
3. Check the starter mechanism.
4. Clean the cooling fins and the complete engine. Rotate the flywheel to check compression.
5. Remove the carburetor.
 - a. Disassemble the carburetor and check for wear or damage.
 - b. Clean in solvent.
 - c. Replace parts as necessary.
 - d. Assemble the carburetor and adjust the needle valves so the engine will start.
6. Check the crossover tube or intake elbow for damaged gaskets.
7. Check the governor linkage and spring for damage or wear. Check the governor adjustment.
8. Remove the flywheel.
 - a. Check for oil leakage at the seals on the flywheel side and the drive shaft side of the engine.
 - b. Check the flywheel key for damage.
9. Remove the breaker cover and check for correct sealing.
10. Check the breaker points, condenser and plunger. Clean and adjust or replace these parts as needed.
11. Check the coil and lead wires for breaks or damaged insulation. Make sure the lead wires do not come in contact with the flywheel. Check the stop switch and lead.
12. Install the breaker cover. Use a sealant where the wires enter.
13.
 - a. Install the flywheel.
 - b. Set the engine timing if necessary.
 - c. Set the air gap of the ignition coil.
 - d. Check for spark with a No. 19051 tester.
14. Remove the cylinder head.
 - a. Check the head gasket.
 - b. Remove the spark plug.
 - c. Remove all carbon.
 - d. Check the valve seats for wear.
15. Install the cylinder head.
 - a. Apply the specified torque to the head bolts.
 - b. Set the spark plug gap or replace if necessary.
16. Fill the engine with oil and fuel. Check the muffler for restrictions or damage.
17. Check the remote control linkage and cable for correct operation.
18. Service the air cleaner. Check the gaskets and element for damage. Install the air cleaner.
19. Run the engine. Adjust the fuel mixture. Adjust the speed setting.

OVERHAUL PROCEDURE

This procedure is recommended to help you start a method for repairing this engine. By using these steps in the same sequence each time you repair an engine, your efficiency will increase.

DISASSEMBLY

- _____ Drain oil
- _____ Air cleaner and stud
- _____ Fuel pipe and tank assembly
- _____ Air cleaner elbow or pipe
- _____ Carburetor and linkage
- _____ Carburetor intake elbow
- _____ Muffler
- _____ Check space between upper and lower carburetor body or carburetor to tank fit
- _____ Check throttle shaft and bushings for wear
- _____ Disassemble carburetor
- _____ Electric starter
- _____ Blower housing
- _____ Spin flywheel to check compression
- _____ Spark plug - adjust gap and clean and wash
- _____ Fuel tank and bracket assembly or carburetor
- _____ Blower housing
- _____ Check air gap - armature to flywheel
- _____ Breather or valve cover
- _____ Cylinder head and shield
- _____ Check tappet clearance
- _____ Valve and springs
- _____ Flywheel
- _____ Breaker point cover
- _____ Check breaker point gap
- _____ Check breaker point plunger hole
- _____ Test condenser and remove if necessary
- _____ Test coil and remove if necessary
- _____ Breaker arm assembly and condenser
- _____ Breaker box
- _____ Breaker shaft
- _____ Check end play
- _____ Remove burrs from crankshaft extension
- _____ Crankcase cover, base or sump
- _____ Auxiliary drive
- _____ Damaged seals
- _____ Mechanical governor parts
- _____ Inspect oil slinger
- _____ Cam gear
- _____ Tappets
- _____ Connecting rod and piston
- _____ Armature assembly and back plate
- _____ Rotor
- _____ Test coil or armature - check leads
- _____ Crankcase cover or sump
- _____ Crankshaft - inspect
- _____ Cam shaft and gear

- _____ Check automatic spark advance
- _____ Cylinder - check bore, main bearing, valve guides and seats, cylinder bore
- _____ Disassemble connecting rod and piston
- _____ Check piston, rings, connecting rod, piston pin

REPAIRS

- _____ Clean parts
- _____ Resize cylinder bore to next oversize
- _____ Replace valve guide - intake or exhaust
- _____ Reface valves and seats and lap
- _____ Replace valve seat insert
- _____ Replace main bearings
- _____ Replace oil seal
- _____ Install breaker point plunger, bushing and plunger in cylinder
- _____ Replace coil or armature or both
- _____ Replace automatic spark advance, weight and spring
- _____ Replace throttle shaft bushing
- _____ Repair carburetor

REASSEMBLE

- _____ Tappets, cam gear, camshaft
- _____ Crankshaft and bearing support
- _____ Crankshaft, bearing plate - adjust crankshaft end play
- _____ Piston, piston pin, connecting rod, rings
- _____ Oil slinger
- _____ Mechanical governor
- _____ Sump or crankcase cover - adjust crankshaft end play
- _____ Adjust valve tappet clearance
- _____ Valves, springs, retainer

- _____ Coil, armature
- _____ Breaker points
- _____ Condenser
- _____ Breaker point cover
- _____ Coil and armature assembly
- _____ Adjust rotor timing
- _____ Breaker box cover
- _____ Flywheel
- _____ Electric starter
- _____ Adjust air gap - armature to flywheel
- _____ Check spark
- _____ Breather or valve cover
- _____ Cylinder head and shield
- _____ Spark plug
- _____ Muffler
- _____ Intake elbow or carburetor and tank
- _____ Carburetor and linkage and governor controls
- _____ Check and adjust mechanical governor
- _____ Blower housing
- _____ Fuel filter parts, tank and line
- _____ Air cleaner elbow or pipe
- _____ Fill crankcase with oil
- _____ Start engine (fill with gas)
- _____ Check spark
- _____ Retighten cylinder head screws
- _____ Adjust carburetor
- _____ Set governor to obtain correct engine speed (Remote controls)
- _____ Clean and assemble air cleaner
- _____ Paint engine and apply decals

TROUBLESHOOTING

The following list gives the most common problems with engine operation. You can have one or a combination of these problems.

1. Will not start
2. Hard starting
3. Backlash when starting
4. Lack of power
5. Vibration
6. Operation not regular
7. Engine heat more than normal
8. Oil consumption more than normal

When the cause of the problem is not easily found, check all of the following systems.

1. Compression
2. Ignition
3. Carburetion
4. Other connected equipment

COMPRESSION CHECK

Rotate the flywheel against compression. The flywheel will return with a fast motion if the compression is good.

If compression is bad, check for:

1. Loose spark plug
2. Loose bolts in the cylinder head
3. Damaged head gasket
4. Damaged valves or seats
5. Not enough tappet clearance
6. Cylinder head warpage
7. Valve stem warpage

8. Worn cylinder bore or piston rings
9. Broken connecting rod

IGNITION CHECK

1. Remove the spark plug.
2. Connect the No. 19051 spark tester to the ignition cable. Set the gap on the tester at .166" (4 mm).
3. Ground the tester on the cylinder head.
4. Move the flywheel with a fast rotation. If spark can be seen at the tester gap, the ignition system function is good.
5. Replace the spark plug.

NOTE: This test can be made by holding the tip of the ignition cable about 1/8" (4 mm) away from the cylinder head. For a more accurate test, use the No. 19051 tester.

If spark does not occur, check for:

1. Wrong armature air gap
2. Worn bearings or crankshaft on the flywheel side of the engine.
3. Damaged flywheel key
4. Wrong gap of the breaker points
5. Dirty or burned breaker points
6. Breaker plunger will not move or worn
7. A short circuit of the ground wire
8. Condenser failure
9. Armature failure

NOTE: If the engine ignition is not regular, use the No. 19051 spark tester. Connect the tester between the spark plug and the ignition cable. Run the engine and check the spark.

CARBURETION CHECK

1. Make sure the fuel tank has a supply of new, clean gasoline.
2. Make sure the shutoff valve on the fuel tank is open (on gravity flow "FLOW-JET" models only).
3. Make sure that fuel flows freely through the fuel line.
4. Check and adjust the needle valves.
5. Check the choke operation.

If the engine will not start, remove and check the spark plug. If the spark plug is wet, check for:

1. Choke defect
2. Wrong fuel mixture
3. Water in the fuel
4. Inlet needle valve held open

If the plug is dry, check for:

1. Leakage at the mounting gaskets of the carburetor
2. Inlet needle valve held closed

Make the following check to find if gasoline is getting through the carburetor:

1. Remove the spark plug
2. Put a small quantity of gasoline into the hole for the spark plug.
3. Install the spark plug.
4. Start the engine.
5. If the engine runs and then stops, check for the same conditions as for a dry spark plug.

OTHER CONNECTED EQUIPMENT

Frequently other equipment can prevent good engine operation. The following chart shows the most common equipment problems.

CAUSE	REPAIR
HARD STARTING, BACKLASH, OR WILL NOT START	
Loose belt	Tighten or replace
Starting under load	Disengage other equipment
Remote choke control not adjusted correctly.	Adjust correctly.
VIBRATION	
Bent blade or balance not correct	Replace or grind as needed
Crankshaft bent	Replace
Mounting bolts loose	Tighten
Mounting plate crack	Repair or replace
POWER LOSS	
Equipment drag	Disengage engine and turn equipment manually. Repair.
Debris under mower chassis	Remove
NOISE	
PTO or belt worn	Repair or replace

ENGINE REMOVAL Model 108 and 110.

1. Remove the tractor drive and attachment drive belts as shown in operator's manual.
2. Remove the hood lanyard from the engine and disconnect the headlight wire if equipped.
3. Remove the fasteners from the hood and remove the hood.
4. Remove the choke/throttle linkage from the carburetor.
5. Remove the fuel line from the carburetor and put a plug in the line or drain the fuel from the tank.
6. Remove the battery ground cable and starter lead.
7. Remove the fasteners holding the mounting plate of the engine.
8. Remove the engine with the mounting plate.

Reverse this procedure to install the engine.

NOTE: See the service manual section for the Model 80 Riding Lawn Mower for engine removal.

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SECTION 3

CARBURETION

AIR CLEANERS

Always check the air cleaner on every engine brought in for service. If the maintenance of the air cleaner is not good, give the owner instruction about correct service.

NOTE: It is important to replace any gaskets of the air cleaner that are worn or damaged. Repair or replace bent mounting screws.

SERVICING THE ELEMENT OF THE AIR CLEANER

Clean and replace the oil in the element every 25 hours of operation during normal conditions. (This is equal to a full season of average operation.) If the operating conditions are severe, check and clean the air cleaner every few hours.

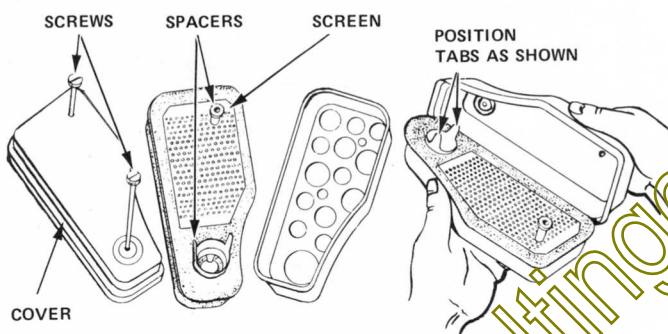


FIGURE 3-1

To service, follow this procedure:

1. Remove the mounting screws.
2. Carefully remove the air cleaner to prevent dirt from entering the carburetor.
3. Disassemble the air cleaner
4. a. Wash the element with kerosene or liquid detergent and water.
b. Put a cloth around the element and apply pressure to dry.
c. Apply engine oil to the element.
d. Apply pressure to the element to remove the extra oil.
5. Assemble the air cleaner and fasten to the carburetor.

CARBURETOR REMOVAL

Before removing the carburetor check for:

1. Air leakage
2. A loose or damaged mounting gasket

Make a note of the position of the governor link, governor spring, remote control or other attachments. Do not bend the links or extend the spring during removal.

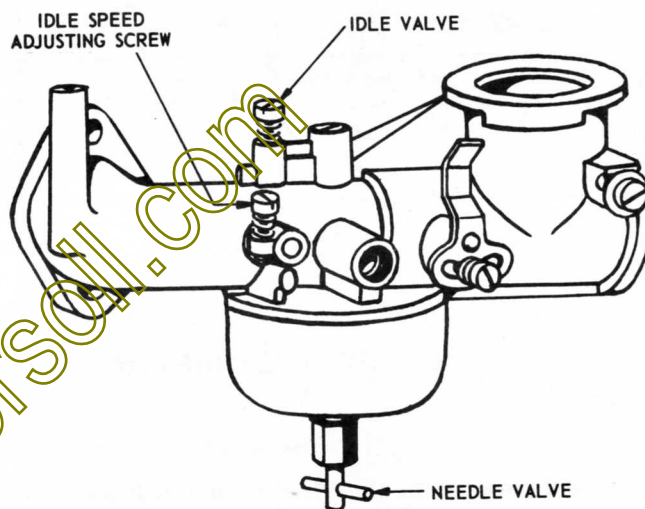


FIGURE 3-2

DISASSEMBLE CARBURETOR

1. Remove the idle valve and needle valve. Discard if they are damaged.
2. Remove the screw from the carburetor bowl and remove the bowl.
3. Remove the pin that holds the float in place. Remove the float and float valve.
4. Check the float for leakage. If the float has a leak or is damaged, replace the float.
5. Use screw driver 19062 to remove the carburetor nozzle.

NOTE: Do not disassemble the carburetor beyond this point unless there is damage in the following areas.

6. Pull out the special "Welch" plug.
7. Remove the choke plate.
8. Press out the stop pin for the choke plate.
9. Remove the Venturi.

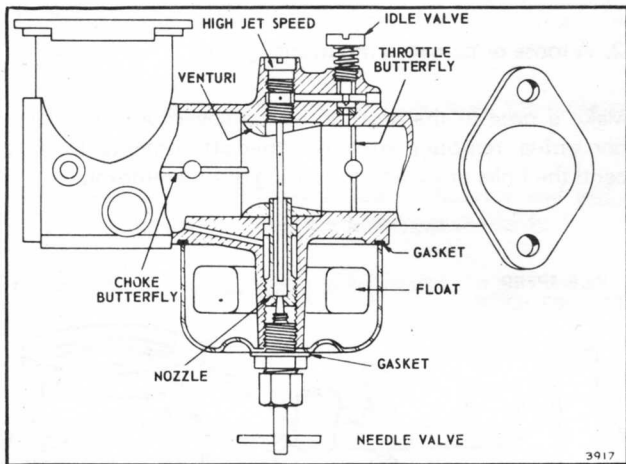


FIGURE 3-3

CHECKING THE THROTTLE SHAFT AND BUSHINGS

The wear between the throttle shaft and bushings must not be more than .010" (0.25 mm).

Check the shaft and bushing wear by using the following procedure:

1. Put a short iron bar on the upper carburetor body as shown in figure 3-4.

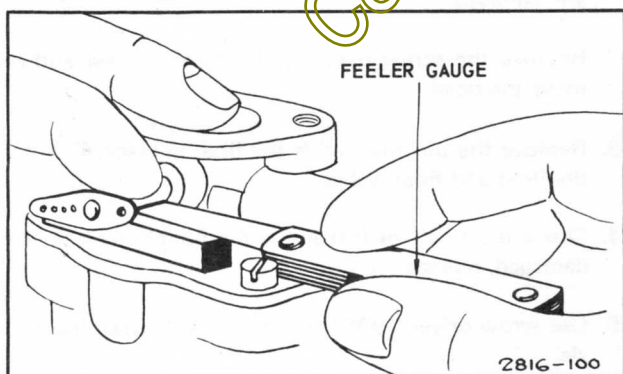


FIGURE 3-4

2. Push up on the throttle shaft.
3. Use a feeler gauge and measure the distance between the iron bar and the throttle shaft.
4. Push down on the throttle shaft.
5. Use a feeler gauge and measure the distance between the iron bar and the throttle shaft.
6. If the difference between the measurements taken in steps 3 and 5 is more than .010 (0.25 mm), follow the next procedure.

REMOVE THROTTLE SHAFT

Only remove the throttle shaft and bushings if the wear is more than .010 (0.25 mm). For removal follow this procedure:

1. Use a thin punch. Push out the pin that holds the throttle stop to the throttle shaft. See figure 3-5.
2. Remove the throttle plate.
3. Pull the throttle shaft out.
4. Check the throttle shaft for a worn area.
5. Replace the throttle shaft and bushing as needed.

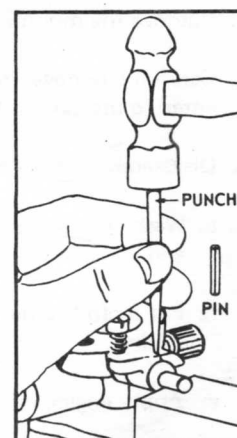
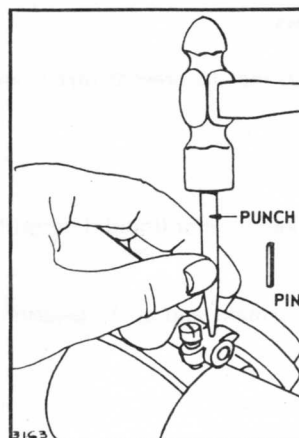


FIGURE 3-5

REPLACE THE THROTTLE SHAFT BUSHINGS

1. Put a 1/4" x 20 tap or a special tool for removal of bushings in a vise.
2. Turn the tap or tool into the bushing by turning the carburetor body as shown in figure 3-6.
3. Pull the bushing from the carburetor.

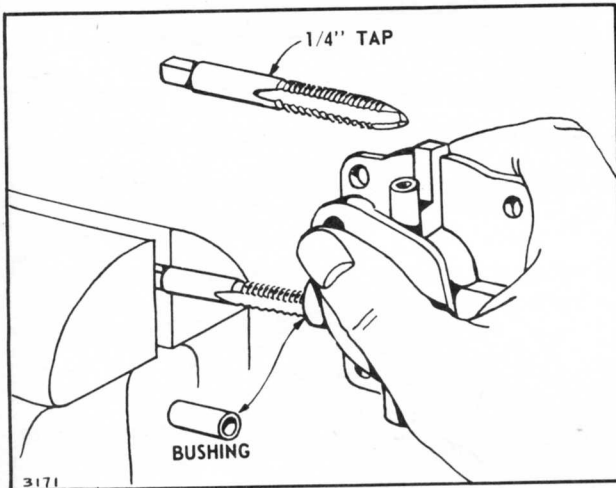


FIGURE 3-6

4. Press new bushings into the carburetor body by using a vise.
5. Put the throttle shaft into the bushings and check for free movement.
6. If the throttle shaft does not move freely in the new bushings, use a 7/32" drill to ream the bushings.
7. Install the throttle shaft, throttle plate and throttle stop.

ASSEMBLE THE CARBURETOR

1. Use new parts as needed.
2. Always use new gaskets.
3. Get a repair kit if needed.
4. Install the Venturi.
5. Install the nozzle jet. The nozzle jet holds the Venturi in place. See figure 3-7.
6. Install the choke shaft and plate.

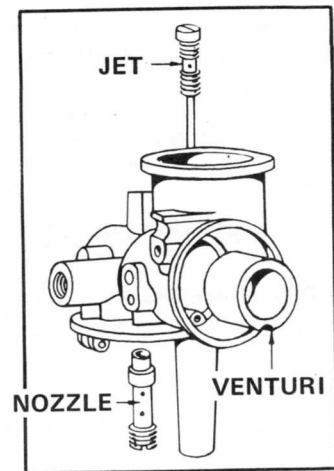
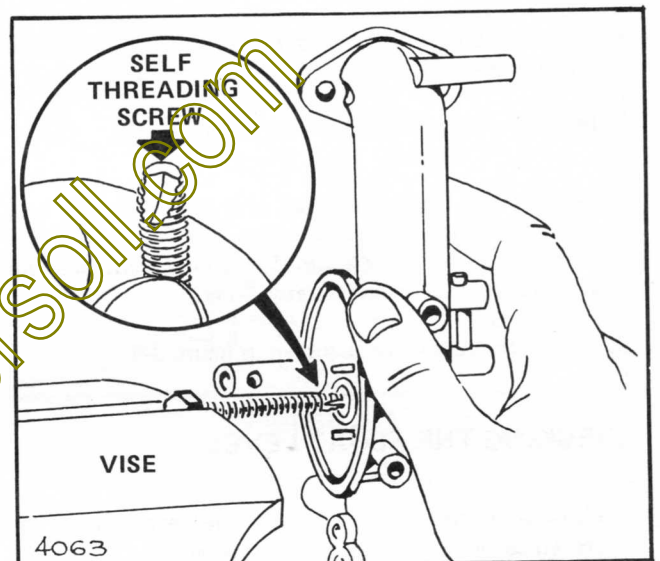


FIGURE 3-7



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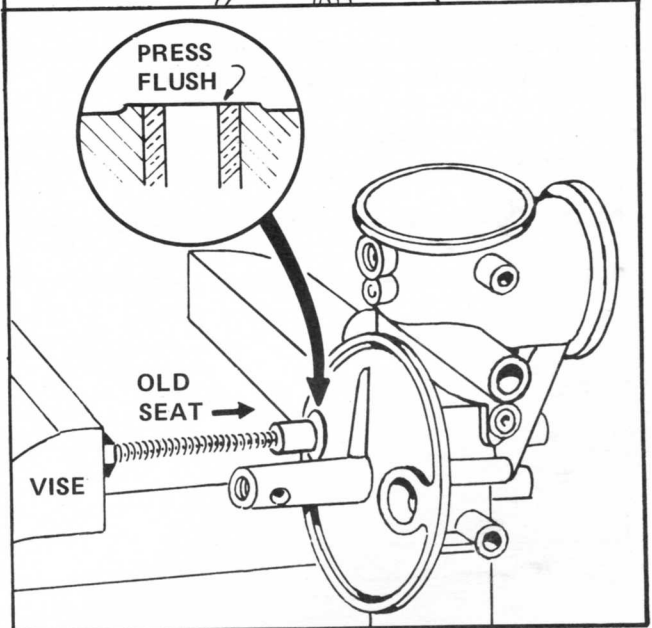
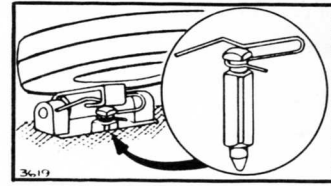


FIGURE 3-8

7. Install a new special "Welch" plug in the carburetor body. Use a sealer to prevent dirt from entering.
8. The seat for the float valve is pressed into the upper body of the carburetor. Do not replace this seat unless it is damaged.



REPLACING THE FLOAT VALVE SEAT

1. Use a No. 93029 self-tapping screw or remove one self-tapping screw from a No. 19069 flywheel puller.
2. Hold the head of the screw in a vise.
3. Turn the screw into the seat by turning the carburetor as shown in figure 3-8.
4. Continue to turn the carburetor to pull the seat out.
5. Keep the old seat fastened to the screw. Use the old seat as a driver.
6. Install the new seat into the carburetor body.
7. Use the old seat as a driver, and press the new seat even with the carburetor body. See figure 3-8. For correct float valve operation, it is important that the seat is even with the carburetor body.
8. Install the float valve as shown in figure 3-9.

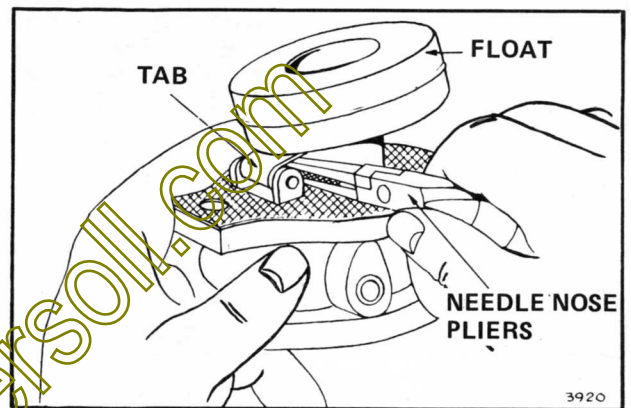
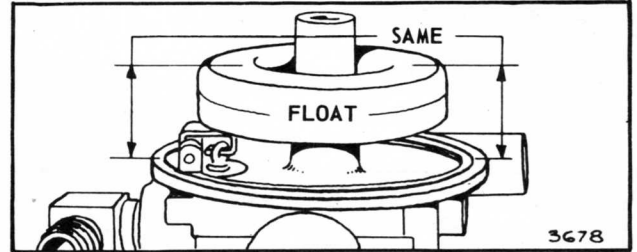


FIGURE 3-9

CHECKING THE FLOAT LEVEL

1. Make sure the body gasket for the carburetor is installed before you check the float level.
2. For correct level, the float must be parallel to the mounting surface of the carburetor. See figure 3-9.
3. To adjust the float, bend the tab on the float. Use a pliers as shown.

NOTE: Do not push on the float or damage can occur.

4. Install the float bowl, idle valve and needle valve.

CARBURETOR ADJUSTMENT

1. Turn the needle valve and idle valve in until they contact the bottom of the seats. Do not apply force.
2. Open each valve 1-1/8 turns. These settings will permit the engine to start.
3. Start the engine. Run the engine at approximately 3000 RPM until the engine becomes warm.
4. Adjust needle valve.
 - a. Turn the valve in until the engine runs bad (too little fuel).
 - b. Turn the valve out until the engine runs bad (too much fuel).
 - c. Turn the valve to a position half way between the positions in steps A and B.
5. Put the throttle in the "Idle" position and set the idle speed. Turn the adjusting screw for the idle speed until the idle speed is 1750 RPM minimum.
6. Adjust the idle valve.
 - a. Turn the idle valve in until the engine runs bad.
 - b. Turn the idle valve out until the engine runs bad.
 - c. Check the idle speed again and set correctly if needed.
 - d. Put the throttle in the fast position. The engine speed must increase smoothly. If the engine speed does not increase correctly, increase the gasoline mixture with the needle valve.

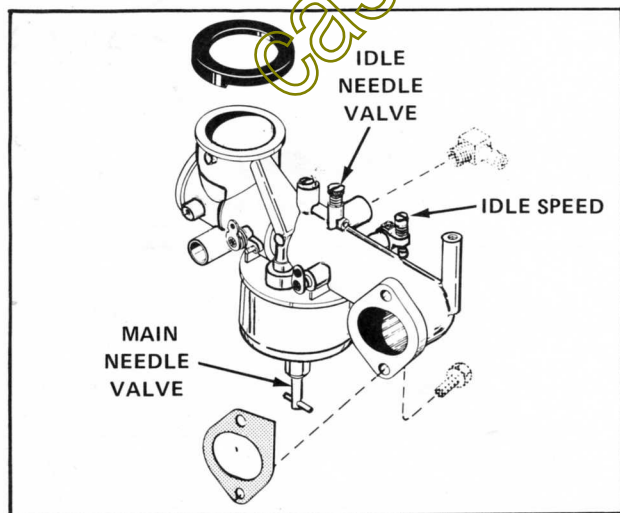


FIGURE 3-10

CHOK-A-MATIC ADJUSTMENT

1. Move the remote control lever to the "Fast" position.
2. See figure 3-11. Check that the choke actuating lever "A" just makes contact with the choke link "B".
3. If the adjustment is not correct, follow this procedure:
 - a. Loosen screw "C".
 - b. Move the throttle cable "D" until the choke actuating lever "A" just makes contact with the choke link "B".
 - c. Tighten screw "C".

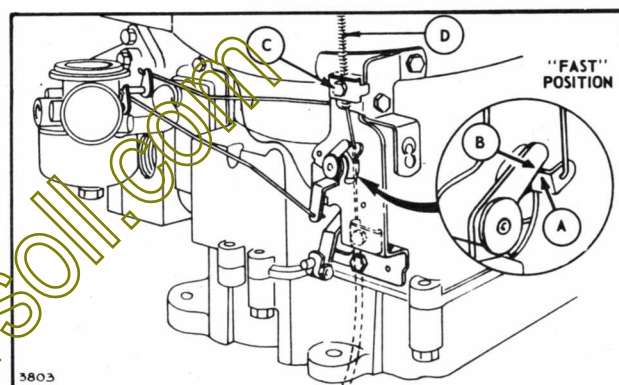


FIGURE 3-11

SECTION 4

GOVERNOR REPLACEMENT AND ADJUSTMENT

REMOVAL

The governor and oil slinger are a single unit.

1. Remove the oil sump.
2. Remove the governor/slinger.
3. The whole unit must be replaced if there is damage.

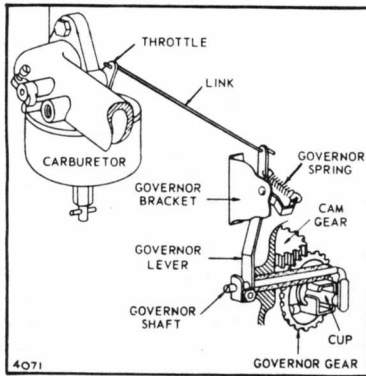


FIGURE 4-1

ADJUSTMENTS

1. Loosen the nut on the governor lever.
2. Hold the throttle lever against the throttle stop.
3. Turn the governor shaft clockwise as far as it will go.
4. Tighten the nut on the governor lever to 35-45 in. lbs. (4-5 Nm) of torque.
5. Move the throttle full travel to check for interference or obstructions. Correct problems if needed.
6. To adjust maximum speed, follow this procedure:
 - a. Start the engine.
 - b. Set the throttle control at "FULL" speed.
 - c. See figure 4-3. Use the tool as shown in figure 4-4 or tool No. 19229 to bend the spring tab to get the needed speed.

NOTE: The idle speed for this engine is 1750 RPM. The maximum operation speed is 3600 RPM. Do not set the speed at more than 3600 RPM.

INSTALLATION

1. Lay the engine on one side so the crankshaft is in a horizontal position.
2. Make sure the governor shaft is in a downward position or the shaft can damage the governor.
3. Put the governor into position.
4. Carefully install the oil sump so the governor assembly does not fall into the crankcase.

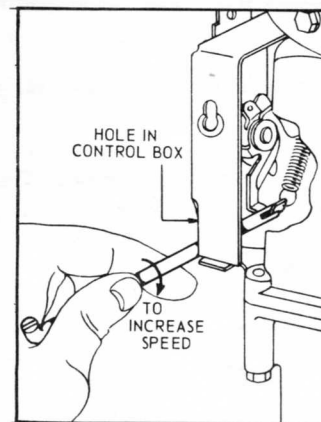


FIGURE 4-3

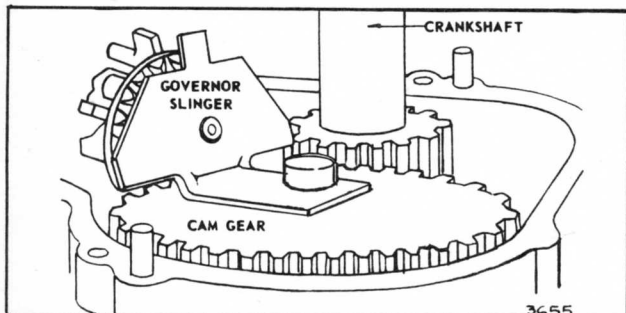


FIGURE 4-2

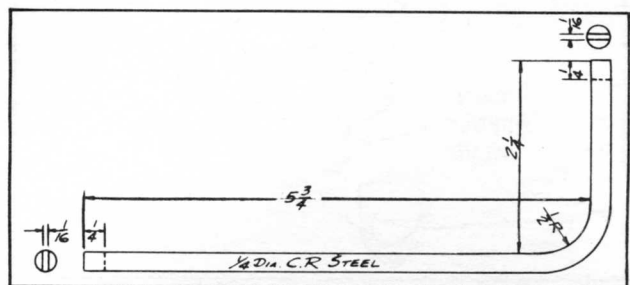


FIGURE 4-4

COMPRESSION

Check the compression. Rotate the flywheel against compression. The flywheel will return with a fast motion if the compression is good. If the compression is bad, check the following.

1. A damaged head gasket
2. Bad valves or seats
3. Worn or damaged piston rings. This will also cause more than normal oil consumption.

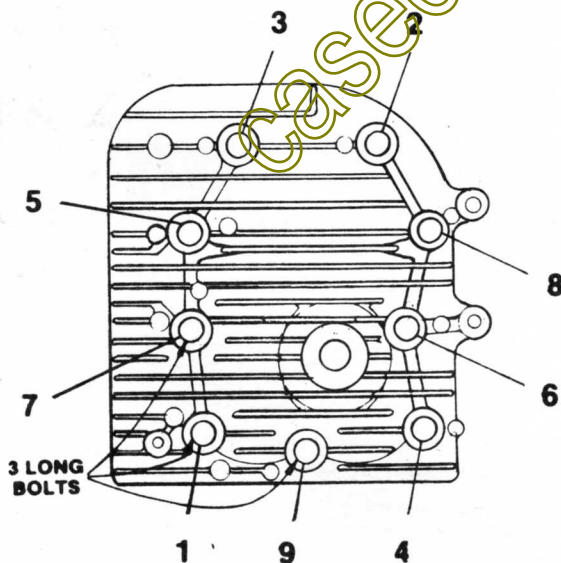
Remove carbon deposits from the combustion chamber every 100 to 200 hours of operation. If the operating loads are severe, remove the deposits at shorter intervals. Always remove carbon deposits each time the cylinder head is removed.

REMOVAL OF THE CYLINDER HEAD AND SHIELD

Make a note of the correct position of all the cylinder head bolts. Wrong bolt installation can cause damage or leave the head loose.

CYLINDER HEAD TORQUE PROCEDURE

1. Make sure the cylinder and cylinder head contact areas are clean.
2. Put a new gasket on the cylinder head and install on the cylinder. Do not use any sealer on the cylinder head gasket.



FIGURES 5-1

3. Put the head shield in place.
4. Put a graphite grease on the head bolts. Put the bolts in the correct position and tighten with your fingers.
5. Use a torque wrench and tighten the cylinder head bolts in the sequence shown in figure 5-1. Repeat this sequence and tighten each bolt a small amount each time until you reach 165 in. lbs. (18.6 Nm) of torque. Do not tighten one bolt completely at one time as this can cause a warp in the cylinder head.

TO REMOVE VALVES

REMOVAL OF EXHAUST VALVE

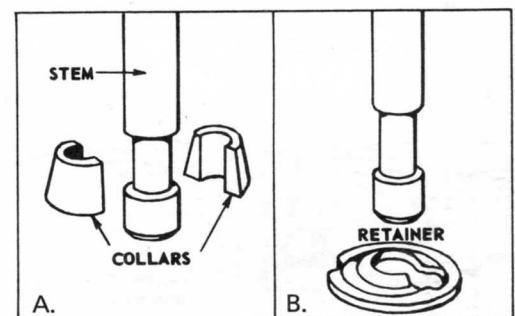
(See A of figure 5-2)

1. Use No. 19063 valve spring compressor.
2. Adjust the compressor jaws until they just make contact with the top and bottom of the valve chamber. This will prevent the upper jaw from sliding into the coils of the spring.
3. Push the compressor in until the upper jaw slides over the end of the spring.
4. Tighten the jaws to compress the spring. See figure 5-3.
5. Remove the valve collars. Remove the valve.
6. Pull out the compressor and spring.

REMOVAL OF INTAKE VALVE

(See B of figure 5-2)

1. Use No. 19063 valve spring compressor.
2. Slide the upper jaw over the top of the valve chamber.
3. Slide the lower jaw between the spring and the retainer. See figure 5-4.



FIGURES 5-2

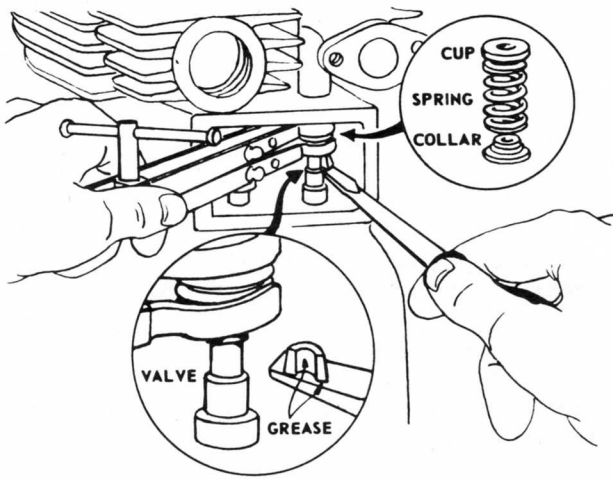


FIGURE 5-3

4. Compress the spring. Remove the retainer.
5. Remove the compressor and spring.

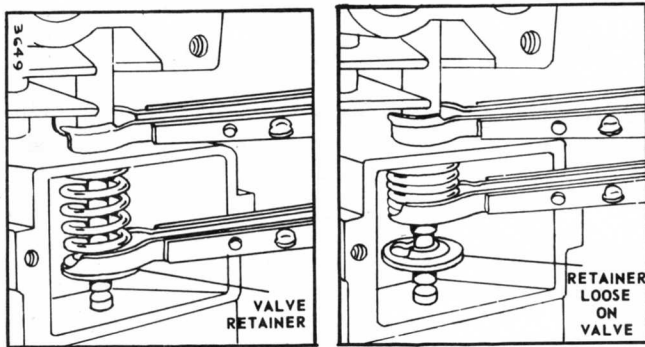


FIGURE 5-4

GRINDING VALVES AND SEATS (See figure 5-5)

A valve or valve seat that is badly burned must be replaced. To repair valves and valve seats follow this procedure:

1. Use a valve grinder and cut the face of the valves and valve seats to:
 - a. 45° exhaust valve
 - b. 30° or 45° intake valve

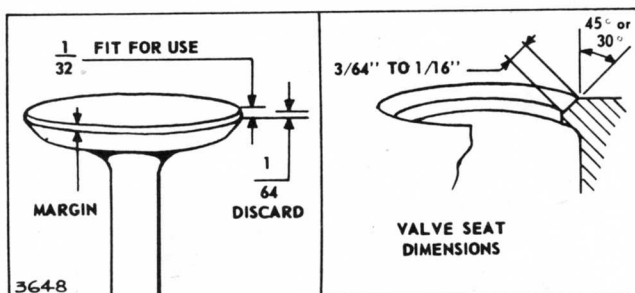


FIGURE 5-5

2. Use a lapping compound to remove the grinding marks from the valves and valve seats. This is important for a good fit between the valves and valve seats.
3. After grinding, the valve seat width must be 3/64" to 1/16" (1.19 to 1.59 mm). Use a narrower stone or cutter to decrease the width if needed.
4. If the valve margin is less than 1/64" (0.4 mm) after grinding, replace the valve.

TO CHECK AND ADJUST TAPPET CLEARANCE

NOTE: Always check the clearance when the parts are cold.

1. Set the valves in the correct positions in the cylinder.
2. To check intake valve follow this procedure:
 - a. Turn the crankshaft until the exhaust valve is at the highest point of travel.
 - b. Use a feeler gauge to check the clearance of the intake valve.
 - c. The clearance must be .005" - .007" (0.13 - .018 mm). Grind the bottom of the valve stem to get the correct clearance.
3. To check exhaust valve clearance follow this procedure:
 - a. Turn the crankshaft until the intake valve is at the highest point of travel.
 - b. Use a feeler gauge to check the clearance of the exhaust valve.
 - c. The clearance must be .009" to .011" (0.23 to 0.28 mm). Grind the bottom of the valve stem to get the correct clearance.

INSTALLING THE VALVES

- To install the exhaust valve follow this procedure:
 - Put the short valve spring and rotator into the No. 19063 spring compressor.
 - Compress the spring until it is solid.
 - Hold the spring in the valve chamber with the rotator to the bottom of the chamber.
 - Slide the valve down through the cylinder and through the spring and rotator.
 - Put the valve and spring in a position to permit installation of the holding collars.
 - Install the collars in the groove in the valves. See figure 5-3.
 - Lower the spring until the rotator fits around the collars.
 - Pull out the spring compressor. Check the collars for correct fit.
- To install the intake valve follow this procedure:
 - Put the long valve spring and retainer in the compressor No. 19063.
 - Put the larger area of the retainer slot toward the front of the valve chamber.

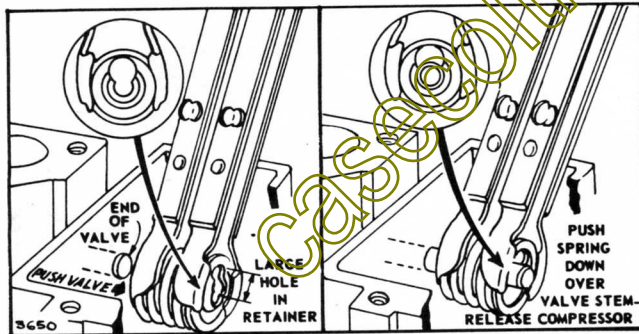


FIGURE 5-6

- Slide the valve down through the cylinder and through the larger area of the retainer slot.
- Move the spring to engage the small area of the retainer slot with the shoulder on the valve stem.
- Release the spring tension. Remove the compressor.

VALVE GUIDES

Put the flat end of the gauge No. 19151 into the valve guide. If the gauge can be put into the valve guide a distance of 5/16" (7.9 mm), the guide is worn. Replace the bushing in the valve guide. See figure 5-7.

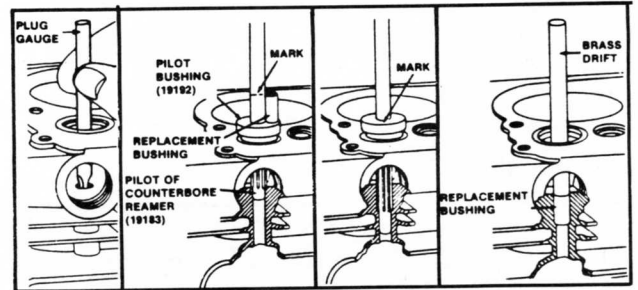


FIGURE 5-7

To replace the bushing in the valve guide follow this procedure:

- Put the pilot of the counterbore reamer No. 19183 into the valve guide.
- Install the pilot bushing No. 19192 on the reamer shaft. Lower the pilot bushing into the valve seat.
- Hold the new bushing No. 230665 for the valve guide on the pilot bushing. Make a mark on the reamer shaft 1/16" (1.59 mm) above the top of the new bushing.
- Ream the valve guide until the mark on the reamer shaft aligns with the top of the pilot bushing. See figure 5-7.
- Put the new bushing in the valve guide. Press down with a brass drift. The top of the bushing must be aligned with the top of the valve guide hole.
- The new No. 230665 bushing comes in the correct size for a standard valve.

NOTE: Check the valve seat after bushing replacement. Repair the seat if it is damaged.

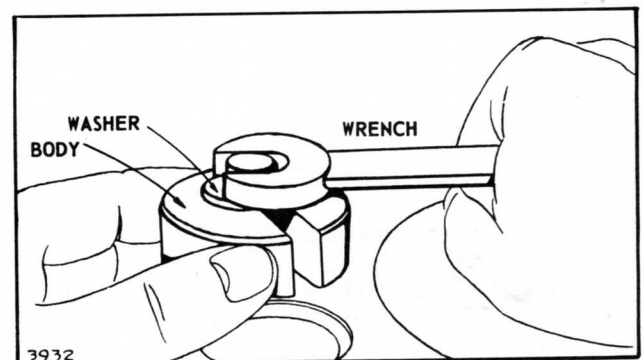


FIGURE 5-8

REPLACEMENT OF THE VALVE SEAT INSERT

Use puller No. 19138 and puller nut No. 19141 to remove the insert.

1. Install the insert puller as shown in figure 5-9. Make sure the puller body does not contact the insert.
2. Turn the bolt with a wrench until the seat is removed.

NOTE: If the puller nut does not fit under the insert, grind the edge to a $1/32''$ (0.8 mm) thickness. See figure 5-9.

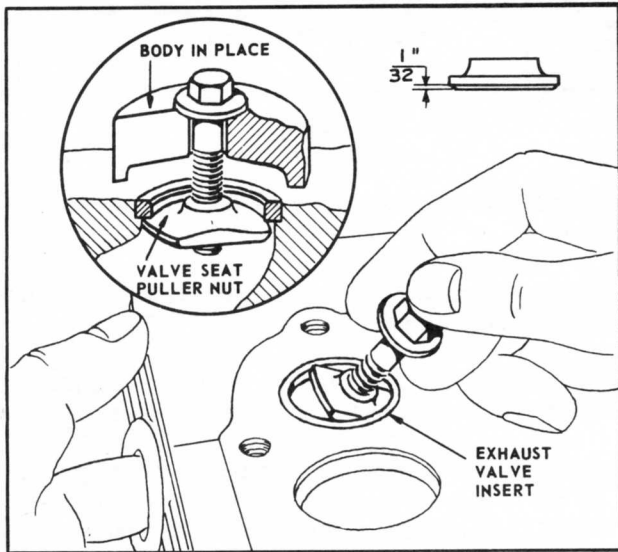


FIGURE 5-9

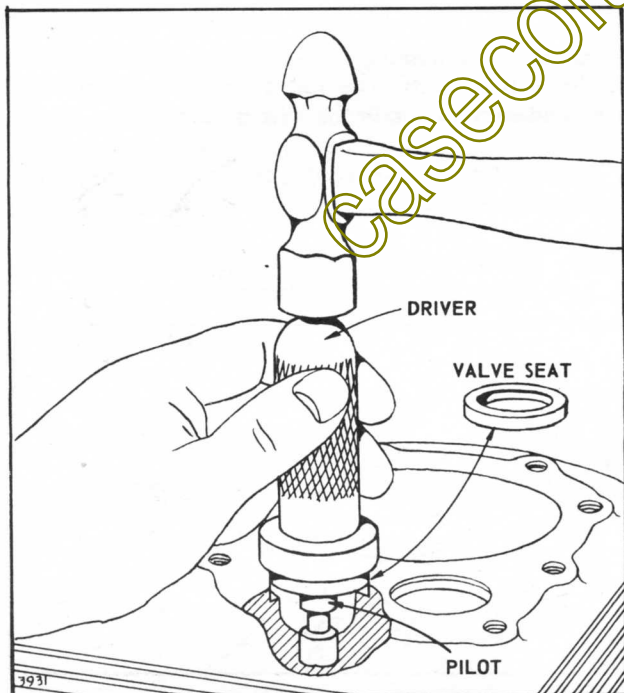


FIGURE 5-10

INSTALLING THE INSERT

Use No. 19127 pilot and No. 19136 driver.

See the chart for correct insert for the valve seat.

1. One outer edge of the insert has a chamfer. Put this down into the valve seat.
2. Put the pilot into the valve guide.
3. Use the old insert as a spacer between the driver and the new insert.
4. Drive the new insert in until it contacts the bottom of the valve seat. The top of the new insert will be below the cylinder surface.
5. Use a punch as in figure 5-11 to fasten the insert in place.

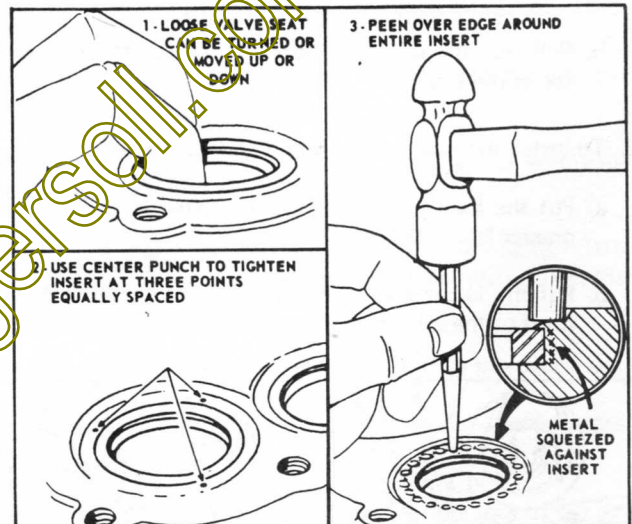


FIGURE 5-11

6. Grind the new insert lightly.
7. Use lapping compound lightly to finish the seats and valves.
8. Clean the area completely.

VALVE SEAT INSERTS

ENGINE MODEL	STANDARD INTAKE	STANDARD EXHAUST
190707	211661	211661
220707	261463	211661

LUBRICATION

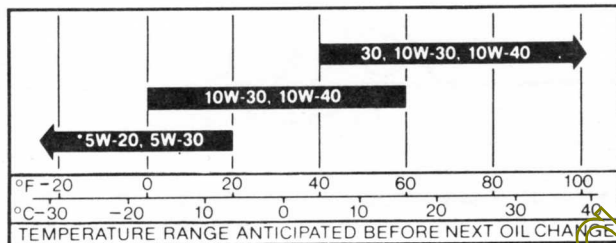
TO CHANGE THE CRANKCASE OIL

1. Put an acceptable container under the drain plug.
2. Remove the oil drain plug.
3. Drain the oil while the engine is warm.
4. Install the drain plug.
5. Remove the filler cap.

OIL CAPACITY CHART

MODEL	CAPACITY	
	Pints	Liters
80-108	2-1/4	1.1
110	3	1.4

RECOMMENDED SAE VISCOSITY GRADES



*If not available, a synthetic oil may be used having 5W-20, 5W-30 or 5W-40 viscosity.

6. Fill the engine with oil. See above for correct grade and quantity.
7. Install the filler cap.
8. Check the oil level after every 5 hours of operation. Keep the oil level between the marks on the dipstick for the Model 80 riding lawn mower. See figure 6-1 for Models 108 and 110 tractors oil level.

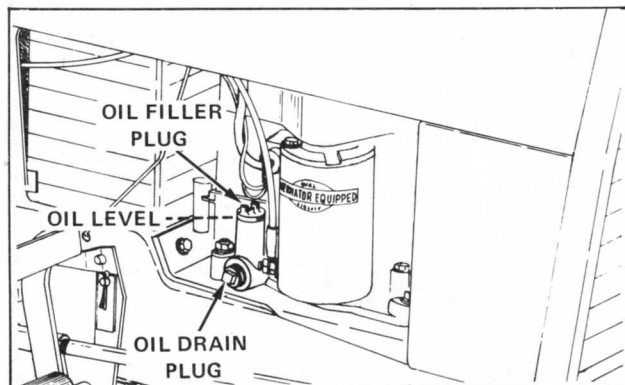
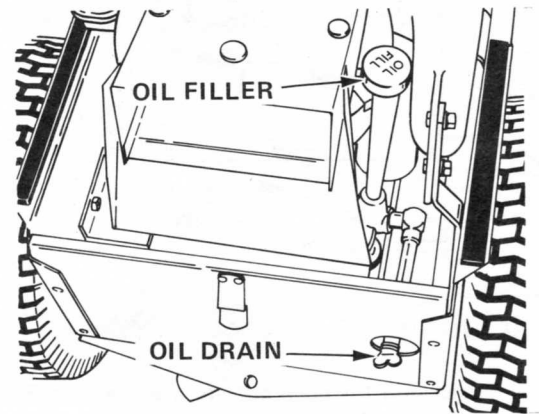


FIGURE 6-1 MODEL 108 and 110 TRACTORS

FIGURE 6-2
MODEL 80 RIDING LAWN MOWER

BREATHER

It is the function of the breather to keep a vacuum in the crankcase. The motion of the piston in the engine causes air flow. The breather permits this air flow to move out of the engine. If the breather is obstructed, the air flow will push oil out of the engine.

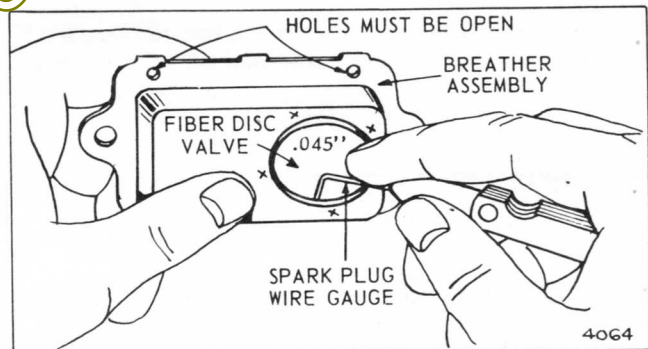


FIGURE 6-3

CHECKING THE BREATHER

1. Use a .045" (1.1 mm) feeler gauge to check the space between the disc valve and the breather body. If this space is more than .045" (1.1 mm), replace the breather. Check as shown in figure 6-3.

NOTE: Do not apply force while checking the breather. Damage to the breather can occur.

2. Always use a new gasket when you install the breather.
3. Make sure the retaining screws are tight to prevent oil leakage.
4. Check the vent tube for damage and correct seal. See figure 6-4.

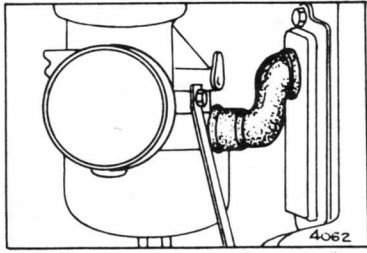


FIGURE 6-4

OIL SLINGER

The oil slinger and the governor are a single unit. The oil slinger is driven by the cam gear.

Check the gear teeth. Replace the unit if the teeth are worn. See figure 6-5.

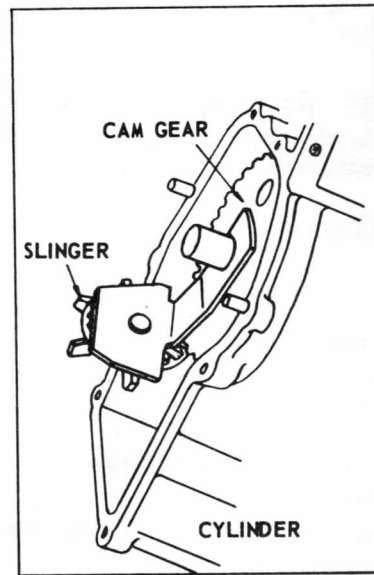


FIGURE 6-5

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SECTION 7

PISTONS, PISTON RINGS AND CONNECTING RODS

ENGINE REMOVAL

See section 2 page 2-1.

PISTON AND CONNECTING ROD REMOVAL

1. Bend the tabs on the screw lock.
2. Remove the screws from the rod cap.

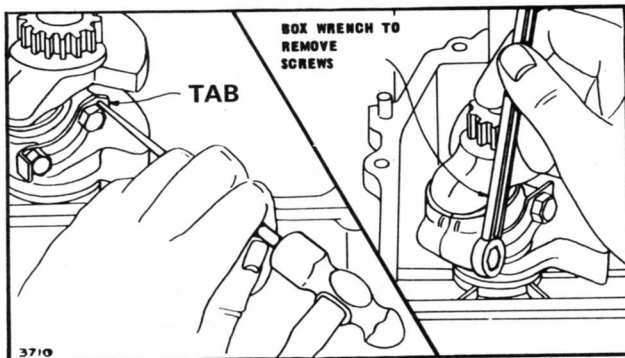


FIGURE 7-1

3. Clean the cylinder bore above the piston to prevent damage to the rings.
4. Push the piston and rod out through the top of the cylinder.

DISASSEMBLE THE PISTON

1. Use a thin nose pliers to pull the pin lock from the piston. Push the pin through the piston and rod to remove the rod. See figure 7-2.
2. Remove the rings one at a time. Use a ring expander to prevent damage to the rings or piston.

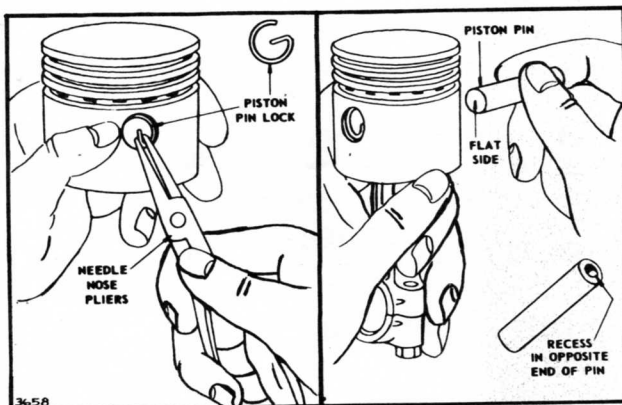


FIGURE 7-2

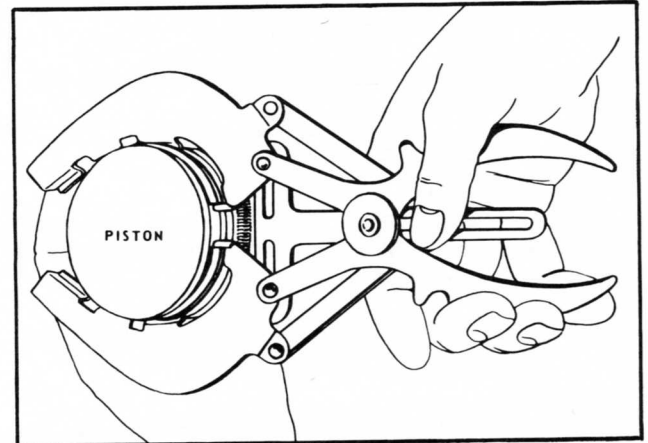


FIGURE 7-3

CHECK THE PISTON

If you are going to grind the cylinder bore, there is no reason to check the piston.

If the cylinder and piston show no wear or scoring, check the piston. Use the following procedure:

1. Clean the carbon from the groove of the top ring.
2. Put a new ring on the groove.
3. Check the space between the ring and the groove. (See figure 7-4.) If the space in the groove is .007" (0.18 mm), replace the piston.

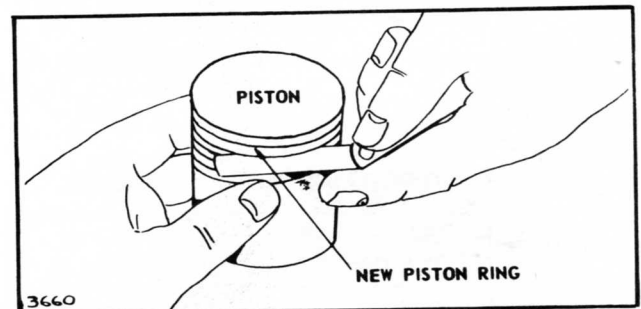


FIGURE 7-4

CHECK THE PISTON RINGS

1. Clean the carbon from the ends of the rings and the cylinder bore.
2. Put each piston ring into the cylinder bore, 1" (25 mm) down from the top.
3. Measure the end gap of each ring.
4. Discard the compression ring if the gap is more than .035" (0.8 mm). Discard the oil ring if the end gap is more than .045" (1.14 mm).

NOTE: Do not remove the glaze from the cylinder wall while you check the rings.

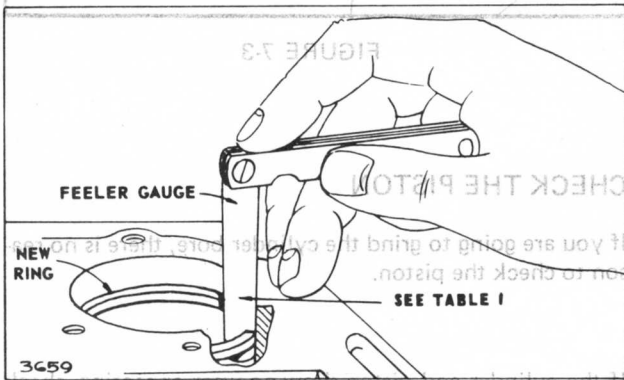


FIGURE 7-5

CHROME PISTON RINGS

Chrome ring sets are available. You will not have to use a cylinder hone or remove the glaze. The cylinder bore can be a maximum of .005" (0.13 mm) oversize when you use chrome rings.

CHECK THE CONNECTING ROD

1. Replace the rod if the crankshaft bearing in the rod is worn or shows scoring. Do not try to repair the rod.
2. Piston pins .005" (0.13 mm) oversize are available. Replace if the connecting rod and piston bearings are worn at the piston pin.
3. Discard the rod if the bearing sizes are more than the chart below.

CONNECTING ROD MAXIMUM BEARING I.D.

MODEL	CRANKSHAFT BEARING I.D.	PISTON PIN BEARING I.D.
190707	1.127" (28.63 mm)	.674" (17.12 mm)
220707	1.252" (31.80 mm)	.802" (20.37 mm)

CHECK THE PISTON PIN

Replace a piston pin worn .0005" (.01 mm).

See the chart below. Discard the piston pin if it is less than the size on the chart.

PISTON PIN AND BORE CHART

MODEL	PISTON PIN	PISTON BORE
190707	.671" (17.04 mm)	.673" (17.09 mm)
220707	.799" (20.29 mm)	.801" (20.35 mm)

ASSEMBLE THE PISTON AND CONNECTING ROD

1. Put a pin lock in the groove at one end of the pin bore in the piston.
2. Push the pin through the piston and connecting rod. Make sure the flat end enters first if you are using a solid pin. Hollow pins can be installed from either end.
3. Use a thin nose pliers to install the other pin lock. Make sure both pin locks are fully installed in the grooves.

INSTALLING THE PISTON RINGS

Figure 7-6 shows the different rings and the correct position of each.

On the center ring the scraper groove must always be down toward the bottom of the piston.

Before installing the rings, clean the holes for return oil and clean the carbon from all grooves. Use a ring expander and install the rings.

NOTE: Install an expander under the oil ring if required.

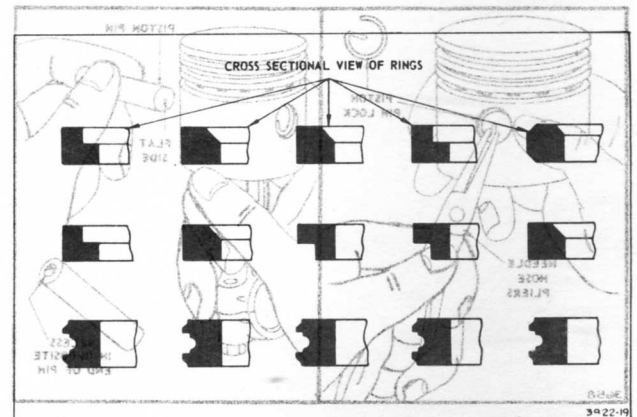


FIGURE 7-6

INSTALLING THE PISTON ASSEMBLY

1. Apply oil to the rings and the side of the piston.
2. Install the ring compressor No. 19070 or No. 19230 on the piston as shown in figure 7-7.

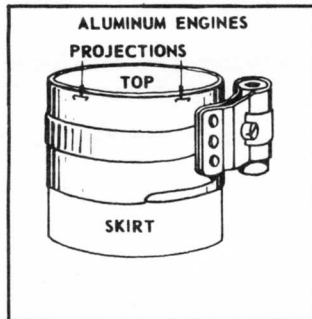


FIGURE 7-7

3. Put the piston head on a flat surface. Push the ring compressor down until the edge is aligned with the edge of the piston head.
4. Fully tighten the ring compressor. Then loosen the ring compressor a small amount.

NOTE: Never install a piston assembly without a ring compressor.

5. Put the piston assembly into the cylinder bore. See figure 7-8.

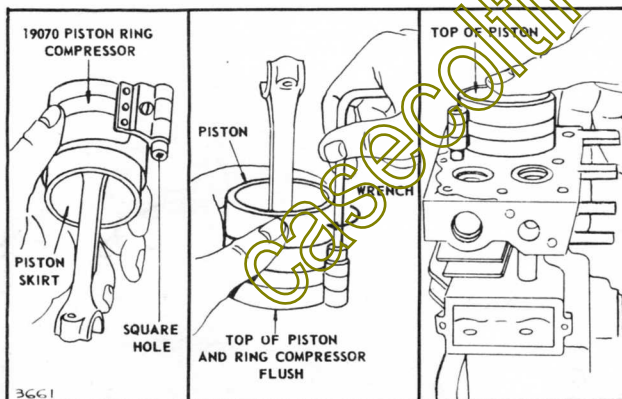


FIGURE 7-8

NOTE: The piston head of the model 220707 engine has a notch at one side. Install this piston with the notch toward the flywheel side of the engine.

6. Push the piston assembly into the cylinder bore.
7. Apply oil to the crankshaft at the point where the connecting rod is installed.
8. Put the rod and rod cap on the crankshaft. See figure 7-9.

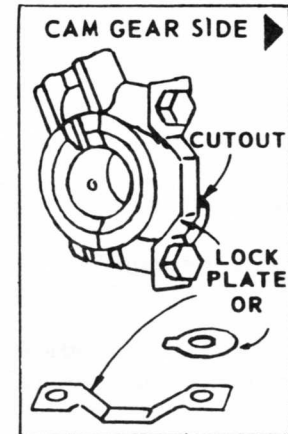


FIGURE 7-9

CONNECTING ROD TORQUE CHART

MODEL	INCH POUNDS	NEWTON METER
190707	165	18.7
220707	185	21.0

NOTE: Rods and caps do not have assembly marks. They will fit in only one position.

9. Install the screw locks and cap screws into the cap and rod.
10. Tighten the cap screws to the torque specified in the chart.
11. Rotate the crankshaft two revolutions to check for correct rod installation. If interference occurs, the rod installation is wrong or the cam gear timing is wrong.
12. If no interference occurs, bend the screw locks against the screw heads. See figure 7-10.

NOTE: After the correct torque has been applied to the cap screws, check to make sure the rod can slide on the crankshaft.

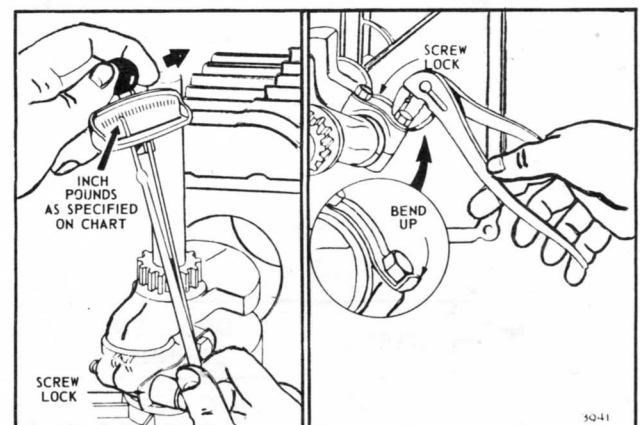


FIGURE 7-10

SECTION 8

CRANKSHAFT AND CAMSHAFT

REMOVE THE ENGINE

See section 2 page 7.

1. Remove any rust or damage from the drive end the crankshaft.
2. Remove the oil sump. Hit the sides of the sump lightly with a soft hammer for easier removal.
3. Turn the crankshaft to align the timing marks on the crankshaft and camshaft.
4. Remove the camshaft.
5. Remove the crankshaft.

CHECK CRANKSHAFT

1. See the crankshaft wear chart. Discard any crankshaft that is worn to less than these sizes. See figure 8-1 for areas to be checked.

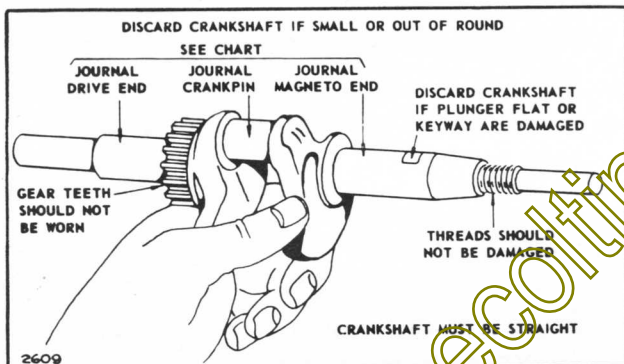


FIGURE 8-1

2. If the crankshaft size is correct, check the keyway. Repair any damage to the keyway. Discard a crankshaft if the keyway or plunger flat is damaged beyond repair.

NOTE: .020" (0.51 mm) undersize connecting rods are available for use on undersize crankshafts. Complete instructions are included.

CHECK CAMSHAFT

Check the gear teeth for wear or damage.

Check the camshaft journals and lobe for wear.

Replace a camshaft with diameters less than that indicated in the chart.

CAMSHAFT WEAR CHART

MODEL	BOTH JOURNALS	CAM LOBE
190707	.4985" (12.661 mm)	.977" (24.92 mm)
220707	.4985" (12.661 mm)	1.184" (30.07 mm)

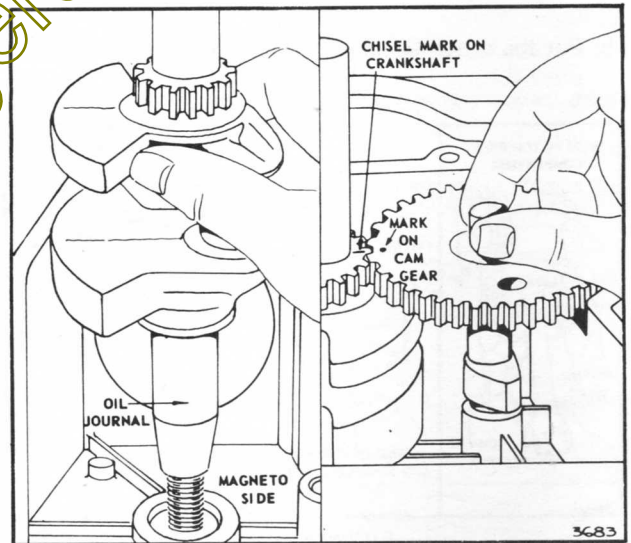


FIGURE 8-2

CRANKSHAFT WEAR CHART

MODEL	DRIVE END JOURNAL	MAGNETO JOURNAL	CRANK PIN JOURNAL
190707	1.179" (29.94 mm)	0.9975" (25.336 mm)	1.122" (28.49 mm)
220707	1.376" (34.95 mm)	1.376" (34.95 mm)	1.247" (31.67 mm)

CRANKSHAFT AND CAMSHAFT INSTALLATION

1. Install the tappets.
2. Install the crankshaft.
3. Align the timing marks on the crankshaft and camshaft gears. Install the camshaft. See figure 8-2.

CRANKCASE COVER AND CRANKSHAFT END MOVEMENT

New gasket sets include three crankcase cover or bearing support gaskets. The sizes are .005" (0.13 mm), .009" (0.23 mm), .015" (0.38 mm).

The correct end movement is from .002" (0.05 mm) to .008" (0.20 mm).

If the end movement is less than .002" (0.05 mm) with one .015" (0.38 mm) gasket in place, add gaskets as required. Normally the end movement will be less than .002" (0.05 mm) when a new crankcase or sump cover is installed.

CHECKING END MOVEMENT

See figure 8-3

To check end movement follow this procedure:

1. Put a dial indicator on the crankshaft with the pointer against the crankcase.
2. Move the crankshaft in and out.
3. The indicator will show end movement.

Or use this procedure:

1. Install a pulley on the crankshaft.
2. Move the pulley in and out.
3. Measure the movement with a feeler gauge.

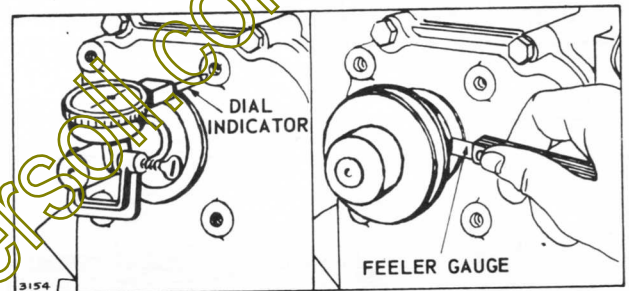


FIGURE 8-3

CYLINDERS AND BEARINGS

INSPECTION

After the engine is disassembled, inspect the cylinder.

Visually check for cracks, damaged threads in the bolt holes, broken fins, scoring of the cylinder bore.

Check the size of the cylinder bore. Use either an inside micrometer or a telescopic gauge and micrometer. See figure 9-1. Make sure the measurement is taken horizontally across the cylinder bore for accuracy.

STANDARD CYLINDER BORE CHART

MODEL	CYLINDER BORE DIAMETER
190707	2.999" to 3.000" (76.17 to 76.2 mm)
220707	3.4375" to 3.4376" (87.313 to 87.315 mm)

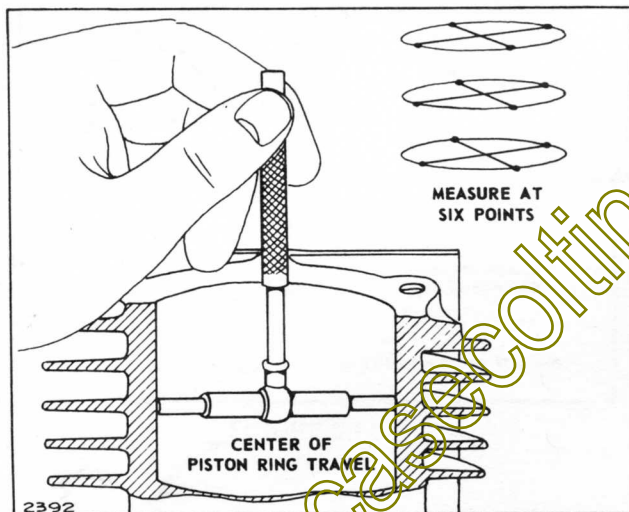


FIGURE 9-1

Grind the cylinder bore if:

1. worn .003" (0.07 mm) oversize
2. or if there is a variation of .0025" (0.064 mm) from an exact circumference.

NOTE: Chrome ring sets are available. You will not have to use a cylinder hone or remove the glaze. The cylinder bore can be a maximum of .005" (0.13 mm) oversize when you use chrome rings.

GRINDING THE CYLINDER BORE

IMPORTANT: Only .010", .020" and .300" (0.25, 0.51 and 0.76 mm) oversize rings and pistons are available. For accurate fit, always change the cylinder bore to the next oversize dimension.

Use cylinder hone No. 19205 to grind the cylinder bore.

Follow the manufacturers recommendation for correct stones and lubrication.

If a bore bar is used on the cylinder wall, a hone must be used to put the crosshatch pattern on the wall.

PREPARATION FOR USING A HONE

1. Clean the cylinder both top and bottom, to remove foreign material.
2. Fasten the cylinder to a heavy iron plate or make a bracket like figure 9-2.

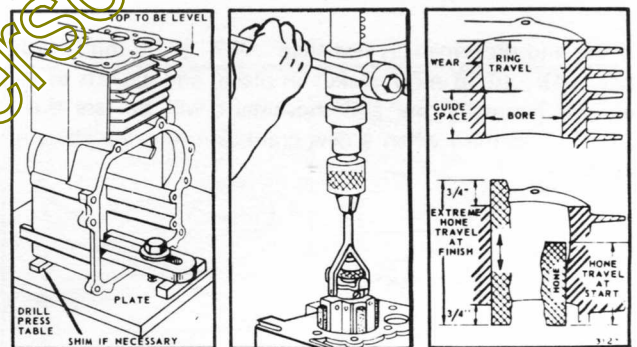


FIGURE 9-2

NOTE: Use a drill press for easiest operation.

3. Use a level to align the chuck of the drill press with the cylinder bore. Use shims as required.
4. Apply a large amount of oil to the work area of the drill press.
5. Put the plate and cylinder on the drill press. Do not fasten the plate to the drill press.

NOTE: If you are using a portable drill, put the plate and cylinder on the floor.

6. Fasten the drive shaft of the hone into the drill chuck.
7. Slide the hone into the cylinder bore.
8. Connect the hone to the drive shaft.
9. Set the drill stop so the hone can only extend approximately 1" (25 mm) beyond the top and bottom of the cylinder bore.

NOTE: If you use a portable drill, cut a woodblock to put inside the cylinder as a stop for the hone .

USING THE HONE

1. Put the hone in the middle of the cylinder bore.
2. Tighten the adjusting knob by hand or with a small screwdriver. Do not use force. The stones must fit lightly against the cylinder wall.
3. Make sure the cylinder and hone are aligned with the driveshaft and drill chuck.
4. Lubricate the hone according to the manufacturers recommendation.
5. Set the speed of the drill press for operation between 300 and 700 RPM.
6. Start the drill. Move the hone up and down at the lower end of the cylinder bore. See figure 9-2. The cylinder bore is not worn at the bottom so the hone will have a straight surface for a guide.
7. As the bottom diameter of the bore increases, gradually increase the length of the stroke. The hone will gradually be moved the full length of the cylinder bore.
8. When cutting tension decreases, stop the hone and tighten the adjusting knob. Frequently check the cylinder bore with an accurate micrometer. Cut the bore approximately .0015" (0.012 mm) oversize because the cylinder will decrease in size while cooling.
9. When you are .0015" (0.038 mm) from the needed size change from the rough stone to the finish stone.

NOTE: Always grind the cylinder .010", .020", or .030" above the standard cylinder size for correct piston fit.

CYLINDER GRINDING PATTERN AND CLEANING

The cylinder bore must have a crosshatch pattern after the grinding operation. See figure 9-3.

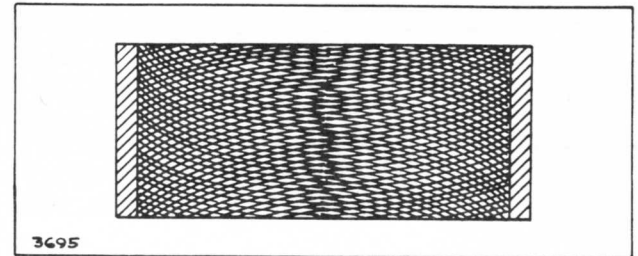


FIGURE 9-3

To get the crosshatch pattern you must use:

1. correct stones
2. correct lubrication
3. correct drill speed
4. fast movement of the hone in the cylinder during the last strokes.

IMPORTANT: The cylinder must be completely cleaned after using the hone. You must remove all grit. Wash the cylinder carefully in a solvent such as kerosene. Clean the cylinder bore with a brush, soap and water.

CHECKING THE BEARINGS

Replace the bearings if:

1. They have scoring.
2. The plug gauge will enter the bearing. Try the gauge at several positions in the bearing. See figure 9-4.

Replace a bearing worn to the dimensions listed in the chart.

CYLINDER BEARING WEAR CHART

MODEL	PTO BEARING	MAGNETO BEARING
190707	1.185" (30.10 mm)	1.004" (25.50 mm)
220707	1.383" (35.13 mm)	1.383" (35.13 mm)

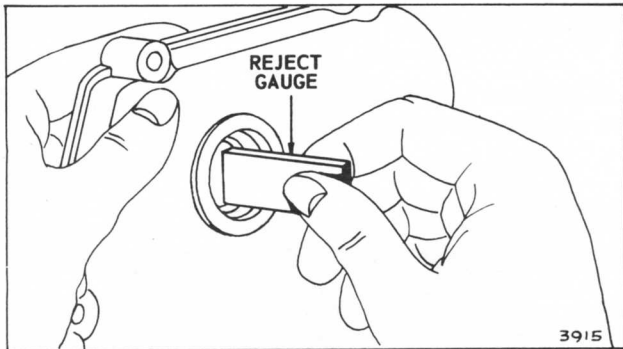


FIGURE 9-4

REPLACING MAGNETO BEARING

There is no replaceable bearing. You must ream the cylinder so a bushing can be installed.

1. Put the pilot guide bushing in the sump bearing. The flange of this guide must be toward the inside of the sump.
2. Assemble the sump to the cylinder. Make sure the pilot guide bushing does not fall out of place.
3. Put the guide bushing into the recessed area for the oil seal. This guide will align the counterbore reamer if the old bearing is badly worn.
4. Assemble the counterbore reamer and the pilot. Put this assembly into the cylinder until the pilot enters the pilot guide bushing in the sump. See figure 9-5.

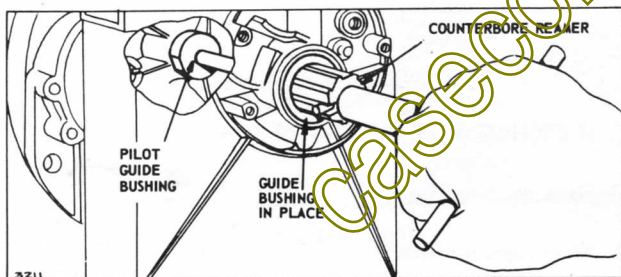


FIGURE 9-5

5. Lubricate the reamer with kerosene.
6. Turn the reamer clockwise. Apply a constant, even pressure until the reamer is completely through the bearing bore.
7. Remove the sump. Pull the reamer out through the sump area. Do not pull the reamer back through the bearing bore.
8. Clean out all the reaming chips.

9. Remove the guide bushing from the recessed area for the oil seal.
10. Set the new bushing on the bearing bore.
 - a. Align the notch in the bushing with the notch in the cylinder.
 - b. Put a mark on the outer rim of the bearing bore opposite of the split in the bushing.
 - c. Use a chisel and hammer to put a notch at the mark on the rim of the bearing bore. Make the notch at a 45 degree angle to the bore surface. See figure 9-6.

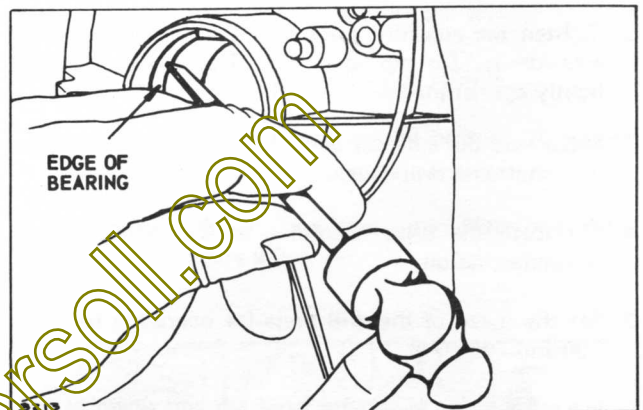


FIGURE 9-6

11. Align the oil holes of the new bushing and the bearing bore
12. Press in the new bushing.
 - a. Use a driver and support.
 - b. The bushing must be flush with the rim of the bearing bore. See figure 9-7.
13. Use a chisel. Drive a piece of the bushing into the notch made in step 10c. This will prevent the bushing from turning.
14. Assemble the sump to the cylinder. Make sure the pilot guide bushing is in place in the sump bearing.
15. Assemble the finish reamer and the pilot. Put this assembly into the cylinder until the pilot enters the pilot guide bushing in the sump. See figure 9-8.
16. Lubricate the reamer with kerosene.

NOTE: Lubrication that is not correct will cause a rough bushing bore.

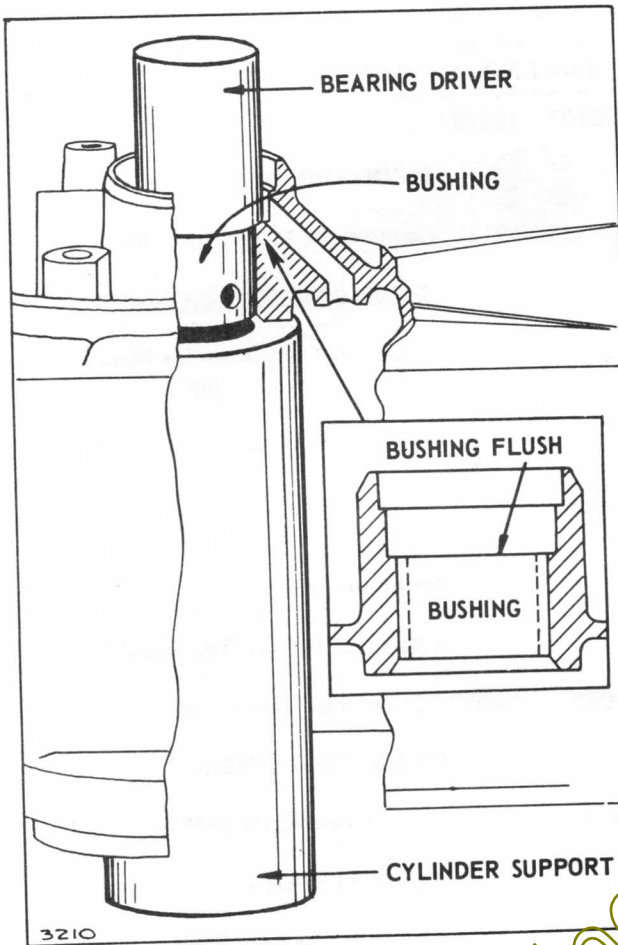


FIGURE 9-7

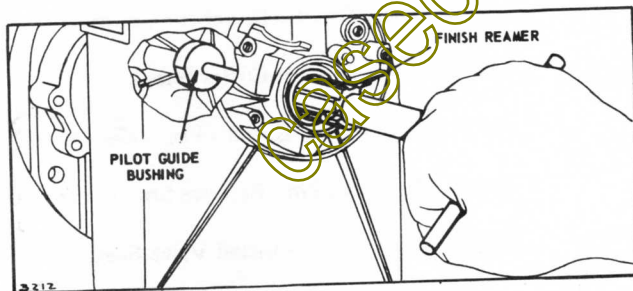


FIGURE 9-8

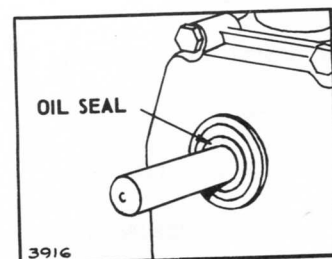


FIGURE 9-9

17. Turn the reamer clockwise. Apply a constant, even pressure until the reamer is completely through the bushing.
18. Remove the sump. Pull the reamer out through the sump area.
19. Remove the pilot guide bushing. Clean out all the reamer chips.

REPLACING PTO BEARING

The PTO bearing in the sump can be repaired in a similar procedure as the magneto bearing.

Always repair one bearing completely before starting the repair of the other bearing.

After both bearings are repaired, press in the new oil seals.

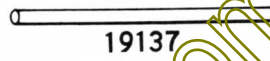
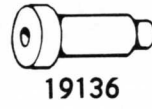
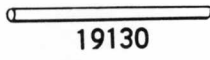
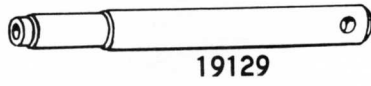
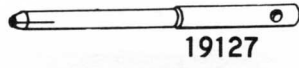
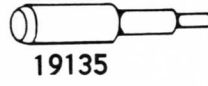
REPLACE OIL SEAL

1. Put the oil seal in position. The sharp edge of the leather or rubber must be toward the inside of the engine.
2. Press the oil seal flush with the hub surface of the cylinder. See figure 9-9.
3. Lubricate the inside diameter of the oil seal before you assemble the engine.

SECTION 10

BRIGGS AND STRATTON SPECIAL TOOLS

BRIGGS AND STRATTON PART NO.	DESCRIPTION	BRIGGS AND STRATTON PART NO.	DESCRIPTION
220707	190707	220707	190707
	PLUG GAUGES		COUNTERBORE CUTTERS
19055	19055 Check Breaker Plunger Hole	19131	Counterbore Valve Insert Hole
19151	19151 Check Valve Guide		CRANKCASE SUPPORT JACK
19164	19164 Check Camshaft Bearings	19123	To Support Crankcase for Removing and Installing Main Bearings
19178	19178 Check Main Bearings		FLYWHEEL PULLERS
	REAMERS	19203	19203 Removal of Flywheel
19056	19056 Ream Hole for Plunger Bushing	93029	Self Threading Screw for Flywheel Pullers
19058	19058 Ream Bushing for Plunger		VALVE SPRING COMPRESSOR
19172	19172 Counterbore for Main Bearings	19063	19063 To Compress Valve Springs
19173	19173 Finish Reamer for Main Bearings		PISTON RING COMPRESSOR
19174	19174 Counterbore for Main Bearings	19070	19070 To Compress Rings on Piston
19175	19175 Finish Reamer for Main Bearings		SPARK TESTER
19183	19183 Ream Valve Guide	19051	19051 For Testing Ignition Spark
	PILOTS		VALVE SEAT REPAIR TOOLS
19096	19096 Main Bearing Reamer Pilot	19127	19127 Pilot for Valve Seat Counterbore
19127	19127 Exp. Pilot for Valve Seat Counterbore	19129	19129 Cutter Shank - Driver for Counterbore
	DRIVERS	19130	19130 T Handle - For Cutter Shank
19057	19057 Install Plunger Bushing	19131	19131 Counterbore Cutter - For Valve Seats
19136	19136 Install Valve Seat Inserts	19135	19135 Knockout Pin - Remove Shank from Cutter
19179	19179 Install Main Bearings	19136	19136 Insert Driver - Install Valve Seats
	GUIDE BUSHINGS	19137	19137 T Handle for Exp. Pilots
19168	19168 Guide Bushing for Main Bearing Reaming	19141	19141 Puller Nut - To remove Valve Seats
19169	19169 Guide Bushing for Main Bearing Reaming		GOVERNOR TAB BENDING TOOL
19170	19170 Guide Bushing for Main Bearing Reaming	19229	19229 Tab bending tool
19171	19171 Guide Bushing for Main Bearing Reaming		
19192	19192 Guide Bushing for Valve Guide Reaming		



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