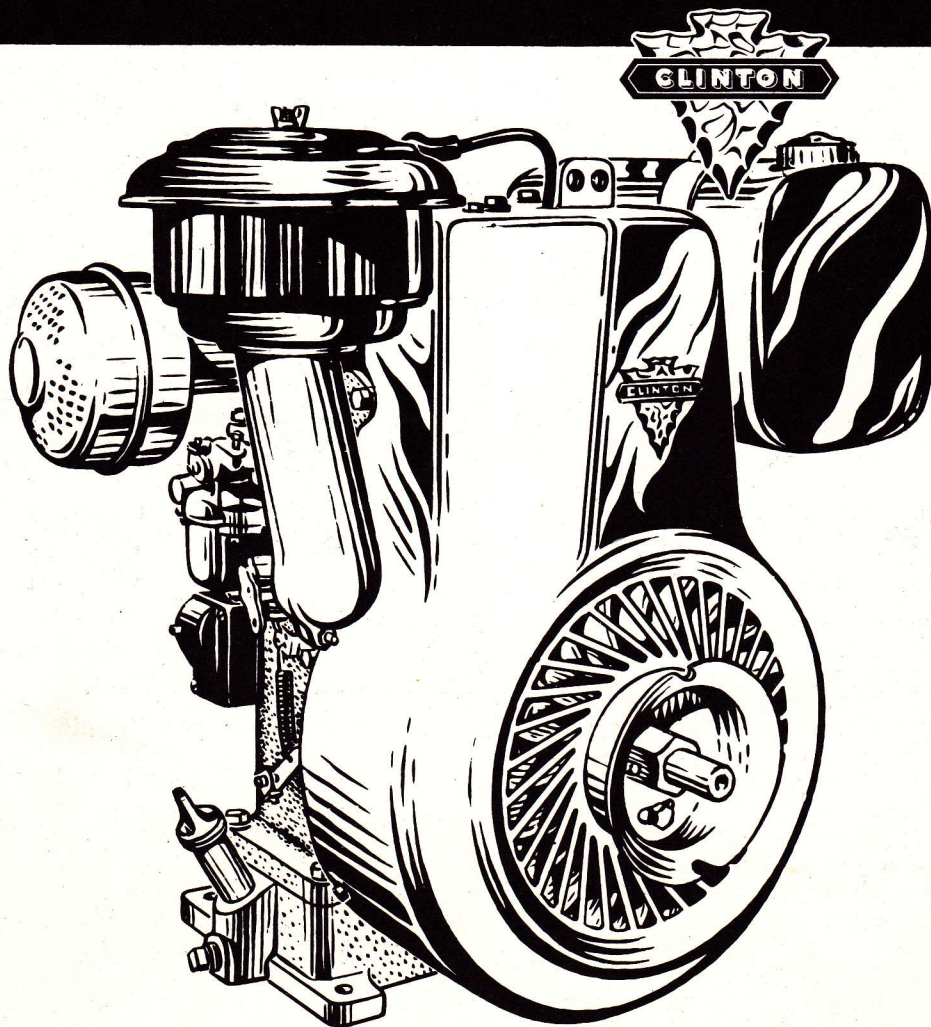


OWNER'S GUIDE to OPERATION and MAINTENANCE



★ **CLINTON** ★
MODELS 1600 AND 2500
4 CYCLE ENGINES



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INTRODUCTION

Superior materials and time-tested techniques have gone into the production and assembly of your new Clinton Engine.

You will need the factory-recommended procedures in this manual, and the specific information contained in the accompanying inserts to keep your engine as dependable as it is when it leaves the factory. Long life and efficient service from precision-built equipment are dependent upon proper operation and maintenance practices. Read the instructions in this manual carefully before you start your engine.

If trouble develops it is suggested that you contact your nearest Authorized Clinton Service Station. All service work must be accomplished by Authorized Service Stations during the warranty period to make the warranty valid. The Clinton Service Organization extends throughout the United States, Canada and many foreign countries. You will find Authorized Clinton Service Stations listed in the classified section of your telephone book as well as in the Service Directory which comes with your engine.

For additional information please feel free to contact the Clinton Central Distributors or dealers or write directly to the factory.

SERVICE DEPARTMENT
ENGINE DIVISION
CLINTON MACHINE COMPANY
MAQUOKETA, IOWA

GENERAL INFORMATION

Cylinder Block—Close grained gray iron, cast under strict metallurgical controls at the Clinton Factory. Head features a turbulent type combustion chamber for higher compression ratios.

Carburetor—Nationally advertised, full float feed, double float, up-draft type.

Magneto—Nationally advertised, modern design, fully moisture-proof, large transformer coil.

Governor—Automatic fly-weight type running in oil with proper provision for assembly of remote controls.

Lubrication—Splash-type; oil drainage from either side of base

Air Filter—Oil bath type.

Flywheel—Deep, curved fins—Sorocco type. Magnets bolted to rim for effectiveness and no increases in engine weight.

Crankshaft—Arma Steel; counterbalanced for smoother performance.

Cooling—Accomplished by an air blast, forcefully created by the Sorocco flywheel and directed over the finned cylinder head by an effectively contoured blower housing.

Bearings—Ball bearing mains, large size with shields to prevent dirt from entering ball races.

Piston—Aluminum alloy, permanent mold, extra long skirts for better guidance and more supporting area. Dome designed for better heat dissemination with ribbed oil slots.

Base—Completely interchangeable with symmetrical mounting holes. Oil filler plug can be on either side, depending upon application requirements.

Connecting Rod—Proven I-Beam construction with effective oil groove for full distribution to crank pin bearing.



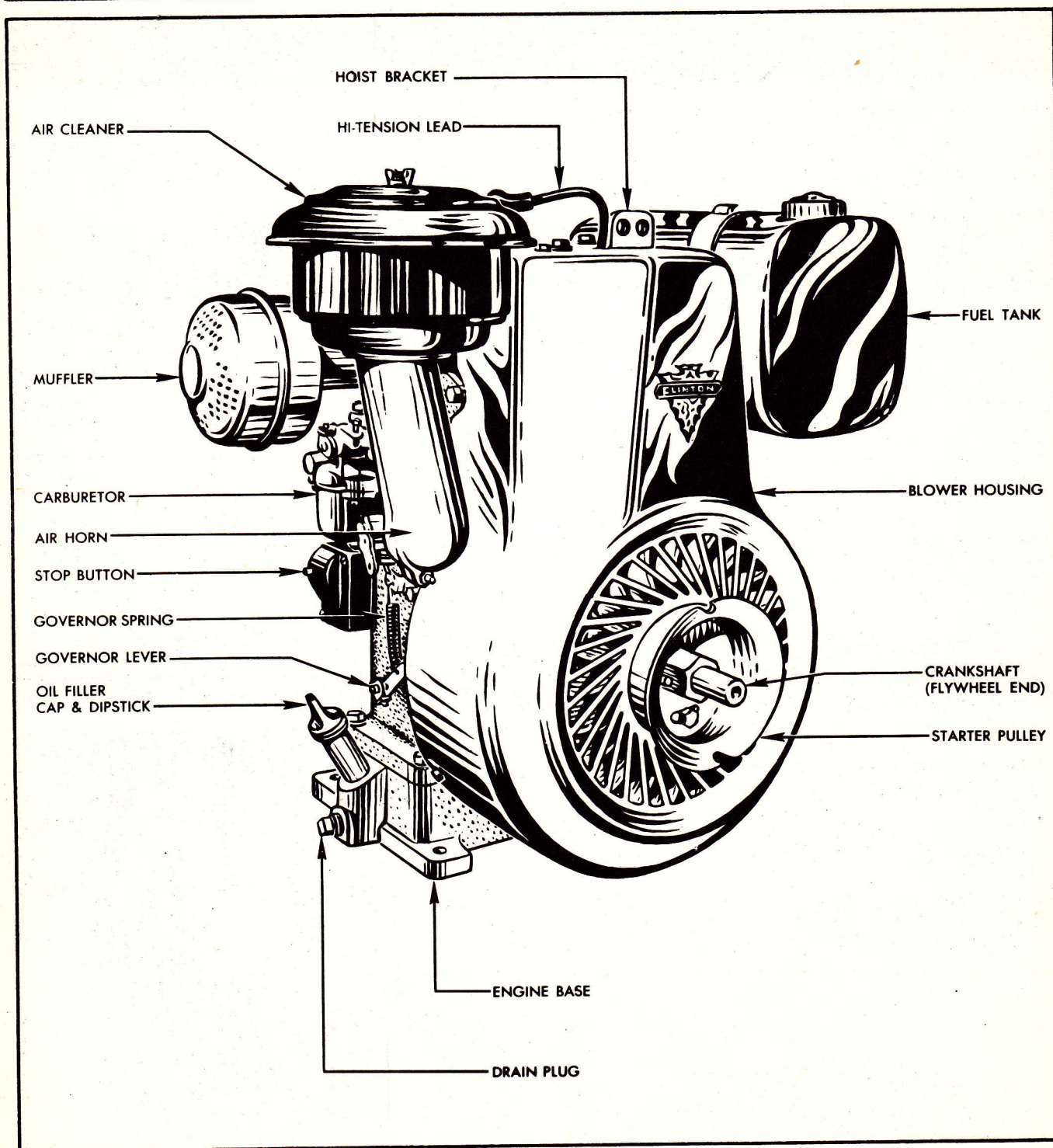


Figure No. 1

KEY PARTS AND CONTROLS

Key parts and controls are called-out in Figure No. 1 so that you may familiarize yourself with the engine.

Some models will incorporate adaptations and variations which change the positions of these items, but generally use this as your guide. Refer to the picture as you read the in-

structions in this Manual. Keep the locations of these controls in mind as you read about their functions, maintenance and service.

Know your controls before you attempt to start and operate the engine.



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SPECIFIC DETAILS ABOUT YOUR ENGINE

Specifications, Basic Parts Lists and exploded views of your particular engine are contained in the inserts accompanying this manual. If the engine is equipped with a reduction gear unit, information of a specific nature is also

included in another insert.

These inserts are exact replicas of the pages pertaining to your engine in the Clinton Master Parts & Service Manual which is used by Authorized Clinton Service Stations.

FUEL AND LUBRICATION

The proper gasoline and oil are vital to the long life and dependability of the engine. Read the following instructions carefully.

TYPE OF GASOLINE

Fill the fuel tank with a good grade of clean fresh regular gasoline, like Mobilgas.

TYPE OF OIL

In temperatures of 32° F. or above, use a high grade oil like Mobiloil Arctic, not heavier than SAE 20W. In temperatures below 32° F., use SAE 10W, like Mobiloil Arctic Special.

CORRECT OIL LEVELS

1. With the engine in a level position remove the oil filler cap and pour oil into the filler neck opening. Approximately 3 pints of oil are required for the 1600 and 4 pints for the 2500 engine, to bring the oil level up to the full mark on the dipstick. (Check oil level often to be sure it is above the 'add' mark on the dipstick.) (See Figure No. 3.)
2. Fill the air cleaner with SAE 50W. The correct oil level is indicated on the face of the filter cup. (See Figure No. 2.)
3. If the engine is equipped with a gear reduction unit remove the vented filler plug at the top of the housing and add oil until it begins to run out of the oil level plug

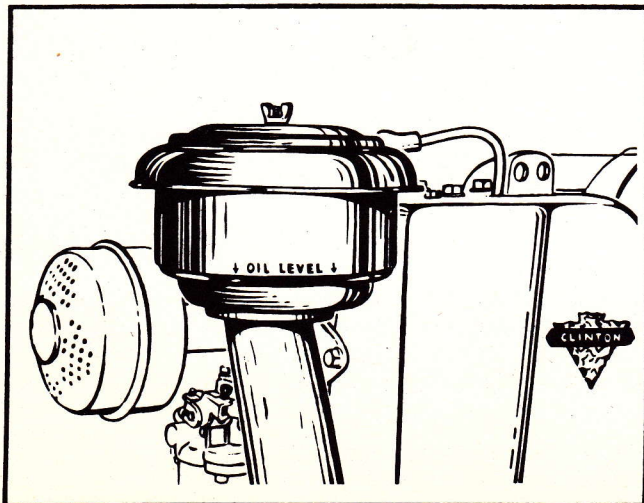


Figure No. 2

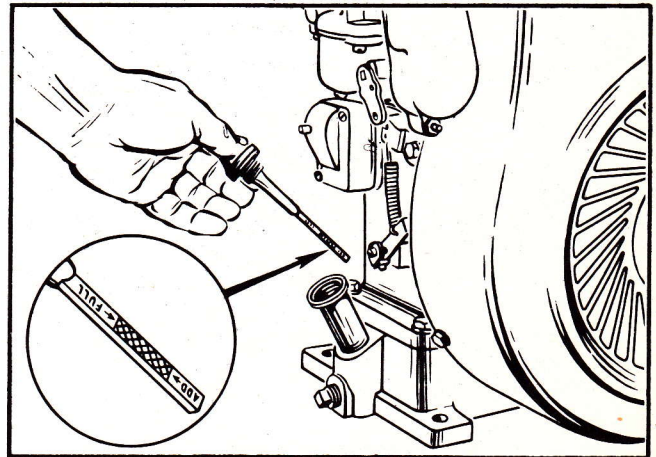


Figure No. 3

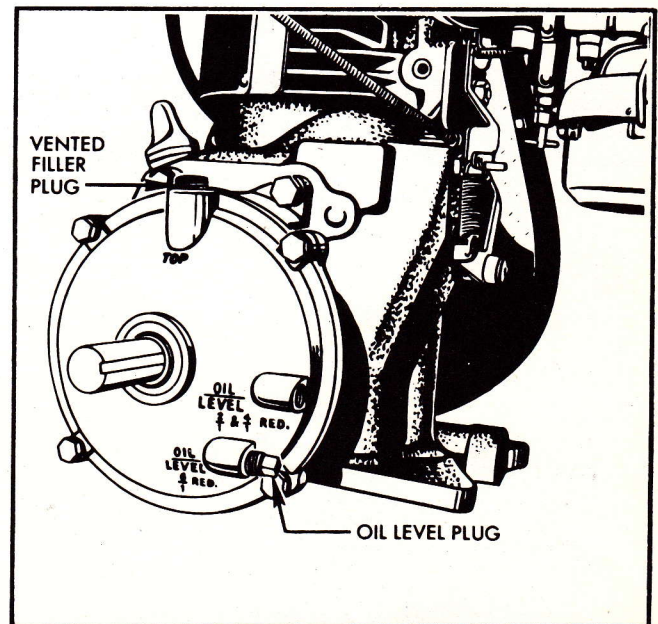


Figure No. 4

hole marked for that particular gear reduction. Overfilling the gear reduction unit will cause the engine to overheat. (See Figure No. 4.)

4. When the engine is properly filled with fuel and oil, wipe off any excess which may have spilled on the engine. Caution: Do not add fuel to fuel tank while engine is running.



STARTING PROCEDURE

The engine should never be started under conditions where exhaust gases cannot be dissipated by proper ventilation. Carbon monoxide, a colorless, odorless gas, is contained in exhaust fumes, and if it is inhaled in sufficient quantities it can be a deadly poison.

TO START THE ENGINE WITH A ROPE

1. Open the shut-off valve by turning it counterclockwise, or to the left.
2. Close the choke on the carburetor by turning it to the right or in a clockwise direction.
3. Place the knot on the starter rope in the notch on the starter pulley and wind the rope around the starter pulley. (See Figure No. 5.)
4. Give the rope a quick, steady pull to spin the flywheel.
5. Open the choke about $\frac{1}{8}$ and repeat Step 4.
6. After the engine warms up, open the choke valve gradually by moving it to the left or clockwise, until the engine runs smoothly with the choke wide open.
7. A warm engine does not require as much choking as a cold one, and a hot engine should not be choked unless it is absolutely necessary.

TO START THE ENGINE WITH A HAND CRANK

1. Open the gasoline shut-off valve by turning it to the left or counter-clockwise.

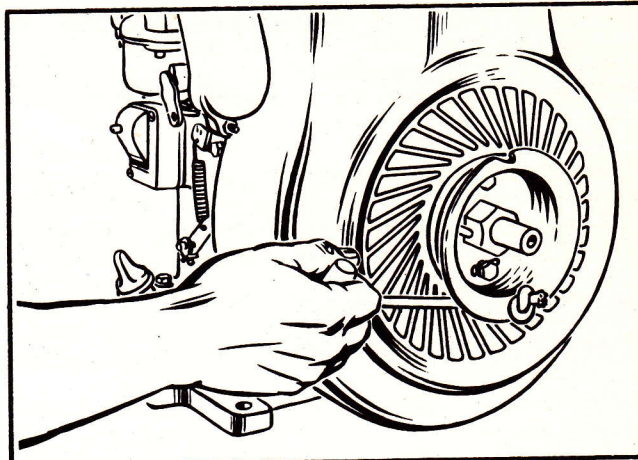


Figure No. 5

2. Completely close the carburetor choke by moving the choke lever to the right or counter-clockwise.
3. Place the hand crank on the crankshaft at the flywheel end so that the crank engages the pin on the flywheel.
4. Rotate the flywheel with the crank until compression is felt. The crank should then be in a downward position (about 5 o'clock).
5. With a quick motion, lift the crank handle to an upward position (about 11 o'clock.) (Spinning the crank handle is unnecessary. One or two revolutions of the engine with the choke lever closed should be sufficient to get an ignitable charge into the combustion chamber of the cylinder.)
6. If further choking is necessary the choke can be opened slightly. The spark is automatically retarded when the engine is cranked.

MAINTENANCE PRACTICES

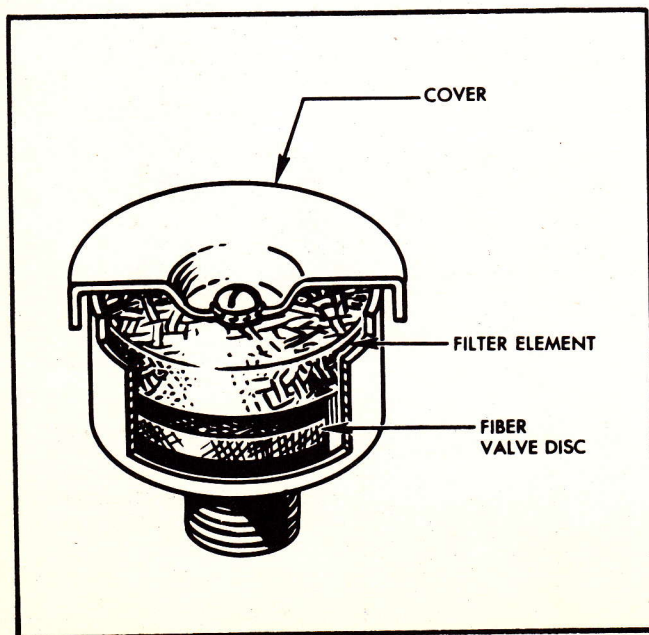


Figure No. 6

Quality-built Clinton Engines are designed to deliver maximum service under rugged conditions, but like all precision-engineered equipment they require proper maintenance to insure long life and dependability.

1. Check the oil level in the base after every five hours of operation.
2. Under normal conditions, the air filter should be cleaned and refilled after every twenty-five (25) hours of use. (See Figure No. 14.) In dusty atmosphere, daily cleaning may be necessary. Do not neglect the air filter.
3. Check the aluminum filter in the breather assembly (See Figure No. 6) after every twenty-five hours of operation at the most. It must be functioning properly to assure maintenance of proper vacuum in the crankcase. (See Service Procedures.)
4. Drain the oil out of the base after every 25 hours of operation and more often if the oil appears dirty or diluted.
5. Check the oil in the gear reduction unit (if any) daily, and add more oil as needed.
6. After 100 hours of operation the carburetor bowl, fuel strainer and fuel filter should be dismantled and cleaned. The cleaning, checking and regapping of the spark plug should also be accomplished at this time.



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7. Periodically, check the muffler for excessive carbon deposits. A sign of muffler clogging is a decided lack of power in the engine.
8. If the engine develops serious trouble, consult your nearest Authorized Clinton Service Station.

OPERATING PRECAUTIONS

1. The first few hours of operation are the key to long service from the engine. Keep a close watch on the unit during this period to be sure that all parts are wearing-in properly.
2. Do not allow the cylinder fins on the engine to become bent, broken or clogged with foreign matter. They are effectively contoured to facilitate air cooling. Any obstructions may cause hot spots to develop.
3. Check all electrical connections and the spark plug before each use of the engine.
4. When the engine is in need of repair, it should not be operated. Minor troubles can become major if they are not corrected.
5. Be sure the governor is in correct adjustment at all times to avoid overloading.
6. Avoid the use of dirty oil, inferior gasoline, or solvents. Clogged fuel lines and excessive carbon deposits will result from such practices and these signs of abuse will automatically void the warranty.
7. Never attempt to refill the fuel tank while the engine is running. Serious explosions can result from spilling gasoline on hot engine surfaces.
8. Check the unit over often to be sure that dirt and dust are not clinging to the screen in the blower housing, thereby impeding the flow of air to cooling system.

GOVERNOR OPERATION

The governor on your engine performs two separate functions. (1) It keeps the engine operating at a constant speed whether it is under load or not, and (2) it prevents the engine from exceeding its predetermined maximum speed.

If you disassemble the governor extreme care should be taken to assemble it again in exactly the same way. Failure to maintain the various tensions in the governor linkage will cause the unit to be out of adjustment and serious damage will result. (See Figure No. 7.)

The governor axle is located near the base and protrudes in from the side of the block. The two governor weights are installed on this and secured with the governor weight pins. Each of the weights has a $\frac{1}{4}$ inch extension on one side and these extensions go opposite each other. The governor gear slides on the axle and engages with the teeth of the cam gear. The governor thimble is installed with the flat side resting on the two weight extensions.

The governor stop assembly, is installed as a unit. The shaft goes through the block and is connected with the carburetor linkage. The long side of the governor stop goes toward the governor gear and acts as a limit stop. The short side of the governor stop is the actuating lever for the thimble. (See Figure No. 8.)

ADJUSTMENTS

1. Loosen the screw and nut which attach the governor throttle linkage lever to the governor shaft.
2. Turn the governor shaft counter-clockwise until it has reached the farthest position.
3. Advance the governor throttle linkage lever to the point where it moves the throttle lever on the carburetor to the wide open or full throttle position.
4. With both the governor and carburetor throttle in this position, tighten the screw and nut which will fasten the governor throttle arm in position.
5. Further finer adjustment is possible by tightening or loosening the nut on the throttle linkage near the carburetor.

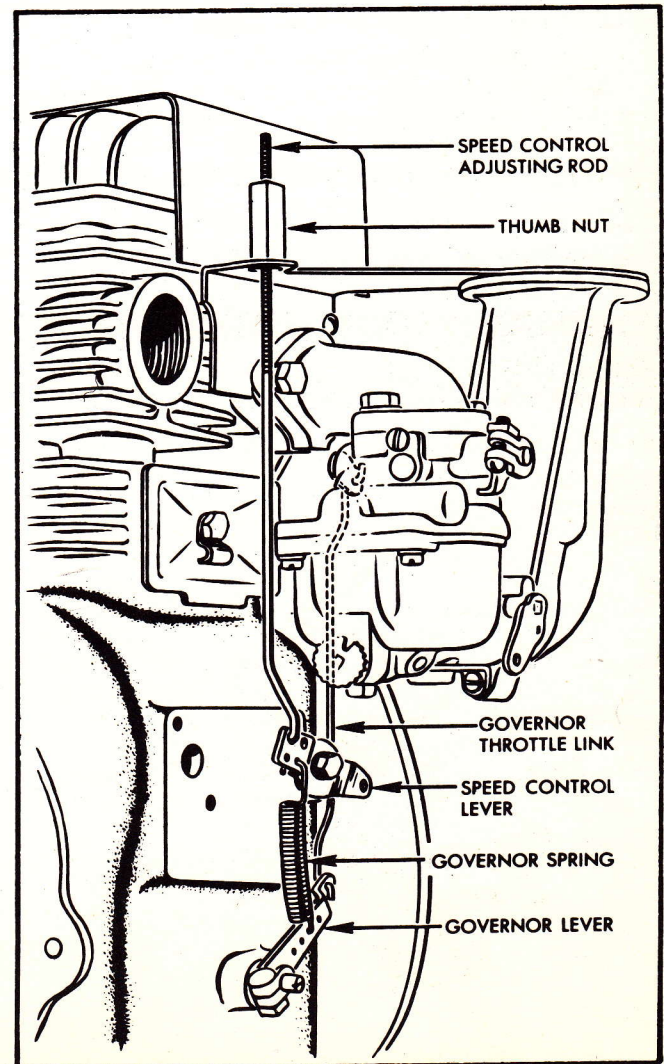


Figure No. 7

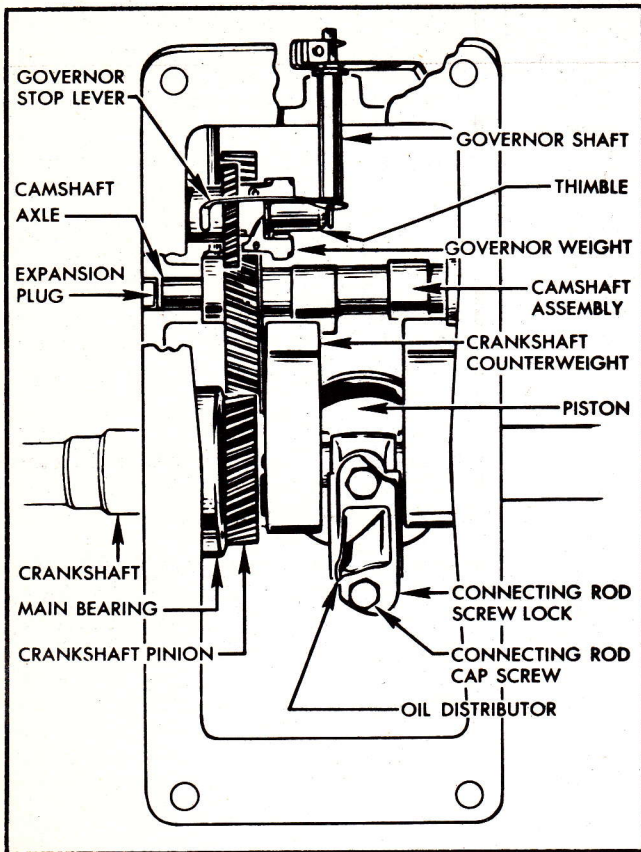


Figure No. 8

CARBURETOR ADJUSTMENTS

Carburetor adjustments are affected by changes in the operating conditions of the engine. The weather, for example, is a determining factor, and correct adjustments will vary from damp weather to hot weather and also from a full fuel tank to a partially filled tank. Keep this in mind as you operate the engine.

FLOAT ADJUSTMENT

1. Remove the carburetor from the engine and invert the throttle body. (See Figure No. 9.) Remove the body gasket.
2. Model 2500 carburetors should have $11/64$ inch (plus or minus $1/64$) between the machined surface of the throttle body and seam of float (both sides).
3. Model 1600 carburetors should have $17/64$ inch (plus or minus $1/64$) between the machined surface of the throttle body and seam of float (both sides).
4. To adjust, bend the lip on the float lever.

IDLE ADJUSTMENT

1. Close the idle adjustment screw and the high speed adjusting needle (See Figure No. 9) by turning them clockwise to a finger tight position.
2. Set the throttle adjusting lever so the motor runs at approximately 1700 R.P.M., the slowest speed at which the engine will run smoothly.

3. Turn the idle adjustment screw open (counter-clockwise) from $1/2$ to $1 1/2$ turns for smoothest engine operation.
4. Now set the hand throttle wide open so the engine is operating at maximum governor speed.
5. Turn the high speed adjusting needle $1/4$ to $1 1/4$ turns open (counter-clockwise) to the point where smoothest engine operation occurs.
6. Final high speed adjustments can be made when the engine is under load.

SERVICING ENGINE PARTS

MAGNETO AND IGNITION SYSTEM

After every 100 hours of operation the magneto, breaker box assembly and spark plug should be inspected. (If the engine refuses to start or is hard to start at any time, check the gas supply, carburetion system and spark plug. If all of these are in good working order, then inspect the magneto.

Design features of the engine ignition system include a large transformer coil, fully moisture proof, mounted on a stator plate behind the flywheel. Two sets of permanently charged magnets are mounted in and rotate with the flywheel. For convenient adjustment and easy ignition shorting, the breaker points assembly is housed in the breaker box on the side of the crankcase. (See Figure No. 10.) The red stop button which protrudes from the cover provides immediate ignition shorting.

SPARK PLUG

1. Four cycle engines are equipped at the factory with 14 mm spark plugs.
2. The spark plug should be removed, cleaned and regapped

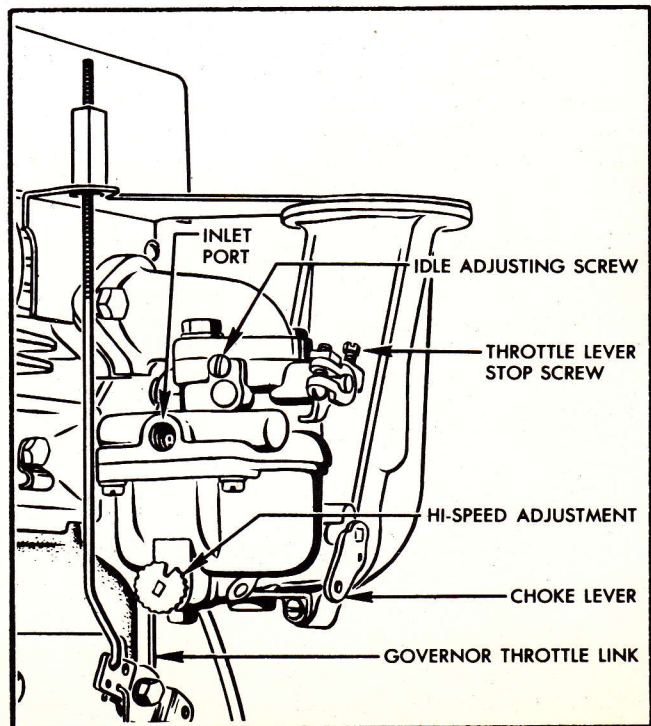


Figure No. 9



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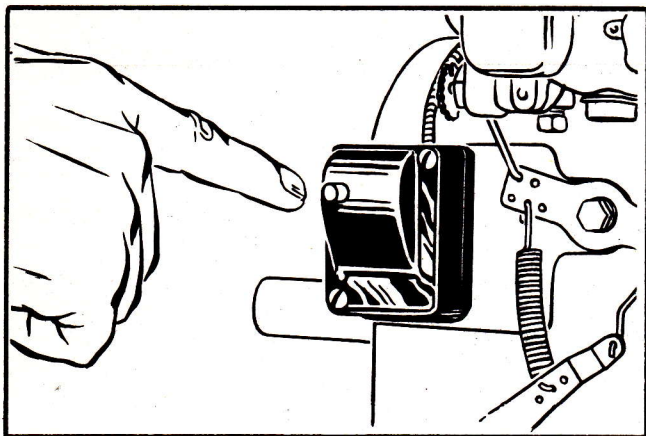


Figure No. 10

after every 100 hours of operation. Cleaning should be accomplished with an automotive type sand blast spark plug cleaner. A new spark plug should be used in preference to one which has been cleaned.

3. Regap the spark plug to .025 inch by bending the ground electrode. Do not attempt to bend the center electrode.
4. Since the cylinder heads on four cycle engines are made of aluminum, spark plug threads should be protected by coating the threads sparingly with graphite lubricant or a special anti-seize compound.
5. When tightening the spark plug, use just enough pressure to flatten the spark plug gasket.

BREAKER POINTS

The breaker point plunger is activated by a movable cam on the cam shaft gear. The spark is in a fully retarded position until the engine reaches a speed of approximately 600 to 900 RPM. The weight assembly on the valve cam gear begins to shift, completing the advance of the spark at approximately 1500 to 1800 RPM.

The weight assembly which controls the advance and retards the spark is similar to the weight assembly of a governor. As the engine gains speed the weight swings outward toward the teeth on the valve cam gear, thus allowing the cam for the breaker point to advance approximately 20°. The weight is held against the breaker point cam, by a spring. The minimum tension of the spring should measure 6 foot ounces. A stronger spring would hold the spark in a retarded position causing lack of power. Too weak a spring would not allow the spark to retard when the engine is stopped, and this would cause the engine to kick when the next attempt is made to start it.

1. To inspect the breaker points, loosen the two screws which hold the breaker box to the block. Note that the stop button is built-in to the cover and is not removed separately.
2. Inspect the points. If they are pitted, it is best to replace them and the condenser also, since a defective condenser is frequently the cause of badly pitted points. If replacement parts are not available, breaker points can be filed with a point file if care is taken to keep the surfaces flat and parallel.
3. Be sure the points are clean, by lightly rubbing a piece of white, unprinted cardboard, moistened with cleaning fluid or lacquer thinner, between them. Avoid using anything that might contaminate or leave lint on the points.
4. Check the points for the proper setting (.030) by using

a feeler gage. This is done by rotating the crankshaft until the points break and inserting the gage between them. If the points have just been replaced or cleaned they will naturally need re-adjustment. This is done in the following way:

- a. Loosen the lock screw (See Figure No. 11).
 - b. Turn the adjustment screw to the proper setting (.030) and check the result with a feeler gage.
 - c. When the correct gap has been obtained, retighten the lock screw. Re-check the gap.
5. To obtain the proper gap the breaker rubbing surface must always be on the highest part of the cam (inside the crankcase).

MAGNETO INSPECTION

1. Remove the two screws on either side of the flywheel nut, which hold the starter pulley in place. Remove the starter pulley noting that there is a notch in it which must be reinstalled in exactly the same place.
2. Turn the fuel shutoff valve off, disconnect the fuel lines and remove the tank from the block. Remove the blower housing from the block, and in this process the lifting fixture clip.
3. To remove the flywheel from the crankshaft it is necessary to loosen the flywheel nut. The flywheel will stick to the shaft. Place TL-931 over the end of the crankshaft. Strike the end of TL-931 with a plastic hammer. Do not strike too hard or you will damage the end of the crankshaft. After one or two sharp blows, the flywheel should jump loose.
4. Remove the nut, key and flywheel from the shaft.
5. The magneto laminations and coil are now exposed. (See Figure No. 12.) Check all three leads to be sure that they are in place and not leaking. The ground lead, which goes from the coil to the laminations, the primary lead to the breaker points terminal, and the secondary or hi-tension lead which goes to the spark plug.
6. Inspect the coil for burned holes through the outside insulation, or for evidence that the spark has been leak-

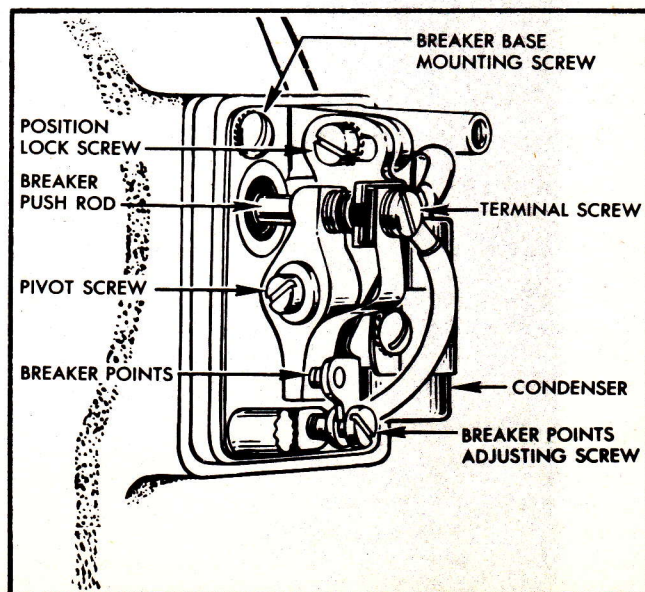


Figure No. 11

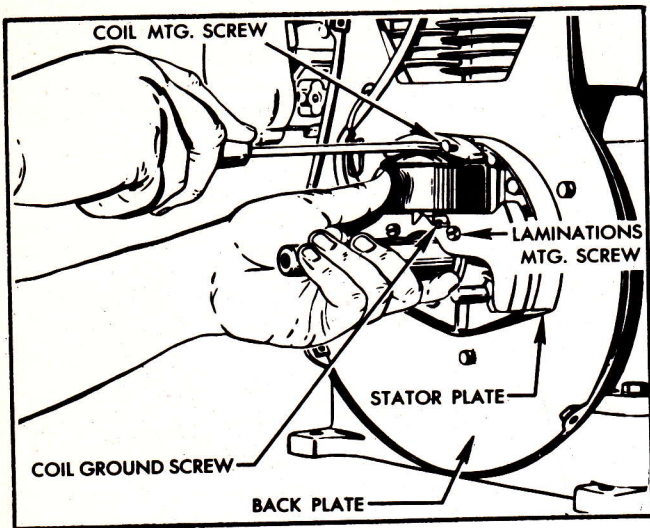


Figure No. 12

- ing to the ground from the terminal where the spark plug lead is connected.
7. Check the coil on a coil tester.
 8. Loosen the primary, secondary and ground leads from the coil.
 9. The coil itself is easily removed by removing the round head screws (not the hexagon head screws) which hold the coil to the laminations. (See Figure No. 12.)
 10. Bend down the clip holding the coil down on the core, being careful not to break off the clip.
 11. Place the coil across the open jaws of a vise with the bottom of the coil resting on the tops of the vise jaws. Tap the center leg of the core gently with a wooden stick until the coil comes off with the coil shield.
 12. Thread the primary leads of the new coil through the slot in the coil shield.
 13. In replacing the coil on the core, great care must be taken not to bend the core which being laminated is very easily distorted. Then the new coil can be pressed in place, being careful not to catch the leads under it. Then rebend the coil clip firmly, but do not pound it down into the coil.
 14. In replacing the high tension lead treat the terminal on the coil gently so it will not pull loose from the coil. Make sure that loose strands of the lead wire are not sticking out to make a short path for the spark to jump to ground.

LUBRICATION

No lubrication is required for the magneto or the breaker box assembly. All necessary lubing was accomplished at the factory.

Oil will cause trouble if it gets on the breaker points. The oil seal which is pressed into the breaker points plate guards the points from oil while allowing the plunger to be properly lubricated. If it becomes damaged or worn, oil will leak from the crankcase into the points assembly, and the breaker plate will have to be replaced.

FLYWHEEL MAGNETS

1. No servicing is necessary to the magnet units in the flywheel. They are assembled and charged permanently at

- the factory. Any magnet unit losing this charge should be returned to the factory for free re-charging.
2. A dubious magnet can be checked on a magneto-meter as shown in Figure No. 13).

FUEL SYSTEM SERVICING

Gummy deposits, caused by use of inferior gasoline or prolonged evaporation, will block fuel lines and close tolerance orifices of the fuel system.

To avoid this clogging the visible fuel filter which incorporates a fuel strainer, permits you to see the condition of the gasoline going into the fuel system.

Keep a close check on the gasoline and at the first sign of gum, dirt or other foreign matter, drain the fuel tank and refill it with fresh gasoline.

1. **Cleaning the Fuel Filter.** Remove the fuel filter bracket and bowl. Clean the bowl and the screen thoroughly and reinstall them on the engine. Open the fuel shut-off valve and check the fuel which passes into the filter.
2. **Cleaning the Fuel Lines.** Close the fuel-shut-off valve. Disconnect the fuel line at the filter. Use compressed air to clean out the line.
3. **To Correct Flooding.** This condition may be caused by tipping the engine to an extreme forward angle. Too much fuel is drawn into the combustion chamber, and the mixture becomes too rich for combustion. It is also possible that the shut-off needle in the carburetor is not seating properly and letting fuel flow unrestricted.
 - a. Close the shut-off valve.
 - b. Crank the engine until it starts then re-open the shut-off valve.
 - c. If the carburetor continues to overflow with fuel, gently tap the body of the carburetor which will usually unseat the needle.
 - d. In cases of excessive flooding which you cannot correct yourself, take the engine to your nearest Authorized Clinton Service Station for fuel system inspection and repair.

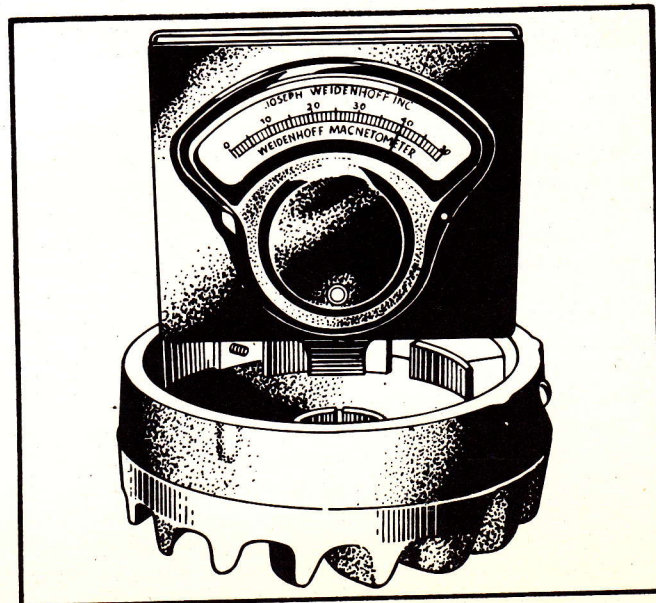


Figure No. 13



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4. **Water condensation in fuel system.** In humid climates when the engine stands in the sun and is not used, water condensation in the fuel tank and lines will occur when the engine cools off at night. A decided lack of power will be noticed if this condition exists. To correct this:
- Drain all gasoline from the fuel system.
 - Strain the fuel through a chamois cloth to remove all the water (which forms bubbles and remains in suspension in the gasoline).
 - The chamois retains the water and allows only pure fuel to pass through.

CLEANING THE AIR FILTER

The air filter is one of the most important parts of the power unit. An engine operating under dusty conditions would wear out in a few hours were it not equipped with an efficient air filter unit. Clean the air filter every twenty-five hours (or more often if conditions require it) in the following manner.

- Remove the air filter assembly from the engine.
- Empty the oil from the cup and clean the cup thoroughly.
- Flush the filter mesh, in the upper assembly with kerosene, gasoline or some other effective solvent. (See Figure No. 14.)
- Fill the lower cup with clean engine oil (using S.A.E. No. 50) to the level mark indicated on its side, then reassemble the upper unit.

CLEANING THE BREATHER ASSEMBLY

Proper vacuum in the crankcase is maintained by the outside-type breather assembly. If the aluminum filter inside the breather cap is allowed to become clogged with foreign matter crankcase vacuum is upset and loss of oil will result. Wash the filter in gasoline often and saturate it with oil before replacing it on the engine.

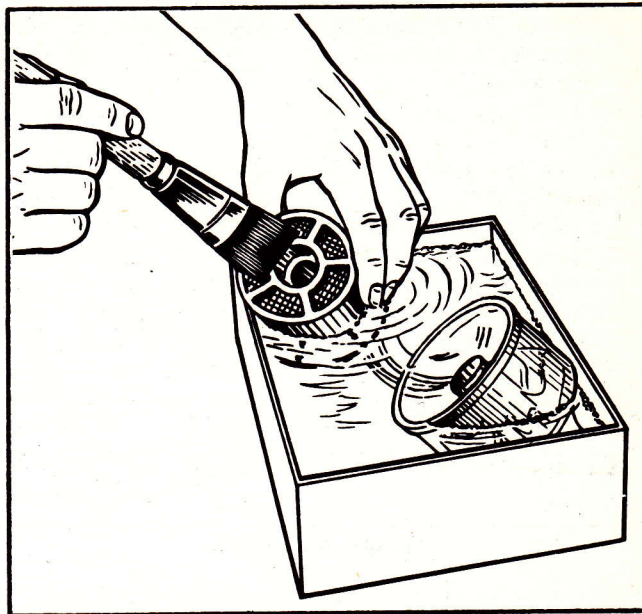


Figure No. 14

Be sure that the fiber valve disc is operating and seating properly and free of swelling. The failure of this part will upset the vacuum in the crankcase and cause the engine to leak oil. (See Figure No. 6.)

MUFFLER

After many hours of use, excessive carbon deposits will form in the muffler, causing lack of power. This can be avoided if you periodically remove the muffler from the engine and rinse it with pure gasoline or solvent. This will loosen the carbon and permit the particles to be blown out with compressed air.

MAINTENANCE AND OVERHAUL

CHECKING VALVE CLEARANCES

To reach the valves it is necessary to remove the carburetor and carburetor manifold, air horn and valve chamber cover.

Valves are set at the factory to provide an operating clearance between the end of the push rod and the valve stem of .012 intake and exhaust. If the engine is operated under extremely dusty conditions, wear on the valve seats will sometimes reduce the clearance to a point where valve life will be shortened. Valve guides are replaceable for easy rebuilding and maintenance.

- Tappet clearance is measured with a feeler gage. Take this measurement only when the tappet is at its widest position by rotating the engine until the tappet rests on the heel of the cam.
- If this clearance is too wide it indicates that the valve seats and valve faces are heavily oxidized, and therefore, the valves are held slightly off their seats.
- If clearance is too close it means considerable wear has

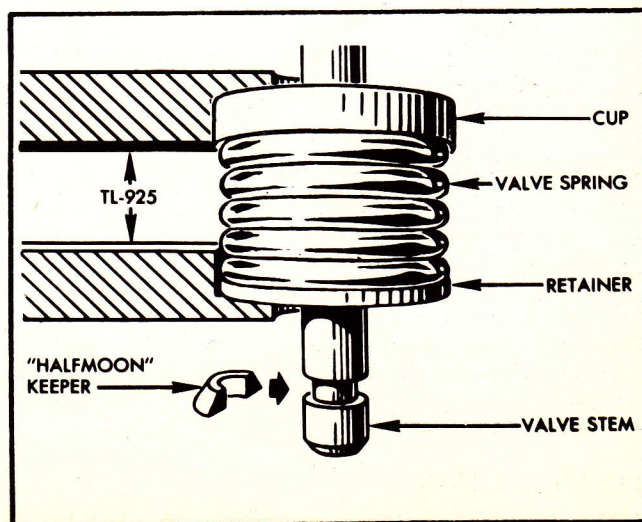


Figure No. 15



taken place at the valve seat and this has allowed the valve to drop. In either case, the valve should be removed for servicing.

4. Remove the tappet case stud first to facilitate removal of the two half-moon keepers.
5. Use TL-925, valve spring compressor (or hold the springs with a screw driver) and lift out the keepers with needle nosed pliers. (See Figure No. 15.)
6. Valves can be ground and resurfaced in the same way that automotive valves are serviced. Carbon, dirt and gum should be cleaned away.
7. Seats should be 1/32 in width, and under no circumstances more than 1/16 in width. In some cases seats can be reconditioned by using a 45° valve seat cutter (TL-932) and/or a 15° undercutter (TL-933). If the seats are badly pitted, however, it is recommended that the engine be taken to your nearest Authorized Clinton Service Station.

CYLINDER HEAD

1. When the engine is disassembled in accordance with instructions on Page 15, inspect the cylinder head for dirt accumulations, carbon deposits and warpage.
2. Scrape the foreign matter from the head with a suitable tool and remove carbon deposits by cleaning with a wire brush. (See Figure No. 16).
3. If the head is warped, place a piece of emery cloth, rough side up on a flat surface. Move the cylinder head (gasket surface downward) in a figure 8 design across the paper until roughness is removed. Be sure the surface is flat in order to avoid damaging the beaded edge of the head.
4. When the head is clean check the spark plug hole threads to be sure they are not flattened.

CYLINDER BLOCK

1. Inspect all gasket faces to see whether any portion of the block has been damaged to such an extent that new gaskets will not provide a seal.

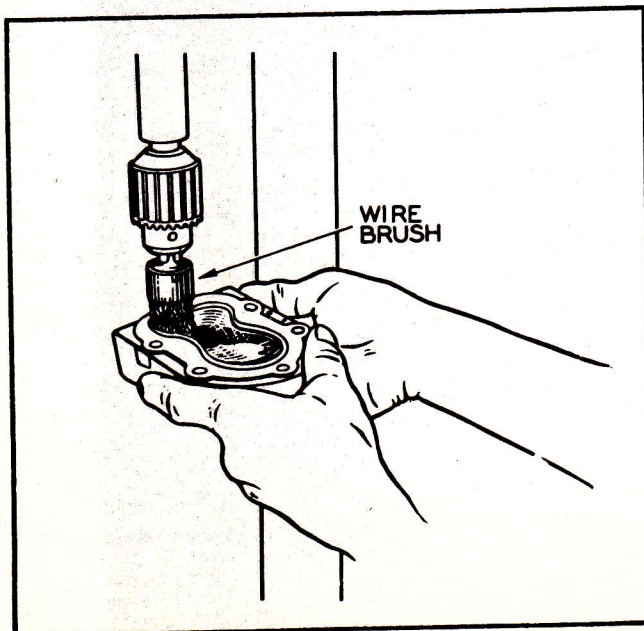


Figure No. 16

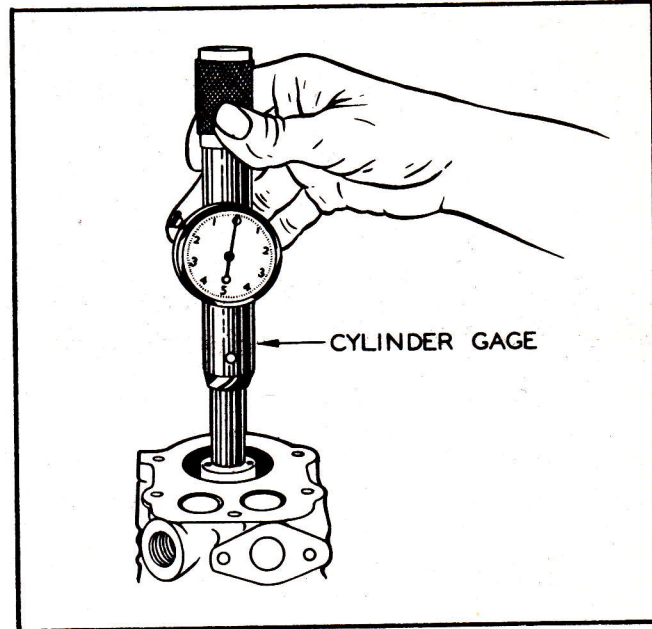


Figure No. 17

2. Check all threaded openings in the casting.
3. Reboring will be necessary if there are signs of scoring, oversize or out-of-roundness.
4. Unless you are fully familiar with honing a cylinder bore and have the proper equipment, it is suggested that you take the engine to your nearest Authorized Clinton Service Station. A faulty reboring job can cause the loss of a perfectly good block.
5. Measure the cylinder with a dial gage (See Figure No. 17) and rebores to the nearest available oversize (Pistons and piston rings are available in standard oversizes .005, .010 and .020 inch, and special oversizes .030 and .040.) Exact reboring permits installing the piston without further measurement.
 - a. Clean the table of a conventional drill press so that the block will lie flat.
 - b. Mount the cylinder hone in the chuck of the drill press, and set the speed of the spindle to rotate at approximately 600 RPM.
 - c. Place the cylinder block on the drill press table and center it under the spindle.
 - d. Install a coarse set of stones in the hone, and insert the hone in cylinder.
 - e. Lower the hone into the cylinder until the lower ends of the stones are in contact with the lowest point of the cylinder, and rotate the adjusting nut until the stones touch the cylinder wall. Continue to rotate the adjusting nut to permit removal of approximately one half (1/2) the estimated amount of metal required for the desired oversize.
 - f. Begin the honing at the bottom of the cylinder and move the hone up and down at the rate of about 50 strokes per minute. About every fourth or fifth stroke, move the hone far enough to extend the stones one inch beyond the cylinder bore. After every 30 or 40 strokes check the bore for size and straightness.
 - g. Keep the stones and felt buffers free of metal by using a wire brush.
 - h. When the bore has been straightened out, continue honing with long strokes carrying the hone through both



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ends of the cylinder approximately one inch, until the cylinder is within .002 inch of the desired finished size.

- i. Check the cylinder with a dial gage as the honing progresses to prevent the removal of too much metal.
- j. Replace the coarse stones with burnishing stones and hone as before until the bore is within .005 inch of desired size.
- k: At this point install finishing stones and remove the last .005 inch by polishing, making one or two checks for size. The cylinder should be finished to approximately .001 inch of the correct size.
- l. Wash the block thoroughly with soap and water solution to remove cuttings; wash cylinder wall with a good commercial solvent and coat with oil to prevent rust.

BASE

1. Remove the four bolts holding the base to the block.
2. Check the base for cracks or warpage.

PISTON AND ROD

1. With the block upside-down on a flat surface, remove the connecting rod cap screws by bending the bolt lock plate flaps outward. Then remove the connecting rod cap and oil distributor. Push piston through top of cylinder bore.
2. Piston Rings (one compression, one scraper, and one oil) must be replaced whenever the piston is removed. Break the rings with care, however to avoid scaring piston lands.
3. The piston should be replaced if it shows signs of score marks, worn ring lands or piston pin bores. (Clearance between the edge of the ring and the land should be .009 inch.)

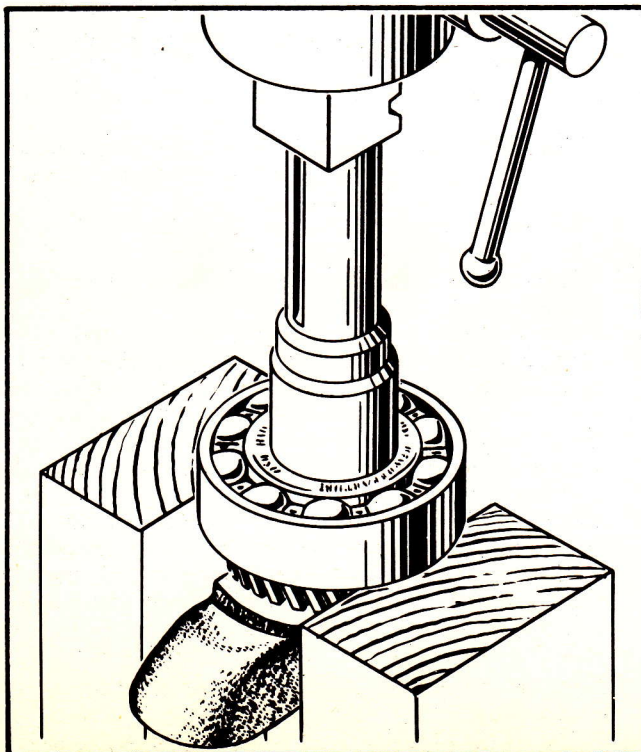


Figure No. 18

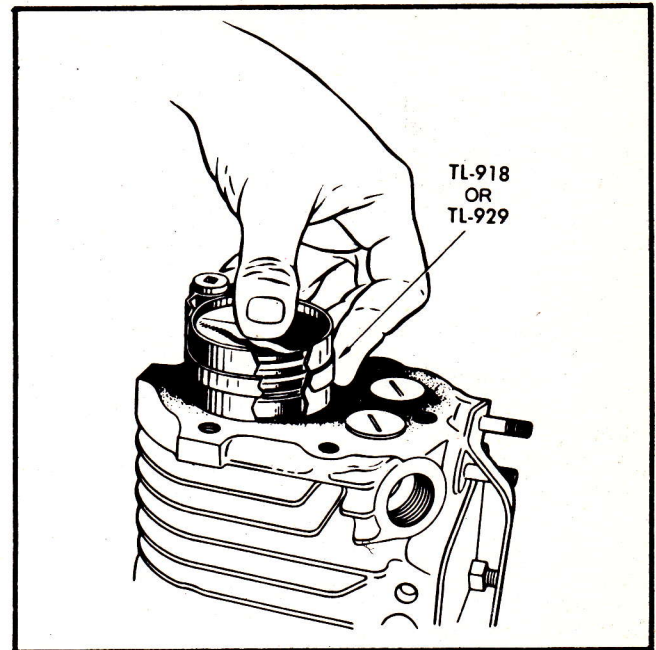


Figure No. 19

4. Use a piston ring compressor (TL-929) to hold the rings in place while installing the piston in the bore (See Figure No. 19.)
5. Lugs on the connecting rod cap must line up with lugs on the connecting rod. Note that one of the connecting rod cap screw bosses is scarfed. This must be replaced toward the valve side of the engine or damage will result.

CRANKSHAFT

1. To remove the crankshaft, tap it lightly, while turning it so that the counterweights clear the cam gear. Then, with a slight up-and-down movement bring the shaft out of the crankcase opening.
2. Inspect the crankshaft for signs of score marks and metallic pick-up. If it is round and smooth slight pick-up can be eliminated by polishing with crocus cloth.
3. Measure the crankshaft journals for out-of-round condition (Main bearing journals—not more than .001) connecting rod journal not more than .0005.) Do not attempt to regrind the crankshaft since undersize bearings are not available.
4. Check the condition of the tapered end of the crankshaft, keyway and threads. Battered threads can sometimes be restored by running a die over them.

BALL BEARINGS

1. Ball bearings are firmly seated against the crankshaft shoulders. They can be removed for inspection by supporting both sides of the bearing on an arbor press while pressing the crankshaft out. (See Figure No. 18.)
2. Inspect the bearing for apparent signs of wear or looseness and replace them if this condition exists.
3. Install the bearings by using a main bearing driver (TL-934) or by heating them in oil and slipping them, while hot, over the braced crankshaft. Let them cool gradually on the shaft for a perfect fit.

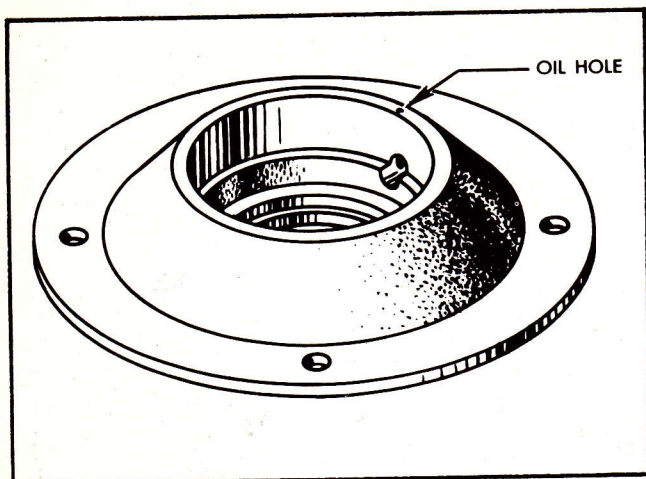


Figure No. 20

BEARING OIL SEAL

1. The bearing flange (See Figure No. 20) houses a bearing oil seal. If oil leaks around the end of the crankshaft, it indicates that this seal must be replaced, using TL-935, oil seal driver.
2. The hole in the bearing flange is an oil drain for the ball bearings. This oil drain must face toward the bottom of the block when the bearing flange is reinstalled on the engine.

CAMSHAFT AND CAM GEAR

1. The camshaft axle is driven out from the flywheel side of the block, taking the expansion plug with it. Check

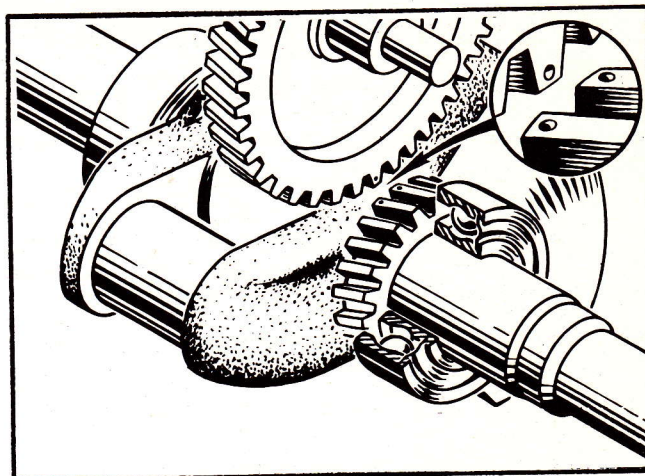


Figure No. 21

the camshaft axle for signs of wear, and replace it if necessary.

2. Replace the camshaft by inserting it through the hole in the flywheel side of the engine until the cam gear can be brought into proper position.

TIMING THE ENGINE

1. Two teeth on the crankshaft are marked with a punch. . . one tooth on the cam gear has a punch.
2. These teeth must mesh when the crankshaft is inserted into the block with a slight tilting motion. (See Figure No. 21.)

FRICITION CLUTCH ASSEMBLY

(ROCKFORD TYPE)

INSTRUCTIONS FOR MAINTENANCE AND SERVICE

DISASSEMBLY OF PTA-S3 $\frac{1}{2}$ 4 (Part No. 16365)

1. TO REMOVE POWER TAKE-OFF ASSEMBLY

- (a) Remove four screws holding PTA to engine housing.
- (b) Apply pressure evenly by hand, keeping PTA horizontally even with engine.
- (c) Slip back using a slight twisting motion.

2. TO REMOVE CLUTCH ASSEMBLY FROM PTA HOUSING

- (a) Remove two hexagon screws, lift out shifting lever and cover.
- (b) Remove three hexagon screws and three lockwashers.
- (c) Slip out clutch and shaft assembly from housing.

3. TO REMOVE CLUTCH ASSEMBLY FROM DRIVE SHAFT

- (a) Loosen lock screw.
- (b) Place wire or clips around clutch plates to keep them compressed.
- (c) Turn release sleeve assembly counterclockwise until free from threads.
- (d) Slip back compressed clutch plates to loosen set screw enough to clear dog point screw from shaft.
- (e) Remove shaft and bearing assembly.



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4. TO REMOVE BEARING FROM SHAFT

- (a) Slip off bearing retainer.
- (b) Remove snap ring.
- (c) Press off bearing using inter-race for pressing surface.

5. TO REMOVE BODY FOR INSPECTION OF PARTS

- (a) Remove release sleeve assembly from body.
- (b) Slip off compressed clutch plates unit from body.
- (c) Remove wire or clips from clutch plates.

NOTE: At this point observe clutch plates for wear — if found in good condition, replace wire or clips for re-assembly.

6. INSPECT AND REMOVE PARTS ATTACHED TO RELEASE SLEEVE

- (a) Mark with file release bearings to retain exact position for reassembly.
- (b) Remove two lock nuts and remove bearing from sleeve.
- (c) To remove adjustment spider, press out three pins.
- (d) If pins, rollers, and levers appear worn — replace.

7. TO REMOVE DRIVING CUP ASSEMBLY FROM ENGINE SHAFT

- (a) Loosen set screw so dog point screw may clear shaft.
- (b) Remove drip cup.
- (c) Observe pilot bearing for wear. To replace, press out and press in new bronze bearing or standard double shield roller bearing.

REASSEMBLY OF PTA-S3 $\frac{1}{2}$ 4 (Part No. 16365)

1. ASSEMBLY OF RELEASE SLEEVE AND BEARING

- (a) Place release bearing around release sleeve using locating mark made in No. 6 (a), insert two screws and assemble two lock nuts, tighten securely.

2. ASSEMBLE CLUTCH BODY, CLUTCH PLATES, DRIVE PLATE AND SEPARATING SPRING

- (a) Stand body upright (large end down), place one clutch plate (friction side up) on body.
- (b) Then put on separating spring and drive plate — then second clutch plate (friction surface down).
- (c) Compress clutch plates, hold with wire clips or copper wire.

3. ASSEMBLY OF RELEASE SLEEVE LINKAGE AND SPIDER

- (a) Stand release sleeve upright with bronze bearing down.
- (b) Place adjustment spider on sleeve with the three lugs of sleeve between the three slots of the spider.
- (c) Assemble lever assembly by placing one lever on each side of roller, insert pin and assemble retaining ring.
- (d) Assemble lever assembly to adjustment spider by inserting pin into slot of lug on sleeve.
- (e) Then press in place.

4. TO ASSEMBLE DRIVE SHAFT BEARING RETAINER AND BEARING

- (a) Press bearing on shaft using inner race for pressure surface.
- (b) Insert snap ring.
- (c) Place bearing retainer over clutch end of shaft with flat side towards bearing.

5. TO ASSEMBLE DRIVE SHAFT BEARING ASSEMBLY TO CLUTCH

- (a) Insert clutch end of shaft into clutch body.
- (b) Move sleeve and adjustment spider assembly towards bearing as far as possible. Slide compressed clutch plates back to expose tapped hole in clutch body. Insert dog point set screw into body and dog point hole in shaft — tighten securely. Insert set screw into body and tighten securely.



INSTRUCTIONS FOR MAINTENANCE AND SERVICE (Cont.)

- (c) Slip compressed clutch plates back against shoulder on body. Thread up adjustment spider and release sleeve assembly on body until rollers contact clutch plate.
- (d) Remove wire clips or copper wire from compressed clutch plates and adjustment spider so clutch can be engaged and disengaged by hand.

NOTE: Leave clutch engaged. After this tighten lock screw in spider making sure lock plug is in place.

6. TO INSTALL CLUTCH AND SHAFT IN PTA HOUSING

- (a) Lay PTA housing on side with hand hole up, then slide in clutch and shaft assembly.
- (b) Insert three screws and lockwashers through housing from outside. Then, working through hand hole, thread screws into tapped holes of the bearing and retainer and tighten securely.

7. TO INSTALL CLUTCH AND HOUSING TO ENGINE

- (a) Assemble drive cup assembly on engine shaft. Thread dog point set screw into engine shaft and lock securely. Then tighten set screw securely.
- (b) Holding PTA housing with hand hole up, engage pilot end of shaft into hole of the pilot bearing in the drive cup. At the same time inserting drive plate into slots of the driving cup to line up the turn snub shaft outside the PTA housing until drive plate and drive cup fit.
- (c) Locate four holes in the engine housing and install the four screws to hold the PTA housing to the engine securely.

CLUTCH ADJUSTMENT

When clutch adjustments are deemed necessary, loosen the set screw in the adjustment spider and turn the spider clockwise approximately one-quarter of a turn.

Insert shifting lever and cover assembly with slots in end of lever fitting over trunnions of the release bearing. Proper clutch adjustment requires approximately twenty pounds at the end of the handle to engage the clutch correctly. If necessary, remove lever and cover assembly and either tighten or loosen clutch adjustment spider.

WARNING: BE SURE TO SECURELY TIGHTEN SET SCREW AFTER EACH CLUTCH ADJUSTMENT.

NOTE: Refer to Service Bulletin 13-A for information on warranty procedure.

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