TEXTRON LYCOMING OPERATOR'S MANUAL

PERIODIC INSPECTION

Revised January, 1993

SECTION 4

PERIODIC INSPECTION

NOTE

Perhaps no other factor is quite so important to safety and durability of the aircraft and its components as faithful and diligent attention to regular checks for minor troubles and prompt repair when they are found.

The operator should bear in mind that the items listed in the following pages do not constitute a complete aircraft inspection, but are meant for the engine only. Consult the airframe manufacturer's handbook for additional instructions.

Pre-Starting Inspection - The daily pre-flight inspection is a check of the aircraft prior to the first flight of the day. This inspection is to determine the general condition of the aircraft and engine.

The importance of proper pre-flight inspection cannot be over emphasized. Statistics prove several hundred accidents occur yearly directly responsible to poor pre-flight inspection.

Among the major causes of poor pre-flight inspection are lack of concentration, reluctance to acknowledge the need for a check list, carelessness bred by familiarity and haste.

1. DAILY PRE-FLIGHT.

a. Be sure all switches are in the "Off" position.

b. Be sure magneto ground wires are connected.

c. Check oil level.

d. See that fuel tanks are full.

e. Check fuel and oil connections, note minor indications for repair at 50 hour inspection. Repair any major leaks before aircraft is flown.

f. Open the fuel drain to remove any accumulation of water and sediment.

g. Make sure all shields and cowling are in place and secure. If any are missing or damaged, repair or replacement should be made before the aircraft is flown.

h. Check controls for general condition, travel and freedom of operation.

i. Induction system air filter should be inspected and serviced in accordance with the airframe manufacturer's recommendations.

2. 25—HOUR INSPECTION. After the first twenty-five hours operating time, new, remanufactured or newly overhauled engines should undergo a 50 hour inspection including draining and renewing lubricating oil. Engines equipped with oil pressure screen are required to comply with the following inspection after every 25 hours operating time.

a. Lubrication System (Engines Equipped with Oil Pressure Screen) -

(1) Remove oil suction and oil pressure screens and check carefully for presence of metal particles that are indicative of internal engine damage. Clean and reinstall the oil suction and oil pressure screens. Drain and renew the lubricating oil.

NOTE

Change the oil at least every four (4) months even if the engine has not accumulated 25 hours since the last oil change.

3. 50—HOUR INSPECTION. In addition to the items listed for daily pre-flight inspection, the following maintenance checks should be made after every 50 hours of operation.

a. Ignition System -

(1) If fouling of spark plugs has been apparent, rotate bottom plugs to upper position.

(2) Examine spark plug leads of cable and ceramics for corrosion and deposits. This condition is evidence of either leaking spark plugs, improper cleaning of the spark plug walls or connector ends. Where this condition is found, clean the cable ends, spark plug walls and ceramics with a dry, clean cloth or a clean cloth moistened with methyl-ethyl ketone. All parts should be clean and dry before reassembly.

(3) Check ignition harness for security of mounting clamps and be sure connections are tight at spark plug and magneto terminals.

b. Fuel and Induction System - Check the primer lines (where applicable) for leaks and security of the clamps. Remove and clean the fuel inlet strainers. Check the mixture control and throttle linkage for travel, freedom of movement, security of the clamps and lubricate if necessary. Check the air intake ducts for leaks, security, filter damage; evidence of dust or other solid material in the ducts is indicative of inadequate filter care or damaged filter. Check vent lines for evidence of fuel or oil seepage; if present, fuel pump may require replacement.

c. Lubrication System (Engines Equipped with an External Full Flow Oil Filter) -

(1) Remove oil suction and oil pressure screens and check carefully for presence of metal particles that are indicative of internal engine damage.

(2) Replace external full flow oil filter element. Drain and renew lubricating oil.

NOTE

Change the oil at least every four (4) months even if the engine has not accumulated 50 hours since the last oil change.

(3) Check oil lines for leaks, particularly at connections for security of anchorage and for wear due to rubbing or vibration, for dents and cracks.

d. Exhaust System - Check attaching flanges at exhaust ports on cylinder for evidence of leakage. If they are loose, they must be removed and machined flat before they are reassembled and tightened. Examine exhaust manifolds for general condition.

e. Cooling System - Check cowling and baffles for damage and secure anchorage. Any damaged or missing part of the cooling system must be repaired or replaced before the aircraft resumes operation.

f. Cylinders - Check rocker box covers for evidence of oil leaks. If found, replace gasket and tighten screws to specified torque (50 inch lbs.).

Check cylinders for evidence of excessive heat which is indicated by burned paint on the cylinder. This condition is indicative of internal damage to the cylinder and, if found, its cause must be determined and corrected before the aircraft resumes operation.

4. 100—HOUR INSPECTION. In addition to the items listed for daily pre-flight and 50 hour inspection, the following maintenance checks should be made after every one hundred hours of operation.

a. Electrical System -

(1) Check all wiring connected to the engine or accessories. Any shielded cables that are damaged should be replaced. Replace clamps or loose wires and check terminals for security and cleanliness.

(2) Remove spark plugs; test, clean and regap. Replace if necessary.

b. Magnetos - Check breaker points for pitting and minimum gap. Check for excessive oil in the breaker compartment, if found, wipe dry with a clean lint free cloth. The felt located at the breaker points should be lubricated in accordance with the magneto manufacturer's instructions. Check magneto to engine timing. Timing procedure is described in Section 5, 1, b of this manual.

c. Engine Accessories - Engine mounted accessories such as pumps, temperature and pressure sensing units should be checked for secure mounting, tight connections.

d. Cylinders - Check cylinders visually for cracked or broken fins.

e. Engine Mounts - Check engine mounting bolts and bushings for security and excessive wear. Replace any bushings that are excessively worn.

f. Fuel Injector Nozzles and Fuel Lines -Check fuel injector nozzles for looseness. Tighten to 60 inch pounds torque. Check fuel lines for fuel stains which are indicative of fuel leaks. Repair or replacement must be accomplished before the aircraft resumes operation.

5. 400—HOUR INSPECTION. In addition to the items listed for daily pre-flight, 50 hour and 100 hour inspections, the following maintenance check should be made after every 400 hours of operation.

Valve Inspection - Remove rocker box covers and check for freedom of valve rockers when valves are closed. Look for evidence of abnormal wear or broken parts in the area of the valve tips, valve keeper, springs and spring seats. If any indications are found, the cylinder and all of its components should be removed (including the piston and connecting rod assembly) and inspected for further damage. Replace any parts that do not conform with limits shown in the latest edition of Special Service Publication No. SSP2070.

6. NON—SCHEDULED INSPECTIONS. Occasionally, service bulletins or service instructions are issued by Textron Lycoming Reciprocating Engine Division that require inspection procedures that are not listed in this manual. Such publications, usually are limited to specified engine models and become obsolete after corrective modification has been accomplished. All such publications are available from Textron Lycoming distributors, or from the factory by subscription. Consult the latest edition of Service Letter No. L114 for subscription information. Maintenance facilities should have an up-to-date file of these publications available at all times.

MAINTENANCE PROCEDURES

MAINTENANCE PROCEDURES (CONT.)

SECTION 5

MAINTENANCE PROCEDURES

The procedures described in this section are provided to guide and instruct personnel in performing such maintenance operations that may be required in conjunction with the periodic inspections listed in the preceding section. No attempt is made to include repair and replacement operations that will be found in the applicable Avco Lycoming Overhaul Manual.

1. IGNITION AND ELECTRICAL SYSTEM.

a. Ignition Harness and Wire Replacement - In the event that an ignition harness or an individual lead is to be replaced, consult the wiring diagram to be sure harness is correctly installed. Mark location of clamps and clips to be certain the replacement is clamped at correct locations.

b. Timing Magnetos to Engine - Although several combinations of magnetos are used on this series engines, (see Table of Models for model application) the timing procedures, with the exception of the method of turning the magnetos to the correct breaker position, are the same for all magnetos.

NOTE

Either the impulse coupling or retard breaker magneto (whichever is applicable) is installed on the left side of the engine.

(1) Remove a spark plug from No. 1 cylinder and place a thumb over the spark plug hole. Rotate the crankshaft in direction of normal rotation until the compression stroke is reached, this is indicated by a positive pressure inside the cylinder tending to push the thumb off the spark plug hole. Continue rotating the crankshaft in direction of normal rotation until the advance timing mark on the front face of the starter ring gear is in exact alignment with the small hole located at the two o'clock position on the front face of the starter housing. (Starter ring gear may be marked at 20^{o} and 25^{o}. Consult engine specifications, or nameplate, for correct timing mark for your installation.)

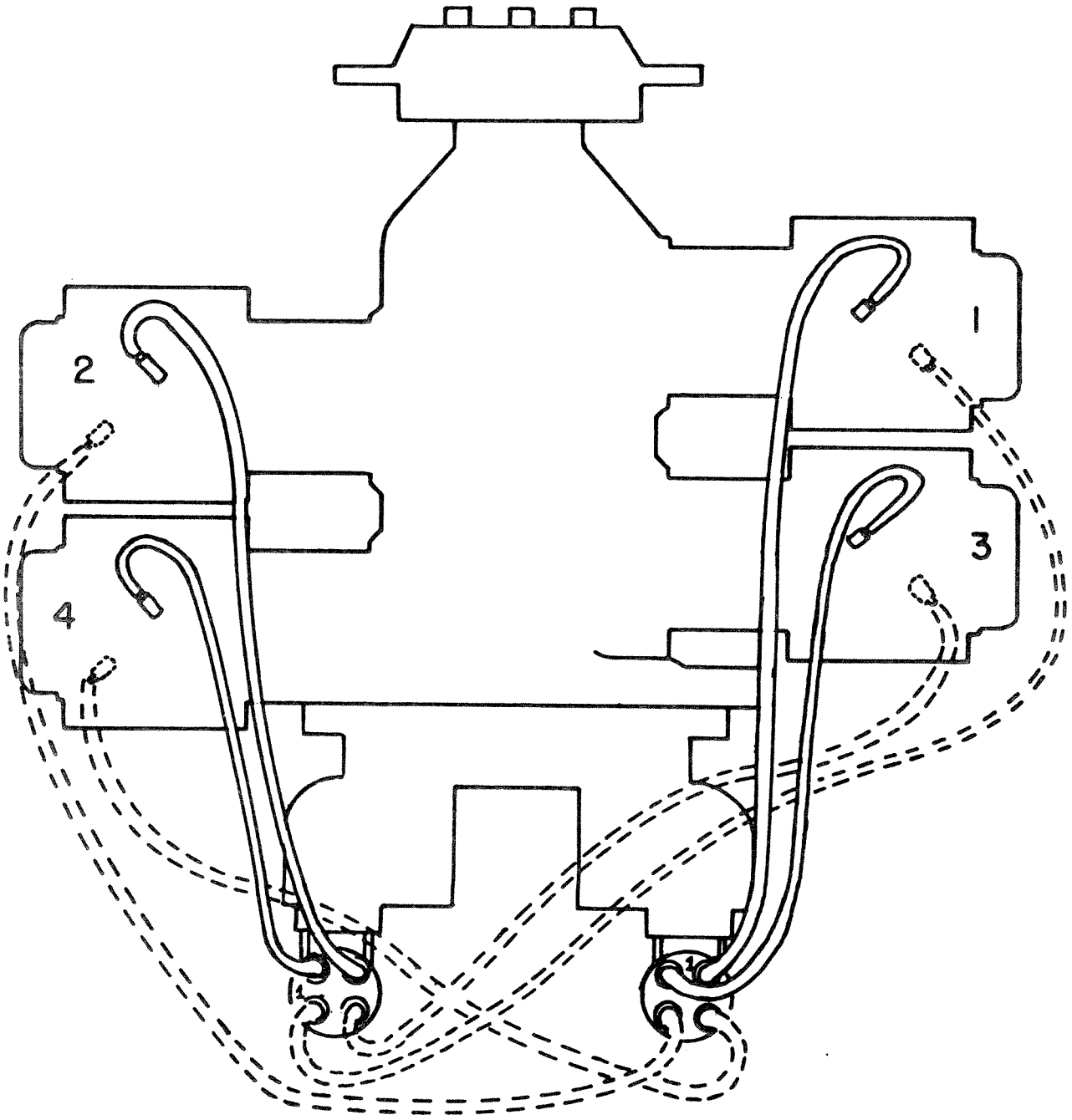
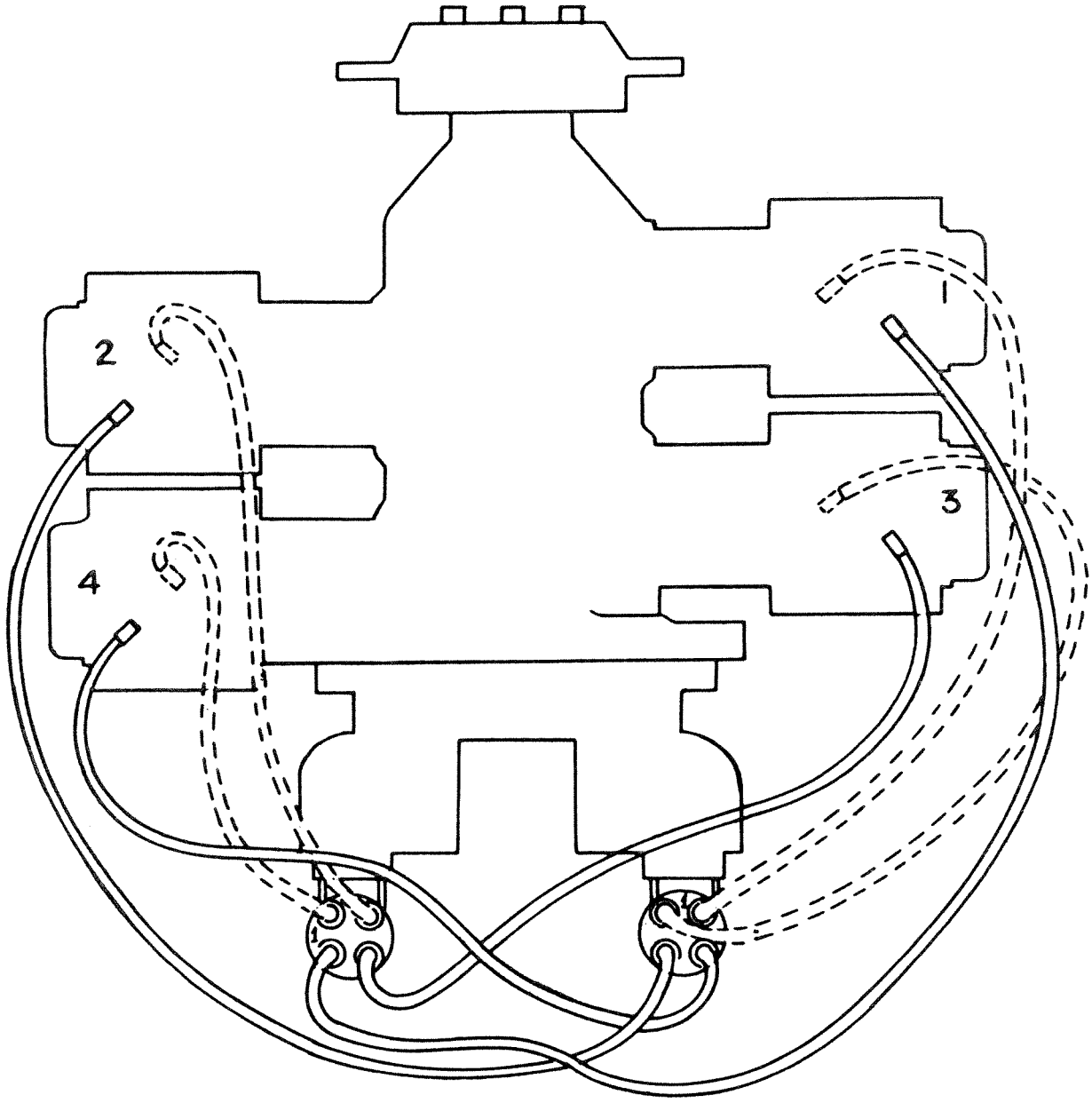


Figure 5-1. Ignition Wiring Diagram



FIRING ORDER
MAGNETO-Left Hand Rotation 1-3-2-4
MAGNETO-Right Hand Rotation 1-4-2-3

Figure 5-2. Ignition Wiring Diagram (Optional)

NOTE

If the crankshaft is accidently turned in the direction opposite normal rotation, repeat the above procedure as accumulated backlash will make the final timing incorrect.

(2) At this point, the engine is ready for assembly of the magnetos.

(a) Bendix Magnetos - Remove the inspection plugs from both magnetos and turn the driveshafts in direction of normal rotation until the first painted chamfered tooth on the distributor gear is aligned in the center of the inspection window.

(b) Slick Magnetos - Remove the bottom vent plugs and "spark out" the magnetos. This is accomplished in the following manner.

(Impulse Coupling Magneto) Hold the T1 or B1 lead wire spring 1/16 in. to 1/8 in. away from the magneto frame and turn the impulse coupling one click at a time until a strong spark jumps between the spring and the frame. Hold the magneto firmly so the coupling will not move beyond the point where it trips and the spark occurs. Reverse the rotation approximately 25° until the timing pin hole appears in the center of the vent plug hole. Hold the rotor by inserting the timing pin and line the timing pin with the center of the vent plug hole.

(Conventional Magneto) Hold the B1 lead wire spring 1/8 in. away from the frame. Turn the gear counter-clockwise vigorously through the flux lines until a strong spark occurs at the lead. Reverse the rotation into the flux until the timing pin hole appears in the center of the vent plug hole and insert the timing pin into the hole.

(3) Being sure that the gear does not move from this position, install gaskets and magnetos on the engine. Secure with washers and nuts; tighten only finger tight.

NOTE

In order to turn the shaft on an impulse coupling magneto, depress the pawl on the impulse coupling with the finger.

(4) Using a battery powered timing light, attach the positive lead to a suitable terminal connected to the ground terminal of the magneto and the negative lead to any unpainted portion of the engine. Rotate the magneto in its mounting flange to a point where the light comes on, then slowly turn it in the opposite direction until the light goes out. Bring the magneto back slowly until the light just comes on. Repeat this with the second magneto.

NOTE

Some timing lights operate in the reverse manner as described above, the light comes on when the breaker points open. Check your timing light instructions.

(5) After both magnetos have been timed to the engine, check, as described below, to ascertain that both magnetos are set to fire together.

(6) Back off the crankshaft a few degrees, the timing lights should go out. Bring the crankshaft slowly back in direction of normal rotation until the timing mark and the hole in the starter housing are in alignment. At this point, both lights should go on simultaneously. Tighten nuts to specified torque.

c. Generator or Alternator Output - The generator or alternator (whichever is applicable) should be checked to determine that the specified voltage and current are being obtained.

2. FUEL SYSTEM.

a. Repair of Fuel Leaks - In the event a line or fitting in the fuel system is replaced, only a fuel soluble lubricant, such as clean engine oil or Loctite Hydraulic Sealant, may be used on the threads. Any other thread lubricant or compound must not be used.

b. Carburetor or Fuel Injector Fuel Inlet Screen Assembly - Remove the assembly and check the screen for distortion or openings in the strainer. Replace for either of these conditions. Clean screen assembly in solvent and dry with compressed air and reinstall. The fuel inlet screen assembly is tightened to 35-40 inch pounds on carburetors and 65-70 inch pounds on fuel injectors.

c. Fuel Grades and Limitations - The recommended aviation grade fuel for the subject engines is listed in Section 3, item 10.

In the event that the specified fuel is not available at some locations, it is permissible to use higher octane fuel. Fuel of a lower octane than specified is not to be used. Under no circumstances should automotive fuel be used (regardless of octane rating).

NOTE

It is recommended that personnel be familiar with Service Instruction No. 1070 regarding specified fuel for Avco Lycoming engines.

d. Air Intake Ducts and Filter - Check all air intake ducts for dirt or restrictions. Inspect and service air filters as instructed in the airframe manufacturer's handbook.

e. Idle Speed and Mixture Adjustment -

(1) Start the engine and warm up in the usual manner until oil and cylinder head temperatures are normal.

(2) Check magnetos. If the "mag-drop" is normal, proceed with idle adjustment.

(3) Set throttle stop screw so that the engine idles at the airframe manufacturer's recommended idling RPM. If the RPM changes appreciably after making idle adjustment during the succeeding steps, readjust the idle speed to the desired RPM.

(4) When the idling speed has been stabilized, move the cockpit mixture control lever with a smooth, steady pull toward the "Idle Cut-Off" position and observe the tachometer for any change during the leaning process. Caution must be exercised to return the mixture control to the "Full Rich" position before the RPM can drop to a point where the engine cuts out. An increase of more than 50 RPM while "leaning out" indicates an excessively rich idle mixture. An immediate decrease in RPM (if not preceded by a momentary increase) indicates the idle mixture is too lean.

If the above indicates that the idle adjustment is too rich or too lean, turn the idle mixture adjustment in the direction required for correction, and check this new position by repeating the above procedure. Make additional adjustments as necessary until a check results in a momentary pick-up of approximately 50 RPM. Each time the adjustment is changed, the engine should be run up to 2000 RPM to clear the engine before proceeding with the RPM check. Make final adjustment of the idle speed adjustment to obtain the desired idling RPM with closed throttle. The above method aims at a setting that will obtain maximum RPM with minimum manifold pressure. In case the setting does not remain stable, check the idle linkage; any looseness in this linkage would cause erratic idling. In all cases, allowance should be made for the effect of weather conditions and field altitude upon idling adjustment.

3. LUBRICATION SYSTEM.

a. Oil Grades and Limitations - Service the engine in accordance with the recommended grade oil as specified in Section 3, item 10.

b. Oil Suction and Oil Pressure Screens - At each twenty-five hour inspection remove, inspect for metal particles, clean and reinstall, not to exceed four (4) months between oil changes.

NOTE

On installations employing full flow oil filters, this step is not practical at this time, but should be observed at the 50 hour inspection, not to exceed four (4) months between oil changes.

c. Oil Relief Valve (Non-Adjustable) - The function of the oil pressure relief valve is to maintain engine oil pressure within specified limits. The valve, although not adjustable, may be controlled by the addition of a maximum of nine STD-425 washers under the cap to increase pressure or the use of a spacer (Textron Lycoming P/N 73629 or 73630) to decrease pressure. A modification on later models has eliminated the need for the spacers. Particles of metal or other foreign matter lodged between the ball and seat will result in faulty readings. It is advisable, therefore, to disassemble, inspect and clean the valve if excessive pressure fluctuations are noted.

d. Oil Relief Valve (Adjustable) - The adjustable oil relief valve enables the operator to maintain engine oil pressure within the specified limits. If the pressure under normal operating conditions should consistently exceed the maximum or minimum specified limits, adjust the valve as follows:

With the engine warmed up and running at approximately 2000 RPM, observe the reading on the oil pressure gage. If the pressure is above maximum or below minimum specified limits, stop engine and screw the adjusting screw out to decrease pressure and in to increase pressure. Depending on installation, the adjusting screw may have only a screw driver slot and is turned with a screw driver; or may have the screw driver slot plus a pinned .375-24 castellated nut and may be turned with either a screw driver or a box wrench.

4. CYLINDERS. Although the complete procedure for disassembly and reassembly is given here, it is recommended that, as a field operation, cylinder maintenance be confined to replacement of the entire assembly. Valve replacement should be undertaken only as an emergency measure.

a. Removal of Cylinder Assembly -

(1) Remove exhaust manifold.

(2) Remove rocker box drain tube, intake pipe, baffle and any clips that might interfere with the removal of the cylinder.

(3) Disconnect ignition cables and remove spark plugs.

(4) Remove rocker box cover and rotate crankshaft until piston is approximately at top center of the compression stroke. This approximate position may be located by observing top of piston through the spark plug hole and also watching the valve action.

(5) Slide valve rocker shafts from cylinder head and remove the valve rockers. Valve rocker shafts can be removed when the cylinder is removed from the engine. Remove rotator cap from exhaust valve stem.

(6) Remove push rods by grasping ball end and pulling rod out of shroud tube. Detach shroud tube spring and lock plate and pull shroud tubes through holes in cylinder head.

NOTE

The hydraulic tappets, push rods, rocker arms and valves must be assembled in the same location from which they were removed.

(7) Remove cylinder base nuts and hold down plates (where employed) then remove cylinder by pulling directly away from crankcase. Be careful not to allow the piston to drop against the crankcase, as the piston leaves the cylinder.

b. Removal of Valves and Valve Springs from Cylinder - Place the cylinder over a block of wood so as to hold the valves in a closed position. Compress the valve springs using the valve spring compressor. Remove the split keys from the end of the valve stem. The valve springs and valve spring seats may now be removed from the cylinder head. Hold the valve stems so that the valves will not fall out and remove the cylinder from the holding block. The valves may now be removed from the inside of the cylinder.

c. Removal of Piston from Connecting Rod - Remove the piston pin plugs. Insert piston pin puller through piston pin, assemble puller nut; then proceed to remove piston pin. Do not allow connecting rod to rest on the cylinder pad of the crankcase. Support with heavy rubber bands, discarded cylinder base oil ring seals or any other method.

d. Removal of Hydraulic Tappet Sockets and Plunger Assemblies - It will be necessary to remove and bleed the hydraulic tappet plunger assembly so that dry tappet clearance can be checked when the cylinder assembly is reinstalled. This is accomplished in the following manner:

(1) Remove the hydraulic tappet push rod socket by inserting the forefinger into the concave end of the socket and withdrawing. The socket will usually stick to the finger firmly enough to be pulled out of the tappet body. If the socket cannot be removed in this manner, it may be removed by grasping the edge of the socket with a pair of needle nose pliers. However, care must be exercised to avoid scratching the socket.

(2) To remove the hydraulic tappet plunger assembly, use the special Avco Lycoming service tool. In the event that the tool is not available, the hydraulic tappet plunger assembly may be removed by a hook in the end of a short piece of lockwire, inserting the lockwire around the edge of the plunger assembly and turning the wire so that the hook engages the spring of the plunger assembly. Draw the plunger assembly out of the tappet body by gently pulling the wire.

CAUTION

Never use a magnet to remove hydraulic plunger assemblies from the crankcase. This can cause the check ball to remain off its seat, rendering the unit inoperative.

e. Assembly of Hydraulic Tappet Plunger Assemblies - To assemble the unit, unseat the ball by inserting a thin clean bronze wire through the oil inlet hole. With the ball off its seat, insert the plunger and twist clockwise so that the spring catches.

f. Assembly of Valves in Cylinder - Prelubricate valve stems with Molytex Grease O or equivalent and insert each valve stem in its respective valve guide. Place cylinder over a block of wood so that the valves are held against the seats and assemble the lower valve spring seat, auxiliary valve spring and outer valve spring over the valve stem and guide. Place the upper valve spring seat on top of the springs.

NOTE

When installing valve springs, place the dampener end of spring (close wound coils marked with dye or lacquer) toward the cylinder.

Using a valve spring compressor, compress the valve springs and place the split keys in the groove around the upper end of the valve stem. Slowly release the pressure on the valve spring compressor and allow the upper spring seat to lock itself in place around the valve keys.

g. Assembly of Cylinder and Related Parts - Rotate the crankshaft so that the connecting rod of the cylinder being assembled is at the top center position that corresponds with both valves closed.

(1) Place each plunger assembly in its respective tappet body and assemble the socket on top of plunger assembly.

(2) Assemble piston with rings so that the cylinder number stamped on the piston pin boss is toward the front of the engine. The piston pin should be a handpush fit. If difficulty is experienced in inserting the piston pin, it is probably caused by carbon or burrs in the piston pin hole. During assembly, always use a generous quantity of oil, both in the piston pin hole and on the piston pin.

(3) Assemble one piston pin plug at each end of the piston pin and place a new rubber oil seal ring around the cylinder skirt. Coat piston and rings and the inside of the cylinder generously with oil.

(4) Using a piston ring compressor, assemble the cylinder over the piston so that the intake and exhaust ports are at the bottom of the engine. Push the cylinder all of the way on, catching the ring compressor as it is pushed off.

NOTE

Before installing cylinder hold-down nuts, lubricate crankcase through stud threads with any one of the following lubricants, or combination of lubricants.

1. 90% SAE 50W engine oil and 10% STP.
2. Parker Thread Lube.
3. 60% SAE 30 engine oil and 40% Parker Thread Lube.

(5) Assemble hold-down plates (where applicable) and cylinder base hold-down nuts and tighten as directed in the following steps:

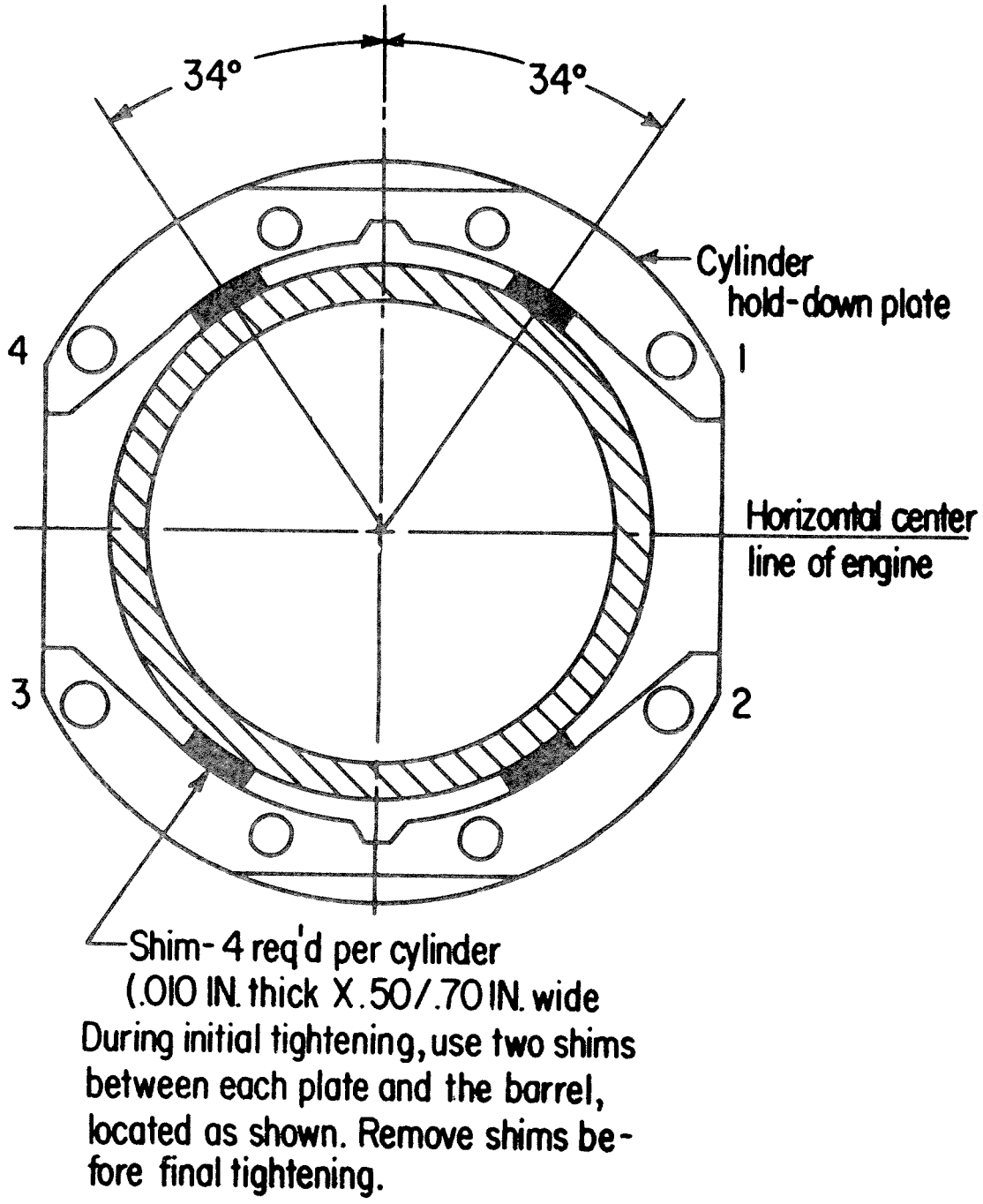


Figure 5-3. Location of Shims Between Cylinder Barrel and Hold-Down Plates (where applicable) and Sequence of Tightening Cylinder Base Hold-Down Nuts

NOTE

At any time a cylinder is replaced, it is necessary to retorque the thru-studs on the cylinder on the opposite side of the engine.

(a) (Engines using hold-down plates) Install shims between cylinder base hold-down plates and cylinder barrel, as directed in figure 5-3, and tighten 1/2 inch hold-down nuts to 300 inch lbs. (25 foot lbs.) torque, using the sequence shown in figure 5-3.

(b) Remove shims, and using the same sequence, tighten the 1/2 inch cylinder base nuts, to 600 in. lbs. (50 foot lbs.) torque.

NOTE

Cylinder assemblies not using hold-down plate are tightened in the same manner as above omitting the shims.

(c) Tighten the 3/8 inch hold-down nuts to 300 inch lbs. (25 foot lbs.) torque. Sequence of tightening is optional.

(d) As a final check, hold the torque wrench on each nut for about five seconds. If the nut does not turn, it may be presumed to be tightened to correct torque.

CAUTION

After all cylinder base nuts have been tightened, remove any nicks in the cylinder fins by filing or burring.

(6) Install a new shroud tube oil seal on the crankcase end of each shroud tube and fit a new annular ring in the groove provided in the rocker box and of each shroud tube. Install each shroud tube through rocker box and seat the end firmly in the crankcase. Place a spacer, two springs, a lock plate and nut over the stud provided in the rocker box and secure both shroud tubes in place. Bend the tang of the lock plate to prevent the nut and spring from loosening.

(7) Assemble each push rod in its respective shroud tube, and assemble each rocker in its respective position by placing rocker between bosses and sliding valve rocker shaft in place to retain rocker. Before installing exhaust valve rocker, place rotator cap over end of exhaust valve stem.

(8) Be sure that the piston is at top center of compression stroke and that both valves are closed. Check clearance between the valve stem tip and the valve rocker. In order to check this clearance, place the thumb of one hand on the valve rocker directly over the end of the push rod and push down so as to compress the hydraulic tappet spring. While holding the spring compressed, the valve clearance should be between .028 and .080 inch. If clearance does not come within these limits, remove the push rod and insert a longer or shorter push rod, as required to correct clearance.

NOTE

Inserting a longer push rod will decrease the valve clearance.

(9) Install intercylinder baffles, rocker box covers, intake pipes, rocker box drain tubes and exhaust manifold.

5. GENERATOR OR ALTERNATOR DRIVE BELT TENSION.

Check the tension of a new belt 25 hours after installation. Refer to Service Instruction No. 1129 and Service Letter No. L160 for methods of checking generator or alternator drive belt tension.