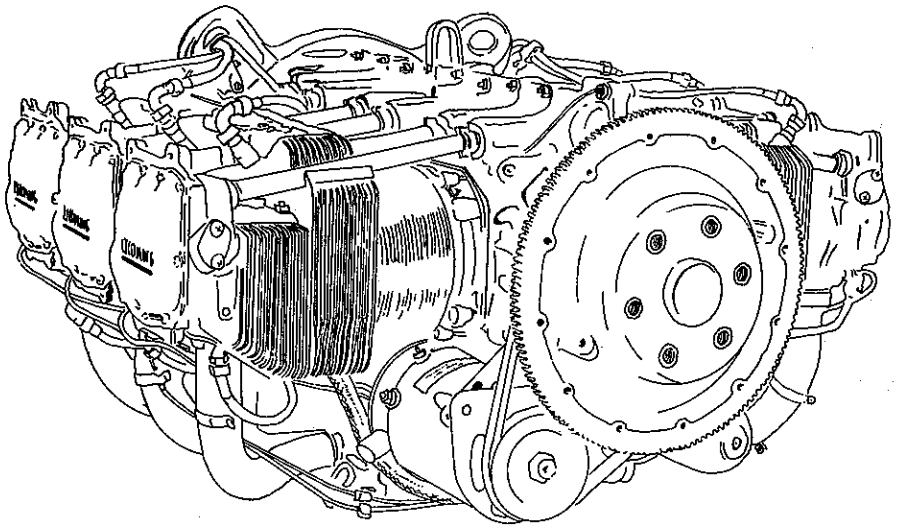
DIRECT DRIVE ENGINE
Overhaul Manual



PART NO. 60294-7

APPROVED BY F.A.A.

TEXTRON Lycoming

Williamsport Plant
Textron Lycoming/Subsidiary of Textron Inc.

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717/323-6181

TEXTRON Lycoming

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TO THE OWNER OF THIS MANUAL

IN ADDITION TO THIS MANUAL AND SUBSEQUENT REVISIONS, ADDITIONAL OVERHAUL AND REPAIR INFORMATION IS PUBLISHED IN THE FORM OF SERVICE BULLETINS AND SERVICE INSTRUCTIONS. THE INFORMATION CONTAINED IN THESE SERVICE BULLETINS AND SERVICE INSTRUCTIONS IS AN INTEGRAL PART OF, AND IS TO BE USED IN CONJUNCTION WITH, THE INFORMATION CONTAINED IN THIS OVERHAUL MANUAL.

THIS OVERHAUL MANUAL AND ALL APPLICABLE SERVICE BULLETINS AND SERVICE INSTRUCTIONS, USED IN CONJUNCTION WITH THE APPROPRIATE OPERATORS MANUAL, CONSTITUTES THE ENGINE MAINTENANCE MANUAL REQUIRED BY FAA-FAR 43.13.

For a period of three (3) years new and revised pages for this manual will be furnished to owners, who fill out the registration card and return it to Textron Lycoming. Registered owners of this manual will be notified of any changes in revision policy or cost of revisions.

Service Bulletins, Service Instructions and Service Letters are available from all Textron Lycoming Distributors or from the factory by subscription. Consult the latest revision to Textron Lycoming Service Letter No. L114. Textron Lycoming also publishes an Index of Service Bulletins, Instructions and Letters that lists all Bulletins, Instructions and Letters in alphabetical order by title and topic as well as a list of Bulletins, Instructions and Letters applicable to each engine series. Consult the Service Publication Section of the latest revision to Service Letter No. L114 for the current part number of the index.

SPECIAL NOTE

The illustrations, pictures and drawings shown in this publication are typical of the subject matter they portray; in no instance are they to be interpreted as examples of any specific engine, equipment or part thereof:

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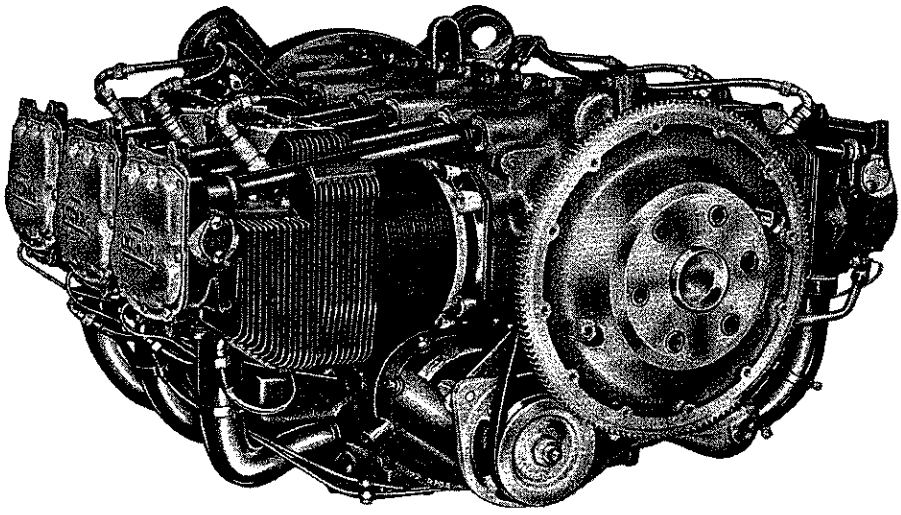
Overhaul Manual

AVCO LYCOMING Direct Drive Engine



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WILLIAMSPORT, PENNSYLVANIA 17701

Fifth Printing

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December 1974

TO THE OWNER OF THIS MANUAL

THIS MANUAL HAS BEEN DESIGNED TO PERMIT ADDITION OF NEW AND REVISED PAGES, AS REQUIRED FOR COVERAGE OF NEW ENGINE MODELS, NEW SHOP PROCEDURES, AND PROCESSES. NEW AND REVISED PAGES WILL BE FURNISHED TO OWNERS OF THIS MANUAL WHO FILL OUT THE REGISTRATION CARD AND RETURN IT TO AVCO LYCOMING. THE PRICE OF THE MANUAL INCLUDES THE COST OF MAILING ALL REVISED AND NEW PAGES FOR THIS MANUAL TO THE ADDRESS SHOWN ON THE CARD FOR A PERIOD OF THREE (3) YEARS. REGISTERED OWNERS OF THE MANUAL WILL BE NOTIFIED OF ANY CHANGE IN REVISION POLICY OR COST OR REVISIONS.

SERVICE BULLETINS, LETTERS AND INSTRUCTIONS

Although the information contained in this manual is up-to-date at time of publication, users are urged to keep abreast of later information through Avco Lycoming Service Bulletins, Instructions and Service Letters which are available from all Avco Lycoming distributors or from the factory by subscription. Consult the latest edition of Service Letter No. L114 for subscription information.

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SECTION 1.
INTRODUCTION

1-1. This manual contains the necessary information for the major overhaul of the Avco Lycoming horizontally installed direct drive engines. Unless otherwise noted, all information and data in the manual will apply equally to all models; those portions of the text applying to any one particular model or series will be so identified.

1-2. The main portion of the text is divided into sections corresponding to the basic engine components. Additional sections are provided for general description, general overhaul and inspection procedures, preservation and storage information, and other items of a non-specific nature.

1-3. The tools required for overhauling the engines (excluding the ordinary mechanic's tools found in most overhaul shops) are listed in SSP-2172 Special Service Tools. Inspection gages are also listed in the same section. Any special information required concerning these tools may be obtained by writing to the Service Department, Avco Lycoming Division, Williamsport, Pennsylvania, 17701. When requesting information concerning any of these tools, refer to the tool by name and part number and not merely by name.

1-4. Parts catalogs, for specific models, may be ordered from the department listed in paragraph 1-3. Because this manual covers the entire series of engines, it is almost impossible to call out attaching parts for specific models. Therefore, it is recommended that the parts catalogs be used in conjunction with the manual, when reassembling the engine.

1-5. Service bulletins, service instructions and service letters are issued from time to time whenever the engine is modified or overhaul procedures revised. When received, these publications should be inserted in the rear of this manual or maintained in a separate file for ready reference.

1-6. The following procedure should be followed if, for any reason, parts are to be returned to the factory. You may obtain from, but preferably have your distributor complete, the applicable warranty or rework form. These forms must include the engine model and serial numbers, number of hours in service, the reason for the parts being returned and any other pertinent facts concerning the parts.

1-7. In this manual all references to locations of various components will be designated when viewing the engine from the rear. The power take off end is considered the front and the accessory drive end the rear. The oil sump is considered the bottom. Cylinders are numbered from front to rear with odd numbered cylinders on the right side.

1-8. The direction of rotation of the crankshaft, as viewed from the rear, is clockwise on all models with the following exception. The direction of rotation of the crankshaft, as viewed from the rear is counterclockwise on all models with the letter L in the model prefix. (Example - LIO-320-B1A). All references to direction of rotation of the various accessory drives are as viewed facing the accessory drive mounting pad.

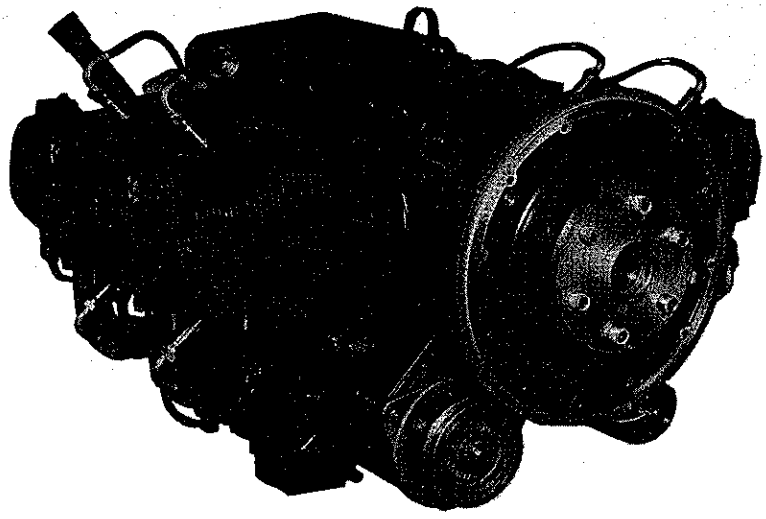


Figure 1-1. Typical 4 Cylinder Engine

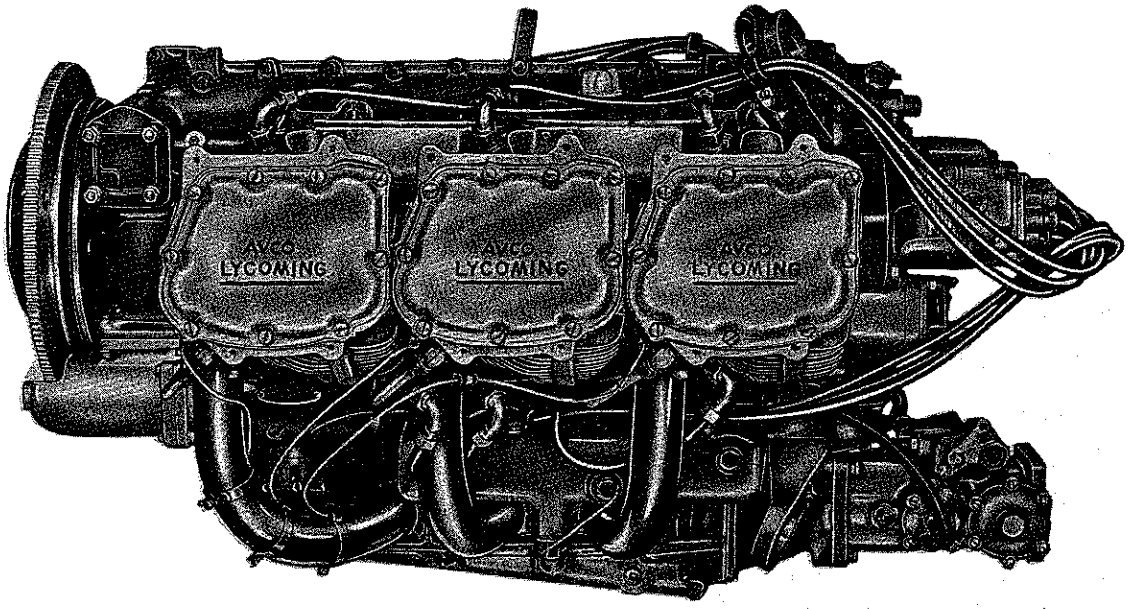


Figure 1-2. Typical 6 Cylinder Engine

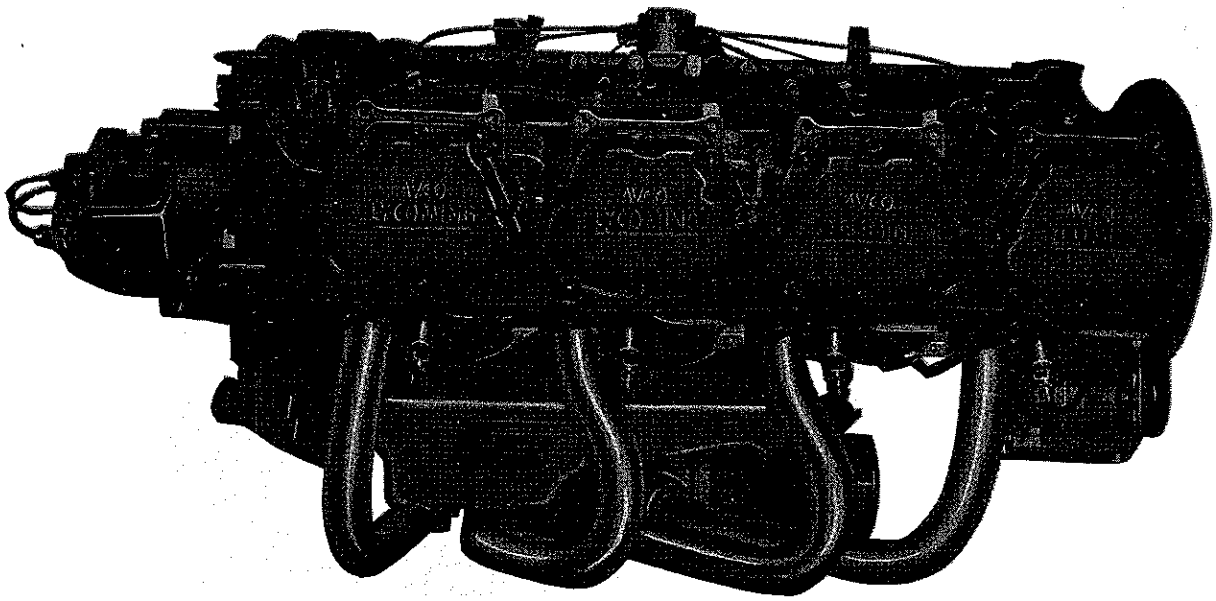


Figure 1-3. Typical 8 Cylinder Engine

SECTION 2.
GENERAL DESCRIPTION

2-1. The engines covered in this manual are direct drive, four, six and eight cylinder, horizontally opposed, air cooled models.

2-2. CYLINDERS. The cylinders are of air cooled construction with the major parts, head and barrel, screwed and shrunk together. The heads are made from an aluminum alloy casting with a fully machined combustion chamber. Valve guides and valve seats are shrunk into machined recesses in the head. Rocker shaft bearing supports are cast integrally with the head along with the housings to form the rocker boxes for both exhaust and intake valve rockers.

2-3. The cylinder barrels are machined from a chrome nickel molybdenum steel forging with deep integral cooling fins. The interior of the barrels are ground and honed to a specified finish.

2-4. Avco Lycoming incorporates a color code painted on cylinder heads designating differences in the cylinder barrels and spark plug lengths. It is essential that personnel be familiar with this code as described in the latest edition of Service Instruction No. 1181.

2-5. Damage will result with the use of incorrect piston rings or spark plug lengths. The latest edition of Service Instruction No. 1037 lists the approved piston, piston ring and cylinder assemblies for all models while the latest edition of Service Instruction No. 1042 lists the approved spark plugs. Consult these publications for correct application to your particular installation.

2-6. VALVE OPERATING MECHANISM. A conventional camshaft is located above and parallel to the crankshaft. The camshaft actuates tappets which operate the

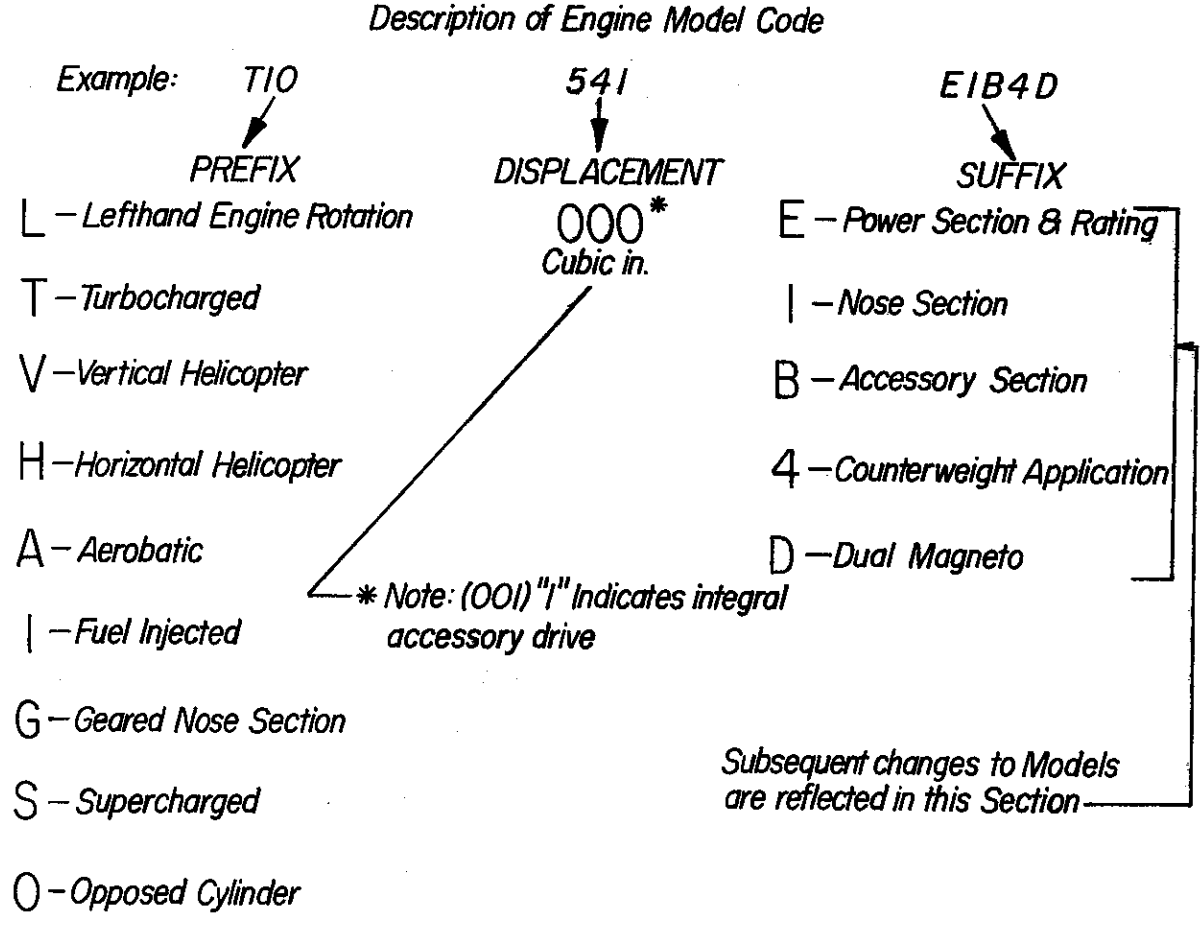


Figure 2-1. Description of Engine Model Code

valves through push rods and valve rockers. The valve rockers are supported on full floating steel shafts. The valve springs bear against hardened steel seats and are retained on the valve stems by means of split keys. A rotator cap is employed on sodium cooled exhaust valves.

NOTE

Hydraulic tappets, which automatically keep the valve clearance at zero, are used on all subject engines except the O-235-C and O-290-D series engines. These series employ solid tappets and the proper valve clearance is obtained with the aid of an adjusting screw located in the valve rocker.

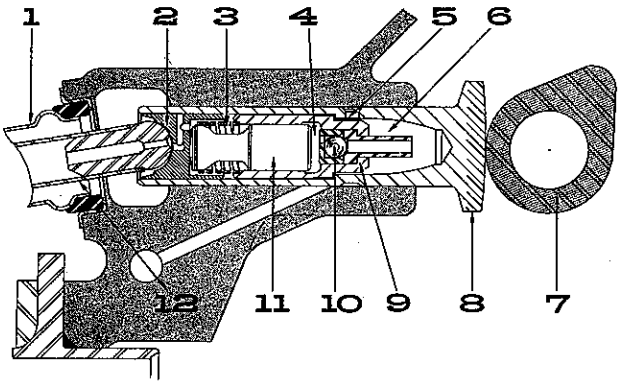


Figure 2-2. Hydraulic Tappet Assembly

2-7. HYDRAULIC TAPPETS. When the valve is closed, the face of the cam follower is on the base circle or back of the cam. The light plunger spring lifts the hydraulic plunger so that its outer end contacts the push rod, exerting a light pressure against it, thus eliminating any clearance in the valve linkage. As the plunger moves outward, the ball check valve moves off its seat. Oil from the supply chamber, which is directly connected to the engine lubrication system, flows in and fills the pressure chamber. As the camshaft rotates, the cam pushes the cam follower and the hy-

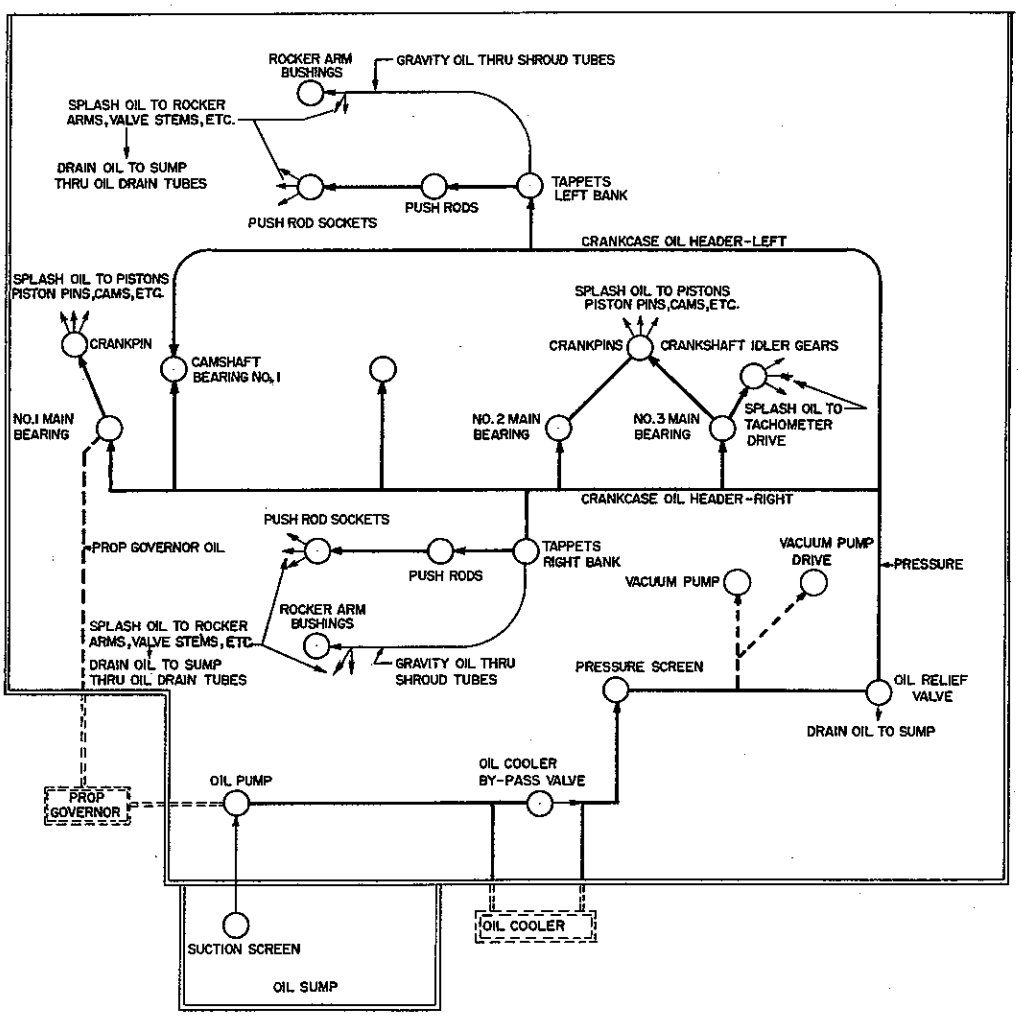


Figure 2-3. Lubrication Diagram - 4 Cylinder Engines

draulic lifter cylinder outward. This action forces the ball check valve onto its seat; thus, the body of oil trapped in the pressure chamber acts as a cushion. During the interval when the engine valve is off its seat, a predetermined leakage occurs between plunger and cylinder bore which compensates for any expansion or contraction occurring in the valve train. Immediately after the engine valve closes, the amount of oil required to fill the pressure chamber flows in from the supply chamber, thereby preparing for another cycle of operation.

2-8. CRANKCASE. The crankcase assembly consists of two reinforced aluminum alloy castings divided at the centerline of the engine and fastened together by a series of studs, bolts and nuts. The mating surfaces of the two castings are joined without the use of a gasket, and the main bearing bores are machined for the use of precision type main bearing inserts. The crankcase forms the bearings for the camshaft.

2-9. CRANKSHAFT. The crankshaft is made from a chrome nickel molybdenum steel forging and all journal surfaces are nitrided. Earlier models were provided with sludge tubes at each crankpin. These sludge tubes are not incorporated in later models. This is not to imply that sludge tubes may be removed and not replaced in crankshafts originally manufactured with sludge tubes. These tubes must be removed and replaced at overhaul.

2-10. CRANKSHAFT COUNTERWEIGHTS. A system of dynamic counterweights, to eliminate torsional vibration, is provided on all six and eight cylinder and some four cylinder engines. Consult the latest edition of Service Instruction No. 1012 for proper combination and location on the crankshaft.

2-11. ACCESSORY HOUSING. The accessory housing is machined from an aluminum alloy casting and is fastened to the rear of the crankcase and the top of the oil sump. Accessories are mounted on machined pads located on the rear of the housing.

2-12. CONNECTING RODS. The connecting rods are made in the form of "H" sections from alloy steel forgings. They have replaceable bearing inserts in the crankshaft ends and split type bronze bushings in the piston ends. The bearing caps on the crankshaft end of the rods are retained by two bolts through each cap secured by a crimp nut.

2-13. PISTONS. The pistons are machined from an aluminum alloy forging. The piston pin is of the full floating type with a plug located in each end of the pin. Consult Service Instruction No. 1037 for proper piston and ring combinations.

2-14. LUBRICATION SYSTEM. All subject engines, with the exception of the AIO series, employ a full

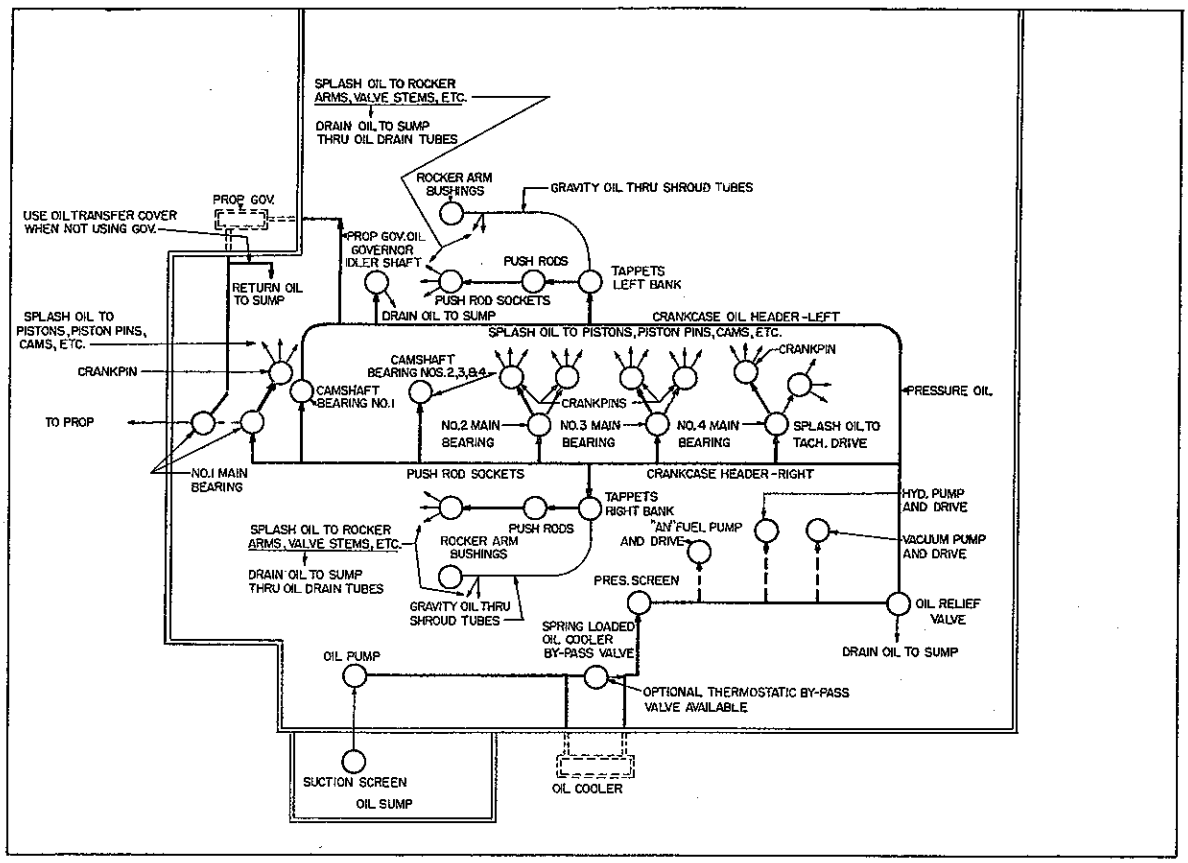


Figure 2-4. Lubrication Diagram - 6 Cylinder Engines

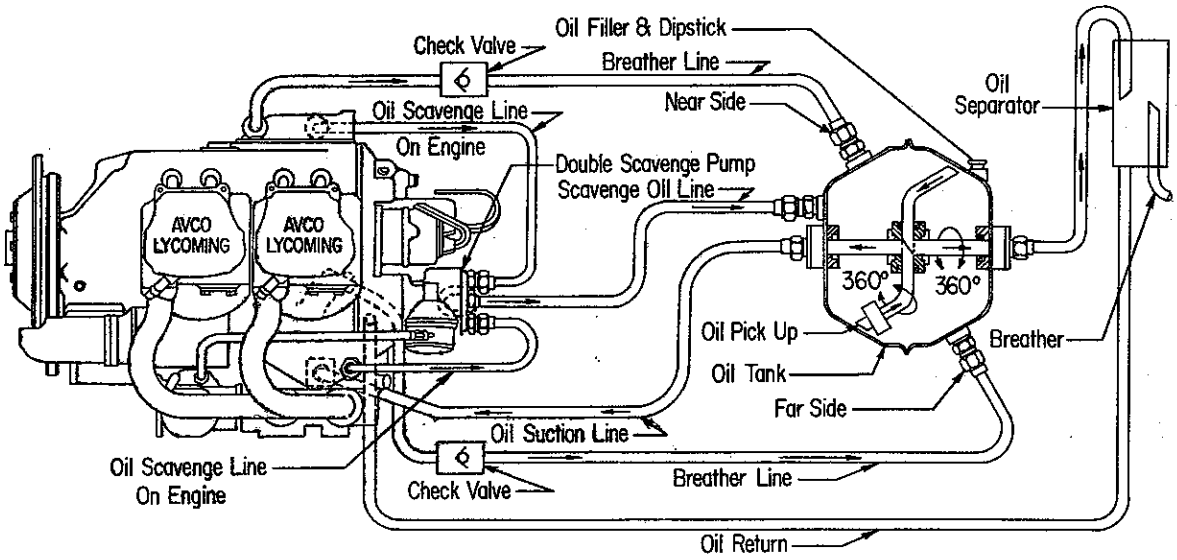


Figure 2-5. Schematic Oil System - AIO-320 and AIO-360

pressure wet sump lubrication system. See figures 2-3 and 2-4 for diagrams of typical four and six cylinder lubrication systems. See figure 2-5 for schematic of the oil system of the AIO series.

2-15. COOLING SYSTEM. These engines are designed to be cooled by air pressure built up on one side of the cylinder and discharged, with accompanying pressure, drop, through the cylinder fins.

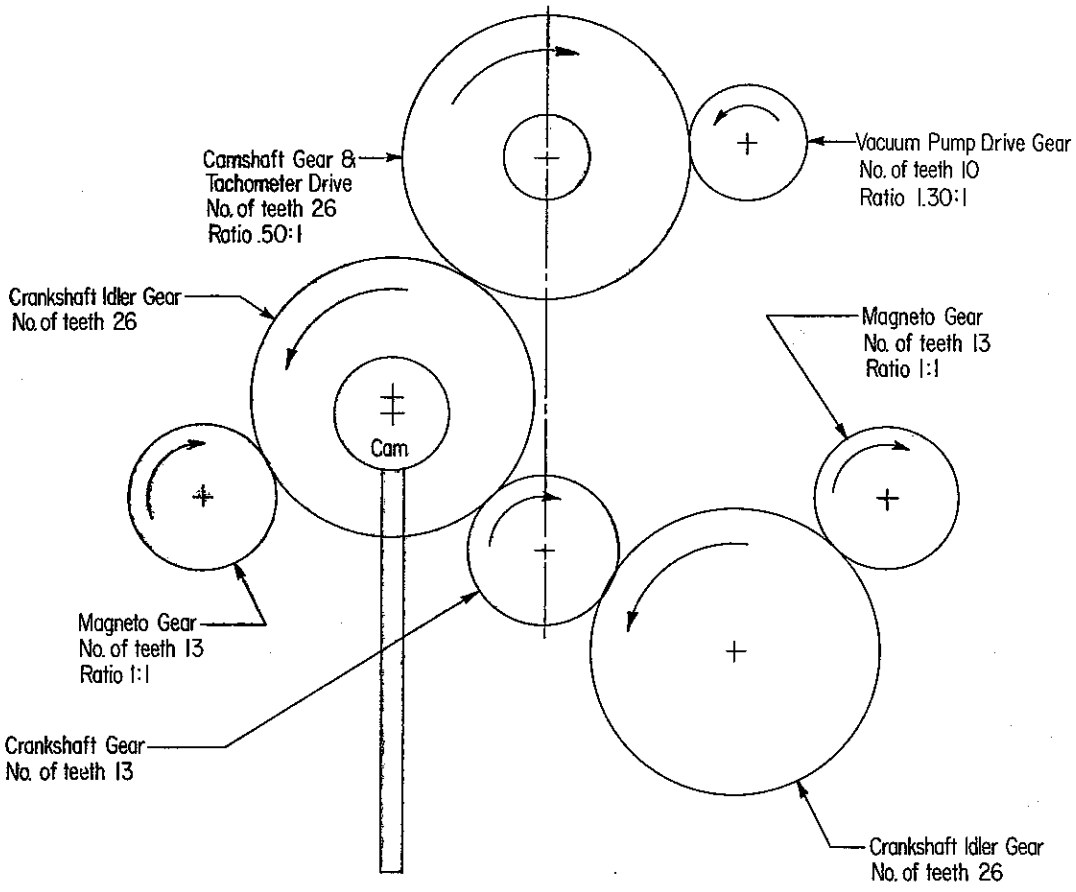


Figure 2-6. Gear Train Diagram - O-235, O-290-D and O-290-D2 Series

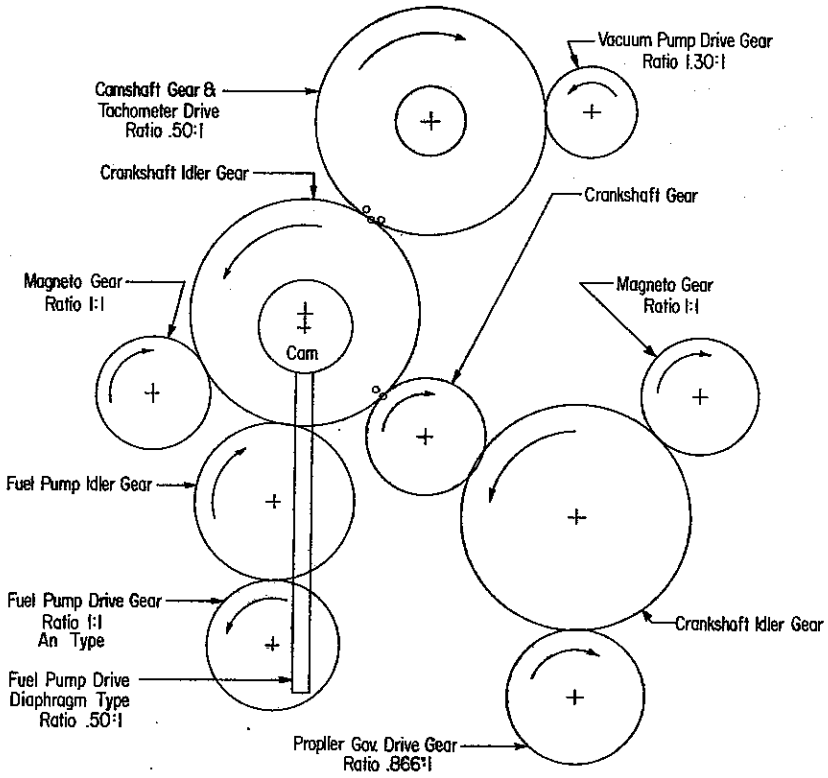


Figure 2-7. Gear Train Diagram - Typical 4 Cylinder Engine

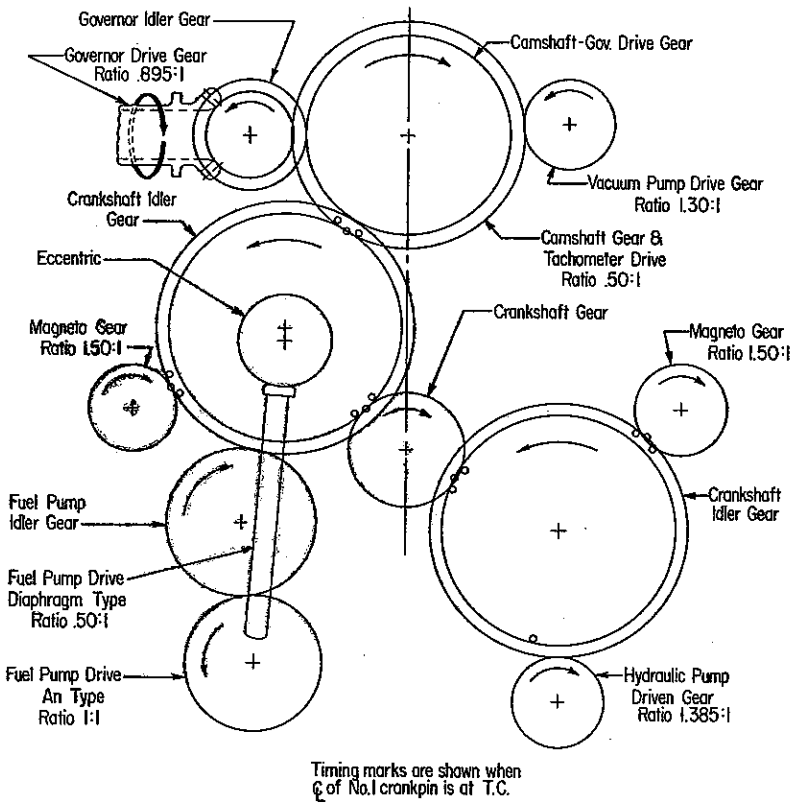


Figure 2-8. Gear Train Diagram - Typical 6 Cylinder Engine

2-16. INDUCTION SYSTEM (Engines Employing Carburetors). Subject engines may be equipped with either a float type or pressure type carburetor. Particularly good distribution of the fuel-air mixture to each cylinder is obtained through the center zone induction system, which is integral with the oil sump and is submerged in oil, insuring a more uniform vaporization of fuel and aiding in cooling the oil in the sump. From the riser the fuel-air mixture is distributed to each cylinder by individual intake pipes.

2-17. INDUCTION SYSTEM (Engines Employing Fuel Injectors). The fuel injection system schedules fuel flow in proportion to airflow and vaporization takes place at the intake ports. In addition, on the TIO-360 and TIO-540 series, a turbocharger furnished as an integral part of the engine provides constant air density to the fuel injector inlet from sea level to critical altitude.

2-18. TURBOCHARGER CONTROLS. The turbocharger control system consists of three components, namely, the exhaust bypass valve (waste gate), the density controller and the differential pressure controller.

The position of the exhaust bypass valve establishes the amount of supercharging delivered to the engine. Increasing oil pressure closes the valve and increases power. Decreasing oil pressure opens the valve and decreases power.

The density controller regulates the oil pressure to the bypass valve while the engine is operating at wide open throttle and limits manifold pressure below critical altitude.

The differential pressure controller regulates the oil pressure to the bypass valve while the engine is operating at part throttle settings below critical altitude.

2-19. IGNITION SYSTEM. Dual ignition is furnished for all subject engines. Several combinations of magnetos and various ignition harnesses are employed. Consult the applicable parts catalog for your particular installation. Consult the latest edition of Service Instruction No. 1042 for a list of Avco Lycoming approved spark plugs.

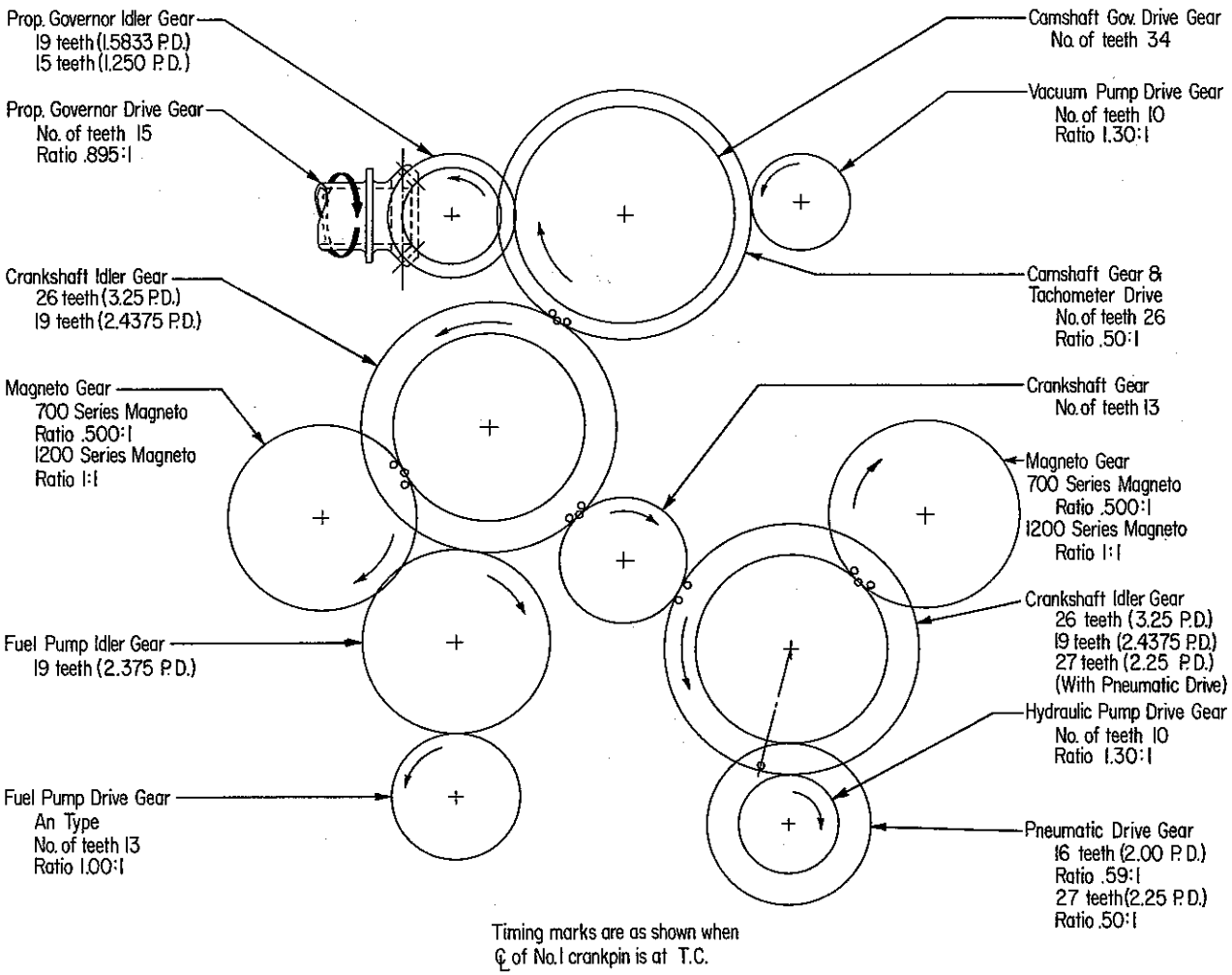


Figure 2-9. Gear Train Diagram - Typical 8 Cylinder Engine

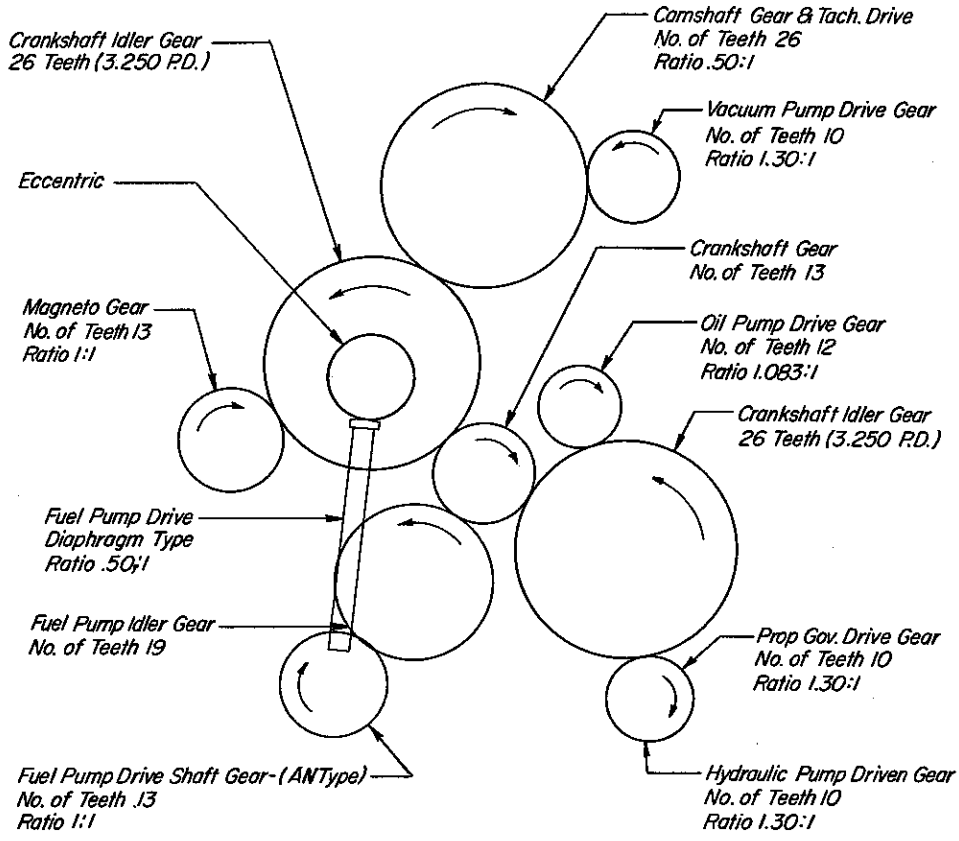


Figure 2-10. Gear Train Diagram - Typical 4 Cylinder (Dual Magneto Housing)

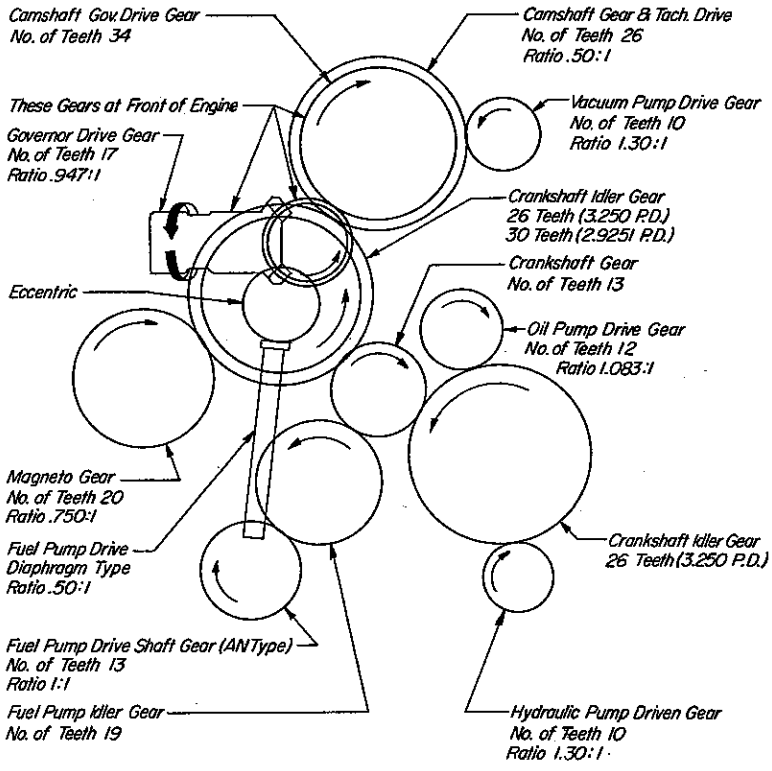


Figure 2-11. Gear Train Diagram - Typical 6 Cylinder (Dual Magneto Housing)

SECTION 3.
GENERAL OVERHAUL PROCEDURES

3-1. This manual will describe in separate sections the complete major overhaul procedures for each individual portion of the engine, thus dividing the manual for all practical purposes, into a series of individual handbooks dealing in turn with each component part. Since there are various overhaul practices and instructions of a non-specific nature, which apply equally to all basic engine components, these general instructions will be grouped together and described in this section, thus avoiding repetition.

3-2. No attempt shall be made to include overhaul procedures for the various trade accessories. These accessories are covered in overhaul manuals published by their respective manufacturer. Only such assembly and disassembly as required by engine installation will be covered.

3-3. Just prior to or immediately after removing the engine from the airframe, remove the oil drain plug and drain the oil from the engine.

3-4. Attach the engine lifting cable to the engine and remove from the airframe.

3-5. Place the skid (ST-278) in the overhaul stand (ST-162). Attach the engine overhaul adapter (ST-165) to the propeller flange and mount the assembly on the engine mounting ring.

3-6. Place the overhaul stand and skid into position and lower the engine to the stand and remove lifting cable. The engine is now in a position to be disassembled. Specific disassembly instructions are contained in the applicable section for each component.

3-7. Inasmuch as visual inspection should be made while disassembling and immediately after disassembly, all individual parts should be laid out in an orderly manner as they are removed from the engine. No cleaning operation should be performed until this initial visual inspection has been completed. All loose studs, cracked cooling fins, loose or damaged fittings, and the like, should be carefully noted and tagged to prevent their being overlooked during regular inspection.

CLEANING

3-8. It is imperative to clean all engine parts thoroughly to facilitate inspection. Two processes are involved in cleaning engine parts; degreasing to remove dirt and sludge (soft carbon) and the removal of hard carbon by decarbonizing, brushing or scraping and grit-blasting.

3-9. DEGREASING. Degreasing is accomplished by immersing or spraying the part in solution of white furnace oil (38-40 specific gravity) or a suitable commercial solvent such as Varsol or Perm-A-Chlor. Operators are warned against the use of solvents with which they are unfamiliar, since there are many products on the market which are injurious to aluminum and magnesium. Extreme care must be exercised if any water-mixed degreasing solutions containing caustic compounds or soap are used. Such compounds, in addition to being potentially dangerous to aluminum and magnesium, may become impregnated in the pores of the metal and cause oil foaming when the engine is returned to service. When using water-mixed solutions therefore, it is imperative that the parts be completely and thoroughly rinsed in clean boiling water after degreasing. Regardless of the method and type of solution used, coat and spray all parts with lubricating oil immediately after cleaning in order to prevent corrosion.

3-10. REMOVAL OF HARD CARBON. While the degreasing solution will remove dirt, grease and soft carbon, deposits of hard carbon will almost invariably remain on many interior surfaces. To facilitate removal, these deposits must first be loosened by immersion in a tank containing a decarbonizing solution (usually heated). A great variety of commercial decarbonizing agents are available, including such products as Gunk, Penetrol, Carbrax, Super-Chemaco, Gerlach No. 70, and many others. Decarbonizers, like the degreasing solutions previously mentioned, fall generally into two catagories, water-soluble and hydrocarbons, and the same caution concerning the use of water-soluble degreasers is applicable to water-soluble decarbonizers.

CAUTION

Extreme caution should be exercised when using a decarbonizing solution on magnesium castings. It is recommended that the use of heated solutions be avoided unless the operator is thoroughly familiar with the particular solution being used. In addition, the operator is strongly advised against immersing steel and magnesium parts in the same decarbonizing tank, because this practice often results in damage to the magnesium parts from corrosion.

3-11. Decarbonizing will usually loosen most of the hard carbon deposits remaining after degreasing; the complete removal of all hard carbon, however, generally requires brushing, scraping or grit-blasting. All of these operations demand care on the part of the mechanic to avoid damage to machined surfaces. In particular, wire brushes and metal scrapers must never be used on any bearing or contact surface.

3-12. When grit-blasting parts do not use sand or any metallic abrasives. It is recommended instead that mildly abrasive organic substances such as rice, baked wheat, plastic pellets, or crushed walnut shells be used. All machined surfaces must, of course, be adequately masked and all openings tightly plugged before blasting. The one exception to this is the valve seats, which may be left unprotected when blasting the cylinder head combustion chamber. It is often advantageous to grit blast the seats, since this will cut the glaze which tends to form (particularly on the exhaust valve seat) thus facilitating subsequent valve seat reconditioning. Under no circumstances should the piston ring grooves be grit blasted. If necessary, soak the piston in petroleum solvent and scrape with a wooden scraper. When grit-blasting housings, plug all drilled oil passages with rubber plugs or other suitable material to prevent the entrances of foreign matter.

3-13. The decarbonizing solution will generally remove most of the enamel from exterior surfaces. All remaining enamel should be removed by grit-blasting particularly in the crevices between cylinder cooling fins.

3-14. At the conclusion of cleaning operations, rinse the parts in petroleum solvent, dry and remove any loose particles by air-blasting. Apply a liberal coating of preservative oil to all surfaces.

INSPECTION

3-15. The inspection of engine parts during overhaul is divided into three catagories, visual, structural and dimensional. The first two deal with the structural defects in parts while the third is concerned with the size, shape and fit.

3-16. Visual inspection should precede all other inspection procedures. Do not clean any parts prior to visual inspection, since indications of dangerous operating condition can often be detected from the residual deposits found in some particular recess of the engine.

3-17. Structural failures can be determined by several different methods depending on the part involved. The following are a few of the methods employed: magnetic particle, dye penetrant, penetrant, x-ray and various electronic methods.

3-18. Dimensional inspections should be carried out in accordance with the measurements and tolerances as called out in the Table of Limits (Section 10).

3-19. It is recommended that an inspection and overhaul form, containing a list of all engine components, be utilized when disassembling an engine. This form should be prepared so that all inspection and overhaul procedures can be checked off and remarks noted. This will also assure that no part is inadvertenly overlooked.

3-20. BEARING SURFACES. All bearing surfaces should be examined for scoring, galling and wear. Considerable scratching and light scoring of aluminum bearing surfaces in the engine will do no harm and should not be considered cause for rejection of the part, provided it falls within the clearances set forth in the Table of Limits. Even though the part may come within specified limits it should not be reassembled into the engine unless inspection shows it to be free of other serious defects. Ball bearings should be examined visually and by feel for roughness, flat spots, flaking or pitting of races and for scoring on the outside of the races. All journal surfaces should be checked for galling, scores, misalignment and out-of-round condition. Shafts, pins etc. should be checked for straightness. This may be done in most cases by using vee blocks and a dial indicator.

3-21. GEARS. All gears should be examined for evidence of pitting and excessive wear. These conditions are of particular importance when they occur on the involute of the teeth; deep pit marks in this area are sufficient cause to reject the gear. Bearing surfaces of all gears should be free from deep scratches. However, minor abrasions may be dressed out with a fine abrasive cloth.

3-22. CORROSION ON STRESSED AREAS. Pitted surfaces in highly stressed areas resulting from corrosion can cause ultimate failure of the part. The following areas should be carefully examined for evidence of such corrosion; interior surfaces of piston pins, the fillets at the edges of crankshaft main and crankpin journal surfaces, and thrust bearing races. If pitting exists on any of the surfaces mentioned to the extent that it cannot be removed by polishing with crocus cloth or other mild abrasive, the part must be rejected.

3-23. SCREWED FITTINGS. Screwed fittings (any parts such as threaded fastenings or plugs) should be inspected for condition of threads. Badly worn or mutilated threads must not be tolerated; the parts should be rejected. However, small defects such as slight nicks or burrs may be dressed out with a small file, fine abrasive cloth, or stone. If the part appears to be distorted, badly galled, or mutilated by overtightening, or from the use of improper tools, it must be replaced with a new one.

3-24. MAGNETIC INSPECTION. All ferro-magnetic steel parts should be inspected by the magnetic particle method. The successful detection of structural failure by magnetic inspection demands skill and experience on the part of operating personnel. It must be remembered that almost any fabricated steel part will show indications of some kind, and it is important that the operator exercise good judgment in evaluating the indications. Too rigid an interpretation may result in the rejection of a sound part, while on the other hand, a part showing a dangerous indication may be returned to service as a result of a too casual diagnosis. In general, areas of stress concentration must be watched closely for fatigue cracks. These areas include such locations as keyways, gear teeth, splines, roots of threads, small holes and fillets.

3-25. Proper judgment must also be used in determining the amount of current (amperage) applied; too little current will not sufficiently magnetize the part, while too heavy an application will permanently dam-

age the part by overheating and burning thin areas adjacent to the electrodes. Again, skill and experience on the part of the operator are of the utmost importance. Consult the latest edition of Service Instruction No. 1285 for proper amperage.

3-26. CORROSION-PREVENTION. Upon completion of inspection, coat all steel parts with preservative oil.

REPAIR AND REPLACEMENT

3-27. DAMAGED PARTS. Abnormal damage such as burrs, nicks, scratches, scoring, or galling should be removed with a fine oil stone, crocus cloth, or any similar abrasive substance. Following any repairs of this type, the part should be carefully cleaned in order to be certain that all abrasive has been removed and then checked with its mating part to assure that the clearances are not excessive. Flanged surfaces that are bent, warped, or nicked may be repaired by lapping to a true surface on a surface plate. Again the part should be cleaned to be certain that all abrasive has been removed. Defective threads can sometimes be repaired with a suitable die or tap. Small nicks can be removed satisfactorily with Swiss pattern files or small, edged stones, pipe tapped threads should not be tapped deeper in order to clean them up, because this practice will invariably result in an oversized tapped hole. If scratches or galling are removed from a bearing surface of a journal it should be buffed to a high finish. Generally it is impossible to repair cracks; however, welding operations may be performed in some parts of housings, providing the area is not a stressed section of the part. For example, almost any area of a rocker box may be welded, but no part of the cylinder head except the fins may be welded.

3-28. PAINTED PARTS. Parts requiring use of paint for protection or appearance should be painted in accordance with the following recommendations using material from the following list of approved materials. Thinner - Toluene or equivalent (AMS3180 or equivalent Federal Spec. TT-T-548). Primer - Zinc chromate (AMS3110 or equivalent MIL-P-8585). Enamel - Phthalate resin type (AMS3125C or equivalent MIL-E-7729).

NOTE

All machined bosses should be masked before painting. Do not paint areas under hold down nuts where torque is required.

3-29. Aluminum and Steel Parts. Parts shall be cleaned and degreased prior to painting. Apply one coat sinc chromate primer, thinned with approximately two parts toluene, and air dry. Apply one coat of enamel and bake at 250°F, to 300°F, for one-half hour. Enamel may be allowed to air dry but an inferior finish will result. Parts from which paint has not been removed may be repainted omitting the primer coat.

3-30. Magnesium Parts. Magnesium parts should be cleaned thoroughly with a dichromate treatment prior to painting. This treatment consists of cleaning all traces of oil and grease from the part by using a neutral, non-corrosive degreasing medium followed by a rinse. After which the part is immersed for 45 minutes in a hot dichromate solution (3/4 lb. of sodium dichromate to one gallon of water at 180°F. to 200°F., quantity as required). The part should be then washed thoroughly in cold running water, dipped in hot water and dried in an air blast. Immediately thereafter the part should be painted with a prime coat and engine enamel in the same manner as prescribed for aluminum parts.

3-31. Shroud Tubes. Shroud tubes should be thoroughly cleaned and dipped in zinc chromate primer thinned to spraying consistency. After the primer is dried the shroud tube should be painted on the outside with engine enamel.

3-32. All paint applied in the foregoing operations should preferably be sprayed; however, if it is necessary to use a brush, care should be exercised to avoid an accumulation of pockets of paint.

3-33. REPLACEMENT OF STUDS. Any studs which are bent, broken, damaged or loose, must be replaced. The method of removing studs depends on the type of stud and manner in which it is broken. The procedure for removing and replacing studs is as follows:

a. If there is sufficient thread area available on stud, use a collet grip tool consisting of a tapered collet that threads onto stud and a housing that slips over the collet. Tighten bolt on top of the housing and draw collet into housing to lock puller on the stud with a tight grip.

b. If the collet type tool cannot be used, drill a small hole into the stud. Employ a pilot bushing to guide drill into center of stud when stud is broken beneath the surface of the crankcase. Redrill the hole to enlarge it to accomodate the proper size extractor. Using the extractor, remove the stud.

c. After studs have been removed, check for size and condition of threads in stud holes to determine whether oversize studs must be used for replacement. Coat threads of studs with thread lubricant, Specification JAN-A-669, and drive stud to correct depth by using a suitable stud driver.

3-34. CORROSION-PREVENTION. At the conclusion of all repair operations and subsequent inspection, coat all steel parts with preservative oil.

REASSEMBLY

3-35. CORROSION-PREVENTION. Prior to assembly of subassemblies, all parts should be cleaned to remove all traces of preservative oil and accumulated foreign matter. During assembly, cover all steel parts with a heavy coat of preservative oil. This mixture should be used on all machined surfaces, especially on bearing surfaces, cylinder bores and piston rings. The practice of using plain lubricating oil during assembly is not recommended.

3-36. PRE-LUBRICATION OF PARTS PRIOR TO ASSEMBLY. Many premature failure of parts have been traced directly to improper pre-lubrication at engine

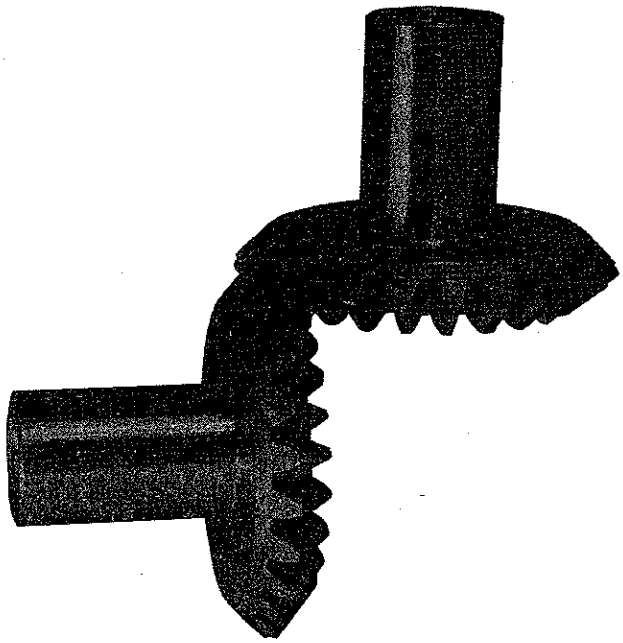


Figure 3-1. Bevel Gear - Showing Extreme Pitch Alignment

assembly. If parts are not properly lubricated, or an inferior lubricant is used, many of the engine parts will become scored before the engine oil goes through its first cycle and has had a chance to lubricate the engine. This, of course, will lead to premature parts failure prior to normal service life, and in some cases, lead to engine failure before normal service hours have been accumulated. It is of utmost importance, therefore, that the following recommendations be adhered to at engine assembly. Consult the latest edition of Service Instruction No. 1059.

3-37. Coat the camshaft lobes, face of tappet bodies and rocker tips with lubri-bond (a) or equivalent.

3-38. Coat the valve stems and the interior of the valve guides with Texaco Molytex "O" or equivalent.

3-39. All other parts should be coated with a mixture of 15% pre-lubricant (STP or equivalent) and 85% SAE No. 50 mineral base aviation grade lubricating oil.

3-40. OILITE BUSHINGS. During overhaul cleaning operations it is possible to wash the oil from these bushings; also, if a bushing has been replaced and either reamed or broached, its porosity may be affected. Therefore, before the bushings are reassembled into the engine they must be impregnated by immersing them for at least fifteen minutes in engine oil that has been heated to 140°F.

3-41. PITCH ALIGNMENT AND BACKLASH IN BEVEL GEAR ASSEMBLIES. During disassembly of engines returned to our factory, inspection personnel occasionally find evidence of incorrectly assembled gears. This condition appears to be wholly confined to bevel gear assemblies wherein one of the gears has been replaced; that is, instances where a comparatively new bevel gear is meshed with an older worn gear. An exaggerated example of this sort is shown in figure 3-1. Note that the edges of the gear are not even; the one gear is too far forward on its longitudinal axis.

3-42. During manufacture of bevel gears, the relationship between the edges of the gear (or tooth length) is carefully controlled. Because of this relationship, the correct location of the interlocking teeth (pitch alignment) of the two bevel gears can be maintained if the mating edges of the gears are even.

3-43. In Avco Lycoming aircraft engines where bevel gears are employed, the gear mountings are similar to the arrangement shown in figure 3-2. That is, a laminated shim is usually provided between the mounting adapter and the housing thus permitting each gear to be moved in either direction, along its longitudinal axis.

3-44. Designs such as this not only provide a means of obtaining correct backlash between the mating gears but also permit adjustment to correct pitch alignment, by correcting uneveness of the edges of the gears. The following procedure is suggested for obtaining both backlash and pitch alignment during assembly of the bevel gears.

a. Assemble each gear and its associated parts in its housing using such gaskets and shims as are specified by the applicable parts catalog. Secure the gear mountings temporarily.

b. Remove or add shim laminations as required to obtain correct backlash.

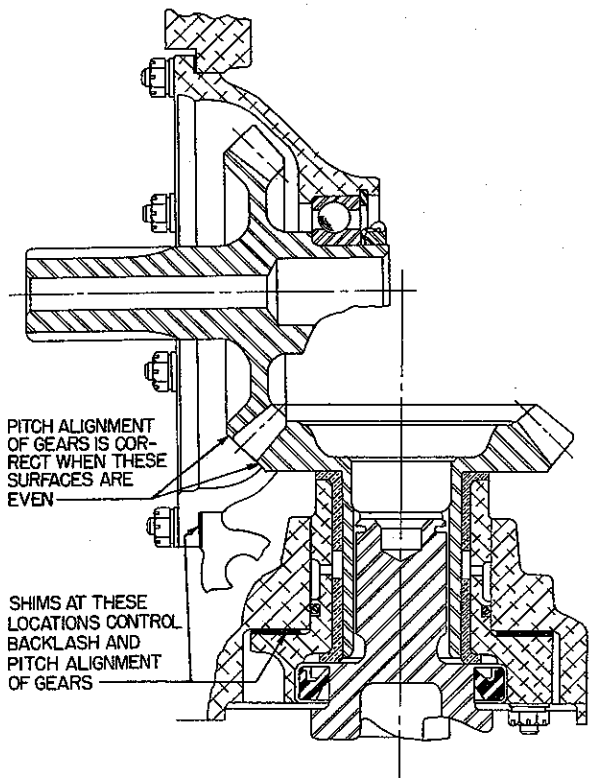


Figure 3-2. Typical Mounting for Support Bevel Gears

c. Visually, and by feel, determine if the edges of the mating gears are even. If the edge of one gear protrudes beyond the edge of the other, remove shims from the protruding gear and add shims of equal thickness to the other gear to achieve pitch alignment of the gears.

NOTE

It is possible to perform step (c) prior to step (b); that is, pitch alignment can be corrected before adjustment for backlash is made provided these precepts are observed. The removal or addition of an equal amount of shim material from both gear mountings will change backlash but not pitch alignment. The removal or addition of shim material from one gear only will change backlash and pitch alignment and the removal of shim material from one gear with the addition of an equal amount of shim material to the other gear will change pitch alignment but not backlash.

3-45. It is strongly recommended that all overhaul facilities adapt a firm policy of checking pitch alignment of bevel gears at the same time backlash is adjusted during engine overhaul.

3-46. TABLE OF LIMITS. The table of limits SSP-2070 should be consulted whenever it is desired to determine the backlash and end clearance of gears, the clearance between mating machined parts, the clearance between moving parts which are in close contact with each other and the torque limits for various nuts, screws and fastenings.

3-47. OIL SEALS AND GASKETS. When building up an engine during major overhaul, replace all oil seals and gaskets throughout the engine. For complete replacement sets of seals and gaskets available for these engines, consult applicable parts catalog.

3-48. ARBITRARY REPLACEMENT OF PARTS. It is recommended that certain parts throughout the engine be replaced at normal overhaul regardless of their apparent condition. Consult the latest edition of Service Bulletin No. 240 for information on the replacing of parts at overhaul. Included among these are the following:

All engine oil hose
All oil seals
All gaskets
All circlips, lockplates and retaining rings
Piston rings
All exhaust valves (except Inconel alloy valves)
All exhaust valve retaining keys
Crankshaft sludge tubes (where applicable)
Cylinder fin stabilizers
All bearing inserts (main and connecting rods)
Magneto drive cushions
Stressed bolts and fastenings
    Camshaft gear attaching bolts
    Connecting rod bolts and nuts
    Crankshaft flange bolts
Damaged Ignition cables
All laminated shims
Crankshaft counterweight bushings

3-49. FUEL SUPPLY LINES (Fuel Injected Engines) The fuel supply lines to the nozzles can become damaged and will leak if not properly installed and clamped at the correct locations. Consult Service Bulletins Nos. 335 and 342 for inspection procedures, configuration of lines and location of clamps, and Service Instruction No. 1301 for identification of fuel line.

SECTION 4.

IGNITION SYSTEM

4-1. GENERAL. All subject four, six and eight cylinder engines are equipped with high tension ignition systems which deliver high tension current directly to the spark plug outlets. Some eight cylinder engines are equipped with a low tension ignition system. This system carries the low tension current, produced by the magneto, through a lead to a transformer mounted on the magneto. The high tension current, produced by the transformer, is carried back through one outlet in the harness assembly to the magneto. The high tension current is then distributed, by the magneto distributor finger, to individual spark plug outlets.

4-2. MAGNETOS. Dual ignition is furnished by three types of magnetos on Avco Lycoming engines. (1) Conventional magneto, (2) impulse coupling magneto, and (3) retard breaker magneto. Either an impulse coupling or a retard breaker magneto is always used on the left side of the engine. A brief description of the impulse coupling magneto and the retard breaker magneto follows.

4-3. IMPULSE COUPLING MAGNETO. The purpose of the impulse coupling is: (1) To spin magnet (between impulse trips) faster than engine cranking speed, thus generating a better spark for starting; (2) automatically retard spark when starting engine. When engine is running, the impulse coupling acts as a drive coupling for the magneto.

4-4. RETARD BREAKER MAGNETO. The retard breaker magneto incorporated two sets of breaker points and provides a fixed retard and long duration boosted spark for easier starting. A source of DC power and a starting vibrator are required to complete the installation and it is recommended that the magneto manufacturer be contacted for information on the various vibrators and switching arrangements available. The -200, -700 and -1200 series magnetos incorporate an integral feed-thru capacitor and require no external noise filter in the magneto ground lead.

4-5. ENGINE FIRING ORDER. 4 cylinder engines (except LIO series) 1-3-2-4. LIO series 1-4-2-3. 6 cylinder engines, 1-4-5-2-3-6. LIO series 1-6-3-2-5-4. 8 cylinder engines, 1-5-8-3-2-6-7-4.

4-6. IGNITION HARNESSES. Ignition harnesses vary with the engine models; however, for purposes of description, all harnesses are composed of the same basic components. Basically, each lead is composed of a magneto terminal assembly, the ignition cable and the spark plug end assembly. The number of leads in the harness assembly is, of course, determined by the number of cylinders on the engine.

4-7. SPARK PLUGS. For information relative to approved spark plugs for the subject engines consult the latest revision of Service Instruction No. 1042 and Service Bulletin 359.

REMOVAL AND DISASSEMBLY

4-8. IGNITION HARNESS. Remove the terminals from the top and bottom spark plugs. Detach all clips, clamps and grommet plates securing the leads to the engine. Complete the removal of the harness by detaching the outlet plates from the magneto. Note that the Slick harness used on some engines is supplied as an assembly with the magneto and it will not be necessary to separate the two.

NOTE

Before detaching clamps, clips, grommet plates etc., mark the location of each. Differences in various installations make it impossible for this manual to point out the correct attaching points.

4-9. MAGNETOS. (Four Cylinder Engines). Loosen and remove the 5/16-18 nuts, washers (also clamps on Slick and -1200 series magnetos) which secure the magneto to the engine. See figure 4-1. Remove magneto and gasket (1) Note that an adapter (7) is used with the impulse coupling magneto. Remove this adapter and gasket (6). No further disassembly of the magneto is required other than the removal of the magneto gear (5) from the drive shaft. Replace the washer (4) and nut (3) to prevent damage to the drive shaft threads.

4-10. MAGNETOS. (Six Cylinder Engines). Loosen and remove the 5/16-18 nuts, washers and lockwashers (also clamps on -1200 series). See figure 4-1. Remove magnetos, gaskets (1), adapters (7) and gaskets (6). Reach inside the drive pad and remove drive cushions (11) magneto gear and cushion retainer (5) and ball bearing (12). Disassemble the nut (3) and bushing (10), (drive coupling (13) from conventional and retard breaker magnetos) and Woodruff keys (9) from the drive shaft.

NOTE

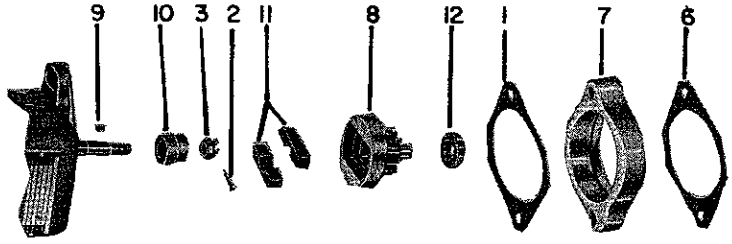
See Service Instruction 1252 for the conversion of 8 cylinder engine with -700 series magnetos to -1200 series magnetos engine.

4-11. MAGNETOS. (Eight Cylinder Engines). Loosen the 5/16-18 nuts and remove the nuts, lockwashers and clamps. Remove magnetos, gaskets (1), adapters (7) and gaskets (6). Reach inside the drive pad and remove the drive cushions (11), retainers (15), centering plates (16) and magneto gears (5). No disassembly of the -700 series magneto is required.

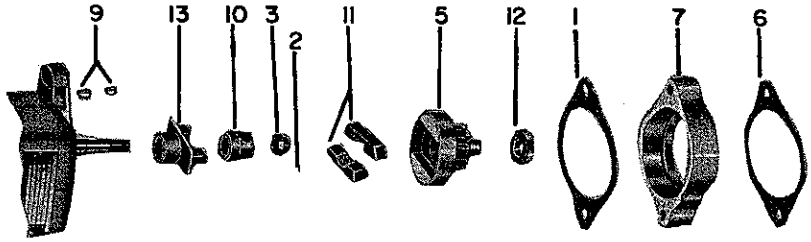
CONVENTIONAL AND RETARD BREAKER

IMPULSE COUPLING

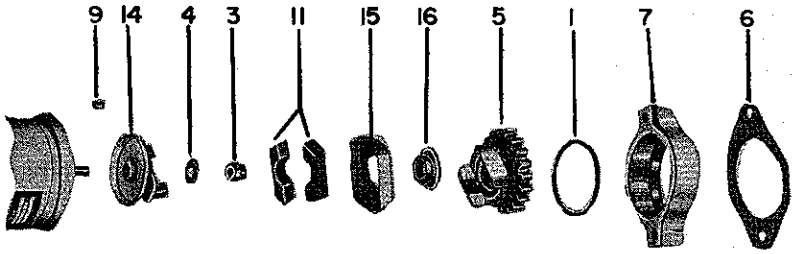
S4-20-200-1200 SERIES AND SLICK MAGNETO DRIVE ASSEMBLIES



S6-20-1200 SERIES IMPULSE COUPLING MAGNETO DRIVE ASSEMBLIES



S6-20-200-1200 SERIES CONVENTIONAL AND RETARD BREAKER MAGNETO-DRIVE ASSEMBLIES



S8-700 SERIES MAGNETO DRIVE ASSEMBLIES

1. Magneto Gasket
2. Cotter Pin
3. Drive Shaft Nut
4. Washer
5. Magneto Gear
6. Adapter Gasket
7. Magneto Adapter
8. Impulse Coupling Gear
9. Woodruff Key
10. Bushing
11. Drive Cushions
12. Ball Bearing
13. Drive Coupling
14. Drive Plate
15. Cushion Retainer
16. Centering Plate

Figure 4-1. Magneto Drive Assemblies

NOTE

The gears mentioned in the preceding paragraphs are associated with and form a part of the accessory drives and should not be considered part of the ignition system. Their removal and reassembly is discussed in this section because they should be removed and reassembled at the times the magnetos are removed or reassembled.

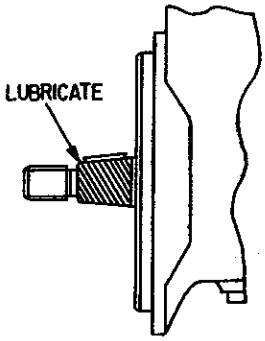


Figure 4-2. Location to Apply Compound

Slick) are given in detail in the latest editions of Service Instructions 1119 or 1153.

4-15. IGNITION HARNESS (Slick). Individual leads may be removed and new lead assemblies fabricated and installed in the following manner.

4-16. See figure 4-5. Remove the harness housing (5) from the magneto. Cut the cable with cutting pliers, close to the outside of the housing, and using a drift tap the ferrule (4) from the housing. Remove the spring (1) and electrode screw (2) from the lead by turning the spring counter-clockwise with a pulling action. Remove the sleeve (2). Remove the spark plug nut (7) from the cable and disassemble the spring (12) electrode screw (10) and sleeve (11) as described above. Discard the ferrules.

4-17. Cut the individual cable to the required length shown in Table 4-1. Make a mark 7/8" from the magneto end and 1" from the spark plug end. Flare out the copper shielding and insert the stripping tool (figure 4-6) beyond the mark. Do not allow the shielding to fold under while inserting tool. With a sharp knife, and using a rolling motion while cutting, cut and remove the copper shielding at the marks. Remove the stripping tool.

TABLE 4-1

LENGTH OF INDIVIDUAL CABLES
(Slick Harness)

Cylinder No. and Plug Location	Magneto No.	Cable Length (Inches)
1 Bottom	1 Right	32
3 Bottom	2 Right	24
2 Top	3 Right	38
4 Top	4 Right	32
1 Top	1 Left	41
3 Top	2 Left	34
2 Bottom	3 Left	32
4 Bottom	4 Left	25

INSPECTION

4-12. IGNITION HARNESS. Unless the harness assembly is in obviously new condition and is known to have been recently installed, it is recommended that the harness be replaced at overhaul.

4-13. MAGNETOS. As previously mentioned, this manual will not endeavor to describe overhaul procedures for trade accessories. Consult the manufacturer's applicable overhaul manual for inspection procedures.

REPAIR AND REPLACEMENT

4-14. IGNITION HARNESS. Although replacement of the ignition harness is recommended, it must be noted that many parts of the harness may be reused in fabricating a new assembly. Instructions for fabricating lead assemblies for all harnesses employed (except

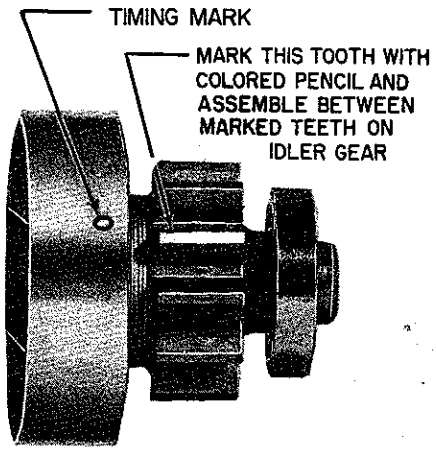


Figure 4-3. Magneto Gear Timing Mark

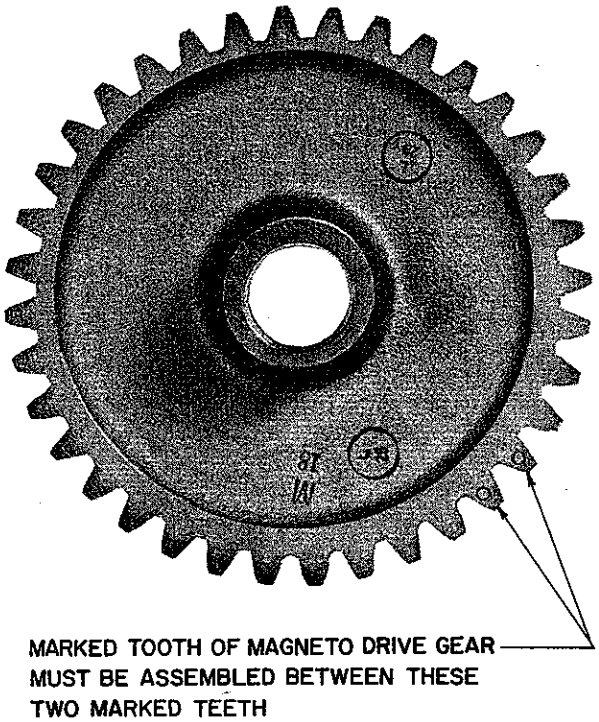
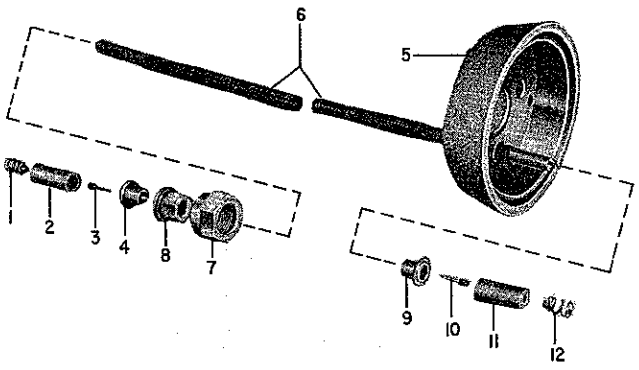


Figure 4-4. Marked Teeth on Crankshaft Idler Gear

4-18. At both ends cut the exposed insulation back from the end 1/16 inch. Do not pull insulation from wire, remove by turning clockwise. Trim the coiled conductor, conductor should protrude approximately two coils. Using the pin vise (figure 4-6) drill and remove silicone rubber from the inside of the coiled conductor, this will facilitate installation of the electrode screw in a later step.



1. Spring
2. Sleeve (Insulator)
3. Electrode Screw
4. Drive Ferrule
5. Housing
6. Cable
7. Spark Plug Nut
8. Hex Ferrule
9. Drive Ferrule
10. Electrode Screw
11. Sleeve (Insulator)
12. Spring

Figure 4-5. Lead Assembly (Slick)

4-19. SPARK PLUG END. Install hex ferrule (8) over lead with flange end toward end of wire. After assembly of this ferrule, bend and rotate the silicone insulation to flare out the copper shielding. Install drive ferrule (9) over insulation and under shielding to within 1/16 inch of flange of hex ferrule. Slide hex ferrule over drive ferrule until tight. Mount drive plate (figure 4-6) in a bench vise. Set hex ferrule in slot of drive plate and, using the drive tool (figure 4-6) drive the drive ferrule flush against the hex ferrule. Install spark plug nut (7) on cable with threaded end toward ferrules.

4-20. MAGNETO END. Install lead through housing (5) and install drive ferrule (4) over insulation and under shielding. Place housing on drive plate and using drive tool, drive ferrule flush to housing.

4-21. BOTH ENDS. Clamp threaded end of electrode screw (3 and 10) in pin vise (figure 4-6) and assemble the screw into the center of the coiled conductor. Turn counter-clockwise and push the screw until the tapered pin portion is flush with the insulation. Place sleeve (2 and 11) over insulation and turn spring (1 and 12) onto electrode screw until the end of the screw is flush with the first large coil of the spring.

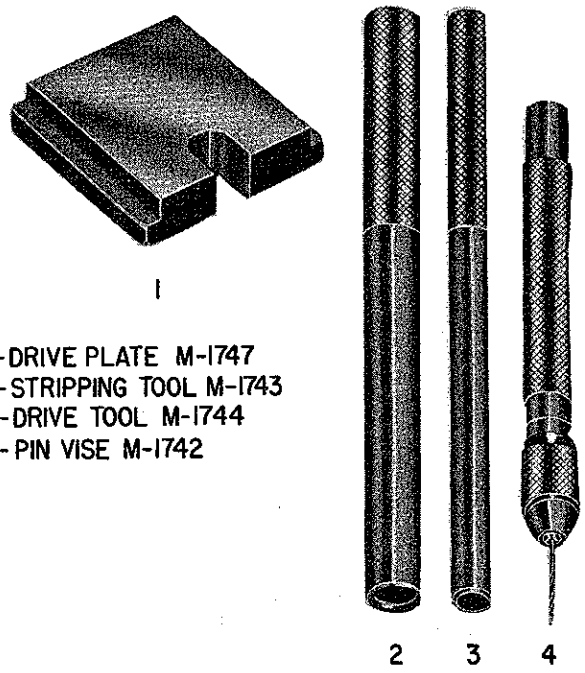


Figure 4-6. Tooling, Slick Harness

4-22. MAGNETOS. As previously mentioned, this overhaul manual will not endeavor to describe overhaul procedures for trade accessories. Consult the manufacturer's applicable manual for overhaul procedures. However, Avco Lycoming Service Bulletins Nos. 183A, 235A, 277, 311, 312, Service Instructions Nos. 1019, 1055, 1074, 1163, 1165 and Service Letters Nos. L122 and L134A, contain information relative to the magnetos covered in this manual. These publications should be consulted to ascertain if they affect your installation.

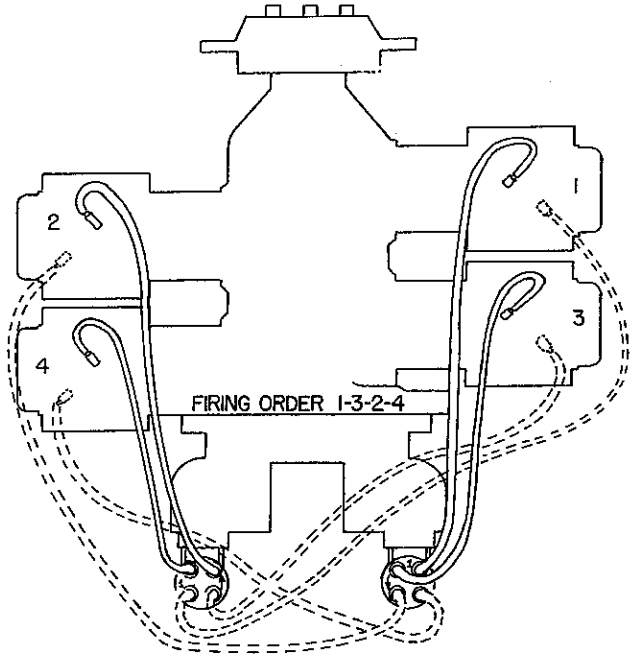


Figure 4-7. Ignition Wiring Diagram
Four Cylinder Engines

REASSEMBLY

4-23. MAGNETOS (All Engines). Before assembling the magneto gear or drive coupling (whichever is applicable) to the magneto drive shaft, apply a light coating of Go-Jo-No-Lox compound or equivalent to the tapered section of the magneto drive shaft. See figure 4-2. This compound is manufactured by Gojer, Inc. Akron 9, Ohio. After assembling gear or coupling, wipe excess compound from the drive shaft.

4-24. MAGNETOS (Four Cylinder Engines). See figure 4-1. Assemble a Woodruff key (9) in the shaft of the conventional or retard breaker magneto. Assemble the magneto gear (5) on the drive shaft, install the washer (4) and nut (3). Tighten to specified torque and secure with cotter pin (2).

4-25. MAGNETOS (Six Cylinder Engines). See figure 4-1. Assemble a Woodruff key (9) in the drive shaft of the conventional or retard breaker magneto and assemble the drive coupling (13) over the key. On all magnetos assemble the Woodruff key (9) and bushing (10) on shaft, install nut (3), tighten to specified torque and secure with cotter pin (2).

4-26. MAGNETOS (Eight Cylinder Engines). As the magneto drive plate was not removed at disassembly no reassembly is required.

INSTALLATION

4-27. MAGNETOS (Four Cylinder Engines). See figure 4-1. Assemble a gasket (1) on magneto mounting pads, note that when the magneto is of the impulse coupling type an additional gasket (6) and adapter (7) are required.

4-28. MAGNETOS (Six Cylinder Engines). See figure 4-1. Assemble a gasket (1), adapter (7) and gasket (6) on the magneto mounting pads. Assemble the ball bearing (12) on the magneto gear and retainer (5) and install the assemblies engaging the marked tooth of the magneto gear (See figure 4-3) between the two marked teeth on the crankshaft idler gear (See figure 4-4). Install the drive cushions (11) in the retainer.

NOTE

The magneto gear and retainer assemblies on engines employing two impulse coupling magnetos and TIO-540 engines use a different assembly on the left and right side. Consult parts catalog for correct part number.

4-29. MAGNETOS (Eight Cylinder Engines). See figure 4-1. Assemble a gasket (1), adapter (7) and gasket (6) on the magneto mounting pads. Assemble and centering plate (16) into the retainer (15) and assemble the drive cushions (11) around the centering plate. Install the magneto gear (5) and the above assemble meshing the magneto gear and the crankshaft idler gears as described for the six cylinder engines.

4-30. TIMING MAGNETO TO ENGINE. (Four, six and eight cylinder engines). Rotate the crankshaft in direction of normal rotation until No. 1 cylinder is on the compression stroke and approximately 35° BTC. Clamp the ignition timing pointer on the advance timing mark on the rear of the starter ring gear. The starter ring gear may be marked at 20° and 25°. Consult engine nameplate for correct advance timing mark to use. Continue rotating the crankshaft until the timing pointer and the parting flange of the crankcase align. Leave the crankshaft in this position until the magneto is installed.

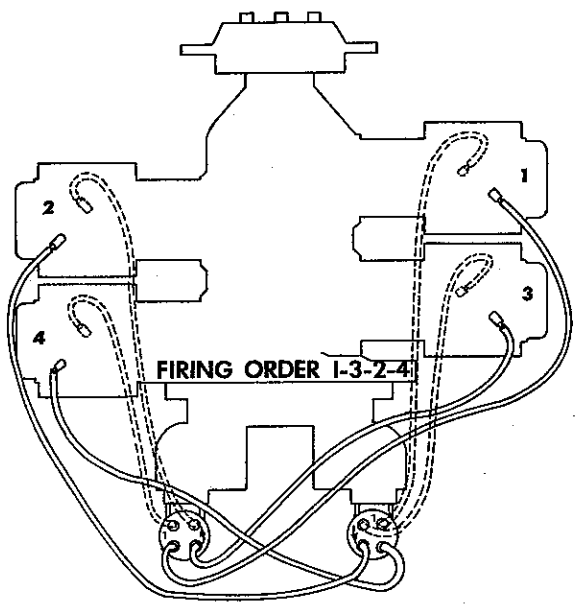


Figure 4-8. Ignition Wiring Diagram
Four Cylinder Engines - Optional

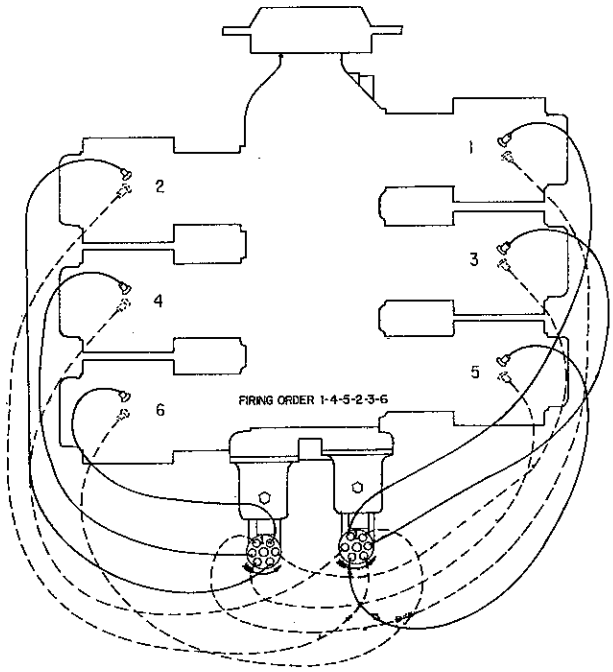


Figure 4-9. Ignition Wiring Diagram
Six Cylinder Engines

4-31. In the event that an ignition timing pointer is not available an alternate method may be used. Rotate the crankshaft in direction of normal rotation until No. 1 cylinder is on the compression stroke and continue rotating the crankshaft until the correct advance timing mark on the front of the starter ring gear is in exact alignment with the small drilled hole located at the two o'clock position on the front face of the starter housing. Leave the crankshaft in this position until the magneto is installed.

NOTE

The advance timing mark is specified on the engine nameplate.

4-32. (All magneto except S8 700 series). Remove the inspection plug from the magneto and rotate the drive shaft in direction of normal rotation until the painted chamfered tooth on the distributor gear is aligned in the center of the inspection window. The shaft on the impulse coupling magnetos can be turned by depressing the pawl on the coupling. Be sure the magneto gear does not move from this position and secure each magneto finger tight. The magnetos are now ready for final timing.

4-33. (Slick Magnetos) (Model 4-51, Impulse Coupling). Remove the bottom vent plug and "SPARK OUT" the magneto.

4-34. To "SPARK OUT" the magneto, hold the lead wire spring (with T1, or B1 on the spark plug nut) 1/16" to 1/8" away from the magneto frame, and turn the impulse coupling one (1) "click" at a time until a strong spark jumps between the spring and the magneto frams. You are to 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.

4-35. Hold the rotor by inserting the timing pin, and line the timing pin with the center of the vent plug hole, and install the magneto on the engine.

4-36. For the Model 4050 magneto (without impulse), install the gear and hold the B1 lead 1/8" away from the frame.

4-37. Turn the gear counterclockwise (L. H.) vigorously through the flux lines until a strong spark occurs at this lead. Reverse the rotation into the flux until the timing pin hole appears. Insert the timing pin in the hole and install the magneto on the engine. The magnetos are now ready for final timing.

4-38. (S8-700 Series). Align the timing mark on the drive plate with the indent on the housing. See figure 4-12.

4-39. Hold the magneto in the above position and assemble it on the engine and tighten the mounting clamps sufficiently to hold the magneto in position yet permit it to be rotated.

4-40. FINAL TIMING (All Magnetos except the S8-700 series). Using a battery powered timing light, attach the positive lead to the ground or switch terminal (whichever is applicable) 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 procedure with the second magneto.

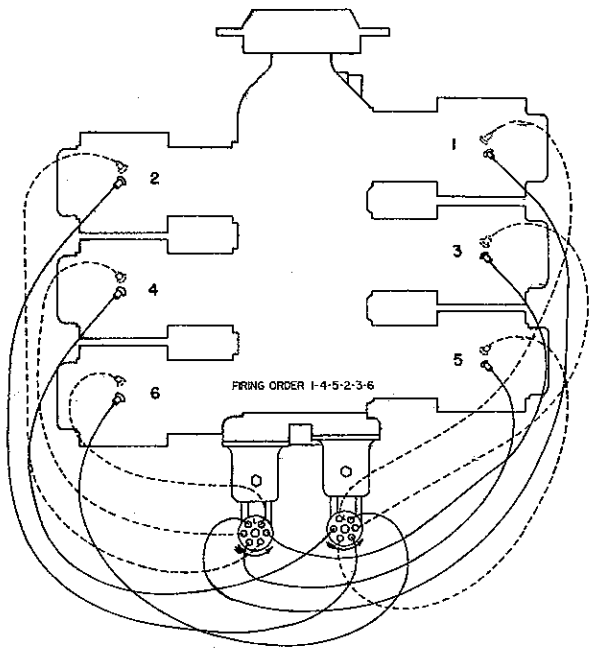


Figure 4-10. Ignition Wiring Diagram
Six Cylinder Engines - Optional

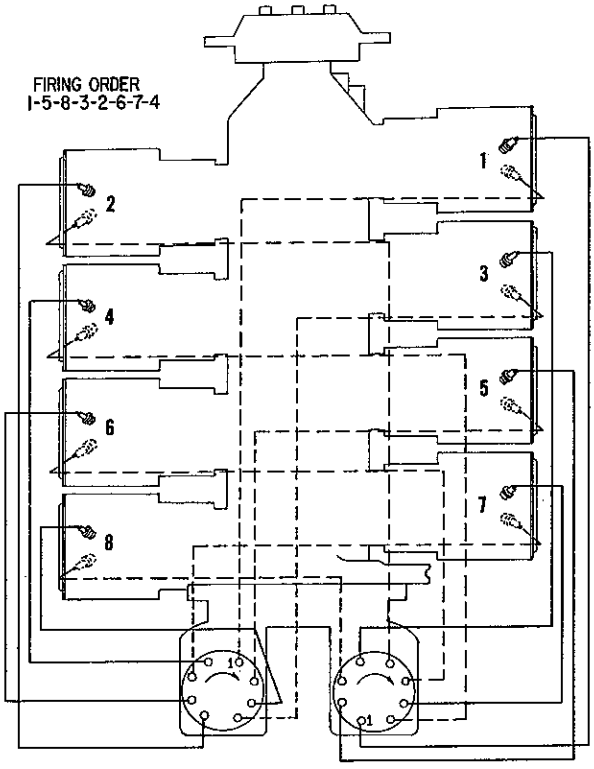


Figure 4-11. Ignition Wiring Diagram

NOTE

AC timing lights operate in the reverse manner as described above, the light goes out when the breaker points open.

4-41. After both magnetos have been timed, check as described in the next paragraph, to ascertain that both magnetos are set to fire together.

4-42. 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 marks are in alignment. At this point, both lights should go on simultaneously. Tighten nuts to specified torque.

4-43. Final Timing D-2000 Dual Magneto. Using a battery power timing light, attach the red lead of timing light to the left switch terminal, green lead of timing light to right switch, black lead to an 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. Tighten the magneto clamps evenly.

4-44. Back off the crankshaft approximately 10° so the timing light goes on. Bring the crankshaft slowly back in direction of normal rotation until light goes out. Indicating the left main breaker opening at No. 1 firing position. The right main breaker monitored by the green light must open within ±2 engine degrees of No. 1 firing position. Completely tighten nuts to specified torque.

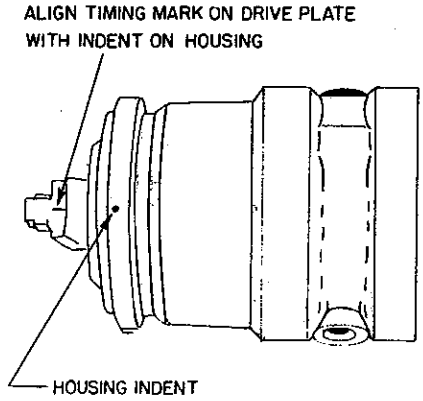


Figure 4-12. Timing Mark on Drive Plate Aligned With Indent on Magneto Housing

4-45. (Final Timing S8-700 Series). Remove the screw lockwasher and dust shield from the opening marked "T" on the side of the magneto. Then with a box wrench, remove the breather. See figure 4-13.

4-46. Connect a timing light to the switch wire (shielded capacitor wire) and to a good ground.

4-47. Insert a small screwdriver through the "T" marked opening and engage the painted rotor timing groove. (The painted lines on the distributor block and finger will be found in approximate alignment.) See figure 4-13. With a light force depress the screwdriver, moving the rotor in a counterclockwise direction, as viewed from the rear, sufficiently to remove any backlash while at the same time, rotate the magneto back and forth in both directions until the breaker points just begin to open, as indicated by the timing light.

NOTE

If inaccessability to the "T" marked hole prevents it from being used for holding out backlash, the magneto distributor block must be removed and the magneto rotor utilized for this purpose. This is accomplished as follows:

a. Disconnect the switch, coil and retard leads from their sockets in the cable outlet plate.

b. Remove the four screws that attach the ignition harness to the magneto.

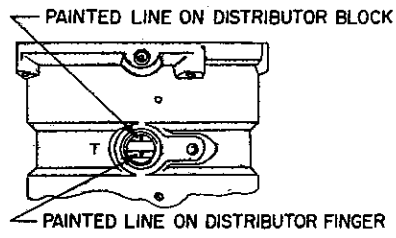


Figure 4-13. Painted Line on Distributor Finger and Block Viewed in Hole "T"

c. Remove the switch, coil and retard leads from their terminals in the distributor block.

d. Loosen the two setscrews mounted radially in the rear flange of the magneto and carefully remove the distributor block from the magneto.

e. Reach into the magneto and grasp the rotor. Note that when the rotor is turned counterclockwise to the point of breaker opening it will spring forward in a clockwise direction if it is released; therefore it must be held in the counterclockwise position while the magneto is rotated back and forth until the breaker points begin to open.

4-48. Tighten the magneto mounting clamps and replace the breather plug, shield, lockwasher and screw in the "T" opening, or if the distributor block was removed:

a. Connect the capacitor, coil and retard leads to their terminals in the distributor block and position the distributor block carefully in place in the magneto. Be sure the coil and retard leads are not pinched between the block and the housing.

b. Tighten the two setscrews that secure the block in the magneto.

c. Secure the harness to the magneto with four setscrews. Be sure the coil and retard leads are not pinched between the magneto and the cable outlet plate.

d. Replace switch, coil and retard leads.

4-49. When this has been accomplished the magneto is properly timed to the engine. If a recheck is required, or at anytime magneto timing is checked, it is necessary to hold out the backlash from the gears as described in paragraph 4-47 and the accompanying note, while a second person turns crankshaft through 20 degrees to firing position of No. 1 cylinder.

4-50. IGNITION HARNESS. After the magnetos have been timed to the engine, assemble the leads to the spark plugs. Consult the applicable wiring diagram for your installation. See figure 4-7, 4-8, 4-9, 4-10 or 4-11.

SECTION 5.

ACCESSORY HOUSING

5-1. It is assumed, at this time, that the magnetos and all accessories have been removed from the accessory housing.

5-2. Unless specifically called out to the contrary, all references to component parts will apply to all engines except those with a housing incorporating dual magnetos in a single housing. These housings will be identified as Dual Magneto Housings.

DISASSEMBLY

5-3. Fuel Pump (Diaphragm type) - See figure 5-3. The fuel pump, (7) located at the lower left of the accessory housing, is removed by unscrewing the two capscrews securing it to the housing.

5-4. Oil Pressure Screen Housing. (Where applicable) See figure 5-1. This housing (3) located just above the center of the accessory housing, is removed by unscrewing the four capscrews or three capscrews and one nut (whichever is applicable) that secure it to the accessory housing. On the O-290-D series, the oil cooler adapter is removed along with the oil pressure screen housing.

5-5. Thermostatic Valve and Oil Pressure Screen Housing. See figure 5-1. This unit, (5) used on some installations, is located at the same place as the oil pressure screen housing described in paragraph 5-4 and is removed in the same manner.

5-6. Oil Filter and Adapter. See figure 5-1. This unit, usually installed as an option, replaces either the oil pressure screen housing or the thermostatic valve and oil pressure screen housing. It can be removed as a unit from the accessory housing. Consult Service Letter 157 for more detail information on all models.

5-7. Oil Cooler Bypass Valve Assembly - See figure 5-1. This assembly is used only in conjunction with the oil pressure screen housing and opening is plugged when using either thermostatic valve or oil filter and adapter. Remove plug (8), gasket (2), spring (7), and plunger (12).

5-8. Oil Filter (Dual Magneto Housing) See figure 5-2. Remove filter assembly (11) by unscrewing the center bolt from the housing. Remove the thermostatic oil cooler bypass valve (21) and gasket (20). Remove retaining ring (10), sleeve (9), seat (8) and spring (7) of the oil filter by pass valve.

5-9. Fuel Pump Driven Gear, AN Type (Where applicable) See figure 5-4. Remove the adapter (3) and gear (5) from the mounting pad on the lower left side of the accessory housing.

5-10. Vacuum Pump Driven Gear (Where applicable) See figure 5-3. Remove the adapter (4) and gear (6) from the mounting pad on the upper right side of the accessory housing.

5-11. Hydraulic Pump Driven Gear (Where applicable) Remove the adapter and gear from the mounting pad on lower right side of the accessory housing.

5-12. Propeller Governor Driven Gear (Where Applicable) See figure 5-3. Remove the propeller governor oil line (12). Remove the adapter (10) from the mounting pad on lower right side of the accessory housing. Remove retaining ring (9), washer (5) from shaft gear and remove shaft gear (11) from adapter (10).

5-13. Dual Drives - Vacuum Pump and Hydraulic Pump - See figure 5-5. Remove brace (2), vacuum and hydraulic pump adapter (13), and dual drive adapter (8). Remove accessory drive gear (9), dual accessory drive gear (10), vacuum pump driven gear (12) and idler gear (11).

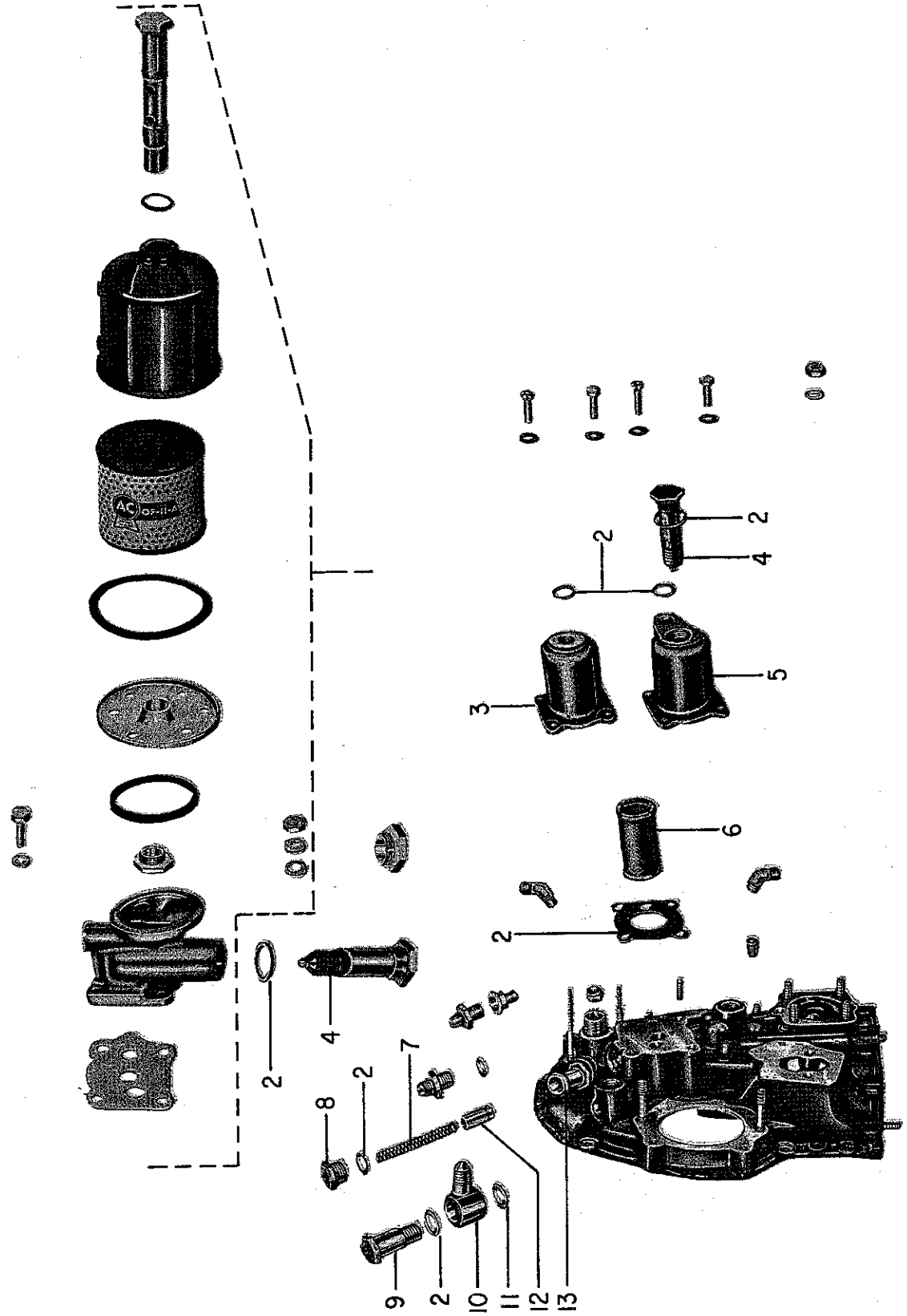
5-14. Dual Drives - Vacuum Pump and Propeller Governor - See figure 5-5. Remove brace (2), vacuum pump and propeller governor drive adapter (5), and dual drive adapter (8). Remove accessory drive gear (9), dual accessory drive gear (10), vacuum pump driven gear (12) and idler gear (11).

5-15. Removal from Engine. The accessory housing is removed from the engine by removing the attaching parts to the crankcase and oil sump. Since various gears are held in place through contact with the crankcase, put the housing on the bench with the inside up to avoid dropping loose gears.

5-16. See figure 5-4. If engine is equipped with "AN" type fuel pump drive, remove the fuel pump idler gear (7) from the idler gear shaft (8). Remove the idler gear shaft from the housing.

5-17. Oil Pump. See figure 5-6. Remove the oil pump body assembly from the accessory housing and detach the oil pump impellers. Pull oil pump drive shaft from the body. Do not remove the oil pump idler shaft unless obvious damage is apparent. A later oil pump assembly (see figure 5-7) employs sintered iron impellers and the idler shaft and driven impeller are one unit. In addition the oil pump drive shaft gear is keyed. These assemblies are not interchangeable.

5-18. Oil Suction Tube (Where applicable) Remove the cotter pins, nuts and washers from inside of housing and bolts from the outside of the housing and remove the oil suction tube.



1. Oil Filter Kit
2. Gaskets
3. Oil Pressure Screen Housing
4. Thermostatic Valve
5. Thermostatic Valve and Oil Pressure Screen Housing
6. Oil Pressure Screen
7. Spring
8. Plug
9. Bolt
10. Elbow
11. Washer
12. Plunger
13. Breather Fitting

Figure 5-1. Oil Pressure Screen, Oil Cooler Bypass Valve and Full Flow Oil Filter

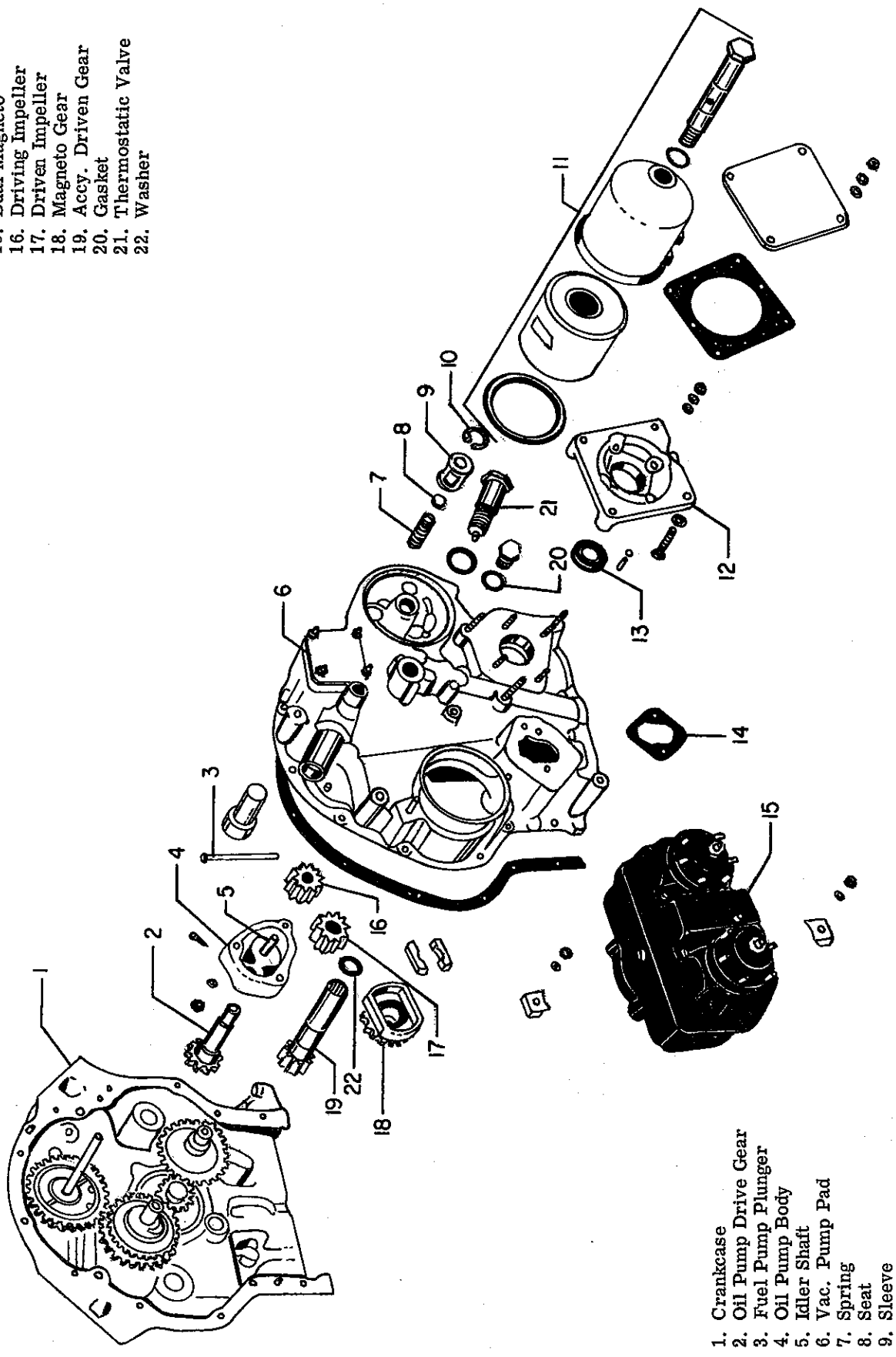
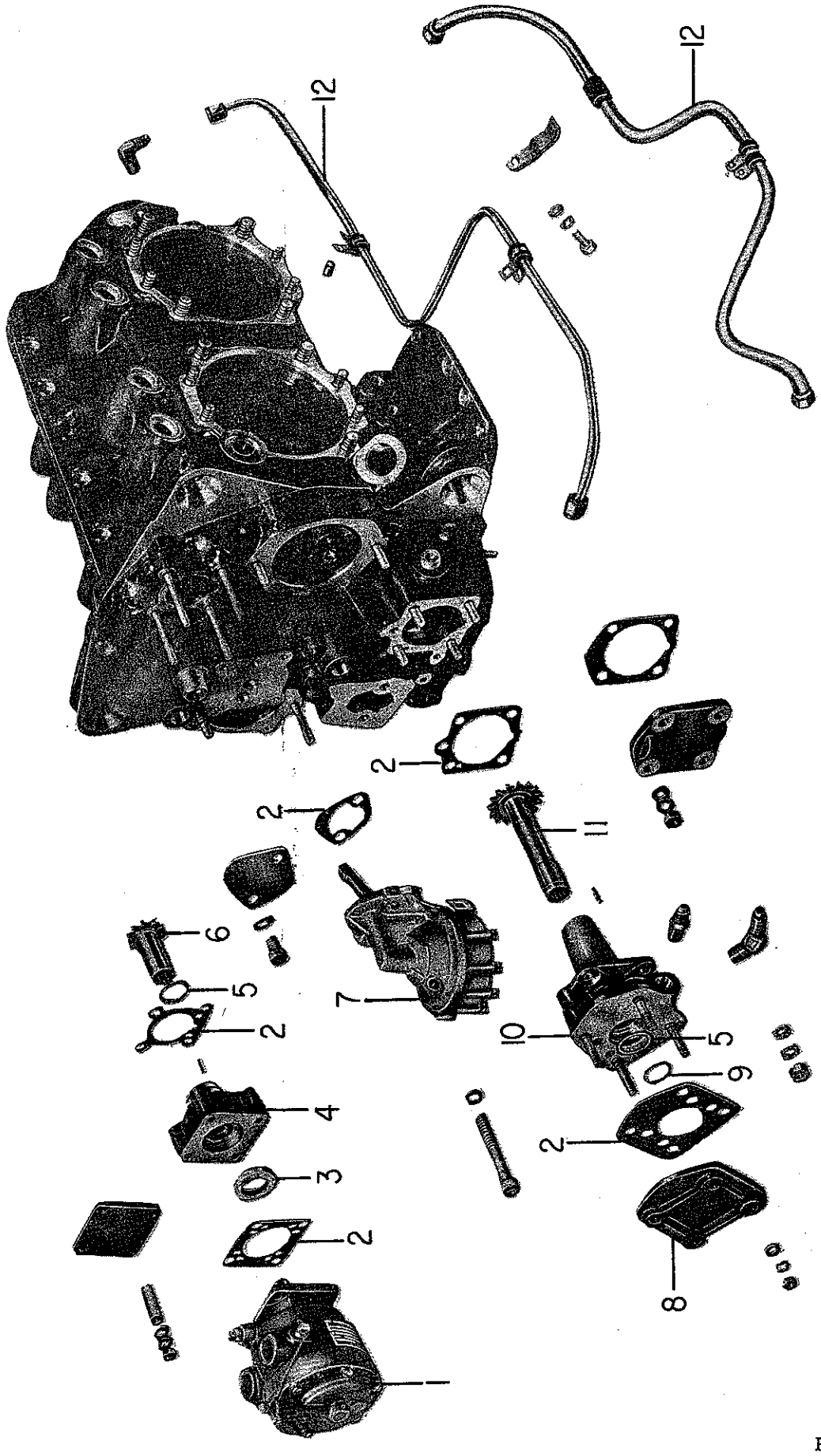


Figure 5-2. Accessory Drive Components - Dual Magneto Housing



1. Vacuum Pump
2. Gasket
3. Oil Seal
4. Adapter
5. Washer
6. Vacuum Pump Driven Gear
7. Fuel Pump
8. Cover
9. Retaining Ring
10. Propeller Governor Drive Adapter
11. Propeller Governor Driven Gear
12. Propeller Governor Oil Line

Figure 5-3. Vacuum Pump and Propeller Governor Drive Assemblies and Propeller Governor Oil Line

5-19. Turbo Scavenge Pump (Where applicable) See figure 5-10 or 5-11. Disassemble as shown in the illustration.

5-20. Oil Scavenge Pump (AIO-360, -320) See figure 5-12. Disassemble as shown in the illustration.

CLEANING

5-21. Drilled Oil Passages. Remove all plugs from oil passages. Particular care must be given to see that oil passages are thoroughly cleaned. Employ a stiff bristle fibre brush and when the oil passages are cleaned, blow out the passages with a petroleum solvent and air. Reinstall all threaded plugs.

5-22. Clean all accessory housing parts in accordance with the general instructions as outlined in Section 3 of this manual

INSPECTION

5-23. Replace all gaskets, oil seals, circlips and retaining rings during reassembly.

REPAIR AND REPLACEMENT

5-24. Replace all gaskets, oil seals, circlips and retaining rings during reassembly.

REASSEMBLY

5-25. Oil Pump - See figure 5-6. Insert oil pump impellers into oil pump body. The driving impeller (4) is manufactured from steel and is installed in the upper compartment of the body. The aluminum driven impeller (5) is installed in the lower compartment. Assemble the oil pump idler shaft (7) in the body and through the driven impeller, secure the idler shaft to the body with a cotter pin. Assemble the oil pump drive shaft (1) through the housing and into the driving impeller. Install the assembly over the mounting studs on the accessory housing and assemble a washer and slotted nut on the studs. Tighten evenly and gradually, turning the drive shaft while tightening to assure free movement of the impellers. Tighten nuts to 150 inch pounds torque and lockwire. The later oil pump assembly employing sintered iron impellers is assembled in the same manner with these exceptions. The driven impeller and idler shaft are manufactured as a unit and the drive shaft is keyed. See figure 5-7.

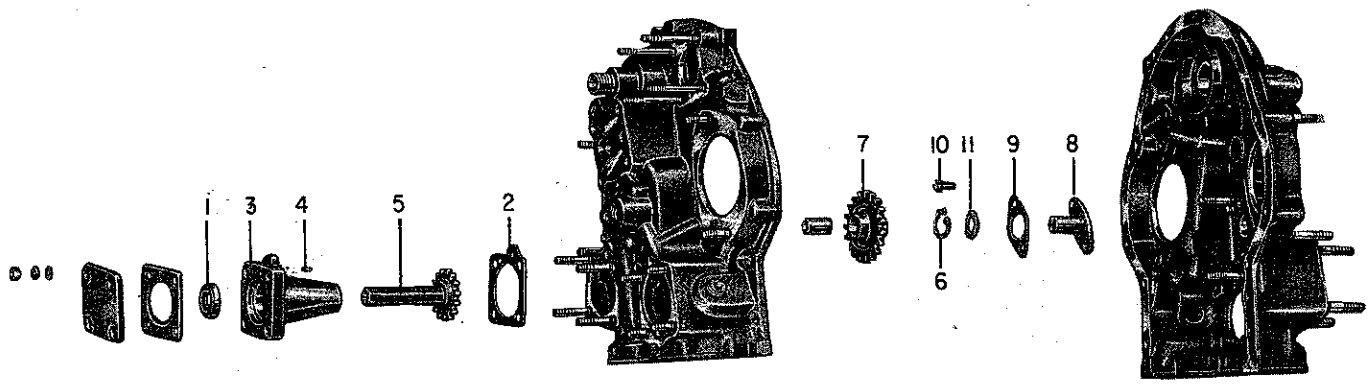
CAUTION

Oil pump bodies are made for both clockwise and counterclockwise rotation engines. Be sure you use the correct oil pump body, these bodies are not interchangeable.

5-26. Oil Pump (Dual Magneto Housings) See figure 5-2. The oil pump assembly used in this series engines is similar to and assembled in the same manner as the first pump described in paragraph 5-25.

5-27. Oil Suction Tube. (Where applicable) Insert two drilled bolts from the outside of the housing. Assemble a gasket and the oil suction tube over the bolt ends and assemble plain washers, lockwashers and slotted nuts and tighten to 75 inch pounds torque. Secure with cotter pins.

5-28. Accessory Housing. Place a new accessory housing gasket over the locating dowels on rear of crankcase. Check assembly of two crankshaft idler gears. Should the engine be equipped with a diaphragm type fuel pump, the hub of the left hand gear should incorporate a cam. The fuel pump plunger should be inserted in the accessory housing as shown. Make certain that should the engine incorporate an "AN" fuel pump drive, the fuel pump idler gear shaft is in place on the inside of the accessory housing cover and is secured with two 1/4-20 hex head screws and a lockplate. Place the fuel pump idler gear on the idler shaft



1. Oil Seal
2. Gasket
3. Fuel Drive Adapter
4. Pin
5. Fuel Pump Driven Gear
6. Retaining Ring
7. Fuel Pump Idler Gear
8. Idler Gear Shaft
9. Lockplate
10. Screw

Figure 5-4. AN Fuel Pump Drive Assembly