

Service Suggestions

Factory Methods of Servicing Lycoming Engines

By C. P. SHATTUCK

THE following are the factory methods of disassembling, installing new components, adjusting and reassembling models "K," "K B," "K A," and "K M," four-cylinder Lycoming engines made by the Lycoming Motors Corporation.

ascertained by consulting the specification tables contained in this issue. Models "K B" and "K A" are employed with trucks, the makes of which using these models can be ascertained by consulting the tables in The Commercial Car Journal. Model "K A"

Fig. 1. Part Longitudinal View of Lycoming Engine, Showing Oiling System, Starting Crank Assembly and How Front-Camshaft Bushing is Secured.

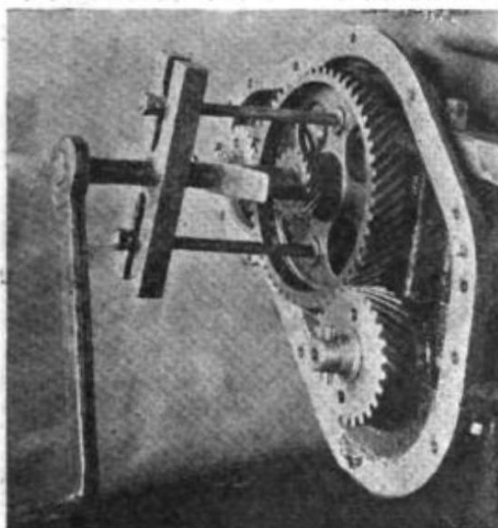
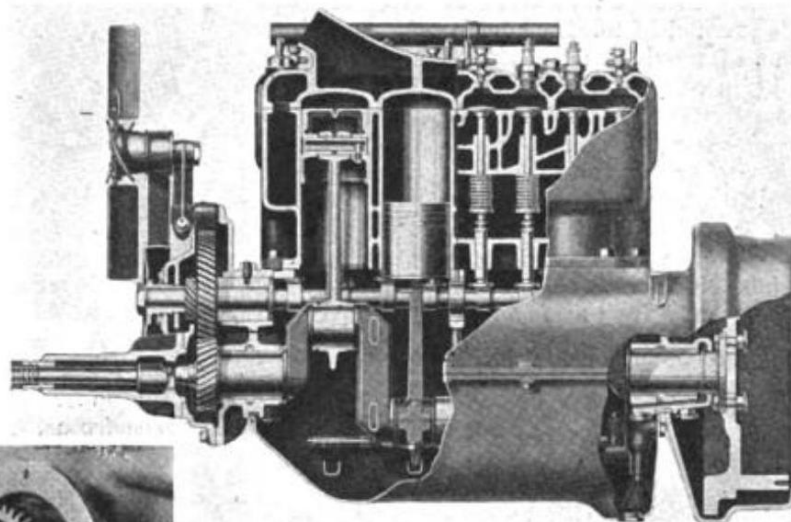


Fig. 2. The Factory Tool for Removing Timing Gears

It is adjustable and can be constructed by the average mechanic and will be needed in the engine rebuild

stroke of $3\frac{1}{2} \times 5$ in., and as the component parts are standardized and interchangeable, servicing is a simple matter. Model "K" is the passenger car engine and the makes of cars with which the engine is used can be

employed. When a magneto is used with the Model "K" it is mounted on a bracket and driven from the camshaft gear. Model "K M" is also equipped with a magneto.

The directions given herein are for a complete overhaul or rebuild of the engines. No instructions are given for disconnecting the various linkage necessary to the removal of the power plant or from clutch and transmission. Neither is instruction given for grinding valves, removing carbon, etc., conventional work with which the mechanic should be familiar. The directions deal with each component and steps of the operation. Use is made of the factory part name throughout and orders for new parts should bear the factory name as well as parts number and required number. Always give the model of engine when ordering.

The overhaul of the engines will be greatly facilitated if a reversible type of engine stand be employed and a gear puller similar to that shown in Fig. 3 be used. The instructions herein apply to the model "K" and are standard with all other models with the

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exception of ignition drive assembly which will be explained in detail.

Remove water inlet manifold held on two studs by two $\frac{3}{8}$ in. S. A. E. nuts. The gasket is NOT shellaced. Remove four $\frac{3}{8}$ in. hex-headed bolts with lock washers on either side of bell housing, two points of the three-point suspension. There are lugs or pads supporting the rear of engine in chassis. Remove the front suspension bolts. There are two or three. Remove engine to stand. Displace clutch and transmission as a unit. Remove timer-distributor. Remove carburetor and intake pipe as a unit. Latter is displaced by removing two $\frac{3}{8}$ in. nuts from studs.

The flywheel housing is in two sections. The upper is integral with the crankcase and the lower half is bolted to it by six $\frac{5}{16}$ in. bolts with lock washers. The engine starter is mounted in the lower half. Remove lower half of flywheel housing. Remove oil drain plug in oil pan (lower half of crankcase) and near flywheel end of pan. Drain oil. The oil pan is secured to the upper case by 14 $\frac{5}{16}$ in. cap screws and there is a cork gasket which is secured to upper half of the crankcase by shellac. The oil pan side of gasket is coated with grease and oil pan can be removed without injury to the gasket. Do NOT use any tool between oil pan and

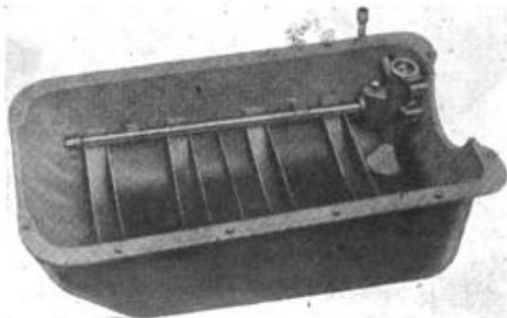


Fig. 3. The Oil Pan With Pump and Tube With Holes Through Which Oil is Fed to the Troughs

gasket as pan can be easily displaced by hand. Remove oil pan and be careful not to bend oil float rod.

Remove fan bracket assembly by loosening the $\frac{3}{8}$ in. cap screw at lower end of bracket and slip bracket off its stud. The fan pulley is mounted on a shaft with a Woodruff key and locked by a $\frac{7}{8}$ in. S. A. E. nut with lock washer. To remove fan pulley first place three $\frac{1}{4}$ in. 24 thread screws with lock washers holding the packing gland in place. Remove nut and lock washer. Use a puller to remove pulley.

The timing-gear case or cover is bolted to the front end of the crankcase by 14 $\frac{5}{16}$ in.

cap screws with lock washers and there are two straight dowels or pins in upper half of crankcase for aligning cover with case. A paper gasket is interposed between the case and cover and that side in contact with the case is coated with shellac. Remove the cap screws and grasp starting crankshaft housing and rock up and down. This will detach

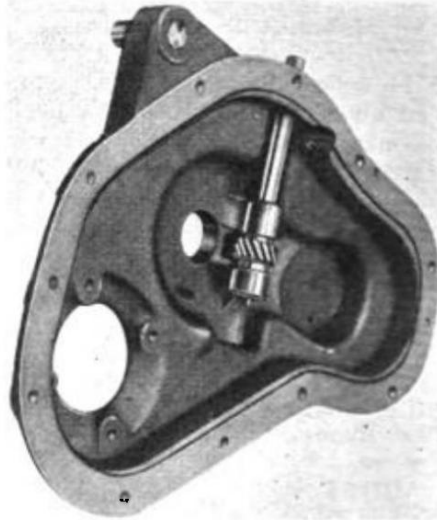


Fig. 4. Showing the Interior of Timing Gear Cover and Ignition Drive Assembly

cover. A new gasket should not be necessary in the reassembly. The generator is mounted in the upper half of the crankcase and is gear driven from the camshaft. (See Fig. 5). To

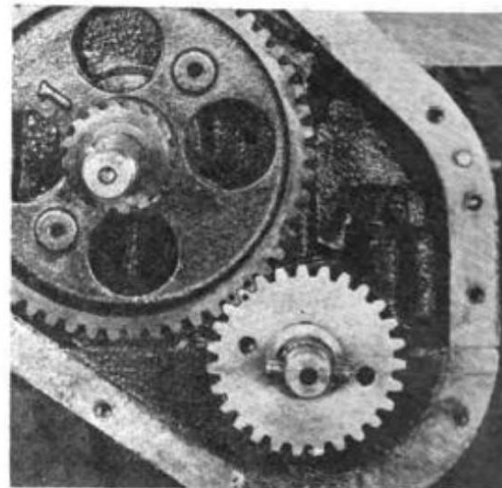


Fig. 5. Timing and Generator Gears Exposed and Showing Punch Marks on Camshaft and Crankshaft Gears Facilitating Timing.

remove generator back off three $\frac{3}{8}$ in. nuts with plate washers and pull out generator with flange and gear as a unit.

The next step is to remove the crankshaft gear. (See Figs. 2 and 5.) The starting

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crankpin in crankshaft gear is locked by a $\frac{1}{4} \times \frac{1}{2}$ in. pin constructed of wire and the pin is driven through the opening in end of shaft and at right angles to the starting crankpin. Driving out the crankpin will shear the lock pin or wire. A new one will be necessary. Before removing crankshaft gear, note if this gear and camshaft gear are marked. A tooth of the crankshaft gear should be prick-punched and two teeth of the camshaft gear also marked or as shown in Fig. 5. This makes correct replacement and timing of gears a simple matter. If gears

1 and 4 are now accessible for removal. Remove cotter pins from nuts (2) of rod cap, No. 1, and with left hand hold rod as shown in Fig. 7. Back off nuts, and lift off cap. Lower rod with piston and slip-on cap and catch nuts. This method is recommended as it insures shims remaining in place and nuts on original bolts. Remove No. 4 rod in same manner then turn crankshaft through 180 deg. or a full half turn and remove rods with pistons 2 and 3.

Note: With the Locomotive engines it is possible to remove a rod with piston and

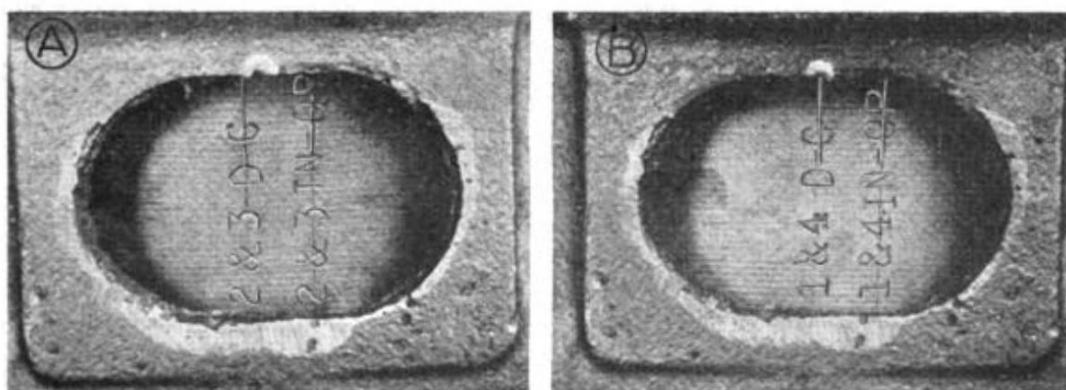


Fig. 6. Flywheel Timing Marks: A, Used When Removing and Replacing Cylinder Bloc; B, Dead Center of Pistons 1 and 4

be not marked prick punch them as shown in the illustration. All timing gears bear a number simplifying ordering new, and all screw holes are $\frac{3}{8}$ in. U. S. standard thread. **USE A GEAR PULLER TO REMOVE ALL GEARS.**

The small gear in front of the camshaft gear (drives timer-distributor shaft) is keyed to shaft with a No. 3 Woodruff and the large or camshaft gear is keyed with a No. 9 Woodruff. The small and large gears are removed as a unit but a **PULLER MUST BE USED.** (See factory puller, Fig. 3).

The cylinder head is held by 16 $\frac{1}{2}$ in. nuts with plate washers and there is the conventional copper-asbestos gasket. No shellac is used on the gasket and it should be replaced in same order as removed. Remove the cylinder head. Remove plate over top of upper flywheel or bell housing and turn crankshaft until marks 2-3 D-C align with center mark on housing or as shown at A in Fig. 6, depicting timing marks. This should be done before removing the cylinder bloc as it will bring pistons 2 and 3 to top dead center thereby largely avoiding the possibility of bending the connecting rods when lifting off the bloc. Remove eight $\frac{7}{16}$ in. S. A. E. nuts with lock washers, securing bloc to case, and remove bloc by lifting straight up or in a vertical plane.

Reverse engine in stand. Connecting rods

rings from the cylinder bloc from the bottom of the bloc and without removing the cylinder head. The bottom of the cylinder is chamfered permitting of easy replacement of the piston with rings.

There are two main bearings and of the split type. The front main bearing cap differs from the rear in that it has two $\frac{5}{16}$ in. cap screws in addition to the four nuts with lock washers. Remove cotter pins from main bearing cap nuts, back off nuts, remove lock washers and cap screws (2), and remove caps. Replace nuts to keep shims in position.

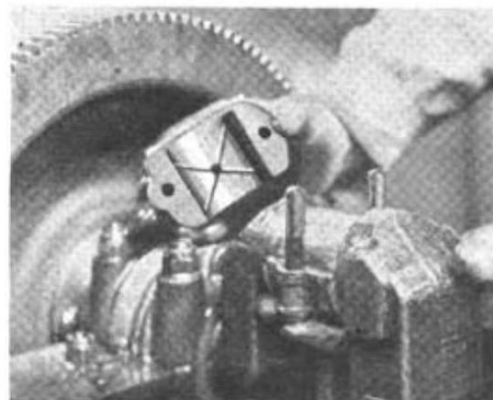


Fig. 7. In Removing Connecting Rod Caps Hold Rod and Bolts as Shown and Keep Shims in Place

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The lubricating oil is circulated by a plunger pump mounted in the oil pan and is screened. The plunger or oil push rod is actuated by an eccentric on the camshaft (see Fig. 8) and **this PLUNGER MUST BE REMOVED BEFORE THE CAM-SHAFT.** To remove plunger displace cotter pin and pull rod up and out through case. Statement is made that it is rare that the camshaft or its bushings will require removal but the operation is given. There are three bushings or bearings. The front is $1\frac{1}{4} \times 2\frac{5}{8}$; center, $\frac{3}{4} \times 1\frac{55}{64}$; rear, which has an

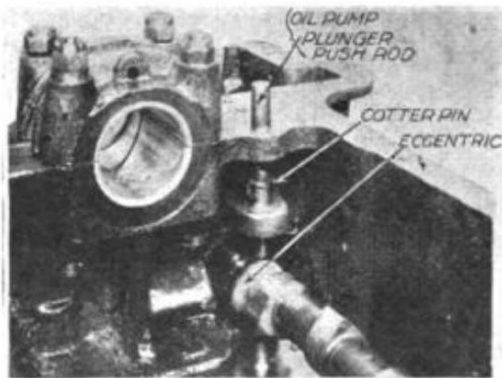


Fig. 8. The Oil Push Rod is Actuated by Camshaft and Should be Removed Before Displacing Camshaft. Push Rod is Secured by a Cotter Pin.

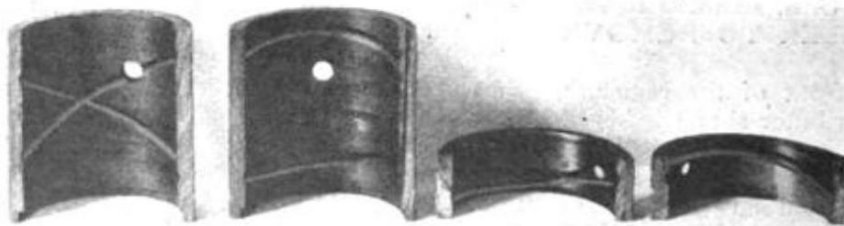


Fig. 9. The Expansion Plug and Center Bushing Cut in Two to Show Oil Grooves and Relation of Oil and Screw Holes to One Another.

expansion plug, $1\frac{3}{4} \times 2\frac{1}{4}$ I. D. The bushings are locked in the case by dog-pointed screws, the screws for the center and rear being in the side of the case and removed from the outside, while the front is a vertical screw on the top of the case between fan bracket and cylinder bloc. The front screw has a $7/16$ in. lock nut.

Remove the front camshaft bushing lock screws. A special puller will be required to remove the camshaft which is displaced with the front bushing. It can be constructed of $\frac{1}{2}$ in. stock $4 \times 2\frac{1}{2}$. Drill and tap center of plate for $7/8$, 18 thread hole. Drill and tap plate for two $7/16$ in. holes, one on either side of first named hole. Thread two bolts, one about $4\frac{1}{2}$ in. long and another about $2\frac{1}{2}$, to screw into the plate. To use puller, screw plate on camshaft and lock with nut

to avoid stresses on threads of shaft. Screw up bolts in plate until against case then tighten both evenly. Tap nut on shaft gently to start shaft with bushing, then continue to turn small bolts, drawing shaft out with bushing. Remove center and rear camshaft bushing lock screws. Drive out bushings with section of pipe.

By referring to Fig. 9, showing the rear and center camshaft bushings split or cut to show interior, it will be noted that they have oil grooves or channels. It will also be noted that there is a hole drilled through the bushing and groove. These oil holes register with oil holes in the crankcase. New or replacement bushings do NOT come drilled for either the oil or lock screw holes as the holes are drilled after the bushing has been installed in the case.

As it is **IMPORTANT THAT BUSHINGS BE CORRECTLY LOCATED**; that is, the oil holes be in a groove and register with oil hole in case, the following method of installation is recommended. For example, when replacing rear bushing with a new one place the old bushing in front of opening in case and so that oil hole in case would register with that in bushing were the latter slipped in position. It will be noted that the oil grooves cross or intersect just above the oil hole. Turn new bushing until the holes align with old or until point where grooves

cross is aligned, then insert bushing. In driving in, make sure that bushing does not turn. Check up position before drilling holes. Employ a $\frac{1}{4}$ in. drill, and be sure to keep the drill in a horizontal plane. Drill through screw hole side, then through opposite wall of housing. The drill should pierce the oil groove diametrically opposite and, after, going through bushing, should enter oil channel in case through which oil is supplied the bushing. Illustration 10 shows how the drill is employed. The front and center bushing holes (screw and oil) differ from the rear in that the holes are about 90 deg. apart. (See Fig. 11.) With these the drilling operation is simpler but it is equally **IMPORTANT THAT THE OIL HOLES IN BUSHINGS REGISTER WITH THOSE IN THE CRANKCASE WEB.** When new

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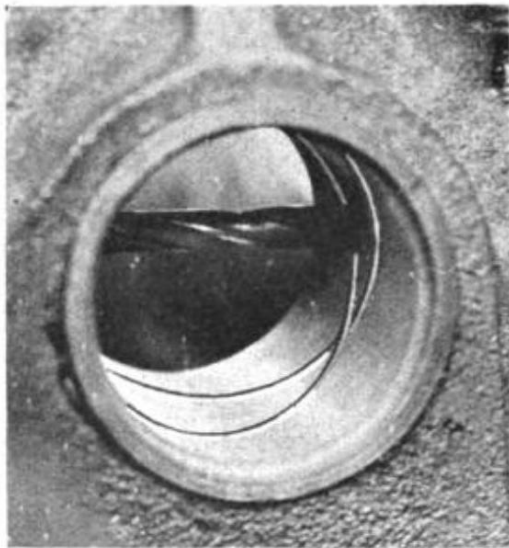


Fig. 10. Showing How Drill is Used and Passing Through Oil Groove as Well as Aligning Holes in Web With Those in Bushing Which is Important.

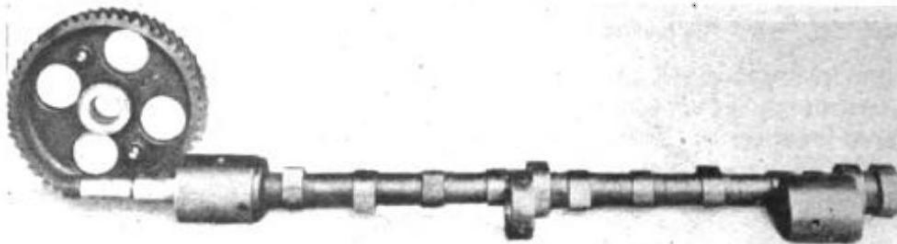


Fig. 11. The Camshaft With Gear Removed and With Front Bushing on Shaft. The Center and Expansion Plug Bushings Are Shown Displaced But in Center.

bushings are installed they should be line reamed to insure a satisfactory job. Clean bushings and shaft, cover with oil and replace camshaft assembly. Replace oil pump push rod or plunger and insert cotter pin in rod.

Main bearings are installed at the factory with two .002 and two .003 in. shims on either side although there may be three .002. When taking up a main bearing it may be practical to remove a .003 in. shim and replace it with a .002. When new main bearings are installed they should be line reamed and burnished, the factory holding the method preferable to scraping in by hand.

When new connecting rod bearings are installed they must be drilled in the rod half with two $\frac{1}{4}$ in. holes and in the cap half with one $\frac{1}{4}$ in. hole to insure sufficient lubrication. When installing new main bearings oil holes should be drilled in upper part of bearing in line with the oil holes in the crankcase which communicate with the oil pockets.

The piston pins are of the fixed type, locked by a screw which is pinned. To remove piston pin to install new bushing remove cotter pin and back out lock screw. Drive out piston pin with a pilot drift from end opposite to lock screw. The bushing is

bronze and is reamed to fit new piston pin and so that when piston is held the free end of rod will drop of its weight or with a slight push.

After installing new rod bearings, piston pin and piston pin bushing it is important that the pin align with crankshaft and that the piston is not out of square with crankpin. The factory tool for checking the assembly is shown in Fig. 12, and a bearing mandrel can be employed for this work. In replacing the connecting rod caps it is important that the dowel pin of metal bearing be on side next to the timing gears or as shown in Fig. 13, otherwise the oil scoop will not pick up lubricant from the troughs. If new shims are required on the connecting rod the factory number and dimensions are as follows: Three .002, three .005 and one .109 in. on either side. The material is brass.

When cylinders are to be reground and new pistons and rings used, the factory recommends a piston clearance or tolerance

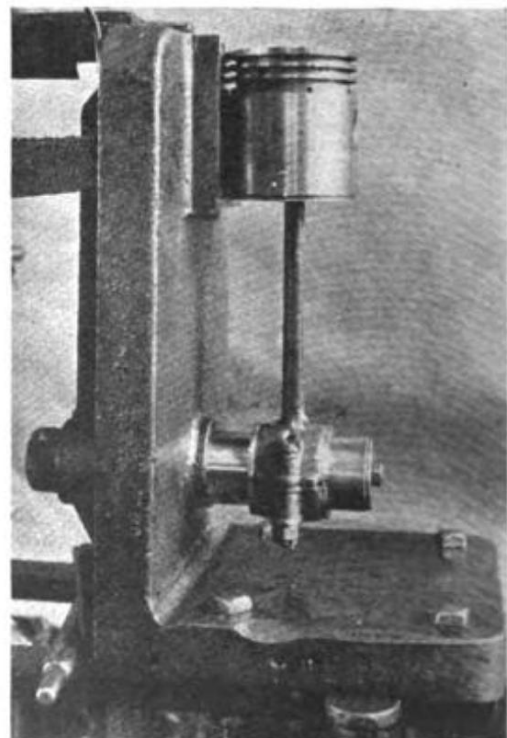


Fig. 12. Factory Method of Assuring Rod and Piston Parallel With Cylinder

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of .0025 in. Oversize pistons with rings fitted are supplied by the Lycoming Motors Corp. in sizes ranging from .005 to .030 in. over standard.

There are three different types of drives for the ignition unit (timer-distributor).

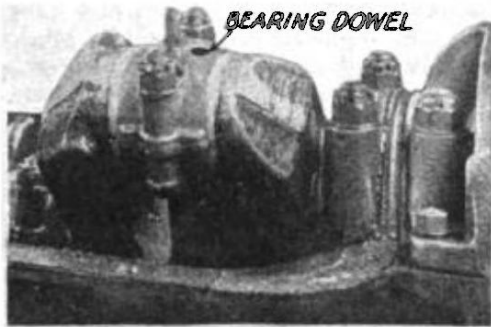


Fig. 13. Rod Caps Should be Replaced With Dowel of Bearing-in Cap Facing Timing Gear End of Case so That Oil Scoop Will Face in Right Direction.

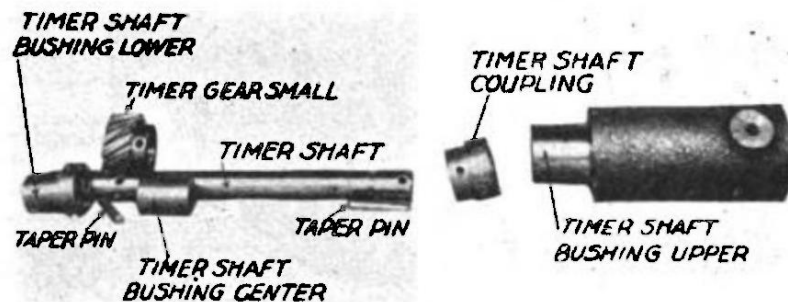
One is the S. A. E. standard design having a $1\frac{1}{16}$ in. diameter shank, and driven through a tongue and slot coupling. The second type is designed to take a distributor having a shank bored out to fit over the $\frac{1}{2}$ in. diameter shaft which extends through the top of the gear case. The third design is similar in construction to the S. A. E. type with the exception that a $\frac{3}{8}$ in. distributor shank is used. The drive for the distributor shaft is by two spiral gears one of which is

but the component parts in proper order of assembly. In replacing the top bushing the circular groove must be on top. When installing new component parts it will be noted that the gear has but one hole. The other must be drilled when gear is on the shaft. The top member or coupling also has but one hole and the other must be similarly drilled. Taper pins are used.

If the ignition unit is displaced it will have to be retimed. To retime turn crankshaft until the piston of the No. 1 cylinder is on top dead center on completion of compression stroke at which time the marks 1 and 4 D. C. should align with center mark on case. Fully retard the spark lever and adjust breaker mechanism so that points just begin to separate. This operation should be performed, of course, with the linkage connected. The firing order of all Lycoming engines is 1-3-4-2.

As the camshaft and crankshaft gears are marked, correct retiming is made easy. Replace camshaft and small gear on shaft and turn shaft until the camshaft gear occupies approximately the same position as shown in Fig. 5. Replace crankshaft gear on shaft turning it so that the marked tooth will be between the two marked teeth of the camshaft gear. Replace starting crank pin and fit new lock pin or wire. If main bearings have been replaced it will be necessary to first start gear on crankshaft and turn the shaft until position for proper mesh of gears is obtained, then drive gear in place.

Fig. 14. The Timer-Distributor (Ignition Unit) Assembly Disassembled and the Component Parts in Proper Order of Assembly.



mounted on the camshaft and is in mesh with another mounted on the $\frac{1}{2}$ in. distributor shaft, and held in place by a split head taper pin. (See Figs. 4, 5 and 14.) To disassemble distributor drive remove taper pin from small spiral gear in the vertical shaft. Use an offset rod to drive out shaft and drive upward through the bushing. The distributor shaft is provided with three bearings: a flanged bronze bushing in the bottom, a straight bronze bushing in the center and a cast-iron bushing at top where the S. A. E. design is used. Where the distributor is bored to fit over the $\frac{1}{2}$ in. shaft a plain type bushing is used in the top of the case. Fig. 14 shows the unit completely disassembled

The possibility of springing the connecting rods when replacing the cylinder bloc will be largely avoided if the pistons 2 and 3 are uppermost. The cylinder walls, pistons and rings should be well covered with oil before replacing the bloc. In replacing cylinder head gasket place the brass side of gasket down or next to the bloc and tighten the nuts on studs in the order shown in Fig. 15, starting with No. 1. Nuts should be gone over a second time after engine is warm.

Should it be necessary to install a new flywheel, the periphery of which is marked with the timing, proceed as follows: With engine in stand with cylinder bloc down, turn crankshaft until the crank throws of 1 and 4

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are uppermost or in a vertical plane. Turn flywheel until marks 1 and 4 D. C. are uppermost. The four holes in the crankshaft flange and those in the flywheel should align. Insert bolts, tighten nuts and insert cotter pins. In the event the starting crank assembly or its bracket is damaged through acci-

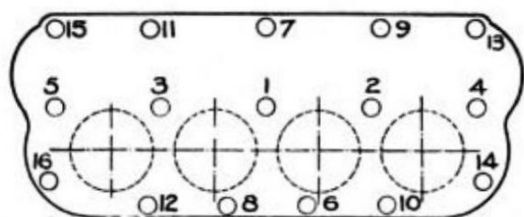


Fig. 15. Diagram, Showing Proper Order of Tightening Cylinder Head Nuts on Studs

dent, the crank may be removed by unscrewing the $1\frac{1}{4}$ in. starting crank plug serving to retain the starting crankshaft and acting as a bearing. The bracket is bolted to the timing gear case.

Provision is made for adjusting the pinion

If new outlet or inlet water hose be required use rubber hose of $2\frac{1}{4}$ in. inside diameter, as given in the Replacement Table elsewhere in this issue.

The best results will be obtained from the engine if the oil is drained from the sump at least every 500 miles of service. This is accomplished by removing the pipe plug at the bottom of the oil pan. Replace plug and pour a couple quarts or more of kerosene through the breather. With the switch off run the engine with the starter about a minute, then drain case and refill with new oil and until gage registers with top red mark, which is the proper oil level. If the pump be suspected of being inoperative it can be tested by removing the cap from the oil pump connection pipe on generator side of oil pan and starting the engine. If oil flows the pump is functioning. If not prime it through the pipe with cylinder oil.

The above directions apply to all models Lycoming engines with the exception of the truck types which differ in that one comes equipped with magneto ignition. When the magneto is employed on the model "K" it is

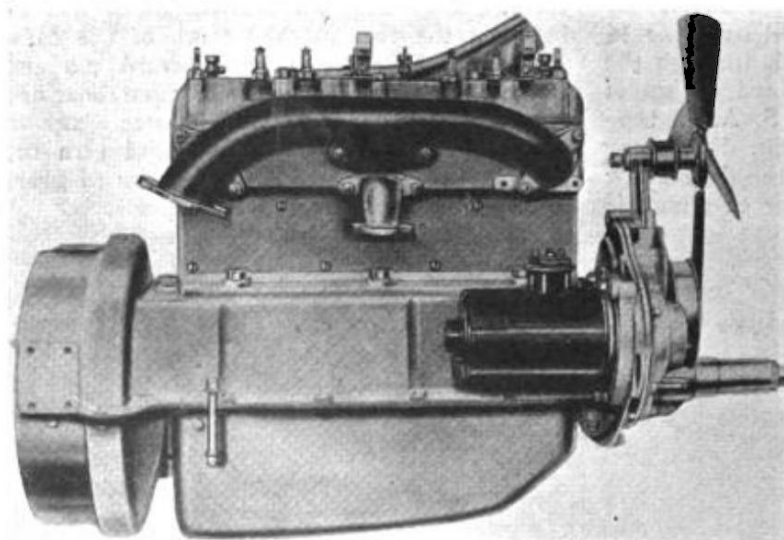


Fig. 16. Generator Side of Lycoming Engine and Showing Pipe Plug for Testing Action of Oil Pump.

of the generator with the driving gear and the clearance should be about .0025 in. To adjust loosen the two cap screws on top of flange, and move generator towards or away from cylinder bloc as may be required and tighten screws.

Before replacing the oil pan flush pump with kerosene, wash screen, and float, and **MAKE SURE THAT HOLES IN OIL SUPPLY PIPE ARE CLEAR.** The oil pump will require no attention other than cleansing. **NEVER ATTEMPT TO CHANGE ITS ADJUSTMENT AS IT IS CORRECTLY SET AT THE FACTORY.** Thoroughly clean oil pan before replacing.

mounted on a bracket and drive taken from the camshaft gear. When a magneto is employed, however, and is to be retimed, the gears will have to be meshed when the piston of the No. 1 cylinder is on top dead center (end of compression stroke) the contact points just beginning to separate, and the distributor brush making contact with the No. 1 segment of distributor. These precautions are necessary owing to the difference in the number of teeth in the driving and driven gear. Complete description for rebuilding the truck types of engines will be published in a coming number of The Commercial Car Journal.