Colt Industries

INSTRUCTIONS
TYPE FM-E, X, Z
MAGNETOS

ENGINE ACCESSORIES OPERATION • BELOIT, WISCONSIN 53511

SERVICE INSTRUCTIONS
TYPE FM-E, FM-X, FM-XD, FM-XDE, FM-XE, FM-XF, FM-XFE, FM-XFZ, FM-XO, FM-XOR, FM-XR, FM-XV, FM-XVE, FM-XY, FM-XYE, FM-XZ, FM-XZE, FM-Z AND FM-ZE MAGNETOS

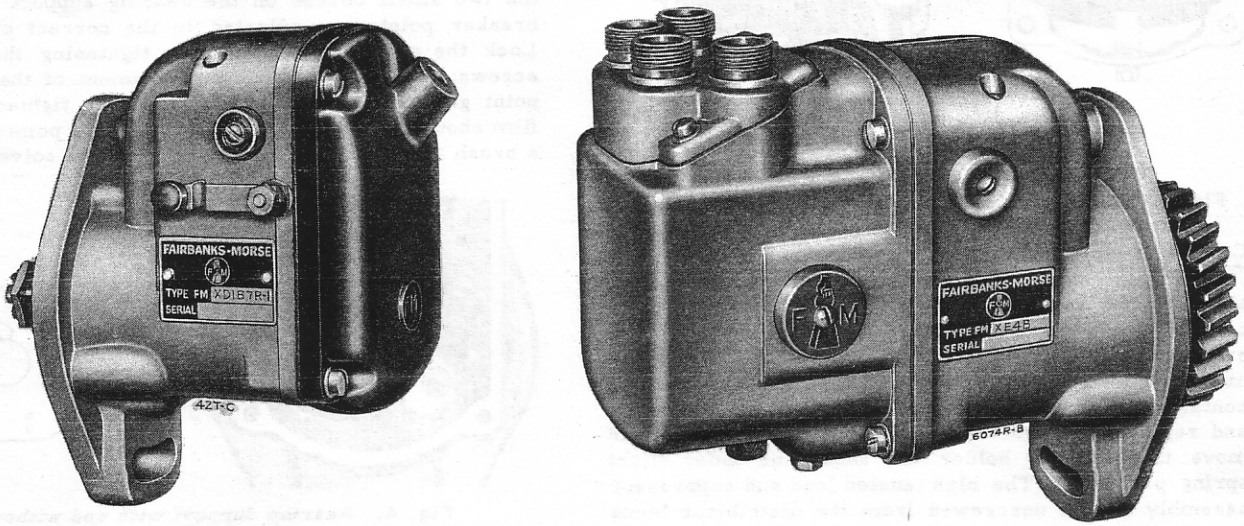

Fig. 1. Standard and Radio Shielded Magnetos

GENERAL DESCRIPTION

Fairbanks Morse Series X magnetos, Fig. 1, are of the rotating magnet design, the basic principle consisting of inducing and continually reversing magnetic flux lines thru an induction coil. This is accomplished by rapidly rotating the permanent magnetic rotor through a stationary field which is the basis of the magnetic circuit.

A one, two, or four-lobe cam actuates a breaker mechanism periodically during each revolution of the rotor. Each time the breaker points are separated by the magnetic rotor cam, an ignition spark is produced. In the one-cylinder magnetos this occurs once per revolution of the rotor. In the two-cylinder magnetos the distributor rotor forms an axial extension of the magnetic rotor and the breaker points are separated twice per revolution of the rotor by a two-lobe cam. Similarly, in the type FM-XV four-pole magnetos, the distributor rotor forms an axial extension of the magnetic rotor. Since the cam of the rotor has four lobes, the breaker points separate four times per revolution producing four ignition sparks. In the standard four-cylinder magnetos, a two-lobe cam is used which produces two ignition sparks per revolution of the magnetic rotor. In all such cases an ignition spark is furnished to each high tension outlet, once for every two revolutions of the magnetic rotor.

In the FM-XR6 and FMZ6 six-cylinder magnetos, a two-lobe cam is used which produces two ignition sparks per revolution of the magnetic rotor. A gear arrangement is used to connect the magnetic rotor with the distributor rotor which furnishes a spark to each high tension outlet once for every three revolutions of the magnetic rotor.

MAGNETO INSPECTION

The entire magneto should be inspected for worn parts every 1000 hours of operation.

End Cap and End Cap Removal

When the usual inspection and spark tests indicate poor magneto performance, the end cap and end cap cover, Fig. 2, if used, should be removed. Tag the ignition cables to insure their proper replacement in the endcap; then remove each high-tension cable from its socket. In the type FM-E magnetos, the end cap cover must be removed to expose the high tension cable terminals before the lead wires can be removed. When removing the end cap of the types FM-X4, FM-XR, FM-XOR, and the FM-XV magnetos, the end cap cover must be removed and the distributor rotor taken off the end of the rotor shaft before the end cap can be removed.

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Supersedes 3133 dated July, 1967
March, 1973

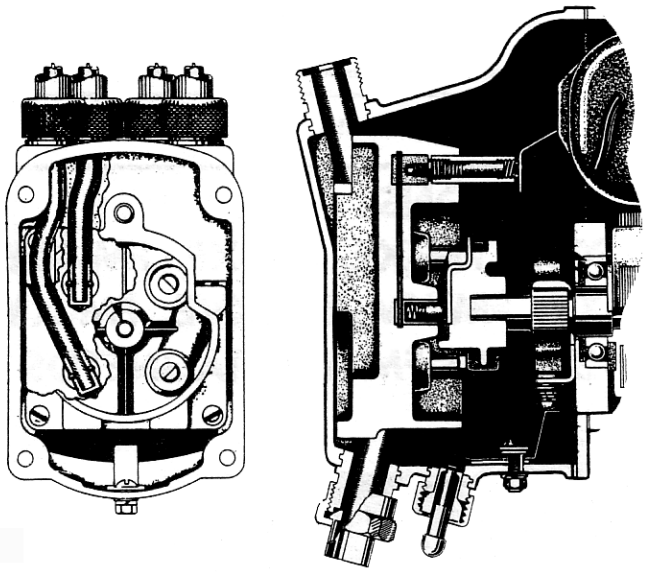


Fig. 2. End Cap and High Tension Cable Terminals

Carbon Brush and Spring

Magnetos for engines with two or more cylinders have a carbon brush and spring assembly in the center of the end cap cover, Fig. 3. Multi-cylinder radio-shielded magnetos have a distributor block in the end cap which contains a carbon brush and spring. Examine the brush and replace it if worn or damaged. The brush should move freely in its holder and should be under slight spring pressure. The high tension lead and suppressor assembly can be unscrewed from the distributor block for inspection, cleaning or replacement.

Breaker Arm, Support Bracket and Points

Breaker points should be checked and adjusted every 500 hours of operation.

To remove the breaker point assembly, Fig. 4, take out the breaker arm terminal screw which releases the coil lead wire, condenser lead, ground contact, and breaker arm spring. Then slide off the fulcrum pin snap ring and lift the breaker arm off the fulcrum pin. Take out the two contact support locking screws, lockwashers, and plate washers, and lift the support bracket from the bearing support.

Inspect the breaker points for pitting or pyramiding. A small tungsten file or fine stone should be used to resurface the points. If the points are badly worn or pitted they should be replaced. When the breaker points have been resurfaced or replaced be sure to adjust them to their proper clearance of 0.015 ±.002 in. at high point of cam. This adjustment is made in the following manner: Loosen the two contact support locking screws. Insert a screwdriver in the horizontal slot at the bottom of the contact support and move it by pivoting the tool between the two small bosses on the bearing support until the breaker points are adjusted to the correct clearance. Lock the assembly in place by tightening the locking screws; then take a final measurement of the breaker point gap after the locking screws are tightened. Oil film should be removed from the breaker points by using a brush and a small quantity of petroleum solvent.

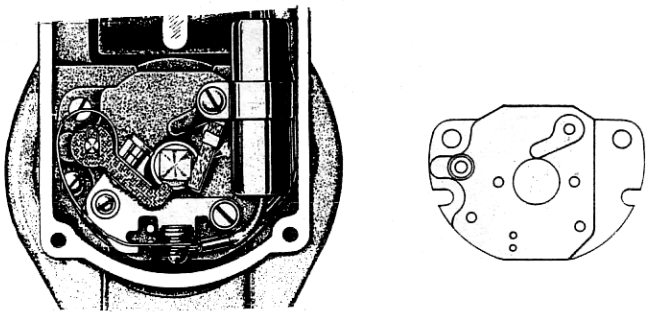
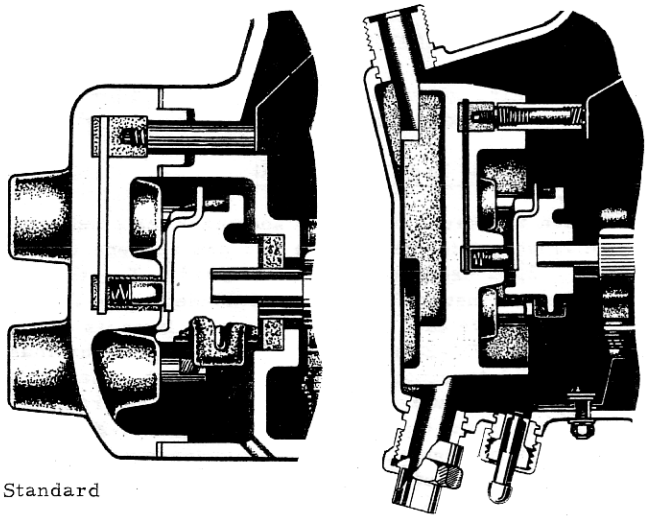


Fig. 4. Bearing Support with and without Point Set, Condenser and Cam Wick

Condenser

Remove the standard condenser from the magneto by unscrewing the condenser mounting screw, Fig. 5. To remove the feed-thru condensers on the FM-E6, FM-XE, FM-XFE, FM-XVE, FM-XYE and FM-XZE multiple cylinder radio-shielded magnetos, take out the two condenser mounting screws.

Clean the condenser and lead wire with a dry cloth; do not damage the lead wire. Then inspect lead wire for damage. Test the condenser for open circuit on a reliable condenser tester or substitute an identical new condenser in its place. The capacity of the AX-M-R-2433 condenser is 0.17-0.23 mfd. The capacity of the S-X-Y



Standard

Radio Shielded with Distributor Block

Fig. 3. Magnetos with Brush and Spring

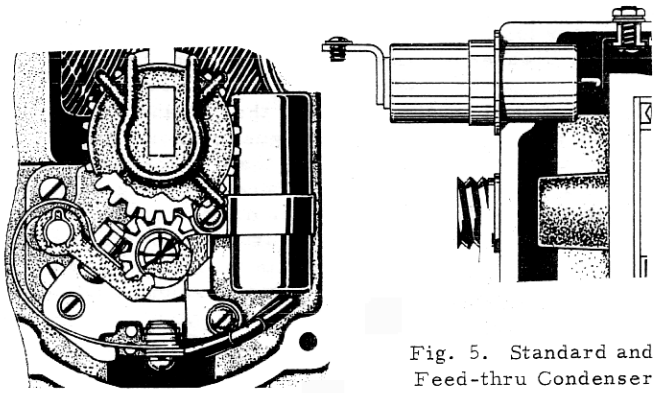
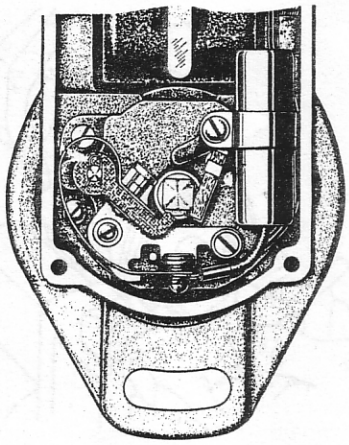
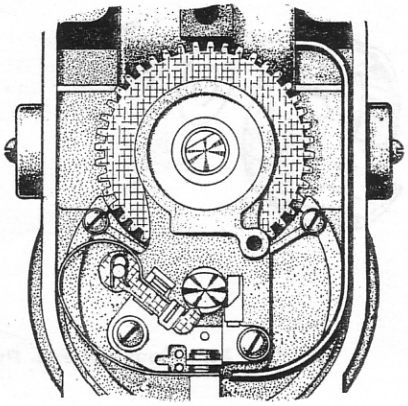


Fig. 5. Standard and Feed-thru Condenser





Condenser not shown

Fig. 6. Two Types of Bearing Supports, CW Rotation

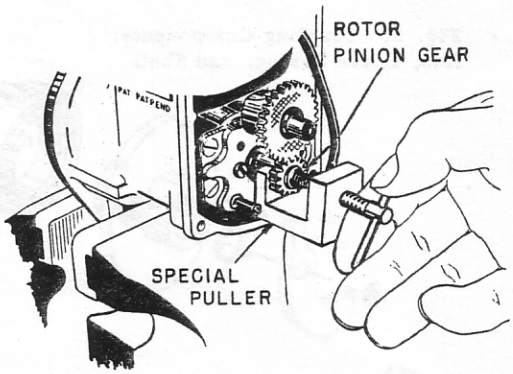


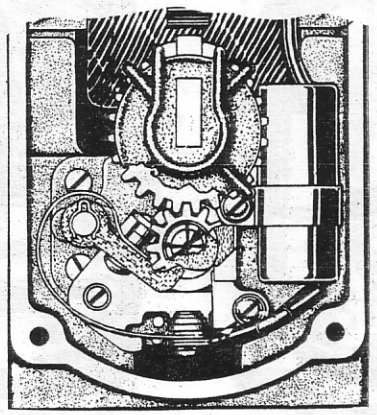
Fig. 6a. Use of
OMT76 Magnetic Rotor Gear Puller

-2433 Condenser is 0.28-0.36 mfd. The capacity of the L-V-2433 condenser is 0.37-0.43 mfd. The capacity of feed-thru condensers is as follows: HX2433 0.28-0.36 mfd, JX2433 0.17-0.23 mfd, KX2433 0.28-0.36 mfd and MX2433 0.28-0.35mfd. Test the condenser at 440v dc for breakdown voltage.

Bearing Support Assembly

Before removing the bearing support assembly, Fig. 6, be sure the breaker arm terminal screw has been removed. On types FM-X4, FM-XE4, FM-XF, FM-XFE, and FM-XZE, the magnetic rotor gear must be removed before the bearing support assembly can be taken out of the housing. Remove the magnetic rotor gear snap ring and draw off the gear using the pinion gear puller OMT76. The magnetic rotor gear pin can then be taken out. On later model magnetos the new style magnetic rotor gear Q5952 can be easily removed after taking off the rotor gear snap ring. Then take the bearing support out of the magneto housing.

On types FM-E, FM-XR and FM-XOR magnetos, if the bearing support is hard to get out, remove the impulse coupling on flange mounting magnetos, and lift out the oil slinger baffle disc, replace the impulse coupling nut on the rotor shaft, and strike the shaft a sharp blow. This will loosen the bearing support so it can be lifted out of the housing. The outer race of the rotor cam end bearing will remain in the bearing support.



CW Rotation

CCW Rotation

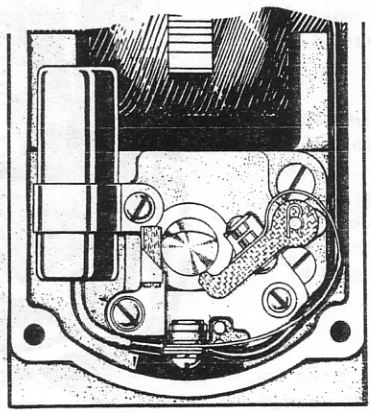


Fig. 7. Bearing Support with and without Distributor Gear

Coil - All FM-X Magnetos

The removal of the coil in all magnetos will be easier if the magnetic rotor is turned to place the magnets in a vertical position or until the flux lock is broken.

The coil in magnetos which have no reduction gear, Fig. 7, between the magnetic rotor and the distributor rotor, can be easily removed for testing. Take out the breaker arm terminal screw, remove the coil lead wire and the condenser. Loosen the coil bridge setscrews located on top of the housing at each side, then slide the coil out of the housing.

The coil in a magneto which has the distributor rotor geared to the magnetic rotor can be removed only after the bearing support assembly has been taken out of the housing. Refer to paragraph Bearing Support Assembly.

Clean the coil lead wire with a dry cloth; do not damage the lead wire. Inspect the coil visually for cracks or exposed windings which would be cause for discarding the coil. Test the coil on a reliable tester.

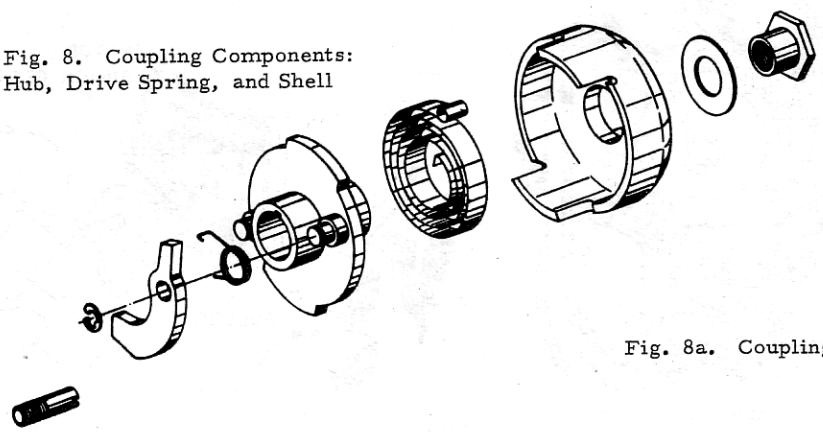
Impulse Coupling

Although much service work can be performed on the magneto without taking the impulse coupling off the rotor shaft, the removal of the magnetic rotor will necessitate complete removal of the coupling. We recommend that the coupling be removed for cleaning and lubrication whenever major service work is done on the magneto.

An impulse coupling is a mechanical device installed on the magnetic rotor shaft between the magneto and engine drive. Its prime purpose is to intensify the ignition spark at low rotative speed, and to automatically retard the ignition spark during the engine starting to eliminate backfire.

The impulse coupling assembly, Fig. 8, consists of a shell, flat or coiled drive spring and coupling hub assembly with or without pawl springs, which is keyed to the magnetic rotor shaft. The drive spring has one end engaged in the longer slot in the coupling hub while the other end has a loop formed which fits into the coupling shell. The coupling shell is fitted into the drive member on the engine drive shaft.

Fig. 8. Coupling Components: Hub, Drive Spring, and Shell



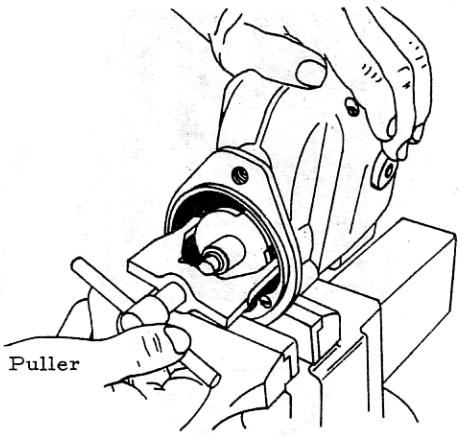


Fig. 8a. Coupling Hub Puller

When the engine is operating at slow speed, the pawl in the coupling hub engages the stop pin in the magneto housing, which prevents further movement of the magnetic rotor. As the engine continues to operate the shell winds up the drive spring. At the point in the engine cycle when the fuel mixture should be ignited, the pawl is released by movement of the coupling shell, and snaps the magnetic rotor forward at high speed through its firing cycle. As the engine speed increases, centrifugal force withdraws the pawls to a position where they no longer engage the stop pin.

In applications where the magneto operates in other than a horizontal position, the force of gravity cannot act upon the coupling pawls during the starting period. To cause the necessary engagement action, small wire springs are attached to each coupling pawl.

To remove the complete impulse coupling, take out the impulse coupling nut lockwire or turn down the lugs of the impulse coupling nut lockwasher; remove the impulse coupling nut and lockwasher. In the base mounted magnetos, remove the impulse outer shell screws, lift out the outer shell cupped washer and the outer shell felt washer.

Remove the complete impulse coupling from the magneto by using the OMT8 puller. If the tension applied by the puller does not loosen the coupling, tap the puller screw with a hammer, which will jar the coupling loose from the rotor shaft. When the coupling is removed, lift out the coupling outer shell flat washer used on base mounting magnetos. The coupling should be disassembled only by an experienced service station. In the event the shell comes loose from the hub when the coupling nut is taken off, care must be exercised in reassembly.

Place the coiled end of the coupling spring in the slot in the shell in the correct rotation for the magneto: clockwise for CW rotation, counterclockwise for CCW rotation viewed when the coupling shell is turned up. Engage the straight end of the spring in the longer slot in the coupling hub and turn the hub one full turn, then push the assembly together and install it onto the magneto.

Distributor Gear Assembly

There are three types of distributor bearings used in FM-X magnetos. An oilite sleeve bearing or a needle bearing may be used in types FM-X4, FM-XE, FM-XF2 FM-XYE and FM-XZE magnetos. To remove the distributor rotor gear, remove the distributor shaft snap ring and slide the shaft and gear from the bearing support, Fig. 9.

Ball bearings are used in the FM-E, FM-XR, and FM-XOR magnetos. To remove the distributor bearing from these magnetos, take out the distributor shaft snap ring. Place a piece of soft lead on the bench, turn the bearing support over so the distributor shaft points downward, grip the bottom of the bearing support with both hands, and strike the end of the distributor shaft on the lead a few times to jar the shaft loose from the bearing.

Distributor sleeve bearings may be pressed out of their respective bearing supports by means of the hand screw press 370TD, and the distributor bearing tool TD2252A. To remove the distributor ball bearing, take off the distributor bearing snap ring and press the bearing out of its support.

Magnetic Rotor Types FM-X, FM-XV

There are three types of magnetic rotors used in the series X magnetos: a two-pole rotor with block magnets; a two-pole rotor with bar magnets perpendicular to the rotor axis; a four-pole rotor with a cylindrical magnet, Fig. 10.

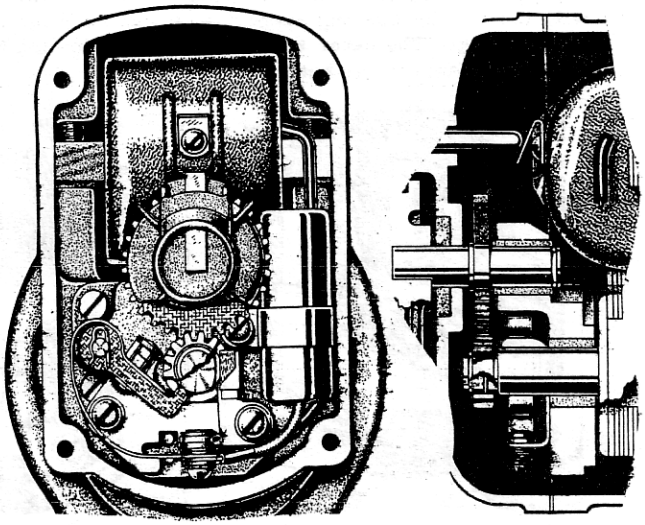


Fig. 9. Bearing Support with Distributor Gear Assembly and Distributor Rotor

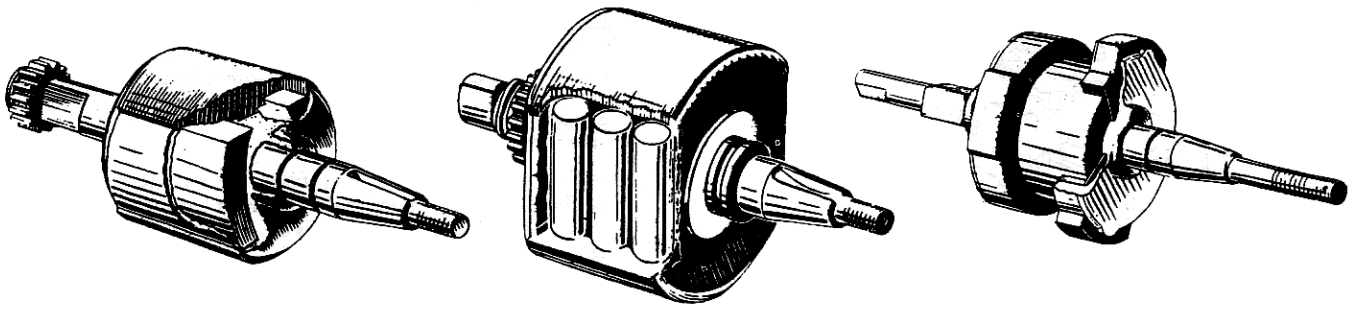


Fig. 10. Two-pole Rotor with Block Magnets. | Two-pole Rotor with Bar Magnets Placed Perpendicular to Rotor Axis | Four-pole Rotor with Cylindrical Magnet

With the impulse coupling and bearing support removed, take out the oil slinger baffle disc, found only on flange mounting magnetos with integral flange. Then remove the rotor drive end seal outer washer by striking it with a punch on the shaft edge. This dishes the washer and permits easy removal. On more recent models, the rotor drive end seal outer washer is made with one edge cut flat making it easy to insert the point of a screwdriver and loosen the washer. Discard the washer after it has been removed from the magneto.

Lift out the rotor drive end seal and the rotor drive end seal inner washer. This washer is a loose fit but may be difficult to remove due to the adhesion of bearing grease. Finally, remove the magneto rotor shaft snap ring which is found only on the types FM-X, FM-XD, FM-XDE, FM-XE, FM-XF, FM-XFE and FM-XZE magnetos.

Press the rotor out of the housing. Place the assembly in the adjustable press with the cam end of the rotor shaft carefully centered in the large hole of the base plate. Then place the brass protective cap over the threaded end of the rotor shaft and apply an even pressure by slowly turning the drive screw. As soon as the rotor is pressed out of the drive end bearing it may be removed from the magneto housing.

In magnetos that have the rotor drive end bearing retaining washer, this washer must be removed before the bearing can be pressed out of the housing.

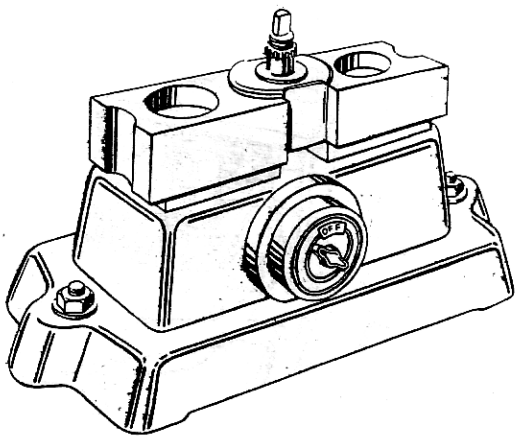


Fig. 11. Magnetizing Standard Two-pole Rotor with Bar Magnets. To magnetize standard two-pole rotor with block magnets, use same setup but reverse charging blocks.

Remagnetizing Magnetic Rotor

Due to the exceptional stability of the Alnico magnets used in Fairbanks Morse magnetos, it is recommended that the rotor be remagnetized only when it has been definitely determined that the ignition spark is below the required minimum value. The remagnetizing process involves the use of suitable equipment and should be undertaken in accordance with the following instructions.

Magnetization

The length of the magnetizing time depends on the type and strength of the charger. It is recommended that the rotors be given a minimum charge of 30 seconds, broken into two periods, or "shots." Arrangements should be made to place the rotor in the magneto housing as soon as it is taken from the magnetizer.

Two-pole Rotors

Determine the polarity of the rotor and the magnetizer, Fig. 11. Place the magnetic pole of the rotor, which attracts the N pole of a compass, in contact with the magnetic pole of the charger which attracts the S pole of the compass. By holding the rotor in the vicinity of a charger while it is in operation, the attraction of unlike poles is easily discernible.

All rotors except those for type FM-XV magnetos are of the two-pole design and should be placed in the charging blocks as described above. The large radii of the charging blocks should be used for rotors from types FM-E, FM-XR and FM-XOR magnetos, and the small radii should be used for rotors from type FM-X units.

Four-pole Rotors

Four-pole rotors, Fig. 12, used in type FM-XV magnetos, must be remagnetized with special care. These rotors have large cylindrical magnets with the axis of the poles parallel to the shaft. The magnetizing blocks must be placed on the charger with maximum surface contact. Insert the rotor in the drilled holes of the magnetizing block with the keyway up.

Drive End Ball Bearing

Release the bearing snap ring with snap ring pliers, and place the magneto in the hand screw press 370TD. Put a brass protective cap over the center of the bearing, Fig. 13. As the screw is turned down, center the assembly in the press. Apply pressure evenly to the inner bearing race until the inner bearing race and ball re-

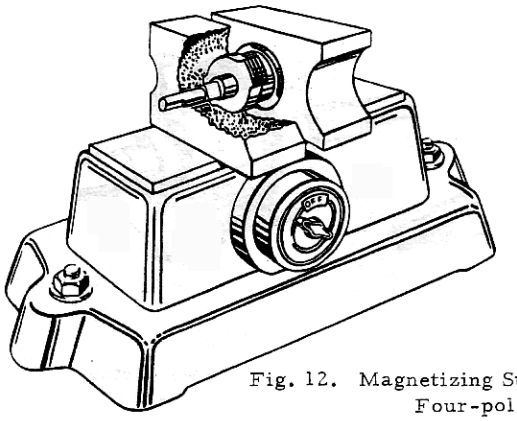


Fig. 12. Magnetizing Standard Four-pole Rotor

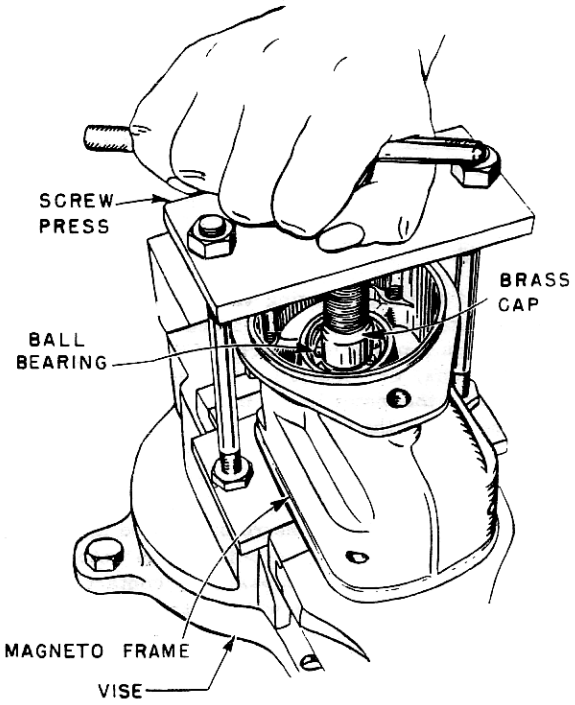


Fig. 13. Pressing Ball Bearing Out of Housing

taining ring are pressed out. The outer bearing race will remain in the housing and may be pressed out if desired. If the bearing is of the non-separable type, the outer race driver must be used with 370TD hand press to press the entire bearing out of the housing

Ball and Needle Bearings

Clean the grease out of the ball bearing, Fig. 14, and the needle bearings, Fig. 15, if used, by soaking them in a petroleum solvent, turning the bearing cage slowly to loosen the old lubricant. Then inspect the bearing carefully. Replace any bearings that are frozen or have broken balls, needles, or excessive axial play. Repack each bearing with FMC011 magneto bearing grease.

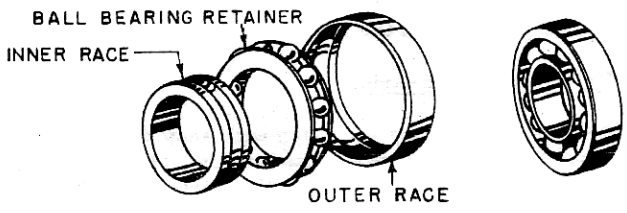


Fig. 14. Separable and Non-separable Ball Bearings

Sleeve Bearings

Oilite bearings, Fig. 16, found in serviceable condition during magneto overhaul may be replaced after soaking them in turbine oil. However, since these bearings are relatively inexpensive it is recommended that a new sleeve bearing be used when the magneto is reassembled.

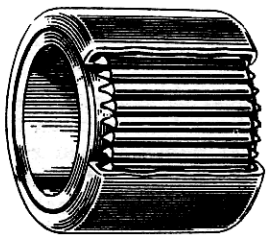


Fig. 15. Needle Bearing

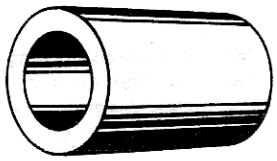


Fig. 16. Sleeve Bearing

Miscellaneous Parts

All other parts should be cleaned with a small, stiff brush moistened with a petroleum solvent. Inspect all castings and machined parts for chips, cracks, stripped or mutilated thread or other defects. Inspect all gears for chips, cracks, broken teeth; all bearing surfaces and keyways and all springs for bending, cracking or loss of tension. Replace any defective parts.

REASSEMBLY OF MAGNETO

If during the overhaul of the magneto the housing has been cleaned with any type solvent solution, be sure to remove any traces of the solution with water and finally remove any remaining water and foreign material with a

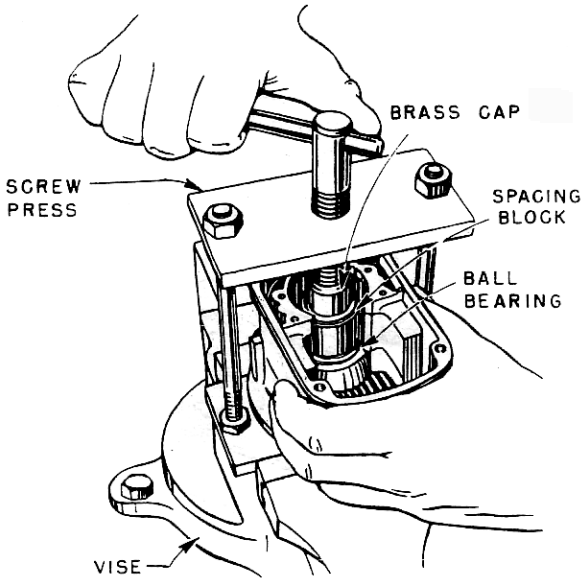


Fig. 17. Pressing Rotor Drive End Bearing into Housing

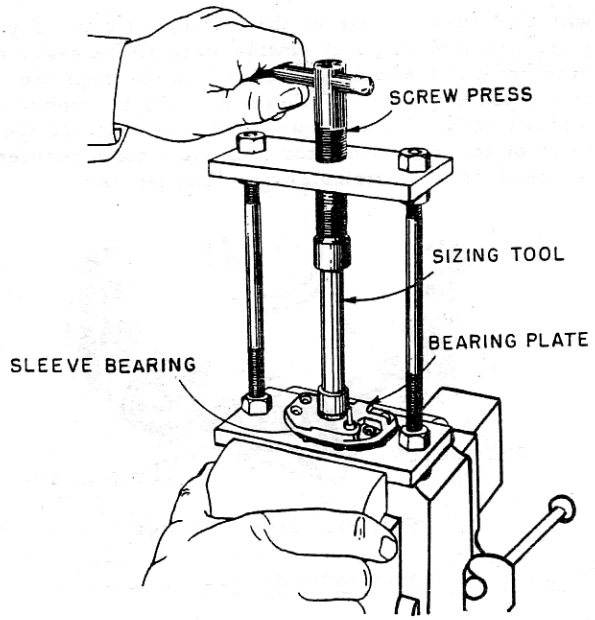


Fig. 18. Pressing Sleeve Bearing into Bearing Support

Petroleum solvent. Then dry the housing thoroughly before reassembling the magneto.

Replacement of Drive End Bearing
Types FM-X1, FM-X2, FM-X4, FM-XE4

The drive end ball bearing used in types FM-X1, FM-X2, FM-X4, and FM-XE4 magnetos, when cleaned, inspected, and repacked with FMCO11 magneto bearing grease, may be replaced in the housing, Fig. 17. Center the bearing by hand, in the housing, and place the housing in the screw press. Place the bearing above the support block carefully centering it with the bearing. Then turn down the drive screw of the press, placing the brass cap between the drive screw and the support block. Be sure the assembly is perpendicular in the press before forcing the bearing into the housing. Replace the magnetic rotor drive end bearing snap ring.

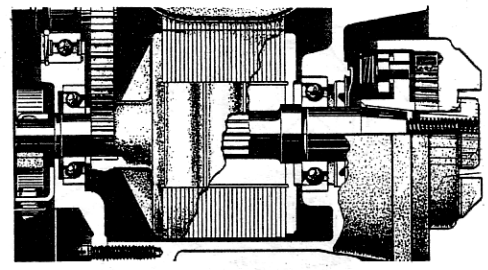
Replacement of Sleeve Bearings

Push the new sleeve bearing on the end of tool TD2252A and place the bearing support plate and tool in the 370TD hand screw pressiin the same position as for removal, Fig. 18. Apply an even, gradual pressure, pushing the bearing into the bearing support until it is flush with the breaker side of the plate. When both the magnetic rotor bearing and the distributor bearing in types FM-XF2, FM-X4, and FM-XE4 magnetos have been replaced, the bearing support is ready to be replaced in the housing.

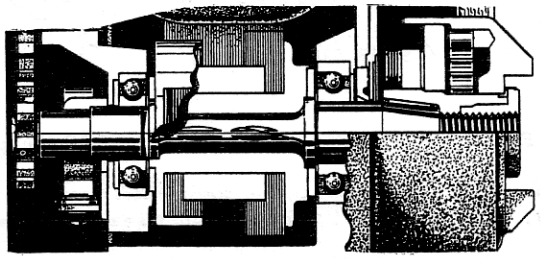
Press the distributor ball bearing into its recess, types FM-E, FM-XR, FM-XOR, using the 370TD press, and replace the distributor bearing snap ring. Then press the distributor shaft into place using the hand press, and replace the distributor shaft snap ring. The bearing support is ready to be replaced in the housing.

Reassembly of Magnetic Rotor
Types FM-XV, FM-XOR, FM-E

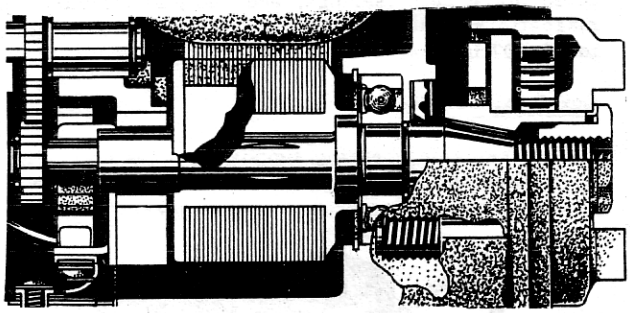
Place a new magnetic rotor bearing oil seal in the drive end recess of the rotor, and a new magnetic rotor seal



Two-pole Rotor with Perpendicular Bar Magnets



Four-pole Rotor with Cylindrical Magnet



Two-pole Rotor with Block Magnets

Fig. 19. Three Types Magnetic Rotors Assembled in Housing

in the cam end recess of the rotor for type FM-XV magnetos, Fig. 19. Slide the bearing thrust washer next to the magnetic rotor gear on rotors for types FM-XR, FM-XOR, and FM-E magnetos. Place the assembly the hand screw press and with the rotor accurately aligned with the bearing race, press the inner bearing race onto the rotor using the inner race driver OMT82 as an auxiliary tool. Press the bearing race for the drive end bearing of types FM-XR, FM-XOR, and FM-E magnetos onto the rotor until it reaches the shoulder of the lamination assembly. Press the races for the other bearings onto the rotor as far as the washers and cork seals will permit. Place the ball retainer on the inner bearing races and replace the rotor and bearing into the housing.

Replacement of Magnetic Rotor into Housing
Types FM-X1, FM-X2, FM-X4

The magnetic rotor types FM-X1, FM-X2, FM-XF2 and FM-XE4 magnetos must be pressed into the housing, Fig. 20, using the 370TD screw press. Place housing in the press with the drive end bearing accurately centered over the large hole in base plate. Then, with brass cap over cam end of the rotor, press the rotor into the bearing until the shoulder of the lamination assembly touches the inner race of drive end bearing. Replace the rotor drive end shaft snap ring in its groove on

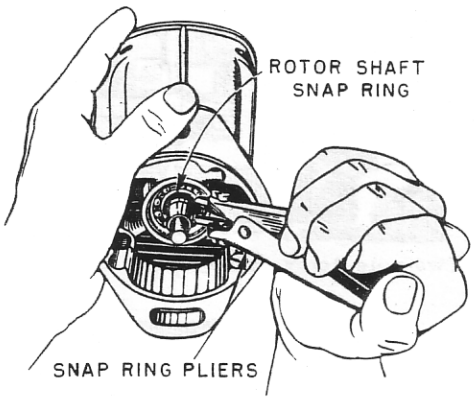


Fig. 20. Replacing Rotor Drive End Shaft Snap Ring

the rotor shaft; replace the rotor shaft seal inner washer, rotor shaft seal and rotor shaft seal outer washer.

When replacing the magnetic rotor on the FM-O, FM-XO, FM-XOR, FM-XY, FM-XV and all magnetos with three piece ball bearings, end end play tolerance of the magnetic rotor between its bearings should be held below 0.007 inches.

Coil Replacement

Before replacing bearing support, set the coil, Fig. 21, in the housing. Tighten the two coil bridge setscrews and seal them with a drop or two of gasket varnish.

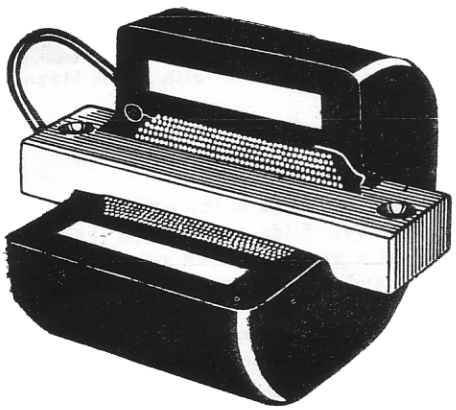


Fig. 21. Cutaway of Molded Coil

Replacement of Bearing Support Assembly and Internal Timing

Replace the distributor shaft and gear assembly in the bearing support of types FM-XF2, FM-X4, and FM-XE4 magnetos and secure it in place with the distributor shaft snap ring. Fasten the bearing support assembly in the housing. Replace the magnetic rotor gear pin and magnetic rotor gear. The former can be tapped into position by placing a hollow cylindrical tool, such as the OMT82, over the cam end of the rotor with the gear partially in place, and striking the cylindrical tool a few light taps. On later model magnetos the new type magnetic rotor can be easily assembled on the cam end of the magnetic rotor without special tools. A snap ring holds this gear onto the shaft. Care must be exercised in meshing the marked teeth of the magnetic rotor gear with the marked teeth of the distributor gear, Fig. 22. when reassembling a clockwise magneto the gears must mesh so that the tooth painted red on the magnetic rotor will mesh between the two teeth on the distributor gear marked "C". On a counterclockwise magneto the red tooth on the magnetic rotor gear must mesh between the two teeth on the distributor gear marked "A".

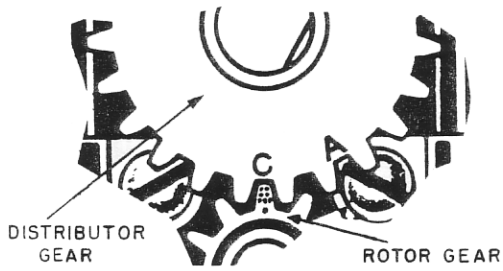


Fig. 22. Gear Markings

Rotation of Coupling Drive Springs

The coupling drive spring can be used for either rotation by simply turning it over. Care must be taken to place the spring correctly in the shell, since incorrect assembly will damage the inside anchor end. Fig. 23. illustrates the correct location of drive springs in series U coupling shells. Catch the inner end of the drive spring in the longer slot of the coupling hub and complete the assembly by winding the drive spring one full turn. Push the assembly together and key the coupling onto the rotor shaft. Replace the impulse coupling nut lockwasher, screw the impulse coupling nut into place, and turn up the lugs on the impulse coupling nut lockwasher, or replace the coupling nut lockwire, if used.

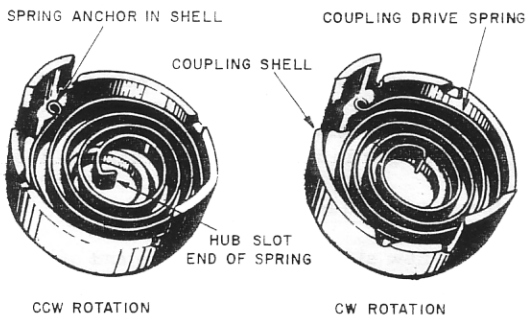


Fig. 23. Position of Drive Spring in Coupling Shell

Assembly of Breaker Mechanism

Remount the condenser on the bearing support. On type FM-XV magnetos the cam wick and holder assembly is mounted on the condenser mounting screw, along with the condenser. On all other magnetos except those with feed-thru condensers the cam wick and holder assembly is supported by the No. 8 contact support locking screw. Remount the breaker arm support bracket by means of the two support bracket locking screws, lockwashers, and flat washers. Slide the arm onto the fulcrum pin and replace the fulcrum pin snap ring.

Place the lead wire terminal from the coil, the terminal from the condenser, the terminal from the ground switch, and the end of the breaker arm spring onto the breaker arm terminal screw, and fasten this screw in

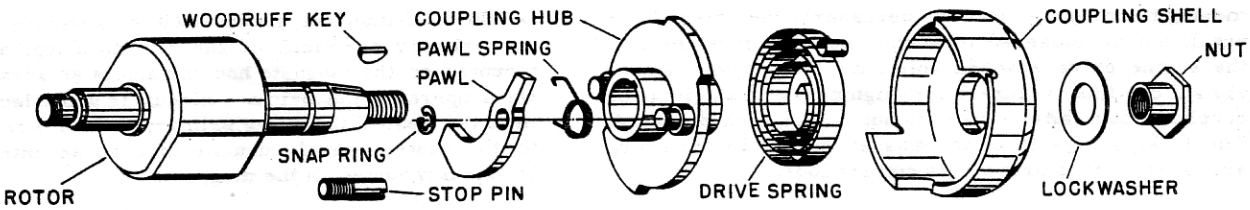


Fig. 24. Magnetic Rotor and Disassembled Impulse Coupling

the bottom of the support bracket. Measure the breaker. point clearance and adjust the clearance if necessary. Refer to paragraph under Breaker Arm, Support Bracket and Points, for details on adjusting breaker point clearances.

Sealing Magneto

Coat the contact surface of the end cap of the standard magnetos with Fairbanks Morse FMCO2 Gasket Varnish. Place a new gasket in the joint and fasten the end cap on the housing with the end cap screws. Push a new distributor shaft seal into the distributorsshaft recess in the end cap of types FM-X4, FM-XF2, FM-XR, FM-XOR and FM-XV4B7 magnetos. Replace the distributor rotor on the end of the distributor shaft, pushing it into place as far as it will go. Then replace the end cap cover using a new gasket.

TIMING MAGNETO TO ENGINE

Accurate timing of the magneto to the engine produces an ignition spark in each cylinder at the exact instant the fuel mixture should be ignited for best engine performance. This instant, which is determined by the engine manufacturer, is designated as a given number of degrees of angular travel of the crankshaft before the piston reaches inner dead center on the compression stroke. When starting the engine, it is advisable to retard the ignition spark until it occurs late enough in the cycle to avoid backfiring. Impulse couplings when used with magnetos automatically provide this spark retarding feature while the engine is being started.

The importance of correctly timing the magneto to the engine cannot be overemphasized, and the steps described below should be followed carefully. Either the advancd spark position method or the impulse coupling trip method may be used. Whichever method is used, the breaker points must first be accurately adjusted to secure proper timing of the ignition spark.

Advance Spark Position Method

Magneto: Set the magneto for advance spark position in the No. 1 cylinder. This is done by turning the rotor from the coupling end in the direction opposite to normal rotation until the distributor contact lines up exactly with the timing boss. With certain exceptions the No. 1 outlet on four-cylinder magnetos is the upper left of the four terminals. On type FM-XOR six-cylinder magnetos the No. 1 cylinder outlet is usually diagonally upward, 30° to the left of vertical. When the magneto is timed for advance spark in the No. 1 cylinder, it should be held exactly in the position until coupled to the engine.

Engine: Engine builders usually indicate by marks on the flywheel and flywheel housing, the position of the engine for advance spark timing. Refer to the engine manufacturer's instruction book for details concerning timing marks on your particular engine. Then rotate the crankshaft until the timing marks coincide, indicating that the No. 1 cylinder is in advance-spark firing position. Be sure that the piston is on its compression stroke.

Impulse Coupling Trip Method

Magneto: Remount the end cap cover on the end cap. Set the magneto for spark discharge to the No. 1 terminal. This may be accomplished by use of a stiff, short length of wire placed in the No. 1 socket and bent to within 1/8 in. of the magneto frame. Then turn the magnetic rotor from the impulse coupling end in its normal direction of rotation until a spark is observed between the wire and the housing. Hold the coupling in the position in which the trip occurred.

Engine: Remove the spark plug, or otherwise determine top dead denter for the piston in the No. 1 cylinder. Then turn the engine over until this position is reached, being certain that the piston is just at the end of its compression stroke.

Coupling Magneto to Engine

Without disturbing the setting of either magneto or engine as determined by the methods above, couple the engine in the following manner

Flange Mounting Magnetos: Engage the drive lugs of the impulse coupling with the driving slots of the engine drive member. A slight movement of the engine flywheel may be necessary to secure accurate alignment. Tighten capscrews and nuts securely.

Base Mounting Magnetos: If no change has been made in the position of the member, it is necessary only to engage the drive lugs of the impulse coupling with the drive slots of the float disc. Be sure that the shaft assembly is properly aligned before securing the base mounting screws.

Adjustable Drive Members

Most engines using base mounting magnetos are equipped with adjustable drive members, Fig. 25. Ordinarily the position of the drive member is not altered when re-

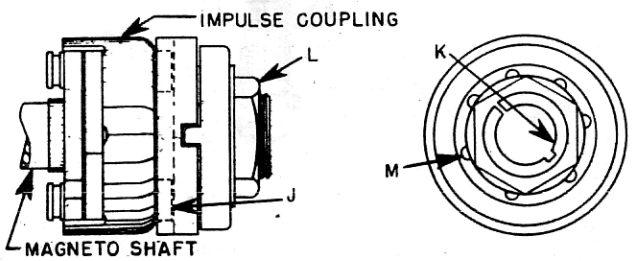


Fig. 25. Adjustable Drive Member

moving the magneto but when necessary, the drive collar nut L can be loosened to permit relative movement of the engine drive shaft in collar K. The drive member slots J can then be turned for alignment with the impulse coupling lugs, after which the nut L should be tightened. The locking lugs M of the washer should be turned up around the nut to prevent its coming loose.

Primary Ground Switches

Engines may be stopped by shutting off the fuel supply or grounding out the magneto ignition circuit. Shutting off the fuel supply has the disadvantage of not stopping the engine quickly, while grounding the ignition circuit stops the engine at once.

Battery ignition systems must be opened to stop the engine while in magneto ignition systems the ignition circuit must be grounded to stop the engine.

Primary ground swtiches must be located in the primary circuit of either type magneto, Fig. 26. The action is instantaneous and fuel is left in the fuel system for immediate starting.

There are many types or styles of ground switches, but in general they may be divided into two groups, those located on the unit and those located away from the unit.

On the self-mounted ground switch, a wire is run from the primary terminal of the coil to a spring switch mounted on the magneto housing and is so arranged that when operated the primary circuit is grounded. On the mounted switch the same primary coil wire is extended to the control panel, usually through an intermediate terminal mounted on the magneto.

When stopping the engine by grounding out the primary circuit, the switch must be kept closed until the engine stops.

Radio Shielded Magnetos

The high voltage spark discharge, which provides ignition for the engine, often causes interference in radio reception. Frequently it is necessary or desirable to eliminate this interference, Fig. 27. In principle, the radio shielding of a magneto requires the replacement of the plastic end cap by an all metal end cap with an insulated plastic distributor block mounted inside. Special outlets are provided for the metal encased high tension cables, and the spark plugs are metal covered. All this exterior metal housing is interconnected and grounded to function as a shield and absorb the interference causing waves. On certain magnetos for military applications the primary ground terminal is located on the end of the feed-thru condenser or on the end of the primary circuit connector.

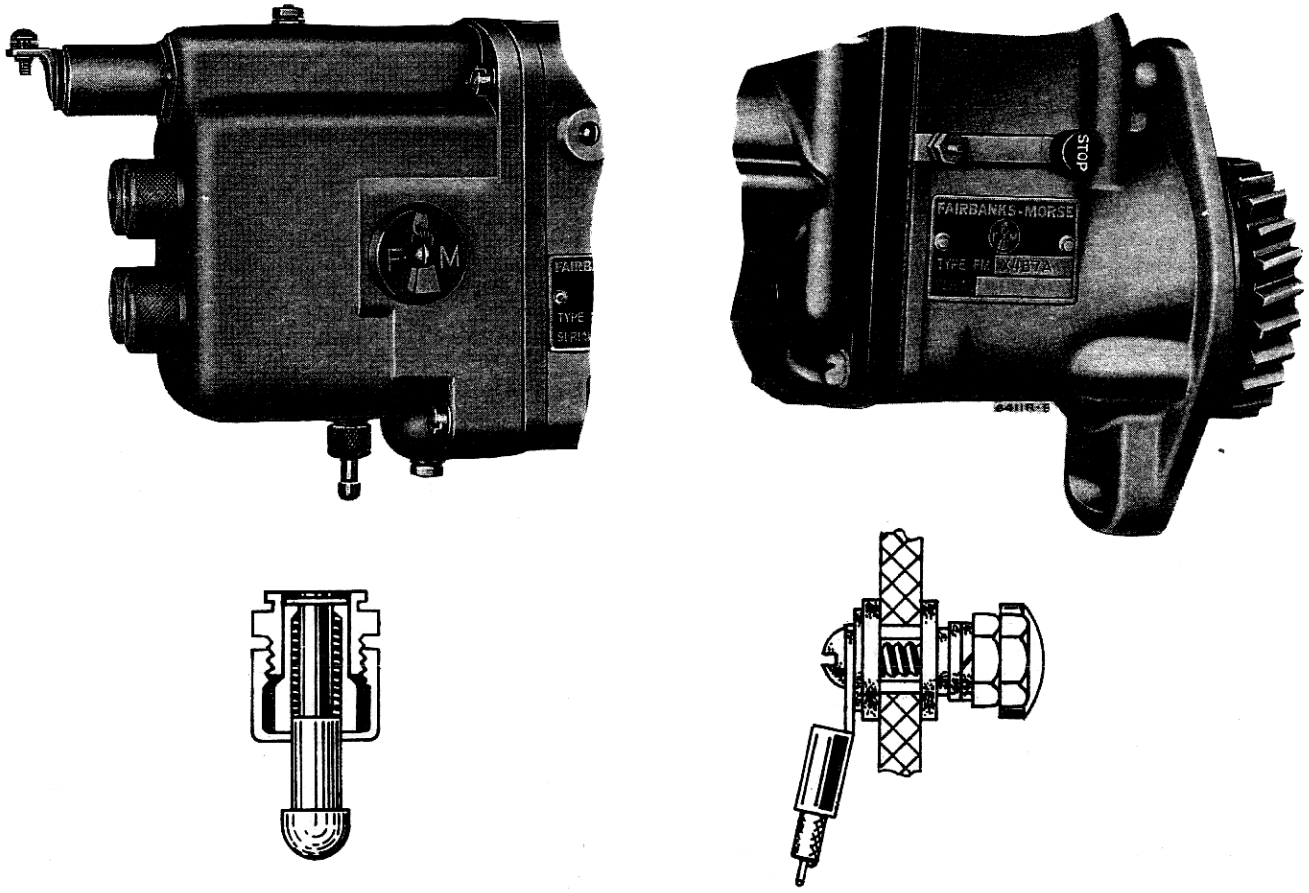


Fig. 26. Push-button and Lever Type Type Ground Switches

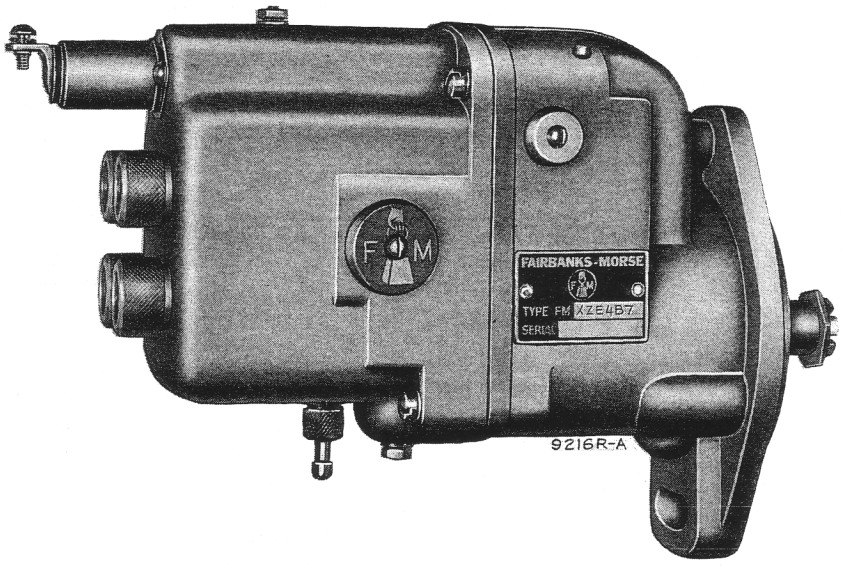


Fig. 27. Complete Radio Shielded Magneto

ALABAMA	
Birmingham	Birmingham Electric Battery Co.
ALASKA	
Seattle	Hatch & Kirk, Inc.
ARIZONA	
Phoenix	Charlie C. Jones Battery & Elec. Co.
ARKANSAS	
Shreveport, La.	Magneto Ignition Service Co.
Tulsa, Okla.	Magneto Ignition Co., Inc.
Memphis, Tenn.	Automotive Electric Service Co. Inc.
CALIFORNIA	
Los Angeles	Pacific Equipment Co.
San Francisco	H. G. Makelim Co.
San Diego	Pee Gee Parts
COLORADA	
Denver	Central Motive Power, Inc.
CONNECTICUT	
Boston, Mass.	A. &J. Auto Ignition Co.
DELAWARE	
Baltimore, Md.	Parks & Hull Automotive Corp.
Philadelphia, Pa.	Motor Ignition Co.
FLORIDA	
Fort White	Paul Hunter
Miami	Electric Sales & Service
Orlando	Interstate Diesel Service
GEORGIA	
Atlanta	Auto Electric & Diesel Co.
Swainsboro	Dealers Supply Co.
Atlanta	Stovall & Co.
HAWAII	
Honolulu	Lanco Engine Services
IDAHO	
Seattle, Wash.	Hatch & Kirk, Inc.
ILLINOIS	
Elmhurst	Illinois Auto Electric Co.
Elmhurst	Midwest Engine Warehouse
Maryland Heights	Electrical Parts & Service Co.
INDIANA	
Indianapolis	Eagle Machine Company
South Bend	Michiana Midget Motors
IOWA	
Des Moines	Electrical Sales & Service Co.
Des Moines	Magneto, Carburetor & Electric Co.
Omaha, Nebr.	Carl A. Anderson, Inc.
KANSAS	
Kansas City, Mo.	Electrical & Magneto Service Co. Inc.
Amarillo, Texas	Wilson Battery & Electric Co.
KENTUCKY	
Louisville	Ellingsworth Auto Electric Co.
Memphis, Tenn.	Automotive Elec. Service Co. Inc.
LOUISIANA	
New Orleans	John M. Walton, Inc.
Shreveport	Magneto Ignition Service Co.
MAINE	
Boston, Mass.	A. &J. Auto Ignition Co.
MARYLAND	
Baltimore	Parks & Hull Automotive Corp.
MASSACHUSETTS	
Boston	A. &J. Auto Ignition Co.
MICHIGAN	
Detroit	Auto Electric & Service Corp.
Milwaukee, Wis.	Wisconsin Magneto Co.
MINNESOTA	
St. Paul	Diesel Service Co.
West St. Paul	Carl A. Anderson, Inc.
MISSISSIPPI	
New Orleans, La.	John M. Walton, Inc.
Memphis, Tenn.	Automotive Elect. Service Co., Inc.
Tupelo	The Wright Company
MISSOURI	
Maryland Heights	Electric Parts & Service Co.
Kansas City	Electrical & Magneto Serv., Inc.
Memphis, Tenn.	Automotive Elec. Service Co., Inc.
MONTANA	
Billings	Original Equipment Co.
Seattle, Wash.	Hatch & Kirk, Inc.
NEBRASKA	
Denver, Colo	Central Motive Power, Inc.
Omaha	Carl A. Anderson, Inc.
NEVADA	
Los Angeles, Calif.	Pacific Equipment Co.
San Francisco, Calif.	H. G. Makelim Co.
San Diego	Pee Gee Parts
NEW HAMPSHIRE	
Boston, Mass.	A. & J. Auto Ignition Co.
NEW JERSEY	
Philadelphia, Pa.	Motor Ignition Co.
NEW MEXICO	
Denver, Colo.	Central Motive Power, Inc.
NEW YORK	
Buffalo	Hettrich Electric Service
Jamaica	John Reiner & Co.
Woodside, L. I.	Broadway Ignition Co., Inc.
East Amherst	Chuck's Cart Sales
NORTH CAROLINA	
Charlotte	Automotive Elec. Associates, Inc.
NORTH DAKOTA	
St. Paul, Minn.	Diesel Service Co.
West St. Paul, Minn.	Carl. A. Anderson, Inc.
Columbus, Ohio	Columbus Diesel Supply Co.
OHIO	
Walbridge,	V. E. Petersen
Cleveland	The Cleveland Ignition Co.
Marietta	Marietta Automotive Warehouse
Cincinnati	J & N Auto Electric
OKLAHOMA	
Oklahoma City	American Electric Ignition Co.
Tulsa	Magneto Ignition Co., Inc.
OREGON	
Portland	Automotive Products, Inc.
PENNSYLVANIA	
Buffalo, N. Y.	Hettrich Electric Service
Philadelphia	Motor Ignition Co.
Pittsburgh	Automotive Ignition Co.
Scranton	Scranton Auto Ignition Co.
Philadelphia	Philadelphia Engine, Inc.
RHODE ISLAND	
Boston, Mass.	A. & J. Auto Ignition Co.
SOUTH CAROLINA	
Columbia	Magneto & Elec. Service In.
SOUTH DAKOTA	
Omaha, Nebr.	Carl A. Anderson, Inc.
St. Paul, Minn.	Diesel Service Co.
West St. Paul, Minn.	Carl A. Anderson, Inc.
TENNESSEE	
Atlanta, Ga.	Auto Electric & Magneto Co.
Memphis	Automotive Elec. Service Co., Inc.
Nashville	Automobile Electric Service Co.
TEXAS	
Amarillo	Wilson Battery & Electric Co.
Dallas	The Grayson Co.
Dallas	The Motor Mart
El Paso	Spitzer A & I Products
Fort Worth	McCoy Sales & Service
Houston	Wahlberg-McCreary, Inc.
Kilgore	Magneto Sales & Service Co.
San Antonia	S. X. Callahan
McAllen	Hoff Parts and Service
UTAH	
Salt Lake City	Diesel Electric Service & Supply
VERMONT	
Boston, Mass.	A. & J. Auto Ignition Co.
VIRGINIA	
Baltimore, Md.	Parks & Hull Automotive Corp.
Bluefield, W. Va	Groseclose Auto Electrical Service
Norfolk	Diesel Injection Sales & Service
WASHINGTON	
Seattle	Hatch & Kirk, Inc.
WEST VIRGINIA	
Baltimore, Md.	Parks & Hull Automotive Corp.
Bluefield	Groseclose Auto Electrical Service
Pittsburgh, Pa.	Automotive Ignition Co.
WISCONSIN	
Milwaukee	Wisconsin Magneto Co.
St. Paul, Minn.	Diesel Service Co.
West St. Paul, Minn.	Carl A. Anderson, Inc.
WYOMING	
Denver, Colo.	Central Motive Power, Inc.
Billings, Mont.	Original Equipment Co.

EXPORT

Colt Industries Engine Accessories Operation
Beloit, Wisconsin

MEXICO

Mexico City, D. F.	Overseas, S. A.

CANADA

ALBERTA	
Calgary	Hutton's, Ltd.
Edmonton	Loveseth, Ltd.
BRITISH COLUMBIA	
Vancouver	Magneto Sales & Service, Ltd.
MANITOBA	
Winnipeg	Auto Elec. Service (Western) Ltd.
ONTARIO	
Toronto	Auto Electric Service Co., Ltd.
Winnipeg, Manitoba	Auto Elec. Service (Western), Ltd.
SASKATCHEWAN	
Regina	Electric Motor Service
Saskatoon	Lambert Electric, Ltd.