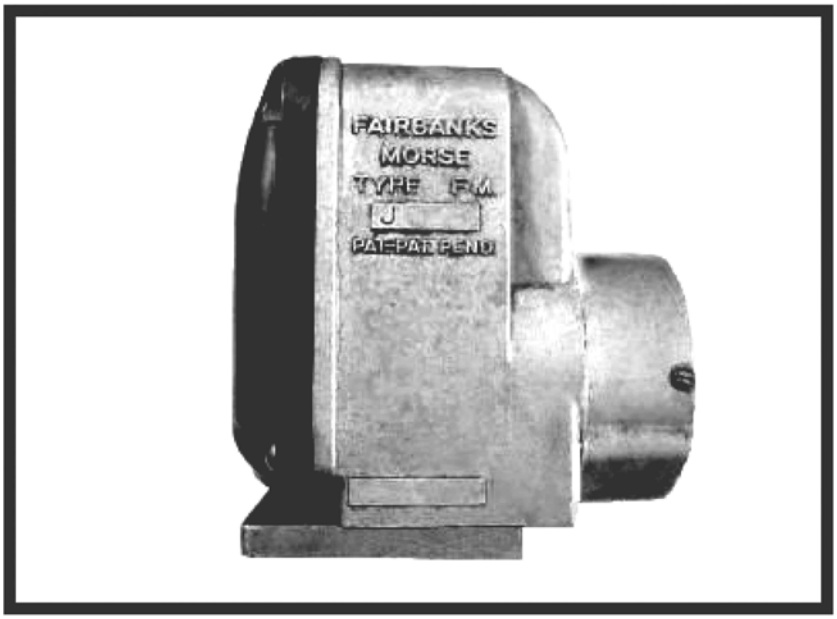
Fairbanks-Morse Magneto



SECTION VI

Ignition System

6-1 GENERAL DESCRIPTION

a. MAGNETO - The magneto is an electrical generating device designed to produce controlled electric-spark discharges. These discharges, which must be of sufficient intensity to meet the ignition requirements of the Gravely internal combustion engine are produced independently of any external source of electric power. The magneto depends solely upon the mechanical energy supplied by hand cranking, which obviates the need for a heavy battery or the generating system to keep it charged.

To increase engine starting efficiency. an impulse-starter mechanism has been incorporated with the magneto, which rotates the magneto shaft much faster than the engine cranking speed, thereby producing a high intensity spark for cranking purposes. This device functions only at cranking speeds and automatically retards the ignition spark while in operation.

b. SPARK PLUG -The actual ignition spark which occurs in the engine cylinder takes place between the electrodes of the spark plug; therefore the importance of the type and the condition of the plug should never be overestimated. The spark plug used in the Gravely engine is commonly referred to as the “cool”, type of plug, all spark plugs being classified into five groups; "hot", “warm”, “normal”. "cool", and "cold". "Cold" plugs are fitted with short insulators which quickly carry heat from the core, while hot plugs are filled with long insulators which dissipate the heat slowly.

The center electrode is generally made of a nickel alloy wire, while the insulator in which it is set is usually made of porcelain. The insulator possesses high electrical and heat resistance to mechanical pressure.

6-2. THEORY OF OPERATION.

Current generation begins in the primary (low tension) circuit when relative movement of the primary winding and the interlocking magnetic field occurs.

The current in the primary coil winding builds a magnetic field which permeates the turns of the secondary coil winding, this field reaching its peak simultaneously with the primary current. Breaker point action interrupts the current flow at the instant of maximum field, and causes the immediate and complete collapse of the magnetic field existing in the coil. The self-induced voltage occurring in the primary winding as a result of the breaker interruption of the primary circuit, is received by the condenser which is connected across the breaker points. This action induces a more rapid collapse of the primary field, and reduces arcing with consequent contact point burning.

The high ratio of turns in the coil secondary winding to those of the primary. induces a very high voltage in the secondary, since each line of force in collapsed primary field cut the turns of the secondary winding. The secondary circuit or high tension is established when this induced voltage is high enough to jump the gap between the spark plug electrodes.

6-3. TROUBLESHOOTING CHART.

TROUBLE	POSSIBLE CAUSE	SUGGESTED REMEDY
A. Flooding	Hot or cold engine. over rich fuel mixture.	Dry out cylinder, crank engine slowly, fuel shut-off; or let engine stand idle for short interval.
B. Insufficient fuel or air.	Empty fuel tank: clogged fuel supply line; clogged air intake.	Replenish fuel; clean fuel supply system and check carburetor; clean air intake system
C. Ignition Connections.	Loose or corroded terminals: broken cable: short circuited switch.	Clean or replace cable terminals; inspect soldered or clamped joints; test and replace cable; check ignition switch.
D. Spark plug	Corroded, worn or damaged points: cracked or carbonized Insulation.	New plug; clean points and insulator, adjust points to recommended opening; never attempt to adjust center electrode.

6-4. REMOVAL AND DISASSEMBLY OF FAIRBANKS-MORSE MAGNETO.

NOTE

Before attempting any repairs, remove all external dirt and provide a clean pan into which the parts may be placed as they are removed.

6-5. REMOVE MAGNETO. --Remove two cap screws which secure magneto to transmission and lift off while disengaging the coupling floating member.

6-6. REMOVE MAGNETO END COVER (5).- Remove four screws, lock washers, and flat washers (4) which fasten end cover (5) to magneto. Remove gasket (6).

6-7. REMOVE CONTACT POINT ARM (48).- Remove screw (44) and lock washer (43) from terminal at moveable contact point arm spring (46): then lift out arm (48).

6-8. REMOVE WICK (54).-Remove screw, (52). lock washer. and flat washer (53), then lift out wick and spacer (54).

6-9. REMOVE CONDENSER (2). Remove screw. lock washer, and flat washer (1), then lift out condenser (2).

6-10. REMOVE STATIONARY CONTACT BRACKET (99).--Remove screw, lock washer and flat washer (47) which fasten bracket and point (49) to bearing slate (50) and lift out. Remove adjusting screw (45).

6-11. REMOVE FRONT BEARING PLATE (50). - Remove four screws (51) then carefully pry and lift out hearing plate (50) and bushing (41).

6.12. REMOVE MAGNETO MOUNTING PLATE - Remove four cap screws and lock washers from under side of magneto and remove mounting plate.

6-13. REMOVE IMPULSE COUPLING SHELL (23).

a. Place contact point end of Rotor in vise equipped with leaded jaws, then bend lip of lock washer (25) away from nut (26), holding impulse coupling shell (23); remove nut and lock washer using pliers, lift out impulse coupling shell complete with drive spring (24).

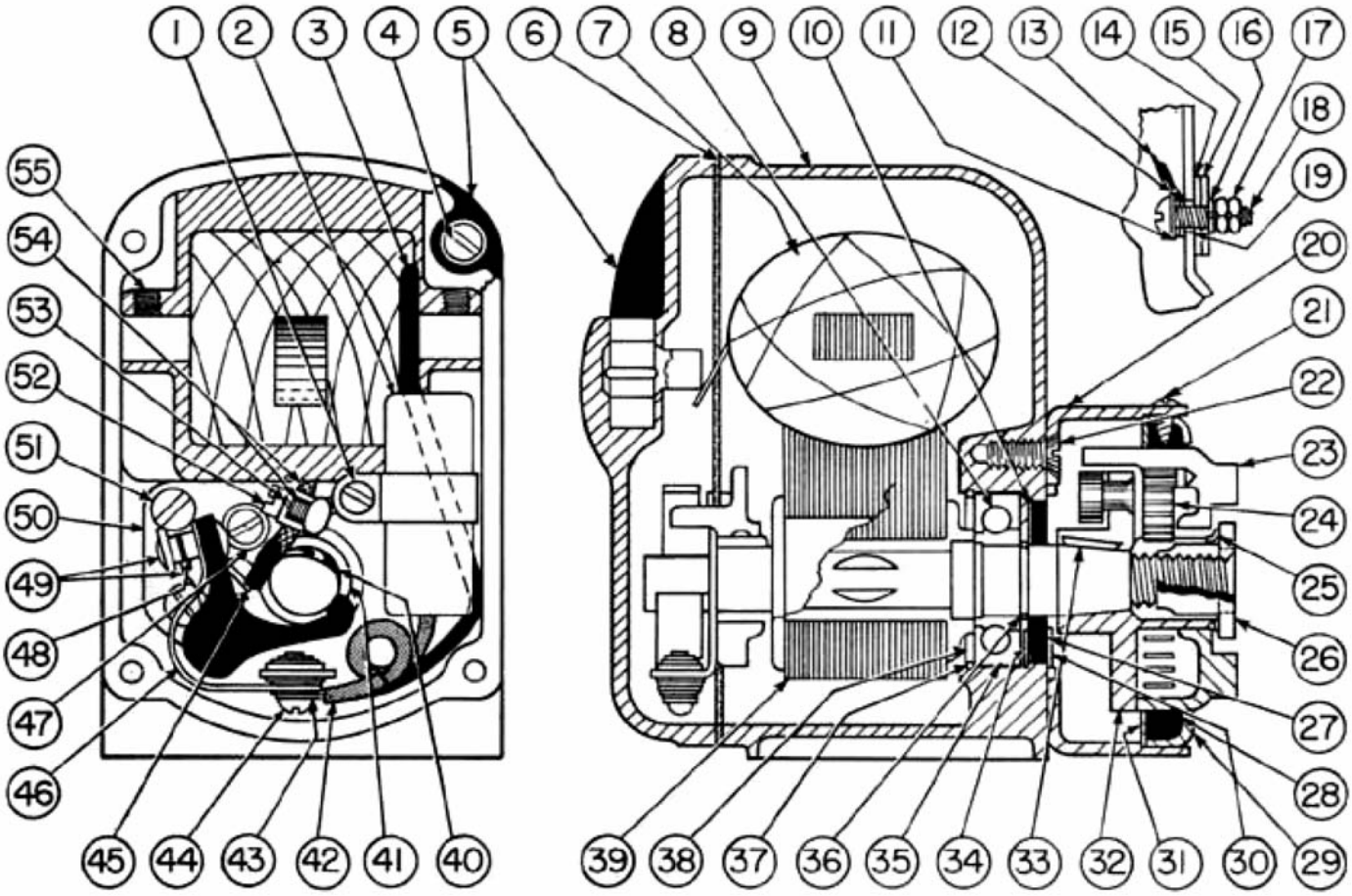


FIG. 25 NOMENCLATURE LIST FOR FAIRBANKS-MORSE MAGNETO

1. Screw Lock Washer & Flat Washer
2. Condenser
3. Primary Terminal
4. Screw Lock Washer & Flat Washer
5. End Cover
6. Gasket
7. Field Coil
8. Thrust Bearing
9. Magneto Housing
10. Thrust Washer (Inner)
11. Flat Washer
12. Insulating Washer
13. Ground Wire
14. Insulating Washer
15. Flat Washer
16. Lock Washer
17. Nut
18. Ground Terminal Screw
19. Insulating Bushing
20. Impulse Starter Housing
21. Self Tapping screw
22. Screw
23. Impulse Coupling Shaft
24. Drive Spring
25. Special Lock Washer
26. Nut
27. Thrust Washer (Outer)
28. Felt Washer
29. Cupped Washer
30. Rubber seal
31. Flat Washer
32. Coupling Hub
33. Key
34. Insulating Washer
35. insulating Strip
36. Snap Ring, Rotor Shot
37. Snap Ring, Bearing
38. Insulating Washer
39. Rotor
40. Cam
41. Sleeve Bearing
42. Condenser Terminal
43. Lock Washer
44. Screw
45. Adjusting screw
46. Spring
47. Screw, Lock Washer & Flat Washer
48. Contact Point Arm, Movable
49. Bracket & Stationary Point
50. Front Bearing Plate
51. Screw
52. Screw (Wick)
53. Lock Washer & Flat Washer
54. Wick and Spacer
55. Screw (Field Coil)

6-14. REMOVE COUPLING HUB (31). - Replace coupling nut (26) and turn down tight, then back off one turn. Using pliers, grip coupling hub (32) and pry up while tapping nut with soft hammer. Lift hub from Rotor taper then remove nut (26), hub {32), and key (33).

6-15. REMOVE IMPULSE STARTER HOUSING (20).

a. Remove two self-tapping screws(21), then using a screwdriver, pry out cupped washer (29) and lift out felt washer (28) and flat washer (31)

b. Remove two screws (22) which fasten impulse starter housing (20) to magneto, then lift off housing.

6-16 REMOVE ROTOR (35).

a. Remove outer thrust washer (27) then pry out rubber seal (30), and inner thrust washer (10).

b. Using a screwdriver remove outer snap ring (36) from rotor shaft.

c. Using a fibre hammer, tap rotor from bearing(8), then remove it from housing.

6-17. REMOVE ROTOR THRUST BEARING (8).

a. Remove inner snap ring (37) using long nosed pliers.

b. Lift out the insulating washer (34), then tap bearing (8) toward magneto body and remove.

c. Lift out bearing insulating strip (35) and the remaining insulating washer (38).

6-18. REMOVE FIELD COIL (7) -Using a narrow bladed screwdriver loosen the two screws (55) in top of magneto body then lift out coil.

NOTE

It will be necessary to tap screwdriver lightly to loosen the screws.

6-19 REMOVE GROUND WIRE AND TERMINAL

a. Remove nuts (17) from ground wire terminal screw (18), then remove lock washer (16), flat washer (15), and insulating washer (14).

b. From inside the magneto, remove terminal screw (18), ground wire (13), flat washer (11), insulating washer (12), and insulating bushing (19).

6-2O. INSPECTION AND SERVICE FOR FARBANKS-MORSE MAGNETO - before inspecting and reassembling the parts, provide a pan of clean solvent, clean rags, and a stiff bristle brush. Do not soak felt parts or insulating material in solvent. Replace all gaskets and test all insulating parts electrically before reinstalling them.

6-21 BREAKER POINT CONTACTS - Examine contact surface carefully. If pitting or pyramiding is apparent, place contacts in a vise where a small tungsten file or fine stone may be used to recondition the surfaces.

NOTE

Contact rots mull be completely free from oil and grease of any kind. Clean with cabontetrachloride using a small brush.

In cases where contact surfaces cannot be renewed satisfactorily or where the breaker arm rubbing block has worn excessively replace with a new assembly. Improper functioning of the breaker arm spring, or loose fit or binding at the pivot bearing, are additional reasons for complete replacement

6-22. CAM WICK - Replace the cam wick whenever new breaker contact points are installed. Do not oil or grease a wick of this type since it is difficult to control the quantity of lubricant as well as match the original impregnation.

6-23. SLEEVE BEARING - Long continued use of a magneto may eventually necessitate replacing the sleeve bearing (41) in the front bearing plate. Since bearing removal is not advisable without use of special tools and fixtures, a new bearing plate and bushing assembly should be installed. Because the bearing is of the porous factory-impregnated type, lubrication is not necessary.

6.24. BALL BEARING - Using a clean solvent in a clean container, swish the bearings in the fluid, then revolve by hand while thus submerged. Compressed air, if completely dry may he used to finish the cleaning.

CAUTION

Never spin bearings with compressed air. After removing bearings from the cleaning fluid, immerse in clean light out and spin until all solvent has been removed.

Repack with medium-soft high melting-point grease; the quantity of grease used should not exceed 1/3 to 1/2 of the total capacity of the bearing. Too much grease is a common cause of bearing failure due to overheating.

6-25. IMPULSE COUPLING. - Clean the impulse coupling thoroughly using solvent, dry with compressed air. Lubricate the drive spring with a small amount of high melting-point grease.

6-26. COIL - Since urgent cases of magneto field service necessities coil checking without use of standard test equipment, the substitution type test must be used. If a new identical part is available, the questionable coil should be substituted by a new one and the magneto spark checked as directed in paragraph 7-42. If a test of the magneto spark then gives acceptable results, the original coil is probably at fault, although it should be checked when standard test equipment is available.

6-27. CONDENSER - Test the condition of the condenser in a similar manner; replace the questionable condenser with a new unit of the same electrical value. then test the magneto spark. If magneto is the satisfactory, the original condenser is probably at fault although it should be checked when standard test equipment is available.

6-28. LEAKAGE PATHS, The high voltage surge of the secondary (high tension) circuit occasionally jumps to ground by a different route than across the spark plug gap. Once such a path is established, the ignition spark is likely to continue on it. The following are the major causes of leakage paths:

1. Carbon or corrosion, moisture, dirt, within the magneto.
2. Broken cable or poor cable connections.
3. Too wide a spark plug gap.
4. Too high engine compression.

A surface leakage path can usually be located because of the burning effect of the high voltage spark on plastic or other insulating materials.

Leakage paths may be cleaned from the surface of end caps and other similar parts, but their use thereafter should be limited to temporary service. Smoothing off sharp edges of corners will also help prevent sparking to ground across air gaps.

6-29. CORROSION CAUSED BY OXIDATION. Continued high voltage arcing within the sealed magneto housing may result in oxidation, which can be a cause of complete failure. Interior corrosion is readily identified once the unit is opened, since it causes a green discoloration of copper and brass parts. A brown deposit is also usually found throughout the magneto together with some evidence of moisture condensation. If corrosion is noticed in time the cause should be located. Causes are as follows:

1. Spark gap across a loose connection in the secondary (high tension).
2. Excess jumping across the safety gap caused either by an incorrectly adjusted safety gap, or by a break in the wire to the spark plug.
3. Carbon paths within the magneto.

The magneto must be completely disassembled and each part thoroughly cleaned. Bearings are an especially difficult problem since the lubricant is usually also oxidized; in most cases it is preferable to replace the bearing. When cleaning metal parts, fine emory cloth may be used, while rotors may be buffed. Parts, so cleaned, should be blown completely free of dust particles with compressed air. All gaskets, seals and washers must be replaced. Inspect bakelite parts for indications of carbon paths. Where there is evidence of flashover, the parts must be discarded, since re-use may result in further oxidation.

6-30. REASSEMBLY AND INSTALLATION OF FAIRBANKS-MORSE MAGNETO. (See Figure 25.)

6-31, REPLACE GROUND WIRE AND TERMINAL.

a. Place insulating washer (12), flat washer (11), ground wire terminal (13), and insulating bushing (19) on terminal screw (18) in the order named; insert into hole in side of housing.

b. On threads of screw (18), install insulating washer (14), flat washer (l5), and lock washer (16); secure in place with nut (17).

6-32, INSTALL FIELD OIL (7). - Place coil in housing so that the bronze spring terminal faces out and point down, then tighten screws (55) securely.

6-33, INSTALL ROTOR THRUST BEARING (8).

a. Place insulating washer (38) and insulating strip (35) in position on rotor thrust bearing (8) then pack bearing with lubrication and assemble in magneto housing so that numbered side of bearing enters the housing first.

b. Install insulating washer (34) and inner snap ring (37) using long nosed pliers.

6-34. INSTALL ROTOR (39).

a. Insert rotor in magneto housing with threaded end through thrust bearing(8); tap into position using a fibre hammer,

b. Place outer snap ring (36) on shaft and hand press into groove.

c. Place inner thrust washer (10) on shaft, then follow with a new rubber seal (30), and the outer thrust washer (27).

6-35. INSTALL IMPULSE STARTER HOUSING (20).

a. Place starter housing (20) in position on magneto housing; secure in piece with screw (22).

b. Lock screws in position by upsetting housing metal into screw grooves, using a small punch.

6-36. INSTALL COUPLING HUB (32), - Install key (33) on rotor shaft, then line up hub keyway and tap lightly in place.

6-37. INSTALL IMPULSE COUPLING SHELL (23).

a. Place coupling shell (23) and spring (24) in position, so that spring flat enters groove in coupling hub (32).

b. Place end of coupling shaft in soft jawed vise, then turn shell clockwise approximately 3/4 turn so that it enters starter housing completely.

NOTE

If shelf will not enter housing completely, position the spring so that it enters the other hub groove.

c. Place Large flat washer (31) in starter housing (20) then insert large felt washer (28) in cupped washer (29) and place in starter housing so that timing mark is at top; lining up holes, secure with self-tapping screws (21).

d. Place lock washer (25) in position on coupling shell and install nut (26). Tighten securely then lock in place by lifting lip of washer up against side of nut, and remove from vise.

6-38. ATTACH MAGNETO MOUNTING PLATE - Fasten mounting plate to magneto housing with four cap screws and lock washers so that small holes face impulse starter.

6-39. INSTALL FRONT BEARING PLATE (50). - Place front bearing plate and bushing assembly in position and secure in place with four flush-head screws (51). Stake in position with a small punch.

6-40. INSTALL STATIONARY CONTACT BRACKET (49). - Install adjusting screw (45) into bearing plate (50); turn down until tight, then loosen 1/2 turn. Install contact bracket loosely with screw, lock washer and flat washer (42).

6-41. REPLACE CONDENSER (2). Install condenser on to bearing plate with flat washer, lock washer and long head screw (1).

6-42. REPLACE WICK (54). - Insert bushing in wick, then insert screw (52) with lflat washer, and lock washer (53) through bushing and install on bearing plate (50).

6-43. - INSTALL CONTACT POINT ARM AND BRACKET (48). - Place contact point arn on bearing plate (50) so that brass rod enters hole in arm, then secure ground lead (13), Spring (46), condenser terminal (42) and primary terminal (3) to threaded fitting on bearing with screw (44) and lock washer (43) in the order named.

6-44. ADJUST CONTACT POINT GAP.

a. Turn Rotor until movable contact arm rests on high portion of cam (40).

b. Adjust gap between points for a clearance of .020" by turning adjusting screw (45) in the proper direction.

c. Tighten contact arm attaching screw (47) securely.

6-45. INSTALL END COVER (5). - Apply a coat ofsealing varnish to gasket surfaces, then place a new gasket (6) in position on end cover. Install and tighten using four flat washers, lock washers, and filister head screws (4).

6-46. TEST MAGNETO

a. CHECK ROTOR ROTATION. - Place magneto on a bench with mounting plate facing "up" so that the impulse coupling will not restrict movement of the rotor, then turn rotor by hand to check for noticeable binding or rubbing.

NOTE

The pull due to the magnetic break which occurs during rotation should not be confused with binding.

b. Insert spark plug wire into end cover socket, and bend to within 1/8" of mounting plate, then turn impulse coupling over by hand, watching for a spark the instant the coupling releases.

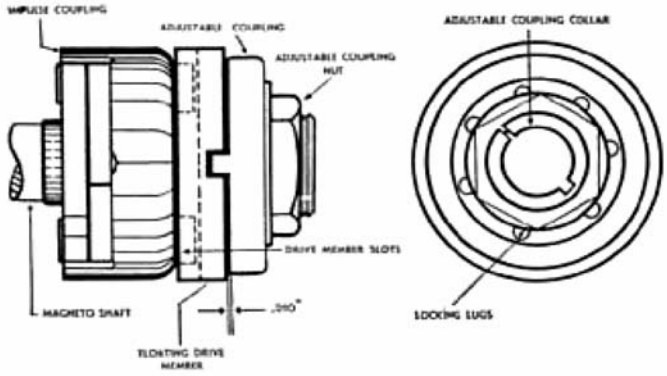


Fig. 26 - MAGNETO TIMING

6-47. INSTALL AND TIME MAGNETO.

a. Set maqneto in place on top of transmission case while engaging the coupling floating member, then secure to transmission case with cap screws and lock washers.

b. Remove cooling fan housing by unscrewing the two cap screws which fasten it to crankcase.

c. Align mark on rim of cooling fan, with mark at top of crankcase housing as shown in figure 24.

d. Loosen lock nut on magneto adjustable coupling, and turn magneto in normal direction of rotation until impulse starter clicks, then reverse rotation until mark on impulse drive member lines up with mark on impulse housing.

e. Insert a .010 feeler gauge between the floating drive member, and the adjustable coupling flange, then tighten coupling lock nut finger tight and remove feeler.

f. Insert a bar across the notches of the crankshaft starting dog; then holding bar rigidly to prevent crankshaft rotation, tighten magneto coupling lock nut with wrench supplied in tool kit and bend lock washer flat over nut. Recheck coupling clearance.

6-48. TESTING IGNITION SPARK. - It should be remembered that a spark produced within an engin cylinder with the fuel mixture compressed, is not identical to a spark produced by the same equipment in open air. The best field test of ignition spark strength is to add a short air gap to the gap of the spark plug and then make the ignition spark jump both gaps as follows: Start the engine, then while it is running, remove the ignition wire from the spark plug terminal and hold it in position about 1/16" away from its spark plug terminal; if the engine continues to run normally, the ignition spark may be assumed to have sufficient strength. However, a test such as this is of little value unless the sparkk plug is in good condition.