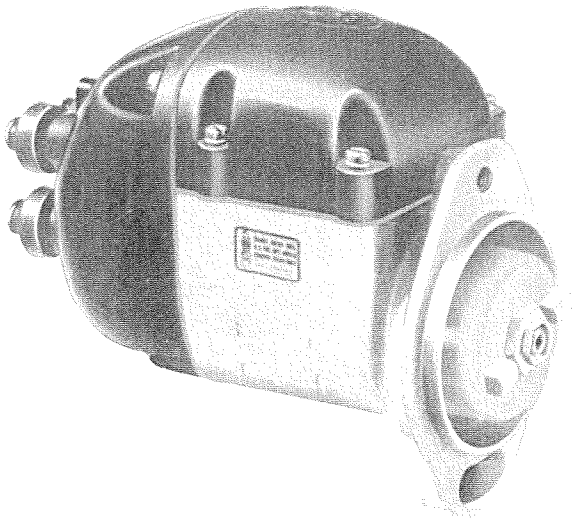
SECTION I

MODEL "4-JMA" MAGNETO



DESCRIPTION

The Model 4-JMA Magneto is a very precisely built, self-contained unit which should never be taken apart in the field, except as discussed in the paragraph under, FIELD SERVICING. MANY MAGNETOS ARE RUINED BECAUSE THEY ARE TAMPERED WITH BY INEXPERIENCED MECHANICS AND OPERATORS UNDER DIRTY, DUSTY CONDITIONS OR AT PLACES WHERE PROPER SERVICE TOOLS ARE NOT AVAILABLE.

FIELD SERVICING

This should include only service operations involving the timing of the engine or replacement of the entire magneto unit.

In normal use the magneto will seldom require timing, unless it has been removed from the engine for servicing. The magneto has been properly timed and adjusted at the factory and the position of the crankshaft, in relation to the occurrence of the spark, does not change appreciably in use.

IN TIMING THE MAGNETO TO THE ENGINE REFER TO THE OPERATORS MANUAL FURNISHED WITH THE ENGINE.

EQUIPMENT REQUIRED

Synchroscope

The synchroscope test stand is an instrument with 3-point spark gaps for testing the ability of a magneto spark jump. It has a protractor (scale in degrees) on which you can determine where the spark will occur on the engine, the relation of the running spark to the impulse spark (lag angle),

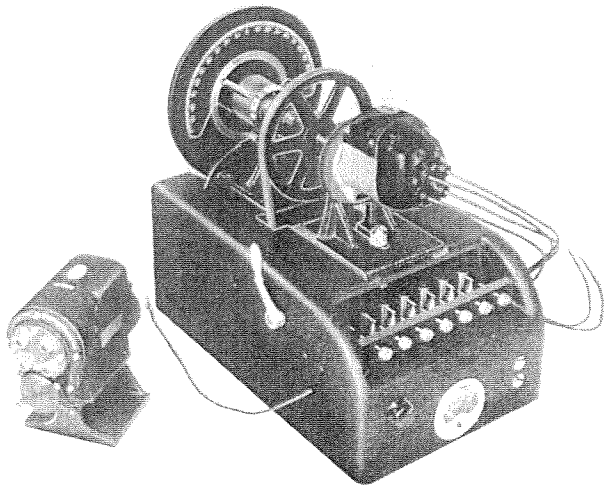


Figure 1. Synchroscope Test Stand

the relation of the running spark to the centerline of the rotor, and the lug angle at time of running spark, also when impulse trips. With 180° on protractor and 2 lights on the movable member of synchroscope, you can readily check the cam to see if the lobes of cam are 180° apart which is essential for good performance of the engine.

Charging Coil

The charging coil should be of sufficient capacity to charge (Alnico) rotors through the frame.

This requires a coil of 12,000 ampere turns or more. To charge a rotor out of the frame and then insert it into place in the frame, you always lose some of your magnetism.

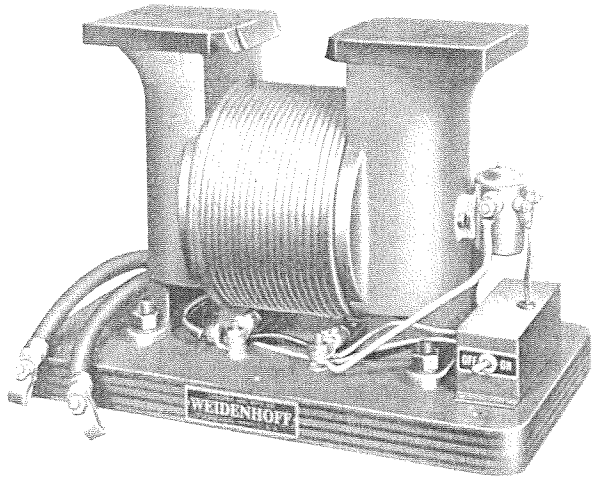


Figure 2. Magnet Charging Coil

When you charge the magnet in place in the frame, you saturate the soft steel core structure before charging the magnet. Then this magnetism does not come from the magnet when it is placed in the frame.

Figure 3. Coil Tester

Coil Tester

This instrument will check an internal breakdown within the coil and will also check a flash-over or insulation defect. Both tests must be made before you can be sure a coil is good.

Condenser Tester

This instrument will check the capacity of the condenser and the resistance. When checking the condenser, it is necessary to check both the capacity and the insulation resistance to determine if a condenser is good or bad. Capacity of Model 4-JMA condenser should be .10 microfarad plus or minus

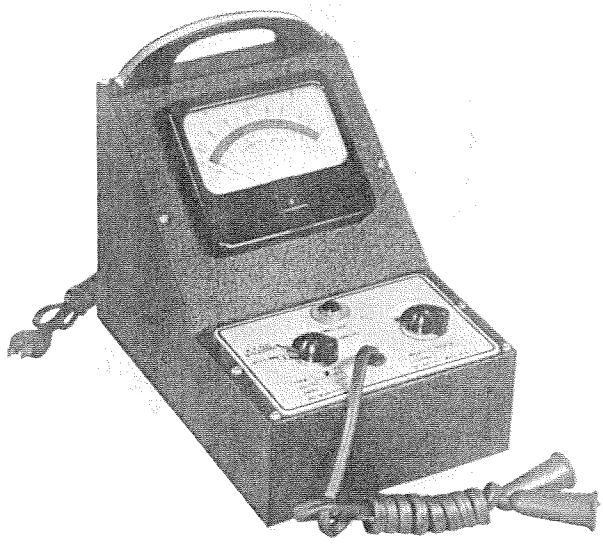


Figure 4. Condenser Tester

10%. The capacity of the Model 4-CMA condenser should be .20 microfarad plus or minus 10%. A condenser should have 2,000 or more ohms resistance at room temperature. When they get below this amount, they become destructive to the contact points.

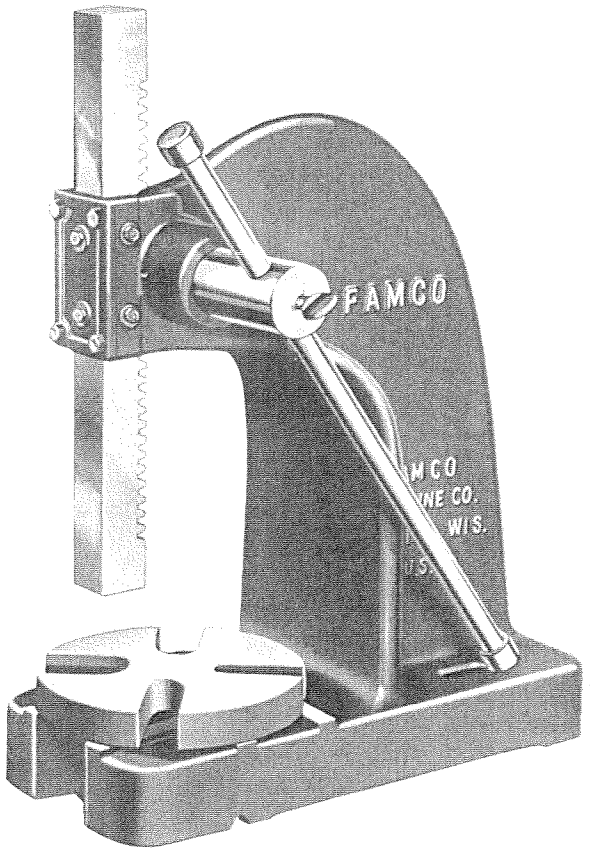


Figure 5. Arbor Press

Arbor Press

This is a necessary tool for pressing the coil into the frame, for pressing the ball bearings into place, and for removing inner races and outer races. You should never use a hammer to drive these parts in or out of place.

In assembling and disassembling various parts on the Case Magneto, it is necessary to have an arbor press which has a capacity of about 11" between the table and ram, or sufficient space to place a magneto frame and our tools between ram and table.

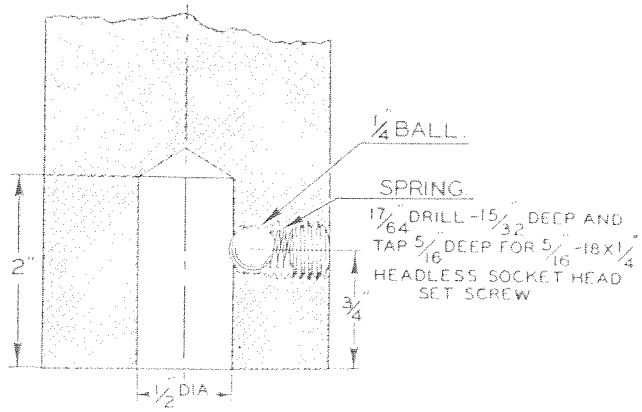


Figure 6. Specifications for Preparing Ram of Arbor Press to Fit Tool Parts

The tool parts, Nos. 15-CMTA, 0-16-CMT, and 0-17-CMT, are held into the ram of the arbor press with a steel ball which is set into the ram of the press, as shown in the sketch Figure 6. This ball engages in the groove turned in the shank of these parts, and holds them in place.

It is necessary to use caution in drilling the 17 64" hole in the ram for this ball as this hole must not be drilled through, but must have a flange to keep the ball from being pushed into the 1/2" hole by the spring. If you now have an arbor press with throat high enough to take in 11", we can furnish you with ball, spring and headless set screw to put into your arbor press ram.

SPECIAL TOOLS

A group of small tools are necessary to properly service all Case Magnetos; they can be ordered under the following part numbers.

1CMT	Coil Puller Model 4-CMA Magneto Use Bracket No. 6-CMTA
2CMT	Bracket to Support Frame (Model 4-JMA Magneto)
01CMT	Pin
02CMT	Pin
03CMT	Blade
04CMT	Screw
05CMT	Jaws
06CMT	Screws
07CMT	Handle
08CMT	Puller End
09CMT	Puller Jaws
010CMT	Puller Jaws
011CMT	Screw
012CMT	Screw
013CMT	Puller Jaws
014CMT	Pin
015CMT	Ball Bearing Inner Race Support
016CMT	Ball Bearing Outer Race Pressing Tool

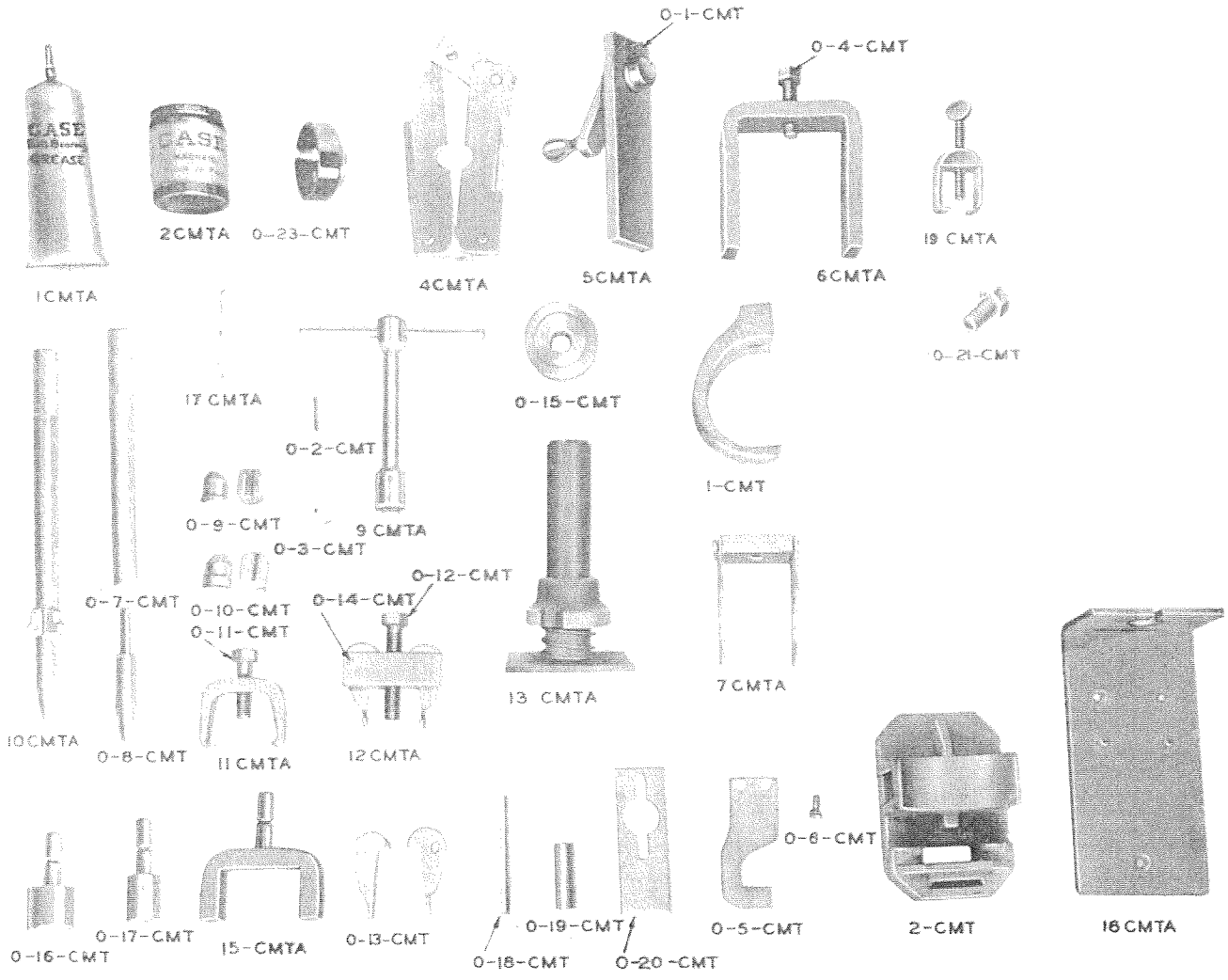


Figure 7. Special Tools

017CMT	Ball Bearing Inner Race Pressing Tool
018CMT	Driving Tool for Carbon Brush
019CMT	Driving Tool for Cam
020CMT	Wrench for Impulse (Model 4-JMA Magneto)
021CMT	Impulse Puller (Aircraft)
022CMT	Timing Gage (Aircraft)
023CMT	Ball Bearing Outer Race Holder
1CMTA	Case Ball Bearing Grease
2CMTA	Paint
4CMTA	Inner Race and Gear Puller
5CMTA	Impulse Coupling Spring Assembly Tool
6CMTA	Coil Puller Bracket (Models 4-CMA and 4-JMA Magneto)
7CMTA	Coil Puller (Model 4-JMA Magneto) Uses Bracket No. 6-CMTA
9CMTA	Impulse Nut Spanner Wrench
10CMTA	Race Puller
11CMTAS	Coupling Puller
12CMTA	Coupling Puller
13CMTA	Holder
15CMTA	Yoke
16CMTA	Bracket
17CMTA	Point Wrench
19CMTA	Gear Puller

SPECIAL TOOLS AND THEIR USE

1CMT—Coil Puller for Model 4-CMA magneto; use with bracket 6CMTA.

2CMT—Bracket to support frame while pressing coil in frame (Model 4-JMA Magneto), used in conjunction with tool No. 020CMT to tighten or remove nut on impulse coupling (Model 4-JMA Magneto.)

015CMT—Tool used for supporting end cap of Model 4-CMA magneto when pressing outer race into place, supporting inner race of ball bearings while pressing on shaft, supporting rotor gear while pressing on shaft (Model 4-CMA Magneto.)

016CMT—Tool used in conjunction with arbor press for removing and pressing in ball bearing outer races on (Model 4-CMA Magneto); for removing and pressing on ball bearing inner races. It is well to leave this tool in ram of arbor press for all kinds of pressing, as it protects the ram of the arbor press and is economical to replace.

017CMT—Tool used in conjunction with arbor press for pressing rotor drive gear on shaft of Model 4-CMA Magneto, and for pressing ball bearing inner races on shafts.

018CMT—Tool recessed to drive center brush into retainer in center of distributor cap.

019CMT—Tool used to drive cam on shaft (Models 4-CMA and 4-JMA magnetos), also used to drive steel gear on rotor shaft of Model 4-JMA magneto.

020CMT—Special wrench used in conjunction with bracket to hold impulse coupling while removing impulse coupling nut on Model 4-JMA magneto.

021CMT—Impulse Coupling Puller, Aircraft Magnetos only.

022CMT—Timing Gauge for Aircraft Magnetos only.

023CMT—Tool used in conjunction with No. 13CMTA for supporting No. 046CM Ball Bearing outer race for assembly into frame of Model 4-JMA magneto. Also used for removing outer race from bearing plate No. 11JMA.

1CMTA—Case Grease is a special heat resistant long life ball bearing grease. This is used in the ball bearings in all Case magnetos.

2CMTA—Magneto black paint is a special paint which will crackle or wrinkle when heat is applied. The heat from a red ray lamp is usually sufficient.

4CMTA—Special tool to pull the inner races off the rotor shaft of Models 4-CMA and 4-JMA magnetos, and to pull rotor gear off shaft of Model 4-CMA magneto.

5CMTA—Tools used for winding and unwinding impulse coupling springs for installing or removing from outer shell. This tool will not distort the spring which would eventually cause spring to break.

6CMTA—Coil puller for removing of Model 4-JMA coil. The same bracket is used for Model 4-CMA coil puller.

7CMTA—Tool to remove the coil from Model 4-JMA magneto, used with bracket No. 6CMTA.

9CMTA—Spanner wrench used in removing and installing impulse coupling castellated nut on Model 4-CMA magneto. The blade is replaceable in this wrench.

10CMTA—Tool for removing ball bearing outer race from frame and end cap of Model 4-CMA magneto.

11CMTA—Impulse coupling puller for Model 4-CMA magneto. Will not work on Model 4-JMA magneto.

12CMTA—Impulse coupling puller for removing impulse coupling of Model 4-JMA magneto. Will not work on Model 4-CMA magneto.

13CMTA—Tool for supporting outer race while pressing into frame.

15CMTA—Yoke used in conjunction with arbor press for pressing coil into frame.

16CMTA—Bracket for holding magneto and impulse coupling while removing impulse coupling nut of Model 4-CMA magneto.

17CMTA—Wrench for adjusting contact points on Model 4-CMA magneto (2 needed), also for assembling breaker bar on Model 4-JMA magneto.

19CMTA—Tool to remove steel gear from Model 4-JMA magneto.

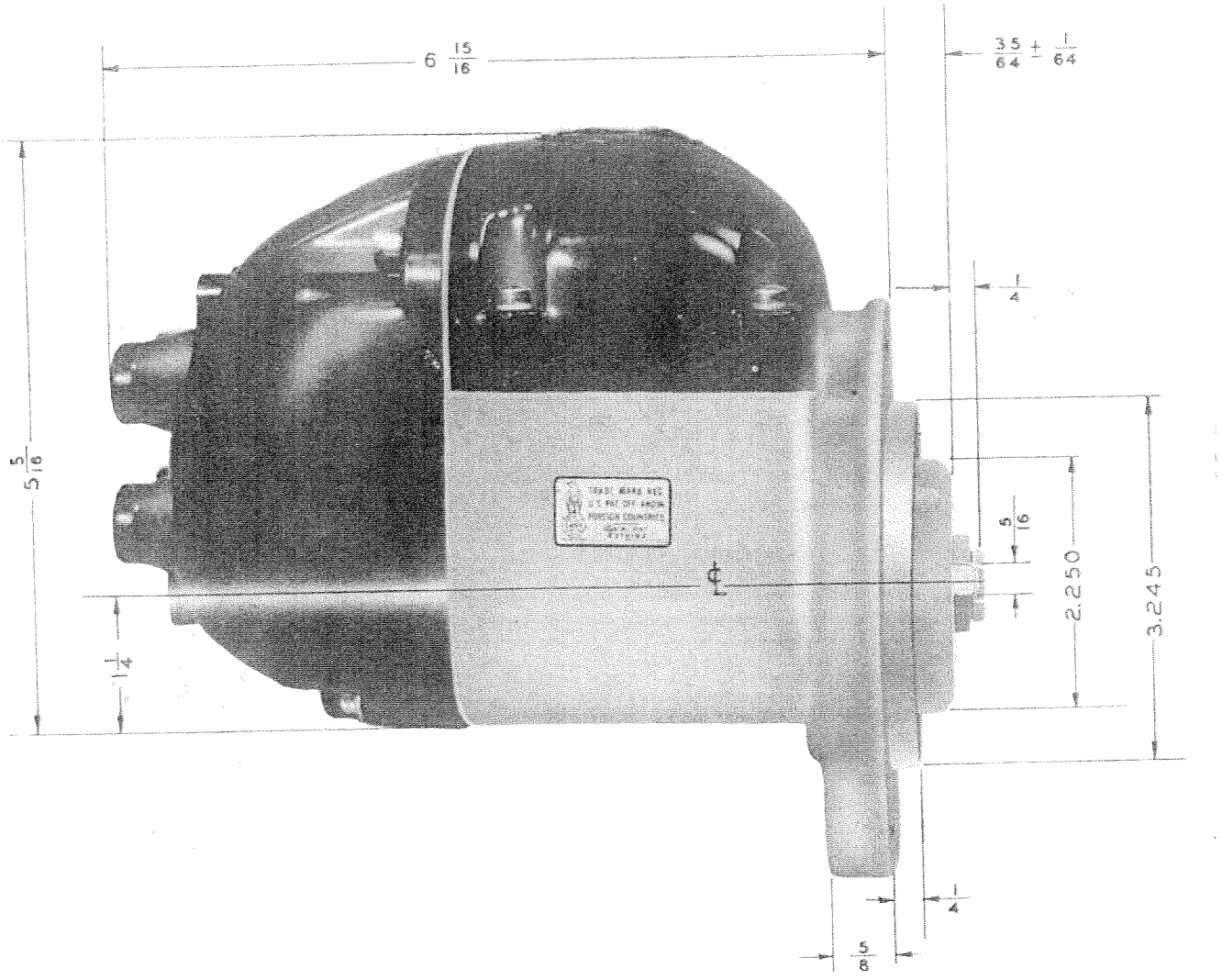


Figure 8. Mounting Specifications

DEGREASING FLUID

For cleaning contact points, etc., we recommend carbon tetrachloride. This can be obtained at most drug stores. THIS FLUID IS POISON. *WARNING: Handle with care. Do not use gasoline for cleaning, where we designate degreasing fluid.*

SAE SPECIFICATIONS

The SAE Flange Mounting Magneto Specifications were developed so magnetos could be made to a given standard.

We developed our magnetos in 1940 and have used the 1940 SAE Specifications. Our driving lugs (lug angle) are horizontal at time of running spark as shown in Figure 9.

1940 SAE specifications. The driving lugs shall be horizontal at time of running spark. Position of lugs at time impulse trips shall vary according to lag angle.

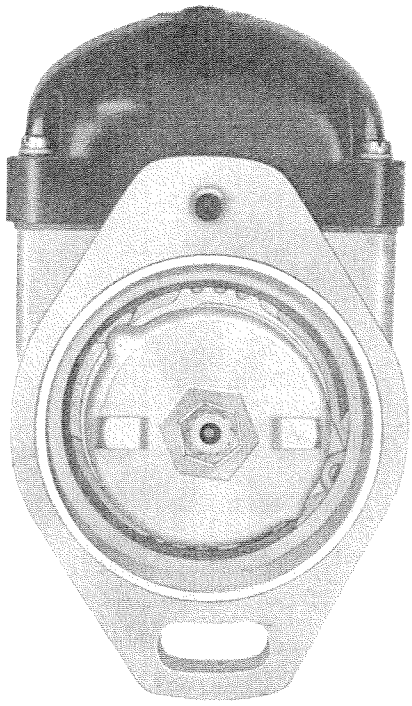


Figure 9. 1940 Position of Driving Lugs at Time of Running Spark

Figure 10 shows the position of lugs when impulse is set to trip at 25°. Position of lugs will vary according to lag angle.

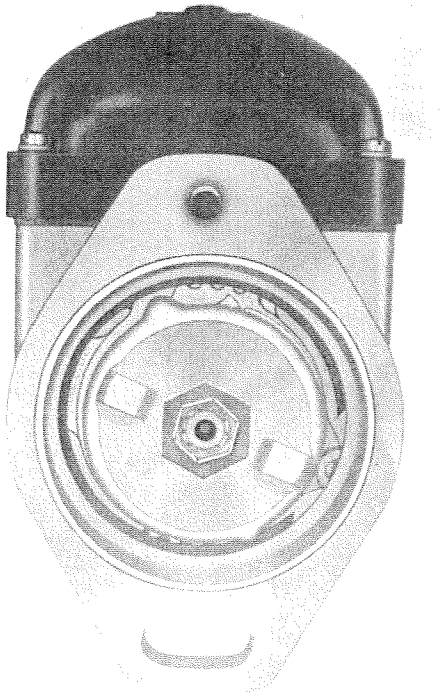


Figure 10. 1941 Position of Driving Lugs at Time Impulse Trips

TESTS TO MAKE BEFORE DISASSEMBLING MAGNETO

Place the magneto on a synchroscope, Figure 11.

The spark plug wire from the distributor cap terminals should be attached to the 3-point spark gaps which are set at 3/8" spark jump gaps, Figure 11.

Turn the magneto by hand in the same direction as it revolves on the engine, to see if there is sufficient spark to jump the 3/8" gap at all terminals, Figure 11. Also, determine whether or not the impulse latches and trips freely, like a new magneto. The latter is checked by feeling only, and the operator must accustom himself to know how a correctly operating impulse feels.

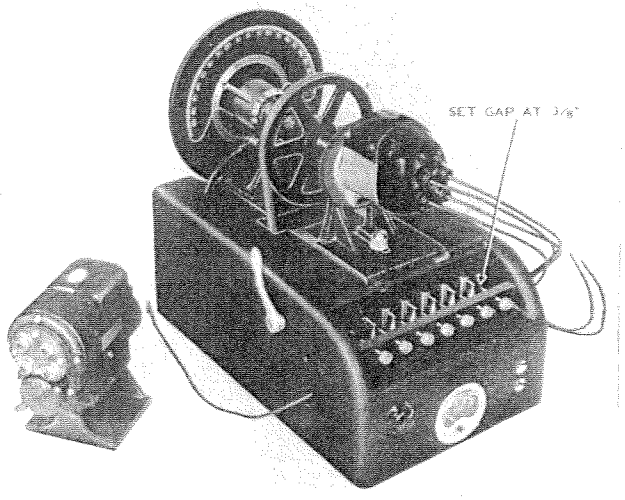


Figure 11. Checking Magneto on Synchroscope

If the magneto is dead, when tripped by hand, continue with tests headed "Remove the Distributor Cap." If it sparks properly refer to paragraph "Spark Cutting out at High Speed."

REMOVE THE DISTRIBUTOR CAP

Remove the two screws and the two special nuts holding the distributor cap, Figure 12.

Remove the distributor cap from magneto. Be careful not to pull distributor disc out of bearing, thus pulling gears out of mesh at the same time. The

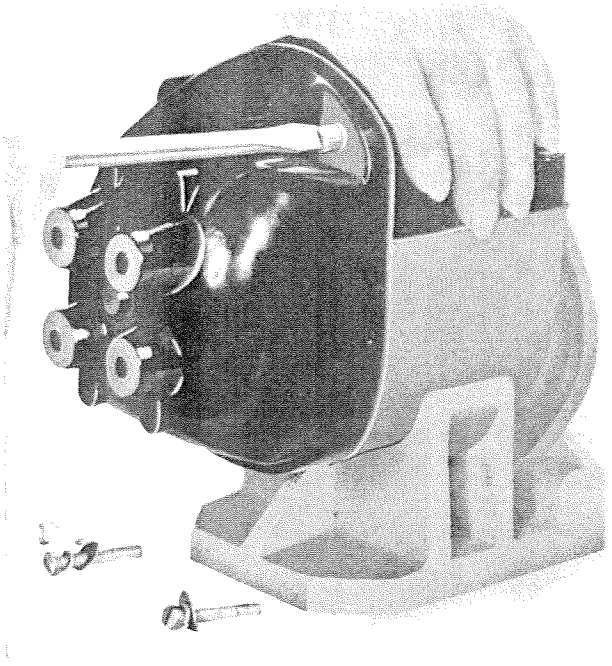


Figure 12. Removing Distributor Cap Screws

grounding spring fastened in the distributor cap is assembled slightly back of the distributor disc, so when the distributor cap is removed, it is necessary to turn the distributor cap slightly clockwise, Figure

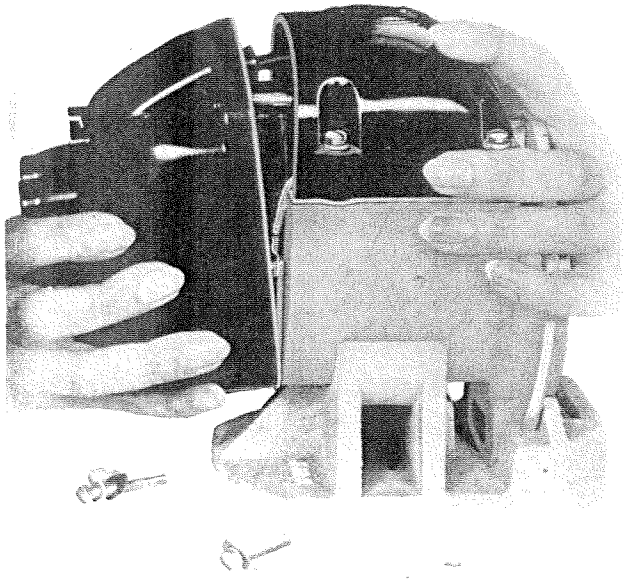


Figure 13. Removing or Replacing Distributor Cap

13, to move grounding spring from in back of the distributor disc.

CHECKING GEAR DRIVE

It is essential that the steel gear on the rotor shaft be properly meshed with the gear on the distributor shaft. When the gears are in any way incorrectly meshed, the T-sector on the distributor disc is away from the brushes in the distributor cap when spark occurs. This would cause the magneto to become corroded, and badly burn the distributor disc face.

The tooth directly over the red dot on the steel gear must mesh between two beveled teeth on the

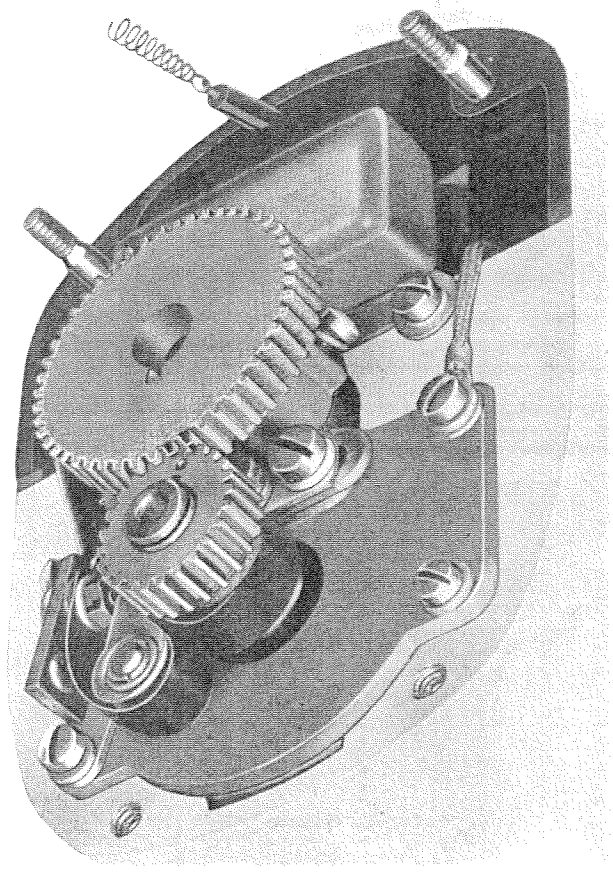


Figure 14. Meshing Distributor Disc Gears

distributor gear, Figure 14. THE BEVEL ON TWO TEETH ON THE CANVAS BASE BAKELITE DISTRIBUTOR GEAR MUST BE ON THE SIDE OF THE GEAR NEXT TO THE DISTRIBUTOR DISC, Figure 15. If the bevel on the teeth is on the side away from the distributor disc, the gear is not assembled properly on the shaft and should be turned over.

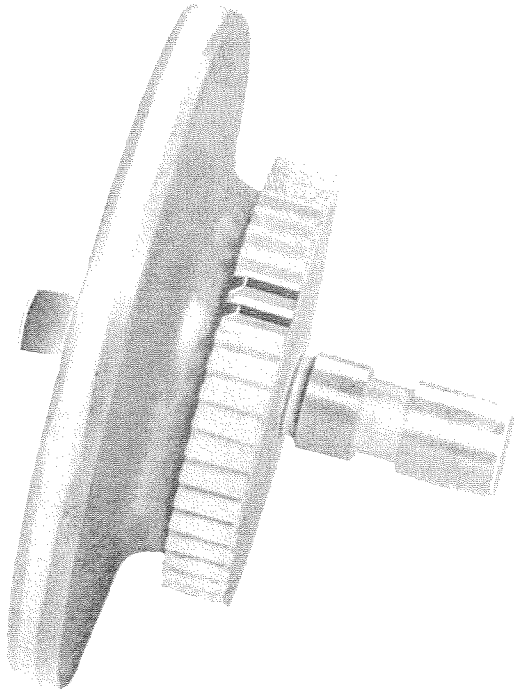


Figure 15. Checking Gear on Distributor Disc Shaft

When the gears are correctly meshed, remove the distributor disc for further tests.

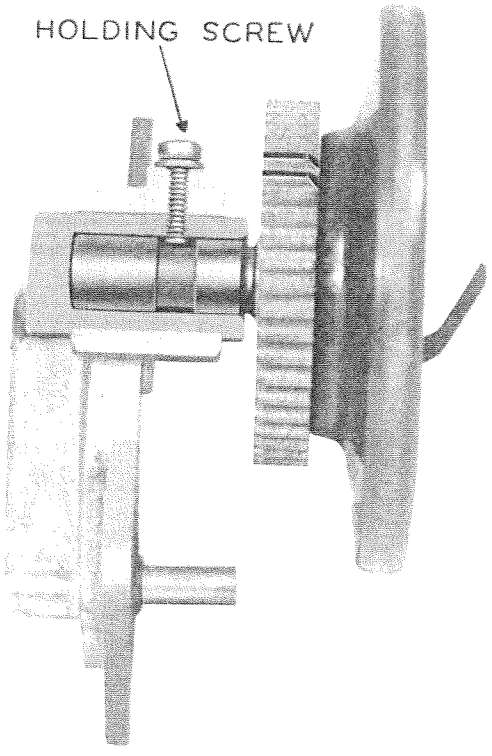


Figure 16. Screw Holding Distributor Disc

The late magnetos are equipped with a screw, Figure 16, which holds the distributor disc shaft in the bearing, to prevent it from being pulled out when removing the distributor block. Loosen this screw about 1 16″ (2 turns) then remove distributor disc as before.

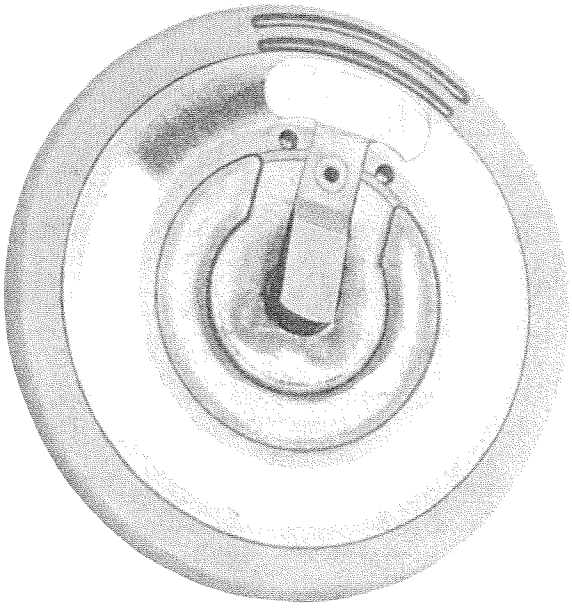


Figure 17. Track on Face of Distributor Disc

DISTRIBUTOR DISC

Should the distributor disc Figure 17, have a black deposit in the brush track, this can be removed with an ink eraser. Do not use emery cloth or sand paper.

This track is caused by not enough spring pressure on brushes No. 102-JMA (brush and spring soldered together, Figure 18). The spring is too weak for the Melmac (brown Material) Disc.

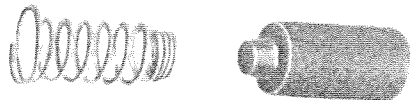


Figure 18. Distributor Brushes

No. 0215JM brush and No. 0216JM spring are to replace the No. 102JMA brush and spring.

Should the flat spring on the face of the disc become worn or broken, it can be replaced by drilling a .098" dia. hole 1/8" deep, in the rivet with a No. 39 drill, and substituting No. 0140JM Spring and No. 0334JM Self Tapping Spring Screw, Figure 19.

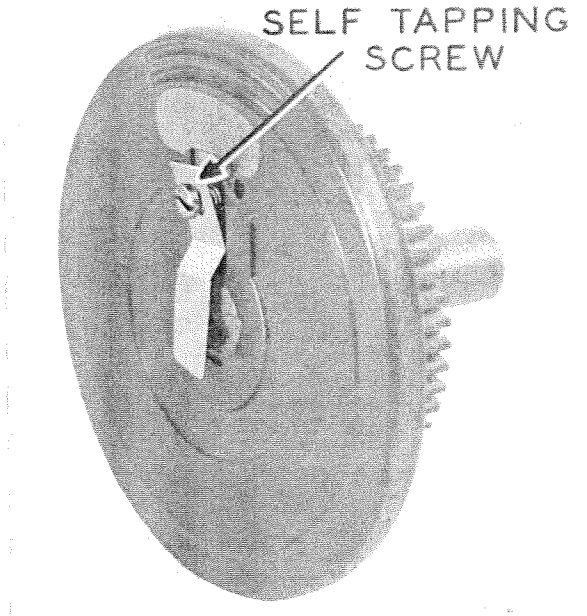


Fig. 19. Flat Spring with Screw

Later discs are equipped with this screw and spring.

CORRODED OR RUSTY MAGNETO

All Case Magnetos are sealed up air tight. There are no ventilating holes through which to change the air. They are designed like this to prevent dust, dirt, rain, fog, salt air and other harmful ingredients from entering the magneto. Therefore, we must be careful that no spark jumps anywhere in this confined air within the magneto.

Should you have a high voltage spark jumping through the air in a confined space (such as in our magnetos), it disassociates, or breaks down the air into the elements from which it is made; namely, oxygen, hydrogen and nitrogen, and while this is being done, you burn out some of the oxygen and some of the hydrogen. Then when these elements come back together, they may be H_2O (water), or HNO_3 (nitric acid), or both.

Should you take one of these magnetos apart and find moisture or little particles of water within the magneto, or should the copper, brass or bronze parts turn dark and then green, and cadmium plated parts turn light green, and the steel parts get rusty, a condition has existed, wherein the spark has been improperly jumping a gap in the magneto. This may be caused by:

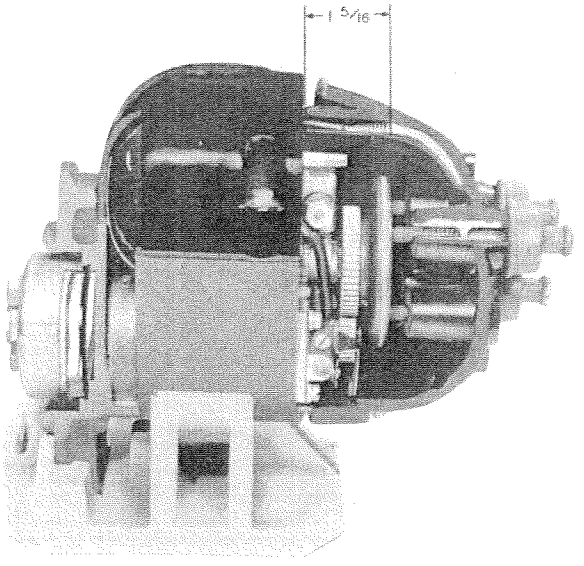


Figure 20. Sectional View of Magneto

1. The distance from the edge of the top cover to the end of the spring being short, (should be 1-5/16"), or burned off, and not making contact with the brass insert in the distributor cap. Figure 20.
2. Broken or stuck brushes in distributor cap. When a brush is stuck and a spark jumps to the end of it, the condition of the brush changes from a glazed surface to a rough condition. This can be easily detected.
3. Worn or broken spring on distributor disc, Figure 19.
4. Improperly meshed gears. Refer to "Checking Gear Drive," Figure 14.
5. Distributor gear backwards on the distributor shaft. Refer to "Checking Gear on Distributor Shaft," Figure 15.
6. Excessive gap in spark plugs.

RUNNING TEST ON SYNCHROSCOPE

Remove the distributor disc, Figure 16.

Clamp the wire leading from left side of synchroscope to secondary lead wire as shown in Figure 21. Run the magneto at full speed. The spark should jump the first 3-point spark gap at left side of synchroscope. (Be sure spark is not grounded through lights in movable disc. Adjust with knob at lower left hand front.)

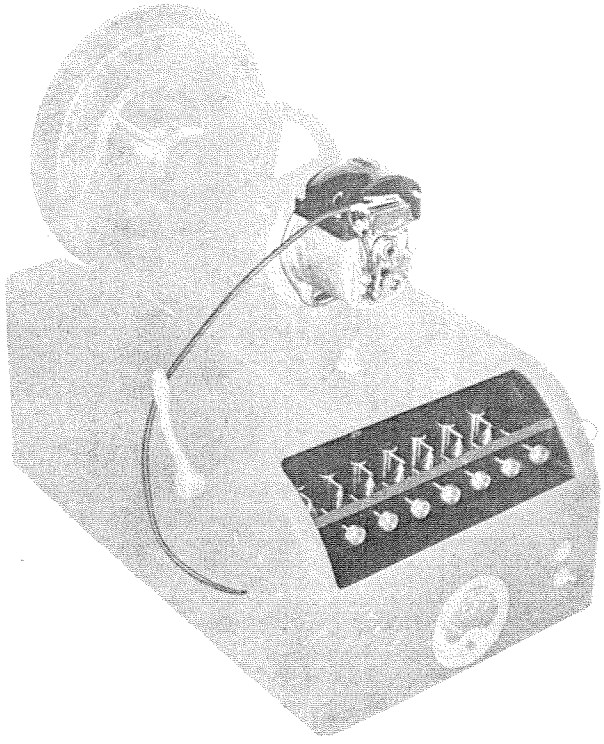


Figure 21. Running Magneto on Synchroscope

If tests show the magneto is dead, refer to "Breaker Arm and contact Points."

If tests show the spark is weak (jumping less than 1/8").

1. Place the magnet in the field of the charging coil, Figure 22.
2. Recharge the magnet with rotor in place in the frame, Figure 22. WARNING: KEYWAY IN ROTOR IS ON NORTH POLE SIDE OF ROTOR. DO NOT REVERSE POLARITY. DO NOT CHARGE MAGNET WITH IMPULSE COUPLING ON MAGNETO AS YOU WILL CHARGE THE IMPULSE PARTS SO THEY WILL NOT LATCH UP. Repeat the running test on the synchroscope.

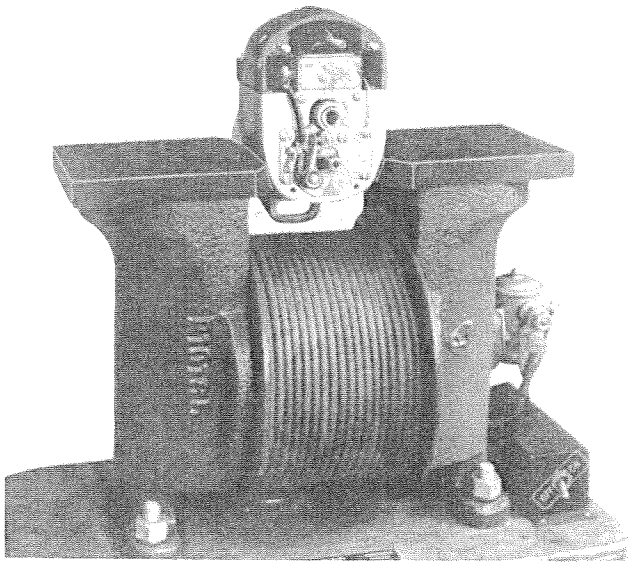


Figure 22. Charging Magnets in Magneto

If the tests show the magneto spark is OK:

1. Replace the distributor Disc, Figure 16.
2. Put the distributor cap back into place, Figure 13.
3. Repeat the tests outlined under "Test To Make Before Disassembling Magneto."

1. If tests made in previous paragraphs show the magneto to be dead, replace the distributor cap with a new one, Figure 13. Repeat the test.
2. If magneto is still dead with new distributor cap, then replace distributor disc with new one and check as before.

BREAKER ARM AND CONTACT POINTS

Test action of the breaker arm to be sure that it operates freely. Figure 23.

If the breaker arm is not free, remove it and clean fulcrum pin and breaker arm bushing thoroughly.

Examine contact points and make certain they are clean.

Make certain that the cam opens the breaker arm between .011 inch and .020 inch.

If contact points have a blue or black surface it must be removed. This should be done on a whetstone and NOT WITH A FILE. Use a very fine

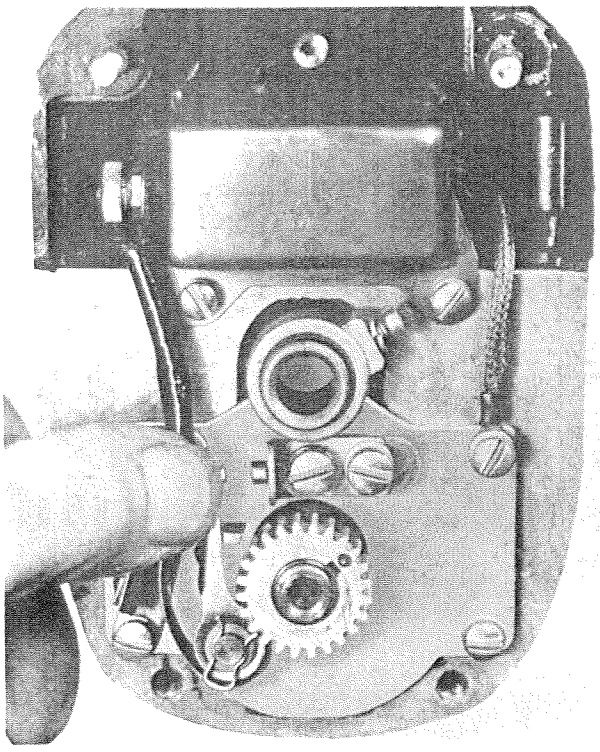


Figure 23. Testing Action of Breaker Bar

stone, setting the point as nearly square as possible. Rub so that the point is made flat. It is essential to

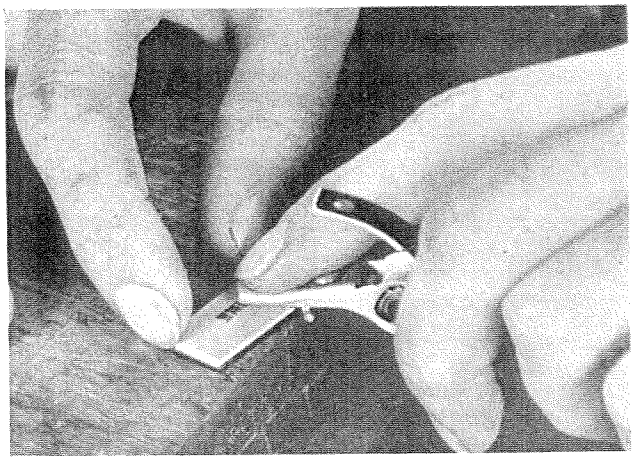


Figure 24. Stoning Contact Points

leave a very smooth surface on the point, Figure 24. After stoning the points, be sure they are clean and free of oil, wash with degreasing fluid. When assembling the contact points on the Model 4-JMA Magneto, it is necessary to have the play (or clearance) in the breaker bar bushing in the correct position, which is with all the play held out in a radial direction of about 7:30 or 8:00 o'clock from the center of the rotor shaft across the fulcrum pin. Be sure to have the spring square so it will not have a twisting effect on the breaker bar, Figure 25. The rubbing block on the breaker bar should be square with the face of periphery of the cam. Should it strike on one side, it could create a rolling action on the face of the contact points which would cause them to burn excessively.

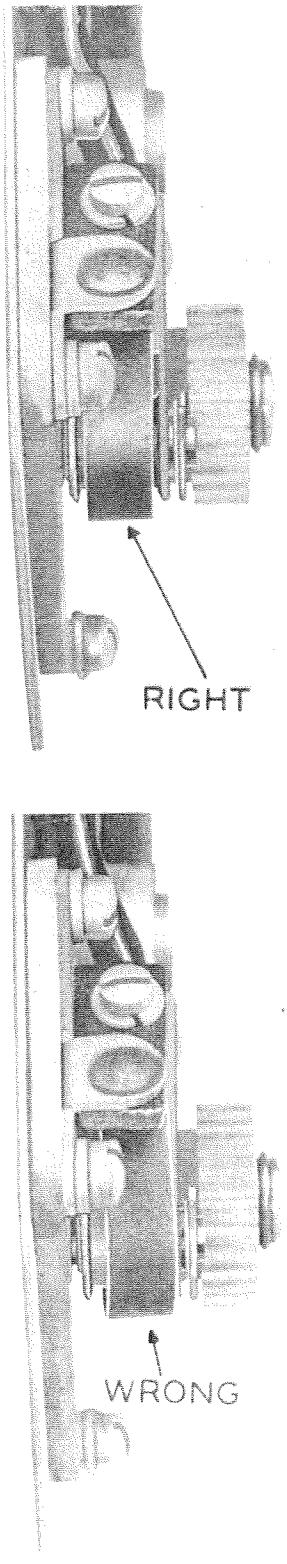


Figure 25. Alignment of Breaker Bar Spring

TIMING MAGNETO ON SYNCHROSCOPE

When adjusting the contact points, care should be used so the breaker bar spring will be square with the fulcrum pin, holding bushings tight against shoulder of fulcrum pin. Check the position of the breaker bar on the fulcrum pin while the magneto is running up to speed. This can be done by pulling out the breaker bar approximately 1/16" on the

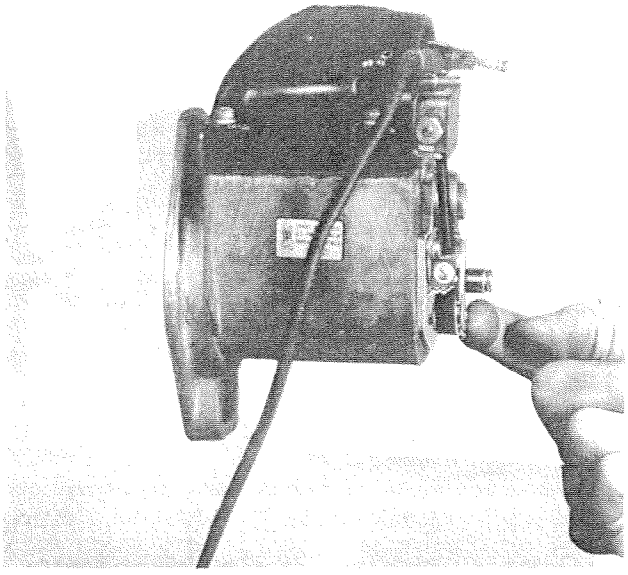


Figure 26. Checking Position of Breaker Bar on Fulcrum Pin

fulcrum pin, Figure 26. Then the action of the spring itself, while the magneto is run, should move the breaker bar back so the bushing is tight against the shoulder of the fulcrum pin. Figure 25.

On recent magnetos the fulcrum pin has a groove near the outer end in which we place a spring to hold a thrust washer which keeps the breaker bar from moving out on the fulcrum pin. If the spring holds the breaker arm in a twisting position on the fulcrum pin it will cause the points to have a wiping action on each other before they open. This causes the points to burn very rapidly. This can be detected while the magneto is running on the Synchroscope. The light in movable disc on synchroscope will not

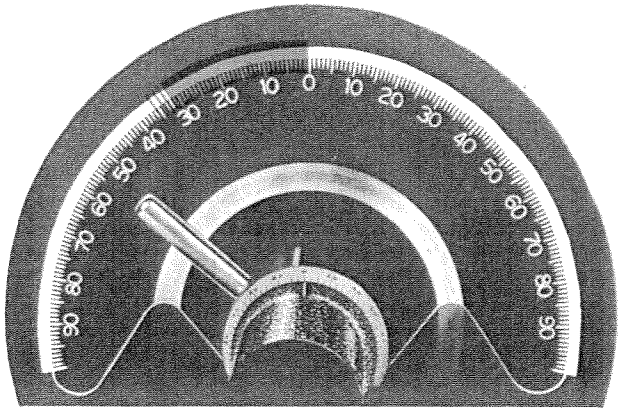


Figure 28. Light Showing Breaker Bar Bounce

occur in the same position at the protractor as shown in Figure 27 and when the points close they will have a rolling or bouncing action as shown by the synchroscope, Figure 28. When the points are properly assembled your synchroscope light will glow like

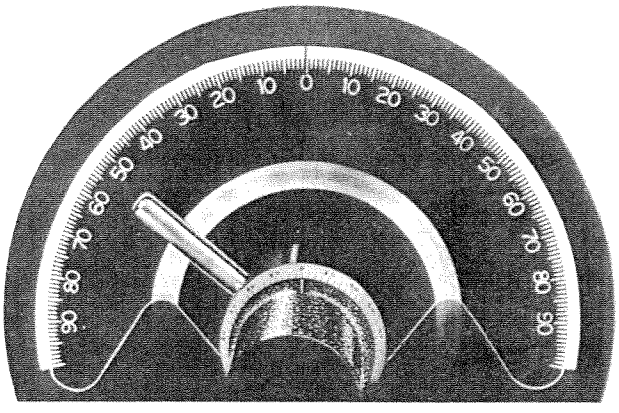


Figure 29. Light Showing Proper Assembly of Contact Points

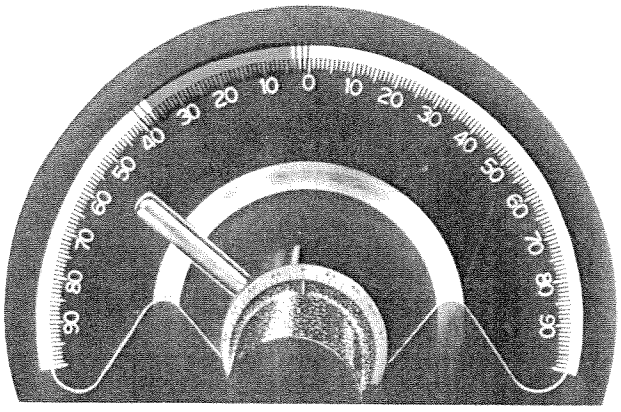


Figure 27. Lights Showing Movement of Points Before Opening

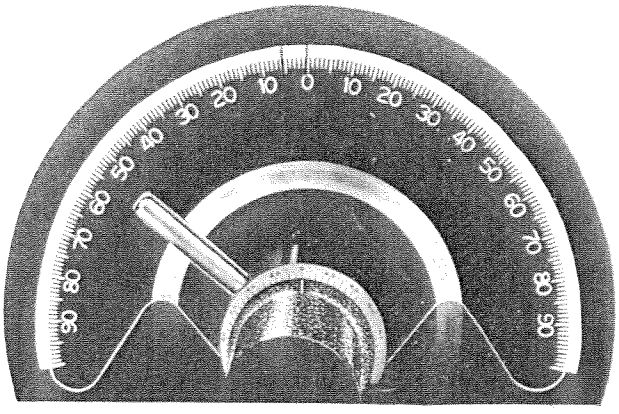


Figure 30. Light Showing Cam Lobes not 180° Apart

Figure 29. Should the lobes on your cam not be 180° apart, you will get two lights on the protractor as in Figure 30. This can be caused by improperly assembling the cam; by keys not being pressed into place in shaft. This can be overcome sometimes, by reversing or turning over the cam. This can also be corrected by filing the cam with a very fine file on the opening curve of the lobe of the cam which makes the early spark. Care must be used in making this adjustment. When the lobes of the cam are 180° apart there will be only one light on the protractor as in Figure 29.

After contact points have been assembled and the magneto timed you are then ready to assemble the distributor gear and distributor cap. Take a strip of clean paper ¼" by 2½" and dip end in degreasing fluid. Place between contact points and draw ¼"

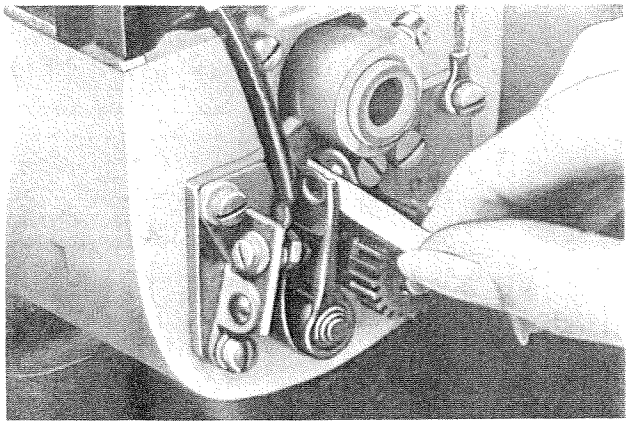


Figure 31. Cleaning Contact Points

through as shown in Figure 31; then remove paper. (Do not draw paper all the way through points.) If there is any noticeable dirt or grease on the paper, repeat this operation until the paper does not show any sign of dirt or grease. Repeat this operation with dry paper, to remove all degreasing fluid. (DO NOT TOUCH WITH FINGER THAT PORTION OF PAPER THAT GOES BETWEEN CONTACT POINTS.) HAVE A SUPPLY OF CLEAN PAPER AS SHOWN IN FIGURE 31 IN A CONTAINER. ALSO A SUPPLY OF CLEAN DEGREASING FLUID.

THE CONDENSER

Should magneto still be dead, run it at the same speed as it runs on the engine and observe the contact points. In normal running, there should be pin point arcing (NOT LARGE BLUE OR YELLOW SPITTING SPARKS; THESE BURN CONTACT POINTS RAPIDLY) between the contact points.

Excessive arcing at the contact points, may be caused by:

1. Dirt or oil between contact points.
2. Defective condenser (open circuit), low insulation resistance.
3. Rolling action on face of contact points caused by cam not striking rubbing block square or bearing only on one side, spring being deformed so as to create a bind between the breaker bar bushing and the fulcrum pin. Figure 25.
4. Having the play; (.0015") between the breaker bar bushing and the fulcrum pin on the wrong side, which will cause a sliding action on the face of the contact points before they open. Figure 27.

If there is no arcing at the contact points, then there is a ground in the primary circuit, or the condenser is shorted, thus grounding it.

Remove the primary lead wire from the condenser as shown in Figure 32. Test condenser with condenser tester (being very careful to follow instruc-

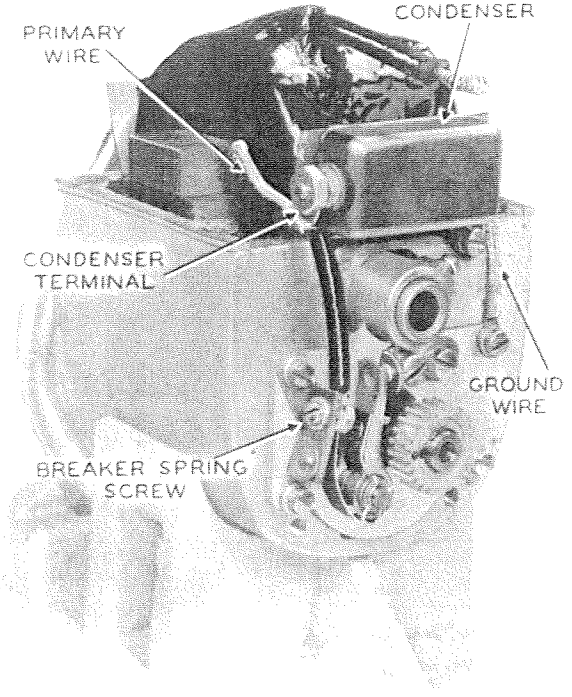


Figure 32. Primary Circuit

tions furnished with condenser tester). The capacity of the condenser should be .40 microgarad plus or minus 10%. If the capacity is too low or too high, this will cause the contact points to burn excessively.

Should condenser be defective, replace with new one and retest.

THE PRIMARY CIRCUIT

The primary circuit follows the wire leading from the coil to the breaker arm, and from the breaker arm through the contact points to the bearing plate and through the grounding wire, to the coil. Figure 32. If it is grounded or short circuited before it gets to contact points, it will be necessary to check to see if the insulation is broken on the lead wire, or the wire is touching the bearing plate or condenser box.

THE COIL

If magneto is still dead, test the coil in the frame with coil tester. (Follow instructions furnished with coil tester.) It is not necessary to remove the coil from frame to test.

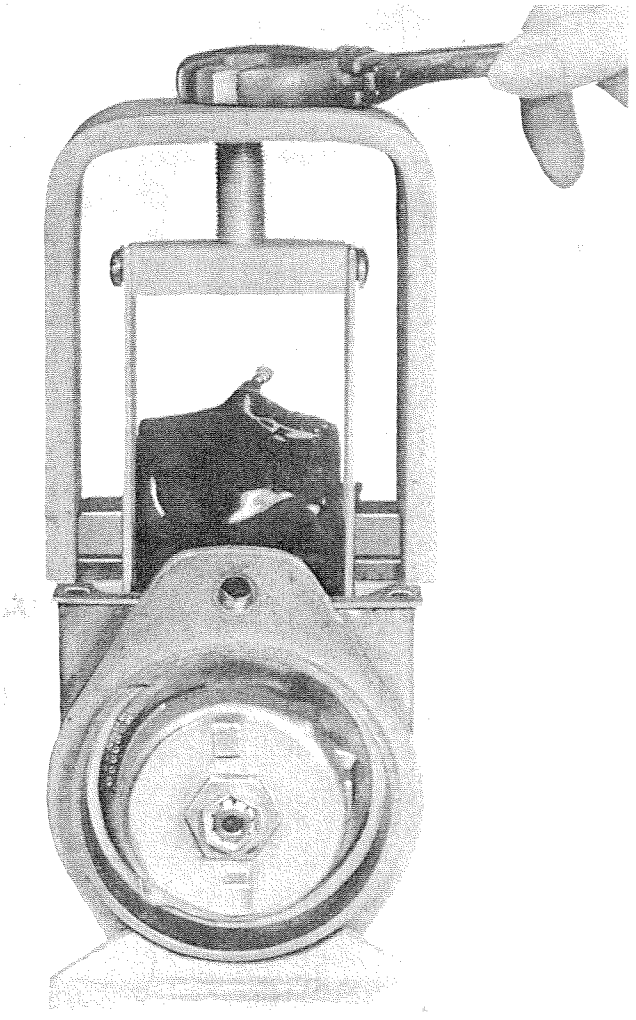


Figure 33. Pulling Coil Out of Frame

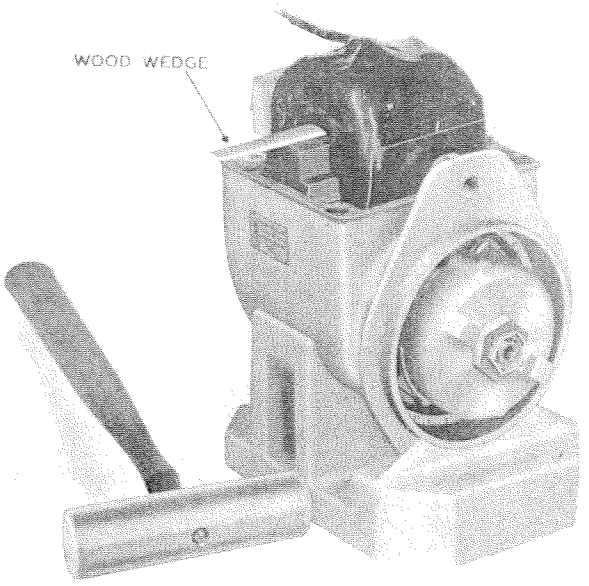


Figure 34. Wood Wedges for Tightening Coil

When coil is found to be dead after testing, remove coil from frame, using the coil puller as shown in Figure 33, slipping the hooks of the puller jaws under the bridge of the coil.

Place the outer bracket over the puller jaws against the magneto frame.

Put the puller bolt in place and, by turning with a wrench, pull the coil from the frame, Figure 33.

Replace with new coil. Should the coil become loose on the bridge (or steel core), it can be tightened by driving a wooden wedge, Part No. 0-313-CAM, between the steel core and the coil, as shown in Figure 34. If there are fibre spacing washers around the steel core at each end of the coil, break and remove. These will not be needed when the coil has been anchored to bridge with wooden wedges.

NEVER ATTEMPT TO REMOVE COIL UNLESS YOU HAVE THE PROPER EQUIPMENT, SUCH AS A COIL PULLER, YOKE AND ARBOR PRESS, WITH WHICH TO REASSEMBLE COIL, AND CHARGING COIL TO RECHARGE THE MAGNET. In attempting to do this without the proper equipment, there is danger of distorting the frame, allowing the rotor to rub the pole pieces; the coil bridge acts as a keeper for the magnetism in the