

Line drawing of a typical point set with principle parts identified.

The modest cost of a new condenser justifies its purchase and installation to eliminate this item as a source of trouble.

Breaker Points

The breaker points in an outboard motor are an extremely important part of the ignition system. A set of points may appear to be in good condition, but they may be the source of hard starting, misfiring, or poor engine performance. The rules and knowledge gained from association with 4-cycle engines do not necessarily apply to a 2-cycle engine. The points should be replaced every 100 hours of operation or at least once a year. **REMEMBER**, the less an outboard engine is operated, the more care it needs. Allowing an outboard engine to remain idle

will do more harm than if it is used regularly.

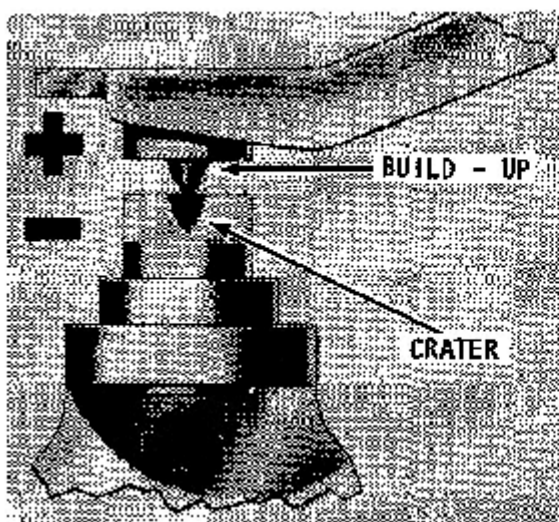
A breaker point set consists of two points. One is attached to a stationary bracket and does not move. The other point is attached to a movable mount. A spring is used to keep the points in contact with each other, except when it is separated by the action of a cam machined onto the distributor shaft. Both points are constructed with a steel base and a tungsten cap fused to the base.

To properly diagnose magneto (spark) problems, the theory of electricity flow must be understood. The flow of electricity through a wire may be compared with the flow of water through a pipe. Consider the voltage in the wire as the water pressure in the pipe and the amperes as the volume of water. Now, if the water pipe is broken, the water does not reach the end of the pipe.

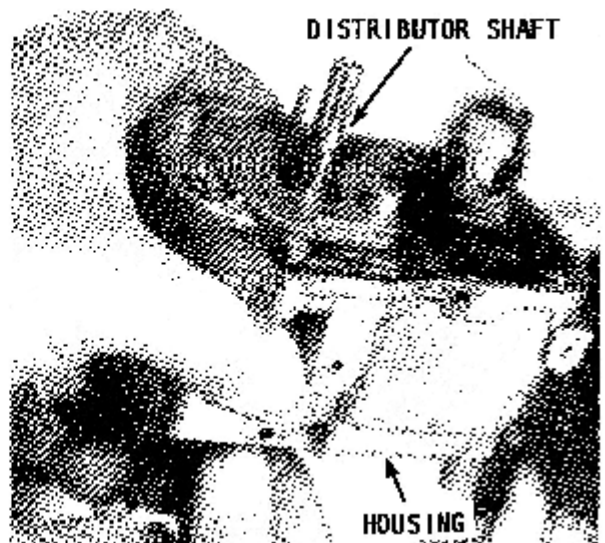
In a similar manner if the wire is broken the flow of electricity is broken. If the pipe springs a leak, the amount of water reaching the end of the pipe is reduced. The same holds true for the wire. If the installation is defective or the wire becomes grounded, the amount of electricity (amperes) reaching the end of the wire is reduced.

Check the wiring carefully, inspect the points closely, and adjust them accurately according to the Specifications in the Appendix.

For timing and synchronizing instructions, see Chapter 6.

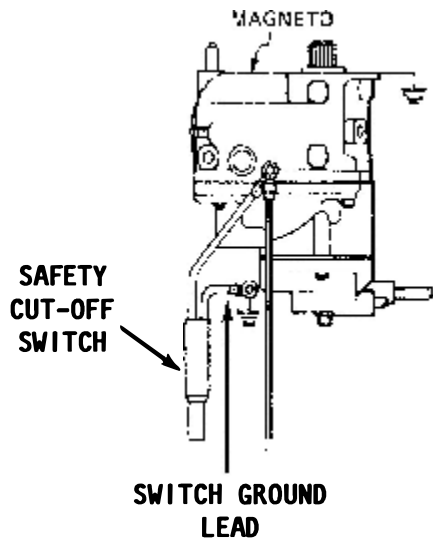


A defective set of points will contribute to hard starting of any outboard unit. Such a condition will also cause misfire when the powerhead is operating at high rpm.



A belt driven magneto removed from the powerhead and ready to be disassembled for cleaning and replacement of defective parts.

5-12 IGNITION



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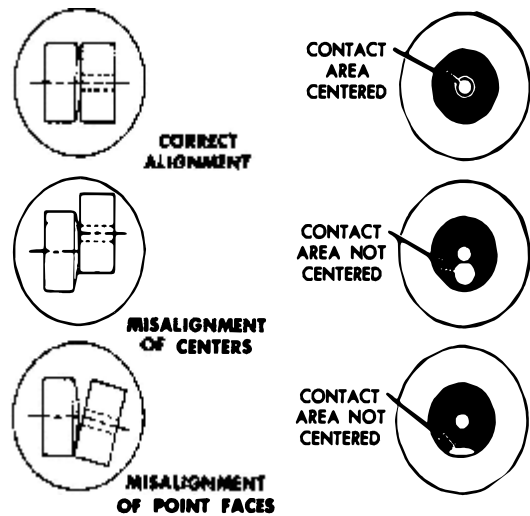
SERVICING TYPE I IGNITION SYSTEM

General Information

Overhaul procedures may differ slightly on various outboard models, but the following general basic instructions will apply to all 4-cylinder Kiekhaefer magnetos.

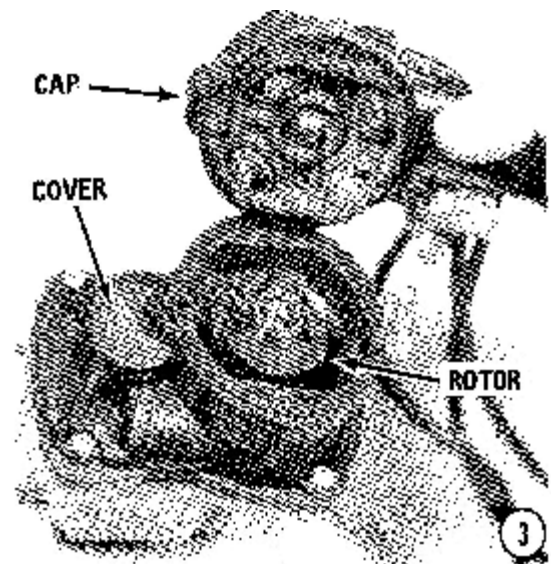
REMOVAL

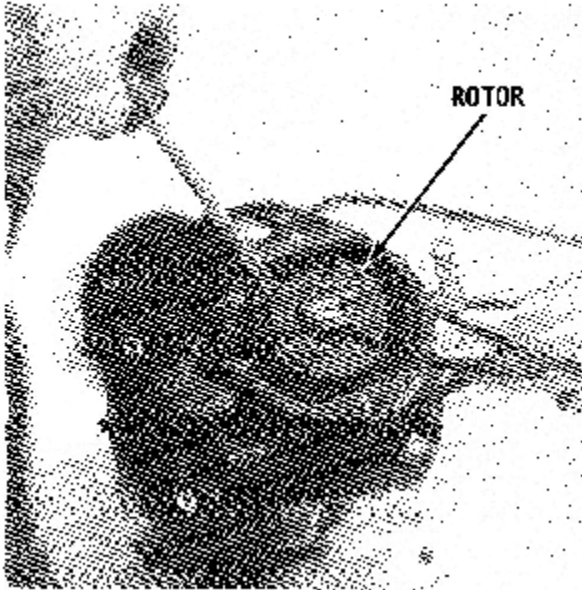
1- Disconnect the battery leads from the battery terminals. Remove the spark plug wires. Use a pulling and twisting motion as a precaution against damaging the connections. Release the high-tension leads by removing the screws from the two hold-down clips on the exhaust side of the engine. Disconnect the braided ground strap from the crankcase, but leave it attached to the



Before setting the breaker point gap, the points must be properly aligned (top). **ALWAYS** bend the stationary point, **NEVER** the breaker lever. Attempting to adjust an old worn set of points is not practical, when compared with the modest cost of a new set, thus eliminating this area as a possible cause of trouble. If a worn set of points is to be retained for emergency use, both contact surfaces of the set should be refaced with a point file.

magneto. Remove the lockwasher and nut from the primary ground screw securing the wire to the magneto. On models with a safety cutoff switch, the switch ground lead is also held by this screw. Remove the screw, D-washer, and clip securing the ground wire to the front of the magneto. If a safety cutoff switch is installed, it will be necessary to remove the screw, D-washer, and clip securing the switch wire to the magneto. Disconnect the air vent lines. Remove the four capscrews attaching the



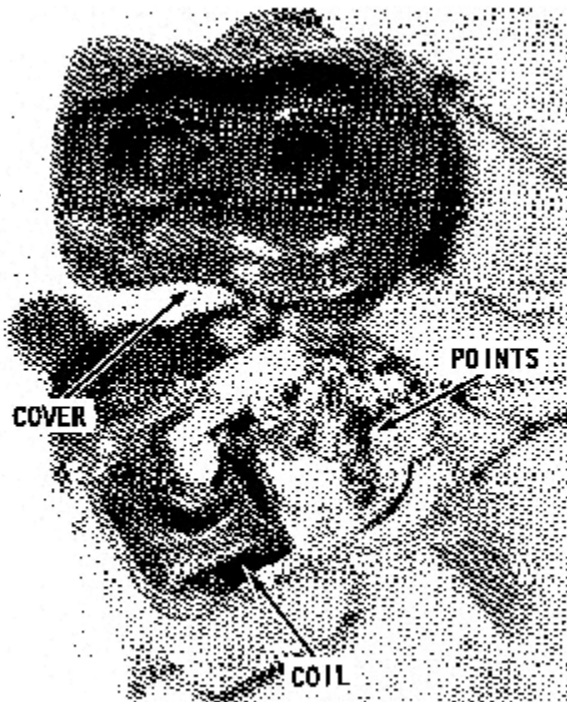


Removing the rotor from the distributor shaft.

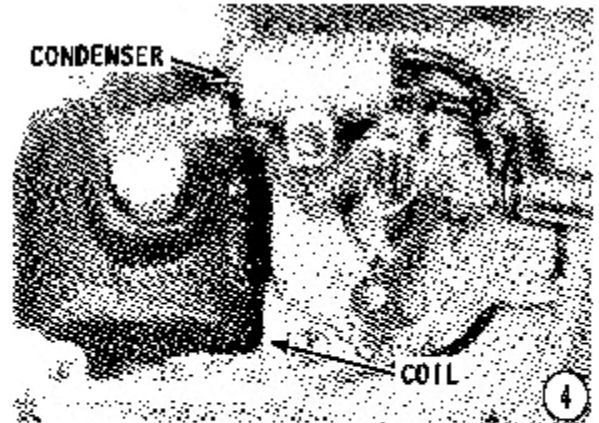
magneto to the magneto adaptor, and then lower the magneto about an inch in order to clear the magneto from the adaptor.

SERVICING

2- Thoroughly clean the exterior of the magneto. If necessary, use a wire brush, solvent, and compressed air. **NEVER** submerge the magneto in solvent. Mount the magneto on a test block and slowly turn the rotor by hand. As the rotor is turned, if any binding or rubbing is felt, no further testing



Distributor cover removed, exposing the breaker point set.

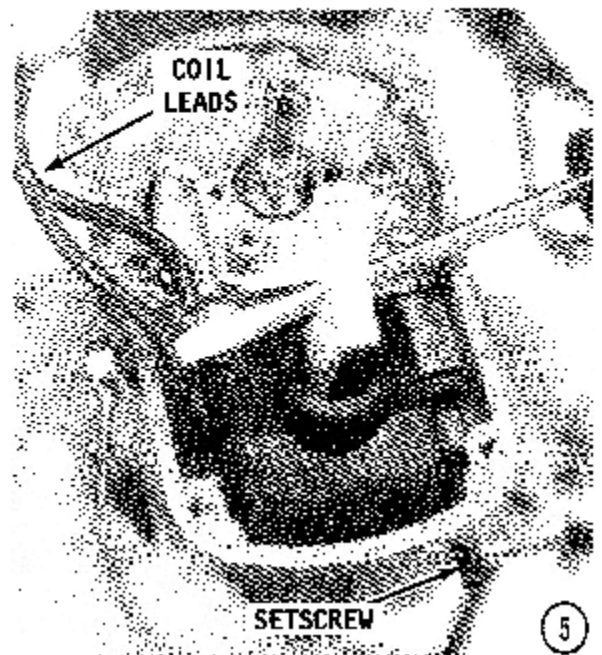


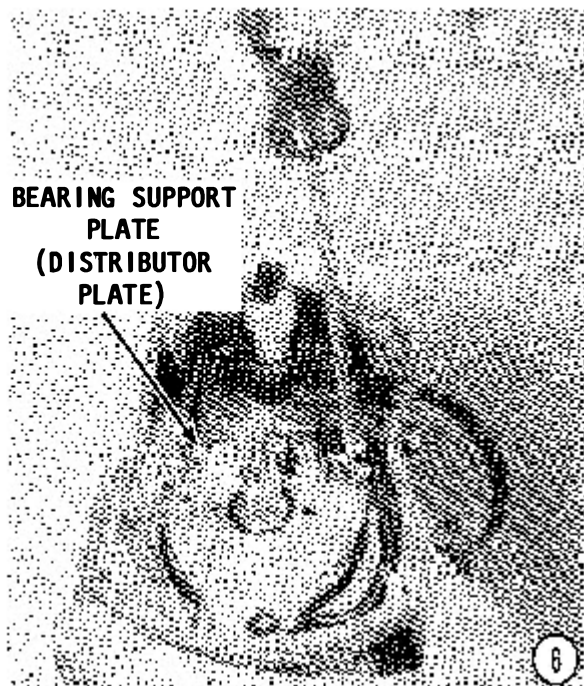
is necessary. The magneto must be disassembled because the bearings are badly worn. Do not confuse the "pull" due to the magnetic field during rotation with binding or rubbing.

3- If the evidence is clear that the magneto requires disassembly, remove the distributor cap, rotor, and the cover. **TAKE CARE** not to damage the parts.

4- Detach the breaker terminal screw securing the primary ground wire, condenser lead, and primary coil lead, and then remove the breaker assembly. Remove the condenser hold-down screw, condenser, and cam wick assembly. Separate the movable breaker assembly from the pivot post by removing the cotter pin and washer. Release the two hold-down screws, and then remove the stationary breaker assembly.

5- Disconnect the coil safetywire; back-off the setscrews; and then remove the coil from the distributor housing.

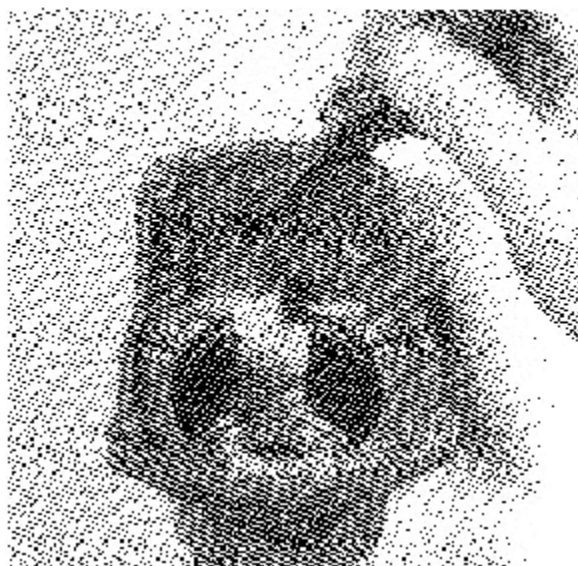




6- Remove the screws and lockwashers securing the bearing support plate to the magneto frame. **CAREFULLY** press out the shaft. The distributor plate will also come out.

CLEANING AND INSPECTING

Inspect all parts for wear or damage. Check the timing belt for cracks, cuts, or other damage. The high-tension leads may be removed after the set screw inside the distributor cap has been removed.



The screwdriver points to a burned area where the coil had been arcing to the distributor housing.

Magnetic Rotor Cracks

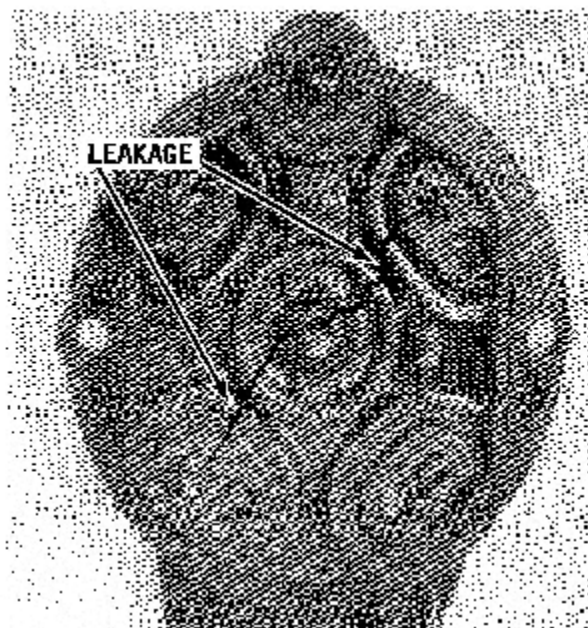
Vertical cracks may be observed in the magnets. Actual tests have shown, without question, that the cracks in no way affect the performance either magnetically or physically for the following reasons:

The magnet steel is a very hard, brittle material with low tensile strength. This material will crack despite all practical measures to prevent them. The cracks which are visible, generally all lie in a plane coinciding with the direction of magnetic flux. Therefore, the possibility of the cracks introducing additional air gaps across the flux path, which could cut down the available flux at the ignition coil, is eliminated.

Leakage Paths

The high-voltage surge of the secondary circuit may establish a path to ground by a different route than across the spark plug gap. Once such a path is established, the spark will most likely continue to jump across to ground.

A surface leakage path can usually be detected because of the burning effect the high-voltage spark has on the plastic insulating material. The condition causing the high-voltage spark to stray from its intended circuit must be corrected. Any repairs of the unit should be performed very **CAREFULLY**, and should include discarding any insulating parts with evidence of high-voltage flashover.



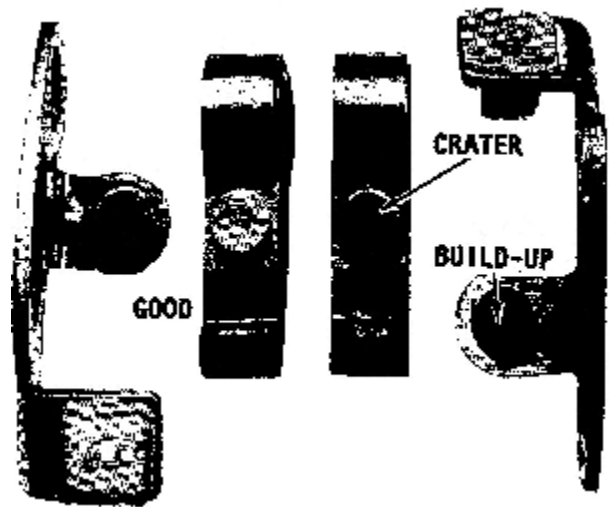
Inspecting the inside of the distributor cap for cracks, worn contacts, and cleanliness.

Corrosion

One cause of complete magneto failure is oxidation inside the unit. Such oxidation is the result of continued high-voltage arcing within the housing. Interior corrosion is easily detected by the green discoloration of the copper and brass parts. Sometimes evidence of moisture condensation may be found. Oxidation may be eliminated, if it is detected in time, by removing the cause. Three common causes of oxidation inside a magneto are: a spark gap across a loose connection in the high-voltage circuit; carbon paths inside the magneto; and broken or sticking center spring-loaded terminal.

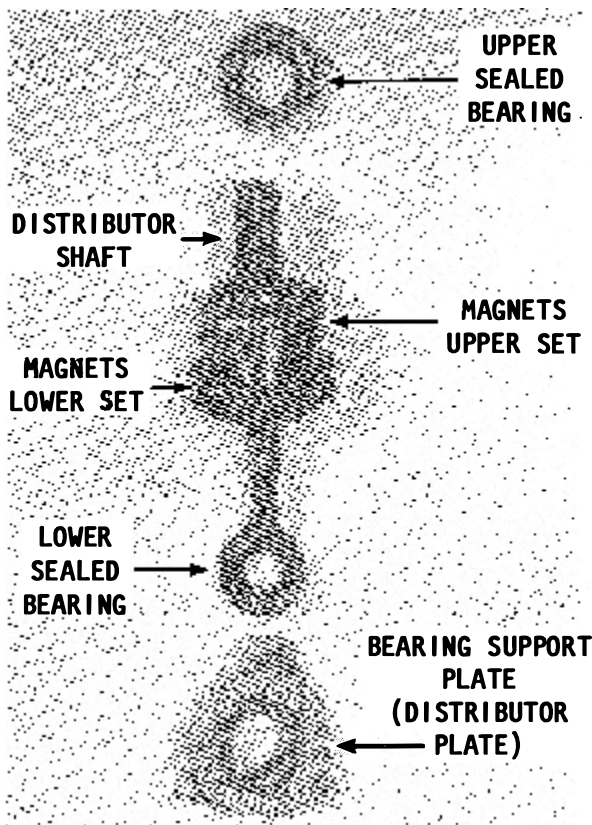
OVERHAUL

Usually an oxidized magneto can be cleaned and returned to satisfactory service. Examine the rubbing block for wear. If the rubbing block is worn to a contour similar to the cam, consider this as evidence of excessive wear. Replace the assembly. If the breaker arm pivot is too tight or too loose in the hole, the assembly should be replaced.

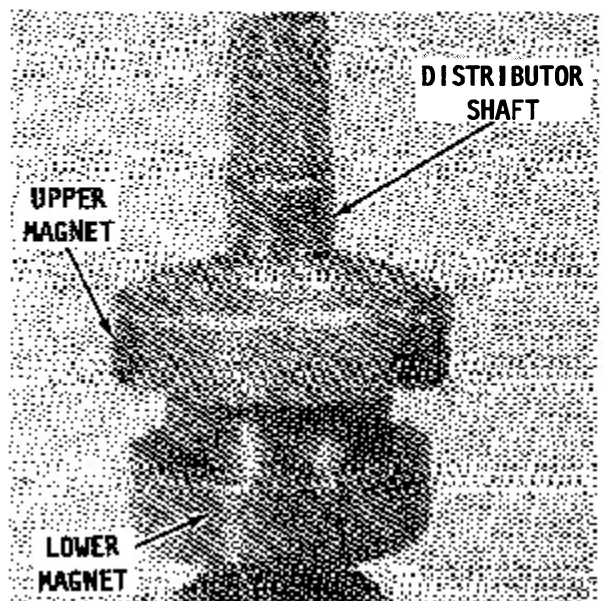


A normal set of breaker points used in a magneto will show evidence of a shallow crater and build-up after a few hours of operation. The left set of points is considered normal and need not be replaced. The set on the right has been in service for more than 450 hours and should be replaced.

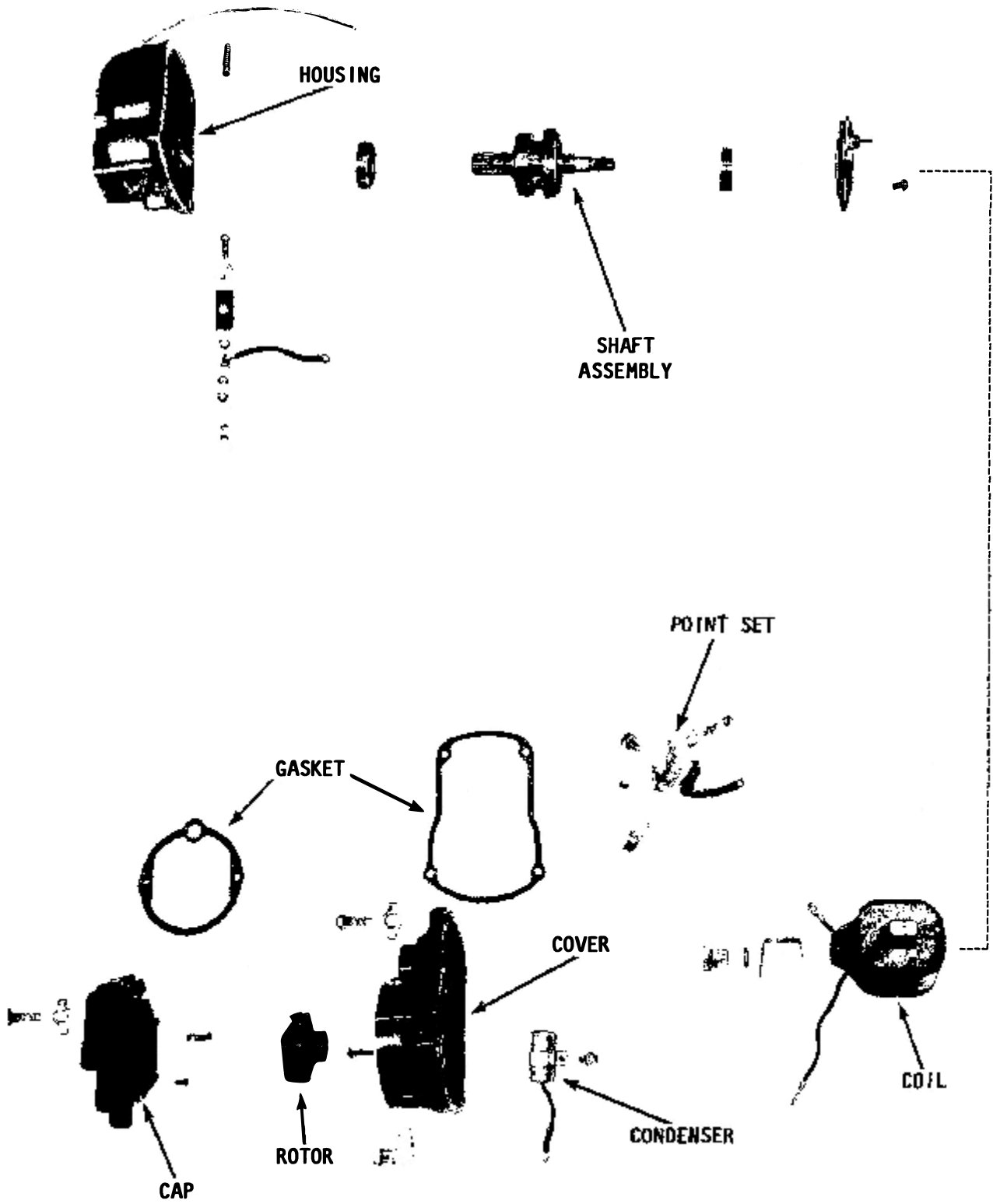
Inspect the breaker points for signs of pitting or pyramiding. In the accompanying illustrations, the set on the left shows only discoloration and some shallow pitting. This set has been operated for only 30 minutes and is considered in excellent condition. The set on the right has considerable build-up and deep crater formations. Running time on this set exceeds 450 hours and they should be replaced.



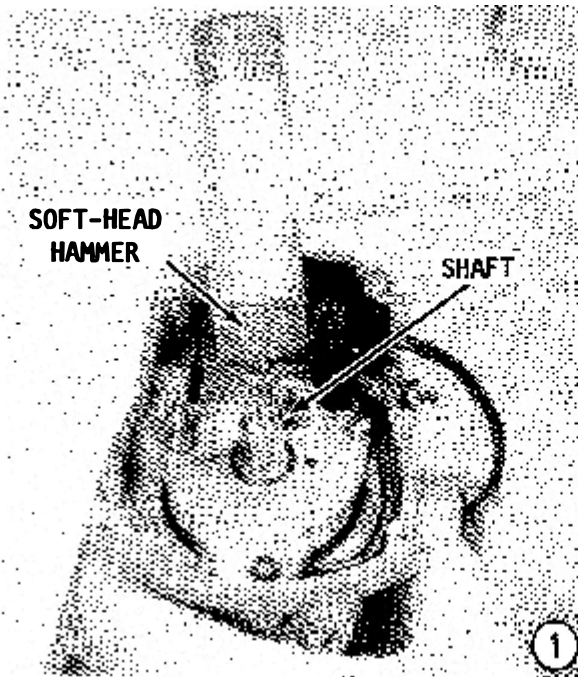
Arrangement of the magneto shaft, sealed bearings (upper and lower), bearing support plate (distributor plate), and both sets of magnets. Note how the upper set of magnets is offset 90° from the lower set.



Closer look at the distributor shaft than the illustration in the left column. The upper and lower magnets are more visible and are clearly shown offset from each other at 90°.



Exploded drawing of a belt-driven magneto with points for the Type I ignition system, with major parts identified.

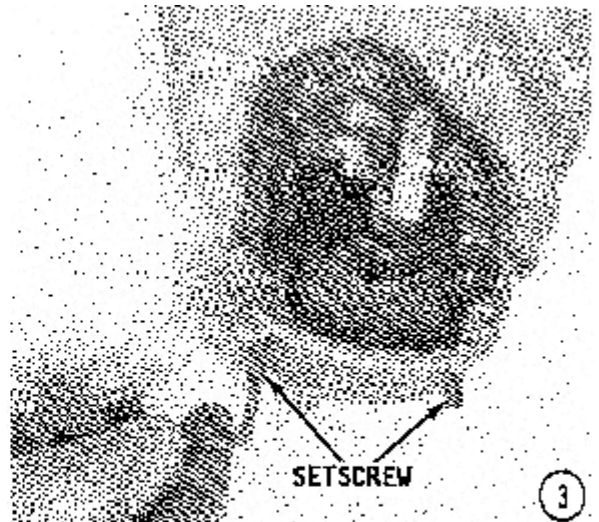


TYPE I ASSEMBLING

1- **CAREFULLY** press the ball bearing drive end into the distributor frame housing. Press the ball bearing opposite drive end into the bearing support. Use **ONLY** a plastic or brass-headed mallet to tap the bearing support into the housing, checking to be sure it is properly aligned. Install the screws and lockwashers to support the frame. Tighten the screws **SECURELY** and evenly. Manually rotate the distributor shaft and magnet assembly and check to be sure there is no feel of binding. It most likely will be tight, now **LIGHTLY** tap the top of the shaft to seat the bearing.

Breaker Assembly Installation

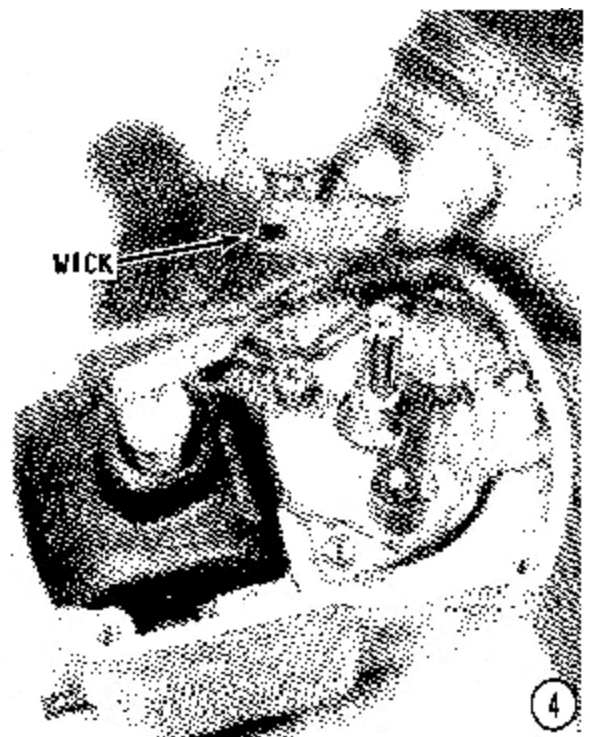
2- If the old points are to be installed, they should first be cleaned with a brush and tetrachloride, or equivalent. If new points

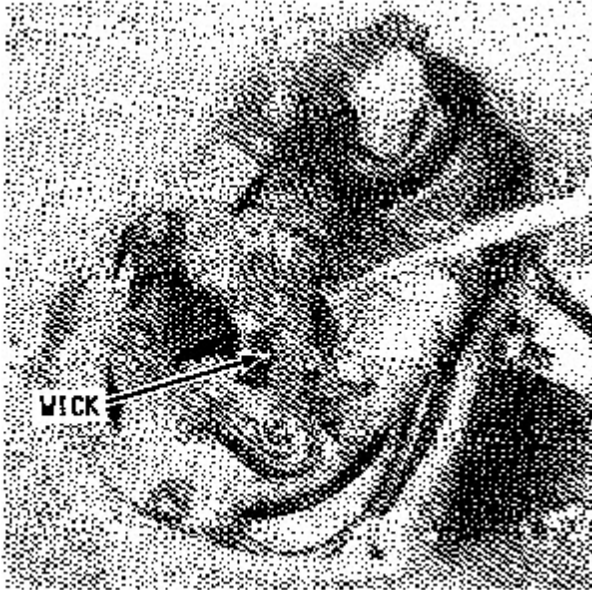


are installed, place them in position, and then bring the two hold-down screws and washers up snug, but not tight. Clean the pivot post and apply a very light coating of Multi-Purpose Lubricant. **TAKE CARE** not to get any grease or oil on the breaker assembly. Install the washer and cotter pin.

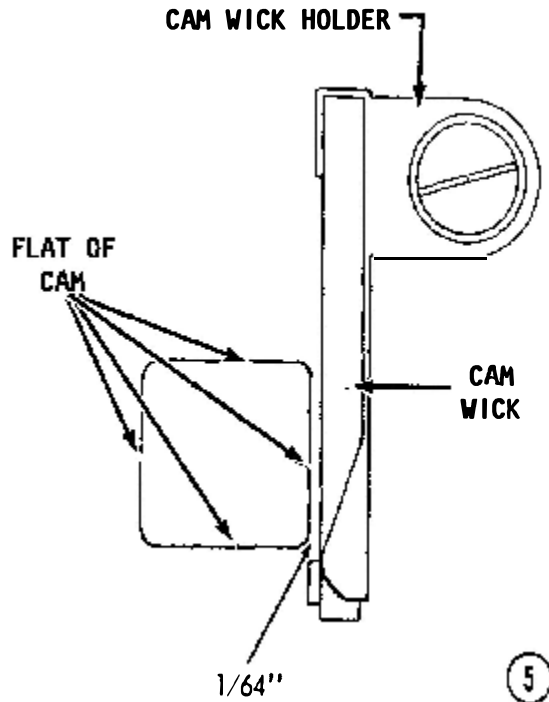
3- Check the coil to be sure the bridge setscrews are in place. Install the coil and tighten the Allen setscrews securely. Secure the setscrews in place with safetywire.

4- Install the holder and cam wick assembly, and the condenser on top of the holder. Secure the condenser and holder in place with the hold-down screw.





The screwdriver points out the cam wick and the space between the wick and the distributor shaft lobe.

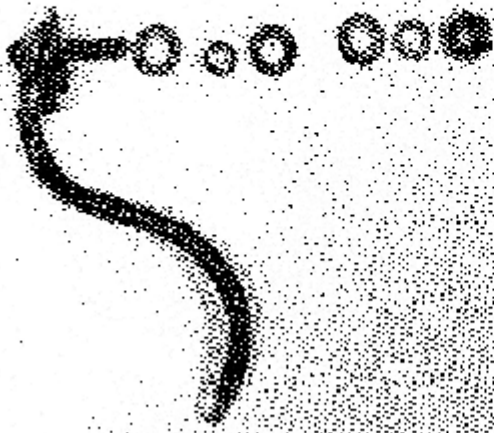


Cam Wick Setting

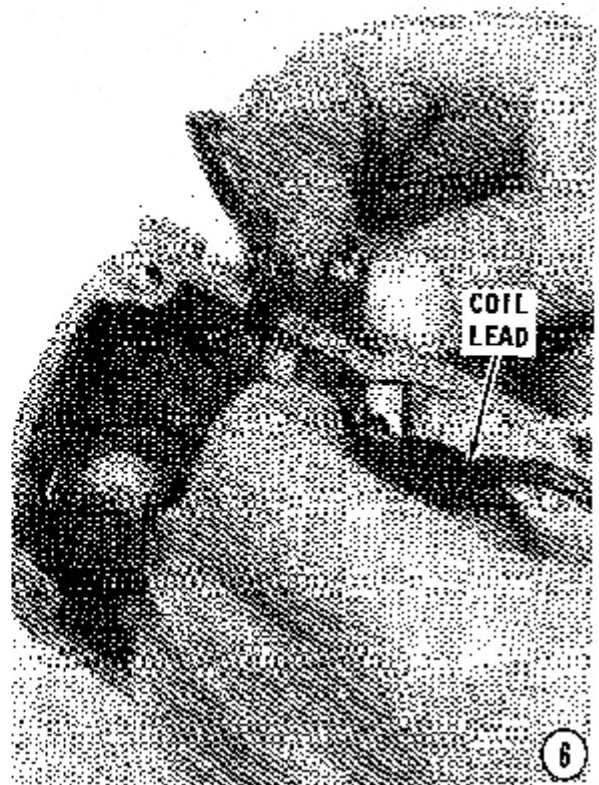
FIRST, THESE WORDS: A new cam wick should be installed every 100 hours of engine operation and each time a breaker assembly is installed. The cam wick is specially lubricated and requires no further lubrication. Any additional lubrication would shorten breaker point life. If the cam wick is set too tight against the flat of the cam shaft, the result may be loosened fiber wick particles and possibly grease thrown off from the wick. If the wick is set too lightly, the cam wick will not lubricate the cam shaft, which will result in rapid wear of the cam follower portion of the breaker assembly. This type of wear will allow the point gap to close. Therefore, if the cam wick is not set

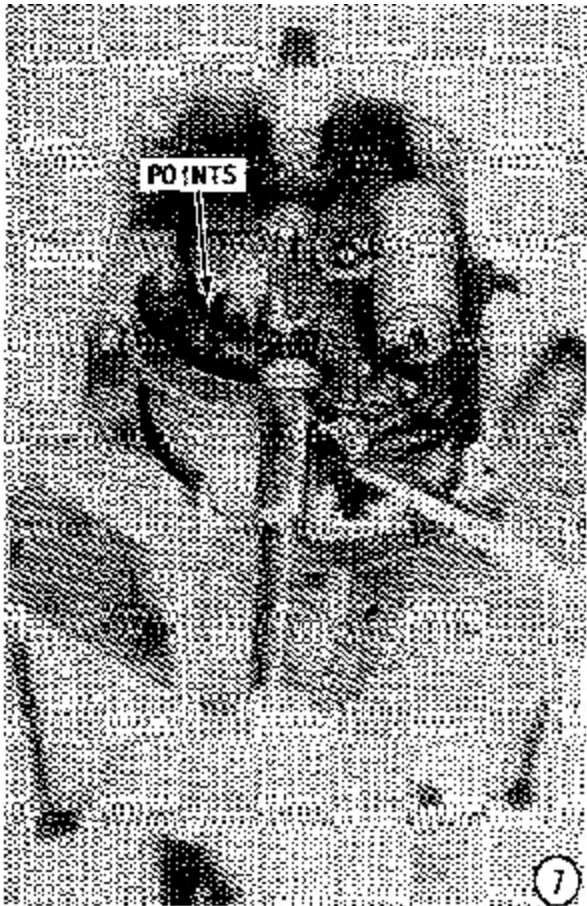
properly, the breaker points would burn and pitted very rapidly, causing the ignition system to fail.

5- Set the cam wick holder so the wick has 1/64" (0.40mm) clearance to the flat of the cam shaft. To make this adjustment, a 0.015" (0.38mm) feeler gauge may be used. After the proper setting has been made, secure the cam wick in place by tightening the hold-down screw.



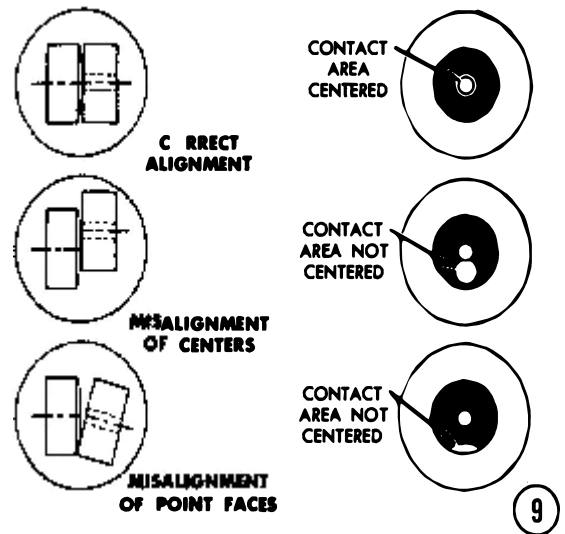
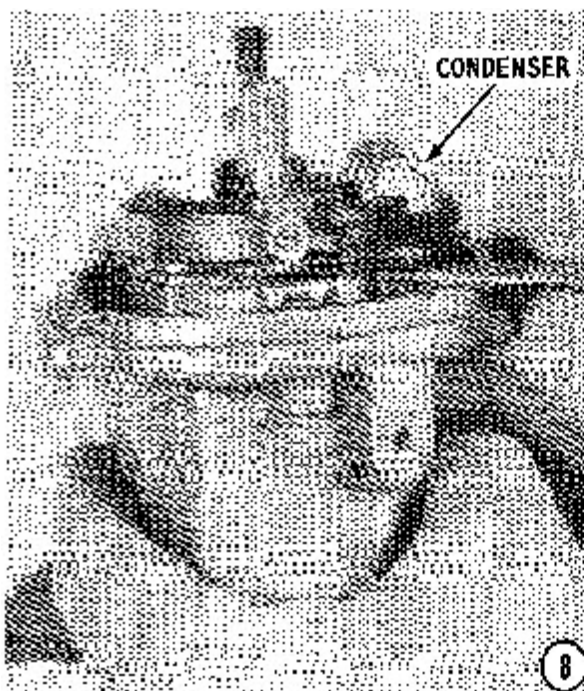
Wire, bushing, screw, and assorted hardware used to connect the point set with the primary side of the coil.





Point Alignment

6- Slide a washer onto the terminal screw, and then insert the screw into the primary lead of the coil. Slide the condenser lead, and then the ground lead onto the terminal screw. Hold the three leads to-



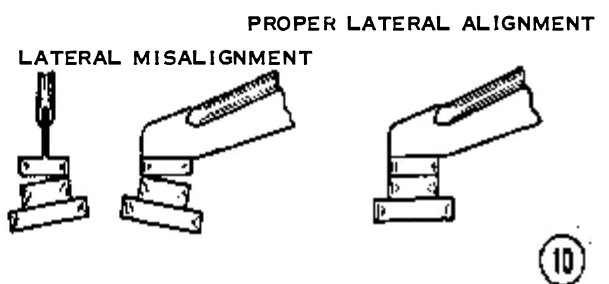
gether and in line to prevent them from shorting out on the support plate, and then insert the screw in the movable and stationary points. Tighten the screws.

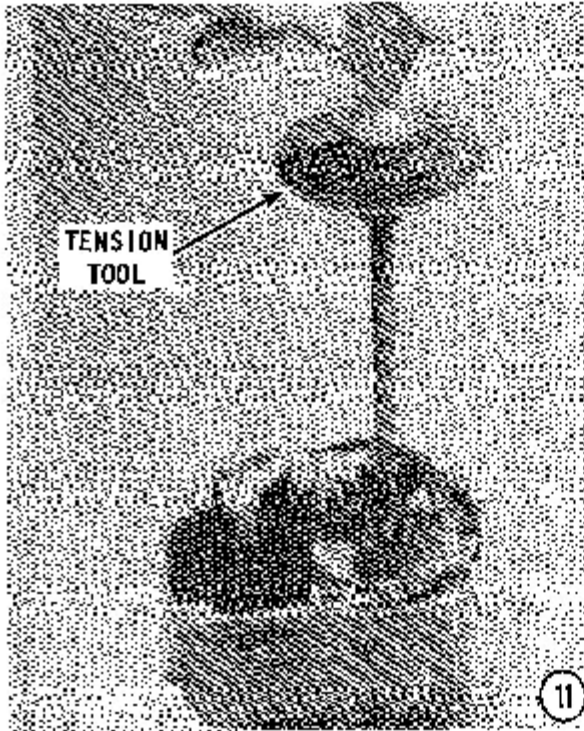
7- Install the coil and condenser wires onto the point set stud. Secure the wires in position with the nut.

8- Check to be sure the wires have not rotated when the nut was tightened and make contact with the distributor base. If the wires do make contact, the points will be shorted out. To correct this condition, loosen the nut, reposition the wires, and then carefully tighten the nut.

9- Align the breaker points by bending or twisting **ONLY** the fixed contact point. The points **MUST** be aligned accurately to provide the best contact surface. This is the only way to assure maximum contact area between the point surfaces and satisfactory point life.

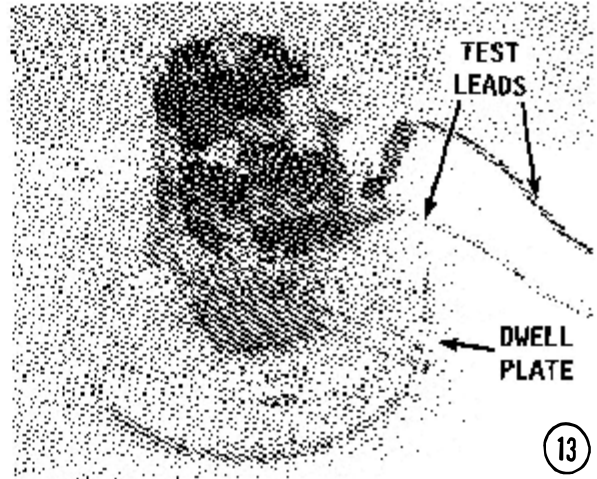
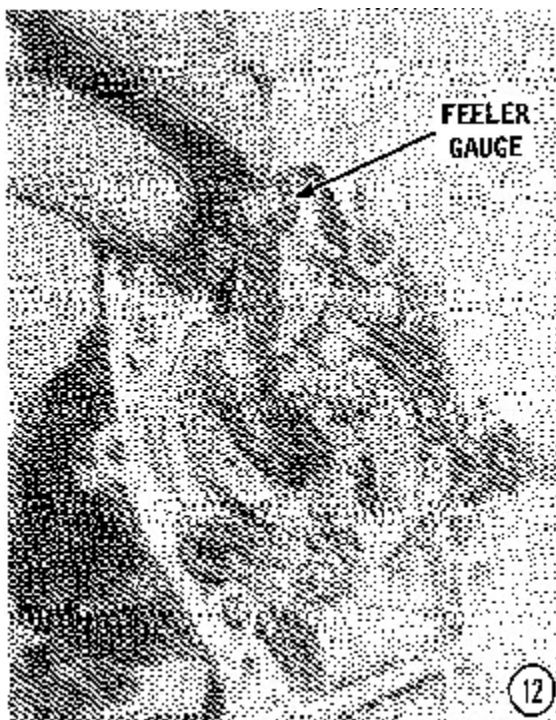
10- If the points are not aligned properly, the result will be premature wear or pitting. This type of damage may change the cam angle, although the actual distance of movement between the points may remain the same.





Breaker Point Spring Tension

If the spring tension is too tight, more than 37 ozs. (1,050gm), the breaker point cam follower will wear rapidly. If the cam follower wears, the breaker points may close after only 5-7 hours of operation. If the spring tension is below 33 ozs. (935gm), the breaker arm will flutter at high speed. Such a flutter will cause engine misfire at high speed.



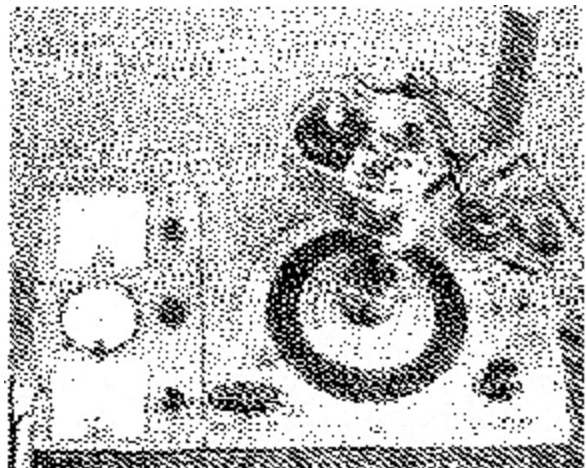
11- Adjust the point spring with your **FINGERS** to 33-37 ozs. (935-1,050gm), tension. **NEVER** use pliers because a sharp bend will surely cause the spring to break later.

Breaker Point Gap Setting

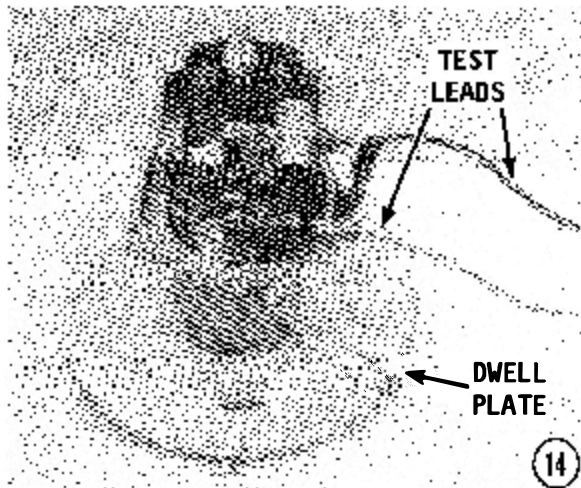
12- The breaker point gap may be set .008" to .010" (0.20mm to 0.25mm), when the cam follower fiber arm is on the highest part of the cam lobe.

HOWEVER, a more efficient method is to adjust the points to 48° dwell. This setting will assure sufficient primary current build-up time.

13- Set the magneto housing drive end collar into the center opening of the dwell plate, with the air intake nozzle extended into the slot on the side of the plate. Install two flat-headed screws through the slots of the dwell plate and into the magneto mounting screw holes. **DO NOT** tighten the screws because the degree plate **MUST** be able to turn. Install the base of the indicator arm



Setting the points on a synchronizing machine. Such equipment is only found in a professional repair shop.

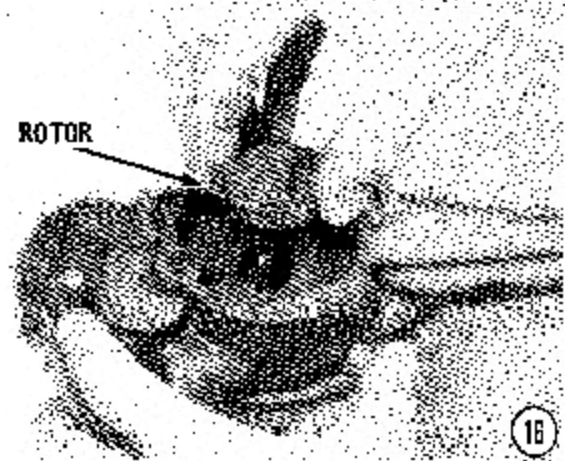


on the large splined drive coupling of the magneto. Tighten the setscrew in the base of the indicator arm. Clamp the large square end of the indicator arm in the vise so that both hands are free for adjusting.

Connect one test lead of an ohmmeter or a self-powered timing lamp to the housing of the magneto. This will be the ground. Connect the second wire to the primary grounding screw. Now, with the breaker points open, **SLOWLY** rotate the magneto armature clockwise until the points close (the lamp lights).

14- Hold the magneto housing in this position and at the same time rotate the dwell plate in either direction until the "Points Close" mark is in line with the indicator arm. Hold the dwell plate and magneto housing together, and at the same time rotate the assembly clockwise until the points close, which must fall on 0° , and remain closed until the pointer indicates the 48° "Points Open" position.

If the rotation is less than 48° , the points open too soon, and the point gap must

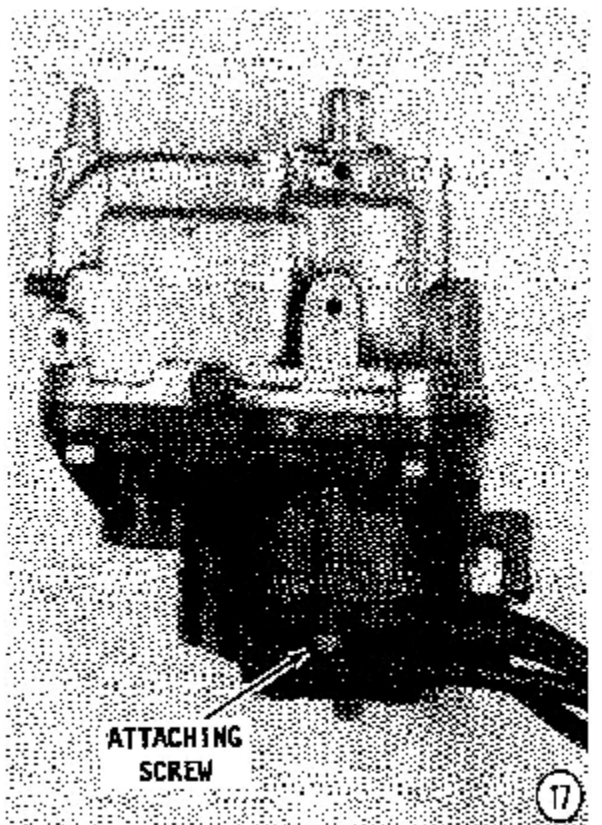
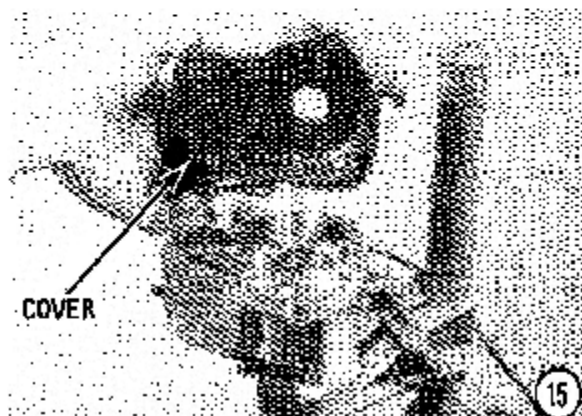


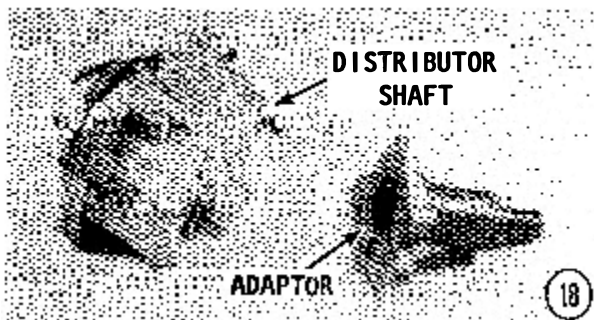
be closed slightly. If the rotation is more than 48° , the breaker points open too late, and the gap must be increased slightly. After each point gap adjustment, repeat the check.

Distributor Cap Installation

15- Place a **NEW** gasket in position on the distributor housing, then place the magneto cover onto the housing.

16- Install the rotor with the rotor aligned with the spline. (On a Fairbanks-Morse magneto, align the rotor with the flat spot on the shaft.)





17- If the high-tension lead was removed, install the lead and secure it place with the setscrew. Install the gasket and distributor cap. Slip the ground strap onto one of the distributor cap screws, then secure the cap in place with the two screws.

Magneto Installation

FIRST THESE WORDS: All powerheads covered in this manual have a magneto adaptor. The magneto can be slipped into the adaptor and secured in place with cap-screws. The adaptor shaft and the magneto shaft have a blanked tooth and a missing spline. When the magneto is installed into

the adaptor with the blanked tooth and missing spline aligned, the magneto is properly timed.

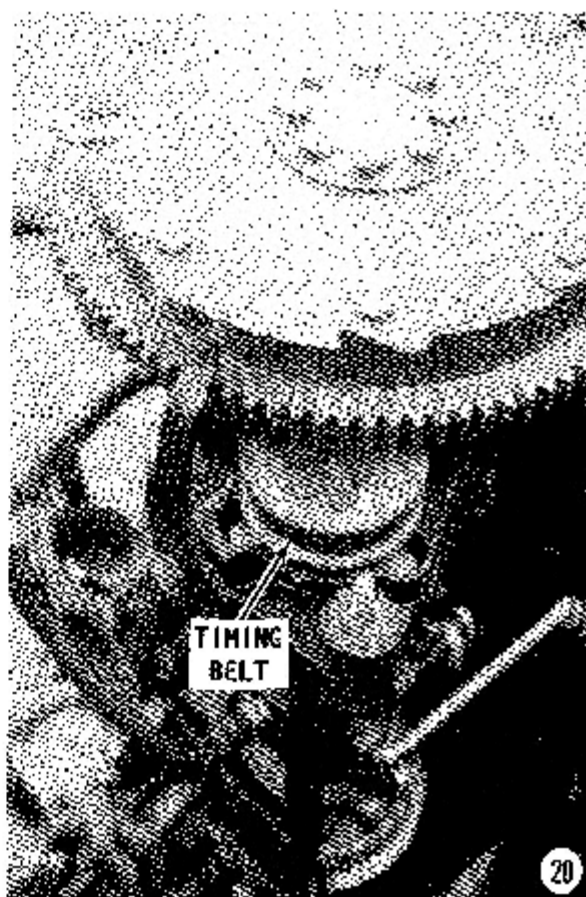
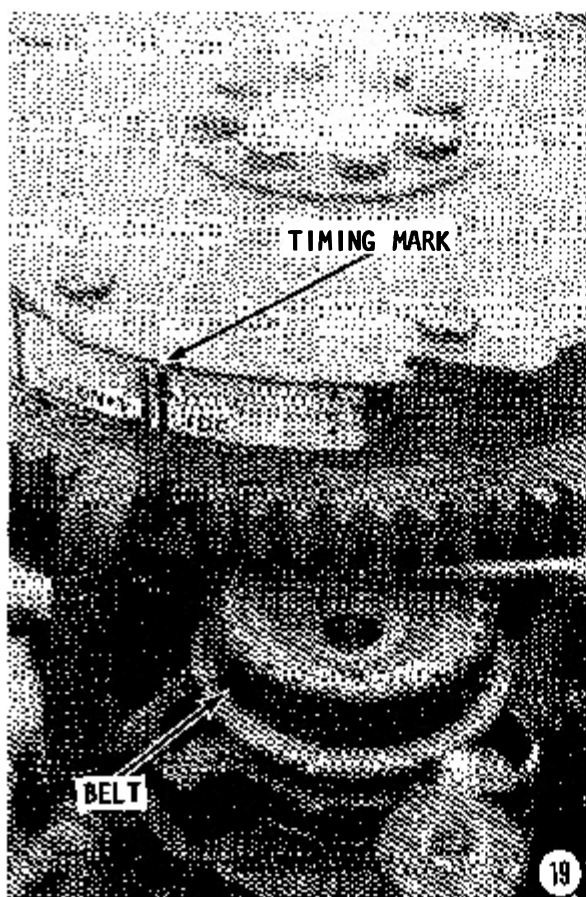
18- Install the magneto into the adaptor with the blanked tooth and missing spline on the shafts aligned, and then secure it in place with the capscrews.

Magneto Drive Belt Replacement

19- If the adaptor has been removed, or if the drive belt timing has been disturbed, it is necessary to time the adaptor pulley to the timing mark on the flywheel. This is accomplished by first rotating the flywheel until the timing mark on the rim is aligned with the center of the crankshaft and the center of the driven pulley. Next, position the arrow on the pulley to point toward the timing mark.

20- Now, replace the timing belt, and then install the plate, capscrew, and washers. Tighten the capscrew to a torque value of 6-in.-lbs (0.69Nm). Connect the battery leads to the battery teminals.

For timing and synchronization procedures, see Chapter 6.



**5-6 TYPE II IGNITION SYSTEM
THUNDERBOLT – DISTRIBUTOR
LIGHTNING ENERGIZER – POINTLESS
ALSO KNOWN AS
ALTERNATOR DRIVER IGNITION (ADI)**

Description

This ignition system is identified as Type II in the Specifications in the Appendix.

A battery is not required for operation of the system, except for cranking the engine. Once the engine is operating, the ignition is completely self-contained.

The alternator driver (charging portion of the distributor) consists of a 4-pole permanent rotating magnet, stationary poles, and high- and low-speed voltage generating coils. The coils are housed in a die cast aluminum housing.

The permanent rotating magnet is pressed onto the distributor shaft and is driven at crankshaft speed by a timing belt around the flywheel pulley and a distributor pulley. When the magnetic poles pass the stationary poles and generating coils, they produce AC voltage at the rate of 4 cycles per engine revolution.

One side of the alternating current cycle charges a capacitor. The opposite side is used to discharge the capacitor into the ignition coil. This sequence occurs 4 times per engine revolution because there are 4 north polarity and 4 south polarity poles on the rotating magnet.

The capacitor voltage is conducted into the ignition coil primary winding. A high strength magnetic field is built around the coil core. Since there is no voltage to sustain this magnetic field, the field col-

lapses rapidly. The rapid collapse induces a high voltage in the coil secondary winding. This voltage is applied to the spark plugs through the ignition rotor, distributor cap and high tension leads.

Advance or retard of the spark is possible by changing the position of the charging coils and stationary poles in relation to the permanent magnet rotor poles.

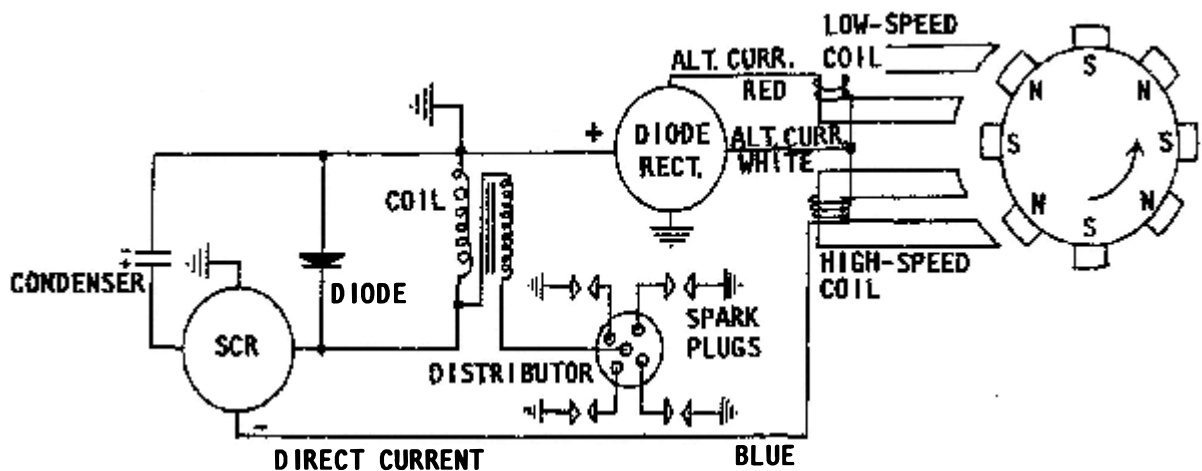
The engine is shut down by shorting the blue switch box terminal to ground with the key switch, tilt switch, or the ignition safety stop switch.

CRITICAL WORDS: These next two paragraphs may well be the most important words in this chapter. Probably the No. 1 cause of electrical problems with outboard power plants is misuse of the wiring harness.

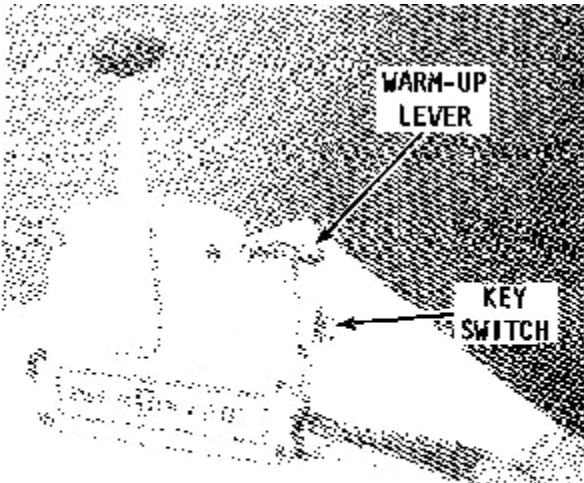
A wiring harness is used between the key switch and the engine. This harness seldom contains wire of sufficient size to allow connecting accessories. Therefore, anytime a new accessory is installed, **NEW** wiring should be used between the battery and the accessory. A separate fuse panel **MUST** be installed on the dash. To connect the fuse panel, use two red and black No. 10 gauge wires from the battery. Again, let it be said, **NEVER** connect accessories through the key switch.

**TROUBLESHOOTING
TYPE II IGNITION SYSTEM**

Always attempt to proceed with the troubleshooting in an orderly manner. The shot-in-the-dark approach will only result in wasted time, incorrect diagnosis, replacement of unnecessary parts, and frustration.



Schematic diagram of the Type II ignition system -- Thunderbolt -- with distributor -- Lightning Energizer -- pointless -- as used on the 4-cylinder in-line powerhead.



Key switch located in the shift box. The box must be disassembled to service the key switch.

Begin the ignition system troubleshooting with the spark plugs and continue through the system until the source of trouble is located.

Key Switch

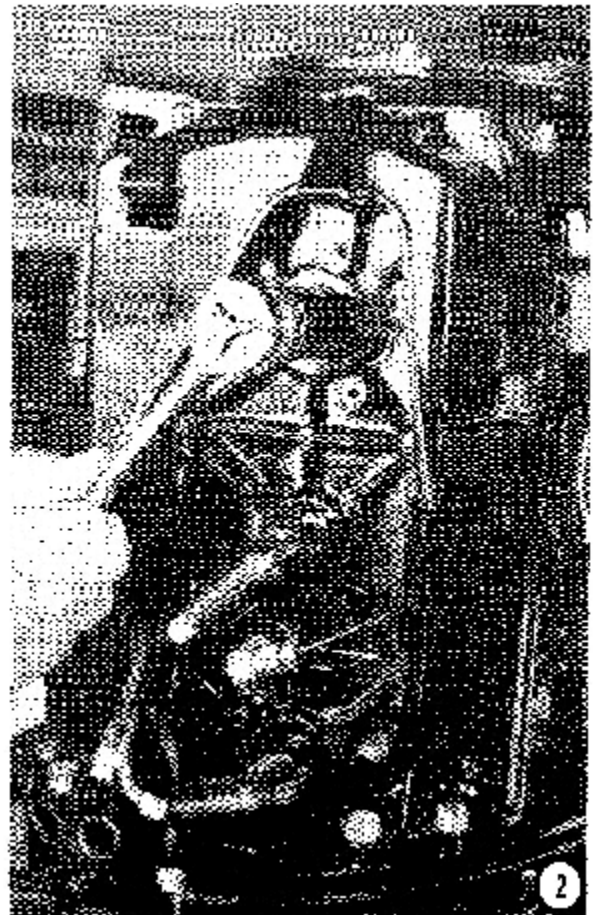
A marine-type key switch **MUST** be installed as a replacement item. An automotive-type switch installation may cause damage to the system.

Spark Plugs

1- Check the plug wires to be sure they are properly connected. Check the entire length of the wires from the plugs to the distributor. If the wire is to be removed from the spark plug, **ALWAYS** use a pulling and twisting motion as a precaution against damaging the connection.

2- Attempt to remove the spark plugs by hand. This is a rough test to determine if the plug is tightened properly. You should not be able to remove the plug without using the proper socket size tool. Remove the spark plugs and keep them in order. Examine each plug and evaluate its condition as described in Section 5-2.

3- Use a spark tester and check for spark at each cylinder. If a spark tester is not available, hold the plug wire about 1/4" (6.35mm) from the engine. Turn the flywheel with a pull starter or electrical starter and check for spark. A strong spark over a wide gap must be observed when testing in this manner, because under compression a strong spark is necessary in order to ignite the air/fuel mixture in the cylinder. This means it is possible to think you have a strong spark, when in reality the spark will



be too weak when the plug is installed. If there is no spark, or if the spark is weak, the trouble is most likely in the distributor or in the switch box.

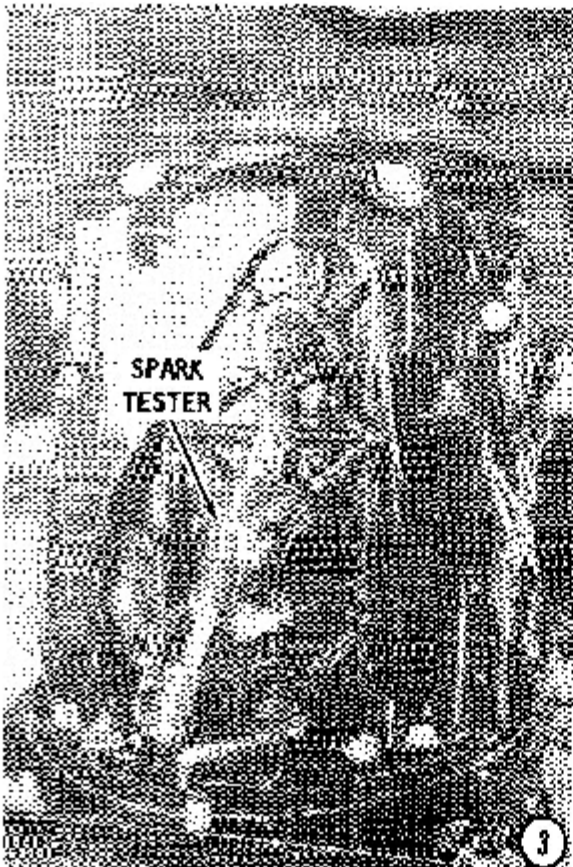
Compression

Before spending too much time and money attempting to trace a problem to the ignition system, a compression check of each cylinder should be made. If the cylinder does not have adequate compression, troubleshooting and attempted service of the ignition or fuel system will fail to give the desired results of satisfactory engine performance.

Remove the spark plug wires by pulling and twisting **ONLY** on the molded cap. **NEVER** pull on the wire because the connection inside the cap may be separated or the boot be damaged. Remove the spark plugs and set them aside in order. This simple procedure will assist in evaluating the performance of each cylinder.

GOOD WORDS

When a compression check is performed, the spark plug leads **MUST** be grounded to the powerhead to prevent excessive strain on the coil. If the leads are not grounded, and simply left hanging, the coil will at-



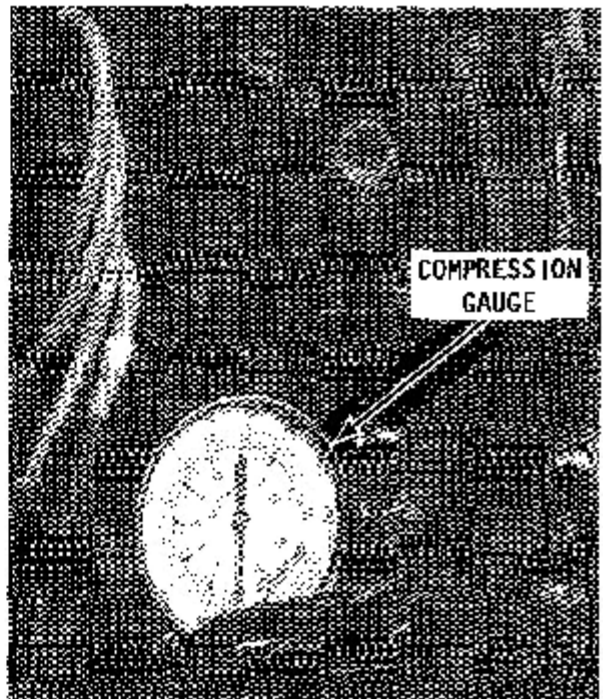
tempt to match the demand created by the spark trying to jump from the plug shell to nearest ground.

Insert a compression gauge into the cylinder spark plug opening. Crank the engine for several revolutions and note the highest compression reading. Repeat the procedure for each cylinder.

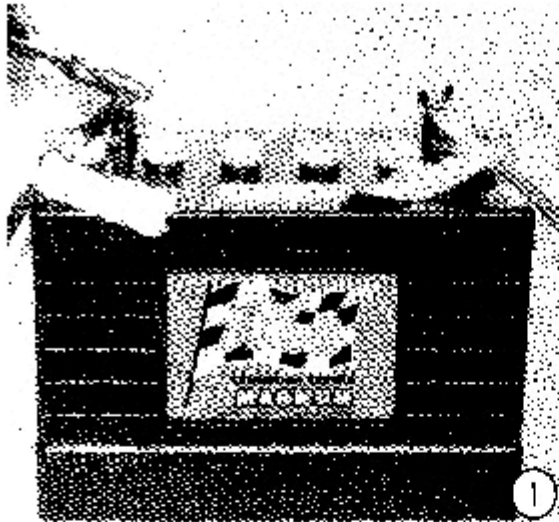
A variation in reading between the cylinders is far more important than the actual individual readings. If a particular cylinder varies more than 20 psi from the others, the cylinder may be scored, the rings frozen, or the piston burned. In-line outboard powerhead covered in this manual do not use a cylinder head. Therefore, low compression in one cylinder **CANNOT** be attributed to a blown head gasket.

SERVICING TYPE II IGNITION SYSTEM

Overhaul procedures may differ slightly on various outboard models, but the following general basic instructions will apply to all outboard engines equipped with the Type II ignition system -- Thunderbolt lightning energizer ignition -- pointless --with a distributor.



When a compression check is performed, the spark plug leads **MUST** be grounded to the powerhead to prevent excessive strain on the coil. If the leads are not grounded, and simply left hanging, the coil will attempt to match the demand created by the spark trying to jump from the plug shell to nearest ground.



REMOVAL

1- Remove the engine cowling. If a battery is used with the engine, disconnect the leads from the battery terminals.

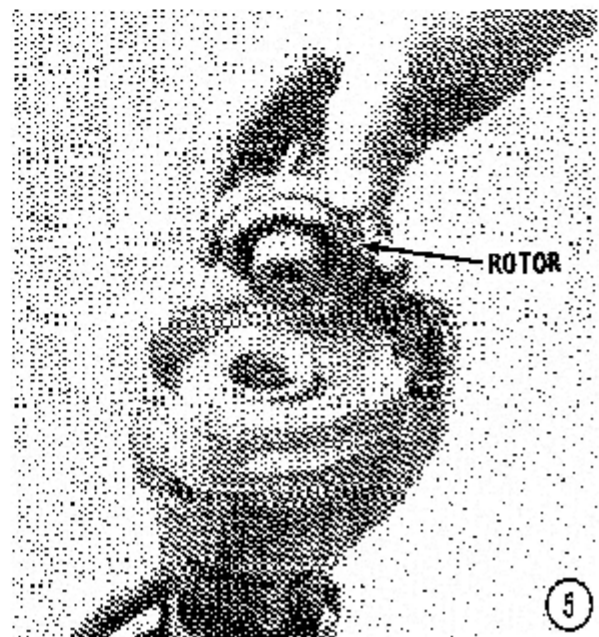
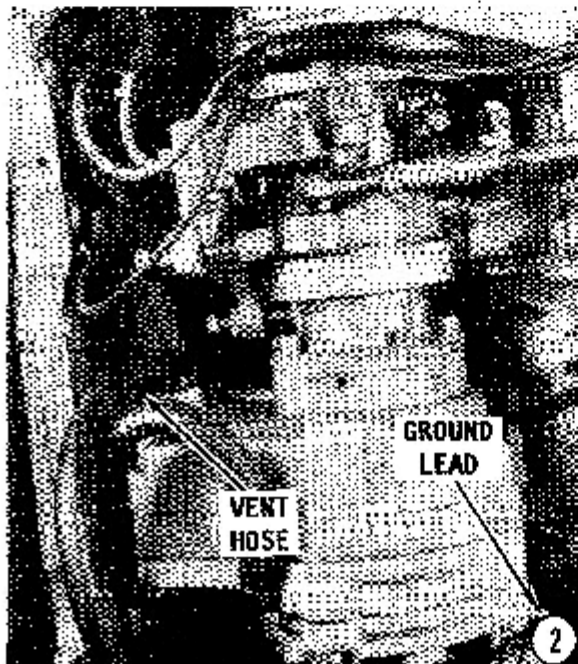
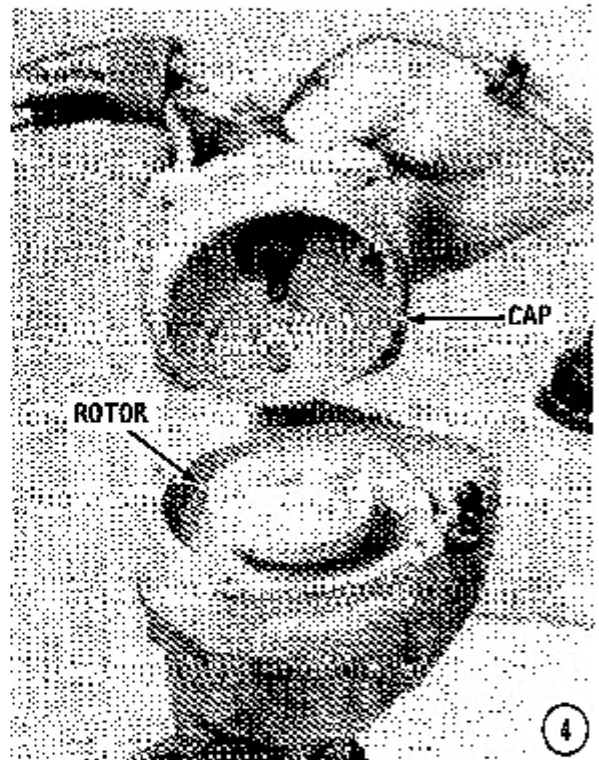
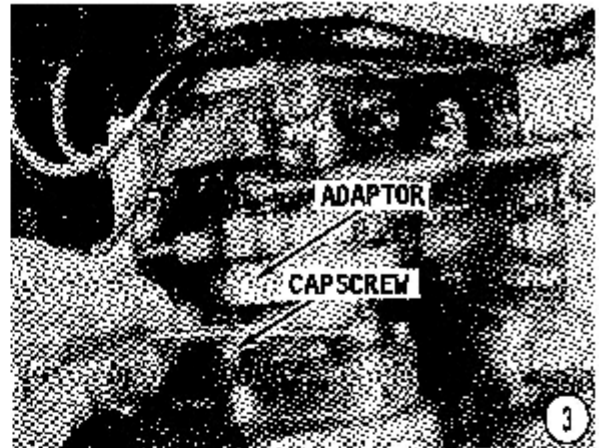
2- Remove the vent hoses and the ground strap from the distributor. Remove the red, white, and blue wire leads on the blue switch box.

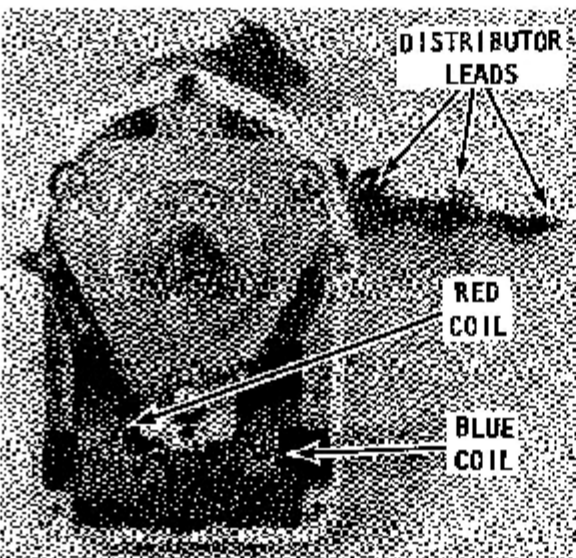
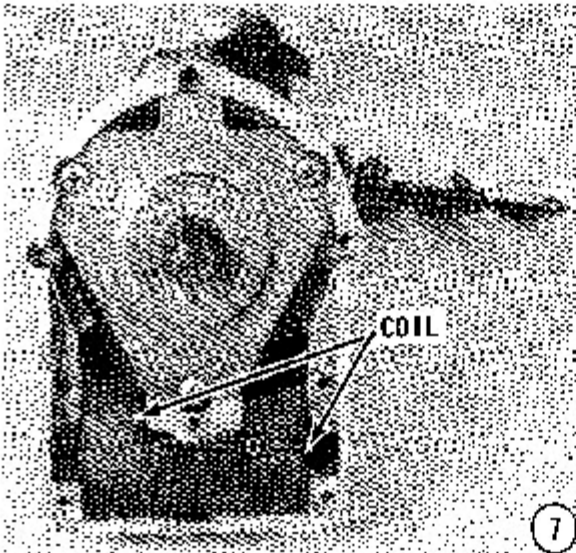
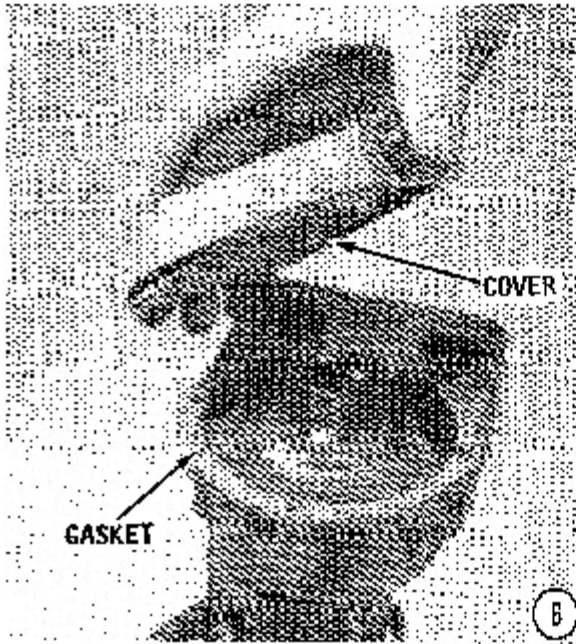
3- Remove the four hex head capscrews securing the distributor to the adaptor, and then remove the distributor from the powerhead.

4- Remove the distributor cap holding screws, and then lift off the cap.

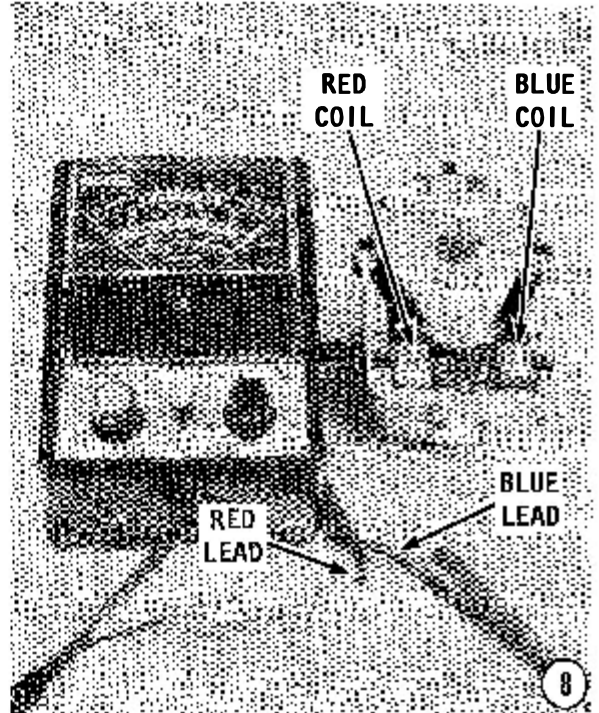
5- Remove the rotor.

6- Back out the screws securing the cover, and then remove the cover. Discard the old gasket.





The coils do not have to be removed for testing. An accurate test can be made with a connection to the distributor leads.



7- After the cover is removed, the low- and high-speed coils are visible. Remove the bearing **ONLY** if the ball bearings have been damaged. To determine damage, rotate the bearing and determine if it turns smoothly for the complete 360°. There should be no evidence of binding or a "rough" spot.

Coil Testing

The low- and high-speed coils do not have to be removed for testing with an ohmmeter.

