RESISTOR TEST

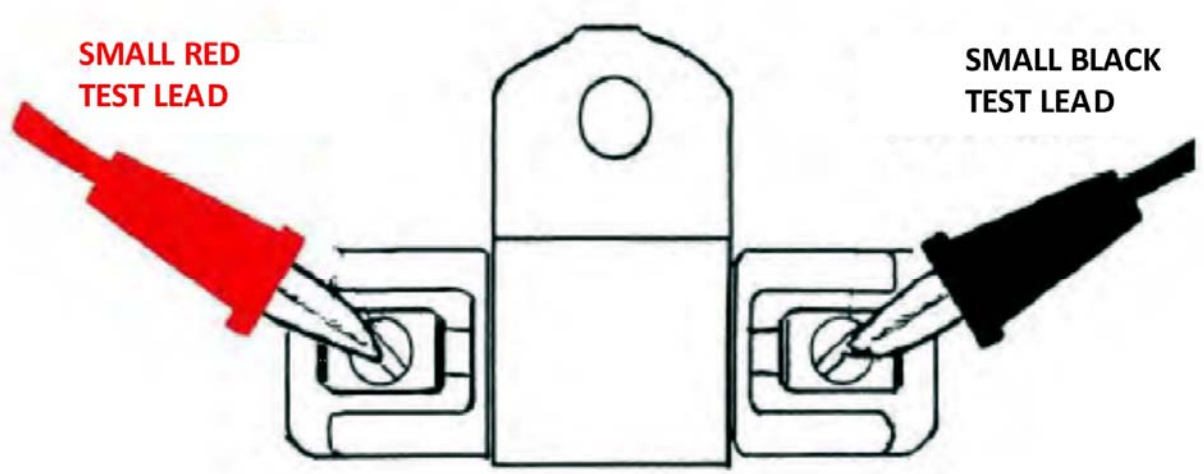

Figure 23

Use scale No. 2 for checking low OHM resistance values. Set selector switch on No. 2, "Distributor Resistance", position. Do not clip test leads together. Turn No. 2 scale meter adjustment knob to adjust meter needle with red line on right side of Scale No. 2. Your meter is now set to check all low OHM values from 0 to 30 OHMS. Clip small red and black test leads to terminals of resistor, as shown in illustration above, and read red figures on Scale No. 2. Replace resistor not meeting the manufacturer's specifications.

Manufacturer	Part No.	Resistance Reading Min	Max
Keikhaefer Mercury	393-1286	1.3	1.7
Keikhaefer Mercury	393-1482	2.0	2.4
Keikhaefer Mercury	393-1572	3.0	3.4
McCulloch (Scott)	332-196	1.7	1.9

HIGH TENSION LEAKAGE - CRACK TEST

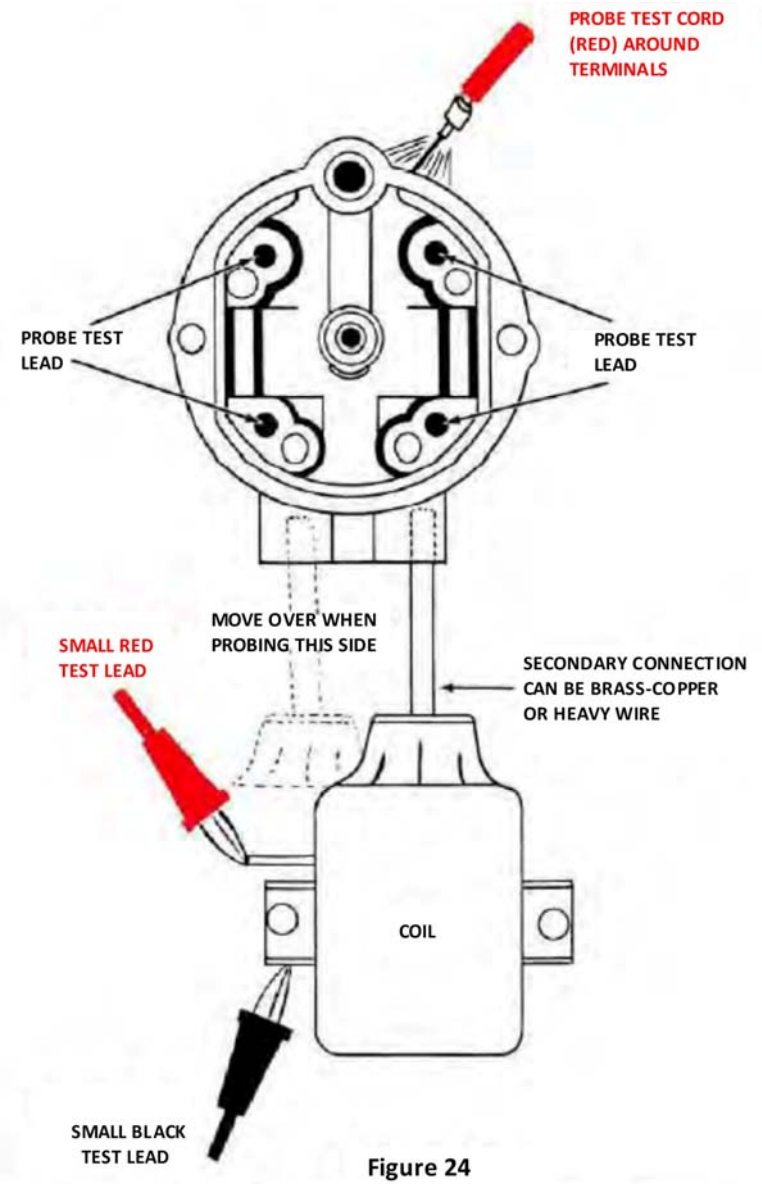

Figure 24

To check for cracks or leakage paths in ignition distributor caps or distributor rotors, clip small red test lead to coil primary lead and black test lead to coil core, as shown in illustration above. A used coil is best for this test, since the coil will be used for inducing a high secondary voltage. The secondary coil terminal must have a brass or copper lead attached so that it will extend fully into the distributor cap spark plug lead wire outlet to provide the spark for this test. Turn selector switch to position No. 1, "Coil Power Test", and turn "LO-HI" current control knob to the "HI" position. Place test probe into jack in tester and pass other end of test probe over area around distributor contact post. If there is a crack or leakage path, it will show up by the spark following a path in the cap rather than sparking directly to the correct terminal. If the spark path occurs, the cap is defective and must be replaced. There should be no spark jump to any other distributor post other than the one being tested. Repeat procedure on each post of distributor cap.

DISTRIBUTOR ROTOR TEST

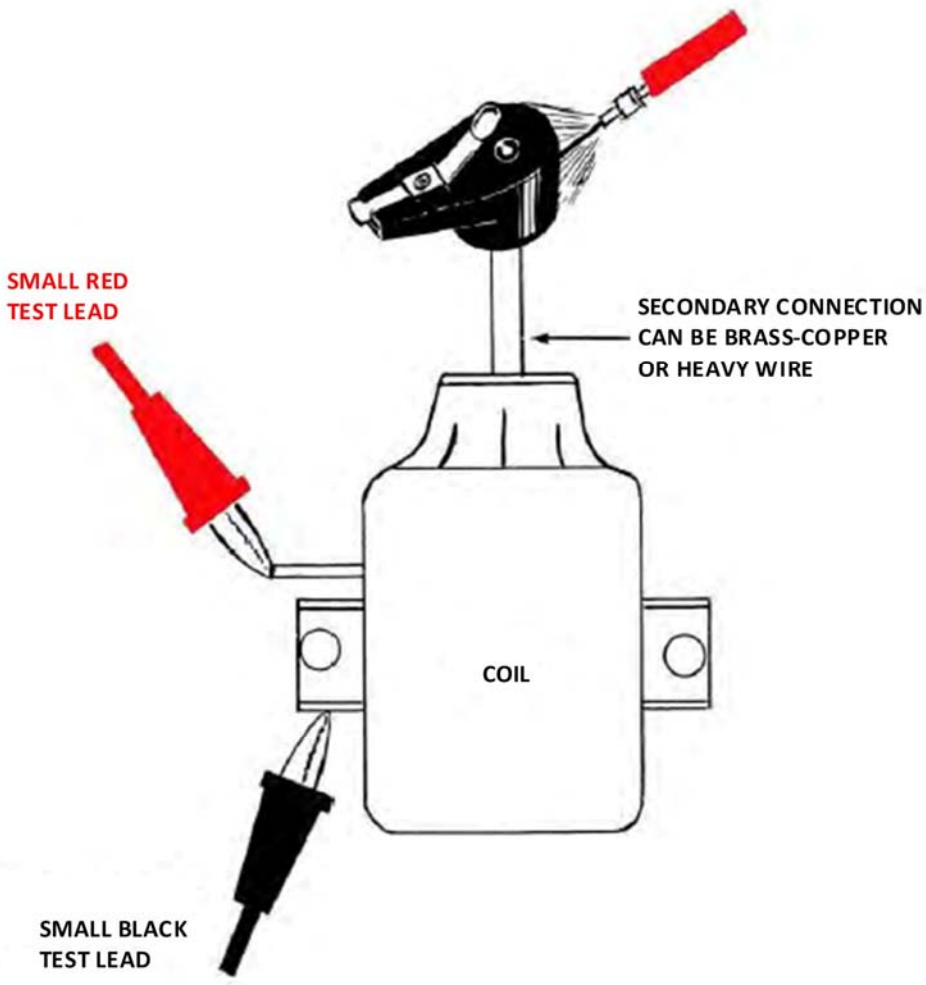

Figure 25

Follow distributor cap leakage test procedure, preceding. Place distributor rotor on high tension terminal of coil so that rotor shaft hole rests on coil terminal as shown in Figure 25. Search around distributor rotor with ground test probe. There should be no spark jump at any point. If a heavy spark does occur, it indicates a defective distributor rotor. Replace defective part.

TESTING COILS WITH TWO SECONDARIES

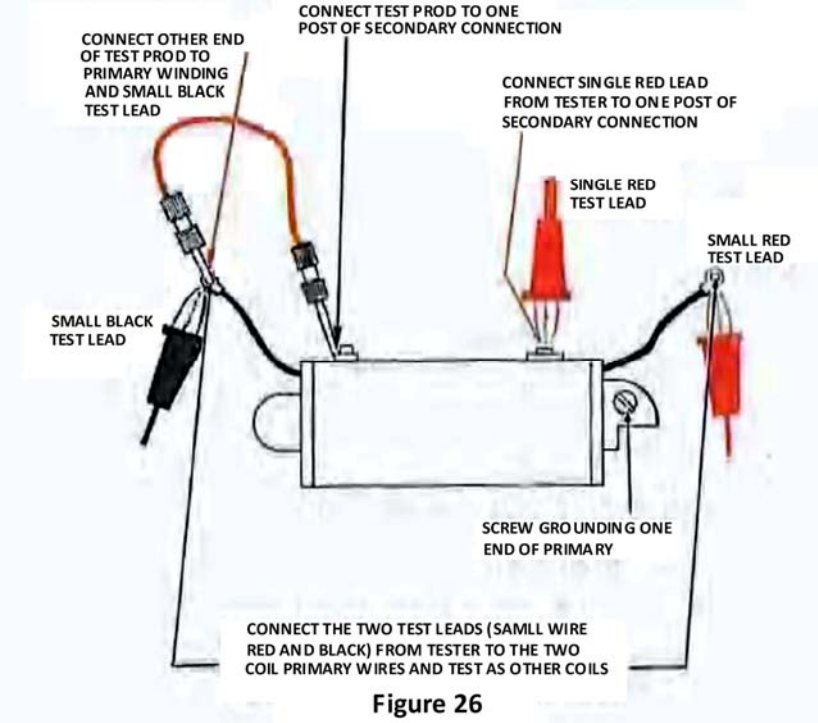

Figure 26

TESTING CONVENTIONAL TYPE MAGNETO

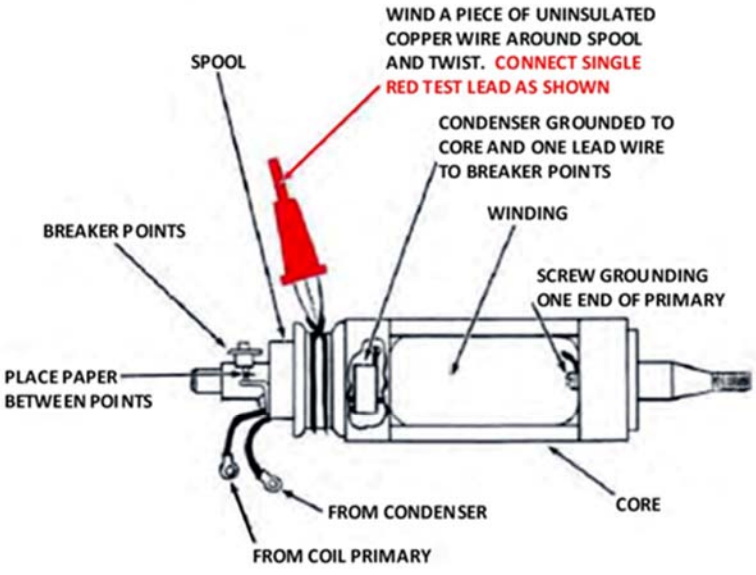

Figure 27

Figure 28

Figure 29

TESTING SELENIUM RECTIFIERS

BY MEASURING DIRECT CURRENT RESISTANCE

1. Set selector switch on position No. 3, “Continuity”.
2. Clip small red and black test leads together and turn meter adjustment knob for Scale No. 3 until meter pointer lines up on set position on Scale No. 3, right side.
3. Connect small red test lead to positive lead on rectifiers. Figure 28.
4. Connect small black test lead to ground stud or lead on rectifier. Figure 28.
5. Note reading of figures on lower band, Scale No. 3.
6. Reverse test leads on rectifier and note readings again.
7. Ratio of two readings should be 10:1 or greater.
8. Remove analyzer test leads and connect to the two alternator leads or lead terminals on rectifier. Figure 29.
9. Note reading on figures on lower band, Scale No. 3.
10. Reverse test leads on rectifier and note readings again.
11. The ratio of the two readings should be no more than 2:1.
12. This is only a preliminary test to determine condition of rectifier. If questionable, as a final test, rectifier should be installed on engine and checked with ammeter while engine is running.

NOTE: This is a true ohm scale, 0 – 200,000 ohms and can be used to test ohm resistance of other electrical components.

FIELD WINDING GROUND TEST

STARTER MOTOR DISASSEMBLED

1. Turn selector switch to position No. 3, “Coil Continuity”.
2. Attach small red test lead to insulated terminal on outside of starter motor and small black test lead to starter motor frame.
3. Meter hand should not move. If it does it indicates the field is grounded.
4. On starter motors having two fields 1) forward winding 2) reverse windings, test both insulated terminals.

GROUND BRUSH TEST

STARTER MOTOR DISASSEMBLED

1. Turn selector switch to No. 3, “Coil Continuity”.
2. Attach small black test lead to the grounded brush and small red test lead to frame to which brush is fastened. (End cap housing or field frame.)
3. Meter hand must move to the right, if not, there is a poor ground connection.
   a) replace the ground brush and lead or
   b) check that the lead connection is secure to the frame.
4. There is also a possibility of the brush holder having a poor ground to the frame or end cap, test by following steps 1, 2, 3 above.

GROUNDED ARMATURE OR FIELD WINDING

STARTER MOTOR ASSEMBLED

1. Raise ground brushes from commutator and insulate them from commutator with cardboard. Make sure brush is not touching commutator.
2. Turn selector switch to position No. 3, “Coil Continuity”.
3. Attach small red test lead to insulated terminal on outside of starter motor and small black test lead to starter motor frame.
4. On starter motors having two fields 1) forward winding 2) reverse windings, test both insulated terminals. While making test move brush lead, making sure there is a solid connection.
5. **If analyzer shows continuity (meter hand moves to the right) there is a ground, check individually (a) and (b) below:**

   a) Check armature - Page 17 Armature Ground Test.

   6) Check Field Winding separately – Page 25 Field Winding Ground Test.

SERVICE SECTION

FOR

EVINRUDE – JOHNSON

UNI-CHARGER

OR

AC GENERATOR
- ALTERNATOR

NOTES:

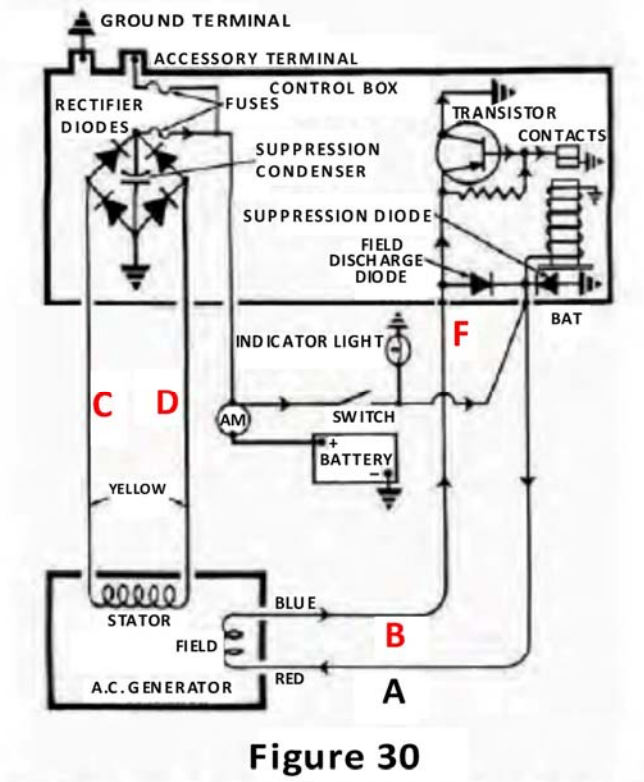

Figure 30

TESTING FOR FAULTY WIRING

1. A short between two wires, or a grounded wire, or high resistance connections can cause the charging circuit to operate improperly.

   A. If the lead from the field winding to the "F" terminal of the regulator (marked "B" in the wiring diagram Fig. 30) should become grounded. Battery will be charged excessively.

   B. If a high resistance should develop at the "BAT" terminals and the wires connected to the "BAT" terminal at regulator. Ammeter will show an excessively high rate of charge, causing battery to use an abnormal amount of water.

   C. A short circuit between leads from the stator winding to the rectifier (wires marked "C" and "D", Fig. 30) or from these becoming ungrounded. Ammeter will show a discharge and an undercharged battery would result.

2. It is important that wiring be checked visually for damage due to corrosion, frayed insulation and loose connections.

3. Additional checks are covered in the following sections.

TESTING FOR SHORTED OR OPEN RECTIFIER DIODES, OR A SHORTED SUPPRESSION CONDENSER (CAPACITOR)

1. Before checking diodes for shorts or opens, disconnect battery leads, the large nylon connector, the condenser lead, the four diode leads from the harness and remove both fuses.

2. To check the condenser for capacity and shorts, refer to pages 11 and 12, Fig. 14. Also top of page 16 for proper grounding.

3. Condenser capacity is approximately .2 microfarads.

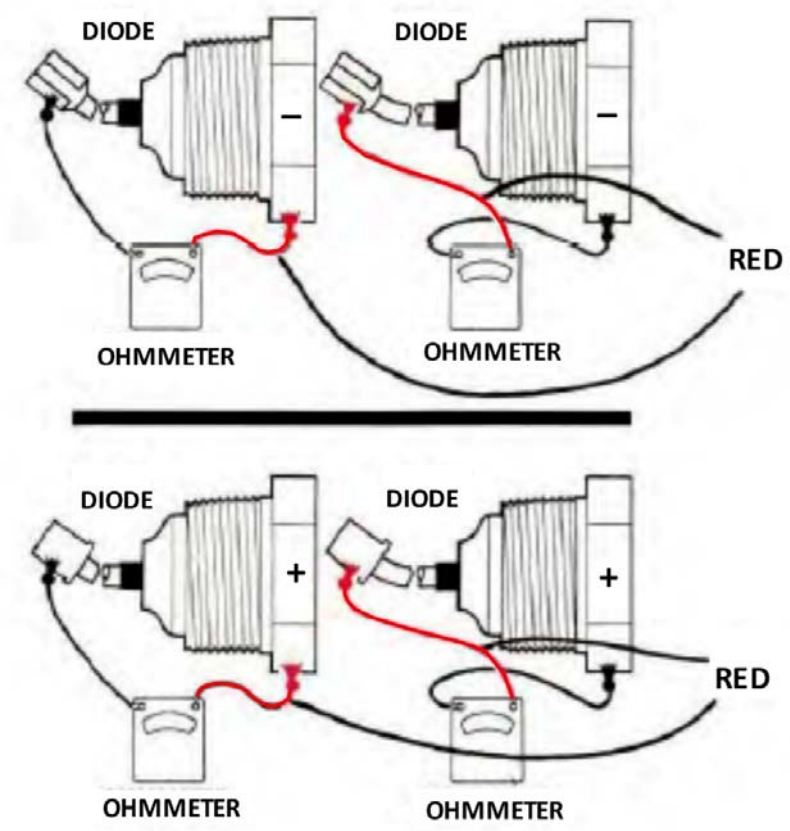

Figure 31

TESTING DIODES

1. To test diodes for shorts and opens, each diode must be checked twice.
2. These two checks are accomplished by reversing the polarity such as the negative and positive.
3. This test can be made on your Merc-O-Tronic Analyzer. (Black lead-, small Red lead-)
4. By placing selector switch on position No. 3 Coil Continuity (See page 8, paragraph 1, 2, and 3) and by reading the lower red figure on meter scale No. 3.
5. Connect small test leads as shown in Fig. 31 between the center post and the base.
6. A zero reading in both test leads as outlined above indicates the diode is shorted.
7. A normal diode will show a high reading in one direction and a low reading in the opposite direction.
8. An infinite (Very High) reading in both tests indicates the diode being tested is open.
9. Before replacing a diode, coat the diode threads with silicone grease or light engine oil, and then tighten to 150 – 180 inch-pounds of torque.

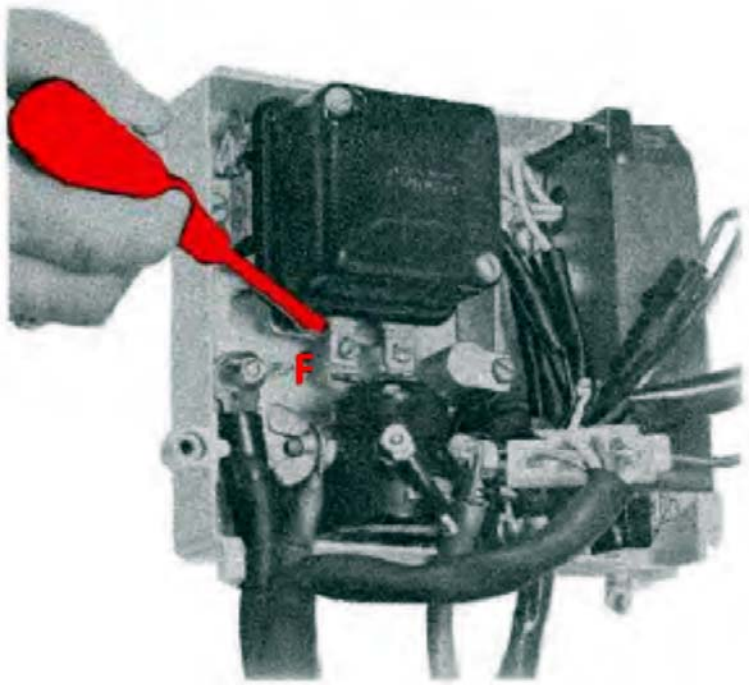

Figure 32

TESTING OUTPUT OF AC GENERATOR OR UNI-CHARGER

1. The AC generator can be checked for output by shorting between the regulator "F" terminal and ground with a screwdriver. (Fig. 32).
   A. Operate engine slightly above idle speed, (1500 RPM) and note the reading on the ammeter.
   B. All accessories must be turned off when this check is made.
   C. If output is increased (note ammeter reading) the AC generator, uni-charger or rectifier is not at fault
   D. The trouble is probably due to an improper regulator voltage setting or a defective regulator.
   E. In this case, proceed to the section entitled "Checking Regulator Voltage Setting".
2. If no output is obtained, the AC generator or uni-charger is defective.
3. Both the field winding and the stator winding should be checked with the ohmmeter on the Merc-O-Tronic Analyzer scale No. 2 or 3 as required.

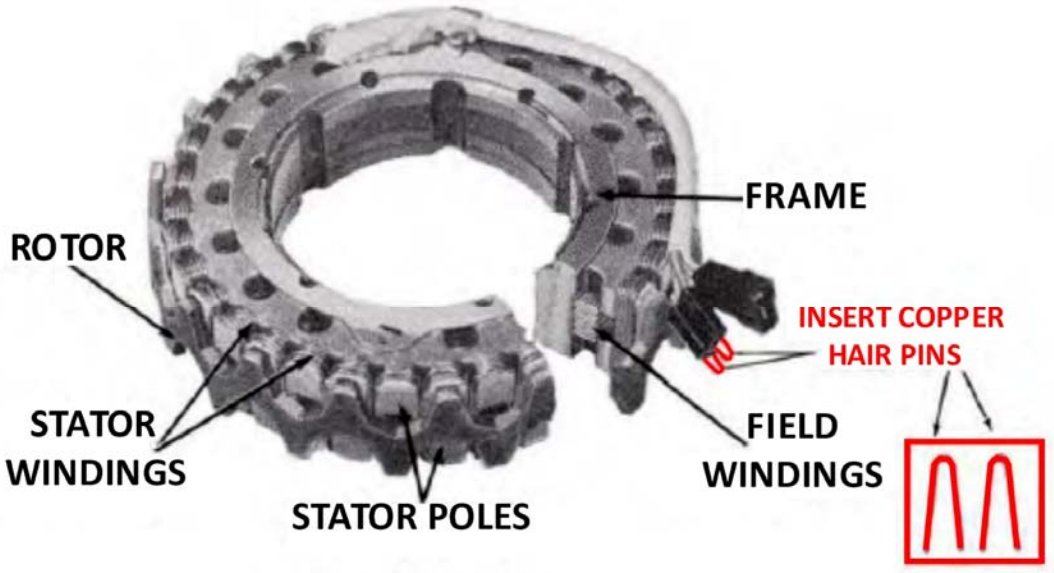

Figure 33

TESTING FIELD WINDINGS

1. To test the field winding, separate the field winding connector (the one with the red and blue leads) from the wiring harness.
2. Take two pieces of bare copper wire(20 GA) about 2" long and shape into hair pins. See illustration above.
3. Place in each female connector making contact with each terminal, see Fig. 33.
4. This will allow you to make field winding test without any difficulty.
   A. Turn selector switch to position No. 2 - do not clip small test leads together.
   B. Adjust meter knob scale No. 2 so meter pointer will line up on red set line on right side of meter.
5. After zeroing in meter pointer attach one small test lead to either hairpin connector and the other small lead to the lamination or stator.
6. The reading should be infinite if the field winding is not grounded.
7. When testing for shorted or open field windings leave the two copper hairpins in position as in Fig. 33.
8. Connect the other small test lead to the hairpin and leave selector switch on Position No. 2, read scale No. 2.
9. The reading should be 1.2 – 3.2 ohms or (1.9 – 2.2 ohms at 80°F.)
10. A lower reading indicates a shorted winding.
11. An infinite reading indicates winding is open.
12. In either case the field winding is defective.

TESTING THE STATOR WINDING

1. Adjust analyzer for the following tests procedure.
   A. Place selector switch on position No. 2.
   B. Adjust meter, knob for scale No. 2 until meter pointer lines up on set position on right side of Scale No. 2.
2. Separate the Stator Winding Connector (the one with the two yellow leads) from the harness.
3. Take one small test lead and attach to one of the copper contacts in the harness connector.
4. The other small test lead attach to the core.
5. Read meter scale No. 2, reading should be infinite.
6. Any meter pointer movement indicates the winding is partially grounded.
7. If meter pointer moves to the left, this indicates the winding is grounded or defective.
8. If meter pointer does not move at all remove small test lead connected to the core and attach to the other copper contact in the harness connector.
9. Leave selector switch on position No. 2.
10. Read meter scale No. 2 (which is the low resistance value scale).
11. Winding should show a reading of minimum .2 – maximum .3.
12. If meter pointer moves only a part of the way, this indicates a poor connection or a partial open.
13. If meter pointer does not move at all or there is an infinite reading this indicates winding is open.
14. In either case the winding is defective and stator assembly should be replaced, or defect located and repaired.
15. Internally shorted stator windings are difficult to test due to the very low resistance of the windings.
16. If all the generator and rectifier checks are satisfactory but the output is low, an internally shorted stator winding (which in some cases do not show up on the meter) could be the cause.

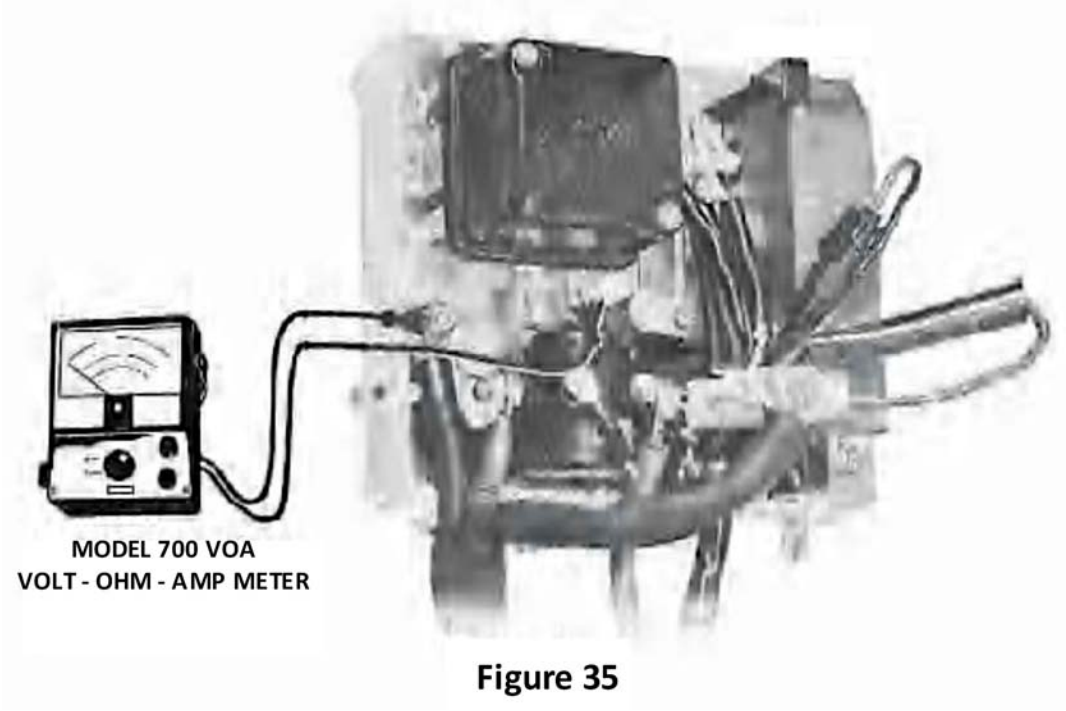

Figure 35

INCORRECT REGULATOR VOLTAGE SETTING

CAUTION: Do not short across any of the terminals in the junction box.

1. To check the voltage setting reconnect all connections and then connect the positive Merc-O-Tronic Model 700 VOA voltmeter lead to the regulator "BAT" terminal and the negative lead to ground. (Fig. 35).
2. Turn on the switch but do not start the engine.
3. The Model 700 VOA voltmeter reads battery voltage.
4. A zero reading indicates an open in the circuit between the regulator and the battery. If green "on light" lights up on the dash the open circuit would be between the key switch and regulator. If ignition coil had current the open would be from the red wire to the field to regulator.
5. Operate the engine at 1500 rpm for 20 minutes with the cover on the regulator and all accessories turned off to bring the regulator to operating temperature.

   For accurate RPM readings use the Merc-O-Tronic Electronic Service Tachometer.
6. Turn off the ignition switch to stop the engine.
7. Restart the engine, operate at 1500 rpm and note the voltage setting.
8. The dash ammeter must show a charge of not over 10 amperes at the time the voltage setting is read.

A fully charged battery must be used to adjust regulator.

9. If the voltage setting is 15 volts or above, the charge rate may continue above 10 amperes after the 20-minute warm–up period.
10. In this case the voltage setting needs to be reduced.
11. If the voltage setting is below 15 volts but the charge rate remains above 10 amperes, continue to charge the battery until the charge rate drops below 10 amperes before reading the voltage setting.
12. The voltage setting should be 14.4 to 15.0 volts at ambient temperature. Ambient temperature is the temperature of the air surrounding the regulator 1/4 inch from the cover.

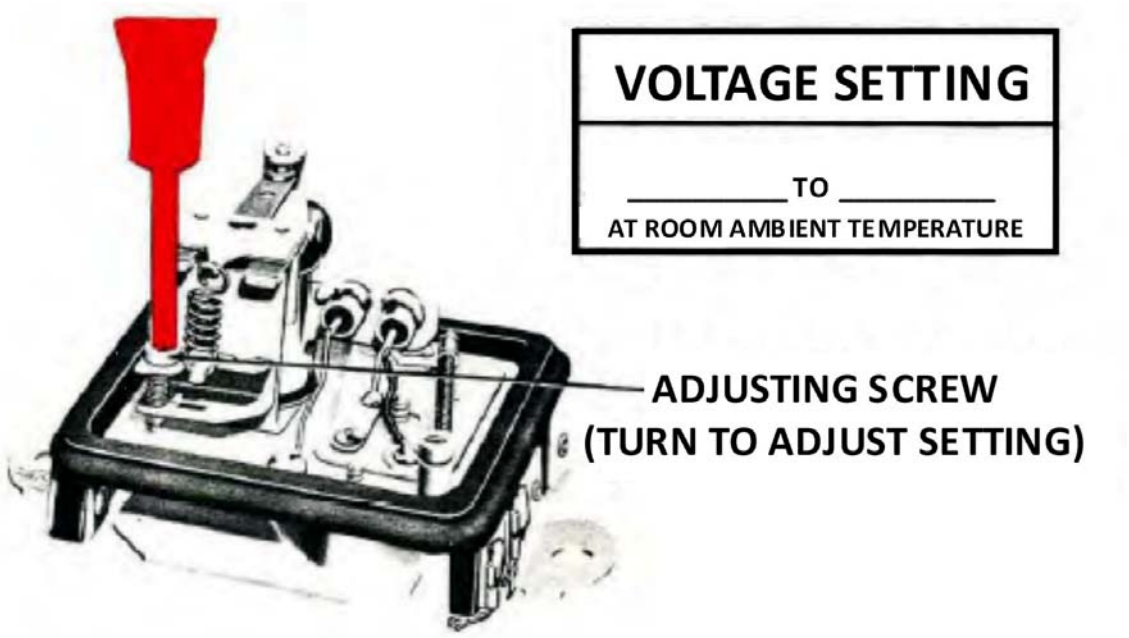

Figure 36

ADJUSTING VOLTAGE SETTING

1. To adjust the voltage setting, remove the regulator cover and turn the voltage adjusting screw located on the back of the voltage unit. (Fig. 36).
2. This should be done after the 20-minute warm-up period with the engine operating at 1500 rpm.
3. Turning the screw clockwise will raise the setting, and counter-clockwise will lower the setting.

CAUTION: Always make final setting by turning the screw clockwise. This insures that the springholder will be against the head of the screw. Therefore, turn the screw counterclockwise farther than necessary to make the adjustment. Then turn the screw clockwise to make final setting. Replace the regulator cover.

4. After making the setting, turn off the switch and stop the engine.
5. Restart the engine and operate it at 1500 rpm and note voltage setting.
6. Readjust if necessary.
7. Always stop and restart the engine before reading the final voltage setting.
8. Always make final voltage checks with the regulator cover in place.
9. If the setting cannot be adjusted to the desired value, the regulator is defective internally.

TAILORING REGULATOR VOLTAGE SETTING

1. Unusual operating conditions may make it necessary to "tailor" the voltage setting to avoid battery overcharge or undercharge.
2. If the engine is operated consistently at low speeds with accessories turned on, the battery may become discharged even though the units in the charging circuit are functioning satisfactorily.
3. Raising the voltage setting to a value within the specified limits may correct the condition.
4. If increasing the setting does not correct the trouble, it is likely that the accessory load is too great for the generator output at that particular speed.
5. Similarly, consistent operation at moderate or high speeds with light electrical loads may result in excessive battery water usage denoting battery overcharge.
6. This is especially true under hot weather conditions.
7. A lower voltage setting in this case may be required.
8. If changing the setting by .3 volt does not correct the condition, the setting should be changed an additional .3 volt and then a check made for an improved battery condition.

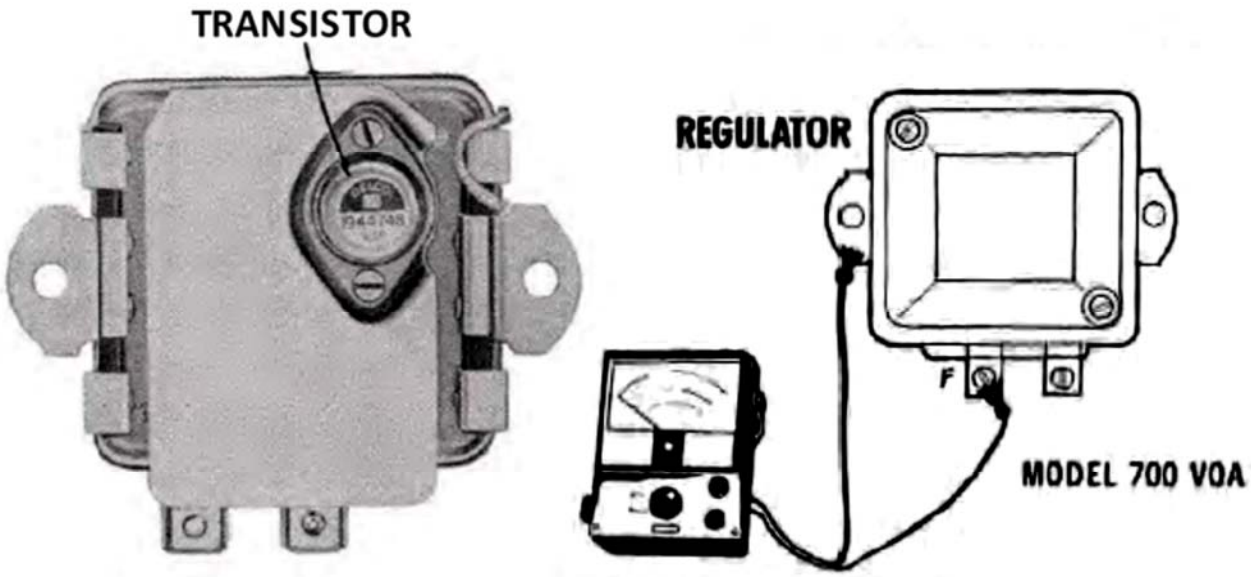

Figure 37

INTERNAL REGULATOR CHECKS

The components inside the regulator may be checked with the regulator connected in the circuit as shown in Figure 30.

TRANSISTOR

1. To check the transistor, connect the Model 700 VOA voltmeter from the regulator "F" terminal to ground (Fig. 37).
2. Close the switch without starting the engine, and note the Model 700 VOA voltmeter reading.
3. A reading of approximately 1 to 2 volts is normal.
4. If the reading is zero volts, the transistor is shorted.
5. An intermittent short between the leads from the field winding to the regulator (marked "A" and "B" on the wiring diagram, Fig. 30), an open regulator field discharge diode, an open suppression diode, or excessive heat can cause the transistor to become shorted.
6. If the reading is approximately 8 to 9 volts the transistor is burned open.
7. An open transistor can result from a direct short between the field winding leads ("A" and "B" in the wiring diagram, Fig. 30), or from interchanging the leads at the regulator "F" and "BAT" terminals.

8. If the reading is battery voltage, both the transistor and regulator resistor are burned open.
9. The transistor and resistor, if damaged, must be replaced before proceeding with the remaining checks.
10. To replace the resistor, merely unsolder the connections.
11. To replace the transistor, disconnect battery and all regulator leads and remove regulator from junction box. Then remove the two transistor attaching screws and unsolder the two transistor connections inside the regulator box.

    NOTE: Do not reconnect the regulator leads until after the field discharge diode and suppression diode have been checked.

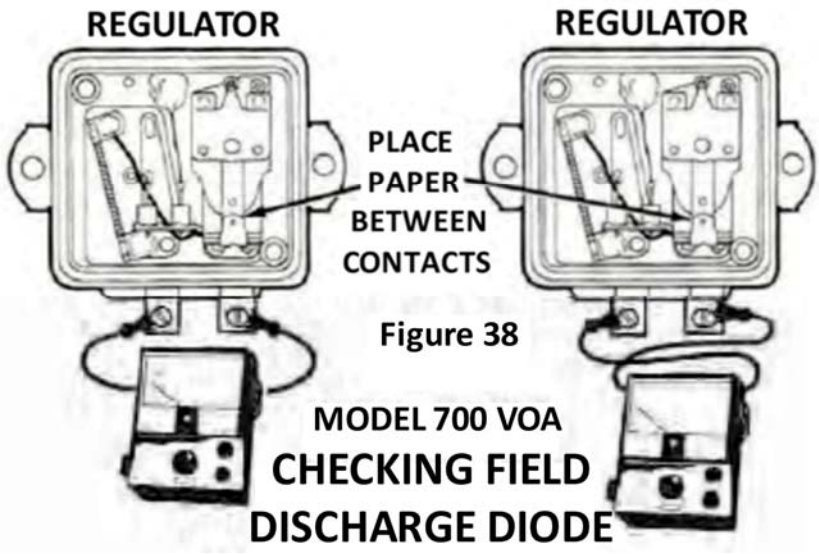

Figure 38

MODEL 700 VOA
CHECKING FIELD
DISCHARGE DIODE

FIELD DISCHARGE DIODE

The following tests can be made on Merc-O-Tronic analyzer selector switch position No. 3 Meter Scale No. 3.

1. To check the field discharge diode, place a small piece of clean white paper between the voltage contacts to insulate them. See Fig. 38.
2. Connect small leads from analyzer to the "F" and "BAT" (Fig. 38) terminals. (Note the readings).
3. Reverse the lead connections to the "F" and "BAT" (Fig. 38) terminals. (Note the readings).
4. If either reading is very high (infinite), the regulator field discharge diode is open.
5. If both readings are approximately zero, the regulator field discharge diode is shorted.
6. Remove the small piece of paper.
7. To replace the diode, merely unsolder the connections.

CAUTION: Excessive heat will damage diode.

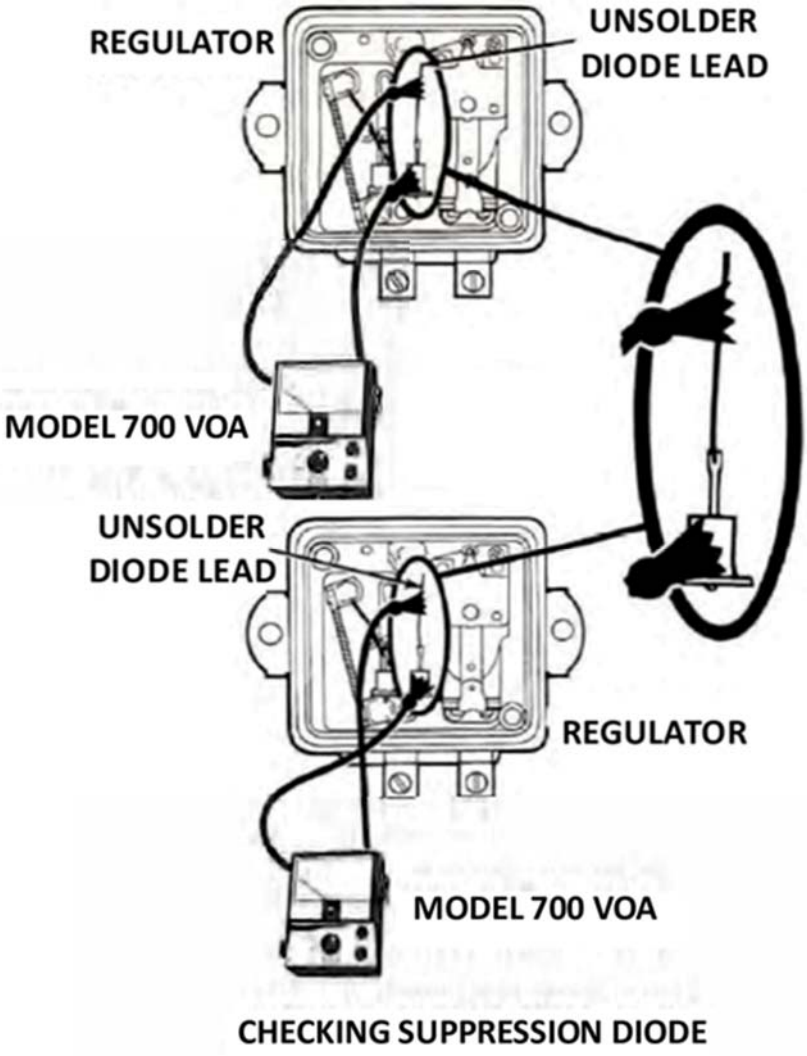

Figure 39

SUPPRESSION DIODE

1. To check the suppression diode, unsolder its lead from the regulator base and connect the small leads from analyzer from the diode lead to the diode case (Fig. 39). Use Test Position No. 3.
2. Then turn polarity reversing switch on Model 700 VOA.
3. If both readings are very high (infinite), the diode is open.
4. If both readings are zero, the diode is shorted.
5. To replace the diode, merely unsolder the connections.

CAUTION: Excessive heat will damage diode.

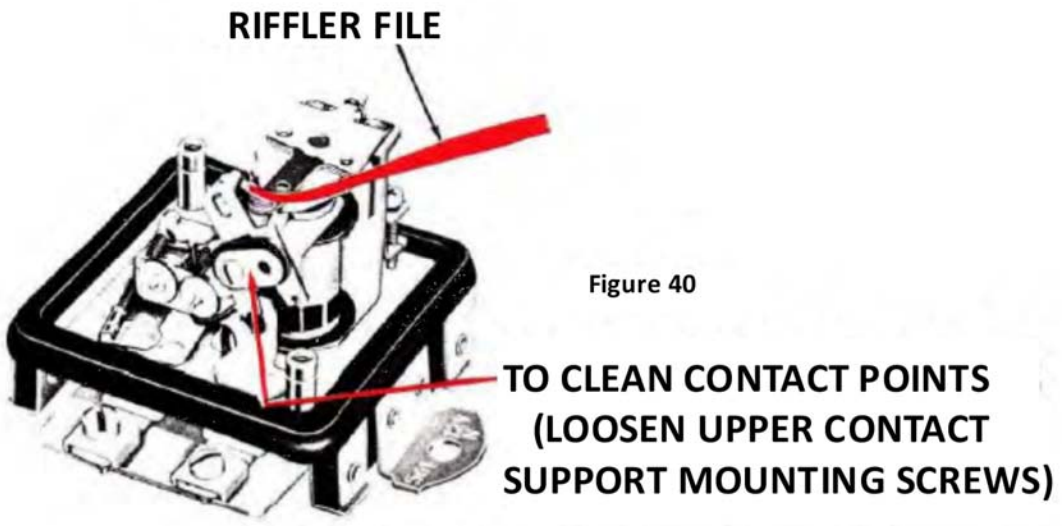

Figure 40

CLEANING CONTACTS

1. If an open transistor was found in the previous check, the large voltage regulator contact must be cleaned with a spoon or riffler file as illustrated in Figure 40.
2. The small soft-alloy contact does not oxidize and must be cleaned with crocus cloth or other fine abrasive material.
3. Contacts should be washed with trichloroethylene or some other non-toxic cleaning solution to remove any foreign material.
4. After cleaning contacts run a piece of stiff paper (such as a business card) between contact under tension, thereby removing any film or foreign matter.

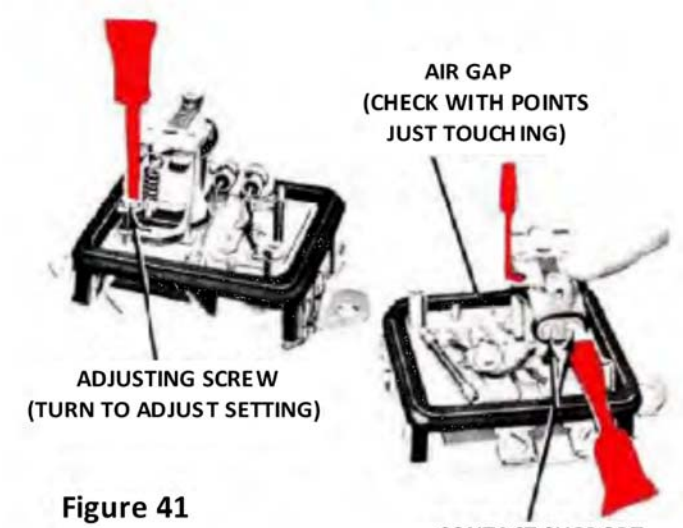

Figure 41

ADJUSTING AIR GAP

1. After cleaning the contacts, set the air gap to .070 inch as shown in Figure 41.
2. Push the armature (not the flat spring) down against a gauge.
3. Adjust the upper contact support so the contacts are aligned squarely and just touch when the support screws are tightened.

MANUFACTURER'S SPECIFICATIONS FOR COIL AND CONDENSER TESTS ON MERC-O-TRONIC IGNITION ANALYZER.

TESTS MADE MUST BE WITHIN THE SPECIFIED TOLERANCES OR THE PART SHOULD BE REPLACED AS IT IS DEFECTIVE AND NOT UP TO MANUFACTURER'S SPECIFICATIONS.

ALL REFERENCES TO USE A 12-VOLT STORAGE BATTERY APPLY TO THE USE OF A MODEL 88, 98 OR 98A ANALYZER ONLY.

NOTES:

SERVICE HINTS

Ignition Failures

I. Engine Misfires at Idle or High Speed, Presuming Carburetion and Fuel are OK, Check For:

Incorrect spark plug gap
Defective or loose spark plugs
Spark plugs of incorrect heat range
Spark plug gap set incorrectly
Sticking or weak breaker arm spring
Incorrect breaker point gap
Breaker points not synchronized
Breaker points not properly adjusted
Loose wire in primary circuit
Defective distributor rotor
Corroded or pitted breaker points
Cracked distributor cap
Leaking or broken high tension wires
Weak armature magnets
Worn cam lobes on distributor or magneto shaft
Worn distributor or magneto shaft bushings
Defective coil or condenser
Defective ignition switch
Spark timing out-of-adjustment

II. Engine Backfires Through Exhaust, Check For:

Cracked spark plug porcelain
Carbon path in distributor cap
Crossed spark plug wires
Air leak at intake deflector
Improper timing

III. Engine Pre-Ignition, Check for Ignition Causes:

Spark advanced too far
Incorrect type spark plugs
Burned spark plug electrodes
Incorrect breaker setting

IV. Starter Motor – If There Is Excessive Current Draw, Check for:

Broken, jammed starter drive
Dirty, gummed armature
Shorted armature
Grounded armature or field
Resistance from engine
Misaligned starting motor
Worn armature shaft bearings
Misaligned armature shaft
Loose field pole pieces

SERVICE HINTS – Cont'd.

IV. Starter Motor (Cont'd)

If Starter Fails to Operate, Check For:

Poor battery ground
Jammed drive
Broken teeth on flywheel
Direct ground in switch
Solenoid dead or shorted
Burned contact points in switch
Improper seating brushes
High mica between commutator segments
Shorted armature
Shorted field or brushes

V. Distributor System Failures – With Ignition System as Guide, If There Is Breaker Point Oxidation, Check For:

High battery voltage
Resistor of incorrect capacity
High resistance in condenser circuit
Incorrect type ignition coil
Extremely high voltage
Moisture formation
Excessive heat from engine

VI. Electrical Failures – If Frequent Battery Charge Is Necessary, Check For:

Corroded battery terminals
Alternator grounded or shorted
Worn out, inefficient battery
Rectifier defective
Short circuit in charging system
Excessive use of electrical units
Short circuit in ignition switch