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Delcotronic Transistor Controlled Magnetic Pulse Type

IGNITION SYSTEMS

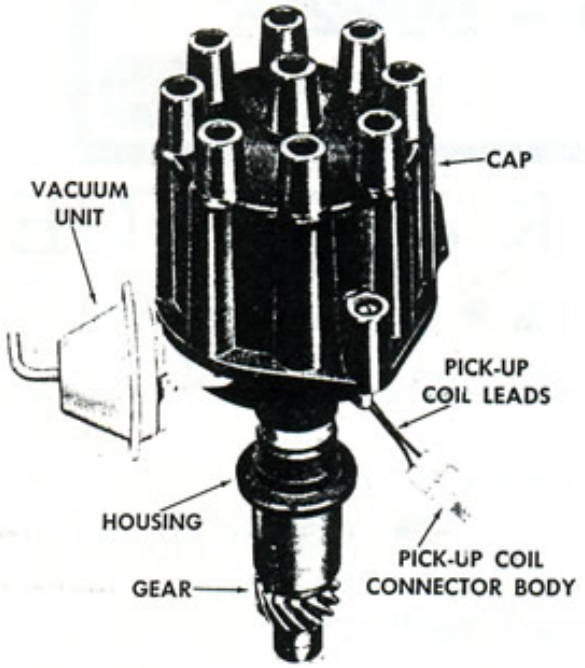

Figure 1—Typical magnetic pulse distributor.

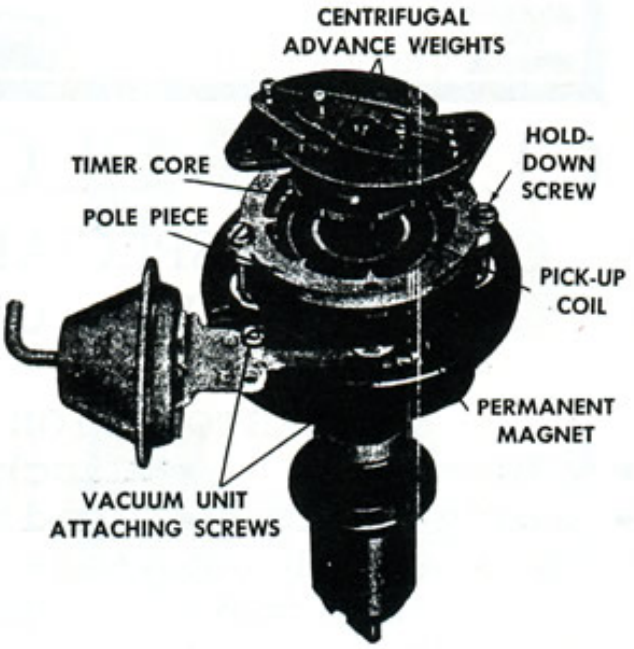

Figure 2—Partially exploded view of typical distributor with cap removed.

The Delcotronic Transistor Controlled Magnetic Pulse Type Ignition System features a specially designed pulse distributor, an ignition pulse amplifier, and a special ignition coil. The other units in the system—the resistors or resistance wires, switch, and battery—are of standard design. A typical magnetic pulse distributor is shown in Figure 1.

Although the external appearance of the distributor resembles a standard distributor, the internal construction is quite different. As shown in the partially exploded view of Figure 2, an iron timer core replaces the conventional breaker cam. The timer core has the same number of equally-spaced projections, or vanes as engine cylinders.

The timer core rotates inside a magnetic pickup assembly, which replaces the conventional breaker plate, contact point set, and condenser assembly.

The magnetic pickup assembly consists of a ceramic permanent magnet, a pole piece and a pickup coil. The pole piece is a metal plate having equally spaced internal teeth, one tooth for each cylinder of the engine.

The magnetic pickup assembly is mounted over the main bearing on the distributor housing, and is made to rotate by the vacuum control unit, thus providing vacuum advance. The timer core is made to rotate about the shaft by conventional advance weights, thus providing centrifugal advance.

The ignition pulse amplifier shown in Figure 3 consists primarily of transistors, resistors, diodes and capacitors mounted onto a printed circuit panelboard. Since there are no moving parts, the control unit is a completely static assembly. The operating principles of the distributor and amplifier are covered in a following section. Some models of amplifiers have a wiring harness as a permanent part of the assembly, instead of a plug-in connector as shown in Figure 3. The service procedures in this bulletin apply equally well to both types.

MAINTENANCE

Since the ignition pulse amplifier is a completely static unit, and the distributor

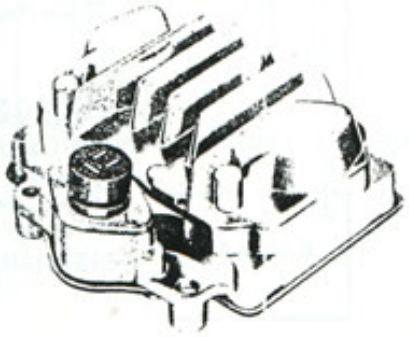

Figure 3—Typical ignition pulse amplifier.

shaft and bushings have permanent-type lubrication, no periodic maintenance is required. The distributor lower bushing is lubricated by engine oil through a splash hole in the distributor housing, and a housing cavity next to the upper bushing contains a supply of lubricant which will last between engine overhaul periods. At time of engine overhaul, the upper bushing may be lubricated by removing the plastic seal and then adding SAE 20 oil to the packing in the cavity. A new plastic seal will be required since the old one will be damaged during removal.

OPERATING PRINCIPLES

A wiring diagram showing the complete circuit for a typical ignition system is illustrated in Figure 4. Note that there are two separate resistors used in this type of circuit. These resistors may be separate units, or they may be in the form of resistance wire in the harness. The resistor connected directly to the switch is bypassed during cranking, whereas the other resistor is always in the circuit. On some applications, the bypass lead may be connected to the cranking motor solenoid instead of to the switch. The use of two resistors permits the required value of resistance to be bypassed during cranking.

In order to fire the spark plug, it is necessary to induce a high voltage in the ignition coil secondary winding by opening the circuit to the coil primary winding. In standard systems, this is accomplished by opening the distributor contact points. In this ignition system, this is accomplished as follows.

When the switch is closed, with the engine not running, current flows through a part of the circuit as shown in Figure 5. The current can be traced from the battery through the switch and resistor R-7 to the amplifier. Current then flows through transistors TR-1 and TR-2, resistors R-1, R-2, and R-5, and the coil primary winding and resistor R-8 to ground, thus completing the circuit back to the battery. It is important to note that under this condition, full current flows through the coil primary winding, and capacitor C-1 is charged with the positive voltage towards transistor TR-2.

When the engine is running, the vanes on the rotating iron core in the distributor line up with the internal teeth on the pole piece. This establishes a magnetic path through the center of the pickup coil, causing a voltage to be induced in the pickup coil. This voltage causes transistor TR-3 to conduct resulting in current flow in the circuit as shown in Figure 6.

The charge on capacitor C-1 causes transistor TR-2 to turn off, which in turn causes transistor TR-1 to turn off. This interrupts the circuit to the ignition coil primary winding, and the high voltage needed to fire the spark plug is induced in the coil secondary winding. These current flow conditions are shown in Figure 6.

The current flow conditions shown in Figure 6 exist until the charge on capacitor C-1 has been dissipated through resistor R-2. When this happens, the system reverts back to the current flow conditions shown in Figure 5. The system is then ready to fire the next spark plug.

Resistor R-1 is a biasing resistor that allows transistor TR-1 to operate. Resistor R-4 is called a feedback resistor, and its purpose is to turn TR-3 off when TR-2 returns to the "on" condition. Zener diode D-1 protects transistor TR-1 from high voltages which may be induced in the coil primary winding. Capacitors C-2 and C-3 protect transistor TR-3 from high voltages which appear in the system. Resistor R-6 protects transistor TR-3 from excessive current in case the pickup coil circuit is grounded.

The above section has explained "what" happens in the ignition system, and has made no attempt to explain "why" the units function as they do. This is a long story, and is not considered to be a part of this bulletin. For a more complete description of the operating principles of transistors, reference may be made to Delco-Remy Training Chart Manuals DR-5133H and DR-5133W.

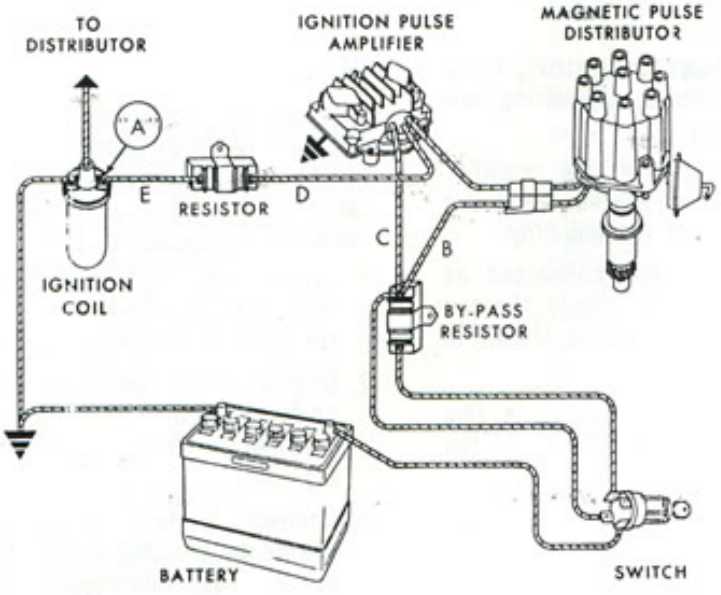

Figure 4—Typical wiring circuit.

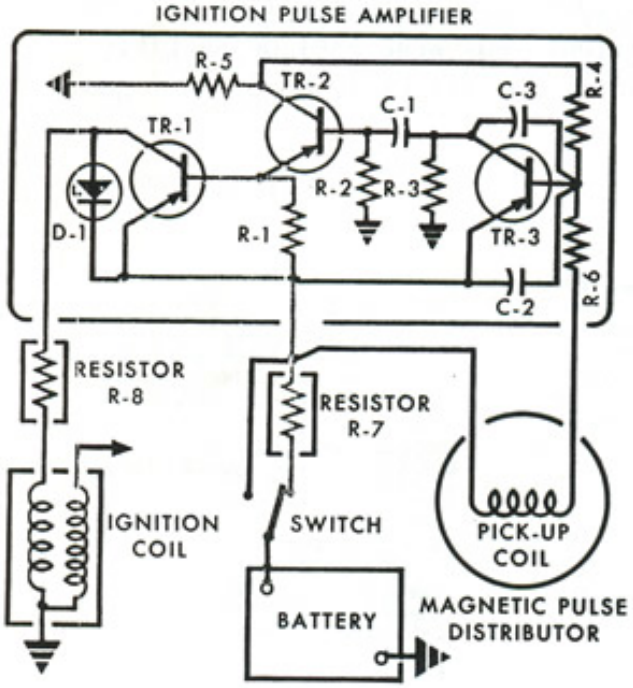

Figure 5—Internal wiring showing current flow in red with switch on and engine not running.

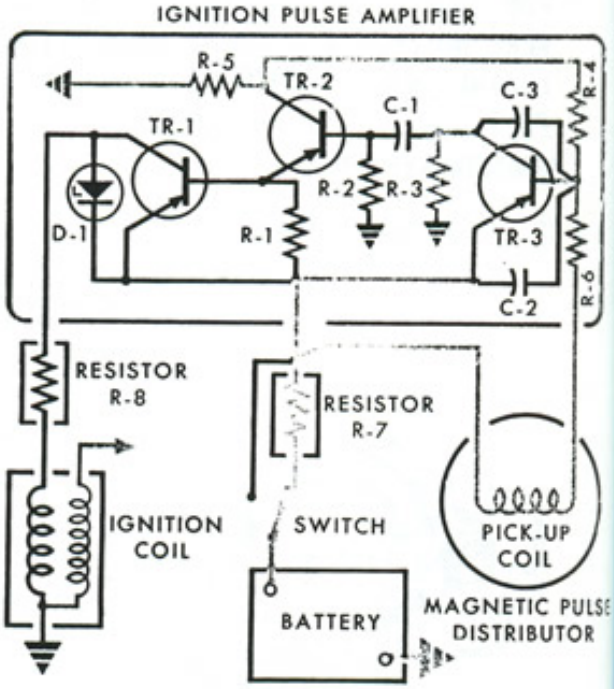

Figure 6—Internal wiring showing current flow in red when spark plug fires.

TROUBLESHOOTING PROCEDURES

CAUTION: Never disconnect the high voltage lead between the coil and distributor, and never disconnect more than three spark plug leads at a time, unless the switch is "OFF." To make compression checks, disconnect the harness plug at the amplifier, or disconnect the lead at the negative terminal on the coil.

IMPORTANT: The circuits shown in this bulletin are typical. Actual circuits may use:

1. Separate resistors or, instead, resistance wire hidden in the wiring harness.
2. A plug-in connector at the amplifier or, instead, a wiring harness which is a permanent part of the amplifier.
3. The resistor and coil connected as shown in Figure 4 or, instead, the coil and resistor connected as shown in Figure 7.

The troubleshooting procedures in this bulletin apply equally well to all of the above types of circuits.

Faulty engine performance usually will be evidenced by one of the following two conditions:

A. Engine miss or surge

B. Engine will not run at all

When troubleshooting the system, use extreme care to avoid accidental shorts and grounds, which may cause instant damage to the amplifier.

A. ENGINE MISS OR SURGE

The vehicle fuel system should be checked in the usual manner. If satisfactory, check the ignition system as follows:

Distributor

Reversal of lead connections, or an intermittent open, short, or ground in the distributor pick-up coil, will cause an engine miss or severe surge condition. Check as follows:

1. Insure that the two distributor leads are connected to the connector body as shown in Figure 8.
2. Disconnect the connector body, and connect an ohmmeter across the distributor pick-up coil (Step 1, Fig. 9).
3. Connect a test stand vacuum source to the distributor, and observe the ohmmeter reading throughout the vacuum range. (This distributor need not be removed from the engine.)

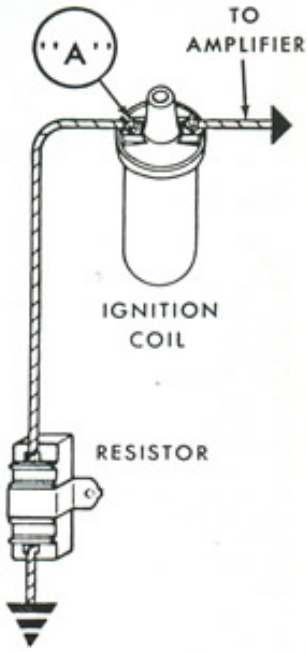

Figure 7—Coil and resistor as connected on some systems.

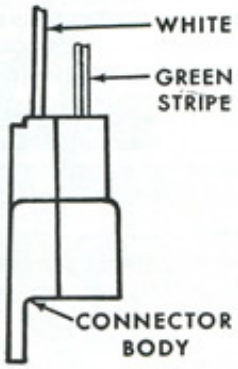

Figure 8—Location of distributor leads in connector body.

4. Any reading outside the 550-750 ohm range indicates a defective pickup coil.
5. Remove one ohmmeter lead from the connector body and connect to ground (Step 2, Fig. 9).
6. Observe the ohmmeter reading throughout the vacuum range.
7. Any reading less than infinite indicates a defective pickup coil.
8. The distributor centrifugal and vacuum advance are not a likely cause of trouble. However, if all succeeding checks are satisfactory, these may be checked on a test stand in the usual manner.

Amplifier

A poorly grounded amplifier can cause an engine miss or surge. To check, temporarily connect a jumper lead from the amplifier housing to a good ground. If the engine performance improves, the amplifier is poorly grounded. Correct as required.

Timing, Spark Plugs, Wiring and Ignition Coil

Checks in these areas should be made in the same manner as for a standard ignition system. In particular, the high-voltage wiring, the ignition coil tower, and the distributor cap inside and out should be checked or inspected for evidence of arc-over or leakage to ground. The timing and spark plugs should be checked in the usual manner as recommended by the vehicle manufacturer.

B. **ENGINE WILL NOT RUN AT ALL**

To determine if the ignition system is operating, hold one spark plug lead about ¼ inch from the engine block and crank the engine. CAUTION: Do not remove the high voltage lead between the coil and distributor. If sparking occurs, the trouble most likely is not ignition. If sparking does not occur, check the ignition system as follows:

1. With the distributor connector and the amplifier connector attached, connect a 12-volt test bulb as shown in Step 1, Figure 10.
2. Turn the ignition switch to the "Start" position and crank the engine.
   a. If the bulb does not light, check the circuit between the connector body and the ignition switch or solenoid bypass terminal for opens.
   b. If the bulb lights, proceed to Step 3.
3. Connect the 12-volt test bulb as shown in Step 2, Figure 10.

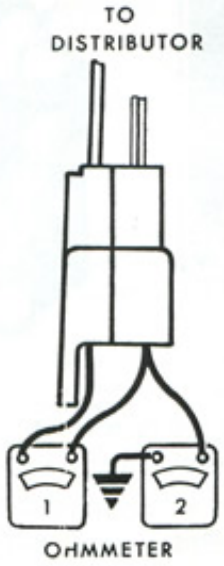

Figure 9—Ohmmeter connections to distributor connector body.

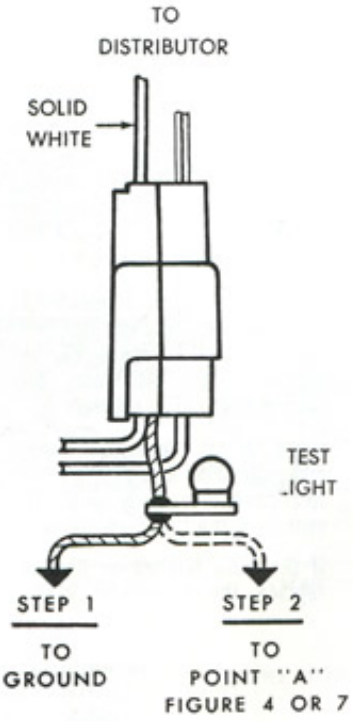

Figure 10—Test Light connections to connector bodies.

4. Turn the ignition switch to the "Start" position, and crank the engine.
   a. If the bulb does not light, there is an open in the circuit between test point "A" and ground. Check the coil or resistor and wiring for opens.
   b. If the bulb burns at normal brilliance, check for an open between test point "A" and the distributor connector. This includes leads B, C, D, and E in Figure 4. If the wiring and connections are satisfactory, check for a poor amplifier ground by temporarily connecting a jumper lead from the amplifier housing to a good ground. If the bulb now burns at half brilliance, the amplifier is poorly grounded. Correct as required and proceed to step "d." If the bulb remains at full brilliance, replace the amplifier, or repair as covered in the next section.

c. If the bulb flickers, the primary circuit is operating normally. Check in the usual manner for a standard ignition system the secondary circuit, including the spark plugs, wiring, ignition coil tower and secondary winding, and the distributor cap inside and out for evidence of arc-over or leakage to ground.

d. If the bulb burns at about half brilliance, turn the switch to the "ON" or run position. If the bulb does not light, there is an open between the bypass resistor and the ignition switch. Correct and then proceed as follows:

Leave the test bulb connected to the amplifier side of the connector, Step 2, Figure 10, but disconnect the distributor connector from the amplifier.

Using a shorting lead, intermittently short across the amplifier connector body with the switch in the "ON" position.

If the bulb flashes or flickers, replace the distributor pickup coil. If the bulb continues to burn at about half brilliance, replace the amplifier, or repair as covered in the next section. Reconnect the distributor to the amplifier.

5. Remove the test lead from point "A" and connect to ground (Step 1, Fig. 10). Turn the ignition switch to the "ON" position.

   a. If the bulb burns at full brilliance, the bypass resistor is not properly connected to the ignition switch. Correct as required.

   b. If the bulb does not light, there is an open between the bypass resistor and the ignition switch.

   c. If the bulb burns at about half brilliance, the bypass resistor is properly connected to the ignition switch.

AMPLIFIER REPAIR

To check the amplifier for defective components, proceed as follows:

1. Remove the bottom plate from the amplifier.
2. To aid in reassembly, note the locations of the lead connections to the panelboard.
3. Remove the three panelboard attaching screws, and lift the assembly from the housing.
4. To aid in reassembly, note any identifying markings on the two transistors and their respective locations on the panelboard and heat sink assembly.
5. Note the thin insulators between the transistors and the heat sink, and the bushing type insulators separating the heat sink from the panelboard.
6. Remove the transistor attaching screws, and separate the two transistors and heat sink from the panelboard.
7. Visually inspect the panelboard for defects.

With the two transistors separated from the assembly, an ohmmeter may be used to check the transistors and components on the panelboard for defects. An ohm-

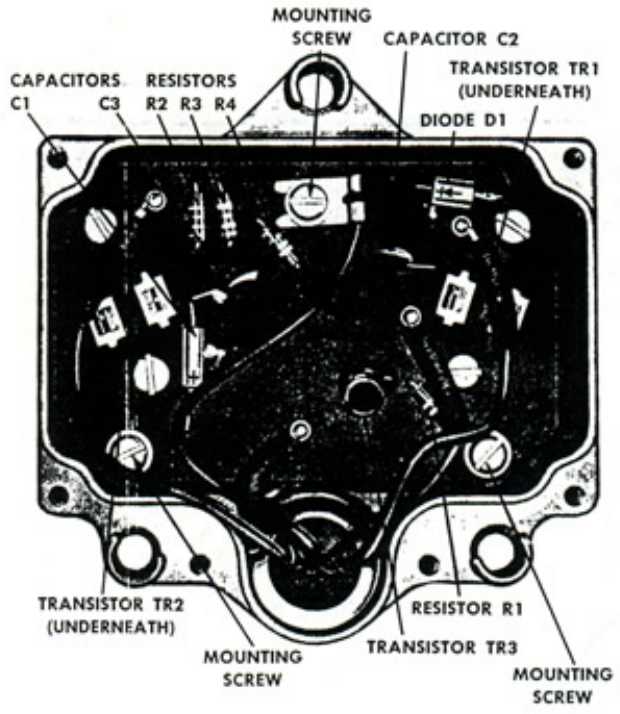

Figure 11—Typical amplifier with bottom plate removed. (Parts keyed to Figures 5 and 6)

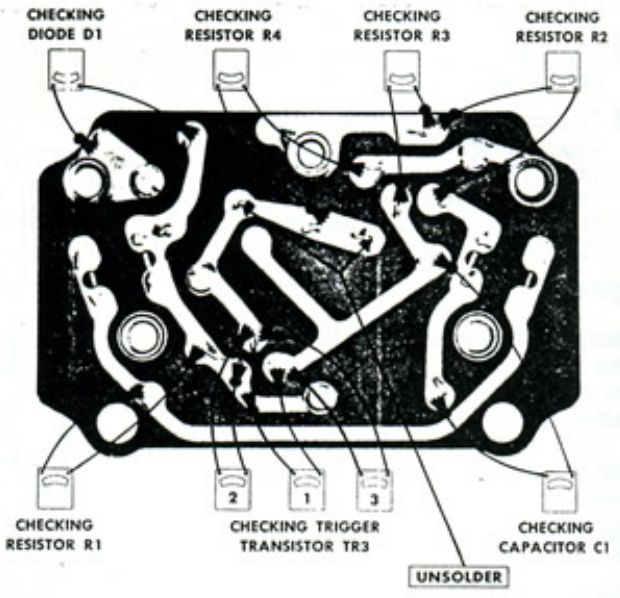

Figure 12—Checking component parts of amplifier shown in Figure 11.

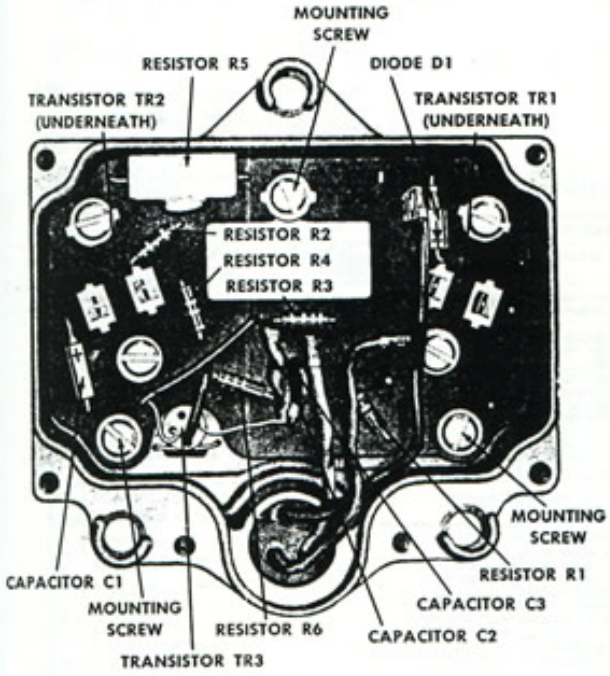

Figure 13—Typical amplifier with bottom plate removed. (Parts keyed to Figures 5 and 6)

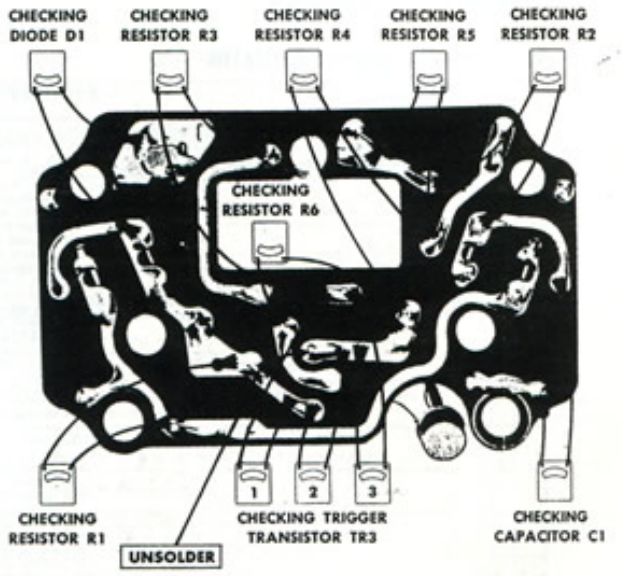

Figure 14—Checking component parts of amplifier shown in Figure 13.

meter having a 1½ volt cell, which is the type usually found in service stations, is recommended. The low range scale on the ohmmeter should be used except where specified otherwise.

A 25 watt soldering gun is recommended, and a 60% tin 40% lead solder should be used when resoldering. Do not use acid core solder. Avoid excessive heat which may damage the panelboard. Chip away any epoxy involved, and apply new epoxy Delco-Remy Part No. 1966807.

Since two different types of panelboards may be encountered, identify the one involved and then refer to either Figures 11 and 12 or Figures 13 and 14. Note that component parts are also identified in Figures 5 and 6.

In order to check the panelboard assembly, it is necessary to unsolder at the locations indicated in Figure 12 or Figure 14 the two capacitors C2 and C3.

In all of the following checks, connect the ohmmeter as shown and then reverse the ohmmeter leads to obtain two readings.

Trigger Transistor TR-3: If both readings in Step 1 are zero, the transistor is shorted. If both readings in Step 2 are zero, the transistor is shorted; and if both readings are infinite, the transistor is open. Interpret Step 3 the same as Step 2.

Diode D-1: If both readings are zero, the diode is shorted; and if both readings are infinite, the diode is open.

Capacitor C-1: If both readings are zero, the capacitor is shorted.

Capacitors C-2 and C-3: Connect the ohmmeter across each capacitor (not illustrated). The capacitor is shorted if both readings are zero.

Resistor R-1: The resistor is open if both readings are infinite.

Resistor R-2: Use an ohmmeter scale on which the 1800 ohm value is within, or nearly within, the middle third of the scale. If both readings are infinite, the resistor is open.

Resistor R-3: Use an ohmmeter scale on which the 680 ohm value is within, or nearly within, the middle third of the scale. If both readings are infinite, the resistor is open.

Resistor R-4: Select an ohmmeter scale on which the 15000 ohm value is within, or nearly within, the middle third of the scale. If **either** reading is infinite, the resistor is open.

Resistor R-5: Use the lowest range ohmmeter scale. The resistor is open if **either** reading is infinite. NOTE: This resistor on some applications may be located in the vehicle wiring harness, and not on the panelboard.

Resistor R-6: An ohmmeter scale on which the 150 ohm value is within, or nearly within the middle third of the scale should be used. If both readings are infinite, the resistor is open. NOTE: This resistor is not used on some amplifier models.

Transistors TR-1 and TR-2: Check each transistor by referring to Figure 15. If both readings in Step 1 are zero, the transistor is shorted. If both readings in Step 2 are zero, the transistor is shorted; and if both readings are infinite, the transistor is open. Interpret Step 3 the same as Step 2.

REASSEMBLY

During assembly, coat with silicone grease both sides of the flat insulators used between the transistors and heat sink, and also the heat sink on the side on which the transistors are mounted.

The silicone grease, which is available commercially, conducts heat and thereby provides better cooling.

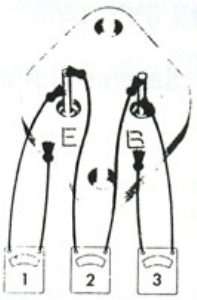

Figure 15—Checking Transistors TR-1 and TR-2.

TROUBLESHOOTING GUIDE

CONDITION	PART TO CHECK	WHAT TO DO	RESULTS
A. ENGINE MISS OR SURGE	Fuel System	Check in normal manner	Correct as required. If satisfactory, check ignition
	Distributor	1. Insure that the two distributor leads are connected to the connector body as shown in Figure 8. 2. Disconnect the connector body, and connect an ohmmeter across the distributor pickup coil (Step 1, Fig. 9). 3. Connect a test stand vacuum source to the distributor, and observe the ohmmeter reading throughout the vacuum range. (The distributor need not be removed from the engine.)	Any reading outside the 550-750 ohm range indicates a defective pickup coil.
		4. Remove one ohmmeter lead from the connector body and connect to ground (Step 2, Fig. 9). 5. Observe the ohmmeter reading throughout the vacuum range.	Any reading less than infinite indicates a defective pickup coil.
		6. The distributor centrifugal and vacuum advance are not a likely cause of trouble. However, if all succeeding checks are satisfactory, these may be checked on a test stand in the usual manner.	
	Amplifier	Temporarily connect a jumper lead from the amplifier housing to a good ground. If the engine performance improves, the amplifier is poorly grounded. Correct as required.	
	Timing, Spark Plugs, Wiring and Ignition Coil	Checks in these areas should be made in the same manner as for a standard ignition system. In particular, the high-voltage wiring, the ignition coil tower, and the distributor cap inside and out should be checked or inspected for evidence of arc-over or leakage to ground. The timing and spark plugs should be checked in the usual manner as recommended by the vehicle manufacturer.	
B. ENGINE WILL NOT RUN AT ALL		Hold one spark plug lead about ¼ inch from the engine block and crank the engine. CAUTION: Do not remove the high tension lead between the coil and distributor.	If spark occurs—ignition system O.K. No spark—check ignition system
	Wiring Circuit	1. With the distributor connector and the amplifier connector attached, connect a 12 volt test bulb as shown in Step 1, Figure 10. 2. Turn the ignition switch to the "Start" position and crank the engine.	a. If the bulb does not light, check the circuit between the connector body and the ignition switch or solenoid bypass terminal for opens. b. If the bulb lights, proceed to Step 3.
		3. Connect the 12 volt test bulb as shown in Step 2, Figure 10. 4. Turn the ignition switch to the "Start" position, and crank the engine.	a. If the bulb does not light, there is an open in the circuit between test point "A" and ground. Check the coil or resistor and wiring for opens. b. If the bulb burns at normal brilliance, check for an open between test point "A" and the distributor connector. If the wiring and connections are satisfactory, temporarily connect a jumper lead from the amplifier housing to a good ground. If the bulb now burns at half brilliance, the amplifier is poorly grounded. Correct as required and proceed to step "d." If the bulb remains at full brilliance, replace or repair the amplifier. c. If the bulb flickers, the primary circuit is operating normally. Check in the usual manner for a standard ignition system the secondary circuit, including the spark plugs, wiring, ignition coil tower and secondary winding, and the distributor cap inside and out for evidence of arc-over or leakage to ground. d. If the bulb burns at about half brilliance, proceed to Step 5.
		5. Turn the switch to the "ON" or run position.	If the bulb does not light, there is an open between the bypass resistor and the ignition switch. Correct and then proceed to Step 6.
		6. Leave the test bulb connected to the amplifier side of the connector, Step 2, Figure 10, but disconnect the distributor connector from the amplifier. Using a shorting lead, intermittently short across the amplifier connector body with the switch in the "ON" position.	If the bulb flashes or flickers, replace the distributor pickup coil. If the bulb continues to burn at about half brilliance, replace or repair the amplifier. Reconnect the distributor to the amplifier, and proceed to Step 7.
		7. Remove the test lead from point "A" and reconnect to ground. (Step 1, Figure 10.) Turn the ignition switch to the "ON" position.	a. If the bulb burns at full brilliance the bypass resistor is not properly connected to the ignition switch. Correct as required. b. If the bulb does not light, there is an open between the bypass resistor and the ignition switch. c. If the bulb burns at about half brilliance, the bypass resistor is properly connected to the ignition switch.