

## SECTION 11-E

### ELECTRO-CRUISE

#### CONTENTS OF SECTION 11-E

Paragraph	Subject	Page	Paragraph	Subject	Page
11-22	Description and Operation of Electro-Cruise . . . . .	11-123	11-23	Electro-Cruise Service Procedures . . . . .	11-129
			11-24	Electro-Cruise Trouble Diagnosis . . . . .	11-133

### 11-22 DESCRIPTION AND OPERATION OF ELECTRO-CRUISE

#### a. Description

The Electro-Cruise is a constant speed regulating system capable of accurate control of car speed over a wide range of road loads. Within the limits of the system, a speed range of 30 to 90 MPH can be accurately held within 2-1/2 MPH of the particular speed setting. Unlike a constant throttle device which locks the throttle in a selected position resulting in speed variation according to the varying road conditions, the Electro-Cruise system compares a measurement of car speed with the selected speed to maintain the selected speed under varying road conditions.

The Electro-Cruise is offered as optional equipment on 45000, 46000, 48000 and 49000 Series.

The Electro-Cruise is an electronic-pneumatic system which consists of a power unit connected to the throttle linkage through a bead chain; an amplifier and relay control assembly; a speed transducer which is an integral part of the speedometer; an engagement switch and CRUISE lamp; and a cruise release switch located on the brake pedal arm support bracket.

In operation, electrical signals from the speed transducer operate a vacuum switch which ports engine vacuum to the power unit. Through constant signals from the

speed transducer, the power unit assumes its proper position to control the throttle opening. The electronic amplifier, engagement switch and brake release switch are the auxiliary components necessary to engage and disengage the system.

1. SPEED SETTING - The speed setting pointer moves over the existing speedometer scale and is set to the desired speed by rotating the speed setting knob at the bottom of the speedometer. See figures 11-171 and 11-172. The desired speed can be set either with the system engaged or disengaged; however, car speed will only be controlled by the Electro-Cruise when the system is engaged. If the speed setting is changed while the system is engaged, car speed will increase or decrease automatically to coincide with the desired setting.

2. ENGAGEMENT - The engagement switch lever and CRUISE lamp assembly is located to the right of the speedometer on 49000 Series cars and fully controls the engagement of the system. See Figure 11-172. On 45000, 46000 and 48000 Series the unit will be located on the speedometer head. To engage the system, it is necessary only to depress the engagement lever or knob until the CRUISE lamp lights indicating the Electro-Cruise is in operation. If car is at or above the speed setting when the engagement lever is depressed, the CRUISE lamp will come on immediately. If car speed is below the speed setting, it is necessary to hold the en-

gagement lever forward until the car has accelerated to the set speed to cause the CRUISE lamp to light. Use of the accelerator pedal is not necessary to obtain the desired set speed with the engagement lever held forward as the Electro-Cruise will automatically accelerate the car to this speed.

However, for faster acceleration to the set speed, the car may be brought up to speed by means of the accelerator pedal and then engaged by depressing the engagement lever when the car is within 2-1/2 MPH of the set speed or above.

3. DISENGAGEMENT - The Electro-Cruise can be disengaged by a touch of the brake pedal, by pulling the engagement lever or knob rearward or by turning the ignition switch to the OFF or LOCK positions. Each of these will restore full accelerator pedal control to the driver. Once the Electro-Cruise has been disengaged, it is necessary to re-engage it again using the engagement lever to restore operation of the system.

4. OVERRIDE - Electro-Cruise system in no way prevents or hinders increases in throttle angle through use of the accelerator pedal. Therefore, if a higher speed is momentarily desired when the system is in operation, the accelerator pedal may be depressed in the normal manner to override the Electro-Cruise. When the accelerator pedal is released, the Electro-Cruise will again maintain the desired set speed without re-engagement.

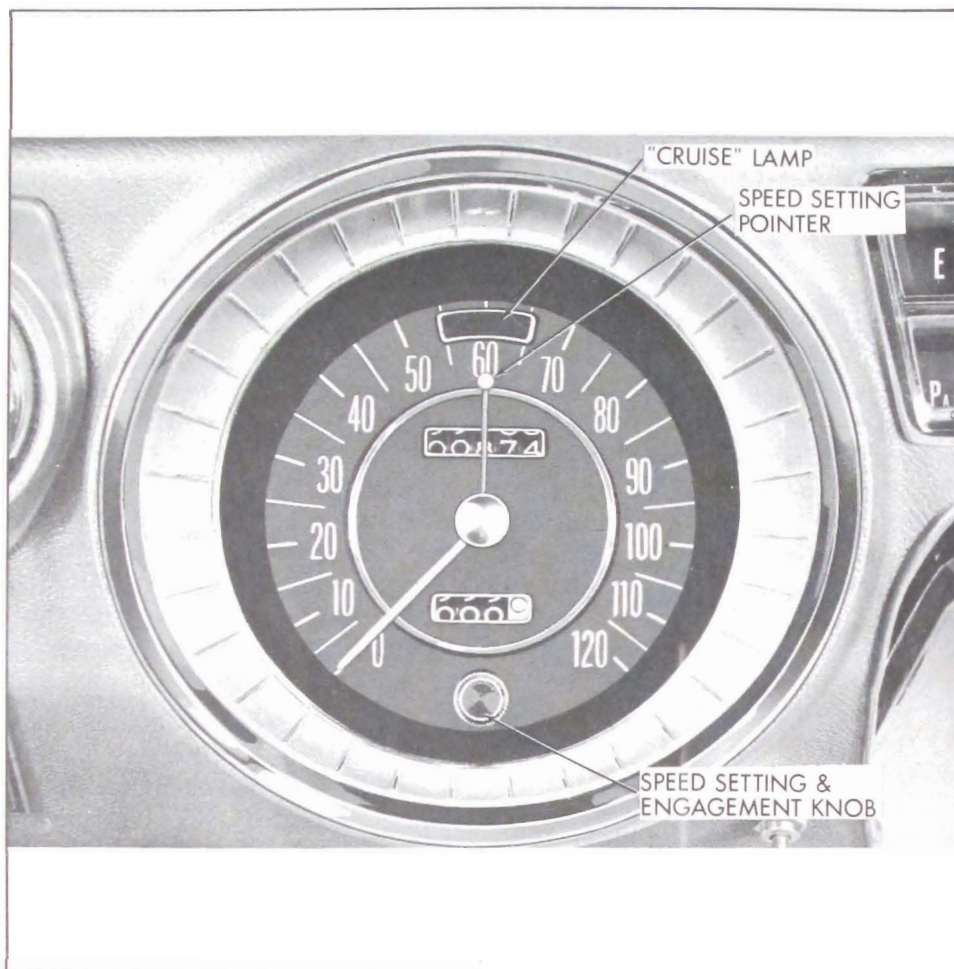


Figure 11-171—Electro-Cruise Controls - 45000, 46000 and 48000 Series

5. **SAFETY PRECAUTIONS** - For obvious safety reasons, the Electro-Cruise should not be used in areas where conditions are not adapted to maintain a constant speed, such as in city-type traffic, winding or hilly roads, bad weather, etc. The Electro-Cruise should not be engaged when the car is being driven on snow, ice or mud.

#### b. Operation

1. **POWER UNIT** - The power unit is basically a pneumatic chamber and porting valve consisting of: an aluminum housing and cover; a power diaphragm and bead chain assembly; a diaphragm return and speed control compensating spring; and air orifice; a vacuum orifice; a control valve; a control valve return spring; a control valve coil; an air filter;

and brake release line fitting. See figure 11-173.

In operation, the power unit receives an electric signal from the electronic control unit which, according to the dictates of the speed transducer, ports the proper vacuum and air mixture into the unit to maintain the desired road speed. The signal which is received by the power unit during normal cruise operation, cycles the control valve armature between the atmosphere and vacuum ports allowing the armature to dwell on the ports for time intervals depending upon the shape of a square wave electrical output from the speed transducer.

When the control valve coil is energized, the "teeter-totter" armature of the control valve is

pulled down against spring tension, closing the air port to atmosphere and opening the vacuum port to the diaphragm chamber. The vacuum admitted, then, tends to increase tension on the bead chain to open the throttle valve.

Similarly, when the control valve coil is not energized, spring tension positions the "teeter-totter" armature of the control valve to close the vacuum port and open the air port to the diaphragm chamber. The air admitted, then, tends to reduce tension on the bead chain to close the throttle valve.

Thus through continual cycling of the control valve, a vacuum level is produced in the diaphragm chamber proportional to the demands of the speed transducer and the tension of the bead chain balances the force of the existing throttle return spring to maintain the required throttle angle. Maximum throttle angle allowed by the power unit is approximately 35°; therefore, when the control valve coil is continuously energized, car acceleration will be held at this angle. In addition, the maximum speed of 90 MPH is determined by this maximum throttle opening.

#### 2. SPEEDOMETER AND SPEED TRANSDUCER

- The speed transducer is integral with the speedometer and utilizes a cam, cam follower, oscillating contact spring and pickup arm to control the electrical impulses reflected from the electronic control unit to the power unit. See figure 11-174. Position of the oscillating contact pin, which determines the set speed, is adjusted by rotating the cam follower mounting ring through a gear arrangement with the speed setting shaft and knob assembly. Rotating the cam follower mounting ring also moves the speed setting pointer to indicate the relative position of the oscillating contact pin, and, therefore, indicate the actual set speed.

When the Electro-Cruise is in operation at the desired set speed, the cam which is mounted to the input shaft oscillates the cam follower to cause oscillation of the contact pin. During one-half of the oscillation, the contact pin will contact the contact spring to complete an electrical circuit to the electronic control unit. During the other one-half of the oscillation, the contact spring is held away from the contact pin by the pickup arm to open the electrical circuit to the electronic control unit. The angle of contact oscillation, or range of proportional control corresponds to a speed of 5 MPH and reflects a square wave electrical impulse to the electronic control unit. See figure 11-175.

As car speed increases within 2-1/2 MPH above the set speed, the pickup arm moves the contact pin to allow the circuit to the electronic control unit to remain open for a greater interval of time during one complete oscillation. Whenever car speed is more than 2-1/2 MPH above the set speed, the circuit to the electronic control unit will be open during the entire oscillation.

As car speed decreases within 2-1/2 MPH below the set speed, the pickup arm moves away from the contact spring to allow the circuit to the electronic control unit to remain closed for a greater interval of time during one complete oscillation. Whenever car is less than 2-1/2 MPH below set speed, the circuit to the electronic control unit will be closed during the entire oscillation. Thus, the electrical signal which is reflected to the electronic control unit is proportional to the interval of time during which the contacts are open or closed which, in turn, is proportional to the amount the speedometer pointer is above or below the set speed.

### 3. AMPLIFIER AND RELAY -

The electronic control unit consists of a relay assembly and a transistor amplifier assembly mounted on a common junction block which is an integral part of the system's wiring harness. Both assemblies are designed to individually plug into the junction block; therefore, each can be service separately. A two ampere fuse is incorporated into the junction block to protect the entire electrical circuitry of the system. In addition, the system is protected by the "BK" and "BZ" fuse located in the main fuse block. See figure 11-176.

The transistor amplifier serves as a power amplifier to increase the strength of the electrical signal from the speed transducer to a value capable of operating the power unit control valve. Since full current flow is not carried by the speed transducer contacts, their life is greatly increased. Design of the amplifier circuit is such that whenever the speed transducer contacts are closed, the circuit through the amplifier

is completed and the power unit coil is energized. Likewise, whenever the speed transducer contacts are open, the circuit through the amplifier is open and the power unit coil is not energized.

As long as the holding coil remains energized to hold the contact points in the Down position, the system will be "locked" in cruise operation and car speed will be controlled by the power unit in accord with the electrical signal produced by the speed transducer. Opening either the ignition switch, the brake release switch or the engagement switch will "unlock" the system from cruise operation by allowing the relay contact points to return to the "up" position.

Two opposing coils and a double set of contact points within the relay assembly function to control the "locking" and "unlocking" of the system in cruise operation. In addition, the relay controls the operation of the CRUISE lamp. See figure 11-176.

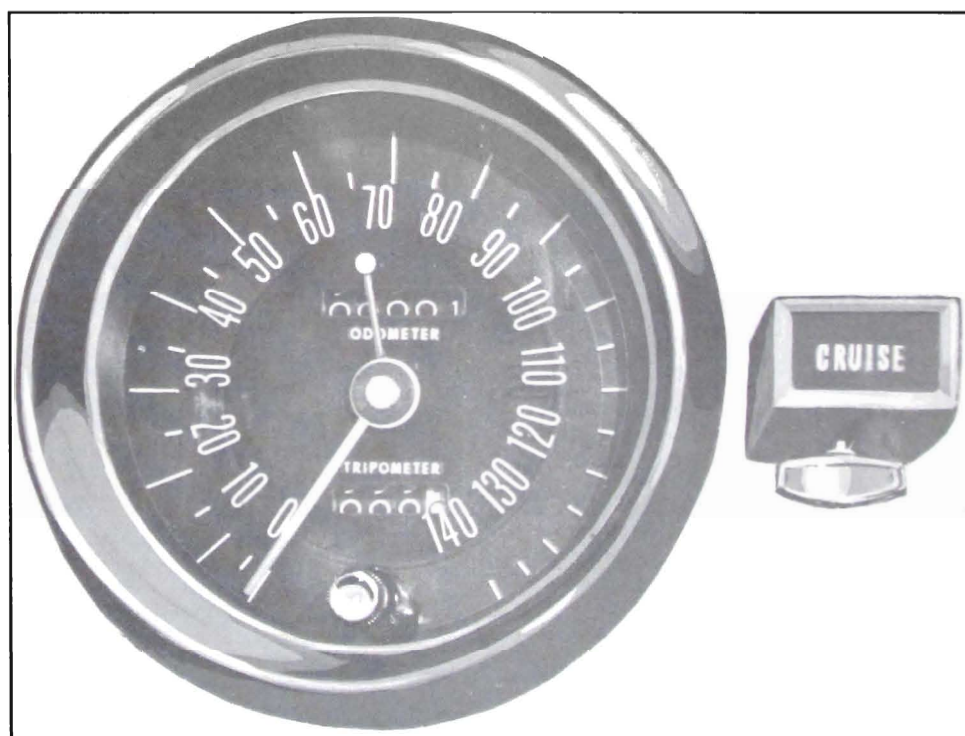


Figure 11-172—Electro-Cruise Controls - 49000 Series

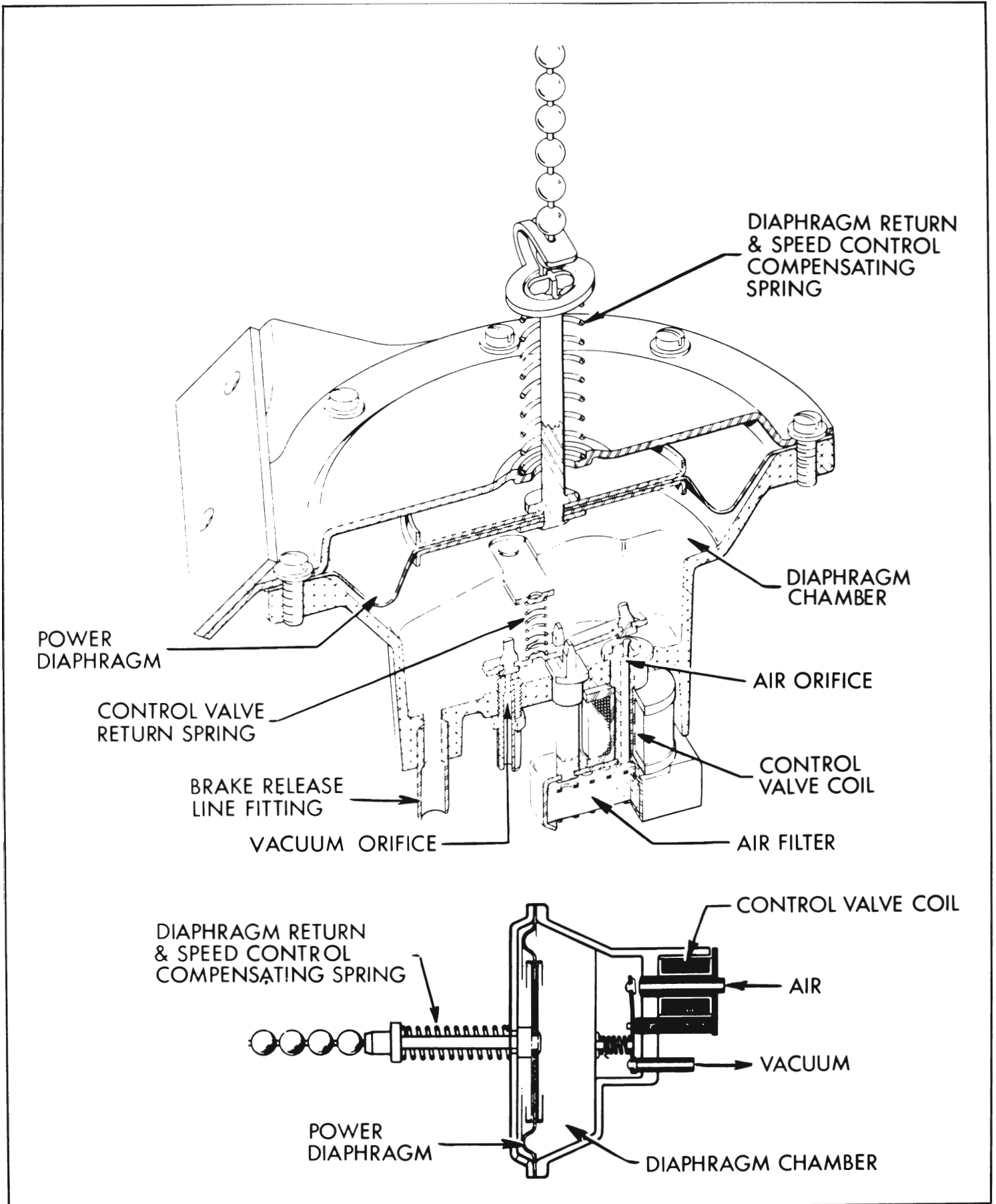


Figure 11-173—Power Unit - 49000 Series

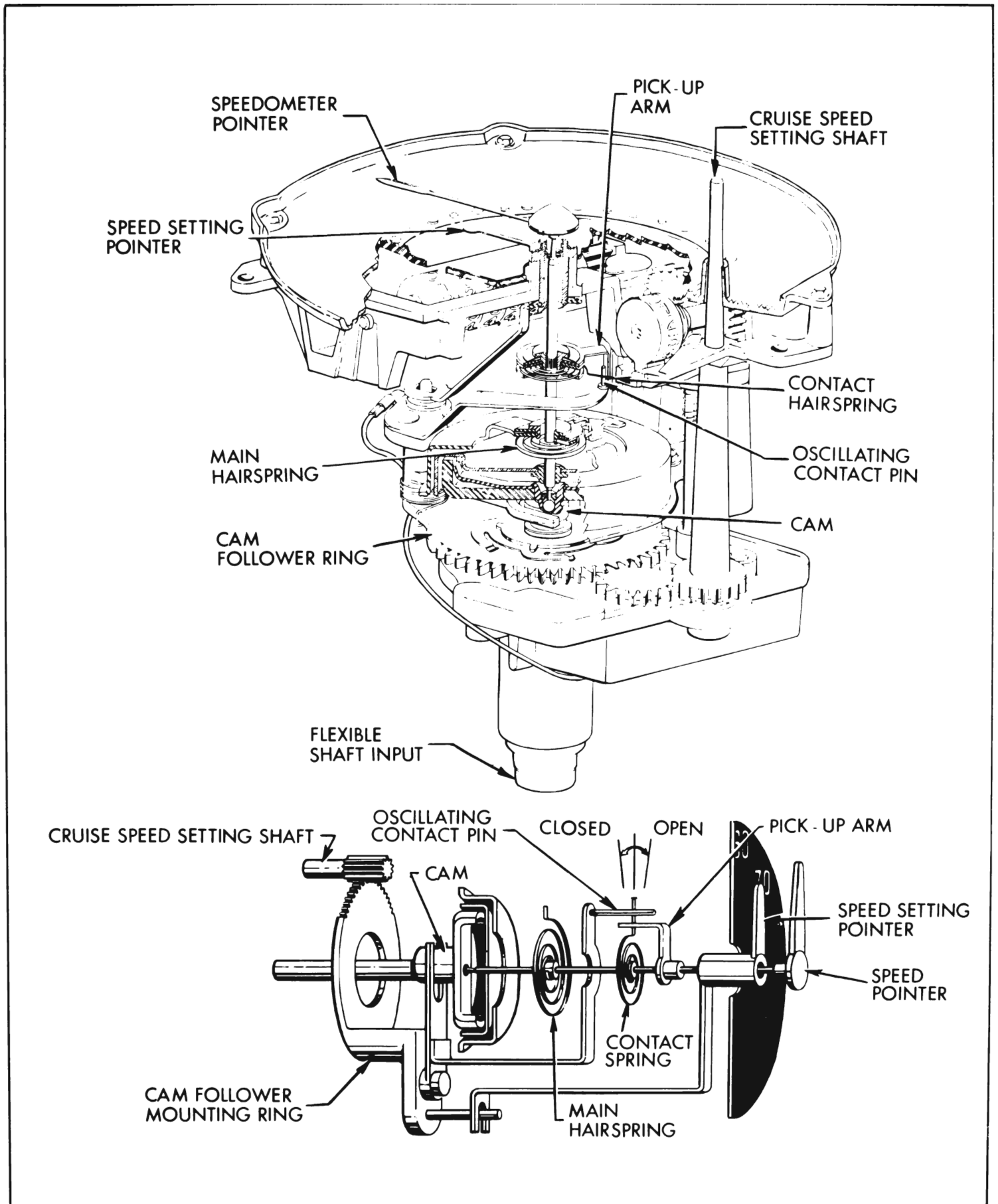


Figure 11-174—Speedometer and Speed Transducer - 49000 Series

Normally the contact points are held in the "up" position by spring tension. Whenever car speed is below set speed and the engagement switch is fully depressed, the holding coil is energized and since the speed transducer contact points are closed, the amplifier circuit is closed allowing the inhibiting coil and power unit coil to be energized. Since the magnetic attraction of the inhibiting coil opposes the attraction of the holding coil, the relay contact points will re-

main in the "up" position allowing the circuit to the power unit coil to be closed only continually depressing the engagement switch. With the relay contact points in the "up" position, the CRUISE lamp circuit is open indicating the system is not "locked" in cruise operation.

When car speed is within 2-1/2 MPH of the set speed or above, the amplifier circuit is opened by opening of the speed transducer contact points, and the in-

hibiting coil circuit will be opened allowing the holding coil to move the contact points to the down position. The CRUISE lamp circuit will then be completed indicating the system is "locked" in cruise operation and the inhibiting coil circuit will be opened to prevent energizing of the coil when the amplifier circuit is once again completed. In addition, a second supply circuit from the engagement switch will be completed enabling the system to function after the switch has been

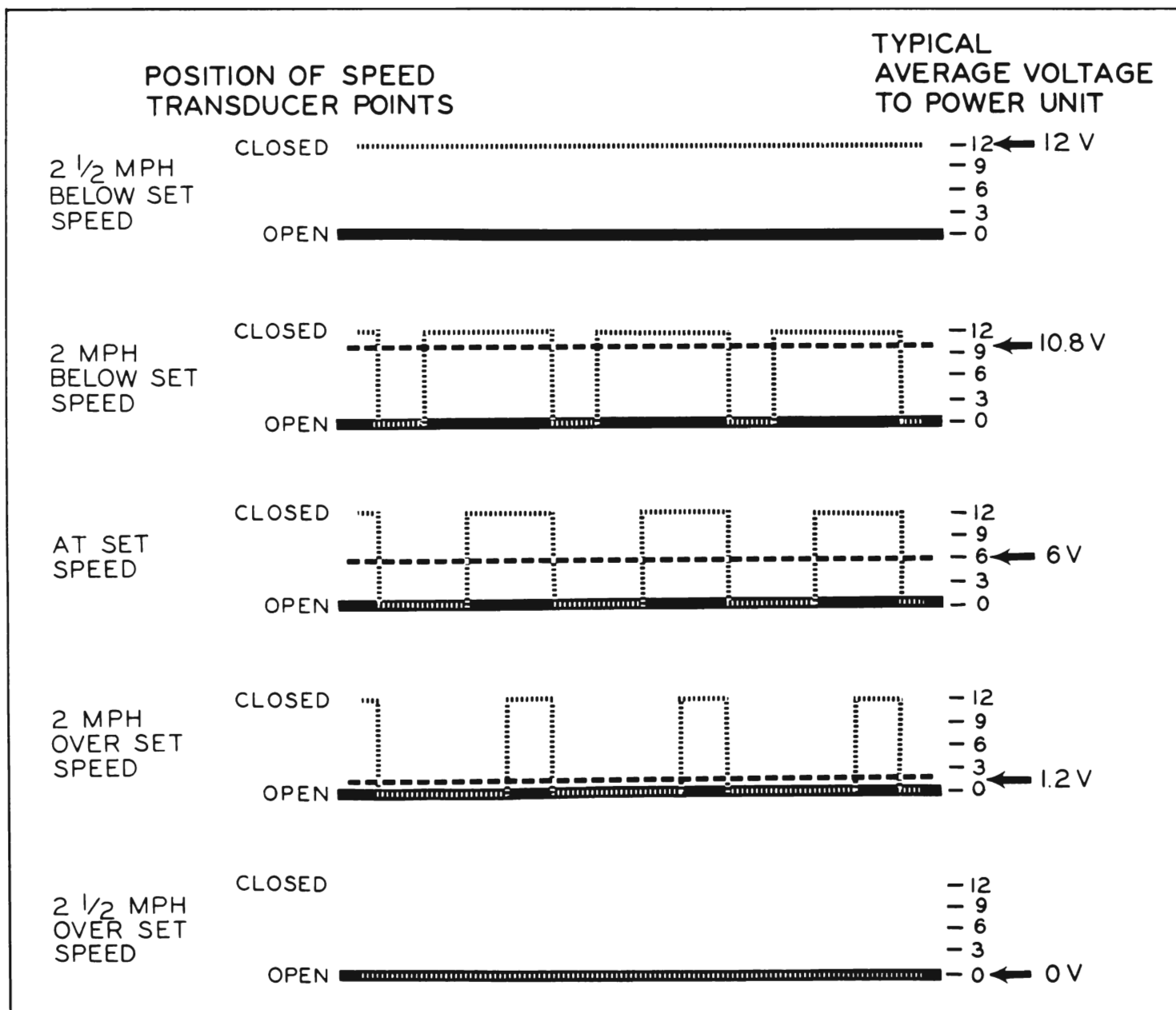


Figure 11-175—Speed Transducer Outputs

released to the Neutral or Cruise position.

**4. ENGAGEMENT SWITCH (49000 only)** - The engagement switch is a three-position switch connected in series with system circuitry. In the first, or "off" position, the circuit through the switch is open and the system is completely disengaged. In the Neutral or Cruise position, the circuit through the switch to the relay is closed and, providing the relay contacts are in the Down position, the system is energized. In the third, or Engage position, the switch to relay circuit is completed as well as a by-pass circuit which, when the relay contact points are in the Up position, initially energizes the system.

**5. BRAKE RELEASE SWITCH** - The brake release switch is an electric-pneumatic switch actuated by movement of the brake pedal arm. Since the switch is connected electrically in series with the system supply circuit, it will fully disengage and "unlock" the system from cruise operation when the switch is opened. Opening of the switch requires a maximum of 1/4" brake pedal travel. Additional pedal travel will open a "flap" type valve to vent the power unit diaphragm chamber to atmosphere assuring positive release of the power unit.

## 11-23 ELECTRO-CRUISE SERVICE PROCEDURES

**IMPORTANT:** Do not lubricate the power unit bead chain or its pulley.

The only maintenance required on the Electro-Cruise is the cleaning of the power unit air filter. The recommendations and procedure for cleaning of the filter are listed in Group 1.

### a. Power Unit Bead Chain Adjustment

1. Disconnect bead chain adapter assembly from clevis pin by snap-

ping it free from clevis pin. See figures 11-177 and 11-178.

2. Adjust engine hot idle speed to recommended setting, and then shut off engine.

3. Reattach bead chain to clevis pin and position carburetor fast idle cam at "hot" idle position.

4. Check bead chain to insure that there is a slight amount of slack in chain.

NOTE: If chain is too loose or too tight, loosen jam nut on threaded stud of throttle lever adapter assembly, and rotate stud until chain is just taut. Then back off threaded stud two full turns.

### b. Brake Release Switch Adjustment

1. Disconnect wiring harness connector from brake release switch, and connect an ohmmeter or test lamp (J-21005) across switch terminals.

NOTE: If desired, the cruise lamp of the engagement switch may be used as a test lamp by unplugging speed transducer connector at speedometer, and leaving brake release switch wiring connector on switch. Then turn ignition switch on and press lever of engagement switch to activate cruise control lamp. The brake pedal must be in the released position (rearward) for the electro-cruise to operate.

2. Loosen the screw that retains brake release switch to brake pedal support bracket. Position the switch to open the circuit within 1/4 inch brake pedal travel.

NOTE: An open circuit will be indicated by an unlit test lamp or indefinite reading on ohmmeter. If cruise lamp is used, an open circuit will be indicated when light goes out.

3. Tighten adjusting screw and recheck adjustment of brake release switch.

### c. Disassembly and Assembly of Power Unit

1. Disconnect the bead adapter chain attached to the clevis pin by snapping it free from clevis pin. See figures 11-177 and 11-178.

2. Remove the wire harness connector from the power unit coil.

3. Remove engine vacuum and brake release switch lines from power unit.

4. Remove screws holding the power unit assembly to the cowl.

5. Depress the diaphragm return spring and remove bead chain.

6. Remove the eight 10-32 cap head screws holding the power unit to its mounting bracket.

7. Remove the control valve return spring by depressing with a knife blade and pushing sideways.

8. Remove control valve.

9. Remove air filter from unit.

10. Wash power unit in a good detergent.

11. Examine diaphragm for cracks and pin holes and replace if necessary.

12. Check control valve pads and its sealing surface for dirt, chips and burrs.

13. Clean or replace air filter as required.

14. Check for obstructions in air and vacuum orifices.

15. Reassemble by reversing disassembly procedure. Care should be taken when the light cap screws are placed back on the mounting bracket to tighten opposite sets of screws at a time and repeat this procedure until they are all tight.

16. After power unit is reinstalled, adjust bead chain (subpar. "a") and leak test unit (par. 11-24 subpar. "a").

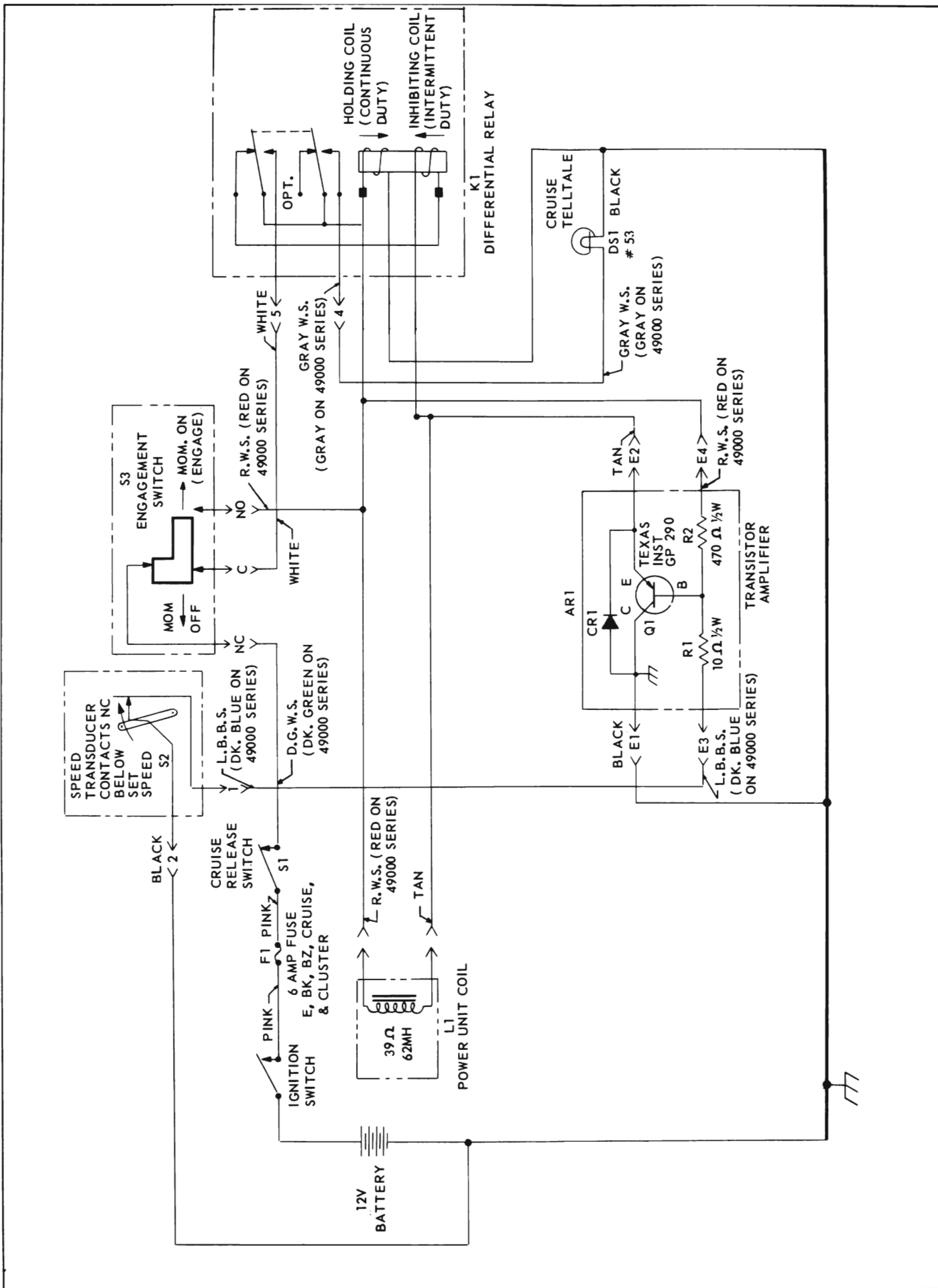


Figure 11-176—Electro-Cruise Wiring Diagram







## 11-24 ELECTRO-CRUISE TROUBLE DIAGNOSIS

Whenever a specific complaint is encountered with the Electro-Cruise system, the Trouble Diagnosis Chart should be used for reference as to the complaint and its possible cause. Whenever a general complaint is encountered, the Trouble Diagnosis Test Procedure Chart (figure 11-183) should be used to determine the area of malfunction. Since the procedures outlined in this chart are performed with the car stationary, it may be necessary, in some cases, to road test the system to determine the specific complaint.

All electrical and vacuum connections and other obvious items, such as the bead chain adjustment and brake release switch adjustment, should be checked and corrected prior to any type of testing.

### a. Vacuum, Air Leak and Power Unit Test

1. Disconnect power unit bead chain from throttle rod bracket threaded stud.

**IMPORTANT:** Check all vacuum hoses for proper attachment at vacuum source, power unit and brake release switch. See figures 11-177 and 11-178.

2. Pull Electro-Cruise engage lever to the off position.

3. Note position of power unit diaphragm pull rod.

4. Start engine and again note position of power unit diaphragm rod. Movement normally indicates leakage through the vacuum orifice and control valve. If maximum movement is noted, the wiring harness connector should be temporarily disconnected from the power unit to eliminate the possibility of an electrical problem. If diaphragm rod still moves into power unit disassembly, inspection and repair of the power

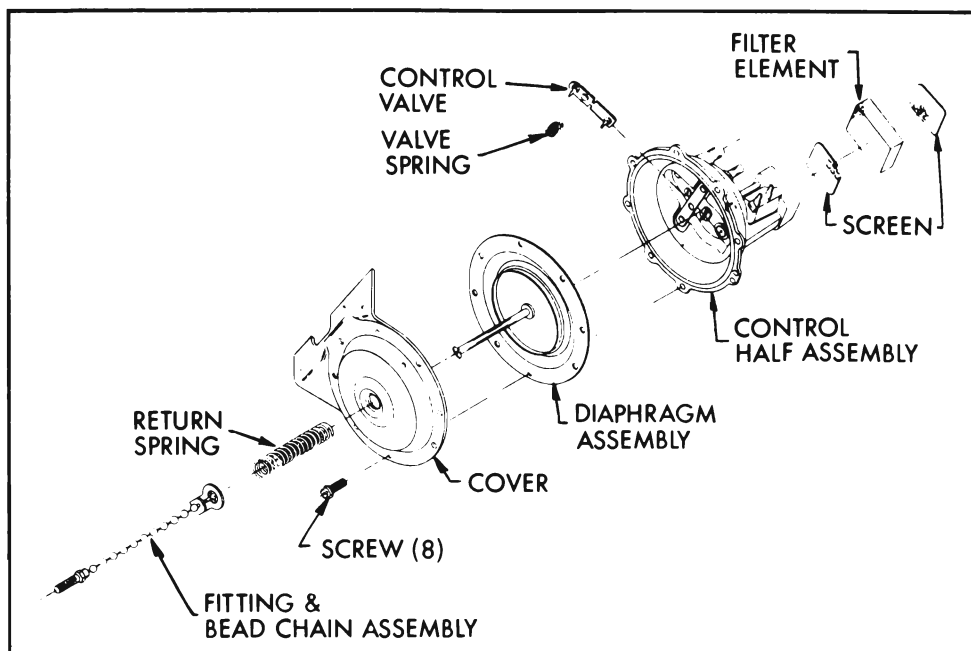


Figure 11-179—Exploded View of Power Unit

unit will be required. Paragraph 11-23, subparagraph 'c'.

5. With engine still running and bead chain still disconnected, push cruise engagement lever forward and hold. If power unit diaphragm rod moves into unit, proceed with Step 6. If rod does not move into unit, remove wiring connector from power unit. Using jumper wires, ground one terminal of unit and connect the other terminal to a 12 volt source and again observe diaphragm rod with engine running. If unit does not operate, remove hose which goes to brake release switch and plug release hose fitting on power unit. If power unit still does not operate properly, it is defective and should be repaired.

6. With power unit diaphragm rod pulled all the way in unit by engine vacuum and engagement lever held forward, clamp off vacuum source hose. Leave hose clamped and engagement lever held forward for 90 seconds. Any outward movement of rod in this period indicates leakage in the hose connections, in the brake release switch, in the power unit diaphragm or through the power unit air orifice and control valve.

7. If leakage is noted, remove hose from the brake switch release hose fitting at the power unit, plug the release hose fitting and repeat Steps 5 and 6. If diaphragm rod now remains stationary for 90 seconds, leakage is indicated in the brake release switch or hose to it. If diaphragm rod still moves outward and all hose connections and conditions of hoses are okay, the power unit

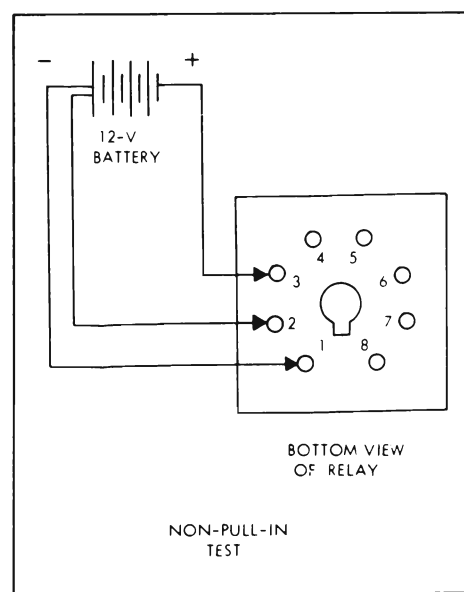


Figure 11-180—Relay Non-Pull-In Check

has an internal leak and should be repaired.

### b. Relay Tests

If through trouble diagnosis, trouble is indicated with the Electro-Cruise relay, the relay can be checked by two methods.

1. The first method or procedure is to substitute a known good relay and perform the procedure outlined in the Trouble Diagnosis Test Procedure chart or road test the car to determine whether or not the condition has been corrected.

2. The second method is to remove the relay and perform the Non-Pull-In and Pull-In checks as outlined below. These checks involve the use of a 12 volt battery, jumper wires and a 12 volt lamp such as a #57 lamp to check operation and continuity of the relay and will conclusively indicate a defective unit. A unit found to be defective will require replacement.

#### (a) Non-Pull-In Check

(1) Connect pins 1 and 2 to the negative terminal of a 12 volt battery. See figure 11-181.

(2) Connect pin 3 to the positive terminal of the battery

(3) When the connection to pin 3 is made, the relay should not pull in. A checking sound will be noted if the relay pulls in and indicates the relay is defective and must be replaced.

(4) Perform Pull-In check.

#### (b) Pull-In Check.

(1) Connect pins 1 and 2 to the negative terminal of a 12 volt battery. See figure 11-180.

(2) Connect pin 3 to the positive terminal of the battery.

(3) Connect a 12 volt test lamp such as a #57 lamp between the negative terminal of the battery

and the relay, alternating the connection between pin 4 and 5.

(4) During either of the above connections, the lamp must not light. If lamp lights, a defective relay is indicated and must be replaced.

(5) Disconnect connection to pin 1 and again alternate the test lamp lead between pin 4 and 5.

(6) During either of the above connections the lamp should light. Failure of the lamp to light indicates a defective relay and must be replaced.

### c. Amplifier Test

The amplifier can be checked using one of two methods similar to checking the relay.

1. The first method is to substitute a known good amplifier and perform the procedure outlined in the Trouble Diagnosis Test Procedure chart, Figure 11-183 or road test the car to determine whether or not the condition has been corrected.

2. The second method is to remove the amplifier and perform check as outlined below. This check involves the use of a 12 volt test lamp to check oper-

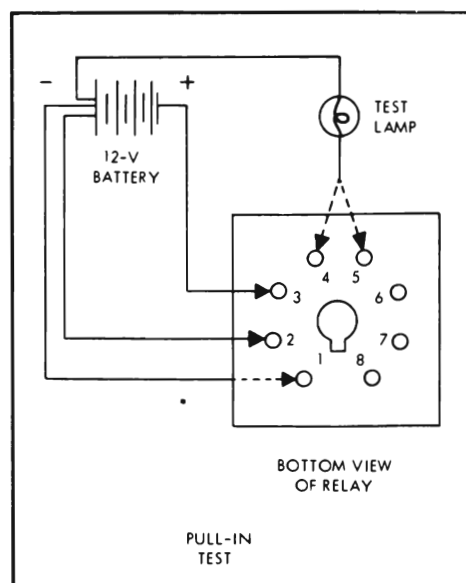


Figure 11-181—Relay Pull-In Check

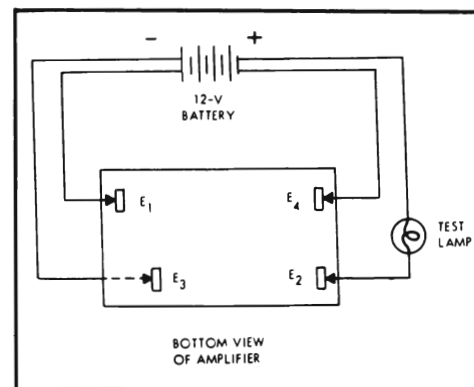


Figure 11-182—Amplifier Test

ation and continuity of the amplifier and will conclusively indicate a defective unit.

(a) Connect terminal E<sub>1</sub> to the negative terminal of the 12 volt battery. See Figure 11-182.

(b) Connect a 12 volt test lamp such as a #57 lamp between the terminal E<sub>2</sub> and the positive terminal of the battery.

(c) Connect terminal E<sub>4</sub> to the positive terminal of the battery.

(d) Momentarily connect terminal E<sub>3</sub> to the ground terminal of the battery and observe test lamp.

(e) The test lamp should light when terminal E<sub>3</sub> is connected to the ground terminal of the battery and should go out when the terminal is disconnected. If lamp remains lit when terminal E<sub>3</sub> is disconnected, or the lamp does not light when terminal E<sub>3</sub> is connected, the amplifier is defective and must be replaced.

### d. Speedometer Testing

Speedometer testing is difficult since conclusive tests can only be performed with the unit in operation. Generally, then, the speedometer is assumed to be in satisfactory condition until all other components have been checked and found to be in satisfactory condition. If, after testing other components, wire harness continuity, electrical connections

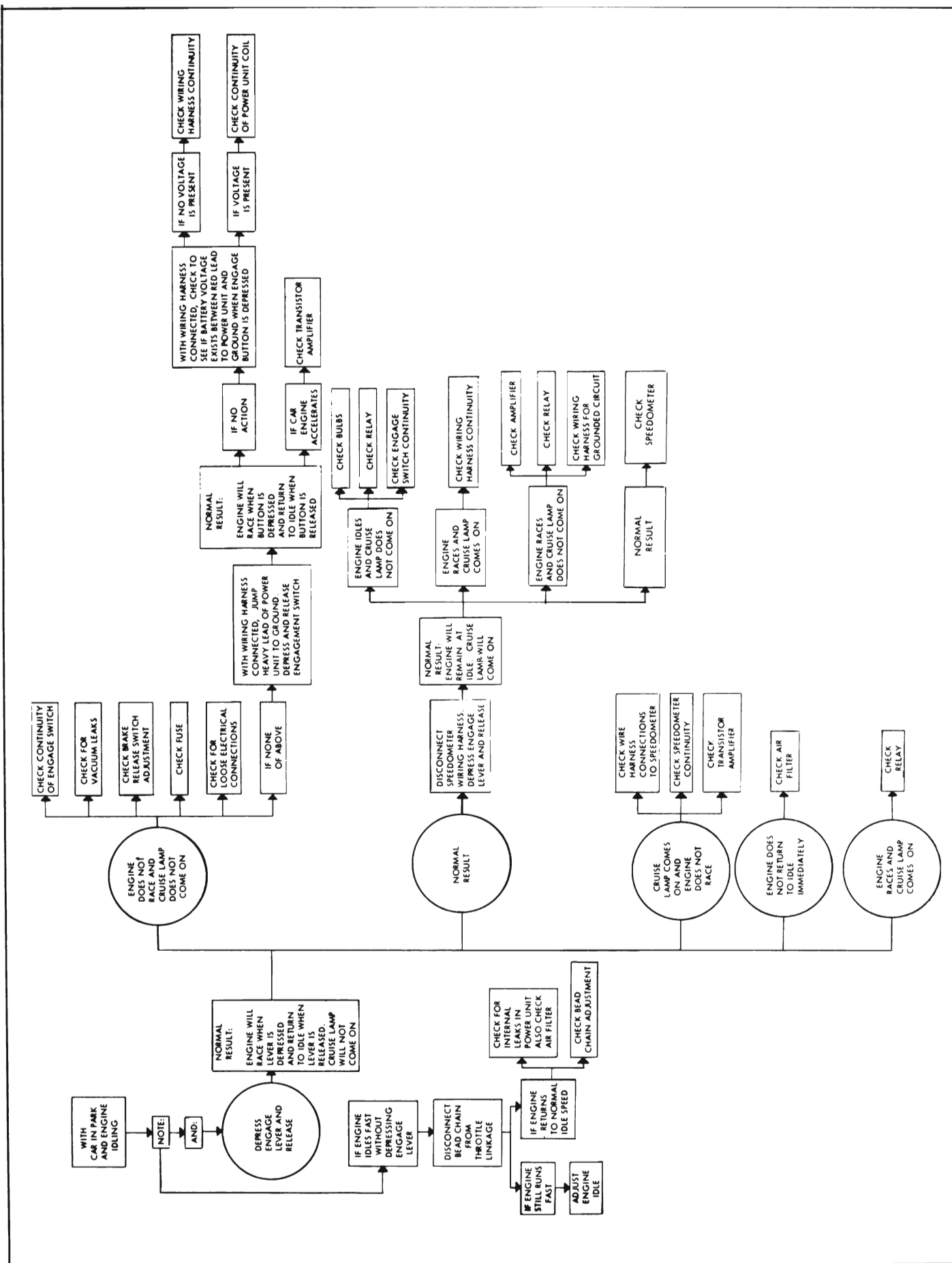


Figure 11-183—Electro-Cruise Trouble Diagnosis Test Procedure Chart

and vacuum leakage are found to be satisfactory, the speedometer should be removed and serviced

by an authorized repair station.  
**e. Continuity Tests**  
 Continuity of the entire Electro-

Cruise electrical system can be checked using the wiring diagram in Figure 11-176.

### Electro-Cruise Trouble Diagnosis Chart

COMPLAINT	POSSIBLE CAUSE
A. No action when lever is pushed.	<ol style="list-style-type: none"> <li>1. Disconnected electrical connections or open in wiring.</li> <li>2. Blown fuses.</li> <li>3. Brake release switch adjustment.</li> <li>4. Vacuum leakage.</li> <li>5. Power unit coil open.</li> <li>6. Defective transistor amplifier.</li> </ol>
B. CRUISE lamp comes on when lever or knob is pushed and no car response.	<ol style="list-style-type: none"> <li>1. Harness to speedometer unplugged or loose.</li> <li>2. Defective speed transducer.</li> <li>3. Defective transistor amplifier.</li> <li>4. Defective relay.</li> </ol>
C. ELECTRO-CRUISE remains engaged when brake is touched.	<ol style="list-style-type: none"> <li>1. Brake release switch adjustment.</li> <li>2. Shorted brake release switch.</li> <li>3. Shorted wire harness.</li> </ol>
D. Blow fuses.	<ol style="list-style-type: none"> <li>1. Shorted wiring.</li> <li>2. Shorted relay, cruise lamp or power unit coil.</li> <li>3. Shorted transistor amplifier.</li> </ol>
E. Engine races as soon as car is started when engage lever or knob is not pushed.	<ol style="list-style-type: none"> <li>1. Shorted wire harness.</li> <li>2. Shorted engage switch.</li> <li>3. Shorted relay.</li> <li>4. Vacuum orifice leak in power unit.</li> <li>5. Stuck accelerator linkage.</li> </ol>
F. ELECTRO-CRUISE will not lock in after set speed is attained.	<ol style="list-style-type: none"> <li>1. Defective relay.</li> <li>2. Defective engage switch.</li> </ol>
G. Car keeps accelerating up past set speed.	<ol style="list-style-type: none"> <li>1. Shorted wire harness.</li> <li>2. Shorted speedometer.</li> <li>3. Defective relay.</li> <li>4. Defective transistor amplifier.</li> </ol>
H. Automatically locks in CRUISE when car goes over bumps.	<ol style="list-style-type: none"> <li>1. Defective relay.</li> </ol>

**Electro-Cruise Trouble Diagnosis Chart (Cont'd)**

COMPLAINT	POSSIBLE CAUSE
I. Drops out of CRUISE control when over bumps.	<ol style="list-style-type: none"> <li>1. Defective relay.</li> <li>2. Loose electrical connections.</li> <li>3. Brake release switch adjustment.</li> </ol>
J. Erratic cruise speed.	<ol style="list-style-type: none"> <li>1. Loose electrical connections.</li> <li>2. Defective speedometer.</li> <li>3. Defective power unit.</li> <li>4. Vacuum leakage.</li> </ol>
K. Slow response.	<ol style="list-style-type: none"> <li>1. Vacuum leakage.</li> </ol>
L. Hunts at slow speed.	<ol style="list-style-type: none"> <li>1. Defective speedometer.</li> <li>2. Bead chain adjustment.</li> <li>3. Stiff accelerator linkage.</li> <li>4. Vacuum leakage.</li> <li>5. Dragging brakes.</li> </ol>
M. Does not disengage when engage lever is pulled out.	<ol style="list-style-type: none"> <li>1. Shorted wire harness.</li> <li>2. Shorted engage switch.</li> <li>3. Defective relay.</li> </ol>
N. CRUISE lamp does not light.	<ol style="list-style-type: none"> <li>1. Burned out lamp bulb.</li> <li>2. Defective relay.</li> <li>3. Disconnected electrical connections or broken wiring.</li> </ol>
O. Engine will not idle at slow speed when ELECTRO-CRUISE is not engaged.	<ol style="list-style-type: none"> <li>1. Vacuum leakage.</li> <li>2. Bead chain adjustment.</li> </ol>
P. Speed setting pointer and speedometer needle do not coincide speed when in cruise.	<ol style="list-style-type: none"> <li>1. Stiff throttle linkage.</li> <li>2. Vacuum leakage.</li> <li>3. Speedometer out of calibration.</li> <li>4. Kinked speedometer cable.</li> </ol>