Electrical System

WARNING: THIS COACH IS EQUIPPED WITH A NEGATIVE GROUND ELECTRICAL SYSTEM.

This group, covering maintenance and repair information on the Electrical Systems, is divided into sections as shown in Index below:

NOTE: Specifications are listed at the end of each specific section.

INDEX OF ELECTRICAL UNITS

Certain electrical units, when closely associated with other systems or units, are covered in other sections of this manual. The following index lists all major electrical units, together with the manual section in which they are covered and page number on which the section begins:

Wiring and Miscellaneous Electrical

ELECTRICAL CIRCUIT DIAGRAMS

The electrical system is divided into several separate systems, each system being classified according to its junction or purpose. A separate wiring diagram is provided for each major system. In some cases, a circuit on one diagram ties-in with circuits shown on other diagrams, and cross references are made to other diagrams. Wiring diagrams, in "Wiring Diagrams" booklet X6814A,

include all standard wiring and the most commonly used special equipment wiring.

NOTE: Due to the many combinations and types of special equipment used, it is impractical to include all special equipment wiring diagrams in this manual. Wiring diagrams covering particular special equipment can be obtained upon request from the factory. Following is a list of wiring diagrams included in "Wiring Diagrams" booklet X-6814A.

COACH MODEL		
PD-4107	PD-4903	Description
MD-2154	MD-2162	Heating and Air Conditioning Wiring Diagram
MD-3135	MD-3135	Directional Light Wiring Diagram
MD-97103	MD-97103	Speedometer Wiring Diagram
MD-97593	MD-2161	Engine Control and Generator Wiring Diagram
MD-97596	MD-2556	Alarm and Signal Wiring Diagram
MD-97597	MD-2063	Transmission Wiring Diagram
MD-98684	MD-2571	Coach Lighting Wiring Diagram
MD-98694	MD-3396	General Wiring Diagram
MD-99314	MD-99314	Windshield Wiper Wiring Diagram
MD-99959	MD-2357	Flashing Step Lamp Wiring Diagram
-	MD-2721	Reading and General Light Wiring Diagram
MD-97595	MD-2565	Lavatory Wiring Diagram
-	MD-3386	Retractable Inter-Axle Wiring Diagram
MD-98923	MD-4601	Engine Control Lock Switch Wiring Diagram

WIRE SIZES AND COLORS

Each wire in the electrical system is of a specific size as designated on the Wiring Diagrams. When replacing wires, the correct size as indicated must be used. Never replace a wire with one of a smaller size.

The insulation on each wire is distinctly colored and patterned to assist in tracing and testing circuits, and to assist in making connections.

Abbreviations and symbols are used in wire insulation color and pattern designations on Wiring Diagrams and in the tabulations which follow. Abbreviations and symbols are as follows:

*Blk.	Black	Nat.	Natural
Brn.	Brown	Or.	Orange
Ch.	Check	Tr.	Tracer
Cr.	Cross	Yell.	Yellow
Grn.	Green	//	Parallel

*All wires leading from electrical compartment junction box into engine compartment are covered with black heat-resistant insulation. To assist in making proper connections, a tag near end of each wire bears the number or abbreviation of the terminal to which it connects.

TESTING CIRCUITS

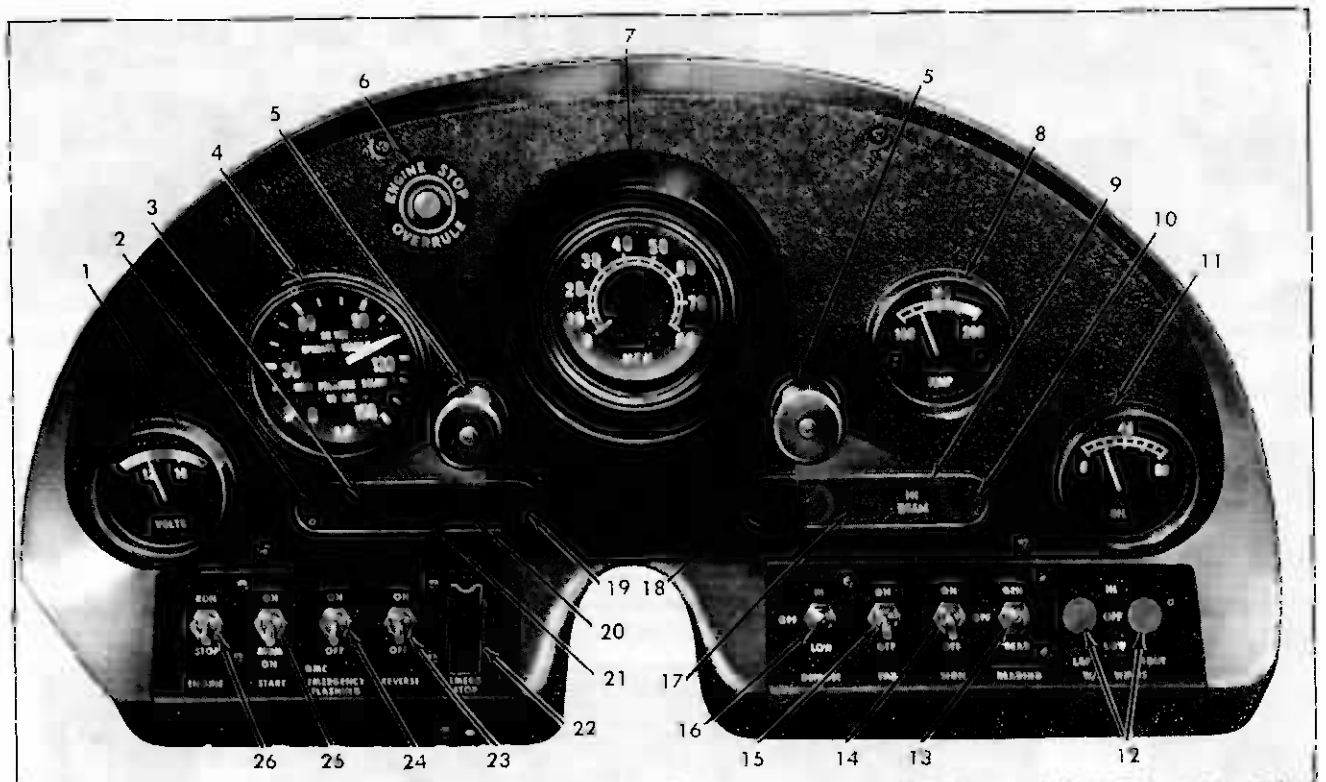
A careful study of the wiring diagrams should be made to determine the source and flow of current through each electrical circuit. When a circuit is thoroughly understood, a point to point check can be made with the aid of the applicable wiring diagram, to determine location of trouble. Any circuit can be tested for continuity or short circuits with a 2-candlepower test light or voltmeter.

All electrical connections must be kept clean and tight. Loose or corroded connections will cause discharged battery, difficult starting, dim lights, and improper functioning of other electrical circuits. Inspect all wiring connections at regular intervals. Make sure knurled nuts on all amphenol plugs are securely tightened. Refer to other sections previously listed under "Index of Electrical Units" for information on major electrical units and systems.

GAUGE, SWITCH, AND TELL-TALE PANEL

Gauge, switch, and tell-tale panel (fig. 1), mounted in front of driver, has an engine temperature gauge, air pressure gauge, generator charge indicator, oil pressure gauge, and speedometer.

The left tell-tale cluster contains the left turn indicator, and tell-tale lights for Hot Engine, Low Oil, Low Air, and Transmission Oil. The right tell-tale cluster contains tell-tale lights for "A/C



1 Voltmeter Gauge
2 Directional Signal - Tell-Tale (Left-Hand)
3 Hot Engine - Tell-Tale
4 Air Pressure Gauge
5 Shielded Panel Lamps
6 Engine Stop Overrule - Switch
7 Speedometer - Gauge
8 Water Temperature Gauge
9 Hi-Beam - Tell-Tale
10 Directional Signal - Tell-Tale (Right-Hand)
11 Oil Pressure Gauge
12 Windshield Wiper Motor - Switch (When Used)
13 General Lighting and Reading Lamp - Switch
14 Destination Sign - Switch
15 Fan Switch
16 Defroster Switch
17 Stop Lamp - Tell-Tale
18 Air Conditioning Stop - Tell-Tale
19 Transmission Oil - Tell-Tale
20 Low Air - Tell-Tale
21 Low Engine Oil - Tell-Tale
22 Engine Emergency Stop - Switch
23 Transmission Reverse - Switch
24 Emergency Flashing Light - Switch
25 Engine Starter - Switch
26 Engine Run - Switch

T-6197

Figure 1--Gauge, Switch and Tell-Tale Panel (Typical)

Stop," "Stop Lamp," "Hi-Beam," and right turn indicator.

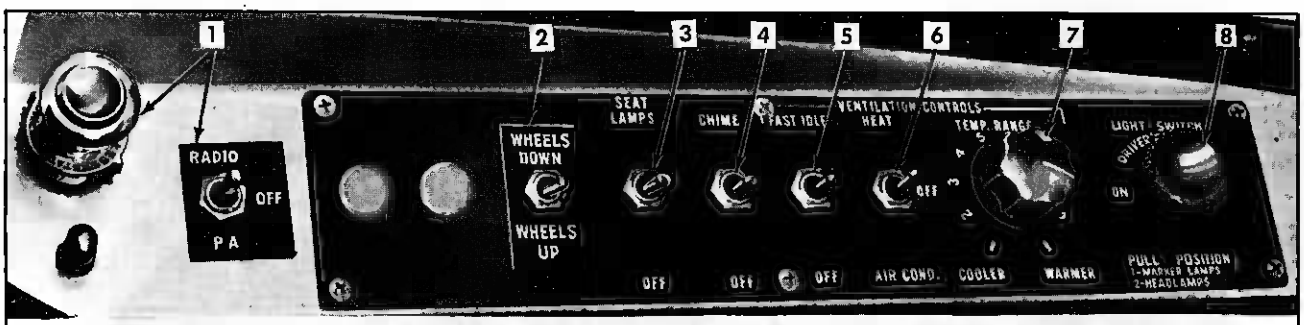
Individual toggle-type switches on left side of console control the engine run circuit, starter, emergency flasher, transmission reverse, and emergency stop. Switches on right side control the defroster, driver's fan, destination sign lights, reading and general interior lights, and left and right windshield wipers.

An engine stop overrule switch is used as special equipment on some vehicles.

Snap-on type instrument lamp bulb sockets are part of the wiring harness assembly. Lamp bulbs are accessible after pulling socket from holder at back of instrument panel.

DRIVER'S CONTROL PANEL

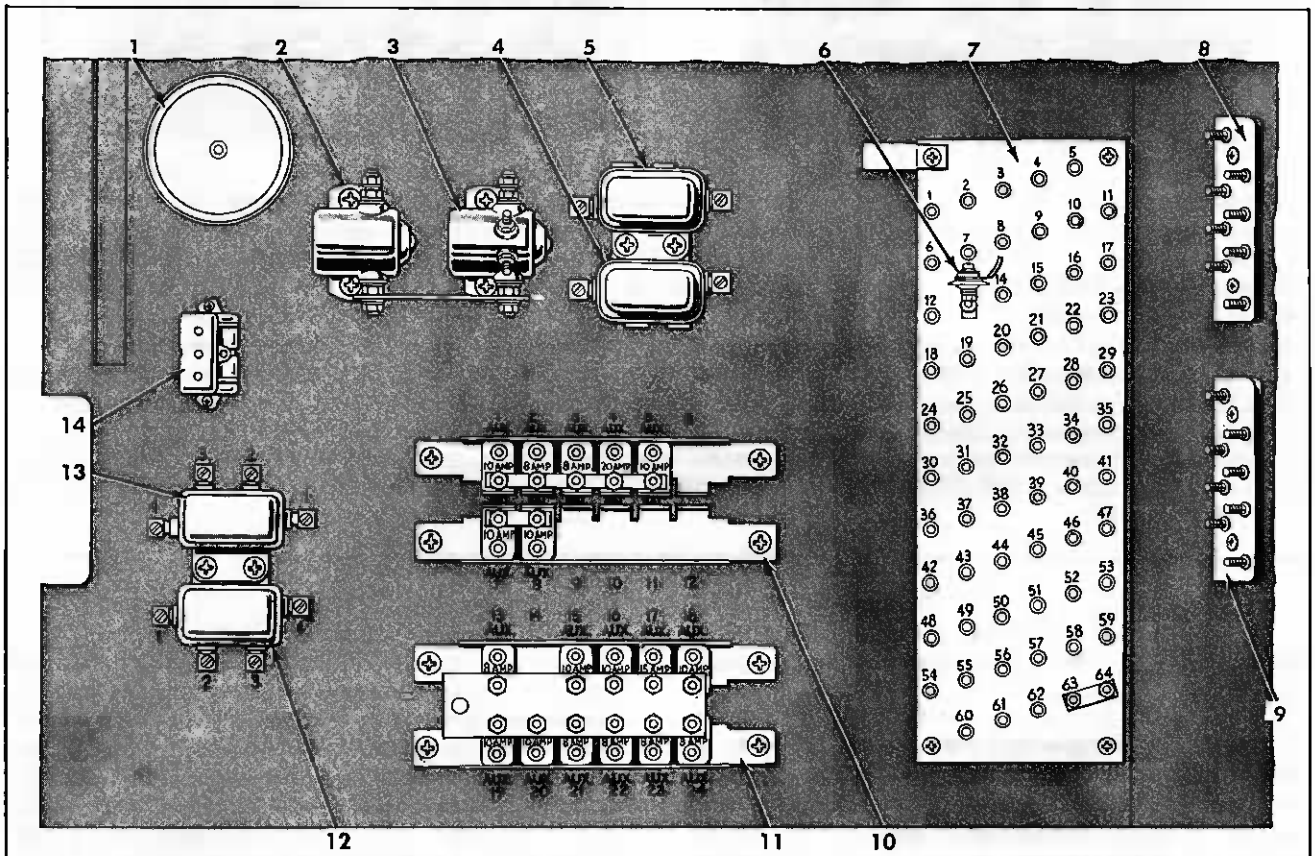
Control panel, located at left of driver (fig. 2), contains switches for operation of seat lamps, passenger chime, engine fast idle, heating and air conditioning controls, and a two-position, push-pull type light switch at the right of control panel. The first position turns on marker, tail, and license plate lights and the second position turns on headlights. Knob changes intensity of instrument lights.



1 Radio Controls (Special Equipment)
2 Axle Lift Control Switch (Special Equipment)
3 Seat Lamps Switch (Special Equipment)
4 Passenger Signal Chime Switch
5 Engine Fast Idle Switch
6 Heating and Air Conditioning Switch
7 Temperature Range Rheostat
8 Light Switch
Driver's Lamp
Marker Lamp
Head Lamps

T-5198

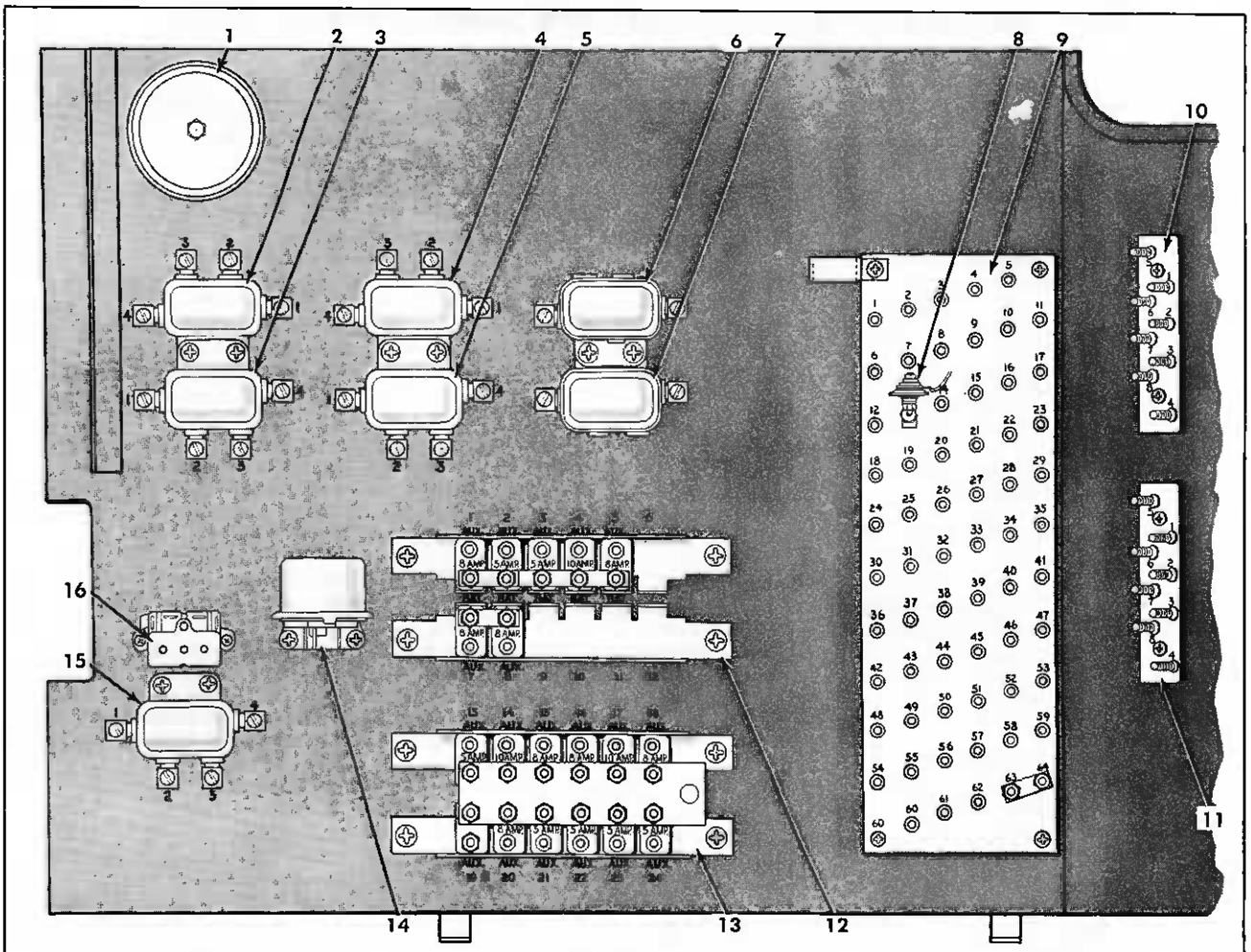
Figure 2—Driver's Control Panel (Typical)



1 Fire Alarm (Special Equipment)
2 Engine Run Magnetic Switch
3 Generator Magnetic Switch
4 Low Engine Oil or Hot Engine Alarm Buzzer
5 Low Air Alarm Buzzer
6 Rectifier
7 Junction Block (64 - Terminals)
8 Junction Block (8 - Terminals)
9 Junction Block (8 - Terminals)
10 Circuit Breaker and Bus Bar
11 Circuit Breaker and Carrier
12 DD3 - Brake Stop Lamp Relay
13 Horn Relay
14 Stop Lamp Relay

T-5199

Figure 3—Driver's Control and Apparatus Panel (Model PD4107)



1 Fire Alarm Bell (Special Equipment)
2 Defroster Low Speed Relay
3 Horn Relay
4 Engine Run Relay
5 Generator Relay
6 Low Air Alarm Buzzer
7 Low Engine Oil or Hot Engine Alarm Buzzer
8 Rectifier
9 Junction Block (64 - Terminals)
10 Junction Block (Special Equipment)
11 Auxiliary Junction Block
12 Circuit Breaker Bar
13 Circuit Breaker Bar
14 Defroster Hi Speed Relay
15 DD-3 Brake Stop Lamp Relay
16 Stop Lamp Relay

Figure 4—Driver's Control and Apparatus Panel (Model PD4903)

Additional plates on panel are provided for special equipment application.

Junction panel (figs. 3 and 4), located below the control panel at left of driver, is accessible after removing the junction, circuit breaker, and electrical apparatus panel cover. Junction panel contains 64 terminal posts, numbered consecutively from 1 through 64. Numbers on panel correspond to numbers on Wiring Diagrams and in tabulations which follow. The tabulation lists each terminal number, the circuit it carries, and the size, color, and pattern of the wire which connects to each terminal. Some of the unused terminals, marked "Open" or "Spare" in the tabulation, are available for use with additional special electrical equipment. Driver's control panel junction numbers appear in the symbol ⬠ on Wiring Diagrams in "Wiring Diagrams" booklet X-6814A.

DRIVER'S CONTROL PANEL JUNCTIONS (SYMBOL ⬠)

Terminal No.	Circuit	Wire Size	Color Code
1	From Stop Lamp Switch to Stop Lamp Relay Terminal #4	16	Red-Nat. Tr.
	To DD-3 Brake Stop Lamp Relay Terminal #2	16	Red-Nat. Tr.
2	From Emergency Stop Switch To Engine Compartment Junction 2 - Model PD-4107	14	Grn.-Red Ch.
	Model PD-4903	16	Grn.-Red Ch.
3	From Transmission Reverse Switch To Engine Comp't. Jct. 3		
	Model PD-4107	14	Blk.-2 Red // Tr.
	Model PD-4903	16	Blk.-2 Red // Tr.
4	From Engine Alarm Buzzer	16	Grn.-Blk. Tr.
	To Engine Compartment Junction 4	16	Grn.-Blk. Tr.
	To Transmission Rectifier		White
5	From Oil Pressure Gauge To Engine Comp't. Jct. 5	16	Grn.-Nat. Cr. Tr.
6	Model PD-4107 (Only)		
	From Light Switch Terminal #4	14	Brn.-Blk. Tr.
	To Front Marker Lamps	14	Brn.-Blk. Tr.
	*To Front Night Lamp	16	Blk.-Red Tr.
	To Battery Compartment Junction 5L	14	Brn.-Blk. Tr.
	Model PD-4903		
	From Light Switch Terminal No. 4	16	Brn.-Blk. Tr.
	To Engine Compartment Junction 6	16	Brn.-Blk. Tr.
	To front Marker Lamp Connector	16	Brn.-Blk. Tr.
	To Regulator Compartment Junction 5L	16	Brn.-Blk. Tr.
	*To Front Seat Night Lamp Connector	16	Brn.-Blk. Tr.
7	From Speedometer Head Insulated Stud to Engine Comp't. Jct. 7	16	Blk.-Nat. Tr.
8	From Low Air Buzzer and Tell-tale To Low Air Pressure Sw.	16	Or.-2 Grn. // Tr.
9	*Spare - (Fire Detectors) From Fire Alarm Bell To Engine Compartment Junction 9 - Model PD-4107	16	Grn.-2 Red // Tr.
	Model PD-4903	18	Grn.-2 Red // Tr.
10	Model PD-4107		
	From Headlamp Switch		
	To Foot Dimmer Switch	14	Brn.
	To Engine Compartment Junction 10	14	Brn.
	Model PD-4903		
	From Headlamp Switch Terminal No. 6		
	To Dimmer Switch	16	Brn.
11	From Stop Lamp Relay To Engine Compartment Junction 11	16	Red-2 Nat. // Tr.
12	Model PD-4107		
	From Stop Lamp Tell-tale To Stop Lamp Relay Terminal #2	16	Red-Blk. Tr.
	Model PD-4903		
	From Stop Lamp Relay Terminal #1 To Stop Lamp Tell-tale	16	Red-Blk. Tr.
13	Model PD-4107		
	From Engine Alarm Buzzer Rectifier and Transmission Low Oil Tell-tale To Engine Compartment Junction 13	16	Blk.-Red Tr.
	Model PD-4903		
	From Transmission Rectifier To Transmission Low Oil Tell-tale and Engine Compartment Junction 13	16	Blk.-Red Tr.
14	From Hot Engine Tell-tale To Engine Compartment Junction 14	16	Grn.-2 Blk. // Tr.
15	From Engine Temperature Gauge To Engine Comp't. Jct. 15	16	Grn.-Blk. Cr. Tr.
16	Model PD-4107		
	From Engine Run Sw. To Engine Run Magnetic Switch	14	Grn.-Brn. Cr. Tr.
	Model PD-4903		
	From Engine Run Switch To Engine Run Relay Terminal #3	16	Grn.-2 Blk. // Tr.
17	From Speedometer Head Ground To Engine Comp't. Junction 17	16	Blk.-2 Nat. // Tr.
18	From Flashing Step Lamp Relay Terminal #1		
	To Night Lamp	16	Blk.-Red Tr. (P & C)
	To Watch Step Sign Connector	16	Nat.
	*To Watch Step Aisle Lamps	16	Nat.
19	From Start Switch To Engine Compartment Junction 19		
	Model PD-4107	14	Grn.-2 Brn. // Tr.
	Model PD-4903	16	Grn.-Blk. Tr.
20	*Spare - To Engine Compartment Junction 20	16	Or.-2 Blk.// Tr.
21	R.H. Directional Signal Lamp Circuit:		
	From R.H. Pilot Relay Terminal No. 4	16	Red-2 Grn. // Tr.
	To R.H. Front Directional Lamp Harness Connector	16	Red-2 Grn. // Tr.
	To R.H. Side Directional Lamp	16	Red-2 Grn. // Tr.
	To Engine Compartment Junction 21	16	Red-2 Grn. // Tr.

*Special Equipment.

(Cont'd.)

DRIVER'S CONTROL PANEL JUNCTIONS (SYMBOL ⧸⧹) (CONT'D)

Terminal No.	Circuit	Wire Size	Color Code
22	From Driver's Control Panel No. 2 Circuit Breaker	14	Grn.
	To Air Brake Switch	16	Grn.
	To Engine Compartment Junction 22	16	Grn.
	To Harness Connector For Transmission Reverse Switch, Trans. Low Oil Tell-tale & Trans. Overrule Sw. (If Used)	16	Grn.
	To Step Lamp and Flasher Wiring Connector	16	Grn.
23	Model PD-4107 (Only)		
	*Spare - From Engine Stop Overrule Sw. To Engine Comp't. Junction 23	14	Grn.-Red Tr.
	Model PD-4903 (Only)		
	*Spare - From Trans. Overrule Sw. To Engine Comp't. Jct. 23.	16	Grn.-Red Tr.
24	From Low Oil Tell-tale To Engine Compartment Junction 24	16	Grn.-2 Nat. // Tr.
25	From Engine Fast Idle Sw. To Engine Compartment Jct. 25	16	Grn.-Nat. Tr.
26	Open		
27	*Speedometer Circuit:		
	From Instrument Cluster Harness Connector To Engine Compartment Junction 27	16	Blk.-Grn. Tr.
28	From Air Brake Switch		
	To Fast Idle Sw. & DD-3 Brake Stop Lamp Relay Term. #3.	16	Grn.-Nat. Tr.
29	Starter Switch Circuit:		
	From Starter Switch Connector		
	Model PD-4107	14	Grn.-Brn. Cr. Tr.
	Model PD-4903	16	Grn.-Brn. Cr. Tr.
	To Engine Alarm Buzzer and Engine Compartment Junction 29		
	Model PD-4107	14	Grn.-Brn. Cr. Tr.
	Model PD-4903	16	Grn.-Brn. Cr. Tr.
30	Spare - To Engine Compartment Junction 30	16	Blk.-Red Cr. Tr.
31	L.H. Directional Lamp Circuit:		
	From L.H. Pilot Lamp Relay		
	To Engine Comp't. Jct. 31 & L.H. Side Directional Lamp	16	Red-Grn. Tr.
32	From Dimmer Sw. Harness Connector To Hi-Beam Tell-tale	16	Brn.-Nat. Cr. Tr.
33	From Destination Sign Switch	16	Brn.-Blk. & Nat. Cr. Tr.
	To Front Destination Sign Lamp Connector	16	Brn.-Blk. & Nat. Cr. Tr.
	*To Side Destination Sign Lamp Connector	16	Brn.-Blk. & Nat. Cr. Tr.
34	Model PD-4107		
	From Interior Light Sw. "Reading" To Reading Lamp Magnetic Switch	16	Nat.-2 Blk. // Tr.
	Model PD-4903		
	From Interior Light Sw. "Reading" To Regulator Panel Jct. 1L	16	Nat.-2 Blk. // Tr.
35	Model PD-4107		
	From Interior Light Sw. "General" To General Lamp Magnetic Switch	16	Nat.-Blk. Tr.
	Model PD-4903		
	From Interior Light Sw. "General" to Regulator Panel Jct. 4L	16	Nat.-Blk. Tr.
36	*Spare - From Hydraulic Fan Solenoid Valve To Engine Comp't. Junction 38 (Model PD-4107)	16	Blk.-2 Red // Tr.
	Model PD-4903		
	From Heating and A/C Sw. "Heat" To Water Pump Relay Terminal No. 3	16	Yell.-Red Tr.
37	*Speedometer Circuit:		
	To Engine Compartment Junction 37	16	Blk.-2 Grn. // Tr.
38	Model PD-4107		
	From Driver's Control Panel No. 1 Circuit Breaker To Battery Compartment Junction 3L	14	Blu.-Nat. Cr. Tr.
	Model PD-4903		
	From Driver's Control Panel No. 1 Circuit Breaker To Regulator Panel Junction 3L	16	Blu.-Nat. Cr. Tr.
39	Model PD-4107		
	*From Battery Comp't. Jct. 2L To Emergency Buzzer	16	Blu.-Nat. Tr.
	Model PD-4903		
	*From Regulator Panel Junction 2L To Emergency Buzzer.	16	Blu.-Nat. Tr.
40	Open		
41	Open		
42	Model PD-4107		
	From Generator Magnetic Sw. To Battery Comp't. No. 6 Circuit Breaker	14	Gray

*Special Equipment.

(Cont'd.)

WIRING AND MISC. ELECT.

DRIVER'S CONTROL PANEL JUNCTIONS (SYMBOL ⬠) (CONT'D)

Terminal No.	Circuit	Wire Size	Color Code
42	Model PD-4903		
	From Regulator Panel No. 6 Circuit Breaker To Generator Relay Terminal No. 3	16	Gray
43	From Temperature Control To Gradustat Resistor	16	Yell.-2 Blu. // Tr.
44	Model PD-4107		
	From Heating and A/C Switch to Temperature Control, Blower Magnetic Switch, and Ventilation Compartment Junction 4	14	Yell.
	Model PD-4903		
	From Heating and A/C Switch Harness Connector To Blower Motor Magnetic Switch	16	Yell.
45	Model PD-4107		
	From Heating and A/C Switch To Battery Comp't. Junction 3R and Blower Motor Magnetic Switch	14	Yell.-2 Red // Tr.
	Model PD-4903		
	From Heating and A/C Switch "A/C" To Defroster Hi-Speed Cut-out Relay Terminal No. 4	16	Yell.-Grn. Tr.
	To Blower Motor Magnetic Switch & Regulator Panel Jct. 3R	16	Yell.-Grn. Tr.
46	Model PD-4107		
	From Air Cond. Tell-tale To Battery Comp't. Junction 6L	16	Yell.-Blk. Cr. Tr.
	Model PD-4903		
	From Regulator Panel Jct. 6L to A/C Tell-tale	16	Yell.-Blk. Cr. Tr.
47	Model PD-4107		
	From Defroster Sw. "HI" To Defroster Fan Harness Connector	14	Yell.-2 Blk. // Tr.
	Model PD-4903		
	From Defroster Switch "HI" To Defroster Low Speed Relay Terminal No. 4	16	Yell.-2 Blu. // Tr.
48	Model PD-4903		
	From Defroster Hi-Speed Cut-Out Relay Terminal #1	16	Blk.-Yell. Ch.
	To Defroster Fan Bolted Connector	16	Yell.-2 Blk. // Cr. Tr.
	Model PD-4107		
	From Defroster Fan Sw. To Defroster Fan Bolted Connector	14	Yell.-Blk. Cr. Tr.
49	From Horn Relay Terminal No. 2 To Horn		
	Model PD-4107	10	Brn.-Blk. & Red Cr. Tr.
	Model PD-4903	14	Brn.-Blk. & Red Cr. Tr.
50	From Horn Relay Terminal No. 3 To Directional Signal Switch Connector	16	Brn.-Red Ch.
51	Model PD-4107		
	*From Seat Lamp Switch To Battery Comp't. Junction 4R	16	Nat.-Blk. Cr. Tr.
	Model PD-4903		
	*From Seat Lamp Switch To Regulator Panel Junction 4R	16	Nat.-Blk. Cr. Tr.
52	From Driver's Control Panel No. 21 Circuit Breaker	16	Nat.-Blk. Cr. Tr.
	To Driver's Lamp Line Connector & Seat Lamp Switch	16	Nat.-Grn. Tr.
53	From Driver's Fan Switch To Fan Connector	16	Yell.-Blu. Tr.
54	Model PD-4107		
	*Wheel Sander Circuit		
	From Wheel Sander Switch	10	Nat.
	To Engine Compartment Junction 54	10	Red-Grn. Tr.
	Model PD-4903		
	*Spare - (Rear Wheel Sander) To Regulator Panel Junction 1R	12	Nat.
55	Model PD-4107		
	*Spare (Fuel Gauge) To Ventilation Compartment Junction 2	16	Or.-Grn. Tr.
	Model PD-4903		
	*Spare (Fuel Gauge) To Battery Compartment Connector	16	Or.-Grn. Tr.
56	Model PD-4107		
	*Spare - To Ventilation Compartment Junction 1	16	Blk.-Nat. Cr. Tr.
	Model PD-4903		
	*From Defroster Switch To Defroster Hi-Speed Cut-Out Relay Terminal No. 2	16	Yell.-Blk. Tr.
57	From Passenger Chime To Chime Switch	16	Grn.-Red Ch.
58	From Chimes Switch To R.H. and L.H. Passenger Signal Switch Connector	16	Grn.-Red Ch.
59	Model PD-4107		
	From Heating and A/C Control Switch	16	Nat.
	To Water Pump Relay Rectifier Connector	16	Yell.-Grn. Tr.
	Model PD-4903		
	Spare - To Regulator Panel	16	Blk.-Red Cr. Tr.

*Special Equipment.

(Cont'd.)

DRIVER'S CONTROL PANEL JUNCTIONS (SYMBOL ⧄) (CONT'D)

Terminal No.	Circuit	Wire Size	Color Code
60	From Driver's Control Panel No. 22 Circuit Breaker		
	To Stop Lamp Switch	16	Red
	To DD-3 Brake Stop Lamp Relay Terminal #1	16	Grn.
61	Open		
62	Model PD-4107		
	From Step Lamp Sw. Connector To Step Lamp Line Connector.	16	Or.
	Model PD-4903		
	From Flashing Step Lamp Relay Junction 4 To Step Lamp Line Connector	16	Or.
63	Open		
64	Ground Circuit		Blk.

DRIVER'S CONTROL PANEL AUXILIARY ⧄A⧄.

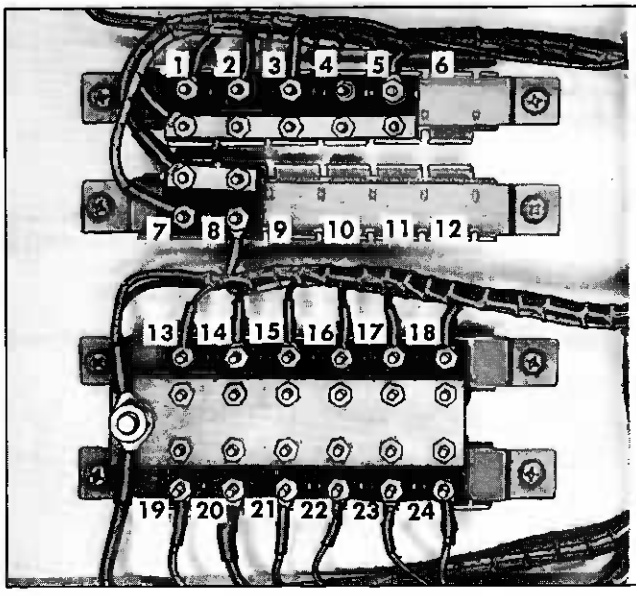
Terminal No.	Circuit	Wire Size	Color Code
A1	From Light Sw. "Dome" To Driver's Lamp Connector	16	Nat.-Red Tr.
A2	Spare - To Defroster Switch		
	Model PD-4107	14	Yell.-Grn. Tr.
	Model PD-4903	16	Yell.-Red Tr.
A3	From Light Switch Terminal No. 2 (PD-4107)	14	Brn.-Grn. Tr.
	From Light Switch Terminal No. 2 (PD-4903)	16	Brn.-Grn. Tr.
	To Shielded Panel Lamp Harness Conn. Model PD-4107	16	Brn.-Blk. Tr.
	Model PD-4903	16	Brn.-Grn. Tr.
A4	Spare - To Engine Compartment Junction 10	16	Brn.
A5	Model PD-4107 - Open		
	Model PD-4903		
	From Wheel Switch "Up" To Intermediate Axle Solenoid Conn.	16	Or.
A6	Open		
A7	Open		
A8	Open		

*Special Equipment.

DRIVER'S CONTROL PANEL CIRCUIT BREAKERS

Circuit breaker panel, located on apparatus panel at left of driver's seat, is accessible after removing the panel cover.

Circuit breakers are automatic reset type, protecting various circuits as indicated in the tabulation which follows. Any condition which causes an overload on a circuit, such as a short, will cause circuit breaker bimetallic element to open



MODEL PD-4107

1. 10-Amp	7. 10-Amp	13. 8-Amp	19. 10-Amp
2. 8-Amp	8. 10-Amp	14. Open	20. 10-Amp
3. 8-Amp	9. Open	15. 10-Amp	21. 8-Amp
4. 20-Amp	10. Open	16. 10-Amp	22. 8-Amp
5. 10-Amp	11. Open	17. 15-Amp	23. 8-Amp
6. Open	12. Open	18. 10-Amp	24. 8-Amp

MODEL PD-4903

1. 8-Amp	7. 8-Amp	13. 5-Amp	19. 5-Amp
2. 5-Amp	8. 8-Amp	14. 10-Amp	20. 8-Amp
3. 5-Amp	9. Open	15. 8-Amp	21. 5-Amp
4. 10-Amp	10. Open	16. 8-Amp	22. 5-Amp
5. 8-Amp	11. Open	17. 10-Amp	23. 5-Amp
6. Open	12. Open	18. 8-Amp	24. 5-Amp

T-5201

Figure 5—Driver's Control Panel Circuit Breakers

circuit; when element cools, circuit breaker will again close circuit. This off and on cycle will repeat until switch controlling defective circuit is turned off, or until cause of overload has been located and corrected. In the event a circuit breaker becomes defective (burns out or sticks closed), the defective circuit breaker must be replaced.

Circuit breaker numbers shown on Wiring Diagrams and in the tabulation which follows do not appear on the circuit breakers or on the panel; to identify circuit breakers, it is necessary to refer to diagram shown in figure 5. Amperage rating of each circuit breaker is also shown in figure 5. Circuit breakers must be installed so the feed or battery wire (or bus bar) connects to the "BAT" or short terminal, and the wire carrying the circuit to the electrical units connects to the "AUX." or long terminal.

The following tabulation lists each circuit breaker number (as identified in figure 5), the circuit it protects, and the size, color, and pattern of the wire (or wires) which connect to the circuit breaker terminals.

DRIVER'S CONTROL PANEL CIRCUIT BREAKERS (MODEL PD4107)

C.B. No.	Circuit	Amps.	Wire Size	Color Code	Fed From
1	To Driver's Control Panel Jct. 38	10	14	Blu.-Nat. Cr. Tr.	Engine Run Magnetic Sw.
2	To Driver's Control Panel Jct. 22	8	14	Grn.	Engine Run Magnetic Sw.
3	To Starter Switch	8	14	Grn.-Red Cr. Tr.	Engine Run Magnetic Sw.
4	To Windshield Wiper Relay	20	14	Grn.-Red Tr.	Engine Run Magnetic Sw.
5	To Step Lamp Switch, Step Lamp Flasher & Relay Junction 2		14	Grn.	Battery
6	Open				
7	To Heating & A/C Switch	10	14	Yell.-Blk. Tr.	Gen. Magnetic Switch
8	To Defroster Switch	10	14	Yell.	Gen. Magnetic Switch
9	Open				
10	Open				
11	Open				
12	Open				
13	To Interior Light Switch	8	16	Nat.-Red Tr.	Battery
14	Open				
15	To Light Switch Terminal No. 5	10	14	Brn.-Red Tr.	Battery
16	To Destination Sign Switch	10	16	Brn.-Blk. Nat. Cr. Tr.	Battery
17	To Directional Flasher	15	16	Red	Battery
18	To Baggage Comp't. Lamp Switch	10	14	Blk.-Red Tr.	Battery
19	To Driver's Fan Switch	10	16	Yell.-Blu. Tr.	Battery
20	To Horn Relay Terminal #1	10	10	Brn.	Battery
21	To Driver's Control Panel Jct. 52	8	16	Nat.-Blk. Cr. Tr.	Battery
22	To Driver's Control Panel Jct. 60	8	16	Red	Battery
23	To Passenger Chime	8	16	Grn.-Red Ch.	Battery
24	To Engine Run Switch	8	14	Red	Battery

DRIVER'S CONTROL PANEL CIRCUIT BREAKERS (MODEL PD4903)

C.B. No.	Circuit	Amps.	Wire Size	Color Code	Fed From
1	*To Driver's Control Panel Jct. 38	8	16	Blu.-Nat. Cr. Tr.	Eng. Run Relay Term. #2
2	To Driver's Control Panel Jct. 22	5	14	Grn.	Eng. Run Relay Term. #2
3	To Starter Switch	5	16	Grn.-Red Tr.	Engine Run Relay
4	To Windshield Wiper Relay	10	14	Grn.-Red Tr.	Engine Run Relay
5	To Step Lamp Sw., Step Lamp Flasher & Step Lamp Relay Terminal #2	8	16	Grn.	Eng. Run Relay Term. #2
6	Open				
7	To Heat and A/C Switch	8	14	Yell.-Blk. Tr.	Heat & A/C Relay Terminal #2
8	To Defroster Sw. & Defroster Hi-Speed Cut-Out Relay Terminal #3	8	16	Yell.	Heat & A/C Relay Terminal #2
9	Open				
10	Open				
11	Open				
12	Open				

*Special Equipment.

(Cont'd.)

DRIVER'S CONTROL PANEL CIRCUIT BREAKERS (CONT'D)

C.B. No.	Circuit	Amps.	Wire Size	Color Code	Fed From
13	To Driver's Fan Switch	5	16	Yell.-Blu. Tr.	Battery
14	To Interior Light Switch	10	16	Nat.-Red Tr.	Battery
15	To Light Switch Terminal #5	8	16	Brn.-Red Tr.	Battery
16	To Destination Sign Switch	8	16	Brn.-Blk. & Nat. Cr. Tr.	Battery
17	To Directional Flasher	10	16	Red	Battery
18	To Regulator Panel Junction 6R	8	16	Blk.-Red Tr.	Battery
19	To Wheel "Up" Switch	5	16	Or.	Battery
20	To Horn Relay Terminal #1	8	14	Brn.	Battery
21	*To Driver's Control Panel Jct. 52	5	16	Nat.-Grn. Tr.	Battery
22	To Driver's Control Panel Jct. 60	5	16	Red	Battery
23	To Passenger Chime	5	16	Grn.-Red Ch.	Battery
24	To Engine Run Switch	5	16	Grn.-2 Blk. // Tr.	Battery

ENGINE COMPARTMENT APPARATUS BOX

Engine compartment apparatus box (fig. 6) is located on the engine compartment bulkhead at upper left side. Access to components is attained by removing three screws securing cover and lifting cover from box.

Components installed in engine compartment apparatus box are identified in figure 6.

Terminal posts on junction panel are numbered from 1 through 38. Numbers on panel correspond to numbers on Wiring Diagrams and in the tabulation which follows. The tabulation lists each terminal number, the circuit it carries, and the size, color, and pattern of the wires which connect to the terminal. Some of the unused terminals, marked "Open" or "Spare" in the tabulation, may be used for special electrical equipment. Terminal post numbers on junction panel appear on Wiring Diagrams in the symbol □.

NOTE: Wires leading from the junction panels into the engine compartment are covered with a special black heat-resistant insulation.

ENGINE COMPARTMENT APPARATUS BOX JUNCTIONS (SYMBOL □)

Terminal No.	Circuit	Wire Size	Color Code
1	Engine Control Circuits:		
	Model PD-4107		
	From Rear Start Switch	14	Grn.-Blk. Cr. Tr.
	To Regulator Sensing Relay Terminal No. 3	14	Grn.-Blk. Cr. Tr.
	To Hot Engine and Low Oil Relay Terminal No. 4	16	Grn.-Blk. Cr. Tr.
	Model PD-4903		
	From Rear Start Switch	16	Grn.-Blk. Cr. Tr.
	To Regulator Sensing Control Relay Terminal No. 3	16	Grn.-Blk. Cr. Tr.
	To Low Oil Relay Terminal No. 4	16	Grn.-Blk. Cr. Tr.
	To Hot Engine Relay Terminal No. 4	16	Grn.-Blk. Cr. Tr.
	*To Engine Stop Relay Terminal No. 3	16	Grn.-Blk. Cr. Tr.
2	From Driver's Control Panel Junction 2 To Emerg. Stop Magnetic Switch	16	Grn.-Red Ch.
3	From Driver's Control Panel Jct. 3 To Reverse Solenoid Magnetic Switch - Model PD-4107	14	Blk.-2 Red // Tr.
	Model PD-4903	16	Blk.-2 Red // Tr.
4	From Driver's Control Panel Jct. 4 to Hot Engine and Low Oil Relay Terminal No. 2	16	Grn.-Blk. Tr.
	*To Engine Stop Relay Terminal No. 4 (PD-4903)	16	Grn.-Blk. Tr.
5	Engine Alarm:		
	From Driver's Control Panel Junction 5	16	Grn.-Nat. Cr. Tr.
	To Engine Oil Pressure Sending Unit	16	Blk.
6	Model PD-4107		
	From Driver's Control Panel Jct. 6 To Rear Marker Lamps	14	Brn.-Blk. Tr.
	To Engine Compartment 6-Cavity Connector	16	Brn.
	Model PD-4903		
	From Driver's Control Panel Jct. 6 To Rear Marker Lamps and Lavatory Lamp Connectors	16	Brn.-Blk. Tr.
	To Tail, License, and Back-up Lamp Connector	16	Brn.

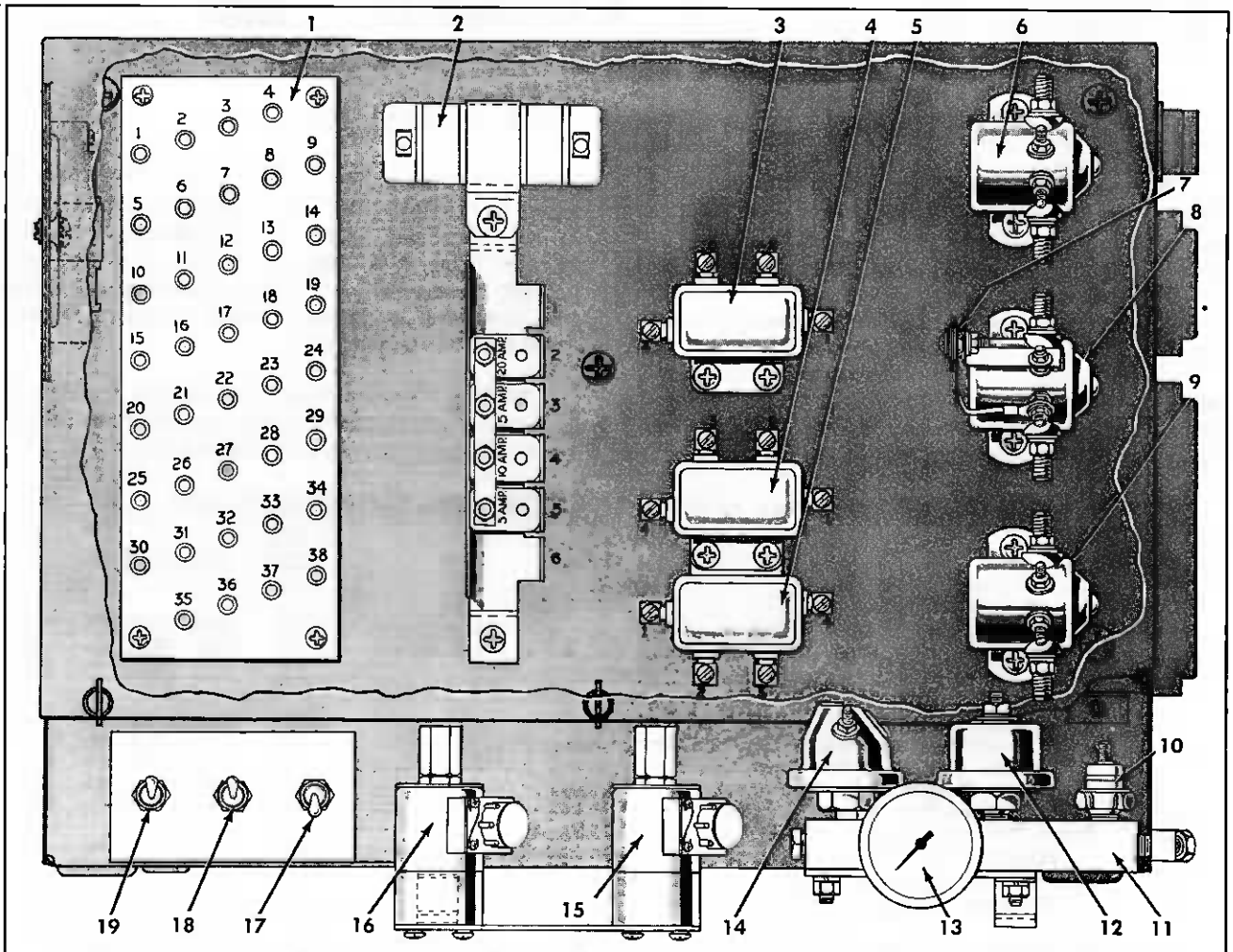
(Cont'd.)

ENGINE COMPARTMENT APPARATUS BOX JUNCTIONS (SYMBOL □) (CONT'D)

Terminal No.	Circuit	Wire Size	Color Code
7	From Driver's Control Panel Junction 7	16	Blk.-Nat. Tr.
	To Engine Harness Connector Contact #10	16	Blk.
8	*From Lavatory Door Switch To Lavatory Lamp Socket	16	Or.
9	*Fire Detector Circuit		
	Model PD-4107		
	From Driver's Control Panel Junction 9	16	Grn.-2 Red // Tr.
	To Engine Harness Connector Contact #11	16	Blk.
	Model PD-4903		
	From Driver's Control Panel Junction 9	18	Grn.-2 Red // Tr.
	To Engine Harness Connector Contact #11	18	Blk.
10	Spare - From Driver's Control Panel Auxiliary Junction 44	16	Brn.

*Special Equipment.

(Cont'd.)



1 Junction Panel (38 Terminals)
2 Circuit Breaker Carrier
3 Automatic Engine Stop Relay (Special Equipment)
4 Engine Low Oil Relay
5 Hot Engine Relay
6 Reverse Magnetic Switch
7 Rectifier
8 Starter Magnetic Switch
9 Emergency Stop Magnetic Switch
10 Oil Pressure Switch
11 Oil Pressure Manifold Assembly
12 Oil Pressure Switch (Air Conditioning)
13 Oil Pressure Gauge
14 Oil Pressure Sending Unit
15 Engine Stop Solenoid
16 Engine Fast Idle Solenoid
17 Engine Compartment Lamp Switch
18 Engine Rear Start Switch
19 Engine Control Switch T-5202

Figure 6—Engine Compartment Apparatus Panel (Typical)

ENGINE COMPARTMENT APPARATUS BOX JUNCTIONS (SYMBOL □) (CONT'D)

Terminal No.	Circuit	Wire Size	Color Code
11	Stop Lamp Circuit:		
	From Driver's Control Panel Junction 11	16	Red-2 Nat. // Tr.
	To Engine Closure Door Amphenol Connector	16	Red
12	Open		
13	From Driver's Control Panel Junction 13	16	Blk.-Red Tr.
	To Transmission Low Oil Switch Resistor	16	Blk.
	To Engine Harness Connector Contact 5	16	Blk.
14	From Driver's Control Panel Junction 14	16	Grn.-2 Blk. // Tr.
	To Engine Harness Connector Contact 6	16	Blk.
	To Hot Engine Magnetic Switch or Relay Terminal No. 3	16	Grn.-2 Blk. // Tr.
15	From Driver's Control Panel Junction 15	16	Grn.-Blk. Cr. Tr.
	To Engine Harness Connector Contact 7	16	Blk.
16	From Engine Harness Connector Contact 13	16	Blk.
	To Engine Compartment 6-Cavity Connector	16	Blk.
17	Speedometer Circuit:		
	From Driver's Control Panel Junction 17	16	Blk.-2 Nat. // Tr.
	To Engine Harness Connector Contact 9	16	Blk.
18	Open		
19	From Driver's Control Panel Jct. 19 To Rear Start Switch		
	Model PD-4107	14	Grn.-2 Brn. // Tr.
	Model PD-4903	16	Grn.-Blk. Tr.
20	Spare - To Driver's Control Panel Junction 20	16	Or.-2 Blk. // Tr.
21	From Driver's Control Panel Junction 21	16	Red-2 Grn. // Tr.
	To Engine Compartment 6-Cavity Connector	16	Dk. Grn.
22	From Driver's Control Panel Jct. 22 - Model PD-4107	14	Grn.
	Model PD-4903	16	Grn.
	To Engine Compartment Apparatus Box No. 5 Circuit Breaker		
	Model PD-4107	14	Grn.
	Model PD-4903	16	Grn.
	To Engine Control Switch	16	Grn.
	*To Engine Stop Relay Terminal No. 1 (PD-4903)	14	Grn.
23	*From Driver's Control Panel Jct. 23 & Engine Stop Relay Term. #2	14	Grn.-Red Tr.
	To Engine Control Switch	16	Grn.
24	From Driver's Control Panel Jct. 24 & Low Oil Relay Term. #3	16	Grn.-2 Nat. // Tr.
	To Low Oil Pressure Switch	16	Blk.
	To Engine Low Oil Pressure Switch Resistor	16	Grn.-2 Nat. // Tr.
25	From Driver's Control Panel Junction 25	16	Grn.-Nat. Tr.
	To Fast Idle Solenoid Valve (N.C.)	16	Blk.
26	Open		
27	*Speedometer Circuit From Driver's Control Panel Junction 27	16	Blk.-Grn. Tr.
28	From Engine Comp't. No. 4 Circuit Breaker To Water Pump Sw.	16	Yell.
29	Model PD-4107		
	From Driver's Control Panel Jct. 29 to Rear Start Switch	14	Grn.-Brn. Cr. Tr.
	Model PD-4903		
	From Driver's Control Panel Junction 29 To Rear Start Switch and Engine and Trans. Low Oil Pressure Switch Resistor	16	Grn.-Brn. Cr. Tr.
30	Spare - From Driver's Control Panel Junction 30	16	Blk.-Red Cr. Tr.
31	L.H. Rear Directional Lamp Circuit:		
	From Driver's Control Panel Junction 31	16	Red-Grn. Cr. Tr.
	To Engine Compartment Door Connector	16	Yell.
32	Engine Compartment Lamp Circuit:		
	From Engine Compartment Lamp Switch	16	Brn.
	To Engine Compartment Lamps	16	Blk.
33	Water Pump Circuit:		
	Model PD-4107		
	From Water Pump Switch To Battery Comp't. Junction 2R	16	Yell.-Red Tr.
	Model PD-4903		
	From Water Pump Switch To Regulator Panel Junction 2R	16	Yell.-Red Tr.
34	Model PD-4107		
	Spare - To Battery Compartment Connector	14	Blk.-Brn. Cr. Tr.
	Model PD-4903		
	Spare - To Regulator Panel Junction	16	Blk.-Red. Cr. Tr.
35	Ground Circuits		Blk.
36	Open		

*Special Equipment.

(Cont'd.)

ENGINE COMPARTMENT APPARATUS BOX JUNCTIONS (SYMBOL ☐) (CONT'D)

Terminal No.	Circuit	Wire Size	Color Code
37	*Speedometer Circuit:		
	From Driver's Control Panel Junction 37	16	Blk.-2 Grn. // Tr.
38	Model PD-4107		
	From A/C Clutch Solenoid Valve	14	Yell.-Blk. Tr.
	To A/C Oil Pressure Switch	14	Blk.
	Model PD-4903		
	From A/C Clutch Relay Terminal No. 2	16	Yell.-Blk. Tr.
	To A/C Oil Pressure Switch (N.C.)	16	Blk.

*Special Equipment.

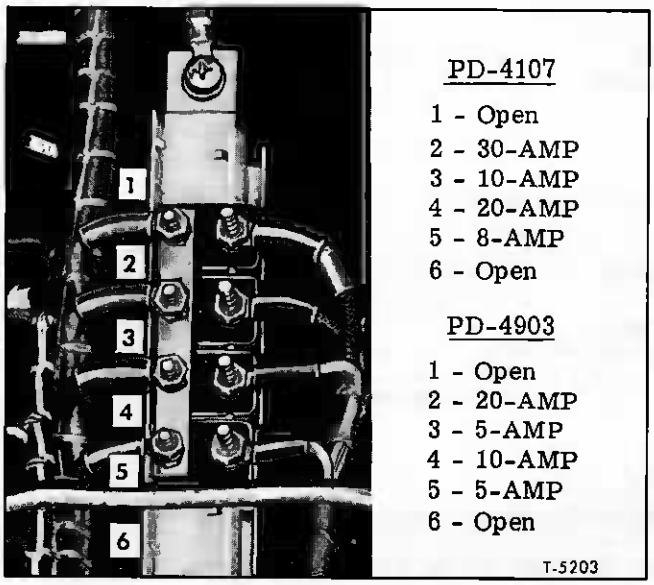


Figure 7—Engine Compartment Apparatus Box Circuit Breakers

ENGINE COMPARTMENT APPARATUS BOX CIRCUIT BREAKERS

Circuit breaker carrier (fig. 7) has space for six automatic-reset type circuit breakers. On coaches with standard electrical equipment, four circuit breakers are used. The remaining circuit breakers are provided for use with special electrical equipment. Operation of circuit breakers is described previously under "Driver's Control Panel Circuit Breakers."

Circuit breaker numbers shown on Wiring Diagrams and in the tabulation which follows do not appear on the circuit breakers or on the panel. To identify the circuit breakers refer to figure 7.

When replacing circuit breakers, make sure the proper amperage rating circuit breaker is used. Make sure all terminal junctions are clean and tight.

Breaker No.	Circuit	Wire Size	Color Code	Fed From
1	Open			
2	To Transmission Reverse Solenoid Magnetic Switch			
	Model PD-4107	10	Blk.-Grn. Tr.	Battery
	Model PD-4903	14	Blk.-Grn. Tr.	Battery
3	To Engine Compartment Lamp Switch	16	Brn.	Battery
4	To Water Pump Switch	16	Yell.	Battery
5	To Engine Compartment Connector Contact No. 12	16	Lt. Grn.	Engine Run Magnetic Switch
6	Open			

BATTERY COMPARTMENT APPARATUS BOX (MODEL PD4107)

Battery compartment apparatus box (fig. 8) is located in left rear baggage compartment above the battery compartment. Access to components is attained by removing shield mounted on top of battery compartment. Components installed in the battery compartment apparatus box are identified in figure 8.

BATTERY COMPARTMENT APPARATUS BOX JUNCTION BLOCKS (PD4107)

Two junction blocks in battery compartment apparatus box are each numbered from 1 through 6. Junction terminal numbers shown on Wiring

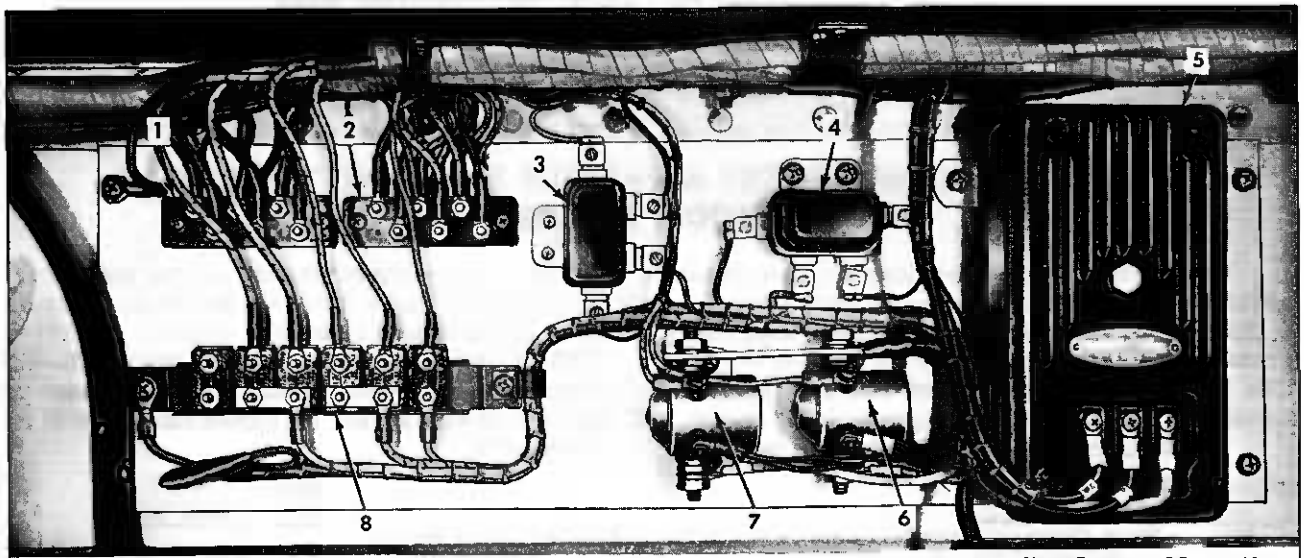
Diagrams and in tabulation appear on the junction blocks. The letters "L" and "R" used with the terminal numbers identify the left and right junction block.

The tabulation which follows lists each terminal number, the circuit it carries, and the size, color, and pattern of the wires which connect to the terminal. A similar tabulation printed on a card is attached to a wiring harness in the battery compartment. Some of the unused terminals, marked "open" or "spare" in the tabulation, may be used for special electrical equipment. Terminal post numbers on junction blocks appear on Wiring Diagram in the symbol

BATTERY COMPARTMENT APPARATUS BOX JUNCTION BLOCKS (SYMBOL ◇)

Terminal No.	Circuit	Wire Size	Color Code
1L	*From Lavatory Switch to Engine Compartment Apparatus Box Junction 8	16	Or.
2L	*From Driver's Control Panel Junction 39 to Lavatory Emergency Switch	16	Blu.-Nat. Tr.
3L	*From Driver's Control Panel Junction 38 to Lavatory Switch	14	Blu.-Nat. Cr. Tr.
4L	*From Lavatory Switch	14	Blu.
	To Lavatory Vent Fan	14	Blk.
5L	From Driver's Control Panel Junction 6	14	Brn.-Blk. Tr.
	To Rear Nite Lamp	16	Blk.-Red Tr.
6L	From Driver's Control Panel Junction 46 to Air Conditioning Cut-out Relay Terminal No. 1	16	Yell.-Blk. Cr. Tr.
1R	*Rear Wheel Sander Circuit:		
	*From Driver's Control Panel Junction 54	10	Red-Grn. Tr.
	*To Rear Wheel Sanders	10	Nat.
2R	From Engine Compartment Junction 33 To Water Pump Relay Terminal No. 3	16	Yell.-Red Tr.
3R	From Driver's Control Panel Junction 45 to Air Conditioning Hi-Lo Pressure Switch Terminal L2	14	Yell.-2 Red // Tr.
4R	From Driver's Control Panel Junction 51	16	Nat.-Blk. Cr. Tr.
	To Seat Lamps	16	Blk.-Gr. Tr.
5R	*Spare - (To Ventilation and A/C Compressor & Control Comp't.)	14	Yell.-Grn. Tr.
6R	Spare - (To Ventilation Compartment Junction 3)	16	Blk.-Brn. Tr.
	(To Engine Compartment Apparatus Box Junction 34)	14	Blk.-Brn. Cr. Tr.

*Special Equipment.



1 Left Junction Block
2 Right Junction Block
3 Regulator Relay
4 Generator Relay
5 Voltage Regulator Assembly
6 General Lighting Magnetic Switch
7 Reading Lamps Magnetic Switch
8 Circuit Breakers

T-5204

Figure 8—Regulator and Apparatus Panel (Model PD4107)

BATTERY COMPARTMENT APPARATUS BOX CIRCUIT BREAKERS (MODEL PD4107)

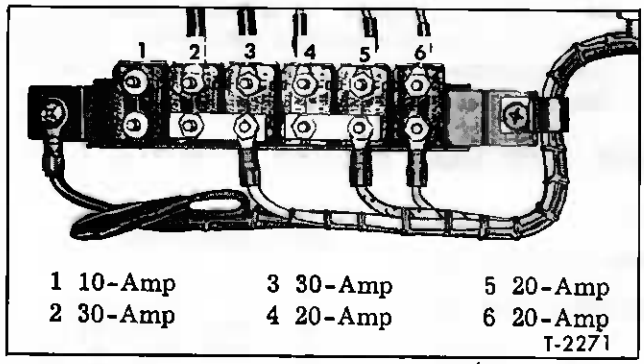


Figure 9—Battery Compartment Circuit Breakers (Model PD4107)

Circuit breakers are accessible after removing shield mounted on top of battery compartment. Operation of circuit breakers is described previously under "Driver's Control Panel Circuit Breakers."

Circuit breaker numbers shown on Wiring Diagrams and in the tabulation which follows do not appear on the circuit breakers or on the panel; to identify circuit breakers, it is necessary to refer to diagram shown in figure 9.

The following tabulation lists each circuit breaker number (as identified in figure 9), the circuit it protects, and the size, color, and pattern of the wire (or wires) which connect to the circuit breaker terminals.

Breaker No.	Circuit	Wire Size	Color Code	Fed From
1	To Lavatory Emergency Switch	14	Blu.-Red Tr.	Battery
	From Reading Lamp Magnetic Switch	14	Red	
2	To L.H. Reading Lamps and Switches	10	Nat.-Red Tr.	Reading Lamp
	From Reading Lamp Magnetic Switch	10	Nat.	Magnetic Switch
3	To R.H. Reading Lamps and Switches	10	Nat.-Red Tr.	Reading Lamp
	From Reading Lamp Magnetic Switch	10	Nat.	Magnetic Switch
4	To L.H. General Lamps	14	Nat.-Blk. Tr.	General Lamp
	From General Lamp Magnetic Switch	10	Nat.-Grn. Cr. Tr.	Magnetic Switch
5	To R.H. General Lamps	14	Nat.-Blk. Tr.	General Lamp
	From General Lamp Magnetic Switch			Magnetic Switch
6	To Driver's Control Panel Junction 42	14	Gray	Generator
	From Generator Relay Terminal No. 2			Relay

REGULATOR COMPARTMENT APPARATUS BOX (MODEL PD4903)

Regulator compartment apparatus box (fig. 10) is located in right front baggage compartment. Access to components is attained by removing shield mounted on side of baggage compartment. Components installed in regulator compartment apparatus box are identified in figure 10.

REGULATOR COMPARTMENT APPARATUS BOX JUNCTION BLOCKS (MODEL PD4903)

Two junction blocks in regulator compartment apparatus box are each numbered from 1 through 6. Junction terminal numbers shown on Wiring Diagrams and in tabulation appear on junction blocks. The letters "L" and "R" used with the terminal numbers identify left and right junction blocks.

The following tabulation lists each terminal number, the circuit it carries, and the size, color, and pattern of wires which connect to the terminal. Some of the unused terminals, marked "OPEN" or "SPARE" in the tabulation, may be used for special electrical equipment. Terminal post numbers on junction blocks appear on Wiring Diagrams in the symbol ◯.

Terminal No.	Circuit	Wire Size	Color Code
1L	From Driver's Control Panel Junction 34 to Reading Lamp Relay Terminal No. 3	16	Nat.-2 Blk. // Tr.
2L	*From Emergency Sw. (Lavatory) To Driver's Control Panel Jct. 39	16	Blu.-Nat. Tr.
3L	*From Lavatory Door Switch To Driver's Control Panel Junction 38	16	Blu.-Nat. Cr. Tr.
4L	From Driver's Control Panel Junction 35 To General Lamp Relay Terminal 3	16	Nat.-Blk. Tr.
5L	From Driver's Control Panel Junction 6 To Longitudinal Air Duct Junction 3L and 3R	16	Brn.-Blk. Tr.

*Special Equipment.

(Cont'd.)

REG. COMPARTMENT APPARATUS BOX JUNCT. BLOCKS (SYMBOL ◇) (PD4903)

Terminal No.	Circuit	Wire Size	Color Code
6L	From Hi-Lo Pressure Switch Terminal M1 To Driver's Control Panel Junction 46	16	Yell.-Blk. Cr. Tr.
1R	*Rear Wheel Sander Circuit:		
	From Driver's Control Panel Junction 54	12	Red-Grn. Tr.
	To Rear Wheel Sanders	12	Nat.
2R	From Blower Motor and Apparatus Panel Circuit Breaker To Engine Compartment Junction 33	16	Yell.-Red Tr.
3R	From Driver's Control Panel 45 To Air Conditioning Hi-Lo Pressure Switch Terminal L2	16	Yell.-Grn. Tr.
4R	*From Driver's Control Panel Junction 51 To Seat Lamps	16	Nat.-Blk. Cr. Tr.
5R	From Baggage Compartment Lamps and Switches To Freon Tank Lamp Line Connector	16	Blk.-Brn. Tr. (P & C)
6R	From Driver's Control Panel No. 18 Circuit Breaker	16	Blk.-Red Tr.
	To Baggage Compartment Lamp Switch	16	Blk.-Grn. Tr.

*Special Equipment

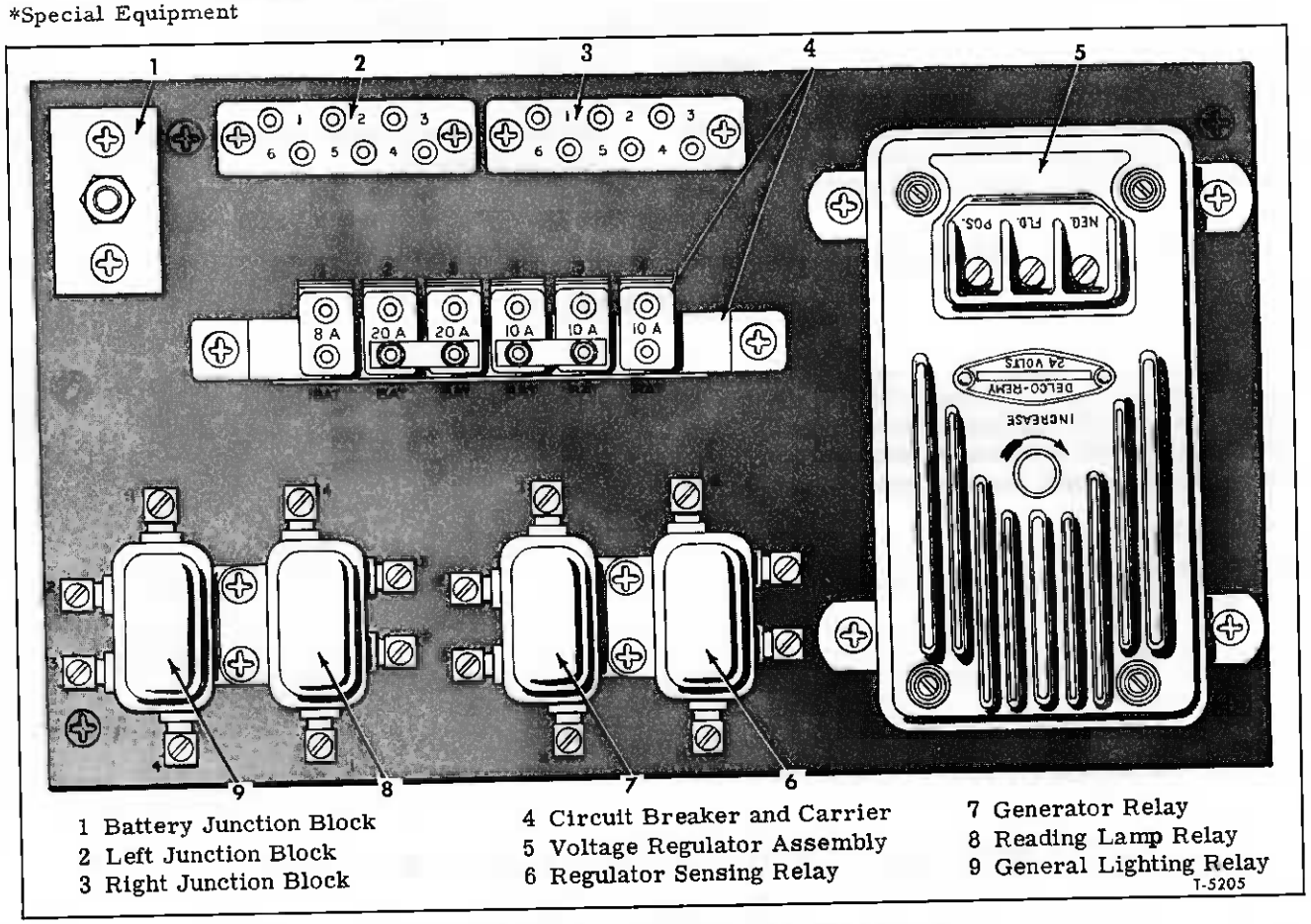


Figure 10—Regulator and Apparatus Panel (Model PD4903)

REGULATOR AND APPARATUS PANEL CIRCUIT BREAKERS (MODEL PD4903)

Circuit breakers are accessible after removing shield mounted on right side of right front baggage compartment. Operation of circuit breakers is described previously under "Driver's Control Panel Circuit Breakers."

Circuit breaker numbers shown on Wiring Diagrams and in the tabulation which follows do not appear on the circuit breakers or on the panel: To identify circuit breakers, refer to figure 10.

The following tabulation lists each circuit breaker number (as identified in fig. 10), the circuit it protects, and the size, color, and pattern of the wire (or wires) which connect to the circuit breaker terminal.

Breaker No.	Circuit	Wire Size	Color Code	Fed From
1	*To Lavatory Door Switch and Emergency Switch	16	Blu.-Blk. Tr.	Battery
2	To Longitudinal Air Duct Terminal 1L	14	Nat.-Red Tr.	Reading Lamp Relay
	From Reading Lamp Relay Terminal No. 2	10	Nat.	
3	To Longitudinal Air Duct Terminal 1R	14	Nat.-Red Tr.	Reading Lamp Relay
	From Reading Lamp Relay Terminal 2	10	Nat.	
4	To Longitudinal Air Duct Terminal 2L	16	Nat.-Blk. Tr.	General Lamp Relay
	From General Lamp Relay			
5	To Longitudinal Air Duct Terminal 2R	16	Nat.-Blk. Tr.	General Lamp Relay
	From General Lamp Relay			
6	To Driver's Control Panel Junction 42	16	Gray	Generator Relay
	From Generator Relay Terminal No. 2			

*Special Equipment.

VENTILATION COMPARTMENT APPARATUS PANEL (MODEL PD4107)

Ventilation compartment apparatus panel is located in ventilation compartment on lower right-hand air duct plate assembly. Components of the ventilation compartment apparatus panel are identified in figure 11.

VENTILATION COMPARTMENT JUNCTION PANEL (MODEL PD4107)

Ventilation compartment junction block contains terminal posts numbered from 1 through 6. Numbers on block correspond to numbers on Wiring Diagrams and in tabulation which follows: The tabulation lists each terminal number, the circuit it carries, and the size, color, and pattern of the wires which connect to the terminals. Terminal post numbers on junction block appear on Wiring Diagrams in the symbol ◇.

Terminal No.	Circuit	Wire Size	Color Code
1	Spare - (To Driver's Control Panel Junction 56)	16	Blk.-Nat. Cr. Tr.
2	*Fuel Gauge Circuit:		
	Spare - (To Driver's Control Panel Junction 55)	16	Or.-Grn. Tr.
3	Spare - (To Battery Compartment Junction 3)	16	Blk.-Brn. Tr.
4	To Driver's Control Panel Jct. 44 & Blower Motors Magnetic Sw.	14	Yell.
5	Open		
6	From Water Pump to Ground	14	Blk.

*Special Equipment.

VENTILATION COMPARTMENT CIRCUIT BREAKERS (MODEL PD4107)

Operation of circuit breakers is described previously under "Driver's Control Panel Circuit Breakers."

The following tabulation lists each circuit breaker (as identified in figure 11), amperage rating, the circuit it protects, and the size, color, and pattern of the wire (or wires) which connect to each circuit breaker terminal:

Breaker No.	Circuit	Wire Size	Color Code	Fed From
90 Amp.	To Bus Bar in Driver's Control Panel	1	Red	Battery
135 Amp.	To Blower Motors Magnetic Switch	2	Red	Battery
20 Amp.	From Battery Compartment Junction 2R	16	Yell.-Red Tr.	
	To Water Pump		Red	
	To Electronic Heat Unit	10	Yell.-Blk. Tr.	

LONGITUDINAL AIR DUCT JUNCTION BLOCKS (MODEL PD4903)

Two junction blocks contain terminal posts numbered from 1 through 6. Numbers on each junction block correspond to numbers on Wiring Diagrams and in the tabulation which follows. The letters "L" and "R" used with the terminal number identify left and right junction blocks.

The following tabulation lists each terminal number, the circuit it carries, and the size, color, and pattern of wires which connect to the terminal. Terminal post numbers on junction blocks appear on Wiring Diagrams in the symbol ⬡ .

Terminal No.	Circuit	Wire Size	Color Code
1L	From Regulator and Apparatus Panel No. 2 Circuit Breaker To Left Side Reading Lamps	14	Nat.-Red Tr.
2L	From Regulator and Apparatus Panel No. 4 Circuit Breaker To General Lamps	16	Nat.-Blk. Tr.
3L	From Regulator and Apparatus Panel Junction 5L Left Center Marker Lamp	16	Brn.-Blk. Tr.
4L	From Left Side Reading Lamps To Ground	14	Blk.
5L	From Regulator and Apparatus Panel Jct. 4L To Seat Lamps	16	Nat.-Blk. Cr. Tr.
6L	From Regulator and Apparatus Panel Junction 1L To Rear Wheel Sander	16	Nat.
1R	From Regulator and Apparatus Panel No. 3 Circuit Breaker To Right Side Reading Lamps	14	Nat.-Red Tr.
2R	From Regulator and Apparatus Panel No. 5 Circuit Breaker To General Lamps	16	Nat.-Blk. Tr.
3R	From Regulator and Apparatus Panel Junction 5L To Right Center Marker Lamp	16	Brn.-Blk. Tr.
4R	From Right Side Reading Lamps To Ground	14	Blk.
5R	From Regulator & Apparatus Panel Jct. 4R To Seat Lamps	16	Nat.-Blk. Cr. Tr.
6R	From Regulator and Apparatus Panel Junction 1R To Rear Wheel Sander	16	Nat.

AMPHENOL CONNECTORS

Wiring harness connections are made at several points on vehicle through Amphenol multiple plug and receptacle type connectors. Terminals in receptacle and on plug are identified by numbers. Locating key in receptacle housing engages a slot in plug to assure proper installation of plug. Numbers on plugs and receptacles correspond to numbers shown on Wiring Diagrams and in the tabulations which follow. Location of each Amphenol connector, together with the symbols and circuit tabulations, follows:

ENGINE AMPHENOL CONNECTOR

Electrical connections between the terminals, circuit breakers and electrical units in engine compartment apparatus box and the engine wiring harness are made through receptacle at right side of engine compartment apparatus box. Refer to symbol ▢ on Wiring Diagrams.

Terminal No.	Circuit	Wire Size PD-4107	Wire Size PD-4903	Color Code
1	From Engine Compartment No. 4 Circuit Breaker To Starter Solenoid	10	12	Blk.
2	From Transmission Reverse Solenoid Magnetic Switch	10		Blk.-Grn. Tr.
	To Reverse Solenoid	10	14	Blk.
3	From Emerg. Stop Magnetic Switch To Emerg. Stop Solenoid	10	12	Blk.
4	From Starter Magnetic Switch To Starter Solenoid	10	12	Blk.
5	From Engine Compartment Apparatus Box Junction 13 To Transmission Oil Pressure Switch	16	16	Blk.
6	From Engine Comp't. Apparatus Box Jct. 14 To Hot Engine Sw.	16	16	Blk.
7	From Engine Compartment Apparatus Box Junction 15 To Engine Temperature Sending Unit	16	16	Blk.

(Cont'd.)

Terminal No.	Circuit	Wire Size PD-4107	Wire Size PD-4903	Color Code
8	From Starter Magnetic Switch To Fuel Pressure Switch	14	16	Blk.
9	From Engine Comp't. Apparatus Box Junction 17 To Speedometer Sending Unit	16	16	Blk.
10	From Engine Compartment Apparatus Box Junction 7 To Speedometer Sending Unit	16	16	Blk.
11	*Fire Detector Circuit: From Engine Comp't. Apparatus Box Jct. 9 To Fire Detectors	16	18	Blk.
12	From Engine Compartment Apparatus Box No. 5 Circuit Breaker To Back-Up Lamp Switch	16	16	Blk.
13	From Back-Up Lamp Switch To Engine Compartment Box Junction 16	16	16	Blk.
14	Open			

*Special Equipment.

ENGINE CLOSURE DOOR AMPHENOL CONNECTOR

Engine compartment closure door wiring harness, carrying circuits to lights on door, is connected to amphenol connector on rear body wiring harness assembly. Refer to symbol ▽ on Wiring Diagram.

Circuit	Wire Size	Color Code
From Engine Compartment Door Connector To Stop Lamps	16	Red
From Engine Compartment Junction 6 To Tail and License Lamps	16	Brn.
From Engine Compartment Junction 16 To Back-Up Lamps		
Model PD-4107	16	Lt. Grn.
Model PD-4903	16	Blk.
From Engine Compartment Junction 21 To R.H. Rear Directional Lamps	16	Dk. Grn.
From Engine Compartment Junction 31 To L.H. Rear Directional Lamps	16	Yell.
Open		

BATTERY JUNCTIONS

Battery junctions are located in several places on the vehicle. Battery cables, carrying current to various parts of the vehicle for operation of electrical systems and units, are connected at these junctions. Connections must be kept clean and tight. If corroded, move battery disconnect switch, located in battery compartment, to "OFF" position; then disconnect cables and thoroughly clean cable ends and junction studs. Connect cables to junction studs, tighten stud nuts firmly, and move battery disconnect switch to "ON" position. Location of battery cable junctions are as follows:

MODEL PD-4107

1. Battery compartment junction (fig. 8), located on wall of rear baggage compartment above battery compartment, is accessible after removing guard mounted on top of battery compartment.

2. Engine compartment apparatus box (fig. 6) battery junction, located approximately in center of the upper engine compartment bulkhead, is accessible through the engine compartment doors.

3. The ventilation compartment apparatus box battery junction, located on lower right-hand air duct plate assembly, is accessible through the evaporator compartment door.

4. Driver's control panel battery junction, located at the bottom of junction panel at left of driver (fig. 3), is accessible after the junction panel cover is removed.

MODEL PD-4903

1. Battery junction (fig. 10), located on regulator and apparatus panel in right front baggage compartment, is accessible after removing cover from regulator and apparatus panel.

2. Battery compartment junction block, mounted on right front intermediate bulkhead, is accessible from inside battery compartment.

3. Driver's control panel battery junction located on junction panel at left of driver (fig. 4) is accessible after junction panel cover is removed.

4. Engine compartment apparatus box battery junction, located approximately in center of upper engine compartment bulkhead (fig. 6) is accessible through engine compartment door.

TELL-TALE ALARM SYSTEM

Tell-tale lights are located on gauge and tell-tale panel in front of driver. Tell-tale identification, shown in figure 1, is visible only when the bulb behind the lettering is illuminated. Following is a list of all tell-tale lights with a brief description of their purpose and a reference to the Wiring Diagram on which the circuit is shown.

1. "HOT ENG." Tell-tale, interconnected with the alarm buzzer, indicates that the temperature of the engine is too high for safe operation. Engine should be stopped immediately and the overheated condition corrected. Circuit is shown on "Alarm and Signal Wiring Diagram." Refer to "NOTE" following step 2 below.

2. "LOW OIL." This tell-tale, interconnected with the alarm buzzer, indicates that the engine lubricating oil pressure is below 3 psi. If tell-tale illuminates and buzzer sounds during operation, stop engine immediately and correct the cause of low oil pressure. Electrical circuit is shown on "Alarm and Signal Wiring Diagram." Refer to "NOTE" below:

NOTE: On vehicles equipped with special automatic engine shut-off system, the "HOT ENG." and "LOW OIL" tell-tale circuits are interconnected with a safety control relay which automatically shuts off the engine when either one of these abnormal conditions occur.

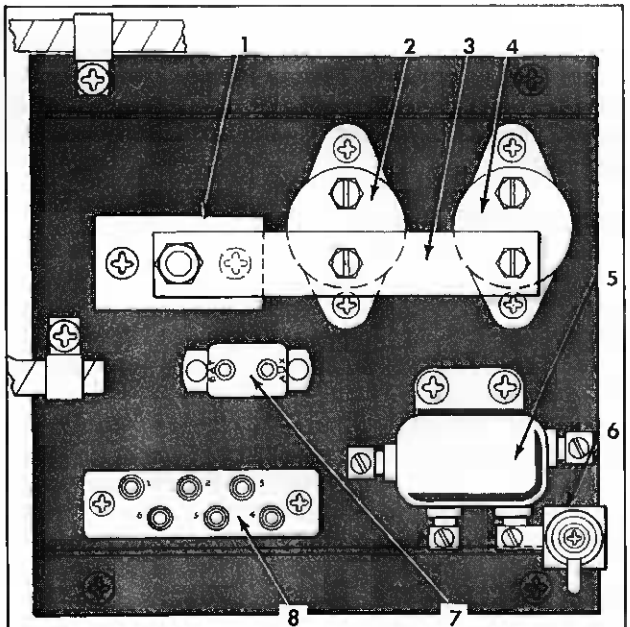
This condition can be overruled by pressing "Over-Rule" switch located on instrument panel. Operation of Automatic Engine Stop System is described later in this section.

3. "LOW AIR." This tell-tale, interconnected with the alarm buzzer, indicates that air pressure is below 55-60 psi. This pressure will not efficiently operate brakes and air suspension system. If tell-tale illuminates and buzzer sounds during operation, stop the vehicle as soon as possible and correct the cause of low air pressure before proceeding. Refer to "Alarm and Signal Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

4. "TRANS. OIL." This tell-tale indicates low oil pressure in the transmission. Electrical circuits and connections are shown on "Transmission Wiring Diagram" in "Wiring Diagrams" booklet X6814A.

5. "A.C. STOP." This tell-tale will illuminate when the refrigerant "Hi-Lo" pressure switch contacts are open, indicating that the compressor drive clutch is disengaged. Refer to "Heating and Air Conditioning Wiring Diagram" in X-6814A.

6. "STOP LAMP." This tell-tale illuminates when brakes are applied to indicate normal functioning of stop lights. If tell-tale does not illuminate when brakes are applied, it is an indication that one or both stop light bulbs are burned out. Refer to "Alarm and Signal Wiring Diagram."



1 Battery Junction Block
2 Circuit Breaker (90 Amp.)
3 Bus Bar
4 Circuit Breaker (135 Amp.)
5 Water Pump Relay
6 Rectifier
7 Circuit Breaker (20 Amp.)
8 Terminal Junction Block (1 thru 6)

T-5206

Figure 11—Ventilation Compartment Apparatus Panel (Model PD4107)

7. "HI-BEAM." This tell-tale illuminates when headlight high beam is being used.

8. "DIRECT SIG." These tell-tale lamps, located at each end of "tell-tale" lamp cluster, flash on and off when directional signals are being used to indicate normal functioning of signals. Failure of either tell-tale lamp indicates a burned out directional signal lamp or defective flasher unit. Electrical circuits are shown on "Stop and Directional Light Wiring Diagram" in booklet X-6814A.

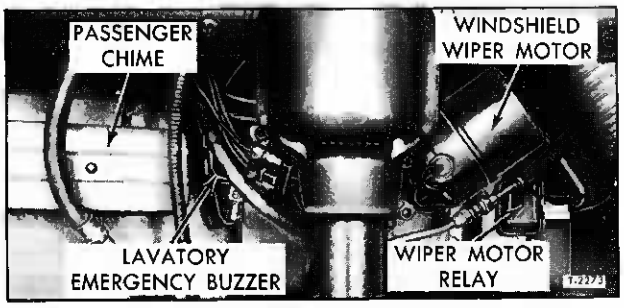


Figure 12—Windshield Wiper Motor, Lavatory Emergency Buzzer, and Chime Unit Installed (Typical)

ALARM BUZZER ASSEMBLIES (1115818 AND 1116882)

NOTE: The 1116882 buzzer is used on PD-4107 coach models equipped with the 12-volt electrical system and the 1115818 buzzer is used on PD-4903 coach models equipped with the 24-volt electrical system.

HOT ENGINE, LOW OIL, AND LOW AIR ALARM BUZZERS

Alarm buzzer assemblies are mounted in driver's control panel junction box at left of driver (figs. 3 and 4). Tell-tale lamps for "HOT ENG." and "LOW OIL" are interconnected with alarm buzzer, and tell-tale lamp for "LOW AIR" is interconnected with alarm buzzer. Circuits can be checked for continuity, referring to "Alarm and Signal Wiring Diagram." The "Engine" switch must be in "RUN" position to energize the circuits. When checking circuits, sending unit switches must be grounded. If buzzer is found to be defective, replace unit.

LAVATORY EMERGENCY ALARM BUZZER

Alarm buzzer is mounted under left side of instrument panel (fig. 12). Buzzer is operated by a push button type switch, marked "TO SIGNAL DRIVER - EMERGENCY ONLY," located on transverse partition of lavatory compartment. Refer to "Lavatory Wiring Diagram" in booklet X-6814A for wiring connections and circuits. When checking circuit for continuity, the "ENGINE" switch must be in the "RUN" position to energize system and switch in lavatory compartment must be grounded. If buzzer is found to be defective, replace unit.

ALARM AND SIGNAL SWITCHES

Low oil pressure switch, engine overheat thermostat, transmission oil, air conditioning stop and low air pressure switch are covered in other sections of this manual as previously indicated under "Index of Electrical Units."

STOP LIGHT, DIRECTIONAL SIGNAL AND HEADLIGHT DIMMER SWITCHES

Tell-tale lamps for stop lights, directional signals and headlight high beams are connected directly to switches which control individual circuits. Refer to "LIGHTING SYSTEM" later in this section for maintenance and location of switches.

ENGINE AUTOMATIC SHUT-OFF SYSTEM

The air-operated injector shut-off system stops the engine when "ENGINE" switch is in "STOP" position. Operation and maintenance of this system is covered in "DIESEL ENGINE" (SEC. 8) of this manual.

On some coaches, an automatic engine shut-off relay system is used in conjunction with the air-operated injector shut-off system. This system is used in conjunction with the low oil pressure and hot engine tell-tale alarm system and the air-operated injector shut-off system to automatically stop the engine when a low oil pressure or hot engine condition occurs. Low oil and hot engine tell-tale circuits are mounted in the Driver's Control Panel (figs. 3 and 4). Hot engine, low oil, and engine stop relays are mounted in Engine Compartment Junction Panel (fig. 6). These units are connected into electrical system as shown on "Engine Control and Generator" and "Alarm and Signal" wiring diagrams.

The engine stop relay, with points normally closed, is fed from the engine run magnetic switch on PD-4107 coach models or from the engine run relay on PD-4903 coach models. Current for energizing the engine stop solenoid valve, which must be energized while the engine is running, is fed through normally closed points of engine stop relay. Relay operating coil is connected to low oil pressure and hot engine relays.

When low oil pressure switch or hot engine switch contacts close, circuit is completed through low oil relay or hot engine relay to engine stop relay operating coil. With relay operating coil energized, relay contacts open, breaking circuit to engine stop solenoid valve. With solenoid valve de-energized, air pressure is admitted to engine shut-off air cylinder. Action of air cylinder on engine governor moves injector racks to "NO-FUEL" position, stopping the engine.

AUTOMATIC ENGINE SHUT-OFF SYSTEM TEST

Start engine and run for a few minutes to build up air pressure in system. Ground the engine overheat thermostat terminal to complete the circuit through the hot engine relay and engine stop relay operating coil. Engine stop solenoid valve should open and admit air to engine shut-off air cylinder on governor, moving the injector racks to "NO-FUEL" position, thus shutting off the engine. If engine does not stop, check operation of engine stop solenoid valve and air cylinder before condemning the engine stop relay. Refer to "Relays" described later in this section.

ENGINE "STOP OVERRULE" SWITCH

Coaches equipped with automatic engine shut-off system also have an overrule switch, located

at top left of driver's instrument panel. Overrule switch is a momentary-on type switch. This switch must be held in for "ON" position and returns to "OFF" position when released. Purpose of switch is to feed current to the engine stop solenoid valve, overruling the engine stop relay. This permits starting the engine and moving the coach to safety in case the automatic shut-off system shuts off the engine.

Electrical connections for "Stop Overrule" switch are shown on "Engine Control and Generator" Wiring Diagram.

RELAYS

Relays are used in some instances to automatically open or close a circuit as operating conditions may require; in other cases they are used to provide a direct connection between the battery and an electrically operated device, with only a small amount of current required to energize the relay operating coil flowing through the controlling switch. The latter use eliminates the use of great lengths of heavy wire, thereby providing higher voltage to the electric device. Several of the same type relays are used on each vehicle; however, they are used in different circuits.

Location, operation, and adjustment of the various relays used on the PD-4107 or PD-4903 Models are described later under individual headings. Refer to applicable Wiring Diagrams for relay circuits.

The following tabulation lists each relay used, its location on the vehicle, and its part number. After determining part number of relay, refer to instructions under that part number for operation and adjustment.

RELAY TABULATION

		PD-4107	PD-4903
A/C Clutch Control	A/C Compressor Compartment (SEC. 26)	1116969	1116964
A/C Generator	A/C Compressor Compartment (SEC. 26)	1115826	1116964
A/C Cut-out	A/C Compressor Compartment (SEC. 26)	1116964	1115861
Automatic Engine Shut-off	Engine Compartment Apparatus Panel (3, Fig. 6)	1115836	1115860
Blower Motors	Heating and Ventilation Compartment (SEC. 26)	2482373	001481
DD3 Brake Stop Lamp	Driver's Control Panel (12, Fig. 3)	1116969	-
DD3 Brake Stop Lamp	Driver's Control Panel (15, Fig. 4)	-	1116964
Defroster Low Speed	Driver's Control Panel (2, Fig. 4)	-	1115860
Defroster Hi Speed	Driver's Control Panel (14, Fig. 4)	-	1115861
Directional Signal Pilot	Under Dash Right-Hand Side	648288	646378
Emergency Stop	Engine Compartment Apparatus Panel (9, Fig. 6)	1119828	001481
Engine Control	Driver's Control Panel (2, Fig. 3)	2257158	-
Engine Control	Driver's Control Panel (4, Fig. 4)	-	1116964
Generator Control "R" Terminal	Regulator Apparatus Panel (4, Fig. 8)	1116967	-
Generator Control "R" Terminal	Regulator Apparatus Panel (7, Fig. 10)	-	1116969
Generator Circuit	Driver's Control Panel (3, Fig. 3)	2257158	-
Generator Circuit	Driver's Control Panel (5, Fig. 4)	-	1116964
Horn	Driver's Control Panel (13, Fig. 3)	1116969	-
Horn	Driver's Control Panel (3, Fig. 4)	-	1116964
Hot Engine and Low Oil	Engine Compartment Panel (4 and 5, Fig. 6)	1116969	1116964
Reading and General Lamps	Regulator Apparatus Panel (6 and 7, Fig. 8)	2257158	-
Reading and General Lamps	Regulator Apparatus Panel (8 and 9, Fig. 10)	-	1116964
Regulator Control	Regulator Apparatus Panel (3, Fig. 8)	1116969	-
Regulator Control	Regulator Apparatus Panel (6, Fig. 10)	-	1116964
Reverse Selector	Engine Compartment Apparatus Panel (6, Fig. 6)	1116928	001481
	Engine Comp't. Apparatus Panel (8, Fig. 6)	1119828	001481
Starter	Driver's Control Panel (14, Fig. 3)	647544	-
Stop Lamp	Driver's Control Panel (16, Fig. 4)	-	653071
Stop Lamp	Heating and Ventilation Compartment (SEC. 26)	1116969	1116964
Water Pump	Under Dash Right-hand Side	1115826	1115861
Watch Step Lamp	Wiper Motor Bracket	1115826	1115861
Windshield Wiper			

RELAY 001481 (MAGNETIC SWITCH)

Several of these relays are used on the PD-4903 coach model as indicated under "Relay Tabulation" previously. Location and function of each relay is described under an individual heading.

BLOWER MOTOR RELAYS (MODEL PD-4903)

Two of these relays are used in the blower motor circuit. Refer to "HEATING AND AIR CONDITIONING" (SEC. 26) of this manual for location and operation of these relays.

EMERGENCY STOP RELAY (MODEL PD-4903)

The emergency stop relay is mounted on engine compartment apparatus panel (fig. 6). Electrical connections and circuits are shown on "Engine Control and Generator Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

Emergency stop relay "BAT." terminal is fed from bus bar in engine compartment apparatus box at No. 3 circuit breaker. Relay operating coil is energized by emergency stop switch on instrument panel in front of driver. When relay operating coil is energized, relay points close, completing circuit from battery to emergency stop solenoid which controls a choke valve to restrict engine air intake.

STARTER RELAY (PD-4903)

Starter relay is mounted on engine compartment apparatus panel (fig. 6). Electrical connections and circuits are shown on "Engine Control and Generator Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

Starter relay "BAT" terminal is fed from bus bar on engine compartment apparatus box at No. 2 circuit breaker. Relay operating coil is energized by starter switch on instrument panel in front of driver. When relay operating coil is energized, points close to complete circuit from battery to engine starter solenoid coil winding. Ground for relay operating coil is routed through fuel pressure switch contacts which are closed only when engine is not running. When engine starts and fuel pressure switch contacts open, relay operating coil is de-energized, breaking circuit to starter solenoid. A rectifier, mounted on starter relay, prevents excessive arcing at fuel pressure switch contacts.

REVERSE RELAY (PD-4903)

The reverse relay is mounted on engine compartment apparatus panel (fig. 6). Electrical connections and circuits are shown on "Engine Control and Generator Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

Reverse relay "BAT" terminal is fed from No. 2 (20-Amp.) circuit breaker in engine compartment apparatus box. Relay operating coil is energized from reverse switch on instrument panel in front of driver. When relay operating coil is energized, relay points close to complete circuit from battery to reverse solenoid mounted on transmission to permit engagement of reverse shift fork.

RELAY ADJUSTMENTS

This relay (magnetic switch) is a sealed unit and is not adjustable or repairable. If this relay fails to function properly, replace unit.

RELAY 646378

Two of these relays are used on PD-4903 coach as directional lamp and tell-tale relays. These relays are sealed units and are not adjustable or repairable. If relay fails to function properly, replace unit.

DIRECTIONAL SIGNAL PILOT RELAYS (PD-4903)

These relays are mounted under the windshield ledge on right-hand heater and defroster panel. Refer to "Directional Lamp Wiring Diagram" in "Wiring Diagrams" booklet X-6814A for electrical circuits.

Relays are connected into the directional lamp and emergency disability switch circuit in such a manner that when directional signal switch is placed in a right or left turn position, or emergency disability switch is placed in "ON" position, current to directional lamps passes through corresponding relay coil winding. With winding energized, armature is attracted to core and relay points close, completing circuit to "Directional Lamp" tell-tale on instrument panel, indicating that directional lamps are illuminated.

Directional lamp pilot relays are sensitive to amperage, requiring the current draw of front, side, and rear bulbs tó close relay points. If one bulb is burned out, current draw will not be sufficient to close relay points, and "Directional Lamp" tell-tale will not illuminate.

RELAY 647544

STOP LAMP RELAY

This relay, used on PD-4107 coach, is mounted on apparatus panel at left of driver (fig. 3). Refer to "Alarm and Signal Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

Stop lamp relay coil winding is fed from stop lamp switch. When brakes are applied and stop lamp switch contacts close, current from driver's control panel No. 22 circuit breaker will energize stop lamp relay coil winding. With winding energized, armature is attracted to core and relay points close, completing circuit to "STOP LAMP" tell-tale on instrument panel, indicating the stop lights are illuminated.

Stop lamp relay is sensitive to amperage, requiring the current draw of both stop lamp bulbs to close the points. If one bulb is burned out, current draw will not be sufficient to close relay points, and "STOP LAMP" tell-tale will not illuminate when brakes are applied.

The stop lamp relay is not adjustable or repairable; therefore, if relay fails to function properly, replace the unit.

RELAY 648288

DIRECTIONAL SIGNAL PILOT RELAYS (PD-4107)

Two of these relays are used on PD-4107 model as directional lamp and tell-tale lamp relays. These relays are not adjustable or repairable; therefore, if relay fails to function properly, replace the unit.

NOTE: For operation of this relay, refer to "Relay 646378" covered previously which will apply.

RELAY 653071

This relay, used in the stop lamp circuit on PD-4903 coach, is mounted on driver's control and apparatus panel at left of driver (16, fig. 4). Refer to "Alarm and Signal Wiring Diagram" in "Wiring Diagrams" booklet X-6814A for electrical circuits and connections.

This relay is a sealed unit and is not adjustable or repairable. If relay fails to function properly, replace the unit.

STOP LAMP RELAY

Relay is connected into stop lamp and stop lamp switch circuit in such a manner that when the brakes are applied and stop lamp switch contacts close, current to left and right stop lights passes through relay coil winding. With coil winding energized, armature is attracted to core and relay points close, completing circuit to "STOP LAMP" tell-tale on instrument panel, indicating that stop lights are illuminated.

Stop lamp relay is sensitive to amperage, requiring the current draw of both stop lamp bulbs to close the points. If one bulb is inoperative, current draw will not be sufficient to close relay points and "STOP LAMP" tell-tale will not illuminate when brakes are applied.

RELAY 1115826

Several of these relays are used on PD-4107 coach model as indicated in "Relay Tabulation" previously. Location and function of each relay is described under individual headings. Relay test instructions apply to all units.

AIR CONDITIONING RELAY (MODEL PD-4107)

This relay is mounted on bulkhead in "Air Conditioning Compressor Compartment" (SEC. 26) (2, fig. 4). Refer to "Heating and Air Conditioning Wiring Diagram" in "Wiring Diagrams" booklet X-6814A for electrical circuits and connections.

Air conditioning relay terminal No. 1 is fed through "LO" air pressure switch when heating and air conditioning switch is in "A/C" position and pressure in air system is above 65 psi. With relay terminal No. 1 energized, current will flow through normally closed contact points and out terminal No. 2 to energize the air conditioning clutch solenoid valve. With solenoid valve energized, current will flow through air conditioning generator field windings, air conditioning control relay, and oil pressure switch to ground thus completing the circuit.

Air conditioning relay terminal No. 3 is connected to operating coil terminal No. 4 through a jumper lead. If high or low pressure is encountered, "HI-LO" pressure switch contacts L2-M2 will open and contact L1-M1 will close. Current from terminal M1 will feed tell-tale lamp and terminals No. 3 and No. 4 on the air conditioning relay. With operating coil energized, the normally closed contacts will open the air conditioning generator field circuit to stop the condenser fan motor. The normally open relay contacts will close and current will flow from relay terminal No. 3 to terminal No. 1. This will hold the relay energized and tell-tale lamp on, even though pressure returns to normal. The circuit must be reset by opening the air conditioning switch and reclosing.

If voltage becomes excessive at air conditioning generator "R" terminal, the air conditioning cut-out relay coil winding will become energized. With winding energized, cut-out relay contacts will close, completing circuit through air conditioning relay operating coil terminal No. 4. With operating coil energized, the normally open relay contacts will close to stop the condenser fan motor and complete circuit to air conditioning tell-tale lamp.

WATCH STEP LAMP RELAY (MODEL PD-4107)

This relay, is used in the watch step sign, watch step aisle lamp (if used) and night lamp flasher electrical circuits. Relay is mounted under instrument panel on right-hand heater and defroster panel. Refer to "Flashing Step Lamp Wiring Diagram" in "Wiring Diagrams" booklet X-6814A for electrical connections and circuits.

Relay terminal No. 1 is connected to watch step sign lamps, night lamp on second left-hand seat, and watch step aisle lamp (if used). Terminal No. 2 is fed from Driver's Control Panel No. 5 circuit breaker and completes circuit to illuminate sign, seat lamp, and aisle lamp (when used) from

engine run switch. Relay coil, terminal No. 4 is fed through step lamp switch when entrance door is open. When relay operating coil is energized, circuit is completed through flasher unit and relay terminal Nos. 3 and 1 to flash "WATCH STEP" sign lamps and night lamp.

WINDSHIELD WIPER RELAYS (MODEL PD-4107)

These two relays are used in the windshield wiper circuit. Relays are mounted on each windshield wiper motor bracket, as shown in figure 12. Electrical connections and circuits are shown on "Windshield Wiper Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

The dual point type relays control each circuit of the two-speed windshield wiper motors. Relay terminal No. 4 and wiper motor terminal No. 2 are fed from battery bus bar on driver's control panel through No. 4 circuit breaker. Relay operating coil terminal No. 5 is grounded through "HI" side of windshield wiper switch. Relay and motor terminal No. 1 are grounded through "LO" side of windshield wiper switch. Relay terminal No. 2 is connected to wiper motor terminal No. 3.

When wiper motor switch is placed in "LO" position, motor terminals Nos. 1 and 3 are grounded through normally closed relay contact points, terminals Nos. 2 and 1, completing low speed circuit. When switch is placed in "HI" position, relay operating coil is energized and contact points connected to relay terminal No. 3 close, completing high speed circuit.

RELAY TEST

Connect voltmeter parallel with operating coil (Nos. 4 and 5 terminals). Connect variable resistance unit between No. 5 terminal and ground. Place engine "RUN" switch in "RUN" position. Slowly decrease resistance until relay activates and note reading on voltmeter. If opening voltage is not within limits listed in "Specifications," replace relay.

RELAY 1115836 (MODEL PD4107)

This relay, used in the automatic engine shut-off system, is mounted on engine compartment apparatus panel (3, fig. 6). Relay connections and circuit are shown on "General Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

Relay "BAT" (No. 1) terminal is fed through engine compartment junction 22 from driver's control panel No. 2 circuit breaker (8-Amp.). When engine is started, current will be supplied from relay terminal No. 1 through normally closed contact points and out terminal No. 2 to energize engine stop solenoid valve coil windings.

Relay terminal No. 4 is fed from engine compartment apparatus panel junction No. 4. Relay terminal No. 3 is connected to hot engine and low oil relays through engine compartment apparatus box junction 1. When the hot engine or low oil switch contacts are closed by an abnormal operating condition, current will flow through relay coil winding terminal No. 4 and out terminal No. 3 to ground at hot engine or low oil switch. With relay winding energized, relay contacts will open to de-energize the engine stop solenoid valve and admit air to engine shut-off air cylinder to stop engine.

RELAY 1115860

DEFROSTER LOW-SPEED RELAY

This relay, used on PD-4903 coach is mounted on driver's control and apparatus panel (fig. 4). Relay connections and circuits are shown on "Heating and Air Conditioning Wiring Diagram in "Wiring Diagrams" booklet X-6814A.

This relay is used to energize defroster fans when heating and air conditioning switch is in "A/C" position. Low-speed relay terminal No. 1 is fed through coil winding of defroster hi-speed cut-out relay. With heating and air conditioning switch in "A/C" position, current will flow through low-speed relay contact points and out terminal No. 2 to ground to energize hi-speed relay operating coil. Current will then flow through low-speed relay operating coil and hi-speed relay terminal No. 1 to operate defroster fans at full speed.

AUTOMATIC ENGINE STOP RELAY

This relay, used in the automatic engine shut-off system on PD-4903 coach (when specified), is mounted on engine compartment apparatus panel (3, fig. 6). Relay connections and circuits are shown on "General Wiring Diagram."

Information pertaining to operation of this relay remains the same as the No. 1115836 relay used on PD-4107 coach covered previously.

RELAY 1115861 (MODEL PD4903)

Several of these relays are used on each PD-4903 coach as indicated in "Relay Tabulation" previously. Location and function of each relay is described under individual headings.

AIR CONDITIONING GENERATOR FIELD RELAY (MODEL PD-4903)

This relay is mounted on bulkhead in air conditioning compressor compartment (SEC. 26, fig. 4). Refer to "Heating and Air Conditioning Wiring Diagram" in "Wiring Diagrams" booklet X-6814A for electrical circuits and connections.

Air conditioning relay terminal No. 1 is fed through low air pressure switch and "HI-LO" pressure switch terminals L2-M2 from "A/C" side of heating and air conditioning switch when air pressure is above 65 psi.

When relay terminal No. 1 energized, current will flow through normally closed contact points and out terminal No. 2 to feed air conditioning clutch solenoid valve and operating coil of air conditioning clutch relay to energize air conditioning generator field windings. With field windings energized, generator will begin to operate.

Air conditioning generator relay terminal No. 3 is connected to operating coil terminal No. 4. If high or low pressure is encountered, "HI-LO" pressure switch contacts L2-M2 will open and contacts L1-M1 will close. Current from terminal M1 will feed tell-tale lamp and relay terminals Nos. 3 and 4. With operating coil energized, normally closed relay contacts will open the generator field circuit to stop the condenser fan motor.

DEFROSTER HI-SPEED
CUT-OUT RELAY (MODEL PD-4903)

This relay is mounted on driver's control and apparatus panel (14, fig. 4). Relay connections and electrical circuits are shown on "Heating and Air Conditioning Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

Relay terminal No. 1 is fed through the defroster fan motors when defroster switch is in "HI" position. With defroster switch in "HI" position, current will flow through driver's control panel junction No. 47 to energize "low-speed" relay operating coil winding causing normally closed contact points to open. Current from driver's control panel junction No. 47 will then feed through the defroster fan motors and driver's control panel junction No. 48 to "hi-speed" cut-out relay terminal No. 1. Current from terminal No. 1 will flow through normally closed relay contact points and out terminal No. 2 to ground on defroster switch to complete the "hi-speed" fan motor circuit.

Relay terminal No. 5 is fed from "A/C" side of heating and air conditioning switch and normally open contact points, terminal No. 3, is fed from driver's control panel No. 8 circuit breaker. With heating and air conditioning switch in "A/C" position, current will flow through relay operating coil and normally closed contact points of the defroster "low-speed" relay to energize "hi-speed" relay coil winding. With "hi-speed" cut-out relay coil winding energized, normally open contact points will close and current will flow from terminals Nos. 3 through 1 to energize defroster fan motors.

WATCH STEP LAMP RELAY

This relay, used on PD-4903 coach, is used in the "WATCH STEP" sign, "WATCH STEP" aisle lamp (when used), and night lamp flasher electrical circuits. Relay is mounted under instrument panel on right-hand heater and defroster panel. Refer to "Flashing Step Lamp Wiring Diagram" in "Wiring Diagrams" booklet X-6814A for electrical connections and circuits.

NOTE: Information pertaining relay operation is the same as covered previously under 1115826 "WATCH STEP" lamp relay.

WINDSHIELD WIPER RELAY

Two relays are used in the windshield wiper circuit. Electrical connections and circuits are shown on "Windshield Wiper Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

NOTE: For relay operation, refer to "Windshield Wiper Relay" under "Relay 1115826" earlier in this section.

RELAY TEST

Connect a voltmeter parallel with operating coil (Nos. 4 and 5 terminals). Connect a variable resistance unit between No. 5 terminal and ground. Place engine "RUN" switch in "RUN" position and slowly decrease resistance until relay activates. Note voltmeter reading. If operating voltage is not within limits listed in "Specifications" at end of this section, replace the relay.

RELAY 1116964 (MODEL PD4903)

Several of these relays are used on each coach as indicated in "Relay Tabulation" previously. Location and function of each relay is described under individual headings. Relay test instructions apply to all units.

AIR CONDITIONING CLUTCH RELAY
(MODEL PD-4903)

This relay is mounted on bulkhead in air conditioning compressor compartment (SEC. 26, fig. 4). Refer to "Heating and Air Conditioning Wiring Diagram" in "Wiring Diagrams" booklet X-6814A for electrical circuits and connections.

Relay operating coil (terminal No. 4) is energized through normally closed contact points of air conditioning generator field relay when heating and air conditioning switch is in "A/C" position and air pressure is above 65 psi. Relay terminals Nos. 3 and 1 are connected by a jumper lead. When low air switch contacts close, current will flow through air conditioning generator field relay to energize clutch relay coil winding, clutch solenoid valve, and generator field winding. With clutch relay coil winding energized, contact points will close to complete circuit through low oil pressure switch.

AIR CONDITIONING GENERATOR RELAY (MODEL PD-4903)

This relay is mounted on bulkhead in air compressor compartment (SEC. 26, fig. 4). Refer to "Heating and Air Conditioning Wiring Diagram" in "Wiring Diagrams" booklet X-6814A for electrical circuits and connections. This relay is used to protect the air conditioning system against excessively high voltage. A resistance unit, connected between generator "R" terminal and relay operating coil (terminal No. 3) drops enough voltage during normal operation to prevent relay operating coil from being energized.

If voltage at generator "R" terminal becomes excessive, relay contacts will close to complete circuit through air conditioning generator field relay, opening the normally closed contacts which opens the generator field and energizes the A/C tell-tale lamp.

GENERATOR RELAY (MODEL PD-4903)

This relay is mounted on driver's control and apparatus panel at left of driver (5, fig. 4). Refer to electrical circuits and connections shown on "Heating and Air Conditioning Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

This relay is used to provide a connection between the battery and the heating and air conditioning switch when the engine is running. Relay operating coil (terminal No. 3) is fed from generator relay (mounted on engine compartment apparatus panel) through No. 6 circuit breaker on regulator apparatus panel when engine is running.

When engine is started, current from generator "R" terminal will energize coil winding of generator relay, mounted on engine compartment apparatus panel. With windings energized, contacts will close to energize coil winding of generator relay, mounted on driver's apparatus and control panel. With windings energized, contacts will close to feed the heating and air conditioning switch.

DD-3 BRAKE STOP LAMP RELAY (MODEL PD-4903)

This relay is mounted on the driver's control and apparatus panel at left of driver (15, fig. 4). Refer to "Alarm and Signal Wiring Diagram," in "Wiring Diagrams" booklet X-6814A, for electrical circuits and connections.

The relay is connected into the stop lamp circuit in such a manner that when air brake switch is activated, normally open switch contacts, will close to energize relay operating coil winding. With winding energized, armature is attracted to core and contacts will close to energize stop lamp tell-tale relay coil windings and complete circuit to stop lamps and stop lamp tell-tale.

ENGINE RUN CONTROL RELAY (MODEL PD-4903)

This relay is mounted on driver's control and apparatus panel at left of driver (4, fig. 4). Electrical circuits and connections are shown on "Engine Control and Generator Wiring Diagram" and "Alarm and Signal Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

Relay "Bat." (No. 1) terminal is fed from battery junction on driver's control panel bus bar. Operating coil (No. 3) terminal is connected to "RUN" side of engine "RUN" switch. When switch is placed in "RUN" position, current is supplied from battery terminal on driver's control panel bus bar through operating coil of relay to ground terminal (No. 4). Contacts will close to complete circuit to driver's control panel bus bar circuit breakers No. 1 through No. 5.

HORN RELAY (MODEL PD-4903)

This relay, used in the horn circuit, is mounted on driver's control and apparatus panel at left of driver (3, fig. 4). Relay connections and circuits are shown on "Alarm and Signal Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

Coil windings of relay (terminals Nos. 3 and 4) are connected in series with the horn button. When horn button is pressed, circuit through relay winding is completed and armature is attracted to core. This completes circuit from No. 1 terminal through closed points and No. 2 terminal to horn.

HOT ENGINE AND LOW OIL RELAYS (MODEL PD-4903)

These relays, used in the automatic engine stop circuit, are mounted on engine compartment apparatus panel (4 and 5, fig. 6). Relay connections and circuits are shown on "Alarm and Signal Wiring Diagram" and "Engine Control and Generator Wiring Diagram" in booklet X-6814A.

Operating coils of each relay are fed from battery through terminal No. 4. Operating coils of each relay are grounded through the corresponding sensing switch located on engine. When either sensing switch closes, caused by a hot engine or low oil condition, circuit is completed through operating coils which close relay contact points. Contact points of each relay (terminal No. 2) are connected in series with the engine alarm buzzer and the automatic engine stop circuit.

READING AND GENERAL LAMP RELAYS (MODEL PD-4903)

Reading and general lamp relays are mounted on regulator and apparatus panel on front intermediate bulkhead (8 and 9, fig. 10). Electrical connections and circuits are shown on "Reading and General Lighting Wiring Diagram," in "Wiring Diagrams" booklet X-6814A.

Reading lamp and general lamp relay "Bat." (No. 1) terminals are fed from regulator and apparatus panel battery junction. Relay operating coil is energized from the "Reading" or "General" position of interior light switch. When operating coil circuit is completed, relay points close, completing circuit from battery to reading or general lamps.

REGULATOR SENSING RELAY
(MODEL PD-4903)

Regulator sensing relay is mounted on regulator and apparatus panel on front intermediate bulkhead (6, fig. 10). Electrical connections and circuits are shown on "Engine Control and Generator Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

Regulator sensing relay "Bat." terminal (No. 1) is fed from "DC" terminal on generator. Relay operating coil terminal (No. 3) is energized from "Normal" position of engine starter switch on driver's instrument panel through engine compartment junction No. 1. When circuit to operating coil is completed, relay points close and circuit is completed from battery to "P" terminal on voltage regulator which feeds current to "Field" circuit of generator.

WATER PUMP RELAY
(MODEL PD-4903)

The water pump relay is mounted in the heating and ventilation compartment. Electrical circuits and connections are shown on "Heating and Air Conditioning Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

Water pump relay "Bat." terminal (No. 1) is fed from battery compartment hot bus bar circuit breaker (60 Amp.). Relay operating coil terminal (No. 3) is energized from "HEAT" position on heating and air conditioning switch on driver's instrument panel. When circuit to operating coil is completed, relay points close and circuit is completed from battery to water pump.

RELAY TEST

With all leads connected to the relay as shown on applicable wiring diagram, connect an accurate reading voltmeter in parallel with the relay operating circuit at No. 3 and No. 4 terminals. Insert a variable resistance unit in series with the operating coil. To check closing voltage, close the relay operating switch, then slowly decrease resistance until points close and note voltage reading. (In some cases, generator must be charging to energize the relay operating circuits.)

If opening voltage is not within limits listed in "Specifications" at end of this section, replace the relay.

RELAY 1116967 (MODEL PD4107)

Generator relay is mounted on the battery compartment apparatus panel (4 , fig. 8). Relay connections and electrical circuits are shown on "Engine Control and Generator Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

Relay "Bat" (No. 1) terminal is fed from battery junction of reading lamp magnetic switch. Operating coil (No. 3) terminal is connected to "R" terminal of generator. When generator is charging, current is supplied from relay "R" terminal of generator through the operating coil of relay to ground terminal (No. 4). This action closes contact points to permit battery current to feed generator magnetic switch. This circuit is used to shut down heating and air conditioning system when generator is not charging.

RELAY TEST

Connect an accurate voltmeter parallel with operating coil at terminal Nos. 3 and 4. Connect a variable resistance in series with coil circuit at terminal No. 3. Start and run engine at fast idle (generator charging), slowly increase resistance until relay points open and note reading on voltmeter. If opening voltage is not within limits listed in "Specifications," replace relay.

RELAY 1116969

Several of these relays are used on each vehicle as indicated in "Relay Tabulation" previously. Location and function of each relay is described under individual headings. Test instructions apply to all units.

GENERATOR RELAY (MODEL PD-4903)

Generator relay is mounted on regulator and apparatus panel on front intermediate bulkhead (7, fig. 10). Relay connections and electrical circuits are shown on "Engine Control and Generator Wiring Diagram" in booklet X-6814A.

Relay "Bat" (No. 1) terminal is fed from battery junction on regulator and apparatus panel. Operating coil terminal (No. 3) is connected to "R" terminal of generator. When generator is charging, current is supplied from relay "R" terminal of generator through operating coil of relay to ground terminal (No. 4). This action closes contact points to permit battery current to feed coil winding of generator relay, mounted on driver's control and apparatus plate, through regulator and apparatus panel No. 6 circuit breaker. This circuit is used to shut down heating and air conditioning system when generator is not charging.

AIR CONDITIONING CONTROL RELAY (MODEL PD-4107)

This relay is mounted on bulkhead in air conditioning compressor compartment (SEC. 26, fig. 4). Refer to "Heating and Air Conditioning Wiring Diagram" in "Wiring Diagrams" booklet X-6814A for electrical circuits and connections.

Relay is a lock-in type unit; that is, after operating coil is energized and contacts close, contacts will remain closed as long as circuit through contacts is not broken. The purpose of this relay is to maintain circuit to air conditioning solenoid valve after oil pressure switch opens.

Relay terminal No. 1 is fed from "A/C" position on heating and air conditioning switch through "HI-LO" pressure switch contacts L2-M2, low air switch, and normally closed contacts of the air conditioning relay when air pressure is above 65 psi. Relay operating coil terminal No. 4 is fed through the same circuit as above. Operating coil terminal No. 3 is grounded through oil pressure switch and relay contacts (No. 1 terminal).

DD-3 BRAKE STOP LAMP RELAY (MODEL PD-4107)

This relay is mounted on driver's control and apparatus panel (12, fig. 3). Electrical circuits and connections are shown on "Alarm and Signal Wiring Diagram" in booklet X-6814A.

The relay is connected into the stop lamp circuit in such a manner that when air brake switch is activated, normally open switch contacts will close to energize relay operating coil winding. With winding energized, armature is attracted to core and contacts will close to energize stop lamp tell-tale relay coil windings and complete circuit to stop lamps and stop lamp tell-tale.

HORN RELAY (MODEL PD-4107)

This relay, used in the horn circuit, is mounted on apparatus panel at left of driver (13, fig. 3). Relay connections and circuits are shown on "Alarm and Signal Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

Coil winding of relay (terminals Nos. 3 and 4) are connected in series with the horn botton. When horn button is pressed, circuit through relay winding is completed and armature is attracted to core. This completes circuit from No. 1 terminal through the closed points and No. 2 terminal to the horn.

HOT ENGINE AND LOW OIL RELAY (MODEL PD-4107)

These relays, used in the automatic engine stop circuit, are mounted on engine compartment apparatus panel (4 and 5, fig. 6). Relay connections and circuits are shown on "Alarm and Signal Wiring Diagram" in the "Wiring Diagrams" booklet X-6814A.

Operating coils of each relay are fed from battery through terminal No. 4 and are grounded through the corresponding sensing switch located on the engine. When either sensing switch closes, caused by a hot engine or low oil condition, circuit is completed through relay operating coil causing contacts to close. Contact points of each relay (terminal No. 2) are connected in series with the engine alarm buzzer and the automatic engine stop circuit.

REGULATOR SENSING RELAY (MODEL PD-4107)

Regulator sensing relay is mounted on the battery compartment apparatus panel (3 , fig. 8). Electrical circuits and connections are shown on "Engine Control and Generator Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

Relay "Bat" terminal (No. 1) is fed from "DC" terminal on generator. Relay operating coil terminal (No. 3) is energized from "Normal" position on engine starter switch on driver's instrument panel through engine compartment junction No. 1. When circuit to operating coil is completed, relay points close and circuit is completed from battery to "P" terminal on voltage regulator which feeds current to "Field" circuit of generator.

WATER PUMP RELAY (MODEL PD-4107)

The water pump relay is mounted on the ventilation compartment apparatus panel. Electrical circuits and connections are shown on "Heating and Air Conditioning Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

Relay "Bat" terminal (No. 1) is fed from ventilation compartment hot bus bar circuit breaker. Relay operating coil terminal (No. 3) is energized from "HEAT" position on heating and air conditioning switch on driver's instrument panel. When circuit to operating coil is completed, relay points close and circuit is completed from battery to water pump.

RELAY TEST

With all leads connected to the relay as shown on the applicable wiring diagram, connect an accurate reading voltmeter in parallel with the relay operating circuit at the No. 3 and No. 4 terminals. Insert a variable resistance unit in series with the operating coil circuit terminal. To check closing voltage, close the relay operating switch, then slowly decrease resistance until points close and note the voltage reading. (In some cases, generator must be charging to energize the relay operating circuits.)

If opening voltage is not within limits listed in "Specifications," replace relay.

RELAY 1119828 (MAGNETIC SWITCH) (MODEL PD4107)

EMERGENCY STOP RELAY

Emergency stop relay is mounted on engine compartment apparatus panel (9, fig. 6). Electrical connections and circuits are shown on "Engine Control and Generator Wiring Diagram" in "Wiring Diagrams" booklet X-6814A.

Relay "Bat" terminal is fed from engine compartment bus bar at No. 3 circuit breaker. Relay operating coil is energized by emergency stop switch located on driver's instrument panel. When operating coil circuit is completed, relay points close, completing circuit from battery to emergency stop solenoid which controls a choke valve to restrict air intake by engine.

REVERSE RELAY

Reverse relay is mounted on engine compartment apparatus panel (6 , fig. 6). Electrical connections and circuits are shown on "Transmission Wiring Diagram" in booklet X-6814A.

Reverse relay "Bat." terminal is fed from engine compartment No. 2 circuit breaker. Relay operating coil is energized from reverse switch located on driver's instrument panel. When operating coil circuit is completed, relay points close, and circuit is completed from battery to reverse solenoid mounted on transmission which controls shift levers to permit engagement of reverse shift fork.

STARTER RELAY (MODEL PD-4107)

Starter is mounted on engine compartment apparatus panel (8, fig. 6). Electrical connections and circuits are shown on "Engine Control and Generator Wiring Diagram" in booklet X-6814A.

Relay "Bat." terminal is fed from engine compartment bus bar at No. 2 circuit breaker. Relay operating coil is energized by starter switch located on driver's instrument panel. When operating coil circuit is completed, relay points close, and circuit is completed from battery to engine starter solenoid. Ground for relay operating coil is routed through contacts of fuel pressure switch, which are closed only when engine is not running. When engine starts, and fuel pressure switch opens, operating coil of relay is de-energized, and points open, breaking circuit to starter solenoid. A rectifier, mounted on starter relay, prevents excessive arcing at contacts of fuel pressure switch.

RELAY ADJUSTMENTS

These relays (magnetic switches) are sealed units and are not adjustable or repairable. If either switch fails to function properly, replace the unit.

RELAY 2257158 (MAGNETIC SWITCH)(MODEL PD4107)

FNGINE RUN RELAY

Engine run relay is mounted on apparatus panel at left of driver (2, fig. 3). Electrical connections and circuits are shown on "Engine Control and Generator Wiring Diagram" in X-6814A.

Relay "Bat." terminal is fed from driver's control panel battery junction. Relay operating coil is energized from "RUN" position of engine "RUN" switch. When operating coil circuit is completed, relay points close, completing circuit from battery to driver's control panel bus bar which supplies current to starter switch, engine compartment controls, and lavatory wiring circuits.

GENERATOR CIRCUIT RELAY

This relay is mounted on apparatus panel at left of driver (3, fig. 3). Electrical connections and circuits are shown on "Engine Control and Generator Wiring Diagram" in booklet X-6814A.

Relay "Bat." terminal is fed from driver's control panel battery junction. Relay operating coil is energized from generator relay terminal is charging, relay operating coil circuit is completed. Relay points close and circuit is completed from battery to driver's control panel bus bar which supplies current to heating and air conditioning switch.

READING AND GENERAL LAMP RELAYS

Reading and general lamp relays are mounted on battery compartment apparatus panel (6 and 7, fig. 8). Electrical connections and circuits are shown on "Coach Lighting Wiring Diagram."

Reading lamp relay "Bat." terminal is fed from battery compartment battery junction. Relay operating coil is energized from the "Reading" position of interior lighting switch. When operating coil circuit is completed, relay points close, completing circuit from battery to reading lamps.

General lamp relay "Bat." terminal is fed from battery compartment battery junction. Relay operating coil is energized from the "General" position of interior lighting switch. When operating coil circuit is completed, relay points close, completing circuit from battery to general lamps.

RELAY ADJUSTMENTS

These relays (magnetic switches) are sealed units and are not adjustable or repairable. If relay fails to function properly, replace the unit.

RELAY 2482373 (MAGNETIC SWITCH) (MODEL PD4107)

Two of these relays (magnetic switches) are used in the blower motor circuits. Refer to "HEATING AND AIR CONDITIONING" (SEC. 26).

HORNS

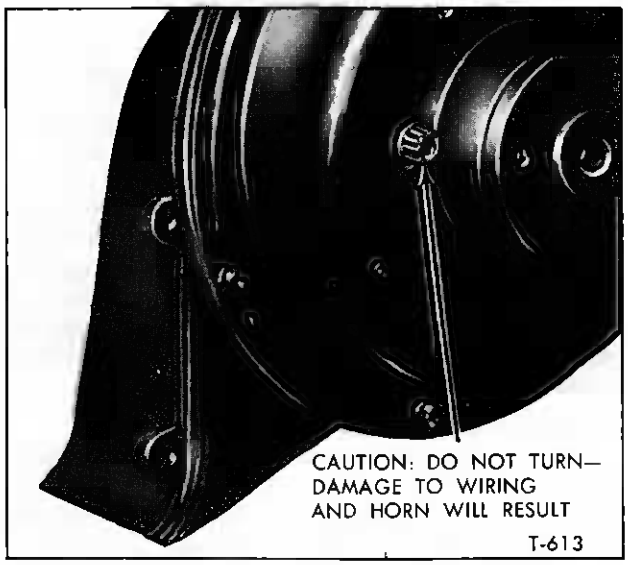


Figure 13—Electric Horns (Typical)

Two electric airtone "S" type horns (fig. 13) are used on each vehicle. On PD-4903 coach, one air horn is used in addition to the electric horns.

ELECTRIC HORNS

Two 12-volt horns are used on PD-4107 coach and two 24-volt horns are used on PD-4903 coach. Refer to "Specifications" at end of this section.

Each horn is carefully adjusted and inspected during manufacture and should operate indefinitely without attention. The horns are assembled with rivets and should not be adjusted or repaired. If a horn becomes inoperative, it must be replaced.

If horns become inoperative, use a jumper lead as follows to make a quick check of the external circuit and isolate the trouble:

1. Connect jumper lead from No. 3 terminal on horn relay to ground. If horn then operates, the trouble is in the horn control circuit. If horn does not operate remove jumper lead and proceed with Step 2.

2. Momentarily connect jumper lead between Nos. 2 and 1 terminals on horn relay. If horn operates, the relay is defective and must be replaced.

3. Horn circuit is internally grounded through the horn mounting. Therefore, it is necessary that a good ground connection be maintained between the horn mounting bracket and its mating part. Check for a good ground by connecting a jumper lead from the horn bracket to the vehicle frame or grounded side of battery. Be sure contact is made through the paint of the horn bracket and frame.

After the above checks have been made and it is established that the horn is at fault, the trouble may be that the horn contacts are held open by a foreign particle. This condition can sometimes be corrected by energizing the horn, then lightly tapping the horn power plant to dislodge the particle.

AIR HORNS

Dual air horns are mounted on brackets located in horn compartment. Air pressure to horns is controlled by a floor mounted control valve.

NOTE: For information pertaining to air horns and control valve, refer to "Air Horns" in "GENERAL BODY MAINTENANCE" (SEC. 3) of this manual.

ELECTRIC SPEEDOMETER

OPERATION

A permanent magnet AC generator (sending unit) is mounted on the transmission and driven by transmission output shaft. Generator supplies a signal whose amplitude is proportional to its driven speed. This signal is rectified to direct current (DC), smoothed and fed to meter movement of speedometer, mounted on instrument panel (fig. 1), where it is read in mph. Refer to "Speedometer Wiring Diagram" in "Wiring Diagrams" booklet X-6814A for electrical connections and circuits.

MAINTENANCE

The following procedures for disassembly, testing, reassembly, and calibration of speedometer system are made after units are removed from the coach. Remove speedometer from instrument panel by disconnecting wiring harness and remove four nuts and lock washers securing speedometer to instrument panel and bracket. Disconnect wiring harness connector from terminal on transmission sending unit and remove sending unit from transmission.

TOOLS AND EQUIPMENT

Electrical equipment and small hand tools required to disassemble, test, and calibrate speedometer system are listed below:

1. Milliammeter with an internal resistance of 100 ohms $\pm$ 10 (Ideal Precision Meter Company Model 350 P-C or equivalent).

2. Variable resistor (10,000 to 100,000 ohms).

If unable to obtain, purchase 0 to 100,000 resistor and place 10,000 resistor in series to prevent accidental meter burn-out.

3. 100 ohm fixed resistor to be used in series with milliameter when testing circuit package.

4. Variable speed test stand (or a distributor test stand if available).

5. Small hand tools such as:

a. No. 10 nut driver.

b. Medium blade screwdriver.

c. Small tipped, fast-heating, soldering iron.

d. Long nose pliers.

e. Tweezers.

DISASSEMBLY (Fig. 14)

CAUTION: Work area must be clean and free of metal particles which could lodge in meter magnet.

1. Pry up and remove bezel, glass, gaskets and retainer. (Be careful not to allow metal particles to enter case.)

2. Remove nut and insulated washer from insulated stud at rear of case.

3. Remove number 10 nuts from speedometer assembly mounting and grounding studs at rear of speedometer cas. Lift out meter movement and circuit package unit. (Do not misplace the insulating washer which insulates the insulating stud from inside case.)

4. Remove white meter lead from circuit board by unsoldering at "+" location on circuit board. Remove black meter lead from circuit board by unsoldering at "-" location on circuit board.

5. Remove two self-locking (circuit board to meter) retaining nuts from front side of circuit board and separate circuit board from meter movement.

TESTS

Permanent Magnet (PM) Generator

PM generator is designed for rugged, long lived performance, with no requirements for field service. Special equipment is required to charge and calibrate special magnet. Bearings are lubricated for lifetime of generator. Check performance of unit as follows:

1. Remove key from drive end of generator and insert a short piece of speedometer cable. Connect other end of cable to a variable speed test stand. (An automatic service type distributor test stand may be used.)

2. Connect "+" lead from AC voltmeter (or a multimeter with selector set to measure AC voltage) to output terminal of generator. Connect "-" lead from voltmeter to frame of generator.

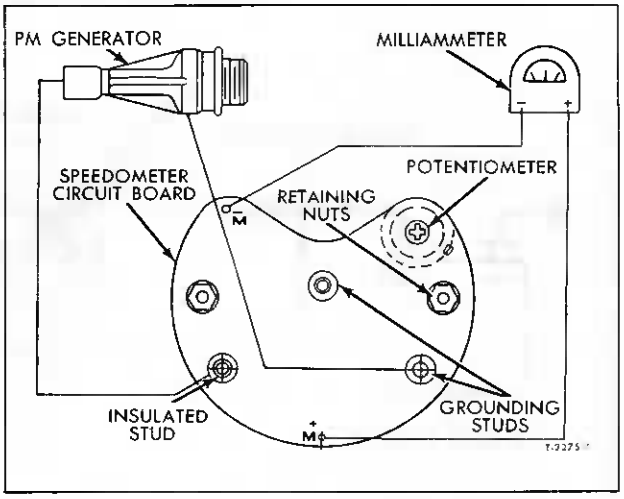


Figure 14—Speedometer System Units and Test Schematic

3. Drive generator by a test stand operating at 1000 rpm. The voltmeter should indicate 6 volts ± 5%. Increase test stand speed to 2000 rpm. The voltmeter should indicate 12 volts ± 5%.

4. If no voltage is shown, or value is above or below desired figure, generator should be replaced.

NOTE: If no defect is found, vehicle should be checked for a poor ground.

METER MOVEMENT (Fig. 15)

1. Set variable resistor to 100,000 ohm position.

2. Connect battery, variable resistor, meter movement and milliammeter as shown in figure 15.

WARNING: Do not accidentally short any part of test circuit to ground.

3. Speedometer meter movement is satisfactory if following readings are obtained under conditions described in A, B, and C:

A. Adjust variable resistor until:
   (1) Speedometer indicates 20 mph.
   (2) At which time milliammeter should indicate .20 ± 2.5%.

B. Slowly adjust variable resistor to a lesser resistance to obtain a reading of 1 milliampere (full scale).

C. Speedometer should indicate 80 mph (full scale) ± 2 mph.

NOTE: Movement of pointer from 0 to full scale should be smooth and even throughout range of operation. Sluggishness or unequal degree of movement could be caused by tangled hairsprings or improper end play. The end play is factory ad-

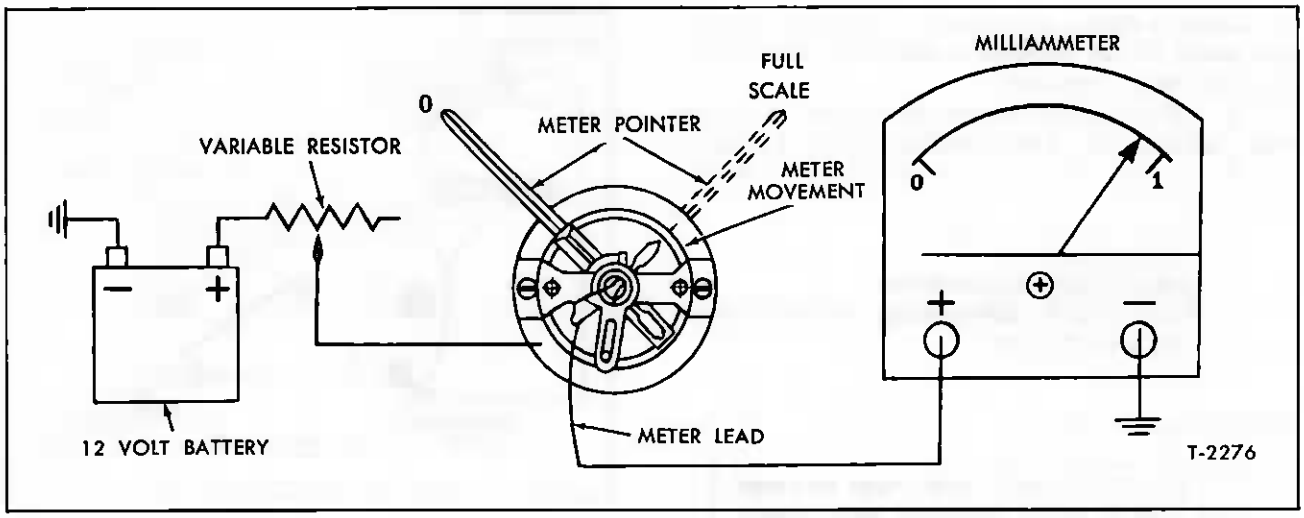


Figure 15—Speedometer Meter Movement Test Schematic

justed and should not be tampered with. Failure to obtain a reading would indicate open coils or hairspring connections. Any of above indications would require replacement of meter movement.

If the meter appears sticky, air gap and magnet surfaces should be examined for metal chips, lint, or dirt. These foreign particles may sometimes be removed with long tweezers. Quite often it is not possible to locate or extract offending particle and it is then necessary to replace meter movement.

CIRCUIT PACKAGE (Fig. 14)

1. Connect PM generator to test stand as directed in Step 1. of permanent magnet generator test in this section.
2. Connect lead from PM generator to insulated terminal at front of circuit board.
3. Make remainder of connections as shown in figure 14. In addition, use a 100 ohm resistor in series with milliammeter during this test.
4. Run test stand at 60 mph (1001 rpm).
5. Speedometer circuit package is satisfactory if the following readings are obtained under conditions in a. and b. following:

a. Adjust potentiometer to provide a milliammeter indication of from 0 to .75.

b. Make final adjustment to provide a milliammeter indication of .73.

NOTE: Action should be smooth throughout range of operation. If no milliammeter indication is possible, or erratic readings are obtained on milliammeter, circuit package should be replaced.

ASSEMBLY (Fig. 14)

1. Assemble meter movement to circuit board and install self-locking nuts.
2. Resolder white meter lead from meter movement to location marked "+" on circuit board.
3. Resolder black meter lead from meter movement to location marked "–" on circuit board.
4. Place insulating washer on insulated terminal at rear of case. Install the No. 10 retaining nuts and tighten.
5. Assemble glass, gaskets, and bezel to case and secure with tape until calibration has been completed.

CALIBRATION

1. Attach jumper wire from PM generator terminal to insulated terminal of speedometer and ground speedometer case to generator housing with jumper wire.
2. Drive generator at a steady test stand speed of 60 mph (1001 rpm).
3. Adjust speedometer potentiometer so that speedometer indicates 60 mph. Use a clean insulated screwdriver.
4. Vary test stand drive speed from 0 mph to 80 mph (1332 rpm). Speedometer indication should be smooth throughout range of operation.
5. Seal case potentiometer opening.
6. Remove tape from bezel and crimp bezel.

Refer to next page for "Specifications."

SPECIFICATIONS

CIRCUIT BREAKERS
Note: Replace circuit breakers with same make and amperage rating.
Type ..... Automatic Reset
Amperage Rating ..... Refer to Figures 5, 7, and 9

ALARM BUZZER (PD-4903)
Make ..... Delco-Remy
Model 1115818
Point Opening 0.015-0.020
Adjust to Buzz at ..... 0.22-0.31 ampere at 26-28 volts

ALARM BUZZER (PD-4107)
Make ..... Delco-Remy
Model 1116882
Point Opening 0.017
Adjust to buzz at ..... 0.25-0.35 ampere at 13.5-14.5 volts

ELECTRIC HORNS (PD-4107)
Make ..... Delco-Remy
Voltage 12
Model
Front Horn (F Note) 9000221
Frequency ..... 360 C.P.S.
Rear Horn (D Note) 9000206
Frequency ..... 285 C.P.S.

ELECTRIC HORNS (PD-4903)
Make ..... Delco-Remy
Voltage 24
Model
Low Note 9000535
Frequency ..... 360 C.P.S.
High Note 9000536
Frequency ..... 450 C.P.S.

SPEEDOMETER HEAD
Make ..... A.C. Spark Plug Division
Model 6412245

SPEEDOMETER DRIVE UNIT
Make ..... A.C. Spark Plug Division
Model 6412933

SPEEDOMETER ADAPTER
Make ..... A.C. Spark Plug Division
Model
PD-4107 1565177
PD-4903 1565176

RELAYS
001481 (Magnetic Switch)
Make ..... Delco-Remy
Type ..... Magnetic Switch
Rated Voltage 24
Current Consumption
Both Windings
Amps 0.83-0.89
Volts 24

646378
Make ..... Metals and Controls
Model 2CR42-143
Rated Voltage 24

647544
Make ..... Metals and Controls
Model 2CR42-164
Rated Voltage 12

648288
Make ..... Metals and Controls
Model 2CR42-935
Rated Voltage 12

1115826
Make ..... Delco-Remy
Air Gap at Core
Points Closed (In.) ..... 0.011 min.
Point Opening (In.) 0.025
Closing Voltage (Range) 8.3-10.2
Sealing Voltage ..... 10.7 max.

1115836
Make ..... Delco-Remy
Air Gap at Core
Points Closed (In.) (a) 0.030
Opening Voltage (Range) (b) 8-10
(a) Armature Down—Tolerance plus or minus 10%
(b) Top Contacts

115860
Make ..... Delco-Remy
Point Opening (In.) 0.020-0.030
Sealing Voltage 14-18

1115861
Make ..... Delco-Remy
Air Gap at Core
Points Closed (In.) ..... 0.011 min.
Point Opening (In.) 0.030
Closing Voltage (Range) 15.5-18.5
Opening Voltage ..... 1.5 min.
Sealing Voltage ..... 22.5 min.

653071
Make ..... Metals and Controls
Model 2CR42-124
Rated Voltage 24

1116964
Make ..... Delco-Remy
Air Gap at Core
Points Closed (In.) ..... 0.011 min.
Point Opening (In.) 0.030
Closing Voltage (Range) 15.5-18.5
Opening Voltage ..... 1.5 min.
Sealing Voltage ..... 22.5 max.

1116967
Make ..... Delco-Remy
Air Gap at Core
Points Closed (In.) ..... 0.011 min.
Point Opening (In.) 0.025
Closing Voltage (Range) 4.5-5.2
Opening Voltage ..... 0.3 min.
Sealing Voltage ..... 5.6 max.

1116969
Make ..... Delco-Remy
Air Gap at Core
Points Closed (In.) ..... 0.011 min.
Point Opening (In.) 0.025
Closing Voltage (Range) 8.8-10.2
Opening Voltage ..... 0.6 min.
Sealing Voltage ..... 11.2 max.

1119828 (Magnetic Switch)
Make ..... Delco-Remy
Rated Voltage 12
Current Consumption
Both Windings
Amps 2.1-2.4
Volts 8

2257158 (Magnetic Switch)
Make ..... Essex Wire Corp.
Model No. 5608-9
Operating Voltage 12-Continuous

2482373 (Magnetic Switch)
Make ..... Prestolite Controls Co.
Voltage 12-Continuous

Batteries

IMPORTANT: ELECTRICAL SYSTEM IS NEGATIVE GROUND.

GENERAL

On PD-4107 coach, two 12-volt batteries, connected in parallel, are mounted in battery compartment box located in rear baggage compartment. Battery cells may be checked and filled through two side access doors. Battery cables are accessible through the front access door. View of batteries installed is shown in figure 1. Battery disconnect points are shown in figure 2.

On PD-4903 coach two 12-volt batteries, connected in series are mounted in right front evaporator compartment (fig. 3).

IMPORTANT: Observe decal on inside of battery compartment door which reads "CAUTION - NEGATIVE GROUND." It must be emphasized that if the batteries are not connected for NEGATIVE GROUND, severe damage to the generator, regulator, batteries, and battery cables will result.

The battery has three major functions to perform on the vehicle:

1. It provides a source of current for starting the engine.
2. It acts as a stabilizer to the voltage in the electrical system.
3. It can, for a limited time, furnish current when electrical demands of the electrical equipment exceed the output of the generator.

BATTERY DISCONNECT SWITCH

NOTE: A battery disconnect switch (fig. 3) is used as standard equipment on PD-4903 coach and as special equipment on the PD-4107 coach.

If it is necessary to disconnect batteries from the electrical system, move disconnect switch lever at top of battery compartment (if used) to "OFF" position; then disconnect battery negative (–) cables at points shown in figures Nos. 2 and 3.

IMPORTANT: After battery cables have been disconnected, wrap terminals with electrical tape or equivalent to prevent accidental grounding.

BATTERY MAINTENANCE

FILLING BATTERY

Electrolyte level in the battery should be checked at least every 1,000 miles or once every two weeks. If the electrolyte level is found to be low, water should be added to each cell until the level rises to the bottom of the vent well. DO NOT OVERFILL.

NOTE: Level of electrolyte can be checked by the use of a flashlight and mirror. Hold mirror over each cell opening and direct flashlight beam so electrolyte level can be seen.

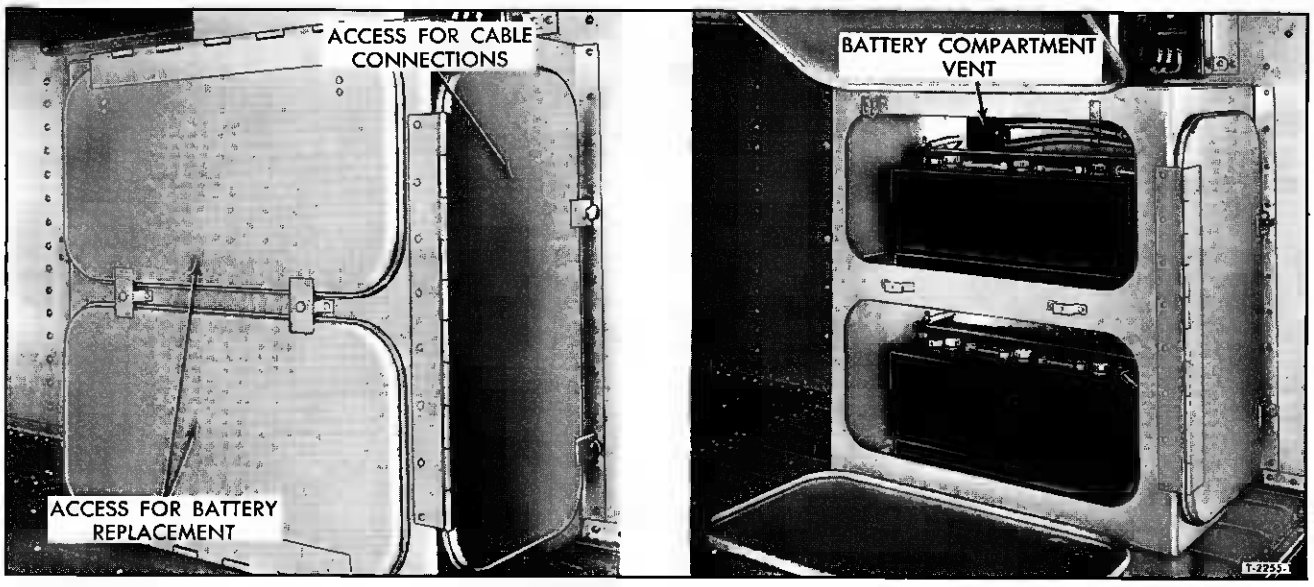


Figure 1—Batteries Installed (Model PD4107)

Distilled water or water passed through a "demineralizer" should be used to eliminate the possibility of harmful impurities being added to the electrolyte. Many common impurities will greatly shorten battery life. DO NOT ADD ANY SUBSTANCE TO THE ELECTROLYTE EXCEPT WATER.

CLEANING AND INSPECTION

The external condition of the battery and the battery cables should be checked periodically. The top of the battery should be kept clean and the battery hold-down bolts should be kept properly tightened. For best results when cleaning battery, wash first with a dilute solution of ammonia or soda to neutralize any acid present, then flush off with clean water. Care must be used to keep vent plugs tight so that the neutralizing solution does not enter the cells. The hold-down bolts should be kept tight enough to prevent the battery from shaking around in its holder, but they should not be tightened excessively as to place a strain on the battery case.

To insure good contact, the battery cable clamps should be tight on the battery posts. If the posts or cable clamps are corroded, the cables should be disconnected and the posts and clamps cleaned separately with a soda solution and a wire brush. Install clamps on battery posts and tighten firmly, then coat posts and clamps with petroleum jelly to help retard corrosion.

COMMON CAUSES OF BATTERY FAILURE

When a battery fails, the cause of failure may be outside the battery. For this reason, when a battery failure is encountered, do not be satisfied to merely rechecharge or replace it. Locate and correct the cause of the failure to prevent recurrence. Some common causes of battery failure are as follows:

1. Defect in generating system such as high resistance or faulty generator or regulator.
2. Overloads caused by defective starter or excessive use of accessories.
3. Dirt and electrolyte on top of batteries causing a constant drain.
4. Hardened battery plates, commonly called sulfation, due to battery being in a low state of charge over a long period of time.
5. Physical defects such as shorted cells, loss of active material from plates, etc.
6. Driving conditions or requirements under which the vehicle is used only for short drives.

BATTERY TESTS

Four battery checks are described following to determine condition of the battery in a minimum amount of time:

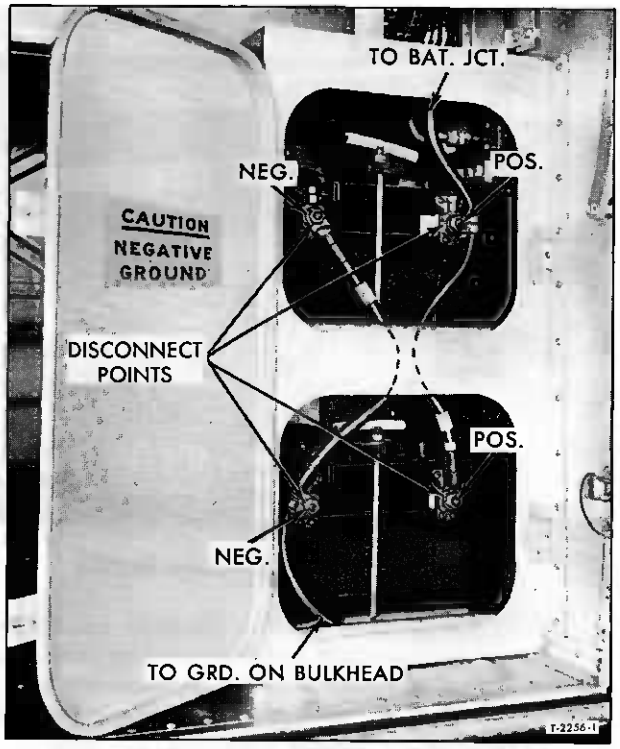


Figure 2—Battery Disconnect Points (Model PD4107)

1. State of charge (Hydrometer Test).
2. Battery Capacity Test.
3. Three Minute Battery Test.
4. Battery Instrument Test.

STATE OF CHARGE (HYDROMETER TEST)

The hydrometer test is merely a means of determining the state of charge of the battery. This test will not necessarily indicate whether the battery is able to perform its normal functions.

1. Measure specific gravity of electrolyte in each battery cell. The hydrometer tube must be held vertically. Do not draw too much electrolyte into the hydrometer. The float must be freely suspended in the electrolyte and the reading taken at eye level. If water has been recently added to the cells, or battery fast charged, the hydrometer reading will be false.

2. Correct hydrometer reading for temperature. When electrolyte temperature is above 80° F., add 4 points (.004) to reading for each 10° above 80°. If electrolyte temperature is below 80° F., subtract 4 points (.004) for each 10 below 80°.

3. Analyze hydrometer readings as follows:

a. If the specific gravity readings are 1.215-1.270 at 80°F., and variation between cells is less than 25 gravity points (.025), the battery presumably is at least ¾ charged and in good condition for further use or testing of engine electrical circuits.

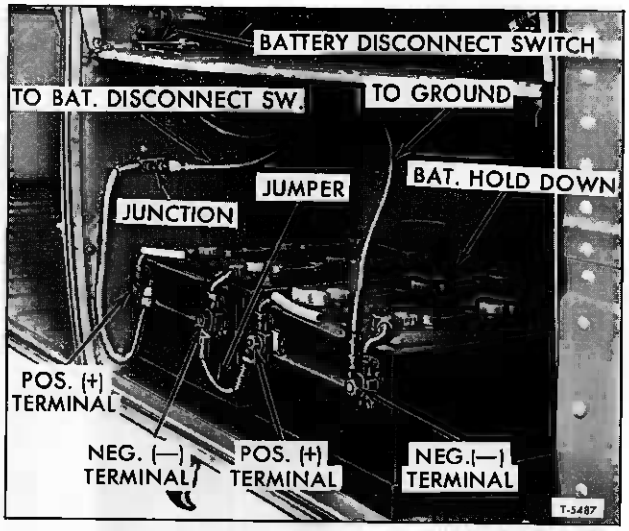


Figure 3—Batteries Installed (Model PD4903)

b. If the specific gravity readings are below 1.215 and the variation between cells is less than 25 gravity points, the battery presumably is in sound condition, but its state of charge is too low for further use or testing electrical circuits.

c. If the specific gravity readings show a variation between cells of more than 25 gravity points, an unsatisfactory battery condition is indicated which may be caused by shorted cells, acid loss, or a worn out battery.

To determine whether a battery is a good battery, regardless of its state of charge, proceed with the "Capacity Test" below:

CAPACITY TEST

This test is one means of determining whether a battery is functioning efficiently to the degree where it can be relied upon to perform all of its duties properly in the vehicle.

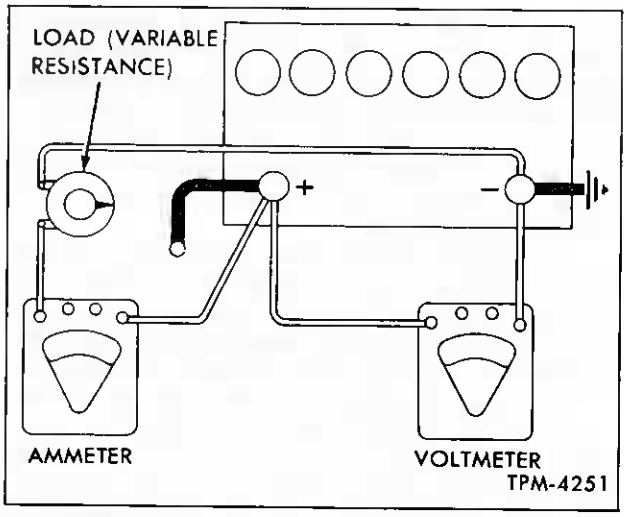


Figure 4—Typical Connections for Battery Capacity Test

A 12-volt battery that will maintain 8.4 volts or better during a capacity test should be considered a good battery. To make this test, use equipment that will take a heavy electrical load from the battery such as a carbon pile or other suitable means. If test equipment is not available for loading battery, the starter may be used as a load.

1. Connect positive voltmeter and ammeter leads to battery positive post and negative voltmeter and ammeter leads to battery negative post (fig. 4).

NOTE: Ammeter cable clips must contact battery posts; voltmeter cable clips must contact battery post or cable clamp, not the ammeter cable clips.

2. Apply a load to the battery of three times the ampere-hour rating of the battery for 15 seconds. Refer to "Specifications" at end of this section for ampere-hour ratings.

3. With ammeter reading specified load, read voltage which should not be less than 8.4 volts.

a. If voltmeter shows 8.4 volts or more, battery has good output capacity and will readily accept a normal charge.

(1) If specific gravity is 1.215 or more, no service is required.

(2) If specific gravity is below 1.215, check charging circuit to determine the cause and correct as required. The battery should be slow-charged for city driving. With highway driving and a good charging system, the battery should charge satisfactorily.

b. If voltmeter shows a reading of less than 8.4 volts, proceed with the "Three-Minute Test" described below:

THREE MINUTE BATTERY TEST

If voltage of less than 8.4 volts was obtained in the "Battery Capacity Test" described previously, an accurate test using a voltmeter and a fast charger will establish in three to four minutes whether battery is good or bad when the battery is in a discharged condition.

This procedure determines the condition of charged or discharged batteries by following the principles that:

a. A charged battery may be tested by taking current out of it.

b. A discharged battery may be tested by passing current through it.

IMPORTANT: THE FOLLOWING TEST SHOULD NOT BE MADE IF BATTERY TEMPERATURE IS BELOW 60°F.

If battery temperature is above 50°F., add battery water, if necessary, and proceed with the Three Minute Test.

CAUTION: DO NOT make the test, which is recommended for discharged batteries, if voltage obtained in "Battery Capacity Test" is 8.4 volts or more. A charged battery will not accept 40 amperes without an excessively high voltage.

TEST PROCEDURE

If voltage obtained in "Battery Capacity Test" was less than 8.4 volts, fast charge the battery at 40 amperes for 3 minutes. Then, with fast charger still operating, test individual cell voltages of the battery.

NOTE: Since cell connectors are not exposed on some batteries, it may be necessary to pierce the cover to contact the connector straps to obtain individual cell voltages. Where pierced, the connectors should be resealed using a warm soldering iron. DO NOT USE AN OPEN FLAME NEAR THE BATTERY.

1. If cell voltages are uneven by more than 0.1 volt, replace the battery.

2. If cell voltages are even within 0.1 volt, test total battery voltage with charger still operating on fast charge.

NOTE: If total voltage is over 15.5 volts, battery is unsatisfactory and is probably sulfated. Battery may be serviceable after a continued slow charge as outlined under "Charging" later in this section. After charging, perform "Battery Capacity Test."

a. If voltage is above 8.4 volts, place battery back in service. If voltage is below 8.4 volts, replace the battery.

b. If voltage is below 15.5 volts, test specific gravity and charge the battery.

BATTERY INSTRUMENT TEST

NOTE: A number of suppliers have approved testing equipment available, such as tester J-22552).

These testers have a programmed test procedure consisting of a series of timed discharge and charge cycles, requiring approximately 2 to 3 minutes, that will determine the condition of a battery with a high degree of accuracy. When using these testers, follow procedures recommended by the tester manufacturer. The battery should not be charged prior to testing as doing so may alter the test results.

CHARGING

Batteries removed from the vehicle for charging should be charged continuously at a low rate until fully charged. Batteries may be safely slow-charged at a rate in amperes equal to 7% of the batteries ampere-hour capacity. (Refer to "Specifications" at end of this section for ampere-hour rating of batteries used.) This is called the "normal" charge rate. The battery is fully charged when specific gravity readings taken at hourly intervals show no increase during three consecutive readings.

A very low rate -- not more than one-half the normal charging rate -- should be used for charging a sulfated battery. In the case of badly sulfated batteries, as much as 100 hours of charging time may be required before the battery becomes fully charged. Badly sulfated batteries may require a continuous slow charge for 48 hours or more before a rise in gravity reading occurs. If the specific gravity reading of any cell fails to reach 1.250 (corrected to 80°F.) or if there is a variation of more than 25 gravity points between cells after thorough slow charging, replace the battery.

Although the slow-charge method is recommended for charging all batteries, discharged batteries in otherwise good condition (refer to "Battery Capacity Test") may be given a boost with a quick charger if time does not permit complete slow charging. When using a quick charger, it must be remembered that the battery is only receiving a partial charge and that the battery electrolyte temperature must not be allowed to exceed 130°F. If the battery heats up excessively, quick charging must be discontinued.

BATTERY CABLES

Check cable leads and connections to determine if they are in good condition. Excessive resistance, generally caused by poor connections, produces abnormal voltage drop which may lower voltage at starting motor to such a low value that normal operation of starting motor will not be obtained. Abnormal voltage drop can be detected with a low reading voltmeter as follows:

NOTE: To prevent engine from starting, place "ENGINE CONTROL" switch in engine compartment in "OFF" position.

1. Check voltage drop between grounded (negative) battery terminal and vehicle frame. Place one prod of voltmeter on battery terminal and other on vehicle frame. With starting motor cranking engine at normal room temperature (70°F), voltage reading should be less than 0.3 volt. If more than this, there is excessive resistance in this circuit.

2. Check voltage drop between ungrounded (positive) battery terminal and starting motor terminal stud while motor is operated. If reading is more than 2.5 volts, there is excessive resistance in circuit.

NOTE: If necessary to extend wire from the meter for this test, use No. 16 or larger wire.

3. Check voltage drop between starting motor housing and vehicle frame. This must be less than 0.2 volt.

STARTING SYSTEM

BATTERY SPECIFICATIONS

Make	Delco-Remy
Model No.	8D6-205
Catalog No.	750
Quantity PD-4107 PD-4103	2 connected Parallel 2 connected in Series
Volts	12
No. of Plates Per Cell	27
Amp Hr. Capacity at 20 Hr. Rate	205
Cranking Ability at 0° F	17.5 Min. at 300 Amps.

Starting System

GENERAL

The starting system includes the batteries, starter, starter solenoid, starter control relay or magnetic switch, starter switches, circuit breakers, and interconnecting wiring and cables. Starting system control circuits are shown on applicable "Engine Control and Generator Wiring Diagram" in "Wiring Diagrams" booklet X-6814A. For information pertaining to Starter Control Relay or Magnetic Switch, refer to "Relays" in "WIRING AND MISCELLANEOUS ELECTRICAL" section of this manual.

CONTROL SYSTEM OPERATION

IMPORTANT: The starter should not be engaged longer than 15 seconds continuously. If engine does not start within this time, wait 10 to 15 seconds before second attempt.

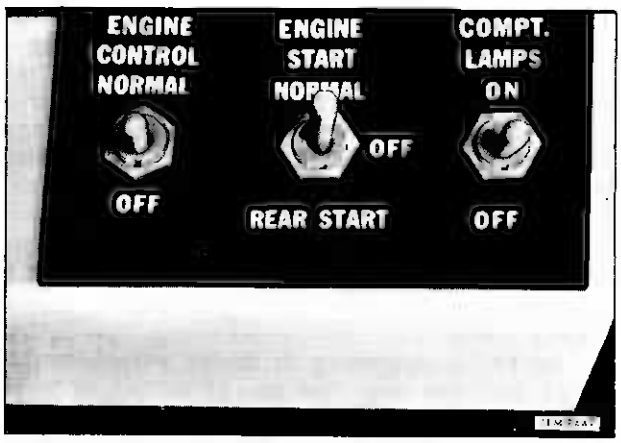


Figure 1—Engine Compartment Control Panel

Starter control system is inoperative with "ENGINE CONTROL" and "ENGINE START" switches located on engine compartment control panel (fig. 1) in the "OFF" position. These switches must be in "NORMAL" position to operate starter from driver's compartment. The "ENGINE CONTROL" switch located on engine compartment control panel must be in "NORMAL" position to operate starter from engine compartment. Operation of starter is as follows:

STARTER OPERATION

IMPORTANT: The transmission shift lever must be in "NEUTRAL" position and the parking brake should be applied before operating the starter.

Starter control system is operative when "ENGINE" switch on driver's control panel is placed in "RUN" position. Before starter motor can be energized with the "START" switch, the rear start and engine control switches on engine compartment control panel must be in "NORMAL" position.

When starter switch is closed, circuit is completed through starter magnetic switch, energizing starter solenoid coil. With solenoid operating coil energized, circuit is completed from battery to starter.

On coaches equipped with an automatic engine shut-off system, circuit from "ENGINE" or "ENGINE CONTROL" switch to engine stop solenoid valve is routed through normally closed contacts of engine stop relay. If engine fails to start within 20 seconds after circuit is energized, relay contacts will open; "ENGINE" or "ENGINE CONTROL" switch must then be momentarily returned to "OFF" position to close relay contacts.

CAUTION: When performing maintenance in engine compartment, place "REAR START" or "ENGINE CONTROL" switch in "OFF" position to prevent engine from being started from driver's control panel. When starting engine from rear controls, make sure transmission is in "NEUTRAL" position and hand brake is applied.

STARTER

DESCRIPTION

Starter (fig. 2) is a heavy duty unit, solenoid operated through an enclosed shift lever. Starter is equipped with a heavy duty sprag type overrunning clutch. A removable plug is provided in shift lever housing to permit adjustment of pinion clearance.

Armature shaft is supported in bronze bushings at three points -- in commutator end frame, in shift lever housing, and in nose housing. Positive lubrication is provided at each bushing by an oil saturated wick that projects through the bushing and contacts the armature shaft. A waste-filled oil reservoir for each wick provides a large oil supply.

O-ring seals are used between commutator end frame and field frame, and between shift lever housing and field frame. A spring-loaded lip-type oil seal together with an O-ring seal in shift lever housing and a boot over the solenoid plunger prevent entry of transmission oil into the armature, field coils, and solenoid case.

Two brushes are carried in each of four holders mounted on plates which are attached to, but insulated from, the commutator end frame. As shown on wiring diagram (fig. 3), two sets of brushes connect to the ground terminal stud on commutator end frame; these connections are made through the brush holder mounting plate. The other two sets of brushes, which are insulated from the mounting plate, connect to the field coil leads.

STARTER DRIVE OPERATION

When starter circuit is energized, shift lever operated by solenoid slides the pinion into mesh with flywheel ring gear teeth. The rotary motion between pinion and ring gear, provided by the spiral splines on clutch shaft, normally relieves tooth abutment on the first attempt. A protective sleeve located on spiral spline acts as a stop for the pinion when extreme tooth abutment occurs. This limits the clutch travel, preventing the switch contacts in solenoid from closing. Therefore, armature cannot rotate before pinion is engaged properly, preventing damage to pinion and ring gear. A second attempt to engage rotates pinion enough to assure proper engagement.

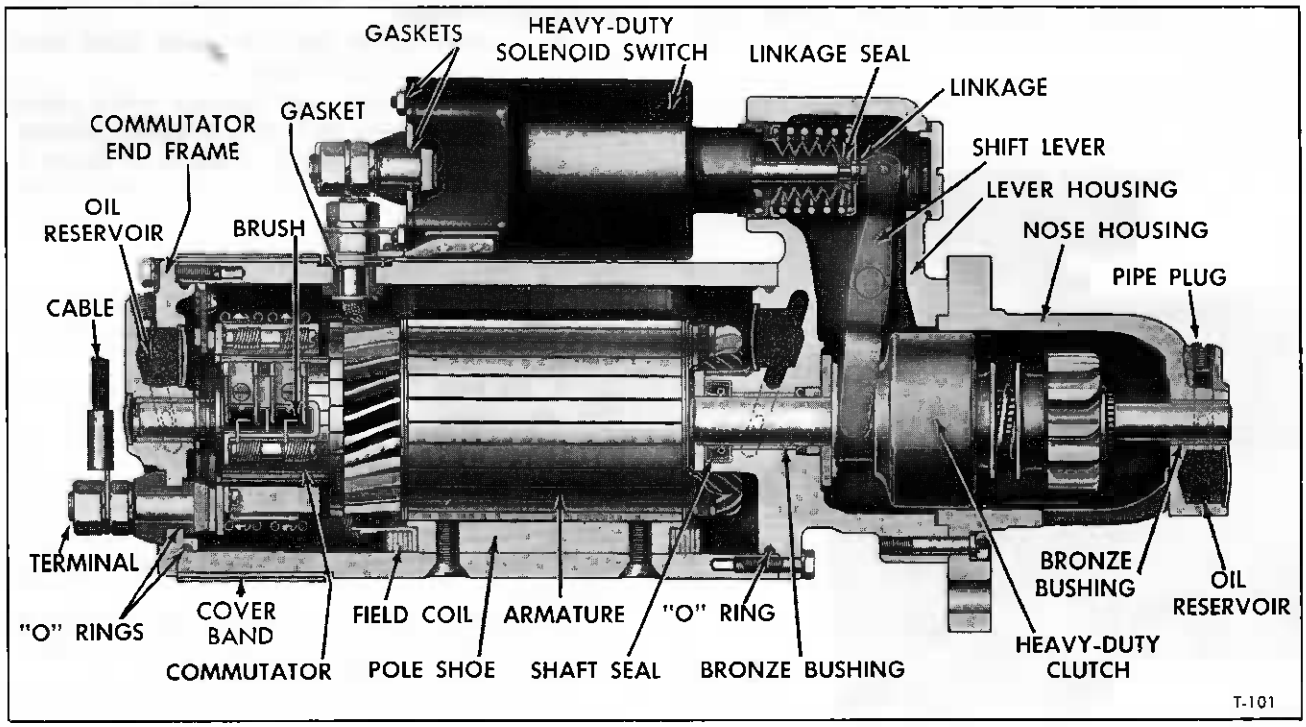


Figure 2—Starter and Solenoid Assembly (Typical)

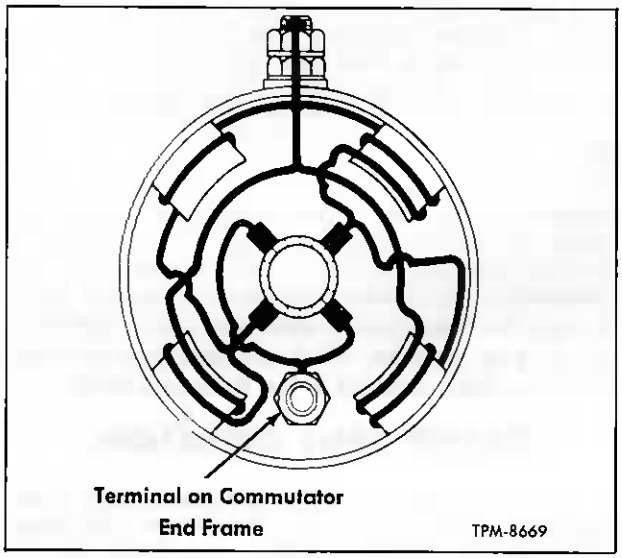


Figure 3—Starter Internal Wiring Diagram

STARTER REPLACEMENT

Starter is accessible through access panel opening under rear seat.

REMOVAL

1. Remove rear seat and engine compartment access panel.
2. Disconnect exhaust pipe from manifold; then remove the manifold.
3. Disconnect negative battery cable from battery or move battery disconnect switch to "OFF" position.
4. Remove wires and cable from starter solenoid.

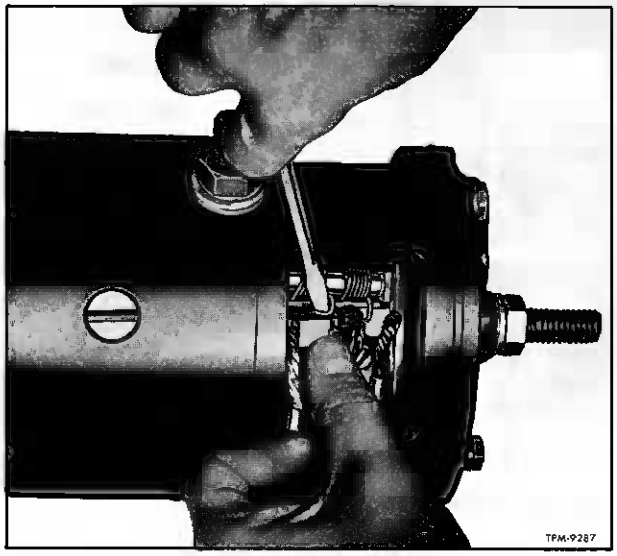


Figure 4—Removing or Installing Brushes

5. Secure a suitable strap around the starter then remove bolts which attach starter to engine. Carefully remove starter through access panel opening.

INSTALLATION

1. Using a suitable strap to support the starter, carefully lower starter motor into position on engine through access panel opening. Install three bolts to attach starter to engine and tighten securely.
2. Connect cable and wires to terminals on starter solenoid.
3. Connect exhaust pipe to manifold and attach exhaust manifold to engine.
4. Install engine access panel cover, then install rear seat.
5. Connect negative battery cable to battery (if removed) or move battery disconnect switch to "ON" position.

MAINTENANCE

Other than periodic lubrication as directed in LUBRICATION (SEC. 13) and keeping cable connections clean and tight, the starter should require no periodic maintenance. The brushes can be inspected and replaced without disassembling the starting motor; however, it must be removed from the engine.

BRUSH REMOVAL

1. Remove starting motor from engine as explained previously.
2. Remove cover band or cover plate from commutator end of field frame.
3. Remove screws and washers which attach brush leads and field coil leads to brush holders.
4. Using a screwdriver as shown in figure 4, bend brush holder spring back and remove brush from holder.

BRUSH INSPECTION

1. When brushes are worn down to less than one-half their original length, they must be replaced (original length is ¾-inch).
2. Be sure leads are secure in brushes and that clips are properly soldered to leads.

BRUSH INSTALLATION

1. Using screwdriver to bend brush holder spring as shown in figure 4, and with groove in brush aligned with ridge in holder, insert brushes in holders.
2. Position brush leads and field coil leads to brush holders and attach with one screw and washer in each brush. Tighten screws firmly.
3. Position cover band or cover plate over commutator end of field frame and tighten screws firmly.

4. Install starting motor on engine as explained previously.

STARTER FREE SPEED CHECK

Before disassembling starter, the following check of starter operation can be made to determine conditions which may require special attention during overhaul.

To make this check, connect an ammeter in series with the positive (+) terminal of a 12-volt battery (two 12-volt batteries connected in series on PD-4903 coach models) and the "BAT" terminal of the starter solenoid (fig. 5). For the return circuit, connect a lead from the starter frame to the battery negative (-) terminal. Connect a voltmeter from solenoid "Bat." terminal to ground on starter frame.

Use a tachometer at end of armature shaft (fig. 5) to determine armature rpm. Energize the solenoid by connecting a jumper lead from the solenoid "Bat." terminal to the solenoid switch terminal. Observe the armature rpm, voltage, and current draw. Failure of starter to operate according to values listed in "Specifications" at end of this section may be due to tight or dry bearings, or to high resistance connections.

STARTER DISASSEMBLY

(Refer to Figure 2)

1. Using a prick punch or small chisel, mark relative positions of commutator end frame and shift lever housing to field frame, and position of nose housing to shift lever housing so they can be reassembled in same positions.

2. Remove nut and lock washer attaching solenoid "Motor" terminal connector strap to terminal stud on field frame. Also, disconnect solenoid ground lead from terminal stud on commutator end frame.

3. Remove plug and gasket from shift lever housing. Remove nut from end of solenoid plunger rod, then remove four cap screws and lock washers attaching solenoid assembly to field frame.

4. Remove six socket-head screws attaching nose housing to shift lever housing. Remove nose housing from lever housing and armature shaft.

5. Remove cover band assembly from commutator and field frame assembly. Disconnect field coil leads from brush holders.

6. Remove bolts and lock washers attaching commutator end frame to field frame. Remove commutator end frame assembly from field frame and armature shaft. Remove thrust washer from armature shaft.

7. Remove bolts and lock washers attaching shift lever housing to field frame. Separate field frame from shift lever housing and remove.

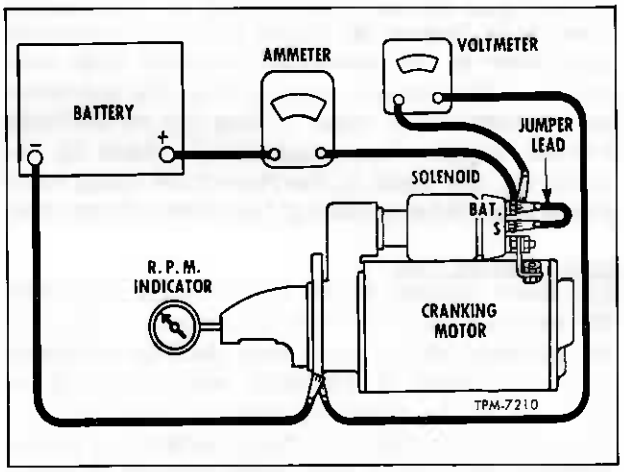


Figure 5—Test Hook-Up for Checking Starter Free Speed

8. Withdraw armature from shift lever housing, removing drive clutch assembly from armature shaft as armature is removed. Remove brake washer from armature shaft, and remove collar and O-ring from counterbore in shift lever housing.

9. It is not necessary to further disassemble starter unless parts require replacement as directed later under "Inspection, Tests, and Repair."

INSPECTION, TESTS, AND REPAIR

(Refer to Figure 2)

The overrunning clutch assembly, armature, and field frame and coil assembly should not be cleaned in a degreasing tank or with grease dissolving solvents, since these would dissolve the lubricant in the clutch mechanism and damage the insulation in the armature and field coils. All parts except the clutch should be cleaned with oleum spirits and a brush. The clutch should be wiped with a clean cloth. Commutator can be cleaned with No. 00 sandpaper. NEVER USE EMERY CLOTH TO CLEAN COMMUTATOR.

ARMATURE

If the armature commutator is worn, dirty, out-of-round, or has high insulation, the armature should be placed in a lathe and the commutator turned down. Do not cut deeper than necessary to remove rough spots or out-of-round condition. DO NOT UNDERCUT THE INSULATION BETWEEN THE COMMUTATOR SEGMENTS AFTER TURNING DOWN THE COMMUTATOR.

The armature should be checked for open circuit, short circuit, and grounds as follows:

Open Circuit Test

Open circuits are usually caused by excessively long cranking periods. The most likely place

for an open circuit to occur is at the commutator riser bars. Inspect the points where the conductors are joined to the commutator bars for loose connections. Poor connections cause arcing and burning of commutator bars. If bars are not too badly burned, repairs can sometimes be made by resoldering the leads in the riser bars, using rosin flux solder. After soldering, turn down commutator.

Short Circuit Test

Short circuits in the armature are located by the use of a growler. When armature is rotated in the growler with a steel strip such as a hacksaw blade held above it, the blade will vibrate above the area of the armature core in which the short circuit is located (fig. 6). The possibility of shorts between the bars is eliminated because of insulation type and high copper content brushes.

Ground Test

Grounds in the armature can be detected with a 110-volt test lamp and test points. If the lamp lights with one test point on commutator and the other on the core or shaft, the armature is grounded. Grounds occur as a result of insulation failure, which is often brought about by overheating due to excessively long cranking periods, or by accumulation of brush dust between the commutator bars and the steel commutator ring.

FIELD COILS

Internal wiring circuits are shown in figure 3. Connect one test lamp lead to the field frame and the other to the terminal stud on the field frame.

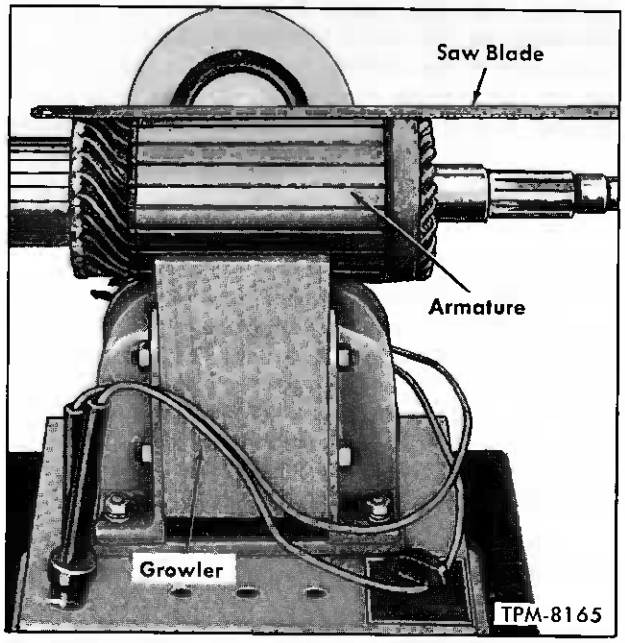


Figure 6—Checking Armature for Short Circuits

If lamp lights, at least one of the field coils is grounded and it must be repaired or replaced.

Connect one test lamp lead to the terminal stud on field frame and the other, in turn, to each of the field coil leads which connect to the brush holders; lamp should light. If lamp fails to light in either case, the field coils are open.

Field Coil Replacement

Field coils can be removed from the field frame by using a pole shoe screwdriver. A pole shoe spreader should also be used to prevent distortion of the field frame. Careful installation of the field coils is necessary to prevent shorting or grounding the field coils as the pole shoes are tightened into place. Each pole shoe has a long lip on one side and short lip on the other; they should be installed with the long lip pointing in the direction of armature rotation so it becomes the trailing (not leading) edge of the pole shoe.

COMMUTATOR END FRAME

Remove all brushes. Place one test lamp lead on end frame, and the other, in turn, on each of the brush holders and on terminal stud. If lamp lights it is an indication of defective brush holder insulation or terminal insulators. Replace defective insulators under brush holder mounting plates or at terminal stud.

Check brush spring tension. If not within limits listed in "Specifications" at end of this section, replace with new springs. Examine brush holders and hinge pins for bent or damaged condition. Any condition which might prohibit free brush action must be corrected.

Examine bushing in end frame for excessive wear or out-of-round condition. Original diameter of bushing is listed in "Specifications" at end of this section. Replace bushing, if necessary, as directed following:

Bushing Replacement

1. Remove expansion plug from armature shaft bore.
2. Remove expansion plug from oil reservoir and remove pipe plug from oil wick passage. Remove packing and oil wick from reservoir.
3. Press old bushing from end frame and press new bushing into place.
4. Using a drill same size as oil wick passage, run drill through passage to cut through edge of bushing. Remove burrs from bushing caused by drilling operation.
5. Install new oil wick and fill oil reservoir with fine wool packing material. Saturate reservoir packing and oil wick with engine oil, then install new expansion plug with gasket in oil reservoir opening.
6. Install new expansion plug with gasket in armature shaft bore in end frame.

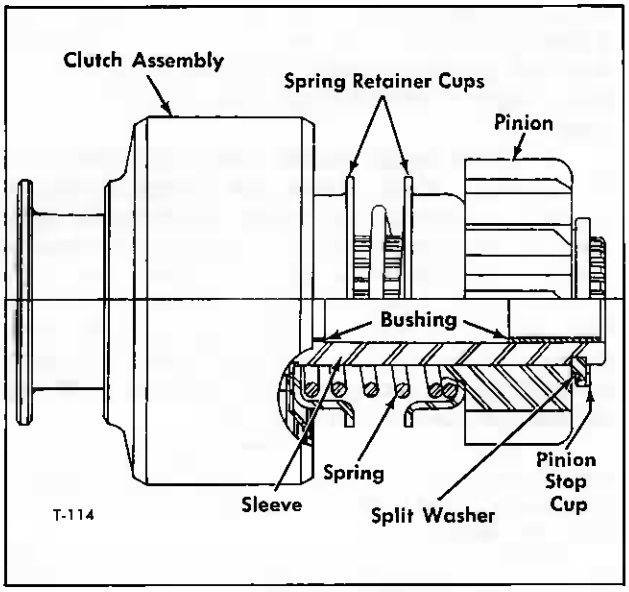


Figure 7—Drive Clutch Assembly (Typical)

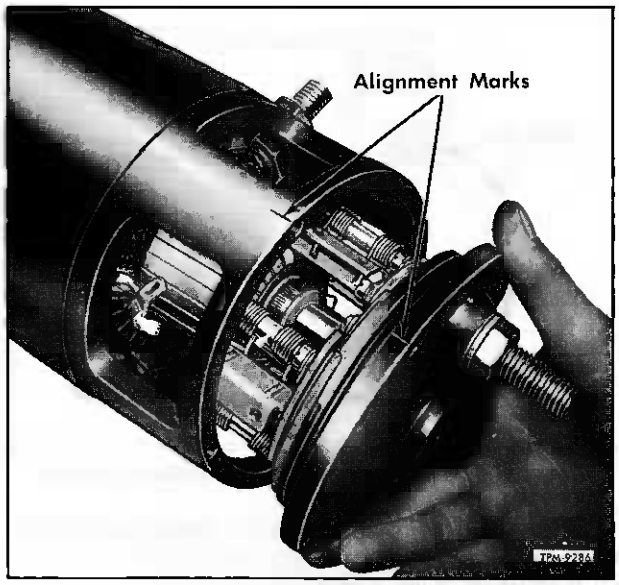


Figure 8—Installing Commutator End Frame

SHIFT LEVER HOUSING

Inspect oil seal and bushing in shift lever housing for evidence of damage or excessive wear. Original diameter of bushing is listed in "Specifications" at end of this section. Replace bushing, if necessary, as directed in "Bushing Replacement" under "Commutator End Frame," omitting steps 1 and 6. When installing new oil seal, lip must point inward.

If shift lever appears excessively loose on lever shaft, worn parts can be replaced by removing retaining ring from exposed small end of lever shaft, then driving shaft out of housing. When installing lever and shaft, use new O-rings in grooves in shaft.

NOSE HOUSING

Inspect bushing in nose housing for wear, referring to "Specifications" for original bushing diameter. Replace bushing, if necessary, as directed in "Bushing Replacement" under "Commutator End Frame," omitting steps 1 and 6.

OVERRUNNING CLUTCH ASSEMBLY

Drive pinion must rotate freely in overrunning direction and must not slip in cranking direction. The overrunning clutch can be serviced as follows, referring to figure 7.

Disassembly

1. Using suitable tools, remove the pinion stop cup and split washers from sleeve.

NOTE: In removing the pinion stop cup, cup will be damaged. Use new cup at assembly.

2. Remove pinion, spring retainer outer cup, spring, and spring retainer inner cup.

Inspection and Repair

1. Inspect spring and spring retainer cups. If not in good usable condition, replace with new parts.

2. Inspect pinion. If teeth are chipped or cracked, replace pinion.

3. Inspect sleeve bushings. If bushings do not meet "Specifications" listed at end of this section, press old bushings out of sleeve and press new bushings into place. Ream bushings to "Specifications" listed at end of this section.

Assembly

1. Install spring retainer inner cup, spring, and spring retainer outer cup on sleeve.

2. Install pinion and pinion stop cup on clutch sleeve.

3. Install split-type washers in groove at end of clutch sleeve.

4. Position clutch sleeve assembly in a vise; then with pinion seated firmly against the pinion stop cup, and using suitable tools, bend pinion stop cup lip over split washers, locking pinion stop and split washers together.

STARTER ASSEMBLY

(Refer to Figure 2)

1. Lubricate splines of armature shaft with engine oil, then insert drive end of armature shaft through shift lever housing until shaft just extends through housing. Place O-ring and collar over the armature shaft and position in counterbore in housing. Place brake washer over end of shaft.

2. Position drive clutch assembly in lever

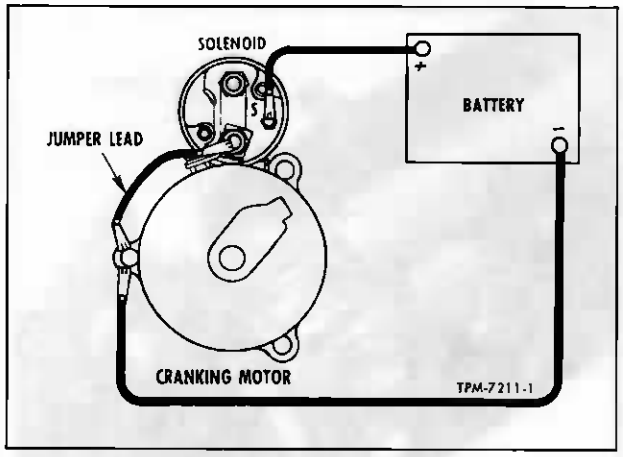


Figure 9—Test Hook-Up for Checking Pinion Clearance

housing with lugs on lever yoke engaging groove in drive clutch shift collar, then push armature shaft through housing and drive clutch.

3. Place gasket in counterbore in shift lever housing, then install nose housing over armature shaft and position at lever housing, with marks made prior to disassembly aligned. Attach nose housing to lever housing with six socket head screws; tighten screws to 13-17 foot-pounds torque.

4. Install new O-ring in groove in field frame side of shift lever housing. Install field frame over armature and position against shift lever housing, with marks made prior to disassembly aligned. Attach lever housing to field frame with five cap screws and lock washers. Tighten cap screws firmly.

5. Position solenoid with plunger assembly on field frame, inserting plunger rod end of solenoid into shift lever housing. Through opening in opposite side of lever housing, make sure plunger rod passes through plunger rod guide in shift lever.

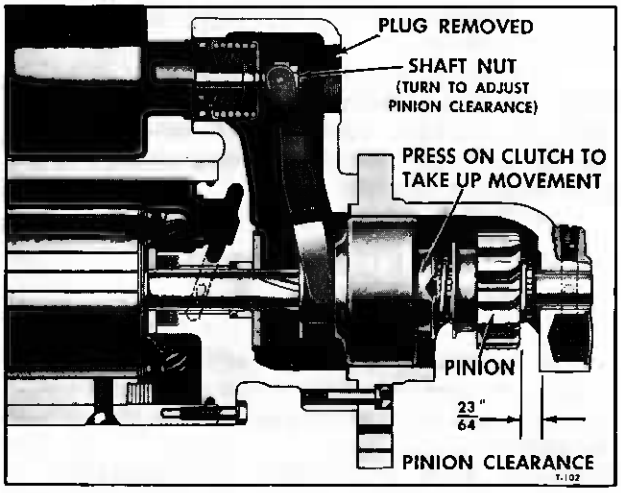


Figure 10—Pinion Clearance Check and Adjustment

Thread adjusting nut a few turns onto plunger rod. Attach solenoid to field frame with four cap screws and lock washers. Install connector strap on solenoid "Motor" terminal and field frame terminal stud.

6. Place thrust washer over commutator end of armature shaft. Place new O-ring in groove around commutator end frame. With marks made prior to disassembly aligned, install end frame to field frame as shown in figure 8. Attach end frame to field frame with four cap screws and lock washers; tighten firmly. Through openings in field frame, install brushes and connect field coil leads to brush holders as previously directed in "Brush Installation" under "Maintenance."

7. Install cover band over commutator end of field frame and tighten two screws firmly. Connect solenoid ground lead to terminal stud on commutator end frame.

NOTE: In order to prevent early starter failure by the entrance of water, oil, or cleaning spray, care should be taken to prevent crimping cover band during installation.

8. Adjust pinion clearance as directed below:

PINION CLEARANCE ADJUSTMENT

1. To check the pinion clearance, connect a 12-volt battery from solenoid switch terminal to starter frame (fig. 9).

NOTE: On PD-4903 coach, use two 12-volt batteries connected in series.

To prevent starter from motoring, connect a heavy jumper from solenoid "Motor" terminal to starter frame (fig. 9).

2. With solenoid energized and drive clutch shifted toward the nose housing, push the pinion back toward armature to take up slack, then check clearance between the pinion and nose housing (fig. 10). Adjust nut on solenoid plunger rod as necessary to obtain the proper clearance of 23/64 inch. After correct adjustment is obtained, install access plug and gasket in shift lever housing.

STARTER SOLENOID

Starter solenoid is used to shift the starter drive pinion into engagement with flywheel teeth and to complete the circuit from battery to starter.

Solenoid has two windings, the pull-in winding and the hold-in winding. When starter switch is closed, both windings are energized, producing a magnetic field which pulls the plunger in. Inward movement of plunger shifts starter pinion into engagement with flywheel ring gear teeth, and closes the main contacts in the solenoid switch to complete the circuit from battery to starter.

The pull-in winding draws comparatively heavy current for a short interval. This is required to shift the pinion into engagement. The hold-in

winding also aids the pull-in winding. As soon as plunger closes the main switch contacts, pull-in winding is de-energized and only the hold-in winding draws current for the balance of the starting cycle.

SOLENOID MAINTENANCE

Solenoid requires no periodic maintenance other than keeping the terminals clean and tight. Always check action of solenoid if it has been removed. If unit fails to function, first check wiring before condemning the solenoid. Solenoid windings can be checked for current draw, open circuit, or shorts. Refer to "Specifications" at end of this section for current values. Solenoid coil, terminals, and switch plunger can be replaced if burned or otherwise damaged. Whenever solenoid is replaced, pinion clearance must be checked and adjusted, if necessary, as previously directed in starter assembly procedures.

STARTING SYSTEM SPECIFICATIONS

	PD-4107	PD-4903
Make	Delco-Remy	Delco-Remy
Starter Model	1114100(a)	1113953(a)
Rotation (Viewing Drive End)	Counterclockwise	Counterclockwise
Minimum Brush Spring Tension (oz)	80	—
No Load Test		
Volts	11.0	23.0
Minimum Amps*	115	60
Maximum Amps*	170	90
Minimum RPM	6300	7000
Maximum RPM	9500	10,700
Starter Solenoid		
Make	Delco-Remy	Delco-Remy
Model No.	1119895	1115517
Rated Voltage	12	24
Current consumption		
Both Windings		
Amps	65.3-73.3	46.1-52.3
Volts	10	20
Hold-In Winding		
Amps	12.7-14.3	6.1-6.8
Volts	10	20

*Includes Solenoid
(a)Pinion Clearance $23/64$" plus or minus $1/32$".

Bushing Diameters (I.D.)	
Commutator End Frame	0.540"-0.544"
Shift Lever Housing	0.810"-0.813"
Nose Housing	0.625"-0.627"
Drive Clutch*	0.6245"-0.6260"

*Burnish After Installation