b. When wheel slipping occurs on locomotives without power-removal feature, the throttle should be partially closed until the buzzer stops, indicating that the wheel slipping is over. When wheel-slip buzzer operates on locomotives with power-removal feature, partially close the throttle, only if there is a chance of the wheels' slipping again. Advance throttle slowly when the possibility of the wheels' slipping is past.

4. *Ground Relay.*

a. Automatic indication of a ground in the electric apparatus is provided by means of a ground relay, *GR*, in the generator circuit.

b. When the ground relay pulls in:

1. *EF* contactor opens.
   a. Exciter field is disconnected from battery to greatly decreased main-generator voltage.
2. *GF* contactor opens.
   a. Main-generator field is weakened by *GFR* resistor. This decreases the generator voltage.

c. *Reset Ground Relay.*

1. Close throttle to *Idle* position.
2. Reset relay by raising the holding latch.
3. If a ground persists, open switch *108*. The locomotive should not be moved any farther in this condition than is necessary to get it in the clear.

5. *Diesel-engine Overspeed Trip.*

Diesel engine overspeed will automatically operate the overspeed trip.

a. Cutout shaft pulls the trip pins on the cutout plungers.
b. High-pressure fuel-injection pumps stop.
c. Diesel engine stops.
d. Reset the overspeed trip lever. Follow instructions given on page 86.

Section 2

Schematic Connection Diagrams

The diagrams and photographs in this section will help operators understand the apparatus and circuits involved in the operation of the Alco—G-E 1000-hp diesel-electric locomotive.

Symbols denoting control devices with current-carrying contacts are underlined. For example, the auxiliary-generator contactor, *A1*, is underlined, but the same symbol, *A1*, referring to the auxiliary generator is not underlined.

Fig. 4. *Master schematic connection diagram*, page 21.

This diagram locates the individual circuits, and is used as a reference to the various detailed schematic diagrams.

Fig. 5. *Main power circuit, with transition relay, wheel-slip relay, and ground relay*, page 22.

This circuit includes the main-generator armature and commutating field, the differential field of the exciter, and the four traction motors. The transition relay, together with the wheel-slip and ground relays, are a part of this circuit.

Fig. 6. *Generator excitation circuit*, page 23.

The main-generator shunt field is excited by the exciter armature. The exciter shunt field has a component of self-excitation from its own armature, and another component of separate excitation from either the battery or the auxiliary generator.

This circuit also includes the excitation resistors and the throttle "*soft-starting*" switch.

Fig. 7. *Power and cranking circuits*, page 24.

The diesel engine is cranked by power supplied to the main-generator armature, commutating field, and starting field from the battery, which operate the generator as a motor to turn over the engine. The starting field is automatically cut out of the circuit as soon as the engine-starting button is released.

Fig. 8. *Auxiliary-generator, voltage-regulating-relay,* and *battery-charging circuits*, page 25.

The auxiliary generator furnishes power for operating the control apparatus and, while the engine is running, supplies separate excitation to the exciter field.

The battery is charged from the auxiliary generator as soon as its voltage is high enough to operate the shunt coil of the reverse-

current relay which closes the battery contactor. If the auxiliary-generator voltage drops below the battery voltage, the relay opens the battery contactor to prevent reverse current flowing from the battery to the auxiliary generator.

Fig. 9. *Engine-starting, control, and alarm circuits*, page 26.

The governor solenoid and pressure switch, together with their interlocks and resistors, and the auxiliary-generator field, with its regulating-relay contacts and resistors, are on the same control switch as the fuel-pump motor. They are connected in this way so that the fuel pump will operate and fuel be available before starting the engine.

The fuel-pump circuit also takes the inductive kick of the auxiliary-generator field when the control switch is opened. This is part of the engine-starting circuit, and it must function properly before the diesel engine will start. The operating coils of the starting contactors GS1 and GS2 should be energized only while starting the diesel engine. This condition is obtained by interlocking the coil circuits of the starting contactors to the B and EF contactors and two fingers and cams of the controller. The wheel-slip buzzer and the overload indicating lamp, together with their operating-relay contacts, are also included on the diagram.

Fig. 10. *Traction control circuits*, page 27.

This diagram is used to show the electric connections which give the correct operation of the traction-motor control devices.

Figs. 11 and 13. *Coil and contact positions on relays and contactors*, pages 28 and 30.

These diagrams locate the individual control devices, and are used as a reference to the various detailed schematic diagrams. The circuit of the device as a part is indicated by a reference to the right of the diagram. Frequently, the separate parts of the respective devices will be found on different diagrams.

Fig. 12. *Interior of control-apparatus compartment, oblique right-side view*, page 29.

The photograph of the right side of the contactor compartment shows the control equipment as it actually is mounted on the locomotive.

Fig. 14. *Interior of control-apparatus compartment, oblique left-side view*, page 31.

This photograph shows the control equipment arrangement on the left side of the contactor compartment.

Fig. 15. *Resistors in control-apparatus compartment*, page 32.

This diagram of the respective control resistors illustrates the internal connections of each resistor.

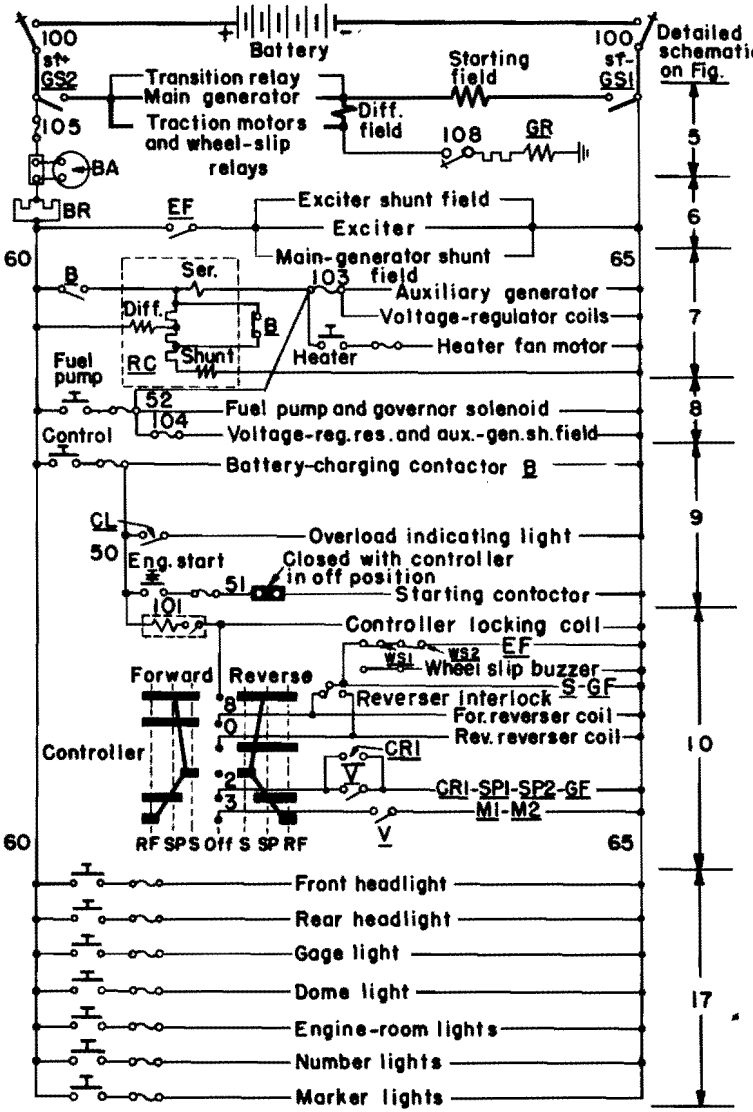


Fig. 4. Master schematic connection diagram

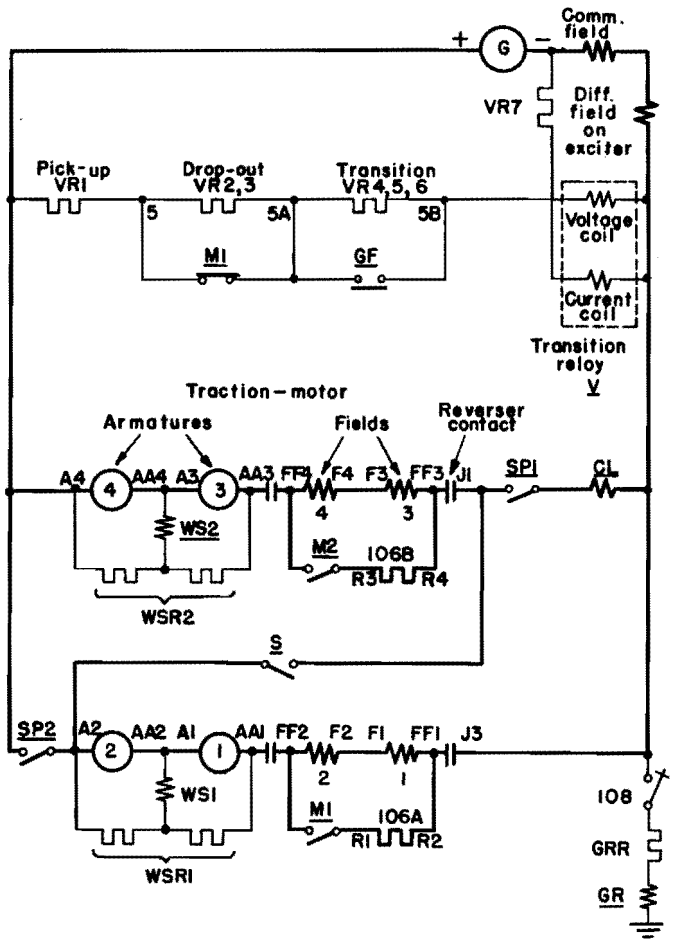


Fig. 5. Schematic diagram of main power circuit with transition, wheel-slip, and ground relays

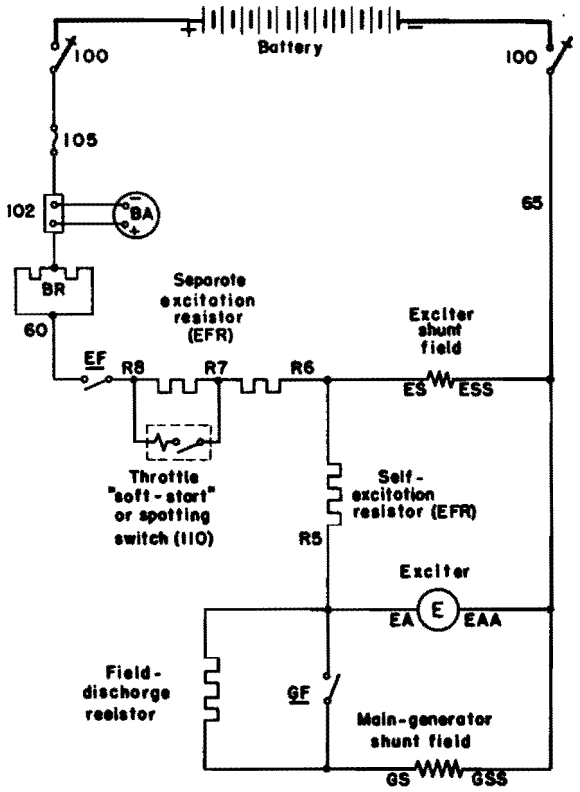


Fig. 6. Schematic diagram of generator excitation circuits

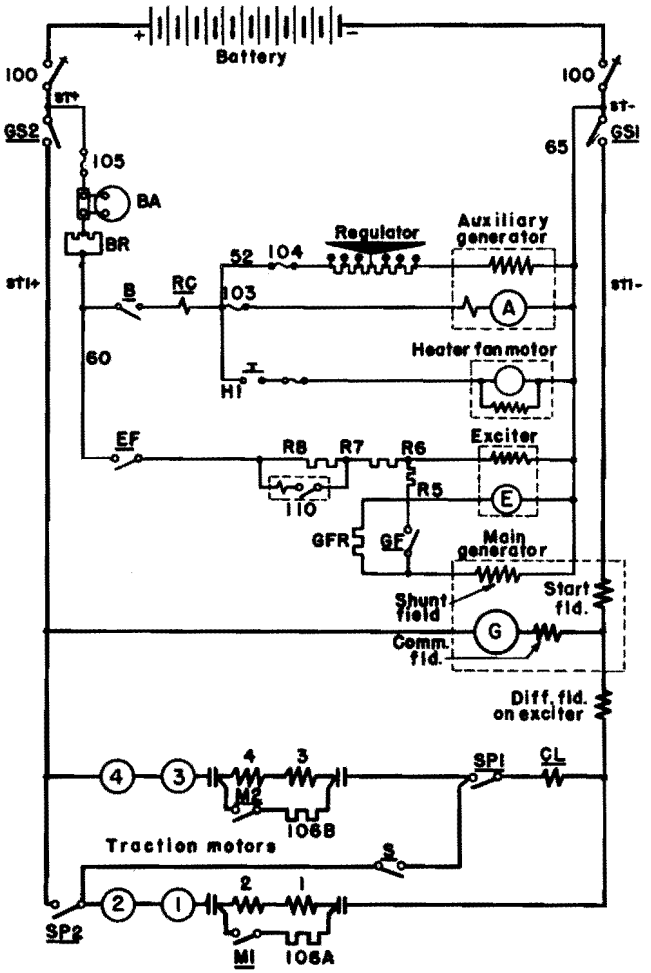


Fig. 7. Schematic diagram of power and cranking circuits

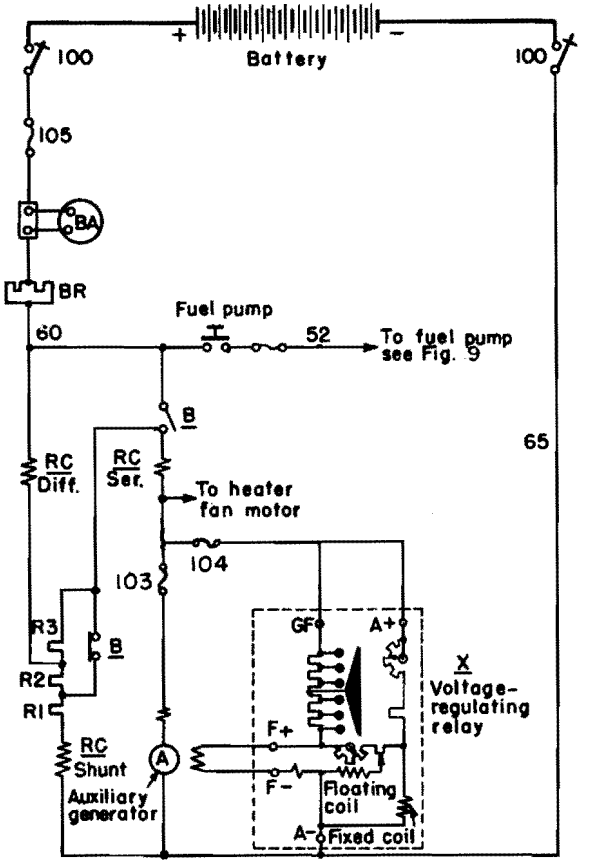


Fig. 8. Schematic diagram of auxiliary-generator, voltage-regulating-relay, and battery-charging circuits

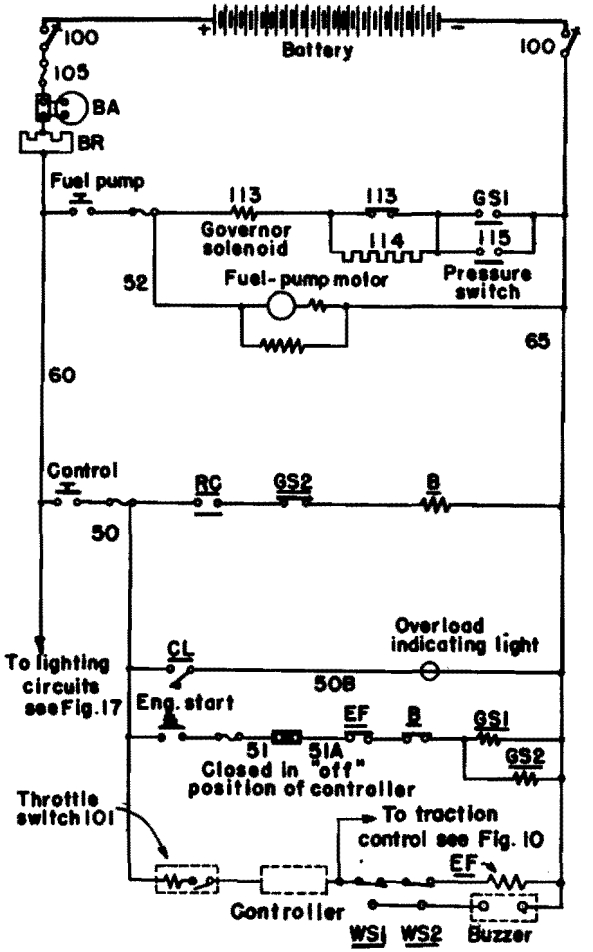


Fig. 9. Schematic diagram of engine-starting, control, and alarm circuits

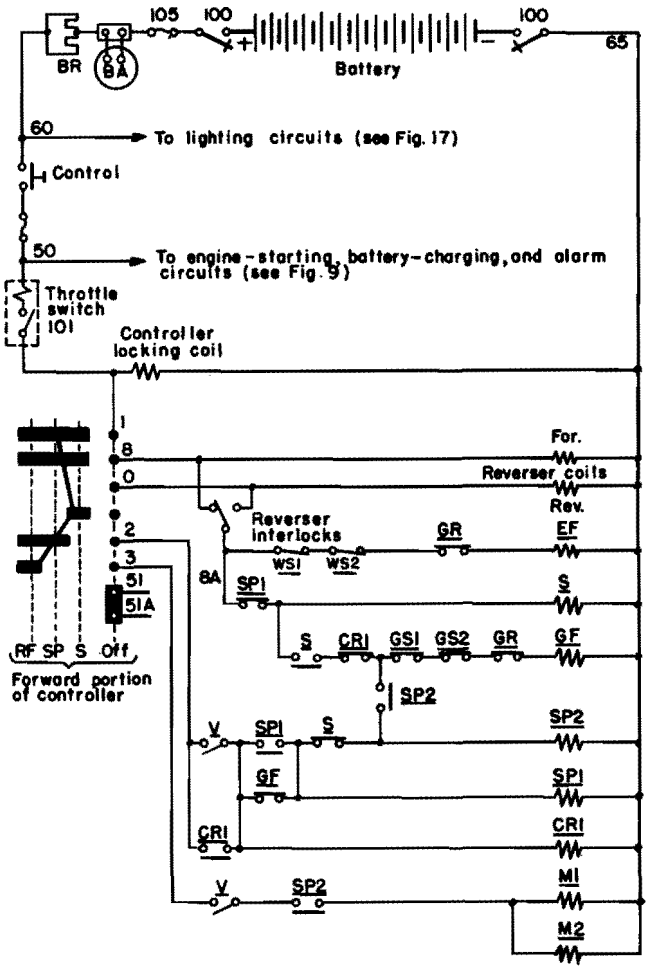
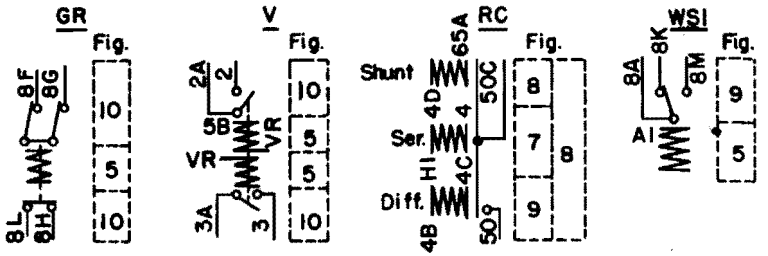
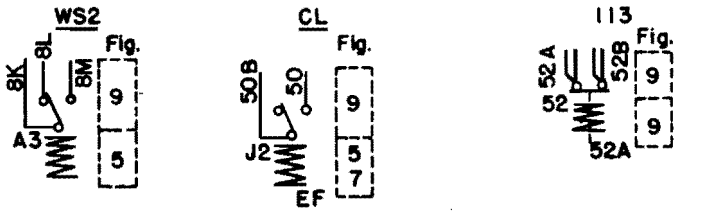


Fig. 10. Schematic diagram of traction control circuits



Mounted on right wall of contactor compartment



Mounted on right wall

Mounted on left wall

Governor solenoid mounted on governor

Legend

- Contact open when relay or contactor is out
- Contact closed when relay or contactor is out
- Interlock open when relay or contactor is out
- Interlock closed when relay or contactor is out
- Operating coil or field coil
- Open knife switch
- Throttle switch open in idle position
- Ammeter shunt
- Fuse

FIG. NO. REFER TO CONNECTION DIAGRAMS

Fig. 11. Coil and contact positions on relays and contactors

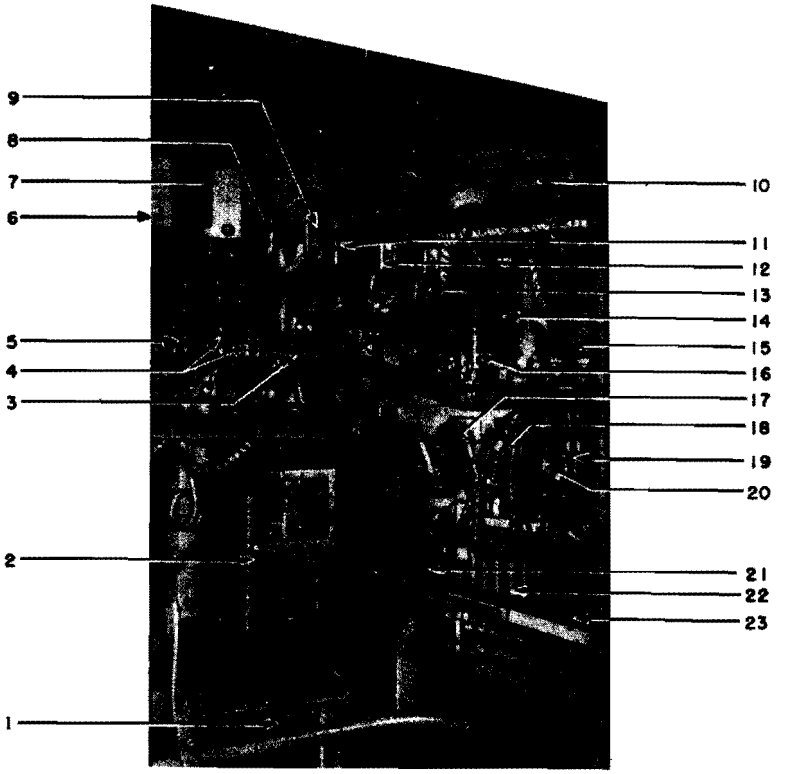


Fig. 12. Interior of control-apparatus compartment, oblique right-side view

1. Intercooler for air compressor
2. 17LH22C1 voltage-regulating relay
3. 17AF14H3 interlock on *SP1* contactor
4. 17AF4A4 interlock on *SP2* contactor
5. 17AF4A3 interlock on *S* contactor
6. 17CP2J3 or K7 *Series* motor contactor, *S*
7. 17CP2J3 or K7 *Series-parallel* motor contactor, *SP2*
8. 17CM12J17 contactor, *GS2*
9. 17CM12J17 contactor, *GS1*
10. "Soft-starting" resistor, CE-247-A1 (EFR)
11. 17CM15AA12 battery-charging contactor, *B*
12. 17CM15AA12 generator field contactor, *GF*
13. 17CM15CC38 exciter field contactor, *EF*
14. Exciter field resistors, CE-247-B1 (EFR)
15. Ground-relay resistor, CE-247-D1 (GRR)
16. Headlight resistors, 17FR7C4 (107A-107B)
17. 17LV24E1 wheel-slip relays (two), *WS1*, *WS2*
18. 17LC19D5 reverse-current relay, *RC*
19. 17LV40H9 ground relay, *GR*
20. 17LC18E2 transfer and field-shunting relay, *V*
21. 17LV40D6 relay, *CR1*
22. Wheel-slip-relay resistors, WSR2
23. Wheel-slip-relay resistors, WSR1

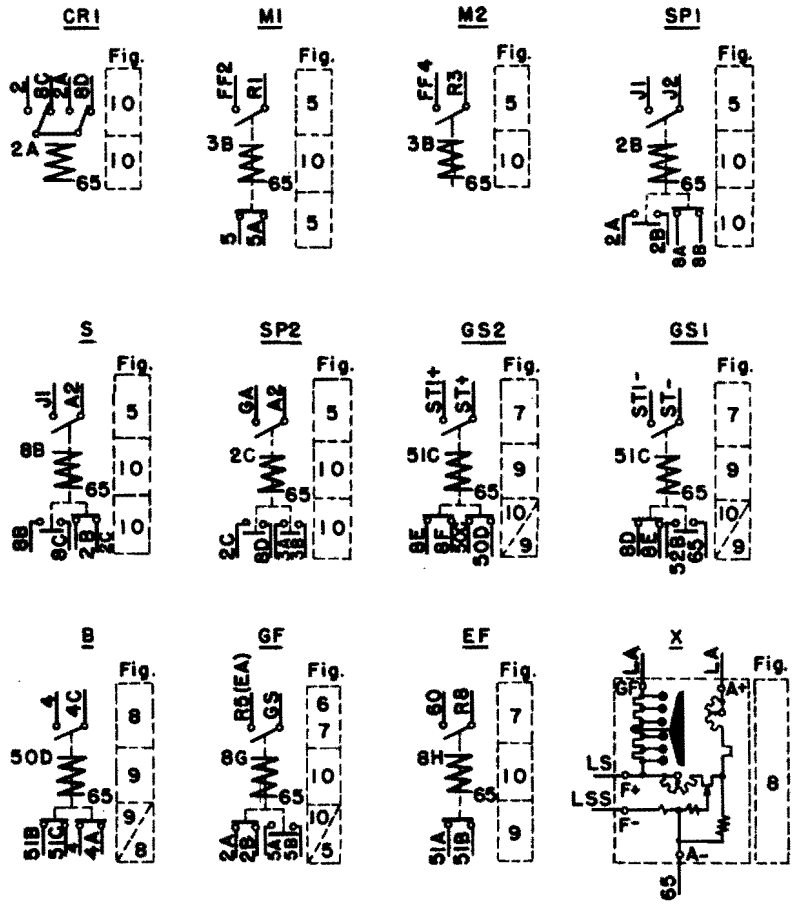


FIG. NO. REFER TO CONNECTION DIAGRAMS

Relays and contactors shown are mounted on front wall of contactor compartment.

Fig. 13. Coil and contact positions on relays and contactors

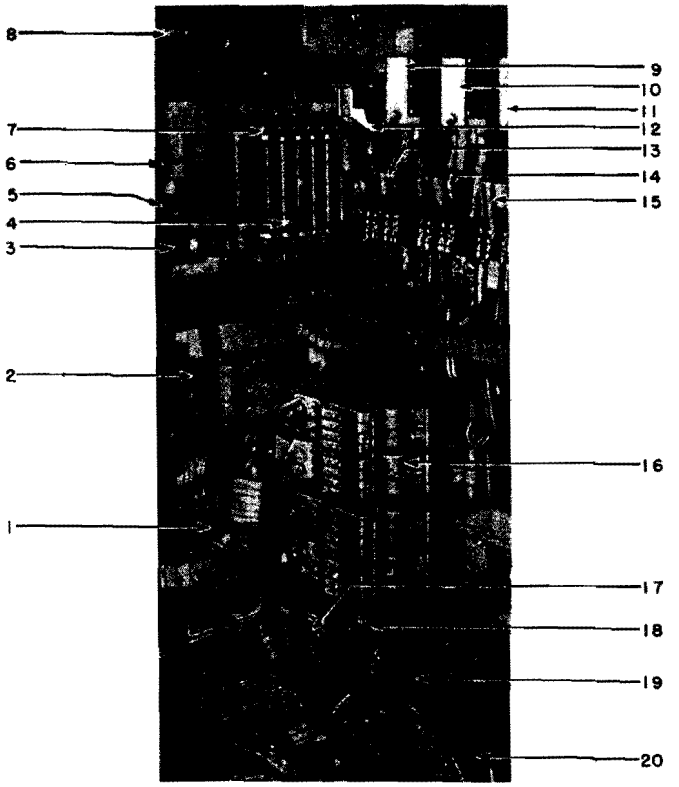


Fig. 14. Interior of control-apparatus compartment, oblique left-side view

1. 17EW102A2 field shunt resistor, 106A and 106B
2. 17LS7C3 overload relay, *CL*
3. Main battery fuse (110 amp), *105*
4. 17FR7C8 control resistor panel (Adjustable resistors for *VR1* to *VR7* transition relay.)
5. Auxiliary-generator fuse (80 amp), *103*
6. Auxiliary-generator field fuse (10 amp), *104*
7. Generator field-discharge resistor on 17FR7C8 panel, GFR
8. Battery-charging resistor CE-247-A1 (BR)
9. *SP1* contactor, 17CP2K7 or J3
10. *S* contactor, 17CP2K7 or J3
11. *SP2* contactor, 17CP2K7 or J3
12. Two *M* field-shunting contactors, 17CM12L4
13. 17AF4A3 interlock on *SP1* contactor
14. 17AF4A3 interlock on *S* contactor
15. 17AF4A4 interlock on *SP2* contactor
16. ME57-E5 or A5 reverser, main drum
17. ME57-E5 or A5 reverser, air engine
18. ME57-E5 or A5 reverser, magnet valves, (two)
19. ME57-E5 or A5 reverser interlock
20. GMG-139 exciter auxiliary generator set, (A)

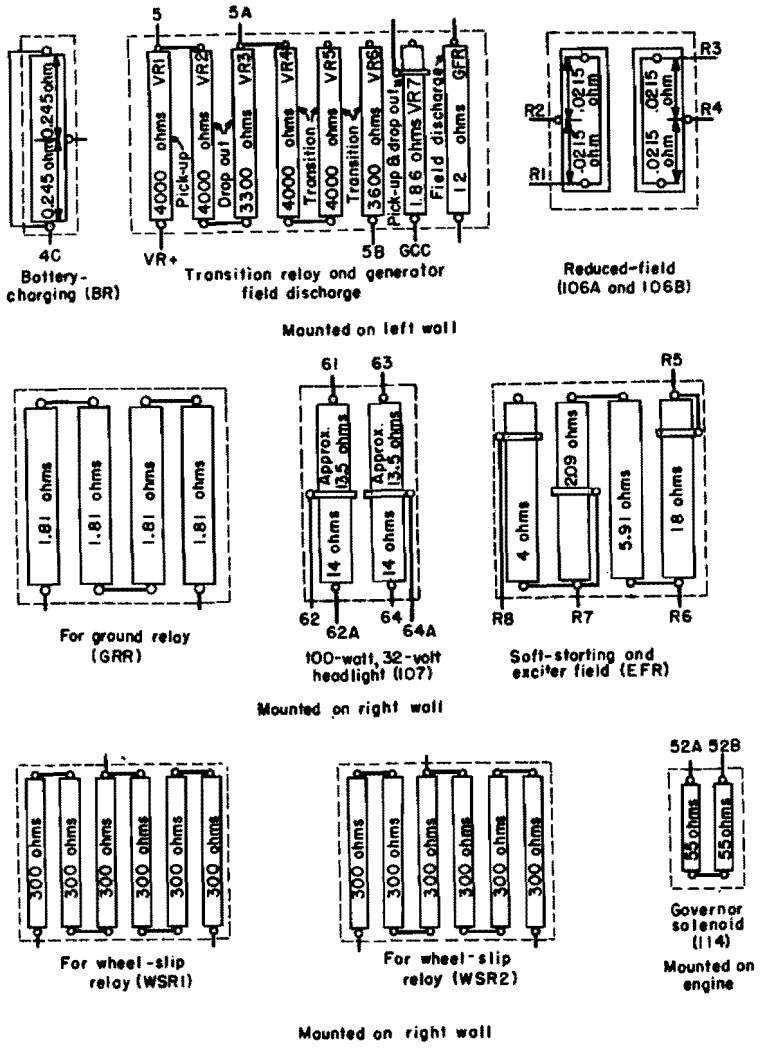


Fig. 15. Resistors in control-apparatus compartment

Cross Index of Control Equipment

Device Symbol	Wire Terminal Numbers: Coil	Wire Terminal Numbers: Contacts: Main	Wire Terminal Numbers: Contacts: Interlock	Pages: Connection Diagram	Pages: Appearance of Device	Pages: Operating Test	Pages: Details	Pages: Description of Operation
B	50D–65	4–4C		26	29	43	49	62
				25	.....	.....	.....	62
			4–4A	25	.....	.....	.....	62
			51B–51C	26	.....	.....	.....	57
BR	.....	.....	.....	21, 23 to 27	31	.....	32	.....
CL	J2–EF	.....	.....	22	31	43	49	87
		50–50B	.....	26	.....	.....	.....	87
CR1	2A–65	.....	.....	27	29	44	49	92
		2–2A	.....	27	.....	.....	.....	92
		8C–8D	.....	27	.....	.....	.....	91
EF	8H–65	.....	.....	27	29	44	49	70
		60–R8	.....	24	.....	.....	.....	89
			51A–51B	26	.....	.....	.....	57
EFR	.....	.....	.....	23, 24, 32	29	.....	32	70
GF	8G–65	.....	.....	27	29	44	49	91
		EA–GS	.....	24	.....	.....	.....	72
			2A–2B	27	.....	.....	.....	92
			5A–5B	22	.....	.....	.....	75
GFR	.....	.....	.....	23, 24	31	.....	32	89
GR	GRR–GRD	.....	.....	22	29	.....	50	89
		8F–8G	.....	27	.....	.....	.....	91
			8L–8H	27	.....	.....	.....	91
GRR	.....	.....	.....	22, 32	29	.....	32	.....
GS1	51C–65	.....	.....	26	29	43	50	57
		(ST–)–(STT–)	.....	24	.....	.....	.....	57
			8D–8E	27	.....	.....	.....	91
			52B–65	26	.....	.....	.....	58

Continued on page 34

Cross Index of Control Equipment (Cont.)

Device Symbol	Wire Terminal Numbers: Coil	Wire Terminal Numbers: Contacts: Main	Wire Terminal Numbers: Contacts: Interlock	Pages: Connection Diagram	Pages: Appearance of Device	Pages: Operating Test	Pages: Details	Pages: Description of Operation
GS2	51C–65	.....	.....	26	29	43	50	57
		(ST+) – (ST1+)	.....	24	.....	.....	.....	57
			8E–8F	27	.....	.....	.....	91
			50C–50D	26	.....	.....	.....	61
M1	3B–65	.....	.....	27	31	45	50	75
		FP2–R1	.....	22	.....	.....	.....	75
			5–5A	22	.....	.....	.....	75
M2	3B–65	.....	.....	27	31	45	50	75
		FP4–R3	.....	22	.....	.....	.....	75
RC	4D–65A	.....	.....	24	29	.....	50	61
	H1–4	.....	.....	25	.....	.....	.....	61
	4B–4C	.....	.....	26	.....	.....	.....	61
		50–50C	.....	26	.....	.....	.....	61
RCR	.....	.....	.....	25	.....	.....	.....	.....
S	8B–65	.....	.....	27	29, 31	44	50	91
		A2–J1	.....	22	.....	.....	.....	72
			2B–2C	27	.....	.....	.....	92
			8B–8C	27	.....	.....	.....	91
SP1	2B–65	.....	.....	27	29, 31	44	51	72
		J1–J2	.....	22	.....	.....	.....	72
			2A–2B	27	.....	.....	.....	92
			8A–8B	27	.....	.....	.....	91
SP2	2C–65	.....	.....	27	29, 31	45	51	72
		GA–A2	.....	22	.....	.....	.....	73
			2C–8D	27	.....	.....	.....	92
			3A–3B	27	.....	.....	.....	93
V	5B–EF	.....	.....	22	29	.....	51	95
	EF–VR7	.....	.....	22	.....	.....	.....	95
		2–2A	.....	27	.....	.....	.....	92
		3–3A	.....	27	.....	.....	.....	93
VR1–7	.....	.....	.....	22	31	.....	32	.....

Cross Index of Control Equipment (Cont.)

Device Symbol	Wire Terminal Numbers: Coil	Wire Terminal Numbers: Contacts: Main	Wire Terminal Numbers: Contacts: Interlock	Pages: Connection Diagram	Pages: Appearance of Device	Pages: Operating Test	Pages: Details	Pages: Description of Operation
WS1	WSR1–A1	.....	.....	22	29	43	52	87
		8A–8K–8M	.....	26, 27	.....	.....	.....	87
WS2	WSR2–A3	.....	.....	22	29	43	52	87
		8K–8L–8M	.....	26, 27	.....	.....	.....	87
WSR1	.....	.....	.....	22	29	.....	32	88
WSR2	.....	.....	.....	22	29	.....	32	88
X	(A+)–(A–)	GF–F+	.....	25	29	.....	52	60
	(F–)–(A–)	.....	.....	25	.....	.....	.....	60
	(A–)–Res.	.....	.....	25	.....	.....	.....	60
Controller Locking Coil	1–65	.....	.....	27	.....	44	52	44
	.....	1–2–3	.....	27	.....	.....	.....	44
	.....	8–0	.....	27	.....	.....	.....	44
	.....	.....	51–51A	26	.....	.....	.....	56
101	.....	50–1	.....	27	69	44	.....	68
106A–B	.....	.....	.....	22, 24, 32	31	.....	32	.....
107A–B	.....	.....	.....	32, 40	29	.....	32	.....
110	.....	R8–R7	.....	23	69	.....	.....	70
113	52–52A	.....	52A–52B	26	.....	44	50	58
114	.....	.....	.....	26, 32	.....	.....	32	.....
115	.....	52B–65	.....	26	.....	44	.....	60
118	65–50A	.....	.....	26	38, 69	42	52	88

Section 3

List of Electric Equipment by Symbols and with Functions

Device Symbol	Device	Function or Circuit
A	Auxiliary generator	Charges battery
B	Battery	Power source for control devices and engine starting
B	Battery-charging contactor	Connects auxiliary generator to battery
BA	Battery ammeter	Shows battery charging or discharging
BR	Battery-charging resistor	Limits battery-charging current
CL	Overload relay	Lights overload indicating lamp
CR1	Control relay	Series-to-parallel transfer
E	Exciter	Energizes main-generator field
EF	Exciter field contactor	Connects exciter field to battery
EFR	Exciter field resistors	Battery excitation and self excitation
G	Main generator	Furnishes power for traction motors
GF	Main-generator field contactor	Energizes main-generator field
GFR	Main-generator field-discharge resistor	Discharges field when *GF* opens
GR	Ground relay	Decreases main-generator voltage when a ground circuit is made
GRR	Ground-relay resistor	Limits current in ground-relay coil
GS1, *GS2*	Engine-starting contactors	Turns engine over from battery
M1, *M2*	Traction-motor field-shunting contactors	Weakens traction-motor fields, producing higher locomotive speed
RC	Reverse-current relay	Controls battery-charging contactor
RCR	Reverse-current-relay resistor	Controls closing and opening of reverse-current-relay contacts
S	Traction-motor series contactor	Connects traction motors in series

LIST OF ELECTRIC EQUIPMENT

Device Symbol	Device	Function or Circuit
SP1, *SP2*	Traction-motor series-parallel contactors	Connect traction motors in series-parallel
V	Traction-motor transfer and field-shunting control (transition) relay	Controls transitions, series to series-parallel to reduced-field, back to series-parallel
VR1 to *VR7* incl.	Resistors for *V* relay	Control closing and opening of transition-relay contacts
WS1, *WS2*	Wheel-slip relays	Ring alarm buzzer when wheels slip, and remove power from main generator. Some locomotives do not have power-removal feature.
WSR1, *WSR2*	Resistors for wheel-slip relays	Provide mid-potential point for wheel-slip relays
X	Voltage-regulating relay	Controls auxiliary-generator voltage
..	Fuel-pump motor	Pumps fuel oil to high-pressure header
No. 1 to *No. 4*	Traction motors	Converts electric energy into mechanical energy to move locomotive
..	Overload indicating lamp	Warns of overload in *Series-parallel* or *Reduced-field* operation
..	Controller	Controls direction of locomotive movement and connections of traction motors
⊣|⊢	Reverser	Reverses traction-motor fields

		Amperes	
100	Battery switch	400	Disconnects battery
101	Throttle control switch	..	Energizes traction control equipment
102	Shunt for battery ammeter	80	Carries current for ammeter BA
103	Fuse for auxiliary generator	80	Auxiliary generator
104	Fuse for auxiliary-generator field	10	Auxiliary-generator field
105	Fuse for battery	110	Battery

Continued on page 39

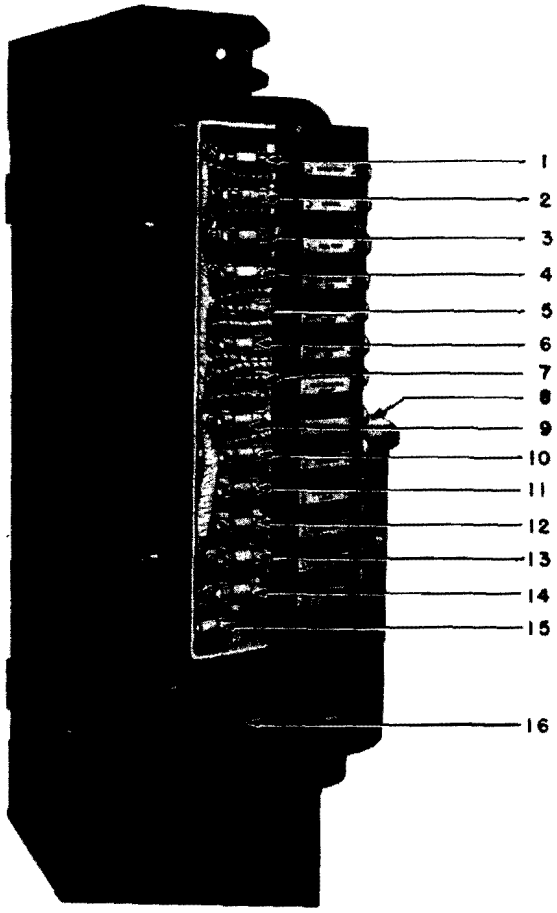


Fig. 16. Control stand, side door open, showing fuses

1. Engine-starting fuse
2. Control fuse
3. Fuel-pump-motor fuse
4. Front-headlight fuse, dim
5. Front headlight, bright, no fuse
6. Rear-headlight, fuse, dim
7. Rear headlight, bright, no fuse
8. C173-R2 controller
9. Gage-light fuse
10. Dome-light fuse
11. Engine-room-lights fuse
12. Number-lights fuse
13. Marker-lights fuse
14. Heater fuse
15. Spare fuse
16. Wheel-slip-buzzer *118*

LIST OF ELECTRIC EQUIPMENT

Device Symbol	Device	Amperes	Function or Circuit
106A *106B*	Traction-motor field-shunting resistors	..	Reduce traction-motor field strength when connected by *M1*, *M2*
107A-B	Headlight resistors	..	Control and reduce headlight brilliance
108	Switch for ground relay	..	Cuts out ground relay
110	Throttle field switch	..	Gives "soft start" for spotting
113	Governor solenoid	..	Shuts down diesel engine
114	Resistor for solenoid	..	Limits current in governor solenoid coil
115	Engine-lubricating oil-pressure switch	..	Shuts down diesel engine
116	Heater-fan motor	..	Circulates warm air in cab
117	17HP4L3 control switch	..	Locomotive control circuits
117	Engine-start switch	10	Starts diesel engine
117	Control switch	10	Battery charging, alarm, engine starting, and traction relay
117	Fuel-pump switch	10	Governor solenoid, fuel-pump motor.
117	Headlights (2)	10	On front and rear of locomotive
117	Gage light	10	Locomotive lights
117	Dome light	10	
117	Engine-room lights	10	
117	Number lights	10	
117	Marker lights	10	
118	Wheel-slip buzzer	..	Warns of wheel slipping

Fuses in Locomotive

In 17HP4L3 Control-switch Push-button Station 117 in Cab

Symbol	Circuit	Amp
.....	Engine-starting	10
.....	Control	10
.....	Fuel-pump-motor	10
.....	Front-headlight, dim	10
.....	Front-headlight, bright, no fuse	..
.....	Rear-headlight, dim	10
.....	Rear-headlight, bright, no fuse	..

Fuses continued on page 40

Fuses in Locomotive (Cont.)

Symbol	Circuit	Amp
.....	Gage-lights	10
.....	Dome-light	10
.....	Engine-room-lights	10
.....	Number-lights	10
.....	Marker-lights	10
.....	Heater	10

Fuses on Left Inside Wall of Cabinet

103	Auxiliary-generator	80
104	Auxiliary-generator-field	10
105	Battery	110

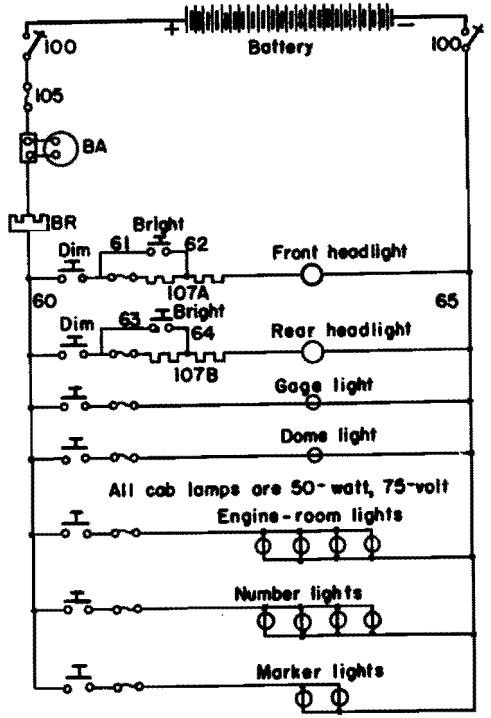


Fig. 17. Schematic connection diagram of lighting and headlight circuits

Effect of Blown Fuses—When Starting Up

Results When Fuse Blows	Fuses Involved
Diesel engine cannot be cranked	*105*, Control-switch fuse, start-switch fuse
Fuel-pump motor will not run	*105*, Fuel-pump motor-switch fuse
	105, Fuel-pump motor-switch fuse
	104, *103*, Control-switch fuse

Effect of Blown Fuses—With Locomotive in Operation

Fuse	Amp.	Results When Fuse Blows
103	*80*	Auxiliary generator will not charge battery Battery ammeter will show discharge Battery will lose its charge
104	*10*	Auxiliary generator will not charge battery Battery ammeter will show discharge Battery will lose its charge
105	*110*	Battery ammeter will read zero Auxiliary generator will furnish control voltage
Engine-start	10	Engine will not turn over
Control	10	Traction-motor contactors will open Battery charge will stop Diesel engine will lose its load
Fuel-pump	10	Fuel-pump motor will stop Governor solenoid will stop engine

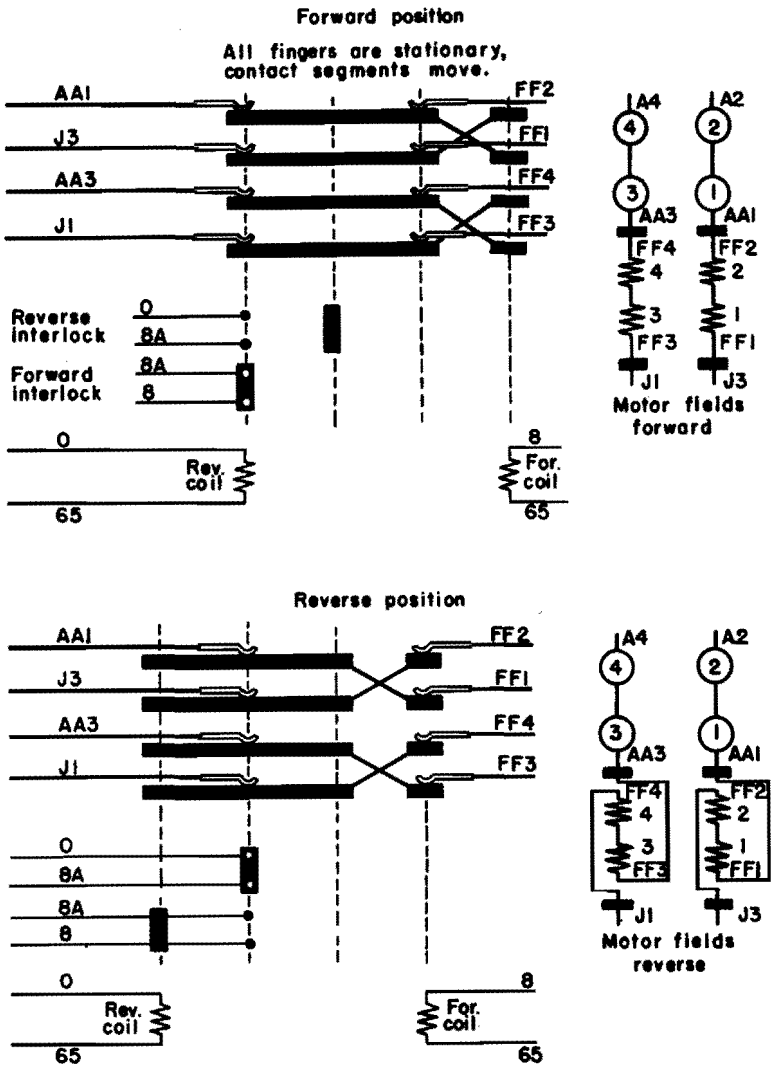


Fig. 18. Schematic diagram of reverser connections

Section 4

Operating Tests on Control Relays and Other Devices

Correct operation of the various control devices can be checked by means of the tests listed below.

These tests should also be used if it is ever necessary to locate a source of trouble.

Instructions must be carefully followed to avoid danger to oneself and damage to the equipment.

Make all tests with diesel engine shut down and with main battery switch No. 100 closed.

Device Symbol	Device Name and Operating Test
1. *B*	*Battery-charging Contactor* a. *Important—Remove Fuse 103.* b. Close *Control* push-button switch. c. Close *RC* relay contacts by hand. 1. Contactor *B* should close. d. Replace *Fuse 103* after test is completed.
2. *Buzzer (118)* *WS1* *WS2*	*Wheel-slip Relays and Buzzer* a. Close *Control* push-button switch. b. Close *WS1* or *WS2* relay by hand. 1. Buzzer should sound.
3. *Overload Indicating Lamp and CL*	*Overload Relay and Indicating Lamp* a. Close *Control* push-button switch. b. Close *CL* relay by hand. 1. Lamp should light.
4. *GS1*, *GS2*	*Engine-starting Contactors* a. Insert fiber strips or thin wooden wedges between main contacts, so that they cannot touch. b. Turn controller to *Off* position. c. Close *Control* push-button switch.