



**OPERATING MANUAL**

TRANSPORTATION SYSTEMS BUSINESS OPERATIONS  
ERIE, PENNSYLVANIA 16531

**GENERAL  ELECTRIC**

**1987  
SERIES-8  
DIESEL-ELECTRIC  
LOCOMOTIVE**

**COVERS ALL MODELS  
B23-8 THROUGH C39-8**

**GENERAL  ELECTRIC**

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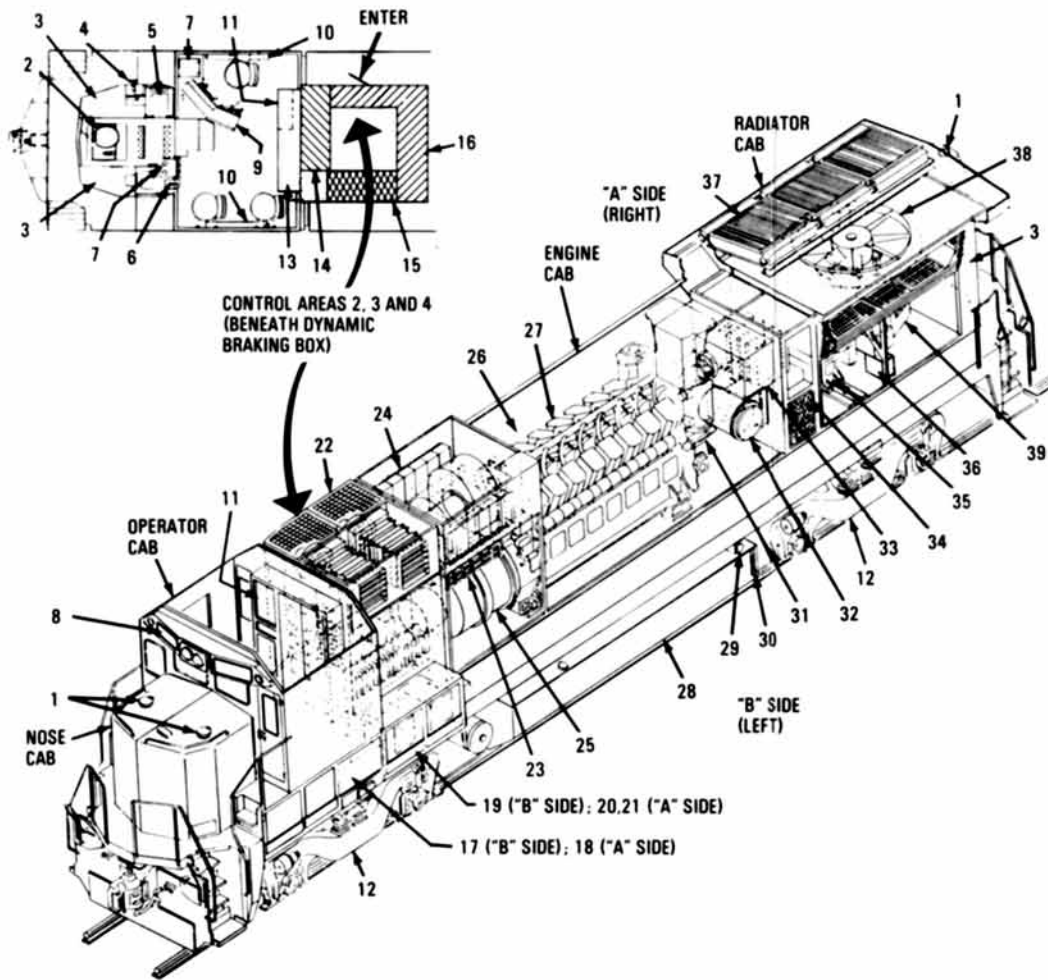
**GENERAL  ELECTRIC**

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FIG. 1, E-34087



| REF. | DESCRIPTION   |
|------|---|
| 1    | SAND FILL   |
| 2    | TOILET AREA   |
| 3    | SAND BOX  |
| 4    | HANDBRAKE   |
| 5    | REFRIGERATOR OR COOLER  |
| 6    | EMERGENCY BRAKE VALVE   |
| 7    | HEATER AND DEFROSTER  |
| 8    | HEADLIGHT, SIGNAL AND NUMBER LIGHT BOX  |
| 9    | CONTROL AREA #5 (CONTROL CONSOLE)   |
| 10   | HEATER, SIDE STRIP  |
| 11   | ENGINE CONTROL PANEL  |
| 12   | TRUCKS: "B" - 2 AXLES PER TRUCK<br>"C" - 3 AXLES PER TRUCK                    |
| 13   | CONTROL AREA #1   |
| 14   | CONTROL AREA #2   |
| 15   | CONTROL AREA #3   |
| 16   | CONTROL AREA #4   |
| 17   | CONTROL AREA #6   |
| 18   | AIR BRAKE COMPARTMENT   |
| 19   | CONTROL AREA #7   |
| 20   | CONTROL AREA #8   |
| 21   | BATTERY BOX   |
| 22   | DYNAMIC BRAKING BOX   |
| 23   | RECTIFIERS (PROPULSION)   |
| 24   | BLOWER BOX AND AIR FILTERS  |
| 25   | ALTERNATORS (MAIN AND AUXILIARY)  |
| 26   | ENGINE START STATION  |
| 27   | ENGINE: B23, B32, C32 (12 CYLINDER, 7FDL12)<br>B39, C39 (16 CYLINDER, 7FDL16) |
| 28   | FUEL TANK AND RETENTION TANK  |
| 29   | FUEL FILL   |
| 30   | FUEL GAGE   |
| 31   | LUBE-OIL COOLER   |
| 32   | LUBE-OIL FILTER   |
| 33   | ENGINE WATER TANK AND WATER CONTROL VALVE                                     |
| 34   | ENGINE AIR FILTER COMPARTMENT   |
| 35   | AIR COMPRESSOR (MOTOR DRIVEN)   |
| 36   | CONTROL AREA #9   |
| 37   | RADIATORS   |
| 38   | RADIATOR FAN  |
| 39   | BLOWER AND AIR FILTERS (NO. 2 END)  |

FIG. 1. LOCATION OF APPARATUS.

GENERAL DATA

|   | B23-8               | B32-8               | C32-8               | B39-8               | C39-8               |
|---|---------------------|---------------------|---------------------|---------------------|---------------------|
| Operating Cab and Controls              | General Purpose B-B | General Purpose B-B | General Purpose C-C | General Purpose B-B | General Purpose C-C |
| Wheel Arrangement                       |                     |                     |                     |                     |                     |
| Engine Data                             |                     |                     |                     |                     |                     |
| Horsepower - Traction                   | 2300                | 3150                | 3150                | 3900                | 3900                |
| Number of Cylinders                     | 12                  | 12                  | 12                  | 16                  | 16                  |
| Model                                   | GE FDL12            | GE FDL12            | GE FDL12            | GE FDL16            | GE FDL16            |
| Bore and Stroke (in.)                   | 9 x 10-1/2          | 9 x 10-1/2          | 9 x 10-1/2          | 9 x 10-1/2          | 9 x 10-1/2          |
| RPM (max.)                              | 1050                | 1050                | 1050                | 1050                | 1050                |
| Compression Ratio                       | 12.7:1              | 12.7:1              | 12.7:1              | 12.7:1              | 12.7:1              |
| Cycle                                   | 4                   | 4                   | 4                   | 4                   | 4                   |
| Turbocharged                            | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| Engine Cooling Fan                      | 1                   | 1                   | 1                   | 1                   | 1                   |
| Engine Cooling Fan Drive                | A-C Motor           | A-C Motor           | A-C Motor           | A-C Motor           | A-C Motor           |
| Traction Equipment                      |                     |                     |                     |                     |                     |
| Main Generator                          | GMG 186             | GMG 186             | GMG 187             | GMG 186             | GMG 187             |
| Traction Motor                          | 4-GE752             | 4-GE752             | 6-GE752             | 4-GE752             | 6-GE752             |
| Traction Motor Blowers                  | 2                   | 2                   | 2                   | 2                   | 2                   |
| Blower Drive                            | A-C Motor           | A-C Motor           | A-C Motor           | A-C Motor           | A-C Motor           |
| Air Brake Schedule                      | 26L                 | 26L                 | 26L                 | 26L                 | 26L                 |
| Major Dimensions                        |                     |                     |                     |                     |                     |
| Length                                  | 63 ft., 7 in.       | 63 ft., 7 in.       | 67 ft., 11 in.      | 66 ft., 4 in.       | 70 ft., 8 in.       |
| Height                                  | 14 ft., 11-1/2 in.  | 14 ft., 11-1/2 in.  | 15 ft., 4-1/2 in.   | 14 ft., 11-1/2 in.  | 15 ft., 4-1/2 in.   |
| Width                                   | 10 ft., 2-3/4 in.   | 10 ft., 2-3/4 in.   | 10 ft., 2-3/4 in.   | 10 ft., 2-3/4 in.   | 10 ft., 2-3/4 in.   |
| Bolster Centers                         | 36 ft., 7 in.       | 36 ft., 7 in.       | 40 ft., 7 in.       | 39 ft., 4 in.       | 43 ft., 4 in.       |
| Truck Wheel Base                        | 9 ft., 0 in.        | 9 ft., 0 in.        | 13 ft., 7 in.       | 9 ft., 0 in.        | 13 ft., 7 in.       |
| Minimum Track Curvature (rad. and deg.) |                     |                     |                     |                     |                     |
| For Single Unit                         | 150 ft./39°         | 150 ft./39°         | 273 ft./21°         | 150 ft./39°         | 273 ft./21°         |
| For MU                                  | 195 ft./29°         | 195 ft./29°         | 273 ft./21°         | 195 ft./29°         | 273 ft./21°         |
| Driving Wheel Diameter (in.)            | 40                  | 40                  | 40                  | 40                  | 40                  |

GENERAL DATA

GEJ-6720

|  | B23-8                | B32-8                | C32-8                | B39-8                | C39-8                |
|--|----------------------|----------------------|----------------------|----------------------|----------------------|
| Weight   |                      |                      |                      |                      |                      |
| Per Axle (pounds minimum and maximum)  | 65,250/70,000        | 67,250/70,000        | 57,717/70,000        | 68,500/70,000        | 61,167/70,000        |
| Total (pounds minimum and maximum)   | 261,000/280,000      | 269,000/280,000      | 346,300/420,000      | 274,000/280,000      | 367,000/420,000      |
| Traction Effort (pounds) Starting at 25% Adhesion for Minimum and Maximum Weight | 65,250/70,000        | 67,250/70,000        | 86,575/105,000       | 68,500/70,000        | 91,750/105,000       |
| Cont. Traction Effort and Speed (mph):   |                      |                      |                      |                      |                      |
| For Smaller Pinion (83/20)   | 71,890 @ 9.2         | 70,140 @ 13.9        | 108,360 @ 8.2        | 68,100 @ 18.3        | 106,790 @ 10.9       |
| For Larger Pinion (81/22)  | 63,780 @ 10.4        | 62,230 @ 15.7        | 96,140 @ 9.2         | 60,420 @ 20.6        | 94,740 @ 12.3        |
| Gear Ratio and Max. Speed (mph)  |                      |                      |                      |                      |                      |
| Smaller Pinion   | 83/20 - 70           | 83/20 - 70           | 83/20 - 70           | 83/20 - 70           | 83/20 - 70           |
| Larger Pinion  | 81/22 - 79           | 81/22 - 79           | 81/22 - 79           | 81/22 - 79           | 81/22 - 79           |
| Supplies   |                      |                      |                      |                      |                      |
| Fuel Tank (gal.)   | 2150                 | 3150                 | 3900                 | 3150                 | 4500                 |
| Coolant (gal.)   | 350                  | 350                  | 350                  | 380                  | 380                  |
| Lube Oil (gal.)  | 260                  | 260                  | 260                  | 360                  | 360                  |
| Sand (cu. ft.)   | 48                   | 48                   | 48                   | 48                   | 48                   |
| Compressor - Air   |                      |                      |                      |                      |                      |
| Maximum Delivery CFM   | 296                  | 296                  | 296                  | 296                  | 296                  |
| Type of Cooling  | Air                  | Air                  | Air                  | Air                  | Air                  |
| Draft Gear   | NC391                | NC391                | NC391                | NC391                | NC391                |
| Air Filtering Devices  |                      |                      |                      |                      |                      |
| Primary  | Vortex Self-Cleaning | Vortex Self-Cleaning | Vortex Self-Cleaning | Vortex Self-Cleaning | Vortex Self-Cleaning |
| Secondary Engine Air Intake  | GE Paper Yes         | GE Paper Yes         | GE Paper Yes         | GE Paper Yes         | GE Paper Yes         |
| Engine Room Pressurized  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |

## INTRODUCTION

All of the operating devices, manual and visual, normally used by the operator during locomotive operation are located near the operator's position. Most of these devices are located either on the control console or on the Engine Control panel.

**NOTE:** *Customer equipment requirements often differ from one railroad to another. Therefore, physical locations and appearance of some devices illustrated in this manual may not agree entirely with the equipment furnished to any particular railroad.*

## DEVICES ON CONTROL CONSOLE (Fig. 2)

The following operating devices are located on the control console:

### Master Controller

The Master Controller is a Set-Up switch used by the operator to control the locomotive during operation. It is equipped with a Throttle handle, Dynamic Braking handle and Reverse handle.

### Reverse Handle

The Reverse handle, the bottom of the three handles, is used to determine the direction of locomotive travel. It has positions REVERSE, OFF and FORWARD. The handle is removable only when the Throttle handle is in IDLE position and Braking handle is in OFF.

## Throttle Handle

The Throttle handle is the middle handle. It has a SHUTDOWN, IDLE and eight major positions or notches for power.

The SHUTDOWN position is located to the right of IDLE and is used in an emergency to shut down all engines of a multiple-unit consist from the operator's position of the controlling unit. Pull out axially on Throttle handle and move the handle to the right to put it into SHUTDOWN.

To increase motoring power, the handle is moved clockwise toward the operator.

## Braking Handle (Dynamic Braking)

The Braking handle is above the Throttle handle and has OFF and SET-UP positions and a notchless BRAKING sector.

In the OFF position, nearest the operator, dynamic braking is shut off. The SET-UP position establishes dynamic braking circuits. Movement beyond this position into the BRAKING sector (counterclockwise away from the operator) increases braking effort.

## Interlocking Between Handles

Interlocking between the handles of the Master Controller is provided as follows:

1. The Reverse handle must be inserted before the Throttle handle can be moved out of IDLE position for power or emergency shutdown.

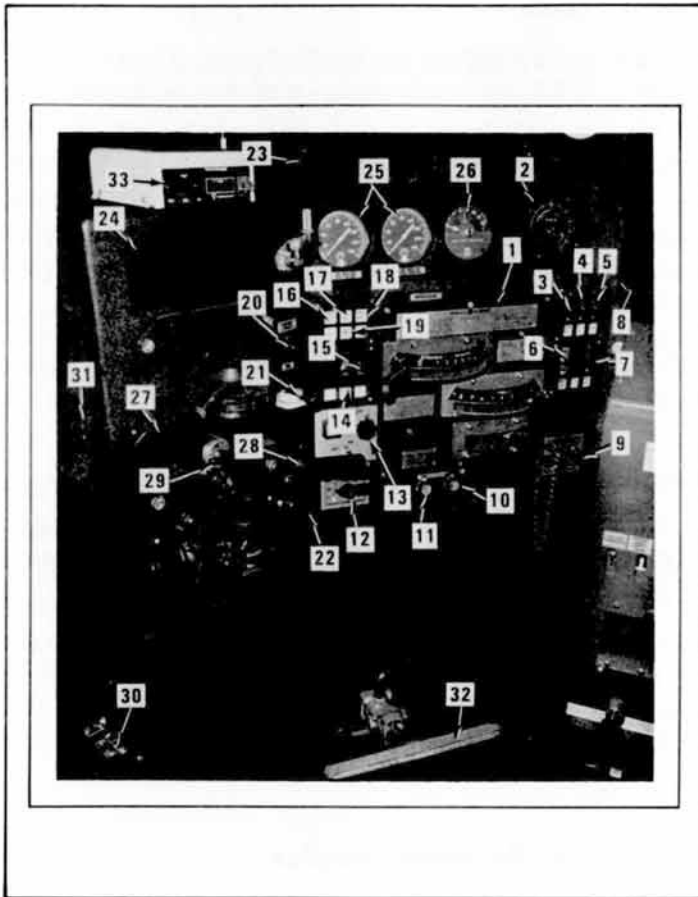


FIG. 2. OPERATOR'S CONTROL CONSOLE.

FIG. 2, E-32783

| REF. | DESCRIPTION                                 |
|------|---|
| 1    | MASTER CONTROLLER                           |
| 2    | LOAD AMMETER                                |
| 3    | ENGINE RUN BREAKER                          |
| 4    | GENERATOR FIELD CIRCUIT BREAKER             |
| 5    | CONTROL CIRCUIT BREAKER                     |
| 6    | POWER LIMIT SWITCH                          |
| 7    | DYNAMIC BRAKING CONTROL CIRCUIT BREAKER     |
| 8    | GAGE LIGHT DIMMER KNOB (ON SIDE OF CONSOLE) |
| 9    | FRONT HEADLIGHT SWITCH                      |
| 10   | TRAINLINE GROUND RESET BUTTON               |
| 11   | CALL BUTTON                                 |
| 12   | REAR HEADLIGHT SWITCH                       |
| 13   | HUMP CONTROL (OPTIONAL)                     |
| 14   | STEP LIGHT SWITCH                           |
| 15   | GAGE LIGHTS SWITCH                          |
| 16   | WHEELSLIP LIGHT                             |
| 17   | PCS OPEN LIGHT                              |
| 18   | DYNAMIC BRAKE WARNING LIGHT                 |
| 19   | SAND LIGHT                                  |
| 20   | LEAD AXLE SAND SWITCH                       |
| 21   | SAND SWITCH                                 |
| 22   | BELL VALVE                                  |
| 23   | HORN VALVE                                  |
| 24   | RADIO LOCATION (OPTIONAL)                   |
| 25   | AIR GAGES                                   |
| 26   | BRAKE PIPE FLOW INDICATOR (OPTIONAL)        |
| 27   | AUTOMATIC BRAKE VALVE HANDLE                |
| 28   | INDEPENDENT BRAKE VALVE HANDLE              |
| 29   | BRAKE PIPE CUT-OUT PILOT VALVE              |
| 30   | MU2A OR DUAL PORTED CUT-OUT COCK            |
| 31   | BRAKE PIPE REGULATING VALVE                 |
| 32   | SAFETY CONTROL PEDAL (OPTIONAL)             |
| 33   | SELECT-A-POWER, FUEL SAVER (OPTIONAL)       |

FIG. 2, E-32783

FIG. 2. OPERATOR'S CONTROL CONSOLE.



2. The Reverse handle can be moved into FORWARD or REVERSE only when the Throttle handle is in IDLE position and the Braking handle is in OFF position.
3. The Reverse handle cannot be moved out of FORWARD or REVERSE position when either the Throttle handle is advanced beyond IDLE or the Braking handle is advanced beyond OFF.
4. The Braking handle must be in OFF position before the Throttle handle can be moved out of IDLE position, except for emergency shutdown.
5. The Throttle handle must be in IDLE and the Reverse handle in FORWARD or REVERSE before the Braking handle can be moved.
6. The Reverse handle can be removed only when the Reverse handle is CENTERED, Braking handle is in OFF and the Throttle handle is in IDLE.

### Operation

To manipulate the controller operating handles during locomotive operation, proceed as follows:

#### Lead or Single-Unit Operation

Operating Handle Set-Up (Reverse handle removed):

1. Braking handle in OFF.
2. Throttle handle in IDLE.

**CAUTION:** *Finding the Braking handle away from OFF or the Throttle handle away from IDLE with the Reverse handle removed indicates that interlocking between handles requires repair or adjustment. Do not attempt to operate.*

3. Insert the Reverse handle.
4. Set Reverse handle for the desired direction of operation.

Operating in Power Mode:

1. Braking handle remains in OFF
2. Move Reverse handle to desired position
3. Move the Throttle handle to the desired notch.

Operation in Dynamic Brake Mode:

1. Throttle handle returned to IDLE
2. Move the Braking handle to SET-UP; pause, then advance as desired.

Operation as Trail Unit:

1. Braking handle in OFF
2. Throttle handle in IDLE
3. Reverse handle centered and removed.

For Emergency Multiple-Unit Shutdown:

In the controlling unit, pull out axially on the Throttle handle, and move it beyond IDLE to SHUTDOWN.

**NOTE:** *In a Trail unit, the Reverse handle must be inserted to release the Throttle handle before it can be moved to SHUTDOWN.*

### Load Ammeter

This meter shows the average current going to each of the traction motors. Motoring is shown to the right of 12 o'clock and has two bands. The Green band is in the continuous rating of the motors and the Red band is the short-time rating.

**CAUTION:** *The control system on this locomotive automatically limits the time in short-time rating to protect the equipment. If other locomotives in the consist do not have this feature, observe the time limit on the meter when in the short-time rating to prevent equipment damage.*

Dynamic Braking is shown to the left of 12 o'clock and has two bands. The Yellow band is the continuous rating of the motors and the Red band is overload. If the meter goes into the Red band, reduce the Braking handle position until the meter goes back into the Yellow band.

### Engine Run Circuit Breaker

The Engine Run breaker controls engine speed. It must be ON to control engine speed of the Lead locomotive and all units of a consist. On Trail units, the breaker is in the OFF position.

### Generator Field Circuit Breaker

The Generator Field circuit breaker is ON whenever the locomotive is powered and operating as a Lead unit. The breaker may be turned off to keep the main generator de-energized when it is necessary to run the engine at speeds higher than IDLE. On Trail locomotives, it is in the OFF position.

### Control Circuit Breaker

The Control breaker must be ON to run the fuel pump, start the engine and provide power to other circuits, including the auxiliaries. In MU operation, this breaker must be ON on the Lead unit only.

### Power Limit Switch

**NOTE:** *This switch may be eliminated as a customer option and may therefore not appear on all locomotives.*

This switch has two positions, NORMAL and NOTCH 7.

When the Leading unit is slipping excessively, the Power Limit switch can be moved to NOTCH 7 to reduce power while the Trailing units are operating at full power. This will reduce the tractive effort on the Leading unit and will usually improve the ability of the locomotive to hold the rail under bad rail conditions.

Also see ALARMS, SAFEGUARDS, POWER DERAILMENTS AND SHUTDOWNS section of this manual.

**NOTE:** *Unless directed otherwise by railroad rules, make sure the Power Limit switch is in NORMAL position on ALL units when boarding the train.*

### Dynamic Braking Control Breaker

**NOTE:** *Dynamic Brake is provided as optional equipment.*

The Dynamic Braking Control breaker is used to control the dynamic braking of the locomotive. In MU operation, this breaker must be ON on the Lead unit only to control the dynamic braking of other units in the consist.

### **Gage Light Dimmer Knob**

The dimmer knob is located on the right side of the console. It is used to brighten and dim the console gage lights.

### **Front Headlight Switch**

This switch controls the operation of the front headlight and has four positions; OFF, DIM, MED and BRIGHT.

### **Trainline Ground Reset Button (Optional)**

Resets the Ground Relay on locomotives which are equipped for trainline ground reset. New Series-8 locomotives may transmit the Reset signal, but do not respond to it.

### **Call Button**

The Call button is used to sound the alarm bell in all locomotive units. This button can be used to test the alarm bell when boarding the locomotive.

### **Rear Headlight Switch**

This switch controls the operation of the front headlight and has four positions; OFF, DIM, MED and BRIGHT.

### **Power Reduction (Hump) Control (Optional)**

Allows operator to precisely control locomotive power outputs. The Hump Control toggle switch has three positions; OFF, LOCAL and TRAINLINE. This toggle switch is set for the desired operation, then the Throttle handle is advanced to the desired notch. The Hump Control potentiometer is then positioned between MIN and MAX to meet horsepower requirement.

### **Step Light Switch**

Turns on all four corner step lights.

### **Gage Light Switch**

Turns on the operator console gage lights.

### **WHEELSLIP Light**

This light, accompanied by an optional buzzer, indicates that the wheels on some locomotives in the consist are slipping. This is a trainlined indication.

### **PCS OPEN Light**

Indicates a Penalty or Emergency air brake application has occurred and power has been limited or removed.

### **DYNAMIC BRAKE WARNING Light**

This light, accompanied by an optional buzzer, indicates that a locomotive in the consist is experiencing excessive dynamic braking current. Reduce the Braking handle position until this light goes out.

### **SAND Light**

Indicates that sanding is taking place either manually or as a result of wheelslip. During a wheelslip, sanding and the SAND light will automatically turn on, then off.

### **Lead Axle Sand Switch**

Sand will be applied to rail in front of the leading axle, depending on locomotive direction.

**Sand Switch**

Sand will be applied to the rail in front of the leading axle of each truck when locomotive speed is less than 7 mph. Above 7 mph, manual sanding is not available. Lead axle sand will still function normally.

**Bell Valve**

Pull the valve handle to sound the bell. Push it in to shut off.

An option provides both the bell and horn to be sounded when the valve is operated.

**Horn Valve**

Pull the valve handle toward the operator to sound the horn.

**Radio Location**

This location is provided for the radio. Operation of the radio should be in accordance with railroad operating rules and procedures.

**Air Gages**

See AIR BRAKE EQUIPMENT section of this manual.

**Brake Pipe Flow Indicator**

See AIR BRAKE EQUIPMENT section of this manual.

**Automatic Brake Valve Handle**

See AIR BRAKE EQUIPMENT section of this manual.

**Independent Brake Valve Handle**

See AIR BRAKE EQUIPMENT section of this manual.

**Brake Pipe Cut-Out Pilot Valve**

See AIR BRAKE EQUIPMENT section of this manual.

**MU2A or Dual Ported Cut-Out Cock**

See AIR BRAKE EQUIPMENT section of this manual.

**Brake Pipe Regulating Valve**

See AIR BRAKE EQUIPMENT section of this manual.

**Safety Control Foot Pedal**

See Safety Control Foot Pedal section of this manual.

**DEVICES ON ENGINE CONTROL  
PANEL (Fig. 3)**

The Engine Control (EC) panel is located on the rear wall of the operator's cab, Fig. 3. Mounted on this panel are various switches, circuit breakers and operating devices used during locomotive operation.

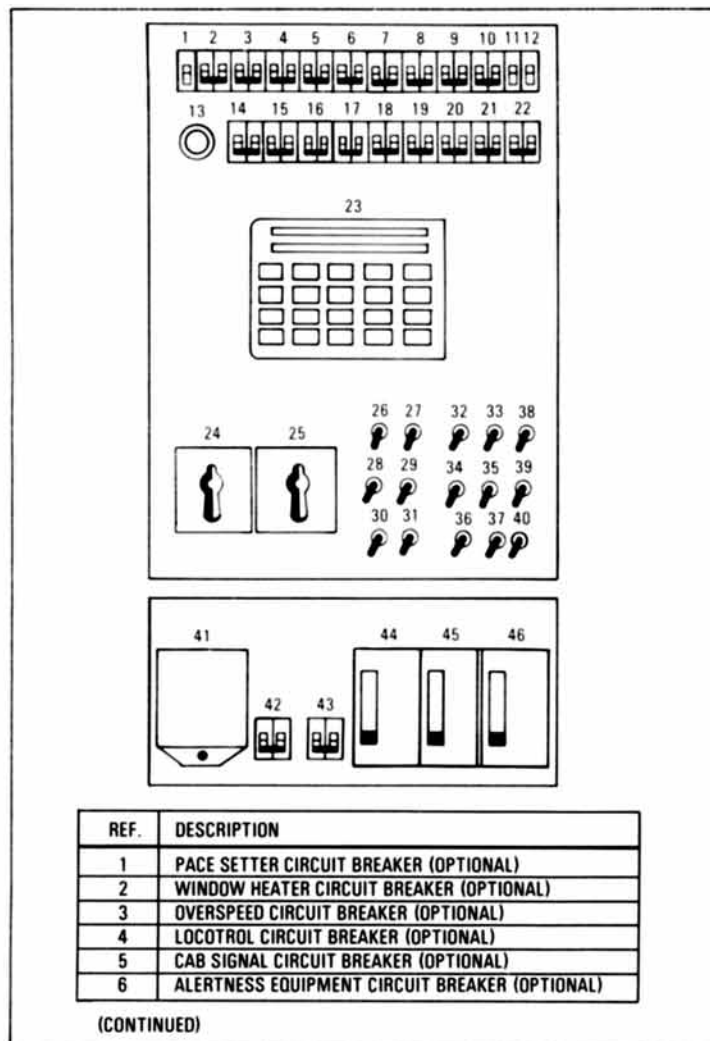


FIG. 3. ENGINE CONTROL PANEL.

| REF. | DESCRIPTION (CONT'D.)   |
|------|---|
| 7    | WARNING LIGHT CIRCUIT BREAKER (OPTIONAL)                      |
| 8    | OSCILLATING LIGHT CIRCUIT BREAKER (OPTIONAL)                  |
| 9    | RADIO CIRCUIT BREAKER (OPTIONAL)                              |
| 10   | WATER COOLER CIRCUIT BREAKER (OPTIONAL)                       |
| 11   | FRONT HEADLIGHT CIRCUIT BREAKER                               |
| 12   | REAR HEADLIGHT CIRCUIT BREAKER                                |
| 13   | ENGINE STOP BUTTON  |
| 14   | AUTOMATIC WATER DRAIN CIRCUIT BREAKER (OPTIONAL)              |
| 15   | TOILET TANK HEATER CIRCUIT BREAKER (OPTIONAL)                 |
| 16   | FLANGE LUBRICATOR CIRCUIT BREAKER (OPTIONAL)                  |
| 17   | AIR DRYER CIRCUIT BREAKER (OPTIONAL)                          |
| 18   | RUNNING LIGHTS CIRCUIT BREAKER (ALL LIGHTS EXCEPT HEADLIGHTS) |
| 19   | AUTO FUEL CIRCUIT BREAKER (OPTIONAL)                          |
| 20   | FUEL PUMP CIRCUIT BREAKER                                     |
| 21   | LOCAL CONTROL CIRCUIT BREAKER                                 |
| 22   | BATTERY CHARGE AND COMPUTER CIRCUIT BREAKER                   |
| 23   | DIAGNOSTIC DISPLAY PANEL (DID)                                |
| 24   | ENGINE CONTROL SWITCH   |
| 25   | MU HEADLIGHT SET-UP SWITCH                                    |
| 26   | CROSSWALK LIGHT SWITCH  |
| 27   | CONTROL COMPARTMENT LIGHT SWITCH                              |
| 28   | FRONT NUMBER LIGHT SWITCH                                     |
| 29   | REAR NUMBER LIGHT SWITCH                                      |
| 30   | FRONT CLASS LIGHT SWITCH                                      |
| 31   | REAR CLASS LIGHT SWITCH                                       |
| 32   | NUMBER 1 MOTOR CUT-OUT  |
| 33   | NUMBER 2 MOTOR CUT-OUT  |
| 34   | NUMBER 3 MOTOR CUT-OUT  |
| 35   | NUMBER 4 MOTOR CUT-OUT  |
| 36   | NUMBER 5 MOTOR CUT-OUT (6-AXLE LOCOMOTIVE ONLY)               |
| 37   | NUMBER 6 MOTOR CUT-OUT (6-AXLE LOCOMOTIVE ONLY)               |
| 38   | SPEED SENSOR CUT-OUT SWITCH                                   |
| 39   | LOCKED AXLE CUT-OUT SWITCH                                    |
| 40   | DYNAMIC BRAKE CUT-OUT SWITCH (OPTIONAL)                       |
| 41   | BATTERY CHARGE RECEPTACLE (OPTIONAL)                          |
| 42   | ENGINEER'S WALL HEATER CIRCUIT BREAKER                        |
| 43   | HELPER'S WALL HEATER CIRCUIT BREAKER                          |
| 44   | CAB HEATER CIRCUIT BREAKER ENGINEER'S POSITION                |
| 45   | CAB HEATER CIRCUIT BREAKER HELPER'S POSITION                  |
| 46   | AIR CONDITIONER CIRCUIT BREAKER (OPTIONAL)                    |

FIG. 3. ENGINE CONTROL PANEL.

FIG. 3, E-34088

FIG. 3, E-34088

### Top Row of Circuit Breakers

The top row of circuit breakers on the EC panel are used for optional equipment or equipment that can be turned OFF when the unit is operating as a Trail unit. From left to right the circuit breakers and their functions are listed. Absence of one of these circuit breakers indicates that the locomotive is not equipped with that option.

- Pace Setter (optional)
- Window Heater (optional)
- Overspeed (optional)
- Locotrol (optional)
- Cab Signal (optional)
- Alertness Equipment (optional)
- Warning Light (optional)
- Oscillating Light (optional)
- Radio (breaker is standard, equipment is optional)
- Water Cooler (breaker is standard, equipment is optional)
- Front Headlight
- Rear Headlight.

### Second Row of Circuit Breakers

The circuit breakers in the second row of circuit breakers are used for both standard and optional equipment, all of which **MUST BE LEFT ON** whenever the unit is operating as a Lead or Trail unit. From left to right the circuit breakers and their functions are listed:

- Automatic Water Drain (optional)
- Toilet Tank Heater (optional)
- Flange Lubricator (optional)
- Air Dryer (optional)

- Running Lights (all lights except headlights)
- Auto Fuel (optional)
- Fuel Pump
- Local Control
- Battery Charge and Computer.

Additional equipment on the Engine Control panel is discussed below:

Engine Stop Button.

To shut down the engine, press the Engine Stop button.

### Diagnostic Display Panel (DID)

See DIAGNOSTIC DISPLAY PANEL section of this manual.

### Engine Control Switch

The Engine Control (EC) switch has four positions:

1. **START** - The Engine Start switch, see Engine Start Station, is effective only when the EC switch is in START. When the engine is running and the EC switch is in START position, engine speed is held at IDLE and power cannot be applied to the locomotive. The power plant is said to be "off the line." The alarm bell will not ring if the engine shuts down.
2. **ISOLATE** - When the engine is running and the EC switch is in the ISOLATE position, the engine speed is held at IDLE and power cannot be applied to the locomotive. The message "ISOLATED" will appear on the Diagnostic Display Panel. The alarm bell will sound if a fault occurs that will shut down the engine.

3. RUN - When the engine is idling and the locomotive is to be operated, the Engine Control (EC) switch must be moved to the RUN position.

**NOTE:** *If the EC switch is left in the RUN position when the diesel engine is shut down, the alarm bell will sound and a message will appear on the Diagnostic Display Panel.*

4. JOG - When the engine is shutdown and the locomotive is to be moved using battery power, the EC switch is moved to the JOG position.

**NOTE:** *JOG is optional equipment.*

### MU Headlight Set-Up Switch

The MU Headlight Set-Up switch has five positions. Positioning of this switch is determined by location of the locomotive unit in the consist and whether the front of the locomotive unit is leading or trailing. Switch positions are as follows:

1. SINGLE OR MIDDLE UNIT - Place switch in this position on any locomotive unit operated singly or on all units, except the Leading or Trailing unit, when the locomotive consist is made up of more than one unit.
2. SHORT HOOD LEAD - LEADING UNIT - Place switch in this position when the Leading unit is operated with the short hood forward.
3. LONG HOOD LEAD - LEADING UNIT - Place switch in this position when the Leading unit is operated with the long hood forward.

4. SHORT HOOD TRAIL - TRAILING UNIT - Place switch in this position when the final Trailing unit is connected so its short hood trails.
5. LONG HOOD TRAIL - TRAILING UNIT - Place switch in this position when the final Trailing locomotive is connected so its long hood trails.

### Crosswalk Light Switch

#### Control Compartment Light Switch

This switch turns on lights in Control Areas 1, 2, 3, 4 and 7.

#### Front Number Light Switch

Operates front number lights.

#### Rear Number Light Switch

Operates rear number lights.

#### Front Class Light Switch

Operates front class lights.

#### Rear Class Light Switch

Operates rear class lights.

### Traction Motor Cut-Out Switches - Pull to Throw

- Number 1 Motor Cut-Out
- Number 2 Motor Cut-Out
- Number 3 Motor Cut-Out
- Number 4 Motor Cut-Out
- Number 5 Motor Cut-Out (six-axle locomotive only)
- Number 6 Motor Cut-Out (six-axle locomotive only).

The Motor Cut-Out switches can be used to cut-out one or more traction motors. At the same time, power output of the locomotive may be reduced. See ALARMS, SAFEGUARDS, POWER DERATIONS AND SHUTDOWNS section of this publication.

**CAUTION:** *It is recommended that these switches be operated only with the Engine Control switch in START or ISOLATE position so the unit is isolated and the Throttle handle in IDLE.*

Under emergency conditions, the locomotive may be operated for a short period of time with one or more motors cut-out. Refer to railroad rules for specific details of operation.

### Speed Sensor Cut-Out Switch

Cuts out the Speed Sensor signal on all traction motors that are cut-out.

**NOTE:** *Two motor speed sensors must be operating for the unit to load.*

**NOTE:** *Speed sensors do not need to be cut-out on cut-out motors. When the Motor Speed Cut-Out switch is in the CUT-OUT position, the speed signals from all speed sensors on motors cut-out are ignored.*

### Locked Axle Cut-Out Switch

Cuts out the Locked Axle Alarm.

### Dynamic Brake Cut-Out Switch (optional)

### Battery Charge Receptacle (optional)

### Engineer's Wall Heater Circuit Breaker

### Helper's Wall Heater Circuit Breaker

### Cab Heater Circuit Breaker Engineer's Position

### Cab Heater Circuit Breaker Helper's Position

### Air Conditioner Circuit Breaker (optional)

## OTHER OPERATOR CAB CONTROLS

### Battery Switch (Fig. 4)

Located behind door below the Engine Control panel.

### Emergency Brake Valve (Fig. 5)

Handle located at the short hood end of the operator cab, between the front cab access door and the nose cab access door. Pulling this handle causes an Emergency brake application and dropping of power.



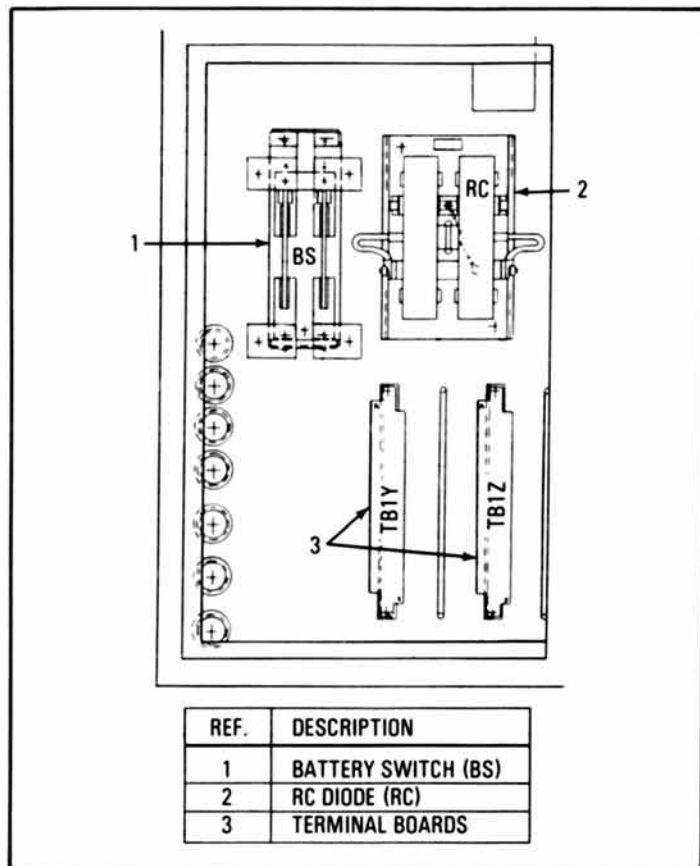


FIG. 4. BATTERY SWITCH COMPARTMENT BENEATH ENGINE CONTROL PANEL.

FIG. 4, E-34089

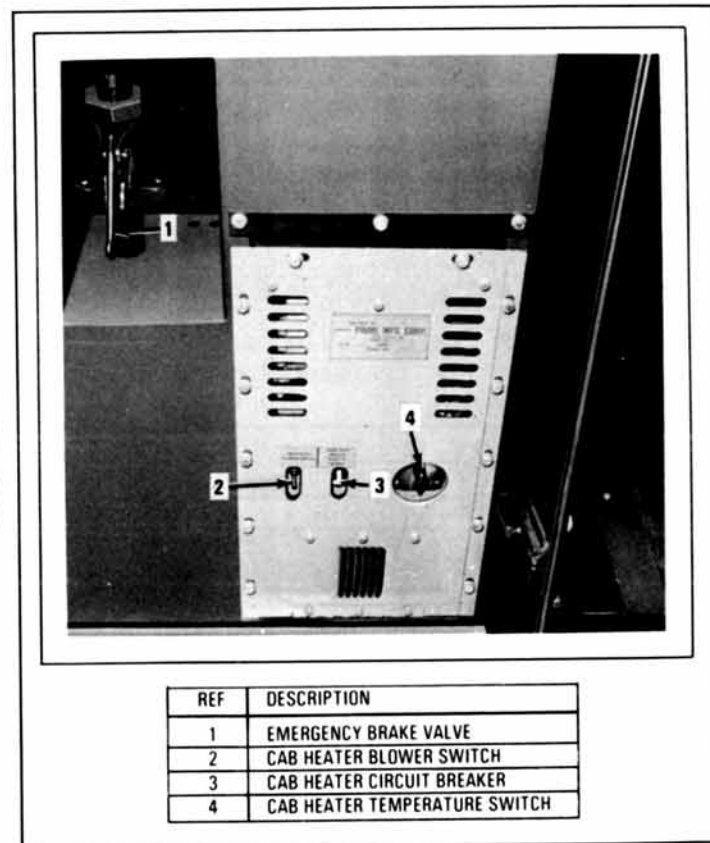


FIG. 5, E-31560

FIG. 5. EMERGENCY BRAKE VALVE AND HELPER'S HEATER (SHORT HOOD LEAD ARRANGEMENT).

**Cab Heater/Defroster Controls - Engineer's and Helper's Positions (Fig. 5)**

Cab heat and windshield defrost is regulated by a rotary switch on each heater that is labeled OFF-LO-MED-HI. Position this switch to the desired heat level from that heater. Each heater also has a toggle switch labeled "HIGH SPEED BLOWER SWITCH" which controls the speed of the heater blower. Position these switches to suit heating and defrosting needs as follows:

| Toggle | Rotary | Result                              |
|--------|--------|-------------------------------------|
| OFF    | OFF    | Unit OFF                            |
| ON     | OFF    | Blower only at HIGH                 |
| OFF    | LO     | Blower at LOW Speed<br>LOW Heat ON  |
| ON     | LO     | Blower at HIGH Speed<br>LOW Heat ON |
| ON     | MED    | Blower at HIGH Speed<br>MED Heat ON |
| ON     | HI     | Blower at HIGH Speed<br>HI Heat ON  |

The Over Heat circuit breaker located on the front of each heater and the Cab Heater circuit breakers located on the Engine Control panel must be ON for heaters to operate.

**CAUTION:** *To avoid overheating and tripping Heater breakers when Cab Heating System is in use, be sure return a ir inlet or heat outlets are not restricted.*

**Windshield Wiper Valves (Fig. 6)**

Located above the operator's and helper's positions.

**Engineer's and Helper's Dome Lights (Fig. 6)**

Located and controlled above the operator's and helper's positions.

**Toilet and Nose Step Light Switch**

Located on the back of the operator's console, this switch turns on the light in the nose cab.

FIG. 6, E-32788 (E-31562 2 OF 3)

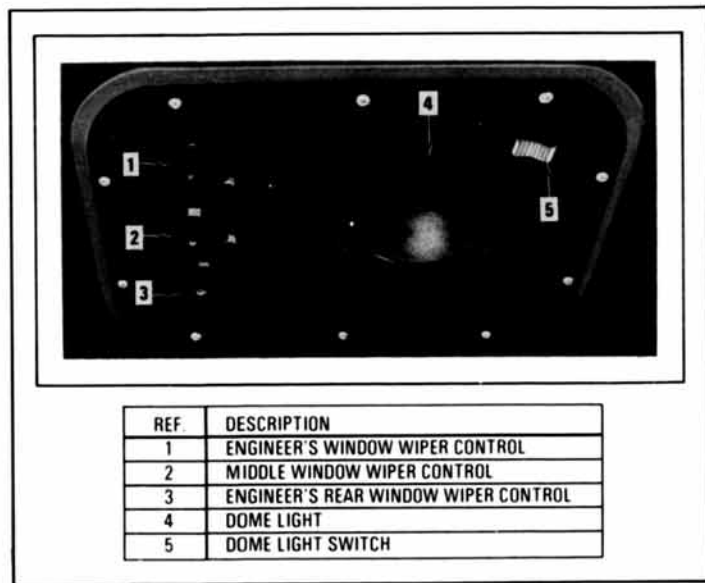


FIG. 6. WINDOW WIPER CONTROLS AND DOME LIGHT.

### Cab Air Conditioner (Optional)

An ON/OFF toggle switch located on the air conditioner turns the unit on. The Blower Speed switch can be used to run the fan at LOW or HIGH speed. The circuit breakers on the air conditioner and on the Engine Control panel, Fig. 3, must be ON and the battery charger running for the unit to operate.

### GENERAL INFORMATION

The DID panel is a fast and accurate means of communications between the locomotive operator and computers. The DID panel can be utilized in several ways:

1. A SUMMARY message on the display, informs the operator of the general status of the locomotive's operating condition, its computers, restriction placed on the locomotive due to faults and, in some cases, the status of the display itself.
2. If an abnormal operating condition (called a "FAULT") is detected, the computers will initiate the ALARM mode. In the ALARM mode, the computer uses the DID panel to alert the operator to the FAULT by displaying a description of the FAULT and, in some cases, ringing the Alarm bell.
3. The FAULT detected may require that certain operating restrictions be imposed on the locomotive as a means of protecting the locomotive's equipment. The locomotive computers impose the necessary restrictions and inform the operator of those restrictions through the DID panel in the form of SUMMARY messages.
4. The FAULT is recorded in a FAULT "Log" for later review by maintenance personnel.
5. The operator can use the DID panel to review all active FAULTS and their related restrictions (SUMMARY messages). The DID panel also enables the operator to reset FAULTS, and attempt to return the locomotive to normal operation.

**NOTE:** *In some cases, the ability to reset certain FAULTS has been restricted to maintenance personnel in accordance with railroad selected options.*

## THE DISPLAY

### Message Windows

The Diagnostic Display (DID) panel has a two-line display window as described in Fig. 7.

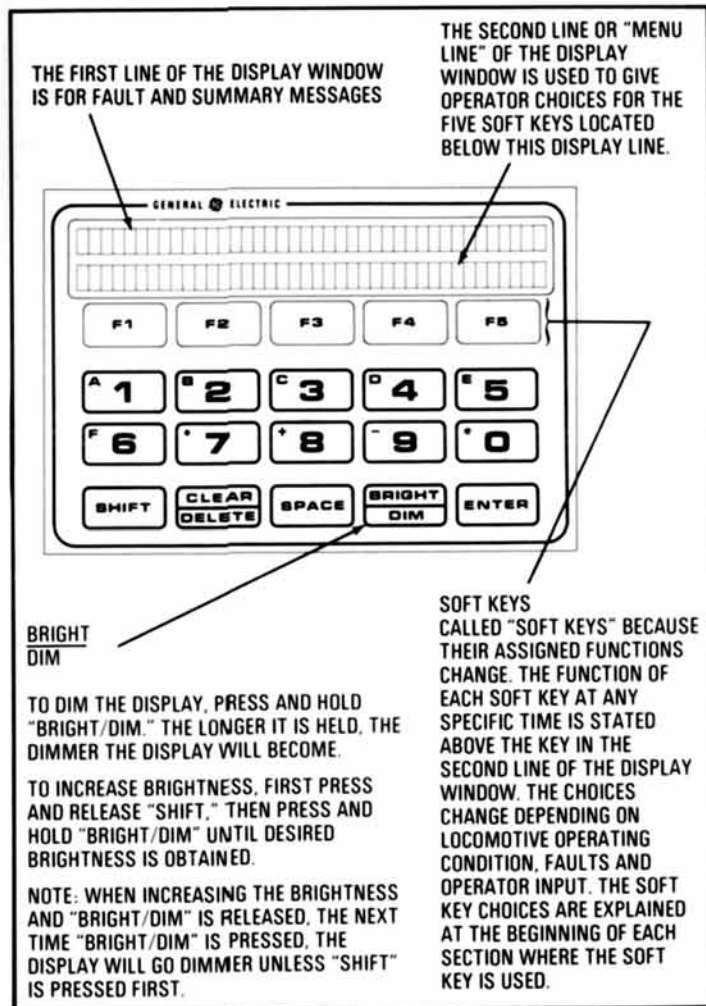
### Keys

Below the two-line display is a keypad with three rows of keys. Fig. 7 describes the use of these keys in Level 1. Other keys on the key pad are used on specific occasions, primarily for Level 2 maintenance operations.

**NOTE:** *Several levels of information access are available through the DID panel. Only Level 1 Operation of the panel is discussed in this publication. For information on operation in Level 2, see the Locomotive Service Manual, Section Q.*

## USING THE DISPLAY

Operation of the locomotive will not be interrupted or degraded and locomotive equipment will not be damaged if a mistake is made while using the DID panel in Level 1. Use of this panel by all responsible persons is encouraged.



**FIG. 7. DIAGNOSTIC DISPLAY PANEL.**

**MESSAGES AT LOCOMOTIVE  
START-UP**

Certain SUMMARY messages are intended to inform the operator of the condition on the DID panel and the locomotive computers as they are powered-up. Several examples follow:

**NOTE:** *These are special SUMMARY messages which are not a result of FAULTS. They require no reset and are not stored in the FAULT log.*

**NOTES:**

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This Display indicates that the power was applied to the system and the DID panel is functioning.

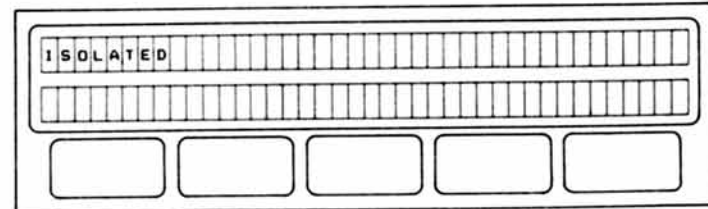
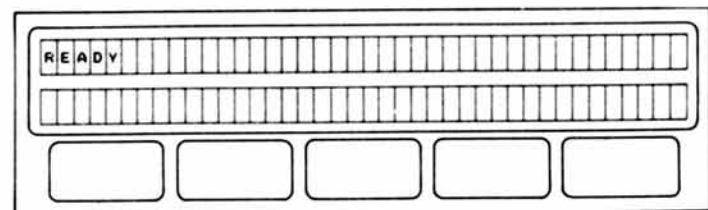
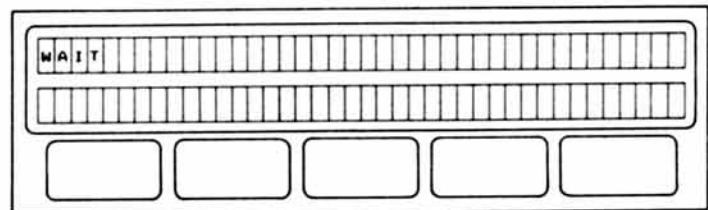
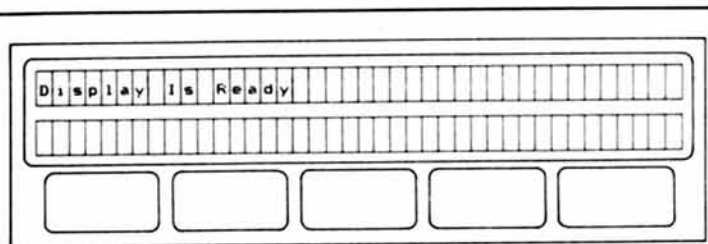
**NOTE:** *This display will appear for 10 to 15 seconds while computers are starting.*

WAIT indicates that the CAB controller is starting to bring the control system "on-line" after power-up.

**NOTE:** *Display of the WAIT message longer than 30 seconds indicates that the CAB controller is not able to bring the control system "on-line" and a problem may exist.*

The READY display indicates all systems are running and the locomotive is READY to function normally.

This display indicates that the Engine Control (EC) switch is in the ISOLATED position.



## OPERATING MODES IN LEVEL 1

After the locomotive computers have been powered-up and are operating normally, three modes of operation are available in Level 1:

1. READY mode
2. ALARM mode
3. FAULT mode.

### READY Mode

READY indicates that all of the locomotive systems are functioning properly, and the locomotive is **“ready” to operate at full power**. READY can be displayed in one of three ways:

1. READY, appearing alone indicates that there have been no FAULTS detected, or reset.
2. “READY-Work Report Stored” indicates a FAULT has occurred, it has been reset, and all operating restrictions imposed by the FAULT have been removed.
3. Some FAULTS do not impose operating restrictions on the locomotive. When this type of FAULT occurs, “READY - Fault Message Stored” will be displayed.

**NOTE:** *As can be seen on the SUMMARY message list, Pages 56 and 57, these READY messages are the three lowest priority messages. They will not be displayed if higher priority SUMMARY messages (operating restrictions) exist.*

## ALARM Mode

The computers check locomotive operation on a continuing basis. If an abnormal condition (FAULT) is detected, the ALARM mode may be initiated by the locomotive computers.

**NOTE:** *If the computer initiates the ALARM mode, when the DID panel is operating in any other mode, it will interrupt that mode to display the ALARM. When the ALARM mode is completed, the display will return to its previous operating mode.*

When the ALARM mode is initiated, a description of the problem will be given on the first line of the display in the form of a FAULT MESSAGE, the word “Silence” will appear on the second line of the display and, in most cases, an alarm bell will sound.

**NOTE:** *When any unit in the locomotive consist initiates an ALARM, the alarm bell on all locomotives will ring. All Series-8 locomotives in the consist are notified of the ALARM through the SUMMARY message, “Alarm from Other Unit.” If the initiating unit is a Series-8 locomotive, a message describing the FAULT and “Silence” will appear on the Display Panel of that unit as described above. Pressing “Silence” on the initiating unit will quiet the ALARM on all trainlined units. The bell can only be silenced from the initiating unit therefore, “Silence” does not appear on any other units in the consist. See “Silence” soft key.*

### “Silence” Soft Key

“Silence” is the only soft key that appears in the ALARM mode. It does not appear in any other mode of operation.

When “Silence” is pressed OR if 30 seconds pass, the ALARM mode is terminated, the bell will stop ringing, the word “Silence” will disappear. The first line of the display will change from the FAULT message to show the operating restriction which has the greatest effect on the locomotive’s ability to operate normally (highest priority SUMMARY message).

**NOTE:** *A few ALARMS are considered so serious that the bell cannot be silenced. In the cases of ENGINE SHUTDOWN, for example, no “Silence” soft key appears. The EC switch on the SHUTDOWN unit must be turned to the START position to silence the bell.*

## FAULT Mode

As mentioned before, as a result of abnormal conditions (FAULTS), it may be necessary to protect the locomotive’s equipment, by placing certain operating restrictions on the locomotive.

The FAULT mode of operation allows the operator to return the locomotive to the READY condition **unless** conditions exist that prohibit READY operation.

The restrictions imposed are displayed in the form of SUMMARY messages. In resetting FAULTS it is important to know the following about SUMMARY messages:

1. If a FAULT is reset, the operating restrictions imposed by it are removed and the related SUMMARY messages are no longer displayed.
2. Several FAULTS may impose the same operating restrictions and will therefore, result in the same SUMMARY message.

**NOTE:** *A SUMMARY message will only be displayed once (by priority) regardless of the number of active FAULTS which generate the same message.*

3. A FAULT may result in more than one SUMMARY message.
4. Under normal operating conditions, the highest priority SUMMARY message will be displayed. Highest priority being those conditions which have the greatest effect on the locomotive’s ability to operate normally.
5. A list of SUMMARY messages by priority appears on Pages 56 and 57.

## FAULT Mode Soft Keys

The following soft keys can be used by the operator to view SUMMARY and FAULT messages and to begin and to complete the reset procedure.

| <u>Soft Key Label</u> | <u>Explanation</u>  |
|-----------------------|---|
| Exit                  | Takes the DID panel out of the current operating mode.  |
| Reset?                | This soft key asks the operator, “Do you want to Reset?” (a FAULT). It can only appear when there Active FAULTS.<br><br>Resetting a FAULT which has imposed operating restrictions is the only way to return the locomotive to the READY condition. |



| <u>Soft Key Label</u> | <u>Explanation</u>  |
|-----------------------|---|
| Reset?<br>(Cont'd.)   | Resetting a FAULT requires two steps: Pressing "Reset?" <b>initiates</b> the reset procedure. When "Reset?" is pressed, the most recent FAULT will be displayed with the choice of resetting that FAULT or looking at other FAULTS which have not been reset ("Active" FAULTS). |

**NOTE:** "Reset" (without the question mark) must be pressed to complete the reset procedure.

|       |   |
|-------|---|
| Reset | Pressing this key <b>completes</b> the reset procedure. Pressing "Reset" tells the computer this FAULT has been corrected, to remove all operating restrictions imposed by it and, if there are no other Active FAULTS, to return the locomotive to normal operation. When <b>all</b> Active FAULTS have been reset, the message "READY - Work Report Stored" will be displayed. If other Active FAULTS remain, the highest priority SUMMARY message will be displayed. |
|-------|---|

**CAUTION:** *Equipment damage may result - If a FAULT reoccurs soon after being reset, the operator should NOT attempt to reset the FAULT more than three (3) times until the cause of the FAULT has been determined and corrected.*

| <u>Soft Key Label</u>    | <u>Explanation</u>  |
|--------------------------|---|
| Reset<br>(Cont'd.)       | <b>NOTE:</b> <i>If a FAULT causes power to be removed, the unit may not load after the FAULT is reset until the call for power is removed and again requested. This is done by momentarily placing the Engine Control (EC) switch in the ISOLATED position.</i><br><br><b>NOTE:</b> <i>If a FAULT is <u>Active</u> (not reset), it will not reoccur. If a FAULT is reset and the problem not corrected, the FAULT will reoccur and the ALARM mode will be re-initiated.</i> |
| Older<br>and<br>Newer    | FAULT messages are displayed in order of <b>most recent</b> first. The "Older" and "Newer" soft keys allow the operator to view "Older" and "Newer" Active FAULT messages respectively.   |
| ShoMore<br>and<br>GoBack | SUMMARY messages are displayed in order of <b>highest priority</b> . "ShoMore" and "GoBack" allow the operator to review ALL SUMMARY messages (operating restrictions). Each time "ShoMore" is pressed, the next lower priority SUMMARY message will be displayed. Pressing "GoBack" will display the next higher priority SUMMARY message.   |



**EXAMPLE - LEVEL 1 OPERATION**

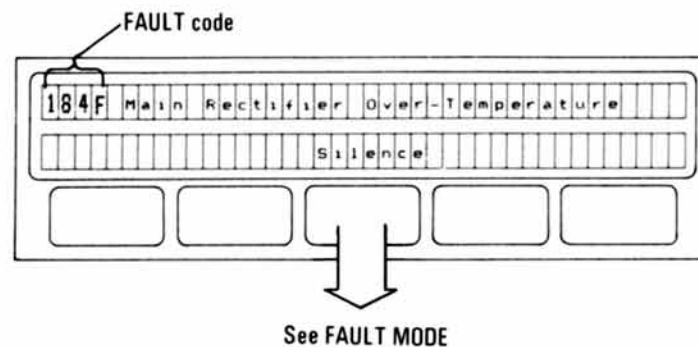
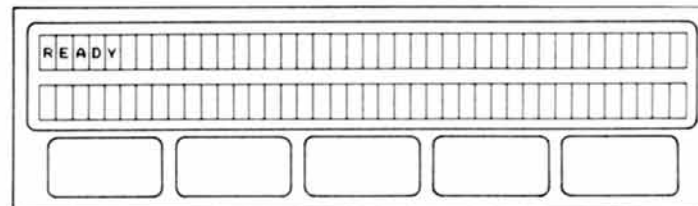
**NOTE:** *The following example is intended to demonstrate DID operation, rather than show actual locomotive operating circumstances.*

Let us assume, for example, that READY is displayed (the locomotive is in the READY mode).

A hot diode condition in the main rectifiers (a FAULT) is detected and the ALARM mode is initiated.

The display will change to show the FAULT, the word "Silence" will appear, and in this case, the alarm bell will ring.

When "Silence" is pressed OR after 30 seconds pass, the ALARM mode is completed; the bell stops ringing, the word "Silence" disappears and the display changes to show the **highest priority SUMMARY** message.



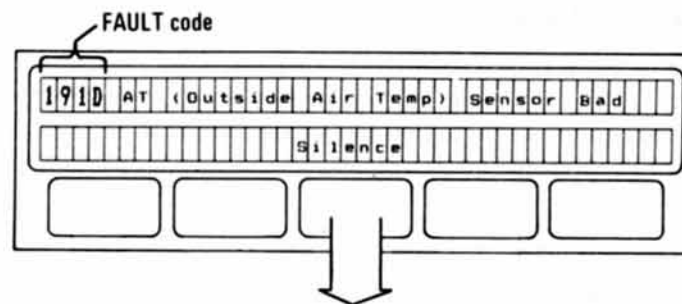
**Second Alarm**

Next, let us assume that a bad outside air temperature sensor is detected. This FAULT occurred after the hot diode FAULT previously discussed and is therefore, a NEWER FAULT.

The ALARM mode is initiated and the display will change to show the bad temperature sensor FAULT.

**NOTE:** *This FAULT is not accompanied by a bell but "Silence" will appear.*

The procedure as previously described will be followed, the ALARM mode will be completed and the highest priority SUMMARY message will be displayed.



See FAULT MODE

**FAULT Mode**

The highest priority SUMMARY message is now displayed. "Won't Load: Hot Diodes" is the highest priority operating restriction placed on the locomotive as a result of the hot diode FAULT and the "Air Temperature Sensor Bad" FAULTS.

The operator now has two choices:

1. Press "Reset?" which will initiate the reset procedure, or
2. Press "ShoMore" to view all operating restrictions placed on the locomotive.

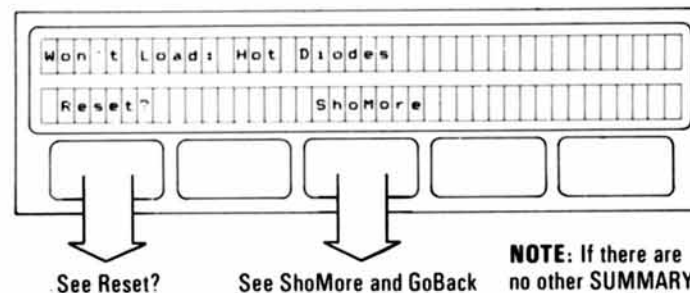
**NOTE:** *Four SUMMARY messages result from the "184F Main Rectifier Over-Temperature" FAULT. They are (highest to lowest priority):*

*"Won't Load: Hot Diodes"*

*"Won't Load: Fault Message Stored"*

*"Won't Self-Load: Fault Message Stored"*

*"No Dynamic Brake: Fault Message Stored."*



**NOTE:** If there are no other SUMMARY messages, "ShoMore" will not appear.

**ShoMore and GoBack**

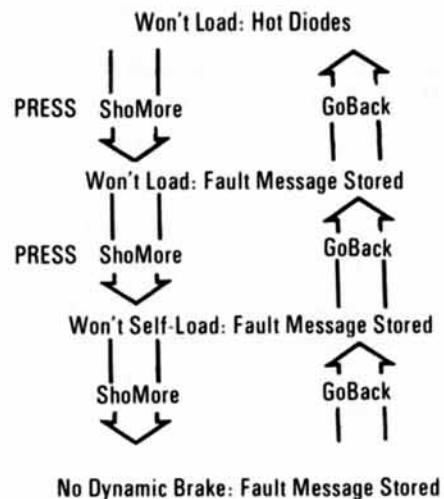
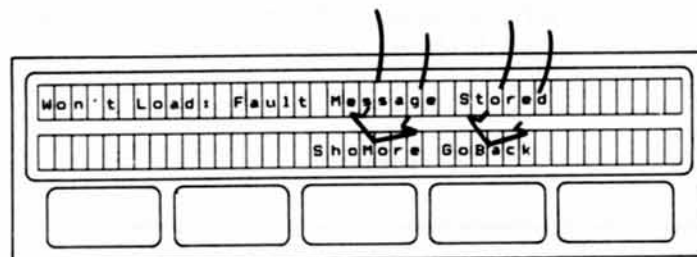
“ShoMore” and “GoBack” allow the operator to review all restrictions placed on the locomotive as a result of Active FAULTS.

Each time “ShoMore” is pressed, the SUMMARY message **next lower** in priority to the message currently displayed is shown.

Each time “GoBack” is pressed, the SUMMARY message **next higher** in priority to the message currently displayed is shown.

**NOTE:** *If 15 seconds pass with no key pad activity, the display will change to show the highest priority SUMMARY message.*

**NOTE:** *If there are no lower priority SUMMARY messages, “ShoMore” will not appear. If there are no higher priority SUMMARY messages, “GoBack” will not appear.*



**Reset?**

“Reset?” is the **first** step in the FAULT reset procedure.

When “Reset?” is pressed, the most recent (newest) FAULT message is displayed.

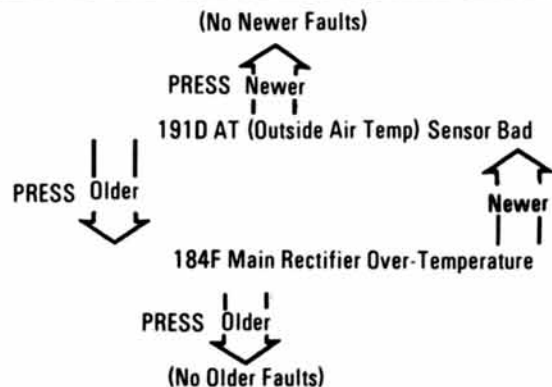
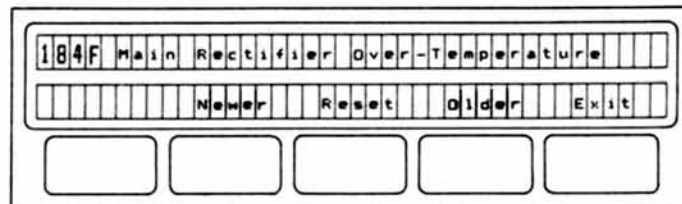
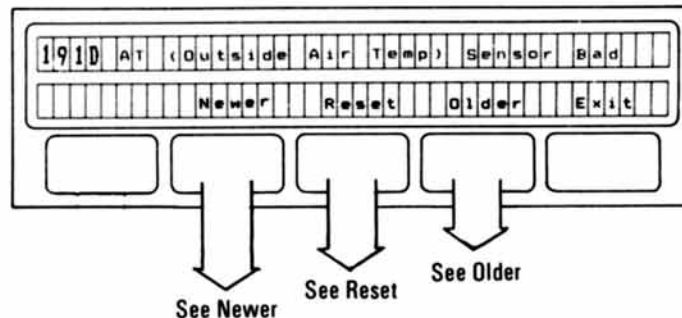
**Older or Newer**

“Newer” and “Older” allow the operator to look at all Active FAULTS and to select the FAULT to be reset.

Each time “Older” is pressed, the FAULT which occurred previous to the FAULT currently displayed will be shown.

Each time “Newer” is pressed, the FAULT which occurred after the FAULT currently displayed will be shown.

**NOTE:** *If there are no older FAULTS and “Older” is pressed, the message “(No Older Faults)” will appear. If there are no newer FAULTS and “Newer” is pressed, the message “(No Newer Faults)” will appear.*



**Reset**

Several things happen when a FAULT is reset:

1. All operating restrictions imposed by the FAULT are removed.
2. If there are other Active FAULTS, the display will show the highest priority SUMMARY message of the remaining Active FAULTS.
3. If there are NO OTHER Active FAULTS, the display will change to show: "READY - Work Report Stored."

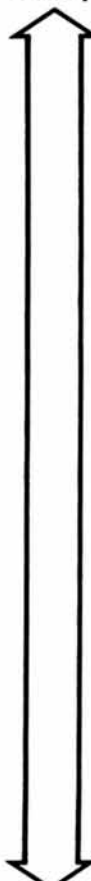
**NOTE:** *The SUMMARY message "READY - Work Report Stored" is for the locomotive maintainer. It tells the maintainer that problems have been encountered which should be investigated.*

**NOTES:**



**LIST OF SUMMARY MESSAGES**

Highest Priority



WAIT  
 WARNING! Air Compressor Does Not Pump  
 Won't Load: Locked Axle Detected  
 Automatic Water Drain Disabled  
 SHUTDOWN: Low Water Flow  
 SHUTDOWN: Low Oil Pressure  
 SHUTDOWN: Low Water Pressure  
 SHUTDOWN: Crankcase Overpressure  
 SHUTDOWN: Engine Overspeed  
 SHUTDOWN: Electrical Control Problem  
 Won't Crank: Electrical Control Problem  
 Engine Not Running  
 Can't Load Now: Too Much Cycling  
 Can't Charge Batteries Now: BRP Cycling  
 No Battery Charge: Elect. Control Prob.  
 No Battery Charge  
 Won't Battery Jog: Elect. Control Prob.  
 Can't Battery Jog: BKT in Wrong Position  
 Can't Self-Load: REV in Wrong Position  
 Won't Load: Overspeed Governor Problem  
 Won't Load: Aux. Alternator Field C/O  
 Won't Load: Side Door Open  
 Won't Load: Electrical Control Problem  
 Won't Load: Too Many Speed Sensors C/O  
 Won't Load: Waiting for Aux. Alternator  
 Won't Load: Hot Engine  
 Won't Load: Power Circuit Ground  
 Won't Load: Power Circuit Problem  
 Won't Load: Battery Charge Problem  
 Won't Load: Hot Diodes  
 Won't Load: MU Error

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Lowest Priority

Won't Load: Fault Message Stored  
 Won't Crank: Fault Message Stored  
 Won't Battery Jog: Fault Message Stored  
 Won't Self-Load: Fault Message Stored  
 ISOLATED  
 Self-Load: LOAD CONDITIONS  
 Operating in STANDBY POWER Mode  
 No Dynamic Brake: Man. Tract. Motor C/O  
 No Dynamic Brake: Auto. Tract. Motor C/O  
 No Dynamic Brake: Elect. Control Prob.  
 No Dynamic Brake: Power Circuit Problem  
 No Dynamic Brake: Fault Message Stored  
 Warning: Locked Axle Alarm is Cut Out  
 Load Limited: PLS in Notch 7  
 Load Limited: PCS Trip  
 Load Limited: Low Oil Pressure  
 Load Limited: Low Water Pressure  
 Load Limited: Hot Engine  
 Load Limited: Cold Engine  
 Load Limited: Dirty Engine Air Filter  
 Load Limited: Traction Motors Cut Out  
 Load Limited: Trac. Motor Temp. Protection  
 Load Limited: Power Circuit Ground  
 Load Limited: Electrical Control Problem  
 May Reduce Load: Radiator Fan Cycling  
 May Reduce Load: Radiator Fan Problem  
 Wrong Wheel Dia./Overspeed Calibration  
 Alarm From Other Unit  
 Fault Log is Almost Full  
 READY - Fault Message Stored  
 READY - Work Report Stored  
 READY

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GENERAL ELECTRIC COMPANY

The Schedule 26-L equipment, arranged for single-end, multiple-unit operation, is used on this locomotive. The principal parts are as follows:

## AIR BRAKE EQUIPMENT ON THE CONTROL CONSOLE (Fig. 2)

### 26-C Brake Valve

This valve consists of two pieces: the automatic brake valve and the independent brake valve. The automatic valve regulates brake pipe pressure to control both locomotive and train brakes. The independent valve controls application and release of the locomotive brakes independent of the train brakes. The independent valve also controls the release of the automatic brake on the locomotive or locomotive consist without effecting the Automatic application on the rest of the train.

### Automatic Brake Valve Handle (Fig. 8)

The Automatic Brake Valve handle has six positions:

1. **RELEASE (RUNNING)** position - This position charges the brake pipe and air brake equipment to release the automatic air brake on the locomotive and train after an Automatic application. This is accomplished by controlling air flow to the brake pipe as set by the regulating valve (on back of brake stand). The **RELEASE** position is at the extreme left of the quadrant and is the normal position when the automatic brake is not in use.
2. **MINIMUM REDUCTION** position - This position is located to the right of the **RELEASE** position where the Brake Valve handle reaches the first raised portion

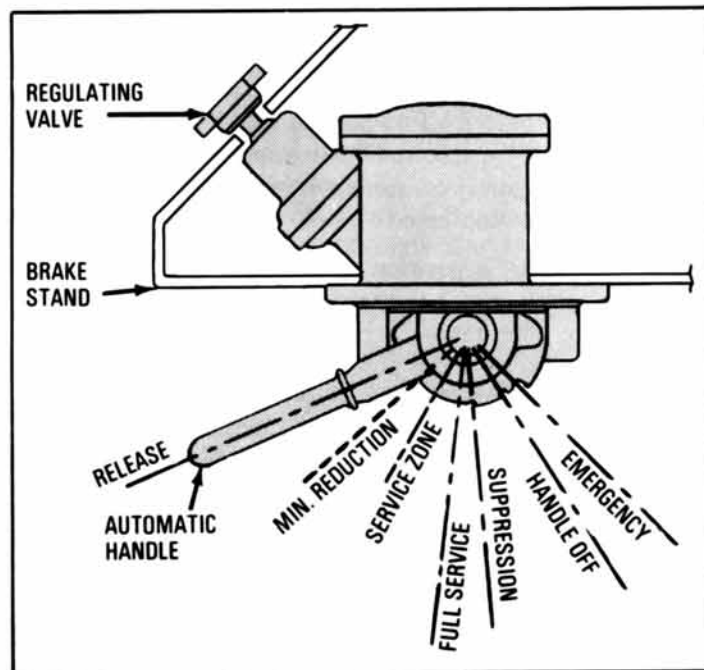


FIG. 8. E-8924E

FIG. 8. AUTOMATIC BRAKE VALVE HANDLE POSITIONS.

of the quadrant. With the Brake Valve handle moved to this position, the Minimum Service application is obtained, which results in a four to six pound brake pipe reduction.

3. **SERVICE** positions - This sector of the Brake Valve handle movement is to the right of the **MINIMUM REDUCTION** position. Moving the handle from the left to right in this sector gradually increases the degree of brake application. At the extreme right of the sector, a Full Service brake application is obtained.

4. **SUPPRESSION** position - This position is located with the handle against the second raised position of the quadrant, to the right of the **RELEASE** position. This position provides a Full Service brake application and, in addition, on locomotives equipped with overspeed control and safety control penalty brakes, these applications will be suppressed.
5. **HANDLE-OFF** position - This position is located by the quadrant notch to the right of the **SUPPRESSION** position. The handle is removable in this position. It must be placed in this position and removed on trailing units of a multiple-unit consist or on locomotives being towed "dead-in-train."
6. **EMERGENCY** position - This position is located to the extreme right of the brake valve quadrant. It is used for making a brake valve Emergency brake application.

When an Emergency application has occurred, the Automatic Brake Valve handle must be moved to the **EMERGENCY** position and left in this position until the equalizing reservoir gage hand indicates zero ("0") pressure and the Sand light is out. The Automatic Brake Valve handle then must be moved to the **RELEASE** position to recharge the brake pipe and release the brakes.

### **Independent Brake Valve Handle**

The Independent Brake Valve handle applies and releases the brakes on the locomotive consist or releases, on the locomotive consist only, the Automatic brake application after an Automatic or Emergency application.

The independent brake valve has two positions: **RELEASE** and **FULL APPLICATION**, with the application zone between. The brake valve is of the self-lapping type which automatically maintains brake cylinder pressure when the application pressure reaches a value corresponding to the handle position. An Independent brake application can be released only by movement of the handle toward the **RELEASE** position. An Automatic Service or Emergency application can be released on the locomotive consist by depressing the Independent Brake Valve handle in the **RELEASE** position.

**NOTE:** *If independent brakes are applied, only minimum dynamic brake can be obtained.*

### **Brake Pipe Cut-Out Pilot Valve (Fig. 2)**

This cock, also known as the "double-heading cock" is located on the front of the automatic brake valve. Push in the handle and turn to position for type of service. The **IN** position is used when the locomotive is operated as a Lead unit. The **OUT** position is used when the locomotive is operated as a Trail unit.

### **MU2A Valve or Dual Ported Cut-Out Cock (Fig. 2)**

This is a two-position valve located on the side of the brake stand. It enables a locomotive equipped with 26-L brakes to be operated in multiple with locomotives having smaller type brake equipment.

The two-position MU2A valve has positions **LEAD/DEAD** and **TRAIL** and the Dual Ported cut-out cock has positions **IN/OPEN** and **OUT/CLOSED**.

1. LEAD/DEAD or IN/OPEN position is used when locomotive unit is operated singly or when it is the Lead unit of a multiple-unit consist. Position is also used when locomotive unit is hauled "dead-in-train."
2. TRAIL or OUT/CLOSED position is used to trail a Lead locomotive having 26-L brake equipment.

### Duplex Air Gages (Fig. 2)

The following duplex (two hands) air gages are located on the operator's console.

Main Reservoir - Equalizing Reservoir - Red hand indicates Main Reservoir (MR) pressure; White hand indicates Equalizing Reservoir (ER) pressure.

Brake Cylinder - Brake Pipe - Red hand indicates locomotive Brake Cylinder (BC) pressure; White hand indicates Brake Pipe (BP) pressure.

### Brake Pipe Air Flow Indicator (Optional) (Fig. 2)

Air flow in the Brake Pipe is indicated by the White hand. The Red hand is set by the operator as maximum brake pipe flow. When the flow is greater than that set, a Red light on the bottom of the indicator will appear.

### AIR BRAKE EQUIPMENT IN AIR BRAKE COMPARTMENT

See Fig. 9 for location of equipment in the air brake compartment. Presence of equipment will depend on the options selected by a railroad. See the Air Piping Diagram for specific air brake valve locations.

### AIR COMPRESSOR SAFETY VALVES

This valve is located in the piping to the first main reservoir at the long hood end of the fuel tank. It is set to open at 150 psi. An optional safety valve is located at the air outlet of the air compressor and is set to operate at 175 psi.

### CUT-OUT COCKS

At specified inspection or maintenance periods, the following manually operated devices are used:

1. Main Reservoir Cut-Out cock - Located on right side of locomotive near the front main reservoir, Fig. 10.
2. Main Reservoir Drain cocks - One located on the end of each main reservoir, usually part of automatic drain valves, Fig. 11.
3. Air-Filter Drain cocks - Located on the main reservoir and auxiliary air filters, Fig. 10.
4. Control-Air Cut-Out cock - Located in air brake compartment, Fig. 9, Item 20.
5. Control-Air Reservoir Drain cock - Located in air brake compartment on rear wall, Fig. 9.
6. Brake Cylinder Cut-Out cocks - Located on right side beneath locomotive platform level (one for each truck), Fig. 12.
7. Air Compressor Governor Cut-Out cock - Located in air compressor compartment accessible from right side of locomotive. Fig. 13.
8. Bell, Horn and Window Wiper Cut-Out cock - Located in air brake compartment, Fig. 9.

9. Sander Control Cut-Out cocks - The front sander cut-out cocks are located in the air brake compartment, Fig. 9. The cut-out cocks for the rear sanders are located inside the radiator cab below the sand box on the left side of the locomotive.
10. Cut-Out Cocks and End Connections in each end of locomotive, Fig. 14:
  - a. Brake Pipe Angle cocks or cut-out cock located behind end frame (BP)
  - b. Main Reservoir Equalizing (MR)
  - c. Actuating (ACT)
  - d. Brake Cylinder Equalizing (Independent Application and Release) (AP).
11. Safety Control Cut-Out cock (optional) - Located in air brake compartment, Fig. 9, or in the nose cab (optional location). Cuts out safety control feature when closed. (See Air Piping Diagram for inclusion and specific location.)
12. Overspeed Control Cut-Out cock (optional) - Located in air brake compartment, Fig. 9. Cuts out overspeed control feature when closed.
13. Dead Engine cock - Located in air brake compartment as part of the air brake rack, Fig. 9.

## ADJUSTING VALVES

### Brake Pipe Regulating Valve (Fig. 2)

The brake pipe regulating valve, located on the control stand, automatically maintains a predetermined air pressure

in the brake system. A clockwise movement of the adjusting handle increases the pressure setting. A counterclockwise movement decreases the pressure setting. Adjust to conform with railroad regulations.

### Control Air Reducing Valve (Located in Control Area 7, Fig. 20)

This valve maintains a predetermined normal air pressure in the air pressure supply for operation of pneumatically operated control equipment. Clockwise adjustment of the adjusting screw increases pressure. Normal control air pressure is 80 lb.

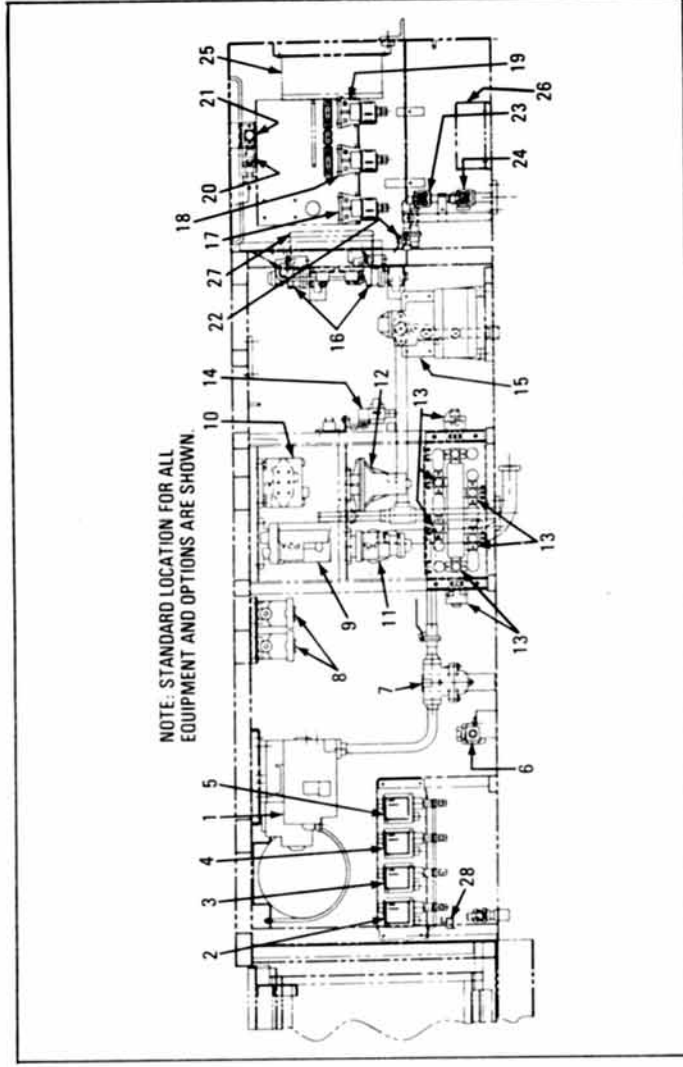


FIG. 9. TYPICAL AIR BRAKE EQUIPMENT LOCATIONS.

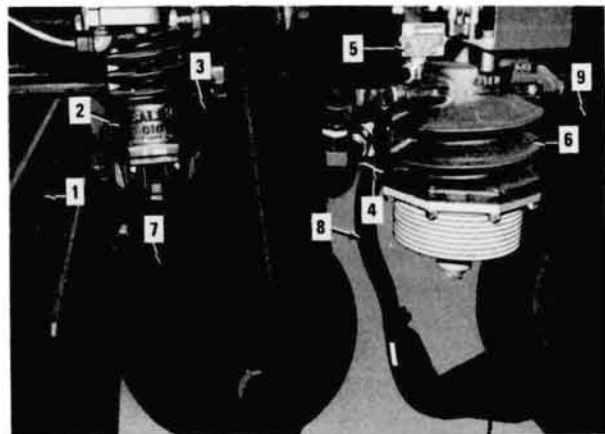
FIG. 9, E-34090

FIG. 9, E-34090

| REF. | DESCRIPTION   | REF. | DESCRIPTION                               |
|------|---|------|---|
| 1    | 26F CONTROL VALVE   | 17   | MAGNET VALVE                              |
| 2    | PRESSURE SWITCH (DBCO OR BCPS)                              | 18   | MAGNET VALVE (OSV)                        |
| 3    | PRESSURE SWITCH (IBS)                                       | 19   | SAFETY CONTROL MAGNET VALVE (SCMV)        |
| 4    | PRESSURE SWITCH (SPS)                                       | 20   | CONTROL AIR CUT-OUT COCK                  |
| 5    | PRESSURE SWITCH (PCS)                                       | 21   | CONTROL AIR CHECK VALVE                   |
| 6    | DEAD ENGINE FIXTURE   |      |   |
| 7    | BRAKE PIPE CUT-OUT COCK AND FILTER                          |      |   |
| 8    | IN-LINE FILTERS (ACT. PIPE AND IND. APPL. AND RELEASE PIPE) |      |   |
| 9    | P2A BRAKE APPLICATION VALVE                                 |      |   |
| 10   | A-1 CHARGING CUT-OFF PILOT VALVE                            |      |   |
| 11   | H-5 RELAY AIR VALVE   |      |   |
| 12   | N-2 REGULATING VALVE  |      |   |
| 13   | CHECK AND DOUBLE CHECK VALVES                               |      |   |
| 14   | DYNAMIC BRAKE MAGNET VALVE (DBM)                            |      |   |
| 15   | RELAY VALVE (J1.4-14 OR J1.6-16)                            |      |   |
| 16   | SHORT HOOD END SANDER CONTROL VALVES (FSCV1 AND FSCV2)      |      |   |
|      |   | 22   | PULSE AIR CUT-OUT COCK                    |
|      |   | 23   | FORWARD SAND CUT-OUT COCK                 |
|      |   | 24   | HORN, BELL AND WIPER CUT-OUT COCK         |
|      |   | 25   | PULSE EQUIPMENT - TRAIN SENTRY (OPTIONAL) |
|      |   | 26   | PULSE SPEED RECORDER (OPTIONAL)           |
|      |   | 27   | PULSE AIR BRAKE MODULE                    |
|      |   | 28   | CONTROL AIR RESERVOIR DRAIN VALVE         |

NOTE: CONTROL AIR REGULATING VALVE AND GAGE ARE LOCATED IN CONTROL AREA 7. SEE FIG. 20.

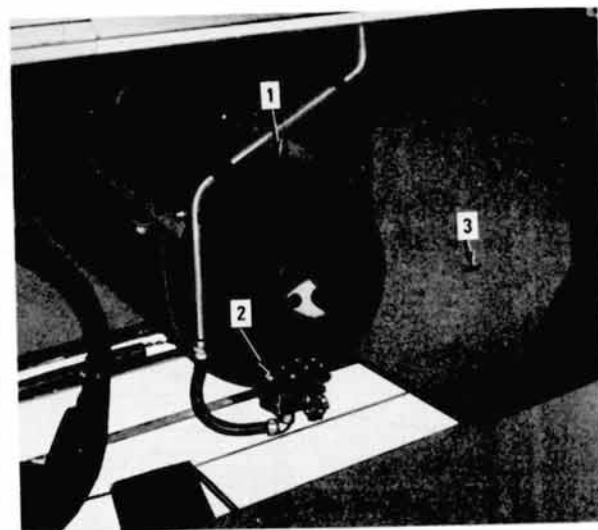
FIG. 9. TYPICAL AIR BRAKE EQUIPMENT LOCATIONS.



| REF | DESCRIPTION                 |
|-----|-----------------------------|
| 1   | FUEL TANK                   |
| 2   | AIR FILTER WITH AUTO DRAIN  |
| 3   | BELL                        |
| 4   | MAIN RESERVOIR CUT OUT COCK |
| 5   | ELECTRIC BLOWDOWN VALVE     |
| 6   | AIR FILTER                  |
| 7   | AIR RESERVOIR               |
| 8   | SAND HOSE                   |
| 9   | TRUCK FRAME                 |

FIG. 10. MAIN RESERVOIR CUT-OUT COCK, MAIN AND AUXILIARY FILTERS AND DRAINS.

FIG. 10, E-31423



| REF | DESCRIPTION   |
|-----|---------------|
| 1   | AIR RESERVOIR |
| 2   | DRAIN VALVE   |
| 3   | FUEL TANK     |

FIG. 11. MAIN RESERVOIR DRAIN VALVE.

FIG. 11, E-31419

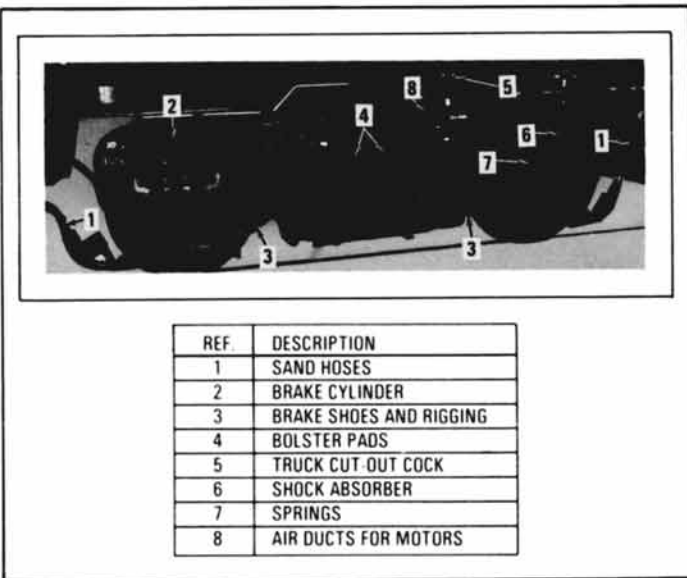


FIG. 12, E-31557A

FIG. 12. TRUCK EQUIPMENT - FOUR-AXLE LOCOMOTIVE.

NOTES:

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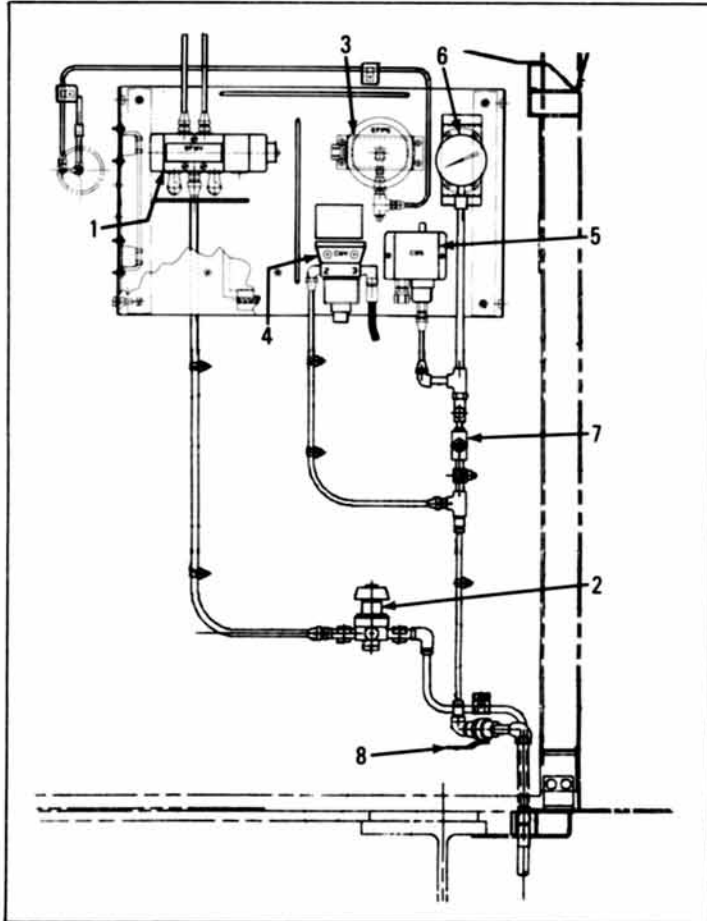


FIG. 13, E-34091

FIG. 13. AIR COMPRESSOR CONTROL PANEL, ENGINE AIR FILTER PRESSURE SWITCH AND ENGINE COOLING WATER FLOW CONTROL VALVE AND PRESSURE REGULATOR.

| REF. | DESCRIPTION                                    |
|------|--|
| 1    | ENGINE COOLING WATER FLOW CONTROL VALVE (WFMV) |
| 2    | PRESSURE REGULATOR                             |
| 3    | ENGINE AIR FILTER PRESSURE SWITCH (EFPS)       |
| 4    | COMPRESSOR MAGNET VALVE (CMV)                  |
| 5    | COMPRESSOR GOVERNOR SWITCH (CGS)               |
| 6    | MAIN RESERVOIR PRESSURE GAGE                   |
| 7    | GAGE AND SWITCH TEST FITTING                   |
| 8    | COMPRESSOR CUT-OUT COCK                        |

FIG. 13, E-34091

FIG. 13. AIR COMPRESSOR CONTROL PANEL, ENGINE AIR FILTER PRESSURE SWITCH AND ENGINE COOLING WATER FLOW CONTROL VALVE AND PRESSURE REGULATOR.

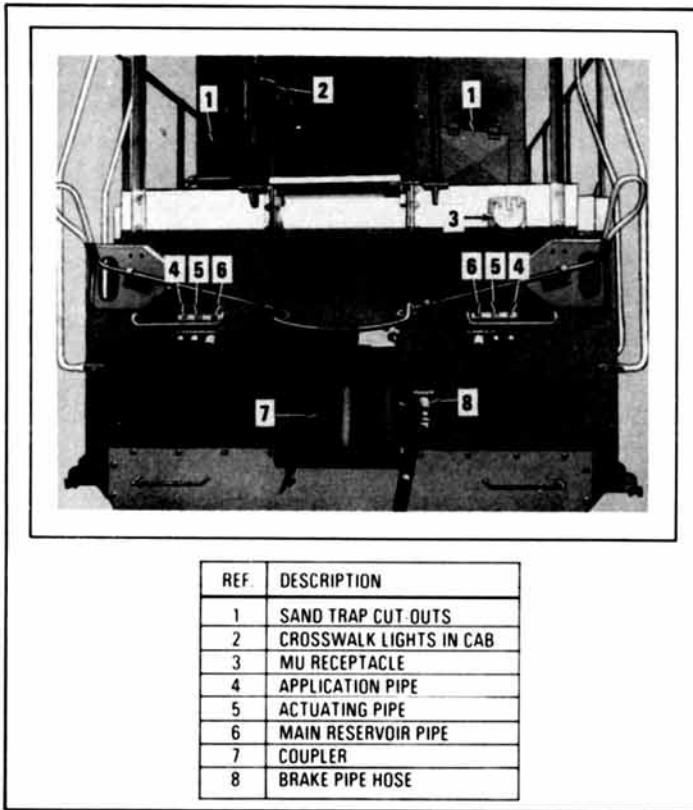


FIG. 14. AIR BRAKE END CONNECTIONS.

FIG. 14, E-31319

## CONTROL COMPARTMENT EQUIPMENT (Fig. 15)

An equipment locker located at the long hood end of the operator cab, and the auxiliary cab house most of the control equipment. The control locker in the operator cab is called Control Area 1. The auxiliary cab, located directly behind the operator cab, houses Control Areas 2, 3 and 4.

In addition, control equipment is located in Control Areas 6 and 7 which are located on the left (B) side and Control Area 8 located on the right (A) side of the locomotive. These Control Areas are accessible from track level. Control Area 9 is located in radiator cab.

Following is a description of each of the control areas:

### Engine Control Panel

Equipment on the EC panel is described earlier in this manual, see pages 15 through 23.

### Control Area 1

Control locker at the long hood end of the operator cab, Fig. 16.

### Control Equipment Areas Located in the Auxiliary Cab (Control Areas 2, 3 and 4)

**WARNING:** *High voltage is present in this compartment when locomotive is under load. When the door to this compartment is opened, the Door Interlock Switch (DIS) will trip causing the unit to drop power. As a safety precaution, open the Auxiliary Alternator Cut-Out switch (BFCO) located inside Control Area 1, Fig. 16, before entering this compartment.*







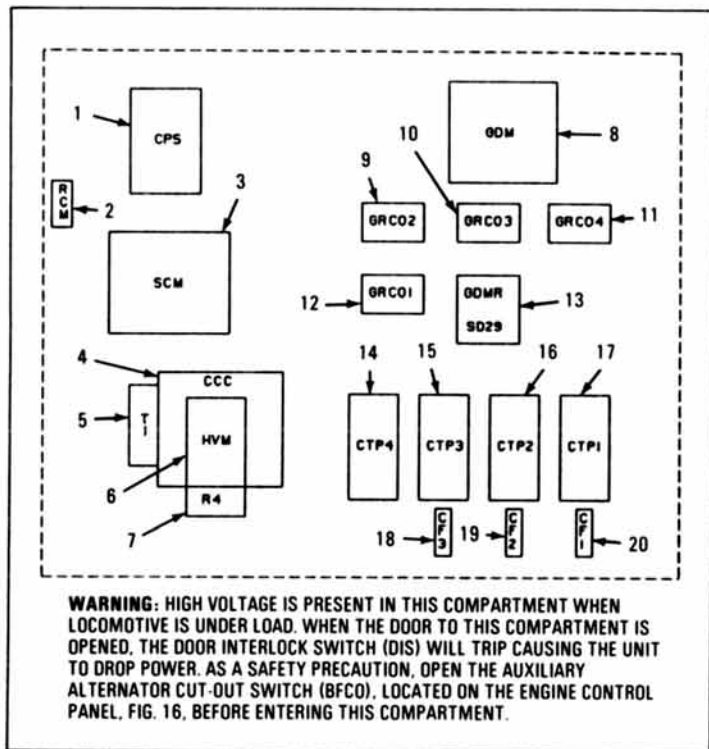


FIG. 17. CONTROL AREA 2 - EQUIPMENT LOCATED ON SHORT HOOD END WALL.

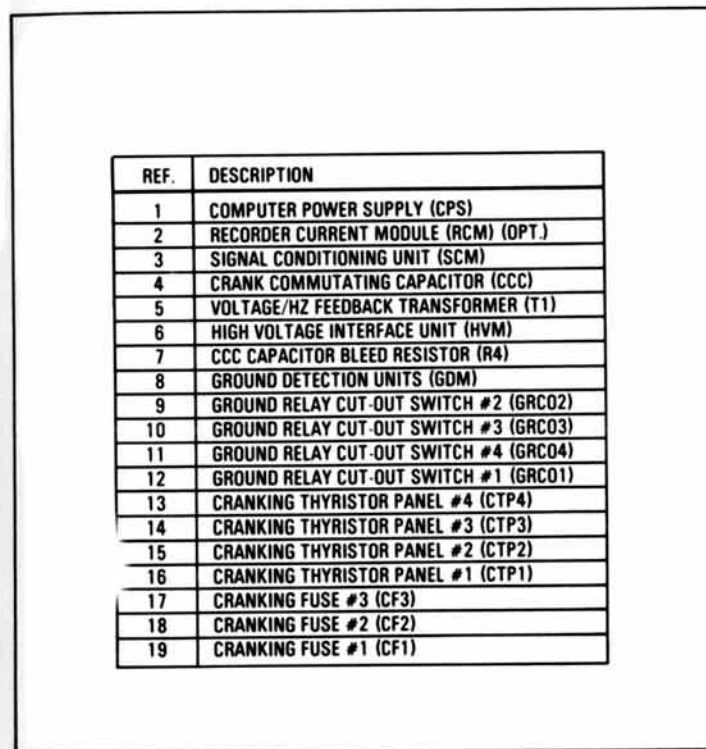


FIG. 17. CONTROL AREA 2 - EQUIPMENT LOCATED ON SHORT HOOD END WALL.

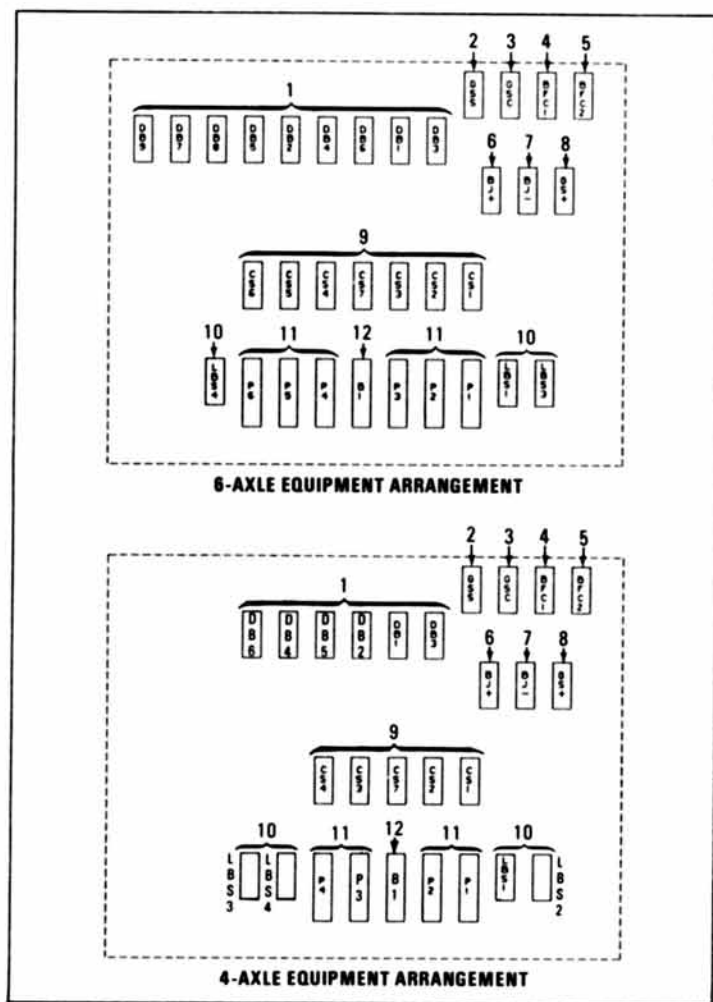


FIG. 18. CONTROL AREA 3 - EQUIPMENT LOCATED ON LEFT-SIDE WALL.

The diagram shows two equipment arrangements for Control Area 3, located on the left-side wall. The top arrangement is for 6-axle equipment, and the bottom is for 4-axle equipment. Both diagrams feature a central group of units labeled '9' and a top row of units labeled '1'. To the right of these are units labeled '2', '3', '4', and '5'. Below the '9' group are units labeled '10', '11', '12', '11', and '10'. The 6-axle arrangement shows units '1' as DB1 through DB8, '9' as MBS1 through MBS8, and '10' through '12' as various power and dynamic braking units. The 4-axle arrangement shows units '1' as DB1 through DB4, '9' as MBS1 through MBS4, and '10' through '12' as various power and dynamic braking units.

**6-AXLE EQUIPMENT ARRANGEMENT**

**4-AXLE EQUIPMENT ARRANGEMENT**

| REF. | DESCRIPTION  |
|------|--|
| 1    | EXTENDED RANGE BRAKING CONTACTORS (IF USED):<br>4-AXLE LOCOMOTIVES, DB1 THRU DB6 INCL.<br>6-AXLE LOCOMOTIVES, DB1 THRU DB9 INCL. |
| 2    | ENGINE CRANK SEQUENCE CONTACTOR (GSS)  |
| 3    | ENGINE CRANK CONTACTOR (GSC)   |
| 4    | TRACT. ALT. FIELD EXCITING CONTACTOR (BFC1)  |
| 5    | TRACT. ALT. FIELD EXCITING CONTACTOR (BFC2)  |
| 6    | BATTERY JOG PLUS CONTACTOR (BJ+)   |
| 7    | BATTERY JOG NEGATIVE CONTACTOR (BJ-)   |
|      | <b>NOTE: BATTERY JOG IS AN OPTION.</b>   |
| 8    | ENGINE CRANK CONTACTOR (GS+)   |
| 9    | CURRENT SHUNTS/SIGNAL CONDITIONING UNITS:<br>4-AXLE LOCOMOTIVES, CS1, 2, 3, 4 AND 7<br>6-AXLE LOCOMOTIVES, CS1 THRU CS7 INCL.    |
| 10   | SELF-LOAD BOX CONTACTORS:<br>4-AXLE LOCOMOTIVES, LBS1 THRU CS4 INCL.<br>6-AXLE LOCOMOTIVES, LBS1, 3 AND 4                        |
| 11   | POWER CONTACTORS:<br>4-AXLE LOCOMOTIVES, P1, 2, 3 AND 4<br>6-AXLE LOCOMOTIVES, P1 THRU P6 INCL.                                  |
| 12   | DYNAMIC BRAKING CONTACTOR (B1)   |

**WARNING: HIGH VOLTAGE IS PRESENT IN THIS COMPARTMENT WHEN LOCOMOTIVE IS UNDER LOAD. WHEN THE DOOR TO THIS COMPARTMENT IS OPENED, THE DOOR INTERLOCK SWITCH (DIS) WILL TRIP CAUSING THE UNIT TO DROP POWER. AS A SAFETY PRECAUTION, OPEN THE AUXILIARY ALTERNATOR CUT-OUT SWITCH (BFCO), LOCATED ON THE ENGINE CONTROL PANEL, FIG. 16, BEFORE ENTERING THIS COMPARTMENT.**

FIG. 18. CONTROL AREA 3 - EQUIPMENT LOCATED ON LEFT-SIDE WALL.

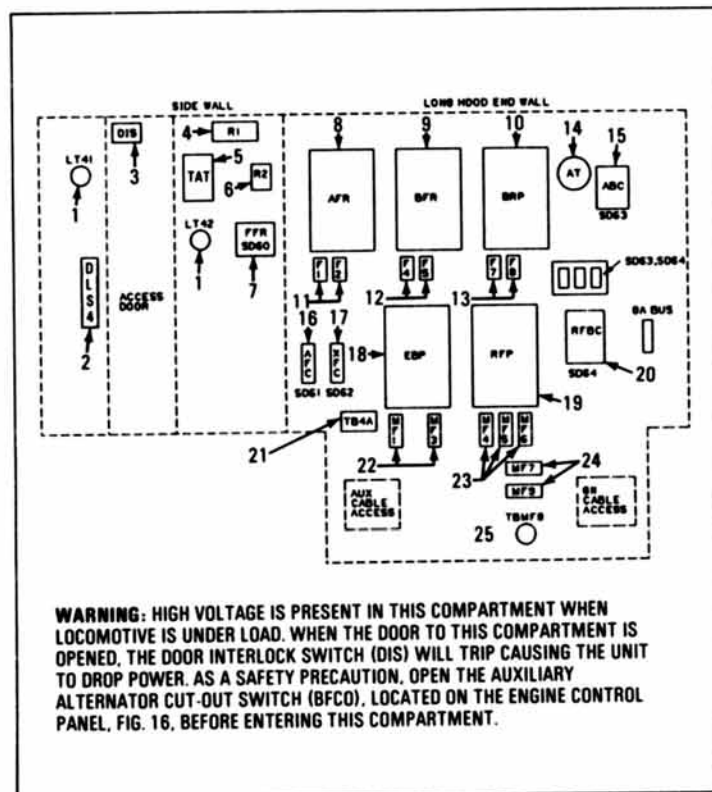


FIG. 19. CONTROL AREA 4 - EQUIPMENT LOCATED ON LONG HOOD END WALL AND THE RIGHT-SIDE WALL.

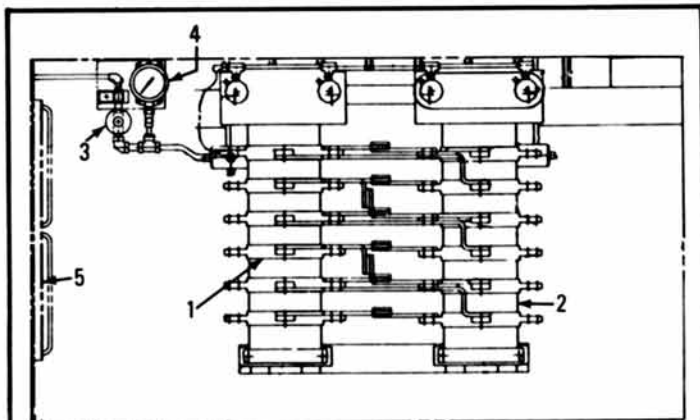
FIG. 19, E-34096

FIG. 19, E-34096

| REF. | DESCRIPTION                                  |
|------|--|
| 1    | COMPARTMENT LIGHTS                           |
| 2    | DROP LIGHT SOCKET (DLS4)                     |
| 3    | DOOR INTERLOCK SWITCH (DIS)                  |
| 4    | ALTERNATOR FIELD CLIPPER RESISTOR (R1)       |
| 5    | ALTERNATOR FIELD CLIPPER PANEL (TAT)         |
| 6    | AUX. ALT. FIELD FLASHING RESISTOR (R2)       |
| 7    | FIELD FLASHING RELAY (FFR)                   |
| 8    | TRACTION ALTERNATOR FIELD REGULATOR (AFR)    |
| 9    | AUXILIARY ALTERNATOR FIELD REGULATOR (BFR)   |
| 10   | BATTERY CHARGER REGULATOR (BRP)              |
| 11   | FUSES (F1 AND F2)                            |
| 12   | FUSES (F4 AND F5)                            |
| 13   | FUSES (F7 AND F8)                            |
| 14   | AMBIENT AIR TEMPERATURE SENSOR (AT)          |
| 15   | ALTERNATOR BLOWER CONTACTOR (ABC)            |
| 16   | ALTERNATOR FIELD CONTACTOR (AFC)             |
| 17   | AUXILIARY ALTERNATOR FIELD CONTACTOR (XFC)   |
| 18   | EQUIPMENT BLOWER MOTOR DRIVE REGULATOR (EBP) |
| 19   | RADIATOR FAN MOTOR DRIVE REGULATOR (RFP)     |
| 20   | RADIATOR FAN BYPASS CONTACTOR (RFBC)         |
| 21   | POWER TERMINAL BOARD                         |
| 22   | EQUIPMENT BLOWER FUSES (MF1 AND MF3)         |
| 23   | RADIATOR FAN FUSES (MF4, MF5 AND MF6)        |
| 24   | COMPRESSOR DRIVE MOTOR FUSES (MF7 AND MF9)   |
| 25   | MOTOR FUSE TERMINAL BOARD (TBMF8)            |

FIG. 19. CONTROL AREA 4 - EQUIPMENT LOCATED ON LONG HOOD END WALL AND THE RIGHT-SIDE WALL.



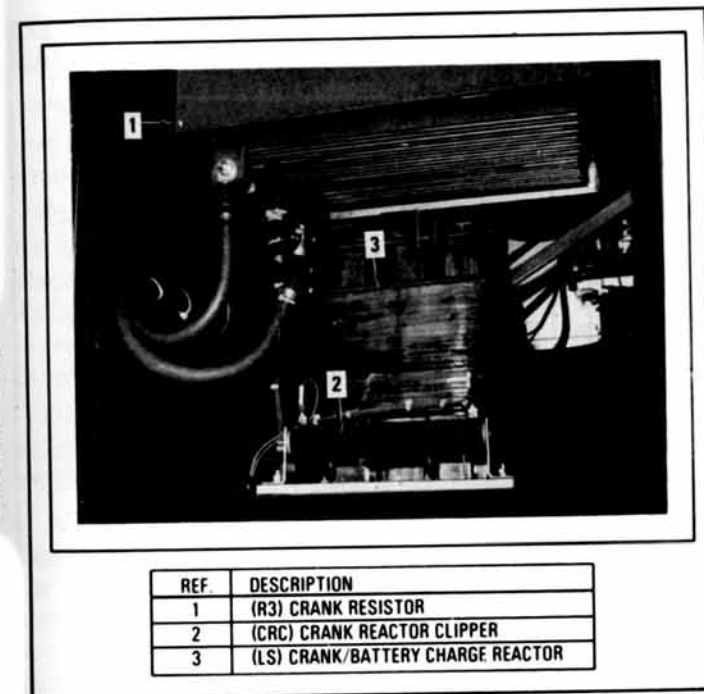


**NOTE:** THE CONTROL AIR RESERVOIR DRAIN VALVE IS LOCATED IN THE AIR BRAKE COMPARTMENT, SEE FIG. 9.

| REF. | DESCRIPTION                    |
|------|--------------------------------|
| 1    | REVERSER (REV)                 |
| 2    | BRAKING SWITCH (BKT)           |
| 3    | CONTROL AIR PRESSURE REGULATOR |
| 4    | CONTROL AIR GAGE               |
| 5    | TERMINAL BOARDS                |

**FIG. 20. CONTROL AREA 7 - LOCATED ON THE LEFT SIDE OF THE LOCOMOTIVE.**

FIG. 20, E-34097



| REF. | DESCRIPTION                       |
|------|-----------------------------------|
| 1    | (R3) CRANK RESISTOR               |
| 2    | (CRC) CRANK REACTOR CLIPPER       |
| 3    | (LS) CRANK/BATTERY CHARGE REACTOR |

**FIG. 21. CONTROL AREA 8 - LOCATED ON THE RIGHT SIDE OF THE LOCOMOTIVE ADJACENT TO THE AIR BRAKE COMPARTMENT.**

FIG. 21, E-31359

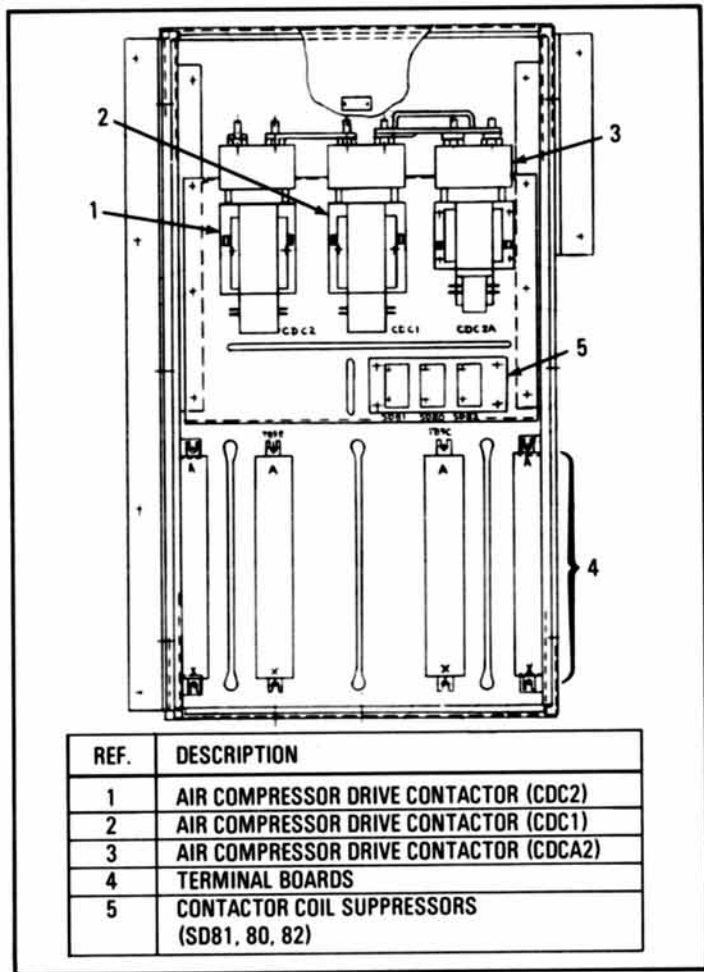


FIG. 22. CONTROL AREA 9 - LOCATED IN THE RADIATOR CAB ON THE LEFT SIDE OF THE LOCOMOTIVE.

### EQUIPMENT BLOWERS AND RADIATOR FAN (Fig. 23)

The Series-8 locomotive uses electric motor-driven traction motor blowers, one motor-driven alternator blower and a motor-driven radiator fan.

The speed of the traction motor blowers and the radiator fan are controlled by solid-state electronics, packaged in Replaceable Units, or RUs which are located in Control Area 4, Fig. 19. This type of control reduces auxiliary loads on the diesel engine since the blowers or fan run only when cooling is required, saving fuel.

Only the alternator blower is not speed-controlled by solid-state electronics. Its speed is directly proportional to engine speed.

A Fan Reverse switch, located in Control Area 1, Fig. 16, can be used to operate the radiator fan in reverse direction for a period of 60 seconds. This is to help clear leaves and debris which has accumulated on the inlet screens and radiators. This switch is intended for use by maintenance personnel.

**NOTE:** *If cooling water temperature is below 150 F, the blowers go to full speed.*

**NOTE:** *If ambient temperature is above 130 F, blowers go to full speed.*

**NOTE:** *If the radiator fans are not operated for a period of 30 minutes, the controllers will automatically operate them at full speed for a period of 10 seconds to prevent bearing brinelling.*

**NOTE:** *If fans have been cycling excessively, the fans will go to full speed.*

FIG. 22, E-34098

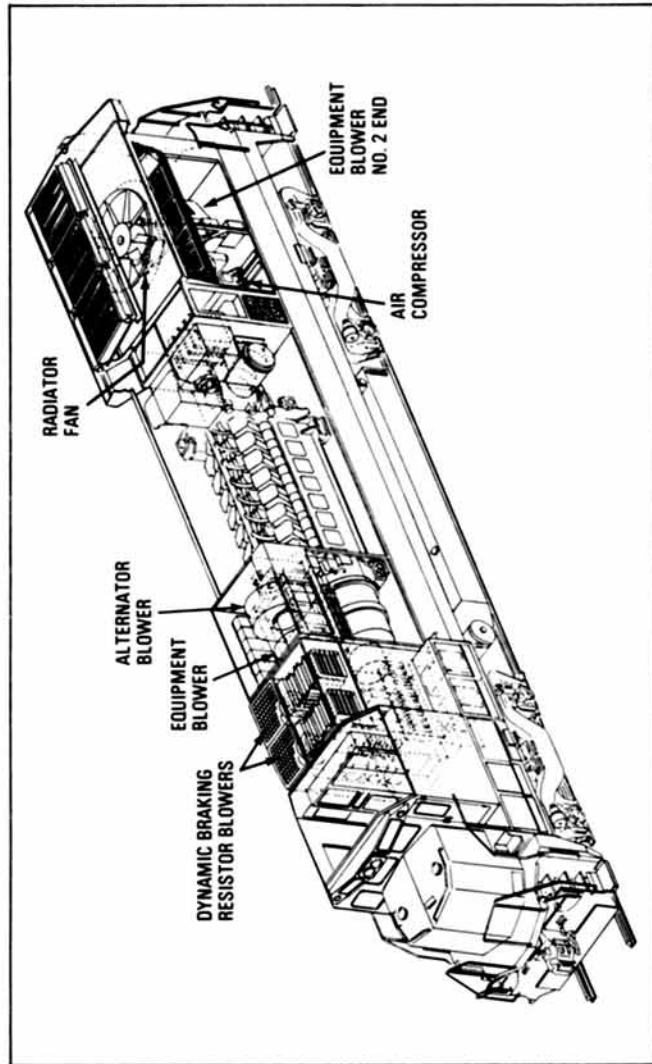


FIG. 23. LOCATION OF EQUIPMENT BLOWERS, DYNAMIC BRAKING RESISTOR BLOWERS, ALTERNATOR BLOWER AND RADIATOR FAN.

FIG. 23, E-34099

## AIR COMPRESSOR

The Series-8 locomotive, built in 1987, uses an air compressor driven by an electric motor. Motor speed and compressor loading are controlled by the EXC Controller. The Compressor Governor Switch (CGS), located on the compressor control panel, monitors main reservoir pressure and provides a pressure signal to EXC. EXC, in turn, energizes the compressor drive contactor to start the air compressor drive motor. After 2 seconds, EXC de-energizes the Compressor Magnet Valve (CMV) to load the compressor. Speed of the air compressor drive motor is also monitored. If EXC has commanded the drive motor to start, but motor speed is not within limits, a FAULT will be logged, and the SUMMARY message "WARNING! Air Compressor Does Not Pump" will be displayed.

## Engine Start Station and START Switch (Fig. 24)

The Engine Start Station is located in the engine cab next to the main traction alternator. It consists of an engine PRIME/START switch, which is used to start the diesel engine, and an ENGINE STOP button.

## DIESEL ENGINE CONTROL GOVERNOR (Fig. 25)

The Diesel Engine Control Governor's primary function is to maintain speed of the diesel engine as called for by the Throttle handle notch setting in the lead locomotive controller. Engine rpm is maintained under a full range of loads. The governor also monitors the engine oil and water pressures, and will modulate the load and engine speed or, if necessary, shut the engine down if either pressure should

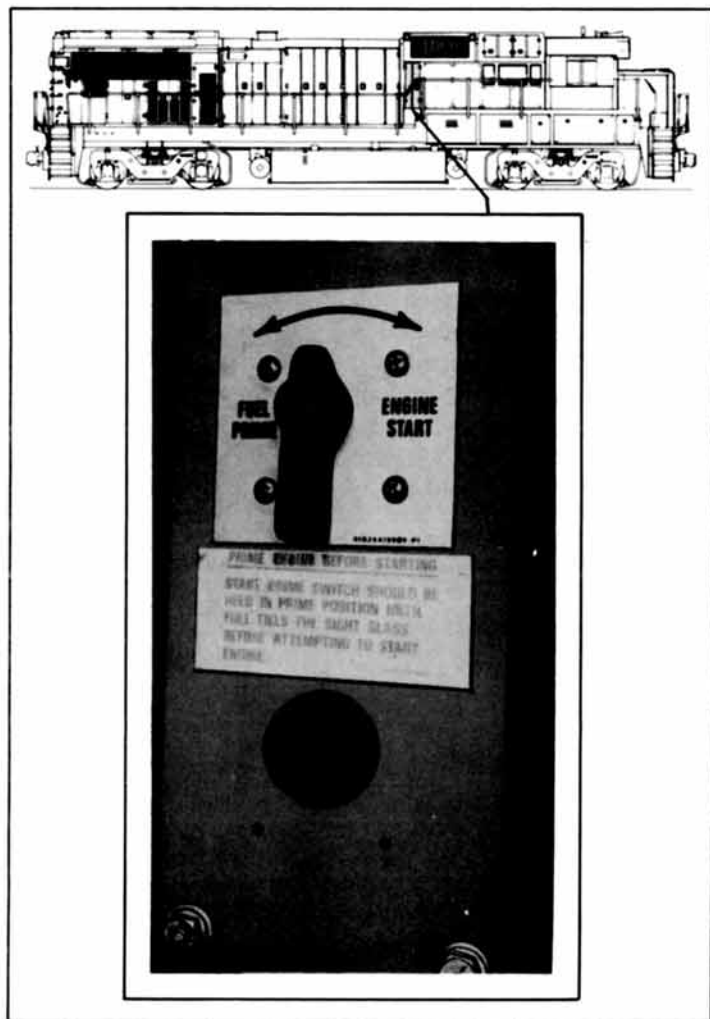


FIG. 24. ENGINE START STATION.

FIG. 24, E-31564A (3 OF 4, 4 OF 4)

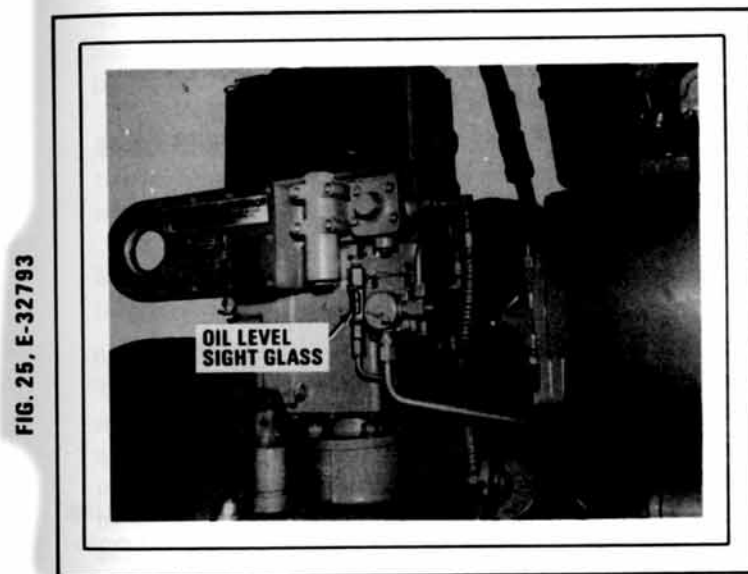


FIG. 25. ENGINE CONTROL GOVERNOR.

fall below preset limits. Intake manifold air pressure is also monitored and the locomotive control system and the governor will limit the fuel available to the engine if the air pressure is below that required for complete combustion.

| Engine Speed to<br>Throttle Handle Position |              |            |
|---|--------------|------------|
| Throttle Handle<br>Position                 | Engine Notch | Engine RPM |
| Idle  | (see Note 1) |            |
| 1   | 1            | 437-444    |
| 2   | 2            | 567-594    |
| 3   | 3            | 705-732    |
| 4   | 4            | 758-786    |
| 5   | 6            | 884-892    |
| 6   | 6            | 884-892    |
| 7   | 7            | 991-998    |
| 8 (see Note 2)                              | 8            | 1047-1054  |

In Dynamic Braking, engine speed depends on the braking effort requested (position of Braking handle) and locomotive speed.

**NOTE 1: HIGH IDLE, REGULAR IDLE, LOW IDLE and LOW LOW IDLE:**

|                     |                |
|---------------------|----------------|
| <b>HIGH IDLE</b>    | <b>567-594</b> |
| <b>Regular IDLE</b> | <b>437-444</b> |
| <b>LOW IDLE</b>     | <b>324-352</b> |
| <b>LOW LOW IDLE</b> | <b>266-274</b> |

*The locomotive control system will automatically reduce engine speed to LOW IDLE or LOW LOW IDLE based on the following requirements:*

*Reverse handle centered and locomotive NOT in Self-Load.*

**OR**

*Reverse handle in FWD or REV for more than five minutes with Throttle in IDLE and Braking handle in OFF.*

**AND**

*Battery charger current and voltage within certain limits based on the TIME current and voltages are within those limits.*

**AND**

*Engine cooling water and oil temperature within certain limits.*

**NOTE 2:** *At certain locomotive speeds, with the Throttle handle in Notch 8, engine RPM will automatically be reduced from Notch 8 speed to Notch 7 speed while maintaining Notch 8 power. This occurs only on locomotives equipped with 16 engines (B39-8 or C39-8) or on B23-8 locomotives. This reduction occurs within a locomotive speed range which is determined by locomotive model and gearing.*

## MISCELLANEOUS EQUIPMENT

1. Handbrake - Located on outside of nose compartment, Fig. 1, Item 4.
2. Emergency Fuel Cut-Off System, Figs. 3, 24 and 28. In an emergency, any one of four electric push-buttons may be depressed momentarily to cut off fuel delivery and shut down the engine. One of these buttons is located on each side of the locomotive platform near the fuel tank. The third and fourth buttons are located on the Engine Control (EC) panel and at the Start Station and are normally used for shutting down the engine.

**NOTE:** *The Emergency Cut-Off button is used to shut down the engine on the local units only. The SHUT-DOWN position of the Throttle handle on the Master Controller will shut down the engines on all units of the consist simultaneously.*

3. Toilet (optional) - Located in the nose cab.
4. Water Cooler and Refrigerator (optional) - Located in the access to the nose cab.

FIG. 26, E-34100

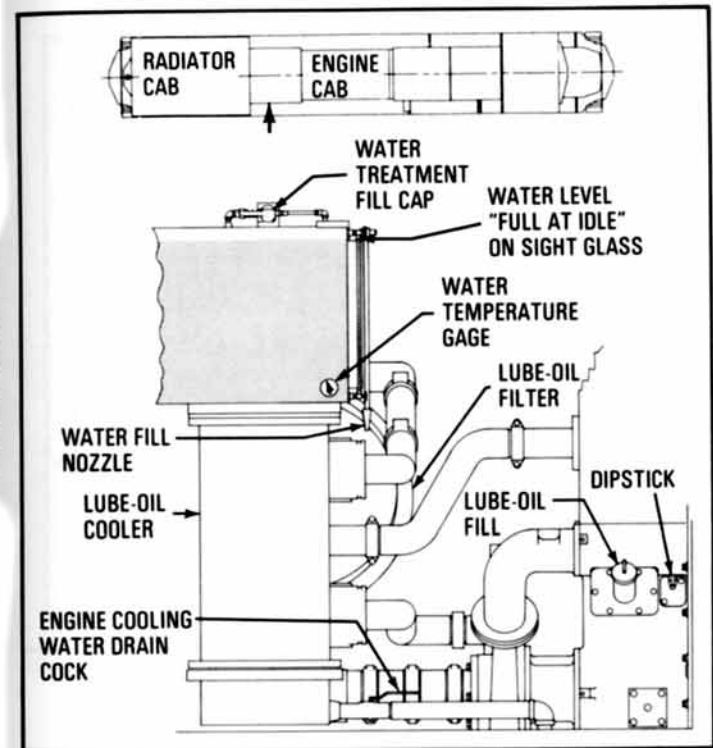


FIG. 26. ENGINE COOLING WATER SIGHT GLASS.

### PRESSURE AND TEMPERATURE GAGES

1. Control Air Gage - Located in Control Area 7, Fig. 20. Normal control air pressure is 80 psi.

**NOTE:** *The following values are nominal due to the effect of varying conditions.*

2. Water Temperature Gage - Located on the right side of the water storage tank, Fig. 26. Normal operating temperature is 188-200 F.

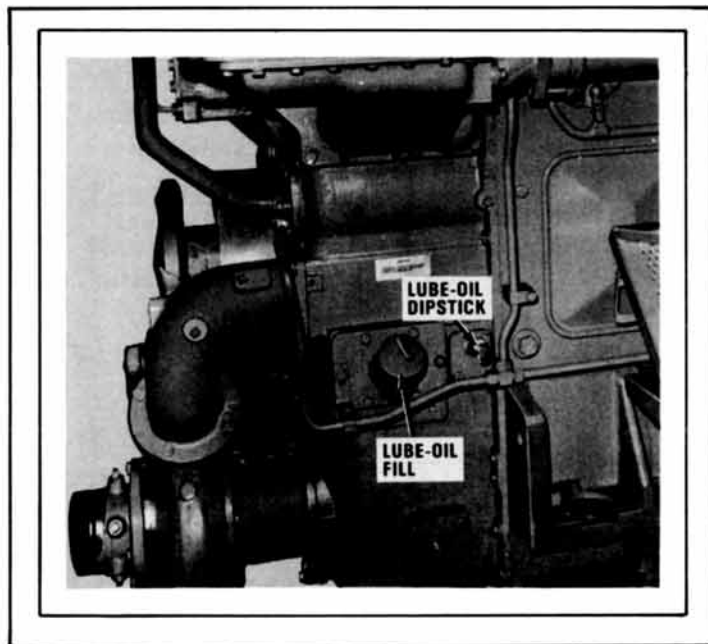


FIG. 27. DIESEL ENGINE LUBE-OIL DIPSTICK AND FILL.

### OTHER GAGES

1. Engine Lubricating-Oil Dipstick - Located on both sides of the engine near the lube-oil fill, Fig. 27. The stick is marked FULL and LOW. Proper level with the engine idling is between FULL and LOW.

**NOTE:** *Overfilling will cause engine to shutdown from excessive crankcase pressure.*

2. Fuel-Oil Sight Glasses - Mounted on both sides of the main fuel tank, Fig. 28, to indicate the level of fuel in the tanks.

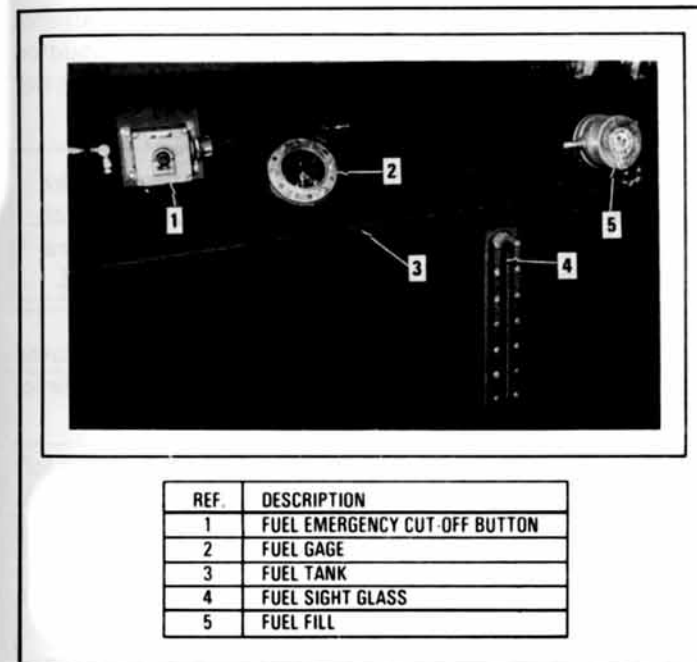


FIG. 28, E-31424

| REF. | DESCRIPTION                   |
|------|-------------------------------|
| 1    | FUEL EMERGENCY CUT-OFF BUTTON |
| 2    | FUEL GAGE                     |
| 3    | FUEL TANK                     |
| 4    | FUEL SIGHT GLASS              |
| 5    | FUEL FILL                     |

FIG. 28. "A" SIDE OF FUEL TANK.

3. Cooling Water - A water level sight glass mounted on the right side of the cooling water storage tank, Fig. 26, indicates the level of the cooling water. Markings near the sight glass indicate the proper level for various conditions of the system.





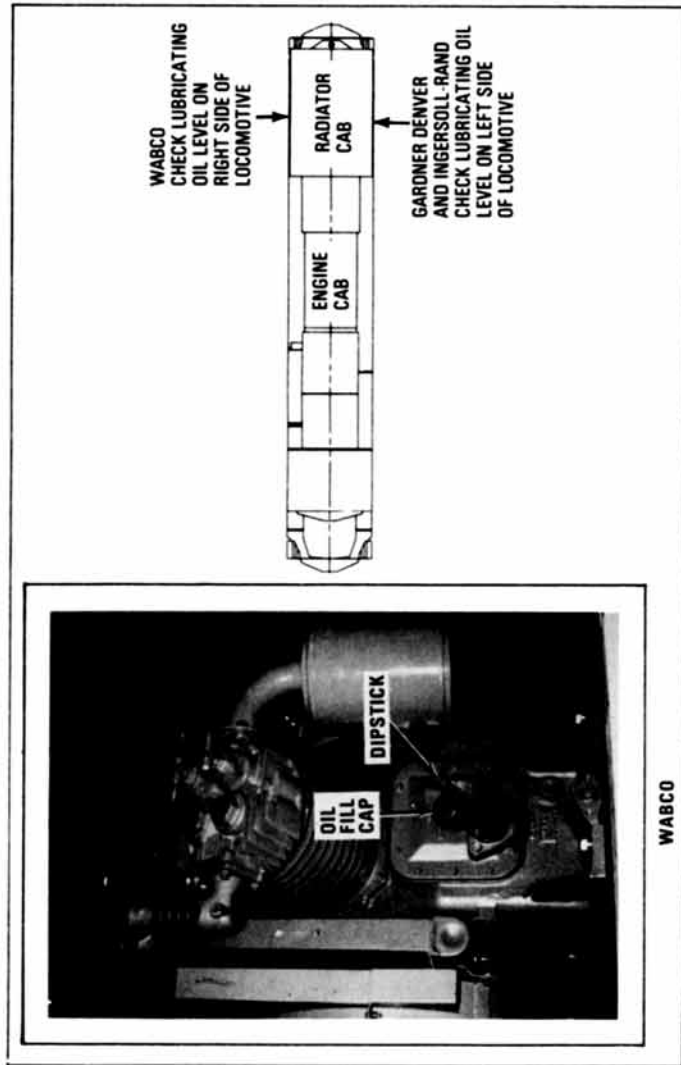


FIG. 29. AIR COMPRESSOR LUBE-OIL DIPSTICK.

FIG. 29, E-34101, E-27417, E-33894

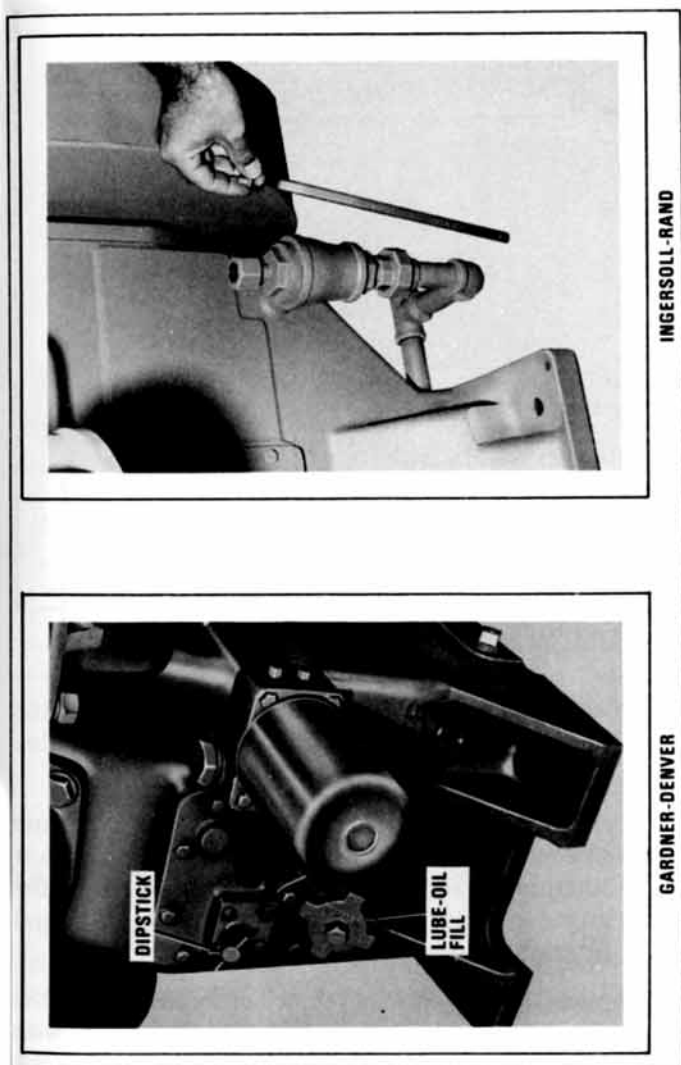
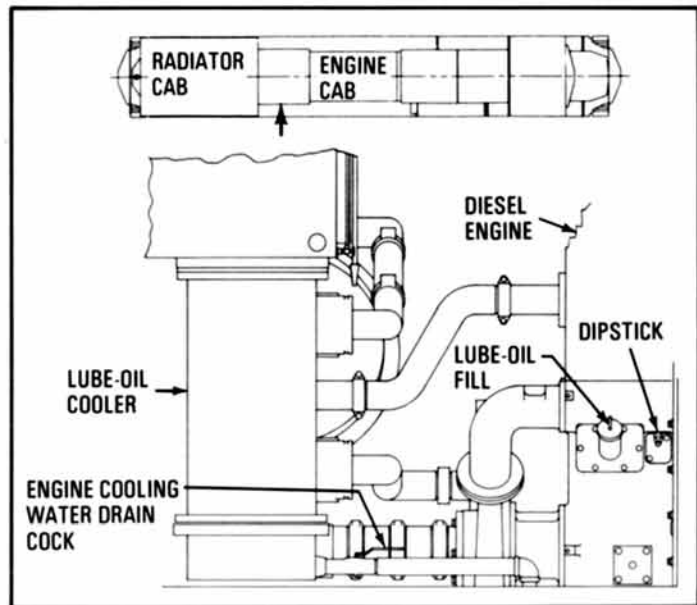


FIG. 29, E-34101, E-27417, E-33894

FIG. 29. AIR COMPRESSOR LUBE-OIL DIPSTICK.

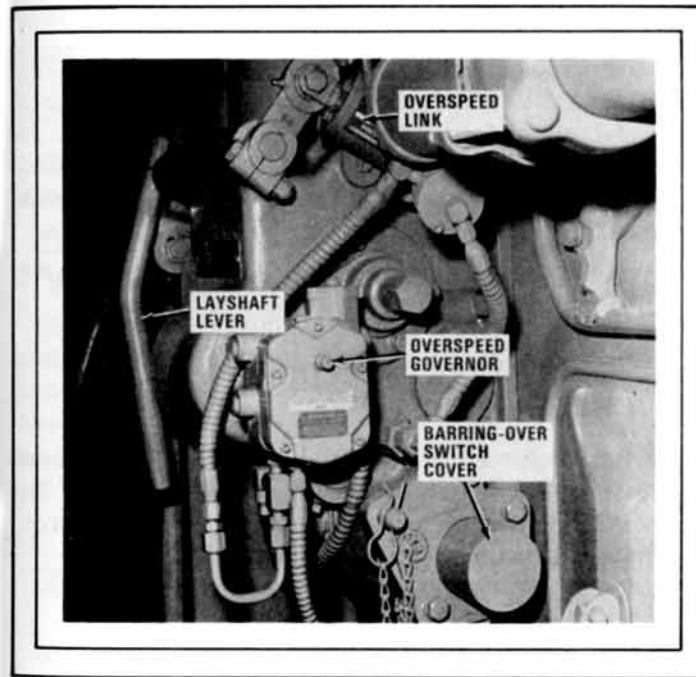


**FIG. 30. ENGINE COOLING WATER DRAIN.**

The cooling water system may be drained by opening the main water drain valve on the right side of the locomotive near the lube-oil pump, Fig. 30.

An optional Automatic Water Dump System will dump the engine cooling water when water temperature is below 40 F. A thermostat actuates, tripping the solenoid in the water drain valve. This opens the automatic drain valve and permits the rapid draining of the cooling water.

This system also has a Control switch located under the water tank. This switch can be used to fill the system with cold water, and to test the water dump valve.



**FIG. 31, E-31863**

**FIG. 31. ENGINE OVERSPEED SYSTEM AND BARRING-OVER SWITCH.**

**BARRING-OVER SWITCH (Fig. 31)**

A Barring-Over switch is located under the cover of the diesel engine barring-over feature behind the engine overspeed governor. This switch prevents the engine from being cranked while engine barring-over procedure is in progress or if the cover has been left off.

## EMERGENCY SANDING

Emergency sanding is automatically applied in FORWARD and REVERSE directions during all Emergency brake applications for a sufficient time to stop the train. In multiple-unit operation, emergency sanding is applied to all units, regardless of whether they are equipped with pneumatic or electro-pneumatic sanding equipment.

**NOTE:** *Customer options may vary the operation of this switch.*

## ENGINE AIR FILTER PRESSURE SWITCH (EFPS) (Fig. 13)

The Engine Air Filter Pressure Switch (EFPS) monitors air pressure drop across the engine air filters. When the Engine Air Filter switch operates, engine rpm follows Throttle handle and maximum power is limited to Notch 6.

## GROUND CUT-OUT SWITCHES (Fig. 17)

Four Ground Cut-Out switches are mounted in Control Area 2 of the Series-8 locomotive.

These are two-pole switches which connect sensing circuits to detect ground leakage current in the following circuits:

1. Propulsion circuit (GRCO1)
2. Excitation supply circuit (GRCO2)
3. Auxiliary motor supply circuit (GRCO3)
4. Battery charging circuit (GRCO4).

One pole of each switch is used to remove the connection from the locomotive frame (chassis ground) to the ground

detection circuitry. This is used to remove the “known” ground when performing insulation tests on the locomotive circuits, or to remove the “known” ground when troubleshooting for ground faults.

One pole of each switch is used to disable control circuits with the switch open.

## THE LOCOMOTIVE WILL NOT LOAD WITH ANY OF THE GROUND CUT-OUT SWITCHES OPEN!

Only the propulsion circuit ground detector will derate locomotive performance based on ground leakage. Propulsion buss voltage is reduced proportional to ground leakage current as follows:

| Ground Current Leakage (amperes) |               | Result  |
|----------------------------------|---------------|---|
| Motoring or Self-Load            | Dynamic Brake |   |
| 0 to 1/2                         | 0 to 1/4      | Causes no deration.   |
| 1/2 to 1                         | 1/4 to 1/2    | Is the range which will derate propulsion buss voltage from no deration at 1/4 ampere to full deration at 1/2 ampere. |
| Above 1                          | Above 1/2     | Is considered a “solid” ground fault. Power is reduced to zero.   |

The other ground leakage detectors will not derate locomotive performance, but when grounds are detected, alarms will be sounded and faults will be logged on the Diagnostic Display Panel.

### MOTOR CUT-OUT SWITCHES (Fig. 3)

Traction motors can be cut out manually or automatically. Manual cut out is done with individual Motor Cut-Out switches on the EC panel. Automatic cut out is done by the microcomputer control if a fault condition such as excessive current or too great a rate of change of current (Motor Flashover) is detected.

**CAUTION:** *It is recommended that motor only be manually cut out when the Engine Control switch is in START or ISOLATE position (unit isolated) and the Throttle handle is in IDLE.*

**NOTE:** *Speed sensors do not need to be cut out on cut out motors. When the Motor Speed Sensor switch is in the CUT-OUT position, the speed signals from the speed sensors on motors which are cut out are ignored.*

When a motor or motors are cut out, total power available for traction is adjusted as follows:

| Motors<br>Cut-Out | Horsepower Available for Input for Traction<br>Per Model |                      |                      |                      |                      |
|-------------------|--|----------------------|----------------------|----------------------|----------------------|
|                   | B23  | B32                  | B39                  | C32                  | C39                  |
| All IN            | 2300   | 3200                 | 3900                 | 3200                 | 3900                 |
| 1 Out             | 2300   | See Note 1           | See Note 1           | 3200                 | 3900                 |
| 2 Out             | See Note 1   | See Note 1           | See Note 1           | 3200                 | 3900                 |
| 3 Out             | See Notes<br>1 and 2                                     | See Notes<br>1 and 2 | See Notes<br>1 and 2 | See Note 1           | See Note 1           |
| 4 Out             | See Notes<br>1 and 2                                     | See Notes<br>1 and 2 | See Notes<br>1 and 2 | See Note 1           | See Note 1           |
| 5 Out             | N/A  | N/A                  | N/A                  | See Notes<br>1 and 2 | See Notes<br>1 and 2 |
| 6 Out             | N/A  | N/A                  | N/A                  | See Notes<br>1 and 2 | See Notes<br>1 and 2 |

**NOTE 1:** Horsepower available for input for traction is limited to 1021 horsepower per each traction motor CUT IN.

**NOTE 2:** Speed sensor inputs from at least two traction motors are required for locomotive to load.

If any motor is cut out on a locomotive, Dynamic Braking on that locomotive is cut out.

### OIL AND WATER TEMPERATURE AND PRESSURE

Horsepower will be derated if one of the following conditions exist:

| <u>Condition</u>                               | <u>Resulting Load Limit</u>   |
|--|---|
| Oil Temp.<br>below 90 F                        | Engine RPM is Notch 1<br>Maximum Power is Notch 1   |
| Oil Temp.<br>below 140 F                       | Engine RPM is Notch 4<br>Maximum Power is Notch 4   |
| Oil or Water<br>Temp. between<br>225 and 235 F | Power is derated from no<br>deration at 225 F to full<br>deration at 235 F  |
| Oil or Water<br>Temp. above 240 F              | Engine RPM returns to<br>IDLE; all power is removed.<br><br><b>NOTE: A special<br/>combination of sensors<br/>together with a built-in<br/>program senses operation in<br/>a tunnel and permits oil or<br/>water temperature to rise to<br/>250 F for ten minutes.</b>                            |
| Low Oil or Water<br>Pressure                   | Low oil and water pressure<br>are monitored by the engine<br>control governor. If low oil<br>or water pressure is detected:<br><br>In Motoring or Self-Load -<br>Power is reduced by one<br>third.<br><br>In Dynamic Brake - Dynamic<br>Brake is nullified if engine<br>speed drops below normal. |

### OVERSPEED - ENGINE SHUTDOWN (Fig. 31)

In the event the diesel engine overspeeds to 1160 rpm, the engine, radiator fans and the equipment blowers are shut down automatically.

After an overspeed shutdown of the engine, move the EC switch to START.

Reset the overspeed link, pull the layshaft lever toward you until a click is heard. Pushing on the layshaft provides more fuel to the cylinders during cranking, if desired. Note that the location of the lever prevents inadvertent manual overspeeding of the engine beyond the trip setting. Once the device trips, manual control of the fuel racks is eliminated.

Proceed to start the engine as described under Starting Engine section. If it overspeeds again, do not restart the engine.

**CAUTION:** *During freezing weather, protect the engine cooling system according to railroad instructions.*

### OVERSPEED - LOCOMOTIVE

When a locomotive equipped with overspeed protection exceeds the maximum permissible speed, as specified by customer, an Overspeed application is initiated.

1. The overspeed whistle blows.
2. In about five seconds, a Penalty brake application is initiated if train speed has not been reduced sufficiently. See air brake regulation for proper procedure.

### PCS SWITCH OPERATION (Fig. 9)

The Pneumatic Control Switch (PCS) is operated from the air brake system. During a safety control Penalty or Emergency brake application, this switch opens. Operation of this switch will affect engine speed, available locomotive power and light the "PCS OPEN" (White) light at the operator's position.

Operating options selected by the railroad will determine how the locomotive control system will react to PCS operation. See railroad operating rules and the locomotive air piping and electrical schematic diagram for application to specific locomotives.

To reset the PCS switch:

1. Move the Throttle handle to IDLE.

**NOTE:** *If the PCS switch has tripped while in dynamic braking, the Dynamic Braking handle must be returned to OFF to reset the circuit.*

2. Move the Automatic Brake Valve handle to SUPPRESSION.
3. Depress the Safety Control foot pedal (if used). (When the application pipe builds-up to normal pressure, PCS will reclose.)
4. Move the Automatic Brake Valve handle to RELEASE.

### POWER LIMIT SWITCH (Fig. 2)

When the Power Limit switch is closed, Engine RPM is limited to Notch 7 and Maximum Power is limited to Notch 7. (Omission of Power Limit Switch is an option.)

### SAFETY CONTROL FOOT PEDAL (Fig. 2)

A foot pedal, if installed, is located at the operator's position. The pedal must be depressed at all times during locomotive operation. If the operator's foot is removed from the pedal for more than five seconds, the brakes will apply at the SERVICE rate. For further description, see Safety Controls section.

### WHEELSLIP

Axle speed is continuously monitored by the locomotive computers. The axle (or wheel) speed of all axles are compared. If the differential in speeds is greater than a preset limit, wheelslip action will take place as follows:

#### wheelslip in Motoring

If differential speeds are greater than the preset limits, a voltage limit is applied to the output of the alternator to keep the differential speed within the specified limit.

If high axle (or wheel) accelerations are measured, indicating a synchronous slip is occurring, the alternator output voltage will also be limited. This voltage limit restriction will be applied proportional to available wheel rail adhesion.

A locked axle or motor overspeed condition will cause output power to go to zero, accompanied by a trainlined wheelslip indication. Power will be applied per the engine load rate schedule when the condition corrects.

## **Sand**

If poor wheel rail adhesion causes the output of the locomotive to fall below a preset percentage of that requested by the Throttle position, or if a large differential in traction motor speeds exist or if a synchronous slip is detected, sand will be automatically applied.

## **Wheelslide Braking**

In braking, the amount of correction is determined by the amount of slide and is accomplished in several stages:

### **Stage 1 - Sand (Dynamic Braking)**

Automatically apply sand to the leading axles on this locomotive if a small difference in motor speeds is detected. Sanding continues for three seconds after the slip is corrected.

### **Stage 2 - Small Power Reduction (Dynamic Braking)**

When the Stage 1 limit is exceeded, a small power reduction goes into effect and sanding continues.

### **Stage 3 - Moderate Power Reduction (Dynamic Braking)**

When Stage 2 limit of wheelslip is exceeded, a moderate power reduction goes into effect and sanding continues.

### **Stage 4 - Complete Power Removal (Dynamic Braking)**

If a large difference in wheel speeds is detected, a quick power output removal accompanied by a trainlined wheelslip indication results.

The following checks and inspections should be made in accordance with railroad rules:

## **BEFORE BOARDING LOCOMOTIVE**

1. Inspect for broken, worn, loose or dragging parts (brake rigging, brake shoes, wheels, traction motor commutator covers, etc.).
2. Check for leaks from outside piping.
3. Properly position all drain and cut-out cocks.
4. Check the proper connections for air hoses and jumper cables (if in multiple with other units).
5. Check the fuel supply on the fuel tank sight glass.

## **AFTER BOARDING LOCOMOTIVE**

1. Remove rags, tools, etc., from moving parts and electrical equipment **WITH ENGINE SHUTDOWN**.
2. Check the diesel engine lubricating-oil supply. Oil level should indicate **FULL** on the dipstick with the engine shut down or at **IDLE**. The dipstick is located on the side of the engine near the lube-oil fill and is marked **LOW** and **FULL**, Fig. 27.
3. Check the governor oil supply. The sight glass on the governor should be full of oil. After engine is started, the oil level must be at the mark on the sight glass, Fig. 25.
4. Check the air compressor lubricating-oil level.

**WARNING:** *Open Local Control Circuit Breaker (LCCB) to prevent air compressor motor from starting while servicing the air compressor.*

5. Check the cooling water supply. Be sure the water drain valve is closed.
6. Check that the diesel-engine overspeed device is reset, Fig. 31.
7. Check that the engine barring-over device is removed from the engine and cover is mounted in place.
8. Check that the following air cut-out cocks are open:
  - a. Air Compressor Governor
  - b. Control Air
  - c. Safety Control (if used)
  - d. Bell, Horn and Window Wiper
  - e. Overspeed Control (if used).
9. Check that the brake-pipe angle cocks are properly positioned.
10. The brake valve pilot cut-out cock (double-heading cock) on the 26L air brake system should be properly positioned.
11. The MU2A valve or dual ported cut-out cock must be positioned according to the location of the unit in the locomotive consist.
12. Check the positions of the Automatic and Independent Brake Valve handles. The Automatic Brake Valve handle should be removed on all Trail units, and the Independent handle should be in RELEASE if not removable.
13. Move the Engine Control switch to START.
14. Properly position the MU Headlight Selector switch.

15. Check that the Throttle handle is in IDLE and the Selector handle is in OFF.
16. Check that the dead-engine cock is closed.

## STARTING ENGINE

1. Perform operations as in Before Boarding Locomotive and After Boarding Locomotive sections.
2. If the engine has been stopped for a considerable period of time, or if a quantity of rain has entered the stack, the cylinders should be cleared of fuel or water accumulation before starting the engine.

Proceed as follows:

- a. Apply the engine barring-over device, and back off the compression relief plugs on the left side of each cylinder.
- b. Rotate the engine at least two complete revolutions by use of the engine barring-over device.
- c. Remove the barring-over device from the engine, and tighten all compression relief plugs before cranking.

**NOTE:** *Cover for barring-over feature must be securely mounted, otherwise engine cannot be cranked. See Barring-Over Switch section.*

3. Check that the emergency stop feature is nullified (Throttle handle in IDLE).
4. Close the Battery switch located behind the door under the EC panel.



5. Turn on all applicable circuit breakers in the top row of breakers on the EC panel.
6. Turn on ALL circuit breakers in the second row of breakers on the EC panel.

**NOTE:** *When starting engines of several locomotives in a multiple-unit consist, start engines one at a time. Close the Control circuit breaker only on one unit at a time. When all engines are running, close the Control circuit breaker on the Lead unit only, open all others.*

7. Check the Diagnostic Display for any fault messages. It should read "READY." If the display says "Can't Crank" or "Won't Crank," the unit will not attempt to crank.
8. Place the Engine Control (EC) switch in the START position.
9. At the Start Station, located near the engine, turn the Start switch to the PRIME position. Hold until solid fuel shows in the sight glass.
10. Turn the switch to the START position and hold until the engine starts.

**NOTE:** *There will be a 2 to 4 second delay between the time the switch is placed in the START position and the diesel engine starts to rotate.*

**NOTE:** *If proper engine lube-oil pressure does not build up within approximately 40 seconds, the governor will shut off fuel and prevent the engine from running.*

**CAUTION:** *Do not discharge the battery excessively by repeated attempts to start. If the first two or three tries are unsuccessful, recheck the starting procedure.*

### BEFORE MOVING LOCOMOTIVE

1. Turn the Engine Control switch to RUN.
2. Make an air brake test and other checks in accordance with railroad regulations.
3. Check the main reservoir air pressure according to railroad rules.
4. Check the control air pressure. Normal pressure is 80 psi.
5. Make an Independent air brake application. Release the handbrake and remove any blocking of the wheels.
6. Allow time for the engine cooling water to warm up before moving the locomotive in accordance with railroad rules. Also see ALARMS, SAFEGUARDS, POWER DERATIONS AND SHUTDOWNS section of this manual.

### FASTER AIR PUMPING

To provide faster air pumping on locomotive, when reservoirs have been drained or after the locomotive has been coupled to a train, proceed as follows:

1. Leave the Generator Field circuit breaker in the OFF position.
2. Close the Control breaker on the Engine Control panel.

3. Insert the Reverse handle.
4. Move the Throttle handle to IDLE/Notch 1. At IDLE/Notch 1, the air compressor motor drives the air compressor at twice engine speed.

**NOTE:** *If the main reservoir air pressure is above 130 psi and is not rising, increasing the engine speed will not raise the pressure.*

### COLD WEATHER ENGINE STARTING/WARM-UP

During cold weather conditions, when a locomotive has been shutdown for a period of time, locomotive horsepower will automatically be derated until the lubricating oil temperature reaches a predetermined level. This special warm-up period is required to avoid equipment failure from thermal or overload strain. See ALARMS, SAFEGUARDS, POWER DERATIONS AND SHUTDOWNS section of this manual.

### MOVING A TRAIN

1. Close the Generator Field circuit breaker on the control console.
2. Move the Reverse handle to the desired direction of movement.
3. Place foot on the Safety Control foot pedal (if used) and release the brakes completely. Several minutes may be required to release the brakes, depending on the length of the train.
4. Advance the Throttle handle.
5. The Throttle handle has notches (IDLE up to Notch 8), with each successive notch representing an increase in power, or locomotive tractive effort.

Starting a train depends on type, length, weight, grade, condition of rail and amount of slack in the train. This locomotive is designed to have easily controlled tractive effort build-up characteristics, with the tractive effort in each notch limited to definite values as the Throttle handle is moved from the lowest to the highest notch. The operator can easily control the amount of tractive effort required to start and accelerate a particular train. Speed can be controlled as desired by reducing or increasing the Throttle handle position.

### STOPPING A TRAIN

Move the Throttle handle to IDLE, and apply the dynamic or air brakes according to railroad regulations. Also see Applying Dynamic Brakes. If leaving the operator's position after the train has stopped, move the Reverse handle to OFF.

**CAUTION:** *The control system of this locomotive will delay movement from power to dynamic braking. If however, other locomotives in the consist do not have this feature, to prevent equipment damage when changing from power to dynamic braking or from dynamic braking to power, pause 10 seconds with the Throttle handle at IDLE and Dynamic Brake handle in OFF.*

### REVERSING LOCOMOTIVE

1. Bring the locomotive to a full stop.
2. Move the Reverse handle to the opposite direction.
3. Release the brakes.
4. Advance the Throttle handle.

### PASSING THROUGH WATER

Do not exceed two or three mph if there is water over the rails. Do not pass through water that is over 2.5 in. above the top of the rail.

### PASSING OVER RAILROAD CROSSINGS

Do not pass over railroad crossings at full power, or traction motor flashover may result. Reduce power by moving the Throttle handle to Notch 5, or below, while all units are passing over the crossing.

### STOPPING ENGINE

1. Move the Throttle handle to IDLE.

**CAUTION:** *After a locomotive has operated under full load for a considerable period of time, allow the engine(s) to run at IDLE for at least five minutes before shutting down. Otherwise, immediate shut-down after such operation could be harmful to some engine components requiring brief idling time.*

2. Open the Generator Field circuit breaker on the control stand.
3. Move the Engine Control switch to START.
4. Press the Engine Stop button on the Engine Control panel or at the Engine Start Station.
5. To shut down all engines when in multiple-unit operation, with the Reverser handle in place, move the Throttle handle to the SHUTDOWN position on the Master Controller. The Throttle handle must be in IDLE before attempting to start the engine.

**NOTE:** *On some older units this will not turn off the fuel pumps. Pushing the STOP button on each unit will turn them off.*

6. Secure the locomotive in accordance with railroad rules and procedures.

## BEFORE LEAVING LOCOMOTIVE

1. Apply the handbrake and release the air brakes after uncoupling from the train.

**NOTE:** *On three-axle floating bolster trucks with low-hung brake cylinders, a "QR," or quick-release valve is provided which removes the air in the one brake cylinder that is in the handbrake system. The handbrake chain must trip the stem of the QR valve and no trapped air is permitted in this brake cylinder; otherwise, if the locomotive air pressure leaks off, the locomotive can roll down the track unattended.*

2. Leave the Throttle handle in IDLE.
3. Close the windows and doors.
4. Open all switches and circuit breakers as described in Control Console Equipment and Engine Control Panel sections of this manual.
5. Open the Battery switch.
6. In freezing weather, precautions must be taken to see that the cooling water does not freeze. See DRAINING COOLING WATER SYSTEM section, and follow railroad rules for this situation.

## SAFETY CONTROLS

The safety control (if installed) consists of a foot-pedal operated air valve, whistle and a cut-out cock. Except when the locomotive is stopped and locomotive brakes are applied, the operator must keep the Safety Control foot pedal depressed at all times. This prevents Safety Control brake application.

After a Penalty brake application has occurred, normal locomotive operation is restored in the following manner:

1. Move the Throttle handle to IDLE.
2. Move the Automatic Brake Valve handle to SUPPRESSION.
3. Depress the Safety Control foot pedal.
4. After the application pipe has built up to normal pressure, move the Automatic Brake Valve handle to RELEASE.

**NOTE:** *Other forms of safety control may be provided. See railroad rules for specific procedures.*

Dynamic braking is applied to the locomotive only.

## APPLYING DYNAMIC BRAKES

Applying dynamic braking is done in the following manner:

**NOTE:** *Dynamic brake cannot be applied on a locomotive which has any traction motor manually or automatically cut out.*

1. Move Throttle handle to IDLE.
2. Move the Dynamic Brake handle to SET-UP position; pause, then advance the handle into the BRAKING sector as desired.
3. After the slack is bunched, manipulate the Dynamic Braking handle until the desired braking effort is obtained. Observe and correct braking effort during the initial period of Dynamic Brake application.

**CAUTION:** *Prolonged operation of dynamic braking in Notch 8 at speeds above 61 miles per hour can cause increased maintenance requirements of traction motors.*

The amount of braking effort obtainable varies with the position of the Dynamic Braking handle for various speeds. Maximum braking effort is obtained in the FULL BRAKING position at speeds of 22 to 30 mph, depending on locomotive gearing.

When a locomotive is equipped with extended range dynamic braking, a series of peak braking efforts will occur down to about 8 mph. If independent air brakes are applied

when dynamic braking is in effect, only minimum dynamic brake will be obtained.

**NOTE:** *Wheelslip warning may occur while in dynamic braking. This indicates wheels are sliding. Sand is applied automatically to the wheels of the sliding unit. Reduce the Braking handle position until the warning stops.*

## USE OF AIR BRAKES DURING DYNAMIC BRAKING

**NOTE:** *If independent air brake pressure is applied above 20 psi during dynamic braking, the dynamic braking effort will immediately go to, and remain at, MINIMUM braking until independent is released.*

When necessary, the automatic air brake may be used in conjunction with the dynamic brake. Automatic air brakes will apply on the train but not on the locomotive. If the Automatic Air Brake handle is moved to the EMERGENCY position, the dynamic brake is removed and brakes on the locomotive, as well as those on the train, go into Emergency application.

The Dynamic Brake Magnet Valve (DBM) nullifies an Automatic air brake application on the locomotives when dynamic braking is being used. This same interlock will release an Automatic application on the locomotives when dynamic brakes are set-up, and prevents reapplication of the automatic brake on the locomotive after release of the dynamic brake.

**NOTE:** *Optional arrangements, if selected by the railroad, may allow automatic brakes on the locomotive to reapply after the release of dynamic brake or may eliminate the Dynamic Brake Magnet Valve (DBM). If DBM is eliminated, automatic brakes will not be released when dynamic brake is applied. Operate air brake and dynamic brake in accordance with railroad operating procedures.*

### RELEASE OF DYNAMIC BRAKING

Release dynamic braking by moving the Dynamic Braking handle to the OFF position.

### OPERATING AS A LEADING UNIT

To operate the locomotive as a Lead unit of a consist, first make the necessary preliminary preparations for operation then proceed as follows:

#### Air Equipment Set-Up

1. Insert the Automatic Brake Valve handle in the HANDLE OFF position.
2. Depress the handle of the brake-valve pilot cut-out cock and move it to the IN position.
3. Depress the handle of the MU2A valve and move it to the LEAD/DEAD position or move the handle of the dual ported cut-out cock to the IN/OPEN position.
4. Move the Independent Brake Valve handle to the FULL APPLICATION position.
5. Test the air brake in accordance with railroad rules.

#### Operating Unit - Electrical Set-Up

1. Close the Generator Field circuit breaker on the control stand. (The Control circuit breaker must be closed on the Lead unit only.)
2. Close the Dynamic Brake circuit breaker (if so equipped).
3. Close the Control circuit breaker.
4. Close all circuit breakers on the Engine Control (EC) panel.
5. Move the MU Headlight Set-Up switch to the required position.

6. Insert the Reverse handle into the Controller.
7. Move the Reverse handle to the desired direction.
8. Operate the locomotive in accordance with operating procedure.

## OPERATING AS A TRAILING UNIT

### Air Equipment Set-Up

1. Make a Full Service application with the Automatic Brake Valve handle.
2. Move the brake valve pilot cut-out (double-heading) cock to the OUT position.
3. Move the Automatic Brake Valve handle to the HANDLE OFF position and remove the handle.
4. Place the Independent handle in RELEASE position.
5. Move the MU2A valve to LEAD/DEAD position, or if the dual ported cut-out cock is used, move the handle to the OUT/CLOSED position.

### Electrical Set-Up

1. Move the Reverse handle to OFF and remove the handle.
2. Open the Generator Field, Control, Engine Run and Dynamic Brake circuit breakers on the control stand.
3. The top row of circuit breakers on the Engine Control (EC) panel can be turned OFF for Trail operation. Second row of breakers MUST BE ON for Trail operation. The Running Lights circuit breaker may be positioned as desired.

4. Place the MU Headlight Set-Up switch in the proper position.

## CHANGING OPERATING ENDS

To change operating control from the cab of one locomotive unit to the cab of another, proceed as follows:

### Vacating Unit - Air Equipment Set-Up

1. Make a Full Service brake-pipe reduction.
2. Allow time for all air blowing sounds to stop; then depress the handle of the brake valve pilot cut-out cock and move it to the OUT position.
3. Place the Automatic Brake Valve handle in the HANDLE OFF position and remove; place the Independent Brake Valve handle in the RELEASE position.
4. Depress the handle on the MU2A valve, and move it to TRAIL position, or the dual ported cut-out cock to the OUT/CLOSED position.

### Vacating Unit - Electrical Set-Up

1. Move the Reverse handle to OFF, and remove the handle.
2. Open the Generator Field, Control, Engine Run and Dynamic Brake circuit breakers on the control stand.
3. The top row of circuit breakers on the Engine Control (EC) panel can be turned OFF for Trail operation. Second row of breakers MUST BE ON for Trail operation. The Running Lights circuit breaker may be positioned as desired.

4. Move the MU Headlight Set-Up switch to the required position.

### **Operating Unit - Air and Electrical Equipment Set-Up**

Set-up the air brakes and electrical equipment on the operating unit as described in Operating As a Leading Unit "Air Equipment Set-Up" and "Electrical Equipment Set-Up" sections.

### **TO OPERATE WITH OTHER TYPES OF UNITS**

This locomotive is equipped with a traction motor thermal simulator which computes traction motor temperatures. This simulator will reduce locomotive output as required to protect the traction motors.

If the units in the locomotive consist are geared for differing maximum speeds, do not run at speeds in excess of that recommended for the unit having the lowest maximum permissible speed.

Similarly, do not operate at low speeds long enough to exceed the specified traction motor ratings on any of the units in the locomotive consist. A locomotive with high horsepower per axle will develop more tractive effort at any given speed than will units of lower horsepower per axle and will, therefore, tend to overload sooner at lower speeds.

When the leading unit is slipping excessively, the Power-Limit switch (if so equipped) can be moved to NOTCH 7 to reduce the power on this unit while the Trailing units are operating at full power. This will reduce the tractive effort on the Leading unit and will usually improve the ability of the locomotive to hold the rail under bad rail conditions.

### **BRAKE PIPE LEAKAGE TEST**

A brake-pipe leakage test can be performed in the following manner:

With the brake system fully charged and with the brake-valve pilot cut-out cock in the IN position, move the Automatic Brake Valve handle promptly toward the SERVICE position until the equalizing reservoir pressure has been reduced 15 psi; then stop and leave the handle in this position.

As soon as the brake-pipe pressure has reduced to the level of the equalizing reservoir pressure (continuous blow from brake-valve exhaust), depress the Brake-Valve Pilot Cut-Out Cock handle and move it to the OUT position. Immediately observe the brake-pipe gage, and time the pressure drop in accordance with railroad rules.

At the completion of the brake-pipe leakage test, move the Brake Valve handle further toward the SERVICE position, and reduce the equalizing reservoir pressure slightly below the brake-pipe pressure. The brake may later be released by returning the Brake Valve handle to the RELEASE position.

### **DEAD HEADING (DEAD-IN-TRAIN)**

1. Place the Independent Brake Valve handle in the RELEASE position and the Automatic Brake Valve handle in the HANDLE OFF position.
2. Depress the Brake Valve Pilot Cut-Out handle and move to the OUT position.



## MULTIPLE-UNIT OPERATION

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3. Depress the handle of the MU2A valve and move to the LEAD/DEAD position. On units equipped with a dual-ported cut-out cock, place the cock in the IN/OPEN position.

**CAUTION:** *To avoid wheel flats, drain main reservoirs of unit 40 psi below the brake pipe pressure used on the train to which the locomotive will be coupled.*

4. Open the dead-engine cock.