SD50

OPERATOR'S MANUAL

5th Edition

* * A Service Department Publication Electro-Motive * *
Division Of General Motors La Grange, Illinois 60525

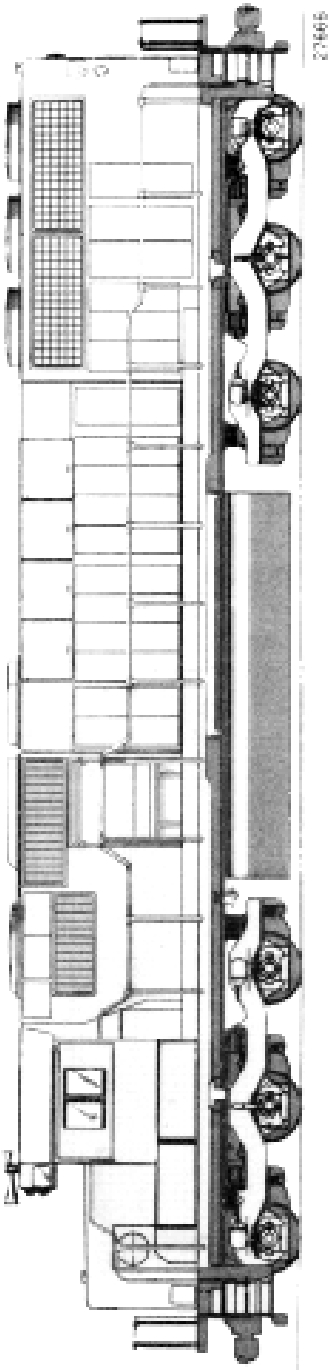
90A1184

NOTICE

The purpose of this manual is to act as a guide in the operation of the locomotive and its equipment. The information was compiled for a typical locomotive with basic equipment and frequently requested extras. The equipment selected for coverage was chosen as representative and not intended as an indication of availability or use on a particular unit or order. When special extra equipment is involved, consult specific drawings' or instructions as provided by the railroad.

Information contained in this manual is based on data available when released for printing.

Minor equipment differences are due to changes made after the manual was published. Later editions will cover these changes.



Typical SD50 Locomotive

INTRODUCTION

This manual has been prepared as a guide for railroad personnel engaged in the operation of the 3600 horsepower General Motors SD50 diesel-electric locomotive. "Super Series" locomotives, such as the SD50, are equipped with an advanced electronic wheel control system.

Locomotive description and operating instructions are divided into four sections as follows:

1. General Description - Describes principal equipment components.

2. Controls - Explains functions of controls used to start and operate the locomotive. Indicating devices to monitor certain locomotive systems also receive coverage.

3. Operation - Outlines procedures for locomotive operation.

4. Troubleshooting - Describes probable causes of operating trouble and suggests operator action.

To be of most benefit to the reader, these sections should be read in sequence.

Information concerning equipment maintenance, adjustment, and testing is contained in other EMD publications pertaining to this model.

GENERAL DATA

Model Designation SD50

Locomotive Type..... (C-C) 0660

Locomotive Horsepower 3600

Diesel Engine
- Model 645F3B
- Number Of Cylinders 16
- Type . . . . . Turbocharged
- Full Speed . . . . . 954 RPM
- Idle Speed . . . . . 200 RPM

Main Generator Model
- Basic AR11A-D18
- Special AR11A-D14
  - Traction Alternator (AR 11A Rectified Output)
    - Maximum Voltage (DC) 1350
    - Continuous Current Rating 7020 Amp
  - Companion Alternator
    - Basic D18
    - Special D14
      - Nominal (AC) Voltage (D18 Or D14) 230

AC Auxiliary Generator Voltage (DC) 74
- Max. Power Output ..... 18 kW

Supplies
- Lube Oil System Capacity
  - Basic Oil Pan ..... 243 Gal.
  - Increased Capacity Pan ..... 395 Gal.
- Cooling System Capacity ..... 276 Gal.
- Sand Capacity (Total)
  - Basic ..... 56 Cu. Ft.
  - Special ..... 72 Cu. Ft.
- Fuel Capacity
  - Basic ..... 3200 Gal.
  - Special ..... 4000 Gal.
  - ..... 4400 Gal.

Retention Tank ..... 100 Gal.
(Reduces fuel capacity by same amount.)

GENERAL DATA (Cont'd)

Major Dimensions
- Height (HTC Trucks)
  - Over Cooling Fans 15' 7-1/ 8"
  - Over Horn . . . . . 15' 5-1/4”
- Width Over Handrail Supports . . . . 10' 3-1/8
- Length Over Coupler Pulling Faces . . . . 71'2"
- Approximate Weight On Rails
  - Basic . . . . . 368,0001bs.
  - Typically Equipped . . . . . 390,0001bs.
- Weight On Drivers 100%

Traction Motors
- Model D87
- Number 6
- Type DC Series Wound, Axle Hung Forced Air Ventilated

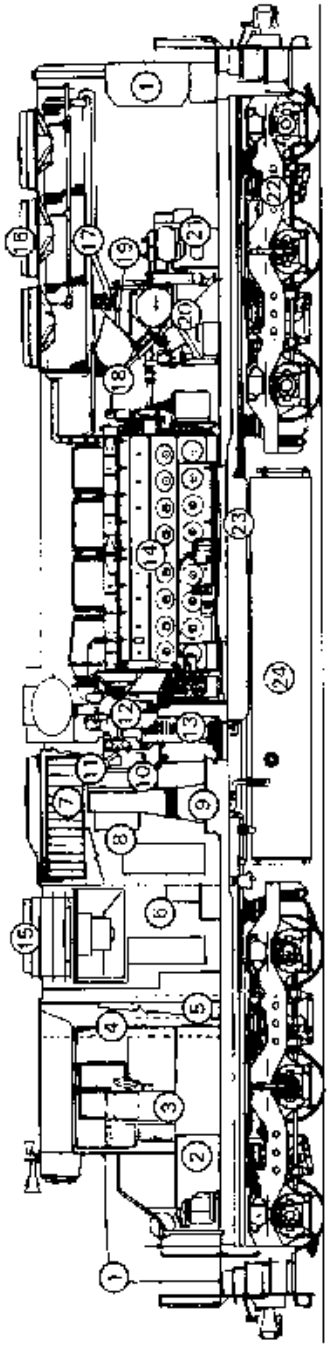
Maximum Locomotive Speed In MPH
(based on rated RPM of traction motors)

Gear Ratio	40" Wheel	42" Wheel
70:17	70	74
69:18	76	80
67:19	82	86
66:20	88	92

Air Compressor
- Model (Basic) . . . . . WBO
- Type . . . . . 2 Stage
- Number Of Cylinders . . . 3
- Displacement At 900 RPM . . 254 Cu. Ft./ Min.
- Compressor Cooling . . . . . Engine Coolant
- Lube Oil Capacity . 10-1 / 2 Gal.

Air Compressor (Cont'd)	
Model (Special)	WBG
Type	2 Stage
Number Of Cylinders	6
Capacity (At 900 RPM)	400 Cu. Ft./ Min.
Air Compressor Cooling	Engine Coolant
Lube Oil Capacity	18 Gal.
Model (Special)	WXO
Type	2 Stage
Number Of Cylinders	3
Displacement At 900 RPM	254 Cu. Ft./ Min.
Air Compressor Cooling	Forced Air
Lube Oil Capacity	10-1 / 2 Gal.
Air Brakes	Type 26L
Storage Battery	
Number Of Cells	32
Voltage	64
Rating (8 Hour)	420 Amp Hr.
Minimum Curve Negotiation Capability	
Single Unit:	
195 Ft. Radius - 29° Curve	
Two Coupled Units:	
235 Ft. Radius - 24° Curve	
Unit Coupled to 50 Ft. Box Car:	
379 Ft. Radius - 15° Curve	

TABLE OF CONTENTS (Cont'd)



1. Sand Box
2. Battery
3. Control Stand
4. Electrical Cabinet
5. Electric Cabinet Air Filter
6. Generator Transition Contactor
7. Inertial Filter
8. Engine Air Filter
9. Traction Motor Blower
10. Ganerator Blower
11. Auxiliary Generator
12. Turbocharger
13. Main Generator
14. Diesel Engine
15. Dynamic Brake Blower
16. Radiator Cooling Fans
17. Radiators
18. Engine Water Tank
19. Lube Oil Cooler
20. Lube Oil Filter
21. Air Compressor
22. Truck
23. Main Air Reservoir
24. Fuel Tank

27493

Typical SD50 Locomotive General Arrangement

SECTION 1

GENERAL DESCRIPTION

INTRODUCTION

The General Motors Model SD50 diesel-electric locomotive, Fig. 1-1, is equipped with a turbocharged 16 cylinder diesel engine which drives the main generator. Electrical power from the main generator is distributed to the traction motors through the high voltage control cabinet. Each of the six traction motors is geared directly to a pair of driving wheels. The maximum rated traction motor speed and the gear ratio of the traction motor to the wheel axle determines the maximum operating speed of the locomotive.

The basic locomotive is arranged and equipped so that the short hood or cab end is considered the front or forward part of the unit. However, the locomotive operates equally well in either direction, and on special order controls may be arranged so that the long hood end is forward, or dual controls may be provided.

While each locomotive is an independent power source, several may be combined in multiple operation to increase load capacity. The operating controls on each unit are jumpered or "trainlined" to allow all the locomotives to be simultaneously controlled from the lead unit.

LOCOMOTIVE OPERATION

Storage batteries provide the energy required to start the diesel engine. The engine start switch controls battery power to two starting motor solenoids mounted at the lower rear right hand side of the engine. These electrical solenoids engage the starting motor pinions with the engine ring gear. When both pinions are engaged, battery power is applied to the starting motors to crank the diesel engine.

The diesel engine must be primed with fuel prior to starting. To do this, the operator places the engine start switch in the FUEL PRIME position. This applies battery power to the fuel pump which pressurizes the injector system with fuel. The fuel pump moves the fuel from the fuel tank under the locomotive to the injectors. After the entire system has been supplied fuel, and the injector racks positioned, the cylinder will fire when the engine is cranked. With the engine running, the fuel pump motor is supplied directly by the auxiliary generator.

The diesel engine is the source of locomotive power. When the engine is running, it directly drives three electrical generators and their associated cooling fans, a multi-cylinder air compressor, a traction motor blower, and the water and lube oil pumps. The engine-driven components in the locomotive system must convert the engine power to other forms to perform their individual functions:

1 . The main generator rotates at engine speed, generating alternating current power. This power is then converted to direct current power by the internal rectifier banks and directed to the traction motors.

2. The companion alternator is physically coupled to the main generator. It supplies current to excite the main generator field and to power the radiator cooling fans, the inertial filter blower, and various transductors and control devices.

3. The auxiliary generator is driven by the engine gear train at three times engine speed. It provides a 74 volt DC output for excitation current to the companion alternator. The auxiliary generator also supplies the 74 volt power needed for control, cab heating, locomotive lighting, and battery charging circuits.

4. The air compressor, located directly in the engine drive train, supplies the necessary air pressure for brakes and other pneumatic devices such as sanders, windshield wipers, shutter operating cylinders, and horn.

5. The engine gear train drives two centrifugal water pumps which circulate coolant through the engine. 6. The lube oil pumps are also connected in the engine gear train. They supply lubricating oil to critical operating surfaces throughout the engine.

Major components of the diesel-electric power system take power from the diesel engine. The electrical nature of this system is seen in the conversion, application, and control of that power.

The main generator supplies electrical energy to the high voltage control cabinet. This cabinet establishes the distribution of power to the traction motors by means of its internal switchgear. The switchgear consists of power contactors, relays, and switches which direct the flow of power as dictated by the control circuits. The control circuits are low voltage (74 volt DC) devices that respond to the operating controls in the cab and to operating conditions.

A major part of the locomotive control system involves the interrelated functions of the throttle, governor, and load regulator. The engine governor holds the engine speed at a constant RPM as set by the throttle. It does this by changing the position of the injector racks which control the amount of fuel supplied to each cylinder. Actual operating conditions create varying train loads. When the load changes, the load regulator acts to vary generator excitation. Thus the load regulator balances the governor speed setting from the throttle with the engine power level determined by the load.

As the throttle is advanced to a higher position, the electrical control system causes more current to flow through the field of the main generator. This increased excitation current results in an increase in power to the traction motors. Thus the locomotive power, as well as engine speed, increases progressively in throttle steps.

Many control and protective circuits are designed using solid state components on printed circuit boards. These circuit boards are constructed as plug-in modules for easier servicing.

These electronic modules monitor and control critical functions in the locomotive power system.

There are six DC traction motors located on the trucks under the locomotive. Each traction motor is geared directly to the axle on which it is mounted. These motors are supplied power through the high voltage control cabinet at the rear of the cab.

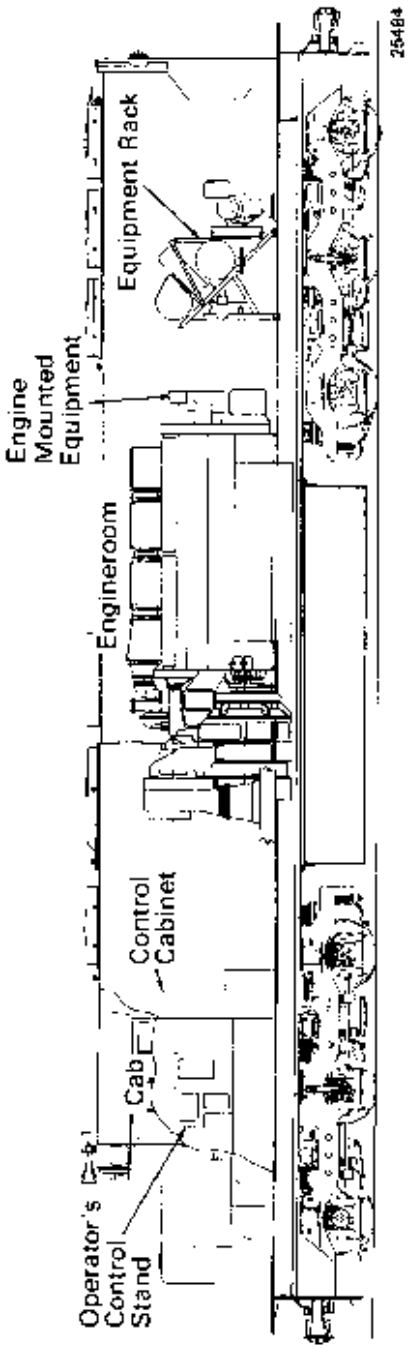


Fig.2-1 – Location Of Operating Controls And Indicating Devices

SECTION 2

CONTROLS AND INDICATING DEVICES

INTRODUCTION

This section provides a brief description of controls and indicating devices used by the operator. Although some equipment receiving coverage is not used during normal operation, it is included to familiarize the operator with its function.

The majority of controls and indicating devices used by the operator are located in the locomotive cab, Fig. 2-1. Engine starting and monitoring equipment is located in the engineroom.

CAB EQUIPMENT

Operating equipment is located in the locomotive cab at two locations: the operator's control stand, and the control cabinet.

OPERATOR'S CONTROL STAND

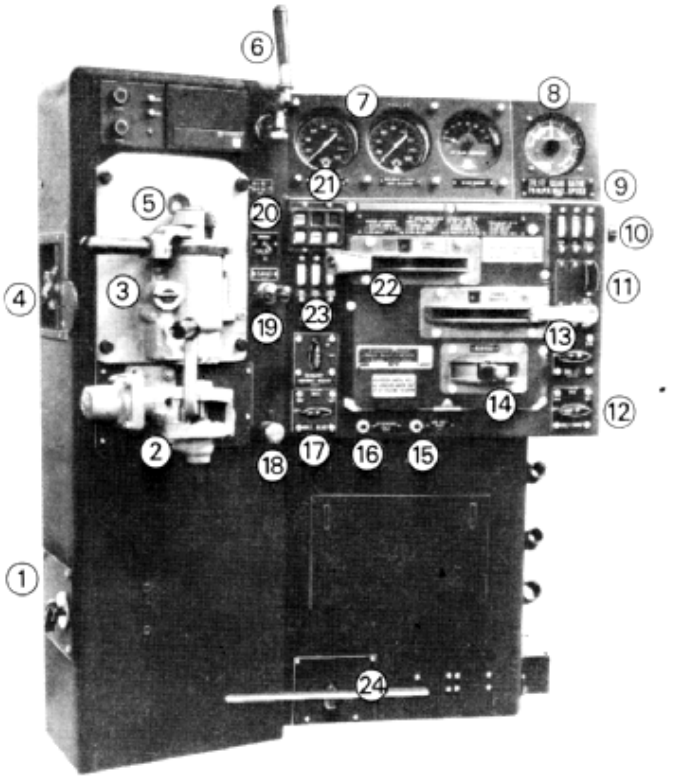
The operator's control stand, Fig. 2-2, contains switches, gauges, and operating handles used by the operator. The individual components are described, together with their functions, in the following paragraphs.

CONTROLLER

The following operating handles are located on the locomotive controller, Fig. 2-3.

DYNAMIC BRAKE HANDLE

A separate handle is provided for control of dynamic brakes, Fig. 2-4, it is uppermost on the controller panel and is moved from left to right to



1. Multiple Unit Valve (MU-2A Or Dual Ported Cutout Cock)
2. Independent Brake Valve
3. Cut-Off Valve
4. Trainline Air Pressure Adjustment Valve
5. Automatic Brake Valve
6. Air Horn Valve
7. Air Gauges
8. Load Current Indicating Meter
9. Control And Operating Switches
10. Light Dimmer
11. Dynamic Brake Circuit Breaker
12. Headlight Switch-Front
13. Throttle Handle
14. Reverser Handle
15. Ground Reset Button
16. Attendant Call Button
17. Headlight Switch-Rear
18. Bell Ringer Valve
19. Manual Sand Lever Switch
20. Lead Truck Sand Switch
21. Indicator Light Panel
22. Dynamic Brake Handle
23. Ground And Light Switches
24. Air Brake Pedal (If Provided)

Fig.2-2 - Typical Operator's Control Stand

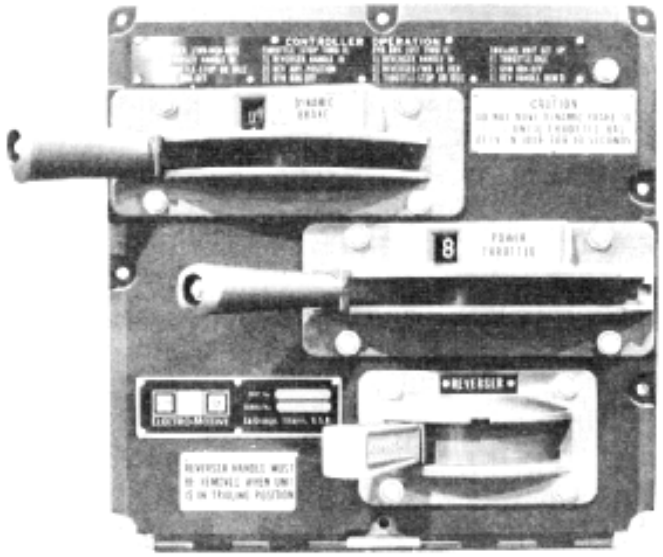


Fig.2-3 - Locomotive Controller

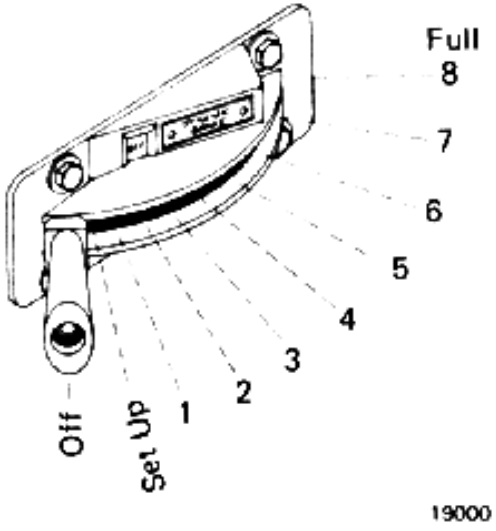


Fig.2-4 - Dynamic Brake Handle

increase braking effort. The handle grip is somewhat out-of-round with the flattened surfaces vertical to distinguish it from the throttle handle, which has its flattened surfaces horizontal. The brake handle has two detent positions; OFF and SETUP, and an operating range 1 through FULL 8, through which the handle moves freely without notching. Mechanical interlocking prevents the dynamic brake handle from being moved out of the OFF position unless the throttle is in IDLE and the reverser is positioned for either forward or reverse operation.

CAUTION

During transfer from power operation to dynamic braking, the throttle must be held in IDLE for 10 seconds before moving the dynamic brake handle to the SET UP position. This is to eliminate the possibility of a sudden surge of braking effort with possible train run-in or motor flash-over.

THROTTLE HANDLE

The throttle handle, Fig. 2-5, is located just below the dynamic brake handle. It is moved from right to left to increase locomotive power. The handle grip is somewhat out-of-round, with the flattened surfaces horizontal to distinguish it from the dynamic brake handle. The throttle has nine detent positions; IDLE, and 1 through 8 plus a STOP position, which is obtained by pulling the handle outward and moving it to the right beyond IDLE to stop all engines in a locomotive consist. Mechanical interlocking prevents the throttle handle from being moved out of IDLE into power positions when the dynamic brake handle is advanced to SET UP or beyond, but it can be moved into STOP position to stop all engines in the consist. The throttle can not be moved when the reverser handle is centered and removed from the controller.

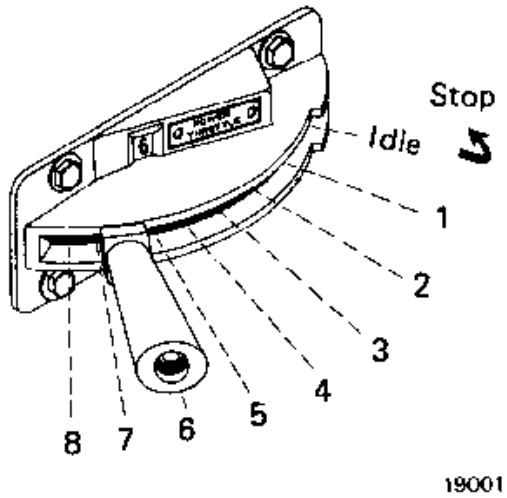


Fig.2-5 - Throttle Handle

REVERSER HANDLE

The reverser handle, Fig. 2-6, is the lowest handle on the controller panel. It has three detent positions; left, centered, and right. When the handle is moved to the right toward the short hood end of the unit, circuits are set up

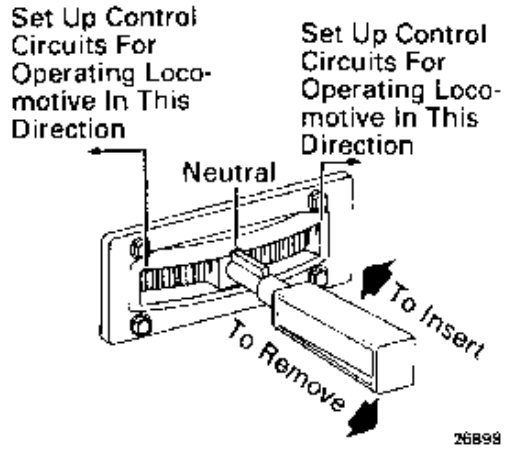


Fig.2-6 - Reverser Handle

for the locomotive to move in that direction. When the handle is moved to the left toward the long hood end, the locomotive will move in that direction when power is applied. With the reverser handle centered, mechanical interlocking prevents movement of the dynamic brake handle, but the throttle handle can be moved. In such case, power will not be applied to the traction motors.

The reverser handle is centered and removed from the panel to lock the throttle in IDLE position and the dynamic brake handle in OFF position.

MECHANICAL INTERLOCKS ON THE CONTROLLER

The handles on the controller are interlocked so that:

1. With reverser handle in neutral (centered) -

    a. Dynamic brake handle can not be moved out of OFF position.

    b. Throttle can be moved to any position.

    c. Reverser handle can be removed from controller if throttle is in IDLE position.

2. Reverser handle in forward or reverse -

    a. Throttle can be moved to any position if dynamic brake handle is in OFF position.

    b. Dynamic brake handle can be moved to any position if throttle is in IDLE position.

3. Reverser handle removed from controller –

    a. Throttle locked in IDLE position.

    b. Dynamic brake handle locked in OFF position.

4. Throttle in IDLE position -

    a. Dynamic brake handle can be moved to any position if reverser is in forward or reverse position.

    b. Reverser handle can be place in neutral, forward, or reverse position if dynamic brake handle is in OFF position.

5. Throttle above IDLE position

    a. Dynamic brake handle can not be moved.

    b. Reverser handle can not be moved.

6. Dynamic brake handle in OFF position –

    a. Throttle can be moved to any position.

    b. Reverser handle can be moved to any position if throttle is in IDLE position.

7. Dynamic brake handle moved out of OFF position –

a. Throttle can not be moved out of IDLE position into power positions, but can be moved into STOP position.

b. Reverser handle can not be moved out of forward or reverse into OFF position.

26L AIR BRAKE EQUIPMENT

Basic locomotives are equipped with type 26L air brake equipment. This equipment is located to the left of the controller and as shown in Fig. 2-7 includes, an automatic brake, independent brake, cut-off pilot valve, a trainline air pressure adjustment valve, and either a dual ported cutout cock or an MU-2A valve.

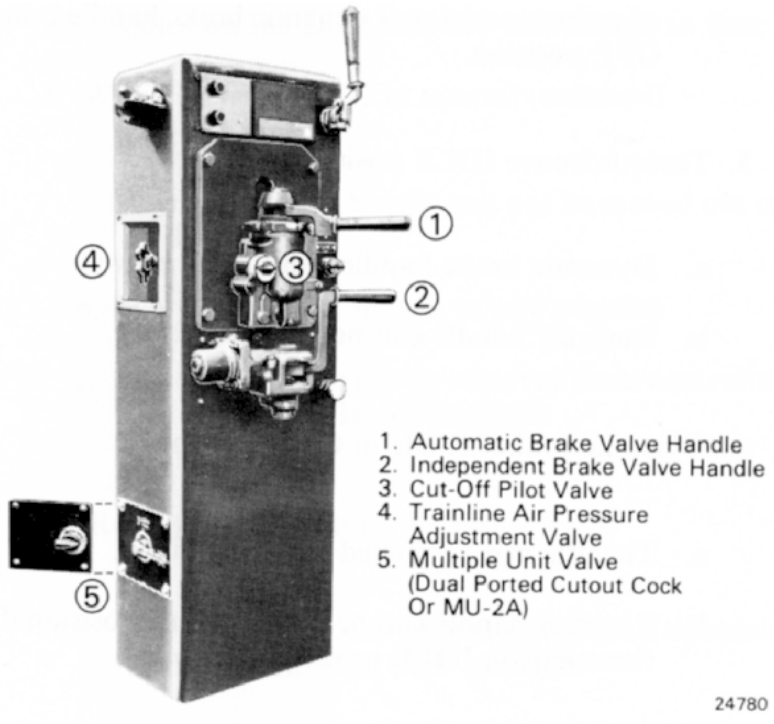


Fig.2-7 - Typical Air Brake Equipment

A dead engine feature is also part of the 26L air brake equipment. The dead engine cutout cock and pressure regulator, Fig. 2-8, are accessible from outside the locomotive through side doors provided. The pressure regulator is set by maintenance personnel and is not to be set by the operator.

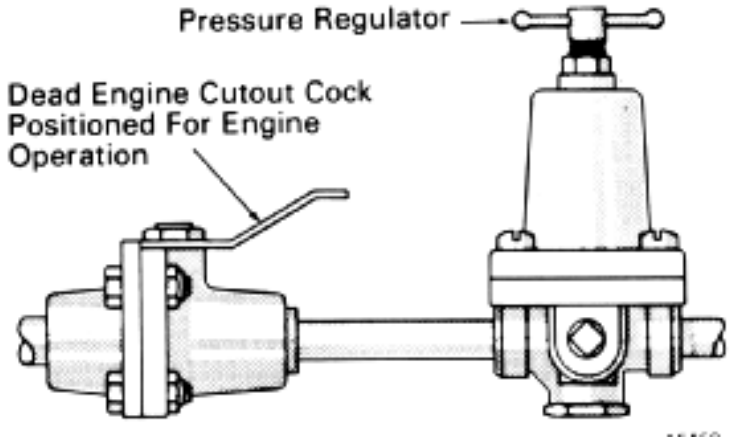


Fig.2-8 - Dead Engine Cutout Cock And Pressure Regulator

AUTOMATIC BRAKE VALVE HANDLE

The automatic brake valve handle, Fig. 2-9, controls the application and release of both the locomotive and train brakes. The brake valve is of the "pressure maintaining type" which will hold brake pipe reductions constant against nominal brake pipe leakage. A brief description of the operating positions follows:

Release Position

This position is for charging the equipment and releasing the locomotive and train brakes. It is located with the handle at the extreme left of the quadrant.

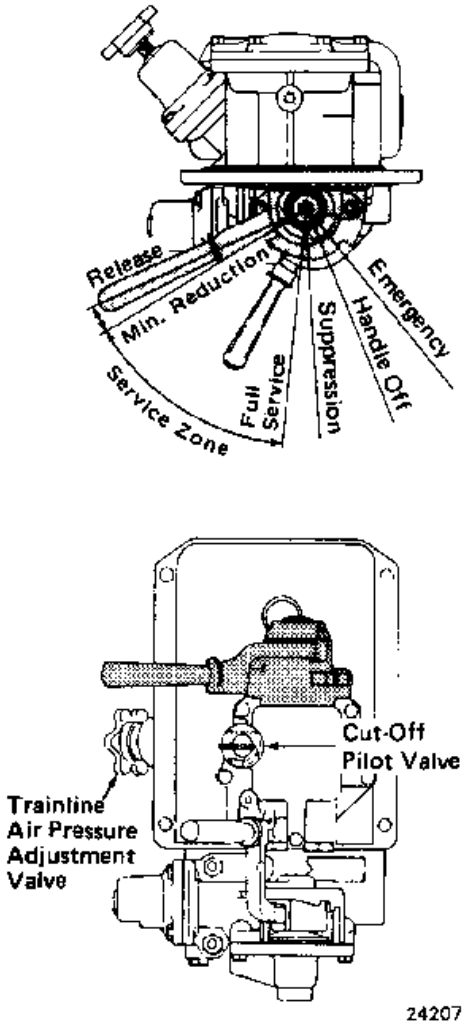


Fig.2-9 - Automatic Brake Valve

Minimum Reduction Position

This position is located with the handle against the first raised portion on the quadrant to the right of release position. With the handle moved to this position, minimum braking effort is obtained.

Service Zone

This position consists of a sector of handle movement to the right of release position. In moving the handle from left to right through the service zone, the degree of braking effort is increased until, with the handle at the extreme right of this sector, the handle is in full service position and full service braking effort is obtained.

Suppression Position

This position is located with the handle against the second raised portion of the quadrant to the right of release position. In addition to providing full service braking effort, as with the handle in full service position, suppression of overspeed control and safety control application, if equipped, is obtained.

Handle Off Position

This position is located by the first quadrant notch to the right of suppression position. If so equipped, the handle is removable in this position. This is the position in which the handle should be placed on trailing units of a multiple-unit locomotive or on locomotives being towed "dead" in a train.

Emergency Position

This position is located to the extreme right of the brake valve quadrant. It is the position that must be used for making brake valve emergency brake applications and for resetting after any emergency application.

INDEPENDENT BRAKE VALVE HANDLE

The independent brake valve handle, Fig. 2-10, is located directly below the automatic brake handle.

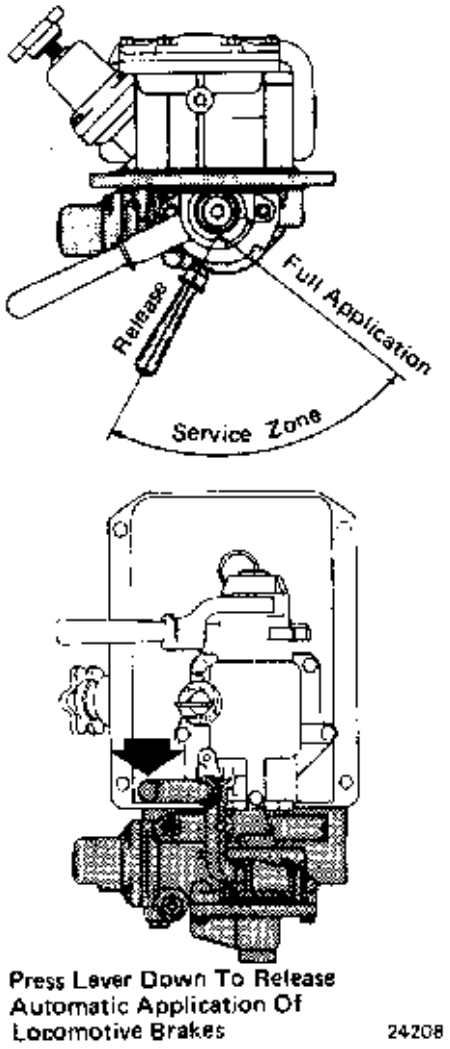


Fig.2-10 - Independent Brake Valve

This handle provides independent control of the locomotive braking effort irrespective of train braking effort. The brake valve is self-lapping and will hold the brakes applied. A brief description of the operating positions follows.

Release Position

This position is located with the handle at the extreme left of the quadrant. This position releases the locomotive brakes, provided the automatic brake handle is also in release position.

Full Application Position

This position is located with the handle at the extreme right of the quadrant. In moving the handle from left to right through the service zone the degree of locomotive braking effort is increased until full application braking effort is obtained.

Depression of the independent brake handle whenever the handle is in release position will cause the release of any automatic brake application existing on the locomotive. Depression of the independent brake handle when in the service zone will release the automatic application of the locomotive brakes to the value corresponding to the position of the independent brake handle.

NOTE

This locomotive model can be equipped with either an MU-2A valve, or a dual ported cutout cock for multiple unit control. Information about both of these devices is provided.

DUAL PORTED CUTOUT COCK

The dual ported cutout cock (if so equipped), Fig. 2-11, is located at the lower left side of the control stand. Its purpose is to set up the locomotive brake system for lead, trail, or dead operation. The handle is placed in the CLOSED IN TRAIL position when the unit is trailing in a consist, and is placed in the OPEN IN LEAD OR DEAD position when leading or dead.

MU-2A VALVE

The MU-2A valve (if so equipped), Fig. 2-11, is located on the left hand side of the air brake stand. Its purpose is to pilot the F 1 selector valve which is a device that enables the air brake equipment of one locomotive unit to be controlled by that of another unit.

The MU-2A valve has two positions which are:

1. LEAD OR DEAD 2. TRAIL 24 OR 26

The valve is positioned by pushing in and turning to the desired setting.

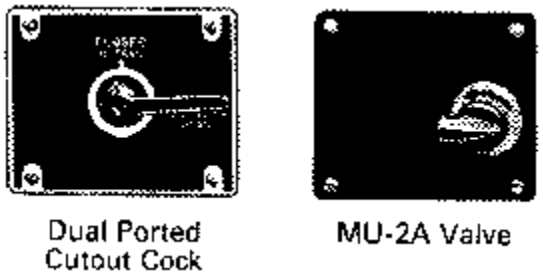


Fig.2-11 - Multiple Unit Valve

CUT-OFF PILOT VALVE

The cut-off pilot valve, Fig. 2-7, is located on the automatic brake valve housing directly beneath the automatic brake handle. The valve has the following two positions:

1. OUT 2. IN

To operate locomotive as the controlling unit, the cut-off valve handle must be pushed in and rotated to the IN position. The OUT position is used when hauling the locomotive "dead" or as a trailing unit in a consist.

On special order the cut-off pilot valve may have the following three positions:

1. OUT
2. FRT (freight)
3. PASS (passenger)

In this case the valve is pushed in and placed in the position desired, depending on make-up of train.

TRAINLINE AIR PRESSURE ADJUSTMENT VALVE

The trainline air pressure adjustment valve, Fig. 2-7, is located to the left of the automatic brake valve. With the automatic brake valve handle in release position, it is used to obtain the brake pipe pressure desired. The automatic brake valve will maintain the selected pressure against overcharge or leakage.

26L AIR BRAKE EQUIPMENT OPERATING POSITIONS

In the absence of specific instructions, usually issued by each railroad to cover its own recommended practices, refer to Fig. 2-12 for brake equipment operating positions most often encountered while the locomotive is in service.

Type Of Service	Automatic Brake Valve	Independent Brake Valve	Cutoff Valve	Dead Engine Cutout Cock	26F Control Valve	Multiple Unit Valve MU2A Valve	Multiple Unit Valve Dual Ported Cutout Cock	Overspeed Cutout Cock	Alertor Cutout Cock	Deadman Cutout Cock
SINGLE LOCOMOTIVE EQUIPMENT										
Lead	Release	Release	In*	Closed	Graduated Direct	Lead	Open	Open	Open	Open
Shipping Dead In Train	Handle Off Position	Release	Out	Open	Direct	Dead	Open	Closed	Closed	Closed
MULTIPLE LOCOMOTIVE EQUIPMENT AND EXTRAS										
Lead	Release	Release	In*	Closed	Graduated Direct	Lead	Open	Open	Open	Open
Trail	Handle Off Position	Release	Out	Closed	Graduated Direct	Trail 24 or 26	Closed	Open	Open	Open
Shipping Dead In Train	Handle Off Position	Release	Out	Open	Direct Release	Dead	Open	Closed	Closed	Closed

*On units equipped with a three position cut-off valve, position valve to either FRT or PASS depending on make-up of train.

27445

Fig.2-12 – 26L Air Brake Equipment Positions

MISCELLANEOUS CONTROLS AND SWITCHES

The following paragraphs describe miscellaneous controls, switches, and indicators typically provided on the operator's control stand, Fig. 2-2.

AIR HORN VALVE

When the air horn lever is pulled, compressed air is supplied to the locomotive air horn.

SANDING SWITCHES

Manual sand is cutout when the locomotive is in Super Series operation and moving above 5 mph. However, if a Super Series locomotive is in consist with older units, movement of the sand lever switch will supply a trainlined signal to the older units and sand will be applied.

Sanding Lead Truck Toggle Switch

The signal from this switch is not trainlined. The switch provides sand to only the lead truck. This method of sanding dresses the rail and is adequate for most conditions. The SAND light will come on when this switch is activated.

Sand Lever Switch

When operated, this lever supplies a signal to the sanding module. The sanding module causes the SAND light on the operator's control stand to turn on, determines which direction the locomotive is moving, and directs the trainlined signal to the appropriate (forward or reverse) sanding magnet valves. The basic switch is non-latching and may be operated in any direction for correct sanding. A directional sanding switch may be provided as an optional extra, and the switch may be latching if requested by the railroad.

Electrically controlled sanding is the basic system used, but since the locomotive may be operated in multiple with older units that are equipped only for pneumatic control of sanding, trainlined pneumatic control of sanding may be provided as an optional extra in addition to electrical control. In such cases, trainlined actuating pipes must be connected between units.

BELL RINGER VALVE

This mushroom type valve actuator operates the locomotive signal bell.

INDICATOR LIGHT PANEL

The indicator light panel, Fig. 2-13, contains lights to indicate operation of various systems within the locomotive. The panel has provisions for six press-to-test lights covered by either white or colored lens caps identified in black letters. The lights are discussed in the following paragraphs.

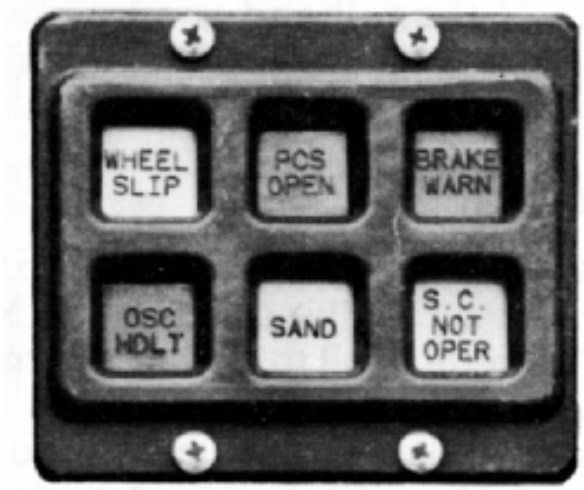


Fig.2-13 - Typical Indicator Light Panel

NOTE

The following indicator lights have a push-to-test feature which allows testing of the lamp circuit alone, isolated from its operation in the power control system. When the lens cap is depressed the supply voltage is impressed across the lamp circuit. After a one second delay the light should go on.

WHEEL SLIP Light

The wheel slip light comes on to indicate one of the following four conditions:

1. Slipping wheels while starting a train. When starting a train, the starting wheel slip system functions to correct wheel slips. Intermittent flashing of the wheel slip light indicates moderate to severe wheel slip. The throttle (locomotive power) should not be reduced unless severe lurching threatens to break the train.

NOTE

Minor slips or wheel creep will not actuate the wheel slip light, but automatic sanding may take place along with regulation of power to the wheels. Do not misinterpret this power control as loss of power due to a fault.

2. Wheel Overspeed. Overspeed conditions which may result from simultaneous wheel slip or excessively high track speed will activate the wheel slip light. In each case locomotive power will be regulated automatically to correct the condition. This condition is indicated when the wheel slip light cycles *on and* off.

CAUTION

Irregular flashing of the wheel slip light when the locomotive is in power and above 1.5 mph could be an indication of a Super Series failure. Operation may continue, but the condition must be reported to authorized maintenance personnel.

3. Locked powered wheel. A locked wheel condition will cause the wheel slip light to be on if the locomotive is under power. This condition is indicated when the wheel slip light is on continuously.

WARNING

Never operate the locomotive with a continuous wheel slip light (locked wheel indication). If circuit difficulty is suspected, stop the locomotive and make a careful inspection to ascertain that there are no locked sliding wheels before proceeding.

4. Wheel slips during dynamic braking. When equipped for dynamic braking, the wheel slip light will come on to indicate when a pair of wheels is detected tending to rotate at a slower speed.

PCS OPEN Light

The PCS OPEN light comes on to indicate a safety control or emergency air brake application. The pneumatic control switch PCS functions to automatically cut power to the traction motors in the event of a safety control or emergency air brake application.

Locomotive power is restored by resetting of the PCS switch. This occurs automatically, provided that:

1. Control of the air brake is recovered.

2. The throttle is returned to IDLE position.

BRAKE WARN Light

This light indicates excessive dynamic braking current. In the event that the brake warning light comes on, reduce dynamic brake handle position immediately to decrease braking effort and prevent possible equipment damage. If the brake warning light does not go out or if the indication repeats, place the dynamic brake cutout switch on the engine control panel of the affected unit in the CUTOUT position. The unit will then operate normally under power, but not in dynamic braking. Total dynamic braking effort of units coupled in consist will be reduced.

OSC HDLT Light

Comes on to indicate that the red oscillating headlight is on, either because of emergency or penalty control brake application or because the signal light control switch on the control stand is positioned at RED.

SAND Light

This light indicates that one of the manual sanding switches is activated.

NOTE

Automatic sanding, initiated by locomotive control circuits, or emergency sanding will not cause the sand light to come on.

S.C. NOT OPER. Light

Comes on to indicate that the automatic train speed control system is not operating. This occurs with either the mode selector switch on the cab indicator in OFF position or the speed control switch on the controller mounted speed control switch box in the OFF position.

LIGHT SWITCHES

Switches for the ground/step light and gauge lights are located to the left of the controller. The lights are on when the switches are in the up position.

7Th THROTTLE KNOCKDOWN SWITCH

This switch, when so equipped, causes 8th throttle operation to be reduced to 7th throttle engine speed and power when placed in the down position.

HEADLIGHT SWITCHES

Two four-position rotary snap switches are provided for independent control of the front and rear headlights. Each switch has OFF, DIM, MED., and BRT. positions.

CONTROL AND OPERATING SWITCHES

A group of three operating switches, Fig. 2-14, is located at the upper right corner of the control stand. They snap into the on position when moved upward. The switches must be set in the on position when the unit leads a consist, and must be set in the off position in trailing consist units.

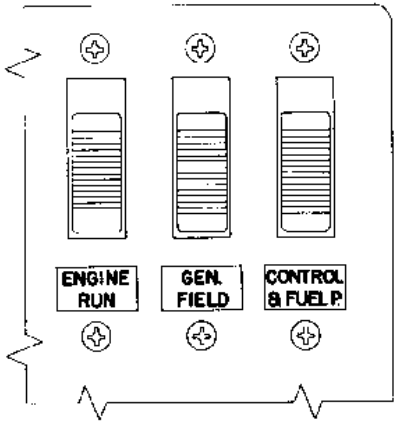


Fig.2-14 - Control And Operating Switches

Engine Run Switch

This switch must be on to obtain throttle control of engine speed. If the engine run switch is off, the engine will run at idle speed (low idle speed, if equipped) regardless of throttle handle position.

Gen. Field Switch

The generator field switch must be on to complete the excitation circuits to the main generator. If the switch is in the off position, the engine will respond to throttle, but the generator will not develop power.

Control & Fuel P. Switch

The control and fuel pump switch provides power to various low voltage control circuits. The switch must be on to start the engine and operate the fuel pump.

SIGNAL LIGHT SWITCH

This switch is used to turn on the locomotive signal light.

DYNAMIC BRAKE CONTROL CIRCUIT BREAKER

On locomotives equipped for dynamic braking, this circuit breaker is provided to protect against a faulty operating or test setup. The circuit breaker should be in the on (up) position for normal operation. A tripped circuit breaker generally indicates that during dynamic brake testing more than one dynamic brake handle in a locomotive consist was out of OFF position.

ATTENDANT CALL PUSHBUTTON

When this button is pressed in any unit coupled in consist, the alarm bell will ring in all units.

GROUND RESET PUSHBUTTON

To restore locomotive power and reset the ground relay when the ground relay tripped light is on, wait 10 seconds, then press the ground reset pushbutton. Power will then reapply. It is not necessary to isolate the unit, or have the throttle in IDLE while pressing the button unless the locomotive is at a standstill.

Repeated resetting of the ground relay is permissible, but instructions as issued by the railroad regarding repeated resetting must be followed. However, in the absence of definite instructions to the contrary, isolate a unit when the ground relay light comes on for a third time after being reset twice.

CAUTION

Report any ground relay alarm indications to proper maintenance personnel.

AIR GAUGES

Air gauges to indicate main reservoir air pressure as well as various pressures concerned with the air brakes are located along the top of the control stand.

LOAD CURRENT INDICATING METER

Locomotive pulling force is indicated by the load current indicating meter. The meter is graduated to read amperes of electrical current, with 1650 being the maximum on the scale. A red area on the meter face indicates when current levels are too high for continuous operation. The meter is connected to indicate average traction motor current.

CAUTION

Observe short time operation plate instructions pertaining to low speed full throttle operation. This plate is located below the load current indicating meter.

The maximum continuous current rating and the short time operating limits were developed for throttle 8 operation. These values must be decreased at lower throttle positions because engine speed, and, consequently traction motor cooling air are reduced.

On locomotives equipped for dynamic braking, a zero center type meter is applied, Fig. 2-15. The meter needle swings to the right of zero to indicate load current during power operation, and it swings to the left of zero to indicate dynamic braking current, with 900 amperes being the maximum reading on the braking portion of the meter.

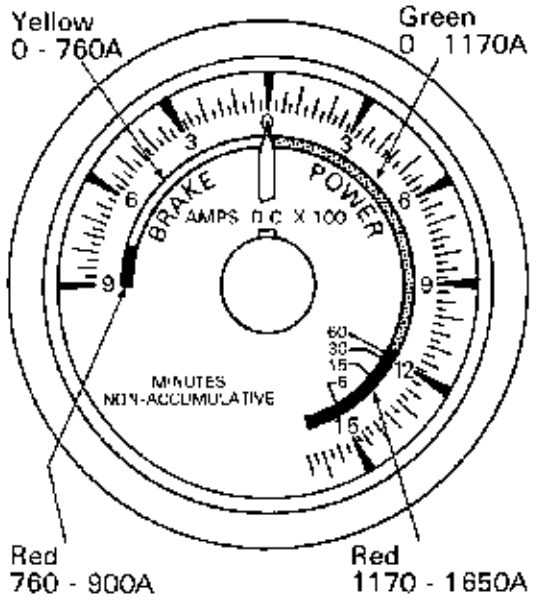


Fig.2-15 - Load Current Indicating Meter

Since the dynamic brake regulator controls maximum braking current, the meter should seldom, if ever, indicate more than 760 amperes, which is the basic rating of the dynamic braking resistor grids.

CONTROL CABINET

The control cabinet contains an engine control panel, a fuse and switch panel, and three circuit breaker panels, Fig. 2-16. Each panel contains controls and/ or indicating devices used by the operator.

WARNING

Never open any control cabinet doors other than to gain access to the circuit breaker and fuse and switch panels. High voltage and current are present throughout the control cabinet.

ENGINE CONTROL PANEL

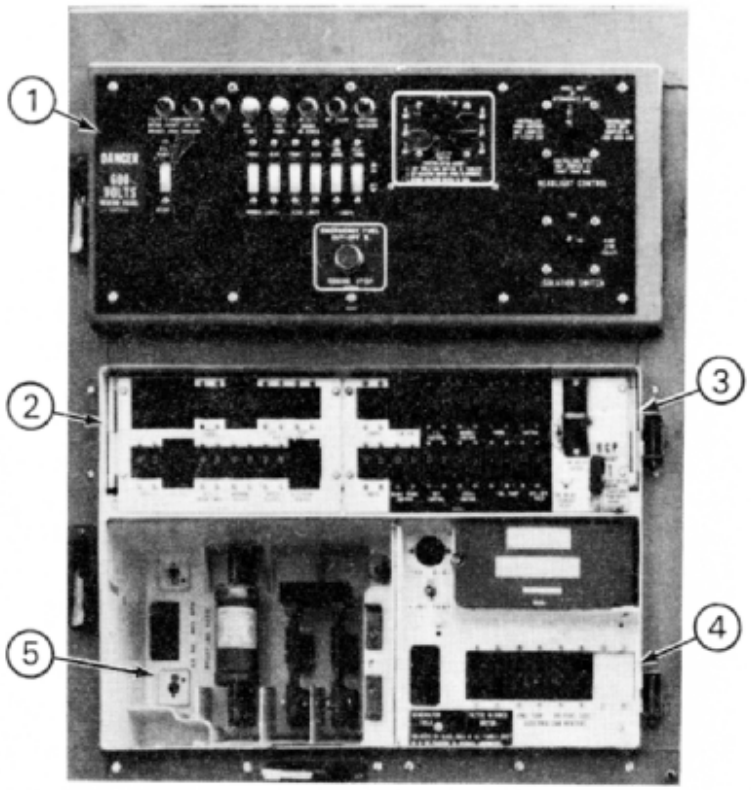
The engine control panel, Fig. 2-17, contains various switches and indicator lights. Since all of these devices will be used by the operator, a brief description of their functions is provided.

INDICATOR LIGHTS (BASIC TYPE) NOTE

An alarm bell accompanies an alarm signal light indication. The bell will ring in all units of a locomotive consist, but the light will come on only in the affected unit.

FILTER BLOWER MOTOR CIRCUIT BREAKER OPEN Light

This light indicates that the carbody inertial filter exhaust blower motor is not receiving power. Check for a tripped filter blower motor circuit breaker on the No. 3 circuit breaker panel. If the breaker will not reset, operation may continue to the nearest maintenance point where the condition should be reported and corrected.

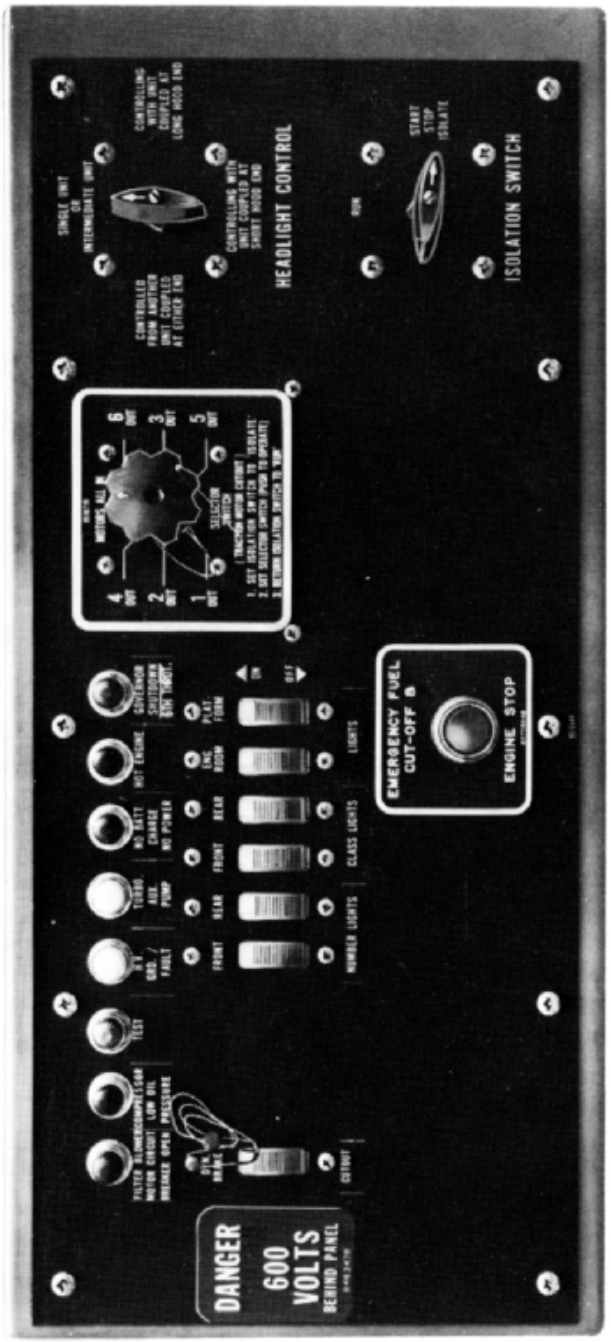


1. Engine Control Panel
2. No. 1 Circuit Breaker Panel
3. No. 2 Circuit Breaker Panel
4. No. 3 Circuit Breaker Panel
5. Fuse And Switch Panel

Fig.2-16 - Typical SD50 Control Cabinet Panels

COMPRESSOR LOW OIL PRESSURE Light

This light indicates that the air compressor is experiencing a low oil pressure condition. Notify maintenance personnel as soon as possible.



27583

Fig.2-17 – Engine Control Panel, With Typical Extras

CONTROLS

TEST Light

The test light comes on when the test panel rotary test switch is placed in the LOAD TEST NO. 1, LOAD TEST NO. 2, or CIRCUIT CHECK position. The light indicates that the locomotive circuits are set up for either load testing when the reverser handle is centered or for circuit check with the generator field circuit breaker open. The locomotive may be equipped to automatically load on its own dynamic braking resistor grids.

CAUTION

Do not perform automatic loading on a unit moving in a consist or train. Do not return test switch to NORMAL position while operating under load.

H.V. GRD./FAULT Light

This light indicates that an electrical path to ground has occurred, or that a group of diodes in the main generator has failed. When the light comes on and the alarm sounds, the operator should wait 10 seconds, then press the ground reset button located on the control stand. Power will then reapply. It is not necessary to isolate the unit, nor is it necessary to have the throttle in idle while pressing the button.

If there is no ground reset button on the control stand, the locomotive will be equipped with special automatic ground relay reset, and the operator need take no action to reset the relay. Such automatic reset devices are equipped for lockout, and automatic reset will be nullified after either a specific number of trips or after a given number of trips within a time period. On the basic locomotive, when the high voltage ground/fault alarm occurs for the third time after using the ground reset button twice, the affected unit should be isolated.

CAUTION

Always report ground fault light indications to proper maintenance personnel.

TURBO. AUX. PUMP Light

This light will come on as soon as the main battery switch and turbo lube pump circuit breaker are closed. It indicates that the turbocharger auxiliary lube oil pump is supplying lube oil to the turbocharger. It will remain on for approximately 35 minutes after the main battery switch is closed. When the fuel prime/engine start switch is operated after the 35 minute period, the time cycle is again re-established and the light remains on for another 35 minutes.

The light will also come on and remain on for approximately 35 minutes after the engine is stopped. It provides an indication that the auxiliary lube oil pump is supplying oil to cool the turbocharger bearings.

If the power supply to the turbo lube pump motor is open, the engine will not start and the light will fail to come on when a starting attempt is made.

NO BATT. CHARGE/NO POWER Light

Indicates that no AC power is being delivered by the companion alternator. This may be due to a tripped GENERATOR FIELD, A.C. CONTROL, AUX. GEN., or AUX. GEN. FIELD circuit breaker, engine shutdown, alternator failure, or failure of the auxiliary generator, which excites the alternator. Main generator cannot produce power without companion alternator output. If this light is on for reasons other than engine shutdown, engine speed and power are reduced to idle conditions.

HOT ENGINE Light

This light operates in conjunction with the alarm bell to warn the operator that engine coolant has reached an excessive temperature. When

operating in throttle positions 7 or 8 a hot engine condition will automatically reduce engine speed and power to throttle position 5 or 6 respectively. If operating in throttle positions 6 or below, engine speed and power will not be reduced during a hot engine condition, however, the hot engine light will be on and the alarm bell will ring.

If the cooling system has failed, a hot lubricating oil detector will shut the engine down before serious engine damage occurs. If hot engine shutdown occurs do not attempt to restart the engine. Report shutdown circumstances to maintenance personnel.

NOTE

The locomotive may be equipped to nullify the hot engine power reduction of a lead unit in a consist. In this case (because the lead unit reverser handle is not centered) the circuit will automatically nullify the power reduction. Lead unit engine speed and power will not be reduced but the alarm bell will ring in all units.

GOVERNOR SHUTDOWN/6TH THROT. Light

This light comes on for one of the following two reasons:

1. A clogged engine air filter has tripped the EFL relay causing a reduction in engine speed from throttle 8 to throttle 6.

2. The engine governor has shut the engine down due to one of the following causes:

   a. True low oil pressure.

   b. Hot engine oil.

   c. Low cooling water pressure, or any condition which causes the differential pressure across the water pump to drop below airbox pressure.

   d. Crankcase (oil pan) overpressure.

A mechanism to detect low engine lubricating oil pressure is built into the engine governor. This mechanism is actuated by true oil pressure failure or by dumping oil from the engine oil line leading to the governor. In either event a small button will pop out of the governor body, indicating that the mechanism has tripped the low oil alarm switch. The light on the engine control panel will come on to indicate that the low oil mechanism has tripped.

When a governor shutdown indication occurs, it is necessary to determine whether the crankcase pressure low water detector has tripped to dump engine oil from the line leading to the governor, or whether a true oil failure has occurred. This can be determined by checking the differential low water-crankcase pressure detector, Fig. 2-27, for protruding reset buttons. A protruding lower button indicates excessive oil pan pressure; a protruding upper button indicates low water.

WARNING

When it is determined that the crankcase pressure detector has tripped, make no further engineroom inspections. Do not attempt to restart the engine. Isolate the unit. Drain the cooling system in accordance with railroad regulations.

If neither the crankcase pressure nor the low water pressure detector has tripped, and engine oil level is satisfactory with a hot engine condition apparent, do not attempt to restart the engine. Report engine shutdown circumstances to authorized maintenance personnel.

INDICATOR LIGHTS (PRESS-TO-TEST)

As extra equipment the engine control panel may have one or more indicating light panels replacing the basic bulbs.

Each indicator light panel has provisions for six push-to test indicator lights. When equipped, a second indicator light panel will contain one to six additional indicator lights.

NOTE

Indicator Light panels are equipped with push-to test lights. This feature allows testing of the lamp circuit alone isolated from it operation in the power control system. When the lens cap is depressed, voltage is supplied to the lamp circuit. After a one second delay, the light should go on.

NO. 1 INDICATOR LIGHT PANEL

The No. 1 indicator light panel, Fig. 2-18, contains six basic indicator lights.

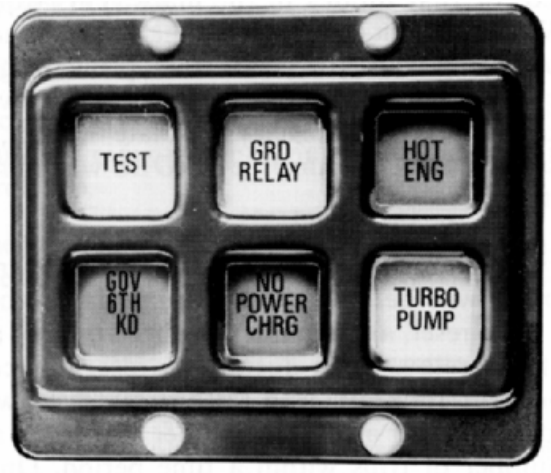


Fig.2-18 - Typical No. 1 Indicator Light Panel

TEST Light

The test light comes on when the test switch is placed in the CIRCUIT CHECK, LOAD TEST NO. 1, or LOAD TEST NO. 2 position. The

light indicates that the locomotive circuits are set up for either load testing or a circuit check. On special order the unit can be equipped to automatically load on its own dynamic braking resistor grids. On basic units the generator buses must be connected to an external loading resistor.

CAUTION

1. Do not perform automatic loading on a unit moving in a consist or train.

2. Do not move test switch to NORMAL position while operating under load.

GRD RELAY Light

This light indicates that an electrical path to ground has occurred, or that diodes in the main generator have failed. When the light comes on and the alarm sounds, the operator should wait 10 seconds, then press the ground reset pushbutton located on the control stand. Power will then reapply. It is not necessary to isolate the unit, nor is it necessary to have the throttle in IDLE when pressing the button.

If there is no ground reset button on the control stand, the locomotive will be equipped with special automatic ground relay reset, and the operator need take no action to reset the relay. Such automatic reset devices are equipped for lockout, and automatic reset will be nullified after either a specific number of trips, or after a given number of trips within a time period. On basic locomotives, when the high voltage ground/ fault alarm occurs for the third time after being reset twice, the affected unit should be isolated.

CAUTION

Report any ground relay alarm indications to proper maintenance personnel.

HOT ENG Light

This light operates in conjunction with the alarm bell to warn the operator that engine coolant has reached an excessive temperature. When operating in throttle positions 7 or 8 a hot engine condition will automatically reduce engine speed and power to the equivalent throttle positions 5 or 6 respectively. If operating in throttle positions 6 or below, engine speed and power will not be reduced during a hot engine condition; however, the hot engine light will be on and the alarm bell will ring.

If the cooling system has failed, a hot lubricating oil detector will shut the engine down before serious engine damage occurs. If hot engine shutdown occurs do not attempt to restart the engine. Report shutdown circumstances to maintenance personnel.

GOV 6TH KD Light

This light comes on for one of the following reasons:

1. A clogged engine air filter has tripped the EFL relay causing a reduction in engine speed from throttle 8 to throttle 6.

2. The engine governor has shut the engine down due to one of the following causes:

   a. True low oil pressure.

   b. Hot engine oil.

   c. Low cooling water pressure, or any condition which causes the differential pressure across the water pump to drop below airbox pressure.

   d. Crankcase (oil pan) overpressure.

Refer to Safety Devices paragraph under Engineroom Equipment Section for information concerning safety devices.

NO POWER CHRG Light

Indicates that no AC power is being delivered by the companion alternator. This may be due to a tripped GENERATOR FIELD, A.C. CONTROL, AUX. GEN., or AUX. GEN. FIELD circuit breaker, engine shutdown, alternator failure, or failure of the auxiliary generator, which excites the alternator. Main generator cannot produce power without companion alternator output. If this light is on for reasons other than engine shutdown, engine speed and power are reduced to idle conditions.

TURBO PUMP Light

This light will come on as soon as the main battery switch and turbo lube pump circuit breaker are closed. It indicates that the turbocharger auxiliary lube oil pump is supplying lube oil to the turbocharger. It will remain on for approximately 35 minutes after the main battery switch is closed. When the fuel prime/ engine start switch is operated after the 35 minute period, the time cycle is again re-established and the light remains on for another 35 minutes.

The light will also come on and remain on for approximately 35 minutes after the engine is stopped. It provides an indication that the auxiliary lube oil pump is supplying oil to cool the turbocharger bearings.

If the power supply to the turbo lube pump motor is open, the engine will not start and the light will fail to come on when a starting attempt is made.

NO. 2 INDICATOR LIGHT PANEL

The No. 2 indicator light panel contains one to six non-basic indicator lights. A typical panel is shown in Fig. 2-19.

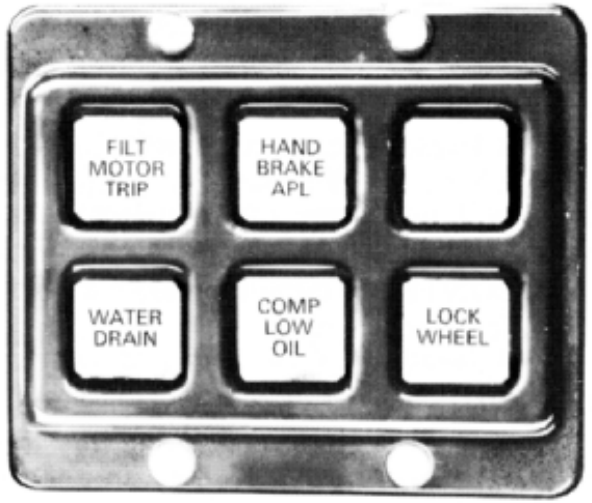


Fig.2-19 - Typical No. 2 Indicator Light Panel

FILT MOTOR TRIP Light

When equipped, this light indicates that the carbody inertial filter blower motor is not receiving power. Check for a tripped filter blower motor circuit breaker on the No. 3 circuit breaker panel. If the breaker will not reset, operation may continue to the nearest maintenance point.

WATER DRAIN Light

This light, accompanied by the alarm bell, indicates that the automatic cooling system drain circuit is disabled. (The circuit and the light are special equipment.) The circuit could be disabled by a tripped WATER DRAIN circuit breaker, by depressing the AUTO. DRAIN COLD

WATER FILL switch on the AC cabinet, or by a fault in the system. When the circuit is disabled, engine speed cannot be raised above idle.

NOTE

This light will not come on to indicate that the automatic cooling system drain circuit is disabled if either the CONTROL circuit breaker or the main battery knife switch is open.

COMP LOW OIL Light

This light indicates that the air compressor is experiencing a low oil pressure condition. Notify maintenance personnel as soon as possible.

LOCK WHEEL Light

This light indicates a locked wheel condition and will be accompanied by a continuous wheel slip light, alarm bell, and buzzer. Observe the following:

LOCKED WHEEL CONTINUOUS WHEEL SLIP LIGHT AND ALARM BELL

PROCEDURE

1. STOP TRAIN
2. LOOK FOR UNIT WITH LOCKED WHEEL INDICA TION
3. ROLL TRAIN SLOWLY AND OBSERVE WHEELS

a. IF WHEEL SLIDES, CUT UNIT OUT OF TRAIN
b. IF ALL WHEELS ROLL AND L. W. RESETS AUTOMATICALLY, PROCEED NORMALLY

WARNING

The operator must not operate any reset or cutout switches on the locked wheel circuit module. If automatic reset follows a locked wheel indication, report the condition at the nearest maintenance point, where an inspection can be made for flat spots on the wheels.

EMERGENCY FUEL CUT-OFF & ENGINE STOP SWITCH

The diesel engine will stop whenever the engine stop pushbutton is pressed. The reaction to the pushbutton is immediate and it need not be held in until the engine stops.

TRACTION MOTOR CUTOUT SWITCH

The traction motor cutout switch, if provided, operates to electrically isolate a defective traction motor. This permits operation with the remaining good motors. The power control system automatically limits power to prevent overloading the operative motors. The isolated motor will continue to rotate as the train moves.

Observe instructions printed on the panel when necessary to cut out a traction motor.

WARNING

Make certain that all wheels rotate freely before operating with a motor cut out.
The dynamic brake system is disconnected when operating with a motor cut out.

HEADLIGHT CONTROL SWITCH

The twin sealed-beam front and rear headlights are controlled by the front and rear headlight switches on the locomotive control stand. Before these switches will function, the headlight circuit breaker must be placed on.

On locomotives equipped for multiple unit operation, a remote headlight control switch is mounted on the engine control panel. This remote headlight control switch provides for operation of the rear unit headlight from the lead unit. The switch positions are set on each unit as follows:

On Lead Unit

If only a single locomotive unit is being used, place the switch in SINGLE UNIT position.

In multiple unit service, if trailing units are coupled to the No. 2 or long hood end of the lead unit, place the switch in the CONTROLLING - COUPLED AT LONG HOOD END position.

In multiple unit service, if trailing units are coupled to the No. 1 or short hood end of the lead unit, place switch in CONTROLLING - COUPLED AT SHORT HOOD END position.

On Intermediate Units

On units operating in between other units in a multiple unit consist, place the switch in the INTERMEDIATE UNIT position.

On Trailing Units

The last unit in a multiple unit consist should have the headlight control switch placed on CONTROLLED - COUPLED AT EITHER END.

ISOLATION SWITCH

The isolation switch has two positions, one labeled START/ STOP/ ISOLATE, the other labeled RUN. The functions of these two positions are as follows:

START/STOP/ISOLATE Position

The isolation switch is placed in this position whenever the diesel engine is to be started. The start switch is effective only when the isolation switch is in this position. This position is also used to isolate the unit, and when isolated the unit will not develop power or respond to the controls. In this event the engine will run at idle speed regardless of throttle position. This position will also silence the alarm bell in the event of a no power or low lube oil alarm. It will not, however, stop the alarm in the event of a hot engine.

If the locomotive is equipped with the remote traction motor cutout switch feature, the isolation switch must be placed in the ISOLATE position before the cutout switch can be operated.

RUN Position

After the engine has been started, the unit can be placed "on the line" by moving the isolation switch to the RUN position. The unit will then respond to control and will develop power in normal operation.

THROTTLE LIMIT SWITCH

When equipped, this switch allows locomotive power to be reduced when operating in throttle positions 7 or 8, while trailing units remain at normal power. Reduced lead unit power helps dress the rails for trailing units. In throttle positions 7 or 8 power will be reduced to the equivalent throttle position 5 or 6 respectively, when this switch is in the THROTTLE LIMIT position. If operating in throttle position 6 or below power will not be reduced.

LOCKED WHEEL CUTOUT AND RESET SWITCH (IF PROVIDED)

For the locked wheel detection system to be operational, this switch must be in the LOCKED WHEEL (up) position. The locked wheel detection system is then effective whether the unit is under power, is shut down, is isolated, or has motors cut out. When the switch is in CUT-OUT & RESET position, locked wheel detection is nullified; however, the wheel slip control system will provide protection against a locked wheel on any units under power without motors cut out.

Should a temporary operating condition such as unequal release of air brakes bring about a locked wheel indication, automatic reset will occur when the wheel again turns freely. When a locked wheel indication is received, follow the procedure outlined under the LOCK WHEEL light paragraph in this manual.

DYNAMIC BRAKE CUTOUT SWITCH (IF PROVIDED)

On units so equipped, when this switch is placed in the CUTOUT position, the individual unit will not operate in dynamic braking. It will however, continue to operate normally under power. The switch can be used to limit the number of units coupled together that will operate in dynamic braking, or it may be used to cut out a unit that is defective in dynamic braking, yet allow it to operate under power.

MISCELLANEOUS LIGHT SWITCHES

Switches are included in circuits for various lights on the locomotive. The switches are closed as desired to operate the class lights, number lights, engineroom lights, and platform lights.

CIRCUIT BREAKER PANELS

The three circuit breaker panels contain circuit breakers and controls used to protect engine, control systems, lights and miscellaneous devices that are used as conditions require. These circuit breakers can be operated as switches, but will trip open when an overload occurs.

NO. 1 CIRCUIT BREAKER PANEL

This panel contains circuit breakers that protect customer requested extra equipment. The No. 1 circuit breaker panel, Fig. 2-20, has provisions for twelve circuit breakers. The following paragraphs contain a brief description of typical circuit systems protected by breakers on this panel.

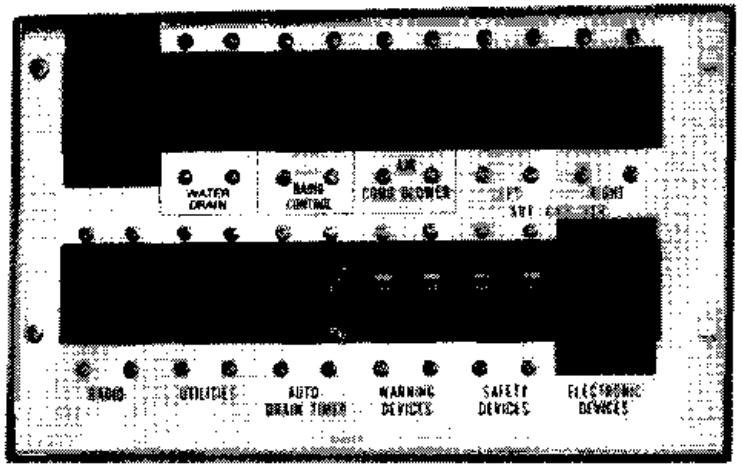


Fig.2-20 - Typical No. 1 Circuit Breaker Panel

Water Drain

This breaker protects the automatic cooling system drain circuit, if circuit is provided. It must be closed to enable arming the circuit (see FUEL PRIME/ENGINE START switch) and must then remain closed continuously to enable the circuit to provide protection against freezing.

Radio Control

When equipped for remote radio control this breaker protects radio control circuits.

Air. Cond. Blower

When equipped with air conditioning this breaker protects the blower fan motor circuits. A separate breaker for the air conditioner compressor is located on No. 3 circuit breaker panel.

Aux. Cab Htr.

These breakers protect the left and right auxiliary cab heaters. Heat control is provided by switches located on the control stand or at the heater.

Radio

Protects circuits that supply the radio, when equipped.

Utilities

When equipped, this breaker protects the toilet immersion heater, or similar devices.

Auto. Drain Timer

Protects circuits that control automatic operation of drain valves in the compressed air system.

Warning Devices

This breaker protects signal light circuits, when equipped. This breaker may also be used to protect similar devices.

Safety Devices

Train overspeed brings about a penalty application of the brakes and operation of the pneumatic control switch to drop locomotive power. This breaker protects the overspeed magnet valve circuit. This breaker may also be used to protect similar devices.

N0. 2 CIRCUIT BREAKER PANEL

The No. 2 circuit breaker panel, Fig. 2-21, contains circuit breakers and switches that protect basic locomotive equipment and control systems. The panel is divided into three sections. The shaded middle section indicates breakers required on for locomotive operation. Breakers in the unshaded section are used as conditions require.

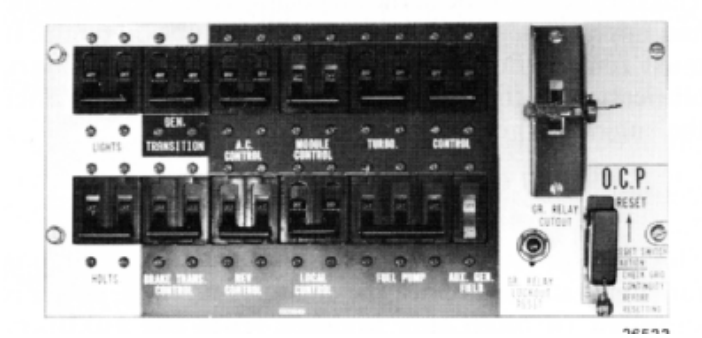


Fig.2-21 - Typical No. 2 Circuit Breaker Panel

Gen. Transition

This breaker protects the main coil of the main generator series contactor, and a portion of its control circuit. Closing it enables forward (parallel-to-series) main generator transition, for high speed operation.

A.C. Control

This breaker protects the portion of the sensor module receiving A.C. power from the companion alternator. The sensor module controls main generator field excitation current level. The no A.C. voltage relay (NV R) is also connected in this circuit. If the breaker trips during locomotive operation, the main generator will not develop power and the no power/charge light on the engine control panel will come on indicating no companion alternator output.

Module Control

This breaker protects the local control circuit that supplies power to the circuit modules and miscellaneous control system devices.

Turbo

This breaker must be in the on position to start the engine and operate the turbocharger auxiliary lube oil pump. It must remain in the on position to provide auxiliary lubrication to the turbocharger at engine start and after the engine is shut down.

Control

This breaker sets up the fuel pump and control circuits for engine starting. Once the engine is running, power is supplied through this breaker from the auxiliary generator to maintain operating control.

Brake Trans. Control

This double pole breaker is located in the feed to the operating motor of the multi-pole, motor operated, ganged switches that control the motor field and armature connections for either dynamic braking or

power operation. Since control power is required to move the transfer switchgear from any position to any other position, the breaker must be closed for power transfer to take place. An open breaker does not prevent switchgear that is already in position from conducting traction motor current, but interlocking prevents an operating setup in conflict with transfer switch position.

Rev. Control

This breaker is located in the feed to the operating motor of the multi-pole, motor operated, ganged switches that control the direction of current flow through the traction motor fields and thus control the direction of locomotive travel. Since control power is required to move the RV transfer switchgear from any position to any other position, this breaker must be closed for power transfer to take place. An open breaker does not prevent switchgear that is already in position from conducting traction motor current, but interlocking prevents an operating setup in conflict with transfer switch position.

Local Control

This circuit breaker establishes "local" power from the auxiliary generator to operate heavy duty switchgear and various control devices.

Fuel Pump

This breaker protects the fuel pump motor circuit. A fuel filter bypass valve is provided to prevent overloading the fuel pump motor if the fuel filter becomes clogged.

Aux. Gen. Field

The field excitation circuit of the auxiliary generator is protected by this breaker. In the event that this breaker trips, it stops auxiliary generator output to the low voltage system and also stops fuel pump

operation. An alternator failure (no power no battery charge) alarm occurs. The engine will stop from lack of fuel.

Lights

This breaker must be on to supply power to switches that control miscellaneous locomotive lights.

Cab Htr.

These breakers provide protection for electrical cab heaters, when applied.

Hdlts.

This breaker must be on to provide current to the front headlight circuit and through the trainline to the light at the rear of the consist.

Ground Relay Cutout Switch

The purpose of the ground relay cutout switch is to eliminate the ground protective relay from the locomotive circuits during certain shop maintenance inspections. It must always be kept closed in normal operation. When this switch is open, it prevents excitation of the main generator and throttle response of the diesel engine in addition to cutting out the ground protective relay.

Open Grid Circuit Reset

This button is used to reset the open grid circuit protective relay (OCP) on units equipped with extended range dynamic braking. If an open circuit occurs in the dynamic braking grids or cabling the OCP relay will pick up, locking out dynamic braking.

CAUTION

Do not reset the OCP relay. The OCP relay should only be reset by maintenance personnel following a thorough inspection of the dynamic brake grids and cabling.

NO. 3 CIRCUIT BREAKER PANEL

The No. 3 circuit breaker panel, Fig. 2-22, has provisions for five circuit breakers. The panel also contains a sealed section. This section contains a test panel intended for use by maintenance personnel during maintenance and testing procedures. A 74 volt receptacle and fuse test switch are also part of this panel.

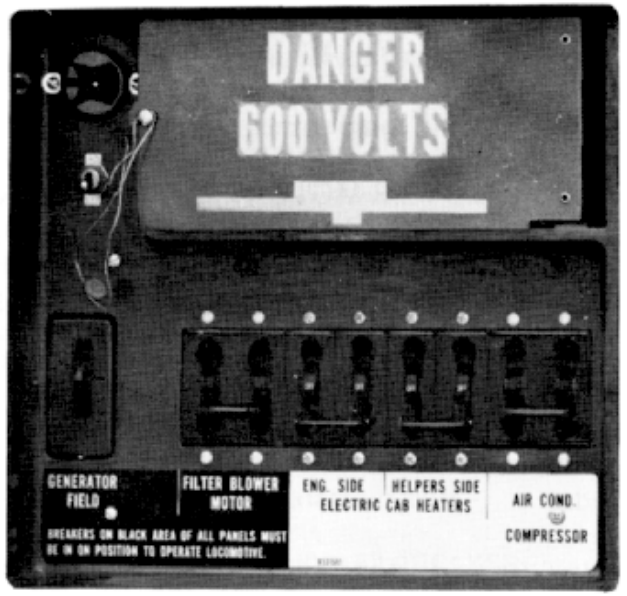


Fig.2-22 - Typical No. 3 Circuit Breaker Panel

The circuit breaker portion of the panel is divided into two sections. Breakers in the shaded section are required on for locomotive operation. Breakers in the unshaded section are to be used as conditions require.

Generator Field

The main generator receives excitation current through a controlled rectifier from the companion alternator. This breaker is provided to protect the controlled rectifier and both generators as well as associated circuitry.

NOTE

Unlike other breakers on the panel that trip to the full off position, the generator field circuit breaker will trip to the center position. After a period for cooling, the breaker must be placed in the full off position before resetting to the on position.

Filter Blower Motor

This breaker protects the inertial filter blower motor circuit. The blower is used to evacuate dirt loaded air from the central air compartment inertial filters.

The FILTER BLOWER MOTOR CIRCUIT BREAKER OPEN (or FILT MOTOR TRIP) light on the engine control panel will come on if this breaker trips open or is inadvertantly left in the off position. If tripped open, operation may continue to the nearest maintenance point.

Electric Cab Heaters Eng. Side

Protects circuits to the cab heater at the operator's station.

Helpers Side

Protects circuits to the cab heater at the helper's side of the cab.

Air Cond. Comp.

When equipped with air conditioning, this breaker protects the air conditioner compressor motor circuits. A separate breaker for the air conditioner blower fan motor is located on the No. 1 circuit breaker panel.

Fuse Test Switch

Refer to Fuse Test Equipment paragraph under the Fuse And Switch Panel section.

74 Volt Receptacle

This receptacle makes 74 volts DC available for maintenance or testing purposes. Power is supplied to the receptacle when the main battery switch and the LIGHTS circuit breaker are closed.

FUSE AND SWITCH PANEL

The fuse and switch panel, Fig. 2-23, contains the equipment described in the following paragraphs.

NOTE

There is no companion alternator field fuse. If a short occurs in this circuit, auxiliary generator voltage will come down, and the machine will not be harmed. A NO BATT. CHARGE NO POWER (NO POWER CHRG) alarm occurs.

AUXILIARY GENERATOR CIRCUIT BREAKER

This breaker connects the auxiliary generator to the low voltage system. It protects against excessive current demands.

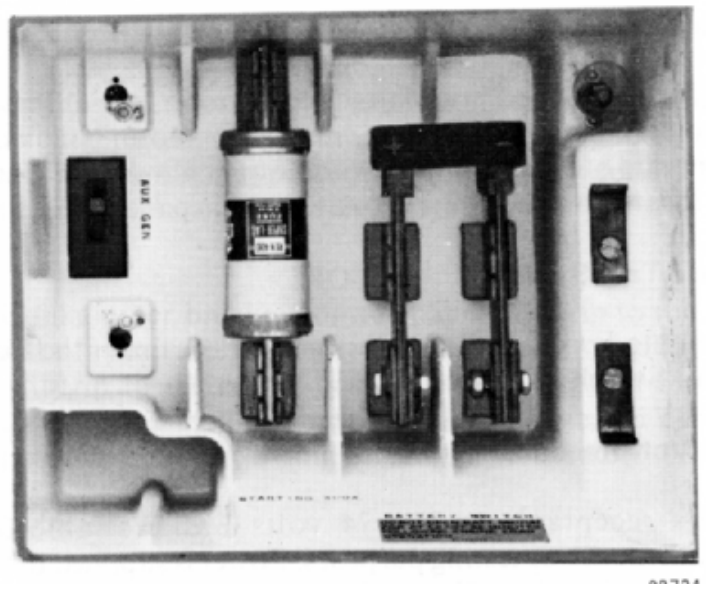


Fig.2-23 - Fuse And Switch Panel

NOTE

Unlike other breakers that trip to the full off position, this breaker will trip to the center position. After a period for cooling, the breaker must be placed in the full off position before resetting to the on position.

STARTING FUSE

The starting fuse is in use only during the period that the diesel engine is actually being started. At this time, battery current flows through the fuse and starting contactor to the starting motors.

Although this fuse should be in good condition and always left in place, it has no effect on locomotive operation other than for engine starting. A defective fuse can be detected when attempting to start the engine, since at that time (even though the starting contactors close) the starting circuit is open.

CAUTION

This model may be equipped with either a 400 or 800 ampere starting fuse depending on starting motor connection. The two fuses are of the same physical size. Observe marking on panel. Do not use an incorrectly rated fuse.

MAIN BATTERY KNIFE SWITCH

This switch is used to connect the batteries to the locomotive low voltage electrical system and should be kept closed at all times during operation.

CAUTION

Do not open battery switch at engine shutdown following load operation. The turbocharger lube oil pump will come on and continue to run for approximately 35 minutes following engine shutdown, then shut off automatically. The 35 minutes allows turbocharger bearings to cool using engine lube oil.

On special order, the turbocharger lube pump is connected on the battery side of the knife switch, so that opening the switch after engine shutdown will not stop the pump. The TURBO AU X. PUMP light will remain on, indicating that the pump is running, after the switch is opened, when so equipped.

FUSE TEST EQUIPMENT

To facilitate testing of fuses, a pair of fuse test blocks and a test light are installed on the fuse and switch panel. A test light toggle switch is located on the No. 3 circuit breaker panel. Fuses may be readily tested as follows. Move test light switch to the on position to make sure the fuse test light is not burned out. Move test light switch to the off position to turn light off. Place fuse to be tested across the test blocks so that

the metal ends of the fuse are in firm contact with the blocks. If the fuse is good the light will come on.

It is always advisable to test fuses before installation. Always isolate the circuits in question by opening their switches before changing or replacing fuses.

ENGINEROOM EQUIPMENT

Engine starting and monitoring equipment is located in the engineroom as shown in Fig. 2-24.

ENGINE STARTING CONTROLS

NOTE

Refer to Operation section for complete inspection and starting instructions.

FUEL PRIME/ENGINE START SWITCH

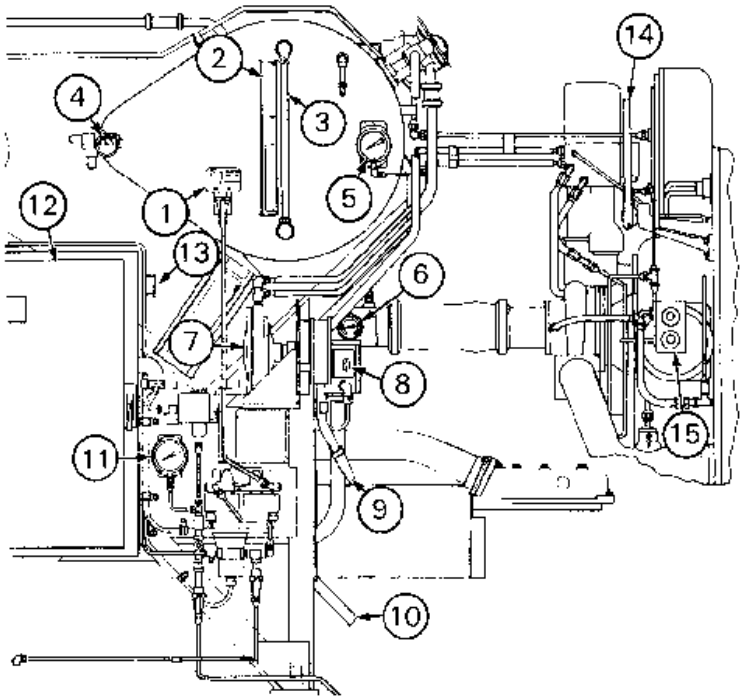
This three position rotary switch, Fig. 2-25, is located in a junction box mounted on the equipment rack. The functions of the three positions are as follows:

FUEL PRIME Position

This position is used to prime the engine with fuel prior to starting. In this position the fuel pump motor is energized with battery power but the engine will not crank. Additional contacts energize the auxiliary turbocharger lube oil pump motor, ensuring a supply of lube oil under pressure to the turbocharger bearings during startup.

ENGINE START Position

This position is used to supply power from the batteries to the starting motors. The starter motor pinion gear engages with the engine ring gear which causes the engine to crank until FP/ ES switch is released.



1. Manual Shutter Control Valve
2. Water Level Instruction Plate
3. Water Level Sight Gauge
4. Fuel Oil Filter Bypass Gauge
5. Lube Oil Pressure Gauge
6. Water Temperature Gauge
7. Load Regulator
8. Fuel Prime/Engine Start Switch
9 Water Filler
10. Water Tank Overflow
11. Air Pressure Gauge
12. AC Cabinet
13. Auto. Drain Cold Water Fill Switch
14. Injector Control Lever (Layshaft)
15. Low Water And Crankcase Pressure Detector (Fig. 2-27) 77AC

Fig.2-24 -Typical Engineroom Equipment

This position also arms the automatic cooling system drain circuit, if provided, when the WATER DRAIN circuit breaker is closed.

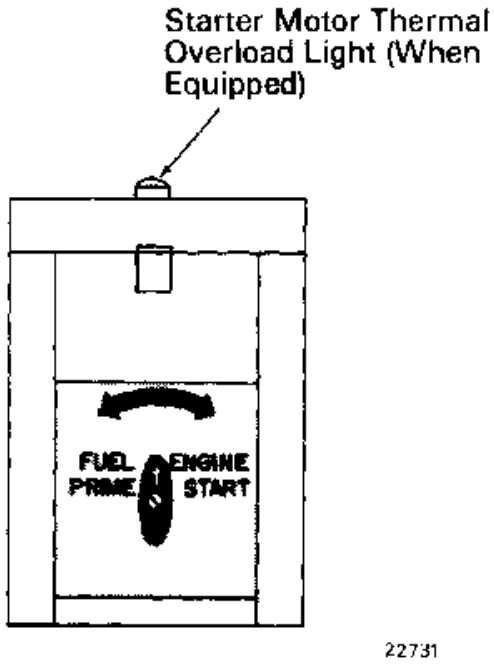


Fig.2-25 - Fuel Prime/Engine Start (FP/ES) Switch

Centered (Off) Position

The FP/ ES switch is spring loaded to return to this position when released. Contacts that are normally closed in this position supply power to the fuel pump motor from the auxiliary generator when the engine is running.

NOTE

When equipped, a light on top of the FP/ ES switch junction box will come on to indicate that the starter motors have been overloaded. When this light is on, power will not be applied to the starter motors regardless of FP/ ES switch position. The light will go out automatically when starter motors have cooled sufficiently to allow restart attempt.

INJECTOR RACK MANUAL CONTROL LEVER (LAYSHAFT)

This engine mounted hand operated lever, Fig. 2-24, may be used to manually operate the injector racks. It is primarily used to position the injector racks during engine cranking, thereby providing an immediate supply of fuel to the cylinders.

CAUTION

On units equipped with engine purge control system, do not push injector control lever until engine has cranked for 6 seconds.

MONITORING DEVICES

The following devices monitor certain locomotive systems. They provide a visual indication as to the condition of the systems.

Each device represents a system which could cause the engine to shut down. Periodic checks of these systems will alert the operator to an impending failure. Report all abnormal readings to proper maintenance personnel.

WATER LEVEL INSTRUCTION PLATE

This plate is mounted next to a sight gauge on the water tank. To check water level, open round valve handle at bottom of gauge. Read water level using the instruction plate as a guide, then close valve. To avoid false readings drain gauge using small drain cock at bottom of gauge.

LUBE OIL PRESSURE GAUGE

This gauge provides a ready reference indicating lube oil pressure. During normal operation lube oil pressure will increase as diesel engine speed increases.

WATER TEMPERATURE GAUGE

Engine inlet water temperature may be readily checked using this gauge. The gauge is color coded to indicate COLD (blue), NORMAL (green), and HOT (red). Temperature approaching the hot zone may indicate tunnel or similar operation.

FILTER BYPASS GAUGE

This gauge indicates the condition of the primary fuel filters. Increased pressure differential across the filters will be indicated by a higher reading on the gauge. As the pressure increases, a bypass valve will begin to open, bypassing the primary fuel filters. This bypassing imposes a filtering burden on the engine mounted fuel oil filters which will shorten their service life.

AIR PRESSURE GAUGE

This gauge indicates No. 1 main air reservoir pressure.

SAFETY DEVICES

A mechanism to detect low engine lubricating oil pressure is built into the engine governor. Under normal operating conditions, engine lubricating oil under pressure is supplied to the mechanism. Should oil pressure drop to a dangerously low level, a small plunger, Fig. 2-26, will pop out the side of the governor body, indicating that the mechanism has tripped. The GOVERNOR SHUTDOWN light will come on and the engine will shut down in approximately 2 seconds if operating in throttle positions 4 and above. At idle, and in throttle positions, 1, 2, and 3, a time delay before shutdown is built into the governor.

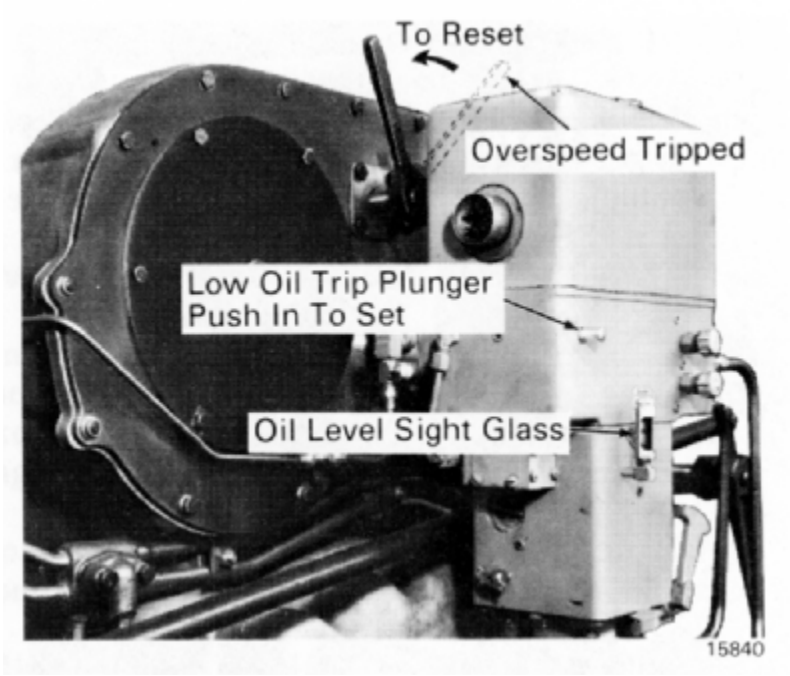


Fig.2-26 - Governor Low Oil Trip Plunger And Engine Overspeed Trip Reset Lever

The locomotive is also equipped with devices, Fig. 2-27, which will detect hot engine oil, low cooling water pressure, and excessive crankcase pressure. When activated, the devices release oil pressure from the line leading to the low oil pressure mechanism in the governor, causing engine shutdown.

If necessary to determine cause of shutdown, check the crankcase pressure and low water pressure detecting devices for protruding reset buttons. A protruding button indicates the device that has caused engine shutdown. If crankcase pressure or low water pressure is not the cause, then the engine was shut down by either the hot oil detector or true oil pressure failure.

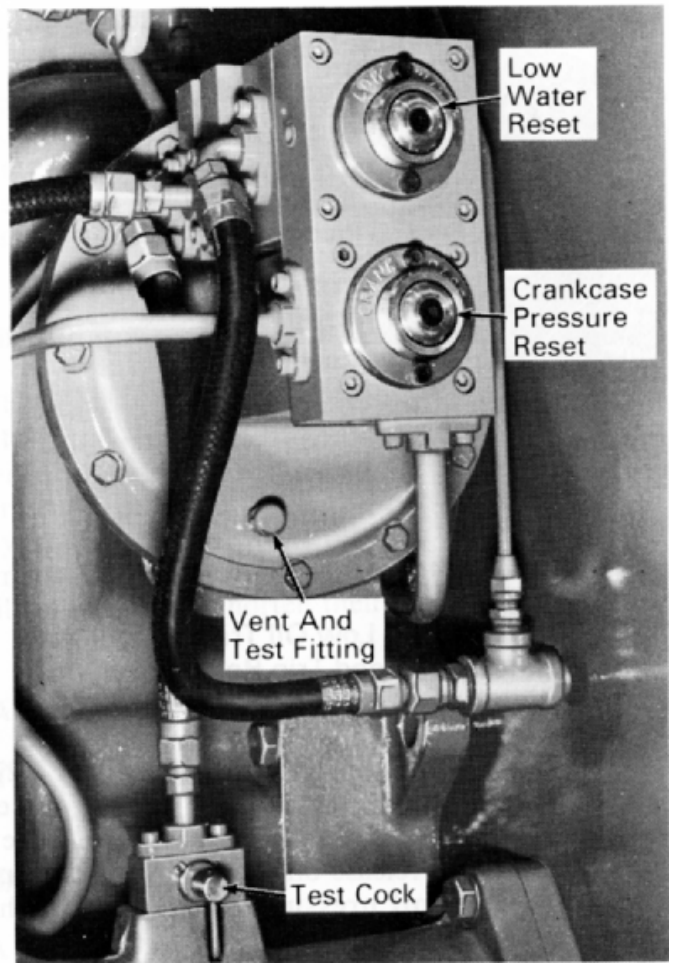


Fig.2-27 - Low Water And Crankcase Pressure Detector

WARNING

When it is determined that the crankcase pressure detector has tripped, make no further engineroom inspections. Do not attempt to restart the engine. Isolate the unit. Drain the cooling system in accordance with railroad regulations if freezing conditions are possible.

If neither the crankcase pressure nor the low water pressure detector has tripped, and engine oil level is satisfactory with a hot engine condition apparent, do not attempt to restart the engine. Report engine shutdown circumstances to maintenance personnel.

OVERSPEED MECHANISM

An overspeed mechanism is provided to stop injection of fuel into the cylinders should engine speed become excessive. This will result in immediate shutdown of the engine and a no battery charge/ no power alarm.

To reset mechanism, move trip reset lever, Fig. 2-26, counterclockwise until it resets.

MISCELLANEOUS DEVICES

MANUAL SHUTTER CONTROL VALVE

During normal operation this valve, Fig. 2-24, is in the OPERATION position. In this position the cooling control system automatically opens and closes the cooling system shutters, depending on conditions.
In an emergency, the shutters may be opened manually by moving the shutter control valve to the TEST position.

AUTO. DRAIN COLD WATER FILL SWITCH

Operating this pushbutton switch, Fig. 2-24, disarms the automatic cooling system drain circuit. (Pushbutton switch and drain circuit are special equipment.) If automatic drain valve is open, operating the switch causes the valve to close, enabling the cooling system to be refilled.

NOTE

Automatic cooling system drain circuit remains disarmed, that is, it will not protect the cooling system against freezing after cold water fill pushbutton is operated, until fuel prime/engine start switch is turned to the START position.

POWER REDUCTION CONTROLS (IF PROVIDED)

These controls, Fig. 2-28, if provided, are located on the operator's control stand.

NOTE

A 5 MPH limit on power reduction is built into the control system. On special order, the 5 MPH limit is deleted.

POWER REDUCTION INDICATOR LIGHT

The power reduction indicator light is on only when the power reduction toggle switch is in the **LOCAL** or the TRAINLINE position, which means that the setting of the power reduction rheostat on the same unit is affecting traction power. The indicator light is off when the toggle switch is OFF. See previous NOTE.

POWER REDUCTION TOGGLE SWITCH

When the power reduction toggle switch is in the LOCAL position, the power reduction rheostat on that unit controls power reduction only on that unit. However, the LOCAL position of the toggle switch does not prevent power reduction on that unit from being controlled by another unit's power reduction circuit.

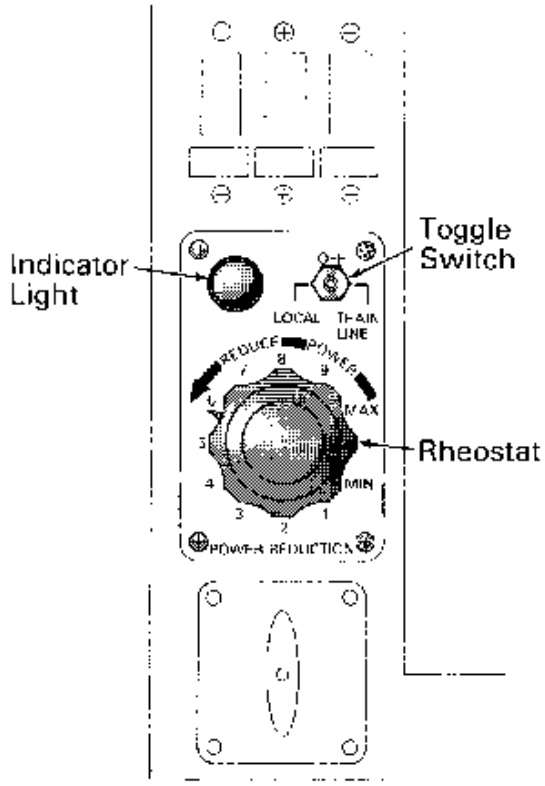


Fig.2-28 - Power Reduction Controls (If Provided)

When the power reduction toggle switch is in the TRAINLINE position, the power reduction rheostat on that unit controls power reduction on that unit and on the other units in the consist.

NOTE

If the power reduction toggle switch on any unit of a consist is in the TRAINLINE position, the power reduction toggle switches on all the other consist units should be in the OFF position. See previous NOTE.

When the power reduction toggle switch is in the OFF position, the power reduction rheostat on that unit has no effect. If the unit is part of a consist, the OFF position of the switch prevents that unit's power reduction rheostat from interfering with the controlling unit.

POWER REDUCTION RHEOSTAT

When activated by the LOCAL or the TRAINLINE position of the power reduction toggle switch, the power reduction rheostat overrides the power level called for by the throttle. For example, if the rheostat is set to reduce power by 1 / 3, it will do so in each throttle position. When set in the MAX position, fully clockwise, the rheostat permits normal power in each throttle position. See note under Power Reduction Controls.

SPOTTER CIRCUIT (IF SO EQUIPPED)

The spotter circuit is used to move the locomotive a slight distance. Battery voltage is applied to two traction motors in series when both spotter switches are operated simultaneously. The Isolation switch must be in RUN and the alarm bell will ring while the circuit is in operation.

SECTION 3

OPERATION

INTRODUCTION

This section covers recommended procedures for operation of the locomotive. The procedures are briefly outlined and do not contain detailed explanation of equipment location or function.

PREPARATION FOR SERVICE

GROUND INSPECTION

Check for the following:

1. Leakage of fuel oil, lube oil, water, or air.
2. Loose or dragging parts.
3. Proper hose connections between units in multiple.
4. Proper positioning of all angle cocks and shut-off valves.
5. Air cut in to truck brake cylinders.
6. Satisfactory condition of brake shoes.
7. Fuel supply.
8. Proper installation of control cables between units.

LEAD UNIT CAB INSPECTION

On the lead or control unit, the control locations described in Section 2 should be checked and the equipment positioned for operation as follows:

FUSE AND SWITCH PANEL

1. Main battery switch closed.

2. All fuses installed and in good condition, and of correct rating as indicated on panel.

CIRCUIT BREAKER PANELS

1. All breakers in the black area of the panels in on position.

2. If automatic cooling system drain circuit (if so equipped) is to protect cooling circuit against freezing after next engine shut-down. WATER DRAIN circuit breaker must be on.

3. Other circuit breakers on as required.

4. At the No. 2 circuit breaker panel, verify that the ground relay cutout switch is closed.

ENGINE CONTROL PANEL

1. Isolation switch in START position.

2. Headlight control switch in proper position for lead unit operation.

3. Dynamic brake cutout switch (if equipped), in DYN. BRAKE (up) position.

4. Miscellaneous switches positioned as required.

5. Remote traction motor cutout switch (if equipped), in MOTORS ALL IN position.

NOTE

The electrical cabinet is pressurized with filtered air. Cabinet doors must be securely closed during locomotive operation.

OPERATOR'S CONTROL STAND

Switches and operating handles on the control stand should be positioned as follows:

1. Place control and fuel pump switch in on (up) position.

2. Place engine run switch and the generator field switches in the off (down) position.

3. If equipped with power reduction circuit, set power reduction toggle switch to OFF position.

4. Light and miscellaneous switches positioned as desired.

5. Move throttle handle to IDLE and dynamic brake handle to OFF position. Position reverser handle to neutral and remove.

26L AIR BRAKE EQUIPMENT

1. Insert automatic brake valve handle (if removed) and place in SUPPRESSION position. This will nullify the application of any safety control equipment used.

2. Insert independent brake valve handle (if removed) and move to FULL APPLICATION position.

3. Position cut-off valve to IN position. On units equipped with a three position cut-off valve, position valve to either FRT or PASS depending on make-up of train.

4. Place multiple unit valve, Fig. 2-11, located at lower left side of control stand in LEAD OR DEAD or in OPEN IN LEAD OR DEAD position as indicated at the valve handle.

STARTING THE DIESEL ENGINE

After the following inspections having been completed, the diesel engine may be started.

ENGINEROOM INSPECTION

The engineroom equipment can be inspected and operated by opening the access doors along the sides of the locomotive long hood.

1. Check air compressor for proper lube oil supply.

2. Check that water level, in water tank sight glass, is near the FULL (ENGINE DEAD) mark on the water level instruction plate.

NOTE

Water level should be rechecked when engine is running. Level should be near FULL (ENGINE RUNNING) mark.

3. Check all valves for proper positioning.

4. Observe for leakage of fuel oil, lube oil, water, or air.

ENGINE INSPECTION

The engine should be inspected before as well as after starting.

1. Check that overspeed mechanism is set.

2. Check that the governor low oil pressure trip plunger is set, and that oil is visible in the governor sight glass.

3. Check that the crankcase (oil pan) pressure and low water pressure detector reset buttons are set (pressed in). If either button protrudes, press and hold button for 5 seconds immediately after engine starts.

4. Check that engine top deck, air box and oil pan inspection covers are in place and are securely closed.

5. Check sight gauge on lube oil filter tank. If gauge is full, proceed to Step 6. If gauge is empty, make certain that oil strainer housing is full. The oil level should be maintained up to the overflow outlet of the housing.

6. Pull out oil level gauge (dipstick) from side of engine oil pan. Oil gauge should be coated with lube oil.

NOTE

A properly filled lube oil system will coat the oil gauge above the FULL mark when the engine is stopped. To obtain an accurate check, recheck level, when the engine is idling and at normal operating temperature.

ENGINE STARTING

After the preceding inspections have been completed, the diesel engine may be started. Close engineroom doors after engine start.
Perform the following:

NOTE

If engine water temperature is 10° C (50° F) or less, preheat engine before attempting to start. Prelube engine if it has been shut down more than 48 hours. Refer to Engine Maintenance Manual for prelube procedures.

1. Open cylinder test cocks and bar over the engine at least one revolution. Observe for leakage from test cocks. Close test cocks.

NOTE

Leakage from cylinder test cocks indicates a problem within the engine. Notify maintenance personnel.

2. Check that all fuses are installed and in good condition, and of the correct rating as indicated on panel. Verify that the main battery and ground relay cutout switches are closed.

3. At the circuit breaker panels, check that all breakers in the black areas are in the on position.

4. At the operator's control stand, make certain that the generator field and engine run switches are off (down). Verify that the control and fuel pump switch is on (up).

NOTE

When starting trailing unit diesel engines and control cables have been connected between units, the control and fuel pump switch should remain off.

5. At the engine control panel, verify that the isolation switch is in the START position.

6. At the equipment rack, place the fuel prime/ engine start switch in the FUEL PRIME position until fuel flows in the return fuel sight glass, Fig. 3-1, clear and free of bubbles (normally 10 to 15 seconds).

CAUTION

On units equipped with engine purge control system, do not push injector control lever until engine has cranked for 6 seconds.

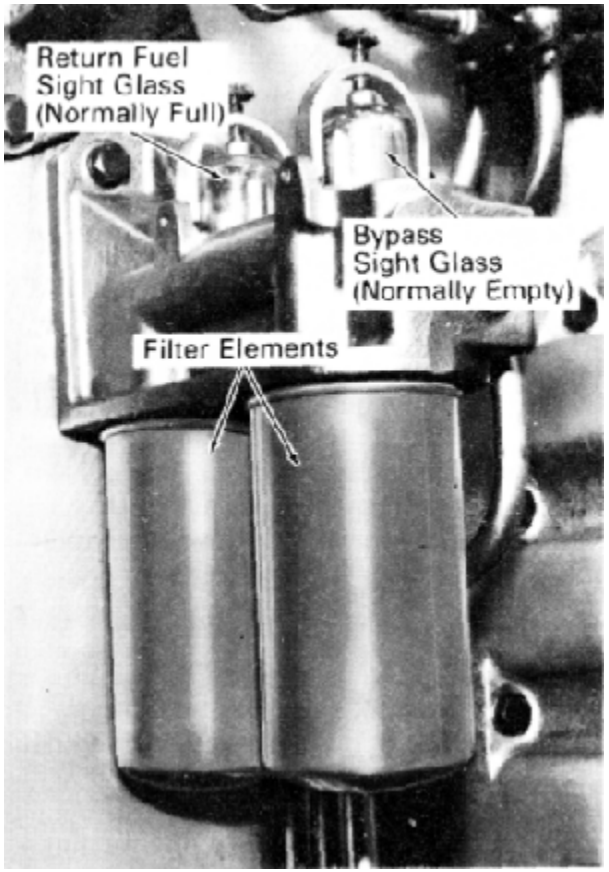


Fig-3-1 - Fuel Oil Sight Glasses

7. Position injector control lever (layshaft) at about one-third rack (about 1.6 on the governor scale), except units equipped with engine purge control system. Move the fuel prime/engine start switch to ENGINE START position. Hold the switch in this position until the engine fires and speed increases, but not more than 20 seconds.

CAUTION

Starter motors should not be allowed to crank engine for more than 20 seconds. If engine fails to start after 20 seconds have elapsed, allow 2 minutes for starter cooling.

8. Release injector control lever when engine comes up to idle speed. Do not advance lever to increase speed until oil pressure is confirmed.

NOTE

Engine water inlet temperature should be allowed to reach 120° F at idle before load is applied.

9. Check low water pressure detector reset button after engine starts. If tripped, press button to reset detector. The engine will shut down after a short time delay if the detector is not reset.

NOTE

If the detector is difficult to reset after engine starts, confirm oil pressure, then position the injector control lever (layshaft) to increase engine speed for a short time, and press the reset button.

10. Check the following with the engine running and at normal operating temperature.

    a. Coolant level is near the FULL (ENGINE RUNNING) mark on the water level instruction plate.

    b. Lube oil level is near the FULL mark on oil level gauge (dipstick).

    c. Governor oil level.

    d. Compressor lube oil level.

TRAILING UNIT CAB INSPECTION

Switches, circuit breakers, and controls located in the cab of a trailing unit should be checked for proper positioning as follows:

FUSE AND SWITCH PANEL

1. Main battery knife switch closed.

2. Fuses installed and in good condition, and of correct rating as indicated on panel.

CIRCUIT BREAKER PANELS

1. All breakers in the black area of the circuit breaker panels in on position.

2. If automatic cooling system drain circuit, special, is to protect cooling system against freezing after next engine shutdown, WATER DRAIN circuit breaker must be on.

3. Other circuit breakers on as required.

4. At the No. 2 circuit breaker panel, verify that the ground relay cutout switch is closed.

ENGINE CONTROL PANEL

I. Isolation switch in START position.

2. Headlight switch in proper position to correspond with unit position in the consist.

3. Dynamic brake cutout switch (if equipped), in DYN. BRAKE position.

4. Miscellaneous switches positioned as required.

5. Remote traction motor cutout switch (if equipped), in MOTORS ALL IN position.

NOTE

The electrical cabinet is pressurized with filtered air. Cabinet doors must be securely closed during locomotive operation.

OPERATOR'S CONTROL STAND

Switches and operating handles on the control stand should be positioned as follows:

1. Control and fuel pump switch, generator field switch, and engine run switch must be off.

2. Move throttle to IDLE and dynamic brake handle to OFF position. Position reverser handle to neutral and remove to lock other handles.

3. If equipped with power reduction circuit, set power reduction toggle switch of OFF position.

4. Light and miscellaneous switches positioned as desired.

26L AIR BRAKE EQUIPMENT

1. Place automatic brake valve handle in HANDLE OFF position. Remove handle (if so equipped).

2. Place independent brake valve handle in RELEASE position. Remove handle (if so equipped).

3. Place cut-off valve to OUT position.

4. Place multiple unit valve in TRAIL or in CLOSED IN TRAIL position as indicated at the valve handle.

STARTING TRAILING UNIT DIESEL ENGINES

Engines in trailing units are started in the same manner as the engine in the lead unit. Refer to "Starting The Diesel Engine" portion of this section.

NOTE

If control jumper cables are already connected between units, ensure that the control and fuel pump, generator field, and engine run switches are off. This will allow these systems to be controlled from the lead unit.

PLACING UNITS ON THE LINE

After the diesel engines are started and inspected, units may be placed on the line as desired by placing the isolation switch on the engine control panel in the cab in the RUN position. If the consist is at a standstill, be certain that the throttle handle in all units is in the IDLE position before placing any unit on the line.

PRECAUTIONS BEFORE MOVING LOCOMOTIVE

The following points should be carefully checked before attempting to move the locomotive under its own power:

1. Make sure that main reservoir air pressure is normal. This is very important, since the locomotive is equipped with electromagnetic switchgear which will function in response to control and permit operation without air pressure for brakes.

2. Check for proper application and release of air brakes.

3. Release hand brake and remove any blocking under the wheels.

CAUTION

It is desirable that engine water temperatures be 49° C (120° F) or higher before full load is applied to the engine. After idling at ambient temperature below -18° C (0° F), increase to full load level should be made gradually.

HANDLING LIGHT LOCOMOTIVE

With the engine started and placed "on-the-line" and the preceding inspections and precautions completed, the locomotive is handled as follows:

1. Place the engine run switch and generator field switch in on (up) position.

2. Place headlight and other lights on as needed.

3. Insert reverser handle and move it to the desired direction of travel, either forward or reverse.

4. Release air brakes.

5. Open throttle to position No. 1, 2, or 3 as needed to move locomotive at desired speed.

NOTE

Locomotive response to throttle movement is almost immediate. There is little delay in power buildup.

6. Throttle should be in IDLE before coming to a dead stop.

7. Reverser handle should be moved to change direction of travel only when locomotive is completely stopped.

DRAINING AIR RESERVOIRS AND STRAINERS

The air reservoirs and air strainers or filters should be drained periodically whether or not equipment is provided with automatic drain valves. Follow the maintenance schedule established by the railroad.

COUPLING LOCOMOTIVES TOGETHER

When coupling units together for multiple unit operation, the procedure below should be followed:

1. Couple and stretch units to ensure couplers are locked.

2. Install control cable between units.

3. Attach platform safety chains between units.

4. Perform ground, engineroom, and engine inspections, as outlined in preceding articles.

5. Position cab controls for trailing unit operation as outlined in preceding articles. Remove reverser handles from all controllers to lock controls.

6. Connect air brake hoses between units.

7. Open required air hose cutout cocks on each unit. 8. Make a setup of the brakes on the consist to determine if brakes apply on each unit. Brakes then must be released to determine if all brakes release. The same procedure must be followed to check the independent brake application. Also, release an automatic service application by depressing the independent brake valve handle down. Inspect all brakes in the consist to determine if they are released.

COUPLING UNITS TOGETHER FOR DYNAMIC BRAKING

The locomotive, when equipped with basic dynamic brakes, makes use of electrical potential from the brake control rheostat to control braking strength by controlling excitation of the main generator field. This electrical potential is impressed upon a trainlined wire to control dynamic braking strength of all units in a consist equipped with potential line brake control. However, the total braking effort of a multi-unit consist can become quite high. Carefully observe railroad rules regarding multiple unit dynamic braking in critical service.

COUPLING LOCOMOTIVE TO TRAIN

Locomotive should be coupled to train using the same care taken when coupling units together. After coupling, make the following checks:

1. Test to see that couplers are locked by stretching connection.

2. Connect air brake hoses.

3. Slowly open air valves on locomotive and train to cut in brakes.

4. Pump up air using the following procedure.

PUMPING UP AIR

After cutting in air brakes on train, note the reaction of the main reservoir air gauge. If pressure falls below trainline pressure, pump up air as follows:

1. Place generator field switch in off position.

2. Move reverser handle to neutral position.

3. Open throttle as needed to speed up engine and thus increase air compressor output.

NOTE

Throttle may be advanced to No. 5 if necessary. Engine should not, however, be run unloaded (as in pumping air) at speeds beyond throttle No. 5 position.

BRAKE PIPE LEAKAGE TEST

Prior to operating the 26L brake equipment, a leakage test must be performed. Brake pipe leakage tests should be made in accordance with the railroad operating rules and Power Brake Law.

STARTING A TRAIN

The method to be used in starting a train depends upon many factors such as, the type, weight and length of the train and amount of slack in the train; as well as the weather, grade and track conditions. Since all of these factors are variable, specific train starting instructions cannot be provided and it will therefore be up to the operator to use good judgment in properly applying the power to suit "requirements. There are, however, certain general considerations that should be observed. They are discussed in the following paragraphs.

A basic characteristic of the diesel locomotive is its high starting tractive effort, which makes it imperative that the air brakes be completely released before any attempt is made to start a train. It is therefore important that sufficient time be allowed after stopping, or otherwise applying brakes, to allow them to be fully released before attempting to start the train.

The locomotive possesses sufficiently high tractive effort to enable it to start most trains without taking slack. The practice of taking slack

indiscriminately should thus be avoided. There will, however, be instances in which it is advisable (and sometimes necessary) to take slack in starting a train. Care should be taken in such cases to prevent excessive locomotive acceleration which will cause undue shock.

Proper throttle handling is important when starting trains since it has a direct bearing on the power being applied. As the throttle is advanced, a power increase occurs almost immediately, and power applied is at a value dependent upon throttle position. It is therefore advisable to advance the throttle one notch at a time when starting a train. A train should be started in as low a throttle position as possible, thus keeping the speed of the locomotive at a minimum until all slack has been removed and the train completely stretched. Sometimes it is advisable to reduce the throttle a notch or two at the moment the locomotive begins to move in order to prevent stretching slack too quickly or to avoid slipping. When ready to start, the following general procedure is recommended.

1. Place isolation switch in RUN position.

2. Move reverser handle to the desired direction, either forward or reverse.

3. Place engine run and generator field switches in the on position.

4. Release both automatic and independent air brakes.

5. Open the throttle one notch every few seconds as follows:

   a. To No. 1 - Loading will stop at a specific low value. This may be noted on the load indicating meter. At an easy starting place the locomotive may start the train.

NOTE

The design of the locomotive power control system makes it generally unnecessary to apply locomotive independent brakes or to manipulate the throttle between position No. 1 and IDLE during starting.

   b. To No. 2, 3, or higher (experience and the demands of the schedule will determine this) until the locomotive moves.

6. Reduce throttle one or more notches if acceleration is too rapid.

7. After the train is stretched, advance throttle as desired.

NOTE

The wheel control system, operating in Super Series, reacts automatically to maximize tractive effort for any particular operating condition. These conditions include wet rails, oiled rails, and full throttle operation for maximum acceleration or climbing hills. The wheel control system is totally automatic and requires no operator action. Therefore the wheel slip light will never come on while in Super Series above 1.5 mph, unless a wheel overspeed, locked powered wheel, or Super Series failure condition exists.

ACCELERATING A TRAIN

After the train has been started, the throttle can be advanced as rapidly as desired to accelerate the train. The speed with which the throttle is advanced depends upon demands of the schedule and the type of locomotive and train involved. In general, however, advancing the throttle one notch at a time is desired to prevent slipping.

The load indicating meter provides the best guide for throttle handling when accelerating a train. By observing this meter it will be noted that the pointer moves toward the right (increased amperage) as the throttle is advanced. As soon as the increased power is absorbed, the meter pointer begins moving toward the left. At that time, the throttle may again be advanced. Thus for maximum acceleration without slipping, the throttle should be advanced one notch each time the meter pointer begins moving toward the left until full power is reached in throttle position No. 8.

A short time operation nameplate is located directly beneath the load current indicating meter.

AIR BRAKING WITH POWER

The method of handling the air brake equipment is left to the discretion of the individual railroad. However, when braking with power, it must be remembered that for any given throttle position, the draw bar pull rapidly increases as the train speed decreases. This pull might become great enough to part the train unless the throttle is reduced as the train speed decreases. Since the pull of the locomotive is indicated by the amperage on the load meter, the operator can maintain a constant pull on the train during a slow down by keeping a steady amperage on the load meter. This is accomplished by reducing the throttle a notch whenever the amperage starts to increase. It is recommended that the independent brakes be kept fully released during power braking. The throttle must be in IDLE before the locomotive comes to a stop.

OPERATING OVER RAIL CROSSING

When operating the locomotive at speeds exceeding 25 MPH, reduce the throttle to No. 4 position at least eight seconds before the locomotive reaches a rail crossing. If the locomotive is operating in No. 4 position or lower, or

running less than 25 M PH, allow the same interval and place the throttle in the next lower position. Advance the throttle after all units of the consist have passed over the crossing. This procedure is necessary to ensure decay of motor and generator voltage to a safe level before the mechanical shock that occurs at rail crossings is transmitted to the motor brushes.

RUNNING THROUGH WATER

Under absolutely no circumstances should the locomotive be operated through water deep enough to touch the bottom of the traction motors. Water any deeper than 3" above the rail is likely to cause traction motor damage. When passing through any water on the rails, exercise every precaution under such circumstances and always go very slowly, never exceeding 2 to 3 MPH.

WHEEL CONTROL SYSTEM

The starting wheel slip system consists of electronic circuits separate from the Super Series wheel control system. The starting wheel slip system provides a backup for the Super Series system in the event of Super Series failure. If all conditions are present for Super Series operation, the locomotive will automatically switch into Super Series operation.

The starting wheel slip system is a modified rate-ofchange corrective type system. It reacts to the severity of the wheel slip by smoothly reducing power and applying sand. Depending upon the severity of the slipping condition, the wheel slip light may or may not flash on and off as the slip is corrected. This system is an improvement over past corrective type wheel slip system however it is not as sophisticated as the Super Series system.

The Super Series system is not a corrective type wheel slip system. It is a wheel control system which allows each traction motor to seek maximum tractive effort. In some cases this involves allowing the wheels to creep (rotate at a slightly faster than ground speed) while being controlled. Under severe rail conditions sand may be applied automatically along with smooth power control. The WHEEL SLIP light will not come on during wheel control while the locomotive is in Super Series.

LOCOMOTIVE SPEED LIMIT

The maximum speed at which the locomotive can be safely operated is determined by the gear ratio. This ratio is expressed as a double number such as 70:17. The 70 indicates the number of teeth on the axle gear while the 17 represents the number of teeth on the traction motor pinion gear.

Since the two gears are meshed together, it can be seen that for this particular ratio the motor armature turns approximately four times for a single revolution of the driving wheels. The locomotive speed limit is therefore determined by the maximum permissible rotation speed of the motor armature. Exceeding this maximum could result in serious damage to the traction motors.

Although not basically applied, overspeed protective equipment is available for installation on locomotives. The equipment consists of an electro-pneumatic arrangement with many possible variations to suit specific requirements. In general, however, an electrical switch in the speed recorder is used to detect the overspeed. This switch in turn inititates certain air brake functions which reduce the train speed.

MIXED GEAR RATIO OPERATION

If the units of the consist are of different gear ratios, the locomotive should not be operated at speeds in excess of that recommended for the unit having the lowest maximum permissible speed. Similarly, operation should never be slower than the minimum continuous speed (or maximum motor amperage) for units having established short time ratings.

To obtain a maximum tonnage rating for any single application, Electro-Motive will, upon request, analyze the actual operation and make specific tonnage rating recommendations.

DYNAMIC BRAKING

WARNING

The dynamic brake system is disconnected when operating with a traction motor cut out.

Dynamic braking, on locomotives so equipped, can prove extremely valuable in retarding train speed in many phases of locomotive operation. It is particularly valuable while descending grades, thus reducing the necessity for using air brakes.

Maximum braking strength is obtained at a specific speed, depending on locomotive gear ratio. Basic locomotives equipped with 70:17 gear ratio, obtain maximum braking strength at approximately 29 MPH. At train speeds higher than the optimum, braking effectiveness gradually declines as speed increases. For this reason, it is important that dynamic braking be started BEFORE train speed becomes excessive. While in dynamic braking, the speed of the train should not be allowed to "creep" up by careless handling of the brake.

To operate dynamic brakes, proceed as follows:

1. The reverser handle must be positioned in the direction of the locomotive movement.

2. Return throttle to idle and hold it in idle for 10 seconds before proceeding.

WARNING

The 10 seconds delay must be accomplished before the braking handle is moved into SET UP position. This delay occurs automatically when the throttle is placed in idle.

It is possible for a sudden surge of braking effort to occur if the dynamic braking handle is open when the automatic delay times out.

3. Move the braking handle into SET UP position. This establishes the dynamic braking circuits. It will also be noted that a slight amount of braking effect occurs, as evidenced by the load current indicating meter.

4. After the slack is bunched, the dynamic braking handle is moved to control dynamic braking strength.

NOTE

When the dynamic brake handle is advanced out of SET UP, the control system sets engine speed to ensure sufficient cooling air for the traction motors.

5. Braking effort may be increased by slowly advancing the handle to FULL 8 position if desired. Maximum braking current can occur over a wide range of braking handle positions. This range allows braking effort to increase as train speed increases. The tendency is to hold train speed relatively constant for a given braking handle position when conditions result in less than the maximum allowable current.

NOTE

On units equipped for "Grid Current Trainline Control" of dynamic braking, current is limited by dynamic brake handle position, with maximum grid current obtainable only when the brake handle is in the FULL 8 position. Braking current will generally be at or near the maximum obtainable at the given handle position, and the tendency for train speed to hold steady for a given handle position is not as effective as with the basic dynamic brake.

6. With automatic regulation of maximum braking strength, the brake warning light on the controller should seldom give indication of excessive braking current. If the brake warning light does flash on however, stop advancing the braking handle until the light goes out.

7. If the light fails to go out after several seconds, move the braking handle back slowly until the light does go out. After the light goes out, the handle may again be advanced to increase braking effort.

NOTE

The brake warning light circuit is "trainlined" so that a warning will be given in the lead unit if any unit in the consist is generating excessive current in dynamic braking. Thus regardless of the load `indicating meter reading or braking handle position (which may be less than maximum), whenever the warning light comes on, it should not be allowed to remain on for any longer than two or three seconds before steps are taken to reduce braking strength. If brake warning indications are repeated, the locomotive should be taken out of dynamic braking and the dynamic brake cutout switch on the engine control panel of the affected unit should be placed in CUTOUT position. The locomotive consist will then operate normally under power and during dynamic braking, but with reduced total braking effort.

8. When necessary, the automatic brake may be used in conjunction with the dynamic brake. However, the independent brake must be KEPT FULLY RELEASED whenever the dynamic brake is in use, or the wheels may slide. As the speed decreases the basic dynamic brake becomes less effective. When the speed further decreases, it is permissible to completely release the dynamic brake by placing the handle in OFF position, applying the independent brake simultaneously to prevent the slack from running out.

CAUTION

When operating in dynamic brake, an air brake application caused by an emergency or safety control condition will disconnect the dynamic brake system.

The locomotive can be operated in dynamic braking when coupled to older units that are not equipped with brake current limiting regulators. If all the units are of the same gear ratio, the unit having the lowest maximum brake current rating should be placed as the lead unit in the consist. The operator can then operate and control the braking effort up to the limit of the unit having the lowest brake current rating, without overloading the dynamic brake system of a trailing unit. The locomotive consist M U ST always be operated so as not to exceed the braking current of the unit having the lowest maximum brake current rating.

Units equipped with dynamic brake current limiting regulators can be operated in multiple with other locomotives in dynamic braking regardless of the gear ratio or difference in the maximum brake current ratings.

DYNAMIC BRAKE WHEEL SLIP CONTROL

During dynamic braking, each series group of two traction motors is connected in parallel with each dynamic braking resistor grid circuit and with the other series connected traction motors. With this arrangement, when a wheel slips it may be motored by other motors in the system. This in effect makes a wheel slip during dynamic braking somewhat self correcting. However, the parallel arrangement of dynamic braking resistor grids and traction motors is such that the full response of the wheel slip control system is available during braking as w e l l as during power operation. The precise and -immediate regulation maintained, plus the motoring effect created by the parallel arrangement, provides extremely stable dynamic brake operation.

In addition to the above, a bridge circuit is employed to protect against the possibility of simultaneous slips that otherwise may not be detected. When a pair of wheels is detected tending to rotate at a slower speed, the retarding effort of the traction motors in the unit affected is reduced (traction alternator field excitation is reduced in the unit affected) and sand is automatically applied to the rails. When the retarding effort of the traction motors in the unit is reduced, the tendency of the wheel set to rotate at a slower speed is overcome. After the wheel set resumes normal rotation, the retarding effort of the traction motors returns (increases) to its former value. Automatic sanding continues for 3 to 5 seconds after the wheel slide tendency is corrected.

OPERATION IN HELPER SERVICE

Basically, there is no difference in the instructions for operating the locomotive as a helper or with a helper. In most instances it is desirable to get over a grade in the shortest possible time. Thus, wherever possible, operation on the grades should be in the full throttle position. The throttle can be reduced, however, where wheel slips cause lurching that may threaten to break the train.

ISOLATING A UNIT

When the occasion arises where it becomes advisable to isolate a locomotive unit, observe the following:

1. When operating under power in a multiple unit consist, a unit may be isolated at any time, but discretion as to timing and necessity should be used.

2. When operating in dynamic braking, it is important to get out of dynamic braking before attempting to isolate the unit. This is done by reducing the braking handle to OFF. The isolation switch can then be moved to ISOLATE position to eliminate the braking on that unit. If the braking is resumed, other units will function normally.

CHANGING OPERATING ENDS

When the locomotive consist includes two or more units with operating controls, the following procedure is recommended in changing from one operating end to the opposite end on locomotives equipped with 26L brakes.

ON END BEING CUT OUT

1. Move the automatic brake valve handle to service position and make a 20-pound reduction.

2. After brake pipe exhaust stops, place cut-off valve in OUT position by pushing knob in and turning to the desired position.

3. Place independent brake handle in fully released position.

4. Place multiple unit valve in TRAIL or in CLOSED IN TRAIL position as indicated at the valve handle.

5. Position the automatic brake valve handle in the handle off position.

6. With dynamic brake handle in OFF position and throttle in IDLE, place the reverser handle in neutral position and remove to lock the controls.

7. Place all switches in the off position. Be absolutely certain that the control and fuel pump switch, generator field switch, and engine run switch are in the off position.

8. At the engine control panel, place headlight control switch in proper position for trailing unit operation. Place other switches on as needed.

9. At the circuit breaker panels, all circuit breakers in the black areas are to remain in the on position. 10. After completing the operations outlined in the preceding steps, move to the cab of the new lead unit.

ON END BEING CUT IN

1. At the control stand, make certain the generator field switch is off.

2. Insert reverser handle and leave in neutral position.

3. Place automatic brake valve handle in suppression position to nullify any safety control, overspeed, or train control used.

4. Insert independent brake valve handle (if removed) and move handle to full independent application position.

5. Position cut-off valve to IN position. On units equipped with a three position cut-off valve, position valve to either FRT or PASS depending on make-up of train.

6. Place dual ported cutout cock in OPEN IN LEAD or DEAD position.

7. At the circuit breaker panels, check that all circuit breakers in the black areas are in the on position.

8. At the engine control panel, place the headlight control switch in proper position, and other switches on as needed.

9. Place the engine run, control and fuel pump, and generator field switch in on position. Other switches may be placed on as needed.

STOPPING ENGINE

There are six ways to stop the engine:

1. Press stop button on engine control panel.

2. Press emergency fuel cut-off button. Emergency fuel cut-off pushbuttons are located near each fuel filter opening. These pushbuttons operate in the same manner as the stop button and need not be held in nor reset.

3. Use injector control lever.

   The injector control lever can be operated to override the engine governor and move the injector racks to the no fuel position.

4. Close the low water detector test cock.

   When the low water detector trips, oil is dumped from the governor low oil shutdown device, stopping the engine.

5. Use throttle handle.

   To stop all engines "on-the-line" in a consist simultaneously from the cab of the lead unit, move the throttle to the IDLE position, pull the handle out and away from the controller, and move it beyond IDLE to the STOP position.

6. Pull out low oil shutdown plunger on the side of the governor.

FREEZING WEATHER PRECAUTIONS

As long as the diesel engine is running, the cooling system will be kept adequately warm regardless of ambient (outside) temperatures encountered. It is only when the ;engine is shut down or stops for any reason that the cooling system requires protection against freezing.

Whenever the engine is shut down, and freezing temperatures are possible, the cooling system, as well as the flush toilet and the water cooler, if so equipped, should be drained or otherwise protected from freezing. The automatic cooling system drain circuit, if provided, will protect the cooling system.

DRAINING THE COOLING SYSTEM (BASIC)

When necessary to drain system, open engine water drain valve located at the pit between the engine and accessory rack. This valve will drain the engine, water tank, water cooled air compressor and associated piping.

CAUTION

If a hot engine is drained, always allow the engine to cool before refilling with coolant.

AUTOMATIC COOLING SYSTEM DRAIN CIRCUIT (IF SO EQUIPPED)

If the circuit is armed, it will activate the automatic drain valve in freezing temperatures to protect the engine and air compressor cooling systems. If the circuit is not armed, and both the battery knife switch and the CONTROL circuit breakers are closed, the WATER DRAIN light on the engine control panel will be on and the alarm bell will be sounding. To manually drain the system, use the manual drain valve, not the test switch on the automatic valve. Both valves are located in the pit between the engine and the accessory rack.

To arm the circuit for automatic operation, proceed as follows.

1. Engine should be stopped. If you do not want the engine to start during this procedure, open the battery knife switch.

2. Close the WATER DRAIN circuit breaker.

3. Turn the fuel prime/ engine start switch to the ENGINE START position for a moment. Circuit should be armed.

4. Open and close the automatic drain valve by momentarily operating the test switch on the valve. Valve operation indicates successful circuit arming. Repeat Step 3 if valve does not operate.

5. Open the battery knife switch and CONTROL circuit breaker unless they should remain closed for some other reason.

   The WATER DRAIN circuit breaker must remain closed and the AUTO. DRAIN COLD WATER FILL switch on the AC cabinet must not be operated as long as the circuit is to remain armed.

To, override the automatic cooling system drain circuit and close the automatic drain valve, press the AUTO. DRAIN COLD WATER FILL pushbutton switch on the side of the AC cabinet. Alarm bell will sound and WATER DRAIN light will go on.

CAUTION

Allow a hot engine to cool down before refilling the cooling system.

After completing refill of cooling system and warming up engine, re-arm the circuit by following the previous procedure.

DRAIN FLUSH TOILET (IF SO EQUIPPED)

1. Flush toilet until all water has drained from tank.

2. Turn off electric toilet tank heater (if so equipped).

3. Remove pipe plug from bottom of toilet flush piping.

DRAIN WATER COOLER (IF SO EQUIPPED)

1. Remove and empty water bottle.

2. Drain remaining water in cooler by holding in the spigot button.

3. Turn off electric power to water cooler (if so equipped).

TOWING LOCOMOTIVE IN TRAIN

When a locomotive unit equipped with 26L air brakes is placed within a train consist to be towed, control and air brake equipment should be set as follows:

1. Drain all air from main reservoirs and air brake equipment unless engine is to remain idling.

2. Place the multiple unit valve in LEAD OR DEAD or in OPEN IN LEAD OR DEAD position as indicated at the valve handle.

3. Place cut-off valve in OUT position.

4. Place independent brake valve handle in release position.

5. Place automatic brake valve handle in handle off position.

6. Cut in dead engine feature by turning cutout cock, Fig. 2-8, to open (90° to pipe) position. Dead engine cock is located beneath cab floor and may be reached through an access door of locomotive.

7. If engine is to remain idling, switches should be positioned as follows:

   a. Isolation switch in START position.

   b. Battery switch and ground relay cutout switch closed.

   c. Generator field circuit breaker OFF.

   d. All breakers in black areas of circuit breaker panels in ON position.

   e. Starting fuse should be removed. Other fuses should be left in place.

   f. Control and fuel pump switch on (up).

   g. Fuel pump circuit breaker ON.

   h. Throttle in IDLE, dynamic brake handle in OFF position. Remove reverser handle from controller to lock the controls.

8. If a locomotive is to be towed dead in a consist, switches should be positioned as follows:

   a. Battery switch open.

   b. All circuit breakers OFF.

   c. All control switches OFF.

   d. Starting fuse removed.

   e. Throttle in IDLE, dynamic brake handle in OFF position.

Remove reverser from controller to lock the controls.

NOTE

If there is danger of freezing, the engine cooling system should be drained. Refer to Freezing Weather Precautions.

LEAVING LOCOMOTIVE UNATTENDED

If at any time it is necessary to leave the locomotive unattended while the engine is running, the following procedure should be adhered to.

1. Observe all railroad safety precautions.

2. Place engine run and generator field switches in the off (down) position.

3. Place throttle in IDLE and dynamic brake handle in OFF position. Remove reverser handle from controller to lock the controls.

SECTION 4

TROUBLESHOOTING

INTRODUCTION

This section covers operational problems that may occur on the road and suggests action that may be taken by the operator in response to the trouble.

Safety devices automatically protect equipment in case of faulty operation of almost any component. In general this protection is obtained by one of the following methods.

1. Complete shutdown of the diesel engine, or complete elimination of a function such as dynamic braking. .

2. Unloading of the diesel engine and restriction to idle engine speed. In some instances manual resetting of the function may be necessary, or automatic resetting after a time delay may be provided.

3. Rough back-up regulation for protection of equipment.

NOTE

Indicator light designations are written as they are given on basic units with the designations of special equipment in parentheses.

Condition	Probable Cause	Suggested Operator's Response
Lead unit engine shutdown.	Engine overspeed shutdown.	Move the throttle handle to IDLE. Reset the overspeed device. Refer to Fig. 2-26. Restart engine. If the engine overspeed device shuts the engine down again, then do not attempt to restart the engine.
	Main generator bearing failure.	Maintenance personnel can confirm this condition by inspecting the BDR relay (if so equipped) on the main panel inside- the high voltage control cabinet. If the BDR light is on, then a main generator bearing failure has occurred and engine starting is prevented.
Lead unit HOT ENGINE (HOT ENG) light on; alarm bell ringing; engine running but engine speed and power reduced (unless equipped with reduced power nullification).	Temporary operating condition is more likely to occur during tunnel or desert operation.	No action unless alarm persists. If alarm continues for more than a few minutes, check that shutters are open and radiator blower motors are operating. Also check for proper coolant level. **CAUTION** If it is necessary to shut down the engine in freezing weather, the cooling system should be drained or otherwise protected to prevent freezing.
	Low coolant level.	The unit should be shut down if coolant level is low or if there are coolant leaks.
	Shutters not operating properly.	If shutters are closed, the manual shutter control valve may be incorrectly set to TEST position. The valve should be set to OPERATE position. The unit should be shut down if the shutters do not open.

Condition	Probable Cause	Suggested Operator's Response
	Radiator blower motors not operating.	If radiator blower motors are not operating, the 200-ampere fuses, located in the AC cabinet, may be open. The unit must be shut down before replacing the fuses. The unit should be shut down if the blower motors do not operate.
Lead unit H.V. GRD. FAULT (GRD RELAY) light on; alarm bell ringing.	Lead unit ground relay operation.	If unit is equipped with automatic ground relay reset, it will reset automatically within 10 seconds unless the total number of ground relay operations is excessive. If unit is not equipped with automatic ground relay reset, take no action for 10 seconds; then press the ground relay reset pushbutton on the control stand. The ground 'relay pushbutton should not be pressed more than three times within any consecutive 30 minute period. If ground relay operation is caused by traction motor flashover or weakened traction motor insulation, it may be possible to continue operation of the unit by cutting out the defective traction motor. The control circuits automatically reduce power of a unit having a traction motor cut out. The unit should be isolated and shut down if more than three ground relay operations occur within any consecutive 30 minute period or if the automatic ground relay reset device locks out.

Condition	Probable Cause	Suggested Operator's Response
Lead unit NO BATT.CHARGE NO POWER (NO POWER C H R G) light on; alarm bell ringing, engine at idle speed or shut down.	No companion alternator output voltage.	If the unit shuts down, check the 10-ampere AUX. GEN. FIELD circuit breaker and the 100-ampere AUXILIARY GENERATOR circuit breaker. Also check the engine over speed trip lever. Reset the circuit breaker or the engine overspeed trip lever and restart engine. If the overspeed trip lever or the circuit breakers trip again the unit should be isolated and shut down. If the unit remains at idle speed, check the 15-ampere AC CONTROL circuit breaker. If the above circuit breakers are not open and the engine overspeed trip lever is set, the unit should be isolated and shut down.
Lead unit GOVERNORSHUTDOWN (GOV DOWN) light on; alarm bell ringing; engine shut down.	Low water detector button tripped.	If both the HOT ENGINE (HOT ENG) and the GOVERNOR SHUTSHUT DOWN (GOV DOWN) lights are on, the unit should be isolated. Do not attempt to restart the engine. Report engine shutdown to authorized maintenance personnel. If the crankcase pressure detector button is set, but the low water detector button and the governor low oil plunger are tripped, per form thorough check of the following items. 1. Cooling water level satisfactory. 2. Cooling water temperature satisfactory. 3. No visible oil leaks or water leaks. 4. Governor oil level satisfactory. 5. Crankcase oil level satisfactory.

Condition	Probable Cause	Suggested Operator's Response
		If all items are normal, the engine may be restarted and placed on the line after resetting the low water detector button and the governor low oil shutdown plunger. If the GOVERNOR DOWN (GOV DOWN) light comes on again, the, unit should be isolated and shutdown.
	Hot or low oil.	If the low water detector button and the crankcase pressure detector button are set but the governor low oil plunger is tripped, do not attempt to restart the engine. Isolate the unit and notify authorized maintenance personnel.
	Crankcase pressure detector tripped.	**WARNING** If crankcase pressure detector has tripped, make no further engineroom inspections. Do not attempt to restart the engine. Isolate the unit. If freezing conditions are possible, drain the cooling system or otherwise protect the system from freezing.
Intermittent WHEEL SLIP light indications at speeds under 1-1/2 mph.		
WHEEL SLIP light on *continuously.* *Irregular flashing* WHEEL SLIP light indications at speeds over 1-1/2 mph in power.	Normal wheel slip correction under severe conditions.	No action required. Do not reduce throttle unless slipping is so severe that it threatens to break the train.
	Locked sliding wheels.	Check that all wheels on the locomotive rotate freely. Do not operate a locomotive unless all wheels rotate freely.
	Possible Super Series system failure.	No operator response. Locomotive will continue to operate on the backup wheel control system. Report condition to authorized maintenance personnel.

Condition	Probable Cause	Suggested Operator's Response
Cycling on and off of WHEEL SLIP light indications over 1-1 / 2 mph in power.	Wheel overspeed.	Reduce speed if overspeed is suspected.
Turbocharger auxiliary pump light on.	Normal condition for 35 minutes after engine start or stop.	No action necessary.
Turbocharger auxiliary pump light not on at engine start or stop.	Tripped turbo lube pump circuit breaker.	Notify authorized maintenance personnel.
PCS OPEN light on.	Penalty brake application.	**NOTE** Observe railroad regulations after any penalty or emergency brake application.
	Emergency brake application (on locomotive equipped for PCS to open upon emergency brake application).	To regain power, move throttle IDLE and automatic brake handle to suppression position, then to release.
Engine will not crank.	Circuit breakers or switches not in proper position.	Move throttle to idle. Move automatic brake handle to emergency position and wait 45 seconds, then move automatic brake handle to release position.
	EP module not operating properly, if equipped.	Refer to Section 3 for engine starting procedures. Bar the engine over one full revolution, then hold BYPASS switch on EP module closed while cranking engine.
	Immersion heater or external battery charging cables connected.	Disconnect immersion heater or external battery charging cables.

Condition	Probable Cause	Suggested Operator's Response
Alarm bell rings; no alarm lights on in lead unit.	Starting fuse defective.	Check fuse and replace if necessary.
	Starter motor thermal overload circuit activated, if equipped.	No action until red light on FP/ ES switch junction box goes out.
	None of the above.	Refer to "Lead unit engine shutdown" at beginning of this section.
	Trailing unit hot engine.	Refer to lead unit HOT ENGINE (HOT ENG).
	Trailing unit low water detector button tripped.	Refer to lead unit GOVERNOR SHUTDOWN (GOV DOWN).
	Trailing unit hot oil or low governor oil.	Refer to lead unit GOVERNOR SHUTDOWN (GOV DOWN).
	Trailing unit crankcase detector button tripped.	Refer to lead unit GOVERNOR SHUTDOWN (GOV DOWN).
	Trailing unit ground relay operation.	Refer to lead unit H.V. GRD/ FAULT (GRD RE-LAY).
	Trailing unit - No companion alternator output voltage.	Refer to lead unit NO BATT. CHARGE NO POWER (NO POWER CHRG) light on.