F40 PH-2D

OPERATOR'S MANUAL

GM Locomotive Group

3rd Edition
Fourth Quarter 1990

VIA Rail

Road Numbers
6400 to 6419
6420 to 6429
6430 to 6458

A Locomotive Product Support Department Publication
Diesel Division General Motors of Canada Limited
2021 Oxford E., London, Ontario, Canada

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NOTICE

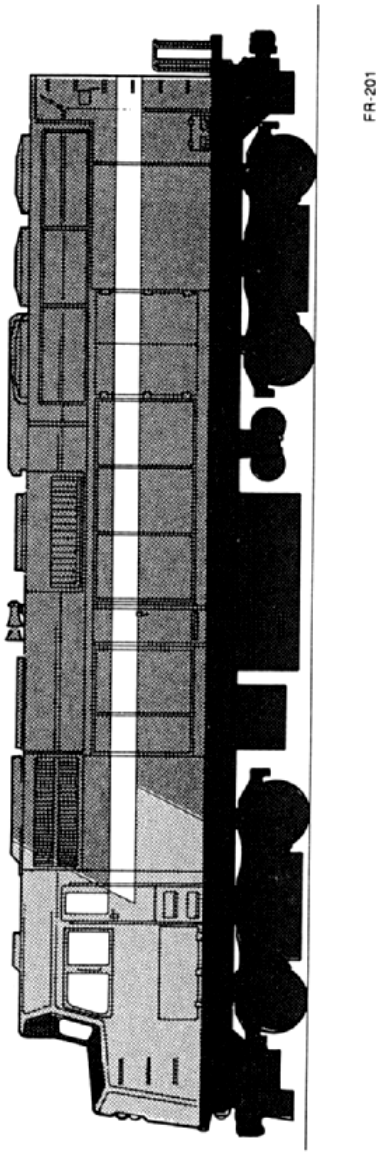
The purpose of this Manual is to serve as a guide in the operation of the locomotive and its equipment. The information was compiled for the following F40PH-2D Locomotives, with basic equipment and requested extras:

Road Numbers	6400 to 6419, 6420 to 6429, 6430 to 6458.

Although minor variations are possible, the equipment selected for coverage has been chosen as representative of this particular model.

Minor differences encountered in equipment are due to changes made after the manual was sent to press. These changes will be covered in subsequent editions of this manual.

When special extra equipment is involved, consult specific drawings or instructions as provided by the railroad.



INTRODUCTION

This manual is presented as a guide for personnel who operate the Model F40PH-2D Locomotive.

The contents of the manual are divided into five sections, as follows:

Section 1 - GENERAL INFORMATION

Section 1 provides pertinent data, as well as a general description of the locomotive.

Section 2 - CONTROLS

This Section explains the functions of the control equipment used in operating the locomotive.

Section 3 - OPERATION

Major operating procedures for the locomotive and its equipment are outlined in this Section.

Section 3A - OPERATION OF THE HEAD END POWER SYSTEM

This Section explains the functions of the control equipment used in the operation of the Head End Power (Auxiliary AC) System.

Section 4 - TROUBLESHOOTING

Section 4 describes the Condition, Probable Cause, and Suggested Operator's Response, for problems which may occur during locomotive operation.

A block of page numbers is allocated to each Section of this Manual. Section 1 starts with page 1-1, Section 2 with 2-1, and the other Sections follow in like manner. Figures are identified by Section and sequence numbers.

To obtain the maximum benefit from this Manual, it is recommended that the Sections be read in the sequence in which they appear.

NOTE

Information pertaining to maintenance, adjustment, and testing is contained in the Locomotive Service Manual. Instructions, for the testing and maintenance of individual locomotive components, are a part of the standard Maintenance Instruction (M.I.) Bulletin Series.

TABLE OF CONTENTS

SECTION 3. OPERATION

SECTION 3A. OPERATION OF THE HEAD END POWER SYSTEM

SECTION 4. TROUBLESHOOTING

GENERAL INFORMATION

GENERAL DATA

MODEL DESIGNATION F40PH-2D

Locomotive Type ..... (B-B) 0440
Locomotive Horsepower 3000

DIESEL ENGINE.....EMD

Model 16-645E3C
Type ..... Turbocharged
Numbers of Cylinders 16
Cylinder Arrangement ..... 45° "V"
Cylinder Bore And Stroke ..... 230.19 mm x 254.0 mm (9 1/16" x 10")
Operating Principle ..... 2 Stroke Cycle, Turbocharged, Unit Injection, Water Cooled
Full Speed ..... 893 RPM
Idle Speed - Normal ..... 460 RPM

MAIN GENERATOR ASSEMBLY AR10JDA-D18A
(Units 6400 - 6429)

TRACTION ALTERNATOR AR10JDA
(Rectified Output)

Number of Poles 10
Nominal Rectified Voltage ..... 600 VDC
Frequency (at 720 RPM) .....60 Hz
Maximum Continuous Current Rating.. 4200 Amperes

EXCITATION ALTERNATOR D18A

Nominal Voltage .....230 VAC
Number of Poles 16
Frequency (at 900 RPM) .....120 Hz

MAIN GENERATOR ASSEMBLY AR10JDAT-CA5A
(Units 6430 - 6458)

TRACTION ALTERNATOR AR10JDAT
(Rectified Output)

Number of Poles 10
Nominal Rectified Voltage .....600 VDC
Frequency (at 720 RPM) .....60 Hz
Maximum Continuous Current Rating.. 4200 Amperes

EXCITATION ALTERNATOR CA5A

Nominal Voltage ..... 230 VAC
Number of Poles 16
Frequency (at 900 RPM) .....120 Hz

HEAD END ALTERNATOR ..... DELCO 2E-7148

Available Power Output ..... 500 kW
Nominal Voltage 480
VAC Maximum Continuous Current
Rating .....750 Amperes Per Phase
Frequency (at 1800 RPM) .....60 Hz

AUXILIARY GENERATOR A-8589

Voltage ....74 DC
Rating .....24 kW

TRACTION MOTOR D77B

Number 4
Type ..... DC, Series Wound Axle Hung
Current Rating
Maximum Continuous Current .....050 Amperes
1 Hour ..... 1075 Amperes
1/2 Hour ..... 1100 Amperes
1/4 Hour ..... 1150 Amperes

TRUCK.....GP

Number 2
Gear Ratio 58:19
Driving Wheel
Number.....2
Pairs Diameter .....1.02 m (40")
Brake Rigging .....Single Shoe
Shoe .....Composite
Number of Cylinders.....2

SPEED LIMITATION **km/h MPH**

Maximum Speed - Based On Rated RPM of Traction Motors	145.0	90.0
Minimum Continuous Speed	13.2	8.2
1 Hour	12.5	7.7
1/2 Hour	11.8	7.3
1/4 Hour	10.3	6.4
Overspeed Setting	148.0	92.0

CURVE NEGOTIATION CAPABILITY

The Truck swing limits the single unit curve negotiation to a 410, or 140 ft. radius curve.

With two similar units coupled in multiple, and limited by the coupler swing (equipped with "F" Couplers), the curve negotiation is 30°, or 192 ft. radius curve .

AIR COMPRESSOR .....GARDNER DENVER

Model WLNA9A
Number of Cylinders 3
Capacity (at 900 RPM) ..... 7.19 m3 (254 Ft .3)/min.

Pressure Setting	kPa	PSI
High	965	140
Low	900	130
Safety	1200	175

PNEUMATIC BRAKE 26LU-L
BLENDED/DYNAMIC BRAKE

NOTE
Pneumatic and Dynamic Brakes are Blended Together.

BATTERY ..... NI-CAD

Model NIFE-H1-19R
Number of Cells.....5
Capacity (5 Hour Rating) .....186 Amp.Hour
Minimum Current During 60 Seconds
at 25°C (77°F) ..... 1800 - 1900 Amps.
At 0°C (32°F) ..... 1400 - 1500 Amps.

SUPPLIES CAPACITY	**Litres**	**Imp. Gals**
Engine Lube Oil	1495.0	329
Volume Between Low and High on Dipstick	178.0	39.0
Compressor Lube Oil	41	9.0
Fuel	6820	1500
Sand	0.57 m3	(20 Ft.^{3})

MAJOR DIMENSIONS	**Metres**	**Ft/in**
Height Over Cab	4.5	14' 9 5/16"
Height Maximum	4.8	15' 7 1/8"
Width Over Hand Rails	3.25	10' 7 13/16"
Distance Over Coupler Pulling Faces	17.12	56' 2"

WEIGHT

Loaded Weight on Rail
(Nominal) .....118 t (260,000 lbs)

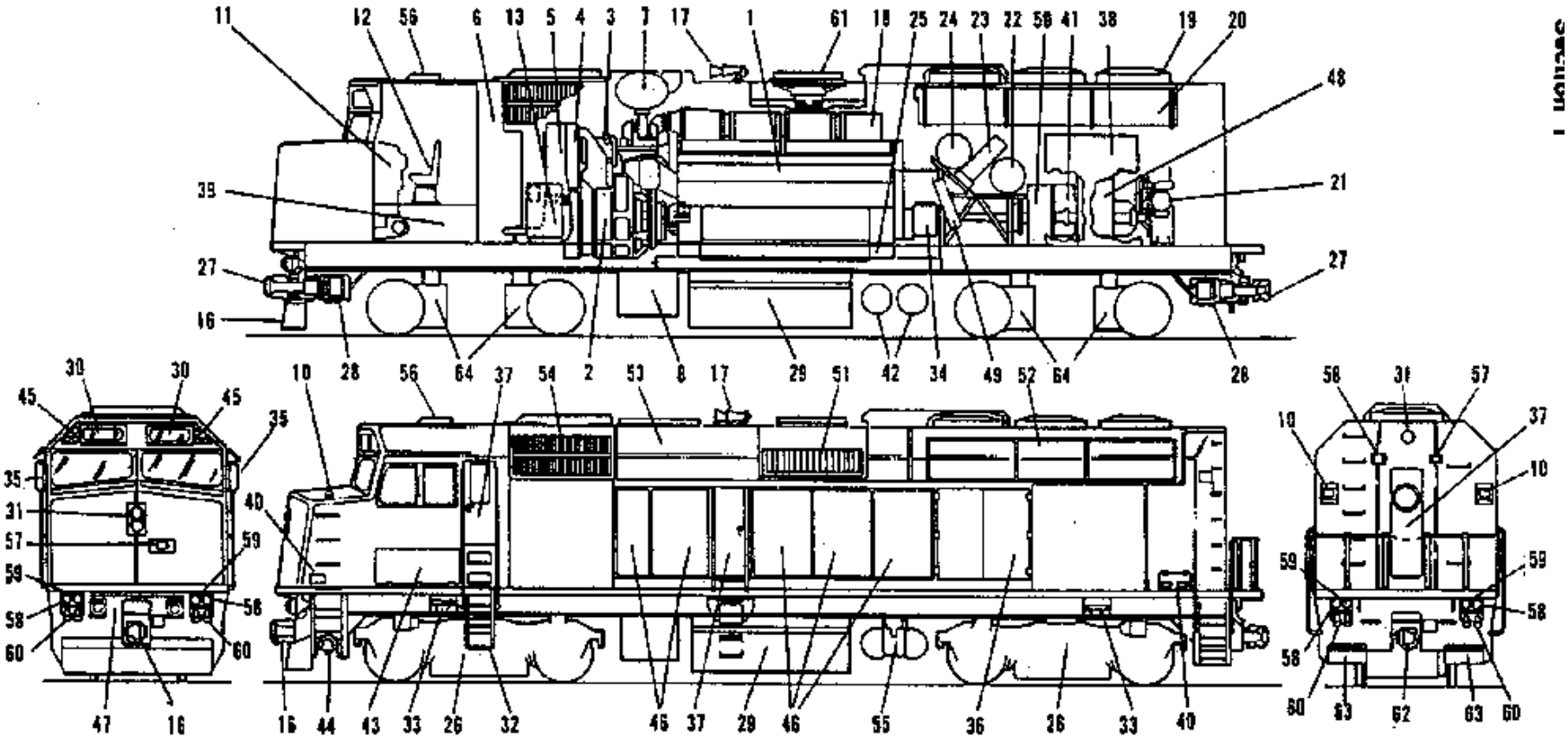
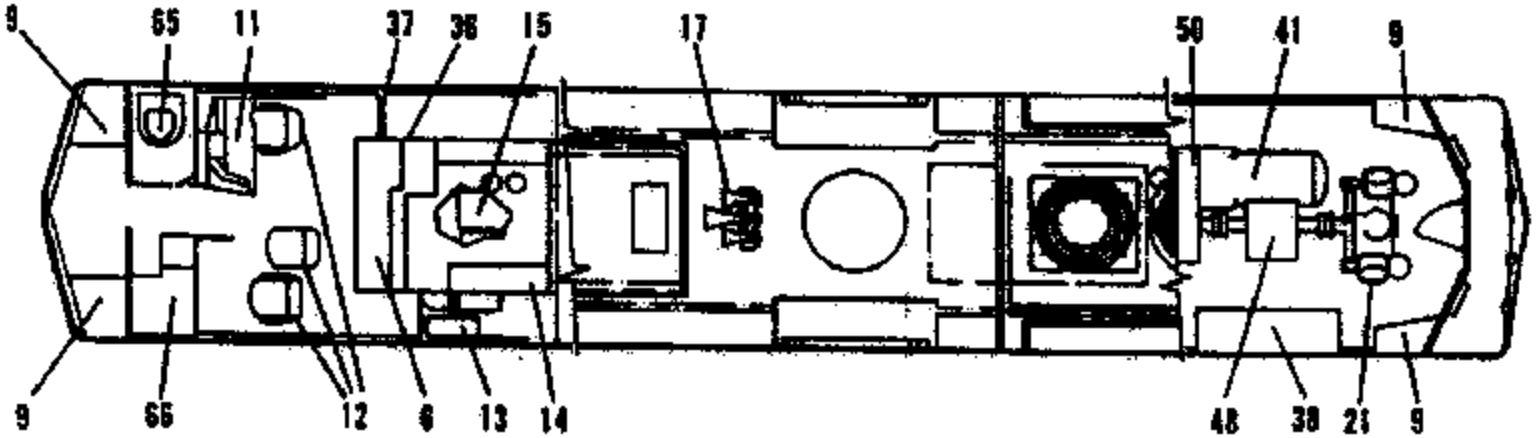


Fig. 1-1 General Arrangement - F40PH-2D Locomotive



1. Engine
2. Main Generator Assembly
3. Auxiliary Generator
4. Generator/Alternator Blower
5. Traction Motor Blower
8. Electrical Control Cabinet
7. Engine Exhaust Silencer
8. Batteries
8. Sand Box
10. Sand Box Fillers
11. Operators Control Console
12. Cab Seat
13. Electrical Cabinet Air Filter
14. Inertial Carbody Fiber
15. Engine Air Filter
18. Road Pilot
17. Horn
18. Exhaust Manifold
18. Radiator Cooling Faro
20. Radiators
21. Air Compressor
22. Lube Oil Filter
23. Lube ON Cooler
24. Engine Water Tank
25. Traction Motor Air Duct
28. Truck
27. Coupler
28. Draft Gear
28. Fuel Tank
30. Number Box
31. HewigMs
32. Steps
33. Jacking Pad
34. Lube Strainer
35. Wind Detle lor
38. Maintenance Door
37. Personnel Door
38. HEP CoMactor Cabinet
38. Air Brake EgWpmwt
40. Sand Trap Aocas
41. HEP Alternator
42. Main Air Reservok
43. Access Door
44. Bell
45. Classlticatlon Lights
48. HEP Control Panel
47. Anti-Climber - Cab end
48. HEP Control Cabinet
48. Fuel Filters
50. Gear Box
51. Dynamic Brake Hatch
52. Cooling Hatch
53. Turbo Exhaust Silencer Hatch
54. Inertial Filter Hatch
55. Ale Dryer
58. Radio Antenna
57. 74VDC Train tine receptacle (2)
58. MU Control Receptacle (5)
59. Corexrtunimldione Receptacle (4)
80. I4EP Receptacle (8)
81. Dynamic Brake Blow
82. Lifting L
83. Storag packs
84. Traction Motor
85. Toilet Room
88. Radio Room

Fig. 1-1 Legend

GENERAL DESCRIPTION

INTRODUCTION

The General Motors F40PH-2D model, which is illustrated in Figure 1-1, is a 3000 horsepower, dieselelectric locomotive intended for passenger service. The locomotive is equipped with a turbocharged 16-cylinder diesel engine that develops 3300 Horsepower at maximum RPM. The main generator converts this mechanical energy into electrical energy, which in turn is distributed through the Electrical Control Cabinet to the Traction Motors. Each of the four Traction Motors is directly geared to a pair of driving wheels. The Traction Motor-to-wheel axle gear ratio determines the maximum operating speed of the locomotive. This model has 58:19 gearing, which provides a top speed of 145 km/h (90 MPH).

The F40PH-2D locomotive has a fully enclosed carbody, which provides protected walkways for easy access to the engineroom. The locomotive is arranged so that the short hood, or cab end, is designated as the front of the unit.

The locomotive is equipped with a secondary electrical alternator referred to as the Head End Alternator. The alternator, which is located between the equipment rack and the Air Compressor, is driven through a 2:1 ratio gear box. This provides a generator speed of 1800 RPM, for an engine speed of 900 RPM.

The Head End Alternator provides electric heating, air conditioning, and cab lighting for the entire train. The operating controls, and appropriate warning lights for this equipment, are located on the Head End Power Control Panel in the cab. The power switching and protective devices, with associated warning lights, are located in two electrical cabinets at the rear of the locomotive.

While each locomotive is an independent power source, several may be combined in Multiple-Unit operation to increase load capacity. To allow all locomotives to be simultaneously controlled from the lead unit, the operating controls on each unit are jumpered or "trainlined". Control system interlocking prevents paralleling of Auxiliary AC Alternators between locomotives. A Trainline Setup Switch allows AC power to be trainlined through the locomotive, without engaging the locomotive's own AC Alternator.

LOCOMOTIVE OPERATION

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

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 with fuel, and the injector racks positioned, the cylinder will fire when the engine is cranked. With the engine running, the power for the fuel pump motor is directly supplied by the Auxiliary Generator.

1. The Traction Alternator rotates at engine speed, and, generates alternating current (AC) power. During the RUN and IDLE operating modes, this power is converted to direct current (DC) power by the internal rectifier banks, and is directed to the Traction Motors. During the

STANDBY mode of operation, Auxiliary AC Power is provided to the passenger cars by the Traction Alternator.

2. The Excitation Alternator is physically coupled to the Traction Alternator. It supplies the necessary current to excite the Traction Alternator field, and to power the radiator cooling fans, the inertial filter blower, and various transductors and control devices.

3. The secondary, or Head End Alternator, rotates at twice the engine speed. During the RUN operating mode, it supplies the passenger section of the train with 60 cycle hotel power for heating, air conditioning, and other passenger conveniences.

4. The Auxiliary Generator is driven by the engine gear train, at three times the engine speed. It provides a 74 Volt DC output for excitation current to the Excitation Alternator. The Auxiliary Generator also supplies the necessary 74 Volt power for control, cab heating, locomotive lighting; and battery charging circuits.

5. The Air Compressor is driven from the auxiliary gear box. It supplies the necessary air pressure for brakes, and for other pneumatic devices, such as sanders, windshield wipers, shutter operating cylinder, and horn.

6. The engine gear train drives two centrifugal water pumps, which, in turn, circulate cooling water through the engine.

7. The lube oil pumps are also connected to 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 Electrical Control Cabinet. This cabinet, by means of its internal switchgear, establishes the distribution of power to the Traction Motors. The internal 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, which respond to the operating controls in the cab, as well as to operating conditions.

The locomotive has four DC Traction Motors, which are located on the trucks under the locomotive. Each Traction Motor is geared directly to the axle on which it is mounted.

A major part of the locomotive control system involves the interrelated functions of the Throttle, Governor, and Load Regulator. To provide the smooth startup acceleration that is normally associated with passenger operation, the Traction Motors are connected in full parallel. In the RUN mode of operation, the Throttle varies the excitation of the Traction Alternator only; engine speed is maintained by the Governor at 893 RPM in all throttle positions.

As the Throttle is advanced to a higher position, the electrical control causes a larger current to flow in the Traction Alternator field. This increased excitation current results in an increase in power to the Traction Motors. Locomotive power is thereby increased progressively in throttle steps, while engine speed is held constant.

In STANDBY mode, the Throttle has no effect on either the excitation of the Traction Alternator, or on the engine speed. The Governor maintains an engine speed of 720 RPM.

In IDLE mode, the Throttle varies the engine speed (as with a conventional freight locomotive), and the engine Governor holds the engine speed at a constant RPM, as set by the Throttle. It accomplishes 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 alternator excitation. As a result, the Load Regulator balances the Governor speed setting from the Throttle, with the engine power level as determined by the load.

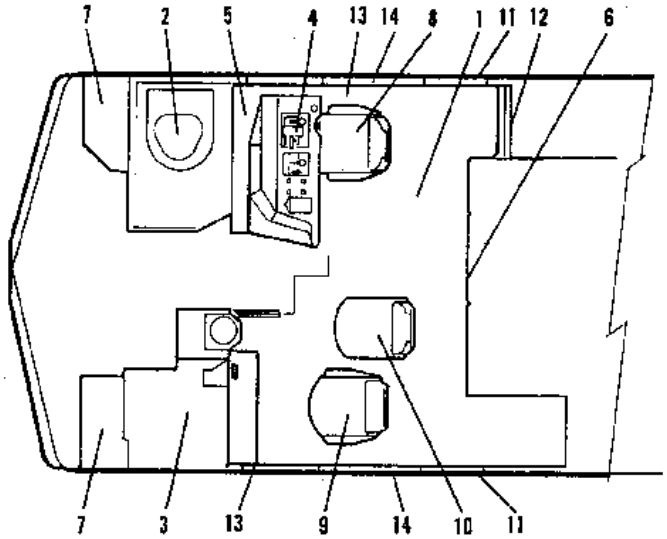
Many control and protective circuits are designed using solid state components on printed circuit boards. These circuit boards are constructed as plug-in Modules for easier servicing. The electronic Modules monitor, and control, critical functions in the locomotive power system.

CONTROLS AND INDICATING DEVICES

INTRODUCTION

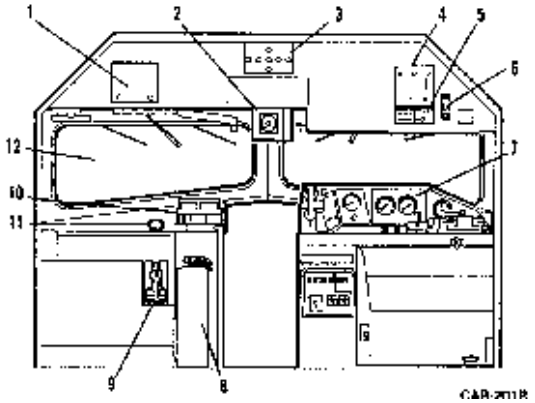
This section of the manual provides a brief description of the locomotive Controls and Indicating Devices available for use by the operator. Although not all are used during normal operation, they are included to familiarize the operator with their functions.

The majority of Controls and Indicating Devices are located in the locomotive cab, Figure 2-1. However, the main engine starting and monitoring devices are located in the engine room.



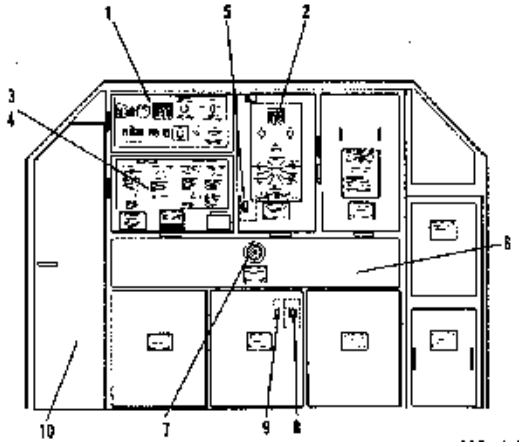
1 - Cab
2 - Toilet
3 - Radio Room
4 - Operator's Console
5 - Overhead Instrumentation
6 - Electrical Control Cabinet
7 - Sand Box
8 - Operator's Seat
9 - Brakeman's Seat
10 - Spare Seat
11 - Entrance Door
12 - Engine Room Door
13 - Heater Vent
14 - Side Window

Fig. 2-1A - Cab Arrangement, Top View



1 - Steam Generator Pane
2 - Speed Indicator
3 - Indicating Light Panel
4 - Warning Light Panel
5 - Two Way Radio
6 - RSC/ER Panel
7 - Operator's Control Console
8 - Fire Extinguisher
9 - Emergency Brake
10 - Hot Plate
11 - Emergency Brake Valve Handle
12 - Windshield

Fig. 2-1B - Cab Arrangement, Front View



1 - Engine Control Panel
2 - Head End Control Panel
3 - Fuse and Switch Panel
4 - Circuit Breaker Panel
5 - Cab Heater Circuit Breaker
8 - Module Compartment
7 - Annunciator Module
8 - Auxiliary Generator Circuit Breaker
9 - Battery Charging Circuit Breaker
10 - Engine Compartment Door

Fig. 2-1C - Cab Arrangement, Rear View

CAB EQUIPMENT

The Controls and Indicating Devices, located in the cab, are situated in one of the following areas:

1. The ELECTRICAL CONTROL CABINET

2. The ENGINEER'S CONTROL CONSOLE

3. The OVERHEAD CONSOLE

ELECTRICAL CONTROL CABINET

The Electrical Control Cabinet forms the rear wall of the cab, and houses the low and high voltage electrical devices necessary for the operation of the locomotive. The lower half of the cabinet contains the high voltage switchgear, while the upper half consists of the Module Compartment, and the panels that are used for control of the locomotive. The Electrical Control Cabinet breakdown is as follows:

1. FUSE AND SWITCH PANEL

2. CIRCUIT BREAKER PANEL

3. ENGINE CONTROL PANEL

4. HEAD END POWER CONTROL PANEL

5. MODULE COMPARTMENT

6. MAIN CONTROL CABINET

WARNING

Open only the cabinet doors necessary to gain access to the Circuit Breaker, and Fuse and Switch Panels. High voltage and current are present throughout the Electrical Control Cabinet.

FUSE AND SWITCH PANEL

The Fuse and Switch Panel is located directly under the Engine Control Panel in the upper left hand corner of the Electrical Control Cabinet.

NOTE

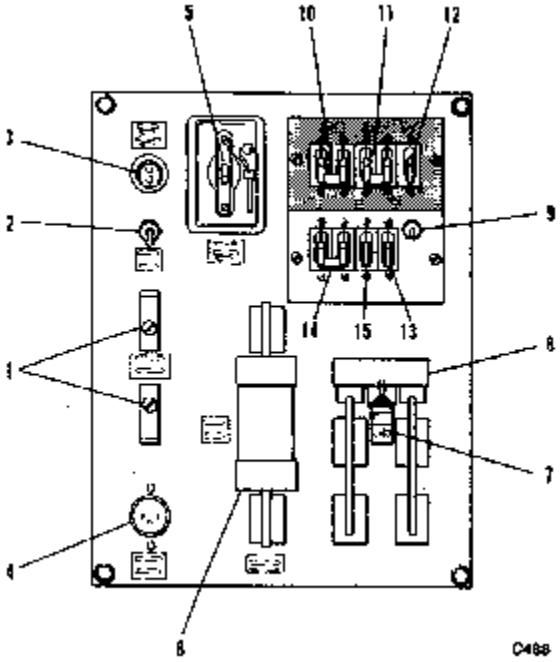
There is no Excitation Alternator field fuse. In order to minimize any voltage drop in the cabling, the field is connected directly across the output of the Auxiliary Generator. This serves to maintain full excitation, and to ensure rapid fan motor starting. If a short circuit occurs across the output of the Auxiliary Generator, the machine being self-excited will not support the short circuit. The Auxiliary Generator voltage will decrease, and the machine will not be harmed. In this event, a NO POWER/ CHRG alarm will be given, and engine speed and power will be reduced to an IDLE condition.

FUSE TEST EQUIPMENT

It is advisable to test fuses before installation. To facilitate the testing of fuses, a pair of FUSE TEST blocks; a Fuse TEST LIGHT, and a TEST LIGHT Toggle Switch are installed on the Fuse Panel. Fuses may be readily tested as follows: To make certain that the Fuse Test Light is not burned out, move the Toggle Switch to the ON position. Extinguish the light by moving the toggle switch to the OFF position. Place a fuse 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. If the fuse is burned out, the light will not come on, and a new fuse will be required.

74 VDC RECEPTACLE

This Receptacle is provided to supply power for test equipment, extension lights, etc. The circuit is protected by a 30A Circuit Breaker.



1 - Fuse Test Blocks
2 - Fuse Test Switch
3 - Fuse Test Light
4 - 74 VDC Receptacle
5 - Ground Relay Cutout Switch
8 - Starting Fuse
7 - Radio Switch
8 - Battery Knife Switch
9 - Ground Relay Reset Switch
10 - HEP Control Circuit Breaker
11 - Car Door Loop Circuit Breaker
12 - HEP Trainline-Complete Circuit Breaker
13 - Steam Generator Remote Control Circuit Breaker
14 - Car Power Management Circuit Breaker
15 - Car Power Management Circuit Breaker

Fig. 2-2 - Fuse and Switch Panel

GROUND RELAY CUTOUT SWITCH

The purpose of the Ground Relay Cutout Switch is to eliminate the ground protective relay from locomotive circuits during certain shop maintenance inspections. It must always be kept closed in normal operation. When this multiple-pole toggle switch is open, it prevents excitation of the main generator, in addition to cutting out the ground protective relay.

STARTING FUSE

The Starting Fuse is in use only during the period that the diesel engine is actually being started. At that 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 would remain open.

CAUTION

The locomotive Is equipped with a 400 Ampere Starting Fuse. Observe Fuse Panel marking. Do not use an Incorrectly rated fuse.

BATTERY SWITCH

The Battery Switch, which is a double-pole, single-throw knife switch, is used to connect the locomotive batteries to the low voltage system. It should be kept closed at all times during locomotive operation.

This Switch may be opened during certain shop maintenance procedures, and in instances where the engine is shut down and the locomotive taken out of service for an extended layover. In the event that the lights, or other low voltage devices, were inadvertently left operating during the layover, this would prevent the battery'from being discharged. Particular attention should be given when a notation at the Switch cautions against opening the Switch immediately after engine shutdown. Following engine shutdown, approximately 35 minutes should be allowed before this Switch is opened after load operation.

NOTE

The Turbocharger Lube Pump is connected on the battery side of the knife switch. Therefore, opening the switch after engine shutdown will not stop the pump. The Turbo Lube Oil Pump will start, and will continue to run for approximately 35 minutes following engine shutdown. The Pump will then shut down automatically.

RADIO SWITCH

Located beneath the Battery Switch, this spring-loaded switch supplies the 74 VDC connection between the locomotive batteries and the voice radio equipment. The Radio Switch contacts are automatically closed when the Battery Knife Switch is placed in the closed position. The Switch can also be manually held CLOSED when the Battery Knife Switch is in the open position.

GROUND RELAY LOCKOUT RESET SWITCH

The purpose of this Toggle Switch, is to manually reset the ground relay, and to restore power after the relay has been locked out at the fourth ground detection.

The ground relay detects high voltage grounds during operation under power. When it trips, audible alarms will sound in all units of a consist. On the unit which is affected, traction alternator excitation is lost, the diesel engine goes to IDLE speed, and the ground relay light comes on. The ground relay will automatically reset three times. It will then lock out if the problem persists.

It is not necessary to isolate the unit, nor is it necessary to place the throttle in the IDLE position before activating the Ground Relay Lockout Reset Switch, unless the locomotive is at a standstill.

Repeated resetting of the ground relay is possible. However, refer to railroad regulations before resetting the lockout function.

HEAD END CONTROL Circuit Breaker

This 30A double-pole Circuit Breaker protects the entire Head End Power Control circuit.

CAR DOOR Circuit Breaker

The Car Door loop circuit is protected by this 5A doublepole Circuit Breaker.

HEP TRAINLINE COMPLETE Circuit Breaker

The 1A single-pole HEP Trainline Complete Circuit Breaker protects the Head End Power distribution control circuitry.

STEAM GENERATOR REMOTE CONTROL
Circuit Breaker

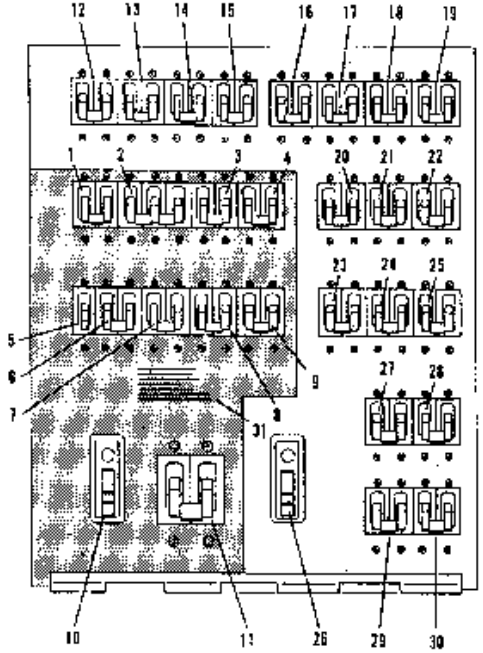
This 15A single-pole Circuit Breaker provides protection for the Steam Generator(s) Remote Control circuit.

CAR POWER MANAGEMENT Circuit Breaker

These two Circuit Breakers, 15A single-pole and 15A doublepole, protect the Car Power Management circuits.

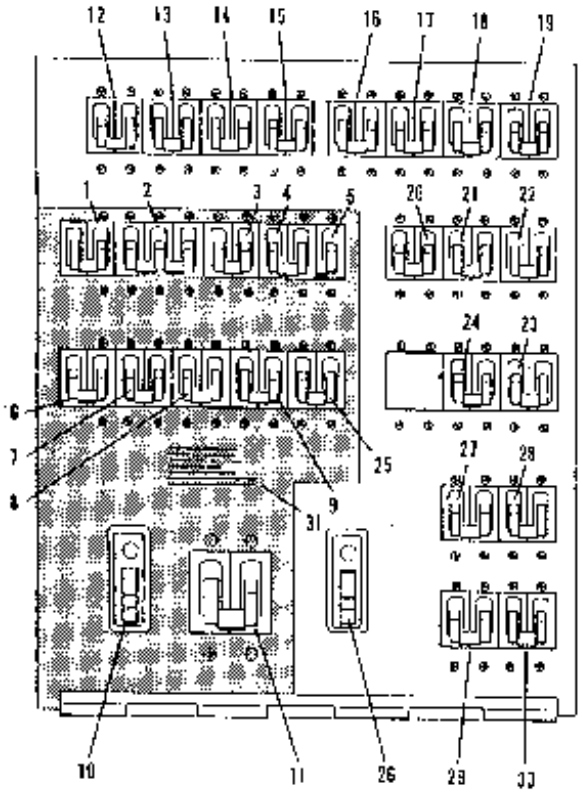
CIRCUIT BREAKER PANEL

The Circuit Breaker Panel is divided into two sections. One section contains breakers that must be in the ON position to operate the locomotive; the other section contains the circuit breakers for lighting, and for miscellaneous devices that are used as conditions dictate. These circuit breakers can be operated as switches, but will trip if an overload occurs.



1 - Turbocharger Luba Pump
2 - Fuel Pump
3 - Control
4 - Local Control
5 - Auxiliary Generator Field
8 - Module Control
7 - Reverser control
8 - AC Control
9 - Brake Transfer Control
10 - Generator Field
11 - Filter Blower Motor
12 - Engine Room Lights
13 - Lights
14 - Headlights
15 - Ditchlights
18 - Auto-drain Timer
17 - Radio
18 - Heated Windshield
19 - Cab Heater Fan Control
20 - Air Dryer
21 - AC Equipment
22 - Hot Plate
23 - Bell Ringer Heater
24 - Drain Heater
25 - ER/Speed Indicator
28 - Steam Generator Trainline
27 - HEP Distribution TSLF
28 - HEP Distribution TSRF
29 - HEP Distribution TSLR
30 - HEP Distribution TSRR
31 - NOTE:
Breakers In black area of Panel must be in 'ON' position to operate the locomotive.

Fig. 2-3A - Circuit Breaker Panel
(Road Numbers 6430 - 6458)



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18 - Heated Windshield
19 - Cab Heater Fan Control
20 - Air Dryer
21 - AC Equipment
22 - Hot Plate
23 - Bell Ringer Heater
24 - Drain Heater
25 - RSC/Speed Indicator
28 - Steam Generator Trainllne
27 - HEP Distribution TSLF
28 - HEP Distribution TSRF
29 - HEP Distribution TSLR
30 - HEP Distribution TSRR
31 - NOTE:
Breakers In black area of Panel must be In 'ON' position to operate the locomotive.

Fig. 2-3B - Circuit Breaker Panel (Road Numbers 6400 -6429)

The GENERATOR FIELD Circuit Breaker will trip to the centered position. After a period for cooling, this breaker must be placed in the full OFF position, before resetting it to the ON position. Other circuit breakers on the Panel will trip to the full OFF position.

BREAKERS REQUIRED "ON" FOR LOCOMOTIVE OPERATION

TURBO Circuit Breaker

This 30A double-pole Circuit Breaker must be in the ON position to start the engine, and to operate the Turbocharger Auxiliary Lube Oil Pump. The Breaker must remain in the ON position, in order to provide lubrication to the turbocharger at engine start, and after the engine has been shut down.

FUEL PUMP Circuit Breaker

This 15A triple-pole Circuit Breaker protects the Fuel Pump motor circuit. If the fuel filter becomes clogged, a fuel filter bypass valve is provided to prevent overloading the Fuel Pump motor.

CONTROL Circuit Breaker

This 40A double-pole Circuit Breaker sets up the Fuel Pump and control circuits for engine starting. Once the engine is running, the power to maintain operating control is supplied through this breaker from the Auxiliary Generator.

LOCAL CONTROL Circuit Breaker

In order to operate heavy duty switchgear and various control devices, this 30A double-pole Circuit Breaker establishes "local" power from the Auxiliary Generator.

AUX. GEN. FIELD Circuit Breaker

The Auxiliary Generator Field Excitation circuit is protected by this

10A single-pole Breaker. Should this Breaker trip, the NO POWER/CHRG alarm will be activated. Auxiliary Generator output would decrease to zero Volts, and would result in a loss of the 74 VDC control voltage. Consequently, many circuits would be adversely affected, including the Excitation Alternator and the Fuel Pump operation. Therefore, the engine would shut down due to lack of fuel.

MODULE CONTROL Circuit Breaker

This 5A double-pole Circuit Breaker protects the local control circuit that supplies power to the electronic control modules.

REVERSER CONTROL Circuit Breaker

This 3A double-pole Circuit Breaker is located in the feed to the operating motor of the multi-pole, motor operated, ganged switches. In turn, these switches 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 one position to another, this Breaker must be closed for power transfer to occur.

AC CONTROL Circuit Breaker

This 15A double-pole Circuit Breaker protects the power supply for various excitation and wheel slip control devices, which are supplied power from the Excitation Alternator. The No Voltage Relay, NVR, is also in this circuit. If the AC Control Breaker trips during locomotive operation, a NO POWER/CHRG alarm will be initiated.

BRAKE TRANSFER CONTROL Circuit Breaker

This 3A double-pole Circuit Breaker is located in the feed to the operating motor of the multi-pole, motor-operated, ganged switches. These switches 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 one position to another, the Brake Transfer Control Breaker must be closed for power transfer to take place.

GENERATOR FIELD Circuit Breaker

By way of a controlled rectifier, the Traction Alternator receives excitation through a pair of slip rings connected to the Excitation Alternator output. The 100A single-pole Generator Field Circuit Breaker protects the controlled rectifier, and the Traction Alternator field windings.

FILTER BLOWER MOTOR Circuit Breaker

This 50A triple-pole Circuit Breaker protects the Filter Blower Motor circuit. The Blower is used to evacuate dust-laden air from the central air compartment inertial filters.

MISCELLANEOUS CIRCUIT BREAKERS

The following Circuit Breakers may be ON, or OFF, according to the requirements of operating conditions.

ENGINE ROOM LIGHTS Circuit Breaker

This 20A double-pole Breaker protects the circuits for the lights that are mounted throughout the engine room. LIGHTS Circuit Breaker

The 40A double-pole Lights Circuit Breaker must be in'the ON position, in order to supply power for individual switches such as Road Number, Class, Platform, Cabinet, Hood, Marker, Controller, Ground, and Gauge Lights.

HEADLIGHTS Circuit Breaker

This 35A double-pole Breaker protects the Headlight circuits

It must be ON to provide current to the front headlight circuit, and through the trainline to the light at the rear of a consist. DITCH

LIGHTS Circuit Breaker

This 20A double-pole Breaker protects the Ditch Lights circuits.

AUTO. DRAIN TIMER Circuit Breaker

This 15A double-pole Circuit Breaker protects the circuits that control the automatic operation of drain valves in the compressed air system.

RADIO Circuit Breaker

The 5A double-pole Radio Circuit Breaker protects the Radio circuits.

HEATED WINDSHIELD Circuit Breaker

This 15A double-pole Circuit Breaker protects the Windshield Heaters and associated circuits.

CAB HEATER FAN CONTROL Circuit Breaker

This 20A double-pole Circuit Breaker protects the devices and circuits associated with the Cab Heater Fan.

AIR DRYER Circuit Breaker

This 15A double-pole Circuit Breaker protects the Air Dryer and associated circuits.

AC EQUIPMENT Circuit Breaker

This 15A double-pole Circuit Breaker protects the Refrigerator and associated AC Equipment circuits.

HOT PLATE Circuit Breaker

This 20A double-pole Circuit Breaker protects the Hot Plate and associated circuits.

BELL RINGER HEATER Circuit Breaker

This 6A double-pole Circuit Breaker protects the Bell Ringer Heater and associated circuits.

DRAIN HEATERS Circuit Breaker

This 6A double-pole Circuit Breaker protects the Drain Heaters, and associated circuits for the drain valves in the compressed air system.

ER/SPEED INDICATOR Circuit Breaker (Road Numbers 6430 – 6458)

This 15A double-pole Circuit Breaker protects the Event Recorder, and the Speed Recorder, as well as their respective control circuits.

RSC/SPEED INDICATOR Circuit Breaker (Road Numbers 6400 - 6429)

This 15A double-pole Circuit Breaker protects the Speed Recorder, the RSC Panel, and their respective control circuits.

STEAM GENERATOR TRAINLINE Circuit Breaker

This 150A single-pole Circuit Breaker protects the 74 Volt supply for the Steam Generator Trainline.

H.E.P. DISTRIBUTION (TSLF, TSRF, TSLR, TSRR)
Circuit Breakers

These 3A double-pole Circuit Breakers protect the switching

motor and circuits for the four transfer switches, which are associated with Head End Power connections.

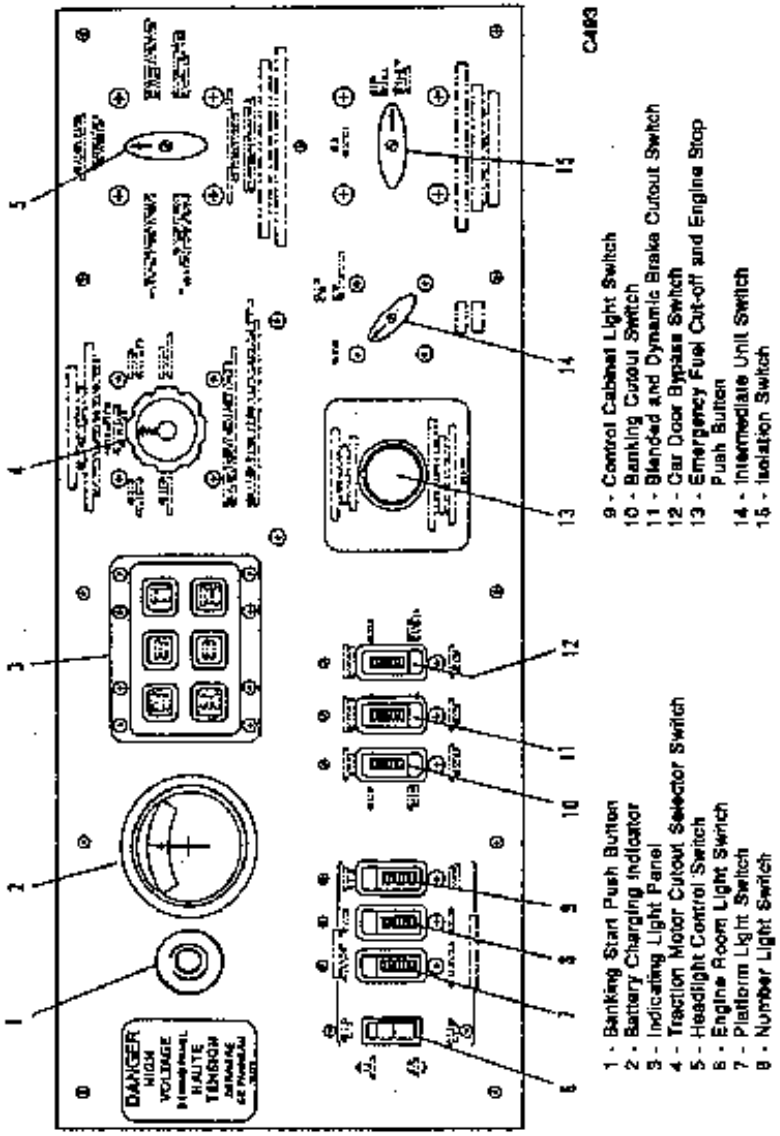


Fig. 2-4 - Engine Control Panel

ENGINE CONTROL PANEL

The Engine Control Panel is situated in the upper left-hand corner of the Electrical Control Cabinet. It contains various switches and indicator lights, which are used in the operation of the locomotive. Following, is a brief description of their individual functions:

BANKING START Pushbutton

This Pushbutton activates the Car Banking Monitoring System. The system will be activated through the locomotive, when the locomotive is coupled to a similarly equipped consist (i.e. operational banking). When the system is operating, the Banking Start Pushbutton will remain illuminated.

BATTERY CHARGING INDICATOR

The Battery Charging Indicator (zero center ammeter) indicates the charge on the locomotive batteries. With the main Battery Knife Switch CLOSED, the Battery Charging Indicator is connected into the low voltage circuits, and indicates the current flowing to and from the storage battery. It does not indicate the output of the Auxiliary Generator, nor does it indicate the current during engine cranking.

INDICATING LIGHT PANEL

This Panel contains six lights, which indicate the condition of various locomotive systems.

NOTE

The following Indicator Lights have a push-to-test feature, which allows testing of the lamp circuit alone. This determines if the lamp is working properly while isolated from its operation in the power control system. When the lens cap is depressed, the supply voltage is applied across the lamp circuit. After a one second delay

the light should illuminate.

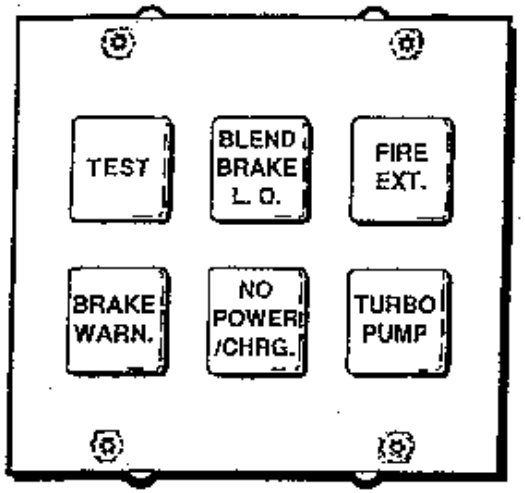


Fig. 2-5 - Engine Control Panel Indicating Light Panel

TEST Light

This Light comes on when the Test Panel Rotary Test Switch is placed in the LOAD TEST 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. With a load test setup, the unit will automatically load on its own dynamic braking resistor grids.

CAUTION

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

While operating In Loa, Test, do not move the Test Switch to the NORMAL position.

BLEND BRAKE L.O. Light

This Light indicates that the Blended Brake System has been

locked out, by either the Blended and Dynamic Brake Cutout Switch being placed in the CUTOUT position, or by a signal from the Dynamic Air Module, DA16.

FIRE EXT. Light

When illuminated, this Light indicates that at least one of the four fire detectors located in the Electrical Control Cabinet has been activated. In this event, the audible alarm will sound, and engine speed will be reduced to IDLE.

NOTE

An alarm signal light indication is normally accompanied by an audible alarm, which will sound in all units of the locomotive consist. However, the alarm light indication will come on only in the affected unit.

BRAKE WARN. Light

This Light, accompanied by an audible alarm, indicates excessive Dynamic Braking current. Whenever the Light comes on, it should not remain on for longer than a few seconds. In the event of repeat Brake Warning indications, place the Blended and 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.

NO POWER/CHRG. Light

This Light will come on, accompanied by an audible alarm, whenever Excitation Alternator output stops, (normally at engine shutdown). The indication can also be caused by a true Auxiliary Alternator failure, a failure of the Auxiliary Generator, or a tripped AC Control Circuit Breaker. In each case, the locomotive will fail to generate power.

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 bearings. 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 reestablished, and the Light will remain on for an additional 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 if a starting attempt is made. In this event; the Soakback System Failure Light at the Fuel Prime/Engine Start Switch will be illuminated.

TRACTION MOTOR CUTOUT SELECTOR SWITCH

The Traction Motor Cutout Selector Switch is used to electrically isolate a defective traction motor. This permits locomotive operation with the remaining good motors. To prevent overloading the operative motors, the power control system automatically limits power. The isolated motor will continue to rotate as the train moves.

Before the Traction Motor Cutout Selector Switch can be operated, the Isolation Switch on the Engine Control Panel must be placed in the ISOLATE position. In order to cut out a defective motor, the Traction Motor Cutout Switch is first depressed to unlock it, and then rotated to the appropriate selection.

WARNING

Before operating with a motor cut out, make certain that all wheels rotate freely.

REMOTE HEADLIGHT CONTROL SWITCH

During multiple unit operation, the Remote Headlight Control Switch provides for operation of the rear unit headlight from the lead unit. The Switch position is set on each unit as follows:

ON LEAD UNIT

If a single locomotive unit is being used, place the Switch in the 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 WITH UNIT 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 the Switch in the CONTROLLING WITH UNIT 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 Remote Headlight Control Switch placed in the CONTROLLED FROM ANOTHER UNIT COUPLED AT EITHER END position.

MISCELLANEOUS SWITCHES

Switches are included in the circuits for various lights and devices on the locomotive. These switches are closed as required to

operate the Number lights, the Engineroom lights, Platform lights, and Electrical Control Cabinet lights.

BANKING CUTOUT Switch

When activated, this Switch will cut out the Car Banking Monitoring System. In this event, the light on the Banking Start Pushbutton will be extinguished.

CAR DOOR BYPASS Switch

If the Door Open warning system continues to operate, after it has been ascertained that all train doors have been closed, the Car Door Bypass Switch may be placed in the "BYPASS" position. This will reestablish traction alternator excitation, and allow the train to proceed. As a result, the Car Door Bypass Activated Light will be ON. The Car Door Bypass Switch is sealed in the OFF (down) position. To activate the Switch, the seal must be broken.

BLENDED AND DYNAMIC BRAKE CUTOUT Switch

When this Switch is placed in the CUTOUT position, the individual unit will not operate with Blended or Dynamic Braking. However, the unit will continue to operate under power with normal air braking. The Switch can be used to limit the number of units in a consist that will operate in Dynamic Braking, or, it may be used to cut out a unit that is defective in Dynamic Braking, yet allow the unit to operate under power.

EMERGENCY FUEL CUTOFF AND ENGINE STOP Push Button

The diesel engine will stop when this pushbutton is pressed. The reaction to the button is immediate. It need not be held in until the engine stops.

INTERMEDIATE UNIT SWITCH - IUS

The Intermediate Unit Switch has two positions: NORMAL,

and MIDDLE UNIT. The functions of these two positions are as follows:

NORMAL

In this position, the complete communication system is connected to the train, so that communication train control functions are operative.

MIDDLE UNIT

In this position, a portion of the communication system is disconnected from the train. This renders the affected controls inoperative. When the locomotive is used as an intermediate unit, the Switch must be in the MIDDLE UNIT position.

ISOLATION Switch

The Isolation Switch has two positions, one labelled START/ STOP/ISOLATE, and the other labelled RUN. The functions of these two positions are as follows:

START/STOPASOLATE 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. When isolated, the unit will not develop power or respond to the controls, and will run only at IDLE speed, regardless of throttle position. In the event of a NO POWER or LOW LOBE OIL alarm, this position will also silence the audible alarm. However, it will not silence the alarm in the event of a HOT ENGINE.

Prior to operating the Traction Motor Cutout Selector Switch, the Isolation Switch must be placed in the ISOLATE position.

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.

ANNUNCIATOR MODULE

The Annunciator Module, AN31, is located in the center of the Module Compartment. A glass window in the compartment door allows easy viewing of the warning lights mounted on the frontal face of the module.

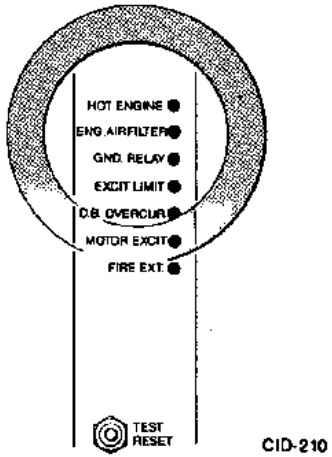


Fig. 2-6 - Annunciator Module

By means of latching relays and lights, the Annunciator records faults, or abnormal operating conditions that may occur during locomotive operation. Once lit, the Annunciator lights will stay on until the guarded TEST/RESET Switch is operated by qualified maintenance personnel. Although correction of a fault, or the resetting of protective devices, will restore the operational status of locomotive systems, these actions alone will not reset the Annunciator.

HEAD END POWER CONTROL PANEL

The Head End Power (HEP) Panel, which is located to the right of the Engine Control and the Circuit Breaker Panels, contains various Controls and Indicating Devices for Head End Power control.

ENABLE Push Button Switch

The ENABLE Pushbutton (Push-To-Turn) Switch must be depressed prior to rotating the Trainline Setup Switch. This Pushbutton will energize the TLS Solenoid to enable a new H.E.P. selection.

HEP START Switch

Provided that the following conditions have been satisfied, the HEP Start pushbutton Switch is used to place the Head End Power (Auxiliary AC) System into operation:

1. There must not be any voltage already on the trainlined AC circuit. This precaution minimizes the possibility of paralleling AC power alternators.

2. The locomotive unit cannot be operating in Low IDLE.

3. The engine must be running, and there must be an output from the Excitation Alternator.

4. All AC jumpers must be in place throughout the train.

5. The Head End Power Mode Switch must be in RUN, or STANDBY.

6. If the unit is set up for Load Test, the Reverser Handle must be centered.

If all these requirements are met, the Auxiliary AC Power System will automatically go into operation when the H.E.P. ON Switch is

pressed, and 480 VAC hotel power will be supplied to the train.

For a more detailed operational description of the Head End Power System, refer to Section 3A in this manual.

Train SELECTION Switch

The Train SELECTION Slide Switch has the following two positions:

1. NORMAL Position - VIA (sealed - up)
2. ALT. Position - AMTRAK/LRC-1 (down)

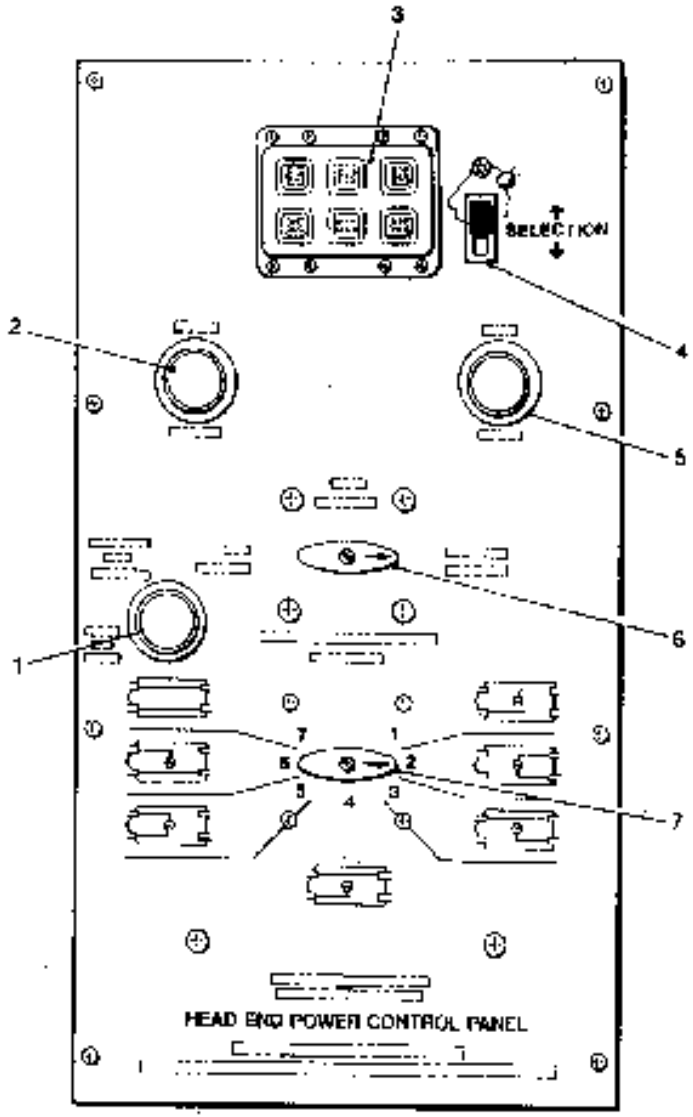
In the sealed "VIA" position, this switch enables H.E.P. control pins #1 and #2 (redundancy circuit). In other words, this position will parallel lines 1 and 2 for greater reliability. If the locomotives are used with AMTRAK, or LRC-1 type coaches, the seal would be broken, and the ALT. position would be used to disable this feature.

HEP STOP Switch

This pushbutton Switch interrupts the operation of the Head End Power (Auxiliary AC) System. It restores Throttle Handle control of engine speed, and eliminates excitation to the Head End Power (Auxiliary AC) Alternator.

HEAD END POWER MODE Switch

The function of the Head End Power Mode Switch is to set up the circuit logic, and to prepare the necessary equipment to engage an auxiliary AC alternator. This may be either the Traction Alternator, or the Head End Alternator. Once the Head End Power Start button is depressed to engage the system, the Head End Power Mode Switch actually determines the response mode of the entire locomotive control system. It has an effect on engine speed control, tractive power capability, alternator excitation, and throttle



1 - Enable Push Button Switch
2 - HEP Start Push Button
3 - Indicating Light Panel
4 - Train Selection Switch
5 - HEP Stop Push Button
6 - HEP Mode Switch
7 - Trainline Set-Up Switch

Fig. 2-7 - Head End Power Control Panel

response.

The Head End Power Mode Switch has the following three positions:

IDLE

The IDLE position isolates the Head End Alternator from the locomotive power system. This position is used when the locomotive is not needed to supply auxiliary AC power. When the Head End Power Mode Switch is in this position, the Traction Alternator provides power for traction, the Head End Alternator is no longer active in the system, and engine speed becomes relative to the position of the Throttle Handle.

NOTE

Until the Head End Power Start button is pressed, the following two positions are ineffective.

RUN

The RUN position sets up the Head End Power Alternator to supply 480 VAC hotel power to the passenger cars. With this arrangement, the Traction Alternator supplies traction power, and the diesel engine turns at a synchronous speed of 893 RPM. The Throttle Handle changes the excitation to vary the traction motor current. However, engine speed remains the same in all positions.

STANDBY

The STANDBY position is intended for routine layovers, which normally occur in passenger service. Some examples of these layovers would be the boarding or detraining of passengers, the scheduling of anticipations or delays, or the preparation of passenger accommodations (heating or air conditioning) prior to boarding. When the Head End Power Mode Switch is in this

position, the Traction Alternator supplies 480 VAC to the train through the trainline receptacles, the diesel engine remains at a constant speed of 720 RPM, and the locomotive has neither traction power, nor throttle response.

TRAINLINE SET-UP Switch

This Switch determines the configuration for the connection of Auxiliary AC Power to the trainlined power network. The source of alternator power can be from either the Head End Alternator, or the Traction Alternator. The multi-position Trainline Setup Switch also determines the connections between the four outlets located at each corner of the locomotive.

The connections for each position are schematically shown on the Panel. When selecting a configuration, first depress the ENABLE Pushbutton to release the Trainline Set-Up Switch. Then, position the Setup Switch knob, so that the arrow points in the direction of the schematic representing the selected combination.

INDICATING LIGHT PANEL

This Panel contains lights, which indicate the condition of various systems within the Head End Power operation.

NOTE

The following Indicator Lights have a push-to-test feature, which allows testing of the lamp circuit alone. This determines if the lamp is working properly while isolated from its operation in the power control system. When the lens cap is depressed, the supply voltage is applied across the lamp circuit. After a one second delay, the light should illuminate.

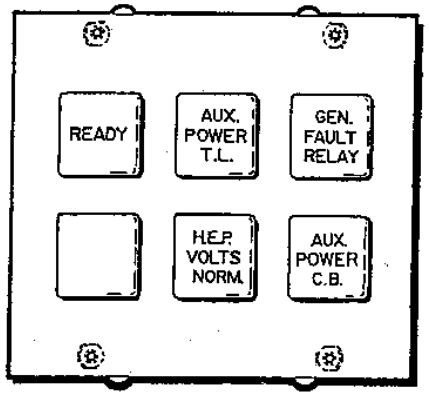


Fig. 2-8 - H.E.P. Control Panel Indicating Light Panel

READY Light

This Light indicates that the circuit conditions, which enable the Head End Power (Auxiliary AC) System to be engaged, have been satisfied, but that the AC Contactor is not CLOSED.

AUXILIARY POWER T.L. Light

This Light indicates that all AC power trainline jumpers are in place throughout the train, and that the Trainline Setup Switch is properly positioned to supply Auxiliary AC power to one end of the locomotive.

NOTE

Before the Auxiliary Power T.L. Light will illuminate, the Head End Power Mode Switch must be in the RUN or STANDBY position.

GEN. FAULT RELAY Light

This Light indicates that a ground fault has occurred in either the particular Auxiliary AC Power Generator Traction Alternator, or in

the Head End Alternator circuit, whichever is supplying AC power at that time.

H.E.P. VOLTS NORM. Light

This Light indicates that Auxiliary AC Power is at the proper voltage and frequency.

AUX. POWER C.B. Light

This Light indicates that the AC Contactor (Circuit Breaker) is closed, and that Auxiliary AC Power is being supplied to the train.

CAB HTR. Circuit Breaker

This 150A double-pole Circuit Breaker, which is located behind the HEP Control Panel, protects the Cab Heater and associated circuits against overcurrent.

BATT CHARGE Circuit Breaker

This 150A double-pole Circuit Breaker is located in the Electrical Control Cabinet under the Module Compartment. It protects the circuitry for the Battery Charging Receptacles. AUX. GEN. Circuit Breaker

The 325A double-pole Auxiliary Generator Circuit Breaker is located in the Electrical Control Cabinet under the Module Compartment. This Breaker is connected between the output of the Auxiliary Generator and the low voltage system to protect against current overloads. If the Circuit Breaker trips, it will interrupt the Auxiliary Generator output. As a result, the fuel pump will stop, the engine will shut down, and a NO POWER/CHRG alarm will be initiated. In order to start the diesel engine, the AUX. GEN. Circuit Breaker must be ON.

OPERATOR'S CONTROL CONSOLE

The Operator's Control Console contains the Switches, Gauges, Communication Devices, and Operating Handles, which are necessary for the operation of the locomotive. Individual components and their functions are described in the following paragraphs:

AIR BRAKE EQUIPMENT

The locomotive is equipped with the 26LU-L Pneumatic Brake System which is blended with Dynamic Brakes. The combining of the two systems is accomplished automatically whenever the Automatic Brake Valve Handle is placed in the service APPLICATION position, and the Throttle Handle is in IDLE. The Blended Brake feature is nullified at speeds below 3.22 km/hour (2 MPH). The locomotive will not transfer into Blended or Dynamic Braking when the locomotive is at a standstill. Minor fluctuations in brake cylinder pressure may be caused by the normal operation of the Blended Brake System, and should not be cause for alarm. The 26LU-L equipment is suitable for Multiple Unit operation with other similarly equipped locomotives.

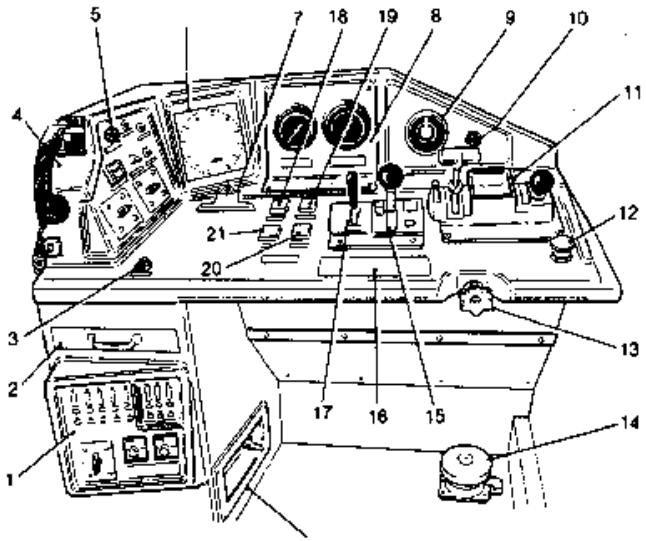
30CDW BRAKE VALVE

The 30CDW Brake Valve houses the Automatic and Independent Brake controls, and the Cut-Off Pilot Valve. Both brake handles are operated in a forward-backward motion. The brakes are released at the backward position.

AUTOMATIC BRAKE VALVE

The Automatic Brake Valve controls the application and release of both the locomotive and the train brakes. 1t is a self-lapping, pressure maintaining valve, which is capable of gradually applying and releasing the brakes.

The following is a description of the six detent positions of the Brake Valve Handle, starting with the most backward position.



1 - Instrument Panel
2 - Lunch Tray
3 - Speed Indicator Light Dimmer
4 - Two-Way Radio Handset
5 - Switch Panel
8 - Speed Indicator
7 - Paper Clip
B - Air Gauges
9 - Load Current Indicator Meter
10 - Ammeter Light Dimrner
11 - 30 CDW Brake Valve
12 - Alertness/RSC Reset Push Button
13 - Trainline Air Pressure Adjustment Valve
14 - Alertness/RSC Reset Foot Pedal
15 - Controller
18 - Controller Operation Instruction Plate
17 - Reverser Handle
18 - Manual Sand Push Button
19 - lead Truck Sand Push Button
20 - Hom Push Button
21 - Bell Push Button
22 - Multiple Unit Valve

Fig. 2-9 - Operator's Control Console

RELEASE

This position is used to release an automatic brake application, and to charge the brake system.

MINIMUM REDUCTION

The Minimum Reduction position provides a 44 to 48 kPa (6 to 7 psi) pressure reduction in the equalizing reservoir. This reduction reduces the brake pipe pressure by a similar amount.

SERVICE ZONE

This position consists of the zone through which brake handle movement regulates the air pipe pressure, from a value which is lower than Minimum Reduction, to a maximum value for a Full Service brake application. To increase the brake application, the handle is moved forward through this sector. When the handle reaches the Full Service position, maximum service braking effort is obtained.

SUPPRESSION

This position is used to suppress an overspeed or safety penalty brake application, while still providing a Full Service braking effort.

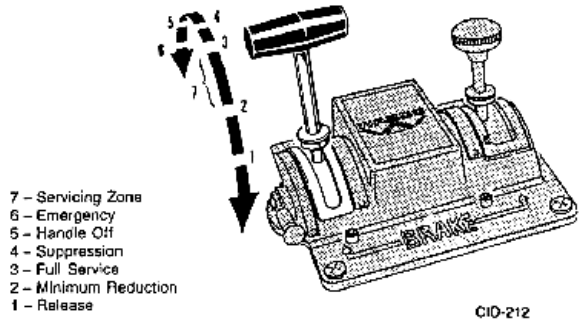


Fig. 2-10 - Automatic Brake

HANDLE OFF

In the HANDLE OFF position, the brake pipe air pressure is reduced to approximately zero, and the brake valve is rendered inoperative. The handle must be in this position, and pulled out, when the locomotive is used as a trailing unit, or is being hauled DEAD in a train. To remove the handle, depress the ring until it touches the valve body. Then, pull out the handle. To reapply the handle, push it firmly into the locating hole while depressing the ring until it touches the valve body. Finally, release the ring into its normal position. The handle is now locked in place.

EMERGENCY

This is the most forward detent position of the Automatic Brake Valve Handle. In this position, the brake pipe air pressure is vented to atmosphere at the fastest possible rate, and thereby provides a rapid emergency brake application.

The EMERGENCY position is also used to reset the air brake system after a train emergency application, which was originated through the emergency valve, or if a break-intwo has occurred in the air hose couplings between train cars.

INDEPENDENT BRAKE VALVE

This brake valve provides independent control of the locomotive braking effort, irrespective of the train braking effort. The Independent Brake Valve is self-lapping, and will hold the brakes applied at a specific level of braking effort. The valve handle has two detent positions, and a bail function:

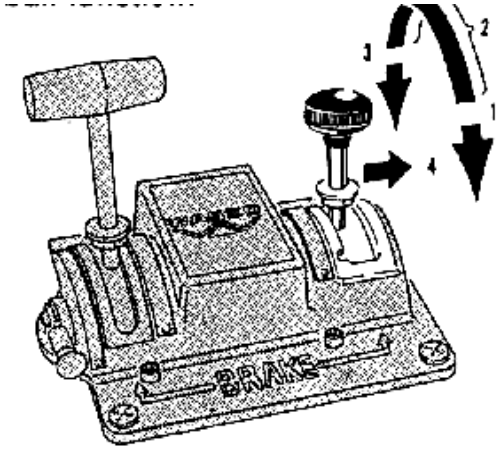


Fig. 2-11 - Independent Brake Valve

RELEASE

This is the most backward position of the handle. It releases the

locomotive brakes, provided that the Automatic Brake Valve Handle is also in the RELEASE position.

When the locomotive is used as a trailing unit, or is being hauled DEAD in a train, the Independent Brake Valve Handle should be placed in this position, and should be removed. The procedure for the removal, and reapplication of the Independent Brake Valve Handle, is identical to the procedure for the Automatic Brake Valve Handle.

APPLICATION

Moving the handle forward through the APPLICATION Zone increases the degree of locomotive braking effort. At the most forward position, Full Application braking is obtained.

BAIL FUNCTION

When the handle is in the RELEASE position, deflection of the Independent Brake Valve Handle to the right causes the release of any automatic brake application on the locomotive.

If the Independent Brake Valve Handle is depressed when it is in the APPLICATION zone, it will release the automatic application of the locomotive brakes, to a value which corresponds to the position

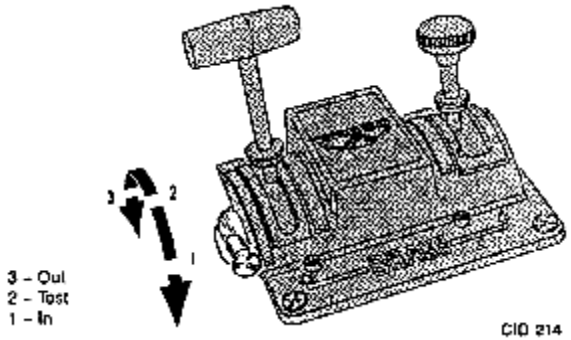


Fig. 2-12 - Cut-Off Pilot Valve

of the Independent Brake Valve Handle.

CUT-OFF PILOT VALVE

The Cut-Off Pilot Valve provides the Operator with a means to isolate the brake valve from the brake system. It also permits the measurement of brake pipe leakage. The valve has the following three detent positions:

IN

When the locomotive is used as the lead, or control unit for all operations, the Cutoff Pilot Valve control knob must be pushed in and rotated to this position.

TEST

The TEST position is only used to measure brake pipe leakage.

OUT

This position is to be used when the locomotive is in service as a trailing unit in a Multiple Unit consist, or when the locomotive is being hauled DEAD in a train.

MULTIPLE UNITS VALVE - (MU-2A Valve)

The MU-2A Valve, which is illustrated in Figure 2-13, is located near the bottom of the left-hand inside panel of the Operator's Console. The MU-2A valve conditions locomotives that are equipped with 26LU-L type brakes, so that they can be used in Multiple-Unit operation with other 26L and 24RL equipped locomotives.

This is accomplished by conditioning leading and trailing units in M.U. operation, to permit independent brake control from the lead locomotive. This ensures that the brake cylinder buildup, and release, is the same on all units.

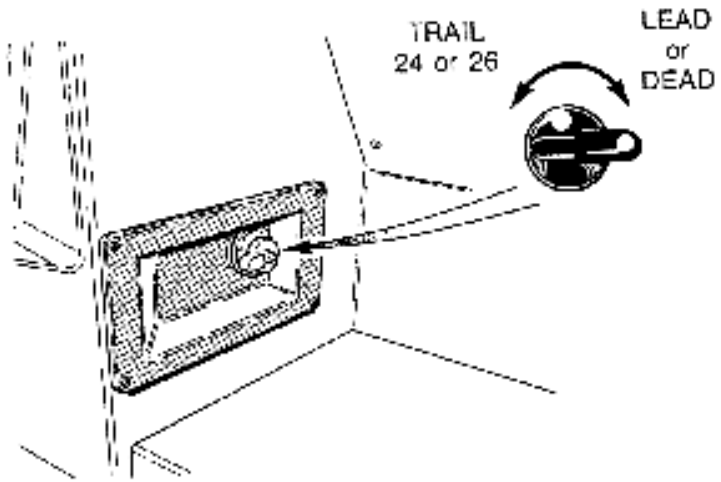


Fig. 2-13 - Multiple Units Valve (MU-2A Valve)

When the locomotive is used as a LEAD Unit, or hauled DEAD in a train, the MU-2A Valve must be rotated to the LEAD or DEAD position.

When the locomotive is used as a Trailing Unit, the MU2A Valve must be placed in the TRAIL - 24 or 26 position. To position the Valve, push and turn the knob to the desired selection.

TRAINLINE AIR PRESSURE ADJUSTMENT VALVE

This valve, which is located in front of the brake control valve, is used to obtain the necessary brake pipe pressure. When setting the pressure, the Automatic Brake Valve Handle must be in the RELEASE position.

AIR GAUGES

The dual Air Gauges, located in the center of the Console, indicate the various brake system pressures.

RIGHT-HAND GAUGE:

The Red hand indicates BRAKE CYLINDER Pressure. The White hand indicates BRAKE PIPE Pressure.

LEFT-HAND GAUGE:

The Red hand indicates MAIN RESERVOIR Pressure. The White hand indicates EQUALIZING RESERVOIR Pressure.

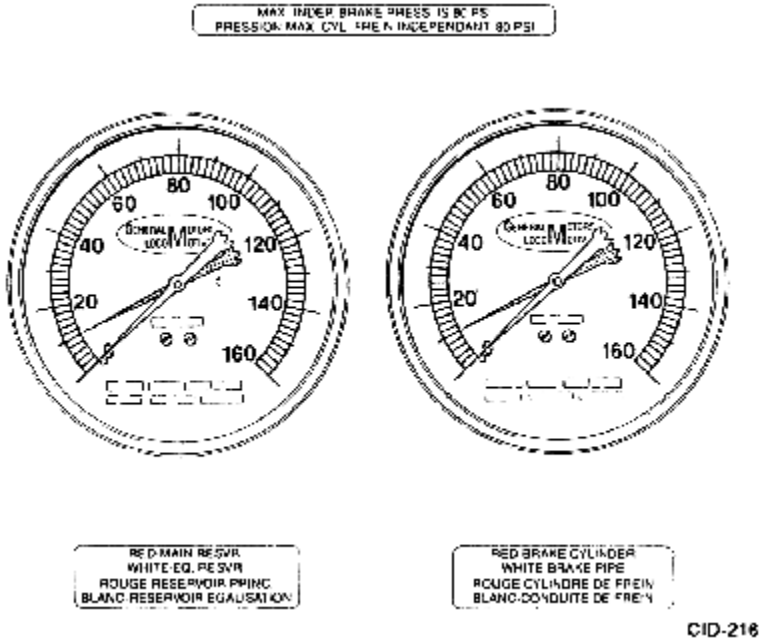


Fig. 2-14 - Air Gauges

26LU-L AIR BRAKE EQUIPMENT OPERATING POSITIONS

Specific instructions are usually issued by the railroad to cover its own recommended practices. In the absence of these instructions, refer to the Chart in Figure 2-15 for the brake equipment operating positions most often encountered while the locomotive is in service.

Type Of Service	Automatic Brake Valve	Independent Brake Valve	Brake Valve Cut-Off Valve	Dead Engine Cutout Cock	26F Control Valve	26C Brake Valve	Multiple Unit Valve: MU-2A Valve	Multiple Unit Valve: Dual Ported Cutout Cock	Overspeed Cutout Cock	Deadman Cutout Cock
Lead	Release	Release	In	Closed	Graduated		Lead Dead	Open	Open	Open
Trail	Handle Off Position	Release	Out	Closed	Graduated		*Trail	Closed	Open	Open
Shipping Dead In Train	Handle Off Position	Release	Out	Open	Direct Release	Relief Valve At Control Reservoir 503 kPa ± 21 kPa (73 ± 2 psi)	Lead Dead	Open	Closed	Closed

*MU-2A Valve in TRAIL position only when MU control hoses are coupled.

Fig. 2-15 - Air Brake Equipment Positions

CONTROLLER

The Controller has two operating handles: the THROTTLE, and the REVERSER.

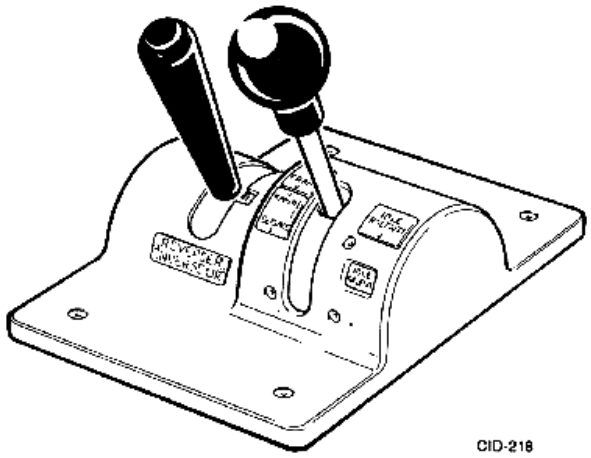


Fig. 2-16 - Controller

REVERSER Handle

This handle, which is located to the left, has three detent positions: CENTERED (Neutral), FORWARD, and REVERSE.

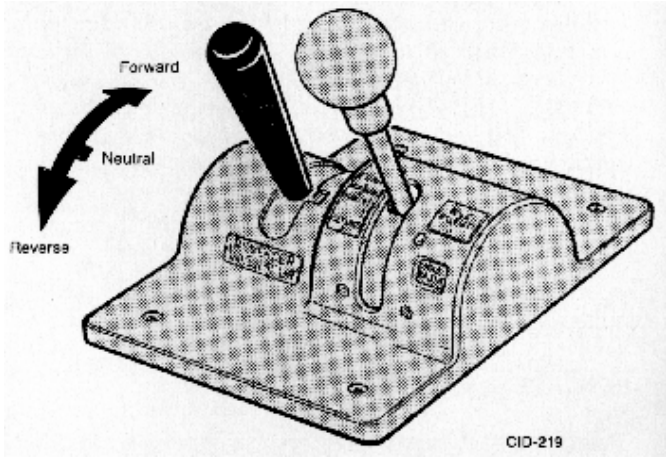


Fig. 2-17 - Reverser Handle

CENTERED Position

In the CENTERED position, the locomotive is in "Neutral". It cannot be moved in either direction on its own power. The handle can be removed to prevent movement of the Reverser, and to lock the Throttle Handle in the IDLE position.

When the locomotive is used as a trailing unit, the Reverser Handle should be removed.

NOTE

Engine speed will be automatically reduced to low IDLE when the Reverser Handle is CENTERED. For normal IDLE speed, the Reverser Handle should be in either the FORWARD, or REVERSE position.

CAUTION

The Reverser direction should not be changed unless the locomotive Is completely stopped. If the Reverser Is moved from FORWARD to REVERSE, or from REVERSE to FORWARD while the locomotive is in motion, this could cause plugging, and ultimately, damage to the Traction Motors.

FORWARD Position

The locomotive will be set up for forward motion when the Reverser Handle is pushed FORWARD.

REVERSE Position

Pulling the handle backwards will set up the locomotive for REVERSE motion.

NOTE

Mechanical interlocking ensures that the Reverser Handle can only be moved when the Throttle Handle is in the IDLE position.

THROTTLE Handle

The Throttle Handle has nine detent positions: IDLE, plus 8 power positions. When the Reverser Handle is CENTERED, and removed from the Controller, mechanical interlocking prevents the Throttle Handle from being moved out of IDLE into the power positions.

When operating the locomotive with the Head End Power Mode Switch in the RUN position, and with the Auxiliary AC (Head End) Power System engaged, the diesel engine will remain at a full speed of 893 RPM in all throttle positions. When operating the locomotive with the Head End Power Mode Switch in the STANDBY position, and with the Auxiliary AC (Head End) Power System engaged, the diesel engine will remain at a constant speed

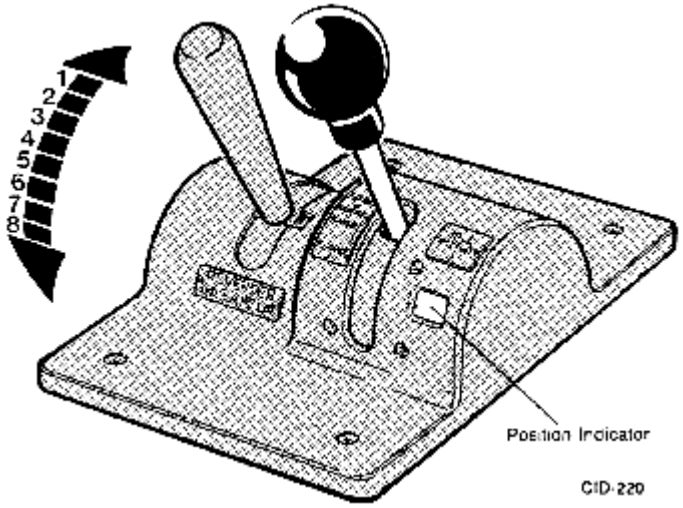


Fig. 2-18 Throttle Handle

of 720 RPM in all throttle positions. No traction power is available in the STANDBY position.

When operating the locomotive without the Auxiliary AC (Head End) Power system engaged, the RPMs of the diesel engine would be relative to the throttle position. This would be similar to a conventional freight locomotive.

MECHANICAL INTERLOCKS ON THE CONTROLLER

The handles on the Controller are interlocked, so that:

1. With the Reverser Handle CENTERED (in neutral), the Throttle can be moved to any position. If the Throttle is in IDLE, the Reverser Handle can be removed from Controller.

2. When the Reverser Handle is in FORWARD or REVERSE, the Throttle can be moved to any position.

3. If the Reverser Handle is removed from the Controller, the Throttle will be locked in the IDLE position.

4. With the Throttle in the IDLE position, the Reverser Handle can be placed in the CENTERED (neutral), FORWARD, or REVERSE position, or it can be removed from the Controller.

5. The Reverser Handle cannot be moved when the Throttle is in any notch above the IDLE position.

ALERTNESS RESET Push Button

This Push Button is located on the Control Console, and is used to reset the Vigilance Control function of the Event Recorder. On locomotives with Road Numbers 6400 to 6429, this device is referred to as the Reset and Sensing Control (RSC) System. (Refer to the Event Recorder system

description under MISCELLANEOUS DEVICES, at the end of this Section).

ALERTNESS RESET Foot Pedal

This foot activated Switch, located on the floor by the driver's seat, serves the same purpose as the Alertness Reset Push Button.

LOAD/BRAKE CURRENT INDICATING METER

The Load/Brake Ammeter, which is located at the right side of the Control Console, indicates traction motor load current, as well as braking current. The Meter face is graduated to show Amperes of electrical current. It indicates zero current when the needle points straight up. The needle swings to the right of zero to indicate Load Current, and to the left of zero to indicate Dynamic Braking Current.

NOTE

The Ammeter is connected in such a way, as to indicate the current flow through the No. 2 Traction Motor. Since the Amperage is the same in all motors, each motor will carry the amount shown on the Meter.

If the No. 2 Traction Motor is cut out, there will be no reading on the Load/Brake Current Indicating Meter. When a traction motor is cut out, control circuits will limit locomotive power, in order to allow the unit to proceed to the next maintenance point.

When measuring Load Current, the Ammeter indicates the pulling force of the locomotive with a maximum possible current of 1500 Amperes. A RED zone on the Meter face, between 1050 and 1500 Amps, shows when current levels are too high for continuous operation.

CAUTION

Observe the short time rating Indication In the RED Zone of the Ammeter pertaining to low speed, full-throttle operation.

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. This is due to the fact that engine speed, and consequently traction motor cooling air, are reduced.

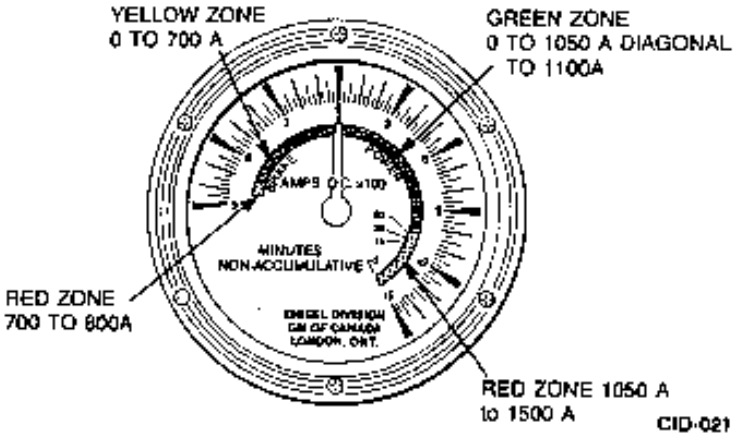


Fig. 2-19 - Load/Brake Current Indicating Meter

In Dynamic Braking, the maximum current is indicated a 800 Amperes, with a "RED Zone" between 700 and 801 Amperes.

Since the Dynamic Brake Regulator controls maximun braking current, the Ammeter should seldom, (if ever) indicate more than 700 Amperes, which is the rating of the Dynamic Braking Resistor Grids.

NOTE

The Wheel Slip Control System functions to correct slips, by an instantaneous reduction of power in small increments, and by the

application of sand. When there is a large number of power reductions in rapid succession, the cumulative effect causes the locomotive to maintain power at a level where adhesion can be maintained. Do not misinterpret this loss of power as a defect in the control system.

AMMETER LIGHT DIMMER

This Dimmer, located to the right of the Ammeter, is used to control the brightness of the Ammeter Light.

SPEED INDICATOR

The Speed Indicator shows the locomotive speed in Miles Per Hour.

SPEED INDICATOR LIGHT DIMMER

This Dimmer, located on the Control Console below the Speed Indicator, is used to control the brightness of the Speed Indicator Light.

MANUAL SAND Push Button

When operated, this non-latching Switch supplies a signal to the Sanding Module, SA10. The Sanding Module then determines the direction of locomotive travel, and directs the trainlined signal to the appropriate (forward, or reverse) Sanding Magnet Valves.

LEAD TRUCK SAND Push Button

When operated, this non-latching Switch supplies a signal to the Sanding Module, SA10. The Sanding Module determines in which direction the locomotive is moving, and directs a signal to provide sand to the lead truck only. This method of sanding dresses the rail, and is adequate for most conditions. The signal is not trainlined.

BELL Push Button

This Push Button has two distinctly divided areas. To activate the locomotive Signal Bell, depress the section of the Push Button marked ON (start). The Bell will keep ringing, until the section marked OFF is depressed.

HORN Push Button

This Push Button activates both the Horn and the Signal Bell. The Bell can only be silenced with the Bell Control Switch.

SWITCH PANEL

The Switch Panel, located on the left side of the Control Console, contains the following switches:

M.U. ENGINE STOP Push Button

This Push Button Switch is used to stop all engines in a consist. It is a dual purpose "Push On/Push Off" type switch, with two distinct sections. Both sections can be independently activated.

To shut down all engines in a consist, depress the RED coloured section of the Switch, identified as "STOP".

To reset the engine start systems for all engines in a consist, depress the BLACK coloured section of the Switch, marked "RUN."

During normal operation, the RUN section of the Switch must be activated (depressed).

GA LTS Dimmer Switch

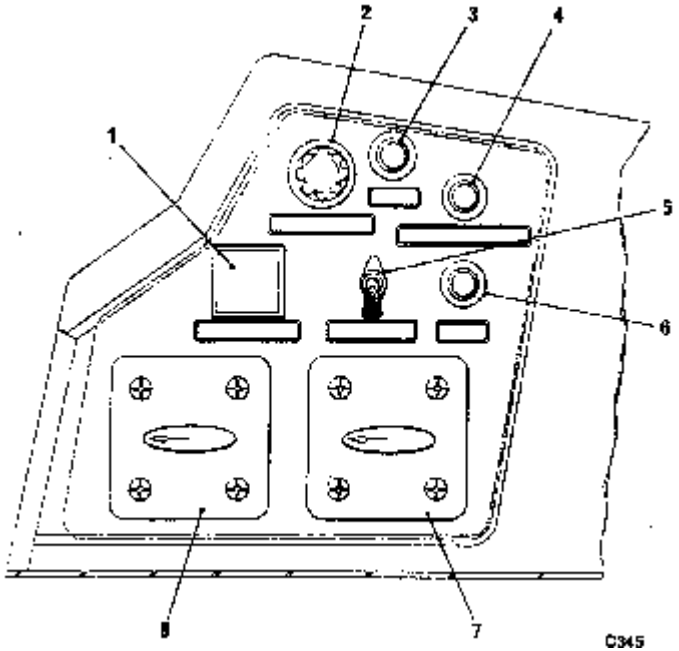
This Dimmer Switch is used to control the brightness of the Gauge Lights.

SILENCE Push Button

The Pushbutton may be used to silence Banking Control System audible alarms. However, indicator lights will still remain active until the alarm condition has been corrected. BLENDED BRAKE, BBL,

RESET Push Button

This Pushbutton is used to reset a lockout of the Blended Brake System. A lockout can occur when the total braking effort goes abnormally high for an extended period of time. This reset is a trainlined function in the Blended Brake control system.



1 - Multiple Unit Engine Stop Push Button
2 - Gauge Lights Dimmer
3 - Silence Push Button
4 - Blended Brake Lockout Reset Push Button
5 - Ditch Lights Switch
6 Attendant Call Push Button
7 - Front Headlight Switch
8 - Rear Headlight Switch

Fig. 2-20 - Switch Panel

DITCH LIGHTS Switch

This Switch controls the operation of the Ditch Lights.

ATTENDANT CALL Push Button

When this button is pressed in any unit of a locomotive consist, the audible alarms will ring in all units.

HEADLIGHT Switches

Two (2) four-position rotary snap switches are provided for independent control of the Front, and Rear Headlights. Each rotary switch has four positions: OFF, DIM, MED, and BRT. All four positions of each switch are operative. However, in a multiple unit consist, the Headlight Control Switches must be properly positioned at the Engine Control Panels of each unit in the consist. In this case, the Headlights will be controlled from the lead unit only.

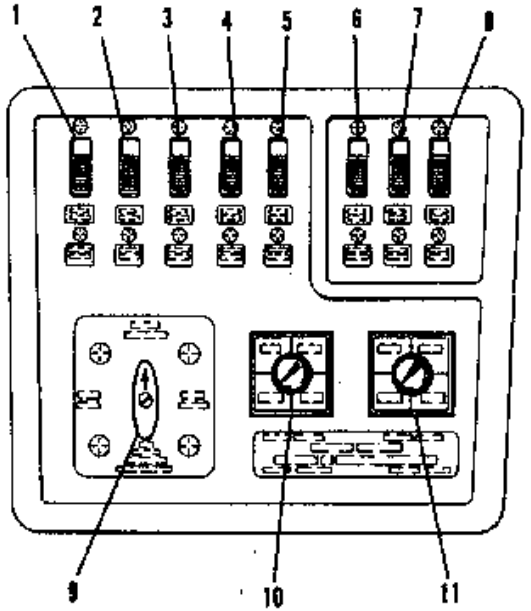
INSTRUMENT PANEL

Switches, which control various functions of the locomotive, are mounted on this Panel. At the top of the Panel is a row of eight slide-on switches. When slid upward, they snap into the ON position.

The Fuel Pump and Control Switch, the Generator Field Switch, and the Engine Run Switch must be ON in the lead unit of a locomotive consist, and must be OFF in trailing units.
Following, is a brief description of the Instrument Panel switches:

HTD W/S Switch

This Switch controls the operation of the Windshield Heaters.



1 - Heated Windshield Switch
2 - Gauge Lights Switch
3 - Back Stop Light Switch
4 - Front Stop Light Switch
5 - Ground Light Switch
6 - Fuel Pump and Control Switch
7 - Generator Field Switch
8 - Engine Run Switch
8 - Heater Switch
10 - Front Left Class Light Switch
11 - Front Right Class Light Switch

Fig. 2-21 - Instrument Panel

GAUGE LTS Switch

This Switch controls the operation of the Gauge Lights.

STEP LTS - BK Switch

This Switch controls the operation of the right, and left side, rear Step Lights.

STEP LTS - FR Switch

This Switch controls the operation of the right side, and left side, front Step Lights.

GRD LTS Switch

This Switch controls the operation of the Ground Lights on the right and left sides of the locomotive.

The following three switches must always be ON in a single or lead unit of a consist, and must be OFF in a trailing unit.

FP AND CONT Switch

This Switch provides power to various low voltage control circuits. It must be in the ON position to start the engine, and to operate the fuel pump.

ENGINE RUN Switch

This Switch must be ON to obtain throttle control of the engine speed. If the Engine Run Switch is OFF, the engine will run at IDLE, regardless of the Throttle Handle position. GEN. FIELD Switch

In order to complete the excitation circuits to the Traction Alternator, the Generator Field Switch must be ON. If the Switch is in the OFF position, the engine will respond to the Throttle, but the generator will not develop power.

HEATER Switch

This Rotary Switch, which is used to control the Cab Heater, has the four following positions: OFF, LO, HI and FAN.

CAUTION

After the Switch has been placed In the OFF position, the fan may keep running to cool the heater elements. Do not open the Cab Heater Fan Control Circuit Breaker before the fan has stopped.

The heater elements are protected against high heat damage by a thermostat. In the event that the heater is automatically shut off by the protective device, the heater circuit must be manually reset.

In order to reset the heater circuit, the Cab Heater Fan Control Circuit Breaker must first be cycled OFF, and then back ON.

If the heater is automatically shut off again, notify maintenance personnel.

CLASS LIGHTS Switch

These two Switches provide independent control of the colour of the Classification Lights, located at the front of locomotive. To select a classification colour, turn the selector knob until the arrow points toward the appropriate colour displayed on the switch frontal area.

The Classification Switches must be operated in accordance with specific railroad instructions.

TWO-WAY RADIO Handset

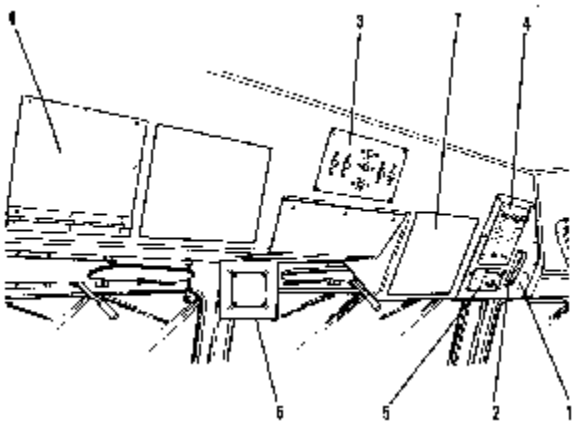
This Handset is used in conjunction with the Two-Way Radio Control Unit mounted on the Overhead Console.

OVERHEAD CONSOLE

The Overhead Console contains various Operation, Communication, and Indicating Devices. Individual components and their functions are described in the paragraphs which follow:

CREW ALERT PANEL (Road Numbers 6430 -6458)

The Crew Alert Panel operates in conjunction with the Event



1- Crew Alert/RSC System Audible Alarm
2- Crew Alert Panel/RSC Alarm Control Panel
3- Indicating Light Panel
4- Warning Light Panel
5- Two-way Radio Control Panel
8- Speed Indicator
7- PA/Intercom System Panel
B- Steam Generator Panel

Fig. 2-22 - Overhead Console

Recorder/Crew Alertness System. In order to prove Crew Alertness, it informs the engineer when an Event Recorder "Reset" must be initiated. It shows the status of the system by means of ALARM Lights, SYSTEM DEFECT Lights, and a System OVERRIDE Light.

RSC ALARM CONTROL PANEL (Road Numbers 6400 - 6429)

This Panel, which operates in conjunction with the Event Recorder/RSC System, performs the same function as the Crew Alert Panel. It contains two Warning Lights and a System DEFECTIVE Light.

CREW ALERT AUDIBLE ALARM

This pulsed, increasing-frequency, Audible Alarm accompanies the Crew Alert Panel visual alarms. On Locomotive Units 6400 through

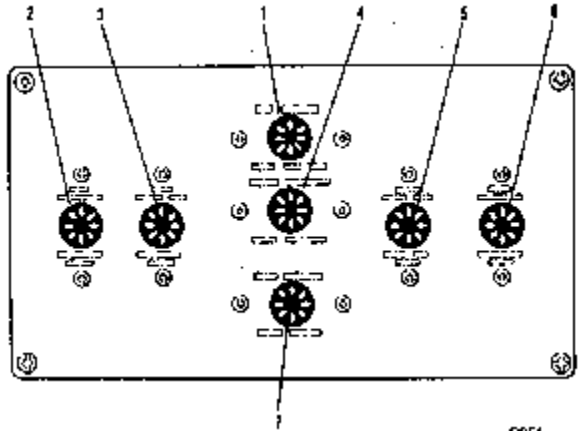
6429, this component is referred to as the RSC System Audible Alarm.

NOTE

For additional information, refer to the Event Recorder system description under MISCELLANEOUS DEVICES, at the end of this Section.

INDICATING LIGHT PANEL

The Lights on this Panel indicate the operation of various systems within the locomotive. When the devices listed on this Panel are in service, the appropriate Indicating Light will be ON.



1- Top Headlight
2- Left Defroster
3- Left Ditchlight
4- Bottom Headlight
5- Right Ditchlight
B- Right Defroster
7- Rear Headlight

Fig. 2-23 - Indicating Light Panel

WARNING LIGHT PANEL

The Warning Light Panel, located on the upper right hand side of

the Console, contains Train and Locomotive Warning Lights, which will be activated due to a fault or warning condition. The lights are divided into two distinct vertical banks. The right hand bank indicates faults on the locomotive, and the left bank indicates faults on the train (cars). The Panel is also equipped with a test switch, as illustrated in Figure 2-24.

The test switch is spring loaded, and may be held CLOSED to test the operation of the warning lights.

LOCOMOTIVE WARNING LIGHTS

PCS OPEN Light

This Light comes on to indicate a safety control or emergency air brake application. In this event, the Pneumatic Control Switch, PCS, functions to automatically cut power to the traction motors. Locomotive power is restored by resetting the PCS Switch. This occurs automatically, provided that:

1. Control of the air brake is recovered, by placing the Automatic Brake Valve Handle in the SUPPRESSION position.

2. The Throttle is returned to the IDLE position.

GROUND FAULT Light

This Light indicates that an electrical path to ground has occurred, or that a group of five diodes in the main generator has failed. The audible alarm is activated when the Light comes ON. In this situation, it is not necessary to isolate the unit, nor is it necessary to return the Throttle to IDLE. The locomotive is equipped with an automatic Ground Relay Reset. At the first, second, and third ground fault indication, the GROUND FAULT Light will come on for 10 to 20 seconds. At the fourth indication, the Light will stay on.

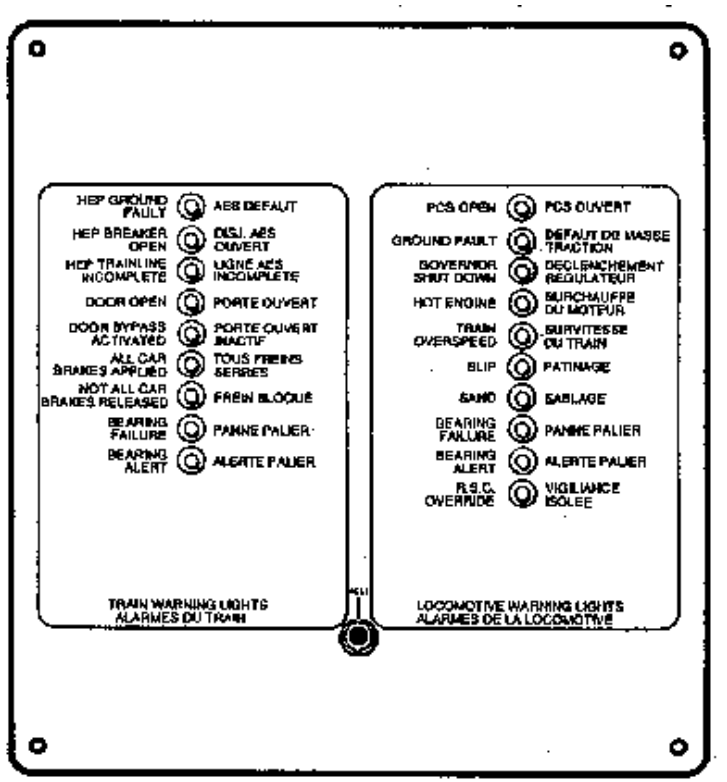


Fig. 2-24 - Overhead Console Warning Light Panel

A ground fault lockout can be reset with the Ground Relay Lockout Reset Switch. The Reset Switch is located on the Fuse and Switch Panel.

WARNING

Always report ground relay Light Indications to the proper maintenance personnel.

GOVERNOR SHUT DOWN Light

This Light indicates either a power reduction, or a complete engine shut down:

1. A clogged engine air filter will reduce engine power and speed by two notches when in Throttle 7 or 8.

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 the airbox pressure.

   d. Crankcase (oil pan) overpressure.

   e. A plugged engine air filter.

A mechanism to detect low engine lubrication oil pressure is built into the engine governor. This mechanism is activated by true oil pressure failure, or by dumping oil from the engine oil line that leads to the governor. In either event, a small button will pop out of the governor body. This indicates 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, or low water pressure 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 verified by checking for a protruding reset button on either the crankcase pressure, or low water pressure detecting device. (This device is illustrated in Figure 2-37). A protruding LOWER button indicates excessive crankcase pressure; a protruding UPPER button .indicates low water pressure.

WARNING

Once It has been determined that the 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 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 the engine shutdown circumstances to authorized maintenance personnel.

HOT ENGINE Light

This Light operates in conjunction with the audible alarm to warn the operator that the engine coolant has reached an excessively high temperature. When operating in Throttle positions 7 or 8, a Hot Engine condition will automatically reduce engine speed and power to Throttle positions 5 or 6 respectively. If operating in Throttle position 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 will sound.

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

TRAIN OVERSPEED Light

If the maximum allowable locomotive speed is exceeded, this Light will come on, and a warning whistle will sound. The whistle will sound for approximately 6 seconds. During this tiem, the speed

must be reduced in order to avoid a penalty brake application.

SLIP Light

Intermittent flashing of the Wheel Slip Light, and sounding of the buzzer, indicates a moderate to severe wheel slip. The Wheel Slip Control System is doing its job, and is correcting the slips. The Throttle (locomotive power) should not be reduced, unless severe lurching threatens to break the train.

A minor slip may not activate the Wheel Slip Light. However, automatic sanding may take place, along with the regulation of power. Do not misinterpret this power control as a loss of power due to a fault.

A continuous Wheel Slip Light, accompanied by the buzzer, could indicate a locked wheel.

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.

SAND Light

This Light indicates that the Lead Truck Sand Switch on the Control Console is ON. When activated, the system will provide continuous sanding at the leading truck of the locomotive consist. This method of sanding dresses the rails, and is adequate for most conditions.

BEARING FAILURE Light

This Light indicates that a locomotive suspension or journal

bearing has failed, normally at a temperature above 1210C (249.8°F). This Light may also indicate that the monitor is defective. When this Light is ON, the modulating buzzer will sound.

WARNING

If this Light comes on, applicable railroad instructions must be followed.

BEARING ALERT Light

This Light warns the operator that a locomotive suspension or journal bearing temperature is abnormal, above 101°C (213.8°F), or that a temperature sensor has failed.

WARNING

If this Light comes on, applicable railroad Instructions must be followed.

R.S.C. OVERRIDE Light

This Light indicates that the Override Switch for the Event Recorder has been placed in the OVERRIDE position. TRAIN

WARNING LIGHTS

HEP GROUND FAULT Light

This Light indicates a ground fault in the Head End Power AC supply. It will stay on until the HEP Ground Detection System is reset. This is accomplished by depressing the Ground Fault Reset Switch.

WARNING

If this Light comes on, applicable railroad Instructions must be followed. Always report ground fault indications to maintenance personnel.

HEP BREAKER OPEN Light

This Light indicates that the main Head End Power Circuit Breaker is OPEN. No power is supplied to the cars. In this event, check the main Head End Power Panel for any tripped protection devices.

HEP TRAINLINE INCOMPLETE Light

This Light indicates that trainline circuits are incomplete, or are incorrectly connected, thereby preventing the AC Contactor from closing.

DOOR OPEN Light

This Light comes on if one or more car doors are open. In this case, the locomotive will be unable to produce tractive power.

DOOR BYPASS ACTIVATED Light

This Light indicates that the Door Bypass Switch is CLOSED. ALL

CAR BRAKES APPLIED Light

This Light will illuminate when all of the car brakes in a train are applied. Failure of the Light to come on, when the automatic brake is applied, indicates that one or more car brakes are not operating.

NOT ALL CAR BRAKES RELEASED Light

This Light indicates that the brakes are applied on one or more cars. This may be caused by a car handbrake remaining applied, or by a faulty braking system.

BEARING FAILURE Light

This Light indicates that a car journal bearing has failed,

normally at a temperature above 121°C (249.8°F). When this Light is on, the modulating buzzer will sound.

WARNING

If this Light comes on, applicable railroad Instructions must be followed.

BEARING ALERT Light

This Light warns the operator that a car journal bearing temperature is abnormal, above 1010C (213.8°F).

WARNING

If this Light comes on, applicable railroad instructions must be followed.

CAR BANKING MONITORING SYSTEM Lights

As illustrated in Figure 2-25, these two Lights are located under the Two-Way Radio.

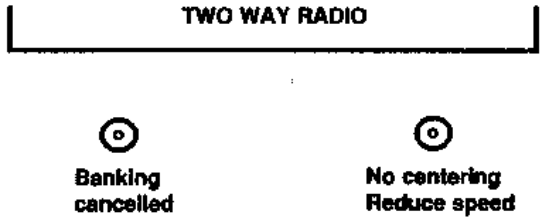


Fig. 2-25 - Car Banking Warning Lights

BANKING CANCELLED Light

This Light indicates a failure of the Banking System in one or more cars. The modulating buzzer will sound for approximately 15 seconds. If a car centering cylinder does not extend, the buzzer will continue to sound until the operator activates the BANKING CUT-OUT Switch.

NO CENTERING - REDUCE SPEED Light

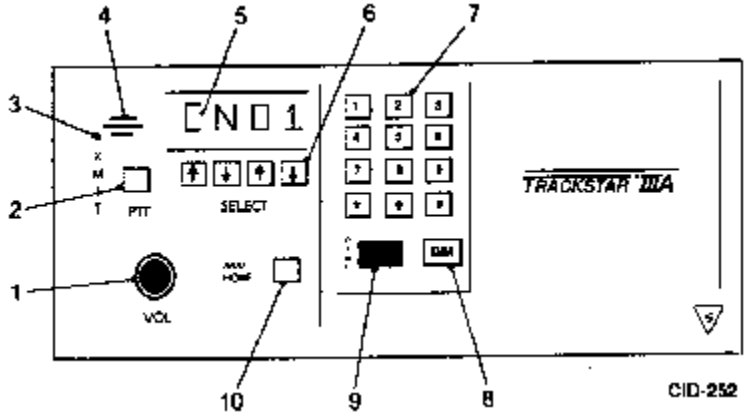
This Light indicates that a car centering cylinder has not extended. The modulating buzzer and Light will remain on for approximately 15 seconds, and will then extinguish.

WARNING

If this Light comes on, applicable railroad Instructions must be followed.

TWO WAY RADIO

The Two-Way "clean-cab" Radio is located under the Warning Light Panel. It contains the necessary controls to communicate with other trains, and with wayside installations. See Figure 2-26. The Radio should be operated in accordance with Railroad Regulations.



1 - Volume Control
2 - Push-To-Talk (PTT) Push Button
3 - Transmit Indicator
4 - Front Panel Microphone
5 - Channel Display
6 - Channel Selection Push Buttons
7 - Keypad and Tone Selector
6 - Display Dim Switch
9 - DTMF/Tone Switch
10 - MR/Home Button

Fig. 2-26 - Two-Way Radio

STEAM GENERATOR PANEL

The Steam Generator Panel is situated overhead, in front of the

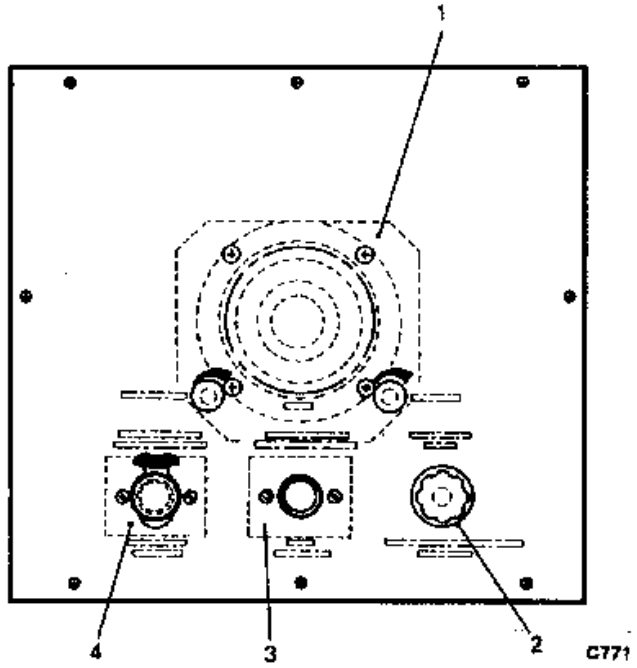
Brakeman's location. As illustrated in Figure 2-27, this Panel contains the following equipment:

SECOND CAB SPEAKER AND CONTROLS

The second cab speaker is located on the Steam Generator Panel. It contains individual controls for both incoming, and outgoing radio communications.

STEAM GENERATOR TRAINLINE SHUTOFF Push Button

This Push Button allows remote control of the Steam Generators on equipment coupled with this locomotive. It energizes the Trainline Shutoff Valve, in order to close the steam supply.



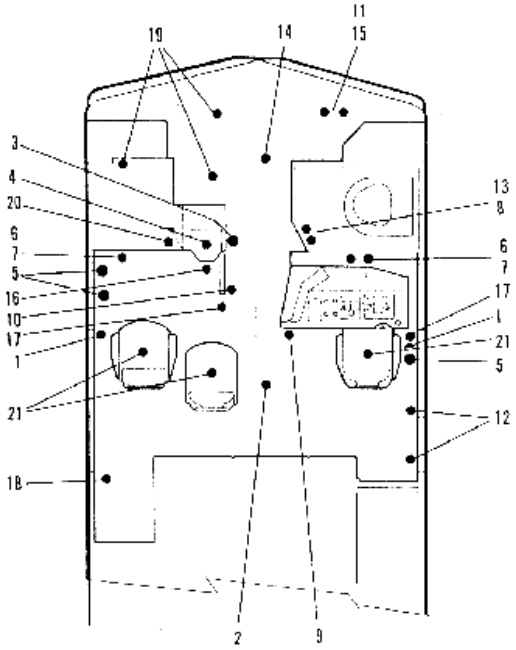
1 - Second Cab Speaker and Controls
2 - Rheostat (Overhead Speed Indicator)
3-Steam Generator Separator Slowdown
4 - Steam Generator Trainline Shutoff

Fig. 2-27 - Steam Generator Panel

STEAM SEPARATOR BLOWDOWN Push Button

This Push Button allows remote control of Steam Generators on equipment coupled with this locomotive. It energizes the Steam Separator Blowdown valve.

CAB AND SHORT HOOD MISCELLANEOUS EQUIPMENT



1 - Reading Light
2 - Overhead Light
3 - Refrigerator
4 - Hot Plate
5 - Heater Vent Control
6 - Windshield Wiper
7 - Heated Windshield
8 - Toilet Room Light
9 - Lunch Tray
10 - Cup Dispenser
11- 18" Pipe Wrench
12- Card Holder
13- Paper Holder
14- Flagman Kit
15- Equipment Box
16- Fire Extinguisher
17- Ashtray
18- Waste Container
19- Light
20- Emergency Brake Valve
21- Seat

Fig. 2-28 - Cab and Short Hood Miscellaneous Equipment

The cab and short hood are equipped with miscellaneous devices for the convenience and safety of the occupants. Figure 2-28 shows the location of these devices.

READING LIGHT AND WINDSHIELD WIPER CONTROL PANEL

A separate Reading Light And Windshield Wiper Control Panel is mounted on each side of the cab. One Panel is situated above the Operator's location, and the other is above the Brakeman's location.

Each Panel contains a light with an integral control switch, as well as the windshield wiper control knob. The knob controls the operation and speed of the wiper on the respective side of the locomotive.

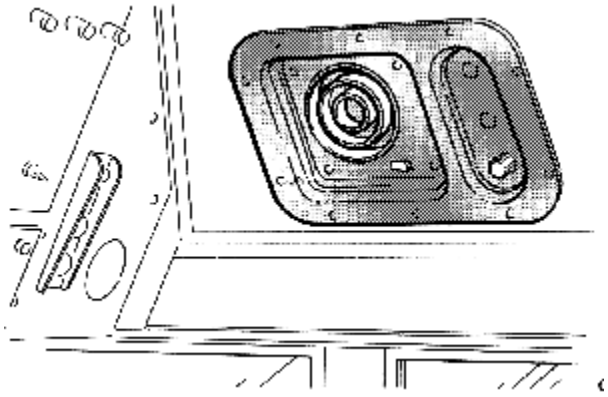


Fig. 2-29 - Reading Light and Windshield Wiper Control Panel

SPEED INDICATOR

A Speed Indicator is provided for use by the Brakeman. It is located under the Overhead Console, between the two windshields, and indicates the speed of the locomotive in Miles Per Hour.

ENGINE ROOM CONTROLS AND DEVICES

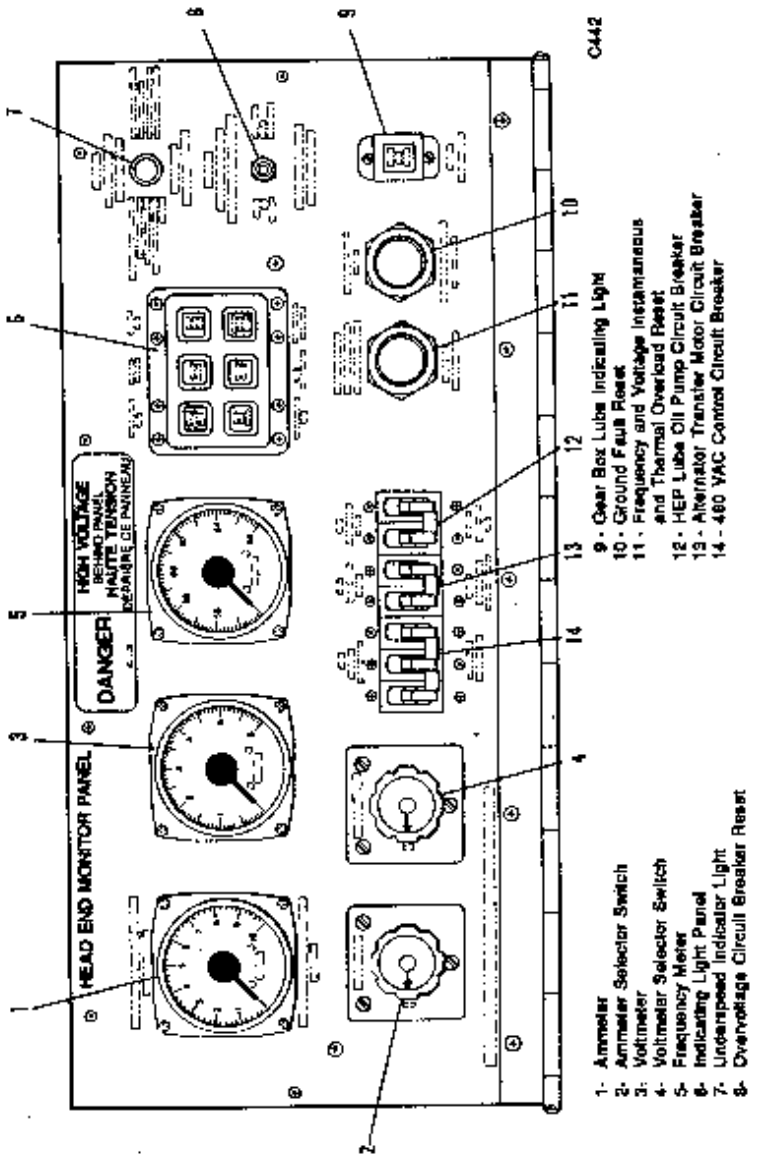


Fig. 2-30 - Head End Monitor Panel

HEAD END POWER MONITOR PANEL

The Head End Power Monitor Panel is mounted on the Head End Power Control Cabinet. It contains monitoring, protective, and control devices, which are associated with the Auxiliary AC Power System. Following is a brief description of the devices:

AMMETER

The Ammeter indicates the output current from the Head End Power Alternator to the trainlihe connections.

AMMETER SWITCH

The Ammeter Switch selects which of the three alternator phases is displayed on the Ammeter.

VOLTMETER

The Voltmeter indicates the output voltage between two phases of the AC Generator.

VOLTMETER SWITCH

The Voltmeter Switch selects which of the two alternator phases that the voltmeter is across. The voltage between these two phases is displayed on the meter.

FREQUENCY METER

The Frequency Meter indicates the frequency of the output voltage, as measured between Phases 1 and 2 of the AC Generator.

INDICATING LIGHT PANEL

The lights on this Panel indicate the condition of the AC Breaker, and the trainline network. Warning indications of instantanuous or

thermal overloads, are also displayed on the Indicating Light Panel.

NOTE

The following Indicator Lights have a push-to-test feature which allows testing of the lamp circuit alone. This determines if the lamp is working properly, while 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.

INST. OVERLOAD Light

This Light indicates that an instantaneous overload has been detected at the AC Contactor, between the AC Power Alternator and the trainlined AC Power Circuit.

FREQ. TRIP Light

This Light comes on to indicate that the Head End (Auxiliary AC) Power System has been disabled by control circuits, due to either an over, or under, frequency condition.

AUX. PWR. T.L. Light

This Light indicates that the trainline jumper cables are in place throughout the train. It also indicates that the Trainline Setup Switch is properly positioned to supply AC power, as selected at the Trainline Setup Switch.

NOTE

Before the AUX. PWR. T.L. Light will come on, the Head End Power Mode Switch must be in the RUN, or STANDBY position.

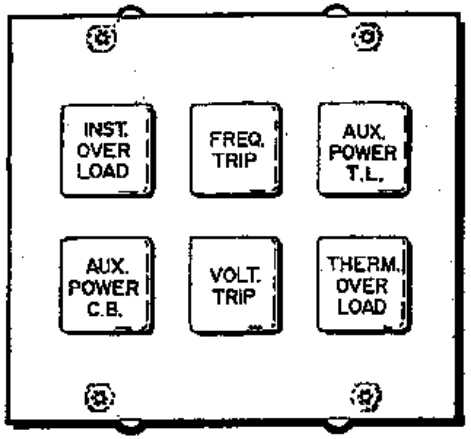


Fig. 2-31 - HEP Monitor Panel Indicating Light Panel

AUX. PWR. C.B. Light

This Light indicates that the AC Contactor (Circuit Breaker) is closed, and that power is being supplied to the trainline circuit.

VOLT TRIP Light

This Light indicates that the Head End (Auxiliary AC) Power System has been disabled by control circuits, due to either an over, or under, voltage condition.

THERM OVERLOAD Light

This Light indicates that a thermal overload has been detected at the AC Contactor, between the AC Power Alternator and the trainlined AC Power Circuit.

LT-HE, UNDERSPEED INDICATOR Light

This Light indicates that the Head End Alternator is not running at a high enough speed; the diesel engine is not turning fast enough.

When the Light is ON, it indicates that the alternator speed is below the level that is necessary to properly maintain the trainlined 480 VAC System at 60 Hz. The alternator output frequency, as seen on the Frequency Meter, will be proportional to engine speed.

CB-HE - OVERVOLTAGE Circuit Breaker Reset

This Push Button resets the Circuit Breaker that protects the Head End Alternator Exciter and Voltage Regulator circuit.

GEAR BOX LUBE Light

When illuminated, the Gear Box Lube Light indicates that the Auxiliary Power Gear Box Lube Pump is not working. The Light should be OFF when the engine is running.

GROUND FAULT RESET Push Button

This Push Button resets the Ground Fault Relay. The Relay provides an indication that a ground fault has occurred, in either the Head End Alternator (in RUN), or the AC output of the Traction Alternator (in STANDBY). When the Ground Fault Relay picks up, the H.E.P. System Ground Light illuminates.

FREQ., VOLT., INST. & THERMAL OVERLOAD RESET Push Button

If an overload is detected at the breaker, between the Head End (Auxiliary AC) Power Alternator and the trainlined AC Power network, this Push Button will reset the instantaneous and thermal overload circuits. If an overload occurs, the overload circuit will interrupt AC power to the train, until the system is reset.

HEP LUBE OIL PUMP Circuit Breaker

This 30A double-pole Circuit Breaker protects the electric

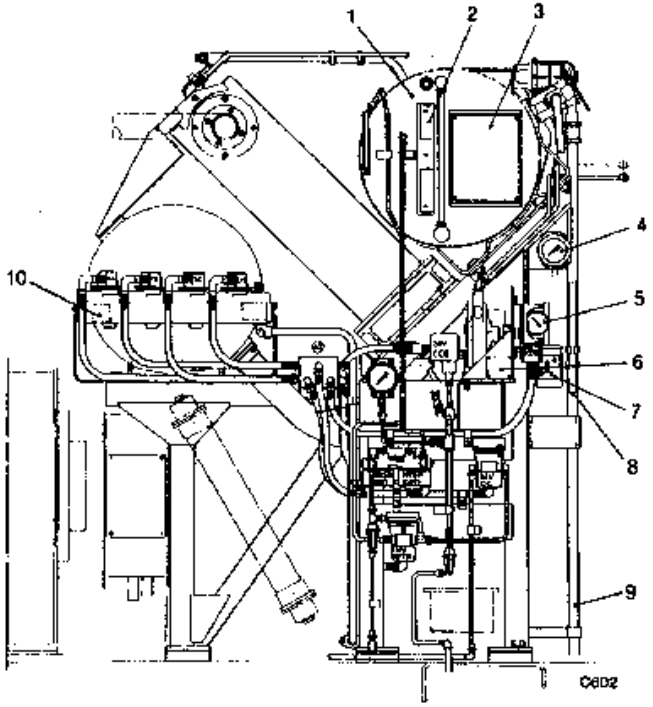
motor, and associated circuitry, for the Recirculating Pump of the Head End Power gear box, and Head End Power Alternator bearing lubrication system.

ALT. TRANSFER MOTOR Circuit Breaker

This 3A double-pole Circuit Breaker protects the Alternator Transfer Switch Motor.

480 V.A.C. CONTROL Circuit Breaker

This 5A triple-pole Circuit Breaker has each of its breaker



1 - Cooling Water Tank
2 - Water Level Sight Gauge
3 - Water Level Instruction Plate
4 - Lube Oil Pressure Gauge
5 - Water Temperature Gauge
6 - Load Regulator
7 - Fuel Prime/Engine Start Switch
6 - Water Filler
9 - Water Tank Overflow
10 - Temperature Switch Manifold

Fig. 2-32 - Engine Start Station

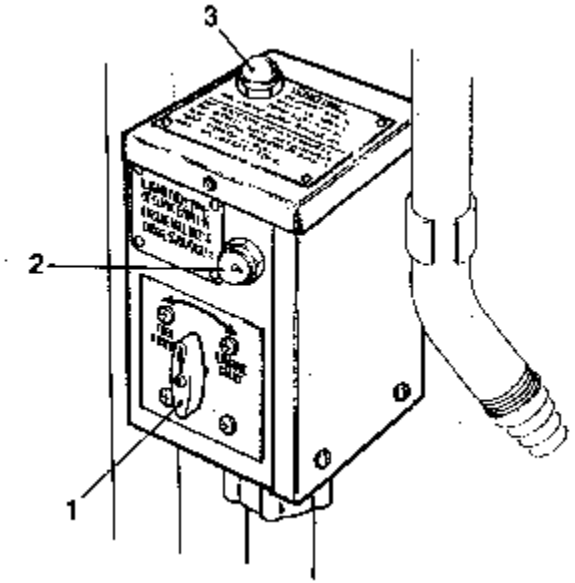
sections between one phase of the Auxiliary AC Power Generator, and the Under/Over-Frequency and Under/OverVoltage protection circuits. In this way, the Circuit Breaker protects these devices, and associated wiring, from an overload in any phase.

ENGINE START STATION

The Main Engine starting and monitoring devices are mounted on the equipment rack, which is located at the front of the engine between the, Head End Power equipment and the engine.

FUEL PRIME/ENGINE START (FP/ES) Switch

This three-position rotary switch, Figure 2-33, is located in a junction box mounted on the equipment rack. The functions of the three positions are as follows:



1. Fuel Prime/Engine Start Switch (FP/ES)
2. Soak Back System Failure Light CID-036
3. Thermal Overload Protection System Light

Fig. 2-33 - Fuel Prime/Engine Start (FP/ES) Switch

FUEL PRIME POSITION

This position is used to prime the engine with fuel, prior to starting. In the Fuel Prime position, the fuel pump motor is energized by battery power, but the engine will not crank. Additional contacts energize the Turbocharger Auxiliary Lube Oil Pump Motor. This ensures a supply of pressurized lube oil to the turbocharger bearings during startup.

ENGINE START POSITION

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

CENTERED (OFF) POSITION

Since the FP/ES Switch is spring loaded, it will return to this position (OFF) when released. While the engine is running, contacts that are normally CLOSED in this position supply power to the fuel pump motor from the Auxiliary Generator.

As illustrated in Figure 2-33, the Soak Back System Failure Light, and the Starter Motor Thermal Overload Protection System Light are mounted adjacent to the FP/ES Switch.

SOAK BACK SYSTEM FAILURE Light

This Light illuminates when a failure exists in the soak back system.

STARTER MOTOR THERMAL OVERLOAD PROTECTION SYSTEM Light

This Light illuminates when the engine starting motors have been overloaded. When the Light comes on, power will not be applied to the starter motors, regardless of the FP/ES

Switch position. When the starter motors have cooled sufficiently to allow a restart attempt, the Light will automatically go' OFF.

INJECTOR RACK MANUAL CONTROL LEVEL (LAYSHAFT)

This engine-mounted, hand operated lever, Figure 2-34, may be used to manually operate the injector racks. It is primarily used to position the injector racks during engine cranking, in order to provide an immediate supply of fuel to the cylinders.

CAUTION

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

MONITORING DEVICES

The locomotive is equipped with monitoring devices to provide a

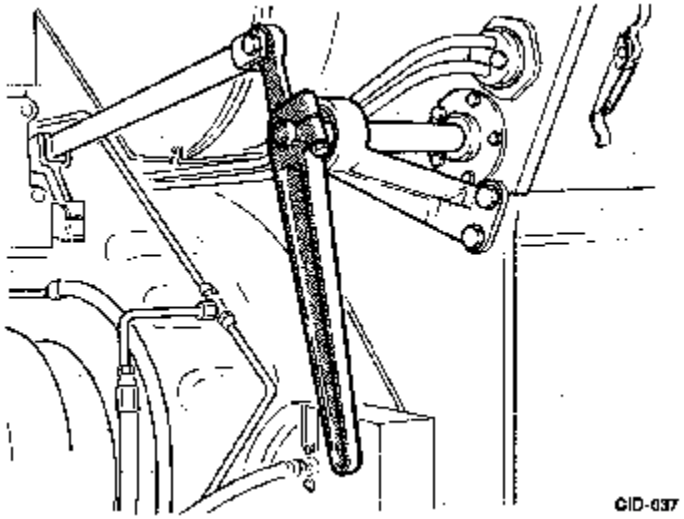


Fig. 2-34 - Injector Rack (Layshaft)

visual indication of the operating conditions for the respective 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. All abnormal readings must be reported to the appropriate maintenance personnel.

WATER LEVEL INSTRUCTION PLATE

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

LUBE OIL PRESSURE GAUGE

This Gauge provides a ready indication of Lube Oil Pressure. During normal operation, oil pressure will increase as the speed of the diesel engine increases.

WATER TEMPERATURE GAUGE

The engine inlet water temperature may be readily checked using the Water Temperature Gauge. The Gauge is colour coded to indicate COLD (blue), NORMAL (green), and HOT (red). A temperature which is approaching the HOT zone may indicate tunnel or similar operation.

FILTER BYPASS GAUGE

The Filter Bypass Gauge indicates the condition of the Primary Fuel Filter. Increased differential pressures across the filter will be indicated by a higher reading on the Gauge. As the pressure increases, a bypass valve will begin to open, and will cause fuel to bypass the Primary Fuel Filter. This bypassing imposes an additional burden on the engine mounted fuel oil filters, which could subsequently shorten their service life. Therefore, this

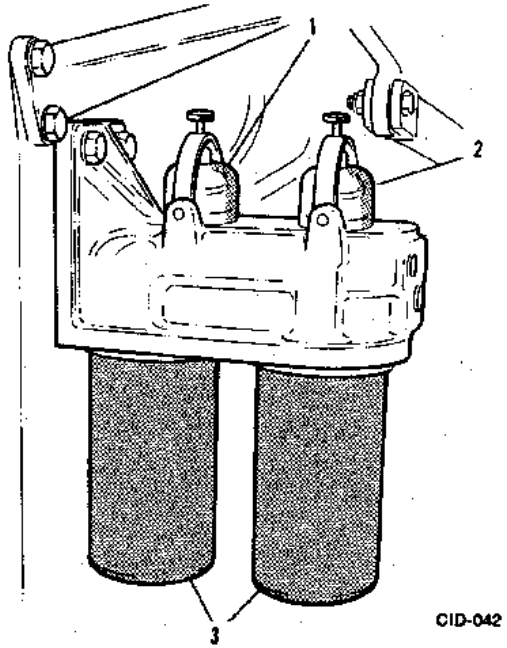
condition should be reported to maintenance personnel as soon as possible.

AIR PRESSURE GAUGE

This Gauge shows the pressure in the No. 1 Main Air Reservoir.

FUEL SIGHT GLASS

In order to give a visual indication of the fuel condition, two Sight Glasses are located on the engine-mounted filter housing.
For proper engine operation, the Return Fuel Sight Glass



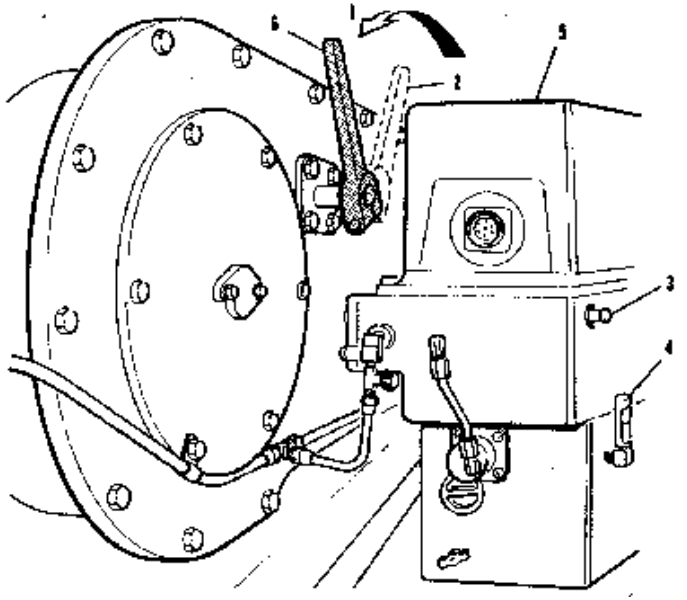
1- Return Fuel Sight Glass (Normally Full)
2- Bypass Sight Glass (Normally Empty)
3- Filter Elements

Fig. 2-35 - Engine Mounted Fuel Filters with Sight Glasses

(adjacent to the engine) should be full, clear, and free of bubbles. At the time of engine start, this Sight Glass may be empty. When the fuel system is primed, turbulent flow will occur. When the fuel in the Sight Glass flows clear and free of bubbles, the engine may be cranked.

The Bypass Sight Glass (farthest from the engine) is normally empty. More than a trickle of fuel in this Sight Glass indicates that the fuel filter elements are becoming clogged. If the condition persists, it may cause the engine to shutdown from lack of fuel.

SAFETY DEVICES



1- To Reset
2- Overspeed Tripped Position
3- Low Oil Trip Plunger Push In To Set
4- ON Level Sight Glass
5- Governor
6- Overspeed Lever

Fig. 2-36 - Governor Low Oil Trip Plunger And Engine Overspeed Trip Reset Lever

LOW OIL PRESSURE DETECTOR

This mechanism, which senses low engine lubricating oil pressure, is built into the engine governor. Under normal operating conditions, engine lubricating oil is supplied to the mechanism under pressure. Should oil pressure drop to a dangerously low level, a small plunger will protrude from the side of the governor body to indicate that the mechanism has tripped. If operating in Throttle positions 4 and above, the GOVERNOR DOWN Light will illuminate, followed by an automatic engine shutdown' after approximately 2 seconds. At IDLE, or in Throttle Positions 1, 2, or 3, the time delay before shutdown is controlled by the governor.

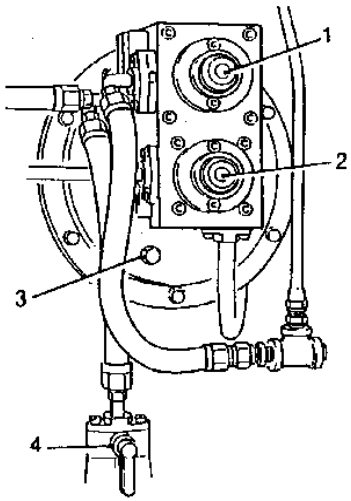
OVERSPEED MECHANISM

Should engine speed become excessive, this mechanism would prevent the injection of fuel into the cylinders. This results in an immediate shutdown of the engine, and a NO POWER/CHRG Alarm. To reset the mechanism, the trip reset lever must be rotated counterclockwise until it resets.

LOW WATER AND CRANKCASE PRESSURE DETECTOR

The locomotive is also equipped with devices which will detect low cooling water pressure, and excessive crankcase pressure. When activated, the devices release oil pressure from the line leading to the low oil pressure detector mechanism in the governor. This, in turn, causes the engine to shut down.

To determine the cause of a shutdown, check for protruding reset buttons at the Crankcase Pressure and Low Water Pressure detecting devices. A protruding button identifies the device which has caused the 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 a true oil pressure failure.



1- Low Water Reset
2- Crankcase Pressure Reset
3- Vent And Test Opening
4- Test Cock

Fig. 2-37 - Low Water And Crankcase Pressure Detector

WARNING

When It Is determined that the Crankcase Pressure Detector has tripped, make no further engine room Inspections. Do not attempt to restart the engine. Isolate the unit. If freezing conditions are possible, drain the cooling system in accordance with railroad regulations.

If neither the Crankcase Pressure, nor the Low Water Pressure Detector has tripped, and the engine oil level is satisfactory with a HOT ENGINE condition apparent, do not attempt to restart the engine. Report the engine shutdown circumstances to maintenance personnel.

LOCOMOTIVE MISCELLANEOUS DEVICES

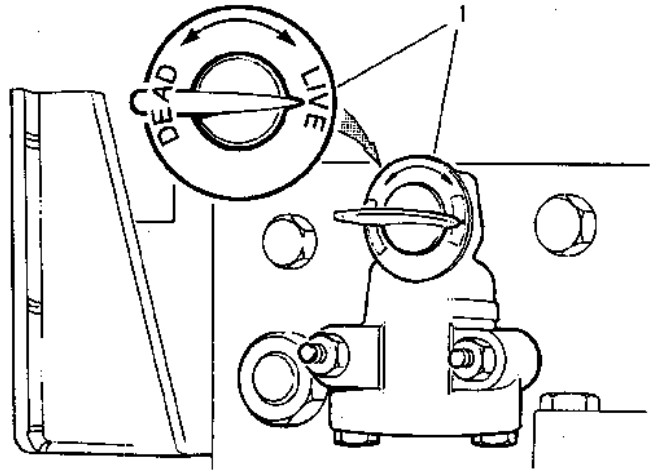
DEAD ENGINE CUTOUT COCK Valve

This Dead Engine feature is part of the 26 LU-L Air Brake

1- Handbrake
2- Emergency Brake Valve
3- Fire Extinguisher - Portable
4- Fire Extinguisher - Automatic
5- Battery Charging Receptacle
6- Outside Light
7- Emergency Fuel Cut-Out
8- Dead Engine Cutout Cock Valve

Fig. 2-38 - Locomotive Miscellaneous Equipment

equipment. It consists of a two-position cock valve, which is closed in the LIVE position, and open in the DEAD position. The Dead Engine Cutout Cock Valve is accessible from outside the locomotive, through a side panel under the cab.



1- Dead Engine CutOut Cock Positioned For Engine Operation

Fig. 2-39 - Dead Engine Cutout Cock Valve

ENGINE FUEL CUT-OUT SWITCHES - EFCO #2 AND EFCO #3

As well as the EFCO/STOP Switch on the Engine Control Panel, two additional Engine Fuel Cut-Out Push Button Switches are located above the fuel tank; one on each side of the locomotive, near each of the fuel fillers.

Depressing any one of these Pushbuttons will shut the engine down by cutting of its fuel supply. The reaction is instantaneous. It is not necessary to maintain pressure on the Pushbutton until the engine stops.

EMERGENCY BRAKE VALVE

The Emergency Brake Valve is a manually operated valve on the brake pipe. When the handle is pulled, the air in the brake pipe is quickly vented to atmosphere. The fast rate of pressure drop in the brake pipe causes an emergency air brake application.

The F40PH-2D Locomotive is equipped with two Emergency Brake Valves; one is located in the cab, and the other is situated on the rear wall of the long hood.

HANDBRAKE

The Handbrake, which is located at the rear of the long hood section, mechanically applies the brake on both axles of the long hood rear. truck.

To apply the Handbrake, pull the handle up and down (pumping action), until the brake is fully set.

To release the Handbrake, pull upward on the release trip lever.

CAUTION

Always release the Handbrake before attempting to move the locomotive.

HOT BOX MONITORING SYSTEM

Locomotives, numbered 6430 to 6458, are equipped with an on-board journal and suspension bearing monitoring system. This system will alert the operator if a bearing temperature exceeds 101°C (213.8°F), or if a sensor becomes faulty. In the event of a monitor failure, or, if a bearing temperature exceeds 121°C (249.8°F), the indication will be accompanied by an audible alarm. As illustrated in Figure 2-40, the monitor will also display the status of the system, and the location of any abnormality.

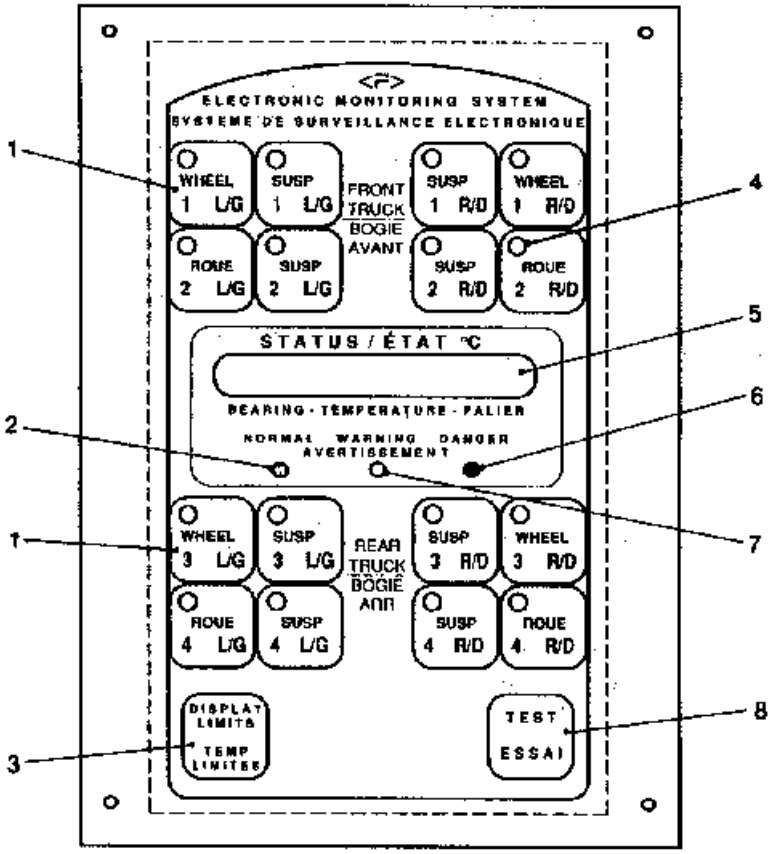


Fig. 2-40 - Hot Box Monitoring System

1. **Membrane Switches**

   Depressing any of the sixteen (16) related Membrane Switches will display the actual bearing temperatures (8 wheels, 8 suspensions).

2. **Normal Mode** (Green Light)

   When illuminated, the Normal Light indicates that there is no fault, and the system is functioning. Temperature sensors are below 102°C (215.6°F).

3. **Display Limits**

   When the Display Limits membrane switch is depressed, it will recall from memory any bearing which has exceeded 1010C (214°F). A normal reading would be "<1010C" (less than 1010C).

4. **Abnormal Indicating Lights**

   These Lights show the location of an abnormal condition.

5. **Display Screen**

   The Display Screen shows the status of the system.

6. **Danger Mode** (Red Light)

   When the Danger Light is illuminated, there is an actual hot box. The bearing temperature is above 1210C (250°F).

7. **Warning Mode** (Yellow Light)

   When the Warning Light is illuminated, there is an abnormality. A bearing may be running increasingly warm, between 102°C and 1210C (216°F and 250°F), or there may be a fault in the system. A short-circuited sensor, an open

sensor, and/or a defective monitor will display in the Warning Mode.

8. Test Switch

When depressed, the Test membrane switch will cause the box to cycle through all the monitored circuits, and display a normal <101°C symbol. It will also recall from memory any temperature above 1010C (214°F), or a circuit fault. All internal and external trainline alarms will function during the time that the monitor is cycling.

CAR BANKING MONITORING SYSTEM

The locomotive is equipped with a Car Banking Startup and Control System. By momentarily depressing the Banking Start Push Button on the Engine Control Panel, the system is activated through the locomotive, when the locomotive is coupled to a consist with operational banking. The system will be activated if the following conditions are met:

1. The Banking Cutout Switch is in the NORMAL position.
2. The banking control box, which is located behind the Engine Control Panel, is switched ON.
3. Head End Power is being supplied to the car consist.
4. All banking systems in a car consist are functional.
5. All car doors are closed.
6. The train must be stopped.

When the system is operating, the Banking Start Push Button will remain illuminated.

EVENT RECORDER and CREW ALERTNESS

As required by law, the locomotive is equipped with a combined Crew Alertness device and Event Recorder. Power for the device, which is located in the short hood compartment opposite the toilet, is supplied by the ER/SP IND Circuit Breaker. The status of the system is indicated by Light Emitting Diodes (LEDs), located near the device. If any attempt is made to tamper with the system, a penalty brake application will be initiated.

NOTE

For a more detailed description, refer to the EVENT RECORDER operating information, as outlined in Section 3 of this Manual.

OPERATION

INTRODUCTION

This Section of the Manual covers recommended procedures for the operation of the F40PH-2D Locomotive. The procedures are briefly outlined, and do not contain detailed explanations of equipment location or function.

The information is arranged in sequence, beginning with inspections in preparation for service, and followed by instructions for starting the engine, handling a light locomotive, coupling to a train, and routine operating phases. Various operating situations and special features are also covered.

PREPARATION FOR SERVICE GROUND INSPECTION

Check the locomotive exterior and running gear 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 operation.

4. Proper positioning of all angle cocks and shut-off valves.

5. Air cut into truck brake cylinders. The cutout cock valve is in the air supply line to the brake cylinders, at underframe level.

6. Satisfactory condition of brake shoes.

7. Adequate supply of fuel.

8. Proper installation of control and power jumper cables between units.

LEAD OR SINGLE UNIT CAB INSPECTION

On the lead or control unit, the various locations of the control equipment described in Section 2 should be checked. The equipment may then be positioned for operation, as follows:

FUSE AND SWITCH PANEL

1. The Battery Switch should be CLOSED.

2. The Ground Relay Cutout Switch should be CLOSED.

3. The 400 Amp Starting Fuse should be installed, and in good condition.

CIRCUIT BREAKER PANEL

1. All Breakers in the black area of the Panel should be in the ON position.

2. Other circuit breakers should be ON, as required.

ENGINE **CONTROL PANEL**

1. The Isolation Switch should be turned to the START position.

2. The Traction Motor Cutout Switch should normally be in the MOTORS ALL IN position.

3. The Blended and Dynamic Brake Cutout Switch should be in the NORMAL (up) position.

4. Miscellaneous switches should be positioned as required.

5. The Headlight Control Switch should be in the proper position for lead unit operation.

6. The Intermediate Unit Switch should be placed in the NORMAL position.

NOTE

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

OPERATOR'S CONTROL CONSOLE

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

1. Place the Control and Fuel Pump Switch in the ON (up) position.

2. Place the Engine Run Switch, and the Generator Field Switch in the OFF (down) position.

3. Lights, and miscellaneous switches should be positioned as required.

4. Move the Throttle Handle to IDLE.

5. Position the Reverser to NEUTRAL, and remove the handle.

6. Insert the Automatic Brake Valve Handle, (if removed), and place it in the SUPPRESSION position. This will nullify the application of any safety control equipment.

7. Insert the Independent Brake Valve Handle, (if removed), and move it to the FULL APPLICATION position.

8. Place the Multiple Unit (MU-2A) Valve in the LEAD position.

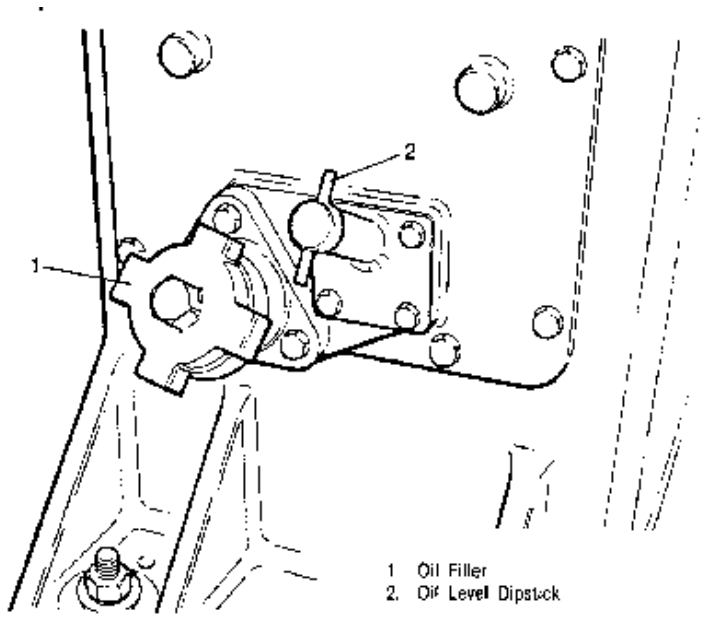


Fig. 3-1 - Air Compressor Lube Oil Gauge and Filler

ENGINE ROOM INSPECTION

The engine can be readily inspected from within the enclosed carbody.

1. Verify that the Air Compressor has a proper supply of lubricating oil.

2. Make certain that the water level, in the Water Tank Sight Glass, is near the FULL (ENGINE DEAD) mark on the Water Level Instruction Plate.

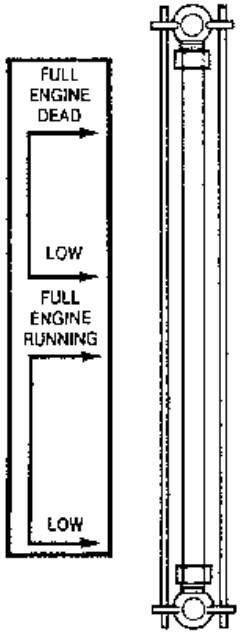


Fig. 3-2 - Water Tank Level Indicating Gauge

3. Check all valves for proper positioning.

4. Inspect the area for leakage of fuel oil, lubricating oil, water, or air.

5. Make sure that the HEP Lube Oil Pump Circuit Breaker is in the ON position.

6. Check the lube oil level in the HEP gear box.

ENGINE INSPECTION

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

1. Check to see that the engine overspeed trip lever is reset.

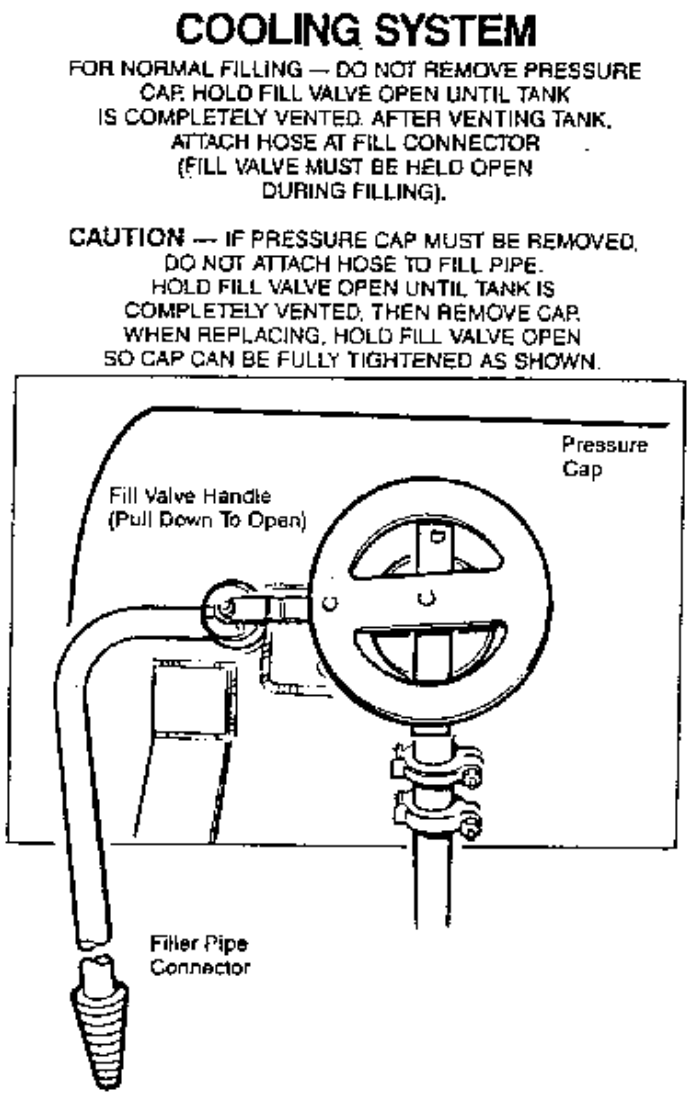


Fig. 3-3 - Cooling System Pressure Cap and Instruction Plate

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

3. Verify that the crankcase (oil pan) pressure detector reset button is set (pressed in). Since the engine must be running, and the cooling system vented in order to permit latching of the low water reset button, refer to Step 7 under "Starting The Diesel Engine".

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

5. Check the sight gauge on the lube oil filter tank. If the gauge is full, pull out oil level gauge (dipstick) from the side of the engine oil pan. The level gauge should be coated with oil, above the FULL mark. If the sight gauge is empty, check the oil level in the strainer housing. This level should be up to the overflow outlet.

STARTING THE DIESEL ENGINE

After the preceding inspections have been completed, the diesel engine may be started. The starting controls are located at the accessory end of the engine, in the area of the equipment rack.

NOTE

If the engine temperature is 10°C (50°F) or less, preheat the engine prior to making a start attempt. Prelube the engine if it has been shut down for more than 48 hours. Refer to the Locomotive Service Manual for Prelube Procedures.

PERFORM THE FOLLOWING:

1. Ensure that all engine room, and engine inspections have been performed.

2. Ensure that all cab controls have been properly positioned for startup.

3. At the equipment rack in the engine room, place the Fuel Prime/Engine Start Switch in the FUEL PRIME position, until fuel in the return fuel sight glass flows clear and free of bubbles (normally 10 to 15 seconds).

NOTE

In order to protect the engine from hydraulic lock during cranking, it is equipped with a Purge Control System. Therefore, the proper starting procedures must be followed to ensure that this protection is operational.

4. Pull back on the injector control lever (layshaft). Then, move the Fuel Prime/Engine Start Switch to the ENGINE START position, and hold the Switch in this position for a maximum of 20 seconds.

NOTE

The Starter Motors should not be allowed to crank the engine for more than 20 seconds. If the engine fails to start after 20 seconds have elapsed, the Start Motor Thermal Overload Protection System will drop out the starters for approximately two minutes. This will allow a sufficient cooling period before the starters can be reused.

5. After an initial period of low speed cranking during the purge cycle (approximately 6 seconds), move the injector control lever to about one-third rack position (approximately 1.6 on the governor scale) to assist the engine start.

6. When the engine fires, and speed increases, release the FP/ES Switch. Release the injector control lever when the engine comes up to IDLE speed. Do not advance the layshaft to increase engine speed, until a satisfactory oil pressure has been confirmed.

CAUTION

After starting the engine (hot or cold), it should be allowed to Idle for at least two minutes. Before the Head End Power System Is engaged, the oil temperature should reach 49C (120°F), which Is equivalent to a water temperature of 65C (150°F).

7. Within 50 seconds after engine startup, verify the position of the low water reset button. The low water detector will often trip during engine startup, especially when a completely drained system has just been filled. The detector may also trip after starting a cold engine, or one that has had the cooling system pressure released. The detector should be reset as soon as possible, after the engine starts and is idling. Otherwise, the engine will shut down after a time delay established by the engine governor.

NOTE

If the detector is difficult to reset after the engine has been started, check the oil pressure. If the oil pressure is satisfactory, position the injector control (layshaft) lever in order to increase engine speed for a short time. Then, press the reset button.

The reset button on some detectors will not latch in when the engine is shut down. If such a condition exists, the detector will probably function correctly if it can be reset after the engine is started.

8. With the engine running at a normal operating temperature, check the following:

   a. The coolant level should be near the FULL (ENGINE RUNNING) mark on the Water Level Instruction Plate.

b. The engine lube oil level should be near the FULL mark on the dipstick.

c. The governor oil level should be satisfactory.

d. The Air Compressor lube oil level should be satisfactory.

e. The engine lube oil pressure should be normal.

TRAILING OR INTERMEDIATE UNIT CAB INSPECTION

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

FUSE AND SWITCH PANEL

1. All Switches should be CLOSED.

2. The 400 Amp Starting Fuse should be installed, and in good condition.

CIRCUIT BREAKER PANEL

1. All Circuit Breakers in the black area of the Circuit Breaker Panel should be in the ON (up) position.

2. Other Circuit Breakers should be ON, as required.

ENGINE CONTROL PANEL

1. The Isolation Switch should be placed in the START position.

2. The Traction Motor Cutout Switch should normally be in the MOTORS ALL IN position.

3. The Blended and Dynamic Brake Cutout Switch should be positioned according to railroad operating procedures for Trailing Units.

4. Miscellaneous switches should be positioned as required.

5. The Headlight Control Switch should be in the proper position to correspond with the Unit position.

6. The Intermediate Unit Switch should be in the MIDDLE UNIT position on an intermediate unit, and in the NORMAL position on a trailing unit.

NOTE

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

OPERATOR'S CONTROL CONSOLE

Switches and operating handles on the Control Console should be positioned as follows:

1. The Control and Fuel Pump Switch, the Generator Field Switch, and the Engine Run Switch, must be OFF.

2. The Throttle Handle should be moved to IDLE.

3. The Reverser Handle should be placed in NEUTRAL, and then removed from the controller in order to lock the other handles.

4. Lights, and miscellaneous switches, should be positioned as required.

5. The Automatic Brake Valve should be placed in the HANDLE

OFF position, and the handle should be removed.

6. The Independent Brake Valve should be in the RELEASE position, and the handle removed.

7. The Multiple Unit Valve should be placed in the TRAIL position.

8. The Cutoff Pilot Valve should be in the OUT position.

STARTING TRAILING OR INTERMEDIATE UNIT DIESEL ENGINES

Engines in trailing or intermediate units are started in the same manner as the engine in the lead unit. However, if control jumper cables are already connected between units, make certain that the Engine Run, and the Control and Fuel Pump Switches in trailing or intermediate units, are set to their OFF positions.

If the train requires Head End (Auxiliary AC) Power, make sure that the controls on the Head End Power Control Panel are correctly positioned for the intended usage. Refer to Sections 2 and 3A in this Manual.

PLACING UNITS ON THE LINE

After the diesel engines have been inspected and started, units may be placed on the line as necessary, by rotating the Isolation Switch to the RUN position. It the consist is at a standstill, make certain that the Throttle handle on each unit is in the IDLE position, prior to placing any unit on the line.

PRECAUTIONS BEFORE MOVING THE LOCOMOTIVE

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

1. Test the Indicator Light Panels to make certain that all lights are operational.

NOTE

In order to determine if an individual lamp is working properly, the Indicator Lights have a push-to-test feature which allows testing of the lamp circuit alone. When the lens cap is depressed, the supply voltage is applied across the lamp circuit. After approximately one second, the light should illuminate.

2. Check for any alarms at the Indicator Light Panels, and at the Annunciator Module. If alarms are evident, investigate and remedy the situation before moving the locomotive.

3. Verify that the pressure in the main air reservoir is normal, at approximately 900 to 965 kPa (130 to 140 psi).

4. Check for the proper application and release of air brakes.

5. Remove any blocking from under the locomotive wheels, and release the Handbrake.

CAUTION

The engine water temperature should be 49°C (120°F), or higher, before a full load is applied to the engine. If an engine has been Idling at ambient temperatures below -18C (0°F), any increase to a full load capacity should be gradual.

HANDLING A LIGHT LOCOMOTIVE

When the preceding inspections and precautions have been completed, and the engine has been started and placed “on-the-

line", the locomotive is handled as follows:

1. Place the Engine Run Switch, and the Generator Field Switch, in the ON (up) position.

2. Place the Headlight, and other lights, ON as needed.

3. Insert the Reverser Handle, and move it in the direction of travel as required, either FORWARD or REVERSE.

4. Release the Air Brakes.

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

NOTE

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

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

CAUTION

Do not move the Reverser Handle to change the direction of travel, UNLESS THE LOCOMOTIVE IS COMPLETELY STOPPED.

DRAINING AIR RESERVOIRS AND FILTERS

The main air reservoirs, and the air filter, should be drained periodically, even though the equipment is provided with automatic drain valves. Follow the maintenance schedule established by the railroad.

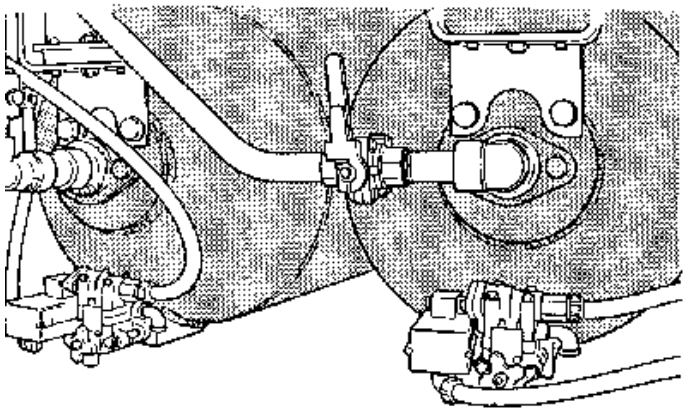


Fig. 3-4 - Main Reservoir Drain Location

ENGINE AIR BOX DRAIN

A metal casting, which is mounted on the front end plate of the engine, connects drain pipes from each side of the air box to a common drain pipe. Pressures in opposition at the casting restrict airflow to a permissible amount, yet allow the elimination of air box contaminants. The system is completely automatic, and requires no attention by the locomotive operator.

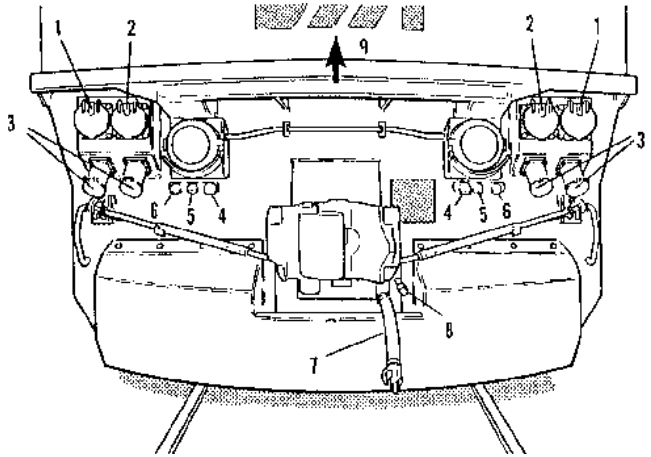
COUPLING LOCOMOTIVE UNITS TOGETHER

When coupling units together for Multiple Unit operation, the procedure below should be followed. Refer to Figures 3-5 and 3-6.

1. Couple and stretch the units. This will ensure that the couplers are locked.

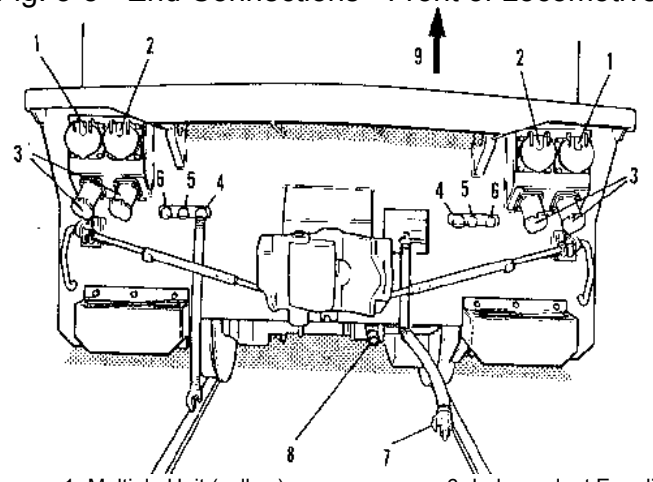
2. Perform ground, engine room, and engine inspections, as outlined in preceding instructions.

3. Position the cab controls, as previously described.



1- Multiple Unit (yellow)
2- Communications (blue)
3- Head End Power (red)
4- Main Reservoir Equalizing
5- Actuating
6- Independent Equalizing
7- Brake Pipe
8- Main Reservoir
9- 74 Volt Receptacle

Fig. 3-5 - End Connections - Front of Locomotive



1- Multiple Unit (yellow)
2- Communications (blue)
3- Head End Power (red)
4- Main Reservoir Equalizing
5- Actuating
6- Independent Equalizing
7- Brake Pipe
8- Main Reservoir
9- 74 Volt Receptacle

Fig. 3-6 - End Connections - Rear of Locomotive

In order to lock the controls, remove the Reverser Handles from all Controllers.

4. Install control cables between units.

5. Install communication cables between units, if required.

6. If Head End (Auxiliary AC) Power equipment is to be used, install AC power cables between units.

7. Connect air brake hoses between units.

8. Open the necessary air hose cutout cocks on each unit.

COUPLING THE LOCOMOTIVE TO A TRAIN

When coupling the locomotive to a train, use the same care and precautions as when coupling units together. After coupling has been completed, perform the following:

1. Verify that couplers are locked by stretching the connections.

2. Make Head End (Auxiliary AC) Power connections as required.

3. Make communications cable connections as required.

4. Connect air brake hoses.

5. To cut in the brakes, slowly open the air valve on the locomotive and train.

BRAKE PIPE LEAKAGE TEST

Prior to operating the brake equipment, a leakage test must be performed. Brake pipie leakage tests should be made in

accordance with the railroad operating rules and governing regulations.

STARTING A TRAIN

The method used in starting a train depends upon many factors. Some of these factors include the type, weight and length of the train, the amount of slack in the train, as well as the weather, grade, and track conditions. Since these factors are variable, specific train starting instructions cannot be provided. It will be up to the operator to use good judgment in properly applying sufficient power to suit requirements. However, certain general considerations that should be observed are discussed in the paragraphs which follow.

A basic characteristic of the diesel locomotive is its high starting tractive effort. This makes it imperative that the air brakes be completely released before any attempt is made to start a train. Therefore, after stopping, or otherwise applying brakes, allow sufficient time for the brakes 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. Therefore, the practice of taking slack indiscriminately should be avoided. However, there will be instances in which it is practical, or sometimes necessary, to take slack in starting a train. In order to prevent excessive locomotive acceleration, which in turn could cause undue shock, extreme care should be taken in such cases.

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. Power is applied at a value which depends on throttle position. Therefore, it is advisable to

advance the throttle one notch at a time when starting a train. Until all slack has been removed, and the train is completely stretched, it should be started in as low a throttle position as possible. This will keep the speed of the locomotive at a minimum. In order to prevent stretching slack too quickly, or to avoid slipping, it is sometimes advisable to reduce the throttle a notch or two at the moment the locomotive begins to move.

When ready to start the train, the following general procedure is recommended:

1. Place the Isolation Switch in the RUN position.

2. Move the Reverser Handle to either FORWARD or REVERSE, as required.

3. Place the Engine Run and Generator Field Switches in the ON (up) position.

4. Release both Automatic and Independent Air Brakes.

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

   a. Throttle No. 1 - Loading will stop at a specific low value. This may be observed on the Load Indicating Meter. The locomotive may then 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 Notch 1 and IDLE during starting.

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

6. If acceleration is too rapid, reduce the Throttle one or more notches.

7. After the train is stretched, advance the Throttle as required.

NOTE

By means of power reduction and sanding, the Wheel Slip Control System reacts rapidly to correct minor slips. As a result, the Wheel SLIP Light seldom comes on to indicate severe slips, which may have been caused by operating at full throttle to climb a grade, or to accelerate. This Wheel Slip corrective action is often observed as a steady reduction of load current, below that which is normally expected at full throttle for a given speed. Do not misinterpret this power reduction as a fault. It is merely the Wheel Slip Control System maintaining the necessary adhesive power to overcome the existing track and grade conditions.

ACCELERATING A TRAIN

After the train has been started, the throttle can be advanced as rapidly as required to accelerate the train. The speed with which the throttle is advanced would depend on demands of the schedule, as well as the type of locomotive and train involved. In general, advancing the throttle one notch at a time will normally prevent slipping. When accelerating a train, the Load Indicating Meter provides the best guide for throttle handling. 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. Therefore, for maximum acceleration without slipping, and until full power is attained in the Notch 8 position,

the throttle should be advanced one notch, each time the Meter pointer begins moving toward the left.

AIR BRAKING WITH POWER

NOTE

Unless the Throttle is in the IDLE position, Dynamic Brakes will not be automatically blended with the Air Brake System.

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. Unless the throttle is reduced as the train speed decreases, the pull might become great enough to part the train. The pull of the locomotive is indicated by the amperage on the Load Meter. By maintaining a steady amperage on this Ammeter during a locomotive slow-down, the operator can maintain a constant pull on the train. This is accomplished by reducing the throttle a notch each time the amperage starts to increase.

During power braking, the Independent Brakes should be kept fully released. The throttle must be in IDLE before the locomotive comes to a stop.

OPERATING OVER RAIL CROSSING

When operating the locomotive at speeds exceeding 40 km/h (25 MPH), reduce the throttle to Notch 4, at least eight seconds before the locomotive reaches a rail crossing. If the locomotive is operating in the Throttle 4 position or lower, or if it is running at less than 40 km/h (25 MPH), 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 the 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 no circumstances should the locomotive be operated through water that is deep enough to touch the bottom of the traction motors. Water, any deeper than 7.5 cm (3") above the rail, is likely to cause traction motor damage. Exercise every precaution under such circumstances. Always proceed very slowly, and never exceed 3 to 4 km/h (2 to 3 MPH).

WHEEL SLIP CORRECTION

Instantaneous reduction of locomotive power, together with automatic sanding, functions to correct wheel slips. After adhesion is regained, a timed application of sand continues while power is being smoothly restored. The system functions entirely automatically, and no action is required by the locomotive operator.

While starting a train when rail conditions are exceptionally poor, an occasional flash of the Wheel SLIP Light indicates a normal functioning of the Wheel Slip Control System. This may be accompanied by automatic sanding. Depending on the severity of the slipping condition, the Wheel SLIP Light may, or may not, flash ON and OFF. However, the Wheel Slip Control System reacts so rapidly to correct minor slips that the Wheel SLIP Light seldom comes on to indicate severe slips. The wheel slip corrective action is often observed at the Load Current Indicating Meter as a steady reduction of load current, below that which is normally expected at full throttle for a given speed. Do not misinterpret this power reduction as a fault. It is merely the Wheel Slip Control System maintaining the

necessary adhesive power to overcome the existing track and grade conditions.

Whenever possible, operation on grades should be at full throttle. In the event of a wheel slip condition, throttle reduction is recommended only in the event of the following conditions:

1. Repeated wheel slip conditions may cause severe lurching that could pull a train apart. (Such severe conditions may indicate the need for a helper locomotive).

2. In unusual conditions, simultaneous wheel slips may be incurred at low speeds, or at engine stall speed. In this situation, the performance of the equipment is directly related to the skill and judgment of the operator. Therefore, the operator must determine whether to apply sand, and/or to reduce throttle.

CAUTION

If the Wheel SLIP Light blinks ON and OFF persistently, or burns continuously during locomotive operation, a pair of wheels may be sliding, or circuit difficulty may exist. The wheels may be sliding due to a locked brake, damaged traction motor bearings, or broken pinion or teeth gear. Due to the seriousness of sliding wheels under such conditions, the locomotive should be IMMEDIATELY STOPPED, and a thorough Investigation made to determine the cause.

Repeated GROUND RELAY tripping, accompanied by unusual noises (such as thumping or squealing), may also indicate serious traction motor problems that should be Investigated at once.

Do not allow any unit, which must be Isolated due to repeated

WHEEL SLIP or GROUND RELAY actions to remain In a locomotive consist, UNLESS IT HAS BEEN ABSOLUTELY DETERMINED THAT ALL OF ITS WHEELS ROTATE FREELY.

LOCOMOTIVE SPEED LIMIT

The maximum speed, at which the locomotive can be safely operated, is determined by the gear ratio. This ratio is indicated by the expression 58:19. The 58 indicates the number of teeth on the axle gear, while the 19 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 three times for a single revolution of the driving wheels. The locomotive speed limit is determined by the maximum permissible rotation speed of the motor armature. Exceeding this maximum could result in serious damage to the traction motors.

MIXED GEAR RATIO OPERATION

If units of the consist have different gear ratios, do NOT operate the locomotive 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.

BLENDED AIR AND DYNAMIC BRAKING

In many phases of locomotive operation, the automatic blending of Dynamic Braking with the Air Brake System provides an extremely valuable assist in retarding train speed. With the gear ratio of 58:19, maximum Dynamic Braking strength is realized at about 43 km/h (27 MPH).

At train speeds higher than the optimum, the effectiveness of Dynamic Braking gradually declines as speed increases.

To operate with Blended Dynamic Brakes, proceed as follows:

1. The Reverser Handle must be positioned in the direction of locomotive movement.

2. The Throttle must be returned to IDLE.

3. Move the Automatic Brake Valve Handle to the SERVICE position. This establishes the Blended Air and Dynamic Brake control circuits.

4. After a brief initial application of minimum braking to bunch slack, normal service braking will begin.

5. The Independent Brake must be kept fully released whenever the Automatic Brake is in use, or the wheels may slide. As locomotive speed decreases below 16 km/h (10 MPH), the Blended Dynamic Brake becomes less effective. When the speed further decreases, the Automatic Brake may be completely released. This is accomplished by placing the Automatic Brake Valve Handle in the RELEASE position, and simultaneously applying the Independent Brake to prevent slack from running out.

The degree of brake application is controlled by the amount of brake pipe reduction. This may either be determined by the Automatic Brake Valve position within the SERVICE ZONE, or it may be maintained at a Full Service application in the SUPPRESSION position. Dynamic Braking assumes the major portion of the braking effort, with supplemental Air Braking being proportionally increased at speeds above, and below, the optimum dynamic braking range. Maximum dynamic braking current is

automatically limited to 700 Amperes by a Current Limiting Regulator.

With the automatic regulation of dynamic braking strength, the Brake Warning Light should rarely, if ever, give an indication of excessive braking current.

NOTE

Regardless of the reading on the Load Indicating Meter, the Brake Warning Light will illuminate whenever the unit is generating excessive dynamic braking current. If the warning light does come ON, it should not remain ON for longer than a few seconds.

If brake warning indications are repeated, the unit should be taken out of blended braking. This is accomplished by placing the Blended and Dynamic Brake Cutout Switch in the CUTOUT position. The locomotive will then operate normally under power, and during braking.

If excessive braking effort continues for an extended period of time, a Blended Brake Lockout (BBL) will occur. In that case, the Blended Brake Lockout Relay must be reset, by using the trainline Blended Brake Reset control.

When coupled to older units which may not be equipped with brake current limiting regulators, the locomotive can still be operated in Blended Dynamic Braking. If all units in a consist are of the same gear ratio, the unit having the lowest maximum brake current rating should be placed as the Lead Unit. The engineer can then operate with an equivalent braking effort, up to the limit of the unit with the lowest brake current rating. This can be accomplished without overloading the Dynamic Brake System of a trailing unit. The locomotive consist must always be operated so as not to exceed

the braking current of the unit which has the lowest maximum brake current rating.

Regardless of gear ratio, or the difference in maximum brake current ratings, units equipped with Dynamic Brake Current Limiting Regulators can be operated in multiple with other locomotives in dynamic braking.

DYNAMIC BRAKE WHEEL SLIDE CONTROL

During Blended Dynamic Braking, each series group of two traction motors are connected in parallel with each Dynamic Braking Resistor Grid circuit, and with the other series connected traction motors. With this arrangement, a sliding wheel may be corrected by other motors in the system. In effect, this makes a wheel slide during Blended Braking somewhat self-correcting. The parallel arrangement, of DB Resistor Grids and traction motors, is such that the full response of the Wheel Slip Control System is available during Blended Dynamic Baking, as well as during power operation. The precise and immediate regulation that is maintained, plus the motoring effect that is created by the parallel arrangement, provides for an extremely stable Blended Brake operation.

In addition to the above, a Bridge Circuit is employed to protect against the possibility of simultaneous wheel slides, which may not otherwise be detected.

When the system detects a pair of wheels that tend to rotate at a slower speed, the retarding effort of the traction motors in the affected unit is reduced. In other words, traction alternator field excitation is reduced in that particular unit. In this event, sand will be automatically applied to the rails. When the retarding effort of the traction motors in that unit is reduced, the tendency of the wheel set to rotate at a slower speed will be overcome. After the wheel set resumes a normal rotation, the retarding effort of the

traction motors will return; it will increase to its former value. After the wheel slide tendency is corrected, automatic sanding will continue for 3 to 5 seconds.

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. Therefore, wherever possible, operation on grades should be at Full Throttle. However, the throttle may be reduced where wheel slips cause lurching that may threaten to break the train.

ISOLATING A UNIT

If it becomes advisable to isolate a locomotive unit, observe the following precautions:

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

2. When operating with Blended Dynamic Braking, it is important to first get out of Dynamic Braking, before attempting to isolate the unit. This is accomplished by placing the Blended and Dynamic Brake Cutout Switch in the CUTOUT position. To eliminate braking on the unit, the Isolation Switch can then be moved to the ISOLATE position. If 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 UNIT BEING CUT OUT (TRAIL)

1. Move the Automatic Brake Valve Handle to the SERVICE position, and make a 138 kPa (20 psi) reduction. Then, move the handle to the SUPPRESSION position.

2. After the brake pipe exhaust stops, place the Cut-Off Pilot Valve in the OUT position.

3. Place the Independent Brake Valve in the fully released (BAIL) position.

4. Place the Multiple Unit (MU-2A) Valve in the TRAIL position.

5. Position the Automatic Brake Valve Handle in the HANDLE OFF position.

6. With the Throttle in the IDLE position, center the Reverser in the NEUTRAL position, and remove the Handle to lock the Controller.

7. At the Console, position Light Switches as required for trailing operation. Place all other switches in the OFF position. Be absolutely certain that the CONTROL and FUEL PUMP, GENERATOR FIELD, and ENGINE RUN Switches are in the OFF position.

8. At the Engine Control Panel, place the Headlight Control Switch in the proper position for Trailing Unit operation. Place other switches ON as needed.

9. At the Circuit Breaker Panel, all breakers in the black area are to remain in the ON position.

10. After completing the above operations, move to the cab of the new Lead Unit.

ON UNIT BEING CUT IN (LEAD)

Switches and operating handles in the cab of the Lead Locomotive should be positioned as follows:

1. At the Control Console, make certain that the GENERATOR FIELD Switch is in the OFF (down) position.

2. Insert the Reverser Handle, and leave it centered in the NEUTRAL position.

3. Place the Automatic Brake Valve Handle in the SUPPRESSION position. This will nullify the application of any safety control, overspeed, or train control equipment.

4. Insert the Independent Brake Valve Handle (if removed), and place it in the FULL APPLICATION position.

6. Turn the Cut-Off Pilot Valve to the IN position.

7. Place the Multiple Unit Valve in the LEAD - DEAD position.

8. At the Circuit Breaker Panel, verify that all circuit breakers in the black area of the Panel are in the ON position. Other circuit breakers may be placed ON as required.

9. At the Engine Control Panel, check that the Isolation Switch is in the START position, the Traction Motor Cutout Selector Switch is in the MOTORS ALL IN position, and that miscellaneous switches are positioned as required.

Place the Headlight Control Switch in the proper position for Lead Unit operation, as listed on the instruction plate.

10. At the Control Console, place the CONTROL and FUEL PUMP, ENGINE RUN, and GENERATOR FIELD Switches in the ON (up) position. Other switches should be positioned as required.

STOPPING THE ENGINE

There are six ways to stop the engine:

1. Press the ENGINE STOP Button on the Engine Control Panel.

   The reaction to the button is immediate. It need not be held in until the engine stops.

2. Press the Emergency Fuel Cutoff & Engine Stop Pushbutton.

   The Emergency Fuel Cutoff Pushbuttons are located near the fuel tank filler valves, one on each side of the locomotive.

   Either one of these pushbuttons will stop the fuel supply to the engine. The reaction to the button is immediate. It need not be held in until the engine stops.

3. Use the injector rack manual control lever (layshaft). The layshaft, at the accessory end of the engine, can be operated to override the engine governor, and to move the injector racks to the "no fuel" position.

4. Rotate the low water detector test cock valve to the horizontal (TEST) position.

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

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

6. Activate the M.U. ENGINE STOP Push Button.

   To simultaneously stop all engines from the cab of the lead unit, depress the Red coloured area marked "STOP" on the M.U. Engine Stop Pushbutton. Since this switch is trainlined, it will stop all similarly equipped locomotives in a consist.

LEAVING A LOCOMOTIVE UNATTENDED

If at any time it becomes necessary to leave the locomotive unattended while the engine is running, perform the following procedure:

1. Observe all railroad safety precautions.

2. Place the ENGINE RUN, and GENERATOR FIELD Switches in the OFF position.

3. Place the Throttle in IDLE, and remove the Reverser Handle from the Controller.

TOWING THE LOCOMOTIVE IN A LOCOMOTIVE CONSIST

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

1. Unless the engine is to remain idling, drain all air from the main reservoirs and air brake equipment.

2. Place the Multiple Unit Valve in the LEAD-DEAD position.

3. Rotate the Cutoff Valve to the OUT position.

4. Place the Independent Brake Valve Handle in the RELEASE position.

5. Place the Automatic Brake Valve Handle in the HANDLE OFF position.

6. Cut in the dead engine feature, by turning the Dead Engine Cutout Cock Valve to the OPEN position. This cock valve is located beneath the cab floor, and may be reached through an access door, outside the locomotive.

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

   a. The Isolation Switch should be in the START position.

   b. The Battery Switch, and the Ground Relay Cutout Switch, should be CLOSED.

   c. The Generator Field Circuit Breaker should be OFF.

   d. All other Breakers in the black area of the Circuit Breaker Panel should be placed in the ON position.

   e. The Starting Fuse should be removed.

   f. The Control and Fuel Pump Switch should be ON.

   g. The Fuel Pump Circuit Breaker should be ON.

   h. With the Throttle in IDLE, the Reverser

Handle should be removed from the Controller to lock the controls.

i. Unless the unit is being used to provide hotel power to the passenger cars, the Head End Power Mode Switch should be placed in the OFF position.

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

   a. The Battery Switch should be OPEN.

   b. All circuit breakers should be OFF.

   c. All control switches should be OFF.

   d. The Starting Fuse should be removed.

   e. With the Throttle in IDLE, the Reverser Handle should be removed from the Controller.

FREEZING WEATHER PRECAUTIONS

As long as the diesel engine is running, the cooling system will be kept adequately warm, regardless of ambient temperatures. It is only when the engine is shut down, or stops for any reason, that the cooling system requires protection against freezing. The proper procedures for draining the system are listed on the Cooling System Drain Instruction Plate, which is mounted on the back wall of the cab.

DRAINING THE COOLING SYSTEM

In the event that the diesel engine is stopped, and a danger of freezing exists, the engine cooling system should be drained.

After the system pressure has been released, the water tank filler cap may be removed. This will facilitate drainage at an increased rate.

CAUTION

If a hot engine has been drained, allow sufficient time for the engine to cool down, before refilling the system with water.

CONTINUED OPERATION FROM THE CAB OF A FAILED LEAD UNIT

If the Lead Unit in a consist should fail due to an engine shutdown or electrical malfunction, the cab heater, cab lights, and windshield defrosters can be kept operating, by using the 74 VDC power from the Trailing Unit.

In this event, carry out the following step-by-step procedure:

1. Stop the train, and set the brakes.

2. On the (shut-down) Lead Unit:

   a. If temperatures are below 0°C (32°F), drain the engine cooling water.

   b. Open the Battery Knife Switch.

   c. Open the FP AND CONT Switch.

   d. Open the STEAM GEN T/L, HOTPLATE, HEP LUBE OIL, HEAD END CONTROL, AUX. GEN. FLD, and FUEL PUMP Circuit Breakers.

   e. Remove the Starting Fuse. Hang DO NOT START ENGINE warning tags at the Engine Start Station, and on the Engine Control Panel.

f. Open the D18A (CA5A) field circuit.

3. On the (operating) Trailing Unit:

Open the CAB HEATER, CAB HTR FAN CONT, HOTPLATE, HEATED WINDSHIELD, and STEAM GEN T/L Circuit Breakers.

4. Connect the Steam Generator jumper cable (74 VDC), between the Lead and Trailing Units.

5. On the Trailing Unit:

a. Close the STEAM GEN T/L Circuit Breaker.

b. Close the FP AND CONT Switch.

c. Make certain that the Isolation Switch is in the RUN position.

6. On the (shut-down) Lead Unit:

a. Close the STEAM GEN. T/L Circuit Breaker.

b. Place the Isolation Switch in the ISOLATE position.

c. Ensure that the GEN. FLD, and ENG. RUN Switches are in the ON position.

d. With the aid of the blocking device provided, latch the Radio Control Switch in the ON position.

CAUTION

The cab heater must not be operated above the LOW position.

7. Resume train operations from the shut down Lead Unit.

CAUTION

During Blended Braking, there will be no Dynamic Braking effort provided by the Lead Unit. Therefore, there will be no Indication of braking current on the Ammeter. The Trailing Units will provide normal Blended Braking.

PASSENGER TRAIN OPERATION GUIDE

BLENDED BRAKING PROCEDURES

Blended Braking refers to the combination of Air and Dynamic Braking, which is initiated by an automatic service brake application. The overall function of this system, which is controlled by the Dynamic Air Module, DA16, is to maintain a uniform braking rate. It accomplishes this by simultaneously "blending" together the Dynamic and Air Brake systems, whenever the train brakes are applied with the Automatic Brake Valve. If Dynamic Braking is inoperative, Blended Braking will not operate. However, normal air braking functions will continue to operate.

Blended Braking will result from an automatic service brake application, provided that:

1. Dynamic Braking is operative.

2. The Throttle is in the IDLE position, (except during a penalty brake application).

3. The Locomotive speed is greater than 8 km/h (5 MPH).

If all of the above conditions are met, Blended Braking will result on units so equipped, whether or not the lead unit is so equipped, and regardless of the locomotive position in the consist.

An Emergency brake application will result in a brake cylinder pressure of approximately 634 kPa (92 psi). As a result, Dynamic Braking would be nullified.

Should a wheel slip occur during the Blended Brake operation, the Dynamic Brake will unload for the duration of the slip.

BLENDED BRAKE OPERATION

1. The engineer controls the degree of brake application by the position of the Automatic Brake Valve Handle in the service zone. The equalizing reservoir, and brake pipe gauges indicate the degree of brake application.

   To the engineer applying a full service Blended Brake application, the apparent difference (as compared to normal air braking) would be indicated as follows:

Speed Range:	**Brake Cylinder Pressure**:
18-143 km/h (11 - 89 MPH)	Initial 412 kPa (60 psi), then decreasing in proportion to dynamic brake build up.
8 - 18 km/h (0-11 MPH)	412 kPa (60 psi) since there is virtually no dynamic brake

Note that at approximately 61 km/h (38 MPH), the Dynamic Brake effort is at Maximum.

2. If a Blended Brake application is in effect, and the Independent Brake is applied, normal or greater than normal independent brake cylinder pressures will develop. This will occur, regardless of the degree of Dynamic Braking as a result of Blended Braking.

3. If the Independent Brake Valve is depressed to the QUICK RELEASE position during the Blended Brake operation, Blended Braking will be released.

4. If the Throttle is moved out of the IDLE position during the

   Blended Brake operation, Blended Braking will cease, and normal locomotive air braking will result.

5. When an Automatic Brake application is in effect with the Throttle in RUN 1 to 8, and if the Throttle is moved to IDLE, Blended Braking will result.

6. During any Emergency Brake application, the brake cylinder pressure will be approximately 634 kPa (92 psi).

7. The Blended Dynamic Braking System is such that the retardation rate on the locomotive is the same as a normal automatic air brake application.

8. An Independent Brake application does not result in Blending Braking.

9. If a traction motor is cut out, Dynamic Braking would be cut out. Therefore, Blended Braking would also be nullified.

BLENDED BRAKE LOCKOUT PROTECTION

A protective device will "lock out" Blended Braking should the braking become abnormally high, or abnormally low. This lock out condition will be indicated by the following:

1. The BBL Relay will pick up.

2. Dynamic Braking will be cut out. This will result in normal Air Braking on the locomotive.

3. The trainlined alarm bell will ring throughout the consist.

4. The BLENDED BRAKE L.O. Light will be illuminated on the Engine Control Panel of the affected unit.

To correct this condition, proceed as follows:

1. Reset the BBL Relay on the affected unit, by depressing the RESET Button. The BLENDED BRAKE L.O. Light will extinguish.

2. If the BBL Relay trips repeatedly, use the Blended and Dynamic Brake Cutout Switch on the Engine Control Panel to cut out Dynamic Braking. After the Dynamic Brake has been cut out, the alarm bell will turn off. However, the BLENDED BRAKE L.O. Light will remain ON, until the BBL Relay is reset.

USE OF BLENDED BRAKING

In the event of a malfunction in the Blended Brake System, train handling must be planned so that the stopping distance of the standard automatic air brake system is sufficient to stop the train at a pre-selected point.

BRAKING FOR SLOWDOWNS

1. To obtain Blended Braking, gradually reduce the Throttle to IDLE.

2. After a minimum 10 second pause, make a slight brake pipe reduction. Do not Bail-off the Independent Brake Valve during this, or any subsequent brake pipe reduction.

3. Make additional brake pipe reductions as needed, normally in increments of 21 - 35 kPa (3 - 5 psi), until the necessary retarding force is obtained.

LOW SPEED STOPPING

When it becomes necessary to initiate a brake application from speeds below 32 km/h (20 MPH), and if automatic Blended Braking

is not applied, proceed as follows:

1. Slowly reduce the Throttle to IDLE.

2. While preventing brake cylinder pressure from developing on the locomotive consist, make a minimum brake pipe reduction.

3. While preventing brake cylinder pressure from developing on the locomotive consist, additional reductions may be made to stop the train at the selected stopping point.

4. As soon as the train stops, apply the Independent Brake.

If the minimum reduction is made soon enough, the stop should not require more than a 69 - 83 kPa (10 - 12 psi) total reduction.

If the train is exceptionally long, and if conditions warrant, the engineer may find it advantageous to leave the Throttle in position 1 or 2, until the brake application becomes effective on the train.

HIGH SPEED STOPPING

The "one application and graduated release" method should be used when braking is initiated at speeds of 32 km/h (20 MPH), and above. To allow a gradual release of the brakes, braking should be started sufficiently in advance of the selected stopping point.

1. To obtain Blended Braking, gradually reduce the Throttle to IDLE.

2. After a 10 second pause, make a minimum brake pipe reduction. Do not Bail-off the Independent Brake Valve during this, or any subsequent reduction.

3. Make additional brake pipe reductions as needed, normally in 21 - 35 kPa (3 - 5 psi) increments, until the necessary retarding force is obtained.

5. When nearing the stopping point, graduate the brakes. As a result, the stop will be made with low brake cylinder pressure; the lower the brake cylinder pressure at the completion of the stop - the smoother the stop.

6. Apply the Independent Brake as soon as the train stops.

EMERGENCY BRAKE APPLICATIONS

1 . In the event of an emergency situation, quickly move the Automatic Brake Valve Handle to the EMERGENCY position, and leave it there until the train stops.

2. DO NOT ATTEMPT TO REGULATE LOCOMOTIVE BRAKE CYLINDER PRESSURE.

3. Place the Throttle in IDLE.

4. Sanding should start immediately, and should continue until the train stops.

EVENT RECORDER/CREW ALERTNESS SYSTEM
(Road Numbers 6430 - 6458)

As required by law, the locomotive is equipped with a combined Crew Alertness and Event Recorder System. Power for the device is supplied by way of the ER/SP IND Circuit Breaker. The status of the system is indicated by Light Emitting Diodes (LEDs), located

near the device. If any attempt is made to tamper with the system, a penalty brake application will be initiated.

The system is enabled when the brake cylinder pressure is less than 103.4 kPa (15 psi), i.e. as soon as the locomotive brakes are released. The system will also be enabled when the locomotive speed is above 0.8 km/h (0.5 MPH), or, when the Reverser is moved from the NEUTRAL position.

The Reset and Sensing Control System is an integral function of the Event Recorder. It consists of an electronic timer, which if not reset within a certain time period, will cause a penalty brake application.

If the operator does not reset the Timing Cycle within a predetermined interval, the system will give a visual and audible warning. The duration of the Timing Cycle, which varies inversely with the locomotive speed, is as follows:

From 0 to approximately 3 km/h (2 MPH), the Timing Cycle will be 20 seconds, plus a 20 second Alarm Cycle. This amounts to a total of 40 seconds before a penalty brake application is initiated.

From 3 to 13 km/h (2 to 8 MPH), the initial Timing Cycle will be 20 seconds. However, if one reset is initiated during that period, the Timing Cycle will automatically increase to approximately 150 seconds.

Above 13 km/h (8 MPH), the Timing Cycles will decrease at higher locomotive speeds. In other words, at 32 km/h (20 MPH), the Timing Cycle would be 104 seconds; at 48 km/h (30 MPH), it would be 88 seconds; and at 97 km/h (60 MPH), the Timing Cycle would decrease to 60 seconds. Refer to the following Timing Cycle Table:

SPEED		TIME ALLOWANCE
Km/hour	MPH	Seconds
0	0	20
3.2	2	20
16.1	10	127
32.2	20	104
48.3	30	88
64.4	40	70
80.5	50	62
96.5	60	60
112.6	70	55
128.7	80	50
144.8	90	46

In order to prevent a penalty brake application, the Timing Cycle may be reset by initiating, or completing, any one of the following actions:

1. Activation of the Alertness Manual Reset Push Button.
2. Activation of the Alertness Reset Foot Pedal.
3. A change in Throttle position.
4. A setup of the Dynamic Brake System (ON or OFF).
5. A minimum change of 41.4 kPa (6 psi) in Brake Pipe Pressure within a 2 second period.
6. Independent Brake Bail (sensed by a 15 psi pressure switch in the actuating pipe).
7. Activation of the Horn (sensed by a 15 psi pressure switch).
8. Activation of the Bell (sensed by a 15 psi pressure switch).
9. Operation of the Manual Sanding Switch.
10. A change in the Front Headlight Control Switch (switching between DIM and BRIGHT).

At the end of the Timing Cycle, an Alarm Cycle will be triggered. The alarm signal consists of flashing ALARM Lights on the Crew Alert Panel, as well as an audible alarm. The audible alarm will

start at a very low intensity, and will build to a high intensity at the end of the Alarm Cycle (approximately 20 seconds).

At the end of the warning period (Alarm Cycle) the overspeed whistle will sound, during which time the operator may still avoid a penalty brake application by immediately placing the Automatic Brake Valve Handle in the SUPPRESSION position.

If the system is not reset by the end of the Alarm Cycle, the Overspeed Relay will deenergize, a penalty brake application will occur, and engine speed will be reduced to IDLE.

To recover from a penalty brake application, allow 30 seconds for the system to reset. Then, place the Automatic Brake Valve Handle in the SUPPRESSION position.

The Event Recorder/Crew Alertness System will be automatically disabled when the locomotive is stationary, the brake applied (brake cylinder pressure greater than 15 psi), and the Reverser Handle centered in the NEUTRAL Position. The system will also be disabled on a locomotive that is set up as a Trailing Unit. The system accomplishes this by detecting an equalizing reservoir pressure that is below 103.4 kPa (15 psi).

In order to avoid disabling the locomotive in the event of a system malfunction, the Event Recorder is equipped with backup circuits and an Override Switch.

When the Override Switch is placed in the OVERRIDE position, the R.S.C. OVERRIDE Light on the Locomotive Warning Panel, as well as the OVERRIDE Light on the Crew Alert Panel, will come ON.

Should a circuit failure occur, the SYSTEM DEFECT Light on the Crew Alert Panel will illuminate.

CAUTION

Any attempt to defeat the Crew Alertness System, by disconnecting the power supply or the input cables, will result in a penalty brake application. This penalty cannot be reset until the system is returned to normal. Disconnecting a signal cable from the axle generator will not allow the microprocessor to function properly, and the allowance time will remain at 20 seconds. Disconnecting the alarm system will prevent the engineer from knowing when to reset the crew alert, and will eventually result in a penalty brake application.

EVENT RECORDER/RSC SYSTEM
(Road Numbers 6400 - 6429)

The Event Recorder/RSC System on Road Numbers 6400 to 6429 is similar to the equipment used on Locomotive Units 6430 to 6458. One difference is that an Alarm Control Panel is used instead of the Crew Alert Panel. However, the function of the system is the same. The microprocessor-controlled Event Recorder/RSC System is designed to detect the operation of locomotive controls as they are manipulated by the engineer, and thus to prove crew alertness.

The system is enabled as soon as the locomotive brakes are released, or, when the locomotive speed is above 0.8 km/h (0.5 MPH), or, when the Reverser is moved into either the FORWARD or REVERSE position.

The Event Recorder/RSC system will be automatically deactivated if all of the following three conditions are met: The locomotive speed is less that 0.8 km/h (0.5 MPH), and, the brake cylinder pressure is greater than 103.4 kPa (15 psi)(brake applied), and, the Reverser Handle is centered in the NEUTRAL Position. The system will also be disabled on a locomotive that is set up in the Trailing mode, by detecting that the pressure in the equalizing

reservoir is below 103.4 kPa (15 psi).

If the operator does not reset the Timing Cycle within a predetermined interval, the system will give a visual and audible warning. If the system is not reset by the end of the warning period, the overspeed system will initiate a penalty brake application, and engine speed will be reduced to IDLE.

The duration of the Timing Cycle, which varies inversely with the locomotive speed, is as follows:

From 0, to approximately 3 km/h (2 MPH), the Timing Cycle will be 20 seconds plus a 20 second Alarm Cycle, for a total of 40 seconds before a penalty brake application is initiated.

From 3 to 13 km/h (2 to 8 MPH), the initial Timing Cycle will be 20 seconds. However, if one reset is initiated during that period, the Timing Cycle will automatically increase to approximately 150 seconds.

Above 13 km/h (8 MPH), the Timing Cycles will decrease at higher locomotive speeds. In other words, at 32 km/h (20 MPH), the Timing Cycle would be 104 seconds; at 48 km/h (30 MPH), it would be 88 seconds; and at 97 km/h (60 MPH), the Timing Cycle would decrease to 60 seconds.

In order to prevent a penalty brake application, the Timing Cycle may be reset by any one of the following actions:

1. Activation of the RSC manual reset.
2. Activation of the RSC foot reset.
3. A change in Throttle position.
4. A Dynamic Brake Setup (ON or OFF).
5. A minimum change of 41.4 kPa (6 psi) in Brake Pipe Pressure within a 2 second period.

6. Independent Brake Bail (sensed by a 15 psi pressure switch).
7. Activation of the Horn (sensed by a 15 psi pressure switch).
8. Activation of the Bell (sensed by a 15 psi pressure switch).
9. Operation of the Manual Sanding Switch.
10. A change in the Front Headlight Control Switch.

At the end of the Timing Cycle, the Alarm Cycle will be triggered for an additional 20 seconds. The alarm signal consists of two flashing lights on the Alarm Control Panel, plus an audible alarm. The pulsed audible alarm will start to sound at a very low intensity, and will build to a high intensity at the end of the Alarm Cycle. At any time during this alarm period, the engineer can still reset the allowance time by activating one of the reset functions.

At the end of the warning period, the overspeed whistle will sound. During this time, the operator may still avoid a penalty brake application by immediately placing the Automatic Brake Valve Handle in SUPPRESSION.

To avoid disabling the locomotive in the event of a system malfunction, the RSC system is equipped with backup circuits and a Manual Override. When activated, the R.S.C OVERRIDE Light will be ON at the Locomotive Warning Panel.

Should a circuit failure occur, the Red coloured DEFECTIVE Light on the Alarm Control Panel will illuminate.

CAUTION

Any attempt to tamper with the system, will result In a penalty brake appllcation.

OPERATION OF THE HEAD END POWER SYSTEM

Although detailed descriptions of the HEP Controls were given in the preceding sections, Section 3A provides specific instructions for the actual operation of the Head End Power System. These instructions assume that the diesel engine is running at the normal IDLE speed.

TRAIN CONNECTIONS FOR AUXILIARY AC POWER

As illustrated in Figure 3A-1, locomotives could be coupled in a consist according to any of the five following configurations:

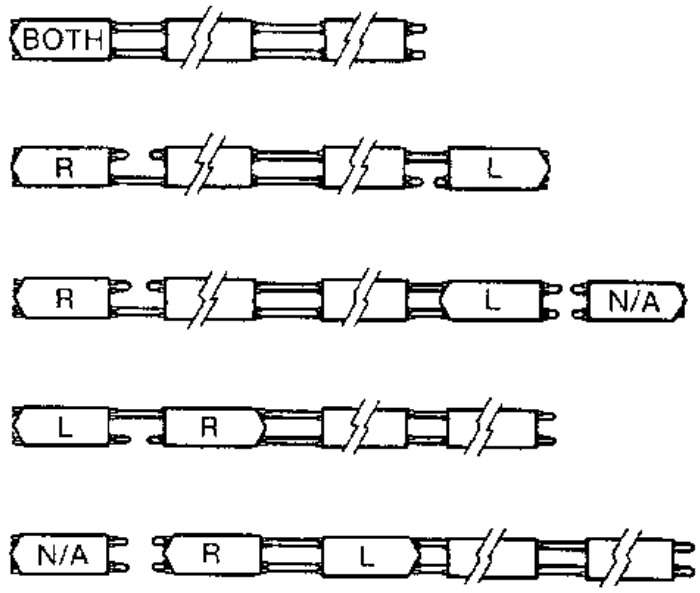


Fig. 3A-1 - Auxiliary AC Power Train Connections

In a single unit consist, the trainline AC power jumpers must be connected on both the right, and left sides of the train.

When more than one locomotive is coupled in a consist, the normal procedure is to connect the AC power cables in such a way that two units provide the required AC power to the cars, (each unit provides power to half of the cars). The AC power of one unit is connected to one side of the train, but, is isolated from the other units. In the same way, the AC power of the second unit is connected to the other side of the train, and is isolated from the other units.

If a third unit is used in the consist, the AC power of that unit should not be connected.

On the last car being supplied with AC power, the set of receptacles on the side being supplied must be jumpered. This serves to close the trainline loop.

NOTE

In trail position, the F40PH-2D locomotive can be connected with the cab leading or trailing.

If two units are used in trail position, the leading train unit must be an F40PH-2D locomotive.

AC POWER TRAINLINE SET-UP

WARNING

Before applying or removing any AC power cables, press the STOP Button on the Head End Power Control Panel. This will ensure that the AC power circuits are OPEN. In this case, the HEP BREAKER OPEN Light on the Warning Panel should be ON.

1. Verify that all AC power jumpers are in place throughout the train.
2. Ensure that the following equipment is properly positioned for operation:

ON THE H.E.P. MONITOR PANEL

a. The 480 VAC Control, and Alternator Transfer Motor Circuit Breakers must be CLOSED.

b. The Frequency and Voltage Instantaneous Thermal Overload Reset Button, the CB-HE Overvoltage Circuit Breaker Reset Button, and the Ground Fault Reset Button should be in the NORMAL position.

ON THE CIRCUIT BREAKER PANEL

The appropriate H.E.P. Distribution Circuit Breakers (TSLF, TSLR, TSRF, and/or TSRR) should be CLOSED, as required.

ON THE FUSE AND SWITCH PANEL

All necessary Circuit Breakers should be CLOSED.

ON THE ENGINE CONTROL PANEL

Place the Isolation Switch in the ISOLATE position.

ON THE HEAD END POWER CONTROL PANEL

a. Position the Head End Power Mode Switch to IDLE.

CAUTION

Before the Trainline Setup Switch Is moved from one position to another, the Head End Power Mode Switch must be in the IDLE position, and there must not be any hotel power on the trainline.

b. Push the Enable Switch, and rotate the Trainline Setup Switch to whichever position corresponds to the configuration of the Head End Power connections (Figure 3A-2).

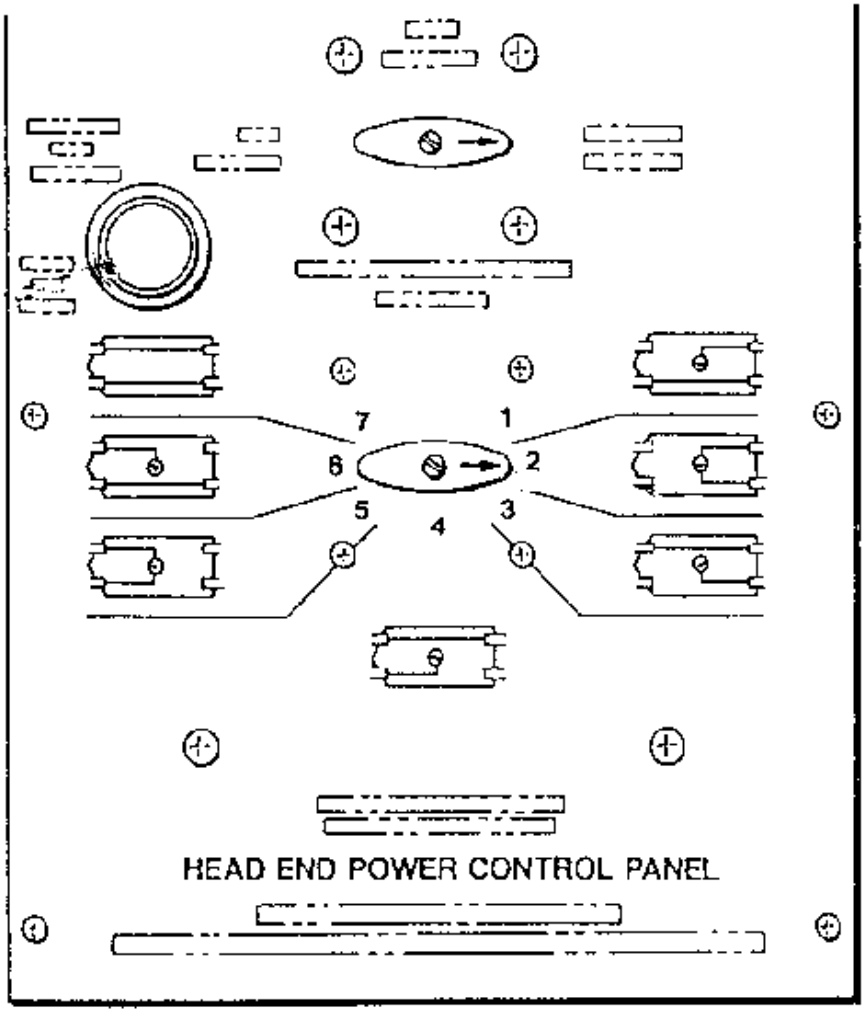


Fig. 3A-2 - Trainline Set-Up Switch

HEAD END POWER CONTROL PANEL

CAUTION

Before the position of the Head End Power Mode Switch Is changed, the Isolation Switch on the Engine Control Panel must be In ISOLATE.

Once the trainline network has been set up, the Head End Power Mode Switch may be rotated to the appropriate selection, as follows:

1. If the unit is not required to provide Head End Power, position the Head End Power Mode Switch to IDLE.

2. If the unit is to provide Head End Power, as well as Traction Power, place the Head End Power Mode Switch in the RUN position.

3. If the unit is to provide Head End Power, but not Traction Power (the locomotive at a standstill), rotate the Head End Power Mode Switch to the STANDBY position.

READY Indicating Light

When illuminated, the HEP READY Light indicates that the following preliminary conditions for Head End Power have been met:

1. The Diesel Engine is running, and the output of the Excitation Alternator is sufficient to supply the necessary power.

2. There is no AC voltage on the Head End Power trainlined circuit.

3. The AC Contactor is OPEN. As a result of this, the AUX. POWER C.B. Light is OFF.

4. The Head End Power Mode Switch is in the RUN or STANDBY position.

HEAD END POWER START SEQUENCE

When the trainline circuit has been properly set up, and the Head End Power Mode has been selected, both the

READY and the AUX. POWER T.L. Lights should be ON, and the TRAINLINE INCOMPLETE Light on the Warning Panel should be OFF.

Once the Head End Power START Switch is depressed, the engagement and operation of the Head End Power System is completely automatic. The following sequence should then be observed:

1. Engine speed will increase to 893 RPM in the RUN mode, or to 720 RPM in the STANDBY mode.

2. As the alternator reaches the correct frequency, the AC Contactor will close, the READY Light will go OFF, and AC power will then be supplied to the trainline. The AUX. POWER C.B. Light will illuminate to indicate this condition.

3. The HEP VOLTS NORM. Light will come ON.

4. The VOLTS, AMPS, and HERTZ Meters, on the HEP Monitor Panel, should indicate the correct readings.

HEAD END POWER INTERRUPT SEQUENCE

If the Head End Power trainline is interrupted for any reason, the following sequence will take place:

1. The AUX. POWER T.L., and AUX. POWER C.B. Lights will go OFF.

2. The TRAINLINE INCOMPLETE, and READY Lights will come ON.

3. Engine speed will change, and will correspond to the position of the throttle handle before the Head End Power System was engaged.

NOTE

Certain operating conditions could occur where the AUX. POWER C.B. Light will go OFF, and the TRAINLINE INCOMPLETE and READY Lights will come ON. This indicates that something has disturbed the output circuit of the AC Contactor, thereby causing the Contactor to OPEN. The disturbance could be due to a disconnected Head End Power jumper cable, a system overload, etc. By pushing the Head End Power STOP button, the operator can completely disable the Head End Power System. In this case, the READY light will go OFF.

HEAD END POWER RESTORE SEQUENCE

To protect HEP equipment from electrical transients, the system has several built in time delays. Any trainline interruption requires a minimum 5 second time delay, before Head End Power can be restored. This is provided that the trainline fault has been corrected.

When continuity of the trainline AC power has been restored, the system must be restarted, as previously described under "Head End Power Start Sequence".

HEAD END POWER SHUTDOWN

The Head End Power System can be shut down by any one of the following:

1. Depressing the Head End Power STOP Pushbutton on the HEP Control Panel.

2. Pushing any one of the Emergency Fuel Cutoff Buttons.

3. Activating the MU Engine STOP Pushbutton on any unit in a consist.

HEAD END POWER-MODE TRANSITIONS

RUN TO STANDBY

CAUTION

Before changing the Head End Power Mode Switch from RUN to the STANDBY mode, the locomotive Isolation Switch on the Engine Control Panel must be in the ISOLATE position, and the Reverser Handle should be centered.

Moving the Head End Power Mode Switch from RUN to STANDBY initiates the following sequence:

1. The AC Contactor will OPEN. The AUX. POWER C.B. Light will be extinguished, and the READY and TRAINLINE INCOMPLETE lights will come ON.

2. Engine speed will decrease to 720 RPM, and there will be a decay in the Head End Alternator voltage.

3. The AC voltage of the Traction Alternator will increase.

4. In not less than 5 seconds, the AC contactor will CLOSE, the READY and TRAINLINE INCOMPLETE Lights will go OFF, and the AUX. POWER C.B. Light will illuminate.

5. The Ammeter will indicate Amperage according to load, the Voltmeter will indicate about 480 Volts AC, and the Frequency Meter will indicate 60 Hz (at 1800 RPM).

STANDBY TO RUN

Moving the Head End Power Mode Switch from STANDBY to RUN initiates the following sequence:

1. The AC contactor will OPEN. The AUX. POWER C.B. Light will go OFF, and the READY and TRAINLINE INCOMPLETE Lights will come ON.

2. The engine speed will increase to 893 RPM.

3. As the Head End Alternator voltage builds up, the Traction Alternator voltage will decay.

4. In approximately 5 seconds, the AC contactor will CLOSE, the READY and TRAINLINE INCOMPLETE Lights will go OFF, and the AUX. POWER C.B. Light will illuminate.

5. The Ammeter will indicate Amperage according to load, the Voltmeter will indicate about 480 Volts AC, and the Frequency Meter will indicate 60 Hz (at 1800 RPM).

NOTE

It requires at least 10 seconds before Traction Power operation can be restored.

TROUBLESHOOTING

INTRODUCTION

This section covers operational problems that may occur on the road, as well as the suggested actions that should be taken by the operator in response to the trouble.

In the event of faulty operation of any component, safety devices will automatically protect equipment. In general, this protection is obtained by one of the following methods:

1. The complete shutdown of the diesel engine, or complete elimination of a function, (such as blended dynamic braking).

2. Unloading of the diesel engine, and restriction of the engine to IDLE 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

When in doubt concerning certain alarm conditions, the applicable Indicator Lights should be tested.

In order to determine if a lamp is working properly in its socket, the Indicator Lights have a push-to-test feature. This allows testing of the lamp circuit alone. When the lens cap is depressed, the supply voltage is applied across the lamp circuit. After approximately one second, the light should illuminate.

CONDITION	PROBABLE CAUSE	SUGGESTED OPERATOR'S RESPONSE
Lead unit HOT ENGINE light ON. Audible alarm ON. Engine running, but engine speed and power reduced. (If the Head End Power System is engaged, engine power will be reduced, but not the engine speed.)	Temporary operating condition.	No action is necessary, unless the alarm persists. If the alarm continues for more than a few minutes, make certain that the shutters are open, and that the radiator blower motors (cooling fans) are operating. Also, check for a proper coolant level.
	Low coolant level.	If the coolant level is low, or if there are coolant leaks, the unit should be shut down. The cooling system should be filled to the proper level before restarting the engine. NOTE If it becomes necessary to shut down the engine in freezing weather, the cooling system should be drained, or otherwise protected against freezing.
	Shutters not operating properly.	If the shutters are closed, the Cutout Cock Valve in the air line to MVSH, located at the equipment rack, may be incorrectly set to the CLOSED position. This valve should be in the OPEN position. If the shutters fail to open, the unit should be shut down.
	Radiator blower motors not operating.	If the radiator blower motors are not operating, the 200 Ampere fuses, located in the Head End Power Control Cabinet, may be OPEN. The unit must be shutdown before replacing the fuses. If the blower motors do not operate, the unit should be shut down.
Lead unit GROUND FAULT Light ON. Alarm ON.	Lead unit Ground Relay operation.	Because the unit is equipped with an automatic Ground Relay Reset, the GR will automatically reset within 10 seconds, unless the total number of Ground Relay operations is excessive.

CONDITION	PROBABLE CAUSE	SUGGESTED OPERATOR'S RESPONSE
		If Ground Relay operation is caused by a traction motor flashover, or by weakened traction motor insulation, it may be possible to continue operation of the unit by cutting out the defective traction motor. Traction motors are cut out individually. Control circuits will automatically reduce power on a unit that has a traction motor cut out. If more than three Ground Relay operations occur within any consecutive 30 minute period, or if the automatic Ground Relay Reset device locks out, the unit should be isolated and shut down. In the event of a lockout, the Ground Relay can be reset with the GROUND FAULT LOCKOUT RESET Switch on the Fuse and Switch Panel. Follow railroad regulations concerning reset of the lockout device.
Full engine speed and power not obtainable.	Plugged engine air filters.	Operation may continue. However, engine speed and power will be restricted at upper throttle positions. The condition should be reported at the first maintenance point.
Lead unit NO POWER/CHRG. Light ON. Alarm ON. Engine at IDLE speed, or shut down.	No D18A (CA5A) Alternator output voltage.	If the unit shuts down, check the 10 Amp AUX. GEN. FIELD Circuit Breaker and the 325 Amp AUXILIARY GENERATOR Circuit Breaker. Also, check the engine overspeed trip lever. Reset the Circuit Breakers, or the engine overspeed trip lever, and restart the 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 Amp 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.

CONDITION	PROBABLE CAUSE	SUGGESTED OPERATOR'S RESPONSE
Lead unit GOVERNOR SHUTDOWN Light ON. Alarm ON. Engine shut down.	Low lube oil pressure. Hot engine oil. crankcase overpressure. Low water detector button tripped.	If both the HOT ENGINE and the GOVERNOR SHUTDOWN 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, check 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. If all of the above items are normal, reset the low water detector button and the governor low oil shutdown plunger. The engine may then be restarted, and placed on line. If the GOVERNOR SHUTDOWN Light comes on again, the unit should be isolated and shut down.
	Hot oil or low governor 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 the crankcase pressure detector has tripped, make no further engine room 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.***

CONDITION	PROBABLE CAUSE	SUGGESTED OPERATOR'S RESPONSE
Intermittent Wheel SLIP Light indications.	Normal wheel slip correction under severe conditions.	No action required. Do not reduce the Throttle, unless slipping is so severe that it threatens to break the train.
Excessive SLIP Light indications.	Locked sliding wheels.	Make certain that all wheels on the locomotive rotate freely. Do not operate a locomotive unless all wheels rotate freely.
TURBO PUMP Light ON.	Normal condition for 35 minutes after engine start or stop.	No action necessary.
TURBO PUMP Light fails to come on at engine start or stop.	Tripped TURBO Circuit Breaker.	Reset the TURBO Circuit Breaker. If the TURBO PUMP Light still does not come ON, notify authorized maintenance personnel. In this case, the Soakback System Failure Light should be ON at the FP/ES Switch.
PCS OPEN Light ON.	Penalty brake application.	NOTE Observe railroad regulations after any penalty or emergency brake application. To regain power and to release the brakes, place the Throttle in IDLE. Move the Automatic Brake Valve Handle, first to the SUPPRESSION position, and then to the RELEASE position.
	Emergency brake application.	Move the Throttle to IDLE. Move the Automatic Brake Valve Handle to the EMERGENCY position and wait 45 seconds. Then, move the Automatic Brake Valve Handle to the RELEASE position.
Engine will not crank.	Circuit breakers, or switches, not their proper positions.	Refer to Section 3 for Engine Starting Procedures.
	Starting Fuse defective.	Check, and replace the Fuse if necessary.

CONDITION	PROBABLE CAUSE	SUGGESTED OPERATOR'S RESPONSE
	Starter Motor Thermal Overload.	No action required. The time delay will automatically hold out the starter motors for a 2 minute cooling period.
	Turbo Pump Failure.	Refer to the TURBO PUMP Light indication in this section.
BRAKE WARN Light.	Regulating system failure.	On the Engine Control Panel of the affected unit, place the Blended and Dynamic Brake Cutout Switch in the CUTOUT position.
Audible alarm sounding. No alarm lights on in lead unit.	Trailing unit HOT ENGINE.	Refer to lead unit HOT ENGINE.
	Trailing unit, low water detector button tripped.	Refer to lead unit GOVERNOR SHUTDOWN.
	Trailing unit, hot oil or low governor oil.	Refer to lead unit GOVERNOR SHUTDOWN.
	Trailing unit, crankcase detector button tripped.	Refer to lead unit GOVERNOR SHUTDOWN.
	Trailing unit, GROUND RELAY operation.	Refer to lead unit GROUND FAULT.
	Trailing unit, no D18A (CA5A) Alternator output voltage.	Refer to lead unit NO POWER/CHRG. Light on.