

EEM

Operating
Manual

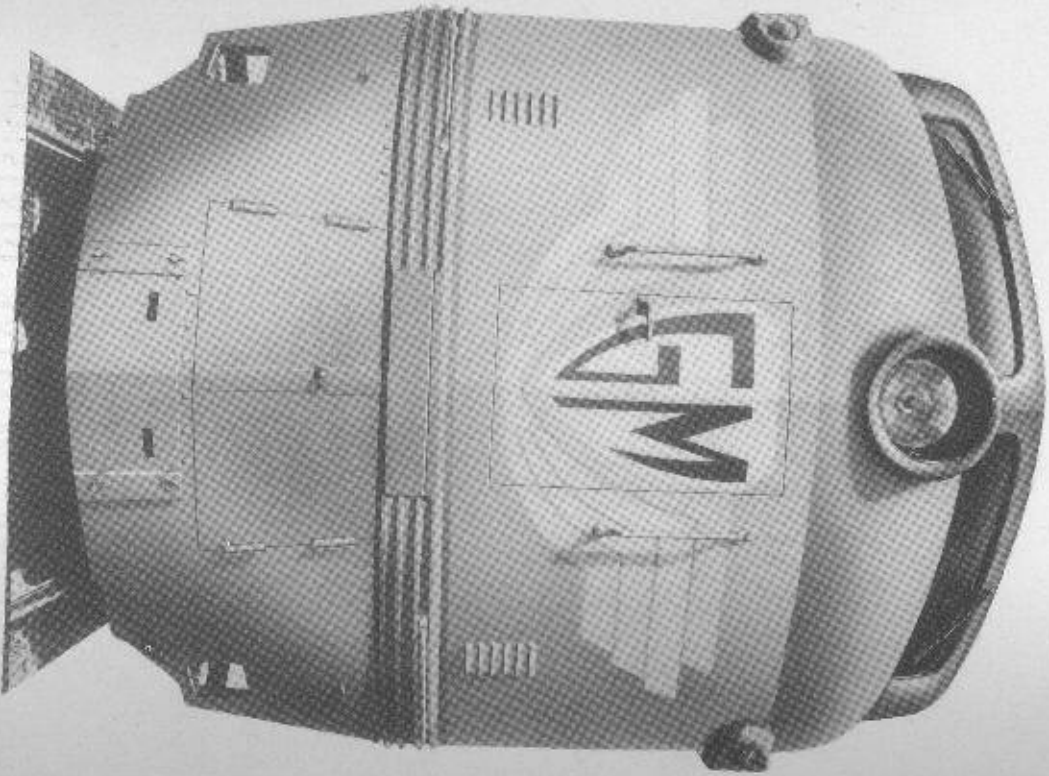


ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION • LA GRANGE, ILLINOIS, U. S. A.

MODEL E7
PASSENGER
LOCOMOTIVE
OPERATING MANUAL
No. 2300



ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION
LA GRANGE, ILLINOIS, U. S. A.



INTRODUCTION

The purpose of this manual is to provide the engineer and fireman with information essential to the efficient and economical operation of the Diesel passenger locomotive.

The manual is divided into sections. The numeral in heavy type at the top corner of each page is the section number. Section 0 contains an index to the manual, an index to plates and a page of general data. Section 1 covers the general description, operating controls and instruments. Section 2 covers the operation of the locomotive. The other sections, contain descriptions of the various "systems" and equipment throughout the locomotive. These sections are in loose-leaf form so that, as changes in procedures and equipment are made, revised pages may be inserted in the manual.

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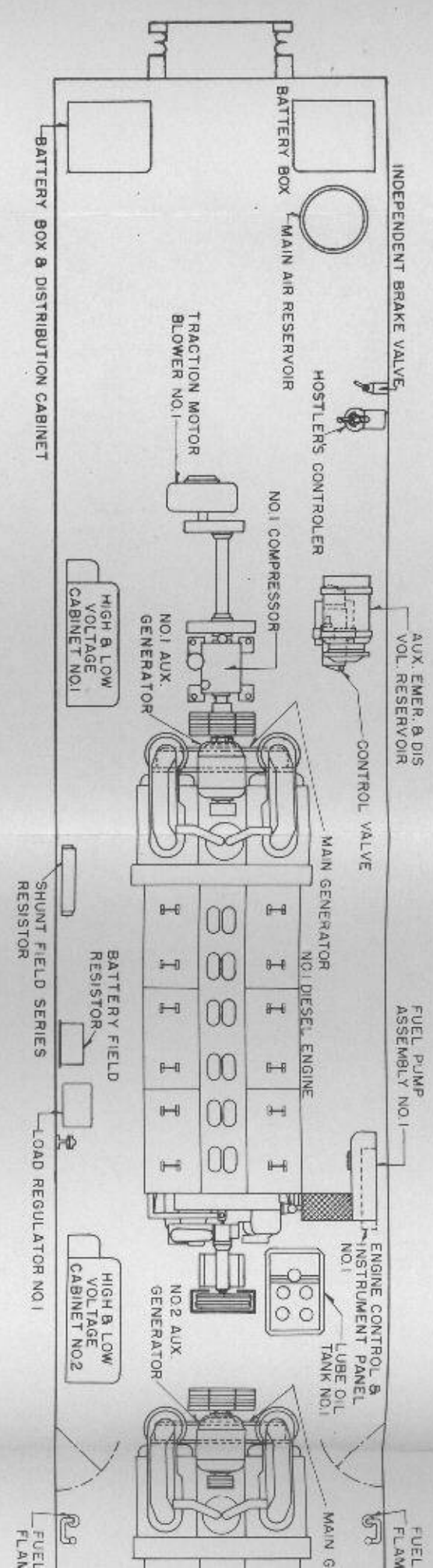
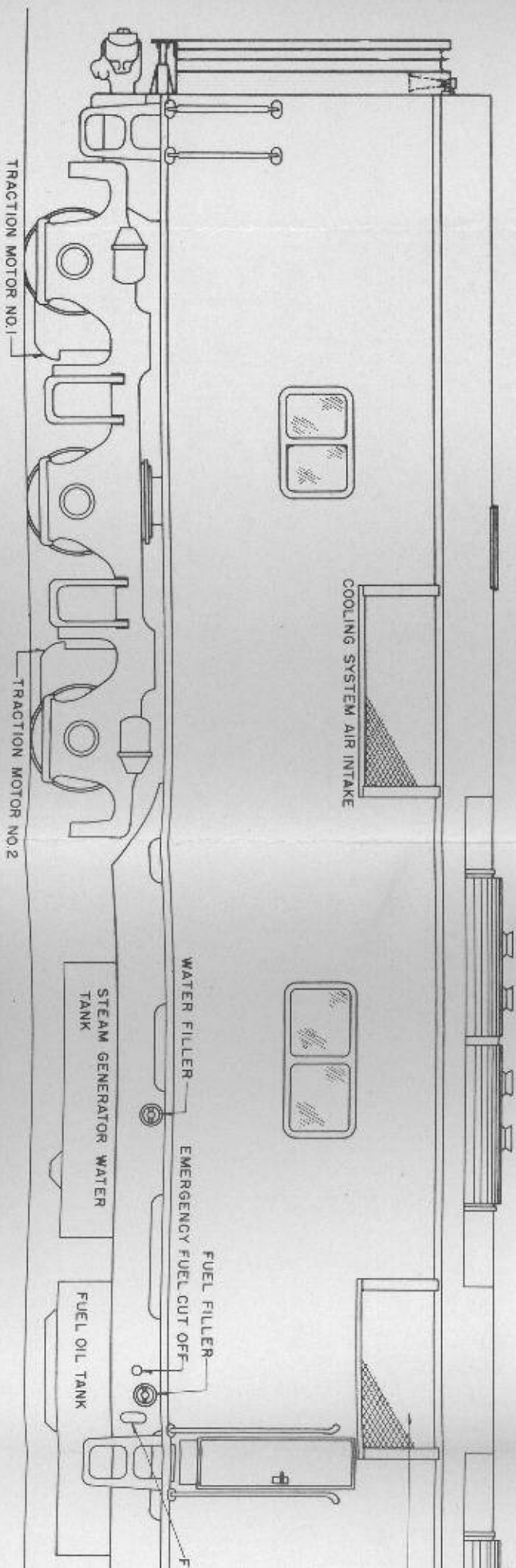
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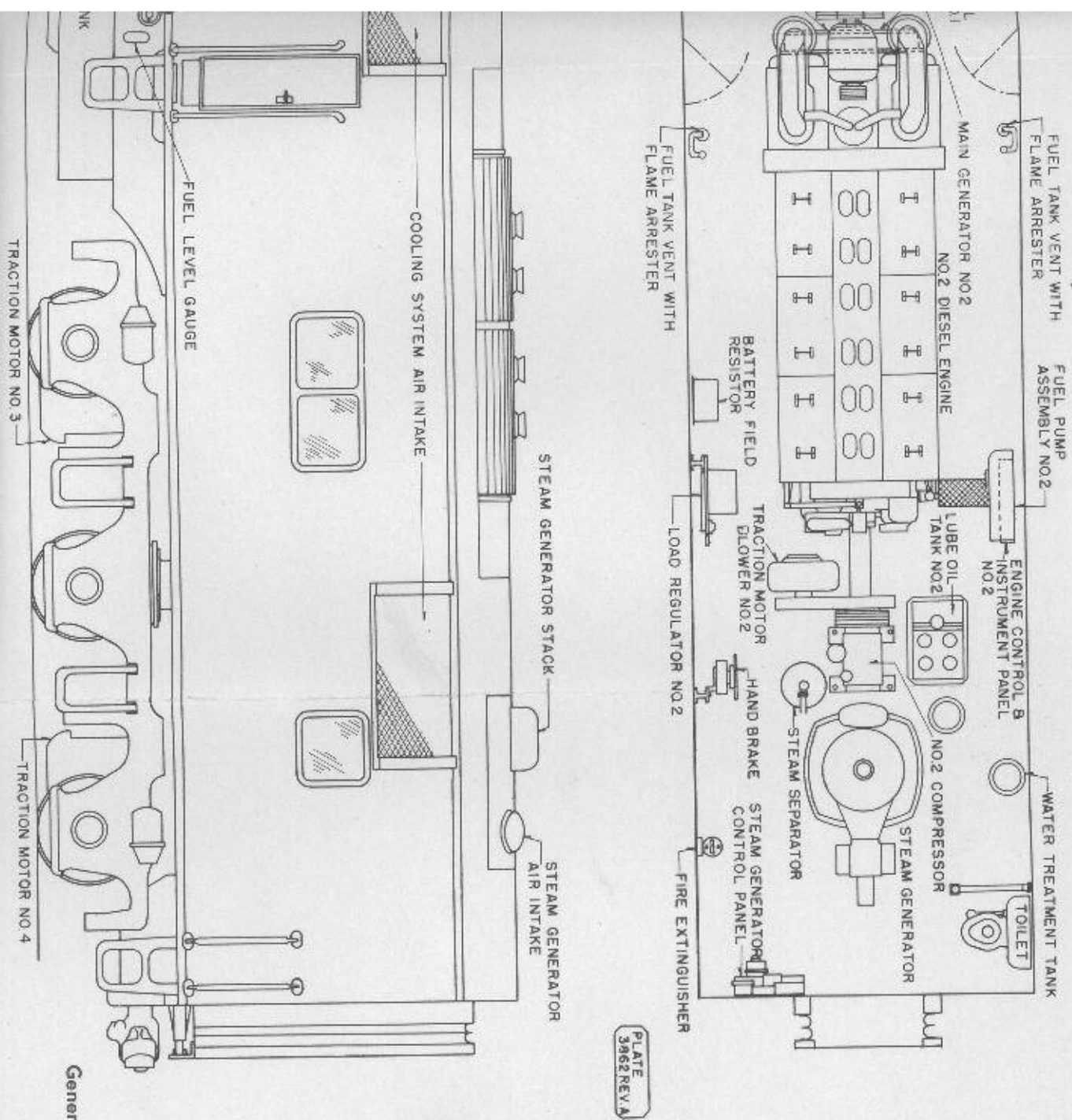
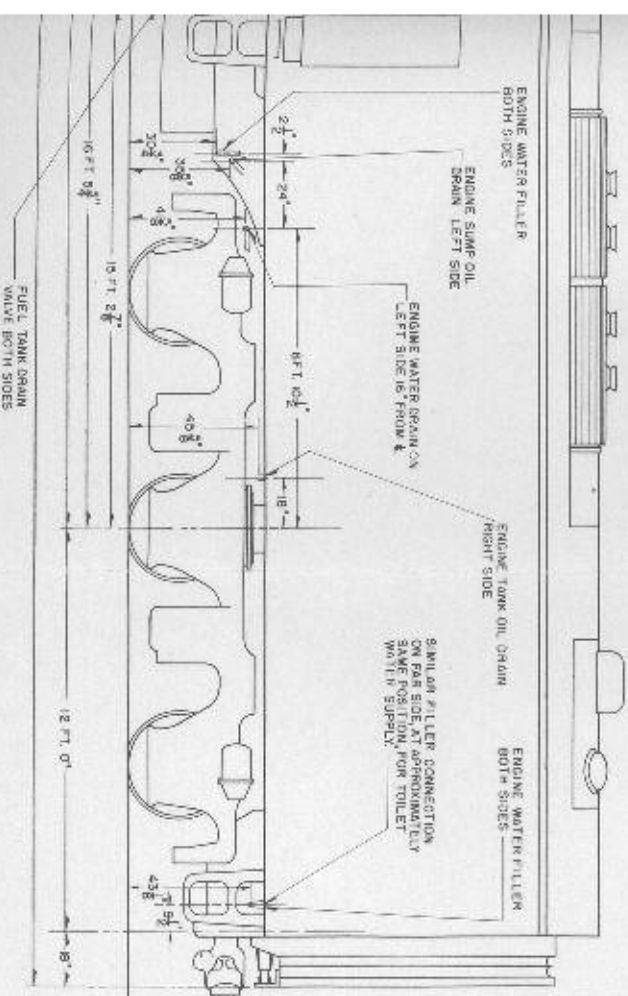
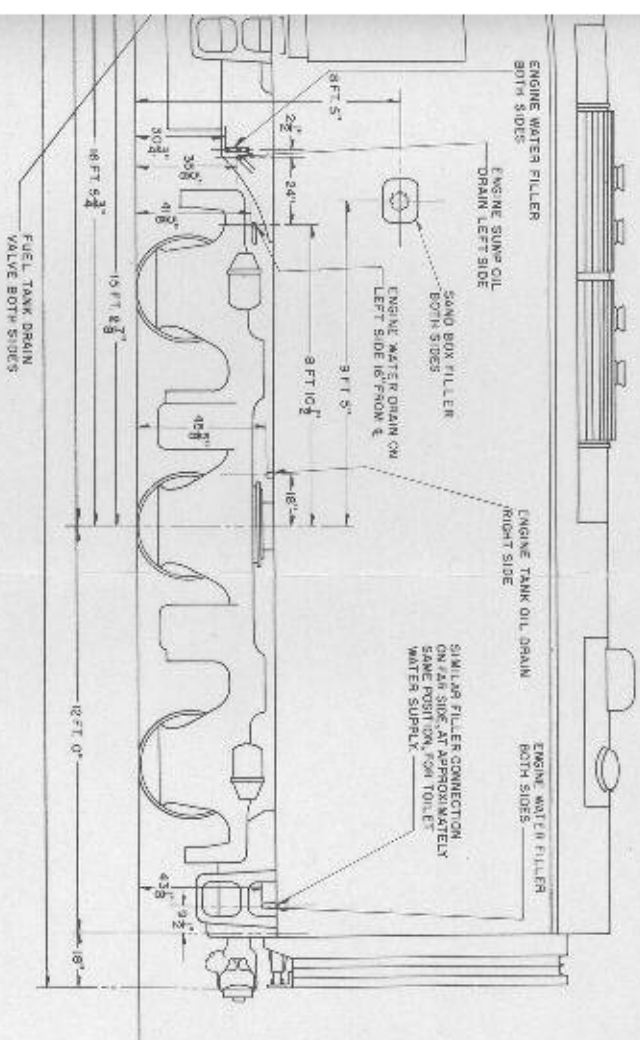


PLATE
 3962 REV. A

General Arrangement
 "B" Unit
 Fig. O-2



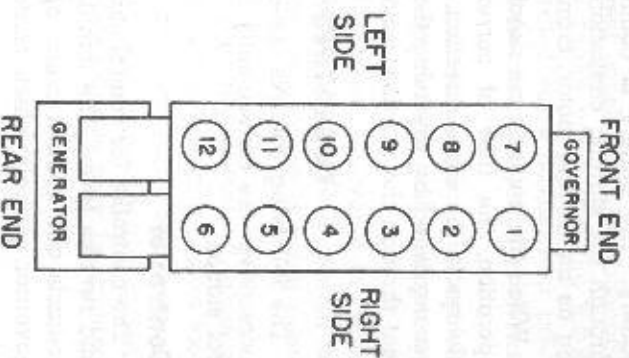
**Drains and Fillers
"A" and "g" Units
Fig. 0-3**

SECTION 1 GENERAL DESCRIPTION

The passenger locomotive consists of one or more units rated at 2000 HP each. The units with a cab are known as the "A" units, those without the cab as "B" units. Each unit contains two power plants, comprising a direct current generator driven by a 12-cylinder Diesel engine. The current generated by the power plant is distributed to the two traction motors on the truck directly under the power plant. The traction motors are geared to the axle through spur gears. Each power plant is electrically independent of any other and may be used independently except for certain low voltage control wiring.

The Diesel engines are "V" type with a 45° angle between banks, and have a compression ratio of 16 to 1. Solid unit injection is employed, there being an injector centrally located in each cylinder head. The engines have a speed range from 275 to 800 RPM controlled by an electro-pneumatic governor control which is operated by movement of the engineer's throttle. In this manner all engines in the locomotive can be controlled simultaneously. Each notch on the engineer's throttle changes the engine speed approximately 75 RPM.

The accompanying sketch serves to identify the cylinder locations, ends and sides of the engine, as they are referred to in this manual. The governor, electro-pneumatic



governor control, water pumps and lubricating oil pumps are mounted on the "Front End." The blowers, oil separator and generator are mounted on the "Rear End."

The engines are fully scavenging. Two blowers are mounted on the rear end of each engine, over the generator. The blowers force air into the space around the cylinders with a pressure of approximately 3 to 5 pounds per square inch. This air is used to scavenge the cylinder of burned gases and supply a fresh charge of air to the cylinder for complete combustion on the next stroke. The air is admitted to the cylinder through a row of ports in the side of the cylinder liner. These ports are uncovered by the piston at the lower end of its downward stroke. Thus, the exhaust gases are expelled around the exhaust valves and a fresh charge of air is made available for the next working stroke.

The energy to start the engine is supplied by a storage battery. The battery is connected to the main generator through the starting contactors, and the generator, operating as an electric motor, cranks the engine.

When the engines are running, and the locomotive is in operation, the flow of current through the generator is always in the same direction. Reversing the locomotive is accomplished by reversing the direction of the flow of current through the traction motor fields.

OPERATING CONTROLS

The following controls, essential to the operation of the locomotive, are conveniently located at the engineer's control station.

Controller

The controller (or control stand) contains the throttle lever and reverse lever. The throttle lever, by means of electric contacts and contact drum, operates the electro-pneumatic governor controls which control the speed of the engines

through the engine governors. The reverse lever operates the electric contacts through the contact drum, which closes a circuit energizing either the forward or reverse magnet valves on the reversers in the high voltage cabinets. There is no mechanical connection between the reverse lever and the reversers.

24RL Air Brake Equipment

The No. 24 RL brake equipment is normally used on these locomotives. The details of this equipment are specified by the railroad to meet their particular operating requirements and vary from road to road. The air brake gauges are located on the instrument panel in front of the engineer. For full description, see the manufacturer's instruction books covering this equipment.

In general, the cab equipment consists of the automatic brake valve, the independent brake valve and the K-2A Rotair valve, a manually operated valve having four positions and located to the right of the controller stand as shown in Figure 1-1.

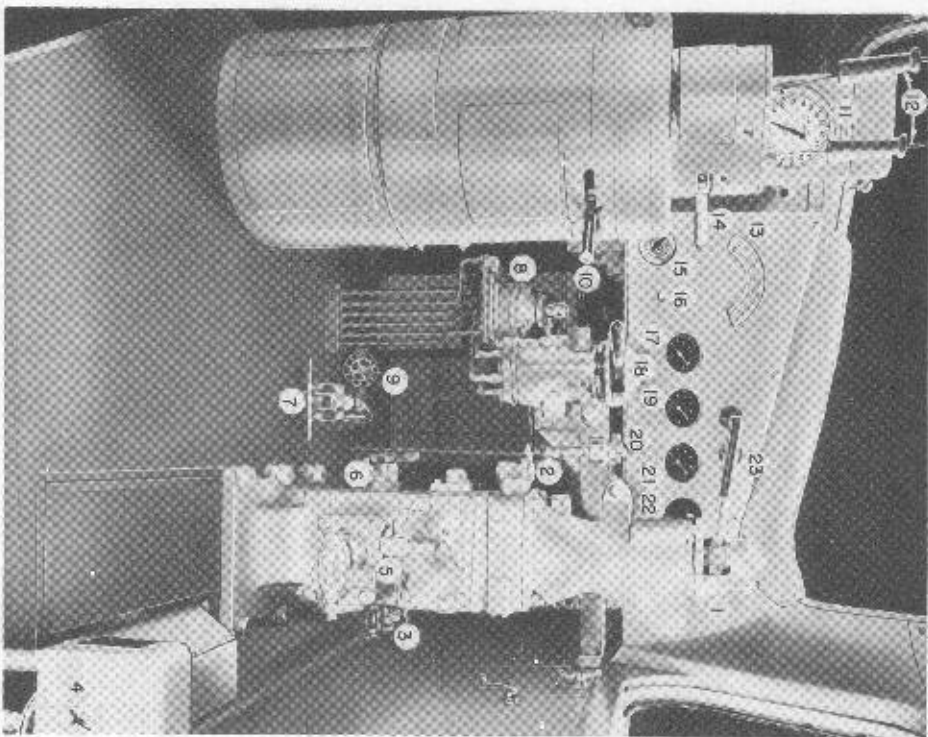
The automatic brake valve handle has six positions (release, running, first service, lap, service and emergency) and may be of the rigid or non-rigid type.

The non-rigid brake valve handle is removable in "Running" position. The rigid brake valve handle is pinned in this position when a double cab locomotive is being operated from the opposite end.

The non-rigid handle, when partially depressed, obtains the same results as holding down the deadman control foot pedal described below. Further downward movement of the handle operates a sanding bail for sand application. However, either or both of these features may be omitted if so specified by the railroad.

LEGEND OF ENGINEER'S CONTROLS

1. Automatic Brake Valve
2. Full Release Selector Cock
3. First Service Position Cock
4. Pneumatic Control Switch (PC)
5. Safety Control Cock
6. Brake Valve Cutout Cock
7. Deadman's Foot Pedal
8. Rotair Valve
9. Cab Heater Valve
10. Reverse Lever
11. Speed Indicator
12. Horn Cords
13. Load Indicating Meter
14. Throttle Lever
15. Heater Switch
16. Windshield Wiper Valve
17. Equalizing Reservoir and Main Reservoir Air Gauge
18. Independent Brake Valve
19. Brake Pipe and Brake Cylinder Air Gauge
20. Bell Valve
21. Application Pipe and Suppression Pipe Air Gauge
(if used)
22. Engineer's Watch Receptacle
23. Wheel Slip Indicator



Engineer's Controls (24RL Brake)

Fig. 1-1

The brake valve also contains:

1. **Brake Valve Cutout Cock**, located on the filling piece portion. When the handle is pointing forward ("Live" position), the brake valve is cut in.
2. **Safety Control Cutout Cock** on the service application portion. When the handle is in the "Out" position, all safety devices (deadman control, locomotive overspeed and train control, where used) are cut out. It is usually sealed in the "In" position for normal operation.
3. **Full Release Selector Cock** on the rotary valve seat portion. When the handle is moved away from the engineer, toward the letters "MR" cast on the block, air at main reservoir pressure is supplied to the chamber above the automatic rotary valve as in the No. 6 ET and No. 8 ET equipment. This provides maximum rate of brake pipe recharge when the brake valve is in release position but overcharging is possible. When the selector cock is moved to the FV position (handle pointing toward engineer), air at pressure controlled by a large capacity feed valve is supplied to the same chamber. With the selector cock handle in this position and the automatic brake valve handle in release position, brake pipe recharge is obtained at a rate which represents the maximum that is possible.

First Service Cock on the filling piece portion. The cock cuts in or out the first service position of the automatic brake valve. When the handle is pointing toward the engineer, the first service position is cut in.

Independent Brake Valve

The S-40-F independent brake valve handle has two positions "Release" and "Full Application" with the "Application Zone" between the two positions. The brake valve is of the self lapping type which automatically laps off the flow of air when the applied pressure reaches the valve corresponding to the position of the brake valve handle in the application zone. Release of locomotive brakes during automatic application is obtained by depressing the brake valve handle in release position.

K-2-A Rotair Valve

The four positions of the K-2-A Rotair valve are "FRGHT," "FRGHT LAP," "PASS LAP" and "PASS." See "OPERATION" for handling of this valve.

Pneumatic Control Switch

The pneumatic control switch (PC) is an air operated electric switch located on the right side of the cab, below the window. This switch is tripped by any "pendly" application of the air brakes. On most locomotives an emergency application of the brake will also trip the "PC" switch. When this switch is tripped, it automatically reduces the speed of the engines to idle and shuts off all fuel pumps. On some locomotives an indicating light will show when the switch is tripped. To reset the switch the throttle must be returned to idle and the brake "recovered." When this has been accomplished the "PC" switch will reset itself and the indicating light will go out. On those locomotives which do not have an indicating light the switch must be reset manually.

Sanding Valve

The sanding valve is a single acting valve which is opened by depressing the automatic brake valve lever, thus operating the sanders. Due to the high tractive effort and even pulling power of the locomotive, it should not be necessary to use sand to start or stop a train except under extremely bad rail conditions, and then only sparingly, as sand is injurious to the moving parts of the trucks and traction motors.

Throttle Emergency Stop Button

This is controlled by a button on the end of the throttle lever. Its purpose is to stop all the engines in the locomotive in case of an emergency. It is operated by pressing the button and pushing the throttle handle beyond the "idle" position.

Caution should be observed in ordinary handling of the throttle so that this button is not pressed in error when closing the throttle. If this is done, the engines will stop and result in a delay while restarting.

Deadman's Foot Pedal and Deadman's Feature on Automatic Brake Valve Lever

The deadman's foot pedal is on the floor directly in front of the engineer. It is necessary for the engineer to keep this pedal depressed at all times during operation of the locomotive—or to keep the automatic brake lever in the deadman's position—otherwise the brakes will be set and the train brought to a stop. To place the automatic brake lever in the deadman's position, depress the lever until a definite catch is felt.

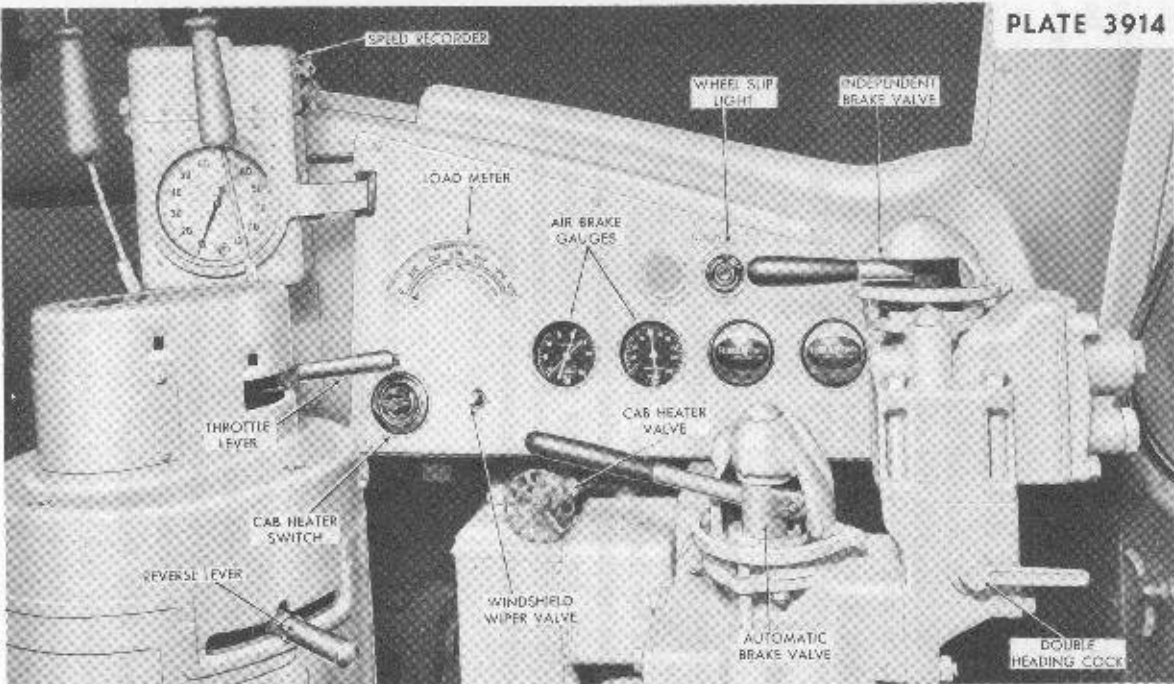
Windshield Wiper Valve

The speed of the wiper is controlled by a needle valve on the instrument panel, which turns the wiper on and off. The wiper should not be run on a dry window, as dirt on the glass or blade will scratch the glass. The wiper blade should be replaced when the rubber becomes worn or hard.

Horn Valve

The horns are operated by air valves which are controlled by pull cords, the handles of which are readily accessible to the engineer.

PLATE 3914



Engineer's Controls (HSC Brake)

Fig. 1-2

Locomotive Bell Valve

The locomotive signal bell is operated by an air valve located at the engineer's station. This bell should not be confused with the alarm bell which is an electrical device.

Engineer's Cab Heater Switch

This is a three speed switch, mounted on the instrument panel, and controls the speed of the engineer's cab heater motor, as well as turning the motor on and off.

ENGINEER'S INSTRUMENTS

Load Indicating Meter

A load indicating ammeter is located on the engineer's instrument panel and is connected in the armature circuit of the "A" unit #1 traction motor. This indicator provides a means for the engineer to check locomotive loading provided the trailing locomotive units have the same gear ratio. The maximum continuous rating is designated by a red triangle at 625 amperes. For information on the use of the load indicating meter, refer to Section 2.

Speed Recorder

The speed recorder, located in front of the control stand, is an hydraulically operated speedometer with recording tape and an odometer. It is driven from an axle on the No. 1 truck of the "A" unit, through a flexible cable. Incorporated in the speed recorder is an electric switch which automatically sets the air brakes and operates the "PC" switch if the train speed exceeds the maximum governed speed of the locomotive.

Wheel Slip Indicator

Whenever one pair of wheels slip on one or more trucks of the locomotive, the wheel slip indicator on the engineer's instrument panel will light. To stop the slippage, ease off

on the throttle, one or more notches. After the wheels stop slipping, indicated by the light going out and staying out, the throttle may be opened to the desired position.

The light will not burn continuously when wheels slip, because the wheels will not slip continuously. The connections of the wheel slip relay to the power plant are such that the power is automatically reduced when the wheels slip. Therefore, the wheel will slip, then stop, slip again and stop—about once a second.

When there is a wheel slip indication, it will probably be only one set of wheels that are slipping, unless the rail conditions are extremely bad. On these locomotives with many traction motors, all of which exert their tractive effort independently, with the connections as outlined above, a wheel slip indication usually means only a partial and temporary loss of tractive effort.

It is, therefore, unnecessary to use sand except under the worst track conditions. Before applying sand, be sure to reduce the throttle until the wheel slip light stops flashing. It should be remembered that sand is injurious to the traction motors and associated apparatus.

If one pair of wheels is locked, due to a broken pinion or axle gear, or the armature shaft frozen in its bearings, the wheel slip signal will light and will stay on as long as current is being supplied to the motors. This is true except in the case of very low locomotive speeds due to the fact that a definite difference in potential between the traction motors is required to make the wheel slip relay function with the transition circuit in the "series" or parallel positions. Therefore, the locomotive speed must be great enough to bring about this difference in potential for any wheel slip indication to be given.

Also, should both pair of driving wheels on the same truck slide, there would be no wheel slip indication.

During transition from series to parallel, the wheel slip relay will pick up, causing wheel slip light to flash. This is not an indication that the wheels are slipping.

The wheel slip relay will give wheel slip indication for both series and parallel operation.

Brake Cylinder and Brake Pipe Gauge

This is a single dial, two-needle gauge; the red needle indicates brake cylinder pressure, and the white needle indicates brake pipe pressure.

Main Reservoir Gauge and Equalizing Reservoir Gauge

This gauge is also of the single dial, two-needle type; the red hand shows the main air reservoir pressure, and the white hand shows equalizing reservoir pressure.

FIREMAN'S CAB INSTRUMENTS AND CONTROLS

The following gauges, switches, and warning lights are located in the instrument panel on the fireman's side of the cab.

Fuel Oil Gauge

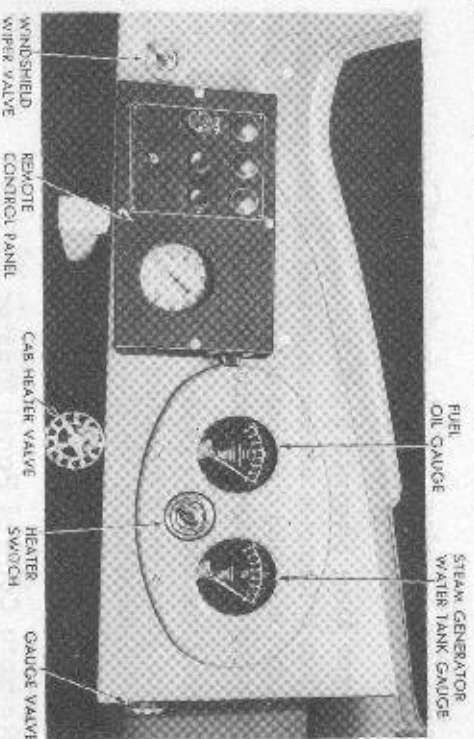
This air-operated gauge is calibrated in inches, from zero to 28, in four inch divisions to show the amount of fuel oil in the tank. The air valve at the gauge is opened to determine the supply of fuel in the tank.

Steam Generator Water Tank Gauge

This gauge is also air-operated and is calibrated in the same manner as the fuel oil gauge.

Low Oil Warning Light

This light warns of either low lubricating oil pressure or high lubricating oil pump suction.



Fireman's Instrument Panel
Fig. 1-3

Hot Engine Warning Light

This light will go on if the water temperature of any engine exceeds 203° F. To determine which engine is causing the alarm to operate, it will be necessary to check the temperature gauge on each engine.

Steam Generator Failure Warning Light

This light is marked "Boiler Off" and will light if the steam generator ceases to operate.

Steam Generator Separator Blowdown Switch (If Used)

This push-button switch operates the separator blowdown valve on the steam generator. A spring returns the switch to the "Off" position when the button is released.

Steam Generator Soot Blower Switch (If Used)

This switch operates the soot blower valves on the steam generator to periodically blow the soot from the coils in the steam generator. An interlock between this switch and the

separator blowdown switch prevents both switches from being used at the same time.

Steam Line Shutoff Switch

When it becomes necessary to shut off the train steam line, due to cutting a car out of the train, this switch is used. A hinged cover prevents accidental operation of the switch.

Train Line Steam Pressure Gauge

This gauge has a maximum capacity of 400 pounds and indicates train line steam pressure. A rheostat mounted on the side of the same panel may be used to regulate the gauge light.

Remote Control Panel Master Switch

This toggle switch controls the steam pressure gauge light and provides current to the three push-button switches on the panel.

Cab Heater Switch

The three-speed switch on the instrument panel controls the operation of the cab heater motor on the fireman's side of the cab.

Windshield Wiper Valve

The windshield wiper is turned on and off and its speed is controlled by the needle valve mounted just to the left of the steam generator panel.

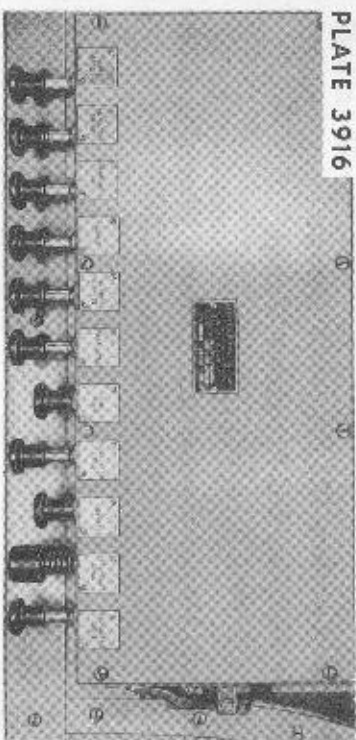
CONTROL PUSH-BUTTON SWITCH BOX

The control push-button switch box, located above the cab window to the right of the engineer, contains the following push-button switches:

- Mars Headlight
- Headlight Bright
- Headlight Dim

- Class Lights
- Number and Gauge Lights
- Defroster Motor
- Fuel Pump
- Generator Field
- Control
- Attendant Call
- Engineer's Light

PLATE 3916



Control Push-Button Switch Box

Fig. 1-4

ENGINE CONTROL AND INSTRUMENT PANEL

These panels are located in the engine room on the side walls of the locomotive at the front ends of the engines. Each engine has its own control and instrument panel which incorporates the following controls and instruments.

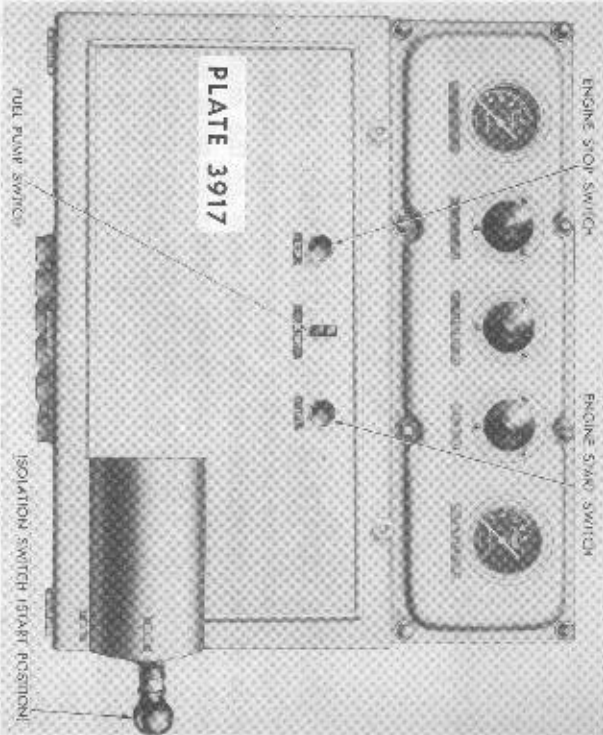
Isolation Switch

The purpose of this switch is to open and close the control circuit of the engine as occasion demands. When starting the engine, this switch must be in the "start" position. After engine is running, the switch is moved to "run" position. This connects the control circuit of the engine to the engi-

neer's controller. If it becomes necessary to isolate the engine, the isolation switch should be moved to the "start" position. This will bring the engine to idle and cut off the power of this engine. See subject under "Isolating an Engine," Section 2.

The following equipment on the engine control and instrument panel is explained elsewhere in this manual, except in those cases in which no further explanation is necessary.

- Piston Cooling Oil Pressure Gauge**
- Main Bearing Oil Pressure Gauge**
- Low Oil Pressure Warning Light**
- Boiler (Steam Generator) Failure Warning Light**



Engine Control and Instrument Panel
Fig. 1-5

- Hot Engine Warning Light**
- Engine Start Switch**
- Engine Stop Switch**
- Fuel Pump Switch**
- Fuel Pump Fuse**
- Fuel Pump Contactor**
- Master Magnet ("E") Valve**

It should be remembered that the warning lights on the engine control and instrument panels do not indicate undesirable conditions in any particular engine, but only warn of some difficulty with one or more of the engines. Individual inspections have to be made to determine which engine is causing the trouble.

HAND BRAKE

The hand brake wheel is located in the left rear end of the engine room in the "A" unit. The hand brake operates only on one pair of wheels on the rear truck. To set the brake, hold down the foot pedal and turn the wheel. To release the brake, advance the wheel enough to release the foot pedal, then release the wheel. Before moving the locomotive, be sure the brake is completely released. Whenever anyone is working around the locomotive trucks, the hand brake should be set.

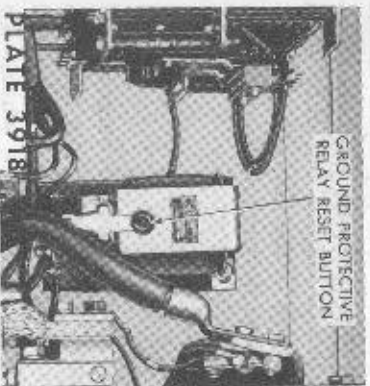
ENGINE OVERSPEED TRIP

This is a flyweight on the engine camshaft which operates small cams under each injector rocker arm, preventing injection of fuel. The trip operates at approximately 880 RPM of the engine. The overspeed trip may be caused to operate by a sudden loss of electrical load, such as wheel slipping or ground relay tripping.

The overspeed trip resetting lever is located on the front end of the engine directly behind the engine governor. If trip operates, it can be reset by turning lever in a counterclockwise direction.

GROUND PROTECTIVE RELAY

If a ground occurs in the high voltage system, the ground protective relay in the high voltage cabinet will open the battery and shunt field contactors and bring the engine to idle. Should this occur, isolate the engine and reset the relay by pushing in the insulated button.



Ground Protective Relay
Reset Button

Fig. 1-6

switch should be opened only by responsible personnel. Keep a constant watch on all electrical equipment, as the relay will not trip when reset with the knife switch open. A ground in the low voltage system will also trip the relay when an engine is being started.

LOAD REGULATOR

The load regulator is a device which loads the engine according to the throttle setting in the cab. It automatically maintains a constant horsepower output corresponding to

each throttle position over the entire range of locomotive speeds.

For the purpose of load regulation the means of determining the horsepower output of the engine is based on the rate of fuel consumption. This is determined by the relationship between the speed setting on the governor and the position of the power piston controlling the opening of the injector racks. If the engine demands more fuel than a predetermined setting, the load regulator reduces the load on the engine by reducing the field excitation of the main generator. If the engine requires less fuel than the predetermined setting or balance point, the load regulator increases the load on the engine by increasing field excitation of the main generator. In this manner, battery voltage, temperature changes in generator windings, or locomotive speeds do not cause overloading or underloading of the engine.

The load regulator has two components: the pilot valve which is attached to the governor; and a self-contained unit in a structural steel frame, which consists of an hydraulic rotary vane type motor attached to a commutator type rheostat. The only external wiring connections are two leads to the generator battery field circuit.

LAYSHAFT MANUAL CONTROL LEVER

The layshaft manual control lever is attached to the end of the injector layshaft and, if necessary, may be used to shut the engine down manually.

HOT JOURNAL ALARM (IF USED)

The journal signal relay is normally energized. If a journal alarm thermal relay opens, the signal relay rings the alarm bells in all units and lights the hot journal light in the unit affected. The journal signal relay has two contacts which close when the holding coil is de-energized.

When Alarm bell operates:

1. **Stop Train.** Determine which unit is ringing the alarm bell. The alarm bell rings in all units of the locomotive, but Hot Journal Indicator will light only in the affected unit. Look for hot journal. If journal is hot, examine for cause and correct, or, if advisable, proceed with caution.
2. If journal is not hot but bell continues to ring, check for defective journal signal relay, blown fuse, a loose wire, or defective individual thermal relays in truck, as in following paragraph.
3. To determine the truck in which a thermal relay is open, remove the rubber covered jumper plug from locomotive body receptacle and insert short-circuited tester plug (part #8004923.) If bell stops ringing, replace tester plug and jumper plug, proceed to check individual thermal relays as in next paragraph.
4. With bell ringing, insert a spare tester plug in each thermal relay lead receptacle until the bell stops ringing. The tester plug from the truck cannot be used, as removal of this plug causes the bells to ring. This will locate the defective thermal relay, which should be replaced at the first maintenance point. The locomotive should not be operated with tester plug in any lead receptacle (except in an emergency), as this will prevent thermal relay or relays from functioning.
5. It may be necessary to silence the bell. If so, remove cover from hot journal alarm box and open the cutout switch. This will not interfere with hot journal alarm on other units of the locomotive.
6. If locomotive is operated with plug in receptacle (as in paragraph 4), or cutout switch open (as in paragraph 5), caution must be observed, as there will be no hot journal alarm indication from the affected thermal relays.

HYDRO-PNEUMATIC RETRACTABLE DRAFT GEAR (IF USED)

Description

The retractable draft gear is moved by an hydraulic cylinder located behind the buffer assembly. The hydraulic fluid (SAE #10 lubricating oil) for the above cylinder is stored in two tanks located in the locomotive nose. Main reservoir air pressure (130±.140#) is directed through a control valve and a directional valve to the free surface of the fluid in one of the storage tanks (position of the directional valve determining which storage tank receives pressure).

The control (3 way) valve with two position lever, supplies air to the directional valve with lever in the open position and vents the hydro-pneumatic system with the lever in the closed position.

The directional (4 way) valve with (2) position lever:

1. Directs air to the "in" storage tank (and vents the "out" storage tank) with lever in down position.
2. Directs air to the "out" storage tank (and vents the "in" storage tank) with lever in up position.

The draft gear is locked in both "in" and "out" positions by two spring loaded keys, or sidelocks.

The air pressure for unlocking these side lock keys is supplied when the control (3 way) valve is opened.

The side locks are fitted with warning whistles, the levers of which bear on the side locks and the whistles sound whenever they are not in the locked position.

Operation

As the operator stands in front of the locomotive facing the coupler, he will find the two operating valves at his left in the draft gear housing with the directional valve

visible and the control valve slightly to the left and covered by the locomotive pilot.

The directional lever operates "up" and "down," giving draft gear extension in the up position and retraction in the down position.

The control valve lever operates toward the front and back of the locomotive. Toward the back is "open" and toward the front is "close and vent."

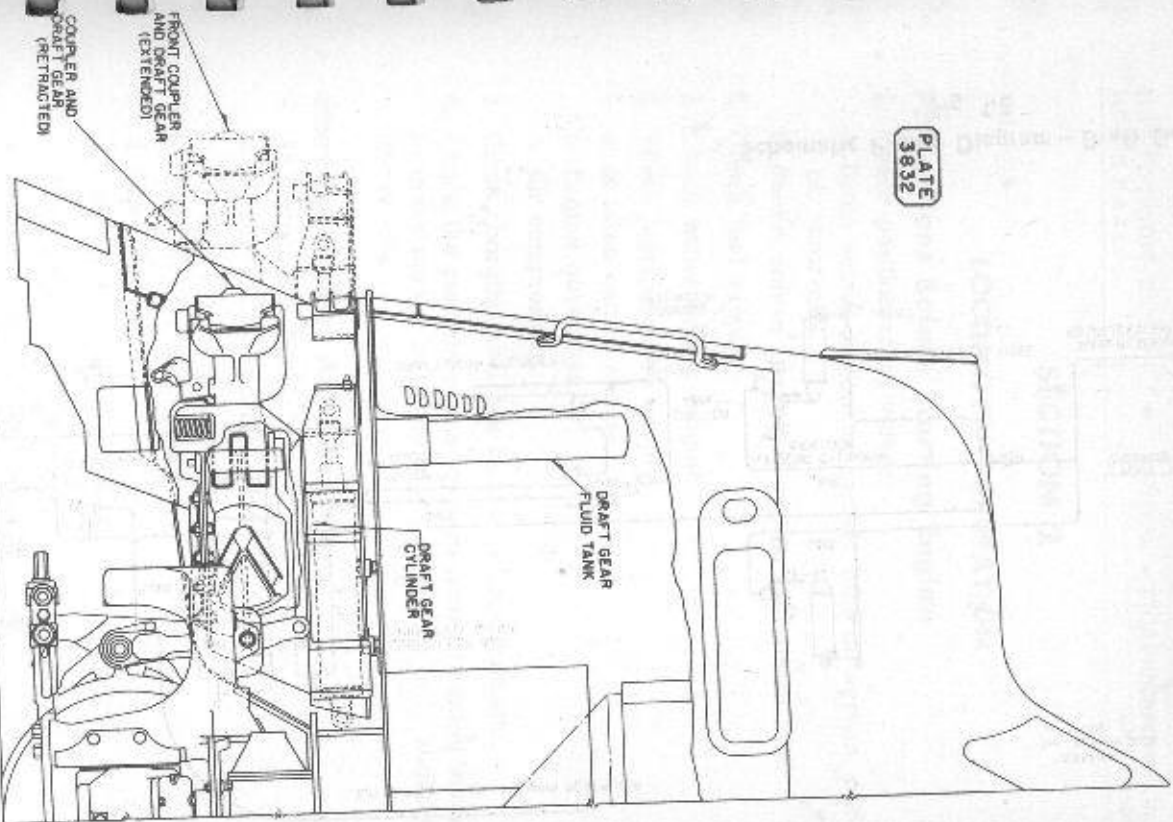
To Extend Draft Gear

1. Open the draft gear doors.
2. Drop air hoses down on face of locomotive pilot and remove uncoupling rods from under draft gear.
3. Depress directional valve lever to the down position.
4. Push control valve lever back to the "open" position (normally side-lock whistles will sound continuously).
5. Raise directional valve to the "up" position.
6. After draft gear is fully extended, pull control valve lever to "close and vent" position (normally side-lock whistles will shut off).

To Retract Draft Gear

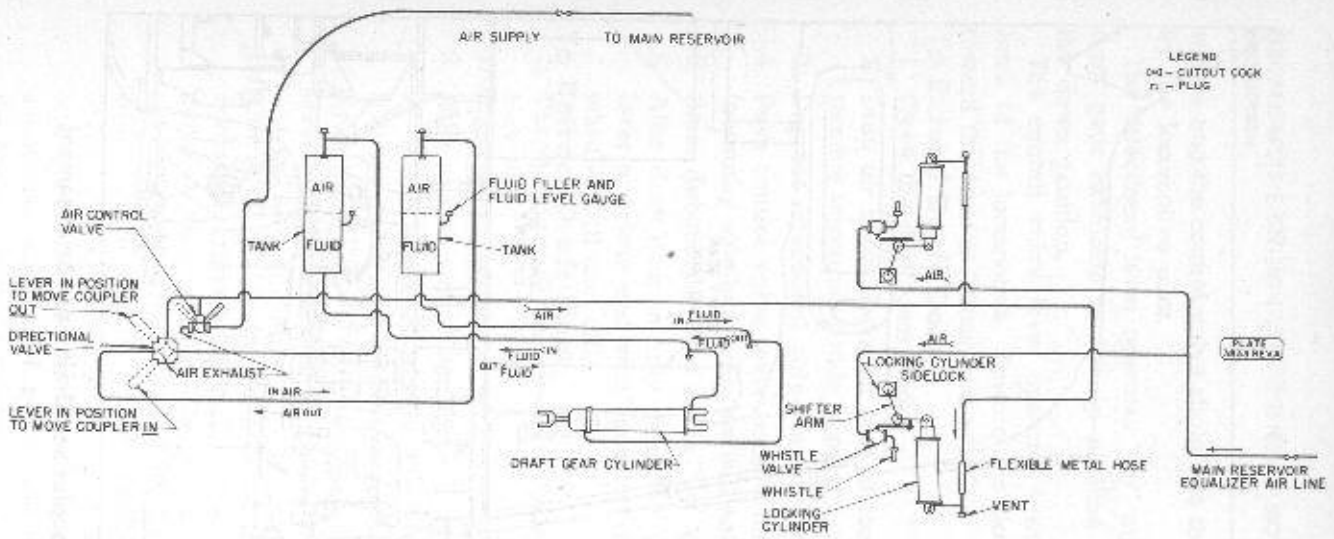
1. Uncoupling rods must first be disengaged from rotary lock lifter.
2. Raise directional valve lever to the "up" position.
3. Push control valve lever back to the "open" position (normally side lock whistle will sound continuously).
4. Depress directional valve lever to the "down" position.
5. After draft gear is fully retracted, pull control valve lever to "close and vent" position (normally side-lock whistles will shut off).

IMPORTANT NOTE—In the nose of the locomotive, up against the right hand wall, is the feed line from the main air reservoir. In this line at this location is a shut-off cock. **THIS COCK SHOULD BE CLOSED AT ALL TIMES WHEN HYDRO-PNEUMATIC SYSTEM IS NOT BEING USED.** When the shut-off cock is closed and the control (3 way) valve is put in position to exhaust to atmosphere, there will be no pressure in the hydro-pneumatic system.



Front Coupler and Draft Gear Arrangement

Fig. 1-7



Schematic Piping Diagram - Draft Gear
Fig. 1-8

SECTION 2

LOCOMOTIVE OPERATION

Precautions Before Starting Engine

1. Check position of all valves:
 - a. Drain valves in cooling system, lube oil system, and air reservoir.
 - b. Steam valves in cooling system and steam line.
2. Check fuel supply.
3. Check water supply (engine).
4. Check lubricating oil supply:
 - a. In main engine sumps.
 - b. Engine governors.
 - c. Air compressors.
5. Close charging switches in low voltage cabinets.
6. Check the position of the layshaft manual control lever to make sure it is in the idle position, or only slightly above idle.

Starting Engines After Layover

1. At Distribution Panel:
 - a. Be sure all fuses are in place.
 - b. Close main battery switch.
 - c. Close master control switch.
 - d. Close light switch.
 - e. Close train control — speed governor switch.
2. At Engineer's Control Station:
 - a. Place throttle in "idle" position.
 - b. Close control push-button switch.
 - c. Close fuel pump switch.
 - d. Set "PC" switch.

3. At Engine:

- a. Test for water accumulation in cylinders. With cylinder test valves open, isolation switch in "start" position, and fuel pump off, use layshaft manual control lever to hold governor power piston in "shut-down" position and turn engine several revolutions by pressing engine "start" button. If discharge of water at test valves is noted, do not start engine until cause of discharge is corrected.
- b. Close cylinder test valves.
- c. Close fuel pump switch on engine control and instrument panel and watch for fuel in 5-pound relief valve sight glass. This will indicate that fuel is circulating through engine fuel oil system.
- d. See that isolation switch is in "start" position.
- e. Press in engine "start" button and hold in until engine starts.
- f. After lubricating oil and piston cooling oil pressures build up, place isolation switch in "run" position. Water temperatures should be up to 125° F. before engines are loaded.

To Move Locomotive

- 1. Make certain main reservoir air pressure is up.
- 2. Release all hand brakes.
- 3. Isolation switches on engine control panels must be in "run" position.
- 4. Close generator field switch in cab push-button switch box.
- 5. Place reverse lever in forward or reverse position as required.
- 6. Place foot on deadman foot pedal and release air brakes.
- 7. See that "PC" switch is set.
- 8. Open throttle as required (see "Handling a Train").

USE OF LOAD INDICATING METER

The pointer on the load indicating meter may be allowed to exceed the maximum continuous rating of 625 amperes only under the following conditions:

- 1. When accelerating a train from a standing start or after passing a "slow order," the pointer may be allowed to swing full scale. As the train speed increases, the pointer will soon return to the left of the red triangle.
- 2. When short distance overloads will not make the pointer indicate in excess of the amperes shown on the following table:

PERMISSIBLE SHORT DISTANCE AMPERES

For Distance Of — Miles	GEAR RATIOS			
	52/25	55/22	56/21	57/20
0 to 2	975	945	935	920
0 to 5	835	815	810	800
0 to 10	760	740	735	730
0 to 15	720	705	700	695
0 to 20	695	680	675	675
Continuous	625	625	625	625

When operating by this table, the throttle should be in the 8th position.

To prevent overheating of the traction motors, it is only permissible to use one of these short distance ratings for any period above the continuous rating.

- 3. In cases where "Special" tonnage or number of cars, with or without helpers, have been set for all ruling grades by careful calculation and the results transmitted to the railroads for their handling.

In general, it is advisable to climb a grade with wide open throttle in order that the time on the grade be kept as short as possible.

Locomotive Operation With Helper Locomotives

On grades where the permissible rating cannot be maintained by the Diesel locomotive alone, steam locomotives are often used as helper engines. When operating under these conditions, the procedure of handling the controls will be greatly different than when operating without a helper.

The maximum rating of the helper locomotive is usually at a lower speed than the continuous safe operating speed of the Diesel locomotive at full throttle. Under these conditions, demands will be made upon the Diesel locomotive to pull more than its share of the load. This will be indicated by the load indicating meter pointer moving to the right of the red triangle. When this occurs, the Diesel locomotive throttle should be reduced so that a larger portion of the load will be taken by the helper locomotive, thus bringing the pointer back to, or below, the red triangle.

OPERATING WITHOUT LOAD INDICATING METER

Should the load indicating meter become inoperative, the operating instructions below should be followed:

To avoid damaging traction motors on passenger locomotives due to excessive heating, it is important that the weight of the train be kept down so that the train speed on grades will not be reduced below the following values when operating with **full engine throttle**:

Gear	Minimum MPH	Maximum Permissible Speed
Ratio 52/25	40	117
55/22	34	100
56/21	31	92
57/20	29	85

*Note: Full throttle operation and traction motors in parallel. (Transition to parallel takes place at approximately 85% of this speed).

When the Diesel locomotive, without an indicating meter, operates with a steam helper, the Diesel throttle must be reduced as the train speed is reduced by the grade, so that more and more of the load will be taken by the helper

locomotive. This is necessary in order to guard against overheating and overheating the traction motors. The correct throttle positions corresponding to train speeds are shown in the following table:

Gear Ratio	Minimum Miles Per Hour At Throttle Positions							
	3	4	5	6	7	8		
52/25	8	14	19.5	26	33	40		
55/22	7	12	16.5	22	28	34		
56/21	6.5	11	15	20.5	25.5	31		
57/20	6	10	14	19	24	29		

TRANSITION

When accelerating a train, transition from series to parallel and from parallel to shunt takes place automatically. When decelerating a train, transition from shunt back to parallel takes place automatically, **but to return the traction motors to series position, the throttle must be placed in "idle"** to allow the parallel contactors to open. The throttle may then be moved to the desired position, and as the train speed increases and as the generator voltage builds up, forward transition will again take place.

In order to protect the generators, transition from parallel back to series must be made when the speed falls below the following figures listed for each corresponding gear ratio:

Gear Ratio	Backward Transition Parallel to Series MPH
52/25	27
55/22	23
56/21	21
57/20	19

HANDLING A TRAIN

During normal operation, it is never necessary to move the throttle or any other controls hastily, except in an emergency. The throttle should be opened one notch at a time, allowing the engine speed to increase accordingly before advancing the throttle another notch. When reducing the throttle position, several seconds should be allowed to let the engine speed decrease accordingly.

Starting a train depends on the type and weight of the train and the grade conditions. Due to the unusually high tractive effort, it is seldom necessary to take slack when starting a train.

When operating over railroad crossings, the throttle **MUST** be reduced to the 3rd notch until all of the power trucks have passed over the crossing. This is to prevent arcing of the brushes on the traction motor commutator.

A throttle emergency stop button is located in the end of the throttle lever. Pressing this button "in" and pushing the throttle over to "stop" position will shut all the engines down. Stopping the engines in this manner should only be done in case of an emergency.

Caution should be observed in ordinary handling of the throttle so that this button is not pressed in error when closing the throttle.

Under **NO** condition should the reverse lever be moved while the locomotive is in motion. When leaving the locomotive, the reverse lever should be removed.

When two or more "A" units are used to make up a locomotive, caution **MUST** be taken not to leave the reverse lever in the controllers of the trailing units. If the lever is left in the controller, it might accidentally be moved, causing a flash-over, sliding the wheels, or both.

AIR BRAKING WITH POWER

In order to keep the train stretched on a rolling grade, it might be necessary to brake the train with power still supplied by the locomotive. In this case, the throttle should be reduced to at least the 6th notch. It is very important that the locomotive brakes be released and kept in the released position when the locomotive is supplying power. This **MUST** be observed.

When preparing to stop with power applied to locomotive and brakes applied to train, it is necessary to reduce the throttle as the train speed decreases. As the train slows down, the pulling power of the locomotive increases rapidly and might become great enough to part the train if the throttle were not reduced. The throttle should be in idle at least 100 feet before the locomotive comes to a full stop.

ISOLATING AN ENGINE WHILE UNDER POWER

If it becomes necessary to take an engine "off the line" while the locomotive is operating under power, it should be done as follows:

1. Reduce the speed of the engine to idle with the lay-shaft manual control lever, so that the traction motor contactors will not have to interrupt the full motor current.
2. Place the isolation switch in the "start" position.
3. Push the engine stop button.
4. Turn off fuel pump.

If the #1 power plant of the leading unit is isolated while the locomotive is under power, the load indicating meter will not function.

PLACING ENGINE BACK "ON THE LINE"

1. Close fuel pump switch.
2. Place isolation switch in "start" position.
3. Start engine in usual way.
4. After lubricating oil pressure builds up, place isolation switch in "run" position. If throttle is above 3rd position, hold off the governor to injector control linkage with layshaft manual control lever to allow engine to come up to speed gradually.

TOWING LOCOMOTIVE

1. When preparing the locomotive for deadheading or yard movement where it will be towed by other power, be sure the reverse lever is in neutral. If the locomotive is to be towed in a train any appreciable distance, the reverser drum should be locked in its neutral position.
2. For setting of air brake equipment, see Air Brake Manufacturer's Instruction Pamphlet.
3. All engine isolation switches should be in "start" position. If it is necessary to keep engines idling for any reason while towing locomotive, the fuel pump and control switches should be left in the closed position.

RUNNING THROUGH WATER

Under *absolutely* no circumstances should the locomotive pass through water which is deep enough to touch the bottom of the traction motor frames. When passing through water, always go at a very slow speed (2-3 miles per hour). Water any deeper than 3 inches above the top of the rails is likely to cause damage to the traction motors.

CHANGING OPERATING ENDS "HSC" BRAKE VALVES

To change from one operating cab to the opposite end, the following procedure should be followed:

1. The throttle must be in "idle" position.
2. Place reverse lever in neutral position and remove lever from controller.
3. Move the handle of the independent brake valve to full application position. Foot may now be removed from deadman pedal, as it is not necessary to keep pedal depressed when brake air cylinder pressure exceeds 30 pounds. With the automatic brake valve handle in release position, turn the brake valve shifter lever to automatic (A.U.) position. Move the automatic brake valve handle to service position and make a 20-pound brake pipe reduction, after which move the brake valve handle to "lap" position and close the double-heading cocks on air brake panel in engine room and under the independent brake valve. Move the independent brake valve handle to release position. Withdraw both brake valve handles and proceed to the other end. The automatic brake valve handle can be withdrawn only in lap position and the independent brake valve handle in release position.
4. Place fuel pump, generator field and control switch buttons in the "off" position. Sufficient fuel is in the systems to allow time to walk to other cab after fuel pump switch is pulled "out."

IN CAB TO BE MADE OPERATIVE

1. Push control switch and fuel pump switch buttons "in."
2. Place double-heading cock in operative position.
3. To assume control at this end, depress the deadman pedal and insert both brake valve handles. Move the handle of the independent brake valve to full application position. Move the automatic brake valve handle to release position and turn the shifter lever to straight

- air (S.A.) position (if electro-pneumatic brakes are used). Then move the automatic brake valve handle to full self-lapping service position. Open the double-heading cocks on air brake panel in engine room and under independent brake valve. After brake cylinder pressure builds up to about 30 pounds, the foot pedal may be released. Gauges should be checked to make sure brake pipe and main reservoirs are fully charged before releasing and proceeding.
4. Place reverse lever in controller and move to desired position.
 5. Push generator field push-button switch "in."
 6. Place foot on deadman pedal and release independent brake.

CHANGING OPERATING ENDS

24RL BRAKE VALVE

When the consist of the locomotive includes two "A" units, the following procedure should be followed in changing from one operating end to the opposite end:

- a. Remove reverse lever.
- b. With deadman control pedal depressed, release independent air brake by placing independent brake valve handle in "RELEASE" position.
- c. Make full service automatic brake application.
- d. Close brake valve cutout cock and release deadman control pedal.
- e. Move the Rotair valve to the proper "LAP" position.
- f. Move the automatic brake valve handle to "RUNNING" position and remove the handle from the brake valve.
- g. Remove the independent brake valve handle in "RELEASE" position.
- h. Open all switches in control push-button box and close

- the switch lock.
- i. Proceed to cab at opposite end. Check "PC" switch and reset if necessary. Open switch lock on control push-button switch box, close control and fuel pump switches and such other switches as are necessary.
 - j. Insert reverse lever, automatic brake valve handle and independent air brake handle.
 - k. Move the Rotair valve to the proper operating position.
 - l. Move independent brake valve handle to "FULL APPLICATION" position and open the brake valve cutout cock slowly, pausing from 5 to 10 seconds in mid-position.
 - m. When ready to move locomotive, depress deadman control pedal or automatic brake valve handle and move independent brake valve handle to "RELEASE" position.

STOPPING ENGINE IN PREPARATION FOR LAYOVER

1. At Engineer's Control Station:
 - a. Close throttle to idle position.
 - b. Place reverse lever in neutral position and remove lever.
 - c. Open generator field switch. (Do not open control switch as it is impossible to shut down engines with "stop" button when the control switch is open.)
 2. At Engine:
 - a. Place isolation switch in "start" position.
 - b. Push engine "stop" button and hold it until engine stops.
- NOTE: Engine will not stop with "stop" button unless control air pressure is up.
- c. Open fuel pump switch.
 - d. Open cylinder test valves on engine.

3. At Engineer's Control Station:

- a. Open control switch.
- b. Open fuel pump switch.

4. At Distribution Panel:

- a. Open main battery switch.
- b. Open control switch.

NOTES

SECTION 3

COOLING SYSTEM

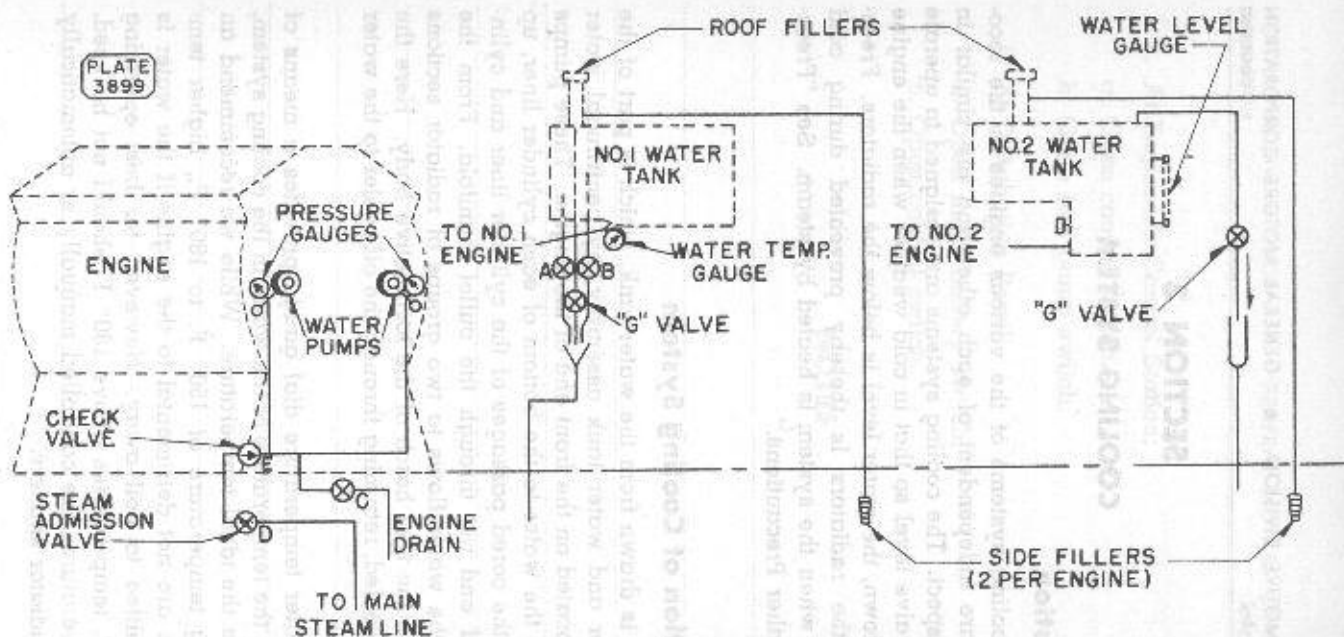
Description

The cooling systems of the various engines in the locomotive are independent of each other and are similar in every respect. The cooling systems are designed to operate at "G" valve level so that in cold weather when the engine is shut down, the water level is below the radiators. Freezing of the radiators is thereby prevented during cold weather when the system is heated by steam. See "Freezing Weather Precautions."

Operation of Cooling System

Water is drawn from the water tank, which is part of the oil cooler and water tank assembly, by centrifugal water pumps located on the front end of the engine. These pumps circulate the water to the bottom of each cylinder liner, up through the cored passages of the cylinder liner and cylinder head and out through the outlet manifold. From the engine, the water flows to two groups of radiator sections located in the roof hatch of the locomotive body. Here the water is cooled, returning through the oil cooler to the water tank.

The water temperature dial gauge provides a means of checking the temperature of the water in the cooling system. 165° F. is the ideal temperature. While we recommend an operating temperature of 150° F. to 180° F., higher temperatures are not detrimental to the engine if the water is not permitted to boil away. However, for best operating economy, temperatures above 180° F. should not be used. The temperatures are controlled manually or automatically by the radiator shutters.



Schematic Diagram - Cooling System Piping
Showing Direction of Water (Both Engines)
Fig. 3-1

Filling the Cooling System

The cooling systems of the engines are filled either through the filler pipes located on the roof of the locomotive above the water tanks, or through the sidelfiller pipes located underneath the locomotive frame. Two sidelfiller pipes are provided for each engine, one on either side of the locomotive, and can be identified by a cone-shaped fitting on the end of the pipe. To fill the system to "G" valve level, proceed as follows:

1. Open the filling level valve "G" (Fig. 3-1). This valve is located below the water tank near the temperature gauge (No. 1 engine) and on the engine room wall to the right of the water tank of the No. 2 engine.
2. Fill slowly until water runs out filling level pipe at valve "G."
3. Close filling level valve "G."
4. Start engine and run for several minutes. This will eliminate any air pockets in the system.
5. Shut down engine and open valve "G."
6. Add water until it runs out the "G" valve.
7. Close "G" valve.

If the cooling system of a hot engine has been drained, do not refill immediately with cold water. If this is done, the sudden change in temperature might crack or warp the cylinder liners or heads.

Adding Water to the System

When it is necessary to add water to the cooling system, proceed as follows:

1. Shut down engine and open "G" valve.
2. Add water slowly until it runs out "G" valve.
3. Close "G" valve.

There is no danger of operating with insufficient water in the cooling systems if the water is not allowed to go

below the minimum level, which is indicated by a line painted on the tank near the water level gauge of the No. 2 engine water tank or at the lower try cock ("A" valve, Fig. 3-1 on the No. 1 engine water tank. The engines should never be operated with the water below these levels. Three try cocks ("A", "B", and "G") are located on the No. 1 cooling water tank—the "G" valve indicates a full tank; the "B" valve indicates half full; and the "A" valve indicates one-quarter full. Progressive lowering of water in the tanks will indicate a leak in the cooling system.

Caution: As specially treated water must be used in the cooling system, water should not be added except at an approved watering station. Abnormal use of cooling system water, or absence of corrosion inhibitor, as indicated by lack of color, should be noted in the locomotive log and reported at the first maintenance point.

Draining Cooling System

To drain the engine cooling system, first open "G" valve, then open "C" valve (Fig. 3-1), which is located below the right-hand water pump, close to the floor of the locomotive.

To drain the complete cooling system in freezing weather, open valves as above and remove pipe plugs from the water pumps. The steam generator water tank should also be drained. Try all other valves for trapped water in pipe lines.

Checking Circulation

The water temperature dial gauge located on the water tank may be used as a means of detecting an irregularity in the operation of the cooling system.

High water temperatures indicate:

1. Shutters not open enough.
2. Insufficient water in system.
3. Faulty circulation.

The pressure gauge on the outlet side of the water pumps should be observed periodically as a check on the operation of the cooling system. A high pressure indicates an obstruction in the cooling system; a low pressure indicates insufficient water supply to the pump, or faulty pump.

Freezing Weather Precautions

Do not use any kind of anti-freeze solution in the cooling system. If the locomotive is to be left standing where there is a danger of freezing, steam may be supplied to the cooling system, or the system can be drained.

For supplying steam to the cooling system, each power plant has a connection with the train steam line through steam admission valve "D" and check valve "E" which are located at the right front corner of the engines at the floor level. The check valve "E" prevents water from draining into the train steam line.

Steam can be supplied by connecting an outside steam line to the train steam line connection at either end of a unit, or by operating the steam generator.

When steam is to be supplied to the cooling system, valves "D" and "G" should be opened. Valve "G" must be open so that condensation will not build up in the radiators where it might freeze in cold weather. Steam being supplied to the cooling system should not be allowed to exceed 50 pounds pressure.

When disconnecting a unit from steam feed, see that the steam admission valves are closed to prevent loss of cooling water make up loss of corrosion inhibitor.

Operation of Shutters

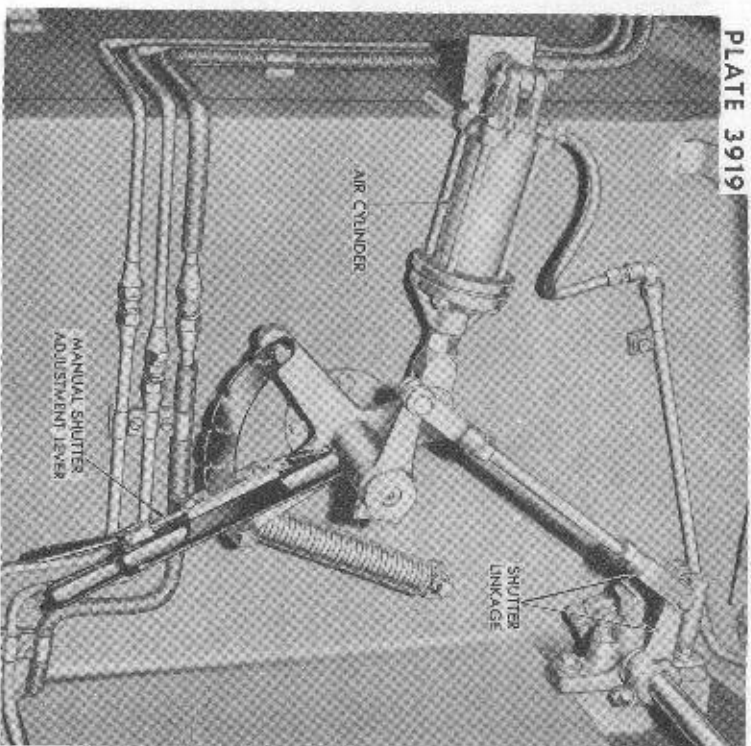
The locomotive is equipped with shutters which control the flow of air to the radiators and thus regulate the temperature of the engine cooling water. The shutters are

normally operated automatically by temperature control switches located in the engine cooling system of the two engines. When the temperature of No. 1 engine, for instance, rises to a point determined by the setting of the switch, the switch closes and operates No. 1 shutter relay, located in a box on the carbony wall, right side. Closing of the relay energizes magnet valves which admit air to shutter operating cylinders, opening the shutters both at the front end and at the middle of the unit. The shutters will remain open until the cooling water temperature drops to the opening point of the temperature control switch. When the switch opens, the relay also opens and de-energizes the magnet valve which cuts off the air to the operating cylinders. The shutters will then close by action of the spring shown in Fig. 3-2.

Similarly, closing of the temperature control switch on No. 2 engine will open the shutters at the rear end and at the middle of the unit. Thus the middle shutters will open if the temperature of either engine rises enough to close the temperature control switch on that engine and will remain open until the temperature falls to the opening point of the switch, regardless of the temperature of the other engine. The temperature control switches are set to open the shutters when the cooling water temperature reaches 165 deg. and close them at 155 deg. These temperatures differ from those shown on the temperature gauge, since the gauge is located at a different point in the cooling system.

In Fig. 3-2, the shutter operating mechanism is shown in "closed shutter" position. The movement of the lever opens the shutters. For automatic shutter operation, the lever is kept latched in the position shown. When the air cylinder operates, it moves the quadrant clockwise against spring tension. When the quadrant turns, the lever also moves since it is latched to the quadrant.

Should failure of the automatic shutter occur, the shutters may be operated manually by the adjustment lever shown in Fig. 3-2. The shutters are closed by moving the lever in the position illustrated and are opened by moving the lever to successive notches on the quadrant which, in manual operation, remains stationary. When operated manually, the shutters should be adjusted to keep engine temperatures at $165^{\circ} \pm 15^{\circ}$ ($150^{\circ} - 180^{\circ}$).



Shutter Operating Mechanism
Fig. 3-2

In case of difficulty with the automatic shutter control, check the air supply and action of the magnet valves by manually operating either or both shutter relays. Also check the fuse found in one shutter relay box. A blown fuse will prevent operation of either shutter relay and all magnet valves. An air valve is provided on later locomotives to cut off the air supply to the automatic shutters. The valve is located at the left side of the steam generator near the junction of the shutter air pipe with the pipe supplying atomizing air for the steam generator.

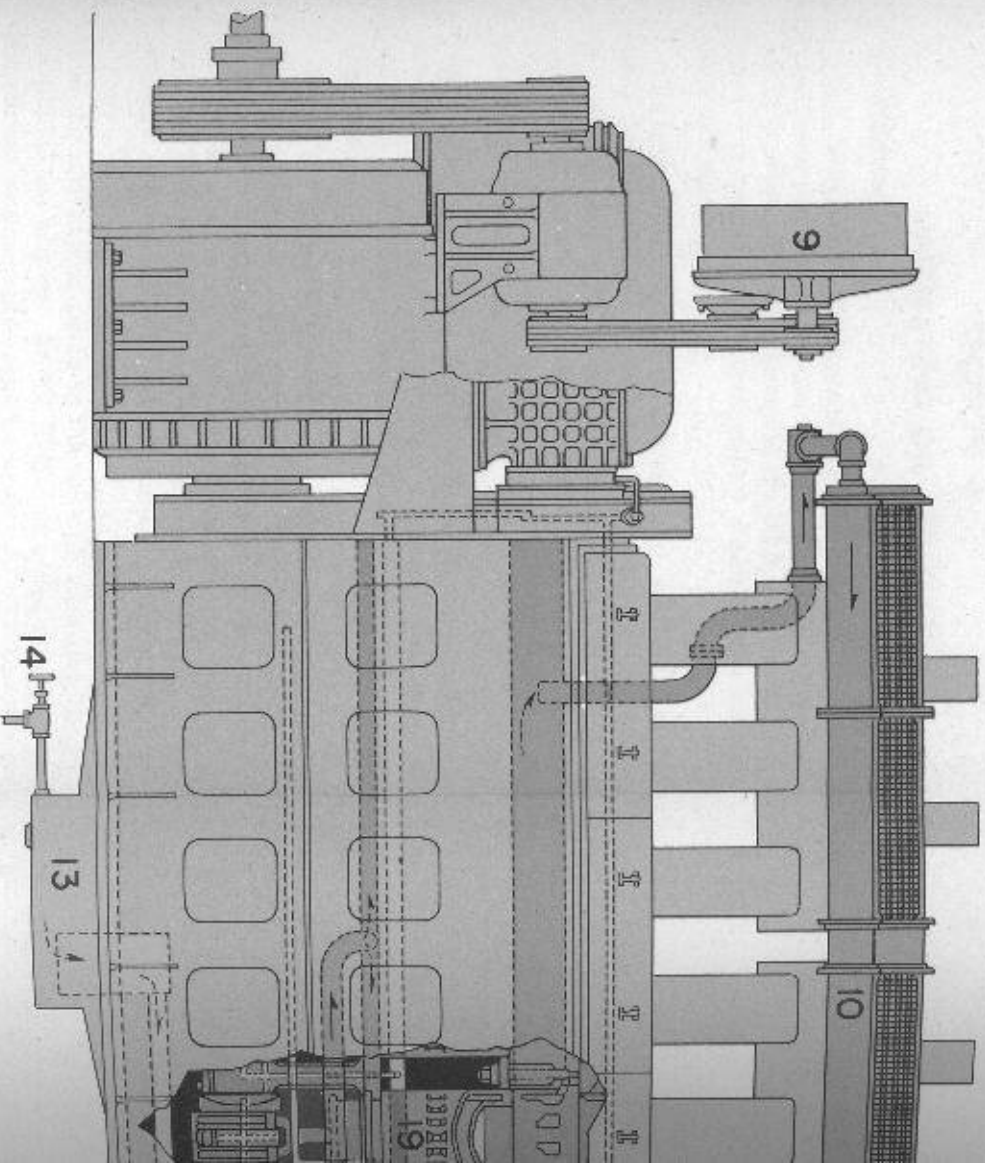
When one engine is "off the line" and idling in cold weather, it may be necessary to take special action to prevent its cooling water temperature from falling too low when the action of the other engine opens the middle shutters. This may be done by opening the manual shutter adjustment lever at the end of the engine under power one or more notches as required. Such action will minimize the time during which the middle shutters will be open.

Cooling Fans and Belts

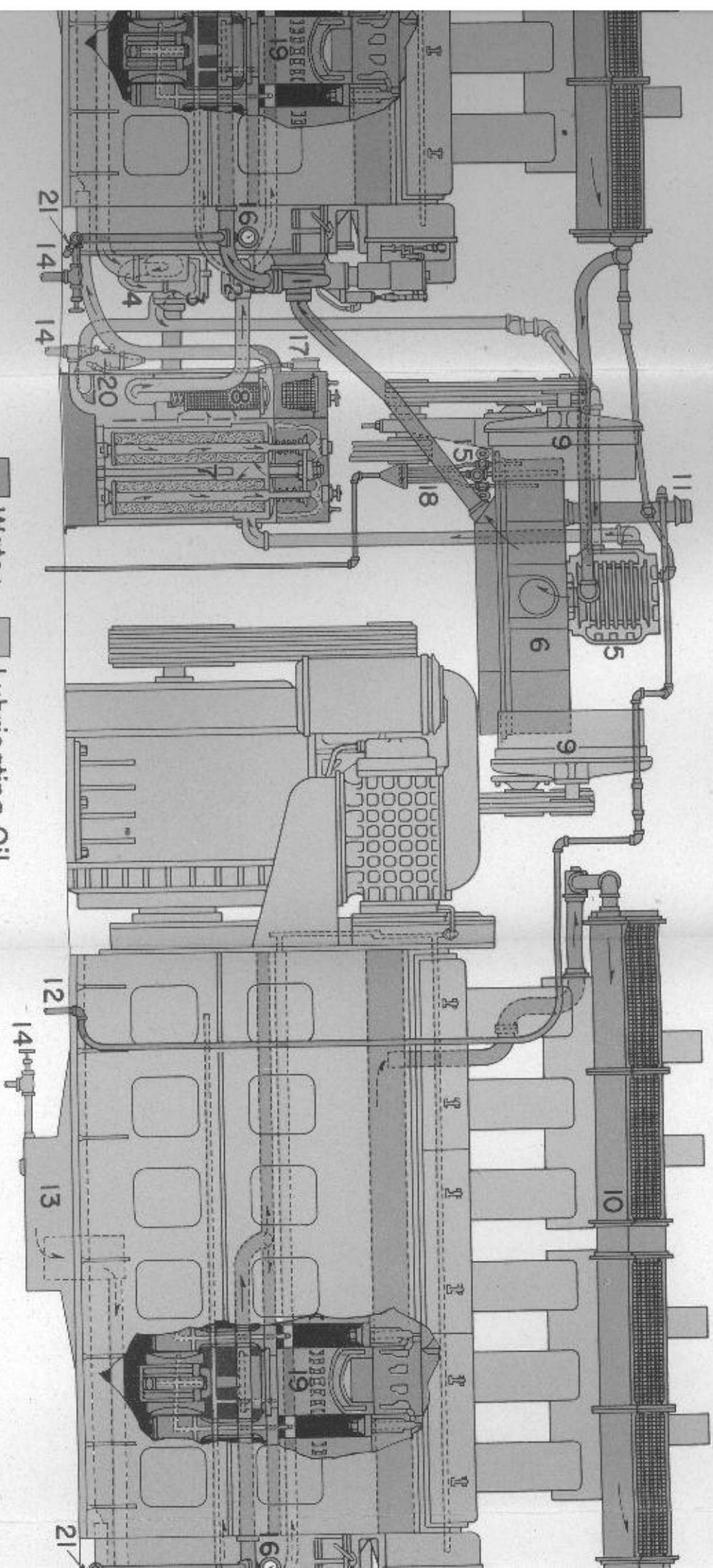
Each engine is equipped with two sets of cooling fans, one set located at each end of the engine. The fans are Vee belt driven through sheaves and jackshafts and their speeds are proportional to the speed of the engine.

Engine High Temperature Alarm Switch

This is a thermal switch, located along side the engine control and instrument panel, which connects with a thermal element in the water outlet manifold of the engine. If the water temperature exceeds 203° F., (gauge temperature may be 8°-12° lower as it registers water inlet temperature), this switch closes, operating the signal relay, which lights the hot engine alarm signal light and rings the alarm bell. The tube leading from the elements to the switch must not be kinked or dented.



1. Water Pump
2. Lubricating Oil
3. Scavenging Oil
4. Sump Oil Screen



Water
 Lubricating Oil

- | | | | | |
|------------|-----------------------|-----------------|-----------------------------|---------------------------|
| ap | 5. Lube Oil Cooler | 9. Cooling Fan | 14. Drains | 18. Water Level Gauge |
| g Oil Pump | 6. Cooling Water Tank | 10. Radiator | 15. "G" Valve | 19. Cylinder Liner |
| g Oil Pump | 7. Lube Oil Filter | 11. Roof Filler | 16. Water Pressure Gauge | 20. Lube Oil Relief Valve |
| Screen | 8. Lube Oil Strainer | 12. Side Filler | 17. Lube Oil Pressure Gauge | 21. Steam Admission Line |
| | | 13. Engine Sump | | |

SECTION 4 LUBRICATING OIL SYSTEM

Description

The lubricating oil systems of the various engines throughout the locomotive are identical to, and independent of, each other. The oil is stored in the oil pan of the engine, instead of an oil supply tank, which classifies the engine as a wet sump type.

The engine lubricating oil system is a pressure system using two positive displacement gear-type pumps combined in a single unit. One pump delivers oil for the pressure lubricating system, the other for piston cooling. The oil supply to these pumps is drawn from the lube oil tank through a common suction pipe.

A scavenging oil pump is used to draw oil from the engine oil pan through a strainer, pump it through the lube oil cooler to the lube oil filters and oil tank strainer chamber.

Operation

When the engine is started, the pressure pumps pick up oil from the bottom of the strainer chamber. This oil provides an initial supply of oil for lubricating the engine until the scavenging pump has refilled the strainer chamber. Until the scavenging oil reaches the strainer chamber, the pressure may read low on the instrument panel gauges.

A by-pass valve set at 60# will permit oil to flow directly from the scavenging pump to the oil tank to ensure an oil supply for the engine. At 800 RPM and under normal conditions the by-pass valve may be open. At idle a pressure in excess of 30# with hot oil is an indication of a dirty oil cooler.

A constant oil level is maintained in the lube oil strainer chamber of the lube oil tank by a baffle plate or "dam." Oil flowing over this dam returns to the engine oil pan. This keeps the scavenging pump suction pipe under oil.

With the engine running, the oil level should always be between the "low" and "high" marks on the bayonet gauge in the engine oil pan. The oil level can be checked with the engine running at any speed.

Oil may be added by removing oil filler cover on the oil tank above the strainer chamber, and pouring required amount through strainer basket.

When the engine is stopped, oil in the cooler core chamber will flow into the oil tank, which will bring the engine oil pan bayonet gauge reading to "system charged." This level is below the "system uncharged" level because some oil is trapped in the lube oil filler, oil lines, and engine.

Oil Separator

The oil separator is mounted between the engine blowers over the main generator. Vapor from the crankcase is drawn through the oil separator to the blower intake. The metal screen in the separator condenses oil from the vapor and returns the oil to the oil pan.

Possible Lubrication Troubles

Absence of Oil in Oil Tank Strainer Chamber. This may be caused by an inoperative scavenging system or an open drain valve. Failure of scavenging system may be due to a broken or loose oil line connection causing an air leak, a faulty scavenging oil pump, or clogged suction strainers.

Low Lubricating Oil Pressure. This may be due to stuck relief valve, broken oil lines, clogged strainers, excessive bearing wear, low oil viscosity, faulty pump, or diluted oil. If relief valve sticks open, inspect for dirt lodged on seat.

Failure of the Oil Pump. This may be due to a sheared shaft, broken housing, or damaged gears.

Dilution—Fuel. It is possible for fuel oil to get into the lubricating oil if an injector is defective or if a fuel oil line, connecting the injector to the fuel oil manifold, should become loose or broken. If such a condition has existed, the viscosity of the lubricating oil should be checked.

Dilution—Water. Water entering the oil can often be detected by discoloration of the oil to a brown or gray color. Considerable water will cause the oil to thicken. An engine should not be run if the presence of water in the oil is detected.

Excessive Oil Consumption. This may be caused by an oil leak, broken or stuck piston rings, worn cylinder liners, improper grade of oil, excessive oil pressure, or clogged drain holes in piston under the oil control piston rings. Cause should be investigated and corrected.

Little or No Oil Consumption. This may be due to water or fuel leaking into the oil, or to the use of too heavy an oil. Cause should be investigated and corrected.

Low Oil Pressure Alarm Switch

This switch is connected to the engine lubricating oil system at the blower oil supply line in such a manner that failure of the lubricating oil pressure will cause the switch contacts to open. When these contacts open, the master (E) magnet valve will be de-energized, shutting off the air supply to the electro-pneumatic control and bringing the engine to idle; the low oil signal lights will light and the alarm bells will ring. Should this occur, do not attempt to load the engine until the cause of the low oil pressure has been located and corrected. This alarm switch will not give low oil protection when the isolation switch is in "start" position.

Lube Oil Suction Alarm Switch

The lube oil suction alarm switch is a vacuum switch connected to the suction side of the lube oil and piston cooling oil pumps, and electrically connected to the master "E" valve and the low oil signal alarm circuits. The purpose of this switch is to reduce the engine speed and at the same time to energize the low oil signal alarm circuit should the oil pump suction reach the value at which the switch is set to operate. Excessive oil pump suction is the result of clogged suction strainers.

Operation of this switch will most commonly occur at full engine speed as the pump suction increases with engine speed. The switch will then open the master "E" valve circuit and close the low oil signal alarm circuit. However, as the engine speed decreases, due to de-energizing the "E" valve, the pump suction will also decrease, allowing the suction switch to reset, thus re-energizing the "E" valve and opening the low oil signal alarm circuit. The engine will then speed up until the pump suction again becomes excessive, and the cycle will repeat. If this occurs, the engine should be isolated and no attempt made to load it until the cause of the lube oil suction alarm is located and corrected.

Lube Oil Pressures

1. Lubricating oil pressure must be maintained at all times. When starting a cold engine, allow it to idle for some time and see that the oil pressures start to build up almost immediately. The pressure should rise on a cold engine to about 40 lbs., and will run approximately 28 lbs. at 800 RPM with engine warm. At idle, pressure should be at least 15 lbs. With normal operation, the lubricating oil pressure should not drop below 20 pounds, with engine running at 800 RPM. However, if the water temperature cannot be held below 180° F., it will be per-

missible to operate the engine with lubricating oil pressure, at the rear end of engine, as low as 15 pounds. This low limit on pressure can only be permitted when the oil temperature is high as a result of the water temperature being above 180° F.

If lubricating oil pressure drops below the above limits, stop the engine, investigate cause, and correct.

2. As the piston cooling oil system has no relief valve, pressure is dependent upon oil temperature, viscosity and engine speed. Average pressure will be 20 to 30 pounds with engine running 800 RPM and 4-8 pounds at idle, with a warm engine.

If pressure drops below 15 pounds with engine at 800 RPM, stop the engine, investigate cause, and correct.

Checking Lube Oil

The lubricating oil systems of the engines are identical to, and independent of, each other; therefore, each engine has to be checked individually. A bayonet gauge is located on the left-hand side of the engine to measure the oil in the oil pan. The engine may be running at any speed when this check is made and the oil should show between the "Low" and "high" marks on the gauge. If the oil shows below the "Low" mark on the gauge, the engine should be shut down until oil is added to bring the oil up to a safe operating level.

bubbles. Air entering the fuel line at any point on the suction side of the fuel pump will cause the engine to misfire or stop. When the engine is shut down and fuel pump running, the presence of bubbles indicates an air leak in the suction line. If bubbles appear only when the engine is running, the injectors are allowing gas to escape from the engine cylinder into the fuel line.

The left-hand sight glass will show fuel by-passing when any of the filters on the pressure side of the fuel pump collect enough dirt to build up a back pressure of 60 pounds. This fuel by-passes the filters and engine and returns to the tank. In an emergency, the globe valve between the 60-pound relief valve and the return pipe to the tank can be closed to force the fuel through the filters. This permits operation of the engine until the maintenance point is reached. Engines should not be operated with 60-pound valve by-passing longer than the required time to reach a maintenance point where filters can be cleaned or changed. If the filters are neglected and the back pressure reaches 100 pounds, the fuel will flow through the center (100-pound) sight glass and relief valve and return to the tank, by-passing the entire discharge filter system and the engine.

Pump Discharge Filter

After the fuel leaves the fuel pump, it passes through the discharge filter. This filter contains three elements made of closely wound string. If discharge filter is clogged with dirt, wax, or any other substance, the condition will be indicated by fuel by-passing through the 60-pound sight glass and relief valve.

Duplex Sintered Bronze Filter

The duplex sintered bronze filters are mounted on the front end of the engine. The two sintered bronze elements

are connected by a three-way valve so that the flow of fuel through the filter can be controlled by the position of the valve handle. When the handle is moved to the left, the left-hand element is cut off and fuel flows through the right-hand element. Moving handle to right cuts off right-hand element. The handle should be either to the left or right, so that only one filter element is in use at a time.

If the element in use becomes dirty, fuel will flow through the 60-pound sight glass. Should this occur, turn handle to opposite side. If this does not correct the condition, it will indicate that either both elements are dirty or the discharge filter is dirty.

Filling Fuel Tanks

The fuel tanks can be filled from either side of the locomotive at a maximum rate of 250 gallons per minute. Watch the level gauge to prevent overflowing the tank. The fuel should be filtered through a reliable fuel filter before it enters the tank. The fuel capacity of each tank is 1200 gallons. Do not handle fuel oil near an open flame.

Draining Fuel Tanks

The fuel tank sump has two drain plugs for draining the tank and two special drilled plugs for draining any water which may have settled in the tank sump. By turning one of these plugs part way out, water can be drained from the sump.

Fuel Tank Vents

Two vents, one on each side, with 4-inch flame arrestors, terminate outside the locomotive unit.

Fuel Gauge

The fuel gauge is a direct reading, air-operated gauge which indicates the quantity of oil in the fuel tank. The fuel gauge is located inside the cab on the fireman's instrument panel.

Fuel Level Gauge

A direct reading sight level gauge is located on each side of the fuel tank adjoining the fuel fillers. This gauge indicates level of fuel oil starting at $4\frac{1}{2}$ " from the top of the tank and should be observed while filling the tank to prevent overflowing.

Fuel Pump

The fuel pump assembly consists of an electric motor and a pump of the rotor gear type. The pump is driven by the motor shaft through a flexible coupling. Do not leave the fuel pump running unnecessarily.

Injector Filters

From the duplex sintered bronze filter, the fuel oil flows to the fuel manifold on the engine. As the fuel enters the injector, it is filtered for the fourth time by the sintered bronze filter mounted in the injector body. The purpose of all this filtering is to protect the finely machined parts of the injector.

As the surplus fuel leaves the injector, it passes through another filter of the same type to prevent a reverse flow of fuel from carrying dirt into the injector when the engine is shut down. These filters should be discarded when dirty, and new ones installed.

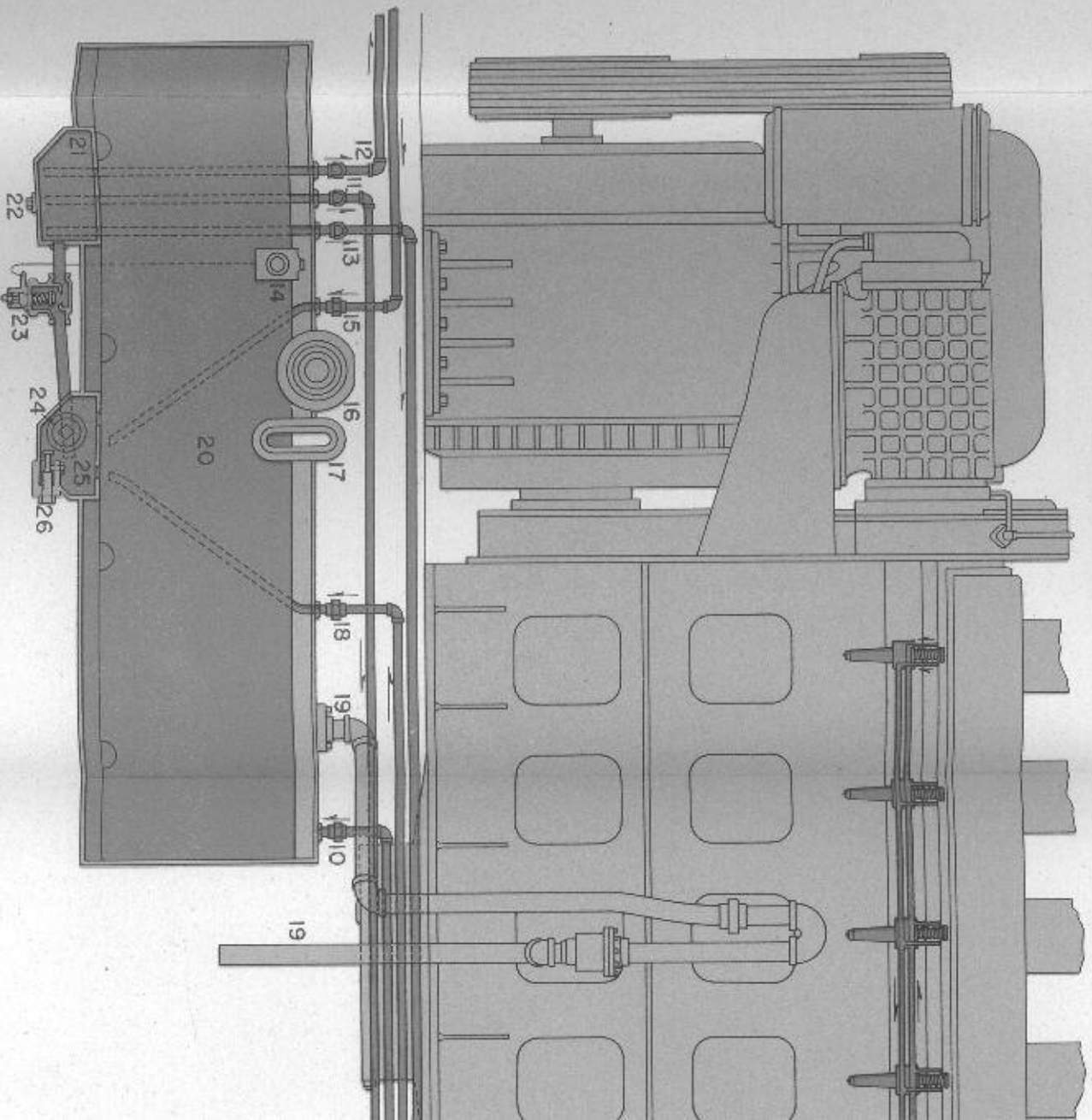
Emergency Fuel Cut Off

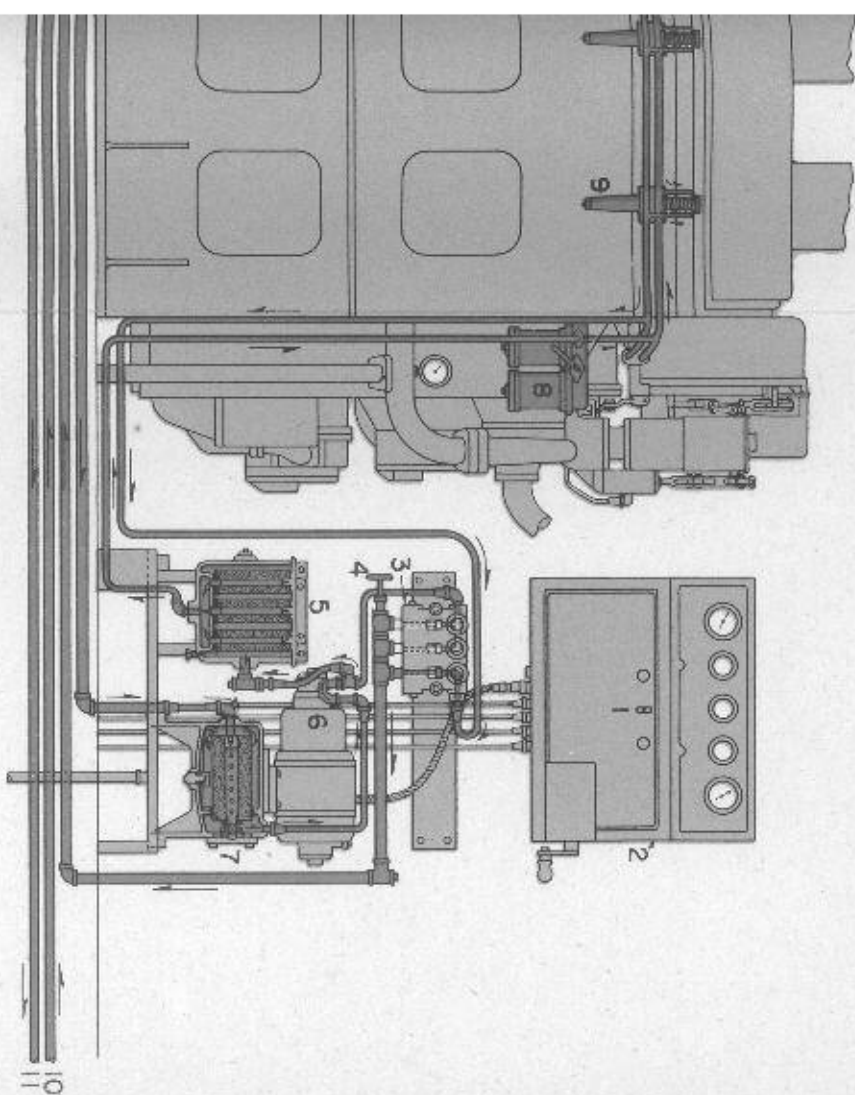
On each side of the locomotive, attached to the side skirt, is a small box with a lift cover. Enclosed in this box is a pull ring on the end of a cable running to the emergency fuel cutoff valve which is located in the feed line from the fuel tank sump to the supply sump. A similar ring is located in the cab. In the event of fire, the valve can be closed, and the fuel supply cut off, by pulling any one of these three rings. If closed, the valve underneath the fuel tank must be reset by hand to the "open" position.

If Fuel Does Not Show in Right-Hand (5-pound) Sight Glass

1. If the fuel pump is running but fuel does not show in the 5-pound sight glass, check the following:
 - a. Supply of fuel in the tank.
 - b. Emergency fuel cutoff valve.
 - c. Broken motor or pump shaft, or loose flexible coupling.
 - d. Defective pump.
 - e. Loose, broken, or clogged supply line.
 - f. Dirt lodged under the 60-pound or 100-pound relief valve seats will prevent fuel oil pressure from building up.
 - g. Suction filter gaskets for air leakage.
2. If fuel pump does not run, check the following:
 - a. Check all fuses in circuit.
 - (1) One 80-ampere control fuse on distribution panel.
 - (2) Fuel pump fuse (15-ampere) in the distribution panel.
 - (3) Fuel pump fuse (10-ampere) in engine control and instrument panel.
 - b. Check switches in circuit.
 - (1) Control knife switch.
 - (2) "PC" switch.
 - (3) Fuel pump switch on engine control and instrument panel.
 - (4) Fuel pump switch (in cab).
 - (5) Main battery switch.
 - c. Check electric connector to fuel pump motor.
3. If motor is running but no fuel is being delivered:
 - a. Check pump couplings and shaft.
 - b. Check fuel supply and emergency fuel cutoff valve (at bottom of fuel tank).
 - c. Check for air leaks in suction line due to broken pipe or loose connection.

1. Fuel Pump Switch
2. Engine Control and Instrument Panel
3. Combination Sight Glass and Relief Valve
4. Valve
5. Discharge Filter
6. Fuel Pump and Motor
7. Suction Filter
8. Sintered Bronze Filter
9. Injector
10. Steam Generator Fuel Return
11. Steam Generator Fuel Supply
12. Fuel Supply to No. 1 Engine
13. Fuel Supply to No. 2 Engine
14. Emergency Fuel Cutoff Pull Ring
15. Fuel Return from No. 1 Engine
16. Fuel Filler
17. Sight Gauge
18. Fuel Return from No. 2 Engine
19. Vent and Flame Arrestor
20. Fuel Tank
21. Fuel Supply Sump
22. Sump Drain Plug
23. Emergency Fuel Cutoff Valve
24. Fuel Drain Plug
25. Fuel Tank Sump
26. Fuel Tank Water Drain Plug

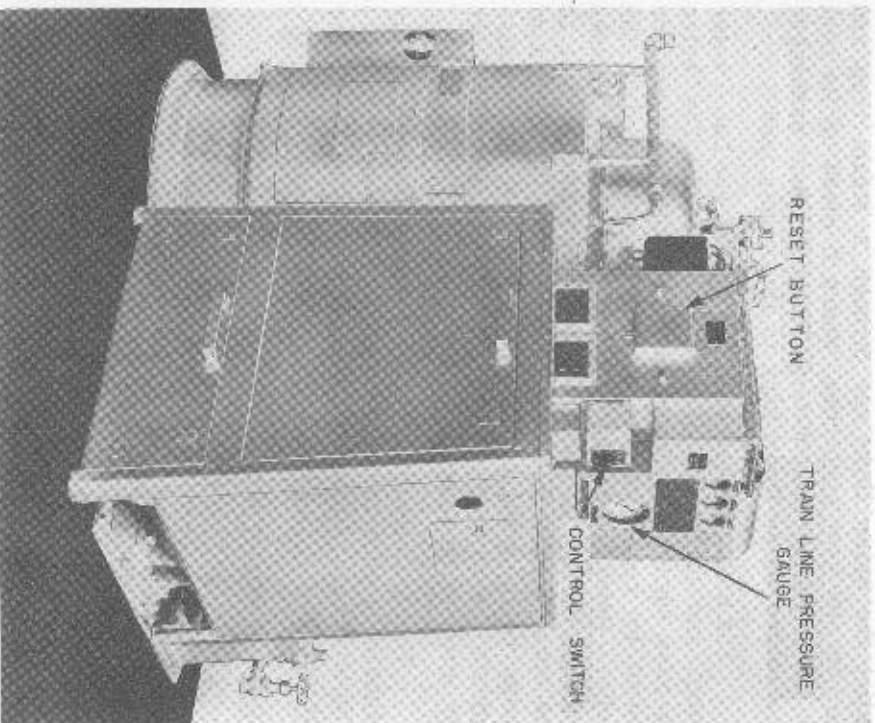




SE 128

Schematic Diagram – Fuel System
Fig. 5-1

2. Be sure the following valves are CLOSED:
Steam shut-off valve to the water by-pass regulator
Steam shut-off valve to the steam pressure gauge
Washout inlet valves-14
Coil blowdown valve-17



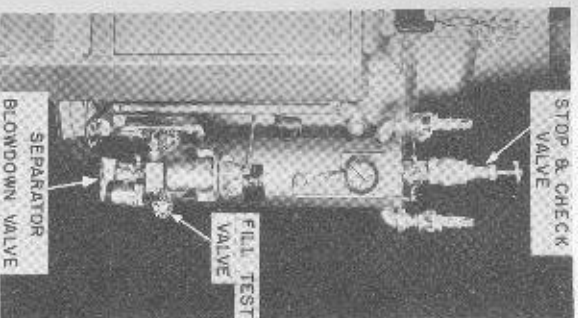
DRK-4516 Vapor-Clarkson Steam Generator

Fig. -2

- Water pump test valve-30
- Stop and check valve on the separator-46
- Manual water by-pass valve-40
- Trainline stop valve-43
- Fill-test valve-50
- Separator blowdown valve-53
- Drain valves-54

3. See that both the control panel reset button and the stack switch reset button are "in." It will not ordinarily be necessary to check the control panel reset where a magnetic overload relay is used instead of a thermal overload relay.

TO START



1. Open separator blowdown valve and drain the steam separator. Reclose the valve.
2. Open the fill-test valve.
3. Close the main switch.
4. Turn control switch knob to the "fill" position to pump water into the coils. While the coils are filling see that spark is available for ignition.
5. When water discharges from the fill-test valve, turn the control switch to "off," close the fill-test valve and open the separator blowdown valve.

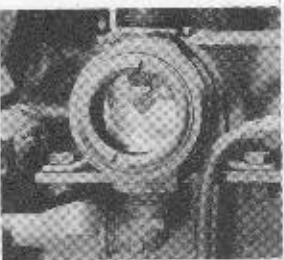
OK-4630 Steam Generator

Fig. -3

6. After the motor has stopped turn the control switch to "run." The fire should light immediately.
7. Close the separator blowdown valve after the steam pressure reaches 50 lbs.
8. Open the separator blowdown valve several times for three to five second intervals during the first few minutes of operation.
9. Set the water by-pass regulator to the required trainline pressure. After the trainline is coupled open the stop and check valve on the steam separator. Open the remote control trainline shut-off valve by depressing the latch, and then open the manual trainline stop valve.

NOTES:

1. If the coils are empty it will take about five minutes to fill the steam generator with water. **DO NOT START THE STEAM GENERATOR UNLESS THE COILS ARE FILLED WITH WATER.**
2. Check the return water flow after the steam generator has settled down to a steady output. On 4530 and 4630 steam generators the indicator should



cycle from 10 to 12 times a minute at high fire, and from 3 to 4 times a minute at low fire; on 4516 and 4616 steam generators it should cycle from 6 to 8 times a minute at high fire, and from 2 to 3 times a minute at low fire.

3. Check the positions of all valves if the steam generator does not start, or will not function properly.

Return Water
Flow Indicator
Fig. 4

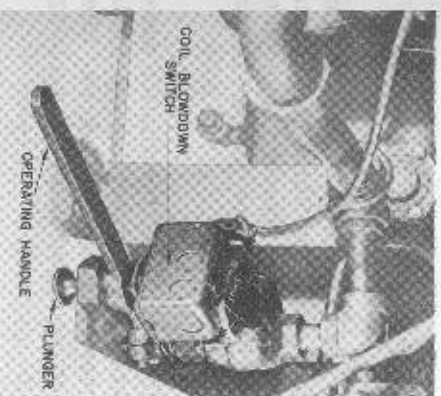
RUNNING ATTENTION

1. Open the separator blowdown valve for five seconds at least once every hour.
2. Turn the handle on the fuel filter during stops. At the same time turn the handle on the filter for the water treatment injector, where the injector method of water treatment is used.

TO SHUT DOWN THE GENERATOR

For short stops it is only necessary to close the trainline shut-off valve. The fire will cycle off and on, and maintain operating pressure in the steam generator. For terminal stops, proceed as follows:

1. Press the trainline shut-off button on the remote control panel. If no remote control panel is provided, close the trainline stop valve.



2. Set the water by-pass regulator to build the generator steam pressure up to 200 pounds, then turn the control switch to "off."

3. Open the coil blowdown valve. When the generator pressure falls to 75 pounds, close the valve.

Coil Blowdown Valve
Fig. 5

4. Open the separator blowdown valve and blow down the steam separator with the remaining pressure. Close the valve.
5. Open the fill-test valve and turn the control switch to "fill." When water discharges from the fill-test valve, turn the control switch to "off," and close the valve.
6. Open the main switch.
7. Close the atomizing air valve.

NOTE

When starting again, drain the steam separator, open the fill-test valve, and again fill the steam generator with water. If the coils are already full, it will only take a moment for water to discharge from the fill-test valve.

FREEZING WEATHER PRECAUTIONS

In severe weather, open the inlet valve to the radiation inside winterizing cabinets while the steam generator is in operation. During layovers, open the inlet valve whenever the temperature drops below freezing.

If a locomotive with a multiple installation does not have all of its generators in operation open the coil blowdown and layover shut-off valves on idle steam generators, whether equipped with winterizing cabinets or not.

If a locomotive is left standing out of service operate one of the steam generators or make a connec-

tion to the yard steam line. In extremely cold weather the water pump and generator controls should be given additional protection against freezing.

If no steam at all is available, thoroughly drain the steam generator. Open the drain valve on the water treatment tank, the water pump test valve, the coil blowdown and separator blowdown valves, and the coil shut-off valve. Break the pipe connections where necessary to completely drain the piping. Turn the water pump by hand to clear it of water, or blow it out with compressed air. Remove the cover of the water treatment or water strainer tank and make sure it is drained.

TROUBLE SHOOTING

If one of the protective switches (magnetic overload relay or thermal overload switch, coil blowdown valve, stack switch high temperature contacts or low temperature outfire contacts) operates to shut down the steam generator, the alarm will ring and the "boiler off" signal will flash on the remote control panel.

Turn the control switch to "off" and use the following instructions as a guide in locating the trouble.

MOTOR AND BURNER SHUT DOWN DURING OPERATION

1. **Blown Fuses:** The main fuse, or circuit breaker, is generally located in the low voltage cabinet of the locomotive. Check this fuse, and check the control fuses in the steam generator control cabinet. The alarm will not ring and instrument light

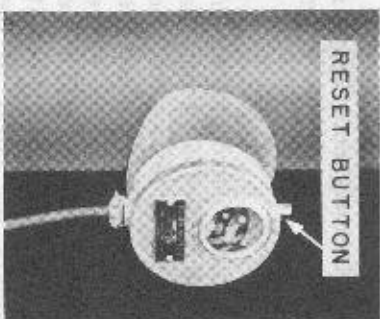
time delay the outfire relay will open the circuit to shut down the steam generator. The alarm will ring. Turn the control switch to "off" and check the following list for possible causes of burner failure.

1. Ignition Failure: No spark is visible through the peep hole glass. The ammeter on the OK steam generators shows a zero reading if no current is available for ignition. Check the ignition circuit fuses in the control cabinet. Tighten loose ignition cable connections and replace chafed or broken wire which may be breaking or grounding the circuit. A short or a ground in the ignition circuit is indicated by an abnormally high reading on the ammeter.

2. Low Atomizing Air Pressure: Be sure the air admission valve is fully open. Clean the strainer at the air pressure reducing valve.

3. Low Fuel Manifold Pressure: Turn the handle on the suction line fuel filter several times. A slight suction leak may cause the manifold pressure to build up slowly; put the control switch on "fill" to bleed the fuel line and bring the manifold pressure up to normal.

4. Low Fuel Nozzle Pressure: Lack of water causes the servo-fuel control to limit the supply of fuel entering



Stack Switch
Fig. 6

will go out if one of these fuses is blown—with one exception: on the OK steam generators, a blown solenoid control fuse will ring the alarm, but will not cause the instrument light to go out.

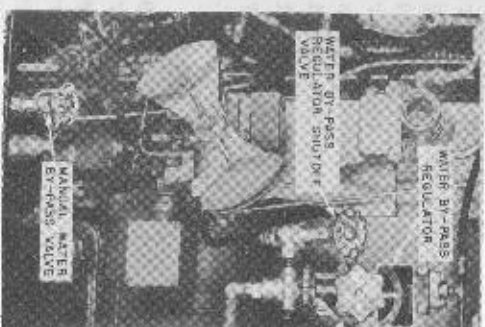
2. Control Panel Reset Button "out:" The alarm will ring. Where a thermal overload switch is used the reset button is located on the exterior of the control panel. Where a magnetic overload relay is used the reset button will be found inside the control cabinet on the relay itself. Turn control switch to "off," check for hot blower or pump bearings, and for tight or loose belts.

3. Stack Switch Reset Button "out:" The alarm will ring; the high temperature contacts in the stack switch will open. Turn control switch to "off;" open the separator blowdown valve and drain the steam separator. Close the valve and reset the button, refill the coils with water, and then start the steam generator.

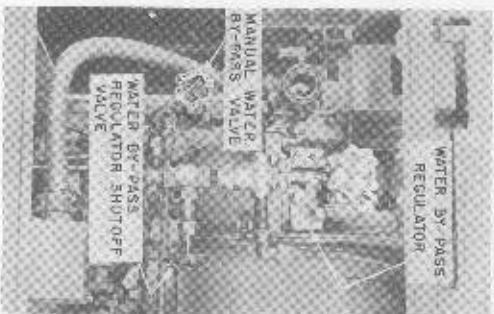
4. Coil Blowdown Valve Partially Open: The alarm will ring. Be sure the latching pin is properly seated in the closed position.

MOTOR STARTS BUT BURNER DOES NOT

If the fire fails to light the outfire contacts on the stack switch will not close, and after a 45 second



Water By-Pass Regulator
OK-4630 Steam Generator
Fig. 7



Water By-Pass Regulator, DRK-4516
Fig. -8

Open and close the water by-pass regulator adjusting handle several times to free the regulator from possible sediment. If the water pressure still remains low, close the water by-pass regulator shut-off valve. The generator will then start at once if the regulator is causing your trouble. Set and manually regulate the trainline steam pressure by opening and adjusting the manual water by-pass valve.

High feed water temperature or leaky water line connections may cause the pump to become air or vapor bound. Violent fluctuation of the water gauge needle indicates this condition. Tighten leaky water line connections, and bleed the line by opening the water pump test valve. Allow water to flow from this valve until no air or vapor bubbles are evident in the water.

the nozzle. (If the water supply is almost completely stopped the servo may also actuate the air solenoid valve to shut off the atomizing air.)

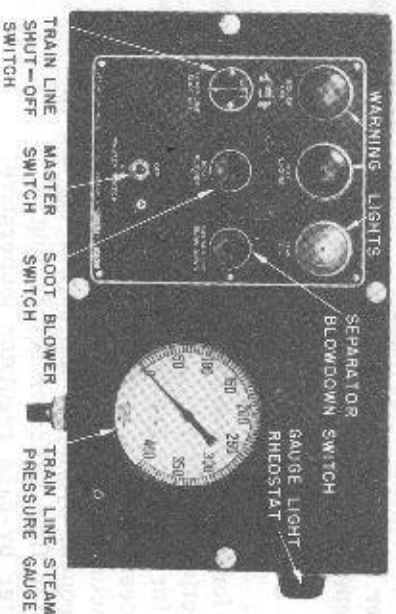
Be sure that the water pump test valve is closed, that the water strainers are clean, that the cover on the water treatment or strainer tank is tight, that the three-way washout valve is correctly positioned, and that the drain valves in the water suction lines are closed tightly.

IRREGULAR TRAINLINE PRESSURE

1. Burner Cycles Off and On: Insufficient water delivery causes the generator to run in superheat; the steam temperature limit control operates to protect the coils from overheating. Check the water pump output as instructed above.
2. Safety Valves Blow: Shut down the steam generator. Lower the trainline pressure setting on the adjusting handle of the water by-pass regulator and start the generator. If the safety valves continue to pop, close the water by-pass regulator shut-off valve and manually regulate the trainline steam pressure by opening and adjusting the manual water by-pass valve.

REMOTE CONTROL EQUIPMENT

The remote control panel is located on the fireman's side of the cab. Mounted on it are a master



Remote Control Panel

Fig. -9

switch to make the panel operative, and push-button switches to operate the separator blowdown and trainline shut-off valves. Three alarm lights are mounted on the panel and connected to the alarm circuit of the locomotive. The lights indicate boiler off, hot engine, and low oil. A trainline steam pressure gauge is also mounted on the panel.

The trainline shut-off valve can be closed from the cab, but to open this valve it is necessary for the fireman to go back to the steam generator. He should then depress the reset latch on the automatic trainline shut-off valve to the position marked open, and finally, he should open the manual shut-off valve.

The soot blower switch is to be used only when a steam generator of the CFK type is included in the installation. The steam admission valve to the soot blowers must be left open in order to blow soot by remote control. However, many railroads are now using a chemical soot destroying compound for soot removal, in which case the soot blower switch button is never used. Follow your railroad's instructions for soot removal.

ITEMS TO REPORT

1. If for any reason the steam generator does not function properly.
2. Water pressure greater than 450 pounds at any time.
3. Excessive stack temperature.
4. Fluctuation of the fuel manifold gauge.
5. Frequent cycling of the burner off and on.
6. Water flow indicator not cycling.
7. Water by-pass regulator inoperative.

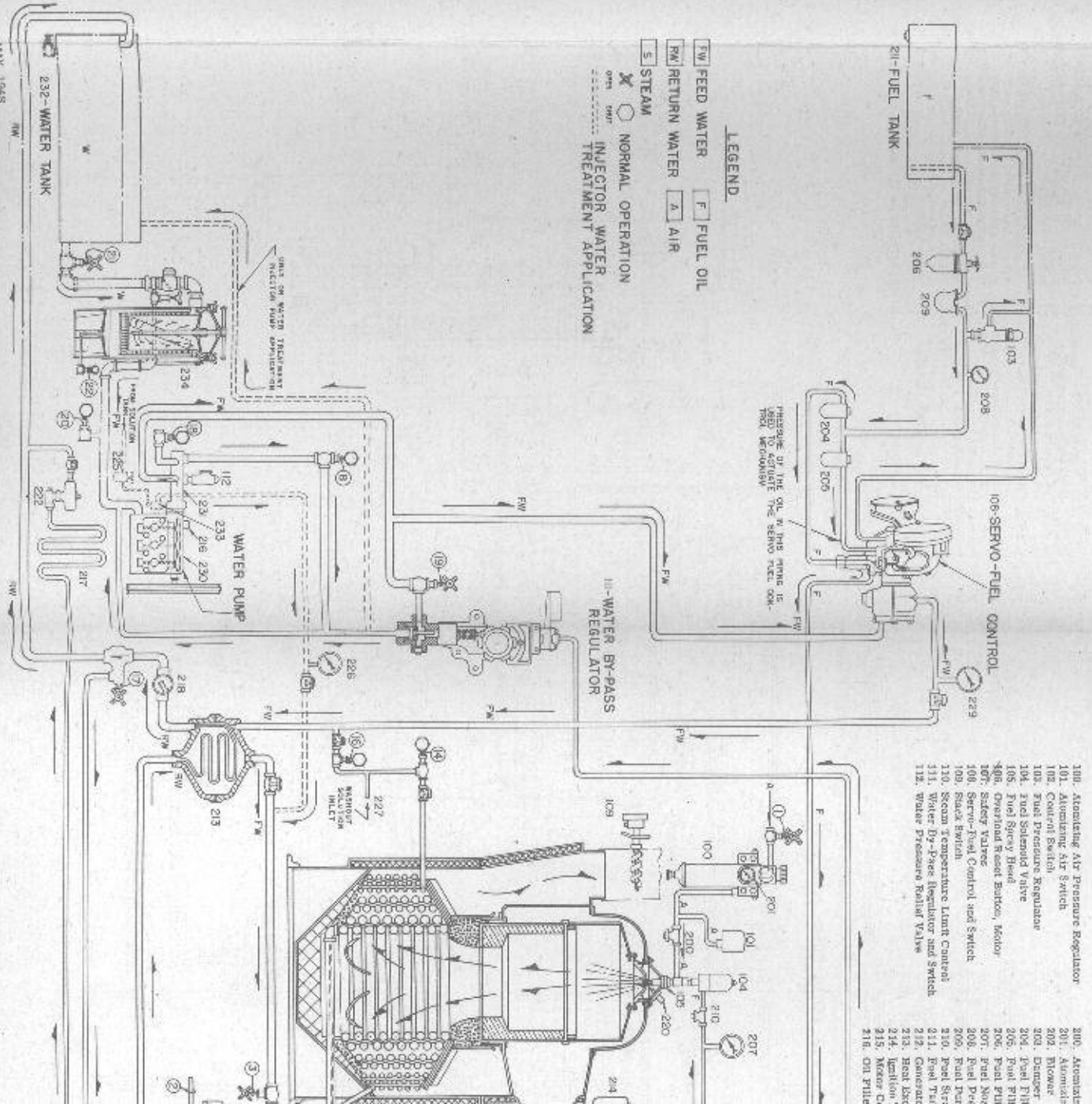
VALVES

Valves designated by odd numbers must be OPEN during normal operation of the steam generator. Valves designated by even numbers must be CLOSED during normal operation of the steam generator. Normally open valves are fitted with a cross type handle; normally closed valves are fitted with the standard round handle. These designations apply only to the OK series steam generators.

- Following valves must be OPEN during normal operation of the steam generator:
- Atomizing Air Shutoff Valve
- Coil Shutoff Valve
- Remote Control Trainline Shutoff Valve
- Reset Lever
- Return Water Outlet Valve
- Steam Admission Valve to Trainline Pressure Gauge
- Steam Admission Valve to Water By-Pass Regulator
- Stop and Check Valve
- Three-Way Washout Valve
- Water By-Pass Regulator Shutoff Valve
- Water Supply Stop Valve

The following valves must be CLOSED during normal operation of the steam generator:

- Coil Blowdown Valve and Switch
- Fill-Test Valve
- Layover Connection Shutoff Valve
- Manual Water By-Pass Valve
- Steam Admission Valve to Radiation (Open in cold weather)
- Steam Separator Blowdown Valve
- Washout Inlet Valve
- Washout Inlet Valve
- Water Pump Test Valve
- Water Suction Line Drain Valve
- Water Treatment Tank Drain Valve



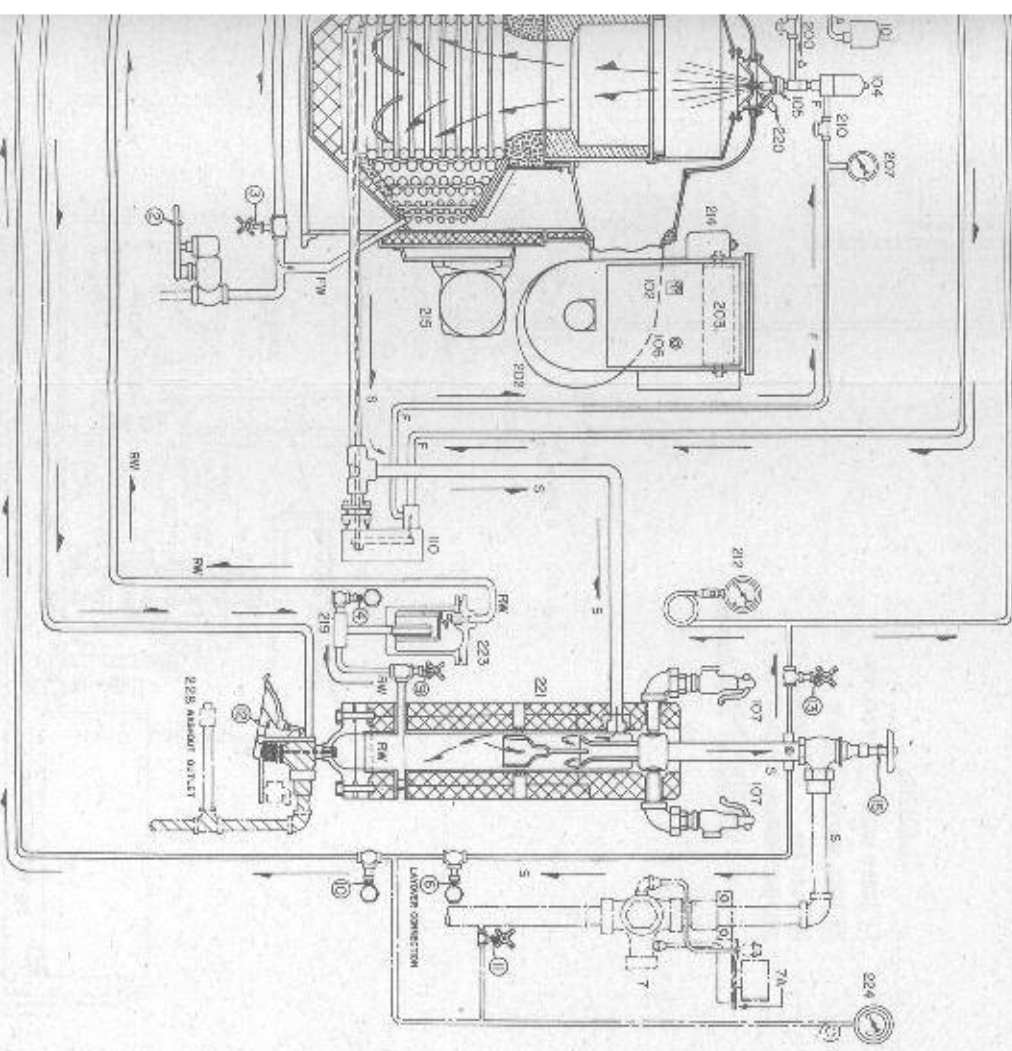
LEGEND

- FW FEED WATER
- RW RETURN WATER
- S STEAM
- F FUEL OIL
- A AIR
- NORMAL OPERATION
- ⊗ INJECTOR WATER APPLICATION

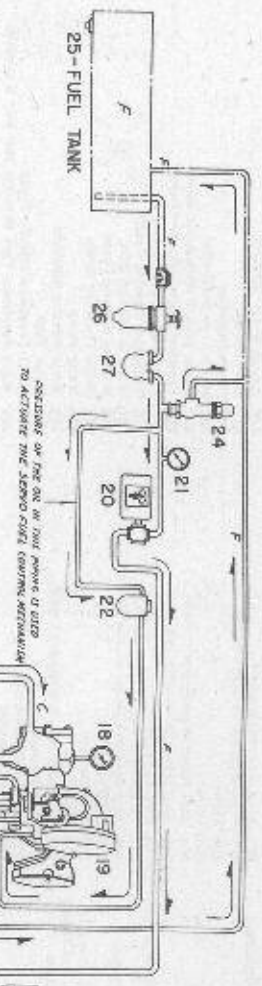
CONTROLS

- 100. Atomizing Air Pressure Regulator
- 101. Atomizing Air Switch
- 102. Control Switch
- 103. Fuel Pressure Regulator
- 104. Fuel Solenoid Valve
- 105. Fuel Supply Head
- 106. Overhaul Reset Button, Motor
- 107. Safety Valve
- 108. Servo-Fuel Control and Switch
- 109. Stack Switch
- 110. Steam Temperature Limit Control
- 111. Water By-Pass Regulator and Switch
- 112. Water Pressure Relief Valve
- 200. Atomizing Air
- 201. Atomizing Air Switch
- 202. Blower
- 203. Damper
- 204. Fuel Filter
- 205. Fuel Filter
- 206. Fuel Filter
- 207. Fuel Pump
- 208. Fuel Pressure
- 209. Fuel Pump
- 210. Fuel Shutoff Valve
- 211. Fuel Tank
- 212. Concentration
- 213. Heat Exchanger
- 214. Location
- 215. Motor Control
- 216. Oil Filter

- APPURTENANCES
- 200. Accounting Air Strainer
 - 201. Accounting Air Pressure Gauge
 - 202. Blower
 - 203. Damper
 - 204. Fuel Filter (fuel pressure line)
 - 205. Fuel Filter (Genco Accounting line)
 - 206. Fuel Filter (Genco Inlet)
 - 207. Fuel Mixture Pressure Gauge
 - 208. Fuel Pressure Gauge (At fuel pressure regulator)
 - 209. Fuel Pump
 - 210. Fuel Strainer
 - 211. Fuel Tank
 - 212. Generator Steam Pressure Gauge
 - 213. Heat Exchanger
 - 214. Ignition Transformer
 - 215. Motor Converter
 - 216. Oil Filter Cap
 - 217. Radiation
 - 218. Return Water Flow Indicator
 - 219. Return Water Strainer
 - 220. Spark Plug
 - 221. Steam Separator
 - 222. Steam Trap (radiation)
 - 223. Steam Trap (return water line)
 - 224. Trivalent Steam Pressure Gauge
 - 225. Treatment Inlet Filter
 - 226. Treatment Inlet Gauge
 - 227. Washout Solution Inlet
 - 228. Washout Solution Outlet
 - 229. Water Pump
 - 230. Water Pump
 - 231. Water Strainer Manifold
 - 232. Water Tank
 - 233. Water Treatment Inlet Pump
 - 234. Water Treatment Tank (Strainer tank only if injector system is used)



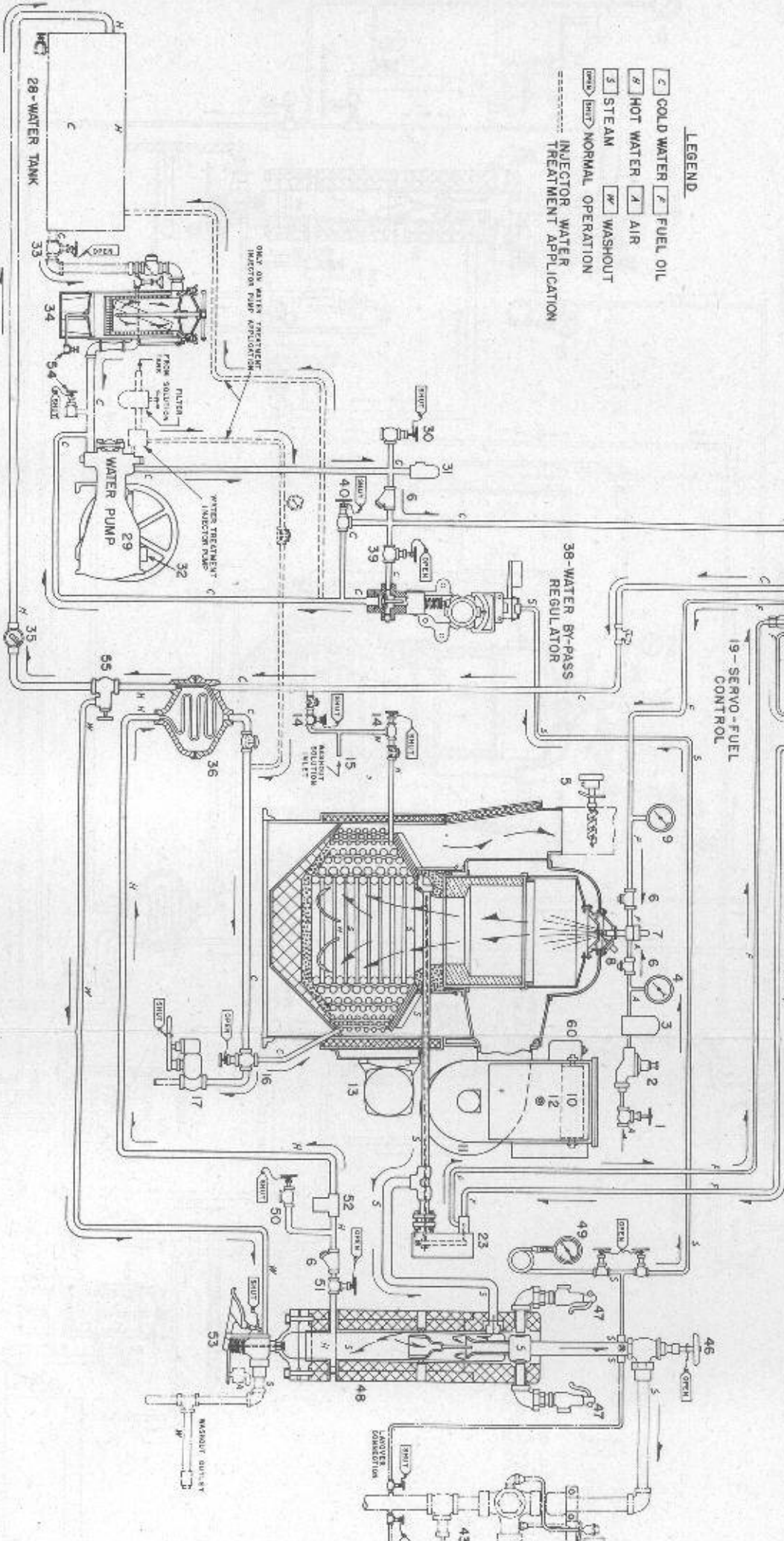
Steam Generator Operation Chart
Types OK-4616 and OK-4630



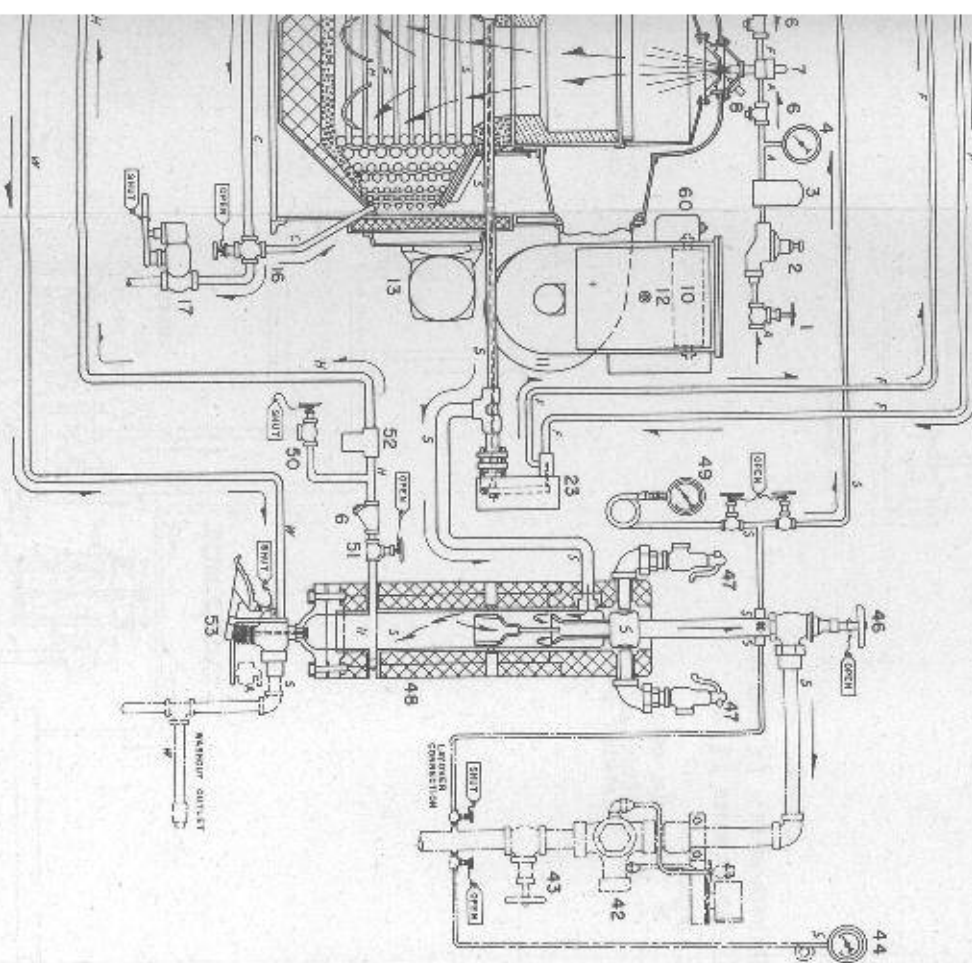
LEGEND

- C COLD WATER
- F FUEL OIL
- H HOT WATER
- A AIR
- S STEAM
- W WASHOUT
- INJECTOR NORMAL OPERATION
- INJECTOR WATER TREATMENT APPLICATION

- 1 - ATOMIZING AIR SHUTOFF VALVE
- 2 - AIR PRESSURE REDUCING VALVE
- 3 - AIR SOLENOID VALVE
- 4 - AIR PRESSURE GAUGE
- 5 - STRAINER
- 6 - FUEL SPRAY HEAD
- 7 - FUEL NOZZLE PRESSURE GAUGE
- 8 - OVERLOAD RESET BUTTON, MOTOR
- 9 - MOTOR CONVERTER
- 10 - WASHOUT INLET VALVES
- 11 - WASHOUT SOLUTION INLET
- 12 - COIL SHUTOFF VALVE
- 13 - COIL BLOWDOWN VALVE
- 14 - WATER PRESSURE GAUGE
- 15 - SERVO-FUEL CONTROL
- 16 - CONTROL SWITCH
- 17 - FUEL MANHOLD PRESSURE GAUGE
- 18 - FUEL FILTER (PRESSURE LINE)
- 19 - STEAM TEMPERATURE LIMIT CONTROL
- 20 - FUEL PRESSURE REGULATOR
- 21 - FUEL TANK
- 22 - FUEL FILTER (SUCTION LINE)
- 23 - FUEL PUMP
- 24 - WATER PUMP
- 25 - OIL FILLER CAP
- 26 - WATER PRESSURE RELIEF VALVE
- 27 - WATER SUPPLY STOP VALVE
- 28 - WATER TREATMENT TANK/STRAINER TANK ONLY
- 29 - WATER TREATMENT INJECTOR PUMP (IS USED)
- 30 - RETURN WATER FLOW INDICATOR
- 31 - HEAT EXCHANGER
- 32 - WATER BY-PASS REGULATOR
- 33 - SHUTOFF VALVE, BY-PASS REGULATOR
- 34 - MANUAL WATER BY-PASS VALVE
- 35 - REMOTE CONTROL TRAILLINE STOP VALVE
- 36 - MANUAL TRAILLINE STOP VALVE
- 37 - TRAILLINE STEAM PRESSURE GAUGE
- 38 - STOP AND CHECK VALVE
- 39 - SAFETY VALVES
- 40 - STEAM SEPARATOR
- 41 - GENERATOR STEAM PRESSURE
- 42 - FILL-TEST VALVE
- 43 - RETURN WATER OUTLET VALVE
- 44 - STEAM TRAP
- 45 - STEAM SEPARATOR BLOWDOWN
- 46 - DRAIN VALVE
- 47 - THREE-WAY WASHOUT VALVE
- 48 - ISHUTION TRANSFORMER



Steam Generator Operation Chart
Types DRK-4516 and DRK-4530



- 19 - SERVO-FUEL CONTROL
- 20 - CONTROL SWITCH
- 21 - FUEL MAINFOLD PRESSURE GAUGE
- 22 - FUEL FILTER (PRESSURE LINE)
- 23 - STEAM TEMPERATURE LIMIT CONTROL
- 24 - FUEL PRESSURE REGULATOR
- 25 - FUEL TANK
- 26 - FUEL FILTER (SUCTION LINE)
- 27 - FUEL PUMP
- 28 - WATER TANK
- 29 - WATER PUMP TEST VALVE
- 30 - WATER PUMP
- 31 - WATER PRESSURE RELIEF VALVE
- 32 - OIL FILLER STOP VALVE
- 33 - WATER TREATMENT TRANSDUCER TANK ONLY
- 34 - WATER TREATMENT INJECTOR PUMP (IS USED)
- 35 - RETURN WATER FLOW INDICATOR
- 36 - HEAT EXCHANGER
- 37 - WATER BY-PASS REGULATOR
- 38 - SHUTOFF VALVE BY-PASS REGULATOR
- 39 - SHUTOFF VALVE BY-PASS VALVE
- 40 - MANUAL CONTROL TRAINLINE SHUTOFF VALVE
- 41 - REMOTE CONTROL TRAINLINE SHUTOFF VALVE
- 42 - MANUAL TRAINLINE STOP VALVE
- 43 - MANUAL STEAM PRESSURE GAUGE
- 44 - STOP AND CHECK VALVE
- 45 - SAFETY VALVE
- 46 - SAFETY VALVE
- 47 - STEAM SEPARATOR
- 48 - GENERATOR STEAM PRESSURE GAUGE
- 49 - FILL-TEST VALVE
- 50 - RETURN WATER OUTLET VALVE
- 51 - STEAM TRAP
- 52 - STEAM SEPARATOR BLOWDOWN VALVE
- 53 - DRAIN VALVE
- 54 - THREE-WAY WASHOUT VALVE
- 55 - IGNITION TRANSFORMER
- 56 - WATER BY-PASS REGULATOR
- 57 - SHUTOFF VALVE BY-PASS REGULATOR
- 58 - MANUAL CONTROL TRAINLINE SHUTOFF VALVE
- 59 - REMOTE CONTROL TRAINLINE SHUTOFF VALVE
- 60 - STOP AND CHECK VALVE

TO START STEAM GENERATOR

1. Open the steam separator blowdown valve—53 and latch in open position. Open the fill-test valve—50.
2. Check the control panel and check switch—5 reset buttons.
3. Check the position of all valves. Open the atomizing air shutoff valve—1.
4. Close the separator blowdown valve—53 when the steam separator—48 is fully drained. Close the main switch and turn the control switch—20 to Fill. Check the ignition spark—8 while the coils are filling.
5. When water discharges from the fill-test valve—50, turn the control switch—20 to Off, close the fill-test valve, and latch open the separator blowdown valve—53.
6. **AFTER THE MOTOR HAS STOPPED**, turn the control switch—20 to Run. The fire should light immediately.
7. When the generator steam pressure—49 reaches 50 lbs. close the separator blowdown valve—53.
8. Open the separator blowdown valve—53 several times for three to five second intervals during the first few minutes of operation.
9. Set the water by-pass regulator—38 to the required trainline pressure—44. After the trainline is cycled open the stop and check valve—46 on the steam separator—48. Open the remote control trainline shutoff valve—42 by depressing the latch. Then open the trainline stop valve—43.

NOTES:

1. If the coils are empty it may take 5 to 10 minutes to fill the Steam Generator with water. **DO NOT START THE GENERATOR UNLESS THE COILS ARE FILLED WITH WATER.**
2. Check the positions of all valves if the Steam Generator does not start or function properly.

RUNNING ATTENTION

1. Open the separator blowdown valve—53 at least once every hour.
2. Turn the handle on the fuel filter during stops. At the same time turn the handle on the filter for the water treatment injector, where this method of water treatment is used.

TO SHUT DOWN STEAM GENERATOR

For short stops it is only necessary to close the trainline stop valve—42. The fire will cycle off and on, and maintain operating pressure in the steam generator. For terminal stops, proceed as follows:

1. Press the trainline shutoff button on the remote control panel. If no remote control panel is provided, close the trainline stop valve—43.
2. Set the water by-pass regulator—38 at maximum output. When the generator pressure—49 reaches 200 lbs. turn the control switch—20 to Off.
3. Open the coil blowdown valve—17. When the generator pressure—49 drops to 75 lbs. close the valve.
4. Open the separator blowdown valve—53 and blow down the steam separator—48 with the remaining pressure. Close the valve.
5. Open the fill-test valve—50 and turn the control switch—20 to Fill. When water discharges from the fill-test valve, turn the control switch to Off, and close the valve.
6. Open the main switch.
7. Close the atomizing air shutoff Valve—1.

NOTES

ELECTRO-MOTIVE DIVISION • GENERAL MOTORS CORPORATION
SECTION P-7.2 ELECTRICAL

SECTION 7

ELECTRICAL EQUIPMENT

This section covers the electrical equipment on the locomotive in a very general sort of way, except for those pieces of equipment that logically fall in other sections of the manual. The reason for including an electrical section in the Operating Manual is to more thoroughly acquaint operating personnel with the locomotive.

Main Generator

The main generator is directly connected to the Diesel engine through a flexible coupling. The generator produces nominal 600-volt direct current for operating the traction motors. A self-aligning bearing in the commutator end housing carries the weight of the commutator end of the generator armature. The other end of the armature is supported by the engine crankshaft. The generator is cooled by air drawn from the commutator end by a fan mounted on the flexible coupling.

Auxiliary Generator

The auxiliary generator is used for charging the locomotive storage batteries and to supply all the low voltage power when the locomotive is operating. The generator is belt-driven from a sheave mounted on the shaft of the main generator. The voltage output of the auxiliary generator is maintained at a constant level of 74 volts by the voltage regulator.

Controller

The controller (or control stand) contains the throttle lever and reverse lever. The throttle lever, by means of electric contacts, operates the electro-pneumatic governor controls, which control the speed of the engines through the engine

governors. The reverse lever operates electric contacts which close a circuit energizing either the forward or reverse magnet valves on the reversers in the high voltage cabinets. There is no mechanical connection between the reverse lever and the reverser.

Reverser

The reverser, located in the high voltage cabinet, is an air-operated reversing switch. Its purpose is to change the direction of flow of current through the traction motor fields, thus reversing the rotation of the traction motors. The current does not reverse in the main generator. If the control air pressure is low (should be 80 pounds) or either of the magnet valves on top of the reverser is inoperative, the reverser will not operate properly.

When the locomotive is to be towed in a train, it is advisable to lock the reverser drum in neutral. During normal operation, a locking pin is screwed into the left-hand side of the reverser. To lock the reverser drum in neutral, this pin should be removed and inserted in the hole on the opposite side. Turn the drum to its neutral position and the pin will engage with the hole in the shaft.

Traction Motors

Each traction motor drives a pair of wheels on the locomotive through spur gears. The two traction motors on each truck are interconnected through the motor control circuit. The traction motors are air cooled by blowers, there being one blower for each pair of motors. Serious damage will result if the traction motor blowers become inoperative. The traction motors in one truck are independent of those in any other truck.

High Voltage Cabinet

There are two high voltage cabinets in each unit of the passenger locomotive, one for each of the two power plants. The cabinets are mounted on the left side wall of the loco-

otive and are at the rear of their respective power plants. The following electrical equipment is in each high voltage cabinet:

Main Power Contactors. These three contactors change the traction motor connections from series to parallel, or vice versa. There is one series contactor (marked "S"), and there are two parallel contactors (marked "P1" and "P2"). They operate on air pressure through magnet valves.

Traction Motor Field Shunting Contactors. These contactors connect the motor field shunting resistors across the traction motor fields, decreasing the resistance of the circuit. This allows more current to flow through the traction motor armatures, increasing the torque of the motors which, in turn, increases the speed of the locomotive.

Reverser. This subject is covered earlier in this section.

Transition Relay. This relay is energized when a predetermined voltage is reached, and operates in conjunction with the time delay relay to close the traction motor parallel contactors. It also operates in conjunction with the shunt field and battery field contactors, causing the latter to open while transition is taking place.

Time Delay Relay. The function of this relay is to allow time for the main generator voltage to decrease before closing the parallel contactors during transition from series to parallel.

Ground Protective Relay. This relay is covered in Section 1.

Wheel Slip Relay. The operation of this relay is covered in Section 1.

Resistors. Certain resistors are also located in the high voltage cabinet, but an explanation of their functions would prove of no particular value to operating personnel.

Low Voltage Cabinet

The low voltage cabinet is actually a part of the high voltage cabinet but the two have separate doors. The following electrical apparatus is in the low voltage cabinet:

Engine Starting Contactors. The starting contactors are used to connect the battery to the main generator for starting the Diesel engine. These starting contactors are of the magnetic type. There are two for each power plant and they are located in the low voltage cabinet. The starting contactors close when the "start" switch button is pressed and isolation switch is in "start" position.

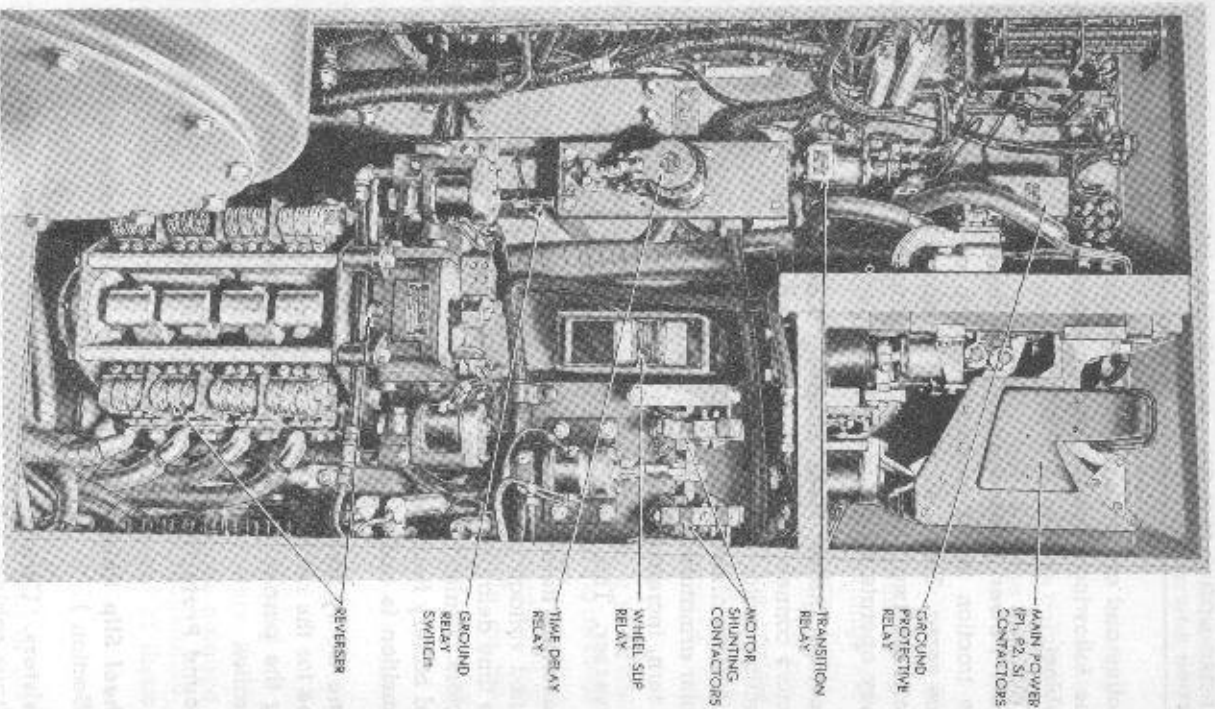
Battery Charging Contactor. This contactor connects the auxiliary generator to the battery. The reverse current relay closes the battery charging contactor when the auxiliary generator voltage is high enough to charge the battery.

Battery Field Contactor. This contactor closes when throttle is moved to Run 1 position, connecting the battery to the main generator battery field. During transition the contactor is opened, reducing the generator output.

Generator Shunt Field Contactor. This contactor connects the main generator shunt field to the main generator armature. As in the case of the battery field contactor, the generator shunt field contactor is opened during transition, reducing the generator output.

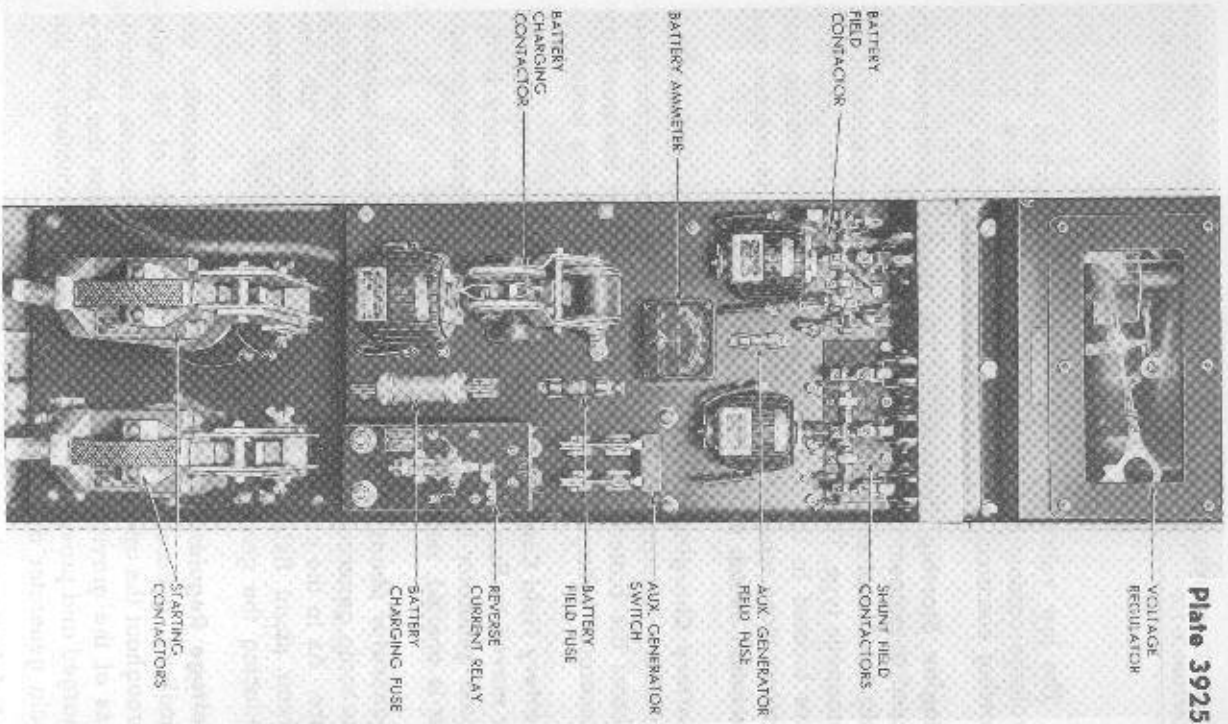
Voltage Regulator. The voltage regulator maintains the auxiliary generator voltage at a constant of 74 volts throughout the operating speed range of the engine, regardless of the gravity of the battery. This keeps the battery charged and provides a constant source of excitation for the main generator during locomotive operation.

A defective voltage regulator will be evidenced by excessive fluctuation of the ammeter in the low voltage cabinet.



High Voltage Cabinet
Fig. 7-1

Plate 3925



Low Voltage Cabinet
Fig. 7-2

Broken or loose auxiliary generator Vee belts will affect the battery charging rate and the excitation of the main generator.

Reverse Current Relay. This relay prevents the battery current from "motoring" the auxiliary generator by opening the battery charging contactor when the auxiliary generator voltage drops below the battery voltage.

Battery Charging Switch. One charging switch is used for each power plant. All battery charging equipment of one power plant (auxiliary generator, reverse current relay, battery charging contactor, and voltage regulator) is isolated from the battery when this switch is open.

Ammeter. The ammeter in the low voltage cabinet indicates auxiliary generator output and does not necessarily agree with the ammeter on the distribution panel.

Distribution Panel

The distribution panel, which is mounted on the cab wall behind the fireman, contains the following electrical equipment:

Main Battery Switch. This switch isolates all circuits from the battery except the external charging receptacle.

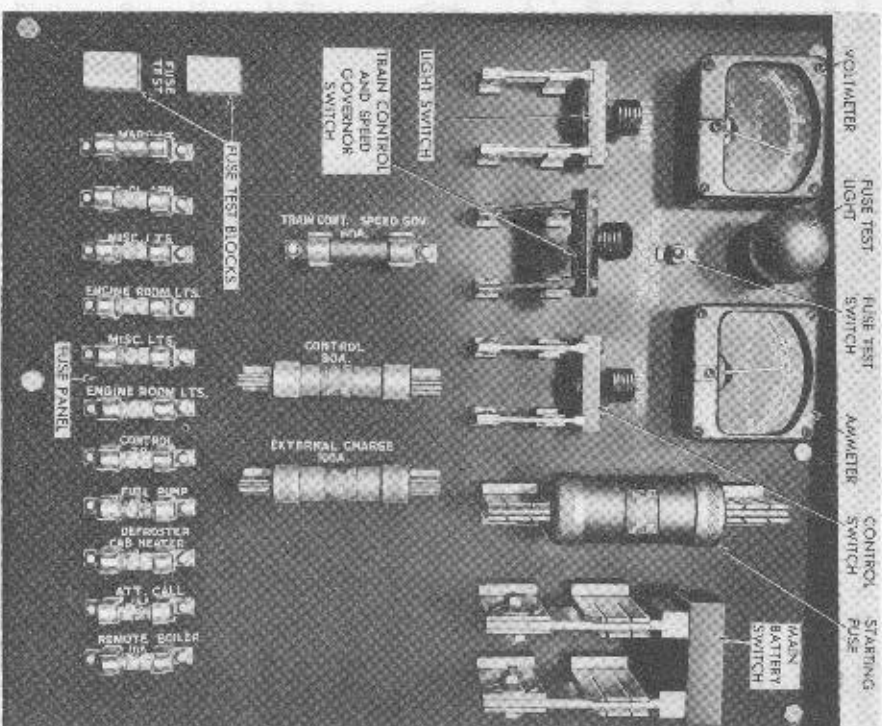
Control Switch. This switch controls battery power to the control equipment (relays, contactors, etc.).

Train Control and Speed Governor Switch. This switch controls the battery power to the train control (if used) and to the train speed governor.

Light Switch. This is the master lighting switch for all lights in the locomotive. If this switch is open, none of the lights can be turned on.

Battery Ammeter. This ammeter shows the net charge or discharge through the battery, except starting current or current from an external charging source.

Battery Voltmeter. This voltmeter indicates battery voltage.



Distribution Panel
Fig. 7-3

Fuses. There are a number of fuses in the distribution panel; each of these fuses protects its particular circuit from overloads.

CAUTION! Never remove the auxiliary generator 30 ampere fuse (in low voltage cabinet) with the engine running. Never pull any fuse unless the switch to that circuit is open.

Fuse Test Switch Light and Blocks. The fuse test switch is in parallel with the fuse test blocks. Lamps as well as fuses may be tested with this switch. Light the lamp, place the fuse in position on the test blocks, and snap the switch "off." If the lamp goes out, the fuse is blown; if it stays lighted, the fuse is good. To test a lamp, screw it into the socket and snap the switch on.

Electro-Pneumatic Governor Control Magnet Valves

An electro-pneumatic governor control is located at the front end of each engine and is used to control the multi-powered units of the locomotive with one throttle. This assembly consists of four magnet valves designated as "A", "B", "C" and "D" valves, and an air engine. An electrical connection between the throttle and the electro-pneumatic governor control energizes the different combinations of the magnet valves. The magnet valves open air valves to admit air to the various cylinders of the air engine. The air engine pistons operate the governor control arm through appropriate linkage. The following chart indicates valve combinations and engine speeds at all throttle positions.

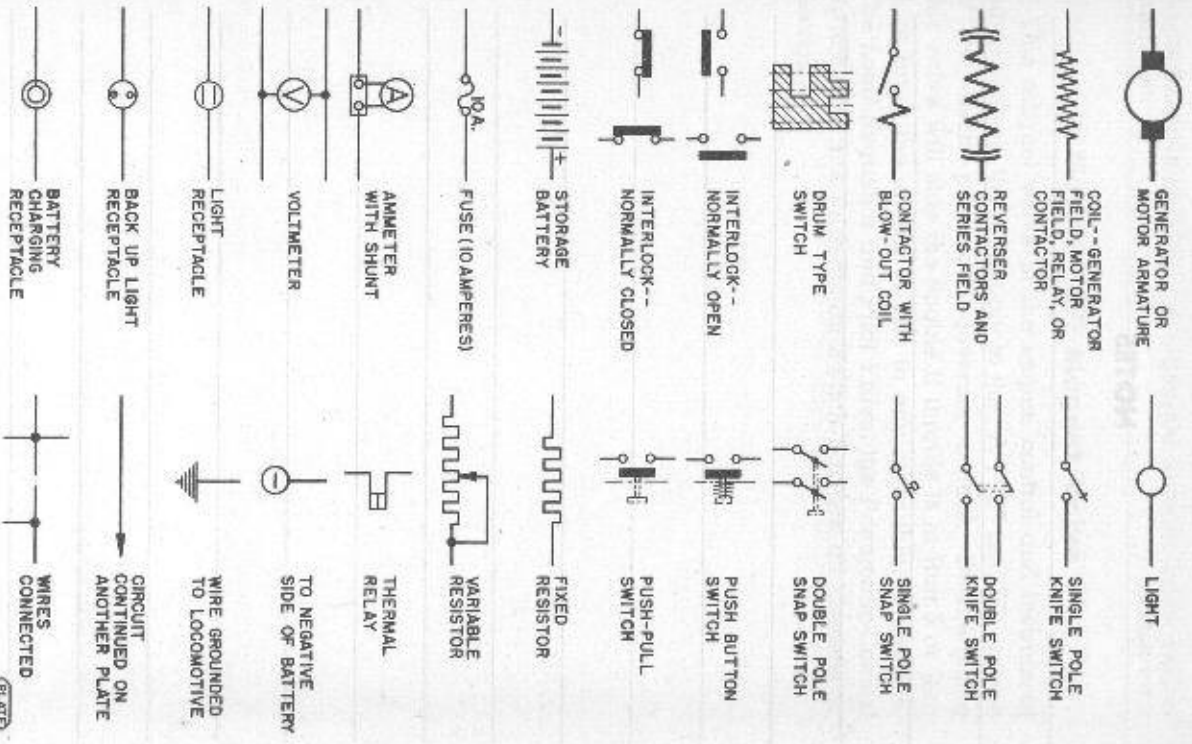
Engine Speed Chart

Throttle Position	Magnet Valves Energized				Engine Speed RPM
	A	B	C	D	
Off				*	0
Idle					275
1	*				275
2	*				350
3	*		*		425
4	*		*		500
5	*	*	*	*	575
6	*	*	*	*	650
7	*	*	*	*	725
8	*	*	*	*	800

Master ("E") Magnet Valve

This magnet valve in the engine control and instrument panel controls the air supply to the "A", "B" and "C" valves of the electro-pneumatic governor control. De-energizing this valve will stop the engine if throttle is in Run 5 or Run 6, or bring the engine to idle in any other throttle position. The Load Regulator and Pilot Valve, the Pneumatic-Control Switch, and the Push-Button Switch Box are all covered in Section 1.

NOTES



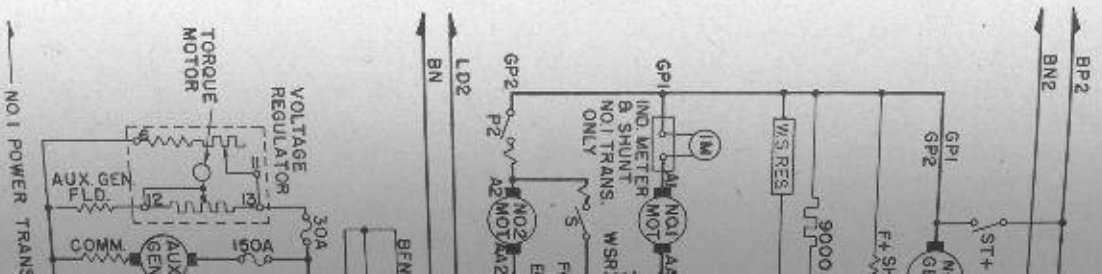
Electrical Symbols
Fig. 7-4

LEGEND OF ELECTRICAL EQUIPMENT

The following is a list of abbreviations used to identify electrical equipment on the wiring diagrams. The wire designations appearing on the diagrams conform with the identification bands on the wires throughout the locomotive. These wire designations are not included in this list.

- | | |
|--------------------|---|
| AV, BV, CV, DV, EV | Electro-Pneumatic Governor Control Valves |
| BA | Steam Generator Alarm Light |
| BC | Battery Charging Contactor |
| BF | Battery Field Contactor |
| COMM | Communicating Field |
| CL | Chias Light or Switch |
| DIFF | Differential Field |
| ETS | Engine High Temperature Alarm Switch |
| FOR | Reverser Magnet Valve--Forward |
| FPC | Fuel Pump Contactor |
| GA | Gauge Light or Switch |
| GR | Ground Protective Relay |
| HDLT | Headlight |
| IM | Transition Indicating Meter |
| IS | Isolation Switch |
| JS | Journal Signal Light |
| JSR | Journal Signal Relay |
| LOP | Low Oil Pressure Alarm Switch |
| LOS | Lube Oil Suction Alarm Switch |
| M | Motor Field Shunting Contactor Magnet Valve |
| NO | Number Light or Switch |
| OS | Oil Signal Light |
| PI, P2 | Parallel Contactors |
| PCS | Pneumatic Control Switch |
| RCR | Reverse Current Relay |
| REV | Reverser Magnet Valve--Reverse |
| S | Series Contactor |
| SH | Shunt Field Contactor |
| SH1, SH2 | Shutter Relays |
| SM1, SM2, SM3 | Speed Recorder Light |
| SP | Signal Relay |
| SR | Starting Contactors |
| ST+, ST- | Shutter Temperature Switch |
| START | Throttle Light |
| STS | Engine High Temperature Signal Light |
| TL | Transition Relay |
| TS | Time Delay Relay |
| VI | Wheel Slip Relay |
| VT | Wheel Slip Light |
| WSR | |
| WS | |

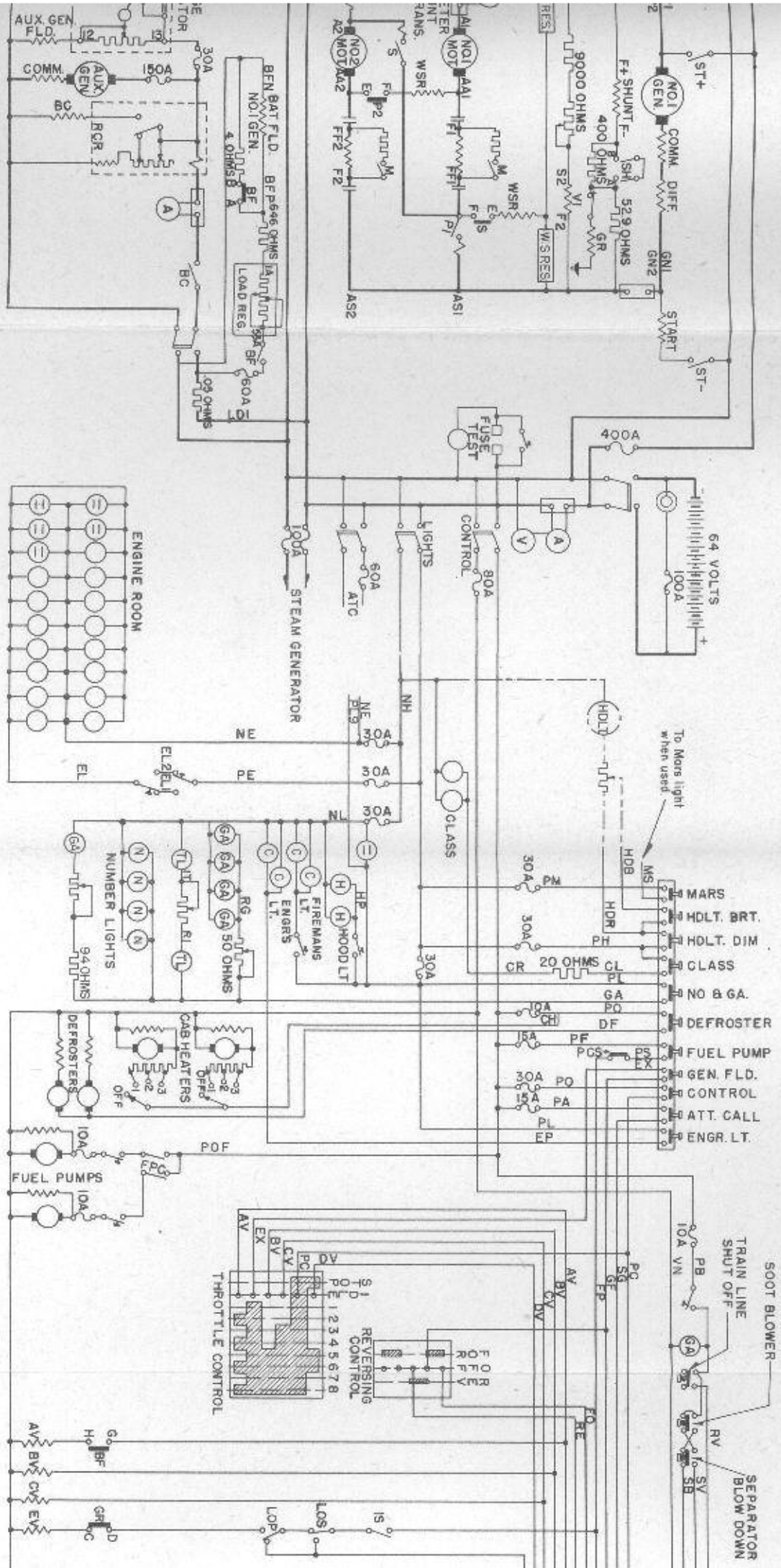
NO. 2 POWER TRANSMISSION & BATTERY CHARGING



POWER TRANSMISSION & BATTERY CHARGING

LIGHTING

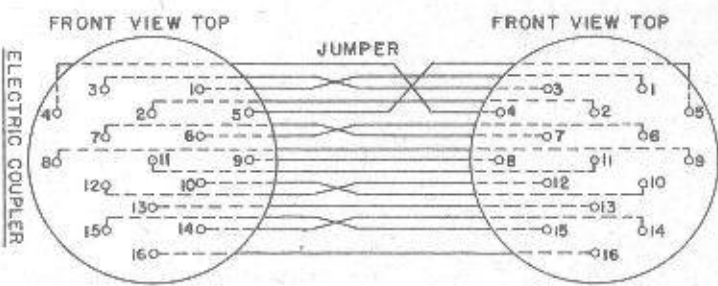
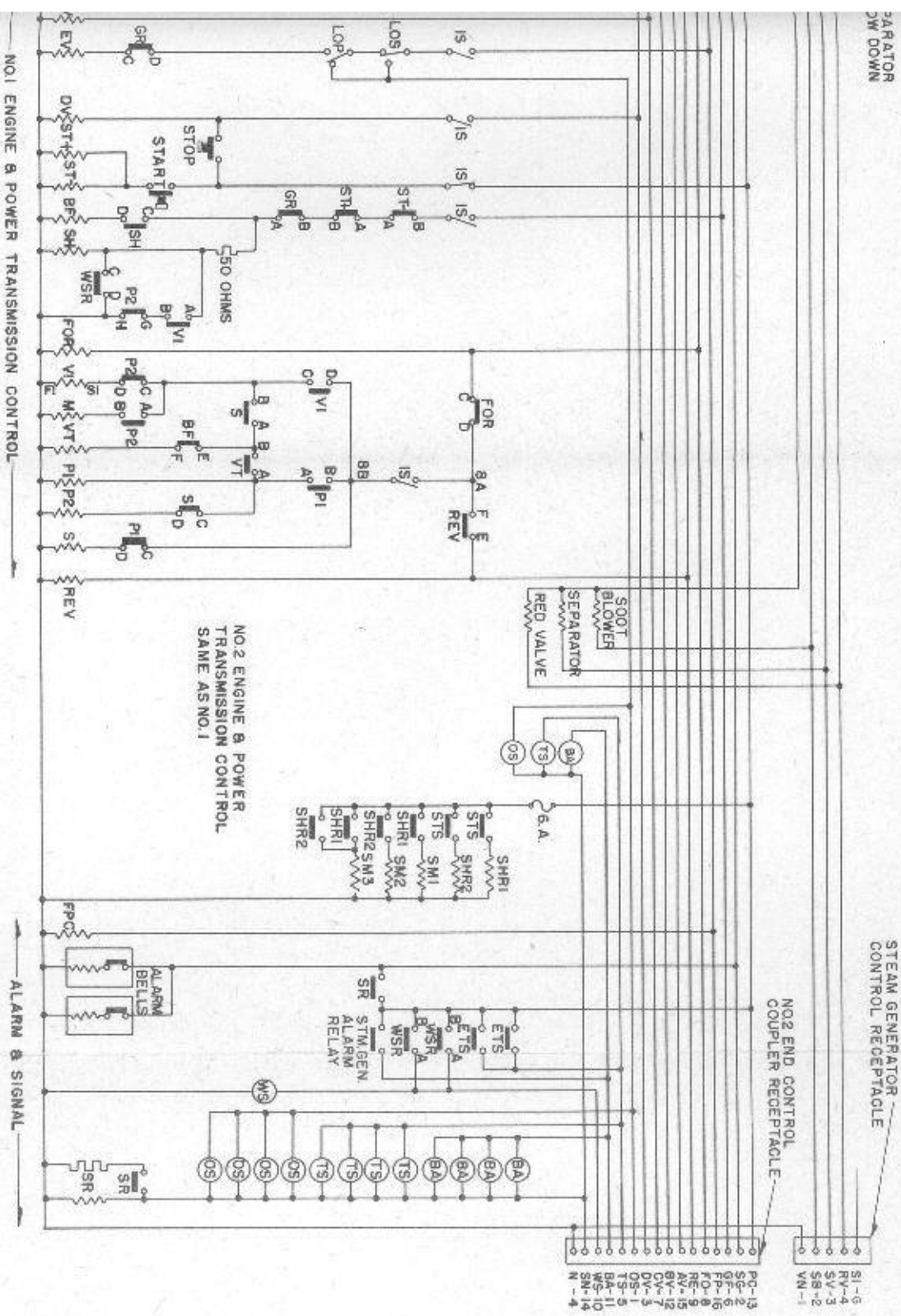
NO. 1



POWER TRANSMISSION & BATTERY CHARGING

LIGHTING

NO. 1



Typical Passenger Locomotive Wiring Diagram

Fig. 7-5

SECTION 8 AIR SYSTEM

Air Compressor

Each power plant in the locomotive is equipped with a type ADX air compressor which is driven by the shaft of the main generator through a Falk coupling. The compressor has its own oil pump and pressure lubricating system. Oil level in the crankcase can be checked on the byronet type gauge.

The compressor is equipped with a governor to maintain the main air reservoir pressure. This governor is adjusted to cut in at 130 pounds pressure, and cut out at 140 pounds pressure. If it is suspected that the governor is stuck, and blowing it out by means of the petcock on the bottom does not help, the condition should be reported to maintenance point for correction.

Draining Air System

The air system should be drained periodically to prevent moisture from being carried into the air brake and control air systems. The detail of the drain valves and their locations are as follows:

- No. 1A Main Reservoir—Ahead of the high voltage cabinet
- No. 2 Main Reservoir—Ahead of control valve
- Air Compressor Governor and Strainer—Right wall alongside #2 engine
- Type "H" Filter—In the engine room on the left side of the cab wall
- Oil Sump Reservoir—One alongside each air compressor
- Intercooler—One on each air compressor
- Control Air Reservoir—In the engine room on the right side of the cab wall

The frequency of draining will depend on local conditions and can be determined by practice. It is recommended that draining be done at time of each crew change until a definite schedule can be determined.

Air Brake System

Refer to the air brake manufacturer's instructions on the operation of air brake equipment.

Control Air System

The control air is used to operate the electro-pneumatic governor control, reversers, and various contactors in the high voltage cabinets.

The control air is supplied from the main air reservoirs through a reducing valve in the line between the main air reservoirs and the control air reservoir. This pressure should be maintained at 80 pounds, plus or minus 3 pounds.

The control air pressure gauges are located on top of the high voltage cabinets and should the gauges indicate main air reservoir pressure, it is probable that the reducing valve is stuck open. If blowing out the filter and tapping the reducing valve does not correct this condition, it should be reported at the maintenance point.

To Pump Up Main Reservoir Air Pressure

1. If the locomotive has been standing inoperative and the air reservoirs have been drained:
 - a. Close all drain cocks.
 - b. Place reverse lever in neutral position.
 - c. Set "PC" switch.
 - d. Start engines in the usual way but do not close the generator field switch.
 - e. Let engines idle for at least five minutes.
 - f. Open throttle, if necessary, to 3rd notch.

2. If locomotive has been coupled to train and train line must be pumped up:

- a. Place reverse lever in neutral position.
- b. Pull out generator field switch.
- c. Open throttle, if necessary, to 3rd notch.

If Air Pressure Does Not Build Up:

1. Check to see that angle cocks and main reservoir drain valves are in proper position.
2. Check main reservoir safety valve in event that it might be stuck open. A light tap may seat it.
3. Blow out filter and air compressor governor.

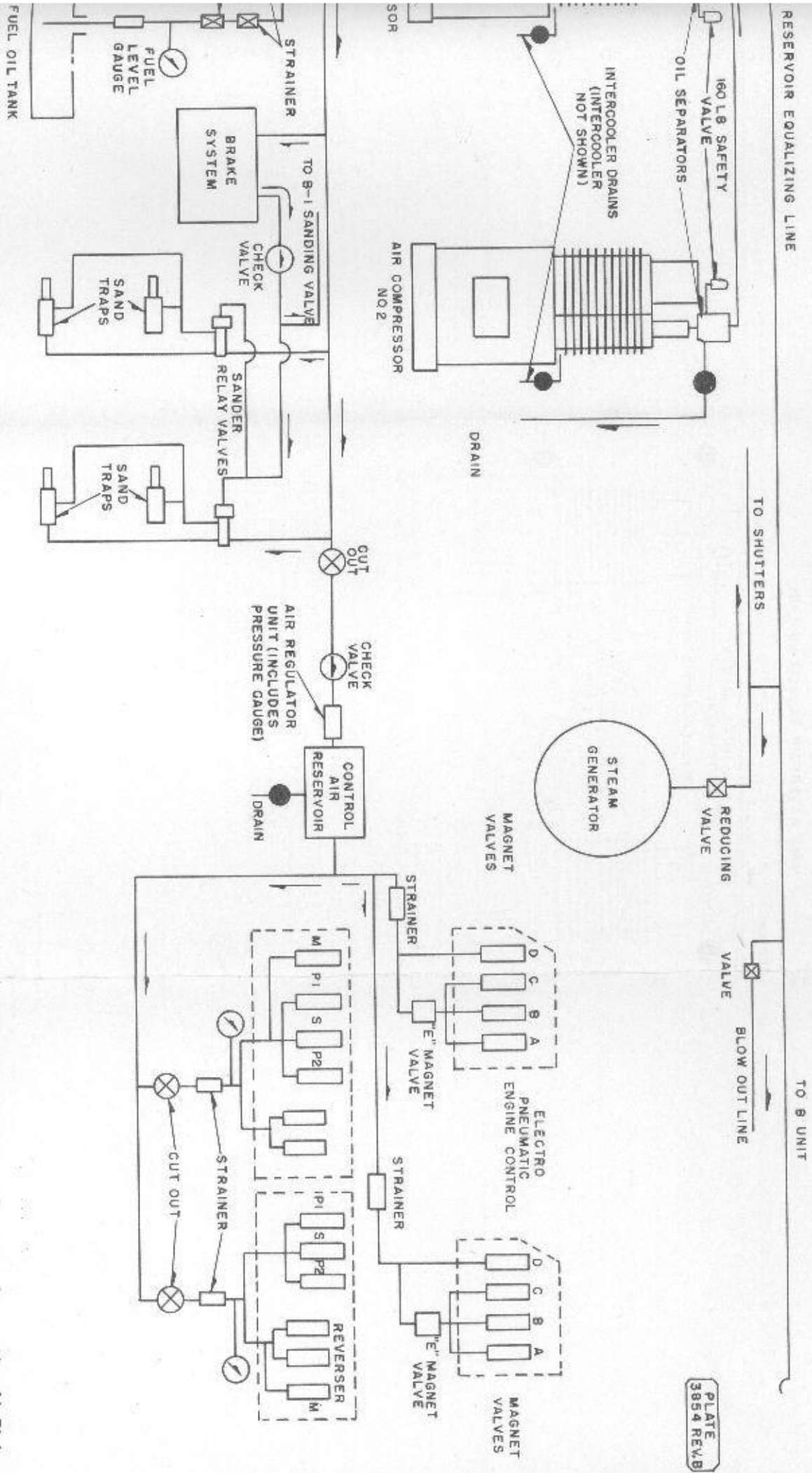


PLATE
3854 REV B

Schematic Diagram - Passenger Locomotive Air Piping

Fig. 8-1

If Engine Fails to Stop

Stop engine with the layshaft manual control lever if, with the control switch closed, engine fails to stop when the throttle is placed in the shut-down position, or when the stop button on the engine control and instrument panel is pushed. Check for binding linkage, inoperative governor control, faulty governor, defective master "E" valve or "D" valve, or loss of control air pressure.

Loss of Load on an Engine

To detect a loss of load on an engine, look at the load indicator dial on the governor. After the engine and generator have had a chance to balance up (about 30 seconds), the load indicator should agree approximately with the indicator on the back of the electro-pneumatic governor control box. If the indicator on the governor is low, it might show that:

1. The motors across that generator are in series, while all the other power plants are in parallel.
2. The "BF" or "SH" contactors are open. This may be caused by:
 - a. Ground relay tripping.
 - b. Starting contactor interlock open.
 - c. Wheel slip relay stuck closed.
3. Battery field fuse blown.
4. Dirty or poorly made contacts any place in the power or generator field circuits. In correcting any of these defects, it is important that the power plant being worked on be "Isolated."
5. Insufficient fuel or air in fuel lines.

Lack of Power

In the engine this may be due to poor combustion, insufficient air, lack of fuel, poor fuel, restriction in exhaust, incorrect timing, leaky exhaust valves, or air box covers not sealed properly.

In the electrical system, lack of power may be caused by low generator field excitation. Low generator field excitation may be due to a faulty connection in the generator battery field circuit, a faulty auxiliary generator, auxiliary generator belts slipping, faulty voltage regulator, a weak battery, or an open generator field contactor. Lack of power may also be due to faulty traction motors or generators, traction motor contactors, load regulator, pilot valve, or improper setting of pilot valve linkage. If a starting contactor sticks shut, the generator of that power plant will not deliver power.

In short, anything preventing the generator from delivering its full output, or preventing the traction motors from delivering their full power, will cut down on locomotive power.

Exhaust Smoke

Smoke at the exhaust is usually an indication of poor combustion of fuel, but may be due also to excess lubricant passing into the combustion chamber. Fuel in a partially burned condition, or engine overload, will cause a black exhaust. If fuel is not igniting, the exhaust smoke may show blue. Blue smoke may appear at light loads, or upon starting, due to low temperature of the combustion chamber. Mistiming, improper fuel, incorrect timing, a faulty injector, or insufficient air, may be the cause of exhaust smoke.

Smoke may also be an indication of a continuous engine overload due to improper pilot valve adjustment, plugged pilot valve feed line, or inoperative load regulator.

If Locomotive Does Not Move When Throttle Is Opened

Some of the items listed below would cause a loss of load on the engines, and result in slow acceleration.

1. Check "PC" switch. (Pull out button to reset.)
2. Check hand brake in every unit to see that they are released.
3. Repeat movement of brake valve to release all brake shoes.
4. Check to see that generator field switch at control station is closed and fuse at distribution panel is good.
5. Check control air pressure and see that reversers are in proper position.
6. Check to see that ground protective relays are set in normal position.
7. Check all fuses:
 - a. 80-Ampere control fuse on the distribution panel.
 - b. 30-Ampere control fuse on the distribution panel.
 - c. 60-Ampere battery field fuse in the low voltage cabinet.
8. The generator shunt or battery field contactors might be open or making poor contact.
9. If starting contactors or wheel slip relay sticks in the closed position, the generator of that power plant will not deliver power.

If Battery Charging Ammeter (In Low Voltage Cabinet) Always Shows Zero

1. See that auxiliary generator switch is closed.
2. Check all fuses in circuit affected:
 - a. 30-Ampere auxiliary generator field fuse in the low voltage cabinet.
 - b. 150-Ampere battery charging fuse in the low voltage cabinet. If replacing fuses is not corrective, the condition should be reported.
3. Auxiliary generator drive belts might be loose or broken.

NOTES

SECTION 10

TRUCKS AND MISCELLANEOUS EQUIPMENT

Traction Motor Blowers

Since the traction motors depend on the traction motor blowers for ventilation, it is imperative that the traction motor blower drive chains be kept in good condition and properly lubricated.

The traction motors depend on each blower for ventilation and the cost of maintaining the blowers and blower drives is such a small item in comparison to the cost of repairing motors damaged by overheating, that particular attention should be paid to see that the drives are in good repair.

The blowers are driven by a chain drive which runs in an oil bath. The blower drive at the #2 engine is supplied with oil from the #2 engine lubricating oil system and the overflow oil is returned to the #2 engine oil pan. The blower drive at the #1 engine carries its own oil supply and the oil must be kept at the proper level.

The blowers turn 2322 RPM when the engine is at 800 RPM.

Vee Belts

The engine cooling fan drive belts should be periodically inspected for wear and adjusted to the proper tension. The belts must not ride on the bottom of the groove or be loose enough to slip or whip.

The belt safety guards should be in place whenever a power plant is in operation. The guards should not rub on the belt or sheaves.

Engine Ramps

An engine ramp which serves two purposes is located on each side of the engine. When lowered, the ramp serves as an elevation to facilitate working on the top deck of the engine. When in the raised position and latched in place, it serves as a protection from the hand hole covers blowing off in the event a crankcase explosion occurs.

Removing Trucks

Fig. 10-1 shows the various jacking pads, blocking pads and their location on the locomotive, as well as the lift required so that the trucks may be removed sideways. Other locomotive dimensions are given in Fig. 0-3.

In removing a truck from one end of the unit, the opposite end of the unit must also be raised at least half way out of the center plate pocket, otherwise the center plate will be sprung out of shape, or cracked.

In cases where an overhead crane is not available and jacks are used for lifting, care must be exercised that jacks are raised equal amounts so that each jack lifts its share of the load, otherwise the carbody may be sprung out of shape.

Blocking should always be provided if the carbody is to be held in a raised position for any length of time.

A jacking pad is provided at each end of the bolsters, with intermediate blocking pads, as shown on Fig. 10-1.

In combination with the truck side bearings is a specially designed truck and side bearing interlock, which also serves to stop the truck from shoving in case of derailment. These interlocks are removed from

inside the carbody by removing cover plates over bolsters and lifting interlocks out.

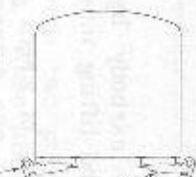
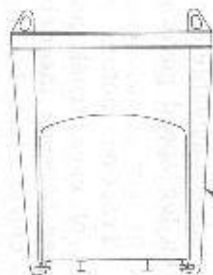
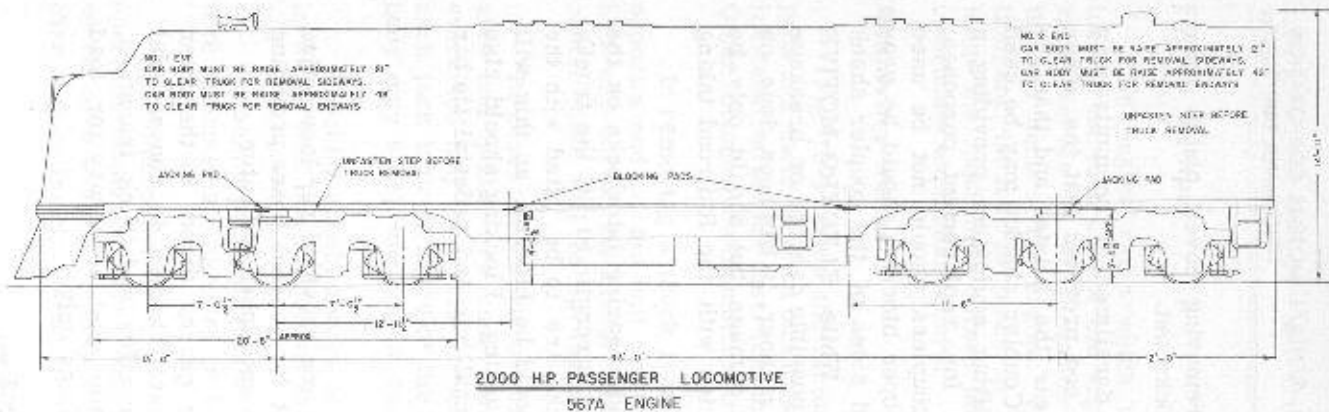
In case of wreck or derailment a locomotive may be lifted at one extreme end provided that the other end is supported at or near the bolster and that the trucks are not attached. Coupler shanks may be used as points for attaching lifting equipment providing a new coupler is at hand for replacement purposes. (Exception - Retractable couplers should not be used for lifting point.) Also, proper blocking should be provided between the top and sides of the coupler shank and the coupler pocket. While ELECTRO-MOTIVE cannot be responsible for possible damage or breakage of parts by lifting in this manner, it has been done on several occasions without damage but should only be used in extreme emergencies with the Railroad taking full responsibility.

Truck and carbody side bearing interlocks on the locomotives have sufficient strength to lift the trucks with the carbody. If trucks are to be lifted with the carbody, truck springs should be blocked, as this will save approximately 3" of jacking. Blocking should also be placed between the journal box and pedestal the bar to further reduce the lift.

Trucks

Two six wheel trucks are provided per locomotive unit, interchangeable except for journal boxes providing drives for speed governor and speed indicator.

Traction motors are geared direct to the outer axles of each truck and are carried in conventional manner between the driver axles and truck transoms. The center axle is an idler, and necessary for load carrying and braking purposes only.



DETAIL CONSTRUCTION DETAIL IN VIEW
 2' FROM ELEVATION DRAWING NO. 305596A
 FROM ELECTRIC MOTION SYSTEM, GENERAL
 MOTORS CORPORATION, LA SALLE,
 ILLINOIS

PLAN VIEW

WORKING LEVELS
 DRAWING NO. 10-107

Clearance for Removing Trucks from Passenger Locomotive
Fig. 10-1