Enginemen's Operating Manual

MODEL G.P.7

DIESEL LOCOMOTIVE

OPERATING MANUAL NO. 2312

FOR

ROAD SWITCHING LOCOMOTIVE

MODEL GP7

With Vapor Car Steam Generator

3rd Edition

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ELECTRO-MOTIVE DIVISION
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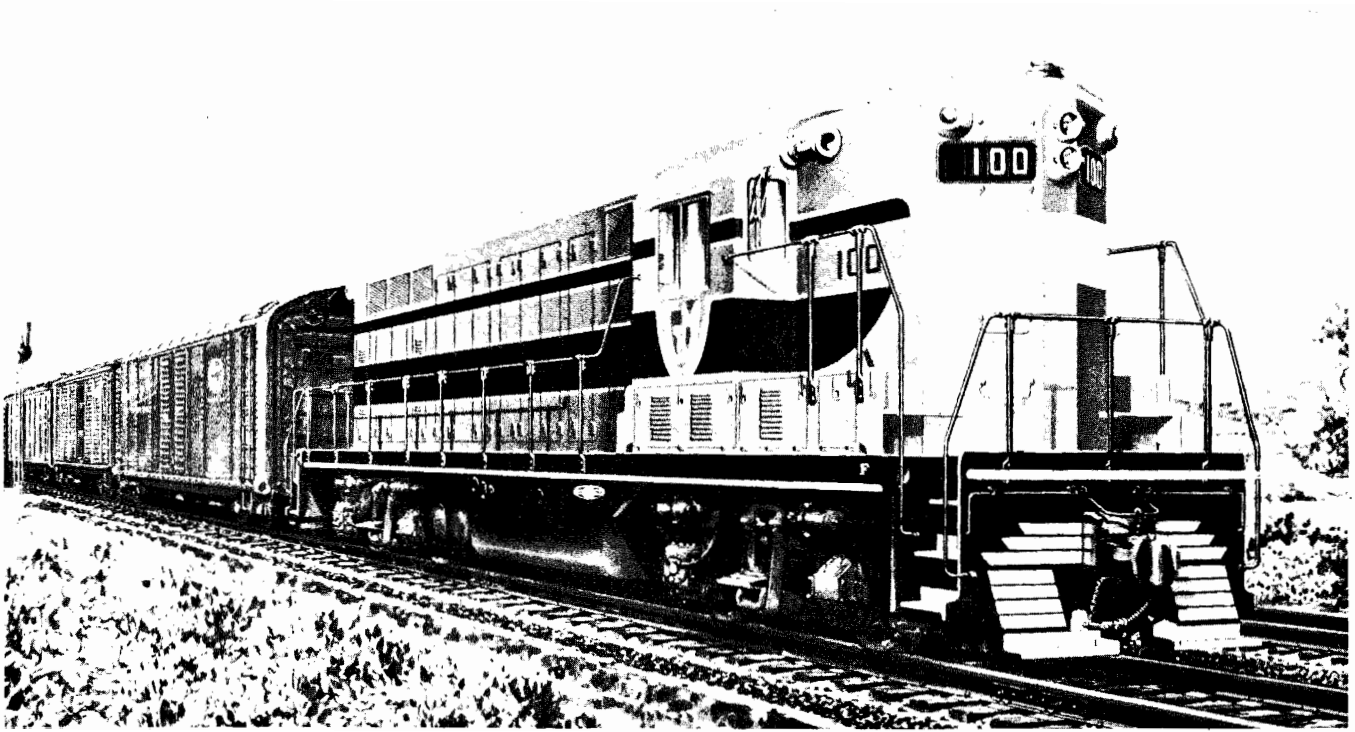
INTRODUCTION

This manual has been produced to assist the engineman in the operation of the Model GP7 locomotive. It covers basic (standard) equipment, as well as the most commonly used "extras."

The first three sections of this manual are devoted to a description of the locomotives, normal operation over the road, and special conditions and problems during operation. Section 4 consists of a general description of the cooling, lubricating oil and fuel oil systems and other necessary information for operation of the locomotive. Section 5 consists of a reprint of the TS-4 "On-the-Road Trouble Shooting" booklet. Section 6 covers the steam generator.

The principal articles of each section are numbered consecutively for ready reference, as is each page of the section. Articles and pages are numbered in the 100 series type of numbering, a page in the 300's is in Section 3 as is any article numbered in the 300's.

A "General Arrangement, Drains and Fillers" chart follows Section 5.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GENERAL DATA

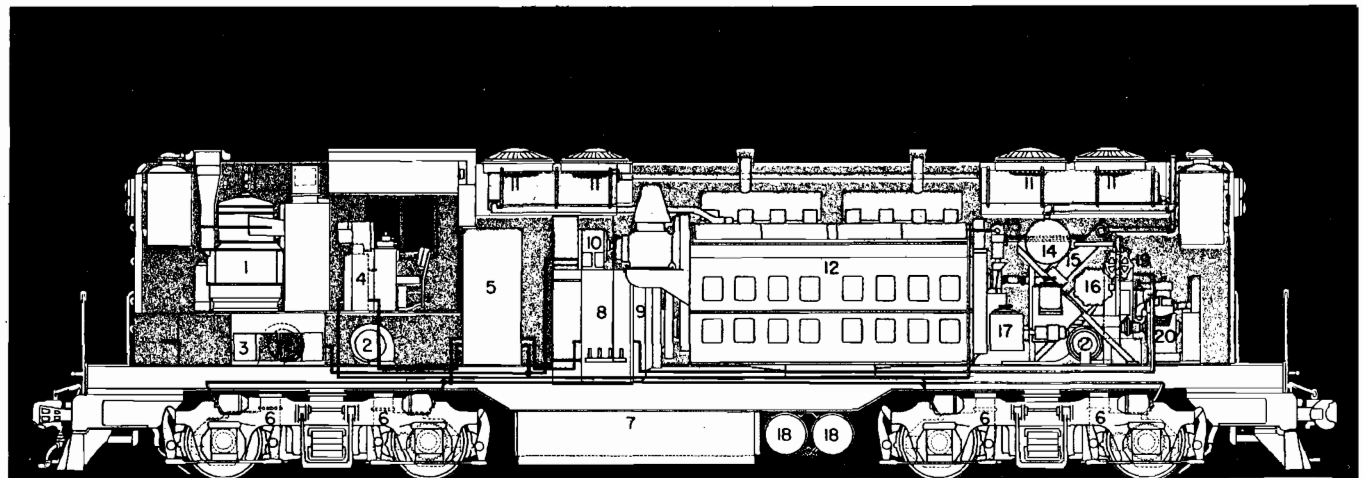
	U.S. Gals.	Imp. Gals.
Fuel Oil Capacity	800	666
Lube Oil Capacity	200	167
Cooling Water Capacity ("G" Valve Level)	230	192
Steam Generator Water Capacity	800	666

Gear Ratios and Maximum Speeds:

65/12	55 MPH
62/15	65 MPH
61/16	71 MPH
60/17	77 MPH
59/18	83 MPH
58/19	89 MPH

Weight - Fully Loaded (Approx.)	240,000 lbs.
Couplers	Type "E"
Sand Capacity	18 cu. ft.
Number Of Drivers	4 pair
Wheel Diameter	40"
Weight On Drivers	100%
Truck Centers	31' 0"
Truck Rigid Wheelbase	9' 0"
Minimum Curve Radius Coupled To Car	150' (39°)
Coupled To Another Locomotive Of Same Type With Type "E" Coupling	274' (21°)
Length Between Coupler Pulling Faces	55' 9"
Maximum Height Above Rail	14' 6"
Width Over Handrails	10' 3"

TABLE OF CONTENTS



1 STEAM GENERATOR
2 TRACTION MOTOR BLOWERS
3 BATTERIES
4 ENGINEER'S CONTROLS
5 ELECTRICAL CABINET
6 TRACTION MOTORS
7 FUEL AND WATER TANKS
8 D.C. GENERATOR
9 A.C. GENERATOR
10 AUX. GENERATOR
11 COOLING FANS
12 DIESEL ENGINE
13 PG GOVERNOR
14 ENGINE WATER TANK
15 LUBE OIL COOLER
16 LUBE OIL FILTER
17 LUBE OIL STRAINERS
18 MAIN AIR RESERVOIR
19 LOAD REGULATOR
20 AIR COMPRESSOR

PRIME MOVER TRANSMISSION AND CONTROL A.C. CURRENT CABLE

SECTION 1

GENERAL DESCRIPTION

A description and general location of equipment on the basic GP7 locomotive is given in this section.

A locomotive consists of one unit rated at 1500 horsepower, however in some cases two or more units may be coupled together for multiple unit operation.

The locomotive may be equipped with either of two types of brake equipment. In order to differentiate between the two types of air brake equipment, the model designations "GP7L" or "GP7R" are used. The GP7L is equipped with 6 BL (USA) or 6 SL (Canadian) brake equipment while the GP7R is equipped with 24 RL brake equipment.

100 **Diesel Engines** Each locomotive has a 16 cylinder, 2 cycle, Model 567B Diesel engine which drives the main generator and auxiliaries described later.

101 **Main Generator And Alternator** The main generator and alternator assembly are directly connected to the Diesel engine crankshaft through a flexible coupling. Two electrically separate sections are mounted on the same shaft and designated as Model D12-D14. The D12 portion produces direct current at a nominal voltage of 600 volts for operation of the traction motors. The D14 section, built into the engine end of the main generator frame is a three phase, 80 KW alternating current generator which furnishes power to drive the engine water cooling fans and the traction motor blowers.

102 **Traction Motors** Four Model D27 traction motors are used in each unit, mounted one on each axle. Each motor is geared to the axle, which it drives, by a motor pinion gear meshing with an axle gear. The gear ratio between these gears is expressed as a double number such as 62/15. In this case the axle gear has 62 teeth while the pinion has 15 teeth.

During acceleration, two steps of traction motor electrical connections (called transition) are used:

1. Series-Parallel 2. Parallel

Transition is the term applied to the changing of traction motor connections on a Diesel-electric locomotive so that full power may be obtained from the main generator, within the range of its current and voltage limits. There is no provision for effecting manual transition on a GP7 locomotive as this takes place automatically (forward and backward).

103 **Auxiliary Equipment** Auxiliary equipment in the GP7 locomotive is driven entirely by direct drive from the Diesel engine or by separate electric motors. No belts are used in the locomotive.

Locomotives with steam generators are equipped with an 18 KW auxiliary generator. Locomotives without a steam generator have a 10 KW auxiliary generator. The auxiliary generator is driven directly by the Diesel engine. It produces direct current at approximately 74 volts to charge the storage batteries and supply the low voltage circuits for lighting, control, generator field excitation, fuel pump operation, etc.

A 5 HP electric driven blower is provided for each traction motor. These blowers supply cooling air for the traction motors. Four 9 HP electric driven cooling fans, thermostatically controlled, supply the air for the engine cooling water radiators.

The locomotive is basically equipped with a Gardner-Denver 3-cylinder, two stage Model WXE air compressor driven through a flexible coupling and an extension shaft from the front end of the engine. The WXE air compressor is rated at 178 CFM at 800 RPM. Air compressor Models WXO or WXG are supplied on special order. The WXO is rated at 225 CFM while the WXG is rated at 356 CFM (at 800 RPM). The WXG is a 6-cylinder air compressor.

ENGINEMAN'S CONTROLS

Two levers and the two brake valve handles control the entire operation of the locomotive. These are the throttle and reverse levers which are mounted in the control stand, and the independent and the automatic brake valve handles.

104 **Throttle Lever** This lever controls the speed of the engine and the train speed in normal operation. The position of the throttle is shown in the illuminated indicator above the lever. The throttle has ten positions, stop, idle, and running speeds 1 to 8. Stop can be obtained by depressing the emergency stop button on the end of the throttle lever and pushing the throttle lever one step beyond the idle position, stopping the engine. Idle position is as far forward as the throttle lever can be moved without depressing the emergency stop button. Each running notch on the throttle (above Run 1) increases the engine speed 75 RPM from 275 RPM at idle to 800 RPM at full throttle. Mechanical interlocks (if used) prevent the throttle from being opened more than one notch at a time to prevent rough train handling.

105 **Reverse Lever** The reverse lever must be moved ONLY when the locomotive is standing still.

Direction of the locomotive is controlled by movement of this lever to the forward or reverse position. In neutral the power contactors will not close when the throttle is opened.

The series contactors (S13, S24) close when the reverse lever is moved to the forward or reverse position even though the throttle may be in "Idle."

The reverse lever can be removed from the control stand only when the lever is placed in the neutral position, provided the throttle is in "Idle" and the transition lever (if used) is in "Off." This locks the operating controls in the control stand.

106 **Transition Lever** The basic GP7L locomotive is not equipped with a transition lever. There are, however, certain types of the GP7 that are equipped with transition levers, even though transition (forward and backward) is fully automatic on the GP7 locomotive. The inclusion of such a lever is principally for use with dynamic brakes, or for the purpose of providing a means for effecting manual transition in other type units (not equipped with automatic transition) when such a unit is being used in multiple unit operation with a GP7. Thus, the transition lever has 5 positions: OFF, 1, 2, 3 and 4; if the locomotive is equipped with dynamic brakes, an additional position "B" (braking range) is also included.

Earlier production GP7 locomotives that were equipped with transition levers had this lever arranged to control the Road-Service feature. On those locomotives, the placing of the transition lever in the OFF position caused the locomotive to start with the "teaser" type of starting; placing the transition lever in the #1 position caused modified maximum field starting to be obtained. Present production locomotives, however, have a toggle switch (located on the side of the con-

troller) to control the Road-Service feature, see Art. 108. Thus, the controller on the GP7 has mechanical interlocking of the levers identical to that found on "F" type locomotives, see Art. 109.

107 **Transition Forestalling Switch** This switch is located on the engineman's control panel and is used to forestall an undesired forward transition.

When the switch is in the "UP-AUTO" position, forward transition will take place automatically at the proper time.

When forward transition is not desired, the switch is placed in the "DOWN-SERIES" position. Traction motor connections will then stay in series-parallel, regardless of locomotive speed, generator voltage or position of load regulator arm, Fig. 1-6.

The transition forestalling switch should not be moved from the "SERIES" to the "AUTO" position unless the throttle is in the 6th position, or lower. However, if the speed of the locomotive is below the forward transition speed, it is permissible to move the switch to the "AUTO" position with full throttle operation. This will prevent any possibility of forward transition taking place at an excessively high voltage.

Movement of the switch from the "AUTO" to the "SERIES" position may be done at any time, as this will not cause backward transition to take place. Backward transition is determined only by the operation of the backward transition relay, or by reducing the throttle to the "Idle" position.

The operation of the transition forestalling switch is not trainlined. In multiple unit operation, the forestalling switch in each unit must be placed in the position in which it is desired to operate the locomotive.

108 **Road Service Switch** The road service switch is a toggle switch located on the right side of the controller, Fig. 1-1. This switch has two positions SWITCHING (up) and ROAD (down). The switch is not mechanically interlocked with the control levers and allows the engineman to select either a fast or slow start, depending on the type of service being performed.

In the ROAD position, normal modified maximum field starting is provided which assures a slow smooth start. With the switch in the SWITCHING position a faster start is provided by use of the "teaser" circuit, which allows the engineman to more fully control the loading of the main generator by the throttle position.

In multiple unit operation the road service switches in all units should be placed in the same position to assure that all units start uniformally.

109 **Mechanical Interlocks On The Controller** The levers on the control stand are interlocked so that:

1. The reverse lever can be operated only with the transition lever in either No. 1 or OFF position and the throttle at IDLE.
2. The reverse lever can be removed from the control stand only with the transition lever in OFF and the throttle at IDLE; this locks against movement of the levers.
3. The throttle can be moved to STOP with any position of transition or reverse levers. With the throttle in STOP the reverse lever cannot be moved.
4. The transition lever cannot be moved from position 2 to 3 or 3 to 2 unless the throttle is in Run 6 or lower.
5. The throttle cannot be opened if the transition lever is in OFF.

ENGINEMAN'S INSTRUMENT PANEL

The instrument panel contains gauges and light indicators to guide the engineman in the proper operation of the locomotive, Fig. 5-1.

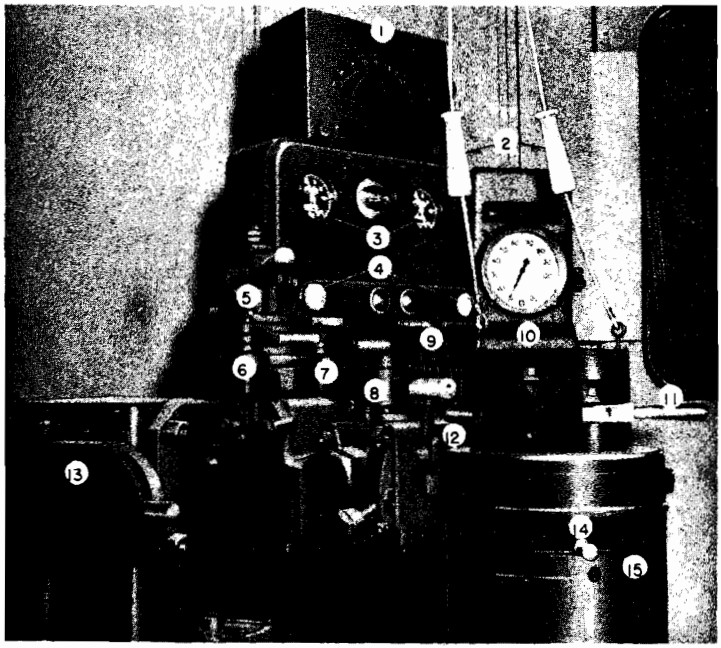
110 **Air Gauges** These are standard gauges. Each gauge is clearly labeled as to its function.

111 **Load Indicating Meter** This meter is basic on all production GP7 locomotives and is mounted above the engineman's control panel. The meter is connected into the leads of the No. 2 motor, but as the amperage is the same in all motors, each motor is getting the amount of current as shown on the meter. Fig. 1-1 and 3-1.

Total main generator output (amperes) is TWICE the amount shown on the meter when in SERIES-PARALLEL and FOUR TIMES the amount shown on the meter when in full PARALLEL.

An instruction plate mounted below the meter shows the permissible short time ratings; these ratings are accumulative. Also shown on the instruction plate is the maximum permissible amperage to use in dynamic braking, should the locomotive be so equipped.

112 **Wheel Slip And Dynamic Brake Warning Light** If the locomotive is equipped with dynamic braking this light will serve as both the wheel slip light and the dynamic brake warning light. This is possible since an interlock on the cam switch prevents the wheel slip relay from lighting this light when the dynamic brake is in use. Without dynamic brakes this light, of course, will only indicate wheel slip action.



1. Load Indicator
2. Horn Pull Cords
3. Air Gauges
4. Alarm Lights
5. Automatic Brake Valve
6. Sander Valve
7. Bell Ringer Valve
8. Independent Brake Valve
9. Control Switches (Circuit Breakers)
10. Speed Recorder
11. Throttle Lever
12. Transition Lever (If Used)
13. Headlight Control — Dim And Bright
14. Reverse Lever
15. Road Service Switch Location

Engineman's Controls
Fig. 1-1

The lighting of this light during power application indicates that the wheels are slipping. The wheel slip light may flash when transition is made from series-parallel to parallel, Fig. 5-1.

When using the dynamic brake, the lighting of this light will indicate that one, or more, of the units in the consist is overloaded and the brake should be reduced.

SWITCHES

The engineman's control switches are mounted on a panel between the throttle stand and the automatic brake valve. Fig. 5-1 and Fig. 1-1.

These switches are in reality circuit breakers and are plainly marked for their respective uses. There are no fuses connected to these switches. The switch lever moves to the "OFF" position when the circuit is overloaded, giving a visual indication as to which circuit is open.

The "Control," "Lights" and "Main Battery" knife switches in the Electrical Control Cabinet (rear wall of operating cab) should all be closed for normal operation, Fig. 5-2.

113 **PC Switch (If Used)** The pneumatic control switch (PC) is an air operated electric switch. This switch is tripped by any "penalty" 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. If the throttle is in the 5th or 6th notch when the "PC" switch is tripped, the engine will stop. Some locomotives are equipped with an indicating light which 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. See Art. 310.

AIR BRAKE EQUIPMENT

114 **General** The GP7L locomotive is equipped with the 6 BL (USA) or 6 SL (Canadian) air brake equipment. The GP7R locomotive is equipped with the 24 RL air brake equipment.

The equipment and operation of the 6 BL or 6 SL brake is practically the same as that of the 6 ET brake, with the exception of a self lapping independent brake valve, and a few other modifications.

As all enginemen are more or less familiar with the operation of the 6 ET brake, no detailed operation of the 6 BL or 6 SL will be included. See Art. 209.

With the number of combinations and modifications possible, no attempt will be made to enumerate them here, as it would be far beyond the scope of this manual to do so. Special instructions for special applications may be had from locomotive manufacturer upon request by the customer.

The 24 RL brake is generally applied to road locomotives and its application to locomotives designed for branch line service is comparatively new. Operating instructions are covered briefly in this manual. More definite instructions may be obtained by contacting the proper railroad officials.

The air brake gauges are located on the instrument panel to the left of the engineman. In general, the cab air brake equipment (24 RL) consists of the automatic

brake valve, the independent brake valve and the K-2-A Rotair Valve, a manually operated valve having four positions. The automatic brake valve handle has 6 positions — release, running, first service, lap, service and emergency; and may be of the rigid or hinged handle type. The automatic brake valve handle (rigid or hinged handle) is removable in the running position. The handle should be removed when the locomotive is being operated from the opposite end. The hinged handle, if required by the railroad, is used to suppress a safety control from the foot pedal (if used) by depressing the handle to a horizontal position. On some railroads a sanding bail provides sanding by further depressing the handle.

The brake valve, Fig. 1-2, also contains:

1. Brake valve cutout cock, located on the filling piece portion.
2. Safety control cutout cock, located on the service application portion.
3. First service position cock.
4. Full release selector cock.

115 **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 and maintains brake cylinder pressure, when the application pressure reaches the value corresponding to the position of the brake valve handle in the application zone. Locomotive brakes may be released after automatic application by depressing the independent brake valve handle in release position.

116 **K-2-A Rotair Valve** The four positions of the K-2-A Rotair valve are "FRGHT," "FRGHT LAP"

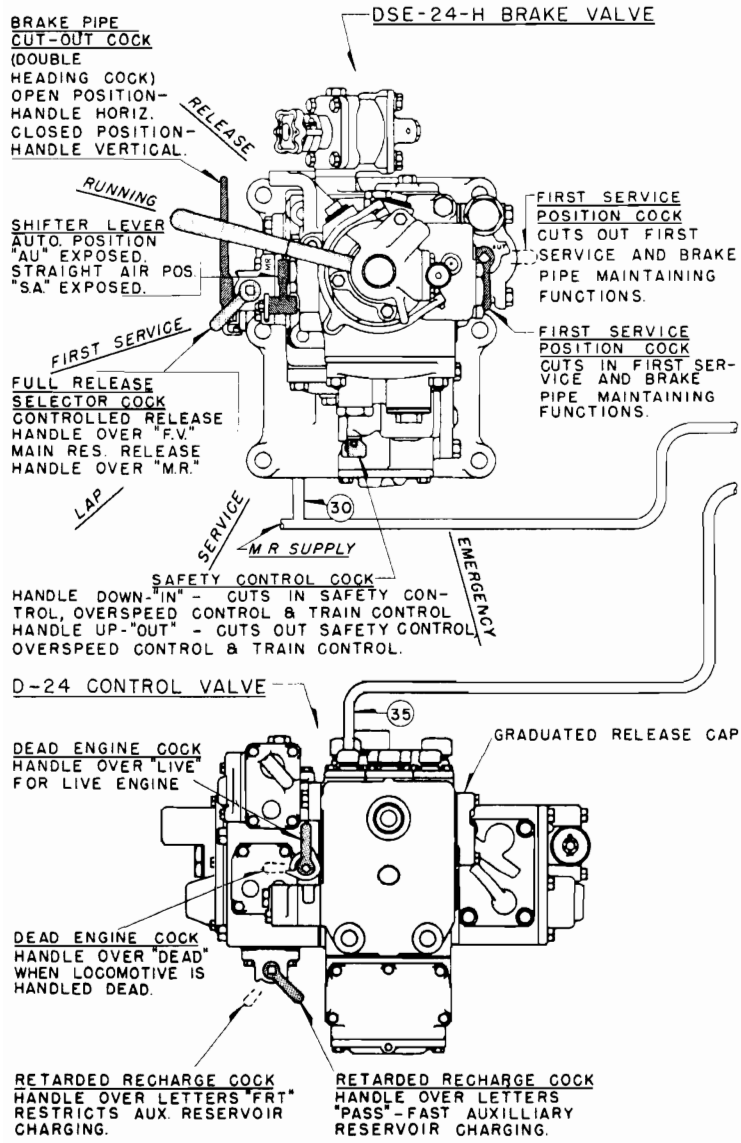
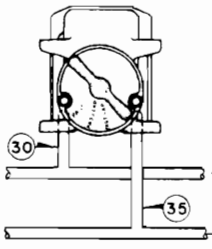

DSE-24-H BRAKE VALVE
BRAKE PIPE CUT-OUT COCK (DOUBLE HEADING COCK) OPEN POSITION- HANDLE HORIZ. CLOSED POSITION- HANDLE VERTICAL.
RELEASE
RUNNING
SHIFTER LEVER AUTO. POSITION "AU" EXPOSED. STRAIGHT AIR POS. "S.A." EXPOSED.
FIRST SERVICE POSITION COCK CUTS OUT FIRST SERVICE AND BRAKE PIPE MAINTAINING FUNCTIONS.
FIRST SERVICE POSITION COCK CUTS IN FIRST SERVICE AND BRAKE PIPE MAINTAINING FUNCTIONS.
FIRST SERVICE
FULL RELEASE SELECTOR COCK CONTROLLED RELEASE HANDLE OVER "F.V." MAIN RES. RELEASE HANDLE OVER "M.R."
LAP
SERVICE
30
M R SUPPLY
EMERGENCY
SAFETY CONTROL COCK
HANDLE DOWN-"IN" - CUTS IN SAFETY CONTROL, OVERSPEED CONTROL & TRAIN CONTROL
HANDLE UP-"OUT" - CUTS OUT SAFETY CONTROL, OVERSPEED CONTROL & TRAIN CONTROL.
D-24 CONTROL VALVE
35
GRADUATED RELEASE CAP
DEAD ENGINE COCK HANDLE OVER "LIVE" FOR LIVE ENGINE
DEAD ENGINE COCK HANDLE OVER "DEAD" WHEN LOCOMOTIVE IS HANDLED DEAD.
RETARDED RECHARGE COCK HANDLE OVER LETTERS "FRT" RESTRICTS AUX. RESERVOIR CHARGING.
RETARDED RECHARGE COCK HANDLE OVER LETTERS "PASS"-FAST AUXILLIARY RESERVOIR CHARGING.

Fig. 1-2

K-2-A ROTAIR VALVE



HANDLE OVER LETTERS "FRGT"
CUTS IN CONTROLLED EMERGENCY FEATURE, SPLIT SERVICE REDUCTION, & INDEPENDENT BRAKE VALVE.

HANDLE OVER LETTERS "FRGT LAP" *
CUTS OUT INDEPENDENT BRAKE VALVE. CONTROLLED EMERGENCY STILL IN EFFECT.

HANDLE OVER LETTERS "PASS LAP" *
CUTS OUT CONTROLLED EMERGENCY & THE INDEPENDENT BRAKE VALVE.

HANDLE OVER LETTERS "PASS"
ALL FEATURES REMAIN CUTOUT AS IN "PASS LAP," EXCEPT INDEPENDENT BRAKE VALVE IS CUT IN

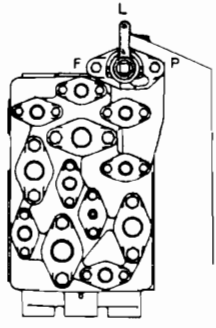
* POSITION USED FOR TRAILING "A" UNITS.

TO INDEPENDENT BRAKE VALVE

"B" UNIT CONTROL VALVE SECTION

NOTE: WHEN DOUBLE HEADING, THE ROTAIR VALVE ON THE SECOND OPERATING UNIT SHOULD BE LEFT IN A LIVE POSITION, "FRGT" OR "PASS", TO RETAIN USE OF INDEPENDENT BRAKE VALVE.

WHEN OPERATING A "B" UNIT ALONE WITH THE HOSTLER'S CONTROL, THE CONTROLLED EMERGENCY SELECTOR COCK MUST BE PLACED IN "PASS" POSITION TO EFFECT QUICK ACTING EMERGENCY IF NEEDED.



HANDLE OVER "F"
CUTS IN CONTROLLED-EMERGENCY BRAKE CYLINDER PRESSURE DEVELOPMENT FEATURE.

HANDLE OVER "L"
POSITION NOT USED WITH OUR EQUIPMENT. HANDLE MUST BE IN PASSENGER OR FREIGHT POSITION.

HANDLE OVER "P"
CUTS OUT CONTROLLED-EMERGENCY BRAKE CYLINDER PRESSURE DEVELOPMENT FEATURE

VIEW OF PIPE BRACKET FOR CONTROL VALVES
SHOWING CONTROLLED-EMERGENCY CUT-OUT COCK IN "B" UNITS.

24 RL Brake Cock Handle Positions
All Types Of Service
Fig. 1-2

"PASS LAP" and "PASS." See Art. 203, Item C, for handling of this valve.

117 **Safety Control Foot Pedal** The safety control foot pedal (if used) is located in front of the engineman's seat. On locomotives equipped with the DS-24-H brake valve, having the hinged automatic brake valve handle, the handle provides an alternate control when it is depressed sufficiently to just contact the sanding bail. Either the pedal or the automatic brake valve handle must be kept depressed at all times except when the locomotive is stopped and the locomotive brakes are applied (30 pounds or more brake cylinder pressure). If both the foot pedal and the automatic brake valve are released, a penalty application of the brakes will result.

MISCELLANEOUS EQUIPMENT

118 **Sanding Valve** When the locomotive is equipped with 24 RL brake with the hinged automatic brake valve handle, sanding is accomplished by depressing the lever beyond the safety control position previously described. This movement operates the sanding bail which opens a port to supply air to the sanding equipment. On locomotives having a rigid handle on the 24 RL automatic brake valve, an independent sanding valve is installed. This valve is operated by moving the lever forward or backward until it latches.

119 **Speed Recorder** The speed recorder, located in front of the control stand, is a hydraulically operated speed indicator with a speed recording tape and an odometer. It is driven from the number 2 axle of the unit, through a flexible cable. Fig. 1-1.

120 **Windshield Wipers** The windshield wipers, four in number, are controlled by valves over the cab windows, two on each side of the cab. The wipers operate independently of each other. They should not be run on a dry window as dirt on the glass or blade will scratch the glass.

121 **Horn Valves** The horns are operated by air valves which are controlled by pull-cords, above the control stand. The horn shut-off valve is located in the nose compartment to the right of the access door from operating cab, just above the floor level.

122 **Locomotive Bell** The locomotive signal bell is under the locomotive floor behind the pilot or switchman's footboards on the right side of front end of locomotive. It is operated by an air valve located at the engineman's station.

123 **Cab Heaters** Two cab heaters are located behind the rear wall of operating cab, above the electrical control panels.

The No. 1 cooling fan cutout switch must be in "Off" position and manually operated shutters for No. 1 section of radiators must be closed in order for the cab heaters to function.

Warm air from the cooling radiators is forced through ducts by the heater fans into the operating cab. The fan motors are controlled individually by four position switches mounted on rear wall of operating cab.

124 **Defrosters** There are no individual defrosters used on the GP7 locomotive. When the cab heater

motors are turned on, warm air blows onto the front and rear windows keeping them clear of condensation.

125 **Classification Lights** Four permanently fixed clear bull's-eye lenses are provided, two on the front of the locomotive hood and two on the rear of the locomotive. Inside the hood and behind each bull's-eye, a small compartment contains the classification light bulb and colored lenses. Red and green lenses are provided in each compartment which can be moved into a position between the bulb and the bull's-eye. To accomplish this, a locking pin is removed, the desired lens swung into place and the locking pin replaced. The colored lenses are accessible from the inside of the hood through hinged doors in the compartments. When both red and green lenses are out of position the permanent bull's-eye lens will show a white light, thus making three colors available.

ENGINE ROOM

The two ends of the engine are designated "FRONT" and "REAR" as shown in Fig. 1-3 which will serve to identify the cylinder locations, ends and sides of the engine, as they are referred to in this manual. The governor, water pumps, and lubricating oil pumps are on the "FRONT END." The blowers, oil separator and generator are mounted on the "REAR END."

The engine is placed so that its rear end is toward the front end of the locomotive when the locomotive is operating in its normally forward direction.

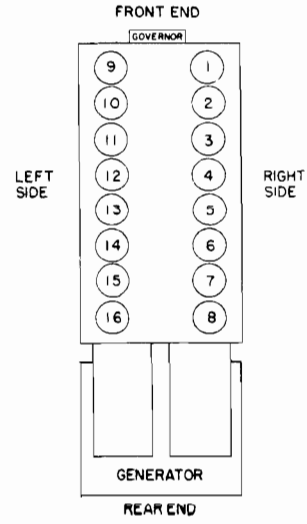


Fig. 1-3

126 **Engine Control** The engine control equipment is conveniently located in the operating cab instead of in the engine room. "START" and "STOP" buttons and the isolation switch are within the engineman's reach, Fig. 5-2. Engine lube oil pressure, control air pressure and water temperature gauges and the signal light panel are on the rear wall of operating cab, above the electrical control cabinet, Fig. 3-3. Fuel and boiler water tank level gauges are mounted on the front wall of operating cab, above the steam generator operating controls, Fig. 3-2.

127 **Isolation Switch** This switch has two positions "START" (handle horizontal) and "RUN" (handle vertical). In "START" position, the power plant is disconnected from the control circuit, and engine is reduced to idle speed. The engine will remain at idle speed and will not respond to throttle control. The power contactors in the electrical control cabinet will not operate. The "Alternator Failure" alarm is inoperative. The "START" and "STOP" buttons are effective only when the isolation switch is in "START" position, Fig. 5-2.

128 **Governor, Governor Speed And Safety Control** The engine is equipped with a Woodward Governor which includes an electro-hydraulic governor speed control, and an unloader (ORS) used during transition. In case of low oil pressure or high vacuum on the suction side of the lube oil pump, the engine governor will stop the engine, and the alarm bells will sound. The yellow "Low Oil" and the blue "Alternator Failure" signal light will show. When the governor safety control stops the engine, the push button on the front of the governor housing moves out approximately 3/8" exposing a red band around the shaft of the button, Fig. 5-4. The governor reset push button must be pressed in to extinquish the "Low Oil" alarm lights and the isolation switch moved

to "START" position to extinquish the "Alternator Failure" alarm lights. Both actions are necessary to stop alarm bells. The push button will not trip if the engine stops due to placing of throttle in emergency stop position, operation of manual layshaft control lever, tripping of ground protective relay when throttle is in Run 5 or 6, or use of the "STOP" button for normal shutdown. In these instances, the "Low Oil" alarm lights will not light but the "Alternator Failure" alarm will function (except when the "STOP" button is used) to serve as a warning that an engine is stopped. When the engine is stopped by governor control action, the push button must be reset before the engine can be started. When the engine is started and run at idling speed, the governor will stop the engine again after approximately forty seconds, if the condition still exists which caused the original shutdown. This time delay is provided to allow a check to determine the cause of the shutdown. However, if an attempt is made to run the engine above idling speed during the delay period, the governor will stop the engine at once should the oil pressure be low or the oil pump suction be high.

129 **Electrical Control Cabinet** The electrical control cabinet contains the various contactors, relays, and other equipment necessary for the electrical and electropneumatic control of the locomotive. Figs. 3-4 and 3-5 show the arrangement of the electrical cabinet with dynamic brake; Figs. 5-2 and 5-3 without dynamic brake.

130 **Control Air Pressure Regulator** The control air for operating power contactors, reverser and cam-switch is supplied from the main reservoir and reduced to 90 $\pm$ 3 pounds by the control air pressure regulator. The pressure regulator is located in the lower right hand corner of the electrical control cabinet on the rear wall of operating cab, Fig. 5-2. The pressure is indicated on a gauge, mounted on the rear wall of the operating cab, over the electrical control cabinet.

131 **Load Regulator** The load regulator is located under the engine hood, adjacent to the air compressor. The operation of the load regulator is controlled by a pilot valve and a dump valve (ORS) in the engine governor. The function of the load regulator is to vary the battery field current in the main generator. Two tumble switches LRS and FTS have been added to the load regulator, which are actuated by the movement of a three fingered plate that is bolted onto the load regulator arm shaft.

When the load regulator arm is in minimum field (4 o'clock) position, one finger of the plate moves LRS switch down. An open interlock on LRS prevents the shunt field contactor from closing. At the same time, a closed interlock on LRS energizes LRC, which partially establishes the circuit for the throttle controlled "Teaser" circuit. With the switch in this position, the amount of battery field current is varied by each throttle position, Fig. 1-4. When load regulator arm reaches mid-position (12 o'clock) a second finger moves LRS to opposite position. This allows the shunt field contactor to close, making main generator excitation normal, and cuts out the throttle controlled "Teaser" circuit. LRS switch will stay in this position until load regulator arm returns to full minimum field position, Fig. 1-5. When load regulator arm reaches maximum field (8 o'clock) position, the third finger closes the other tumble switch FTS, changing the motor connections from series-parallel to parallel, Fig. 1-6. FTS will open as the load regulator arm moves back away from maximum field, but the motor connections will stay in parallel until the backward transition relay is energized by approximately 2500 amperes main generator current. When the throttle is closed to idle, all P contactors open, and the S contactors close. As the throttle is reopened, the motor connections will be series-parallel, remaining so until the load regulator arm reaches maximum field, when the transition cycle is repeated.

132 **Layshaft Manual Control Lever** The layshaft manual control lever is attached to the end of the injector layshaft, at the left front corner of the engine. Because the engine controls are located in the electrical control cabinet in the operating cab of the GP7 locomotive, this lever cannot be readily used for controlling engine speed manually while taking an engine "off the line" or while putting an engine back "on the line" if the locomotive should be used in multiple unit operation.

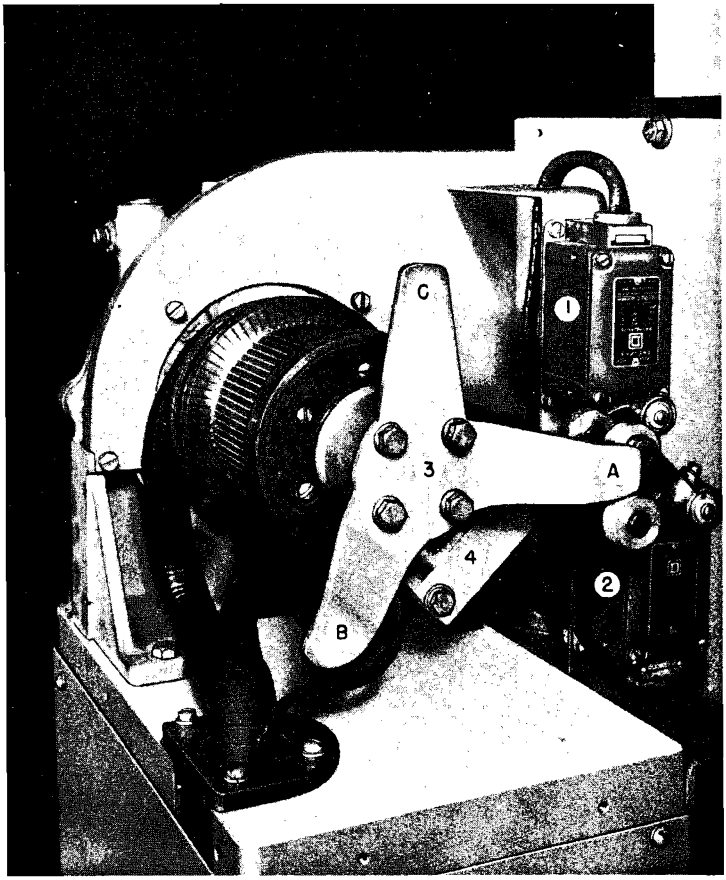
133 **Indicators, Gauges And Protective Devices** The gauges and alarm lights are mounted on the rear wall of the operating cab, above the electrical control cabinet, Fig. 3-3.

134 **Engine Overspeed Trip** If the engine speed exceeds approximately 910 RPM, an engine overspeed device, located on the front of the engine behind the engine governor, See Fig. 5-5, Section 5, will trip and bring the engine to a stop.

135 **Hand Brake** The hand brake is mounted on the outside of the engineroom hood, and on the rear platform of the locomotive.

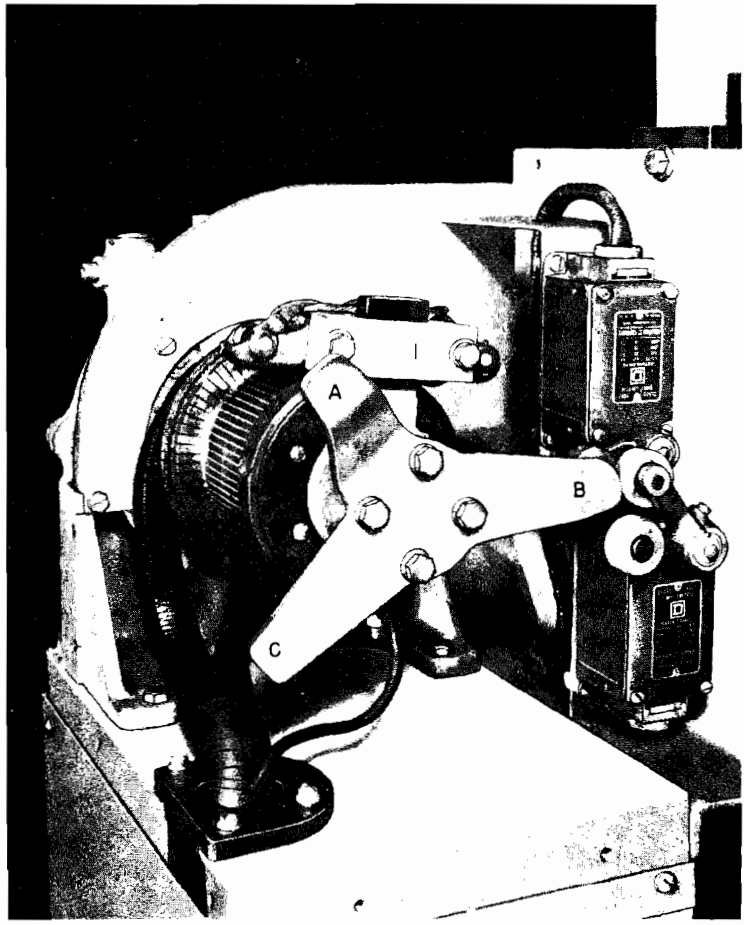
The hand brake is applied by pumping the long handle up and down and released by pulling on the short release lever. It is effective on one pair of wheels only.

Whenever anyone is working around the locomotive trucks, the hand brake should be applied.



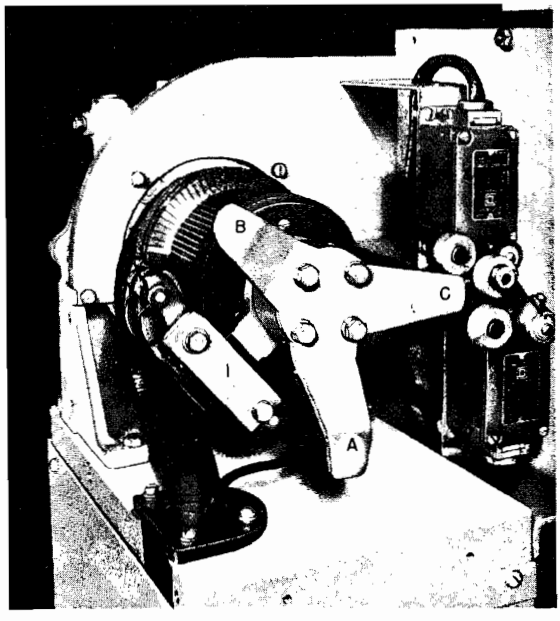
1. Forward Transition Switch (FTS)
2. Load Regulator Shunting Switch (LRS)
3. Actuating Fingers — A,B,C
4. Load regulator arm, minimum field (4 o'clock) position, LRS interlocks CD closed, energizing LRC. This partially completes the throttle controlled "Teaser" circuit in the generator battery field circuit. The open AB interlock prevents the generator shunt field contactor from closing.

Load Regulator Arm — Minimum Position
Fig. 1-4



Load regulator arm "1" in mid (12 o'clock) position. "B" finger has tripped LRS, opening CD interlock which de-energizes LRC, cutting out "Teaser" circuit. AB interlock closes, allowing generator shunt field to close. Battery field excitation of main generator normal.

Load Regulator Arm — Mid-Position
Fig. 1-5



Load regulator arm "1" in maximum field (8 o'clock) position. "C" finger has tripped FTS, closing FTS interlock CD which energizes parallel relay PR, causing forward transition to take place from series-parallel to full parallel.

As the load regulator arm moves away from maximum field, "C" finger also moves away from FTS, allowing FTS to assume its normal position. PR relay stays energized through its holding circuit, and the traction motors stay in parallel.

The motors remain in parallel until generator amperage has increased to the pickup value of the backward transition relay BTR. This action de-energizes PR, opening power contactors P1-P2-P3 and P4. The series contactors S13-S24 close, changing the motor connections back to series-parallel normal battery field, closing the throttle to idle will also change the motor connections back to series-parallel, normal battery field.

The "Teaser" circuit remains cut out until the load regulator arm gets back to minimum field (4 o'clock) position, when "A" finger trips LRS back to effect this change.

Load Regulator Arm — Maximum Field Position
Fig. 1-6

NOTES

SECTION 2

NORMAL OPERATION

Successful road operation and dependable function of all GP7 locomotives are entirely dependent upon the quality of inspection and repair at regular maintenance periods, as well as the proficiency of the operating crew. As a supplement to terminal maintenance, a "pre-service check" should be made by the engine crew upon boarding the locomotive; to insure adequate supplies to make the trip.

It is strongly recommended that the items listed in Art. 203 be checked thoroughly and without omission, for carelessness is most often the cause of road failures which cause unnecessary delays.

200 **Starting Engine**

1. Close all switches in distribution panel and place the isolation switch in START position.
2. At engineman's station close "control" and "fuel pump" switches.
3. Place independent brake in full "application" position.
4. Check "PC" switch open light.
5. Remove reverse lever from controller.
6. Check engine lube oil and water levels and oil level in governor and air compressor.
7. Test signal alarm system by placing isolation switch in "Run" position momentarily. Blue light should light and bells should ring.
8. If engine has been shut down more than two hours, open cylinder test valves, pull layshaft closed and press "START" button on engine control panel. Crank engine over a few revolutions. If liquid was discharged from cylinders, investigate; if not, close test valves and proceed.

9. Turn on fuel pump switch and check for fuel flow through sight glass on fuel filter nearest engine (mounted on the right front of engine).
10. Check setting of overspeed trip (pull to set).
11. Check governor oil alarm trip button.
12. Press engine start button until engine starts (not more than fifteen seconds).
13. Check oil pressure.
14. Check ground relay.
15. Check starting contactor interlocks.
16. Idle engine until water temperature comes up to 125° on gauge before working engine.
17. Place isolation switch in "Run" position (vertical).
18. For starting troubles, see Section 5.

201 **Stopping Engine Normally** (For stopping while under power, see Art. 308).

1. Place throttle in idle.
2. Place isolation switch in "START" position.
3. Push engine "STOP" button in and hold it until engine stops.
4. Place fuel pump switch in "Off" position.
5. Open cylinder test valves on engine (if more than two hour layover).

202 **Securing Locomotive At Engineman's Control Station In Preparation For Layover**

1. Place reverse lever in "NEUTRAL" position and remove lever from controller.
2. Open all switches on engineman's control station and distribution panel (after engine has been stopped).
3. Release air brakes and set hand brake. As an added precaution against locomotive moving, block the wheels.

203 When Boarding The Locomotive

A. Inspect exterior of locomotive and running gear for:

1. Liquids leaking from the locomotive
2. Loose or dragging parts.
3. Proper positioning of angle cocks and shut-off valves.
4. Observe brake cylinder piston travel, if air brakes are set.

B. In the engine room with engine running (if engine is not running, see Art. 200 for starting instructions), the following check is to be made:

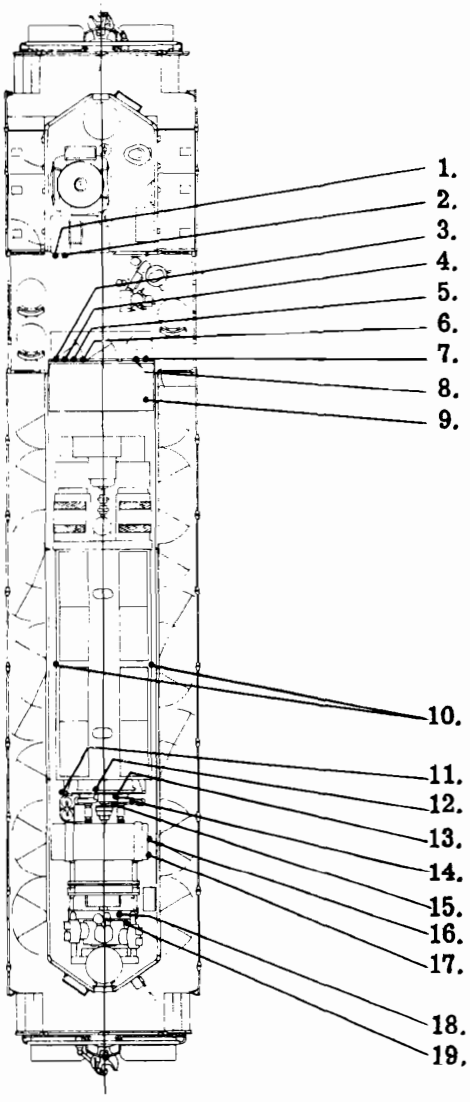
1. Check for oil, water and fuel leaks.
2. Check gauges, indicators and switches as listed in Fig. 2-1.
3. Drain condensation from air brake system.
4. Check and release hand brake.

NOTE: It is good practice to check battery ammeter, rear wall of operating cab to see that the auxiliary generator is charging.

C. In The Cab

1. Check brake valve cutout cock (double heading cock) and Rotair valve position ("FRGHT" or "PASS" as desired — "PASS" recommended for running light, or for light freight trains, 25 cars or less).
2. Install reverse lever and move to desired direction, either "FORWARD" or "REVERSE."
3. Turn "Generator Field" switch "On."

NOTE: Item 1 refers to locomotives equipped with 24 RL brakes.



Location Of Gauges, Relays And Equipment
Fig. 2-1

ENGINE ROOM CHECK CHART

Item	Reading		Ref. Art No.	Unit Failure Check
	Idle	800 RPM		
1. Stm. Gen. Water Supply	Sufficient supply			
2. Fuel Oil Supply	Sufficient supply			X
3. Water Temperature	125° Min.	165° ± 15°	200	R
4. Control Air Pressure	90 ± 8 lbs.		314	X
5. Lube Oil Pressure	6 lbs. min.	35 to 45 lbs.	128	YB
6. Ground Relay	Pointer to yellow dot		316	X
7. Isolation Switch	Run position		320	X
8. Auxiliary Gen. Am.	0 or +	0 or +		
9. Starting Contactors	Not stuck in start position		313	X

FAILURE CHECK. Should a unit fail to perform properly check items lettered as "X". The letters R, B, YB, indicate items that will cause Red, Blue, or Yellow and blue lights to come on. See Art. 306 for details.

10. Lube Oil Level	Run level		401	
11. Fuel Flow	Thru: glass nearer eng.		322	X
12. Overspeed Trip	Latched (Pull to set)		323	B
13. Eng. Speed & Fuel Ind.	Pointers as in Fig. 5-4		319	X
14. Water Pressure	0 to 5 lbs.	25 to 35 lbs		R
15. Governor Oil Level	Between lines			
16. Cooling Water Level	Between lines		400	R
17. "G" Valve	Run closed			
18. Air Comp. Intercooler	Approx. 80 lbs. when pumping			
19. Air Comp. Oil Pres.	10# Min.			

Fig. 2-1

204 Handling Light Locomotives

A. Running light (complete cab preparation, Art. 203, item C).

1. Place foot on safety control foot pedal (if used).
2. Release independent brake.
3. Open throttle one notch at a time. To open throttle, jerk it gently one notch and release. This will permit the lever to set itself for the next notch.
4. NOTE THAT LOCOMOTIVE ROLLS FREELY AND CARE SHOULD BE USED IN JUDGING THE SPEED.
5. Close throttle to idle before setting brake.
6. Locomotive must be standing still at the time the reverse lever is moved.

B. Coupling to train:

After coupling to a train, stretch coupling to insure knuckles are properly locked. If main reservoir pressure falls below feed valve setting when brakes are cut in, proceed as follows:

1. Put generator field switch in "Off" position.
2. Place reverse lever in neutral.
3. Advance throttle to 4th, 5th or 6th notch, or as far as needed to pump up the brakes.

After air test has been made, and trainline has been fully recharged, it is not necessary to keep pumping to maximum main reservoir pressure. This additional pressure will be pumped up while starting train.

HANDLING A TRAIN

205 Starting

FREIGHT AND SWITCHING

There is a minimum time lag between movement of the throttle and actual movement of the GP7 locomo-

tive when the Road Service switch is in the switching position (due to the throttle controlled "teaser" circuit). With the Road Service switch in the Road position a slower start is obtained with the modified maximum field type of starting.

As practical experience is the best teacher, it would be almost impossible to write definite instructions for train starting that would apply to all conditions and at all times. The following is suggested as a guide, but it is realized that operating conditions vary widely. Hasty throttle handling may cause damage and delays.

1. Starting with slack stretched.
   a. Release brakes.
   b. Open throttle one notch at a time, pausing in each position for about 2 seconds, until train starts. It should be unnecessary to go beyond Run 5 to start a train, unless on a grade or with a very heavy train.
   c. Ordinarily it will not be necessary to bunch slack. If slack is bunched, great care must be taken to prevent damaged couplers.
2. Starting with slack bunched:
   a. Release brakes.
   b. Open throttle to Run 2. If locomotive stretches slack too fast, drop back to Run 1. If locomotive does not stretch train, open throttle to Run 3.
   c. Locomotive should stretch, and possibly start, the train in Run 3. If not, open throttle to Run 4.
   d. After the slack is stretched and train moving, open the throttle as required to accelerate train. If wheels slip, reduce the throttle to stop the slipping.

PASSENGER

Same as No. 1 above, starting with slack stretched. Since passenger trains start easier than long freight

trains, reducing throttle one or two notches will generally not be necessary.

In starting passenger trains it is necessary to consider the weight of the train, the amount of slack, the condition of the rails, and the demands of the schedule.

A high reading on the load indicating meter is permissible when starting a train. However, the indicating pointer must continue moving to the left as train accelerates, and must be at 825 amperes or less before the short time amperage ratings are exceeded.

206 **Accelerating A Train** With the throttle in Run 8, the indicating meter pointer should move slowly toward the left. If the pointer stays in the overload area, operation can be continued until the short time overload ratings are consumed.

BRAKING

207 **Air Braking With Power** When braking with power it must be remembered that for any given throttle position the draw-bar-pull rapidly increases as the train speed decreases. This pull might become great enough to part the train unless the throttle is reduced as the train speed drops. Since the pull of the locomotive is shown by the amperage on the load meter, the engineman can maintain a constant pull on the train during a slow down, by keeping a steady indication on the load meter. This is done by reducing the throttle a notch whenever the amperage starts to increase. It is recommended that the independent brakes be kept fully released during power braking. The throttle MUST always be in the Idle position before the locomotive is brought to a dead stop.

MISCELLANEOUS OPERATING INSTRUCTIONS

208 **Operation Over Railroad Crossing** When crossing railroad crossings, reduce throttle to the 5th notch before reaching crossing and leave reduced until all units are over crossing in order to reduce arcing from the brushes to the motor commutator.

209 **Changing Operating Ends** When the consist of the locomotive includes two units with operating controls, the following procedures should be followed in changing from one operating end to the opposite end.

1. Locomotive equipped with 24 RL Brake.
   a. REMOVE REVERSE LEVER.
   b. With safety control foot pedal depressed (if used) release independent air brake by placing independent brake valve handle in "RELEASE" position.
   c. Make full service automatic brake reduction.
   d. Close brake pipe cutout cock (double heading cock) and release safety control foot 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 at engineman's control station ("Off" position).
   i. Proceed to cab at opposite end. Check "PC" switch (if used). Close control and fuel pump switches ("On" position) and other switches as are necessary.
   j. Insert reverse lever, automatic brake valve and independent brake valve handles. Place

independent brake valve in "full application" position.

k. Move the Rotair valve to the proper operating position.

l. Open brake pipe cutout cock (double heading cock) slowly, pausing from five to ten seconds in mid-position.

m. When ready to move locomotive, depress safety control foot pedal or automatic brake valve handle and move the independent brake valve to "RELEASE" position.

2. Locomotive equipped with 6 BL or 6 SL brake.

a. REMOVE REVERSE LEVER.

b. Make a full service brake pipe reduction.

c. Move double heading cock to "Trailing" (4 o'clock) position and release safety control foot pedal (if used).

d. Move the independent brake valve handle to "RELEASE" position.

e. Leave the automatic brake valve handle in the "LAP" position.

f. Set the transfer valve operating cock to open or "Trailing" position. (If not included as part of the double heading cock).

g. Open all switches at engineman's control station ("Off" position).

h. Proceed to cab at opposite end. Check "PC" switch (if used). Close control and fuel pump switches ("On" position) and any other switches that are necessary.

i. Insert reverse lever and brake valve handles. Place independent brake valve in full "application" position.

j. Open double heading cock to "Lead" (6 o'clock) position slowly.

k. Place automatic brake in "running" position.

l. When ready to move locomotive, depress safety control foot pedal, and move independent brake valve to "RELEASE" position.

NOTE: When hauling locomotive "dead" place the independent and automatic brake valve handles in the RELEASE and RUNNING positions, respectively, move the double heading cock to the 3 o'clock position and open the dead engine cock.

Locomotives equipped with safety control, foot pedal or automatic train control, use the N-1-A brake application valve. The brake valve cutout cock (double heading cock) is mounted on this N-1-A brake application valve instead of on the automatic brake valve. The N-1-A brake application valve is located under the operating cab and can be reached through a small trap door in the operating cab floor.

210 **Leaving Locomotive** Officials of the Mechanical Department of the various railroads generally issue instructions of this nature that will apply to their own individual requirements, as conditions will vary with each different railroad, and in a good many instances between different localities on the same railroad.

211 **Air Box Drains** Each engine has two air box drain tanks incorporated in the engine oil pan near the generator end, one on each side. These tanks have a valve in the drain line so that the tanks may be drained when the locomotive is standing still, and sludge and oil from the tank will not be carried onto the running gear.

212 **Unusual Operating Conditions** Unusual operating conditions such as overloading, running through water, failure of indicating meter, isolating units etc., are covered in Section 3.

NOTES

SECTION 3

SPECIAL CONDITIONS AND PROBLEMS DURING OPERATION

There are several conditions which may be encountered from time to time which require special operating instructions. If the instructions are closely followed no damage to the equipment will result. Careless operation under these specialized conditions can be very costly.

300 **Freezing Weather Precautions** In freezing weather, precautions must be taken to see that the water in the locomotive does not freeze. If locomotive is tied up at an outlying terminal where steam from an outside source is available, this may be used to prevent freezing during the layover. If train line steam is not available, the entire system will have to be drained. Steam admission valves are provided on the following equipment, so that if engine and steam generator are inoperative, steam from an external source may be supplied to prevent freezing.

Steam Generator (These valves should be opened)

1. Heating coil valve.
2. Water suction line valve.
3. Water tank valve.

For detailed instructions, see Steam Generator Section.

Engine Cooling System (These valves should be opened)

1. Steam admission valve to engine cooling water.
2. Toilet water tank valve.
3. "G" valve.

In freezing weather if heating facilities are not available, all water must be drained from locomotive.

1. Engine cooling system. The engine water drain valve will drain the entire engine cooling system, EXCEPT the water pump on the right bank. A pipe plug in the bottom of this water pump scroll MUST be removed to prevent freezing.
2. Steam generator. (See Steam Generator Section).
3. Steam generator water tank.
4. Toilet water tank.
5. "G" valve.
6. Air system.
   a. Air compressor oil separator.
   b. Upper sump reservoir.
   c. No. 2 main reservoir.
   d. Type "H" filter, and/or a centrifugal type filter, depending upon the type of brake equipment used.
   e. Electrical control air regulator.
   f. Electrical control air reservoir.
   g. Strainers at engine control and instrument panel, and electrical control cabinet.
   h. Air compressor intercooler.

301 Towing Locomotive

1. Be sure reverse lever is in neutral position. If locomotive is to be towed in a train any appreciable distance, the reverser switch must be placed in neutral and locked in that position. To lock the reverser switch, remove the locking pin which during normal operation is screwed into the left hand side of the reverser housing. With the reverse lever in neutral, punch the buttons on top of reverser switch lightly, to center. After switch has been centered, shut off control air. (If control air is not available, close control air shutoff valve, place wrench

on square portion of switch shaft, or, if there is no square on the shaft, a hole through the shaft will be found at the bottom end of shaft where it sticks through the bottom of the reverser frame, where a round bar, NOT the locking pin, may be used to center the switch manually). Insert pin into hole in the right side of reverser housing, pushing pin all the way through the reverser switch shaft, and screw pin into threaded hole on left side of reverser housing.

2. Isolation switch must be in "START" position. If it is necessary to keep the engine idling for any reason while towing locomotive, the fuel pump and control switches should be left in the closed position.
3. The air brake equipment should be set according to the air brake manufacturer's bulletins.

302 **Operating With A Helper Locomotive** Basically there is no difference in the instructions for operating the locomotive with a Steam or Diesel helper as compared to operating the locomotive without a helper.

It is always desirable to reach the top of a grade in the least possible time in order to avoid possible damage to the electrical equipment.

Helper locomotives may have tonnage ratings which are based on lower speeds than those for the principal locomotive. Under these conditions it is permissible to operate the principal locomotive within the limits of the short time ratings. Under these same conditions, when the drag speed of the helper locomotive is lower than that of the principal locomotive (that is, with a Steam helper locomotive or a Diesel helper locomotive of a higher gear ratio), it is permissible to reduce the throttle of the principal locomotive, when the 8th throttle operation results in a meter reading that exceeds the maximum short time rating. By this procedure it will

be found that maximum advantage can be taken of the combination of the principal and helper locomotives. The throttle must be successively reduced as the higher short time ratings are consumed but should not be operated below the 5th notch. If the time limit for a higher amperage short time rating is not used, that amount of time may be added once, and only once, to any lower amperage time limit. However, if all short time current limitations have been consumed and top of the grade has not yet been reached, tonnage must be reduced.

In case the principal and helper locomotives are identical model Diesels and are of the SAME GEAR RATIO, the principal locomotive will be obliged to operate within its continuous rating to conform with the helper locomotive operation described in paragraph 302A.

302A **Operating As A Helper Locomotive** The nature of the operation of a helper locomotive is such that its operation is contingent upon the handling and performance of the principal locomotive.

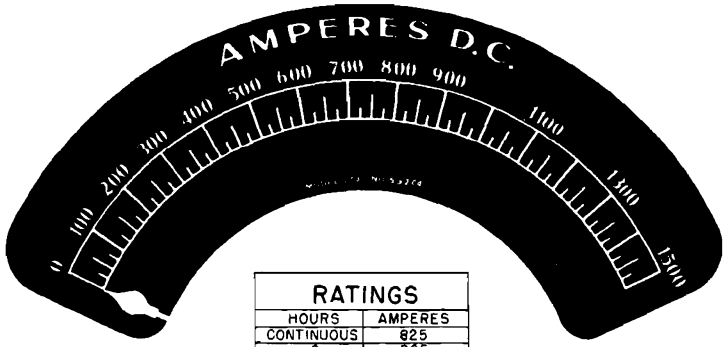
Due to the lack of communication between the helper and principal locomotive, there is always the possibility that the helper locomotive, due to unforeseen circumstances in train handling, will be called upon to assume more than its normal share of the load. In view of this possibility, the helper locomotive should be assigned tonnage consistent with its continuous rating. This will permit the helper locomotive to assume a larger share of the tonnage and still not exceed its short time ratings when the unexpected occasion arises requiring the principal locomotive to reduce throttle.

Instructions included in articles 302 and 302A serve as a general guide to locomotive use. To obtain a maximum tonnage rating for any single application, Electro-Motive will, upon request, analyze the actual operation and make specific tonnage rating recommendations.

303 **Doubleheading** Prior to double heading behind another locomotive, make a full service brake pipe reduction with the automatic brake valve and close the double heading cock. Return the automatic brake valve handle to the running position and place the independent brake valve in release position. The operation of the throttle is normal, but the brakes are controlled from the lead locomotive. The engineman on the second locomotive may make an emergency application of the brakes with automatic brake valve, and/or may release his locomotive brakes by depressing the independent brake valve handle, in the release position.

304 **Operating In Short Time Overload Zone** On GP7 locomotives equipped with 65:12 or 62:15 gearing, the traction motors are almost self-protected, because, in most cases, this gearing allows operation up to the point of locomotive wheel slip before entering the range of short time restrictions.

For locomotives with higher speed gear ratios a plate mounted below the meter dial, Fig. 3-1, shows the permissible time of operation at different stages



RATINGS	
HOURS	AMPERES
CONTINUOUS	825
2	865
1	900
1/2	925
1/4	950
DYNAMIC BRAKES 600 AMPERES MAXIMUM	

Load Indicating Meter
Fig. 3-1

of overload. The short time overload ratings are accumulative, which means that it is permissible to operate the full time of each rating consecutively or in any combination.

When starting a train, the pointer of the load indicating meter may go beyond the continuous rating (825 amperes). This is of no concern provided the pointer soon moves to the left of the continuous rating. However, if the pointer remains in the overload area or enters it on a grade, the rules governing the use of the short time ratings given in the preceding paragraphs will apply.

This data serves as a general guide to locomotive use. To obtain a maximum tonnage rating for any single application, Electro-Motive will, upon request, analyze the actual operation and make specific tonnage rating recommendations.

305 **Slowing Down Because Of A Grade** As the train slows down on a grade the pointer on the indicating meter will move slowly toward the right.

1. If all units in the consist are operating in automatic transition, backward transition will take place automatically.
2. If any unit in the consist is operating in manual transition, the transition lever must be moved according to the transition speeds shown in that unit's operating manual.

PROBLEMS DURING OPERATION

306 **If Alarm Bells Ring** An alarm signal light will be lighted in the alarm light bank.

RED Engine water temperature over 208° at outlet. Check water level, shutters and fans. If condition cannot be corrected at once reduce throttle and investigate for cause. If the fuel pump motor circuit breaker in the

engine control panel is "Open" or "Off," the fuel pump will stop and cooling system fan and shutter control will be inoperative.

YELLOW & BLUE — Low lube oil pressure or high lube oil suction. Engine will be stopped. Isolate engine and reset governor trip button to stop alarm bells. Check oil level and condition. If no difficulty is evident start engine, check oil pressure. Place engine on line. Watch oil pressure gauge. Under extremely high temperatures and otherwise normal engine may have oil pressure fall low enough to trip the alarm.

BLUE — Alternator failure (whenever engine stops while "on the line" this light will light, since stopping engine, of course, stops the alternator). Check overspeed trip and fuel flow, start engine and attempt to put engine "on the line." If light comes on instantly, or if light lights with engine running, check auxiliary generator field and alternator field circuit breakers. If light does not come on, after engine is started, but engine will not respond to throttle, check ground relay. See Art. 316.

GREEN — Steam generator failure. See Section 6.

NOTE: The yellow lube oil alarm light will burn whenever the governor low oil alarm switch is tripped whether isolation switch is in "start" or "run" position. The "low oil" alarm light and "alternator failure" lights are energized through the fuel pump control circuit so that if the "PC" switch is tripped or the fuel pump switch in the cab pulled out or the fuel pump switch in the electrical control cabinet is "Off" these alarms will not operate.

307 **If Locomotive Fails To Produce Power With Engine Running** (If engine is stopped, start engine, see Art. 200).

1. Check "control," "generator field," and "fuel pump" switches or circuit breakers and position of reverse lever.
2. Check "PC" switch (if used) — tell-tale pin should be down or indicating light not burning.
3. Check brakes.
4. Refer to Fig. 2-1, Section 2, and check each item under "Unit Failures Check" for proper setting and reading.
5. Check battery field fuse (80-ampere) on low voltage panel.
6. A careful check of these items will reveal the more common difficulties (75% of the troubles). An unusual difficulty requires careful study of the particular situation.

NOTE: If locomotive is putting out power, output of "A" unit can be read directly from load indicating meter. Throttle response can be told by sound of engine. Both are important observations.

Any piece of mechanical equipment is subject to some difficulties. An arrangement of protective devices is provided on these locomotives to prevent damage in case of a failure or careless operation. OVERLOADING IS ONE EXCEPTION AND IS ENTIRELY THE RESPONSIBILITY OF THE ENGINEMAN. As soon as it is apparent that the tonnage is too great, the engineman must take the proper steps to reduce train tonnage.

In cases of serious difficulty in a unit an investigation should be made immediately.

308 **Isolating and Stopping An Engine While Under Power** (For normal stopping procedure, see Art. 201).

If it becomes necessary to take engine "off the line" while the locomotive is operating under power (multiple unit operation) it should be done as follows:

1. Pull manual control lever shut. Hold until engine stops.
2. When bell starts ringing place the isolation switch in the "start" position.
3. Place fuel pump switch in "Off" position.

309 **Starting And Placing Engine On The Line While Under Power** (Multiple Unit Operation).

1. Start engine in the usual way. (See Art. 200).
2. After lubricating oil pressure builds up, place isolation switch in "Run" position.

SPECIFIC DIFFICULTIES

310 **Recovery Of Control Of Brake After Penalty Application (If Used)**

1. Place automatic brake valve in "LAP."
2. Close throttle to idle.
3. Place foot on safety control foot pedal.
*4. Wait until application pipe builds up to main reservoir pressure. (Listen for exhaust or watch PC switch light - if used).
5. Reset train control.
6. Check PC switch.
7. Release brakes.

* If "PC" will not reset with automatic brake valve handle in "LAP," after an emergency application, place brake valve handle in running position.

311 **Setting "PC" Switch** (If Used) Recover brake, see Art. 310. If "PC" switch is tripped locomotive will have power in number one throttle position (shown on load indicating meter) but engine speed will not advance as throttle is open. Fuel pumps will be stopped. In No. 5 or No. 6 throttle position the engines will stop. No bells will ring. The "fuel pump" switch in the cab "Off" or in the electrical control cabinet "Off" will cause the same difficulty as a tripped "PC" switch.

312 **Auxiliary Generator Charging Rate** Failure of auxiliary generator will stop excitation of alternator and cause a blue light. Normal output should keep battery ammeter at 0 or show some charge. In case of auxiliary generator failure stop engine and check 30-ampere auxiliary generator field circuit breaker and 150-ampere output fuse.

313 **Starting Contactors** Main contact points must not stick closed. The interlock located underneath main contactor must be closed and making good contact. If interlocks do not close or make contact, engine will speed up when throttle is opened but will not load. The fuel indicator on the governor will be unbalanced to minimum fuel (low power piston) and load regulator will point toward 5 o'clock.

314 **Control Air** Control air should be 90 $\pm$ 3 lbs. to supply air to close main contactors. Failure of control air will stop power output as main contactors will not close. Engines will speed up in response to throttle. The fuel indicator will be unbalanced to minimum fuel (low power piston) and load regulator will point toward 5 o'clock. (See Art. 319).

315 **Battery Ammeter** The battery ammeter should show 0 or some charge at all times with engine running. If discharge shows on ammeter, but loco-

motive continues to operate, the battery charging contactor may be open, or the 150 ampere charging fuse may be blown. Locomotive will continue to operate until batteries are exhausted.

If discharge shows on ammeter and blue light lights, engine will run at idle speed, but locomotive will not operate. Check 150-ampere charging fuse, auxiliary generator field or alternator field circuit breakers, or the auxiliary generator cutout switch may be open.

316 **Ground Relay** If the ground relay trips, a light on the engineman's panel will come on, the alarm bell will ring and the engine will return to idle, or stop, if the throttle is in Run 5 or 6 (if the engine stops, the blue alternator failure alarm light will also light). A pointer in the ground relay points to a yellow dot when set, and to a red dot when tripped. To reset: Isolate engine, reset relay and put engine on the line. If the relay continues to trip, investigate the cause.

317 **Wheel Slip Control** If wheel slipping occurs, the wheel slip control, located in the electrical control cabinet behind the power contactors, will operate. This will light the wheel slip indicator on the engineer's instrument panel in the cab. Wheel slip action automatically reduces the power output of the main generator which reduces the traction motor torque, stopping the slipping.

It will generally be unnecessary to reduce the throttle because of momentary wheel slip action, as the locomotive will automatically reduce its power to stop the slipping and reapply the power after the slipping has stopped.

Under extremely poor rail conditions, repeated wheel slipping may occur and sand should be applied to stop this slipping. Whenever possible, slipping should be anticipated and sand applied to prevent it.

318 **Alarm Indications For One Pair Of Wheels Sliding** If one pair of wheels should slide when starting a train, the wheel slip light will flash on and off intermittently, but as the train speed increases, the light will stay on more or less continuously, and will not go out when the throttle is reduced and sand applied. The light will go out when throttle is closed to idle.

Under this condition, the engine crew should make an immediate investigation to determine the cause. The wheels may be sliding due to a locked brake, a broken gear tooth wedged between the pinion and ring gear, or a motor bearing may have seized.

Repeated ground relay action, accompanied with unusual noises such as continuous thumping or squealing, or the smell of burning paint or insulation, may be an indication of very serious traction motor trouble that should be investigated at once.

IF A POWER PLANT MUST BE ISOLATED BECAUSE OF REPEATED WHEEL SLIP OR GROUND RELAY ACTION, DO NOT ALLOW THAT UNIT TO REMAIN IN THE LOCOMOTIVE CONSIST UNLESS IT IS CERTAIN THAT ALL OF ITS WHEELS ROTATE FREELY.

319 **Engine Speed And Fuel Indicators** (On governor) There are two pointers on the cover of the governor. One of these pointers indicates the throttle position of the engine and is labeled "speed." The second pointer indicates the position of the power piston in 16ths of an inch and is labeled "fuel." The lower the number on the "fuel scale" the greater the quantity of fuel which is being injected into the cylinders. In No. 8 throttle "speed" position the fuel indicator needle should read between 5 and 6 if the engine is properly loaded. In general, the two pointers should be checked only in No. 8 throttle position as indications at part

throttle may be misleading. If a marked variation is noted the trouble should be investigated. Excessive fuel (lower number on fuel scale) will indicate engine trouble. Minimum fuel will indicate electrical trouble.

320 **Isolation Switch** Isolation switch must be firmly in "Run" position to obtain power from the unit.

321 **Load Regulator** When operating in No. 8 throttle position (multiple unit operation) the load regulators throughout the locomotive should be in approximately the same position. Extreme unbalance of the load regulator arm in one unit to maximum or minimum field is an indication of difficulty and should be investigated.

If during full throttle operation one unit shows minimum field (arm in 5 o'clock position) trouble may be either mechanical or electrical. If in maximum field (arm in 8 o'clock position) inspect for loss of electrical load.

322 **Fuel Flow** For proper engine operation, a good flow of fuel (clear and free of bubbles) should be indicated in the fuel return sight glass, located on the duplex filter assembly, nearest the engine.

Normally, a small amount of fuel will leak by the plunger, and come out the small hole in the standpipe of the by-pass sight glass. If the leakage is enough so the fuel flows out the top of the standpipe this fact should be reported to maintenance.

If no fuel is flowing through the fuel return sight glass, check the fuel pump and the motor. If fuel pump motor is stopped, check "PC" switch, circuit breaker at engineman's control station, circuit breaker and control switch in electrical control cabinet and flexible electrical connection to motor.

If pump is running but no fuel is pumped, check fuel supply, emergency fuel cutoff under the unit, or check for a suction leak in piping between tank and pump, also, check for broken or slipping coupling at fuel pump.

323 **Overspeed Trip** When tripped, fuel is stopped at the injectors and engine can not be started. Whenever an engine is found stopped always check overspeed trip by pulling firmly on the lever (counter-clockwise) to be sure it is set. (See Fig. 5-5, Sec. 5).

324 **Battery Field Fuse** There is an 80-ampere fuse in the battery field circuit of the main generator. Should this fuse be blown no power will be developed. The battery field fuse is located on the low voltage panel which is in the electrical control cabinet.

325 **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 low speed (2 to 3 miles per hour). Water any deeper than three inches above the top of the rails is likely to cause damage to the traction motors.

326 **Multiple Unit Operation** The GP7 locomotive was basically designed for single unit operation, but can be arranged for multiple unit operation. When properly equipped, the GP7 may operate in any position with other GP7, FT, F2, F3, BL2, or F7 units.

It will generally be unnecessary to make on the spot decisions as to the type of units that a particular GP7 is equipped to operate with in multiple, as this will have been included in the original specifications of

that unit. However, before attempting multiple unit operation among the various models there are four important items to consider, which are as follows:

1. Units having 6 BL or 6 SL brake equipment cannot be operated in multiple with units having 24 RL brake equipment, and vice versa.

2. Unless all units are to be operated in automatic transition, a method of making manual transition at the proper time must be available. (Art. 106).

3. The proper power plant jumper cables must be available (i.e. 27:27 or 27:21, etc.).

4. If the units of a multiple consist are of different gear ratios and/or different continuous ratings, the locomotive should not be operated so that the unit geared for the HIGHEST minimum continuous speed is overloaded by being operated below that speed, or short time rating; nor must the locomotive be permitted to operate at a speed in excess of that for the unit having the LOWEST maximum permissible speed.

The GP7L, when equipped for multiple unit operation, will generally be expected to operate as a single unit or with other GP7L units (as it is not provided with 24RL brake equipment) and therefore is not supplied with a transition lever.

On special order the GP7L can be equipped to operate in multiple with units that do not have automatic transition. In this case a transition lever will necessarily be supplied. "Teaser" starting will be obtainable with the Road-Service switch in the Switching position; modified maximum field starting being provided with the switch in the Road position.

The GP7R locomotive is intended for either single or multiple unit operation. Since the GP7R has a transition lever, this unit may be used in the lead position of a multiple unit consist, as transition on trailing

units can be controlled manually if necessary. (Any multiple unit GP7 will, of course, operate satisfactorily in a trailing position even though the lead unit might have to be controlled manually.)

When operating the GP7R as the lead unit, power is delivered by placing the transition lever in the No. 1 position and opening the throttle to whatever position is necessary.

If two or more GP7 units are operated together it is recommended that all the Road service switches be placed in the same position. All units will then be operating with the same type of starting. A mechanical interlock in the controller prevents the throttle from being opened with the transition lever in "Off."

When operating with a GP7 leading and a BL2 trailing (in road service) the GP7 Road service switch is placed in the Road position, the BL2 transition lever in "Off" and the LRC (Road Service) switch of the BL2 in the "Road" position. If the BL2 is not operating in automatic transition, the transition lever of the GP7 must be moved manually to effect transition on the BL2. If the GP7 is trailing, the Road Service Switch is placed in the same position as the LRC (Service) switch of the BL2.

Whenever a GP7 is operated as a trailing unit the control switches and brake equipment should be set as is the standard procedure on all "F" type locomotives as outlined in Art. 209. The transition lever (if used) should be placed in the "Off" position and the reverse lever removed from the controller, thereby locking the controller.

If all units of a locomotive consist are not equipped for automatic transition, or if automatic transition has been cut out in one or more units, transition must be made manually at the proper time (according to the speeds given in the operating manual for the particular type of unit that is being controlled manually). The transition lever must be moved at the proper time to

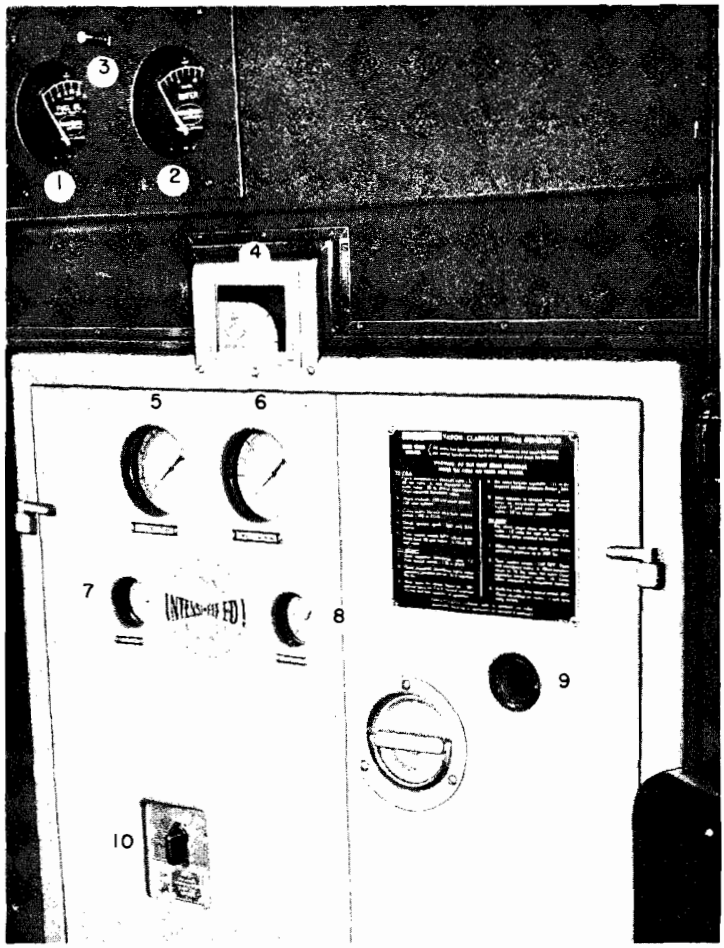
effect transition on the units in manual position, but transition will take place automatically in each unit set for automatic transition when the proper main generator voltage or amperage is reached.

Be cautious when operating GP7 or F7 units (short time ratings being the same for both) in conjunction with other units. If the GP7 or the F7 is in the lead, the load indicator may show perfectly safe loading for the GP7 or F7, but remember, FT, F2, or F3 units do not have as low a continuous operating speed as either the GP7 or F7. The load indicator on the leading GP7 or F7 will NOT show an overload on different type trailing units. Tonnage will have to be adjusted so that the lowest speed of the train will not get below the minimum speed, or short time rating, of the unit or units (FT, F2, or F3) having a higher minimum continuous operating speed than that of the GP7 or F7.

When making transition manually, from 2 to 3, or 3 to 2, the throttle must first be reduced to Run 6, move the transition lever to the desired position and open the throttle to Run 8.

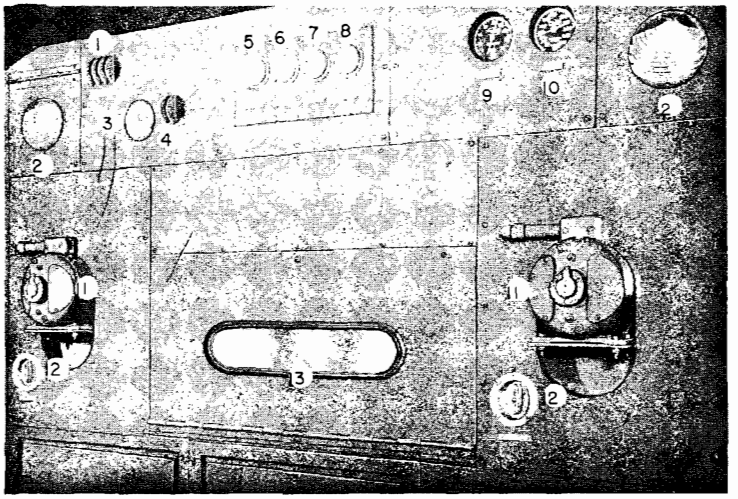
GP7 locomotives are equipped with twin sealed beam headlights which are controlled by switches on the engineman's control panel and the three point dimming control switch. On locomotives equipped for "MU" operation a remote headlight switch is included. This switch is located in a box below the window in front of the engineman. The switch has four positions and should be placed in the position corresponding to the operation as described on the name plate on the face of the switch box. In case a GP7 is being used as a middle unit in a 3 or 4 unit consist, the remote headlight switch should be placed in the single unit position.

327 **Dual Cab Control Operation** Dual controls in the cab enable the locomotive to be operated from either control station thereby allowing the engineer to



1. Fuel Oil Gauge
2. Boiler Supply Water Level Gauge
3. Push Button Needle Valve For Gauges
4. Damper Position Indicator
5. Trainline Steam Gauge
6. Steam Generator Pressure Gauge
7. Fuel Pressure Gauge
8. Fuel Pressure At Nozzle
9. Return Water Sight Glass
10. Control Switch

Front Wall Of Operating Cab
Fig. 3-2



1. Platform Light Switches
2. Cab Lights
3. Battery Ammeter
4. Cutout Switch for No. 1 Cooling Fan
5. Hot Engine Alarm Light (RED)
6. Boiler Stopped Alarm Light (GREEN)
7. Low Oil Alarm Light (YELLOW)
8. Alternator Failure Alarm Light (BLUE)
9. Electrical Control Air Pressure Gauge
10. Engine Water Temperature Gauge
11. Cab Heating Motors
12. Cab Heater Switches
13. AC Contactor Panel Window

Rear Wall Of Operating Cab
Fig. 3-3

choose his control station depending on the direction in which the locomotive is to be operated.

Two identical control and brake stands are provided in the cab of the locomotive. Both control stations are equipped with load indicating meters but only one control stand is equipped with a speed recorder; the other stand is equipped with a speed indicator. This allows the engineman to observe his speed at either control stand. If the locomotive is equipped with overspeed control, the speed recorder will govern the maximum speed regardless of locomotive direction.

GP7L locomotives equipped with dual controls are provided with transition levers in order to establish a method of interlocking between the two controllers. The transition lever locks the control stand when it is in the "Off" position. The throttle can only be advanced in transition "1."

GP7R locomotives equipped with dual controls are also provided with transition levers. With a GP7R locomotive the Road-Service switch allows the engineman to choose between the "Teaser" method of initial starting or modified maximum field starting. "Teaser" starting is available only when the Road-Service switch is in the switching position. The throttle may be advanced in transition positions 1, 2, 3 and 4. Removal of the reverse lever from the control stand locks the transition lever in "Off" and the throttle in "Idle."

The control switches on the two engineer's control panels in the cab of these locomotives are connected in series; the proper switches at both control stations must be closed in order to operate the locomotive.

To facilitate the operation of the various switches in the two control panels it is recommended that ALL switches at the NON-OPERATING control station be placed in the "On" position. The engineman may then

turn on ONLY those switches at the OPERATING control station that are necessary for the operation of the locomotive. In this manner the engineman will be able to instantly turn "On" or "Off" any item from the operating control station where he is located. The Road Service switch should be left in the switching position at the non-operative control station.

When changing operation from one control station to the other the procedure for handling the throttle, transition and reverse levers and the brake equipment is the same as that given for changing ends (Art. 209) with the following exceptions:

1. The control switches must be handled as mentioned in the preceding paragraph.
2. With 24RL brake equipment the rotair valve is NOT to be moved to either of the "LAP" positions, as there is only one rotair valve on GP7R locomotives equipped with dual controls.

When changing ends in multiple unit operation, the procedure outlined in Art. 209 must be followed completely, with the understanding that all switches at the dual control stations are to be placed in the "Off" position in the unit that is being made inoperative.

328 **Dynamic Brake Operation** Some locomotives are provided with additional electrical equipment permitting a portion of the power developed by the momentum of the train to be converted into an effective negative power, retarding the speed of the train. This feature is known as the dynamic brake and is especially useful as a holding brake, on descending grades.

The traction motor armatures, being geared to the axles, are rotating whenever the train is moving. When using the dynamic brake, electrical circuits are set up which convert the traction motors into generators. Since it takes power to rotate a generator this action

retards the train. The power thus generated is dissipated in resistors, called grids, which are cooled by a motor driven fan. The grids and fan are located in the top of the carbody directly above the center of the engine. The grid cooling fan motor receives its power from that generated by the #2 "traction motor."

Before using the dynamic brake a check should be made to see that the unit selector switch, located next to the instrument panel, is set to correspond with the number of units in the locomotive consist, and that the reverse lever is in the direction in which the locomotive is moving. Following this, place the throttle in "Idle," waiting at least 10 seconds before moving the transition lever to the "Off" position. In the "Off" position the dynamic braking circuits are partially established and depending upon the speed of the train, enough braking may be present in this position to bunch the slack. If necessary, move the lever to "B" and wait until the slack is bunched. After the slack is bunched the lever may be further moved to the right to give the desired amount of braking effort.

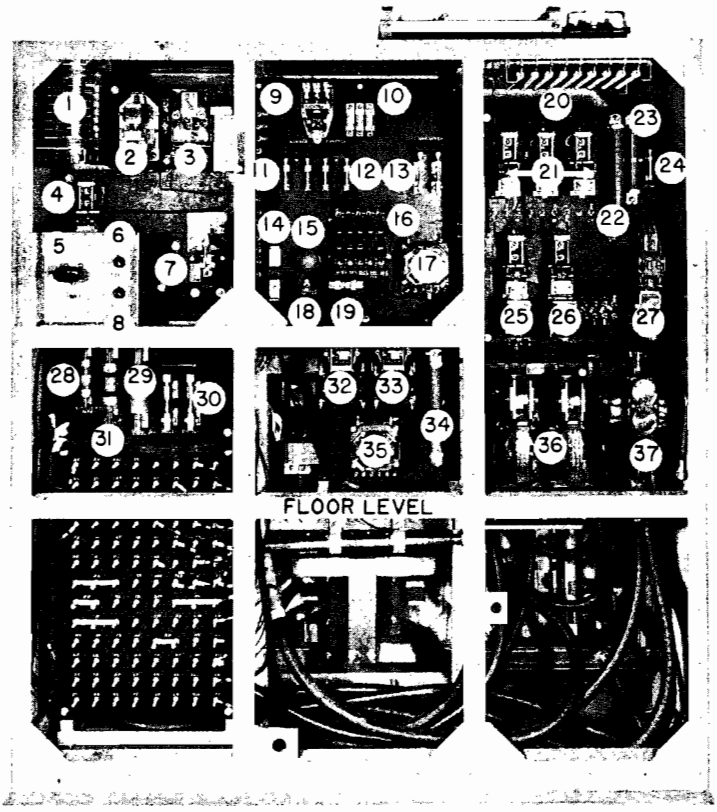
The dynamic brake is, in effect, an independent brake and the load indicating meter is now acting as a "brake cylinder pressure gauge." The needle of the indicating meter must not be allowed to go beyond the 600 ampere marking on the dial of the meter, nor must the dynamic brake warning light be permitted to stay lit. In either case, slightly reduce the brake until these conditions are remedied.

Variations in the idling speed of the engines, motor and generator characteristics, and setting of the brake warning relay may cause the dynamic brake warning light to come on before the meter needle reaches 600 amperes, but in any case, the light must not be permitted to remain lit. The light is an indication of an overload, and operating with it "On" might damage traction motors, braking grids, or grid cooling fan motors.

The independent brake must be kept fully released at all times when the dynamic brake is in use, or the wheels may slide. As the speed decreases below 10 miles per hour the dynamic brake becomes less effective. When the speed further decreases it is permissible to completely release the dynamic brake by placing the transition lever in the "No. 1" position, and apply the independent brake simultaneously to prevent the slack from running out.

Whenever desirable the automatic brake may be used in conjunction with the dynamic brake provided the independent brake is KEPT FULLY RELEASED.

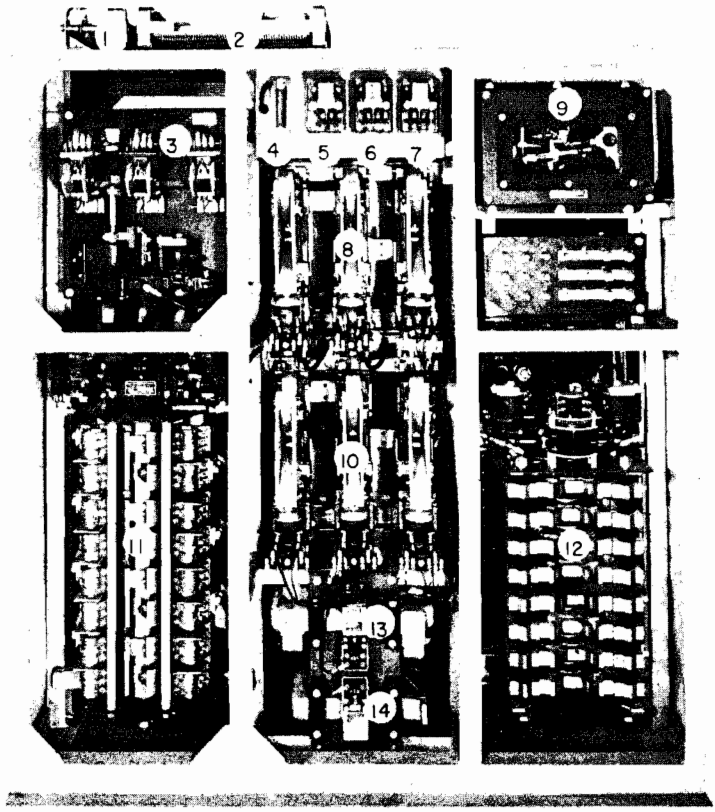
The most effective use of the dynamic brake is between 15 and 25 miles per hour depending on the gear ratio. Speed on grades should not be allowed to "creep up" by careless handling of the brake, as this is a holding brake and is not effective for slowing down heavy trains on steep grades.



Electrical Control Cabinet — With Dynamic Braking
View From Operating Cab
Fig. 3-4

ELECTRICAL CABINET — WITH DYNAMIC BRAKING
(View From Operating Cab)

1. Battery Charging Resistor
2. VT Relay
3. Parallel Relay (PR)
4. Battery Charging Contactor (BC)
5. Isolation Switch
6. Start Push Button
7. Reverse Current Relay (RCR)
8. Stop Push Button
9. No Voltage Relay (NVR)
10. Signal Light Resistors
11. Main "Lights" Switch
12. Main "Control" Switch
13. Auxiliary Generator Switch
14. Fuse Test Block
15. Fuse Test Light
16. Circuit Breakers — Heaters, Lights, Fuel Pump, Auxiliary Generator Field, Alternator Field
17. Ground Relay (GR)
18. Fuse Test Switch
19. Ground Relay Light Resistor
20. Generator Shunt Field Resistor (52.9 ohms)
21. Teaser Circuit Contactors — A,B,C
22. Generator Shunt Field Discharge Resistor
23. SH And LRC Operating Coil Resistor
24. Ground Relay Knife Switch
25. LRC Contactor
26. Battery Field Contactor (BF)
27. Shunt Field Contactor (SH)
28. Battery Field Fuse — 80-Ampere
29. Starting Fuse — 400-Ampere
30. Main Battery Switch
31. Battery Charging (Aux. Gen.) Fuse
32. Field Loop Contactor (FL)
33. Pneumatic Control Relay (PCR)
34. BWR Resistor (7000 ohms)
35. Brake Warning Relay (BWR)
36. Starting Contactors — ST+ ST-
37. Control Air Regulator



Electrical Control Cabinet — With Dynamic Braking
View From Engine Room
Fig. 3-5

ELECTRICAL CABINET — WITH DYNAMIC BRAKING
(View From Engine Room)

1. Alternator Field Resistor
2. Battery Field Discharge Resistor (3.3 Ohms) — "C" And "B" Teaser Resistors Are Located Behind The Battery Field Discharge Resistor
3. Dynamic Brake Contactors (B)
4. Signal Relay Resistor
5. Signal Relay (SR)
6. Fuel Pump Control Relay (FPC)
7. ER Relay
8. Power Contactors — P3-S13-P1
9. Low Voltage Regulator
10. Power Contactors — P4-S24-P2
11. Reverser Switch
12. Cam Switch (CS)
13. Wheel Slip Relay (WSR)
14. Backward Transition Relay (BTR)

NOTES

NOTES

SECTION 4

COOLING, LUBRICATING OIL AND FUEL OIL SYSTEMS

COOLING SYSTEM

A schematic diagram of the cooling system is shown in Fig. 4-1. Water is circulated through the engine cooling system by two pumps mounted on the engine. Cooling air is supplied through the radiators by four AC driven cooling fans (numbered from front to rear). The fans are individually controlled by four thermostatic switches set to operate the fans at the temperatures shown on the wiring diagram in this manual. Each fan is individually shut off when the water temperature is 10° below the temperature at which its switch closed. The ten sections of the radiator (five in each bank) are partitioned into three separate areas: The #1 fan draws air through two sections; the #2 fan draws air through the next two sections; the #3 and #4 fans draw air through the remaining six radiator sections. The shutters for the #1 fan are operated manually (Art. 123). The shutters for the #2 area are automatically controlled by the thermostatic switch for the #2 fan. The thermostatic switch for the #4 fan also controls the remaining shutters enclosing the six sections of radiator. The sequence of operating the fans (with rising temperature) is 1-3-4-2. When the #3 fan starts it draws in air through the #4 fan opening, down through the end radiator sections then upward through the forward sections and is discharged by the #3 fan. When the #4 fan starts the shutters open over the normal outside air intakes for the #3 and #4 fans.

In case the temperature of the cooling water leaving the engine reaches 208°, the high temperature alarm switch will close; this will cause the hot engine alarm light (RED) to be lit and the alarm bell to ring.

400 **Operating Water Level** Operating water levels are stenciled on the water tank next to the water gauge glass to indicate minimum and maximum water levels with engine running and stopped. The engine should never be operated with the water below the low water level. Progressive lowering of the water in the gauge glass indicates a leak in the cooling system and should be reported, Fig. 4-3.

The system is filled either through the filler pipe located on the roof of the locomotive or through the filler pipe at the rear of the unit on either side.

To fill the system proceed as follows:

1. Stop engine.
2. Open filling level valve "G."
3. Fill slowly until water runs out filling level pipe at valve "G."
4. Close filling level valve "G."

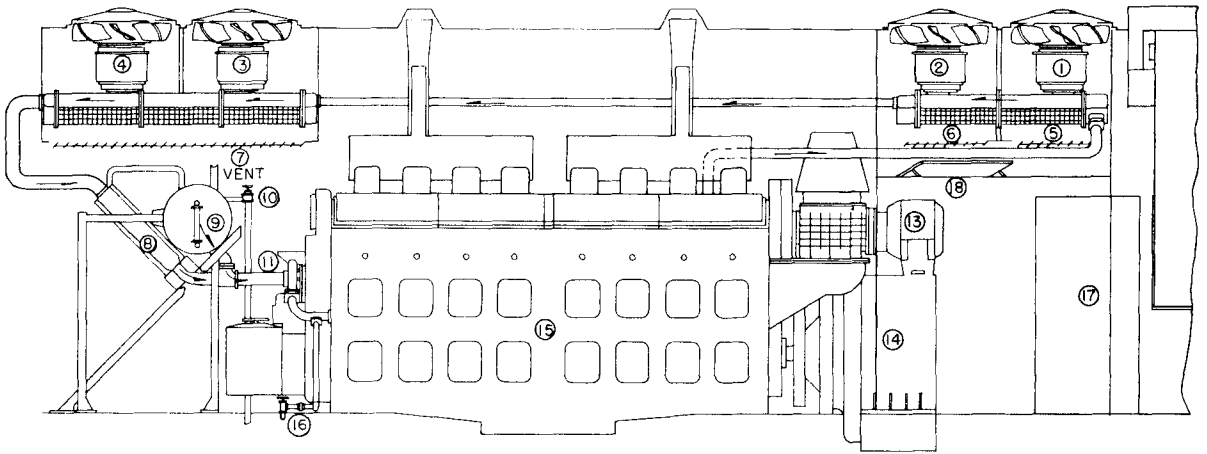
If filling a dry or nearly dry engine also follow these additional steps:

5. Start engine and run several minutes. This will eliminate any air pockets in the system.
6. Shut down engine and open valve "G."
7. Add water until it runs out filling level pipe.
8. Close filling level valve "G."

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 and heads.

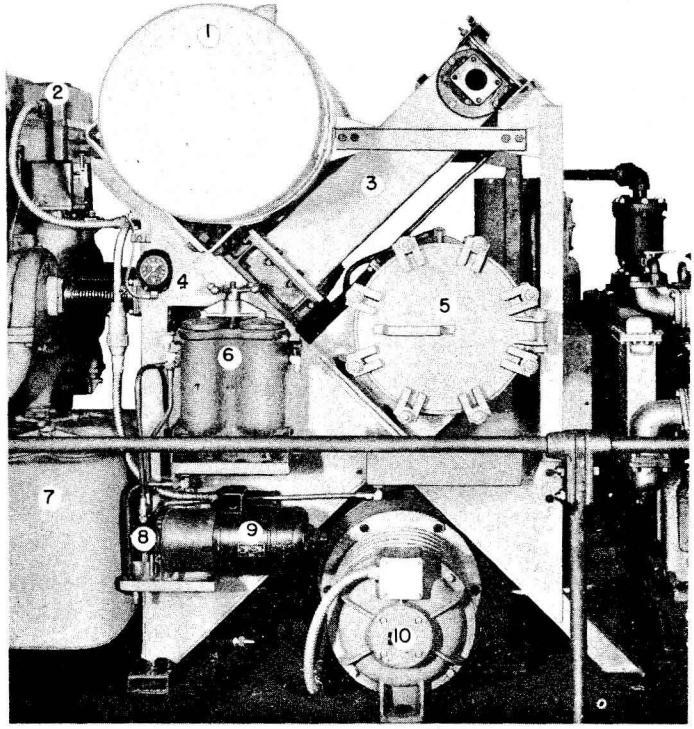
CAUTION: 1. Do not attempt to fill the cooling system through the drain pipe located underneath the locomotive.

2. The system should not be filled above the maximum water level indicated on the water tank in order to:
   a. Prevent freezing radiators in winter.
   b. Prevent loss of rush inhibitor when draining back to "G" valve level.



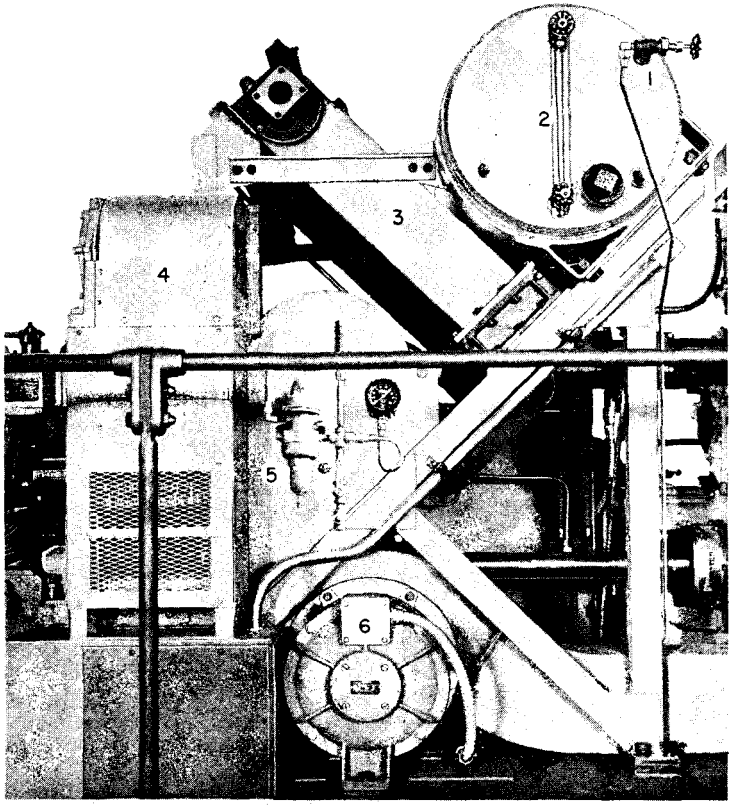
1. No. 1 Cooling Fan
2. No. 2 Cooling Fan
3. No. 3 Cooling Fan
4. No. 4 Cooling Fan
5. Manually Operated Shutter
6. Automatic Operated Shutter For No. 2 Fan
7. Automatic Operated Shutter For No. 3 and No. 4 Fans
8. Lube Oil Cooler
9. Cooling Water Supply Tank
10. "G" Valve
11. Water Pumps
12. Cooling Water Outlet From Engine
13. Auxiliary Generator
14. Main Generator
15. Diesel Engine
16. Water Drain
17. Control Cabinet

COOLING SYSTEM SCHEMATIC DIAGRAM
Fig. 4-1



1. Cooling Water Supply Tank
2. Engine Governor
3. Oil Cooler Housing
4. Lubricating Oil Pressure Gauge
5. Lube Oil Filter Housing (Michiana)
6. Dual Fuel Oil Filter Housing
7. Lube Oil Strainer Housing
8. Fuel Oil Pump
9. Fuel Oil Pump Motor
10. Traction Motor Blower and Motor

Plumbing Stack (Left Side)
Fig. 4-2



1. "G" Valve
2. Cooling Water Level Sight Glass
3. Oil Cooler Housing
4. Load Regulator
5. Air Compressor Governor
6. Traction Motor Blower and Motor

Plumbing Stack (Right Side)
Fig. 4-3

LUBRICATING OIL SYSTEM

Oil under pressure is forced through the engine for lubrication and piston cooling by the combination piston cooling and lube oil pump. Lube oil which falls into the oil pan is picked up by the scavenging oil pump and forced through the oil filters and cooler to the oil strainer housing where it is ready for recirculation by the oil pump. The excess returns to the oil pan where it is held until used.

401 **Oil Level** The oil level may be checked with the engine running at any speed and should read between "Low" and "Full" on either bayonet gauge (one on each side of engine). When the engine is stopped the oil from the filter and cooler will drain back into the oil pan and the level on the dipstick should show "system charged." The mark "system uncharged" is used by maintenance forces when filling oil pan when new oil filter elements are installed.

402 **Adding Oil To System** When oil is added to the system, it must be poured through the opening having the square cap on top of the strainer housing. Should the round caps be removed while the engine is running, hot oil under pressure will come from the openings and possibly cause personal injury.

When the engine is stopped, all the oil in the cooler core chamber will drain into the strainer chamber and then overflow into the engine oil pan, 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 filter, oil lines and engine.

403 **Oil Pressure** Oil pressure at 800 RPM is normally 35 to 45 pounds. It should not drop below 20 pounds. At idle the pressure should be at least 6 pounds. (In the event of dangerously low oil pressure the engines will automatically be stopped), Fig. 4-2.

FUEL OIL SYSTEM

Fuel in each unit is circulated through the injectors by an electric driven fuel pump. Failure of pump to operate, closed emergency fuel cutoff valve, or clogged strainer can cause fuel failure. See Section 5 of this manual.

404 **Filling Fuel Tanks** The fuel tanks can be filled from either side of the locomotive. Direct reading sight level gauges located on each side of the fuel tank adjoining the fuel fillers indicate level of fuel oil starting at 4-1/2" from the top of the tank and should be observed while filling the tank to prevent overflowing. The fuel should be filtered through a reliable fuel filter before it enters the tank. DO NOT HANDLE FUEL OIL NEAR AN OPEN FLAME.

405 **Fuel Gauge** located on front wall of operating cab, in front of fireman, is a direct reading, air operated gauge which indicates quantity of oil in the fuel tank. The gauge does not show fuel level continuously; a push-button needle valve directly below the fuel gauge must be pushed in to get fuel level indication on gauge, Fig. 3-2.

406 **Emergency Fuel Cutoff Valve** An "Emergency Fuel Cutoff Valve" is provided to cut off the fuel supply to the fuel pump in the event of fire, or any emergency. It is located inside a compartment on the

lower front center of the fuel tank. 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 the cable running to the fuel cutoff valve. A similar ring is located in the operating cab.

The fuel cutoff valve can be tripped, and the fuel cut off by pulling any one of these rings. If tripped, the valve must be reset manually.

To reset: crawl under locomotive, pull valve stem out and set yoke in place to hold valve open. See Fig. 5-6, Section 5.

SECTION 5

ON-THE-ROAD TROUBLE-SHOOTING

This section is a reprint of the TS4-GP7 edition of the "On-the-Road Trouble-Shooting" booklet. It provides a check list calling the operator's attention to the troubles which are most frequently encountered on the road, and which can be quickly remedied thereby eliminating many delays.

No attempt is made to explain general operation and functions of equipment on the locomotive. For such information refer to the other sections of this manual.

500 After the items on the following Check List are references to article, page and figure numbers, where additional information will be found.

501 HOW TO START THE ENGINE

CAUTION: If the engine has been stopped more than two hours, the cylinders should be blown out. (Art. 510 — Page 513)

a. Place the fuel pump and control circuit breaker on the engineman's control panel in the "On" position; then wait a few seconds. (Fig. 5-1 — Page 506)

b. Place isolation switch in "Start" position. (Item 4, Fig. 5-2 — Page 507)

c. Press "Start" button solidly until engine starts. (Item 5, Fig. 5-2 — Page 507)

d. Place isolation switch in "Run" position. (Item 4, Fig. 5-2 — Page 507)

CAUTION: Before placing the isolation switch in the "Run" position, make certain that the locomotive will not move by:

(1) Placing main generator field switch in "Off" position. (Fig. 5-1 — Page 506)

(2) Placing throttle in idle.

(3) Placing reverse lever in neutral.

If engine starts but stops as soon as isolation switch is placed in "Run," throttle may be in "Stop" position.

502 THE ENGINE DOES NOT ROTATE WHEN "START" BUTTON IS PRESSED

a. Control circuit breaker on engineman's control panel must be in the "On" position. (Fig. 5-1 — Page 506)

b. Isolation switch must be in the "Start" position. (Item 4, Fig. 5-2 — Page 507)

c. 400-ampere starting fuse must be good. (Item 29, Fig. 5-2 — Page 507)

d. Main battery switch must be closed. (Item 30, Fig. 5-2 — Page 507)

e. Control switch in the distribution panel must be closed. (Item 11, Fig. 5-2 — Page 507)

503 THE ENGINE ROTATES BUT DOES NOT START WHEN "START" BUTTON IS PRESSED

a. Fuel pump circuit breaker on the engineman's control panel must be "On." (Fig. 5-1 — Page 506)

b. Low oil pressure button on the governor must be pressed in. (Fig. 5-4 — Page 511)

c. Engine overspeed must not be tripped. (Fig. 5-5 — Page 512)

d. Fuel pump circuit breaker in the distribution panel must be "On." (Item 13, Fig. 5-2 — Page 507)

e. Emergency fuel cut-off valve under the locomotive must not be tripped. (Fig. 5-6 — Page 512)

f. The PC switch (if used) must not be tripped. (Art. 515 — Page 514)

504 THE ENGINE DOES NOT SPEED UP WHEN THROTTLE IS OPENED

a. Control circuit breaker on engineman's control panel must be "On." (Fig. 5-1 — Page 506)

b. Isolation switch must be in "Run" position. (Item 4, Fig. 5-2 — Page 507)

c. PC switch (if used) must not be tripped. (Art. 515 — Page 514)

d. Ground relay must not be tripped. (Item 18, Fig. 5-2 — Page 507)

e. No voltage relay must not be open. (Item 8, Fig. 5-2 — Page 507)

f. Control switch in electrical control cabinet must be closed. (Item 11, Fig. 5-2 — Page 507)

g. Fuel pump circuit breaker on the engineman's control panel must be "On." (Fig. 5-1 — Page 506)

505 THE ENGINE SPEED PICKS UP BUT LOCOMOTIVE DOES NOT MOVE WHEN THROTTLE IS OPENED

a. Reverse lever must be in either reverse or forward position.

b. Generator field circuit breaker on the engineman's control panel must be "On." (Fig. 5-1 — Page 506)

c. There must be 80 pounds control air pressure. (Art. 516 — Page 515)

d. Starting contactors must not be stuck. (Item 17, Fig. 5-3 — Page 509)

e. All brakes, hand and air must be released.

f. 80-ampere battery field fuse must be good. (Item 27, Fig. 5-2 — Page 507)

506 ENGINE GOES TO IDLE

a. Ground relay might be tripped. (Art. 511 — Page 513)

b. No voltage relay might be opened. (Art. 514 — Page 514)

c. PC switch (if used) might be tripped. (Art. 515 — Page 514)

d. Control circuit breaker on the engineman's control panel might be "Off." (Fig. 5-1 — Page 506)

e. Fuel pump circuit breaker on the engineman's control panel might be "Off." (Fig. 5-1 — Page 506)

507 ENGINE STOPS

a. Throttle might be in "Stop" position.

b. Low oil pressure button on the governor might be out. (Art. 513 — Page 513)

c. Engine overspeed might be tripped. (Art. 512 — Page 513)

d. No voltage relay might be opened. (Art. 514 — Page 514)

e. Ground relay might be tripped. (Art. 511 — Page 513)

f. Fuel pump circuit breaker on the engineman's control panel might be "Off." (Fig. 5-1 — Page 506)

g. Fuel pump circuit breaker in the distribution panel might be "Off." (Item 13, Fig. 5-2 — Page 507)

h. Control circuit breaker on the engineman's control panel might be "Off." (Fig. 5-1 — Page 506)

i. PC switch (if used) might be tripped. (Art. 515 — Page 514)

j. Emergency fuel cut-off valve under the locomotive might be tripped. (Fig. 5-6 — Page 512)

508 TYING UP THE LOCOMOTIVE

a. Put isolation switch in "Start" position. (Item 4, Fig. 5-2 — Page 507)

b. Press "Stop" button solidly until engine stops. (Item 6, Fig. 5-2 — Page 507)

c. Put all circuit breakers on the engineman's control panel in the "Off" position. (Fig. 5-1 — Page 506)

d. Remove reverse lever.

e. Pull main battery switch. (Item 30, Fig. 5-2 — Page 507)

f. Set hand brake.

g. Take precautions against freezing in cold weather.

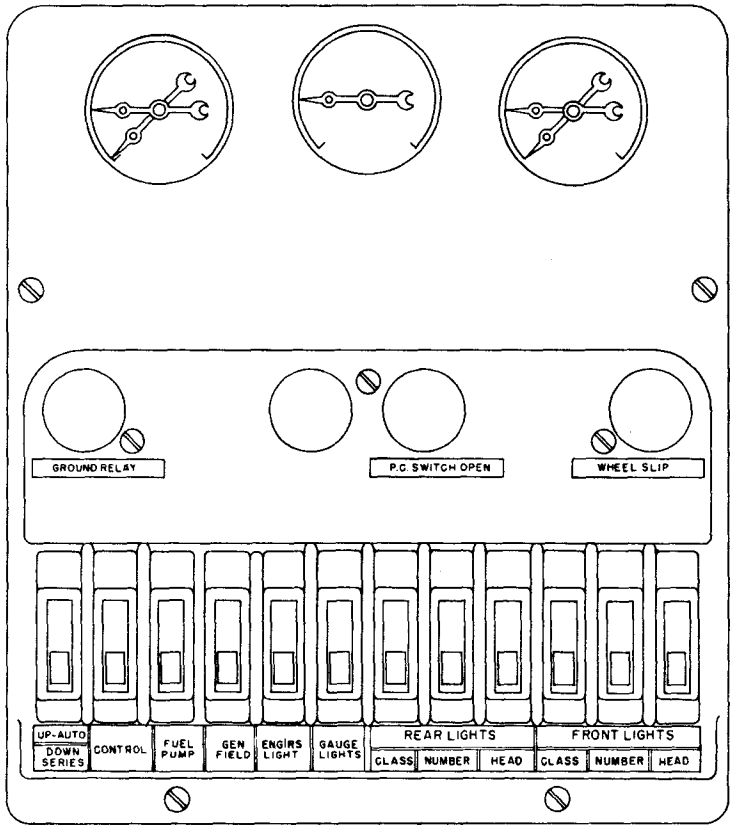
509 BATTERY AMMETER SHOWS CONTINUAL DISCHARGE

a. Battery charging contactor located above the isolation switch must be closed. (Art. 518 — Page 515; also Item 3, Fig. 5-2 — Page 507)

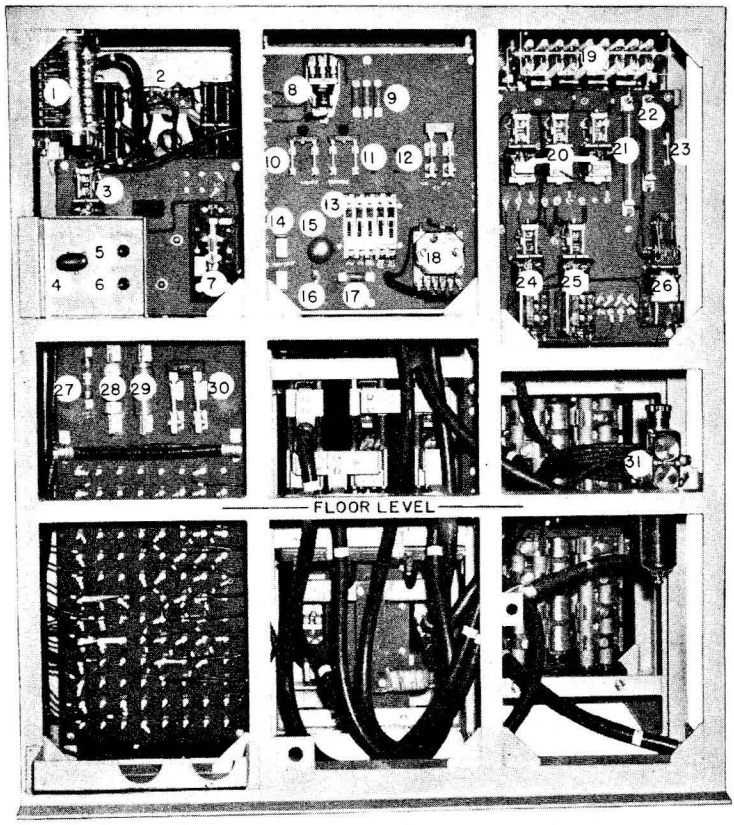
b. 150 or 250-ampere battery charging (auxiliary generator) fuse under the isolation switch must be good. (Item 28, Fig. 5-2 — Page 507)

c. The auxiliary generator field circuit breaker in the electrical control cabinet must be "On." (Item 13, Fig. 5-2 — Page 507)

d. The auxiliary generator cutout switch in the electrical control cabinet must be closed. (Item 12, Fig. 5-2 — Page 507)



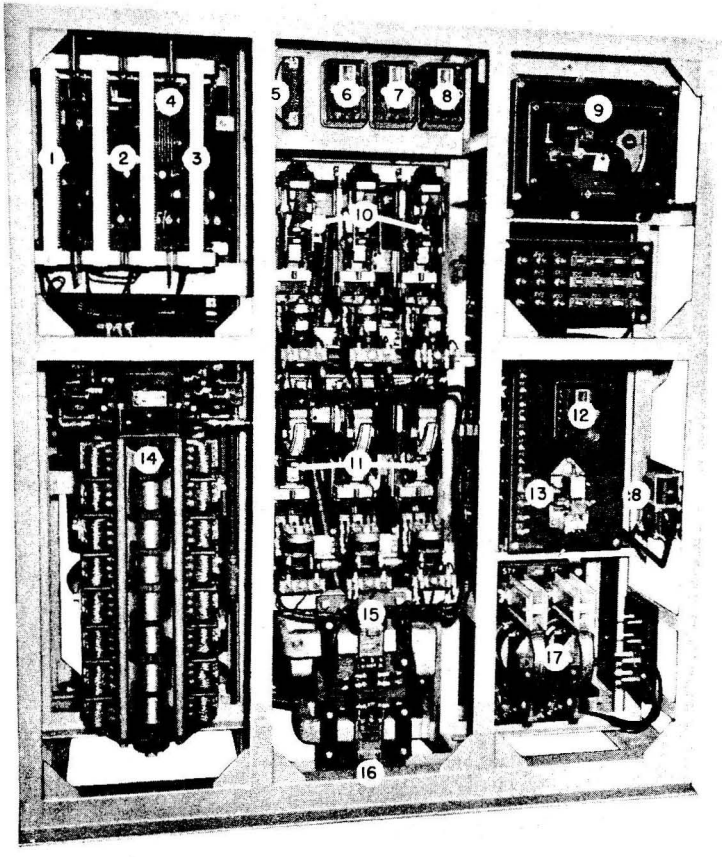
Engineman's Control Panel
Fig. 5-1



Electrical Control Cabinet
View From Operating Cab
Fig. 5-2

ELECTRICAL CONTROL CABINET
(View From Operating Cab)

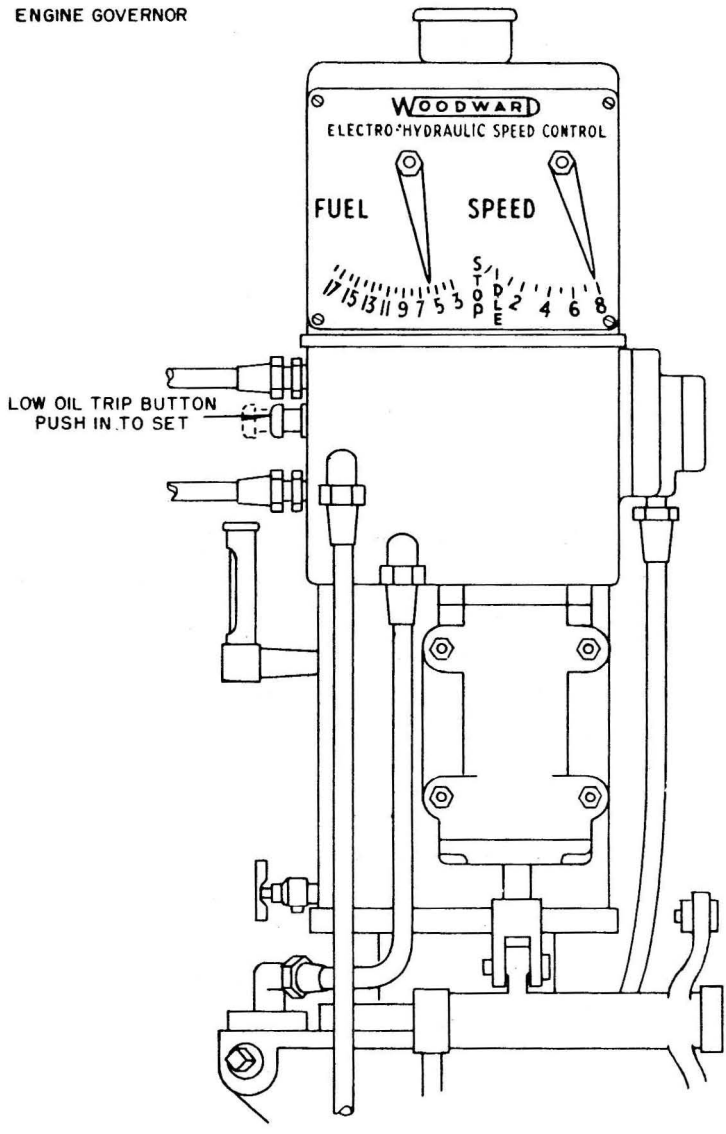
1. Battery Charging Resistor
2. Rear Of Voltage Regulator
3. Battery Charging Contactor
4. Isolation Switch
5. Start Push Button
6. Stop Push Button
7. Reverse Current Relay (RCR)
8. No Voltage Relay (NVR)
9. Signal Light Resistors
10. Main "Lights" Switch
11. Main "Control" Switch
12. Auxiliary Generator Switch
13. Circuit Breakers — Heaters, Lights, Fuel Pump, Auxiliary Generator Field, Alternator Field
14. Fuse Test Block
15. Fuse Test Light
16. Fuse Test Switch
17. Ground Relay Resistor
18. Ground Relay (GR)
19. Generator Shunt Field Resistor
20. Teaser Circuit Contactors — A,B,C
21. Generator Shunt Field Discharge Resistor
22. Resistor For Shorting Out LRC Or SH Contactors When Wheel Slip Relay Has Picked Up
23. Ground Relay Knife Switch
24. LRC Contactor
25. Battery Field Contactor (BF)
26. Shunt Field Contactor (SH)
27. Battery Field Fuse — 80-Ampere
28. Auxiliary Generator (Battery Charging) Fuse — 150-250-Ampere
29. Starting Fuse — 400-Ampere
30. Main Battery Switch
31. Control Air Regulator



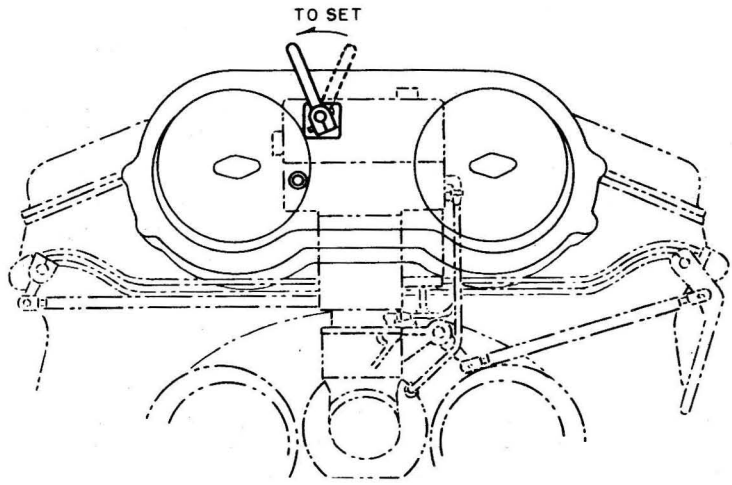
Electrical Control Cabinet
View From Engine Room
Fig. 5-3

ELECTRICAL CONTROL CABINET
(View From Engine Room)

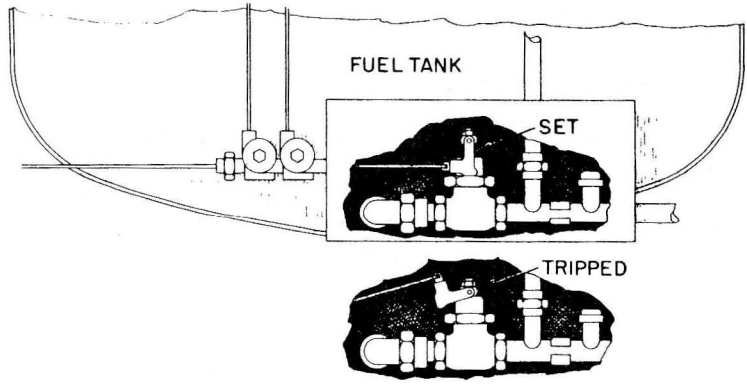
1. Battery Field Discharge Resistor
2. Teaser Circuit Resistors
3. Alternator Field Resistor
4. Selineum Rectifier
5. Signal Relay Resistor
6. Signal Relay (SR)
7. Fuel Pump Control Relay (FPC)
8. ER Relay
9. Voltage Regulator
10. Power Contactors — P3-S13-P1
11. Power Contactors — P4-S24-P2
12. Parallel Relay (PR)
13. VT Relay
14. Reverser Switch
15. Wheel Slip Relay (WSR)
16. Backward Transition Relay (BTR)
17. Starting Contactors — ST+ ST-
18. Pneumatic Control Relay (PCR)



Governor
Fig. 5-4



Overspeed Trip
Fig. 5-5



Fuel Cutoff Valve
Fig. 5-6

510 CYLINDER TEST VALVES

Open all the cylinder test valves on both sides of the engine; 8 on each side, 16 in all. Crank engine over a few revolutions with the starter. If liquid is discharged from cylinders, investigate; if not, close cylinder test valves, and start engine in usual manner. Do not turn on fuel pump prior to this test as the engine will start. If the engine does start with the cylinder test valves open, stop it immediately with the "Stop" button.

511 GROUND RELAY

When the ground relay trips, the light on the engineman's panel (Fig. 5-1 — Page 506) will burn, the alarm bell will ring, and the engine will come to idle unless the throttle is in Run 5 or 6, then the engine will stop. To reset, put throttle in idle, press the reset button, which will position the pointer towards the yellow dot. In case the engine has stopped, start it in the usual manner. When the pointer points to the red dot the ground relay is tripped.

512 OVERSPEED TRIP

When the overspeed is tripped, the engine will stop immediately, the alarm bell will ring, and the blue light will come on. To reset, pull the reset lever (Fig. 5-5 — Page 512) about 4" counter-clockwise, or outward, and then start engine in the usual manner.

513 LOW OIL PRESSURE BUTTON

If the low oil pressure trip button (Fig. 5-4 — Page 511) moves out until the red part of the shaft is showing, the engine will stop at once, the blue and yellow alarm light will come on and the alarm bell will ring. To reset, push the button in as far as it will go, and then start the engine in the usual manner.

514 NO VOLTAGE RELAY (NVR)

If the NVR opens, the engine will go to idle, or stop if the throttle is in Run 5 or 6; the blue light will burn and the alarm bell will ring. The possible trouble is the auxiliary generator field or alternator field circuit breakers being in the "Off" position in the electrical cabinet (Item 13, Fig. 5-2), or a blown battery charging fuse (Item 28, Fig. 5-2). To correct: isolate the engine and place the circuit breakers in the "On" position or replace the battery charging fuse.

CAUTION: Open the auxiliary generator switch (Item 12, Fig. 5-2) before removing or replacing the battery charging fuse.

515 PC SWITCH (IF USED)

An emergency application of air will trip the PC switch. When the switch is tripped, the light on the engineman's control stand (Fig. 5-1 — Page 506) will come on, the engine will come to idle (stop immediately if throttle is in Run 5 or 6) and stop eventually from lack of fuel. The alarm bell will not ring. To reset:

a. Place automatic brake valve in "LAP."

b. Close throttle to idle.

c. Place foot on safety control foot pedal (if used).

*d. Wait until application pipe builds up to main reservoir pressure. (Listen for exhaust, or watch PC switch light, if used).

e. Reset train control (if used).

f. Place automatic brake valve in "Running" to release brakes.

* If PC will not reset with automatic brake valve in "LAP," after an emergency application, place brake valve in "Running" position.

516 CONTROL AIR

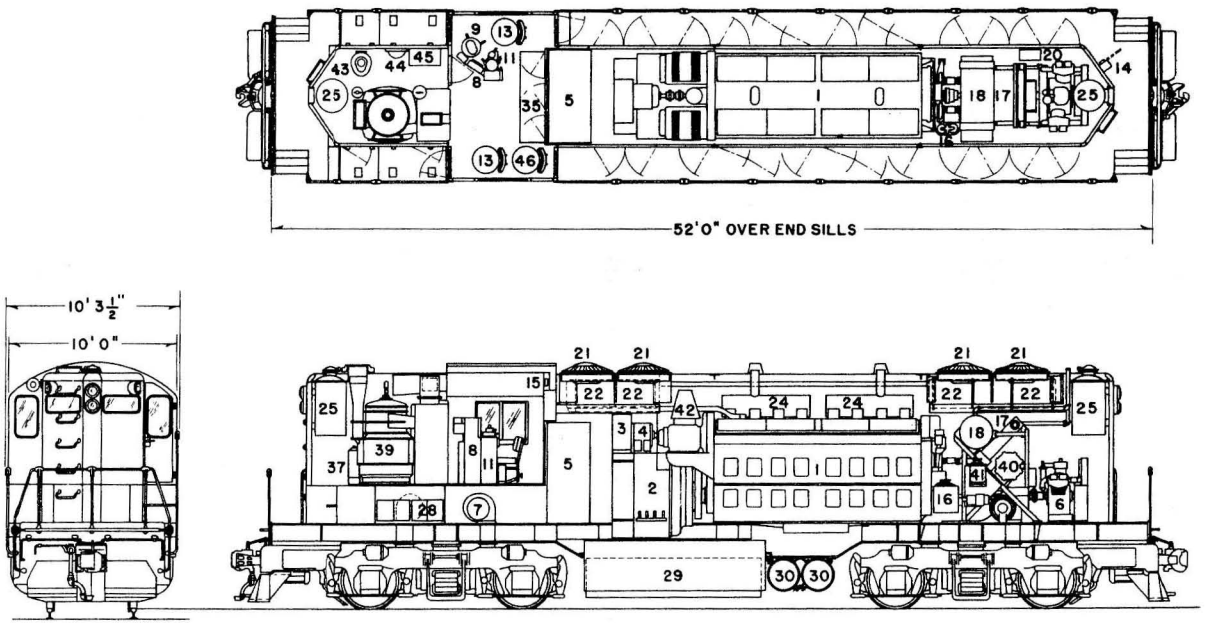
For the locomotive to operate, the control air pressure as shown by the gauge at the rear of the cab must be 80 $\pm$ 3 lbs. To raise or lower the pressure adjust the top of the regulator. After adjusting pressure, throw the reverser a few times and make final adjustment.

517 STARTING CONTACTORS

Starting contactors (Item 17, Fig. 5-3 — Page 509) sometimes weld together when an engine is started, especially if the "Start" button is not held in solidly. If one welds, the locomotive will not move even though the engine will pick up speed. To correct, pry the contacts apart with a piece of wood or other non-conductive material.

518 BATTERY CHARGING

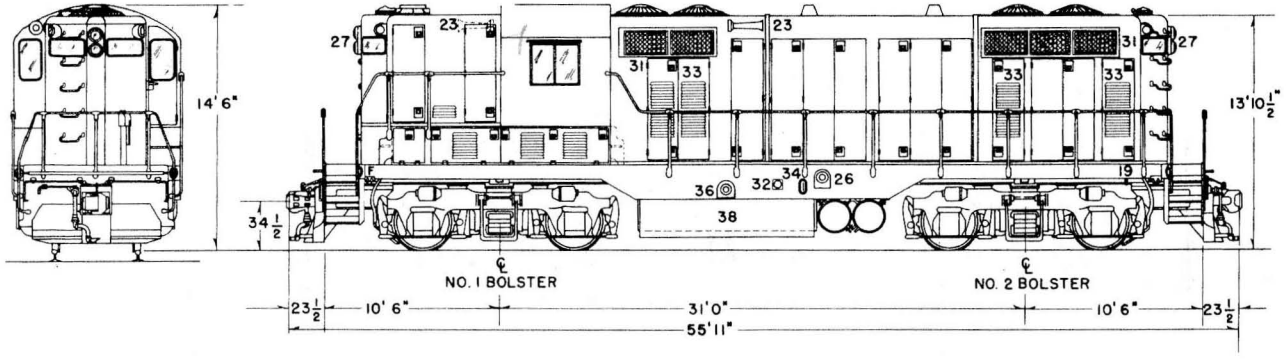
The battery charging contactor BC (Item 3, Fig. 5-2 — Page 507) located over the isolation switch must close when the engine is running and open when the engine stops. The battery charging contactor closes when the movable arm of reverse current relay RCR moves back. The reverse current relay (Item 7, Fig. 5-2 — Page 507) is located in the electrical control cabinet. The battery charging (auxiliary generator output) fuse (Item 28, Fig. 5-2 — Page 507) is located under the isolation switch. If a test shows this fuse burned out, replace with a new one. Also make sure that the auxiliary generator field and the alternator field circuit breakers in the electrical control cabinet (Item 13, Fig. 5-2 — Page 507) are "On."


52'0" OVER END SILLS
10' 3 1/2"
10' 0"

NOTES

CHART 1 - GENERAL ARRANGEMENT, DRAINS AND FILLERS

1. Engine Model 16-567B.
2. Main Gen. Model D12-D14.
3. Generator Blower.
4. Auxiliary Generator.
5. Control Cabinet.
6. Air Compressor.
7. Traction Motor Blower.
8. Control Panel & Instrument Board.
9. Control Stand.
10. Speed Recorder.
11. Air Brake Valve.
12. Cab Heater.
13. Seat.
14. Hand Brake.
15. Gauge Panel.
16. Lub. Oil Filler.
17. Lub. Oil Cooler.
18. Engine Water Tank.
19. Engine Water Filler.
20. Load Regulator.
21. 36" Fan & Motor.
22. Radiator.
23. Horn.
24. Exhaust Manifold.
25. Sand Box - 9 Cu. Ft.
26. Fuel Filler.
27. Headlight - Twin Sealed Beam.
28. Batteries.
29. Fuel Tank
30. Main Air Reservoir.
31. Air Intake & Shutters.
32. Emergency Fuel Cut-Off.
33. Air Intake For Engine Room.
34. Fuel Tank Gauge.
35. Trap Door.
36. Boiler Water Filler.
37. Boiler Water Softener.
38. Boiler Water Tanks
39. Boiler.
40. Lub. Oil Filter.
41. Dual Fuel Filter.
42. Engine Air Intake Silencer.
43. Toilet.
44. Wash Stand.
45. Clothes Locker.
46. Third Cab Seat.



SECTION 6

STEAM GENERATOR OK-4625

INTRODUCTION

The instructions contained in this section are for the guidance of personnel engaged in the operation of Model OK-4625 steam generators. A general description of the steam generator is given, the operating technique is outlined and a trouble shooting section is provided for the operator.

The symbol number after each device mentioned in the text refers to the schematic operating chart at the end of this section. The numbers are used to facilitate identification of the various devices.

The chart shows the various controls and devices on the OK-4625 steam generator and outlines the flow of fuel, water and steam.

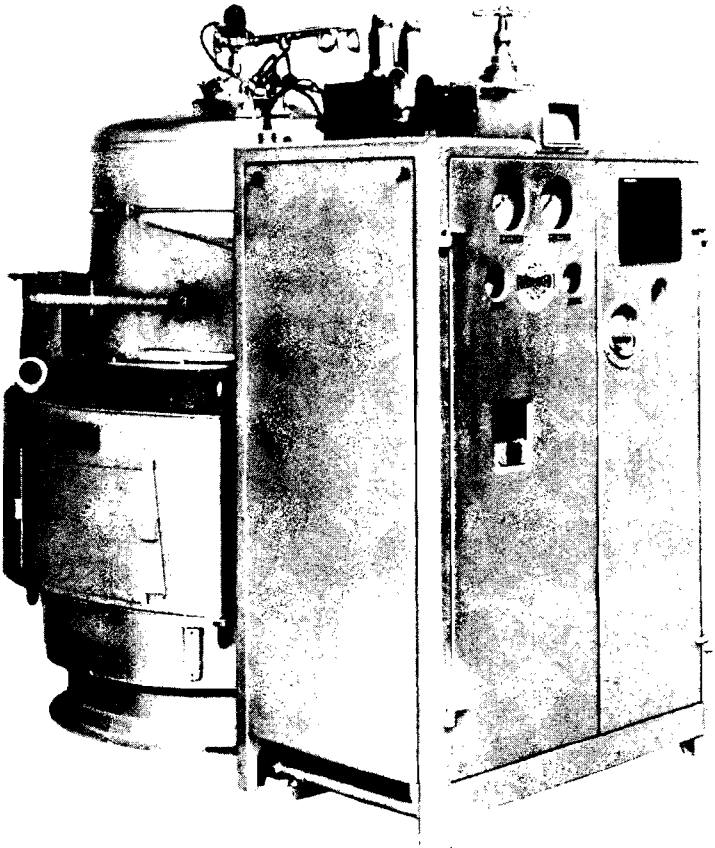
DESCRIPTION

The 4625 steam generators have a rated evaporative capacity of 2750 pounds per hour. Operation is completely automatic after the steam generator is started, and full operating steam pressure is reached within a few minutes.

The steam generating part of the unit consists of three sets of coiled water tubing, nested and connected in series to form a single tube several hundred feet long. Feed water, after passing through the heat exchanger, goes through the economizer coil and from there to the main coils of the steam generator. As the water progresses through the coils it is converted into steam. Heat is furnished by the combustion of diesel fuel oil, which is sprayed by compressed air

through the atomizing nozzle in the fuel spray head-105 into the firepot above the coils. Here the fine oil spray mixes with air supplied by the blower-202, and is ignited by a continuous electric spark-220. The hot gases flow, first downward, then up and outward through the nest of coils, finally flowing out the stack.

The supply of fuel is regulated to evaporate 90% to 95% of the water pumped through the coils. The



OK-4625 Steam Generator — Fig. 6-1

excess water flushes scale and sludge from the coils and is carried over with the steam into the steam separator-221, where the water and sludge are removed before the steam flows into the trainline.

The excess water collects in the bottom of the steam separator. Water above the level of the return outlet flows out through a steam trap-223 and through the heat exchanger-213, where it gives up its heat to the incoming feed water. From the heat exchanger the return water flows through return water flow indicator-218 back to the water supply tank-232.

The motor converter-215 drives the blower-202, water pump-230 and fuel pump-209 at a constant speed. The water by-pass regulator-111 automatically controls steam generator output by regulating the amount of water fed to the coils. Before entering the coils, the water passes through servo-fuel control-108, which admits fuel to the spray nozzle in direct proportion to the amount of water entering the coils. The servo-fuel control also adjusts the damper-203 to admit the proper amount of air for efficient combustion of the fuel.

The trainline steam pressure is regulated by adjusting the setting of the water by-pass regulator-111. The length of train and the weather conditions determine the setting.

BEFORE STARTING

The 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.

1. Make certain that the following valves are OPEN:

   Atomizing Air Shutoff Valve-1
   Coil Shutoff Valve-3
   Return Water Outlet Valve-9
   Trainline Cross-Over Valve-11
   Steam Admission Valve-13 to Water By-Pass Regulator-111
   Three-Way Washout Valve-17
   Water By-Pass Regulator Shutoff Valve-19
   Water Supply Stop Valve-21

2. Be sure that the following valves are CLOSED:

   Coil Blowdown Valve-2
   Layover Connection Shutoff Valve-6
   Manual Water By-Pass Valve-8
   Steam Admission Valve-10 to Radiation-217
   Washout Inlet Valves-14 and 16
   Water Pump Test Valve-18
   Water Drain Valves-20 and 22

3. See that both the overload reset button-106 and the stack switch-109 reset button are "In." The overload reset button is located inside the control panel on the magnetic overload relay.

TO FILL

1. Open the atomizing air shutoff valve-1 and fill-test valve-4; latch open the separator blowdown valve-12 to drain the steam separator. Close the separator blowdown valve when the separator is completely drained.

2. Close the main switch and turn the control switch-102 to FILL.

3. While the coils are filling see that spark-220 is available for ignition. Check ALL valves.

4. When water discharges from the fill-test valve-4 turn the control switch-102 to OFF and close the fill-test valve.

CAUTION: The water pump, being a high pressure pump is liable to apply an undesirable hydrostatic test to the steam generator, gauges and controls, unless the control switch is immediately placed in the "Off" position when water discharges from the fill-test valve.

NOTE: If the coils are empty it will take about five minutes to fill the steam generator with water.

TO START

CAUTION: Do not start the steam generator unless the coils are filled.

1. Latch open the separator blowdown valve-12 and turn the control switch-102 to RUN. (For easy starting, be sure the control switch has been OFF long enough for the motor to come to a full stop).

2. Close the separator blowdown valve when the generator steam pressure gauge-212 registers approximately 150 pounds.

3. OPEN THE SEPARATOR BLOWDOWN VALVE SEVERAL TIMES FOR THREE TO FIVE SECOND INTERVALS DURING THE FIRST FEW MINUTES OF OPERATION.

4. Set the water by-pass regulator-111 to the required trainline pressure.

5. After the trainline is coupled, open the remote control trainline shutoff valve-7 (if used) by depressing the reset lever-7a. Then open the trainline stop (shutoff) valve-15.

NOTES:

1. Check the return water flow after the steam generator has settled down to a steady output. On 2750 pound units it should cycle from 4 to 10 times a minute.
2. If the steam generator does not start or function properly, check all valves to see that they are open or closed as indicated in the operation chart.
3. The steam generator should come up to full operating pressure in one or two minutes; it may take 10 to 15 minutes to build up the required operating steam pressure in the trainline.

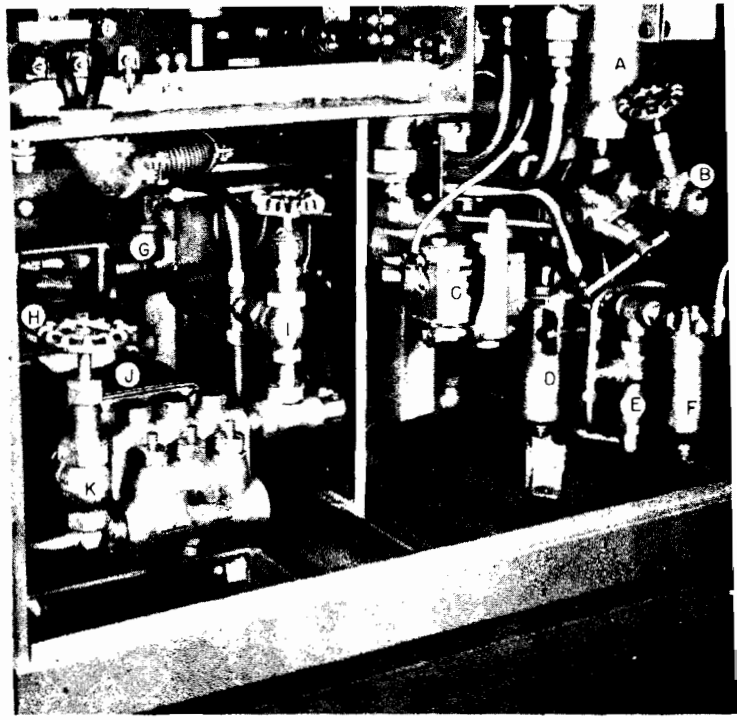
RUNNING ATTENTION

1. Open the separator blowdown valve-12 for 2-3 seconds approximately every 1/2 hour. Frequent blowdowns will reduce the tendency for sludge to accumulate.
2. Turn the handle on the fuel filter-206 during stops. At the same time, turn the handle on the treatment injector filter-225, where this method of water treatment is used.

TO SHUT DOWN STEAM GENERATOR

For short stops it is only necessary to close the stop and check valve-15. The fire will cycle and maintain operating pressure in the steam generator. For terminal stops, proceed as follows:

1. Close the stop and check valve-15 and the remote control trainline shutoff valve-7 (if used).
2. Set the water by-pass regulator-111 to maximum output. When the generator steam pressure gauge-212 registers 200 pounds turn the control switch-102 to OFF.



A. Steam Trap-223
B. Fill Test Valve-4
C. Coil Blowdown Valve-2
D. Fuel Filter (Suction)-206
E. Fuel Pressure Regulator-103
F. Fuel Filter (Pressure)-204
G. Fuel Pump-209
H. Water Pump Crankcase Filler Pipe-216. Bayonet Type Oil Gauge To The Right Of Filler Pipe, Just Visible Over Valve Handle
I. Manual Water By-Pass Valve-8
J. Water Pump-230
K. Water Pump Test Valve-18

Lower Section Of Control Cabinet
Fig. 6-2

3. Open the coil blowdown valve-2. When the generator pressure drops to 100 pounds close the valve.

4. Open the separator blowdown valve-12 and blow down the steam separator-221 with the remaining pressure.

5. Fill the coils with water according to the procedure given on Page 603, with the exception that it will be found advantageous to fill a "hot" steam generator with the separator blowdown valve latched open, thereby purging the coils while also eliminating the discharge of obnoxious steam within the compartment.

6. Close the atomizing air shutoff valve-1 and open the main switch.

NOTE: When starting, do not omit draining the steam separator, opening the fill-test valve, and again filling 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

The inlet valve-10 to the radiation-217 should be opened when operating during severe weather.

If a locomotive with a multiple installation does not have all of its steam generators in operation, open the layover connection shutoff valve-6 and the inlet valve-10 to the radiation on idle steam generators.

CAUTION: Trainline remote control valve-7 (when used) and/or trainline stop valve-15 must be closed when shutting off steam to the trainline.

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

nection to the yard steam line. In extremely cold weather the water pump-230 and steam generator controls should be given additional protection against freezing.

If no steam at all is available, thoroughly drain the steam generator. Open the drain valves-20 and 22, the water pump test valve-18, the coil blowdown valve-2, the separator blowdown valve-12 and the coil shutoff valve-3. 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-234 and make sure it is drained.

Standby Heating For GP7 Locomotives (If Used)

Standby heating was applied to GP7 locomotives to prevent freeze up when locomotive is in switching or freight service, and the steam generator is not used for heating the train.

A small toggle switch is mounted on the side of the control switch box. This toggle switch is marked "Passenger" and "Standby." When the locomotive is to be used in passenger service the toggle switch is moved to the "Passenger" position. The steam generator operation is normal in this position.

When standby heating is desired, move the toggle switch to "Standby" and the steam generator control switch to "Run." Open valves-6, 24 and 26, and open valve-10 if not already open. Close the trainline stop valve-15 and the cross-over valve-11. Be sure the steam separator blowdown valve-12 and the coil blowdown valve-2 are both closed.

Because the control switch is in "Run," the water pump circulates water through the entire steam gener-

ator system. When the temperature of the water in the suction line reaches approximately 100° F., a thermal bulb in this line actuates an aquastat which in turn energizes the solenoid valve, admitting fuel oil to the combustion chamber. This fuel oil ignites, heating the water in the steam generator coils. This heated water circulates back to the supply tank. As the water temperature in the tank and the pump suction reaches approximately 140° F., the thermal bulb again actuates the aquastat, de-energizing the solenoid valve which cuts off the fuel for the fire. As the water temperature drops, the cycle is repeated.

TROUBLE SHOOTING

If one of the protective switches (magnetic overload relay, coil blowdown valve switch, stack switch high temperature contacts or low temperature 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-102 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 alarm will not ring and the instrument lights will go out. 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. A test lamp and fuse clips wired inside the control cabinet may be used to check the fuses.

2. Overload reset button-106 "out:" The alarm will ring; the instrument lights will remain on. Turn

the control switch-102 OFF; check for hot blower-202 or water pump-230 bearings and for poorly adjusted pulley belts. Check the setting of the belt tension adjuster. Push the overload reset button "in."

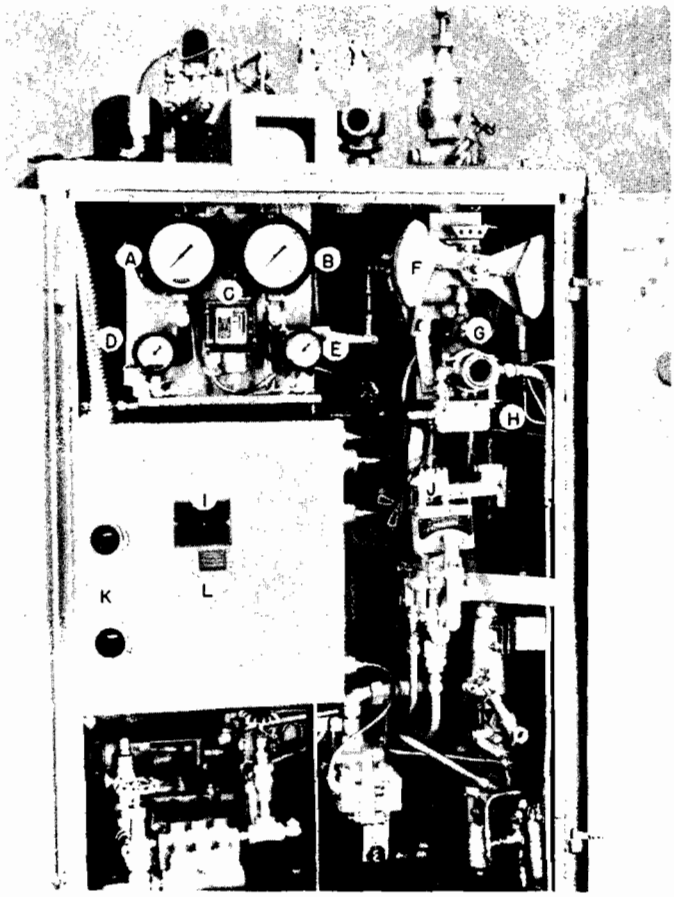
3. Stack switch-109 reset button "out:" The high temperature contacts in the stack switch are open; the alarm will ring and the instrument lights will remain on. Turn the control switch-102 to OFF; open the separator blowdown valve-12 and drain the steam separator-221. Close the separator blowdown valve, push in the stack switch reset button, refill the coils with water, and then start the steam generator.

4. Coil blowdown valve-2 partially open: The alarm will ring, the instrument lights will remain on. Be sure the locking pin on the coil blowdown valve handle is properly seated in the closed position.

Motor Starts But Burner Does Not

If the fire fails to light, the low temperature contacts on the stack switch-109 will not close and after a 45 second time delay the outfire relay will open the circuit to shut down the steam generator. The alarm will ring and the instrument lights will remain on. Turn the control switch-102 OFF and check the following list for possible causes for the burner failure.

1. Ignition failure: Turn control switch to RUN — no spark visible through the peep hole glass, or spark is of low intensity. If an ignition fuse is blown or if the current flow is broken for any other reason, the ammeter in the ignition circuit registers zero when the ammeter test button is pressed in. If the ammeter registers below normal, the spark plug electrodes are dirty or too far apart. If the ammeter registers above normal the electrodes are too close together, or the ignition circuit is grounded.



A. Trainline Pressure Gauge-224
B. Steam Generator Pressure Gauge-212
C. Differential Air Pressure Switch
D. Fuel Oil Pressure In Manifold-208
E. Fuel Oil Pressure At Nozzle-207
F. Servo Fuel Control-108
G. Return Water Sight Glass-218
H. Atomizing Air Pressure Regulator-100
I. Control Switch
J. Trainline Pressure Regulator-111
K. Windows For Observing Contactors
L. Overload Relay Reset

Full View Of Control Cabinet
Fig. 6-3

Check the ignition fuses — use the test lamp and clips installed in the control cabinet for that purpose. Tighten loose cable connections and replace chafed or broken wire which may be breaking or grounding the circuit.

2. Low atomizing air pressure-201: The air switch-101 opens and breaks the circuit to the fuel solenoid valve-104, which then stops the flow of fuel to the sprayhead-105.

   Be sure the air admission valve is fully open. Clean the strainer screen in the atomizing air line and drain the atomizing air pressure regulator-100. If the low atomizing air pressure persists, tighten the adjusting screw at the top of the air pressure regulator to increase the atomizing pressure.

3. Low fuel manifold pressure-208: Turn the handle on the suction line fuel filter-206 several times. A slight suction leak may cause the manifold pressure to build up slowly; put the control switch-102 on FILL to bleed the fuel line and bring the manifold pressure up to normal.

4. Low fuel nozzle pressure-207: Lack of water causes the servo fuel control-108 to limit the supply of fuel entering the nozzle. (If the water supply is almost completely stopped, the cam plate may come down far enough to actuate the cutout switch on the servo and close the fuel solenoid valve-104).

   Be sure that the pump belts have proper tension, the water pump test valve-18 is closed, the cover on the water treatment or strainer tank-234 is tight, the three-way washout valve-17 is fully open, and that the drain valves-20 and 22 are tightly closed.

   Open and close the water by-pass regulator-111 adjusting handle several times to free the regulator from possible sediment. If the water pressure gauge-229 still registers low, close the water by-pass regulator shutoff valve-19. This closes the water by-pass

line and permits all of the feed water to flow to the servo-fuel control-108; the steam generator will start at once if the by-pass regulator is causing the trouble. Set and manually regulate the trainline steam pressure by adjusting the manual water by-pass valve-8.

High feed water temperature or leaky water line connections may cause the water pump-230 to become air or vapor bound. Violent fluctuation of the water pressure gauge needle indicates this condition. Tighten leaky water line connections and bleed the line by opening the water pump test valve-18. Allow water to flow from this valve until no air or vapor bubbles are evident in the water.

Irregular Trainline Pressure

1. Burner cycles off and on: Insufficient water delivery causes the steam generator to run in superheat; the steam temperature limit control-110 operates to protect the coils against overheating. Check the water pump output as instructed in the preceding paragraphs.
2. Safety valves blow: Shut down the steam generator. Lower the trainline pressure setting on the adjusting handle of the water by-pass regulator-111 and start the steam generator again. If the safety valves-107 continue to pop, close the water by-pass regulator shutoff valve-19 and manually regulate the trainline steam pressure by opening and adjusting the manual water by-pass valve-8.

ITEMS TO REPORT

1. Water pressure greater than 450 pounds at any time.
2. Excessive stack temperature.
3. Fluctuation of the fuel manifold pressure.
4. Frequent cycling of the burner.
5. Water flow indicator not cycling.
6. Water by-pass regulator inoperative.
7. Any faulty operation of the steam generator.

NOTES

STEAM GENERATOR OPERATION CHART
OK-4625

100. Atomizing Air Pressure Regulator
101. Atomizing Air Switch
102. Control Switch
103. Fuel Pressure Regulator
104. Fuel Solenoid Valve
105. Fuel Spray Head
106. Overload Reset Button, Motor
107. Safety Valves
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 Strainer
201. Atomizing Air Pressure Gauge
202. Blower
203. Damper
204. Fuel Filter (Fuel pressure line)
205. Fuel Filter (Servo actuating line)
206. Fuel Filter (Suction line)
207. Fuel Nozzle 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 Filler Cap
217. Radiation
218. Return Water Flow Indicator
219. Return Water Strainer
220. Spark Plugs
221. Steam Separator
222. Steam Trap (Radiation)
223. Steam Trap (Return water line)
224. Trainline Steam Pressure Gauge
225. Treatment Injector Filter
226. Treatment Injector Gauge
227. Washout Solution Inlet
228. Washout Solution Outlet
229. Water Pressure Gauge
230. Water Pump
231. Water Strainer Manifold
232. Water Tank
233. Water Treatment Injector Pump
234. Water Treatment Tank (Strainer tank only if injector system is used)

VALVES

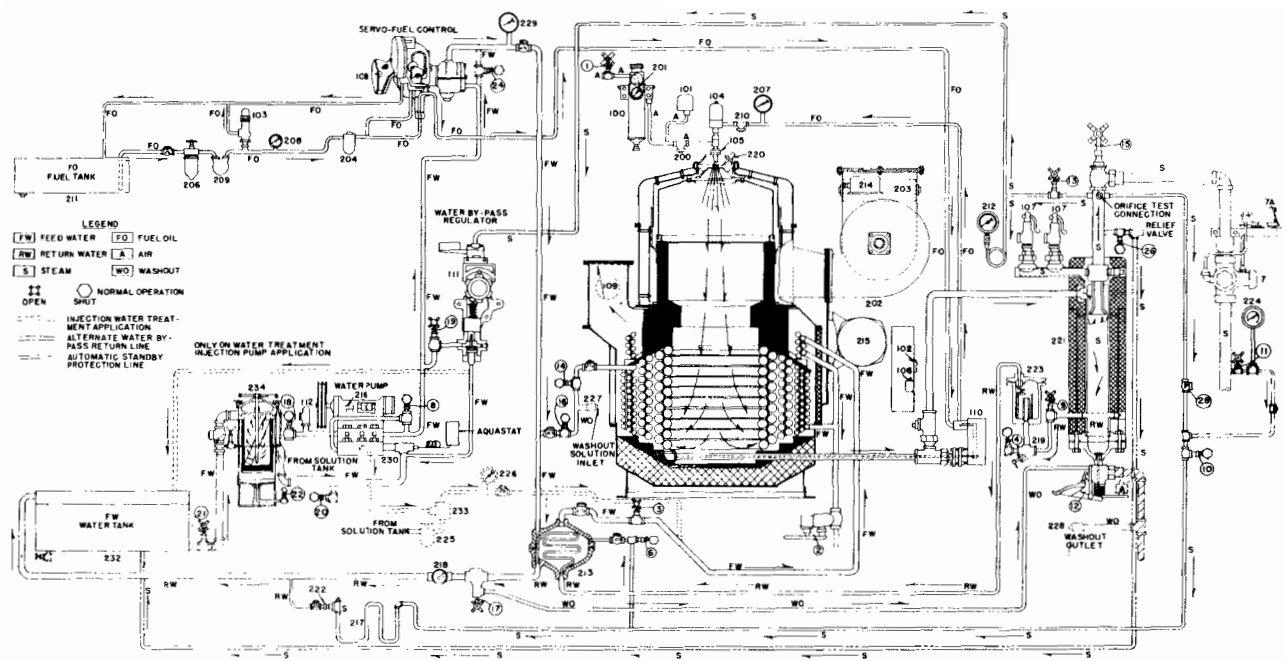
Valves designated by odd numbers must be O P E N during normal operation of the steam generator. Valves designated by even numbers must be CLOSED during normal operation of the steam generator. Normally open valves are fitted with a cross type handle, normally closed valves are fitted with the standard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

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

1. Atomizing Air Shutoff Valve
3. Coil Shutoff Valve
7. Remote Control Trainline Shutoff Valve (If Used)
7a. Reset Lever (If Used)
9. Return Water Outlet Valve
11. Trainline Pressure Gauge And Cross-Over Valve
13. Steam Admission Valve to Water By-Pass Regulator
15. Trainline Stop (Shutoff) Valve
17. Three-Way Washout Valve
19. Water By-Pass Regulator Shutoff Valve
21. Water Supply Stop Valve

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

2. Coil Blowdown Valve and Switch
4. Fill-Test Valve
6. Layover Connection Shutoff Valve
8. Manual Water By-Pass Valve
10. Steam Admission Valve to Radiation (Open in cold weather)
12. Steam Separator Blowdown Valve
14. Washout Inlet Valve
16. Washout Inlet Valve
18. Water Pump Test Valve
20. Water Suction Line Drain Valve
22. Water Treatment Tank Drain Valve
26. Standby Steam Valve to Water Tank


SERVO-FUEL CONTROL
FO
FUEL TANK
211
LEGEND
FW FEED WATER
FO FUEL OIL
RW RETURN WATER
A AIR
S STEAM
WO WASHOUT
OPEN
NORMAL OPERATION
SHUT
INJECTION WATER TREATMENT APPLICATION
ALTERNATE WATER BY-PASS RETURN LINE
AUTOMATIC STANDBY PROTECTION LINE
WATER BY-PASS REGULATOR
ONLY ON WATER TREATMENT INJECTION PUMP APPLICATION
WATER PUMP
216
AQUASTAT
FROM SOLUTION TANK
FW WATER TANK
232
FROM SOLUTION TANK
WASHOUT SOLUTION INLET
ORIFICE TEST CONNECTION RELIEF VALVE
WASHOUT OUTLET

STEAM GENERATOR TROUBLE SHOOTING CHART

Symptoms	Cause of Trouble	Remedy
Panel lights do not light; bell does not ring (Control switch "OFF" Main boiler switch "ON)	Main battery switch "OPEN" Auxiliary generator switch "OPEN"	Close
	100 amp. boiler fuse (2) blown (distribution panel)	Test and replace
	10 amp. control fuse (2) blown (boiler panel)	Test and replace
Motor does not run (control switch "FILL," bell rings)	Stack switch tripped	Re-set
	Motor overload tripped	Re-set
	Coil blowdown valve "OPEN"	Close
Motor runs, no strong flow of water from water pump test valve	Water tank empty	Fill
	Valve on suction line closed (on line to treatment tank)	Open
	Drain valve on suction line or treatment tank open	Close
	Top of treatment tank not tight	Re-set and tighten
	Treatment tank strainer clogged	Clean
	Water in storage tank too hot	Make sure steam heat valve to water tank is closed

STEAM GENERATOR TROUBLE SHOOTING CHART (CONT'D)

Symptoms	Cause of Trouble	Remedy
Motor runs, no spark at electrodes	Wires from electrodes to transformer broken or grounding	Repair
	Terminals loose on transformer	Tighten
	Gap between electrodes too wide	Reduce gap (should be 3/16")
	10 amp. ignition fuse (2 on boiler panel) blown	Test and replace
Motor runs, fire does not light "Run"	Atomizing air valve closed	Open
	Motor not allowed to stop before turning switch to run	Turn "fill" briefly, then to "off." After motor has stopped and servo control is all the way down, turn to "Run"
	Electrodes not properly adjusted	Adjust. Report to maintenance.
	Nozzle not properly adjusted	Adjust. Report to maintenance.
Generator shuts off, bell rings	Stack switch tripped	Reset stack switch, refill coils, start steam generator, and set water by-pass regulator at slightly lower pressure. Report to maintenance.

STEAM GENERATOR TROUBLE SHOOTING CHART (CONT'D)

Symptoms	Cause of Trouble	Remedy
Generator shuts off,	Motor overload relay trips, shutting down generator	Reset overload relay, refill coils and start steam generator. Report to maintenance.
Generator runs, dome gets hot	Lack of air, dirty coils	Set water by-pass regulator back 10 to 15 lbs. Report to maintenance.
Generator runs but no water returns through water flow indicator	Valve in return line from separator closed	Open
	Return water strainer clogged	Clean
	Steam too dry	Report to maintenance
Generator runs but trainline pressure cannot be controlled by water by-pass regulator	Steam admission valve closed	Open
	Water admission valve closed	Open
	Defective water by-pass regulator	Close water shutoff valve to water by-pass regulator, use manual by-pass valve to control pressure. Report to maintenance.