



**GP20**

# **OPERATING MANUAL**

**GENERAL MOTORS**  
LOCOMOTIVES



*SP*



# **DIESEL LOCOMOTIVE OPERATING MANUAL**



**for  
MODEL GP 20  
ADDON  
for  
TRAIN SIMULATOR 2013**





*Southern Pacific*

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## **GENERAL DESCRIPTION**

The General Motors Model GP20 locomotive is equipped with a diesel engine that delivers 2000 horsepower to the main generator for tractive purposes. This power is then distributed to four traction motors each of which is directly geared to a pair of driving wheels.

The locomotive may consist of one or more individual units each of which is completely functional power plant. When coupled together for multiple unit operation, all can be simultaneously controlled from a single set of controls located in the cab of the lead unit.

This manual describes some functions of this virtual model for Train Simulator 2013 and provides a brief description of how the locomotive operates.

## **FUNCTIONAL COMPONENTS**

### **STORAGE BATTERY**

The storage battery supplies power to run the fuel pump and to start the engine through motorizing of the main generator. It also supplies power for the lights and control circuits. Once the engine is running, the auxiliary generator provides all low voltage needs and it charges the battery as well.

An ammeter is provided on the rear cab wall above the electrical cabinet to indicate whether the storage battery is being charged or discharged.

## ELECTRICAL CONTROL CABINET

Forming the rear wall of the cab is the electric cabinet. Within the cabinet are the majority of electrical devices required to control locomotive operation. These consist of fuses, circuits breakers, switches, etc.

Cabinet access door is provided for purposes of equipment control and inspection. They should be always kept closed during the locomotive operation.

## ENGINE COOLING FANS

Two cooling fans are mounted in the roof at the long hood end of the locomotive. Their function is to draw air through the radiators assemblies beneath them in order to maintain proper temperatures of the engine.

Each of these fans are 48" in diameter and are driven by 25 horsepower motors. They are designed for heavy duty service to provide the air flow volume needed for engine cooling. They will function automatically in response to thermostat control. Each fan has a switch for control.

To avoid a quick increment of the temperature and an overheat of the diesel engine, both switches must be ON before the engine starting.

## FUEL PUMP

A small direct current electric motor is used to drive the fuel pump. The motor operates on battery current in order to supply fuel to the engine for starting purposes, once the engine is running, the energy should be supplied by the auxiliary generator.



## CONTROL CIRCUIT BREAKER

This circuit breaker must be in the ON position in order for the locomotive to be operated. It establishes power from the battery for operating the fuel pump and starting the engine.

## LOCAL CONTROL BREAKER

This circuit breaker must be in the ON position in order for the locomotive to be operated. It establishes "local" power from the auxiliary generator to operate certain of the heavy-duty electromagnetic switchgear components contained in that particular unit.

## LIGHTS CIRCUIT BREAKER

This circuit breaker must be ON to supply power for the individual switches provided for platform, numbers, signal and head lights.

## MAIN BATTERY KNIFE SWITCH

The large double pole, single throw knife switch at the lower right hand corner of the control panel is the main battery switch and is used to connect the battery to the locomotive low voltage system. It should be kept closed at all times during operation.

If this switch were left open, the fuel pump could not be started, the lights would not function and the engine could not be started. If the switch were opened after the engine was started and the auxiliary generator was supplying the low voltage needs, then the batteries could not be charged.

## BATTERY CHARGING AMMETER

With the main battery switch closed, the battery charging ammeter is connected into the low voltage circuit to indicate the



extent of current flowing to or from the storage battery. This meter does not indicate the output current of the auxiliary generator. Since the storage battery is usually well charged, the meter in normal operation should read zero or slight charge.

When the engine and auxiliary generator are stopped, all low voltage current requirements such as for lights, fuel pump motor and cab heaters are supplied by the storage battery. In such instances, current would be coming from the battery which would be discharging. The meter pointer would be reading to the left of the center-zero position to indicate the extent of discharge.

When the diesel engine is started, the auxiliary generator is in operation and will be supplying all low voltage current needs. In addition, the generator will also be charging the storage battery. In such instances, current will be flowing to the storage battery and would be indicated by the meter pointer being to the right of center-zero or charge side of the meter.

During the normal operation, the meter should always be indicating either zero or a slight charge. A zero indication would mean that the battery was fully charged.

## AUXILIARY GENERATOR

The purpose of the auxiliary generator is to supply power for the low voltage electrical system of the locomotive. This low voltage is used for such important functions as actuating electrical control circuits and equipment, charging the storage battery, lighting, fuel pump, cab heater, defogger, etc.

## UNIT SELECTOR SWITCH

This switch allows the remote control of the trailing locomotives and should be set to the N° 1, 2, 3 or 4 position depending on the number of locomotive units physically connected together.



This switch position is of importance only in the lead locomotive unit during the operation.

This switch **MUST** be set to the N° 1 position in all trailing locomotive units.

## ISOLATION SWITCH

The isolation switch has two positions, namely **START** (or isolate) and **RUN**. The function of these two positions are as follows:

### A. Start Position

The isolation switch is placed in this position whenever the diesel engine is to be started or stopped. The **START** and **STOP** push buttons are effective only in this switch position.

### B. Run Position

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

## ENGINE START PUSH BUTTON

In order to start the diesel engine, the fuel pump must be running, the isolation switch must be in the **START** position and then the **START** push button may be depressed. This motorizes the main generator to crank the engine.

In starting the engine, the push button should be depressed firmly and held in until the engine starts. If the engine does not start, refer to the trouble shooting section of this manual for likely causes.



## ENGINE STOP BUTTON

To stop the diesel engine, the isolation switch must first be placed in the START position after which the engine STOP push button may be depressed. Doing so produces a gradual drop of the fuel pressure which causes the diesel engine to stop.

## FUEL PUMP CIRCUIT BREAKER

The fuel pump circuit breaker must be ON for normal operation.

## TEMPERATURE METER

The engine temperature can be checked looking at this meter. While the diesel engine is not running this meter will show the ambient temperature for reference. Check these values just in the moment after the scenario has loaded to verify if some action for heating is required.

## CAB HEATER

There is a cab heater which blows warm air into the cab for heating. This device is especially useful to defog the glasses in low ambient temperatures.

## ENGINE HEATER

There is a engine heater which produces a engine heating for cold starting. Use this component if the ambient temperature is below of 40° Fahrenheit, otherwise the diesel engine could take a long time to start which could discharge the battery quickly. Once the diesel engine is running, the heater must be stopped to avoid an unneeded increasing of the engine temperature.

## AUTOSANDER

If the switch of the Autosander function is ON, an automatic flow of sand will be released on a wheel slip event. There is a dial to set the time for the sand dropping. The sanding lapse can be 5 to 20 seconds.

## AUTOMATIC UNLOAD

If the switch of the Automatic Unload function is ON, and if a wheel slip event is detected, after a few seconds, an automatic drop of the power will affect the traction motors in order to avoid wheels slipping. Power is then gradually reapplied after slipping has stopped.

This feature can be used together with the Autosander function, for redundant safety.

## OPERATING SWITCHES

Along the front face of the control stand are a group of switches. At each switch is an identifying nameplate indicating switch function. The switches are in ON position when moved upward.

Before the engine can be started, the FUEL PUMP switch must be placed ON.

After being started, the engine speed can be controlled by the throttle providing the ENGINE RUN switch is placed ON. To obtain power from the locomotive, the GENERATOR FIELD switch must be placed ON. These three important switches are grouped together at the extreme right side on the stand.

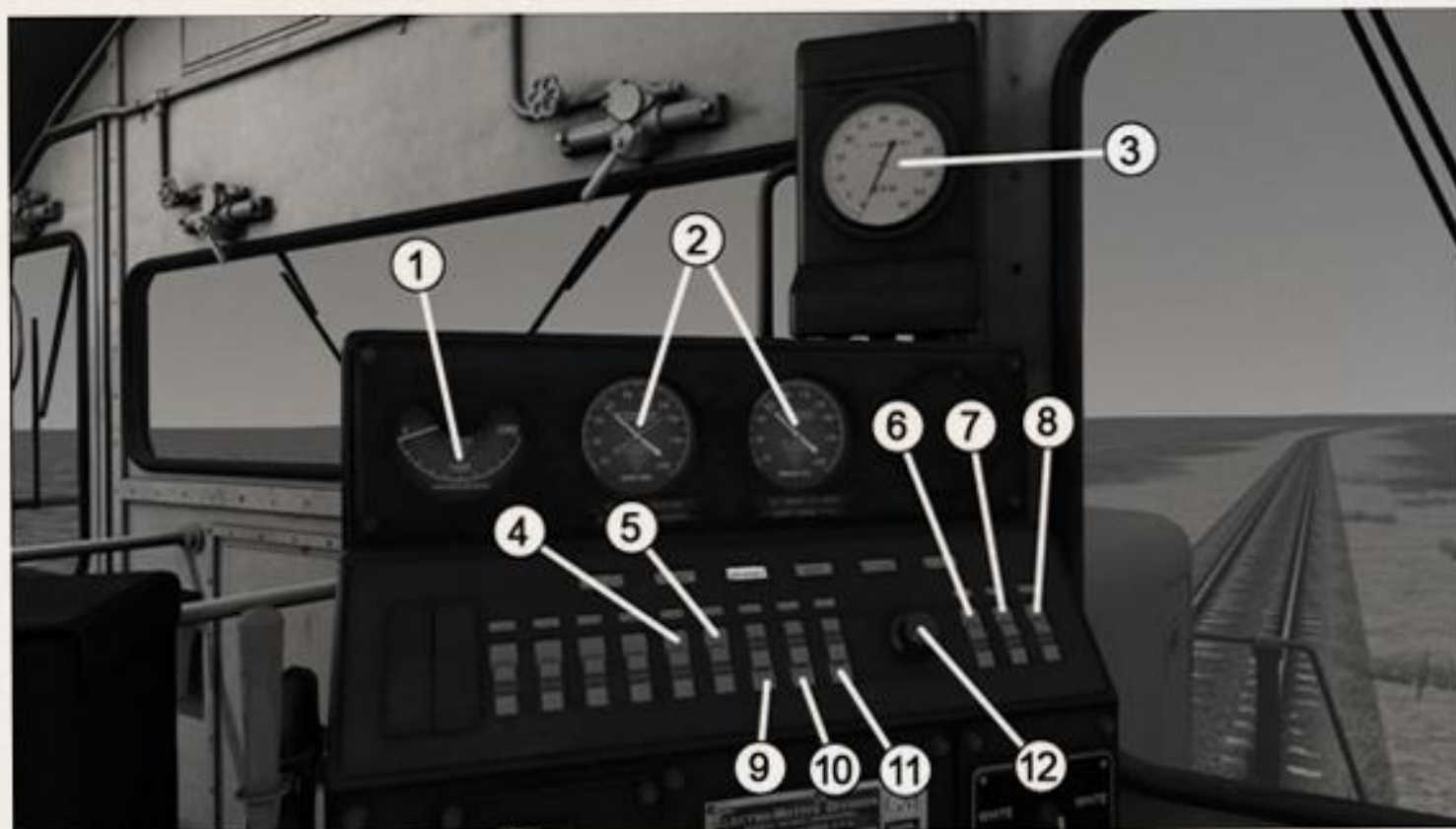


## THROTTLE LEVER - STOP POSITION

To stop all engines, the throttle lever is pulled out away from the stand and then moved one step beyond **IDLE** to **STOP** position. The **IDLE** position is as far forward as the throttle lever can be moved without pulling it away from the stand. To avoid an undesired or accidental stopping of the engines, the throttle lever has a timer which locks the lever during one second in the **IDLE** position when the lever is moved from higher positions. However, a careful handling of the lever is advised.

## LOCATING COMPONENTS OF THE CAB

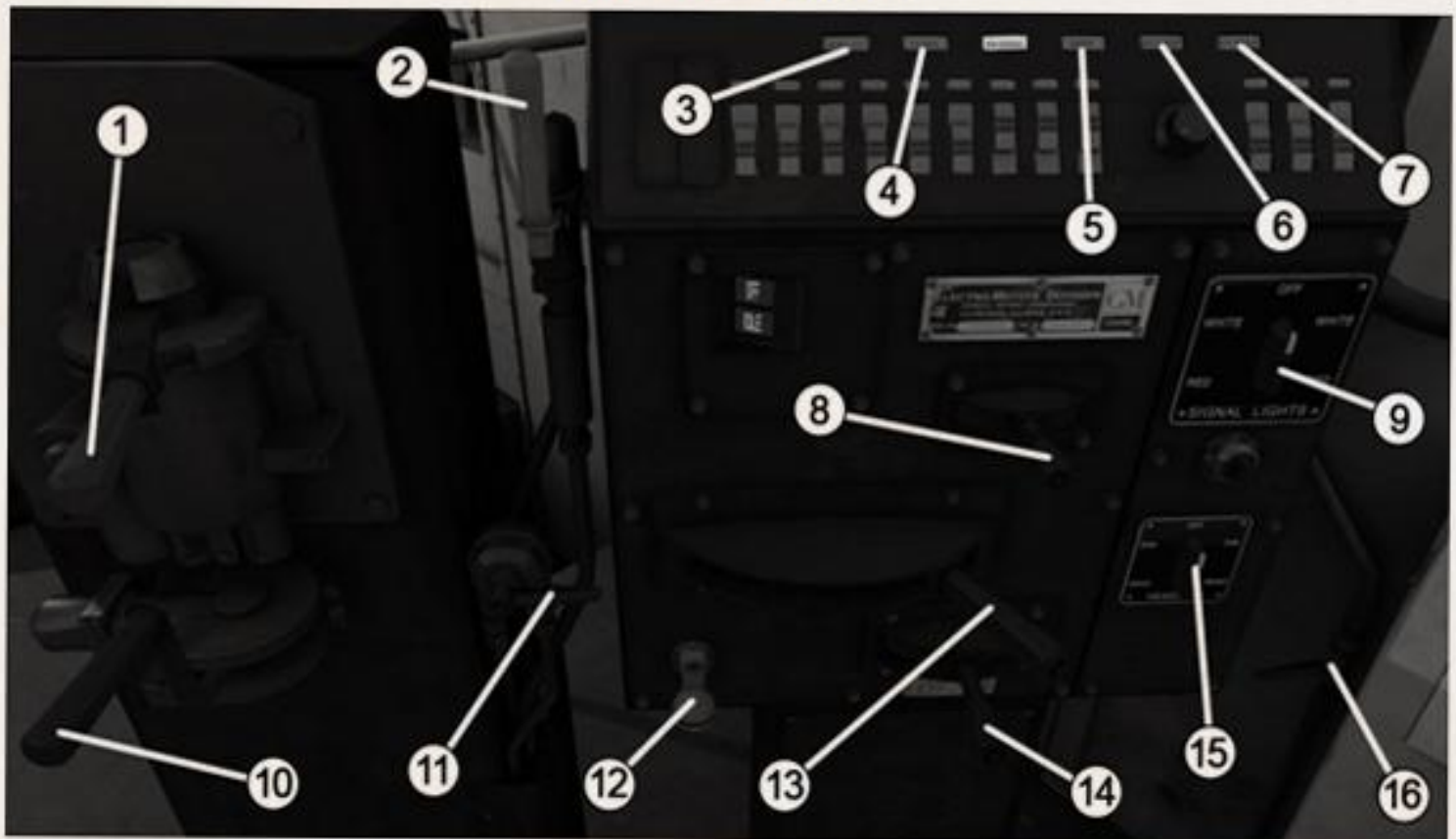
### CONTROL STAND A



- |                        |                            |
|------------------------|----------------------------|
| 1.- Load Meter         | 7.- Generator Field Switch |
| 2.- Air Gauges         | 8.- Fuel Pump Switch       |
| 3.- Speedometer        | 9.- Indicators Light       |
| 4.- Autosander Switch  | 10.- Speedometer Light     |
| 5.- Auto Unload Switch | 11.- Gauges Light          |
| 6.- Run Engine Switch  | 12.- Autosander Timer      |



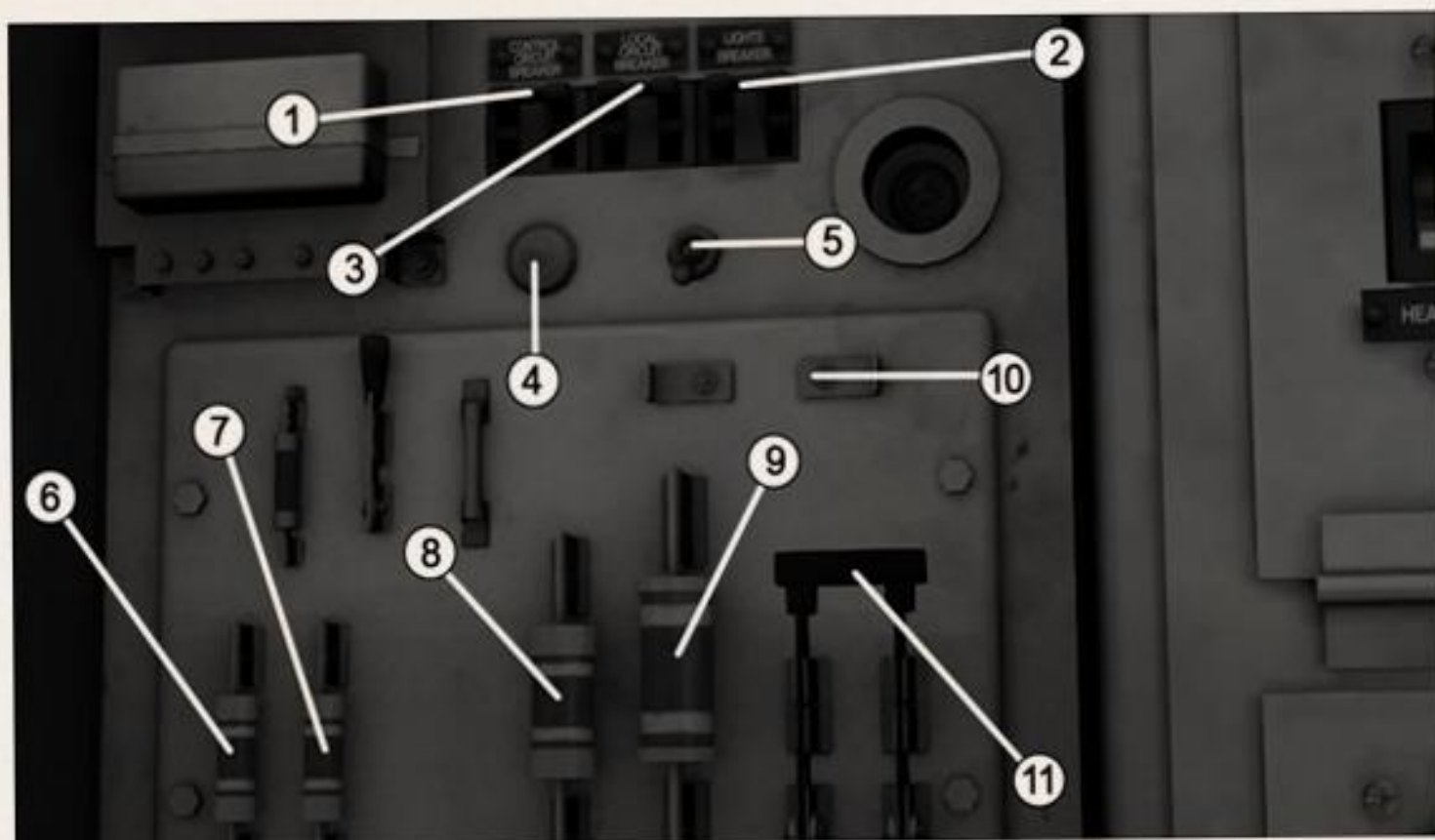
## CONTROL STAND B



- 1.- Train Brake
- 2.- Horn Valve
- 3.- Wheelslip Alert
- 4.- PC Open Alert
- 5.- Sander Alert
- 6.- Autosander Alert
- 7.- Auto Unload Alert
- 8.- Selector Lever

- 9.- Signal Lights Dial
- 10.- Independent Brake
- 11.- Bell Valve
- 12.- Sander Switch
- 13.- Throttle Lever
- 14.- Reverser Lever
- 15.- Headlights Dial
- 16.- Wipers Valve

## ELECTRICAL CONTROL CABINET

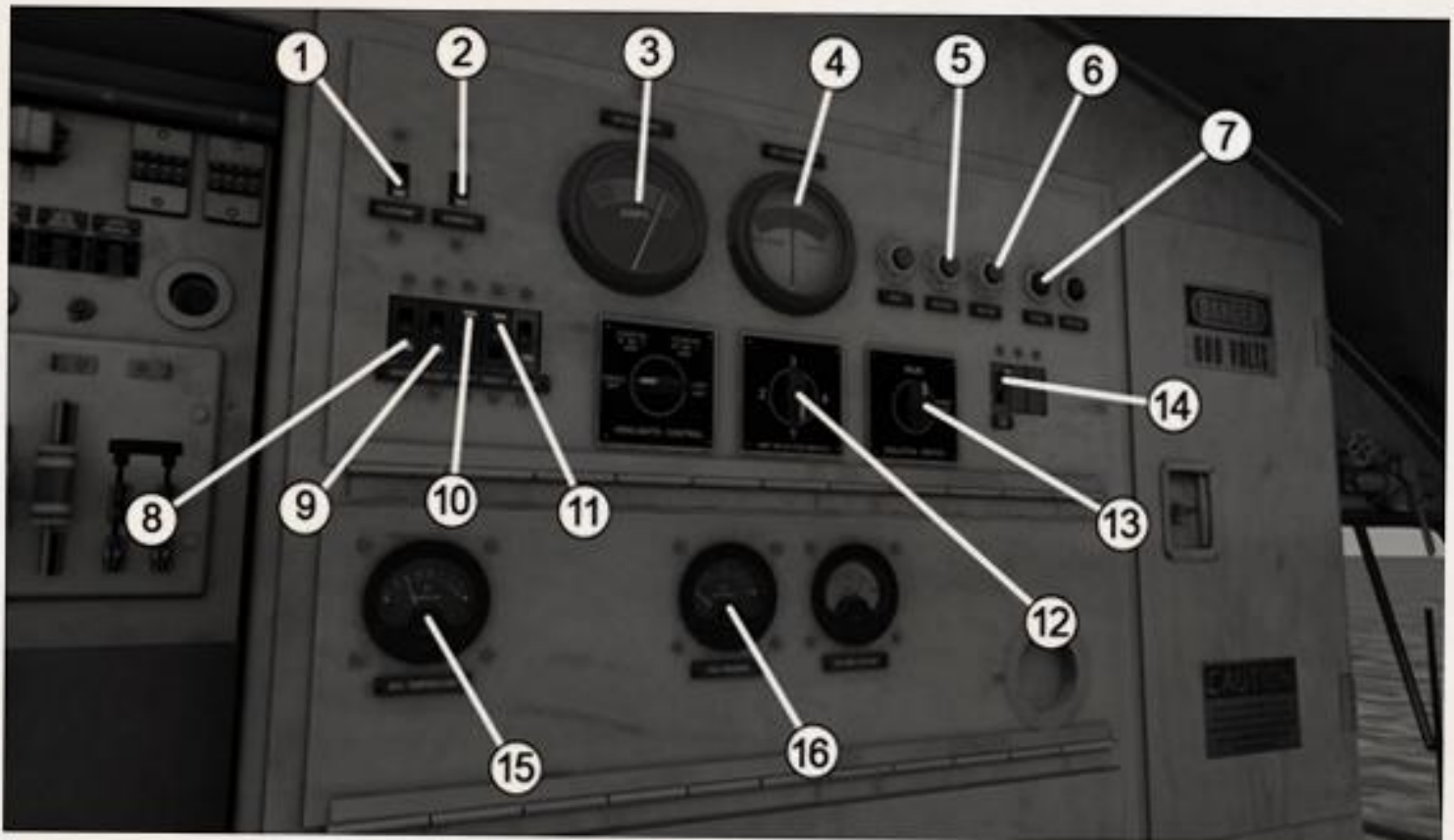


- 1.- Control Circuit Breaker
- 2.- Lights Breaker
- 3.- Local Circuit Breaker
- 4.- Fuse Test Light
- 5.- Fuse Test Switch
- 6.- Battery Field Fuse

- 7.- Lights Fuse
- 8.- Auxiliary Generator Fuse
- 9.- Starting Fuse
- 10.- Fuse test Equipment
- 11.- Battery Knife Switch



## ENGINE CONTROL PANEL



- 1.- Platform Lights
- 2.- Numbers Lights
- 3.- Battery Charge
- 4.- Battery Charging State
- 5.- Engine Start Button
- 6.- Engine Stop Button
- 7.- Overheat Alert
- 8.- Cab Heater Switch

- 9.- Engine Heater
- 10.- Fan N° 1 Switch
- 11.- Fan N° 2 Switch
- 12.- Unit Selector Switch
- 13.- Isolator Switch
- 14.- Fuel Pump Breaker
- 15.- Temperature Meter
- 16.- Fuel Pressure Meter

## **PREPARATION FOR SERVICE**

Before of the engine starting the control areas should be checked and the equipment positioned for operation as follows:

### **ELECTRICAL CONTROL CABINET**

- 1.- Main battery switch closed.
- 2.- Control circuit breaker ON.
- 3.- All fuses installed and in good condition.
- 4.- Local circuit breaker ON.
- 5.- Lights circuit breaker ON.

### **ENGINE CONTROL PANEL**

- 1.- Fuel pump circuit breaker ON.
- 2.- Isolation switch in START position.
- 3.- Unit selector switch in position to correspond with total number of units in locomotive consist.(Only for lead unit)
- 4.- Both switches of fans must be ON.
- 5.- Engine heater ON as required.

### **MAIN CONTROL STAND**

- 1.- Place fuel pump switch ON.
- 2.- Place engine run switch ON.
- 3.- Make sure reverser lever is in neutral position.
- 4.- Make sure throttle is in IDLE.
- 5.- Make sure selector is in OFF.



## **TO START DIESEL ENGINE**

After completing the preceding inspections, the diesel engine may be started as follows:

- 1.- make sure the isolation switch is in START, fuel pump breaker is ON, and fuel pump switch is ON.
- 2.- Observe that fuel pressure is satisfactory (over 10 psi)
- 3.- Firmly press start push button in and hold until engine starts and runs.
- 4.- After starting engine, place the unit "on the line" by moving isolation switch to RUN position.

## **MOVING THE LOCOMOTIVE**

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

- 1.- Place de selector lever in the N° 1 position.
- 2.- Move reverser lever to the desired direction, either FORWARD or REVERSE.
- 3.- Place generator field switch in ON position.
- 4.- Place automatic sanding switch ON if desired.
- 5.- Release both automatic and independent air brakes.
- 6.- Open the throttle one notch every 1 to 2 seconds as follows:
  - a. To Run 1 - Note the load meter pointer start moving to the right.

b. To Run 2 - Note the engine speed increase. at an easy starting place, the locomotive may start the train in Run 1 to 2.

c. To Run 3 or higher (experience and demands of the schedule will determine this) until the locomotive moves.

7.- Reduce the throttle one or more notches if acceleration is too rapid.

8.- After the train is stretched, advance throttle as desired

### TO STOP ENGINE

There are two ways of stopping the engine:

(1) normal and (2) emergency.

1.- Place isolation switch in START position and press in on Stop button, holding it until engine stops.

2.- In an emergency, all engines are simultaneously stopped by pulling the throttle lever out away from the stand, then pushing it one step beyond IDLE to the STOP position.

NOTE: The diesel engine may also be stopped if any of the fuel pump switches goes to OFF position or if the electrical supply for the fuel pump is cut in.

### DYNAMIC BRAKE

To operate dynamic brakes, proceed as follows:

1.- Observe that the unit selector switch position in the lead unit corresponds to the number of units in the locomotive consist.



- 2.- The reverser lever should be positioned in the same direction of locomotive movement.
- 3.- Throttle must be reduced to IDLE.
- 4.- Move the selector lever from N° 1 to OFF position.
- 5.- Move the selector lever to the "B" or braking position. This establishes the dynamic braking circuits.
- 6.- Braking effort may be increased by slowly advancing the throttle to the full sth notch position if desired.

### TEMPERATURE CONTROL

The temperature control is as follows:

If thermostat reaches  $170^{\circ} \pm 1^{\circ}$  F energizes the No. 1 cooling fan.

The temperature should drop below  $155^{\circ}$  F to stop the No. 1 cooling fan.

If thermostat reaches  $180^{\circ} \pm 1^{\circ}$  F energizes the No. 2 cooling fan.

The temperature should drop below  $165^{\circ}$  F to stop the No. 2 cooling fan.

### HOT ENGINE ALARM

A hot engine alarm relay will close when the diesel engine reaches a temperature of approximately  $200^{\circ}$  F. This will cause the alarm bells to ring and will light the red HOT ENGINE light on the engine control panel.

If the temperature continues increasing the throttle will be set to IDLE, automatically. Once the temperature drops below  $200^{\circ}$  F, the HOT ENGINE light will turn off and the overheat state will finish. However, the throttle lever must be reset (put the lever in idle position) to get the throttle control again.

In an extreme situation, if the temperature reaches 220° F, the diesel engine will be stopped in emergency mode.

## ALERTS LIGHTS

### WHEELSLIP ALERT

On the control stand, a flashing alert light will turn ON if a wheel slip event is detected. Corrective action is seldom necessary particularly if the automatic sanding feature is cut in.

### AUTOSANDER ALERT

On the control stand, an alert light will turn ON if the automatic sander system is armed and it has started.

### AUTOMATIC UNLOAD ALERT

If the automatic unload system is armed, an alert light will turn ON after 4 seconds since a wheel slip event is detected. The light will keep ON during the unload process but will turn OFF when the power is being reapplied again.

### PNEUMATIC CONTROL ALERT

If the direct brake lever is set at emergency position the throttle will be set to IDLE, automatically and an alert light (labeled PC OPEN) will turn ON. Once the brake is released, the light will back to OFF. However, the throttle lever must be reset (put the lever in idle position) to get the throttle control again.



## **TROUBLE SHOOTING**

### **ENGINE CANNOT BE STARTED**

Engine starting difficulties fall into two categories, namely, engine does not rotate when START button is pressed, or engine rotates but does not start. The following items should be checked in either event:

#### **Engine Does Not Rotate**

- 1.- Main battery must be sufficiently charged.
- 2.- Main battery switch must be closed.
- 3.- Control circuit breaker must be ON.
- 4.- Starting fuse must be good and in place.

#### **Engine Rotates But Does Not Start**

- 1.- Reverser lever must be in NEUTRAL.
- 2.- Selector must be in OFF.
- 3.- Throttle lever must be in IDLE.
- 4.- Fuel pump switch must be ON.
- 5.- Fuel pump breaker must be ON.
- 6.- Isolation switch must be in START.
- 7.- Fuel pressure should be over 10 psi.

**Note:** A low ambient temperature may cause the diesel engine takes a long time to start. Use the engine heater if required.

## ENGINE DOES NOT RESPOND TO THROTTLE

In instances where an engine is running normally at IDLE speed but does not speed up when throttle is advanced, the following items should be checked:

- 1.- Isolation switch must be in RUN.
- 2.- Engine run switch must be ON.
- 3.- Selector must be in POWER N° 1 position.

## LOCOMOTIVE DOES NOT LOAD UP

In instances where the diesel engine is running and responds properly to throttle yet the locomotive does not move or load up, the following items should be checked:

- 1.- Reverser lever must be in either FORWARD or REVERSE.
- 2.- Generator field switch must be ON.

## ENGINE STOPS DURING OPERATION

If suddenly the engine stops during normal operation, check these possible causes.

- 1.- Insufficient fuel.
- 2.- Engine temperature over 220° F.
- 3.- Throttle lever in STOP position.
- 4.- Fuel pump switch OFF.
- 5.- Fuel pump breaker OFF.



## **INCLUDED SCENARIOS**

### **DONNER PASS**

#### **1.- Freshly Frozen Norden Waters**

Christmas is probably the best time of the year to remember those fantastic 'Snowball Special' trains from the beginning of the 20th Century. Tomorrow, a steam hauled special train will travel along the Donner Pass to commemorate those legendary trains. So it has been decided to tidy Truckee station a little bit and move some wagons out of the way to ensure there's room in the sidings for the 'Snowball Special' tomorrow. A nice and easy job for your GP-20, isn't it?

#### **2.- Sparks-Reno Local**

Reno's yard holds a few freight cars that need swapping every day. To avoid interfering with the day traffic, these local trains are operated at night time with a GP-20 at the helm. It's a nice and quiet Summer night - what else could you be doing other than switching wagons?