LOCOMOTIVE OPERATING INSTRUCTIONS

"A Service Institution"

Four - 5400 H. P. Freight Locomotives
Numbers 501 to 508 Incl.

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No. 10

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Who hereby agree to return to the proper official when called for, or upon leaving the service, or failing to do so, authorizes the deduction of fifty cents (50c) from wages due.

GENERAL NOTICE

Each Employee whose duties are in any way connected with the operation of 5400 H.P. Diesel Freight Locomotives will be required to familiarize themselves with these instructions.

O. A. GARBER
Chief Mechanical Officer

SECTION I

GENERAL DESCRIPTION

The freight locomotive is rated at 5400 HP. and includes four sections, each having one 16-cylinder Diesel engine and direct current generator. From each power plant current is wired to the two four-wheel trucks under the respective section. The sections are electrically independent of each other except for certain low voltage wires. The sections with cabs will be known as 1st Sections, those without as 2nd Sections.

The two 1st Sections are similar to each other as are the two 2nd Sections in between.

The Model 16-567 Diesel engine in each section is rated at 1350 HP. at 800 R.P.M.

These 8½" bore, 10" stroke, two cycle engines turn counter clockwise (when facing the generator end). In the 1st Section the generator end of the engine is toward the cab end. In the 2nd Section the generator end of the engine is to the rear of the section. This brings the accessory ends of the engines adjacent. See the Floor Plan drawing in Section 1 for details.

The engines are "V" type with a 45 Deg. angle between banks, and a compression ratio of 16 to 1. Solid unit injection is employed, there being an injector centrally located in each cylinder head. The engines have a speed range of from 275 to 800 R.P.M. Their speed is controlled by a governor control which is an air operated device connected electrically to the engineer's throttle. In this way all four engines in the locomotive can be controlled simultaneously. Each notch on the engineer's throttle changes the engine speed 75 R.P.M.

The two ends of the engine are referred to in various ways, and Figure 1 shows these names and the cylinder numbers.

The engines are fully scavenging. Two blowers are mounted on each engine over the generator. These force air into the space around the cylinders with a pressure of 3 to 5 pounds. When the piston is at the lower end of its stroke it uncovers a row of ports admitting this scavenging air. Thus the exhaust gases are expelled around the exhaust valves and a fresh charge of air is made available for the next working stroke.

Starting the engines is accomplished by connecting the locomotive storage battery to the main generator, operating it as a motor. The starting field in the generator is used only for starting the engine. The other fields control the output of the generator.

The flow of current through the generator is always in the same direction. Reversing of the locomotive is accomplished by reversing the direction of current in the traction motor fields only. The engineer's reversing lever is not connected in any way (other than by the control circuit) to the reverser in the high voltage cabinet.

Detailed descriptions of each phase of operating the locomotive can be found in the following pages of Section 1:

LOCOMOTIVE OPERATION

ENGINEER'S CONTROLS: (See Plate 3161)

1. The Engineer's control station contains the locomotive throttle, transition lever, and reversing lever.

2. The control push-button box on the right of the control station has fused switches for:
   a. Attendant's call.
   b. Master Control (2 buttons).
   c. Generator Field.
   d. Fuel Pump.
   e. Defroster Blower.
   f. Number lights.
   g. Gauge lights.
   h. Classification lights.

3. The instrument panel contains the following indicators: application pipe and suppression pipe air gauge, main reservoir and equalizing reservoir air gauge, brake cylinder and brake pipe air gauge, and wheel slip light. The gauges are indirectly lighted for night operation.

4. The transition indicator is an ammeter connected in the armature circuit of the 1st Section's No. 4 traction motor. This indicates the proper position for the transition lever.

5. The sanding valve operates the sand traps throughout the entire locomotive. This is a one-way valve, operating the first two sections in forward sanding and the last two sections in reverse sanding when the valve is moved.

6. The bell valve operates the locomotive signal bell. (This is not the alarm bell, which is an electrical device.)

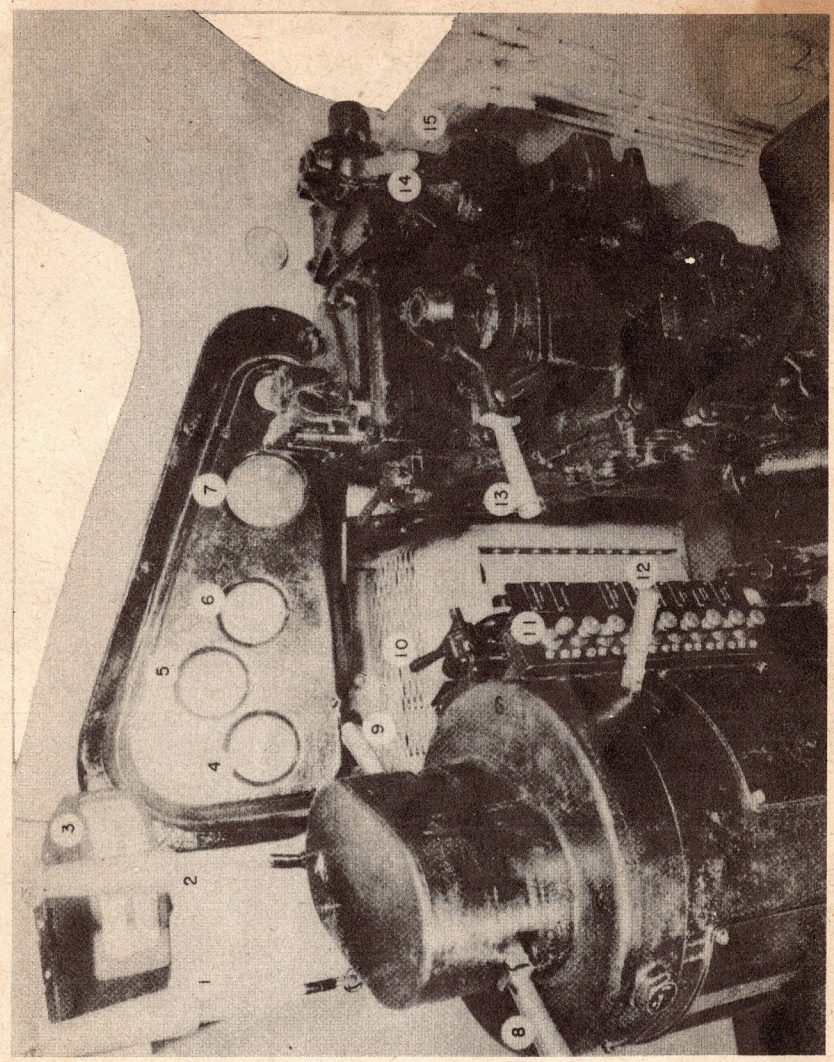
7. The headlight switch is located to the right of the engineer. It has an "off", "dim", and "bright" position.

8. The hand brake hand wheel is located in the cab of the first section and right rear of the second section. To set brake, hold down the foot pedal and turn the wheel. To release the brake, advance the wheel enough to release the foot pedal and then let go and stay clear of the wheel. Before moving the locomotive, be sure the brake is completely released. Whenever anyone is working around the locomotive trucks, have the hand brake on.

9. The pneumatic control switch is an air operated switch located on the right hand side of the cab, below the window. The purpose of this switch is to reduce the speed of the engines to idling when a Deadman, Overspeed, or Automatic Train Control brake application is made. An emergency application will not affect the switch. This switch also breaks the control circuit to the fuel pump contactors and "E" magnet valve of the engine control circuit.

   The switch has normally closed contacts and is set to open at 40# and close at 20# pressure. The switch is connected through the brake application valve in such a way that a shot of air is communicated to the switch and contacts are opened. This reduces the engines to idling speed and shuts off the fuel pumps. Under normal operation, there is zero pressure on the switch and the contacts are closed.

   The switch has a "lock-out" button which holds the contacts open after the switch is once operated, making it necessary to



1&2 HORN CORDS
3 TRANSITION INDICATOR
4 TRAIN CONTROL APPLICATION & SUPPRESSION GAUGE
5 EQUALIZING & MAIN RESERVOIR GAUGE
6 BRAKE PIPING & BRAKE CONTROL GAUGE
7 SPEEDOMETER
8 TRANSITION LEVER
9 THROTTLE
10 BELL VALVE
11 CONTROL SWITCHES
12 REVERSING HANDLE
13 AUTOMATIC BRAKE VALVE
14 INDEPENDENT BRAKE VALVE
15 SANDING VALVE

ENGINEER'S CONTROLS PLATE 3161

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reset the switch before the engines can again be operated. The switch has a manual reset button which must be pulled out after the brakes have been released.

ENGINE CONTROL AND INSTRUMENT PANEL:

This panel is mounted on the wall of the engine room at the accessory end of each engine. It contains the gauges, lights, relays, and switches used in conjunction with engine operation.

DISTRIBUTION PANEL:

This panel contains the switches and fuses controlling the battery circuits throughout the locomotive. (See Plate 3173.) This panel also contains the ammeter, voltmeter and fuse test light.

PRECAUTIONS BEFORE STARTING ENGINE:

1. Check positions of all valves for correctness.
   a. Drain valves in cooling, lube oil system, and air reservoirs.
   b. Steam valves in cooling system and steam line.
2. Check fuel supply.
3. Check water supply.
4. Check lubricating oil supply.
   a. In main engine sumps.
   b. Engine governors.
   c. Air compressors.
5. Close charging switches in low voltage cabinets.

STARTING ENGINES AFTER LAYOVER:

1. At Distribution Panel:
   a. Be sure all fuses are in place.
   b. Close main battery switch.
   c. Close main control switch.
   d. Close light or train control switches as required.

2. At engineer's control station:
   a. Put throttle in idle position.
   b. Close control push-button switch.
   c. Close fuel pump switch.
   d. Set PC switch.

3. At engine:
   a. Test for cylinder accumulation. With cylinder test valves open and isolation switch in "Start" position (and fuel pump off), rotate engine once by hand, using turning bar. If discharge at test valves is noted, do not start engine until cause of discharge is removed.
   b. Close cylinder test valves.
   c. Close fuel pump switch on Engine Instrument Panel, and watch for fuel in 5# relief valve sight glass.
   d. See that isolation switch is in "Start" position.
   e. Push injector control lever toward engine until pointer on injector linkage dial is on idle or slightly above. This will open the injectors, starting the engine quickly, reducing unnecessary strain on the batteries.
   f. Push engine "Start" button and hold in until engine speed reaches approximately 200 R.P.M. (By this time starting current has reduced so that the starting contactors will not be burned.) Do not hold button down for more than 10 seconds at a time.

   g. After lubricating oil pressure builds up, place isolation switch in "run" position. Water temperature should be up to 125 Deg. F. before locomotive is worked.

TO MOVE LOCOMOTIVE:

1. Make certain main reservoir air pressure is up.
2. Release all hand brakes.
3. Isolation switches on engine control panels must be in "run" position.
4. Press in generator field switch on engineer's control stand.
5. Transition lever must be in position No. 1.
6. Place reversing handle in desired position.
7. Put foot on Deadman Pedal and release brakes.
8. Set pneumatic-control switch.
9. Open throttle as required (see next paragraph).

HANDLING TRAIN:

During normal operation it is never necessary to move the throttle or any other controls hastily. Each move should be thought out carefully and made smoothly.

Due to the unusual amount of starting or tractive effort of this locomotive, it is highly essential that no attempt be made to start the train for a period of from 3 to 5 minutes after the brakes have started to release. Then proceed as follows:

1. Starting a Train:

Proceed in general as follows:
Place transition lever in No. 1 Position.
Place throttle in Run 1 for 2 or 3 seconds.
Then.....Run 2 for 2 or 3 seconds.
Then.....Run 3 for 10 or 15 seconds.

Then if the train keeps moving in Run 3, leave the throttle in that position **until all the slack is out,** then open the throttle to the required notch, taking at least 4 to 5 seconds in each position.

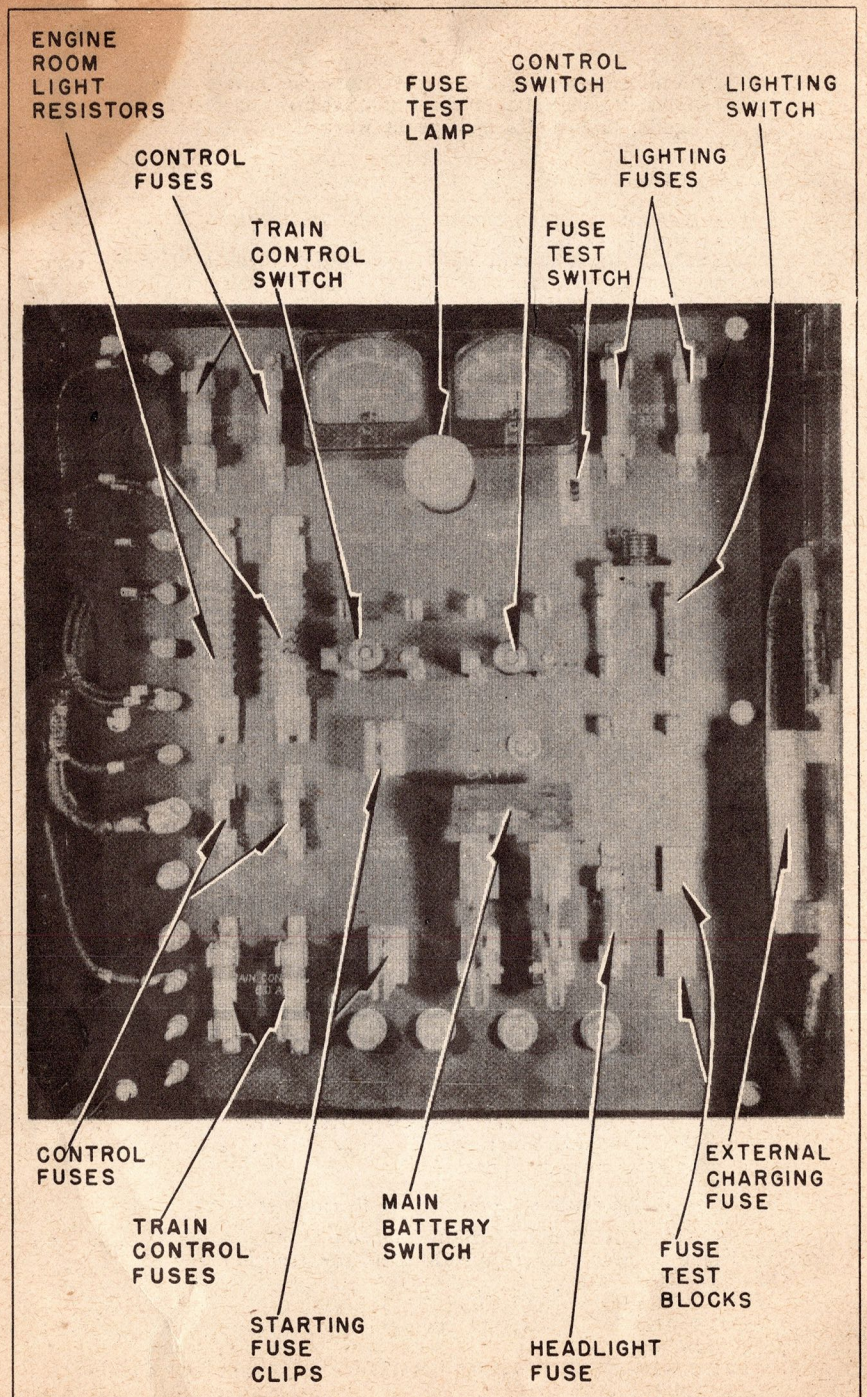
If the train cannot be started in Run 3, open throttle to Run 4. As soon as the locomotive moves, notch back to Run 3 until it is certain that all slack is out. If the locomotive stops, repeat the above. **Make certain that all brakes are released before leaving throttle in Run 4 for more than 10 seconds.**

2. Taking Slack:

With the high tractive effort at starting of this locomotive it is seldom necessary to bunch slack. If a tight train will not start, look for brake trouble. Bunching slack and starting with a jerk may result in damaged couplers.

3. Operation of Transition Lever and Indicating Meter:

The transition lever, located on the top of the control stand, has four positions to give four connections of the traction motors.
These positions are:
No. 1 SERIES-PARALLEL (0-21 MPH)
No. 1 and No. 4 traction motors are permanently connected in parallel.
No. 2 and No. 3 traction motors are permanently connected in parallel.
In the No. 1 position these two sets are in series. (See Fig. 2.)



DISTRIBUTION PANEL PLATE 3173

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No. 2 SERIES-PARALLEL-SHUNT (21-32 MPH)
The fields of each motor are shunted by resistors.

No. 3 PARALLEL (32-58 MPH)
All motors are connected in parallel. (See Fig. 3.)

No. 4 PARALLEL-SHUNT (58 to 70 MPH)
The fields of each motor are shunted by resistors.

A definition of transition is inserted at this point so that the term will not be confusing. Transition is the changing of the traction motor connections to obtain the desired locomotive tractive effort and speed within the voltage and current operating limits of the main generator.

To obtain maximum tractive effort when the train is at low speed, the traction motors are connected in series-parallel. As their speed increases, the generator voltage rises and traction motor current reduces until the indicating meter (traction motor ammeter) drops into the area marked 2. The engineer then moves the transition lever to position No. 2 which shunts the traction motor fields. This reduces the generator voltage and increases the traction motor current for increased speed.

As train speed continues to increase, the generator voltage increases. the traction motor current decreases, and the engineer shifts to No. 3 position, parallel; then finally, No. 4 position, parallel-shunt.

In this way, the locomotive is able to produce the most tractive effort over its entire speed range.

The indicating meter has four areas on its face corresponding to the positions of the transition lever as well as a red overload area. As the throttle is opened, but before the train speed increases, the pointer will swing to the right, indicating high traction motor current. If the throttle is not opened any more and the train speed increases, the pointer will move back toward the left. The locomotive should not be operated with pointer in the red area except when accelerating a train while making exceptionally hard starts. The pointer should not come to rest in the red area. In other words, when the balance speed is reached, the pointer should be to the left of the red area.

The upper red triangular mark indicates the maximum continuous current. The locomotive should not be operated with the pointer to the right of this mark continuously. Otherwise, the traction motors will be over-heated. The locomotive should not be operated to the right of this mark except where Electro-Motive performance calculations indicate that it is permissible to exceed the continuous rating under the particular local conditions. If the transition lever is in the No. 2 position, and the pointer moves to the right of this mark, shifting to No. 1 position will move the pointer to the left of the triangular mark. If tonnage ratings have not been supplied by E.M.D., the following precaution should be followed: if, the pointer moves to the right of the mark while in the No. 1 position and stays there for 30 minutes, it will be necessary to stop and reduce tonnage.

Tonnage ratings that have been established must be reduced in case of engine or traction motor failure in proportion to the number of locomotive sections remaining in service.

See Fig. 4 for sketch of transition meter dial.

The locomotive should always be started with the transition lever in the No. 1 position. When the throttle is in Run 8 position, the pointer will swing into the area marked (1). As the train speed increases, the pointer will move to the left. As the pointer reaches the shift lines,

the transition lever should be moved to the position indicated by the meter. The indicator pointer should always be in the numbered area corresponding to the position of the lever with the throttle in Run 8 position, and in this area or to the left of it in any lower position of the throttle.

As the train speed decreases due to a grade, the pointer will gradually move to the right. When the pointer crosses a shift point, the transition lever must be moved to the position indicated. This should be done regardless of the throttle position and the lever should be in the No. 1 position before the locomotive comes to a stop. Always move the lever one notch at a time.

No damage will result in failing to advance the transition lever with increasing speed. But serious damage will result, and the electrical equipment will overload, if the lever is not backing off at the point indicated when the locomotive speed is decreasing due to a grade.

The transition lever is mechanically interlocked with the throttle so that the lever can be moved from 1 to 2, 2 to 1, 3 to 4, or 4 to 3 in any throttle position. The lever cannot be moved from 2 to 3 or from 3 to 2 with the throttle in the 7th or 8th position.

The transition lever slides in a slot which is notched at both top and bottom. The lever has lugs on the top and bottom which engage in these slots, arranged so that the lever can only be moved from one notch to the next by proper manipulation. The lug on the top is integral with the lever, while the lug on the bottom can be depressed up into the lever. (See sketch.) To move the lever from one position to the next, the lever is lifted (A), and while it held up against the top quadrant (B), it is moved in the direction desired with the top lug held against the side of the upper slot (C). The lever is then lowered (D), which compresses the bottom lug (E), allowing the lever to slide to the next position "F". (See Fig. 5.)

4. Operation of Wheel Slip Indicator:

Whenever any wheels slip, either one pair of wheels or both pair of wheels on the same truck, or on any truck on the unit, the indicator on the engineer's instrument panel will light. To stop the slippage, ease off on the throttle. Do not apply sand until after the slippage has been stopped.

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

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

5. Manual Transition Speeds:

If at any time the transition meter does not function properly, or the leading section has been isolated, it will be necessary to make transition by reference to the locomotive speed. The table below shows the approximate speeds at which transition should occur.

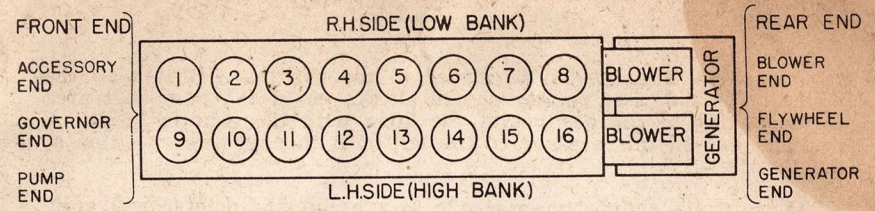
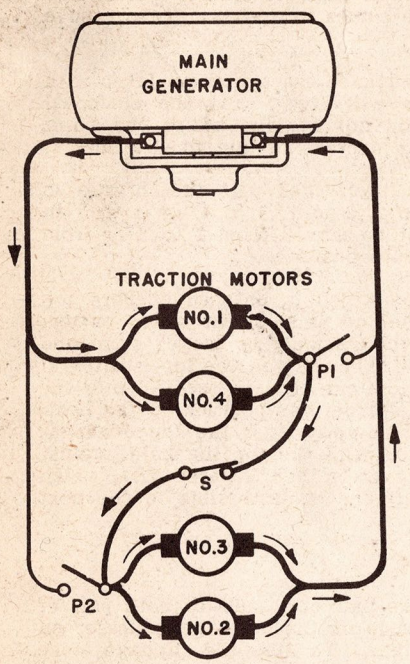
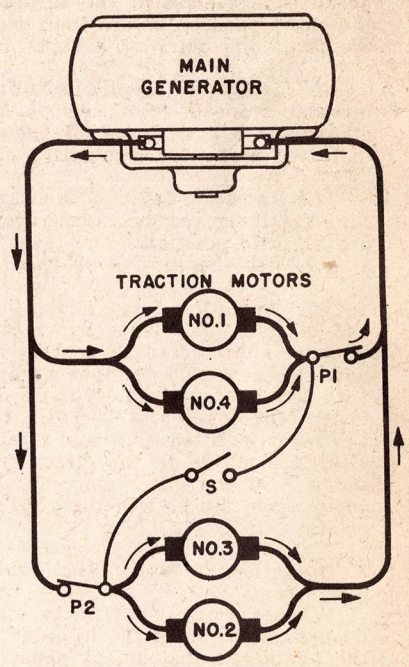


FIGURE 1



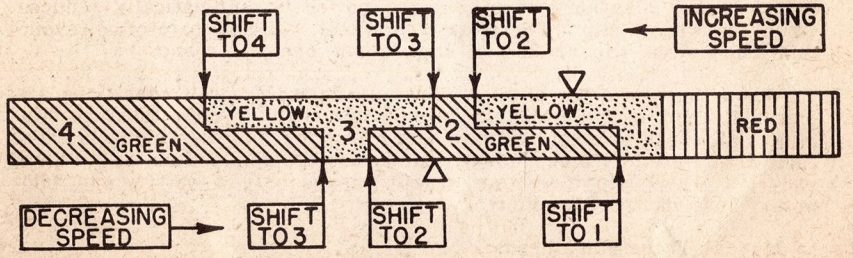
SERIES-PARALLEL

FIGURE 2



PARALLEL

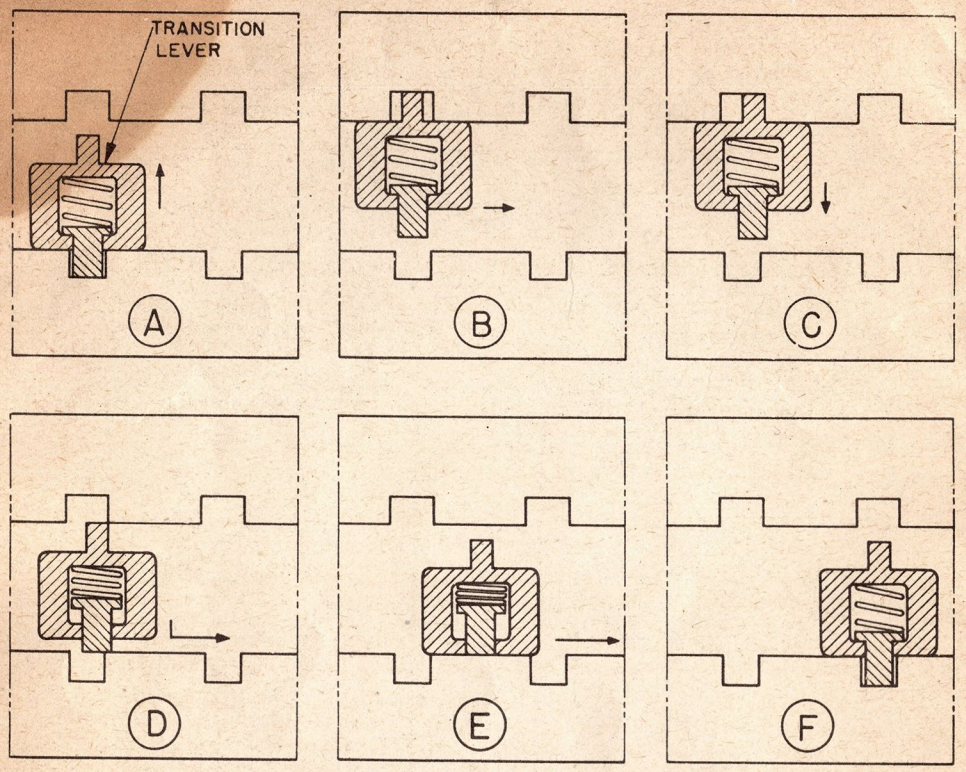
FIGURE 3



TRANSITION METER DIAL

FIGURE 4

PLATE 3650 PAGE 1



TRANSITION LEVER OPERATING DIAGRAM

FIGURE 5

PLATE 3650 PAGE 2

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Shift from Position	To Position	M.P.H.
1	2	21
2	3	32
3	4	58
4	3	52
3	2	28
2	1	21

Maximum permissible speed—70.
Approximate minimum continuous speed in 8th notch—15.5.

These locomotives are equipped with a switch in the speed recorder which will automatically set the air brakes and operate the pneumatic control switch if the train speed exceeds 70 miles per hour.

6. Sanding:

On this locomotive, with its many traction motors, sanding is unnecessary except with the very worst track condition. If sand is used, it should be applied sparingly by operating the sanding valve only after the wheel slip indicator light flashes, indicating bad track conditions, rather than to leave the valve open. It should be remembered that sand is injurious to the traction motors and associated apparatus.

7. Air Braking with Power:

To keep train slack stretched while stopping or slowing down, the throttle should be left in the eighth position while brake is being applied and slack being adjusted. As soon as brake is applied, and when speed begins to reduce, the throttle must be reduced to at least the sixth position, keeping locomotive brakes released. This must be observed.

When preparing to stop with power applied to locomotive and brakes applied to train, it is necessary to reduce the throttle as the train speed decreases. The transition lever must also be reduced as indicated by the transition meter. As the train slows down, the pulling power of the lomocotive increases rapidly and may become great enough to part the train if the throttle is not reduced. The throttle should be in idle 100 feet before the locomotive comes to a dead stop. A final brake pipe reduction must be made when not more than 40 feet from stop, brake pipe air exhausting at time stop is completed, allowing locomotive brake to apply heavily with this reduction.

8. Operating Over Railroad Crossings:

The throttle must be reduced to the 5th notch until all power trucks have passed over the crossing. This is to prevent sparking of the brushes on the commutators of the traction motors.

9. Operating Reversing Handle:

Under no condition should the reversing handle be moved while the locomotive is in motion. When leaving the locomotive, the reversing lever can be removed.

In connection with the operation of the reversing handle, it should be noted that the reverser drum in the high voltage cabinet does not assume the position corresponding to that of the reversing handle until the throttle is advanced to the No. 1 position (if the transition lever is in No. 1, 2, 3 or 4 position). In the event a locomotive backs onto a train on a hill, and the engineer lets gravity start the train, or if when double-heading, and the Diesel locomotive was backed onto the train and the other locomotive was permitted to start the train, the reverser drum will be in the wrong position. This will be the case even though the engineer has moved the reversing handle to the direction in

which the locomotive is moving, unless he first opens the throttle to No. 1 position. (He may then go back to idle, if he so desires.) This condition may be recognized at once by a steady glow on the wheel slip light. If this happens, the train must be stopped, the throttle opened to No. 1 position, and then closed.

CONTROL STATION INTERLOCKS:

The different controls of the engineer's control station are interlocked so that:

1. The reversing handle can be thrown with the transition lever in either No. 1 or "off" position.
2. The reversing handle can be removed only with the transition lever in "off" position.
3. The throttle cannot be opened when the transition lever is in "off" or electric braking.
4. The throttle can be moved to "off" with any position of transition or reversing levers.
5. The transition lever cannot be moved from 2 to 3 or from 3 to 2 with throttle in the 7th or 8th position.

SETTING CONTROLS IN TRAILING 1ST SECTION:

Before changing ends, the various controls in a 1st section, which is at the rear end of a locomotive, should be set as follows:

1. Throttle in idle position.
2. Transition lever should be moved to "off" position; then,
3. Place reversing handle in neutral and remove it.
4. Pull control push button.
5. Pull all remaining push buttons and lift locking pin on switch box.
6. Close double heading cock on brake valve.
7. Pin automatic brake valve in running position.
8. Pin handle of independent brake valve in lap position.

CAUTION: Never have the following push buttons "in" at any two sections at the same time:
Control
Generator
Fuel Pump

TOWING LOCOMOTIVE:

1. Be sure reversing handle is in neutral. If the locomotive is to be towed in a train any appreciable distance, the reverser drum should also be locked in the neutral position. See the Reverser paragraph in Section 5.
2. For setting of air brake equipment, see the brake manufacturer's instruction bulletin.
3. If it is desired to keep the hot journal signal alarm working, the main battery switch, control knife switch, and control push button switch must be closed.

ISOLATING A POWER PLANT WHILE UNDER POWER:

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

1. Reduce the speed of the engine with the layshaft manual control lever so that the traction motor contactors will not have to interrupt the full motor current.

2. Place the isolation switch in the "start" position.
3. Push the engine stop button.
4. Turn off fuel pump.

If the power plant of the leading section is isolated while the locomotive is under power, the transition meter will not function; therefore, transition must be determined by the speedometer according to the figures given in this section under the paragraph "Manual Transition Speeds".

PLACING ENGINE BACK "ON THE LINE":

1. Close fuel pump switch.
2. Place isolation switch in "start" position.
3. Start engine in usual way.
4. After lubricating oil pressure builds up, place isolation switch in "run" position. If throttle is above 5th position, hold off on governor to injector linkage to allow engine to come up to speed gradually.

PRECAUTIONS DURING LOCOMOTIVE OPERATION:

1. Maintain engine cooling water temperature at 165 Deg. F., plus or minus 15 Deg. This is accomplished by proper manipulation of the fan clutches and shutters.
2. Lubricating oil pressure should be approximately 30# at 800 R.P.M. If main bearing pressure drops below 20# (at 800 R.P.M.—hot oil), stop the engine and investigate.
3. Piston cooling oil pressure should be 20-30# at 800 R.P.M. If pressure drops below 15# (at 800 R.P.M.—hot oil), stop the engine and investigate.
4. The fuel pressure sight glasses should be observed frequently to check supply of fuel to the engine.
5. Observe the charging ammeters periodically to see that they are indicating a charge. The charging voltage should be 76 volts.
6. Control air pressure should be 80#, plus or minus 3#.
7. If a traction motor becomes inoperative, isolate the power plant in that section.

STOPPING ENGINE IN PREPARATION FOR LAYOVER:

1. At engineer's control station:
   a. Close throttle to idle position.
   b. Put transition lever in "off" position.
   c. Place reversing handle in neutral position and remove handle.
   d. Open generator field switch. (Do not open control switch, as it is impossible to shut down engines with stop button without the control.)

2. At engine:
   a. Place isolation switch in "start" position.
   b. Push engine "stop" button and hold it until engine stops.
   c. Open fuel pump switch.
   d. Open cylinder test valves in engine.

NOTE: Engine will not stop unless control air pressure is up.

3. At main control station:
   a. Open control switch.
   b. Open fuel pump switch.
4. At distribution panel:
   a. Open main battery switch.
   b. Open control switch.

TO PUMP UP MAIN RESERVOIR AIR PRESSURE:

1. If the locomotive has been standing inoperative and the air reservoirs have been drained:
   a. Close all drain cocks.
   b. Place reversing handle in the neutral position.
   c. Set pneumatic control switch.
   d. Start engines in the usual way, but do not close the generator field switch.
   e. Let engines idle for at least five minutes.
   f. Place transition lever in No. 1 position.
   g. Open throttle to increase engine and compressor speeds.
2. If locomotive has been coupled to train and train line must be pumped up:
   a. Place reversing handle in neutral position.
   b. Pull out generator field switch.
   c. Place transition lever in No. 1 position.
   d. Open throttle to increase engine and compressor speeds.

TROUBLE SHOOTING

IF FUEL DOES NOT SHOW IN R. H. (5#) SIGHT GLASS:

1. If fuel pump does not run:
   a. Check all fuses in circuit—
      1. Two 60A control fuses on distribution panel.
      2. Fuel pump fuse (15A) in engineer's control stand.
      3. Fuel pump fuse (10A) in engine control panel.
   b. Check switches in circuit—
      1. Control knife switch.
      2. Pneumatic control switch.
      3. Fuel pump switch at controller.
      4. Fuel pump switch on engine instrument panel.
   c. Check electric connector to fuel pump motor.
2. If motor is running but no fuel is being delivered:
   a. Check pump couplings and shafts.
   b. Check fuel supply and emergency cut-off valve.
   c. Check for air leaks in suction line due to broken pipe or loose connection. Use emergency line (capped pipe next to regular pipe) if necessary.

IF ENGINE DOES NOT ROTATE WHEN ATTEMPT IS MADE TO START:

1. Repeat customary sequence of operations in starting engine, making sure that all controls and switches are in correct position.
2. Check all fuses affecting starting circuit.
   a. Starting fuse. This is the 400 ampere fuse on the distribution panel.
   b. 60 ampere control fuses on the distribution panel.
   c. 30 ampere control fuses. These fuses are located opposite the control push button switches at the control station.
3. The battery may be too weak to turn engine over. Turn on engine room lights and note whether they become dim or go out when the starter button is pressed.
4. Check to see that both the starting contactors at the bottom of the low voltage cabinet go in.

IF ENGINE ROTATES BUT DOES NOT FIRE WHEN STARTER BUTTON IS PRESSED:

1. Check cylinder test valves at each cylinder, making sure they are closed.
2. Check injector linkage in event that it may be stuck in shut-down position.
3. Check to see that overspeed trip shaft is latched in "run" position.

IF LOCOMOTIVE DOES NOT MOVE WHEN THROTTLE IS OPENED:

(Some of the items listed below would cause a loss of load on one engine, which would cause slow acceleration.)

1. Check pneumatic control switch. (Pull out button to reset.)
2. Check hand brakes in every section to see that they are released.
3. Repeat movement of brake valve to release all brake shoes.
4. Check to see that generator field switch at control station is closed, and fuse good.
5. Check control air pressure and see that reversers and cam switches are in proper position.
6. Check to see that ground protective relays are set in normal position after engines are started.
7. Check all fuses:
   a. 60 ampere control fuses on the distribution panel.
   b. 30 ampere control fuses opposite the control switch at the control station.
   c. 80 ampere battery field fuse in the low voltage cabinet.
   d. 15 ampere generator field fuse in control switch box.
8. The generator or battery field contactors may be open or making poor contact.
9. If starting contactor or wheel slip relay sticks shut, the generator of that power plant will not deliver power.

LOSS OF LOAD ON AN ENGINE:

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

1. That motors across that generator are in series-parallel while all the other power plants are in parallel.
2. The "BF" or "SF" contactors are out. This may be caused by:
   a. Ground relay tripping.
   b. Starting contactor interlock open.
   c. Wheel slip relay stuck.
3. Battery field fuse blown.
4. Dirty or poorly made contacts any place in the power or generator field circuits. In correcting any of these defects it is important that the power plant being worked on is isolated.
5. The engine overspeed trip may have operated. This is a flyweight on the engine camshafts which operate small cams under each injector rocker arm, thus preventing injection. The trip operates at approximately 800 R.P.M. of the engine. Over-speeding may be caused by a sudden loss of electrical load, such as a wheel slipping or ground relay tripping.

IF BATTERY CHARGING AMMETER (IN LOW VOLTAGE CABINET) ALWAYS SHOWS ZERO:

1. See that auxiliary generator switch is closed.
2. Check all fuses in circuit affected.
   a. 30 ampere auxiliary generator field fuse in the low voltage cabinet.
   b. 150 ampere battery charging fuse in the low voltage cabinet.
3. Auxiliary generator drive belts may be loose or broken. In this case, or if replacing fuses is not corrective, the maintainer should be notified and the condition corrected.

IF AIR PRESSURE DOES NOT BUILD UP:

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

IF LOCOMOTIVE STOPS IN OPERATION:

If the locomotive suddenly becomes inoperative, immediately check the control fuses (60A) on the distribution panel, then check the control fuses in the box on the control station. A wire may have been jarred loose, or may be burned off. The fuel supply may have stopped. The pneumatic control switch may have opened.

IF AN ENGINE FAILS TO STOP:

Stop engine with an injector control shaft lever if engine fails to stop when the throttle is placed in the shut-down position. Check for binding linkage, inoperative governor control, faulty governor, or defective "E" master valve or "D" valve.

LACK OF POWER:

In the engine this may be due to poor combustion, insufficient air, lack of or poor fuel, restriction in exhaust, incorrect timing, or leaky exhaust valves.

In the electrical system, lack of power may be due to low generator field excitation. Low generator field excitation may be due to a faulty connection in the generator battery field circuit, a faulty auxiliary generator or voltage regulator, a weak battery or an open generator field contactor. Lack of power may also be due to faulty traction motors or generators, traction motor contactors, a faulty load regulator, pilot valve, or improper setting of pilot valve linkage.

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

CUTTING OUT AN INJECTOR:

Some of the reasons for cutting out an injector are:

1. A stuck injector rack or plunger.
2. A defective exhaust valve or piston.

When an injector is to be made inoperative, the engine must be stopped and clamp 8069968 installed. The two bolts on this tool screw into the cylinder head lifting holes. The center clamp then pushes the injector rocker arm down so that it no longer touches the camshaft.

A cylinder should not be cut out if the reason for unloading the cylinder can be remedied, nor should an engine be operated with a cylinder cut out any longer than is absolutely necessary. Not more than two injectors on any one engine should be made inoperative at one time. If more than two cylinders need to be unloaded, the engine should not be worked.

EXHAUST SMOKE:

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

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

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 to a very slow speed (2-3 miles per hour). Water any deeper than 3 inches above the tracks is likely to cause damage to the traction motors.

SPARE SUPPLIES:

See that supplies are replenished as spare stock is used. There should be an adequate supply of spare fuses, lamps, lintless rags (never waste), lubricating oil, etc. Keep the fire extinguishers full and in working condition.

SAFETY DEVICES:

Certain pieces of equipment are provided for safety purposes. These include:

Emergency fuel cutoff.

"Low Oil Pressure" Alarm.

"Hot Engine" Alarm.

"Wheel Slip" Light.

"Hot Journal" Alarm.

"Dead Man's Pedal." See Air Brake Manufacturer's Instructions.

See Bulletin 1702 for Safety Hints.

GENERAL DATA

Fuel Oil Capacity	1200 Gals. per engine
Lubricating Oil Capacity	180 Gals. per engine
Cooling Water Capacity	245 Gals. per engine
Sand Capacity	22 cubic feet 1st Section 18 cubic feet 2nd Section
Wheel Diameter	40″
Gear Ratio	16/61
Size of Journal	6½″ x 12″
Maximum Negotiable Curve	250′ Radius (or 23° Curve)
Maximum Permissible Speed	70 MPH
Inside Diameter of Motor Suspension Bearing	8″
Couplers	E-link-E-link-E
Air Brakes	8-EL type