THE NEW YORK CENTRAL RAILROAD COMPANY

Operating Instructions

Class DFA-5a, DFA-5b, DFB-5a, DPA-3a Fairbanks-Morse Diesel Locomotives 5000 to 5005, Inc., 5100 to 5101, Incl., and 4400 to 4405, Incl.

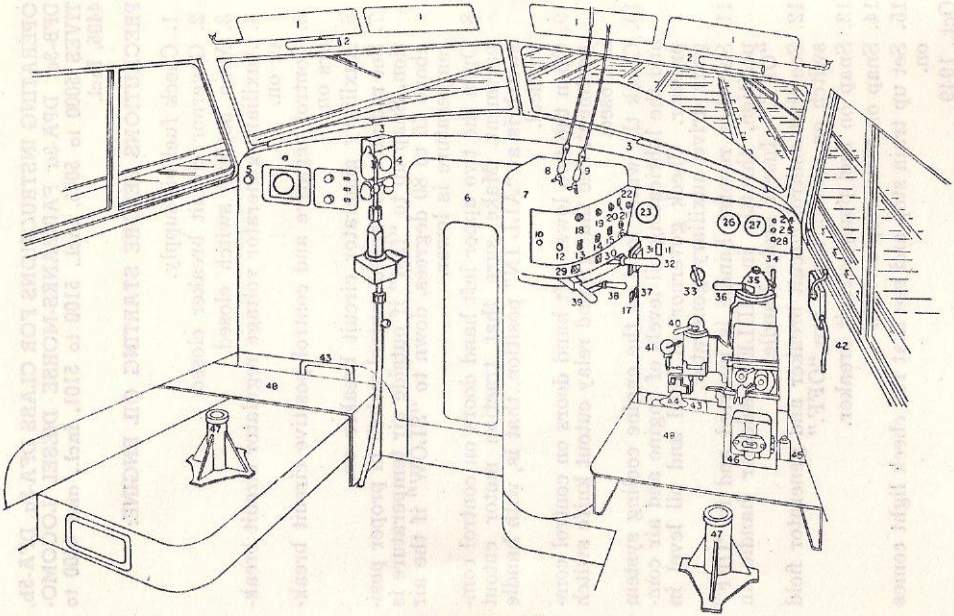
Office of Gen'l. Supt. Equipment
New York, N. Y.
Revised Oct. 3, 1949.

OPERATING INSTRUCTIONS FOR CLASS DFA-5a, DFA-5b, DFB-5a, DPA-3a FAIRBANKS-MORSE DIESEL LOCOMOTIVES 5000 to 5005, Incl., 5100 to 5101, Incl., and 4400 to 4405, Incl.

PRECAUTIONS BEFORE STARTING OIL ENGINE:

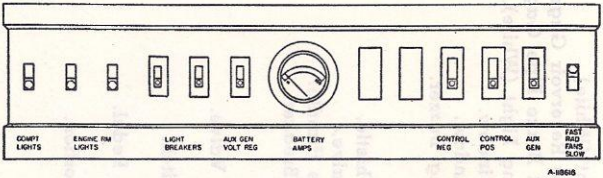
1. Check fuel oil supply.
2. Governor circuit breaker closed.
3. Main battery switch closed.
4. Auxiliary generator voltage regulator circuit breaker on.
5. Control negative and control positive circuit breakers on.
6. Auxiliary generator circuit breaker on.
7. Set radiator fan speed control switch in proper position. Snap up to "fast" if outside air temperature is above 75 to 80 degrees, down to "SLOW" if the air temperature is lower.
8. Open the two upper left hand doors on control compartment. Make sure that traction motor cutout switch is at "ALL IN" position, that is, with handle vertical.
9. Open the two lower left hand doors on control compartment. See that ground relay cutout knife switch is closed.
10. Check the water level of the engine cooling system and the lubricating oil levels of engine and air compressor. Check governor oil level and oil level in gear drive auxiliary generator.
11. See that reverse handle is inserted and in "OFF" position, throttle in "IDLE," selector handle in "OFF." Insert brake handles.
12. See that control circuit breaker and generator field switch on control stand are "OFF."
13. Snap on fuel pump circuit breaker.
14. Snap on train stop switch.
15. Set up train stop and see that red check light comes on.

Oct., 1949



Operating Cab.

1. Sun Visers.
2. Windshield Wipers and Motors.
3. Defroster Openings.
4. Speed Recorder
5. Windshield Wiper Control Valve
6. Door to Hood.
7. Control Stand.
8. Whistle Pull Cord (rear).
9. Whistle Pull Cord (front).
10. Train Control Light (Red).
11. Train Signal Whistle
12. Attendant Call Button.
13. Headlight Circuit Breaker.
14. Headlight Dim and Bright Switch.
15. Order Light Switch.
16. Emergency Engine Stop Button.
17. Control Circuit Breaker.
18. Gage Light Switch and Rheostat.
19. Heater Switch and Rheostat
20. Defroster Switch and Rheostat.
21. Generator Field Switch.
22. Windshield Wiper Control Valve.
23. Load-Braking Indicator.
24. Power Off Light (White).
25. Brake Warning Light (White).
26. Main and Equalizing Reservoir Gage.
27. Brake Cylinder and Brake Pipe Gage.
28. Wheel Slip Indicating Light (White).
29. Selector Position Window.
30. Throttle Position Window.
31. Wheel Slip Warning Buzzer.
32. Throttle Handle.
33. Rotair Valve.
34. Air Brake Signal Whistle.
35. Automatic Brake Valve.
36. Automatic Air Brake Handle.
37. Fuel Pump Circuit Breaker.
38. Reverse Handle.
39. Selector Handle.
40. Independent Brake Valve.
41. Bell Ringer Valve.
42. Acknowledging Switch.
43. Cab Heater.
44. Safety Control Foot Pedal.
45. First Service Cock.
46. Equalizing Piston Portion.
47. Seat Stands.
48. Foot Rests.



Compartment Control Panel.

STARTING ENGINES AND PUTTING ENGINES ON LINE

STARTING OIL ENGINE:

1. Check the engine overspeed governor reset lever on engine above power plant regulator to be in reset position.

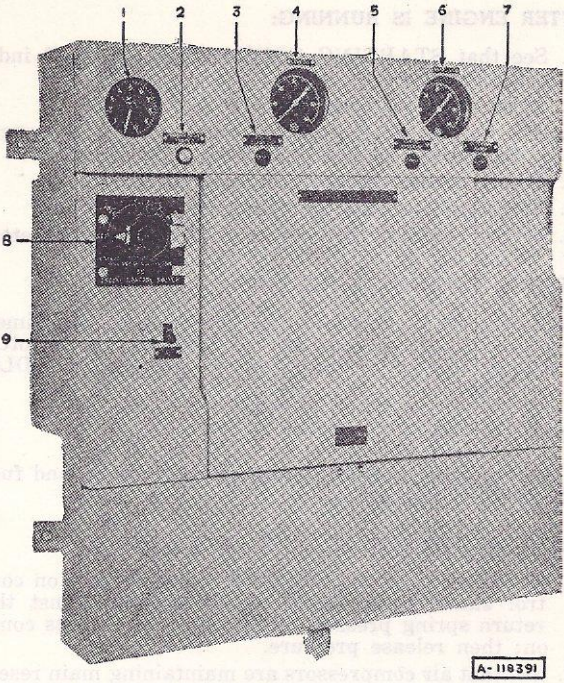
2. Snap on fuel pump switch on engine control panel and note that fuel pump runs and fuel oil pressure builds up to between 12 and 18 lbs. on gauge on engine control panel.

3. Starting with engine control switch in "OFF" position. Rotate to "IDLE." Hesitate momentarily; then pull out on switch knob to start position.

4. Hold knob in START position until engine fires, and lubricating oil pressure low oil pressure alarm light goes out. Pressure will be approximately 8 lbs.

   NOTE: The engine should start turning promptly when the engine control switch knob is pulled out and firing should occur within a few revolutions.

5. If engine does not fire, release knob and turn to OFF position. Repeat engine start. Do not attempt to start engine repeatedly as this will run down the batteries.



1. Not Used.
2. Ground Relay Tripped Indicating Light (white)
3. Boiler Flame Out Indicating Light (blue)—not used
4. Lube Oil Pressure Gage
5. Low Oil Pressure Indicating Light (yellow)
6. Fuel Oil Pressure Gage
7. Hot Engine Indicating Light (red)
8. Engine Control Switch
9. Fuel Pump Switch

Engine Control Panel

AFTER ENGINE IS RUNNING:

1. See that STARTING CONTACTOR CLOSED indicator light is out.
2. Lubricating oil pressure is at least 8 lbs.
3. Air compressor and traction motor blowers are operating normally. Blue indicating light is out.
4. Radiator shutters are in normal position.
5. There are no leaks in piping system.
6. Proper reading is being obtained on battery ammeter.

PUTTING ENGINE ON THE LINE:

1. Turn engine control switch (one position at a time) to RUN. It comes under control of the throttle handle as soon as the switch is moved above IDLE position.

FINAL CHECK:

Make a final check on operation and lube oil and fuel oil pressure gages.

PREPARATIONS FOR MOVING LOCOMOTIVE:

1. If necessary, turn gage light control switch on control stand to ON and hold clockwise against the return spring pressure until gage panel lights come on; then release pressure.
2. See that air compressors are maintaining main reservoir air pressure at 130-140 lbs. and control air is 70 lbs. Plus or minus 10 lbs.
3. See that air brake equipment is properly set up on all units.
4. See if hand brakes are released.
5. Make necessary air brake tests. Place foot on safety control pedal before releasing locomotive brakes.
6. Test operation of Horns, bell and sanders.
7. Close generator field switch and control circuit breaker on control stand panel.

8. When locomotive is to be moved light Rotair valve on leading "A" unit must be in "P" and on trailing unit, if used in "PL" position.
9. Engineer must make visual inspection of exterior of locomotive and running gear for:
   (1) Liquids leaking from locomotive.
   (2) Loose parts.
   (3) Proper positioning of Angle Cocks and Shut Off Valves.

PUMPING UP TRAIN LINE:

If main reservoir pressure cannot be maintained while charging trainline, proceed as follows:

1. Close control breaker at control stand.
2. Move reverser handle to OFF position.
3. Place selector handle in position 1.
4. Advance the throttle handle to notch 3 (one notch at a time).

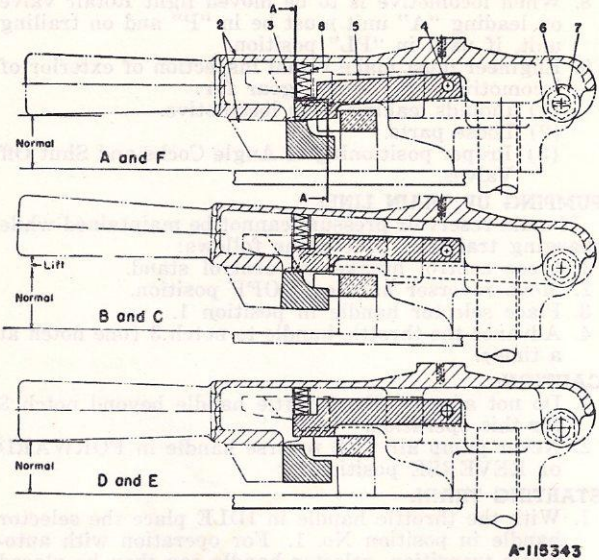
CAUTION:

1. Do not advance the throttle handle beyond notch 3 for this operation.
2. Never pump air with reverse handle in FORWARD or REVERSE position.

STARTING TRAIN:

1. With the throttle handle in IDLE place the selector handle in position No. 1. For operation with automatic transition, selector handle can then be placed in position 4 *after* train has started. (Automatic transition on all F-M Road Freight and Passenger Locomotives.)
2. Move reverse handle to FORWARD or REVERSE as required by train movement.

   NOTE: Under some conditions it may be desirable to forestall a forward transition change. For instance, a grade may be encountered which levels off slightly for one or more short distances in the course of its length. These easings of the grade may possibly cause the automatic transition to go up one step and then return almost immediately to its former position. Under these circumstances it is recommended practice to place the transition lever in the position corresponding to the one in which the

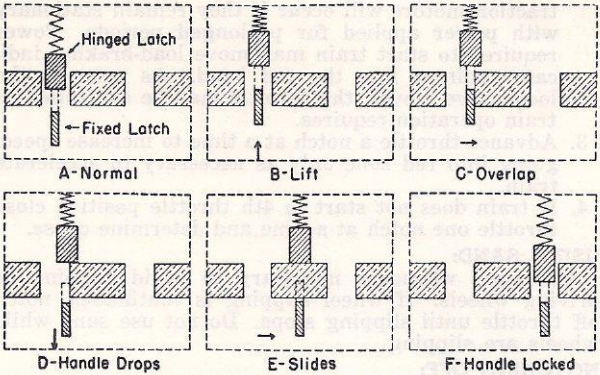


Selector Handle Latching—Side View

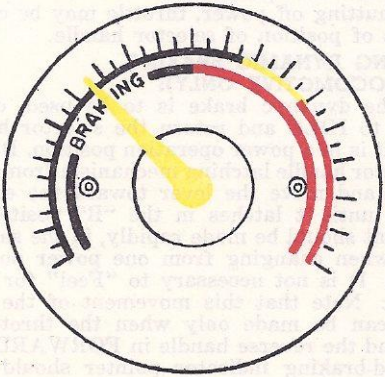
units are operating on the major portion of the hill. The automatic transition will not advance beyond the position at which the transition lever is set and the momentary transition advances will be avoided.

CAUTION:

1. Never move reverse handle from one position to another unless locomotive is at a standstill; otherwise damage to equipment will result. When making transition from position 2 to 3, or from position 3 to 2, it will be necessary to have throttle handle in notch 6 or lower.
2. When ready to start, release air brakes. Wait until train brakes are fully released; then place throttle in notch 1. If the locomotive does not move, advance



Selector Handle Latching A-115294



LOAD-BRAKING INDICATOR A-120802

Selector Handle Latching

throttle one notch at a time until it does. Damage to traction motors will occur if they remain stationary with power applied for prolonged periods. Power required to start train may move load-braking indicator pointer into the red band. As soon as the locomotive moves, the throttle may be controlled as train operation requires.

3. Advance throttle a notch at a time to increase speed, going into red zone only as necessary to accelerate train.
4. If train does not start in 4th throttle position close throttle one notch at a time and determine cause.

USING SAND:

Use sand whenever necessary to avoid slipping of driving wheels. If wheel slipping is continuous, notch off throttle until slipping stops. Do not use sand while wheels are slipping.

NOTCHING OFF:

1. Notching off should, if possible, be done a notch at a time for smooth operation.
2. When shutting off power, throttle may be closed regardless of position of selector handle.

ESTABLISHING DYNAMIC BRAKING (FREIGHT LOCOMOTIVE ONLY):

1. When the dynamic brake is to be used, close the throttle to IDLE and return the selector handle to OFF if it is in a power operation position. Disengage the selector handle latching mechanism from the OFF position and move the lever toward the engineer's position until it latches in the "B" position. This movement should be made rapidly, in the same manner as when changing from one power position to another. It is not necessary to "Feel" for the "B" position. Note that this movement of the selector handle can be made only when the throttle is in IDLE and the reverse handle in FORWARD.
2. The load-braking indicator pointer should show a slight movement as dynamic braking is established. Disengage the selector handle and move it forward very SLOWLY until the pointer moves up to approximately 100 amperes. The braking effort obtained at this point will be enough to bunch the slack, and the selector handle should not be advanced any further until the slack is bunched.

USING THE DYNAMIC BRAKE (FREIGHT LOCOMOTIVES ONLY):

1. When the slack is bunched, move the handle slowly toward the right. As the handle is moved, the reading of the load-braking indicator will rise and the dynamic brake effect will increase. If maximum braking is desired, continue the movement of the handle until the pointer of the load-braking indicator reaches the upper limit of the white zone. Do not allow the pointer to go into the red zone.
2. If the braking effect, at maximum application, is sufficient to slow down the train, the pointer will fall back as the train speed drops. To maintain maximum braking effort, continue the movement of handle to keep the pointer near the upper end of the white zone as the train speed decreases. If a steady speed is desired rather than a slow down, ease off on the dynamic brake by moving the handle back toward OFF, until the train speed steadies at the required miles per hour. To hold this speed the handle can be move slightly forward to retard the train or back to speed it up.
3. Do not let air brake apply on locomotive while using dynamic brake.

RELEASING THE DYNAMIC BRAKE (FREIGHT LOCOMOTIVES ONLY):

Release of the dynamic brake should be made gradually to avoid run-out in the train under certain conditions. Keep in mind that the dynamic brake has somewhat the same effect as a powerful independent air brake and be governed accordingly.

When releasing the dynamic brake, a light application of independent air may be made as the handle is moved from "B" to OFF and the independent then slowly released. This action should be taken when grade conditions are such that the locomotive will tend to "run away" from the train when the dynamic brake is released.

STOPPING ENGINES:
SHUTTING DOWN ENGINE:

1. Move engine control switch to IDLE position.

2. Stop the engine by turning engine control switch to OFF.
3. Snap OFF fuel pump switch on engine panel.

EMERGENCIES

STOPPING ALL ENGINES FROM LEADING UNIT:

1. In case of an emergency requiring the immediate simultaneous stopping of all power plants, push engine stop button on control stand panel. This button should only be used for this purpose.

   NOTE: After stopping the engines in this manner, open the control circuit breaker in the operating unit cab before starting the engines. If the breaker is left closed, the engine control switches in all units must be moved to OFF before any engine can be started.
2. Snap OFF the fuel pump circuit breaker in the leading "A" unit to stop all fuel pumps.

REMOVING ENGINE FROM LINE:

An engine in any unit can be removed from the line, with the locomotive running at any speed on any throttle notch, by turning the engine control switch to IDLE.

RETURNING ENGINE TO LINE:

Any engine can be put back on the line, after being in IDLE by turning the ENGINE CONTROL switch to RUN, one position at a time. A slight pause is desirable at each position to allow engine to come up to speed under load, in case the throttle is open. As the engine comes up to speed, it will assume its share of load for each position on the engine control switch.

SHUTTING DOWN ANY ENGINE WITH TRAIN IN MOTION:

Any engine can be shut down in emergencies by the stop push button above the overspeed reset lever on the control side of the engine. Normally, an engine is stopped by turning the engine control switch to OFF. After shutting down an engine, snap the fuel pump switch to OFF on the engine control panel.

STARTING THE ENGINE WITH TRAIN IN MOTION:

Follow complete procedure for starting engine, and putting on the line in accordance with "Starting engines and putting engines On The Line." Train stop may apply brakes when starting engine in leading "A" unit.

SHUTTING OFF ALL FUEL IN CASE OF FIRE:

1. Pull nearest emergency fuel trip handle on each unit.
2. Snap OFF fuel pump switches.
3. Snap OFF fuel pump circuit breaker on control stand.
4. Shut down all engines by pushing stop button at engineman's position.

OPERATING PRECAUTIONS:

REVERSING:

Bring locomotive to a dead stop before moving reverse handle for opposite locomotive movement.

OPERATING THROUGH WATER:

Do not operate locomotive through water more than 3 inches over top of rail, and then at a speed not exceeding 3 M.P.H.

PASSING OVER RAILROAD CROSSING:

When crossing a railroad crossing, throttle should be moved back to Notch 3 and kept in that position until all locomotive units have passed over the crossing.

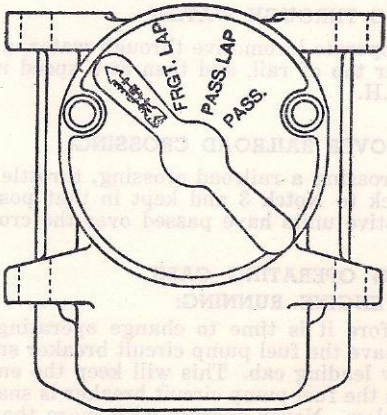
CHANGING OPERATING CABS

KEEPING ENGINE RUNNING:

Just before it is time to change operating cabs, arrange to have the fuel pump circuit breaker snapped ON in the new leading cab. This will keep the engines running when the fuel pump circuit breaker is snapped OFF as in 7 below. Never operate with more than one fuel pump breaker closed, except for a few seconds when changing ends.

LEADING CAB:

1. Selector handle must be in OFF position, throttle in IDLE and reverser handle moved to OFF and removed.
2. Make a full service automatic brake application, return the brake valve to lap and close the double heading cock.
3. Remove the independent brake valve handle in RELEASE position.
4. Move the automatic brake valve handle to RUNNING position and remove it.
5. Move the K-2-A Rotair valve to "PASS LAP" or "FRGT LAP" position, depending on whether the locomotive is operating light or in passenger or freight service.
6. Close the signal line supply cock.



Rotair Valve

7. Snap OFF control circuit breaker, generator field switch, train stop gen. and fuel pump circuit breaker on the control stand. Make sure fuel pump circuit breaker is ON in new leading cab (as in 1) before opening the trailing cab fuel pump breaker.

NEW LEADING CAB:

1. Start train stop generator and reset train stop system.
2. Snap ON generator field switch and control circuit breaker.
3. Open the signal line supply cock.
4. Apply the automatic brake valve handle, apply the handle to the independent brake valve and move the K-2-A Rotair valve to the proper operating position. "PASS or FRGT." The position should correspond to the "LAP" setting in the trailing unit cab.
5. Move the independent brake valve handle to "FULL APPLICATION" position and open double heading cock.
6. Replace reverse handle, leaving reverse handle in OFF position.
7. Make air brake test.
8. Locomotive is now ready to move in accordance with instructions on "Moving Locomotive."

LEAVING LOCOMOTIVE FOR LAYOVER:

1. Shut down diesel engines and snap OFF fuel pump switches on all engine control panels.
2. Protect against freezing, if necessary. (See Freezing Weather Precautions).
3. Remove reverse handles from control stands and place in storage box.
4. Snap OFF control circuit breaker and generator field switch at control stand.
5. Set hand brake in each unit.
6. Open main battery switch in each unit.

TOWING LOCOMOTIVE DEAD IN TRAIN:

Move reverse handle to OFF position and remove from control stand. Throttle handle in each "A" unit must be in IDLE and selector handle in OFF position.

Air brakes must be set up as follows:

a. Close double heading cock on the automatic brake valve.

b. Remove handles from both brake valves (automatic in RUNNING position and independent in RELEASE position).

c. Place the K-2-A Rotair valve in PASS position.

d. Dead engine cock handle, on the D-24 control valve, must be moved toward the DEAD position.

NOTE: In dead heading a "B" unit, move the dead engine cock handle on the D-24 control valve of that unit toward the DEAD position.

PROTECT AGAINST FREEZING IF NECESSARY

(See "Freezing Weather Precautions"):

OPEN MAIN BATTERY SWITCH:

PERIODIC INSPECTION ON ROAD:

General:

1. Observation of each power plant on the road need only be made as operating schedules permit.

LUBE OIL PRESSURE:

1. Normal lubricating oil pressures with the throttle in notch 8 is 20 lbs. to 35 lbs. hot oil. At idling speed the lubricating oil pressure should be above 8 lbs.

2. If the lube oil pressure falls below 15 lbs. in the 8th notch, the engine will stop and the alarm bells will sound throughout the locomotive. The yellow "LOW OIL PRESSURE" alarm indicators will light in the unit effected.

   WARNING: Never operate a Diesel engine without sufficient lubricating oil or sufficient pressure.

FUEL OIL PRESSURE:

The fuel oil pressure is normally 12 lbs. to 18 lbs. on gage on the engine control panel. If pressure should vary above or below these limits, report the trouble for correction.

BATTERY CHARGING:

The battery ammeter pointer should be in the CHARGE section of the dial.

ENGINE HIGH TEMPERATURE ALARM.

High temperature of the engine cooling water or lubricating oil will reduce the power output of the unit concerned by 25% and actuate the HOT ENGINE alarm.

Isolate engine and after 5 minutes stop engine unless trouble is found.

Check cooling water.

Check operation of shutters which should be open.

See that cooling fans are running. Check 300 amp. auxiliary generator fuse.

SUMMARY OF OPERATING PRECAUTIONS:

1. In case of fire, quickly pull nearest emergency fuel trip handle.

2. If a locomotive or a unit continues to develop power with throttle handle in IDLE, or if throttle handle sticks in a power notch, snap OFF control circuit breakers and generator field switch on control stand panel. If power continues, close control circuit breaker and press engine stop button on control stand of leading unit. Afterwards open fuel pump circuit breaker.

ELECTRICAL PRECAUTIONS:

1. Watch battery charging ammeters on inspection rounds to see that normal battery charging is taking place.

2. A circuit breaker which trips on overload assumes a position approximately midway between ON and

OFF. It must be moved to OFF position before it can be reset. If necessary to reset tripped circuit breakers, first make certain equipment affected is in operating condition. If circuit breakers reopen, remedy this trouble or shut down the affected apparatus.

3. Do not block in contactors, relays or circuit breakers.
4. Observe that traction motor blowers are operating at all times when locomotive is under power.

GROUND RELAY:

Tripping of a ground relay effects only one power plant (each power plant has a ground relay) and causes the engine to go to idle. Tripping of ground relay will cause alarm bells to ring and power plant affected will show ground relay light.

1. Isolate engine affected.
2. Reset ground relay.
3. Put engine on line.
4. If engine does not load, check ground relay again.
5. If ground relay trips more than two more times, immediately isolate engine. Do not open ground relay knife switch.

"PC" SWITCH:

"PC" switch tripped, caused by:

1. Train control brake application.
2. Safety control brake application.
3. Speed governor brake application.
4. Emergency brake application.

Causes all engines to go idle. "PC" warning light comes on when "PC" swtich is tripped. Throttle must be in IDLE before "PC" light will go out to regain control of engines.

STUCK STARTING CONTACTOR LIGHT:

If one or both starting contactors stick completely closed, the white starting contactor light will show on unit affected. (This will light when starting an engine.)

1. Isolate engine affected.

2. Pry open the stuck contactor with a dry wooden stick.
3. Put engine on line.

DIESEL ENGINE PRECAUTIONS:

1. Report all unusual sounds or actions of any part of diesel engines, diesel engine accessories or electrical equipment. Shut down affected engine if necessary.
2. Keep diesel engines running as continuously as possible, shutting down only on account of trouble.
3. Do not attempt to correct trouble by making adjustments to engine, power plant regulator, temperature or pressure switch or any control device. Trouble should be reported for correction.

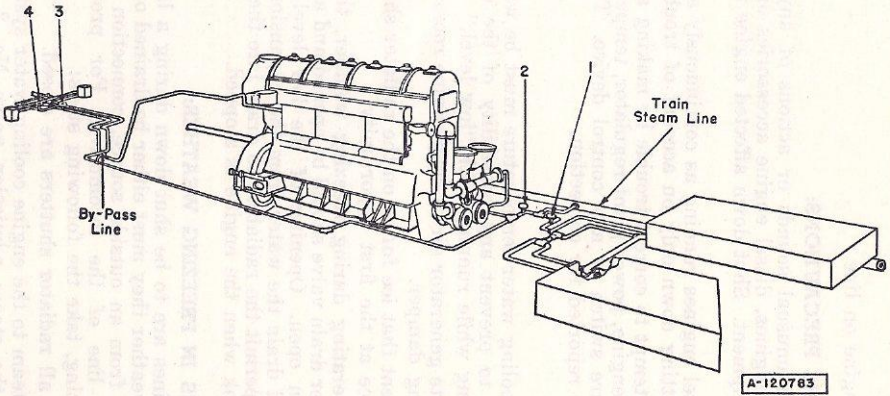
RUNNING:

1. Engine cooling water temperature must be watched carefully to prevent any possibility of the engine overheating while running with "low level."
2. Recirculate generator air to keep engine room warm by opening damper.
3. In the event that ice forms on the radiator shutters, remove ice at the first opportunity.
4. When operating during freezing weather, the low level water drain valve should be opened and allowed to remain open. Opening of the low level drain valve will drain the water from the expansion tank and will permit the radiators to drain into the lower water tank when the engine is stopped.

SHUT DOWNS IN FREEZING WEATHER:

If the engines are to be shut down during a layover in freezing weather they must either be drained or heated by steam from an outside source, connection to the steam train line of the locomotive. For protection against freezing, take the following steps:

1. See that all radiator shutters are closed.
2. Supply steam to the engine cooling water system by opening the steam admission valve No. 2. Open



Standby Steam Heating Arrangement

valve No. 1 to supply steam to the cooling water tanks and piping.

3. Open the "low level" (not shown in illustration but located near the front end of the left hand water tank) to prevent the radiators from filling with water as the heating steam condenses in the system.
4. Open valves No. 3 and No. 4 to provide heating steam for the cab heaters. Be sure that valve No. 3 is open before opening valve No. 4 in order to have the heaters full of water when steam is admitted.
5. Drain toilet water tanks.
6. See instructions "To Shut Down Steam Generator Enroute During Cold Weather."

DRAINING:

In case heating system is not available, proceed as follows:

1. Drain all cooling systems by opening all drain valves provided in piping systems.
2. REMOVE: Lower drain plugs of both exhaust manifold water jackets, adjacent to number 10 cylinder (two on each side).

   Drain plugs on the underside of both exhaust "L" water jackets (two).

   Drain plug on the water inlet header nameplate (one).

   Drain plugs on the under side of the oil cooler heads (two).
3. Empty water treatment device if used.
4. Drain toilet water tanks.
5. Drain cab heaters.
6. See instructions for draining steam generator "To Shut Down Steam Generator Enroute During Cold Weather."

LOG BOOK

Engine crew *must* enter in Log Book all troubles with equipment indicating where trouble occurred and what if any, correction was made. Also, enter items to be repaired at maintenance point as well as improper performance of engines or locomotives, incidents causing delays, etc. Each entry must be signed and dated and must specify train number or symbol.

THE NEW YORK CENTRAL RAILROAD COMPANY

Operating Instructions

Class DFA-1b, DFA-2a, DFB-2a, DFA-2b, DFB-2b, DFA-2c, DFB-2c, DFA-2d, DFB-2d, DFA-2e, DFB-2e, DCA-1a, DCB-1a, Electro-Motive Diesel Locomotives 1604 to 1676 Incl., 2404 to 2435, Incl., 3500 to 3503 Incl., and 3600 to 3601.

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OPERATING INSTRUCTIONS

Class DFA-1b, DFA-2a, DFB-2a, DFA-2b, DFB-2b, DFA-2c, DFB-2c, DFA-2d, DFB-2d, DFA-2e, DFB-2e, DCA-1a, DCB-1a, Electro-Motive Diesel Locomotives, 1604 to 1676 Incl., 2404 to 2435, Incl., 3500 to 3503 Incl. and 3600 and 3601.

PRECAUTIONS BEFORE STARTING OIL ENGINES:

1. Check Fuel oil supply, each uit.
2. Check engine cooling water supply, each engine.
3. Check lubricating oil supply, each engine.
4. Check lube oil level in each air compressor.
5. Check supply of sand.
6. On combination units, check boiler water supply.
7. Check governor oil level.

STARTING ENGINES AND PUTTING ENGINES ON LINE:

TO START ENGINES:

A—IN LEADING "A" UNIT:

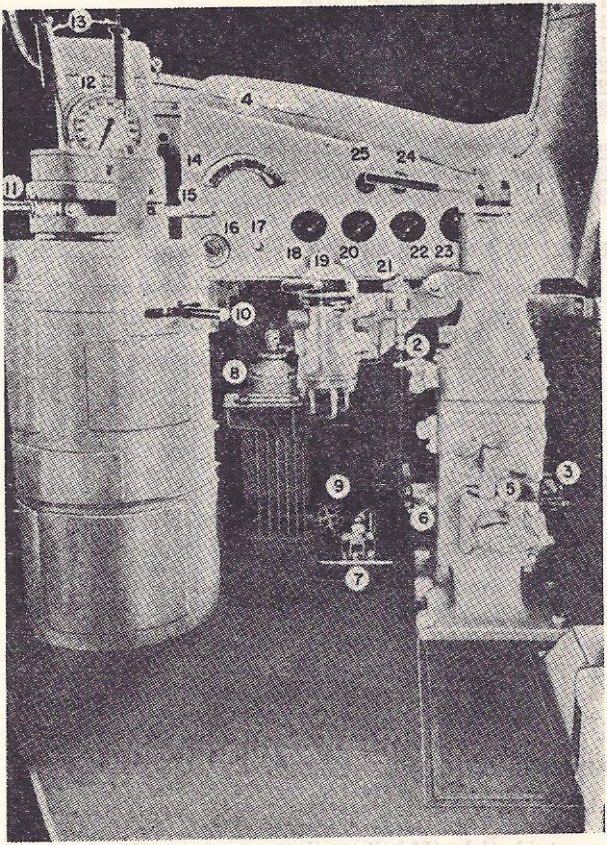
1. Close all knife switches in distribution panel.
2. Start train stop MG set.
3. Set up train stop and see that red check light comes on.
4. Place automatic brake valve in "Lap" and "Rotair" valve in either "P" or "F" and open double heading cock.
5. Place independent brake valve in full application position.
6. Place throttle in "Idle" and note that "PC" light is *not* on.
7. Place transition lever in "Off."
8. Put reverse lever in neutral.
9. Put in "Control" and "Fuel Pump" push buttons (and whatever light buttons are needed).
10. At engine starting panel in engineroom, turn on fuel pump.
11. Be sure fuel pump starts and "5-lb. glass" next to engine, fills with clear fuel.

12. Isolation Switch must be in "Start" position.
13. Woodward Governor low oil shut-down plunger must be in and red band plunger *not visible.* No alarm bells or lights should be on.
14. Open all cylinder test valves, *hold lay shaft lever in shut down position* and push starting button. Hold button long eonugh for engine to make several revolutions and check for any indication of water or oil in cylinders. If accumulation appears, report to Terminal Foreman. Close test valves.
15. Check position of overspeed trip lever and reset if necessary.
16. Push lay shaft lever toward engine until "Fuel" pointer on governor indicates "11" or "13" and keep firm hold on lever.
17. Push starting button and hold until engine fires, then let go. If engine fails to start in 10 seconds, release button and ascertain cause.
18. Keep ahold of lay shaft lever to prevent engine racing, and bring to idle speed (Fuel pointer at "17").

    (Note: During starting, the alarm bell will ring and starting contactor light will come on. This should stop as soon as starting button is released).

LEGEND OF ENGINEER'S CONTROLS:

1. Automatic Brake Valve
2. Full Release Selector Cock (not used)
3. First Service position Cock
4. Pneumatic Control (PC) Off-Light
5. Safety Control Cock
6. Brake Valve Cutout Cock
7. Deadman's Foot Pedal
8. Rotair Valve (Selector)
9. Cab Heater Valve
10. Reverse Lever
11. Transition Lever
12. Speed Indicator
13. Horn Cords
14. Load and Transition Indicating Meter
15. Throttle Lever
16. Heater Switch



Engineer's Controls

17. Windshield Wiper Valve
18. Equalizing Reservoir and Main Reservoir Air Gauge
19. Independent Brake Valve
20. Brake Pipe and Brake Cylinder Air Gauge
21. Bell Valve
22. Application Pipe and Suppression Pipe Air Gauge (not used)
23. Engineer's Watch Receptacle
24. Wheel Slip Indicator
25. Dynamic Brake Warning Light

B—IN "B" UNIT OR UNITS:

1. Repeat items 1 and 10 and 18 inclusive above.
2. See that the following air cocks are closed:
   "A" Cock under brake valve.
   "B" Main reservoir cock to brake pipe feed valve.
3. Place controlled emergency cock or control valve in "PASS" or "FRT" corresponding to "P" or "F" position selected on leading "A" unit.

C—IN TRAILING "A" UNIT IF USED:

1. Close double heading cock, Place Rotair valve in either "PL" or "FL" corresponding to "P" or "F" position selected on leading unit, move automatic brake valve to "Running" and remove handle, move independent brake valve to "Running" and remove handle.
2. Place throttle in "Idle."
3. Place transition lever in "Off."
4. Place reverse lever in "Neutral" and remove lever.
5. Repeat items 1 and 10 to 18 above.

AFTER EACH ENGINE IS RUNNING:

1. See that starting contactor light is out. If not, a starting contactor is stuck. Free same with a dry wood stick. (If bell continues to ring and red ground relay light is on, reset ground relay).
2. Lubricating oil pressure should be at least 5 lbs.

3. As soon as lube oil pressure comes up, put Isolation Switch in "Run." (Note: if alarm bell rings and blue light comes on, stop engine and check 30A auxiliary generator field fuse and 35A alternator field fuse).
4. Air compressor and traction motor blowers should be operating normally and no alarm lights on.
5. Radiator shutters should be in normal position.
6. Check:
   (1) Ground relay should be set.
   (2) Auxiliary generator ammeter in low voltage cabinet should show charge.
   (3) Battery charging ammeter in Distribution Panel should show charge.

FINAL CHECK:

1. Make a final check on operation and lube oil and fuel oil pressure gauges. No alarm bells or lights should be on.

PREPARATION FOR MOVING LOCOMOTIVE:

1. See that air compressors are maintaining main reservoir pressure at 130—140 lbs.
2. All engines should be idle not less than 5 minutes.
3. After air is pumped up, place automatic brake valve in running.
4. Check control air pressure on gauge in Distribution Panel of each unit. Should all show 80 lbs. plus or minus 10 lbs.
5. See that air brake equipment is properly set up on all units.
6. Release all hand brakes.
7. Make necessary air brake tests. (Place foot on safety control pedal before releasing locomotive brake).
8. Test operation of Bell, Horn and Sanders.
9. Engineer must make visual inspection of exterior of locomotive and running gear for:
   (1) Liquids leaking from locomotive.
   (2) Loose parts.
   (3) Proper positioning of Angle Cocks and Shut Off Valve.

TO MOVE LOCOMOTIVE LIGHT:

1. Rotair valve on leading "A" unit must be in "P" and on trailing "A" unit, if used in "PL" on "B" unit or units if used see that controlled emergency cock is in "Pass" position.

2. Put in "Generator Field" push button.
3. Place foot on safety control pedal.
4. Put automatic brake valve in "Running."
5. Put reverse lever in "FORWARD" or "REVERSE" as required.
6. Put transition lever in "1."
7. Release independent brake.
8. Open throttle to "Run 1" and note that transition meter indicates power, then in few seconds to "Run 2" and advance as required, pausing in each position. Close throttle by steps same as above described except in emergency.
9. If locomotive is to be operated at road speed, light-transition lever may be advanced as described under heading "Use of Transition Meter." If merely operated in yard movement, keep transition lever in "1."

PUMPING UP AIR ON TRAIN:

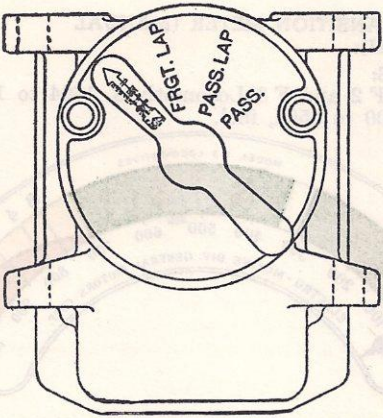
Since air compressors run at engine speed, it is permissible to increase this speed when there is large demand for air when standing coupled to train.

1. Put reverser in "Neutral."
2. Put transition lever in "1."
3. Open throttle as above described to "Run 3." (Do not exceed "Run 3").

STARTING TRAIN:

Having complied with all previous instructions above, engines running, train control re-set, air pumped up, etc., proceeds as follows:

1. If passenger train, set Rotair valve in leading "A" unit to "P" and in trailing "A" unit, if used, to "PL." If freight train, set Rotair valve in leading "A" unit to "F" and in trailing "A" unit, if used, to "FL." In "B" unit if used set controlled emergency cock in position to correspond with leading "A" unit.
2. Push buttons "Control," "Gen. Field" and "Fuel Pump" must be in.
3. All Isolation Switches must be in "Run."
4. No alarm bells ringing.
5. Place foot on safety control pedal.
6. Automatic brake valve in "Running."



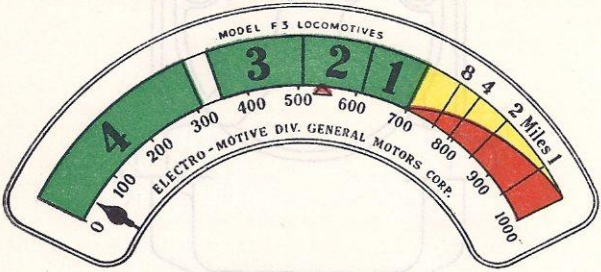
Rotair Valve

7. Release Independent brake.
8. Put reverse lever in "Forward" or "Reverse" as required.
9. Throttle must be in "Idle."
10. Put transition lever in "1."
11. Open thottle to "Run 1."
12. Continue to notch out, stopping at each notch long enough for transition meter to steady and locomotive starts to move.
13. After locomotive starts to move, maintain throttle in the notch which will keep the locomotive moving without accelerating until train is stretched. If train does not start in the 5th notch, close throttle and determine cause.
14. When conditions permit don't attempt to start heavy trains without using sand sparingly, and don't apply sand when wheel slip light is burning or flashing or transition meter pointer is moving up and down its scale, without first reducing throttle until wheel slip light remains out, and transition meter pointer is steady.

USE OF TRANSITION METER (MANUAL TRANSITION):

A—METERS:

1. Model F 2 and F 3 Locomotives, 1604 to 1635, incl. and 3500 to 3503, incl.

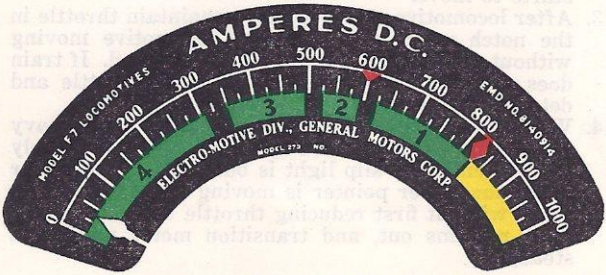


Load and Transition Indicating Meter

In starting trains it is permissible for pointer to be in the yellow-read area for the distances shown. However, these overload ratings are not accumulative ratings. Locomotive must not be operated at 1-mile rating for 1 mile, then at 2-mile rating for 2 miles, etc. Reduce tonnage if unable to operate out of yellow-red area.

In shifting to higher transitions, the meter is a guide only providing throttle is in "Run 8."

2. Model F 7 Locomotives, 1636 to 1676, incl.



Transition and Load Indicating Meter

In starting trains, it is permissible for pointer to be in the yellow area for the time as indicated on the plate mounted below the meter dial. *These shorttime overload ratings are accumulative.* Locomotive can be operated at 900 amperes for ½ hour and then at 850 amperes for 2 hours, etc. Reduce tonnage if unable to operate out of yellow area within these limits.

In shifting to higher transitions, the meter is a guide only providing throttle is in "Run 8."

The red diamond and black line at 825 amperes shows the maximum continuous current rating.

OPERATION OF F7 LOCOMOTIVES WITH OTHER UNITS:

If Electro-motive 1500 HP F 7 locomotive units 1636—1676 and 2420—2435 operate in conjunction with any of the following, the F 3 tonnage and load ratings will govern both types of locomotives:

(a) Electro-motive 1500 HP F 3 locomotive units 1606—1635 and 2404—2419.

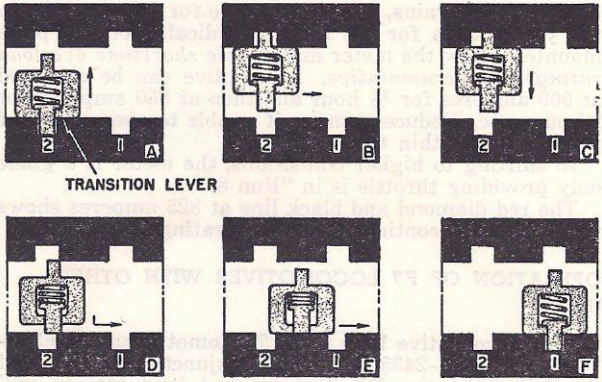
(b) Electro-motive 1350 HP F 2 locomotive units 1604—1605.

(c) Electro-motive 1350 HP FT locomotive units 1600—1603 and 2400—2403.

(The F 3 tonnage and load ratings are the same as the F 2 and FT.)

B—INCREASING SPEED:

1. As pointer moves from right to left and crosses into green area marked "2," move transition lever to "2."
2. As pointer moves farther to the left and crosses into green area marked "3," reduce throttle to "Run 6" and move transition lever to "3." Then, after a short pause, advance throttle thru "'Run 7" and back to "Run 8."
3. As pointer continues to move to the left and crosses into green area marked "4," move transition lever to "4."



Transition Lever Operating Diagram

C—DECREASING SPEED:

As the train speed decreases due to a grade, the pointer will gradually move to the right. When the pointer crosses the white area from 4 to 3, or the black lines between the other areas the transition lever MUST be moved to the position indicated. This MUST be done regardless of the throttle position.

No damage will result in failing to advance the transition lever with increasing speed. But the electrical equipment will be overloaded and serious damage might result if the lever is not backed off to a point indicated when the locomotive speed is decreasing due to a grade. The transition lever should be in the No. 1 position before the locomotive comes to a stop.

(NOTE: Throttle must also be reduced to "Run 6" before moving transition lever from "3" to "2" and same pause before advancing throttle.)

Minimum safe continuous speed in "Transition 1" and throttle in "Run 8" is 16 M.P.H. for freight units and 25 M.P.H. for combination units.

If transition meter is defective move transition lever in accordance with speed as indicated below:

All Classes, Electro-Motive Road Freight Locomotives	*Combination Locomotives*
SHIFT 1-2—20 M.P.H.	30 M.P.H.
SHIFT 2-3—25 M.P.H.	40 M.P.H.
SHIFT 3-4—50 M.P.H.	75 M.P.H.

NOTCHING OFF:

1. Notching off should, if possible, be done a notch at a time for smooth operation.
2. When shutting off power, throttle may be closed regardless of position of transition lever.

DYNAMIC BRAKING (Freight Locomotives only):

This device may be used to bunch cars and hold train speed on descending grades or reduce train speed for slow downs, preparatory to stopping.

1. Place throttle in "Idle" after pausing in each throttle position.
2. Move transition lever to "Off" and hold until slack is bunched.
3. Then move transition lever over the quadrant to right of "Off" position. Dynamic brake will apply with increased force the farther the lever is moved to the right.
4. Dynamic braking force is indicated by Transition meter pointer moving to the right, but should not be increased so pointer will pass the red triangle at bottom of meter scale. (NOTE: This should not be confused with Red Diamond, Locomotives 1637-1676.)
5. Dynamic brake warning light will come on if brake is used excessively. Move transition lever to left until light goes out.
6. Train cannot be stopped with dynamic brake.
7. Do not let air brake apply on locomotive while using dynamic brake.

RELEASING THE DYNAMIC BRAKE:

Release of the dynamic brake should be made gradually to avoid run-out in the train under certain conditions.

Keep in mind that the dynamic brake has somewhat the same effect as a powerful independent air brake and be governed accordingly.

When releasing the dynamic brake, a light application of independent air may be made as the handle is moved from "B" to "OFF" and the independent then slowly released. This action should be taken if grade conditions are such that the locomotive will tend to "run away" from the train when the dynamic brake is released.

STOPPING:

If air brake only is to be used:

1. Reduce throttle to "Run 4."
2. Follow standard air brake procedure.
3. As speed decreases reduce throttle one step at a time and also bring transition lever back with decreasing speed. At least 100 ft. before stop is made, transition lever should be in "1" and throttle in "Idle."

OPERATION OF LOCOMOTIVES WITH AUTOMATIC TRANSITION:

The automatic transition provides automatic changing of traction motor circuits throughout the forward and backward transition ranges without manual shifting of the transition lever by the engineer. The shifts are made at proper times which are determined by the voltage and current load of the main generator.

For operation with automatic transition, the cutout switches in the electrical control cabinets of all units must be in "AUTOMATIC" position. Should the automatic transition in one unit of the locomotive fail to function, the switch should be placed in the "MANUAL" position in all units and the locomotive operated by manual use of the transition lever.

Throttle handling while starting, accelerating and running is identical with that used for manual transition.

Under some operating conditions it may be desirable to forestall a forward transition change. For instance, a grade may be encountered which levels off slightly for one or more short distances in the course of its length.

These easings of the grade may possibly cause the automatic transition to go up one step and then return almost immediately to its former position. Under these circumstances, it is recommended practice to place the transition lever in the position corresponding to the one in which the units are operating on the major portion of the hill. The automatic transition will not advance beyond the position at which the transition lever is set and the momentary transition advances will be avoided.

In starting a train with locomotive using automatic transition:—With throttle in "Idle" place transition in No. 1, open throttle as indicated under starting train Item 11 until train has started. Transition lever can then be placed in No. 4 position.

REMOVING ENGINE FROM LINE:

1. Reduce engine speed by pulling on lay shaft lever until engine is running at idle speed.
2. Place Isolation Switch in "Start."
3. If desired to stop engine, push "Stop" button at engine starting panel and hold until engine stops. Or, pull lay shaft lever until engine stops and then shut off fuel pump.

RETURNING ENGINE TO LINE:

1. Get engine started in usual manner.
2. Hold lay shaft lever firmly with engine idling and place Isolation Switch in "Run."
3. Still holding lay shaft lever, allow engine speed to increase gradually. Take 5 to 10 seconds to allow engine to come up to speed until Woodward governor takes over.

(NOTE: Never isolate an engine while using dynamic brake without first stopping engine, also, do not put engine on line while brake is being used.)

EMERGENCIES:

STOPPING ALL ENGINES FROM LEADING UNIT:

In case of emergency requiring the immediate simultaneous stopping of all power plants, push stop button at

end of throttle handle and shove handle past "Idle" to "stop." Pull out "Fuel Pump" push button.

SHUTTING OFF ALL FUEL IN CASE OF FIRE:

1. Pull nearest emergency fuel cutout trip handle on each unit.
2. Snap OFF fuel pump switches.
3. Pull out fuel pump push button in leading cab.

   NOTE: The emergency fuel valve is located under fuel tank on freight units and in recess at end of tank on combination units; when tripped it stays in closed position and it is necessary to reset by raising valve stem and sliding the retainer in place.

4. Shut down all engines as above described under "Emergencies."

OPERATING PRECAUTIONS:

REVERSING:

Bring locomotive to a dead stop before moving reverse handle for opposite locomotive movement.

OPERATING THROUGH WATER:

Do not operate locomotive through water more than 3 inches over top of rail and then at a speed not exceeding 3 M.P.H.

PASSING OVER RAILROAD CROSSING:

When crossing a railroad crossing, throttle should be moved back to "Run" "3" and kept in that position until all locomotive units have passed over the crossing.

CHANGING OPERATING CABS:

KEEPING ENGINES RUNNING:

LEADING CAB:

1. Transition lever must be in "Off" position, throttle in "Idle" and reverser handle moved to "Off" and removed.
2. Make a full service automatic brake reduction, return brake valve to "lap" and close the double heading cock.

3. Put independent brake valve in running and remove handle.
4. Move the automatic brake valve handle to "running" position and remove it.
5. Move the rotair valve to "PL" or "FL" position, depending on whether the locomotive is to operate Light or in Passenger or Freight service. (Controlled emergency cock in "B" unit must be in corresponding "Pass" or "FRT" position.)
6. Pull out all push button switches and lock push button box.
7. Shut off train stop. Motor-Generator set.

NEW LEADING CAB:

1. Start train stop Motor-Generator set.
2. Push in "Fuel Pump," "control," "Generator-Field" and any other push buttons needed.
3. Insert handle in automatic brake valve and move to "lap" position.
4. Move rotair valve to "P" or "F" corresponding to the "Lap" setting in trailing cab.
5. Insert handle on Independent brake valve and move to "Full application" position.
6. Reset train stop by holding back on forestalling lever until acknowledging whistle blows and stops blowing. Release lever, and note that train stop check light comes on.
7. Open double-heading cock.
8. Insert Reverser handle leaving same in "Off" position.
9. Make air brake test.
10. Locomotive is now ready to move according to previous instructions.

LEAVING LOCOMOTIVE FOR LAYOVER:

1. Shut down Diesel engines and shut OFF fuel pump switches on all engine control panels.
2. Protect against freezing, if necessary. (See Freezing Weather Precautions.)

3. Remove reverse handles from control stands and place in storage box.
4. Pull out all push button switches.
5. Set hand brake in each unit.
6. Open main battery switch in each unit.

TOWING LOCOMOTIVE DEAD IN TRAIN:

1. Move reserve handle of "Off" position and remove from control stand.
2. Throttle handle in each "A" unit must be in IDLE and Transition Lever in OFF position.
3. Air brakes must be set up as follows:
   a. Close double heading cock on the automatic brake valve.
   b. Remove handle from both brake valves (automatic in RUNNING position and independent in RELEASE position).
   c. Place the K-2-A Rotair valve in PASS position.
   d. Dead engine cock handle, on the D-24 control valve, must be moved toward the DEAD position.

   NOTE: In dead heading a "B" unit, move the dead engine cock handle on the D-24 control valve of that unit toward the DEAD position.
4. Protect against freezing if necessary. (See Freezing Weather Precautions.)
5. Open all main battery switches.

PERIODIC INSPECTION ON ROAD:

General:

1. Observation of each power plant on the road need only be made as operating schedules permit.

LUBE OIL PRESSURE:

1. Normal lubricating oil pressures with the throttle in "Run 8" is 35 lbs. to 45 lbs. hot oil, and never less than 15 lbs. At idling speed the lubricating oil pressure should be above 5 lbs.

2. If the lube oil pressure falls below 15 lbs. in the 8th notch, the engine will stop and the alarm bells will sound throughout the locomotive. The yellow "LOW OIL PRESSURE" alarm indicators will light in the unit affected.

WARNING: Never operate a Diesel engine without sufficient lubricating oil or sufficient pressure.

FUEL OIL PRESSURE:

1. The fuel sight glasses on the sintered bronze filter assembly should be observed frequently to check supply of fuel to the engine. Fuel should show in 5-lb. glass only. Report if much fuel shows in 60-lb. glass.

BATTERY CHARGING:

1. Observe the auxiliary generator ammeters in the low voltage cabinets periodically, also, battery ammeters in distribution panels to see that they are indicating charge.

ENGINE TEMPERATURE:

1. Check engine cooling water temperature. Temperature should be maintained at 155° F., plus or minus 15° F. If temperature is not in this range, report this fact at the first maintenance point.

MISCELLANEOUS INSPECTIONS AND PRECAUTIONS:

1. Check traction motor blowers. If a blower is not operating properly, isolate engine until condition is corrected.
2. Electric control air pressure should be 80 pounds plus or minus 10 pounds.
3. Check AC fan motor overloads and re-set and report any that have tripped.
4. Do not operate locomotive with side doors open.
5. In filling engine cooling systems enroute, do not overflow.
6. Keep Diesel engines running as continuously as possible, shutting down only on account of trouble. If one unit is inoperative, keep engine idling if possible and isolated.

7. If wheel slip light comes on and off intermittently, even though throttle is reduced, stop train and check for wheels sliding.
8. Engine cooling water level, during freezing weather should be maintained at the "G" valve level with engine shut down.

SHUT DOWNS IN FREEZING WEATHER:

If the engines are to be shut down during a layover in freezing weather, they must either be drained or heated by steam from an outside source, connecting to the steam train line of the locomotive. For protection against freezing, take the following steps:

1. See that all radiator shutters are closed.
2. Supply steam to the engine cooling water system by opening the steam admission valve to supply steam direct to the cooling system of each engine, located at floor level at accessory end of engine.
3. Open "G" valve, located at engine cooling water tank at left side of unit.
4. Open steam admission valve to cab heaters located at floor level near front end of engine room in "A" units and open steam valves at each cab heater.
5. Drain toilet water tanks.
6. Open steam valves to steam generator heater and steam separator. Open coil blow down valve.

SHUT DOWNS ENROUTE:

If engine is shut down enroute and steam is available from train line, proceed as outlined in Items 1, 2 and 3 above.

If steam generator is shut down enroute and steam is available from train line, proceed as outlined in Items 4, 5 and 6 above.

DRAINING:

In case steam is not available, proceed as follows:

1. Open main cooling system drain valve located at floor level at accessory end of engine.

2. Open cab heater valve located in engine room above steps leading to cab.
3. Open cab heater drain valve located at floor level in engine room at left side of unit, near accessory end of engine. Remove plug from right bank water pump. (Left side of unit.)
4. Drain toilet water tank.
5. Open steam line drain valve on right side of engine room at foot of steps leading to the cab.
6. See instructions for draining steam generator in instructions for operating steam generating equipment.

LOCOMOTIVE PROTECTIVE DEVICES:

1. PC Switch tripped, caused by:
   a. Train control brake application.
   b. Safety control brake application.
   c. Speed Governor brake application.
   d. Emergency brake application.

Causes all engines to go to idle unless throttle is in "Run 5" or "Run 6" in which case all engines stop. Also stops all fuel pumps and will cause engines to starve for fuel. "PC" warning light comes on when "PC" switch is tripped. Throttle must be in "Idle" before "PC" light will go out to regain control of engines. If engines stop due to "PC" switch, no alarm will sound.

2—GROUND RELAYS:

Tripping of a ground relay affects only the one power plant (each power plant has a ground relay) and causes the engine to go to idle unless thottle is in "Run 5" or "Run 6" in which case the engine stops. Tripping of ground relay will cause alarm bells to ring and power plant affected will show ground relay red light.

a. Isolate the engine affected and re-start if necessary.
b. Reset ground relay after engine is started.
c. Put engine on line. (See "Returning Engine to Line.")
d. If engine does not load, check ground relay again, it may have tripped during starting.
e. If ground relay trips more than two more times, immediately isolate engine. Do not open ground relay knife switch.

3—ENGINE OVERSPEED TRIP:

When load is suddenly removed from an engine due to wheels slipping or other cause with throttle advanced, the engine speed may increase to such a value that the engine overspeed trip will function to stop engine. This can also happen due to mishandling of throttle or manual lay shaft lever.

a. Isolate the engine.

b. Re-set overspeed trip handle at front end of engine.

c. Start engine and put on line. (See "Returning Engine to Line.")

4—ENGINE GOVERNOR SAFETY CONTROL:

In case of low oil pressure or high vacuum on the suction side of the lube oil and piston cooling oil pumps, the engine governor will stop the engine. The alarm bells will sound in all units of the locomotive The yellow "LOW OIL" and the blue "Alternator Failure" signal light will show in the unit affected.

When the governor safety control stops the engine, a push-button on the front of the governor housing moves out approximately ⅜" exposing a red band around the shaft of the button. The governor reset push-button must be pressed in to put out the "LOW OIL" alarm lights and the isolation switch moved to "START" position to cut out the "Alternator Failure" alarm lights. Both actions are necessary to stop the alarm bells.

The push button will not trip if engine stops for cause other than low oil pressure or high lub oil suction.

a. Isolate the engine.

b. Push in governor trip button.

c. Start engine and put on line. (See "Returning Engine To Line.")

d. Note oil pressure and suction on two respective gauges.

5—ENGINE HIGH TEMPERATURE ALARM:

If engine temperature exceed 204° F., the alarm bells will ring on all units and "Hot engine" red light will show on unit affected. This alarm does not stop engine

and serious damage will be done if engine is operated at excessive temperature.

a. Isolate engine and after about 5 minutes stop engine unless trouble is found.

b. Check:

1. Cooling water.
2. Shutters; should be open.
3. Cooling fan thermal overload devices and reset if any are tripped. If only 1 pair of buttons, trips repeatedly and temperature is normal, do not reset. If hot engine alarms continue to ring, isolate engine.
4. Oil pressure.

6—ALTERNATOR FAILURE ALARM:

Cooling fans and traction motor blowers (4 each per unit) are driven by alternating current motors supplied by an A.C. Generator. Failure of this generator will ring alarms in all units and light a blue warning light in affected unit. This will also cause engine to go to idle or stop if throttle is in "Run 5" or "Run 6." This alarm is only effective if isolation switch is in "Run." Stop engine and check:

(a) 35 amp. alternator field fuse.

(b) 30 amp. auxiliary generator field fuse.

7—STUCK STARTING CONTACTOR ALARM:

If one or both starting contactors stick completely closed, the alarm bells will ring on all units and white starting contactor light shill show on unit affected. (This alarm will ring while starting an engine.)

1. Pry open the stuck contactor with a dry wooden stick.

8—EMERGENCY FUEL CUT-OFF:

This is a snap-action valve and can be tripped to shut off fuel to engines and boilers in case of fire by pulling a ring attached to a cable on either exterior side of unit or in engine room or cab. (See "Shutting off All Fuel in Case of Fire.")

9—STARTING FUSE:

This is a 400 amp. fuse for protection of generator starting windings. If blown, operation of starter button will operate starting contactors but engine will not rotate. Excessive "cranking" of engine may cause fuse to blow. It is located in the Distribution Panel of each unit.

10—CONTROL AND LIGHTING FUSES:

Fuses for all control functions, main control fuse, train control MG set fuse, boiler fuses where used, and light fuses are located in Distribution Panel. These can be tested on fuse test blocks in same panel.

11—OTHER FUSES:

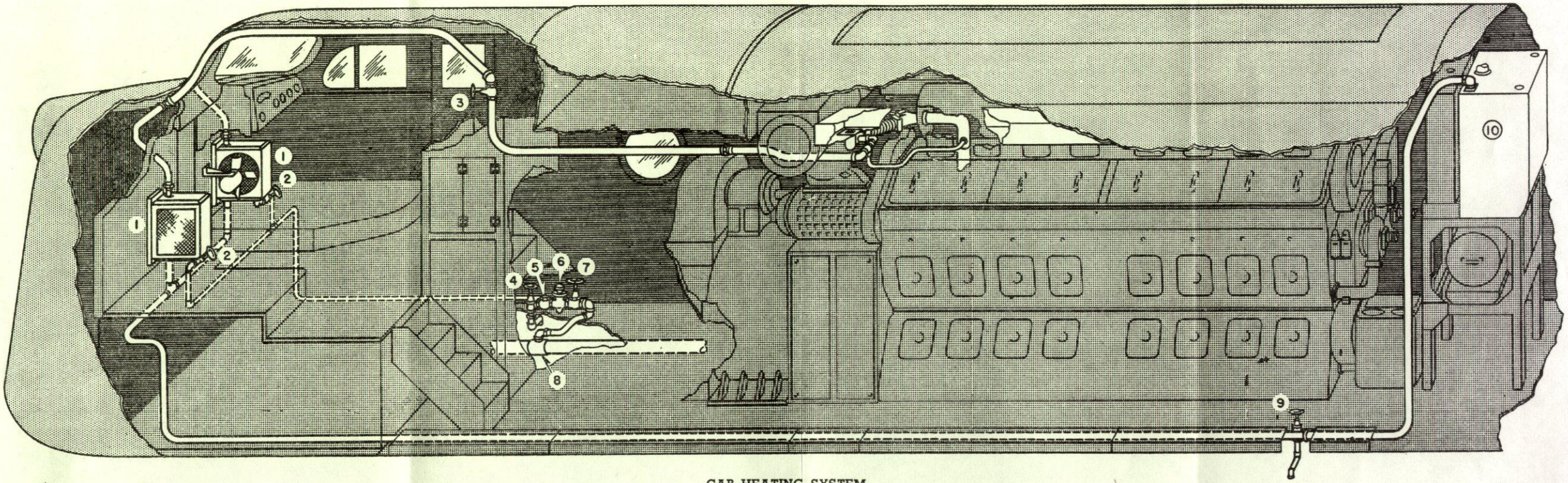
Auxiliary generator fuse, battery field fuse, auxiliary generator field fuse and alternator field fuse are located in low voltage cabinet.

IMPORTANT NOTICE

If any engine or power equipment fails to operate, and checking of all controls and safety devices in accordance wtih these instructions does not correct the difficulty, the engine should be isolated or stopped, and proper entry made in Log Book. Engine crew should not attempt to make any adjustments. If serious trouble develops, notify the next engine terminal. (See Shut Downs in Freezing Weather.)

LOG BOOK

Engine crew *must* enter in Log Book all troubles with equipment indicating where trouble occurred and what if any, correction was made. Also, enter items to be repaired at maintenance point as well as improper performance of engines or locomotive, incidents causing delays, etc. Each entry must be signed and dated and must specify train number or symbol.

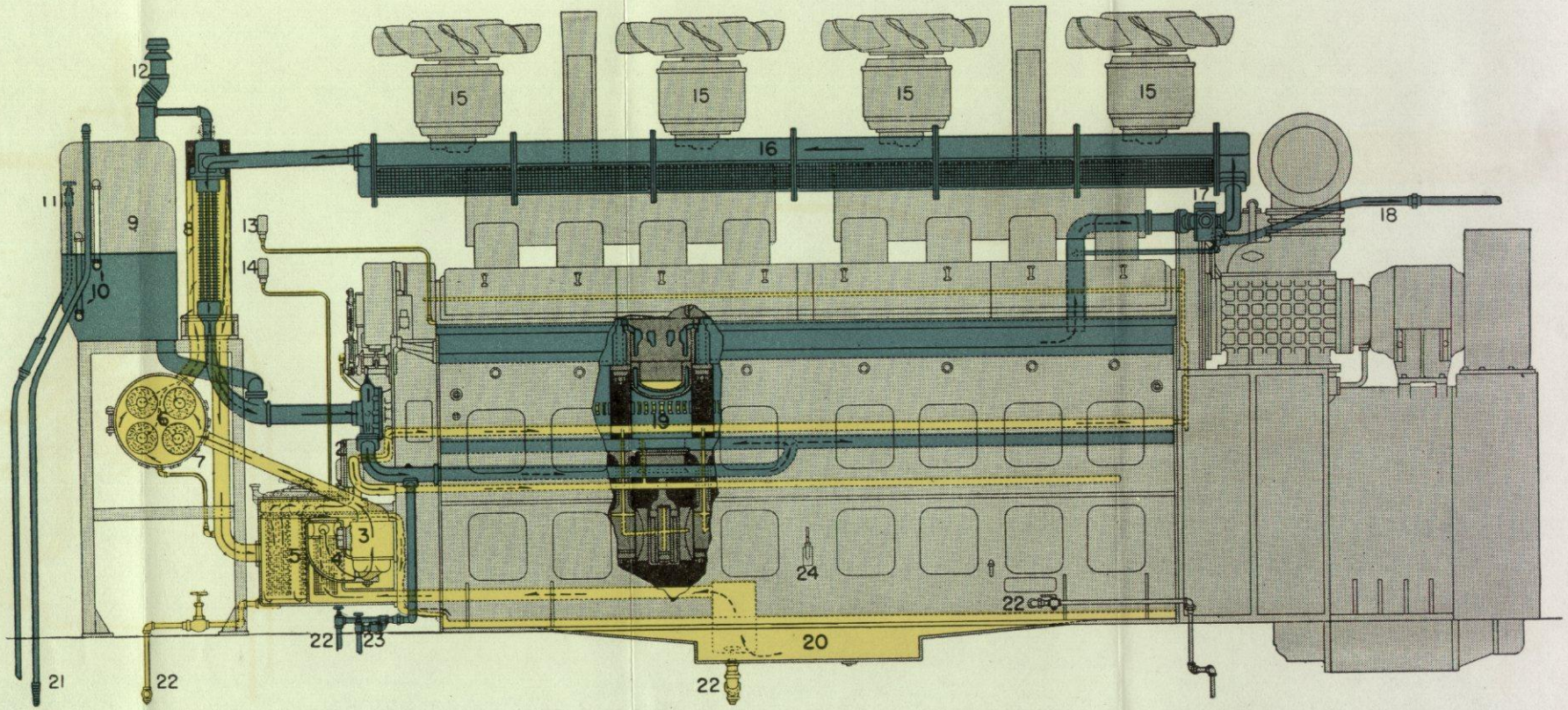


CAB HEATING SYSTEM

1. Cab Heaters
2. Cab Heater Steam Valves
3. Cab Heater Valve
4. Steam Heating Line Drain Valve
5. Check Valve
6. Steam Pressure Reducing Valve
7. Steam Admission Valve
8. Steam Trainline Connection
9. Cab Heater Drain Valve
10. Engine Cooling Water Tank

1. Water Pump
2. Lubricating Oil Pump
3. Scavenging Oil Pump
4. Sump Oil Strainer
5. Lube Oil Strainers
6. Lube Oil Filter
7. Lube Oil Relief Valves
8. Lube Oil Cooler
9. Cooling Water Tank
10. Water Level Gauges
11. "G" Valve
12. Roof Filler
*13. Low Oil Pressure Alarm Switch
*14. Lube Oil Suction Alarm Switch
15. Cooling Fans
16. Radiator
17. Thermostat Switch
18. To Cab Heater
19. Cylinder Liner
20. Engine Sump
21. Side Filler
22. Drains
23. Steam Admission Line
24. Bayonet Gauge

*These items are incorporated in the governor on locomotives equipped with Type SI governor with electro-hydraulic speed control.



Schematic of Cooling and Lube Oil Systems

THE NEW YORK CENTRAL RAILROAD COMPANY

Operating Instructions

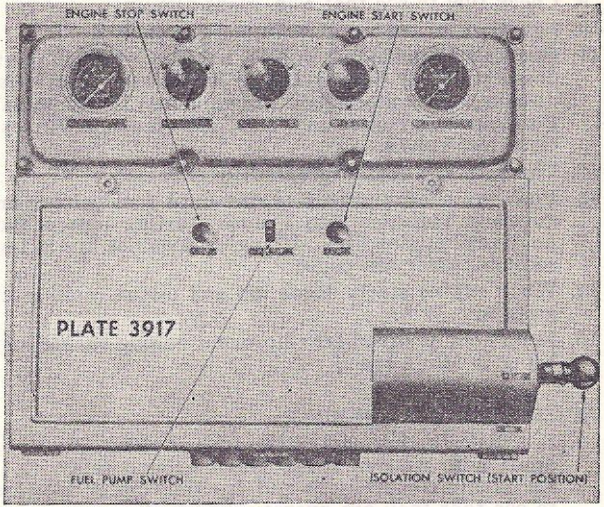
Class DPA-1a, DPB-1a, DPA-1b, DPB-1b, DPA-1c, DPB-1c, DPA-1d, Electro-Motive Passenger Locomotives 4000 to 4035 Incl. and 4100 to 4113 Incl.

Revised Oct. 3, 1949.

OPERATING INSTRUCTIONS FOR CLASS DPA-1a, b, c and d, 4000 to 4035 and DPB-1a, b and c, 4100-4113, ELECTRO-MOTIVE PASSENGER DIESELS.

PRECAUTIONS BEFORE STARTING OIL ENGINE:

1. Check fuel oil supply, each unit.
2. Check engine cooling water, each engine.
3. Check lubricating oil supply, each engine.
4. Check lubricating oil level each air compressor.
5. Check sand supply.
6. Check boiler water supply, each unit.
7. Check governor oil level.



Engine Control and Instrument Panel

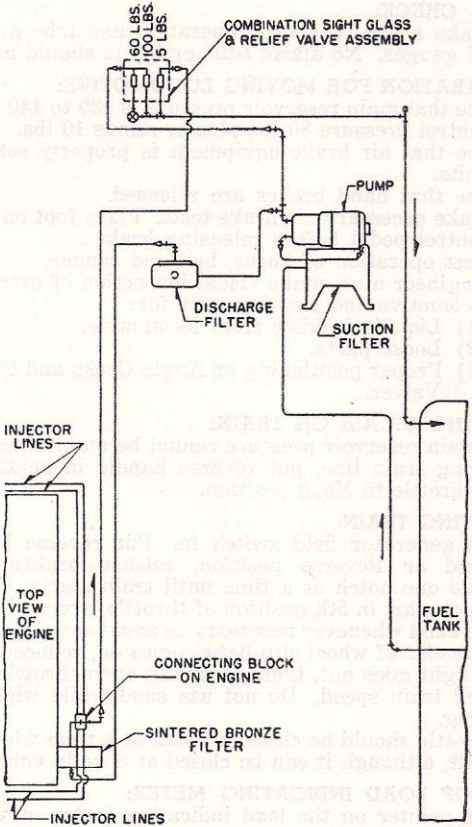
Oct., 1949

STARTING ENGINES AND PUTTING ENGINES ON THE LINE:

1. Close all switches in distribution panel.
2. Start train stop MG set.
3. Set up train stop and see that red check light comes on.
4. Place automatic brake valve in lap position and independent brake valve in full application position.
5. Put throttle in "idle" and see that "PC" switch is *not* on.
6. Put reverse lever in neutral.
7. Put in control and fuel pump push buttons.
8. Turn on fuel pump at engine starting panel.
9. Check fuel to see that 5 lb. glass fills up.
10. Isolation switch must be in start position.
11. Open all cylinder test valves, hold lay shaft in shut down position, push starting button and note any discharge of water or oil in cylinders. If accumulations appear, report to Diesel Maintenance Forces, close test valves.
12. Check to see that overspeed lever is set.
13. Push lay shaft towards engine until fuel pointer on governor indicates 2 to 3, push starting button and hold until engine fires. If engine does not fire in ten seconds, ascertain cause.
14. When engine starts check lub and piston cooling oil gauges.
15. Keep hold of lay shaft to prevent engine racing and bring to idling speed.

AFTER ENGINE IS RUNNING:

1. See that starting contactors are not stuck, if so pry apart with wooden stick. Reset ground relay.
2. Check air compressors and traction motor blowers to see that they are operating normally.
3. Check auxiliary generator ammeter and battery charging ammeter.



BOTH ENGINES

Schematic Diagram—Fuel System

FINAL CHECK:

1. Make a final check on operation and lube and fuel oil gauges. No alarm bells or lights should be on.

PREPARATION FOR MOVING LOCOMOTIVE:

1. See that main reservoir pressure is 130 to 140 lb. and control pressure 80 lb., plus or minus 10 lbs.
2. See that air brake equipment is properly set in all units.
3. See that hand brakes are released.
4. Make necessary air brake tests. Place foot on safety control pedal before releasing brakes.
5. Test operation of horns, bell and sander.
6. Engineer must make visual inspection of exterior of locomotive and running gear for:
   (1) Liquids leaking from locomotive.
   (2) Loose parts.
   (3) Proper positioning of Angle Cocks and Shut Off Valves.

PUMPING UP AIR ON TRAIN:

If main reservoir pressure cannot be maintained while charging train line, put reverse handle in neutral and open throttle to No. 3 position.

STARTING TRAIN:

Put generator field switch in. Put reverse lever in forward or Reverse position, release brakes. Open throttle one notch at a time until train starts. If train does not start in 5th position of throttle, ascertain cause.

Use sand whenever necessary to avoid slipping of driving wheels. If wheel slip light comes on, reduce throttle until light goes out, then gradually open throttle to the desired train speed. Do not use sand while wheels are slipping.

Throttle should be closed a notch at a time when shutting off, although it can be closed at once in emergency.

USE OF LOAD INDICATING METER:

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

1. When accelerating a train from a standing start or after passing a "slow order," the pointer may be al-

lowed to swing full scale. As the train speed increases the pointer will soon return to the left of the red triangle.

2. When short distance overloads will not make the pointer indicate in excess of the amperes shown on the following table:

Permissible Short Distance Amperes

For Distance Of — Miles	
0 to 2	945
0 to 5	815
0 to 10	740
0 to 15	705
0 to 20	680
Continuous	625

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

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

REMOVING ENGINE FROM LINE:

An engine in any unit can be removed from the line at any time by moving lay shaft lever to idle position, and place isolation switch in start position. Hold in stop button and shut off fuel pump if it is desired to stop engine.

RETURNING ENGINE TO LINE:

Any engine can be put back on the line by starting engine and hold lay shaft lever until engine idles. Put isolation switch in run position and gradually move lay shaft lever until engine comes up to speed and governor takes over.

EMERGENCIES:

Shutting Down Engine

In case of emergency requiring the immediate simultaneous stopping of all power plants, push in on button on end of throttle and push handle to off position. Pull out fuel pump button.

Shutting off All Fuel in Case of Fire

Pull nearest emergency fuel cut out trip handle on each unit.

OPERATING PRECAUTIONS:

REVERSING:

Bring locomotive to a dead stop before moving reverse handle for opposite movement.

OPERATING THROUGH WATER:

Do not operate locomotive through water more than 3″ over rail and not to exceed 3 M.P.H.

PASSING OVER RAILROAD CROSSINGS:

When crossing a railroad crossing, throttle should be moved back to Notch 3 and kept in that position until all units have passed over crossing.

CHANGING OPERATING CABS:

1. Throttle must be in idle, reverser in neutral and remove handle.
2. Place foot on safety control pedal and release independent brake.
3. Make a full service automatic brake application, return brake valve to lap and close double heading cock.
4. Remove the independent brake valve handle in release position.
5. Move the automatic brake valve handle to running position and remove—Units 4008 to 4029.
   On Units 4000 to 4007 remove automatic brake valve handle in LAP position.
6. Turn rotair valve to "PASS. LAP" position Units 4008 to 4029.
   On Units 4000 to 4007 turn up independent brake valve cut-out cock.
7. Pull out all push button switches and lock push button box.
8. Shut off train stop MG. set.

NEW LEADING CAB:

1. Start train stop MG set.
2. Push in fuel pump, control, generator field and any other switches needed.
3. Insert handle on automatic brake valve and move to lap position.
4. Insert handle in independent brake valve and move to full application.
5. Reset train control by holding back on forestalling lever until acknowledging whistle blows and stops blowing.
6. On Units 4008 to 4029 turn rotair valve to "PASS" position. Units 4000 to 4007 turn down independent brake valve cut-out cock.
7. Open double heading cock.
8. Insert reverser handle.
9. Make air brake test.
10. Locomotive is now ready to move.

LEAVING LOCOMOTIVE FOR LAYOVER:

1 Shut down engines and snap off all fuel pump switches on all engine control panels.
2. Protect against freezing if necessary. (See Freezing Weather Precautions).
3. Remove reverse handles from control stands and place in storage box.
4. Pull out all push button switches.
5. Set hand brake in each unit.
6. Open main battery switch in each unit.

TOWING LOCOMOTIVE DEAD IN TRAIN:

1. Remove reverse handle.
2. Throttle in idle position.
3. Air brake must be set up as follows:
   Close double heading cock on the automatic brake valve.

Remove all brake handles.
Dead engine cock handle must be moved to the dead position.

4. Protect against freezing.
5. Open all main battery switches.

PERIODIC INSPECTION ON ROAD:

1. Observation of each power plant on the road need only be made as operating schedules permit.

LUBE OIL PRESSURE:

1. Normal lubricating oil pressures with the throttle in No. 8 position is 35 to 45 pounds, and never less than 15 pounds. At idling speed the lubricating oil pressure should be above 5 pounds.
2. If the lube oil falls below 15 lbs. in the 8th notch, the engine will stop or idle and the alarm bells will sound throughout the locomotive. The yellow low oil pressure alarm indicators will light in the unit affected. If oil pressure is low and engine is idling shut down engine at once.

WARNING:

Never operate a diesel engine without sufficient lube oil or sufficient pressure.

FUEL OIL PRESSURE:

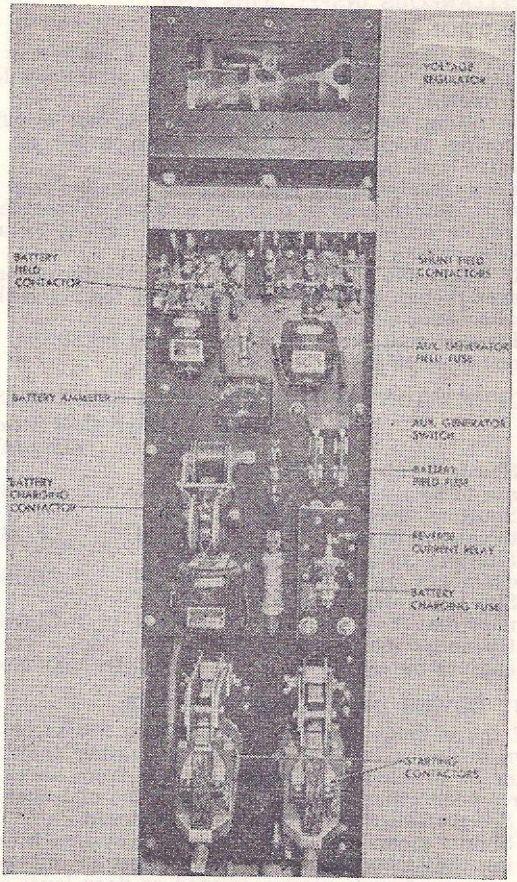
1. The fuel sight glasses should be observed frequently to check supply of fuel to the engine. Fuel should show in 5 lb. glass only. Report if fuel shows in 60 lb. glass.

BATTERY CHARGING:

1. Check the auxiliary generator ammeters in the low voltage cabinets periodically, also battery ammeters in distribution panels. Should show charge.

ENGINE TEMPERATURE:

1. Check engine cooling water temperature, which should be maintained at 155 degrees plus or minus 15 degrees. If not in this range report at first maintenance point.



Low Voltage Cabinet

MISCELLANEOUS INSPECTIONS AND PRECAUTIONS:

1. Check traction motor blowers. If a blower is not operating properly, isolate engine until trouble is corrected.
2. In filling engine cooling system, do not overflow. During freezing weather maintain water at "G" valve level with engine shut down.
3. Keep diesel engines running as continuously as possible, shutting down only on account of trouble. If trouble ocurs that traction motors cannot be used, keep engine isolated.
4. If wheel slip light comes on and off intermittently, even though throttle is reduced, stop train and check wheels for sliding.
5. Electric control air pressure should be 80 lbs. plus or minus 10 lbs.

OPERATION OF ENGINE ROOM SHUTTERS

	Warm Weather Operation	*Cold Weather Operation*
1. Shutters above boilers are to be	OPEN	CLOSED
2. Shutters over stairway to cab are to be	OPEN	CLOSED
3. Shutters in center fan chambers are to be	OPEN	CLOSED
4. Shutters above governors may be	OPEN	CLOSED
5. Openings at sides of engines on ceiling to be	CLOSED	OPEN

SHUT DOWNS IN FREEZING WEATHER:

If the engines and steam generators are to be shut down during a layover in freezing weather they must either be drained or heated by steam from an outside source connecting to the steam train line of locomotive.

1. See that all radiator shutters are closed.
2. Supply steam to the cooling water system by opening the steam admission valve direct to the cooling system of each engine, located at floor level at accessory end of engine.

3. Open "G" valve.
4. Drain toilet water tanks.
5. Open steam valves to steam generator heater and separator. Open coil blow down valve.

SHUT DOWNS ENROUTE:

If engine is shut down enroute and steam is available from train line, proceed as outlined in Items 1, 2 and 3 above.

If steam generator is shut down enroute and steam is available from train line, proceed as outlined in Items 4 and 5 above.

DRAINING:

In case steam is not available, proceed as follows:

1. Open main cooling system drain valve located at floor level at accessory end of engine.
2. Remove plug from right bank water pump.
3. Drain toilet water tank.
4. See instructions for draining steam generator in instructions for operating steam generating equipment.

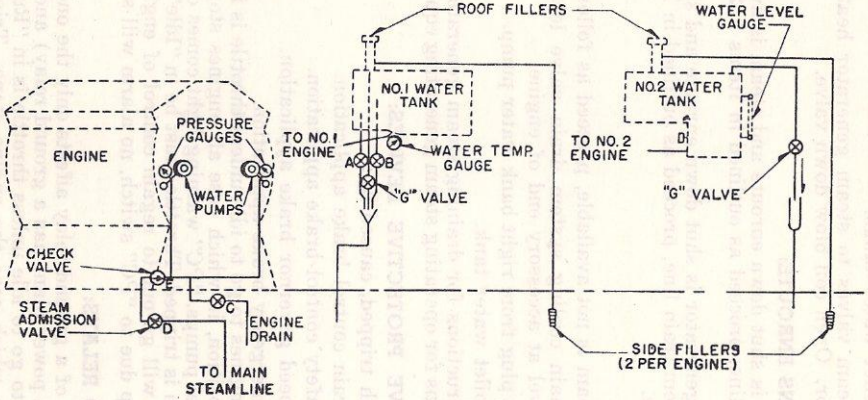
LOCOMOTIVE PROTECTIVE DEVICES:

1. PC switch tripped, caused by:
   a. Train control brake application.
   b. Safety control brake application.
   c. Speed governor brake application.
   d. Emergency brake application.

causes all engines to go to idle unless throttle is in No. 5 or No. 6 position, in which case all engines stop. Also stops all fuel pumps. "PC" warning light comes on when "PC" switch is tripped. Throttle must be in "Idle" before "PC" light will go out to regain control of engines. If engines stop due to "PC" switch, no alarm will sound.

2. GROUND RELAYS:

Tripping of a ground relay affects only the one power plant (each power plant has a ground relay) and causes the engine to go to idle unless throttle is in "Run 5" or "Run 6" in which case the engine stops. Tripping of



Schematic Cooling and Water Piping Diagram—Drains and Fillers

ground relay will cause alarm bells to ring and power plant affected will show ground relay red light if so equipped.

a. Isolate the engine affected and re-start if necessary.

b. Reset ground relay.

c. Put engine on line. (See "Returning Engine to Line").

d. If ground relay trips more than two more times, immediately isolate engine. Do not open ground relay knife switch.

3. ENGINE OVERSPEED TRIP:

When load is suddenly removed from an engine due to wheels slipping or other cause with throttle advanced, the engine speed may increase to such a value that the engine overspeed trip will function to stop engine. This can also happen due to mishandling of throttle or manual lay shaft lever.

a. Isolate the engine.

b. Reset overspeed trip handle at front end of engine.

c. Start engine and put on line. (See "Returning Engine to Line.")

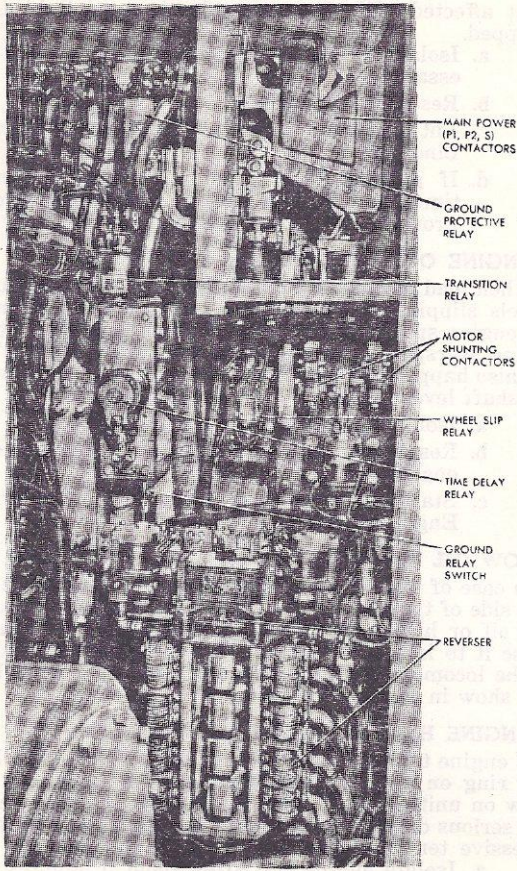
4. LOW OIL PRESSURE

In case of low oil pressure or high vacuum on the suction side of the lube oil and piston cooling oil pumps, the low oil or high suction switch will stop the engine or cause it to idle. The alarm bells will sound in all units of the locomotive. The yellow "LOW OIL" signal light will show in the unit affected.

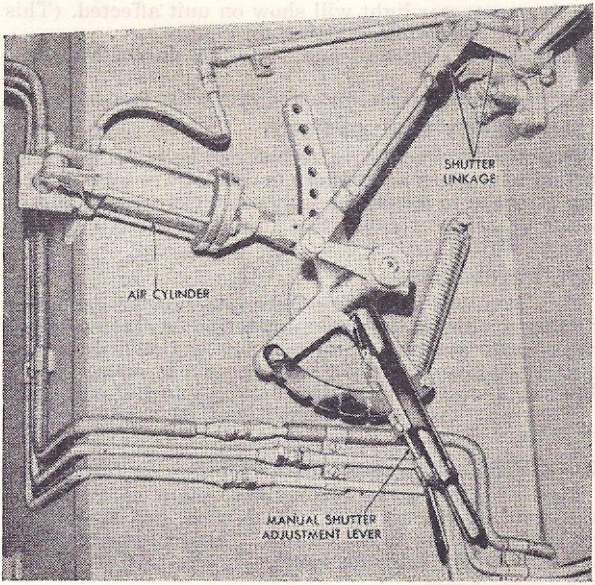
5. ENGINE HIGH TEMPERATURE ALARM:

If engine temperature exceeds 204° F., the alarm bells will ring on all units and "Hot Engine" red light will show on unit affected. This alarm does not stop engine and serious damage will be done if engine is operated at excessive temperature.

a. Isolate engine and after about 5 minutes stop engine unless trouble is found.



High Voltage Cabinet



Shutter Operating Mechanism

b. Check:
   1. Cooling water.
   2. Shutters; should be open.
   3. Cooling fan belts to see that they are in good condition. If hot engine alarm continues to ring, isolate engine.
   4. Oil pressure.
   5. Check for blown shutter fuse. (Located in shutter operating control box.)

6. STUCK STARTING CONTACTOR ALARM:

If one or both starting contactors stick completely closed, the alarm bells will ring on all units and white

starting contactor light will show on unit affected. (This alarm will ring while starting an engine.)

NOTE: Units 4000-4007 and 4100-4103 do not have this feature.

1. Pry open the stuck contactor with a dry wooden stick.

8. EMERGENCY FUEL CUT-OUT:

This is a snap-action valve and can be tripped to shut off fuel to engines and boilers in case of fire by pulling a ring attached to a cable on either exterior side of unit or in engine room or cab. (See "Shutting off All Fuel in Case of Fire".)

9. STARTING FUSE:

This is a 400 amp. fuse for protection of generator starting windings. If blown, operation of starter button will operate starting contactors but engine will not rotate. Excessive "cranking" of engine may cause fuse to blow. It is located in the Distribution Panel of each unit.

Warning: Two engines must not be started at the same time.

10. CONTROL AND LIGHTING FUSES:

Fuses for all control functions, main control fuse, train control MG set fuse, where used, and light fuses are located in Distribution Panel. These can be tested on fuse test blocks in same panel.

11. OTHER FUSES:

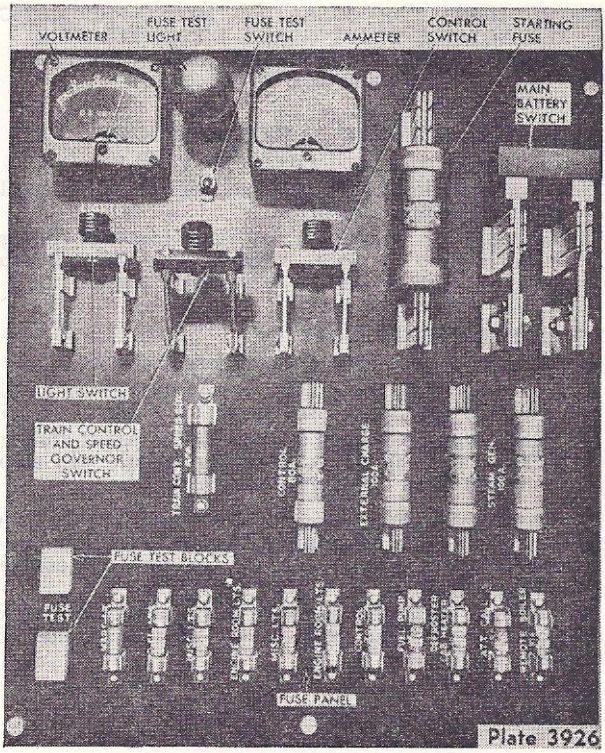
Auxiliary generator fuse, battery field fuse, auxiliary generator field fuse are located in low voltage cabinet.

IMPORTANT NOTICE

If any engine or power equipment fails to operate, and checking of all controls and safety devices in accordance with these instructions does not correct the difficulty, the engine should be isolated or stopped and proper entry made in Log Book. Engine crew should not attempt to make any adjustments. If serious trouble develops, notify the next engine terminal.

LOG BOOK

Engine crew *must* enter in Log Book all troubles with equipment indicating where trouble occurred and what



Distribution Panel

if any, correction was made. Also, enter items to be repaired at maintenance point as well as improper performance of engines or locomotive, incidents causing delays, etc. Each entry must be signed and dated and must specify train number or symbol.

INSTRUCTIONS FOR OPERATING HYDRO-PNEUMATIC RETRACTABLE DRAFT GEARS, DIESEL ELECTRIC LOCOMOTIVES, CLASS DPA-1A ROAD NUMBERS 4000-4007 ONLY

TO MOVE DRAFT GEAR TO EXTENDED POSITION

1. Raise large cock handle as far as it will go.
2. Open operating valve, when coupler has reached full extended position, close valve.
3. Rock coupler sideways a few times to assist sliding locks to drop in place. Warning whistle will stop sounding when locks are in proper position.

TO RETRACT DRAFT GEAR

1. Place large cock handle in downward position.
2. Open operating valve, when coupler has reached full retracted position, close valve.
3. Rock coupler sideways a few times to assist sliding locks to drop in place. Warning whistle will stop sounding when locks are in proper position.

In the event main reservoirs are not charged it will be necessary to couple brake pipe air hose to another locomotive and charge reservoirs by opening dead engine fixture cut-out cock.

To operate draft gear as above it is necessary to break seal and open cut-out cock on the right-hand side of nose compartment.

Revised Oct., 1949

THE NEW YORK CENTRAL RAILROAD COMPANY

Operating Instructions

Class DFA-3a, DFB-3a, DFA-3b, DFB-3b, DFA-3c, DFB-3c, DFA-3d, DFB-3d, DFA-3e, DFB-3e, DPA-2a, DPB-2a, DPA-2b, DPB-2b, Alco Locomotives 1000 to 1043, Incl., 2300 to 2322, Incl., 4200 to 4203, Incl., and 4300 to 4303, Incl.

Office of Gen'l. Supt. Equipment
New York, N. Y.
Revised Oct. 3, 1949.

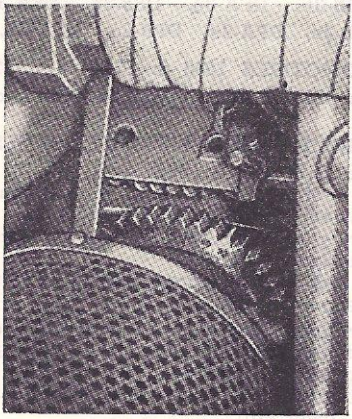
OPERATING INSTRUCTIONS FOR CLASS DFA-3α, DFB-3α, DFA-3b, DFB-3b, DFA-3c, DFB-3c, DFA-3d, DFB-3d, DFA-3e, DFB-3e, DPA-2α, DPB-2α, DPA-2b, DPB-2b.

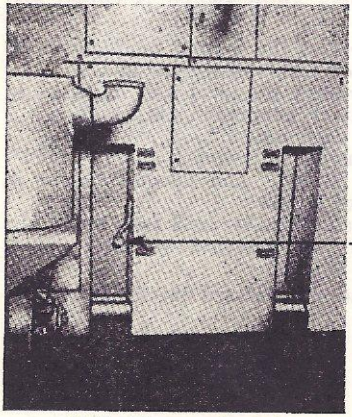
ALCO LOCOMOTIVES 1000 to 1043, Incl., 2300 to 2322, Incl., 4200 to 4203, Incl. and 4300 to 4303, Incl.

PRECAUTIONS BEFORE STARTING ENGINES:

1. Check fuel oil supply, each unit.
2. Governor circuit breaker closed, each unit.
3. Main battery switch closed, each unit.
4. Auxiliary generator voltage regulator circuit breaker closed, each unit.
5. Control negative and control positive circuit breakers closed, each unit.
6. Auxiliary generator circuit breaker closed, each unit.
7. See that temperature control switch is in "Automatic" position, each unit.
8. See that traction motor cutout switch is in "All in" position, each unit.
9. See that ground relay knife switch is closed and sealed, each unit.
10. Check the water level of the engine cooling system and the lubricating oil levels of engine and air compressor. Check governor oil level and oil level in gear drive for auxiliary generator, each unit.
11. Check sand supply, each unit.
12. See that reverse handle is inserted and in "OFF" position, throttle in "IDLE" and selector handle in "OFF". Insert brake handles.
13. See that control circuit breaker and fuel pump circuit breaker at engineman's control stand are closed.
14. Snap on train stop switch.
15. Set up train stop and see that red check light comes on.
16. Snap on crankcase exhauster circuit breaker, each unit.
17. See that oil engine turning gear is disengaged and locked, each unit.

Diesel Engine Turning Gear

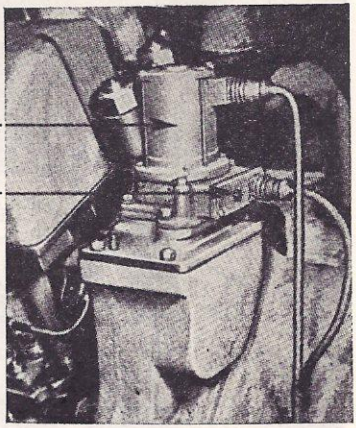




Main Battery Switch

STARTING ENGINES AND PUTTING ENGINES ON LINE:

1. Check the engine overspeed trip reset button. This is pressed in to reset.

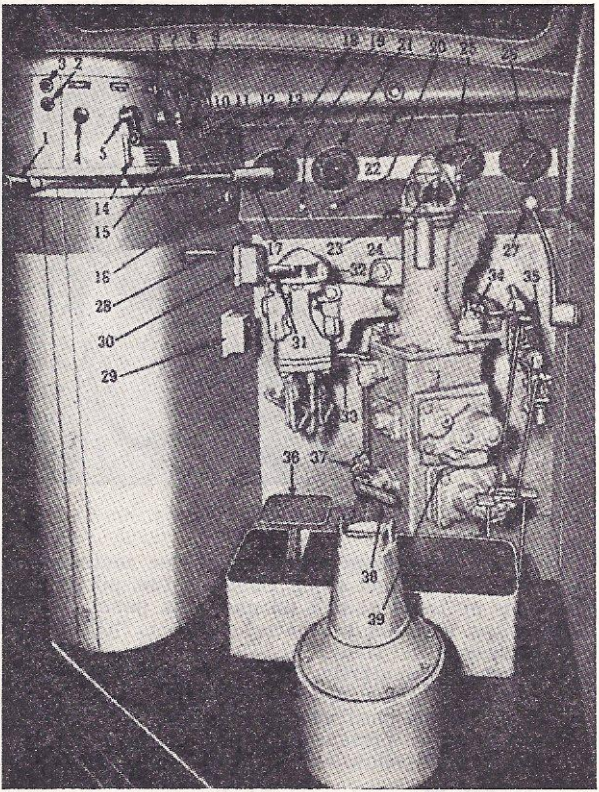


Engine Overspeed Trip

2. Snap on fuel pump switch on engine control panel and note that fuel pump runs and fuel oil pressure builds up to 30 pounds on gauge on panel.
3. Starting with engine control switch in "OFF" position, rotate to "IDLE."
4. Hesitate momentarily; then turn start lever on engine control panel clockwise to crank engine. Hold switch closed until engine fires and 20 pounds of lubricating oil pressure shows on gauge. Alarm bell will stop and yellow low oil pressure light will go out.

NOTE: The engine should start turning promptly when the start lever is turned and firing should occur within a few revolutions.

Engineman's Control Position



ENGINEMAN'S POSITION:

1. Selector Handle
2. Low Lube Oil Pressure Light
3. Hot Engine Light
4. Attendant Call Button
5. Headlight Switch
6. Cab Heater Control
7. Gage Light Control
8. Defroster Control
9. Emergency Engine Stop Button
10. Control Switch
11. Generator Field Switch
12. Fuel Pump Switch
13. Train Control Switch (when used)
14. Transition Window
15. Throttle Window
16. WindshieldWiperValve
17. Throttle Handle
18. Load Indicator
19. Wheel Slip Light
20. Power Cut-off Light
21. Speed-transition Indicator
22. Train Order Light Switch
23. Sanding Bail
24. Automatic Air Brake Handle
25. Brake Cylinder and Brake Pipe Air Gage
26. Main and Equalizing Reservoir Air Gage
27. Cab Window Handle
28. Reserve Handle
29. Wheel Slip Buzzer
30. Alarm Buzzer—low oil pressure, hot engine, ground relay out, boiler flame out
31. Independent Air Brake Handle
32. Rotair Valve (not shown)
34. Bell Valve
35. Horn Valves
36. Deadman Pedal
37. Feed Valve
38. Double Heading Valve
39 Safety Control Cut-out Cock

5. If engine does not fire, release start lever and turn control switch to "OFF" position. Repeat engine start. Do not attempt to start engine repeatedly as this will run down the batteries.

Engine Control Panel

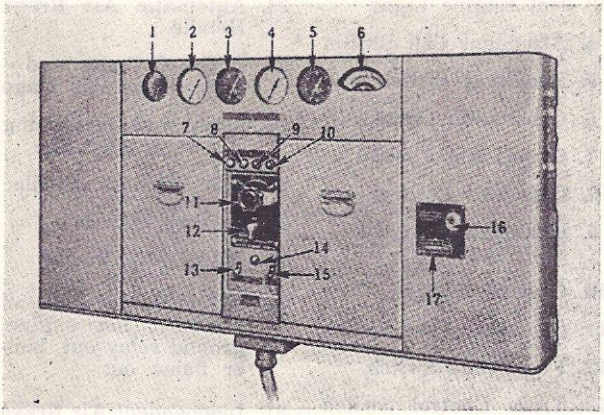
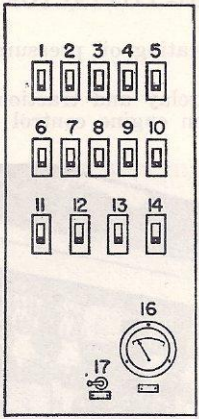


Fig. 10

1. Not Used
2. Lube Oil Pressure Gage
3. Fuel Oil Pressure Gage
4. Not Used
5. Turbosupercharger Air Pressure Gage
6. Engine Water Temperature Gage
7. Ground Relay and Traction Motor Blower Light
8. Boiler Flame Light
9. Low Lube Oil Pressure Light
10. Hot Engine Water Light
11. Engine Control Knob
12. Engine Starting Switch
13. Panel Light Switch
14. Crankcase Exhauster Light
15. Fuel Pump Switch
16. Radiator Fan Control Switch
17. Manual Radiator Fan Control

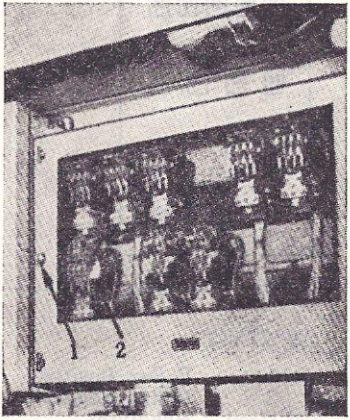


Contactor Compartment Panels

"A" UNIT	*"B" UNIT*	
1	1	Boiler Positive
2	2	Boiler Negative
3	Not Used	Headlight
4	4	Engine Room Lights
5	Not Used	Cab Lights and Auxiliaries
6	6	Fuel Pump
7	7	Crankcase Exhauster
8	8	Motor-Generator Set
9	9	Auxiliary Generator Field
10	10	Blower Generator Field
11	11	Control Negative
12	12	Control Positive
13	13	Auxiliary Generator
14	14	Blower Generator
16	16	Auxiliary Generator Ammeter
17	17	Compartment Lights

AFTER ENGINE IS RUNNING:

1. See that STARTING CONTACTOR CLOSED indicator light is out.
2. See that the lubricating oil pressure is at least 20 pounds.
3. See that ground relay and traction motor blower indicating lights on engine control panels are out.



1. Ground Relay Reset Button
2. Ground Relay

4. Open crank case exhauster circuit breaker on contactor control panel.
5. Check level of engine lubricating oil. Should be at the high mark on bayonet gauge with engine idling and crankcase exhauster shut off.
6. Close crank case exhauster circuit breaker. Note that "EXHAUSTER RUNNING" light in on.
7. See that there is no leak in piping systems.
8. Check battery ammeter for proper reading.

PUTTING ENGINES ON THE LINE:

1. Turn engine control switch (one position at a time) to "RUN." It comes under control of the throttle as soon as the switch is moved above the "IDLE" position.

FINAL CHECK:

Make a final check on operation and lube oil and fuel oil pressure gauges.

PREPARATIONS FOR MOVING LOCOMOTIVE:

1. If necessary, turn gauge control light switch on control switch on control stand to ON and hold clockwise against the return spring pressure until gauge panel lights come on; then release pressure.
2. See that air compressors are maintaining main reservoir air pressure at 130-140 lbs. and control air is 70 lbs. plus or minus 10 lbs.
3. See that air brake equipment is properly set up on all units.
4. See if hand brakes are released.
5. Make necessary air brake tests. Place foot on safety control pedal before releasing locomotive brakes.
6. Test operation of horns, bells, and sanders.
7. Close generator field switch.

When locomotive is to be moved light, Rotair valve on leading "A" unit must be in "P" and on trailing "A" unit in "PL."

9. Engineer must make visual inspection of exterior of locomotive and running gear for:
   (1) Liquids leaking from locomotive
   (2) Loose parts.
   (3) Proper positioning of Angle Cocks and Shut Off Valves.

IN "B" UNIT OR UNITS:

1. Repeat items 1 to 5 under Starting Engines, items 1 to 8 under After Engine is Running, and Item 1 under Putting Engines on the Line.
2. See that the following air cocks are closed:
   a. Cock under brake valve.
   b. Main reservoir cock to brake pipe feed valve.
3. Place controlled emergency cock on control valve in "PASS" or "FRT" corresponding to "P" or "F" position selected on leading "A" unit.

PUMPING UP TRAIN LINE:

If main reservoir pressure cannot be maintained while charging trainline, proceed as follows:

1. Close control breaker at control stand.

2. Move reverser handle to OFF position.
3. Place selector handle in position 1.
4. Advance the throttle handle to notch 3 or below (one notch at a time).

CAUTION:

1. Do not advance the throttle handle beyond notch 3 for this operation.
2. Never pump air with reverse handle in FORWARD or REVERSE position.

STARTING TRAIN:

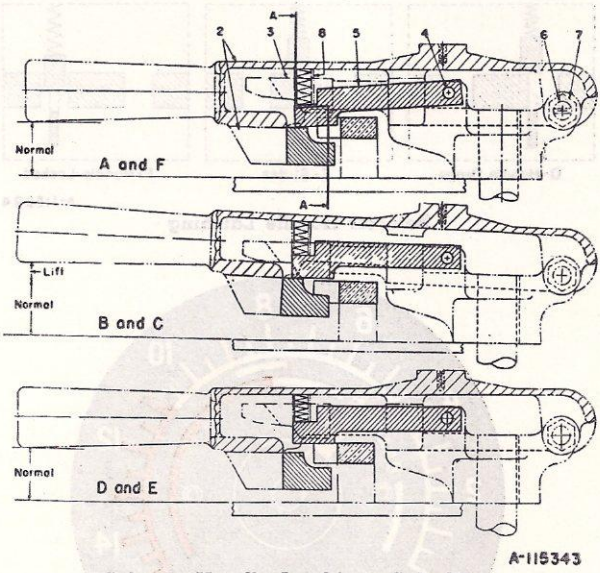
1. With the throttle handle in IDLE place the selector handle in position No. 1. For operation with automatic transition, selector handle can then be placed in position 4 *after* train has started. (Automatic transition on passenger locomotives 4200-4203 and 4300-4303 and freight locomotive 1014 to 1043 and 2307 to 2322 only.) Locomotive units 1000 to 1013 and 2300 to 2306 must be operated in manual transition. If one of these units is coupled with a unit having automatic transition the entire locomotive must be operated in manual transition or damage to equipment will occur.
2. Move reverse handle to FORWARD or REVERSE as required by train movement.

   NOTE: Under some conditions it may be desirable to forestall a forward transition change. For instance, a grade may be encountered which levels off slightly for one or more short distances in the course of its length. These easings of the grade may possibly cause the automatic transition to go up one step and then return almost immediately to its former position. Under these circumstances, it is recommended practice to place the transition lever in the position corresponding to the one in which the units are operating on the major portion of the hill. The automatic transition will not advance beyond the position at which the transition lever is set and the momentary transition advances will be avoided.
3. If transition meter is defective move transition lever in accordance with speed as indicated below:

   Shift 1-2.....20 MPH Shift 2-3.....25 MPH Shift 3-4.....50 MPH

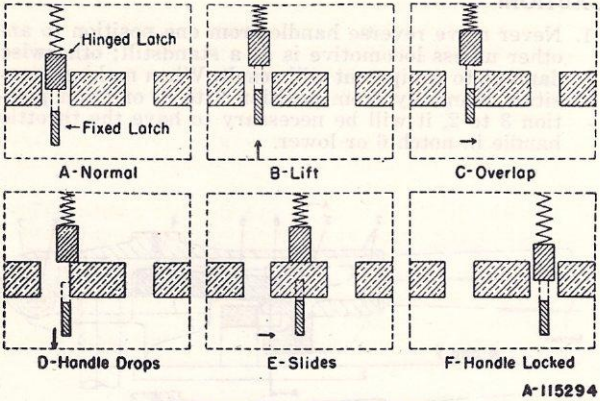
CAUTION:

1. Never move reverse handle from one position to another unless locomotive is at a standstill; otherwise damage to equipment will result. When making transition manually from position 2 to 3, or from position 3 to 2, it will be necessary to have the throttle handle in notch 6 or lower.

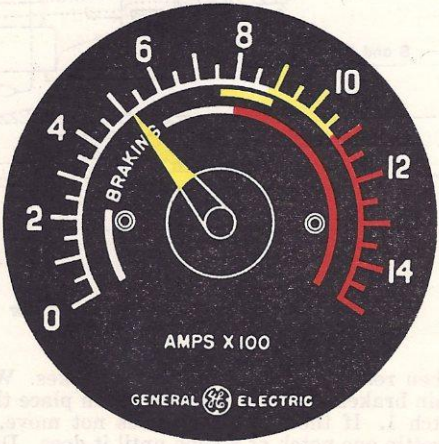


Selector Handle Latching—Side View

2. When ready to start, release air brakes. Wait until train brakes are fully released; then place throttle in notch 1. If the locomotive does not move, advance throttle one notch at a time until it does. Damage to



Selector Handle Latching



traction motors will occur if they remain stationary with power applied for prolonged periods. Power required to start train may move load-braking indicator into the red band. As soon as the locomotive moves, the throttle may be controlled as train operation requires.

3. Advance throttle a notch at a time to increase speed, going into red zone only as necessary to accelerate train.
4. If train does not start in 5th throttle position close throttle one notch at a time and determine cause.

USING SAND:

Use sand whenever necessary to avoid slipping of driving wheels. If wheel slipping is continuous, notch off throttle until slipping stops. Do not use sand while wheels are slipping.

NOTCHING OFF:

1. Notching off should, if possible, be done one notch at a time for smooth operation.
2. When shutting off power, throttle may be closed any time regardless of the position of the selector handle.

ESTABLISHING DYNAMIC BRAKING (FREIGHT LOCOMOTIVE ONLY):

1. When the dynamic brake is to be used, close the throttle to IDLE and return the selector handle to OFF if it is in a power operation position. Disengage the selector handle latching mechanism from the OFF position and move the lever toward the engineer's position until it latches in the "B" position. This movement should be made rapidly, in the same manner as when changing from one power position to another. It is not necessary to "Feel" for the "B" position. Note that this movement of the selector handle can be made only when the throttle is in IDLE and the reverse handle in FORWARD.
2. The load-braking indicator pointer should show a slight movement as dynamic braking is established.

Disengage the selector handle and move it forward very SLOWLY until the pointer moves up to approximately 100 amperes. The braking effort obtained at this point will be enough to bunch the slack, and the selector handle should not be advanced any further until the slack is bunched.

USING THE DYNAMIC BRAKE (FREIGHT LOCOMOTIVES ONLY):

1. When the slack is bunched, move the handle slowly toward the right. As the handle is moved, the reading of the load-braking indicator will rise and the dynamic brake effect will increase. If maximum braking is desired, continue the movement of the handle until the pointer of the load-braking indicator reaches the upper limit of the white zone. Do not allow the pointer to go into the red zone.
2. If the breaking effect, at maximum application, is sufficient to slow down the train, the pointer will fall back as the train speed drops. To maintain maximum braking effort, continue the movement of the handle to keep the pointer near the upper end of the white zone as the train speed decreases. If a steady speed is desired rather than a slow down, ease off on the dynamic brake by moving the handle back toward OFF, until the train speed steadies at the required miles per hour. To hold this speed the handle can be moved slightly forward to retard the train or back to speed it up.
3. Do not let air brake apply on locomotive while using dynamic brake.

RELEASING THE DYNAMIC BRAKE (FREIGHT LOCOMOTIVES ONLY):

Release of the dynamic brake should be made gradually to avoid run-out in the train under certain conditions. Keep in mind that the dynamic brake has somewhat the same effect as a powerful independent air brake and be governed accordingly.

When releasing the dynamic brake, a light application of independent air may be made as the handle is moved

from "B" to OFF and the independent then slowly released. This action should be taken if grade conditions are such that the locomotive will tend to "run away" from the train when the dynamic brake is released.

STOPPING ENGINES:

SHUTTING DOWN ENGINES:

1. Move engine control switch to IDLE position.
2. Stop the engine by turning engine control switch to OFF.
3. Snap off fuel pump switch on engine panel.

EMERGENCIES:

STOPPING ALL ENGINES FROM LEADING UNIT:

1. In case of an emergency requiring the immediate simultaneous stopping of all power plants, push engine stop button on control stand. This button should only be used for this purpose.

   NOTE: After stopping the engines in this manner, open control circuit breaker in the operating cab before starting the engines. If the breaker is left closed, the engine control switches in all units must be moved to OFF before any engine can be started.
2. Snap off the fuel pump circuit breaker in the cab of the leading "A" unit to stop all fuel pumps.

REMOVING ENGINE FROM LINE:

An engine in any unit can be removed from the line, with the locomotive running at any speed on any throttle notch, by turning the engine control switch to IDLE.

RETURNING ENGINE TO LINE:

Any engine can be put back on the line, after being in IDLE by turning the ENGINE CONTROL switch to RUN, one position at a time. A slight pause is desirable at each position to allow engine to come up to speed under load, in case the throttle is open. As the engine comes up to speed, it will assume its share of load for each position on the engine control switch. .

SHUTTING DOWN ANY ENGINE WITH TRAIN IN MOTION:

An engine is stopped by turning the engine control switch to OFF. After shutting down an engine, snap the fuel pump switch to OFF on the engine control panel.

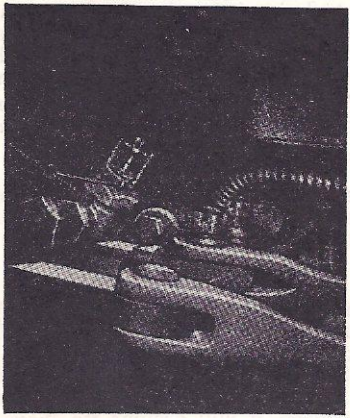
STARTING THE ENGINE WITH TRAIN IN MOTION:

Follow complete procedure for starting engine, and putting on the line in accordance with "Starting engines and putting engines On The Line." Train Stop may apply brakes when starting engine in leading "A" unit.

SHUTTING OFF ALL FUEL IN CASE OF FIRE:

1. Pull nearest emergency fuel trip handle on each unit.
2. Snap OFF fuel pump switches.
3. Snap OFF fuel pump circuit breaker on control stand.
4. Shut down all engines by pushing stop button at engineman's position.

Below Platform



Emergency Fuel Shut-off Valve

OPERATING PRECAUTIONS:

REVERSING:

Bring locomotive to a dead stop before moving reverse handle for opposite locomotive movement.

OPERATING THROUGH WATER:

Do not operate locomotive through water more than 3 inches over top of rail, and then at a speed not exceeding 3 M.P.H.

PASSING OVER RAILROAD CROSSINGS:

When crossing a railroad crossing, throttle should be moved back to Notch 3 and kept in that position until all locomotive units have passed over the crossing.

CHANGING OPERATING CABS:

KEEPING ENGINES RUNNING:

Just before it is time to change operating cabs, arrange to have the fuel pump circuit breaker snapped ON in the new leading cab, (or at hostler's control station if operation is from "B" unit). This will keep the engines running when the fuel pump circuit breaker is snapped OFF as in 7 below. Never operate with more than one fuel pump circuit breaker closed, except for a few seconds when changing ends.

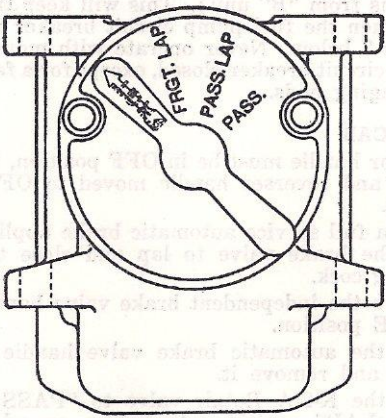
LEADING CAB:

1. Selector handle must be in OFF position, throttle in IDLE and reverser handle moved to OFF and removed.
2. Make a full service automatic brake application, return the brake valve to lap and close the double heading cock.
3. Remove the independent brake valve handle in RELEASE position.
4. Move the automatic brake valve handle to RUNNING and remove it.
5. Move the K-2-A Rotair valve to "PASS LAP" or "FRT LAP" position, depending on whether the locomotive is operating in passenger or freight service, or light.

6. Close the signal line supply cock.
7. Snap OFF control circuit breaker, generator field switch, train stop generator and fuel pump circuit breaker on the control stand. Make sure fuel pump circuit breaker is ON in new leading cab before opening the trailing cab fuel pump breaker.

NEW LEADING CAB:

1. Start train stop generator and reset train stop system.
2. Snap ON generator field switch and control circuit breaker.
3. Open signal line supply cock.
4. Apply automatic brake valve handle, apply the handle to the independent brake valve and move the K-2-A Rotair valve to the proper operating position, "PASS" or "FRT." The position should correspond to the "LAP" setting in the trailing cab.



Rotair Valve

5. Move the independent brake valve handle to "FULL APPLICATION" position and open double heading cock.
6. Replace reverse handle, leaving reverse handle in OFF position.
7. Make air brake test.
8. Locomotive is now ready to move in accordance with instructions on "Moving Locomotive."

OPERATING FROM "B" UNIT HOSTLER'S CONTROLS:

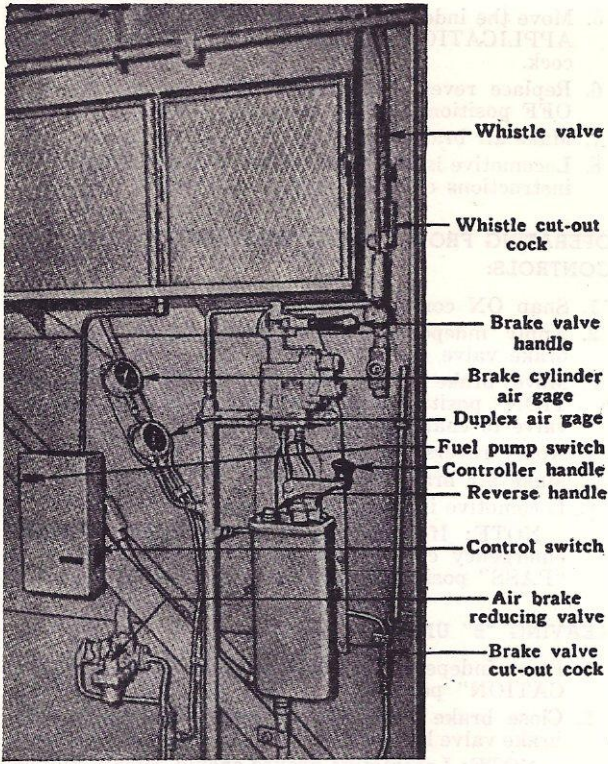
1. Snap ON control circuit breaker.
2. Apply independent brake valve handle and open brake valve cut-out cock.
3. Move brake valve handle to "FULL APPLICATION" position and open cut-out cock on reducing valve to charge brake pipe.
4. Apply reverse handle.
5. Make air brake test.
6. Locomotive is now ready to move.

   NOTE: If "B" unit is moved alone, controlled emergency cock on D-24 control valve must be in "PASS" position.

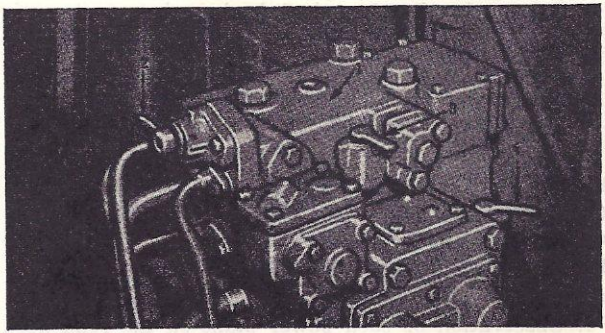
LEAVING "B" UNIT:

1. Place independent brake valve in "FULL APPLICATION" position.
2. Close brake valve cut-out cock, move independent brake valve handle to RELEASE and remove handle.

   NOTE: Locomotive brakes should remain applied.
3. Place reverser handle in "OFF" and remove handle.
4. Close cut-out cock on reducing valve.
5. Snap OFF control circuit breaker.
6. Snap OFF fuel pump circuit breaker. Make sure fuel pump circuit breaker is ON in new leading cab before opening "B" unit fuel pump breaker.



Hostler's Station—"B" Unit



1. D-24 Control Valve
2. Control Emergency Cut-out Cock
3. Dead Engine Cut-out Cock
4. Charging Change-over Cock

LEAVING LOCOMOTIVE FOR LAYOVER:

1. Shut down diesel engines and snap OFF fuel pump switches on all engine control panels.
2. Protect against freezing if necessary. (See "SHUT DOWNS IN FREEZING WEATHER.")
3. Remove reverse handles from control stand and place in storage box.
4. Snap OFF control circuit breaker and generator field switch at control stand.
5. Set hand brake in each unit.
6. Open main battery switch in each unit.

TOWING LOCOMOTIVE DEAD IN TRAIN:

Move reverse handle to "OFF" position and remove from control stand. Throttle handle in each "A" unit must be in IDLE and selector handle in OFF position. Air brakes must be set up as follows:

a. Close double heading cock on the automatic brake valve.

b. Remove handles from both brake valves (automatic in RUNNING position and independent in RELEASE position.)
c. Place the K-2-A Rotair valve in PASS position.
d. Dead engine cock handle, on the D-24 control valves in all units, must be moved toward the DEAD position.

PROTECT AGAINST FREEZING IF NECESSARY (SEE "SHUT DOWNS IN FREEZING WEATHER"):

OPEN MAIN BATTERY SWITCH:

PERIODIC INSPECTION ON ROAD:

GENERAL:

1. Observation of each power plant on the road need only be made as operating schedules permit.

LUBE OIL PRESSURE:

1. Normal lubricating oil pressure with throttle in notch 8 is 40 to 65 lbs. hot oil. At idling speed the lubricating oil pressure should be above 20 lbs.
2. If the lube oil pressure falls below 20 lbs. while throttle is in fifth notch or above, the engine will return to idle and the alarm bells will sound throughout the locomotive. The yellow "LOW OIL PRESSURE" alarm indicator will light in the unit affected.
3. If oil pressure drops to 7 lbs. with throttle in any notch engine will stop.

WARNING:

Never operate a Diesel engine without sufficient lubricating oil or sufficient pressure.

FUEL OIL PRESSURE:

The fuel oil pressure is normally 20-40 lbs. on gauge on engine control panel. If pressure should vary above or below these limits, report the trouble for correction.

BATTERY CHARGING:

The battery ammeter pointer should be in the "CHARGE' section of the dial.

ENGINE HIGH TEMPERATURE ALARM:

High temperature of the engine cooling water or lubricating oil will reduce the power output of the unit concerned by 25% and actuate the HOT ENGINE alarm.

Isolate engine and after 5 minutes stop engine unless trouble is found.

Check cooling water.

Check operation of shutters which should be open. (Shutters may be opened manually by closing shutter air supply cock an bleeding air from lines. Shutter may then be adjusted as required and locked in place with clamp on handle.)

See that cooling fan is running.

NOTE: See that temperature switch is in "AUTOMATIC" position. If in "AUTOMATIC" position it is necessary to turn to "MANUAL" to manually regulate fan speed.

GROUND RELAY:

Tripping of a ground relay affects only one power plant (each power plant has a ground relay) and causes the engine to go to idle. Tripping of ground relay will cause alarm bells to ring and power plant affected will show ground relay light.

1. Isolate engine affected.
2. Reset ground relay.
3. Put engine on line.
4. If engine does not load, check ground relay again.
5. If ground relay trips more than two more times, immediately isolate engine. Do not open ground relay knife switch.

"PC" SWITCH:

"PC" Switch tripped, caused by:

1. Train control brake application.
2. Safety control brake application.
3. Speed governor brake application.
4. Emergency brake application.

Causes all engines to go to idle. "PC" warning light comes on when "PC" switch is tripped. Throttle must be in IDLE before "PC" light will go out to regain control of engines.

STUCK STARTING CONTACTOR LIGHT:

If one or both starting contactors stick completely closed, the white starting contactor light will show on unit affected. (This will light when starting an engine.)

1. Isolate engine affected.
2. Pry open the stuck contactor with a dry wooden stick.
3. Put engine on line.

SUMMARY OF OPERATING PRECAUTIONS:

1. In case of fire, quickly pull nearest emergency fuel trip handle.
2. If a locomotive or a unit continues to develop power with throttle handle in IDLE, or if throttle handle sticks in a power notch, snap OFF control circuit breakers and generator field switch on control stand panel. If power continues, close control circuit breaker and press engine stop button on control stand of leading unit. Afterwards open fuel pump circuit breaker.

ELECTRICAL PRECAUTIONS:

1. Watch battery charging ammeters on inspection rounds to see that normal battery charging is taking place.
2. A circuit breaker which trips on overload assumes a position approximately midway between ON and OFF. It must be moved to OFF position before it can be reset. If necessary to reset tripped circuit breakers, first make certain affected apparatus is in operating condition. If circuit breakers reopen, remedy this trouble or shut down the affected apparatus.
3. Do not block in contactors, relays or circuit breakers.
4. Observe that traction motor blowers are operating at all times when locomotive is under power.

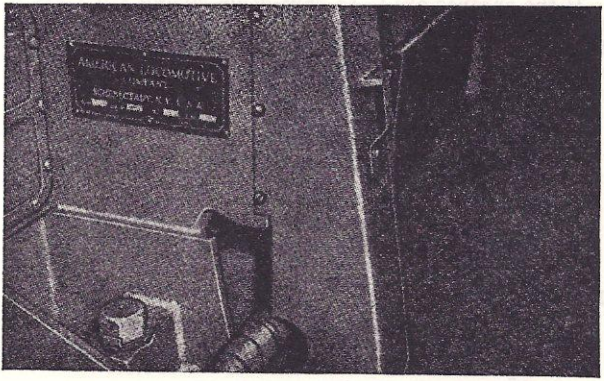
DIESEL ENGINE PRECAUTIONS:

1. Report all unusual sounds or actions of any part of diesel engines, diesel engine accessories or electrical equipment. Shut down affected engine if necessary.
2. Keep diesel engines running as continuously as possible, shutting down only on account of trouble.
3. Do not attempt to correct trouble by making adjustments to engine, power plant regulator, temperature or pressure switch or any control device. Trouble should be reported for correction.

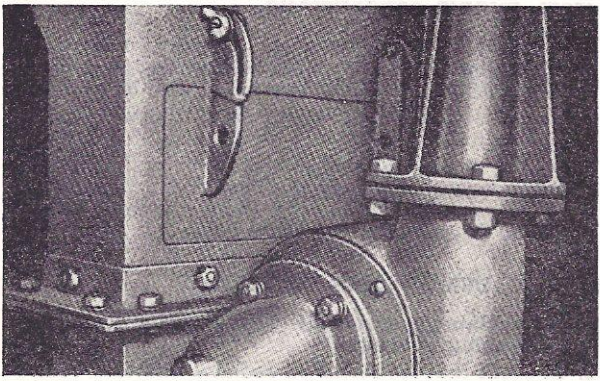
RUNNING DURING COLD WEATHER:

1. Recirculate generator air to keep engine room warm by opening damper.
2. In event that ice forms on radiator shutters, remove at first opportunity.

Main Generator Dampers



Left Side—Engine Room



Right Side—Engine Room

SHUT DOWNS IN FREEZING WEATHER:

If the engines are to be shut down during a layover in freezing weather they must either be drained or heated by steam from an outside source, connection to the steam train line of the locomotive. For protection against freezing, take the following steps:

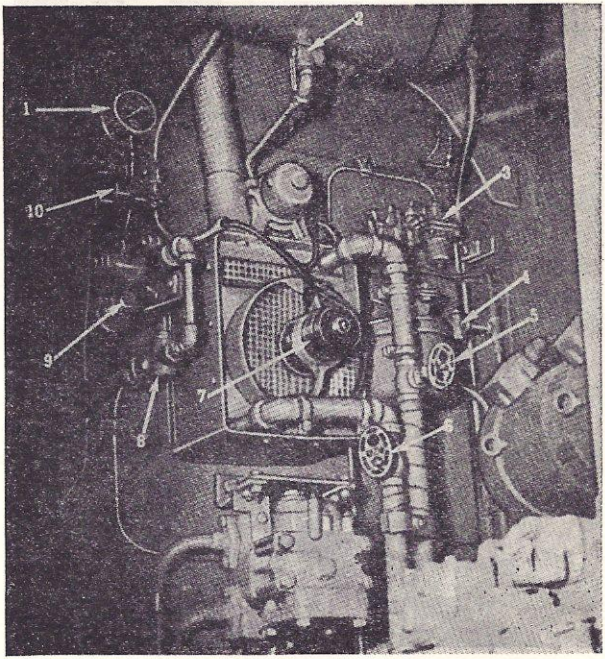
1. See that all radiator shutters are closed.
2. If steam is available, supply steam to engine and cooling water tanks by opening steam admission valves.
3. Drain toilet water tanks.
4. Open steam valves to steam generator heater and steam separator. Open coil blow down valve.

DRAINING:

In case steam is not available, proceed as follows:

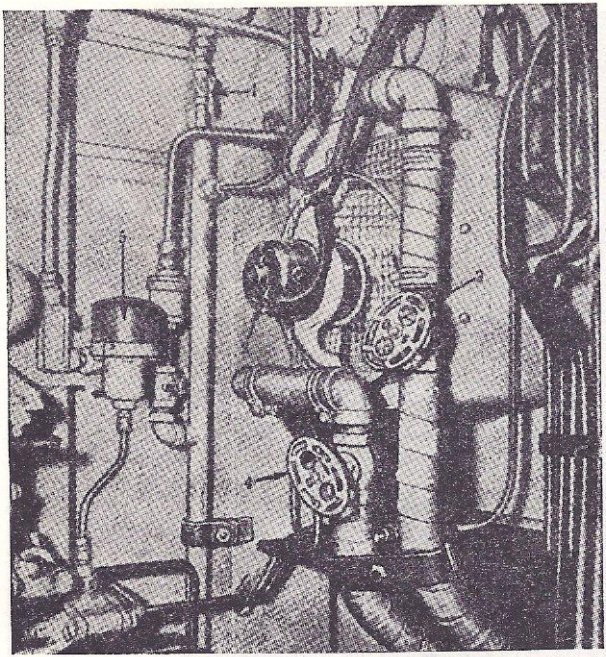
1. Drain engine
   a. Open drain valve at base of oil cooler.
   b. Remove plug in bottom of water pump.
   c. Open both valves to each cab heater.

2. Drain toilet water tanks.
3. See instructions for draining steam generator in Instructions for Operating Steam Generating Equipment.



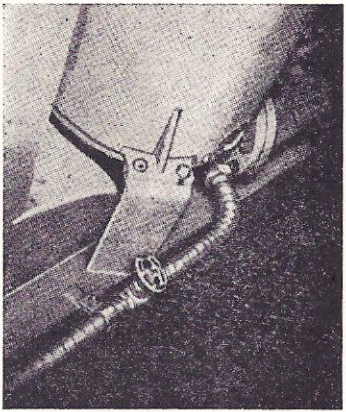
1. Control Air Gage
2. Control Air Reservoir Drain
3. NS-1 Reducing Valve
4. Signal Line Cut-out Cock
5. Cab Heater Outlet Valve
6. Cab Heater Inlet Valve
7. Cab Heater Motor
8. Control Air Cut-out Cock
9. Control Air Reducing Valve
10. Car Discharge Valve

Hood—Engineman's Side



1. Windshield Wiper Cut-out Cock
2. Cab Heater Motor
3. Cab Heater Outlet Valve
4. Cab Heater Inlet Valve
5. Sander Switch

Engine Water Drain Valve



Valve under lube oil cooler

IMPORTANT NOTICE

If any engine or power enquipment fails to operate, and checking of all controls and safety devices in accordance with these instructions does not correct the difficulty, the engine should be isolated or stopped, and proper entry made in the Log Book. Engine crew should not attempt to make any adjustments. If serious trouble develops, notify the next engine terminal. (See Shut Downs in Freezing Weather.)

LOG BOOK

Engine crew *must* enter in Log Book all troubles with equipment indicating where the trouble occurred and what if any, correction was made. Also, enter items to be repaired at maintenance point as well as improper performance of engines or locomotive, incidents causing delays, etc. Each entry must be signed and dated and must specify train number or symbol.

THE NEW YORK CENTRAL RAILROAD COMPANY

Operating Instructions

Class DFA-1a, DFB-1a Electro-Motive Diesel Locomotives—1600 to 1603 Incl., and 2400 to 2403 Incl.

OPERATING INSTRUCTIONS

CLASS DFA-1A, DFB-1A, ELECTRO-MOTIVE DIESEL LOCOMOTIVES—1600 TO 1603 INCL., AND 2400 TO 2403 INCL.

PRECAUTIONS BEFORE STARTING OIL ENGINES:

1. Check fuel oil supply, each unit.
2. Check engine cooling water supply, each engine.
3. Check lubricating oil supply, each engine.
4. Check oil in 90 degree fan drives, each unit.
5. Check oil in engine air compressor, each unit.
6. Check supply of sand.

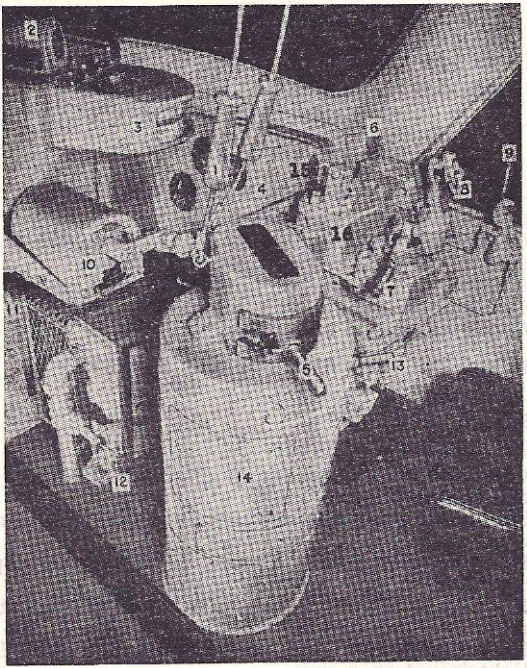
STARTING ENGINES AND PUTTING ENGINES ON LINE:

TO START ENGINES:

A—IN LEADING "A" UNIT:

1. Close all knife switches in distribution panel.
2. Start train stop MG set.
3. Set up train stop and see that red check light comes on.
4. Place automatic brake valve in "LAP" and open double heading cock.
5. Place independent brake valve in full application position.
6. Place throttle in IDLE position and note that "PC" light is *not* on.
7. Place transition lever in "OFF."
8. Put reverse lever in neutral.
9. Put in "Control" and "Fuel Pump" push buttons (and whatever light buttons are needed).
10. At engine starting panel in engine room, turn on fuel pump.
11. Be sure fuel pump starts and "5-lb. glass" fills with clear fuel.
12. Isolation switch must be in "Start" position. No alarm bells or lights should be on.

Engineer's Controls



1. Horn Cords.
2. Dynamic Brake Warning Light.
3. Transition Indicator.
4. Instrument Panel.
5. Transition Lever.
6. Windshield Wiper Valve.
7. Automatic Brake Valve.
8. Independent Brake Valve.
9. Sanding Valve.
10. Unit Selector Switch.
11. Hood Light Switch.
12. Cab Heating Valve.
13. Reversing Handle.
14. Controller.
15. Safety Control Cut-out Cock.
16. Doubleheading Cock.

13. Open all cylinder test valves, *hold layshaft lever in shut down position* and push starting button. Hold button long enough for engine to make several revolutions and check for any indication of water or oil in cylinders. If accumulation appears, report to Terminal Foreman. Close test valves.
14. Check position of overspeed trip lever and reset if necessary.
15. Push layshaft lever toward engine until fuel pointer on governor indicates 2 to 3 and keep firm hold on lever.
16. Push starting button and hold until engine fires, then let go. If engine fails to start in 10 seconds, release button and ascertain cause.
17. Keep ahold of layshaft lever to prevent engine racing and bring to idle speed.

B—IN "B" UNIT OR UNITS:

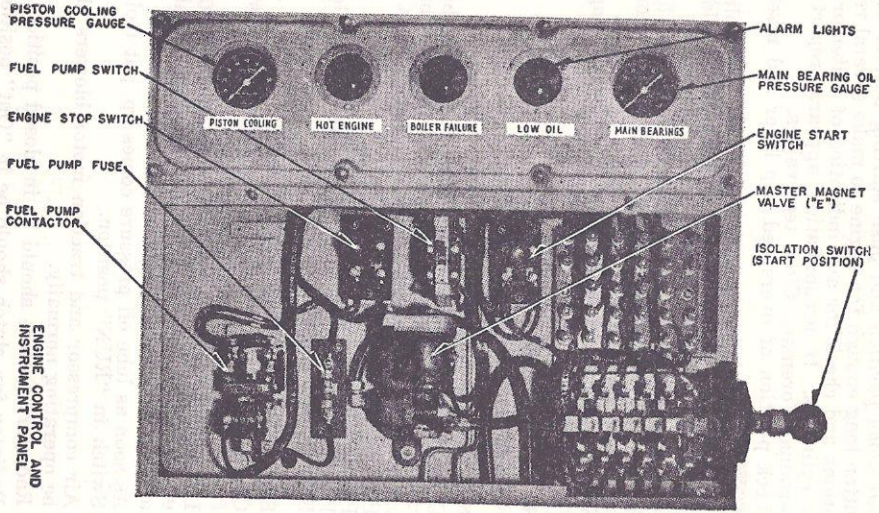
1. Repeat items 10 to 17 above.

C—IN TRAILING "A" UNIT, IF USED:

1. Close double heading cock. Place automatic brake valve in "RUNNING" position and independent brake valve in "LAP" position and pin both handles.
2. Place throttle in "IDLE."
3. Place transition lever in "OFF."
4. Place reverse lever in "NEUTRAL" and remove lever.
5. Repeat items 10 to 17 above.

AFTER EACH ENGINE IS RUNNING:

1. Check starting contactors. If a contactor is stuck, free same with a dry wooden stick.
2. Lubricating oil pressure should be at least 10 lbs. engine idling, hot oil. Piston cooling oil should be at least 5 lbs. engine idling, hot oil.
3. As soon as lube oil pressure comes up, put Isolation Switch in "RUN" position.
4. Air compressor and traction motor blowers should be operating normally.
5. Radiator shutters should be in closed position.
6. Radiator fan clutch should be in "Out" position.



ENGINE CONTROL AND INSTRUMENT PANEL

7. Check:
   (1) Ground relay should be set.
   (2) Auxiliary generator ammeter in low voltage cabinet should show charge.
   (3) Battery charging ammeter in distribution panel should show charge.

FINAL CHECK:

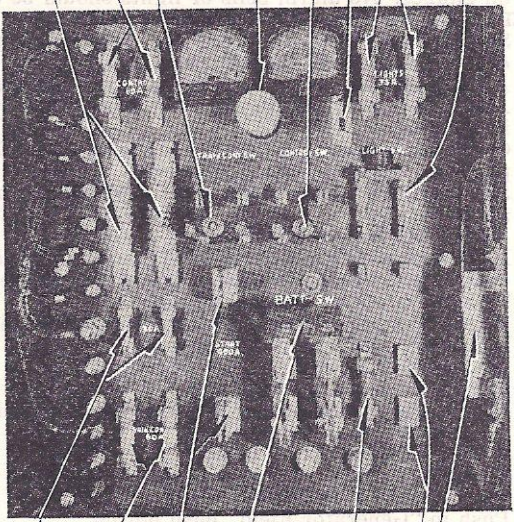
1. Make a final check on operation and lube oil and fuel oil gauges. No alarm bells or lights should be on.

PREPARATIONS FOR MOVING LOCOMOTIVE:

1. See that air compressors are maintaining main reservoir pressure at 130-140 pounds.
2. All engines should idle not less than five (5) minutes.
3. After air is pumped up, place automatic brake valve in running.
4. Check control air pressure in each unit; should be 80 pounds, plus or minus 10 pounds.
5. See that air brake equipment is properly set up on all units.
6. Release all hand brakes.
7. Make necessary air brake tests. (Place foot on safety control pedal before releasing locomotive brake.)
8. Test operation of bell, horn and sanders.
9. Engineer must make visual inspection of exterior of locomotive and running gear for:
   (1) Liquids leaking from locomotive.
   (2) Loose parts.
   (3) Proper positioning of Angle Cocks and Shut Off Valves.

TO MOVE LOCOMOTIVE LIGHT:

1. See that controlled emergency cocks on all "A" units are in "PASS" position.
2. Push in "Generator Field" push button.
3. Place foot on safety control pedal.
4. Place automatic brake valve in "Running."
5. Put reverse lever in "Forward" or "Reverse" as required.
6. Put transition lever in "1."
7. Release independent brake.
8. Open throttle to "Run 1" and note that transition meter indicates power; then in a few seconds to "Run 2" and advance as required, pausing in each position. Close throttle by steps, the same as described above except in emergency.



DISTRIBUTION PANEL

9. If locomotives are to be operated at road speed, light, transition lever may be advanced as described under heading "Use of Transition Meter." If merely operated in yard movement, keep transition lever in "1."

PUMPING UP AIR ON TRAIN:

Since air compressors run at engine speed, it is permissible to increase this speed when there is a large demand for air when standing coupled to train.

1. Put reverser in "Neutral."
2. Put transition lever in "1."
3. Open throttle as above described to Run 3. (Do not exceed Run 3.)

STARTING TRAIN:

Having complied with all previous instructions above, engines running, train stop reset, air pumped up, etc., proceed as follows:

1. Set controlled emergency cocks on all "A" units in proper position.
2. Push buttons "Control," "Gen. Field," and "Fuel Pump" must be in.
3. All isolation switches must be in "RUN."
4. No alarm bells ringing.
5. Engage radiator fan drive clutches.
6. Place foot on safety control pedal.
7. Automatic brake valve in "Running."
8. Release independent brake.
9. Put reverse lever in "Forward" or "Reverse" as required.
10. Throttle must be in "IDLE."
11. Put transition lever in "1."
12. Open throttle to "Run 1."
13. Continue to notch out, stopping at each notch long enough for transition meter to steady and locomotive starts to move.
14. After locomotive starts to move, maintain throttle in the notch which will keep the locomotive moving without accelerating until train is stretched. If train does not start in the 5th notch, close throttle and determine cause.

15. When conditions permit, do not attempt to start heavy trains without using sand sparingly, and do not apply sand when wheel slip light is burning or flashing or transition meter pointer is moving up and down its scale without first reducing throttle until wheel slip light remains out and transition meter pointer is steady.

USE OF TRANSITION METER (MANUAL TRANSITION):

In starting trains it is permissible for pointer to be in the yellow-red area. Reduce tonnage if unable to operate out of the yellow-red area.

In shifting to higher transitions, the meter is a guide only providing throttle is in "Run 8."

A—INCREASING SPEED:

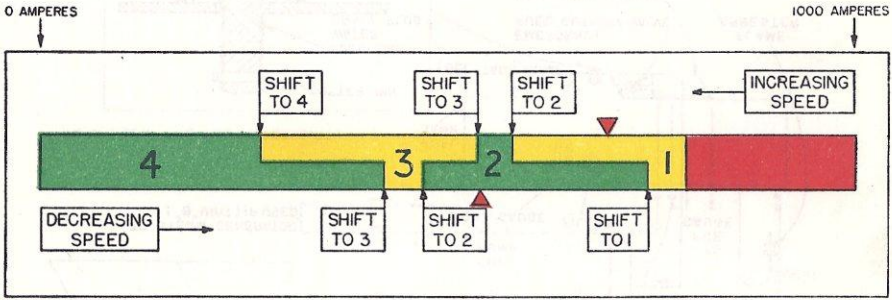
1. As pointer moves from right to left and crosses into area marked "2," shift transition lever to "2."
2. As pointer moves to area marked "3," reduce throttle to "6," shift transition lever to "3." Then after a short pause, advance throttle through "7" and back to "8."
3. As pointer moves to area "4," shift transition lever to "4."

B—DECREASING SPEED:

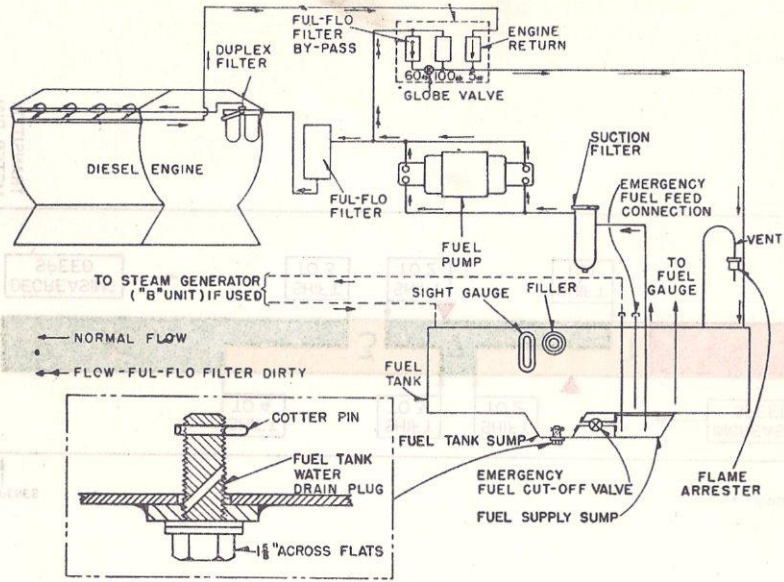
As the train speed decreases due to a grade, the pointer will gradually move to the right. When the pointer crosses from 4 to 3, or down to a lower area, the transition lever MUST be moved to the position indicated. This must be done regardless of throttle position.

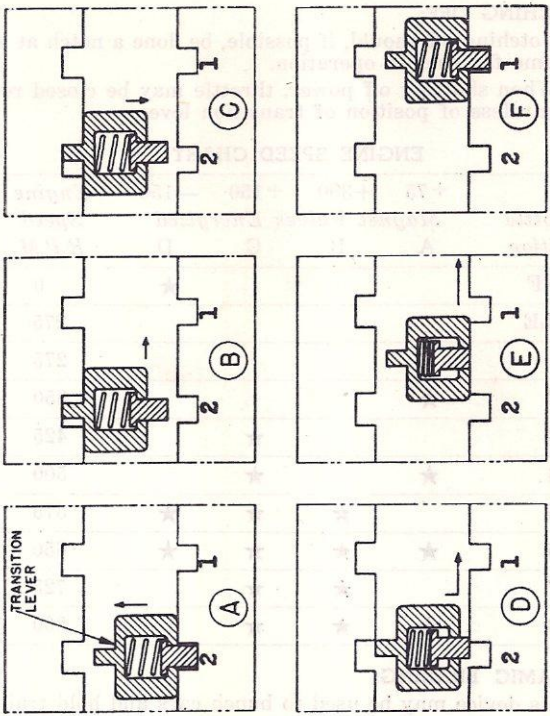
No damage will result in failing to advance the transition lever with increasing speed. But the electrical equipment will be overloaded and serious damage might result if the lever is not backed off to a point indicated when the locomotive speed is decreasing due to a grade. The transition lever should be in No. 1 position before the locomotive comes to a stop.

(NOTE: Throttle must also be reduced to "Run 6" before moving the transition lever from 3 to 2 and same pause before advancing throttle.)



TRANSITION METER DIAL


FUL-FLO FILTER BY-PASS
ENGINE RETURN
DUPLEX FILTER
GLOBE VALVE
DIESEL ENGINE
SUCTION FILTER
FUL-FLO FILTER
EMERGENCY FUEL FEED CONNECTION
FUEL PUMP
VENT
TO STEAM GENERATOR ("B" UNIT) IF USED
SIGHT GAUGE
FILLER
TO FUEL GAUGE
NORMAL FLOW
FLOW-FUL-FLO FILTER DIRTY
FUEL TANK
COTTER PIN
FUEL TANK SUMP
FUEL TANK WATER DRAIN PLUG
EMERGENCY FUEL CUT-OFF VALVE
FLAME ARRESTER
FUEL SUPPLY SUMP
1 5/8" ACROSS FLATS



TRANSITION LEVER OPERATING DIAGRAM

Minimum safe continuous speed in "Transition 1" and throttle in "Run 8" is 14 M.P.H.

If transition meter is defective move transition lever in accordance with speed as indicated below:

SHIFT 1-2—20 M.P.H.
SHIFT 2-3—30 M.P.H.
SHIFT 3-4—50 M.P.H.

NOTCHING OFF:

1. Notching off should, if possible, be done a notch at a time for smooth operation.
2. When shutting off power, throttle may be closed regardless of position of transition lever.

ENGINE SPEED CHART

Throttle Position	+75 *Magnet Valves Energized* A	+300 B	+150 C	—150 D	*Engine Speed R.P.M.*
OFF				★	0
IDLE					275
1					275
2	★				350
3			★		425
4	★		★		500
5		★	★	★	575
6	★	★	★	★	650
7		★	★		725
8	★	★	★		800

DYNAMIC BRAKING:

This device may be used to bunch cars and hold train speed on descending grades or reduce train speed for slow-downs, preparatory to stopping.

1. Place throttle in IDLE after pausing in each throttle position.
2. Move transition lever to OFF and hold until slack is bunched.
3. Then move transition lever over quadrant to right of OFF position. Dynamic brake will apply with increasing force the farther the lever is moved to the right.

4. Dynamic braking force is indicated by Transition meter pointer moving to the right, but should not be increased so pointer will pass the red triangle at bottom of meter scale.
5. Dynamic brake warning light will come on if brake is used excessively. Move transition lever to left until light goes out.
6. Train cannot be stopped with dynamic brake.
7. Do not let air brake apply on locomotive while using dynamic brake.

RELEASING THE DYNAMIC BRAKE:

Release of the dynamic brake should be made gradually to avoid run-out in the train under certain conditions. Keep in mind that the dynamic brake has somewhat the same effect as a powerful independent air brake and be governed accordingly.

When releasing dynamic brake, a light application of independent air may be made as the handle is moved from "B" to "OFF" and the independent then slowly released. This action should be taken if grade conditions are such that the locomotive will tend to "run away" from the train when the dynamic brake is released.

STOPPING:

If air brake only is used:

1. Reduce throttle to "Run 4."
2. Follow standard air brake procedure.
3. As speed decreases, reduce throttle one notch at a time and also bring transition lever back with decreasing speed. At least 100 feet before stop is made. transition lever should be in "1" and throttle in "Idle."

REMOVING ENGINE FROM LINE:

1. Reduce engine speed by pulling on lay shaft lever until engine is running at idle speed.
3. If desired to stop engine, push "STOP" button at engine starting panel and hold until engine stops, or pull lay shaft lever until engine stops and then shut off fuel pump switch.

RETURNING ENGINE TO LINE:

1. Get engine started in usual manner.
2. Hold lay shaft lever firmly with engine idling and place Isolation Switch in "RUN."
3. Still holding lay shaft lever, allow engine speed to increase gradually. Take 5 to 10 seconds to allow engine to come up to speed until Woodward governor takes over.

   (NOTE: Never isolate an engine while using dynamic brake without first stopping engine, also, do not put engine on line while dynamic brake is being used.)

EMERGENCIES:

STOPPING ALL ENGINES FROM LEADING UNIT:

In case of emergency requiring the immediate simultaneous stopping of all power plants, push "Stop" button at end of throttle handle and shove handle past "Idle" to "Stop." Pull out "Fuel Pump" push button.

SHUTTING OFF ALL FUEL IN CASE OF FIRE:

1. Pull nearest emergency fuel cutout trip handle on each unit.
2. Snap OFF fuel pump switches.
3. Pull out fuel pump push button in leading cab.

   (NOTE: The emergency fuel valve is located under fuel tank on these units; when tripped it stays in closed position and it is necessary to reset by raising valve stem and sliding retainer in place.
4. Shut down all engines as above described under "Emergencies."

OPERATING PRECAUTIONS:

REVERSING:

Bring locomotive to a dead stop before moving reverse handle for opposite locomotive movement.

OPERATING THROUGH WATER:

Do not operate locomotive through water more than 3 inches over top of rail, and then at a speed not exceeding 3 miles per hour.

PASSING OVER RAILROAD CROSSING:

When crossing a railroad crossing, throttle should be moved back to "Run 3" and kept in that position until all locomotive units have passed over the crossing.

CHANGING OPERATING CABS:

KEEPING ENGINES RUNNING:

LEADING CAB:

1. Transition lever must be in "Off" position throttle in "Idle" and reverser handle moved to "Off" and removed.
2. Make a full service automatic brake application, return brake to "lap" and close the double-heading cock.
3. Place independent brake valve in "lap" and pin handle.
4. Move the automatic brake valve handle to "running" position and pin handle.
5. Pull out all push button switches and lock push button box.
6. Shut off train stop MG set.

NEW LEADING CAB:

1. Start train stop MG set.
2. Push in "Fuel Pump," "Control," "Generator Field" and any other push buttons needed.
3. Remove pins from brake valve handles and place automatic brake valve in "lap."
4. Place independent brake valve in full application position.
5. Reset train stop bly holding back on forestalling lever until acknowledging whistle blows and stops blowing. Release lever, and note that train stop check light comes on.
6. Open double-heading cock.
7. Insert reverser handle in "O" position.
8. Make air brake test.
9. Locomotive is now ready to move according to previous instructions.

LEAVING LOCOMOTIVE FOR LAYOVER:

1. Shut down Diesel engines and shut off "Fuel Pump" switches on all engine control panels.
2. Protect against freezing, if necessary.
   (See Shut Downs in Freezing Weather.)
3. Remove reverser handle from control stand and place in storage box.
4. Pull out all push button switches.
5. Set hand brake in each unit.
6. Open main battery switch in each unit.

TOWING LOCOMOTIVE DEAD IN TRAIN:

1. Move reverser handle to "Off" position and remove from control stand.
2. Throttle handle in each "A" unit must be in "Idle" and transition lever in "O" position.
3. Air brakes must be set up as follows:
   a. Close double heading cock on automatic brake valve.
   b. Pin brake valve handles.
   c. Place controlled emergency cocks in "PASS" position.
   d. Place caps on No. 8 distributing valves in DEAD position.
4. Protect against freezing if necessary. (See Shut Downs in Freezing Weather.)
5. Open all main battery switches.
6. PIN ALL REVERSERS IN NEUTRAL POSITION.

PERIODIC INSPECTIONS ON ROAD:

General:

1. Observation of each power plant on road need only be made as operating schedules permit.

LUBE OIL PRESSURE:

1. Normal lubricating oil pressure with the throttle in "Run 8" is 35 lbs. to 45 lbs. hot oil ,and never less than 15 lbs. At idling speed the lubricating oil pressure should be above 10 lbs.

   Piston cooling oil pressure should be 20 to 30 lbs. in "Run 8," hot oil, and never less than 15 lbs. At

idling speed the piston cooling pressure should be at least 5 lbs., hot oil.

2. If the lube oil pressure falls below 10 lbs. the alarm bells will sound and the yellow "Low Oil" lights will light.

WARNING:

Never operate a Diesel engine without sufficient lubricating oil or sufficient pressure.

FUEL OIL PRESSURE:

1. The 5 lb. fuel sight glass should be observed frequently to check supply of fuel to the engine. Fuel should show in 5 lb. glass only. Report if much fuel shows in 60 lb. glass.

BATTERY CHARGING:

1. Observe the auxiliary generator ammeters in low voltage cabinets periodically, also battery ammeters in distribution panels to see that they are indicating charge.

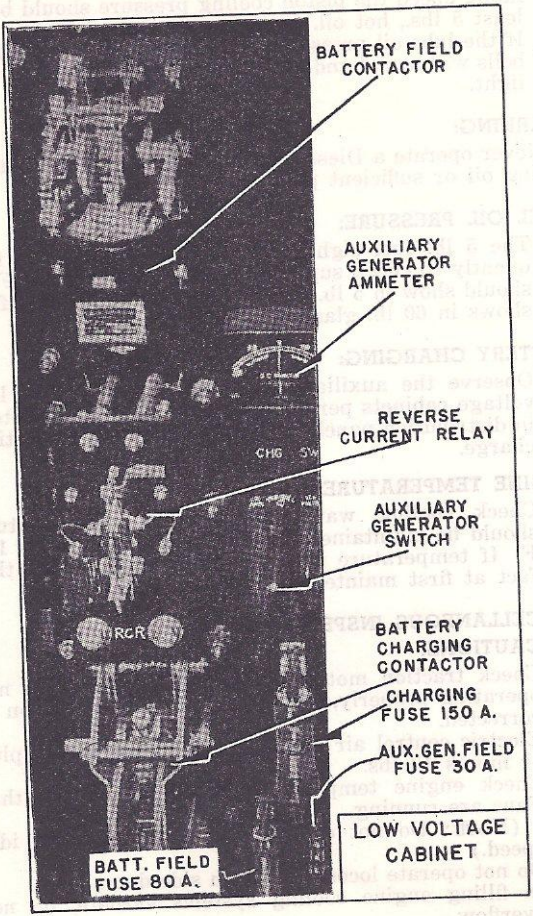
ENGINE TEMPERATURE:

1. Check cooling water temperature. Temperature should be maintained at 155° F., plus or minus 15° F. If temperature is not in this range, report this fact at first maintenance point.

MISCELLANEOUS INSPECTIONS AND PRECAUTIONS:

1. Check traction motor blowers. If a blower is not operating properly, isolate engine until condition is corrected.
2. Electric control air pressure should be 80 lbs., plus or minus 10 lbs.
3. Check engine temperature periodically. See that Fans are running.

   (NOTE: Do not engage fan clutches above idle speed.)
4. Do not operate locomotive with side doors open.
5. In filling engine cooling systems enroute, do not overflow.


BATTERY FIELD CONTACTOR
AUXILIARY GENERATOR AMMETER
REVERSE CURRENT RELAY
CHG SW
AUXILIARY GENERATOR SWITCH
RCR
BATTERY CHARGING CONTACTOR
CHARGING FUSE 150 A.
AUX. GEN. FIELD FUSE 30 A.
LOW VOLTAGE CABINET
BATT. FIELD FUSE 80 A.

6. Keep Diesel engines running as continuously as possible, shutting down only on account of trouble. If one unit is inoperative, keep engine idling if possible and isolate.
7. If wheel slip light comes on and off intermittently, even though throttle is reduced, stop train and check for wheels sliding.
8. Engine cooling water level, during freezing weather, should be maintained at the "G" valve level with engine shut down.

SHUT DOWNS IN FREEZING WEATHER:

If engines are to be shut down during a layover in freezing weather, they must either be drained or heated by steam from an outside source, connecting to the steam trainline of the locomotive. For protection against freezing, take the following steps:

1. See that all radiator shutters are closed.
2. Supply steam to the engine cooling water system by opening the steam admission valve to supply steam direct to the cooling system of each engine, located at floor lever at accessory end of engine.
3. Open "G" valve located on left side wall at accessory end of engine.
4. Drain toilet water tanks.

SHUT DOWNS ENROUTE:

If engine is shut down enroute and steam is available from train line, proceed as outlined in Items 1 to 4 above.

DRAINING:

In case steam is not available, proceed as follows:

1. Open main cooling system drain valve located at floor level at accessory end of engine.
2. Open cab heater valves. Remove drain plugs from cab heater lines. These plugs are located under the rear of the cab floor to the right and left of the steps leading into the cab.
3. Drain toilet water tanks.

LOCOMOTIVE PROTECTIVE DEVICES:

1. "PC" switch tripped caused by:
   (a) Train control brake application.
   (b) Safety control brake application.
   (c) Speed governor brake application.

Causes all engines to go to idle unless throttle is in "Run 5" or "Run 6," in which case all engines stop. Also stops all fuel pumps and will cause engines to starve for fuel. "PC" warning light comes on when "PC" switch is tripped. Throttle must be in Idle before "PC" light will go out to regain control of engines. If engines stop due to "PC" switch, no alarm will sound.

2. GROUND RELAYS:

Tripping of a ground relay affects only the one power plant, (each power plant has a ground relay) and causes the engine to go to "Idle" unless the throttle is in "Run 5" or "Run 6," in which case the engine stops.

(a) Isolate engine affected and re-start if necessary.
(b) Reset ground relay after engine is started.
(c) Put engine on line. (See Returning Engine to Line.)
(d) If engine does not load, check ground relay again, it may have tripped during starting.
(e) If ground relay trips more than two more times, immediately isolate engine. Do not open Ground Relay knife switch.

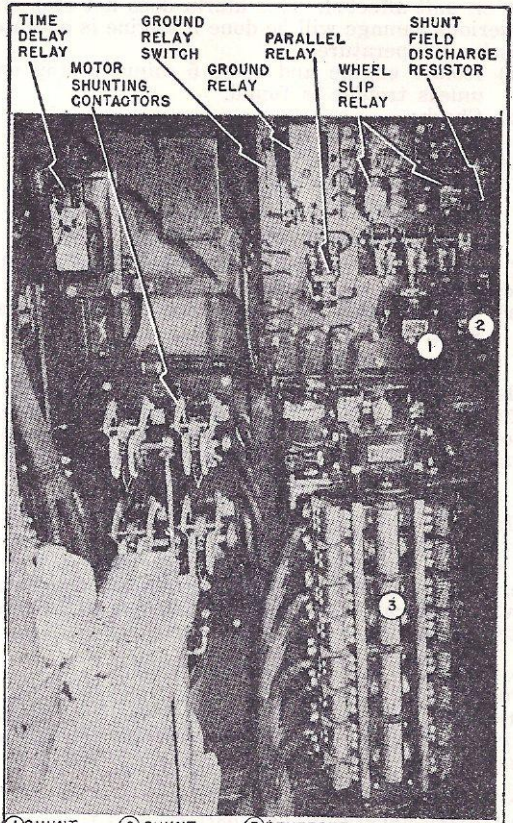
3. ENGINE OVERSPEED TRIP:

When load is suddenly removed from an engine due to wheels slipping or other cause with throttle advanced, the engine speed may increase to such a value that the engine overspeed trip will function to stop engine. This can also happen due to mishandling of throttle or manual lay shaft lever.

(a) Isolate the engine.
(b) Reset overspeed trip handle at front of engine.
(c) Start engine and put on line. (See "Returning Engine to Line.")

4. ENGINE HIGH TEMPERATURE ALARM:

If engine temperature exceeds 200° F., the alarm bells will ring on all units and "Hot Engine" red light will



(1) SHUNT FIELD CONTACTOR (2) SHUNT FIELD CONTACTOR RESISTOR (3) REVERSER

HIGH VOLTAGE CABINET

show on unit affected. This alarm does not stop engine and serious damage will be done if engine is operated at excessive temperature.

(a) Isolate engine and after 5 minutes stop engine unless trouble is found.

(b) Check:
   1. Fan clutches not engaged.
   2. Shutters not open enough.
   3. Insufficient water in system.
   4. Oil pressure.

5. STUCK STARTING CONTACTORS:

If one or both starting contactors stick completely closed, that unit would have no power.

(a) Pry open the stuck contactors with a dry wooden stick.

6. EMERGENCY FUEL CUT-OFF:

This is a snap-action valve and can be tripped to shut off fuel to engines in case of fire by pulling a ring attached to a cable on either exterior side of unit or in engine-room or cab. (See "Shutting off all Fuel in Case of Fire.")

7. STARTING FUSE:

This is a 400 amp. fuse for protection of generator starting windings. If blown, operation of starter button will operate starting contactors but engine will not rotate. Excessive "cranking" of engine may cause fuse to blow. It is located in the distribution panel. These can be tested on fuse test block in same panel.

8. CONTROL AND LIGHTING FUSES:

Fuses for all control functions, main control fuse, train control MG set fuse and lighting fuses are located in distribution panel. They can be tested on fuse test blocks in same panel.

9. OTHER FUSES:

Auxiliary generator fuse, battery field fuse, and auxiliary generator field fuse are located in low voltage cabinet.

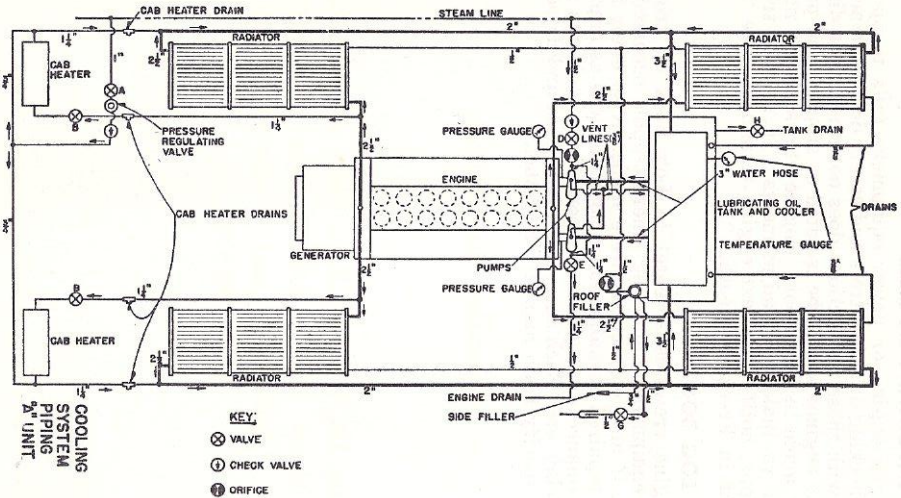
Individual circuit fuses are located in push button box at engineman's control station.

10. IMPORTANT NOTICE:

If any engine or power equipment fails to operate, and checking of all controls and safety devices in accordance with these instructions does not correct the difficulty, the engines should be isolated or stopped and proper entry made in Log Book. Engine crews should not attempt to make any adjustments. If serious trouble develops, notify the next engine terminal. (See "Shut Downs in Freezing Weather.")

11. LOG BOOK:

Engine crews *must* enter in Log Book all troubles with equipment, indicating where trouble occurred and what, if any, corrections were made. Also enter items to be repaired at maintenance points as well as improper performance of engines or locomotives, incidents causing delay, etc. Each entry must be signed and dated and must specify train number or symbol.



COOLING SYSTEM PIPING "A" UNIT

THE NEW YORK CENTRAL RAILROAD COMPANY

Operating Instructions

Class DCA-2a, DCB-2a, DFA-4a, DFB-4a Baldwin Diesel Locomotives 3200-3203 incl., 3300-3301, incl., 3400-3403, incl., and 3700-3701, incl.

OPERATING INSTRUCTIONS FOR CLASS DCA-2A, DCB-2A, DFA-4A, DFB-4A BALDWIN DIESEL LOCOMOTIVES 3200-3203, incl., 3300-3301, incl., 3400-3403, incl. and 3700-3701, incl.

PRECAUTIONS BEFORE STARTING OIL ENGINE:

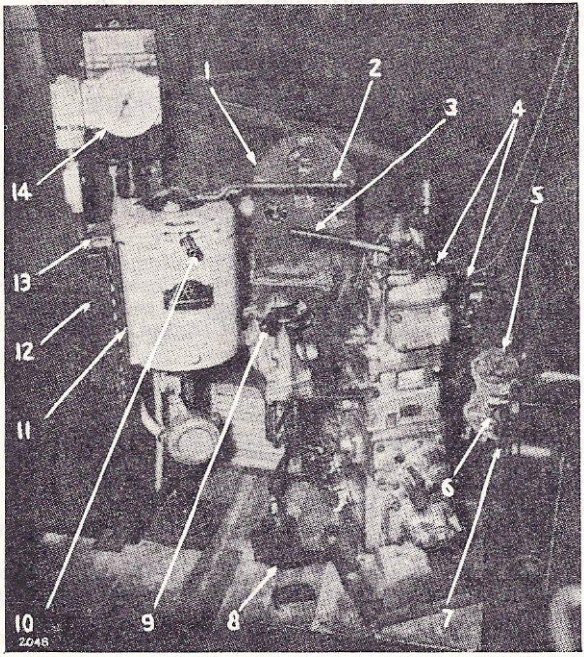
1. Check fuel oil supply.
2. Power cut out switch closed. (In contactor compartment.)
3. Traction motor cut-out switches closed.
4. Blower relay by-pass switch closed.
5. Main battery switch closed.
6. Radiator fan and shutter switch in automatic position.
7. Ground relay cut out knife switch closed.
8. Check the water level of the engine cooling system and the lubricating oil levels of engine and air compressor.

STARTING ENGINES AND PUTTING ENGINES ON LINE:

TO START ENGINES:

A—IN LEADING "A" UNIT:

1. Start train stop MG set.
2. Set up train stop and see that red check light comes on.
3. Place automatic brake valve in "LAP" and Rotair valve in either "P" or "F" and open double heading cock.
4. Place independent brake valve in full application position.
5. Place throttle in "Idle" and note that "PC" light is *not* on.
6. Put reverse lever in "Neutral."
7. Put in "Control" push button (and whatever light buttons are needed).
8. Check engine overspeed trip.
9. At engine starting panel in engine room, turn on fuel pump.
10. Be sure fuel pump starts and fuel pressure builds up to approximately 30-35 lbs.
11. Close engine shut-down switch. Alarm bell will ring.



Engineer's Position

1. Gauge and Meter Box.
2. Throttle.
3. Automatic Air Brake.
4. Air Horn Valves.
5. Hand Sander Valve.
6. Bell Ringer.
7. Train Control Acknowledging Switch.
8. Deadman Pedal.
9. Independent Brake Valve.
10. Reverse Lever.
11. Master Controller.
12. Control Push Button Switch Station.
13. Lock for Control Switches.
14. Speedometer.

12. Press engine start button and hold until engine fires and lube oil pressure exceeds 20 pounds. Alarm bell should stop. If engine fails to start in 10 seconds, release button and ascertain cause.
13. Place isolation switch in "ON" position.

B—IN "B" UNIT OR UNITS:

1. Repeat items 8 to 14 above.
2. See that the following cocks are closed:
   "A" Cock under brake valve.
   "B" Main reservoir cock to brake pipe feed valve.
3. Place controlled emergency cock on control valve in "PASS" or "FRT" corresponding to "P" or "F" position selected on leading unit.

C—IN TRAILING "A" UNIT IF USED:

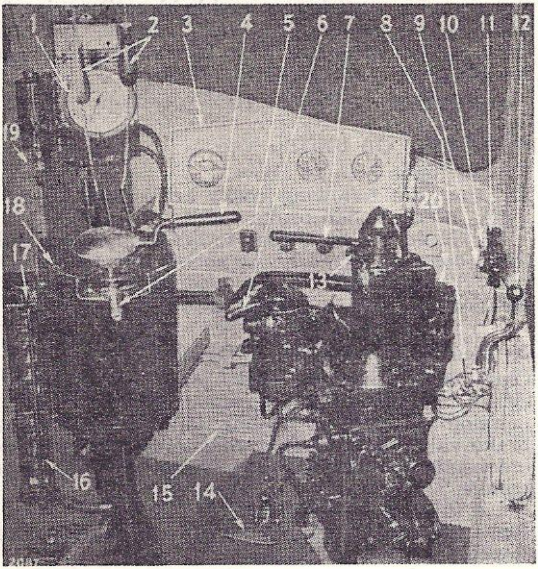
1. Close double heading cock, place Rotair valve in either "PL" or "FL" corresponding to "P" or "F" position selected on leading unit, move automatic brake valve to "Running" and remove handle, move independent brake valve to "Running" and remove handle.
2. Place throttle in "Idle."
3. Place reverse lever in "Neutral" and remove lever.
4. Repeat items 8 to 14 above.

AFTER EACH ENGINE IN RUNNING:

1. See that starting contactor light is out. If not, a starting contactor is stuck. Free same with a dry wood stick.
2. Lubricating oil pressure should be at least 20 lbs.
3. Air compressor and traction motor blowers should be operating normally and no alarm lights on.
4. Radiator shutters should be in normal position.
5. See that there are no leaks in piping systems.
6. Battery ammeter should show charge.
7. Ground relay should be set.

FINAL CHECK:

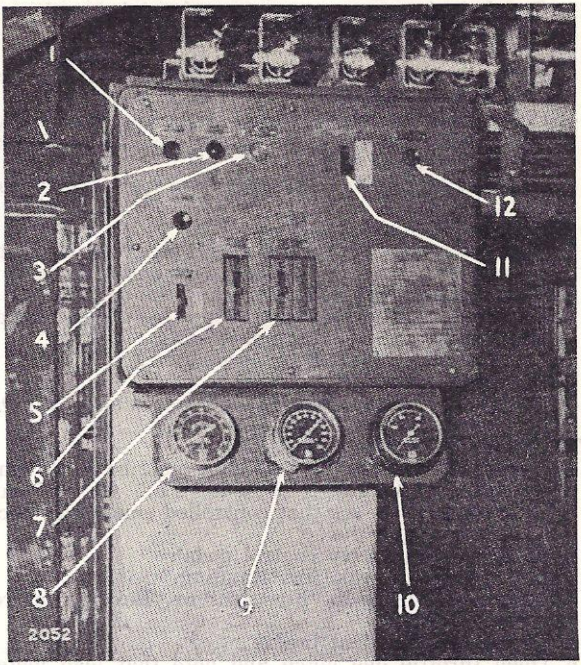
Make a final check on operation and lube oil and fuel oil pressure gauges. No alarm bells or lights should be on.



Engineer's Position

1. Speed Recorder.
2. Air Horn Grips.
3. Instrument Box.
4. Throttle.
5. Reverse Lever.
6. Independent Brake.
7. Automatic Brake.
8. Bell Ringer.
9. Power Off Light.
10. Wheel Slip Light.
11. Window Washer.
12. Acknowledging Switch.
13. Hand Sander.
14. Safety Control Pedal.
15. Engineer's Heater.
16. Control Switch Station.
17. Lockout Lever.
18. Master Controller.
19. Rotair Valve.
20. Wheel Slip Buzzer (not shown).

Freight Locomotives Only



Engine Control Panel

1. Low Lube Oil Pressure Warning Light.
2. Hot Engine, Warning Light.
3. Stuck Starter Contactor, Warning Light.
4. Attendant Call.
5. Fan and Shutter Switch.
6. Fuel Supply Pump Switch.
7. Engine Shutdown Switch.
8. Fuel Oil Pressure Gauge.
9. Lube Oil Pressure Gauge.
10. Water Temperature Gauge.
11. Isolating Switch.
12. Engine Start Button.

PREPARATION FOR MOVING LOCOMOTIVE:

1. See that air compressors are maintaining main reservoir pressure at 130-140 lbs.
2. All engines should idle not less than 5 minutes.
3. After air is pumped up, place automatic brake valve in running.
4. Check control air pressure on gauge in nose of "A" unit or at boiler end of "B" unit. Should show 70 lbs. plus or minus 10 lbs.
5. See that air brake equipment is properly set up on all units.
6. Release all hand brakes.
7. Make necessary air brake tests. (Place foot on safety control pedal before releasing locomotive brake.)
8. Test operation of Bell, Horn and Sander.
9. Engineer must make visual inspection of exterior of locomotive and running gear for:
   (1) Liquids leaking from locomotive.
   (2) Loose parts.
   (3) Proper positioning of Angle Cocks and Shut Off Valves.

TO MOVE LOCOMOTIVE LIGHT:

1. Rotair valve on leading "A" unit must be in "P" and on trailing "A" unit if used, in "PL." On "B" unit or units, if used, see that controlled emergency cock is in "Pass" position.
2. Place foot on safety control pedal.
3. Put automatic brake in "Running."
4. Put reverse lever in "Forward" or "Reverse" as required.
5. Release independent brake.
6. Open throttle one notch and note that load meter indicates power, then in a few seconds open throttle slowly and advance as required. Close throttle slowly, same as above described except in emergency.

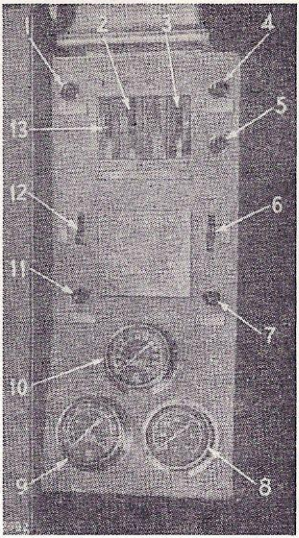
PUMPING UP AIR ON TRAIN:

Since air compressors run at engine speed, it is permissible to increase this speed when there is large demand for air when standing coupled to train.

1. Put reverser in neutral.
2. Open throttle as above described to one third position.

CAUTION:

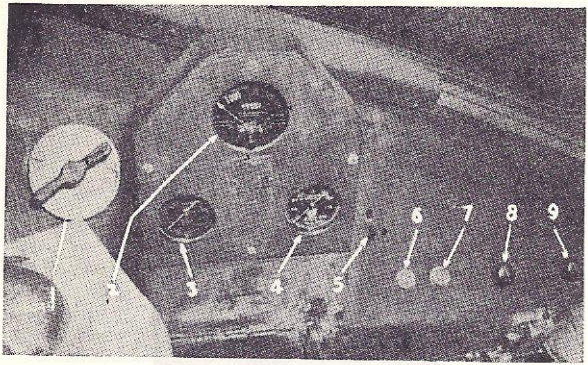
1. Do not advance throttle beyond one third position for this operation.
2. Never pump air with reverse lever in FORWARD or REVERSE position.



Engine Control Panel

Freight Locomotives Only

1. Low Oil Light.
2. Engine Stop Switch.
3. Fuel Pump Switch.
4. Stuck Contactor Light.
5. Hot Engine Light.
6. Isolating Switch.
7. Attendant Call Button.
8. Water Temperature Gauge.
9. Fuel Oil Gauge.
10. Lube Oil Gauge.
11. Engine Start Button.
12. Fan and Shutter Switch.
13. Auxiliay Generator Switch.



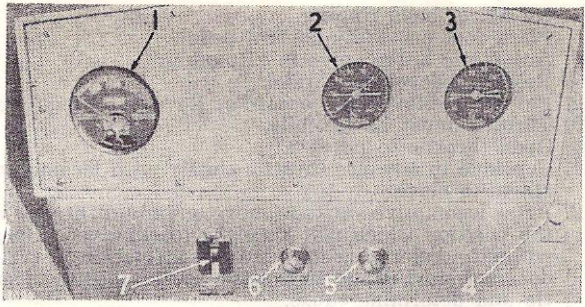
Instruments—Engineer's Position

1. **Rotair Valve; Air Brake System.**
2. **Ammeter; Eingine-Generator Unit.**
3. **Brake Pipe and Cylinder Pressure Gauge.**
4. **Main and Equalizing Reservoir Pressure Gauge.**
5. **Train Control Switch.**
6. **Power Off Light.**
7. **Wheel Slip Light.**
8. **Gauge Light Rheostat.**
9. **Cab Heater Motor Rheostat.**

STARTING TRAIN:

Having complied with all previous instructions above, engines running, train control reset, air pumped up, etc., proceed as follows:

1. If passenger train, set Rotair valve in leading "A" unit to "P" and in trailing "A" unit, if used, to "PL." If freight train, set Rotair valve in leading "A" unit to "F" and in trailing "A" unit, if used, to "FL." In "B" unit if used, set controlled emergency cock on position to correspond with leading "A" unit.
2. Control push button must be in.
3. All Isolation Switches in engine rooms must be "ON."



Instruments—Engineer's Position

1. **Load Ammeter (current reading on controlling "A" unit).**
2. **Brake Pipe and Cylinder Pressure Gauge.**
3. **Main and Equalizing Reservoir Pressure Gauge.**
4. **Dynamic Braking Overload Light.**
5. **Rheostat, Engineer's Cab Heater.**
6. **Gauge Light Rheostat.**
7. **Train Control Switch.**

Freight Locomotives Only

4. No alarm bells ringing.
5. Place foot on safety control pedal.
6. Automatic brake valve in "Running."
7. Release independent brake.
8. Put reverse lever in Forward or Reverse as required.
9. Throttle must be in "Idle."
10. Open throttle to notch 1.
11. Continue to advance throttle slowly until locomotive starts to move.
12. After locomotive starts to move, maintain throttle in the position which will keep the locomotive moving without accelerating until train is stretched. If train does not start in the ½ throttle position, close throttle and determine cause.
13. When conditions permit, don't attempt to start heavy trains without using sand sparingly, and don't apply sand when wheel slip light is burning or flashing or load meter pointer is moving up and down its scale, without first reducing throttle until wheel slip light remains out, and load meter pointer is steady.

CAUTION:

1. Never move reverse handle from one position to another unless locomotive is a a standstill; otherwise damage to equipment will result.

USE OF LOAD INDICATING METER:

In starting trains it is permissible for pointer to be in the red overload area for the times indicated. These overload rating are not consecutive ratings. Locomotive must not be operated at 10 minute rating for 10 minutes, then at 20 minute rating for 20 minutes, etc. Reduce tonnage if unable to operate out of the red area.

Current Limits

Generator Current (Amperes) (3200-3203)	*Traction Motor Current (Amperes)* (3400-3403)	*(Time Minutes)*
1800	900	Continuous
2000	1000	40
2200	1100	20
2600	1300	10
3000	1500	6
3600	1800	4

DYNAMIC BRAKING (FREIGHT LOCOMOTIVES ONLY):

This device may be used to bunch cars and hold train speed on descending grades or reduce train speed for slow-downs, preparatory to stopping.

1. Move throttle to "OFF" position.
2. Make certain locomotive speed is below 50 m.p.h. If necessary, bring speed down to this value by making a service application and make sure independent brake is fully released before using dynamic brake.
3. Move reverser to the dynamic breaking position.
   NOTE: Trip the small latch under lever to move lever to "Dynamic Braking" position.
4. Move throttle one notch and leave there until slack is bunched.
5. Move the throttle over the quadrant to the left. Dynamic brake will apply with increased force the farther the throttle is moved to the left.
6. Dynamic braking force is indicated by load indicatmeter pointer moving to the right but should not be increased beyond 750 amps.
7. Dynamic brake warning light will come on if brake is used excessively. Move throttle to the right towards "OFF" until light goes out.
8. Train cannot be stopped with Dynamic Brake.
9. Do not let air brake apply on locomotive while using dynamic brake.

RELEASING THE DYNAMIC BRAKE:

Release of the dynamic brake should be made gradually to avoid run-out in the train under certain conditions. Keep in mind that the dynamic brake has somewhat the same effect as a powerful independent brake and be governed accordingly.

When releasing the dynamic brake, a light application of independent air may be made as the reverse lever is moved from "Dynamic Brake" to "Forward" and the independent then slowly released. This action should be taken if grade conditions are such that the locomotive will tend to "run away" from the train when the dynamic brake is released.

THROTTLING OFF:

1. Throttling off should, if possible, be done slowly for smooth operation.

REMOVING ENGINE FROM LINE:

1. Turn isolating switch to "Off."
2. If desired to stop engine, open engine shut-down switch. Then turn off fuel pump and auxiliary generator switches.

RETURNING ENGINE TO LINE:

1. Get engine started in usual manner. (Train stop may apply brakes when starting engine in leading "A" unit.)
2. Turn isolating switch "ON."
3. Close auxiliary generator switch.

EMERGENCIES:

STOPPING ALL ENGINES FROM LEADING UNIT:

In case of emergency requiring the immediate simultaneous stopping of all power plants, push stop button in control switch box at control stand.

SHUTTING OFF ALL FUEL IN CASE OF FIRE:

1. Pull nearest emergency fuel cutout trip handle on each unit.
2. Snap OFF fuel pump switches.
   (NOTE: The emergency fuel valve is located on top of fuel tank; when tripped it stays in closed position and it is necessary to reset by raising valve stem and sliding retainer in place.)
3. Shut down all engines as above described under "Emergencies."

OPERATING PRECAUTIONS:

REVERSING:

Bring locomotive to a dead stop before moving reverse handle for opposite locomotive movement.

OPERATING THROUGH WATER:

Do not operate locomotive through water more than 3

inches over top of rail, and then at a speed not exceeding 3 M.P.H.

PASSING OVER RAILROAD CROSSING:

When crossing a railroad crossing, throttle should be moved back to 1/3 position and kept in that position until all locomotive units have passed over the crossing.

CHANGING OPERATING CABS:

KEEPING ENGINES RUNNING:

LEADING CAB:

1. Place throttle in "Idle," reverse handle in "Off" and remove handle.
2. Make a full service automatic brake application, return brake valve to "Lap" and close the double heading cock.
3. Put independent brake valve in Running and remove handle.
4. Move the automatic brake valve handle to Running position and remove it.
5. Move the Rotair valve to "PL" or "FL" position, depending on whether the locomotive is to operate Light or in Passenger or Freight service. (Controlled emergency cock on "B" unit must be on corresponding "Pass" or "Frt" position.)
6. Pull out all push button switches and lock push button box and remove key.
7. Shut off train stop MG set.
8. Close signal line supply cock.

NEW LEADING CAB:

1. Start train stop MG set.
2. Insert key and unlock push button box. Push in Control and any other control push buttons that are needed.
3. Insert handle in automatic brake valve and move to "Lap" position.
4. Move rotair valve to "P" or "F" corresponding to the "Lap" setting in trailing cab.
5. Insert handle in independent brake valve and move to "Full Application" position.

6. Reset train stop by holding back on forestalling lever until acknowledging whistle blows and stops blowing. Release lever, and note that train stop check light comes on.
7. Open double-heading cock.
8. Open signal line supply cock.
9. Insert reverser handle leaving same in "OFF" position.
11. Locomotive is now ready to move according to previous instructions.

OPERATING FROM "B" UNIT HOSTLER'S CONTROLS:

1. Insert key and unlock push button box. Push in Control and any other push buttons that are needed.
2. Apply independent brake valve handle and open brake valve cut-out cock.
3. Move brake valve handle to "Full Application" position and open cut-out cock on reducing valve to charge brake pipe.
4. Apply reverse handle.
5. Make air brake test.
6. Locomotive is now ready to move.

(NOTE: If "B" unit is moved alone, controlled emergency cock on D-24 control valve must be on "PASS" position.)

LEAVING "B" UNIT:

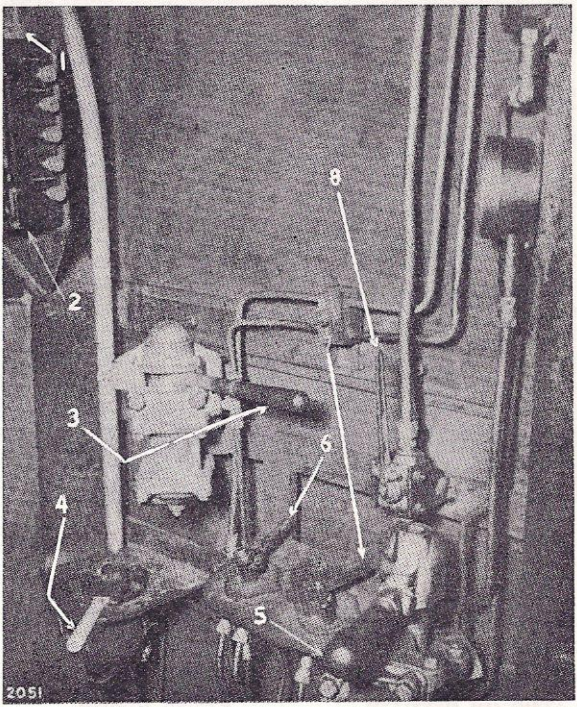
1. Place independent brake valve in "Full Application" position.
2. Close brake valve cut-out cock, move independent brake valve handle to Release position and remove handle.

(NOTE: Locomotive brakes should remain applied.)

3. Place reverser handle in "OFF" and remove handle.
4. Close cut-out cock on reducing valve.
5. Pull out all push buttons, lock box and remove key.

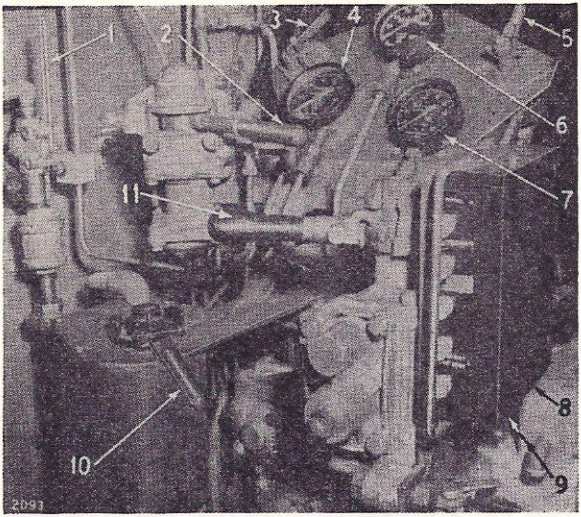
LEAVING LOCOMOTIVE FOR LAYOVER:

1. Shut down Diesel engines and shut OFF fuel pump and auxiliary generator switches on all engine control panels.



Hostler's Position

1. Lock for Control Switches.
2. Control Push Button Switch Station.
3. Throttle.
4. Reverse Lever.
5. Brake Valve.
6. Bell Ringer.
7. Hand Sander Valve.
8. Air Horn Valve.



Hostler's Position

1. Air Horn.
2. Throttle.
3. Bell Ringer.
4. Main Air Reservoir Pressure Gauge.
5. Hand Sander.
6. Brake Oil and Cylinder Pressure Gauge.
7. Control Air Pressure Gauge.
8. Control Push Button Switch Station.
9. Lockout Lever (on under side of control station).
10. Reverse Lever.
11. Brake Handle.

Freight Locomotives Only

2. Protect against freezing, if necessary. (See Freezing Weather Precaution.)
3. Remove reverser handles from control stands and place in storage box.
4. Pull out all push button switches.
5. Set hand brake in each unit.
6. Open main battery switch in each unit.

TOWING LOCOMOTIVE DEAD IN TRAIN:

1. Move reverse handle to "Off" position and remove from control stand.
2. Throttle handle in each "A" unit must be in Idle.
3. Air brakes must be set up as follows:
   a. Close double heading cock on automatic brake valve.
   b. Remove handles from both brake valves (automatic in Running and independent in Release position.)
   c. Place rotair valve in "Pass" position.
   d. Dead engine cock handle, on D-24 control valve, must be moved toward DEAD position.

   (NOTE: In dead heading a "B" unit, move the dead engine cock handle on the D-24 control valve of that unit toward the DEAD position. Place the controlled emergency cut-out cock in "PASS" position.)
4. Protect against freezing if necessary. (See Freezing Weather Precautions.)
5. Open all main battery switches.

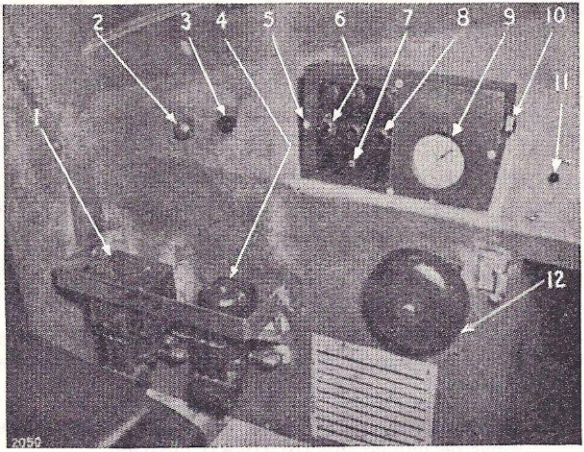
PERIODIC INSPECTION ON ROAD:

General:

1. Observation of each power plant on the road need only be made as operating schedules permit.

LUBE OIL PRESSURE:

1. Normal lubricating oil pressure with full throttle is 40 lbs. to 65 lbs. hot oil, and never less than 25 lbs. At idling speed the lubricating oil pressure should be above 20 lbs.
2. If the lube oil pressure falls below 20 lbs. the engine



Fireman's Position

1. Train Control Acknowledging Whistle.
2. Windshield Washer Spray Valve.
3. Heater Rheostat.
4. Train Control Overspeed Warning Whistle.
5. Boiler Remote Control Panel.
6. Train Line Shut-Off Switch.
7. Boiler Master Switch.
8. Boiler Separator Blow-Down Switch.
9. Train Line Steam Pressure Gauge.
10. Gauge Light Rheostat.
11. Train Control Light.
12. Alarm Bell.

will stop and the alarm bells will sound throughout the locomotive. The yellow "LOW OIL" alarm indicator will light in the unit affected.

WARNING:

Never operate a Diesel engine without sufficient lubricating oil or sufficient pressure.

FUEL OIL PRESSURE:

1. The fuel oil pressure is normally 20 lbs. to 35 lbs. on gauge on engine control panel. If pressure should vary above or below these limits, report the trouble for correction.

BATTERY CHARGING:

The batery ammeter pointer should be in the CHARGE section of the dial.

ENGINE HIGH TEMPERATURE ALARM:

High temperature of the engine cooling water will actuate the HOT ENGINE Alarm.

1. Isolate engine and after 5 minutes stop engine unless trouble is found.
2. Check cooling water.

   (NOTE: Cooling water may be added enroute by opening valve near steam generator and operating steam generator water pump.)
3. Check operation of shutters which should be open.
4. See that cooling fans are running. It not, open power cut-out switch and check 110 amp. fan fuse.

SUMMARY OF OPERATING PRECAUTIONS:

1. In case of fire, quickly pull nearest fuel trip handle.
2. If a locomotive or a unit continues to develop power with the throttle in IDLE, or if throttle handle sticks in a power notch, pull out control push button at control stand. If power continues, press emergency engine stop button on control stand of leading unit. Afterwards turn off fuel pump switches at engine control panels.

ELECTRICAL PRECAUTIONS:

1. Watch battery ammeters in inspection rounds to see that normal battery charging is taking place.
2. A circuit breaker which trips on overload assumes a position approximately midway between ON and OFF position. It must be moved to OFF position before it can be reset. If necessary to reset tripped circuit breaker, first make certain equipment affected is in operating condition. If circuit breaker reopens, remedy the trouble or shut down affected apparatus.
3. Do not block in contactors, relays, or circuit breakers.
4. Observe that traction motor blowers are operating at all times when locomotive is under power. If not, isolate engine, open power cut-out switch and check 110 amp. blower fuse.

GROUND RELAY:

Tripping of a ground relay affects only one power plant (each power plant has a ground relay) and causes the engine to do to idle. Tripping of a ground relay will cause alarm bells to ring and power plant affected will show ground relay light.

1. Isolate engine affected.
2. Reset ground relay.
3. Put engine on line.
4. If engine does not load, check ground relay again.
5. If ground relay trips more than two more times, immediately isolate engine. Do not open ground relay knife switch.

"PC" SWITCH:

"PC" switch tripped, caused by:

1. Train control brake application.
2. Safety control brake application.
3. Speed governor brake application.
4. Emergency brake application.

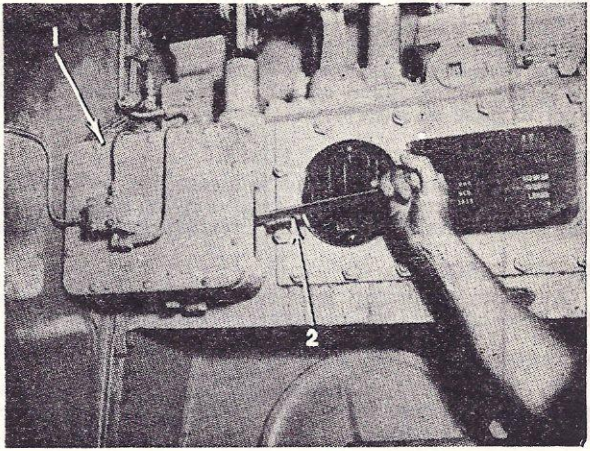
Causes all engines to go idle. "PC" warning light comes on when "PC" switch is tripped. Throttle must be in IDLE before "PC" light will go out to regain control of engines.

STUCK STARTING CONTACTOR LIGHT:

If one or both starting contactors stick completely

closed, the white starting contactor light will show on unit affected. (This will light when starting an engine.)

1. Isolate engine affected.
2. Pry open the stuck contactor with a dry wooden stick.
3. Put engine on line.



Overspeed Stop

1. **Overpeed Stop.**
2. **Fuel Pump Priming and Overspeed Stop Reset Bar (Pull Down to Reset).**

ENGINE OVERSPEED TRIP:

When load is suddenly removed from an engine due to wheels slipping or other cause with throttle advanced, the engine speed may increase to such a value that the engine overspeed trip will function to stop engine. This can also happen due to mishandling of the throttle.

1. Isolate engine.
2. Reset overspeed trip. Trip is located beneath engine

governor and a tool is provided to reset same. Reset by inserting tool and force trip down to latch. Remove tool.

3. Start engine and put on line. (Train stop may apply brakes when starting engine on leading "A" unit.)

EMERGENCY FUEL CUT-OFF VALVE:

This is a snap-action valve and can be tripped to shut off fuel to engines and boilers in case of fire by pulling a ring attached to a cable on either exterior side of unit or in the engine room or cab. (See "Shutting off All Fuel in Case of Fire.")

CONTROL AND LIGHTING FUSES:

Fuses for control functions are located in push button switch box at control stand. These may be tested by trying fuse in question in lighting circuit such as cab lights.

OTHER FUSES:

Auxiliary generator, traction motor blowers, radiator fan fuses are located in contactor compartment.

WARNING:

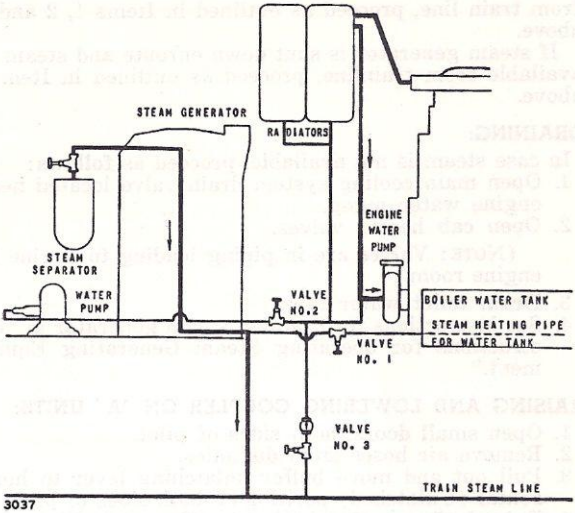
To check traction motor blower or radiator fan fuses power cut-off switch must be opened to remove power from these circuits.

DIESEL ENGINE PRECAUTIONS:

1. Report all unusual sounds or actions of any part of Diesel engines, Diesel engine accessories or electrical equipment. Shut down affected engine if necessary.
2. Keep Diesel engines running as continuously as possible, shutting down only on account of trouble.
3. Do not attempt to correct trouble by making adjustments to engine, power plant regulator, temperature or pressure switch or any control device. Trouble should be reported for corection.

SHUT DOWNS IN FREEZING WEATHER

If the engines are to be shut down during a layover in freezing weather they must either be drained or heated



Valve No. 3 Steam Valve For Engine Cooling System

by steam from an outside source connection to the steam train line of the locomotive. For protection against freezing, take the following steps:

1. See that radiator shutters are closed.
2. Supply steam to the engine cooling water system by opening the steam admission valve located near engine water pump. Cab heater valves should also be open.
3. Drain toilet water tanks.
4. Open steam valves to steam generator heater and steam separator. Open coil blow down valve.

SHUT DOWNS ENROUTE:

If engine is shut down enroute and steam is available

from train line, proceed as outlined in Items 1, 2 and 3 above.

If steam generator is shut down enroute and steam is available from trainline, proceed as outlined in Item 4 above.

DRAINING:

In case steam is not available, proceed as follows:

1. Open main cooling system drain valve located near engine water pump.
2. Open cab heater valves.

   (NOTE: Valves are in piping leading to engine in engine room.)
3. Drain toilet water tank.
4. See instructions for draining steam generator in "Instructions for operating Steam Generating Equipment."

RAISING AND LOWERING COUPLER ON "A" UNITS:

1. Open small doors, both sides of pilot.
2. Remove air hoses from dummies.
3. Pull out and move buffer unlatching lever to horizontal (Unlatched) position on both sides of pilot.
4. Raise buffer casting by hand. (Two man job.)
5. *Return buffer unlatching lever to vertical (Latched) position.* Both sides of pilot.
6. Unhook safety hook and remove draw bar positioning pin locking bolt.
7. Press down on coupler head and remove draw bar positioning pin.
8. Raise draw bar to horizontal position and reapply draw bar positioning pin, locking bolt, and safety hook. (No. 7 and 8 are two-man job.)
9. Push steam heat connector back to clear pilot lower cross member.
10. Raise pilot lower cross member at both ends and tip back until it drops in locking position.

To close doors, reverse the above.

IMPORTANT NOTICE

If any engine or power equipment fails to operate, and checking of all controls and safety devices in accordance

with these instructions does not correct the difficulty, the engine should be isolated or stopped, and proper entry made in Log Book. Engine crew should not attempt to make any adjustments. If serious trouble develops notify the next engine terminal. (See Shut Downs in Freezing Weather.)

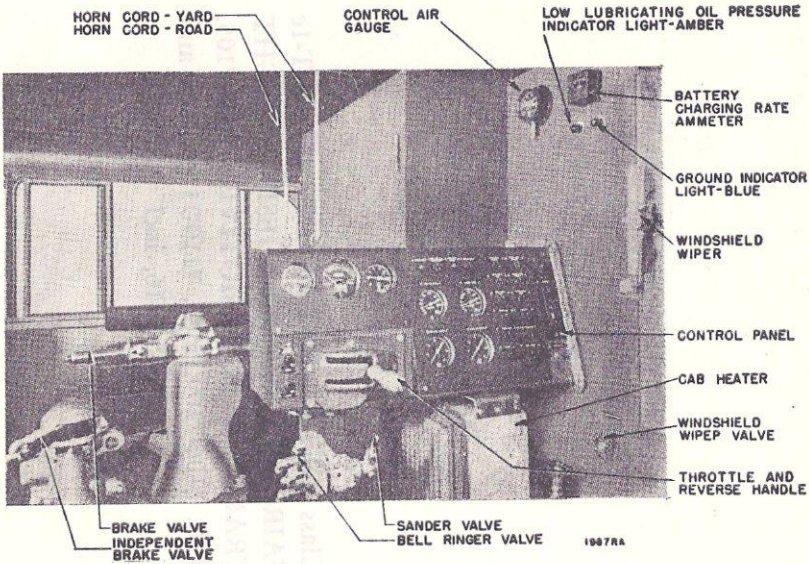
LOG BOOK

Engine crew *must* enter in Log Book all troubles with equipment indicating where trouble occurred and what if any, correction was made. Also, enter items to be repaired at maintenance point as well as improper performance of engines or locomotive, incidents causing delays, etc. Each entry must be signed and dated and must specify train number or symbol.

THE NEW YORK CENTRAL RAILROAD COMPANY

Operating Instructions

Class DFT-1a, DFT-1d, DFT-1b, DFT-1c FAIRBANKS-MORSE DIESEL FREIGHT TRANSFER LOCOMOTIVES 7100-7105, incl., 7106-7109, incl., 7110-7114, incl., and 7115-7116, incl.



Locomotive Control Panel and Brake Pedestal

OPERATING INSTRUCTIONS FOR CLASS

DFT-1a, DFT-1d, DFT-1b, DFT-1c, FAIRBANKS-MORSE DIESEL FREIGHT TRANSFER LOCOMOTIVES 7100-7105 incl., 7106-7109, incl., 7100-7114 incl., and 7115-7116, inc.

PRECAUTIONS BEFORE STARTING OIL ENGINE:

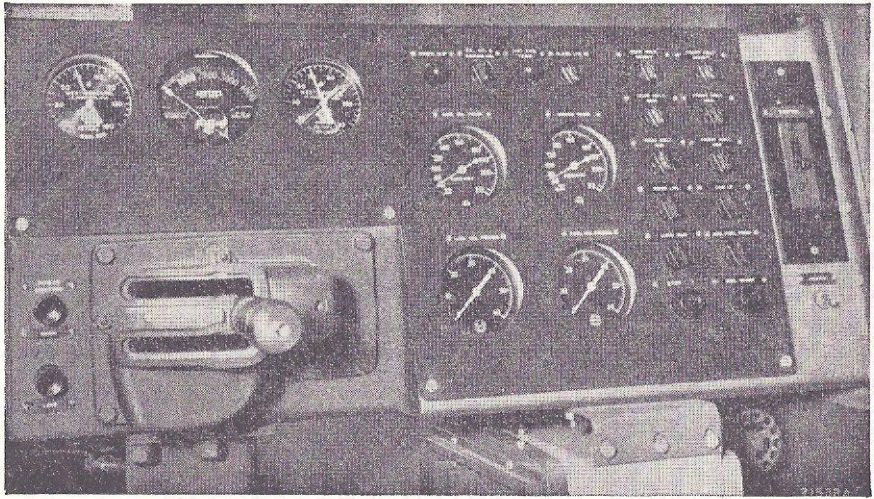
1. Check fuel oil supply.
2. Check engine cooling water supply.
3. Check engine lube oil supply.
4. Check air compressor oil level.
5. Check governor oil level.
6. Check supply of sand.

A—TO START ENGINE:

1. Close main battery switch in electrical cabinet. The yellow "LOW OIL" pressure light on the cab bulkhead will light.
2. Close both traction motor cut-out switches in electrical cabinet.
3. Close control switch on control panel .
4. Close auxiliary fuel pump switch (turn arrow to right) and wait for fuel pressure gauge to register 15 to 20 lbs.
5. "LOCOMOTIVE RUN" switch must be in "OFF position.
6. Press down on "START" button. Hold down until engine starts and continue to hold down until lubricating oil pressure builds up and indicator light goes off. If the engine fails to start after 10 seconds release button and ascertain cause.
7. Turn off auxiliary fuel pump switch after engine is running.

B—IN MULTIPLE UNIT OPERATION:

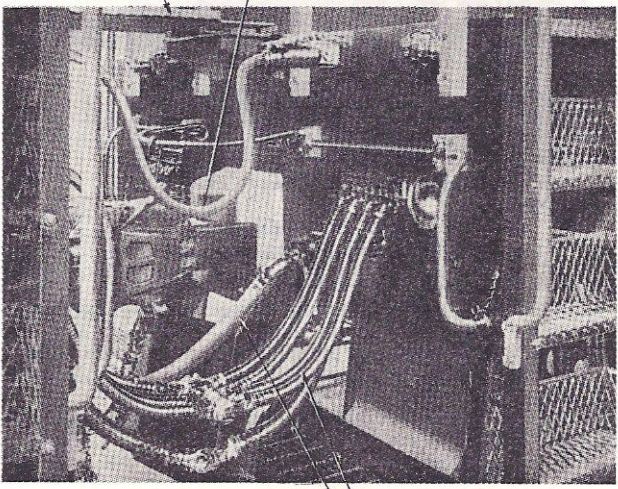
1. Inspect each unit as outlined above under PRECAUTIONS BEFORE STARTING OIL ENGINES.
2. Connecting the units.
   (a) Couple the units and check that couplers are locked.



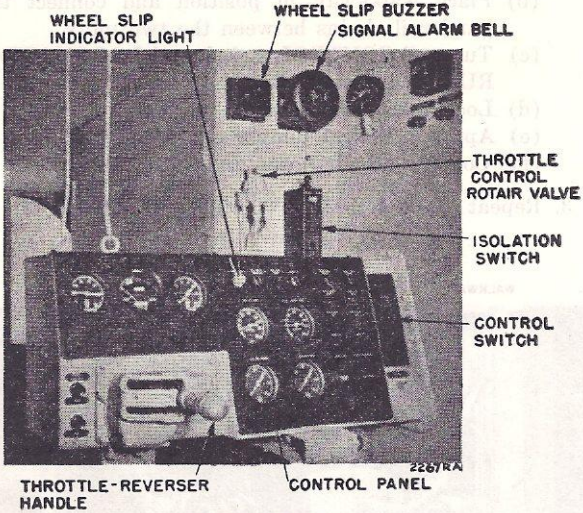
Control Panel

(b) Place walkaway in position and connect the hand rail chains between the two units.
(c) Turn off CONTROL switch and LOCOMOTIVE RUN switch on both units.
(d) Lock throttles in neutral position.
(e) Apply electrical jumper connection.
(f) Connect all air hoses and open cocks.

3. Repeat items 1 to 7 in "TO START ENGINE."



Electrical Jumper and Air Hose Connections



Control Equipment
(Multiple Unit Equipped Loco's)

AFTER ENGINE IS RUNNING:

1. Check starting contactor. If contactor is stuck, free same with dry wooden stick.
2. Check lubricating oil pressure gauge on control panel, should not be less than 5 lbs., engine idling, hot oil.
3. Fuel oil pressure should be at least 5 lbs.
4. Battery ammeter should register a positive charge while the engine is running.

IN TRAILING UNIT, IF USED:

1. Place throttle cut-out rotair valve in NON-CONTROL" position.
2. Lock throttle reverser handle in "neutral" position.
3. Place isolation switch in "POWER" position.
4. Make 20 lb. brake pipe reduction with automatic brake valve, lap valve and close double heading cut-out cock.

5. Remove automatic brake valve handle in running position and place in storage compartment.
6. Move Independent brake valve to running position, remove handle and place in storage compartment.
7. Allow blow of air to stop and place rotair valve in proper lap position.

IN LEAD UNIT:

1. Place throttle cut-out rotair valve in "CONTROL" position.
2. Place isolation switch in "POWER" position.
3. Insert brake valve handles in Running position.
4. Place rotair valve in "PASS" or "FRGT" position and apply independent brake fully.
5. Place automatic brake valve handle in lap position and open double heading cock.
6. Place automatic brake valve in running position.

FINAL CHECK:

1. Make a final check on operation and lube oil and fuel oil gauges. No alarm light should be on. (No bell ringing in MU operation.)

PREPARATIONS FOR MOVING LOCOMOTIVE:

1. See that air compressor(s) is maintaining main reservoir pressure of 130-140 lbs. and control air pressure is 80 lbs. plus or minus 5 lbs.
2. All engines should idle not less than 5 minutes.
3. See that air brake equipment is properly set up on all units.
4. Release all hand brakes.
5. Make necessary air brake tests.
6. Test operation of bell, horn and sanders.

TO MOVE LOCOMOTIVE LIGHT:

1. Rotair valve on leading unit must be in "P" and on trailing unit, if used, in "PL."
2. Close locomotive run switch with throttle in "OFF" position.
3. Place automatic brake valve in running.
4. Place independent brake valve in running.

5. Place the throttle lever in desired direction of motion. UP—moves the throttle lever to reverse. DOWN—moves the throttle lever to forward.
6. Open throttle to first notch in slot and note that load ammeter indicates power, then advance the throttle slowly.
8. If load ammeter does not register with throttle in first notch, return throttle to "OF" position and make sure the locomotive run switch is closed.

PUMPING UP AIR ON TRAIN:

Since air compressors run at engine speed, it is permissible to increase this speed when there is a large demand for air when standing coupled to train.

1. Place throttle in "OFF" position.
2. Turn locomotive run switch to "OFF" position.
3. Open throttle to about one third throttle.

STARTING TRAIN:

Having complied with all the previous instructions above, engines running, air pumped up, etc., proceed as follows:

1. Control switch and locomotive run switch must be in "ON" position.
2. All isolation switches must be in "POWER" position.
3. No alarm bell ringing. (Locos. 7106-7109 incl., are equipped for M. U. operation and *have* alarm bell. All other units do not have alarm bell.)
4. Automatic brake valve in running.
5. Release independent brake.
6. Place throttle lever in desired direction of motion.
7. Place throttle in first notch.
8. Continue to move throttle out slowly, until locomotive begins to move. If train does not start with throttle reasonably advanced, close throttle and determine cause.
9. When conditions permit, do not attempt to start heavy trains without using sand sparingly and do not apply sand when wheel slip light is burning or flashing or load ammeter pointer is moving up and down its scale without first reducing the throttle until wheel slip light remain out and load ammeter pointer is steady.

STOPPING:

1. Reduce throttle to at least half throttle.
2. Follow standard air brake procedure.
3. As speed decreases, reduce throttle gradually. At least 100 feet before stop is made, throttle should be in idle.

TO OPERATE "POWER CONTROL":

1. To spot cars and ease movement of cars, push in "LOW POWER" button (bottom button) of "POWER CONTROL."
2. For normal operation, push the HIGH POWER button (Top button). Higher power operation will cut in automatically when the throttle exceeds two-thirds position or engine speed exceeds 650 R.P.M. High power operation nullifies low power operation which will have to be reset if low power is desired. To nullify low power feature, press high power button. This may be done at any time in any throttle position.

REMOVING ENGINE FROM LINE:

1. Reduce engine speed to idle by means of the throttle.
2. Place isolation switch in "START" position.
3. If desired to stop engine:
   (a) Except in emergency, wait until water temperature drops to 165° F.
   (b) Open locomotive run switch and control switch.
   (c) Push in engine stop button and hold in until yellow low oil pressure indicator light comes on.
   (d) Lock throttle in neutral position by rotating the lever grip to the right.
   (e) If near engine, stop by pushing emergency stop push button on the control end, governor side.
4. The locomotive can be operated with either the lead or the trailing unit engine dead, controlling the locomotive from the cab of the leading unit in the same manner.

EMERGENCIES:

STOPPING ALL ENGINES:

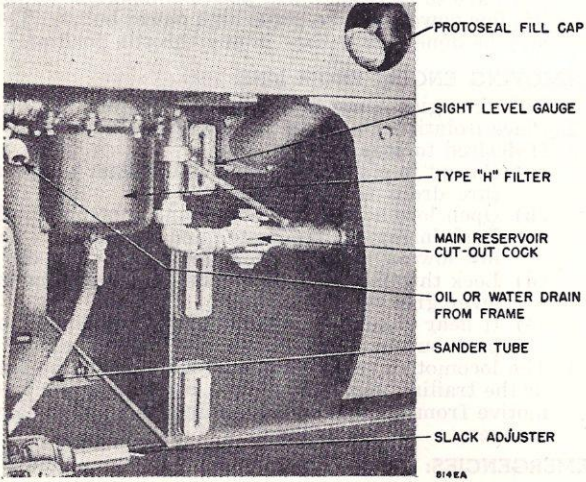
In case of emergency, requiring the immediate stopping of all power plants it will be necessary to stop the engines in the cab of each unit. See REMOVING ENGINE FROM LINE.

SHUTTING OFF ALL FUEL IN CASE OF FIRE:

1. Pull the nearest emergency fuel cut trip handle on each unit.

   (NOTE: The emergency fuel valve is located at the right front end of the fuel tank on these locomotives. When tripped it stays in closed position and it is necessary to reset by raising valve stem and sliding retainer in place.)

2. Shut down all engines as described in "REMOVING ENGINES FROM LINE."



Fuel Tank

OPERATING PRECAUTIONS:

REVERSING:

Bring locomotive to a dead stop before moving throttle for opposite locomotive movement.

OPERATING THROUGH WATER:

Do not operate locomotive through water more than 3 inches over the top of the rail, and then not at a speed exceeding 3 miles per hour.

PASSING OVER RAILROAD CROSSINGS:

When crossing a roilroad crossing, throttle should be moved back to first notch and kept in that position until all locomotive units have passed over the crossing.

CHANGING OPERATING CABS:

KEEPING ENGINES RUNNING:

LEADING CAB:

(a) Throttle off and locked in neutral position.
(b) Make 20 lb. reduction with automatic brake valve and lap valve.
(c) Close double heading cock and remove automatic brake valve in running position.
(d) Place independent brake valve handle in running position and remove handle.
(e) Allow independent brake blow to stop and place rotair valve in proper lap.
(f) Place throttle cut-out rotair valve in non-control position.
(g) Lock throttle reverser in "OFF" position.
(h) See that isolation switch is in "POWER" position.
(i) Turn off control switch, locomotive run switch and light switches on control panel.
(j) Place brake valve handles in box and go to other end.

NEW LEADING CAB:

(a) Turn on necessary lights.
(b) Turn on control and locomotive run switches at Control Panel.
(c) See that isolation switch is in "POWER" position.
(d) Place throttle cut out rotair valve in "Control" position.
(e) Insert brake valve handle in running position.
(f) Place rotair valve in "FRT" or "PASS" and apply independent brake fully.
(g) Place automatic brake valve in lap position and open double heading cock.
(h) Place automatic brake valve in running position.

LEAVING LOCOMOTIVE FOR LAYOVER:

1. Shut down diesel engine.
2. Protect against freezing, if necessary. See "SHUT-DOWN IN FREEZING WEATHER."
3. Lock throttle in neutral position by rotating lever grip to the right.
4. Open all switches on control panel.
5. Set hand brake.
6. Open main battery switch.

TOWING LOCOMOTIVE(S) DEAD IN TRAIN:

1. Lock throttle in neutral position by rotating lever grip to the right.
2. Air brakes must be set up as follows:
   (a) Close double heading cock on brake valve.
   (b) Remove handles from each brake valve in RUNNING position.
   (c) Place K-2 rotair valve in PASS Position.
   (d) Dead engine cock handle, on the D-24 Control valve, must be moved toward the DEAD position.
3. Protect against freezing if necessary. See "SHUT-DOWNS IN FREEZING WEATHER."
4. Open main battery switch.

PERIODIC INSPECTIONS ON ROAD:

GENERAL:

1. A frequent check of the instruments on the control panel should be made during the operation of the locomotive.
2. Check the level of the lubricating oil and cooling water once each eight hour shift when operating in the yard and when convenient at stops in road service.
3. Investigate immediately any unusual sounds or odors.
4. Never exceed the maximum safe speed of the locomotive. (65 mph).

LUBE OIL PRESSURE:

1. Check the lubricating oil pressure gauge on the control panel. This should not be less than 5 lbs. with the engine idling. With engine at full speed, the lubricating oil pressure should be above 24 lbs.
2. If lube oil pressure falls below 5 lbs., the yellow "LOW OIL" light will light, and the low oil pressure switch will open the engine governor solenoid circuit. When the solenoid is not energized the governor moves the fuel pump racks to no fuel position and shuts down the engine.

WARNING:

Never operate a Diesel Engine without sufficient lubricating oil or sufficient pressure.

FUEL OIL PRESSURE:

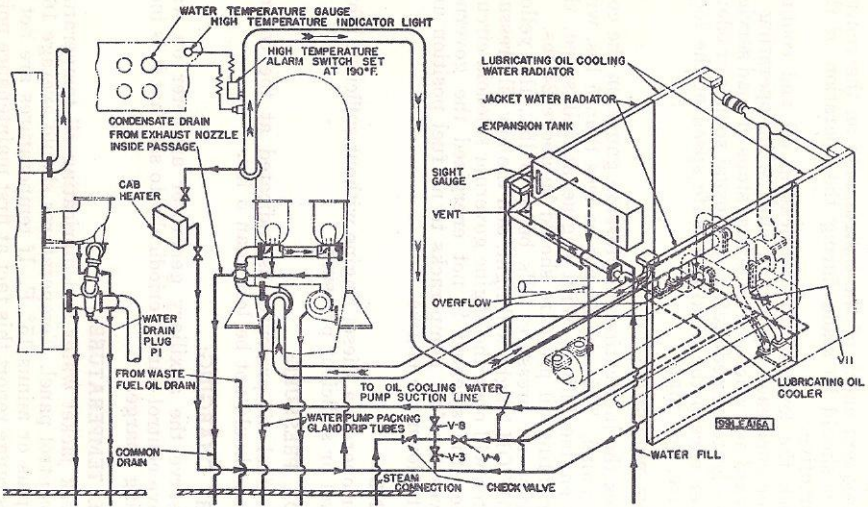
1. The fuel oil pressure, as indicated at the control panel should not be less than 5 lbs.

BATTERY CHARGING:

1. Observe the auxiliary generator ammeter on wall above control panel periodically to see that it is indicating charge.

ENGINE TEMPERATURE:

1. Check jacket water and lubricating oil temperature at control panel. Temperatures should average 160° F. plus or minus 15° F. If temperatures are not in this range report this fact at first maintenance point.



Engine Jacket Water Cooling System 2000 H.P. Unit

MISCELLANEOUS INSPECTIONS AND PRECAUTIONS:

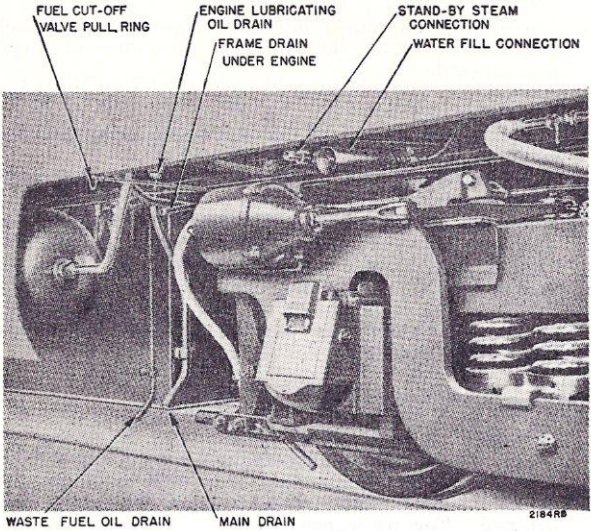
1. Check traction motor blowers. If a blower is not operating properly, do not use engine until condition is corrected.
2. Electric control air pressure should be 80 lbs. plus or minus 10 lbs.
3. Check jacket water and lubricating oil temperatures periodically.
4. In filling engine cooling system, keep overflow to a minimum.
5. Keep engine running as continuously as possible, shutting down only on account of trouble. In multiple unit operation with one unit inoperative, keep engine idling if possible and isolate.
6. If wheel slip light comes on and off, intermittently even though throttle is reduced, stop train and check for wheels sliding.

SHUT-DOWNS IN FREEZING WEATHER:

1. If engine is to be shut down during a layover in freezing weather, the locomotive must be protected from freezing by connecting to a stand-by steam line or the cooling water system must be completely drained. For protection against freezing take the following steps:
   (a) See that all radiator shutters are closed.
   (b) Supply steam to the engine cooling system by attaching steam hose to outside connection provided on right side of locomotive just ahead of fuel tank.
   (c) Open valves V3, V4 and V11. Valve V8 must be closed tight. (See illustration of JACKET WATER COOLING SYSTEM.)

SHUT DOWNS ENROUTE:

If in multiple unit operation and one engine is shut down enroute the locomotive must be protected from freezing by completely draining the cooling water system.



Water Fill, Steam Connection, and Water and Oil Drains

DRAINING:

In case steam is not available, proceed as follows:

(a) Drain the radiator and jacket water cooling systems by opening valves V3 and V8 in the drain line. (See Cooling Systems Illustration.)

(b) Remove drain plug from each water pump.

LOCOMOTIVE PROTECTIVE DEVICES:

1. GROUND RELAY:

Tripping of a ground relay affects only the one power plant (multiple unit operation) causes the engine to go to idle and will light the white ground relay indicating light. In MU operation the alarm bell will ring.

(a) Single unit operation—move throttle to "OFF" position. M. U. operation—move throttle to off position and place isolation switch in "START" position—use throttle as desired.

(b) Reset Ground Relay.

(c) Single unit operation—advance throttle as desired, multiple unit operation—move throttle to "OFF" position. Place isolation switch in "POWER" position. Use throttle as desired.

(d) If ground relay trips more than two times—single unit operation—move throttle to "OFF" position. Notify maintenance forces and do not move locomotive under its own power until cause of trouble is located and corrected. Do not open ground relay knife switch.

Multiple unit operation—place isolation switch in "START" position. Do not open Ground relay knife switch.

2. ENGINE OVERSPEED TRIP:

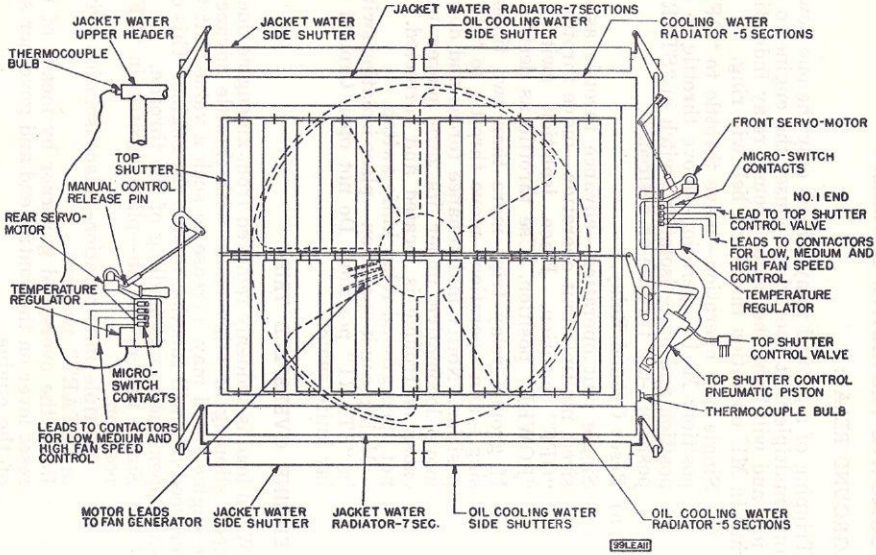
When load is suddenly removed from an engine due to wheels slipping or other cause with throttle advanced, the engine speed may increase to such a value that the overspeed trip will function to stop the engine. This can also happen due to mishandling of the throttle.

(a) Single unit operation—place throttle in "OFF" position.

Multiple unit operation—place isolation switch in "START" position.

(b) Reset the overspeed governor by means of the reset lever on the control end and governor side of the engine.

(c) Restart engine. See section "TO START ENGINE."


JACKET WATER UPPER HEADER
THERMOCOUPLE BULB
JACKET WATER SIDE SHUTTER
JACKET WATER RADIATOR-7 SECTIONS
OIL COOLING WATER SIDE SHUTTER
COOLING WATER RADIATOR -5 SECTIONS
TOP SHUTTER
MANUAL CONTROL RELEASE PIN
REAR SERVO-MOTOR
TEMPERATURE REGULATOR
MICRO-SWITCH CONTACTS
LEADS TO CONTACTORS FOR LOW, MEDIUM AND HIGH FAN SPEED CONTROL
MOTOR LEADS TO FAN GENERATOR
JACKET WATER SIDE SHUTTER
JACKET WATER RADIATOR-7 SEC.
OIL COOLING WATER SIDE SHUTTERS
OIL COOLING WATER RADIATOR -5 SECTIONS
FRONT SERVO-MOTOR
MICRO-SWITCH CONTACTS
NO. I END
LEAD TO TOP SHUTTER CONTROL VALVE
LEADS TO CONTACTORS FOR LOW, MEDIUM AND HIGH FAN SPEED CONTROL
TEMPERATURE REGULATOR
TOP SHUTTER CONTROL VALVE
TOP SHUTTER CONTROL PNEUMATIC PISTON
THERMOCOUPLE BULB
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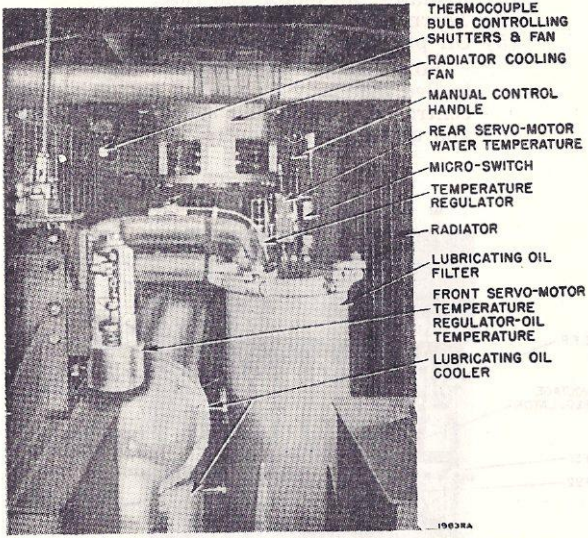
(d) Single unit operation—open throttle as desired. Multiple unit operation—with throttle in "OFF" position, place isolation switch in "POWER" position.



Radiators, Cooler, and Filters—2000 H.P. Unit

3. ENGINE HIGH TEMPERATURE ALARM:

If engine jacket water temperature exceeds 190° F, the "HOT ENGINE" temperature light (RED) will show on the unit affected. (On units equipped for M. U. Operation, the alarm bell will ring.) This light (or bell) does not stop engine and serious damage will be done if engine is operated at excessive temperatures.

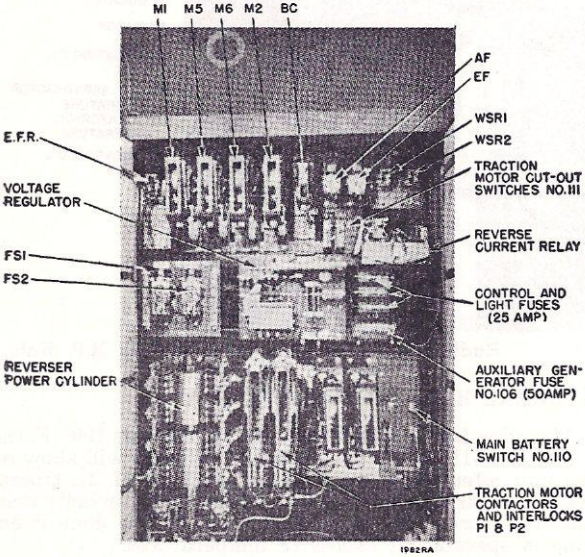
(a) Single unit operation—place throttle in "OFF" position. Multiple unit operation—isolate engine.

(b) After 5 minutes stop engine if trouble is not found.

(c) Check:

(1) Cooling water.
(2) Shutters; should be open.
(3) Radiator fan motor and fuse.
(4) Thermostat or servo-motor.
(5) Oil pressure to servo-motor.

NOTE: Shutters and fan speed can be controlled manually by pulling out on manual control release pin on servo-motor linkage and using manual control lever.



Electrical Cabinet—Switches and Fuses

4. EMERGENCY FUEL CUT-OFF:

This is a snap action valve and can be tripped to shut off fuel to the engine in case of fire by pulling a ring attached to a cable in the cab, or, on either exterior side of the locomotive frame adjacent to the fuel tank.

5. STUCK STARTING CONTACTORS:

If one or both starting contactors stick completely closed that unit will have no power. The white "STARTING CONTACTOR STUCK" light on the cab bulkhead will light. (On units equipped for M. U. Operation the alarm bell will ring.)

Single unit operation—

(a) Throttle in "OFF" position.
(b) Pry open stuck contactors with a dry wooden stick.

Multiple unit operation—

(a) Throttle in "OFF" position.
(b) Isolate engine affected by placing the isolation switch in "START" position.
(c) Pry open stuck contactors with a dry wooden stick.
(d) Place isolation switch in "POWER" position.
(e) Use throttle as desired.

6. LOW OIL PRESSURE:

In the case of low oil pressure the low oil pressure switch will stop the engine or cause it to idle and the yellow "LOW OIL" signal light will show on the cab bulkhead of the unit affected. (On units equipped for M. U. Operation the alarm bell will ring.)

7. GENERATOR FOR RADIATOR FAN AND TRACTION MOTOR BLOWERS:

The radiator fan and traction motor blowers are driven by direct current motors supplied by a D. C. Generator. Failure of this generator or the protecting fuses causes the purple blower alarm light on the cab bulkhead to burn continuously and the engine to be unloaded making it impossible to operate the unit. (On units equipped for M. U. operation the alarm bell will ring.) Stop engine and check:

(a) Fan generator.

(b) 350 ampere radiator fan motor fuse.
(c) 250 ampere traction motor blower fuse.

NOTE: Above fuses are located side by side on engineroom side of electrical cabinet.

8. CONTROL, LIGHTING AND AUXILIARY GENERATOR FUSES:

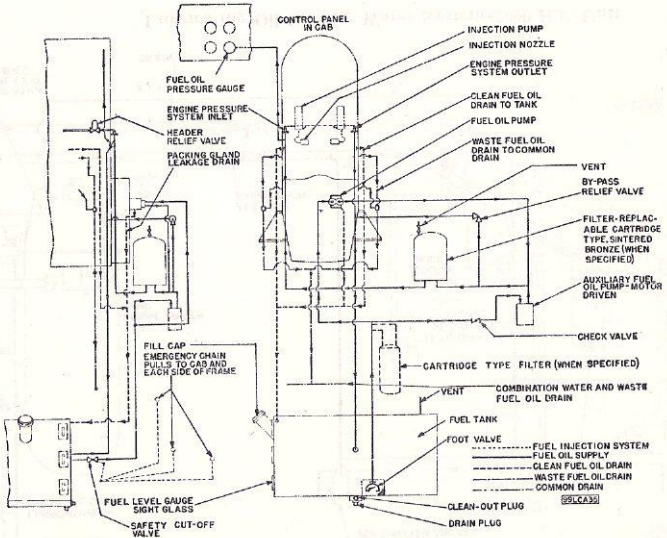
Control, lighting and auxiliary generator fuses are located in the electrical cabinet on the cab side. These may be tested by trying the fuse in question in a lighting circuit such as cab lights.

IMPORTANT NOTICE

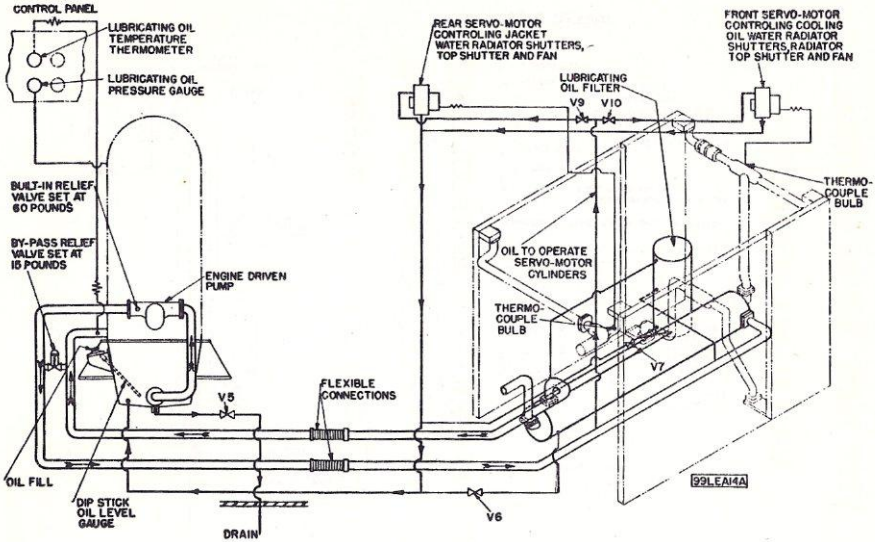
If any engine or power equipment fails to operate, and checking of all controls and safety devices in accordance with these instructions does not correct the difficulty, the engine should be isolated or stopped, and proper entry made in Log Book. Engine crew should not attempt to make any adjustment. If serious trouble develops, notify the next engine terminal. (See "SHUT DOWNS IN FREEZING WEATHER.)

LOG BOOK

Engine crew *must* enter in Log Book all troubles with equipment indicating where trouble occurred and what, if any, correction was made. Also, enter items to be repaired at maintenance point as well as any improper performance of engines or locomotives, incidents causing delays, etc. Each entry must be signed and dated and must specify train number or symbol.



Fuel Supply System



Lubricating Oil Cooling Water System-2000 H.P. Unit

THE NEW YORK CENTRAL RAILROAD COMPANY

INSTRUCTIONS FOR OPERATION OF DIESEL-ELECTRIC SWITCHING LOCOMOTIVES—ALL CLASSES

Office of Gen'l. Supt. Equipment
New York, N. Y.
Revised Oct. 3, 1949.

ELECTRO-MOTIVE CLASS DEs-4 LOCOMOTIVES

ROAD NUMBERS 567 TO 573 INCL.

PRECAUTIONS BEFORE STARTING ENGINE:

1. Check fuel oil supply.
2. Check engine cooling water supply.
3. Check lubricating oil supply.
4. Check lub-oil level in air compressor.

TO START ENGINE:

1. Close main battery switch.
2. If engine has been shut down for some time, check for accumulation of water and oil with compression relief valves open. Close valves.
3. Place throttle in idle position.
4. See that shut down lever is in run position.
5. Place reverser in neutral position.
6. Press in CONTROL button.
7. Press in FUEL PUMP button.
8. See that fuel pressure gauge registers at least five (5) lbs. pressure.
9. Press in ENGINE START button and hold until lubricating oil pressure builds up to 15 lbs. Release button.

PRECAUTIONS BEFORE MOVING LOCOMOTIVE:

1. Check lubricating oil pressure. Pressure should build up immediately after the engine is started. Engine must be shut down at once if no pressure is indicated.
2. Check engine cooling water temperature. Unless engine is warm, allow it to idle for 15 minutes before engine is worked. Be sure radiator shutters are closed.

3. Check control air pressure gauge. This gauge should be 80 lbs. plus or minus 10 lbs.

TO MOVE LOCOMOTIVE:

1. Release hand brakes.
2. Press in GENERATOR FIELD button.
3. Place reverser handle in direction locomotive is to be moved.
4. Release air brakes.
5. Pull out throttle gradually to move load without slipping wheels.

   CAUTION: In moving the locomotive, do not pump throttle on and off.

PRECAUTIONS DURING LOCOMOTIVE OPERATION:

1. Do not shut down engine at any time unless trouble develops. Engine may be shut down only if tied up at the completion of work with no relief and then only at regular maintenance points.
2. Maintain cooling water temperature of 150°-170° F. Temperature of cooling water can be controlled by operation of radiator shutters.
3. Lubricating oil pressure at 750 R.P.M. should be 25-45 lbs.
   CAUTION: Shut down engine immediately if pressure fails.
4. Control air pressure should be 80 lbs. plus or minus 10.
5. Fuel pressure gauge should read about 5 lbs. As long as any pressure is indicated, operation is satisfactory. Pressure below 5 lbs. should, however, be reported.
6. Observe battery ammeter readings frequently; should not show discharge with engine running.
7. Listen for wheel slip buzzer when starting heavy loads. If buzzer sounds, partially close throttle. Do not apply sand while wheels are slipping.

8. To pump up air quickly, place reverser in neutral position, pull out GENERATOR FIELD button and operate engine at not over ½ speed.
9. Drain water from main air reservoirs at least every eight (8) hours of operation.
10. Rotate fuel oil filter handle three complete turns to right once for each eight (8) hours of operation.
11. Rotato Cuno lubricating oil filter handle three complete turns to the right, once for each eight (8) hours of operation.
12. Open and close throttle slowly.
1.3. In running through water locomotive must be operated slowly. Under no circumstances should the locomotive pass through water deep enough to touch the bottom of the traction motor frames.
14. In passing over crossovers at more than very slow speed, ease the throttle off but do not necessarily close it all the way.

TO STOP ENGINE:

1. Close throttle to idle position.
2. Place reverse lever in neutral position.
3. Pull out GENERATOR FIELD button.
4. Allow engine to idle a minute or two.
5. Place shut-down lever in stop position.
6. Pull out fuel pump switch.
7. Pull out CONTROL switch.
8. Set hand brake.
9. If weather is cold and temperature is near freezing or below. the engine must not be shut down unless the locomotive is placed inside a shelter to prevent damage. If engine fails while in service and cannot be started, drain cooling water in freezing weather.

SAFETY DEVICES

EMERGENCY FUEL OIL SHUT OFF:

This valve is located at center of back end of fuel tank

of locomotive and may be closed in case of emergency by pulling rings, one on either side of the frame and from the engineman's position. Valve may be opened by raising valve and sliding retainer in place.

ENGINE OVERSPEED TRIP:

This trip shuts down engine in case of overspeed and serves as protection to engines. It must be reset before engine can be started. It is located on front end of engine on "A" side.

LOW OIL PRESSURE SHUT DOWN:

This device nullifies throttle control and engine may only be idled. Shut down engine and notify maintainer immediately.

IMPORTANT NOTICE

If engine fails to operate and checking of all controls and safety devices in accordance with these instructions does not correct the difficulty, the maintainer should be notified at once. Enginemen should not attempt to make any adjustments. If trouble develops in any one of the traction motors notify maintainer at once.

Office of Gen'l. Supt. Equipment
NEW YORK CENTRAL RAILROAD CO.
New York, Oct. 3, 1949.

ELECTRO-MOTIVE CLASS DEs-4 LOCOMOTIVES ROAD NUMBERS 567 TO 573 INCL.

DRAINING COOLING SYSTEM

If engine cannot be started and there is danger of freezing cooling system, drain all water.

1. Open drain valve located on fireman's side of locomotive inside hood near 3rd door from cab at floor level.
2. Open drain cock at bottom of water pump.
3. On locomotives equipped with Immersion heater drain heater pump.

Proper quantity of cooling water inhibitor must be added to the cooling system when refilled.

Office of Gen'l. Supt. Equipment
NEW YORK CENTRAL RAILROAD CO.
Revised—Oct. 3, 1949.

ELECTRO-MOTIVE CLASSES DEs-5 AND 6 LOCOMOTIVES
ROAD NUMBERS 574 TO 609 INCL., 617 TO 621, INCL. AND 650 TO 704, INCL.

PRECAUTIONS BEFORE STARTING ENGINE:

1. Check fuel oil supply.
2. Check engine cooling water supply.
3. Check lubricating oil supply.
4. Check lub-oil level in air compressor.

TO START ENGINE:

1. Close main battery switch.
2. If engine has been shut down for some time, check for accumulation of water and oil with compression relief valves open. Close valves.
3. Place throttle in idle position.
4. See that shut down lever is in run position (if so equipped).
5. Place reverser handle in neutral position.
6. Press in CONTROL button.
7. Press in FUEL PUMP button.
8. See that fuel pressure gauge registers at least five (5) lbs. pressure.
9. Press in ENGINE START button and hold until engine fires. Release button.

PRECAUTIONS BEFORE MOVING LOCOMOTIVE:

1. Check lubricating oil pressure.
   Pressure should build up immediately after the engine is started. Engine must be shut down at once if no pressure is indicated.
2. Check piston cooling oil pressure. Pressure should build up immediately after the engine is started. Engine must be shut down at once if no pressure is indicated.

PRECAUTIONS BEFORE MOVING LOCOMOTIVE (continued):

3. Unless engine is warm, close radiator shutters. (Automatic shutters on locomotives 585 to 609, incl.) Allow engine to idle for at least 15 minutes before engine is worked .
4. Check control air pressure gauge. This gauge should read 80 lbs.

TO MOVE LOCOMOTIVE:

1. Release hand brakes.
2. Press in Generator Field button.
3. Place reverser handle in direction locomotive is to be moved.
   (a) (Locomotives 585 to 609, inc., only.) If locomotive is to be used in heavy, slow speed switching, the Selective Transition Switch should be "IN-SERIES." If used in fast light switching, the switch should be in the "OUT-AUTO" position.
4. Release air brakes.
5. Pull out throttle gradually to move load without slipping wheels.

   CAUTION: In moving the locomotive, do not pump the throttle handle back and forth.

PRECAUTIONS DURING LOCOMOTIVE OPERATION:

1. Do not shut down engine at any time unless trouble develops. Engine should not be shut down at any time unles trouble of some nature develops. Engine may be shut down only if tied up at the completion of work with no relief and then only at regular maintenance points.
2. Maintain cooling water temperature of 150°-170° F. Temperature of cooling water can be controlled by operation of radiator shutters. (Automatic shutters on locomotives 585 to 609, incl.)

   CAUTION: Shut down engine immediately if pressure fails.

PRECAUTIONS DURING LOCOMOTIVE OPERATION (continued):

4. Piston cooling oil pressure at full throttle should be 15-25 lbs.

   CAUTION: Shut down engine immediately if pressure fails.

5. Control air pressure should be 80 lbs. plus or minus 10.

6. Fuel pressure gauge should read about 5 lbs. As long as any pressure is indicated, operation is satisfactory. Pressure below 5 lbs. should, however, re reported.

7. Observe voltmeter and ammeter readings occasionally. Voltmeter should register between 74-76 volts and ammeter to right of zero with engine running.

8. When wheel slip indication is received, throttle must be slowly closed and reopened to move load. Do not apply sand while wheels are slipping.

9. To pump up air quickly, place reverser in neutral position, pull out GENERATOR FIELD button and operate engine at approximately ½ speed.

10. Drain water from main air reservoirs at least every eight (8) hours of operation.

11. Rotate fuel oil filter handle one complete turn to the right once for each eight (8) hours of operation.

12. Rotate Cuno lubricating oil filter handle three complete turns to the right, once for each eight hours of operation.

13. Open and close throttle slowly.

14. In running through water locomotive must be operated slowly. Under no circumstances should the locomotive pass through water deep enough to touch the bottom of the traction motor frames.

PRECAUTIONS DURING LOCOMOTIVE OPERATION (continued):

15. In passing over crossovers at more than very slow speed, ease the throttle off but do not necessarily close it all the way.
16. To obtain transition in multiple unit operation of DEs-6f Locos. 695, 696 and 697, open throttle to sixth position, press transition button and advance throttle to eighth position.

TO STOP ENGINE:

1. Close throttle to idle position.
2. Place reverser in neutral position.
3. Pull out GENERATOR FIELD button.
4. Allow engine to idle a minute or two.
5. Place shut down lever in stop position (if so equipped) or press in button on end of throttle and close throttle to stop position.
6. Pull out FUEL PUMP switch.
7. Pull out CONTROL switch, after engine has stopped.
8. Set hand brake.
9. If weather is cold and temperature is near freezing or below, the engine must not be shut down unless the locomotive is placed inside a shelter to prevent damage. If engine fails while in service and cannot be started, drain cooling water in freezing weather.

SAFETY DEVICES

EMERGENCY FUEL OIL SHUT OFF:

This valve is located ahead of fuel tank on left side of locomotive and may be closed in case of emergency by pulling rings, on either side of the frame and from the engineer's position. Valve may be reset by raising valve and sliding retainer in place.

GROUND PROTECTIVE RELAY:

This relay opens and releases all electrical energy whenever a ground on any of the apparatus occurs. It is located in the control cabinet and must be reset by hand with throttle closed, before the locomotive can be moved. If relay opens repeatedly, maintainer should be notified immediately.

ENGINE OVERSPEED TRIP:

This trip shuts down engine in case trouble is experienced with governor. It protects engine from overspeed. It must be reset before engine can be started.

LOW OIL PRESSURE SHUT DOWN:

This shut down provides some protection to the engine bearings in case of low oil pressure. Its operation nullifies throttle control and engine may only be idled. Shut down engine. Maintainer must be notified at once.

COMPRESSION RELIEF VALVES:

These valves are located one on each cylinder to relieve presence of water or fuel. They should be opened if engine has been standing for some time and the engine rotated a few turns. Be sure fuel pump is off. If there is no indication of water, close all valves and start engine in the regular manner.

STARTER FUSE:

This fuse protects the generator starter windings. If blown, operation of starter button will produce no results. It is located in control cabinet.

CONTROL FUSES:

These fuses are located in the control cabinet. Any one of these fuses if blown will affect the operation of the locomotive. Do not remove or change fuses with engine running.

LOW OIL INDICATING LIGHT: ON LOCO'S. 695, 696, 697.

This light will operate if engine lubricating oil pressure fails and oil-engine must be shut down immediately.

HOT ENGINE INDICATING LIGHT: ON LOCO'S. 695, 696, 697.

This light will operate if engine cooling water exceeds safe operating temperature. When lighted, idle engine and open shutters for a short period. If light continues to burn, shut down oil engine.

IMPORTANT NOTICE

If engine fails to operate and checking of all controls and safety devices in accordance with these instructions does not correct the difficulty, the maintainer should be notified at once. Engineman should not attempt to make any adjustments. If trouble develops in any one of the traction motors notify maintainer at once.

Office of Gen'l. Supt. Equipment
NEW YORK CENTRAL RAILROAD CO.
New York, Oct. 3, 1949.

ELECTRO-MOTIVE CLASSES DEs-5 AND 6 LOCOMOTIVES

ROAD NUMBERS 574 TO 609 INCL., 617 TO 621, INCL., AND 650 TO 704, INCL.

DRAINING COOLING SYSTEM

If engine cannot be started and there is danger of freezing cooling system, drain all water.

1, Open cab heater valves (if closed).

2. Open four drain valves at front of engine at floor level.

3. Open "H" overflow valve.

4. Remove plug at bottom of water pump.

5. On locomotives equipped with Immersion heaters drain heater pump.

Proper quantity of cooling water inhibitor must be added to the cooling system when refilled.

Office of Gen'l. Supt. Equipment
NEW YORK CENTRAL RAILROAD CO.
Oct., 1949

AMERICAN LOCOMOTIVE (ALCO) CLASS DEs-7 LOCOMOTIVES ROAD NUMBERS 800 TO 810 INCL.

PRECAUTIONS BEFORE STARTING ENGINE:

1. Check fuel oil supply.
2. Check cooling water supply.
3. See that crankcase has lubricating oil to proper level.
4. Check lubricating oil level in air compressor.

TO START ENGINE:

1. Close main battery switch.
2. Be sure throttle is in idle position.
3. Be sure controller is in neutral position.
4. Press in control button.
5. Press in fuel pump button.
6. See that fuel oil pressure builds up to 40 lbs. or more.
7. Place 3 position air valve in "start" position.
8. Press in engine start button and hold until lubricating oil pressure builds up to 20 lbs.
9. Move 3 position air valve lever to "run" position.

PRECAUTIONS BEFORE MOVING LOCOMOTIVE:

1. Check lubricating oil supply by use of bayonet gauge on right side of locomotive at base of engine. With engine running, gauge should read ½ to full.
2. Check lubricating oil pressure, 35 to 45 lbs.
3. Check engine cooling water temperature. Keep operating temperatures between 150 and 170 degrees, by operating the "Low," "Med" and "High" speed radiator fan control buttons on control stand. Unless engine is warm, idle it for 15 minutes before engine is worked.
4. Press in Aux-gen. button and note that battery ammeter shows charge.
5. Press in air compressor button and note that main reservoir pressure builds up to 135 lbs.
6. Check control air pressure—70 lbs.
7. Press in traction motor blower button.

TO MOVE LOCOMOTIVE:

1. Release hand brake and remove wheel blocking.
2. Move controller handle from neutral to one of its three positions in the direction locomotive is to be moved.

   NOTE: The three positions of controller, both forward and reverse are:

   1. Series—slow speed—heavy loads.
   2. Series parallel—intermediate speeds—medium loads.
   3. Reduced field—high speeds—light loads.
3. Release air brakes.
4. Open throttle steadily to start train and obtain desired speed, do not jerk or slam throttle on and off.
5. When operating in series, series parallel or reduced field position and speed decreases due to grade, transition to series must be made manually:
   (a) When speed drops to 8 miles per hour or
   (b) When load ammeter current exceeds 500 amps.
6. Transition to series is made as follows:
   Reduce throttle to one quarter (¼) open position, move controller to series, or first position, then open throttle slowly.
7. To transfer from series, to series parallel, after a speed of 8 MPH has been attained, place controller in series parallel or reduced field position then press series holding button.
8. Changing from series parallel to Reduced Field, is taken care of automatically, provided the controller handle is in the reduced field position.

PRECAUTIONS DURING LOCOMOTIVE OPERATION:

1. DO NOT SHUT DOWN ENGINE AT ANY TIME UNLESS TROUBLE DEVELOPS. Engine may be shut down only if tied up at completion of work with no relief and then only at regular maintenance points.
2. Maintain cooling water temperature of 150-170 degrees. Temperature of cooling water can be con-

trolled by operation of radiator fans. If temperature rises above 170 degrees with high speed fan button in, check to see whether fan is operating.

3. Lubricating oil pressure should be 35-45 lbs. at full throttle.

   CAUTION: Shut down engine immediately if pressure fails.

4. Control air pressure should be 70 lbs. plus or minus 10 lbs.
5. Fuel oil pressure gauge should read 40 lbs. or more. Report pressure below 30 lbs.
6. Observe ammeter readings while operating and keep within limits specified.
7. Drain water from main reservoirs every eight (8) hours of operation.
8. At least once each 8 hours see that traction motor blower is revolving properly. Locomotive must not be worked with defective blowers.
9. Rotate fuel oil and lubricating oil filter handles one or more complete turns to the right for each eight (8) hours of operation. Fuel oil filter is located inside engine compartment on the right side of locomotive. Lubricating oil filters are located inside engine compartment at left back end of locomotive.
10. Open and close throttle slowly.
11. In operating through water, locomotive should be operated slowly. Under no circumstances should locomotive pass through water deep enough to touch the bottom of traction motor frames.
12. In passing over crossovers at more than very slow speed, ease the throttle off but do not necessarily close it all the way.
13. Observe battery charge ammeter. Should not show discharge with engine running.
14. Listen for wheel slip buzzer when starting heavy loads. If buzzer sounds, partially close throttle. Do not apply sand while wheels are slipping.

TO STOP ENGINE:

1. Close Throttle.
2. Place controller handle in neutral position.
3. Allow engine to idle a minute or two.
4. Place 3 position air valve lever in stop position.
5 Pull out fuel pump button.
6. Pull out control button.
7. Set hand brake.
8. If weather is cold and temperature is near freezing or below, the engine must not be shut down unless the locomotive is placed inside a shelter to prevent damage. In case engine fails while in service and cannot be started, drain cooling water in freezing weather.

SAFETY DEVICES

ENGINE OVERSPEED TRIP:

This trip shuts down engine in case of overspeed. It protects the engine. It must be reset before engine can be started.

EMERGENCY FUEL CUT-OFF VALVE:

Located inside cabinet rear of cab, may be closed by pulling red balls on either side of locomotive and in cab. Valve may be opened by raising valve and placing retainer into place.

LOW OIL PRESSURE DEVICE:

This device stops engine in case of low oil pressure when 3 way cock is in run position. Do not allow engine to run with low oil pressure. Notify maintainer at once.

IMPORTANT NOTICE

If engine fails to operate and checking all control and safety devices in accordance with these instructions does not correct the trouble, the maintainer should be notified at once. Engineman should not attempt to make any adjustment. If trouble develops in any one of the four traction motors notify maintainer at once.

Office of Gen'l. Supt. Equipment
NEW YORK CENTRAL RAILROAD CO.
New York, Oct. 3, 1949.

AMERICAN LOCOMOTIVE (ALCO) CLASS DEs-7 LOCOMOTIVES ROAD NUMBERS 800 TO 810 INCL.

DRAINING COOLING SYSTEM

If engine cannot be started and there is danger of freezing cooling system, drain all water.

1. Open main drain valve near front end of engine (rear end of locomotive hood near cab) at floor level. Engineman's side.
2. Open valve in piping from engine block. Engineman's side.
3. On locomotives equipped with Immersion heaters drain heater pump.

Proper quantity of cooling water inhibitor must be added to the cooling system when refilled.

Office of Gen'l. Supt. Equipment
NEW YORK CENTRAL RAILROAD CO.
New York, Oct. 3, 1949.

AMERICAN LOCOMOTIVE (ALCO) CLASSES DEs-8, 9, AND 11 LOCOMOTIVES

ROAD NUMBERS 811 TO 863 INCL., 900 TO 907, INCL., AND 8500 TO 8536, INCL.

PRECAUTIONS BEFORE STARTING ENGINE:

1. Check fuel oil supply.
2. Check cooling water supply.
3. See that crankcase has lubricating oil, but do not check for correct level until engine is running.
4. Check lubricating oil level in air compressor.

TO START ENGINE:

1. Close main battery switch.
2. Be sure throttle is in idle position.
3. Be sure controller is in neutral position.
4. Press in fuel pump button.
5. See that fuel oil pressure builds up to 40 lbs. or more.
6. Press in control button.
7. Press in engine start button and hold until lubricating oil pressure builds up to 20 lbs.

PRECAUTIONS BEFORE MOVING LOCOMOTIVE:

1. Check lubricating oil supply.
   Check lubricating oil supply by use of bayonet gauge on left side of base of engine. With engine running, gauge should read ½ to full.
2. Check lubricating oil pressure 35 to 45 lbs.
3. Check engine cooling water temperature. Keep operating temperature between 150-170 degrees by opening or closing shutters. Shutter lever is located above control stand on front partition. Un-

less engine is warm, idle for 15 minutes before engine is worked.

4. Check control air pressure—70 lbs.

5. Open both side radiator shutters when engine reaches operating temperatures. Set shutters in accordance with weather conditions.

TO MOVE LOCOMOTIVE:

1. Release hand brake and remove wheel blocking.

2. Move controller handle from neutral to one of its three positions in the direction locomotive is to be moved.

   NOTE: The three positions of controller, both forward and reverse, are:

   1. Series—slow speed—heavy loads,
   2. Series parallel—intermediate speed—medium loads,
   3. Reduced field—high speeds—light loads.

3. Release air brakes.

4. Open throttle steadily to start train and obtain desired speed. Do not jerk or slam the throttle on and off.

5. When operating in series parallel or reduced field position of controller and speed decreases due to grade, transition to series must be made manually
   (a) when speed drops to 8 miles per hour or
   (b) when overload light comes on.
   Transition to series is made as follows:
   Reduce throttle to below the one-quarter (¼) open position, move controller to first position, open throttle slowly.
   NOTE: On locomotives equipped with series parallel button it is necessary to press this button after speed of 8 M.P.H. has been attained in order to transfer to series parallel and reduced field.

PRECAUTIONS DURING LOCOMOTIVE OPERATION:

1. Do not shut down engine at any time unless trouble develops. Engine should not be shut down at any time unless trouble of some nature develops. Engine may be shut down only if tied up at completion of work with no relief and then only at regular maintenance points.
2. Maintain cooling water temperature of 150-170 degrees. Temperature of cooling water can be controlled by operation of shutter lever. If temperature rises above 170 degrees with manually operated shutters open, check outside shutters at radiators to see that they are open. Check water level in cooling system.
3. Lubricating oil pressure should be 35-45 lbs. at full throttle.

   CAUTION: Shut down engine immediately if pressure fails.
4. Control air pressure should be 70 lbs., plus or minus 10 lbs.
5. Fuel oil pressure gauge should read 40 lbs. or more. Report pressure below 30 lbs.
6. Observe ammeter readings while operating and keep within limits specified.
7. Drain water from main reservoirs every eight (8) hours of operation.
8. At least each each 8 hours see that traction motor blowers are revolving properly. Locomotive must not be worked with defective blowers.
9. Rotate fuel oil and lubricating oil filter handles one or more complete turns to the right for each eight (8) hours of operation. Fuel oil filter is located inside engine compartment on the left side of engine.

   Lubricating oil filters are located inside engine compartment at right front end of engine.
10. Open and close throttle slowly.

PRECAUTIONS DURING LOCOMOTIVE OPERATION (continued):

11. In operating through water locomotive should be operated slowly. Under no circumstances should locomotive pass through water deep enough to touch the bottom of traction motor frames.
12. In passing over crossovers at more than very slow speed, ease the throttle off but do not necessarily close it all the way.
13. Observe battery charge ammeter. It should not show discharge with engine running.
14. Listen for wheel slip buzzer when starting heavy loads. If buzzer operates, partially close throttle and reopen slowly to move load. Do not apply sand while wheels are slipping.

TO STOP ENGINE:

1. Close throttle.
2. Place controller in neutral position.
3. Allow engine to idle a minute or two.
4. Pull out fuel pump button.
5. Pull out control button.
6. Set hand brake.
7. If weather is cold and temperature is near freezing or below, the engine must not be shut down unless the locomotive is placed inside a shelter to prevent damage. In case engine fails while in service and cannot be started, drain cooling water in freezing weather.

SAFETY DEVICES

GROUND PROTECTIVE RELAY:

Located inside cabinet front of cab on upper right side. Can be reset by lifting reset lever.

ENGINE OVERSPEED TRIP:

This trip shuts down engine in case of overspeed. It protects the engine. It must be reset before engine can be started.

EMERGENCY FUEL CUT-OIL VALVE:

Located inside cabinet front of cab, may be closed by pulling red ball on either side of locomotive and in cab. Valve may be reset by raising valve and placing retainer into place.

SAFETY DEVICES

CONTROL FUSES:

These fuses are located in the control cabinet. Any one fuse, if blown, will affect the operation of the locomotive. Do not remove or change fuses with engine running.

LOW OIL PRESSURE SHUT DOWN:

This stops engine in case of low oil pressure.

IMPORTANT NOTICE

If engine fails to operate and checking of all controls and safety devices in accordance with these instructions does not correct the difficulty, the maintainer should be notified at once.

Engineman should not attempt to make any adjustments.

If trouble is experienced with any of the four traction motors, notify maintainer at once.

Office of Gen'l. Supt. Equipment
NEW YORK CENTRAL RAILROAD CO.
New York, Oct. 3, 1949.

AMERICAN LOCOMOTIVE (ALCO) CLASSES DEs-8, 9, AND 11 LOCOMOTIVES

ROAD NUMBERS 590, 811 TO 863 INCL., 900 TO 907, INCL., AND 8500 TO 8536, INCL.

DRAINING COOLING SYSTEM

If engine cannot be started and there is danger of freezing cooling system, drain all water.

1. Open main drain valve near front of engine on fireman's side.
2. Open valve in piping from engine block.
3. Open cab heater valves (if closed).
4. On 1000 H.P. engines class DEs-11 open drain valve at turbo charger.
5. On locomotives equipped with Immersion heaters drain heater pump.

Proper quantity of cooling water inhibitor must be added to the cooling system when refilled.

Office of Gen'l. Supt. Equipment
NEW YORK CENTRAL RAILROAD CO.
New York, Oct. 3, 1949.

BALDWIN LOCOMOTIVE CLASSES DEs-10 AND 12 LOCOMOTIVES ROAD NUMBERS 750 TO 761 INCL. AND 8600 TO 8607 INCL.

PRECAUTIONS BEFORE STARTING ENGINE:

1. Check fuel oil supply.
2. Check engine cooling water supply.
3. Check lubricating oil supply.
4. Check lubricating oil level in air compressor.

TO START ENGINE:

1. Close main battery switch.
2. Be sure throttle is in idle position.
3. Be sure reverser is in neutral position.
4. Turn control switch button to ON position. See that fuel pressure gauges register at least 25 lbs. pressure.
. Press in engine start button and hold until engine fires and lubricating oil pressure builds up to 20 lbs.
6. After engine is running and all pressures are satisfactory, close exciter field switch and see that battery ammeter hand goes to charge side.

PRECAUTIONS BEFORE MOVING LOCOMOTIVE:

1. Check lubricating oil pressure.
2. Unless engine is warm allow engine to idle for at least 15 minutes before engine is worked.
3. Check control air pressure; should be 70 lbs.

TO MOVE LOCOMOTIVE:

1. Release hand brakes.
2. Place reverser handle in direction locomotive is to be moved.
3. Release air brakes.
4. Pull back steady and gradual on throttle to move load without slipping wheels.

   CAUTION: In moving locomotive do not pump throttle handle back and forth.

PRECAUTIONS DURING LOCOMOTIVE OPERATION:

1. Do not shut down engine at any time unless trouble develops. Engine should not be shut down at any time unless trouble of some nature develops. Engine may be shut down only if tied up at completion of work with no relief and then only at regular maintenance points.

2. Temperature of cooling water is controlled by operation of automatic radiator shutters. Should the cooling water temperature rise above 180° F., check the position of shutters. If shutter is closed, open the manual control valve. This valve is located on a channel iron stiffening member inside the left front hood door, and is sealed in the "normal" position. Break the seal and turn the valve handle to the left. Should the cooling water temperature remain above 180° F. with shutter open, the locomotive should not work until the cause of the overheating is found and corrected.

   Locomotives 750 to 754 inclusive are equipped with manually operated shutters, these must be adjusted to maintain cooling water temperature between 150° and 180°. Avoid sudden temperature changes.

PRECAUTIONS DURING LOCOMOTIVE OPERATION (continued):

3. Lubricating oil pressure shoudl be 20-80 lbs.
   CAUTION: Shut down engine immediately if pressure falls below 15 lbs.

4. Control air pressure should be 70 lbs., plus or minus 10 lbs.

5. Fuel pressure gauges should read 25 lbs. or more. Pressure below 20 lbs. should be reported immediately.

6. Observe battery ammeter readings occasionally. Ammeter should not register DISCHARGE with engine running and exciter field switch in ON position.

7. Prevent slipping of wheels. When wheels slip under load, indicating horn will sound and throttle should be moved toward idle position until warning ceases. Slow acceleration may then be resumed. Do not apply sand while wheels are slipping.

8. At least once each 8 hours see that traction motor blowers are revolving properly. Locomotive must not be worked with defective blowers.

9. To pump up air, place reverser in neutral position and operate throttle to bring engine to approximately one-half (½) speed. Do not exceed this engine speed. Close throttle before attempting to move reverser.

10. Drain water from main air reservoirs at least once every eight (8) hours of operation.

11. Rotate lubricating oil filter handle one complete turn to the right once for each eight (8) hours of operation. Lubricating oil filter is located at the forward left corner of engine base at forward end of engine hood.

12. Open and close throttle slowly.

PRECAUTION DURING LOCOMOTIVE OPERATION (continued):

13. In operating through water locomotive should be operated very slowly. Under no circumstances should locomotive pass through water deep enough to touch the bottom of traction motor frames.

14. In passing over crossovers at more than very slow speed, ease the throttle off but do not necessarily close it all the way.

15. At all times large ammeter should be watched and under no circumstances should the following readings be exceeded:

		660 H.P.	1000 H.P.
Amperes	continuous—	950	1060
"	40 minutes—	1050	1200
"	20 " —	1200	1350
"	15 " —	1300	1400
"	9 " —	1500	2000

TO STOP ENGINE:

1. Close throttle to idle position.
2. Place reverser in neutral position.
3. Allow engine to idle a minute or two.
4. Move exciter field button to OFF position.
5. Move control button to OFF position.
6. Set hand brake.
7. If weather is cold and temperature is near freezing or below, the engine must not be shut down unless the locomotive is placed inside a shelter to prevent damage. In case engine fails while in service and cannot be started, drain cooling water in freezing weather.

SAFETY DEVICES

EMERGENCY FUEL OIL SHUT OFF:

This valve is located ahead of the fuel tank on left side of locomotive and may be closed in case of emergency by pulling rings, one on either side of the frame and from engineer's position. Valve may be opened by raising valve and sliding retainer in place.

ENGINE OVERSPEED TRIP:

This trip shuts down engine in case trouble is experienced with governor. It protects engine from overspeed. It must be reset before engine can be started.

LOW OIL PRESSURE SHUT DOWN:

This shut down provides protection to the engine bearings in case of low oil pressure. Its operation shuts down engine. Maintainer must be notified at once.

CONTROL FUSES:

These fuses are located in the control cabinet. If blown they will affect starting and operating the locomotive. Do not remove or change fuses with engine running.

IMPORTANT NOTICE

If engine fails to operate and checking of all controls and safety devices in accordance with these instructions does not correct the difficulty, the maintainer should be notified at once.

Engineman should not attempt to make any adjustments. If trouble is experienced with any one of the four traction motors, notify maintainer at once.

Office of Gen'l. Supt. Equipment
NEW YORK CENTRAL RAILROAD CO.
Oct., 1949

BALDWIN LOCOMOTIVE CLASSES DEs-10 AND 12 LOCOMOTIVES

ROAD NUMBERS 750 TO 761 INCL. AND 8600 TO 8607 INCL.

DRAINING COOLING SYSTEM

If engine cannot be started and there is danger of freezing cooling system, drain all water.

1. Open main drain valve front end of engine on fireman's side at floor level.
2. Remove plug from bottom of water pump.
3. On locomotives equipped with Immersion heaters drain heater pump.

Proper quantity of cooling water inhibitor must be added to the cooling system when refilled.

Office of Gen'l. Supt. Equipment
NEW YORK CENTRAL RAILROAD CO.
Oct., 1949

ELECTRO-MOTIVE CLASS DEs-13 LOCOMOTIVES

ROAD NUMBERS 8700 TO 8704 INCL., 8715 TO 8739 INCL., 8750 TO 8773 INCL., 8774 TO 8789 INCL., 8790 TO 8855 INCL.

PRECAUTIONS BEFORE STARTING ENGINE:

1. Check fuel oil supply.
2. Check engine cooling water supply.
3. Check lubricating oil supply.
4. Check lub-oil level in air compressor.

TO START ENGINE:

1. Close main battery switch.
2. If engine has been shut down for some time, check for accumulation of water and oil with compression relief valves open. Close valves.
3. Place throttle in idle position.
4. See that shut down lever is in run position.
5. Place reverser in neutral position.
6. Press in CONTROL button.
7. Press in FUEL PUMP button.
8. See that fuel pressure gauge register at least five (5) lbs. pressure.
9. Press in ENGINE START button and hold until engine fires. Release button.

PRECAUTIONS BEORE MOVING LOCOMOTIVE:

1. Check lubricating oil pressure. Pressure should build up immediately after the engine is started. Engine must be shut down at once if no pressure is indicated.

Revised—Oct., 1949

2. Check piston cooling oil pressure. Pressure should build up immediately after the engine is started. Engine must be shut down at once if no pressure is indicated.
3. Unless engine is warm, close radiator shutters. Allow engine to idle for at least 15 minutes before engine is worked.
4. Check control air pressure gauge. This gauge should read 80 lbs.

TO MOVE LOCOMOTIVE:

1. Release hand brakes.
2. Press in GENERATOR FIELD button.
3. Place reverser handle in direction locomotive is to be moved.
4. If locomotive is to be used in heavy slow speed switching, the Selective Transition Switch should be "IN—SERIES". If used in fast light switching or transfer work, the switch should be in the "OUT—AUTO" position.
5. Release air brakes.
6. Pull out throttle gradually to move load without slipping wheels. CAUTION: In moving the locomotive, do not pump the throttle handle back and forth.
7. The load ammeter may indicate more than 625 amps. on starting but locomotive should not be operated continuously at over 625 amps.

PRECAUTIONS DURING LOCOMOTIVE OPERATION:

1. Do not shut down engine at any time unless trouble develops. Engine should not be shut down at any time unless trouble of some nature develops. Engine may be shut down only if it ties up at the completion of work with no relief and then only at regular maintenance points.

2. Maintain cooling water temperature of 150°-170°. Temperature of cooling water can be controlled by operation of radiator shutters.
3. Lubricating oil pressure at full throttle should be 30-40 lbs. CAUTION: Shut down engine immediately if pressure fails.
4. Piston cooling oil pressure at full throttle should be 20-30 lbs. CAUTION: Shut down engine immediately if pressure fails.
5. Control air pressure should be 80 lbs. plus or minus 10.
6. Fuel pressure gauge should read about 5 lbs. As long as any pressure is indicated, operation is satisfactory. Pressure below 5 lbs. however, should be reported.
7. Observe battery ammeter reading occasionally. Should be to right of zero with engine running.
8. When wheel slip indication is received with possible fluctuation of load ammeter, throttle must be eased off until wheels stop slipping. Do not apply sand while wheels are slipping.
9. If continuous wheel-slip indication is received and load ammeter indicates steady high current, this is caused by current limit relay (not wheel slip) and indicates electrical overload. Either ease off throttle, or if operating in Series-Parallel, close and open throttle to make transition back to Series.
10. To pump up air quickly, place reverser in neutral position, pull out GENERATOR FIELD button and operate engine at approximately ½ speed.
11. Drain water from main air reservoirs at least once every eight (8) hours of operation.
12. At least once each 8 hours see that traction motor blowers are revolving properly. Locomotive must not be worked with defective blowers.
13. Open and close throttle slowly.
14. In running through water locomotive must be operated slowly. Under no circumstances should the

locomotive pass through water deep enough to touch the bottom of the traction motor frames.

15. In passing over crossovers at more than very slow speed, ease the throttle off but do not necessarily close it all the way.
16. Transition to Series-Parallel if Selective Transition Switch is in "OUT-AUTO" position, will occur at about 9 M.P.H. but will not drop back to series automatically. (See Item 9 above.)

TO STOP ENGINE:

1. Close throttle to idle position.
2. Place reverser in neutral position.
3. Pull out GENERATOR FIELD button.
4. Allow engine to idle a minute or two.
5. Place shut down lever in stop position.
6. Pull out FUEL PUMP switch.
7. Pull out CONTROL switch, after engine has stopped.
8. Set hand brake.
9. If weather is cold and temperature is near freezing or below, the engine must not be shut down unless the locomotive is placed inside a shelter to prevent damage. If engine fails while in service and cannot be started, drain cooling water in freezing weather.

SAFETY DEVICES

EMERGENCY FUEL OIL SHUT OFF:

This valve is located ahead of fuel tank on left side of locomotive and may be closed in case of emergency by pulling rings, on either side of the frame and from the engineer's position. Valve may be reset by raising valve and sliding retainer in place.

GROUND PROTECTIVE RELAY:

This relay opens and releases all electrical energy whenever a ground on any of the apparatus occurs. It is located in the high voltage cabinet and must be reset by hand with throttle closed, before the locomotive can be moved. If relay opens repeatedly, maintainer should be notified immediately.

ENGINE OVERSPEED TRIP:

This trip shuts down engine in case trouble is experienced with governor. It protects engine from overspeed. It must be reset before engine can be started.

LOW OIL PRESSURE SHUT DOWN:

This shut down provides some protection to the engine bearings in case of low oil pressure. Its operation nullifies throttle control and engine may only be idled. Shut down engine. Maintainer must be notified at once.

COMPRESSION RELIEF VALVES:

These valves are located one on each cylinder to relieve presence of water or fuel. They should be opened if engine has been standing for some time and the engine rotated a few turns. Be sure fuel pump is off. If there is no indication of water, close all valves and start engine in the regular manner.

STARTER FUSE:

This fuse protects the generator starter windings. If blown, operation of starter button will produce no results. It is located in low voltage cabinet.

CONTROL AND LIGHT FUSES:

Fuses for the following push buttons:

Control, Generator-Field, Fuel Pump, Engine Starter and Cab Heater are located in control push button switch box. Other low voltage power fuses are located in the

low voltage cabinet. Principal light fuses are located in lighting push button switch box. Blowing of any of the above except light and cab heater fuses will affect operation of the locomotive. Do not remove or change fuses in low voltage cabinet with engine running. Engine room light fuse is located in high voltage cabinet.

IMPORTANT NOTICE

If engine fails to operate and checking of all controls and safety devices in accordance with these instructions does not correct the difficulty, the maintainer should be notified at once. Engineman should not attempt to make any adjustments. If trouble develops in any one of the traction motors notify maintainer at once.

Office of Gen'l. Supt. Equipment
NEW YORK CENTRAL RAILROAD CO.
Oct., 1949

ELECTRO-MOTIVE CLASS DEs-13 LOCOMOTIVES

ROAD NUMBERS 8700 TO 8704 INCL., 8715 TO 8739 INCL., 8750 TO 8773 INCL., 8774 TO 8789 INCL., 8790 TO 8855 INCL.

DRAINING COOLING SYSTEM

If engine cannot be started and there is danger of freezing cooling system, drain all water.

1. Open cab heater valves (if closed).
2. Open "G" overflow valve.
3. Open main drain valve near flywheel fireman's side of engine at floor level.
4. Open by-pass valve near load regulator fireman's side of engine at floor level.
5. Remove plug from bottom of right water pump (Enginemen's side of engine).
6. On locomotives equipped with Immersion heaters drain heater pump.

Proper quantity of cooling water inhibitor must be added to the cooling system when refilled.

Office of Gen'l. Supt. Equipment
NEW YORK CENTRAL RAILROAD CO.
Oct., 1949

OPERATION OF IMMERSION HEATERS USED IN STANDBY SERVICE ON LOCOMOTIVES SO EQUIPPED DURING LAYOVER PERIODS

When weather is likely to get cold enough to cause freezing during layover periods and locomotive is equipped with immersion heaters where electric outlets are available proceed as follows:

1. Shut down engine.
2. Plug power cable into receptacle on either side of locomotive. (Plug fits only one way so care must be used to see that it is entered into the receptacle properly.)
3. Pump pilot light should glow at once when switch at source of current is closed.
4. Press test switch to see that heater pilot light glows.
5. If equipment does not function as above—restart engine immediately and report condition to the supervisor in charge before leaving locomotive.

Oct., 1949

THE NEW YORK CENTRAL SYSTEM

INSTRUCTIONS FOR OPERATING REMOTE CONTROL EQUIPMENT FOR VAPOR-CLARKSON DRK-4516—1600 LB., OK-4625—2500 LB. AND DRK-4530—3000 LB. TYPE STEAM GENERATING UNITS ON DIESEL ELECTRIC ROAD LOCOMOTIVES.

Office of Gen'l. Supt. Equipment
New York, N. Y.
January 8, 1947.
Revised May, 1950

DRK-4516, OK-4625 AND DRK-4530 TYPE

VAPOR CLARKSON STEAM GENERATING UNITS

SECTION I

GENERAL DESCRIPTION

Steam generating units of the "DRK" and "OK" series are of the forced circulation, coiled water tube type. They are oil fired and have electric ignition. The heat absorption portion with most "DRK" type generators consists of three compactly wound coils of steel tubing, connected in series to form a single tube several hundred feet in length set within a fire box or furnace compartment. The "OK" type, and some "DRK" type, have, in addition to the above 3 coils, an economizer coil, located outside of the coil refractory in the path of the exhaust gases. The economizer coil is in series with the other coils and forms a part of the single tube.

Water is forced into the outer (or, economizer) coil of this tube by a feed pump. Oil is supplied to the burner by a fuel pump, while air for combustion is delivered to the combustion chamber by a blower. The hot combustion gases pass through the coil layers before flowing to the stack. The water in its passage through the coils is heated and converted into steam. The steam flows from the coils into an external steam separator and from it to the steam train line. After filling the coils with cold water, steam is generated to full operating pressure in one or two minutes after fire is lighted.

During operation, a slight excess of water is circulated through the coils to flush out scale-forming material. The water and sludge are removed from the steam in the separator and fall to a sump in the bottom of that vessel. The sludge is blown out periodically through a blow-down valve. The excess water is returned to the water supply tank through a coil type heat exchanger. In flowing through the coil, the hot water preheats the feed water which flows through the casing of the heat exchanger.

CAPACITY AND PRESSURE

The rated capacity of the 4516 type steam generator is 1600 lbs. of water evaporation per hour from 60° feed water to steam at 300 p. s. i.; that of the 4625 type—2750 lbs.; that of the 4530 type—3000 lbs. The 4516 and 4530 type are capable of delivering 20% above rated capacity; the 4625 type can deliver 10% above rated capacity.

STEAM OUTPUT AND TRAIN LINE PRESSURE CONTROL

The steam output of the generator is automatically controlled, in accordance with demand, by a water by-pass regulator which by-passes a varying amount of the water being delivered to the coils.

The steam generator pressure (boiler pressure) and train line pressure are also controlled by the automatic water by-pass regulating valve which may be set to any desired pressure between 50 and 250 p.s.i. The length of train and the weather conditions determine what the setting should be.

BURNER

The burner which burns Diesel Fuel oil, consists of a fuel spray head which is equipped with a spray nozzle of the air atomizing type. Air for atomizing, or breaking up the fuel into a fine spray, is supplied by the air brake compressor on the locomotive. This spray is ignited by the spark plugs as it issues from the nozzle. Should the air pressure be too low for proper atomization, a valve within the spray head, "DRK" type generator, will close to prevent the discharge of fuel oil into the combustion chamber. With the "OK" type generator, low air pressure will allow spring tension to open the air switch contacts, de-energizing the fuel solenoid valve and preventing the discharge of fuel oil into the combustion chamber. The amount of fuel delivered to the burner is regulated by the servo-fuel control in proportion to the quantity of water entering the steam generating coils. To control the air for combustion, the servo-fuel control is linked to a damper in the air intake stack.

MOTOR CONVERTER

The motor which drives the water pump, fuel pump and blower is a combination motor-converter which furnishes alternating current to a transformer for electric ignition.

MAIN SWITCH

The main switch for starting the equipment is located on a wall near the steam generating unit.

CONTROL SWITCH

The motor will not start unless the control switch, is in either the "Fill" or "Run" position.

On "DRK" type generators, with the switch in the "Fill" position, water will be pumped into the steam generator, the fuel cut-off valve is shut and the burner will not light. Turning the switch to "Run" opens the fuel cut-off valve and the burner starts at once.

On "OK" type generators, with the switch in the "Fill" position, water will be pumped into the steam generator, the fuel solenoid valve is de-energized and the burner will not light. Turning the switch to "Run" energizes the fuel solenoid valve and burner starts at once.

STEAM GENERATOR CONTROL PANEL

The control panel contains the relays and resistors required for starting and accelerating the motor. It also contains a re-settable overload switch to protect the motor.

STEAM SEPARATOR

The excess water removed from the steam in this vessel drains to the bottom of the separator and, as the level rises above the return water outlet pipe, this water is forced out through the return water outlet valve and through a steam trap.

PROTECTIVE DEVICES

To protect the steam generator against possible damage, a number of safety devices are provided. These

devices will either shut down the burner or the motor. They are as follows:

STACK SWITCH

This device is operated by a temperature-sensitive helix inserted into the side of the stack. Should the steam generating coils become scaled or sooted up externally, the heat transfer through the coils to the feed water will be reduced and the stack temperature will rise. If this temperature exceeds 900° F., the stack switch will open and shut down the motor. Shut down due to the operation of this device will be evident by the tripping out of its reset button. The alarm bell will ring.

Also located in the stack switch is a low temperature set of contacts. These are open when the stack is cool and will close as the stack temperature reaches approximately 250° F. The low temperature contacts do not cause the reset button to trip.

OUTFIRE RELAY

This is a time delay device. Since the stack switch low temperature contacts are open at temperatures below 250° F., it is necessary to provide a means of temporarily by-passing this device in order to start the motor when the stack is cold.

When the main switch is on and the control switch is in the "OFF" or "FILL" position, the outfire relay is closed. In the "RUN" position of the control switch, the outfire relay is de-energized, however the time delay feature requires 45 seconds before the relay opens. After this time, if the stack switch low temperature contacts have not closed, the motor will be stopped and the alarm bell will ring.

NOTE: It is necessary to return the control switch to "OFF" position to reset the outfire relay and obtain another 45 seconds time interval.

FUEL CONTROL (Also Low Water Cut-off)

This control meters the fuel to the burner in proper relation to the water entering the coils. It also adjusts

the air damper for good combustion throughout the entire range of output. Both functions are accomplished by adjustable cams.

If an insufficient amount of water is flowing to the steam generating coils, the servo-fuel control will open the low water cut-off switch to de-energize the air solenoid valve. Lack of atomizing air will cause the burner to shut down. The stack temperature will then begin to drop and as it falls below 250° F., the low temperature stack switch will stop the motor and ring the alarm. The stack switch reset button does not appear.

STEAM TEMPERATURE LIMIT CONTROL

This control consists of a rod and tube thermostat set within the combustion chamber which operates a fuel metering valve. The tube of the thermostat is also the steam outlet pipe from the coils. Excessive steam temperatures (above 410-425° F.), or absence of steam, causes the tube to expand and meter the fuel preventing damage to the coils from overheating. This control does not cause the motor to shut down and does not require manual re-setting.

OTHER SAFETY DEVICES

Other safeguards provided in addition to those mentioned before are as follows:

(1) Two safety valves mounted on the steam separator. These valves are usually set to relieve at 295 and 300 lbs. pressure

(2) Two fuses in the control circuit and two fuses in the ignition circuit, located on the control panel.

(3.) A water relief valve to protect against excessive water pressure should the coils become clogged with scale or the line become obstructed. It is set to open at between 500 and 600 lbs. pressure.

REMOTE CONTROLS

Some installations are provided with remote control equipment to allow for blowing down of the steam sep-

arator and for shutting off the steam to the train line from the locomotive cab. Such equipment includes a remote control cabinet located in the cab in front of the fireman's seat, an electro-pneumatic control cabinet and an electrically operated automatic train line shut-off valve, as well as the required air cylinder on the separator blowdown valve. On multiple steam generator installations, there is one electro-pneumatic cabinet and one automatic train line shut-off valve for each generator. One remote control panel, however, will control all of the steam generators.

ELECTRO-PNEUMATIC CONTROL CABINET

The electro-pneumatic control cabinet is located near the steam generator and contains an electrically operated air valve. This valve admits air to the air cylinder on the separator blowdown valve to open it when the separator blowdown button is pressed on the remote control panel.

TRAIN LINE SHUT-OFF VALVE

When the train line shut-off button on the remote control panel is pressed, the train line shut-off valve is electrically tripped to close. By going back to the steam generator and depressing a latching lever on the train line shut-off valve to open it, steam can be again admitted to the train line.

SECTION II

DIRECTIONS FOR OPERATING

BEFORE STARTING

1. Check to see that the following valves are open: Water Suction Stop Valve, Coil Shut-off Valve, Water Inlet Valve to Water By-Pass Regulator, Steam Generator Stop Valve. Return Water Outlet Valve at Steam Separator, Water Return Valve in line to tank, and Atomizing Air Admission Valve. Also, pet cocks in steam lines to Water By-Pass Regulator and to Steam Gauge.
2. The following valves should be closed: Washout Solution Admission Valve, Washout Solution Return Valve, Manual Water By-Pass Valve, Coil Blowdown Valve, Water Pump Test Valve, and all drain valves in the line between the water tank and the water pump. Type "OK" generators, only—layover connection shut-off valve and steam admission valve to radiation (open in cold weather.)
3. See that reset button on Control Panel is "in".
4. See that Stack Switch reset button is "in".

STARTING STEAM GENERATOR

1. Open Separator Blowdown Valve (foot operated) for about one minute to drain Steam Separator; then reclose valve.
2. Open Fill-Test Valve at Separator.
3. Close Main Switch.
4. Turn Control Switch to "Fill" position. (Motor will start and fill the steam generator with water.)
5. As soon as water discharges from the Fill-Test Valve, turn control switch to "off" position, close the "Fill-Test" valve, wait a few seconds until the motor stops, then turn the control switch to "Run". Burner should start at once.
6. Depress latching lever on Train Line Shut-Off Valve, to open the valve to admit steam to the train line, and open manual train line valve.

7. Set Water By-Pass Regulator to required steam train line pressure. Where two or more steam generators are used on a locomotive and their running is required by the weather conditions, the Water By-Pass Regulators on all steam generators should be set approximately the same.
8. Open the foot-operated Separator Blowdown Valve two or three times, for three to five second intervals, to drain Separator during the first few minutes of operation.

NOTES:

1. It may take 5 to 10 minutes time to fill the steam generator with water, if entirely empty. DO NOT START STEAM GENERATOR UNLESS THE COILS HAVE BEEN FILLED WITH WATER.
2. It may take several minutes time to build up required steam train line pressure.
3. Check the return water flow. On 4530 and 4625 generators the indicator should cycle 10 to 12 times per minute at high fire and 3 to 4 times per minute low fire with generator up to operating temperature. 4516 generators should cycle 6 to 8 times "high fire" and 2 to 3 times per minute "low fire".

Check to Be Made By the Operator

After Starting Steam Generator

1. Check the atomizing air pressure as indicated on gauge. This pressure should be:

   About 60-80 lbs. on the DRK-4530 types of Units

   About 30-35 lbs. on the DRK-4516 types of Units

   About 70 lbs. on the OK-4625 types of Units

Check Fuel Pressure

Manifold Pressure	Type of Unit
145-160 lbs.	DRK-4516
145-160 lbs.	DRK-4530
145-160 lbs.	OK-4625

If Motor or Fire Fails to Start

If fire fails to start within 10 seconds, look through peep sight glass at top of steam generator to see if there is sparking at the spark plug electrodes. Also, check the water pressure and the fuel pressure.

(a) If motor fails to start, check to see that the Main Switch is closed and motor overload reset button is in.

(b) If motor is operating and there is no sparking at the plugs, turn Control Switch at once to "Off" position and check for chafed or broken ignition cable or loose or broken cable connections.

(c) If motor is operating and spark plugs are functioning, check the water pressure. If no pressure shows on gauge, or the pressure is too low, check to see that Water Suction Stop Valve is open. The Coil Blowdown Valve or one of the drain valves may be open. There may be no air pressure to the Spray Head Nozzle, or the air pressure may be too low.

OPERATING STEAM GENERATORS

WITH REMOTE CONTROL

NOTE: After the steam generator(s) has (have) been started and the steam pressure on each generator, and train line pressure has been properly set, the following operations can be performed from the locomotive cab, when Remote Control equipment is installed:

1. Turn the Master Switch on the Remote Control Panel to "On" position.
2. Adjust the Rheostat on the right-hand side of the Remote Control Panel to give desired illumination for the steam train line pressure gauge.
3. About every half hour, depress the Separator Blowdown Push Button and hold it "in" for 3 to 5 seconds.

4. If the admission of steam to the train line is to be shut off for the purpose of cutting a car out of the train, lift the protecting cap over the Train line- Shut-off Button and press the button and close train line globe valve.
5. After the admission of steam to the train line has been shut off by remote control, it will be necessary to open each Train Line Shut-off Valve manually (at the steam generator) by depressing the latching lever, when ready to get steam back into train line. Globe valve must be opened slowly to full open position.

RUNNING ATTENTION WHEN NO REMOTE CONTROL EQUIPMENT IS INSTALLED

1. Open the Separator Blowdown Valve half hourly from 3 to 5 seconds to blow down Separator.
2. Check the various gauges to assure yourself generator is running satisfactorily.

TO SHUT DOWN STEAM GENERATOR WITH REMOTE CONTROL

1. Depress Train Line Shut-off Button on Remote Control Panel.
2. Turn Master Switch on Remote Control to "Off" position.
3. When train stops, go back to each steam generator and shut it down in the following manner:
   (a) Turn Control Switch to "Off" position.
   (b) Open Coil Blowdown Valve. Observe boiler pressure; when it falls to 50 lbs. close the valve.
   (c) Open Separator Blowdown Valve to blow down Steam Separator with remaining pressure; then, reclose valve.

Revised May, 1950

(d) Refill the steam generator with water by turning the Control Switch to "Fill" position and open the Fill-Test Valve on the Separator. When water begins to discharge from the valve, close it and turn Control Switch to "off" position.

(e) Open Main Switch. Close atomizing air valve.

NOTE: The steam generator is now filled and ready for use. When restarting, do not omit draining Separator, opening Fill-Test Valve and again filling the steam generator with water, as this may not have been done by someone when shutting down. When coils are already filled with water it will only take about one minute for this to be indicated by discharge of water from the Fill-Test Valve.

INSTRUCTIONS FOR DRAINING VAPOR DRK-4516, DRK-4530 AND OK-4625 TYPE STEAM GENERATORS FOR PROTECTION AGAINST FREEZING.

1—When possible, raise steam pressure on steam generators letting it cycle several times. Set train line pressure at 100 lbs. and open remote control and manual steam train line valves with steam end valves closed. Close steam train line valves after pressure in train line reaches 100 lbs. and open both end valves. Open coil blowdown valve until generator pressure reaches 75 lbs., close it and open separator blowdown valve.

2—It will be necessary to proceed with work outlined as follows whether the above can be done or not.

3—Open water supply line floor drain valves at "A" and "B" unit steam generators, (this valve will be applied to "OK" generators.) Also water return line floor drain valve at "B" unit steam generator small water tank. Open water supply line valve and open plug drain valve at large water tank in "B" unit.

4—Close water suction stop valve and open wide the drain valve in line from bottom of water treatment

tank. (This valve will be applied to "OK" generators).

5—Open water pump test valve wide.

6—Open wide water pump, test valve, the three bleeder test plugs and remove drain plug in bottom of water pump. Work water out of pump by turning it over by hand in clockwise direction.

7—Remove cover from water treatment tank, lift out treatment chamber and strainer screen and empty water from both.

8—Close stop valve on top of separator.

9—Coil admission valve to be wide open.

10—Separator blowdown valve to be closed.

11—Close water return line valve ahead of steam trap at separator.

12—Open coil blowdown valve wide.

13—Connect air hose to water fill test valve at separator and blow what water remains in steam generator coils (with exception of economizer coil, "OK" and some "DRK" generators, only) and piping out of oil blowdown valve. Then close water fill test.

14—Open water return line valve at separator.

15—With air hose connected to water fill test valve blow air through the strainer, trap, coils in heat exchanger and then out through drain line valve.

16—Break pipe connection at right of water by-pass regulator and connect air hose to blow through the fuel control, heat exchanger chamber (and economizer coil, "OK" and some "DRK" generators, only) and piping out of coil blowdown valve. Close coil blowdown valve.

17—Remove plug in strainer at separator and reapply.

18—Break connection at left side of water by-pass regulating valve and with pump test valve open, blow air through piping.

19—Open separator blowdown valve.

20—Break water return line from heat exchanger.

21—Break water inlet and outlet connectings to servo-fuel control body and blow out with air.

22—Remove drain plugs in bottom of heat exchanger and steam trap.

23—Break steam and water lines to all steam gauges, water pressure gauge and to water by-pass regulating valve and blow out with air. Soak up with a cloth what water remains on top of steam actuated diaphragm of water by-pass regulator.

24—Break connection on bottom of water by-pass regulating valve and blow with air.

25—Break water hose connection between "A" and "B" units and blow out with air.

26—Break steam connections between "A" and "B" units, let drain and reconnect.

27—Open drain valve in steam line to cab heaters.

28—After all the draining has been completed, all valves are to be left open except the following:

a—Steam generator water suction stop valve.

b—Steam generator stop valve in top of separator.

c—Manual steam train line shut-off valve.

d—Steam train line end valves.

e—Water supply line floor drain valves at "A" and "B" unit steam generators.

f—Water return line floor drain at "B" unit steam generator 200 gal. tank.

SECTION III

TROUBLE SHOOTING WITHIN THE SCOPE OF THE OPERATOR

ALARM AND WARNING SIGNAL

LIGHT INDICATIONS

In event of steam generator shut down an alarm bell will ring, and the "Boiler 'Off'" Warning Signal Light

will flash "on", on the warning light panel of the unit involved.

To stop the alarm, turn the Control Swith to "OFF" on the steam generator involved. Then, investigate the cause of the difficulty, and remedy as indicated below.

NOTE: It is to be understood that strainers and other parts indicated as possibly clogged are to be removed, taken apart and cleaned.

Steam Generator Is Shut Down

Symptoms, Cause and Remedy

1. RESET BUTTON "OUT" ON STACK SWITCH: Shut down is due to excessive stack temperature brought about by the burning of excessive fuel because of improper adjustment of the Fuel Pressure Regulator or to other causes the remedy for which is not within the scope of the operator. To overcome difficulty, proceed as follows:

   (a) Open Separator Blowdown Valve to drain Separator, and reclose valve.

   (b) Reset stack Switch Button.

   (c) Turn Control Switch to "Fill" position, close Main Switch and refill the steam generator with water as indicated under "Starting Steam Generator" on page 5. This will cause the blower to cool down the stack.

   (d) Turn Control Switch to "Run" position, to restart the burner.

2. RESET BUTTON "OUT" ON STEAM GENERATOR CONTROL PANEL: Shut down is due to motor overload. Proceed as follows:

   (a) Turn control switch to "OFF" position. Check for cause of overload by turning pump by hand to see that it is not locked.

   (b) Press motor overload reset button to reset switch. Start steam generator in usual manner.

3. If both reset buttons are in, reset main switch, or breaker. Start steam generator in usual manner.

   (a) **If motor and Burner Will not Restart:** (Circuit breaker may have tripped, if so lever will be in center position, move lever to full "off" position and then to the "on" position to reset. In those units using fuses instead of circuit breakers, main fuse(s) may be blown. Fuse† may be blown in circuits to motor. If not, check relay contacts.

   (b) **If Motor Restarts but Burner Does Not and No Spark Shows Through Peep Sight Glass at Burner Spray Head:**
      (1) Check fuses† on Control Panel in the Converter circuit to the Ignition Transformer.
      (2) Check for loose or broken ignition cable connections.

   (c) **If Motor Restarts but Burner Does Not and Spark Shows Through Peep Sight Glass:**
      (1) Check atomizing air pressure; if less than * lbs., strainer may be clogged at Air Pressure Reducing Valve.
      (2) If atomizing air pressure is satisfactory, air or fuel strainer at Burner Spray Head may be clogged and should be cleaned. The spray nozzle may be clogged; take out spray head, remove nozzle and clean it. Use a toothpick or a wooden splint to clean nozzle discharge orifices. Do NOT use a metal pick.
      (3) If water pressure does not show on gauge, or if the pressure is low, the shut down is due to operation of the Servo-Fuel Control because of lack of water brought about by: lack of water in tanks, coil blowdown valve open, air leak in water suction line

* See Page 10 for pressure.

† A 15 ampere fuse is required in each of the four fuse locations.

(water treatment or strainer tank cover or suction line strainer tank cover loose, rubber breather hose loose in suction line, etc.), clogged strainer screen in water treatment tank or in line strainer tank.

(4) **Inoperative Water By-Pass Regulator:** Try closing the Water Inlet Valve to the Water By-Pass Regulator. If Burner starts at once: this is an indication that the Water By-Pass Regulator is inoperative. To set and manually regulate the steam train line pressure, open and operate the Manual Water By-Pass Valve.

(5) **If Burner does not Restart upon closing Water Inlet Valve to Water By-Pass Regulator:** If fuel pressure does not show on manifold pressure gauge while water pressure appears to be adquate: this is an indication that Purolator Oil Filter is clogged; turn handle on filter clockwise several times to free filter. If fuel pressure on nozzle pressure gauge is excessive while water pressure appears to be adequate: this is an indication of a clogged strainer or nozzle at Burner Fuel Spray Head. After determining cause of trouble and remedying it, **be sure to reopen Water Inlet Valve to Water By-Pass Regulator when restarting steam generator.**

Sharp Drop in Train Line Pressure

BURNER CYCLES "OFF" AND "ON"

This is an indication that burner is being shut down by the Steam Temperature Limit Control because of excessive steam temperature caused by insufficient water delivery and is also an indication that the Servo-Fuel Control may be out of adjustment. **Do not attempt to adjust the Fuel Control—this is a job for a qualified maintainer.**

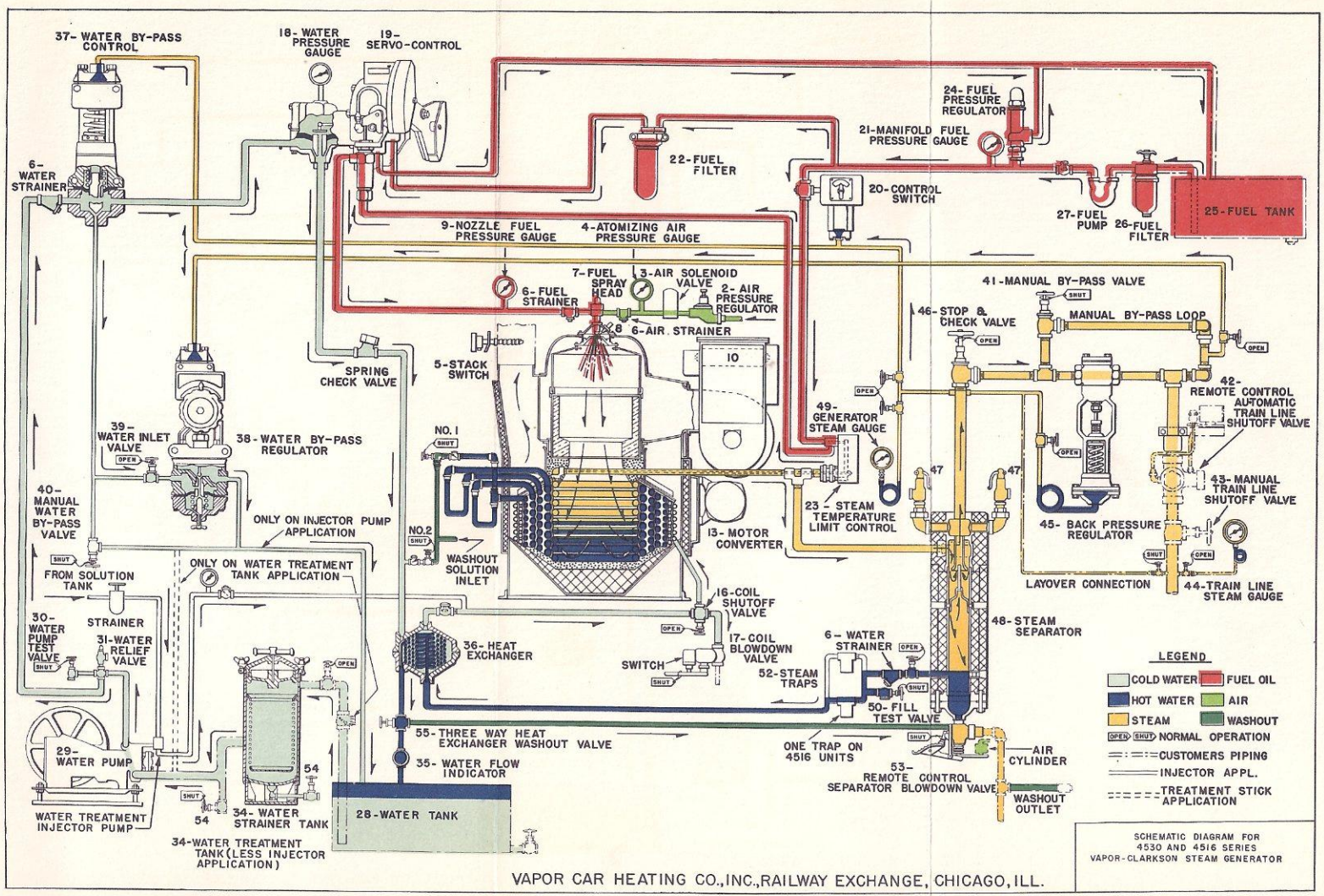
NOTES:

1. Report any difficulty encountered during service upon arrival at destination, and indicate what corrective measures have been taken, if any.

2. Type DRK and OK steam generators have controls so arranged to shut down motor and pump when steam is not required and burner goes out.

May, 1950

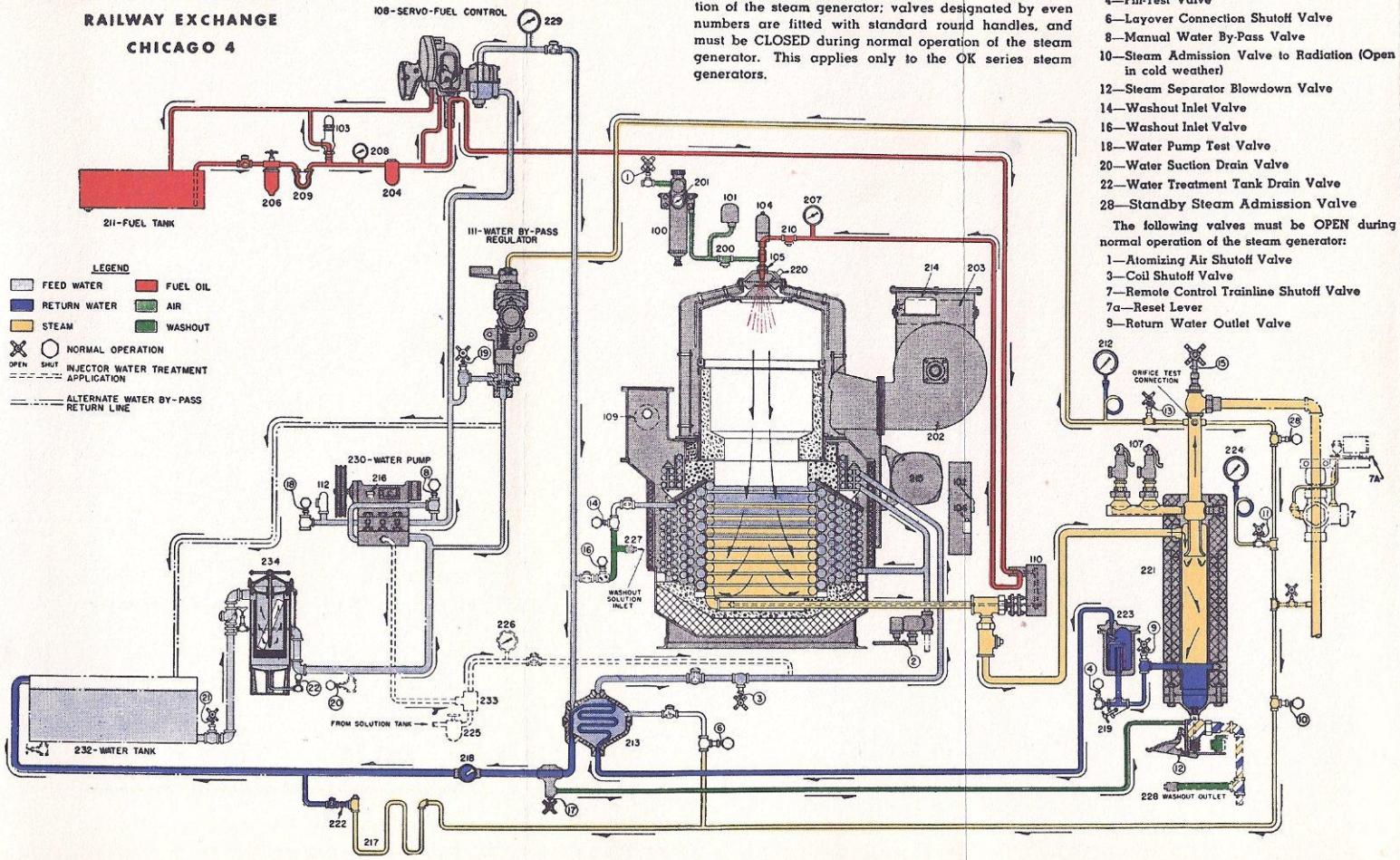
Printed in U. S. A.


37- WATER BY-PASS CONTROL
18- WATER PRESSURE GAUGE
19- SERVO-CONTROL
6- WATER STRAINER
22- FUEL FILTER
24- FUEL PRESSURE REGULATOR
21- MANIFOLD FUEL PRESSURE GAUGE
20- CONTROL SWITCH
27- FUEL PUMP
26- FUEL FILTER
25- FUEL TANK
9- NOZZLE FUEL PRESSURE GAUGE
4- ATOMIZING AIR PRESSURE GAUGE
7- FUEL SPRAY HEAD
3- AIR SOLENOID VALVE
2- AIR PRESSURE REGULATOR
6- FUEL STRAINER
8
6- AIR STRAINER
41- MANUAL BY-PASS VALVE
SHUT
46- STOP & CHECK VALVE
MANUAL BY-PASS LOOP
OPEN
5- STACK SWITCH
10
SPRING CHECK VALVE
42- REMOTE CONTROL AUTOMATIC TRAIN LINE SHUTOFF VALVE
49- GENERATOR STEAM GAUGE
39- WATER INLET VALVE
38- WATER BY-PASS REGULATOR
NO. 1
47
43- MANUAL TRAIN LINE SHUTOFF VALVE
40- MANUAL WATER BY-PASS VALVE
ONLY ON INJECTOR PUMP APPLICATION
NO. 2
23- STEAM TEMPERATURE LIMIT CONTROL
13- MOTOR CONVERTER
45- BACK PRESSURE REGULATOR
WASHOUT SOLUTION INLET
FROM SOLUTION TANK
ONLY ON WATER TREATMENT TANK APPLICATION
LAYOVER CONNECTION
44- TRAIN LINE STEAM GAUGE
16- COIL SHUTOFF VALVE
30- WATER PUMP TEST VALVE
STRAINER
31- WATER RELIEF VALVE
36- HEAT EXCHANGER
17- COIL BLOWDOWN VALVE
48- STEAM SEPARATOR
6- WATER STRAINER
SWITCH
52- STEAM TRAPS
50- FILL TEST VALVE
55- THREE WAY HEAT EXCHANGER WASHOUT VALVE
ONE TRAP ON 4516 UNITS
AIR CYLINDER
29- WATER PUMP
35- WATER FLOW INDICATOR
53- REMOTE CONTROL SEPARATOR BLOWDOWN VALVE
54
WASHOUT OUTLET
WATER TREATMENT INJECTOR PUMP
34- WATER STRAINER TANK
28- WATER TANK
34- WATER TREATMENT TANK (LESS INJECTOR APPLICATION)
LEGEND
COLD WATER
FUEL OIL
HOT WATER
AIR
STEAM
WASHOUT
OPEN SHUT NORMAL OPERATION
CUSTOMERS PIPING
INJECTOR APPL.
TREATMENT STICK APPLICATION
SCHEMATIC DIAGRAM FOR 4530 AND 4516 SERIES VAPOR-CLARKSON STEAM GENERATOR
VAPOR CAR HEATING CO., INC., RAILWAY EXCHANGE, CHICAGO, ILL.

Schematic Piping Diagram, OK-4625 Series Vapor-Clarkson Steam Generator.

VAPOR HEATING CORPORATION
RAILWAY EXCHANGE
CHICAGO 4

VALVES Valves designated by odd numbers are fitted with cross type handles, and must be OPEN during normal operation of the steam generator; valves designated by even numbers are fitted with standard round handles, and must be CLOSED during normal operation of the steam generator. This applies only to the OK series steam generators.



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 Drain Valve
22—Water Treatment Tank Drain Valve
28—Standby Steam Admission Valve

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

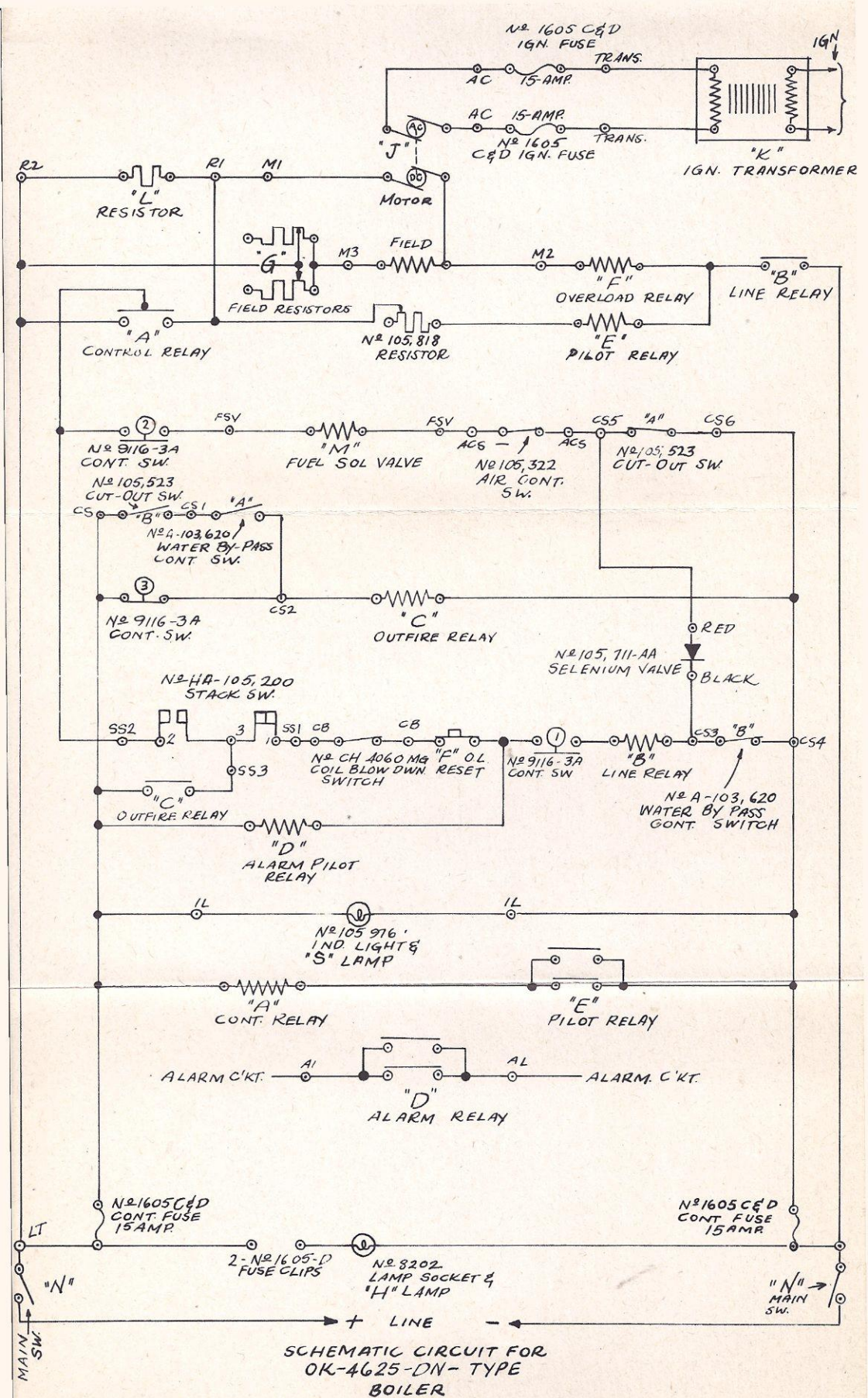
1—Atomizing Air Shutoff Valve
3—Coil Shutoff Valve
7—Remote Control Trainline Shutoff Valve
7a—Reset Lever
9—Return Water Outlet Valve
11—Steam Admission Valve to Trainline Pressure Gauge
13—Steam Admission Valve to Water By-Pass Regulator
15—Stop and Check Valve (Closed during start or shut down procedure)
17—Three-Way Washout Valve
19—Water By-Pass Regulator Shutoff Valve.
21—Water Supply Stop Valve

CONTROLS

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

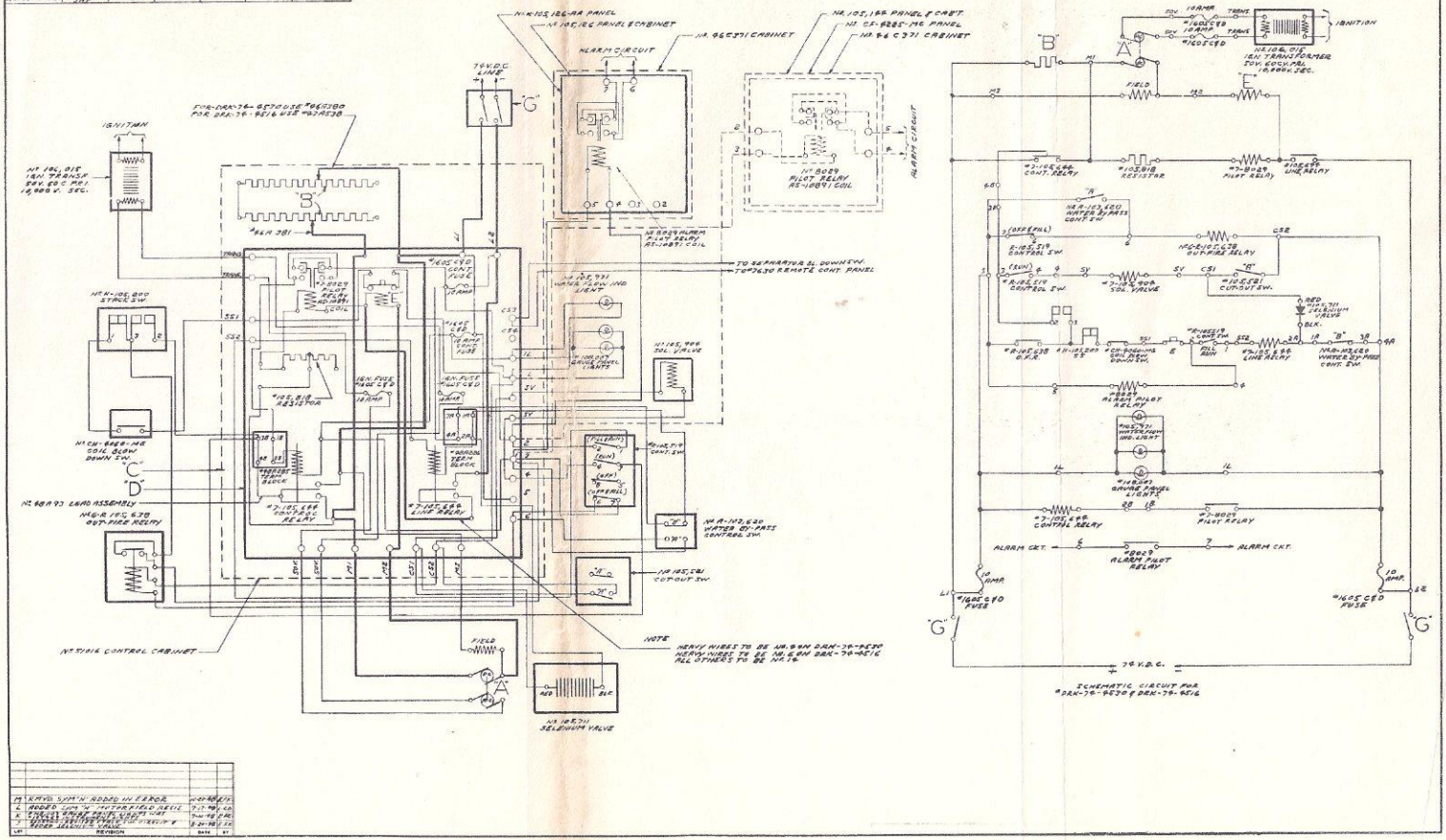
APPURTENANCES

200—Atomizing Air Strainer
201—Atomizing Air Pressure Gauge
202—Blower
203—Damper
204—Fuel Filter (Pressure 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 Filter Cap
217—Radiation
218—Return Water Flow Indicator
219—Return Water Strainer
220—Spark Plugs
221—Steam Separator
222—Orifice Nipple (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
232—Water Tank
233—Water Treatment Injector Pump
234—Water Treatment Tank
(Strainer tank only if injector system is used)



SCHEMATIC CIRCUIT FOR
OK-4625-DN- TYPE
BOILER

	F	D	C	O	E	G
BOILER	METER CONTROL	RESISTOR	CONTROL PANEL	MAGNETIC RELAY	MAIN SW.	
DRK-76-9330	7-105,828	7-105,810	7-105,1126	7-105,1126A	105,660	CB-9225-MA
DRK-76-9316	7-105,828	7-105,811	7-105,1126	7-105,1126A	105,681	CB-9220-MA


IGNITION
NO. 105,815 IGN. TRANSF. 60V. 60 CYC. PRI. 14,000 V. SEC.
NO. K-105,800 STACK SW.
NO. CW-8868-MA COIL BLOW DOWN SW.
NO. 9818 LEAD ASSEMBLY
NO. G-R 105,628 OUT-FIRED RELAY
NO. 9316 CONTROL CABINET
FOR DRK-76-9330 USE #7-105,830
FOR DRK-76-9316 USE #7-105,811
#105,810 RESISTOR
#7-105,828 CONT. RELAY
#7-105,828 LINE RELAY
#105,660 FUSE
#105,681 FUSE
IGN. FUSE 1/2 AMP
IGN. FUSE 1/2 AMP
#105,1126 RESISTOR
#7-105,1126 CONT. RELAY
#7-105,1126 LINE RELAY
NO. 105,1126 HEATER BLOCK
NO. 105,1126 HEATER BLOCK
NO. 105,1126 HEATER BLOCK

The New York Central System

INSTRUCTIONS FOR OPERATING ELESCO STEAM GENERATOR TYPE M-2

Office of Gen'l. Supt. Equipment
New York, N. Y.
Revised Oct. 3, 1949

SECTION I

GENERAL DESCRIPTION

The Elesco steam generator is especially designed for applications where steam must be available on short notice, where space and weight are limiting factors, and where particular operating requirements call for an equipment which is compact and sturdy. The unit is furnished complete with all auxiliaries and controls. Once started, the operation is entirely automatic.

The Elesco steam generator operates on the forced circulation principle and therefore is not dependent upon natural circulation. A small hot water circulating pump, close-coupled to an electric motor, forces the hot water contained in the system at steam temperature through the tubes of the generator. While the generator is in operation, the quantity of water circulated is constant, regardless of steam output. At maximum capacity, the quantity of water circulated is approximately ten times the amount of steam produced. The forced circulation principle assures proper cooling of the tubes and eliminates scale formation almost entirely.

By referring directly to the attached flow diagram on card 5L-70816, it will be seen that the generator consists of a radiant or combustion chamber section and a convection section. The heating surface of the radiant section consists of three elements forming the envelope of the combustion chamber. Each element is connected to the inlet and outlet headers. The convection section consists of five elements which are also connected to the inlet and outlet headers. Each of the eight elements is equipped with an orifice at the inlet end to insure equal distribution of the circulated water.

The electric motor which drives the hot water circulating pump also drives the oil pump and the blower.

The feed pump is of the reciprocating type and is steam-operated. The steam supply valve for the pump is actuated by a float located in the steam separator. A rise in water level reduces the regulating valve opening and

retards the speed of the feed pump and a reduction in water level effects the reverse.

The fuel oil which is forced to the mechanical atomizing nozzles of the burner is controlled by a regulating device actuated by steam pressure. When the steam pressure is low, oil flow will be maximum, and an increase in steam pressure above normal will result in a reduction of oil flow. Proper mixture of air and fuel oil is automatically maintained at all rates of firing, thus high combustion efficiency is assured at all load settings.

The control for the water and the control for the oil act independently of each other and thus do not have to be coordinated.

STEAM SUPPLY TO TRAINLINE

The steam supply to the trainline is controlled by a reducing valve which can be adjusted to give the desired trainline pressure. A solenoid trip valve and an under-pressure valve are located in the reducing valve pressure control line to open or close the reducing valve.

The solenoid trip valve must be manually latched open to permit the reducing valve to open. It can be tripped by remote control from the cab, thereby, closing the reducing valve and shutting off the steam supply to the trainline.

SAFETY DEVICES

All controls are automatic and in addition to two safety valves, the following safety devices are provided.

(a) High-Pressure Limit Switch
(b) Differential Pressure Switch (Low Water Safety Switch)
(c) Photo-Electric Combustion Control Switch
(d) Under-Pressure Valve

(a) The high-pressure limit switch cuts off the fuel supply should the normal operating steam pressure be exceeded.

(b) The differential pressure switch, also called the low water safety switch, cuts off the fuel oil supply in the event the water in the steam separator falls below a safe limit for operation.

(c) The photo-electric combustion control switch cuts off the fuel oil supply in the event of flame failure.

(d) The under-pressure valve prevents the steam generator pressure from falling below 200 PSI by reducing the flow of steam through the reducing valve, in case of an overload or in case of a broken trainline.

SECTION II
FORCED CIRCULATION SYSTEM

1. Forced Circulation Flow Circuit

The hot water circulating pump (26) which is close-coupled to the motor takes water at steam temperature from the steam separator (27) and forces it through strainer and check valve into the inlet header (28) whence it is distributed to the three radiant or combustion chamber elements (29) and to the five convection section elements (30). An orifice is located at the entrance to each element. These orifices are made of stainless steel and if inspection should be necessary, they may be removed with a wrench made especially for this purpose.

The outlet of each element enters a common header (31) which empties into the steam separator (27).

2. Hot Water Circulating Pump

The hot water circulating pump (26) is a single suction centrifugal pump close-coupled to the electric motor. The long end of the motor shaft is protected by a hardened removable sleeve. The impeller is a machined casting, keyed to the shaft and fastened by a left hand thread acorn nut.

The wearing rings are removable. The stuffing box has a water-cooled jacket through which cool water from the feed pump is constantly passed. It is important that the stuffiing box gland be tightened only enough to permit a slight water drip.

3. Circulating Pump Discharge Line Strainer

A Y-Type strainer having a stainless steel screen is located in the pump discharge line to prevent any large particles from obstructing the water distribution orifices. A removable cap is provided for removal of large particles. Smaller particles collected on the bottom of the strainer can pass into the line (32) leading to the sludge settling chamber from where they may be blown out through the manual blow-down valve.

4. Steam Separator

The steam separator (27) is an unfired pressure vessel serving as a steam separator, water storage space, and as a sludge settling chamber. The latter is partitioned off from the steam separator chamber and water storage space. The vessel is equipped with two safety valves, an air vent cock, water gauge, blow-down valve, and a feed water regulator.

Water and steam from the heating coils enter at (33) and most of the water is separated out by baffles located in the upper part of the steam separator. The steam passes up and out through the steam discharge on top of the separator. The water passes to the circulating pump suction.

The lower part of the steam separator is a sludge settling chamber (34). A portion of the water, carrying small particles and suspended solids from the circulating pump discharge strainer enters the chamber at (32). The water leaves the chamber through pipe line (35) and passes through a choke into the feedwater connection to the boiler. Due to the low velocity of flow through the sludge chamber, a large part of the solids will settle out. The settled material may then be blown out through manual blown-down valve through the remote control blow-down valve, or through the automatic blow-down system.

5. Automatic Blow-Down

The automatic blow-down (36) is designed to blow down a certain amount of water containing solids. It is recommended that the water to be blown should equal from 3 to 4 per cent of the steam output (for example: at 3000 lb. per hr. evaporation, the blow-down should be 90 to 120 lb. per hr.).

The automatic blow-down (36) consists of a small heat exchanger (37) by which the hot blow-down water is cooled by feed water on its way to the steam generator. The cooled blow-down water enters the thermostatically controlled automatic blow-down valve (36) which will pass only water that has been cooled to the temperature at which the trap has been set to operate.

SECTION III

FEEDWATER SYSTEM

FEEDWATER FLOW CIRCUIT

The feedwater pump (10) takes water from the supply tank through water treatment tank and strainer. The water to the boiler is discharged from the pump thru the automatic blow-down heat exchanger (37) and feedwater pump discharge line check valve and mixes with hot water from the sludge settling chamber before entering the outlet header (31). The feedwater, mixing with the steam and hot water in the outlet header is immediately raised to steam temperature. The oxygen liberated from the feedwater by this deaeration passes out the top of the steam separator together with the steam. A portion of the water from the feedwater pump passes through the hot water circulating pump stuffing box cooling jacket (37) thence thru heat exchanger (38) to strainer (39), exhaust steam heat exchanger (40), and back to the supply tank.

1. FEEDWATER PUMP

The feedwater pump (10) is of the conventional duplex type. To put water into a cold steam generator the pump is run with air by opening air valve (9) and closing steam valve (23). After sufficient water has been added, valve (9) must be closed and valve (23) opened. When the system is under steam pressure, the pump will run on steam. The water level is automatically held constant by water regulator attached to the steam separator.

2. WATER REGULATOR

The function of the water regulator is to maintain a constant water level in the steam separator. This is accomplished by means of a float which actuates a plunger valve. The position of the valve controls the flow of steam to the steam driven reciprocating feed pump (10). The water level can be adjusted by a spring. By turning

adjusting stem to the right the water level will decrease, while it will increase if the stem is turned to the left. Once this stem has been properly set it should be locked in position.

The valve requires little maintenance. If the valve is suspected of sticking, this may be checked without removing the valve from the steam separator. With no pressure and low water in the generator, the float should be down and the counterweight up. By removing pipe plugs from the regulator chamber and pushing down on the counterweight with a rod the float should rise, and it should fall as the force against the counterweight is released.

3. HEAT EXCHANGER

The heat exchanger (40) is of the jet condenser type. Water from the circulating pump gland cooling jacket passes through an orifice and venturi, thus entraining and condensing steam from the feedwater pump exhaust. The condensed steam and heated water then returns to the water supply tank.

When the condition exists that there is more exhaust steam than the feedwater heater is capable of condensing, the excess steam will be discharged to atmosphere through vent pipe (41).

SECTION IV

1. FUEL OIL FLOW CIRCUIT

Fuel oil from the supply tank passes through a suction line strainer and sight glass to the fuel oil pump (42). Fuel oil under pressure passes through pressure oil filter to fuel oil relief valve. Since the fuel oil pump is a constant volume pump, the oil not used by the burners flows through a by-pass to the supply tank. Oil to all burner nozzles passes through main oil solenoid valve (43) and thence to small burner solenoid valve (44), and to large burner solenoid valve (45). Oil flow to the large burners is regulated by oil regulating valve (46), the opening of which is controlled by steam pressure acting on the bellows.

An oil pressure connection is taken to the spring-loaded air damper control cylinder (47). Thus a higher oil pressure to the large burners causes the piston to move and open the air inlet damper allowing more air to mix with the larger quantity of oil being burned, thus maintaining a constant air to fuel ratio for complete combustion and high thermal efficiency.

2. BURNER

The oil burner head (48) is of the mechanical atomizing type having a small burner nozzle and two large burner nozzles. The small burner nozzle is used for starting up and for carrying light loads (up to 600 lb. steam per hr.) and is ignited by a spark from ignition electrodes. The large burner nozzles are operated under varying oil pressure according to the steam demand.

The oil burner wind box has an opening (49) to permit the addition of powdered soot remover compound. Opening the air gates of soot remover tank permits air to sweep over and pick up the compound which then enters the combustion chamber to mix with the hot gases and chemically remove the soot from all the heating coils.

3. FUEL OIL PUMP SUCTION LINE STRAINER

This strainer consists of a large number of close-spaced brass washers, between which the oil must flow. When the handle on the filter is turned, a blade between each washer rotates and wipes the openings clean. A plug at the bottom is for removal of the collected impurities.

4. PRESSURE OIL FILTER

This filter is of the cloth bag filter element type. Its purpose is to remove the smaller particles that pass through the filter in the fuel oil suction line. The cloth filter bags are removable for cleaning or replacement.

5. OIL SOLENOID VALVES

The three fuel oil solenoid valves (43, 44 and 45) are of the impact type and the solenoid coil must be energized to open the valve. Energizing the coil causes a plunger to move up quickly, and its momentum due to the electro-magnetic pull lifts the valve with a positive action.

6. FUEL OIL RELIEF VALVE

This valve maintains a constant fuel oil pump discharge pressure of approximately 250 psi. It has a spring-loaded piston, the load on which may be adjusted by screwing the top cap up or down. The fuel oil not required by the burners passes through a port and returns to the supply tank.

7. OIL REGULATING VALVE

This valve (46) regulates the flow of fuel oil to the large burner nozzles to maintain a constant steam pressure. Steam pressure on the bellows acts against a spring to close the valve when the steam pressure is high, and the spring opens the valve when the steam pressure is low. The valve stem packing is of the O-ring type which means low friction and little maintenance.

8. FUEL OIL PUMP

The fuel oil pump (42) is of the gear type and is V-belt driven from the blower shaft. It is important that the by-pass fuel oil line be open at all times to prevent damage to the pump due to excessive oil pressures. In case the pump should be in need of any repairs it should be returned to the factory.

9. FUEL OIL SUCTION LINE CHECK VALVE

A check valve (51) in the fuel oil suction line prevents fuel oil from draining back from the pump to the supply tank when the steam generator is shut off, and thereby avoids the difficulty that might otherwise be experienced in priming the pump when starting the steam generator.

10. FUEL OIL SIGHT GLASS

The sole purpose of a sight glass in the fuel oil suction line is to give a visible means of determining whether or not fuel oil is flowing.

11. BLOWER

The forced draft blower (50) is V-belt driven and runs at a constant speed of approximately 2700 rpm. The blower wheel is of all steel construction and is dynamically balanced. The blower shaft runs on grease-lubricated ball bearings which require infrequent attention.

SECTION V
OPERATING INSTRUCTIONS

The Elesco Type M-2 steam generator is designed for a maximum operating steam pressure of 325 lbs. and a rated steam output of 3,000 lbs. per hour plus 20%. The controls and safety devices incorporated insure full automatic operation after starting, and are set to maintain an operating steam pressure ranging from 260 to 290 lbs. The fuel metering controls are actuated by boiler pressure and at high steam outputs the boiler pressure will be closer to 290 lbs. and at light loads the pressure will approach 260 lbs.

Two safety valves are provided, one being set for 325 lbs. and the other for 335 lbs., thus with the automatic controls working properly the safety valves should not come into play.

In starting the steam generator and while opening the steam line to the train heating system, the instructions given below should be followed. The operating procedure is simple and is such that the operator does not necessarily require an understanding of the working principle of the steam generator, yet, as is true with any mechanical device, a general knowledge of the working principle is desirable.

ELESCO STEAM GENERATOR TYPE M-2
TROUBLE SHOOTING

NORMAL	*TROUBLE*	*ACTION*
I. When Main Switch is Closed.		
A. Pressure gage lamp, water gage lamp, and Electric Eye indicating lamp light.	If one of these lamps does not light.	Check for burned out lamp.
	If none of these lamps light.	Check for blown main line 150 amp. fuses or tripped line circuit breaker if used. Check for blown fuses in motor control cabinet.
B. Alarm bell should not ring.	If alarm bell rings.	Push "Stop" button in. Check Control Switch—it should be in "Starting" position.
II. After pushing "Start" button with Control Switch in "Starting" position.		
A. Motor starts and comes up to speed, driving circulating pump, fuel oil pump, and blower fan wheel.	If motor does not start.	Check "Reset" of motor overload relay in motor control cabinet. Reset if necessary by pushing reset button down. Check main

(Cont. following page)

NORMAL	TROUBLE	ACTION
II. After pushing "Start" button with Control Switch in "Starting" position. (Cont.)		line fuses (or if circuit breaker is used, reset it if found tripped). Check for blown fuses in motor control cabinet.
B. "Start" indicating lamp lights.	If "Start" indicating lamp does not light and motor is running.	Check for burned out lamp.
C. Alarm Bell should not ring.	If alarm bell rings.	Check Control Switch. It should be in "Starting" position.
III. Steam Generator Motor Running.		
A. Pressure gage, white hand, circulating pump pressure should be 30 to 40 lb. greater than red hand. (The 30 to 40 lb. difference in these pressures is called "Differential Pressure"). It shows steam	If there is no differential pressure or pressure is low or unsteady.	Check for proper amount of water in steam separator which is with water level showing in glass and add water if necessary. Check circulating pump discharge line strainer — it may require cleaning.

(Cont. following page)

NORMAL	TROUBLE	ACTION
III. Steam Generator Motor Running. (Cont.)		
generator has proper water circulation.		
B. Fuel Oil Pressure Gage, red hand, pump pressure should be between 240 and 260 lb.	If fuel oil pump pressure is low or no pressure.	Check for oil in pump suction line by inspecting flow in sight glass. Turn handle on fuel oil pump suction line strainer to clean strainer. Check to see that fuel oil pump shaft is rotating. Check belt tension. Fuel oil relief valve may be stuck open.
	If fuel oil pump pressure is too high.	Fuel oil relief valve may be stuck closed. Pressure gage may be defective.
C. Main oil solenoid valve opens after differential pressure is established.	If main oil solenoid valve does not open. It makes a definite "click" when it opens.	

(Cont. following page)

NORMAL	TROUBLE	ACTION
IV. Control Switch is placed in "Running" position to make steam generator fire.		
A. "Burner On" lamp lights.	If "Burner On" lamp does not light and steam generator fires.	Check for burned out lamp.
	If "Burner On" lamp does not light and alarm bell rings.	Check for proper amount of water in steam separator which is water level showing in glass. Not enough water can cause loss of differential pressure. Steam generator will not fire if differential pressure is less than about 20 lbs. Also check items under "Action", III-A.
B. Small burner oil solenoid valve opens. This will be indicated by fuel oil pressure gage, red hand dropping about 25 lb. Ignition converter runs	If steam generator does not fire within about 5 seconds, shut-down will occur and alarm bell will ring.	Restart steam generator, check fuel oil pump pressure and when Control Switch is placed in "Running" position note drop in fuel oil pump pressure which indicates that small

(Cont. following page)

NORMAL	TROUBLE	ACTION
IV. Control Switch is placed in "Running" position to make steam generator fire. (Cont.)		
for about 5 seconds providing spark, after which it cuts out. As soon as fire is established Electric Eye indicating lamp goes out.		burner oil solenoid valve opens. Check small burner tip for plugging. Check through burner peep hole for proper spark and oil atomizing. Check air damper and rigging to see that it is in low position.
	If no spark or improper spark.	Check electric wiring between ignition transformer and electrodes. Check for dirty or defective electrodes. (Gap between electrodes should be $\frac{3}{16}''$).
	If steam generator fires for about 5 seconds and Electric Eye indicating lamp remains on and then a shutdown occurs with both	With steam generator shut down clean Electric Eye lenses.

(Cont. following page)

NORMAL	TROUBLE	ACTION
1V. Control Switch is placed in "Running" position to make steam generator fire. (Cont.)		
	"Start" and "Burner On" indicating lights, going out and alarm bell rings.	
V. Steam Generator operating with closed trainline shut-off valve.		
A. Steam generator fire is automatically cut out when steam pressure reaches 295 lb. When steam pressure drops to 285 lb. it refires. Small burner going on and off at short intervals is called "Cycling."	If steam generator shuts down when cycling, alarm bell rings with both the "Start" and "Burner On" indicating lights out and motor running at reduced speed.	Place Control Switch in "Starting" position — this will cut out alarm bell. Restart steam generator. Place Control Switch in "Running" position. Also check items under "Action" IV-B.
	If alarm bell rings with "Start" indicating light on and "Burner On" indicating light out.	Check items under "Action" IV-A. Check feedwater pump steam valve for full open. Check water gage

(Cont. following page)

NORMAL	TROUBLE	ACTION
V. Steam Generator operating with closed trainline shut-off valve. (Cont.)		
		glass on steam separator for indication that water in steam separator may be foaming—if so, give good blow-down using manual blow-down valve.
	If smoke shows at stack when refiring and then stack clears.	Check small burner and electrodes. Burner is not igniting as quickly as it should.
VI. Steam generator feeding steam to trainline.		
A. With low steam demand steam generator may cycle as in "V". With normal steam demand both the small and large burners will be on. The large burner pressure white hand on	If steam generator stops firing alarm bell rings with "Start" indicating light on and "Burner On" indicating light out.	Check differential pressure, water in glass, water storage tank, feedwater pump and its piping. Check feedwater pump steam valve for full open. Check action feedwater pump, may be sucking air through leaky

(Cont. following page)

	NORMAL	TROUBLE	ACTION
VI.	Steam generator feeding steam to trainline. (Cont.)		
	fuel oil gage is controlled by the oil regulating valve and it varies with steam demand.		cover on water treatment tank. Check items under "Action" V-A.
		If steam generator shuts down, alarm bell rings — "Start" and "Burner On" indicating lights out and motor running at reduced speed.	Check for fuel oil pump pressure. With steam generator off, clean Electric Eye lenses. Also check items under "Action" IV-B.
		If steam generator shuts down, alarm bell rings, both indicating lights out, motor shuts down.	Check for blown main line fuses. Also check items under "Action" II-A.
		If smoke shows at stack with large burner on.	Check action of air damper and rigging. Check blower fan wheel belts.

BEFORE STARTING STEAM GENERATOR:

1—Auxiliary Generator on locomotive should be running and main air reservoir should have at least 60 lb. pressure.

2—Check position of all valves. Valves with cross handles should be fully opened.

Valves with round handles should be closed, excepting water glass valves, Refs. 2 and 6.

3—Turn handle, Ref. 7, on fuel oil filter one full turn.

4—Close main switch by moving handle, Ref. 1, to the "ON" position.

STARTING STEAM GENERATOR:

1—If no water shows in the glass run feedwater pump, Ref. 10, on air as follows:—

(a) Close pump steam valve, Ref. 23.

(b) Open pump air valve, Ref. 9.

(c) Open steam separator air vent cock, Ref. 3, while filling.

2—When water reaches top of water glass, place control switch, Ref. 12, in starting position. Push "START" button, Ref. 14, and motor will run.

3—Continue to operate feedwater pump on air until water remains in water glass, then shut pump air valve, Ref. 9, and open pump steam valve, Ref. 23.

4—Close steam separator air vent cock, Ref. 3.

5—Place control switch, Ref. 12, in running position. Steam generator will fire.

6—As steam generator comes up to pressure, water will tend to rise, use manual blow-down valve, Ref. 25, to maintain water level in glass.

TO FEED STEAM TO TRAINLINE:

Steam generator pressure should be 275 lb. shown on pressure gage, Ref. 16, red hand before proceeding.

TO FEED STEAM TO TRAINLINE (Continued):

1—Set lever of steam flow control valve, Ref. 22, in position 2.

2—Open remote control steam shut-off solenoid valve, Ref. 5, by pulling lever down to latched position.

3—Slowly open main steam line shut-off valve, Ref. 18, to full open position.

4—If required use manual blow-down valve, Ref. 25, to maintain water level in glass.

5—Loosen wing lock nut on stem of steam pressure reducing valve, Ref. 21, and adjust this valve to give the desired reducing valve setting. After reducing valve is set, tighten wing lock nut. (Make certain that manual by-pass valve is tightly closed.)

6—For high trainline steam demands, during cold weather, move lever of steam flow control valve, Ref. 22, very slowly to position 4.

7—When trainline is fully charged trainline pressure will be about reducing valve pressure. These pressures show on steam gage, Ref. 17.

PARALLELING ELESCO STEAM GENERATORS:

1—Set steam flow control valve levers, Ref. 22, in same position.

2—Adjust reducing valve, Ref. 21, to have about same pressures, white hand on steam pressure gage, Ref. 17, within 5 to 10 lbs.

RUNNING ATTENTION:

1—Operate remote control solenoid blowdown valve, Ref. 11, about 5 seconds every ½ hour by means of separator blowdown switch on remote control panel in locomotive cab.

TO SHUT DOWN STEAM GENERATOR:

1—Close steam shut-off valve, Ref. 18, and open manual blowdown valve, Ref. 25, slowly and blow for 5 seconds.

TO SHUT DOWN STEAM GENERATOR (Continued):

2—Push "STOP" button, Ref. 13, the motor will continue to run but at a reduced speed for cool down period.

3—When steam pressure has dropped to about 50 lbs. motor will automatically stop. After motor has stopped, move main switch handle, Ref. 1, to "OFF" position.

TO SHUT DOWN STEAM GENERATOR ENROUTE DURING COLD WEATHER:

1—Close steam line shut-off valve, Ref. 18.

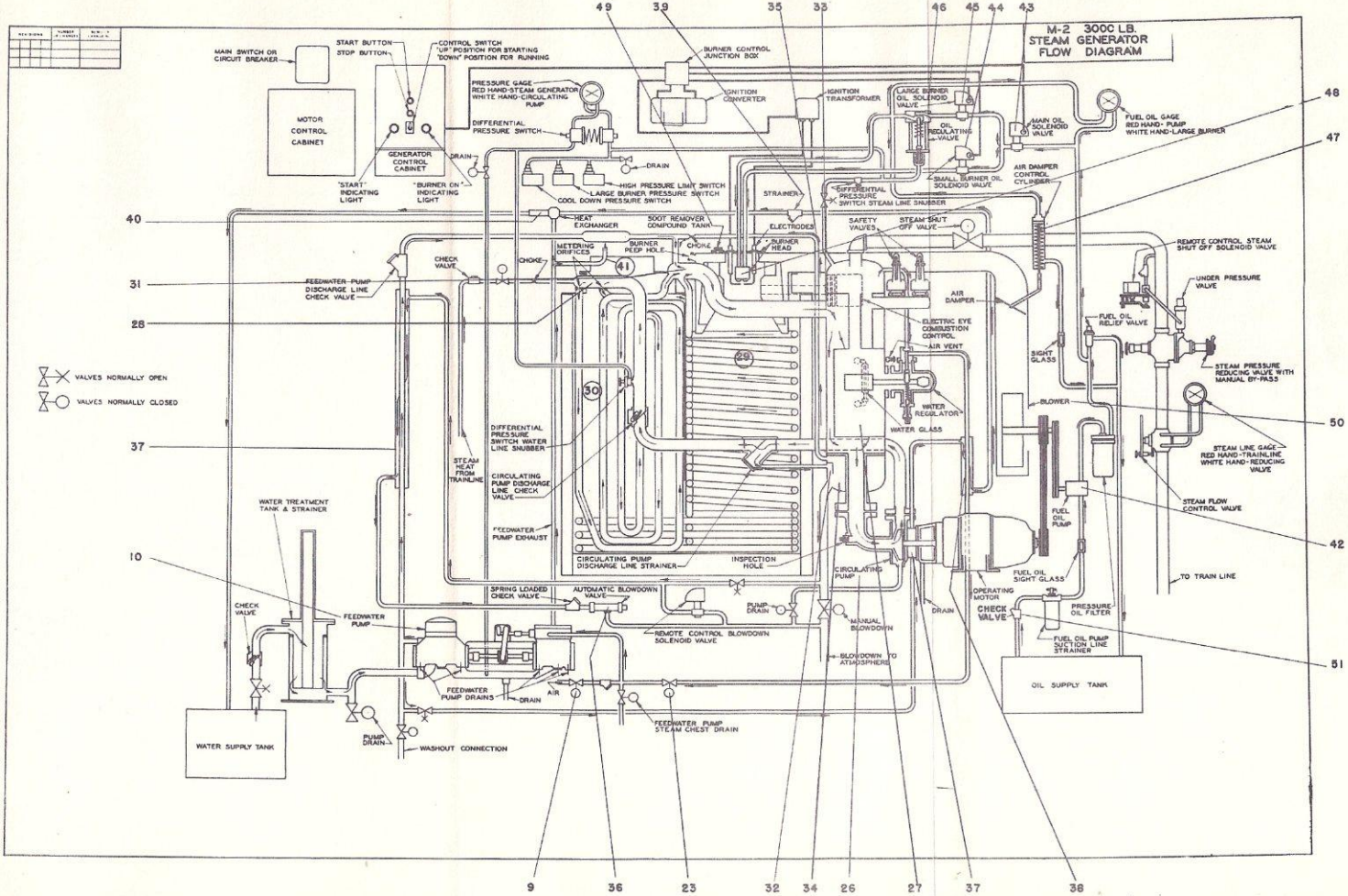
2—Push "STOP" button, Ref. 13.

3—Open manual blowdown valve, Ref. 25, and circulating pump drain valve, Ref. 8, wide to thoroughly blowdown generator. After generator is blown down leave these valves *cracked* open.

4—Open oil regulating valve drain, Ref. 4, differential switch steam line drain, Ref. 19, differential switch water line drain, Ref. 20, and feedwater pump steam line drain, Ref. 24.

5—Open steam generator heater valve, Ref. 15. This connects steam generator to trainline, allowing steam from trainline to enter to prevent freezing.

6—Move main switch handle, Ref. 1 to "OFF" position.


M-2 3000 LB.
STEAM GENERATOR
FLOW DIAGRAM
MAIN SWITCH OR CIRCUIT BREAKER
MOTOR CONTROL CABINET
START BUTTON
STOP BUTTON
CONTROL SWITCH "UP" POSITION FOR STARTING "DOWN" POSITION FOR RUNNING
GENERATOR CONTROL CABINET
"START" INDICATING LIGHT
"BURNER ON" INDICATING LIGHT
DRAIN
PRESSURE GAGE RED HAND-STEAM GENERATOR WHITE HAND-CIRCULATING PUMP
DIFFERENTIAL PRESSURE SWITCH
BURNER CONTROL JUNCTION BOX
IGNITION CONVERTER
IGNITION TRANSFORMER
LARGE BURNER OIL SOLENOID VALVE
OIL REGULATING VALVE
MAIN OIL SOLENOID VALVE
FUEL OIL GAGE RED HAND-PUMP WHITE HAND-LARGE BURNER
HIGH PRESSURE LIMIT SWITCH
LARGE BURNER PRESSURE SWITCH
COOL DOWN PRESSURE SWITCH
STRAINER
SMALL BURNER OIL SOLENOID VALVE
AIR DAMPER CONTROL CYLINDER
DIFFERENTIAL PRESSURE SWITCH STEAM LINE SNUBBER
HEAT EXCHANGER
SOOT REMOVER COMPOUND TANK
ELECTRODES
SAFETY VALVES
STEAM SHUT OFF VALVE
REMOTE CONTROL STEAM SHUT OFF SOLENOID VALVE
METERING ORIFICES
BURNER REDP HOLE
CHOKE
BURNER HEAD
CHECK VALVE
FEEDWATER-PUMP DISCHARGE LINE CHECK VALVE
AIR DAMPER
UNDER PRESSURE VALVE
FUEL OIL RELIEF VALVE
ELECTRIC EYE COMBUSTION CONTROL
AIR VENT
SIGHT GLASS
STEAM PRESSURE REDUCING VALVE WITH MANUAL BY-PASS
VALVES NORMALLY OPEN
VALVES NORMALLY CLOSED
WATER REGULATOR
WATER GLASS
BLOWER
DIFFERENTIAL PRESSURE SWITCH WATER LINE SNUBBER
STEAM HEAT FROM TRAINLINE
CIRCULATING PUMP DISCHARGE LINE CHECK VALVE
STEAM LINE GAGE RED HAND-TRAINLINE WHITE HAND-REDUCING VALVE
STEAM FLOW CONTROL VALVE
WATER TREATMENT TANK & STRAINER
FEEDWATER PUMP EXHAUST
FUEL OIL PUMP
CIRCULATING PUMP DISCHARGE LINE STRAINER
INSPECTION HOLE
CIRCULATING PUMP
FUEL OIL SIGHT GLASS
TO TRAIN LINE
SPRING LOADED CHECK VALVE
AUTOMATIC BLOWDOWN VALVE
PUMP DRAIN
MANUAL BLOWDOWN
OPERATING MOTOR
CHECK VALVE
PRESSURE OIL FILTER
FEEDWATER PUMP
REMOTE CONTROL BLOWDOWN SOLENOID VALVE
BLOWDOWN TO ATMOSPHERE
FUEL OIL PUMP SUCTION LINE STRAINER
OIL SUPPLY TANK
FEEDWATER PUMP DRAINS
AIR
FEEDWATER PUMP STEAM CHEST DRAIN
WATER SUPPLY TANK
PUMP DRAIN
WASHOUT CONNECTION
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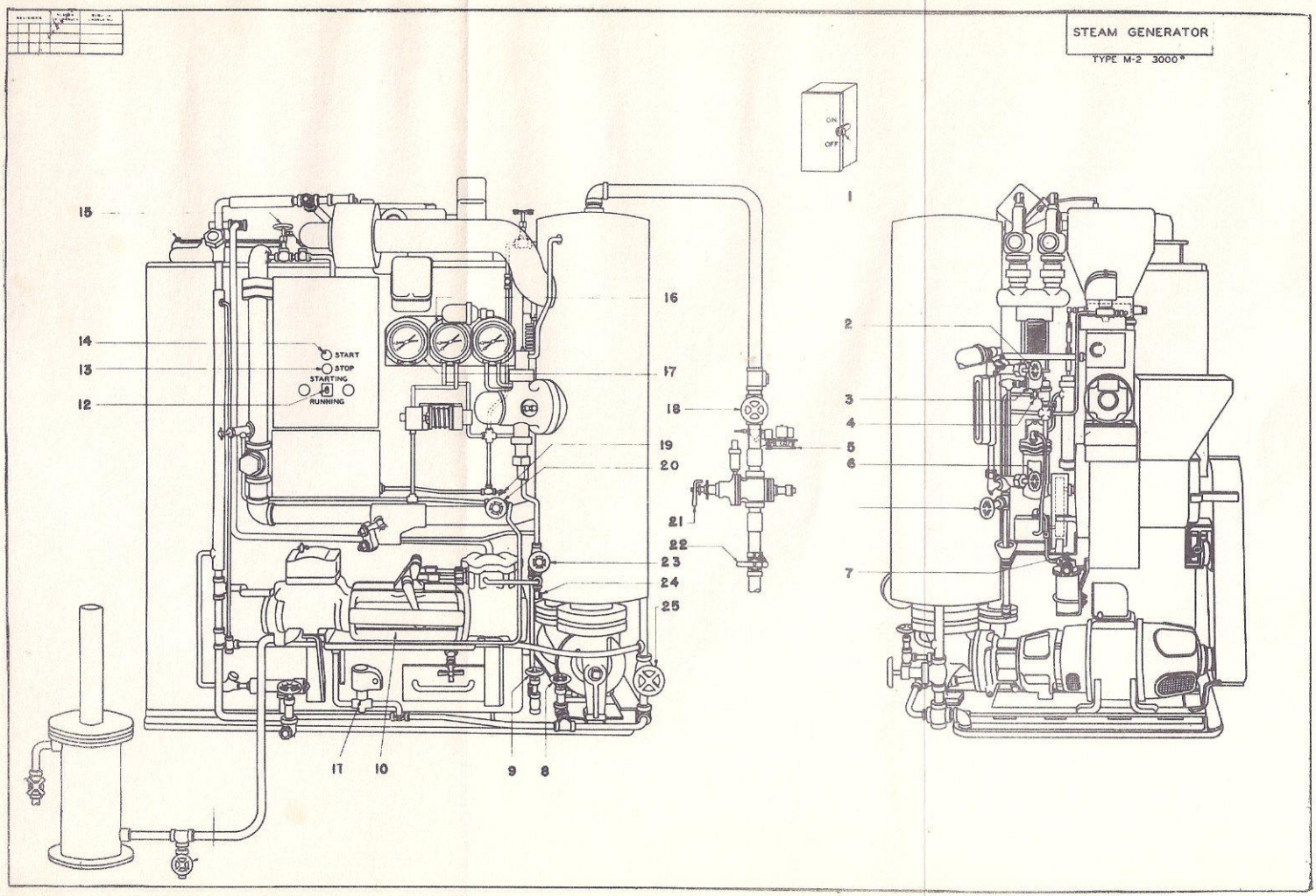
STEAM GENERATOR
TYPE M-2 3000#
ON
OFF
START
STOP
STARTING
RUNNING
1
2
3
4
5
6
7
8
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10
11
12
13
14
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