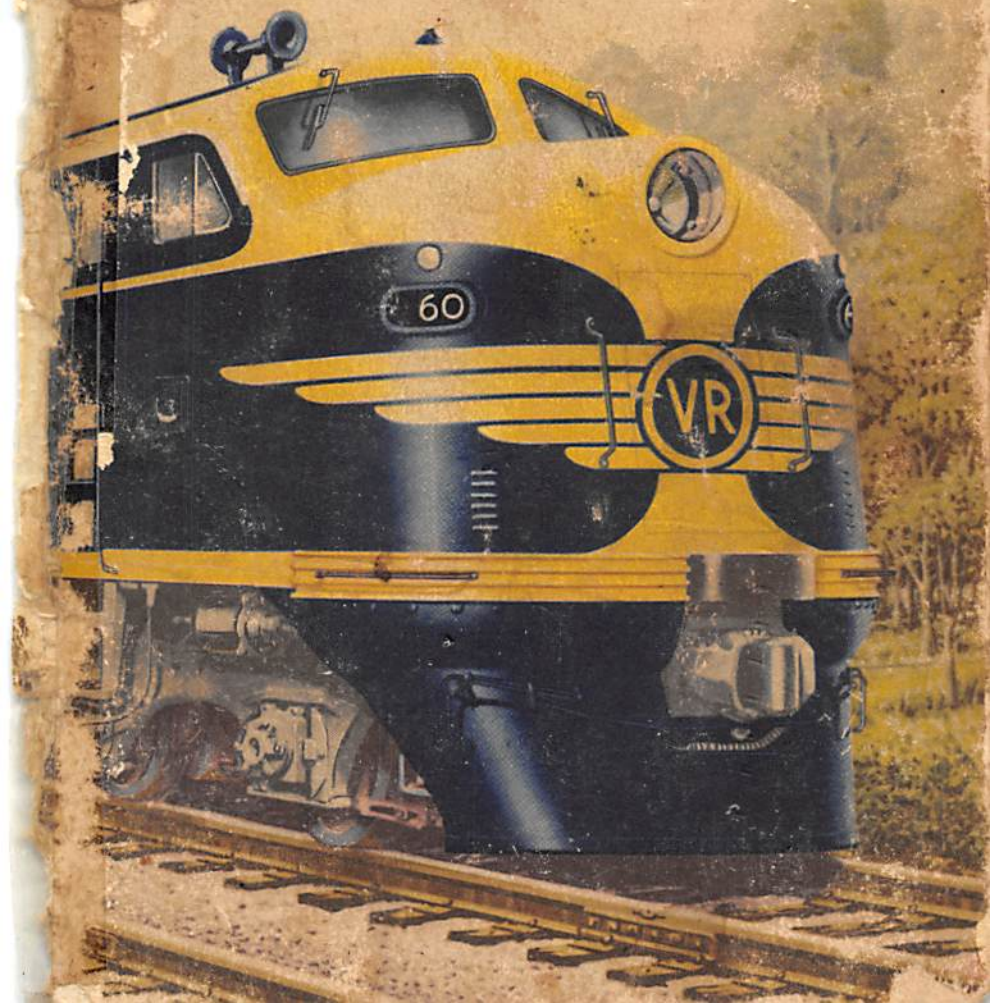
OPERATING MANUAL CLYDE-GM DIESEL LOCOMOTIVE ML2



J. L. Kelly
Bendigo Loco

CLYDE - G. M.
DIESEL LOCOMOTIVE
Mainliner Model 2

PRICE: 7/6 per copy

THE CLYDE ENGINEERING CO. PTY. LTD.

CLYDE WORKS

CLYDE, N.S.W., AUSTRALIA

in association with

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION

LA GRANGE, ILLINOIS, U.S.A.

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SET-UP, PRINTED AND BOUND IN AUSTRALIA BY

THE CLYDE ENGINEERING CO. PTY. LTD., CLYDE, N.S.W.

CONTENTS

INTRODUCTION

This manual is written specifically for locomotive operating crews and no attempt has been made to include instruction on the repair and adjustment of equipment.

Repair information is issued to the Railways and is kept in Locomotive Depots in the form of Maintenance Instructions.

The General Arrangement Diagram at the end of this book may be unfolded to show the location of the major component parts mentioned in the text. These major items are depicted in sketches throughout the text to show their component parts in greater detail.

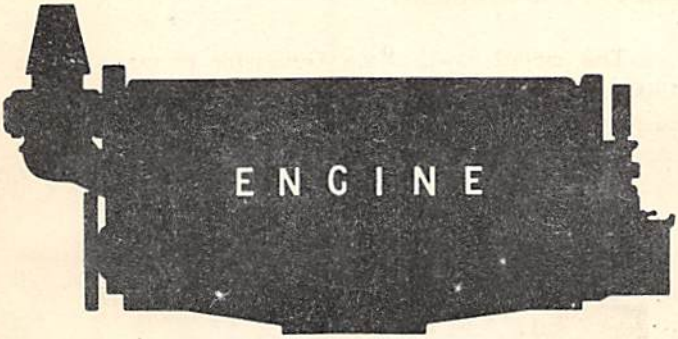
PART I

GENERAL DESCRIPTION

THE CLYDE ENGINEERING CO. PTY. LTD.
AUSTRALIA

"HOME OF THE DIESEL LOCOMOTIVE"

POWER GENERATION

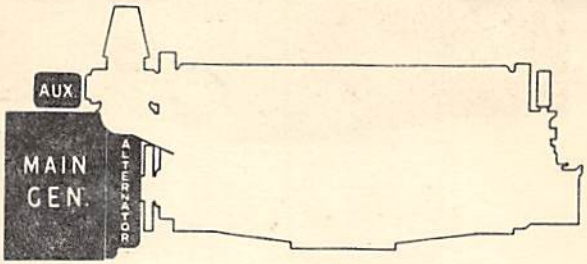


All the power for the operation of the locomotive is developed from the fuel oil burned by a model 16–567B two–stroke cycle General Motors Diesel Engine. The engine has solid fuel injection, blower scavenging and operates at speeds from 275 RPM to 800 RPM.

CONVERSION TO ELECTRICITY

The mechanical energy developed by the engine is converted to electricity.

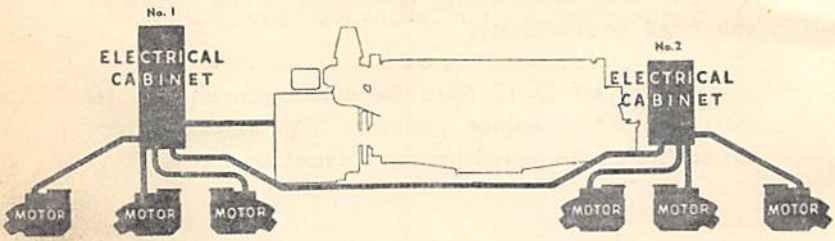
The model D–12 Main Generator converts up to 1500 HP of the engine power to high voltage direct current for use in propelling the locomotive.



The model D–14 Alternator is a three phase 80 KW AC generator and converts about 65 HP of the engine power to alternating current to operate radiator fans and traction motor blowers.

The Auxiliary Generator converts a small amount of the engine power to low voltage direct current at approximately 74 volts for use in charging the engine starting battery, exciting the main generator, operating the controls, and providing current for all locomotive lights.

CONVERSION TO MECHANICAL POWER



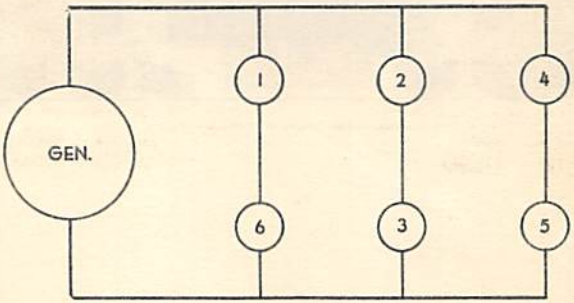
The electrical energy developed by the main generator is conducted to the Electrical Cabinets. In the Electrical Cabinets the current is distributed to six model D.27 Traction Motors which are geared to the wheels. The motors convert the electrical energy to mechanical energy for propelling the locomotive.

Current from the alternator and auxiliary generator is also distributed through the Electrical Cabinets.

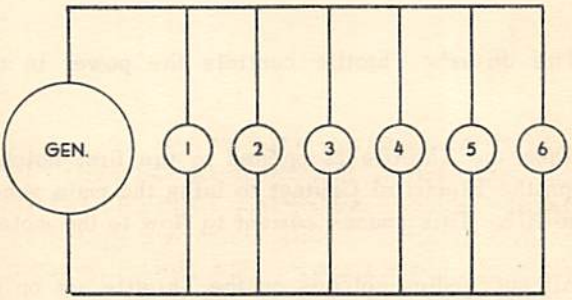
CONVERSION TO MECHANICAL POWER (Cont'd.)

Two types of traction motor electrical connection are used so that full power may be obtained from the main generator within the range of its current and voltage limits, namely:–

1. Series–parallel – for starting and heavy pulling.

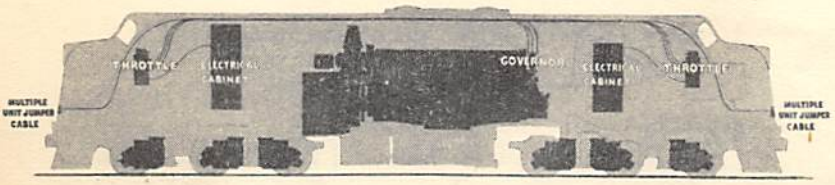


2. Parallel – For higher speeds.



The change from one type of connection to another is called Transition and is effected automatically.

CONTROL OF POWER



The driver's Throttle controls the power in two ways.

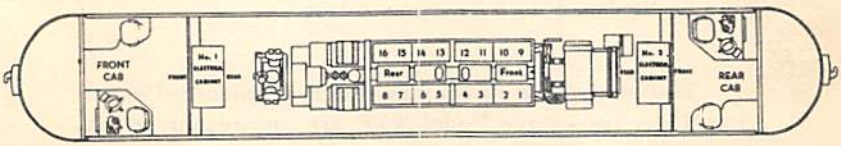
When the Throttle is opened to the first notch it acts on the Electrical Cabinet to bring the main generator to life. This causes current to flow to the motors.

All succeeding notches on the Throttle act on the Governor and cause the engine speed to increase by 75 RPM for each notch. This increases the pulling power of the locomotive.

CONTROL OF POWER (Cont'd.)

In multiple unit operation these controls go through the Jumper Cable between units so that all engines and generators in all units can be controlled from one throttle.

The locomotive has a driver's cab at each end equipped with an identical set of control equipment on the driver's control panel. In the following paragraphs, it is assumed that the locomotive is being driven from the front cab, and all circuit breakers on the driver's control panel in the rear cab are OFF.



NOTE THAT THE FRONT OF THE ENGINE IS TO THE REAR OF THE LOCOMOTIVE

AUXILIARY EQUIPMENT

Auxiliary equipment is driven by direct drive from the Diesel engine or by separate electric motor.

A 5 h.p. electrically driven blower is provided for each traction motor and delivers cooling air to the traction motors while the diesel engine is running.

Four 9 H.P. electrically driven cooling fans, thermostatically controlled, supply air for cooling the engine water. Blowers and fans are driven by alternating current supplied from the D.14 alternator.

When the dynamic brake is in use, two cooling fans mounted in the roof, are driven by direct current generated by No.2 and No.5 Traction Motors.

The locomotive is equipped with a Gardner-Denver 3 cylinder two-stage Model WXE air compressor driven from the diesel engine through a flexible coupling and capable of delivering 178 cubic feet of air per minute at 800 RPM. This air is delivered to the Westinghouse Brake and the control air systems.

PART 2

STARTING AND STOPPING ENGINES

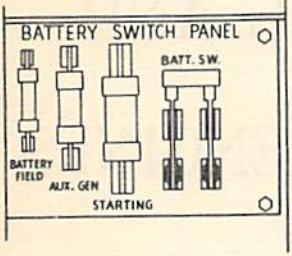
THE CLYDE ENGINEERING CO. PTY. LTD.
AUSTRALIA

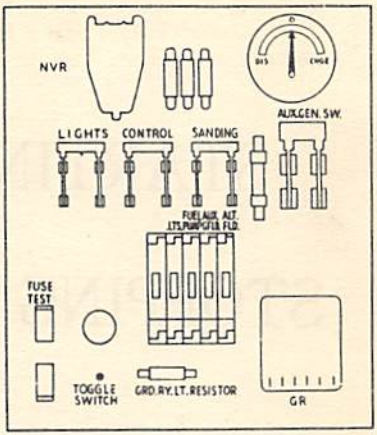
"HOME OF THE DIESEL LOCOMOTIVE"

PREPARATIONS FOR STARTING ENGINES

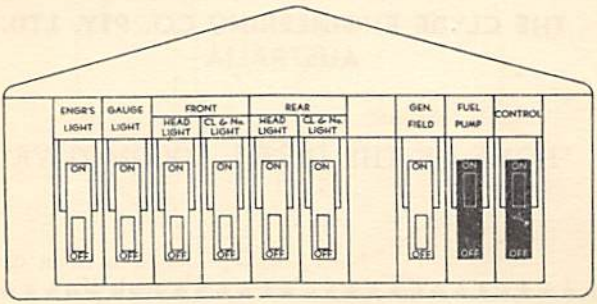
In the cab:

1. Hand Brake should be ON.
2. Air brakes should be set.
3. Dynamic brake lever should be OFF.
4. Reverser handle should be removed.
5. In the electrical cabinet –
   (a) Close all Switches and circuit breakers on the Distribution Panel.





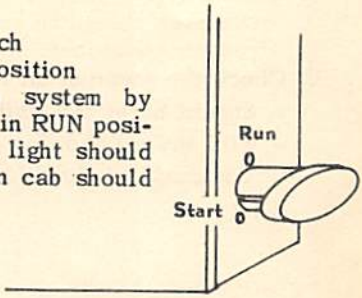
6. At the driver's control panel –
   (a) Switch the Control circuit breaker ON.
   (b) Switch the Fuel Pump circuit breaker ON.



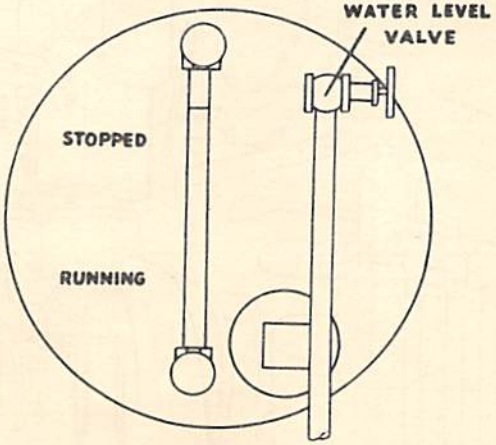
PREPARATIONS FOR STARTING ENGINES (Cont'd.)

In the Engine Room:

1. Check the isolation switch
   – should be in START position
   (a) Test signal alarm system by placing isolation switch in RUN position momentarily. Blue light should appear and alarm bell in cab should ring.

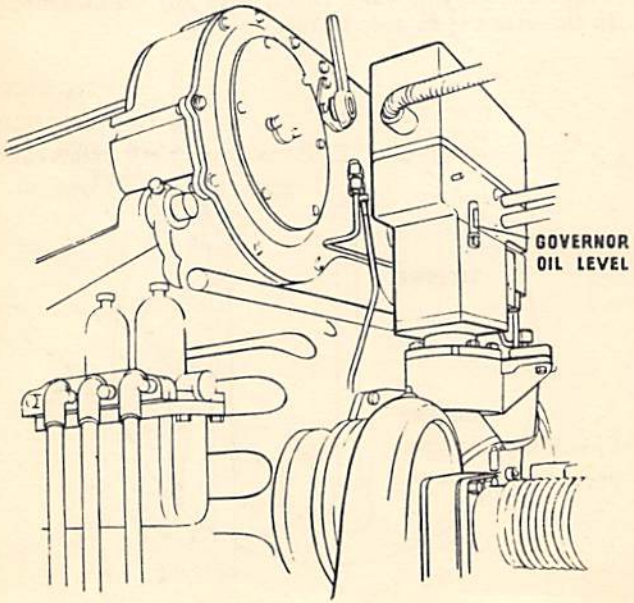


2. Check the engine water level, with any water showing in the glass it is safe to run.



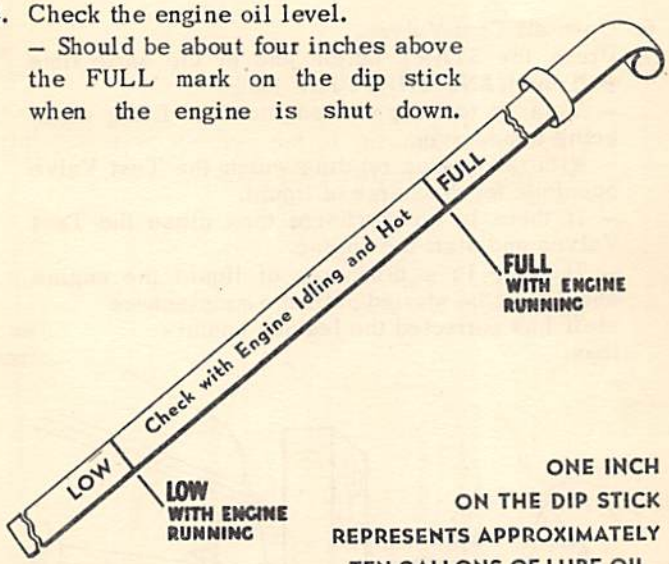
PREPARATIONS FOR STARTING ENGINES (Cont'd.)

3. Check the governor oil level.
   - Should be at the mark in the middle of the glass.
   - With any oil showing in the glass it is safe to run.
   - Too much oil should be reported.



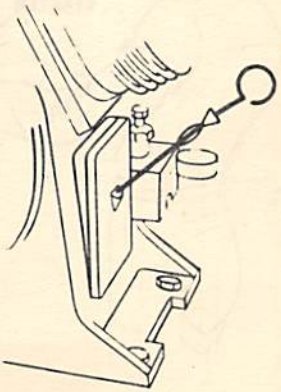
PREPARATIONS FOR STARTING ENGINES (Cont'd.)

4. Check the engine oil level.
   – Should be about four inches above the FULL mark on the dip stick when the engine is shut down.



ONE INCH
ON THE DIP STICK
REPRESENTS APPROXIMATELY
TEN GALLONS OF LUBE OIL

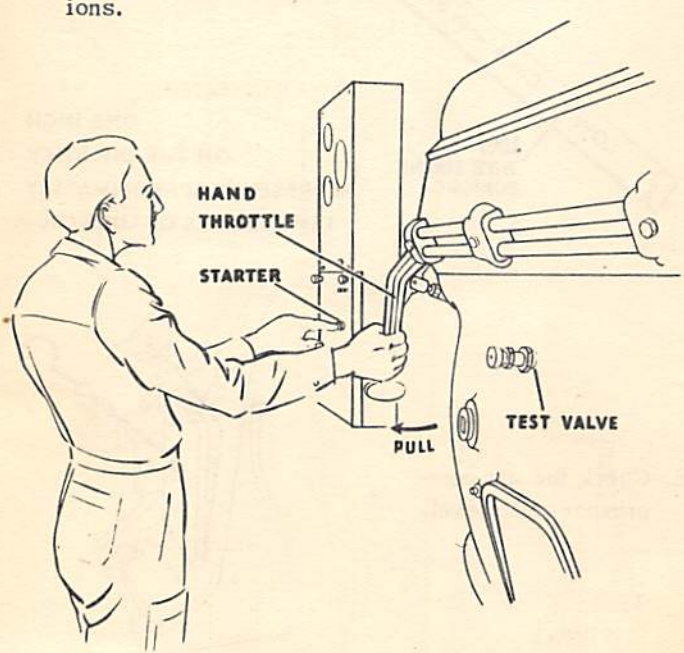
5. Check the air compressor oil level.



PREPARATIONS FOR STARTING ENGINES (Cont'd.)

IF THE ENGINE HAS BEEN SHUT DOWN FOR MORE THAN TWO HOURS.

6. Open all Test Valves.
7. Press the START button and at the same time pull the HAND THROTTLE back.
   – This is to keep the engine from firing while being turned over.
   – With the engine rotating watch the Test Valve openings for discharge of liquid.
   – If there is no discharge then close the Test Valves and start the engine.
   – If there is a discharge of liquid the engine should not be started until the maintenance staff has corrected the leaking conditions.

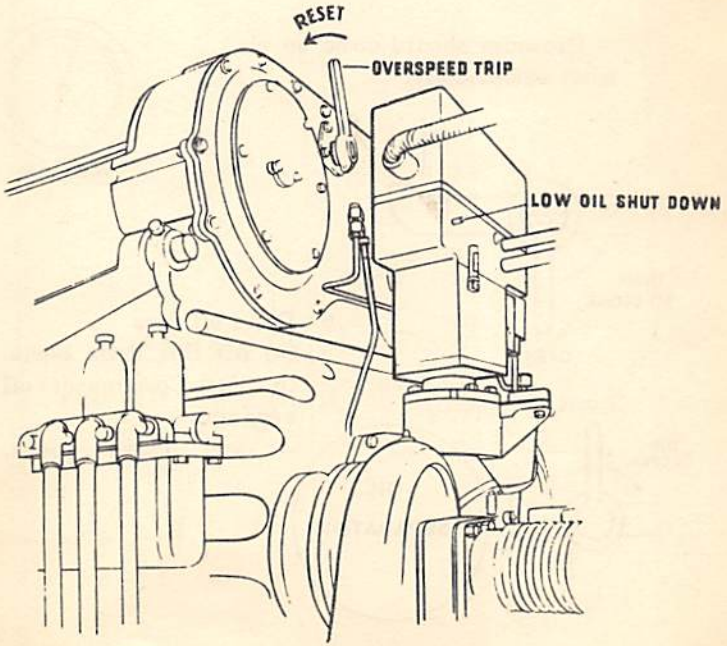


STARTING ENGINES

In the Engine Room:

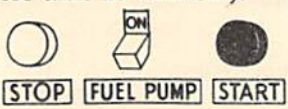
1. Turn the Fuel Pump switch ON.
2. Check the Low Oil Trip Button – Push in to set.

3. Check the Overspeed Trip.
   – Pull as indicated to reset.



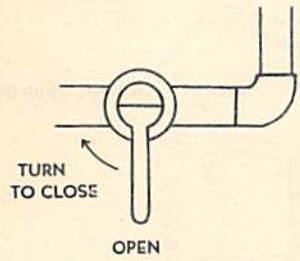
STARTING ENGINES (Cont'd.)

4. Press the START button and hold until the engine starts (not more than 15 seconds).

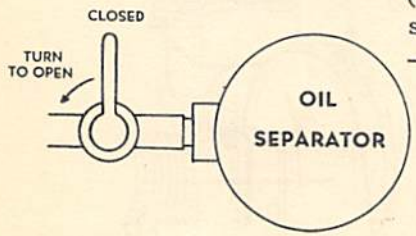


5. Check the oil pressure and suction gauges.

– Pressure should come up almost immediately.



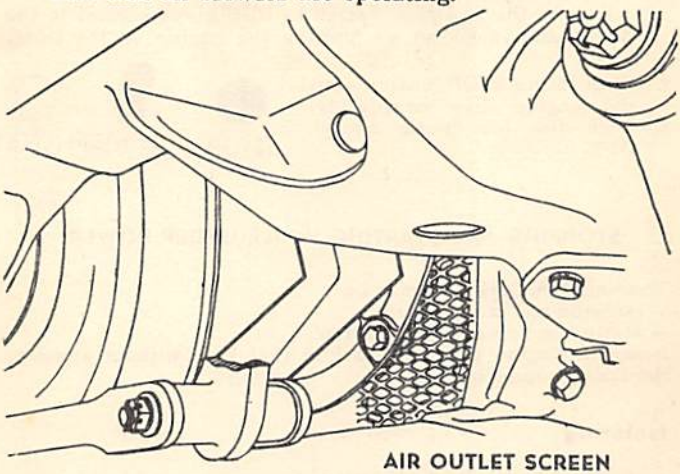
6. Drain oil from
   (a) Air Box drain tanks.
   (b) Air Compressor oil separator
   – and close cocks.



STARTING ENGINES (Cont'd.)

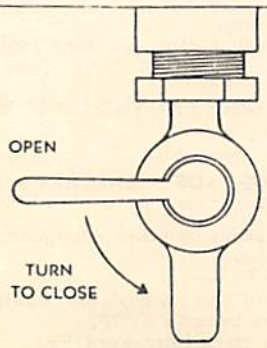
On the Ground

1. Check for flow of air from traction motors to ensure that all blowers are operating.



AIR OUTLET SCREEN

2. Drain condensate from main reservoirs and close cocks.



STOPPING ENGINES

When Stopping the Engine Normally

1. Turn the Isolation Switch to START.
   —This is known as 'isolating the engine' because it takes control away from the driver.
   —Turning the Isolation Switch to RUN gives control to the driver and is known as 'putting the engine on the line'.

2. Hold in the STOP switch until the engine dies completely.
3. Turn the fuel pump switch OFF.

STOPPING AND STARTING WHILE UNDER POWER

The engine in any Unit may be
– Isolated and stopped or
– Started and placed 'on the line'
from the Engine Control Panel in that Unit without stopping the train or reducing throttle.

Isolating

1. Pull hand throttle back till engine stops.
2. When blue light appears turn Isolation switch to START.

Placing on the Line

1. Start Engine in usual way.
2. When lube oil pressure builds up, turn Isolation Switch to RUN.

DO NOT PLACE AN ENGINE 'ON THE LINE' WHILE USING THE DYNAMIC BRAKE.

EMERGENCY STOPPING OF ENGINES FROM CAB

In case of fire, collision, or other emergency all engines can be stopped from the cab.

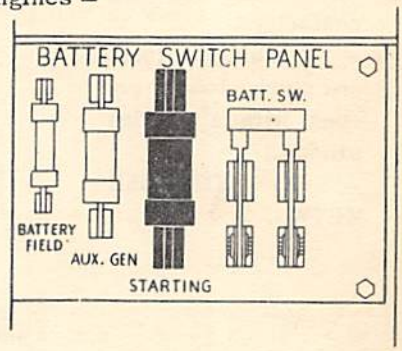
1. Hold in the button on the end of the throttle and push the throttle all the way back to STOP.
2. Switch the Fuel Pump circuit breaker OFF.

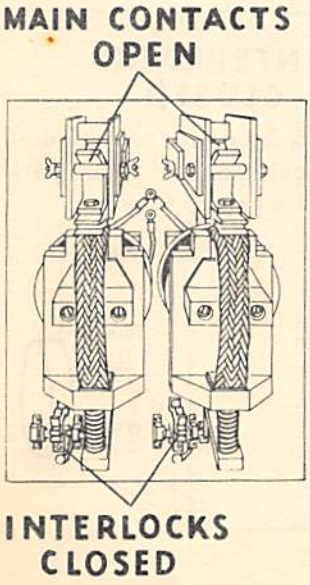
STOPPING ENGINES (Cont'd.)

To prevent Starting of the Engine

To work safely without the danger of someone accidentally starting engines –

1. Remove the starting fuse.



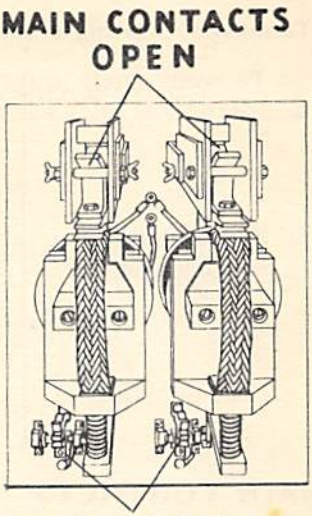


2. Block the starting contactors OPEN with wooden wedges – DO NOT USE METAL.

GIVING ENGINE CONTROL TO THE DRIVER

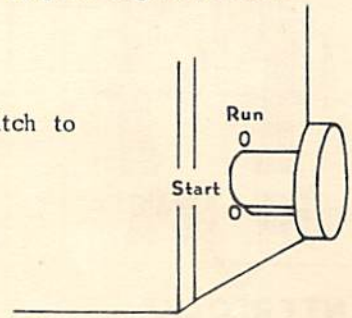
In the Engine Room:

1. Check the starting contactors.
   – If main contacts are stuck closed, pry open with a wooden stick.
   – DO NOT USE METAL.



2. Check the engine temperature.
   – Should be 125° before putting the engine to work.

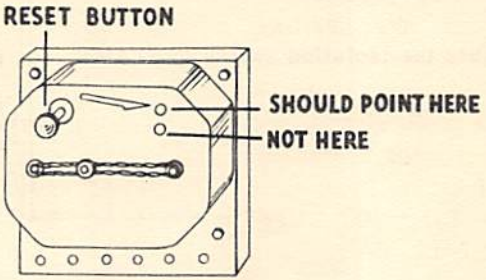
3. Turn the isolation switch to RUN.



GIVING ENGINE CONTROL TO THE DRIVER (Cont'd.)

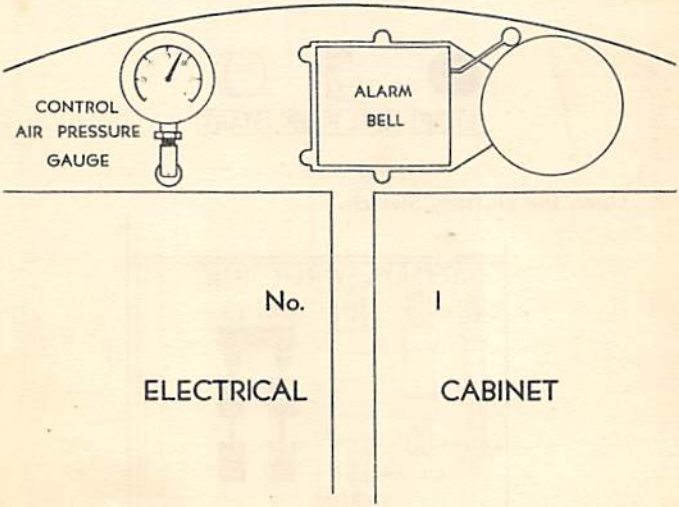
In the cab:

1. Check the ground relay.
   – If tripped press RESET button.



2. Check control air pressure.
   – Should be 90 lbs.

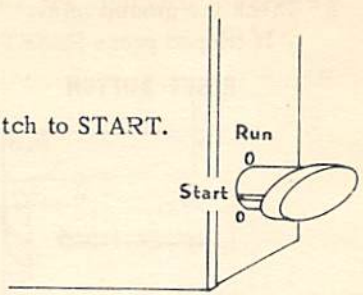
3. Release the Hand Brake.



SAFETY PRECAUTIONS

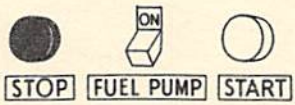
To Kill High Voltage

1. Turn the isolation switch to START.

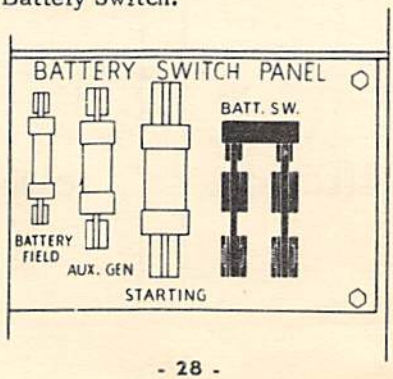


To Kill Low Voltage and Alternating Current

1. Stop the Diesel Engine.



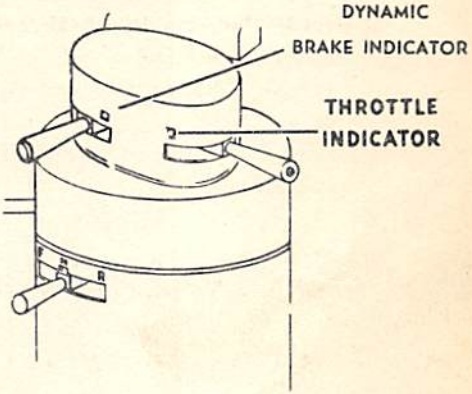
2. Open the Battery Switch.



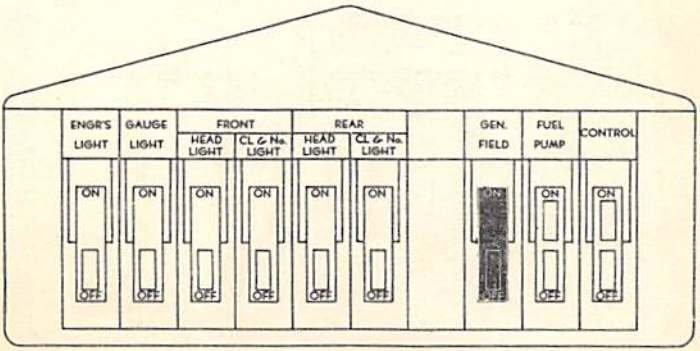
SAFETY PRECAUTIONS (Cont'd.)

To prevent moving the Locomotive while engine is running

Before leaving the locomotive unattended



1. Move Dynamic Brake Lever to OFF.
2. Remove the reverser handle.
3. Switch the Generator Field circuit breaker OFF.
4. Apply the hand brake.



SAFETY PRECAUTIONS (Cont'd.)

When leaving the Locomotive

After shutting down the engine

1. Apply the Hand Brake.
2. Place Dynamic Brake lever in OFF and remove the reverser handle.
3. Open all circuit breakers on the driver's control panel.
4. Open the Main Battery Switch in the Electrical Cabinet.

PART 3

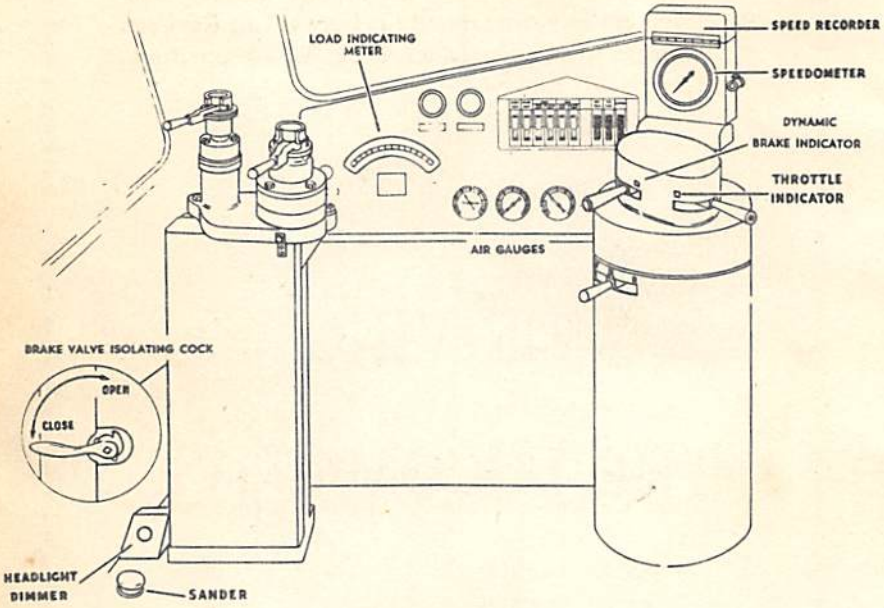
DRIVING

THE LOCOMOTIVE

THE CLYDE ENGINEERING CO. PTY. LTD.
AUSTRALIA

"HOME OF THE DIESEL LOCOMOTIVE"

HANDLING THE TRAIN



Starting Characteristic

Diesel Locomotives have an extremely high starting tractive effort.

– It is never necessary to bunch slack in making a start with a Diesel Locomotive.

– If slack is in the train care must be taken not to run the slack out too fast. Fast starts may jolt passengers and break trains.

HANDLING THE TRAIN (Cont'd.)

To Start the Train

1. Switch the Generator Field circuit breaker ON.
2. Place the Reverser Handle in Forward, or Reverse.
3. Dynamic Brake lever must be No. 1 position.
4. Release Air Brakes.
5. Open the Throttle.

To Stop the Train

1. Close the Throttle.
2. Apply the Brakes.

To Reverse the Train

1. Close the Throttle.
   – Apply the Brakes.
   – Wait until the locomotive comes to a stop.
2. Throw the Reverser handle to the opposite direction.
3. Release the Brakes
   – Open the Throttle.
   NEVER THROW THE REVERSER HANDLE WITH THE LOCOMOTIVE IN MOTION.

To Pump Air

The Diesel Engine is mechanically connected to the air compressor.

– To accelerate the pumping of air without applying power to the locomotive:

1. Place the Reverser in NEUTRAL.
2. Switch the Generator field Circuit breaker OFF.
3. Open the Throttle to not over the 4th notch.

OPERATING PRECAUTIONS

Opening Throttle

The throttle should be opened one notch at a time with a pause between notches.

THE STOP BUTTON ON THE END OF THE THROTTLE IS AN EMERGENCY FEATURE AND SHOULD NOT BE USED DURING NORMAL THROTTLE HANDLING.

Closing Throttle

It is possible to close the throttle to IDLE in one sweep, but this should not be done in normal handling. Close the throttle one notch at a time allowing a pause between notches.

The throttle should be closed before the brakes are applied.

Mechanical Interlocks between Throttle, Reverser and Dynamic Brake Lever

The levers on the controller are interlocked so that:

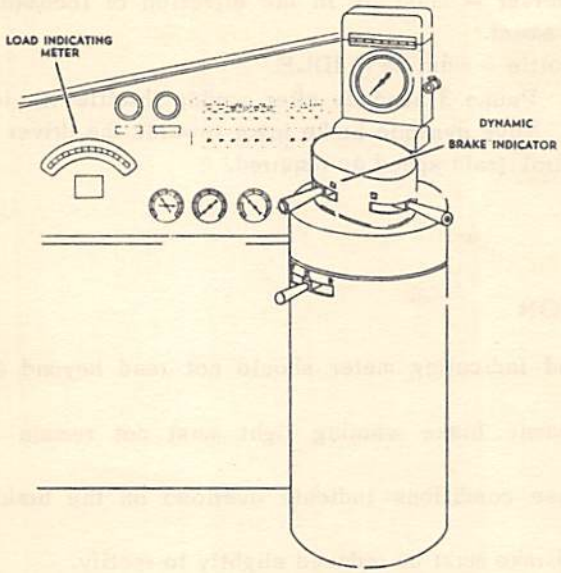
1. Throttle cannot be opened if
   (a) Reverser handle removed, or
   (b) Dynamic brake lever in OFF or B position.
2. Reverser cannot be thrown if
   (a) Throttle Open or in STOP, or
   (b) Dynamic brake lever in B position.
3. Reverser handle cannot be removed or inserted unless
   (a) Dynamic brake lever is in OFF, and
   (b) Throttle is in IDLE.
4. Dynamic brake lever cannot be moved to any position – with throttle open.
   Dynamic brake lever cannot be moved to B – with reverser in NEUTRAL.

Running through water

If water is high enough to reach the wheel flanges, the locomotive speed should not exceed 3 m.p.h.

If water is above the rail level the locomotive must not proceed under any circumstances.

DYNAMIC BRAKE OPERATION



Used to retard the train.

– Electrical connections are made to convert the traction motors into generators.
– Power required to rotate the "generators" retards the locomotive.
– "Generator" output is dissipated in resistors or grids located in the roof and cooled by motor driven fans.
– Acts in similar manner to independent air brake.
– Load indicating meter acts as "brake cylinder pressure gauge".

DYNAMIC BRAKE OPERATION (Cont'd.)

To Use the Dynamic Brake

1. Reverser – must be in the direction of locomotive movement.
2. Throttle – must be in IDLE.
3. (a) Pause 3 seconds after moving throttle to idle.
   (b) Move dynamic brake lever towards the driver to control train speed as required.

CAUTION

Load indicating meter should not read beyond 600 amps.

Dynamic brake warning light must not remain lit.

These conditions indicate overload on the braking system.

– Brake must be reduced slightly to rectify.

DO NOT PLACE AN ENGINE ON THE LINE WHILE USING THE DYNAMIC BRAKE.

During dynamic braking an interlock prevents any application of the air brakes on the locomotive wheels.

– The automatic air brake may be used in conjunction with the dynamic brake to reduce train speed further.

– The dynamic brake is most effective at speeds between 15 and 25 m.p.h.

– Speed on grades must not be allowed to creep up by careless handling of the brake.

DYNAMIC BRAKE OPERATION (Cont'd.)

Wheel Slip and Dynamic Brake Warning Light

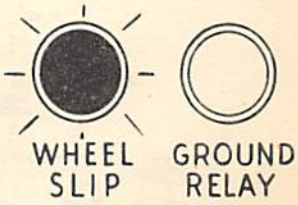
One light serves as both:

– Wheel slip light during power application.

– Dynamic Brake Warning light when the dynamic brake is in use.

During power application

The light indicates that the wheels are slipping.



1. Reduce the throttle.
2. Apply sand if required.
3. Open throttle more slowly.

– Sand should be used to prevent slipping – not to stop it.

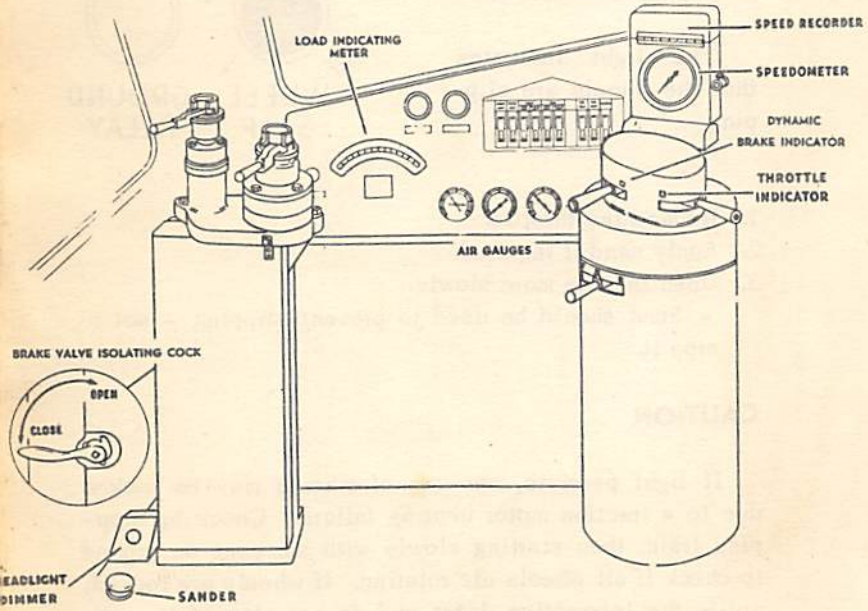
CAUTION

If light persists, one set of wheels may be locked due to a traction motor bearing failure. Check by stopping train, then starting slowly with someone on ground to check if all wheels are rotating. If wheels are locked, notify the locomotive depot and do not attempt to move locomotive.

During Dynamic Braking

The light indicates an overload in the braking system. Reduce braking until light disappears.

MISCELLANEOUS CAB EQUIPMENT



MISCELLANEOUS CAB EQUIPMENT (Cont'd.)

Load Indicating Meter

Amount of current shown on the meter is flowing to each motor.

Total main generator output in amperes is:–

Series parallel – THREE times amount shown on the meter.

Parallel – SIX times amount shown on the meter.

A high reading on the load indicating meter is permissible when starting a train, provided the pointer moves to the left of the continuous rating as the train accelerates.

Pointer must be at or below the continuous amperage before the short time ratings are exceeded.

Short time ratings are NOT cumulative.

Air Gauges

Standard gauges – clearly labelled as to function.

Control Switches

Switches mounted on the driver's control panel are circuit breakers – there are no fuses connected to these switches.

Switch lever moves towards OFF position when circuit is overloaded.

Move to OFF position, then to ON, to reset.

Speedometer

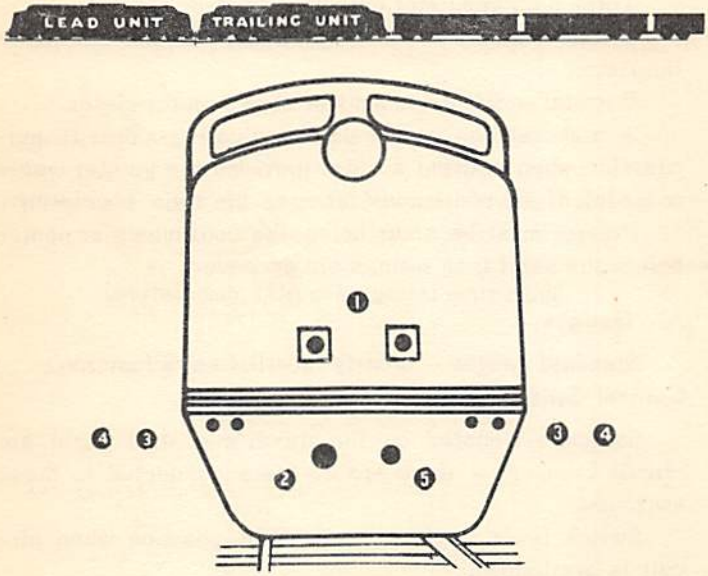
A speed recorder is located in the front cab and a speed indicator in the rear cab.

Horn Valves

Horns are operated by pull-cords. Horn shut-off valves are provided at both ends of the locomotive and are all accessible from the nose compartment. On some units, the valve is located in the nose compartment on the bulkhead wall in front of the driver's position, while in others, it is located below the floorboards under the driver's position.

MULTIPLE UNIT OPERATION

Units may be coupled together at either end to form a locomotive operated from one cab.



Each engine must be started separately.

1. Connect jumper cable between units.
   – Only one jumper is needed and may be connected across either side.
2. Connect Brake pipe.
3. Connect Independent release pipe.
4. Connect No. 3 Control pipe.
5. Connect Main Reservoir.
6. Open angle cocks.
   – Hoses may be connected on either side.
   – All Isolation Switches must be in RUN position.

MULTIPLE UNIT OPERATION (Cont'd.)

If for any reason (3) and (4) Independent Release and No. 3 Control pipes are not connected between units, one independent handle in the trailing unit must be placed in the Running position.

Setting up cab controls

The procedure for changing ends (with engine running), is the same for single or multiple unit operation, with the exception that with multiple unit operation, the brake handles are removed from the brake pedestal of the trailing unit and placed in the glove box at that end.

When leaving cab:

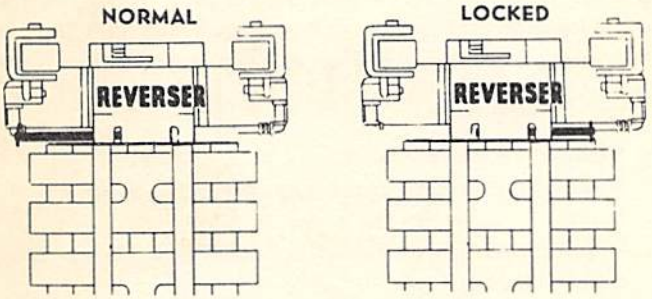
1. Remove reverser handle.
2. Make full service brake application with automatic brake.
3. Close brake valve isolating cock and remove both brake handles.
4. Switch circuit breakers on driver's control panel to OFF.
5. Switch off lights not required, close doors and windows.
6. Walk through unit or units to opposite end.

When entering cab:

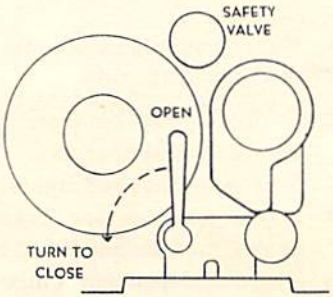
1. Switch circuit breakers on driver's control panel ON as for normal operation.
2. Switch on required lights.
3. Insert reverser and brake valve handles and place dynamic brake handle to No. 1 position.
4. Place independent brake handle in full application position.
5. Open brake valve isolating cock.
6. Proceed with normal locomotive operation.

TOWING THE LOCOMOTIVE

1. Reverser handle should be removed.
   – The reverser switch should be centred in the neutral position by manually operating the buttons on top of the switch. The locking pin normally carried on the left side of the reverser switch should be inserted from the right side and screwed home to lock the reverser.



2. Isolation switch should be in START position.
3. Brake Valve Isolating Cock should be closed.



4. Dead Engine Device cock in the distributing valve should be open, handle pointing toward safety valve.
5. Both brake handles should be in the RUNNING position.

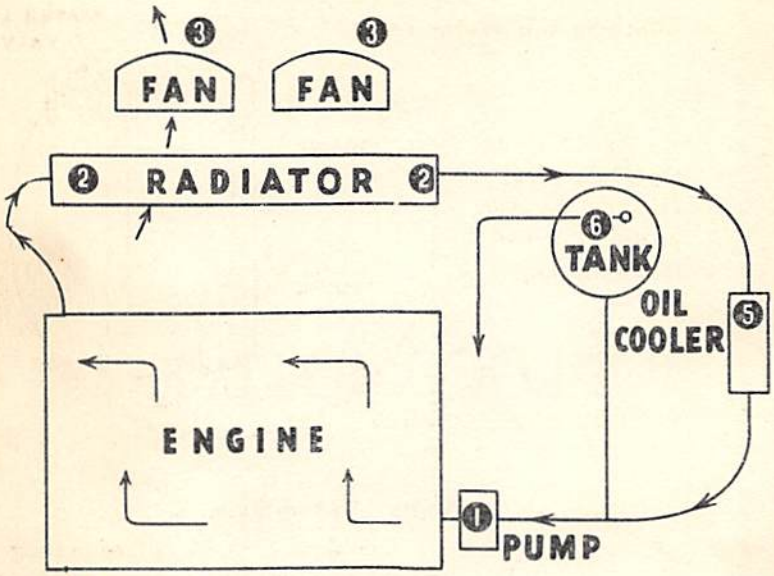
PART 4

LOCOMOTIVE SYSTEMS

THE CLYDE ENGINEERING CO. PTY. LTD.
AUSTRALIA

"HOME OF THE DIESEL LOCOMOTIVE"

COOLING SYSTEM

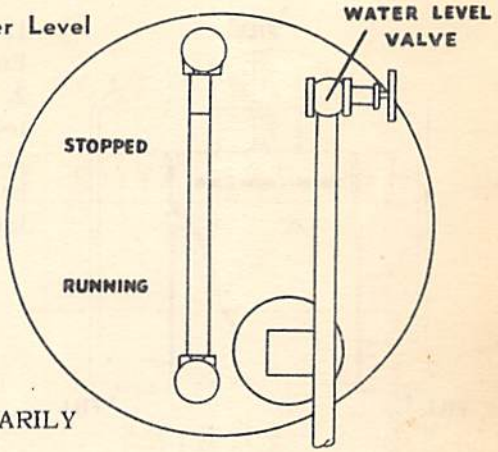


Path of the Water

1. The PUMP drives water through the engine to cool the cylinders.
2. The RADIATORS receive this water and the heat is given up to the air.
3. COOLING FANS control the amount of air through the radiators by operating in varying combinations.
4. THERMOSTATS cut the cooling fans in and out in accordance with engine tempeature.
5. The LUBE OIL COOLER uses the water to remove heat from the engine lubricating oil.
6. THE TANK
   - Provides a reservoir of space for water draining from the radiators when the engine shuts down.
   - Provides surplus water to make up for evaporation.

COOLING SYSTEM (Cont'd.)

Checking the Water Level



As long as there is any water showing in the glass it is safe to run the engine.

DO NOT ADD WATER UNNECESSARILY

Water Temperature

Should be 125° F, before putting the engine to work.

- Alarms start at 208° F.
- Engine should not be operated with water boiling.

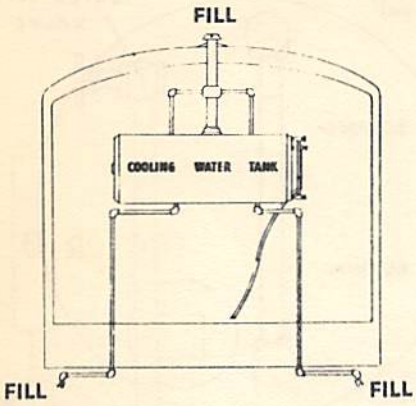
Water Treatment

The water used in the Diesel Locomotive Cooling system is treated with a special compound to reduce mineral deposits and resist corrosion. This treatment is different from that used for steam locomotives. For this reason the system should ONLY be filled where this special water is available.

Only in emergency should ordinary water be used.

Treated water must not be used for drinking or washing.

COOLING SYSTEM (Cont'd.)

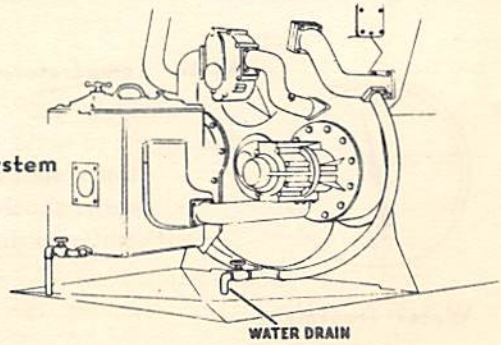


Filling the System

1. Stop the Diesel Engine.
2. Open the water level valve.
3. Attach a filling hose at any FILL location.
   (a) Fill the system slowly until water runs out of the Water Level Pipe.
   (b) Close the Water Level Valve.

Draining the System

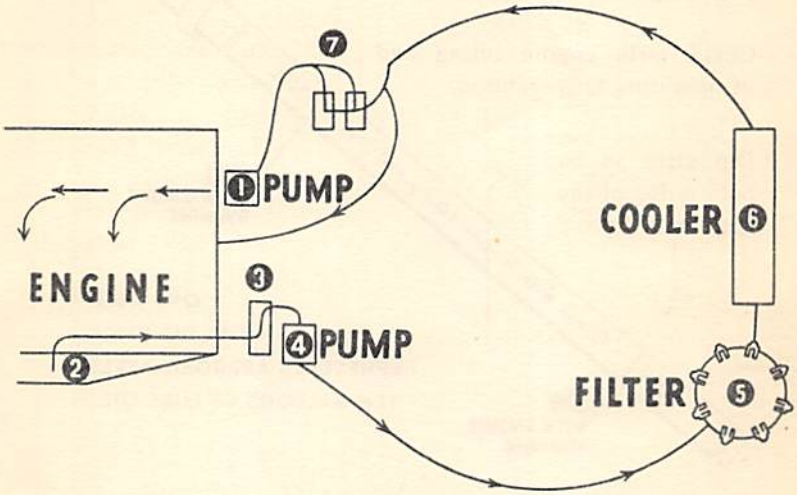
1. Open the drainvalve.



PRECAUTIONS – Sudden changes in engine temperature cause expansion and contraction which cracks engine parts, cause seals to shrink and generally cause leaks.

DO NOT FILL HOT ENGINES WITH COLD WATER

LUBE OIL SYSTEM



Path of the Oil

1. The PRESSURE PUMP delivers the oil to the engine where it lubricates and cools the engine parts.
2. The ENGINE SUMP receives the oil when it has finished its job.
3. A STRAINER prevents particles from damaging
4. the SCAVENGER PUMP which sends oil to
5. the OIL FILTER where the oil is cleaned and
6. the LUBE OIL COOLER where the heat of the oil is given to the engine cooling water.
7. The SUCTION STRAINERS prevent particles from damaging the pressure pump which sends the oil back through the engine.

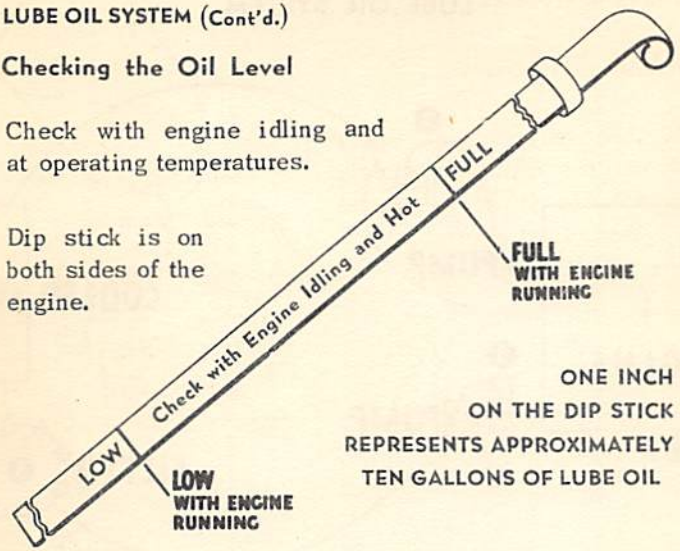
   – Surplus oil overflows to the engine sump.

LUBE OIL SYSTEM (Cont'd.)

Checking the Oil Level

Check with engine idling and at operating temperatures.

Dip stick is on both sides of the engine.



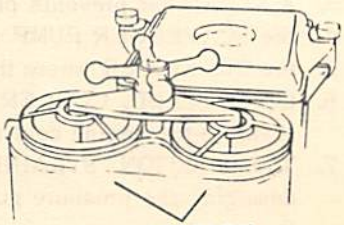
ONE INCH
ON THE DIP STICK
REPRESENTS APPROXIMATELY
TEN GALLONS OF LUBE OIL

Oil Pressure

Full engine speed
– Usually 30 to 50 lbs. but should not be less than 20 lbs. per square inch.
Idle Speed – 6 lbs. minimum.
– If Pressure falls dangerously low or suction is too high the engine will shut down automatically.
– Low oil pressure may indicate a low oil level.

High suction usually indicates dirty suction strainer

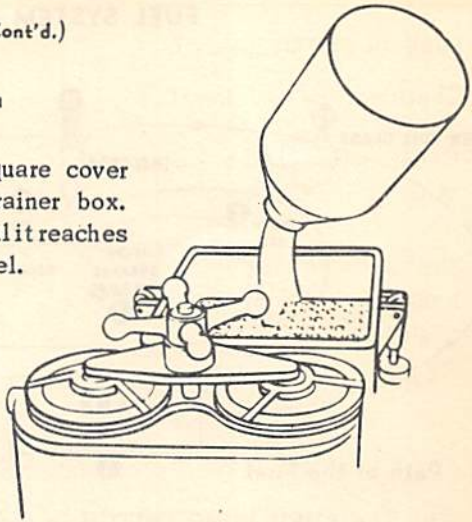
– Strainers cannot be removed unless engine is shut down.



LUBE OIL SYSTEM (Cont'd.)

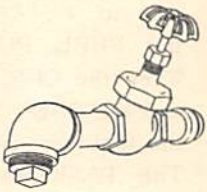
Filling the System

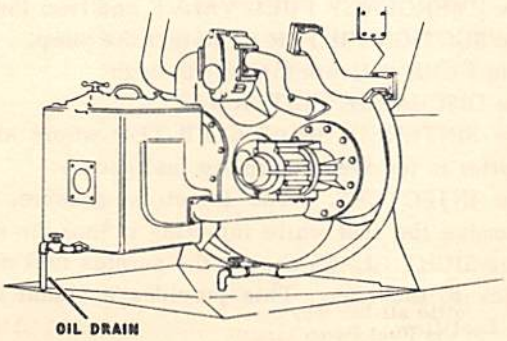
1. Remove the square cover on the oil strainer box.
2. Pour in oil until it reaches the correct level.



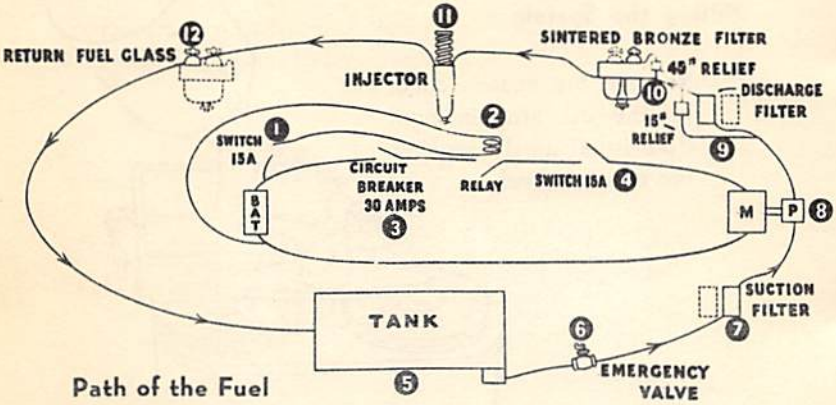
Draining the Oil

1. Remove drain plugs and open valves.





FUEL SYSTEM



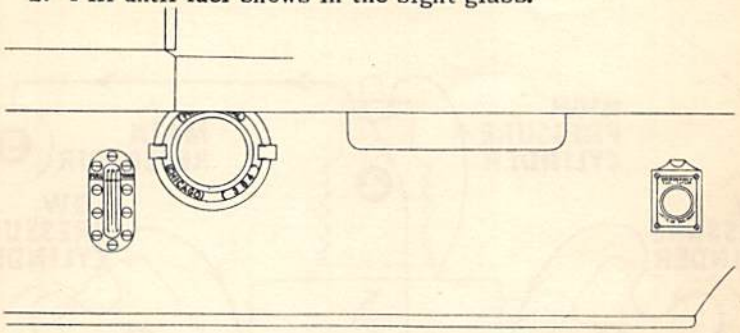
Path of the Fuel

1. The FUEL PUMP SWITCH in the cab closes the circuit to
2. the FUEL PUMP relays in all locomotive units.
3. When the CIRCUIT BREAKERS in each unit are ON
4. and the FUEL PUMP SWITCH in each unit is closed, the fuel pump begins to run.
5. The TANK where the fuel is stored supplies fuel through
6. the EMERGENCY FUEL VALVE and from there to
7. the SUCTION FILTER to protect the pump.
8. The PUMP delivers the fuel through
9. the DISCHARGE FILTER and
10. the SINTERED BRONZE FILTER where all foreign matter is removed before the fuel goes to
11. the INJECTORS. The injectors measure, time and atomise the fuel while injecting it into the cylinders.
12. The SIGHT GLASS checks the surplus fuel on the way back to the tank. This provides a visual indication of fuel flow.

FUEL SYSTEM (Cont'd.)

To Fill the Tank

1. Remove the cap on either side of the locomotive.
2. Fill until fuel shows in the sight glass.

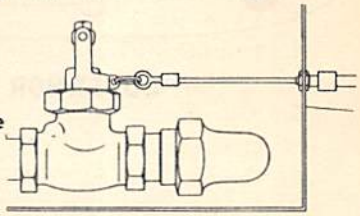


KEEP OPEN FLAMES AWAY WHEN FILLING.

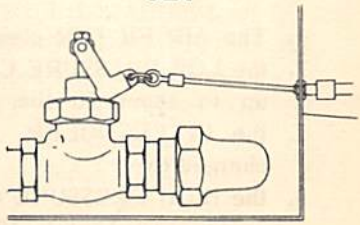
In case of fire pull emergency fuel valve rings on either side of the locomotive.

To Reset the Emergency Valve

1. Go outside of the locomotive to the rear of the fuel tank on the left side. – Open the box covering the valve.
2. Pull up the stem of the valve and block it up by pulling cage under.

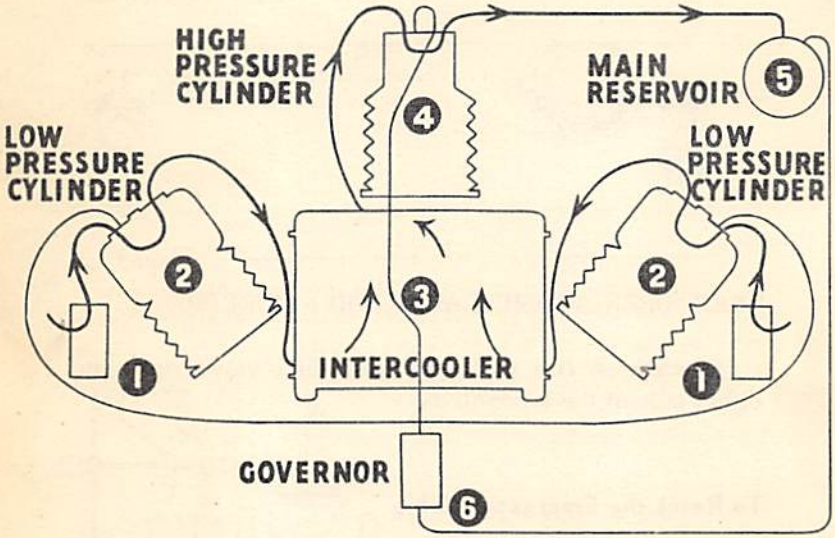


SET



TRIPPED

AIR SYSTEM



Path of the Air

1. The AIR FILTER cleans the air before passing it to
2. the LOW PRESSURE CYLINDERS. The air is pumped up to about 30 lbs. pressure and discharged into
3. the INTERCOOLER. The air is cooled and discharged to
4. the HIGH PRESSURE CYLINDER where it is pumped up to approximately 120 lbs. and discharged into the main reservoir.

AIR SYSTEM (Cont'd.)

Air Compressor Unloaded

5. When the MAIN RESERVOIR reaches its maximum pressure it unseats a piston in
6. the AIR COMPRESSOR GOVERNOR.
7. The UNLOADER LINES carry the air pressure to the compressor suction valves.
   – The pressure in the unloader lines holds the suction valves off their seats. Even though the compressor continues its rotation, no air is compressed. The air goes in and out through the breathers.

Air Compressor Loaded

When the pressure in the main reservoir is reduced, a spring in the governor forces the governor piston down and closes off the air from the main reservoir. This causes the suction valve to seat and the compressor to start pumping.

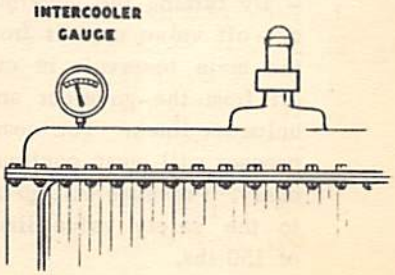
Lubricating Oil Pressure and Level

Pressure should be
– 10 lbs. minimum at idle speed.

Intercooler Pressure

Intercooler gauge should register approximately 30 lbs. when the compressor is pumping.

– relief valve is set at 50 lbs.
– If the pressure with the compressor pumping is substantially higher or lower than 30 lbs. it should be reported.



AIR SYSTEM (Cont'd.)

Main Reservoir Pressure

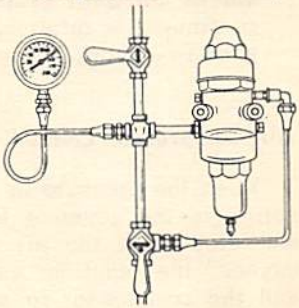
Pressure should be 110 to 120 lbs.

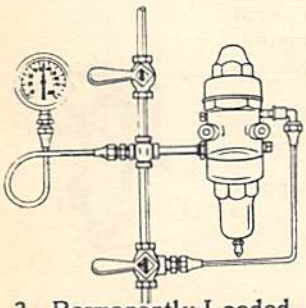
– Control is automatic, but can be controlled manually.

Manual Control of Air Pumping

In emergencies it may be necessary to control the loading and unloading of the compressor manually.

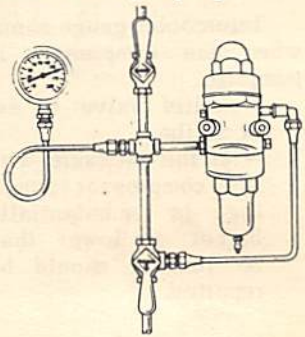
1. Normal Operation
   – The governor controls the compressor.
   – Valves should be as indicated in the diagram.





2. Permanently Unloaded
   – By turning the by-pass valve handle up, air from the main reservoir goes direct into the unloader line, this prevents the compressor from pumping.

3. Permanently Loaded
   – By turning the governor cut-off valve up, air from the main reservoir is cut off from the governor and unloader lines. The compressor will pump continuously. Pressure will go up to the safety valve limit of 150 lbs.



GENERATOR LOAD CONTROL

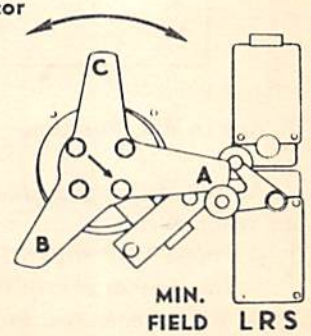
Load Regulator - Description

The function of the load regulator is to vary the battery field current in the main generator.

The Load Regulator also
– Engages and disengages the TEASER circuit used for faster starting.
– Makes FORWARD TRANSITION, by changing the traction motor connections from SERIES–PARALLEL to PARALLEL.

The movement of the load regulator arm is controlled by the flow of oil from the engine governor.

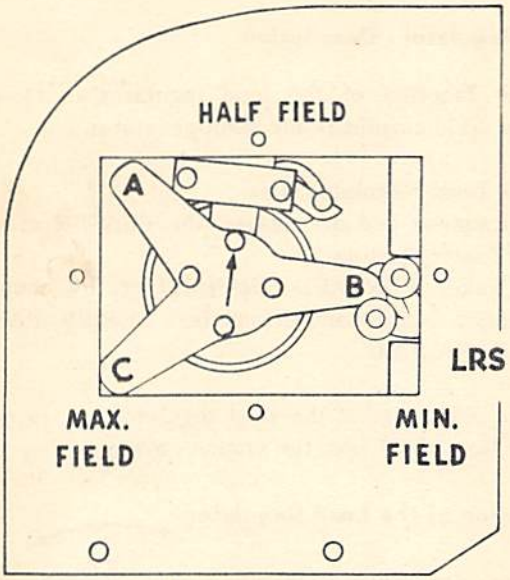
Operation of the Load Regulator



A. Arm in minimum Field Position.

When the throttle is in idle – the load regulator arm moves to the minimum field position.
– Finger "A" holds down the load regulator switch (LRS)
– In this position the "Teaser" circuit is partially established, and the amount of battery field current to the main generator is controlled by the throttle position through the A, B and C Teaser contactors in the No. 1 Electrical Cabinet.

GENERATOR LOAD CONTROL (Cont'd.)



B. Arm in Mid-Position.

As the locomotive gathers speed and the load regulator arm reaches mid-position

– Finger "B" trips LRS.

– The Teaser circuit is now inoperative and

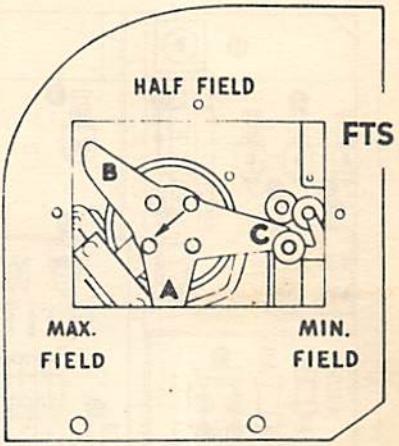
– Main generator excitation is normal, being controlled by the movement of the load regulator arm.

– The Teaser circuit remains inoperative until the load regulator arm returns to minimum field and finger "A" trips LRS in the reverse direction.

This occurs every time the throttle is closed to IDLE.

GENERATOR LOAD CONTROL (Cont'd.)

When the load regulator arm reaches maximum field position
–Finger "C" closes the Forward Transition Switch (FTS) and causes FORWARD TRANSITION to take place
– opening the SERIES-PARALLEL power Contactors S16, S23 and S45 and closing the PARALLEL power Contactors P1, P2, P3, P4, P5 and P6.

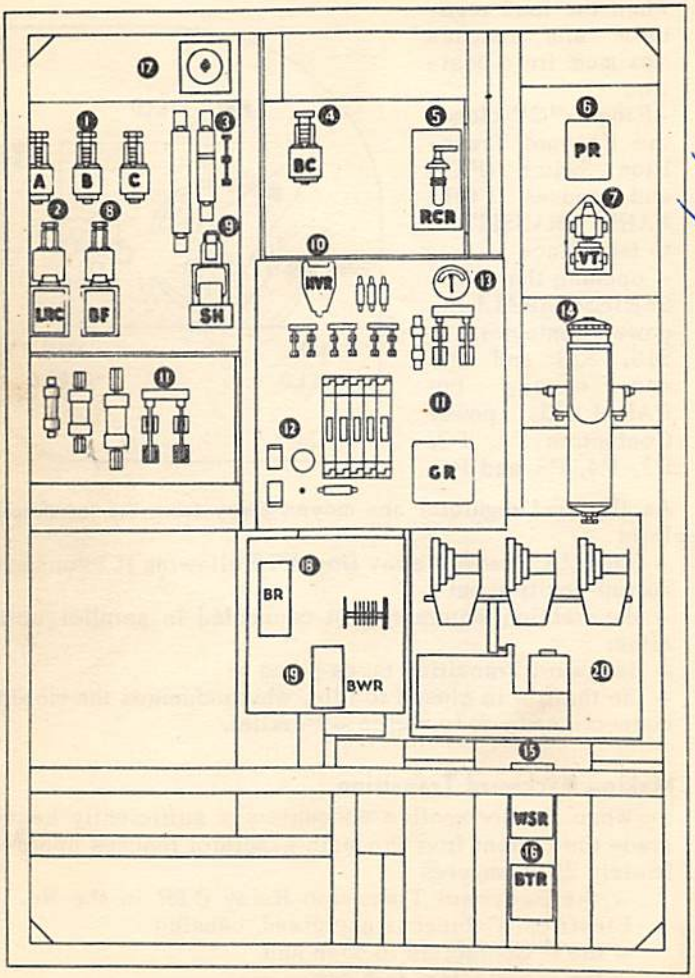


As the load regulator arm moves away from the maximum field
– finger "C" moves away from FTS allowing it to assume normal position but
– the traction motors remain connected in parallel until either
– Backward Transition takes place or
– the throttle is closed to Idle, which changes the motors connections back to Series – Parallel.

Making Backward Transition

When the locomotive encounters a sufficiently heavy grade the current from the main generator reaches approximately 2500 amperes
– the Backward Transition Relay BTR in the No. 1 Electrical Cabinet is energized, causing
– the P Contactors to open and
– the S contactors to close.
– The traction motor connections have been changed from PARALLEL to SERIES – PARALLEL.

ELECTRICAL CONTROLS



FRONT OF No. 1 ELECTRICAL CABINET

ELECTRICAL CONTROLS (Cont'd.)

Front of No. 1 Electrical Cabinet

1. TEASER CONTACTORS – used for fast starting of locomotive.

2. LOAD REGULATOR CONTACTOR – Controls the feed to the teaser contactors.

3. GROUND RELAY CUTOUT – Not to be opened by engine crews. Opens circuit to ground relay.

4. BATTERY CHARGING CONTACTOR – Connects the battery to the auxiliary generator when the engine is running. Controlled by the Reverse Current Relay.

5. REVERSE CURRENT RELAY – When current flows from the auxiliary generator toward the battery, it closes the B.C. When the current reverses it opens the B.C.

ELECTRICAL CONTROLS (Cont'd.)

6. PARALLEL RELAY – Controls transitions from series to parallel and back.

7. TIME DELAY RELAY – Delays the opening of the main power contactors during transition to give the generator field time to die.

8. BATTERY FIELD CONTACTOR – Connects the main generator battery field to the low voltage.

9. SHUNT FIELD CONTACTOR – Connects the main generator shunt field to the high voltage.

10. NO VOLTAGE RELAY – Lights the alarm light and sounds the bell when there is no alternating current.

11. DISTRIBUTION PANEL – Switches, fuses and circuit breakers on the panel described, as used, elsewhere in this book.

12. FUSE TEST – Lay the fuse to be tested across the copper blocks. If the fuse is good, the light should shine. To test this light tum the toggle switch on and off.

13. BATTERY CHARGING AMMETER – Should read zero or show some charge at all times with engine running.

ELECTRICAL CONTROLS (Cont'd.)

14. CONTROL AIR PRESSURE REGULATOR – Reduces main reservoir pressure for use in operating pneumatic-electric contactors.

15. WHEEL SLIP RELAY No. 1 – Lights the cab indicator, reduces the engine speed and load when the wheels slip. Connected to No. 1 and No. 3 traction motors.

16. BACKWARD TRANSITION RELAY – Protects the generator by changing circuits from parallel to series when the locomotive is heavily loaded.

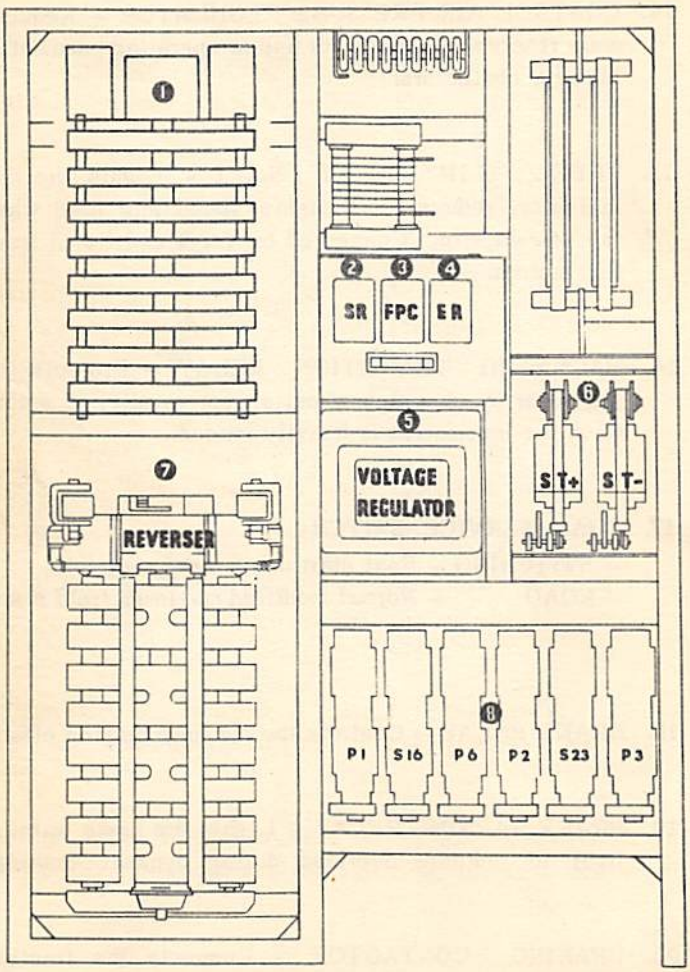
17. ROAD SERVICE SWITCH
    – SWITCHING – Fast start using Teaser circuit
    – ROAD – Normal modified maximum field start.

18. BRAKE RELAY – Controls the dynamic braking effort.

19. BRAKE WARNING RELAY – Lights the brake warning light to indicate overload during dynamic braking.

20. BRAKING CONTACTOR – Connects the traction motor fields to the main generator during dynamic braking.

ELECTRICAL CONTROLS (Cont'd.)



REAR OF No. 1 ELECTRICAL CABINET

ELECTRICAL CONTROLS (Cont'd.)

Rear of No. 1 Electrical Cabinet

1. CAM SWITCH No. 1 – During dynamic braking connects No. 1, No. 2 and No. 3 traction motor armatures to the braking grids and establishes braking fields.

2. SIGNAL RELAY – Rings the alarm bell.

3. FUEL PUMP CONTACTOR – Emergency feature. Makes it possible for the driver to stop all fuel pumps from the cab.

4. ENGINE CONTROL RELAY – Controls circuit from the throttle to the governor.

5. VOLTAGE REGULATOR – Controls the auxiliary generator output to a fixed voltage.

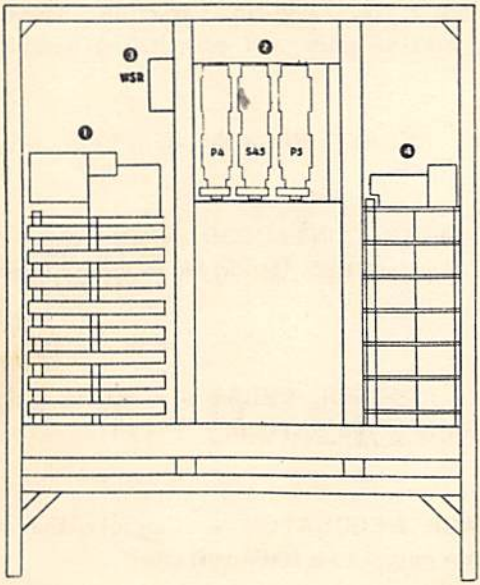
6. STARTING CONTACTORS – Connect the battery to the main generator for turning the engine over.

7. REVERSER No. 1 – Changes the traction motor connections to reverse the direction of locomotive movement.

8. POWER CONTACTORS – Connect the traction motors with the main generator.

ELECTRICAL CONTROLS (Cont'd.)

FRONT OF No. 2 ELECTRICAL CABINET



1. CAM SWITCH No. 2 – During dynamic braking connects No. 4, No. 5 and No. 6 traction motor armatures to the braking grids and establishes braking fields.

2. POWER CONTACTORS – Connect the traction motors to the main generator.

3. WHEEL SLIP RELAY No. 2 – Lights the cab indicator reduces the engine speed and load when the wheels slip. Connected to No. 4 and No. 6 traction motors.

4. REVERSER No. 2 – Changes the traction motor connections to reverse the direction of locomotive movement.

PART 5

TROUBLE SHOOTING

THE CLYDE ENGINEERING CO. PTY. LTD.
AUSTRALIA

"HOME OF THE DIESEL LOCOMOTIVE"

ENGINE WILL NOT START

Engine will not Turn Over

Check:

1. Control circuit breaker on driver's control panel
2. Main Battery Switch
3. Control Switch on distribution panel.
4. 400 amp. starting fuse.
5. Isolation Switch – must be in START.

Engine Rotates but will not Fire

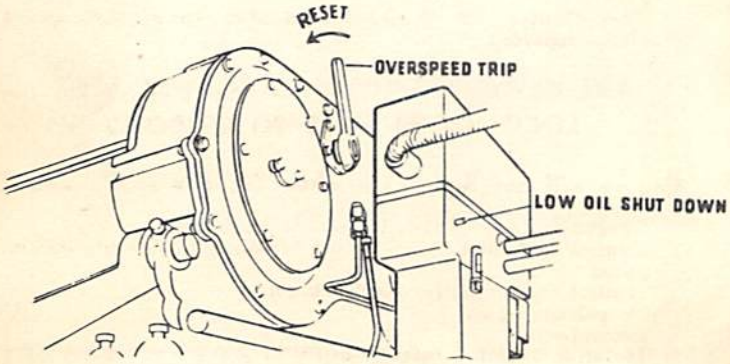
Check

1. Overspeed trip
2. Low oil pressure button on governor
3. Fuel flow in sight glass
4. Fuel pump circuit breakers on driver's control panel and distribution panel.
5. Fuel Pump switch on engine control panel
6. Emergency fuel cut-off valve.

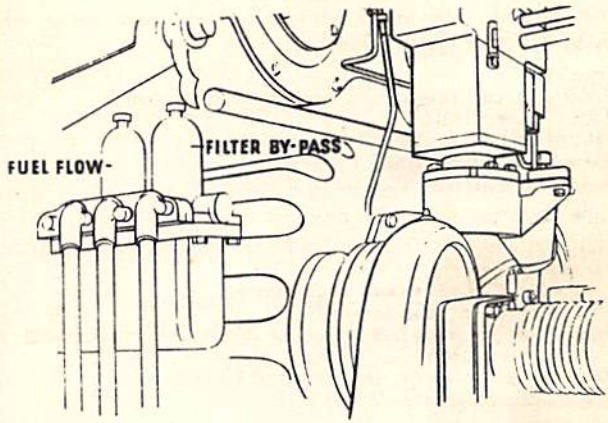
If the engine starts but stops as soon as the Isolation Switch is turned to RUN the throttle may be in the STOP position.

OVERSPEED TRIP

Operates at approximately 900 RPM.
- Fuel is stopped at Injectors.
- Engine cannot be started.
- PULL LEVER ANTI–CLOCKWISE TO RESET.
- Start engine in usual manner.



FUEL FLOW



Normally a good flow of fuel clear and free from bubbles should be indicated in the return sight glass.

If no fuel flow, check:

1. Fuel pump and motor.
2. Circuit breakers and switches.

If motor is running but fuel is not flowing, check:

1. Fuel supply.
2. Emergency fuel cut off valve.
3. Leak in suction piping between tank and pump.
4. Broken or slipping coupling between motor and pump.

Fuel flowing out of stand pipe in by-pass sight glass should be reported.

LOCOMOTIVE FAILS TO RESPOND

Engine will not Speed Up when Throttle is Opened

Check:

1. Control and Fuel Pump circuit breakers on driver's control panel.
2. Control switch in electrical cabinet.
3. No voltage relay.
4. Ground relay.
5. Isolation Switch – must be in RUN.

LOCOMOTIVE FAILS TO RESPOND (Cont'd.)

Engine Speeds Up but Locomotive will not move when Throttle is Opened

Check:

1. Reverser handle – must be forward or reverse.
2. Generator field circuit breaker on drivers control panel.
3. 80 amp. battery field fuse.
4. Control air pressure – must be 90 lbs. Isolate engine before changing.
5. Starting contactors – must be open and interlocks closed.
6. Hand and air brakes – must be released.

Engine goes to Idle

Check:

1. Ground Relay.
2. No Voltage Relay.
3. Control and Fuel Pump circuit breakers on driver's control panel.

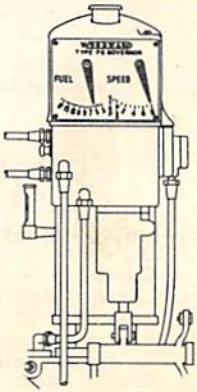
Engine Stops

Check:

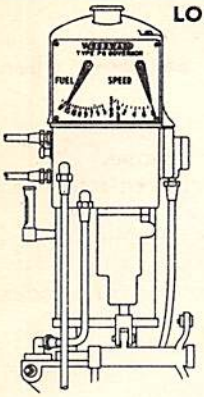
1. Throttle – may be in STOP position
2. Control and Fuel Pump Circuit breakers on driver's control panel.
3. Fuel Pump circuit breaker in electrical cabinet.
4. No Voltage Relay.
5. Ground Relay.
6. Overspeed Trip.
7. Low oil pressure button.
8. Fuel Pump switch on Engine control panel.
9. Emergency fuel cut-off valve.

Engine Loading

Speed and Fuel indicators on the cover of the governor should be approximately parallel at all throttle positions.



CORRECT



LOCOMOTIVE FAILS TO RESPOND (Cont'd.)

1. Check with throttle in 8th notch.
   – Excessive fuel indicates engine trouble.
   – Minimum fuel indicates electrical trouble.

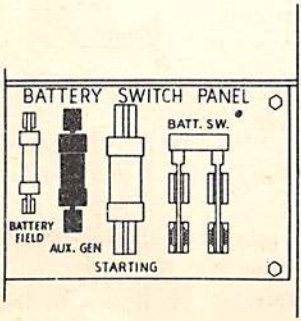
If indication incorrect:

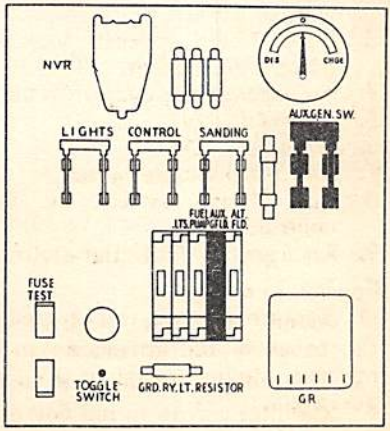
1. Isolate engine.
2. Check Battery field fuse.

INCORRECT **Battery Charging Ammeter**

If Ammeter shows continuous DISCHARGE with engine running – Check:

1. Auxiliary generator field circuit breaker and auxiliary generator switch in electrical cabinet.
2. Battery charging (Auxiliary Generator) fuse - 150 amp.
3. Battery charging contactor on front of electrical cabinet – must be closed.



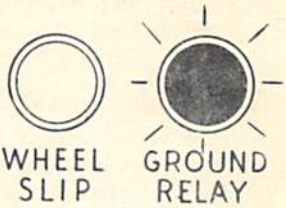


ALARMS

Alarm Bell situated on the rear wall of both cabs.

Alarm lights –

(a) On the driver's control panel:
Ground Relay – Main generator Grounded.



(b) On the Engine Control Panel:
Red – Hot Engine.
Yellow – Low Oil Pressure or High Suction.
Blue – Alternator failure.

In Multiple Unit operation
– Alarm Bell rings in all units.
– Light shows ONLY in unit in trouble.

Ground Relay

Engine will return to idle or will stop if throttle in notch 5 or 6. If Engine stops, blue light will also be lit.

1. Isolate Engine, reset ground relay be pushing button to move pointer from red to yellow dot.
2. Put engine on the line and if relay continues to trip (pointer moves to red dot) do not use power in this unit.

ALARMS (Cont'd.)

Red Light - Hot Engine Alarm

Engine water temperature is over 208° F. at outlet:

1. Isolate engine and investigate cause.
   – Bell will stop and light will go out when engine cools.

Yellow Light - Low Oil Pressure or High Oil Suction

Trip button moves out till red band appears. Engine will stop and blue light will also be lit.

1. Isolate engine and reset the governor trip button.
2. Check oil level and condition.
3. Start engine and observe oil pressure and suction gauges.
   – If fault still exists engine will shut down after approx. 40 seconds running at idle speed.
   – If an attempt is made to run above idle speed during the delay period, the engine will stop immediately.

Blue Light - Alternator Failure

Designed to indicate "no voltage" on the alternator. Due to alternator being stopped light will burn whenever engine stops while "on the line".

1. Turn Isolation Switch to START.
   Check:
2. Overspeed Trip.
3. Oil Pressure Failure.
4. Fuel Flow.
5. Start engine and put "on the line".

If light comes on instantly or burns with engine running the No Voltage Relay may be open.

If NVR opens the engine will go to IDLE or will stop if throttle is in Notch 5 or 6.

Check:

1. Auxiliary Generator circuit breaker.
2. Alternator Field circuit breaker.
3. Battery charging (Auxiliary Generator) fuse

CAUTION – Open the auxiliary generator switch in the electrical cabinet before removing or replacing fuse or resetting circuit breakers.

GENERAL SPECIFICATIONS

Weight (fully loaded) 112 Tons	240,000 lbs.
Starting Tractive Effort	60,000 lbs.
Continuous Tractive Effort	40,000 lbs.
Speed at Continuous Rating	11 m.p.h.
Maximum Permissible Speed	83 m.p.h.
Gear Ratio	59/18
Number of drivers	12
Weight on drivers	100%
Wheel diameter	40"
Fuel Oil	1000 gallons
Lube Oil	165 gallons
Cooling Water	185 gallons
Sand	16 cubic feet
Bogie Centres	34 feet
Bogie Rigid Wheelbase	13 ft. 2 in.
Minimum Curve Radius	5 chains
Length between coupler pulling faces	60 ft. 10 in.
Height above rail level	14 ft.
Width overall	9 ft. 9 in.
Track Gauge	5 ft. 3 in.