



Operating Instructions
"N" Class
Diesel Electric
Locomotive



N CLASS DIESEL ELECTRIC LOCOMOTIVES

INTRODUCTION

The following operating manual for V/Line N Class Diesel Electric Locomotives has been prepared as a reference for V/Line Locomotive Drivers when operating these locomotives.

These locomotives use the latest advancements in locomotive technology. This book will describe the operating characteristics of these locomotives and has a comprehensive fault finding section at the rear.

It is strongly advised to immediately report any operating irregularity or malfunction of these locomotives in the Locomotive Log Book and also advise Locomotive Maintenance staff and Train Control by the Train to Base radio.

CONTENTS

| | <u>PAGE</u> |
|---|-------------|
| <u>INTRODUCTION</u> | 1 |
| Basic Statistics. | 2 |
| <u>SECTION 1 GENERAL DESCRIPTION</u> | 4 |
| Locomotive Cab Layouts. | 5 |
| Layout of Electrical Cabinets. | 8 |
| <u>SECTION 2 LOCOMOTIVE SYSTEMS</u> | 12 |
| The Engine and Engine Room. | 13 |
| Locomotive Operation. | 13 |
| Ground Relay. | 14 |
| Starting the Diesel Engine. | 15 |
| Stopping the Diesel Engine. | 15 |
| Engine Protector. | 16 |
| Changing Ends. | 17 |
| Vigilance Control. | 18 |
| Penalty Brake. | 18 |
| Motor/Brake Transfer Switch. | 18 |
| Reverser Transfer Switch. | 18 |
| Dead Engine Device. | 19 |
| <u>SECTION 3 NORMAL OPERATION OF LOCOMOTIVE</u> | 20 |
| Circuit Breaker Panel. | 23 |
| Power Contactors. | 25 |
| Blocked Intake Filters. | 26 |
| Staff Exchangers. | 26 |
| General Operating Instructions. | 27 |
| Head End Power Unit. | 28 |
| <u>SECTION 4 DEFECTS AND FAULT FINDING CHECKLISTS</u> | 31 |
| No Revs - Little or No Power. | 33 |
| Revs - But No Power. | 34 |
| Engine Shuts Down. | 37 |

BASIC STATISTICS

| | |
|---------------------------|---|
| MODEL NUMBER | JT 22HC - 2 |
| WHEEL NOTATION | CO - CO |
| LOCOMOTIVE POWER | 1846 KW (Engine); 1698 KW (Traction) |
| DIESEL ENGINE | 645 E3 B or 645 F3B |
| TYPE | TURBO CHARGED |
| ENGINE SPEED RANGE | 315 RPM - 900 RPM |
| LOW IDLE SPEED | 255 RPM |
| MAIN ALTERNATOR | A.R.10 |
| COMPANION ALTERNATOR | D.18 |
| AUXILIARY ALTERNATOR | 18 KW - 74 VOLTS. |
| TRACTION MOTORS | D.43 |
| GEAR RATIO | 59:18 |
| MAXIMUM PERMISSIBLE SPEED | 115 KPH |
| FUEL CAPACITY | 6800 LITRES |
| COOLING WATER CAPACITY | 681 LITRES |
| LUBRICATING OIL CAPACITY | 690 LITRES |
| ROADWORTHY WEIGHT | 118 TONNES |
| OVERALL LENGTH | 20,034 MM |
| OVERALL WIDTH | 3122 MM |
| OVERALL HEIGHT | 4260 MM |
| HEAD END POWER UNIT | 350 KVA 8 CYLINDER 8V-92T |

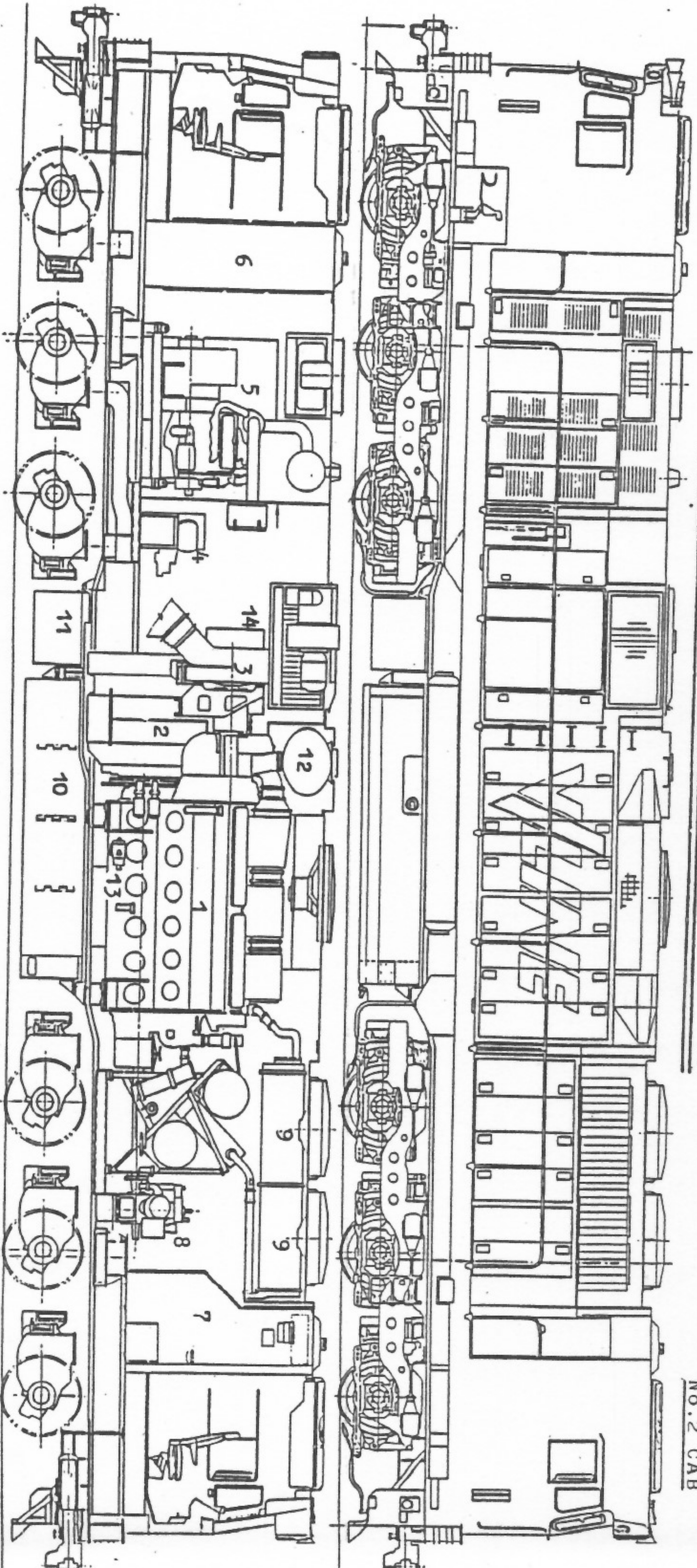
BUILT G.M., CLYDE, MARTIN & KINGS
ENTERED SERVICE SEPTEMBER, 1985.

No. 1 CAB

"N" CLASS DIESEL ELECTRIC LOCOMOTIVE

451 - 475

No. 2 CAB



PARTS ITEMISATION LIST

- 1 645E3B DIESEL ENGINE
- 2 MAIN ALTERNATOR/COMPANION ALTERNATOR
- 3 TRACTION MOTOR BLOWER
- 4 AIR BRAKE PACK 26L
- 5 HEAD END POWER UNIT
- 6 ELECTRICAL CABINET
- 7 TOILET COMPARTMENT
- 8 W.B.O. AIR COMPRESSOR
- 9 RADIATOR BANK
- 10 FUEL TANK
- 11 BATTERY BOX
- 12 EXHAUST MUFFLER
- 13 TURBO LUBE PUMP
- 14 AUXILIARY ALTERNATOR

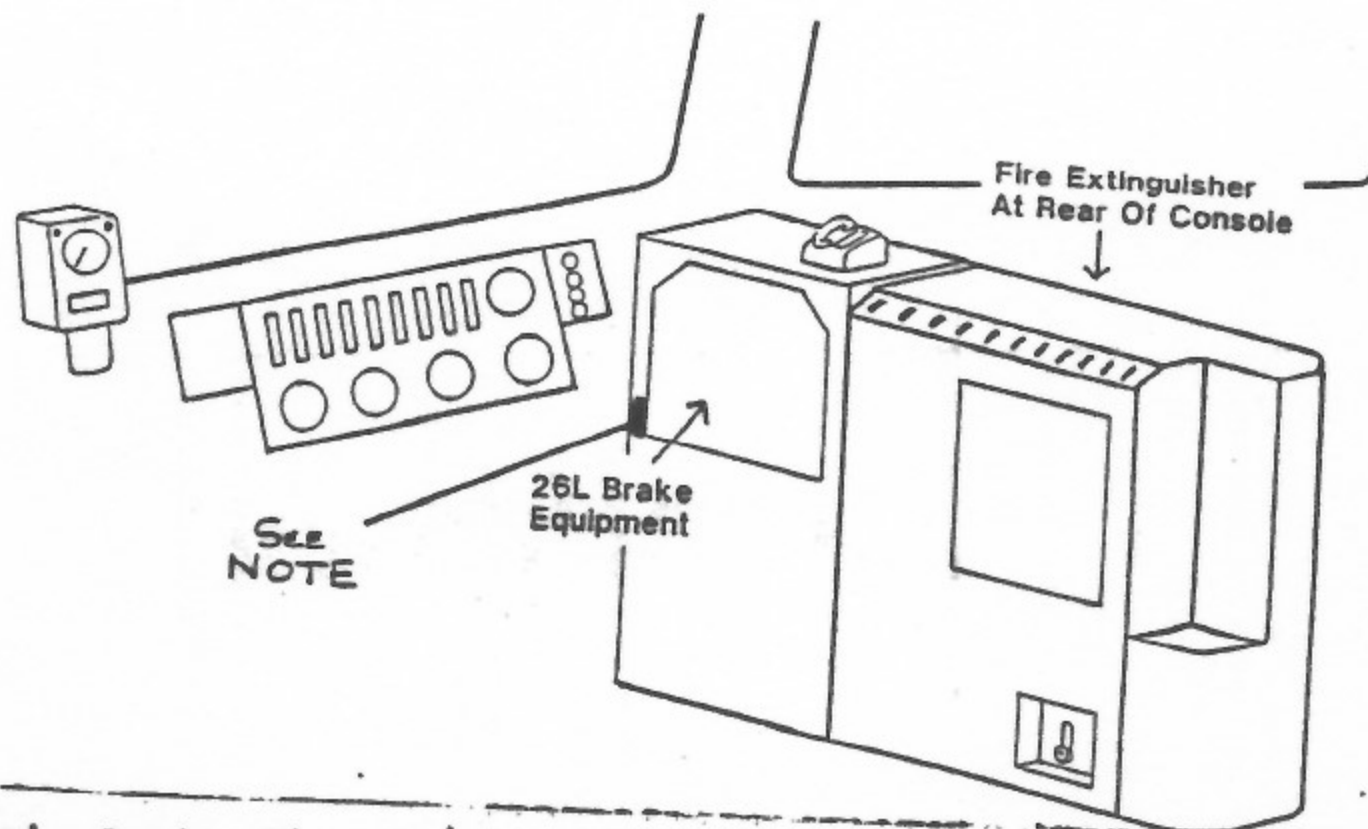
Section 1

General Description

DESCRIPTION OF LOCOMOTIVE CABS.

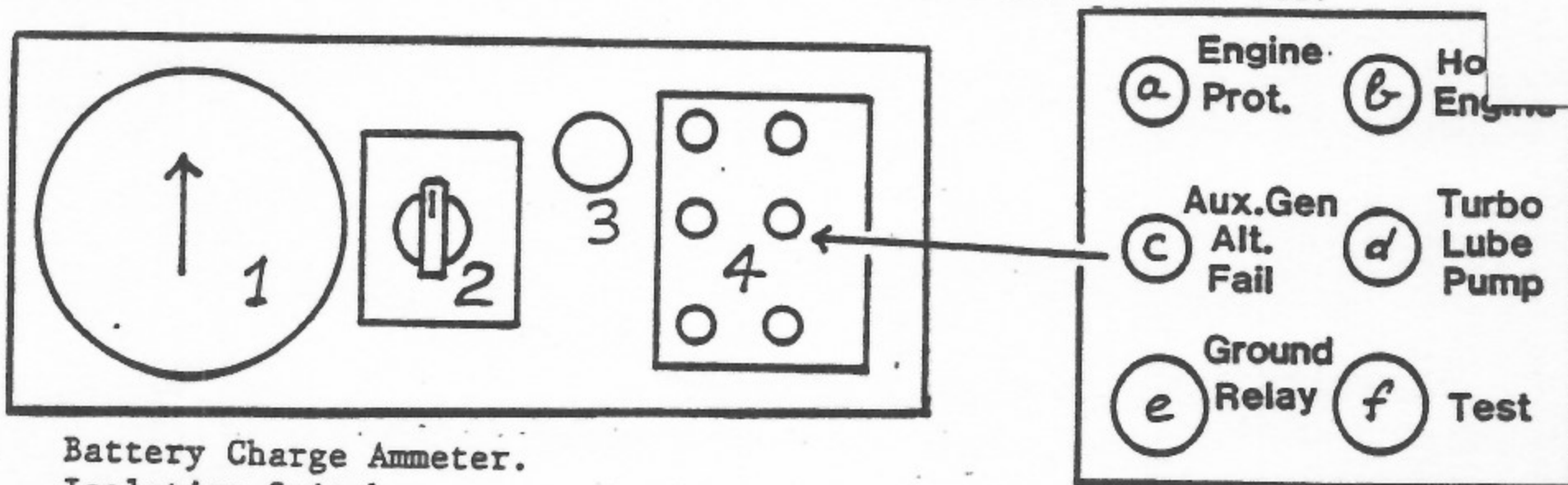
CAB CONTROLS - These locomotives are double ended and have identical driving controls at each end.

DIAGRAM OF CAB CONTROLS.



NOTE Dynamic Brake Circuit Breaker, this circuit Breaker protects the dynamic brake rheostat. MUST BE ON FOR DYNAMIC BRAKE OPERATION from that driving console.
The controls in both cabs are identical.

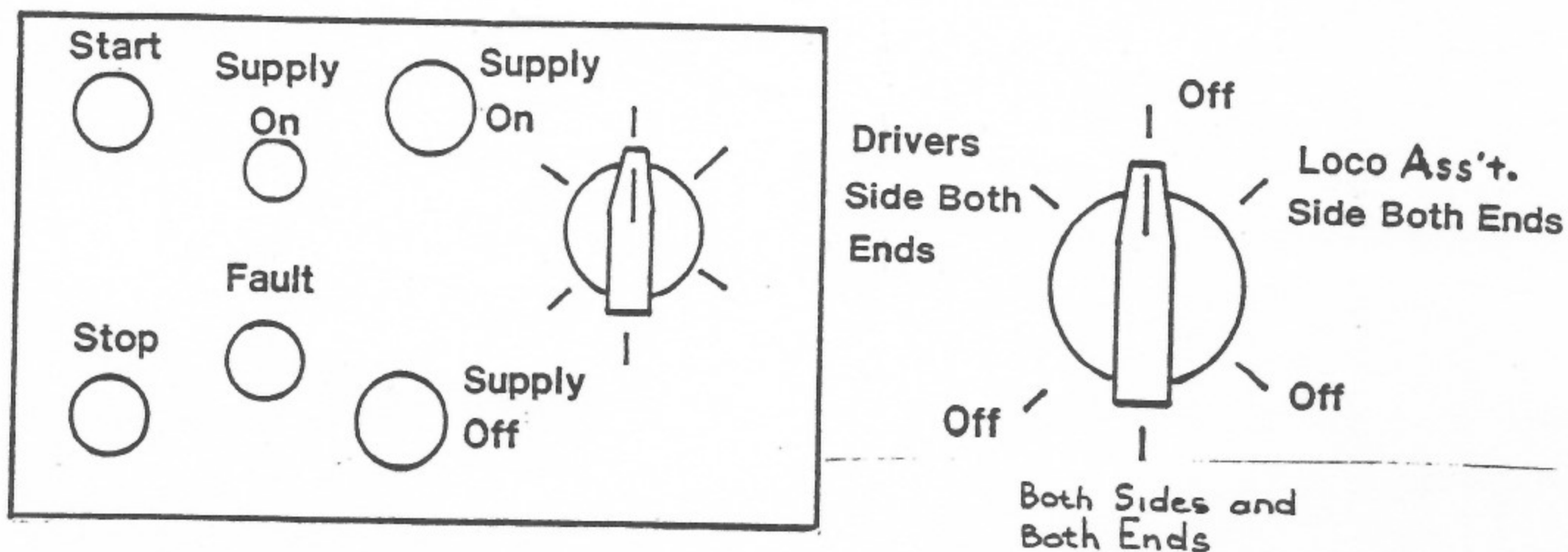
NO.1 END CAB - The following is located on the back of No.1 end Cab.



1. Battery Charge Ammeter.
2. Isolation Switch.
3. Engine STOP button.
4. Indicator Light Panel.
- (a) Engine Protector (YELLOW LIGHT)
- (b) Hot Engine (RED LIGHT)
- (c) Auxiliary Generator/Alternator Failure (BLUE LIGHT)
- (d) Turbo Tube Pump (BLUE LIGHT)
- (e) Ground Relay (RED LIGHT)
- (f) Test (YELLOW LIGHT)*

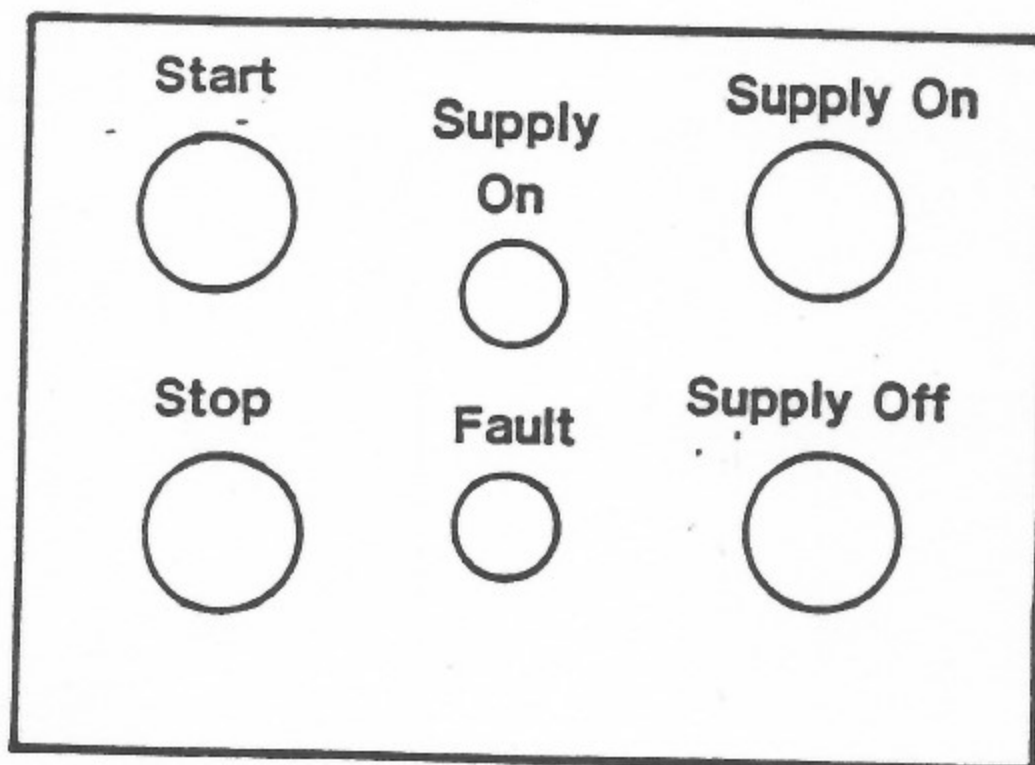
* This light, if illuminated will render the locomotive inoperative. If illuminated, Locomotive Maintenance Staff MUST be notified and their instructions carried out.

DRIVERS SIDE CEILING NO.1 END. The following diagram applies to No.1 end of the Locomotive. This panel controls the Head End Power Unit.



NOTE THE HEAD END POWER SOCKET SELECTION SWITCH IS ONLY LOCATED AT NO.1 END. BEFORE CHANGING ENDS THIS SWITCH MUST BE LOCATED IN THE POSITION THAT IS REQUIRED TO SUPPLY HEAD END SUPPLY TO CARRIAGE SETS.

DRIVERS SIDE CEILING (NO.2 END) - The following diagram applies to No.2 end of the locomotive. This panel controls the Head End Power Unit.



The following is a brief description of the above panels;

START Starts the H.E.P.UNIT.

STOP Stops the H.E.P.UNIT.

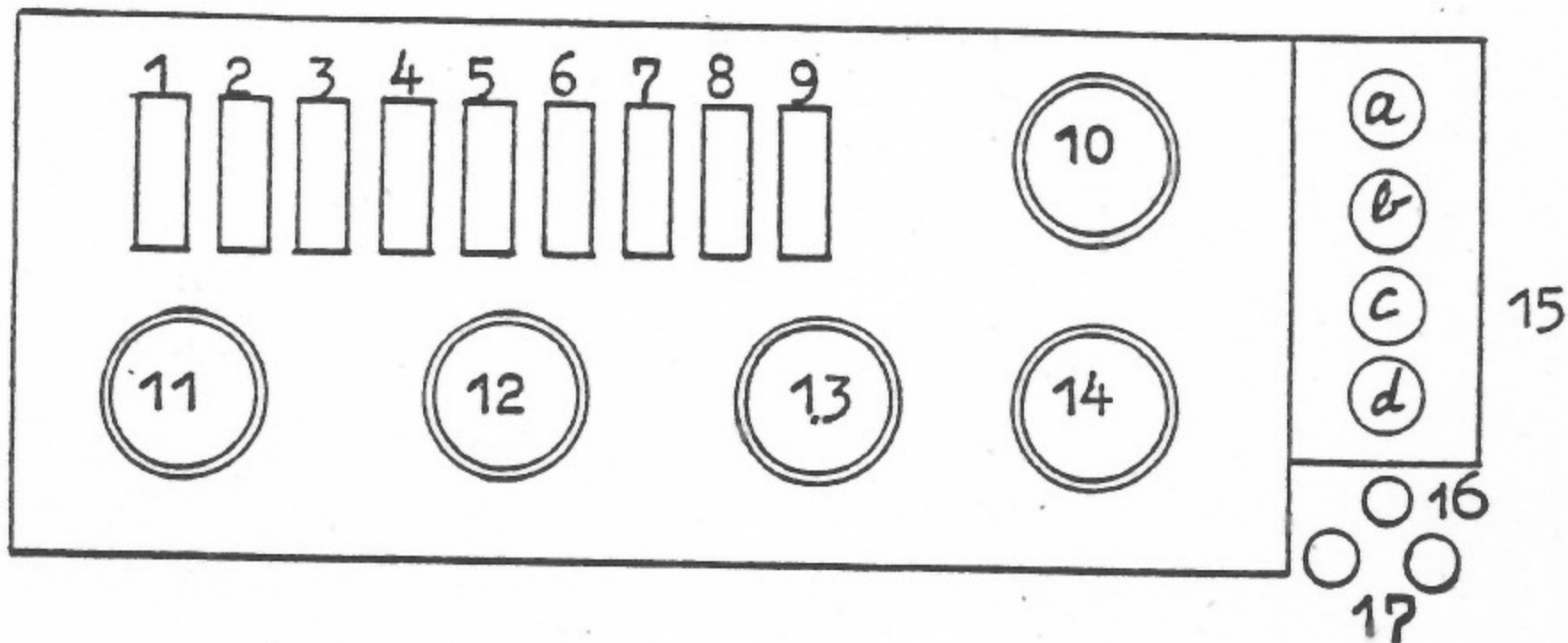
SUPPLY ON Illuminates when H.E.P. UNIT is supplying 415 Volts. to carriages.

FAULT Illuminates when H.E.P. UNIT SUPPLY has failed.

SUPPLY ON BUTTON Pushed to obtain SUPPLY (ALLOW H.E.P. ENGINE TO IDLE FOR APPROX 1 MINUTE BEFORE PRESSING).

SUPPLY OFF BUTTON Pushed to stop SUPPLY to carriages.

FOR FURTHER INFORMATION ON THE HEAD END POWER UNIT, REFER TO PAGE 28

DRIVING PANEL LAYOUT.Switches

- 1 - Headlight Dim/Up - Bright/Down.
- 2 - Headlight Front ON/OFF
- 3 - Headlight Rear ON/OFF
- 4 - Engine Run.
- 5 - Control and Fuel Pump
- 6 - Generator Field
- 7 - Manual Power Control ON/OFF
- 8 - Manual Power Control Lead Unit/All Units
- 9 - Radio

GAUGES

- 10 - Load Ammeter
- 11 - Brake Pipe Flow Indicator
- 12 - Main Reservoir/Equalizing Reservoir
- 13 - Brake Cylinders Front/Rear
- 14 - Brake Pipe

INDICATING

- 15A - Wheel Slip (Red)

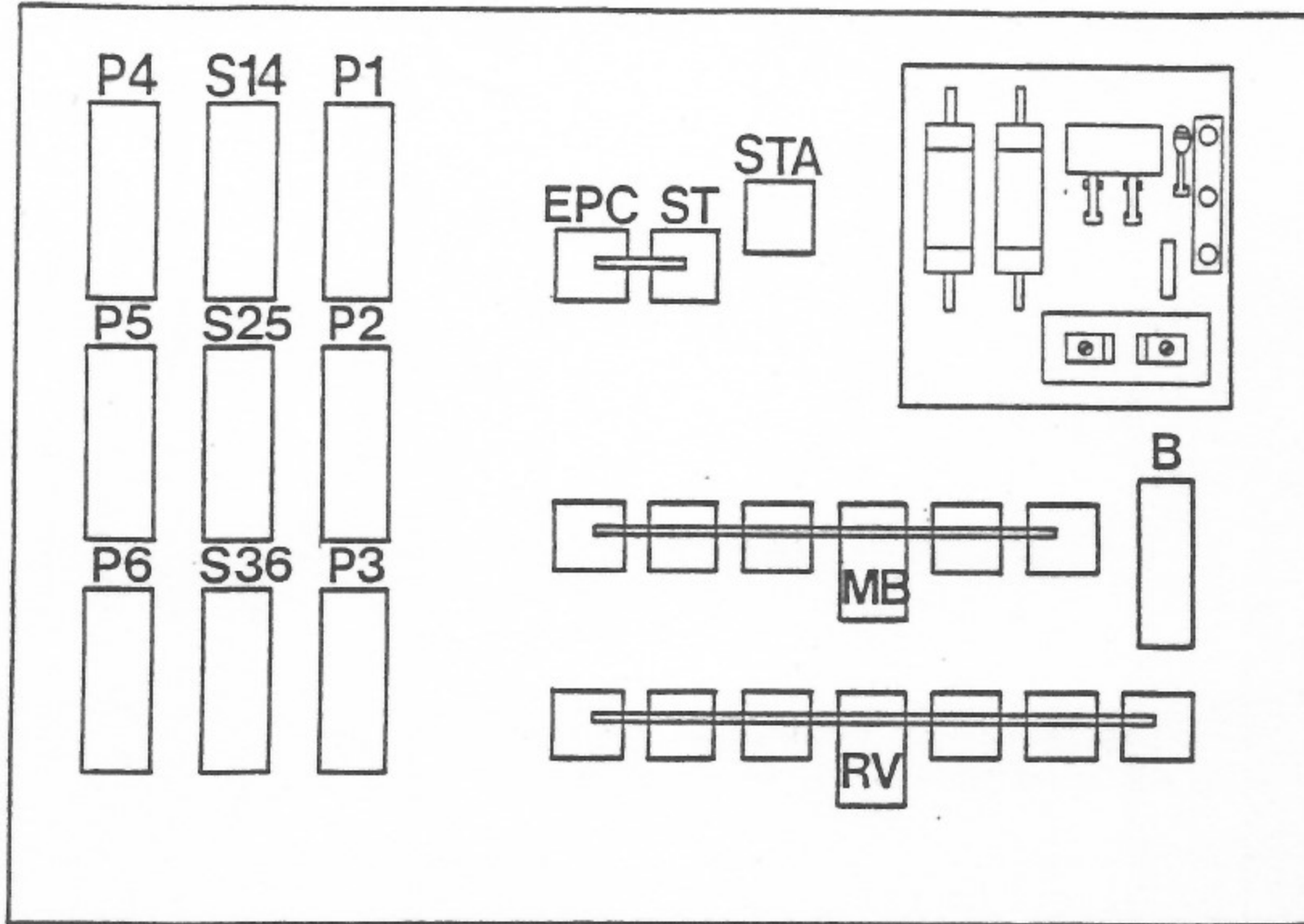
LIGHTS

- 15B - Brake Cylinder (Red)
- 15C - Fault/Brake Warning (Yellow)
- 15D - Manual Power Control (Green)

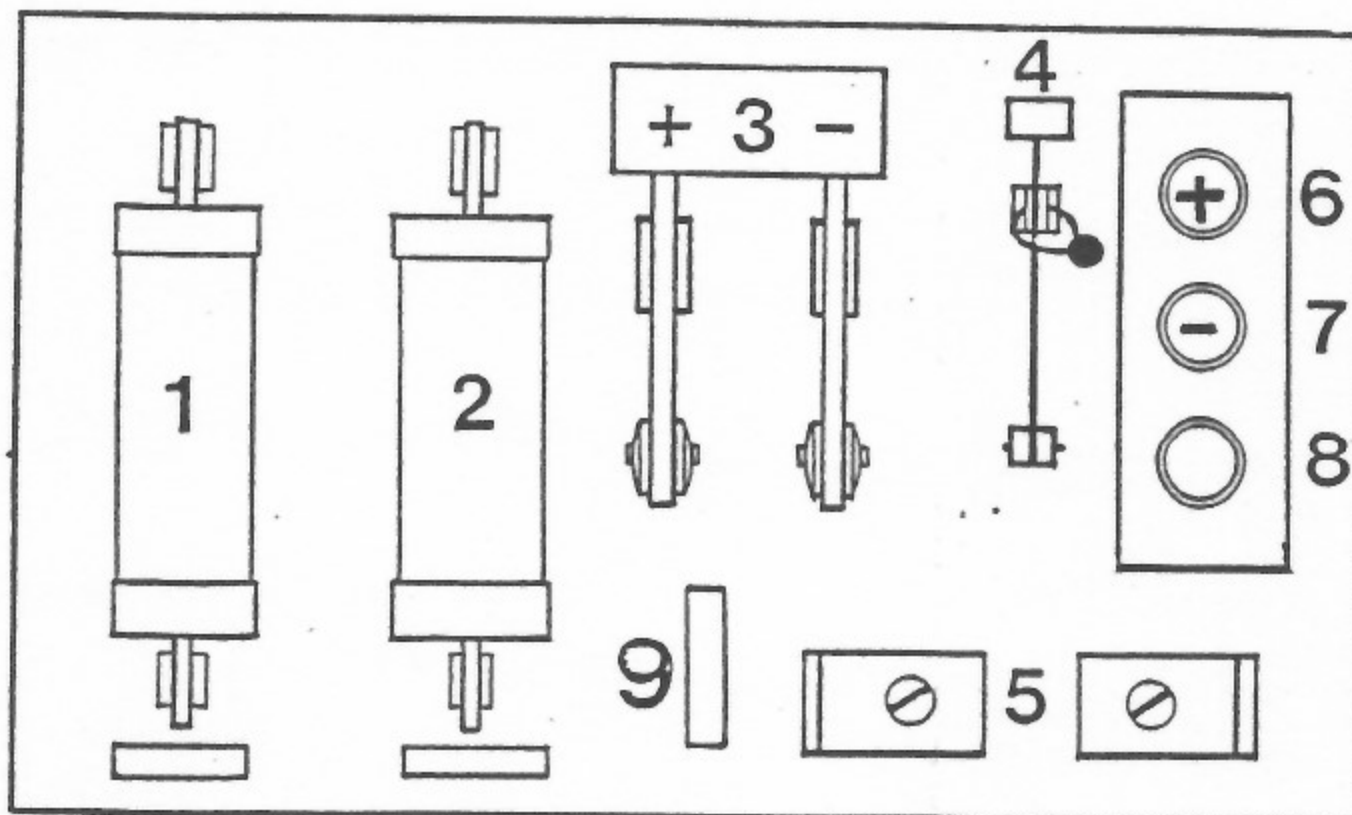
SWITCH

- 16 - Test Lamp Switch (Left Turbo Lube Light only; Right ALL other Lights).
- 17 - Windscreen Wiper and Washer Drivers Side.

LAYOUT OF ELECTRICAL CABINET



DISTRIBUTION PANEL NO.1 END



1. 400 amp starting fuse for H.E.P. engine.
2. 800 amp starting fuse for Main Diesel engine.
3. Battery knife switch.
4. Ground relay knife switch must be sealed and closed at all times.
5. Fuse test rack.
6. Positive low voltage ground light.
7. Negative low voltage ground light.
8. Fuse test light.
9. Fuse test switch.

LAYOUT OF ELECTRICAL CABINET - This part of the Electrical Cabinet is located No.1 end of the locomotive on the side of the Main Electrical Cabinet.

POWER CONTACTORS

| | |
|-----|-------------------------------|
| P4 | PARALLEL CONTACTOR |
| S14 | SERIES CONTACTOR |
| P1 | PARALLEL CONTACTOR |
| P5 | PARALLEL CONTACTOR |
| S25 | SERIES CONTACTOR |
| P2 | PARALLEL CONTACTOR |
| P6 | PARALLEL CONTACTOR |
| S36 | SERIES CONTACTOR |
| P3 | PARALLEL CONTACTOR |
| EPC | ENGINE PURGE CONTACTOR |
| ST | STARTING CONTACTOR |
| STA | STARTING AUXILIARY CONTACTOR |
| MB | MOTOR BRAKING TRANSFER SWITCH |
| RV | REVERSER TRANSFER SWITCH |

DISTRIBUTION PANEL - The following equipment is located in the fuse test panel.

1. 400 AMP HEAD END POWER FUSE
2. 800 AMP STARTING FUSE
3. BATTERY KNIFE SWITCH
4. GROUND RELAY KNIFE SWITCH
5. BATTERY FUSE TEST JACKS
6. POSITIVE LOW VOLTAGE GROUND LIGHT
7. NEGATIVE LOW VOLTAGE GROUND LIGHT
8. FUSE TEST LIGHT
9. FUSE TEST LIGHT SWITCH

MODULE PANEL - This module panel is located at the side of the Electrical Cabinet above the high voltage electrical cabinet.

| | | |
|-----|------|-------------------------------|
| 1. | VR13 | VOLTAGE REGULATOR MODULE |
| 2. | TH14 | THROTTLE RESPONSE MODULE |
| 3. | RC12 | RATE CONTROL MODULE |
| 4. | EP11 | ENGINE PURGE |
| 5. | FP30 | FEED BACK AND PERFORMANCE |
| 6. | AN12 | ANNUNCIATOR |
| 7. | GV12 | GENERATOR VOLTAGE |
| 8. | GX2 | GENERATOR EXCITATION |
| 9. | EL11 | EXCITATION LIMIT |
| 10. | SE13 | SENSOR |
| 11. | WS10 | WHEEL SLIP |
| 12. | TR16 | TRANSITION MODULE |
| 13. | DR14 | DYNAMIC BRAKE REGULATOR |
| 14. | DP16 | DYNAMIC BRAKE PROTECTION |
| 15. | DE14 | DYNAMIC BRAKE EXTENDED RANGE |
| 16. | DG15 | DYNAMIC BRAKE GRID PROTECTION |

NOTE: Drivers and Locomotive Assistants are not to interfere with any of these modules or their related equipment.

The only module of concern to Enginemen is the E.P.11 (Engine Purge) Module. - For instruction see page 18.

N CLASS

NO.1 END RELAY PANEL ITEMISATION

| | | | |
|------|---|----|--|
| BR1 | C | 2 | BRAKING CONTACTOR) RED FOR BRAKING |
| BR2 | C | 3 | BRAKING CONTACTOR) GREEN FOR POWERING |
| CDR | C | 9 | CONTACTOR DELAY RELAY |
| COR | B | 6 | MOTOR CUT OUT RELAY - RED FOR MOTORS CUT OUT |
| DP1 | C | 13 | DYNAMIC BRAKE PILOT RELAY |
| DP1A | C | 14 | DYNAMIC BRAKE PILOT RELAY |
| DP2 | C | 15 | DYNAMIC BRAKE PILOT RELAY |
| DGX | C | 11 | DYNAMIC GRID EXCITATION RELAY |
| EFL | T | 10 | ENGINE RELAY LATCHING RELAY |
| EQP | T | 7 | EQUIPMENT PROTECTION RELAY |
| ER | B | 7 | ENGINE RELAY - MUST BE RED FOR REVS AND POWER |
| FOR | B | 2 | REVERSER RELAY - RED FOR NO.1 END DIRECTION GREEN FOR NO.2 END DIRECTION |
| FPC | C | 6 | FUEL PUMP CONTACTOR |
| FPR | C | 12 | FUEL PUMP RELAY - MUST BE RED WITH ENGINE RUNNING |
| FPCR | B | 10 | FUEL PUMP CONTACTOR RELAY - MUST BE RED WITH ENGINE RUNNING |
| FTX | B | 13 | FORWARD TRANSITION AUXILIARY |
| GFX | B | 12 | GENERATOR FIELD AUXILIARY - RED IN NOTCH 1 OR ABOVE |
| GR | B | 1 | GROUND RELAY - MUST BE GREEN FOR POWERING |
| LUR | B | 9 | LEAD UNIT RELAY - RED WITH HUMP CONTROL IN USE |
| MCOX | T | 3 | MOTOR CUT OUT AUXILIARY - RED WHEN TRACTION MOTORS ARE ISOLATED |
| MR | B | 4 | MOTOR RELAY RED FOR POWERING |
| MRA | T | 4 | MOTOR RELAY AUXILIARY RED FOR POWERING |
| NIR | T | 5 | NORMAL IDLE RELAY - RED WITH REVERSER IN DIRECTION |
| NVR | C | 1 | NO VOLT RELAY. DE-ENERGISED BUTTON IN, ENERGISED BUTTON OUT |
| OCL | T | 6 | OPEN CIRCUIT WATCHOUT RELAY |
| OCP | B | 14 | OVER CURRENT PROTECTION |
| PCR | T | 12 | PNEUMATIC CONTROL RELAY - RED WHEN IN NOTCH 1 AND |
| PR | B | 5 | PARRALLEL RELAY |
| PRA | C | 4 | PARRALLEL RELAY AUXILIARY |
| PRR | C | 5 | POWER CONTROL RELAY RED WHEN MANUAL POWER CONTROL IS IN USE |
| RER | B | 3 | REVERSER RELAY RED WHEN IN NO.2 DIRECTION - GREEN WHEN IN NO.1 END |
| RVF | T | 11 | DIRECTION TRANSFER SWITCH FARWARD RELAY |
| STX | C | 10 | STARTING RELAY AUXILIARY |
| TDR | T | 14 | TIME DELAY RELAY |
| TDS | T | 13 | TIME DELAY SANDING |
| TDR | T | 14 | TIME DELAY RESERVOIR RELAY |
| TLTD | T | 1 | TURBO LUBE PUMP TIME DELAY |
| THL | T | 8 | THROTTLE AUXILIARY RELAY |
| THX | C | 8 | THROTTLE RELAY AUXILIARY |
| TSR | B | 8 | TIME SEQUENCE RELAY - RED FOR POWER, GREEN FOR DYNAMIC BRAKE |
| TLPR | B | 11 | TURBO LUBE PUMP RELAY |
| VSR | C | 7 | VIGILANCE SELECTOR RELAY |
| WD | T | 3 | WHEELSLIP DETECTION DISABLE RELAY |
| WL | T | 2 | WHEEL SLIP LIGHT |

CREWS CAN ONLY OBSERVE, REPORT AND AWAIT INSTRUCTIONS

| | | | | | | | | |
|------|----------------------|----|------|----------------------|----|------|----------------------|----|
| TLTD | <input type="text"/> | 1 | NVR | <input type="text"/> | 1 | GR | <input type="text"/> | 1 |
| WL | <input type="text"/> | 2 | BR1 | <input type="text"/> | 2 | FOR | <input type="text"/> | 2 |
| WD | <input type="text"/> | 3 | BR2 | <input type="text"/> | 3 | RER | <input type="text"/> | 3 |
| MCOX | <input type="text"/> | 4 | PRA | <input type="text"/> | 4 | MR | <input type="text"/> | 4 |
| MRA | <input type="text"/> | 5 | PRR | <input type="text"/> | 5 | PR | <input type="text"/> | 5 |
| NIR | <input type="text"/> | 6 | FPC | <input type="text"/> | 6 | COR | <input type="text"/> | 6 |
| OCL | <input type="text"/> | 7 | VSR | <input type="text"/> | 7 | ER | <input type="text"/> | 7 |
| EOP | <input type="text"/> | 8 | THX | <input type="text"/> | 8 | TSR | <input type="text"/> | 8 |
| THL | <input type="text"/> | 9 | CDR | <input type="text"/> | 9 | LUR | <input type="text"/> | 9 |
| EFL | <input type="text"/> | 10 | STX | <input type="text"/> | 10 | FPCR | <input type="text"/> | 10 |
| RVF | <input type="text"/> | 11 | DGX | <input type="text"/> | 11 | TLPR | <input type="text"/> | 11 |
| PCR | <input type="text"/> | 12 | FPR | <input type="text"/> | 12 | GFX | <input type="text"/> | 12 |
| TDS | <input type="text"/> | 13 | DPI | <input type="text"/> | 13 | FTX | <input type="text"/> | 13 |
| TDR | <input type="text"/> | 14 | DPIA | <input type="text"/> | 14 | OCP | <input type="text"/> | 14 |
| | | | DP2 | <input type="text"/> | 15 | | | |

Section 2

Locomotive Systems

THE ENGINE AND ENGINE ROOM - The Engine Room on these locomotives differ from other VLINE locomotives because it has two compartments. One is a compartment that houses the generating equipment. The other compartment is similar to other V/LINE locomotives.

THE ENGINE

The Diesel Engine fitted to these locomotives is a General Motors type 645E3B, or 645F3B V-12, water cooled, turbo charged and is solid fuel injected. A standard overspeed trip is fitted to guard against an overspeed condition and operates at approx. 1,000 RPM.

At 900 RPM, the Diesel Engine develops 1846 KW, the electrical energy from the A.R.10 Traction Alternator available for traction is 1698 KW.

A large proportion of the Mechanical Energy from the Diesel Engine is converted into electrical energy by means of the AR10 Traction Alternator and its rectifying equipment. This electrical combination produces and converts high output Alternating Current into Direct Current for traction purposes. The current produced from the rectifying equipment passes to the electrical cabinet at No.1 end of the locomotive then to the 6 No. D43 Traction Motors.

The remainder of the Mechanical Energy from the Diesel Engine provides power for the D.18 Companion Alternator, the 18 KW Auxiliary Alternator, Traction Motor Blower No.1 end of the locomotive, and the Gardner Denver Air Compressor.

The D.18 Companion Alternator is provided to supply A.C power for the following:

1. Radiator Cooling fans, (2 No.).
2. Dynavane Air Cleaner at No.1 end of the engine room.
3. Silicon Control Rectifier (S.C.R.) to convert A.C. power to D.C. power for excitation of A.R.10 Main Traction Alternator.

The 18 KW Auxiliary Alternator and rectifying equipment provides D.C. power for:-

1. Control Circuits.
2. Battery Charging.
3. Fuel Pump operation (while engine is running).
4. Air Conditioning.
5. Heaters and Hot Plates.
6. Lighting Circuits.
7. Other locomotive low voltage requirements.

OPERATION OF FUEL PUMP - If the Diesel Engine shuts down, the fuel pump will stop. This is an inbuilt safety feature on all modern diesel electric locomotives manufactured by General Motors. When the engine is shut down, the fuel pump operates from the battery output when the ENGINE PRIME BUTTON or ENGINE START BUTTON is pressed. When the engine is running, the 18 KW Auxiliary Alternator provides the current for fuel pump operation.

LOCOMOTIVE OPERATION - The Engine and Power Range control system responses on these locomotives are basically similar to other recent General Motors locomotives.

These locomotives operate in a similar manner to the C class locomotives. The six traction motors start off in a Series/Parallel set up of three groups of 2 motors - 1-4, 2-5 and 3 & 6. Then at a pre determined speed, the locomotive changes to full Parallel.

After powering the locomotive, and the dynamic brake is to be used, the Locomotive Driver MUST ensure that at least 10 seconds has elapsed before selecting dynamic braking.

This allows the Main Traction Alternator output, control and excitation systems to fade before braking conditions are selected.

When this 10 seconds has elapsed, the dynamic brake selector can now be placed into "SET UP". When the POWER BRAKE TRANSFER SWITCH GEAR has thrown, a slight amount of braking current will show on the load ammeter.

If the 10 seconds delay is disregarded, severe coupling action will take place and damage to the locomotive systems can occur.

These locomotives have a modified extended range dynamic braking set up. This means as the locomotive speed decreases, the braking efficiency remains constant by automatic isolation of segments of grid area in proportion to speed reduction. As speed increases, the grids are automatically cut back in.

When Dynamic Braking, the Engine Revs increase because both "A" and "C" solenoids in the governor are energised. This will increase Engine equivalent to NOTCH 4, to increase cooling air flow for Traction Alternator and Traction Motor Blowers.

When dynamic braking, the maximum amperage permissible is 600 amps. If the limit is exceeded, an automatic system reduces the excitation of the AR10 Main Traction Alternator thus reducing traction motor field excitation.

When overloading occurs, the Fault/Brake Warning Light (Yellow) on the Drivers panel will illuminate and then go out when the condition is automatically corrected.

Automatic sanding will also occur during this period. Should this condition persist the dynamic brake controller MUST be eased off in order to overcome the braking excess.

During dynamic braking, the Independent Brake Valve is available for operation in emergency conditions but this is undesirable and it should always be carried in the release position otherwise damage to wheels and rails will result if both Dynamic and Independent Brake are simultaneously applied.

If traction motors are cut out, the M.C.O. (MOTOR CUT OUT SWITCH) will prevent dynamic brake operation.

DO NOT PLACE A LOCOMOTIVE "ON LINE" OR "OFF LINE" when dynamic braking.

Vigilance control is still operational during dynamic braking.

GROUND RELAY - When a ground relay occurs, the Main Traction Alternator output is lost, engine speed is reduced to idle, and an Alarm Circuit is energised. This alarm is trainlined via the jumper cables to other locomotives in multi unit, but the Ground Relay Light will only illuminate on the affected unit.

TO RESET - A standard Ground Relay reset button is provided on the driving panel at each end of the Locomotives.

As a reminder, if Ground Relays do occur, Traction Motors can be isolated.

STARTING THE DIESEL ENGINE - The Battery Knife switch must be closed and All Circuit Breaker in the electrical cabinet placed ON. The Turbo Tube Pump Light must be ON, if not press the STOP button to initiate the working of the Turbo Lube Pump (this is done to pre lube the bearings prior to starting the engine). Isolation Switch must be on START.

The Generator Field switch must be off, the Engine Run and the Control and Fuel Pump switches MUST be ON.

These locomotives are equipped with what is known as Creep Crank method of engine starting. The usual FUEL PRIME/ENGINE START buttons are provided on the starting panel near the layshaft.

Turn off all switches, close all windows and shut all cab doors. Creep Crank starting eliminates the requirements of having to open test cocks on an engine that has been shut down in excess of two (2) hours.

NORMAL ENGINE STARTING - After making standard pre starting checks, the engine is now ready for starting. Push in the ENGINE PRIME button until the fuel system has been purged of air.

Hold the Layshaft back to the NO FUEL position and press the START button. Initially during the first 6 - 7 seconds retarded engine cranking at 25 to 30 RPM with intermittent stop will occur. After approx 6 - 7 seconds this retarded cranking will automatically change over to normal cranking speed. When this occurs simply push in approx 1/3 on the layshaft to assist in prompt engine starting.

During this initial 6 - 7 seconds if a hydraulic lock occurs (liquid trapped on top of a piston), the engine will stall. If the START button is still held the starting fuse could blow.

AT ANY TIME DURING THE INITIAL STAGE OF ENGINE CRANKING, AND THE ENGINE DOES NOT TURN OVER IN RESPONSE TO THE ENGINE START BUTTON, ALL TEST COCKS MUST BE OPENED TO CHECK FOR LIQUID IN ANY CYLINDERS. ANY OBSERVENCE OF DISCHARGE FROM TEST COCKS MUST IMMEDIATELY BE REPORTED TO THE LOCOMOTIVE MAINTENANCE STAFF.

ABNORMAL STARTING - If for some reason the "Creep Crank" system becomes defective the Engine WILL NOT start when the START button is pressed.

To enable engine starting to be carried out, the Creep Crank system must be by-passed. This is done by holding down or up a spring loaded toggle switch. This switch is located on the E.P. Module in the Electrical Cabinet. When this starting procedure is carried out ALL Test Cocks MUST be opened 3 full turns. Before the engine can be turned over the Creep Crank By-Pass switch must be held either UP or down.

If the engine has been shut down up to 2 hours, the procedure of opening the test cocks is not necessary.

An 800 AMP Starting Fuse is provided in the Electrical Cabinet for protection of the Starting Circuit.

STOPPING THE ENGINE - To shut down the engine, secure the locomotive with the handbrake, make a full service application of the brakes. Press the STOP button (on these locomotives it is not necessary to hold the STOP button in). Once the shut down procedure has been initiated release the STOP button.

ENSURE THAT TURBO LUBE PUMP LIGHT ILLUMINATES WHEN ENGINE HAS SHUT DOWN. IF IT FAILS TO ILLUMINATE REFER TO PAGE 17.

ENGINE SYSTEMS

LUBE OIL SYSTEM - The Lube Oil system on these locomotives is the same as other V/LINE locomotives. An additional electrically operated turbo lube Oil Pump is provided to supply oil to the Turbocharger before starting the Diesel Engine or after shutting down the Diesel Engine.

FUEL SYSTEM - The Fuel system on these locomotives is the same as other General Motors locomotives in service with V/LINE.

WATER COOLING SYSTEM - These locomotives have a pressurised cooling system similar to other modern locomotives on V/LINE except that on these locomotives a cover plate covers the filler cap on the header tank. In order to top up the cooling system this cover plate MUST be rotated to one side. The movement of the cover plate also operates a cock which will vent the pressure built up in the cooling system. When this pressure has been vented, either the filler cap can be removed or a hose placed on a filler pipe cone to top up to the required level of coolant in the system.

If a Hot Engine Alarm occurs, engine revs/speed increase will not occur in Notches 7 and 8. The maximum engine revs obtainable will be equal to Notch 6.

AT ANY TIME WATER IS ADDED TO A HOT ENGINE, THE ENGINE MUST BE LEFT RUNNING AT IDLE SPEED.

WARNING THE COOLING SYSTEM ON THESE AND OTHER V/LINE LOCOMOTIVES IS TREATED WITH A CHROMATE SOLUTION. DO NOT USE FOR DRINKING, OR WASHING.

AIR COMPRESSOR - A standard Gardner Denver WBO type air compressor is fitted.

COMPRESSOR GOVERNOR - The Compressor Governor on these locomotives is train lined so that when operating in Multi Unit all compressors "Cut in" and "Cut out" simultaneously.

These locomotives are fitted with an Electric Governor. The Governor operation is train lined in Multi Unit and will operate the Governors on other Locomotives that are fitted with this type of Governor.

A Compressor Magnet Valve is provided which is energised when Main Reservoir pressure is increased to the setting of the Compressor Governor. Energising of the Compressor Magnet Valve allows Main Reservoir pressure to flow to the Compressor Unloaded valves, cutting out the Compressor (Compressor continues to rotate but will not pump air).

A cut out cock is provided on the Main Reservoir supply to the Compressor Governor and Magnet Valve which must be open for normal Compressor operation. If the Compressor Governor should fail the Compressor can be permanently cut in by closing the cut out cock (handle across pipe) resulting in Main Reservoir pressure being controlled at the setting of the Main Reservoir Safety Valve.

HANDBRAKE - A standard type ratchet handbrake is located along the catwalk, drivers side along No.1 end of locomotives.

ENGINE PROTECTOR - The new standard General Motors type 2 button Engine Protector is fitted to the engine block near the lay shaft. Under some conditions it may be necessary to hold the top button (LOW WATER) in while sufficient water pressure is achieved in the water cooling system to latch in the button after engine starting.

NOTE: On this new type Engine Protector, Top Button is the Water Button, the Bottom Button is the Positive Crank Case button. The same instruction apply however to these buttons as for previous Engine Protectors as fitted to other V/LINE Diesel Electric Locomotives.

ENSURE THAT TURBO LUBE PUMP LIGHT ILLUMINATES. IF NOT CHECK TURBO LUBE PUMP CIRCUIT BREAKER in electrical cabinet. If tripped reset and check turbo lube pump for operation. If not operating the Locomotive Maintenance Staff MUST be notified. Turn off all circuit breakers and switches and open main battery knife switch.

CHANGING ENDS - The following instructions MUST be adhered to when changing from one driving end to another driving end or other locomotive in multi unit.

1. STOP locomotive with independent brake.
2. Make full service application with automatic brake.
3. Change MU2A valve to TRAIL 6 - 26.
4. Place automatic brake handle in HANDLE OFF position and place brake valve cut off valve to OUT position.
5. Carefully return independent handle to release and remove both independent handle and automatic handles.
6. Turn off all switches EXCEPT MARKER LIGHT SWITCH. (If required).
7. Centre and remove the reverser handle.
8. TURN OFF AIR CONDITIONING UNIT.
9. Close all windows and doors.
10. Switch off
 - (a) Engine Run Switch.
 - (b) Control and Fuel Pump Switch.
 - (c) Generator field switch.

The same procedure is to be applied whether changing from one end to another or changing from one locomotive to another.

CUTTING IN OTHER DRIVING CAB

1. TURN ON CONTROL AND FUEL PUMP SWITCH.
2. TURN ON ENGINE RUN SWITCH.
3. Place on both Independent and Automatic Brake handles and cut brake valves in.

LEADING LOCOMOTIVE NOT EQUIPPED WITH 26L OR NO.7 BRAKE

The following describes the method of isolating cab brake equipment on a trailing "N" class locomotive when it is not possible to connect No.3 Control and No.4 Independent Release pipes through to the leading locomotive.

1. Apply Independent Brake.
2. Make full service application of Automatic Brake.
3. Place Automatic Brake to HANDLE OFF position remove handle and place brake valve cut off valve to OUT.
4. Carefully move independent handle to release position, but do not remove.
5. LEAVE MU2A VALVE IN LEAD or DEAD, AND INDEPENDENT BRAKE VALVE IN RELEASE POSITION.

VIGILANCE CONTROL EQUIPMENT - These locomotives are equipped with FISCHER TYPE vigilance control apparatus. This equipment is fully electrical in operation. A Vigilance Control circuit breaker on the circuit breaker panel protects the Vigilance Control circuits for both the Drivers and the Locomotive Assistants Vigilance Control at both ends of the locomotive.

If the Vigilance Control apparatus becomes defective and cannot be re-set, open the Vigilance Control Circuit Breaker. This will render both Drivers and Locomotive Assistants Vigilance Control at both ends of the locomotives totally inoperative.

The Driver MUST advise Control, Locomotive Maintenance staff and the Guard if this occurs and carry out necessary instruction laid down in the event of NO Vigilance Control operation.

On the Locomotive Assistant's side a dimmer switch is provided for bright/dim control of the vigilance control light. Both Drivers button and Locomotive Assistant's button are instant in operation when pressed. The Drivers Vigilance system operates as for standard V/LINE locomotives.

The operation of the Locomotive Assistants Vigilance control is such that after the initial press of the acknowledgement button, 90 seconds elapses before the white indicating lights start to flash, and then after a short delay a gong will sound. If cancellation does not occur within a further 10 seconds a Penalty Brake will occur.

On the Locomotive Assistant side of the cab, a switch is provided as to operate either the centre or the side light.

An Intersystem change over switch is located on the left hand corner of the windscreen on the drivers side. THIS SWITCH MUST BE UP FOR VICTORIAN POSITION.

PENALTY BRAKE RESET - To reset the Penalty Brake, there is an inbuilt time delay of approx 30 seconds once a Penalty Brake application has occurred. While the time delay is running through its time sequence the Vigilance control light flashes. When the Penalty Brake application occurs, the driver MUST make a full service application of the Automatic Brake. When the time delay of approx 30 seconds has completed its time sequence the Vigilance control light will steady to a continually illuminated light. When the light steadies press the Drivers Vigilance Control Button, return the Automatic Brake handle to Release. When the Air Brake has fully charged, operation of locomotive can now continue.

MOTOR/BRAKE TRANSFER SWITCH - This Transfer Switch provides for either Powering or Dynamic Braking function of the locomotive function from Powering to Braking. When the locomotive is set for Powering, the indicator points to No.1. When the locomotive is set for Braking, the indicator points to No.2.

If the MOTOR BRAKE TRANSFER CIRCUIT BREAKER trips on the Circuit Breaker panel, the locomotive will stay in the setting that was selected prior to the Circuit Breaker tripping. A time delay of up to 3 seconds will occur when changing from one mode to the other.

REVERSER TRANSFER SWITCH - This Transfer Switch provides for either the Forward or Reverse operation of the locomotive. The reverser on the control stand energises or de energises the FOR or RER relays in the electrical cabinet which in turn alter positioning of the Reverser Transfer Switch gear motor. When the reverser is placed into the forward direction from No.1 end the pointer indicator points to No.2. When the reverser is placed into the forward direction for No.2 end of the locomotive, the pointer indicator points to No.1.

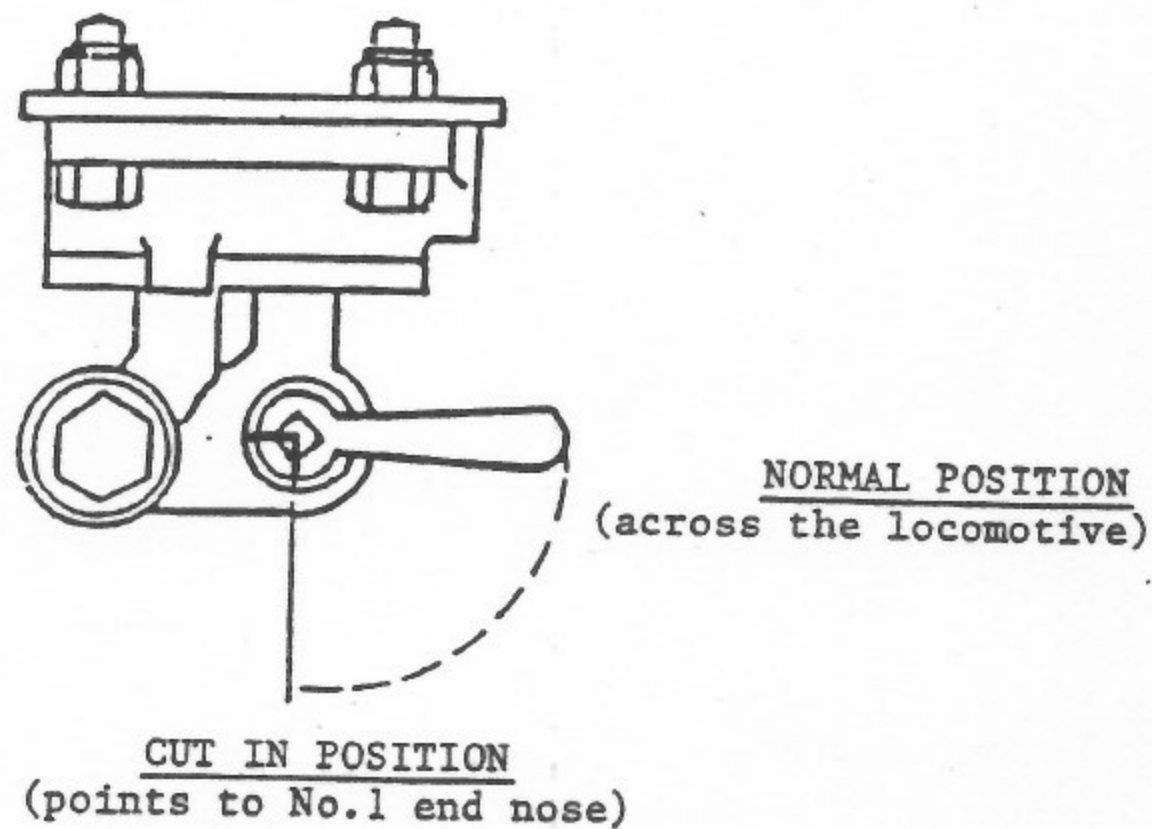
DEAD ENGINE DEVICE

If the locomotive is to be hauled dead, or has a defective air compressor and the Main Reservoir, is not connected this procedure MUST be adopted.

The dead engine device is situated behind the A.R.10 Traction Alternator, and when required MUST be cut in to allow 350 KPa of brake pipe pressure to flow to the main reservoir for application of brake on the locomotive.

When the dead engine device is CUT IN to allow Brake Pipe Pressure to flow to the Main Reservoir, the cock handle points toward the No.1 end nose of the locomotive. When in the NORMAL Position the cock handle points across to the Drivers side of the No.1 end of the locomotive.

Access to the Dead Engine Device is from Locomotive Assistants side, 6 doors back from the No.1 end cab on the Locomotive.



AIR BRAKE EQUIPMENT - These locomotives are equipped with standard 26L brake equipment.

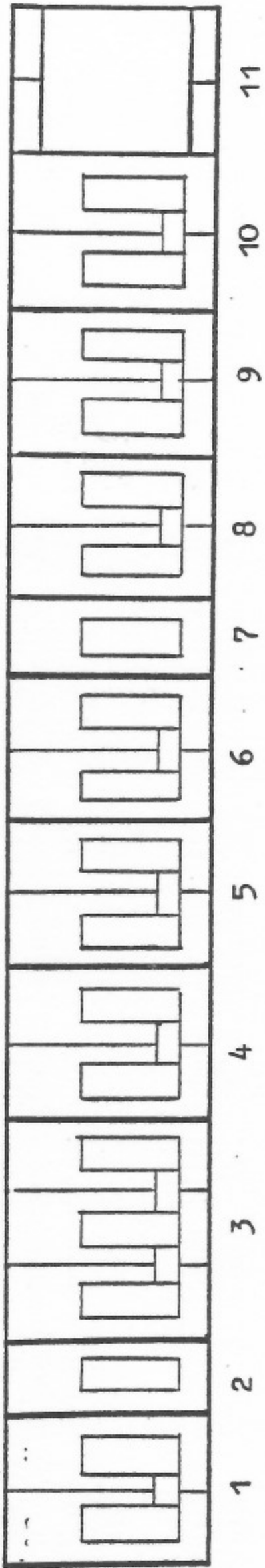
BRAKE PISTON TRAVEL - The Brake Piston travel on these locomotives is 50mm to 150mm (2" to 6").

Section 3

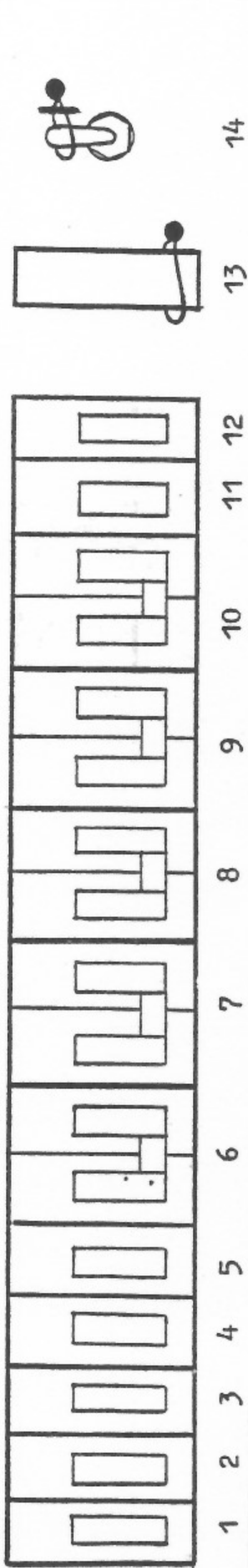
Normal Operation of the Locomotive

CIRCUIT BREAKER PANEL

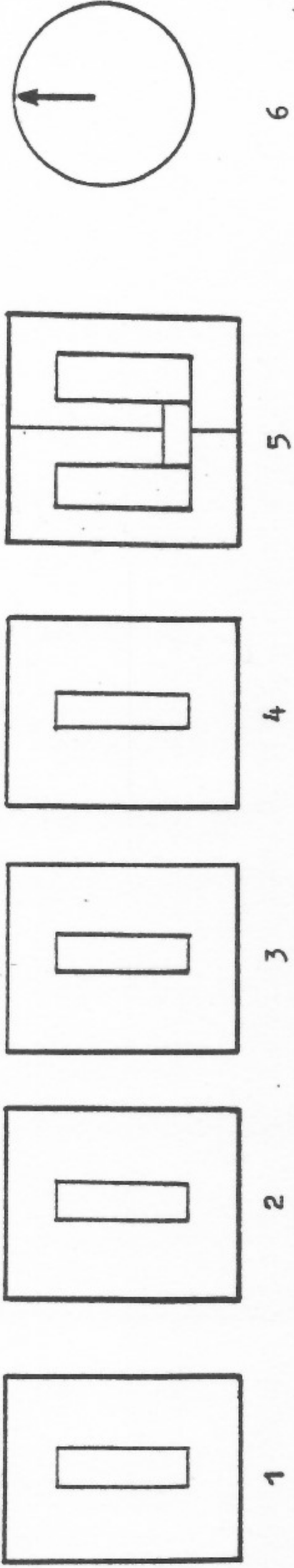
TOP ROW



CENTRE ROW



BOTTOM ROW



CIRCUIT BREAKERSTOP ROW

1. A.C. CONTROL - Protects the Modules that receives A.C. current from the D.18 Auxiliary Alternator. The N.V.R. (NO VOLT RELAY) is connected in this circuit and if the A.C. CONTROL circuit breaker is tripped, the N.V.R. will drop out.
2. AUXILIARY GENERATOR FIELD - Protects the Auxiliary Generator Field circuit from an overload of current.
3. FUEL PUMP - Protects the Fuel Pump motor circuit.
4. BRAKE TRANSFER CONTROL - This circuit breaker MUST be closed to allow control current to operate the Power/Brake Transfer Switch Gear motor and mechanism. An open circuit does not prevent switch gear that is in the correct position from receiving motor or braking current but interlock prevent operation in a conflicting movement to that of the Transfer Switch position.
5. MOTOR REVERSER CONTROL - This circuit breaker MUST be closed to allow control current to operate the Reverser Transfer Switch Gear motor and mechanism. An open circuit does not prevent switch gear that is in the correct position from receiving traction motor current but interlocks prevent operation in the opposite direction to that already set up.
6. LOCAL CONTROL - This circuit breaker provides control voltage supply from Auxiliary Alternator to heavy duty switch gear and other local control devices.
If tripped or placed to OFF, the engine will SHUTDOWN.
7. HEADLIGHT - Protects Headlight circuits.
8. MODULE CONTROL - Protects the local control circuit that supplies current to the various modules and miscellaneous control system devices.
9. CONTROL - Protects the Fuel Pump and Engine Control circuits. Current is supplied through this circuit breaker for the Fuel Pump and Control Circuits.
10. LIGHTS - Protects all lighting circuits.
11. TURBO LUBE PUMP - A guard is provided over this circuit breaker to prevent accidental movement to the OFF position. MUST be ON at all times to provide supply of control current to Turbo Pump Motor if the circuit is energised.

CIRCUIT BREAKERSCENTRE ROW

1. HOT PLATE - Protects the hot plate circuit against an overload of current.
2. CAB HEATERS NO.1)
3. CAB HEATERS NO.2) Protects the cab heater at both ends
of the locomotive from an overload of
current.
4. DEMISTER NO.1)
5. DEMISTER NO.2) Protects the windscreen demisters at
both ends of the locomotive from an
overload of current.

6. H.E.P. CONTROL - Protects the H.E.P. Unit from an overload of current.
7. VIGILANCE - Protects the Vigilance Control Unit against an overload of current.
8. RADIO - Provides current for the radio equipment at both ends of the locomotive and protects these circuits from an overload of current.
9. STAFF EXCHANGE NO.1) Protects the staff exchangers at
10. STAFF EXCHANGE NO.2) both ends of the locomotive from an
overload of current.
11. AIR CONDITIONING NO.1) These two circuit breakers protect
12. AIR CONDITIONING NO.2) the ventilating motors at the
respective ends of the locomotive
for air conditioning purposes.
13. O.C.P. SWITCH - Over Current Protection switch, covered and sealed.
14. DYNAMIC BRAKE CIRCUIT - MUST BE UP and SEALED. Isolated only when advised to do same by Locomotive Maintenance.

CIRCUIT BREAKERS

- BOTTOM ROW 1. MAIN GENERATOR FIELD (MAIN TRACTION ALTERNATOR FIELD) - The Traction Alternator receives excitation from the D-18 Alternator and Controlled Rectifier. This circuit breaker will protect the Controlled Rectifier and Traction Alternator field windings against an overload of current. Should this circuit breaker trip a complete loss of traction power will occur, engine runs will return to idle, the Alternator Failure will illuminate on the affected locomotive and the Audible Fault Alarm will sound and the Fault/Brake Warning light illuminate on all locomotives in M/U.
2. AUXILIARY GENERATOR OUTPUT (AUXILIARY ALTERNATOR OUTPUT) - Protects the Auxiliary Alternator output from excessive demands. When tripped, the N.V.R. will drop out, resulting in the illumination of both BLUE LIGHT (ALT FAILURE) and YELLOW FAULT/BRAKE WARNING LIGHT (on drivers panel) and audible fault alarm. The engine revs will return to IDLE and complete loss of traction power will occur.
 3. AIR CONDITIONING NO.1) These two circuit breakers protect
 4. AIR CONDITIONING NO.2) the Air Conditioning Unit
Compressors at the respective ends
of the locomotive.
 5. FILTER BLOWER - Protects the A.C. Filter Blower Motor from an overload of current.
 6. TRACTION MOTOR ISOLATION - Used when it is desired to isolate pairs of traction motors.

EXCITATION LIMIT - Because these locomotives have a Main Traction Alternator and Rectifying equipment, it is possible to achieve a condition that is known as Excitation Limit. On earlier Traction Alternator fitted locomotives when this condition is reached all power and engine revs are lost to safeguard the generation equipment.

On "N" class locomotives, however when an Excitation Limit condition is reached, the equipment will automatically safeguard its own excitation system by reducing excitation to prevent damage from occurring but maintain both engine revs and power. The revs will remain as per throttle setting but the amperage will be automatically reduced.

* OPERATION OF FAULT LIGHT - The Fault light is the third light on the drivers panel will illuminate when the following conditions occur.

- a - Hot Engine
- b - Module Control Circuit Breaker tripped
- c - Wheel overspeed
- d - Locked Wheel/Traction Motor
- e - Grid Fan Failure - Dynamic Brake
- f - Open Circuit of Dynamic Brake Grids
- * g - Overloading when Dynamic Braking

* This feature is usually automatic in correction. If the light does illuminate when dynamic braking, reduce setting on dynamic brake handle to reduce amperage. Normal operation is that the light only "blinks" on and off.

DO NOT ALLOW THE LIGHT TO STAY ON FOR MORE THAN 2-3 SECONDS.

When the light illuminates, and stays on, STOP locomotive and inspect the lights on the Annunciator Panel (see page) to ascertain what fault has occurred. ADVISE LOCOMOTIVE MAINTENANCE AND TRAIN CONTROL AND PLACE A SUITABLE BOOKING IN THE LOG BOOK.

* NOTE. THIS LIGHT IS KNOWN TECHNICALLY AS THE FAULT/BRAKE WARNING LIGHT.

SHOULD THE AUDIBLE FAULT ALARM SOUND AND GROUND RELAY LIGHT ILLUMINATE FOR THE THIRD TIME, THE AFFECTED LOCOMOTIVE SHOULD BE ISOLATED (ISOLATION SWITCH TO START) AFTER RESETTING GROUND RELAY AND THE LOCOMOTIVE REGARDED AS DISABLED. FAILURE TO OBSERVE THIS PROCEDURE REGARDING GROUND RELAYS COULD RESULT IN SEVERE DAMAGE TO THE MAIN TRACTION ALTERNATOR AND ITS EQUIPMENT. TRAIN CONTROL AND LOCOMOTIVE MAINTENANCE PERSONNEL MUST BE ADVISED AS SOON AS PRACTICABLE.

A Ground Relay Knife Isolation Switch is provided. This Switch is sealed.

UNDER NO CIRCUMSTANCES IS IT TO BE OPENED. IT MUST REMAIN CLOSED AND SEALED.

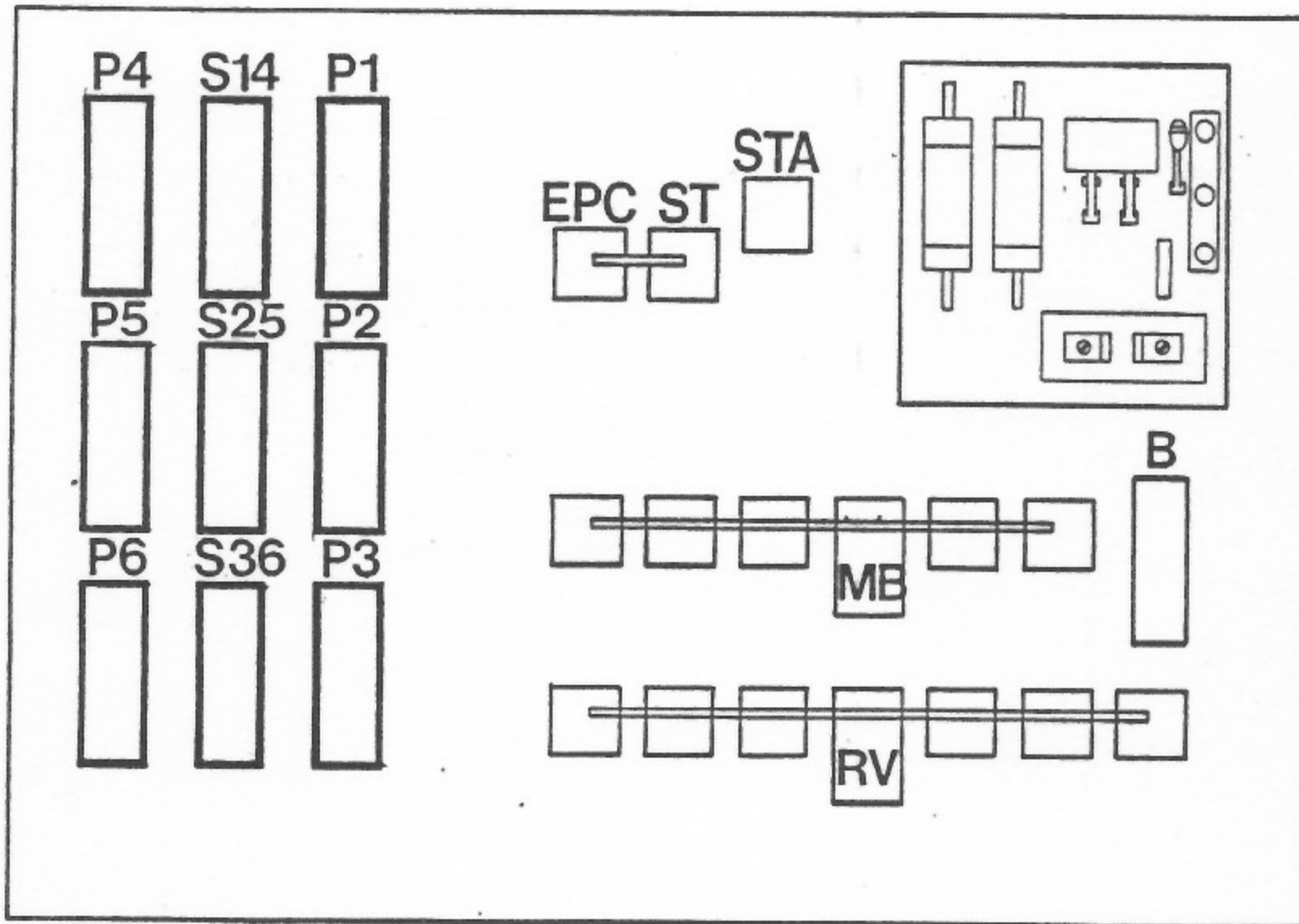
POWER CONTACTORS - To permit this locomotive to achieve maximum speed, Forward Transition occurs at 50kph. 9 No. power contactors are provided and are arranged in 3 rows of 3 contactors.

A small indicator plate is provided on the interlocks beneath each Power Contactor to indicate if that particular Power Contactor is ENERGISED or DE-ENERGISED.

- OPEN - DE-ENERGISED (WHITE BACKGROUND WITH RED WRITING)
- CLOSED - ENERGISED (RED BACK GROUND WITH WHITE WRITING)

With the Generator field switch ON, and the Reverser in direction, quickly move the throttle into NOTCH 1 and back to idle. Inspect the Power Contractors. The 3 No. Series Parallel Contactors (S14, S25 & S36) should be closed and the 6 No. Parrallel Power Contactors (P1, P2, P3, P4, P5, & P6) should be open.

With the Reverser in NEUTRAL, all 9 Power Contactors will OPEN.



BLOCKED ENGINE INTAKE FILTERS - This locomotive is provided with an Engine Filter Switch (E.F.S.) which senses blocked engine Intake Filters.

Should blocked engine filters cause the E.F.S. to close, an Engine Filter Latching Relay will operate, resulting in illumination of the Yellow, Engine Protector Light (not accompanied by a Fault/Brake Warning Light and Audible Fault Alarm).

In addition, Engine revs will be limited to the equivalent to notch 6. It should be noted that full engine output will be available in notch 6.

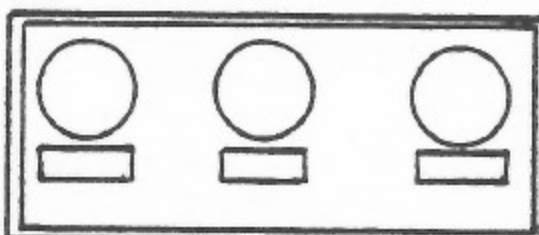
If the Engine Protector Light illuminates and Engine revs will not increase above notch 6, the Locomotive Driver may continue to clear the section but MUST advise Locomotive Maintenance staff as early as practicable and act as advised.

STAFF EXCHANGERS - These locomotives have electrically operated staff exchangers which are located beneath the trap door behind the drivers seat at both ends of the locomotive.

The operating buttons for the staff exchanger are located beneath the floor panel, that when raised for access to the staff exchanger make for easy accessibility to operating buttons.

The 3 panel buttons are Labelled as follows:

RAISE
PARK
DOWN



OPERATION - Raise the trap door and secure same with clip on cab wall. Push RAISE button and when the Staff Exchanger has fully raised, operate the Release Cable, then push DOWN button to fully lower the staff exchanger. When placing the Staff Exchanger to the Park position, the release lever is not to be operated. The PARK button when pressed will lower the Staff Exchanger to this position.

Ensure that the Staff Exchanger is secured in the PARK position before placing the floor panel back into position.

NOTE:- IF EITHER STAFF EXCHANGER FAILS TO OPERATE, CHECK THE CIRCUIT BREAKERS IN THE CIRCUIT BREAKER PANEL.

TRACTION MOTOR SWITCH When for some reason it becomes necessary to isolate traction motors the following procedure MUST be carried out.

- 1 STOP the locomotive,
- 2 Place the ISOLATION SWITCH to START,
- 3 Push the TRACTION MOTOR LATCH OUT SWITCH in and rotate the switch to isolate pair by pair to attempt to solve the problem.
- 4 After operation of the traction motor switch, the isolation switch MUST be placed to RUN (ON LINE).

It is not necessary to get permission to isolate traction motors, but the driver MUST place a suitable booking in the Locomotive Log Book, giving full particulars. If the locomotive is used in freight service, it may be necessary to reduce the load to 2/3rds of full load.

GENERAL OPERATING INSTRUCTIONS

WATER OVER THE RAIL: Under NO circumstances is the locomotive to pass through water that is more 75mm (3") above the top of the rail.

If water is above the top of the rail but less than 75mm (3"), the locomotive may proceed at a speed NOT to exceeding 5 kmh.

In all cases of water over the rail, if the driver has any doubts DO NOT PROCEED.

OPERATING OVER RAIL CROSSINGS: When operating at the speeds exceeding 40 kmh, reduce the throttle at least 8 seconds before the locomotive reaches a rail crossing. If the locomotive is operating in Notch 4 or lower or running less than 40 kmh allow the same interval and place the throttle in the next lowest position. Advance the throttle after all units of the consist have passed over the crossing.

This procedure is necessary to ensure decay of motor and generator voltage to a safe level before the mechanical shock that occurs at rail crossings is transmitted to the motor brushes.

FAULT/BRAKE WARNING LIGHT OPERATION: This light will flash if overloading occurs during Dynamic Braking in the same manner as the Brake Warning light on earlier V/Line locomotives.

It will also illuminate for a short time in the event of an Excitation Limit being exceeded until automatic correction takes place.

The Fault/Brake Warning Light will also illuminate for Engine Protection, Ground Relay or Alternator Failure (NOT HOT ENGINE) which is also indicated by the appropriate lights at No.1 end of the locomotive illuminating.

When operating from No.2 end of the locomotive and the Fault/Brake Warning Light illuminates and stays on, STOP the train. Go to No.1 cab and observe the indicating lights for action necessary to clear the section.

NOTE: The Fault/Brake Warning Light may illuminated then go out under some conditions, and therefore no corrective action is required by the Drivers (such an indication would occur during Dynamic Braking).

HOT ENGINE: When the Hot Engine light (RED LIGHT) illuminates along with an Audible Fault Alarm, the Driver should evaluate the circumstances as to location, if the section can be cleared easily etc and should also check the water level in the water tank.

Test water gauge first before taking water reading for granted.

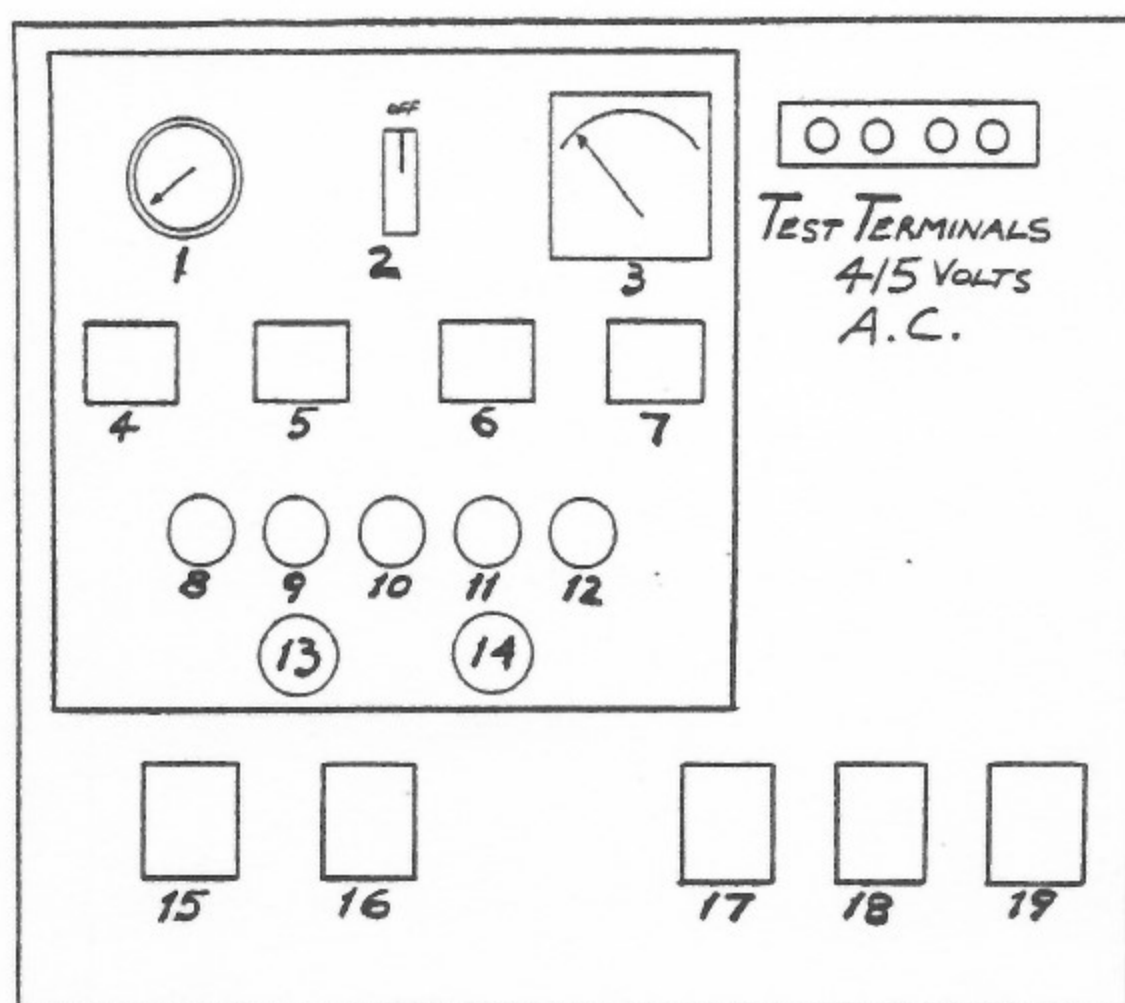
Advise Locomotive Maintenance Staff of a Hot Engine condition and make a suitable booking in the locomotive log book.

On these locomotives during a Hot Engine Condition, the Engine Revs will not increase above those equivalent to NOTCH 6, for instructions see page 12.

FUEL CONSERVATION: When for any reason the locomotive is to remain stationary, the Locomotive Driver is to move the Reverser handle to the NEUTRAL position. By doing this the Low Speed Idle feature is initiated reducing the engine revs by 60 RPM to 255 PPM. The feature is designed to conserve fuel.

The Low Idle feature will also operate when the Isolation Switch is in the START position.

HEAD END POWER UNIT These Locomotives are equipped with a 350 kva V/8 415 volt A.C Head End Power Unit. The Unit is located near the No.1 end cab. A distribution panel is located on the cat walk on the Locomotive Assistants side, and is as follows:-



The layout is as follows:-

1. - Engine Tachometer
2. - Ammeter Selection Switch (Should be off, Maintenance test only)
3. - Ammeter
4. - Oil Temperature
5. - Oil Pressure
6. - Water Temperature
7. - Hours Run
8. - Over Speed Light - Illuminates when an overspeed trip has occurred
9. - Low Water Level - Illuminates when water level is low for H.E.P.
10. - Hot Water Temperature - Illuminates when cooling temp of H.E.P. is high
11. - Low Oil Pressure - Illuminates when oil pressure is low on H.E.P.
12. - Fan Fault - Illuminates when H.E.P. cooling fan fails
13. - Start - Starts H.E.P. Unit
14. - Stop/Reset. Resets fault also stops H.E.P.
15. - H.E.P. Alt Field. - Protects field of H.E.P. Alternator.
16. - Train Line Control - Protects train supply, if trips NO train supply.
17. - Drivers Side - Protects drivers side 415 volts A.C. output (Both Ends).
18. - Locomotive Assistants Side - Protects Locomotive Assistants side 415 A.C. output (Both Ends).
19. - H.E.P. Output - Protects H.E.P. output

A sight glass is located along the catwalk, Locomotive Assistants side No.1 end.

ITEMISATION OF H.E.P. CONTROL PANEL EQUIPMENT.

Lights - Overspeed. This light illuminates when an overspeed has occurred to the H.E.P. Engine. This will occur at 1750 r.p.m. If this occurs press Stop/Reset, re-start engine, then after a period of approx. 1 - 2 minutes, PRESS "SUPPLY ON" button if required. If overspeed trip occurs again, advise Locomotive Maintenance Staff and await instructions. H.E.P. Fault Light will illuminate and the Audible Fault will sound in both cabs.

Low Water Level - This light illuminates when the H.E.P. Engine Cooling System water level falls below a pre-determined level, shutting down the H.E.P. Engine. The H.E.P. Engine and System MUST now be checked for water leaks. If no water leaks are found, top up at next suitable location, press STOP/RESET button and re-start. If illuminate again advise Locomotive Maintenance. If when checking for water leaking, and evidence is found of a water leak DO NOT TOP UP System without first advising Locomotive Maintenance. H.E.P. fault light will illuminate in car and Audible Fault Alarm will sound in both cabs.

Hot Water Temperature. This light will illuminate when the H.E.P. water temperature exceeds a pre-determined level. When this occurs the H.E.P. Engine will shut down. Check water level for H.E.P. Engine, check H.E.P. fan for operation AFTER restarting H.E.P. Engine. The STOP/RESET button MUST be pressed before restarting the H.E.P. If the H.E.P. engine shuts down again advise Locomotive Maintenance. WHEN SHUT DOWN, the H.E.P. Fault Light in cab will illuminate and Sonar Alert will sound in cabs.

Low Oil Pressure. This light will illuminate when the oil pressure in the H.E.P. Engine has dropped, causing the engine to shut down. The H.E.P. Fault Light will illuminate, and the Sonar Alarm will sound in the cabs. If this occurs check level of oil in Engine dipstick and if low advise Locomotive Maintenance.

Fan Fault. This light will illuminate when a failure has occurred to H.E.P. Radiator Cooling Fan. The engine will eventually shut down. The H.E.P. Fault Light will illuminate, and the Sonar Alarm will sound in the cabs.

NOTE:- It is the Drivers responsibility to enter into the Log Book ANY operating difficulty or fault of the Head End Power Unit as well as General Locomotive faults and operating difficulties.

Operation of Head End Power. Before starting the H.E.P. engine, the driver must check cooling water level (Gauge along body side on Locomotive Assistants side, No.1 end), engine sump oil level, and make an external inspection of the H.E.P. engine. However if the locomotive has been serviced by Maintenance Staff, these checks are not required by the driver.

The H.E.P. engine is then started as follows.

Ensure that Battery Switch is properly in position, check H.E.P. Control Panel (on side of Loco body Locomotive Assistants side No.1 end) if no fault lights are illuminated place ALL Circuit Breakers ON, proceed back to cab and press H.E.P. START BUTTON. When engine fires and run, release start button.

ALLOW TO RUN AT IDLE FOR AT LEAST 1 - 2 MINUTES AT LEAST BEFORE USING TO PROVIDE TRAIN SUPPLY.

Difficulty in Starting the H.E.P. Engine. If the H.E.P. Engine has been shut down for some time, the Fuel Pump on the H.E.P. (which is mechanically driven) may not be able to purge the fuel system of air in the H.E.P. resulting in the H.E.P. Engine cranking but not firing. DO NOT ATTEMPT FURTHER STARTING, THIS WILL ONLY DAMAGE STARTING MOTOR ON H.E.P. To enable the engine to be started however, an additional pipe feeds from the Main Fuel Pump on the Main Diesel Engine. This pipe has a cock that when opened will provide fuel to purge the fuel system of the H.E.P. After the duration of 1 - 2 minutes, attempt to start the H.E.P. Engine. Once the engine has started and is running, CLOSE FULLY THE FUEL COCK NEAR THE FUEL PUMP.

Stopping The H.E.P. Engine. Simply press STOP button which will energise the shut down solenoid of the H.E.P. Engine.

Faults on Head End Power Unit. The H.E.P. Engine has devices fitted that will shut down the engine if a fault occurs. They are as follows:-

- a. An Engine Overspeed - Can Reset
- b. Low Water Level - Top Up Water Level - Can Reset.
- c. Hot Water Temperature - Check water Level - Fan Operation.
- d. Low Oil Pressure - Can only reset if oil is added (Maintenance Staff ONLY)
- e. Fan Fault - Maintenance Staff to advise.

Any of these faults will shut the H.E.P. Engine down, illuminate the H.E.P. Fault light and energise the Audible Fault Alarm in the driving cabs. With the above faults a Fault Indicating light on the H.E.P. Panel will also illuminate to indicate the fault that has caused the shut down. After the system has been checked, Locomotive Maintenance staff notified and if the problem can be rectified, the H.E.P. Engine can only be re-started after the STOP/RESET button is pressed. This will extinguish the H.E.P. Fault light, reset the protective mechanism after which the H.E.P. engine can be started.

IF ANY FAULT PERSISTS CONTACT LOCOMOTIVE MAINTENANCE, PLACE SUITABLE BOOKING IN LOG BOOK AND ADVISE CHANGE OVER CREW.

Section 4

Defects and Fault Finding Checklists

FAULT FINDING

MULTI UNIT OPERATION The Audible Fault Alarm and the Fault/Brake Warning light are both train lined via the Multi Unit jumper cable.

Therefore if a fault develops on an individual locomotive causing the Audible Fault Alarm and/or the Fault/Brake Warning Light to illuminate, this indication will also be given on all other locomotives coupled in multi unit.

The Faulty locomotive may be detected by various colour warning lights which will only illuminate on the affected locomotive.

SYMPTONS - NO REVS, LITTLE OR NO POWER

| POSSIBLE CAUSE | ADDITIONAL SYMPTOMS | CORRECTION | LOCATION |
|---|--|--|------------------------------------|
| Engine Run Switch Off or defective | - First Notch Power available | - If defective, use Engine Run Switch in trailing cab. | - On Drivers Panel |
| Control & Fuel Pump Switch Off or defective | - Engine will shut down in a few minutes a/c fuel pump stops. After shut down, Alternator Failure Light on effected Loco and Fault/Brake Warning Light and audible Fault Alarm on all loco's in M/U. | - If defective use Control & Fuel Fuel Pump Switch in trailing cab. | - On Drivers Panel |
| Engine Relay (E.R.) not picking up. | - Fault Light and Audible Fault Alarm on all Loco's in M/U. First notch power available | - Have Loco Assistant turn Engine Switch On and Off and observe Engine Relay for operation. If defective, seek advice. | - No.1 end Cab electrical cabinet. |
| Ground Relay | - Ground Relay light on effected Loco. Fault/Brake Warning Light & Audible Fault Alarm on all Loco's in M/U. | - Return throttle to idle and press - G.R. reset button on ground relay reset button. | Drivers panel (both cabs) |
| Auxiliary Generator Output Circuit Breaker Trip (100 amp) | - Alternator Failure light on effected Loco. Fault/Brake Warning Light & Audible Fault Alarm on all Loco's in M/U. | - Move Circuit Breaker to fully off position, then reset. | - Circuit Breaker Panel. |
| Auxiliary Generator Field Circuit Breaker Trips (10 amp) | - Alternator Failure Light on effected Loco. Fault/Brake Warning Light & Audible Fault Alarm on all Loco's in M/U. | - Move Circuit Breaker to fully Off position, then reset. | - Circuit Breaker Panel |
| A.C. Control Circuit | - Alternator Failure Light on effected Loco. Fault/Brake Warning Light & Audible fault alarm on ALL locos in M/U. | - Move Circuit Breaker to fully Off position, then reset. | - Circuit Breaker Panel |
| No Volt Relay Fails or Drops Out. | - Alternator Failure Light on effected Loco. Fault/Brake Warning Light & Audible Fault Alarm on all Loco's in M/U. | - Seek Advice | - No.1 end Cab electrical |
| Control Circuit Breaker Trips (40 amp) | - Engine will shut down in a few minutes a/c fuel pump stops. | - Move Circuit Breaker to fully Off position, then reset. | - Circuit Breaker Panel. (Top Row) |

SYMPTONS - NO REVS, LITTLE OR NO POWER (Cont'd)

| POSSIBLE CAUSE | ADDITIONAL SYMPTONS | CORRECTION | LOCATION |
|--|---|--|------------------------------------|
| Isolation Switch on | - NIL. | - Turn Isolation Switch to RUN | - |
| START | | | |
| Generator Field Circuit Breaker Trips (100 amp) | - Alternator Failure Light on effected Loco. Fault/Brake Warning Light & Audible Fault Alarm on all Loco's in M/U. | - Move Circuit Breaker to fully Off - (Bottom Row) position, then reset | - Circuit Breaker Panel. |
| NOTE 1: | - IF THE ABOVE PROCEDURES ARE CARRIED OUT & NO FAULT FOUND, TRY CONTROL STAND IN TRAILING CAB. - TRY GOVERNOR JUMPER CABLE, ENSURE IT IS SECURE. | | |
| NOTE 2: | - Unlike early Clyde/G.M. Locomotives, 'N' Class Locomotives do not shut down in Notch 5 or 6 in the event of certain faults. - Always place suitable booking in log book, and if considered necessary, the Driver should advise the Train Controller, Locomotive Maintenance Staff. | | |
| <u>SYMPTONS - ENGINE REVS BUT NO POWER</u> | | | |
| POSSIBLE CAUSE | ADDITIONAL SYMPTONS | CORRECTION | LOCATION |
| Generator Field Switch Off or defective | - NIL | - If defective Loco Assist to apply power from trailing cab, Driver to control braking from leading cab to clear section only. Then seek advice. | - Drivers Panel. |
| Reverser Handle in neutral. | - NIL | - Move to required direction | - Controller Stand. |
| Generator Field Contractor (G.F.C.) Generator Field Auxiliary (G.F.A.) Generator Field Delay Contractor (G.F.D.) | - NIL | - Check to ensure all three Contractors pick up in Notch 1. If not seek advice. | - High Tension Electrical Cabinet. |

SYMPTOMS - ENGINE REVS BUT NO POWER (Cont'd)

| POSSIBLE CAUSE | ADDITIONAL SYMPTOMS | CORRECTION | LOCATION |
|---|--|--|---|
| FOR & RER Relays not picking up or stuck in. | - If either of these relays fails to pick up or stuck in, locomotive will power one direction only. | - With Reverser in neutral, both FOR & RER should be open. In No.1 Cab, place reverser in Forward FOR should pick up. In No.1 Cab, place reverser in Reverse RER should pick up. | - Main Electrical Cabinet No.1 End Cab. |
| Reverser Control Circuit Breaker (3 amp) Trips. | - If tripped, no power to operate reverser switches & locomotive will power in one direction only. | - Move Circuit Breaker to fully off position and reset. | - Circuit Breaker Panel. (Top Row). |
| Reverser Switch fails to throw. | - Loco will power in one direction only. | - Operate reverser and note that reserver switch operates. If not, check Reverser Control C.B. No Response, seek advice. | - High Tension Electrical Cabinet. |
| Brake Transfer Contactor - Circuit Breaker (3 amp) trips. | - If tripped, no power to operate brake transfer switch. Loco will not power following use of dynamic brake OR Dynamic Brake will not operate after powering. | - Move Circuit Breaker to fully off position, then reset. | - Circuit Breaker Panel. (Top Row). |
| Brake Transfer Switch (M.B.) fails to throw | - Loco will power but dynamic brake will not operate. OR No power available immediately following use of dynamic brake. | - Use Dynamic Brake handle and throttle and look for Brake Transfer Switch operation. Check Brake Transfer Switch Circuit Breaker. No response, seek advice. | - High Tension Electrical Cabinet. |

SYMPTOMS - ENGINE REVS BUT NO POWER (Cont'd)

| POSSIBLE CAUSE | ADDITIONAL SYMPTOMS | CORRECTION | LOCATION |
|--|---|---|------------------------------------|
| Power Contactors stuck in or failing to close. | - NIL | - Reverser in neutral - all power contactors should be open. Move reverser to direction, with Gen. Field on, <u>open & close</u> throttle, Series power power contactors (S14, S25 & S36) should close. No response, seek advice. | - High tension Electrical Cabinet. |
| NOTE: Power Contactors indicators: Red Letters - open White Letters - closed | | | |
| Traction Motor Cut Out Switch not latched out. | - Will only occur after T.M. Cut Out switch has been operated. | - Operate T.M. Cut Out Switch and ensure it is properly latched only. | - Circuit Breaker Panel. |
| Power Knock Out Switch (P.K.S.S.) | - Brake Pipe Pressure has fallen below 240 K.p.a. | - Restore Brake Pipe pressure to not less than 275 K.p.a. with throttle in idle to reset P.C.R. If still no response, drain brake pipe, restore pressure and try again. | |
| Pneumatic Control Relay (P.C.R.R.) | As Above. | - As Above P.C.R. is de-energised by opening of P.K.S. If still no response tap P.C.R. | |
| Penalty Brake Application (V.C.) | - Brake Pipe pressure will reduce to less than 240 K.p.a., P.K.S. will open and P.C.R. is de-energised. | - After approximately 30 seconds Loco Assistants V.C. light will stop flashing. When light is steady, press Drivers V.C. button. Recharge Brake Pipe to not less than 275 K.p.a. with throttle in idle to reset P.C.R. | |

If after checking for fault and no cause is found, shut engine down, turn off all switches and circuit breakers and open battery knife switch.

Reclose Battery Knife switch turn on all switches and breakers and restart.

Try again - If no response, seek advice from maintenance staff and act as instructed.

SYMPTOMS - ENGINE SHUTS DOWN

| POSSIBLE CAUSE | ADDITIONAL SYMPTOMS | CORRECTION | LOCATION |
|--|--|--|--|
| Stop Button accidentally pressed. | <ul style="list-style-type: none"> - Stop Button operates with Isolation Switch in START or RUN. Once shut down operation has been initiated engine will shut down even if button is released. If Isolation Switch is in Run - Alternator Failure Light on effected loco, Fault/Brake Warning Light and audible fault alarm on all loco's in M/U. | <ul style="list-style-type: none"> - Restart Engine. | |
| Throttle in Stop | <ul style="list-style-type: none"> - Only applicable if Isolation Switch is in RUN. NOTE: All loco's in M/U will also shut down. Alternator Failure on effected loco. Fault/Brake Warning Light and Audible Fault Alarm on all loco's in M/U. | <ul style="list-style-type: none"> - Place throttle in Idle before restarting. | |
| Control & Fuel Pump Switch Off or defective | <ul style="list-style-type: none"> - No revs or power for a short time then engine shuts down a/c fuel pump stops. After shut down, Alt Failure light on effected loco. Fault/Brake Warning Lighting & Audible Fault Alarm on all loco's in M/U. | <ul style="list-style-type: none"> - If defective use Cont. & F. Pump Switch in trailing cab. | <ul style="list-style-type: none"> - On Locomotive Drivers Console. |
| Control Circuit Breaker (40 amp) trips. | <ul style="list-style-type: none"> - No revs or power for a short time then engine shuts down a/c fuel pump stops. | <ul style="list-style-type: none"> - Move Circuit Breaker to fully off position & reset. | <ul style="list-style-type: none"> - Circuit Breaker Panel. (Top Row). |
| Auxiliary Generator Output Circuit Breaker (100 amps) trips. | <ul style="list-style-type: none"> - No revs or power for a short time then engine shuts down a/c fuel pump stops. Immediately after C.B. trips the Alt Failure Light shines on effected loco and the Fault/Brake Warning Light and audible fault alarm operates on all loco's in M/U. | <ul style="list-style-type: none"> - Move circuit Breaker to full off position & reset. | <ul style="list-style-type: none"> - Circuit Braker Panel (Bottom Row). |

SYMPTOMS - ENGINE SHUTS DOWN (Cont'd)

| POSSIBLE CAUSE | ADDITIONAL SYMPTOMS | CORRECTION | LOCATION |
|--|---|--|--|
| Auxiliary General Field Circuit Breaker. (10 Amp) trips. | - No power or revs for a short time then engine shuts down a/c fuel pump stops. Immediately after circuit breaker trips The Alt. Failure Light shines on effected loco and Fault/Brake Warning Light and Audible Alarm operate on all units in M/U. | - Move circuit breaker to fully off position, then reset. | - Circuit Breaker Panel. (Bottom Row). |
| Local Control Circuit Breaker (30 amps) trips. | - Engine immediately shuts down. Alternator Failure Light on effected loco and Fault/Brake Warning Light and Audible Fault Alarm on all loco's in M/U. | - Move Circuit Breaker to fully off position, then reset. | - Circuit Breaker Panel. (Top Row). |
| Fuel Pump Circuit Breaker (15 amp) trips. | - Fuel pump contactor will open and after a short time engine shuts down a/c fuel pump stops. After shut down - All failure light on effected loco and Fault/Brake Warning light and Audible Fault Alarm on all loco's in M/U. | - Move Circuit Breaker to fully off position, then reset. | - Circuit Breaker Panel. (Top Row). |
| Fuel Pump Relay fails (F.P.R.) | - After a short time engine shuts down a/c fuel pump stops. After shut down - alt failure light on effected loco. and Fault/Brake Warning Light and Audible Fault Alarm on all loco's in M/U. | - Have Loco Asst. operate Control & Fuel Pump Switch and note operation of F.P.R. If it fails to pick up, tap lightly. No response, seek advice. | - Main Control Panel Electrical Cabinet. |
| Fuel Pump Contactor Fails (F.P.C.) | - After a short time engine shuts down a/c fuel pump stops. After shut down - Alt Failure light on effected loco and Fault/Braking Warning Light and audible fault alarm on all loco's in M/U. | - Have Loco Assist operate Engine Prime Switch (isolation switch in START) F.P.C. should close when button is pressed. If it fails to pick up, tap lightly. No response - seek advice. | - Main Control Panel Electrical Cabinet. |

SYMPTOMS - ENGINE SHUTS DOWN

| POSSIBLE CAUSE | ADDITIONAL SYMPTOMS | CORRECTION | LOCATION |
|--|--|---|--|
| Fuel Pump Contactor Relay (F.P.C.R.) | - Immediate shut down, Alt Failure light on effected loco and Fault/Brake Warning Light and audible fault alarm on all loco's in M/U. | - Turn off and reset local control C.B. - Press Start Button for a short time during which time F.P.C.R. should pick up and stay closed. If not, tap lightly & try again. No response, seek advice. | - Main Control Panel Electrical Cabinet. |
| Governor Oil Level Low | - Alternator Failure Light on effected Loco. Fault/Brake Warning Light and Audible Fault Alarm on all loco's in M/U. No oil in governor sight glass. | - Top up oil level to sight glass from oil pan. | - Woodward Governor. |
| Governor Jumper Cable | - Alt Failure Light on effected Loco. Fault/Brake Warning Light & Audible Fault Alarm on all loco's in M/U. | - Inspect Governor Cable and ensure it is secure. | - Woodward Governor |
| Over Speed Trip | - Alt Failure Light on effected Loco. Fault/Brake Warning Light & Audible Fault Alarm on all loco's in M/U. Trip handle will be in 2 o'clock position. | - Reset to 10 o'clock position. If it trips again, do not operate loco above notch 7. | - Near Woodward Governor. |
| Low Oil Shut down or Engine Protector operation. | - Yellow Engine Protector and Blue Alt Failure Light on effected Loco. Fault/Brake Warning Light & Audible Fault Alarm on all loco's in M/U. | - First inspect Eng. Protector Upper Button - Low Water Lower Button - Positive Crankcase Pressure obey applicable instructions. If Low oil button only has operated - reset inspect oil pan level, if O.K. restart and ensure sufficient oil pressure (40 Kpa idling). | - Near Layshaft |
| Bent Pins in Multi Unit Socket. | - Alt failure light on effected loco. Fault/Brake Warning Light & Audible Fault Alarm on all loco's in M/U. | - Inspect both sockets, if detected, prise apart with wooden wedge. | - Both sides of both ends of locomotive. |
| Defective M/U Jumper Cable | - Only applicable to M/U operation. | - Change Cable and Label defective cable. | |

SYMPTOMS - ENGINE SHUTS DOWN

| POSSIBLE CAUSE | ADDITIONAL SYMPTOMS | CORRECTION | LOCATION |
|---|---|---|----------|
| Fuel System Faults (fuel glass nearest engine empty or has bubbles in fuel). | - Engine Revs may be erratic before actual shut down. Alt Failure Light on effected Loco. Fault/Brake Warning Light & Audible Fault Alarm on all loco's in M/U. | - Check to ensure fuel is in tank. Inspect all visible fuel lines for leakage. Check to ensure fuel pump is running and coupling is not slipping. Inspect for blocked final filter - by pass glass furthest from engine has fuel running through it. May be able to restart and clear section in lower notches. | |

If the locomotive is being operated from No.2 end, the locomotive MUST be stopped where practicable and the driver MUST then proceed to No.1 end to ascertain the reason for the Fault/Brake Warning light and Audible Warning.

Q NOTE:-- When any of the previously faults, or any Operational Malfunction occurs, the Driver is to give full details of occurrence in Locomotive Log Book, if the Driver considers it necessary Locomotive Maintenance and Train Control are to be informed.