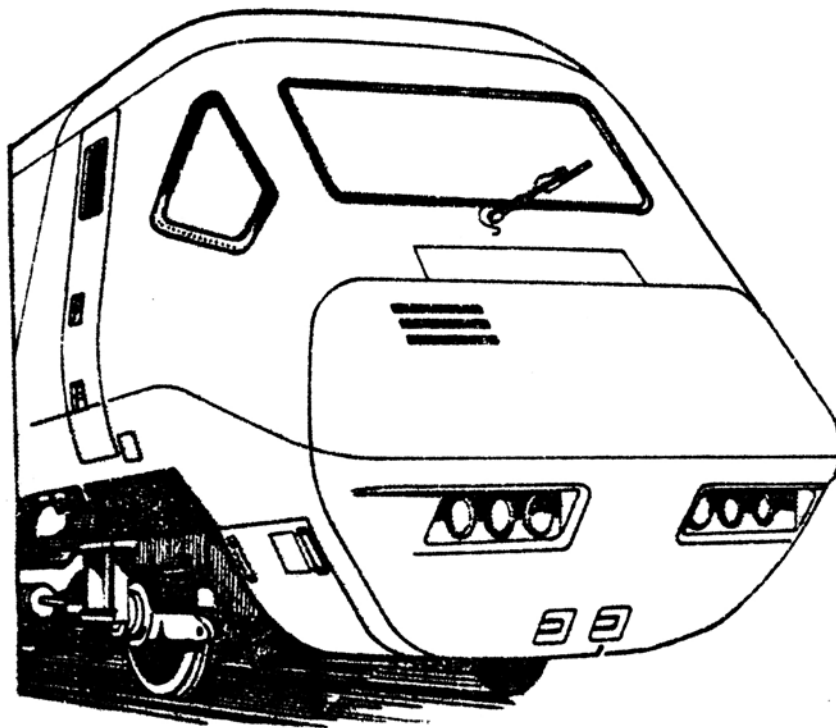


British Rail : Scottish Region



CM&EE Training Centres

APT



Course Notes

2. Geography

APT - P

Driving Trailer Equipment Location (See Fig. D1)

DRIVING CONTROLS

Master Selector (See Fig. D3)

The selector has four positions; OFF, AUXILIARY, FORWARD AND REVERSE. It is unlocked by a Master Key and in "Auxiliary" battery power is made available for lifting the pantograph and starting the Motor Alternator sets or Diesel Alternator sets; brakes may also be tested in this position. Traction power is not obtained until FORWARD or REVERSE is selected.

Power Demand Lever

The power demand lever has 9 positions, OFF Notches 1 - 7 and Boost; the traction power increases incrementally as the handle is "notched" up.

The Boost position enables the driver to obtain extra power for about 5 seconds in every 25 seconds to overcome difficult hill starting etc. The Boost notch is spring-loaded to prevent a continuous demand signal and is only operative up to 6.25 mph.

Brake Demand Lever

The brake demand lever has 9 positions like the Power lever but works in the opposite direction. The levers are so arranged that if they are both pushed forward - a natural motion for an emergency - the power is cut off and the brakes are switched to give maximum braking effort.

The power demand signal is removed should the brake lever be moved higher than notch 2. This feature of allowing power to be applied while a small brake application is retained, facilitates starting on rising gradients without "slipping back". The last notch "EMERGENCY" is, like the Power demand lever, spring-loaded to prevent accidental application.

In addition to this normal brake demand lever there is an Emergency Brake Push Button situated to the front of it (Fig.D2)

Parking Brakes (Fig.D2)

The Parking Brake System comprises 4 parking brake packs situated one in each van trailer and power car. Each pack can be operated individually, locally or as a complete system from a driving cab. The Master Selector must be in the Forward or Reverse position before control can be taken. This is to prevent accidental parking brake release causing a train to run away on a down gradient without braking effort being instantly available from the power brakes. The cab operating controls consist of 2 buttons "APPLIED" and "RELEASED" and an indicator which shows "ON", "OFF" or a "Cross Hatch" indicating a partial application.

Van trailers have 2 axles with Parking Brake equipment fitted while Power Cars have 4 axles with Parking Brake equipment fitted.

Driver's Safety Device (DSD) (Fig D3)

On the floor in front of the driver is a foot-pedal which must be depressed while the Master Selector is in the "Forward" or "Reverse" positions. Should the pedal be released for longer than 3 - 5 seconds an Emergency brake application is made automatically.

Should the system fail, it can be isolated by a switch in the panel on the right hand side of the cab.

Automatic Warning System (AWS)

In principle the AWS for APT - P is the same as that used on present locomotives. Should the system fail it can be isolated by the appropriate switch in the panel mounted on the right hand side of the cab.

Emergency Brake Loop (EBL)

APT - P has no air trainpipe, but has an electrical equivalent. In the leading driving cab there is a Brake Encoder Unit (behind the front desk). This takes the signals generated by the position of the brake lever and produces voltages to pass down the train lines to control the local electronic brake units. It also provides an Alternating Current which is passed down a train line to the end of the train and returns through each Brake Electronic Control Unit.

If this current fails to be detected at the local electronic brake units it produces an emergency brake application. In general terms therefore it operates exactly the same as an air trainpipe in that should the train break both portions would stop. In the driving cab the emergency brake loop may also be open-circuited to provide emergency braking, through the action of:- AWS, DSD, C-APT, Emergency Stop Button, Brake Handle (Pos.8), Passenger Communication, Towing Interface, in its assisting mode only.

Beneath the drivers desk on the left hand side are situated isolating valves for :- (Front to Back) Transient Pressure Valve, Windscreen Washer/Wiper, Main Reservoir Air Pressure Gauge, Towing Manifold. (See Fig.D2)

Low Main Air Pressure Protection Isolation.

If an air pipe bursts between coaches this enables the Driving Trailer to be isolated in order to release the brakes on the remainder of the train.

Passenger Communication System

This is a train line passing along the train through lever operated switches in the coaches. This system replaces the Passenger Communication Chain in existing stock. If any passenger "pulls the cord" the electrical circuit is broken and the Emergency Brake Loop is open-circuited causing full emergency brake application. The driver can however push and hold a button on his desk which overrides the brakes until the button is released. This overriding can be done only on the Passenger Communication System and not on any of the other causes of emergency braking.

Towing Interface

A "Tow. Enable" switch which has to be operated by the driver, to energise the towing circuitry, is situated in the panel on the right hand side of the cab.

The purpose of the towing interface is to enable joint braking when APT - P is being assisted by a locomotive. The towing interface provides emergency braking on both the APT - P and the locomotive and can be operated from either in any of the "normal" ways e.g. train division, passenger communication etc. It also enables the locomotive driver to have full linear control of the APT - P brake system in addition to his own train brakes from the locomotive automatic brake handle.

In the air brake position this "Tow. Enable" switch isolates the tilt on the Driving Trailer on which it is located and also energises the brake and tilt pumps throughout the train. (The Master Selector will be in the "Auxiliary" position).

The switch also has an "APT" position which is used if a second APT is utilised for assisting purposes.

Communication Equipment (Fig D4)

Driver/guard communication units are fitted in Driving cabs, Guard's compartments and at each end of the Power Cars. They can be used as soon as the Battery Isolating Switches are closed. The units consist of a rectangular box with a standard GPO type telephone handset fitted on the face, a Call button and an electronic horn.

Each vehicle, other than the Power Cars, has a Public Address amplifier which operates up to 10 loudspeakers. In each Catering vehicle and Guard's compartment a microphone unit is fitted which provides the whole train with Guard's announcements and Catering Staff calls for meals and refreshments.

Horn Controls (Fig D3)

APT - P has 2 air horns which are situated in the nose cone. The pitches are different from other traction units being E flat and C flat. Each horn has 2 valves, one to produce full volume and the other to provide a softer sound. The loud valves are inhibited until "Forward" or "Reverse" is selected to limit the possibility of maximum volume being applied in a Depot or Station.

Driver's Desk Layout

Referring to Figure D3 the layout includes the "standard" gauges viz Speedometer which is calibrated from 0 - 180 mph, Main Reservoir Air Pressure Gauge which has a range from 0 - 15 bar, the Brake Pressure Gauge, which provides a local indication only and is calibrated from 0 - 5 bar, and the AWS "Sunflower" Indicator.

Additional gauges are provided in the form of a "Brake Meter" and "C - APT" Indicator.

The Brake Meter is calibrated from 0 - 8. These numbers correspond with the brake demand lever notch position to give an indication of the effectiveness of the braking system, and rate of deceleration. The "C - APT" Advance Warning Indicator is operated from a transponder on the track, via a bogie mounted aerial. The train equipment is mounted in the rear bulkhead of the cab, at "A" side. (See Fig. D2)

A number of indicator lights are also provided as follows:-

Auxiliary Supply Fault Light

This indicator light is provided to direct the driver's attention to his side indicator panel when an MA or DA set fails and requires action on his part. Also indicates a battery charger has failed in either Driving Trailer.

Traction Fault Light

This light indicates that a fault exists in the traction equipment. It also indicates that a Battery Charger has failed in either Power Car.

Passenger Communication Alarm Light

This indicates that the Passenger Communication system has been activated and may be overridden by the Passenger Alarm Override button which enables the driver to temporarily overcome the brake application and halt his train in a safe location.

Speed Restriction Start Light

This light is illuminated for 4 seconds on the commencement of a track speed restriction. Operated by the C-APT system.

Overhead Line Light

This is a blue light which, when illuminated, indicates that Overhead Line Supply is available.

Traction Power Light

This indicates to the driver, when he demands power, that more than 100 Amps are passing through 4 or more motors when 2 Power Cars are in operation, or 3 or more motors if there is only 1 Power Car in operation. When the above conditions are met, the lamp will go out after some 5 seconds.

Wheel Spin Light

This light indicates that excessive traction power is being applied in the prevailing track conditions. Normally the Power Car traction equipment controls wheel spin although under extreme conditions the train performance is improved overall by the driver reducing the power applied.

Traction Temperature Light

When the coolant oil, surrounding the Thyristors rises above its normal working temperature, this light illuminates to indicate to the driver that he should reduce power. In the event of the Driver failing to do so and the oil temperature continuing to rise then all traction power is lost.

Tilt Failed Light.

Indicates to the driver a tilt failure. Train reverts to normal line speed.

PUSH BUTTONS

A comprehensive array of "Push-Buttons" is provided as shown in the following Table.

<u>Function</u>	<u>Colour</u>
Fire Alarm Test	Red
Pass. Alarm Override	Red
Pan Down	Red
Pan Up/Reset	Black
Bulb Test	Blue
Call Guard	White
MA/DA Set Local/Remote Start	Green
Stop	Red
Parking Brake ON/OFF	Clear
AWS Reset	Blue
C-APT Reset	Yellow
Emergency Brake Button	Red

DSD Reset is by foot pedal.

Switches for cab, equipment bay, head, tail and marker lights are situated on a panel to the left of the Driver's desk.

EQUIPMENT COMPARTMENT

Moving from the cab to the equipment compartment on "A" side, situated on the rear of the cab bulkhead is the Fire Control Station. Inside this is the Fire Alarm Test Switch which, it should be noted, tests only the equipment on the Driving Trailer.

Brake Control Unit (BCU)

This unit controls the brake on No.1 axle. The water-glycol tank is immediately below the unit, while the upper reservoir contains the air supply.

To the right of the air reservoir is the brake intensifier and to the left of the reservoir is the brake isolating cock for No.1 axle. Beneath the floor plates adjacent to the BCU is the circulating pump.

Adjacent to the unit at floor level is the air suspension isolating cock for No.1 bogie.

Battery Charge Unit

This unit contains a fault light (red), battery charging light (blue) and the Train Traction Control supply circuit breaker which supplies the DC train control lines. The unit is fitted with an ammeter and voltmeter.

Beneath the battery charger are the batteries, while the battery charge transformer is located to the left of the unit.

Battery Isolating Switch and Fuse Panel

The BIS is located on the left of the panel and is a simple ON/OFF position switch.

Located on the fuse panel is the DC control switch CS 1 controlling the 110v supply to the vehicle.

<u>Fuse</u>	<u>Function</u>
LF	Protects CLCB1/2 Cab lights
CF1 - 5	Control fuses, 40A, 10A, 10A, 10A, and 10A respectively
LK1	Negative Earth Link
BEL	Battery Earth Link
CLCB1/2	Cab lighting circuit breaker 5A rating
FCB	Fire protection circuit breaker 10A rating
AWSCB	AWS circuit breaker, 5A rating
CCB 3, 4, 5	Control Circuit Breakers each 5A rating

To the left hand side of the battery container are the Battery Fuse (BF), 80A rating and the Battery Charging Fuse (BCF), 80A rating.

Finally on "A" side is the Brake Electronics Unit (BECU) for No.2 axle while to the left of this unit and below it is the corresponding unit for No.1 axle.

"B" Side Equipment

Starting again at the cab end the first unit is the Radiator for the diesel engine. Beneath this is the engine air start isolating cock which is self-venting. The diesel engine is a Cummins 6-cylinder in-line turbo-charge unit fitted with air start equipment and directly coupled to a 250 kVA alternator. See Fig. D5a.

An air start lubricator is provided and an ether dispenser for cold starting; both containers are on the front of the engine.

Electrical Control Equipment Cubicle (D.A. set) See Fig D5.
This is located above the alternator and contains, reading from top to bottom, a Frequency Meter and Engine Hour Recorder.

Local Start and Stop Buttons (EAR PROTECTORS MUST BE USED WHEN STARTING FROM THIS LOCATION).

Fault Panel containing test and reset switches for checking the panel indicator lights.

At the bottom is a locked compartment containing the Diesel Alternator Isolating and Phase Testing Switches and reset button. This reset button is used to reset any "latched" fault relay which may be causing an indication on the Fault Panel. If a fault occurs and is rectified, or rectifies itself, one half of the appropriate indication lamp remains lit as a record until the Fault Panel is reset by Maintenance Staff.

Behind this compartment are located control relays which are displayed in Figure D5.

On the passenger compartment bulkhead are the AC Control Circuit Breakers (SCB1/2) and the Earth Leakage Detection Unit.

SALOON

Vestibule No.2 End

Facing the exterior door the cubicle on the left contains, from top to bottom:-

Door Emergency Handle which operates the step latch mechanically, by Bowden cable, and vents the air pressure which was keeping the door closed and the steps raised.

Passenger Alarm light which is fitted to all trailer vehicles and illuminates a red panel when the alarm is pulled in the same vehicle.

Interior and Exterior door timing release.

Door Pneumatic Pack containing 3 switches which provide isolation for the Exterior door, Interior door and transient pressure valve.

The door locking mechanism and door seal choke are on the lower right hand side of the cubicle with the door step control and latching mechanism at the very bottom.

NOTE:- THE INTERIOR DOOR SLIDES BACK INTO THIS CUBICLE AND MUST THEREFORE BE ISOLATED BEFORE ANY WORK IS STARTED.

Access to the exterior door step latch mechanism is obtained by removing a panel at floor level on the saloon side of the bulkhead below the adjacent seat.

Facing the exterior door, the cubicle on the right contains from top to bottom:-

Indicators: the Blue indicator when illuminated indicates "Tilt Failure" while the Green indicator when illuminated indicates "Air Conditioning On". Both are only local indications.

To the left of the cubicle are the terminal connections and towards the bottom Local Control Switches for Air Conditioning (ON/OFF) Tilt (ON/OFF) and Lights (Half/Full).

VEHICLE EXTERIOR (See Fig. D6)

Starting from No.2 end "B" side the first compartment contains:-

Brake Pack for No.3 axle.

Brake Pump.

Brake Intensifier.

Brake Isolating Cock.

Moving towards the nose end, the next compartment (No.2) contains:-

The Hydro-kinetic brake radiator, fan and thermostat.

No.3 Compartment - This contains the Contactor Panel incorporating on the right COS1 and 2. COS1 controls the tilt and brake pumps while COS2 controls the electronics, air conditioning and lights. (See Fig. D7)

These Change-Over Switches (COS) have three positions viz:-

1 - Shore Supply; 0 - Off; 2 - Normal.

Both switches can be padlocked in the "OFF" position. To the left of the

panel is a six position switch for maintenance purposes covering the following functions:-

- 1) } Not Used.
- 2) }
3. Normal.

NB. This switch should be used cautiously and MUST be returned to Normal immediately after use.

4. Brake pump run.
5. Brake pump run.
6. Brake pump run.

Using this switch the above equipment may be run if a 3-phase supply is available, irrespective of the position of the Driver's controls.

Beneath this Contactor Panel are the vehicle air conditioning control buttons. The heating test button brings on 3 stages of heating while the cooling test button brings in the first stage of cooling followed after a short delay by the second stage. Red indicator lamps on the right hand side show which stages of heating and cooling are operating. 3-phase AC is required for the above tests.

The "Transient Pressure Valve Closed" light is beneath the heating/cooling indicators.

To the left of this equipment is a hinged panel behind which are the relays and contactors with their terminal connections located below.

Mounted on the panel are circuit breakers as shown in the following table.

	CIRCUIT BREAKER	FUNCTION
Top Row	CCB1/2	Control Circuit Breaker
	ESCB1/2	Electronic supply
	TCB1/2	Tilt supply
	BCB1/2/3	Brake supply to AC/DC DC/DC units.
	CSCB1/2	C-APT supplies
	BCCB	Battery charge
Bottom Row	ACCB1/2/3/4	Air conditioning supply
	WCCB1/2	Toilet and cleaning sockets supply
	LCB1/2/3/4	Lighting supply
	ISCB	Inspection lamp supply

CIRCUIT BREAKER	FUNCTION
GLCB	Guard's lamp supply
DICB	Destination indicator
PBCB	Parking brake supply
DCB	Demister supply
HLCB	Headlamp supply
CHCB	Cab heat supply
HCB	Hotplate supply
RLCB	Reading lamp supply

To the left is the Drain Cock for the water tank. Above it is a filling point and to its left a filling valve; this valve depressurises the tank before filling and also opens the overflow. Further left is small valve and water separator which supplies air to the coach doors and toilet wash basin water supply tank. Behind the electrical panel are two reservoirs for the air suspension.

No.4 Compartment

This contains the Refrigeration pack which may be supplied by either "Denco Miller" or "Temperature Limited". These packs are interchangeable.

No.5 Compartment

This contains the Tilt pack radiator and thermostat.

No.6 Compartment

This contains the Brake radiator, and thermostat, for No.2 axle.

No.7 Compartment

This contains the Brake radiator, and thermostat, for No.1 axle.

No.8 Compartment

This contains the Diesel fuel tank holding 909 litres (100 gallons). There is another tank on "A" side and both are connected by a balancing pipe. Filling points are provided on each side of the vehicle.

No.9 Compartment

This contains the Water-Glycol reservoir for No.2 axle Hydro-Kinetic brake.

No.10 Compartment

This contains the Air start reservoir for the diesel engine.

Transient pressure valve.

Headlight transformer.

Nose End (Fig.D8)

The Nose End can be raised by pulling the right hand lever when facing the nose cone.

The nose end can be raised to either of two positions:-

Fully Up - when the train (or vehicle) is coupled to an assisting traction unit.

Half Up - when a lamp inspection is being carried out.

Once raised fully, a safety catch retains the cone in its new position.

Retractable buffers: these can be extended by removing the locking pin, turning the buffer through 90°, extending and replacing the locking pin.

A Drop-head buckeye coupling is fitted to allow the coupling to either another passenger vehicle, or locomotive.

Main reservoir air pipes (for the air supply from an assisting vehicle) are located adjacent to the Buffers.

Brake pipe for connecting to an assisting unit.

Warning horns.

The Cable across the bottom of the nose end is used when the assisting unit is another APT. It conveys Brake Loop and communication signals.

"A" SIDE, moving towards No.2 end

No.1 Compartment

This contains the Windscreen washer water tank.

The remainder of the space is taken up by the Air start reservoir for the Diesel engine.

No.2 Compartment

This contains the Brake pack for No.2 axle.

No.3 Compartment

This contains a Fuel Tank similar in size and capacity, and linked, to that on "B" side.

No.4 Compartment

This contains the tilt pack comprising large and small hydraulic pumps and hydraulic accumulator. An oil pressure gauge, which is operated by a blue test button. A maximum temperature recorder and sight glass for oil level

are fitted while two indicator lights are provided to indicate when the hydraulic fluid filters require cleaning.

The Red test button to the right of the pack will cause the large tilt pump to run and shut off the small tilt pump for static tilt pressure testing.

A Dump/Level valve is located to the left of the pack.

No.5 Compartment (2 Bays)

This contains a row of filters for the air conditioning equipment. Behind the filters is a Transient Pressure Valve and banks of heater elements.

NOTE: THE TRANSIENT PRESSURE VALVE IS RAM OPERATED KEEP YOUR HANDS CLEAR.

No.6 Compartment

This contains the Electronic Supplies comprising two green boxes providing the AC/DC supplies for Brakes/Tilt and the other for C - APT.

Two blue boxes provide the DC/DC supplies for Brakes/Tilt and C - APT.

The AC/DC boxes operate when a 3-phase supply is available.

The DC/DC boxes operate when no 3-phase supply is available via battery.

The small blue box to the right of the compartment contains Ripper Systems Limited Communication Equipment. Next to it is the electronics interface connection panel.

A water filler point is also situated in this compartment.

No.7 Compartment (2 Bays)

This Compartment contains the Brake Electronics for No.3 axle.

Brake Air reservoir located in the Right Hand bay.

The Water-glycol Reservoir located in the Left Hand bay.

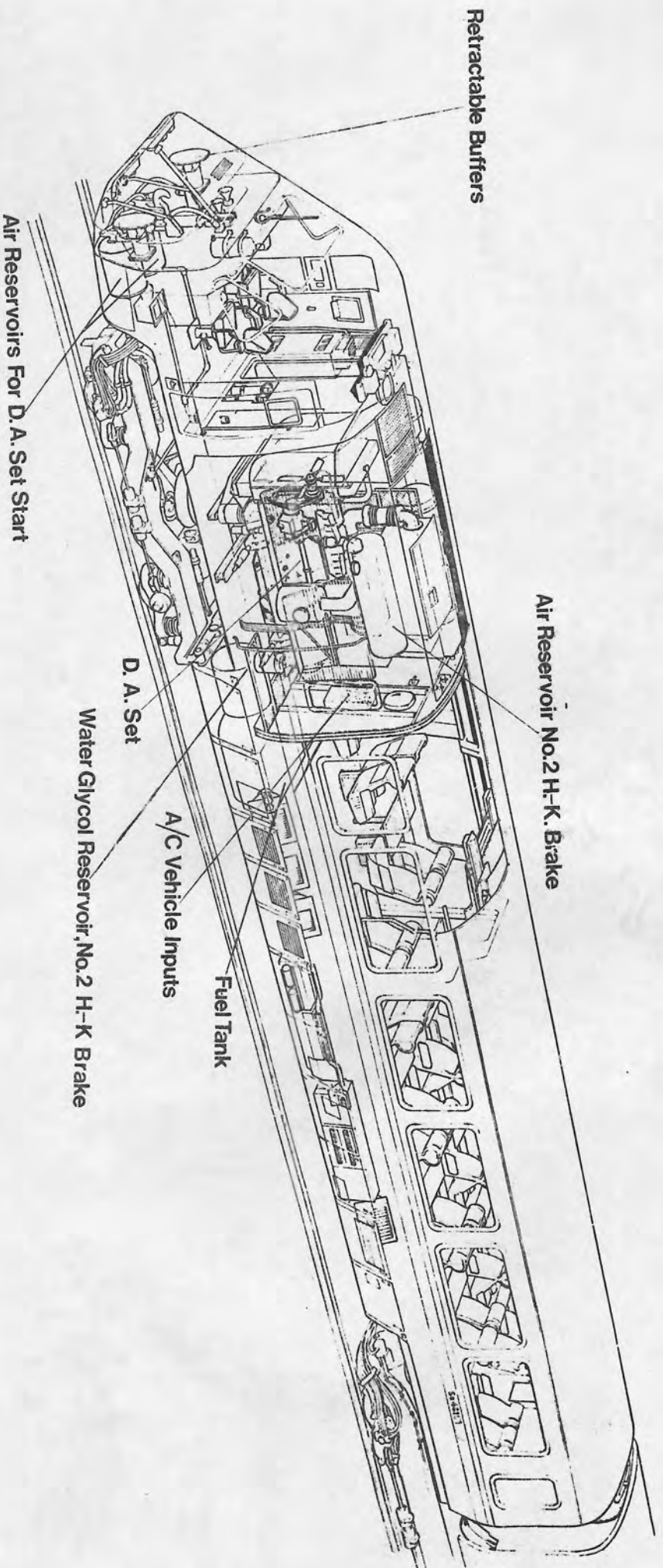
An isolating cock and check valve for isolating the air suspension for No.2 end of the Driving Trailer.

The Air Suspension drain cock is on the left of the compartment and is used after the Air Suspension System has been isolated.

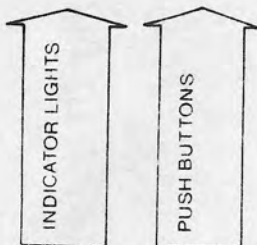
STUDENTS NOTES.

APT-P DRIVING TRAILER.

Fig. D1



--16--



RED Auxiliary supply

RED Traction fault

RED Pass.alarm

WHITE Start speed restriction

BLUE Overhead line

RED Traction power

RED Wheel spin

RED Traction over-temp.

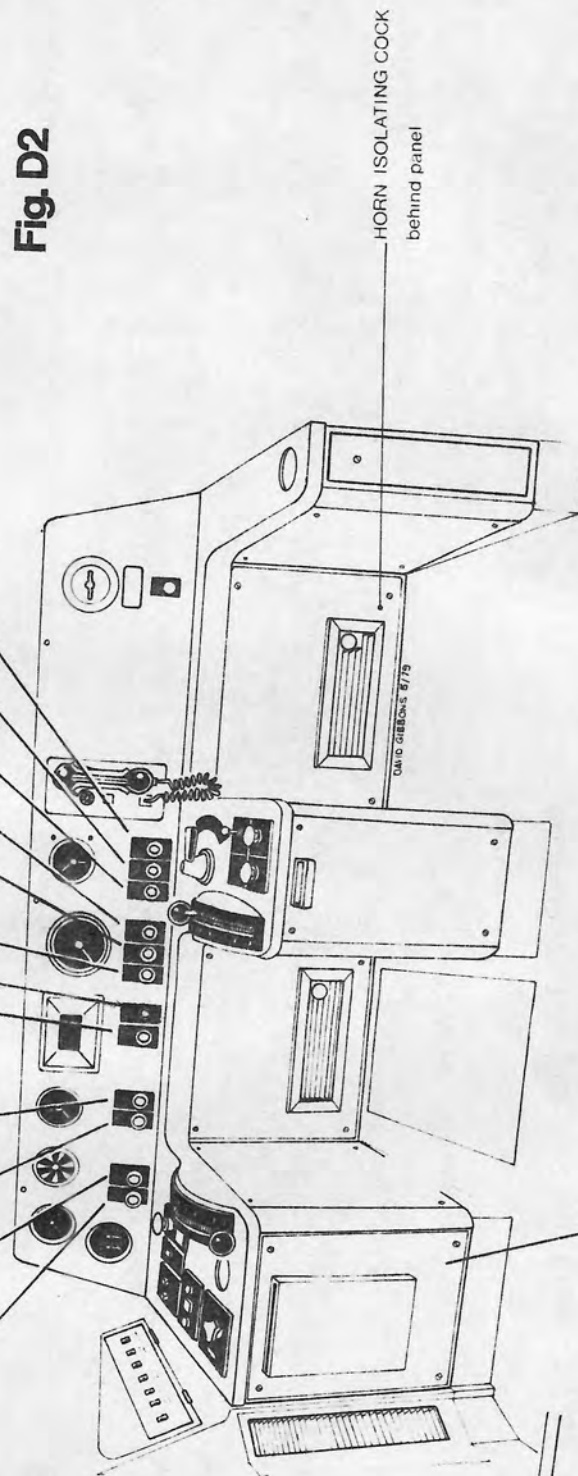
RED Pass.alarm override

RED PAN DOWN

BLACK Pan up reset

TILT FAILED LIGHT

Fig. D2



HORN ISOLATING COCK
behind panel

TRANSLUCENT PRESSURE VALVE
WINDSCREEN WASH/TIE
MAIN RESERVOIR GAUGE
TOTTING MANIFOLD

ISOLATION SWITCHES
BEHIND DESK.

Emergency brake button

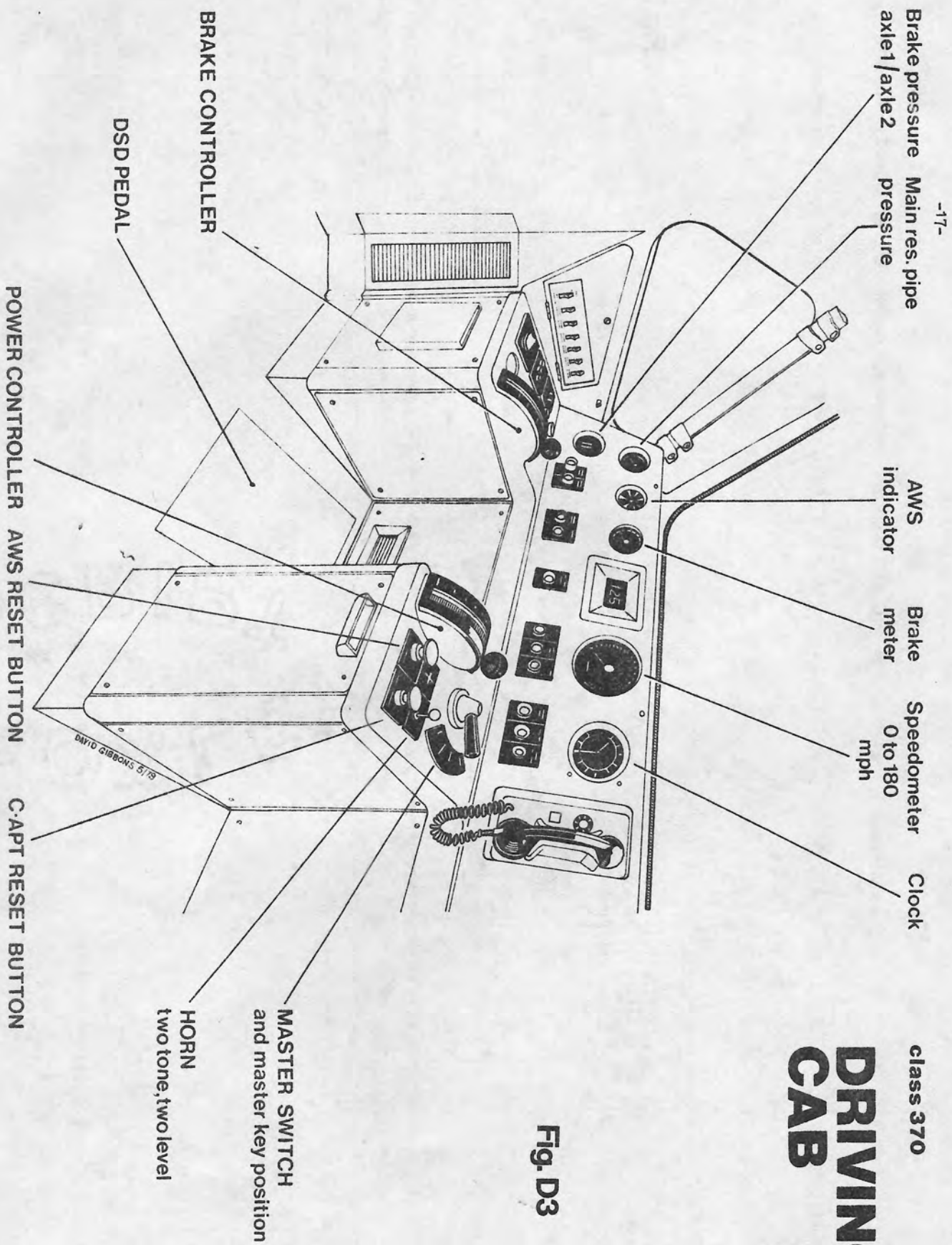
Indicator bulb test button

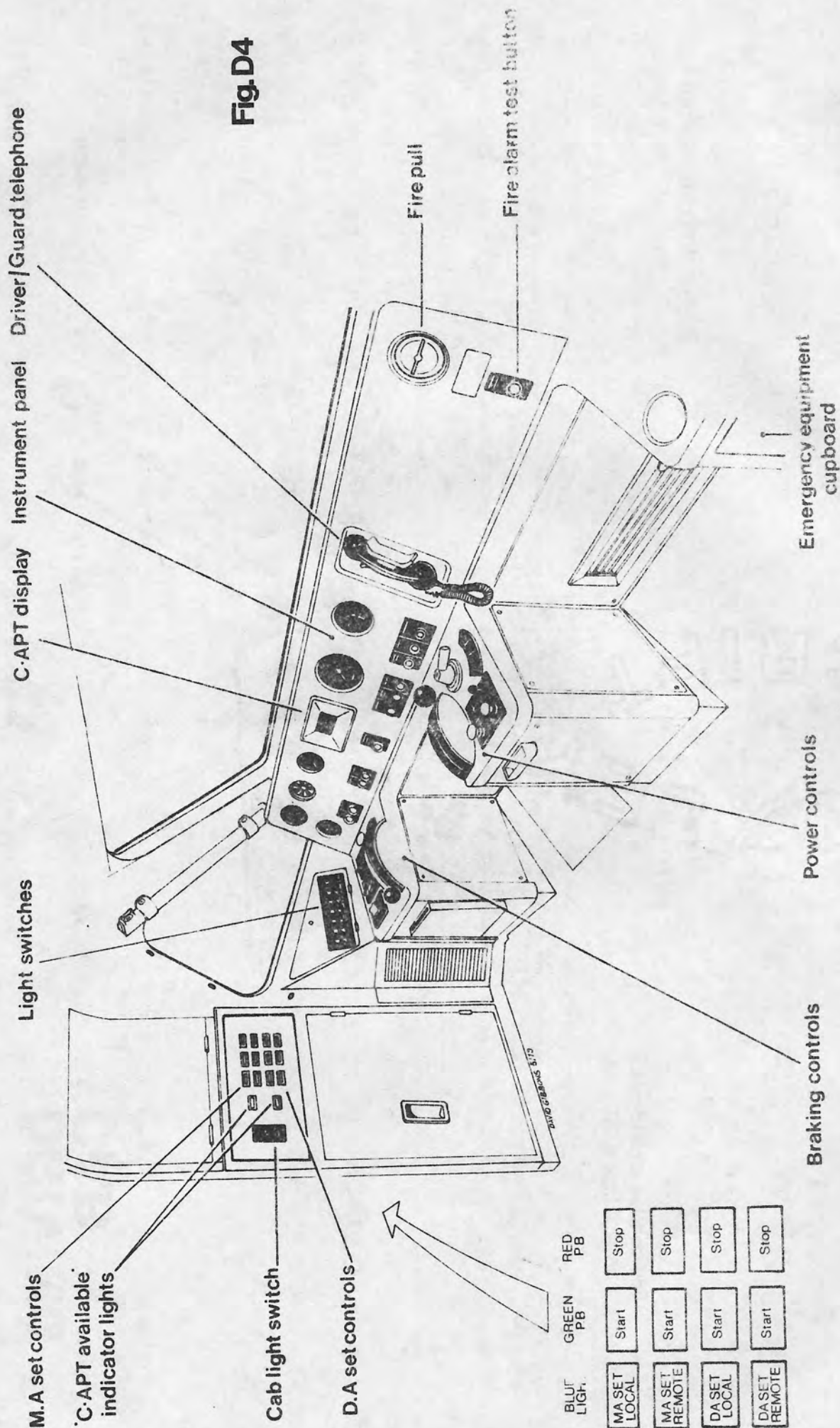
Cab air cond.
switches

hydraulic
parking brake

windscreen
wash/wipe
and
demist

class 370 DRIVING CAB





DIESEL ALTERNATOR CONTROL PANEL EQUIPMENT
CLASS 370 DRIVING TRAILER (See fig. D5)

ACR Alternator Contactor Relay. (110V)
 AHR Alternator Healthy Relay. (110V)
 ASTR Activate Start Relay (110V)
 AVR Automatic Voltage Regulator.
 CT1 Current Transformer) 1 C.T. per phase, fed into
 CT2 Current Transformer) ammeter test switch.
 CT3 Current Transformer)
 DAC Diesel Alternator Contactor (240v 1 phase)
 EF Earth fault (24v).
 FS1) 3 phase supply from Permanent Magnet pilot exciter (90Vac)
 FS2) to rectifier (for supplying main exciter field).
 FS3)
 FS4) Supply to AVR sensing) Supply to Voltmeter
 FS5 terminals) test switch.
 FS6 Supply to Hz and Hour meter)
 FS7 Supply to D.A.C. contactor coil.
 FS8 Supply to Coolant block heater on diesel engine.
 FS9 Supply to Fault Relays via reset button.
 1LR Overvoltage fault Relay (110v), Operated by OV) Mechanically
 2LR Under frequency Relay, (110v), Operated by UF) latched, reset
 3LR Over frequency Relay, (110v), Operated by OF) by Fault reset
 4LR Earth Fault Relay (110v), Operated by EF) Push Button.
 5LR Low oil pressure relay, (110v),
 6LR Low coolant level relay (110v).
 NVR No Volts Relay (240v 1 phase)
 OF Over Frequency (24v)
 OL Over Load (24v)
 OSR Over Speed Relay (110v)
 OV Over Voltage (24v)
 PSU Power Supply Unit
 RDF Rotating Diode Failure (24v)
 SPR Stop Relay (110v)
 STR Start Relay (110v)
 UF Under Frequency (24v)
 UV Under Voltage (24v)

Test Switch Functions

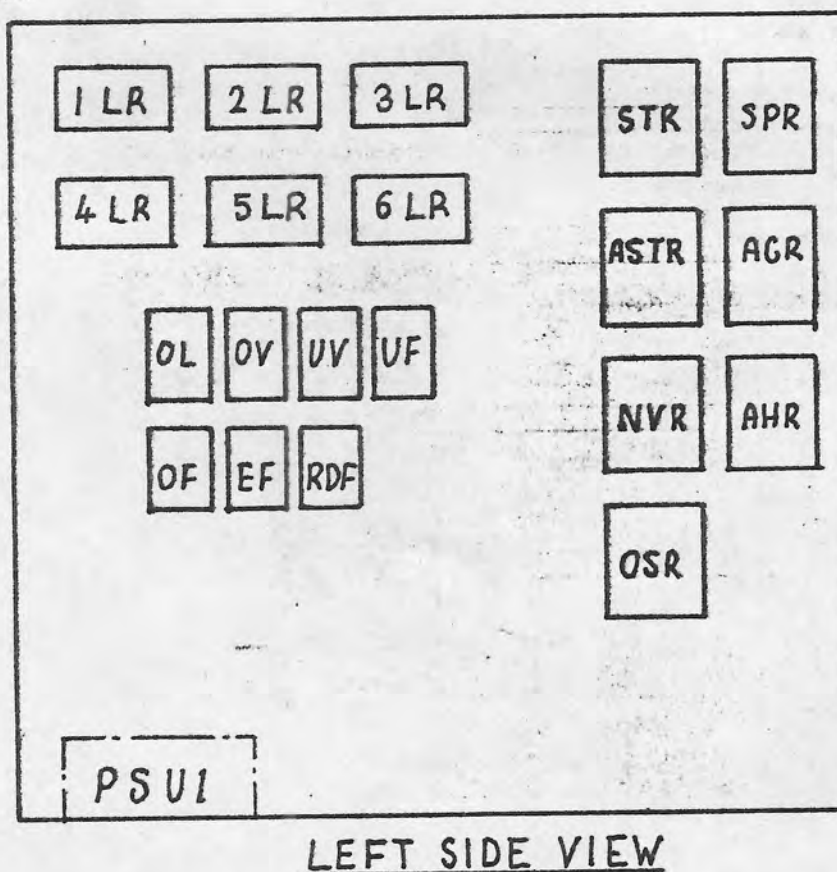
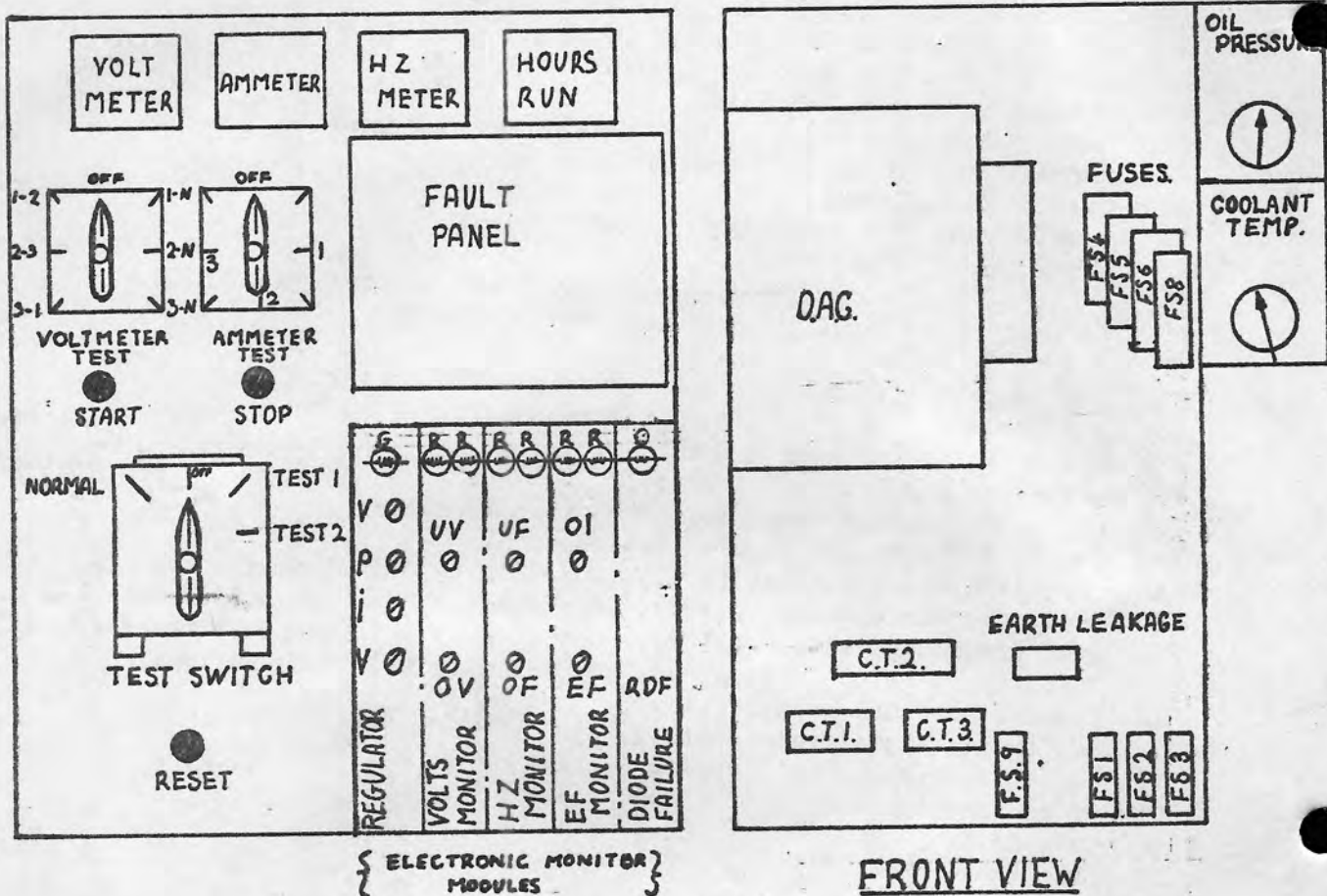
OFF	-	D.A. control isolated.
NORMAL	-	NORMAL
TEST 1	-	D.A. can be started.
TEST 2	-	D.A. can be started and bought on line.

NOTE:- Mounted on Diesel Engine are:-

ASV	Air Start Valve	(110v)
ESV	Ether Start Valve	(110v)
FSV	Fuel Solenoid Valve	(110v)

DIESEL ALTERNATOR CONTROL PANEL LAYOUT (A.P.T.) CLASS 370

Fig D5.



DIESEL UNIT

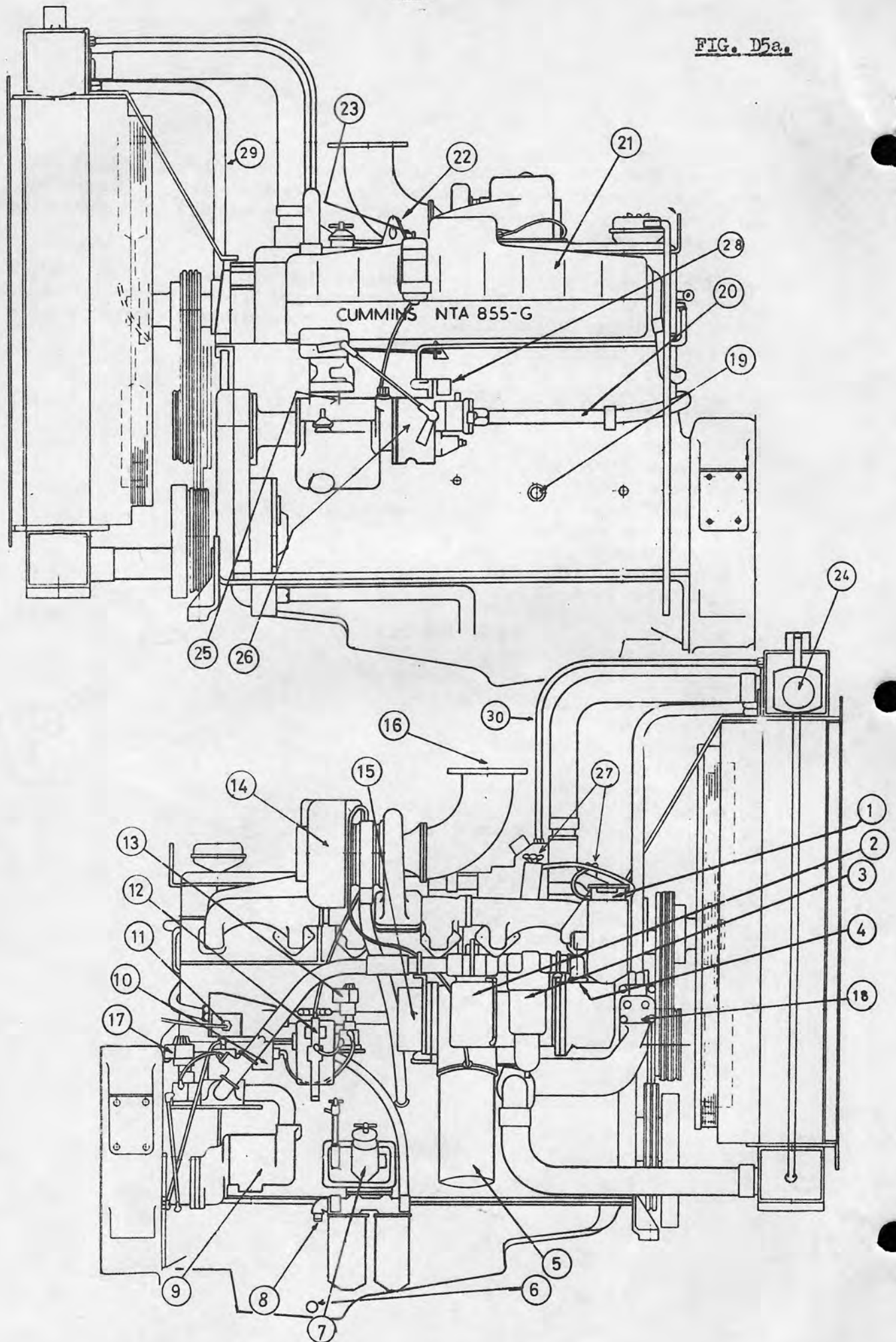
The Diesel engine is an in-line, six-cylinder, turbocharged CUMMINS NTA 855-G. A hydraulic governor is used to enable the speed of the engine (and consequently the frequency of the alternator supply) to be maintained within close limits.

Most of the components of the engine needing maintenance - oil, fuel, air and water filters, plus the air start system are located on the left-hand side of the engine (viewed from the front) to enable easy access to these components when the engine is in situ.

COMPONENT IDENTIFICATION LEGEND

1. Corrosion Resistor
2. Air Line Lubricator
3. Air Line Filter
4. Air Line Inlet
5. Lubricating Oil Filter
6. Lubricating Oil Drain Plug
7. Lubricating Oil Filler
8. Fuel Inlet Connection
9. Air Starter
10. Pressure Reduction Valve for Ether Start
11. Water Heater
12. Ether Injector for Cold Starting
13. Ether Start Solenoid Valve
14. Turbocharger
15. Ether Start Thermostat
16. Exhaust Outlet
17. Air Start Solenoid Valve
18. Water pump
19. Lubrication Oil Pressure Switch
20. Fuel Pipe
21. Intercooler
22. Fuel Filters
23. Overspeed Switch Reset Button
24. Coolant Level Switch
25. Governor
26. Fuel Pump
27. Water Filter Isolation Valves
28. Fuel Solenoid Valve
29. Water Make Up Hose for Engine Filling
30. Vent Hose

FIG. D5a.

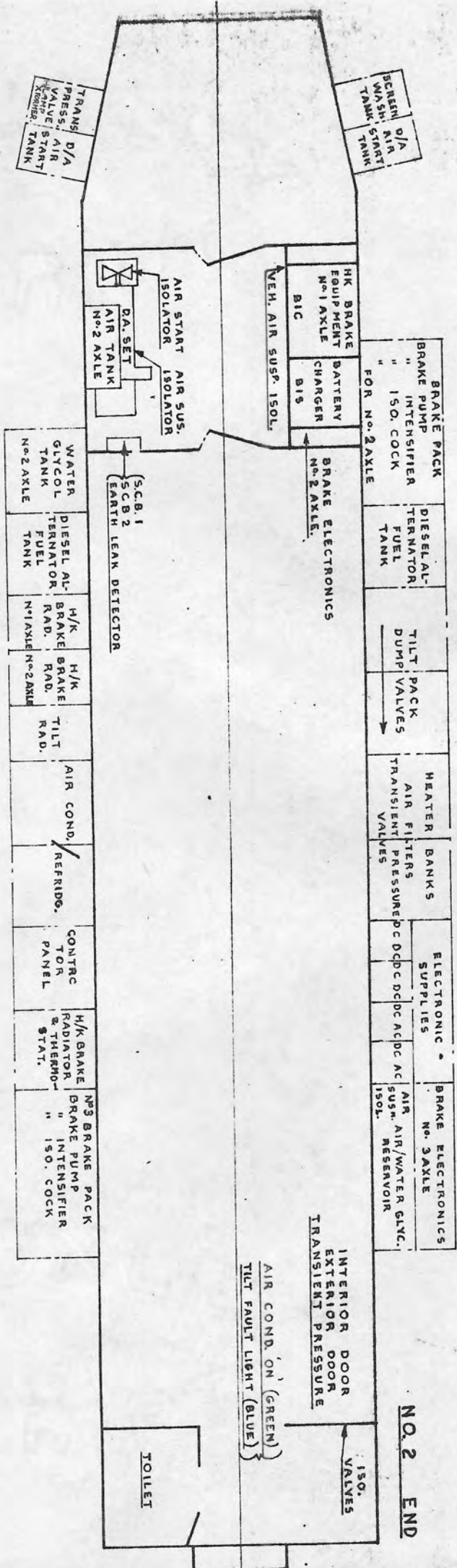


GENERAL LAY-OUT DRIVING TRAILER 3 AXLE VEH.

Fig.D6.

A.P.T.

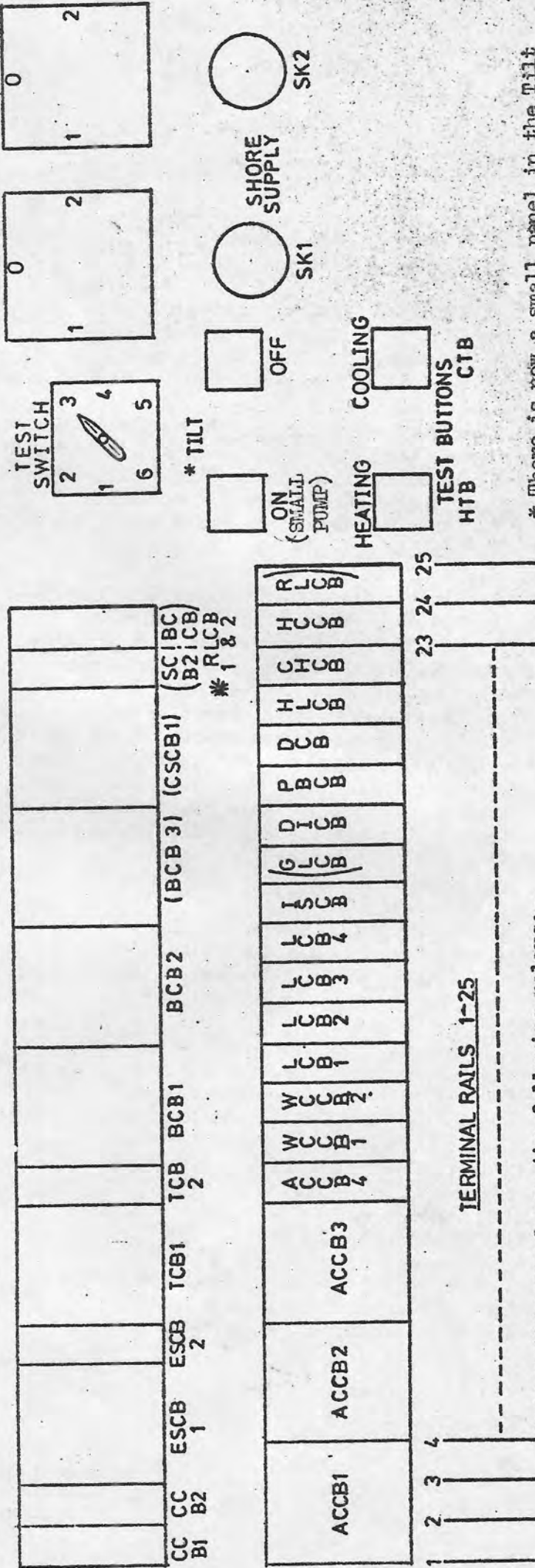
'A' SIDE



'B' SIDE

INTERMEDIATE, DRIVING AND VAN TRAILER CONTACTOR PANEL

FIG D7



* There is now a small panel in the Tilt Bay containing a Red and a Green button. To operate large pump press the Green button, to stop press Red button.

Equipment in brackets not found on intermediate vehicle contactor panel.

* RLCB1/2 TAKES THE PLACE OF SCB2, BCCB ON 1ST CLASS INTERMEDIATE VEHICLES.

CONTACTOR PANEL. (See Fig.D7)

Equipment on Contactor Panel in alphabetical order:-

AC1	Air Conditioning on slave Relay.
AC2	Air Conditioning Off Relay.
AC3	Air Conditioning On Relay.
ACCB1)	Air Conditioning (Refrigeration Pack.
ACCB2)	A.C. Supply (Circulation Fans.
ACCB3)	Circuit Breakers. (Heating Elements.
ACCB4)	Air Conditioning A.C. Control Supply Circuit Breaker.
ASR	Air Conditioning Supply Relay.
BCB1)	Brake Circulating Pump Supply Circuit Breakers No. 1 axle.
BCB2)	Brake Circulating Pump Supply Circuit Breakers No. 2 axle.
BCB3)	Brake Circulating Pump Supply Circuit Breakers No. 3 axle.
BCCB	Battery Charger (Supply) Circuit Breaker.
BFC1	Brake Radiator Fan Contactor No. 1 axle.
BFC2	Brake Radiator Fan Contactor No. 2 axle.
BFC3	Brake Radiator Fan Contactor No. 3 axle.
BOL 1	HK Brake Circulating Pump Overload No. 1 axle.
BOL 2	HK Brake Radiator Fan Overload No. 1 axle.
BOL 3	HK Brake Circulating Pump Overload No. 2 axle.
BOL 4	HK Brake Radiator Fan Overload No. 2 axle.
BOL 5	HK Brake Circulating Pump Overload No. 3 axle.
BOL 6	HK Brake Radiator Fan Overload No. 3 axle.
BPC 1	HK Brake Circulating Pump Contactor No. 1 axle.
BPC 2	HK Brake Circulating Pump Contactor No. 2 axle.
BPC 3	HK Brake Circulating Pump Contactor No. 3 axle.
CCB 1	A.C. Control Circuit Breakers Brake and Tilt Pump and Fan Contactors.
CCE 2	D.C. Control Circuit Breaker. All Vehicle D.C. Systems.
CFC	Circulating Fan Contactor.
CHCB	Cab Heat Circuit Breaker. A.C. to Cab Air Conditioning.
COR	Controls On Relay.
COS 1	Change Over Switch. Tilt and Brakes.
COS 2	Change Over Switch. Air Conditioning and Electronics.
CSCB1	CAPT A.C. Supply Circuit Breaker. A.C./D.C. Module.
CSCB2	CAPT D.C. Supply Circuit Breaker. D.C./D.C. Module.
CTB	Cooling Test Button.
CTR	Close Transient Pressure Valve Relay.
DCB	Driving Cab Circuit Breaker. D.C. Supplies to Cab Services.
DICB	Destinator Indicator Circuit Breaker.
ESCB1	Electronic A.C. Supply Circuit Breaker.
ESCB2	Electronic D.C. Supply Circuit Breaker.
FFC	Fresh - Air Fan Contactor.
GLCB	Guard's Lamp Circuit Breaker. (Including Luggage Area).
HC 1	Heating Contactor.
HC 2	Heating Contactor.
HC 3	Heating Contactor.
HCB	Hot Plate Circuit Breaker. Driver's Cooker.
HLCB	Headlamp Circuit Breaker. (A.C.).
HTB	Heating Test Button.

ISCB		Inspection Lamp Supply Circuit Breaker.
LC		Lighting Contactor.
LCB	1)	Saloon Lighting (A.C.) Circuit Breaker.
LCB	2)	
LCB	3	Reading Lights Circuit Breaker. (1st Class).
LCB	4	Saloon Lighting (D.C.) Circuit Breaker.
LP	1	Cooling 2nd Stage.
LP	2	Cooling 1st Stage.
LP	3	Heating 1st
LP	4	Heating 2nd
LP	5	Heating 3rd
LP	6	Fresh Air Fan Failed or Valve Closed.
LR	1	Lights On Relay.
LR	2	Lights Off Relay
LSR		Load Shedding Relay. For Use If D.A. Set Running.
OL	1	Overload Circulating Fan.
OL	2	Overload Fresh Air Fan.
PDCB		Parking Brake Circuit Breaker.
RLCB	1	Reading Lamp Circuit Breaker. A.C. Secondary Feed Via LCB 3.
RLCB	2	Reading Lamp Circuit Breaker. A.C. Secondary Feed Via LCB 3.
TCB	1	Tilt Power Supply Circuit Breaker.
TCB	2	Tilt Oil Heater Circuit Breaker.
TFC		Tilt Radiator Fan Contactor.
TOL	1	Tilt Oil Pump Overload.
TOL	2	Tilt Oil Pump Overload.
TOL	3	Tilt Radiator Fan Overload.
TPC	1	Tilt Oil Pump Contactor.
TPC	2	Tilt Oil Pump Contactor.
TPR		Transient Pressure Relay.
TS		Test Switch.
Positions	1	Not used.
Positions	2	
Positions	3	Normal.
Positions	4	Brake Pump. Runs Pump No. 1 Axle.
Positions	5	Brake Pump. Runs Pump No. 2 Axle.
Positions	6	Brake Pump. Runs Pump No. 3 Axle.
TVR	1	Transient Pressure Valve Master Relay. D/T Only.
TVR	2	Transient Valve Master Relay.
WCCB	1	Toilet Supply No. 1 End.
WCCB	2	Toilet Supply No. 2 End.

*CDR Compressor Delay Relay. (Air Conditioning).

STUDENTS NOTES.

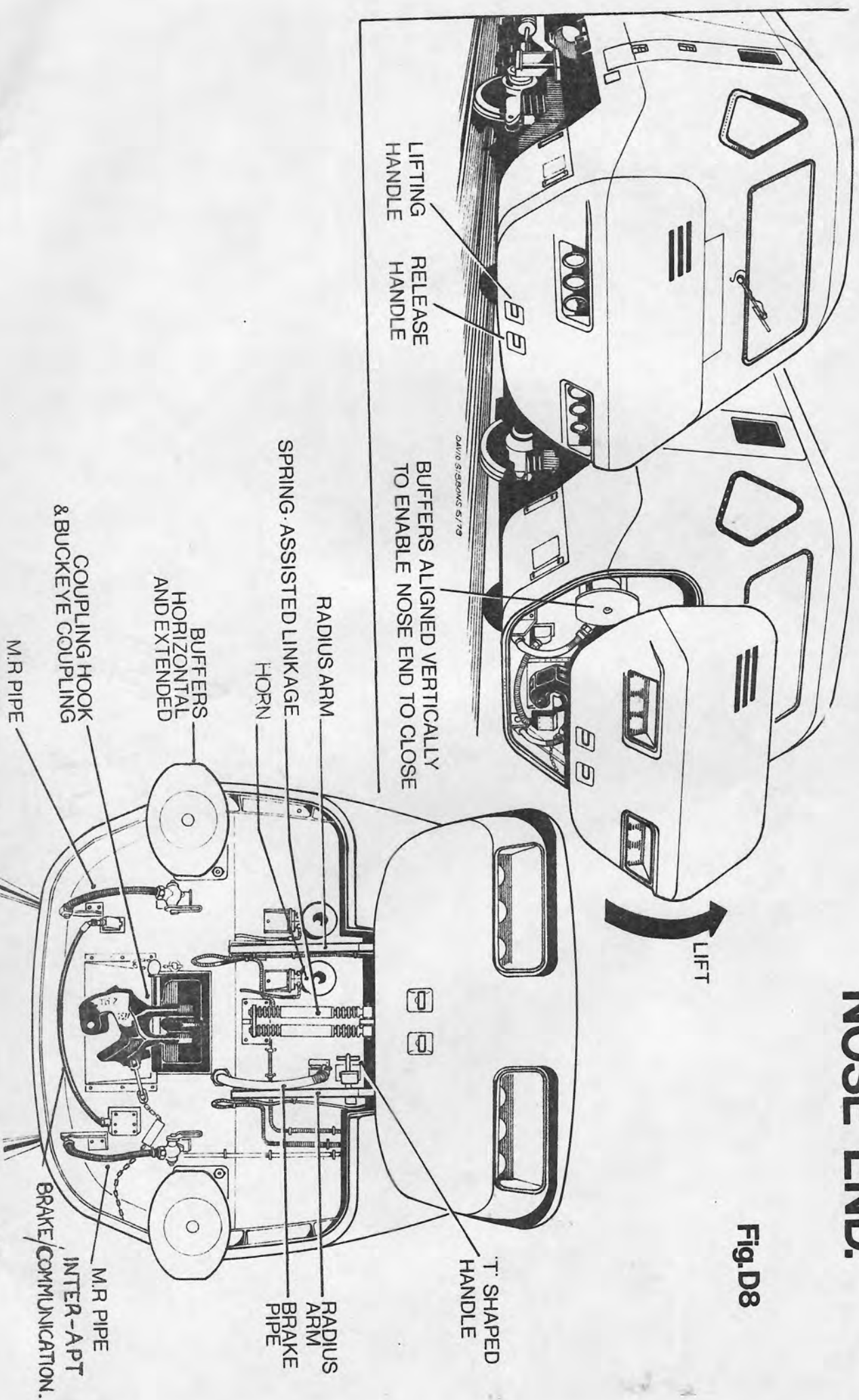
NOSE END IN NORMAL POSITION

-28-

NOSE END BEING RAISED

NOSE END.

Fig.D8



INTERMEDIATE TRAILER.

Intermediate Trailers Equipment Location. (See Fig.IT.2)

Starting on "B" side No 2 end, first compartment:-

Brake Pack.
Brake Pump.
Brake Intensifier.
Brake Isolating Cock.

1st. Compartment Moving Left "B" Side.

Hydro-Kinetic brake radiator and thermostat.

2nd. Compartment : 2 Bays.

Contactor panel :- Right hand side, C.O.S. 1 and C.O.S. 2.
C.O.S. 1 controls tilt and brake pumps. C.O.S. 2 controls electronics, air conditioning and lights.
C.O.S. (Change over switch) positions :-

- 1 Shore supply.
- 0 Off.
- 2 Normal.

Both switches can be padlocked in "OFF" position.

To the left is a six position switch, for maintenance purposes :-

- 1) Not Used.
- 2)
- 3 Normal.
- 4 No.1 Brake Pump run.
- 5 No.2. Brake Pump run.
- 6 Not used on Intermediate Trailer.

Actual panel is standard on all vehicles. Certain items are omitted on intermediate trailers.

For detail see driving trailer training note.

3rd. Compartment Moving Left "B" Side.

Refrigeration pack and air conditioning.

4th.-Compartment Moving Left "B" Side.

Tilt radiator.

5th. Compartment Moving Left "B" Side.

Empty.

6th. Compartment Moving Left "B" Side.

Two bays :-

Water filling point and tanks, also surge reservoir for air suspension.

7th. Compartment Moving Left "B" Side.

Two bays :-

Brake electronics for No 1 axle, also air reservoir and water glycol reservoir.

Starting "A" Side, (No 1 end) first compartment.

Brake Pack.

Brake Pump.

Brake Intensifier.

Brake Isolating Cock.

2nd. Compartment Moving Left "A" Side.

Hydro-Kinetic brake radiator and thermostat.

3rd. Compartment : 2 Bays.

Surge reservoir for air suspension and water tank supplying hand washing facilities.

4th. Compartment Moving Left "A" Side.

Tilt pack. (occupying two bays). On left hand bulkhead there are two dump valves.

5th. Compartment Moving Left "A" Side.

(Two bays) Heater banks and a row of filters, behind filters are the inlet transient pressure valves.

TRANSIENT PRESSURE VALVES ARE RAM OPERATED, DO NOT PUT HAND NEAR GAP.

6th. Compartment Moving Left "A" Side.

Electronic supplies, AC/DC (Green) and DC/DC (Blue) packs one of each.

7th. Compartment Moving Left "A" Side.

(Two bays) Brake electronics for No2 axle, also air and water glycol reservoirs.

The air suspension isolating cock for No2 end is also to the left of this compartment.

Intermediate Trailers Internal Equipment (See Fig.IT.1.)Vestibule No 1 End (Right side.)

Starting at the bottom of the righthand vestibule, the facing door conceals the vehicle electrical inputs. Four cables enter the bottom. These are AC vehicle inputs from bus-bars, feeding up through SCB 1 and 2, (70 A.); Above these is an Earth Leakage Detection Unit. To the left of the Earth Leakage Unit is CF 1 fuse (40A.) This protects DC inputs to vehicle, but not DC train line control functions, such as door control.

Above the Earth Leakage Detector is the control switch. This isolates the local DC supplies to vehicle.

Note :- DC train lines in the vehicle will remain live.

Vestibule No 1 End (Left side.)

Starting at top of lefthand vestibule is the emergency handle, with indicator to show when passenger alarm has been activated (red light). Beneath this are the door relays, and pneumatic pack. The door locking mechanism and seal choke are adjacent to the pneumatic pack.

At the bottom is the door step control and latching mechanism. The interior sliding door is controlled from the same pack. The trailing edge of the interior door has a mag'lock switch to sense when the door is closed.

NOTE :- THE INTERIOR DOOR SLIDES INTO THIS CUBICLE. THE DOOR MUST BE ISOLATED BEFORE STARTING WORK IN THIS AREA. THE ISOLATING VALVE IS ONE OF THREE ON THE ADJACENT PNEUMATIC PACK.

The other two valves isolate the exterior door and the transient pressure valve.

Also in the vestibule are the exterior door control buttons for the use of passengers.

Door Open: Situated on the Right side of the exterior door.

Door Closed: Situated on the Left side vestibule bulkhead.

Note, the exterior door can only be operated by a passenger after the Guard has unlocked it from his Control panel, unless the emergency handle is used.

Toilet Compartment.

The toilet is of the chemical recirculating type actuated by lowering the seat cover. The fluid used is Elsan Blue.

The mirror hinges forward to reveal the dropper resistors for the "Toilet Engaged" indicator.

The panel below the wash basin can be removed to reveal :

Circulating Pump for Elsan Blue.

Timer Relay.

Water Heater/Thermostat Unit.

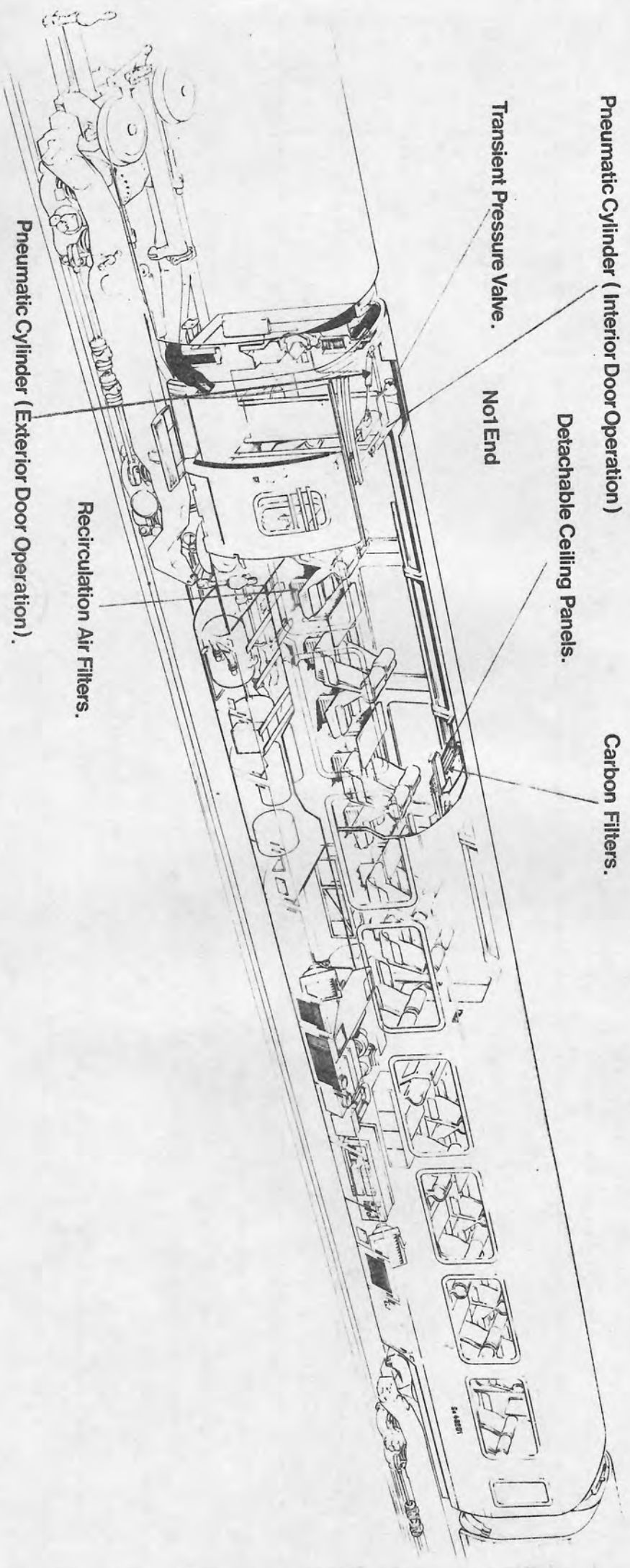
Access to plumbing.

There is a Shaver socket to the left of the mirror.

Water is supplied to the wash basin at a preset temperature by operating a floor button.

STUDENT'S NOTES.

APT-P INTERMEDIATE TRAILER CAR. Fig.IT.1

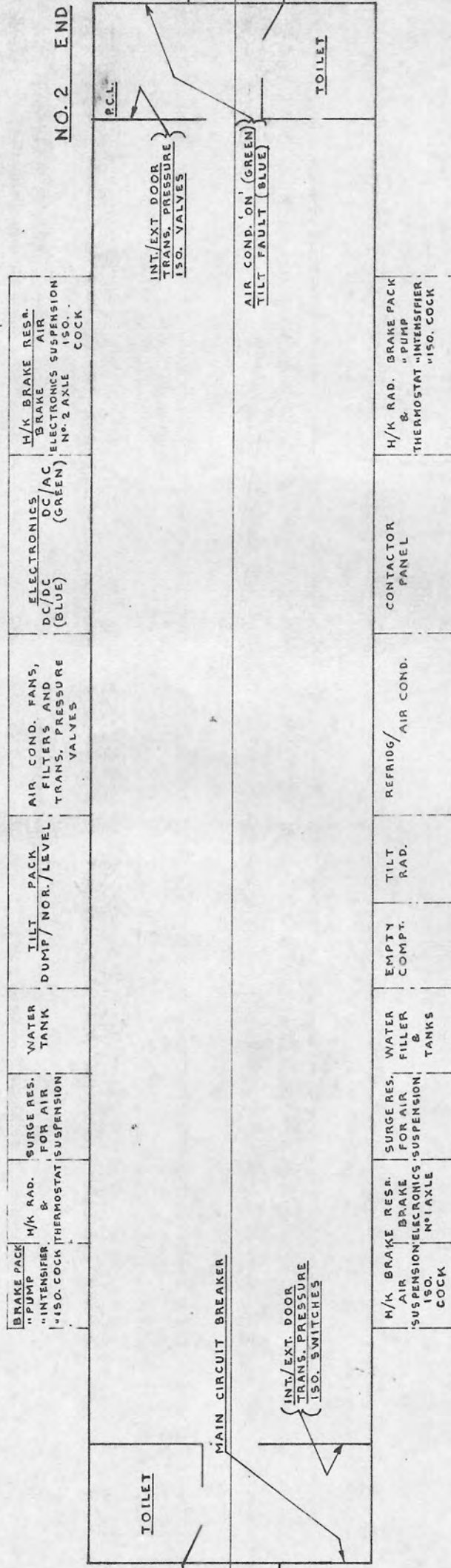


INTER. TRAILER 2 AXLE VEH.

Fig.I.T. 2.

A.P.T.

'A' SIDE



'B' SIDE

BRITISH RAILWAYS
CM&EE DEPT.
GLASGOW
DRG. Nº. GL - APT - A3-3
SCALE :- N.T.S.

M.K.

VAN TRAILER

The van trailer basically comprises of 4 sections :-

Passenger (First), Guard/Luggage Compartment, Equipment Bay and Underbelly Equipment. (See Fig. V1).

This vehicle is always situated with its No.2 end to the power car.

Passenger Accommodation

Designated first class, fitted with reclining seats and individual reading lamps, etc. Emergency equipment is housed a sealed panel located within the dividing bulkhead between the passenger saloon and the Guard's compartment.

Guard's Compartment

Situated at No.2 end of the vehicle, contains :-

Guard's control panel. See Fig. V2.

A Lifting hatch to the right of the Driver/Guard telephone reveals the hydraulic parking brake, pump and controls. At the base of the compartment is an aperture through which the hand pumping lever engages the pump mechanism in the event of an electrical fault in the pump. The apply/release selector lever is biased to "apply" at all times when untouched. This means that a person manually operating the parking brake, need only fit and pump the large yellow painted handle to apply the brake. To release the parking brake, the selector must be held against a spring action whilst simultaneously operating the aforementioned hand pump.

The parking brake operates on the BT 12a bogie axles only. The manual brake handle must always be replaced on its clip within the cabinet after use.

On the Guard's compartment end bulkhead, there is the cooker and beneath this is a 13-amp cleaner's socket. Adjacent to the cooker is the letter rack, above which is a hinged panel concealing track circuit clips and detonators.

Exterior Door Controls

See Fig. V3.

Equipment Bay

This area is divided into 'A' and 'B' sides by a central companion way.

"A" Side :-

The brake equipment for No.3 axle on "this" vehicle. The water glycol tank is at the bottom, above this, the brake hydraulic pack and above these units the brake air reservoir. Behind the equipment room entry door, is the brake isolating cock for No.3 axle.

To the right of the air reservoir is the brake intensifier (28.1). The brake circulating pump is underneath the central companion way, access is from the third plate along from the luggage compartment/equipment bay door. The scavenge ejector is under the second floor plate.

The electronics for the brake are above and to the left of the compressed air cooling fan.

* Main Air Compressor

Main air is supplied by a "FLUIDAIR" rotary compressor, with a pressurised oil sump.

NOTE

THE SUMP FILLER PLUG AT THE BASE OF THE COMPRESSOR MUST NOT BE REMOVED UNTIL AT LEAST 20 MINUTES HAS ELAPSED AFTER SHUT-DOWN.

Adjacent to the compressor is the compressed air after cooler and compressor sump oil cooler in a combined unit.

NOTE

THE COOLING FAN GRID MUST NOT BE LEANED UPON. PERSONAL CONTACT WITH THE RUNNING FAN WILL RESULT IN MOST SEVERE INJURY.

Motor Alternator Control Cubicle

This is located above the compressor. See Fig. V4a/b.

Parking Brake Fluid Reservoir

Located to the left of the motor alternator control cubicle; it has a reservoir capacity of :-

1.6 gallons.

The specified brake fluid (at time of writing) is :-

Shell "Tellus T.15".

The reservoir is fitted with a minimum/maximum sightglass. Fluid level should be checked with the parking brake applied.

Control Jumper Terminations

Located behind an aluminium panel, between the compressor fan and the brake equipment.

- * Note vehicle 48605 is fitted with two Hydrovane compressors, however THE SAME SAFETY PRECAUTIONS APPLY.

"B" Side

Motor Alternator

This unit provides the normal auxiliary electrical supply of 415 volts 3 phase and 250 volts AC and has a continuous rating of 430 kVA, the input to the motor alternator is derived from the 25 kV overhead supply which is transformed down to 800 volts single phase AC and rectified by means of a thyristor bridge located in the power car, to 510 volts DC. All the motor controls are in the power car.

The 510 volts DC supply for the motor is passed to the van trailer by means of jumpers using standard 600 amp ETH plug and sockets, due to the current capacity these are paralleled. All controls for the alternator are mounted in the van trailer car.

The isolating valve and pressure regulator for the motor alternator air suspension is located on the dividing bulkhead, between the equipment room and luggage compartment.

Vehicle Air Suspension

Above the motor alternator set, there are two air surge reservoirs for the vehicle air suspension. The isolating cock (vehicle air suspension) is located beneath the far end (right hand) of the motor alternator on the floor.

Moving outside the vehicle to location :- (See Fig. V5).

'B' Side No.2 End

First compartment (full depth panel) contains :-

The No.2 axle brake pack.

The Second Compartment

A small hatch (beneath the doorstep), containing :-

The brake isolating cock, and the Brake Electronics, No 2 axle.

Behind the brake electronics is the air reservoir for No.2 axle brake.

The Third and Fourth Compartments

Contains the air conditioning/refrigeration pack.

The Next Three Compartments (5, 6 & 7)

Contain the Tilt radiator, HK brake radiator, No.3 axle, and the HK brake radiator, No.2 axle.

The Eighth and Ninth Compartments/

The Eighth and Ninth Compartments

Form a large single compartment (double hatch) containing the electronic modules and virtually identical to the corresponding compartment on the intermediate trailer. This compartment also contains the water filler.

The Final Two Compartments (10 and 11)

Contains the brake electronics, No.1 axle; and HK glycol reservoir and air suspension isolating cock. Behind this equipment are the air suspension surge reservoirs.

Commencing 'A' Side, No.1 End

First Compartment

Contains the brake control pack, No.1 axle, also the brake pump, intensifier (40.1), and isolating cock for this axle.

Second Compartment

Contains the HK brake radiator for No.1 axle.

Third and Fourth Compartments

Contains a Contactor panel (standard) on which passenger reading and Guard's lamp circuit breakers are used. The water filler is behind the left panel of the two, covering the contactor bays.

Fifth and Sixth Compartments

Contains the tilt pack, occupying two bays.

There is a red button mounted upon the right hand bulkhead and :-

If the small tilt pump is running either off the test switch or the train tilt on/off switch in the Guard's office, when the vehicle is stationary, depression of the red button stops the small pump and starts the large pump. This feature is most useful for testing the large pump. The pressure delivered (large pump running) is 20.7 MN/m^2 (3000 lbf/in^2). To obtain a pressure reading, the blue button adjacent to the gauge must be depressed. After releasing the blue button, the pressure indication on the gauge must return to zero.

Seventh and Eighth Compartments

Containing the air conditioning heater fans, transient pressure valves, and air filters.

NOTE

TRANSIENT PRESSURE VALVES ARE RAM OPERATED, DO NOT PUT YOUR HANDS NEAR THE GAP!

Ninth Compartment (Small Hatch)

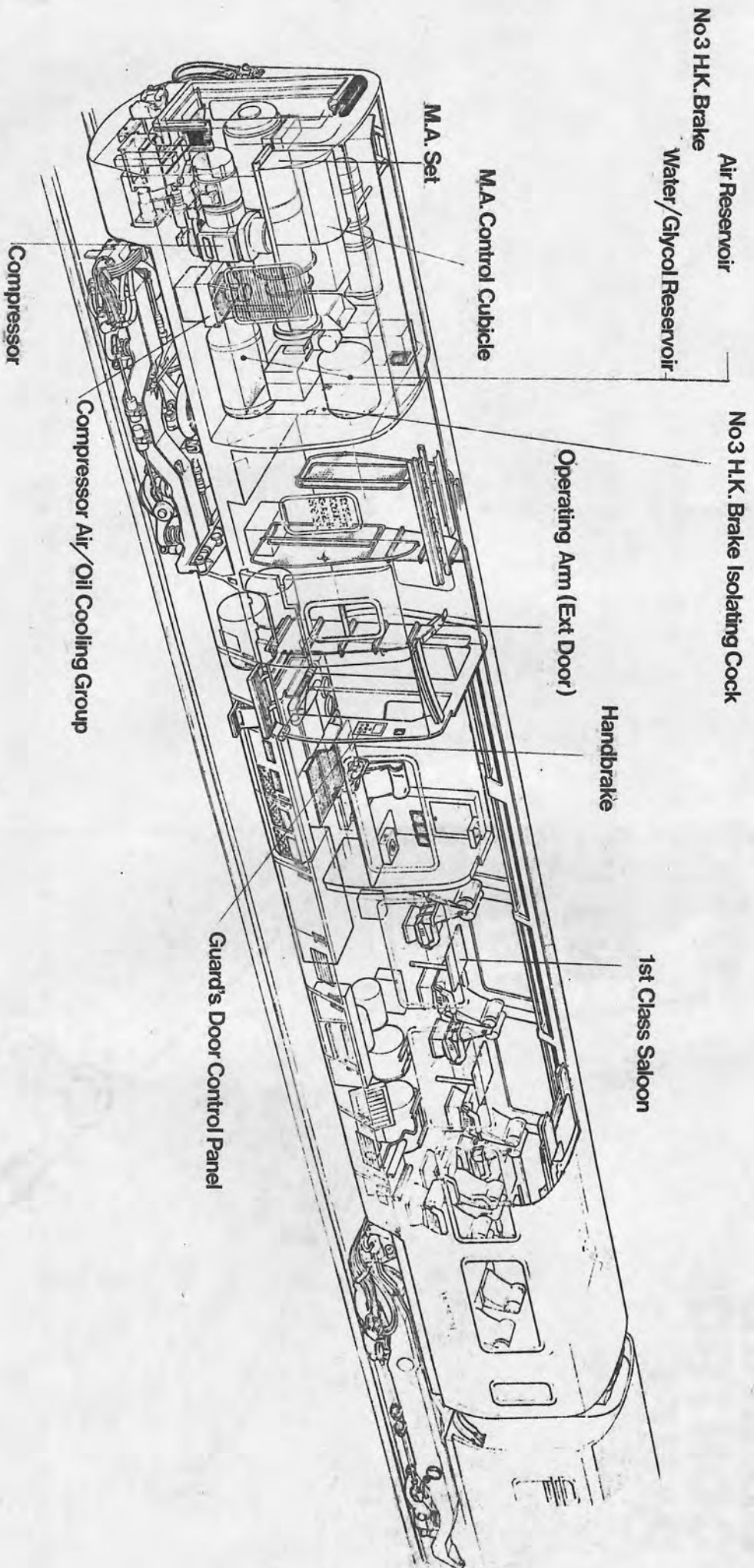
Located beneath the luggage compartment main entrance door and contains the water glycol tank for No.2 axle brake.

Tenth Compartment

Contains the brake intensifier (28.1) and water and glycol circulating pump for No.2 axle brake.

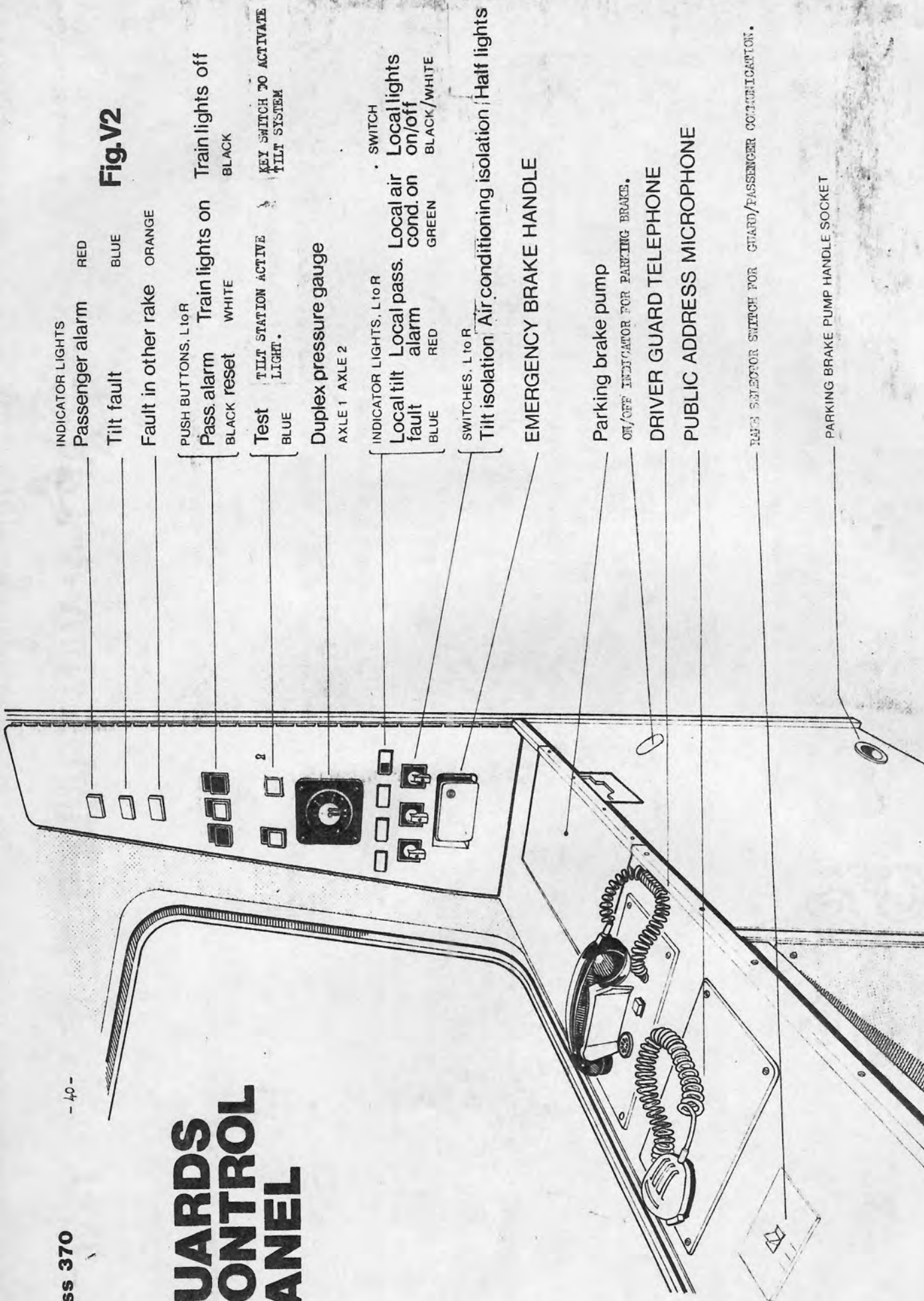
APT-P VAN TRAILER

Fig.V1

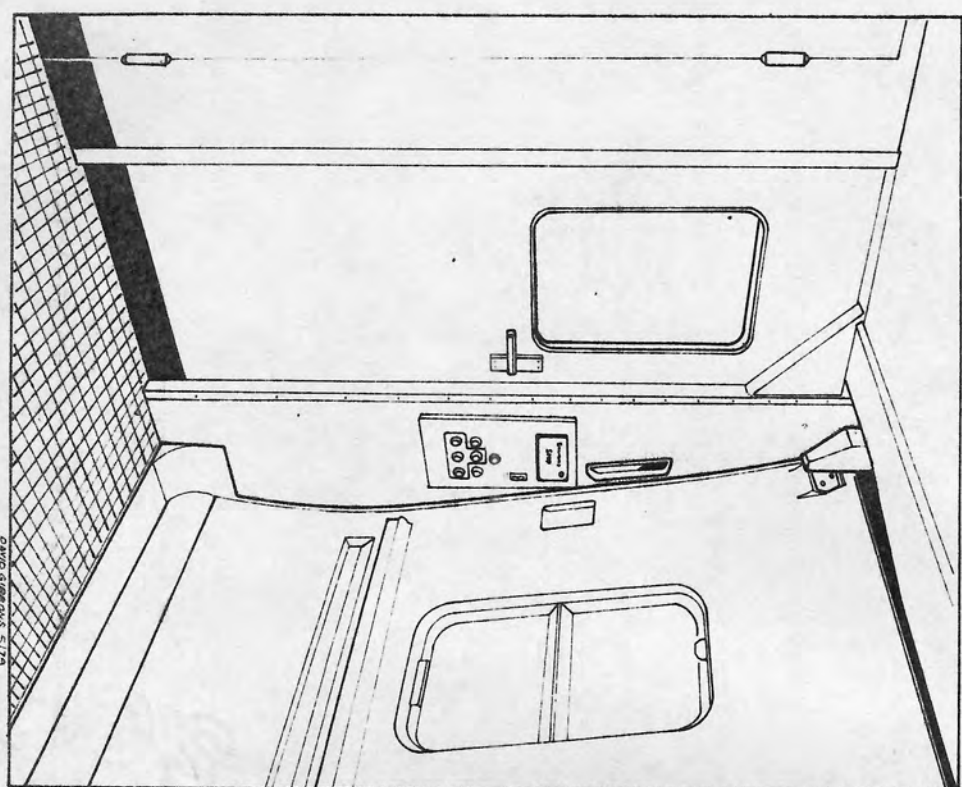


GUARDS CONTROL PANEL

Fig.V2



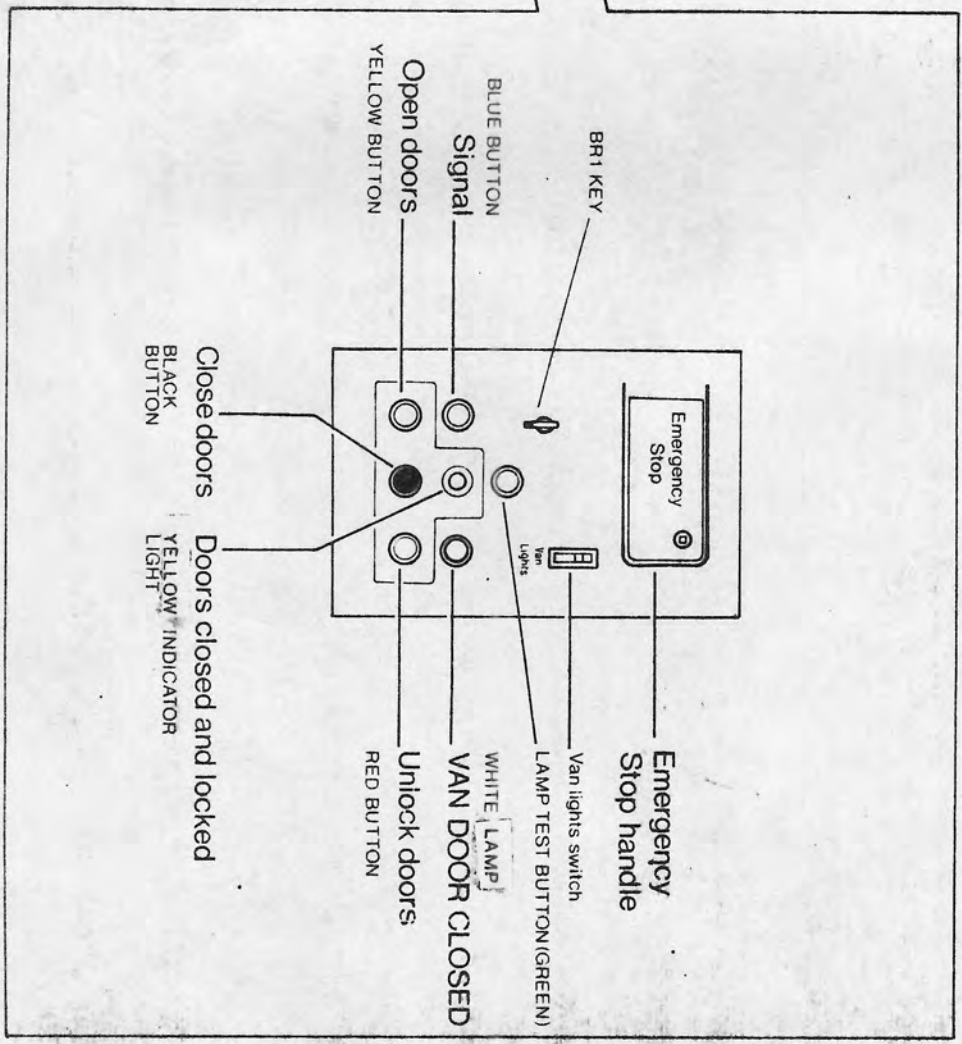
TRAILER BRAKE FIRST - DOOR CONTROL PANEL

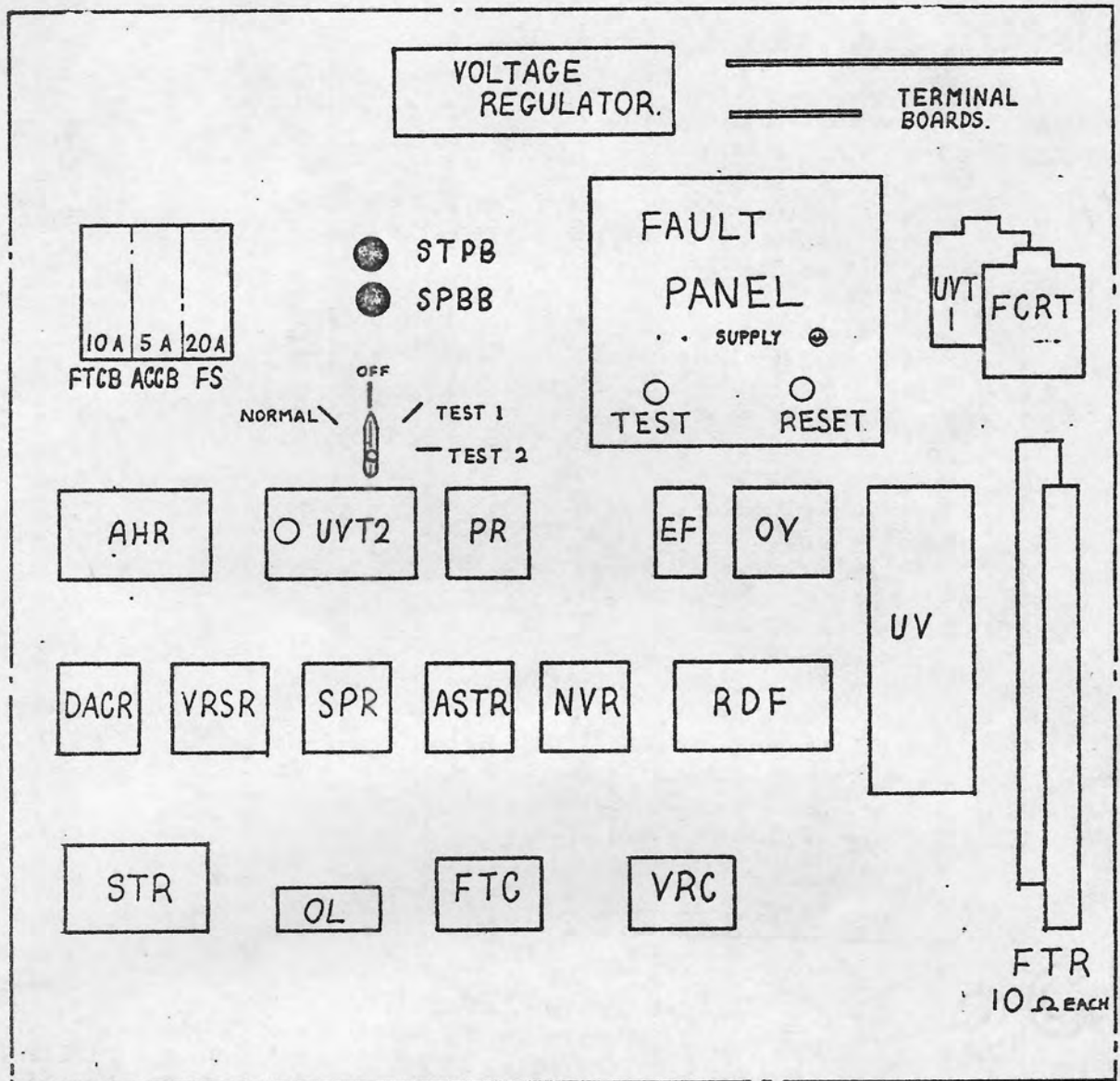


DOOR CONTROLS

Fig. V3

Class 370



EQUIPMENT ON LEFT HAND SIDE FACING CUBICLE

FS. 20A protects the supply to FTCTB and ACCB.

1 MOTOR ALTERNATOR CONTROL PANEL
CLASS 370 VAN TRAILER

Equipment on left hand side facing cubicle.

ACCB	Alternator Control Circuit Breaker.
AHR	Alternator Healthy Relay. Energised via FS20A, ACCB, STR, OL, EF, OV, VRSR.
ASTR	Alternator Pulse Start Relay. Energises STR.
DAOR	Diesel Alternator Interlock Relay. Prevents M.A. coming on line if D.A. set on line.
EF	Earth Fault Relay.
FCTR	Fan Current Timing Relay. Set to 15 seconds.
FTC	Field Tickling Contactor. Supplies M.A. tickling field.
FTCB	Field Tickling Circuit Breaker.
FTR	Field Tickling Resistor.
NVR	No Volts Relay. Operates Aux. Supply Lamp in Cab.
CL	Overload Relay.
OV	Over Voltage Relay.
FR	Proving Relay. Energised via FS 20A, ACCB, FDR.
RDF	Rotating Diode Failure Relay.
SFR	Stop Relay. Energised from SPTB.
SPTB	Stop Push Button.
STPB	Start Push Button.
STR	Start and Run Relay. Energises RUN Relay.
UV	Under Voltage Relay. Energises UUT2.
UVT1	Under Voltage Timer. Set to 5 seconds.
UVT2	Under Voltage Timer.
VRC	Voltage Regulator Contactor.
VRSR	Voltage Regulator Slave Relay.

TEST SWITCH FUNCTIONS.

OFF	-	M.A. Set Control Isolated.
NORMAL	-	M.A. Set Controlled By Means of Cab Buttons.
TEST 1	-	M.A. Set Controlled By Local Buttons In Van Trailer.
TEST 2	-	M.A. Set Controlled By Local Buttons In Van Trailer And Brought On Line.

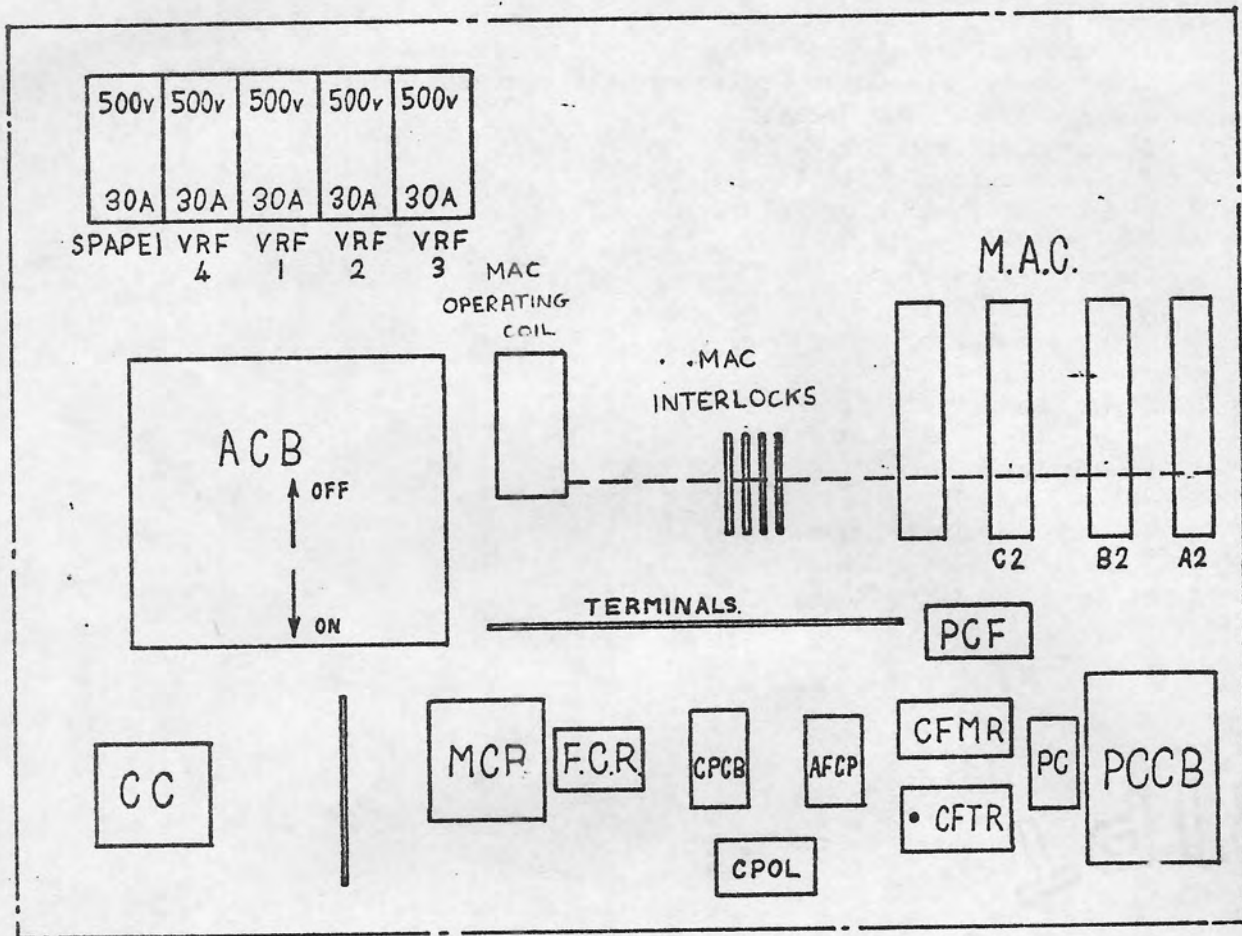
NOTE:- To release stop button in M.A. cubicle, turn Anti clockwise and pull out.

MOTOR ALTERNATOR CONTROL PANEL
CLASS 370 VAN TRAILER

Equipment on right hand side facing cubicle.

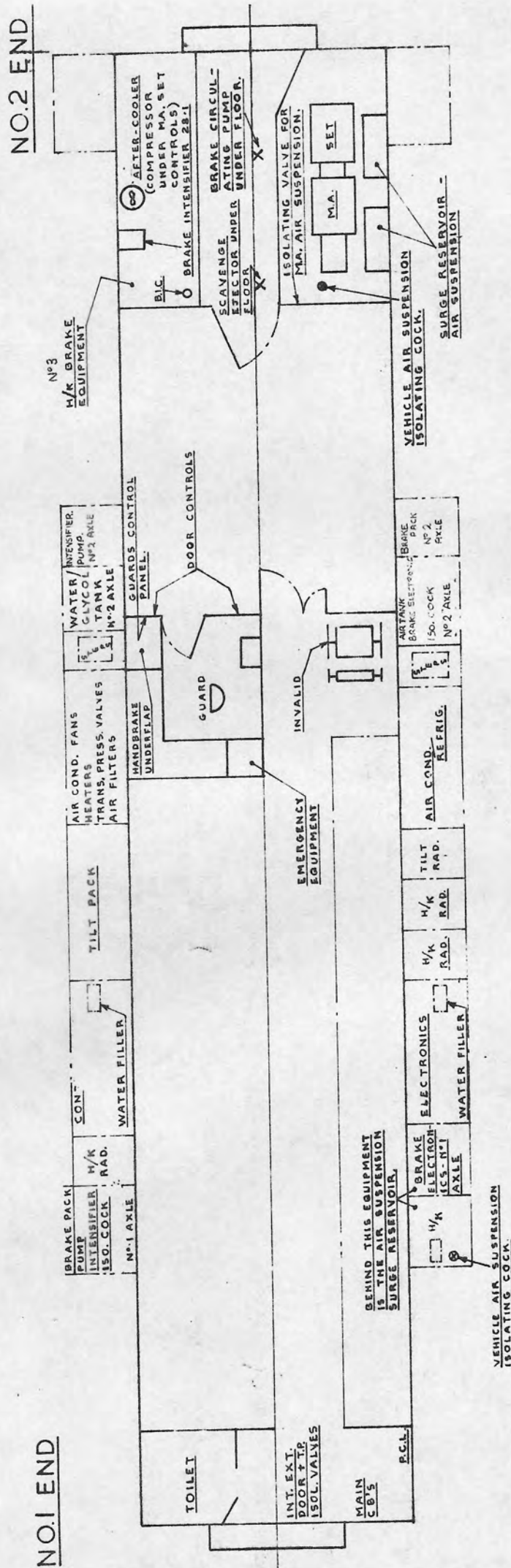
ACB	Alternator Circuit Breaker.	
AFCF	After Cooler Fan Motor Protector.	(Compressor Fan).
AHR	Alternator Healthy Relay.	
CC	Compressor Contactor.	
CFMR	Compressor Fan Monitoring Relay.	
CFTR	Compressor Fan Timing Relay.	
CPCF	Compressor Circuit Breaker.	
CPOL	Compressor Overload.	
FCR	Fan Current Relay.	
MAC	Motor Alternator Contactor.	
MCP	M.A. Cooling Fan.	
PCCB	Power Car Circuit Breaker.	
PC	Power Car Supply Contactor.	(415v 3ph).
PCF	Power Car Fuse.	
VRF1	Voltage Regulator Fuse.	} 415v 3ph feed to AVR.
VRF2	Voltage Regulator Fuse.	
VRF3	Voltage Regulator Fuse.	
VRF4	Voltage Regulator Fuse.	

EQUIPMENT ON RIGHT HAND SIDE FACING CUBICLE



GENERAL LAY-OUT
TRAILER BRAKE 3 AXLE VEHICLE

A.P.T.



POWER CAR (See figs.P.1. and P.6)

The APT-P power cars are lightweight steel semi-monocoque structures with deep side skirts.

Each power car is carried on 2 x 4-wheeled bogies and contains Thyristor electrical control equipment feeding 4 x 750kW body mounted traction motors. The motors drive the axles via a body mounted gearbox, cardan shaft, and lightweight final drive reduction gearbox.

Each powered axle is hydro-kinetically braked, the brake being fitted to the body mounted gearbox in the mechanical drive to the axle.

Power cars are equipped with anti-tilt mechanisms to ensure that the pantograph remains level as the body tilts.

The body of the power car may be divided into 3 compartments:-

- a) No. 1 compartment (under the pantograph) which houses No. 1 and 2 traction motors.
- b) No. 2 compartment (the centre) which houses the control equipment.
- c) No. 3 compartment (far end) which houses No. 3 and 4 traction motors, and is a duplicate of No. 1 compartment.

There is a full length corridor which further divides the body into:-

- a) Side "A" on the right hand side.)
 - b) Side "B" on the left hand side.)
- Looking towards No. 1 end.

Hydro-kinetic Brake Control Unit

Four of these units are located directly opposite each traction motor cubicle.

Each complete unit comprises the air reservoir, underneath which will be found the fluid reservoir (water glycol). In front of the fluid reservoir is the pump. The ejector is mounted on the floor adjacent to the pump, with the brake pack mounted in the supporting frame above the fluid reservoir.

Air is supplied to the brake air reservoir from the train air line. The small unit incorporated in the pipe (train air line to air reservoir) is the strainer/check valve. The next item on this line is the air isolating cock for this brake unit.

The companionway for the bodyside door divides the H.K. radiator from the main brake unit. The air for this radiator is drawn through the anti-tilt chamber, by the fan motor located at the base of the chamber.

The brake intensifier, giving a pressure multiplication of 28:1 is located above and to the left of the fluid reservoir.

The transmission brake, is directly coupled to the transfer gearbox and is therefore inside the traction motor/transmission cubicle.

The rectangular casting on top of the brake houses 3 valves, the main inlet valve (fluid admission) and the 2 selector valves.

The panel mounted on the frame to the left of the H.K. brake air tank houses the Shunters horn, shunting brake button, corridor light switch (for power car) and inspection lamp socket. The local tilt isolation switch (power car only) is located to the left, immediately adjacent to this panel. On the vehicle end bulkhead, next to the aforementioned control panel is the parking brake fluid reservoir, underneath which will be found the parking brake control pack. The yellow handle for manual operation is located in its clip, adjacent to the brake isolating cock. The water glycol filling point is on the back of the H.K. fluid tank and access to this point is via a hatch in the bodyside (budget lock). The red button mounted on the left bulkhead just inside the hatch is the brake release button.

Anti-Tilt Chambers

NOTE. ANTI-TILT CHAMBERS MUST NOT BE ENTERED UNLESS OVERHEAD LINE ISOLATION HAS BEEN CARRIED OUT IN ACCORDANCE WITH THE DEPOT INSTRUCTIONS. TILT ISOLATION MUST BE CARRIED OUT IN ACCORDANCE WITH APT3, THIS AREA MUST BE TREATED SIMILARLY TO THE ROOF.

Centre Section

"B" side.

From No. 2 traction motor, working toward No. 2 end :- traction motor control cubicle No. 2. (See fig. P2).

Each traction motor has its own cubicle (4 per power car). The only difference between the cubicles concerns the positions of the air isolating cocks for the traction motor contactors.

The air passes to the isolating cock via a reducing valve (6.19 bar - 90 psi) with cubicles 1 and 4. The isolating cock and valve will be found outside and adjacent to the cubicle. The isolating cocks and reducing valves serving cubicles 2 and 3, will be found inside these units, at the base.

Above No. 2 cubicle will be found the pantograph air isolating cock, and the pantograph auto drop isolating switch.

Also above the cubicle is the temperature switch (55°) serving No. 1 H.K. brake radiator. Adjacent No. 1 H.K. brake air reservoir is the choke oil conservator with filling point, sight glass (2 BS 148) and replaceable silica gel filter, (air drier).

Fault Indicator Panel

Displays indication of fault. If fault self rectifies, an indication remains on the panel. If a fault persists a double indication will be present. The panel display may be reset, using the black reset button, located behind the hinged flap at the base of the panel. Also behind this flap is a red power supply failed lamp, and a test button for checking the illumination of all indicator panels. The power supply fuse (5 amp.) is located between the test and reset buttons. Behind the display panel are 5 fuses:-

FS 19	}	10 amp. 88 v. Supplies to ASEA electronics cubicle.
FS 20		
FS 21	}	150 amp. Single phase 240 v. from auxiliary transformer (split into three).
FS 22		
FS 23		

Beneath these fuses is the :-

Excitation/Auxiliary Transformer

It is supplied at 807 v. a.c. and has two output windings.

1. 240 v. single phase for a.c. auxiliary motors on the power car, e.g. radiator fan motors.
2. 40 v. centre tapped for the separately excited fields of the traction motors.

Auxiliary Control Panel

See figs. P3a, b and c.

Tilt Pack

The complete tilt pack module (on power cars) is located inside the vehicle body, between the auxiliary control cubicle and the :-

Thyristor Electronics Cubicle

Within each of three sections is a hinged panel containing replaceable electronic cards.

The purpose of each card is depicted inside the covering door panel. Each card has a series of numbered holes into which test probes may be inserted (by authorised personnel only) and various sections of the power car electrical and electronics circuits can be monitored.

When the card module (hinged) is open, access may be gained to the electrical supply equipment.

Beneath the electronics cubicle are the thyristor control packs for traction/motor alternator set control.

To the left of electronics cubicle is the silica gel breather for the thyristor equipment.

Auxiliary Power Unit Cubicle

Controls for the motor alternator sets or set. (in the event of two power cars) are contained in this cubicle. For layout, see fig. P4.

To the left of the aforementioned controls is No. 4 traction motor cubicle. Directly opposite this cubicle is brake pack No. 4.

This now brings us to "A" side of the vehicle, No. 2 end, working back towards No. 1 end.

Adjacent to the H.K. brake air reservoir No. 4 is the H.K. radiator temperature switch for No. 4 brake unit. To the right of this switch is the No. 2 end pantograph isolating cock (if fitted).

The inspection lamp socket will be found on the brake equipment frame beneath the radiator temperature switch.

To the left of the H.K. brake air reservoir is the transformer oil conservator. The filling point, sight glass and breather are mounted on the tank.

Electronics Interface and Fire Gong

Located adjacent to the transformer oil conservator is the electronics interface for :-

WSR	Wheel Spin Relay. 24 v.
SSR1)	Speed Sensing Relays. 24 v. These relays are fed from
SSR2)	the power car brake system speed sensors.
TFR1	Tilt Fault Relay. 24 v.

Battery Charger

The battery charger is identical with the one on the Driving Trailer, except that it does not give a reading with BIS at ' Off ' position.

Air Blast Breaker (ABB.) Governor

Mounted above the battery charger, the governor, (pressure switch) will not allow the A.B.B. to close until sufficient air is available. The governor is set to close at 5.16 bar (75 psi) and to open at 4.12 bar (49 psi). NB. It is the intention to replace the ABB with a VCB .

Main Earthing Switch

Adjacent to the compressor governor, and lockable by padlock. In the earth position to the handlepoints towards the central companionway.

Electronic Supplies

A.C. D.C./D.C. D.C. packs :- A.C.-D.C. pack is coloured green, while the D.C.-D.C. pack is coloured blue. These units supply tilt;brakes, C-APT, (D/T only) and public address systems (T/C's only)

Beneath the electronic supplies equipment are the thyristor control packs for traction control.

Adjacent to the D.C.-D.C. electronic pack is the battery compartment. Beneath the batteries are three fans :- centre is car vent, the other two are radiator fans for cooling Thyristors and Chokes.

Traction Control Cubicle

Contains the battery isolating switch and traction control equipment. For full layout see figs. P5a, b and c.

Auxiliary Compressor

Above No 1 traction motor control cubicle, this compressor provides air for initial pantograph raise and is a 100 v. D.C. unit type B.P.O./2 manufactured by Bristol Pneumatic Tools Ltd. This compressor is of the single stage single acting air cooled type. It is directly coupled, and flange mounted to the electric motor, in the form of a self-contained unit.

Compressor oil sump capacity :- $\frac{1}{4}$ pint.
Manufacturers recommended oil grade :- Rotella TX 10W/30.

The apparatus beneath the compressor is the pantograph raise/lower pneumatic equipment, and the auxiliary compressor governor (pressure switch).

This compressor also supplies air to the motor alternator set and start contactors and is run directly from the power car batteries via a contactor.

The following two items are located on the underframe of the power car.

Traction Choke

This is located on the underframe near to No. 1 end (pantograph end) and contains six choke windings. It is oil cooled.

Choke L1 - 4 are in series with their respective traction motor armatures. Chokes 5-6 are in series with their respective motor alternator set drive motors.

Note the different arrangement of links for different train formations, e.g. with 2 power cars each supplying 1 M.A. set then the chokes are in series, while with 1 power car using both its M.A. sets, the chokes are separate.

Main Transformer

This is mounted on the underframe near to No. 2 bogie and is oil and air force cooled.

The neutral side of the primary winding is connected to earth via axle brushes and an alternative path to earth is provided via a resistor and protection relay, which detects loss of contact on all axles and opens the Air Blast Breakers. There are 5 secondary windings. Four are used for power to the armatures of the traction motors and are each of 573 v. connected in series pairs.

The fifth winding (807 v. - 1291 KVA) is used as a source of power for :-

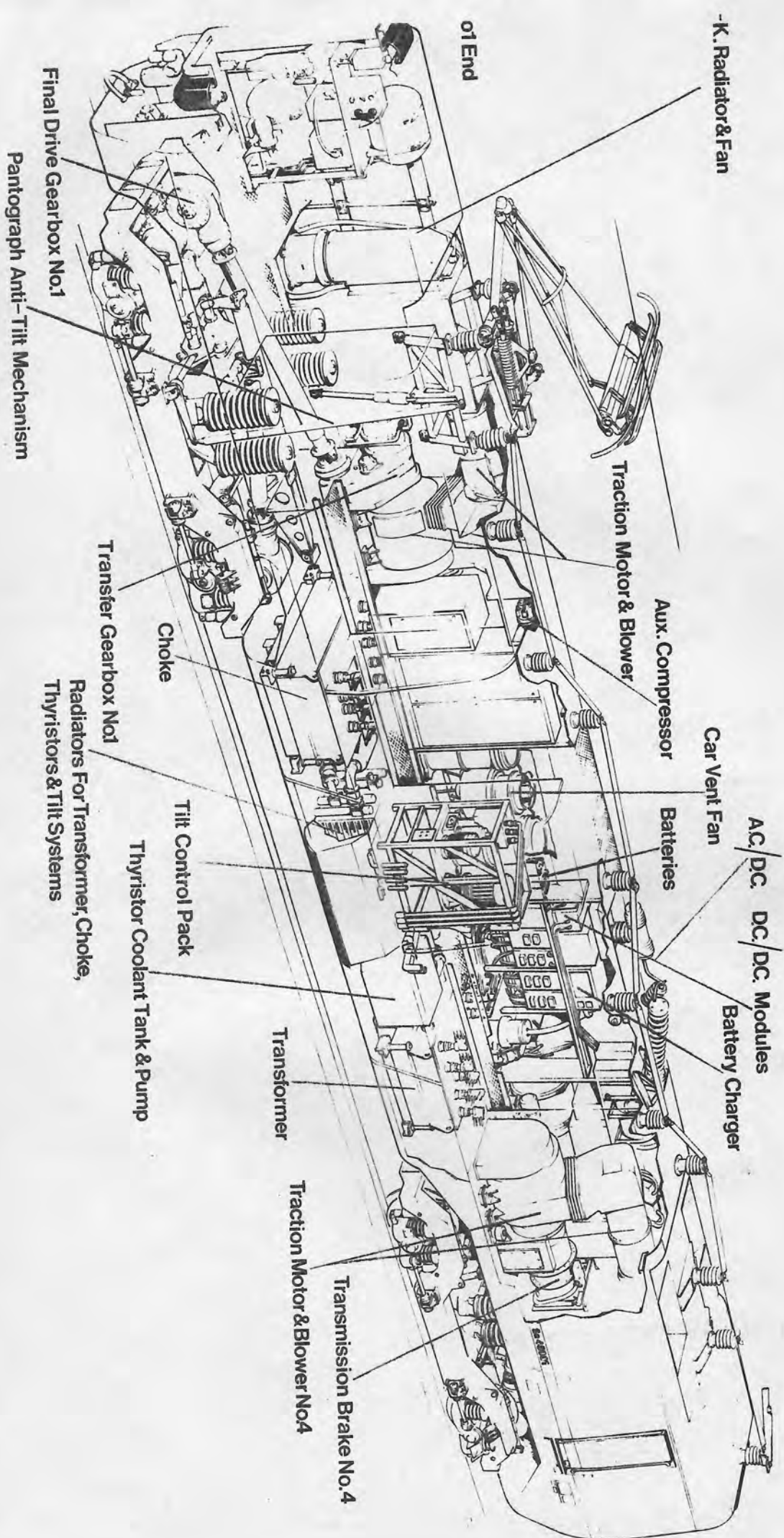
1. The motor alternator sets.
2. The excitation/auxiliary transformer.

STUDENT'S NOTES.

CHOTAK
SCRIPT

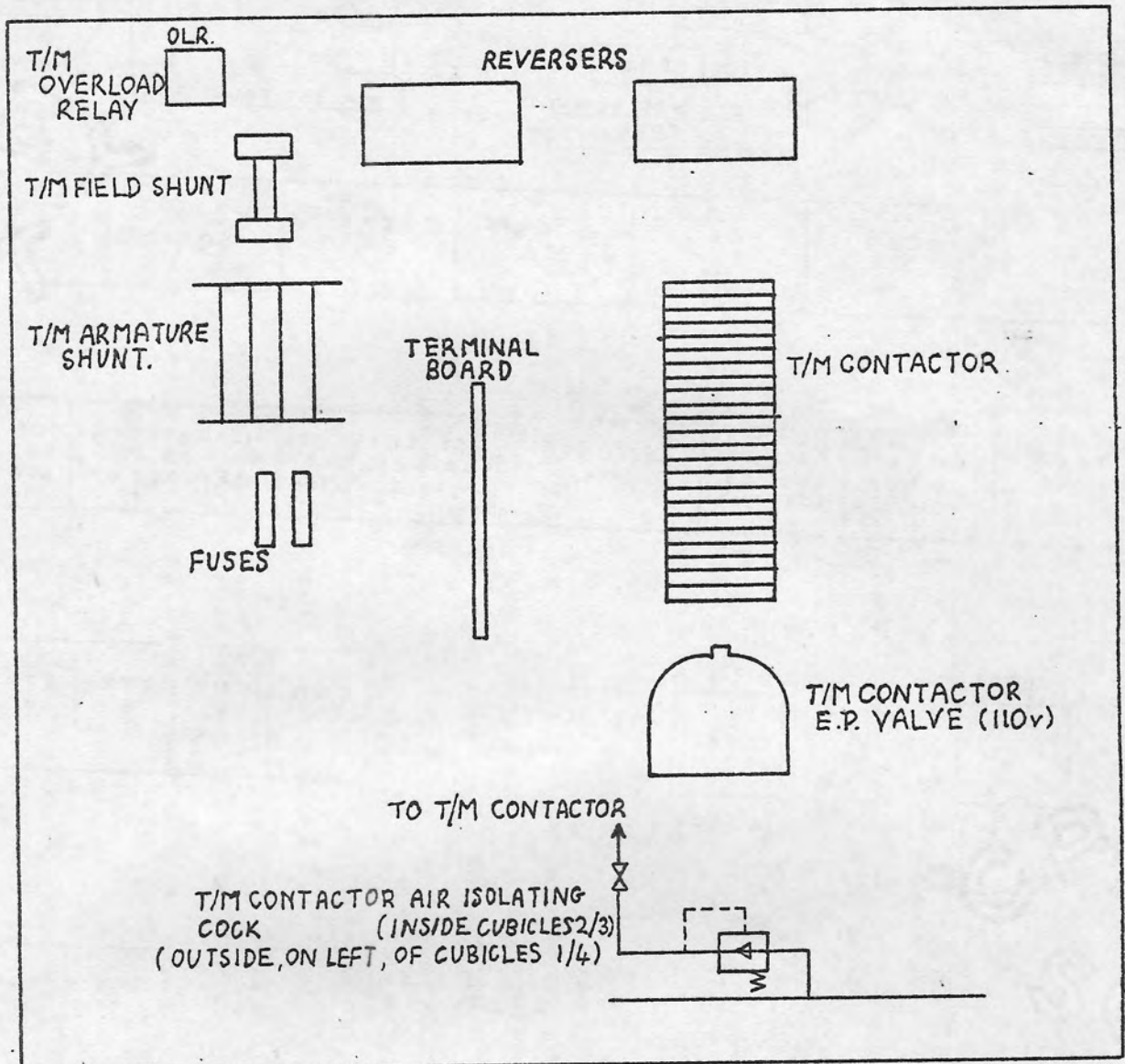
APT-P POWER CAR.

Fig. P1



TRACTION MOTOR CONTROL CUBICLE
CLASS 370 POWER CAR
A.P.T.

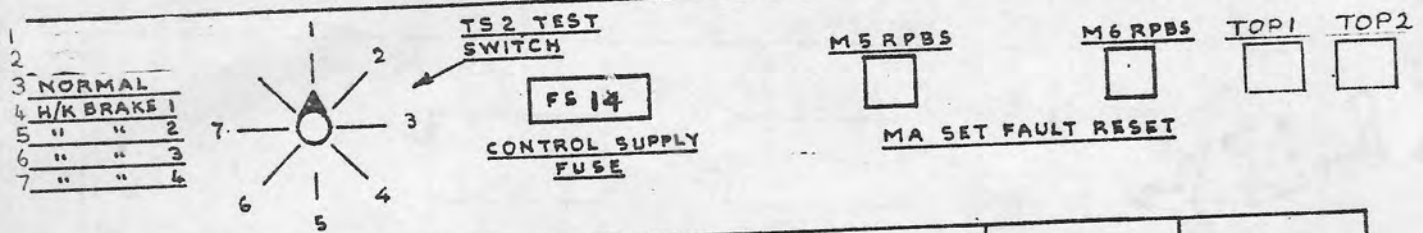
Fig P2



AUXILIARY CONTROL CIRCUITS CLASS 370 POWER CAR

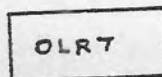
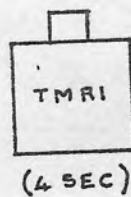
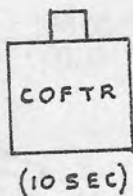
Fig P3a

BELOW IS THE EQUIPMENT ON THE LEFT
HAND SIDE FACING THE CUBICLE.



BCB1 20A	BCB2 20A	BCB3 20A	BCB4 20A	BCB5 5A	TCB1 50A	TCB2 5A
-------------	-------------	-------------	-------------	------------	-------------	------------

TYCB 80A	R11 CB 30A	R12 CB 30A	R21 CB 30A	R22 CB 30A	CHCB 40A	TOP CB 40A	TMB1 CB 30A	TMB2 CB 30A	TMB3 CB 30A	TMB4 CB 30A	CMCB 5A	COP CB 40A	CV CB 30A
-------------	------------------	------------------	------------------	------------------	-------------	------------------	-------------------	-------------------	-------------------	-------------------	------------	------------------	-----------------



CUR 5	CUR 6	EFR 5	EFR 6
----------	----------	----------	----------



EFR 7	TSOR 5
----------	-----------

BVR	NVRI	TBFR	BIR	B3R
-----	------	------	-----	-----

R2R	CVR	RIR	B2R	B4R
-----	-----	-----	-----	-----

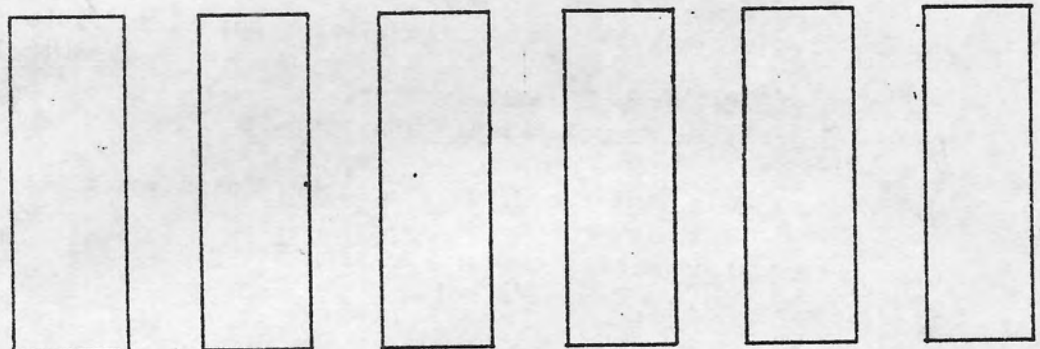
LEFT HAND DOOR DETAILS

BPC1	BFC1	BPC2	BFC2	TPC1
------	------	------	------	------

BPOL1	BFOL1	BPOL2	BFOL2	TOL1
-------	-------	-------	-------	------

BPC3	BFC3	BPC4	BFC4	TPC2
------	------	------	------	------

BPOL3	BFOL3	BPOL4	BFOL4	TOL2
-------	-------	-------	-------	------



CAPACITORS IN SINGLE PHASE MOTOR CIRCUITS

AUXILIARY CONTROL CUBICLE (See fig P3a/b)

Equipment contained in LHS, facing cubicle, in alphabetical order:-

BCB1	H.K. Brake pump and Fan Circuit Breaker	No.1 axle	(3 phase 415v)
BCB2	" " " " " "	No.2 axle	" "
BCB3	" " " " " "	No.3 axle	" "
BCB4	" " " " " "	No.4 axle	" "
BCB5	Supply to AC/DC (Green) Unit		
B1R	T/M Cooling Fans current sensing relay.	No.1 T/M	(240v 1 phase)
B2R	" " " " " "	No.2 T/M	" "
B3R	" " " " " "	No.3 T/M	" "
B4R	" " " " " "	No.4 T/M	" "
BFC1	H.K. Brake radiator Fan contactor.	No.1 axle	
BFC2	" " " " " "	No.2 axle	
BFC3	" " " " " "	No.3 axle	
BFC4	" " " " " "	No.4 axle	
BFOL1	H.K. Brake radiator Fan overloads	No.1 axle	
BFOL2	" " " " " "	No.2 axle	
BFOL3	" " " " " "	No.3 axle	
BFOL4	" " " " " "	No.4 axle	
BFR5-6	Thyristor Bridge Failure Relay, M/A set.		
BPC1	H.K. Brake Circulating pump contactor.	No.1 axle	
BPC2	" " " " " "	No.2 axle	
BPC3	" " " " " "	No.3 axle	
BPC4	" " " " " "	No.4 axle	
BPOL1	H.K. Brake circulating Pump Overload	No.1 axle	
BPOL2	" " " " " "	No.2 axle	
BPOL3	" " " " " "	No.3 axle	
BPOL4	" " " " " "	No.4 axle	
BVR	Battery Volts Relay (Drops out below 82.5V).		
CHCB	Battery Charger Supply Circuit Breaker (2 pole).		
CMCB(T/M)	Armature Current Monitoring unit supply Circuit Breaker (also supplies NVR)		
COFTR	Choke Oil Fault Timing Relay. Delay set is sufficient to exceed a neutral section.		
COPCB	Choke Oil Pump Circuit Breaker.		
CUR 5)	Current Unbalance Relay. M/A set.		
CUR 6)			
CVCB (Power)	Car Vent Fan Circuit Breaker. Cools power car by extracting hot air.		
CVR (Power)	Car Vent Fan current sensing Relay, (110V).		
EFR5)	Earth Fault Relay. M/A set.		
EFR6)			
EFR7 (Aux. transformer)	Earth Fault Relay.		
M5EPBS)	M/A set Fault Reset Push Button,		
M6RPBS)	resets OLSR, EFSR, BFSR, OSR, TFSR.		
NVR1	No Volts Relay. Detect if line volts less than 15kV, (240V1 phase)		
NVR2			

Contd/... Auxiliary Control Cubicle (See fig P3a/b)

OLR7 Primary Overload Relay for aux. transformer.
 R11CB Cooling group 1 Radiator fan 1 Circuit Breaker.
 R12CB " " 1 " " 2 " "
 R21CB " " 2 " " 1 " "
 R22CB " " 2 " " 2 " "
 R1R Radiator cooling group 1 current sensing Relay.
 R2R " " " 2 " " "
 TCB1 Tilt Circuit Breaker, Supply to large and small tilt pumps
 (3ph 415V).
 TCB2 Tilt Circuit Breaker. Supply to Tilt pre-heater. (1ph 240V)
 TMB1CB T/M Blower Circuit Breaker No.1. T/M
 TMB2CB " " " " No.2 T/M
 TMB3CB " " " " No.3 T/M
 TMB4CB " " " " No.4 T/M
 TMR1 Timing sequence Relay, (110V) Set at 4 sec., delay "on".
 TOPTR Transformer Oil Fault Timing Relay(110V). Delay set to exceed
 a neutral section.
 TOL1 Tilt pump Overload. Large pump.
 TOL2 Tilt pump Overload. Small pump.
 TOPCB Transformer Oil Pump Circuit Breaker.
 TPC1 Tilt Pump Contactor. Large pump.
 TPC2 Tilt Pump Contactor. Small pump.
 TYCB Thyristor oil pump Circuit Breaker.
 TYOPTR Thyristor Oil Pump Timing Relay (110V). Delay set to
 exceed a neutral section.

Modifications.

TBFR Tilt Bay Fan motor current sensing Relay.(Tilt Bay ventilation).
 TOP1 Tilt On push button.
 TOP2 Tilt Off push button.
 NOTE. The test switch preselects which pump is to be run.

AUXILIARY CONTROL CUBICLE CLASS 370. POWER CAR

Fig P3c

BELOW IS THE EQUIPMENT ON THE
RIGHT HAND SIDE FACING THE CUBICLE

RAIL NO. 1

" " 2

" " 3

" " 4

" " 5

" " 6

" " 7

TERMINAL STRIPS

CC 2

● CHFTR

AC 1

AC 2

AC 3

RCC

TMBC
1

TMBC
2

TMBC
3

TMBC
4

● NVTR

● TMR 2

● TMR 3

● RUN 5

● RUN 6

● AC

FTSR
5

FTSR
6

LSR

MPR
5

MPR
6

TAR
1

TAR
2

● TYFR

TSR

NVSR

COR

BFSR
5

BFSR
R

BFSR
6

BFSR
R

EFSR
5

EFSR
R

EFSR
6

EFSR
R

EFSR
7

EFSR
R

TMSR

CVPR

CPR
1

CPR
R

CPR
2

CPR
R

MOSR
5

MOSR
R

MOSR
6

MOSR
R

OLSR
5

OLSR
R

OLSR
6

OLSR
R

R2PR

CPR
3

CPR
R

CPR
4

CPR
R

OSR
5

OSR
R

OSR
6

OSR
R

TFSR
5

TFSR
R

TFSR
6

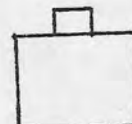
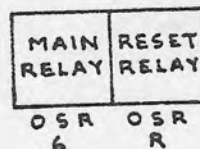
TFSR
R

R1PR

LEGEND



TIME DELAY
RELAY



AGASTAT TIME
DELAY RELAY

AUXILIARY CONTROL CUBICLE (see fig.P3c)

Equipment contained in RHS, facing cubicle, in alphabetical order:-

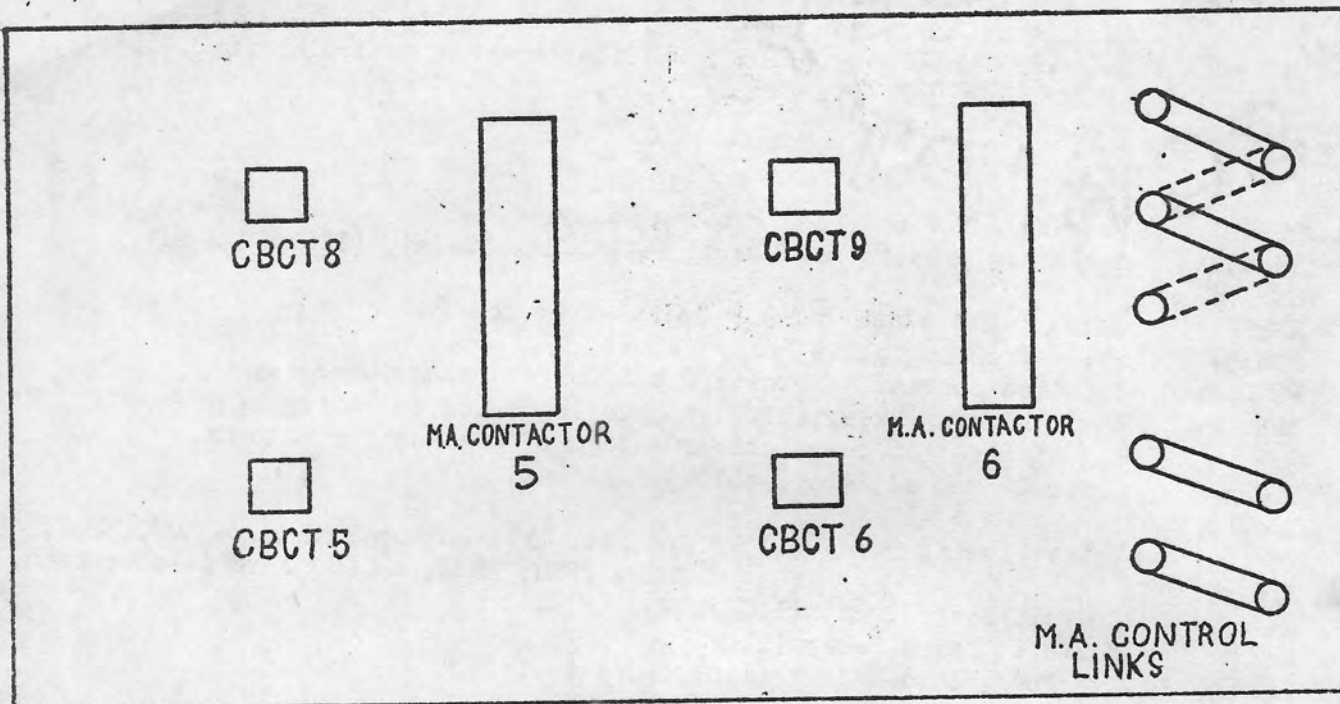
ACTR	Auxiliary Compressor (for initial panto raise) Timing Relay, (110V).
BFSR5-6	Bridge Failure Slave Relay, M/A set.
CC 2	Auxiliary Compressor Contactor.
COR	Controls "On" Relay, (110V). Operates via cab controls via T.W.13. (110V)
CPR1	Cooling (fan) Proving Relay T/M 1.
CPR2	" " " " T/M 2.
CPR3	" " " " T/M 3.
CPR4	" " " " T/M 4.
CVPR	(Power) Car Vent (Fan) Proving Relay.
EFSR5)	Auxiliary transformer), Earth fault Slave Relay, (110V) M/A set.
EFSR6)	
EFSR7	Earth fault slave relay. Operated by EFR 7.
FTSR5)	Field Tickling Slave Relay (110V) M/A set.
FTSR6)	Supplies current to excite field for starting purposes.
LSR	Load Shedding Relay, (110V). Sheds loads for operation of D/A set. e.g. Large Tilt pumps and 3rd stage of heating for saloons.
MOSR5)	Motor Overspeed Relay, (110V) M/A set.
MOSR6)	
MPR 5)	Motor Proving Relay (110V) M/A Set. Will not operate if:- RUN, EFSR,
MPR 6)	OLSR, BFSR, TFSR, or OSR have de-energised.
NVSR	No Volt Slave Relay (110V).
NVTR	No Volt Timing Relay (110V).
OLSR5)	Overload Slave Relay, (110V). M/A set.
OLSR6)	
OSR5)	Over Speed Relay, (110V). M/A set.
OSR6)	
RCC	Radiator Cooling Contactor (All radiators)
R1PR	Radiator Proving Relay No.1. group.
R2PR	" " " " No.2. group.
RUN5)	RUN Relay, (110V). Proves EFSR, OLSR, BFSR, TFSR, OSR and jumper
RUN6)	between Van Trailer and Power Car.
TAR1	Traction Auxiliaries Relay, (110V). Affected by NVSR, Choke oil temperature thyristor oil temperature, pressure. Shuts down M/A set.
TAR2	Traction Auxiliaries Relay, (110V). Shuts off traction power.
TFSR5)	Tachometer Fault Slave Relay, (110V). M/A set.
6)	
TMBC1	T/M Blower Contactor No.1 T/M.
TMBC2	" " " " No.2 T/M
TMBC3	" " " " No.3 T/M
TMBC4	" " " " No.4 T/M
TMR	Timing Sequence Relay, (110V).
TMR3	" " " " "
TMSR	T/M Blower Start Relay, (110V).
TSR	Timer Slave Relay, (110V)
TYFR	Thyristor Oil Cooling Fault Relay, (110V).

Modifications.

AC1	Tilt On slave Relay.
AC2	Tilt Off Relay.
AC3	Tilt On Relay.
CHFR	(Battery)Charger Failure Timing Relay

EQUIPMENT LAYOUT FACING CUBICLE

Fig P4



NOTE : Link Configuration shown for 1 power car train formation.
 2 links to be changed to dotted configuration for 2 power car train formation.
 Contactor 5 used if 2 power car formation.
 Contactor 5 and 6 used if 1 power car formation.

CLASS 370 POWER CAR
EQUIPMENT ON LEFT HAND SIDE FACING CUBICLE

Fig P5a

RAIL N°1

2

3

4

5

6

7

8

9

PIR	FRI	RRI	ACR1	ACR 2
-----	-----	-----	------	-------

● MPSR 1	PUSR1	PUSR1 R	● ESPTR
----------	-------	------------	---------

APR1	APR2	APR 3	APR 4
------	------	-------	-------

● MPSR 2	MPR 1	MPR 2	MPR 3	MPR 4
----------	-------	-------	-------	-------

LOR	TDISR	PUR 1
-----	-------	-------

● MPSR 3		TSPR	APR	oLPSR
----------	--	------	-----	-------

FRSR	FR	RR
------	----	----

● MPSR 4	TS oSR	TSOSR	ADSR	TPR1
----------	--------	-------	------	------

MDR	MDR R	FFSR1	FFSR1 R	FFSR2	FFSR2 R
-----	----------	-------	------------	-------	------------

FFSR3	FFSR3 R	FFSR4	FFSR4 R	BAR
-------	------------	-------	------------	-----

BTR	BTR R	oLSR1	oLSR2 R	oLSR2	oLSR2 R
-----	----------	-------	------------	-------	------------

oLSR3	oLSR3 R	oLSR4	oLSR4 R	ESPR
-------	------------	-------	------------	------

EFSR1	EFSR1 R	EFSR2	EFSR2 R	EFSR3	EFSR3 R
-------	------------	-------	------------	-------	------------

EFSR4	EFSR4 R	VBR	VBR R	FCSR
-------	------------	-----	----------	------

TRACTION CONTROL CUBICLE (See Fig.5a)

Equipment contained in L.H.S. facing cubicle in alphabetical order:

ACR1 Armature Current monitoring Relay. Alters circuitry if 2 power cars in train.
 ACR2 Armature Current monitoring Relay. Brings up Traction fault lamp in cab.
 ADSR Auto Power Control Receiver Slave Relay. Energised from APC receiver on bogie.
 APR1 Auto Power Control Relay) De-energises ABB
 APR2 Auto Power Control Relay) Operated when reset magnet passed
 APR3 Auto Power Control Relay) Operates " " " " to drop out APR's.
 APR4 Auto Power Control Relay)
 BAR Bucholz Alarm Relay
 BTR Bucholz Trip Relay
 EFSR1 Earth Fault Slave Relay No. 1/2 T/M armature
 EFSR2 Earth Fault Slave Relay No. 3/4 T/M armature
 EFSR3 Earth Fault Slave Relay No. 1/2/3/4 T/M fields
 EFSR4 Earth Fault Slave Relay Primary winding, Main Transformer
 ESPR Electronics Supply Proving Relay. Trips if supply is faulty.
 FCSR Field Current Sensing Relay. Prevents reversing motors whilst in motion.
 FFSR1 Fuse Failure Slave Relay. T/M1 Fuse in thyristor pack
 FFSR2 " " " " T/M 2 " " " "
 FFSR3 Fuse Failure Slave Relay T/M3 " " " "
 FFSR4 " " " " T/M4 " " " "
 FR Forward Relay T/M 1/2
 FR1 Forward Relay T/M 3/4
 FRSR Forward/Reverse Select Relay
 LOR Lock Out Relay Prevents reset of O.H.B.
 MDR Motor Disconnect Relay. Operates if armature current above 160A with no field current.
 MPR1 Motor Proving Relay. T/M 1) Operates providing CPR, OLSR
 MPR2 " " " T/M 2) and FFSR not tripped
 MPR3 " " " T/M 3)
 MPR4 " " " T/M 4)
 MPSR1 Motor Proving Slave Relay 1 (T/M 1) Energised by MPR,
 MPSR2 " " " ")Sec. (T/M 2) brings in Motor
 MPSR3 " " " ")delay (T/M 3) Contactors
 MPSR4 " " " ") (T/M 4)
 OLPSR Overload Primary (xformer) Slave Relay
 OLSR1 Overload Slave Relay (Set)
 OLSR2 " " " (to) De-energises MPR and
 OLSR3 " " " (1.5) ultimately the
 OLSR4 " " " (on) Motor Contactors
 (Scale)
 PIR Panto Interlock Relay. Ensures only 1 panto can be raised.
 PUSR " Up Slave Relay
 PUR1 " Up Relay
 PUR3 Not used.
 RR Reverse Relay. T/M 1/2.
 RR1 Reverse Relay. T/M 3/4.
 TD1SR Traction Demand Interlock Slave Relay. Proves circuits from Driving Cab eg. Parking Brake.
 TPR Traction Proving Relay. De-energised by OLR7 and OLSR 1/2/3/4. Interlocks in TMR and supply to Electronics.
 TSOSR (Main) X former secondary Overload Relay.
 VBR Vacuum Breaker Relay. Operates ABB.
Modifications.
 BSPR. Electronics Supply Proving Timing Relay. (Prevents false indication of supply failure)
 TCSR. Transformer Secondary Proving Relay.

TRACTION CONTROL CUBICLE
CLASS 370 POWER CAR

Fig P5b

EQUIPMENT ON RIGHT HAND SIDE FACING CUBICLE

☐ FRPBS

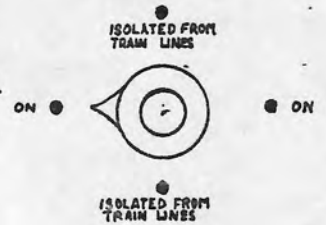
☐ PUPBS1

☐ MRPBS1

☐ MRPBS2

☐ PDPBS

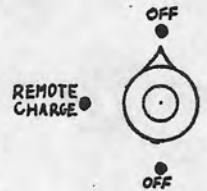
TRACTION CONTROL
ISOLATOR
I.S.I.



FS1	FS2	FS3	FS4	FS5	FS6	FS7	FS8	FS9	FS10	FS11	FS12	FS13
MOTOR ALT 5	MOTOR ALL 6	AUX CONTRL	APC CCTS	ASEA ELECT	T'TION CONTRL	SPARE	SPARE	INTER VEHICLE POWER CARS	FIRE ALARM	SPARE	BATTERY FUSES	

ACB	BCB	PBCB	FCB	TCB	LCB
-----	-----	------	-----	-----	-----

FUSE TEST
LAMP



RAIL 11

RAIL 12

CUR1	CUR2	EFR1	EFR2
------	------	------	------

TSOR 1	TSOR 2
-----------	-----------

CUR3	CUR4	EFR3	EFR4	FFR1/2	FFR2/4	TSOR3	TSOR4
------	------	------	------	--------	--------	-------	-------

OLPR

TBTR1

TBTR2

CVSR

CAPACITORS FOR T/M



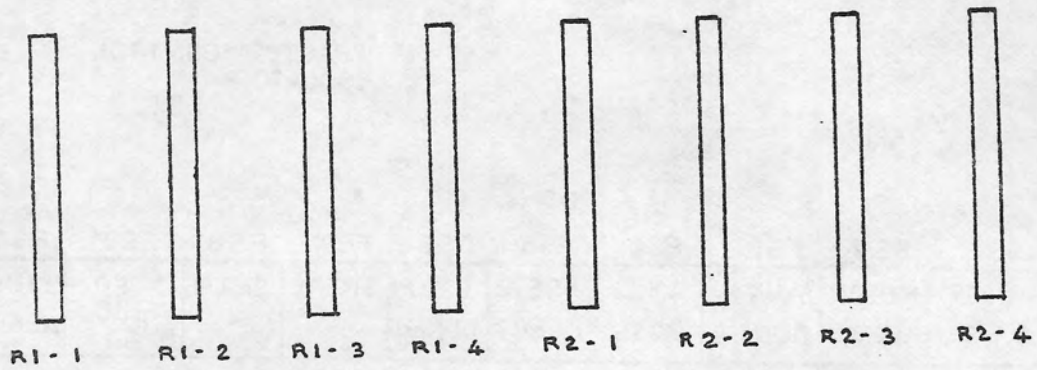
ARMATURE CURRENT MODULE SUPPLY

TRANSFORMER
FOR ARMATURE
CURRENT
MODULE
SUPPLY

TRACTION CONTROL CUBICLE
CLASS 370 POWER CAR

Fig. P5c

EQUIPMENT BEHIND TOP RHS TRACTION CONTROL
CUBICLE.



ARMATURE CURRENT
MONITORING MODULE

STUDENT'S NOTES.

Fig. P6

GENERAL LAY-OUT
POWER CAR 4 AXLE VEHICLE
A.P.T.

