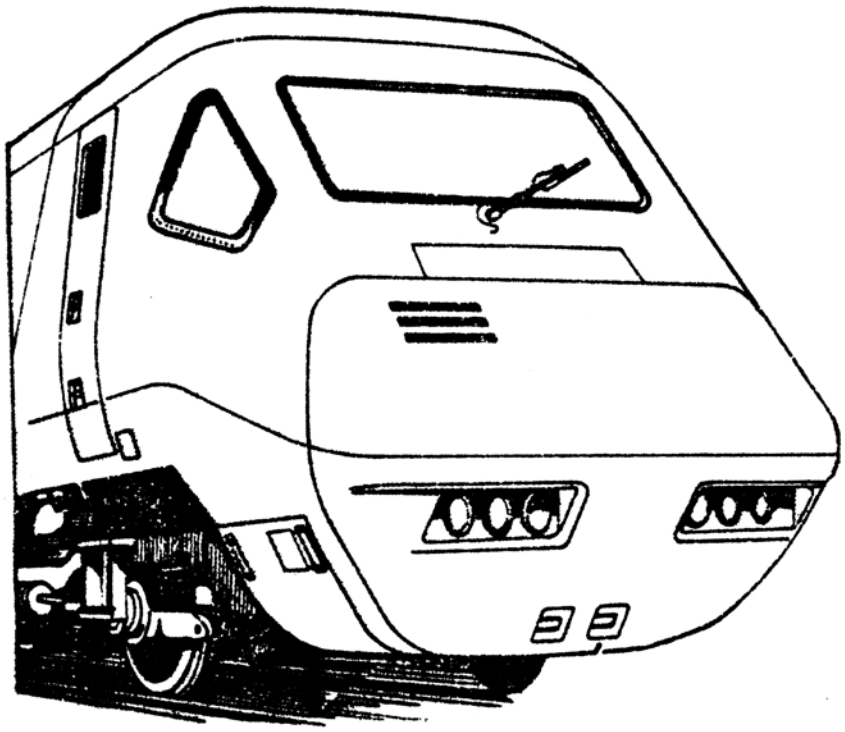
British Rail : Scottish Region

CM&EE Training Centres

APT



Course Notes

4. Electrical Distribution-Auxiliaries

AUXILIARY SUPPLY SYSTEMS A.C. AND D.C.

1. General Introduction

The APT train formation comprises 2 BO-BO non driving power cars situated between 2 identical 6-Car trailer rakes (for train formation refer to the Introduction handout).

The auxiliary electrical supplies for Trailer Cars fall into three categories :-

(a) 415 volts 3 phase. 50HZ A.C.

(b) 250 volts 1 phase. 50HZ A.C.

(c) Nominal 110 volts D.C.

The A.C. supplies are derived from either of two sources, a Motor Alternator set which is located in each Van Trailer Car or a Diesel Alternator set mounted in each Driving Trailer Car.

Motor Alternator Set

This unit provides the normal auxiliary electrical supply of 415 volts and 250 volts A.C. 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 A.C. and rectified by means of a thyristor bridge, located in the Power Car, to 510 volts D.C. See Fig 7. The controls for the Motor Alternator set are located in the APU cubicle in the Power Car. (See Fig P4 in Power Car Geography Notes).

The 510 volts D.C. 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.

Diesel Alternator

The Diesel Alternator has been included to provide a stand-by supply of 415 volts and 250 volts A.C. at 50HZ if a Motor Alternator set should fail, or if the train has to be towed.

The output of the Diesel Alternator is 250 kVA with the same tolerances on voltage and frequency as the Motor Alternator set. Due to its output being lower than the Motor Alternator certain non essential loads are shed when the Diesel Alternator set is in use. Interlocking is provided to ensure that both alternators cannot be connected to the supply lines at the same time.

D.C. Supplies (110 volts)

A nominal 110 volt D.C. supply for each rake of trailer cars is provided by a nickel cadmium battery located in the Driving Trailer Car, the battery consists of 75 cells and has a rating of 200 Ampere hours. The D.C. supply is exclusive to that rake. The negatives of all batteries (including the power cars) are all connected together. One train wire 66 is connected to the positive of all batteries (including the power cars) via a blocking diode to feed all traction control circuits. Train wire 67 is fed from train wire 66 at each Driving Trailer Car to feed auxiliary electrical systems which can be controlled from either rake of trailer cars. e.g. External Doors, Air Conditioning and Lights.

Initial Supply Distribution (Figs. 1 & 2)

The main distribution cables on trailer cars, both A.C. and D.C. are carried through the vehicle in an underfloor duct, mineral insulated cable is used for both A.C. and D.C. distribution systems.

The neutral of the A.C. system is earthed at the Motor Alternator or Diesel Alternator, whichever is in use at the time.

STUDENT'S NOTES.

Local Distribution - Driving Trailer Car (Fig. 3)

All supplies for the vehicle are tapped off in the equipment bay, where the two main circuit breakers (SCB1 and 2) for the A.C. supply, and the Control Switch and Fuse (CS1 and CF1) for the D.C. supply are located. Also in the equipment bay are the Battery Switch and Fuse.

The 415 volts 3 phase A.C. 50HZ supply is used to provide electrical power for the following :-

Tilt Hydraulic Power Pack

No. 1 Oil Pump	11KW.
No. 2 Oil Pump	3KW.
Radiator Fan Motor	0.75KW.

HK Brake

No. 1, 2 and 3, Circulating Pump Motors	0.6KW each.
No. 1, 2 and 3, Radiator Fan Motors	1.3KW each.

Electronic Power Supply

Tilt and HK Brake Control Interface.

Air Conditioning

This will be provided by either :-

Denco-Miller Limited

No. 1 and 2 Compressor Motors.
No. 1 and 2 Condensor Fan Motors.
Circulating Fan Motor.
Fresh Air Fan Motor.
Heater Battery.

or

Temperature Limited

No. 1 Compressor Motor.
No. 1 and 2 Condensor Fan Motors.
Circulating Fan Motor.
Fresh Air Fan Motor
Heater Battery.

C APT Power Supply.

The 250 volts A.C. single phase and neutral is used to provide power for the following :-

(a) No. 2 end Toilet Pump and Control.
(b) Shaver Socket.
(c) Water Heater.
(d) Tilt Oil pre-heater 0.75KW.
(e) Saloon Lighting (75%).
(f) Hotplate.
(g) Cab Air Conditioning.
(h) Battery Charger.
(i) Destination Indicators and Headlights.

(j) A.C. Control to Tilt and HK Brake/Contactor Coils.

(k) Air Conditioning Control.

The 110 Volts D.C. supply is used to provide power for the following :-

(a) Saloon Lighting (25%).

(b) Cab Lighting.

(c) Cab Controls.

(d) Handlamp Sockets.

(e) Fire Protection System.

(f) External Door Control.

(g) Internal Door Control.

(h) Transient Pressure Shut-Off Valve.

(i) Air Conditioning Local Control.

(j) Lighting Local Control.

(k) Battery Supply to Traction Control Circuits.

(l) Electronic Power Supply to Tilt and HK Brake Interface.

Local Distribution - Intermediate Trailer Car

All supplies for the vehicle are tapped off at No. 1 end vestibule only In the right-hand equipment cubicle facing the exterior door at No. 1 end are the two main circuit breakers (SCB1 and 2) for the A.C. supply, and the Control Switch and Fuse (CF1 and CS1) for the D.C. supply.

The 415 volts 3 phase A.C. 50HZ supply is used to provide electrical power for the following :-

Tilt Hydraulic Power Pack

No. 1 Oil Pump Motor	11KW.
No. 2 Oil Pump Motor	3KW.
Radiator Fan Motor	0.75KW.

HK Brake

No. 1 Circulating Pump Motor	0.6KW.
No. 2 Circulating Pump Motor	0.6KW.
No. 1 Radiator Fan Motor	1.3KW.
No. 2 Radiator Fan Motor	1.3KW.

Electronic Power Supply

Tilt and HK Brake Control and Interface.

Air Conditioning

This will be provided by either :-

Denco-Miller Limited

No. 1 and 2 Compressor Motors.
No. 1 and 2 Condensor Fan Motors.
Circulating Fan Motor.
Fresh Air Fan Motor.
Heater Battery.

or

Temperature Limited

No. 1 Compressor Motor.
No. 1 and 2 Condensor Fan Motors.
Circulating Fan Motor.
Fresh Air Fan Motor.
Heater Battery.

The 250 volts A.C. single phase and neutral is used to provide power for the following :-

(a) Nos1&2 end Toilet Pump and Control.
(b) Shaver Socket.
(c) Water Heater.
(d) Tilt Oil pre-heater 0.75KW.
(e) Saloon Lighting (75%)
(f) Ac Control to Tilt and HK Brake/Contactor Coils.
(g) Air Conditioning Control.

The 110 volts. D.C. supply is used to provide power for the following :-

(a) Saloon Lighting (25%).
(b) Handlamp Sockets.
(c) External Door Control.
(d) Internal Door Control.
(e) Transient Pressure Shut-Off Valve.
(f) Air Conditioning Local Control.
(g) Lighting Local Control.
(h) Electronic Power Supply - Tilt and HK Brake Interface.

Local Distribution - Van Trailer Car

All supplies for the vehicle are tapped off at No. 1 end via the two main circuit breakers (SCB1 and 2) for the A.C. supply and the Control Switch and Fuse (CS1 and CF1) for the D.C. supply. There are two equipment areas which accommodate the controls for the Motor Alternator and Compressor and the main circuit breakers which supply the Power Car with its A.C. supply.

The 415 volts 3 phase supply is used to provide electrical power for the following :-

Tilt Hydraulic Power Pack

No. 1 Oil Pump Motor	11KW.
No. 2 Oil Pump Motor	3KW.
Radiator Fan Motor	

HK Brake

No. 1 Circulating Pump	0.6KW.
No. 2 Circulating Pump	0.6KW.
No. 3 Circulating Pump	0.6KW.
No. 1 Radiator Fan Motor	1.3KW.
No. 2 Radiator Fan Motor	1.3KW.
No. 3 Radiator Fan Motor	1.3KW.

Electronic Power Supply

Tilt and HK Brake Control and Interface.

Air Conditioning

This will be provided by either :-

Denco-Miller Limited

No. 1 and 2 Compressor Motors.
No. 1 and 2 Condensor Fan Motors.
Circulating Fan Motor.
Fresh Air Fan Motor.
Heater Battery.

or

Temperature Limited

No. 1 Compressor Motor.
No. 1 and 2 Condensor Fan Motors.
Circulating Fan Motor.
Fresh Air Fan Motor.
Heater Battery.

Compressor and After Cooler Fan Motors.

The 250 volts A.C. single phase and neutral is used to provide the power for the following :-

(a) No. 1 Toilet Pump and Control.

(b) Guard's Hotplate.

(c) Cleaner's Socket.

(d) Compressor Control.
(e) Saloon Lighting (75%).
(f) Reading Lights Transformer.
(g) Destination Indicators.
(h) Tilt Oil pre-heater, (0.75kW).
(i) Shaver Socket.
(j) Water Heater.
(k) A.C. Control to Tilt and HK Brake Contactor Coils.
(l) Air Conditioning Control.
(m) No Volt Relay (2). Motor Alternator Power Control

The 110 volts D.C. supply is used to provide power for the following :-

(a) Saloon Lighting.
(b) External Door Control.
(c) Internal Door Control.
(d) Train Door Controls A and B Sides.
(e) Electronic Power Supply - Tilt and HK Brake Interface.
(f) Parking Brake.
(g) Handlamp Sockets.
(h) Air Conditioning Control, Local and Train.
(i) Lighting Control, Local and Train.
(j) Tilt and Passenger Communication Fault Indication.
(k) Load Shedding
(l) Transient Pressure Shut-Off Valve.
(m) Field Tickling for MA Set initial excitation.

NOTE.
On all vehicles except the Power Car there is a COS switch. This comes between the SCB 1 and 2 and the vehicle's AC supply system. It is located on the Contactor panel in the underbelly. This switch is used to isolate the relevant equipment as shown in the diagrams.

Local Distribution - Power Car.

The Power Car's electrical distribution system is different to the Trailer vehicles and may be summarised as follows;

The 415 volts 3 phase supply is used to provide electrical power for the following :-

Tilt Hydraulic Power Pack

No. 1 Oil Pump Motor 11KW
No. 2 Oil Pump Motor 3KW

HK Brake

Nos 1,2,3, and 4 Circulating Pump 0.6KW.
Nos 1,2,3, and 4 Radiator Fan Motors 1.3KW.

Electronic Power Supply.

Tilt and HK Brake Control and Interface.

Auxiliary Controls

Supplied from 'A' phase - neutral, via FS 14.

The 250 volt AC single phase and neutral is used to provide the power for the following :-

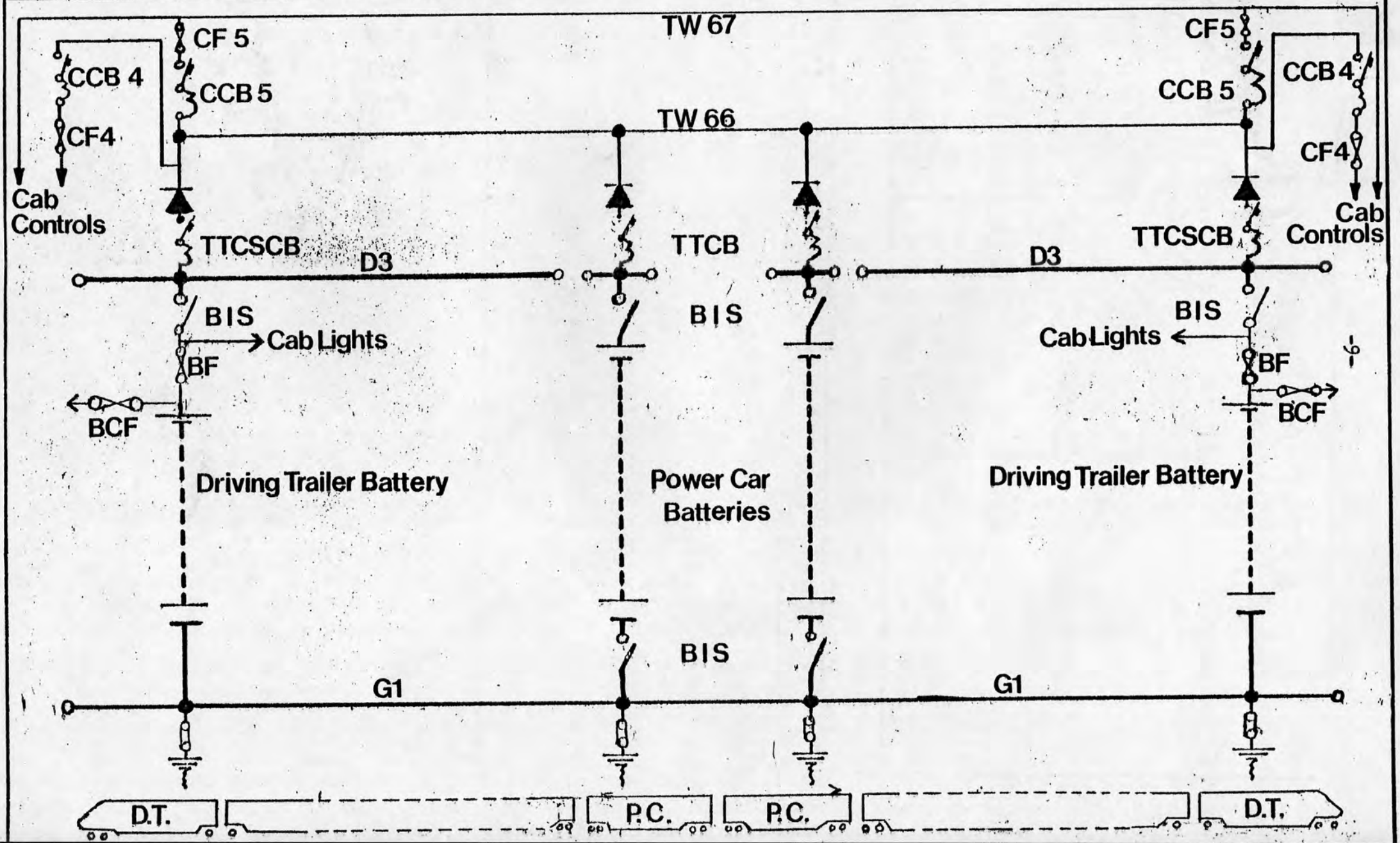
a) Traction Motor Current Monitoring.
b) Battery Charger.
c) Thyristor Oil Cooling Pump.
d) Choke Oil Cooling Pump.
e) Transformer Oil Cooling Pump.
f) Traction Motor Cooling Fans Nos 1,2,3, and 4.
g) Car Ventilation Fan.
h) Cooling Fan, Group 1 Radiators.
j) Cooling Fan, Group 2 Radiators.

The 110 volt D.C. supply is used to provide power for the following;:-

a) Lights
b) Inspection Lamp Sockets.
c) Tilt and Brake Supply
d) Auxiliary Air Compressor.
e) Parking Brake.
f) Fire Alarm.
g) Traction Control fuses FS 1 - 8, and 11.
h) Train Traction Control Supply.
j) Battery Charger Ammeter.

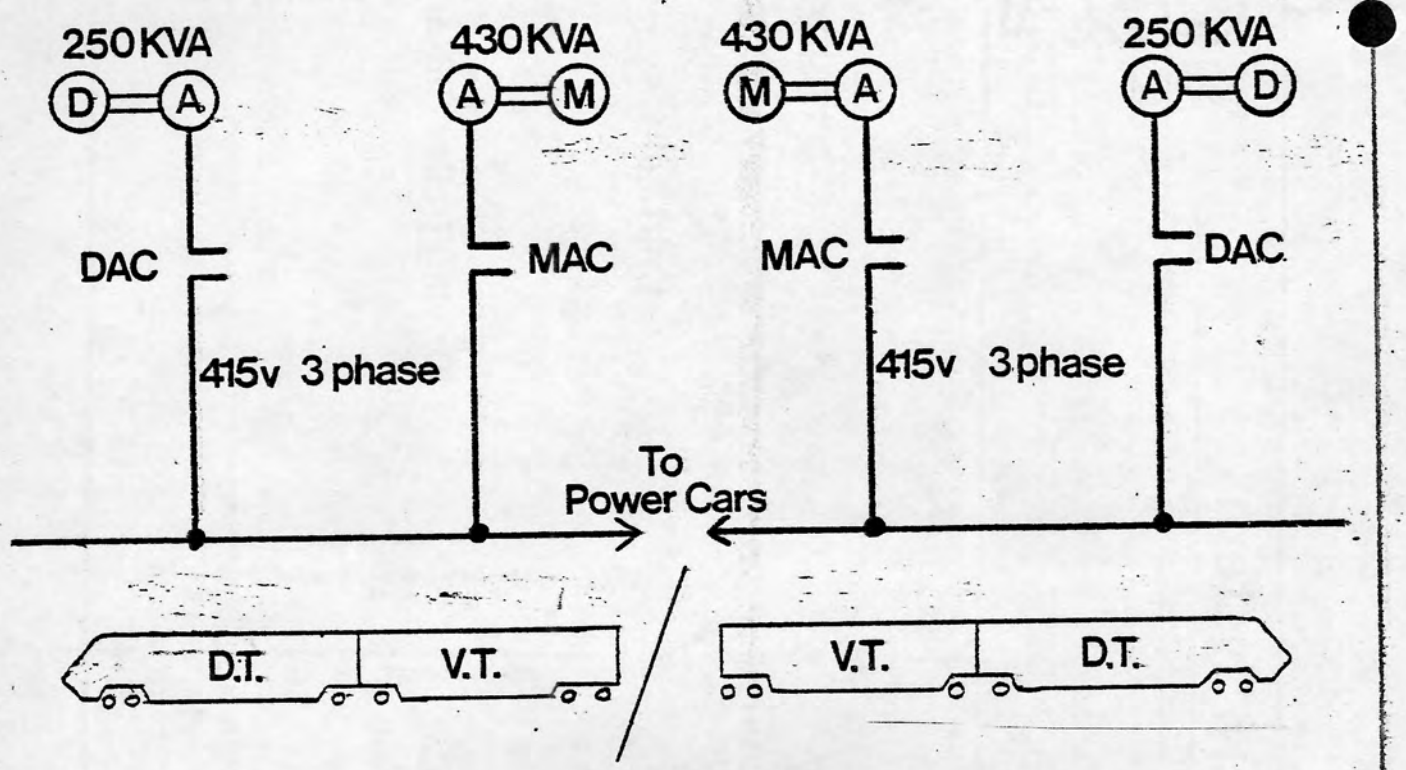
APT-P DC Supply System

Fig.1



APT-P AC Supply System

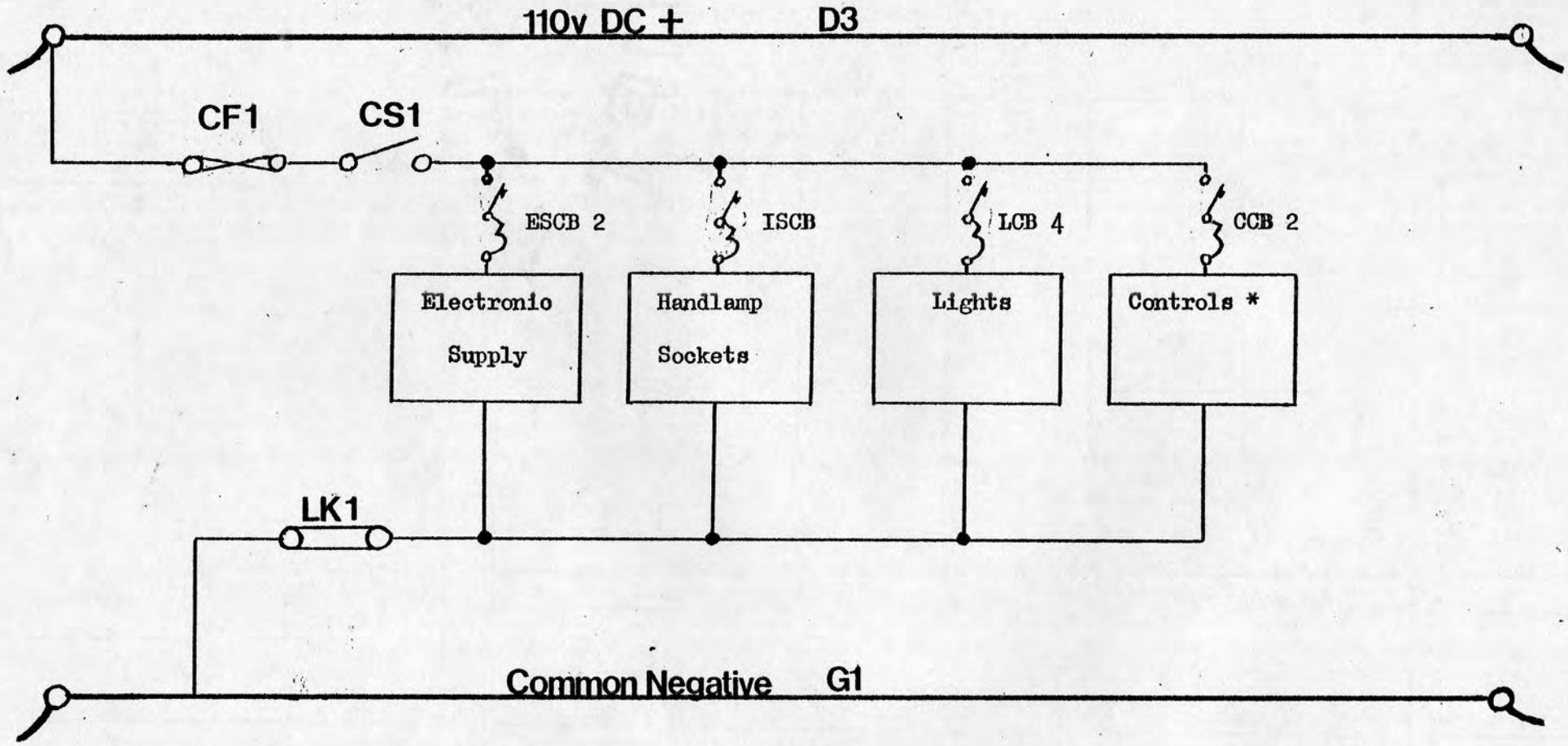
Fig.2



APT-P D.C. Distribution, Intermediate Trailer.

Fig. 3

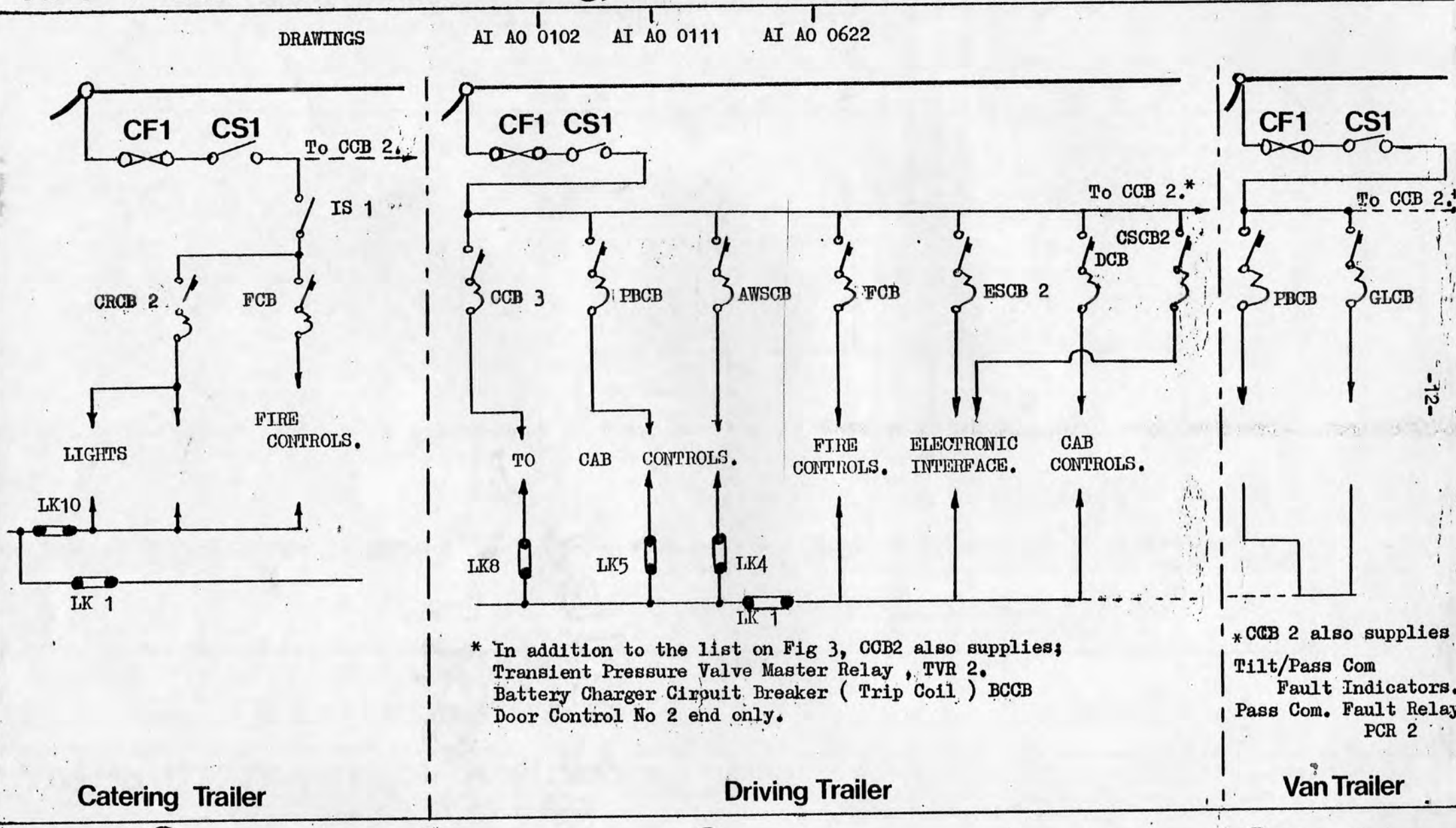
DRAWING AI AO 0004



* Internal and External Door Control, No 1 and No 2xend.
Transient Pressure Valves, SV 1, SV 2, and SV 3 coils.
Lighting Contactor, LC.
Air Conditioning " On " Lamp, No 2 end vestibule.

APT–P D.C. Distribution: Driving, Van and Catering Trailers

Fig.4



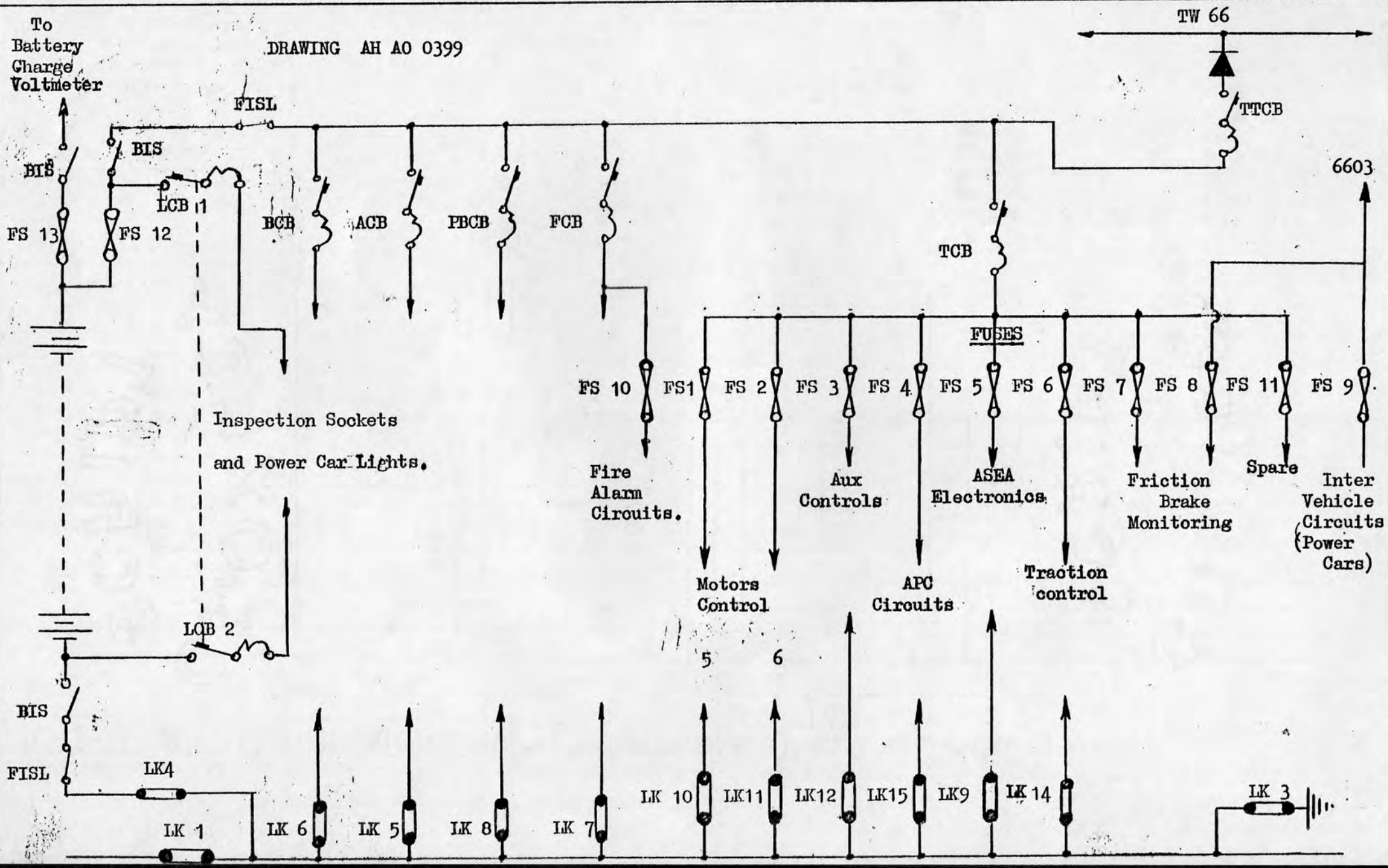
* In addition to the list on Fig 3, CCB2 also supplies;
Transient Pressure Valve Master Relay , TVR 2.
Battery Charger Circuit Breaker (Trip Coil) BCCB
Door Control No 2 end only.

* CCB 2 also supplies
Tilt/Pass Com
Fault Indicators.
Pass Com. Fault Relay
PCR 2

Catering Trailer | **Driving Trailer** | **Van Trailer**

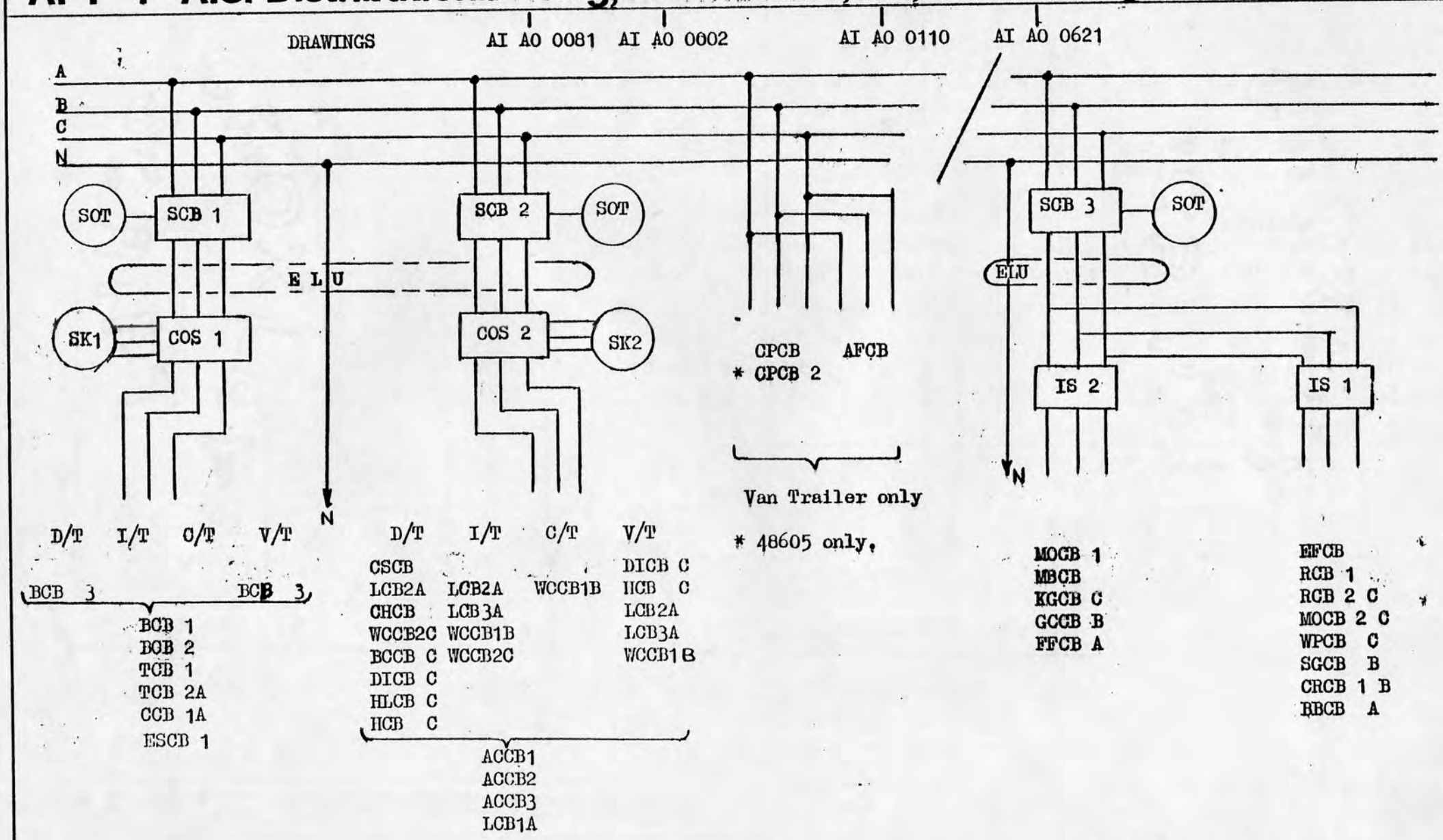
APT-P D.C. Distribution: Power Car

Fig.5



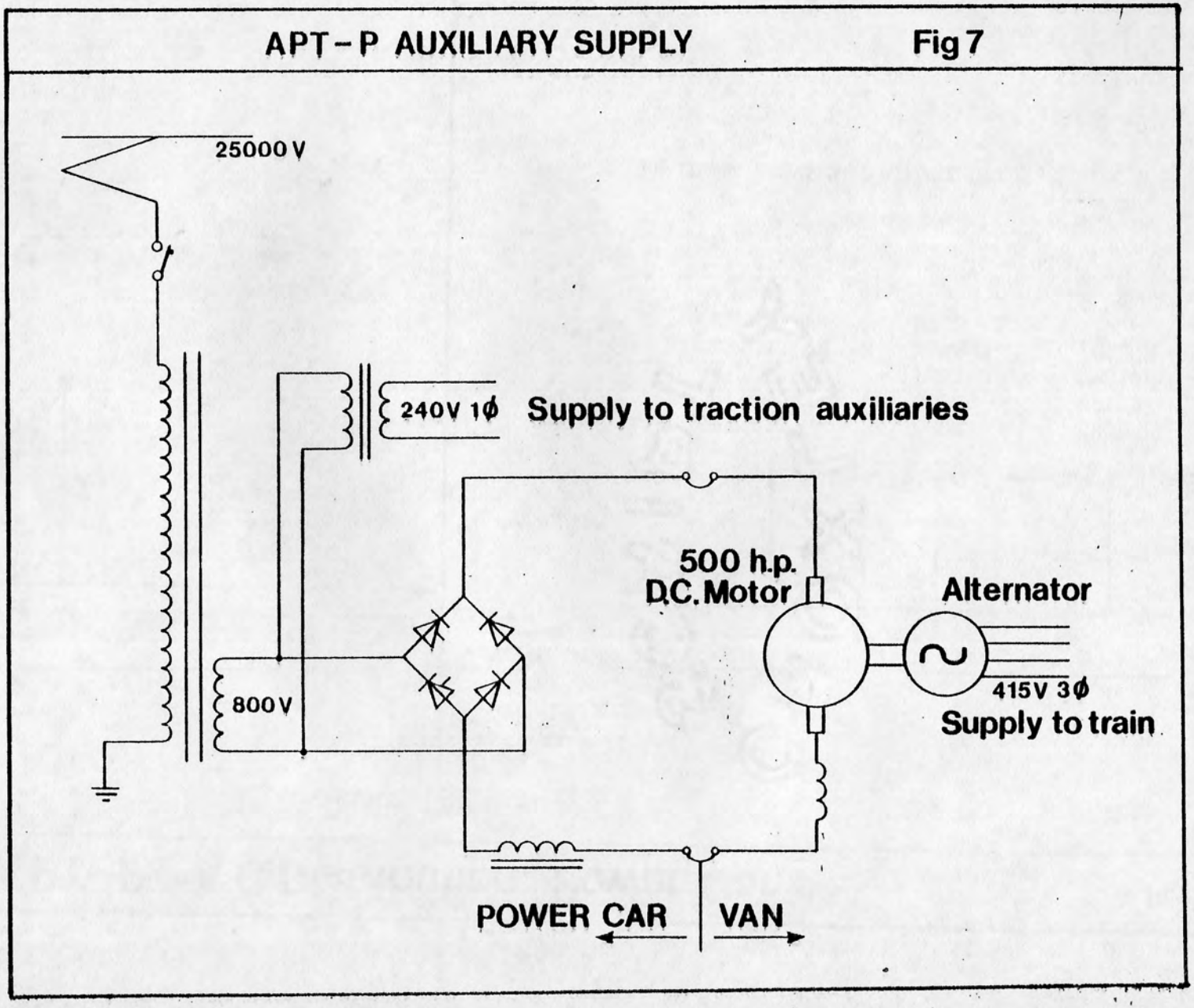
APT-P A.C. Distribution:Driving,Intermediate,Van,and Catering Trailer.

Fig 6



CATERING VEHICLE ONLY.

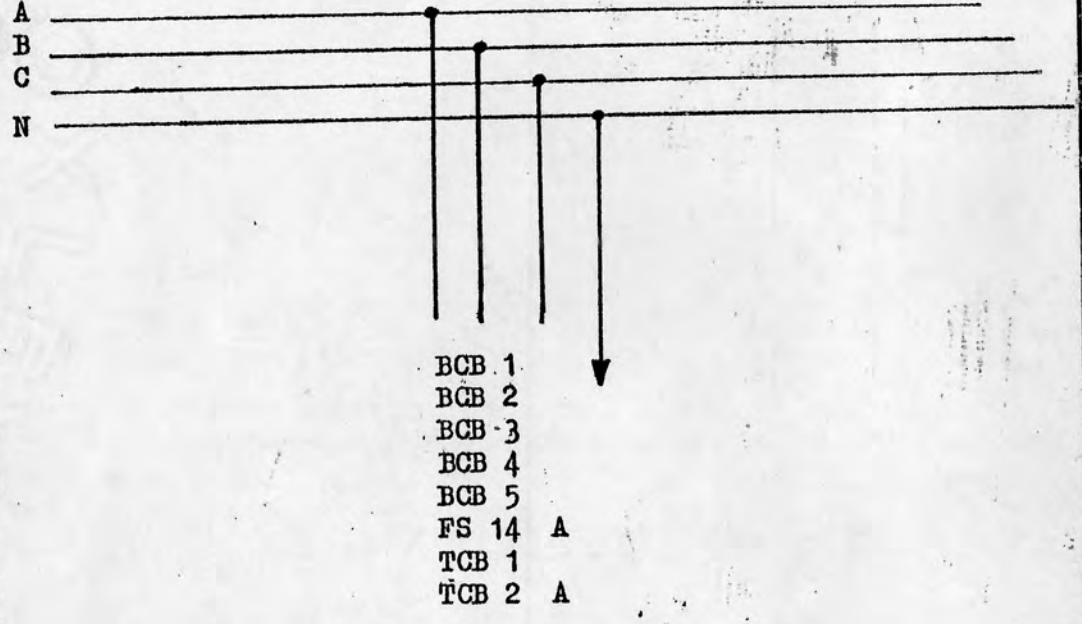
APT-P AUXILIARY SUPPLY Fig 7



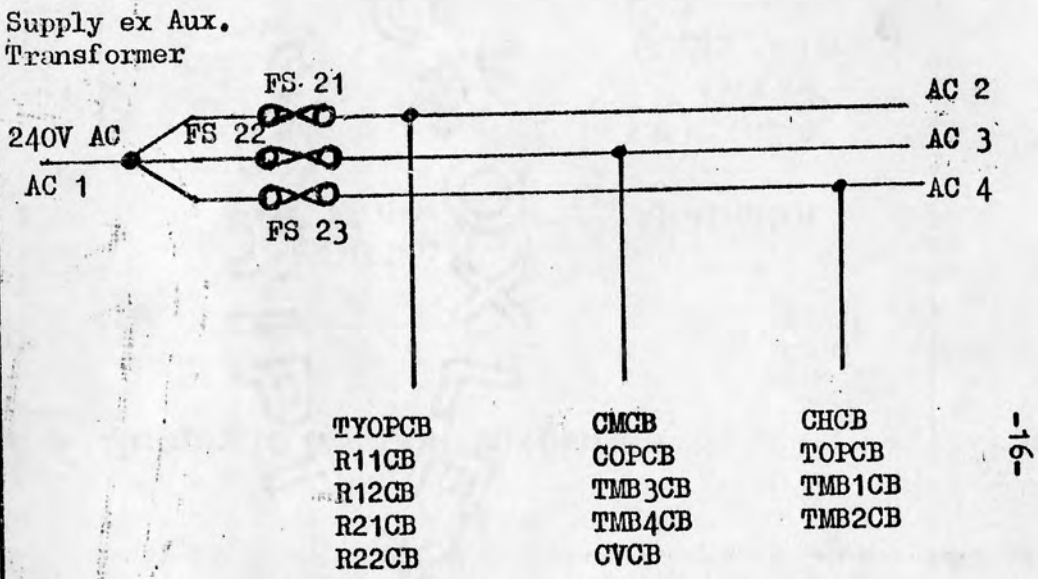
APT-P A.C.Distribution, Power Car.

Fig 8

DRAWING AH AO 0017



415V 3Ph 50Hz DISTRIBUTION.



SINGLE PHASE 240V. AC. DISTRIBUTION.