FV 432 MK 2 & 2/1
ELECTRICAL SYSTEMS

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SCHOOL
OF
ELECTRICAL
AND
MECHANICAL ENGINEERING
BORDON HANTS

CONTENTS

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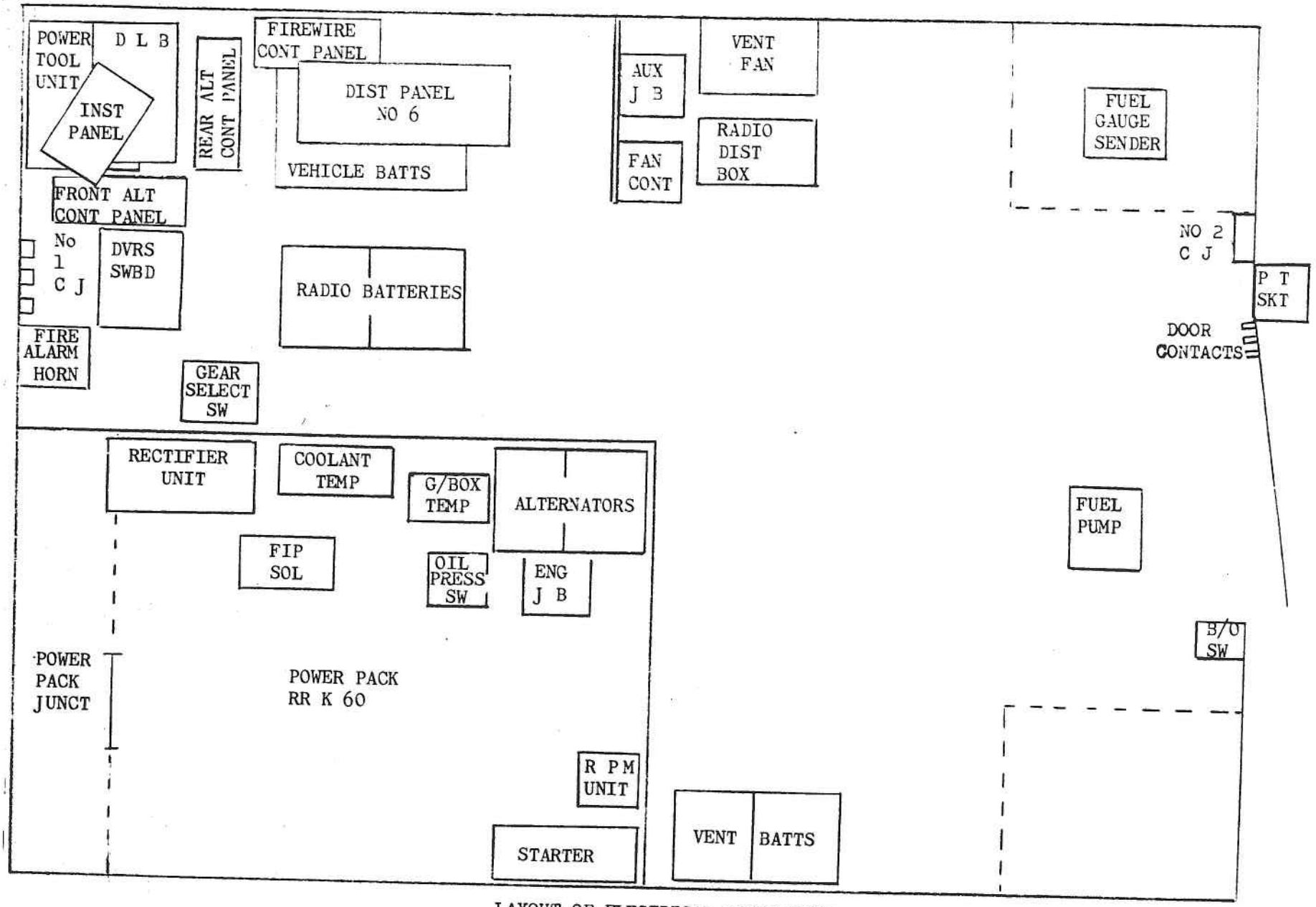
Amended Jan 1980 P.B.M.



LAYOUT OF ELECTRICAL COMPONENTS
FIG. 1

FV 430 SERIES FITTED WITH R.R. K60 ENGINES

ELECTRICAL PRECIS

BATTERIES

The vehicle is wired on the 24V negative earth system, with the exception of the power pack, which is an insulated return to the vehicle negative bus-bar. Three sets of batteries are utilised, automotive (to RH of driver), radio (beneath driver's seat) and ventilation (front LH side of personnel compartment) on FV 432. Different battery arrangements apply to other vehicles in the series.

Each set comprises two 12V 100 Ah (NATO type) batteries connected in series. Additional batteries can be accommodated down the centre of the personnel compartment for the command role, and externally to the vehicle in side shelters.

FUSES/CCT BREAKERS

The location and function of fuses is detailed in User Handbook FV 432 Mk 2 page 15. Where Dist. Panel No.6 (i.e. combined Dist. Panel and Access Control Panel) is fitted, function of thermal circuit breakers is listed under cct. bkr. cover plate.

DRIVERS SWITCHBOARD

Consists of Turnlight Swbd., Engine Swbd., and External Lighting Swbd., mounted on an easily detachable common frame.

The Turnlight Swbd. houses a turnlight pilot lamp and main beam warning lamp, as well as the turnlight switch. A standard 24V flasher unit is mounted inside the switchboard.

The Engine Swbd. houses the generator and oil pressure w/lps., the engine switch, and the starter switch. The engine sw. controls the following circuits:

a. Starter switch.

b. Oil and gen. w/lps.

c. Fuel pump and f.i.p. solenoid.

d. Coolant and g/box temperature gauges.

e. Fuel gauge.

f. Inst. panel illumination lamps.

The External Lighting Swbd. controls the external driving lights of the vehicle. Operation of the switches is detailed in EMER E.102/2 p. 67.

F.I.P. SOLENOID

This is a two-stage solenoid, with "pull-in" and "hold-on" coils. When the solenoid is energised, the pull-in coil is open circuited by contacts, operated by the solenoid armature action.

Failure of the contacts to open due to maladjustment made it necessary to modify the FIP SOL, but the modified unit is only fitted when a replacement is necessary. Two types of solenoid will, therefore, be found in use.

PRE-MODIFIED TYPE

The solenoid is fed from the vehicle batteries via cct bkr L in the distribution panel, and the engine switch.

MODIFIED TYPE (EMER POWER S567/1 MOD NO 23)

The solenoid hold on coil is fed via cct bkr L and the engine switch. The pull in coil is fed via the starter switch and is connected to terminal 'A' in the engine junction box.

Care must be taken when fitting this unit to ensure that the contact gap is between 0.8-1.6mm (0.030"-0.060") when the solenoid is energised. The maximum permitted misalignment of the armature shaft linkage is 6 degrees, otherwise the solenoid armature can "jam" in its housing.

FIP SOL FAULT FINDING - SEE P45.

FUEL PUMP

This is a conventional type of transfer pump, capable of delivering 30 gallons/hour. It is mounted externally to the fuel balance tank by a circular flange. The electric motor is completely enclosed, i.e. dustproof and water proof. The unit has a design life of 1000 hours running with no maintenance.

FUEL PUMP FAULT FINDING

If fuel pump does not operate with vehicle master switch, and engine switch on, check if other engine switch controlled circuits are operative (see item 3 page 3). If these are not functioning, check relevant fuse or circuit breaker. If all these circuits are working, proceed as follows:

Disconnect socket 23 at D.L.B. and measure the resistance between D.L.B. 23A and D.L.B. 24C.

- ZERO RESISTANCE
  Check resistance between DLB 23B and negative.
  - HIGH RESISTANCE
    Fault in DLB.
  - LOW RESISTANCE
    Check resistance between 23A and 23B on FP harness
    (Correct 2.5 Ω)
    - CORRECT
      Faulty fuel pump
    - INCORRECT
      Check pump and harness individually
- HIGH RESISTANCE
  Check individual sections in paralleling link and DLB. Also mating of connectors.

FIP SOL AND FUEL PUMP CIRCUITS
SHOWING PRE-MODIFIED FIP SOL

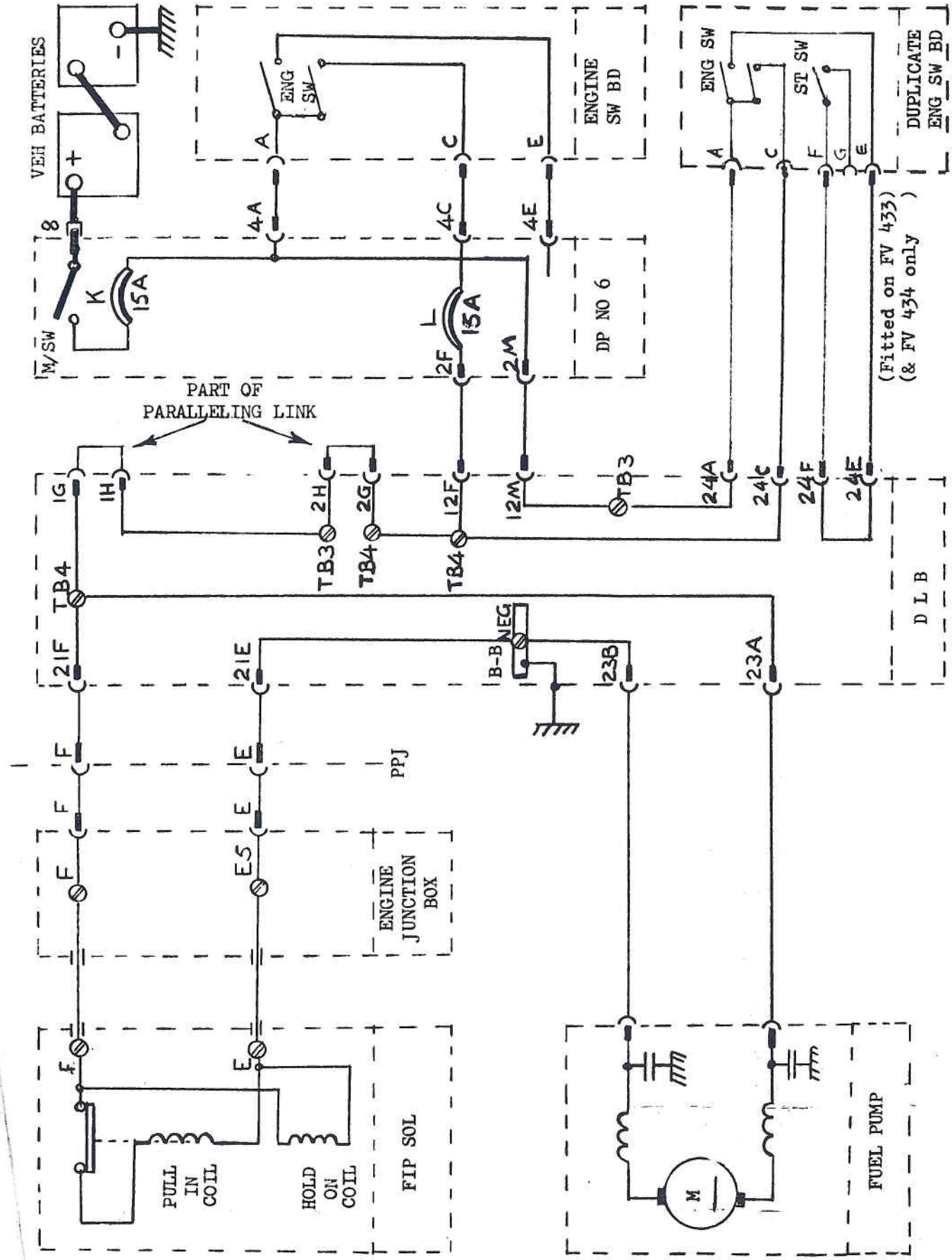
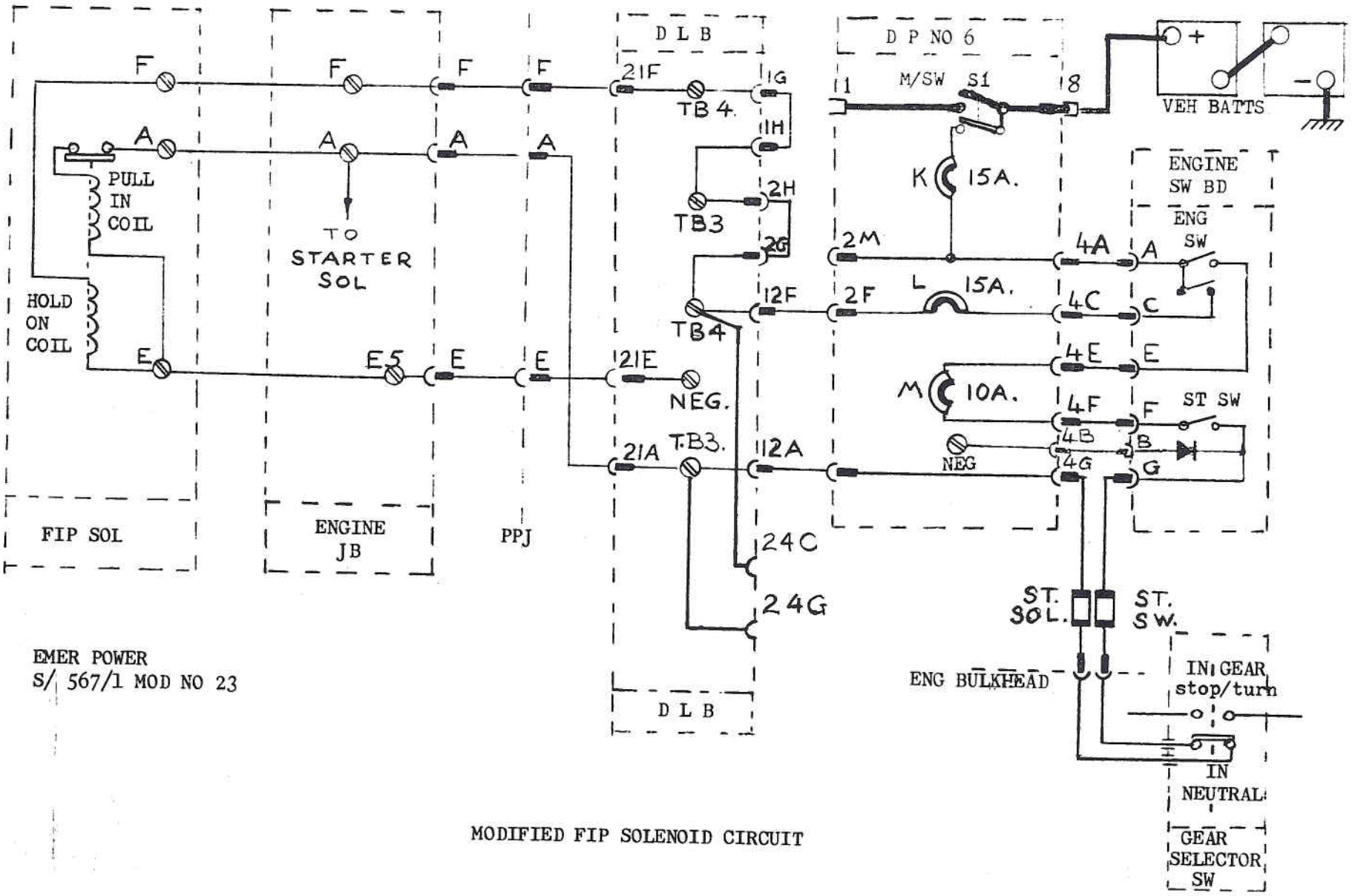


FIG 2



EMER POWER
S/ 567/1 MOD NO 23

MODIFIED FIP SOLENOID CIRCUIT

FIG 2A

COOLANT AND G/BOX TEMP. INDICATION

Each indication system consists of two units, a temperature gauge on the Inst. Panel, and an engine mounted temperature bulb, energised via fuse D or cct. bkr. M in Dist. Panel. The g/box temp. bulb circuit is taken directly through the power pack junction, and not via the engine JB. The resistance of either temp. bulb at 70°F is 90-100 ohms. The coolant temp. gauge is calibrated from -4 to 24 x 10°F, the gearbox temp. gauge from -4 to 30 x 10°F.

Typical faults:

i) Both gauges fail to move from rest: break in supply to inst. panel, check fuse or CB.

ii) One gauge fails to move from rest: short cct. to negative in temp. bulb cct from R2 on gauge. If not, fault is inside inst. panel, either faulty gauge or open cct. positive feed to gauge.

iii) One gauge reads full scale, as soon as engine sw. is closed: o/c or high res in temp. bulb line from R2 on gauge to negative. If not, fault is a faulty gauge.

OIL PRESSURE W/LAMP

Fed from fuse D or cct. bkr. M in Dist. Panel, when engine sw. is closed, yellow w/lamp should come on via closed oil pressure sw. mounted on engine. When engine is run, and oil pressure reaches 5-12 lbs per sq. inch, pressure sw. opens, removing negative feed from w/lamp, lamp goes out.

Typical Faults:

i) Lamp fails to come on via engine sw:
provided all other engine sw. controlled ccts. are 'on', press bulb to test.

(a) Lamp lights: fault is an open cct. in the line from w/lamp, via oil pressure sw. to negative.

(b) Lamp doesn't light: check bulb, and if satisfactory, fault is an open cct. positive feed to w/lp.

ii) Lamp fails to go out when engine is run: check engine oil level, and if correct, disconnect feed at terminal D in engine JB.

(a) Lamp stays on: short cct. to negative between w/lamp and terminal D.

(b) Lamp goes out. Disconnect leads from oil press. switch. Check for short cct. between terminal D in Engine J.Box and negative. If serviceable, replace oil press. switch. If short cct. exists, oil press. switch leads from Engine J.Box to switch are defective.

ENGINE RPM INDICATOR

This comprises two units, a sender unit which is a permanent magnet a.c. generator, the magnet being driven by the engine, and a tachometer mounted on the inst. panel, which is an a.c. voltmeter, calibrated in r.p.m.

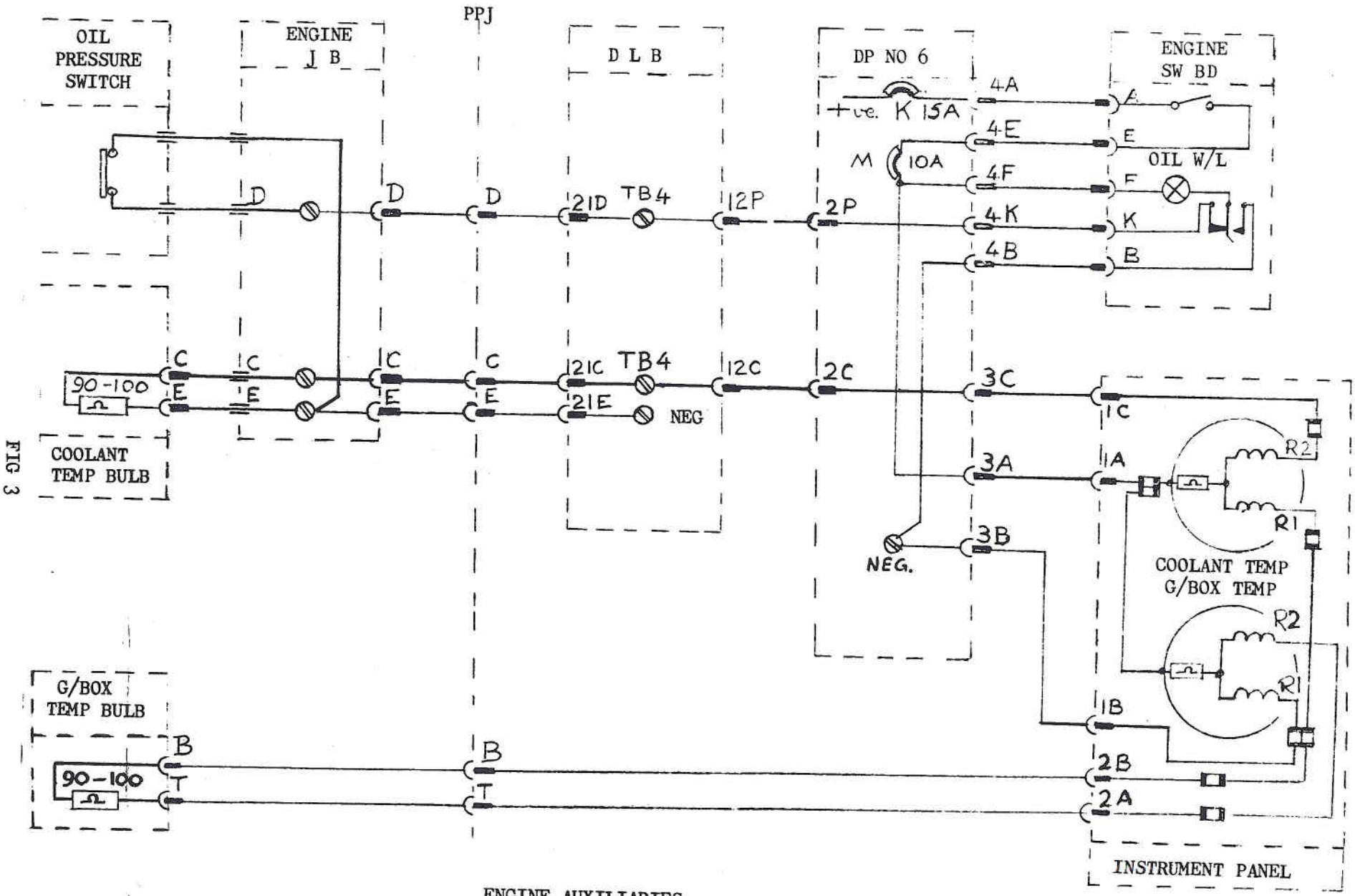
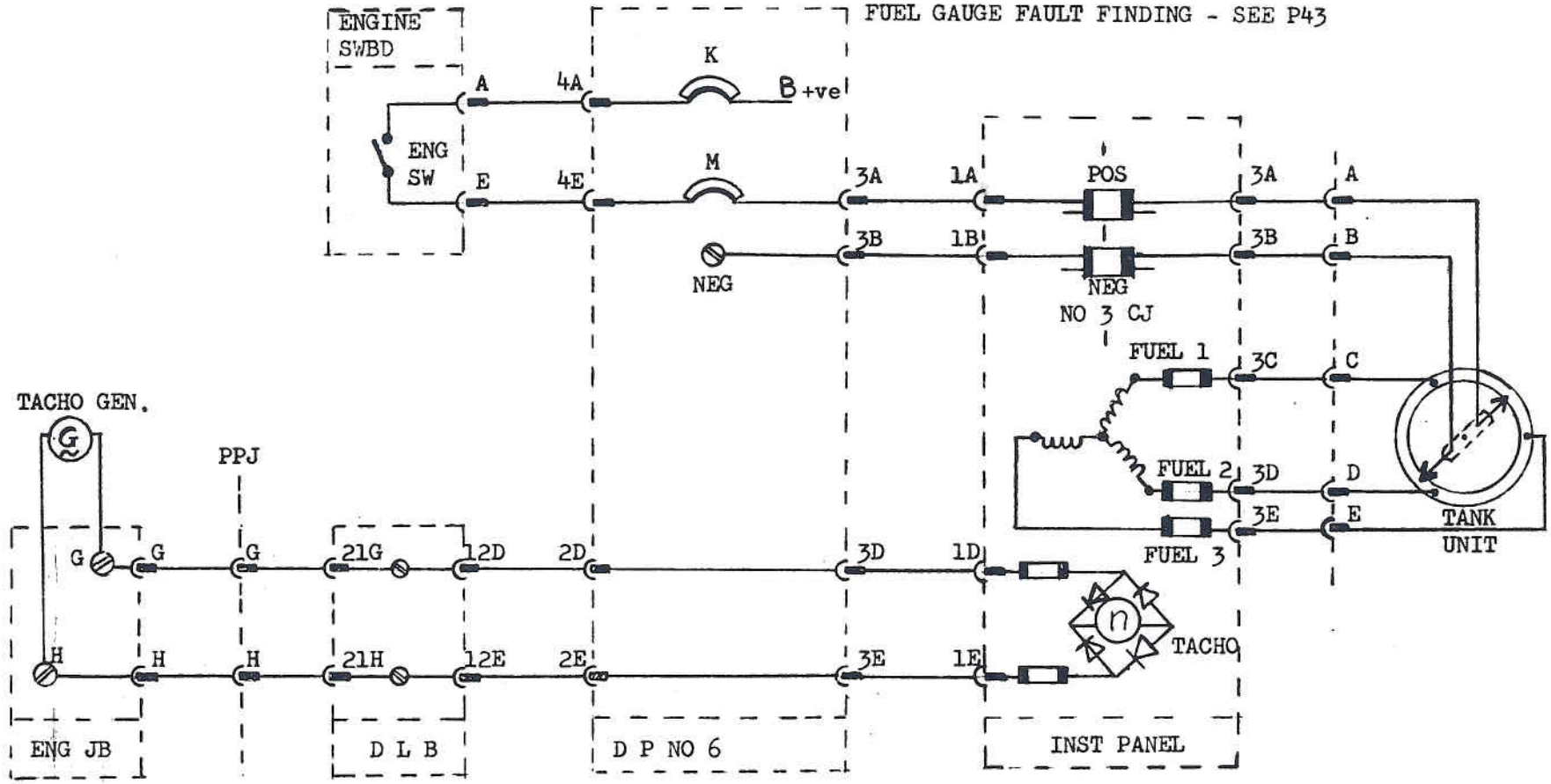


FIG 3

ENGINE AUXILIARIES

FIG 4



ENGINE RPM INDICATOR AND FUEL GAUGE CIRCUITS

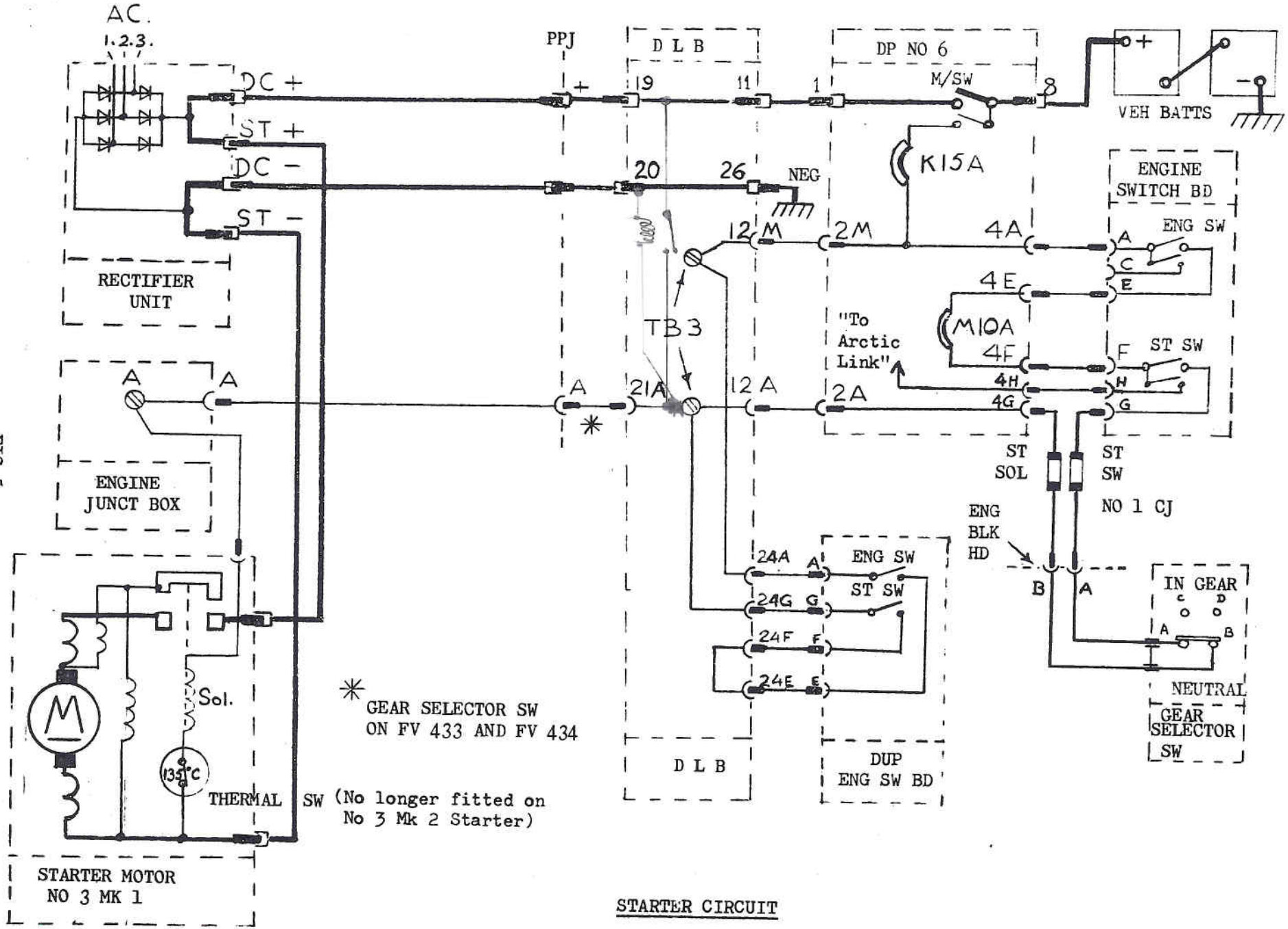


FIG 5 TO

STARTER CIRCUIT

STARTER MOTOR (3 MK 1 OR 3 MK 2)

This is a larger version of the conventional Axial type of starter, previously used on wheeled 'A' vehicles i.e. Saladin, Ferret. A description of the principles involved is given in EMER Power S.522 p.69.

In addition, starter No.3 MK 1 has a built in thermal switch, mounted on the brush gear assembly, and connected in series with the starter solenoid. This is to prevent damage to the starter in the event of over-heating, the switch opening at 135°C and reclosing at 90°C, giving a delay time of up to 2½ hours.

The starter solenoid is fed via the gear change interlock switch, to prevent operation of the starter if a gear is selected. The main positive and negative feeds to the motor are taken via the rectifier unit.

Starter No.3 Mk 2 differs from the MK 1 in that no thermal switch is fitted.

If starter does not engage, when attempting to start, check gear lever is in neutral position, check fuse D or cct. bkr. M in Dist. Panel. If all correct, check battery volts at insp. skt with master sw, eng sw, and starter sw closed. (ie: under working conditions of the battery.) If low, "slave" from another vehicle. If starter still fails, or if own batteries are serviceable, SEE P. 44 FOR FAULT FINDING CHART.

ARCTIC LINK (SEE FIG 5 AND FIG 7)

This is a facility to provide better starting under extremely cold conditions. A cable marked 12H on TB3 in the DLB is connected to a terminal marked "NORMAL". In Arctic conditions this cable is moved to an adjacent terminal marked "ARCTIC". When the starter switch is closed with the cable in the "ARCTIC" position, automotive battery voltage is applied to the "generator only" line causing the radio battery protection relay to close (if the radio batteries are correctly connected), and also operating the "gen only" relay in the distribution panel. The "gen only" relay allows the ventilation battery protection relay to close provided they are correctly connected and their voltage is above 18 V. All three sets of batteries are therefore connected in parallel and will provide better starting.

IMPORTANT - THIS FACILITY MUST NOT BE USED ON FV 433.

RADIO DISTRIBUTION PANEL NO 1 MK 3

Fitted on the front RH sill of the personnel compt., the panel provides the connection for the radio batteries, and controls the supply to the radios.

The panel houses the radio battery master sw., external charge sw., radio battery charge w/lamp, main radio supply fuse, and terminals to receive an external charging set harness connections.

The panel provides the following facilities:

(a) Warning lamp indication when the radio batteries are on charge from the vehicle generating system i.e. warning lamp goes out when gen. only relay is energised.

(b) Ability to keep radio batteries (and command batteries if fitted) on charge from an external source, so that engine need not be constantly run. In this case, there is no warning lamp indication.

(c) Ability for external batteries to be charged directly from the radio bus-bar.

Full details on the use of the R.D.P. are given in User H/book.

D.L.B. WARNING LAMP

This is a small press to test w/lamp (green in colour), mounted on the side of the DLB, which glows dimly when pressed to test. It is used in conjunction with a protection relay inside the DLB, preventing damage to the generating system if the radio battery leads are earthed or cross-connected.

For normal operation, the w/lp is out when the engine is stationary, and glows DIMLY when engine is run.

With the radio batteries removed, and the leads earthing, the lamp will be off with engine stationary, but will glow BRIGHTLY when engine is run.

With the radio batteries cross-connected i.e. +ve lead to B-ve and "earth" lead to B + ve, the lamp will glow BRIGHTLY as soon as radio battery m/sw. is ON, indicating that engine should NOT BE RUN.

NOTE: When lamp is pressed to test, the protection relay may be heard operating. This depends on manufacturing tolerance on the "press to test" lamp holder. E.M.E.R. Power P.162/3 P.7 para 17.

OPERATION OF RADIO BATT PROTECTION CIRCUIT

The gen only line feeds the Control Circuit for the Radio Batt Protection Relay. This feeds the 12V Relay via DLB W/L and resistor in parallel. Energises relay whose contacts connect the coil of the Radio Protection Relay to +VE. This Relay energises and its contact connects the Radio Batts to the +VE Busbar in the DLB, thus putting them on charge.

This only occurs if Radio Batts are correctly connected.

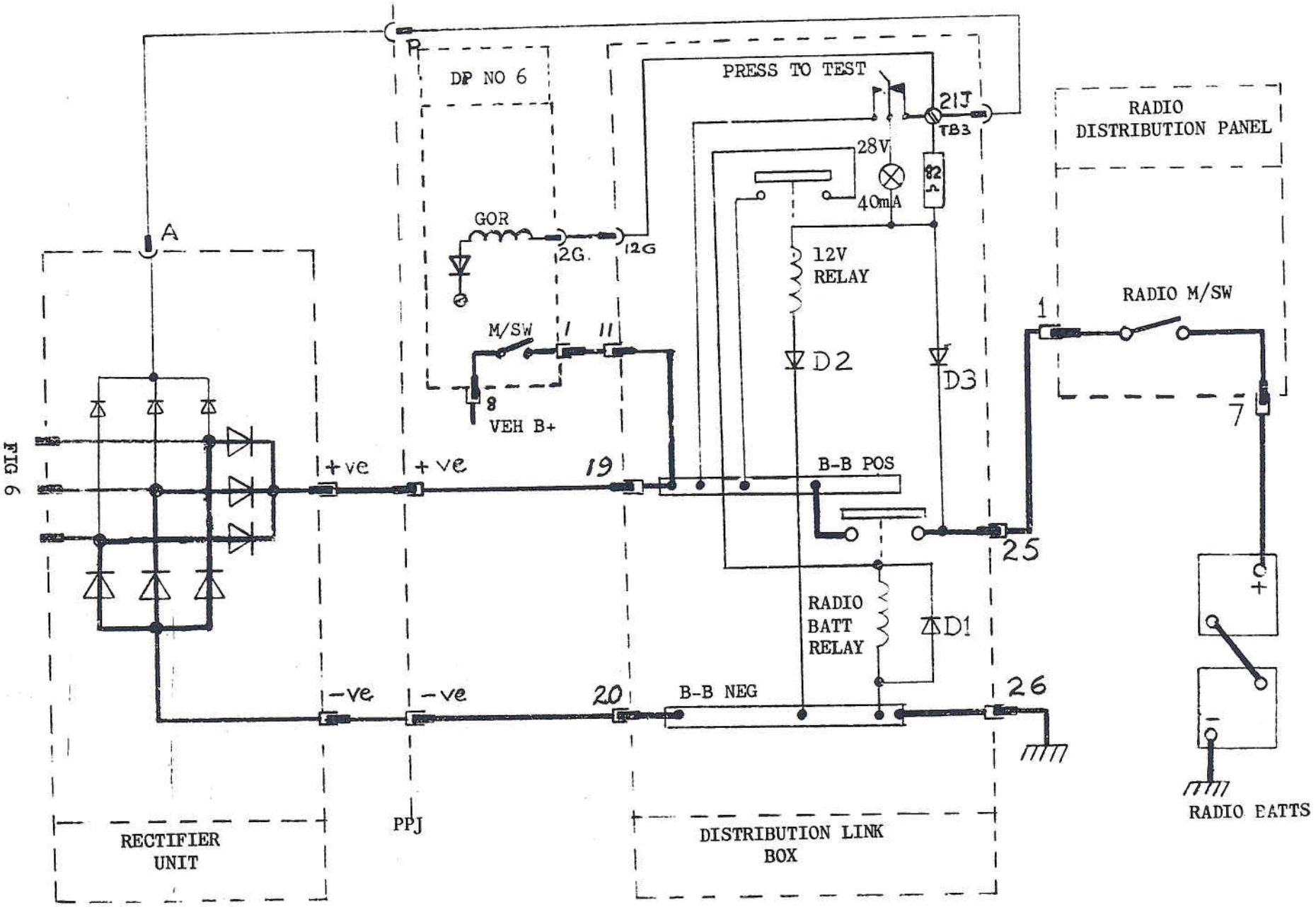
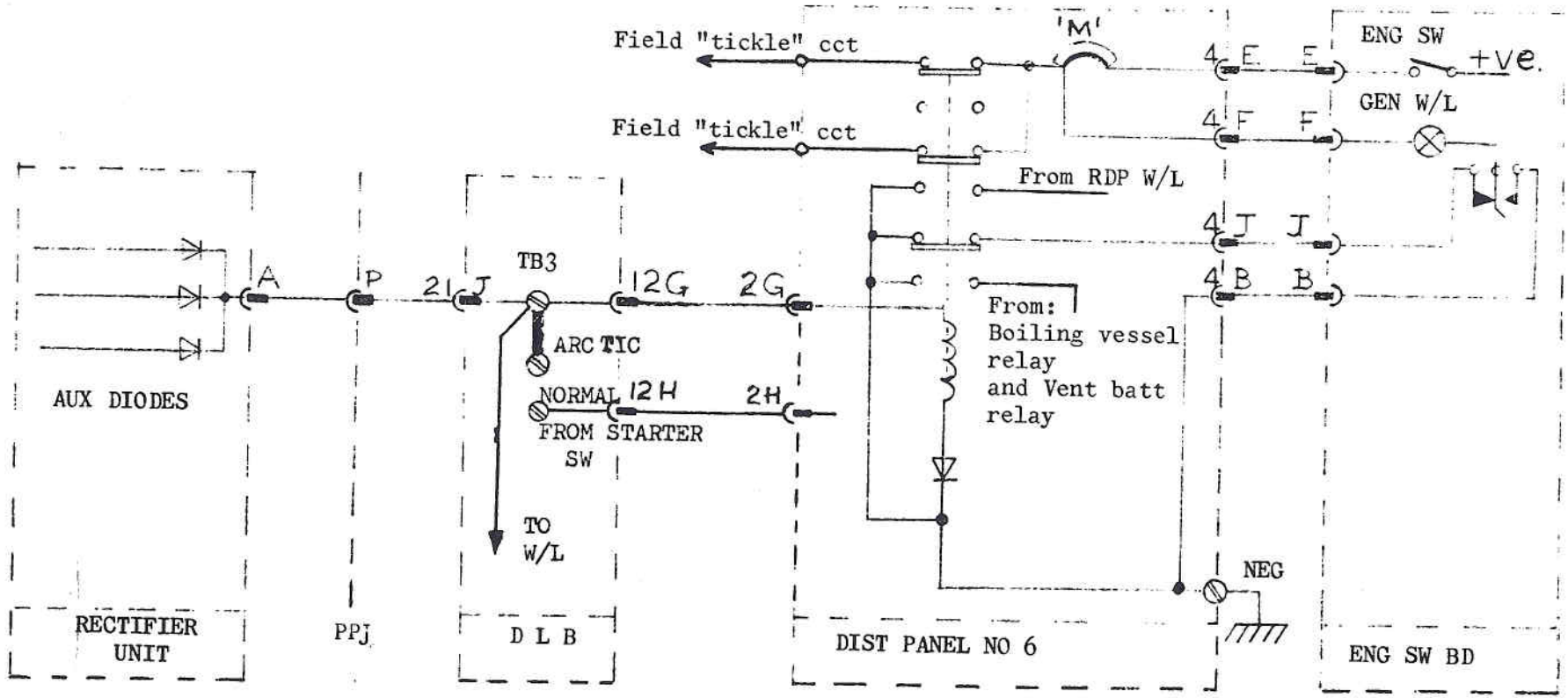


FIG 6

DISTRIBUTION LINK BOX W/L CIRCUIT

FIG 7



"GEN ONLY" RELAY CIRCUIT

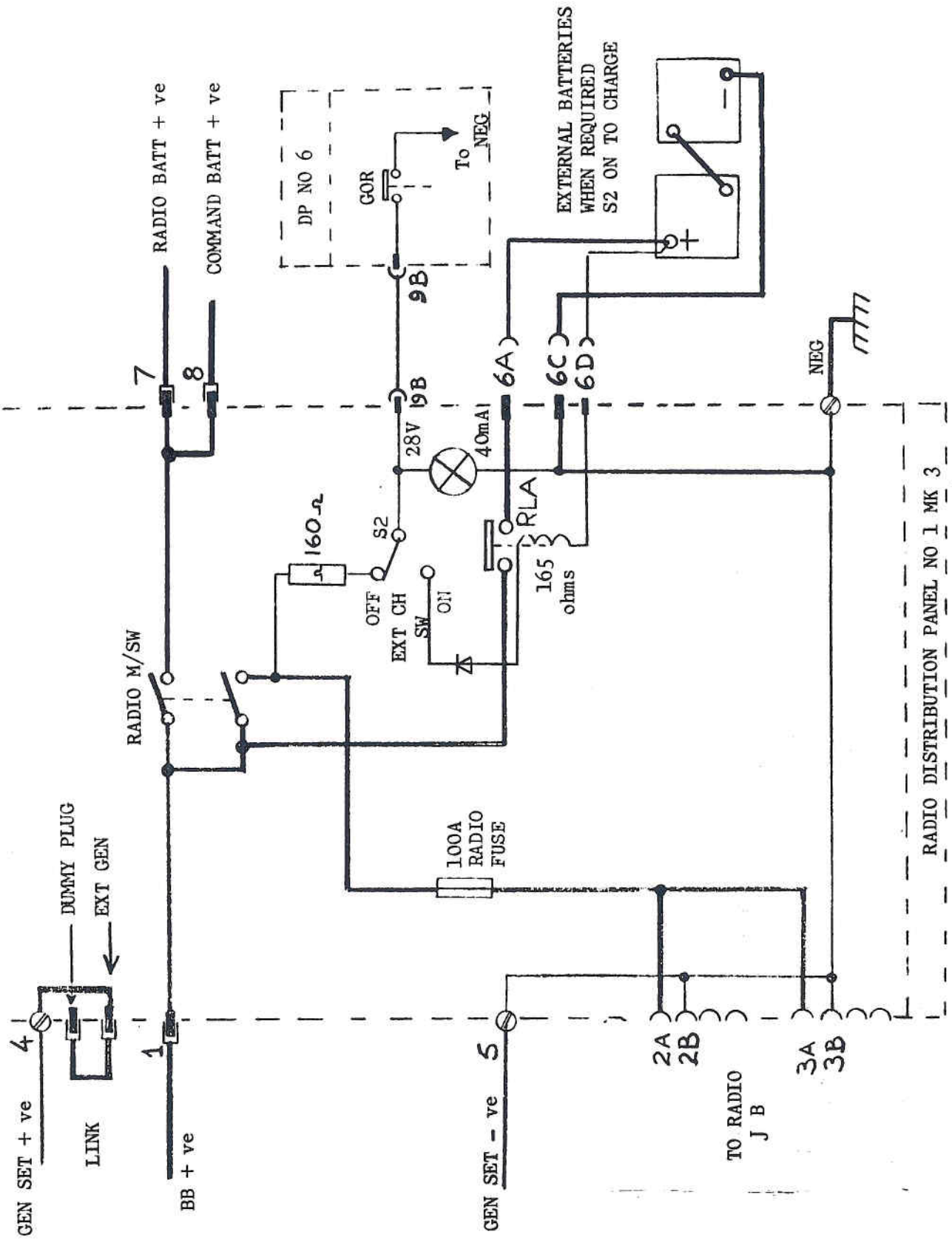
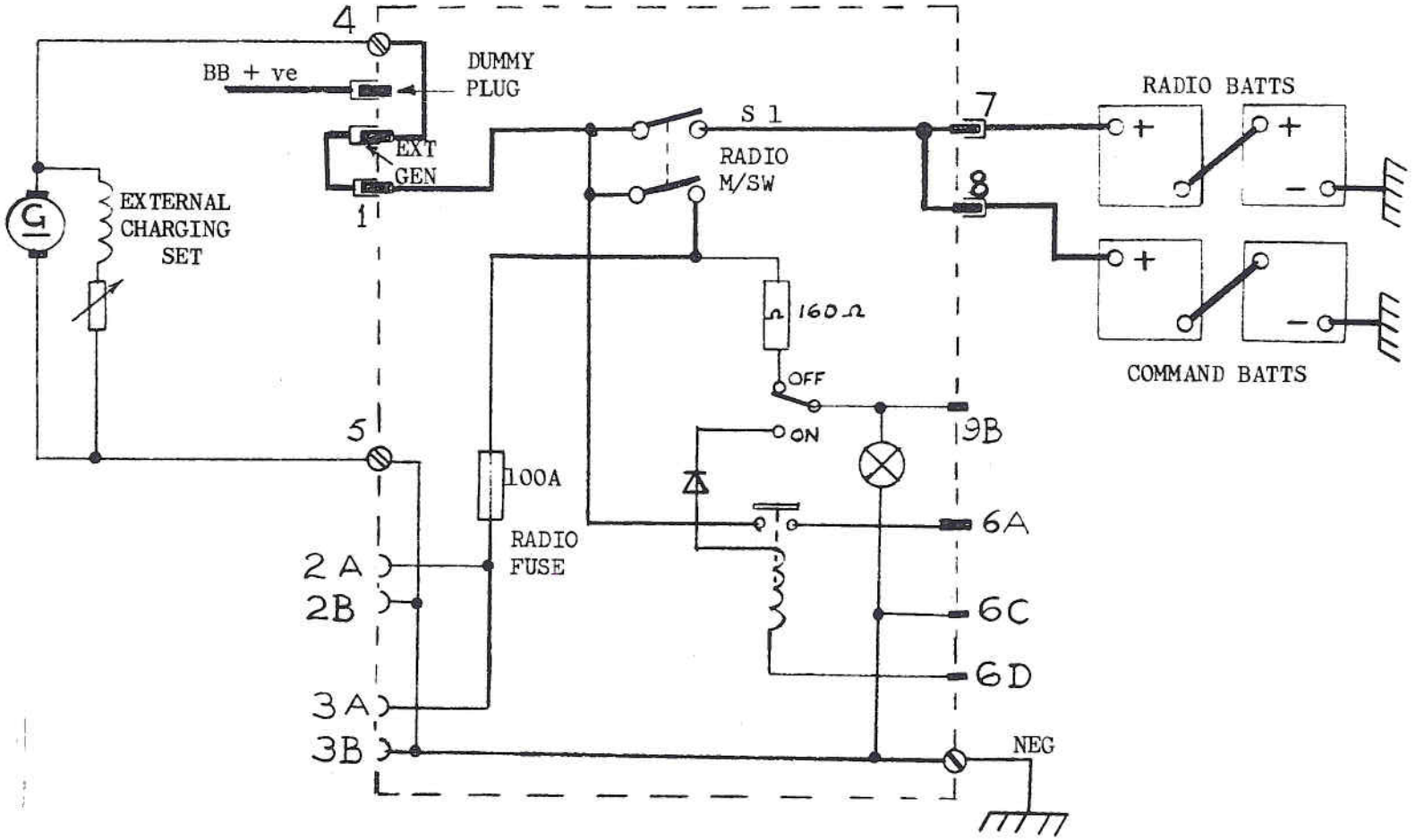
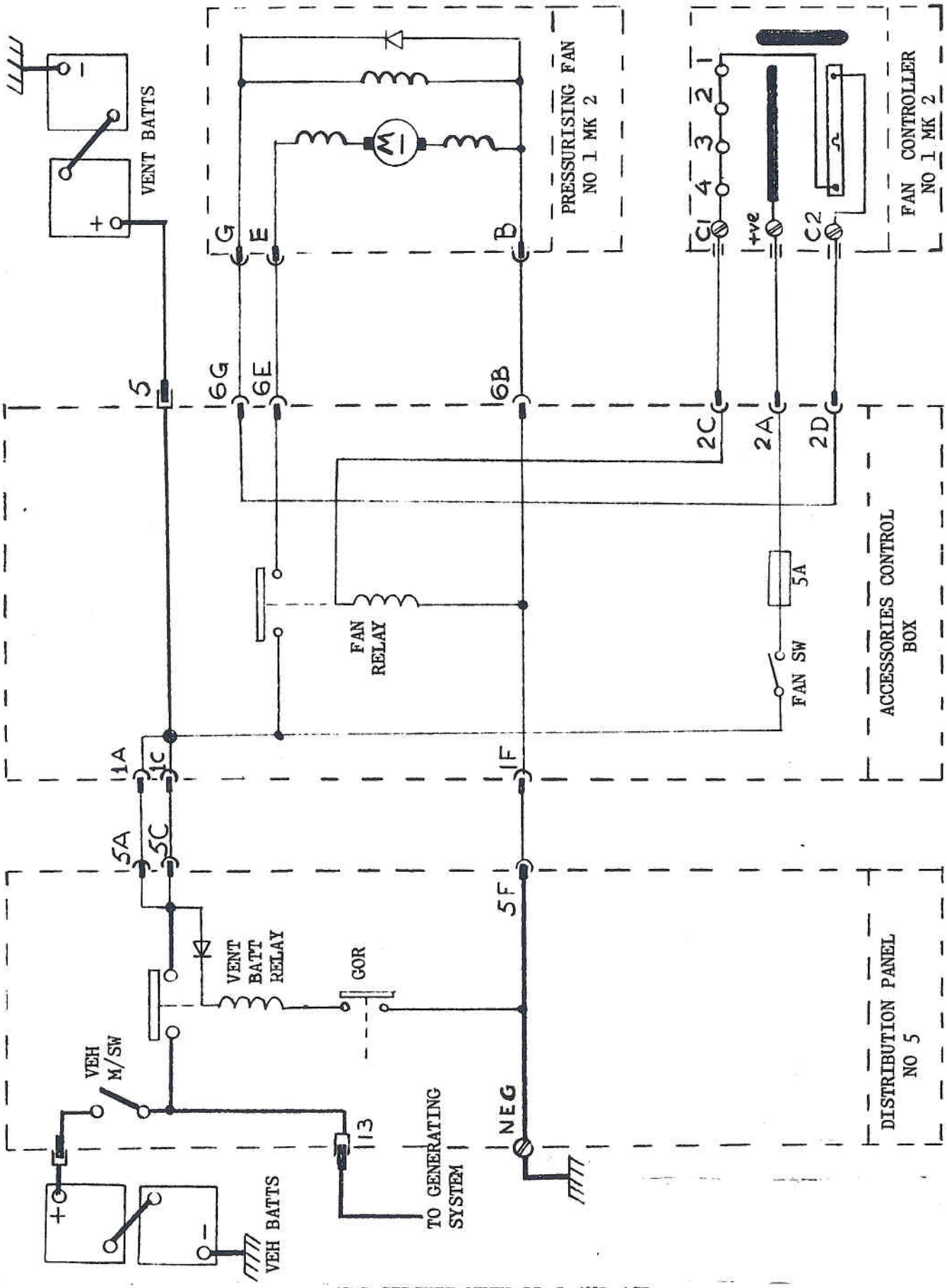

RADIO DISTRIBUTION PANEL NO 1 MK 3
RADIO BATT + ve
COMMAND BATT + ve
DP NO 6
GOR
To NEG
EXTERNAL BATTERIES
WHEN REQUIRED
S2 ON TO CHARGE
NEG
RADIO M/SW
160Ω
S2
OFF
EXT CH SW
ON
28V
40mA
RLA
165 ohms
100A RADIO FUSE
DUMMY PLUG
EXT GEN
LINK
GEN SET + ve
BB + ve
GEN SET - ve
TO RADIO J B
7
8
9B
6A
6C
6D
4
1
5
2A
2B
3A
3B

FIG 8

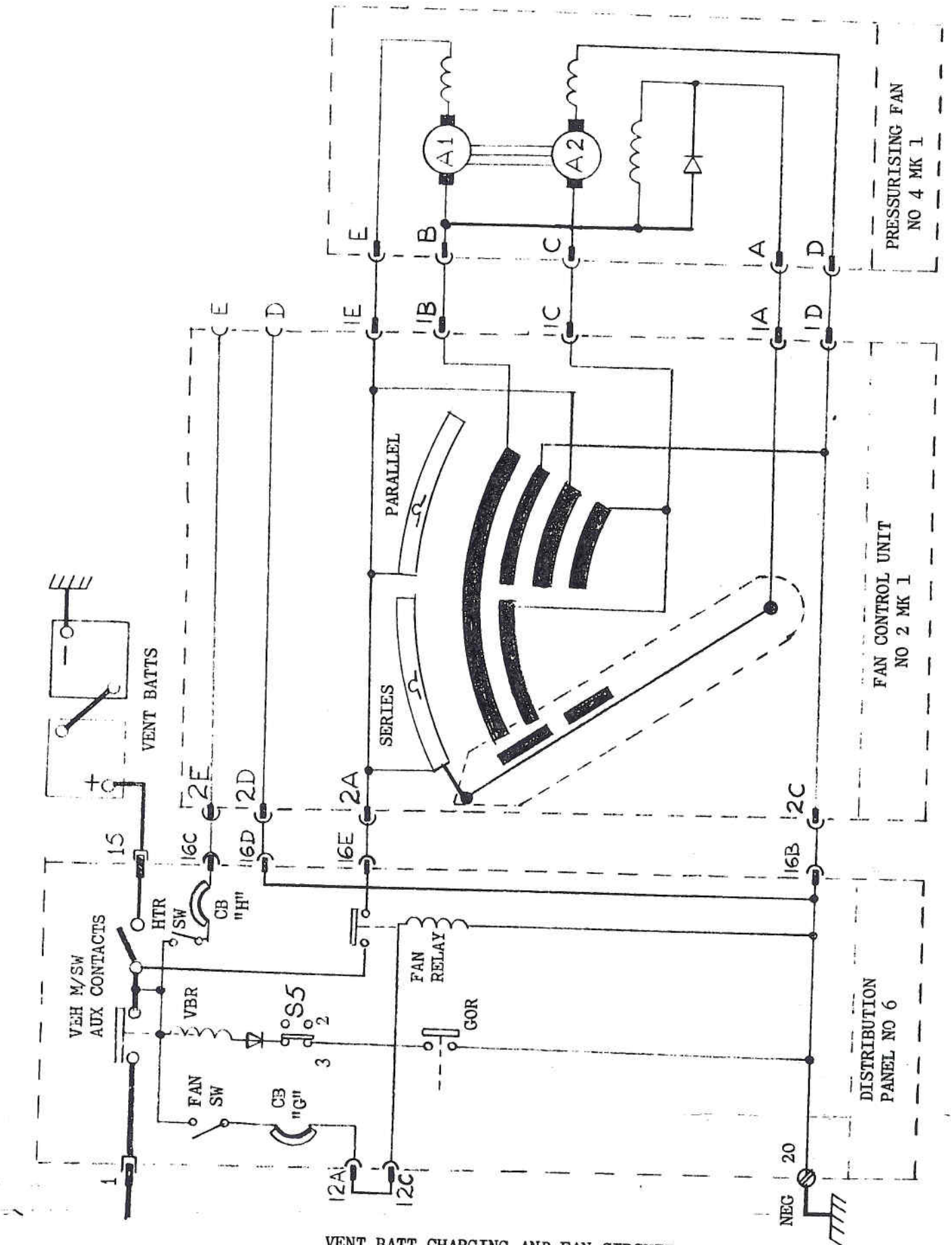


RADIO DISTRIBUTION BOX NO 1 MK 3
SHOWING EXTERNAL CHARGING SET CONNECTED

FIG 9



NBC CIRCUIT WITH DP 5 AND ACB
FIG 10



VENT BATT CHARGING AND FAN CIRCUIT
FIG 11

VENTILATING (N.B.C) EQUIPMENT

The vehicle is protected against nuclear, bacteriological and chemical fall-out by being pressurised above atmospheric pressure. This is achieved by air being drawn into the vehicle via special filters. A fan pressurising unit is provided, mounted on the RH side of the personnel compt. Provision is also made for the circulating air to be warmed or cooled depending on conditions.

On MK 2 vehicles, a 7" fan is controlled at 4 speeds by a fan controller switch, marked AC/DC, but only used in the DC positions.

On MK 2/1 vehicles, the filters are 'inboard' the vehicle, and a smaller fan is used with a wider range of speed control, using a fan controller sw. No.2 MK 1, marked 'MIN' and 'MAX' speed.

Where an Access Control Box and Dist. panel No.5 is fitted, the ventilation fan is switched on by the fan sw. and controller only, but where Dist. Panel NO.6 is fitted, the vehicle master sw. must also be on, as the fan circuit is now taken through the m/sw. auxiliary contacts.

Where a DP No 6 and 4 speed controller (No 1 Mk2) are fitted together see diagram in EMER Tkd Veh E102/2 Chapter 10 Page 104.

NOTE: The ventilation fan can be used directly from the ventilation batteries, and at the max. speed, these batteries will quickly become discharged.

VENTILATION BATTERY CHARGING

The ventilation batteries are charged from the vehicle bus-bars via a protection relay in the Dist. Panel No.5 (or Dist. Panel No.6 where fitted). The relay circuit is completed by a contact of the gen only relay when this is energised, and the relay itself requires a voltage of 18 volts to operate. This voltage is derived from the vent. batteries, hence if they are allowed to discharge below 18V, they cannot be charged from the vehicle generating system. The battery selector sw in the DP6 must be in the 3 battery position.

A rectifier in the relay cct. prevents it from operating if the vent. batteries are cross-connected.

BOILING VESSELS: can only be used

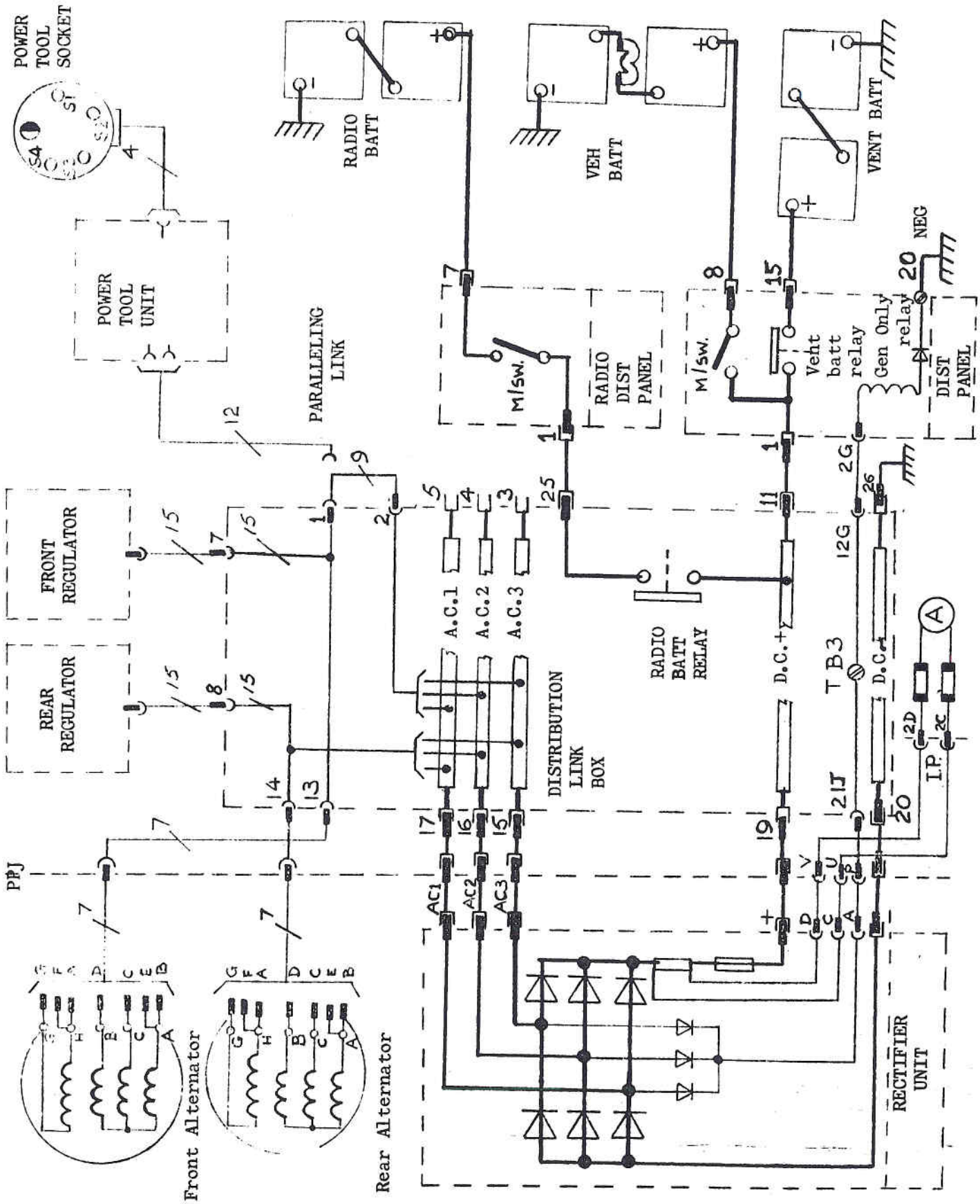
(a) when Gen Only Relay operates (see P14).

(b) if Vent Batts are correctly connected and above 18 volts.

N.B. Care must be taken to connect and disconnect Boiling Vessels using special adaptor, NOT at Dist Panel sockets. Boiling Vessel contains thermal trip, which will open cct the relay coil if the vessel runs dry and overheats.

EXTERNAL LTG SKT: Supplied from Vent Batts via Ext Ltg Sw on Dist Panel, independent of Veh M/Sw. Socket situated on Power Tool Skt, for penthouse lighting in Command Role.

FV 434 & 432 AMBULANCE: no Vent Batts fitted. A lead between RDP 8 and DP15 allows Vent Fan and Boiling Vessel relays to operate from the Radio Batts.



GENERATING SYSTEM
FIG 12

GENERATING SYSTEM

The generating system employs two alternators mounted back to back on either side of a gearbox (step-up ratio 2.95:1) driven from the engine. To achieve phase synchronisation between the two alternators, their stators and rotors are located mechanically.

The a.c. outputs of the two alternators are "paralleled" at the Distribution Link Box by means of the inter-connecting cable harness between SKT 1 and SKT 2 known as the "paralleling link". The combined a.c. output is fed to the Rectififer Unit located in the engine oil tank where it is rectified and the resultant d.c. output is fed to the D.L.B. and then to the respective Distribution Panels to supply the vehicle d.c. loads.

GEN ONLY RELAY

In addition to the main rectifiers in the rectifier unit there are three auxiliary rectifiers each fed from one phase. These provide a "Gen Only" line to operate the "Gen Only" relay in the Distribution Panel. One function of Gen Only relay is to switch off the Generator Warning Light on Engine Switchboard when alternators are running.

REGULATION

Voltage regulation is by means of two transistorised regulator panels, one for each alternator to control and d.c. output to 28.5 $\pm$ 0.5 volts.

POWER TOOLS

Provision is made for operating a.c. power tools and for this operation the "paralleling link" is broken by disconnecting the cable harness from SKT 1 on D.L.B. and connecting the mating harness from the Power Tool Unit in its place, i.e. to SKT 1. The two alternators now operate as two separate generating systems. The rear alternator continues to supply the vehicle d.c. loads up to 100A and the front alternator the Power Tool Unit and hence the Power Tool socket at the rear of the vehicle. (208V 400 Hz at 2710 r.p.m. indicated engine speed). See page 23.

BATTERY ANALOGUE

Interconnecting the two vehicle batteries is a battery analogue in which are embedded two thermal switches, a cold switch which opens at 105°F and a hot switch which closes at 120°F. The hot switchclosing changes the regulated d.c. voltage from 28.5 to 27 $\pm$ 0.5 volts. The cold switch opening switches off battery heating where this is fitted.

LOAD SHARING

A load sharing transformer, (located in the D.L.B.) is connected, to one phase of each alternator. The function of these transformers is to automatically adjust the alternator voltages so that they share the load equally.

It is important to remember that with a faulty channel connected to the system, the regulated voltage of the serviceable channel will be lower than 28.5V $\pm$ 0.5V.

FIELD CIRCUIT

The Fields of both alternators are fed from AC2 and AC3 Busbars in the DLB through the SCRs in the Regulator Panel for each Alternator.

Therefore in the Power Tool Mode, the Current for the Front Alternator Field is supplied from the AC Busbars, which are now supplied by the Rear Alternator only.

SUMMARY OF GENERATING AND CHARGING SYSTEMS

1. Radio m/sw ON, Ext CH sw OFF, RDP W/L ON, DLB W/L off.

2. Vehicle M/Sw on, press to test DLB W/L, should come on dim, relays in DLB may or may not be heard to operate.

   Release press to test DLB W/L should be off.

3. Eng sw on. Gen W/L should be on.

   At this stage RDP W/L should be on.
   Gen W/L should be on.
   DLB W/L should be off.

4. Start engine and let it idle: 780-800 rev/min. Gen only line supplied via aux. diodes in main rectifier unit.

   a. When gen. voltage reaches 16 - 18V Gen. only relay operates.

   This: (1) Disconnects the tickle voltage to both Alt. Fields

   (2) Disconnects Gen. W/L from Neg. to switch it off.

   (3) Connects to Negative the following:

   Vent Batt protection relay coil.
   RDP W/L Pos. This short circuits the lamp to switch it off.
   Boiling vessel relay coils.

5. The Vehicle Batts. should be on charge as soon as the Gen Voltage is higher than Batt Volts. No relay to operate.

   The Vent Batts should be on charge. See p19.

   The Radio Batts should be on charge. See pages 12 and 13.

6. Location of relays:

   a. Gen Only - Dist Panel.

   b. Vent Batt Protection - Dist Panel.

   c. Radio Batt. Protection Relay

      Control Circuit for this Relay including 12V Relay, 3 Diodes, DLB W/L and Resistor.

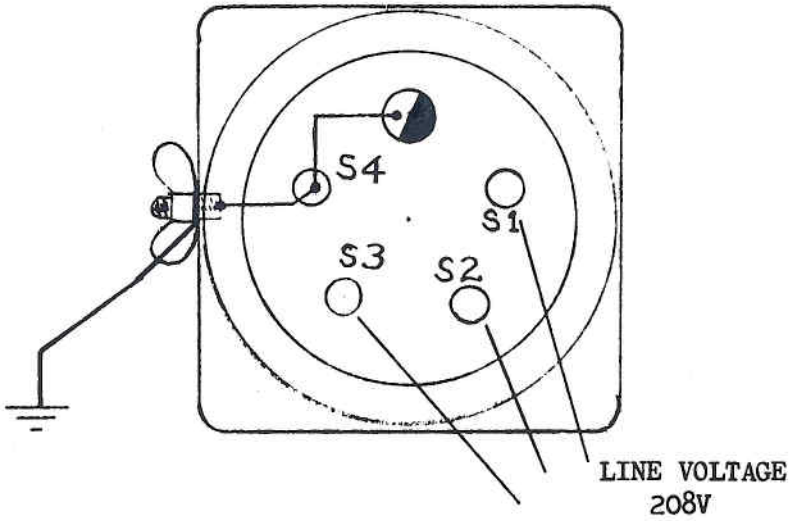
      } All in the D.L.B.

   d. Boiling vessel relays in DP.

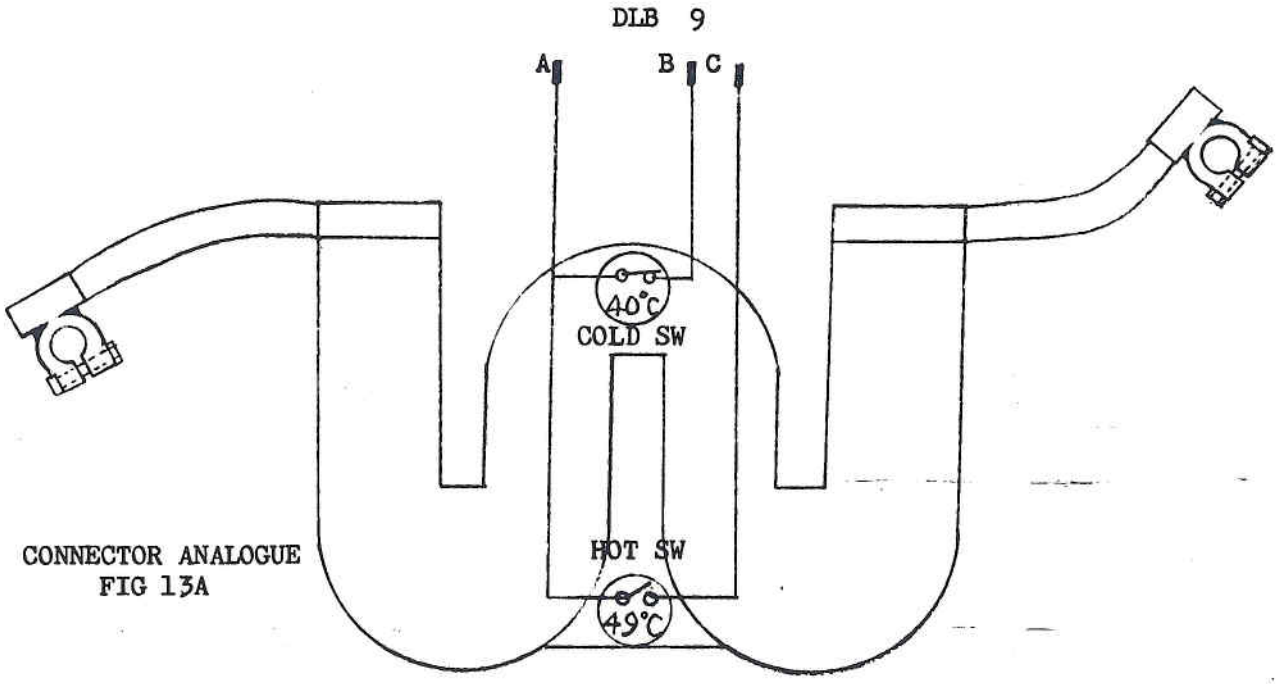
POWER TOOLS

The power tools are supplied from the front alternator, which is connected to the PTU. The engine speed for operation of these tools is 2710 rev/min. This gives a line voltage of 208V at 400 Hz at the PT SKT. Correct speed is essential to provide efficient operation and prevent damage to the power tools. In this mode the rear alternator supplies the field current for the front alternator which is controlled by the front regulator.

The line voltage produced by the front alternator is 115V which is fed to the PTU and transformed to 208V. Regulation is maintained by taking a reference voltage of 28.5V from a sensing transformer and rectifiers in the PTU.



POWER TOOL SKT
FIG 13



CONNECTOR ANALOGUE
FIG 13A

GENERATING SYSTEM FUNCTIONAL CHECK

Radio M/SW on check RDP W/L (EXT CH SW OFF)

Check DLB W/L

Veh M/SW on.

Press to test DLB W/L

Eng sw on - start engine - run at idling speed.

Check:-

- Ammeter
- Gen W/L
- R.D.P. W/L
- D.L.B. W/L

Power Tool Mode:-

Run Engine and check:-

- Ammeter
- W/LS
- Power Tool Voltage

NORMAL MODE:

Eng Stationary - Veh Batt Volts .....

Run Engine - Veh Batt Volts .....

Eng Stationary - Radio Batt Volts .....

Run Engine - Radio Batt Volts .....

Eng Stationary - Vent Batt Volts .....

Run Engine - Vent Batt Volts .....

Gen Volts 27v Check Battery Analogue.

Check External Battery Charging as necessary.

FAULT FINDING

Having carried out a functional check on the generating system, as detailed above, if any faults are found to exist, then proceed as follows:

A systematic fault finding procedure is detailed on pages 25-35, but before proceeding with these checks, carry out a harness check on the paralleling link.

NOTE: FOR ALL CHECKS WHEN ENGINE IS RUN,(EXCEPT P.T. CHECK) SPEED MUST BE 780-800 R.P.M.

COMPLETE CHARGING FAILURE (1) No ammeter reading (2) Gen. warning lamp remains ON. Engine stationary.

Note voltage at INSP. SKT. Run engine and check if voltage increases.

No

Check Alternators are rotating. Stop engine.

Disconnect front alternator harness at D.L.B. 13. front regulator at D.L.B.7
Run engine

SYSTEM COMES "ON LINE". Ammeter reads. W/L goes out

Stop engine

Check cable harnesses from D.L.B. 13 to front alternator and from D.L.B. 7 to front 'regulator'. Replace any defective harness, but also check front 'regulator' for short circuit between pins L & M.

Serviceable

Disconnect rear 'regulator' harness at 'regulator'
Connect rear 'regulator' harness to front 'regulator'
Run engine

SYSTEM FAILS TO COME 'ON LINE'
Stop engine

REPLACE FRONT 'REGULATOR'

SYSTEM COMES 'ON LINE'
Stop engine

REPLACE FRONT ALTERNATOR

Short circuit

Replace front 'regulator' and see note on P.35

SYSTEM FAILS TO COME "ON LINE"

Stop engine

See Page 26

Yes

Check mating of SKT on Rectifier Unit

System serviceable

System U/S

Check ammeter circuit from Skt to shunt

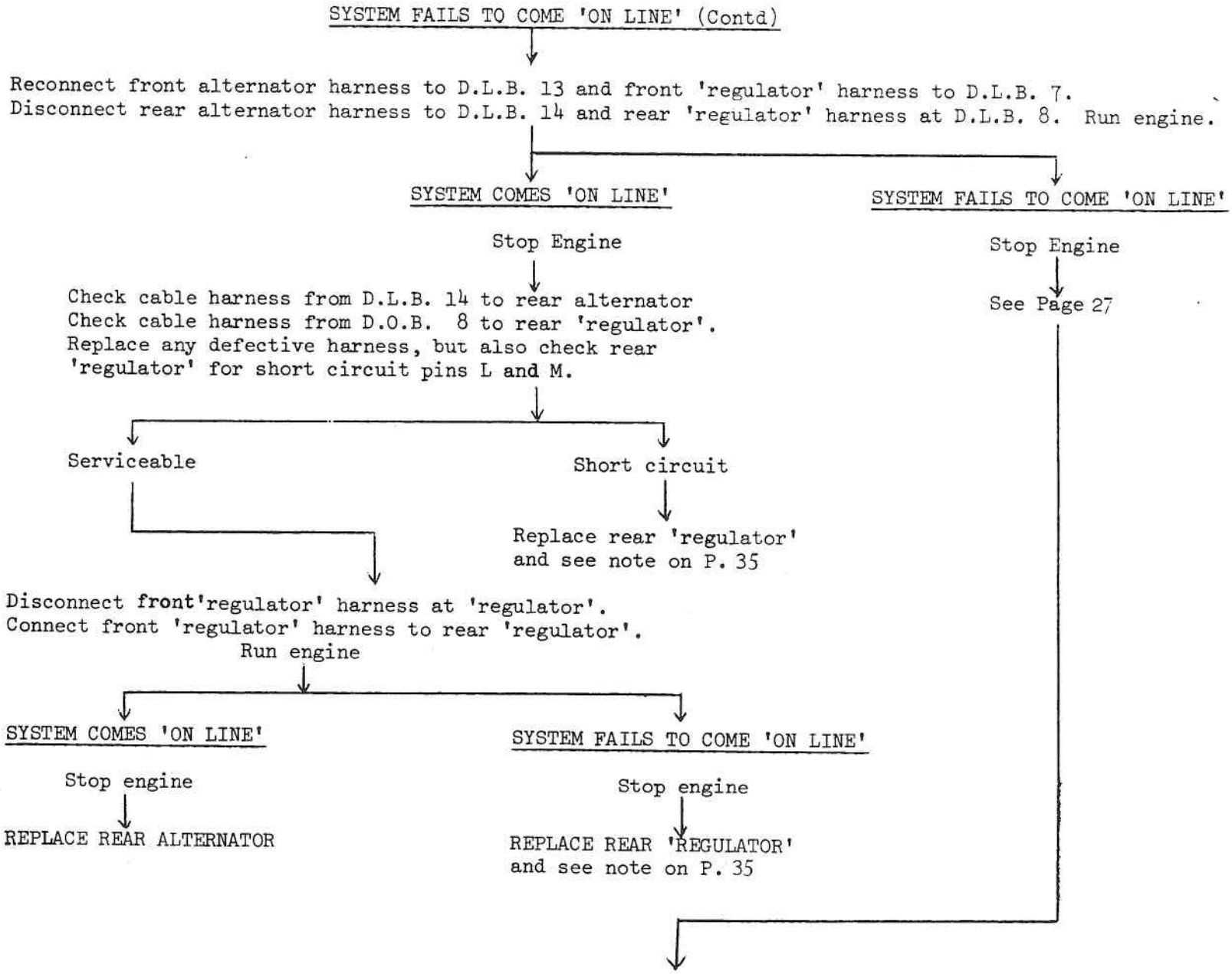
U/S Rectify

S

Check ammeter circuit from Rectifier Unit

Rectify

See Page 29 "Gen only fault


SYSTEM FAILS TO COME 'ON LINE' (Contd)
Reconnect front alternator harness to D.L.B. 13 and front 'regulator' harness to D.L.B. 7.
Disconnect rear alternator harness to D.L.B. 14 and rear 'regulator' harness at D.L.B. 8. Run engine.
SYSTEM COMES 'ON LINE'
SYSTEM FAILS TO COME 'ON LINE'
Stop Engine
Stop Engine
See Page 27
Check cable harness from D.L.B. 14 to rear alternator
Check cable harness from D.O.B. 8 to rear 'regulator'.
Replace any defective harness, but also check rear
'regulator' for short circuit pins L and M.
Serviceable
Short circuit
Replace rear 'regulator'
and see note on P. 35
Disconnect front'regulator' harness at 'regulator'.
Connect front 'regulator' harness to rear 'regulator'.
Run engine
SYSTEM COMES 'ON LINE'
SYSTEM FAILS TO COME 'ON LINE'
Stop engine
Stop engine
REPLACE REAR ALTERNATOR
REPLACE REAR 'REGULATOR'
and see note on P. 35

SYSTEM FAILS TO COME 'ON LINE' (Contd)

Check 'Paralleling Link' for short circuits. If unserviceable, replace link, and see note on P.35
If serviceable

↓

Check main rectifiers in Rectifier Unit. If unserviceable, rectify fault and see note on P.35
If serviceable

↓

Disconnect D.L.B.13 and D.L.B.7. Check D.L.B. for short circuits between phase lines.
If unserviceable, rectify fault and see note on P.35

↓

If, after carrying out the above checks, no fault is dianosed, then A FAULT EXISTS ON EACH CHARGING CHANNEL

↓

Check harnesses: D.L.B.7 to front 'regulator'. D.L.B.8 to rear 'regulator'. D.L.B.13 to front alternator. D.L.B.14 to rear alternator. If a harness is found defective, replace, and see note on P. 35. If serviceable, reconnect all harnesses except at P P Junction.

↓

Connect rear alternator harness from D.L.B.14 to front alternator output socket at P P Junction
Run engine.

↓

SYSTEM COMES 'ON LINE'

Stop engine

↓

REPLACE FRONT 'REGULATOR' AND REAR ALTERNATOR

SYSTEM FAILS TO COME 'ON LINE'

Stop engine

↓

See page 28

↓

SYSTEM FAILS TO COME 'ON LINE' (Contd)

Disconnect rear alternator harness from front alternator socket at P.P. junction.
Connect front alternator harness to rear alternator socket at P.P. junction.
Run engine

SYSTEM COMES 'ON LINE'

Stop engine
Replace front alternator
and rear 'regulator'

SYSTEM FAILS TO COME 'ON LINE'

Stop engine

Reconnect rear alternator harness to correct socket at P.P. junction.
Connect a known serviceable 'regulator' to rear 'regulator' harness.
Run engine.

SYSTEM COMES 'ON LINE'

Stop engine

REPLACE REAR 'REGULATOR'
and see note on P 35.

SYSTEM FAILS TO COME 'ON LINE'

Stop engine

REPLACE REAR ALTERNATOR

Connect up original rear 'regulator'
Run engine

SYSTEM COMES 'ON LINE'

Rear charging system is serviceable.

Proceed under action of "Low Power Tool Output"

(see page 31)

SYSTEM FAILS TO COME 'ON LINE'

Replace rear 'regulator'
and see note on P.35

'GENERATOR ONLY' FAULT

Indicated by (1) Ammeter shows reading
(2) Gen. warning lamp remains 'ON'

↓

Run engine, and check D.L.B. W/L is on dim

D.L.B. W/L DOES NOT LIGHT

CHECK VOLTAGE AT TB.3.12G.

UNDER 16v

↓

Stop engine

↓

Check line from T.B.3 to outlet plug (pin A) on REctifier Unit, for open circuit, high resistance, or short circuit.
If serviceable

↓

Reconnect plug at Rectifier Unit

↓

Measure forward resistance (30 ohms approx) and reverse resistance (above 10,000 ohms) of auxiliary rectifiers, from D.L.B.21 (pin J) and AC1, AC2 and AC3 at D.L.B. or P.P. junction.

OVER 16v

STOP ENGINE
REPAIR W/L CCT

D.L.B, W/L LIGHTS

Stop engine

↓

Disconnect D.L.B.12 & measure resistance from 12G to T.B.3; should be zero ohms.
If serviceable

↓

Measure resistance between pin 12G on harness and negative (125 ohms)

RESISTANCE IS 125 Ohms

↓

Likely faults:-
a. 'Gen only' relay contacts 'sticking' in closed position.
b. Gen. warning lamp is finding a false negative.

RESISTANCE IS NOT 125 ohms

Fault is in relay circuit from D.L.B.12 into the Distribution Panel

↓

NB. There is a rectifier in series with the relay coil, so an incorrectly connected ohmmeter will show excess of 10,000 ohms even if circuit is correct.

CHARGING FAULT

Indicated by (1) Ammeter reads zero
(2) Gen. warning lamp goes off

↓

Check battery voltage at Inspection Socket and note value

↓

Run engine, and note voltage again at Inspection Socket

VOLTAGE EXCEEDS BATTERY VOLTS

Stop engine

↓

Check ammeter circuit from Rectifier Unit to Instrument Panel by disconnecting harness at Rectifier Unit and Inst. Panel Socket 2. If serviceable

↓

Measure resistance between pins C and D at Rectifier Unit outlet socket

RESISTANCE IS ZERO Ohms

Check ammeter and circuit within Inst Panel.

If serviceable

↓

A SHORT CIRCUIT EXISTS BETWEEN PINS C AND D IN RECTIFIER UNIT.
Rectify fault and see Note on P.35

OHMMETER SHOWS A HIGH RESISTANCE OR OPEN CIRCUIT

↓

FAULT IS INSIDE RECTIFIER UNIT
Rectify fault and see note on P.35

VOLTAGE REMAINS AT BATTERY VOLTS

Stop engine

↓

Check main fuse on Rectifier Unit
If serviceable

↓

Check main rectifiers for forward resistance (30 ohms) and reverse resistance (above 10,000 ohms) between DC+ and AC 1, AC 2, and AC 3 at D.L.B. or P.P. Junction for the positive rectifiers, and between DC- and AC 1, AC 2 and AC 3 for the negative rectifiers.

Having rectified any faults, see Note on P. 35

ONE CHARGING CHANNEL FAILS TO COME 'ON LINE'

This fault is only likely to be noticed when in the Power Tool Mode
Indicated by:

LOW POWER TOOL OUTPUT (FRONT CHARGING CHANNEL FAILS)

Stop engine

↓

Connect up 'Paralleling Link' for normal d.c. mode of operation. (If in power tool mode)

↓

Disconnect at D.L.B. 14 and D.L.B. 8

Run engine

↓

See Page 34

NO AMMETER READING AND LOW POWER TOOL OUTPUT (REAR CHARGING CHANNEL FAILS)

Stop engine

↓

Connect up 'Paralleling Link' for normal dc. mode of operation. (If in power tool mode).

↓

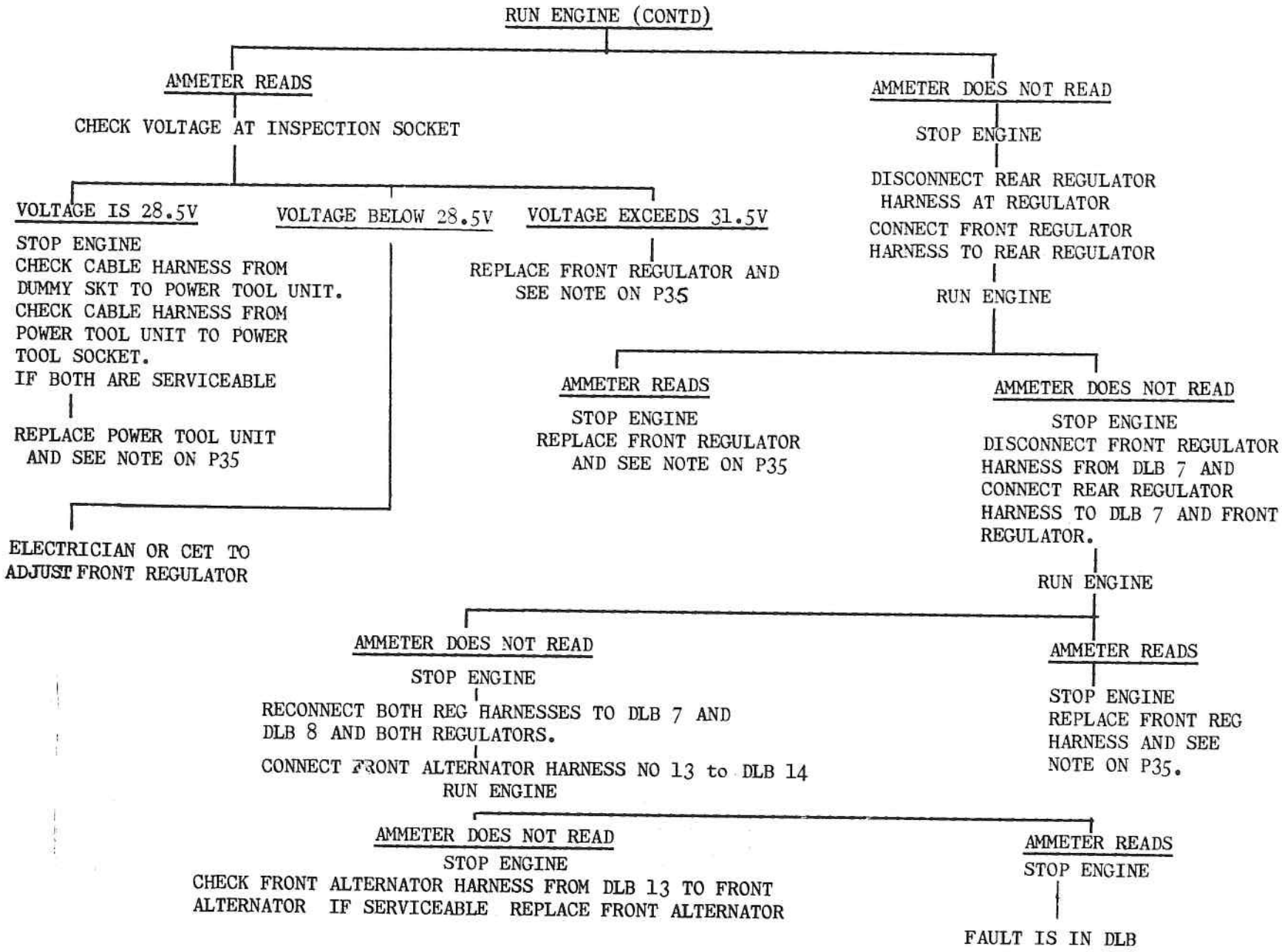
Disconnect at D.L.B. 13 and D.L.B. 7

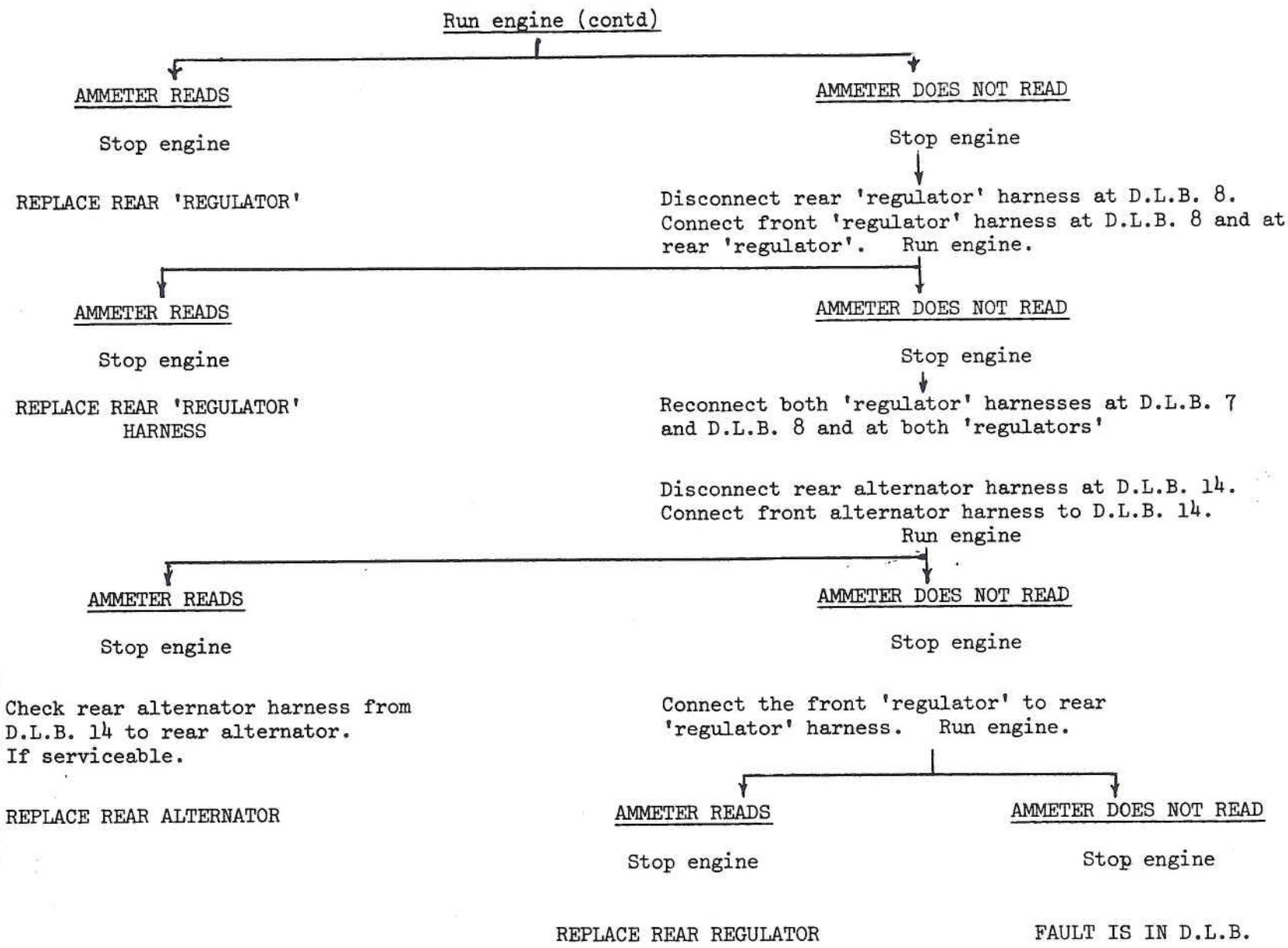
↓

Disconnect rear 'regulator' harness at 'regulator' and connect this harness to front 'regulator'

↓

See Page 33


RUN ENGINE (CONTD)
AMMETER READS
CHECK VOLTAGE AT INSPECTION SOCKET
VOLTAGE IS 28.5V
STOP ENGINE
CHECK CABLE HARNESS FROM DUMMY SKT TO POWER TOOL UNIT.
CHECK CABLE HARNESS FROM POWER TOOL UNIT TO POWER TOOL SOCKET.
IF BOTH ARE SERVICEABLE
REPLACE POWER TOOL UNIT AND SEE NOTE ON P35
VOLTAGE BELOW 28.5V
ELECTRICIAN OR CET TO ADJUST FRONT REGULATOR
VOLTAGE EXCEEDS 31.5V
REPLACE FRONT REGULATOR AND SEE NOTE ON P35
AMMETER DOES NOT READ
STOP ENGINE
DISCONNECT REAR REGULATOR HARNESS AT REGULATOR
CONNECT FRONT REGULATOR HARNESS TO REAR REGULATOR
RUN ENGINE
AMMETER READS
STOP ENGINE
REPLACE FRONT REGULATOR AND SEE NOTE ON P35
AMMETER DOES NOT READ
STOP ENGINE
DISCONNECT FRONT REGULATOR HARNESS FROM DLB 7 AND CONNECT REAR REGULATOR HARNESS TO DLB 7 AND FRONT REGULATOR.
RUN ENGINE
AMMETER DOES NOT READ
STOP ENGINE
RECONNECT BOTH REG HARNESSES TO DLB 7 AND DLB 8 AND BOTH REGULATORS.
CONNECT FRONT ALTERNATOR HARNESS NO 13 to DLB 14
RUN ENGINE
AMMETER DOES NOT READ
STOP ENGINE
CHECK FRONT ALTERNATOR HARNESS FROM DLB 13 TO FRONT ALTERNATOR IF SERVICEABLE REPLACE FRONT ALTERNATOR
AMMETER READS
STOP ENGINE
FAULT IS IN DLB
AMMETER READS
STOP ENGINE
REPLACE FRONT REG HARNESS AND SEE NOTE ON P35.


Run engine (contd)
AMMETER READS
Stop engine
REPLACE REAR 'REGULATOR'
AMMETER DOES NOT READ
Stop engine
Disconnect rear 'regulator' harness at D.L.B. 8.
Connect front 'regulator' harness at D.L.B. 8 and at rear 'regulator'. Run engine.
AMMETER READS
Stop engine
REPLACE REAR 'REGULATOR' HARNESS
AMMETER DOES NOT READ
Stop engine
Reconnect both 'regulator' harnesses at D.L.B. 7 and D.L.B. 8 and at both 'regulators'
Disconnect rear alternator harness at D.L.B. 14.
Connect front alternator harness to D.L.B. 14.
Run engine
AMMETER READS
Stop engine
Check rear alternator harness from D.L.B. 14 to rear alternator.
If serviceable.
REPLACE REAR ALTERNATOR
AMMETER DOES NOT READ
Stop engine
Connect the front 'regulator' to rear 'regulator' harness. Run engine.
AMMETER READS
Stop engine
REPLACE REAR REGULATOR
AMMETER DOES NOT READ
Stop engine
FAULT IS IN D.L.B.

INCORRECT LINE VOLTAGE

INDICATED BY (1) BATTERIES OVERHEATING, (2) CONTINUALLY "FLAT" BATTERIES, (3) LOW AMMETER READING

RUN ENGINE

CHECK VOLTAGE AT INSPECTION SOCKET ON DIST PANEL

CORRECT VOLTAGE 28.5V ± 0.5V (OR 27 ± 0.5V IF ANALOGUE HOT SW IS CLOSED

CORRECT VOLTAGE

STOP ENGINE.
CHECK BATTERIES
AND CONNECTIONS

INCORRECT VOLTAGE

STOP ENGINE

DISCONNECT BATT ANALOGUE HARNESS AT DLB 9

RUN ENGINE AND CHECK VOLTAGE AT INSPECTION SOCKET

OVER 31.5V

INCORRECT VOLTAGE

STOP ENGINE

DISCONNECT FRONT ALTERNATOR AT DLB 13
AND FRONT REGULATOR AT DLB 7

CORRECT VOLTAGE

FAULTY HOT SWITCH
IF TEMP IS BELOW 120°F
REPLACE ANALOGUE.

RUN ENGINE AND CHECK VOLTAGE AT INSP SKT

VOLTAGE IS 28.5V ± 0.5V

STOP ENGINE

FAULT IN FRONT CHANNEL
SEE P31
(ONE CHANNEL FAILURE)
RECONNECT DLB 13 & 7

VOLTAGE EXCEEDS 31.5V

STOP ENGINE

REPLACE REAR REGULATOR
AND SEE NOTE ON P35

VOLTAGE IS BETWEEN 25-31.5V (But incorrect)

STOP ENGINE

ELECTRICIAN OR CET
SHOULD ADJUST REAR
REGULATOR AND SEE
NOTE ON P35

VOLTAGE DOES NOT RISE

FAULT IN REAR
CHANNEL SEE P31
(ONE CHANNEL FAILURE)

Stop engine (Contd)

↓

Reconnect front alternator to D.L.B.13 and front 'regulator' to D.L.B. 7
Disconnect rear alternator at D.L.B.14 and rear 'regulator' at D.L.B. 8

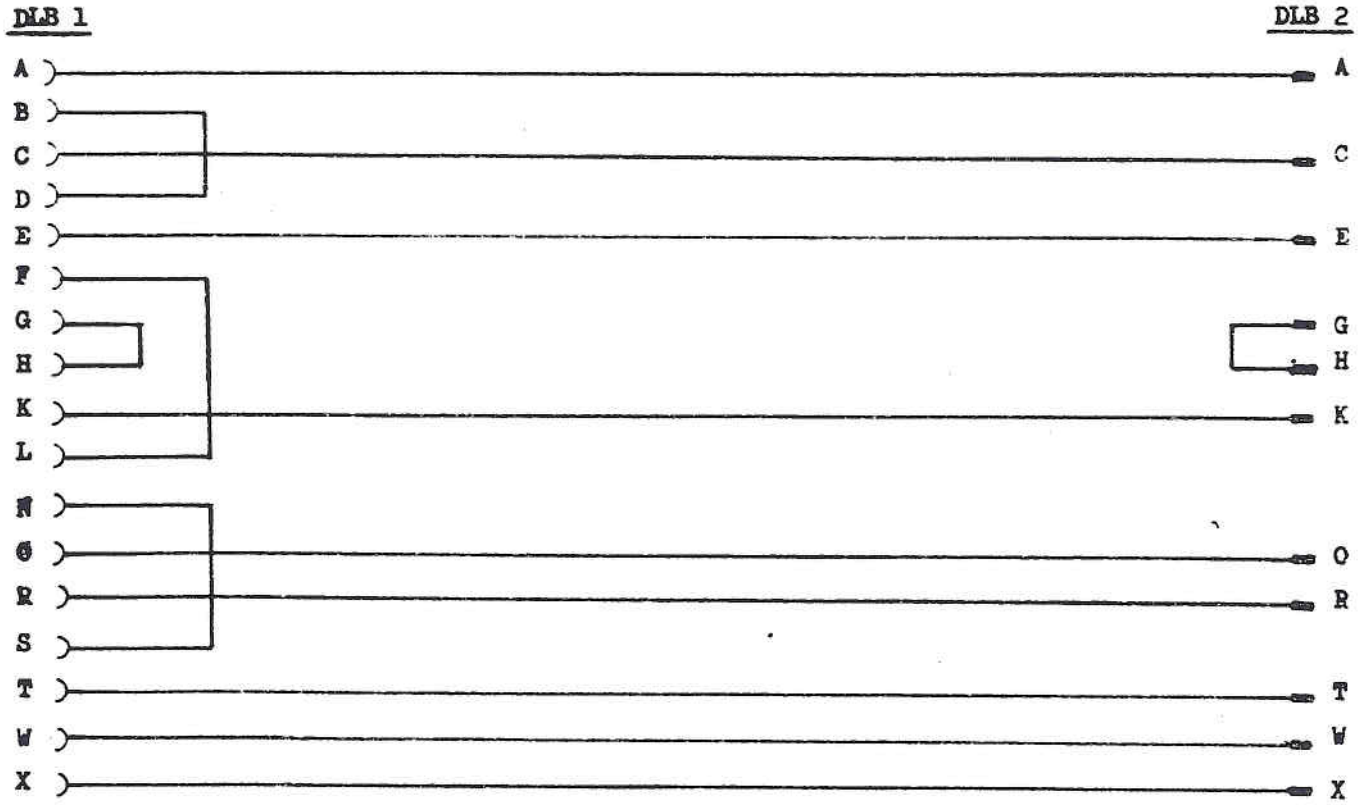
↓

Run engine. Check voltage at Inspection Socket

VOLTAGE EXCEEDS 31.5 VOLTS OR BELOW 25 VOLTS	VOLTAGE BETWEEN 25 - 31.5 VOLTS
Stop engine	Stop engine
↓	↓
REPLACE FRONT 'REGULATOR' and see Note below.	Electrician or Control Equipment Technician should ADJUST FRONT 'REGULATOR' and see Note below

---

NOTE: Where a defective component or harness has been diagnosed, and rectified, it is essential that each individual charging channel is separately checked, by leaving the other channel disconnected at the D.L.B. and running the engine. Should a further fault exist, this will be diagnosed by referring to Page 31 "ONE CHARGING CHANNEL FAILS TO COME ON LINE". N.B. It is not now necessary to connect up for Power Tool Mode.



PARALLELING LINK

FIG 14

FIRE WIRE SYSTEM - OPERATION refer to Fig 15

1. Supply to the F.W.C.B. is provided as soon as the vehicle batteries are connected to the vehicle system.

2. This supply does not pass through the vehicle master switch.

3. In the F.W.C.B. this supply sub-divided - one line being taken to one of 2 normally open relay contacts, and the other line via a polarity sensing diode to a transistorised component known as an oscillator.

4. The D.C. pos line taken to one contact of a relay will provide supply to a fire alarm horn when the relay contact closes (the relay energises under overheat or test conditions).

5. The D.C. pos line into the transistorised oscillator causes oscillator action which results in continuous AC output from the oscillator to supply the fire wire/detector loop. The fire wire/detector loop is fed from two paralleled output plugs on the F.W.C.B. so that supply to fire wire is maintained in event of one supply line becoming open circuit.

6. With vehicle master switch 'ON' another 24v DC + line from vehicle batteries is connected to another contact (normally open) of the relay - and this is taken to the flasher unit and warning lamps in the dvr's and personnel compt in the vehicle when relay operates under overheat or test conditions.

7. Under normal operating temperature conditions the impedance of the fire wire/detector loop is high - and the current drawn by it from the oscillator is not sufficient to energise the fire alarm system.

8. The relay coil is supplied from the oscillator via a S.C.R. and with 'normal' currents from oscillator to fire wire loop the PD developed across a resistor in series with fire wire is insufficient to trigger S.C.R. - and with SCR non conducting, the relay coil does not energise and relay contacts remain open, hence no alarm horn or flashing warning lamps operate.

9. With localised intense or overall overheat conditions the capacitance of the fire wire/detector loop increases and its impedance decreases. Consequently the current it now takes from the oscillator increases. At some critical temperature the current is large enough to provide the requisite PD to be developed across the SCR gate and anode electrodes to trigger the SCR. When this occurs the SCR conducts, acting as a half wave rectifier, and causes the relay coil to energise. A slugging capacitor in parallel with the relay coil maintains relay coil energisation during non-conducting half cycle.

10. With relay coil energised, 3 sets of relay contacts close 1st set of contacts now supply 24v DC to fire alarm horn, 2nd set of contacts supplies 24v DC to flasher unit and lights if vehicle master switch closed. 3rd set of contacts short out a resistor in series with fire wire detector loop. This ensures alarm continues to operate until temperature has fallen to lower than initiating value.

11. Feed back capacitors (not shown in diagram) in F.W.C.B. pass interference signals generated by alarm horn into vehicle intercom system to give additional method of warning.

12. In event of an open circuit occurring in fire wire/detector loop system will still operate and warn in actual overheat conditions.

13. TEST FACILITY

a. A test sw is located on F.W.C.B. When this is operated it disconnects one end of the F.W. from the AC supply and at the same time inserts a capacitor in parallel with the F.W. at its disconnected end - the effect being to increase the capacitance of the system and consequent increase in current to trigger the S.C.R.

b. If fire wire loop is continuous, alarm horn will sound and lights flash if m/s on.

c. Failure of horn to sound under test conditions normally indicates open circuit fire wire detector loop (but other faults could also give this symptom).

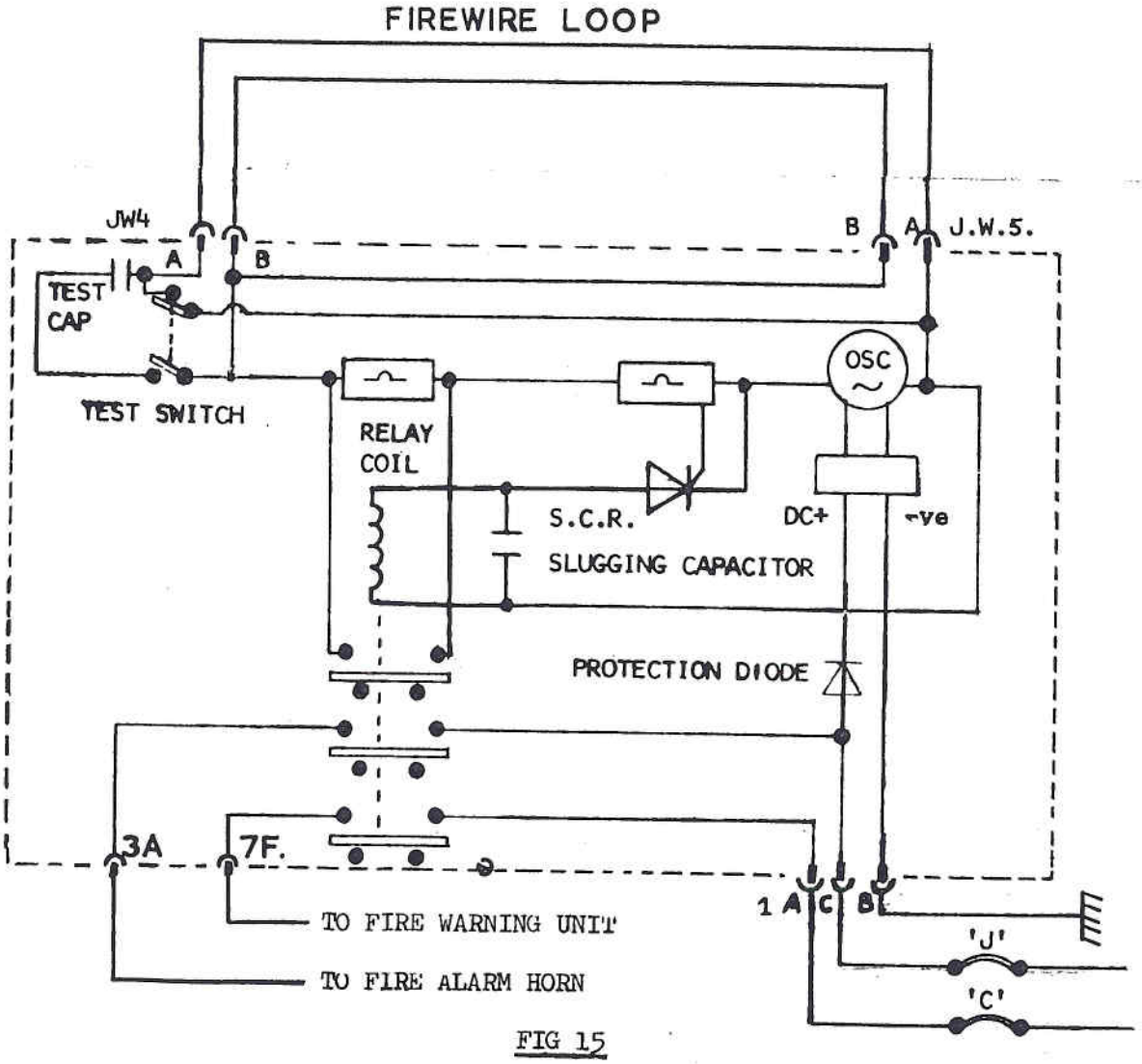


FIG 15

FIRE ALARM SYSTEM - INSTALLATION AND FAULT FINDING

The system consists of a Graviner Firewire, which loops around the transmission compartment and also around the power pack, a Firewire Control Box, a fire alarm horn, and two flashing type warning lamps.

The fire detecting system is always "live" provided the vehicle batteries are connected. Often a slight hum may be heard from the Firewire Control Box when connected to the vehicle batteries, but the absence of hum does not necessarily mean that there is no D.C. supply to the FWCB. With veh m/sw OFF, only the horn will sound, when system operates with m/sw ON, warning lamps will also 'flash'.

Housed on the Control Box is a test switch, which tests the complete system, provided the m/sw is ON. In the event of a broken or disconnected Firewire element, the system will not operate in the 'test' condition.

Other faults in the firewire loop or associated circuitry may cause the alarm system to continue operating after the Test Switch has been released. The D.C. supply must be disconnected in order to stop the horn sounding when this occurs, and is achieved by "tripping" circuit breaker 'J' in the DP No 6 or removing fuse 'F' in the DP No 5.

Care must be taken not to crush or sharply bend the firewire. All connections must be clean and tight, to prevent the ingress of moisture, as this can cause false warning. The connections should be cleaned with C.T.C. or 'TRICO'. After work on the power pack or transmission compartment, the system should always be tested for operation.

FAULT FINDING

If system fails to warn when test switch is operated, check supply fuse F or cct bkr J in Dist Panel. If serviceable, remove connectors JW4 and JW5 from control box, measure a.c. voltage output between pins A and B at each outlet.

a. NO VOLTAGE, box does not buzz:

Check supply into Control Box (24v D.C.) at JW1.

(1) If incorrect voltage, check cable harness from Dist Panel to Control Box. If serviceable, fault is inside Dist Panel.

(2) If correct voltage, replace Control Box.

b. NO VOLTAGE, box does buzz: replace Control Box.

c. INCORRECT VOLTAGE - replace with serviceable control box and retest.

d. CORRECT VOLTAGE, nominal 3.9V A.C. measured with AVO set to correct scale, ie: 10V scale on model 7, 9V scale on model 12.

Either 3.9V or 6.5V will be indicated on model 12 AVO.

(1) Check continuity of Firewire harness between A of JW4 and JW5, this should read approx 130 ohms. If incorrect, individual sections of Firewire harness must be checked. Inner conductor 2-3 ohms/ft.

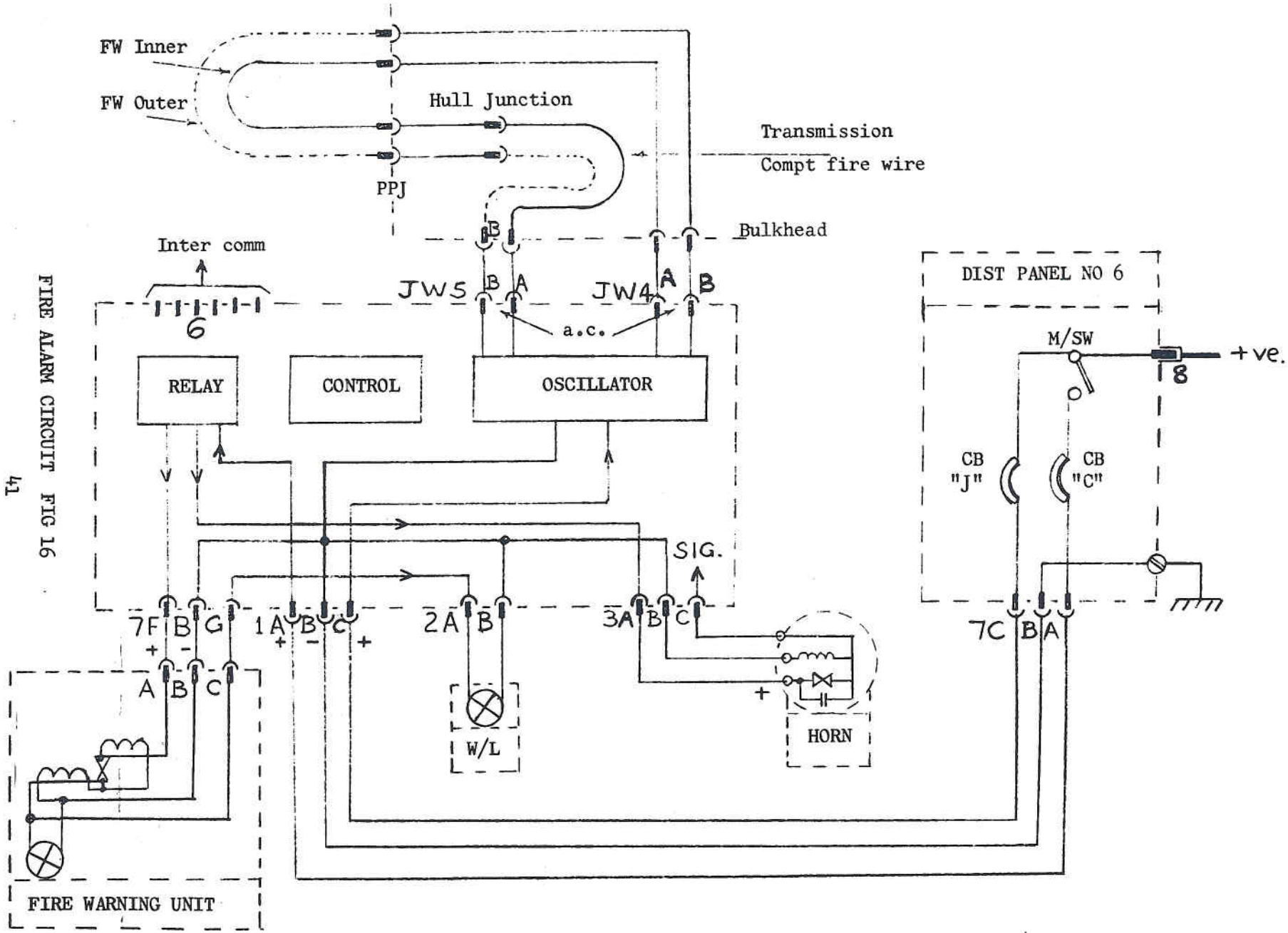
/(2) ...

(2) If 130 ohms, check continuity of Firewire harness outer conductor between JW4 and JW5 pins B, should read 0 ohms. If incorrect check individual sections.

(3) If (1) and (2) are correct, check insulation of Firewire harness between JW4 pins A and B, ensuring JW5 is also disconnected. Using a 500V megger, an insulation of 1M ohm or above is correct. If below 1M ohm, check insulation of individual elements, which should each be above 20M ohms.

e. <u>If all Firewire checks are correct</u>, fire alarm horn and fire warning unit circuits must be checked, and if correct, replace Control Box.

f. If alarm continues after test switch is released, then a fault condition exists in either the FWBC or in the FW loop (or in both components), and a complete check of the FW loop as detailed in d. Tests a, b and c will indicate whether or not the FW loop is/is not at fault. If the firewire loop is serviceable, then the fault exists in the FWBC.



FIRE ALARM CIRCUIT FIG 16

INTERIOR LIGHTING (Diagram EMER TKD VEH E103/2 CH 9 P.91)

Provided by six lamps of the combined switch and dimmer type. Switched on by SW2 on the Anx. Junction Box or by blackout switch. For normal working, SW2 is left on, but under blackout conditions, SW2 is left off, and the blackout switch controls the lights i.e. when rear vehicle door is opened, lights are off. Provision is also made for the fitting of fluorescent lights when a vehicle is required as a Command Post.

EXTERIOR LIGHTING (Diagram EMER TKD VEH E103/2 CH 9 Ps 90-91)

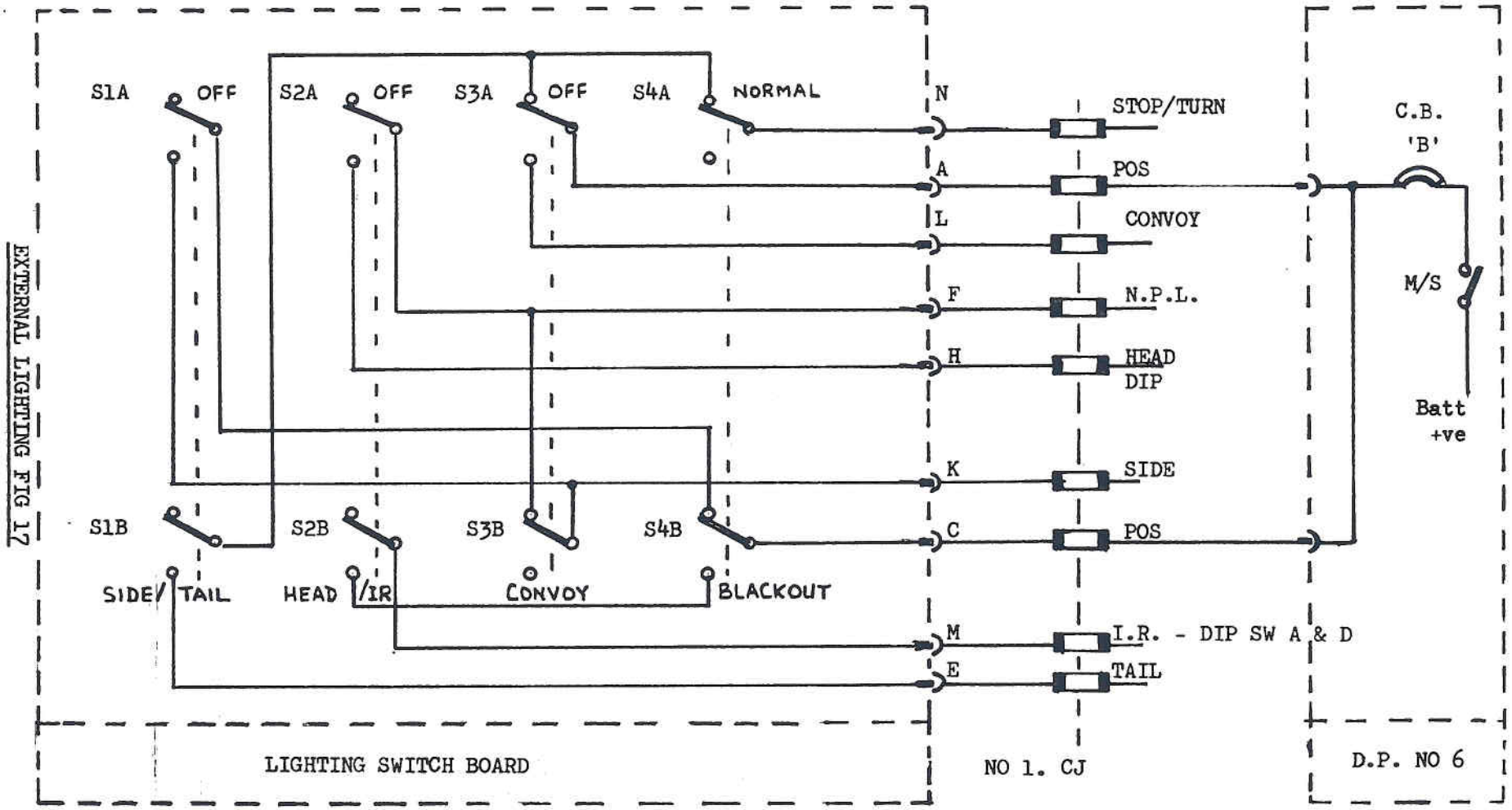
The exterior lighting is fed from the automotive batteries via cct.bkr. 'B' (15A) in the dist panel, and through No 1 connector junction. In addition the rear lights are supplied via No 2 con junct. The number plate and convoy lights are also supplied via contacts on the rear door, see EMER TKD VEH E102/2 CH 10 P57.

The switch board comprises four double pole two way switches. The switching arrangement is shown below.

Switches				*Lights*						
Blackout	*Tail Side*	*Head IR*	*Convoy*	*Tail*	*Side*	*Head*	*Registration Plate*	*Convoy*	*IR*	*Turn and Stop*
NORMAL WORKING (Convoy sw up. BO sw up to normal)										
OFF	OFF	OFF	OFF	-	-	-	-	-	-	OPERATIVE
OFF	ON	OFF	OFF	ON	ON	-	ON	-	-	OPERATIVE
OFF	ON	ON	OFF	ON	ON	ON	ON	-	-	OPERATIVE
CONVOY WORKING (Convoy sw down. BO sw up to normal)										
OFF	OFF	OFF	ON	-	-	-	-	ON	-	-
OFF	ON	OFF	ON	-	ON	-	-	ON	-	-
BLACKOUT WORKING (BO switch down to blackout)										
ON	OFF	OFF	OFF	-	-	-	-	-	-	-
ON	OFF	OFF	ON	-	-	-	-	ON	-	-
ON	ON	OFF	OFF	ON	-	-	-	-	-	-
ON	OFF	ON	OFF	-	-	-	-	-	ON	-
ON	ON	ON	OFF	ON	-	-	-	-	ON	-
ON	OFF	ON	ON	-	-	-	-	ON	ON	-

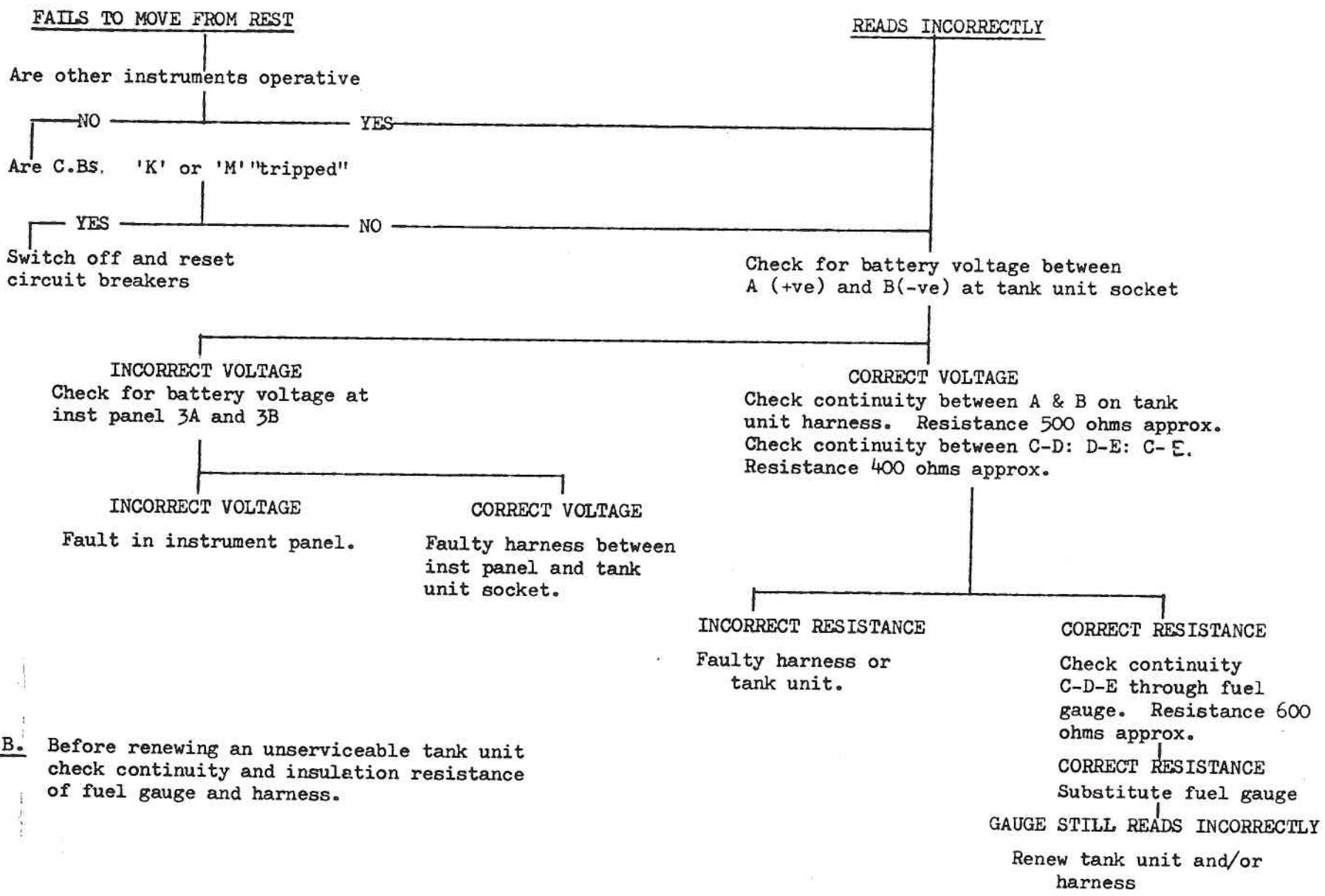
Switch positions not indicated in the table are inoperative

EXTERNAL LIGHTING FIG 17



S1 - SIDE & TAIL
S2 - HEAD/I.R.
S3 - CONVOY
S4 - NORMAL/BLACKOUT

FUEL GAUGE



N.B. Before renewing an unserviceable tank unit check continuity and insulation resistance of fuel gauge and harness.

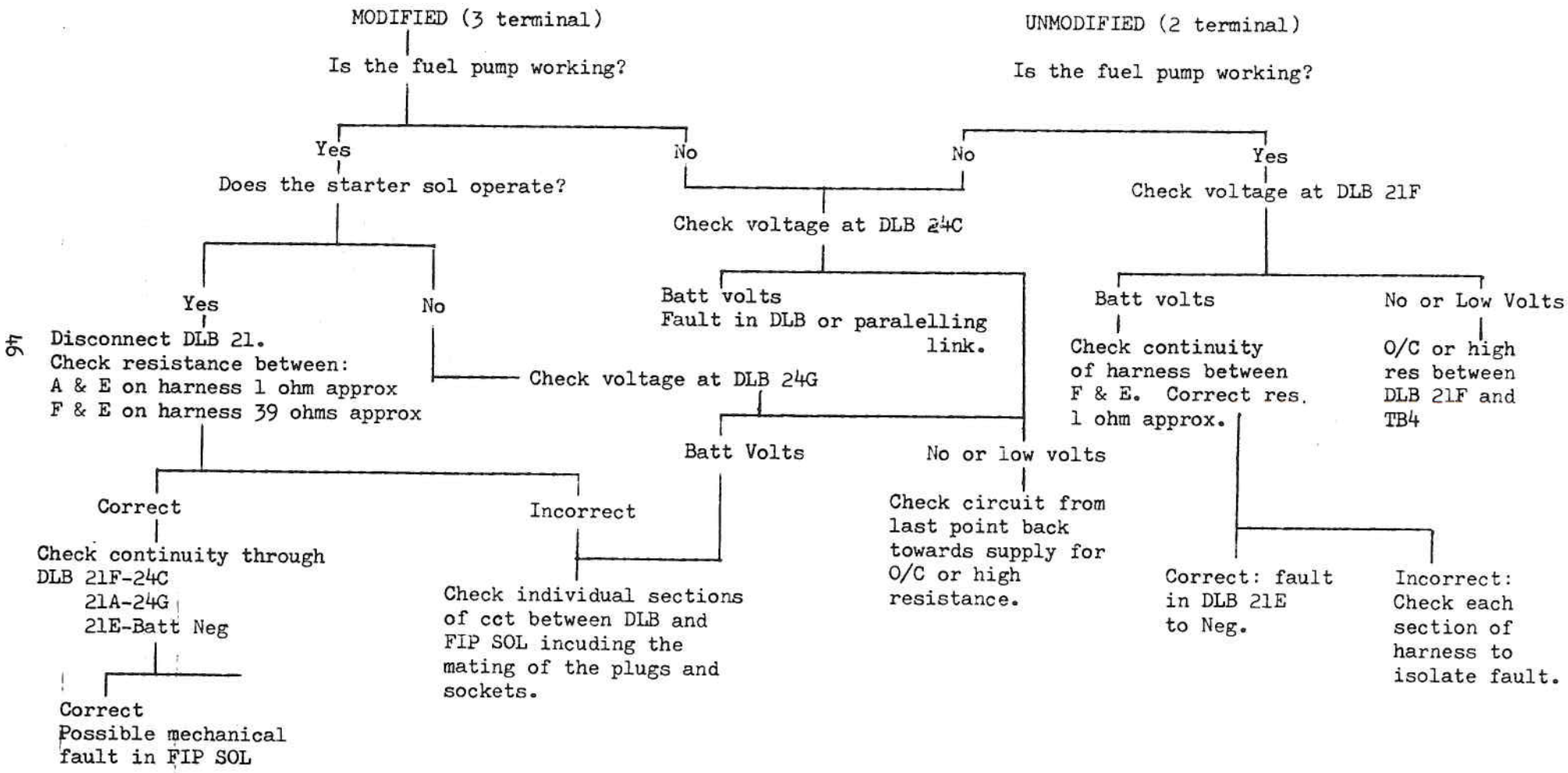
STARTER MOTOR FAULT FINDING

STARTER MOTOR FAILS TO TURN THE ENGINE (FIRST READ NOTE ON P.11)

- Starter solenoid is heard to operate
  - CORRECT SOLENOID CURRENT (3.5A approx)
    - M/Sw OFF. Remove DC +ve and DC -ve at P.P.J. and reconnect having wrapped flexible leads on the "Southdown" Connectors. Measure voltage on these leads with M/Sw ON. Attempt to start the engine.
      - VOLTAGE REMAINS CONSTANT — Remove pack and check leads and/or starter motor.
      - 15-19 VOLTS — Check for volt drop before PPJ. If correct remove pack and check starter motor.
      - VOLTAGE FALLS WELL BELOW 15v — Check volt drop before P.P.J. back to supply.
    - NO SOLENOID CURRENT — O/C between engine J.B. and NEG via starter motor.
  - BATTERY VOLTAGE — Check solenoid current at engine junction box. N.B. Ensure FIP SOL is isolated if it is a modified type.
  - NO OR LOW VOLTAGE — O/C or high resistance between engine junction box and D.L.B. 24G. Check continuity of individual harnesses.
- Starter solenoid is not heard to operate
  - Check voltage at D.L.B. 24G with apprp appropriate switches on.
    - BATTERY VOLTAGE — Check voltage at terminal 'A' in engine junction box.
    - NO OR LOW VOLTAGE — O/C or high resistance before test point. Check continuity of circuit back towards supply.

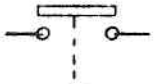
FIP. SOL. FAULT FINDING

Before fault finding on the FIP SOL circuit, establish whether it is of the modified type. (See P.4).



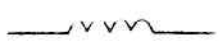
SYMBOLS USED IN THIS PRECIS

Switch 

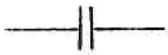
Relay 

Circuit breaker 

Chassis connection 

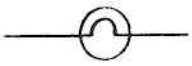
Winding (shunt) 

Winding (series) 

Capacitor 

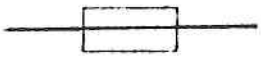
Snap connector 

Warning lamp 

Lamp filament 

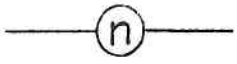
Break and make switch 

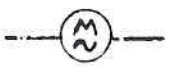
Resistor 

Fuse 

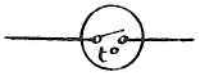
Ammeter Shunt 

Meter (ammeter) 

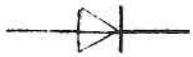
Meter (tachometer) 

Motor d.c.  a.c. 

Generator d.c.  a.c. 

Thermal switch 

Plug and socket 

Diode 

SCR 

Choke 

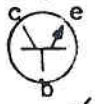
Carbon pile 

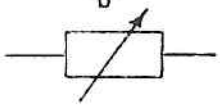
Zener 

Thermal magnetic cct breaker 

Southdown connector 

Transistor PNP 

Transistor NPN 

Resistor variable 

Conductor connections:

a. junction 

b. common point 

c. no connection 

Earth