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LOCOMOTIVES 138-193
CLASS 46

C.M.E.E. DEPT.
PADDINGTON

BRITISH RAILWAYS (WESTERN REGION)

C.M. & E.E. DEPARTMENT

PADDINGTON

Locomotives 138-193 Class 46.
2,500 H.P. Diesel Electric (1 Co-Co 1).

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10. Drivers' Safety Device (Vigilance).
Complete Locomotive Electrical Schematic.

SEQUENCE OF OPERATION

CIRCUIT DESCRIPTION

The following information describes the operating sequence and the effect upon the control circuits and ancillary systems when the engine is started and the locomotive controls are operated. The following description is to be used in conjunction with the schematic taken from drawing number LS 1529A for dual braked locomotives.

1. LIGHTING AND FIRE EXTINGUISHERS.

All driving and maintenance lights are available from the battery when the isolating switch (LS) is turned to the BATTERY SUPPLY position, or from an external 110 volt supply via. the shed lighting socket SLS1 or 2 when LS is turned to SHED SUPPLY.

The load is divided into three systems protected by circuit breakers DLCB, MLCB 1 and MLCB 2. Light circuits are seperately switched and lights are taken alternately from two of the main systems to prevent complete loss of lights in the event of a fault developing in any one system.

2. DRIVING CONTROLS.

The following sub-headings relate to the driving controls and are arranged in the sequence the controls are used during normal driving. The circuits and systems affected as a result of operating a control are listed under the appropriate sub-heading.

NOTE:- Except where otherwise stated, it is assumed that both AWS change-end switches in OFF, and all other switches are in their normal running positions.

A. BATTERY ISOLATING SWITCH (BIS) closed.

The following circuits are energised:

1) Battery voltmeter (Vb)

2) Drivers' safety device control unit, via. control circuit breaker (CCB) and wires 52 & 27.

3) Relay FAR via. the fire detectors and test buttons.

4) Engine stopped warning lights in the cabs.

5) The external fuel gauges; these read the same as the gauge in No.1. fuel tank.

6) The water tank external gauges.

7) The appropriate BRAKE SELECTOR SWITCH (BSS) 'position' lamp is illuminated in both cabs.

B. Reverser handle to ENGINE ONLY (E.O.)

1) Wire 12 is energised.

2) Warning lamp in the cabs and control cubicle are lit.

ALARM and WHEELSLIP - DIM

Cubicle lights - GREEN

3) With the brake selector switch (BSS) in:-

1) AIR PASS. RAVA is energised.

2) VAC. PASS. RAVV is energised.

3) VAC GOODS. DMTV is energised.

4) Contactor WPC1 closes and the combined pump set runs at slow speed.

5) Contactor BMC closes via. relay BFR.

6) Contactor EXC closes via. contact EXYa.

7) C1 and/or C2 close via governor CGa, emergency change-over switch (ECS), dependant on position of brake selector switch (BSS) and particular driving cab.

C. ENGINE START switch closed and held.

1) Contactor SCC is energised via S2d, VRf, M1c, M2c, M3c and LOCAL START n/c contact. S1 is energised via the main contacts of SCC.

2) Contactor S2 is energised via. S1g, The main generator is connected as a series motor across the battery and motors the engine up to firing speed.

3) The auxiliary generator field is open-circuited by contacts S1d and S2b.

4) The auxiliary earth fault relay (AEFR) is open-circuited by contact S1c.

5) Relay STR is open-circuited by S1b.

6) The engine run valve (ERV) is energised via STRe, S1f and S2g, changing the engine governor to the run condition.

7) The engine fires and runs at idling speed, oil pressure builds up and oil pressure switch (OPS) operates.

8) The ENGINE STOPPED lamp dims.

D. ENGINE START switch released (Engine started)

1) Contactors SCC, S1 and S2 open.

2) The feed to the engine run valve is maintained via. ERVRE, OPSa, WPSa, and STRe.

3) The auxiliary generator field circuit is restored by S1d and S2b and the auxiliary generator voltage builds up. The exhauster, the blower motors, the compressor(s) run and battery charging commences.

NOTE;- The AVR now maintains the auxiliary voltage at 110, less 1 volt for each 15 amps of battery charge current.

4) Relay VR energises.

5) WPC2 closes and the combined pumps set runs at high speed.

6) The engine hour meter (EHM) starts to record.

7) Auxiliary earth fault protection is restored.

8) The load regulator runs back to minimum field (40), switch La closes and LRR is energised.

9) As air pressure and vacuum build up, the control circuit, auto air and vacuum governors (CCG, AAG, VG) close.

E. A.W.S. switch ON.

1) AWS convertor runs.

2) AWS horn blows, press reset button, horn silenced.

3) The circuit is completed between the reverser and power controller.

4) The DSD. control circuits are established.

F. The reverser handle to FORWARD OR REVERSE.

1) The DMV is de-energised and the brakes applied unless the DSD pedal or bush button is depressed.

2) PCR is energised via, wire 4.

G. Power handle to ON.

1) PCR is maintained via, wire 5.

2) The appropriate reverser solenoid (E/P valve) is energised via, wire 7 or 8 and reversing takes place.

3) The traction motor contactors close, energised via prooving contacts on the reverser, PCRb, LRRa and the traction motor isolating switches.

4) The main generator field contactors GX & GZ close, energised via. prooving contacts of the reverser, PCRb, EMS (normal), M3g, M2G and M1g.

5) The engine speed valve (ESV) is energised.

6) Low power is applied to the traction motors.

H. Power handle moved to $\frac{1}{4}$ position.

1) Air pressure from the controller to the engine governor rises and the engine speed increases. Increased power is fed to the traction motors.

2) As the load regulator moves to increase power to the traction motors, switch La opens, LRR is de-energised and the traction motor contactors are held in via. wire 12, VRd, M1. 2& 3f, LRRf and the traction motor isolating switches.

3) Further movement of the power handle towards MAXIMUM, increases the air pressure applied to the engine governor which causes the engine to run at a higher speed and the load regulator moves towards 0 to keep the generator output such that the engine is always fully loaded.

I. Power handle to OFF.

1) The feeds to wires 5 and 7 or 8 are broken, PCR, GX, GZ and ESV are de-energised.

2) Air pressure to the engine governor is cut off by ESV and the engine speed is reduced to idling.

3) The load regulator runs back to position 40, closing La, LRR is re-energised, breaking the feed to the traction motor contactors.

4) PCR is re-energised from wire 4 via. LRRb.

J. ENGINE STOP button depressed.

1) STR is energised, the engine run valve is de-energised and the engine stops.

2) As the engine speed decreases the auxiliary generator voltage falls. The auxiliary machines stop and VR is de-energised.

3) WPC drops out and the combined pump set runs at slow speed.

3. FIELD SHUNT (divert) CONTROL

When the load regulator reaches the maximum field position the traction motor fields are automatically weakened by connecting divert resistances in parrallel with them. This causes the load regulator to take up a new position below maximum for the same tractive effort and speed, thus the range of the regulator is effectively increased. Three stages of field weakening are used, all three pairs of motors being field-weakened simultaneously at each stage.

A. Field weakening

1) Full field to weak field stage 1 (FF to WF1)

(a) The load regulator reaches MAX., switch Lc closes, thus operating SR5.

(b) Relay SR2 is energised via M1e, M2e of M3e, FSRa, SR5c and FSC1a, SR2 then holds via its own contact SR2b and FSC1a.

(c) Valve LRS is energised via SR2e causing the load regulator to run back and reduce load on the main generator.

(d) Switch Lc opens and SR5 drops out.

(e) As the load regulator runs back the voltage across SR1 coil rises until it operates.

(f) Contactor FSC1 closes via FSRa, SR4g, SR3g and SR1a, FSC1 then holds via its own holding contact FSC1f.

(g) SR2 is de-energised and drops out, breaking the circuits to SR1 and LRS.

The load regulator is again under control of the engine governor and the sequence is complete, with one stage of resistance in parallel with each pair of traction motor fields.

2) Weak field stage 1 to stage 2 (WF1 to WF2)

(a) The load regulator reaches MAX., switch Lc closes thus operating relay SR5.

(b) Relay SR3 is energised via SR1f, SR5b and FSC1c.

(c) Relay SR2 is energised via M1e, M2e or M3e, FSRa, SR3c, SR5c and FSC2a. SR2 then holds via its own contact SR2b.

(d) LRS is energised causing the load regulator to run back.

(e) Switch Lc opens and SR5 drops out.

(f) As the load regulator runs back, the voltage across SR1 rises until the relay operates.

(g) Contactor FSC2 closes via FSRa, SR4g, SR1b and SR3b and holds via its own holding contact FSC2g.

(h) SR2 is de-energised and drops out, breaking the circuits to SR1 and LRS..

The load regulator is again under control of the governor and the sequence is complete, with two stages of resistance in parallel with each pair of traction motor fields.

3) Weak field stage 2 to stage 3 (WF2 to WF3).

(a) The load regulator reaches MAX., switch Lc closes, thus operating relay SR5.

(b) Relay SR4 is energised via SR1e, SR5a and FSC2f. FSC2 is now held direct instead of via FSRa.

(c) Relay SR2 is energised via M1e, M2e, M3e, FSRa, SR5c, SR4c and FSC3a; SR2 then holds in via its own contact SR2b.

(d) LRS is energised, causing the load regulator to run back.

(e) Switch Lc opens and SR5 drops out.

(f) As the load regulator runs back the voltage across SR1 rises until the relay operates.

(g) Contactor FSC3 closes via FSRa, SR1c and SR4b and holds by its own holding contact FSC3f.

(h) SR2 is de-energised, breaking the circuits to SR1 and LRS.

The load regulator is again under control of the governor and the sequence is complete with three stages of resistance in parallel with each pair of traction motor fields.

NOTE:-

If the main generator reaches 1000 volts before the load regulator reaches maximum field (position 0), relay VLR will operate to energise SR5 and initiate the sequence, instead of switch Lc.

B. Field strengthening.

1) Weak field stage 3 to stage 2 (WF3 to WF2)

(a) When the traction motor current reaches a pre-set value (approximately 800 amps per motor circuit) relay FSR operates and breaks the circuit to FSC3. FSC1 and FSC2 are held closed by direct feeds via SR3a and SR4a respectively.

(b) The de-magnetising coil of FSR is energised via FSC3c and SR4d.

(c) SR4 is de-energised and drops out.

(d) FSC2 is now held via FSRa and the sequence is complete with two stages of resistance in parallel with each pair of motor fields

2) Weak field stage 2 to stage 1 (WF2 to WF1)

(a) Relay FSR operates and breaks the circuit to FSC2.

(b) FSR de-magnetising coil is energised via FSC2c and SR3d; FSR drops out.

(c) SR3 is de-energised and drops out.

(d) FSC1 is now held via FSRa and the sequence is complete with one stage of resistance in parallel with each motor circuit.

3) Weak field stage 1 to full field (WF1 to FF)

(a) Relay FSR operates and breaks the circuit to FSC1.

NOTE;-

The FSR remains in the energised position until the locomotive speed increases, allowing the load regulator to run around to the maximum field position. Just prior to this condition, switch Lb closes to energise the demagnetising coil, and revert the FSR back to its normal condition.

4. CAB CONTROLS.

A. THE AUTOMATIC AIR BRAKE VALVE

This valve has five positions: RELEASE, RUNNING, INITIAL, FULL SERVICE, EMERGENCY. In the RELEASE position a micro-switch is closed to energise the choke valve (XCV) and contactor EXY. The exhausters run at high speed drawing against the full 2ins. train pipe. In all other brake valve positions XCV and EXY are de-energised, the exhausters run at half speed drawing against a 3/8ins. choke in the train pipe.

B. THE STRAIGHT AIR BRAKE.

The valve applies the brakes on the locomotive only. It is self-lapping and gives variable pressures between 0 and 70 p.s.i. depending on the position of the handle.

C. ANTI-SLIP PUSH BUTTON.

Situated in the end of the power handle. When it is depressed the anti-slip brake valve (SBV) is energised via. wire 18, giving a light brake application on all the driving wheels on the locomotive.

D. DRIVERS' SAFETY DEVICE.

The pedal or push button must be kept depressed when the reversing handle is in FORWARD or REVERSE.

E. SANDING PEDAL.

Allows the leading sanding valve (only) to operate on both bogies to increase adhesion under slippery rail conditions.

5. DRIVERS' WARNING LAMPS.

Six volt, 3 watt lamps are used, each lamp is connected in series with a dropping resistor, operating on a 110 volt supply. A separate series resistance in each lamp circuit causes the lamp to burn dim and is short-circuited to brighten the lamp under fault conditions.

1) Engine stopped. (Red)
   Contact OPSb closes to short-circuit the resistance at the same time OPR is energised.

2) Wheel-slip. (Amber)
   A contact of any wheel-slip relay closes to short circuit the resistance.

3) Boiler alarm (White)
The resistance is short-circuited by contacts in the boiler control panel to indicate a boiler fault.

4) General alarm. (Blue)
The resistance is short-circuited by contacts:-

a) WTSb to indicate high cooling water temperature.
b) GZc to indicate loss of power.
c) MBRa and VRc in series to indicate a blower fault.

The brake indicator light in the cabs show the position of the brake selector switch in the control cubicle.

6. CUBICLE WARNING LAMPS.

In each circuit two lamps are in series, a 230v. 15w. red lamp, and a 110v. 15w. green lamp. Under normal conditions a contact shorts-out the red lamp, so the green light shows. Under fault conditions the shorting contact opens, so that both lamps are in series, but because the resistance valves of the lamps are different, only the red light is bright.

1) Blowers.
Contacts MBRb and VRg open to indicate a blower fault.

2) Earth fault.
Contact AEFRf or PEFRa open to indicate a fault and latches until reset by maintenance staff.

3) Water pressure.
Contact WPRf opens to indicate low water pressure and latches until reset by maintenance staff.

4) Water temperature.
Contact WTSa opens to indicate high cooling water temperature.

5) Oil pressure.
Contact OPRf opens to indicate low engine lubricating oil pressure and latches until reset by maintenance staff.

7. INTERLOCKS AND SAFETY DEVICES

A. Controller

Interlocks are provided to prevent mishandling and to ensure that the control handles cannot be operated simultaneously or in the wrong sequence.

1) The master key can only be removed or inserted when the reverser handle is in OFF.

2) The reverser handle can only be moved when the master key is in place and the power control handle is in OFF.

3) The power control handle can only be moved when the reverser handle is in FORWARD or REVERSE.

4) Power cannot be applied until the A.W.S. is switched on in the cab in use.

If the A.W.S. is defective it can be isolated by a special switch handle but the change-end switch must be closed.

B. Start contactors

These cannot be energised if:

1) The engine is already running and VR has operated.

2) A traction motor contactor is stuck or welded closed.

3) S2 is stuck or welded closed.

C. Engine run valve

This valve will be de-energised and the engine will stop if:

1) Lubricating oil pressure falls below 12 p.s.i.

2) Cooling water pressure falls below 4 p.s.i.

In addition, the appropriate relay will operate and latch to show a warning light on the cubicle.

D. Power control relay

This relay cannot be energised if:

1) The power control handle is away from OFF.

2) The load regulator is away from minimum field and LRR is de-energised.

3) The exhauster is switched to TEST.

4) S1, S2 or GZ is closed.

It will be de-energised if:

1) Main reservoir air pressure falls below 55 p.s.i.

2) Train pipe vacuum falls below 12½ in. Hg.

3) The power earth fault relay operates.

E. Traction motor contactors

These cannot close if:

1) The reverser does not throw correctly to the direction selected.

2) The load regulator is not in minimum field.

3) PCR is not energised.

NOTE:

When the motor contactors are closed and the load regulator is away from minimum field, they hold themselves closed until the power control handle is returned to OFF and the load regulator returns to minimum field.

F. Engine speed valve (ESV)

This valve is de-energised and the engine speed falls to idling if:

1) The controller is returned to OFF.

2) PCR is de-energised.

G. Generator field contactors GX and GZ

These will open if:

1) The controller is returned to OFF.

2) PCR is de-energised.

H. Wheelslip detection

When wheelslip occurs, the slipping wheels lose adhesion with the rails and the traction motor accelerates. Since the motors are connected in series-parallel, the voltage across the accelerating motor increases and the voltage across the non-slipping motor of the same pair decreases. This voltage difference is detected by comparing the centre-point between the two motor armatures with the centre-point of a parallel resistance through the coil of a relay.

When a relay operates:

1) LRS is energised to reduce load.

2) The wheelslip light in each cab brightens to warn the driver.

I. Driver's safety device (D.S.D.)

1) When the reverser handle is in FORWARD or REVERSE, the D.S.D. pedal or push button must be depressed.

2) If both are released, valve DMV is de-energised and an emergency brake application is initiated.

3) Loss of vacuum operates VG to de-energise PCR and remove power.

J. Earth fault relays.

1) Power earth fault relay (PEFR)

If a fault to earth develops on the positive side of the main generator, PEFR will trip.

(a) PCR will be de-energised, causing loss of power.

(b) The EARTH FAULT light on the control cubicle will change to RED.

2) Auxiliary earth fault relay (AEFR)

If a fault to earth occurs on either pole of the auxiliary or control circuits, AEFR will trip.

(a) The EARTH FAULT light on the control cubicle will change to RED.

NOTE:

To prevent false operation due to circulating currents during starting, AEFR is isolated by S1c when S1 is closed.

K. Motor blower relays

1) Blower fault relay (BFR)

The two opposing coils are connected, one in parallel with each motor. If a fault develops in one motor, the voltages across the motors, and therefore across the relay coils, will be out of balance. This will cause the relay to operate and open BMC, stopping the blowers and operating MBR.

2) Motor blower relay (MBR)

This relay is in series with the blower motors. If the motor circuit is opened, due directly to a faulty motor or to BRF operating:

(a) The BLOWERS light on the control cubicle changes to RED.

(b) The GENERAL ALARM light on the driver's desk changes to BRIGHT.

L. Fire alarms

Bi-metal switches are fitted in the roof of the locomotive at various points to detect excessively high temperature. If any switch opens, the feed to relay FAR is broken, the relay drops and completes the circuit to ring the fire bells.

8. SWITCHES.

The locomotive is fitted with a number of manually-operated switches, some being necessary for normal driving and the others to enable the locomotive to be driven after a fault has developed, or for maintenance purposes.

A. Lighting switch (LS)

This is a rotary switch having two positions:

1) BATTERY SUPPLY, connecting the lighting circuits to the battery.

2) SHED SUPPLY, connecting the lighting circuits to the shed supply sockets. If necessary the lights can be supplied from an external 110 volt source.

B. Battery isolating switch (BIS)

This is a double-pole ON/OFF switch fitted with flick blades. In the ON (up) position it connects the battery to the control, starting and charging circuits.

C. A.W.S. change-end switch

This is a two-position, multi-pole rotary switch. In the ON (handle up) position it completes the A.W.S. circuits: it also completes the circuit between the reverser handle and the power control handle to ensure that the A.W.S. is switched on in the cab in use.

D. Brake SELECTOR switch (BSS)

This is a rotary switch controlling the speed of emergency braking: it has four positions:

1) Air Passenger.

2) Air Goods.

3) Vacuum Passenger.

4) Vacuum Goods.

E. Engine maintenance switch (EMS)

This is a rotary switch having two positions:

1) MAINTENANCE, used for checking the engine speeds: contactors GX and GZ are open-circuited so that the main generator does not develop dangerously high voltages when the engine is at top speed.

2) NORMAL, the circuit to GZ and GX is complete so that the main generator is excited normally.

F. Motor isolating switches (MIS1-3)

A group of three rotary switches fitted to enable a defective traction motor circuit to be isolated so that the locomotive can be driven on the remaining motors.

G. Exhauster isolating switch

This is a rotary switch having three positions:

1) NORMAL, the exhauster runs normally, fed from the auxiliary generator

2) OFF, the exhauster is shut down: the locomotive can be driven in emergency if VG is closed manually.

3) TEST, the exhauster is fed from the battery: the locomotive cannot be driven with the switch in this position.

H. Emergency compressor switch.

This switch is required when the locomotive is working a vacuum fitted train. In the event of a failure of the compressor by turning the switch from NORMAL to EMERGENCY the other compressor can be used.

1. Water pump control switch (WPCS)

This is a rotary switch having three positions:

1) AUTO, the normal position, contactor WPC1 is closed via the reverser handle and wire 12.

2) OFF, contactor WPC1 is open-circuited and the pump does not run.

3) DIRECT, contactor WPC1 is closed by a direct feed from wire 52, and the pump runs independent of the controller position.

9. FUSES.

Traction motor blower motors (1)	125 amp.
Exhauster motor	125 amp.
Pump set motor	100 amp.
Compressor motors (2)	100 amp.
Heaters (2)	60 amp.
Boiler	60 amp.
Cookers (2)	20 amp.
Battery rectifier	300/400 amp.

10. VIGILANCE DSD SYSTEM.

Description of Operation.

This system is controlled Electromagnetically as opposed to the other vigilance system which was controlled Electronically.

The principle of operation is the same such that an audible WARNING, in the form of A Buzzer, is produced every 60 sec's.

This system does not rely for its functioning on the three position foot pedal and hand button but utilizes the existing two position foot pedal and hand button (Second Mans Side Only). The operation is as follows:-

When a direction is selected the Buzzer will sound (only in the cab concerned). By depressing the foot or hand switch the Buzzer will be silenced. Due to a time delay relay the Buzzer will again sound after 60 sec's, and unless this is acknowledged by resetting the system the brakes will be applied after approx 7 sec's.

TO RE-SET Simply release the DSD foot or hand switch and Depress.

Selecting either the 'engine only' of 'off' position on the master controller automatically overides the time delay relay and the Buzzer is permanently silenced, and the DMV is held energised. This system is electrically linked with the AWS, so that if the DSD Buzzer and AWS Horn sound at the same time, it is only necessary to cancel the AWS by depressing and releasing the AWS Reset Button. This action will automatically reset the DSD time delay relay for another 60 sec's.

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This action can only occur when the AWS requires cancelling, and not by depressing and releasing the AWS Button at any other time. Releasing and depressing the DSD Foot or Hand Switch will not at any time cancel the AWS Horn.

CIRCUIT DESCRIPTION.

Three relays are situated in the vigilance control box:-

1) Time Delay Relay (TDR)
2) Slave Relay (SR)
3) AWS Relay.

Principle of operation as follows:-

Assume BIS to be Closed. When a direction is selected the Buzzer will sound. The circuit being made through either Terminal 1 or Terminal 12 depending on which cab is being used.

Assume "A" Cab

Circuit to buzzer via Terminal 1, SR/1 and TDR/1 in Parallel.

Depressing the DSD Foot or Hand Switch energises TDR Coil via Terminal 2 AWS/1 and SR/3.

NOTE:
The N/C TDR Delay Contact will not open for 60 Sec's.

TDR/3 Contact closes to place a retaining feed on TDR Coil, via TDR Delay contact.

TDR/1 Contact opens but the Buzzer still sounds.

TDR/4 & TDR/5 Contacts close to prepare a circuit to DMV.

TDR/6 Contact Opens but no current flows in this circuit.

TDR/2 Contact closes to energise SR Coil.

SR/1 Contact opens and the Buzzer is silenced.

SR/2 Contact closes to retain SR Coil.

SR/4 Contact closes to complete the circuit to the DMV.

SR/3 Contact opens leaving TDR/3 and TDR Delay Contacts holding in TDR Coil.

The circuit will now remain in this state for 60 sec's, or until the foot or hand switch is released.

After 60 sec's the TDR Delay contact opens to de-energise TDR Coil.

TDR/4 and TDR/5 contacts open to de-energise DMV.

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TDR/1 Contact closes and the Buzzer sounds.

The TDR Delay contact will be closed (Due to TDR Coil being de-energised) but TDR coil will not be re-energised due to TDR/3 contact having opened.

If this situation is allowed to prevail a brake application will result after approx. 7 sec's.

In order to reset, release the DSD Foot or Hand Switch (This action de-energises SR Coil) and re-depress. The circuit is again prepared for another 60 sec's.

If during the 60 sec's the DSD Foot or Hand Switch is released SR coil and TDR Coil will immediately be de-energised.

The DMV will be de-energised and the Buzzer will sound and again the brakes will be applied unless the system is re-set.

When the master controller is moved to the "Engine Only" position TDR and SR Coils are de-energised. The DMV however, remains energised via cables 53 and 595 and the spare SR N/C Contact.

AWS ASPECT

If at the end of 60 sec's the Buzzer sounds and at that precise moment the locomotive passes over a dead AWS Ramp causing the AWS Horn to sound, only one action is necessary, that is to depress and release the AWS re-set Button. This action apart from silencing the AWS Horn will energise the AWS relay (in the vigilance control box) causing its contact AWS/1 to open and close. This action is similar to releasing and depressing the foot or hand switch and does in fact re-set the DSD circuit thus silencing the Buzzer and re-energising the DMV for a further 60 sec's.

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N O T E S

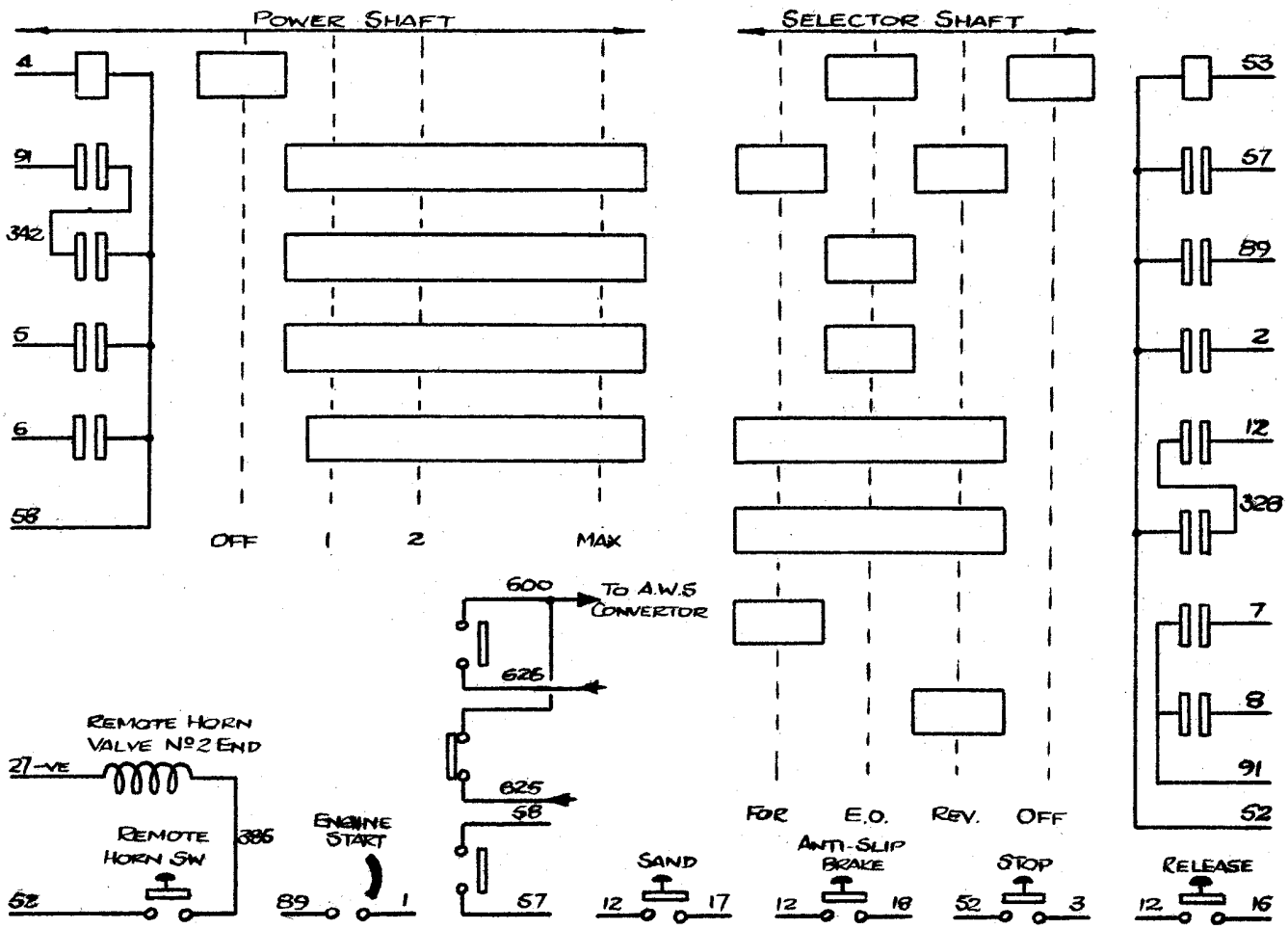
REFERENCE	ACTIVE SWITCHES	DESCRIPTION
Aa, Ab, Ac		AMMETERS
A.A.G		AUTO AIR GOVERNOR
A.E.F.R.	f	AUXILIARY EARTH FAULT RELAY
A.E.I.L.		AUXILIARY EARTH ISOLATING LINK
AFL		AUXILIARY GENERATOR FIELD LINK
A.V.R.		AUTOMATIC VOLTAGE REGULATOR
B.F.R.	a	BLOWER MOTOR FAULT RELAY
B.I.L.R.E 1-2		BRAKE INDICATOR LAMP RESISTOR
B.I.S.	2	BATTERY ISOLATING SWITCH
B.M.C.		BLOWER MOTOR CONTACTOR
B.M.F.		BLOWER MOTOR FUSE
B.M.R.		BLOWER MOTOR RESISTOR
B.O.F.		BOILER FUSE
B.R.K.		BATTERY RECTIFIER
B.R.K.C.P.		BATTERY RECTIFIER CAPACITOR
B.R.K.F		BATTERY RECTIFIER FUSE
B.S.S.		BRAKE SELECTOR SWITCH
C1-2		COMPRESSOR CONTACTOR
C1-2		CAPACITOR
CCB	2	CONTROL CIRCUIT BREAKER
CCG	2	CONTROL CIRCUIT GOVERNOR
CCR		CONTROL CIRCUIT RESTRICTION RELAY
CF1-2		COMPRESSOR FUSE
CG	1	COMPRESSOR GOVERNOR
COF1-2		COOKER FUSE
CRE1-2		COMPRESSOR RESISTOR
CS1-2		CHARGING SOCKET
DLCB	2	DRIVING LIGHTS CIRCUIT BREAKER
DMTV		DEADMANS TIMING VALVE
DMV		DEADMANS VALVE
DRE1-4		DIMMER RESISTOR
ECS		EMERGENCY COMPRESSOR CHANGE-OVER SWITCH
EHM		ENGINE HOUR METER
EHMSS		ENGINE HOUR METER SURGE SUPPRESSOR
EMS	1	ENGINE MAINTENANCE SWITCH
EMT		EMERGENCY START TERMINAL
ERV		ENGINE RUN VALVE
ERVRE		ENGINE RUN VALVE RESISTOR
ESV		ENGINE SPEED VALVE
EXC	b	EXHAUSTER CONTACTOR
EXF		EXHAUSTER FUSE

REFERENCE	ACTIVE SWITCHES	DESCRIPTION
EXIS	2	EXHAUSTER ISOLATING SWITCH
EXRE		EXHAUSTER RESISTOR
EXV	a	EXHAUSTER DIVERTOR CONTACTOR
FAR	a	FIRE ALARM RELAY
FCV1-2		FEED CUT OFF VALVE
FSC1	a,e,f	FIELD SHUNTING CONTACTOR 1
FSC2	a,c,e,f,g	FIELD SHUNTING CONTACTOR 2
FSC3	a,c,e,f	FIELD SHUNTING CONTACTOR 3
FSR	a,b,d	FIELD STRENGTHENING RELAY
FSRE 1-9		FIELD SHUNTING RESISTOR
GX	b,d	MAIN GENERATOR SEPARATE FIELD CONTACTOR
GZ	a,c	MAIN GENERATOR SELF FIELD CONTACTOR
HF 1-2		HEATER FUSE
La, Lb, Lc	1	LOAD REGULATOR SWITCHES
LRR a,b,f.	a,b,f	LOAD REGULATOR RELAY
LRRE		LOAD REGULATOR RESISTOR
LRS		LOAD REDUCING SOLENOID
LS	2	LIGHTING SWITCH
LS 1-2		LOUDSPEAKER
M1-3	a,b,c e,f,g	MOTOR CONTACTOR
MBF		MOTOR BLOWER FUSE
MBR	a,b	MOTOR BLOWER RELAY
MCD		MOTOR CONTACTOR SURGE PROTECTION DISC
MIL 1-3		MOTOR ISOLATING LINK
MIS 1-3	1	MOTOR ISOLATING SWITCH
MLCB 1-2	2	MAINTENANCE LIGHTS CIRCUIT BREAKER
OPR	f	OIL PRESSURE RELAY
OPS	2	OIL PRESSURE SWITCH
PCR	a,b	POWER CONTROL RELAY
PEFR	a,c	POWER EARTH FAULT RELAY
PEIL		POWER EARTH ISOLATING LINK
RAVA		RESTRICTED APPLICATION BRAKE VALVE (AIR)
RAVV		RESTRICTED APPLICATION BRAKE VALVE (VACUUM)
S1	a,b,c,d,g	STARTING CONTACTOR
S2	a,b,d,g	STARTING CONTACTOR
SBV		SLIP BRAKE VALVE
SCC	b	START CIRCUIT CONTACTOR
SFBRE		MAIN GENERATOR SEPARATE FIELD BALLAST RESIST.
SFRE		MAIN GENERATOR SELF FIELD RESISTOR
SFRK 1-2		MAIN GENERATOR SELF FIELD RECTIFIER
SLS 1-2		SHED LIGHTING SOCKET

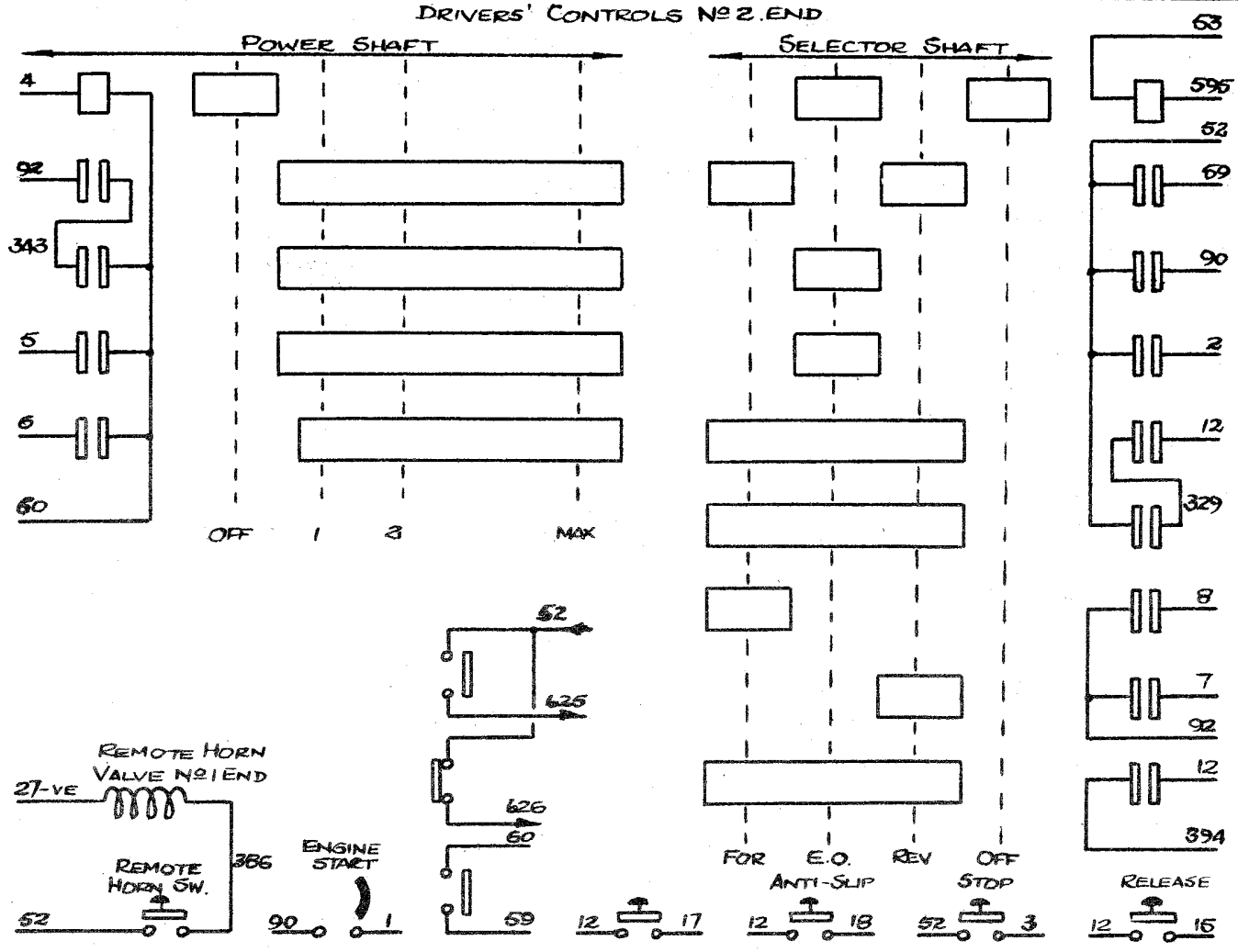
REFERENCE	ACTIVE SWITCHES	DESCRIPTION
SPFRK		MAIN GENERATOR SEPARATE FIELD RECTIFIER
SR1	a,b,c,e,f	FIELD SHUNTING RELAY
SR 2-4	a,b,c d,e,g	FIELD SHUNTING RELAY
SR5	a,b,c,f	FIELD SHUNTING RELAY
STR	a,b,f,g	STOP RELAY
SVR 1-4		SANDER VALVE
TDR		TIME DELAY RELAY
Vb, Vg		VOLTMETER
Vg Re		MAIN GENERATOR VOLTMETER RESISTOR
VG	1	VACUUM GOVERNOR
VLDR	b	VOLTAGE LIMIT DROPOUT RELAY
VLR	b	VOLTAGE LIMIT RELAY
VLRE		VOLTAGE LIMIT RELAY RESISTOR
VR	a,b,c d,f,g	VOLTAGE RELAY
WPC1 -2	a,b,c,d	WATER PUMP CONTACTOR
WPCS	1	WATER PUMP CONTROL SWITCH
WPF		WATER PUMP FUSE
WPR	f	WATER PRESSURE RELAY
WPS	2	WATER PRESSURE SWITCH
WRE 1-17		WARNING RESISTOR
WRK		WARNING RECTIFIER
WSR1-3	a,b	WHEELSLIP RELAY
WSRE 1-3		WHEELSLIP RESISTOR
WSRRE 1-3		WHEELSLIP RELAY RESISTOR
WSSR	a,b,c,d	WHEELSLIP SENSITIVITY RELAY
WSSRE 1-2		WHEELSLIP SENSITIVITY RESISTOR
WTS	2	WATER TEMPERATURE SWITCH
XCV		EXHAUSTER CHOKE VALVE

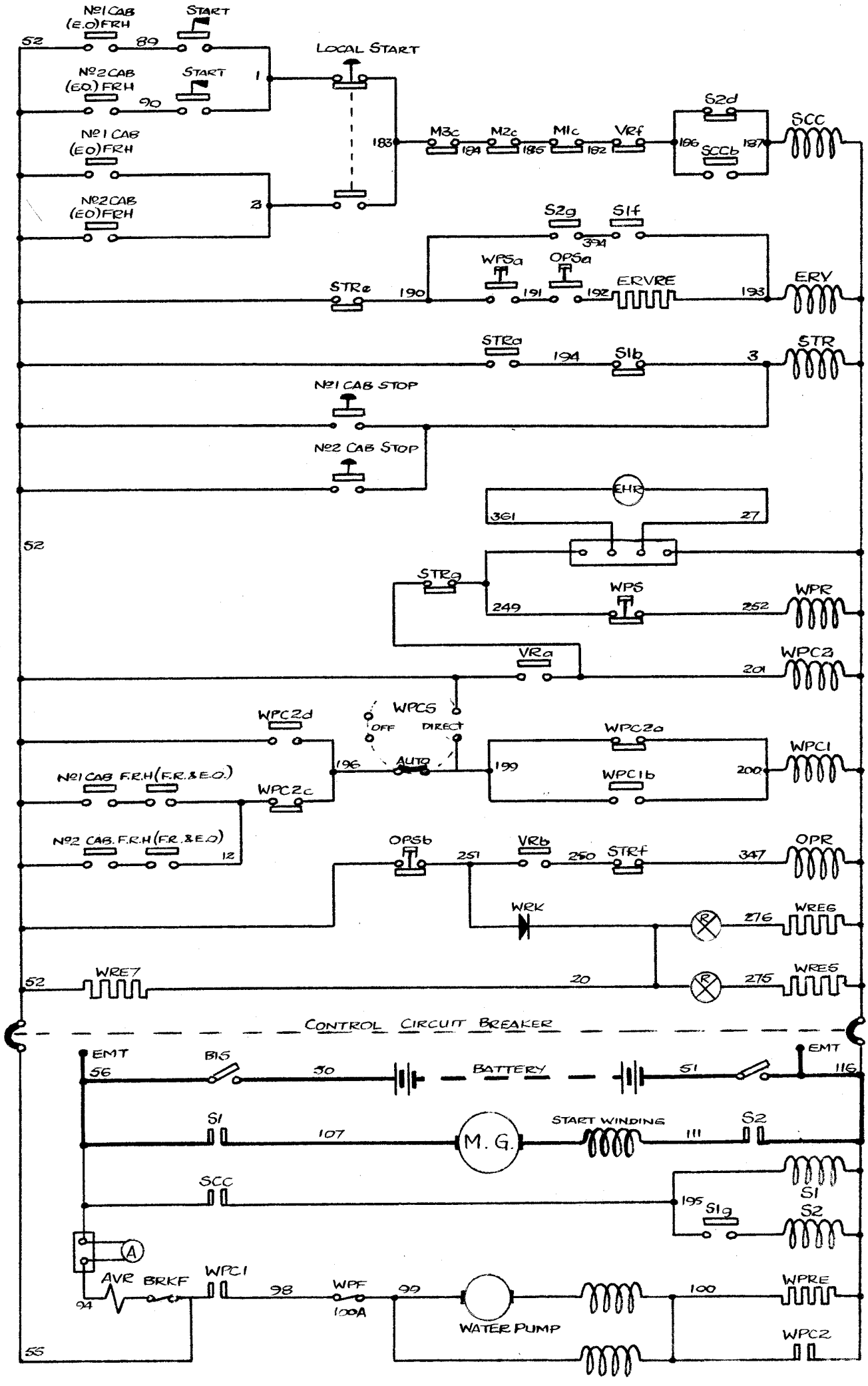
LIST OF NEGATIVE WIRE GROUPS FROM CONTROL CUBICLE TO LOCO	
WIRE Nº	DESTINATION WITHIN LOCOMOTIVE
27/AW	AWS. VOLTAGE CONVERTER
27/D	BRAKE CUBICLE
27/D1	SAND VALVES Nº1 END
27/D2	SAND VALVES Nº2 END
27/P	POWER UNIT
116/B2	BLOWER MOTOR Nº2 END
116/C1	CAB Nº1 END
116/C2	CAB Nº2 END
116/E	EXHAUSTER MOTOR

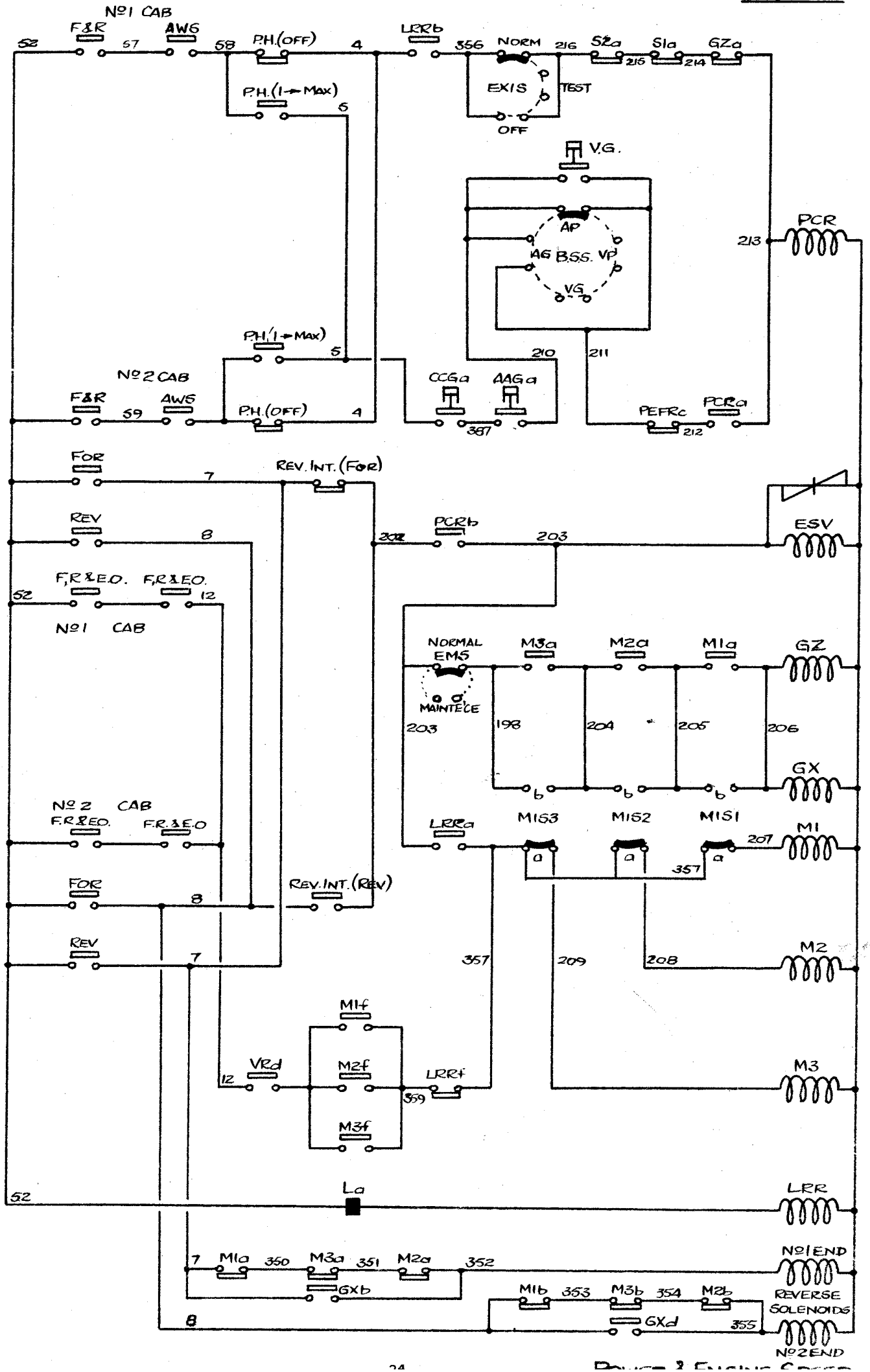
DRIVERS' CONTROLS Nº1 END

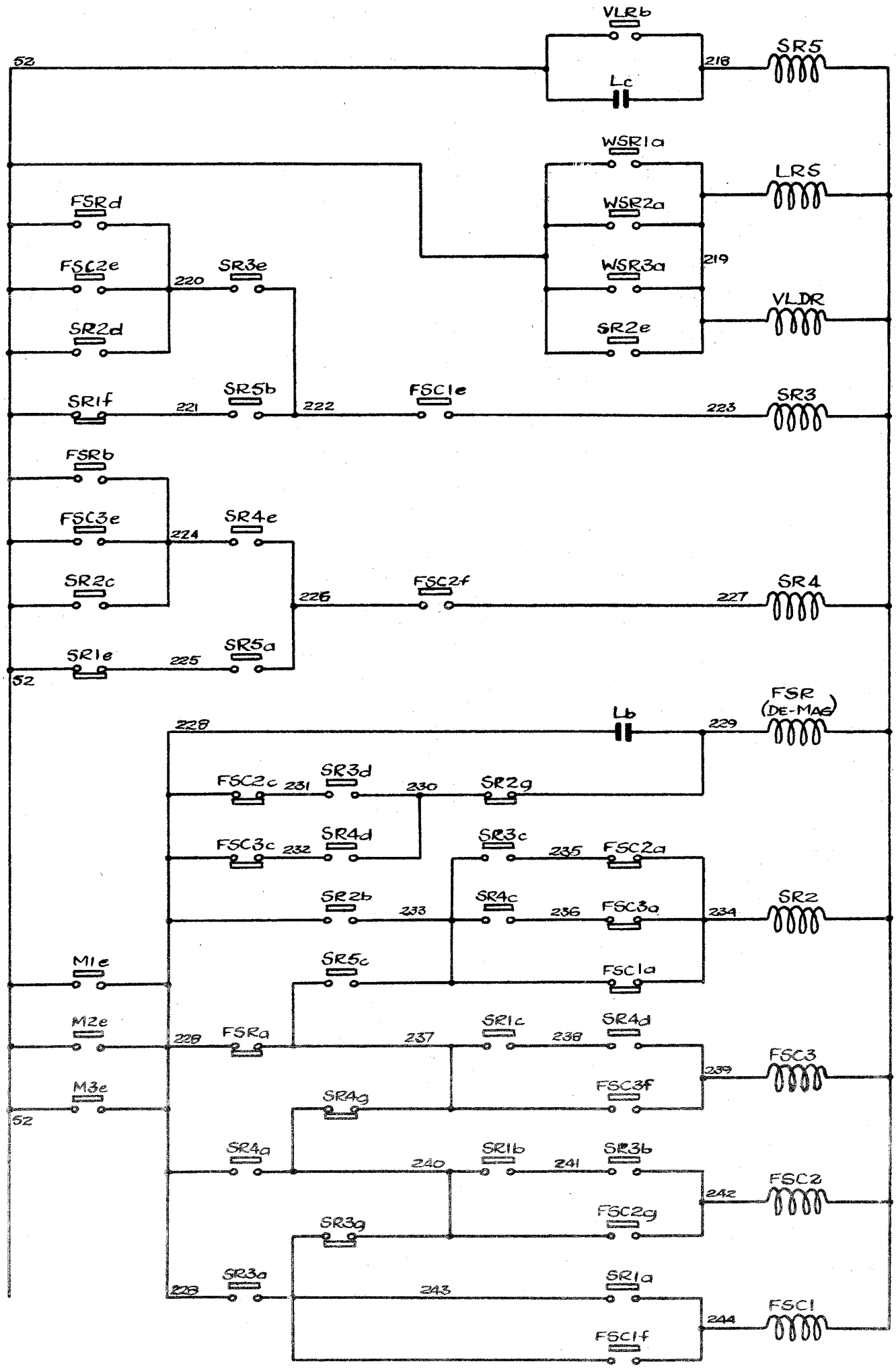


DRIVERS' CONTROLS Nº2 END

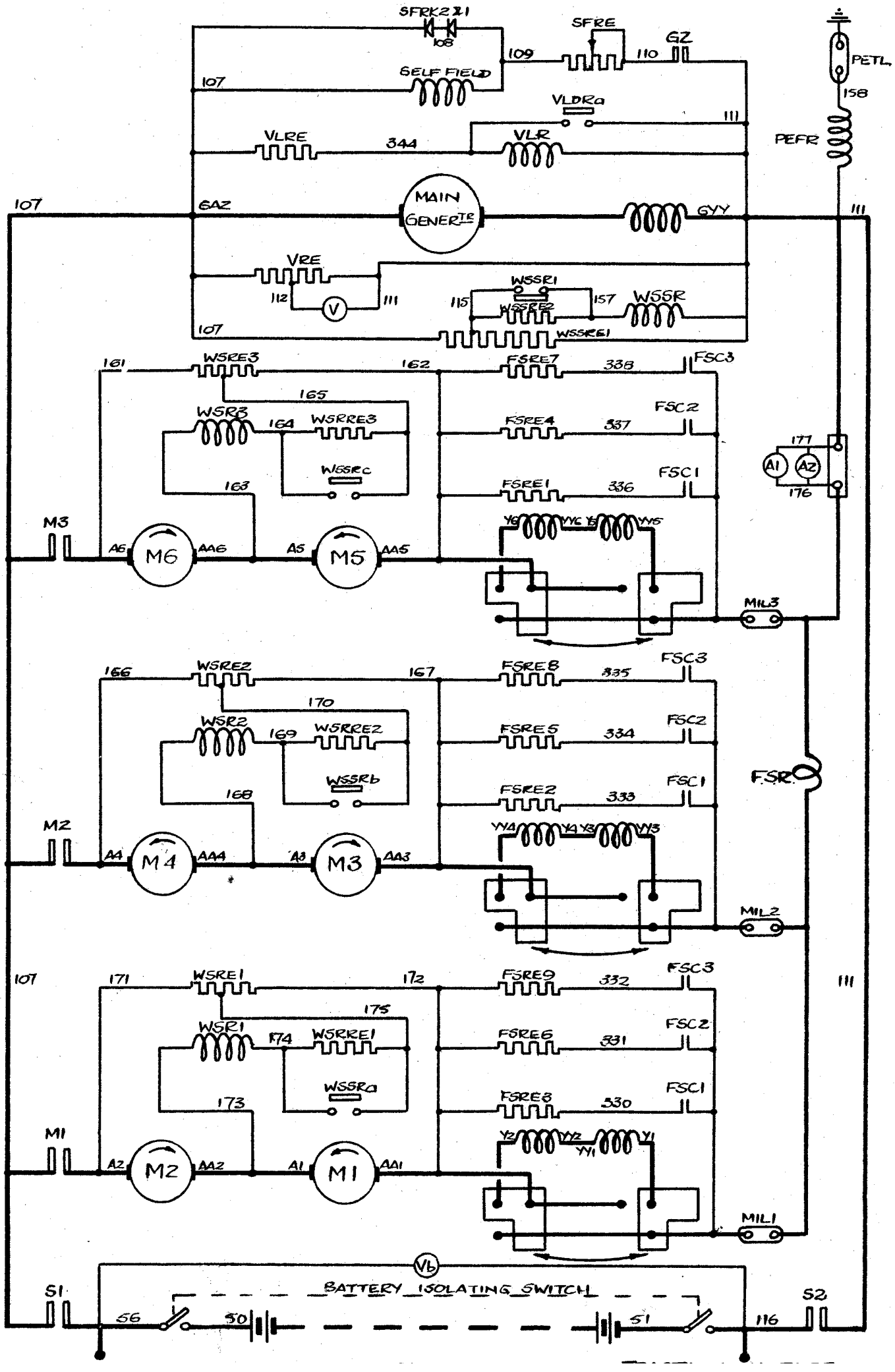


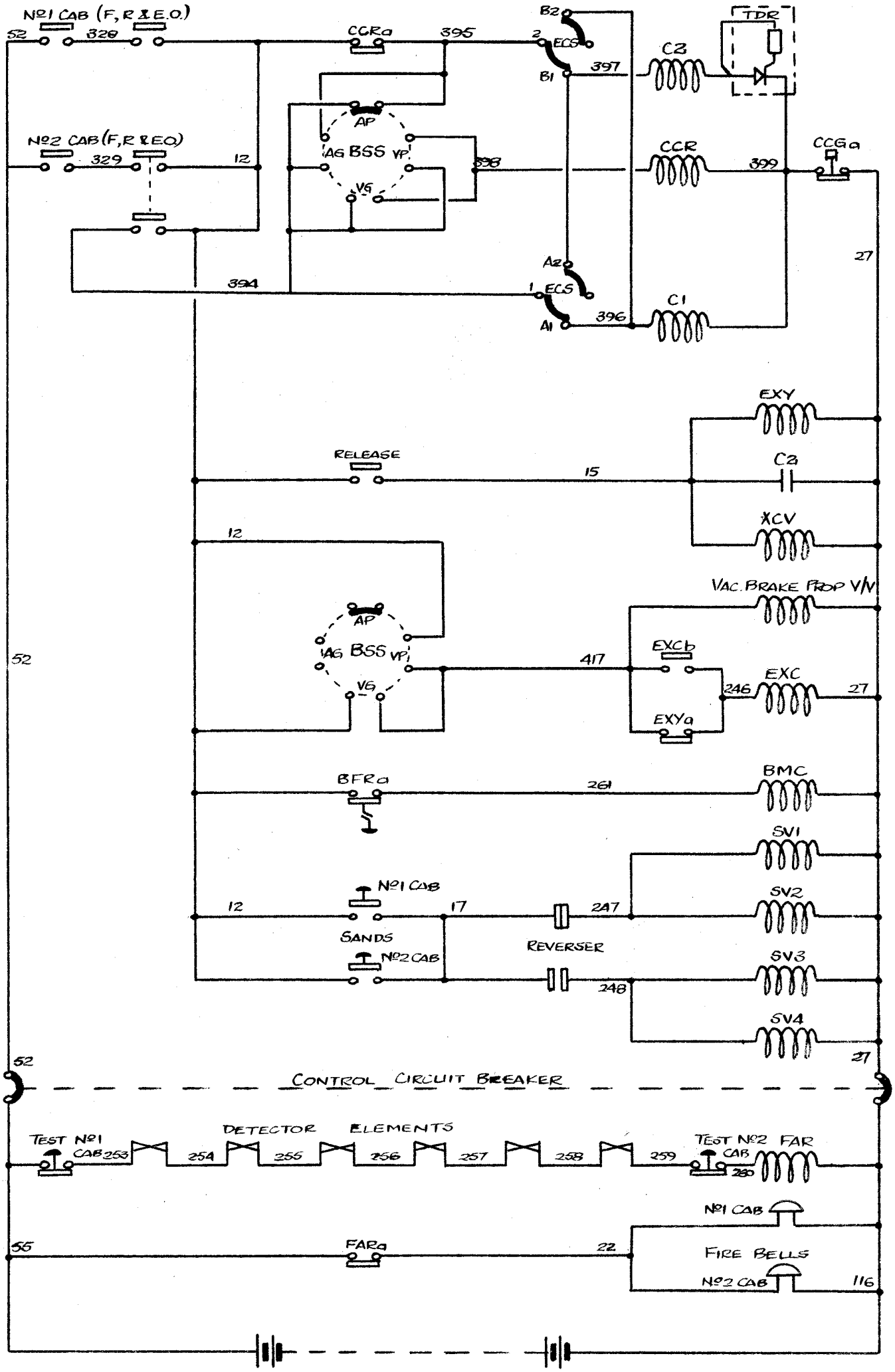


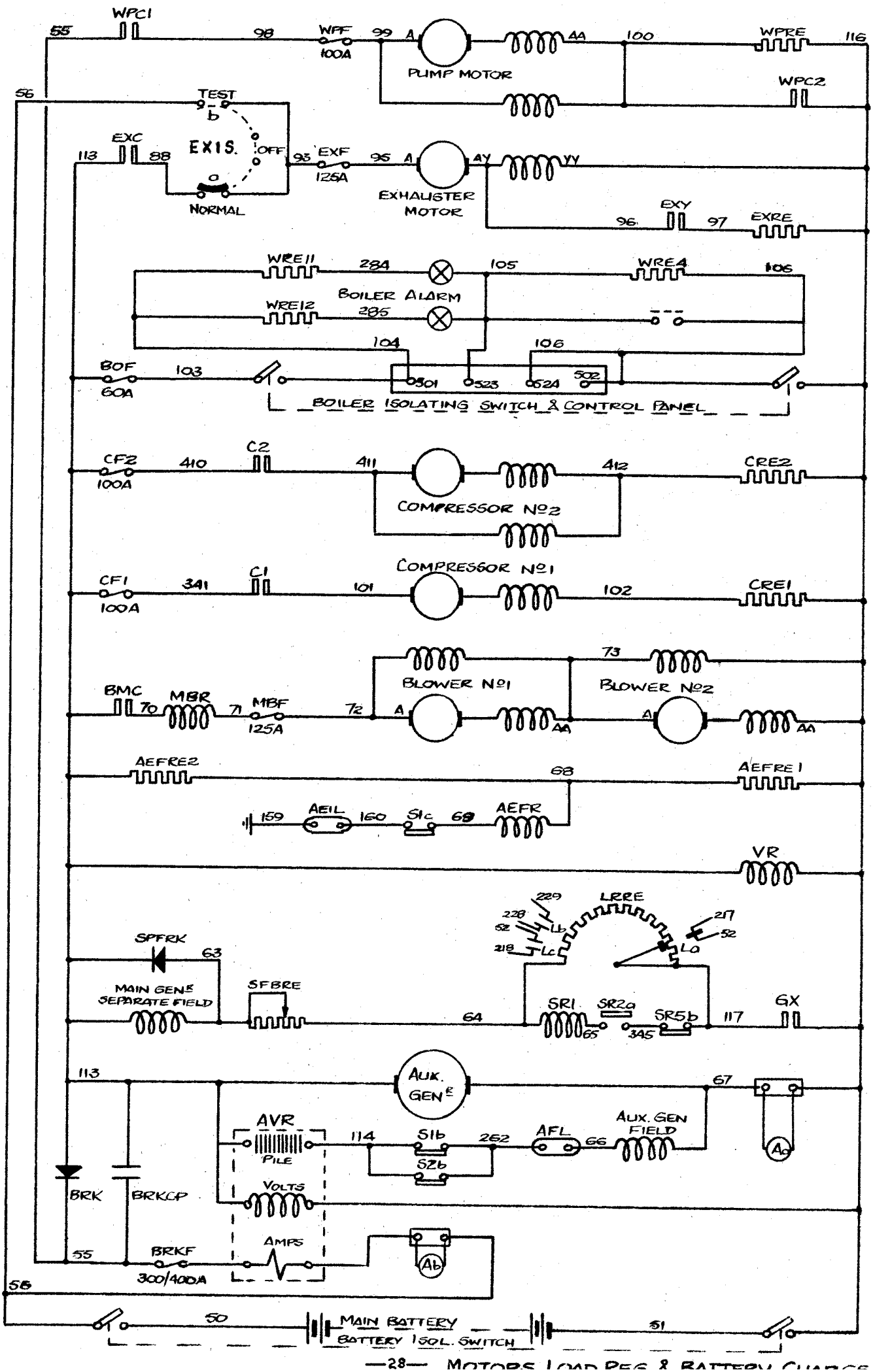


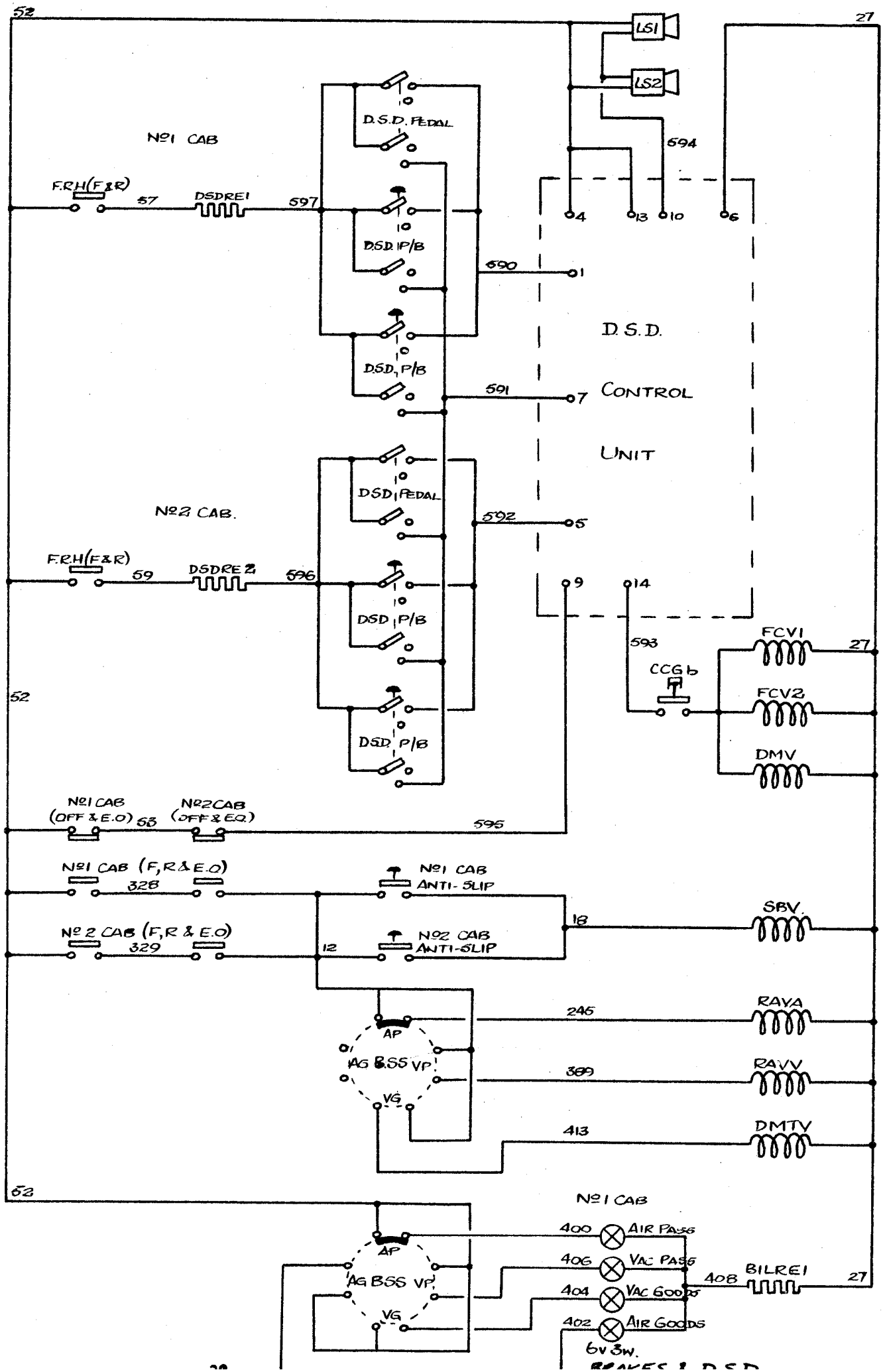


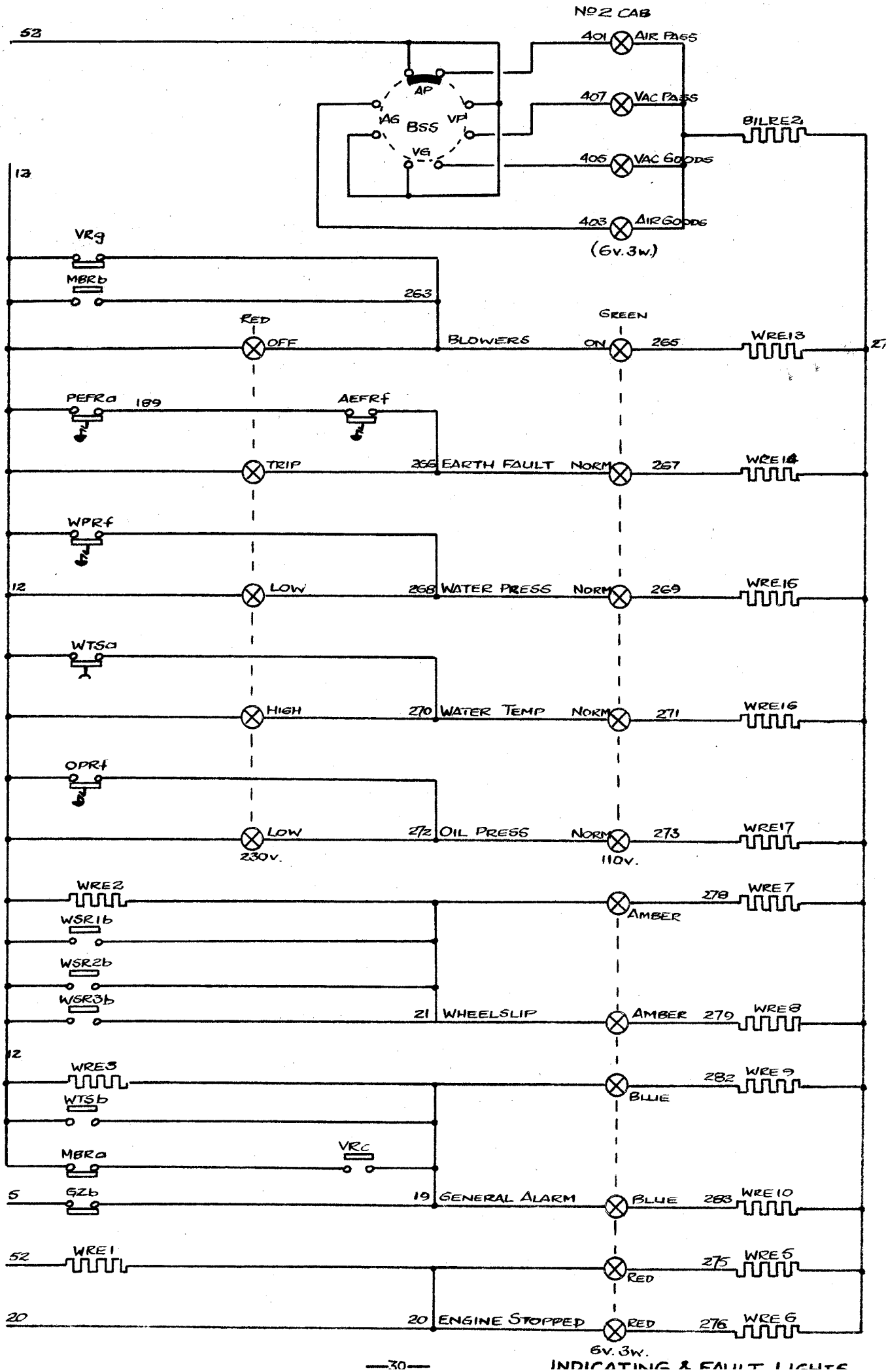
FIELD DIVERSION



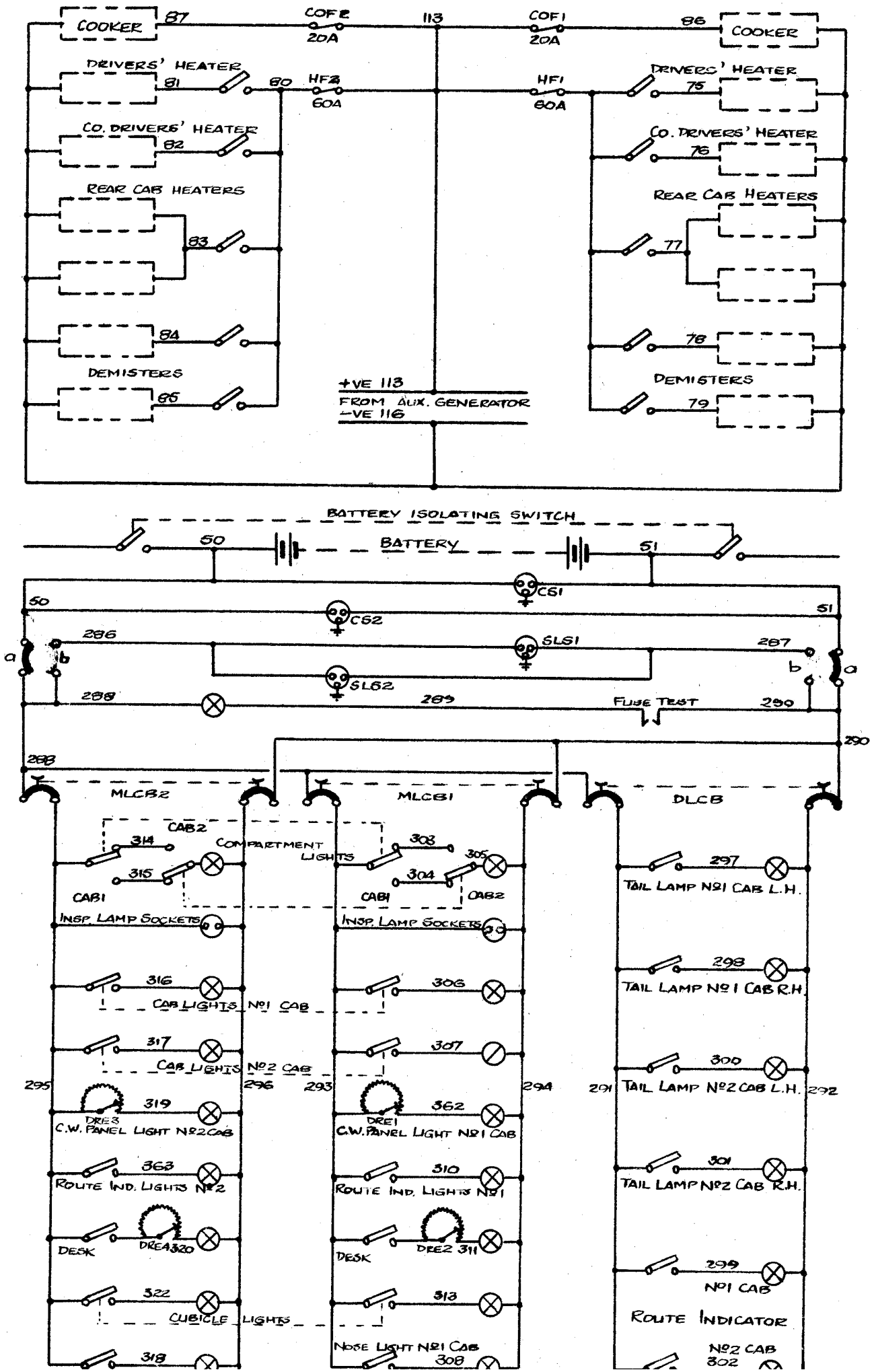


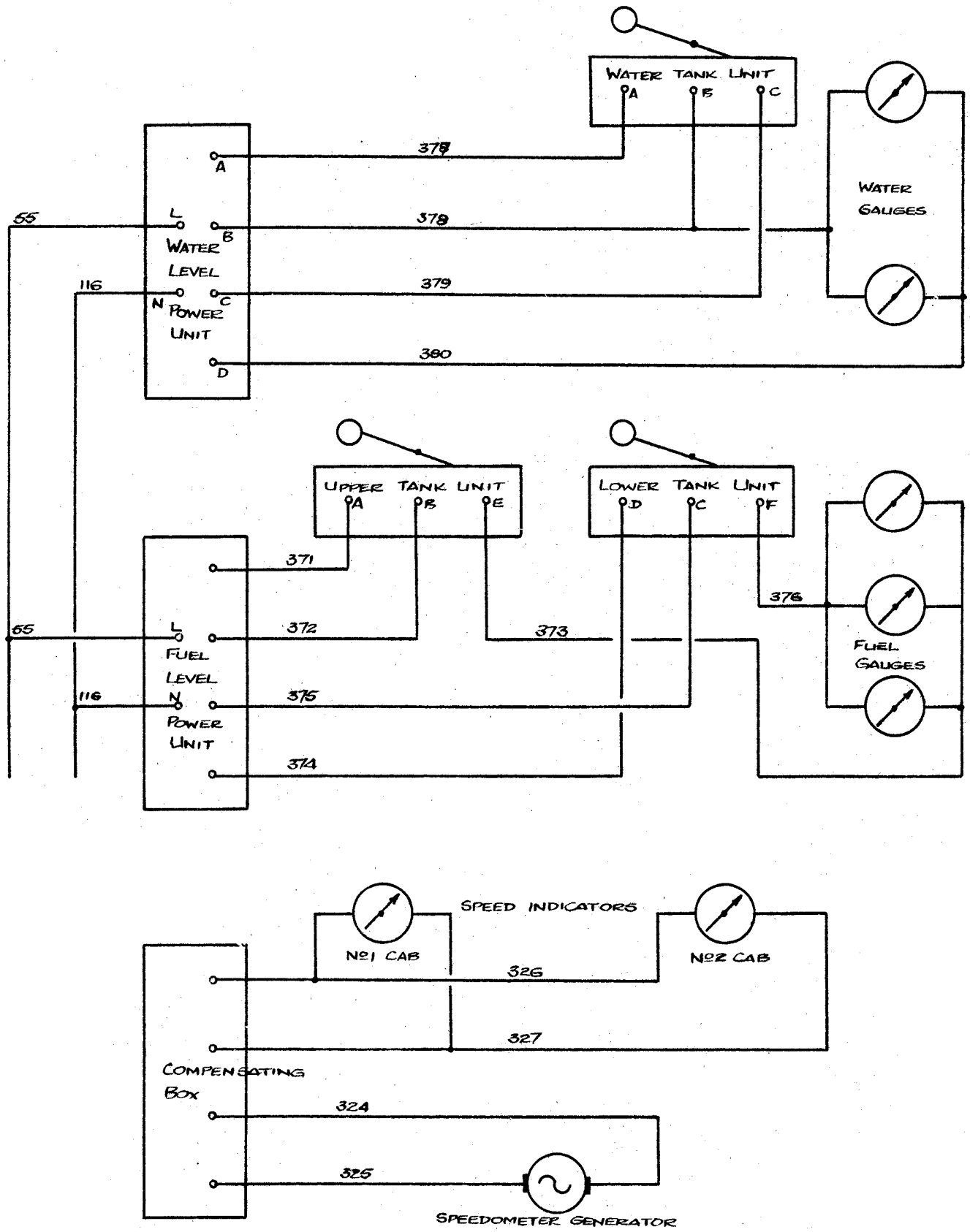


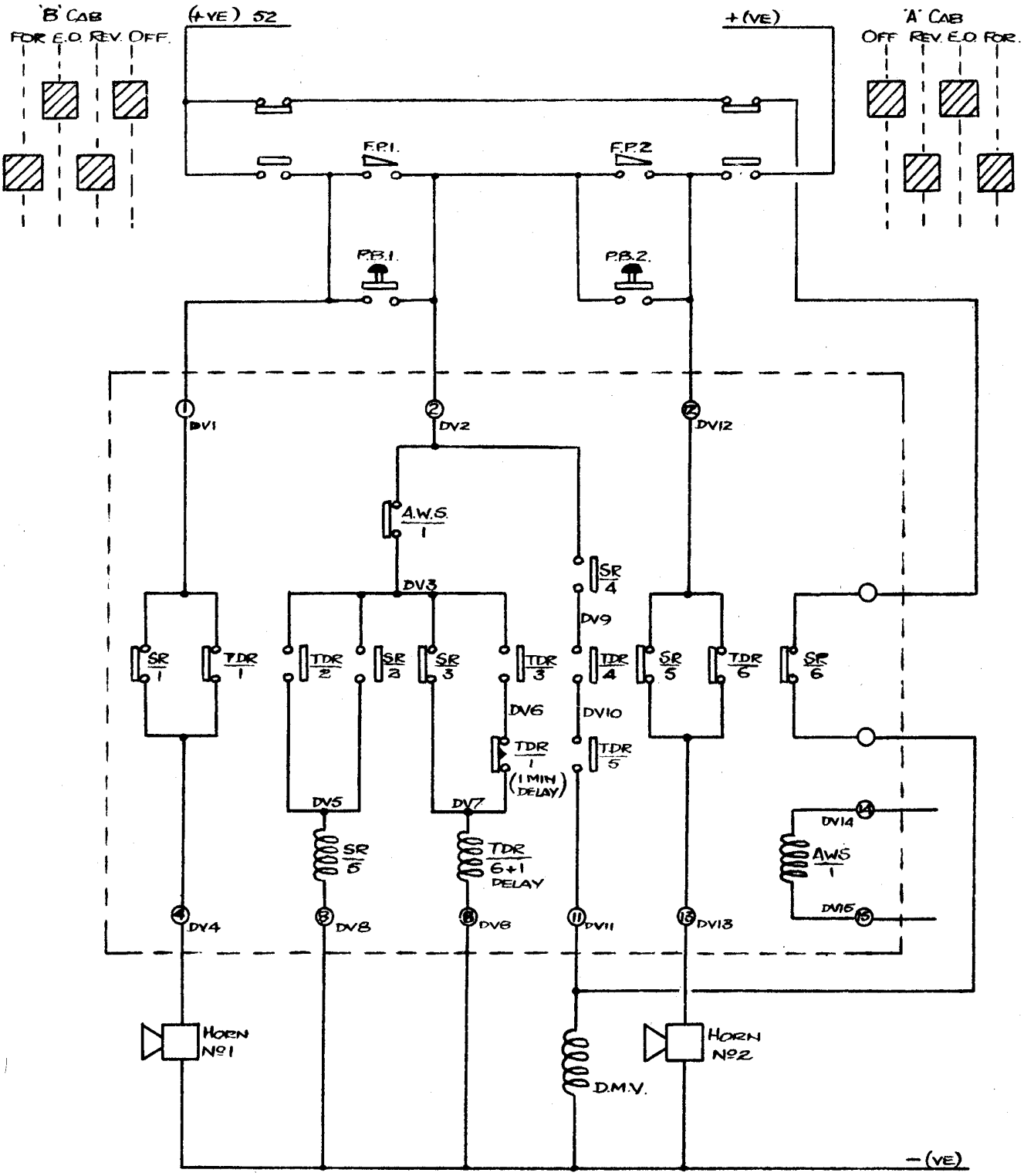




INDICATING & FAULT LIGHTS







SYMBOL	MAKE & DESCRIPTION	TYPE
F.P.1 & 2	FOOTPEDAL	
P.B.1 & 2	PUSHBUTTON	
A.W.S.	A.W.S. RESET RELAY	B.R. CAT Nº 9/62/10532 DO.-44
S.R.	SLAVE RELAY "SQUARE D"	110 VOLTS
D.M.V.	DEADMANS VALVE	
T.D.R.	TIME DELAY RELAY "SQUARE D"	D.E.O-42 110 VOLTS P.36:8
HORN	WARNING BUZZER "GENTS"	110 VOLTS.