BRITISH RAILWAYS
DIESEL MULTIPLE UNIT
MAIN LINE DE LUXE EXPRESS SERVICES

THE J. Stone Group

A.ALLEN

J. STONE & CO. (DEPTFORD) LTD., LONDON, S.E.14, ENGLAND

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BRITISH RAILWAYS

DIESEL MULTIPLE UNIT MAIN LINE DE LUXE EXPRESS SERVICES

J. STONE & COMPANY (DEPTFORD) LIMITED . ENGINEERS . LONDON . S.E.14.

D.725/12/58

BRITISH RAILWAYS AIR CONDITIONED TRAIN

AUXILIARY POWER EQUIPMENT

INTRODUCTION

The Midland Region train consists of 6 cars and the Western Region train of 8 cars, the train arrangements being shown in Fig.1.

The power for the Air Conditioning equipment and for lighting the train is obtained from 2 auxiliary power units mounted on the underframes of the cars situated next to the Motive Power Cars, i.e. the Kitchen cars on the Midland Region 6 car trains and the 2nd class Parlour cars on the Western Region 8 car trains.

Each auxiliary power unit consists of an engine driven alternator with its associated voltage regulator and switchgear, arranged to supply its own feeder mains running the length of the train. The two feeder systems are separate and distinct and distributors are tapped off at each car. No provision is made for parallel running of the alternators.

One power unit will be sufficient for summer cooling and normal heating conditions, but both units will be required for extreme winter conditions. Under normal conditions one power unit will act as a standby.

Automatic control gear is provided to ensure that priority loads will be connected to the first power unit to be started up. Additional loads will be supplied by the second power unit. The shutting down of the first power unit automatically sheds the priority load on to the second power unit.

The terminal voltage of the alternators is controlled by automatic carbon pile regulators.

The starting and stopping of the engines is controlled by push buttons in the same car as the auxiliary power unit. The current for the control circuits and starting motor is provided from a 24 volt battery.

The electrical inter-car couplings must be inserted throughout the train before the feeder contactors can be closed. Any break in the coupling circuits immediately disconnects the feeder mains from the power units. This ensures that exposed coupling pins are safe.

A comprehensive system of protective devices, embodying visual warning is provided to safeguard the electrical and mechanical apparatus.

AUXILIARY POWER CAR EQUIPMENT

Mounted on the underframe of each auxiliary power car is an engine driven alternator set comprising :

> Rolls Royce horizontal 8 cylinder normally aspirated oil engine, type C8 NFH Series 821.
>
> Stone's TONUM alternator with overhung exciter, type ARK 64L/XR22S, 150 KVA, 400V, 3-phase, 50 c/s.

The engine and alternator are bolted together to form one unit. The alternator is driven from the engine by means of a Twiflex coupling..

The engine alternator unit is resiliently mounted under the car, the shafts being parallel to the direction of travel. The engine is accessible for servicing from both sides of the track. The radiator is mounted on the underframe in such a position that air is drawn in from the side of the car by the 'Serck' hydraulicly driven fan.

The exhaust gases pass from the engine exhaust manifold through flexible piping to an underframe mounted silencer and then to the end of the car where they enter a secondary silencer before exhausting at roof level.

The fuel tank is situated on the centre line of the underframe and has a capacity of 100 gallons. Two filler pipes fitted with caps are provided, one on each side of the car. Two mechanical fuel gauges are fitted to the tank and one is visible from each filling position.

The 4-pole alternator is of the rotating field type having salient poles with pole face windings for improved stability of operation. The machine is totally enclosed and is cooled by an external cowled fan, mounted on an extension of the rotor shaft, which blows air over the finned exterior.

In addition to the engine driven alternator set, electrical equipment in totally enclosed boxes is mounted on the underframe of the auxiliary power car. The following are the principal items mounted under the car : (See Fig.2.)

- Feeder contactor panel
- Feeder interlock and tachometer relay panel
- Load change-over panel
- Battery charging transformer - rectifier units
- Battery, 24 volt 216 Ah.

The following equipment is installed in a control cubicle inside the car : (See Fig.3.)

- Engine control panel
- Instrument and indicator light panel
- Regulator panel
- Stabilising transformer panel
- Fuse and distribution panel

The following protective devices are incorporated in the equipment :

Overvoltage relay

Overload relay

Low water level switch

Low oil pressure switch

Fire control switches

In addition the usual fuse protection is provided.

The overvoltage relay is energised if the line voltage exceeds 600 V and interrupts the supply to the control circuits. The fuel-on solenoid is de-energised at the same time and the engine shuts down. The 'Overvoltage' indicator light will be brought into operation. The relay is situated on the Fuse and Distribution panel and may be reset by hand after removal of the panel cover.

An overload on any of the three phases operates the overload relay, which opens the feeder contactor, isolates the alternator, and brings the 'Overload' indicator light into operation. The relay is situated in the feeder contactor switchbox beneath the car but may be reset by hand from within the car.

The low water level and low oil pressure switches de-energise the fuel solenoid relay and shut down the engine. Appropriate warning indicator lights are brought into operation.

The fire control switches energise the feed stop relay which in turn trips the fuel solenoid relay, so stopping the engine. Warning is given by a bell and the operation of a special indicator light in the driver's cab.

ELECTRICAL OPERATION

Starting and stopping push button controls are arranged from two positions.

a) Inside the Car, on the Engine Control panel

b) Outside the Car, on one side near the engine

STARTING (Inside the car)

Starting from inside the car causes the engine to run up to its normal speed of 1500 r.p.m., excites the alternator and connects it to its distribution feeder.

The 'Start' button is depressed and energises the start circuit, i.e., the Start and Release relay, the Start relay, and the thermal relay. The coil circuits of the interlock relay and idling solenoid are also opened. Energising the start circuit operates the Starter solenoid, the Fuel Solenoid relay and lights the green 'Start' indicator light.

The Starter solenoid operates the Starter motor.

The Fuel Solenoid relay operates the 'Fuel-on' solenoid and lights the green 'Fuel-on' indicator light. It also energises a Priming solenoid which resets an Excess Fuel device for starting. Since the Excess Fuel device has a 'once only' action, if the engine fails to start from cold at the first attempt, both the 'Stop' and 'Start' buttons must be pressed to obtain 'Excess Fuel' for the restart.

When both the green 'Start' and 'Fuel-on' indicator lights are illuminated, the 'Start' button may be released as the remainder of the starting sequence is automatic.

On firing, the engine accelerates and as it passes through idling speed, the idling speed tachometer relay operates closing the re-start delay relay. This relay has no delay on closing but only on opening. The re-start delay relay energises the re-start control relay which in turn de-energises the starter solenoid, extinguishes the 'Start' indicator light and inserts an economy resistance in series with the fuel solenoid relay.

When the operating speed is reached, a second tachometer relay energises a synchronous relay. The alternator having built up to full voltage, operation of the synchronous relay brings in the main contactor to energise the distribution feeder. The appropriate phase indicator neon lamps are illuminated as the feeder phases become live.

After about 17 seconds, the thermal relay operates, to terminate the starting sequence. The operation of the relay de-energises its own heater coil, the 'Start' relay and, if the engine fails to fire, the 'Start and Release' relay. The re-set period of the thermal relay is some 2 to 3 minutes which must elapse before the engine can again be started. This gives some protection against starting abuse.

In the case of an engine misfire the following sequence of events takes place. The initial firing of the engine causes the idling speed to be exceeded and the tachometer relay functions at about 90 r.p.m. to re-connect the starter solenoid. A restart delay relay ensures that the starter solenoid cannot be re-energised until the engine has come to rest.

STARTING (Outside the car)

Starting from outside the car causes the engine to run up to its normal speed but does not excite the alternator.

On pressing the outside 'Start' button, the start circuit and interlock relay are energised. Operation of this start circuit results in the engine starting and running up to normal speed. The interlock relay open-circuits the exciter field, so preventing the build-up of the alternator voltage.

IDLING

The engine may be run at its idling speed of about 400 r.p.m. by operation of the external 'Idling' push button, when an 'Idling' indicator light is illuminated inside the car. In order to run the engine at idling speed it must first be run for five to six minutes at normal speed to allow it to warm up. The 'Idling' button may then be pressed to bring the engine down to idling speed.

If the engine has already been started from outside the car and is running at either speed, it can be brought to its normal operating condition by pressing the 'Start' button inside the car. If the engine is running at normal speed this will release the interlock relay, thus exciting the alternator and bringing in the main contactor. If the engine is idling, pressing the internal 'Start' button de-energises the idling and interlock relays. This brings the set to its normal speed and operating condition and extinguishes the 'Idling' indicator light inside the car. While the engine is idling, depression of the external 'Start' button has no effect on the operation.

If the engine is idling and it is required to run the engine at full speed from outside the car, the engine must be shut down and re-started by operation of the external 'Start' and 'Stop' push buttons.

STOPPING

Depressing either the external or internal 'Stop' button disconnects the engine control circuits from the supply and results in the engine shutting down.

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POWER DISTRIBUTION

The power for lighting and air conditioning the train is generated at 400 V A.C. 3 phase 50 c/s and is distributed by two 4 wire feeders running the length of the train.

The bulk of the lighting is supplied at 230 V A.C. by phase to neutral connection on the 400 V feeders, the remainder being supplied at 110 V A.C. from a 230/110 V lighting transformer.

The compressor, condenser fan motor and floor and air heaters are supplied directly with 3 phase power at 400 V.

The air conditioning fan motor and the control circuits are supplied by a 3 phase transformer-rectifier unit, which also maintains the 24 V 216 Ah battery in a charged condition. The emergency lighting supply is obtained from the battery which is mounted beneath the car.

Block schematic diagrams of the power distribution on each car are shown in Figs. 4 to 8 inclusive.

AIR CONDITIONING SYSTEM

INTRODUCTION

The functions of an air conditioning system for a railway coach may be summarised as follows :

a) The control of temperature and humidity within established comfort limits regardless of outside conditions.

b) The supply of the correct amount of outside air and the circulation of all the air in the coach with a controlled, draught-free distribution.

c) The elimination of dirt and dust, both of external and internal origin.

The principal advantages of an air conditioned vehicle are :

a) The heat insulation of the sealed vehicle results in effective insulation against external noise.

b) Cleanliness of upholstery, fittings, decorations, service appointments and napery, resulting in longer life and consequent reduction in maintenance costs.

c) A healthy, draughtless, clean and comfortable atmosphere.

CONDITIONS REQUIRED

Experience in the technique of air conditioning has established a definite zone of satisfactory temperature and relative humidity conditions.

This zone is indicated in the accompanying chart, Fig.9, which shows effective temperatures; that is temperatures which will give equal sensations of comfort with varying dry bulb temperatures and humidities.

For example :

72°F DRY BULB and 56% RELATIVE HUMIDITY is equivalent to an effective temperature of 68°F.

74°F DRY BULB and 37% RELATIVE HUMIDITY is also equivalent to 68°F., effective and it can therefore be said that a similar proportion of passengers will feel comfortable under these two conditions.

The required conditions can be produced by a refrigerating and heating installation, which must be accurately controlled and capable of some adjustment to suit detailed requirements of the particular service.

Air cooling and dehumidification are accomplished by means of a mechanical refrigeration system employing Freon 12 or Arcton 6 as the refrigerant. The compressor and condenser units of the system are mounted on the underframe of the cars. The evaporator unit is mounted above the car ceiling.

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Heating is effected by means of electric heating elements mounted both in the air conditioning unit and at floor level.

The temperature conditions within the car are thermostatically controlled, the transition from operation of cooling to heating equipment, or vice versa, being automatically effected. Three different temperature settings for heating and cooling are provided, which can be selected by a manual control switch within the car.

AIR CONDITIONING SYSTEM

The movement of the air in the car is created by the centrifugal fans in the air conditioning unit. Outside air 'M' (see Fig.10.) is introduced through the filter 'J' and mixed with a proportion of return air 'L' which has been filtered through the filter 'H'. This mixture is then blown over the cooling coils of the evaporator 'E' and delivered into the air duct from where it is distributed to the car.

Part of the air delivered into the car is allowed to escape to the outside atmosphere through static ventilators but a slight pressure is always maintained within the car.

Before entering the air conditioning unit, the air may have a high moisture content which is contributed to by the moisture that is given off by passengers and moisture contained in the outside air. In passing over the cooling coils of the evaporator the air is in intimate contact with a large number of cold metallic surfaces which are at a temperature below that of the dew point of the air, and a proportion of the moisture in the air therefore condenses.

When air heating is required the same circuit is employed. The air again passes over the cooling coils, which are then ineffective and over a group of heating elements which raise the air temperature to a controlled level.

REFRIGERATION SYSTEM

The refrigerating system is of the electro-mechanical type and consists essentially of the following components : (See fig.10.)

A - Motor Compressor

B - Condenser

C - Liquid Receiver

D - Expansion Valve

E - ~~Evaporator~~

F - ~~Filter~~ EVAPORATOR

G - Dehydrator FILTER

The compressor is a type 5F30 hermetically sealed motor compressor, which employs the return refrigerant flow to cool the motor. It is mounted on the underframe together with the condenser, liquid receiver, filter and dehydrator, the condenser having two motor driven fans mounted upon it.

The evaporator and expansion valve form part of the air conditioning roof unit.

The compressor draws refrigerant vapour from the evaporator and in compressing it, raises its temperature.

The high pressure, high temperature vapour is delivered into the air cooled condenser where its heat is removed by the passage of cooling air over the condenser coils. It liquifies and collects in the liquid receiver. From here it passes through the filter and dehydrator cartridges and is then piped to the air conditioning roof unit. It is metered through a small orifice in the expansion valve and on passing into the evaporator coils which are at a lower pressure, it evaporates. Its temperature falls and the evaporator coils are thus cooled.

The air passing over the evaporator coils is lowered in temperature and its moisture content is reduced.

The refrigerant leaving the evaporator is completely vaporised and returns in this state to the compressor, completing the refrigeration cycle.

CONTROL EQUIPMENT

The equipment is controlled from the Air Conditioning Control panel situated in a cupboard within the car. This panel is in two sections situated one above the other and known as the 'Heating Panel' and the 'Heating and Cooling Panel' respectively.

The upper section of the panel carries the following equipment operating at 24 V D.C. :

Master relay

Fan motor relay

Time delay relay

'Vapor' Temperature Control Relays

and the following equipment operating at 110 V A.C. :

Heating contactor *

No-volt relay

The panel has the following manual controls :

Fan and temperature control isolating switch

Time delay setting selector

Temperature control switch

Pilot lights, indicating the operation of the air conditioning equipment, are also mounted on this panel.

The lower section of the panel carries the following equipment operating at 110 V A.C. :

Heating contactor *

Line contactor *

Pilot contactor *

Star-Delta contactor *

Motor Compressor circuit breakers

Condenser fan motor circuit breakers

Synchronous timing relay

The 110 V A.C. control voltage for both sections of the panel is provided by the control transformer mounted on the lower section. The coils of the contactors marked * operate at 110 volts; their contacts operate in 400 volt circuits.

The electrical control of the air conditioning equipment is entirely automatic, being governed by the sensitive thermostats which operate pilot relays. Closure of the fan and temperature control isolating switch energises the control circuit and starts the fan motor. When the demand is for heating, the heating contactors are energised. When the demand is for cooling, the line contactors are energised to start the condenser fan motor and the compressor motor through a Star-Delta sequence.

The time delay relay is incorporated to ease the load that would be imposed on the power supply if the air conditioning motor compressors on each car started simultaneously. This is a thermal relay having a variable resistance in the heater circuit that can be set manually to give the required delay time. The dial is calibrated from 1 to 15 and each setting represents approximately five seconds. The dial in each car should be set to a different setting so that switching on the train air conditioning system results in the equipment in each car starting at a different time.

The temperature control switch enables one of four operating conditions to be selected.

OFF position	All air conditioning circuits are open.
LOW position	The heating comes on when the temperature falls below 68°F. The cooling goes off when the temperature falls below 70°F.
MEDIUM position	The heating comes on when the temperature falls below 71°F. The cooling goes off when the temperature falls below 73°F.
HIGH position	The heating comes on when the temperature falls below 74°F. The cooling goes off when the temperature falls below 76°F.

If the Fan and Temperature Control Isolating switch is open or the fan circuit is broken, the fan series relay will be de-energised and the air conditioning control circuits opened. This provides a safeguard against overheating in the air conditioning unit.

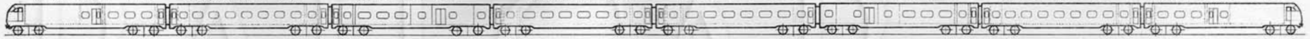
Protection against overload of the motor compressor and condenser fan motor is provided by miniature circuit breakers mounted on the Heating and Cooling panel.

BRITISH RAILWAYS

DIESEL MULTIPLE UNIT MAIN LINE DE LUXE EXPRESS SERVICES

8-CAR UNIT

MOTOR COACH 2ND CLASS | PARLOUR CAR 2ND CLASS | KITCHEN CAR 1ST CLASS | PARLOUR CAR 1ST CLASS | PARLOUR CAR 1ST CLASS | KITCHEN CAR 1ST CLASS | PARLOUR CAR 2ND CLASS | MOTOR COACH 2ND CLASS



MOTOR COACH 2ND CLASS

UNDERFRAME
CONDENSER UNIT
COMPRESSOR UNIT
LOAD CHANGE-OVER PANEL
24 VOLT BATTERY
BATTERY CHARGING UNIT

INSIDE CAR
AIR CONDITIONING ROOF UNIT
FLOOR HEATING UNIT
AIR CONDITIONING CONTROL PANELS
THERMOSTATS
FUSE AND DISTRIBUTION PANEL
A.C. BULK LIGHTING
24 VOLT D.C. EMERGENCY LIGHTING

PARLOUR CAR 2ND CLASS

UNDERFRAME
ENGINE-ALTERNATOR SET
ENGINE CONTROL EQUIPMENT
FEEDER CONTACTOR SWITCHBOX
FEEDER INTERLOCK PANEL

CONDENSER UNIT
COMPRESSOR UNIT
LOAD CHANGE-OVER PANEL
24 VOLT BATTERY
BATTERY CHARGING UNIT

INSIDE CAR
ENGINE CONTROL PANEL
INSTRUMENT AND INDICATOR LIGHTS PANEL
VOLTAGE CONTROL EQUIPMENT

AIR CONDITIONING ROOF UNIT
FLOOR HEATING UNIT
AIR CONDITIONING CONTROL PANELS
THERMOSTATS
FUSE AND DISTRIBUTION PANEL
A.C. BULK LIGHTING
24 VOLT D.C. EMERGENCY LIGHTING

KITCHEN CAR 1ST CLASS

UNDERFRAME
CONDENSER UNIT
COMPRESSOR UNIT
LOAD CHANGE-OVER PANEL
24 VOLT BATTERY
BATTERY CHARGING UNIT

INSIDE CAR
AIR CONDITIONING ROOF UNIT
FLOOR HEATING UNIT
AIR CONDITIONING CONTROL PANELS
THERMOSTATS
FUSE AND DISTRIBUTION PANEL
A.C. BULK LIGHTING
24 VOLT D.C. EMERGENCY LIGHTING
KITCHEN EQUIPMENT & REFRIGERATOR

PARLOUR CAR 1ST CLASS

UNDERFRAME
CONDENSER UNIT
COMPRESSOR UNIT
LOAD CHANGE-OVER PANEL
24 VOLT BATTERY
BATTERY CHARGING UNIT

INSIDE CAR
AIR CONDITIONING ROOF UNIT
FLOOR HEATING UNIT
AIR CONDITIONING CONTROL PANELS
THERMOSTATS
FUSE AND DISTRIBUTION PANEL
A.C. BULK LIGHTING
24 VOLT D.C. EMERGENCY LIGHTING

PARLOUR CAR 1ST CLASS

UNDERFRAME
CONDENSER UNIT
COMPRESSOR UNIT
LOAD CHANGE-OVER PANEL
24 VOLT BATTERY
BATTERY CHARGING UNIT

INSIDE CAR
AIR CONDITIONING ROOF UNIT
FLOOR HEATING UNIT
AIR CONDITIONING CONTROL PANELS
THERMOSTATS
FUSE AND DISTRIBUTION PANEL
A.C. BULK LIGHTING
24 VOLT D.C. EMERGENCY LIGHTING

KITCHEN CAR 1ST CLASS

UNDERFRAME
CONDENSER UNIT
COMPRESSOR UNIT
LOAD CHANGE-OVER PANEL
24 VOLT BATTERY
BATTERY CHARGING UNIT

INSIDE CAR
AIR CONDITIONING ROOF UNIT
FLOOR HEATING UNIT
AIR CONDITIONING CONTROL PANELS
THERMOSTATS
FUSE AND DISTRIBUTION PANEL
A.C. BULK LIGHTING
24 VOLT D.C. EMERGENCY LIGHTING
KITCHEN EQUIPMENT & REFRIGERATOR

PARLOUR CAR 2ND CLASS

UNDERFRAME
ENGINE-ALTERNATOR SET
ENGINE CONTROL EQUIPMENT
FEEDER CONTACTOR SWITCHBOX
FEEDER INTERLOCK PANEL

CONDENSER UNIT
COMPRESSOR UNIT
LOAD CHANGE-OVER PANEL
24 VOLT BATTERY
BATTERY CHARGING UNIT

INSIDE CAR
ENGINE CONTROL PANEL
INSTRUMENT AND INDICATOR LIGHTS PANEL
VOLTAGE CONTROL EQUIPMENT

AIR CONDITIONING ROOF UNIT
FLOOR HEATING UNIT
AIR CONDITIONING CONTROL PANELS
THERMOSTATS
FUSE AND DISTRIBUTION PANEL
A.C. BULK LIGHTING
24 VOLT D.C. EMERGENCY LIGHTING

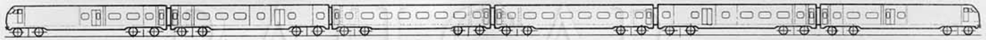
MOTOR COACH 2ND CLASS

UNDERFRAME
CONDENSER UNIT
COMPRESSOR UNIT
LOAD CHANGE-OVER PANEL
24 VOLT BATTERY
BATTERY CHARGING UNIT

INSIDE CAR
AIR CONDITIONING ROOF UNIT
FLOOR HEATING UNIT
AIR CONDITIONING CONTROL PANELS
THERMOSTATS
FUSE AND DISTRIBUTION PANEL
A.C. BULK LIGHTING
24 VOLT D.C. EMERGENCY LIGHTING

6-CAR UNIT

MOTOR COACH 1ST CLASS | KITCHEN CAR 1ST CLASS | PARLOUR CAR 1ST CLASS | PARLOUR CAR 1ST CLASS | KITCHEN CAR 1ST CLASS | MOTOR COACH 1ST CLASS



MOTOR COACH 1ST CLASS

UNDERFRAME
CONDENSER UNIT
COMPRESSOR UNIT
LOAD CHANGE-OVER PANEL
24 VOLT BATTERY
BATTERY CHARGING UNIT

INSIDE CAR
AIR CONDITIONING ROOF UNIT
FLOOR HEATING UNIT
AIR CONDITIONING CONTROL PANELS
THERMOSTATS
FUSE AND DISTRIBUTION PANEL
A.C. BULK LIGHTING
24 VOLT D.C. EMERGENCY LIGHTING

KITCHEN CAR 1ST CLASS

UNDERFRAME
ENGINE-ALTERNATOR SET
ENGINE CONTROL EQUIPMENT
FEEDER CONTACTOR SWITCHBOX
FEEDER INTERLOCK PANEL

CONDENSER UNIT
COMPRESSOR UNIT
LOAD CHANGE-OVER PANEL
24 VOLT BATTERY
BATTERY CHARGING UNIT

INSIDE CAR
ENGINE CONTROL PANEL
INSTRUMENT AND INDICATOR LIGHTS PANEL
VOLTAGE CONTROL EQUIPMENT

AIR CONDITIONING ROOF UNIT
FLOOR HEATING UNIT
AIR CONDITIONING CONTROL PANELS
THERMOSTATS
FUSE AND DISTRIBUTION PANEL
A.C. BULK LIGHTING
24 VOLT D.C. EMERGENCY LIGHTING
KITCHEN EQUIPMENT AND REFRIGERATOR

PARLOUR CAR 1ST CLASS

UNDERFRAME
CONDENSER UNIT
COMPRESSOR UNIT
LOAD CHANGE-OVER PANEL
24 VOLT BATTERY
BATTERY CHARGING UNIT

INSIDE CAR
AIR CONDITIONING ROOF UNIT
FLOOR HEATING UNIT
AIR CONDITIONING CONTROL PANELS
THERMOSTATS
FUSE AND DISTRIBUTION PANEL
A.C. BULK LIGHTING
24 VOLT D.C. EMERGENCY LIGHTING

PARLOUR CAR 1ST CLASS

UNDERFRAME
CONDENSER UNIT
COMPRESSOR UNIT
LOAD CHANGE-OVER PANEL
24 VOLT BATTERY
BATTERY CHARGING UNIT

INSIDE CAR
AIR CONDITIONING ROOF UNIT
FLOOR HEATING UNIT
AIR CONDITIONING CONTROL PANELS
THERMOSTATS
FUSE AND DISTRIBUTION PANEL
A.C. BULK LIGHTING
24 VOLT D.C. EMERGENCY LIGHTING

KITCHEN CAR 1ST CLASS

UNDERFRAME
ENGINE-ALTERNATOR SET
ENGINE CONTROL EQUIPMENT
FEEDER CONTACTOR SWITCHBOX
FEEDER INTERLOCK PANEL

CONDENSER UNIT
COMPRESSOR UNIT
LOAD CHANGE-OVER PANEL
24 VOLT BATTERY
BATTERY CHARGING UNIT

INSIDE CAR
ENGINE CONTROL PANEL
INSTRUMENT AND INDICATOR LIGHTS PANEL
VOLTAGE CONTROL EQUIPMENT

AIR CONDITIONING ROOF UNIT
FLOOR HEATING UNIT
AIR CONDITIONING CONTROL PANELS
THERMOSTATS
FUSE AND DISTRIBUTION PANEL
A.C. BULK LIGHTING
24 VOLT D.C. EMERGENCY LIGHTING
KITCHEN EQUIPMENT AND REFRIGERATOR

MOTOR COACH 1ST CLASS

UNDERFRAME
CONDENSER UNIT
COMPRESSOR UNIT
LOAD CHANGE-OVER PANEL
24 VOLT BATTERY
BATTERY CHARGING UNIT

INSIDE CAR
AIR CONDITIONING ROOF UNIT
FLOOR HEATING UNIT
AIR CONDITIONING CONTROL PANELS
THERMOSTATS
FUSE AND DISTRIBUTION PANEL
A.C. BULK LIGHTING
24 VOLT D.C. EMERGENCY LIGHTING

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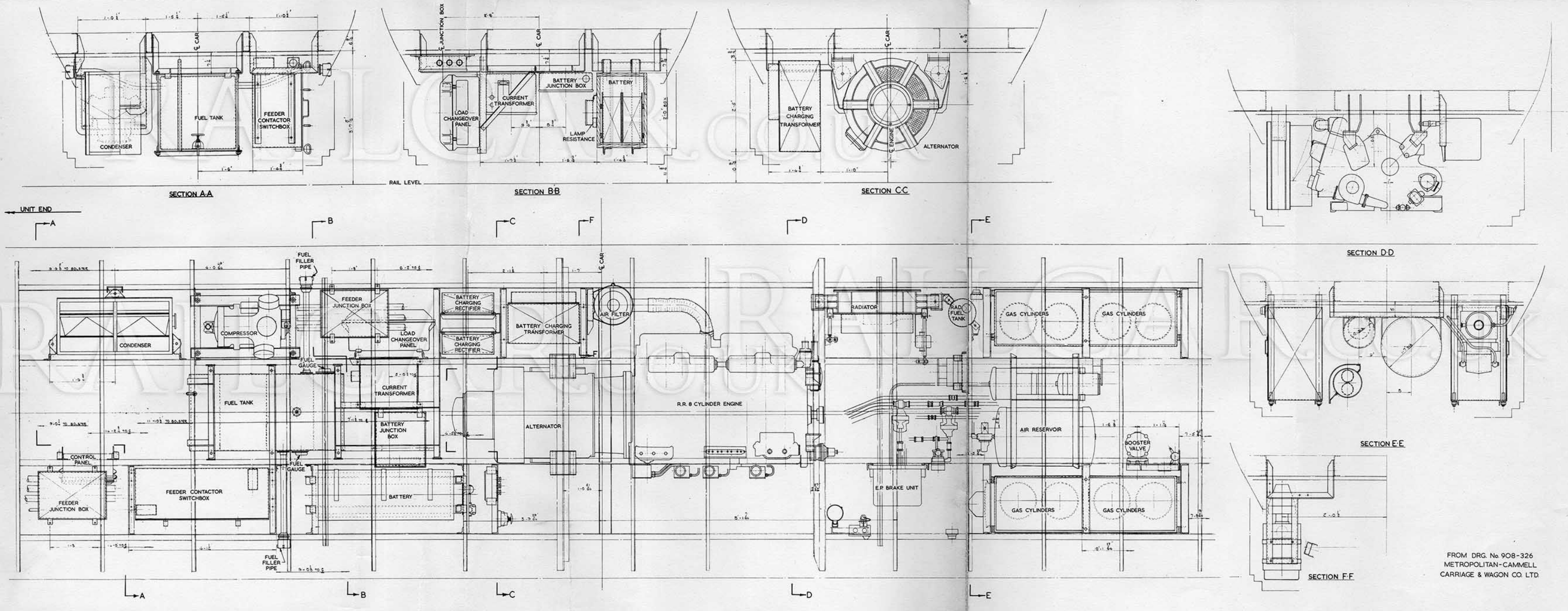
SECTION
FIG. Nº 1



SECTION
FIG. Nº 2

LAYOUT OF AUXILIARY EQUIPMENT IN UNDERFRAME. (TYPICAL)

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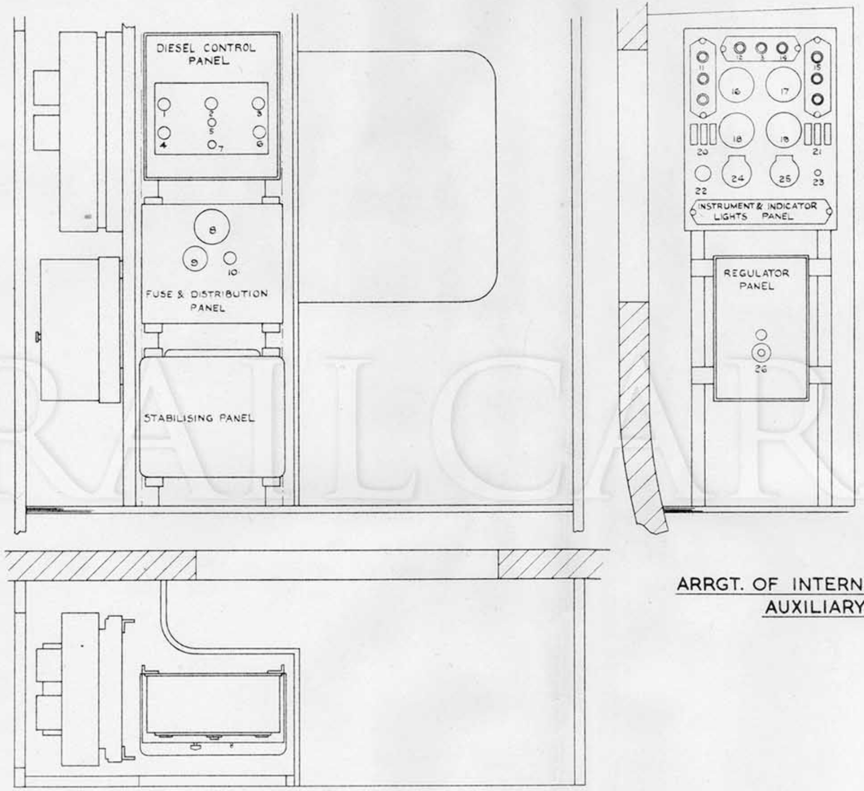
SECTION

FIG. Nº 2



1	LOW OIL PRESSURE LIGHT
2	LOW WATER LEVEL LIGHT
3	IDLING LIGHT
4	FUEL ON LIGHT
5	STOP BUTTON
6	STARTING LIGHT
7	START BUTTON
8	BATTERY AMMETER
9	BATTERY CHARGE ISOLATING SWITCH
10	BATTERY CONTACTOR SWITCH
11	LOCAL PHASE INDICATOR LIGHTS
12	OVERLOAD LIGHT
13	FEEDER CONTROL ON LIGHT
14	OVERVOLTAGE LIGHT
15	REMOTE PHASE INDICATOR LIGHTS
16	EXCITER CURRENT
17	EXCITER VOLTAGE
18	ALTERNATOR CURRENT
19	ALTERNATOR LINE VOLTS
20	FUSES FOR ITEM 11
21	FUSES FOR ITEM 15
22	FEEDER CONTROL ISOLATING SWITCH
23	OVERLOAD RESET
24	ALTERNATOR AMMETER SWITCH
25	ALTERNATOR VOLTMETER SWITCH
26	VOLTAGE ADJUSTER

ARRGT. OF INTERNAL SWITCHGEAR FOR AUXILIARY POWER CAR

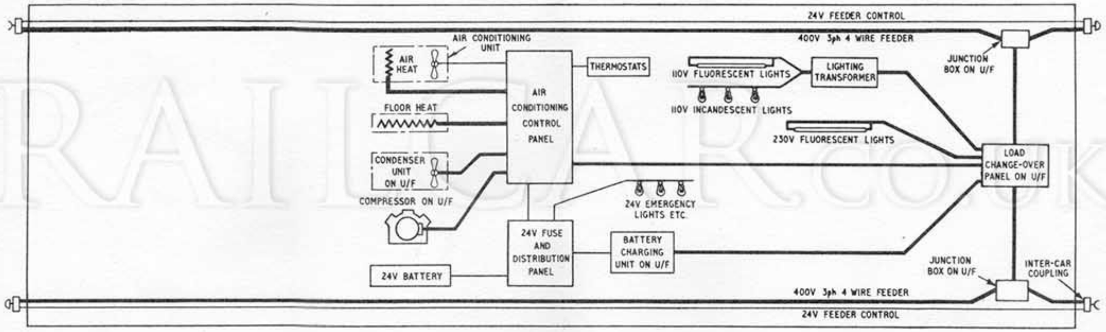
SECTION
FIG. No. 3

WESTERN REGION EIGHT-CAR TRAIN

MOTOR COACH, SECOND CLASS

LONDON MIDLAND REGION SIX-CAR TRAIN

MOTOR COACH, FIRST CLASS



BLOCK SCHEMATIC DIAGRAM OF ELECTRICAL EQUIPMENT

SECTION	
FIG. Nº	4

SECTION	
FIG. Nº	4

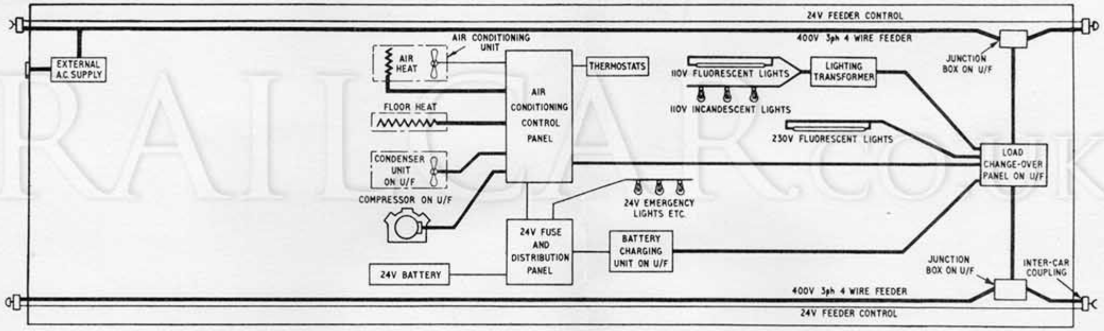
SECTION

FIG. Nº 5

WESTERN REGION EIGHT-CAR TRAIN

LONDON MIDLAND REGION SIX-CAR TRAIN

PARLOUR CAR, FIRST CLASS

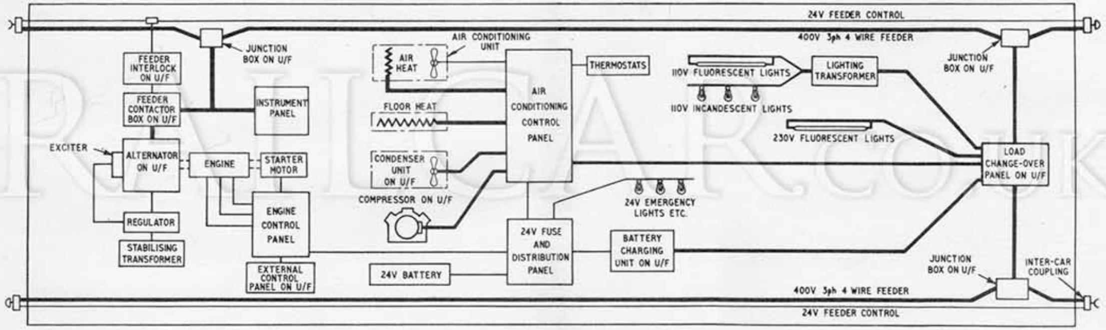


BLOCK SCHEMATIC DIAGRAM OF ELECTRICAL EQUIPMENT

WESTERN REGION EIGHT-CAR TRAIN

PARLOUR CAR, SECOND CLASS

WITH AUXILIARY POWER EQUIPMENT



BLOCK SCHEMATIC DIAGRAM OF ELECTRICAL EQUIPMENT

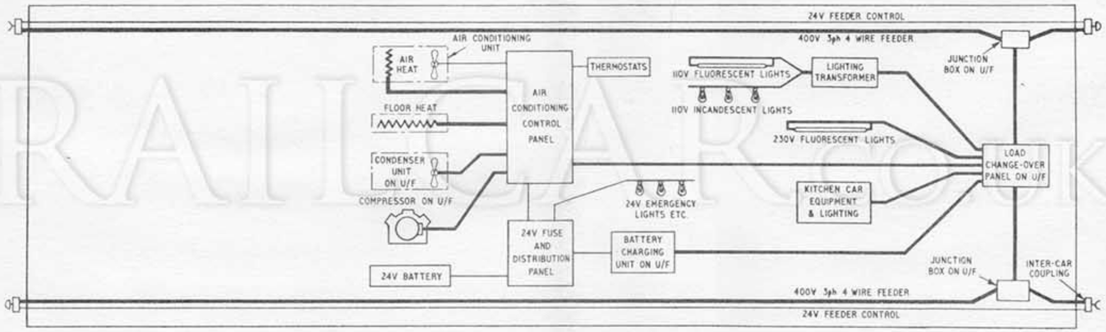
SECTION	
FIG. Nº	6

J. STONE & COMPANY (DEPTFORD) LTD

SECTION	
FIG. Nº	6

WESTERN REGION EIGHT-CAR TRAIN

KITCHEN CAR, FIRST CLASS



BLOCK SCHEMATIC DIAGRAM OF ELECTRICAL EQUIPMENT

SECTION
FIG. Nº 7

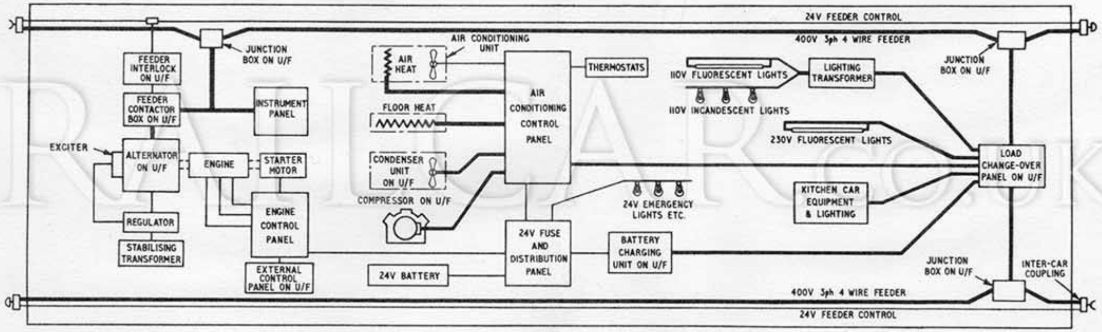
SECTION

FIG. Nº 8

LONDON MIDLAND REGION SIX-CAR TRAIN

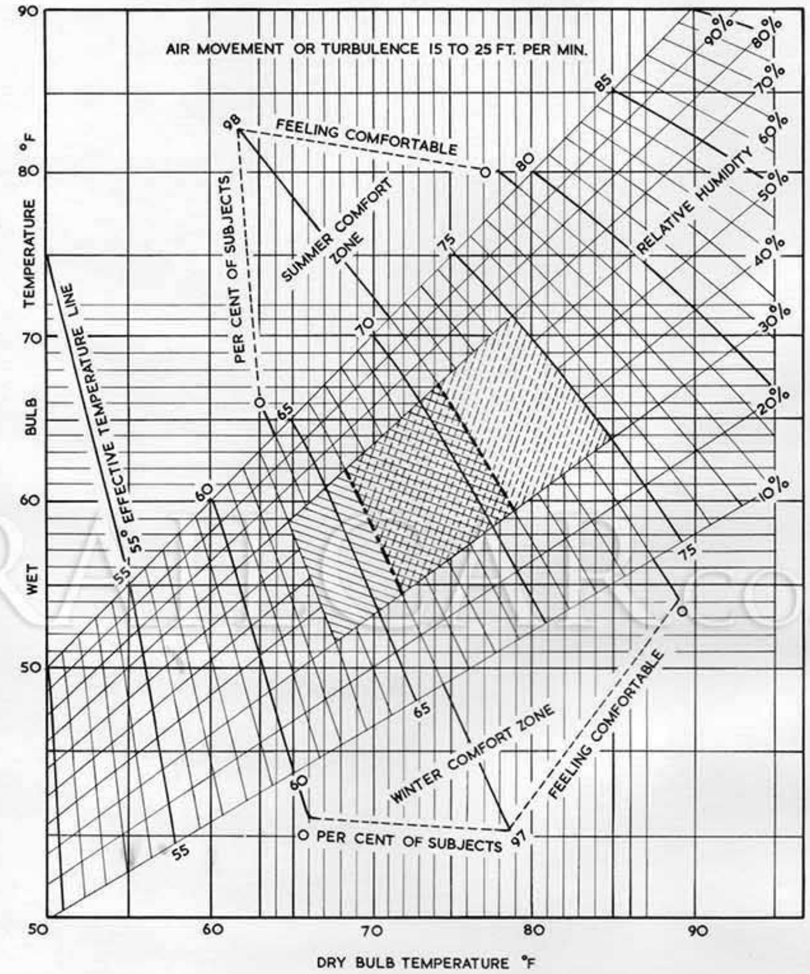
KITCHEN CAR, FIRST CLASS

WITH AUXILIARY POWER EQUIPMENT



BLOCK SCHEMATIC DIAGRAM OF ELECTRICAL EQUIPMENT

EFFECTIVE TEMPERATURE OR COMFORT CHART



(hatched box)	AVERAGE WINTER COMFORT ZONE
—·—·—	AVERAGE WINTER COMFORT LINE
(hatched box)	AVERAGE SUMMER COMFORT ZONE
- - - - - - -	AVERAGE SUMMER COMFORT LINE

SECTION

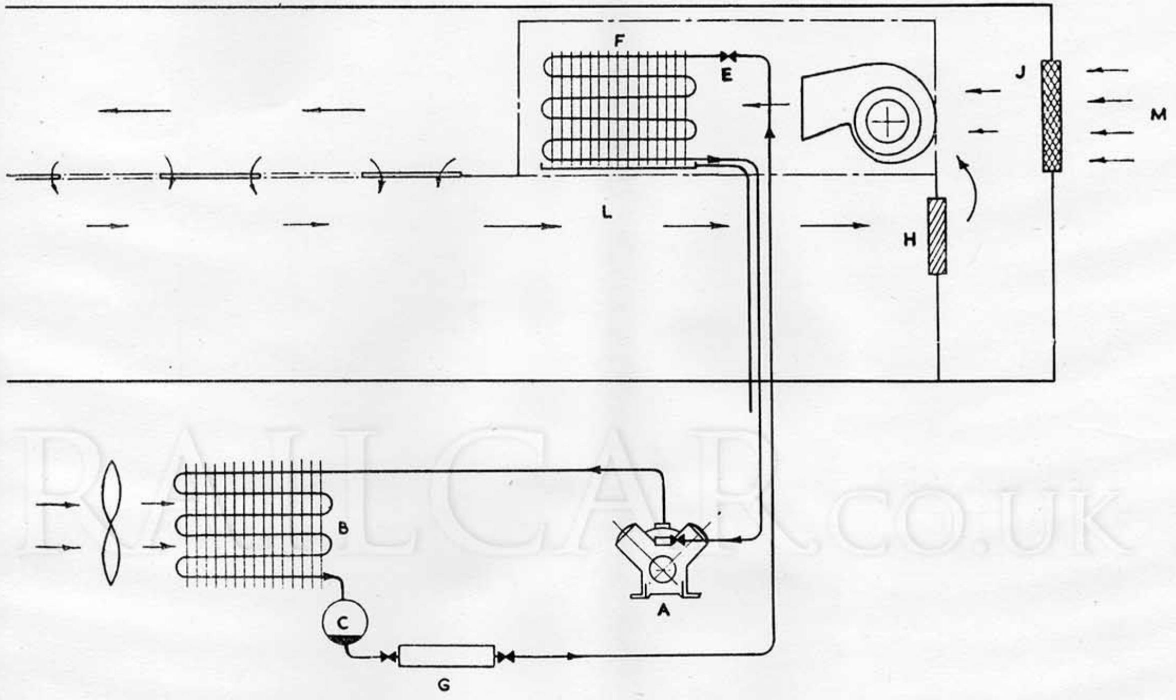
FIG. Nº 9

ASHVE COMFORT CHART FOR AIR VELOCITIES OF 15 TO 25 F.P.M. (STILL AIR)

J. STONE & COMPANY (DEPTFORD) LTD

SECTION

FIG. Nº 9



A. Compressor.
B. Condenser.
C. Liquid Receiver.
E. Expansion Valve.
F. Evaporator.
G. Dehydrator and Filter
H. Return Air Filter.
J. Outside Air Filter.
L. Return Air.
M. Outside Air.

SECTION
FIG. Nº 10

REFRIGERATION SYSTEM AND AIR CIRCULATION

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SECTION
FIG. Nº 10

BRITISH RAILWAYS - DIESEL MULTIPLE-UNIT MAIN LINE DE LUXE EXPRESS SERVICES.

AUTOMATIC OPERATION OF LOAD CONTACTORS.

The capacity of the two engine-alternator sets is such that, for the greater part of the year, the electrical power required throughout the train to provide for air-conditioning, lighting, battery-charging, etc. will be supplied by one set, while the other serves as a stand-by. During the coldest weather, however, an increase in heating will be required, and this will necessitate running the second set in order to supply the additional heaters.

Since each alternator supplies power to its own feeder, the function of the load contactors is to connect the essential circuits to the feeder supplied by the alternator first started up (whichever it may be), and, if the second alternator is started up later, to connect the additional heating load to the feeder supplied by the second alternator.

The essential loads are supplied through contactor A from one feeder or through contactor B from the other feeder. When neither feeder is alive,

Continued ....

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these contactors have their coil circuits connected to their respective feeders, ready to be energized, but the two contactors are electrically interlocked. The additional heaters are supplied through contactors C or D, as the case may be.

If then we assume that the lower feeder in the schematic diagram is made alive, contactor A will close, and its interlock contacts will open the coil circuit of contactor B, making the closing of the latter impossible.

Contactors A and B have further interlock contacts (normally open) in the coil circuits of contactors D and C, respectively. Therefore, locking out contactor B also locks out contactor C, while the closing of contactor A completes the coil circuit of contactor D, so that the latter will close as soon as the upper feeder is energized, and will connect the additional heating circuit to that feeder.

It is to be noted that, in the event of a fault developing in the engine-alternator set supplying the essential loads which makes it necessary or desirable to shut down, these loads can be transferred to the other set with practically no

Continued ....

interruption in the supply. If the second set is not running, it must be started up and preferably, warmed up for a few minutes. The first set is then shut down, and the loss of voltage will open contactor A, which will immediately close contactor B, or vice versa, as the case may be. For a few seconds there will be low volts on the line until the first contactor opens. In very cold weather when the second set is already in use, it is only necessary to shut down the first set, but it will be appreciated that, in this case, there will be no power available for the additional heating after the change-over.

BRITISH RAILWAYS - DIESEL MULTIPLE-UNIT MAIN LINE DE LUXE EXPRESS SERVICES.

COMPRESSOR MOTOR STARTING.

The compressor motor starts automatically when the cooling pilot relay is closed by the cooling thermostats. The closing of this relay completes the circuit through the synchronous timing relay, which consists of a synchronous clock movement operating switches by means of cam discs. The rotor of the clock starts to rotate immediately.

At the end of one second, contacts "a" and "b" of the timing relay are closed. Contact "a" closes the 3-phase line contactor, whereupon the two condenser fan motors start immediately, and contact "b" provides a path to the timing relay in parallel with the normally closed auxiliary contacts on the delta contactor.

At the end of two seconds, the contact "a" is opened again, but the line contactor is held in by its self-retaining contacts.

At the end of three seconds, the timing relay closes contact "c". This energizes the star contactor, the closing of which completes the circuits through the motor windings connected in star, and the motor accelerates. Normally closed contacts on the star

Continued ....

contactor which are in series with the delta contactor coil, are opened, while other contacts on the star contactor are closed to energize the pilot contactor, which is then held in by its own contacts. The pilot contactor closes contacts in series with the delta contactor coil, but the circuit is still open-circuited by the star contactor contacts.

At the end of eleven seconds, when the motor has had eight seconds in which to accelerate to full speed, the timing relay opens contact "c" again, which opens the star contactor. This contactor, on opening, closes its auxiliary contacts in the delta contactor coil circuit. The delta contactor closes immediately and re-connects the motor windings in delta. Auxiliary contacts on the delta contactor in parallel with contact "b" in the timing relay circuit are opened, while other such contacts illuminate the compressor indicator lamp to show that the starting operation has been completed.

At the end of thirty seconds, the timing relay opens contact "b" and the clock movement comes to rest ready for the next starting operation.

BRITISH RAILWAYS - DIESEL MULTIPLE-UNIT MAIN LINE DE LUXE EXPRESS SERVICES.

LIGHTING CONTROL.

Providing that one of the alternators is running and the lights isolating switch is closed, the luggage rack fluorescent lights will be illuminated through the 230/110V transformer, and various other circuits will be available under the control of manual switches, such as the guard's lights and heater, kitchen lights and kitchen equipment, public address system, etc., supplied at 230V.

Main lighting is controlled from the motor coach by means of the well-known arrangement of "on" and "off" push buttons, contactor and release relay. These are all operated from the 24V battery circuit. The contactor referred to is marked LC1 on the diagram. When energized, it closes contacts in the emergency lights circuit and in the coil circuit of contactor LC2. The coil circuit of LC2 is connected between the yellow phase and neutral, and consequently LC2 will not close if the A.C. lighting supply is not on, in which case the 24V emergency lights are left connected to the battery. If the A.C. supply is available, LC2 will close its contacts, switching on the main fluorescent lights in two banks between the neutral and the yellow and blue

Continued ....

phases, respectively, and connecting the toilet and vestibule fluorescent lights to the 230/110V transformer. In this case, when the blue lighting circuit is made live, the contactor LC3 is energized. Its contacts which are in the emergency lighting circuit and are normally closed, will open and will disconnect the emergency lights.

It will be seen that, whenever the lighting contactor LC1 is closed, an interruption in the A.C. supply will cause the emergency lights to be switched on and that they will be extinguished as soon as the A.C. supply is resumed.

BRITISH RAILWAYS - DIESEL MULTIPLE-UNIT MAIN LINE DE LUXE EXPRESS SERVICES.

AIR CONDITIONING CONTROL.

General

When climatic conditions are suitable, the fan may be run without bringing cooling or heating into play. It is only necessary to close the fan switch, leaving the temperature control switch in the off position. The fan will then circulate filtered air through the coach, and the fan motor pilot lamp will be illuminated.

Closing the fan switch will energize the fan series relay, the contacts of which will energize the heater circuit of the time delay relay through the no-volt relay contacts. It follows that this circuit can be operated only if at least one alternator is running, with the appropriate feeder and load contactors closed, in order to energize the no-volt coil. The closing of the time delay relay contacts operates the master control relay, which, on closing, permits operation of the temperature controls. The master control relay also closes self-retaining contacts and opens the heater circuit of the time delay relay.

The function of the time delay relay is to prevent all the compressor motors throughout the train starting

Continued ....

simultaneously as soon as a feeder is made alive, a condition which would produce a serious overload on the alternator. In order to avoid this happening, the heaters of the time delay relays are supplied with current through variable series resistors, which are mounted on the panels and provided with scales and pointers. Clockwise rotation of the pointer decreases the heater current and increases the time required to deflect the bimetal strip, this increasing the time delay. Position 1 on the scale gives a delay of about ~~5~~ 18 seconds, and each division adds another 5 seconds, approximately. Throughout the coaches composing a train, the time delay settings should be such that no two are alike: by this means a suitable staggering of starting times is achieved.

<u>Thermostats.</u>

The thermostats are of the mercury-in-glass type, the only essential difference between them and ordinary dry-bulb thermometers being that the thermostats have two wires sealed into the glass at different heights up the stem in order to make contact with the mercury, and they have an additional bulb some distance up the stem which is surrounded by a fine wire heater winding.

Continued ....

The value of temperature etched on the stem of the thermostat and indicated on the drawings is the ambient temperature at which the mercury just makes contact with the upper wire when the heater winding is not connected, and this is called the "natural setting" of the thermostat. When a small current is passed through the winding, the level of the mercury is raised, and the thermostat will make and break contact at ambient temperatures lower than the natural setting. By varying the heater winding current the operating temperature can be lowered as desired, but it can never be higher than the natural setting. For this reason the heater winding is called the "bias winding", and this type of thermostat is known as a "biased thermostat".

Two thermostats are used for cooling control and two for heating control. Their operation is explained below.

<u>Temperature Control Switch.</u>

In addition to the off position, this switch has three working positions for controlling under "low", "medium" and "high" cooling and heating conditions, respectively. The temperatures corresponding to the three positions are:-

Continued ....

Position	Cooling	Heating
~~Low~~ High	76°F.	74°F.
Medium	73°	71°
~~High~~ Low	70°	68°

The function of the switch, in each of its working positions, is to connect one resistor in series with the bias windings of the cooling thermostats, and another in series with the bias windings of the heating thermostats, of such ohmic values that they pass the currents necessary to reduce the operating temperatures of the thermostats from the natural setting to the temperatures given above.

Cooling

Two thermostats are used for cooling control, their contacts being connected in series with each other and with the coil of the cooling pilot relay.

Assuming that the temperature control switch has been placed in the "low" position, the operating temperatures of both thermostats will be lowered by 8°F., i.e., the thermostat marked 78°F. will work at 70°F. and the one marked 79°F will work at 71°F.

With rising temperature in the coach, a temperature slightly higher than 70°F. will produce no change, because, although the contacts of the 70°F.

Continued ....

thermostat have closed, those of the 71°F. thermostat are still open. When the temperature reaches 71°F. the contacts of the second thermostat close, so that the circuit through the coil of the cooling pilot relay is complete. The contacts of this relay close and initiate the operation of starting the compressor motor.
When the cooling pilot relay closes, it also short-circuits the second thermostat (71°F), with the result that the coach temperature can fall to 70°F. without stopping the compressor. At this temperature, however, the first thermostat (70°F.) opens its contacts and de-energizes the cooling pilot relay, thus shutting down the compressor motor.

The cooling pilot relay has additional contacts which, when the relay is energized, lock out the heating by opening the heating relay circuits, and also connect an additional resistor in parallel with that already connected in series with the bias windings of the heating thermostats. The latter operation increases the current in the bias windings, and therefore, the heat of the mercury in the thermostats, so that, when cooling ceases, there will be a slight time delay, during which the thermostats cool down, before the latter can operate to switch on heating.

Continued ....

The cooling pilot relay has a rectifier connected in parallel with its coil to serve as a discharge path. Without such provision, breaking the inductive coil circuit at the thermostat contacts might cause arcing sufficient to burn the contacts and foul the mercury.

When it is required to run the compressor under temperature conditions too low to produce automatic starting, the panel terminals LL1 and LL3 may be connected together with a piece of wire. Closing the fan switch and the temperature control switch will then start the compressor regardless of temperature conditions.

Heating

Heating is controlled by two thermostats, both of which have a natural setting of 76°F. Each of the thermostats has its contacts connected in parallel with the coil of one of the two heating relays. Under high temperature conditions, the level of mercury in the thermostats is high enough to keep the relay coils short circuited, but, when the temperature falls sufficiently, the mercury breaks contact and energizes the relays, so that heating is switched on. Two resistors are connected in series with each relay coil in order to prevent a short-circuit across the 24V line

Continued....

when the coil is short-circuited.

When cooling ceases, the cooling pilot relay is de-energized, so that the coil circuits of the heating relays are re-connected and the bias winding currents are restored to their working values. As soon as the thermostats have cooled down, the heating controls are ready to provide normal operation.

Assuming that the temperature control switch is in the "low" position, the working temperatures of the two thermostats will be reduced by 8°F., i.e., they will both operate at 68°F. Consequently, when the coach temperature falls to this value, both thermostats will open their contacts, removing the short-circuits across the coils of the heating relays 1 and 2, so that these relays close, and, in turn, close the heating contactors 1 and 2, respectively. When contactor 1 closes, it will always connect the first stage of air and floor heat, but whether the closing of contactor 2 makes the second stage effective or not, will, of course, depend upon whether the second alternator is running or shut down. The coach temperature will now rise until the thermostats again short-circuit the relay coils and switch off the heaters.

Continued ....

The thermostats will maintain this cycle of switching on and switching off as long as heating is required. When the outside temperature is falling, the "ON" periods will increase, and the "OFF" periods will decrease, in length of time. If, with only one alternator running, a stage is reached when the heaters are switched off only for short periods at infrequent intervals, it is a clear indication that the second alternator set should be started up immediately. The operation of the heating contactors should be observed from time to time by watching the indicating lamps on the panel, marked "air and floor heat 1" and "air and floor heat 2". The first of these will light when heating contactor 1 closes and is extinguished when this contactor opens; the second lamp will behave in a similar manner relative to contactor 2, but only when the second alternator set is running.

Other indicating lamps on the panel show when:-

(1) The circulating fan is running

(2) The first alternator supply is on

(3) The second alternator supply is on

(4) The compressor is running.

BRITISH RAILWAYS - DIESEL MULTIPLE-UNIT MAIN LINE DE LUXE EXPRESS SERVICES.

STARTING OPERATIONS

When the start push button inside the coach is pressed -

(1) - The interlock relay, if it has been energized by the push button outside the coach, is de-energized, so that the exciter field circuit is re-connected to permit the alternator to generate. The description of starting from outside the coach will make the operation clear.

- The idling solenoid is switched off if it has already been operated from outside.
- The start relay is energized.
- The lock-out relay is energized.
- The start and release relay is energized.
- The heater circuit of the thermal relay is connected.

(2) - The start relay energizes the fuel solenoid relay and prepares its own self- retaining circuit.

- The lock-out relay disconnects the battery from its charging circuit. (See section "Lock-out Relay" below.)
- The start and release relay energizes the starter solenoid and lights the "engine starting" lamp.

Continued ....

It also short-circuits resistance in the fuel solenoid circuit.

(3) - The fuel solenoid relay energizes the fuel solenoid and also the oil indicator relay, which is then held in through its self-retaining contacts.

- The starter solenoid connects the starter motor to the battery, so that the engine is turned.

(4) - The fuel solenoid, in addition to opening the fuel valve, energises the priming solenoid and the fuel relay, and lights the "fuel on" lamp.

(5) - The priming solenoid provides a rich mixture for starting.

- The fuel relay energizes part of the positive line from the battery which provides for the start relay holding itself in, and therefore, as soon as the "fuel on" lamp lights, the start push button can be released.

(6) As the engine passes through idling speed, the tacho. relay (idling) energises the re-start delay relay. This relay has no delay on closing but only on opening. The re-start delay relay energizes the re-start control relay, which in its turn de-energizes the start and release relay.

Continued ....

Opening the start and release relay inserts economy resistance in series with the fuel solenoid coil, and opens the starter solenoid so that the starter motor comes to rest and the "engine starting" lamp is extinguished.

(7) About 17 seconds after pressing the start button, the thermal relay opens its contacts, switching off its own heater circuit, the start relay, the lock-out relay, and (if the engine has not reached idling speed) the start and release relay.

- The thermal relay contacts require 2-3 minutes to close again, which helps to prevent abuse of the battery and starting gear.
- The start relay opens its contacts in parallel with the push buttons, so preventing a re-start except by use of the push buttons. It also opens contacts in series with the coil of the fuel solenoid relay, but, providing the engine oil pressure has risen normally, the place of these contacts is taken by contacts on the low oil pressure switch.
- The lock-out relay re-closes its contacts in the battery contactor coil circuit, so that the

Continued ....

battery can be charged. (See section "Lock-out Relay" below).

- The effect of de-energising the start and release relay is as described in the proceeding paragraph.

(8) As soon as the engine set reaches synchronous speed, the synchronous tacho. relay will energise the synchronous relay.

(9) If the feeder control isolating switch is now closed and the loop through the C1 and C2 lines is complete, the feeder relay will close, energizing the interlock contactor, making the feeder overload protection effective, and lighting the "feeder control on" indicating lamp.

(10) The operation of the interlock contactor will close the feeder contactor and so connect the alternator to the feeder, whereupon the appropriate phase indicator lamps light.

(11) If during starting, the engine reaches such a speed that the idling tacho. relay operates, and immediately afterwards the engine shuts down, the opening of the tacho. relay, which will occur at an engine speed of about 90 r.p.m., re-connects the start and release relay, so re-starting the

Continued ....

starter motor. The function of the re-start delay relay is to provide several seconds delay before re-connecting, so that the engine will come to rest before re-engagement of the starter motor.

When the start push button outside the coach is pressed -

Starting proceeds as described above, but the push button energizes the interlock relay, which opens the exciter field circuit so that the alternator cannot generate its voltage. The relay has self-retaining contacts which keep it energized after the push button is released.

If the engine has been started from inside the coach, the push button lock-out relay will have been operated, making it impossible for operation of the outside push buttons to have any effect.

Idling

When the engine has been started from outside, its speed can be reduced to idling speed (about 400 r.p.m) by pressing the idling button situated outside the coach. An "idling" indicator lamp is then illuminated inside the coach. The engine, if cold, should be run at full speed for 5 to 6 minutes to allow it to warm up, before pressing the idling button.

Continued ....

While the engine is idling, pressing the outside start button will not affect the operation. If it is required to increase to full load speed using the outside controls, the engine must be shut down by means of the stop button and re-started by using the start button.

If the engine has been started from outside, it can be brought to its normal operating condition by pressing the start button inside the coach. If the engine is running at full speed, this operation will release the interlock relay, so that the alternator is excited and the feeder contactor closes. If the engine is idling, pressing the internal start button de-energizes the idling solenoid as well as the interlock relay, so that the engine speed is raised to full speed and normal operating conditions are established. The "idling" indicator lamp is extinguished.

Shutting Down

Pressing either the external or internal stop button disconnects the engine control circuits. The fuel valve then closes and the engine shuts down.

Lock-out Relay.

The function of this relay is to protect the battery charging rectifiers against overload during

Continued ....

the engine starting operation. The condition of danger only arises when one of the alternator sets is running and it is required to start the second one. Under these conditions, the first alternator will be charging the battery of the second set through the transformer and rectifiers. Consequently, a large proportion of the starting current would be drawn from the A.C. line through the rectifiers, constituting a severe overload on the latter.

As provision is made for the circuit between the rectifiers and the battery to be opened during the starting operation and re-connected afterwards, any such danger is obviated.

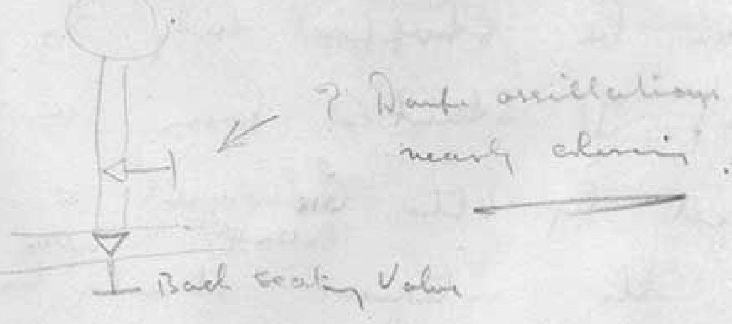
Shutting Down

If the engine has been started from the inside, it can be stopped only by the Internal Stop button. If Started from outside, it can be stopped by the External (External) or internal stop button, unless the internal start button has subsequently been pressed, in which case, only the internal stop button will shut down the engine.

Re Constitutionary

Publication 1/20

Stop Valves of compressor is of the back seating type.



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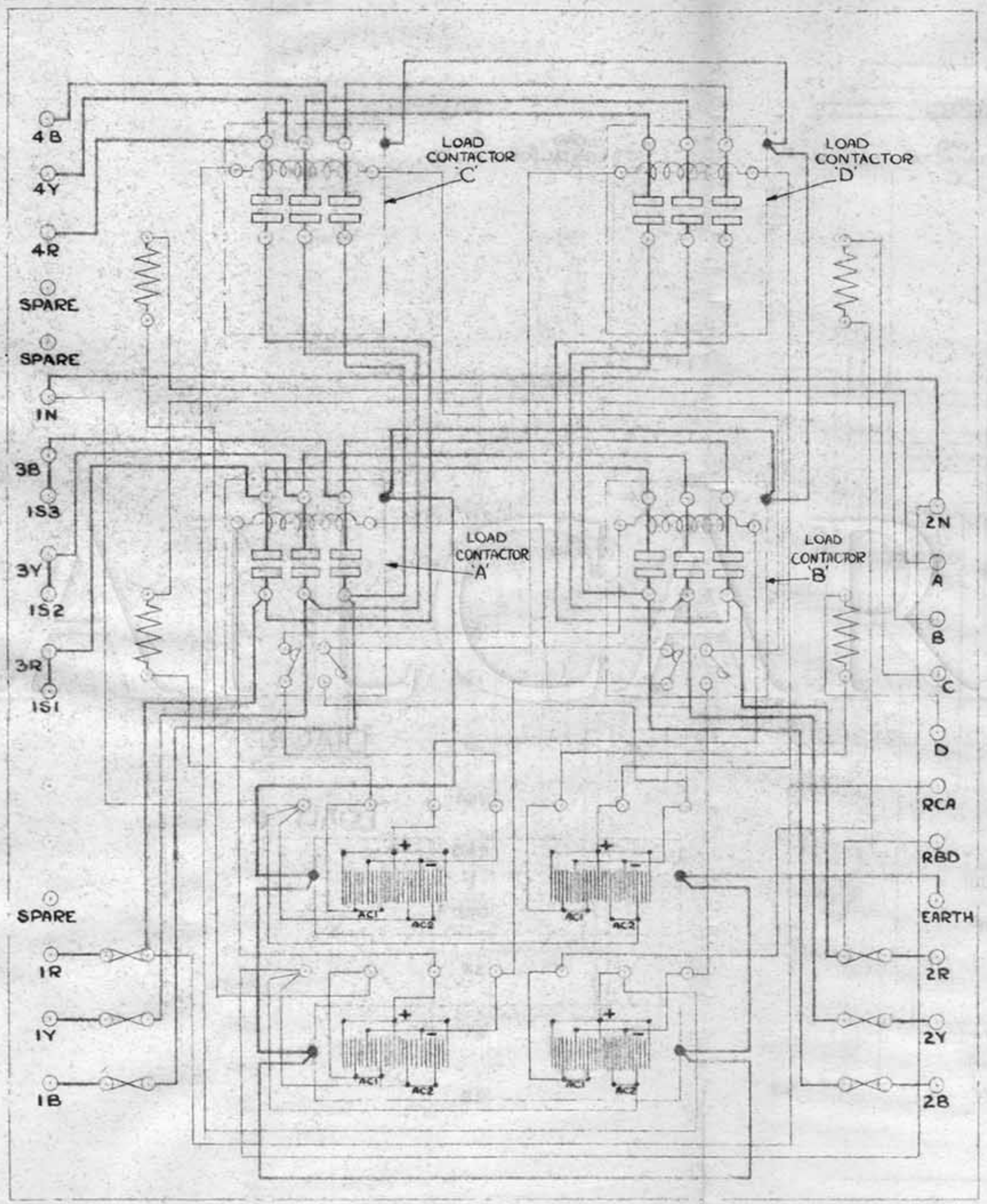

NOTE
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DIAGRAM OF CONNECTIONS
FOR
LOAD CHANGEOVER PANEL

24 NOV 1958

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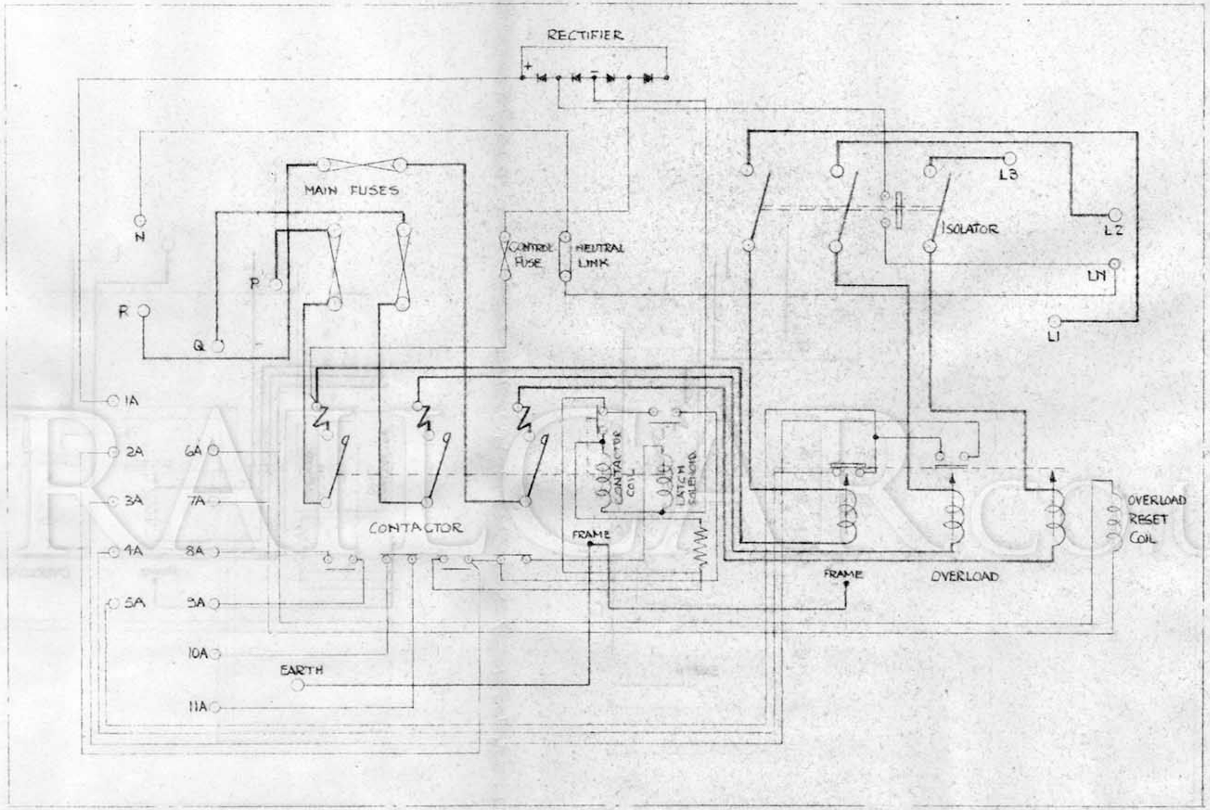

DIAGRAM OF CONNECTIONS
FOR
FEEDER CONTACTOR PANEL

NOTE

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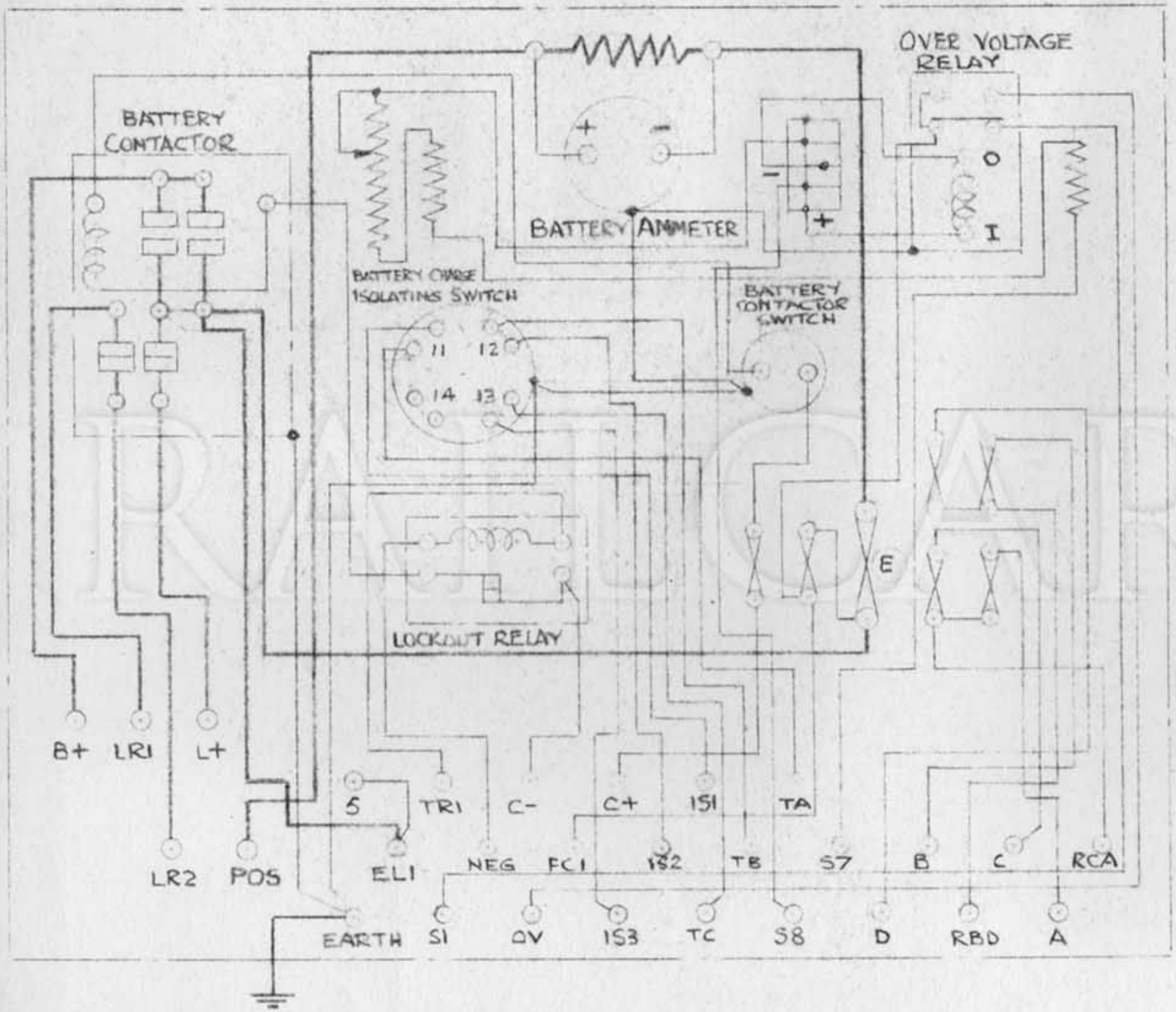
DIAGRAM OF CONNECTIONS FOR FUSE & DISTRIBUTION PANEL



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J. STONE & COMPANY (DEPTFORD) LTD. ELECTRICAL ENGINEERS DEPTFORD, LONDON, S.E. DRAWING OFFICE 24 NOV 1958

J. STONE & Co. (DEPTFORD) LTD LONDON.

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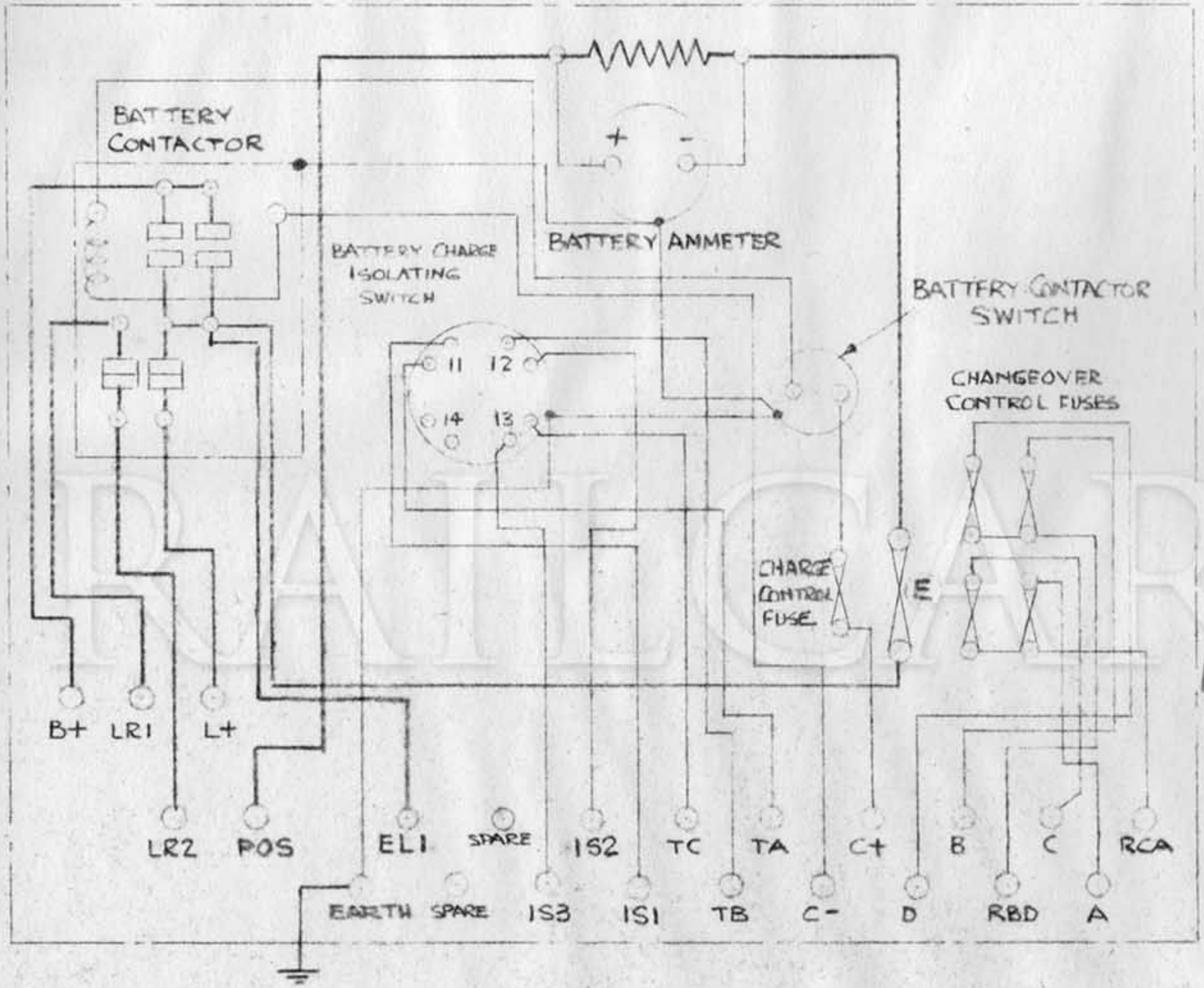

DIAGRAM OF CONNECTIONS FOR FUSE & DISTRIBUTION PANEL

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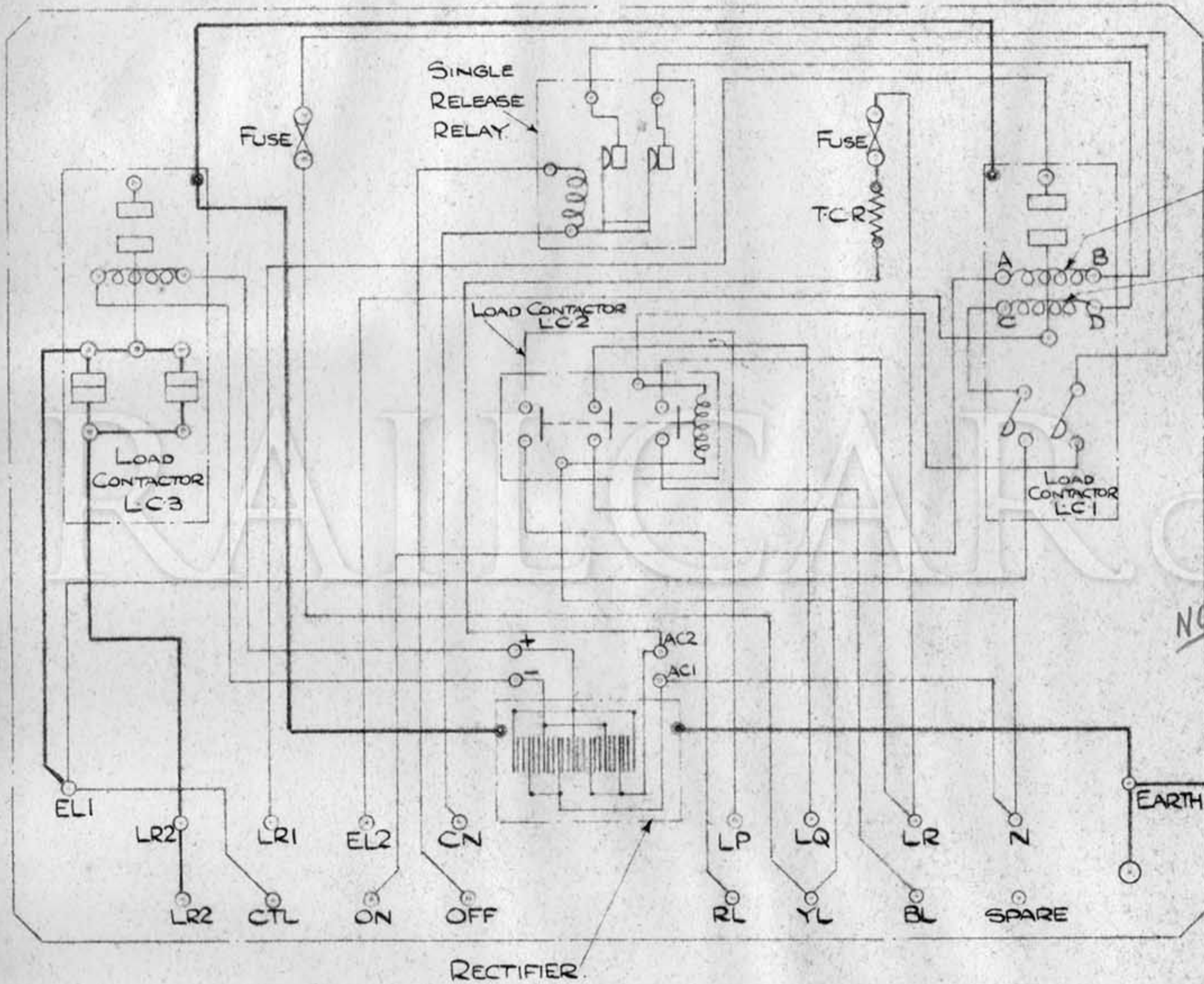

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24 NOV 1958

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Diagram Of Connections For Through Lighting Control Panel

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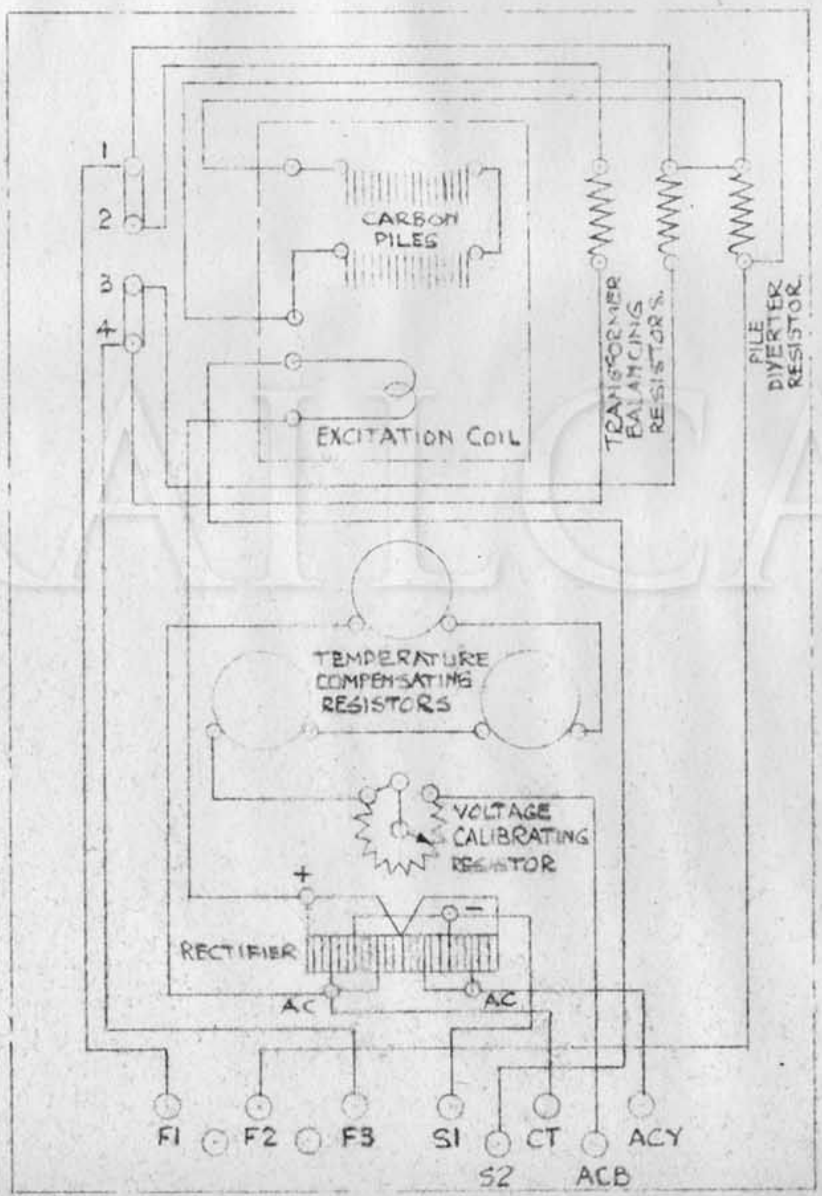

DIAGRAM OF CONNECTIONS FOR AUTOMATIC VOLTAGE REGULATOR

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24 NOV 1958
ENGINEERS, DEPTFORD, LONDON, S.E.

J. STONE & Co. (DEPTFORD) LTD. LONDON

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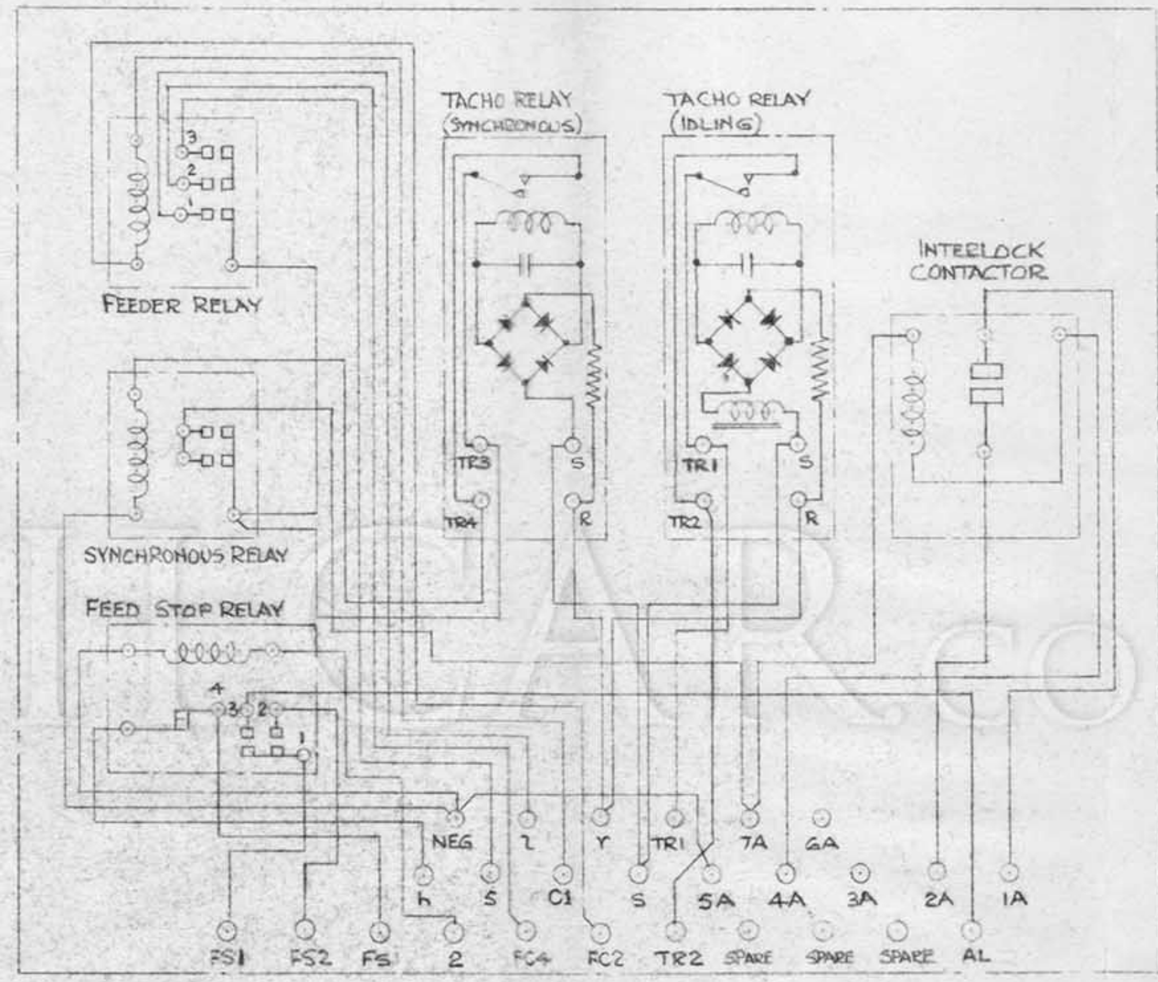

NOTE
THIS DIAGRAM IS CORRECT TO DATE OF ISSUE ONLY

DIAGRAM OF CONNECTIONS
FOR
FEEDER INTERLOCK & TACHO RELAY PANEL

J. STONE & C^O. (DEPTFORD) L^TD. LONDON.

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TRACED BY
TRG. CHD. BY
DATE 12-3-58

GA. DRAWING No.

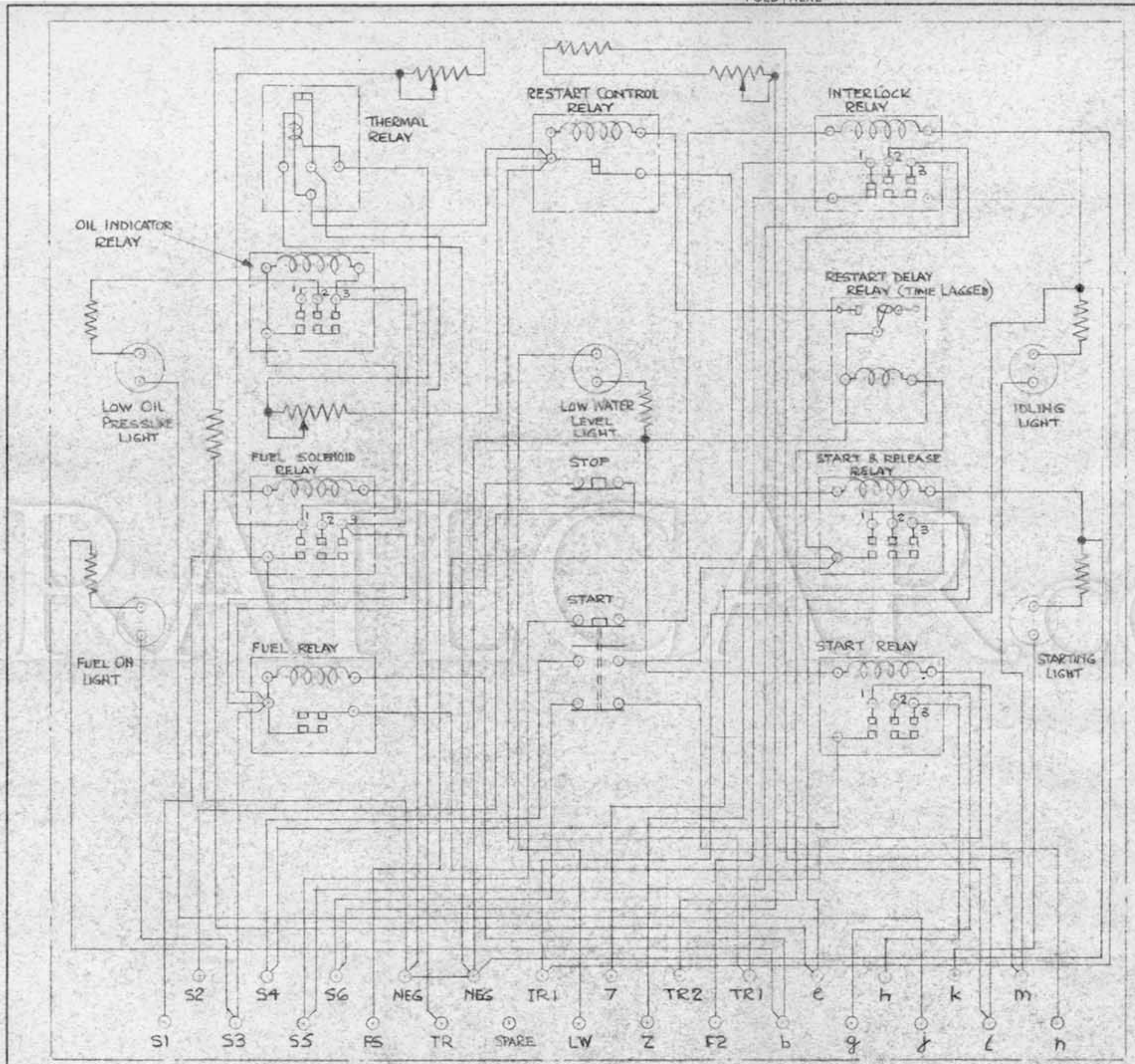


DIAGRAM OF CONNECTIONS FOR DIESEL CONTROL PANEL

NOTE:- THIS DIAGRAM IS CORRECT AT DATE OF ISSUE ONLY.

J. STONE & Co. (DEPTFORD) LTD. LONDON.

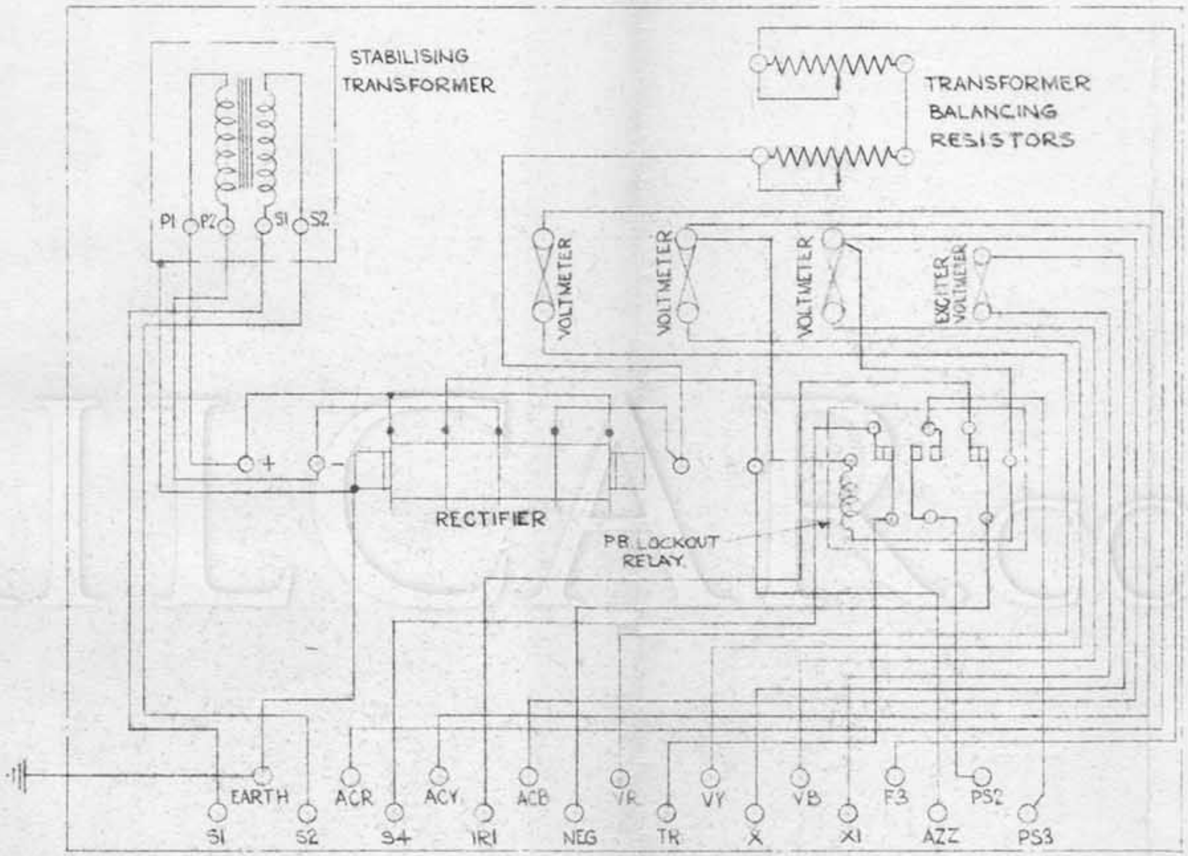
[redacted]

DRAWN BY ERL
DRG. CHD. BY
TRACED BY
TRG. CHD. BY
DATE 12-2-58

MOD		MOD	
1	INT'K RELAY COIL WAS CONNECTED TO "NEG". THERM. RELAY CONTACT WAS CONNECTED TO "S4"	2	TOP OF IDLING LIGHT RESISTOR WAS CONNECTED TO TOP OF STARTING LIGHT RESISTOR.
29/12/57	PC 4707 ERL	21/IV/58	PC 4822 PCJ

FOLD HERE

GA. DRAWING No.



NOTE

THIS DIAGRAM IS CORRECT TO DATE OF ISSUE ONLY

DIAGRAM OF CONNECTIONS FOR STABILISING PANEL

1	P.B. LOCKOUT RELAY ADDED	
25/7/58	PC 4707	

J. STONE & Co. (DEPTFORD) LTD. LONDON.

[redacted]

DRAWN BY	D.A.V.
DRG. CHD. BY	
TRACED BY	
TRG. CHD. BY	
DATE	25.9.58

GA. DRAWING No.

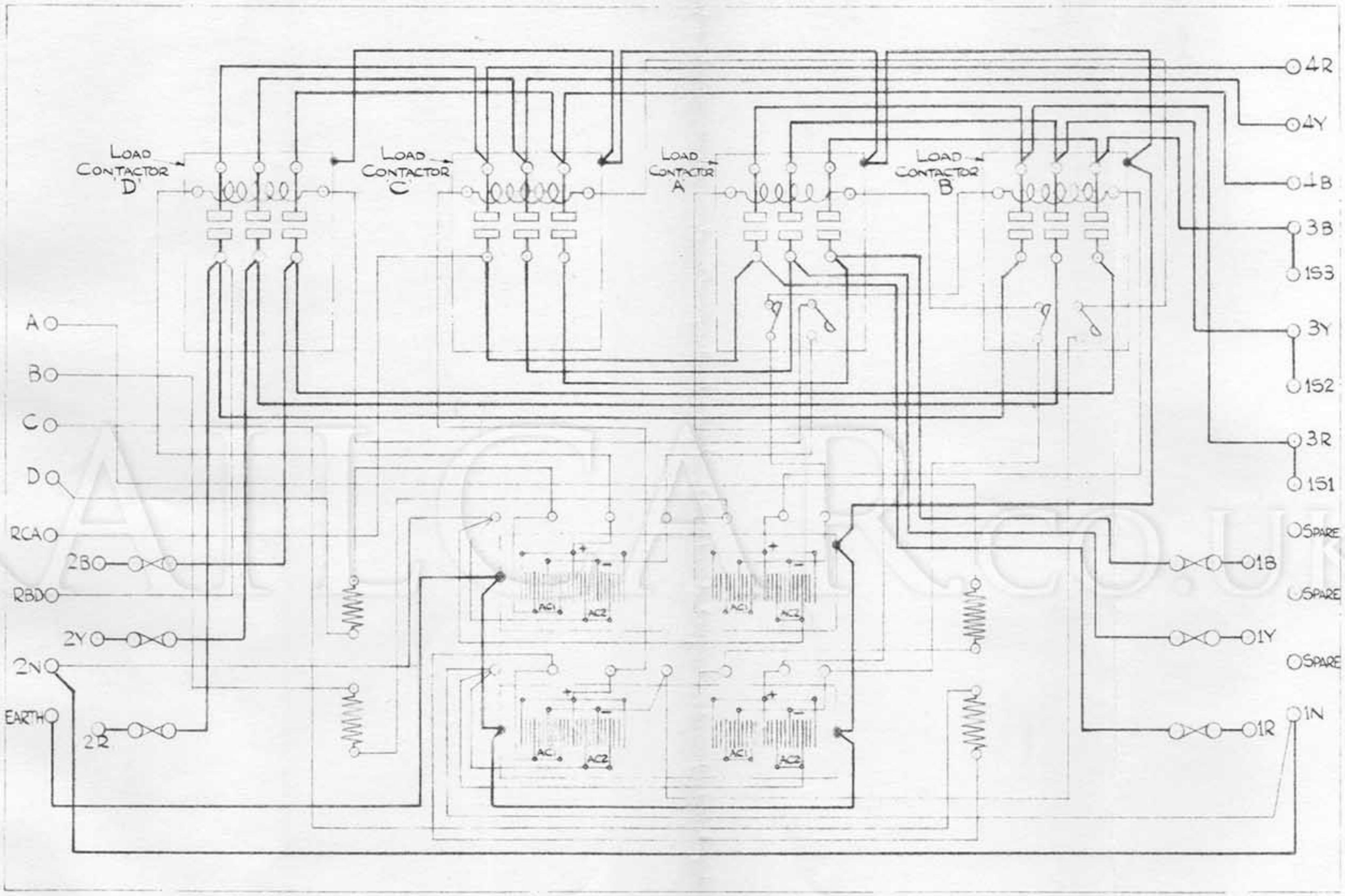


DIAGRAM OF CONNECTIONS FOR LOAD CHANGEOVER PANEL.

NOTE
THIS DIAGRAM IS CORRECT TO DATE OF ISSUE ONLY.

J. STONE & Co. (DEPTFORD) LTD. LONDON.

[redacted]

DRAWN BY GJJ
DRG. CHD. BY
TRACED BY
TRG. CHD. BY
DATE 30 MAY '58