C.A.V.

A.C. GENERATOR EQUIPMENT

FOR USE ON

BRITISH RAILWAYS

DIESEL RAIL CARS

MAINTENANCE INSTRUCTIONS

C.A.V. LIMITED ACTON LONDON W. 3

AC824-2

GENERATOR EQUIPMENT

FOR USE ON

BRITISH RAILWAYS RAIL CARS

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MAINTENANCE NOTES

The AC824-2 alternator requires little attention during service, and a mechanical check as follows is recommended:-

ALTERNATOR BEARING LUBRICATION

a) DRIVE END BEARING. Quarter of an ounce of Shell Alvania 3 grease must be injected into the bearing every 6 months or 50,000 miles whichever period is the longer. A suitable grease gun for the accurate measurement of grease is obtainable from Tecalmit Ltd., type number JCB92.

COMMUTATOR END BEARING. This should receive attention every 12 months or 100,000 miles whichever period is the longer. Before attempting lubrication, the commutator end shield must be clean and free from dirt. The bearing cap may then be removed, the ball race thus exposed must be completely filled with Shell Alvania 3 grease. It must be worked well into the balls and cage, using fingers or a suitable spatula. The bearing cap which forms the enclosure for the bearing assembly is to be packed to half its capacity with grease, this will allow the escape of grease from the bearing.

b) Check drive belts for undue wear and defects, and ensure that the belts are adjusted to the correct tension, in accordance with British Railways instructions.

c) Check for any loose nuts, screws etc.

d) It is essential that all electrical connections should be clean and securely tightened to ensure sound electrical contact throughout the circuit.

e) Check for unusual noises in the alternator indicating worn bearings, whilst the engine is run at top speed. Should such a noise be heard the alternator must be returned to the MAIN WORKS for examination.

NOTE: Another cause of an unusual noise, would be the failure of one of the rectifiers, with consequent overheating of the alternator (in this case it might reach a temperature of over 150°C). THIS COMMENT DOES NOT APPLY TO UNITS FITTED WITH THE PROTECTION DEVICE.

f) Ensure that replacement rectifiers and regulators are of the correct type, i.e. RUG-10 (which supersedes RUG-1) rectifier for the 19-cell Nife and RUG-14 (which supersedes RUG-2) rectifier for the 12-cell Lead Acid batteries.

NOTE: Rectifiers RUG-10 and RUG-11 are the same as RUG-1 and RUG-2 respectively, but fitted with protection device (see page 12).

Should the alternator and associated rectifier fail to operate satisfactorily and the mechanical check called for above has found no defect, then electrical checks should be made by the following procedure.

TESTING FOR FAULTS IN OPERATION

NOTE: During the testing of the equipment, the following points should be carefully observed:-

a) ALTERNATOR SHOULD NOT BE RUN ABOVE 2000 R.P.M. WITH BATTERY DISCONNECTED FROM RECTIFIER.

b) DO NOT SUBJECT RECTIFIERS OR CONTROL BOARDS TO MEGGER TEST.

c) DISCONNECT RECTIFIER WHEN MEGGER TESTING CAR WIRING.

} see note on Megger Testing

d) Care should be taken during setting of the open circuit voltage to ensure that output voltage is always kept below 35 volts D.C.

e) The C.A.V. AC824-6 alternator is designed and fitted to operate at a ratio to engine speed of 2.8 : 1

f) Attention is drawn to the section dealing with the Protection Unit.

MEGGER TESTING

Paragraph (b) under heading "TESTING FOR FAULTS IN OPERATION" states "DO NOT SUBJECT RECTIFIERS OR CONTROL BOARDS TO MEGGER TEST", this must be adhered to except where such tests are to be made at the MAIN WORKS. It is then, with certain reservations listed below, permissible to carry out megger tests on the rectifier unit.

a) Battery to be disconnected from circuit.

b) Megger voltage to be 100 volts maximum.

c) Connect terminals B-, B+ and all six A.C. terminals (rectifier) together - making sure that the connections are good.

d) The megger can now be connected between any of the above terminals and earth, to measure the insulation resistance of the whole rectifier and control board circuit.

NOTE: 1. Any attempt to use a megger without first connecting as above, can result in permanent damage to the rectifier diodes.

2. For bench testing rectifier, paragraphs (b), (d), and (c) should be observed.

OPEN CIRCUIT VOLTAGE CHECK

Alternator A

1. Disconnect one end of the balance winding (yellow flex from voltage regulator to terminal marked W on diagram of rectifier and control board Fig. 4.)

2. Disconnect lead from terminal B+ (DC terminal block).

3. Disconnect lead from terminal F+ (alternator B).

4. Place a wedge between coil and armature of BRK-19 current regulator, in the B rectifier line, to hold contacts open.

5. All fuses must be in circuit.

6. Actuate DR24-7 relay by placing drivers key in "ON" position.

7. Run alternator A at 2000 R.P.M. (engine speed 700 R.P.M.)

8. Test for open circuit voltage, with voltmeter connected between B- and the input terminal D+ from rectifier A. The open circuit voltage should be as follows:-

Rectifier type	~~RUG-10 (supersedes RUG-1)~~	RUG-11 ~~(supersedes RUG-2)~~
Voltage Regulator	N-29	N-30
Battery type	~~19 cell Nife~~	12 cell Lead Acid
Open Circuit Voltage	30.5 - 30.75 volts	~~29.0 - 29.25 volts~~

9. Stop the alternator, and if necessary adjust the open circuit voltage as described in the voltage control regulator section.

10. Replace F+ lead into terminal of alternator B.

11. Remove wedge from between coil and armature of BRK-19 current regulator in the B rectifier line.

Alternator B

1. Disconnect lead from terminal F+ (alternator A).

2. Place a wedge between coil and armature of BRK-19 Current regulator in the A rectifier line, to hold contacts open.

3. Repeat tests as for alternator A, check and adjust as necessary.

4. Remove wedge from between coil and armature of current regulator.

5. Replace F+ lead into terminal of alternator A.

6. Replace balance winding connection.

7. Replace lead on terminal B+.

CURRENT SETTING CHECK

Alternator A

1. Disconnect one end of balance winding (yellow flex from voltage regulator to terminal marked W on diagram of rectifier and control board Fig. 4).

2. Disconnect lead from terminal F+ (alternator B).

3. Place a wedge between coil and armature of BRK-19 current regulator, in B rectifier line, to hold contacts open.

4. Remove fuse from line A.

5. Connect a 0-60 amp or 0-100 amp D.C. ammeter across fuse terminals of line A.

6. Switch on all car lights (to act as load) for a period of 10 to 15 minutes.

7. With load still on, run alternator A at 2000 R.P.M. and note current setting, this should be 30 ± 1.0 amp.

8. Stop the engine and adjust if necessary the current setting of the BRK-19 regulator on the 'A' alternator line (see section on BRK-19 Regulator).

9. Repeat paragraphs 6 and 7.

10. Remove ammeter.

11. Remove wedge from between coil and armature of current regulator.

12. Replace lead from F+ of alternator B.

13. Replace fuse in line A.

Alternator B

1. Disconnect lead from terminal F+ of alternator A.

2. Remove fuse from line B.

3. Place wedge between coil and armature of current regulator in A line, to hold contacts open.

4. Repeat test as for alternator A, resetting if necessary.

5. Remove wedge from between coil and armature of current regulator.

6. Replace lead into F+ terminal of alternator A.

7. Replace balance winding (terminal marked W in Fig. 4).

8. Replace fuse in line B.

PARALLEL OUTPUT CHECK

When both machines are running at approx. 2000 R.P.M. and delivering a combined output of 85~~90~~ 80 amps, the voltage across the balance winding should be measured across terminals marked W, Fig.4. This should not exceed 10 millivolts, when either machine is started first, any excess may be corrected by a careful adjustment of one of the voltage settings.

As the 10 millivolts out of balance may be in either direction it is advisable to use a centre zero mill-voltmeter.

Whilst this test is in progress ensure that both current regulators are firmly closed.

FAULT FINDING

If no voltage registers between B- and D+ terminals on either of the rectifiers during open circuit tests, replace all connections in faulty circuit and check on the following in order stated:-

1. With drivers key in position check for 24 volts on terminals marked 1 and 2. (D.C. Terminal block control board). Battery voltage should appear across both pairs of field terminals marked F+ and F-. If voltage fails to appear, clean contacts on DR relay and 312-15 relay (Protection Unit) with fine clean sandpaper or, preferably a contact file, and if the fault still persists, do the same with all

four contacts on current and voltage regulators.

2. Disconnect both F+ leads from the rectifier and check with an Avometer for continuity between F- terminals and F+ lead from each alternator. The resistance of the field coil is 16 ohms, if the reading is appreciably less or more than this, insert an ammeter between F+ (control board) and F+ (alternator). The current reading should be approx. 1.5 amp; if the current is more, the field coil is short circuited; if it is less, then the brushes should be removed and the contact face wiped with clean fine sand-paper. If open circuit persists then field coils will be at fault and alternator should be replaced.

3. Disconnect 6 leads from alternator terminals marked AC on rectifier. Run both engines at idling and measure the AC volts between each pair of three leads from each alternator. The three voltage readings on each alternator should be equal to within 2 volts and of the order of 20-30 volts.

4. If all above tests are satisfactory, alternator is cleared and the fault is in the rectifier or control board.

5. Keeping the alternator leads disconnected, remove drivers key and both fuses and check each of 12 rectifier cells by measuring forward and reverse resistance between each A.C. lead and D+ and B- terminals. The forward resistance measured with an Avometer should be about 5 ohms and the reverse resistance above 200 ohms. (On units fitted with Protection Device, reverse resistance on two cells will be approx. 80 ohms, due to resistance of Protection Device shunting two cells). The above test clears the rectifier.

GERMANIUM RECTIFIER UNIT

The unit is comprised of two 50 amp germanium rectifier units enclosed within a steel panelled box. The three leads from each A.C. generator enter the rectifier unit through two terminal boxes on the A.C. panel side. The D.C. leads pass through to the regulator base on which are mounted the regulators, fuses and a relay.

Dependant on the type of battery used the rectifier and voltage regulator change accordingly, the following table shows the combinations in use.

Battery	~~19 Cell Nife~~	12 Cell Lead Acid
Rectifier	~~RUG-10 (supersedes RUG-1)~~	RUG-~~19~~ (~~supersedes RUG-2~~)
Voltage Regulators	N-29 (Twin)	N-30 (Twin)
Current Regulators	Two BRK-~~19~~	~~Two BRK-19~~
Relay	DR24-7	~~DR24-7~~
Fuses	Two 120 amp	~~Two 120 amp~~

DR24-7 RELAY

The function of the DR24-7 is to "close" the charging circuit when the drivers key is placed in the 'ON' position. This is done by direct application of battery voltage.

Mechanical Setting

1. Air gap between core and armature in closed position, should be .002 to .004 inches. Adjustment can be made by varying the number of packing shims.

2. Set contact air gap to .034 to .037 inches, by carefully bending the moving contact strip arm.

Electrical Setting

1. Connect winding of DR24-7 to an external variable 24 volt D.C. supply preferably incorporating a potentiometer.

2. Adjust setting spring by turning nut to give a smart closing action of relay contacts between 19-20 volts.

3. Having made the adjustment see that nut is located firmly in position against curve of the locking tag to prevent it from turning.

TYPE N-29 ~~AND N-30~~ VOLTAGE REGULATOR FIG. 1

The N type regulator as used in conjunction with the AC824-~~6~~ generating equiment is made up as one unit comprising two voltage regulators.

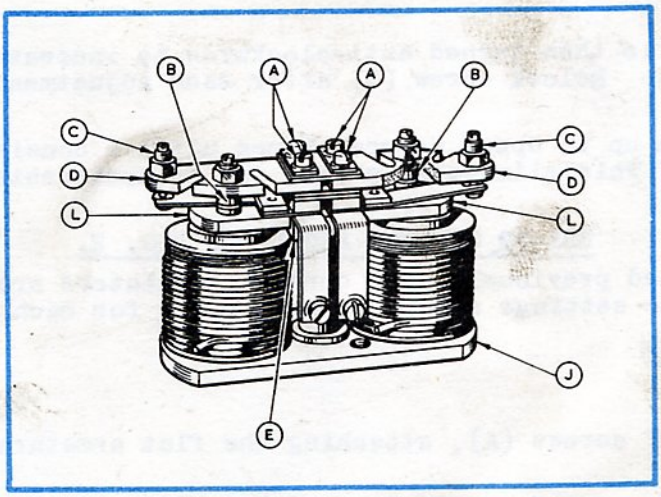

FIG. 1. TWIN VOLTAGE REGULATOR (N-29 ~~AND N-30~~)

The voltage regulators differ, dependant on the type of battery employed; the table following the heading "Germanium Rectifier Unit" (page 8) shows the variations used.

Mechanical Setting

It is not advisable to disturb the regulator armature, but if this has been done, the following operations should be carried out on each element in turn before attempting the electrical setting.

1. Slacken off armature fixing screws (A).

2. Place 0.008 inch feeler between the back of armature (L) and centre block (E).

3. Press armature back squarely, on the feeler and tighten armature screws (A).

4. Adjust be means of adjustable contact (B) the air gap between the core and the armature to 0.048 inches. The gap must be measured on the outer tip of the armature with a feeler resting against the side of the brass stop pin.

NOTE: When setting the back air gap care must be taken to see that the connection strips and the mica strips are not proud of the block on either side. With the armature fixed squarely, the contacts must line up and the adjusting screw be central in the spring slot. The contact carriers (D) must be parallel with the regulator base (J).

Electrical Setting

NOTE: The open circuit voltage is checked as described on page 3 and if different from the value given should be reset as follows:-

1. Slacken locknut of screw (C).

2. Screw (C) is then turned anti-clockwise to increase voltage and vice-versa. Relock screw (C) after each adjustment.

3. Run engine up to speed several times until a consistant reading is obtained. This eliminates errors due to hysteresis of the core.

BRK-12 CURRENT REGULATOR FIG. 2.

As mentioned previously, two current regulators are used on each control board, the settings should be as follows for each.

Mechanical Setting

Armature

1. Slacken off screws (A), attaching the flat armature spring to frame.

2. Slacken off adjustable contacts (B).

3. Slacken off setting and stop spring adjusting screws (C) and (D).

4. Press armature (L) down firmly on to core so that back of armature is against frame (J).

5. The gap (if any) which appears between the top frame and underside of the armature hinge spring must be closed by inserting packing pieces until contact is established with the spring. Care must be taken against using an excessive thickness of packing and so distorting the spring.

6. Tighten screws (A)

7. With the armature pressed down it should touch the core at front or rear, and a maximum gap at 0.005 inches can be allowed between the parts not touching. A 0.002 inch feeler should not enter between the back of the armature and frame.

NOTE: The correct number of packing shims is inserted during adjustment before despatch from the C.A.V. works, and should not require attention during the life of the regulator. Difficulty may arise, however, if a regulator has been completely stripped, and shims lost, or no record kept of the quantity used in each case.

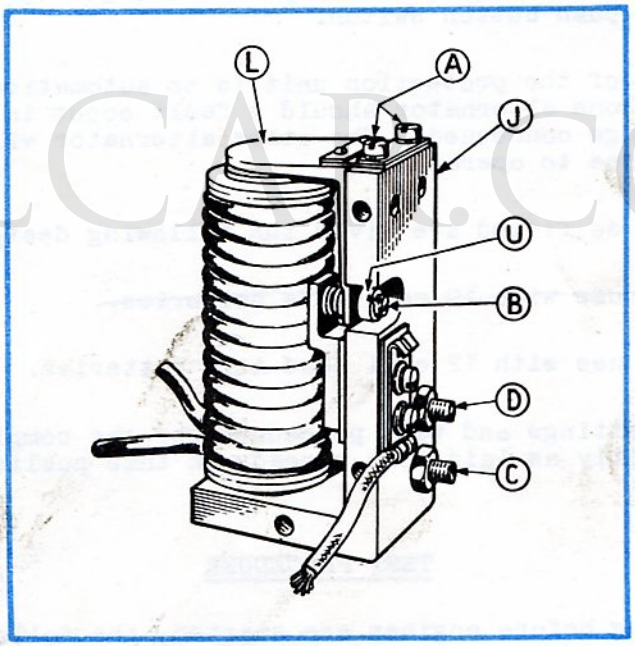

FIG. 2. CURRENT REGULATOR (BRK-12)

Contact

1. Screw in adjusting screw (C) to deflect spring.

2. Adjust moving contact (B) until gap between tip of armature and core lies between 0.048 and 0.053 inches when the contacts are closed.

3. Lock contact (B) in position with nut (U).

4. Screw in stop screw (D) until it just touches steel stop spring, then screw back three quarters of a turn and lock in position with nut.

Electrical Setting

1. Adjust current to correct value (~~50~~ ± 1.0 amp at 2000 R.P.M. on the alternator) by means of screw (C), which is turned clockwise to increase current and vice-versa. Relock nut on screw (C) after each adjustment.

2. Restart the engine and run two or three times until a consistant reading is obtained. This eliminates errors due to hysteresis of the regulator core.

PROTECTION UNIT

Later type A.C. generating equipment supplied to British Railways for rail car use is fitted with a protection device. This is located on the side of the rectifier box, and comprises two 312-15 relays, a green pilot light and a push button switch.

The object of the protection unit is to automatically disconnect the excitation of one alternator should a fault occur in any one cell of the rectifier bridge concerned. The other alternator will remain in circuit and continue to operate.

Rectifiers so fitted are given the following designations.

~~RUG-10 for use with 19 cell Nife batteries.~~

RUG-14 for use with 12 cell Lead Acid batteries.

The main settings and test procedure for the complete generating equipment are exactly as laid down already in this publication.

TEST PROCEDURE

Each morning before engines are started, the following check should be carried out.

1. Place drivers key switch in 'ON' position, engine stationary.

2. Press button on protection unit, if rectifiers are operating satisfactorily the green pilot light (also on protection unit) will be illuminated. Should the pilot lamp fail to light, work as follows:-

   a) Change pilot bulb in case of failure, and check system again.

b) If the light still does not operate then the rectifier will be short circuited and must be replaced. To verify such a failure, remove cover from protection unit and inspect the relays, one of which will have closed.

RELAY TYPE 312-15

Mechanical Setting

1. Front yoke gap with armature pulled down should be 0.004 ± 0.002 inches. Adjustment is by screw contact on frame.

2. Core gap should be between 0.000 and 0.004 inches. adjustment is by shims under coil.

3. Top contact gap should be 0.028 ± 0.002 inches. Adjustment by screw on top contact.

4. Pressure needed to pull down armature - 75 to 100 grammes, measured at the centre of armature $\frac{1}{8}$ inch from edge. Adjustment by nut controlling coil spring tension of back of relay.

Electrical Setting

1. Pull in voltage on D.C. supply to be as follows:-

   Top coil 10 to 10.5 volts.

   Bottom coil 11 to 11.5 volts.

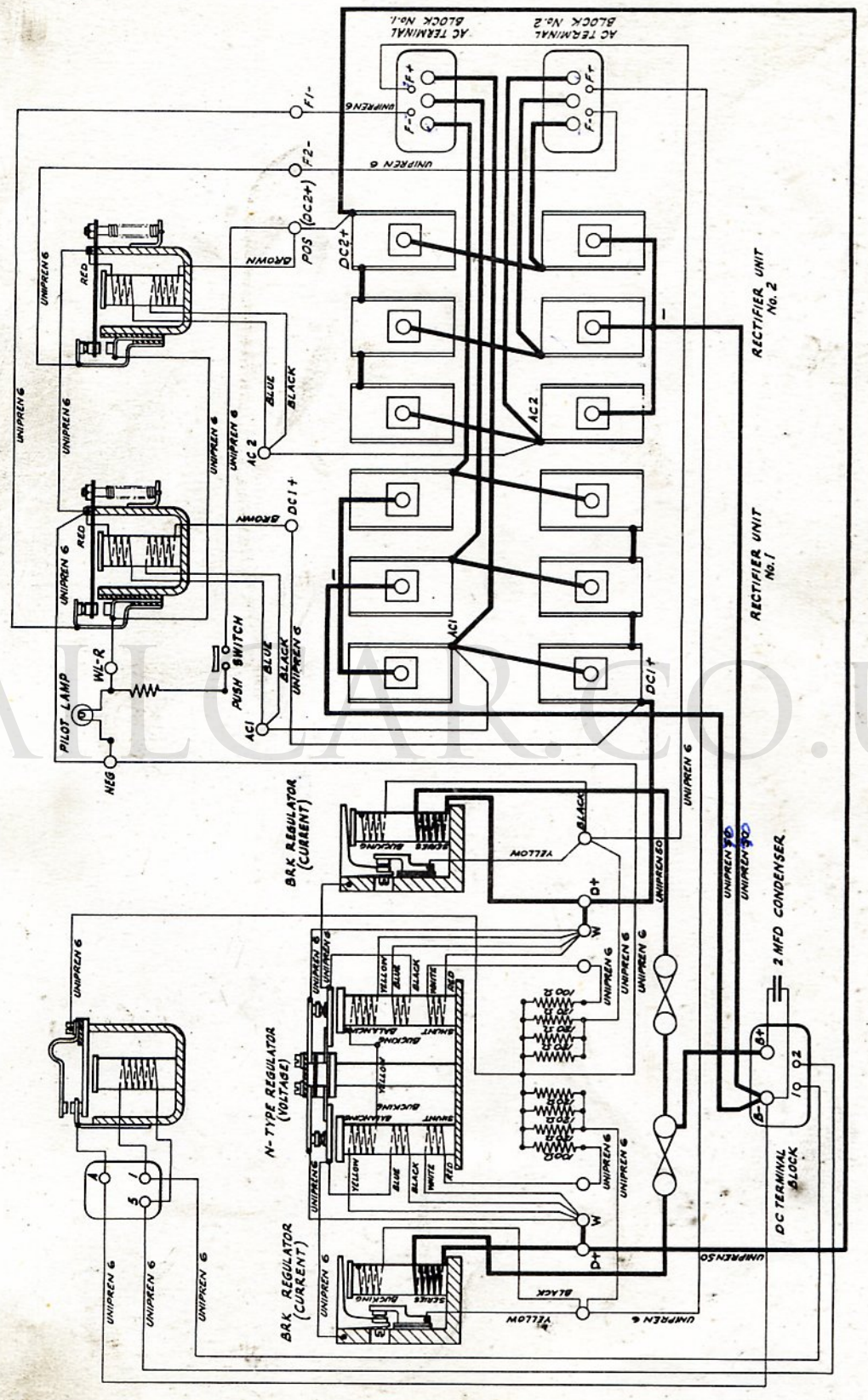

FIG. 3. WIRING DIAGRAM OF TWIN RECTIFIER UNIT

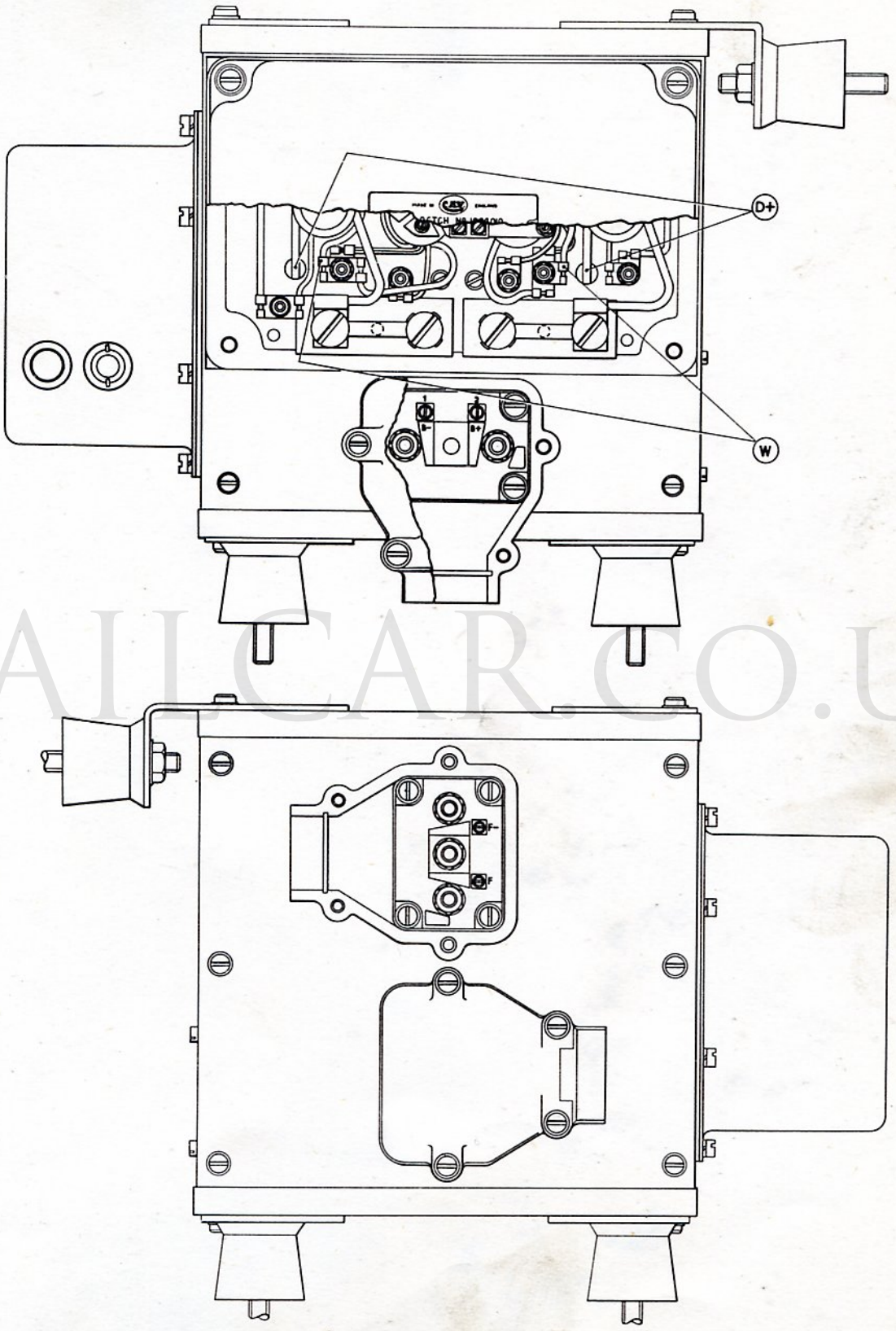

FIG. 4. RECTIFIER UNIT WITH CONTROL PANEL

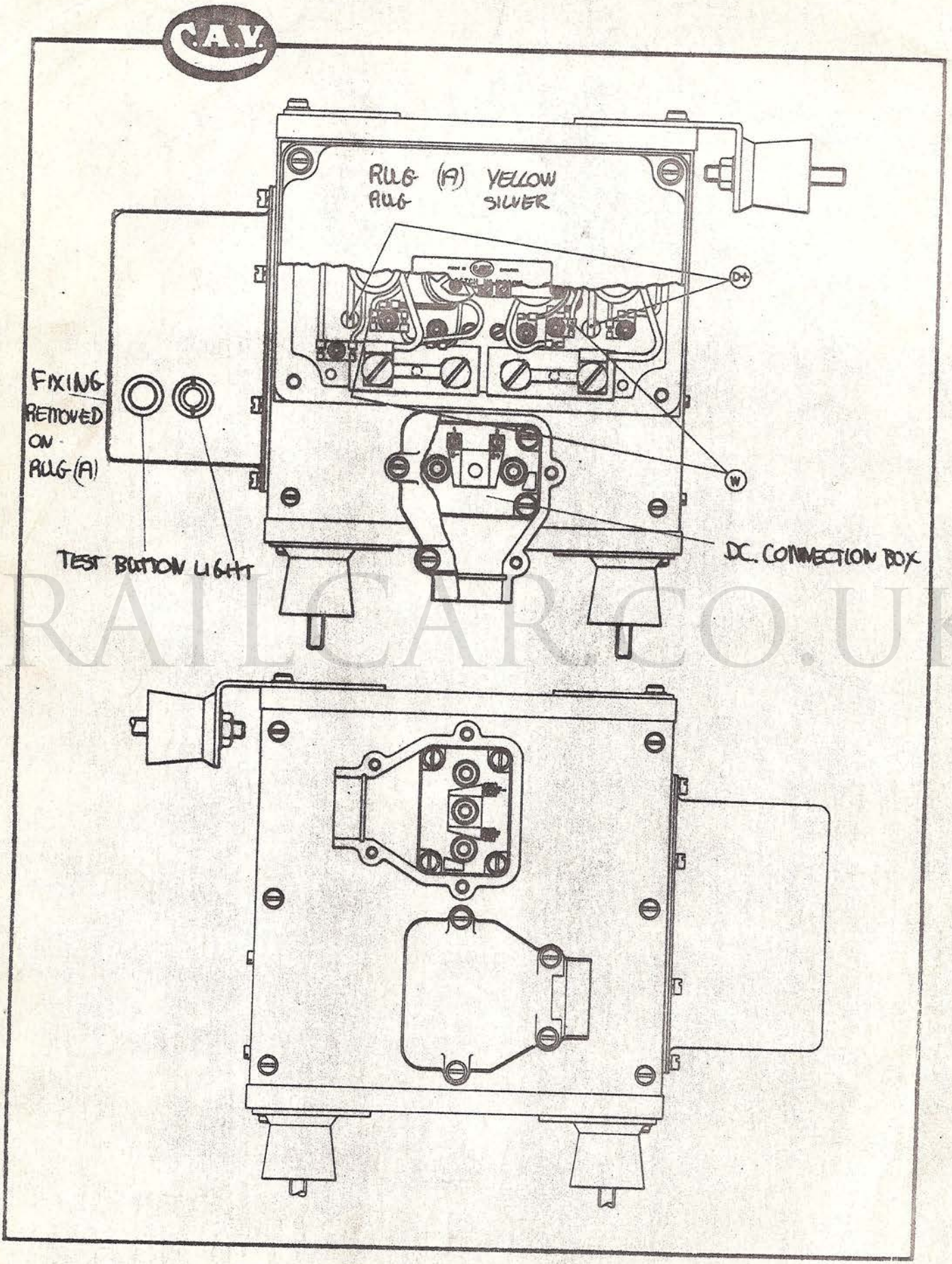

FIG. 4. RECTIFIER UNIT WITH CONTROL PANEL

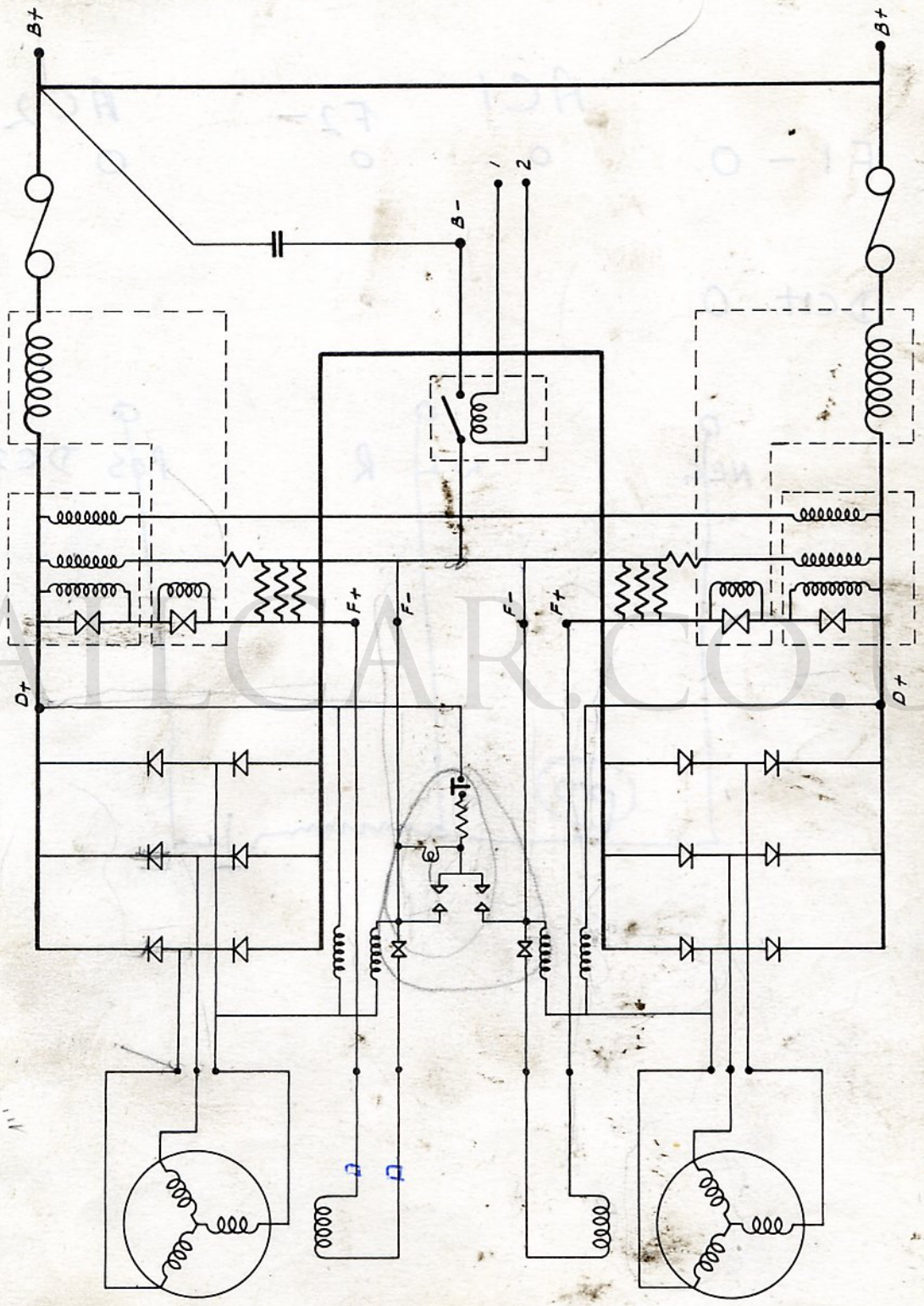

FIG. 5. WIRING DIAGRAM