See AP1135-0754-1 Not held C

Chapter 24

RECTIFIER AND A.C. CONTROL BOX, TYPE LKB 400, FORM B3/5

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Rectifier and a.c. control box, Type LKB 400, B3/5	*Ref. No. 5UC/7093*
Input voltage	*26V, 3-phase, a.c.*
Output voltage	*28V, d.c.*
Load current	*350A*
Minimum cooling air requirement	*2000 ft/min.*
Weight	*23 lb. 14 oz.*

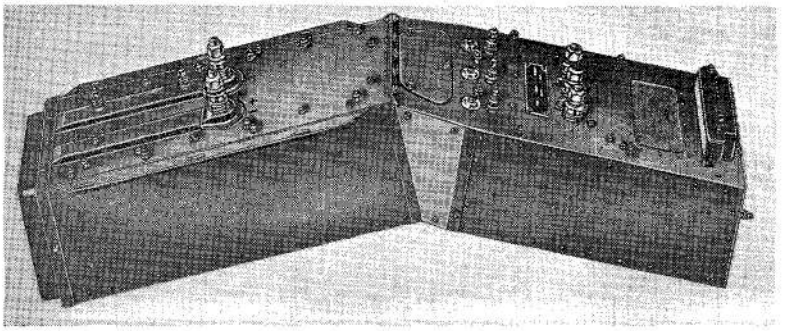


Fig. 1. Rectifier and a.c. control box, Type LKB 400, Form B3/5

Introduction

1. The Type LBK 400, Form B3/5 rectifier and a.c. control box is used to provide the d.c. output and a.c. generator field current of a single generator channel in a multi-generator a.c. system. It also provides metering and differential signals, and an equalizing signal for multiple channel operation.

DESCRIPTION

2. The components of the unit are mounted in a box built on two side frames of welded aluminium-alloy section, side and bottom plates being riveted to these. Removable end plate and cover plates are fitted to the a.c. end of the box. The main a.c. terminals, auxiliary a.c. terminals, field rectifier and terminals, and the metering circuits and terminals are mounted on the a.c. cover, which can be removed as a unit. The main d.c. terminals and ammeter shunt terminals are mounted on the d.c. cover. The main rectifier is housed in the d.c. end. Connections between the a.c. end and the main rectifier are made by bolted joints which are accessible when the inspection cover on the a.c. end cover is removed.

OPERATION

3. The circuit diagram for the unit is shown in fig. 2, reference should also be made to the circuit diagram in the Aircraft Handbook, which shows the unit connected in circuit with the associated components.

4. The a.c. output from the generator is supplied to the unit through terminals A, B, and C and is passed through the main rectifier to the d.c. terminals. The d.c. negative terminal is connected to earth, and the d.c. positive terminal is connected through the main contactor to the generator busbar. The field rectifier terminals are connected to the a.c. generator field through the carbon pile of the main voltage regulator and a latched contactor. Under no load conditions the output voltage of the field rectifier is approximately the same as the main rectifier, but as the d.c. load increases the a.c. voltage will rise due to the drop in the main rectifier. The field rectifier has a similar forward drop so that the field rectifier voltage will increase with the d.c. load, making it possible to obtain a high field current which improves the available output of the unit, particularly at low engine speeds.

5. The rectifiers in the differential circuit have a lower forward drop than the main rectifier, and as a result the voltage produced at terminal 13 is higher than the output voltage of the main rectifier. A differential relay, forming part of the switchbox generator control, Type LKF B7, which is described in A.P.4343C, Vol. 1, Book 3, is connected between terminal 13 and the busbar. This relay is set to close and operate the main contactor when the differential voltage is slightly higher than the busbar voltage. Application of a d.c. load after the differential relay has closed increases the differential voltage, which gives increases contact pressure with increase in load. As the engine speed is reduced, a point is reached when the output voltage of the differential rectifier is equal to that of the busbar, at this point the output voltage of the main rectifier is lower than that of the busbar, but the main rectifier prevents reverse current being drawn from the busbar. A further reduction of engine speed causes the output voltage of the differential rectifier to fall below that of the busbar, a reverse current flows from the busbar through the differential relay, the path to earth being completed through the 250 ohm resistor.

At a preset value the differential relay will drop out, de-energizing the main contactor and the generator channel is removed from the busbar.

6. The equalizing circuit is supplied from three star-connected current transformers in the a.c. lines. The output of these current transformers is rectified and passed through a resistor which develops a voltage proportional to the a.c. current. The equalizing voltage is of the order of 20V at full load. The shunt in the equalizing circuit carries a d.c. current proportional to the a.c. load current, and is designed to produce a voltage at terminals 9 and 10 which is the same as that which would be produced by the main shunt if the total load were rectified in the main rectifier.

SERVICING

General

7. The unit should be serviced in accordance with the relevant Servicing Schedule and with the instructions contained in this chapter.

Routine servicing

8. Little routine servicing can be accomplished between bay servicing periods. Check the unit for security of attachment and the electrical connections for tightness. Remove the a.c. end inspection cover and examine the bolted joints for signs of overheating. Check the following circuits for continuity using a Type F testmeter.

(1) Between terminals 6, 7 and 8, and A, B and C respectively.

(2) Between terminals 13 and 15 the resistance should be 250 ohms $\pm$ 10%.

9. If the external wiring can be disconnected, the following resistance checks should be carried out:

(1) With one lead of the testmeter on terminal 13 and the other lead placed on terminals A, B and C in turn, check the rectifiers in the differential circuit. The forward resistance of each rectifier

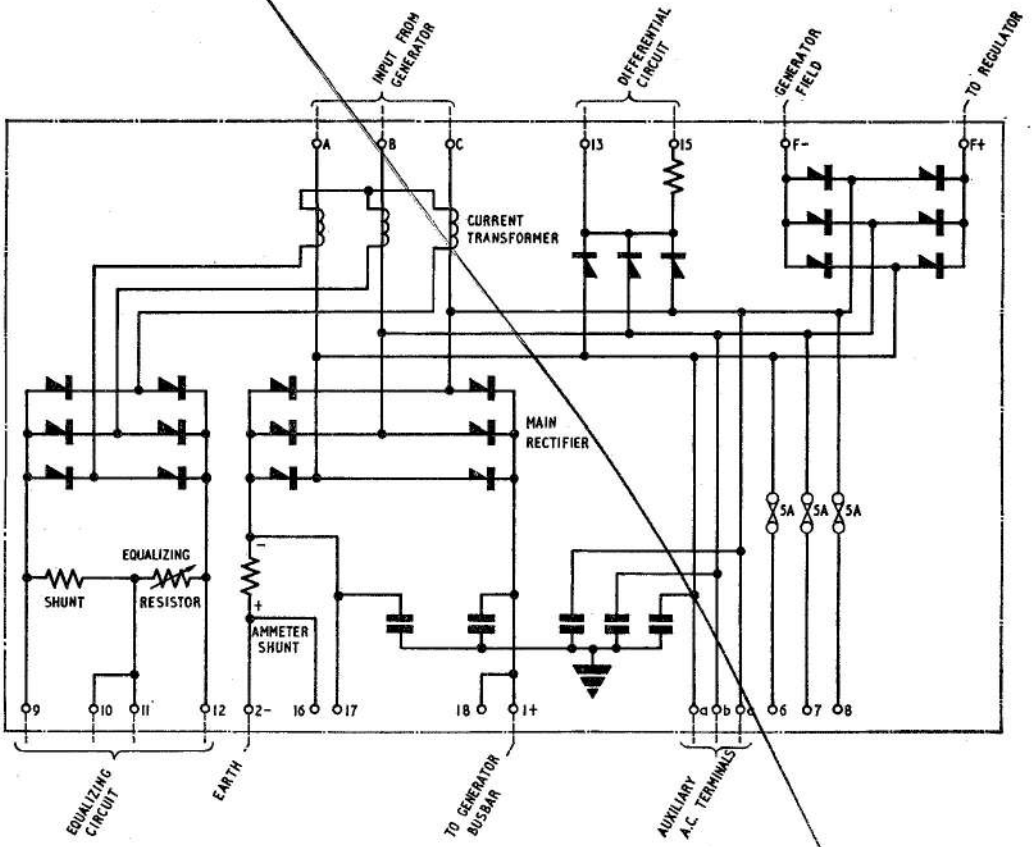


Fig. 2. Circuit diagram

measured on the 10k ohms range should be less than 10 ohms at 22 deg. C, and the reverse resistance measured on the 1 megohm range should be greater than 10k ohms.

(2) With one lead of the testmeter on terminal F-, and the other lead placed on terminals A, B and C in turn, check the rectifiers in the field rectifier bridge circuit. The forward resistance of the rectifiers measured on the 10k ohms range should be between 30 and 40 ohms at 20 deg.C, and the reverse resistance measured on the 1 megohm range should be greater than 30k ohms.

(3) With one lead of the testmeter on terminal 2– and the other lead placed on terminals A, B and C in turn, check the main rectifier. Using a Type F testmeter on the 10k ohm range, the forward resistance should be within the limits of 5 and 10 ohms. The reverse resistance when measured on the 1 megohm should be of the order of 500 megohms.

(4) Check that the resistance between terminals 11 and 12 is approximately 15 ohms.

Dismantling

10. Reference should be made to fig. 3 which shows an exploded view of the control box. It should not be necessary to dismantle the unit completely, normally dismantling should be stopped at the stage necessary for the renewal of unserviceable parts to be made.

A.C.-end cover

11. Unscrew the three 4 B.A. nyloc nuts securing the inspection cover and lift off the cover. Unscrew the three $\frac{1}{4}$ in. B.S.F. screws securing the a.c. connection strips to the main rectifier. Unscrew the five 4 B.A. screws and six 4 B.A. nyloc nuts securing the a.c.-end cover to the frame. Remove the end cover.

D.C.-end cover

12. (1) Unscrew the eight 4 B.A. screws securing the inlet moulding on the end frame and remove the moulding.

(2) Unscrew the twelve 2 B.A. nyloc nuts, the eight 4 B.A. nyloc nuts, and the two 4 B.A. screws securing the d.c.-end cover to the frame.

(3) Unscrew the two $\frac{1}{4}$ in. B.S.F. nuts securing the d.c. connection strips to the main rectifier. Unscrew the two 4 B.A. nuts securing the d.c. connection strips to the capacitor connection strip. Loosen the two 4 B.A. nuts securing the d.c. connection strips to the capacitor connection strip. Loosen the 2 B.A. nyloc nuts on each capacitor. Remove the cover.

Main rectifier

13. If it is necessary to remove the rectifier from the frame, unscrew the twelve 2 B.A. securing nuts.

Bay servicing

14. The servicing detailed in the following paragraphs should be performed after the covers have been removed.

General

15. Examine all connections for security, and wiring for external signs of burning or damaged insulation. Examine the heavy current connection strips for distortion and corrosion. All dust and foreign matter should be blown out of the box using a jet of dry compressed air.

Frame

16. Examine the frame for damage or distortion and signs of corrosion. Check that all riveted parts are securely fixed. Examine the ventilation gauze for damage, and clean using lead free gasolene.

Main rectifier

17. Examine for signs of pitting or burning, and check that the studs are not bent and that there are no damaged threads. To ascertain the serviceability of the main rectifier, the following tests should be carried out using a pure d.c. supply. If the figures given for the tests are not obtainable, the rectifier should be replaced with a serviceable unit.

18. *Forward drop.*—Apply a forward d.c. voltage across each arm of the rectifier in turn and measure the voltage drop when the current reaches a steady value of 36A. Check between the three a.c. terminals (positive) and the positive terminal, and between the negative terminal (positive) and the three a.c. terminals. The voltage drop should be of the order of 1V.

19. *Reverse current.*—Apply a reverse d.c. voltage of 25V across each arm of the rectifier in turn, and measure the reverse current after the voltage has been maintained for one minute. Check between the positive terminal (positive) and the three a.c. terminals, and between the three a.c. terminals (positive)

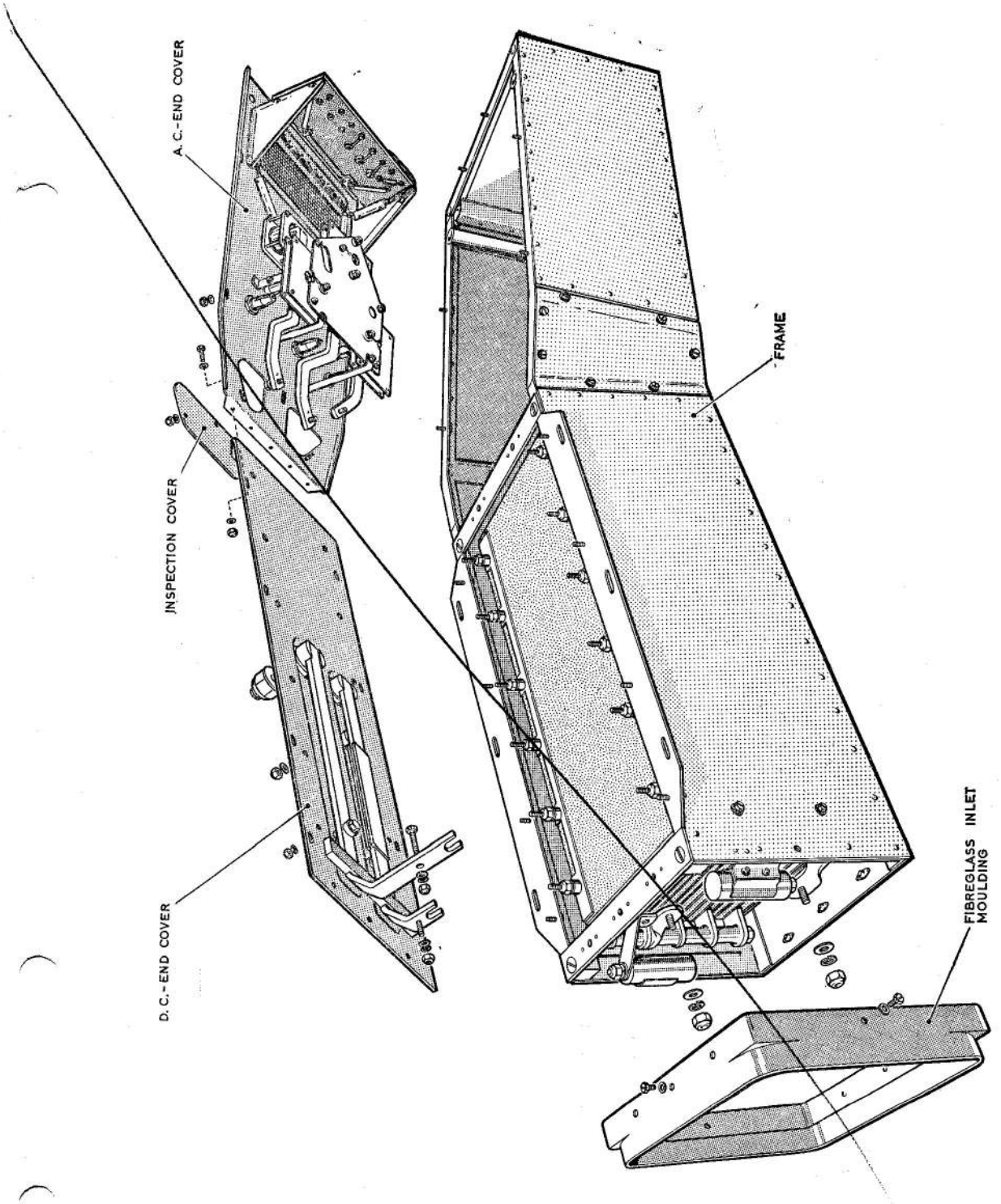


Fig. 3. Exploded view

and the negative terminal. The reverse current should be of the order of 1·5A.

Current transformer

20. Examine the coils for signs of overheating and check that the nuts securing the clamping plates are tight. Check the resistance of each coil, which should be within the limits of 2·5 and 3·0 ohms at 20 deg.C.

Capacitors

21. Check the insulation resistance of each capacitor; when tested with a 250V insulation resistance tester, the reading obtained should be not less than 5 megohms.

Field rectifier unit

22. The field rectifier unit should be removed from the a.c. cover and tested as follows:—

(1) Connect the three pairs of studs together with a limiting resistor of about 500 ohms in series with the supply to protect the rectifier and meter.

(2) Apply an inverse voltage of 100V between the shorted studs and the positive connection. The current taken should be less than 1·5 mA.

(3) Apply an inverse voltage of 100V between the shorted studs and the negative connection. The current should be less than 1·5 mA.

23. If the current is in excess of 1·5 mA, isolate the rectifiers and test each one as follows:—

(1) Using a Type F testmeter on the 10k ohms range, measure the forward resistance, which should be within the limits of 32 to 37 ohms at 22 deg.C.

(2) Using a Type F testmeter on the 1 megohm range measure the reverse resistance, which should be greater than 50k ohms.

After re-assembly the tests given in para. 22 should be repeated.

Panel components

24. *Rectifiers.*—The rectifier resistance should be checked using a Type F testmeter, the forward resistance should be measured on the 10k ohms range and the reverse resistance using the 1 megohm range.

(1) With the lead removed from the equalizing resistor and the three input leads removed from the equalizing rectifier, check the rectifiers in the equalizing bridge. The forward resistance should be less than 20 ohms at 20 deg.C, and the reverse resistance should be greater than 30k ohms.

(2) Disconnect the three leads from the differential circuit rectifiers. The forward resistance of each rectifier should be within the limits of 5 to 10 ohms, and the reverse resistance greater than 50k ohms. If the reverse resistance is lower than this figure, the rectifier should be checked by applying a reverse voltage of 100V d.c. across the rectifier, and measuring the reverse current, which should not exceed 2mA and should show no tendency to rise. A series resistor should be used in the circuit to protect the ammeter.

25. *Resistors.*—Examine the fixed resistor for signs of overheating, and check that it is securely soldered to its terminal studs on the panel.

(1) Using a Type F testmeter measure the resistance, which should be within the limits of 250 ohms $\pm$ 10%.

(2) Check that the equalizing resistor is secure on its mounting spindle. The resistance should be within the limits of 14·95 and 15·05 ohms at 20 deg.C.

(3) Examine the shunt for damage and signs of corrosion, and check that its resistance is within the limits of 0·132 and 0·135 ohms at 20 deg.C.

Assembly

Main rectifier

26. If the main rectifier has been removed, it should be positioned in the frame so that the a.c. connections are in the centre of the frame, and secured in position with the twelve 2 B.A. nyloc nuts and plain washers.

D.C.-end cover

27. Ensure that the mating surfaces of the connection strips and the rectifier terminals are perfectly clean before they are bolted together. Position a 4 B.A. screw in each of the connection strips so that the head of the screw will be next to the main rectifier. Fit the cover to the frame, locating the connection-strip slots on the studs on the rectifier terminals. Position the capacitor connection strip, and fit and tighten the two 4 B.A. securing nuts. Tighten the 2 B.A. nyloc nut on each capacitor. Secure the d.c. connection strips to the main rectifier with a plain washer, locking washer and $\frac{1}{4}$ in. B.S.F. nut, fitted in that order. Secure the cover to the rectifier studs by twelve 2 B.A. plain washers and nyloc nuts . Fit two 4 B.A. screws and plain washers through the two remaining holes in the cover. Refit the inlet moulding and secure in position with eight 4 B.A. screws and plain washers.

A.C.-end cover

28. Ensure that the mating surfaces of the connection strips and the rectifier terminals are perfectly clean before they are bolted together. Position the end cover on the six studs protruding from the sides of the frame, and fit a 4 B.A. nyloc nut and plain washer to each stud. Fit the five 4 B.A. screws joining the two end covers together. Secure the three connection strips to their respective terminals on the main rectifier with the three $\frac{1}{4}$ in. B.S.F. screws.

TESTING

General

29. The unit should be connected to the test circuit as shown in fig. 6 using the generator, voltage regulators and stabilizing transformers normally associated with the unit when installed.

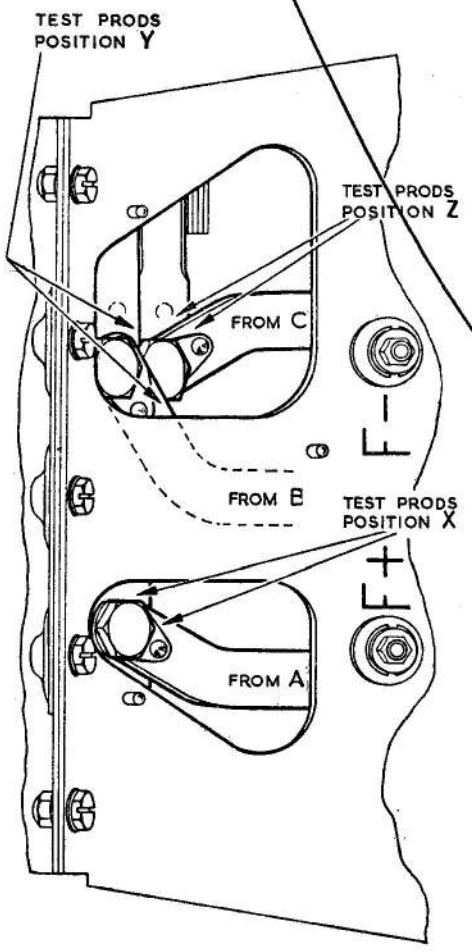


Fig. 4. View with inspection cover removed (a.c. end)

Resistance tests

30. The joint resistance between the d.c. connection strips and the main rectifier, and the a.c. connection strips and the main rectifier should be checked in the following manner. Connect the d.c. supply across the main rectifier, with the positive side to terminal A and the negative side to terminal B. Pass a current of 36A through the rectifier and test between the prod positions shown in fig. 4 and 5.

(1) The voltage drop across position X and position R should not exceed 0·1 mV per ampere of current flowing, that is, with a current of 36A the maximum voltage drop would be 3·6 mV.

(2) Transfer the positive lead of the d.c. supply to terminal B, and test between prod position Y; transfer the positive lead to terminal C, and test between prod position Z. The voltage drop for each test should be within the limits quoted in sub-para. (1).

(3) Connect the positive lead of the d.c. supply to terminal 2– and the negative lead of the d.c. supply to one of the a.c. terminals. The voltage drop across prod position S should be within the limits quoted in sub-para. (1).

Load tests

31. The field circuit should not be closed when the generator is running as the resulting overvoltage may cause damage to the main rectifier. A cooling air supply should be connected to the unit before commencing tests.

Field supplied from the main rectifier

32. Ensure that the changeover switches are set for the field supply to be provided from the main rectifier. Run the generator at 7000 rev/min., switch on the full load of 350A d.c., and set the output voltage to 28V d.c.

33. *Differential voltage.*—On no load, the voltage at terminal 13 (terminal 15 earth) should be slightly higher than the output voltage of the main rectifier. This voltage should increase with load.

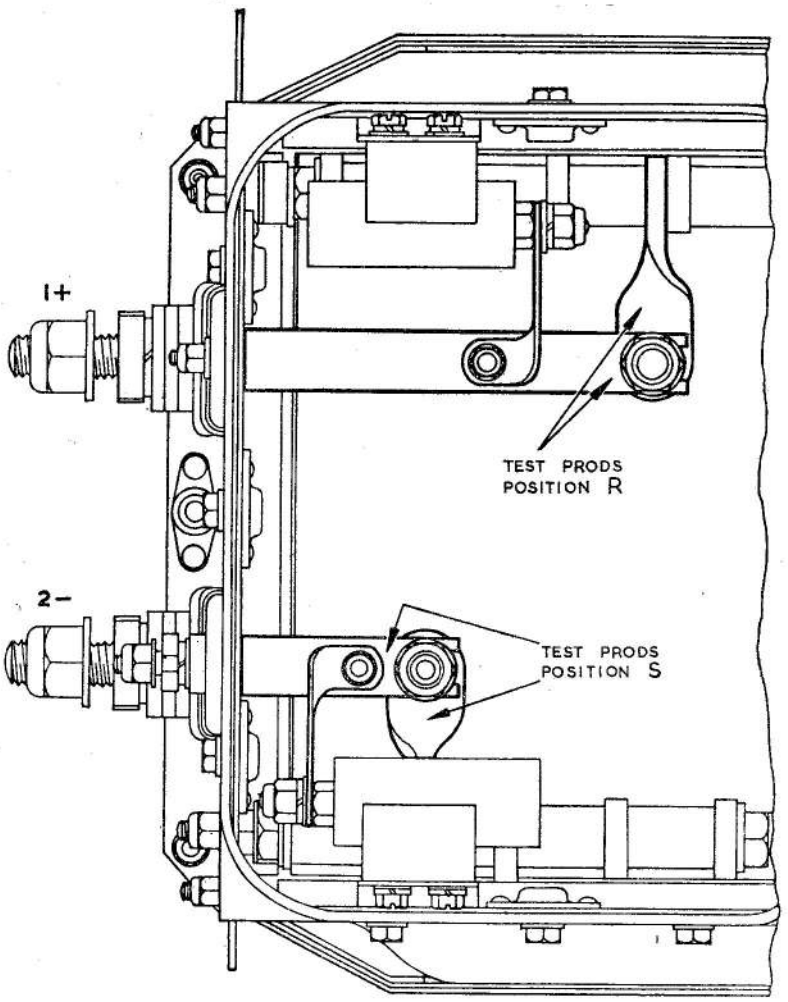


Fig. 5. View looking on air inlet (d.c. end)

34. *Field rectifier voltage.*—On no load the voltage at the field terminals should be about 0·5V higher than the output voltage of the main rectifier, and must be of the correct polarity. At full load the field rectifier voltage should be approx. 35V.

35. *Shunt voltage at d.c. end.*—The voltage at terminals 16 and 17 should be 50mV $\pm 2\frac{1}{2}\%$ per 100A. Terminal 16 should be positive and the voltages should be checked at loads of 100A, 200A, and 300A d.c.

36. *Shunt voltage at a.c. end.*—The voltage at terminals 9 and 10 should be 50·2 mV $\pm 1\frac{1}{2}\%$ per 100A. Terminal 10 should be positive and the voltages should be checked at loads of 100A, 200A, and 300A d.c.

37. *Equalizing voltage.*—The voltage at terminals 11 and 12 should be between 19·25V and 19·64V at load of 350A d.c., that is, 5·5V to 5·61V per 100A. Terminal 12 should be positive and the voltages should be checked at 100A, 200A, and 300A d.c.

Field supplied from the field rectifier

38. Ensure that the changeover switches are set for the field supply to be provided from the field rectifier.

(1) Run the generator at 7000 rev/min. and set the output voltage to 28V d.c.

(2) Run the generator at 2500 rev/min. on no load and check that the output voltage is 28V d.c.

(3) Run the generator at 4400 rev/min. and check that the unit maintains a 350A load at 28V d.c.

(4) Run the generator at 7000 rev/min. and switch on a load of 350A at 28V d.c., allow this load to be delivered for 15 min.

Insulation tests

39. Connect together terminals A, B, C, 1, 2, 6, 7, 8, 13 and 15, and terminals 9, 10, 11 and 12. Isolate the two suppressors at the d.c. end of the main rectifier, and isolate the suppressor earths on the a.c. end cover. Using a 250V insulation resistance tester check the insulation resistance between the following points:—

(1) Between the first group of terminals wired together and the second group of terminals wired together.

(2) Between each group and the frame.

The readings obtained should be less than 5 megohms for each test. Replace the suppressor earths, and then check the continuity from the earths to the frame and of both covers to the frame.

P31615 166687/4927 4/62 2250 C & P Gp 375

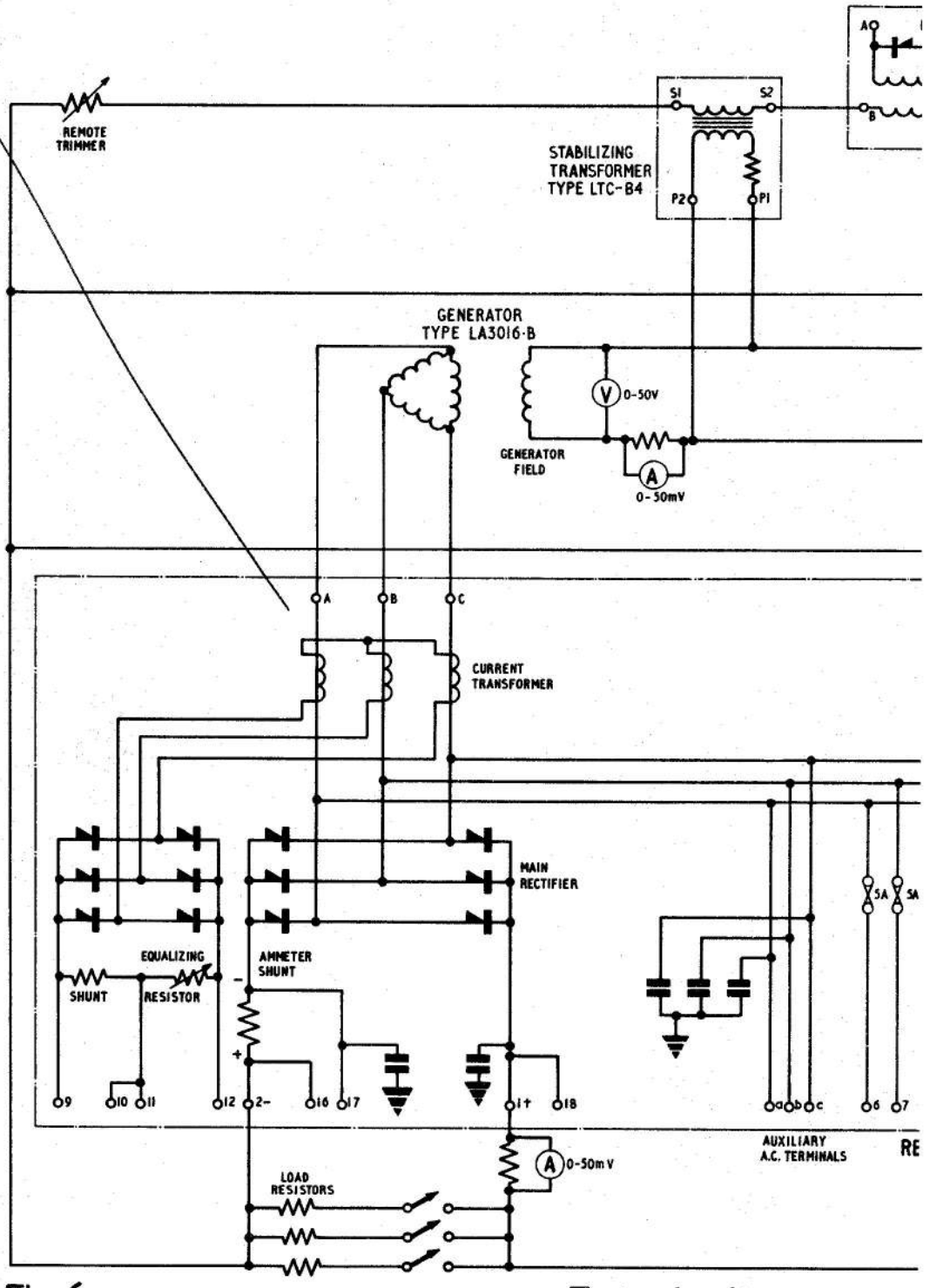
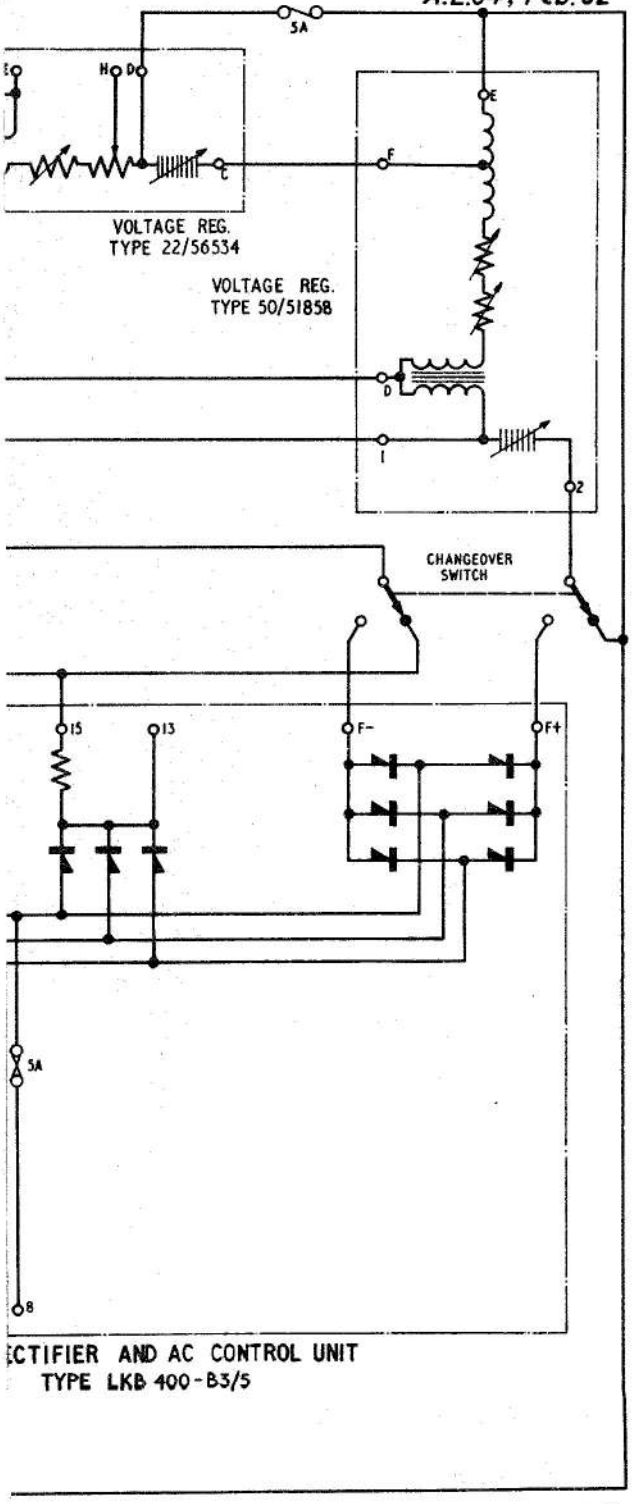


Fig. 6 Test circuit

RESTRICTED

PP8998 166688 4928 2.62 2256 C&P Gp. 924 (4)



ECTIFIER AND AC CONTROL UNIT
TYPE LKB 400-B3/5

Fig. 6