Chapter 6

ROTARY INVERTER, TYPE 100A (ROTAX S2903)

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Rotary inverter, Type 100A	*Stores Ref. 5UB/4933*
Inverter unit only—	
Input	*22·5–23·5 volts d.c.*
Output	*162 watts, 0·81 p.f., 115 volts, 400 c/s, 3-phase a.c.*
Inverter with control panel, Type 12—	
(matched pair) (For Naval Air use) ...	*Stores Ref. 5UB/6507*
Input	*25–28 volts d.c.*
Output	*150 watts, 0·8 p.f., 115 volts, 400 c/s, 3-phase a.c.*
Phase sequence	*A–B–C*
D.C. brushes—	
Grade Nobrac LAB No. F2C	*Stores Ref. 5UB/5958*
Spring pressure	*4·8–5·8 oz.*
A.C. brushes—	
Grade Nobrac LAB No. F2B	*Stores Ref. 5UB/5959*
Spring pressure	*0·75-2 oz.*
Shunt field resistor (40 ohms)	*Stores Ref. 5UB/5920*
or Type ZA.4801/1	*Stores Ref. 5UB/6058*
Rotation (viewed from commutator end)	*Anti-clockwise*
Weight	*6 lb.*
Used with—	
Control panel, Type 12	*Stores Ref. 5UC/4939*

Introduction

1. The rotary inverter, Type 100A, is substantially similar to the inverter unit in the Type 100B described in Chap. 7. It has no regulator box incorporated, and is designed to be used in conjunction with the control panel, Type 12. A plug is fitted in the side of the inverter for making the connection. With an input of 22·5 to 23·5 volts d.c., the inverter unit gives a nominal output of 115 volts, 400 c/s, 3-phase a.c., 200 VA, 0·81 power factor, at a speed of 12,000 r.p.m.

DESCRIPTION

2. The inverter unit (*fig.* 1) is carried in a cradle which has four mounting holes, equally disposed, to give four possible mounting positions of the inverter relative to the control panel. If preferable, the control panel may be mounted remote from the inverter unit.

Inverter unit

3. The armature shaft, carrying the commutator and slip-ring assemblies (*fig.* 2), is held in two ball bearings, one in the commutator end frame and the other in the slip-ring end

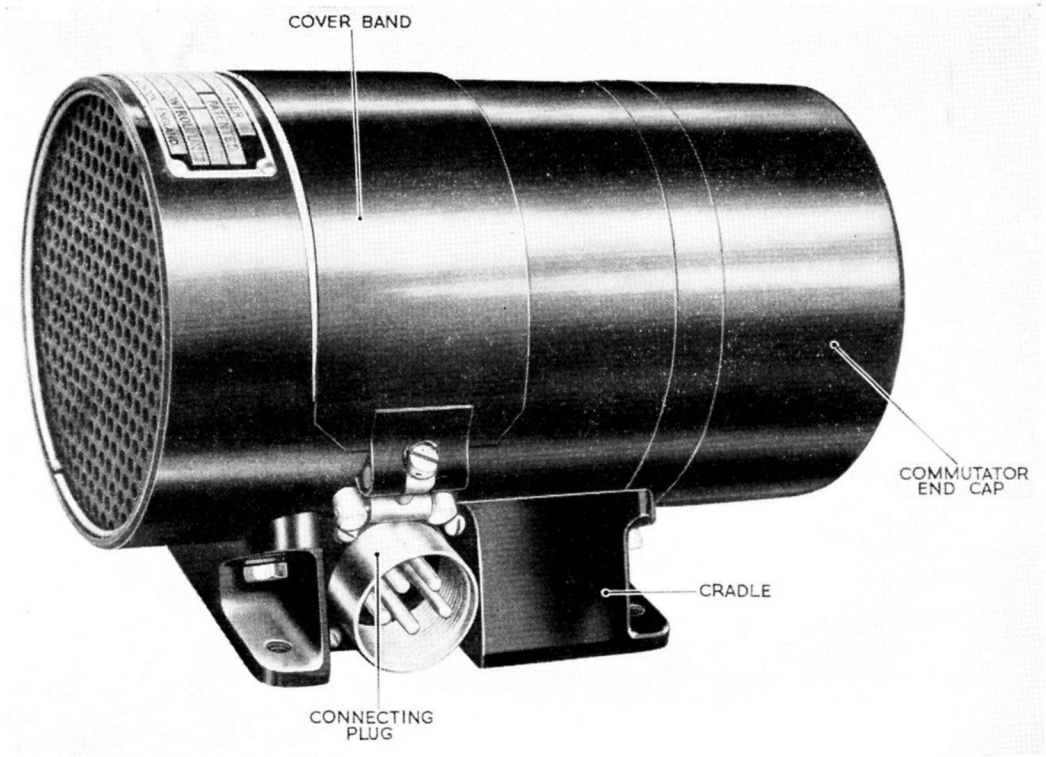

Fig. 1. Rotary inverter, Type 100A

frame. The bearings at both the commutator and slip-ring ends have been selectively fitted to give a clearance of 0·0001—0·0004 in. on the armature shaft and in the housings. For this purpose, the bearings and housings are graded A, B or C, according to their dimensions; to assist identification, housings are marked A, B, or C, and bearings are marked with one, two or three dots. A 1-dot bearing is used with a grade A housing, a 2-dot bearing with a grade B housing, and a 3-dot bearing with a grade C housing, so ensuring the required clearances.

4. The commutator end bearing cap is secured to the end frame by four ch/hd. screws with spring washers, and is enclosed by the end cap, which is held to the end frame by two ch/hd. screws with plain and spring washers. The end cap is perforated to assist ventilation.

5. At the opposite end, the bearing clamp plate is secured to the slip-ring end frame by four ch/hd. screws, with plain and spring washers. At the other side of the end frame is the bearing cap, held by four ch/hd. screws and washers, and a fan is fitted to the end of the armature shaft and secured by a hexagonal nut and lock-washer. Since the bearing is located by the fan boss, no attempt should be made to run the machine without the fan fitted. A perforated screen is held in position by a circlip sprung into the end frame.

6. Cooling of the machine is effected by the fan at the slip-ring end, circulation of air being assisted by the perforations at each end of the inverter unit and the four holes in the slip-ring end frame. The extension of the frame, which forms the yoke, is slotted to allow the passage of air, and the base plate has a central perforated portion.

7. The d.c. brush gear is secured to the commutator end frame by two ch/hd. screws with plain and spring washers; the fixing screws pass through slotted holes in the end frame which allow for adjustment of the brush position. Brush pressure is maintained by springs which are coiled round the trigger posts and bear on the brush triggers. Access to the d.c. brush gear is gained through holes in the commutator end frame, after removal of the end cap.

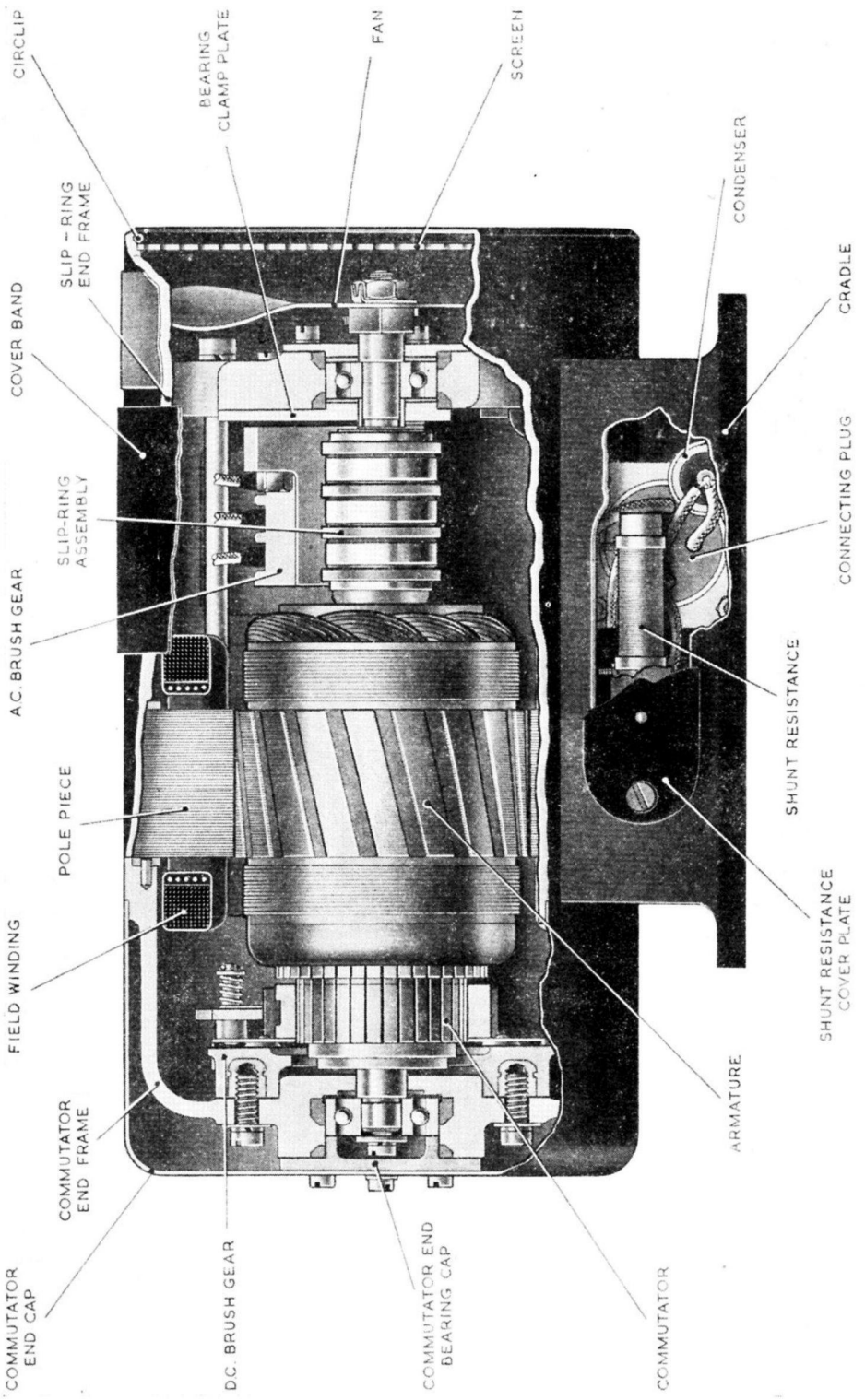

Fig. 2. Sectional view of inverter unit

8. The four pole pieces are mounted in the bore of the yoke, which is integral with the slip-ring end frame, and carry the field windings, wound in compound coils. A circuit diagram giving the connections is shown in fig. 4.

9. The armature is laminated, and the conductors are carried in skewed slots fitted with slot liners. Both input and output windings are carried in common slots, the 3-phase a.c. winding (27½ S.W.G.) being that nearest the shaft, with the d.c. winding (20 S.W.G.) above it. At the output end, the conductors are brought out to the slip-rings, phase A to ring one, phase B to ring two, and phase C to ring three, in that order, ring one being that nearest the armature. Two bands, each consisting of ten turns of wire, are used to retain the conductors against centrifugal stresses.

10. Access to the slip-ring assembly is gained by removing the cover band. Brush pressure is maintained by coil springs; the outer ends of the springs bear on small copper strips, held in position by, and forming electrical connection to, the brush terminals.

Cradle

11. In the cradle are housed a capacitor and the 40-ohm shunt field resistor (*fig.* 3). The resistor is fitted with three copper tapping clips, each 0·628 in. thick. Access to the resistor is gained by removing the two ch/hd. screws, with plain and spring washers, which secure the plate on which it is mounted, or alternatively by removing the base plate, when the capacitor also can be reached. The plug for connecting the inverter to the control panel, Type 12, is fitted to the cradle on the opposite side from the shunt resistor.

SERVICING

12. General information on the servicing of inverters will be found in A.P.4343, Vol. 1, Sect. 8. In addition, the following points should be noted.

Bearings and lubrication

13. The bearings are packed with grease XG–275 (Stores *Ref.* 34*B*/100512) on manufacture, and should not normally require attention between major servicing periods.

D.C. brush gear

14. Details of the brush grade and correct spring pressure are given under Leading Particulars; the minimum permissible brush

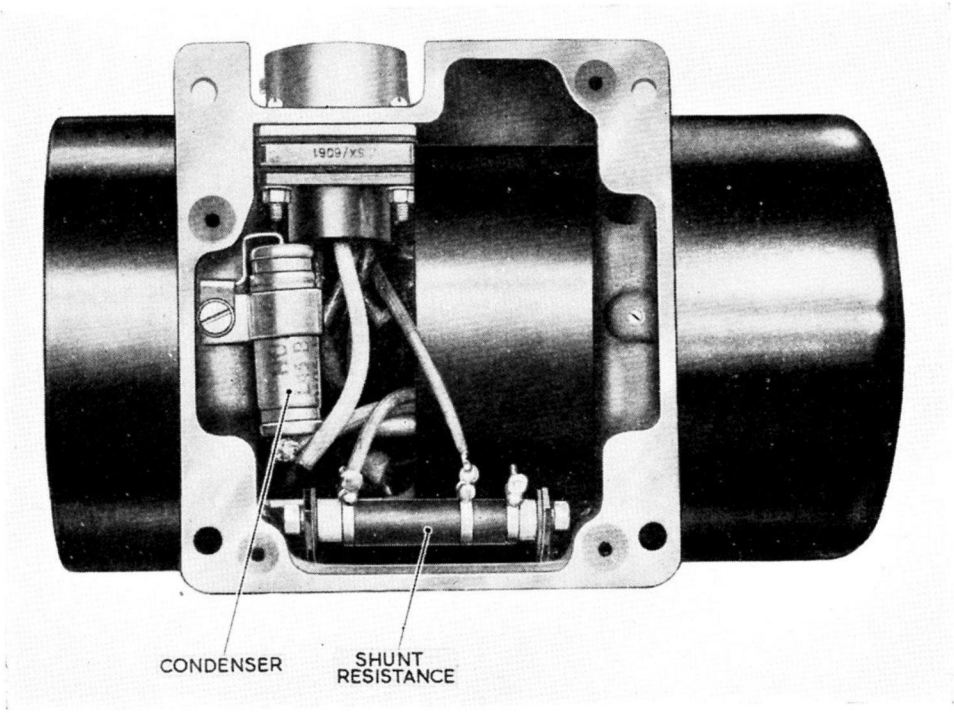

Fig. 3. View with base cover removed

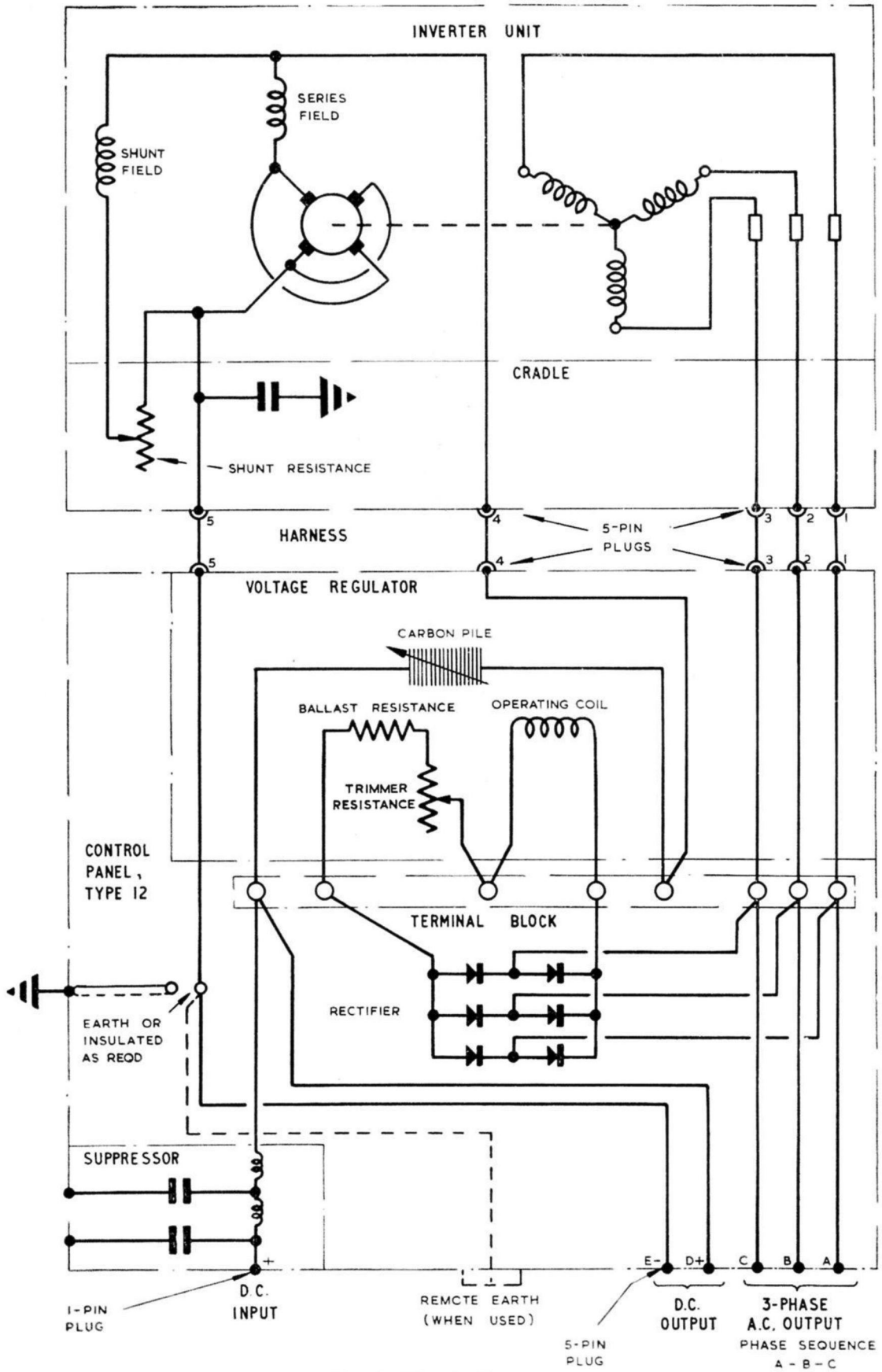

Fig. 4. Circuit diagram

(A.L.211, Dec. 56)

length, measured along the shortest edge, is 0·32 in. The brush springs should be checked for corrosion; if this is present, apply one drop of oil OM–13 (Stores Ref. 34D/100570), and work the spring until the oil is between the coils.

Note . . .

Care should be taken to ensure that springs in accordance with A.P.1068, Book 3, Part 2 are used.

15. Should it be found necessary to dismantle the brush gear for cleaning, the brush position should be carefully marked before removing the screws securing the brush adjustment. When replacing, ensure that it is set in the original position as follows.

16. When viewed from the commutator end, the centre of each fixing screw should be $\frac{1}{32}$ in. to $\frac{1}{16}$ in. from the centre of the adjusting slot in a clockwise direction. This position will give optimum conditions for commutation.

A.C. brush gear

17. Details of the brush grade and correct spring pressure are given under Leading Particulars; the minimum permissible brush length, measured from the shoulder, is 0·2 in.

18. It is important for the maintenance of brush pressure that the terminal screws should be kept firmly tightened down, as these screws also hold the small copper strips upon which the brush springs bear.

Shunt field resistor

19. Check that the resistor is fitted with copper tapping clips, 0·028 in. thick, and that the clips are secure. Unless a new resistor has been fitted, or it is suspected that the setting is disturbed, it should not be necessary to adjust the position of the clip. The shunt field resistor should not be regarded as a trimmer resistor, since it has been set to give the correct excitation current, and if disturbed unnecessarily will lead to incorrect speed.

Setting up the inverter

20. The following paragraphs describe the recommended setting-up procedure for this inverter, in conjunction with the control panel, Type 12. The setting is very critical, and should be made as accurately as possible to ensure optimum performance of the inverter; the two components should subsequently be regarded as a matched pair and be used together. For Naval Air use these may be demanded as a matched pair, see Leading Particulars. It is necessary to obtain a regulation loop of 4 volts between no load and full load; in addition, the frequency should remain substantially constant with a maximum variation of 4 c/s.

21. The inverter tester (Stores Ref. 5G/565), described in A.P.4343S, Vol. 1, Sect. 15, should be used to give the test loading. Although the 100A load on this tester is that for the inverter unit only, it will in practice provide a satisfactory load for the procedure outlined below. A frequency meter, 300–400–500 c/s (Stores Ref. 5Q/154) will also be required, and an a.c. voltmeter, 0–150 volts, suitable for use on 400 c/s, and approved as being of sufficient accuracy for this purpose. A moving coil voltmeter, 0–40 volts, and a moving coil ammeter, 0–30 amp., will be required for measuring the d.c. input to the inverter.

22. It is necessary to provide a d.c. input infinitely variable between 15 and 35 volts. The output from the control panel is taken to the inverter tester, and the a.c. voltmeter connected across any two of the phases.

23. The inverter and control panel should have been serviced in the normal manner, particular attention having been paid to the bedding of the brushes and the condition of the voltage regulator armature. Proceed as follows:—

(1) With an input of 27 volts d.c., run the inverter on no load for at least an hour.

(2) With the inverter still on no load, adjust the input to 19 volts d.c. Place the trimmer resistor $\frac{1}{3}$ to $\frac{1}{2}$ of its range up from the minimum voltage position.

(3) Raise the input voltage slowly until the output reads 115 volts a.c., or until no further rise is obtained. The input must now read 21–22·5 volts d.c.

(4) Raise the input to 27 volts d.c. The output must now read 119–121 volts a.c.

(5) Raise the input to 35 volts d.c. The output must remain within $\pm \frac{1}{2}$ volt of the figure obtained in sub-para. (4).

(6) Lower the input to 19 volts d.c., and return to 27 volts d.c. Switch on the appropriate load, when the output should drop to not less than 115 volts a.c.

24. If the inverter fails any of the tests in para. 23, the regulator must be correctly adjusted for its dip position as follows:—

(1) Unlock the pile compression screw and magnet core plug.

(2) Switch on the inverter on no load, with the input set at 27 volts d.c.

(3) Turn the pile compression screw in a clockwise direction until the output voltage rises, then turn anti-clockwise until the output voltage just ◄ stops ► dropping. Turn a further $\frac{1}{8}$ turn in an anti-clockwise direction, and switch off the inverter.

(4) Switch on the inverter and note the output voltage. Adjust the output to 115 volts a.c. by turning the magnet core plug. (Turn clockwise to lower the voltage and vice versa). Switch off the inverter.

(5) Re-start the inverter and re-check for the dip position as in sub-para (3). Switch off the inverter.

(6) Re-start the inverter and check the output, which should be 119–121 volts a.c. If not, repeat sub-para. (3), (4), and (5) until this is obtained. Switch off the inverter.

(7) Re-start the inverter, with an input of 19 volts d.c. Raise the input voltage until the output is 115 volts a.c., when the input must be 21–22·5 volts d.c.

(8) Raise the input voltage until the output voltage just stops rising. The output must be 119–121 volts a.c.

(9) Raise the input to 35 volts d.c. The output voltage must remain within $\pm \frac{1}{2}$ volt of the figure obtained in sub-para. (8). Switch off the inverter.

(10) Re-start the inverter, with an input of 27 volts d.c. Switch on the load, when the output must be not less than 115 volts a.c. Switch off the load, when the output must be within 119–121 volts a.c. Repeat this test three times.

(11) If these tests cannot be satisfied, the pile stack must be renewed, particular care being taken to ensure that the armature carbon button and the pile compression screw carbon button are unburnt.

Note . . .

When making these tests all tools used must be insulated, and, in addition, the tool for moving the pile compression screw and the magnet core plug must be made from a non-ferrous metal. (Such a tool must be made up locally). When adjusting the pile compression screw and the magnet core plug, ensure that the locking screws are unlocked to the minimum amount, since the re-locking process may disturb the adjustments.

25. (1) Re-start the inverter, with an input of 27 volts d.c., and switch on the load. The frequency should be 395 c/s, and must not rise or fall when the load is switched on and off. If this test is not satisfied, proceed as follows.

(2) Switch off the inverter and inspect all brushes for 100 per cent bedding. If the brushes are not bedded, run the inverter for 4–8 hours until 100 per cent bedding is achieved.

(3) When the brush bedding is satisfactory, switch on the inverter on load. Apply a light finger load to all four brush triggers at once. The frequency should drop; if it does not, the brush spring pressure or sticking brushes will be the cause.

(4) Apply a light finger load to each brush trigger in turn. The frequency should drop in each instance; if it does not, the brush bedding or incorrect brush gear position will be the cause.

(5) Should the frequency fall on load, move the brush gear in a clockwise direction. Switch off the inverter, and re-start on no load. Switch on the load, and note the effect on the frequency. Repeat until the frequency remains substantially stable on and off load. (Should the frequency rise on load, the brush gear must be moved in an anti-clockwise direction).

(6) If necessary, re-set the frequency to 395 c/s by adjusting the shunt field resistor. Repeat sub-para. (5) if the frequency fluctuates on and off load. Run the inverter for 10 minutes and re-check. It is absolutely essential that the frequency be set at 395 c/s, and remain stable at that figure both on and off load. To this end sub-para. (5) and (6) must be repeated until optimum performance is achieved.

26. This completes the setting up of the inverter, and para. 23 and para. 25, sub-para. (1) must be repeated to prove the regulation. In addition, raise the input to 35 volts d.c. witn the inverter on load, when the frequency should rise to a figure not exceeding 400 c/s, and the output to a figure not exceeding 119–121 volts a.c. Now raise each brush trigger in turn, when the commutation on the opposite brush must remain good with no excessive sparking.

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ELECTRICAL MANUAL, CONTROL AND DISTRIBUTION EQUIPMENT (AIRBORNE)

ADVANCE INFORMATION LEAFLET No.1/57

Insert this leaflet in A.P.4343B, Vol.1, Sect.16, Chap.6, to face para.26.

Line 5. "Inverter on load should read inverter on no load."

Notes

(1) The information contained in this leaflet will be incorporated by normal amendment list action in due course.

(2) If, after receipt of this leaflet, an amendment list with a prior date and conflicting information is received, the information in the leaflet is to take precedence.

ENGINEER