Chapter 3

GENERATOR, TYPE U

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Generator, Type U	Stores Ref. 5UA/349
Output voltage	80V, a.c.
Output current	15 amp.
Excitation voltage	24V, d.c.
Field resistance	7·45 ohm
Rotation	Clockwise or anti-clockwise
Max. speed (continuous)	6,000 r.p.m.
Frequency at 3,000 r.p.m.	1,400 c/s
Weight	35 lb.

Introduction

1. The a.c. generator Type U (*fig.* 1) has been designed to give a maximum output of 15 amp. at 80V, a.c. when excited from the aircraft's 24V, d.c. system. Normally the output voltage of this generator is controlled by a control panel Type 5 with which is incorporated a voltage regulator Type EU, or the control panel Type 5A incorporating the voltage regulator Type EU2. A full description of these two control panels is given in A.P.4343B, Vol. 1, Sect. 7, Chap. 3 and 4 respectively. In order that the full rated output may be obtained over the full speed range, a capacitor of 11μF must be connected in series with the a.c. winding. Allowance is made for this within the control panels.

2. The generator is intended to be engine driven through gearing and is designed to run at available speeds up to 6,000 r.p.m. continuous maximum. For periods not exceeding five minutes its maximum speed may be 7,500 r.p.m. At 3,000 r.p.m. the output frequency is 1,400 c/s.

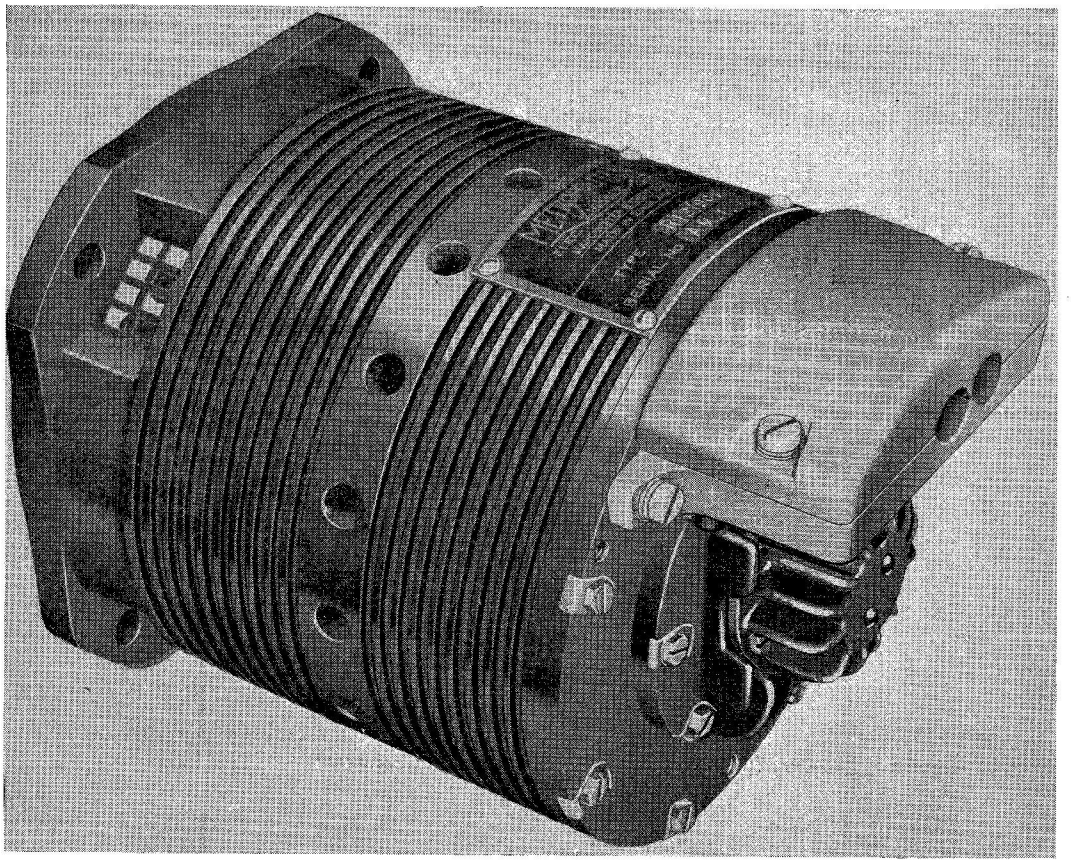

Fig. 1. A.C. generator, Type U

PRINCIPLE OF OPERATION

3. The generator is of the homopolar type in which a unidirectional field of constant value passes across an air gap between the rotor and stator. Both the rotor and stator are provided with laminated teeth ; the slots of the latter carrying the a.c. winding. As the rotor turns, the reluctance of the air gap at any tooth of the stator will vary from a minimum when a tooth of the rotor is opposite it, to a maximum when a slot is opposite. The flux linking a conductor of the winding at that point will vary accordingly between maximum and minimum values, and an E.M.F. will be induced in the conductor. If there were the same number of slots in the rotor and the stator, the flux linking the conductors in each slot, would, at any instant, be varying in the same direction, and consequently the E.M.F.'s in every conductor would have the same sense, and to complete the winding it would be necessary to make connections behind the stator punchings. If, however, the number of slots in the rotor is made to differ slightly from the number in the stator (say by 2), there will be two diametrically opposite points at which the relative positions of rotor teeth and stator conductor are identical—say, for example, with a rotor tooth opposite to a stator tooth corresponding to maximum flux. At two points 90 deg. from the first two, a rotor slot will be opposite to a stator tooth, corresponding to a minimum flux. The E.M.F. induced in the conductors at the second pair of points will consequently be of opposite sense, i.e. 180 deg. to that generated at the first pair of points.

4. The conditions are thus similar to those for a normal four pole winding, and the coil sides for a full pitched winding would be 90 deg. (mechanical) apart. The frequency depends on the rate of passage of the rotor teeth past any given point on the stator, i.e. upon the speed of rotation and the

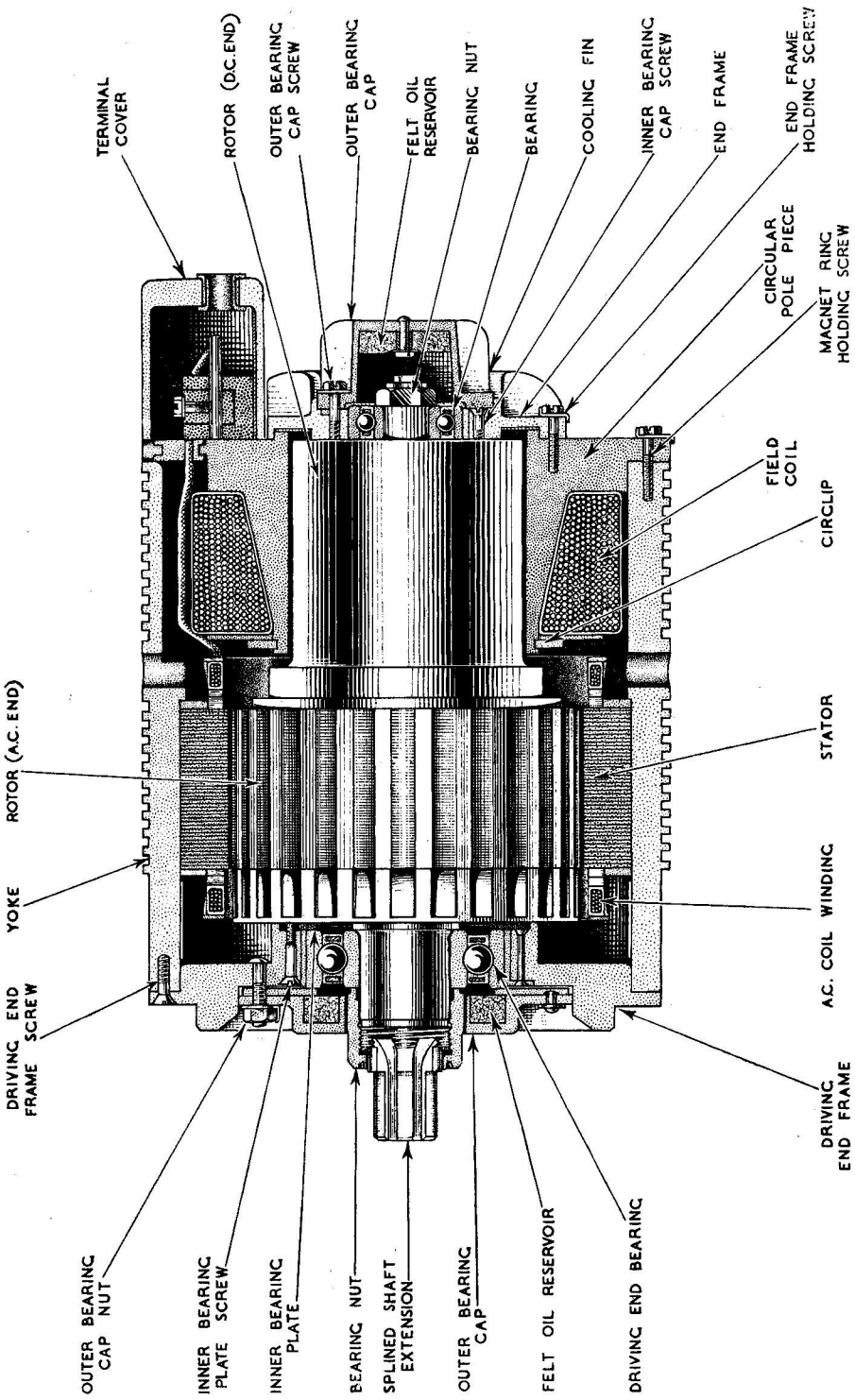

Fig. 2. General arrangement, generator, Type U

number of rotor teeth, and not upon the number of stator teeth, or the apparent number in the a.c. winding.

DESCRIPTION

5. Fig. 1 shows a general view of the generator, a sectional view is given in fig. 2, and reference should be made to these illustrations when following the description.

6. The mild steel yoke is flanged at the driving end to provide a means of attachment for the generator to the engine. The driving-end frame is spigoted to this flange and secured to it by four countersunk screws. It carries the driving end bearing. The stator laminations are spot welded inside the yoke.

Windings

7. Screwed to the end frame at the non-drive end is an annular mild steel pole piece carrying the exciting winding.

8. The a.c. output winding is wound in slots on the laminated stator and brought out to two terminal connections (*para.* 14).

9. The magnetic circuit is arranged so that d.c. excitation current flowing in the annular field coil surrounding one end of the rotor sets up a flux which passes from the pole piece across the air gap to the solid portion of the rotor. It is then passed to the laminated rotor teeth, back across the air gap to the stator and the circuit completed by way of the yoke.

Bearings

10. The drive-end ball bearing is held within a housing in the end frame by inner and outer bearing plates, and retained on the rotor shaft by a special nut.

11. The non drive-end ball bearing is housed in the end frame with an inner and outer bearing cap and in early models was retained by a nut. In later models this nut has been replaced by a special sleeve pressed on to the shaft.

12. The bearings are oil lubricated; two systems being in use. In early models (*fig.* 2), an oil-soaked felt ring housed in the outer bearing cap forms the oil reservoir for the system, and transfer of oil from the reservoir to the bearing is effected solely by surface tension of the oil. Later models incorporate an improved system (*fig.* 3). In this system a felt washer is attached to a thin metal disc at the outer side of both bearings which serves to prevent the washer being drawn into the bearing. This felt washer makes light rubbing contact on the shaft sleeve, and is also in contact with the main reservoir felt in the bearing cap. Oil is thus transferred from the reservoir to the shaft sleeve by the felt wiping washer, and then passes to the bearing under the action of centrifugal force. A similar wiping washer is fitted on the inner side of the bearing and at the driving-end is fed by oil from the main reservoir felt by capillary action through three wicks. These wicks are however, omitted at the non-drive end.

Cooling

13. The generator is cooled by through ventilation, air being circulated through the machine by a small fan built into the rotor. Cooling is assisted by fins on the yoke, end frame, and bearing cap.

Terminals

14. The layout of the terminals contained in the terminal box mounted on the non-drive end is shown in fig. 4. The a.c. winding is connected to the two outer terminals (yellow and blue spot respectively), whilst the d.c. exciting winding is connected to the two middle terminals which are marked with a white and black spot respectively.

INSTALLATION

15. The generator is secured to the main engine by four bolts passing through the mounting flanges, and should be so arranged that the terminal cover is easily accessible.

SERVICING

16. Very little servicing needs to be done to these generators apart from lubricating the bearings. They should be inspected to see that all electrical connections are tight and free from corrosion, and all mechanical fixings are secure.

Lubrication

17. To lubricate the bearings it is necessary to remove the generator from the aircraft, and proceed as follows. Remove the outer bearing cap and Vellumoid gasket at the driving-end by taking off the six nuts. Well soak the felt of the outer bearing cap in lubricating oil (OM–170). After soaking and replacing the felt in the bearing cap, lightly depress the felt with the fingers to exude superfluous oil and wipe the metal part free from oil with a soft rag. Re-fit the outer bearing cap and the Vellumoid gasket to the

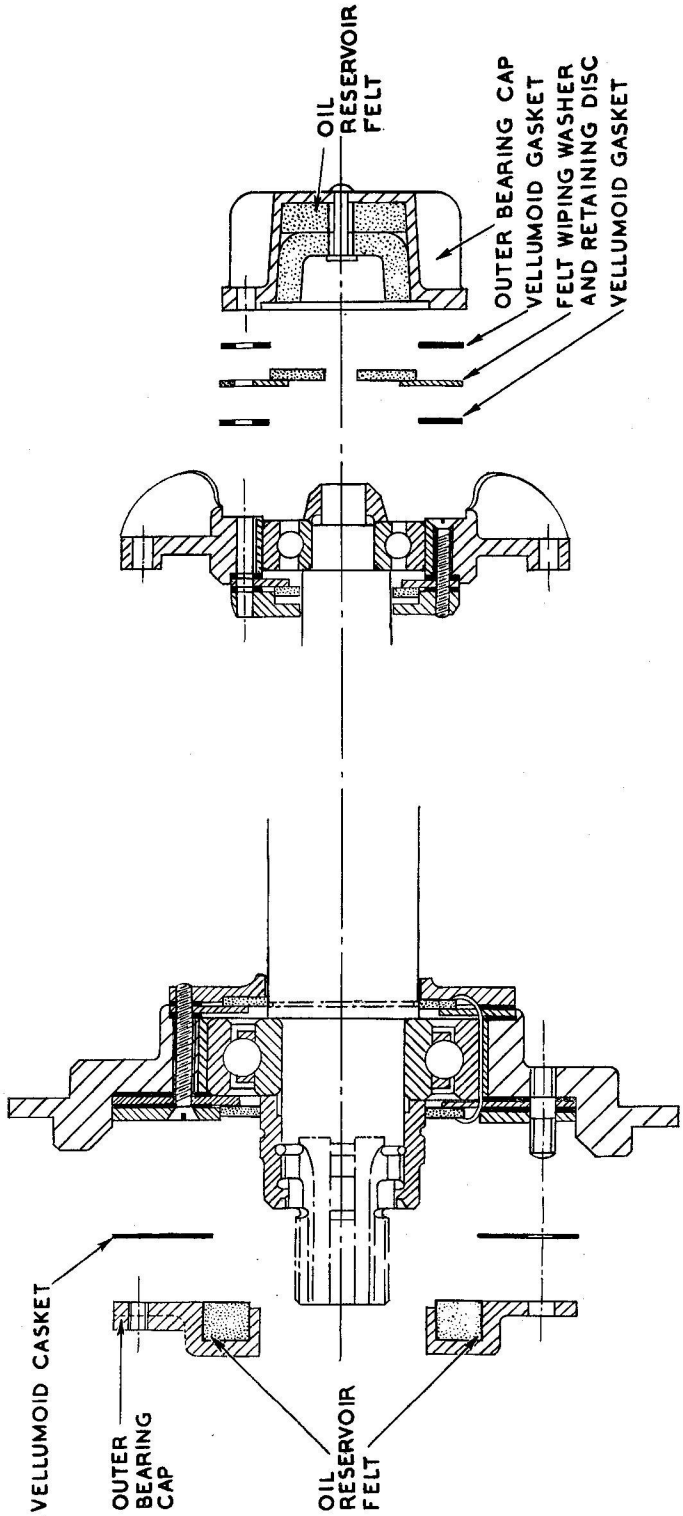

Fig. 3. Modified lubrication system (partly dismantled)

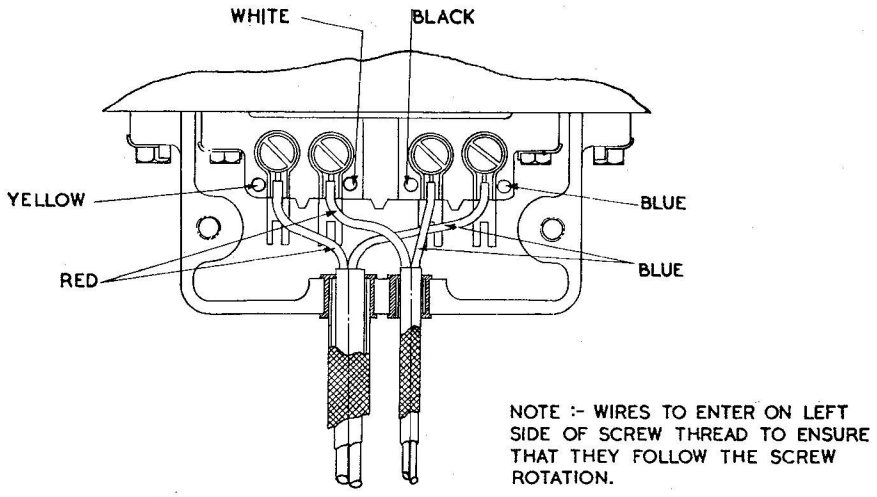

Fig. 4. Terminal connections

driving end, and replace the nuts securely and lock the tab washers. At the non-drive end take out the screws holding the outer bearing cap and remove the latter. This frees two Vellumoid gaskets and a felt wiping washer and retaining disc. Soak the outer bearing cap and the felt wiping washer in lubricating oil as for the driving end. After soaking shake and wipe off surplus oil from the metal parts. Re-fit the components in the following order; Vellumoid gasket, felt wiping washer and retaining disc (felt AWAY from the bearing), Vellumoid gasket, and finally the outer bearing cap. Fit and secure the three fixing screws and lock the tab washers. Fig. 3 illustrates the order in which the components are fitted and this should be referred to. The countersunk screws under the bearing caps, at both the driving end and the non-drive end must not be removed.

TESTING

18. A check should be made to see that the rotor revolves freely, without excessive noise or end play in the bearings.

19. The generator should be connected to its appropriate control panel, this latter being connected to a suitable source of d.c. supply and to a suitable load. Switchboard, Type K (*Stores Ref.* 5G/214), and loading panel (*Stores Ref.* 5G/215), are available for this purpose. The generator should then be run at approximately 4,000 r.p.m. with an output current of 15 amp. for a period of 20 minutes. At the end of this period the insulation resistance of all live parts together to the frame should be not less than ·05 megohms when measured with a 250V insulation tester.

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