Now 113B-0139-1

Chapter 23

GENERATOR, E.E., TYPE AE2054

Cancelled

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Generator, Type AE2054	*Ref. No.* 5UA/7193
Output	20*kVA*
Line voltage	200*V*
Phases	3
Frequency	400 *c/s*
Time rating	*Continuous*
Cooling	*Blast air*
Rotation	*Clockwise (looking on drive end)*
Altitude range	0-60000 *ft*
Speed	12000 *rev/min*
Weight	65 *lb*

Brushes—Commutator

Grade	*K.C.E.G.* 11
Minimum length	$\frac{7}{16}$ *in.*
Spring pressure	$14\frac{1}{4}$-$16\frac{3}{4}$ *oz*

Brushes—Slipring

Grade	*K.C.E.G.* 11
Minimum length	0·45 *in.*
Spring pressure	$7\frac{3}{4}$-$10\frac{1}{4}$ *oz*

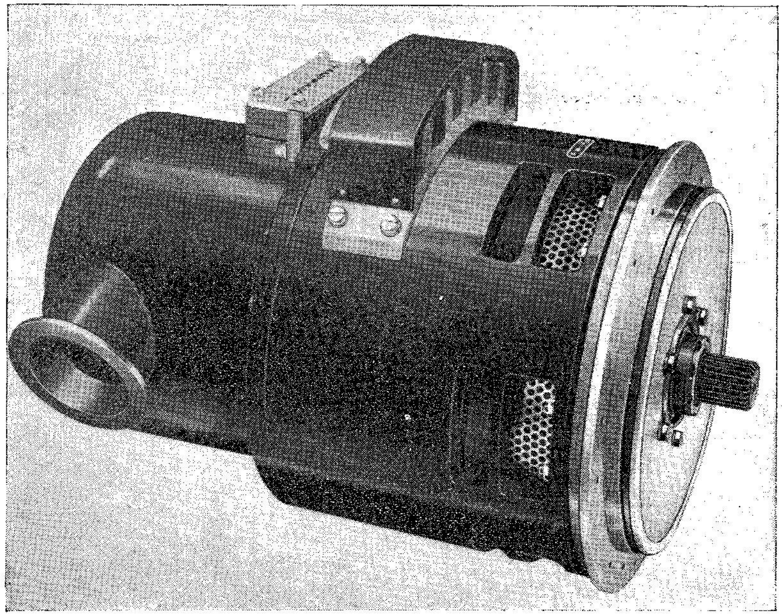

Fig. 1. Generator, Type AE2054

Introduction

1. The Type AE2054 a.c. generator (fig. 1) is designed to supply power to a 200V, 400 c/s a.c. system at a nominal speed of 12000 rev/min.

DESCRIPTION

General

2. The generator has a salient four-pole rotor integral with which is a d.c. exciter fitted with bias, shunt and compensating windings. The rotating assembly is supported by and rotates in pressure oil fed bearings which are supported in the drive end (d.e.) and tail end (t.e.) endplates. Each endplate is secured to the frame and stator assembly. Terminal blocks (a.c. and d.c.) secured to the stator and t.e. assemblies are utilized to connect the generator into an aircraft electrical system. High temperature preformed packings ('O' rings) are used in the assembly of the machine to prevent ingress of oil from the oil pressure system into the rotor, stator, and exciter assemblies. The generator is blast air cooled and incorporates a manacle mounting flange and serrated drive shaft (see fig. 2).

Frame assembly

3. Positioned within the machined light alloy frame is the wound stator, the core of which houses the 3-phase, four-pole windings. The frame is machined to permit oil flow and tapped holes allow the fixture of endplates and a.c. terminal block. Fitted within the d.e. of the frame is a perforated cover, which prevents the entry of foreign matter into the machine via the air outlet ports.

Tail-end endplate assembly

4. Secured to one end of the t.e. endplate assembly is the brushgear assembly, exciter assembly and d.c. terminal block. Housed within a recess at the opposite end of the endplate is the flanged outer race of the roller bearing and the seal-housing-retainer assembly. Positioned between the retainer assembly and the flanged bearing are inner and outer mounting rings and preformed packings. Adjacent to the flange of the bearing is the t.e. endcap which is clamped to the endplate and bearing with hex. hd. bolts anchored in the seal-housing retainer assembly. Housed within the endplate is an oil flow restrictor, oil jet and sealing plugs. The sealing plugs are locked in position with cupwashers.

Seal housing retainer assembly

5. An oil-seal, oil-slinger assembly is positioned within the seal housing which is secured to the seal retainer with c'sk hd. screws. A preformed packing assembled to the outer periphery of the seal retainer seals the assembly to the t.e. endplate. The oil slinger prevents oil from percolating down the shaft and also ensures that oil enters the hole drilled for drainage purposes.

Drive-end endplate assembly

6. Housed within the light alloy d.e. endplate is the flanged ball bearing. Adjacent to the bearing is the seal retainer which is clamped to the d.e. endplate with hex. hd. bolts which are sealed and locked in position. The seal which is clamped in position with the seal retainer abutts inner and outer mounting rings, sealing rings and preformed packing assembly. The endplate is secured to the motor frame with studs, nuts and tabwashers.

Brushgear assembly

7. The a.c. and d.c. brush boxes are positioned on insulating mounting rings which are secured together with c'sk hd. screws. The brush boxes are positioned on the rings so that the hex. hd. bolts and tab plates securing three of the brush boxes to the a.c. mounting ring pass through the mounting ring assembly and are anchored in the brush boxes positioned on the d.c. mounting ring. The remaining six brush boxes i.e. three on the a.c. ring and three on the d.c. ring, are secured in position to the rings by hex. hd. bolts and tab plates. Each brush box is a machined casting which supports a serrated slotted pin on which is assembled a coiled spring and 'e' clip (s). Brush spring pressure applied by the brush fingers on the brushes can be varied by the position of the serrated slotted pin. Brush pigtails and flexible leads are secured to the brush boxes with ch. hd. screws and spring washers.

Exciter field assembly

8. The six pole d.c. exciter field assembly comprises shunt field windings, compensating field windings and a bias winding. The windings are positioned within a laminated yoke to which the pole pieces are pinned and bolted. Leads emerging from the windings connect the assembly in circuit. The field assembly is secured to the d.e. endplate by the yoke, which is a push fit in the recess machined in the drive end of the t.e. endplate. The yoke is retained in position by five sets of hex. nuts, hex. bolts, clamps and tab washers. Slackening of the clamp assembly permits the rotation of the field assembly to facilitate the setting of the neutral position.

Rotor assembly

9. The laminated four-pole rotor core assembly located on the hollow shaft is locked on the shaft by a clamping nut which is pinned in position to the shaft. Steel bands and coil supports are positioned on the windings at each end of the core. Bolted to the clamping nut at the d.e. of the rotor core is a deflector ring which is designed and positioned to prevent oil entering the rotor windings. Pressed on to the t.e. of the armature shaft is the armature commutator assembly and the slipring assembly. The slipring assembly is connected to the rotor windings by insulated copper leads, which locate in a groove machined in the shaft. The rotor assembly is balanced by weights, which are secured to the coil supports with hex. hd. bolts. Serrations integral with the d.e. of the shaft provides the coupling medium to connect the generator to associated drive equipment. Threads machined on each end of the rotor shaft provide a locking medium for the bearings in conjunction with a locking ring and cup washer at the (d.e.) of the shaft, and a locknut and cup washer at the t.e. of the shaft.

Exciter armature assembly

10. The laminated core of the armature houses the coils (two per slot) which forms the progressive wave wound winding. The ends of the coils are brazed to an 86-segment commutator which forms an integral part of the armature assembly.

Slipring assembly

11. Two sliprings shrunk on to a mica insulated bush assembly forms the slipring assembly.

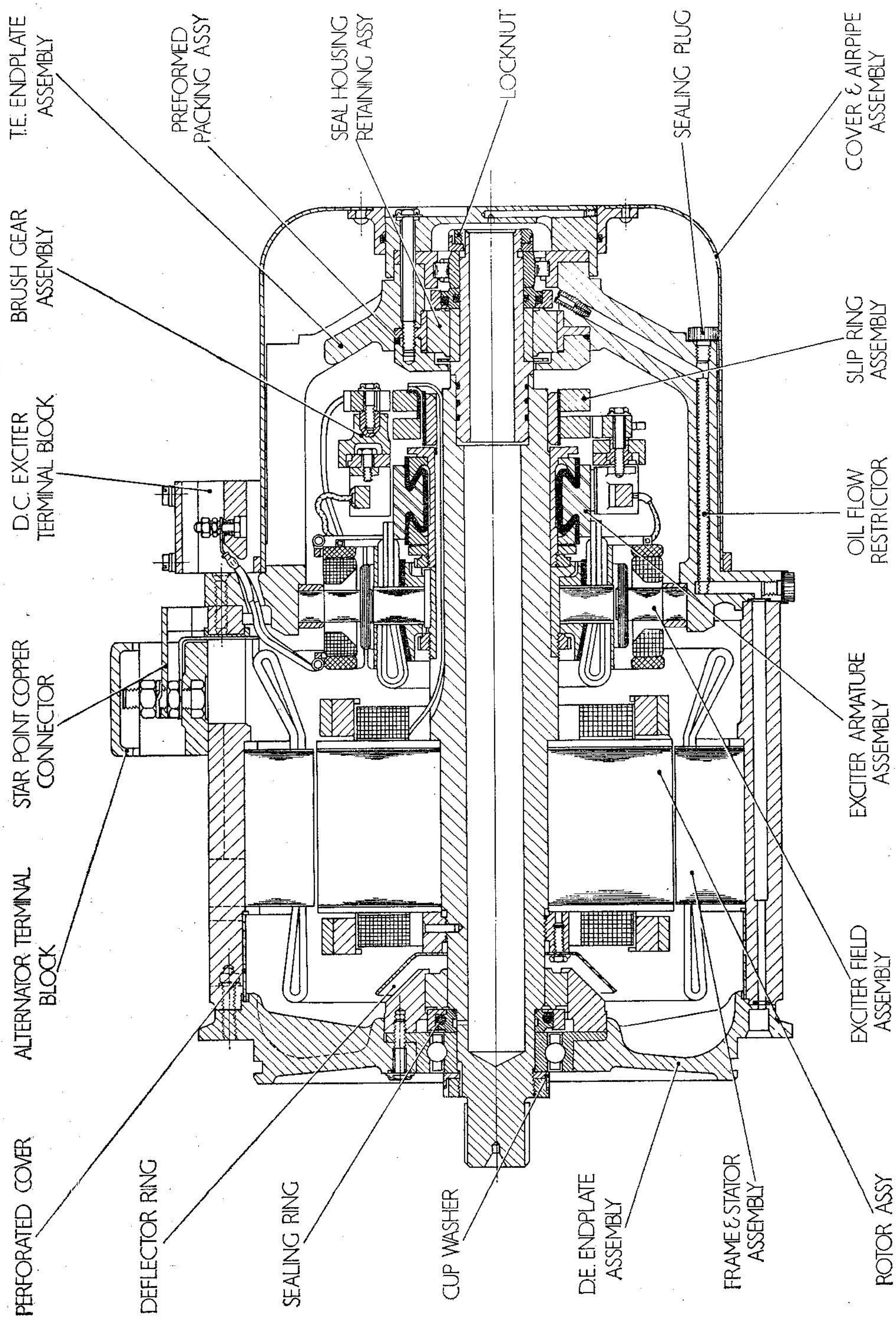

Fig. 2. Sectional view

Cover and airpipe assembly

12. The light alloy cover assembly comprises a welded and riveted assembly of a cover, air inlet pipe flange and housing. The housing and cover are a riveted assembly and the cover, inlet pipe and mounting flange is a welded assembly. The cover is fitted over the t.e. assembly and slots on the machined diameter of the t.e. endplate. Three sets of clamps, hex. hd. bolts and tab washers are used to secure the cover and airpipe assembly to the t.e. endplate. A preformed packing positioned in the housing riveted to the cover, provides a seal between the cover assembly and t.e. endplate assembly.

Terminal blocks

13. The terminal blocks are of moulded construction and cast in the mouldings are inserts. Studs (locating in the inserts), nuts and spring washers provide the means of securing external leads to the generator. Insulated covers are secured to the terminal blocks with ch. hd. screws and washers.

Note . . .

The a.c. terminal studs are threaded $^5/_{16}$ in. U.N.F. and the d.c. terminal studs are threaded 4 B.A.

Connections

14. A diagram of the generator internal connections is shown in fig. 3. A copper connection, shorting the generator terminals A1, B1 and C1 together, is used to create the star point of the stator windings at the a.c. terminal block.

Cooling

15. The generator is cooled by blast air. Air enters the machine via the air inlet pipe fitted to the t.e. cover and leaves the machine through slots in the d.e. of the stator frame assembly.

Lubrication system

16. Lubrication of the generator is by means of oil which is circulated at a pressure of 50 lb/in^2. Oil enters the lubrication system of the generator from the gearbox via the drilled stator frame and proceeds to the t.e. bearing via the drilling in the t.e. endplate. Housed in the endplate is an oil flow restrictor and an oil jet. Oil from the jet passes through the roller bearing into the recess of the t.e. endcap. The endcap is drilled to allow a flow of oil to take place into the hollow shaft of the rotor without excess pressure having to be built up to overcome the back pressure created by the pumping action of the castellated t.e. locknut. Oil from the hollow shaft returns to the gearbox via a hole drilled in the shaft which allows oil to flow to the t.e. bearing via holes in the inner mating ring. An oil drainage hole is incorporated in the t.e. endcap, t.e. endplate and seal housing retainer assembly. Oil flow is governed by the oil flow restrictor which limits the flow in accordance with the temperature of the oil on entry into the lubrication system (see fig. 4).

INSTALLATION

General

17. Before installing the generator ensure that the direction of rotation of the rotor shaft, as indicated by the direction plate fixed to the d.e. of the machine, is suitable for connection to associate drive equipment.

Mounting

18. Fit a sealing ring in the groove machined in the d.e. endplate and mate the generator with associate equipment. Secure the generator in position using a manacle clamp.

Terminal and air pipe connections

19. Connect the generator terminals into the aircraft electrical system and clamp cooling air pipes to the air inlet pipe positioned at the t.e. of the generator.

OPERATION

20. When the generator is run up to the operating speed the output of the d.c. exciter is delivered to the rotor winding via the commutator, sliprings and compensating windings. Current flowing in the rotor induces an e.m.f. in the star connected stator windings. The output of the stator windings is controlled by a voltage regulator which regulates the excitation of the main field coils of the exciter. A separately excited bias winding incorporated in the exciter field windings promotes the build up of voltage under starting conditions and also prevents reversal of polarity taking place within the rotor during transient load conditions.

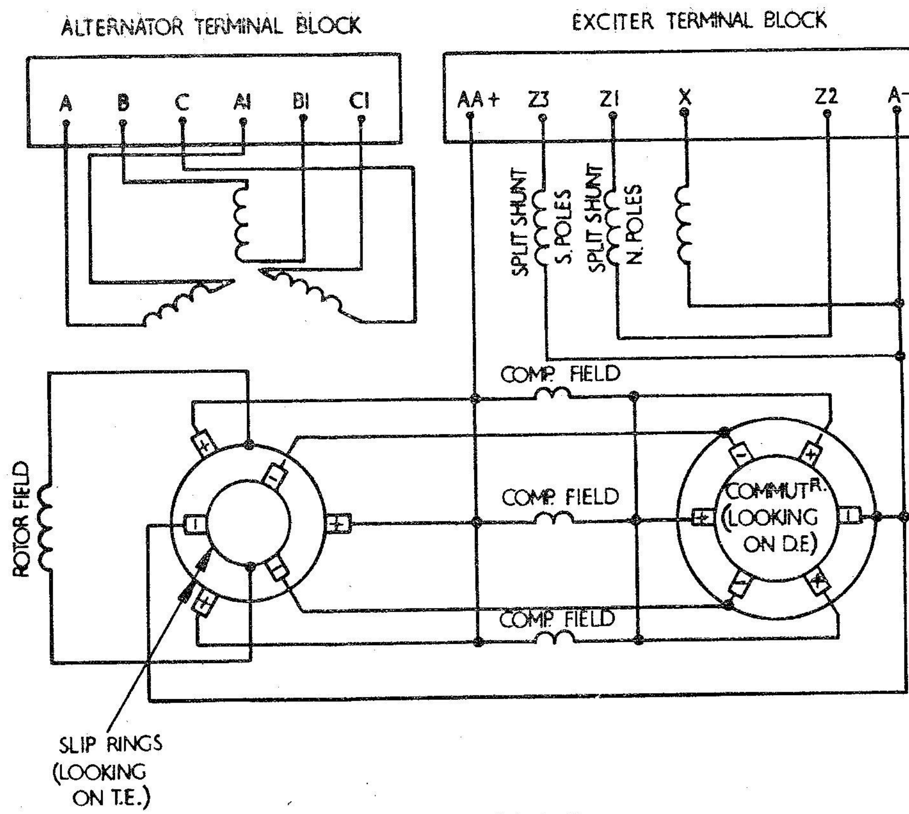

Fig. 3. Internal wiring diagram

SERVICING

General

21. To enable the generator to be examined the air pipes should be removed from the t.e. of the generator and the t.e. cover detached. To facilitate examination of the terminal connections remove the terminal covers. Examine the generator for the security of all screws, bolts, nuts, washers and electrical connections. Check also the general serviceability of components and examine for oil leakage.

Brush renewal

22. Brush grades and minimum lengths are given in the Leading Particulars to be found at the commencement of this chapter. Brushes should be renewed if the length of brush available indicates that the minimum length will be reached before the next servicing period or examination.

Brush bedding

23. To bed the brushes the machine should be connected as shown in fig. 5 and driven at 12000 rev/min on no load for a period of 15 hours or until the brushes have bedded 80% axially and 100% circumferentially. The current flowing in the bias field should be set at 0·75 amperes and current flow in the shunt field should be adjusted so that no sparking occurs at the sliprings or commutator. The shunt field current should be checked at hourly intervals and adjusted if necessary up to a maximum of 5 amperes. Oil should be fed at a pressure of 50 lb/in.^{2} (using E.E. L3 oil) to the generator during brush bedding procedure and the tests described in paragraph 25 carried out to determine oil leakage. Under no circumstances should the machine be run without blast air being applied at a pressure of 6 in. W.G.

Setting neutral position

24. To locate the brushes into the magnetic neutral axis of the machine it is necessary to unclamp the yoke of the d.c. exciter, this is accomplished by unlocking and unscrewing the five sets of hex. hd. bolts and tabwashers located in the t.e.

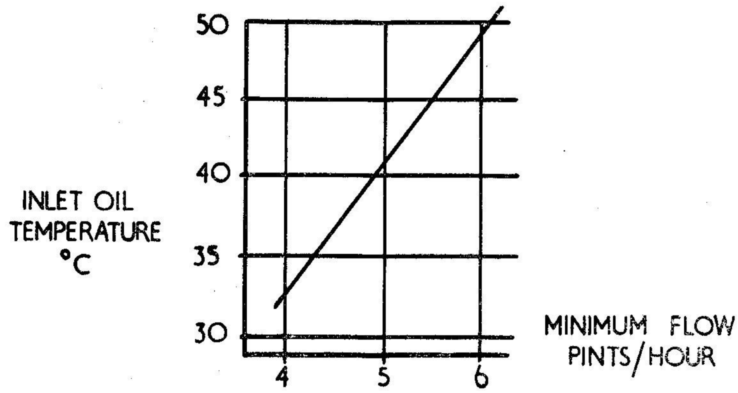

Fig. 4. Oil flow lubrication characteristc

endplate. The brushes should then be rocked into the magnetic neutral axis by using the weak field method as follows:—

(1) Connect a 0-75 mV centre zero voltmeter across a positive and negative brush.

(2) Apply a two volt supply intermittently to the field terminals and secure the brushgear in the position which causes the needle of the voltmeter to deflect in both directions.

(3) Ensure that the bi-directional flick of the voltmeter can be obtained for various positions of the armature.

Oil leakage

25. When the machine is running at approx. 12000 rev/min oil leakage from the d.e. and t.e. of the machine should be checked as follows:—

Drive-end—Oil leakage past the drive end seal should be collected using a special collector ring clamped externally on the machine over the air outlet ports and the leakage per hour determined over three periods of five hours. Oil leakage should not exceed 1½ c.c. per hour.

Tail end — Oil leakage out of the breather hole in the t.e. bearing endcap should not exceed 5 c.c. per

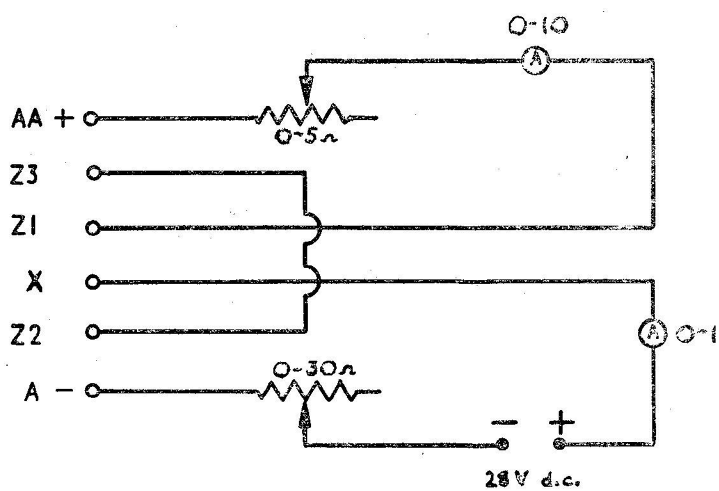

Fig. 5. Brush bedding circuit diagram

hour. Oil leaking past the t.e. seal and blown out through the vapour seal hole in the endcap should not exceed 5 c.c. per hour. Leakage past the seal into the machine is not permissible.

Commutator and sliprings

26. The minimum diameter of the commutator and sliprings is 2·95 in. Under no circumstances should a rotor assembly be put into service with a dimension less than that stated above. Commutator separators should be undercut to a depth of $^1/_{32}$ in.

Oil seal surfaces

27. Oil seal and outer mating ring surfaces which abut each other on assembly should have a surface finish which should be flat to within three helium light bands.

Servicing procedure

28. When servicing the generator it is recommended that the requirements detailed in paragraphs (1) to (5) are observed.

(1) Before any dismantling takes place on a generator all oil should be removed from the machine using a vacuum oil pump.

(2) When removing the t.e. locknut use E.E.Co. jig No. 2036 A10 to prevent the rotation of the rotor.

(3) When removing the rotor d.e. endplate assembly from the stator t.e. endplate assembly utilize E.E.Co. jig No. 2036 A07.

(4) Oil seals should be pressure tested at a pressure of 20 lb/in² for a period of 30 minutes.

(5) Before any electrical testing takes place on a reassembled generator the machine should be given a static oil test at a pressure of 20 lb/in² for a period of 45 minutes. An oil flow restrictor should not be fitted for the above test. The generator should then be given a further test for a period of 10 minutes at a pressure of 50 lb/in² with an oil flow restrictor assembled in position. Minimum oil flow at 50 lb/in² should be not less than 4½ fluid oz in 5 minutes. The machines should be examined for oil leaks upon completion of the tests and remedial action taken where necessary.

TESTING

General

29. Before installing a new or reconditioned generator the machine should be tested in accordance with the following paragraphs. No testing should take place on a generator (except on static testing) unless blast air is supplied to the machine at a pressure of 6 in. W.G. and oil at a pressure of 50 lb/in² is circulated through the lubrication system.

Resistance test

30. Check the resistance of the windings. All resistance values stated have been corrected to 20°C.

Stator per phase	0·0404 to 0·0493 ohms
Rotor	0·582 to 0·710 ohms
Main shunt field	
(Z_1, Z_2)	0·594 to 0·670 ohms
(Z_3, A—ve)	0·594 to 0·670 ohms
Bias field	9·10 to 10·26 ohms
Compensating field	0·0076 to 0·0117 ohms

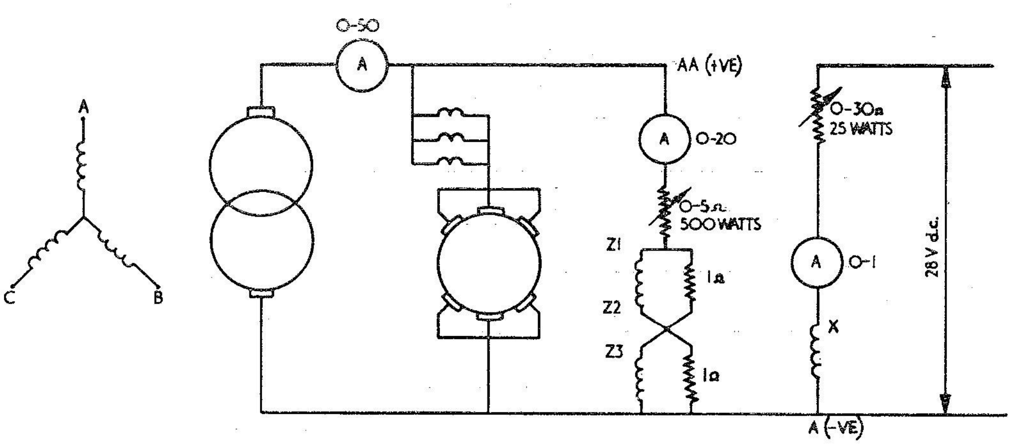

Fig. 6. No load test circuit

Phase rotation and voltage balance test

31. Check that when the machine is driven in a clockwise direction (when viewed looking at the d.e. of the machine) the phase rotation is A.B.C.

32. With the machine running at a speed of 12000 rev/min on no load, check that the line voltages A-B, B-C and C-A and the phase voltages A-A, B-B and C-C lie within $\pm 1\%$ of their respective mean values.

Note . . .

(1) *Nominal value of line voltage is* 200 *volts.*

(2) *Nominal value of phase voltage is* 115 *volts.*

Open circuit test

33. Connect the generator as shown in the test circuit fig. 6. Run the generator at a speed of 12000 rev/min, self excited on no load with a current of 0·75 amperes flowing through the bias winding. Adjust the shunt field current to 10 amperes and check that the rotor current is within the range 20 to 26 amperes.

Caution . . .

Ensure that the maximum amount of cooling air is applied to the machine during this test.

34. Separately excite the shunt field with NO current flowing through the bias winding and adjust the voltage (measured between lines) to 200 volts by varying the shunt field current. The shunt field current to obtain this voltage should not exceed 4 amperes.

Short circuit test

35. Drive the generator at a speed of 12000 rev/min with the stator terminals A-B-C short circuited. With a generator line current of 75 amperes the shunt field current should not exceed 7 amperes.

Insulation resistance test

36. Measure the insulation resistance between each stator winding and the frame, and between the A-terminal and the frame. The readings obtained should be not less than 0·05 megohms at 500V d.c.