Chapter 16

GENERATOR TYPE 162 (E.E. TYPE AE.2036)

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LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Generator, Type 162	*Ref. No.* 5*UA*/6555
Output	20*kVA*, 3-*phase*
Frequency	400 *c/s*
Rated voltage	208*V*
Rated current	57·7*A*
Regulated voltage	200*V*
Power factor	0·8
Nominal speed	12,000 *rev/min*
Overload (5 *min*)	30 *kVA*
Overspeed (5 *min*)	15,000 *rev/min*
Exciter field voltage	12·4*V* (*max*)
Exciter field current	13·2*A* (*max*)
Altitude rating	0-60,000 *ft.*
Rotation	*Clockwise*
Brushes—Commutator	
Grade	*KCEG* 11
New length	0·75 *in.* (*On longest side*)
Minimum length	0·5 *in.* (*On shortest side*)
Spring pressure	$14\frac{1}{4}$-$16\frac{3}{4}$ *oz.*
Brushes—Slipring	
Grade	*KCEG* 11
New length	0·71 *in.* (*On longest side*)
Minimum length	0·45 *in.* (*On longest side*)
Spring pressure	$7\frac{3}{4}$-$10\frac{1}{4}$ *oz.*
Overall length	$15\frac{1}{32}$ *in.*
Overall width	$9\frac{15}{16}$ *in.*
Overall height	$10\frac{19}{32}$ *in.*
Total weight	65 *lb*

Introduction

1. The Type 162, 20 kVA generator (fig. 1) is designed to supply power to a 400 c/s, 200V a.c. system.

DESCRIPTION

General

2. The generator has a salient four pole rotor and an integral exciter incorporated on the rotor shaft, which is supported in ball and roller bearings at the drive end (d.e.) and tail-end (t.e.) respectively. The exciter is provided with interpoles and a compensating winding to ensure good commutation and stability under varying loads and conditions. The rotor is built up on a serrated drive shaft and mounting is by means of a taper flange and quick release manacle clamp. A sectioned drawing is shown in fig. 2.

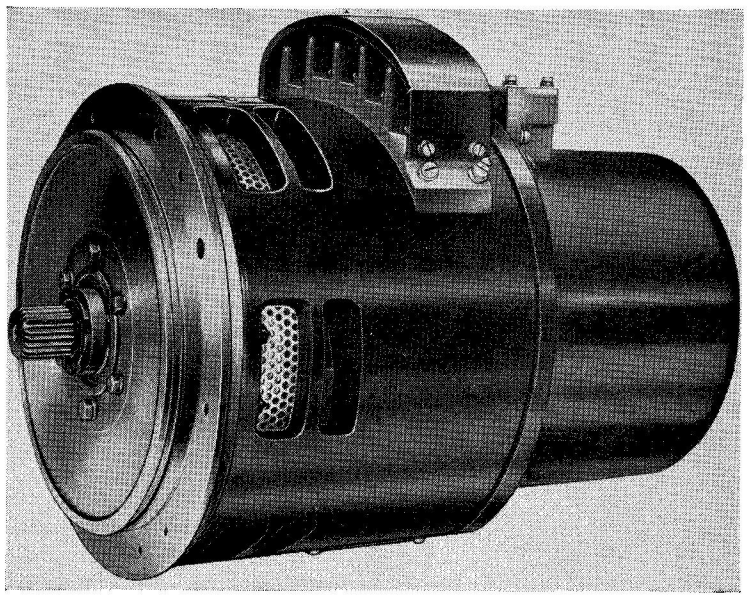

Fig. 1. Generator, Type 162

Frame

3. The frame is a machined light alloy casting which is anodised to provide a protective finish, it houses the rotor and provides mountings for the stator windings and a.c. terminal block.

Tail-end endplate

4. The t.e. endplate is a light alloy machined casting, which carries the exciter field assembly, interpoles, d.c. brushgear assembly, slipring brushgear assembly and d.c. exciter terminal block, and houses the roller bearing which supports the tail end of the rotor shaft. The endplate is secured by ten 2 B.A. hexagon-headed bolts which pass through the endplate flange and screw into the frame. Tabwashers lock the heads of the bolts.

Roller bearing

◄ **5.** The flanged outer race of the roller bearing assembly is a push fit in the t.e. endplate. The inner race of the bearing is an interference fit on the rotor shaft and is secured by a locknut which is in turn locked by a cup-washer. The flange of the outer race is clamped against the endplate assembly by the t.e. endcap and secured by four 2 B.A. hexagon head bolts which are passed through them and screw into the retainer assembly, the bolt heads are sealed by bonded seals and locked by tabwashers. A section of the t.e. endcap extends towards the d.e. and is a running fit inside the rotor shaft. A scroll machined on its outer diameter effects a pumping action on oil delivery to the d.e. bearing. To retain oil in the bearing 'O' rings are located between inner mating ring and shaft, inner and outer mating rings, retainer assembly and t.e. endplate. A carbon oil seal is fitted over the shank of the oil slinger, and is in contact with the outer mating ring, it is attached to the seal retainer by two countersunk 4 B.A. screws. Any oil reaching the slinger ring is passed via drillings in the seal retainer, seal flange, t.e. endplate and endcap to atmosphere. ►

Slipring brushgear

6. The slipring brushgear comprises six brush boxes attached to the brushgear mounting ring. The negative brushes are connected to a common busbar. The positive brushes are connected directly to the d.c. exciter.

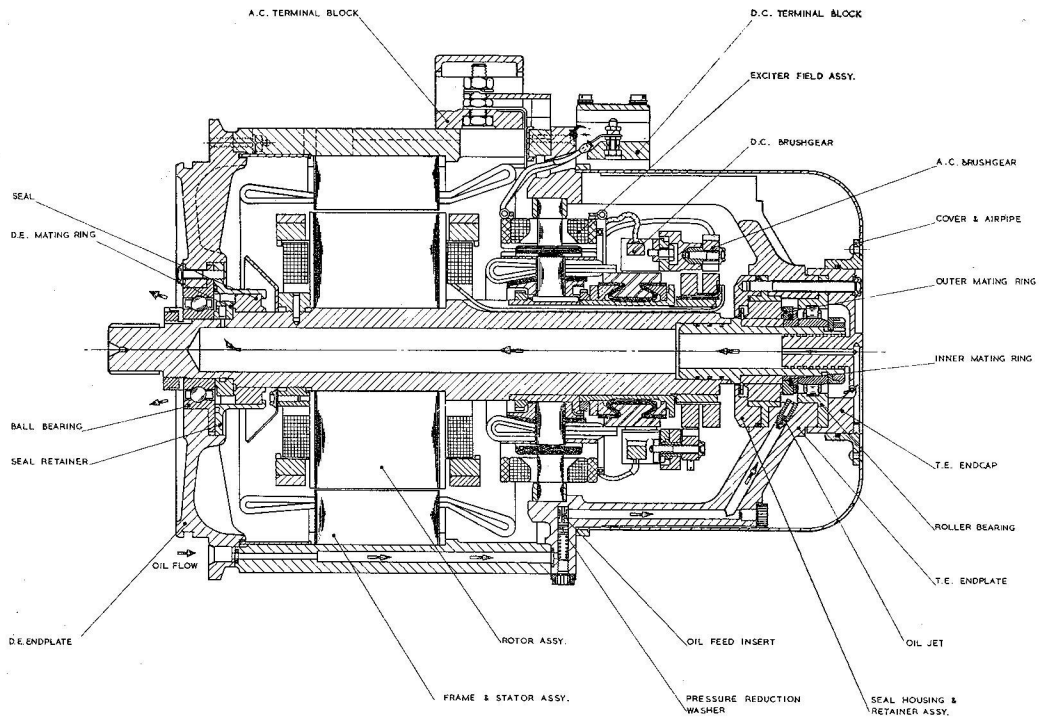

Fig. 2. Sectional view

D.C. exciter brushgear

7. The d.c. exciter brushgear comprises three positive and three negative brush boxes attached to the mounting ring assembly. The negative brushes are connected to a common busbar, and the positive brushes are connected directly to the positive slipring brushes. The brushgear mounting ring and mounting ring assembly are held together by three 4 B.A. countersunk screws and six 4 B.A. hexagon bolts which also secure the negative d.c. brush boxes. The complete assembly is secured by three 2 B.A. bolts screwed into the t.e. endplate assembly, the heads are locked with tabwashers.

Driving end endplate

8. The d.e. endplate is a light alloy machined casting incorporating a manacle clamp type mounting flange. A machined bore accommodates the bearing outer race. The endplate is secured to the frame by twelve 2 B.A. studs and nuts locked with tabwashers.

Ball bearing

◄ **9.** The outer race of the bearing is a push fit in the d.e. endplate and is secured by six 2 B.A. bolts, which are fitted with a bonded seal and tabwasher at the outer end, they pass through the endplate, bearing flange and screw into the seal retainer. The inner race is an interference fit on the shaft, and is held against the inner mating ring which in turn abutts a shoulder on the shaft. The inner race is secured by a ring nut, locked by a cup washer. Oil leakage from the bearing housing into the frame is prevented by a carbon oil seal fitted over the shaft, which bears against the outer mating ring and is located by the seal retainer. In addition 'O' rings are located between the inner mating ring and the shoulder on the shaft, between the inner and outer mating rings, and between the seal retainer and bearing outer race. ►

Rotor assembly

10. The shaft assembly is hollow, except for the splined driven end, it comprises two major components; the shaft, and the shaft end

which fits into the register at the end of the shaft and is brazed in position during manufacture.

A.C. Rotor

11. At the driving end of the shaft is the rotating field rotor. This is of four pole, salient construction with a single coil on each pole piece producing poles of alternate polarity. Balancing is accomplished by means of balance weights, secured to the coil supports, on either side of the rotor, held in position by two 4 B.A. hexagon head bolts.

D.C. exciter armature

12. Mounted adjacent to the rotor is the exciter armature assembly. This is progressive wave wound with 86 coils, which terminate at the 86 segment commutator at the tail-end of the armature assembly.

Sliprings

13. Midway between the armature assembly and the tail-end roller bearing, and mounted on the rotor shaft are two sliprings, through which the d.c. excitation current is fed from the d.c. exciter to the rotor windings. Two insulated supply leads to the rotor pass along machined slots in the shaft, inside the armature bush, and are brazed, one to each slipring connector strap. The outer slipring is in the positive and the inner, the negative.

Exciter field assembly

14. The exciter field assembly comprises the following major components:—

(1) Field windings, comprising six individual coils, each made up of shunt windings and bias windings.

(2) Six compensating coils.

(3) Exciter yoke.

(4) Six field poles of 21 laminations each.

The entire field assembly is secured to the d.e. endplate by the yoke, which is a push fit in a machined recess at the rotor end, and is retained in position by five 2 B.A. bolts which pass through the face of the endplate and screw into five clamping plates. When these bolts are slackened, the field assembly is free to rotate within the t.e. endplate thereby facilitating setting of the neutral position.

A.C. stator assembly

15. The stator, has 48 slots on its inner diameter with the conductor slots skewed one slot pitch. The windings, comprising 48 coils, are double layer bar wound at four slots per pole phase, two turns per coil, four conductors per slot. The ends of the coils are brought out and connections made by brazing, the phase ends being brought out to six terminals on the a.c. output terminal block, which is mounted on the outside of

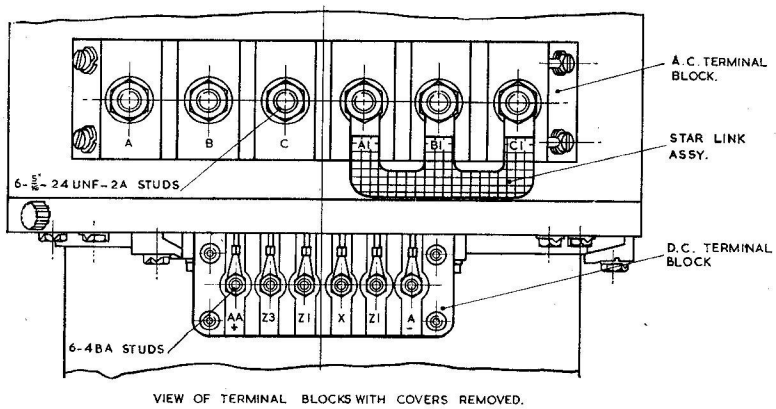

Fig. 3. View of terminal blocks with covers removed

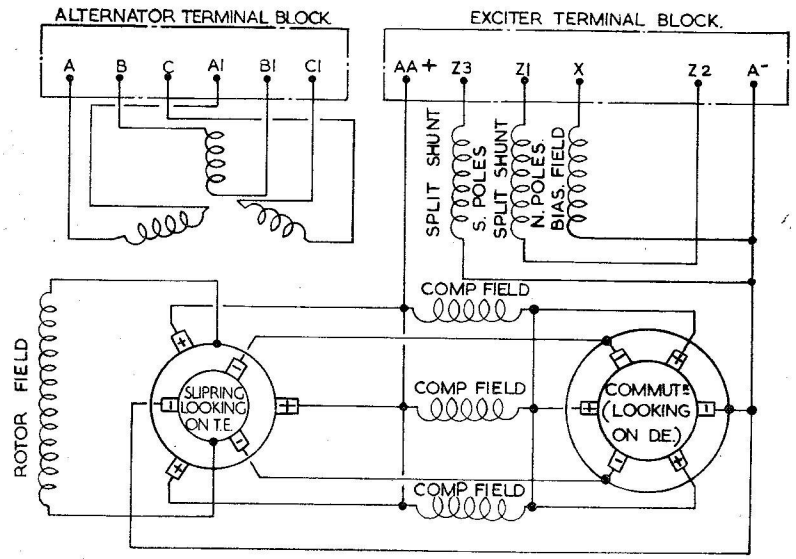

Fig. 4. Schematic diagram of connections

the frame. The stator assembly is located within the frame by two $\frac{3}{16}$ in. dowel pins.

Cover and air pipe

16. Both the cover and air inlet pipe, are of light alloy joined by aluminium brazing, The cover fits over the tail-end assembly and seats on a machined diameter at the flanged end. The cover is held in position by six cover retaining clamps, which are held by 2 B.A. hexagon head bolts screwed into the t.e. endplate flange and locked with tab-washers. A flange, riveted to the inside of the cover at the outer end, is a close fit round the t.e. endcap. An 'O' ring is fitted between the two components to effect the necessary seal.

Cooling

17. Blast air cooling is employed, entering the generator through a duct at the tail end, passing through slots in the t.e. endplates which directs the air onto the brushgear assembly of the commutator and sliprings. From here the air passes over the armature windings and through the a.c. rotor windings and d.c. exciter field windings, leaving the machine through the perforated cover located adjacent to slots at the drive end of the frame.

Lubrication system

◀ **18.** Oil is fed under pressure from the gear-box to an oilway in the d.e. endplate through an oil transfer ferrule which is fitted with two 'O' rings. The ferrule is interposed between the gearbox and the generator. An oil gallery in the frame (fig. 2) transfers oil to a radial drilling in the t.e. endplate. An oil flow restrictor formed by a threaded rod, is housed in the oil gallery between the radial drilling, and the t.e. roller bearing oil jet. From the roller bearing the oil is passed to the centre of the hollow rotor shaft either via a drilling in the t.e. endcap or by a scroll pump formed by a section of the endcap. A radial drilling at the shaft drive end aligns with a drilled hole in the mating ring which allows oil to pass to the ball bearing and then return to the gearbox. It will be noted that all oil to the t.e. bearing is then passed to the d.e. bearing. This supplements the oil which the bearing receives as a result of being exposed to the flow of lubricant in the gear-box. Normal oil pressure is 50 lb/in^2 with minimum oil flow of 2 pints per hour at 15°C and 5 pints per hour at 40°C. ▶

SERVICING

General

19. Little routine servicing can be carried out between bay servicing periods other than to check the security of all screws, bolts, electrical connections and to examine the machine for signs of oil leakage.

◀ **20** Before dismantling the generator it is recommended that a vacuum pump be applied to the oil inlet to remove surplus oil.

Failure to observe this precaution will result in contamination of the machine with oil and render inspection difficult. After lifting all brushes from the commutator the tail-endcap can be removed with the aid of a special extractor. An extractor is also required to remove the tail-end bearing outer race. Three 4 B.A. tapped holes in the air ports at the drive end of the stator are provided to allow extraction of the endplate and rotor from the frame assembly. Extreme care should be exercised when withdrawing the rotor assembly to avoid damage to the carbon oil seal otherwise cracks or chipping of the seal face may occur. Before assembly of the oil seal it should be pressure tested using the appropriate pressure testing rig. Should the seal prove faulty it should be lapped on a diamond lap plate and checked using monochromatic light and an optical flat to ensure the seal surface is flat to within three helium light bands. After lapping the seal should be rechecked on the pressure rig. When the seal has been fitted to the machine, the complete machine should be subjected to a pressure test at 50 lb/in² for one hour. The oil should be allowed to flow freely from the d.e. bearing. Should any internal leakage occur the machine must be dismantled and the leaks rectified. ▶

21. The internal wiring of the generator is shown in fig. 4.

Brushes

22. The brushes should be checked at regular intervals to ensure sufficient length and freedom of movement in their respective brush boxes. New brushes should be fitted if the rate of wear indicates that the minimum length may be reached before the next servicing period or inspection.

TESTING

No load test

23. Mount the generator on a test bench and connect as shown in fig. 5, using a Type AE.7506 and AE.7511 voltage regulator, together with the associated rectifier bank of proven serviceability. Ensure that the value of P2 is set to 0·55 ohms. Switch on the 28-volt d.c. external supply and adjust P1 for a correct reading of 0·75 amperes. Before starting the prime mover, ensure that cooling air at 6 in. W.G. air inlet and a minimum of 15 lb/in² oil pressure is supplied to the generator, in that order. Run up to 12,000 rev/min when the output voltage should be regulated at 200 volts.

Insulation test

24. Using a 500-volt insulation tester, check the insulation resistance readings of the stator coils and exciter windings. These should be not less than 50,000 ohms between the windings and earth.

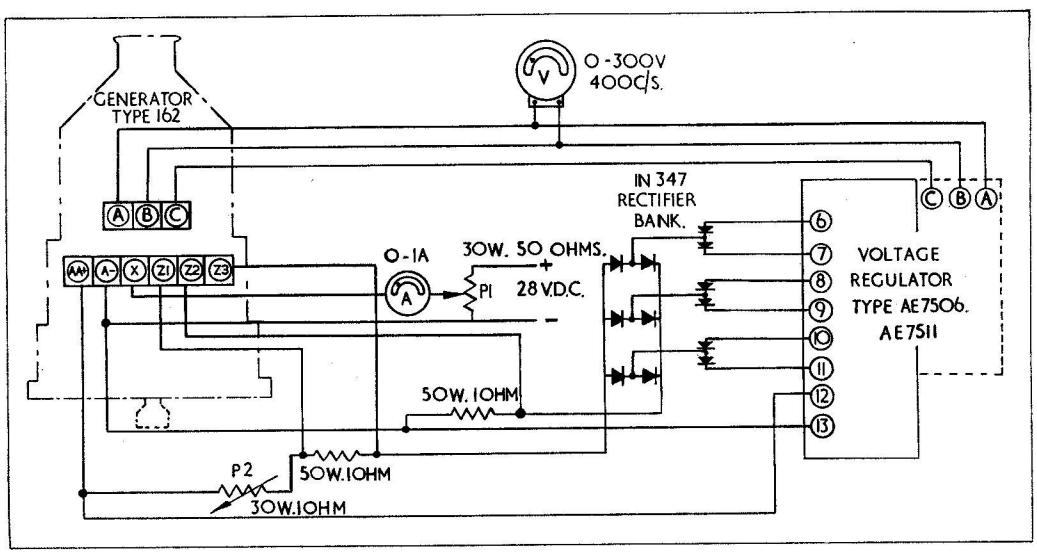

Fig. 5. No load test circuit