See AP113B-0103-16

Chapter 10

GENERATORS, ROTAX, N0400 SERIES

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Introduction

1. Generators in the N0400 series are 22 kVA, 0·8 power factor, 208V a.c., 400 c/s, 3-phase, 6-pole machines, delivering this output at 8,000 r.p.m. As this output will vary dependent on speed and load, the alternator may be regarded as a variable voltage and frequency machine. In conjunction with a transformer and rectifier system almost any a.c. or d.c. voltage may be obtained, subject to the limitations of voltage and frequency of the transformer rectifier unit itself.

DESCRIPTION

Rotor

2. A typical generator in the N0400 series is illustrated in fig. 1. The rotor is carried in two bearings, a roller bearing at the drive end and a ball bearing at the slipring end. Its shaft is splined at the drive end to receive the drive coupling and extends beyond the slipring end bearing to carry the two sliprings.

Lubrication

3. To prevent oil entering the machine from the driving source, an oil seal, housed in a

carrier plate bolted to the main housing, is fitted over the shaft at the drive end. This oil seal requires a small but continuous supply of oil to prevent wear on the portion of the seal in contact with the shaft, which is provided by a splash or spray feed from the driving source.

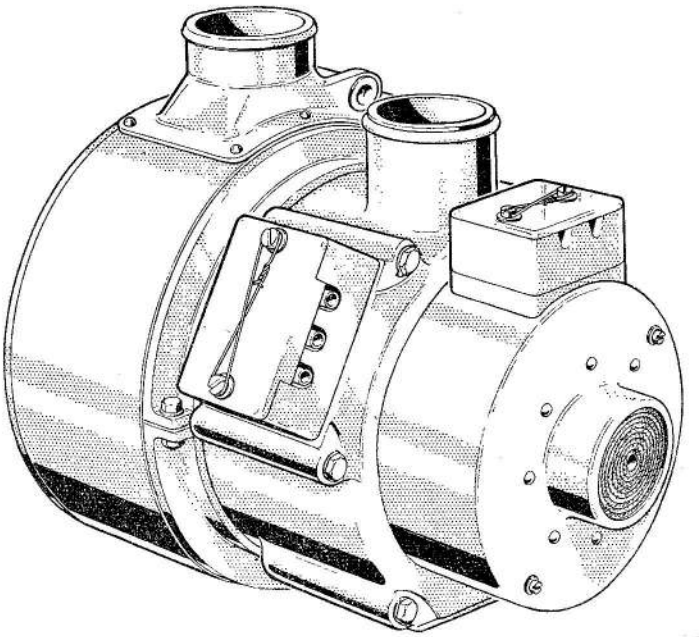


Fig. 1. Typical N0400 series generator

Casing

4. The casing of the generator is formed by three light alloy castings, the main and brush gear housings and the end frame. Forming an integral part of the main housing at the drive end is the mounting flange with a locating spigot. The three-phase stator is clamped in the main housing by the end frame, and for cooling purposes, eight ventilation slots forward in the main housing lead into a duct on the housing circumference and thence to a piped air outlet.

End frame

5. The end frame houses the slipring end bearing and air inlet. It also carries the a.c. output terminal block.

Brushgear

6. Six brushes, three equispaced on each slipring, are mounted in their boxes in the brushgear housing, which also carries the rotor input terminal block. The brushgear housing is fitted with a detachable metal cover, incorporating a flame trap over the brushgear air outlet on the rotor axis.

General

7. The radial location of each of the three castings relative to one another is variable, enabling terminal and air spout positions to be varied if necessary.

8. The machine is blast air cooled, having a pressure drop across it equivalent to a 7 in. head of water (static), with an air flow rate of 120 cu. ft. per minute (approx.) at ground level. Part of this air flow is directed via two orifices in the end frame over the brushgear and out through the flame trap. This prevents carbon dust being carried into the main housing and bearings.

9. The rotating field has six salient poles, the two ends of the winding being connected one to each slipring. The stator has a three-phase star connected winding, the star point being made externally on three terminals with a connecting link, and the other three ends of the windings being brought out to a three-way terminal block. Phase sequence identification is achieved by the markings 'A,' 'B' and 'C' on this terminal block, corresponding to red, white and blue wires, the phase sequence being in that order when rotation is clockwise (looking on drive end).

Operation

10. Input d.c. rotor excitation is obtained via a regulating resistor from a 28-volt supply. This current is fed to the rotor via the two sliprings and brushes. Only this low voltage supply passes through the brushes.

INSTALLATION

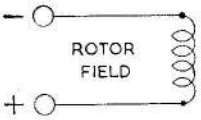
11. Installation details will be found in the appropriate handbook for the aircraft in which the generator is being installed.

SERVICING

12. ◄ Full repair information will be found in Vol. 6 of this publication. ► Servicing will normally be restricted to visual inspection, electrical tests and brushgear maintenance as described in the following paragraphs. These operations should be effected with the unit mounted in its normal position in the aircraft.

Brushgear

13. Disconnect the external leads and remove the brushgear cover plate. Any deposits of carbon dust should be removed with a dry compress air supply or bellows. Then:—



(1) Measure the brushes for wear. They must be long enough to operate satisfactorily until the next servicing period. Minimum brush length is given in "Leading Particulars".

(2) Inspect the brush boxes. Brushes should be a free fit in their boxes with no excessive play. A tendency to bind may be due to the presence of carbon dust.

(3) Using a spring balance (*Ref. No.* 1*H*/97), attached to the brush spring tips, raise them level with the top of the brush boxes. The reading should be between 1 lb. and 1 lb. 6 oz.

General

14. All internal connections should be examined for condition and security, and the sliprings examined for scores or burns.

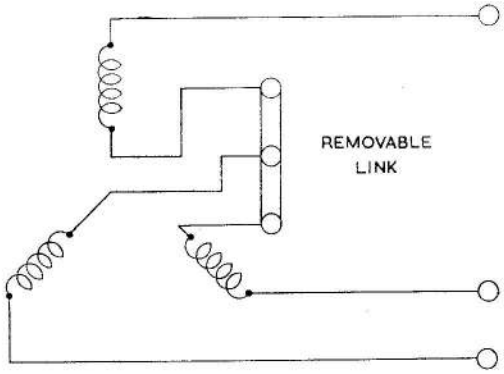


Fig. 2. Circuit diagram

15. Examine the generator for traces of oil which, if present, should have the point of ingress traced.

Insulation resistance tests

16. Using a 500-volt insulation resistance tester for the stator and a 250V for the rotor, measure the insulation resistance between the windings and earth. This should not be less than 50,000 ohms.

17. Finally, inspect the mounting bolts for tighteness; replace the brushgear cover plate and remake the external connections.

Appendix 1

GENERATOR, TYPE 157 (ROTAX N0404)

LEADING PARTICULARS

Generator, Type 157	*Ref. No. 5UA/6120*
Maximum output at 8,000 *r.p.m.*	22 *kVA*, 208*V a.c.*
Maximum d.c. excitation	26 *amp.*, 24*V d.c.*
Output terminals	$\frac{5}{16}$ *in. B.S.F.*
Excitation terminals	$\frac{5}{16}$ *in. B.S.F.*
Minimum brush length	0·400 *in.*
Brush spring tension	16 *to* 22 *oz.*
Cooling air	120 *cu.ft/min. at* 7 *in. head*
Rotation	*Either direction*
Mounting	*Flange*
Overall dimensions—	
Length...	12·65 *in.*
Height...	8·85 *in.*
Width	8·85 *in.*
Weight	45 *lb*

1. The a.c. generator, Type 157 (*Rotax N*0404) is identical to that described and illustrated in the main chapter.

Appendix 2

GENERATOR, ROTAX, TYPE N0409

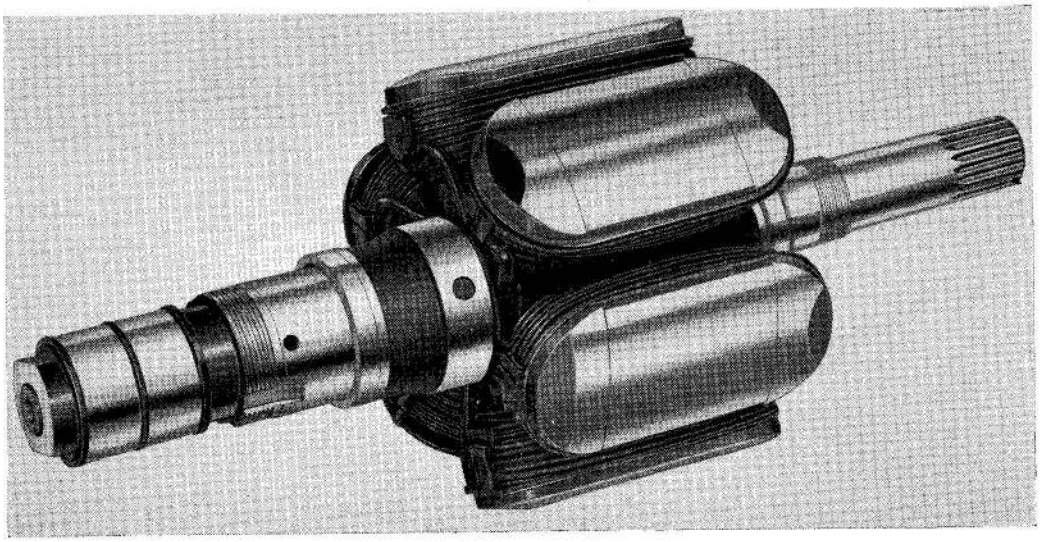


Fig. 1. Rotor assembly

1. The 22 kVA, 208V, 400 c/s, 3-phase a.c. generator, Rotax, Type N0409, is supplied to the Plessey Co. in an unmounted condition, as component parts of the ram air turbine unit, Type TRA/170/26. The main assemblies provided are as shown in fig. 1, 2, and 3, viz., rotor assembly, stator assembly, and brushgear assembly. Sundry items for fitting the generator to the ram air turbine are also provided, i.e., ball and roller bearings, six brush flex and tag assemblies (*grade KC EG*11 *brushes*), rotor spacer, and liner, two special leads and special nuts and washers.

2. Electrical characteristics are in general the same as earlier types in the N0400 series, maximum d.c. excitation being 26 amp., 24V d.c. The output is maintained within the required limits by a control unit, Rotax, Type U3702/2.

3. Further information on fitting and subsequent testing of the generator type N0409 when mounted with the turbine will be found in A.P.2240C, Vol. 1.

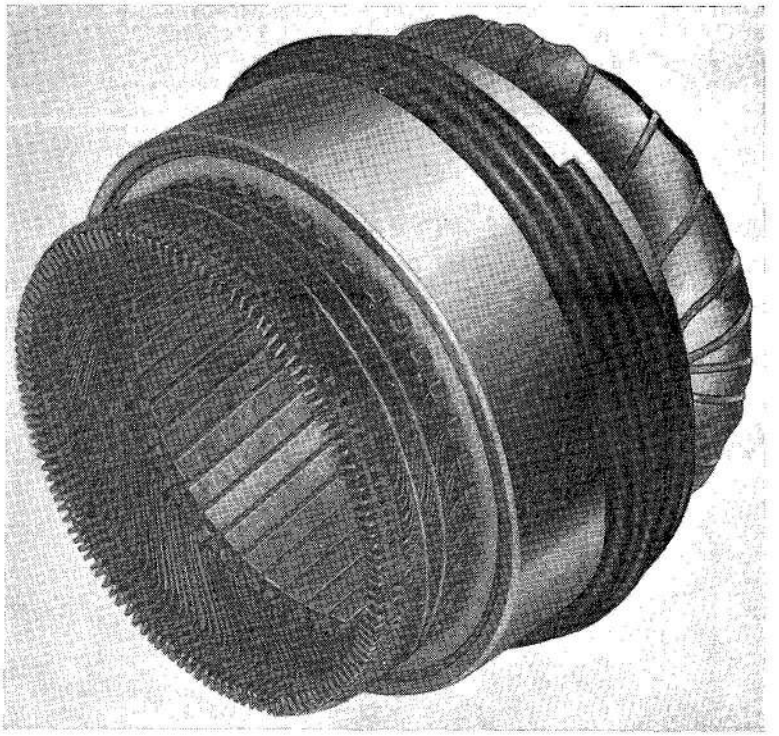


Fig. 2. Stator assembly

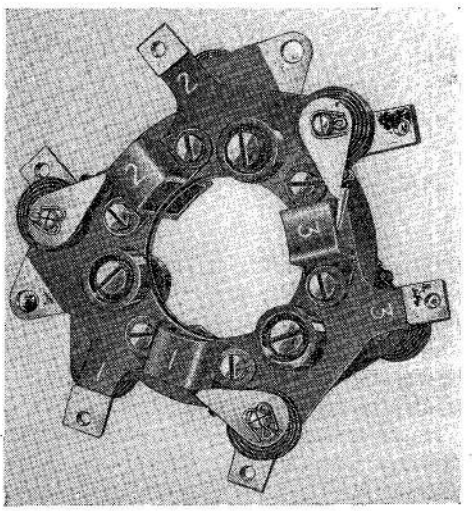


Fig. 3. Brushgear assembly

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Appendix 3

GENERATOR, ROTAX, TYPE N0408

LEADING PARTICULARS

Generator, Type N0408	*Ref. No. 5UA/6927*
Maximum output	22 *kVA at* 8000 *r.p.m.*, 208 *V*, 0·8 *P.F.*, 400 *c/s*
Rating	*continuous*
Maximum d.c. excitation	26 *amp.*, 24 *volts*
Output terminals A, B, and C	·250 – 28 *U.N.F. studs*
Transformer output terminals: 1, 2, *and* 3	4 *B.A. studs*
Star point terminal N	2 *B.A. stud*
*Excitation terminals X and X*1	·312 – 24 *U.N.F. studs*
Minimum permissible brush length	0·687 *in.*
Brush length (new)...	...0·985 *in. (measured on long side)*
Brush grade	*KCEG*.11
Brush spring pressure (taken at the top of the brush box)	21·5 ± 1 *oz.*
Minimum slip ring diameter	1·343 *in.*
Slip ring diameter (new)	1·385 $^{+\cdot 0}_{-\cdot 010}$ *in.*
Rotation (at drive end)	*clockwise*
Cooling (blast air)	120 *cu ft/min. at* 7 *in. head*
Mounting (flange and drive)	*S.B.A.C. R.S.*581
Mounting attitude	*unrestricted*
Ambient temperature range	– 70 *deg. C to* + 50 *deg. C.*
Altitude	40,000 *ft. (max)*
Overall dimensions —	
Length (including shaft)	13·636 *in.*
Height	9·414 *in.*
Width	11·300 *in.*

1. The a.c. generator, Type N0408, is similar to that described and illustrated in the main chapter except that the air outlet has been repositioned at a revised angle in a clockwise direction, adjacent to and below the a.c. terminal box, when viewed from the drive end of the machine. The generator is designed for manacle ring mounting, and there is no flame trap incorporated in the brushgear housing.

2. The stator windings are star connected and the star point is brought out to provide a neutral connection (*fig.* 1). The conductors between the a.c. generator phase windings and the star point are taken through a set of Merz-Price protective transformers to act as through turn primaries. The protective transformer secondaries are delta connected.

3. Separate terminal boxes are provided for a.c. output and d.c. excitation input. The

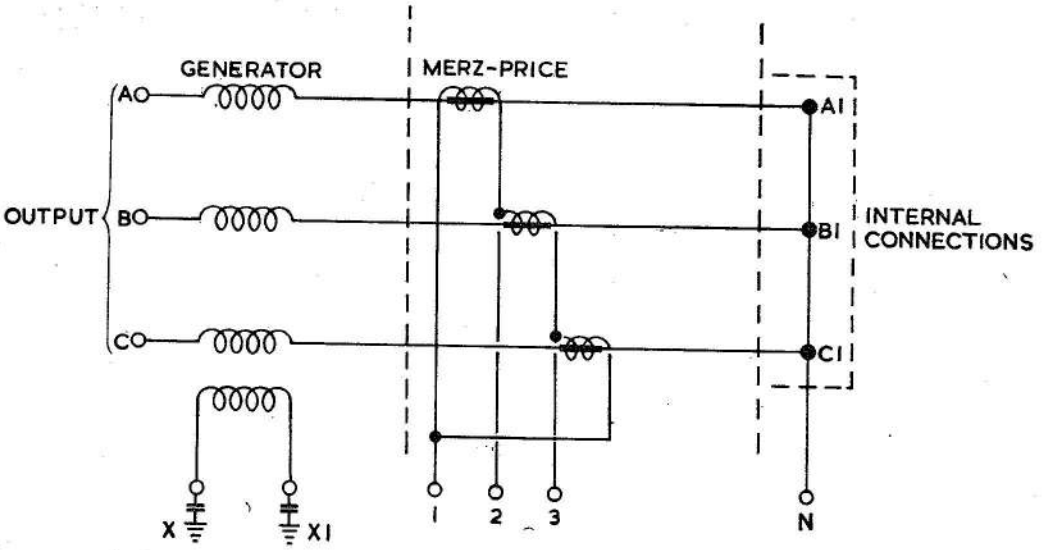

Fig. 1. Diagram of internal connections

d.c. terminal box contains two 0·5μF suppression capacitors, one connected between each d.c. excitation input lead and the frame, and the a.c. terminal box houses the Merz-Price transformers.

4. Provision has been made on the casing for fitting heat detectors and their associated fittings, if required. The heat detectors and fittings are as follows:—

Heat detector type	Rotax No.	Heat detector fitting	Rotax No.
Vaporstat	N141145	Bracket	N148258
Klixon	N146602	Plate	N148259
Plugstat	N149812	Bracket	N148258/1

Note . . .

The casing has two holes tapped 4 B.A. for installation of the heat detector fittings.

Testing

5. In addition to the tests specified in the main chapter, the following tests may be applied.

Open-circuit test

6. With the machine driven at 8,000 r.p.m. and the output open-circuited, set the line voltages to an average value of 208V by adjustment to the rotor current, which should lie between 7·2 and 8·8 amp.

Short-circuit test

7. Short-circuit terminals A, B and C with short lengths of heavy-duty cable through current transformers. Short-circuit protection unit terminals 1, 2 and 3 through adequate cables and ammeters. With the generator driven at 8,000 r.p.m., increase the rotor current until the average stator line current is 41·6 amp. The rotor current should lie between 14 and 15 amp., and each of the three protection unit currents between 165 and 185 mA. The machine should be maintained on short-circuit for 15 min.

Insulation resistance tests

8. Using a 500-volt insulation resistance tester for the stator and a 250-volt tester for the rotor, measure the insulation resistance between the following points:—

(1) Stator and frame.

(2) Rotor, brushgear and frame.

(3) Terminals 1, 2, 3 and frame.

(4) Terminals 1, 2 and 3 together and A, B and C together. The reading should not be less than 50,000 ohms.

Note . . .

The suppression capacitors should be disconnected while making this test.

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