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Chapter 6

GENERATORS, ROTAX, N0600 SERIES

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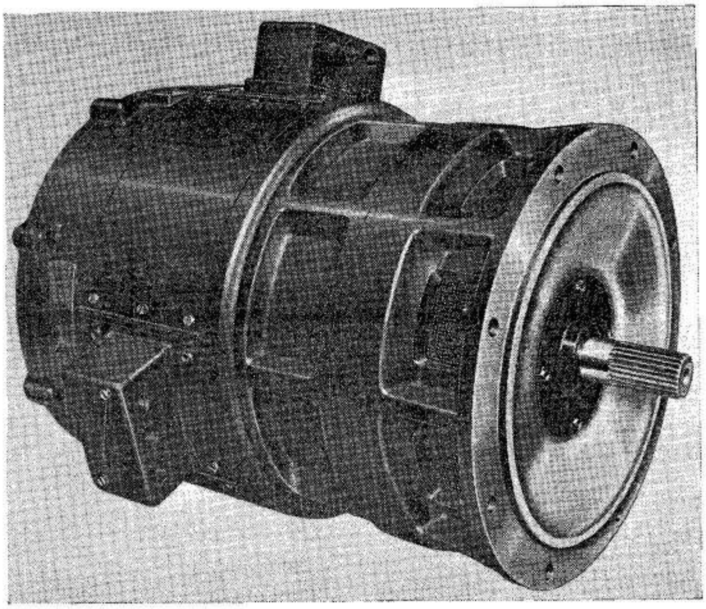

Fig. 1. Typical N0600 series generator

Introduction

1. The engine-driven a.c. generators in the N0600 series require a 28V, d.c. excitation supply and produce two three-phase outputs simultaneously, viz., 100 amp. at 210V a.c. and 200 amp. at 105V a.c. The generator operates satisfactorily when driven at speeds ranging from 3,300 r.p.m. to 10,100 r.p.m., supplying frequencies from 165 c/s to 505 c/s. Rotation is anti-clockwise (looking on the drive end).

2. With cooling provided by the impeller fan alone, the generator is continuously rated at 30 kVA up to 20,000 ft. Fan cooling is intended to satisfy requirements when the aircraft is on the ground. Under normal flight conditions, cooling is effected by ram air at 6 in. to 7 in. W.G. assisted by the internal fan. With ram air cooling the generator will deliver 73 kVA at altitudes up to 55,000 ft. and over a temperature range of −70 deg. C. to +50 deg. C.

DESCRIPTION

3. The generator (*fig.* 1) is enclosed within three main housings, viz., the drive end frame, the stator frame and the end housing. The drive end frame receives a liner which supports the drive end roller bearing of the rotor shaft and houses a rubber oil seal which prevents the ingress of engine oil into the machine. The drive end frame also has eight gauze air outlet windows equispaced around its circumference. The stator frame contains the stator stack and windings, and is fitted with an eyebolt which provides a means of lifting the generator by tackle (the generator rests horizontally when suspended from this point). The end housing supports the brush-gear assembly and the slipring end ball bearing of the rotor shaft. The terminal blocks are mounted mutually at 120 deg. around the periphery of the end housing. The stator frame is clamped between the end housing and the drive end frame by eight studs.

Rotor and fan

4. The rotor carries the exciter winding which is wound on to six salient poles. The winding is energized from a 28V d.c. supply fed to it via sliprings mounted on the rotor shaft. The shaft is carried by a roller bearing at the drive end and a ball bearing at the slipring end. The drive end of the shaft, projecting outside the drive end frame, has a serrated spline for connection to the engine coupling.

5. An impeller fan is keyed to the rotor shaft at its slipring extremity (outside the end housing). The fan consists of a disc having radial blades which impel the air centrifugally. The fan is enclosed by an impeller cover fitted to the end of the generator. Air enters through a central inlet in this cover and is driven by the fan into an annular air flow guide at the rim of the fan disc. The air passes through openings in the bearing support of the end housing, between the windings of the rotor and stator and out through the drive end gauze windows.

Stator

6. The stator consists of a stack of laminations bolted within the stator frame. The inner periphery is slotted to receive the 150V and 210V three-phase windings. The slots are skewed at 2/3 slot pitch in order to obtain a true, harmonic free sinusoidal waveform in the generated outputs and to reduce running noise. The stator is wave wound and the conductors are wound in pairs, each 210V conductor lying beside its corresponding 105V conductor. The phases of the two windings are connected in star, and the star point of the 210V winding is brought out to a terminal.

Brushgear

7. Each slipring is supplied by three brushes set mutually at 120 deg. The brushgear consists of two similar brass brush rings, each carrying three brush boxes, secured back to back and separated by an insulation ring. The brushgear is bolted to the interior of the end housing. The brushes are maintained in contact with the sliprings by brush triggers which communicate the pressure of coiled brush springs to the tops of the brushes. The three brushes on each ring are electrically common. Access to the brushes for purposes of inspection is gained by removing three screw retained covers situated between the terminal blocks on the end housing.

Electrical connections

8. Electrical connections are made to three three-pole moulded terminal blocks equally spaced around the periphery of the end housing. Two of the blocks contain the three-phase a.c. output terminals; A1, B1, C1 are the 105V terminals and A2, B2, C2 are the 210V terminals. All these terminals are $\frac{3}{8}$ in. B.S.F. studs to suit 6–170 ampere "Prenal" cable lugs (*Ref. No.* 5*X*/6568). The third terminal block carries the rotor terminal connections (R, R) and the 210V star point terminal(s). Terminals on this block are $\frac{1}{4}$ in. B.S.F. studs to suit 3–70 ampere "Prenal" cable lugs (*Ref. No.* 5*X*/6553). The terminals are enclosed by screw retained moulded covers, the retaining screws being locked by tie wires.

Note . . .

The rotor terminals (R, R) are not polarized. Either may be connected to the positive of the supply.

INSTALLATION

9. The mounting face of the generator has a spigot 10·498 in. in diameter; there are eight 0·4687 in. diameter clearance holes in the mounting flange, equispaced on a 12·000 in. P.C.D.

10. The end housing has four pairs of holes equispaced around its periphery to provide fixings for one or more steadying brackets, as required by a particular installation. The holes are tapped $\frac{3}{8}$ in. B.S.F. and the two holes for each bracket are spaced 3·000 in. at centres.

11. The drive shaft has a serrated spline 1·375 in. long cut in a 1·250 in. nominal diameter. A $\frac{3}{8}$ in. B.S.F. hole, 0·750 in. deep, is tapped axially into the end of the drive shaft.

Oil seal lubrication

12. Before fitting a generator to an engine (or before making any test run) ensure that the oil seal in the drive end frame is thoroughly lubricated with oil of the same grade as that in use on the engine.

SERVICING

13. Make a general inspection of the generator to ensure that it is secure on its mounting and that no damage has been sustained. Inspect the electrical connections to ensure that they are clean and secure; ensure that the air inlet connection is secure and that the air exit gauzes are free from obstruction.

14. Ascertain by shining a lamp into the air outlet gauzes and into the brush inspection windows, whether there are any signs of oil having found its way into the machine. If oil is present, it indicates that the oil seal has broken down and the generator should be withdrawn as unserviceable.

Brushes

15. Remove the three screw retained brush inspection covers (breaking the locking tie wires) to gain access to the brushes through the inspection windows and make the following inspections.

(1) Examine the brushes for condition and wear; cracking or chipping renders a brush unserviceable. Measure the length of the brushes at the centre of the contact arc. The minimum permissible brush length is 0·500 in. and any brush which has worn so close to this minimum that it is considered unlikely to give a satisfactory performance until the next servicing, should be regarded as unserviceable.

(2) Ensure that the brushes are free but not slack in their boxes. If they are tight as a result of carbon deposits having formed in the boxes, these deposits should be removed.

(3) Measure the brush spring pressure, using a spring balance (*Ref. No.* 1*H*/97). The pressure at the tip of each brush trigger as it is lifted from the brush should be 1·69 lb–1·83 lb.

(4) Examine the sliprings for burns, scores and carbon deposits. If necessary, they should be cleaned with a soft rag soaked in lead-free white spirit.

On completing these inspections, refit the three inspection covers, locking the screws with new tie-wires.

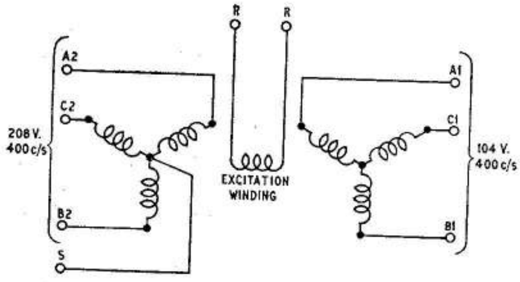

Fig. 2. Diagram of internal connections

Testing

Open-circuit test

16. The generator must be driven at 8,000 r.p.m. with the outputs open circuited and the rotor energized from a variable supply with a suitable ammeter in circuit. The output from the higher voltage windings should be made to read 208V (average of line voltages) by adjusting the rotor excitation current. This current should not exceed 11 amperes. The voltage measured between terminal S and terminals A2, B2 and C2 in turn should be between 115V and 125V.

17. Under the conditions of testing stated in para. 16, the low voltage windings should yield an output of 104V (average of line voltages) when the rotor excitation current is between 10 and 11 amperes.

Short-circuit test

18. The output from the higher voltage windings should be short-circuited through a current transformer in each line, using short lengths of heavy duty cable. The line current should be obtained by connecting, suitable ammeters into the secondary circuits of the transformers. The generator should be driven at 8,000 r.p.m. and the average line current of the output adjusted to 100 amperes. The excitation current should not be increased above 26 amperes to obtain this.

19. The short circuit arrangement described in para. 18 should be removed and a similar arrangement connected to the low voltage terminals. The generator should be driven at 8,000 r.p.m. and the output current set to 200 amperes (average of three lines). The excitation current should not exceed 26 amperes.

Note . . .

Before commencing any test detailed in para. 16 *to* 19, *ensure that the oil seal is properly primed with engine oil.*

Insulation resistance tests

20. The insulation resistance should be measured between the following points, using a 500V insulation resistance tester. A reading of at least 50,000 ohms should be obtained in each test.

(1) Frame and terminals A1, B1, C1, A2 B2 and C2.

(2) Terminal A1 and terminals S and R.

(3) Terminal S and terminal R.

21. The insulation resistance between terminal R and frame, measured with a 250V insulation resistance tester, should not be less than 50,000 ohms.

Appendix 1

GENERATOR, TYPE 154 (ROTAX N0603)

LEADING PARTICULARS

Generator, Type 154	*Ref. No. 5UA/5985*
Output—	
(1)	100 *amp. at* 210*V a.c.*
(2)	200 *amp. at* 105*V a.c.*
Phase	*Three*
Rating	*Continuous between* 6,750 *r.p.m. and* 10,000 *r.p.m.*
Speed range	3,300 *r.p.m. to* 10,000 *r.p.m.*
Frequency	165–505 *c/s*
Direction of rotation (looking on drive end)	*Anti-clockwise*
Excitation voltage	28*V d.c.*
Excitation current (maximum continuous)	56·5 *amp.*
Moment of inertia of moving parts	3·26 lb/ft^2
Cooling	*Impeller fan and blast air*
Brush grade	*K.C.E.G.* 11
Minimum brush length	0·500 *in.*
Minimum slip-ring diameter	2·182 *in.*
Brush spring pressure	1·69–1·83 *lb.*
Operational temperature range	−70 *deg. C. to* +50 *deg. C.*
Operational ceiling	55,000 *ft.*
Length (air intake to mounting face)	18·800 *in.*
Length of drive shaft (from mounting face)	2·750 *in.*
Maximum diameter	13·375 *in.*
Weight	180 *lb.*

1. The a.c. generator, Type 154 (*Rotax N*0603) is identical to that described and illustrated in the main chapter.

Appendix 2

GENERATOR, TYPE 166 (ROTAX N0605)

LEADING PARTICULARS

Generator, Type 166	*Ref. No. 5UA/6931*
Output—	
(1)	100 *amp. at* 210*V a.c.*
(2)	200 *amp. at* 105*V a.c.*
Phase	*Three*
Rating	*Continuous between* 6,750 *r.p.m. and* 10,000 *r.p.m.*
Speed range	3,300 *r.p.m. to* 10,000 *r.p.m.*
Frequency	165–505 *c/s*
Direction of rotation (looking on drive end)	*Anti-clockwise*
Excitation voltage	28*V d.c.*
Excitation current (maximum continuous)	56·5 *amp.*
Moment of inertia of moving parts	3·26 lb/ft^2
Cooling	*Impeller fan and blast air*
Brush grade	*K.C.E.G.* 11
Minimum brush length	0·500 *in.*
Minimum slip-ring diameter	2·182 *in.*
Brush spring pressure	1·69–1·83 *lb.*
Operational temperature range	−70 *deg. C. to* +50 *deg. C.*
Operational ceiling	55,000 *ft.*
Length (air intake to mounting face)	18·800 *in.*
Length of drive shaft (from mounting face)	2·750 *in.*
Maximum diameter	13·375 *in.*
Weight	180 *lb.*

1. The a.c. generator, Type 166 (*Rotax N*0605) is identical to that described and illustrated in the main chapter, except that a heavier capacity neutral lead has been fitted between the star point of the 210-volt internal stator winding and the external terminal S.

2. The introduction of a heavier star point lead is a new a.c. load application designed specifically for Victor Mk. 1A aircraft.