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Chapter 18

BLEED AIR TURBINE GENERATOR, ROTAX, TYPE BT0102
(incorporating Generator, Rotax, Type B3601/1)

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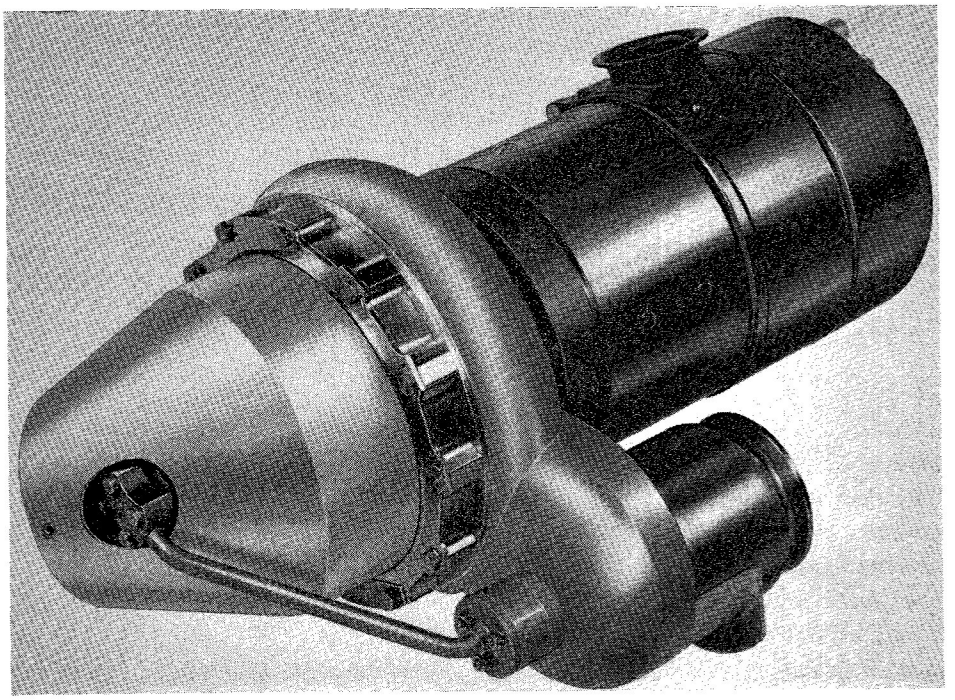
LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Bleed air turbine generator, Type BT0102 (*incorporating generator, B3601/1*) ...	*Ref. No. 5UA/7875*
Output (maximum)	*3·5 kW at 28V d.c.*
Rating	*Continuous*
Speed range	11,000-13,000 *r.p.m.*
Speed control	*Governor and governor valve*
Rotation	*Clockwise looking on drive end*
Brush length (new)	0·562 *in.* ±0·010 *in. (over short edge)*
Minimum permissible brush length	...0·437 *in. (over long edge)*
Brush grade	*P.E.G. X22 carbon*
Commutator diameter (new)	2·250±0·005 *in.*
Commutator diameter (min. permissible)	2·170 *in.*
Cooling	*Blast air*
Ambient temperature range	—60 *deg. C to* +115 *deg. C.*
Altitude	60,000 *ft. (max.)*



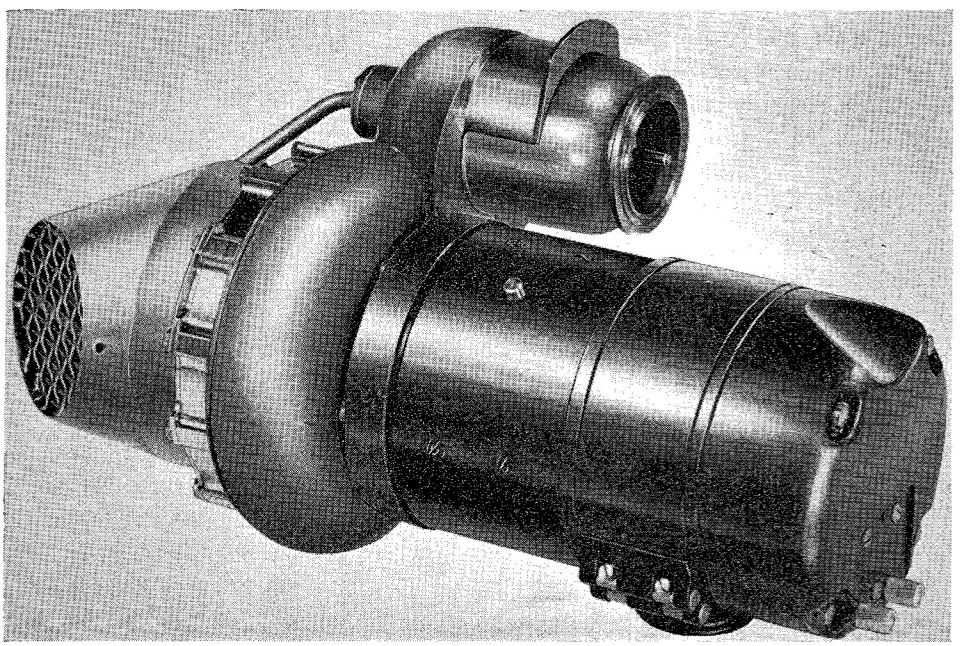


Fig. 1. General views of BT0102 turbine generator

LEADING PARTICULARS—*continued*

Overall dimensions—

Length	16·00 *in.*
Width	8·30 *in.*
Height	9·00 *in.*
Weight	32 *lb.*

ESTIMATED AIR FLOW REQUIREMENTS FOR 3·5 kW 28 VOLTS

Air inlet temperature (deg. C.)	Minimum cooling air in lb./min. at ground level
+70	8·1
+45	6 estimated static pressure head 8 in. W.G.
+30	5·2
+10	4·4
—10	3·8
—30	3·3

Auxiliary air control valve, Type M6702

Overall dimensions—

Length	6·604±·030 *in.*
Width	3·390 *in.*
Axis of unit to centre of Plessey plug	2·606 *in.*
Nominal pressure	210 *lb./in²*
Maximum pressure	250 *lb./in²*
Nominal temperature	350 *deg.C.*
Maximum temperature	500 *deg.C.*
Ambient temperature range	—70 *deg.C to* +200 *deg.C.*
Solenoid voltage	24*V d.c.*
Solenoid current	2 *amp.*
Weight	3¾ *lb.*

Introduction

1. The Type BT0102 bleed air turbine generator is designed for auxiliary installations, and is rated to supply a maximum of 3·5 kW at 28 volts d.c. during ground running, taxying, or during an emergency.

2. The unit is used in conjunction with Rotax air control valve, Type M6702, which provides an air supply to the turbine of 20 lb./in² from an air inlet supply of up to 210 lb./in². An integral control valve also embodies an on/off control by means of a 24 volt d.c. solenoid, this being energized when the unit is OFF.

3. The generator is fully suppressed for radio interference and the suppression unit, combined with the terminal block assembly is built into the end housing. The output is controlled by the transistorized voltage regulator, Newton Type 31/63553.

DESCRIPTION

4. The BT0102 turbine unit comprises a driving rotor wheel and associated governor mechanism, secured to the splined end of the

generator armature shaft. The top section of a volute and nozzle assembly, together with a rotor wheel shroud and exhaust baffle, enclose the above turbine drive. The lower section of the volute positions and houses the governor valve, which is protected by the inlet shell.

Generator, Type B3601/1

5. The B3601/1 generator (fig. 2) is a shunt wound machine, with the armature assembly supported in a ballrace at the commutator end and supported in a roller race at the driving end of the unit. The complete assembly is housed within the yoke and field coil assembly, this being interposed between the drive end frame and the commutator end frame.

6. The brush gear assembly, ballrace and radio suppression unit are all protected by a brush inspection cover and end cover, the latter being supported by the commutator end frame.

7. The driving end frame supports the roller race and associated bearing retainer and grease seal. The drive end frame is secured to the yoke assembly by six bolts and their associated locking washers; this assembly provides the main location and support for the turbine adapter and mounting spigot.

Turbine wheel

8. The turbine wheel (fig. 4) is of a frangible construction and consists of a steel hub, 39 Hidaminium blades and a high tensile steel rim. The blades are located on the periphery of the rotor, by means of short dowel pins, and the outer rim is shrunk on to the blades holding them in position. The outer rim is located axially by three long pins 120 degrees apart, which pass through three blades into a groove on the inside diameter of the rim. The rim is weakened in three positions, 120 degrees apart, by three elongated holes and is designed to fracture at these positions should an overspeed occur.

Governor housing assembly

9. The governor mechanism is designed to operate through centrifugal force of the turbine wheel, the governor housing being torque loaded to the turbine wheel via an internal thread located in the armature drive shaft of the generator. Four governor weights, working in conjunction with four friction compensating weights, operate the air release mechanism to spill out excess air concentrated at the pivot ring, which is held under tension by a carbon seal support spring.

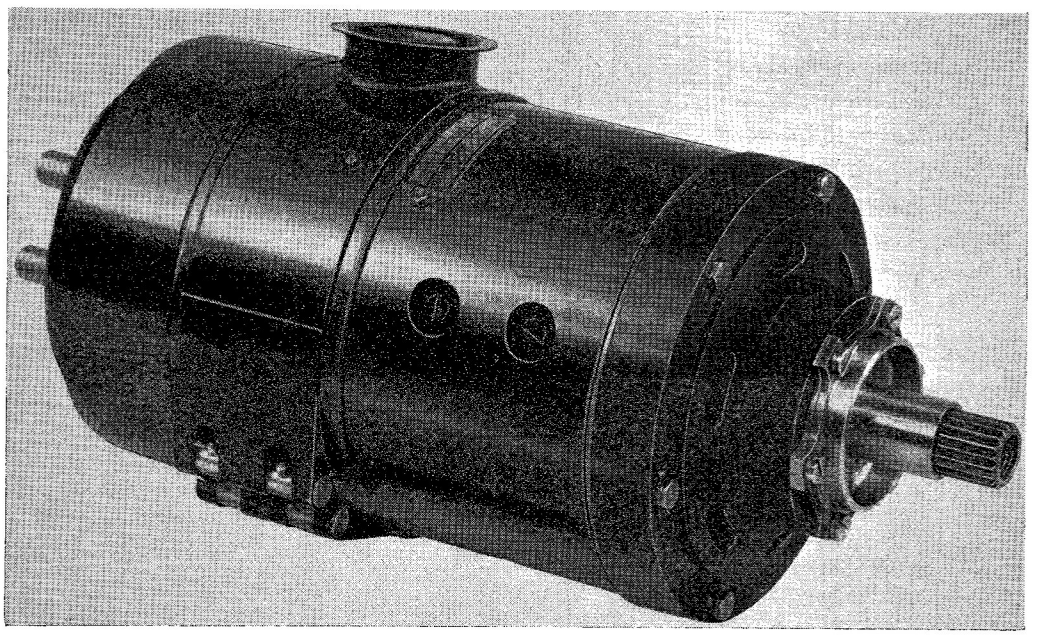


Fig. 2. View of generator, Type B3601/1

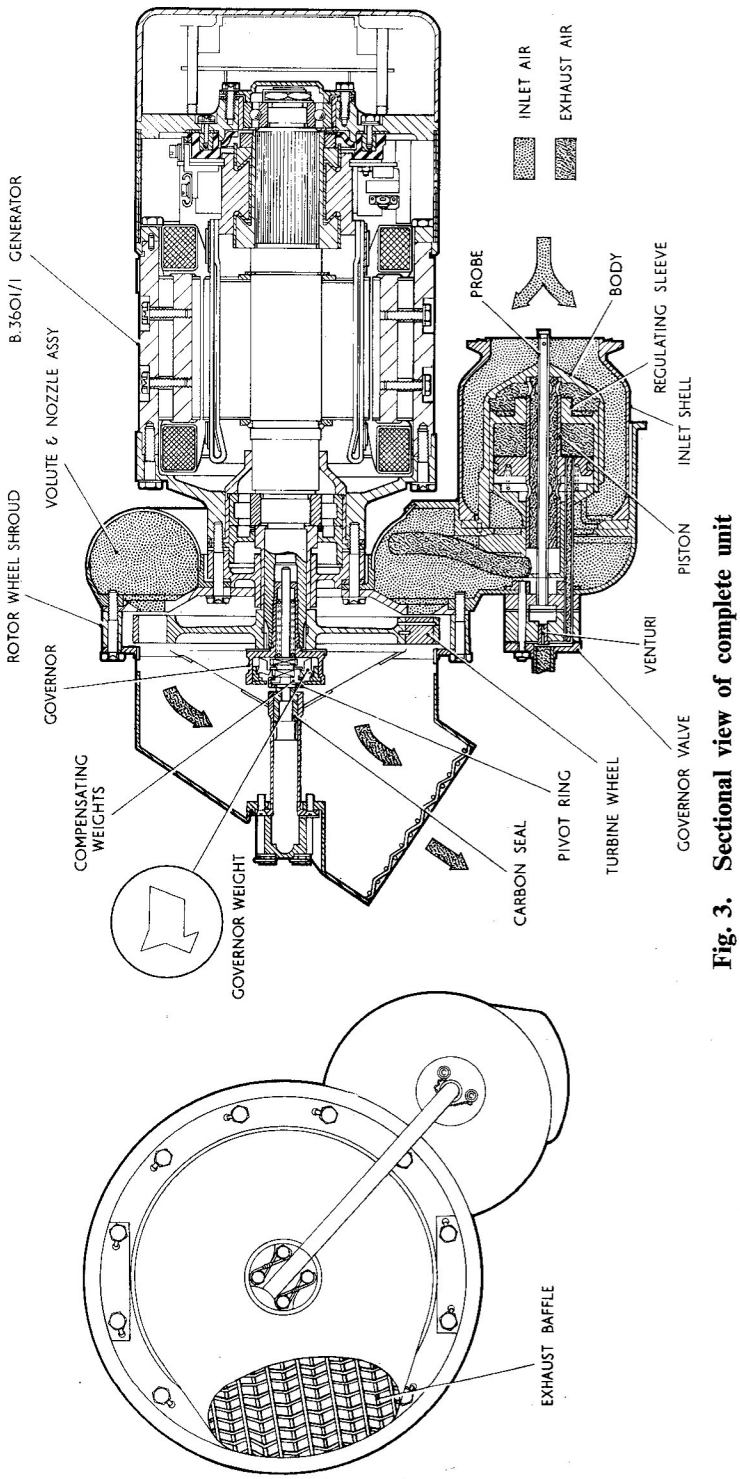


Fig. 3. Sectional view of complete unit

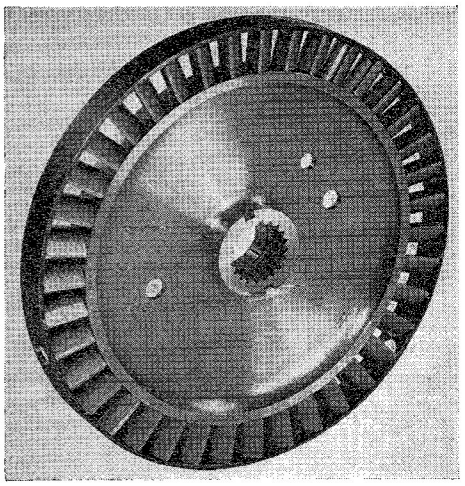


Fig. 4. Turbine wheel

Volute and nozzle assembly

10. The volute and nozzle plate assembly is secured to the generator drive end frame via an intermediate air seal located on the armature shaft of the generator; six securing bolts maintain the assembly in the correct axial position. The inlet air end of the volute retains the inlet air shell that protects and houses the governor valve; this valve operates on an internal fixed piston which provides support at each end for the sensing air probe.

Governor valve assembly

11. The governor valve consists of a fixed piston and associated carbon ring over which is mounted the regulating sleeve. The above assembly is housed within a dome body secured to the volute flange; located on the horizontal axis of the hollow fixed piston is the governor air sensing probe, secured at both ends in the housings and protected by the air inlet shell.

Turbine rotor shroud

12. The rotor shroud is interposed between the volute and nozzle assembly and exhaust baffle; it is designed to protect the turbine in an emergency, by preventing the bursting rotor wheel rim from damaging the nozzle plate on the governor assembly should an overspeed occur. This will ensure a fail safe condition to prevail should the driving blades become free of the rotor hub, as they will concentrate in the exhaust baffle housing.

Exhaust baffle assembly

13. The exhaust baffle assembly is designed basically to exhaust the outlet air from the turbine wheel; in addition to its basic function, it is designed to support the venturi connecting pipe and block assembly from the governor valve to the governor housing mechanism, located on the rotor hub.

14. An internal mounting in the exhaust chamber retains an integral baffle to assist distribution of spill air through governor action released via the governor valve.

Air control valve, Type M6702

15. The M6702 valve outlet pressure is controlled to 20^{+10}_{-0} lb./in² with up to 210 lb./in² air at 350 deg. C applied to the inlet (fig. 5). The unit embodies an on/off control by a 24 volt d.c. solenoid which is energized when the unit is OFF.

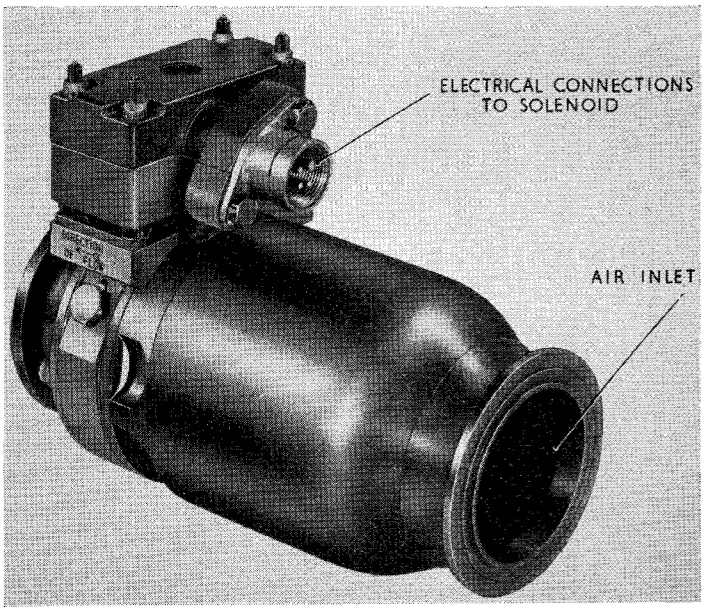
OPERATION

16. Air is supplied to the unit via the M6702 valve at 20^{+10}_{-0} lb./in². The speed of the turbine (12,000 r.p.m. nominal) is controlled by means of a mechanical governor, and a governor valve. The turbine volute pressure necessary to maintain the turbine unit speed varies with the load applied to the generator; this is regulated by the governor valve and the mechanical governor as follows.

17. The inlet pressure is fed to the governor servo system via the air sensing probe and venturi. The inlet pressure is fed to the inside of the regulating sleeve via the sensing probe, and is modified by the opening or closing of the governor orifice, which is regulated by the mechanical speed sensing governor.

18. An increase in turbine speed above the nominal range will, through centrifugal force, actuate the mechanical governor weights, and via the governor compensating weights, open the governor orifice.

19. This has the effect of reducing the excess pressure inside the regulating sleeve, originating from a high volute pressure, which closes the valve sleeve through the governor valve and volute system. The discharge of excess air from the sleeve is released under pressure through the governor orifice.



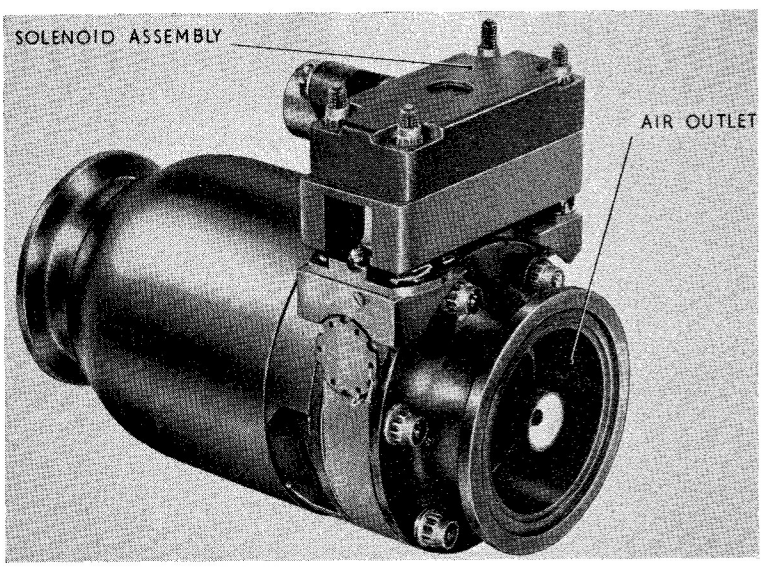


Fig. 5. Air control valve, Type M6702

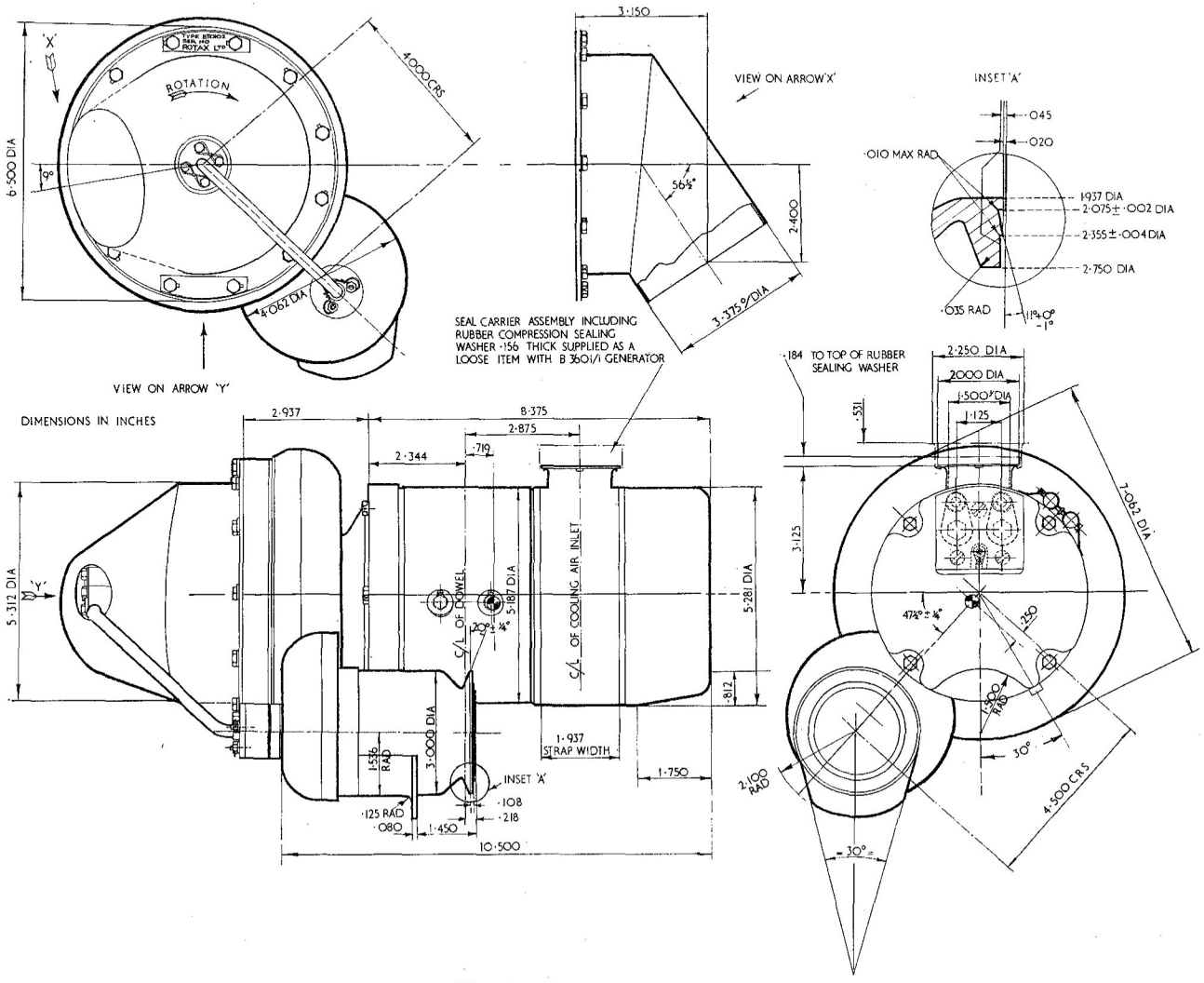


Fig. 6. Installation drawing

20. With the release of excess air from the system, the volute pressure and regulating sleeve pressure are again in balance to regulate the turbine speed in relation to the generator load.

INSTALLATION

21. The unit is cradle mounted, provision being made for positioning the axis by the introduction of a 0·312 in. diameter dowel pin located on the yoke assembly which projects 0·218 in. from the yoke periphery. Dimensions for complete installation of the turbine generator are given in the installation drawing (fig. 6); installation details for mounting the M6702 control valve will be found in the relevant aircraft handbook.

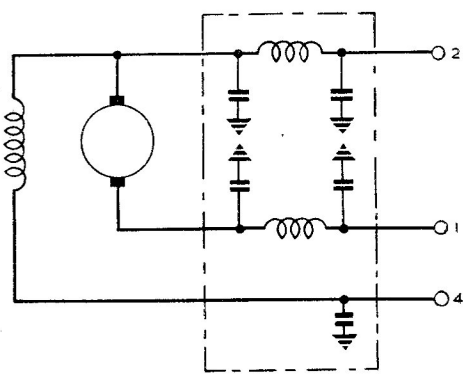


Fig. 7. Diagram of internal connections

Electrical connections

22. External connection is made by means of suitable lengths of cable to which are crimped the appropriate lugs as follows: Main terminal studs No. 1 and 2 to suit 0·250 in. B.S.F. copper crimping lugs (Rotax N 149267/2). Shunt terminal stud No. 4 to suit 4 B.A. copper crimping lug (N 149267/1). The generator is fully suppressed for radio interference. The M 6702 control valve incorporates Plessey plug CZ 70779 to connect with mating socket CZ 70772.

SERVICING

23. To check the brush gear, it will be necessary to remove the cover band and air inlet assembly. To check the brush spring pressure, use a spring balance; when the lip end of the spring is in line with the top of the brush box, the load should be 22-26 oz. for each of the four springs.

24. Remove the four brushes by raising the brush springs to enable the brush to be withdrawn from the brush box. Check that the length of each brush is such that it will continue to operate satisfactorily until the next servicing period. The minimum permissible length for each brush is 0·437 in. when measured on the long side of the brush.

25. Examine the brushes and remove any carbon deposit with a supply of clean dry compressed air. Check that the brushes are a sliding fit in their boxes, and examine the corners of the box for any excess carbon dust which, if in evidence, can be removed with a cloth moistened with lead free gasoline.

26. Release the four 2 B.A. locking studs and tab washers from the generator commutator end cover, also remove the associated terminal block cover by unscrewing the three securing screws. Remove the covers, then check the suppression unit to ensure that all lockings are secure and that the mounting base moulding is not chipped or cracked, also inspect for any fractured leads, and check the cable crimping of the main and shunt terminals for security.

27. If the brush gear and suppression unit are considered satisfactory for further service, assemble the cooling air inlet and cover band assembly. Assemble the generator end cover, with the associated locking screws and locking washers; also the terminal block cover and tighten this in position with the three securing screws.

28. If the generator output is satisfactory, very little servicing will be necessary on the generator turbine, except to ensure that all lockings are secure and that the manacle ring clampings on the turbine air inlet pipe connection, also the auxiliary unit pipe connections for the M 6702 control valve.

29. If further servicing to the unit is considered necessary other than that given in para. 23 to 28, it is recommended that the unit be returned to the manufacturer for repair, as full facilities must be available for subsequent complete retesting of the turbine and generator.

Lubrication

30. Lubrication of the unit should not be necessary during minor servicing periods.

The governor valve is lubricated by impregnation processes during manufacture; the bearings are lubricated on manufacture with grease XG-277, but since lubrication in service entails extensive dismantling with subsequent complete re-testing of the unit, it is not recommended that this be undertaken except on repair.

Insulation resistance test

31. Check the insulation resistance between all live parts and the frame, using a 100 volt insulation resistance tester; the insulation resistance should not be less than 0·5 megohm (for R.N.) or 0·05 megohm (for R.A.F.).

Note . . .

The maximum permissible voltage for checking the insulation resistance is 100 *volts* (*max.*) *with the suppression capacitors in circuit* (*fig.* 7).

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