Chapter 1

ROTARY TRANSFORMERS

LIST OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

Introduction

1. This chapter provides general information on rotary transformers; although individual machines may vary slightly in design, such description and servicing procedure as is given in the following paragraphs will in general be applicable to all.

2. The function of a rotary transformer is to convert a d.c. supply at one voltage to a d.c. output at one or more other voltages, and its main application in aircraft is to supply d.c. at the required voltage to various items of radar equipment.

DESCRIPTION

3. A typical rotary transformer is shown in fig. 1. The machine has, on the common armature core, a motor winding and one or more generator windings. Each winding has its own commutator and occasionally one of the generator windings is connected to slip-rings. The motor winding is electrically insulated from each generator winding within the armature but may be externally connected. There is only one field system.

Commutators

4. Commutators are of composite construction, consisting of copper segments separated from each other and the armature shaft by mica or micanite sections. In some instances these sections are undercut below the level of the copper and the whole assembly is called a recessed-mica commutator. In other instances, the insulation is finished level with the copper and thus forms a flush commutator.

5. The type of brush to be used determines whether the commutator is flush or recessed,

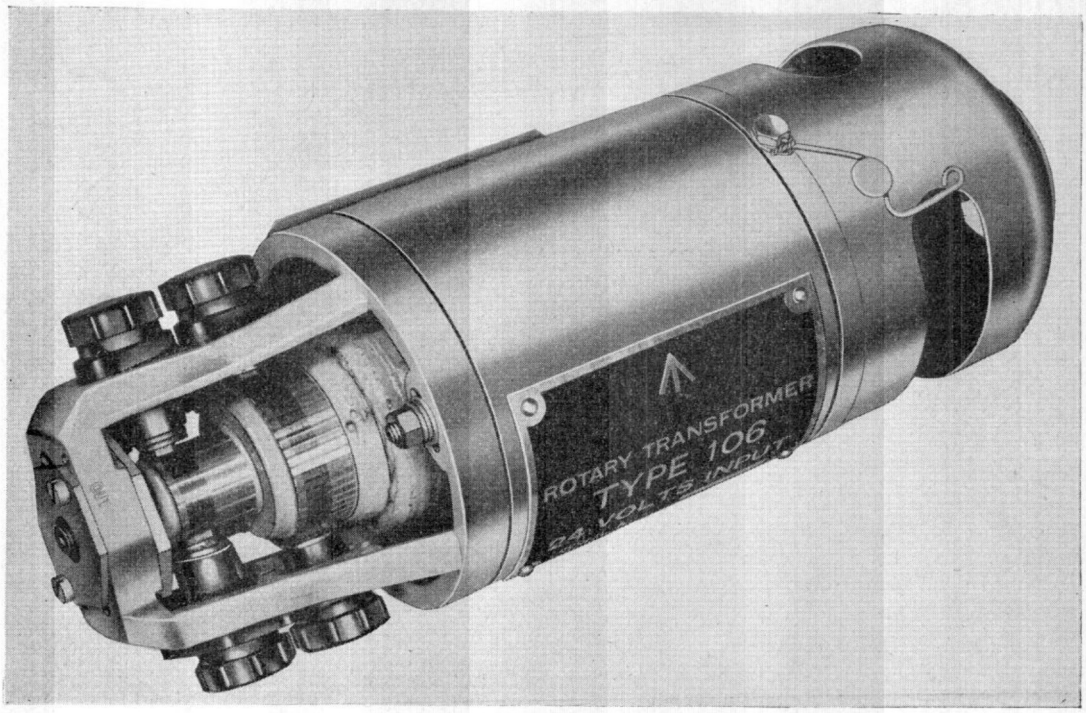

Fig. 1. Typical rotary transformer

and a brush of material designed to run on a recessed-mica commutator cannot be run on a flush-mica surface. The opposite is also the case.

6. After assembly on the armature shaft and after winding and impregnation, the commutators are turned to limits of great accuracy and then "run-in" on light load. At this stage the film begins to form over the brush track which is essential for good commutation. This film ultimately becomes a chocolate-brown, glossy track.

Brush gear

7. Brush pressure is maintained by coil springs in compression for plunger type brush gear, or by clock type springs for rocker type brush gear. Access to the brush gear is gained by removal of the end covers.

Armature

8. The armature is of orthodox laminated construction, with skewed slots to reduce commutator ripple. The windings are held in position by slot wedges and finally bound with steel wires; the ends of the conductors are soldered to the appropriate segments of the commutator risers and are secured by binding cord.

9. The armature shaft bearings are housed in the end shields, the bearing housing liner normally being cast integral with the end shield. Foreign matter is excluded by bearing caps, beneath which may be fitted shims for the adjustment of armature end play.

Suppression of radio interference

10. Rotary transformers supplying the current for wireless equipment have chokes connected in series with the leads, and condensers fitted between the leads and earth, which filter out high-frequency currents generated at the commutator and prevent their causing radio interference. These components are usually mounted on or close to the machine. In the more recent machines all these items are contained in a suppressor unit.

Fitting

11. When a new or reconditioned rotary transformer is fitted, it should be run on the normal rated voltage. The generated voltage and the input current are to be measured; polarity tests should also be made, it being first ascertained that the armature is rotating in the right direction.

12. The apparatus associated with the rotary transformer must be kept in good order, and the wiring connections examined and tested periodically. Faults in these items may cause damage to the machine and failure of the electrical supply.

SERVICING

13. Rotary transformers are pieces of delicate apparatus and should be treated as precision instruments. They are initially manufactured to very fine limits of mechanical accuracy and electrical performance; no effort, therefore, should be spared to ensure that they are maintained to these standards. Since the general principle of design is similar for all airborne rotary transformers, the following servicing instructions will apply, except where specific instructions are given in the chapter in A.P.4343B, Vol. 1 for a particular machine.

14. Rotary transformers in storage should be kept in a clean, dry place and should not

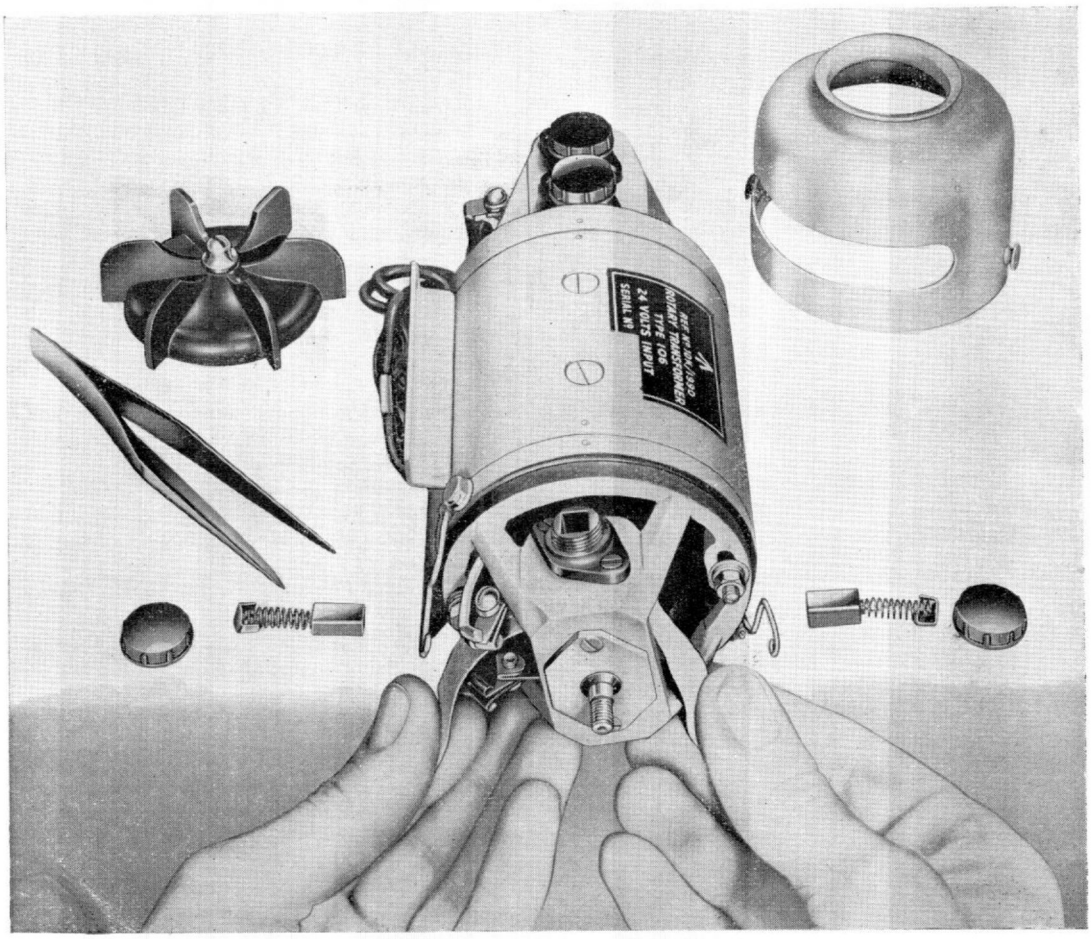

Fig. 2. Method of bedding-in brushes

be allowed to come into contact with, or be stored near, filled batteries because of the destructive effect of the fumes given off by the electrolyte.

Brush gear

15. The brushes should be free to slide easily in their boxes, and should be bedded down evenly over their whole contact arc and over at least 80 per cent of their contact area. If any brush shows signs of sticking, the inner surface of the box may be cleaned with lead-free gasoline, or, if this proves ineffective, the brush may be carefully smoothed down with grade 00 glass paper. The brush springs should be free to apply their full pressure to the brush.

16. To avoid failure of the machines during operational periods the pigtails should be examined for any signs of abrasion. The brushes should be renewed before they are excessively worn, only brushes of the correct size and grade being used. When new brushes are fitted to a rotary transformer, it is important that the contact between the brush-face and commutator should be as intimate as possible. This can only be achieved by carrying out the bedding-in process carefully and methodically. The principle is common to all rotary transformers, but may vary in detail according to the type of brush gear fitted.

17. Assuming that the old brushes have been removed, the first step is to obtain a strip of grade 00 sandpaper the width of the particular commutator. The sandpaper, which should be at least 12 in. in length, is fed under the brush box with the abrasive side outwards until about 6 in. projects on each side of the machine (*fig.* 2). A pair of small tweezers will be of assistance at this stage.

18. The correct brush is then placed in the box and full spring pressure applied either by allowing the clock-type spring to bear or by screwing on the brush cap. By gripping the projecting sandpaper between the thumb and forefinger of each hand and by bracing the second and third fingers of each hand against the side members of the end frame, a downwards pressure may be applied to the sandpaper. This pressure serves both to pull the paper to the radius of the commutator and to rock the armature gently backwards and forwards.

19. This movement must be very small. Usually about six cycles will be sufficient, after which a visual examination is made of the brush-face to see if it has been formed to the commutator radius. The procedure is repeated until such is the condition.

20. When this condition has been obtained, the brush is removed before the paper is withdrawn. All the dust is then blown out ACROSS the machine so that none goes towards the bearings. Particular care is taken to ensure that the brush is replaced in the exact position in which it was formed. This is very important because some types of brush gear hold the brush at an angle of approximately 10 deg. to the commutator. The second brush is then subjected to the same treatment.

21. After installation of the newly-bedded brushes, the machine must be run on 50 per cent of full load until at least 80 per cent of the contact area is polished (indicating intimate contact). This normally takes two or three hours, but may, in some instances, be considerably longer. Too much importance cannot be attached to bedding of brushes, and should the process be rushed, or insufficient care taken, the machine will not give a satisfactory performance. The resultant damage to the commutator surfaces may be irreparable.

Commutators

22. The commutator must not be touched with any grade of sandpaper, emery paper, crocus paper, or abrasive sheet of any kind. Liquid cleaners such as Brasso must not be used, neither must trichlorethylene, carbon tetrachloride, nor lead-free gasoline. Carbon dust should be thoroughly removed using an air blast, but no further cleaning is permissible. If any trouble persists after this treatment, then the machine must be regarded as defective and returned to a Repair Depot.

Note . . .

The ideal commutator surface, as illustrated in fig. 1, should be glossy, with a dark chocolate-brown or purple strip on the brush track and the remainder of the surface a dull copper colour.

Bearings

23. Bearings are lubricated with sufficient grease for 1,000 hours of working life, and they should not be touched or inspected

except when the machine is dismantled at a Repair Depot.

Permanent magnet rotary transformers

24. The armature of a rotary transformer employing permanent magnet fields should not be removed without the provision of the special equipment available at Repair Depots. Care should be taken to see that when the armature is removed, the keepers are inserted simultaneously, otherwise the resultant loss of residual magnetism will seriously impair the efficiency of the machine. For the same reason particular care is to be taken to avoid knocking or undue vibration when handling this type of machine.

Location of faults

25. The following table indicates possible faults which may be met with when servicing rotary transformers and the appropriate remedy. If any servicing other than that described in this chapter is required, the machine must be sent to a Repair Depot which is equipped with the necessary equipment. Instructions for this procedure will be issued in the appropriate chapter of Volume 6 of this publication.

TABLE I

Fault-finding chart

Defect	Possible cause	Remedy
1. Sparking at the commutator	(1) Brush sticking in holder	(1) Clean with cloth moistened with lead-free gasoline. Only if necessary is the brush to be rubbed with 00 sandpaper. Only one or two strokes will be needed.
	(2) Brush not bedded	(2) Bed according to para. 17 to 21.
	(3) Brush edge broken	(3) Bed according to para. 17 to 21.
	(4) Worn brushes	(4) Renew and bed according to para. 17 to 21.
	(5) Dirt on brushes or commutator	(5) Clean according to para. 22.
	(6) Incorrect brush position	(6) Return to Repair Depot for adjustment.
	(7) Projecting mica	(7) Return to Repair Depot for undercutting and/or skimming.
	(8) Worn commutator	(8) Return to Repair Depot for skimming.
	(9) Formation of flat on commutator	(9) Return to Repair Depot for skimming.
	(10) Commutator out of truth	(10) Return to Repair Depot for skimming.
	(11) Armature current excessive	(11) Return to Repair Depot for testing.
2. High speed	(1) High resistance or break in field circuit	(1) Return to Repair Depot for testing.

Defect	Possible cause	Remedy
3. Overheating	(1) Low insulation resistance	(1) Return to Repair Depot for testing.
	(2) Short-circuit in one or more field or armature coils	(2) Return to Repair Depot for testing.
4. Failure to start	(1) No supply	(1) Check terminal voltage of line and between brushes.
	(2) Brushes not in contact with commutator	(2) Treat as for sticking brushes. Examine the brush pressure.
	(3) Short-circuit in field coils.	(3) Return to Repair Depot for testing.
	(4) Open-circuit in field or armature	(4) Return to Repair Depot for testing.
5. Low output voltage	(1) Dirty commutator	(1) Clean according to para. 22.
	(2) High resistance face on the brushes	(2) Proceed as for bedding the brushes (para. 17 to 21).
6. Excessive mechanical vibration	(1) Broken fan	(1) Renew fan. If vibration persists, the machine should be returned to the Repair Depot.

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