Chapter I

DYNAMOTOR, Type D

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

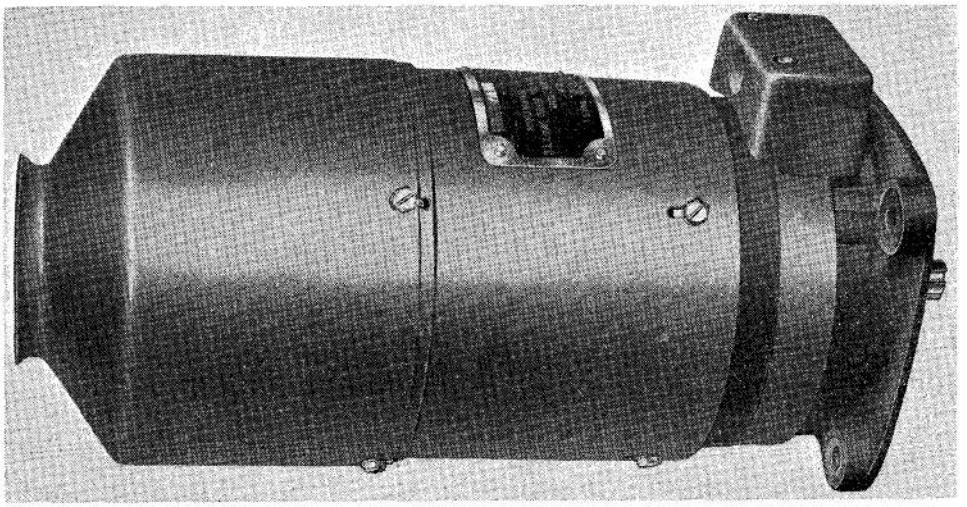

Fig. 1. Dynamotor, Type D

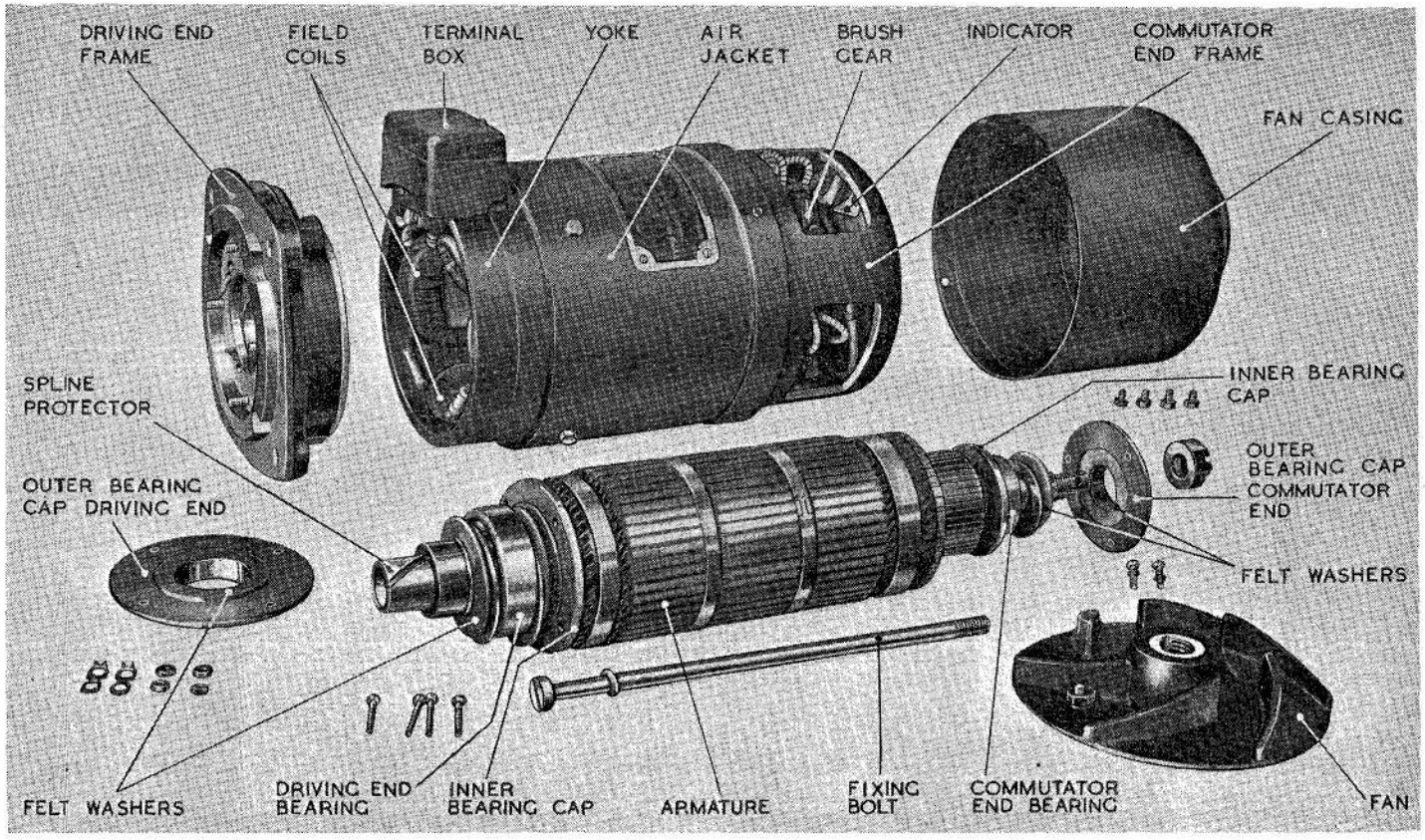

Fig. 2. Dynamotor, Type D, partly dismantled

LEADING PARTICULARS

Dynamotor, Type D	
Anti-clockwise No. 2	*Stores Ref. 5UB/4157*
Clockwise	*Stores Ref. 5UB/520*
Full output as a motor	*50 lb. in torque at 1,000 r.p.m. approx. (Input 24 volts 50 amp. approx.) Rating—1 min.*
Full output as a generator	*29 volts 40 amp. Rating—continuous* **Note.**—*If the machine is working as a generator in an ambient temperature exceeding 30° C. (86° F.) the continuous output should not exceed 29 volts 33 amp.*
Speed range for continuous operation as a generator	*4,000—5,000 r.p.m.*
Maximum speed for 5 min.	*6,000 r.p.m.*
Brushes	*Grade EGO (Stores Ref. 5UB/3659)*
Brush spring pressure	*18–24 oz.*
Lubricant	*Oil OM–170 (Stores Ref. 34B/60)*
Weight	*42 lb.*
Suppressor used	*Type L (Stores Ref. 5CY/924)*
Voltage regulator	*Type C (Stores Ref. 5UC/1013)*
Switchboard for testing	*Type B*
Resistance, field winding at 20° C.	*Shunt 11·0 ohms* / *Series 0·098 ohms* } ± *10 per cent*

Introduction

1. This is a dual purpose machine intended primarily for use in conjunction with a petrol engine, as an auxiliary power unit for installation in aircraft, or for ground use. It serves firstly as an electric motor supplied from an accumulator to start the petrol engine and secondly as a self-cooled generator when driven by the engine. When in use as a generator the output voltage is controlled by a carbon pile voltage regulator acting on the shunt field. The machine may be coupled to the engine either directly or by means of a suitable belt drive.

DESCRIPTION

2. This machine (*fig.* 1) is of four pole construction and has both series and shunt field windings assembled on the same pole pieces. These field windings are so connected in circuit by means of a single and a two-way solenoid switch, that the series winding is disconnected when the machine is running as a dynamo, and is brought into circuit when the push-button is operated and the machine runs as a compound wound motor. The solenoid switches are so connected that they are both operated by the same push-switch.

3. One end of the shunt field is connected internally to the positive terminal and the other the shunt field terminal and one end of the series field is connected internally to the negative terminal and the other to the series field terminal. The terminal markings are as follows (*fig.* 4) :—

Positive ..	Yellow spot
Negative ..	Blue spot
Shunt field ..	Small terminal adjacent to the positive terminal
Series field ..	Terminal adjacent to the negative terminal

Bearings

4. The armature (*fig.* 2 *and* 3) is carried in two oil lubricated ball bearings, one of which is located in the driving end frame, the other being free to slide in an annular recess in the commutator end frame. The driving end bearing is held in place on the shaft by

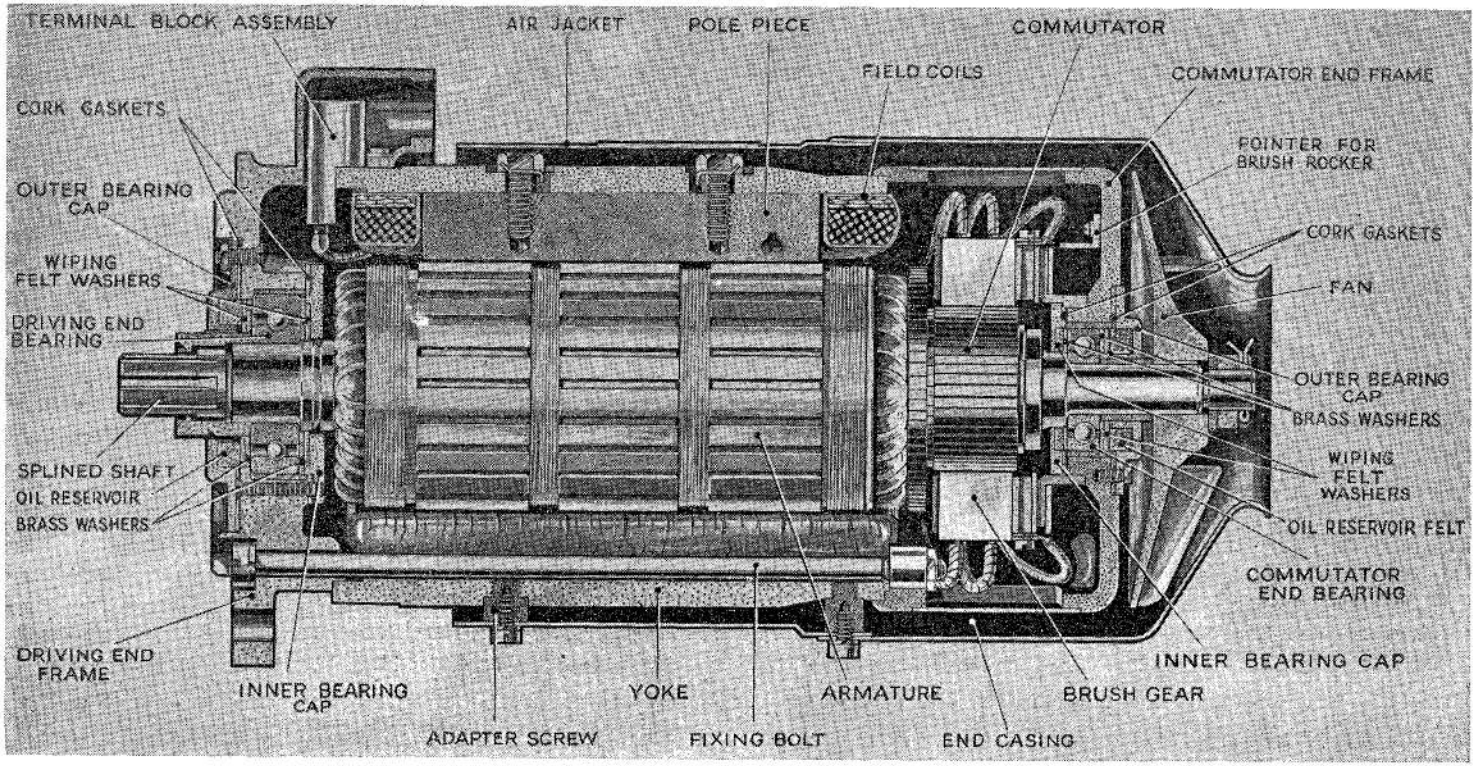

Fig. 3. Sectional perspective drawing of the dynamotor, Type D

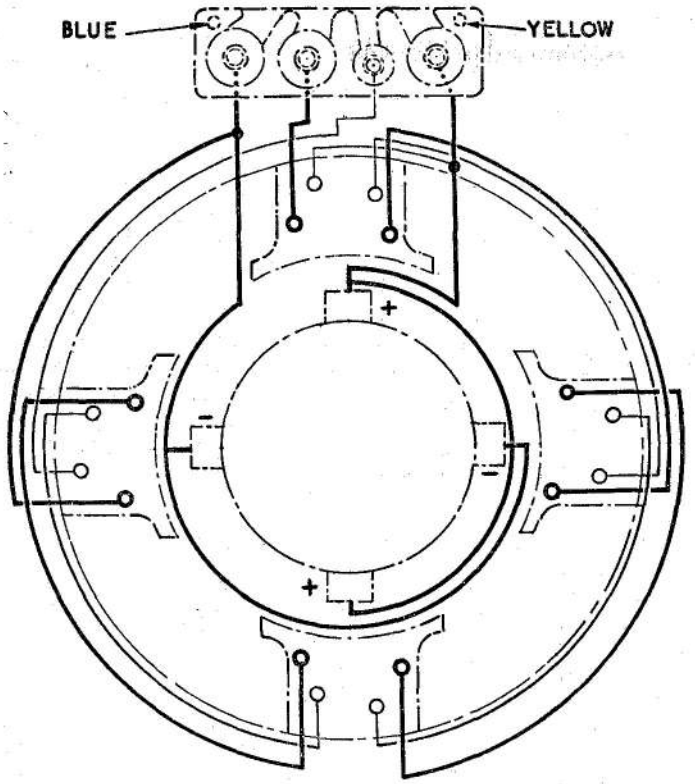

Fig. 4. Internal wiring diagram

a lock-nut and the commutator end bearing by the castellated nut which secures the fan.

Lubrication

5. At the driving end, the outer bearing cap is secured to the end frame by four studs and nuts, and carries a large oil-soaked felt ring which acts as a reservoir. In contact with this reservoir felt is the outer wiping felt washer which also rubs lightly on the nut securing the bearing to the shaft. Oil is thus transferred from the reservoir to the shaft and then flows to the bearing when the generator is running, under the action of centrifugal force. A similar wiping felt washer is fitted at the inner side of the bearing and is housed in a recess in the inner bearing cap. Oil is fed from the reservoir felt to the inner wiping felt washer by means of four wicks which pass through holes in the end frame. One end of each wick is inserted between the inner bearing cap and the inner wiping felt washer, the other end being inserted between the outer wiping felt washer and the reservoir felt. Note particularly that a brass washer is fitted between each wiping felt and the bearing. The purpose of these washers is to prevent the wiping felt washers from being drawn into the bearing when the generator is running, and it is most important that they should always be assembled in their correct positions.

6. The lubrication arrangements for the commutator end bearing are similar, except that the wicks between the inner and outer wiping felts are omitted. Again note the position of the brass washers between the wiping felt washers and the bearing.

Brush gear

7. Four brushes are employed, set diametrically about the commutator. Diametrically opposite brushes are interconnected, one pair being connected to the positive terminal and the other pair to the negative terminal, by means of flexible leads. The brush rocker is secured to the commutator end frame by two countersunk head screws which pass through holes in the end frame. Access to these screws is obtained by removing the outer bearing cap (held by three studs and nuts) and the cork gasket, at the commutator end. To adjust the brush position these screws must first be slackened off. The correct position of the brush rocker is marked by a white line painted on the brush rocker, which should correspond with the brass pointer fixed to the end frame.

Cooling

8. The dynamotor, when running as a generator, is self cooled by means of a fan fitted to an extension of the shaft. This fan is located on the shaft extension by a cylindrical distance piece which is a sliding fit on the shaft, and is secured by a key and a castellated nut and split pin. An air jacket surrounds the yoke, and an end casing, which covers the fan and the commutator end frame, is attached by four screws and forms an extension of the air jacket. Air is drawn in

through the large aperture in the end casing, passes over the brush gear apertures, along the yoke and leaves through the open end of the jacket near the driving end frame.

INSTALLATION

9. Before fitting a dynamotor, check that the direction of rotation, and type are correct for the particular engine and aircraft. These details are given on the name plate attached to the yoke of the machine. Note that the direction of rotation is taken when looking at the driving end of the machine.

10. The splined end of the shaft protruding beyond the driving end frame should be protected by a ferrule when the generator is not in use. Before installation this ferrule must be removed. In some installations a coupling member, which is intended to engage with a corresponding member on the engine, or a belt pulley, is fitted to the dynamotor shaft. With this arrangement, care should be taken to see that the coupling member or pulley is a close sliding fit on the shaft and that it is properly secured by an axial or clamping bolt which should be suitably locked after tightening. In other installations the dynamotor shaft engages directly with a suitably splined driving member on the engine. In each case the shaft should first be coated lightly with clean engine oil.

11. Belt drives usually employ a vee belt. This type of belt should always be run with a slight amount of slack to avoid imposing a heavy load on the driving end bearing.

OPERATION

12. Whether the dynamotor is directly coupled to an engine or belt driven, the drive should be so arranged that over the speed range of the engine used, the speed range of the dynamotor when employed as a generator is within the limits quoted in Leading Particulars.

13. The machine is controlled by an external regulator which is designed to maintain the output voltage at a steady figure, irrespective of fluctuating engine speed, the state of charge of the battery, or the load connected to the supply. In an airborne installation the battery is connected in parallel with the dynamotor, and supplies all the general services loads when the generator is not running or when, due to a reduction in engine speed, the voltage of the dynamotor falls below the figure at which the cut-out opens. In a ground installation, the battery and consequently the solenoid switches and the cut-out are usually omitted. The full circuit diagram is shown in fig. 5.

Parallel operation of dynamotors

14. Where two or more dynamotors are employed in parallel or a dynamotor is connected in parallel with an engine driven generator, it is essential that the regulator should be correctly connected for this purpose, as otherwise the machines will not share the load equally and considerable trouble will then be experienced. Reference should therefore be made to A.P.4343B, Vol. 1, Sect. 1, in which the regulators used are described, and full operating instructions are given.

SERVICING

15. Information on the servicing of generators, which is generally applicable to the dynamotor, Type D, is given in A.P.4343, Vol. 1, Sect. 2, Chap. 1.

16. Dynamotors should be inspected after removal of the commutator covers. The external connections should also be checked for condition and security, and all nuts, union caps and fixing screws should be checked and tightened where necessary.

17. When inspecting dynamotors on aircraft dispersed in the open, every care should be taken to prevent the ingress of moisture into the machines or terminal boxes.

Lubrication

18. If inspection has indicated that the dynamotor is otherwise serviceable, it may be lubricated without dismantling completely. To lubricate proceed as follows :—

Driving end bearing

(1) Remove the four nuts which hold the outer bearing cap in place and remove cap, taking care not to damage the cork gasket. If the cap is tight, insert four 2 B.A. screws in the tapped holes provided, and screw in gently.

(2) Remove the outer wiping felt washer and the brass washer (*para.* 8). If necessary, use two small wire hooks to do this. Examine the bearings for sign of wear or damage.

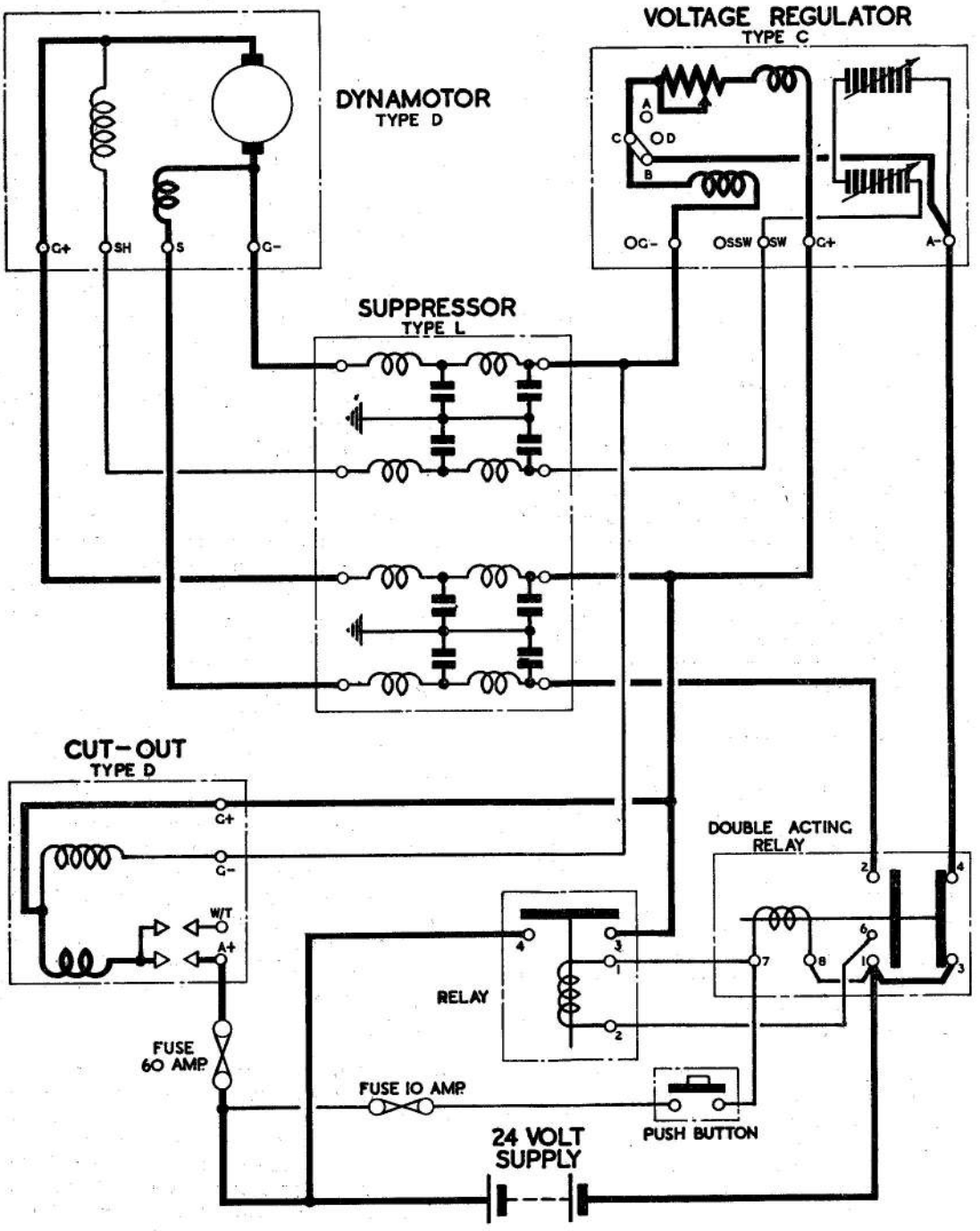

Fig. 5. Typical circuit diagram

3) If the bearing is satisfactory insert not more than three or four drops of oil, and work into the bearing by rotating the armature.

(4) Soak the felt reservoir and the wiping felt washer with oil OM–170 (Stores Ref. 34B/60) and wipe off any surplus oil. The wiping felt washer should be replaced if worn.

(5) Refit the brass washer, wiping felt washer and gasket. The gasket should be renewed, if damaged.

(6) Refit the outer bearing cap.

Commutator end bearing

(7) Remove the end casing. Take off the castellated nut on the end of the shaft extension, and draw off the fan, taking care not to lose the key.

(8) Undo the nuts which hold the outer bearing cap in place and detach the cap, taking care not to damage the cork gasket. If the cap is tight, insert three 4 B.A. screws in the tapped holes provided and screw in gently.

(9) Proceed as in sub-para. (2) to (6) above.

(10) Refit the fan, taking care to see that the distance piece and key are both in place. Refit the castellated nut and end casing.

Dismantling and re-assembling

19. Special care should be taken to avoid damage to the ends of armature shafts or the threads thereon. If it is necessary to strike or grip them, a piece of hard wood or soft metal should always be interposed. The core of an armature should never be gripped tightly in a vice as this causes distortion of the laminations with consequent breakdown of the insulation. Where locating pins are provided, care should be taken in assembly to see that they are in place and registering correctly in their appropriate slots before tightening. When removing commutator end frames from yokes, it is usually necessary to remove a number of connections and their respective positions should therefore first be noted carefully so that they may be replaced correctly.

Dismantling

20. To dismantle the dynamotor first proceed as in sub-para. (1), (2), (7), and (8) of para. 18 and then continue as follows:—

(1) Lift the brushes from the commutator and take out the through bolts which hold the end frames to the yoke.

(2) Remove the two screws which secure the brush rocker, taking care not to lose the shakeproof washers. These screws are accessible when the outer bearing cap and gasket at the commutator end are removed.

(3) The armature and driving end frame can now be detached from the yoke by tapping gently on the commutator end of the armature shaft.

(4) To dismantle the driving end bearing, remove the four countersunk head screws which are accessible when the outer bearing cap and cork gasket have been removed.

(5) Tap the armature gently out of the end frame taking care not to lose the oil wicks.

Re-assembly

21. If the dynamotor has been completely dismantled, it will be found advantageous first to re-assemble the driving end frame complete with bearing, wiping felt washers and bearing caps. Care should be taken to insert the wicks between the inner felt wiping washer and the oil reservoir felt correctly, as described in para. 18. The armature should then be supported in a vertical position with the shaft resting on a block of wood or other soft material, and the driving end frame should be driven on to it. For this purpose, a clean piece of steel or brass tube of suitable length and size to fit over the shaft and rest against the inner journal of the bearing (not against the bearing cap), will be required. Particular care should be taken during this operation not to damage the threads on the shaft. The shaft nut should then be refitted and tightened.

22. Continue re-assembling in the reverse order to dismantling, and see that all screws and nuts are locked as required. When refitting the armature to the yoke it is necessary to ensure that the brass washer and inner wiping felt washer at the commutator end are centralised. This may most easily be done if the yoke is supported in a vertical position when inserting the armature. It may be found helpful to screw a piece of 4 B.A. rod of suitable length into

one of the holes in the bearing plate at the commutator end to act as a locating pin. This can be withdrawn subsequently from the outside.

Brush gear

23. Brush types and spring pressures are given in Leading Particulars. To adjust the brush position, slacken the two countersunk head screws mentioned in para. 7. If it is considered necessary to check the brush position, the positive terminal of the battery should be connected to the positive (yellow spot) terminal of the dynamotor, and the negative terminal of the battery should be connected, through a tapping key, to the shunt field terminal of the dynamotor.

Testing

24. The circuit diagram given in fig. 5 is appropriate for testing this machine, except that the suppressor may be omitted.

As a motor

25. A torque test is not necessary for general service testing and it will be sufficient to check that when connected in accordance with the diagram, and when the starter switch is pressed, the dynamotor runs as a motor in the direction of rotation as stated on the nameplate.

As a generator

26. The machine should be tested as described in the following paragraphs, using a suitable test set. The appropriate loading panel should be substituted for the battery shown in fig. 5.

27. It is essential that the regulator used should be correctly set in accordance with the instructions laid down in A.P.4343B, Vol. 1, Sect. 1. With the regulator, Type C, the link should connect terminals B and C (the position for non-parallel running as a single unit) when the generator voltage for all loads up to full load should be approximately 28. The negative terminal of the generator should be connected to terminal G—(1,000 W.).

28. With the machine connected in the appropriate test circuit, run up on no load to approximately 4,000 r.p.m. There should be no hesitation in build up and the correct voltage should be attained.

29. Run at the same speed on half load for ten minutes. During this run, there should be no more than pin-point sparking at the brushes. At the end of this test the brushes should still slide freely in their boxes.

Note . . .

The dynamotor should not be run continuously at any output greater than 28 *volts* 10 *amp. without the fan and end casing in position, or serious damage due to overheating will result.*

Insulation

30. Whilst the machine is still hot from the preceding test, the resistance of all live parts together to the frame, measured with a 250-volt insulation resistance tester, should be not less than 0·1 megohm.

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