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ELECTRICAL EQUIPMENT MANUAL—POWER SERVICES (AIRBORNE)
This is A.L. No. 44 to A.P.1095C, Vol. I, and concerns Sect. 5
Delete "*(To be issued later)*" after title of Chap. 9 in the List of Chapters.
Amend title to read "Generators, d.c., types K, KX, KZ1, and KZ2," *write* "A.L.44" in the outer margin of the list, *insert* this chapter, and make an entry in the Amendment Record Sheet at the beginning of the Volume.

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CHAPTER 9

GENERATORS, d.c., types K, KX, KZ1, and KZ2.

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CHAPTER 9

GENERATORS, d.c., types K, KX, KZ1, and KZ2

Introduction

1. This chapter deals with a series of d.c. aircraft generators which, with the exception of the wind-driven type, KZ1 are intended to be driven through gearing from the aircraft engine. In all cases the voltage of the generator is controlled by a carbon pile voltage regulator acting on the field.

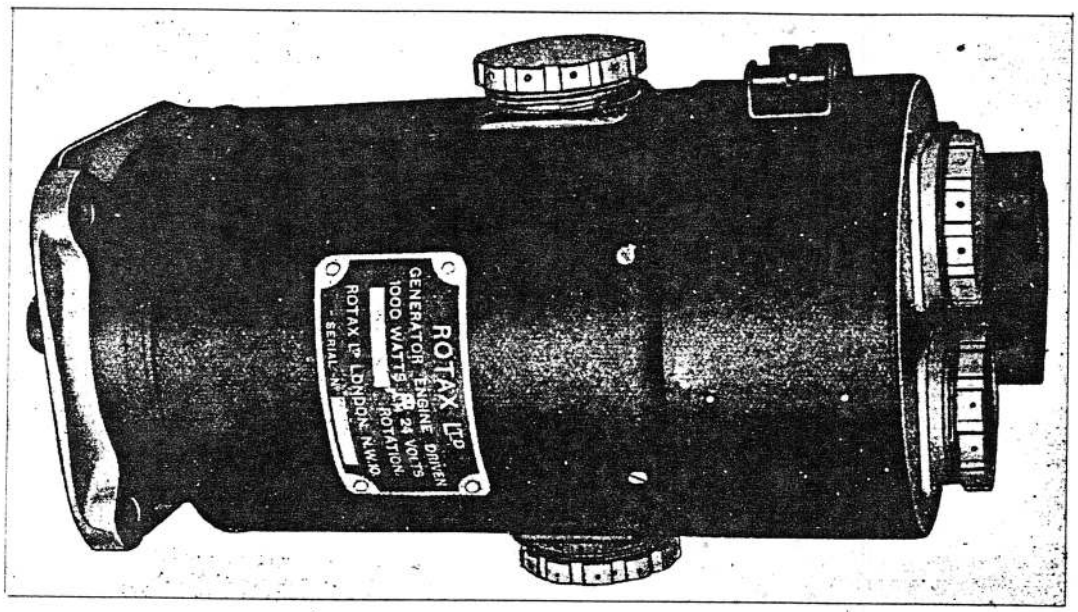

Fig. 1.—Engine-driven generator, type K

Leading particulars

2. ***Generator, type K.*** S.I.S.2392

		Stores Ref.
Anti-clockwise rotation		5U/975
Clockwise rotation		5U/976
Output	29 volts, 40 amps. full load.	
Speed range	3,500–6,000 r.p.m. continous operation. 7,500 r.p.m. max. speed for 5 minutes.	
Brushes, Grade EGO ...	High altitude	5U/2384
	General	5U/1172
Brush spring pressure	12–18 ozs.	
Lubricant	Grease	*34A/89
Weight	36 lbs.	
Cable	Trigenmet 2	5E/2014
Suppressor	Type O	5C/968
Regulator	Type A or C	5U/899 or 5U/1013
Switchboard, test ...	Type B	5G/1947
Resistance, field windings	14 ohms at 20 deg. C $\pm$ 10 per cent.	

		Stores Ref
Generator, type KX. S.I.S.2774		
Anti-clockwise rotation		5U/189
Clockwise rotation		5U/190
Output	29 volts, 60 amps. full load.	
Speed range	3,300–6,000 r.p.m. continuous operation.	
	7,500 r.p.m. max. speed for 5 minutes.	
Brushes, Grade EGO ...	High altitude	5U/2384
	General	5U/1172
Brush spring pressure	12–18 ozs.	
Lubricant	Grease	*34A/89
Weight	36 lbs.	
Cable	Trigenmet 2 or	5E/2014
	Trigenmet 3	5E/2159
Suppressor	Type W or	5C/1614
	Type Y	5C/2605
Regulator	F.24	5U/192
Switchboard, test ...	Type B	5G/1947
Used with additional loading panel		5G/2677
Resistance, field windings	7 ohms at 20 deg. C. ± 10 per cent.	
Generator, type KZ1. S.I.S.3050		
Clockwise rotation only		5T/207
Output	100 volts, 8 amps. full load.	
Speed range	3,300–6,000 r.p.m. continuous operation.	
	7,500 r.p.m. maximum speed for 5 mins.	
Brushes, Grade EGO		5U/1172
Brush spring pressure	12–18 ozs.	
Lubricant	Grease	*34A/89
Weight	36 lbs.	
Cable	Trigenmet 1	5E/2013
Suppressor	Type L	5C/924
Regulator	Type CZ1.	5T/116
Switchboard, test	Type K	5G/214
Used with loading panel		5G/215
Resistance, field windings	7 ohms at 20 deg. C. ± 10 per cent.	
Generator, type KZ2. S.I.S.2774.		
Clockwise rotation only		5T/240
(Other details as for generator, type KZ1).		

* 1 lb. tins. In 14 lb. drums the Ref. No. is 34A/84.

DESCRIPTION

Generator, type K

3. This generator is self-excited, and of four-pole, shunt-wound construction. The terminal markings are as follows:—

Positive, G +; Field, S; Negative, G — .

One end of the field winding is connected internally to the positive terminal, and the other end to terminal S.

Bearings

4. The armature is carried in two grease 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.

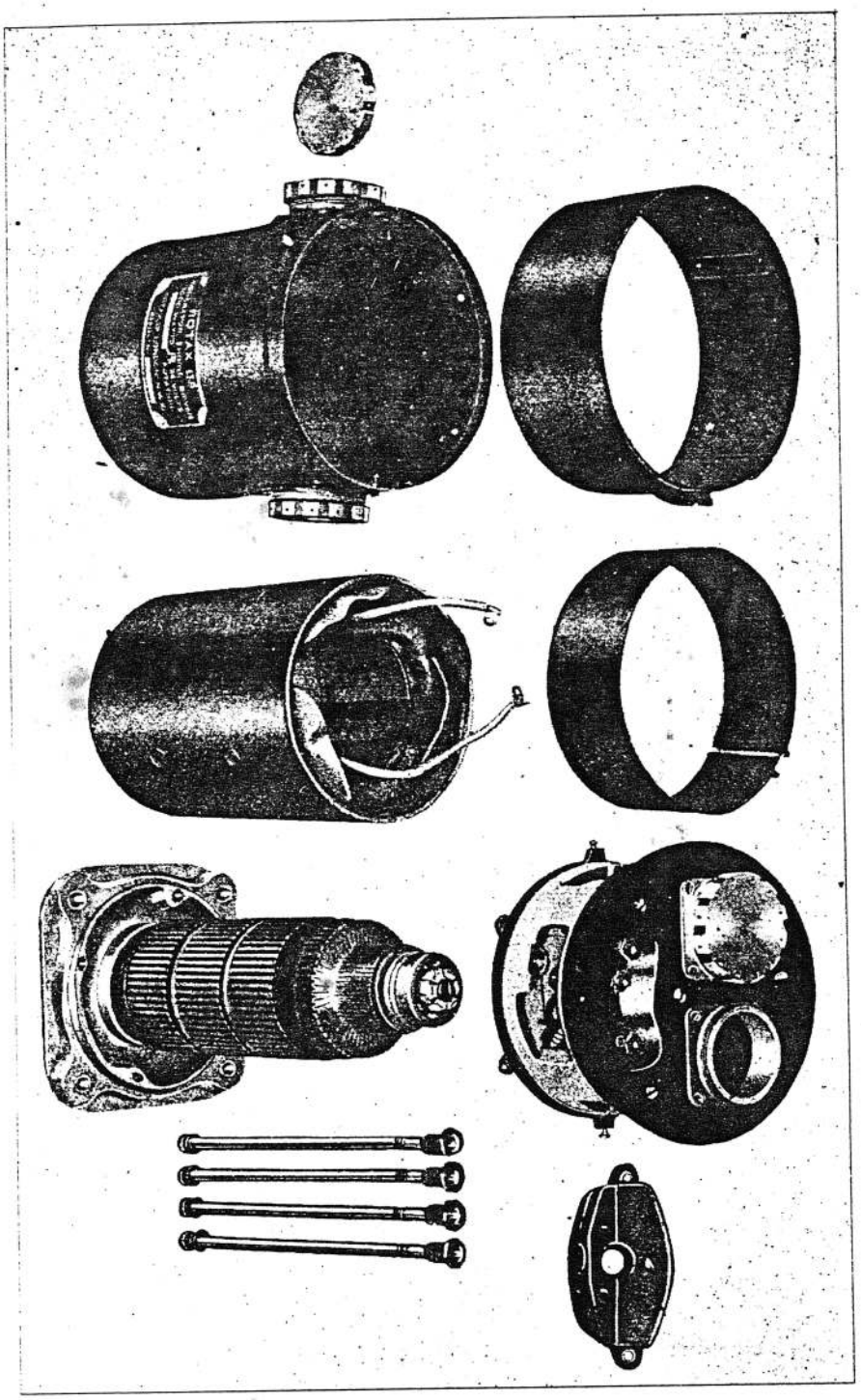

Fig. 2.—Dismantled view, generator, type K

Brush gear

5. Four brushes are set diametrically about the commutator, connections being brought out from the brushes through flexible connections to the connecting rings which are mounted on, and insulated from, the end frame, and thence to the terminals. The brush rocker is secured to the commutator end frame by two 6 B.A. screws and nuts accessible through the air pipe unions on the end frame. To adjust the brush position these nuts must be slackened off, as described in para. 23. The correct position of the brush rocker is marked by corresponding white lines painted on the rocker and on the commutator end frame, or on a part rigidly attached to the end frame (usually the inner end of the field terminal).

Cooling

6. The generator is intended to be cooled by air from the slipstream. Air enters the machine through the inlet air pipe and circulates about the air jacket which surrounds the yoke, leaving through the outlet pipe. The brush gear is enclosed by the inner cover band which is clamped over the brush gear apertures in the commutator end frame. The outer cover band covers the opening formed between the outer jacket and the commutator end frame.

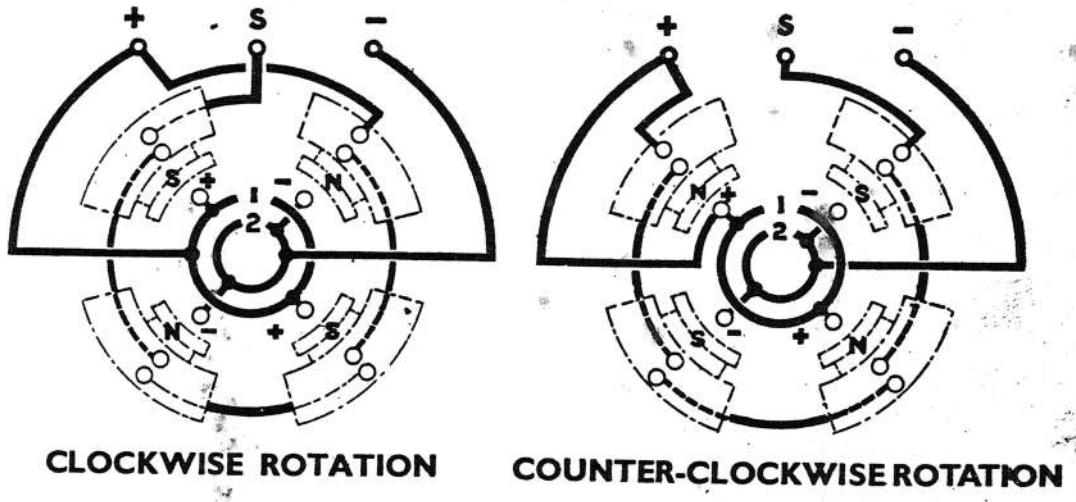

Fig. 3.—Diagram of field connections, K and KX generators, looking at commutator end

7. Four air-pipe unions are fitted but only two are used at any one time. The two not in use should be blanked off with the blanking caps provided. The arrangement of air pipes for each installation is decided during manufacture of the aircraft and should not be altered without authority.

INSTALLATION

8. The arrangements for the mounting of an engine-driven generator in an aircraft depend primarily upon the type of engine, and in some cases also, on the particular aircraft. There are thus a number of different arrangements for each generator. Reference may be made to the Service Instruction Sheet (*see* para. 2) in which general instructions for the installation of this generator are given.

9. Before fitting a generator, check that its type and direction of rotation are correct for the particular engine and aircraft. These details are given on the nameplate attached to the yoke of the machine. Note that the direction of rotation is that in which the armature rotates when viewed from 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. In some installations a coupling member, which is intended to engage with a corresponding member on the engine, is fitted to the generator shaft. With this arrangement, care should be taken to see that the coupling member is a close sliding fit on the shaft, and that it is properly secured by axial or clamping bolt which should be suitably locked after tightening. In other installations the generator shaft engages directly with a suitably splined driving member on the engine. In either case the shaft should first be coated lightly with clean engine oil.

11. Anti-corrosive treatment is to be applied to certain components after installing a generator. Information on this subject is given in para 20, Chap. 1 of the Section.

12. As cooling air pipes are usually of thin aluminium, care should be taken to see that they are not bent or restricted, except as designed, especially at the inlet or outlet apertures.

OPERATION

13. Reference should be made to the Chapter on general principles of operation in this Section. The generator is coupled to the aero engine through gearing. It may be fitted either on the engine or on an auxiliary gear-box. The gear ratio is so arranged that over the speed range of the particular engine the speed range of the generator drive is within the limits given in para. 2 for the generator being used.

14. The generator 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 accumulator, or the load connected to the supply. The accumulator is connected in parallel with the generator, 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 generator falls below the figure at which the cut-out opens.

Parallel operation of generators

15. Where two or more generators are employed in parallel it is essential that the regulator should be correctly connected for this purpose, as otherwise the generators will not share the load equally, and considerable trouble will then be experienced. Reference should, therefore, be made to Section 6 of the publication in which the regulators used are described, and full operating instructions are given.

SERVICING

16. The following instructions on servicing are to be read in conjunction with the general information on this subject given in Chap. 1 of this Section. Generators are to be inspected at the periods laid down in the appropriate aircraft Inspection Schedule. In general, they should be inspected carefully at each minor inspection by 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. Generators should be removed from the engine for more detailed examination and lubrication after every period of approximately 120 flying hours (or nearest equivalent inspection) and at every major inspection. Where, however, experience with a particular installation clearly indicates that the generator is capable of running for longer periods without requiring inspection or lubrication, the length of flying time between inspections and removals may be increased if authorised by the responsible authority concerned. When inspecting generators on aircraft dispersed in the open, every care should be taken to prevent ingress of moisture into the generators or terminal boxes.

Bearings and lubrication

17. This generator requires to be dismantled for lubrication. The bearings are grease-lubricated. For general instructions on servicing and lubrication of bearings, *see* para. 8 of Chap. 1 of this Section.

Dismantling

General note

18. 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 hardwood 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 with their appropriate slots, before tightening up. 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.

19. To dismantle this generator, proceed as follows:—

Remove the commutator cover bands and lift the brushes off the commutator. Remove the four bolts passing through the yoke by unscrewing at the driving end. Extract the armature and driving end frame by tapping gently on opposite sides of the frame or prising carefully with two screwdrivers. To dismantle the driving end bearing unscrew the oil thrower disc nut, remove the three countersunk headed screws in the driving end frame which hold the bearing retaining plate and tap the armature gently out of the end frame.

Insulation resistance

20. Before assembling components, refer to para. 26, Chapter 1 of the this Section, for details of insulation resistance testing.

Assembling

21. Assemble in the reverse order and see that all screws and nuts are locked as required. Special attention should be paid to the peening of the driving end bearing plate screws. Early models of this type of generator have through bolts (Stores Ref. 5U/263), $7\frac{31}{32}$ inches long, with a spring washer (A.G.S.585/E) underneath the head at the driving end. These should be replaced by the later type of through bolt (Stores Ref. 5U/3430), $8\frac{1}{4}$ inches long, with a plain steel washer (Stores Ref. 5U/3755) underneath the head. A lock-nut (Stores Ref. 5U/3431) should then be fitted to each through bolt at the commutator end, after the original fixing nut (Stores Ref. 5U/253) has been refitted. Note that the lock-nut (Stores Ref. 5U/3431) is a special size to allow clearance for the brush springs. Particular care should be taken to see that the nuts in the terminal box, which hold the terminals in place, are securely tightened. If this is not done there is a tendency, when the nuts securing the lugs to the external cables are subsequently tightened, for the terminals to turn and so damage the insulation, particularly of the field terminal. When fitting the driving end frame care should be taken to ensure that the dowel pin on the end frame locates correctly with the appropriate slot in the yoke.

Brush gear

22. Brush types and spring pressures are given in para. 2. The recommended method of testing spring pressure is by means of a 2 lb. spring balance or similar type. It will be found helpful if a small hook of stiff wire is made to attach to the spring balance and hook into the eye on the end of the spring. The spring pressure is that recorded on the balance when the spring is held steadily, by a radial pull, just clear of the top surface of the brush. It is intended that the high altitude brush (Stores Ref. 5U/2384), as opposed to the general brush (Stores Ref. 5U/1172), shall become the standard on this type of generator. Thus, brushes which need renewal should be replaced by the high altitude type. Generators fitted with high altitude brushes should be identified by painting "HA brushes" on the yoke in 1 in. high white letters. Instructions on the servicing of brush gear and brushes are given in para. 14 of Chapter 1 of this Section.

23. The method of adjusting the brush rocker is given in para. 5 of this chapter. If it is considered necessary to check the brush position, reference should be made to para. 18, Chapter 1 of this Section. When making this check, the positive terminal of the accumulator should be connected to the terminal marked G + on the generator, and the negative terminal of the accumulator should be connected, through the tapping key, to the terminal marked S.

Commutator, armature, and field coils

24. Information on the servicing of these items is contained in Chapter 1 of this Section.

TESTS

25. Instructions for testing, applicable to generator, type K, are given in para. 27 of Chapter 1 of this Section. The appropriate test circuit diagram is given in fig. 4 of this chapter; this should be used in conjunction with the information given for this generator in para. 2. The generator testing set described in Chapter 1, Section 4 of A.P.1095H, or any similar testing set, may be used.

26. It is essential that the regulator used in any test circuit should be correctly set in accordance with the instructions given in Section 6 of the publication. With regulator, type C, which is now more generally used, the link should connect the terminals B and C (position for non-parallel running as a single unit), when the generator voltage for all loads up to full load should be approximately 29. With regulator, type B, however, in which there is no link, the generator voltage should be approximately 29 on no load and 26 on full load. There are two G — terminals on both these types of regulator. With either regulator the negative terminal of the generator should be connected to the terminal marked G —1,000 W. For the purpose of the test described in sub-para. (vi), para. 27 of Chapter 1, the generator should be run on full load for 20 minutes.

27. The generator should not be run continuously at any output greater than 29 volts 10 amperes without cooling air, or serious damage due to overheating will occur. The tests specified above, with careful examination during servicing, are sufficient to ensure that a generator is fit for service.

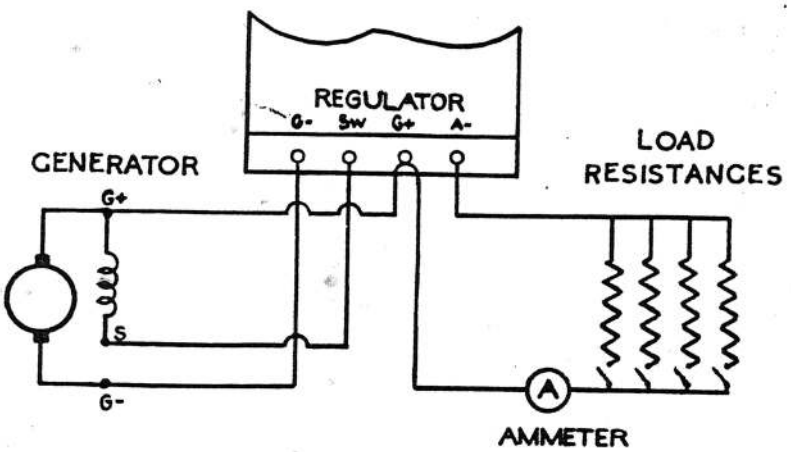

Fig. 4.—Test circuit diagram, generators, K and KX

DESCRIPTION

Generator, type KX

28. This generator is similar in nearly all respects to generator, type K. The most important difference is that it is directly cooled (*see* para. 29), and therefore gives a greater output. It is a self-excited, four-pole, shunt wound machine. The terminal markings are as follows:—

Positive, G +; field, S; negative, G —

One end of the field winding is connected internally to the positive terminal and the other end to the terminal marked S.

29. Generator, type KX, has been fitted with two types of terminal box. Earlier models have box, Stores Ref. 5U/1171 (as fitted to generator, type K), which is suitable for Trigenmet No. 2 cable only. Later models have box, Stores Ref. 5U/373 (illustrated in fig. 7), which has a larger cable entry hole, and is suitable for either Trigenmet No. 2 or No. 3 cables. The different combinations of terminal box and cable end fittings used are given in Table 1.

TABLE 1

Cable fittings required	*Box, Stores Ref. 5U/1171, with Trigenmet 2 cable*	*Box, Stores Ref. 5U/373, with Trigenmet 2 cable*	*Box, Stores Ref. 5U/373, with Trigenmet 3 cable*
Positive terminal lug	A.G.S.1737—1 Stores Ref. 5C/2326	A.G.S.1737—1 Stores Ref. 5C/2326	A.G.S.1738–2 Stores Ref. 5U/2329
Negative terminal lug	A.G.S.1737—1 Stores Ref. 5C/2326	A.G.S.1737—1 Stores Ref. 5C/2326	A.G.S.1738–1 Stores Ref. 5C/2447
Field terminal lug	A.G.S.1737—2 Stores Ref. 5C/2446	A.G.S.1737—2 Stores Ref. 5C/2446	A.G.S.1737-2 Stores Ref. 5C/2446
Cable sleeve, inner	A.G.S.1660—E Stores Ref. 5K/67	A.G.S.1723 Stores Ref. 5K/192	A.G.S.1722–A Stores Ref. 5K/195
Cable sleeve, outer	A.G.S.1660—F Stores Ref. 5K/71	A.G.S.1724 Stores Ref. 5K/193	A.G.S.1722–B Stores Ref. 5K/196

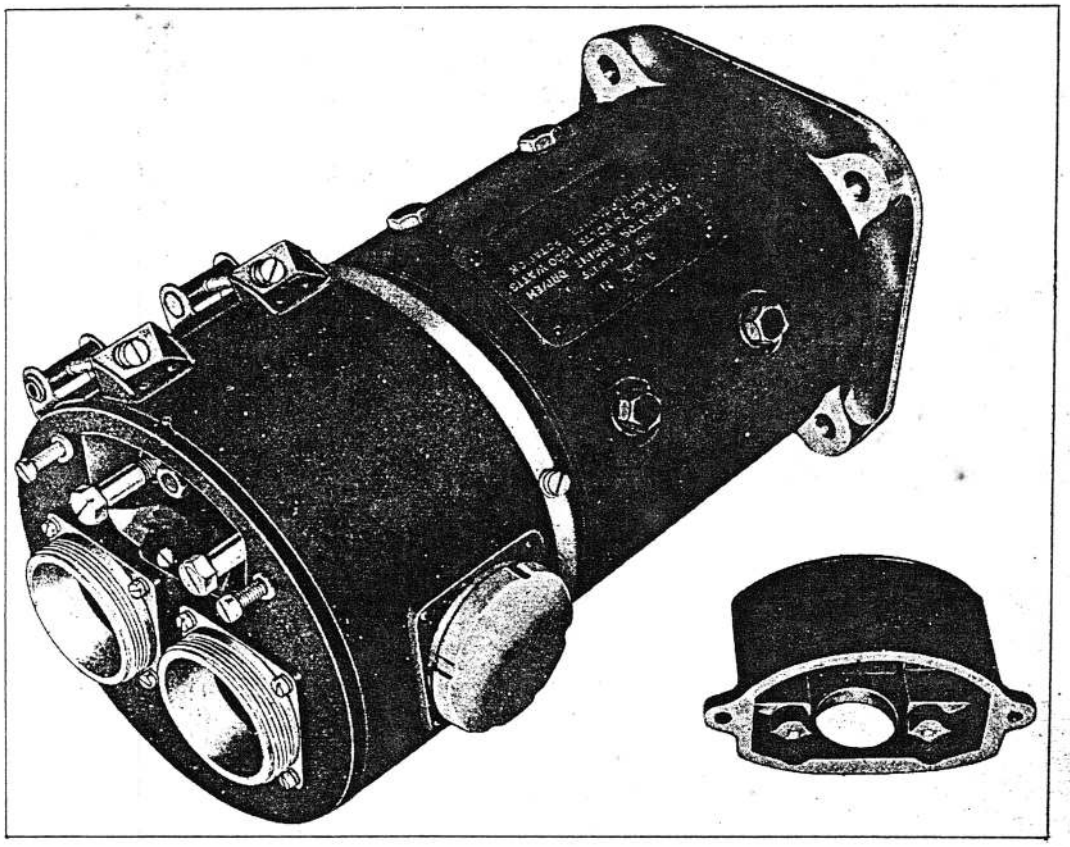

Fig. 5.—Engine-driven generator, type KX

Bearings

30. Refer to para. 4.

Brush gear

31. Refer to para. 5.

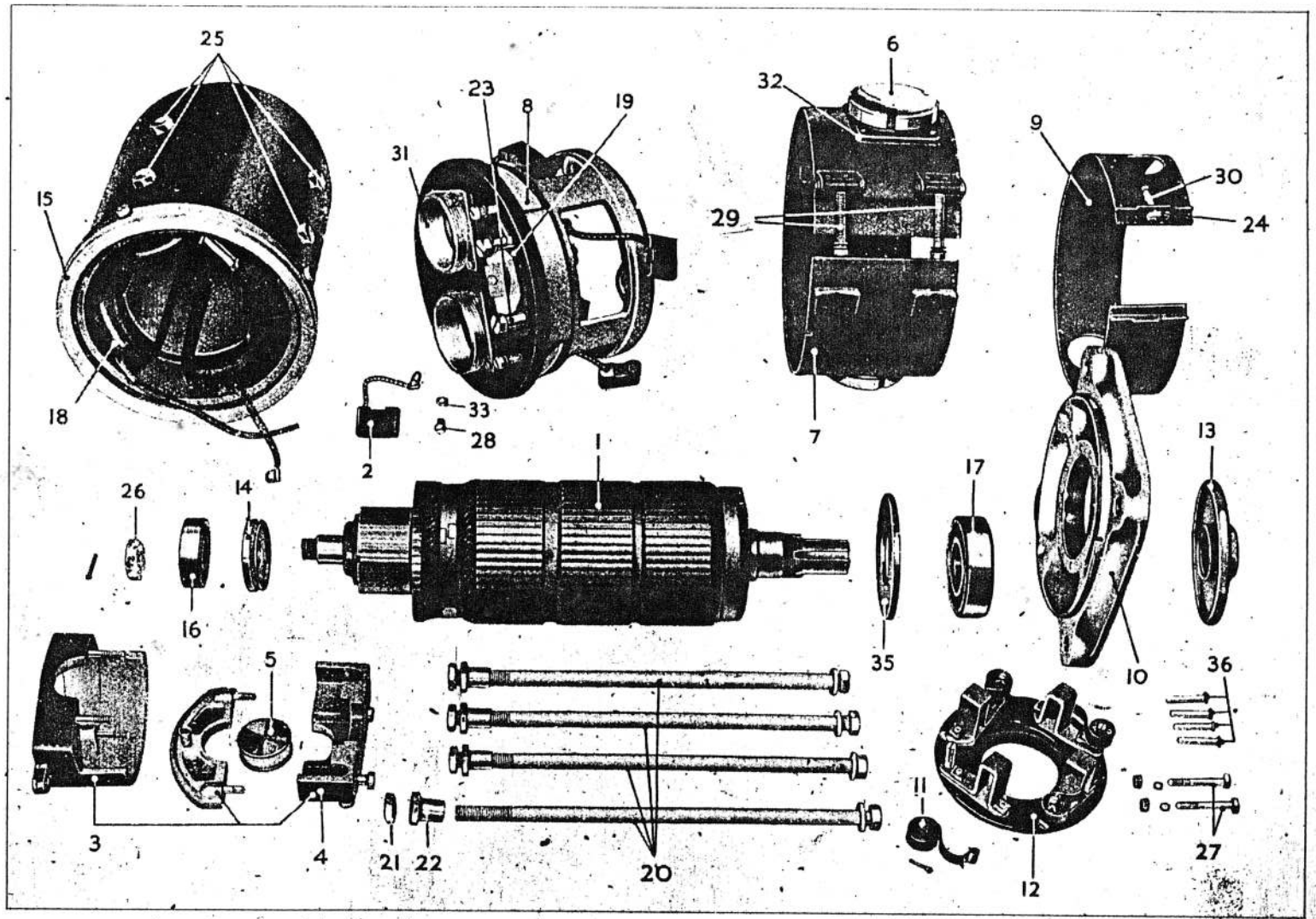

Fig. 6.—Dismantled view, generator, type KX

Key to fig. 6

1. Armature
2. Brushes
3. Terminal box
4. Terminal box lid
5. Terminal box plug
6. Air pipe union cap
7. Commutator end outer cover band
8. Commutator end frame
9. Commutator end inner cover band
10. Driving end frame
11. Brush spring
12. Brush rocker assembly
13. Driving end oil thrower and bearing nut
14. Commutator end oil thrower
15. Spigot ring
16. Commutator end ball bearing
17. Driving end ball bearing
18. Field coil
19. Insulating plate
20. Through bolts
21. Lock nut
22. Nut
23. Terminal fixing nut
24. Inner cover band nut
25. Pole piece fixing screws
26. Bearing clamp nut
27. Brush rocker fixing screws
28. Brush gear connection screw
29. Commutator end outer cover band screws
30. Commutator end inner cover band screws
31. Commutator end frame air pipe union
32. Commutator end outer cover band screws
33. Lock washer
35. Inner bearing plate
36. Inner bearing plate screws

Cooling

32. The generator is intended to be cooled by air from the slipstream. It is directly cooled, that is the air jacket as used in type K is dispensed with and air is blown directly into the machine over the commutator. The brush gear is enclosed by the inner cover band, which is clamped over the brush gear apertures in the commutator end frame and has two diametrically opposed holes or slots cut in it. The outer cover band is carried on the end frame and on a spigot support ring secured to the yoke. Both cover bands are located by dowel pins, and it is important to see that these are in place and engaging with their corresponding slots, thus ensuring that the air-pipe unions on the outer cover band are correctly placed in relation to the holes in the inner cover band.

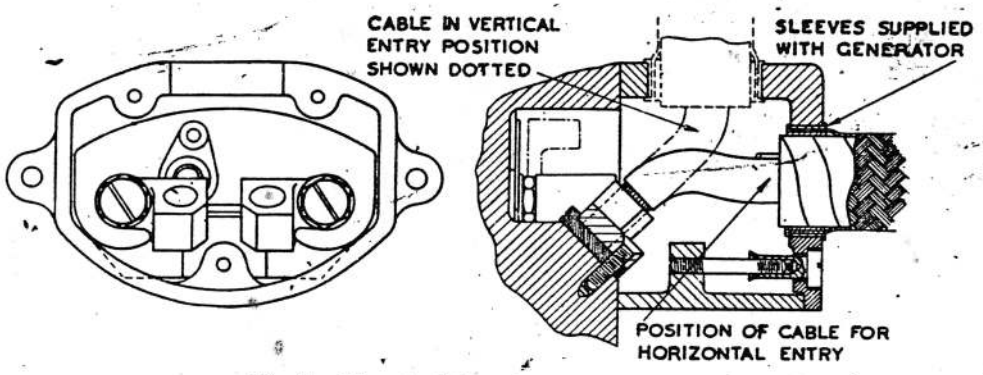

Fig. 7.—Terminal box, generator, type KX

33. Four air-pipe unions are fitted, but only two are used at any one time. The two not used should be blanked off with the blanking caps provided. The arrangement of air-pipes for each installation is decided during manufacture of the aircraft, and should not be altered without authority.

INSTALLATION AND OPERATION

34. The information contained in para. 8–15 of the chapter applies also to generator, type KX.

SERVICING

35. All the information contained in para. 16–24 of this Chapter under this heading for generator, type K, applies also to generator, type KX. Note instructions on modification to through bolts in para. 21. A part section view of the KX generator is shown in fig. 8.

TESTS

36. Instructions for testing, applicable to generator, type KX, are given in para. 27 of Chap. 1 of this section. The appropriate test circuit diagram is given in fig. 4 of this chapter, and this should

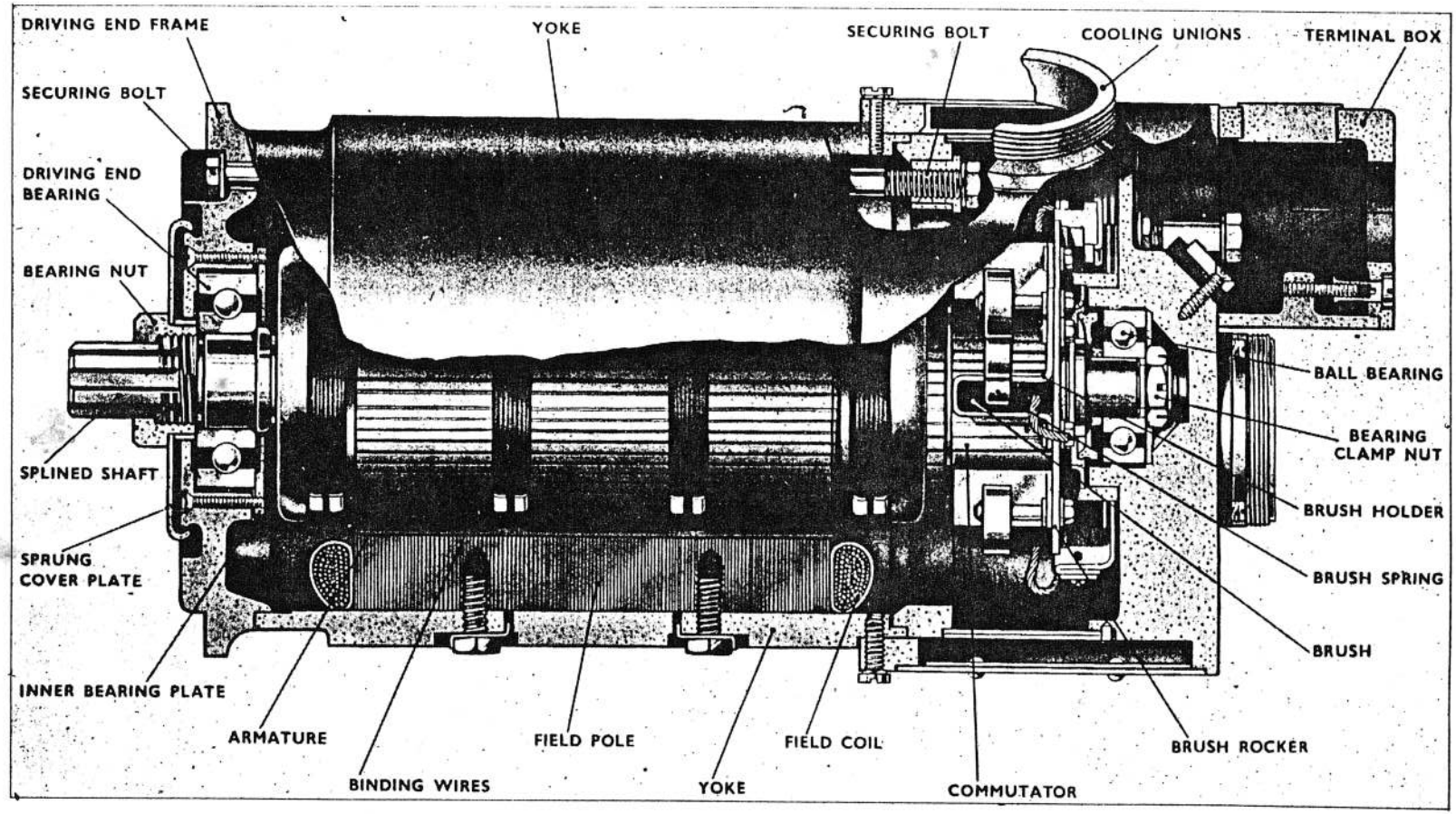

Fig. 8.—Part section view, generator, type KX

be used in conjunction with the information given for this generator in para. 2. The generator testing set described in Chapter 1, Section 4, of A.P.1095H, or any similar testing set, may be used. With some driving motors supplied with this test set, however, it may not be possible to obtain the full output of 29 volts 60 amperes from the generator, in which case, if a larger test set is not available, the generator may be tested at an output of 29 volts 50 amperes.

37. It is essential that the regulator used in any test circuit should be correctly set in accordance with the instructions given in Section 6 of this publication. The link should connect the terminals B and C (position for non-parallel running as a single unit), when the generator voltage for all loads up to full load should be approximately 29.

Note.—For the purpose of the test described in sub-para. (vi), para. 27 of Chapter 1, the generator should be run on full load for **10** minutes.

38. The generator should not be run continuously at any output greater than 29 volts 10 amperes without cooling air, or serious damage due to overheating will occur.

39. The tests specified above, together with careful examination during servicing are sufficient to ensure that a generator is fit for service.

DESCRIPTION

Generators, types KZ1 and KZ2

40. These two generators are generally similar in construction to generator, type KX. Electrically, however, they differ considerably from the other two generators described in the chapter, as the armature is wound for an output of 100 volts, while the field is intended to be separately excited at 24–29 volts from the aircraft general services supply. The armature and field windings are therefore insulated from each other, and are brought out to two pairs of terminals which are marked as follows:—

Armature:— Positive, G + : Negative, G —
Field:— Positive, S + : Negative, S —

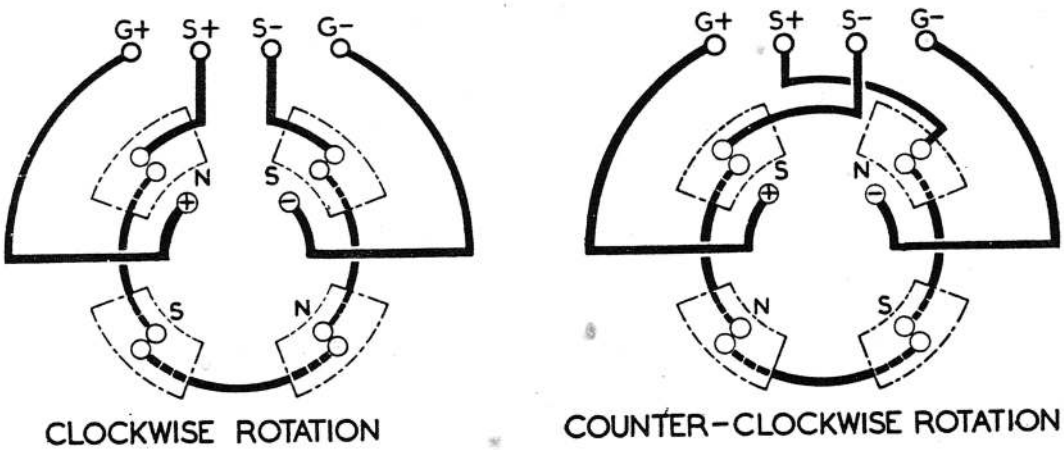

Fig. 9.—Diagram of field connections, KZ1 and KZ2 generators looking at commutator end

41. Generator, type KZ1, is intended to be wind driven. An extended shaft is provided at the driving end, to carry a metal windmill (Stores Ref. 5T/488) and spinner. In consequence of this method of drive, special cooling arrangements are adopted (*see* para. 45).

42. Generator, type KZ2, is intended to be driven through gearing from the aircraft engine, and the shaft at the driving end is identical with that of type KX.

Both generators are of four-pole construction, having the same field winding as type KX, and have the same electrical characteristics. They are available for clockwise direction of rotation only.

Bearings

43. Refer to para. 4.

Brush gear

44. The brush rocker in both generators is similar in construction to that in generator, type KX (*see* para. 5), but carries only two brush boxes, set at 90 deg. The flexible connections from the brushes are taken direct to the positive and negative main terminals, connecting rings being dispensed with. The method of adjustment of the brush rocker given in para. 5 applies also to these generators.

Cooling

45. Both generators are intended to be cooled by air from the slipstream. Generator, type KZ1, is intended to be housed in a streamlined nacelle mounted externally on the aircraft. Referring to para. 32 (KX generator) the outer cover band is omitted, and the inner cover band has no holes in it. Air from the slipstream flows into the nacelle through suitable piping, is directed over the outer surfaces of the generator, and exhausted through an aperture in the rear of the nacelle. For details of the cooling of generator, Type KZ2, *see* para. 32 and 33.

46. The arrangement of air pipes for each installation is decided during manufacture of the aircraft, and should not be altered without authority.

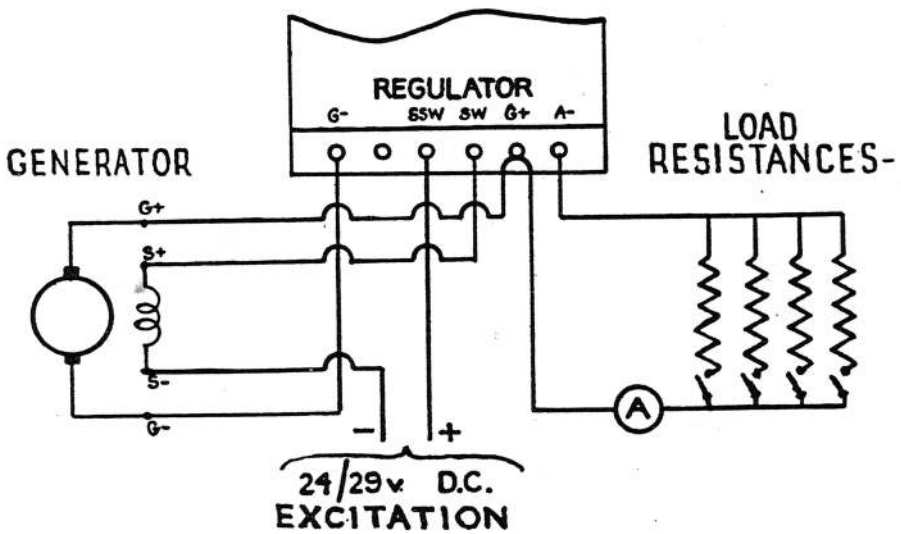

Fig. 10.—Test circuit diagram, generators, types KZ1 and KZ2

INSTALLATION AND OPERATION

47. These generators are primarily intended for a special application, and reference should be made to the Air Publication for the Aircraft on which they are being installed. Reference should also be made to the relevant portions of para. 8–14. These two types of generators are not intended for parallel operation.

SERVICING

48. Refer to para. 16–24. Note, however, that when dismantling generator, type KZ1, the windmill must first be removed. This can be done by engaging a bearing extractor with the plate on the front of the windmill, which is exposed when the spinner is removed. Note also that when checking the brush position (*see* para. 23) the positive terminal of the accumulator should be con-