Chapter 11

PUMP, FUEL, PLESSEY, MB.022 SERIES

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Performance rating of pump	100 *g.p.h. at* 100 *lb. per sq. in. max. at* 24 *volt d.c. using kerosene to Spec. D.Eng.R.D.*2482
Motor	24 *volt d.c., flame proof, self contained and bolted to pump unit* *Intermittent rating* 1 *min. at* 29 *volt d.c. full load*
Current consumption	19 *amp. at* 24 *volt d.c. normal load* 25 *amp. at* 29 *volt d.c. full load*
Power output	$13\frac{1}{3}$ *oz. in. torque at* 13,000 *r.p.m. and* 11 *amp. max.*
Weight of complete unit	4 *to* $4\frac{1}{2}$ *lb. depending on the Mark.*
Inlet conditions (*recommended*)	*Small positive head, to* 21 *lb. per in.*^{2} *positive pressure.*
Suction head (*maximum*)	4 *in Hg: for self priming.* 12 *in Hg: after priming.*
Lubrication	*By the circulating fluid only*

Introduction

1. The Plessey Type MB022 is an electrically-driven booster pump, designed for engine priming and starting gas turbine engines. The pump supplies fuel to the engine until sufficient speed has been attained for the main engine driven pumps to take over, at which point it is switched off.

DESCRIPTION

2. The pump itself is of the single-stage gear, positive displacement type and is coupled to an electric motor by means of a drive shaft which also carries a gland seal assembly. Integral with the pump is a relief valve, which is adjustable in operation over a small range for setting maximum delivery pressure.

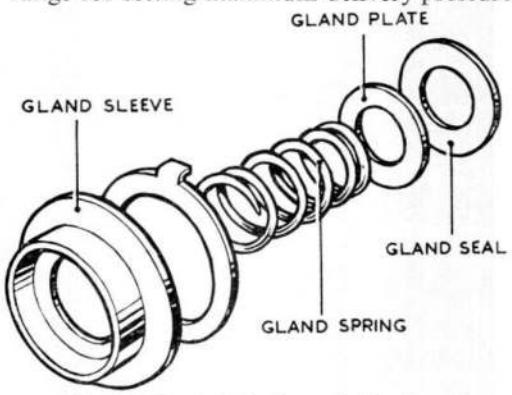

Fig. 2. Exploded view of gland seal (Marks 1 to 9, 32 and 33)

3. There are two series of Mark number viz:—
Marks, 1, 2, 3, 4, 5, 6, 7 and 9 and Marks, 23, 26, 27, 29, 30, 32, 33, 34 and 35.

4. The important difference between these two series is in the gland seal assembly. In the series Mark 1 to 9 a single face type seal is used. For Mark 23 to 35—with the exception of Marks 32 and 33—an improved duplex arrangement has been adopted.

5. There is a minor dimensional difference in the pump body used in the two series, otherwise the basic design of the pump unit is common to all marks (i.e. Mark 1 to 35). Performance details are identical throughout the range.

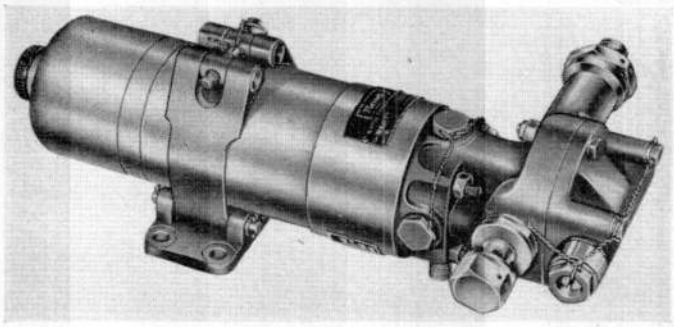

Fig. 1. General view of pump

6. With the exception that an improved electric motor was introduced for the majority of models after Mark 4, the remaining differences between the various marks are solely concerned with the external fittings, such as the inlet and outlet arrangements, mounting bracket, etc., as required for installations in different types of aircraft. The details of all these differences will be contained in the relevant chapter for the individual pump (*A.P.*4343*D*, *Vol.*1, *Book* 2).

PUMP UNIT

7. The pump unit comprises the body which houses the drive, gland seal, and gear assemblies, and the cover containing the relief valve. The aluminium body has two machined bores, in each of which, is fitted a bronze sleeve; these sleeves form journal

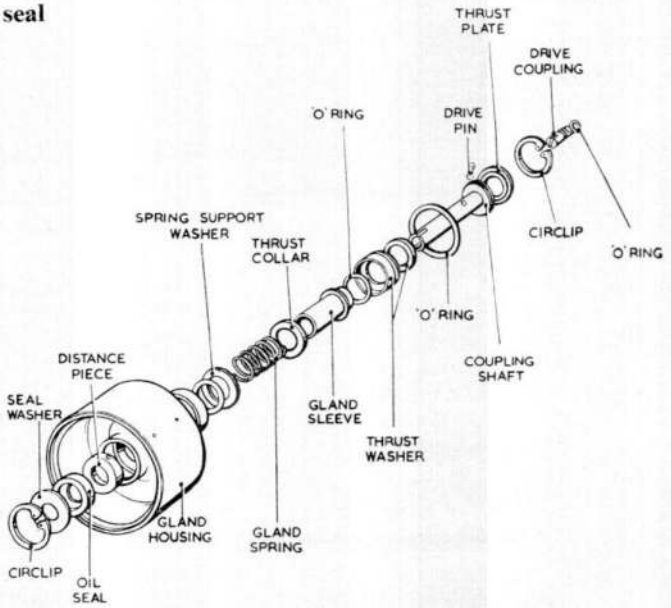

Fig. 3. Exploded view of Duplex Type gland seal (Marks 23, 26, 27, 29, 30, 34 and 35)

bearings for the steel shafts carrying the pump gear wheels. The gear wheel end of each shaft is prevented from axial movement by abutment against a steel ball bearing. One gear shaft is driven by the motor through a coupling in the drive shaft and gland seal assembly, and the two gears mesh together in a machined pocket of special form, cut in the body.

Lubrication

8. Lubrication is provided by the passage of fuel through the pump and no other lubrication is required.

Gland seal (Marks 1, 2, 3, 4, 5, 6, 7, 9, 32 and 33)

9. The seal is made between a rotating steel thrust plate and a stationary carbon washer, the mating faces of which are lapped perfectly flat and smooth. The rotating member is positively driven by projections from the gland sleeve, which in turn is attached to, and revolves with, the drive shaft of the pump. This gland sleeve also houses the gland spring, thrust plate and a synthetic washer, the periphery of which seals the bore of the gland sleeve. This washer also serves to prevent leakage past the back of the thrust washer. The gland itself is vented to the suction side of the pump and, therefore is equally effective when there is pressure at the pump inlet. The stationary carbon washer in its housing is sealed to the pump body by means of a synthetic " O " ring and retained in position by a lock plate and steel snap ring. A drain port connection is provided at one of four alternative positions, 90° apart.

Gland seal (Marks 23, 26, 27, 29, 30, 34 and 35)

10. The seal is made between a stationary carbon ring, held in a suitable housing, and the face of a flange formed on the rotating drive shaft, the mating faces being lapped flat and smooth. Contact is maintained between the seal faces by pressure from a spring which is located on a sleeve within the main gland housing. The spring thrust is taken by the other face of the drive shaft flange abutting a P.T.F.E.—impregnated bearing surface located in the front end of the main gland housing.

11. Leakage from the gland is prevented from entering the motor by a lip-type shaft seal, fitted at the motor end of the gland assembly and is ducted to the drain union.

Relief valve

12. This is mounted in the end cover of the pump unit and may be adjusted through a small range of pressures by means of an adjusting screw and adjusting key, the head of which is slotted to accept a screwdriver. After setting to the required pressure, the adjusting key is locked by means of the lock nut.

13. The delivery pressure may be adjusted to a maximum pressure of 130 lb. per sq. in. This applies to all marks. Complete units as despatched from the factory, normally have the relief valve set to operate between 125 and 130 lb. per sq, in., so as to give a delivery pressure of 100 lb. per sq. in., when delivery is not less than 100 gallons per hour of kerosene. Where positive inlet pressure is employed, such pressure will be additive to the pressure difference developed by the pump, i.e., the relief valve is a plain pressure relief valve and is not in any way balanced with respect to inlet pressure.

Non-return valve—Type NR.022

14. The Plessey NR.022 is a non-return valve designed primarily for use with the MB.022 series of electrically driven manifold booster pumps, which requires a flow capacity of 100 g.p.h. at 100 lb. per in^2.

15. There are several categories and marks of this non-return valve, but, except for the outlet union, each is of the same basic design, as indicated below, consisting of:—

(*a*) Aluminium body, internally threaded in $\frac{3}{8}$ in. B.S.P. at the inlet, and $\frac{1}{2}$ in. B.S.P. at the outlet end. An arrow, which indicates the direction of flow is impressed on the side.

(*b*) Stainless steel inlet unit, with $\frac{3}{8}$ in. B.S.P. external threads at each end. This union must be screwed into the valve body, so that the externally chamfered end forms a seating for the valve plate, and at the other end, a connection for mounting on the pump.

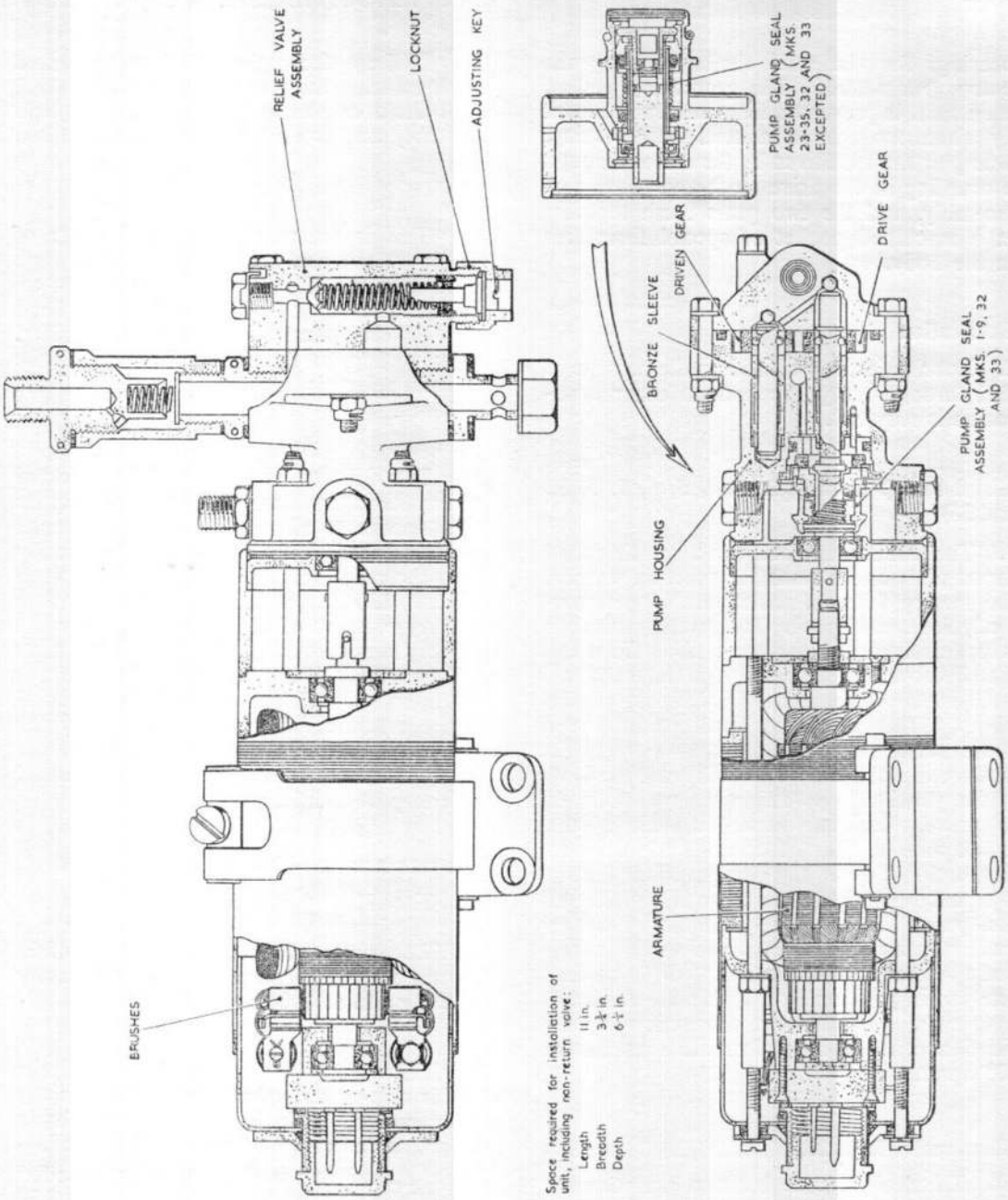

Fig. 4. Sectional view of pump showing alternative gland seals

(*c*) Brass valve plate, which is held against the seat of the inlet union by the pressure of a light spring.

(*d*) Steel coil spring, which is cadmium plated, fitted between the valve plate and the outlet union.

(*e*) Aluminium gaskets, fitted between the body and the unions at either end, to form fuel tight joints.

16. These valves fall into two categories as follows:—

Category A—This comprises units which

form part of a pump assembly; they are divided into two groups, the valves in each group differing basically in the size of the delivery port, and the type of thread, i.e. B.S.P. or U.N.F.

Group 1 Valves with restrictor Part No. C.A.1072 and C.A.1078

Group 2 Valves without restrictors (see Category B below)

Mk.1	CV.9199
Mk.2	CV.9759
Mk.3	CV.2642

Category B—This comprises units which are supplied as separate items using as sub-assemblies, valves of category A, Group 2 which, because they may be used in this manner, have been allocated Mark Nos. (as yet there has been no requirement for the supply of the Mk.3 as a separate unit), this would necessitate the creation of a special assembly indicating lock-wiring and detailing the items required.

Mark No.	Part No.	Using Part No.
Mk.1	CV.10574	CV.9199
Mk.2	CV.10575	CV.9759
Mk.3	—	CA.2642

17. These NR.022 non-return valves which are supplied as separate items, i.e. not necessarily as part of the pump assembly (a special requirement may be that the non-return valve is fitted in the fuel line from the pump delivery outlet, and not as an integral part of the pump) are given mark numbers which vary, according to the delivery orifice.

Note . . .

*The categories and marks of the NR.*022 *non-return valve vary according to installation requirements, but only by variation of the outlet unions. These are supplied with, or, without restrictors, and with different sizes and types of thread at the delivery end.*

*NR.*022 (*Servicing*)

18. The only inspection required, other than at overhaul, will be on gaskets and installation joints, for signs of leakage of fuel.

19. No special equipment is needed for normal testing and servicing of this valve.

20. The period between overhauls should be the same as for the type MB.022 fuel pump.

21. The valve plate and valve seating should be inspected, and, if necessary lapped, or replaced. If there is any doubt about the condition of the valve spring, it should be renewed.

*NR.*022 (*Testing*)

22. The following tests after overhaul are required, using Kerosene D.Eng.R.D.2482.

Test No. 1. (*a*) Apply a fluid pressure of 1500 lb per in^2 for two minutes to the outlet union of the valve with the inlet port open; leakage past the valve must not exceed 10 c.c. during this test, which should be recorded.

Test No. 2. (*b*) Test No. 1 must be immediately followed by applying a pressure of 50 lb per in^2 for two minutes with the inlet port open. Leakage must not exceed 10 c.c.s during this test.

*NR.*022 *valves Mk.*1 *and Mk.*2 (*Schedule of parts*)

23. These non-return valves are supplied as separate items for fuel line fitting, and comprise the following:—

Part No.	Description	Quantity Mk.1	Quantity Mk.2
CV.10574	Complete assembly Mk.1 valve consisting of:—	1	
	N.R.V. assembly CV.9199	1	
	Label V.9191	1	
CV.10575	Complete assembly		1
	N.R.V. assembly CV.9759		1
	Label V.9191		1
CV.9199	Non-return valve assembly comprising the items listed below and including Union Special $\frac{1}{2}$ in. x $\frac{3}{8}$ in. B.S.P. V.8025	1	
CV.9759	Non-return valve assemply (the same items as for CV.9199), but including Union spanner $\frac{1}{2}$ in. x $\frac{1}{4}$ in. B.S.P. V.9069		1
V.7835	Gasket $\frac{1}{2}$ in. B.S.P.	1	1
V.8026	Valve plate	1	1
V.8023	Body	1	1

Motor

24. The 24 volt d.c. driving motor is of the flame-proof, totally-enclosed type, and has a long shunt compound winding. It is designed to give its rated output on 28 volt supply at 13,000 r.p.m. It will, however, operate the pump satisfactorily at any voltage between 18 and 29 volts with a maximum current consumption of 25 amperes.

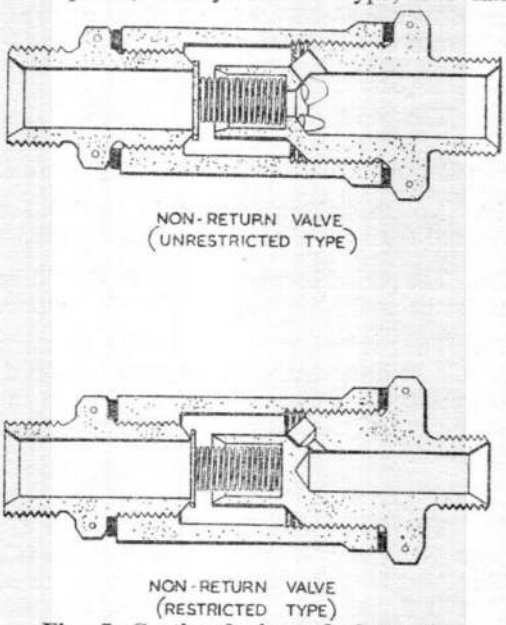

Fig. 5. Sectional view of alternative non-return valves

25. The machine is constructed with die-cast end plates, the central portion comprising the laminated field magnet assembly and field coil windings. The end plates house the ball bearings which are packed with high melting point, anti-freeze grease during assembly.

26. To simplify replacement, the brushgear is designed as a separate complete unit and is retained by two screws holding the bakelite insulator to special lugs on the end plate.

27. To secure accurate alignment of the drive, a spigot is turned on the motor end plate, on to which fits the pump distance sleeve and the pump unit, the complete assembly being finally secured by means of special studs, washers and nuts. Two types of motor are used, CZ26817 and CZ74585; the type of motor appropriate to any particular mark of pump may be identified by reference to the individual chapter in A.P.4343D, Vol. 1, Book 2.

Parts applicable to both motors

1	PLUG, DUST
2	PLATE, CLAMP
3	WASHER, SEALING
5	SLEEVE, RUBBER
6	SCREW CSK. HD., 4B.A. X $\frac{5}{8}$ in.
10	WASHER, SHAKEPROOF, INT. 2B.A.
11	ARMATURE
12	BALL, BEARING, DRIVE END (HOFFMAN 108)
13	NUT, BEARING, DRIVE END
14	SCREW, CSK. HD., 4B.A. X $\frac{1}{4}$ IN.
15	WASHER, BEARING, DRIVE END
16	STUDS, THROUGH
17	STUDS, THROUGH
18	PLATE, DRIVE END
19	PIN, DRIVE
26	PLATE, MOUNTING, MOTOR
27	SCREW, CSK. HD., 4B.A. X $\frac{5}{16}$ IN.
28	WASHER, SHAKEPROOF, EXT. 4B.A.
29	WASHER, BEARING, COMM. END
30	BEARING, BALL, COMM. END (HOFFMAN 106)
32	GASKET
35	RING, SEALING, RUBBER
37	WASHER, 4B.A.

Parts applicable to motor CZ 26817 only

4	COVER, BRUSHGEAR
7	SCREW, CH. HD., 4B.A. X $\frac{5}{16}$ IN.
8	WASHER, SHAKEPROOF, INT. 4B.A.
9	SCREW
20	SPRING, BRUSH
21	BRUSHGEAR ASSEMBLY
22	BRUSHES, CARBON
23	YOKE AND FIELD COIL ASSEMBLY
25	END-FRAME, COMMUTATOR
31	MOULDING, PLUG
33	SCREW, CSK. HD., 6B.A. X $\frac{3}{8}$ IN.
34	WASHER, SHAKEPROOF, SPECIAL
36	PLUG (SHELL)
38	SCREW, COVER, CH. HD., 4B.A. X $\frac{7}{8}$ IN.

Parts applicable to motor CZ 74585 only

24	YOKE AND FIELD COIL ASSEMBLY
39	COVER, BRUSHGEAR
40	SCREW
41	PLATE, LOCKING, BRUSHGEAR
42	PLATE, CLAMP, BRUSHGEAR
43	END-FRAME, COMMUTATOR
44	BRUSHGEAR ASSEMBLY
45	SPRING, BRUSH
46	BRUSH AND TAG ASSEMBLY
47	WASHER, SPRING, D.C. 6B.A.
48	WASHER, GROVER, 8B.A.
49	SCREW, CH. HD., 8B.A. X $\frac{1}{4}$ IN.
50	NUT, 8B.A.
51	SCREW, CH. HD., 6B.A. X $\frac{1}{4}$ IN.
52	MOULDING, PLUG
53	SCREW, HEX. HD., 6B.A. X $\frac{3}{8}$ IN.
54	PLATE, LOCKING
55	PLUG (SHELL)
56	WASHER, GROVER, 4B.A.
57	SCREW, COVER

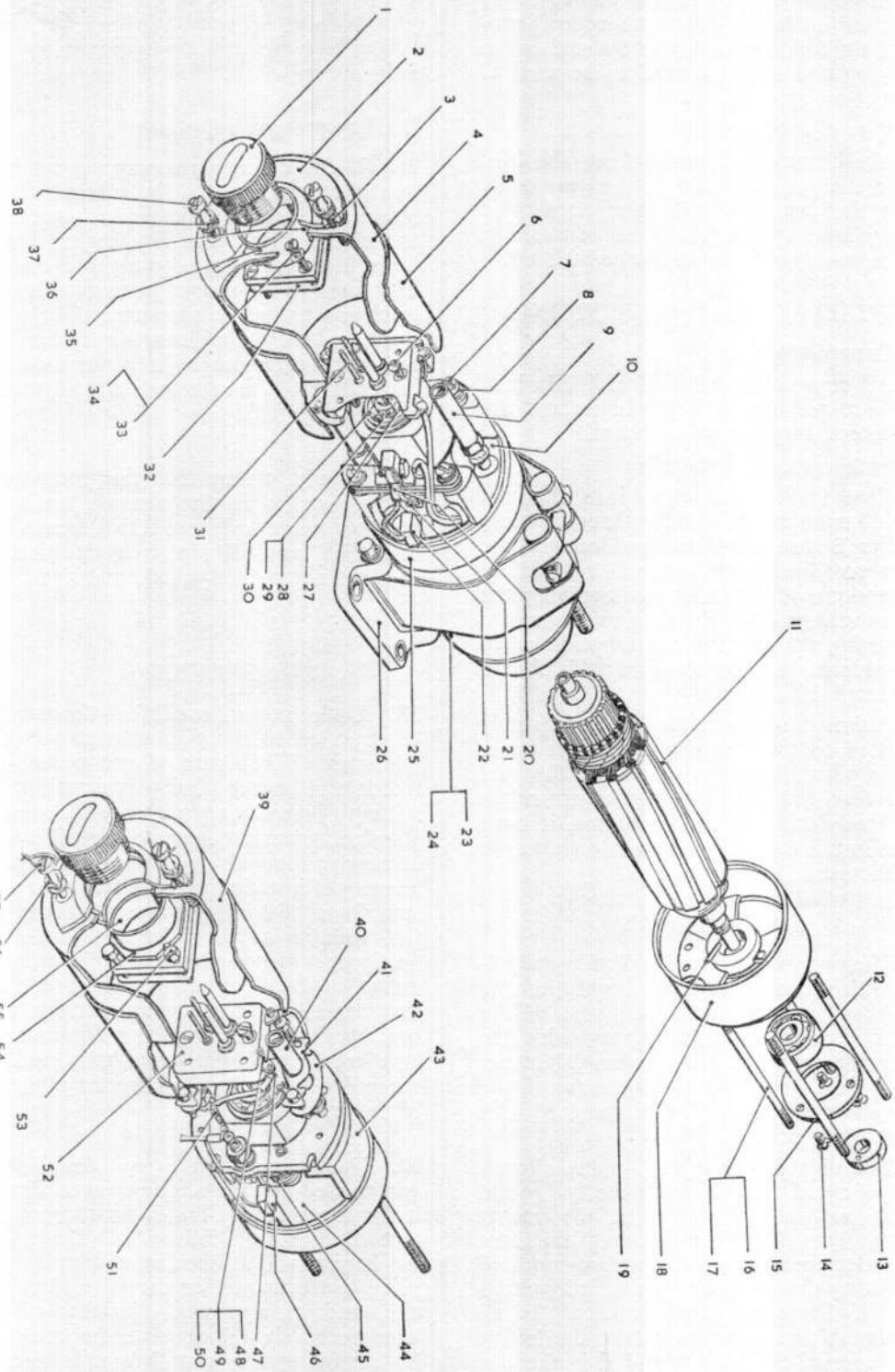

Fig. 6. Exploded view of motors, Type CZ26817 and CZ74585

Electrical connection

28. Electrical supply to the motor is by means of a Breeze plug connection, projecting through the centre of the end cover. Only plug pins 1 and 2 need to be used as live connections (*fig.* 4).

Principles of operation

29. Fluid is carried round from the inlet side in the pockets between the gear teeth. At the delivery outlet side, pockets of fluid are displaced by the gear teeth re-meshing, and, in consequence, pressure is built up.

INSTALLATION AND SERVICING

Interchangeability

30. All component parts of each Mark of Pump are produced to fine limits and are fully interchangeable with spares.

Preparation prior to installation

31. Remove the dust covers from the inlet and outlet unions, the gland drain connection, and the Breeze plug electrical connection. Where possible the unit should be checked for freedom of operation by applying the normal voltage (24 volt, d.c.) to the motor and noting the current consumption when the motor has run up to speed; this should not exceed 14 amperes.

32. Although the pump has been adequately lubricated by the manufacturers, it is beneficial to pour a little engine oil into the inlet port beforehand. If the unit does not rotate quite freely under these conditions, it must not be installed, but returned at once to the manufacturers for examination.

INSTALLATION

33. The pumps must be installed in accordance with the drawings and instructions of the aircraft constructor. The bore of the inlet and outlet pipes may vary with the service the pump has to perform, but can always be determined by the size of the union connections supplied as standard with each mark of pump.

34. The unit may be fitted in the aircraft in any desired attitude from the horizontal to the vertical (always with the motor uppermost). The disposition of the inlet and outlet ports may be altered as required by rotating the pump or moving it longitudinally in the saddle strap bracket. In all attitudes of the pump, see that the lowest drain port of the four provided is the one used, transferring the $\frac{1}{8}$ in. B.S.P. union connection as may be necessary.

35. The drain pipe should fall away continuously from the pump to its point of discharge, to avoid any possibility of a fuel trap and a build-up of liquid in the drive shaft housing.

Delivery pressure adjustment

36. If the delivery pressure, as set by the manufacturers has to be altered for any reason, loosen the adjuster lock-nut on the top of the relief valve housing, and with a screwdriver turn the adjuster in a clockwise direction to increase pressure, or anti-clockwise to reduce pressure. After adjustment, re-lock the adjuster by tightening the lock-nut. Pressure adjustment should not be made while the pump is actually running and passing fuel.

37. Finally, ensure that the pump unit is safely installed in the aircraft, seeing that locking wires are properly secured and unbroken, and all pipe and electrical connections are properly made and tight.

SERVICING

38. Under normal conditions the pump can be expected to function satisfactorily for a minimum of 1000 runs of one minute under full load (the runs being reasonably intermittent) without any necessity for overhaul. Routine inspection, however, should be made at regular intervals to check such items as: security of installation; electrical connection; soundness of locking wires; freedom from fuel leakage at the inlet and outlet connections; evidence of excessive gland leakage; extent of brush wear on the motor commutator. Any necessary attention to rectify possible faults on these items does not mean interference with the pump unit itself, and so will not involve subsequent rig testing of the unit.

39. The pump unit is so designed and constructed that there is no need to dismantle it for examination if it is functioning satisfactorily. Any failure of the internal mechanism will at once be evident by erratic pump performance, or excessive gland leakage, and at any sign of either of these conditions, should at once be dealt with by removing the complete unit from the aircraft and sending it (preferably to the manufacturer) for complete overhaul.

40. Since each pump is fitted with a saddle mounting bracket and strap, both pump and mounting bracket must be kept together, if removed from the aircraft.

Insulation resistance test

41. On installation of the unit in an aircraft for operational service, measure the insulation resistance between the live parts and earth, using a 250 volt insulation resistance tester. The insulation resistance must not be less than 2 megohms.

42. Due to the humidity prevalent in an aircraft at dispersal points, after installation, the minimum permissible insulation resistance is 50,000 ohms.

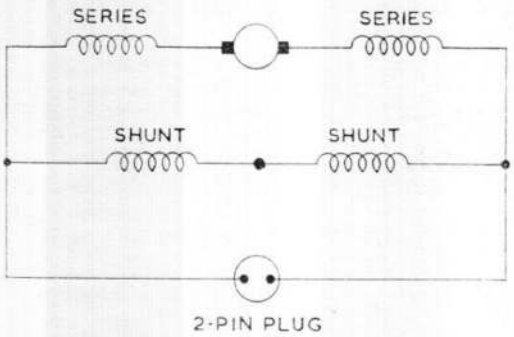

Fig. 7. Circuit diagram

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