CANCELLED DO NOT DESTROY

Chapter 12

PUMP, WATER, FB.1 SERIES

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~~RESTRICTED~~

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APPENDICES

Introduction

1. The FB.1 series pumps dealt with in this chapter are used for the supply of water under pressure in aircraft toilet systems. Reconditioning instructions are given for the Mk. 9 and Mk. 10 pumps, and appendices to the chapter cover differences in procedure for the earlier Mk. 7 and Mk. 8 pumps and any later pumps in the series. The Mk. 9 and Mk. 10 pumps differ from each other in the positioning of the delivery outlet in the pump casing relative to the electrical connection on the motor unit as shown in Fig. 10.

2. The pump assembly comprises an impeller driven by the extended armature shaft of a 24 V. d.c. motor. A mounting flange integral with the pump casing permits attachment of the unit to a water supply tank as either a horizontal or hanging installation. Double shielded ball bearings are normally fitted to the motor and are prepacked with an approved low-freezing point/high melting point grease. Single shielded or non-shielded bearings may be found to be fitted to some pumps. Although instructions are given for the replacement of these bearings with similar units, it is recommended that fully protected bearings are used whenever possible.

Key to Fig. 1

1 DELIVERY ADAPTOR
2 JOINT WASHER
3 MOTOR STUD
4 SUCTION COVER
5 IMPELLER ASSEMBLY
6 BELLOWS GLAND
7 SUCTION COVER GASKET
8 CAP NUT
9 FIBRE WASHER
10 PUMP CASING
11 BREATHER PLUG ASSEMBLY
12 IMPELLER NUT
13 SHAFT NUT
14 SPRING WASHER
15 DRIVE-END FRAME ASSEMBLY
16 SLINGER
17 OUTER BEARING RETAINER
18 DRIVE-END BEARING
19 TERMINAL BOX COVER
20 DRIVE SCREW-COVER FIXING
21 C/SK. HD. SCREW (BEARING RETAINER)
22 INNER BEARING RETAINER
23 CABLE SLEEVE
24 SUPPRESSION BOX
25 FIELD ASSEMBLY
26 TIE-BOLT
27 BRUSH GEAR NUT ASSEMBLY
28 BRUSH BOX ASSEMBLY
29 C/SK. SCREW (BRUSH BOX ASSEMBLY)
30 ELECTRICAL CONNECTION
31 SHAKEPROOF WASHER
32 RD. HD. SCREW
33 COMMUTATOR-END FRAME ASSEMBLY
34 LOCKPLATE
35 FAN
36 END COVER
37 SPRING CLIP
38 DRIVE SCREW
39 BEARING RETAINER
40 COMMUTATOR-END BEARING
41 FAN NUT
42 TAB WASHER
43 FAN SPACER WASHER
44 FAN PEG
45 SPACER
46 SLINGER
47 BRUSH & TAG ASSEMBLY
48 COMMUTATOR BAND SUB-ASSEMBLY
49 ARMATURE ASSEMBLY
50 FIBRE BEARING RETAINER
51 IMPELLER PIN
52 LARGE DRIVE-END BAND SUB-ASSEMBLY

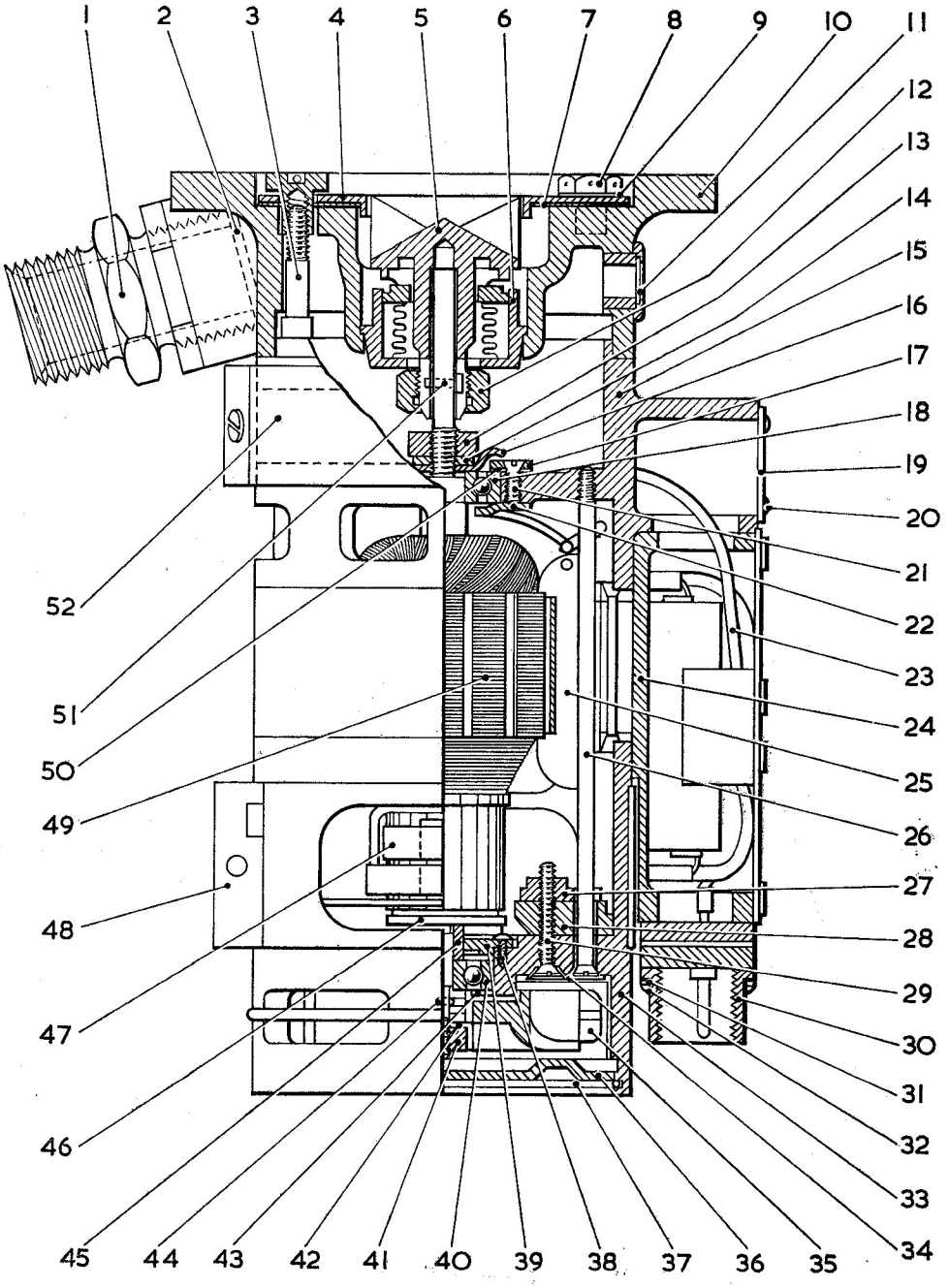

Fig. 1. Pump assembly—key diagram

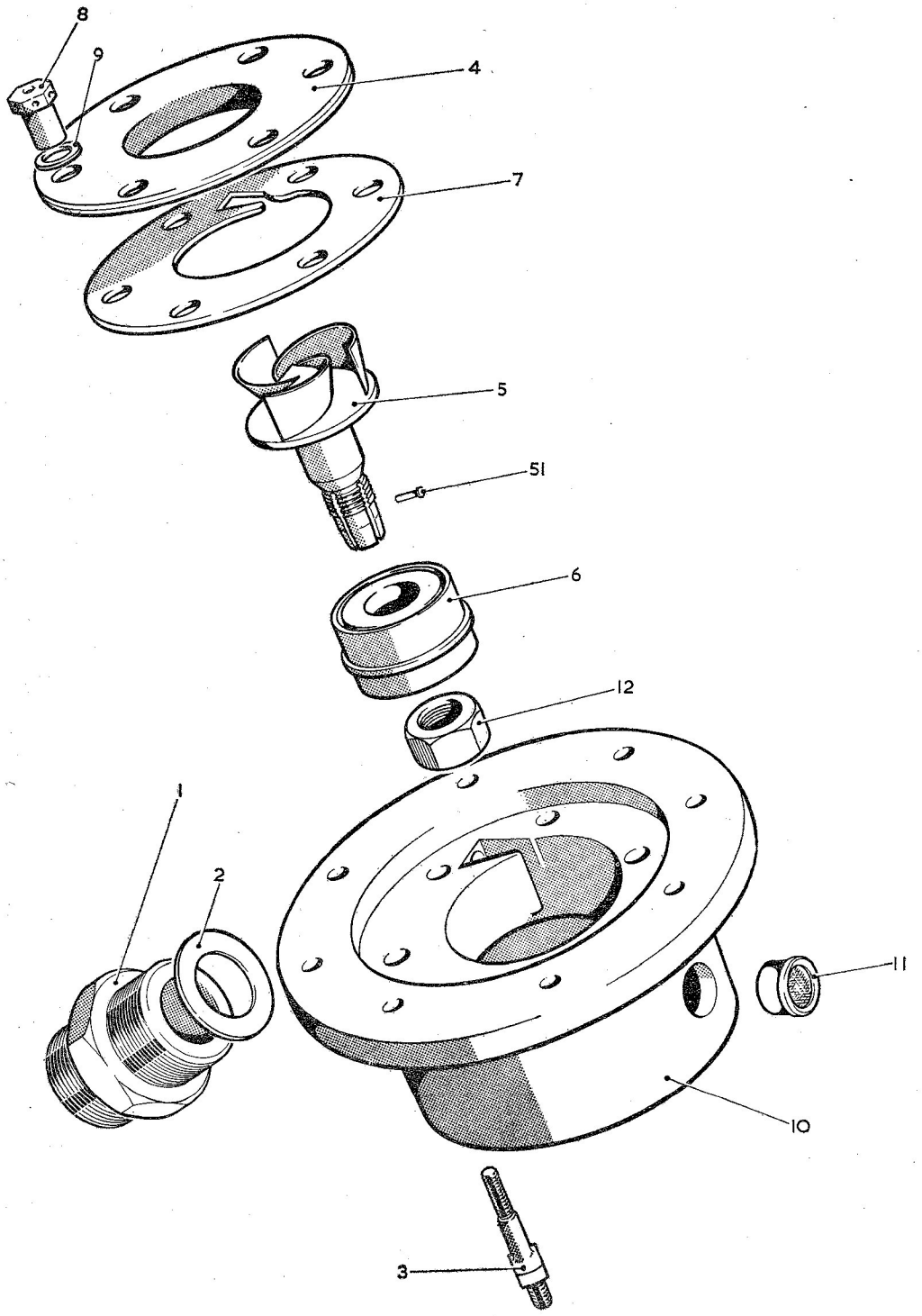

Fig. 2. Exploded view of pump unit components

Key to Fig. 2

1 DELIVERY ADAPTOR
2 JOINT WASHER
3 MOTOR STUD
4 SUCTION COVER
5 IMPELLER ASSEMBLY
6 BELLOWS GLAND
7 SUCTION COVER GASKET
8 CAP NUT
9 FIBRE WASHER
10 PUMP CASING
11 BREATHER PLUG ASSEMBLY
12 IMPELLER NUT
51 IMPELLER PIN

RECONDITIONING

Tools and test equipment

3. In addition to the standard bench tools, the special tools listed in Table 1 are required to overhaul FB.1 pumps. The pumps can be tested on the universal test rig (Ref. No. 5G/3494) details of which are given in A.P.4343S, Vol. 1, Book 2, Sect. 10, Chap. 1. Water must be used for all tests.

TABLE 1

Special tools and equipment

Nomenclature		Part number	Fig.
Hand press		SPE.10143	
Impeller nut spanner		96121	4
Pressing sleeve	Bellows gland removal	SPE.19508	5
Guide bush	Bellows gland removal	SPE.19509	5
Base plate	Bellows gland removal	SPE.19510	5
Motor shaft nut spanner		96066	6
Calibrated fan		SPE.19513	7
Calibrated fan		SPE.19514	7
Pressing sleeve	Bellows gland assembly	SPE.19511	9
Base assembly	Bellows gland assembly	SPE.19512	9
Impeller setting gauge		92916	11
Sleeve for checking impeller concentricity		91648	11
Suction cover positioning gauge		91649	11

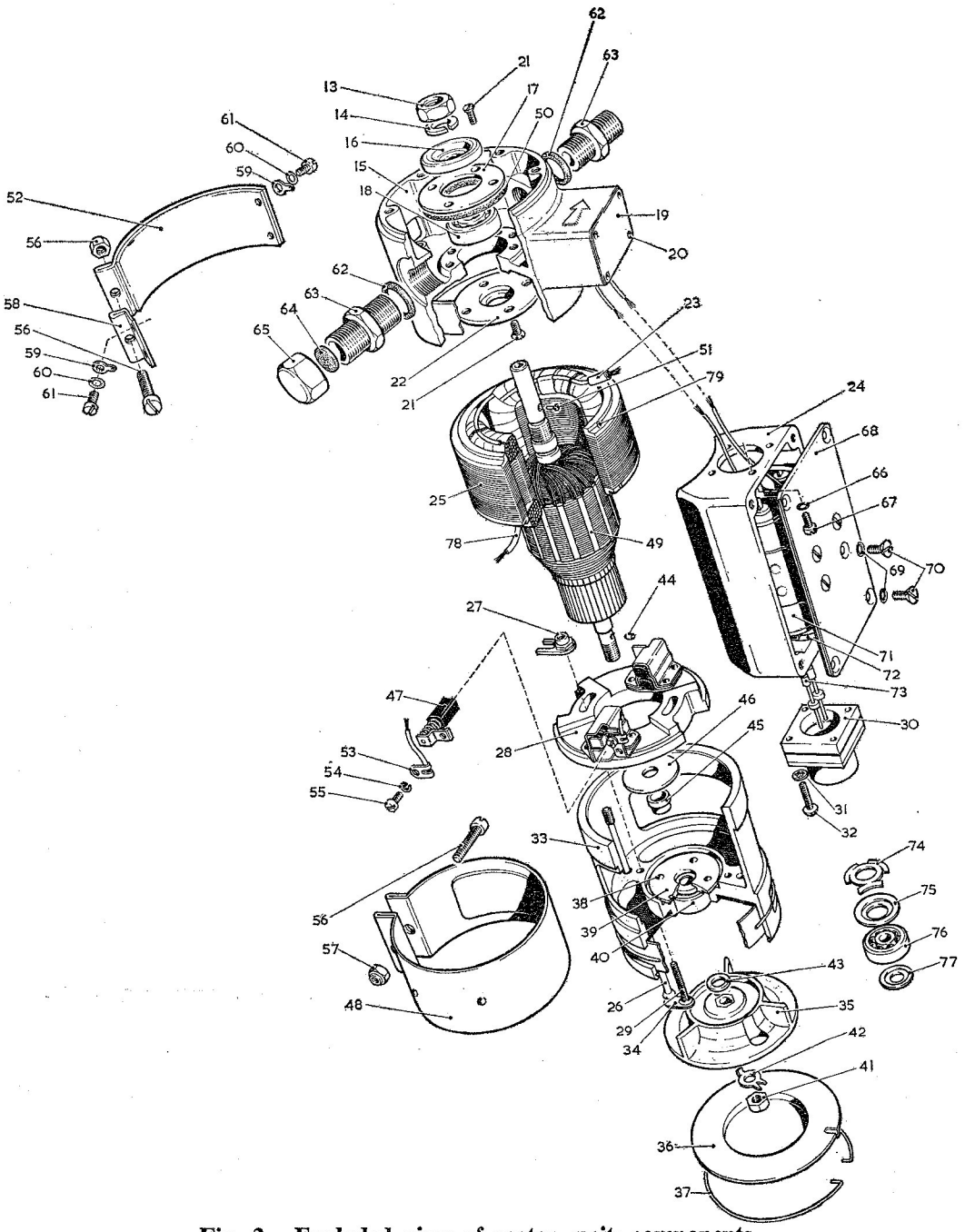

Fig. 3. Exploded view of motor unit components

Key to Fig. 3

13 SHAFT NUT
14 SPRING WASHER
15 DRIVE END FRAME ASSEMBLY
16 SLINGER
17 OUTER BEARING RETAINER
18 DRIVE-END BEARING
19 TERMINAL BOX COVER
20 DRIVE SCREW
21 BEARING RETAINER SCREW (C/SK HD.)
22 INNER BEARING RETAINER
23 CABLE SLEEVE
24 SUPPRESSION BOX
25 FIELD ASSEMBLY
26 TIE-BOLT
27 BRUSH GEAR NUT ASSEMBLY
28 BRUSH BOX ASSEMBLY
29 BRUSH BOX SCREW (C/SK. HD.)
30 ELECTRICAL CONNECTION
31 SHAKEPROOF WASHER
32 RD. HD. SCREW
33 COMMUTATOR-END FRAME ASSEMBLY
34 LOCKPLATE
35 FAN
36 END COVER
37 SPRING CLIP
38 DRIVE SCREW
39 BEARING RETAINER
40 COMMUTATOR-END BEARING
41 FAN NUT
42 TAB WASHER
43 FAN SPACER WASHER
44 FAN PEG
45 SPACER
46 SLINGER
47 BRUSH AND TAG ASSEMBLY
48 COMMUTATOR BAND SUB-ASSEMBLY
49 ARMATURE ASSEMBLY
50 BEARING RETAINER
51 SHAFT PIN
52 DRIVE END BAND SUB-ASSEMBLY (LARGE)
53 TERMINAL TAG
54 SPRING WASHER (BRUSH SECURING)
55 BRUSH SCREW (RD. HD.)
56 BAND RETAINING SCREW (CH. HD.)
57 BAND SCREW NUT
58 DRIVE END BAND (SMALL)
59 WIRE LOCKING TAG
60 SHAKEPROOF WASHER
61 BAND FIXING SCREW
62 JOINT WASHER
63 GLAND DRAIN ADAPTOR
64 JOINT DISC.
65 BLANKING CAP
66 SHAKEPROOF WASHER
67 SUPPRESSION BOX SCREW
68 SUPPRESSION BOX LID
69 SHAKEPROOF WASHER
70 SCREW C/SK. HD.
71 CAPACITOR
72 CABLE
73 CABLE SCREW
74 BEARING LOADING SPRING
75 GREASE SHIELD
76 BEARING (NON-SHIELDED)
77 GREASE SHIELD
78 CABLE SLEEVE
79 DOWEL PIN

DISMANTLING

Removing the pump suction cover

4. (1) Cut all the external locking wires.

(2) Remove the cap nuts (8, fig. 2) and the joint washers (9). Withdraw the suction cover (4) and remove the joint washer (7) from the pump casing (10).

Removing the impeller (fig. 2 and 3)

5. (1) Remove the two screws (61, fig. 3), shakeproof washers (60) and the locking wire tag (59) from the large drive-end band (52). Remove the nut (57) and screw (56) to release the large drive-end band from the small drive end band (58).

(2) Release the spring clip (37) and remove the motor end cover (36).

(3) Disengage the tangs of the tab washer (42), using a box spanner to hold the fan nut (41), unscrew the impeller nut (12, fig. 2) using the special spanner 96121 (fig. 4).

(4) Withdraw the impeller (5) from the gland unit (6).

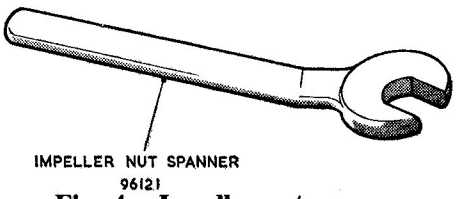

Fig. 4. Impeller nut spanner

Removing the pump casing (fig. 2 and 3)

6. (1) Mark or note the position of the pump casing (10) relative to the end frame and withdraw the casing complete with the gland unit (6) from the end frame (15).

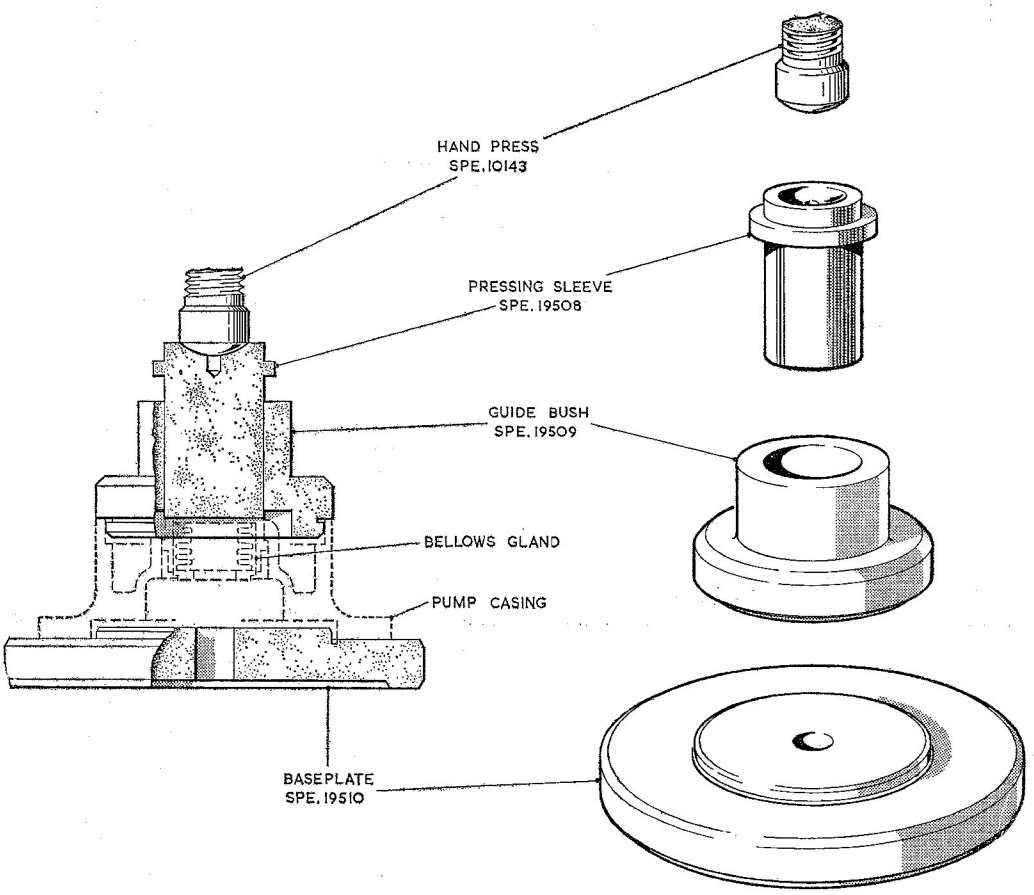

Fig. 5. Tools for removing metallic bellows gland from pump casing

(2) Remove the studs (3) from the end frame.

(3) Remove the shaft pin (51) and withdraw the impeller nut (12) from the armature shaft.

Removing the bellows gland from the pump casing

7. (1) The bellows gland unit (6) should be removed only if there is evidence of leakage or if the sealing face is scored or otherwise damaged.

(2) Heat the pump casing (10) to between 125 and 150°C and using the special tools illustrated in fig. 5 press the bellows gland out of the casing.

(3) The breather unit can only be removed from the pump casing using special tools. If the gauze is damaged, return the casing to the pump manufacturer for replacement of the complete breather unit.

Removing the delivery and gland drain adaptors

8. (1) Remove the delivery adaptor (1) and joint washer (2) from the pump casing.

(2) Unscrew the blanking cap (65) from the adaptor (63) and extract the joint disc (64) from the cap.

(3) Remove both gland drain adaptors (63) and joint washers (62) from the end frame.

Dismantling the motor unit

Removing the electrical connection and radio-interference suppression assembly

9. (1) Remove the four screws (32) and shakeproof washers (31) securing the electrical connection (3) to the suppression box (24). Withdraw the metal portion of the plug and drilled moulded plate from the pins. Slide the pins to

the ends of both slots in the moulded backplate and withdraw them.

(2) Remove the eight screws (70) and shakeproof washers (69) to release both capacitors (71) and the suppression box lid (68). Unsolder the motor leads to the suppressor tags and remove the capacitors.

(3) Remove the four cheese-head screws (67) and shakeproof washers (66) to separate the box (24) from the drive-end frame (15).

Removing the brushes

10. (1) Release the nut (57) and screw (56) to remove the commutator band (48) from the motor unit.

(2) Remove the four screws (55) and lockwashers (54) securing the brush assemblies (47) and field coil terminal tags (53) to the brush boxes. Before withdrawing the brushes, identify each with its brush box. This will facilitate re-bedding when the original brushes are used for a further period of service, by enabling them to be returned to their original boxes.

Removing the fan

11. (1) Using a $^{3}/_{16}$ in. B.S.W. box spanner to unscrew the fan nut (41). Remove the tab washer (42), fan (35) and fan peg (44). Remove the fan spacer washer (43).

(2) Withdraw the grease shield (77), if fitted.

Separating the end-frame assemblies

12. (1) Mark the position of the brush gear assembly relative to the commutator end-frame (33).

(2) Slacken the two brush gear screws (29) and release the locking tags (34) from each tie-bolt (26).

(3) Remove the tie-bolts and separate the commutator end frame (33) from the yoke of the field assembly (25). Take care not to scratch the commutator on the brush boxes.

(4) Remove the spacer (45) and slinger (46) from the armature shaft.

(5) Use the spanner 96066 (fig. 6) to remove the shaft nut (13), spring washers (14) and slinger (16). Carefully withdraw the armature from the field assembly.

(6) Remove the drive-end frame (15) from the field assembly, Do not attempt to remove the field coils from the field yoke.

Dismantling the commutator-end frame unit

13. (1) Remove the two screws (29) and nuts (27) and locking tags (34) to release the brush gear assembly from the commutator end frame (33).

(2) Press the bearing (40) out of its housing. If bearings without integral grease shields are fitted, remove also the load spring (74) and grease shield (75).

(3) Do not attempt to remove the bearing retainer (39), flame trap or soldered ring from the commutator-end frame.

Dismantling the drive-end frame unit

14. (1) Remove the outer bearing retainer (17) and fibre bearing retainer (50) by removing the four c/sk. head screws (21) and breaking the jointing compound seal.

(2) Remove the inner bearing retainer (22) by releasing the four c/sk. head screws (21). Press the bearing (18) out of its housing. Do not attempt to remove the flame trap from the end frame (15).

(3) Remove the terminal box cover (19) only if damaged.

EXAMINATION

Cleaning

15. Immerse the armature and field assembly in white spirit and use a soft bristle brush to dislodge carbon deposits. After cleaning both the armature and field assemblies, blow off surplus spirit and allow to dry out for several hours. Complete drying in an oven at approximately 93°C.

16. Ensure that all jointing compound and gasket material are removed from mating pump component surfaces, using an approved remover if necessary. All parts except the electrical connections, the bearings and synthetic material or rubber components should be cleaned in a dry cleaning solvent, or if excessively dirty, in a heavy duty degreasant. After cleaning allow to dry out for 12 hours and complete drying in an oven at about 93°C.

17. It is recommended that the bearings are renewed at each overhaul of the pump. If bearings of shielded type are being re-used, wipe clean with cloth dampened with white spirit. Bearings which are non-shielded or shielded on one side may be cleaned by flushing in white spirit. Lubricate the bearings as stated in para. 20.

Detailed procedure

18. Parts should be inspected in accordance with Table 2 and checked for conformity with the Schedule of Fits, Clearances and Repair Tolerances given in Table 3.

TABLE 2

Detailed examination of components

Item	Examination	Action if faulty
Armature	Insulation resistance to shaft. Use a 500 V. insulation resistance tester.	Clean thoroughly using white spirit. Dry for prolonged period at 105°C in a ventilated oven. Allow the armature to cool. Check that insulation resistance is not less than 50 megohms. If below this figure, continue drying process. Cool. Re-check.
	Commutator for loose conductors.	Reject for re-winding.
	Commutator for scoring.	Skim the commutator. Minimum permissible diameter for further use is 23·5 mm. (0.·925 in.). Undercut mica between segments 0·6 mm. (0·025 in.) wide × 0·5 mm. (0·020 in.) deep as necessary. Check that no copper burrs are shorting across the mica between commutator segments. Commutator to be true with spindle to within 0·0006 in. total indicator reading when running on shaft journals.
	Fouling of armature on pole-pieces.	Check armature spindle for concentricity and side play of bearings.
	Short or open-circuited conductors. Use voltage drop-tester or growler.	Clean undercutting of mica between the commutator segments. Remove copper burrs. If still unsatisfactory reject the armature.
	Armature spindle for concentricity. Measure close to its end.	Maximum total indicator reading 0·025 mm. (0·001 in.). If in excess of this figure, straighten or reject.

Item	Examination	Action if faulty
Field	Charring or other evidence of overheating and general damage.	Renew the complete assembly.
	Total resistance of windings measured and corrected to 15°C (59°F), 148·1 ± 12·6 ohms. Shunt: 67·5/80 ohms per coil. Series: 0·25/0·35 ohms per coil.	Renew the complete assembly.
	Continuity of coils. Use a 500 V. insulation resistance tester.	Reject assembly.
	Condition of field coils.	If damaged, renew the complete assembly.
	Insulation resistance of coils to frame.	Clean thoroughly using white spirit. Dry for a prolonged period at 105°C in a ventilated oven. Allow to cool. Check that the insulation resistance reading is not less than 50 megohms. If below this figure continue the drying process. Cool. Re-check.
	Condition of field coil lead coverings.	If damaged cover with additional sleeving.
Brush gear	Brushes for wear. Fit of brushes in brush boxes.	See Fits and Clearances, Table 3. Brushes should slide freely in the brush boxes. Remove all traces of carbon that has collected in the corners of the brush boxes.
	Brush spring pressure to be 4·3 oz. ± 0·5 oz. when compressed to 0·375 in.; 2·5 oz. ± 0·5 oz. when compressed to 0·625 in.	If not within limits, renew the brush assembly.
	Examine brush pigtail leads for fraying and looseness in the brush carbon.	Renew brush assembly.
	Condition of each part.	If damaged or corroded, renew.
Bearings	It is recommended that new ball bearings are fitted at each overhaul of the pump.	
Metallic bellows gland	Scoring of seal face.	If slight, relap to a mirror finish. If excessive renew.
	Damage to convolutions.	Renew gland.

Item	Examination	Action if faulty
Impeller assembly	Examine carbon for scoring, cracks, damage and specks of metal indicating partial seizure of the sealing face.	If slight scoring only, relap to a mirror finish. Otherwise renew the assembly.
Gaskets, joint rings, etc.	Renew at each overhaul.	Renew.
Electrical connection	Chipped contact pin retainer plates. Damaged threads or contact pins.	Renew the assembly.
Electrical leads	Examine for worn insulation sleeving.	Recover or renew as necessary.
Drive-end frame assembly	Check that flame trap is secure and undamaged.	Renew assembly.
Commutator-end frame assembly	Check security of bearing retainer. Condition and security of flame trap.	Renew the assembly.
Capacitors	Each capacitor should be individually checked with a 250-volt constant pressure insulation resistance tester. Insulation resistance between terminal and earth to be not less than 50 megohms.	Renew.

Repair of field coil leads

19. (1) Damaged leads may be renewed by cutting back the old lead and stripping both the old and the new leads bare for at least $^{5}/_{16}$ in. (8 mm.).

(2) Clean the bared wires, twist them together and solder the joined wires. Bind the joint with silk tape and cover with 3 mm. or 3·5 mm. i/dia. sleeving as necessary. Apply air drying varnish to the joint.

Lubrication of single shielded and non-shielded bearings

20. (1) Apply XG.295 grease to the space between the inner and outer races. For a single shielded bearing, two thirds of the accessible circumference should be filled with grease. One third of the circumference on each side of a non-shielded bearing should be filled with grease. Rotate the outer race to work the lubricant into the bearing.

(2) Place the bearings in clean wrappings until they are required for assembling into the pump motor unit.

TABLE 3

Schedule of fits, clearances and repair tolerances

Part and description	Dimensions New	Permissible worn dimension	Clearance New	Permissible worn clearance	Remarks
MOTOR UNIT					
1. BRUSH LENGTH (to centre of radius)	11·11 mm. (0·437 in.)	8·38 mm. (0·330 in.)	—	—	—
2. COMMUTATOR diameter	25·45 mm. / 24·76 mm. (1·002 in.) / (0·975 in.)	23·5 mm. (0·925 in.)	—	—	Diamond turn at each recondition
3. ARMATURE end float	—	—	0·125 mm. (0·005 in.)	0·2 mm. (0·008 in.)	Max. clearances
4. ARMATURE SHAFT IN DRIVE-END BALL RACE diameter	7·998 mm. / 7·990 mm. (0·3149 in.) / (0·3146 in.)	—	—	—	Selective assembly
bore	8·000 mm. / 7·990 mm. (0·3150 in.) / (0·3145 in.)	—	—	—	
5. ARMATURE SHAFT IN COMMUTATOR-END BALL RACE diameter	6·987 mm. / 6·979 mm. (0·2751 in.) / (0·2748 in.)	—	—	—	Selective assembly
bore	7·000 mm. / 6·990 mm. (0·2755 in.) / (0·2752 in.)	—	—	—	

Part and description	Dimensions New	Permissible worn dimension	Clearance New	Permissible worn clearance	Remarks
6. COMMUTATOR-END BALL RACE IN HOUSING diameter	22·00 mm. 21·990 mm. (0·8661 in.) (0·8657 in.)	—	—	—	Selective assembly
bore	22·016 mm. 22·004 mm. (0·8668 in.) (0·8663 in.)	—	—	—	
PUMP UNIT 7. CARBON SEAL SEAT FACE TO IMPELLER BLADE TIPS	19·1 mm. 18·9 mm. (0·755 in.) (0·745 in.)	18·66 mm. (0·735 in.)	---	---	Scored surface of carbon seal to be removed by lapping
8. IMPELLER diameter	31·394 mm. 31·356 mm. (1·2360 in.) (1·2345 in.)	—	0·444 mm. 0·356 mm.	—	
9. SUCTION COVER bore	31·80 mm. 31·75 mm. (1·252 in.) (1·250 in.)	—	(0·0175 in.) (0·014 in.)	—	
10. RADIAL CLEARANCE BETWEEN IMPELLER AND SUCTION COVER	—	—	0·075 mm. (0·003 in.) min.	—	Impeller eccentricity allowed for
11. IMPELLER eccentricity	—	—	0·1 mm. (0·004 in.) max.	—	

ASSEMBLING

Motor unit

Assembling the drive-end frame (fig. 3)

21. (1) Pre-select a bearing (18) that is a firm slide fit under thumb pressure both on the armature shaft (49) and in the drive-end frame (15). Retain the armature assembly and the drive-end frame and suitably mark both so that they can be paired with the selected bearings at a later stage of assembling. Check that the selected bearing is smooth running with no roughness when the inner race is rotated by hand.

(2) Check that the bearing housing in the end frame (15) is perfectly clean and that the wall surface is smooth and free from score marks, burrs and adhering swarf. Apply Hermeticoll jointing compound to the mating surfaces only of the bearing retainer (50), outer bearing retainer (17) and end frame (15).

(3) Fit the bearing retainers (50) and (17) to the end frame and secure them with four screws (21), using an approved air drying varnish under the heads and on the threads of the screws just before assembly. Remove any excess jointing compound from the bearing retainers and bearing housing.

(4) Fit the selected bearing into the end frame housing. A single shielded bearing must be fitted with the shield facing the armature winding. When a non-shielded bearing is used, fit the grease shield (75) facing the armature windings. Fit the bearing retainer (22) and secure it with four screws (21) using an air drying varnish to lock the screws.

Assembling the commutator-end frame

22. (1) Pre-select a bearing that is a firm slide fit under thumb pressure both on the selected armature spindle (para. 24) and in the commutator end frame (33). Suitably mark the components for assembling together at a later stage.

(2) Insert the selected bearing into the end-frame housing. When a single-shielded bearing is used, first fit the loading spring (74) and grease shield (75), followed by the bearing with the shield facing outwards. A non-shielded bearing is fitted in a similar manner to a single shielded bearing except that an additional grease shield (77) must be fitted against the bearing outer face at a later assembly stage.

Assembling the brush gear

23. (1) Fit the brush gear assembly (28) in the commutator-end frame and align it with marks made before dismantling. Place locking washers (34) under the heads of both brush box securing screws and secure the brush gear assembly lightly with the screws and brush gear nuts (27).

Fitting the drive-end frame and armature to the field assembly

24. (1) Support the pre-selected armature (49) in a padded vice clamp.

(2) Position the bearing already located in the drive-end frame (15) over the armature shaft. Fit the slinger (16), spring washer (14) and shaft nut (13) to the armature shaft. Use the spanner 96066 (fig. 6) to tighten the shaft nut.

(3) Remove the armature from the padded clamp and with the armature supported turn the assembly through 180° and fit the field assembly (25) over the armature, passing the untagged coil leads through apertures in the end frame. Ensure that the dowel pin (79) is correctly located in the end frame slot.

Fitting the commutator-end frame

25. (1) Fit the slinger (46) and the spacer (45), large diameter end first, over the armature shaft.

(2) Place the commutator-end frame over the armature, aligning with the dowel pin in the field assembly. Ensure that the field leads are accessible by threading through the brush gear access windows in the commutator-end frame.

(3) Hold the brush box assembly and slacken the fixing screws (29) slightly.

Swing the locking tag (34) under each screw to one side and insert the tie-bolts (26) through the commutator-end frame and field assembly into the drive-end frame. Ensure that both tie-bolts pass through the forked plates of the brush gear nuts (27).

(4) Tighten the tie-bolts evenly in turn. Gently tap the end frames around their circumference, using a raw-hide mallet, to ensure that they are fully bedded on the field assembly spigots.

(5) Re-position the locking washers (34) and tighten the brush gear screws (29) sufficiently to hold the brush gear assembly in position and prevent damage to the commutator.

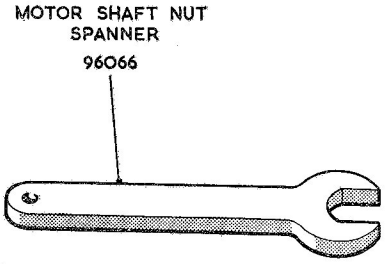

Fig. 6. Motor shaft nut spanner

(6) When a non-shielded bearing (76) is fitted in the commutator-end frame (33) fit a grease shield (77) with the dished side towards the bearing.

(7) Fit spacing washers (43) as required to ensure that the fan (35) is clear of the commutator-end frame. Refit the fan peg (44), fan (35), tab-washer (42) and fan-nut (41). Hold the motor shaft by using spanner 96066 (fig. 6) on the shaft nut, and tighten the fan nut with a box spanner. Do not bend tabwasher at this stage.

Checking the armature shaft for truth

26. (1) Check the armature shaft for truth using a clock gauge and vee blocks. Eccentricity must not exceed 0·002 in. total movement.

(2) Check the drive-end frame spigot for truth with the shaft. Either mount a clock gauge on the armature spindle and rotate the armature or support the armature between centres and rotate the motor body on the armature bearings. The spigot must be true within 0·002 in. total reading. Error may be caused by uneven tightening of the tie-bolts. If necessary, remove the fan and check the tie-bolts. Re-assemble the fan and re-check.

Fitting the radio-interference suppression assembly and electrical connection

27. (1) Pass the field coil leads through the end of the suppression box (24) and secure the box to the end frame (15) with four shakeproof washers (66) and cheese-head screws (67).

(2) Solder a field lead to the end tag of each capacitor (71) and check the soldering of the electrical connection pin leads to the second capacitor tag. Renew if necessary.

(3) Secure both capacitors to the suppression box lid (68) with four shakeproof washers (69) and four screws (70). Fit the lid (68) to the suppression box with four shakeproof washers (69) and screws (70), ensuring that the two leads and pins of the electrical connection (30) pass through the end of the box (24).

(4) Fit each pin through the slotted backplate and slide them to the ends of the slots. Fit the drilled moulded plate over the pins. Fit the metal portion of the electrical connection to the moulded plate and secure the plug to the suppression box with four screws (32) and shakeproof washers (31).

Pre-bedding new brushes

28. (1) Preferably using a slave motor, insert a brush (47) into each of four brush boxes, retaining them with the screws (55).

(2) With a strip of fine grade (000) glass paper wrapped around the commutator, turn the armature by hand until the brushes are bedded over their full width of arc.

Brush bedding

29. (1) Remove the brushes from the brush boxes of the slave motor, clean the brush faces with a small bristle brush and transfer the brushes to the motor unit being assembled. If the original brushes are being used, facilitate re-bedding by fitting them to their original boxes, as indicated by the markings made during dismantling.

(2) Secure each brush with a screw (55) and a spring washer (54) connecting the adjacent field coil lead and tag (53) to the first brush of each pair. The field leads should pass outside the tie-bolts which serve to prevent the leads fouling the commutator.

(3) Run the motor unit without load at 20-22 V. d.c. input and with the brush gear set in a position giving minimum sparking at the commutators for approximately three hours, or until the brushes bed over their full width of arc with at least 80% of their face area in contact with the commutator. Running is to be continued until this condition is achieved. After examination of brushes, ensure that they are returned to the brush box in which they were bedded.

(4) At the conclusion of the brush bedding run, fit the calibrated fans (listed in Table 1) to obtain the correct torque loading, then adjust the brushes to obtain the speed settings as detailed in para. 39, with the motor unit at normal running temperature.

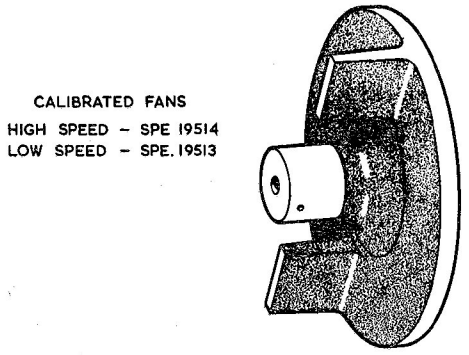

Fig. 7. Calibrated fan for motor torque test

(5) When the motor speed has been correctly set, tighten the brush screws (55).

(6) Positively identify each brush with the box in which it is fitted. Remove the brushes, clean out all carbon dust with dry compressed air and replace the brushes in their original boxes. Reconnect the field coil leads.

(7) Fit the commutator band sub-assembly to the motor and secure the band with the screw (56) and self locking nut (57).

Machining the pump casting location spigot

Note . . .

These instructions apply only to rebuilt pumps in which a new drive-end frame (15) *has been fitted.*

30. (1) Re-check the armature spindle for truth using a dial gauge and vee-block. Eccentricity must not exceed 0·002 in. total indicator reading.

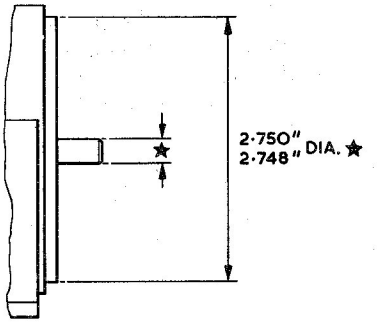

Fig. 8. Motor spigot machining details

(2) Support the motor unit shaft between lathe centres and turn the pump casing location spigot to the dimensions detailed in fig. 8.

Note . . .

Take care that no swarf or other foreign matter gets into the motor unit during this operation. All apertures should be temporarily sealed with tape or other suitable material.

Pump unit

Fitting the metallic bellows glands
(fig. 2 and 3)

31. (1) Ensure that the pump casing (10) is perfectly clean and free from burrs. Heat the casing to between 125° and 150°C.

(2) Smear Wellseal jointing compound on the shroud of the bellows gland (6)

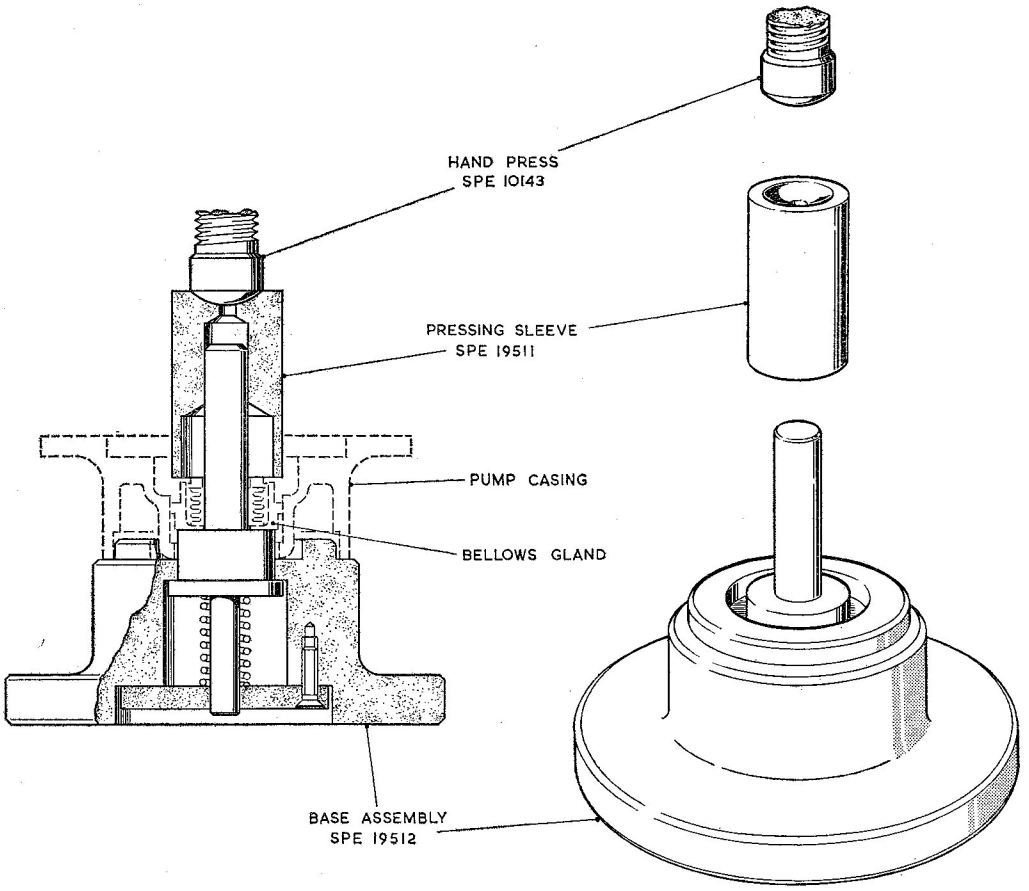

Fig. 9. Tools for assembling the metallic bellows gland into the pump casing

on the side away from the seating face, ensuring that jointing compound does not contact the seal face or convolutions of the gland. Using the special tools illustrated in fig. 9 press the bellows gland into the pump casing.

Assembling the pump casing to the motor unit

32. (1) Screw the studs (3) into the drive-end frame of the motor unit (if previously removed). Tighten down to the face and then slacken them back until the flats on their shoulders are evenly clear of the motor spigot, so that the pump casing will lock them and prevent them slackening further.

(2) Fit the joint washer (2) and delivery adaptor (1) to the pump casing (10) after checking that the breather assembly is in position and undamaged (para. 7(3)).

(3) Fit the impeller pin (51) through the hole in the pump shaft and position the impeller nut (12) on the shaft.

(4) Position the pump casing over the studs in the correct angular position relative to the electrical connection on the motor unit (fig. 10). Ensure that the motor spigot is clean and that the casing can be pushed fully home.

(5) Fit the impeller (5) to the motor shaft, engaging the pin in one of the four impeller slots.

Setting the impeller

33. (1) Insert the finger into the impeller nut access opening in the motor end frame to start the nut on the impeller thread.

(2) Fit the special gauge 92916 (fig. 11) to the flange of the pump casing.

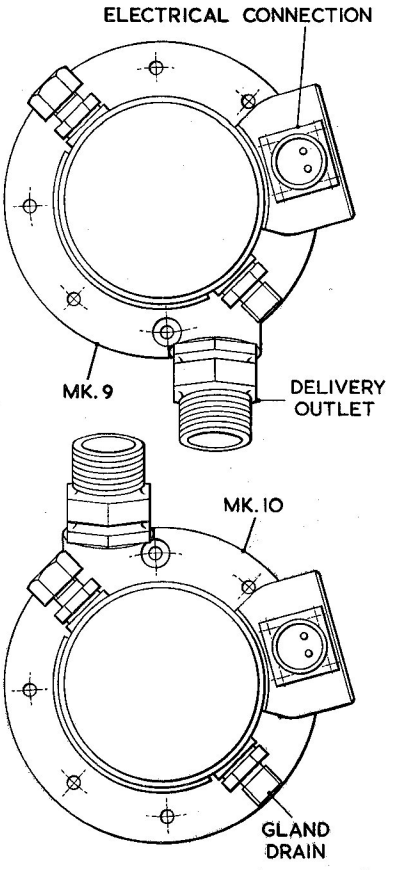

Fig. 10. Alignment of delivery outlet and electrical connection

(3) Slide the impeller into the recessed portion until it contacts the inner face of the setting gauge.

(4) Holding the shaft nut (13, fig. 3) with the spanner 96066 (fig. 6), tighten the impeller nut (12, fig. 2) with the spanner 96121 (fig. 4), ensuring that the end of the impeller remains in contact with the face of the gauge.

(5) Remove the gauge.

(6) Fit the sleeve 91648 (fig. 11) over the impeller blades and check concentricity by using a dial gauge on the sleeve and rotating the shaft by hand. Total eccentricity must not be more than 0·004 in. total indicator reading. If necessary, try different angular position of the impeller relative to the shaft pin until an acceptable position is found. Always use the gauge (fig. 11) when setting the impeller.

Fitting the suction cover

34. (1) Paint the mating surfaces of the suction cover (4) and pump casing (10) with Wellseal jointing compound.

(2) Fit a new joint washer (7) and secure the suction cover loosely to the pump casing with six fibre joint washers (9) and cap nuts (8).

(3) Insert the setting gauge 91649 (fig. 11) in the suction cover bore. Tighten the cap nuts evenly in turn, ensuring that the gauge is free to turn, during tightening, with the impeller in several different positions.

(4) Wire lock and seal the cap nuts.

Fitting the motor end cover (fig. 2)

35. (1) Bend up the tangs of the tab washer (42) against the nut (41) if not already locked.

(2) Fit the motor end cover (36), dished side outwards, to the commutator end frame and retain the cover with the spring clip. Rotate the armature by hand and check that the fan does not foul the end cover.

Replacing the drive-end band assembly

36. (1) Secure the plain end of the large band sub-assembly (52) and a wire locking tag (59) to the end frame (15) with two shakeproof washers (60) and screws (61).

(2) If removed during dismantling, refit the small band sub-assembly (58) and a wire locking tag (59) to the end frame (15) with two screws (61) and shakeproof washers (60). Secure both drive-end bands together with the screw (56) and nut (57).

Fitting the gland drain unions

37. (1) Fit an adaptor (63) and joint washer (62) to each gland drain tapping.

(2) Fit a blanking cap (65) and joint disc (64) to the connection not being used for drainage. Use an approved

sealant on the thread of the blanking cap.

(3) Wire lock the blanking cap and adaptors to the locking wire tags (59) already secured to the drive-end frame.

(4) If the pump is not being tested immediately, it should be enclosed in a polythene bag or other suitable packing to prevent ingress of dirt and other matter likely to prejudice the operation of the pump. After testing, the delivery outlet gland drain and electrical connections should be plugged and the unit enclosed in a polythene bag or other packing until required for use. Store the pump in a moisture free area away from excessive heat.

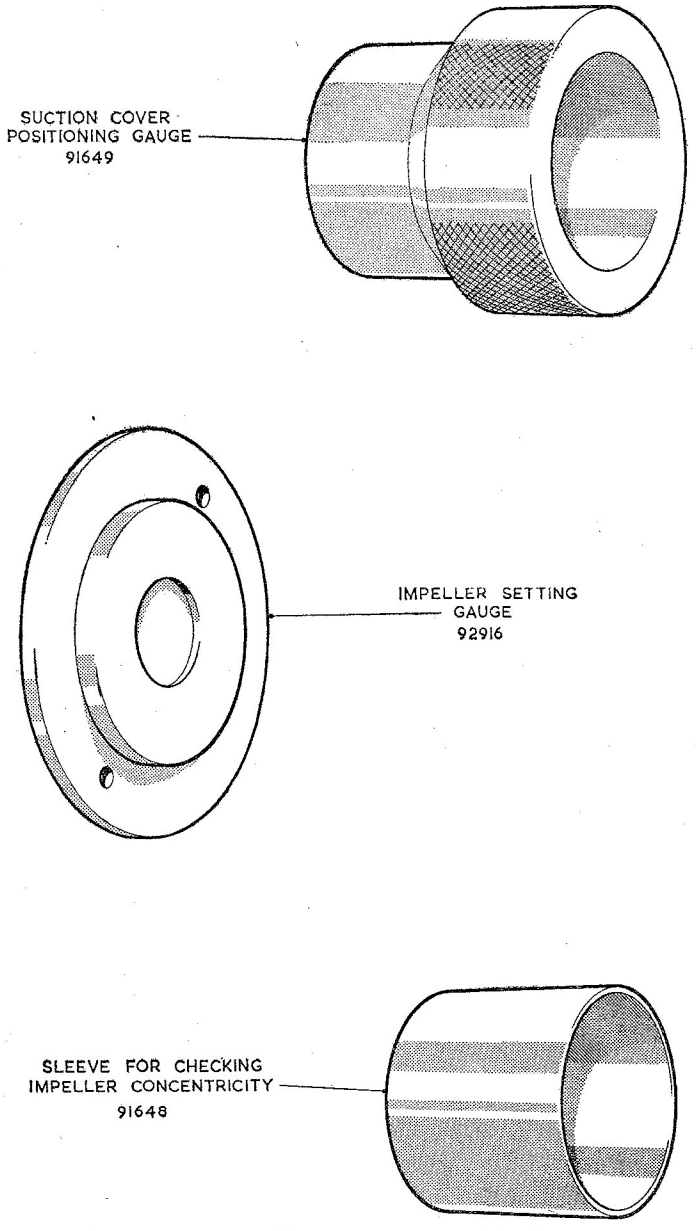

Fig. 11. Impeller alignment and positioning gauges

TESTING

General

38. The complete pump must be tested in accordance with the Schedule of Tests detailed in para. 39 to 45. If the pump fails to meet the requirements of the Schedule of Tests, it should be rejected.

Motor brush bedding and torque test

39. Full details on the procedure to be adopted are given at the appropriate stage of assembling (para. 29). Conditions to be fulfilled are as follows:

(1) The brushes must bed over their full width of arc with at least 80 per cent of their face area in contact with the commutator.

(2) The motor is to be subjected to a torque of 9 oz. in. applied by means of the calibrated fans (fig. 7) or by a suitable dynamometer. With the motor running under load on applied voltage of 24V d.c. and 29V d.c. check that speed and current consumption are within the following limits:—

Minimum speed 8700 rev/min: current 7·0 amps. max.
Minimum speed 12,500 rev/min: current 7·5 amps. max.

Insulation resistance test

40. The insulation resistance is to be measured at the following times:—

(1) The motor unit only immediately after brush bedding and torque test (para. 29).

(2) The complete pump before gland leakage tests (para. 42) and after completion of the calibration test (para. 46).

41. All the above tests are to be carried out with the motor unit warm. Use a 250V constant pressure insulation resistance tester. The insulation resistance must at no time be less than 2 megohms (10 megohms after torque test).

Gland leakage test

42. With the pump attached to a test tank and a one foot head of water above the pump inlet, apply air pressure at 10 lb/in^2 over the water. With the pump running and also stationary observe for:—

(1) External leakage of water.

(2) Internal leakage of water.

(3) Gland leakage.

The maximum permissible rate of leakage past the gland is 2 cc. per hour when running and 1 cc. per hour when stationary. No other leakage is permissible.

Starting test

43. With the pump fully primed and the supply voltage adjusted to 16V d.c. operate the pump by switching on the supply. The pump must start immediately. Repeat this test several times.

Dry test

44. Mount the pump clear of water and run the pump for 5 minutes on an applied voltage of 29V d.c. The current is to be observed during this test and must not be greater than 6 amps.

Note . . .

The dry test should be carried out immediately after the starting test to ensure that the seal is not run in a completely dry condition.

Endurance test

45. Run the pump for 1 hour with a 6 in. head of water over the pump inlet on an applied voltage of 24V d.c. and a flow of 200 g.p.h. Repeat the previous test with an applied voltage of 29V d.c. Record the delivery pressure and current at the beginning and end of each part of the test and check for conformity with the figures detailed in Table 4. Any appreciable change in performance, other than that caused by the initial warming up, will necessitate rejection of the pump.

TABLE 4

Endurance test

Volts d.c.	Flow g.p.h.	Delivery press lb/in^2 (min.)	Current amps (max.)
24	200	9·0	7·0
29	200	14·0	7·5

Calibration test

46. When running on a voltage of 29V d.c., the pressure at the pump outlet must not exceed 26 lb/in^2, when there is no flow. With a six inch head of water above the pump inlet, apply voltages of 29V d.c., 24V d.c., and 22V d.c., adjust the flow regulating valve to obtain flows from 0 to 500 gal./hr. in steps of 100 gal./hr. for each voltage. Record the delivery pressure and the motor current at each stage, then draw graphs of the flow against the delivery pressure. Check, using the graphs, that the pump conforms to the conditions given in Table 5.

TABLE 5

Calibration test

Volts d.c.	Flow g.p.h.	Delivery press lb/in^2 (min.)	Current amps (max.)
29	200	14·0	7·5
24	200	9·0	7·0
22	200	7·0	6·5

Appendix 1

RECONDITIONING FB.1, MK. 7 AND MK. 8 WATER PUMPS

General

1. This appendix details the differences in procedure for reconditioning FB.1, Mk. 7 and 8 pumps as compared to the procedure detailed in the main chapter for FB.1, Mk. 9 and 10 pumps. Mk. 7 and 8 pumps are fitted with spring-loaded carbon type glands, and later marks are fitted with metallic bellows type glands; it is recommended that the carbon types are replaced by metallic bellows glands and that Mk. 7 and 8 pumps are modified to Mk. 9 and 10 standard during reconditioning.

Tools and test equipment

2. The tools listed under Table 1 of the main chapter are required for reconditioning Mk. 7 and 8 pumps; additional tools will not be required.

DISMANTLING

3. The dismantling procedure is identical to the procedure detailed in the main chapter, with the following exceptions. References in parenthesis apply to the main chapter.

Removing the impeller

4. The procedure is generally similar to that given for FB.1, Mk. 9 and 10 pumps (para. 5) but when the impeller is removed, the carbon ring, rubber seal, spreader ring and spring of the spring-loaded carbon type gland will be released.

Removing the gland face

5. The procedure is generally similar to that given for a metallic bellows gland (para. 7). Pre-heat the pump casing to between 125° and 150°C, and use the gland removal tools (fig. 5) to press the gland face out of the casing.

ASSEMBLING

6. The pump should be assembled to a Mk. 9 or Mk. 10 standard. A new impeller assembly with an integral carbon seating (item 5, fig. 2) and a metallic bellows gland unit (6) will be required as replacement for the redundant Mk. 7 and 8 components.

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