Chapter 44

PUMP, WATER, FB.1 SERIES

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Introduction

1. Type FB.1 series pumps are electrically driven self-contained units designed to supply water under pressure to aircraft toilet systems. Rated operating voltage is 24V d.c.

2. All FB.1 series pumps are of the centrifugal type, and are designed for bolting direct to the tank or sump by means of an integral mounting flange as either a horizontal or hanging installation. Details of the differences between the mark numbers of each type, together with the Leading Particulars, are given in the Appendix to this chapter.

DESCRIPTION

General

3. A typical FB.1 series pump (FB1 Mk.9 and 10) is shown in Fig.2 This basic arrangement is common to all FB.1 series pumps covered by this chapter, differences

between the mark numbers being in the type of gland fitted and/or the positioning of the delivery outlet on the pump casing relative to the electrical connection on the motor unit. Radio interference noise suppressors are included in the internal electrical circuits of all the pumps.

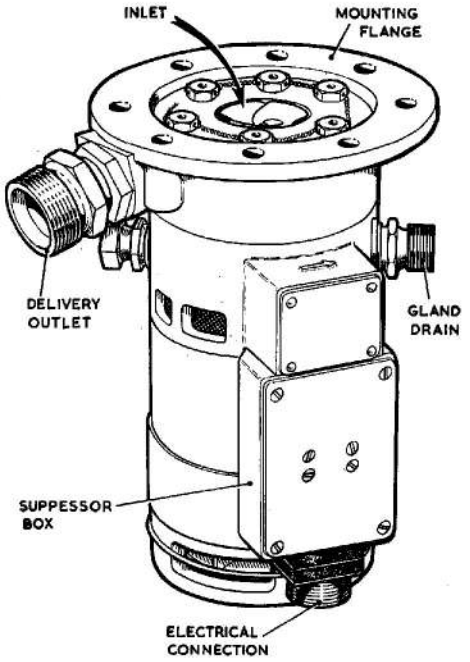

Fig. 1. External view of typical FB.1 water pump (FB.1 Mk. 9 and 10)

Motor Units

4. The driving motor is a fan cooled, flameproof, d.c. compound wound machine suitable for operating on a supply voltage of 22·0/29·0V d.c.. Brush gear is of unit construction, to facilitate assembly, comprising twin sets of brushes, with access through ports in the motor end frame. An extension of the commutator end frame houses the six-bladed cooling fan which draws cooling air through the flameproof apertures in the drive-end frame; the air passes through the stator assembly and is exhausted through further wire protected apertures in the commutator end frame.

5. The armature shaft is supported by two ball bearings, both of which are pre-packed during manufacture with an anti-freeze, high melting-point grease and cannot be re-lubricated. The lower bearing is locked to the armature shaft with an assembly which includes a thrower ring to fling off any fuel which may have seeped past the main gland. Capacitors are fitted in a suppressor box attached to the side of the motor casing; the box also carries the pump electrical connection

Pump unit

6. The pump casing houses the shrouded, single-entry, end-suction type impeller. The impeller is mounted to the end of the extended armature shaft by means of a slotted cone nut collet coupling device. The collet is similar to a chuck in operation, and, when tightened, grips the armature shaft The rotary carbon seal component of the metallic bellows gland (Mk.9 and 10 only) is set into the back face of the impeller, the stationary gland component being a press fit in the pump casing.

7. The pump casing embodies an angled delivery connection fitted with a $\frac{1}{4}$in. B.S.P. coupling. The position of this delivery outlet relative to the electrical connection varies with the mark number of the pump.

OPERATION

8. When the pump motor is energised, water from the tank is drawn into the eye of the impeller and forced through the volute channels of the pump casing into the delivery line.

9. Under conditions in which the flow from the pump is low due to reduced requirements, the impeller continues to rotate at approximately normal speed without causing any excessive increase in delivery pressure.

REMOVAL AND INSTALLATION

Removal

10. Before attempting to remove a pump, ensure that the tank has been emptied of any water and that the electrical supply to the pump has been swiched off.

11. The precise method of removing the FB.1 series pump from a particular installation is detailed in the appropriate Aircraft Handbook.
In general terms it will consist of disconnecting the water delivery and gland drain pipes and the electrical connection socket. The pump can then be removed by releasing the eight nuts securing it to the tank mounting ring. Take care to support the weight of the pump throughout this operation.

Pre-installation checks

12. The installation of all new pumps should be preceded by the following checks:—

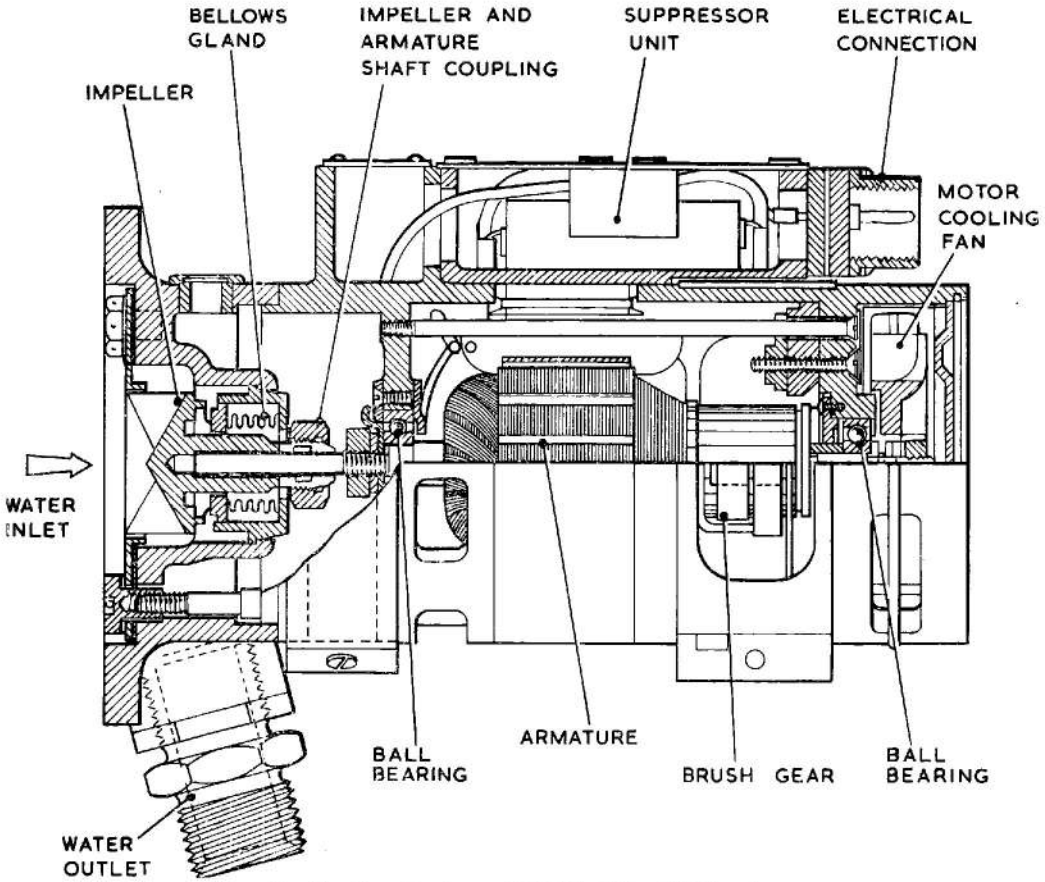

Fig. 2. Sectional view of FB.1, Mk. 9/10 water pump

(1) Ensure that the pump has not been stored for longer than the specified maximum period (i.e. 12 months in the original packing and carton as supplied by the manufacturer or 3 years where special packing has been provided). Pumps stored for periods in excess of these maxima must not be used without being dismantled, examined, rebuilt and tested as detailed in Vol. 6.

(2) Inspect exterior of pump for evidence of damage, security of locking wires, general cleanliness and corrosion. Blend out areas of slight corrosion and apply a protective finish (e.g. chromic acid solution) to the unprotected area.

(3) Check that transit plugs have been removed from the delivery outlet, gland drain and electrical connection, and check that tape or other protective material has been removed from the pump inlet and various breather apertures.

(4) It is advisable to make a starting check on the pump before installation. Apply a 24V d.c. electrical supply through the pump electrical connection. The pump must start immediately. Repeat the test several times. If the pump fails to start immediately, it should be returned to an overhaul base for further serviceability testing using approved equipment.

Installation

13. The above pre-installation checks apply to all aircraft installations of these pumps. For detailed procedure in a particular aircraft, reference should be made to the relevant Aircraft Handbook.

14. As a general example, installation in the aircraft will comprise the following operations :—

(1) Fitting a new joint washer between the pump mounting flange and the tank stud ring, using an approved jointing compound on both sides of the washer.

(2) Determining the correct angular position on assembly of the pump delivery outlet and securing the pump to the tank with eight self-locking nuts or nuts and lockwashers. If not already fitted, it is advisable to assemble a wire mesh filter inside the tank flange mounting to prevent ingress of tank sediment into the pump. This filter should if possible embody a vortex eliminator.

(3) Connecting the water delivery pipe, and a gland drain pipe to a union in the lowest of the two alternative gland drain positions. The unused gland drain tapping should be plugged. Ensure when relevant that the open end of the gland drain pipe faces towards the rear of the aircraft to avoid possible pressurisation in flight.

(4) Connecting the electrical supply socket to the pump.

(5) Wire locking all pipe connections, union nuts, etc.

(6) If the pump is fitted in a confined tank compartment check that this is well ventilated to ensure adequate air circulation for cooling the motor unit.

SERVICING

Routine inspection

15. At routine inspections the following procedure applies :—

(1) Inspect all the pipe connections and wire locking to the pump. Check the joint between the pump and the tank for leakage. Correct as necessary.

(2) Test the pump, as detailed in para. 17 to 23. If the pump performance is found to be unsatisfactory in any way, the pump must be removed from the aircraft and a new or reconditioned unit fitted. No in-situ maintenance should be attempted.

16. At the periods laid down in the appropriate Servicing Schedules, all pumps are to be replaced by new or reconditioned units drawn from stores. Faulty and time expired pumps must be returned to a Maintenance Unit or to the manufacturer for repair.

Electrical test

17. A routine electrical test in accordance with the appropriate Servicing Schedule should be made to ascertain that the motor unit is functioning satisfactorily. These tests must be made with the motor unit on load,—i.e. pumping fluid. The pump must be replaced by a new or reconditioned unit if there is any indication of erratic performance such as excessive current consumption.

"No-flow" test

Note . . .

The following "No-flow" electrical test is only applicable to aircraft with the necessary instrumentation. Where no test panel is provided, particular attention should be paid to the electrical test (*para.* 17) *and operational test* (*para.* 21).

18. Ascertain the position of the aircraft pump test socket and switches by reference to the relevant Aircraft Handbook. Proceed as follows :—

(1) Close all cocks between the pump and toilet sysem so that no flow can take place.

(2) Connect a suitable portable ammeter to the test socket on the test panel. Note that when using a clip-on type ammeter the tongs should be opened and closed smartly prior to use to reduce the hysteresis error. Note also that in some installations the ammeter test socket normally has its contacts shorted by a plug with its pins connected together and this plug must be removed before the portable ammeter can be plugged in. In these installations the pump switches must be switched on one at a time for test purposes.

(3) Switch on the pump by depressing the switch on the test panel. Observe the ammeter reading for a period of not less than 30 seconds..

19. Interpret the readings obtained as follows :—

(1) A steady reading not exceeding that indicated by the graph (Fig. 3) for the measured applied voltage, indicates that the motor is functioning satisfactorily.

Note . . .

The graph (*Fig.* 3) *is provided as a guide to pump performance under*

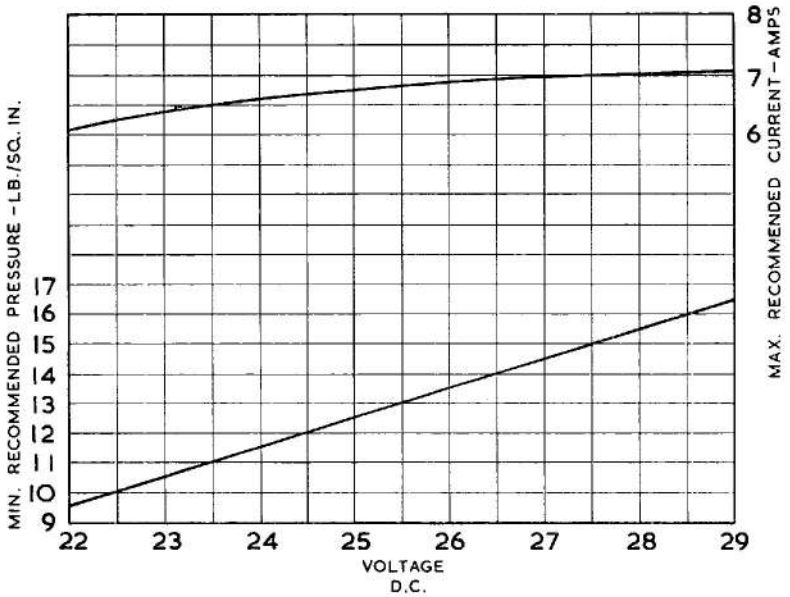

Fig. 3. No-flow electrical test graph

no-flow conditions; the figures derived from it are not to be interpreted as forming part of the approved Acceptance Test Specification for the pump.

(2) Current consumption in excess of the graph reading indicates either a faulty motor unit, a rise in torque loading due to the obstruction of moving parts, or a restriction of the flow.

(3) A fluctuating reading indicates faulty contacts, defective brushes, faulty commutation or that bearings or other rotating parts are binding.

(4) A zero reading indicates an open circuit and is consistent with a blown fuse, defective switch, faulty wiring or a complete motor failure.

20. When the above tests have been completed, release the test switch and disconnect the ammeter. Fit the shorting plug to the ammeter test socket, if removed as detailed in para. 18(2). *Failure to replace the shorting plug, after the tests have been completed, will render all pumps inoperative.*

Operational test

21. Subject to the electrical test being completed satisfactorily, the pump should be tested where possible for proof of performance, and checked against the performance figures quoted in the appropriate appendix to this chapter. Refer to the relevant Aircraft Handbook for procedure details. For possible causes of failure to obtain the required performance see Table 1.

Gland leakage

22. During the above tests an examination should be made of the gland drain exit for leakage. The leakage must not exceed 2 drops per minute while the pump is running or 1 drop per minute while stationary. Any leakage in excess of these figures will necessitate removal of the pump from the aircraft.

Insulation resistance test

23. Using a 250V constant pressure insulation resistance tester measure the insulation resistance between the electrical supply socket pins and earth. When a new pump is drawn from Stores the insulation resistance must be not less than 2 megohms. After installation, due to humidity conditions prevalent in aircraft at dispersal points, the minimum permissible insulation resistance is 50,000 ohms.

TABLE 1

Faults, possible causes and rectification

Fault	Possible cause	Rectification
Gland leakage	(1) Bad finish between gland seal faces. (2) Insufficient pressure between gland seal faces.	All these conditions require that the pump is removed from the aircraft and returned to a Maintenance Unit or to the pump manufacturer for reconditioning.
Excessive current consumption	(1) Excessive loading on gland. (2) Faulty motor unit. (3) Fouling of impeller by foreign matter or by suction cover. (4) Check field coils for continuity. (When armature is free to turn but pump will not start).	
Low delivery pressure	(1) Faulty motor unit (2) Impeded impeller	
Pressure surge	(1) Tight or pre-loaded bearings (2) Excessive loading on gland	
Low insulation resistance	(1) Dampness in motor windings	

Appendix 1

PUMPS, WATER, TYPE FB.1 Mk. 7, 8, 9 and 10

Pump, water, Type FB.1 Mk.7	**Ref. 5UE/6598**
Pump, water, Type FB.1 Mk.8	**Ref. 5UE/6599**
Pump, water, Type FB.1 Mk.9	**Ref. 5UE/6890**
Pump, water, Type FB.1 Mk.10	**Ref. 5UE/6891**
Voltage limits	22·0/29·0*V d.c.*
Rated voltage	24·0*V d.c.*
Rated output at 24·0V d.c.	200 *gal./hr.*
Delivery pressure at rated output/voltage	9·0 *lb./in.²* (*min.*)
Maximum current consumption at rated output/voltage	7·0*A*
Maximum no-flow delivery pressure at 29·0V d.c.	26·0 *lb./in.²*
Minimum no-flow delivery pressure	*See fig. 3, basic chap.*
Electrical connection (Plessey 2CZ.140052)	*Ref. No. 5X/6720*
Delivery outlet union	$\frac{3}{4}$ *in. B.S.P. (male)*
Gland drain union	$\frac{1}{4}$ *in. B.S.P. (male)*
Weight of unit	5*lb.* 10 *oz.*

Type differentiation

1. Basic differences between the various marks of FB.1 pumps covered by this appendix are as detailed below. For general details see the basic chapter.

FB.1 Mk.7 — Generally as the Mk.9 pump described in the basic chapter but fitted with a spring loaded carbon type gland and not the metallic bellows type gland of the later version.

FB.1 Mk.8 — Generally as the Mk.10 pump described in the basic chapter but fitted with a spring loaded carbon type gland and not the metallic bellows type gland of the later version.

*FB.1 Mk.9 — Version of pump covered by basic chapter

*FB.1 Mk.10 — Version of pump covered by basic chapter

***Note . . .**

The FB.1 Mk. 9 and 10 pumps differ from one another only in the angular relationship between the electrical connection and the delivery outlet union.

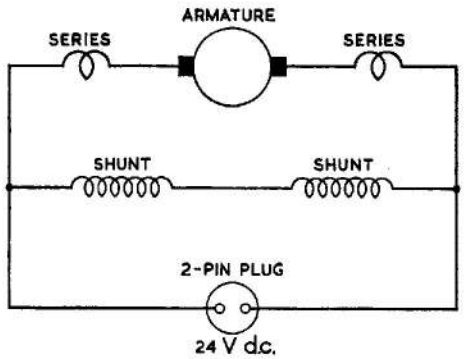

Fig. 1. Circuit diagram—FB.1 Mk.7, 8, 9, and 10 pumps

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