Chapter 4

PUMPS, FUEL, SPE.106

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Introduction

1. Type SPE.106 fuel booster pumps are electrically driven, self contained units designed to supply fuel under pressure to the aircraft engine-driven pump, or alternatively to transfer fuel from auxiliary to main tanks. Rated operating voltage is 110V d.c. Details of the differences between the mark numbers together with the Leading Particulars are given in the appendices to this chapter.

DESCRIPTION

General

2. A typical SPE.106 pump is illustrated in Fig. 2. This basic pump design is a self-contained unit comprising three main sub-assemblies :

(1) The driving motor unit, with casing.
(2) The upper base assembly.
(3) The lower base assembly.

Motor unit

3. The motor unit is a flameproof d.c. compound (Mk. 1) or series (Mk. 2 and subsequent marks) wound machine suitable for use on a supply voltage of 100/116V d.c. Brush gear is of unit construction, to facilitate assembly, comprising four brushes, two on each side in pairs, producing two brush tracks. 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 relubricated. The upper bearing is retained in a steel sleeve, and the inner race of the lower bearing is locked to the armature shaft by a screwed ring which incorporates a "thrower" to fling off any fuel which may have seeped past the main gland. The design of thrower nut fitted varies according to the mark of pump being examined (refer to appendices).

4. The complete motor unit spigots into a recess in the pump upper base casting and is enclosed in a light alloy casing, which, when bolted into position, compresses a synthetic rubber joint ring to form a fuel tight assembly.

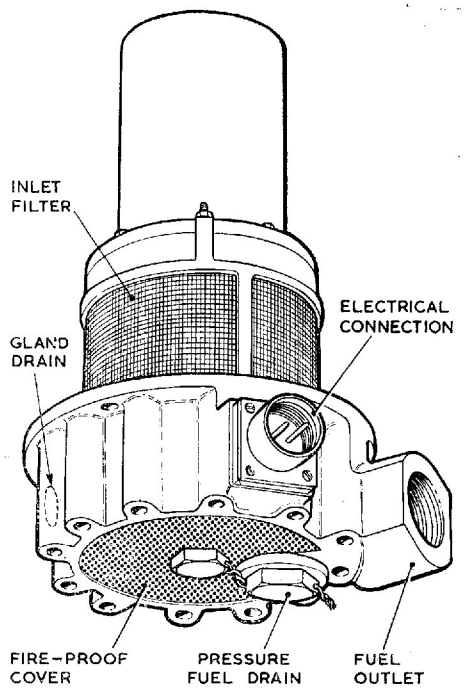

Fig. 1. External view of typical SPE.106 fuel pump

Upper base assembly

5. The upper base assembly comprises two circular end plates separated by two cored pillars. The upper end of the casting is recessed to locate the motor unit and the pillars provide (1) a combined motor vent and a conduit for the electric supply leads to the motor unit brush gear and (2) a drain duct through which fuel seepage past the main gland is drained to external piping and atmosphere. The main metallic bellows type gland preventing fuel ingress into the motor unit is also fitted into this casting.

6. The armature shaft of the motor unit extends through the main gland and carries the rotating member of the seal and a combined helico centrifugal impeller. A vapour guide cone fitted around the fuel inlet to the impeller system diverts any fuel and air vapour which may be evolved under operating conditions out of the main fuel stream through the pump.

Lower base assembly

7. The lower base casting has a circular flange with twelve 2-B.A. clearance holes for attachment of the pump assembly to the tank stud ring. It also carries the $\frac{5}{8}$ in.

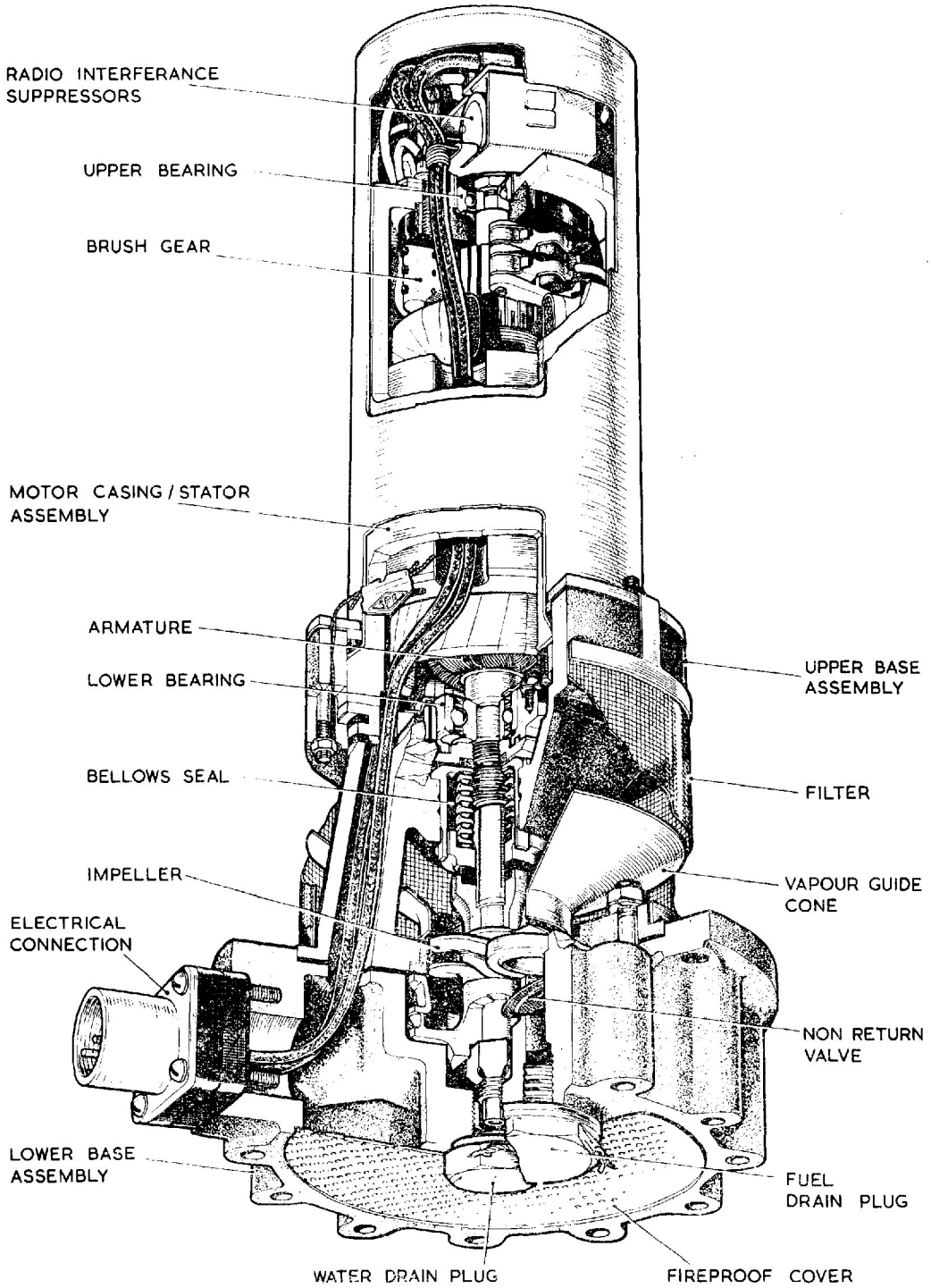

Fig. 2. Sectional view of typical SPE.106 fuel pump

B.S.P. fuel delivery outlet, a $\frac{1}{4}$ in. B.S.P. gland drain connection and a mounting for the electrical connection, all of which are outside the tank when the pump is installed. A perforated fireproof cover fits over the motor breather aperture and a $\frac{1}{2}$ in. B.S.P. plug is provided in the base of the delivery outlet to blank off the pressure fuel drain connection. A by-pass flap valve is fitted at the delivery end of the integral cast volute in the base casting to enable fuel to be drawn directly from the tank by the engine-driven fuel pump when the booster pump is idle. This valve is normally held closed by booster pump delivery pressure.

Filter

8. A cylindrical wire mesh filter completely surrounds the fuel entry to the pump and prevents the ingress of foreign matter into the impeller system and fuel delivery line.

OPERATION

9. When the pump motor is energised, fuel from the tank is drawn into the eye of the helico-centrifugal impeller system and then forced through the spiral volute in the pump base casting to the fuel outlet connection and to the delivery line.

10. Under conditions in which the flow from the booster pump is low, due to reduced engine requirements, the impellers continue to rotate at approximately normal speed without causing any excessive increase in fuel delivery pressure.

11. When the pump is idle, the delivery pressure on the underside of the by-pass valve is relieved, allowing the valve to open and enabling the engine driven pump to draw fuel direct from the tank without passing through the impeller system of the pump.

REMOVAL AND INSTALLATION

Removal

12. Before attempting to remove a pump, ensure that the tank has been drained of fuel and that the electrical supply to the pump has been switched off. The former can be checked by easing the drain plug in the delivery outlet of the lower base casting, when, if there is any fuel remaining in the tank it will have a free flow through the by-pass valve and volute passages of the pump, to the drain plug.

13. The precise method of removing an SPE.106 pump is detailed in the appropriate Aircraft Handbook. In general terms it will consist of disconnecting the fuel delivery and gland drain pipes and the electrical connection socket. The pump can then be removed by releasing the twelve nuts securing it to the tank mounting ring. Take care to support the weight of the pump during this operation. Two $\frac{1}{4}$ in. B.S.F. screws can be used in the lower base casting tapped flange holes to assist in breaking the joint with the tank mounting ring.

Pre-installation checks

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

(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 and tested as detailed in Vol. 6.

(2) Inspect the exterior of the pump for evidence of damage, security of locking wires and seals, general cleanliness and corrosion. Blend out slight areas of corrosion and apply an approved protective finish to the unprotected area.

(3) Check that transit plugs have been removed from the delivery outlet, gland drain and electrical connection and remove any tape or any other protective material from the inlet filter and motor breather.

(4) It is advisable to make a starting check on the pump before installation. Apply a 112V d.c. electrical supply through the electrical connection. The pump must start immediately. Repeat the test several times. If the pump fails to start immediately on any test it should be returned to an overhaul base for further serviceability testing using approved equipment.

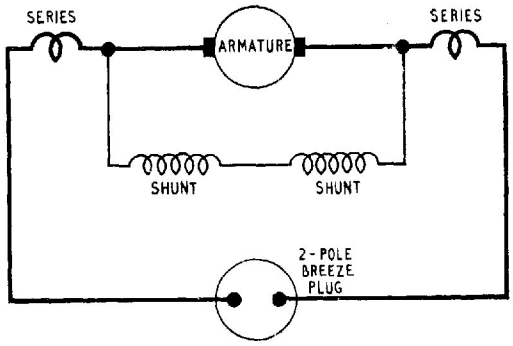

Fig. 3. Circuit diagram, SPE.106, Mk. 1 fuel pump

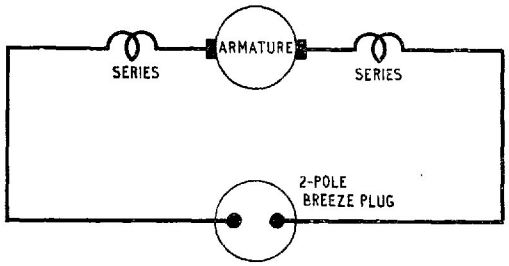

Fig. 4. Circuit diagram, SPE.106, Mk. 2 fuel pump

Installation

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

16. 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) Securing the pump with twelve 2-B.A. nuts and lock washers.

(3) Reconnecting the fuel delivery and gland drain pipes—ensuring where relevant that the open end of the latter is in a low pressure area under flight conditions.

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

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

SERVICING

Routine inspection

17. 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 fuel tank for leakage. Correct as necessary.

(2) Test the pump as detailed in para. 19-25. 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 is possible.

(3) Ensure that the by-pass valve is functioning correctly by completing the relevant tests detailed in the appropriate Aircraft Handbook.

18. 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

19. A routine electrical test in accordance with the appropriate Servicing Schedule should be carried out to ensure that the motor unit is functioning satisfactorily. These tests must be made with the motor unit on load, i.e. immersed in and pumping fuel. 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 fuel flow' test

Note . . .

The following 'no fuel flow' electrical test is only applicable to aircraft installations of the pump which include the necessary instrumentation. Where no test panel is provided, particular atten-

tion should be paid to the electrical test (para. 19) and to the operational test (para. 23).

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

(1) Close all fuel cocks between the pump and engine to ensure that no fuel can flow.

(2) Connect a suitable portable ammeter to the socket on the test panel.

Note . . .

When using a clip-on type ammeter, the tongs should be opened and closed smartly prior to use to reduce the hysteresis error.

(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.

21. 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 unit is functioning satisfactorily.

Note . . .

The graph (fig. 5) is provided as a guide to pump performance under no-flow conditions: the figures derived from it are not to be interpreted as forming a 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 fuel 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.

22. When the above tests have been completed, release the test switch and disconnect the ammeter.

Operational test

23. 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. Possible causes of failure to obtain the required performance are given in Table 1.

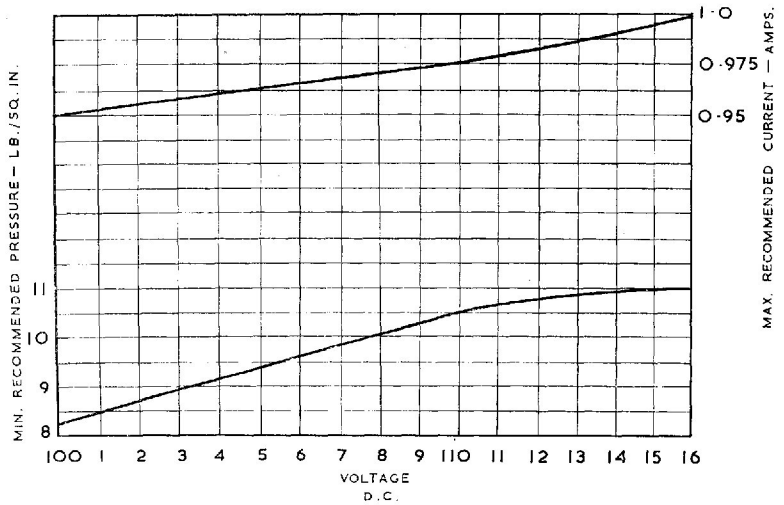

Fig. 5. " No fuel flow " electrical test graph

Gland leakage check

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

Insulation resistance test

25. Using a 500 volt insulation resistance tester, measure the insulation resistance between the 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 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 metallic bellows gland. (2) Faulty motor unit. (3) Fouling of impeller by foreign matter.	
Low delivery pressure	(1) Faulty motor unit.	
Pressure surge	(1) Tight or pre-loaded bearings. (2) Excessive loading on metallic bellows gland.	
Low insulation resistance	(1) Dampness in motor windings.	

Appendix 1

PUMPS, FUEL, TYPE SPE.106 MK. 1, 2 AND 3

Pump, fuel, Type SPE.106 Mk. 1	**Ref. 5UE/6234**
Pump, fuel, Type SPE.106 Mk. 2	**Ref. 5UE/6524**
Pump, fuel, Type SPE.106 Mk. 3	**Ref. 5UE/6524**
Voltage limits	100/116*V d.c.*
Rated voltage	110*V d.c.*
Rated output at 112*V d.c.*	100 *gal./hr.*
Delivery pressure at rated output/voltage	9·5 *lb./in².* (*min.*)
Maximum current consumption at rated output/voltage	*Mk.* 1...1·2*A*
	Mk. 2 *and* 3 ... 0·98*A*
Maximum 'no-flow' delivery pressure at 116*V d.c.*	27 *lb. in².* (*all marks*)
Minimum 'no-flow' delivery pressure	*See Fig.* 5, *basic chapter*
Electrical connection, Plessey 2CZ.140052	*Ref. No.* 5*X*/6720
Delivery outlet tapping	$\frac{5}{8}$ *in. B.S.P.*
Gland drain tapping	$\frac{1}{4}$ *in. B.S.P.*
Weight of unit	3·75 *lb.*

Type differentiation

1. Basic differences between the various marks of SPE.106 pumps are as follows :

SPE. 106 *Mk.* 1 Initial production design.

SPE. 106 *Mk.* 2 Generally similar to the Mk. 1 pump but incorporates a series wound motor unit and a different grade of carbon brush to improve motor life. A smaller metallic bellows gland with an inherent frequency at a higher speed range is fitted.

SPE. 106*Mk.* 3 Basically similar to the Mk. 2 pump but fitted with grade FM.6 brushes.

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