Chapter 15

PUMP, FUEL, B.P.1 AND B.P.1/RS SERIES

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF APPENDICES

Introduction

1. The pumps in the B.P.1 series (*fig.* 1), are of the direct drive type and are designed to fit into the base of an aircraft fuel tank, fuel collector box, or sump. They are electrically driven self contained units, operating from a nominal 24V d.c. supply.

2. These pumps are intended primarily for use as booster pumps, to supply vapour free fuel under pressure to the aircraft main fuel supply line. An alternative use is that of transferring fuel from the auxiliary to the main tanks.

DESCRIPTION

General

3. A sectional view of a typical B.P.1 pump is shown in Fig. 2. It consists of a motor supported in the upper end of an intermediate casting (upper base assembly) which in turn is secured to the base casting (lower base assembly). A gasket interposed between the upper and lower base assembly provides a fuel tight seal. A mounting flange is formed as an integral part of the base casting, and is suitably drilled for securing the pump to the aircraft fuel tank.

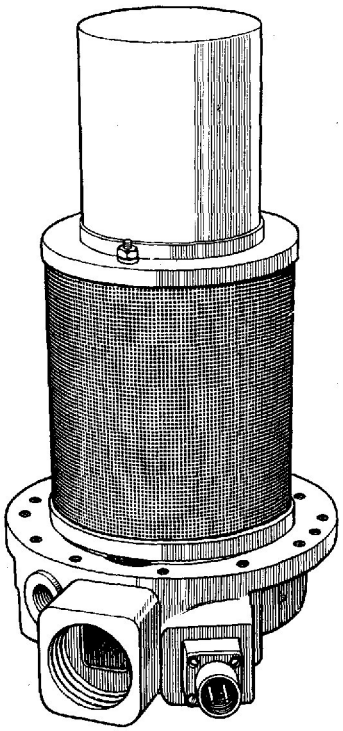


Fig. 1. General view of a typical B.P.1, fuel booster pump

4. The motor, which is immersed in fuel, is encased and hermetically sealed against the ingress of fuel. The lower end of the armature spindle extends through the upper base casting, and the pump impeller is secured to the spindle end and is positioned within a volute chamber formed by the upper and lower base castings. A sealing gland is fitted to the armature spindle between the impeller and the motor lower bearing.

Motor

5. The motor is a totally enclosed, compound wound, two pole machine, with a speed of 6,600 r.p.m. Both the rotor bearings are of the ball type, the upper bearing being secured to the motor shaft by a pinnacle nut, whilst the lower bearing is secured to the shaft by a special nut which acts as a thrower ring. The upper bearing is housed between the brush box retainer and the brush box, and the lower bearing is housed in the motor casing base plate.

6. The motor base plate is spigoted into the motor casing, and is provided with three elongated holes; two of the holes allow air to pass to the interior of the motor, and the third hole provides an entry for the motor leads from the electrical connection.

Upper base assembly

7. The upper base assembly upon which the motor is mounted, comprises in the main two circular ends separated by three hollow pillars. One of these pillars acts as a conduit for the motor input leads, one serves as a drain duct from the space between the lower motor bearing and the upper surface of the gland bellows, while the third pillar allows air to pass to the motor "breather" holes in the motor base plate. The portways between the pillars form the fuel inlet to the impeller system.

8. The upper end of the casting is machined to receive the motor and also houses the metal bellows fuel sealing gland. When the pump is assembled a flared cone, known as the vapour assister, is fitted on the motor shaft immediately below the bellows. A three-section vapour guide cone, located around the mouth of the impeller chamber, serves to carry away accumulations of fuel vapour and air developed during high rates of climb to altitude.

Impeller

9. The impeller is a twin bladed spiral fan, fitted adjacent to the vapour assister on the motor spindle, and is secured to the spindle by a hexagon nut.

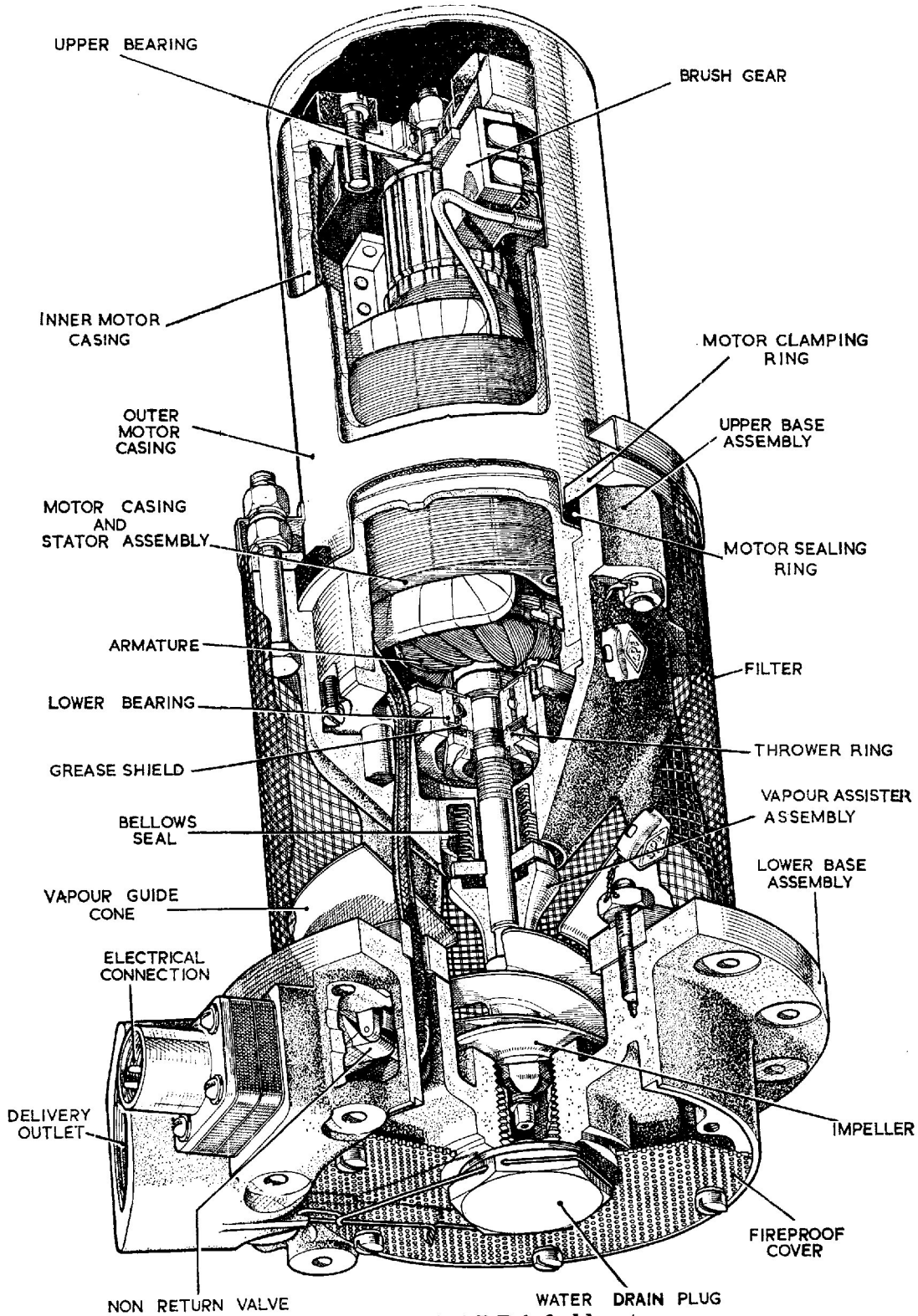
Lower base assembly

10. The base for the pump is a casting in which is formed a volute chamber leading to the pump outlet. A boss, adjacent to the outlet is machined to provide a seating for a two-pole Breeze type plug which is the electrical connection for the motor. At the other side of the pump outlet is a tapped hole which is the exit from the gland drain duct.

11. A by-pass valve is incorporated in the assembly. The valve is hinged to an annular seat let into the pump base just above the fuel outlet and is clamped in position when the upper base casting is secured to the base. Whilst the pump is in operation the pressure of fuel passing through the pump outlet prevents the valve from opening. A screwed plug, located centrally in the base permits drainage of water from the fuel tank without having to remove the pump. A fireproof cover is fitted to the bottom of the casting and secured with six screws and washers.

Filter

12. A cylindrical wire gauze filter completely



Sectional view of a typical B.P.1, fuel booster pump

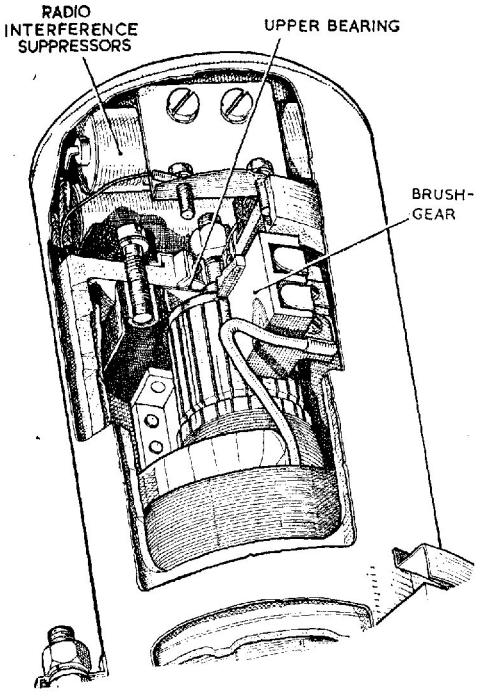


Fig. 3. Part sectional view of a typical B.P.1/RS fuel booster pump

encloses the portways in the upper base assembly, thus preventing the ingress of foreign matter to the interior of the pump. The filter is secured to the body of the pump by nuts on two of the extended bolts used to secure the joint clamping ring of the motor.

Radio interference suppressors

13. Pumps identified by the letters 'RS' have built in radio interference suppressors, which are fitted at the rear of the brush assembly. A part sectional view of a typical B.P.1/RS pump is shown in Fig. 3.

OPERATION

14. The impeller, driven at constant speed, draws fuel from the tank and forces it, via the volute in the base casting to the pump outlet and thence to the fuel line.

15. Under conditions when the pump is supplying fuel in excess of engine requirements, the impeller continues to rotate but the pressure is maintained with predetermined limits.

16. When the pump is idle, the pressure on the underside of the by-pass valve is relieved and it opens to allow fuel to pass from the tank through the pump, when the engine-driven pump is drawing fuel from the tank.

17. The type of impeller used in the pump ensures maximum performance of the pump under conditions of sudden and rapid de-aeration, due to high rates of climb or other manoeuvres. It also assists in quick recovery from vapour locking caused by the temporary removal of fuel from the vicinity of the impeller.

INSTALLATION

18. When fitting a new pump ensure that the fuel tank has been emptied before removing the old pump. This may be checked by easing off the joint of the fuel delivery pipe. If there is any fuel left in the tank it will have a free passage through the by-pass valve, which will be open when the pump is idle.

19. When it is certain that the tank is empty, disconnect the fuel delivery pipe, the gland drain pipe and the electrical supply cable from the Breeze plug. Next remove the nuts securing the pump to its seating on the fuel tank and carefully withdraw the pump from the tank. Suitable bolts, screwed into two $\frac{1}{4}$ in. B.S.F. tapped extractor holes in the pump base, will assist in this operation.

20. Before fitting the new pump make sure that it is clean externally and that any adhesive tape or plugs serving as protection over the pump apertures have been removed. In addition ensure that the jointing ring on the mounting flange of the pump is in good condition. Insert the pump through the hole in the fuel tank and tighten up the securing nuts around the mounting flange.

21. To ensure that the pump is free from foreign matter prior to finally connecting the fuel supply pipes, the electrical supply cable should be connected to the pump and the motor switched on. A small quantity of fuel put into the tank will then be delivered by the pump into a suitable receptacle, and in passing, through the pump the fuel will carry any impurities with it. When this has been done the pump outlet may be connected with the full supply line.

22. When received from Stores the gland drain exit will be fitted with a plug. When the pump has been installed and tested this plug should be removed and a drain pipe

fitted. This pipe should be installed in such a manner that the level of the pipe at no point is higher than the connection when the aircraft in on the ground or in level flight. The outlet end of this pipe must be external to the aircraft and should terminate in a low pressure area. The end of the pipe should be cut at 45 deg. with the chamfer facing aft. Failure to fit this pipe may result in fuel, which may have seeped through the bellows gland, washing away the grease from the motor lower bearing and may possibly cause failure of the bearing.

SERVICING

Electrical test

23. An electrical test must be made periodically to ascertain that the motor of the fuel pump is functioning correctly. When making such tests ENSURE THAT THE PUMP IS IMMERSED IN FUEL.

24. Having ascertained the position of the aircraft fuel pump test socket and switches by reference to the appropriate Aircraft Handbook proceed as follows :—

(1) Close all fuel cocks between pumps and engines to ensure that no fuel can flow.

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

(3) Switch on the pump by pressing the switch on the test panel, NOT THE NORMAL FUEL PUMP SWITCH, for a period of not less than half a minute.

25. Interpret readings as follows :—

(1) A steady reading not exceeding the figure quoted in the Leading Particulars in the appendix to this chapter indicates that the pump operation is satisfactory.

(2) A reading in excess of those quoted in the appendix indicates that the motor is faulty.

(3) A fluctuating reading indicates faulty contacts, defective brushes, or a faulty commutator.

(4) A zero reading is consistent with either a blown fuse, defective wiring or complete motor failure.

26. When these tests have been satisfactorily completed, release the test switch and disconnect the ammeter from the test socket.

Functional Test

27. When the electrical tests have been completed the pump should be tested to check the pressure of the fuel being delivered. The pressure value is given in the appendix to this chapter. If this value is not obtained the fault may probably be traced to a damaged impeller or incorrectly loaded gland bellows.

Periodic inspection

28. When examining the pump at the appropriate inspection periods care should be taken to conform with the following points:—

(1) Check the fuel outlet pipe coupling and Breeze plug connection for tightness.

(2) Test the pump as detailed in para. 20 to 22. If the pump is found to be faulty it must be returned to Stores and a new or reconditoned one fitted.

(3) Ensure that the by-pass valve is functioning correctly. To do this turn on the tank selector cock and the appropriate engine master cock; then switch on the pump and observe the fuel pressure as indicated by the fuel pressure gauge or fuel pressure warning light. Very low pressure or failure to extinguish the warning light indicates that the by-pass valve is not functioning correctly. In certain installations the fuel pressure warning light is set to operate at a pressure

higher than that which the pump can deliver. Therefore check the light setting before rejecting a suspected pump.

Note . . .

It is essential that the idle cut-off control should be in the CUT-OFF position throughout this test when it is applied to installations where the engines are fitted with Bendix or other type injection carburettors.

29. At the periods laid down in the appropriate Servicing Schedules all pumps are to be replaced by new or reconditioned pumps; old pumps are to be returned to stores and dealt with, according to current authorized procedure.

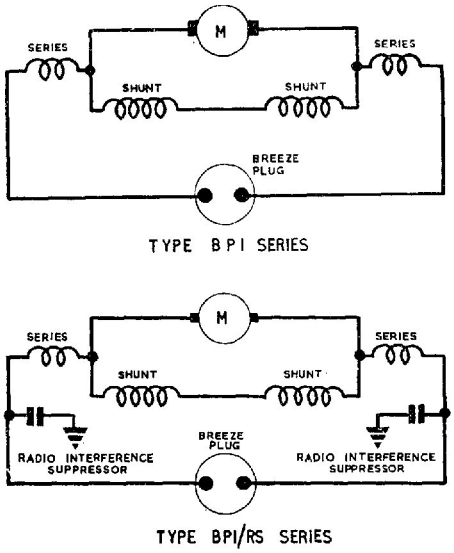


Fig 4. Circuit diagrams

Appendix 1

PUMP, FUEL, B.P.1 MK. 4

LEADING PARTICULARS

B.P. 1 Mk. 4	**Ref. No. 5UE/4828**
Motor unit	*24V d.c. flame proof*
Rated output	*200 g.p.h.*
Fuel delivery pressure (at rated voltage)	*9 lb/in² (min.)*
Rated voltage	*24V d.c.*
Maximum current consumption	*8A at 24V d.c.*
(under above condition)	*9A at 28·8V d.c.*
No flow delivery pressure (max.)	*16 lb/in² at 28V d.c.*
Electrical connector (Plessey CZ76498)	*Ref. No. 5X/6720*
Brush	
New length	*11·8 mm (0·465 in.)*
Minimum length for re-use	*10·6 mm (0·417 in.)*
Spring pressure	*4·5 oz. when compressed to 7-9 mm*
Type	*CM 5H.*
Commutator	
Minimum diameter for re-use	*24 mm (0·945 in.)*
Maximum eccentricity with shaft journals	*·001 T.I.R.*
	depth width
Undercut segments	*0·5 mm 0·91 mm*
Bearings	
Upper	*Hoffmann 106PP 2-dot fit or Fischer R6PP 2-dot fit*
Lower	*Hoffman 109PP 2-dot fit or Fischer R9PP 2-dot fit*
Delivery outlet	*1 in. B.S.P.*
Gland drain	*¼ in. B.S.P.*

Note . . .
Dismantling these pumps to inspect or replace brushes or bearings will necessitate full re-testing of the unit in accordance with the approved schedule of Acceptance Tests.

B.P.1 Mk. 4
The fuel pump, B.P.1 Mk. 4 is identical to the one described and illustrated in the main chapter.

Appendix 2

PUMP, FUEL, B.P.1 AND B.P.1/RS MK. 4—VARIANTS

LEADING PARTICULARS

B.P. 1 Mk. 4A	**Ref. No.**
B.P. 1/RS Mk. 4A	**Ref. No. 5UE/6705**
B.P.1 Mk. 4B	**Ref. No.**
B.P.1/RS Mk. 4B	**Ref. No. 5UE/6861**
Motor unit	*24V d.c. flame proof*
Rated output	200 *g.p.h.*
Fuel delivery pressure (at rated voltage)	9 *lb/in²* (*min.*)
Rated voltage	*24V d.c.*
Maximum current consumption	*8A at 24V d.c.*
(under above condition)	*9A at 28·8V d.c.*
No flow delivery pressure (max.)	16 *lb/in² at 28V d.c.*
Electrical connector (Plessey CZ76498)	*Ref. No. 5X/6720*
Suppressor unit (B.P. 1/RS Mk. 4A and 4B only)	*SPE 12336*
Brush	
New length	11·8 *mm* (0·465 *in.*)
Minimum length for re-use	10·6 *mm* (0·417 *in.*)
Spring pressure	4·5 *oz. when compressed to 7-9 mm*
Type	*E.G.O.*
Commutator	
Minimum diameter for re-use	24 *mm* (0·945 *in.*)
Maximum eccentricity with shaft journals	001 *T.I.R.*
	depth *width*
Undercut segments	0·5 mm 0·91 *mm*
Bearings	
Upper	*Hoffmann 106PP 2-dot fit or Fischer R6PP 2-dot fit*
Lower	*Hoffmann 109PP 2-dot fit or Fischer R9PP 2-dot fit*
Delivery outlet	1 *in. B.S.P.*
Gland drain	¼ *in. B.S.P.*

Note . . .

Dismantling these pumps to inspect or replace brushes or bearings will necessitate full retesting of the unit in accordance with the approved schedule of Acceptance Tests.

Type differentiation

B.P. 1 Mk. 4A
Basically as main chapter but improved grade of brush fitted.

B.P. 1/RS Mk. 4A
Generally as B.P. 1 Mk. 4A but has radio interference suppressors fitted.

B.P. 1 Mk. 4B
Basically as B.P. 1 Mk. 4A but differs only in the finish of the filter assembly which is electro-tin plated instead of Cadmium plate.

B.P. 1/RS Mk. 4B
Generally as B.P. 1 Mk. 4B but has radio interference suppressors fitted.

Appendix 3

PUMP, FUEL, B.P.1 AND B.P.1/RS MK. 5—VARIANTS

LEADING PARTICULARS

B.P. 1 Mk. 5A	**Ref. No.**
B.P. 1/RS Mk. 5A	**Ref. No.**
B.P. 1 Mk. 5B	**Ref. No.**
B.P. 1/RS Mk. 5B	**Ref. No.**
Motor unit	*24V d.c. flame proof*
Rated output	*200 g.p.h.*
Fuel delivery pressure (at rated voltage)	*9 lb/in² (min.)*
Rated voltage	*24V d.c.*
Maximum current consumption	*8A at 24V d.c.*
(under above condition)	*9A at 28·8V d.c.*
No flow delivery pressure (max.)	*16 lb/in² at 28V d.c.*
Electrical connector (Plessey CZ76498)	*Ref. No. 5X/6720*
Suppressor unit (B.P. 1/RS Mk. 5A and 5B only)	*SPE 12336*
Brush	
New length	*11·8 mm (0·465 in.)*
Minimum length for re-use	*10·6 mm (0·417 in.)*
Spring pressure	*4·5 oz. when compressed to 7-9 mm*
Type	*E.G.O.*
Commutator	
Minimum diameter for re-use	*24 mm (0·945 in.)*
Maximum eccentricity with shaft journals	*001 T.I.R.*
	depth width
Undercut segments	*0·5 mm 0·91 mm*
Bearings	
Upper	*Hoffman 106PP 2-dot fit or Fischer R6PP 2-dot fit*
Lower	*Hoffman 109PP 2-dot fit or Fischer R9PP 2-dot fit*
Delivery outlet	*1 in. B.S.P.*
Gland drain	*¼ in. B.S.P.*

Note . . .

Dismantling these pumps to inspect or replace brushes or bearings will necessitate full retesting of the unit in accordance with the approved schedule of Acceptance Tests.

Type differentiation

B.P.1 Mk. 5A

Basically as B.P.1 Mk. 4A, but is fitted with an improved armature in which windings are brazed to commutator.

B.P.1/RS Mk. 5A

Generally as for B.P.1 Mk. 5A but has radio suppressors fitted.

B.P.1 Mk. 5B

Basically as B.P.1 Mk. 4B but is fitted with improved armature in which windings are brazed to commutator.

B.P.1/RS Mk. 5B

Generally as B.P.1 Mk. 4B but has radio suppressors fitted.

Appendix 4

PUMP, FUEL, B.P.1F MK. 4A & B.P.1F MK. 5B

LEADING PARTICULARS

B.P.1F Mk. 4A	**Ref. No. 5UE/6752**
B.P. 1F Mk. 5B	**Ref. No. 5UE/**
Motor unit	*24V d.c. flameproof*
Voltage range	.... *22·0/28·8V d.c.*
Rated voltage	.... *24·0V d.c.*
Rated output (at rated voltage)	.... *200 g.p.h.*
Delivery pressure (at rated voltage/output)	.... *9·0 lb/in² (min.)*
Current consumption (at rated voltage/output)	.... *8A (max.)*
No fuel flow delivery pressure (max.)....	*16 lb/in² at 28·8V d.c.*
Electrical connection (Plessey 2CZ.140052)	.. *Ref. No. 5X/6720*
Delivery outlet	.... *1 in. B.S.P.*
Gland drain	.... *¼ in. B.S.P.*
Weight of pump	.... *7 lb.*

Type differentiation

B.P.1F Mk. 4A

Basically similar to the pump described and illustrated in the main chapter, but differs in the machining details of the lower base casting.

B.P.1F Mk. 5B

Basically similar to B.P.1F Mk. 4A but it is fitted with an improved armature in which the windings are brazed to the commutator. The finish of the filter is electro-tin instead of the cadmium plate of the Mk. 4A unit.

Note . . .

When carrying out tests on a test rig which provides variable delivery pressure control, the performance of B.P.1F series pumps should be checked against the following additional requirements:—

Voltage .... *24V d.c.*

Delivery pressure *3·0 lb/in²/min.*

Flow .... *600 g.p.h.*