Chapter 7

PUMPS, METHANOL/WATER, TYPE SPM.7 SERIES

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Introduction

1. The types SPM.7 and SPM.7/RS methanol/water injection pumps (*fig.* 1) are electrically driven, and supply methanol/water under pressure to the aircraft engine for increased performance during take-off. The pumps are designed for use on a 26V d.c. aircraft supply and have an intermittent 10-minute rating at this voltage.

2. All SPM.7 and SPM.7/RS pumps are the direct drive type, designed for installation in a vertical position in the base of a methanol/water tank. The suffix/RS denotes that the pump includes radio interference suppressors in its internal electrical circuit and this constitutes the essential difference between the two types. Details of the differences between the mark numbers of each type, together with the Leading Particulars are given in the appendices to this chapter.

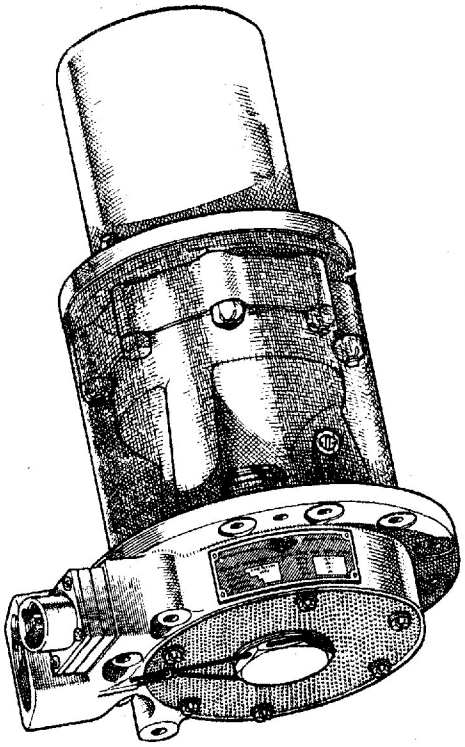

Fig. 1. External view of typical SPM.7 Series methanol/water pump

Note . . .

To simplify the text, the word 'fluid' will henceforth imply methanol/water in each instance.

DESCRIPTION

General

3. A typical SPM.7/RS pump is shown in fig. 2. This arrangement is common to all SPM.7 and SPM.7/RS pumps except for the exclusion of the radio interference suppression device at the upper end of the motor unit on all SPM.7 pumps, and differences in the seal' arrangement for various mark numbers of each type (Details are given in the Appendices at the end of this Chapter).

4. The basic pump is a self-contained unit and comprises three main sub-assemblies :—

(1) The driving motor, with casing.

(2) The upper base assembly.

(3) The lower base assembly.

Motor unit

5. The driving motor is located in the upper pump base and comprises a motor casing with the field assembly shrunk into position, the brush gear, brushes and the motor base plate. The motor is flameproof and of the totally enclosed, compound wound type using a conventional two-pole construction.

6. The armature is supported by two ball-bearings—the upper end bearing being retained in a steel sleeve. The inner race of the lower, drive-end bearing is locked to the armature shaft by a thrower ring which will fling off any fluid which has seeped past the main gland. Both bearings are pre-packed with anti-freeze/high melting point grease, during manufacture, and cannot be re-lubricated.

7. The brush gear is of unit construction and consists of two pairs of brushes in boxes mounted to a moulded carrier.

8. Ratio interference suppressor units are mounted to the top motor casing of SPM.7/RS pumps, but not to SPM.7 pumps (para. 3). The complete motor unit is enclosed in a light alloy casing and is secured to the upper base assembly by eight studs and self-locking nuts, which when tightened compress a synthetic rubber joint ring to prevent fuel ingress into the motor.

Upper base assembly

9. The upper base assembly comprises two circular ends separated by three cored pillars. The upper end of the casting is recessed to take the motor unit, and the pillars provide a conduit for the electric supply leads, a drain duct from the space between the lower motor bearing and the upper surface of the gland unit, and a motor vent. The casting also houses the main gland which prevents fluid access to the motor unit. The types of gland fitted to the various mark numbers are detailed in the appendices.

Impeller

10. The armature shaft extends through the main gland and carries the centrifugal type impeller, which is housed in a chamber formed by the two base castings. Vapour separation is assisted by either a separate component mounted above the impeller or by a formed part of the main gland, according to the pump mark number.

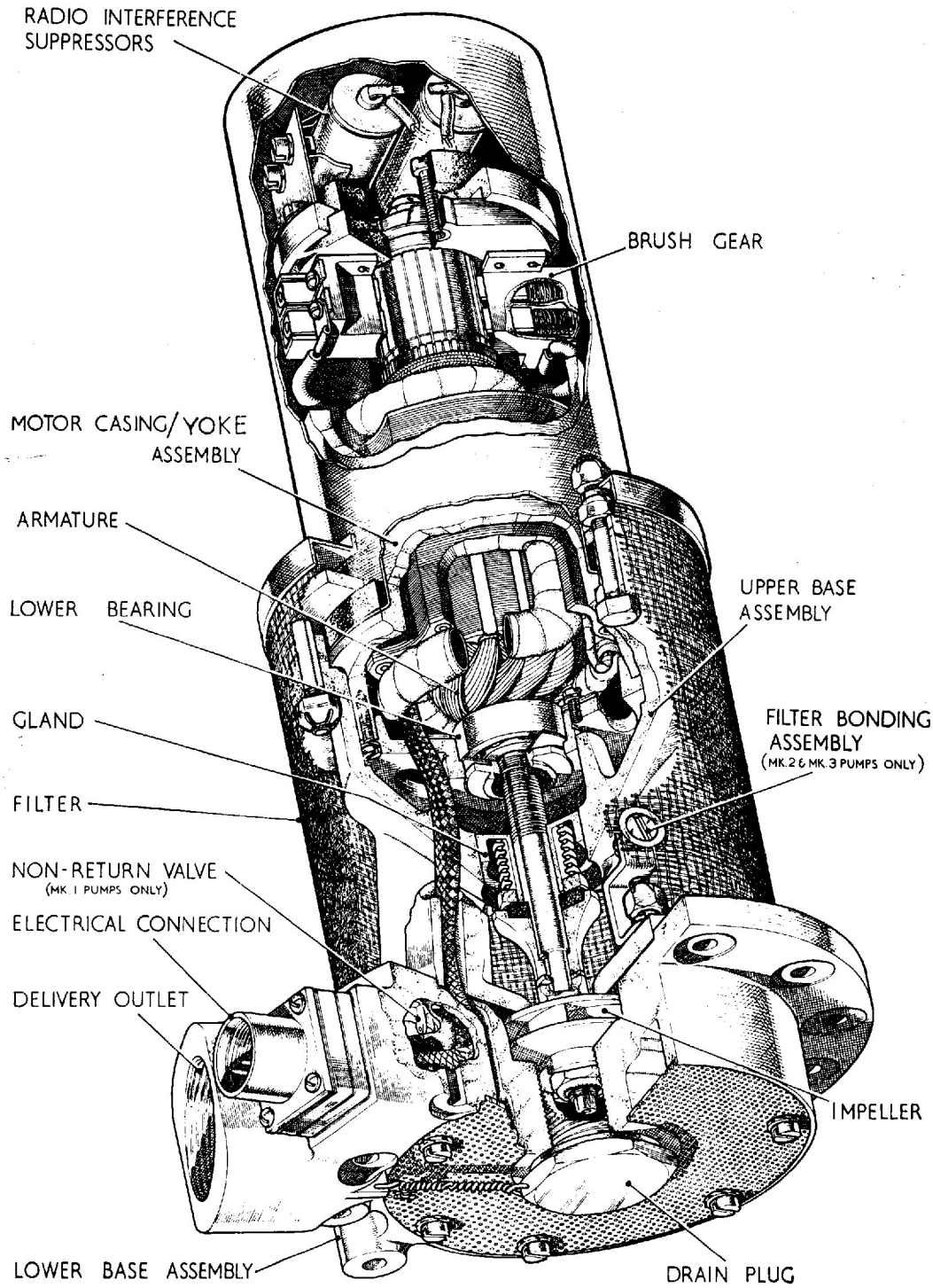

Fig. 2. Sectional view of SPM.7/RS methanol/water pump

Lower base assembly

11. The lower base assembly incorporates 1 in. B.S.P. outlet, a $\frac{1}{4}$ in. B.S.P. gland drain connection, a motor breather, and a mounting for the electrical connection, all of which are outside the tank when the pump is installed. A cast spiral volute from the impeller chamber opens into the delivery outlet; on early mark numbers of each type of pump, a by-pass flap valve is fitted at the delivery outlet end of the volute. When the pump is in operation, the flap valve is kept closed by the pressure of fluid in the delivery outlet, but it opens to give the fluid direct access to the delivery outlet when the pump is idle. On later units the by-pass valve housing is blanked off. (See appendices).

Filter

12. A cylindrical mesh filter completely surrounds the fluid entry to the pump and prevents the ingress of foreign matter into the impeller system.

OPERATION

13. When the pump motor is energised, the impeller, which is keyed to the armature shaft, rotates, and fluid is drawn through the wire mesh filter into the impeller system. The fluid is forced, through the spiral volute in the pump base casting, to the fluid outlet connection and to the delivery line.

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

15. On pumps fitted with by-pass valves, the valve will open to allow fluid to pass directly into the delivery line when the pump becomes idle. This fluid will then be drawn into the system by the engine driven pump.

REMOVAL AND INSTALLATION

Removal

16. Before attempting to remove a pump ensure that the tank has been drained of fluid and that the electric supply to the motor unit has been switched off and disconnected. For precise details of the removal procedure, relative to a particular installation, refer to the appropriate Aircraft Handbook. Generally, removal will comprise the disconnection of the pump delivery line, electrical and gland drain connections, and the separation of the lower base casting from the tank stud ring. Use two $\frac{1}{4}$ in. B.S.F. bolts in the tapped pump mounting flange holes to assist in breaking the joint at the tank mounting ring. Support the weight of the pump during removal.

Pre-installation checks

17. 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 longer periods must not be used without being dismantled, examined and tested as detailed in Vol. 6.

(2) Inspect exterior of pump for evidence of damage and security of locking wires and seals. Ensure that pump is clean externally.

(3) Check that transit plugs and/or tape have been removed from the delivery outlet, gland drain and electrical connections.

Starting test before installation

18. Immerse the pump upside down to within half an inch of the flange of the base casting for a few seconds only in a small tank of methanol/water mixture 60/40/1 (D.E.R.D.2491). Do not allow methanol/water mixture to contaminate the electrical connection or flow into the gland drain outlet during or after immersion. Remove the pump and allow the surplus fluid to drain off before turning the correct way up. Apply a 26V d.c. supply to the pump. The pump should start immediately. If it starts satisfactorily, switch off the supply and repeat the test several times.

19. Failure to start may be due to 'sticking' at the seal faces, resulting from the nature of the fluid being pumped, and can be remedied by cutting the locking wires to the central drain plug in the pump base, removing the plug, and, with a suitable tool engaged on the flats of the armature shaft (0·152 in. A/F), giving it a sharp twist to break any adhesion at the seal faces. Apply 26V d.c. supply to the pump and repeat the starting tests. When the test has been satisfactorily completed, refit the drain plug and wire-lock to the base casting. If the pump still fails to start, it must be returned to

stores and dealt with under current authorized procedure.

Note . . .

'Sticking' at the seal faces is most likely to occur on pumps fitted with metallic bellows type glands (see Appendices).

Installation

20. For detailed procedure covering installation in a particular aircraft, reference should be made to the appropriate Aircraft Handbook.

21. As a general example, installation in the aircraft of a pump which has completed the pre-installation checks will comprise the following operations:

(1) Fitting a new joint washer over the tank mounting ring.

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

(3) Reconnecting the fluid delivery and gland drain pipes, ensuring that the end of the latter faces to the rear of the aircraft to prevent possible pressurisation during flight.

(4) Reconnecting the electrical supply.

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

SERVICING

Routine inspection

22. At routine inspections the following procedure applies:—

(1) Examine all the pipe connections and wire-locking to the pump. Correct as necessary.

(2) Test the pump as detailed in para. 24-28. If the pump is found to be defective it must be removed, and a new or reconditioned unit fitted. No in-situ maintenance is possible.

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

Electrical tests

24. A routine electrical check 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 on load—i.e. with the pump immersed in and 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, or unusual running features.

Note . . .

The following 'No-fuel flow' electrical test is only applicable to aircraft with a test panel. Where no provision is made for this test, particular attention should be made to the Electrical test (para. 24) and Operational test (para. 29).

'No-fuel flow' electrical test

25. Ascertain the position of the pump test socket and switches, then proceed as follows:—

(1) Close all the 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.

(3) Switch on the pump by pressing the switch on the test panel (not the normal fluid pump switch) for a period of not less than $\frac{1}{2}$ minute. During this period the current consumption of the motor should be noted.

Note . . .

When using a clip-on-type ammeter, open and close the tongs smartly prior to use to reduce the hysteresis errors.

Gland leakage

26. During the tests an examination should be made of the gland drain exit for fuel 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.

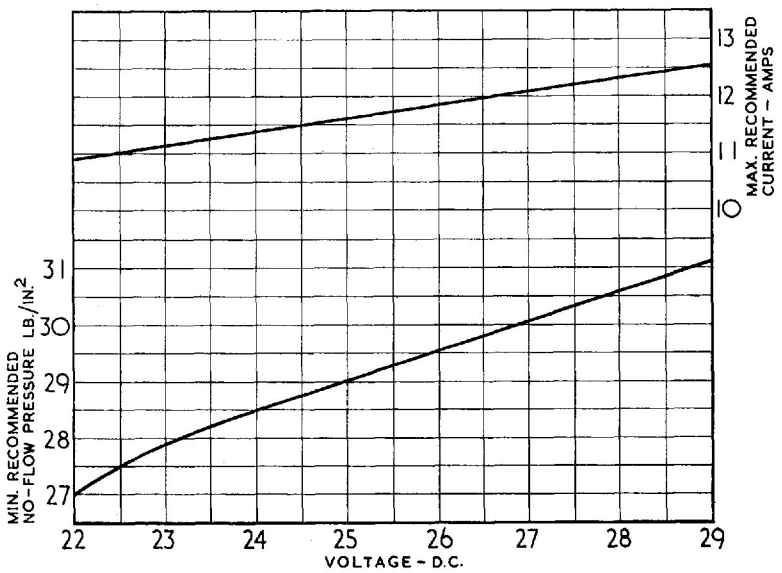

Fig. 3. 'No fuel flow' electrical test graph

27. The readings obtained during the tests can be interpreted as follows:—

(1) A steady reading not exceeding the figure obtained from the graph (*fig.* 3) for the measured applied voltage, indicates that the motor unit is satisfactory.

Note . . .

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

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

Operational test

29. Pumps removed from aircraft, unless already proved to be unsatisfactory, should be tested for proof of performance, and checked against the figures given in the appropriate Appendix to this chapter. For possible causes of failure to obtain the quoted performance, see Table 1.

Insulation resistance test

30. Using a 500-volt insulation resistance tester for SPM.7 pumps, or a 250-volt constant pressure instrument for SPM.7/RS pumps, measure the insulation resistance between the plug pins and earth. When a new pump is installed the insulation resistance must be not less than 2 megohms. After installation, due to humidity conditions at aircraft 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 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.
	(2) Insufficient pressure between gland seal faces.	
Excessive current consumption	(1) Excessive gland loading.	
	(2) Faulty motor unit.	
	(3) Moving parts (e.g., impeller) fouled by foreign matter.	
Low delivery pressure	(1) Faulty motor unit.	
Pressure surges	(1) Tight or pre-loaded bearings.	
	(2) Excessive gland loading.	
Low insulation	(1) Dampness in motor windings.	

Appendix 1

PUMPS, METHANOL/WATER, TYPE SPM.7 Mk. 1

LEADING PARTICULARS

Pump, methanol/water, Type SPM.7 Mk. 1 *Ref. No. 5UE/5272*

Voltage limits	24-28·8*V d.c.*
Rated voltage	26*V d.c.*
Rated output at operating voltage	250 *g.p.h.*
Operating time limits (intermittent rating)	24*V d.c.* 15 *min. ON:* 10 *min. OFF* 26*V d.c.* 10 *min. ON:* 10 *min. OFF* 28·8*V d.c.* 5 *min. ON:* 10 *min. OFF*
Fluid delivery pressure at operating voltage	25 *lb./in²* *min.*
Maximum current consumption (Rated output at operating voltage)	12*A*
Minimum no-flow delivery pressure	*See fig.* 3 (*basic chapter*)
Electrical connection	*Plessey* 2*CZ.*140052
Delivery outlet	1 *in. B.S.P.*
Gland drain	$\frac{1}{4}$ *in. B.S.P.*
Weight of unit	7 *lb.*

Introduction

1. The Type SPM.7 Mk. 1 methanol/water pump is similar to the pump described in the basic chapter and is fitted with a metallic bellows type gland preventing fluid entry into the motor unit. External parts of the pump are not protected against the corrosive action of the fluid vapour and consequently the fluid level in the tank should be kept such that the pump is always submerged.

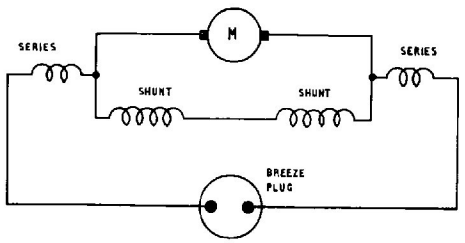

Fig. 1. Circuit diagram—SPM.7 pumps

Appendix 2

PUMPS, METHANOL/WATER, TYPE SPM.7 Mk. 2 and Mk. 3

LEADING PARTICULARS

Pump, methanol/water, Type SPM.7 Mk. 2	*Ref. No.*
Pump, methanol/water, Type SPM.7 Mk. 3	*Ref. No.*
Voltage limits	24-28·8*V d.c.*
Rated voltage	26*V d.c.*
Rated output at operating voltage	500 *g.p.h.*
Operating time limits (intermittent rating)	24*V d.c.* 15 *min. ON:* 10 *min. OFF* 26*V d.c.* 10 *min. ON:* 10 *min. OFF* 28·8*V d.c.* 5 *min. ON:* 10 *min. OFF*
Fluid delivery pressure at operating voltage	22·5 *lb./in²* *min.*
Maximum current consumption (Rated output at operating voltage)	13·5*A*
Minimum no-flow delivery pressure	*See fig.* 3 (*basic chapter*)
Electrical connection	*Plessey* 2*CZ*.140052
Delivery outlet	1 *in. B.S.P.*
Gland drain	$\frac{1}{4}$ *in. B.S.P.*
Weight of unit	7 *lb.*

Introduction

1. The Type SPM.7 Mk. 2 and Mk. 3 methanol/water pumps are generally similar to that unit described in the basic chapter but with differences as detailed below.

Menthanol/water pump Type SPM.7 Mk.2

2. The type SPM.7 Mk. 2 pump is fitted with a metallic bellows type gland preventing fluid entry into the motor unit and differs from the SPM.7 Mk. 1 in that all surfaces in contact with the fluid or vapour are protected against corrosion. The cylindrical filter is made of Monel metal and fixing nuts are of stainless steel. Improved bonding is obtained by fitting a bonding strip between the filter assembly and the upper base casting. The by-pass valve is omitted, and a blanking plate is fitted.

Methanol/water pump Type SPM.7 Mk.3

3. The Type SPM.7 Mk. 3 pump is basically similar to the Mk. 2 unit but a new dynamic seal arrangement (*fig.* 1) is fitted in place of the metallic bellows type gland. The Mk. 3 seal is designed to reduce the possibility of

adhesion at the seal faces, particularly when the pump is started up after a period of rest. On the motor unit, Nimonic steel brush springs are fitted to further resist corrosion.

Note . . .

The circuit diagram for SPM.7 Mk. 2 and Mk. 3 pumps is as shown in App. 1, fig. 1.

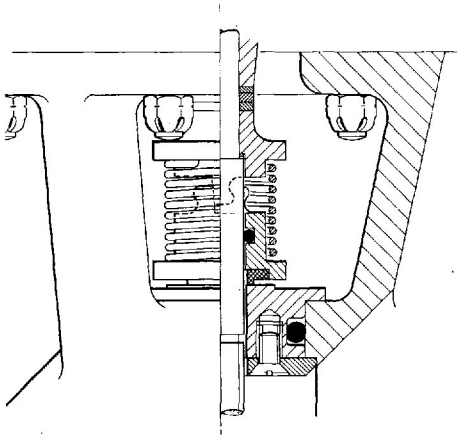

Fig. 1. Dynamic seal arrangement, SPM.7 Mk. 3 pump

Appendix 3

PUMPS, METHANOL/WATER, TYPE SPM.7/RS Mk. 1, Mk. 2 and Mk. 3

LEADING PARTICULARS

Pump, methanol/water, Type SPM.7/RS Mk. 1	.... *Ref No.*
Pump, methanol/water, Type SPM.7/RS Mk. 2	*Ref. No. 5UE/6860*
Pump, methanol/water, Type SPM.7/RS Mk. 3	.... *Ref No.*
Voltage limits	24-28·8*V d.c.*
Rated voltage	26*V d.c.*
Rated output at operating voltage	500 *g.p.h.*
Operating time limits .... (*intermittent rating*)	24*V d.c.* 15 *min. ON:* 10 *min. OFF* 26*V d.c.* 10 *min. ON:* 10 *min. OFF* 28·8*V d.c.* 5 *min. ON:* 10 *min. OFF*
Fluid delivery pressure at operating voltage	22·5 *lb./in²* min.
Maximum current consumption (*Rated output at operating voltage*)	13·5*A*
Minimum no-flow delivery pressure	*See fig.* 3 (*basic chapter*)
Electrical connection	*Plessey* 2*CZ*.140052
Delivery outlet	.... 1 *in. B.S.P.*
Gland drain	.... ¼ *in. B.S.P.*
Weight of unit	.... 7 *lb.* 4 *oz.*

Introduction

1. The Type SPM.7/RS methanol/water pumps are all similar in general design to the pump described in the basic chapter, with differences between mark numbers as detailed in para. 2. Radio interference suppressors are included in the internal electrical circuit of each unit.

Type differentiation

2. Basic differences between the various marks of SPM.7/RS pumps are as follows:—

SPM.7/RS Mk. 1

Basic design, fitted with a metallic bellows type gland preventing fuel entry into the motor unit.

SPM.7/RS Mk. 2

Generally as Mk. 1, but all surfaces in contact with the fluid or vapour are protected against corrosion, The cylindrical filter is of Monel metal with stainless steel fixing nuts. Improved bonding is obtained by fitting a bonding strip between the filter assembly

and the upper base casting. The by-pass valve is omitted and a blanking plate is fitted.

SPM.7/RS Mk. 3

Generally as Mk. 2, but a dynamic seal arrangement (App. 2, fig. 1) replaces the metallic bellows type gland, to reduce adhesion at the seal faces, particularly when starting up after a period of rest. Nimonic steel brush springs are fitted in the motor unit to further resist corrosion.

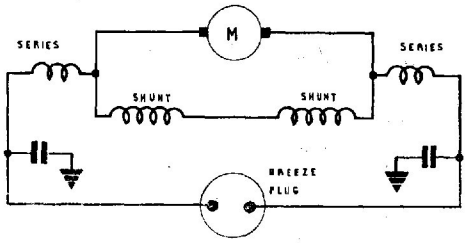

Fig. 1. Circuit diagram—SPM.7/RS pumps

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