Chapter 17

PUMP, FUEL, B.P.5, B.P.5/RS and B.P.5A/RS SERIES

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Introduction

1. Type B.P.5, B.P.5/RS and B.P.5A/RS series fuel booster pumps are electrically driven, self-contained units designed to supply fuel under pressure to the aircraft engine-driven pumps, or alternatively to transfer fuel from auxiliary to main tanks. Rated operating voltage is 24V d.c.

2. All B.P.5, B.P.5/RS and B.P.5A/RS pumps are of the direct drive type for installation in a vertical attitude in the base of the fuel tank or sump. The suffix /RS denotes that the pump includes radio interference suppressors in its internal electrical circuit and this constitutes the essential difference between the basic type designations. Details of the differences between the mark numbers of each type, together with the Leading Particulars are given in the appendices to this chapter.

DESCRIPTION

General

3. A typical B.P.5/RS pump is shown in Fig. 2. This basic arrangement is common to all B.P.5, B.P.5/RS and B.P.5A/RS pumps except for the exclusion of the radio interference suppressors from the upper end of the motor unit on all B.P.5 pumps, and differences in components used for preventing fuel ingress into the motor unit on various mark numbers of each type. Details are given in the appendices to this chapter.

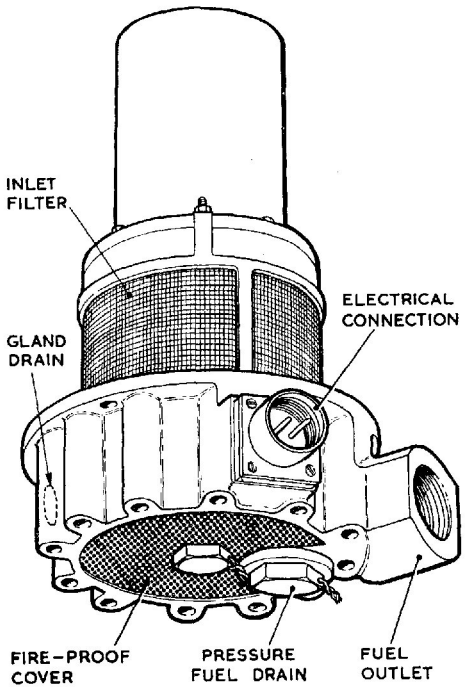

Fig. 1. External view of typical B.P.5/RS fuel pump

4. The 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

5. The motor unit is a flameproof d.c. compound wound machine suitable for use on a supply voltage of 22·0/28·8V d.c. The brush gear is of unit construction to facilitate assembly, and contains 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).

6. Capacitors are fitted to the upper end of the motor casing of B.P.5/RS and B.P.5A/RS pumps, but not to B.P.5 pumps (para. 3), to suppress interference to radio. 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.

Upper base assembly

7. The upper base assembly comprises two circular ends separated by two cored pillars. The upper end of the casting is recessed to locate the motor unit. One of the pillars provides a combined motor vent and conduit for the electric supply leads to the motor unit brush gear, and the other pillar provides 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 housed in this casting.

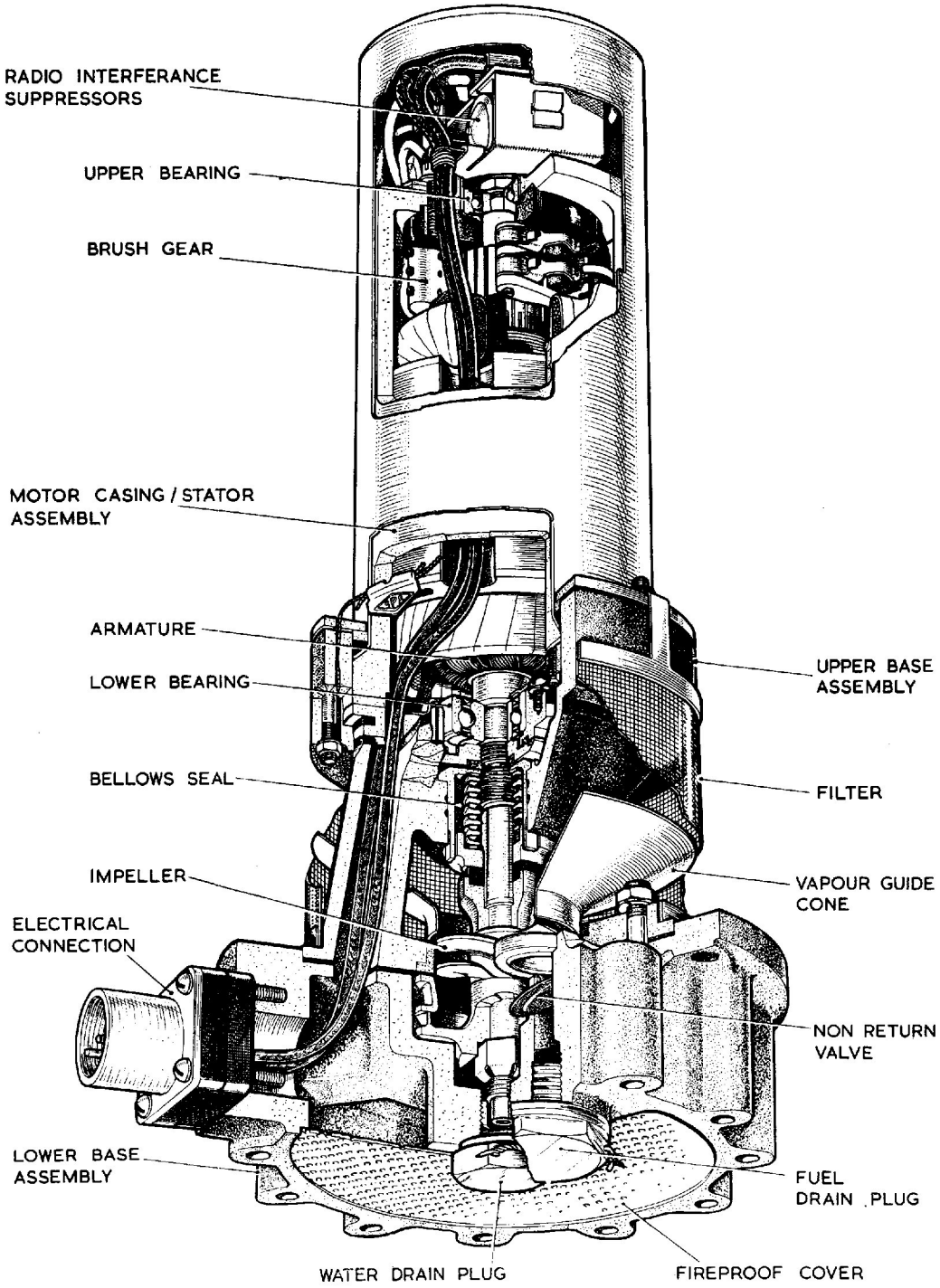

Fig. 2. Sectional view of B.P.5/RS Mk. 5 fuel pump

8. 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 type impeller. A vapour guide cone fitted around the fuel inlet to the impeller system diverts fuel and air vapour evolved under operating conditions out of the main fuel stream through the pump.

Lower base assembly

9. 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. 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 pressure.

Filter

10. A cylindrical 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

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

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

13. When the pump is idle, the delivery pressure on the underside of the by-pass valve is reduced, 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

14. 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.

15. The precise method of removing a B.P.5, B.P.5/RS or B.P.5A/RS series 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 if necessary, in the lower base casting tapped flange holes, to assist in breaking the joint with the tank mounting ring.

Pre-installation checks

16. 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, general cleanliness and corrosion. Blend out slight areas of 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 remove any tape or other protective material from the inlet filter and motor breather gauzes.

(4) It is advisable to make a starting check on the pump before installation. Apply a 24V 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 it should be returned to an overhaul base for further serviceability testing using approved equipment.

Installation

17. 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.

18. 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 lockwashers.

(3) Reconnecting the fuel delivery and gland drain pipes, ensuring when relevant that the open end of the latter faces towards the rear of the aircraft to prevent possible pressurisation in flight.

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

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

SERVICING

Routine Inspection

19. 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. 21-26. 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 relevant tests detailed in the appropriate Aircraft Handbook.

20. 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

21. 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. 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 with the necessary instrumentation. Where no test panel is provided, particular attention should be paid to the Electrical test (para. 21) and Operational test (para. 27).

22. 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 that 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.

23. 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.

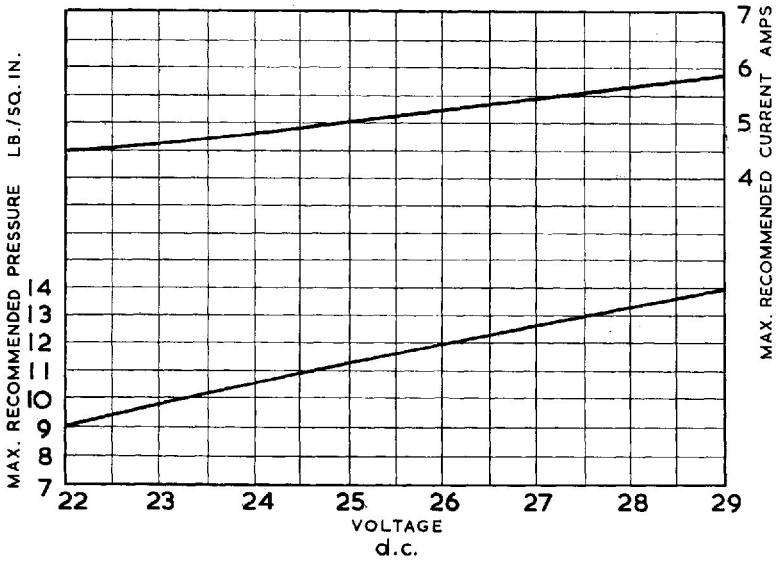

Fig. 3. 'No fuel-flow' electrical test graph

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 consistant with a blown fuse, defective switch, faulty wiring or a complete motor failure.

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

Gland leakage

25. During the above 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 from the aircraft.

Insulation resistance test

26. Using a 500V insulation resistance tester for B.P.5 pumps or a 250V constant pressure insulation resistance tester for B.P.5/RS and B.P.5A/RS pumps, measure the insulation resistance between the plug pins and earth. Where 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.

Operational test

27. Subject to the preceding tests being satisfactory, pumps that have been removed should be tested on a suitable rig, where possible, for proof of performance and the results obtained should be 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, refer to Table 1.

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 re-conditioning
Excessive current	(1) Excessive loading on metallic bellows gland (2) Faulty motor unit (3) Fouling of impeller by foreign matter	
Low delivery pressure	Faulty motor unit	
Pressure surge	(1) Tight or pre-loaded bearings (2) Excessive loading on metallic bellows gland	
Low insulation resistance	Dampness in motor windings	

Appendix 1

PUMPS, FUEL, TYPE B.P.5, Mk. 4 and 5

LEADING PARTICULARS

Pump, fuel, Type B.P.5 Mk. 4	**Ref. 5UE/6246**
Pump, fuel, Type B.P.5 Mk. 5	**Ref. 5UE/6534**
Voltage limits	22·0/28·8*V d.c.*
Rated voltage	24·0*V d.c.*
Rated output at 24·0*V d.c.*	100 *gal./hour*
Delivery pressure at rated output/voltage	9·0 *lb./in².* *min.*
Maximum current consumption at rated output/voltage ...	4·75*A*
Maximum no-flow delivery pressure at 28·8*V d.c.* ...	18·0 *lb/in².*
Minimum no-flow delivery pressure	*See Fig.* 3, *basic chapter*
Electrical connection (*Plessey* 2*CZ*.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	4 *lb.* 2 *oz.*

Introduction

1. The type B.P.5 Mk. 4 and 5 fuel pumps are basically as described in the basic chapter and are *not* fitted with radio interference noise suppressors.

Type differentiation

2. Basic differences between the various marks of B.P.5 series pumps covered by this appendix are as follows:—

B.P.5 Mk. 4

Basic design covered in this chapter.

B.P.5 Mk. 5

Generally similar to B.P.5 Mk. 4 but includes a rubber seal between the upper base and the motor unit at the cable inlet and a redesigned thrower assembly to prevent fuel ingress into the motor unit. Modified lower motor unit bearing housing assembly.

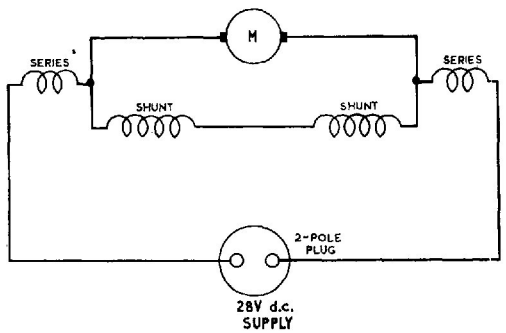

Fig. 1. Circuit diagram, B.P.5, Mk. 4 pump

Appendix 2

PUMPS, FUEL, TYPE B.P.5/RS, Mk. 4 and 5

LEADING PARTICULARS

Pump, fuel, Type B.P.5/RS Mk. 4	**Ref. 5UE/**
Pump, fuel, Type B.P.5/RS Mk. 5	**Ref. 5UE/6718**
Voltage limits	22·0/28·8*V d.c.*
Rated voltage	24·0*V d.c.*
Rated output at 24·0*V d.c.*	100 *gal./hour*
Delivery pressure at rated output/voltage	9·0 *lb./in².min.*
Maximum current consumption at rated output/voltage	4·75*A*
Maximum no-flow delivery pressure at 28·8*V d.c.*	18·0 *lb./in².*
Minimum no-flow delivery pressure	*See Fig.* 3, *basic chapter*
Electrical connection, Plessey 2*CZ.*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	4 *lb.* 6 *oz.*

Introduction

1. The type B.P.5/RS Mk. 4 and 5 fuel pumps are similar to that described in the basic chapter. Radio interference noise suppressors are included in the internal electrical circuit.

Type differentiation

2. Basic differences between the various marks of B.P.5/RS series pumps covered by this appendix are as follows:—

B.P.5/RS Mk. 4

Basic design covered in this chapter.

B.P.5/RS Mk. 5

Generally similar to B.P.5/RS Mk. 4 but includes a rubber seal between the upper base and the motor unit at the cable inlet and a redesigned thrower assembly to prevent fuel ingress into the motor unit. The method of mounting the lower motor unit bearing is also modified.

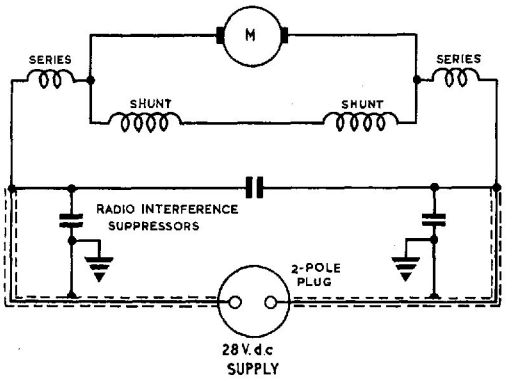

Fig. 1. Circuit diagram, B.P.5/RS, Mk. 5 pump

Appendix 3

PUMP, FUEL, TYPE B.P.5A/RS Mk. 5

LEADING PARTICULARS

Pump, fuel, Type B.P.5A/RS Mk. 5	**Ref. 5UE/**
Voltage limits	22·0/28·8*V d.c.*
Rated voltage	24·0*V d.c.*
Rated output at 24·0*V d.c.*	100 *gal./hour*
Delivery pressure at rated output/voltage	9·0 *lb./in².* *min.*
Maximum current consumption at rated output/voltage ...	4·75*A*
Maximum no-flow delivery pressure at 28·8*V d.c.*	18·0 *lb./in².*
Minimum no-flow delivery pressure	*See Fig.* 3, *basic chapter*
Electrical connection, Plessey 2*CZ.*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	4 *lb.* 6 *oz.*

1. The type B.P.5A/RS Mk. 5 fuel pump is similar to that described in the basic chapter. Radio interference noise suppressors complying with the conditions of B.S.100G are included in the internal electrical circuit.

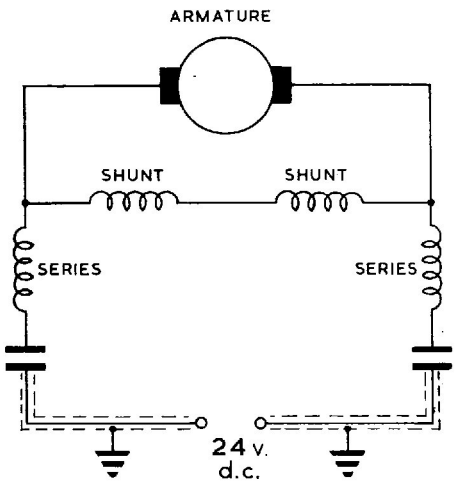

Fig. 1. Circuit diagram, B.P.5A/RS, Mk. 5