CANCELLED) DO NOT DESTROY

ADMIRALTY
AIR MINISTRY

ELECTRICAL MANUAL, ROTARY CONSUMER EQUIPMENT (AIRBORNE)
This is A.L. No. 16 to A.P.4343D, Vol. 6
Section 7. List of Chapters: *amend* the title of Chapter 7 to read "Pump, fuel, FB.160, Mk. 2", *delete* "*(to be issued later)*" after the title of the chapter and *write* "(A.L.16)" in the outer margin against the amendment. *Insert* this Chapter 7 to follow Chapter 6. *Record* the incorporation of this A.L. in the Amendment Record Sheet.

Chapter 7

PUMP, FUEL, FB 160, Mk. 2

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LEADING PARTICULARS

Stores Ref. No.	*5U/5387*
Normal delivery rating on 24 volt supply	*400 G.P.H. at 10 lb. per sq. in* *900 G.P.H. at 4 lb. per sq. in.*
Motor speed (nominal)	*6,400 r.p.m. at 24 volt.* *7,600 r.p.m. at 29 volt.*
Impeller periphery clearance	*0·003 in. (min.)*
Maximum consumption at	*22 volt* ... *8·0 amp.* *24 volt* ... *9·0 amp.* *29 volt* ... *10·0 amp.*

Introduction

1. Although the FB 160 Mk. 2 pump is basically similar to others in the FB group, the body of the pump is different in that the mounting flange is on the side of the unit, to permit mounting internally on the side of the fuel tank. The only portion of the unit to be presented to the outside of the tank is that on which are mounted the fuel outlet, motor breathing aperture, gland drains and the electrical supply plug.

2. The general instructions for repair and reconditioning (A.P.4343, Vol. 6, Sect. 16, Chap. 1, and Appendix 1 thereto) are applicable unless otherwise stated in the following paragraphs.

RECONDITIONING

3. In addition to the normal tools and workshop equipment the following demandable items will be required for reconditioning the FB 160 Mk. 2 pump;

examine brushes and remove the cooling fan, taking care not to lose its driving pin.

12. Unscrew the motor through bolts, but do not remove the brush-holder clamping bolts, and separate the commutator end-frame from the field yoke, leaving the drive end-frame in position. Unscrew the nut on the drive end of the armature shaft by gripping the commutator end bearing seating of the shaft with the special tool (*fig.* 3) whilst turning the nut. Remove the nut and its neighbouring slinger ring and extract the armature from the motor. Unscrew the retaining plates securing the drive end bearing and extract both the drive end and the commutator end bearing. These bearings may be extracted by gently tapping the inner race, using a soft brass or an aluminium drift.

13. Check the commutator for truth with a dial indicator and vee-blocks. The total permissible eccentricity is 0·001 in. (i.e., ± 0·0005 in.). Also check fits and clearances in accordance with the details given in Appendix 1 to this chapter.

14. The cleaning and examination of the field and armature coils, as well as the other motor components are to be carried out in accordance with the instructions in A.P.4343, Vol. 6, Sect. 16, Chap. 1 and Appendix 1 thereto, especially with regard to the instructions pertaining to the non-removal of the brush holder.

Bellows gland

15. Whilst the motor is separated from the pump body examine the bellows fuel gland. In instances where the bronze sealing face is damaged or worn, a new gland must normally be fitted. Instructions for fitting a new gland as well as temporary expedient measures, are given in A.P.4343, Vol. 6, Sect. 16, Chap. 1, App. 1. (the pressing tool for the gland is Part No. 00407).

ASSEMBLING

Motor

16. Fit new ball bearings in both the motor end frames, ensuring before doing so that the bearings are a satisfactory fit on the appropriate ends of the armature shaft. Fit the retaining plates on both sides of the drive end bearing, using a small amount of gasoline proof jointing compound to seal the retaining plate on the pump side of the drive end frame. Care must be taken

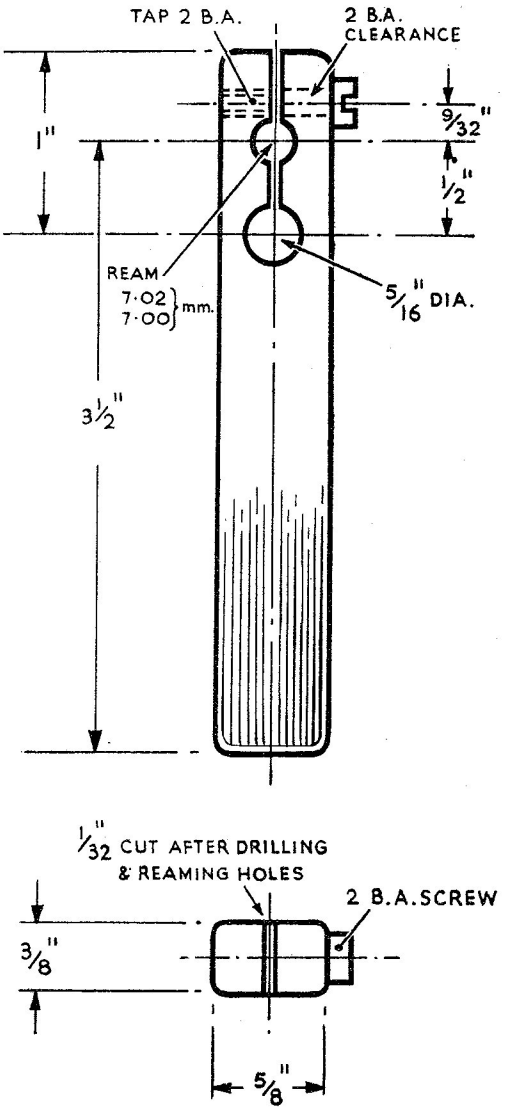

Fig. 3. Tool for gripping armature shaft

to ensure that the compound does not enter the interior of the bearing.

17. Assemble the armature into the motor body, ensuring that the driving end of the shaft is correctly seated into its bearing and then fit the insulation washer, followed by the distance piece on the commutator end of the shaft. Fit the commutator end frame and brush assembly to the motor body and tighten the motor through-bolts as evenly as possible, gently tapping the end frames around their peripheries with a rawhide mallet to ensure that the frames bed home fully. Whilst this is being done, check that the armature turns freely and

that the motor leads have been fed through the end frame without any possibility of fouling moving parts.

18. To prevent the motor through-bolts turning, lock them by peening the metal surrounding the heads of the bolts into the slots in the heads. Alternatively, on types where locking tabs are fitted, the tabs must be secured under the heads of the adjacent brush gear screws. The brush gear screws must be left loose until the through-bolts are fitted and tightened. Swing the locking tabs into position over the heads of the through-bolts, tighten the brush gear screws and push one tag of each of the locking tabs into the screwdriver slot of the adjacent through-bolt.

19. Replace the slinger ring and apply two or three drops of gasoline proof jointing compound to the shaft at the centre of the ring. Fit the spring washer and tighten its associated nut by hand, or fit the " Twicklip " where this alternative method of securing is used. Fit the driving pin, fan, tab washer, and fan securing nut, employing spacing washers where necessary to ensure clearance between the motor end frame and the fan. Tighten the fan nut with a box spanner whilst holding the drive end nut of the shaft with another box spanner. When this has been done, ascertain that the armature will still spin freely.

Armature truth

20. After fitting the fan, check the armature for truth; eccentricity must not exceed $\pm$ 0·001 in. Also check the spigot on the drive end frame for concentricity. This may be done by supporting the armature on lathe centres and gently rotating the motor body on the armature bearings, checking the truth by bringing a dial indicator to bear on the spigot. The total range of movement must not exceed 0·002 in. Unless the through-bolts have been tightened evenly, the drive end frame will not run true. If necessary, remove the fan, check that the frames are fully bedded home on the motor body, make sure that the through-bolts have been tightened and again test for truth.

Brushes

21. Fit the numbered brushes the correct way round in their respective holders. In instances where new brushes are necessary, make sure that they are properly bedded in on the commutator before assembling the motor to the pump assembly. Then fit a small pulley (*para.* 22) to the shaft and run the motor on a light load, with a suitable 24-volt supply, for a short while until at least 80 per cent. bedding of the brushes is obtained. During this trial run, the current consumption should not exceed 6·5 amp.

Torque test

22. Test the motor for power output on 24 volts and on 29 volts, using a torque test rig similar to that described in A.P.4343, Vol. 6, Sect. 16, Chap. 1, App. 1. On 24 volts a torque of 16·5 oz. in. should be obtained with a minimum speed of 6,400 r.p.m., whilst with a 29 volt supply, a torque of 19 oz. in. should be obtained with the motor running at a minimum speed of 7,600 r.p.m. With the test rig referred to, the recommended size of pulley to be fitted on the shaft will be 1-inch radius, whilst weights totalling 24 ounces should cover the requirements of both tests.

Fitting motor to pump body

23. Place the impeller driving pin in its position on the impeller shaft and slip the impeller nut on to the shaft prior to presenting the motor to the pump body; **this cannot be done subsequently** Feed the motor leads through the passage leading to the electrical supply plug on the pump body and carefully fit the motor to the pump body, using a new gasket between the motor and the pump. Make sure that the impeller shaft does not foul and damage the bellows gland during this operation. Also ensure that the motor takes up its correct angular relationship to the pump body. When this has been done, assemble the electric leads to the supply plug and secure the latter in position.

24. Fit the motor and its clamping ring, interposing a new gasket between the ring and the upper edge of the pump body. Fit the twelve screws round the periphery of the cover and tighten them evenly to ensure a fuel tight joint between the cover and pump body.

Impeller

25. Take particular care to ensure that the gland sealing face and impeller carbon ring are absolutely clean before fitting the

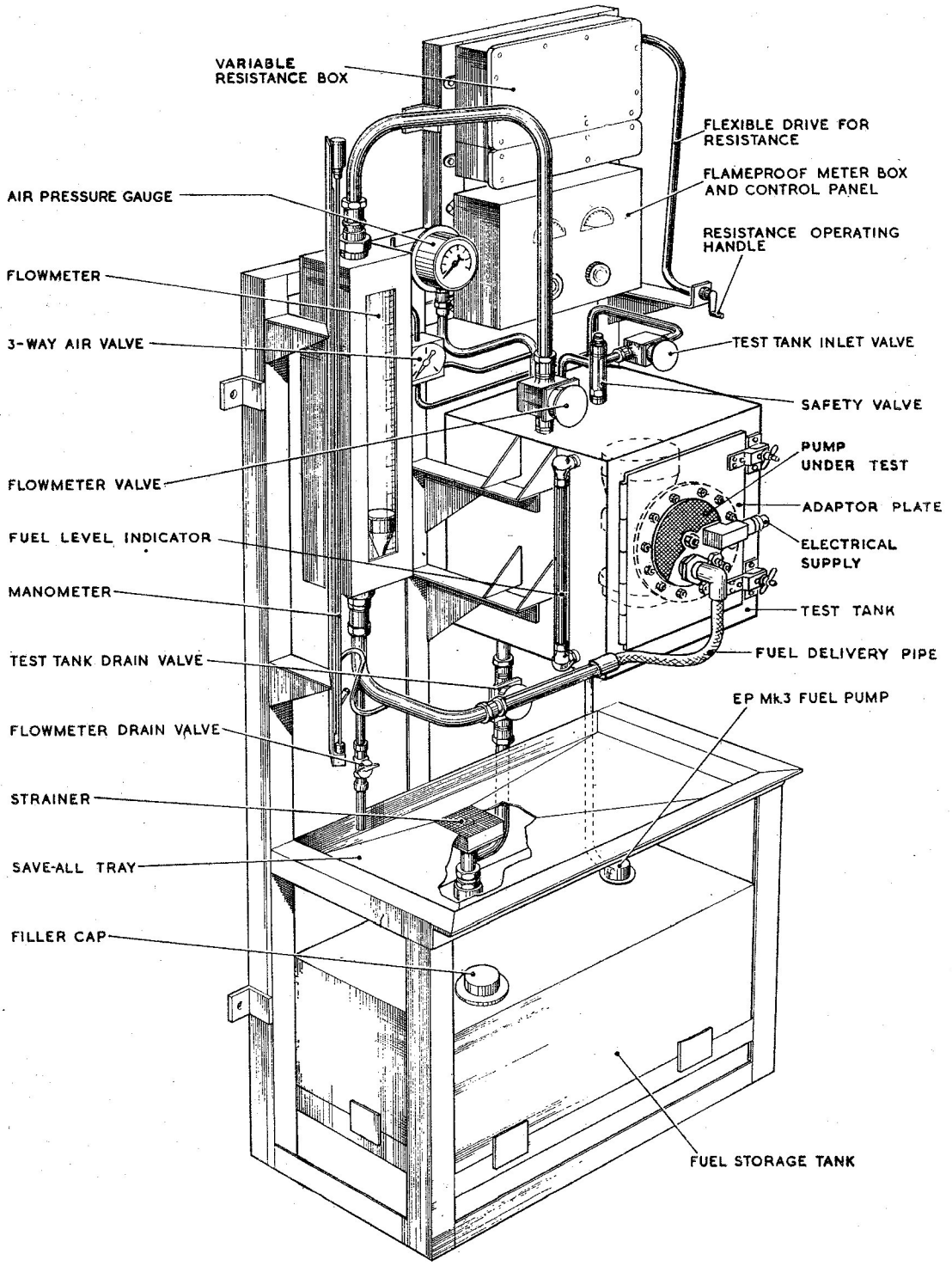

Fig. 4. Typical test rig

impeller. Grip the impeller in the gripping tool (*para.* 9) and feed the impeller on to the impeller shaft, engaging the driving pin on the shaft in one of the four slots in the impeller. Whilst this is being done, guide the impeller nut on to the tapered neck of the impeller chuck by means of a suitable soft metal implement inserted into the impeller access aperture. When the face of the impeller gripping tool touches the forward face of the impeller chamber, the impeller will be in its correct axial position on the shaft and the impeller nut must then be tightened by holding it with the tommy bar (*fig.* 2) whilst the impeller is rotated by means of the gripping tool. Care must be taken not to bend the impeller shaft during this operation.

Inlet end components

26. Press the by-pass valve into its housing, if it has been removed for any reason, check that the valve is absolutely clean and that the valve flap operates freely to sit squarely on its seating when it is in the closed position. Fit the suction cover in position, ensuring that the by-pass valve inlet is not covered and that the tips of the impeller blades are flush with the outer face of the suction cover. Screw in the cover securing studs to finger tightness and carefully turn the impeller with the fingers to ensure that there is clearance between the impeller and the throat of the suction cover. This clearance, tested with the gauge for setting suction cover clearance (Part No. 92893) or measured with a narrow feeler gauge, should not be less than 0·003 in. at any point. When this condition is satisfied, tighten the studs with a spanner and place a spacing washer (*para.* 6) on each of the five securing studs. Also screw in and tighten the hexagon headed screw (*para.* 7). Fit the suction baffle cone on the studs and, having made certain that there is a small clearance between the outer edge of the impeller and the inner end of the suction baffle, screw on and tighten up the baffle securing nuts.

Clearance and running tests

27. At this stage connect a d.c. supply to the motor through a circuit similar to that used for the torque test (*para.* 22). Set the variable resistor to its maximum value, in order to ensure a very low voltage being applied to the motor, and switch on. Then *very slowly* adjust the voltage till the motor commences to turn, noting very carefully whether there is any indication of the impeller fouling. If there is the slightest indication of fouling the current must be switched off immediately and the cause investigated.

28. Assuming that the test in the previous paragraph has been satisfactory, adjust the resistance in the supply circuit gradually to increase the voltage across the pump motor terminals from 12 up to 24 volts. Allow the pump to run for not more than five minutes at 24 volts, then switch off and disconnect from the supply circuit. At no time during this test must the current exceed 7 amp.

29. When the foregoing tests have been satisfactorily completed, insert a length of suitable wire through the small holes in the baffle cone and the hexagon headed screw in the suction cover and fix a lead seal to the twisted ends of the wire. Then, after making sure that it is perfectly clean, secure the domed fuel filter to the spider in the baffle cone by means of the central nut and spring washer.

TESTING

General

30. A test rig is being developed on the lines of that shown in fig. 4. Whilst the ultimate design may differ in details it will be basically similar and will be described in A.P.4343S, Vol. 1, Sect. 16 when finalized.

Performance test

31. Secure the FB160 pump by its mounting flange to the adapter plate so that when the plate is secured to the test tank the pump will be inside the tank and have its delivery and gland outlets, as well as the electric supply plug, presented to the exterior of the tank. Make sure that the bolts securing the adapter plate to the tank are tightened to ensure that there will be no fuel leakage, and couple up the fuel delivery pipe of the rig to the pump delivery outlet.

32. Open the test tank inlet valve and the flowmeter valve; also close the test tank drain valve. In addition make sure that the flowmeter drain valve is closed. Then switch on the electric supply to the E.P. pump in the storage tank and run the pump till the fuel level indicator on the test tank shows that the fuel level is sufficient to

immerse the pump under test. Switch off the E.P. pump and close the test tank inlet valve. The test rig will now be ready for tests as described in the following paragraphs.

33. Connect the electric supply to the FB160 pump, switch on and adjust the input to 22 volts. Adjust the flowmeter valve till a fuel pressure of 8 lb. per sq. in. is recorded on the manometer and record the rate of flow as well as the current consumption. Allow the pump to run under these conditions for one hour and again record the rate of flow and current consumption. In the event of any appreciable change of performance, repeat the test run until steady results are obtained.

34. Repeat the above test with the input voltage raised to 29 and the flowmeter valve again adjusted to give a pressure of 8 lb. per sq. in.

Gland leakage

35. Close the flowmeter valve and again run the pump on 29 volts for a short while to permit the pump to be examined for gland leakage. With gasoline (or a test substitute, such as an approved distillate) the permissible leakage from the gland is two drops per minute when the pump is running, or one drop when stationary. If tested with kerosine the permissible leakage is four drops per minute when running and two drops per minute when stationary. In instances where the leakage is only slightly in excess of these limits a cure may often be effected by running the pump on load for a period until bedding in of the rubbing surface of the gland is effected. In instances where the leakage is excessive, the tests must be discontinued and the cause of leakage investigated.

Fuel delivery

36. When the tests detailed in para. 33 to 35 have been satisfactorily completed, check the performance of the pump to the following requirements, with the flowmeter valve open.

Volts	*lb. per sq. in.*	G.*P.H.* (*min.*)	*amps* (*max.*)
22	5	500	8·0
24	9-12	400	9·0
29	10	600	10·0

Insulation

37. The insulation resistance of the motor must be tested prior to starting and after completing the performance tests (*para.* 31 *to* 36), while the motor is still warm. The insulation resistance must not be less than 2 megohms, measured on a 250-volt insulation resistance tester.

Protection

38. In all instances when the pump is not to be put into immediate service, protective caps must be fitted on the drain and delivery connections. As an alternative, where suitable caps are not available, pieces of clean rag or other suitable material may be tied over the connections to prevent the ingress of foreign matter. In addition, precautions must be taken to avoid the possibility of damage to either the fuel filter or the motor breather gauze.

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APPENDIX I — **SCHEDULE OF FITS, CLEARANCES, AND REPAIR TOLERANCES (FB.160, Mk. 2, FUEL PUMP)** — **(All dimensions in inches)**

Ref. No. on Diagram 1 (1)	Part and Description (2)		Dimension, New (3)	Permissible Worn Dimension (4)	Clearance, New (5)	Permissible Worn Clearance (6)	Remarks (7)
	MOTOR ASSEMBLY						
1	BRUSH LENGTH	Measured to centre of radius	0·415 / 0·435	0·330	—	—	Brush shortens approx. 0·010 in 250 hours
2	BRUSH SPRINGS	Free length Compressed length Load in position	1·287 0·575 4·5 oz.	— 0·700 2·75 oz.	— — —	— — —	Pigtail is not taut at the permissible worn dimension quoted. Actual length of pigtail in spring 1·00
3	BRUSH CLEARANCE IN GUIDES		—	—	0·002	0·007	
4	COMMUTATOR		1·360 / 1·377	1·312	—	—	Diameter reduces approx. 0·001 in 250 hours
5	BALL BEARINGS	End float between inner and outer races	—	—	0·002	0·004	
	PUMP ASSEMBLY						
6	IMPELLER CHAMBER	Bore of bush	1·6255 / 1·628	1·631	0·013	0·021	Should not be worn by contact but may be scratched by abrasives in fuel. Minimum radial clearance (allowing for impeller eccentricity) should not be less than 0·003
	IMPELLER	Diameter	1·6115 / 1·6125	1·610	0·0165		
7	IMPELLER	Maximum eccentricity	0·004	—	—	—	Indicator reading

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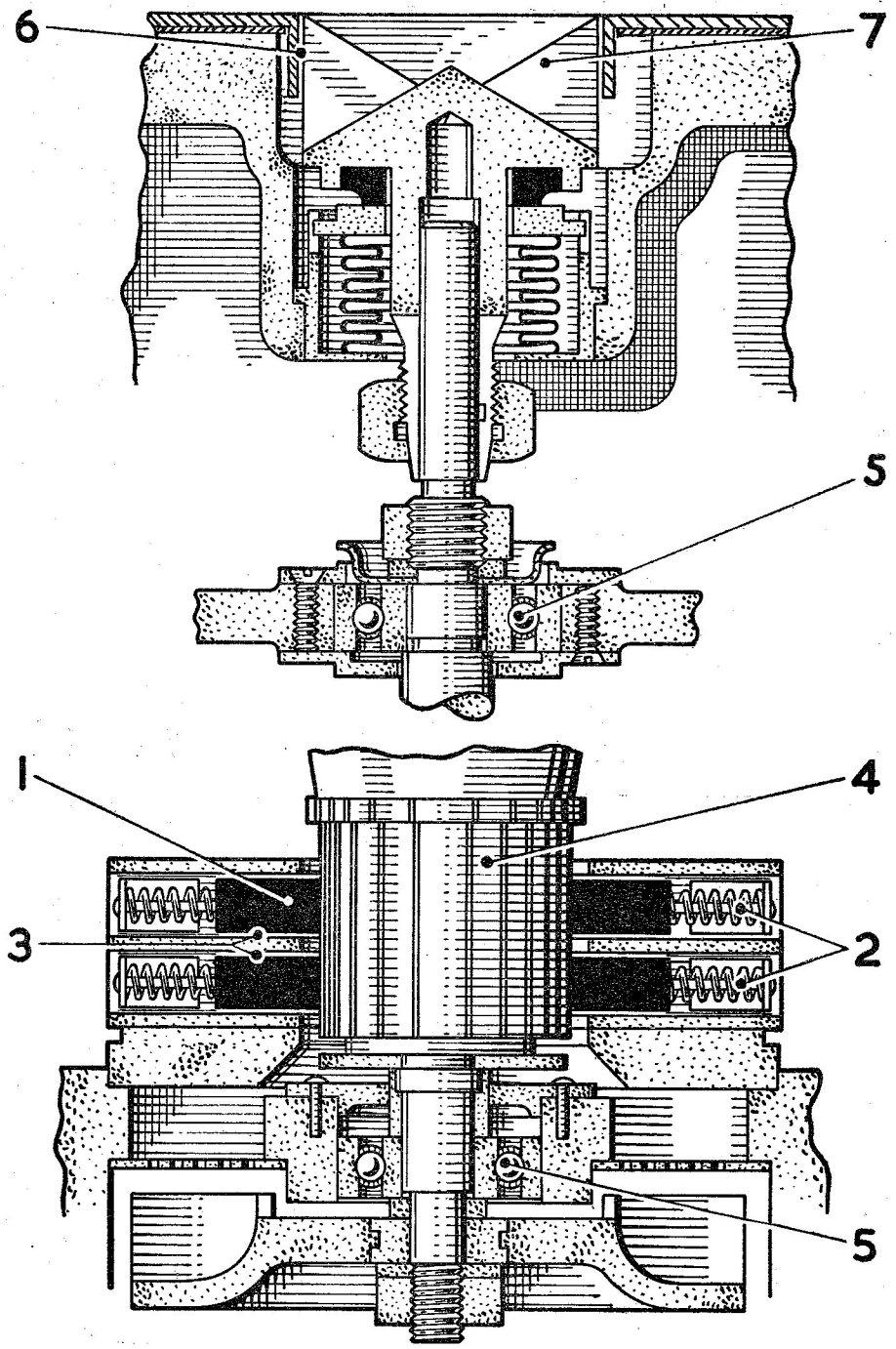

Diagram 1. Pump, fuel, F.B. 160, Mk. 2

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