May 6, 1958 J. W. DICKEY 2,833,221

ELECTRO-MAGNETIC PLUNGER PUMP

Filed Oct. 27, 1954 2 Sheets-Sheet 1

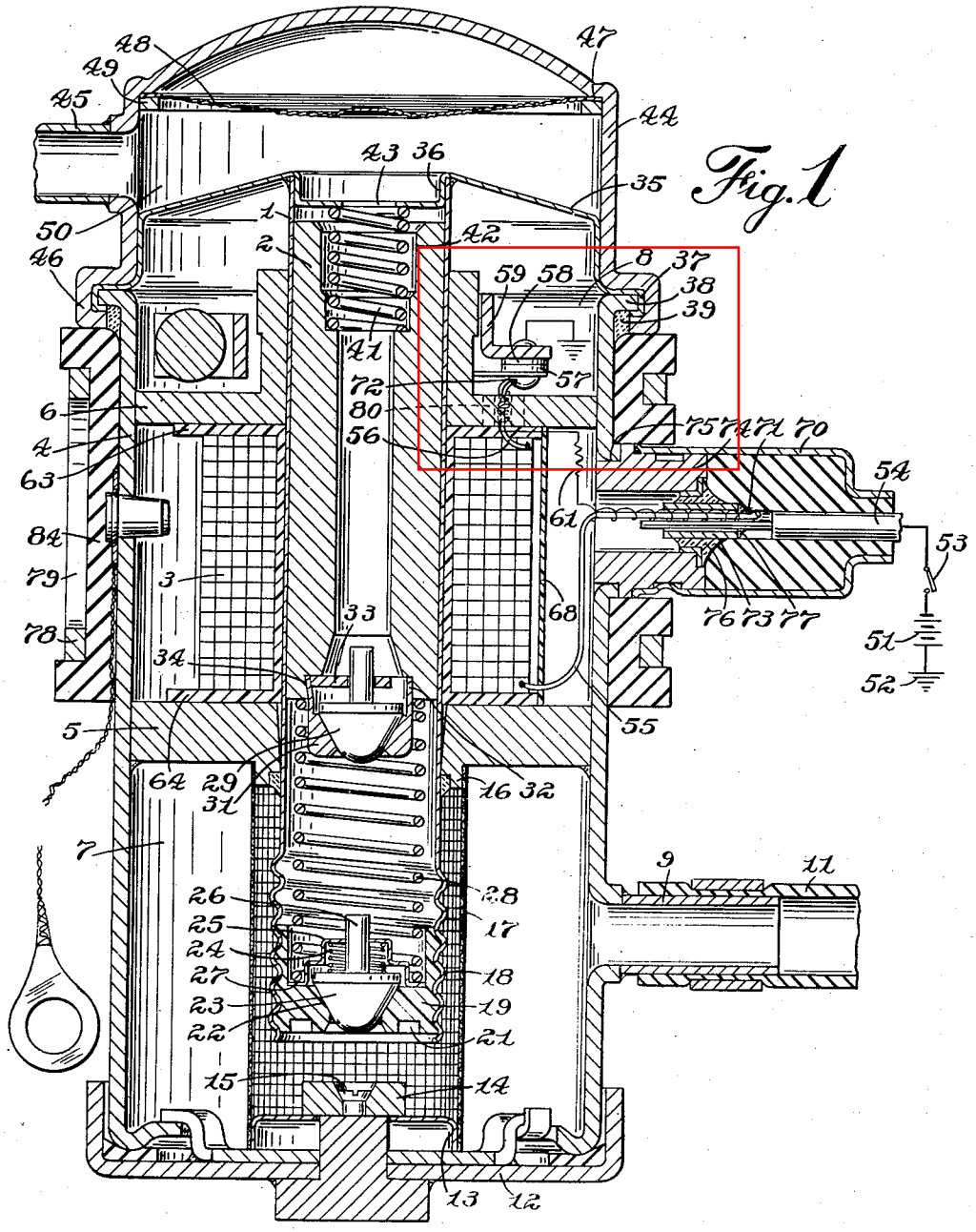


Fig. 1

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Fig. 6

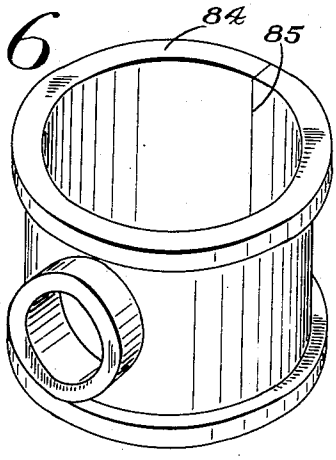



Fig. 5

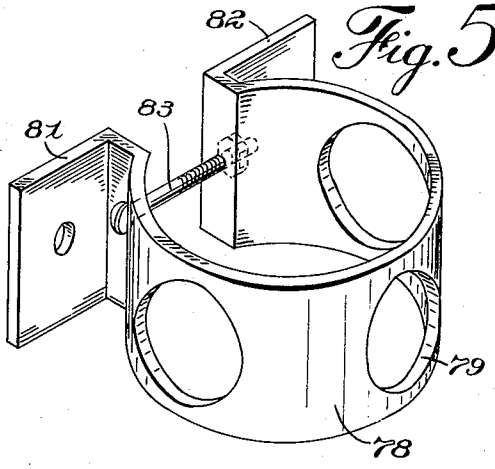
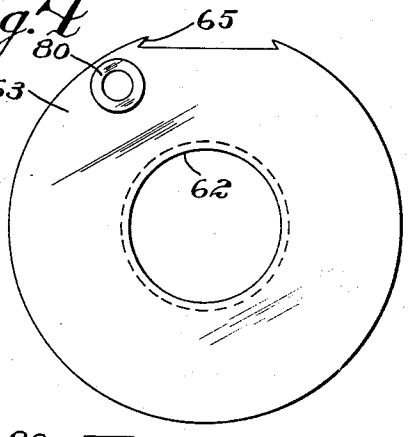



Fig. 4



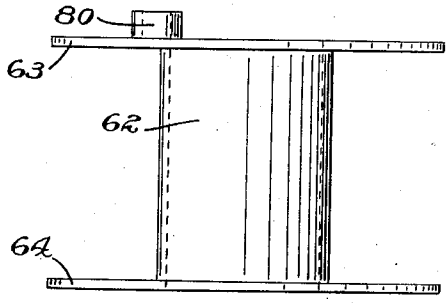




Fig. 3

Fig. 2

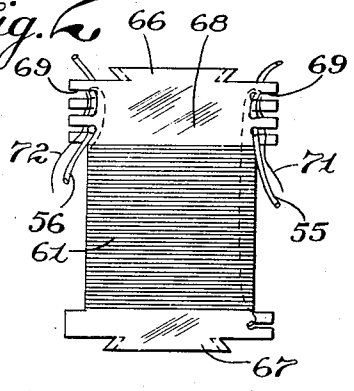




Fig. 2a

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# ELECTRO-MAGNETIC PLUNGER PUMP

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Application October 27, 1954, Serial No. 464,940

5 Claims. (Cl. 103—53)

The present invention relates to an electro-magnetic plunger pump and more particularly to a reciprocating spring-actuated piston pump for transferring liquids.

This invention is an improvement on the pump disclosed in the patent to Dickey et al. 2,472,067 by incorporation therein of a number of novel features which cooperate to secure the objective of a pump which is of simple and economical design, and is readily assembled by methods which insure permanently tight joints free from leakage or contamination.

It is another object to provide such a device which is adapted for easy installation in various positions and attitudes.

It is another object to provide such a device incorporating convenient means for adjusting the output pressure of the pump.

It is another object to provide such a device which is hermetrically sealed by a soldering operation in which there is no possibility of solder or flux gaining access to the interior of the pump.

It is another object to provide such a device including an air dome chamber which may be sealed and tested prior to assembly on the pump.

Further objects and advantages will be apparent from the following description taken in connection with the accompanying drawing in which:

Fig. 1 is a vertical substantially mid-sectional view of a preferred embodiment of the invention, parts of the electrical circuit being shown diagrammatically;

Fig. 2 is a detail in elevation of the shunt resistor element;

Fig. 2(*a*) is an end view of the core for the same;

Fig. 3 is a side elevation of the spool for holding the solenoid coil;

Fig. 4 is a top view of the same;

Fig. 5 is a detail in perspective of the mounting clamp for the pump; and

Fig. 6 is a perspective detail of the elastically deformable sleeve embracing the pump within the mounting bracket.

In Fig. 1 of the drawing there is illustrated a hollow cylinder **1** of suitable non-magnetic material within which a hollow magnetic piston **2** is slidably mounted. An electro-magnet **3** surrounds the cylinder and piston and is mounted coaxially within a cylindrical casing **4** of magnetic material by means of annular pole pieces **5** and **6** at the ends thereof. The casing **4** extends beyond the pole pieces **5** and **6** to provide an inlet chamber **7** and an interrupter chamber **8**, and the non-magnetic cylinder **1** extends at its ends beyond the pole pieces **5** and **6** into the inlet and interrupter chambers respectively.

The inlet chamber **7** is provided with an inlet nipple fitting **9** for attachment of hose **11**, and is closed by a detachable cap **12** which carries a mounting cup member **13** on which a permanent magnetic collector element **14** is suitably fixed as indicated at **15**. The pole piece **5** is formed with a shoulder **16** having the same diameter as the mounting cup **13**, and a cylindrical filter



**17** is frictionally mounted at its ends on said cup member and shoulder to thereby filter the incoming liquid prior to its entry into the pump cylinder **1**.

The input end of the cylinder **1** is internally threaded as shown at **18**, and a valve nipple **19** is threaded into the cylinder for longitudinal adjustment therein, which may be facilitated by the provision of spanner sockets **21** in its lower end. Nipple **19** is formed with a tapered valve seat **22** against which a check valve plunger **23** is pressed by a valve spring **24** which is maintained under slight compression by a cup-shaped spider member **25** forming a guide for the valve stem **26** and having a flange **27** seated in a counter-bore in the nipple **19**.

A compression spring **28** is located within the lower end of the pump cylinder **1**, resting on the flange **27** of spider **25** and bearing at its upper end on the lower end of the piston **2** whereby said spring biases the piston toward the discharge end of the cylinder as illustrated. A second check valve **29** is retained on the lower end of the piston **2** by means of a seat member **31** having a skirt **32** which is expanded into an undercut counter-bore in the end of said piston. This is conveniently accomplished by introducing a spider guide member **33** which is originally of dished formation, and flattening it out in order to expand said skirt at circumferentially spaced points as illustrated at **34**.

A cup-shaped partition member **35** is provided with a centrally located cylindrical shoulder **36** which is forced into the upper end of the cylinder **1** and preferably soldered or brazed thereon in order to form a tight seal. The rim **37** of the partition member **35** is spun over a lip **38** on the upper end of the casing member **4** and is soldered thereto as indicated at **39** to form a closure for the interrupter chamber **8**. A buffer spring **41** is preferably located in a counter-bore **42** in the upper end of piston **2** and bears against the partition member **35** adjacent a central opening **43** therein, to cushion the reciprocation of the piston at times when it may be operated while the pump is empty.

A domed cap member **44** provided with an outlet nipple fitting **45** is mounted on the outlet end of the casing **4** by bending its rim **46** over the lip **38** of the casing and soldering the joint as shown at **39** simultaneously with the attachment of the partition member **35**. The cap **44** is formed with an annular shoulder **47**, and an impervious circular flexible diaphragm **48** is seated on said shoulder and maintained in sealed connection therewith by means of a sealing ring **49** having a press fit against said shoulder, thereby forming an output chamber **50** in said cap between the partition **35** and diaphragm **48**.

In the manufacture of the pump, the diaphragm **48** is mounted and sealed in the cap member **44** prior to assembly of the cap, so that the tightness of the seal may conveniently be tested while disassembled. Assembly is then accomplished by seating the partition member **35** and cap **44** in nested relation on the lip **38** of casing **4**, and crimping the edges thereof around said lip as shown. This operation makes a tight joint even without the solder seal, whereby any possibility of solder or flux entering the pump during the soldering operation is prevented.

Means for energizing the solenoid **3** intermittently to cause reciprocation of the plunger **2** is provided comprising a battery **51** which is grounded at **52** and connected through a switch **53** and cable **54** to one terminal lead **55** of the solenoid. The other terminal lead **56** is connected to a fixed contact **57** which cooperates with a movable grounded contact **58** mounted on a cradle **59** carrying a permanent magnet which causes the cradle to tilt and closes said contacts when the piston **2** approaches the upper end of its stroke. This interrupter mechanism is the

same in structure and operation as that shown and described in Patent 2,472,067 above referred to, so that further description thereof is deemed unnecessary.

The terminal wires **55** and **56** of solenoid **3** are shunted by a resistor **61** which is preferably constructed as best shown in Fig. 2. The solenoid **3** is mounted on a spool **62** (Figs. 3 and 4) of suitable insulating material having terminal flanges **63**, **64** provided with dove-tail notches **65** receiving the complementarily formed ends **66** and **67** of a strip of insulating material **68** forming the core on which the resistor **61** is coiled. The upper end of the mount **68** is preferably provided with slotted recesses **69** forming convenient anchorages for the terminal wires **55** and **56** of the solenoid, as well as for the ends **71** and **72** of the resistor which are wound around said terminal wires and soldered thereto.

In order to form a hermetically sealed connection to the battery cable **54** a metallic tube **73** is sealed within a nipple **74** suitably mounted in a fluid tight manner in an opening **75** in the side of the casing **4**. This sealing connection is preferably formed by means of a fused vitreous material as indicated at **76** forming a permanent rigid and leak-proof joint which also insulates the tube **73** from the casing. The end of the cable **54**, and the terminal wire **55** with the end **71** of the resistor wound around it are passed through the tube **73** in overlapping relation, and are rigidly sealed together by a single soldering operation as shown at **77**. The junction of the battery cable to the pump leads is preferably covered by a weather-proof enclosure **70** in the form of a metallic sleeve with a core of rubber or the like formed around the junction. The opposite terminal wire **56** of the solenoid with the end **72** of the resistor wire wound about it is led through a nipple **80** formed on one end flange **63** of the spool **62**, traversing the pole piece **6** and attached by a single soldering operation to the fixed contact **57**.

Means are provided for mounting the pump conveniently in the most advantageous relation to the inlet and outlet conduits of any particular installation. For this purpose a clamping bracket **78** (Fig. 5) is formed as a band for surrounding the body of the pump having a plurality of openings **79** for alternatively receiving the nipple **74** to thereby permit three optional orientations of the pump. The bracket **78** is formed with laterally extending feet **81**, **82** for attachment to a fixed support in any suitable manner, and is clamped to the pump by a bolt **83** or the like.

In order to insure quietness of operation a flanged split bushing **84** of elastically deformable material is preferably interposed between the bracket **78** and the body of the pump.

In installing the device, the bracket **78** is applied to the pump with the cushioning sleeve **84** contained therein, in such position as to orient the pump most conveniently to the input and output conduits, thus reducing the necessity for angular pipe fittings. It will be undersood that the bracket is sufficiently elastic to be expanded as necessary for the insertion of the nipple **74** in the selected opening **79**. The sleeve **84** may be sufficiently elastic to be applied by stretching but if desired may be slit as indicated at **85** to permit its application to the pump.

After the pump has been mounted and the tubular and electrical connections completed, closure of switch **53** causes energization of electro-magnet **3** which accordingly draws the plunger **2** downwardly compressing the spring **28** until the contact **58** is permitted to move away from the fixed contact **57**. The spring **28** then actuates the piston on its discharge stroke, at the end of which contacts **57**, **58** are again closed. The fluctuations of pressure in the output chamber **50** are cushioned by the air dome provided by the diaphragm **48**.

Adjustment of the output pressure is readily effected by removing the cover **12** and rotating the nipple **19** by means of an appropriate spanner. By this means, the pressure of the spring **28** is adjusted to provide the desired output pressure of the pump.

Although but one embodiment of the invention has been shown and described in detail it will be understood that changes may be made in the design and arrangement of the parts without departing from the spirit of the invention.

I claim:

1. In an electromagnetic pump a cylinder of non-magnetic material, a hollow magnetic piston slidably mounted therein, an electromagnet surrounding the cylinder and piston, a cylindrical casing of magnetic material, annular pole pieces at the ends of the electromagnet supporting the magnet and cylinder assembly coaxially in the casing, said casing extending beyond both said pole pieces to provide an inlet chamber at one end and an interrupter chamber at the other end formed with a terminal radial lip, said cylinder extending into both said chambers; a cup-shaped partition member formed with a centrally located cylindrical shoulder having a sealed connection to the outlet end of the pump cylinder, and having its rim tightly embracing said lip on the end of the casing, thereby forming a closure for the interrupter chamber, a domed cap member having a rim tightly embracing the rim of the partition member and the lip of the casing and externally sealed to the casing, cooperating with said partition member to form an output chamber, means for yieldingly biasing the piston toward the output chamber, means for intermittently energizing the electromagnet to draw the piston toward the input chamber and valve means for transferring liquid from the input chamber to the output chamber responsive to reciprocation of the piston; including further a flexible impervious diaphragm and means for hermetically sealing the rim of the diaphragm to the interior of the cup in spaced relation to the dome, to thereby provide an expansible dome chamber partitioned off from the output chamber.

2. An electromagnetic pump as set forth in claim 1 in which the means for energizing the electro-magnet comprises a source of current, a conductor connecting said source to one terminal wire of the electromagnet, an insulating nipple sealed in the wall of the casing, said conductor and wire traversing the nipple in opposite directions in overlapping relation, and a fused metallic seal closing the nipple and uniting said conductor and wire.

3. An electromagnetic pump as set forth in claim 2 including further a resistor connected in parallel with the electromagnet, one terminal lead of the resistor also traversing said nipple and being united with the conductor from the power source and the terminal wire of the electromagnet by said fused metallic seal.

4. An electromagnetic pump as set forth in claim 1 in which the end of the cylinder which extends into the input chamber is internally threaded, and the means for biasing the piston toward the output chamber comprises a compression spring bearing at one end on the piston, and a nipple threaded in the input end of the cylinder carrying an input check valve and forming an adjustable abutment for the other end of said spring.

5. An electromagnetic pump as set forth in claim 1 in which the inlet chamber of the casing is provided with an inlet nipple fitting, and the domed cap member is provided with an outlet nipple fitting, and including further a mounting bracket embracing the pump casing with freedom for rotary adjustment, and clamping means for holding the pump in adjusted position.

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