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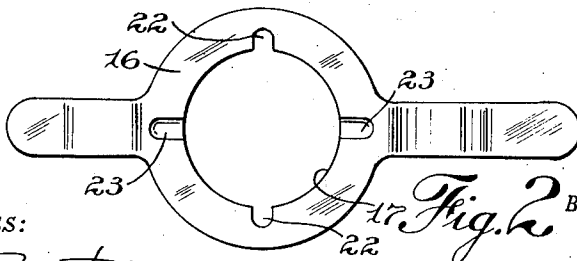
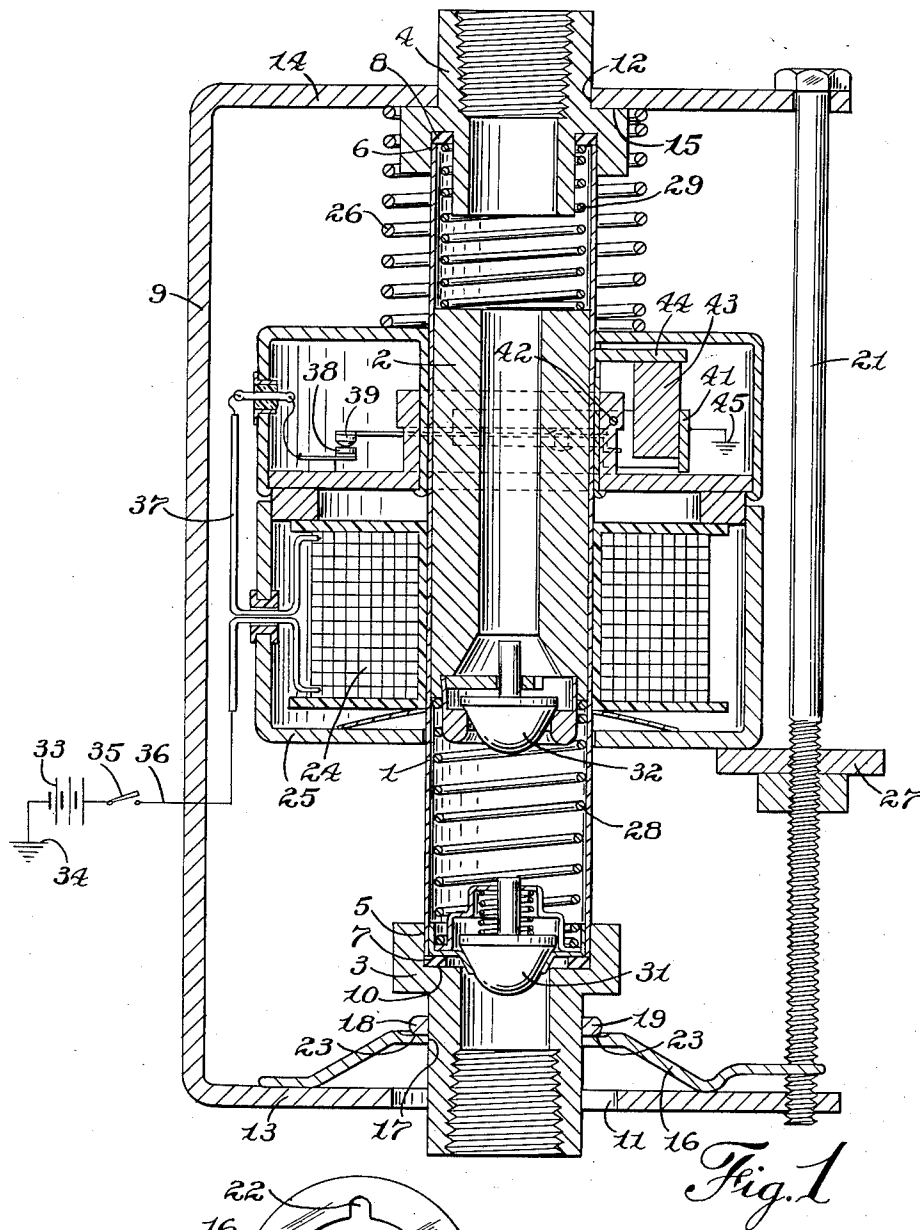
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2,768,580

RECIPROCATING ELECTROMAGNETIC PUMP

Filed Jan. 25, 1955

3 Sheets-Sheet 1



WITNESS:

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3 Sheets-Sheet 2

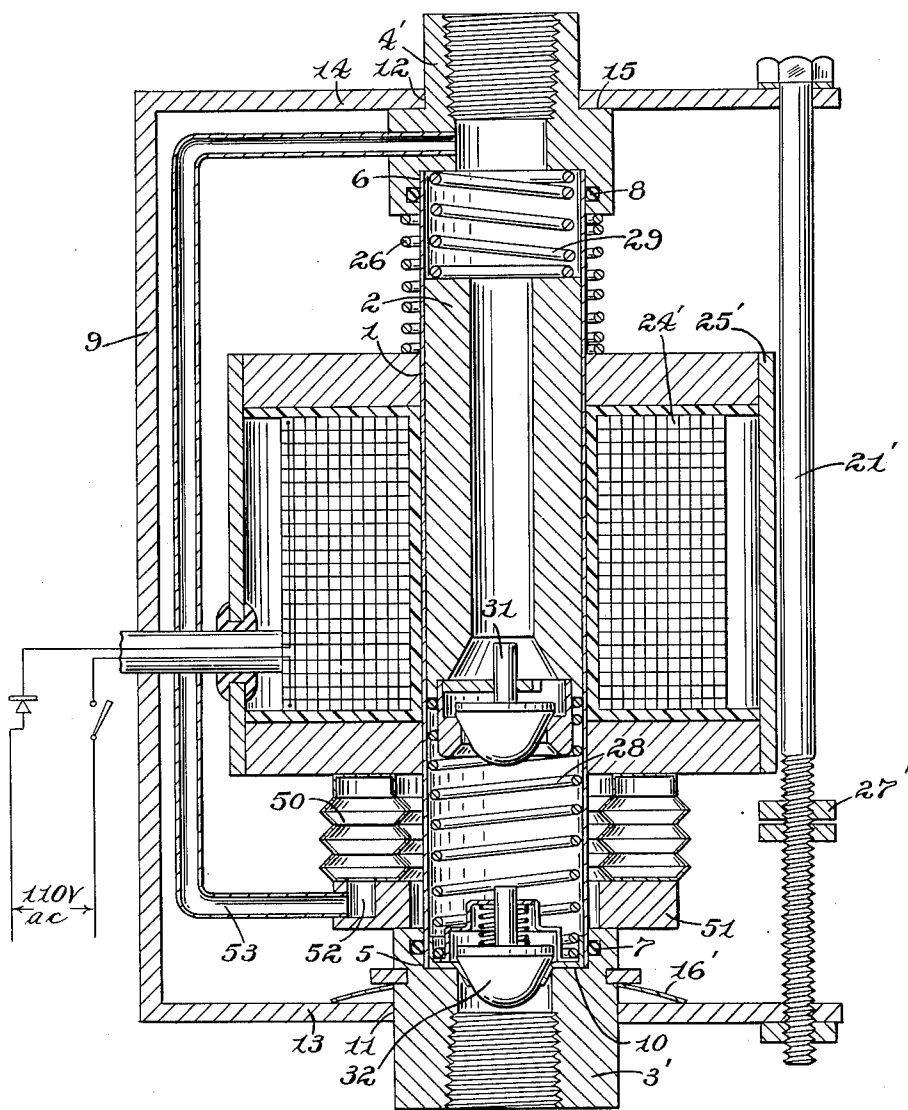


Fig. 3

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3 Sheets-Sheet 3

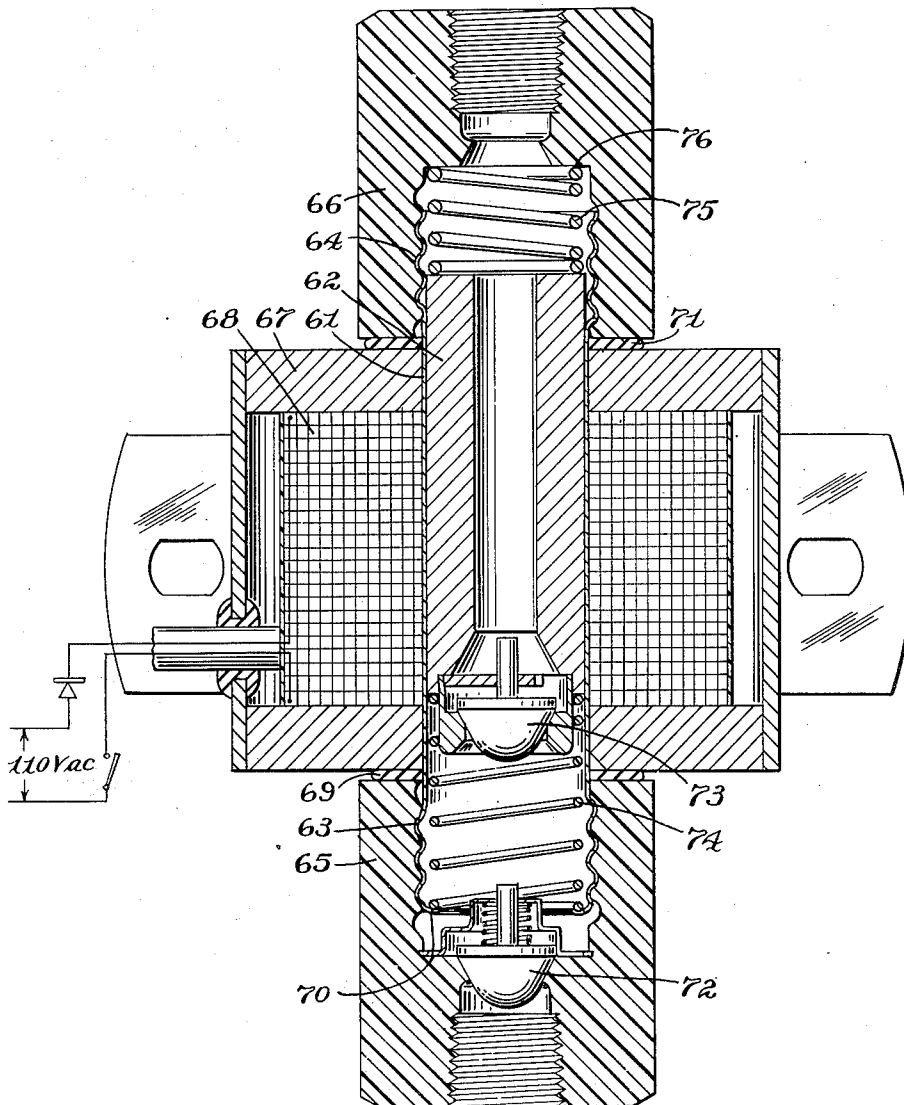


Fig. 1

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RECIPROCATING ELECTROMAGNETIC PUMP

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4 Claims. (Cl. 103—38)

The present invention relates to a reciprocating electromagnetic pump, and more particularly such a pump of simplified structure with provision for adjustable output.

It is an object of the present invention to provide a novel pump of this character operable by pulsating direct current in which the output pressure is externally adjustable in a convenient manner.

It is another object to provide such a device in which the output may be adjusted while the pump is in operation.

It is another object to provide such a device including means for automatically adjusting the pump to maintain the predetermined pressure.

It is another object to provide such a device including adjustable means for predetermining the maximum output pressure of 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;

Fig. 2 is a detail of the clamping spring member;

Fig. 3 is a view similar to Fig. 1 showing an embodiment of the invention in which the output of the pump is controlled automatically; and

Fig. 4 is a vertical mid-sectional view of a further simplified embodiment of the invention.

In Fig. 1 of the drawing there is illustrated a hollow cylinder 1 of suitable non-magnetic material in which a hollow piston 2 of magnetic material such as soft iron is slidably mounted.

An input fitting 3 and an output fitting 4 are provided with sockets 5 and 6 respectively receiving the ends of the cylinder 1, the connection being sealed by any suitable means as by packing rings 7 and 8 respectively. A U-shaped frame 9 is provided with openings 11, 12 in its arms 13, 14 adapted to receive the input and output fittings 3 and 4, the output fitting being provided with a shoulder 15 bearing against the inner surface of the arm 14. A clamping spring member 16 (Fig. 2) is seated on the arm 13 of frame member 9 and is provided with a central opening 17 receiving the shank of the input fitting 3. Said input fitting is provided with a pair of diametrically arranged studs 18, 19, forming a thrust bearing for the spring 16 whereby the assembly of the cylinder 1 and fittings 3 and 4 are clamped together in the frame 9. A bolt 21 traversing the arm 14 and threaded into the end of the arm 13 serves to apply clamping pressure by preventing the arms from spreading apart.

As best shown in Fig. 2 the spring 16 is formed with a pair of diametrically arranged notches 22, formed to permit passage of the studs 18, 19 therethrough when the spring is rotated to bring the notches into registry therewith, thereby permitting convenient disassembly of the pump. Said spring is also provided with a pair of diametrically arranged seats 23 formed to receive the pins

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18, 19 and form therewith a detent means for resisting accidental rotation of the spring away from its normal position.

Means are provided for reciprocating the piston 2 within the cylinder 1 comprising an electromagnet 24 mounted in a casing 25 of magnetic material which is slidably mounted on the cylinder 1. A spring 26 urges the casing 25 toward the input end of the pump, and a flanged nut 27 threaded on the bolt 21 forms an adjustable stop for the casing to determine the relative location of the electromagnet 24 with respect to the piston 2, and consequently the length of stroke of the piston responsive to energization of the electromagnet.

The piston 2 is positioned within the cylinder 1 by means of a spring 28 located in the cylinder between the piston and an abutment provided by an internal shoulder 10 of the inlet fitting 3. When the pump is vertically mounted, the piston may rest on the spring 28 by gravity alone, or if preferred, a spring 29 may be interposed between the piston and the outlet fitting 4.

A check valve 31 is located at the inlet end of the cylinder 1, and a second check valve 32 is mounted in the piston 2, whereby reciprocation of the piston causes fluid entering the inlet 3 to be discharged from the outlet 4.

Means for supplying pulsating electric current to the electromagnet 24 is provided comprising a battery 33, one terminal of which is grounded at 34 while the other terminal is connected through a switch 35 by means of a lead 36 to one terminal of the coil 24. The opposite terminal of the coil is connected by a lead 37 to a fixed insulated contact 38, and a movable contact 39 is mounted on a cradle 41 pivoted at 42 to permit contact 39 to move into and out of engagement with contact 38. A permanent magnet 43 mounted on said cradle has a pole piece 44 conforming to the exterior of the cylinder 1 and thereby sensing the proximity of the upper end of the piston 2 whereby the cradle moves to close the contacts 38, 39 when the piston approaches the pole piece 44 and permits the contacts to open when the piston is drawn away by the attraction of the electromagnet 24. The cradle 41 is grounded at 45 to complete the electrical circuit.

In operation, closure of the switch 35 causes reciprocation of the piston 2 by the periodic energization of electromagnet 24. When the magnet 24 is energized the piston 2 is drawn down compressing or cocking the spring 28. When contacts 38, 39 open, the magnet 24 is deenergized and the spring 28 permitted to return the piston to its normal position, this movement constituting the discharge stroke of the pump. The output of the pump is regulated by adjusting the stop nut 27 on the bolt 21 to vary the position of the electromagnet 24 with respect to the piston 2. Lowering the electromagnet causes an increase in the length of stroke of the piston and consequently the compression of the actuating spring 28, to correspondingly increase the output of the pump.

In Fig. 3 of the drawings there is illustrated an embodiment of the invention in which the output is regulated automatically.

The various operating elements of the pump are the same as those in the embodiment first described and are similarly numbered. In this embodiment however the casing 25' of the electromagnet 24' bears on a flexible bellows 50 which is seated on a fixed thrust member in the form of a ring 51 resting on the inlet fitting 3' and having a channel 52 opening into the bellows 50 and connected by a conduit 53 to the interior of the outlet fitting 4'.

By this arrangement, the expansion of the bellows 50, and consequently the position of the electromagnet 24'

is determined by the output pressure of the pump whereby the electromagnet is automatically positioned to compensate for variations in output pressure caused by fluctuations of volume required by the device being supplied by the pump.

The maximum output of the pump may if desired be limited by a stop nut 27' on the clamping bolt 21'.

In this embodiment of the invention, an optional variation is incorporated in that energization of the electromagnet is accomplished by means of rectified alternating current from a conventional power supply as indicated diagrammatically.

In Fig. 4 of the drawings there is illustrated an embodiment of the invention reduced substantially to its simplest terms.

As there shown, a cylinder 61 of non-magnetic material having a hollow piston 62 of magnetic material slidably mounted therein is threaded at its ends as shown at 63 and 64 for the reception respectively of an internally threaded inlet fitting 65 and a similar outlet fitting 66 of suitable material such as nylon.

A casing 67 of magnetic material containing an electromagnet 68 is clamped between the inlet and outlet fittings, preferably with the inter-position of suitable packing means 69, 71, said casing being slidably mounted on the cylinder 61 and located in any desired relation to the piston 62 by suitable adjustment of the fittings 63, 66 on the ends of said cylinder.

A check valve 72 is located in the inlet fitting 65, a second check valve 73 is located in the piston 62, and a spring 74, resting on an internal shoulder 70 formed on the inlet end of cylinder 61 defines the normal position of the piston in respect to the electro-magnet 68. If desired, a second spring 75 may be interposed between the upper end of the piston and shoulder 76 in the outlet fitting 66.

Energization of the electromagnet 68 is accomplished in this instance by rectified alternating current as diagrammatically illustrated.

In this embodiment of the invention, the adjustment of the electromagnet 68 relative to the normal position of the piston 62 in cylinder 61 is accomplished by loosening one of the fittings 65, 66, and tightening the other to the desired degree. The stroke of the piston and the compression of the actuating spring 74 are thus readily adjusted to secure the desired output from the pump.

Although certain embodiments of the invention have been shown and described in detail it will be understood that other embodiments are possible and changes may be made in the design and arrangements of the parts without departing from the spirit of the invention.

I claim:

1. In a reciprocatory electromagnetic pump, a hollow cylinder of non-magnetic material, a hollow piston of

magnetic material slidably mounted in the cylinder, check valves in the cylinder and piston arranged to cause unidirectional flow of liquid through the pump responsive to reciprocation of the piston, an electromagnet slidably mounted on the cylinder, means for intermittently energizing said electromagnet, a spring urging the piston in the direction of discharge of the pump, an abutment for said spring, and means for so positioning the electromagnet on the cylinder relative to said abutment as to cause the electromagnet when energized, to move the piston a predetermined distance to compress said spring; including further an inlet fitting and an outlet fitting mounted on the ends of the cylinder, packing means in said fittings, a frame receiving and supporting said fittings, and spring means in the frame for clamping the fittings with the packing means against the ends of the cylinder.

2. In a reciprocatory electromagnetic pump, a hollow cylinder of non-magnetic material, a hollow piston of magnetic material slidably mounted in the cylinder, check valves in the cylinder and piston arranged to cause unidirectional flow of liquid through the pump responsive to reciprocation of the piston, an electromagnet slidably mounted on the cylinder, means for intermittently energizing said electromagnet, a spring urging the piston in the direction of discharge of the pump, an abutment for said spring, and means for so positioning the electromagnet on the cylinder relative to said abutment as to cause the electromagnet when energized, to move the piston a predetermined distance to compress said spring; in which the means for positioning the electromagnet on the cylinder comprises a spring operative to move the electromagnet on the cylinder toward the inlet end of the cylinder, and an adjustable stop for limiting such movement of the electromagnet.

3. A pump as set forth in claim 2 including further means responsive to the output pressure of the pump for adjusting the position of the electromagnet on the cylinder.

4. A pump as set forth in claim 3 in which said pressure responsive means includes a fixed thrust member spaced from said electromagnet, a cylindrical bellows interposed between the electromagnet and thrust member, and means for inflating said bellows responsive to the output pressure of the pump.

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