Sept. 2, 1941. E. M. LIEBERMAN 2,254,432

MAGNETIC PUMP

Filed Oct. 25, 1939 2 Sheets-Sheet 1

Fig. 1.

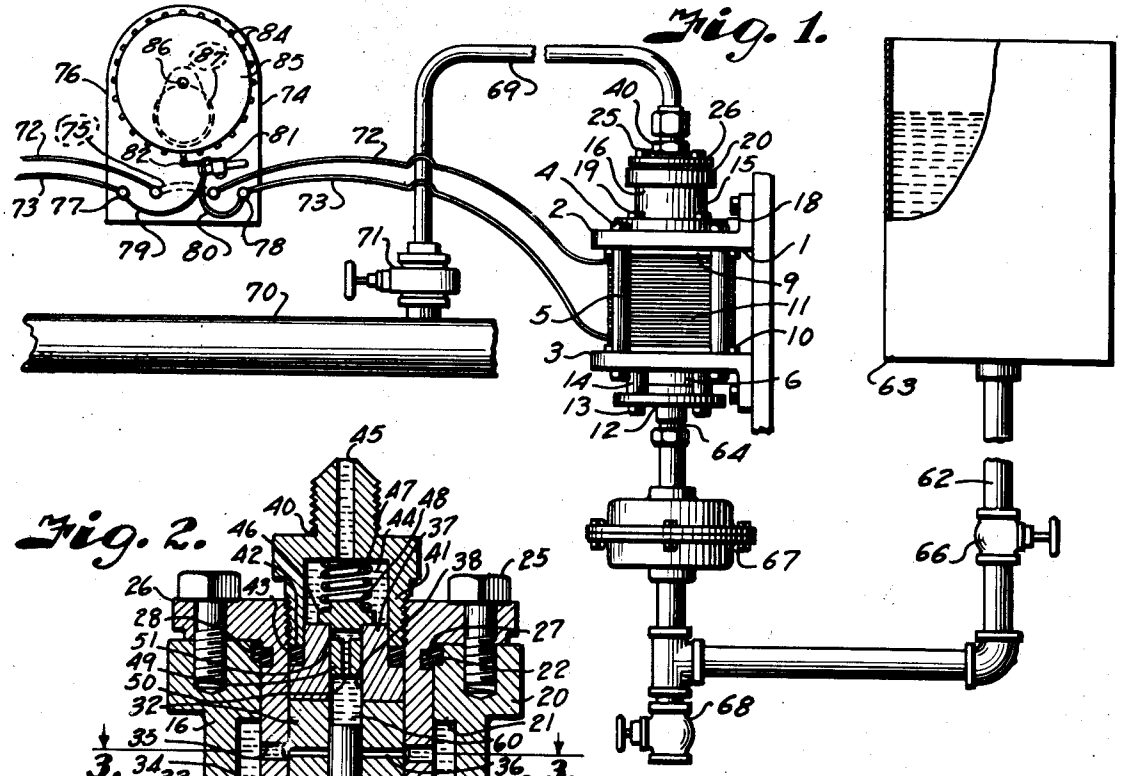


Fig. 2.

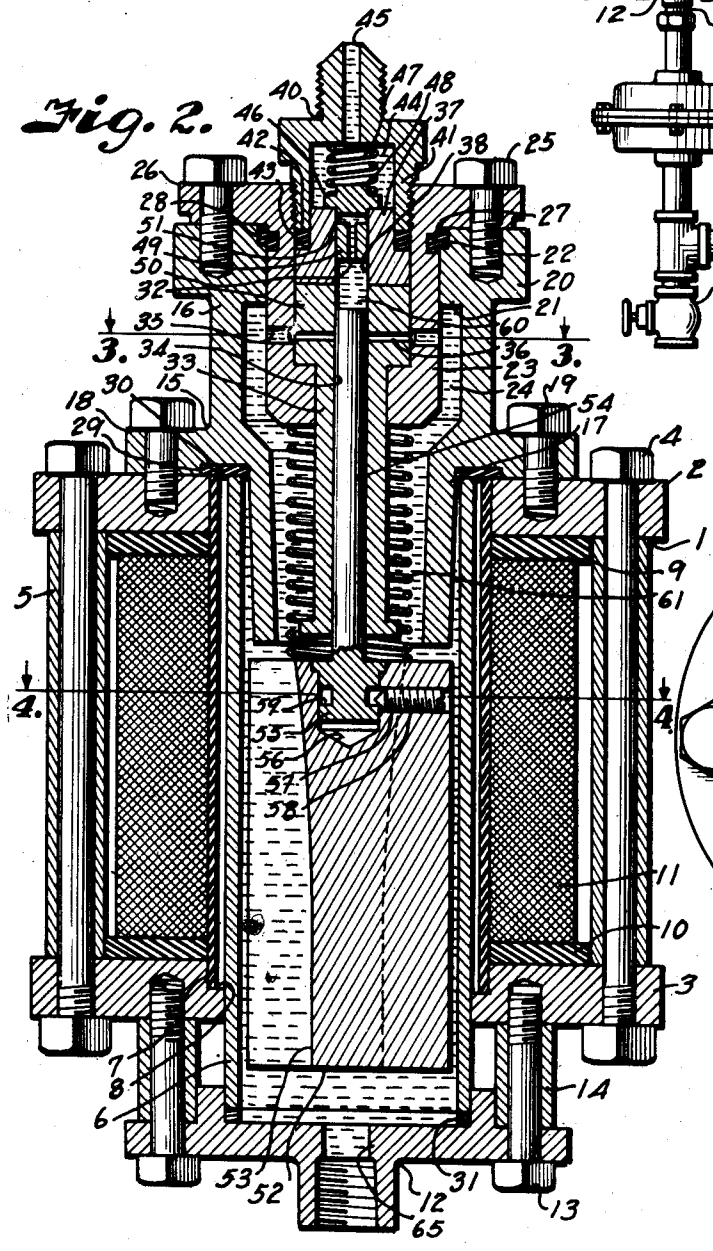
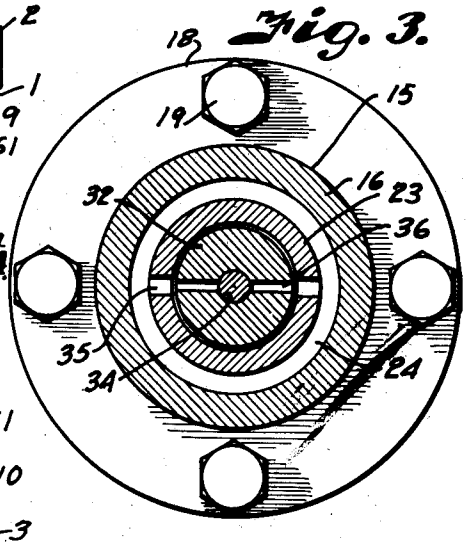


Fig. 3.



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Fig. 4.

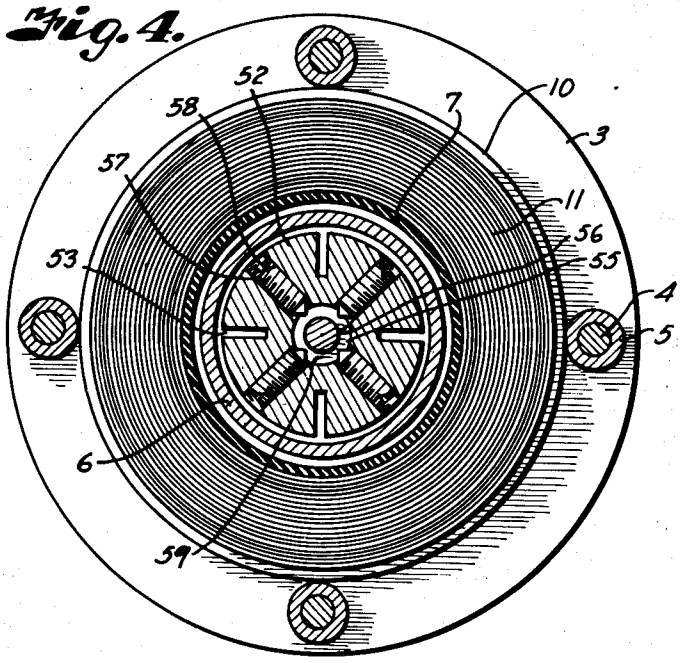


Fig. 5.

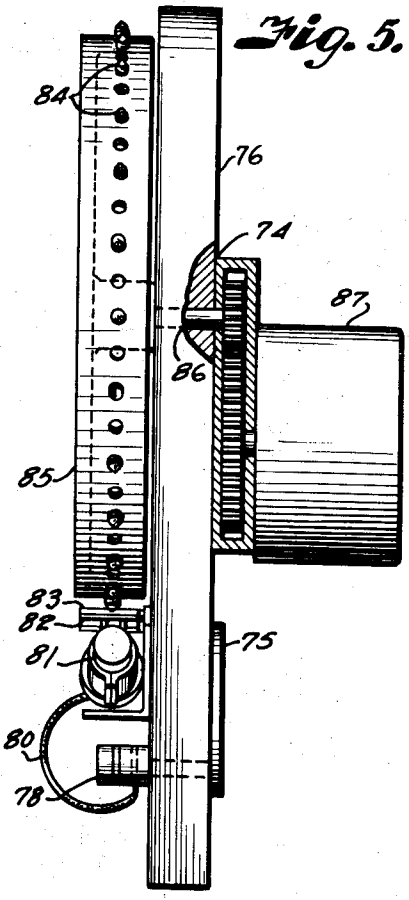


Fig. 6.

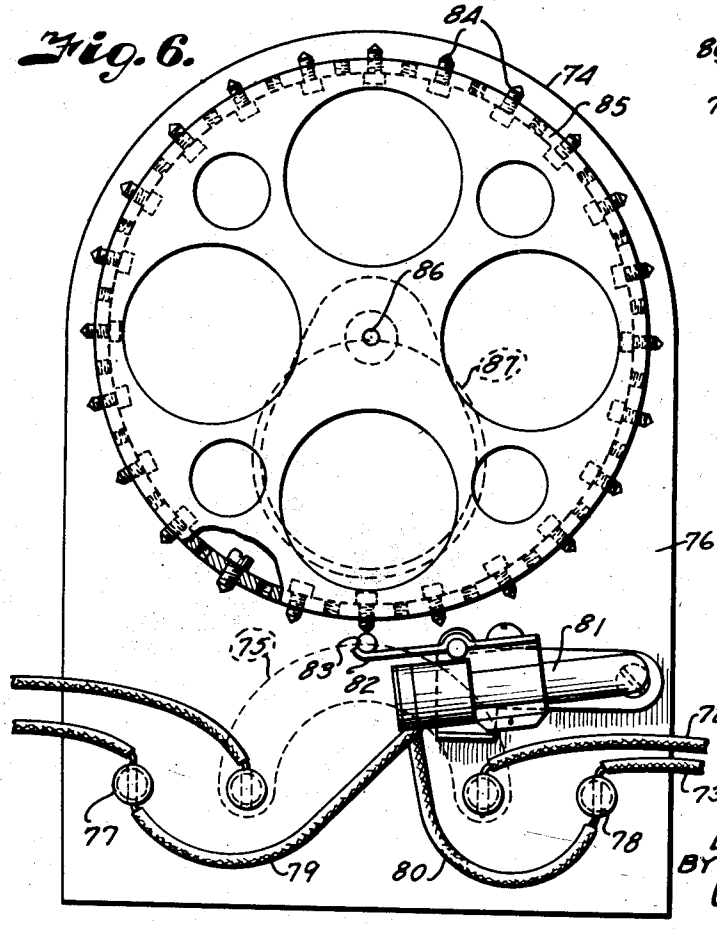
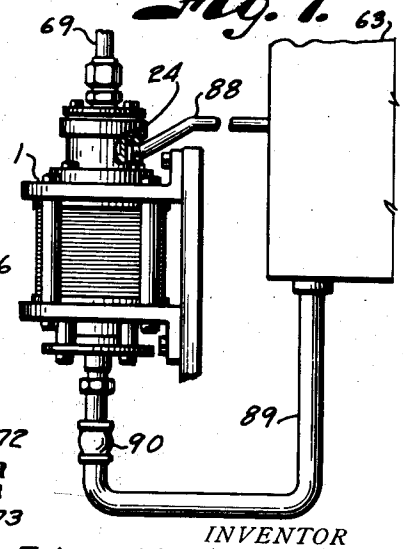


Fig. 7.



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MAGNETIC PUMP

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Application October 25, 1939, Serial No. 301,224

12 Claims. (Cl. 103—53)

My invention relates to magnetic pumps, and more particularly to apparatus of that character for supplying treating compound intermittently and in substantially measured quantity to hot water and steam systems, or for other uses; the principal object of the invention being to provide apparatus of this character whereby liquid compound drawn from storage may be passed in minor flow to a major flow or other body of liquid to be treated in measured quantities under time or other control, insuring desired proportioning of the treating compound to the main body of fluid.

In accomplishing this and other objects of the invention, I have provided improved details of structure, the preferred forms of which are illustrated in the accompanying drawings, wherein:

Fig. 1 is a side elevation of apparatus embodying my invention, illustrating a form of pump control mechanism selected for conveniently disclosing operation of the pump.

Fig. 2 is a vertical section through the magnetic pump mechanism.

Fig. 3 is a horizontal section through the pump on the line 3—3, Fig. 2.

Fig. 4 is a horizontal section through the pump on the line 4—4, Fig. 2.

Fig. 5 is a side elevation of the pump control mechanism.

Fig. 6 is a front elevation of the pump control mechanism.

Fig. 7 is a diagrammatic view of the pump and storage reservoir showing a line for circulation of part of the treating liquid through the pump and reservoir.

Referring more in detail to the drawings:

1 designates a magnetic pump, including a frame comprising top and bottom plates 2—3 held by bolts 4 passed through tubes 5 between the plates, whereby the plates are retained in spaced relation.

Extending through central apertures in the plates 2—3 is a non-magnetic tube 6, and extending about and in spaced relation to the tube 6 is a non-magnetic cylinder 7 having its upper end located in the aperture in the upper plate and its lower end seated in an offset 8 in the lower plate. Located about the cylinder 7, with its ends insulated from plates 2—3 by rings 9 and 10, is a coil 11. The tube 6 projects below the bottom of the lower plate 3 and seats in a cup 12 held to the lower plate 3 by lag bolts 13 extending through the base of the cup and through spacers 14 surrounding the vertical cup flange, which forms a retaining wall for the lower end of the tube 6, into threaded sockets in the bottom plate 3.

Mounted on the top plate 2 is a cap 15 comprising a cylindrical body 16 having an integral, insert skirt 17 at its lower end depending into the interior of the tube 6, an annular flange 18 at about the upper skirt line seated on the top plate 2 and provided with apertures through which lag bolts 19 are projected into threaded sockets in the top plate 2 to retain the cap on the pump frame, and an enlarged ring 20 at its upper end provided with an interior flange 21 having an inset seat 22 at its upper edge.

Suspended through a central aperture in the ring 20 is a pump holder 23 of sufficiently less diameter than the cylinder 16 of the cap 15 to provide a space 24 within the cylinder and about the pump holder. The pump holder is held in place by lag bolts 25 which extend through a flange 26 on the upper end of the holder into the ring 20 of the cap 15; a gasket 27 being located in an annular groove 28 in the pump holder and in the seat 22 in the ring 20. A gasket 29 is located in a downwardly opening recess 30 in the bottom of flange 18 of cap 15 and on top of plate 2 to be engaged by the upper ends of tube 6 and cylinder 7, and a gasket 31 is located in the seat in the suspended cup 12 so that when the bolts 13 and 19 are tightened the ends of the tube 6 are held between the gaskets 29 and 31, and the ends of the cylinder 7 between the gasket 29 and the bottom of the offset 8 in the lower plate 3 to seal the interior of the barrel so formed in such a manner as to render it liquid tight.

Seated within the chamber of the pump holder is a head 32 of a pump barrel 33 projected through the bottom of the pump holder into the interior of the skirt 17 to about the bottom thereof, the barrel 32—33 having a central channel 34 forming a plunger chamber, as presently described, and the pump holder 23 and head 32 having communicating ports 35 and 36 whereby fluid may pass from the interior of tube 6 around the skirt 17 into the cap chamber 24 and through the ports 35 and 36 into the plunger chamber when the ports 36 are uncovered upon lowering of the plunger.

A valve body 37 seats on the barrel head 32 within the pump holder 23, and has a channel 38 registering with the plunger chamber 34. The valve body 37 is held to its seat in the holder 23 by a nipple 40, having a lower, exteriorly threaded collar 41 screwed into the holder 23 against a gasket 42 on a shoulder 43 in the upper

portion of the valve body. The nipple 40 has an interior chamber 44 communicating with the channel 38 in valve body 37 and an outlet channel 45 communicating with the chamber 44 for discharge of fluid from the pump.

Located within the nipple chamber 44 is a valve including a head 46 held to seat on the top of the valve body 37 by a compression spring 47 which bears on the top of the valve head 46 around a center boss 48 and against the top of the chamber 44. A stem 49 depending from the head 46 extends into the channel 38 of the valve body, the valve stem 49 having an axial bore 50 in its lower end connecting with the channel 38, and transverse ports 51 communicating with the upper end of the bore 50. The ports 51 are closed by the wall of the channel 38 when the stem is at the lower end of its travel, but open to the chamber 44 in the nipple, when the stem is lifted, as presently described.

Located within the tube 6 is an armature 52 spaced from the wall of the tube to provide fluid passage within the tube about the armature, and having exterior longitudinal slots 53 for providing cooling surfaces, obviating large eddy currents and increasing flow capacity within the tube.

54 designates a plunger operable in chamber 34 and having a head 55 seated in a socket 56 in the top of the armature and held thereto by set-screws 57 extending through apertures 58 in the armature 52 into an annular groove 59 in the head. The upper end of the plunger is spaced from the lower end of the valve stem 49 to provide a compression chamber 60 in the valve body and head of the barrel, as and for the purpose presently described.

A compression spring 61 surrounds the barrel 33 to bear at its upper end against the bottom of the pump holder 23 and at its lower end against the top of the armature, to supplement force of gravity in lowering of the armature after each discharge stroke.

A supply line 62 provides communication between a treating fluid compound supply tank 63 and the interior of the tube 6 through a nipple 64 on and a port 65 in the cup 12 which supports the armature tube, the supply line being preferably provided with a cut-off valve 66, a filter 67 and drain valve 68.

Attached to the nipple 40 at the discharge end of the pump is a line 69 leading to the major flow line 70 for fluid to be treated, and provided with a manual control valve 71. Interposed in the lead lines 72 and 73 of the coil 11 is an intermitter or program switch 74, preferably comprising a bus-bar 75 on a board 76, through which current is passed between sections of the line 72.

Also mounted on the board 76 are posts 77 and 78, with which respective sections of line 73 are connected, as are intermediate wires 79 and 80, leading through a mercury switch 81, pivoted on the board and provided with a finger 82 having a bearing member 83 engageable by buttons 84 on a disk 85 rotatably mounted on the board and operable through a shaft 86 from clock or other operating mechanism indicated at 87. The buttons 84 are spaced about the disk to provide desired sequential energization of the armature as a solenoid motor and resultant operation of the pump plunger for supply of treating liquid, and which are setable to provide variation in intermittent supply of the treating liquid.

With the parts of the pump assembled as described, when the mercury switch is open, weight of the armature, supplemented by force of the spring 61 retains the armature at the bottom of the stroke, and liquid treating compound flowing from the supply tank into the tube 6 by gravity fills the tube, runs around the skirt of the cap through the channel between the cap and pump holder and enters the plunger chamber through the ports in the pump holder and barrel head to admit a charge of the liquid above the plunger, where it is held by the valve 46 due to seating of the valve by its spring 47.

When the operating circuit is closed through the mercury switch in response to rocking of the switch by the intermitter, the armature is elevated in response to energization of its coil, against the resistance of the spring 61, for lifting the plunger 54 to close the ports 36 and lift the charge of treating liquid in the compression chamber 60 over the plunger, unseating the valve against the resistance of its spring and delivering the charge through the valve ports, the upper chamber and discharge line into the body of fluid to be treated. When the circuit is opened by return of the mercury switch, the coil is de-energized, permitting the armature to return to the bottom of the barrel, and the outlet valve to reseat, return of the armature lowering the plunger to uncover the ports 36 to admit another charge to the compression chamber for discharge upon a succeeding upward movement of the armature and plunger. Upward movement of the armature creates suction in the tube which supplements gravity flow of treating liquid to the tube from the storage tank.

It is apparent that with the pump mechanism described, accurately and uniformly measured charges are admitted to the plunger chamber for definite supply of treating compound to a liquid to be treated, and that the supply of compound may be varied by adjustment of the intermitter or its operating mechanism to increase or decrease rate of supply of the charges from the pump.

In Fig. 7, I have illustrated optional equipment for circulating treating fluid through the pump and supply reservoir to cool the pump, consisting of a pipe 88 leading from the annular space 24 within the cap cylinder and tube of the pump back to the supply reservoir, through which part of the treating fluid may be displaced from the pump to the reservoir upon each lifting movement of the armature. In such equipment the feed line 89 from the reservoir is provided with a check valve 90 to prevent return of fluid to the reservoir under pressure from the descending armature.

What I claim and desire to secure by Letters Patent is:

1. An electromagnetic pump including a coil, a tube forming an armature chamber, an armature in said armature chamber, means sealing the chamber from the coil, means forming a combined plunger and valve chamber, having port connection with the armature chamber and having a valved outlet, a plunger in the plunger chamber, operably connected with the armature, means for supplying fluid to the armature chamber, a switch controlled circuit for the coil, and automatic means for intermittently opening and closing the switch circuit.

2. An electromagnetic pump including a fluid tight tube, a coil surrounding the tube, a combination plunger and valve chamber having port connection with the interior of the tube, a valve

controlling discharge from said chamber, a solenoid core in the tube responsive to the coil, a plunger operable by the core, controlling the port connection with the interior of the tube to admit measured charges of fluid to said chamber and discharge said charges from the chamber against resistance of the valve, means for admitting fluid to the tube, and means for intermittently supplying current to the coil.

3. An electromagnetic pump including a fluid tight tube, a plunger cylinder comprising a chamber having port connection with the interior of the tube, a valve head having a chamber communicating with the cylinder chamber, a valve yieldingly closing the valve chamber, a solenoid core in the tube, a plunger connected with the core operable in the plunger cylinder controlling said port connection with the interior of the tube to admit measured charges of fluid from the tube to the plunger and valve chambers and deliver said charges against the resistance of said valve, a coil surrounding the tube, and means for intermittently supplying current to the coil.

4. An electromagnetic pump including a tube sealed at its ends to provide a fluid tight chamber, a cap having a skirt extending into one end of the tube chamber, a pump holder in the cap having an interior chamber and a port connecting said chamber with the tube chamber through the skirt, a barrel in the pump holder having a port communicating with the port in the pump holder, a valve body in the chamber of the pump holder having a chamber communicating with the interior of the barrel, a nipple on said pump holder having an interior chamber and a discharge port, a valve in the nipple chamber extending into the chamber of the valve body and seatable on the valve body, means yieldingly retaining the valve on its seat, a solenoid core in the tube chamber, a plunger operable in the barrel in response to reciprocation of the core to admit measured charges of fluid to the chamber of the valve body and discharge said charges through the valve chamber against the yielding resistance on said valve, means for admitting fluid to the tube chamber, a coil surrounding the tube, and means for intermittently supplying current to the coil.

5. In an electromagnetic pump; a solenoid motor comprising a coil, a reciprocable armature responsive to intermittent energization of the coil, and means for intermittently energizing said coil; means forming a fluid tight chamber in substantially surrounding relation to the armature; means for supplying fluid to said chamber; means allowing ejection of fluid charges from said chamber in response to reciprocation of said armature, and means for circulating a portion of said fluid between said chamber and supply means.

6. In an electromagnetic pump; a solenoid motor comprising a coil, an armature, said armature being movable in one direction responsive to energization of the coil, and means for energizing said coil; means forming a fluid tight chamber in substantially surrounding relation to the armature; means for supplying fluid to said chamber; means allowing ejection of fluid charges from said chamber in response to movement of said armature in said direction; and yielding means for moving said armature in an opposite direction upon deenergization of said coil.

7. In an electromagnetic pump, a coil, a reciprocable member responsive to intermittent energization of the coil, and means for intermittently energizing said coil, means forming a fluid tight chamber within the coil and encircling the reciprocable member for containing a body of fluid in substantially surrounding relation to the member, means for supplying fluid to said chamber, a holder mounted on said member chamber having a chamber communicating with the member chamber, a barrel mounted on said holder having a chamber therein communicating with said holder chamber, a plunger connected with said member and reciprocable in said barrel, and means allowing ejection of fluid charges from the barrel chamber in response to reciprocation of the member.

8. In an electromagnetic pump; a solenoid motor comprising a coil, a reciprocable armature responsive to intermittent energization of the coil, and means for intermittently energizing said coil; means forming a fluid tight chamber in substantially surrounding relation to the armature; means for supplying fluid to said chamber; a hollow holder supported by said chamber forming means and communicating with said chamber, a barrel mounted on said holder having an end depending into said chamber, said barrel having a bore therethrough, a head on the barrel having a port normally communicating said bore with the interior of said holder, a plunger in said bore connected with said armature adapted to close said port in response to reciprocation of the armature, and means in said holder to allow ejection of fluid charges from said barrel bore in response to reciprocation of said armature and plunger.

9. In an electromagnetic pump, a motor, a reciprocable member responsive to intermittent energization of the motor, means for intermittently energizing said motor, means forming a fluid tight chamber in substantially surrounding relation to the member, means for supplying fluid to said chamber, a hollow cap communicating with the chamber and having a skirt depending into said chamber, a hollow holder mounted in said cap, the interiors of said cap and holder being in communication, a barrel mounted on said holder having an end depending into said chamber through said depending end of the cap, said barrel having a bore therethrough, a head on the barrel provided with a port normally communicating said bore with the interior of said cap through said holder, a plunger in said bore connected with said member adapted to close said port in response to reciprocation of the member, a valve body on said holder cooperating with the bore of the barrel to form a chamber, and a valve in said body to allow ejection of fluid charges from said valve body chamber in response to reciprocation of said member and plunger.

10. In an electromagnetic pump, a motor, a reciprocable member responsive to intermittent energization of the motor, means for intermittently energizing said motor, means forming a fluid tight chamber in substantially surrounding relation to the member, means for supplying fluid to said chamber, a hollow cap communicating with the chamber and having a skirt depending into said chamber, a hollow holder mounted in said cap, the interiors of said cap and holder being in communication, a barrel mounted on said holder having an end depending into said chamber through said depending end of the cap, said barrel having a bore there-

through, a head on the barrel provided with a port normally communicating said bore with the interior of said cap through said holder, a plunger in said bore connected with said member adapted to close said port in response to reciprocation of the member, a valve body on said holder cooperating with the bore of the barrel to form a chamber, a valve in said body to allow ejection of fluid charges from said valve body chamber in response to reciprocation of said member and plunger, a nipple on said holder, and means bearing against the nipple yieldingly urging said valve to closed position relative to said valve body chamber for normally closing the same.

11. In an electromagnetic pump; a solenoid motor comprising a coil, a reciprocable armature responsive to intermittent energization of the coil, and means for intermittently energizing said coil; means forming a fluid tight chamber in substantially surrounding relation to the armature; means for supplying fluid to said chamber; a hollow cap mounted on and communicating with the chamber and having a skirt depending into said chamber, a hollow holder mounted in said cap, the interiors of said cap and holder normally being in communication, a barrel mounted on said holder having an end depending into said chamber through said depending end of the cap, said barrel having a bore therethrough, a head on the barrel having a port normally communicating said bore with the interior of said cap, a plunger in said bore connected with said armature adapted to close said port in response to reciprocation of the armature, a valve body on said holder cooperating with the bore of the barrel to form a chamber, a valve in said body to allow ejection of fluid charges from said valve body chamber in response to reciprocation of said armature and plunger, a nipple on said holder, and means bearing against the nipple yieldingly urging said said valve to closed position relative to said valve body chamber, said valve having ports for communicating the valve body chamber with the nipple when unseated relative to said valve body chamber in response to reciprocation of said armature and plunger.

12. An electromagnetic pump including, a cylindrical chamber, a coil encircling the exterior of the chamber, an armature reciprocable in the chamber and of smaller diameter to provide a fluid passageway about said armature, a plunger chamber coaxial with the cylindrical chamber, a plunger in the plunger chamber and having connection with the armature, means forming an annular fluid passageway about the plunger chamber and having connection with the plunger chamber, a valve chamber connected with the plunger chamber and having a liquid outlet orifice, a valve in the valve chamber controlling discharge of fluid from the plunger chamber, means for admitting fluid to the cylindrical chamber at the end opposite the plunger, and means for intermittently energizing the coil to effect reciprocation of the armature for actuating the plunger.

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