July 2, 1957 J. C. POMYKATA 2,797,646

SOLENOID-OPERATED, SELF-RESTRICTING INLET PUMP

Filed Aug. 21, 1953

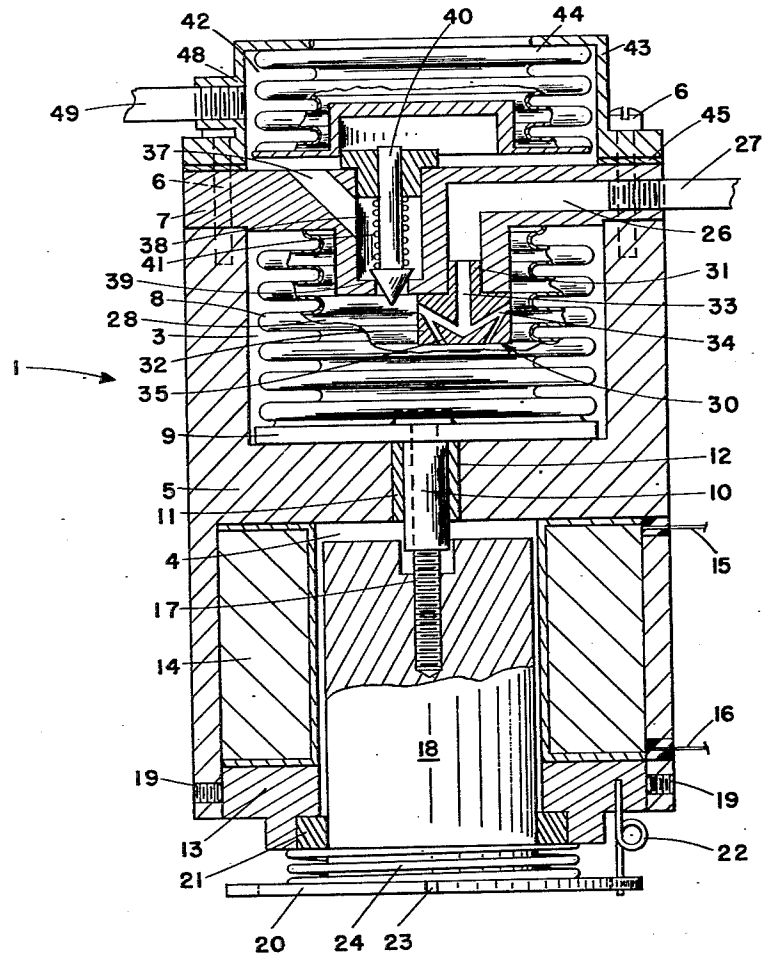


FIG. 1

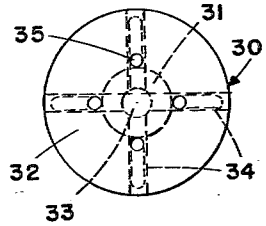


FIG. 2

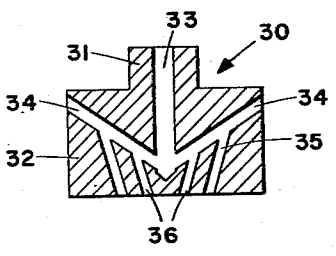


FIG. 3

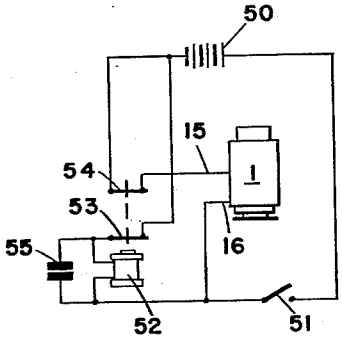


FIG. 4

INVENTOR.

JOHN C. POMYKATA

BY

William R. Lane

ATTORNEY

United States Patent Office

2,797,646

Patented July 2, 1957

2,797,646

SOLENOID-OPERATED, SELF-RESTRICTING INLET PUMP

John C. Pomykata, Whittier, Calif., assignor to North American Aviation, Inc.

Application August 21, 1953, Serial No. 375,617

7 Claims. (Cl. 103—53)

The invention relates to pumps, and more particularly to a pump for corrosive fluids which contains a self-restricting inlet choke requiring no moving parts or liquid seals.

Heretofore, valves of the "check" type (i. e., designed for fluid flow in one direction only) have been required in the inlet passageways of reciprocating piston pumps. Said check valves are conventionally designed with a spring operated closing element, such as a ball or flapper, which is forced open by the fluid pressure on the pump intake stroke to allow fluid to enter the pump chamber, and closed by the spring during the pump output stroke. In such a conventional system, the moving parts of the valve must be made of high-cost non-corrosive material when the pump is required to move corrosive fluids. The use of conventional check valves in the inlet to reciprocatory pumps is objectionable, since such valves are liable to incur fouling, the intake pressure and therefore fluid velocity generally being less than that generated by the output stroke of the pump.

Also, reciprocatory pumps are normally constructed so that the fluid being pumped comes in contact with other moving parts, requiring fluid seals around said moving parts. This necessitates constructing the seals and moving parts of high-cost, corrosive-resistant material, and even under such circumstances wear and deterioration occur fairly rapidly. Due to constructional limitations, the size and weight for a given displacement volume of such conventional pumps are such that they are not adaptable for use in installations requiring a high displacement-size, weight ratio.

This invention contemplates the provision of an economically constructed miniature, light-weight fluid pump having no moving parts in contact with the fluid until after the fluid is discharged from the pumping chamber.

This invention also contemplates an improved self-cleaning, self-restricting inlet choke valve for a reciprocating pump, said choke having no moving parts.

This invention also contemplates actuating means for a reciprocating pump, which means cooperates with the self-restricting inlet choke to accomplish the desired results.

It is therefore an object of this invention to provide an improved pump for circulation of fluids in which the fluids are not in contact with moving parts of the pump until after discharge thereof.

It is another object of this invention to provide a self-cleaning, self-restricting inlet choke having no moving parts.

It is still another object of this invention to provide an actuating means for a reciprocating pump, which means improves the operation of the self-restricting inlet choke in said pump.

Other objects of invention will become apparent from the following description taken in connection with the accompanying drawings, in which—

Fig. 1 is a cross-sectional view showing the interior

details of a pump as constructed in accordance with this invention;

Fig. 2 is a bottom plan view of the inlet choke shown in Fig. 1;

Fig. 3 is a cross-sectional view of the inlet choke shown in Fig. 1 illustrating a modification thereof; and

Fig. 4 is a semi-schematic view of the pump in elevation and the actuating circuit therefor.

In detail, referring to Fig. 1, the body 1 of the pump of this invention is of generally cylindrical shape having coaxial bores 3, 4, opening outwardly of the ends thereof and sharing a common bottom wall 5. Covering the open end of bore 3 and secured to body 1 as by bolts 6 is a generally disc-shaped cap 7. Bellows 8 is secured at one end to the underside of cap 7 and extends within bore 3. The other end of bellows 8 is secured to a piston 9 which, before being actuated, rests at the bottom of bore 3 adjacent wall 5.

Piston 9 has depending therefrom and secured thereto rod 10 which is adapted to reciprocate in bushing 11 secured in central axial throughbore 12 in wall 5. Held within bore 4 by inwardly directed flange 13 at the open end of said bore is solenoid coil 14. Radial set screws 19 serve to hold flange 13 to body 1. Electrical leads 15, 16 are provided for supplying current to coil 14 for a purpose to be later described.

The end of rod 10 opposite piston 9 is adjustably secured as by bolt 17 to ferromagnetic core 18, the upper end of which, at rest, is spaced downwardly from wall 5. Core 18 extends through the bore of coil 14, and its lower end extends outwardly of flange 13 and has notched disc 20 welded thereto. Core 18 is mounted for rotation and reciprocation in bushing 21 which is fixed in a circumferential recess in the interior of flange 13. Detent 22 extends from flange 13 into one of the notches 23 in disc 20 so as to prevent rotation of disc 20 and associated core 18. To retain core 18 in its extended position, helical spring 24 is provided surrounding said core and reacting between flange 13 and disc 20.

Cap 7 is ported so as to provide an inlet passageway 26 that may be connected to a source of fluid (not shown) as by pipe 27. Positioned at the point where passageway 26 communicates with the chamber 28, which is formed by the bellows 8 as walls, cap 7 as a top, and piston 9 as a bottom, is self-restricting inlet choke 30. Choke 30 is in the form of a two-step cylinder having a smaller diameter body portion 31 and a larger diameter body portion 32. Smaller portion 31 is fitted into passageway 26, and larger portion 32 extends into chamber 28. A central axial main bore 33 opens outwardly of portion 31 and terminates within portion 32. Angularly disposed with reference to bore 33 and within body portion 32 of choke 30 are a plurality of passageways 34 of smaller diameter than bore 33. Said passageways communicate with chamber 28 at the sides of portion 32 and terminatae within portion 32 at their juncture with bore 33. A plurality of similar passageways 35 formed in portion 32 terminate at and communicate with passageways 34 at their juncture therewith, and open outwardly of portion 32 into chamber 28 at the end of portion 32. Passageways 35 are of the same or slightly smaller diameter than passageways 34.

An advantageous but not restrictive arrangement is shown in Fig. 1 in which passageways 34 are disposed at approximately 60 degrees, and passageways 35 at approximately 20 degrees to the central axis of bore 33. Passageways 34, 35 are shown approximately one-half the diameter of bore 33, and Fig. 2 shows four passageways 34 and four passageways 35.

As a modification, Fig. 3 shows in cross-section a choke similar to that shown in Fig. 1 and on which the

same numerals are used in referring to similar elements. The valve in Fig. 3 contains additional passageways 36 having the same angularity as passageways 35 but disposed inwardly of passageways 35 toward passageway 33. Again, passageways 34 are shown as approximately one-half the diameter of passageway 33 and passageways 35, 36 are shown approximately one-third the diameter of passageway 33.

Cap 7 also contains outlet port 37 which communicates with chamber 28 through valve port 38. At the point where valve port 38 communicates with chamber 28, said valve port is formed with a circular hole, or valve seat 39 which is adapted to be closed by needle valve element 40. Spring 41 serves to force valve element 40 in contact with seat 39. At its end remote from chamber 28, valve outlet port 37 communicates with chamber 42 which is enclosed by housing 43 secured to cap 7 and body 1 by bolts 6. Gasket 45 may serve to seal the joint between housing 43 and cap 7. Secured within housing 43 is accumulator bellows 44 which serves to reduce pulsations in the output of the pump. Housing 43 may be formed with boss 48 for securing outlet pipe 49, that communicates with chamber 42, to housing 43.

Fig. 4 shows a voltage source, such as battery 50, connected in series by leads 15, 16 to solenoid coil 14, the circuit also containing operating switch 51. Connected in parallel with solenoid coil 14 is the coil of relay 52 so arranged that when relay coil 52 is energized it will open switches 53, 54. Switch 53 is in series with relay coil 52, and switch 54 is in series with solenoid coil 14, both switches being held in the open position by springs (not shown). Condenser 55 is connected across relay coil 52.

In operation, when switch 51 is closed condenser 55 begins to charge and a magnetic field is built up in relay coil 52 and solenoid coil 14. The field built up in solenoid coil 14 attracts core 18 inwardly against the force of spring 24. This causes piston 9 to compress bellows 8, thereby decreasing the size of chamber 28 and forcing fluid therein past valve 40 through port 37 into chamber 42, thereby building up pressure in chamber 42. This pressure will, of course, force fluid out outlet pipe 49.

This output stroke also forces fluid through passageways 34 and passageways 35 in inlet choke 30. Because of the intersection of passageways 34 and 35 a turbulent effect is created at said intersection and, hence, a temporary stoppage of the flow of the fluid. Any fluid flowing past the intersection of passageways 34 and 35 will meet at the intersection of passageways 34 and main bore 33, creating there a secondary turbulent effect assuring little or no flow of fluid out of main bore 33. The addition of passageways 36 in the modification shown in Fig. 3 provides a plurality of additional intersections, assuring the stoppage of fluid within choke 30. As a further modification, choke 30 may be simplified by eliminating both passageways 35, 36, thereby relying on the turbulent effect created at the intersection of passageways 34 and main bore 33. Because of the rapidity of the output stroke as actuated by solenoid coil 14, choke 30 operates in effect as a check valve.

As soon as solenoid coil 14 is energized, relay coil 52 is sufficiently energized to open switches 53, 54, thereby de-energizing solenoid coil 14. However, condenser 55 now discharges through relay coil 52, thereby continuing to energizes relay coil 52 and retain switches 53, 54 in the open position. As long as switch 54 is open and solenoid coil 14 de-energized, spring 24 forces piston 9 to expand bellows 8, thereby drawing fluid in inlet passageway 26 and through choke 30 into chamber 28. The intake stroke is then sufficiently longer than the output stroke, because of the continued energizing of relay coil 52 by the discharge of condenser 55 therethrough, to allow expanded chamber 28 to be again filled with fluid.

If it is desired to change the length of the stroke of piston 9, detent 22 may be removed from notch 23, and core 18 rotated so as to provide a larger space between the inner end of core 18 and wall 5.

Although it has been found that best results are obtained when the intake stroke is longer in duration than the output stroke, such circumstances are not essential to the operation of choke 30. It is seen that choke 30 is simple to construct, contains no moving parts to become fouled or worn and, due to the reversal of flow of fluid therethrough, is self-cleaning.

Although the invention has been described and illustrated in detail, it is to be clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of this invention being limited only by the terms of the appended claims.

I claim:

1. A bellows-type pump comprising a flexible-wall forming a chamber for containing fluid, an inlet passageway and an outlet passageway communicating with said chamber, a self-restricting choke in said inlet passageway and a check valve in said outlet passageway, a solenoid operatively connected with said chamber for decreasing the capacity thereof when said solenoid is actuated, and an electrically powered circuit for intermittently actuating said solenoid, said circuit including a timing means having a source of a direct current potential, a relay having at least two normally closed contacts, one of said contacts being connected in series with the coil of said relay across said source, the other of said contacts being connected in series with said solenoid coil, and a condenser connected across said relay coil whereby the time of actuation of said solenoid is substantially less than the time during which said solenoid is not actuated.

2. A bellows-type pump comprising a partially closed bellows forming a chamber for containing fluid, an inlet passageway and an outlet passageway communicating with said chamber, a self-restricting choke in said inlet passageway and a check valve in said outlet passageway, a solenoid operatively connected with said chamber for decreasing the capacity thereof when said solenoid is actuated, a source of power, switching means connected to intermittently energize the coil of said solenoid from said source of power, and timer means connected to control said switching means in a manner to energize said coil for substantially shorter periods of time than said coil is de-energized whereby fluid is pumped from said inlet passageway to said outlet passageway, adjustable spring means external of said solenoid for increasing the capacity of said chamber during the time when said solenoid is not actuated, and means for adjusting the core of said solenoid to change the distance length of the stroke of said pump.

3. A pump comprising a bellows forming a chamber for containing fluid, an inlet passageway and an outlet passageway communicating with said chamber, a self-restricting choke in said inlet passageway and a check valve in said outlet passageway, said self-restricting choke being formed with intersecting passageways one end of which communicates with said chamber, a solenoid operatively connected with said chamber for decreasing the capacity thereof when said solenoid is actuated, an electrically powered circuit for intermittently actuating said solenoid, said circuit containing a first switch in series with said solenoid, a relay coil in parallel with said solenoid, a second switch in series with said relay coil, and a condenser in parallel with said relay coil, both of said switches being actuated by said relay coil.

4. A bellows-type pump comprising a bellows having one sealed end forming a chamber for containing fluid, an inlet passageway and an outlet passageway communicating with said chamber, a self-restricting choke in said inlet passageway and a check valve in said outlet passage-

way, said self-restricting choke being formed with intersecting passageways one end of which communicates with said chamber, a solenoid operatively connected with said chamber for decreasing the capacity thereof when said solenoid is actuated, an electrically powered circuit for intermittently actuating said solenoid, said circuit containing a first switch in series with said solenoid, a relay coil in parallel with said solenoid, a second switch in series with said relay coil, and a condenser in parallel with said relay coil, both of said switches being actuated by said relay coil, and the capacitance of said condenser being of such a magnitude as to maintain said switches open for a substantially greater period of time than said switches are closed whereby fluid is caused to enter said chamber for a greater period than that during which fluid is forced from said chamber.

5. In a reciprocating pump, a self-restricting inlet choke comprising a body having a main bore, one end of which communicates with the inlet side of said body and the other end of which terminates within said body, first passageways disposed at acute angles to said main bore and communicating between said other end of said main bore and one face of the outlet of said body, and second passageways disposed at acute angles to said main bore and said first passageways communicating between said first passageways and another face of the outlet of said body whereby streams of fluid forced into said first and said second passageways will impinge each on the other causing turbulence and a temporary stoppage of said streams.

6. In a reciprocating pump, a self-restricting inlet choke comprising a body having a main bore, one end of which communicates with the inlet side of said body and the other end of which terminates within said body, first passageways disposed at acute angles to said main bore and communicating between said other end of said main bore and one face of the outlet of said body, and second passageways disposed at acute angles to said main bore and said first passageways communicating between said first passageways and another face of the outlet of said body whereby streams of fluid forced into said first and said second passageways will impinge each on the other causing turbulence and a temporary stoppage of said streams, the total of the cross-sectional areas of said first passageways being approximately equal to the cross-sectional area of said main bore and the total of the cross-sectional areas of said second passageways being less than the cross-sectional area of said main bore.

7. In combination with a reciprocating pump for pumping fluids, a self-restricting inlet choke in an inlet line of the pump, said choke comprising a body having a main bore extending internally from an inlet surface of said body, first passageways disposed at acute angles to said main bore and communicating between the internal end of said main bore and an outlet surface of said body, second passageways disposed at acute angles to said main bore and said first passageways and communicating between said first passageways and another outlet surface of said body; and electrical regulating means controlling said pump insuring greater fluid flow through said choke on the inlet stroke than on the output stroke of said pump.

References Cited in the file of this patent

UNITED STATES PATENTS

325,459	Taylor	Sept. 1, 1885
1,346,555	Reeves	July 13, 1920
1,570,381	Lea	Jan. 19, 1926
2,216,703	Ericson	Oct. 1, 1940
2,322,026	Jaeckel	June 15, 1943
2,590,217	Snyder	Mar. 25, 1952
2,662,590	Reich	Dec. 15, 1953