Nov. 13, 1923. 1,473,924

E. B. CUSHMAN

DIAPHRAGM PUMP

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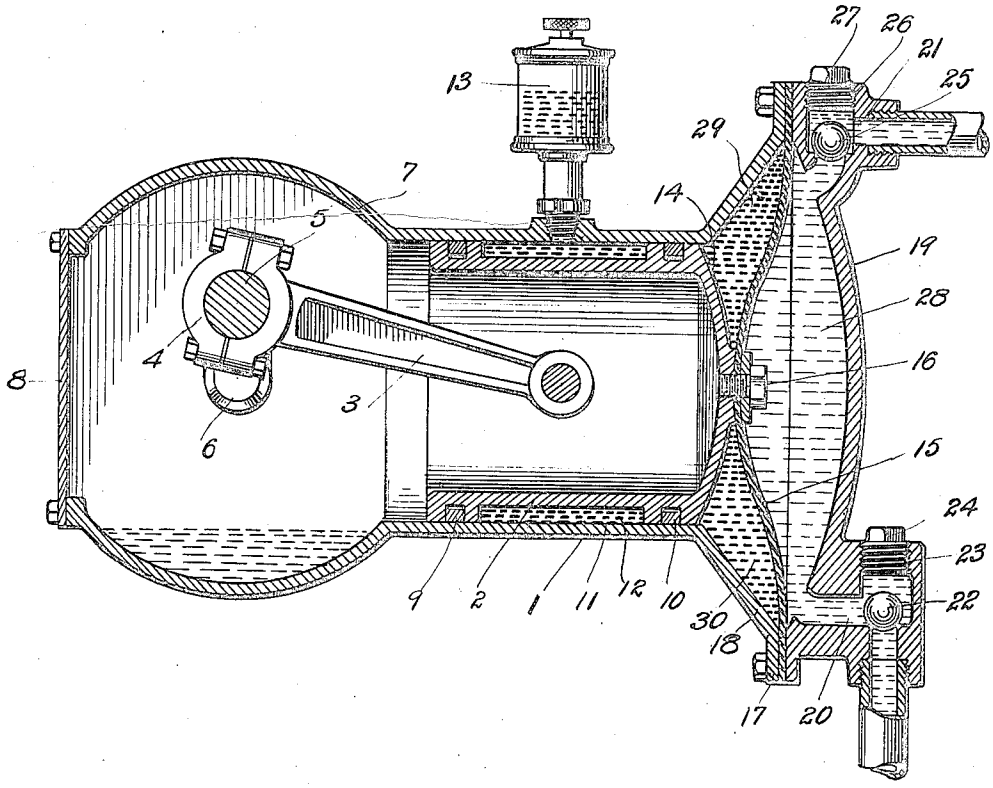

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UNITED STATES PATENT OFFICE.

EVERETT B. CUSHMAN, OF LANSING, MICHIGAN, ASSIGNOR TO BEAN SPRAY PUMP CO., OF SAN JOSE, CALIFORNIA, A CORPORATION OF CALIFORNIA.

DIAPHRAGM PUMP.

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To all whom it may concern:

Be it known that I, EVERETT B. CUSHMAN, a citizen of the United States, residing at Lansing, in the county of Ingham and State of Michigan, have invented certain new and useful Improvements in Diaphragm Pumps; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

This invention relates to pumps and particularly to spray pumps for use in passing insecticides, fungicides, disinfectants, paint and other liquids, hereinafter referred to as "liquids," through a pumping chamber, the pump being the prime mover for causing the liquid to flow from the source of supply to the point of distribution.

The invention is particularly applicable for use in connection with spraying apparatuses used for handling insecticides, fungicides, disinfectants and the like because the spraying compounds usually contain acids and grit which tend to corrode and cut out the interior walls of the working parts of an ordinary pump, resulting in leaky stuffing boxes, frequent replacements of costly brass cylinders and, of course, necessitating the use of expensive porcelain enameled parts.

I have provided a novel, inexpensive, efficient type of pump in which the liquids do not come in contact with the reciprocating power piston, thus eliminating entirely the principal cause of expense and trouble with spray pumps. In my pump the power piston is connected to or operated in conjunction with a diaphragm which functions on the intake stroke to draw the liquid into the pump casing and on the discharge stroke to force out the liquid with sufficient pressure to meet the necessary requirements.

Diaphragm pumps have been used heretofore but the ordinary diaphragm pump is not designed nor capable of working under high pressure. The three or four hundred pounds pressure to the square inch frequently required cannot be handled by the ordinary form of diaphragm pump in which pressure is not evenly distributed over both exposed sides of the entire diaphragm.

In my pump the diaphragm and pistons may be attached together so as to provide a positive action of the diaphragm for high speed work and in order that there may be maintained a constant uniform pressure over the entire exposed surfaces of the diaphragm, I introduce a fluid between the pump piston and the diaphragm, the fluid preferably being non-compressible, oil being especially adapted for this purpose. By using oil between the pistons and the diaphragm so as to equally apply pressure over the entire sure against the diaphragm for forcing the surface of the diaphragm, the applied pres- Liquid from the pump chamber on the opposite side of the diaphragm is distributed equally over the walls of the diaphragm with the liquid on both sides of same so that there is no localized strains at any particular point as applied to the diaphragm. Therefore, breaking or cracking of the diaphragm is eliminated.

The pump piston is further packed with oil contained in a groove around the piston, sealing off the piston from the crank case and from the pressure chamber in which the non-compressible fluid is contained.

In actual practice, however, there may be some slight leakage of the fluid packing from the piston so I have provided means for automatically replenishing the supply in case of need.

The novel construction of the invention will be best understood by reference to the following description in connection with the accompanying drawings, in which—

The figure is a vertical, longitudinal, sectional view through a pump constructed in accordance with my invention.

The pump cylinder 1 is provided with a reciprocatory piston 2, which is operated by a piston rod 3 having a strap 4 at one end about a crank 5 of the crank shaft 6. The crank shaft 6 may receive its power from any suitable motive source and in actual practice I prefer to enclose the crank shaft in a crank case 7, which is part of the cylinder 1. A lubricating medium may be introduced in the crank case by removing the cover plate 8.

The reciprocating piston 2 has the usual packing rings 9 and 10 and intermediate its ends the piston is provided with an oil groove 11 to contain a body of sealing oil or other appropriate liquid 12, which will provide a liquid seal for the piston and prevent

air escaping past it. Some of the oil or other liquid may leak from the groove 11 during the operation of the pump and for this reason I provide a lubricating cup 13 of appropriate construction, which may replenish the supply in the groove 11.

The end of the piston is shown as rounded at 14 and for high speed pumps it may be connected to the center of a diaphragm 15 by a bolt connection 16. The outer edge of the diaphragm 15 is secured between the flange 17 on the flared portion 18 and the edge of the cylinder head 19. The cylinder head is provided with an inlet port 20 and an outlet port 21. The inlet port 20 is provided with a check valve 22, which may be introduced through the opening 23, normally closed by the plug 24.

A similar valve 25 is provided for the outlet port and it may be introduced through the opening 25 normally closed by the plug 27. The space 28 between the diaphragm and the head 19 is the liquid chamber through which the liquids pass.

The space between the flared portion 18, the end of the piston 14 and the outer wall of the diaphragm 15 constitutes a fluid pressure chamber 29, which preferably contains a non-compressible liquid, for example, oil, although in some cases air pressure may be used. The fluid 30 in the chamber 29 is designed to exert a uniform pressure against the outer face of the diaphragm so that there will be no local application of the power to the diaphragm when it is moving into collapsed or liquid-discharging position. Therefore, there will be practically no liability of the diaphragm cracking or breaking under the heavy duty pressures to which the pump may at times be subjected. In view of the fact that the diaphragm may be connected directly to the piston, it is obvious that in such cases there will be a quick action of the diaphragm in either direction, permitting the pump to be run at relatively high speeds, which is not possible with the ordinary type of diaphragm pump.

Since the liquid drawn through the pump chamber will often be a corrosive liquid and since there is no piston plunger or stuffing box in the chamber to be subjected to the corrosive liquid, the usual expensive replacement parts in the spray pump are eliminated. Material for the diaphragm resistant to the corrosive liquids is easily obtainable and by using porcelain enameled metal for the head 12, it will be apparent that the life of the pump will be long and the maintenance cost reduced to a minimum.

It will be observed that the device is simple in construction, efficient in operation, and easily assembled or taken apart whenever the occasion demands.

It is understood that changes in form, proportion and minor details of construction may be resorted to without departing from the spirit of the invention or sacrificing any of its advantages.

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

1. A diaphragm pump comprising a casing having a liquid chamber with an inlet and an outlet, one wall of the chamber consisting of a diaphragm, a piston in the casing connected to the diaphragm, and a fluid located between the piston and the diaphragm to exert pressure over the entire exposed outer surfaces of the diaphragm.

2. A pump casing, a diaphragm dividing the casing into two compartments, one having a valved inlet and a valved outlet, the other comprising a fluid chamber, a piston in the casing connected to the diaphragm, and a fluid in the fluid chamber between the piston and the diaphragm for intermittently applying uniform pressure against the outer surface of the diaphragm.

3. A pump casing, a diaphragm dividing the pump casing into two compartments, one having a valved inlet and a valved outlet, a reciprocatory piston connected to the diaphragm to cause the diaphragm to move back and forth in alternating suction and discharge strokes for the valved compartment, and a fluid between the piston and the diaphragm to exert uniform pressure against the diaphragm when the piston is moving on its compression stroke.

4. A pump comprising a casing, a diaphragm dividing the casing into two compartments, one having a valved inlet and a valved outlet, a piston in the other chamber connected to the diaphragm to impart alternating suction and discharge movements to the diaphragm, and means between the piston and the outer surface of the diaphragm to apply a uniform pressure over the entire exposed outer surface of the diaphragm.

In testimony whereof I affix my signature.

EVERETT B. CUSHMAN.