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2,753,804

DIAPHRAGM PUMP

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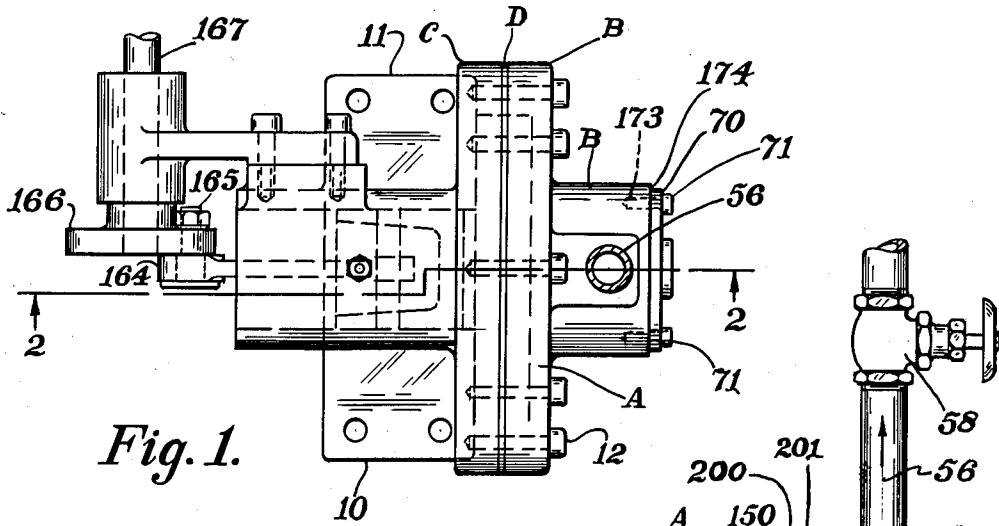


Fig. 1.

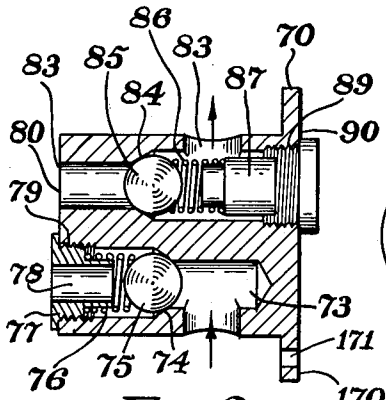


Fig. 3.

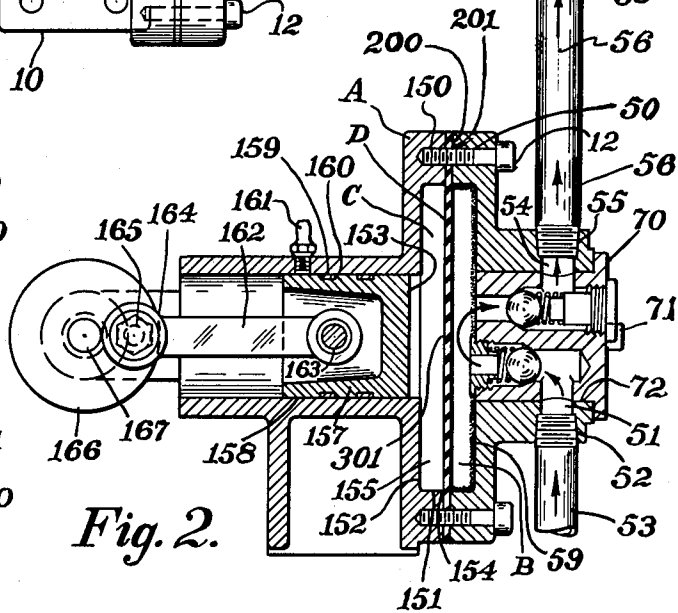


Fig. 2.

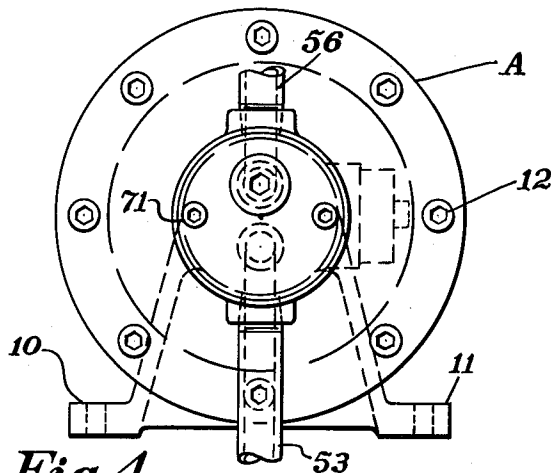


Fig. 4.

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DIAPHRAGM PUMP

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4 Claims. (Cl. 103—44)

This invention relates to diaphragm pumps and especially to such pumps adapted for pumping latex glue or similar liquids.

Diaphragm pumps usually utilize reciprocating mechanism or solenoids to flex the central portion of the diaphragm from a concave position on the suction stroke to a convex position on the pressure stroke. It has been customary to attach a reinforcing plate to such diaphragms, to connect a piston to the centre of the diaphragm, or to the reinforcing plate, or to contact the diaphragm with a coil spring all of which may cause frequent fracturing of the material of the diaphragm.

The principal object of this invention is to provide a pump having a compact housing in which the diaphragm is flexed by means of an air cushion whereby the diaphragm surface is completely free of any contact with any mechanical part of the pump. Another object of my invention is the provision, in such a housing, of integral air cylinder means for flexing a diaphragm with a uniform pressure exerted on the entire surface thereof thus preventing wear and fractures at one or more points on the surface as in prior devices. Still another object of my invention is to provide an airtight air cushion, between the diaphragm and the reciprocating mechanism associated therewith, which tends to balance the pressures on the bearings of the reciprocating mechanism during operation of the pump. A further object of my invention is the provision of a slidably removable plug, of a diameter about half that of the diaphragm and containing a pair of liquid inlet and outlet valves whereby the pumping chamber can be easily reached for cleaning and a plug, with fouled, or malfunctioning, valves, quickly replaced.

Further objects of my invention will be apparent in the following description and in the accompanying drawing in which:

Fig. 1 is a plan view of my device.

Fig. 2 is a side elevation thereof, in section on line 2—2 of Fig. 1 and

Fig. 3 is an enlarged view of the plug as shown in Fig. 2 and Fig. 4 is an end elevation of my device.

As shown in the drawings A is the housing of my new diaphragm pump, the housing A including suitable leg members 10 and 11 by which it is supported. Housing A is formed in two sections, the liquid chamber section B and the air chamber section C and the flexible impermeforate diaphragm D forms a partition between the two sections. The outer periphery 200 of diaphragm D contains openings 201 for bolts 12 which pass through holes 50 in section B and are threaded in holes 150 in section C thereby sealing the periphery of diaphragm D at the juncture of sections B and C.

A cylindrical plug 70, of large diameter, is removably secured by bolts 71 in an opening 72 in section B, the opening 72 being located opposite the centre 301 of diaphragm D, perpendicular thereto and forming an elongated extension of uniform cross section to liquid chamber B. Plug 70 is bored and counterbored from

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its inner face 80 to form an inlet conduit 73 and a seat 74 for an inlet ball valve 75. The inlet ball valve 75 is held against seat 74 by a coil spring 76 which abuts on a valve plug 77, bored at 78 in continuation of conduit 73 and threaded at 79 in the inner face 80 of plug 70.

Plug 70 is also bored and counterbored from its outer face 90 to form an outlet conduit 83 and a seat 84 for an outlet ball valve 85. The outlet ball valve 85 is held against seat 84 by a coil spring 86 which abuts on a valve plug 87 threaded at 89 in the outer face 90 of plug 70.

The liquid chamber section B is bored at 51 and threaded at 52 to receive a liquid inlet pipe 53 and is bored at 54 and threaded at 55 to receive a liquid outlet pipe 56. Upon flexing of diaphragm D to a concave position, ball valve 85 is sucked against seat 84 and ball valve 75 is sucked away from seat 74 thereby filling liquid chamber B with liquid drawn through pipe 53, conduit 73 and conduit 78. Upon flexing of diaphragm D to a convex position, ball valve 75 is pressed against seat 74 and ball valve 85 is pressed away from seat 84 thereby forcing the liquid in chamber B through conduit 83 and out pipe 56.

Where unclean, corrosive or sticky liquid is being passed through chamber B, and ordinary flushing out of the same is not effective, the plug 70 can be unbolted and slidably withdrawn from opening 72 to give easy access to the entire chamber B for removing sediment or crustation. Similarly, in the event that the ball valve mechanism or conduits of plug 70 become fouled, the entire plug can be easily removed and replaced by a substitute plug while the fouled plug is being cleaned, thus assuring continuous operation. I provide an annular flange 170, on plug 70, having unthreaded bolt holes 171 for bolts 71 and provide threaded holes 173 in the outer face 174 of B to receive and retain bolts 71.

Another advantage of this construction is that pipes 55 and 56 need not be removed while plug 70 is being removed for repairs or cleaning of the liquid chamber B thus permitting the pump to remain in its original installation. Because of the unusually large area of contact between the smooth cylindrical surface of plug 70 and the smooth cylindrical surface of opening 72 together with annular flange 170, no gaskets are required to prevent leakage of liquid from chamber B.

It should be noted that diaphragm D of my device, which preferably is of rubber or other resilient material, has no reinforcing plates, contacts no springs and is not directly connected to any moving part of my device. The diaphragm D is thus subject to wear only from contact with liquid, over one entire surface exposed to chamber B, and to air, over the entire opposite surface exposed to chamber C.

As shown the air chamber section C, of pump housing A includes an air pressure chamber 155 formed by rigid, impermeforate chamber walls, such as side wall 151 and end wall 152, a movable, rigid, impermeforate wall section 153 and the flexible diaphragm D, mounted across the diaphragm opening 154, and air sealed around its periphery 200. The movable wall section 153 is formed by the inner face of a piston head 157, slidable in a piston head cylinder 158 preferably integral with, and in extension of air chamber section C and preferably perpendicular to diaphragm D. Suitable piston rings 159 are mounted in ring grooves 160 in 157 to maintain the air pressure in chamber 155 and a suitable lubricating element 161 is provided in cylinder 158 to facilitate reciprocation of the piston therein.

A connecting rod 162 is pivotally mounted at 163 to piston head 157 and its other end 164 is pivotally mounted at 165 to a power pulley 166, rotated on shaft 167, by any suitable source of power, not shown herein.

In operation the piston head 157 is reciprocated in cylinder 158 by the rotation of shaft 167 with its piston stroke spaced from the flexible imperforate diaphragm D and at no time directly in contact with the diaphragm. The inner face 153 of the piston head 157 repeatedly compresses and expands the air in air pressure chamber 155 thus repeatedly flexing diaphragm D and thereby pumping the liquid in chamber B as explained above. Air pressure chamber 155 thus acts as an air cushion between the diaphragm and the means for flexing the same thereby preventing damage to the material of the diaphragm and providing smooth, balanced pumping operation.

My improved diaphragm pump is particularly useful for pumping liquids, such as latex or the like, which have a very severe corrosive action on certain metals. The pressure chamber C of my pump is completely isolated from pumping chamber B by the imperforate diaphragm D and initially there is no possibility of corrosive liquid coming into contact with the piston or cylinder since there is no hole in the operating surface of diaphragm D. Diaphragm D remains imperforate under long periods of use since it has no contact with wearing surfaces of metal and is flexed only by contact with an air cushion uniformly pressing on its entire surface. Similarly, the provision of my removable plug 70, carrying all the moving valve mechanism and liquid conduits of my device, provides a novel means for keeping the pump in continuous operation.

As shown at 59 the inner surfaces of liquid chamber section B may be coated with rubber, or other material, resistant to corrosion, whereby the only surface subject to corrosion is that of the removable plug 70. A plug which has been subject to corrosion is quickly removed by unthreading bolts 71, and an uncorroded plug inserted in its place in a few minutes' time.

My improved diaphragm pump can obviously be operated with the diaphragm horizontal, instead of in the vertical position shown in the drawings, if desired.

A globe valve 58, or a petcock, may be placed in the outlet pipe 56, as indicated in Fig. 2, and the piston head 157 of my new diaphragm pump may continue to reciprocate while the valve 58 is entirely closed. This advantage is due to the fact that the diaphragm is flexed only by expansion and compression of the air in air chamber section C and the closing of outlet pipe 56 merely results in greater compression of the air cushion in section C without damaging the diaphragm or other pump parts.

It is thus possible to regulate the flow of liquid on the discharge side of my pump by closing down, or shutting off completely, the flow through any point in its outlet pipe such as 56 and without shutting off the pump motor. It should be noted that the liquid in the pumping chamber is not agitated during the shut off period and that there is no increased strain or stress on the motor or pump during such shut off period.

I claim:

1. In a liquid pump the combination of a pump housing; a flexible, imperforate, diaphragm peripherally secured in said housing intermediate thereof and separating said housing into a liquid pumping chamber and

an air tight, air pressure chamber, the latter chamber including a piston head cylinder in extension thereof and opening directly therein; a piston head, entirely of rigid material, spaced from said diaphragm and reciprocable in said cylinder, said piston head being adapted to flex the diaphragm by alternately increasing and decreasing the air pressure of the air confined in said air tight chamber and a cylindrical valve plug, removably fixed in a cylindrical opening in the wall of said liquid pumping chamber, opposite to said diaphragm, said opening being about half the area of said diaphragm and said plug having a smooth cylindrical face for axial sliding into and out of said opening.

2. In a liquid pump the combination of a pump housing; a flexible, imperforate diaphragm peripherally secured in said housing intermediate thereof to form a liquid pumping chamber on one side of said diaphragm and an air pressure chamber on the opposite side of said diaphragm; a piston head cylinder integrally formed in said housing as an elongated air chamber extension of uniform cross section leading directly into said air pressure chamber perpendicular to, but spaced from, the central portion of said diaphragm; a piston head of rigid imperforate material reciprocable in said cylinder and tightly fitted therein to make said air chamber and cylinder air tight; a connecting rod operably connected to said piston head to advance and retract the same in said cylinder without said piston head contacting said diaphragm, a cylindrical valve plug opening formed in said housing as an elongated liquid chamber extension of uniform cross section leading directly into said liquid pumping chamber perpendicular to, but spaced from, the central portion of said diaphragm, a slidably removable cylindrical valve plug fixed within, and filling, said valve plug opening and a liquid inlet and a liquid outlet valve mounted in said cylindrical valve plug.

3. A pump as specified in claim 2 wherein the diameter of said valve plug and said valve plug opening is about half the diameter of said diaphragm whereby said valve plug opening serves as a clean-out opening.

4. A pump as specified in claim 2 plus a liquid inlet pipe and a liquid outlet pipe fixed to the pump housing and connected to said plug only by conduits registerable by slideable positioning of said plug whereby said valve plug is slidably removable from said opening without affecting said pipes.

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