Aug. 6, 1929. E. P. LARSH 1,723,360

PUMP

Filed Oct. 19, 1925 3 Sheets-Sheet 1

Fig 4

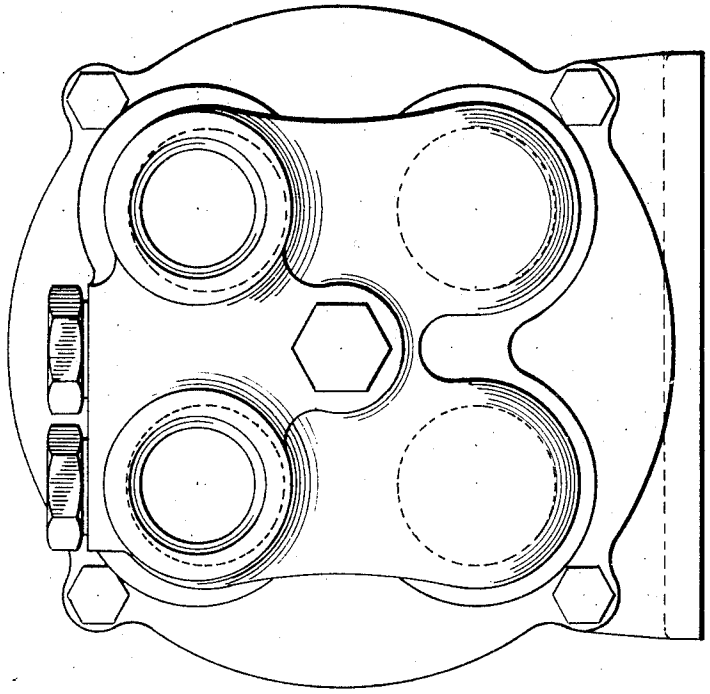
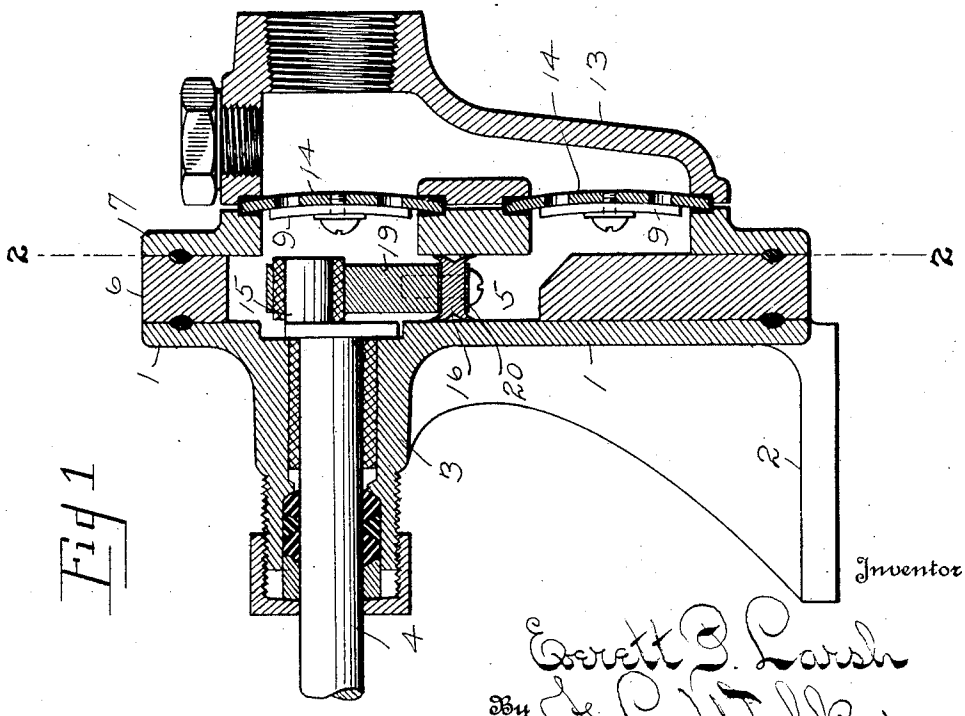


Fig 1



Inventor

Everett P. Larsh

By H. L. Walker

Attorney

Aug. 6, 1929. E. P. LARSH 1,723,360

PUMP

Filed Oct. 19, 1925 3 Sheets-Sheet 2

Fig 3

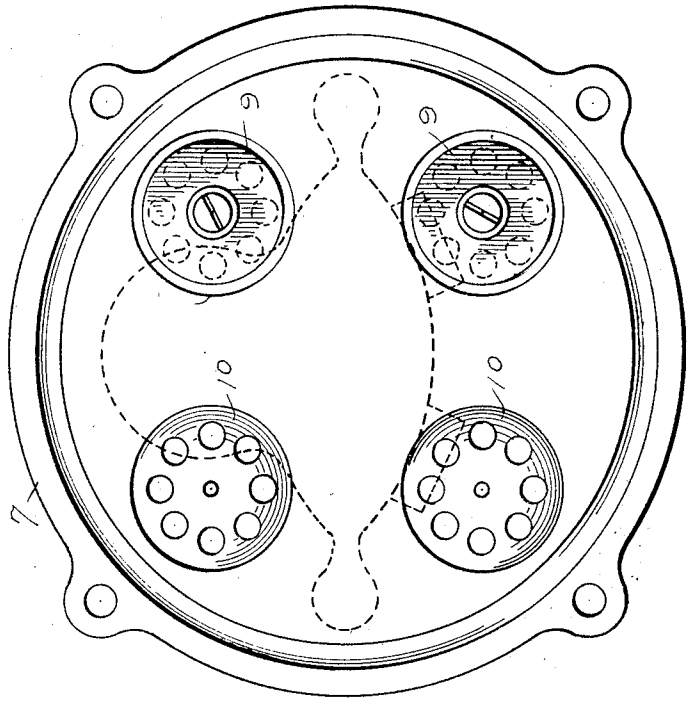
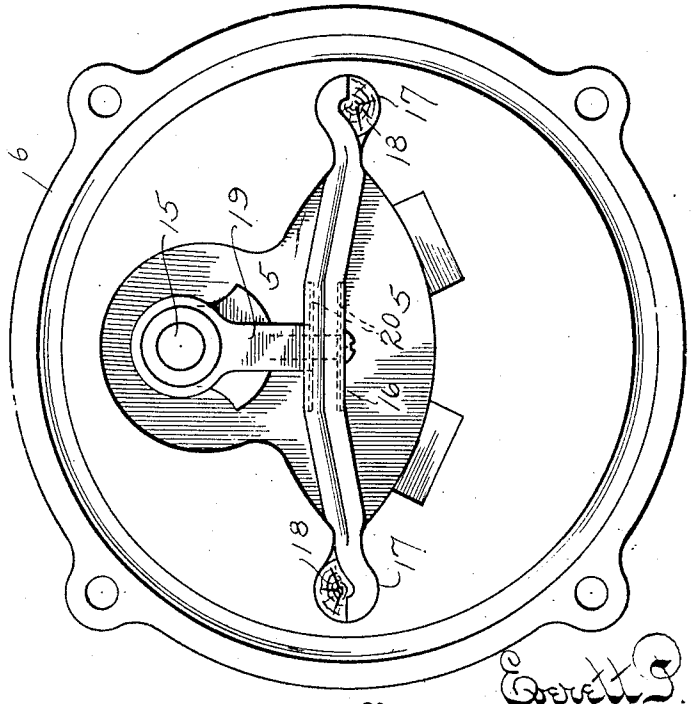


Fig 2



Inventor

Everett P. Larsh

By H. E. Walker Attorney

Aug. 6, 1929. E. P. LARSH 1,723,360

PUMP

Filed Oct. 19, 1925 3 Sheets-Sheet 3

Fig 8

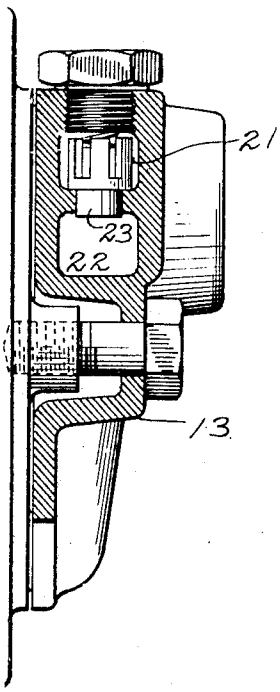
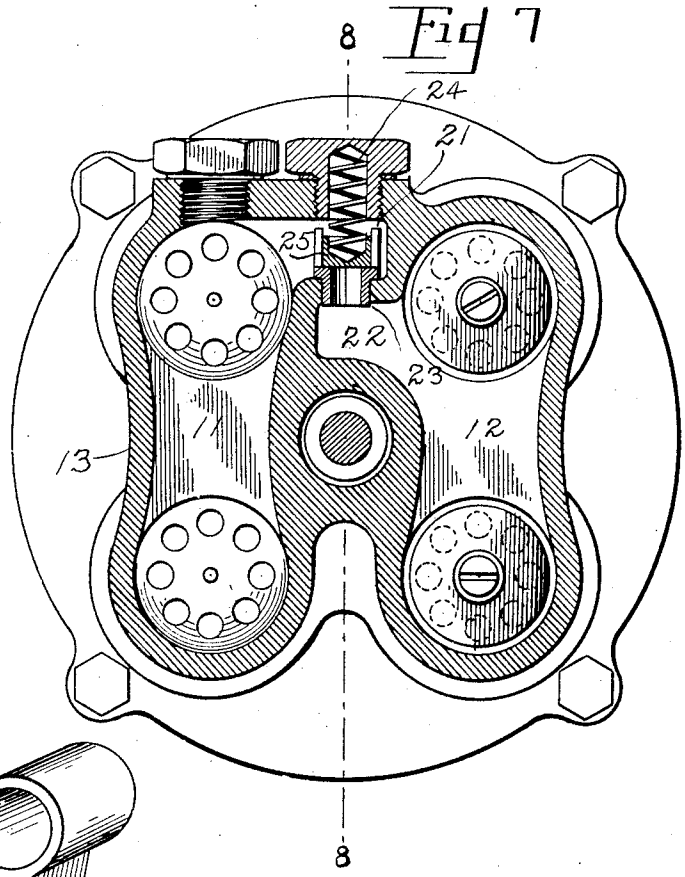


Fig 7



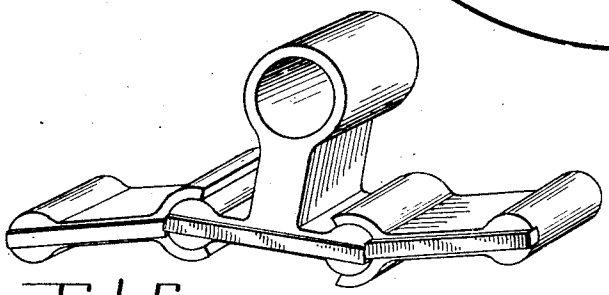


Fig 6

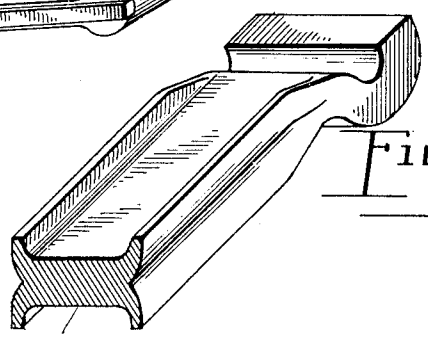


Fig 5

Inventor

Everett P. Larsh

By H. L. Walker

Attorney

Patented Aug. 6, 1929. 1,723,360

UNITED STATES PATENT OFFICE.

EVERETT P. LARSH, OF DAYTON, OHIO, ASSIGNOR TO THE MASTER ELECTRIC COMPANY, OF DAYTON, OHIO, A CORPORATION OF OHIO.

PUMP.

Application filed October 19, 1925. Serial No. 63,392.

My invention relates to pumps and fluid pressure motors of the expanding chamber type. The invention is particularly applicable to hydraulic pumps, although not limited to such application, but may be utilized for delivering under pressure, various liquids or fluids, and when combined with suitable valve gear, the primary features herein shown and described may be utilized as a fluid pressure motor.

The structure forming the subject matter hereof, utilizes in combination, the more advantageous characteristics of a diaphragm pump and those of a reciprocating piston pump or motor. In the present invention, there is contemplated a pressure chamber having spaced flat parallel side walls, the chamber being divided into compartments alternately expansible and contractible by an intermediate flexible partition wall. The partition wall is fixedly connected at its ends to the end walls of the chamber, while the intermediate portion is capable of to and fro warping movement, in which the lateral margins of the flexible wall are free for to and fro sliding or wiping engagement upon the spaced parallel flat side walls of the chamber. The flexible partition wall is given a vibratory movement to alternately extend and contract the respective compartments by means of crank shaft connected with the flexible partition wall at a medial point by a connecting rod or pitman. Inlet and discharge valves are located on opposite sides of the flexible partition wall affording inlet and outlet passages to the respective compartments. The construction necessitates minimum clearance requirement, while affording a maximum displacement in relation to the total full piston movement.

The structure as a whole forms a small compact unit, capable of being mounted directly upon the head of an electric motor, or being mounted as a separate unit for high speed operation, and possesses high efficiency, and a large output capacity, in comparison with the power requirements.

The object of the invention is to simplify the structure as well as the means and mode of operation of fluid pressure devices, whereby they will not only be cheapened in construction, but will be more efficient in use, positive in operation, uniform in action, and unlikely to get out of repair.

A further object of the invention is to provide a pump or like construction, having a minimum number of parts, and of simple, compact construction, necessitating but a small amount of machine operations, and therefore, economical in manufacture and maintenance.

A further object is to provide a pump or like device, of high efficiency, and maximum output with minimum power requirement.

A further object of the invention is to provide a flexible piston construction which will embody the advantageous characteristics of a diaphragm while eliminating the objectionable features thereof.

A further object of the invention is to provide a large capacity continuous flow pump having a short stroke.

A further object of the invention is to provide an improved form of valve and valve seat mounting.

With the above primary and other incidental objects in view as will more fully appear in the specification, the invention consists of the features of construction, the parts and combinations thereof, and the mode of operation or their equivalents as hereinafter described and set forth in the claims.

In the accompanying drawings, wherein is shown the preferred, but obviously not necessarily the only form of embodiment of the invention, Fig. 1 is a vertical sectional view of the assembled pump structure forming the subject matter hereof. Fig. 2 is a transverse sectional view thereof, on line 2—2 of Fig. 1, viewed toward the left, to illustrate the compression chamber and flexible piston wall. Fig. 3 is a similar view on the same plane, but viewed toward the right, showing the location of the inlet and discharge port, and by dotted lines, the relative position of the compression chamber, and flexible piston. Fig. 4 is an exterior view showing the discharge head in elevation. Fig. 5 is a detail perspective view of the flexible piston, removed from the chamber. Fig. 6 illustrates a modification wherein the flexible piston comprises a succession of hinged jointed sections. Fig. 7 is a transverse sectional view of the fluid supply and discharge chambers, and the relief valve therebetween. Fig. 8 is a vertical sectional view on line 8—8 of Fig. 7.

Like parts are indicated by similar characters of reference throughout the several views.

For simplicity and economy of manufacture, the pump casing or housing has been shown as comprising a series of plates or parallel sections arranged side by side. The first of these sections comprises the head 1, which has been shown provided with a supporting bracket or foot 2, and with a laterally projecting boss or bearing sleeve 3, to receive the drive shaft 4. This drive shaft 4, may comprise the armature shaft of an electric motor, of which the primary head 1 forms a part of the motor casing. Otherwise the shaft 4 may carry a driven pulley or gear actuated from any suitable source of power. By constructing the head 1 as a separate member, the face of the head may be conveniently and economically finished by grinding or otherwise to afford a substantially uniform flat surface. The pump chamber 5 comprises a recess or opening, through a main disc or plate 6, which is positioned against the flat face of the primary head 1, which forms one of the lateral or side walls of the pump chamber. The opposite side of the pump chamber 5 is formed by the flat side of a plate 7, parallel with and bearing against the side of the main plate 6, to enclose the chamber 5, for which the flat engagement faces of the head 1 and plate 7 form parallel spaced side walls. The intermediate plate 7 is provided with a series of circular openings registering with inlet and outlet valves 9 and 10, communicating with supply and discharge chambers of a head 13, secured to the outer side of the plate 7 and enclosing therebetween the valve seats of the inlet and outlet valve discs 14. The pump chamber 5 is of trilobular shape, the upper lobe of the chamber being of substantially circular form, to accommodate a crank head 15, upon the drive shaft 4. To insure uniform smooth operation, the crank 15 is of the balanced type. The chamber 5 is separated into two non-communicating compartments, by means of a transverse flexible wall or partition 16. This flexible wall or partition 16 performs the function of a piston and possesses certain characteristics of both a diaphragm and a reciprocatory piston head. The flexible piston wall or partition is preferably formed from a leather strap, although other flexible composition materials may be employed, or in lieu thereof, a pointed metallic piston wall may be utilized. The piston strap or partition, whether of leather or other flexible composition material, is either formed of two superposed laminations, or if a single piece of sufficient thickness is employed, such strip of material is scored along its longitudinal lateral margins to form parallel tongues or beads, which are turned in opposite directions to form two channel surfaces, oppositely disposed. The ends of the flexible piston wall or strap are secured in the end walls of the pump chamber 5. These end walls are provided with small recesses or socket openings 17, to receive the terminal ends of the flexible piston strap, which are secured therein by any suitable attachment means, as for example, wooden wedges 18, driven tightly into the recesses or openings 17, to clamp the ends of the piston wall or strap therein. This piston wall or strap is of such width to exactly fit the interior of the chamber, intermediate its flat parallel side walls, against which the out-turned beads or flanges formed by the marginal scoring of the strap have free wiping or sliding engagement. While the intermediate flexible wall or piston strap is fixedly secured to the walls of the pump chamber at its opposite ends, the intermediate portions of such flexible wall or piston strap is free for warping or vibratory movement within the chamber, during which the margins of the straps or flexible wall move to and fro upon the flat parallel side walls somewhat in the manner of a reciprocatory piston. The upturned marginal edges of the strap forming oppositely disposed channel surfaces perform the function of a cup leather to seal the contact between the flexible piston wall and the parallel side walls of the chamber to prevent leakage from one compartment to the other of the chamber, past such wall or piston strap. This flexible wall or piston strap is medially connected to the crank 15, by a pitman or connecting rod 19, mounted at one end upon the crank 15, and having its other end secured to the piston strap. Preferably, bearing plates 20 are provided upon opposite sides of the piston strap or flexible wall, at the point of attachment of the connecting rod 19. These bearing plates extend on opposite sides of the connecting rods, throughout a range of approximately one third the length of the flexible piston strap or wall. These bearing plates are slightly curved away from the strap at their extremities and serve to distribute the bending strain. As the operating crank shaft is rotated, the piston strap or flexible wall 16 is given a vibratory movement to and fro with a peculiar warping or undulating effect, which in practice has been found very effective in expelling water or other liquid from first, one compartment, and then the other compartment of the pump chamber. Merely, as an example but with no intention of establishing proportions and relative sizes of parts, it has been found in practice that a pump constructed as herein shown and described, wherein the crank shaft has three eights inch throw, acting upon the piston wall or strap, having an effective length of three inches in a pump chamber, approximately one half inch in width, develops a discharge output of two hundred gallons per hour under a power requirement of one-eighth horsepower.

The inlet compartment 11 of the head 13, communicates with the respective compart-

ments on opposite sides of the flexible piston strap 16, through valved inlets 9, one of which communicates with each compartment. Likewise the discharge chamber 12 of the head 13, communicates through similar outlet valves 10 with the respective compartments of the pump chamber 5. While the inlet and outlet valves 9 and 10 may be of any suitable and convenient construction, it has been found by experiment that circular discs of resilient material or of flexible character, such as rubber or leather, held upon their seats by a centrally located stud or screw, are most satisfactory. The valve seats 14 comprise perforated discs of metal, preferably of concavo-convex form. These valved seat discs are clamped between the intermediate plate 7, and the pump head 13, or may be fixedly secured in the circular registering openings of either of these members by pressing the plate into the opening under sufficient pressure to reduce the convexity of the valve seat plate and thereby expand them into firm engagement within the opening. The flexible valve discs 9, are located upon the concave side of such valve seat discs and extend into overlapping relation with the perforations 19 of such discs. By locating the flexible valve discs 9, upon the concave side of the discs 14, the peripheries of the valve members adhere closely to the corresponding seats.

As a safety precaution, a relief valve 25 is provided between the discharge chamber 12 and the intake chamber 11 of the head 13. These chambers or compartments have overlapping recesses 21 and 22, in the partition between which is located the valve seat 23, upon which the valve 25 normally rests, under the influence of the spring 24. However, in the event of excessive back pressure in the discharge line, this valve will open to automatically relieve such back pressure, by permitting a return flow to the suction side of the pump.

From the above description, it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts, without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific details shown, but that the means and construction herein disclosed comprises the preferred form of several modes of putting the invention into effect and the invention is, therefore, claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

Having thus described my invention, I claim:

1. In a construction of the character described, a chamber having spaced parallel side walls, inlet and outlet ports leading to and from said chamber, a continuous partition of flexible material in said chamber, separating the chamber into alternately expansible and contractible compartments having its opposite ends engaged in fixed relation with the walls of the chamber and the medial portion having sliding contact upon the spaced parallel side walls, and means for flexing the partition to and fro to vary the capacity of the compartments.

2. In a construction of the character described, a chamber having spaced parallel side walls, inlet and outlet ports leading to and from the chamber, an integral continuous flexible wall for said chamber interposed between the spaced parallel side walls, the opposite ends of the flexible wall being fixed, the intermediate portion of the flexible wall being capable of a to and fro bending movement, in which the opposite lateral margins of the flexible wall have to and fro wiping engagement upon the spaced parallel side walls of the chamber, and means to vibrate the flexible wall.

3. In a construction of the character described, a chamber having spaced parallel side walls, inlet and outlet ports leading to and from the chamber, a unitary flexible diaphragm in said chamber comprising a single piece of material having two opposite fixed margins and two opposite free margins, the latter having sliding contact upon the spaced parallel side walls of the chamber, a crank and a connecting rod connecting the crank with the medial portion of said diaphragm.

4. In a construction of the character described, a casing having internally two opposite flat walls, a continuous partition of flexible material interposed between the flat walls having its ends fixed and its medial portion capable of to and fro warping movement in which the lateral margins of the flexible partition have free sliding contact upon the internally flat walls of the casing, a revoluble crank shaft, a connecting rod connecting the flexible partition medially with the crank shaft and valved inlet and outlet ports communicating with the casing on opposite sides of the flexible partition.

5. In a fluid pressure apparatus of the character described, a pressure chamber, a flexible piston member therein of elongated strip form, the ends of said piston being fixedly secured, and the longitudinal side margins being free, oppositely extending flexible lips on the side margins of said piston strip, the medial portion of said flexible piston being capable of to and fro warping movement and

means for affording a sealed contact between the free longitudinal margins of the flexible piston and the flat side walls of the chamber.

6. In a fluid pressure apparatus of the character described, a pressure chamber having interiorly opposite flat walls, a continuous flexible partition strip of greater length than the distance across the chamber extending across the chamber in perpendicular relation, to the flat side walls, and capable of to and fro warping movement therebetween, the ends of the flexible strip being fixedly secured while the longitudinal margins are free for to and fro wiping engagement upon the flat side walls during the warping movement of the flexible partition and sealing means for effecting a leak tight contact between the wiping margins of the partition and the flat walls of the chamber.

7. In a fluid pressure apparatus of the character described, a pressure chamber having interiorly opposite flat walls, and a flexible strap piston capable of to and fro warping movement, extending intermediate the flat walls and in perpendicular relation thereto, with its opposite ends attached and its longitudinal margins free for to and fro wiping contact upon the flat walls of the chamber, said strap piston being of double channel shape and having flexible marginal flanges pressed into contact with the flat side walls by fluid pressure within the chamber.

8. In a fluid pressure apparatus of the character described, a pressure chamber having interiorly opposite flat walls, and a flexible strap piston capable of to and fro warping movement, extending intermediate the flat walls and in perpendicular relation thereto, with its opposite ends attached and its longitudinal margins free for to and fro wiping contact upon the flat walls of the chamber, said strap piston being longitudinally scored upon its free edges, and oppositely disposed marginal flanges formed thereon by such marginal scoring, which flanges are pressed into sealing contact with the flat side walls by fluid pressure within the chamber.

9. In a fluid pressure apparatus of the character described, a pressure chamber, having interiorly opposite flat walls, and a flexible strap piston capable of to and fro warping movement, extending intermediate the flat walls and in perpendicular relation thereto, with its opposite ends attached and its longitudinal margins free for to and fro wiping contact upon the flat walls of the chamber, a crank shaft, a connecting rod attached to said flexible piston at a medial point, and bearing plates located on opposite sides of the flexible piston and extending in opposite directions from the point of attachment of said connecting rod thereto.

10. In a fluid pressure apparatus of the character described, a pressure chamber, having interiorly oppositely flat walls, and a flexible strap piston capable of to and fro warping movement, extending intermediate the flat walls and in perpendicular relation thereto, with its opposite ends attached and its longitudinal margins free for to and fro wiping contact upon the flat walls of the chamber, and means for stiffening an intermediate portion of the flexible partition and confining the flexing movement to portions adjacent the attached ends.

11. In a fluid pressure apparatus of the character described, a pressure chamber, having interiorly opposite flat walls, and a flexible strap piston capable of to and fro warping movement, extending intermediate the flat walls and in perpendicular relation thereto, with its opposite ends attached and its longitudinal margins free for to and fro wiping contact upon the flat walls of the chamber, the intermediate portion of the partition being rendered resistant to flexing movement while effecting to and fro movement in unison with the flexing movement of the partition at opposite sides of such intermediate portion.

12. In a fluid pressure apparatus of the character described, a pressure chamber, having interiorly opposite flat walls, and a flexible strap piston capable of to and fro warping movement, extending intermediate the flat walls and in perpendicular relation thereto, with its opposite ends attached and its longitudinal margins free for to and fro wiping contact upon the flat walls of the chamber, and clamp plates on opposite sides of the medial portion of the flexible partition limiting the flexing movement of the medial section while permitting its to and fro movement in unison with the flexing movement of the lateral portions of the partition at opposite sides of the clamp plates.

In testimony whereof, I have hereunto set my hand this 28th day of September A. D. 1925.

EVERETT P. LARSH.