



## UNITED STATES PATENT OFFICE

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## HYDRAULIC FLUID DEVICE

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This invention relates to an improved construction of a constant force pumping unit, both for circulating hydraulic and other fluids including gases.

One of the objects of the invention is to provide a cylinder which is used for containing the hydraulic fluid with means for forcing the fluid from the cylinder or container by a piston pressure operation against a fixed inner wall.

Another object of the invention is the provision of a constant force pumping unit for hydraulic pressure fluids and gases, comprising an enclosing container or cylinder, a fixed conical wall within the container or cylinder and having an open lower end, and a piston slidable within and against the fixed conical wall to produce an expulsive effect upon the contained pressure fluid.

A further object of the invention is the provision of a constant force pumping unit for hydraulic pressure fluids, comprising a container adapted to hold either a hydraulic fluid or a gas, or both fluid and gas simultaneously, an inner wall, and a pressure piston slidable within the inner wall and constructed of expansible material charged with compressed air, so that it will maintain a self sealing pressure engagement with the fixed inner wall for the full length of its stroke.

For further comprehension of the invention, and of the objects and advantages thereof, reference will be had to the following description and accompanying drawing, and to the appended claims in which the various novel features of the invention are more particularly set forth.

In the accompanying drawing forming a material part of this disclosure:

Fig. 1 is a vertical sectional view through the pumping unit.

Fig. 2 is a top plan view thereof.

Fig. 3 is a detail enlarged sectional view, showing the check valve for controlling the air inlet to prevent a vacuum condition forming in the container.

Referring to the drawings, which illustrate the practical embodiment of the invention, 10 designates a container or cylinder, which is provided with a bottom wall 11, detachably secured in place, as by the cooperating flanges 12 and 13, and the connecting bolts 14.

The upper end of the container or cylinder 10 is provided with a top end wall 15, suitably mounted in place thereon, as by the inturred flange 16 and the thrust head 17. The upper end wall 15 is provided with an intake 18 for either air or hydraulic fluid having a ball check valve

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19, supported in place by means of the cantilever spring 20. The upper end wall 15 is also provided with a discharge outlet 21, through which either a hydraulic fluid or a gas may be passed, which is controlled by the ball check valve 22, held in place by the cantilever spring 23.

Within the container or cylinder 10 a fixed inner wall 24, of approximately frusto-conical construction, is secured against the upper end wall 15 by means of the ring 25, which is threaded against the ring flange 26, formed on the cover or upper end wall 15, and which has a clamping action against the flanged upper end 24<sup>a</sup> of the fixed inner wall 24, to hold said flanged end in pressure engagement with the upper end wall 15. The lower end of the conical wall 24 is provided with an outlet 27, which is normally open.

Within the conical inner wall 24 a piston 28 is slidably mounted, on the inner end of the piston rod 29, which slides through the central bearing 30 of the upper end wall 15. The upper end of this piston rod is equipped with a handle 31.

The piston 28 is constructed of elastic and expansible rubber or other similar material, natural or synthetic, and is of general hollow construction, so that it can be charged with compressed air, through the valved nipple 32. The air pressure found suitable is thirty pounds per square inch.

The fluid enclosed by the inner wall 24 will be displaced downwardly through the lower discharge opening 27 thereof, and will be expelled into the chamber 33, outside of this conical inner wall, thereby raising the level of the pressure fluid in the outer chamber and either causing it or any gas compressed in the outer chamber to be discharged through the service outlet 21, to any transmitting conduit or piping, which need not be shown, and which is coupled to the nipple 21<sup>a</sup>.

Fluid may be replaced in the container 10 by means of the filler nipple 33, and is equipped with a suitable closure means 34 therefor.

An airhole 35, is provided in the upper end wall 15, for the purpose of allowing air, at atmospheric pressure to act upon the upper face of the piston 28, at all times, thereby aiding the piston in the performance of useful work on the downward stroke.

By moving the piston upwardly as the fresh fluid or gas is added, suction will be created within the container to induce an inward flow of the fresh fluid or gas.

When downward pressure is applied to the pneumatic piston, it will assume a dished condition, with its bottom face or end formed into an

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outside convex curve and its upper face or end formed into a concave curve.

The operation of this pump is based upon those laws of physics which state that the total force exerted upon an area is equal to the product of the pressure and cross-sectional area, and all pressures exerted upon a fluid or gas in a sealed container are transmitted equally throughout. If the force exerted upon the piston be constant, then the cross-sectional area of the piston in engagement with either the hydraulic fluid or gas and the pressure exerted upon the piston must continuously vary as the piston is forced downwardly from the upper end portion of the fixed conical wall 24. On account of its own pliability, its elastic construction, and the compressible change of compressed air, the piston will remain in constant engagement with and will mold itself to the changed conditions of the fixed inner wall, at all times.

Although the chamber 24 is of conical form, it is understood that it may be of any shape required, in order that the product of its horizontal cross-sectional area at any point, and the pressure exerted upon the piston at that point, may be equal to the desired constant force exerted upon the piston throughout. The volume of fluid displaced by the expansible piston 23 is at its maximum value when the piston commences its downward stroke from the position shown in Fig. 1. The volumetric piston displacement becomes less and less as the piston approaches the end of its stroke at the lower-most point in the conical chamber. That is, a predetermined piston movement at the beginning of the stroke will cause a much greater volumetric displacement than at the end of the stroke. Considering the extent of piston movement required for a predetermined displacement, it has been found that a greater extent of piston movement is required at the end of the stroke. But on the other hand, a back pressure is being built up. By decreasing the piston volumetric displacement (or, conversely, increasing the length of the required piston movement, as explained above), the normal force required to be exerted on the pump handle 31 will be maintained constant throughout the pump operation as the said back pressure builds up.

With the conical chamber, shown on the drawing, the force required to be exerted will be fairly constant. The chamber, however, may be shaped to cause the force exerted on the pump handle to be precisely constant, that is, to vary the volumetric displacement of the piston throughout its stroke so that a substantially constant force will be required to be exerted on the pump handle throughout the stroke.

It is also understood that the piston may exert pressure upon either a hydraulic fluid or a gas within the chamber 24, and that both a hydraulic fluid and a gas may be used in the pump simultaneously.

While we have illustrated and described the preferred embodiment of our invention, it is to be understood that we do not limit ourselves to

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the precise construction herein disclosed and the right is reserved to all changes and modifications coming within the scope of the invention as defined in the appended claims.

Having thus described our invention, what we claim as new and desire to secure by United States Letters Patent is:

1. A constant force hydraulic fluid device, comprising an outer container having bottom and top end walls and a valved inlet and valved outlet, an inner wall forming a conical chamber supported on the top end wall and provided at its smaller end with a discharge opening located near the bottom, and a pneumatic and expandable piston slidable within the conical chamber, and a piston rod connected to said piston extending outwardly of the container.

2. A constant force hydraulic fluid device, comprising an outer container having bottom and top end walls and a valved inlet and a valved outlet, an inner wall forming a conical chamber supported by its larger end on the top end wall and spaced from the bottom end wall and provided with a discharge opening, a piston constructed with a hollow elastic body and charged with compressed air slidable within said conical chamber, and a rod connected with said piston and extending from said container.

3. In a constant force pump, a tubular wall forming a chamber which reduces in diameter and which has its greatest diameter at the top, a disc closing the top of said tubular wall, said tubular wall having an open bottom, a hollow resilient piston vertically slidably mounted within said wall, said piston being filled with compressed air, and means for lowering said piston within said chamber, whereby when said piston is lowered it will deform itself to compensate for the changing cross sectional diameter of said chamber.

4. In a constant force pump, a tubular wall forming a chamber which reduces in diameter and which has its greatest diameter at the top, a disc closing the top of said tubular wall, said tubular wall having an open bottom, a hollow resilient piston vertically slidably mounted within said wall, said piston being filled with compressed air, and means for lowering said piston within said chamber, whereby when said piston is lowered it will deform itself to compensate for the changing cross sectional diameter of said chamber, and a valved nipple mounted on said piston for renewing the supply of compressed air therein.

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