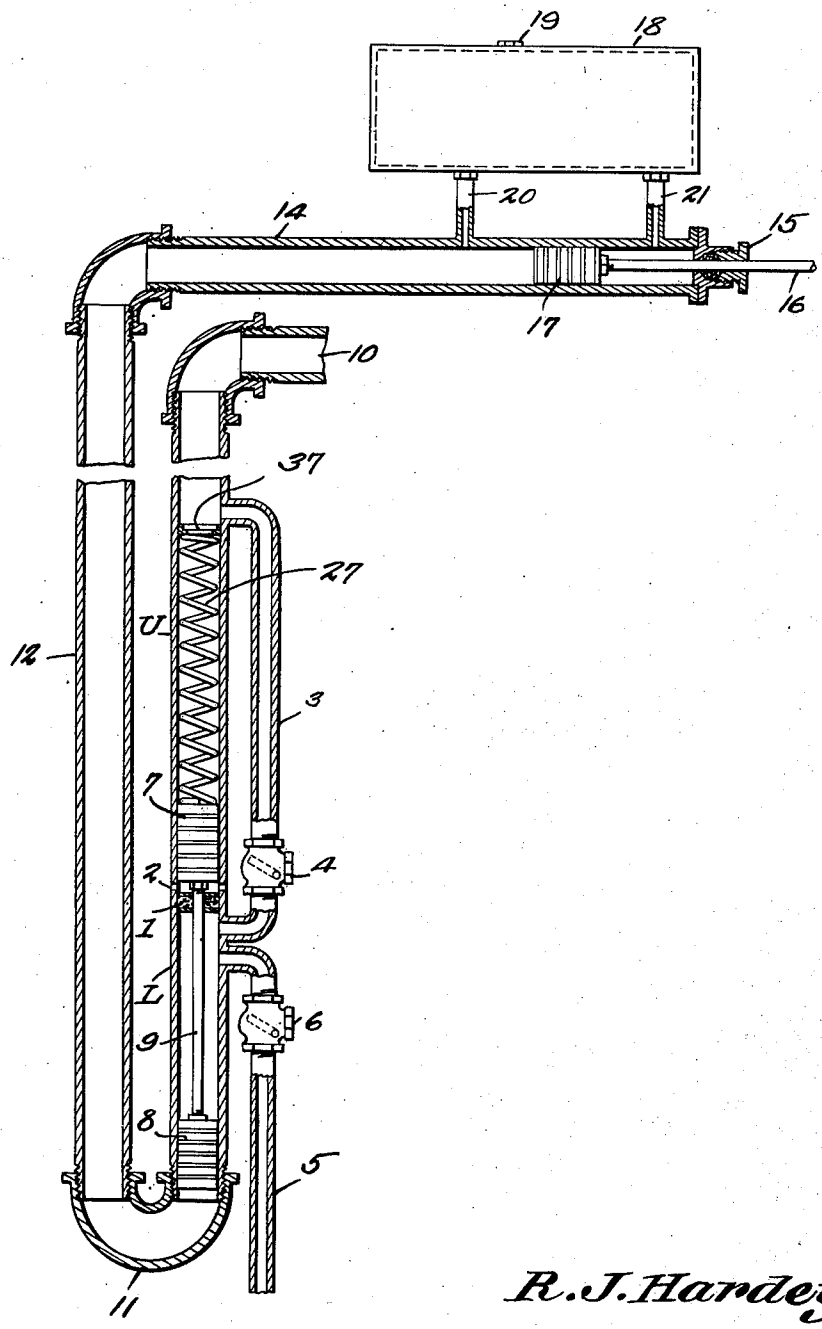
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HYDRAULIC PUMP FOR LIQUIDS

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HYDRAULIC PUMP FOR LIQUIDS

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This invention aims to provide novel means whereby the weight of a column of fluid in a vertically-acting piston pump may be offset by the weight of fluid in a vertical fluid-pressure line, thereby to provide approximate piston balance, means being provided for putting operating pressure on the fluid in the fluid pressure line, to secure actuation of the piston. Another object of this invention is to supply structural details for carrying out the aforesaid operation, and other operations auxiliary thereto.

A mechanic who abides by what is claimed, may make such changes as his skill may direct, without departing from the spirit of the invention.

In the drawing, the device is disclosed in a single figure which, for the major part, is a vertical section.

The letter L marks a substantially vertical, lower pump cylinder, and the letter U designates a substantially vertical upper pump cylinder, aligned axially with the lower pump cylinder. The pump cylinders L and U are shown as integrally formed, but that construction need not be insisted upon. The individuality of the cylinders L and U is maintained by a partition 1 in the tubular, vertical member of which the cylinders L and U form parts, the partition preferably being a stuffing box. The upper cylinder U is supplied with one or more lateral vents 2, located above and in close vicinity to the partition 1.

The numeral 3 designates a vertical discharge conduit. The lower end of the discharge conduit 3 communicates with the lower cylinder L at a place below the partition 1, but in close relation to the partition. The upper end of the discharge conduit 3 communicates with the upper cylinder U at a place spaced vertically above the partition 1. A downwardly closing check valve 4 is interposed in the discharge conduit 3 and is located near the partition 1.

At 5 there appears a depending inlet for the lower cylinder L. The inlet 5 communicates with the cylinder L at a place below the partition 1 and below, but close to, the lower end of the discharge conduit 3. A downwardly closing check valve 6 is interposed in the inlet 5 and is located near the upper end of the inlet.

An upper pump piston 7 is mounted for reciprocation in the upper cylinder U. A lower pump piston 8 is mounted for reciprocation in the lower cylinder L. The pistons 7 and 8 are joined by a rod connection 9, mounted to reciprocate in the partition 1. The inlet 5 communicates with the cylinder L at a place well above the lower piston 8, when that piston is at the limit of its downward travel. An abutment ring 37 is mounted fixedly in the upper cylinder U. A compression spring 27 is interposed between the abutment ring 37 and the upper piston 7.

The upper end of the upper cylinder U is supplied with an outlet 10. The lower end of the lower cylinder L is joined by a bend 11 to the lower end of a vertical fluid pressure line 12, connected at its upper end with a master or fluid pressure cylinder 14, shown as disposed horizontally, the position of said cylinder being optional.

A gland 15 is mounted on one end of the cylinder 14. A power operated piston rod 16 reciprocates in the gland 15. The piston rod 16 carries a master piston 17, slideably mounted in the cylinder 14.

The numeral 18 designates a tank, adapted to contain the actuating fluid, the tank being located above the cylinder 14. The tank 18 has a filling closure 19. Communication between the tank 18 and the cylinder 14 is established by spaced connections 20 and 21. The connection 21 is located adjacent to the gland 15. The connection 20 is remote from the gland 15.

As to gross operation, when the piston 17 moves to the right, suction is created in the cylinder 14, the fluid pressure line 12 and the bend 11, the upward pressure on the piston 8 being relieved, and that piston being caused to move downwardly. The check valve 4 closes, the check valve 6 opens, and liquid enters the cylinder L through the inlet 5.

When the piston 17 moves to the left, pressure is created in the cylinder 14, the fluid pressure line 12 and the bend 11, upward pressure being exerted upon the piston 8, that piston being caused to move upwardly. The check valve 4 opens, the check valve 6 closes, and liquid in the cylinder L flows into the cylinder U by way of the discharge conduit 3. Upon the upward stroke of the piston 7, the liquid in the cylinder U is discharged through the outlet 10.

It is to be noted that there is a head of fluid on the piston 7, acting counter to the head of actuating fluid which exerts an upward pressure on the piston 8, and the piston structure 7—8 remains approximately balanced at all times. The function of the spring 27 is to supplement the effect of the head on the piston 7, and to aid in returning the piston structure 7—8 to the lowered position shown in the drawing, against the upward pressure of the actuating fluid in the pressure line 12, on the piston 8.

The vents 2 promote an easy movement of the piston 7.

A concrete example will promote a clear understanding of the device. Suppose that two open strings of pipe (10—12) are run into a hole, to a depth of several thousand feet, the strings being connected at their lower ends by the bend 11. Assume that both strings are filled with liquid. By applying a small amount of pressure at the top of the liquid in one string (12), the liquid will be caused to emerge from the top of the other string (10).

Assume that the device is installed three thousand feet deep in an oil well, and that the spring 27 exerts a pressure of ten pounds per square inch on top of the piston 7. The outlet line 10 is filled with oil, and actuating fluid is in place in the string 12—11. The pressure on top of the piston 7 is 3000×.334, plus 10 (depth of well times pressure per square inch of oil one foot in depth, plus spring pressure), or a total of 1012 pounds.

The pressure in the string 12—11 is 1004 pounds, beneath the piston 8 (assuming a distance of 6 feet from the bottom of the piston 8 to the top of the piston 7). The aforesaid difference in pressures, 1012 pounds less 1004 pounds, or 8 pounds, would cause the piston structure 7—8 to assume the lowered position depicted in the drawing. If a pressure of 8 pounds were exerted in the string 12—11, by the master piston 17 in the master cylinder 14, the two pressures will be balanced and any additional pressure effected by the piston 17 will cause the piston structure 7—8 to move upwardly, forcing liquid in the cylinder L to pass through the conduit 3 and the outlet 10.

When the piston 17 moves to the right, the pressure beneath the piston 8 is lessened, and the weight of the liquid on the piston 7, which weight is held in the outlet 10 by the check valve 4, plus the pressure of the spring 27, exerts sufficient effort on the top of the piston 7 to cause the piston structure 7—8 to return to the lowered position shown. A fresh supply of liquid enters the cylinder L by way of the inlet 5, and the cycle is completed.

The actuating fluid functioning below the piston 8 may be the same as the fluid pumped, but if there is a difference in the fluids, compensation may be afforded by changing the spring 27.

Considered structurally, the advantages of the device will be appreciated by those skilled in the art. They include a minority of parts, resulting in small installation costs and decreased charges for up-keep and operation.

What is claimed:

1. In a pumping mechanism, separate, substantially vertical upper and lower cylinders, the upper cylinder having an upper outlet, a discharge conduit communicating with the upper portion of the lower cylinder and with the upper cylinder at a place below the outlet, an inlet communicating with the upper portion of the lower cylinder, a downwardly closing check valve in the inlet and a downwardly closing check valve in the discharge conduit, an upper piston slidable in the upper cylinder below the upper end of the discharge conduit, a lower piston slidable in the lower cylinder, a connection uniting the pistons, a substantially vertical fluid pressure line communicating with the lower portion of the lower cylinder at a place below the lower piston, and power-driven means spaced from the cylinders and the outlet, and exerting operating pressure on the fluid in the fluid pressure line, exclusively.

2. In a pumping mechanism, separate, substantially vertical upper and lower cylinders, the upper cylinder having an upper outlet, a discharge conduit communicating with the upper portion of the lower cylinder and with the upper cylinder at a place below the outlet, an inlet communicating with the upper portion of the lower cylinder, a downwardly closing check valve in the inlet and a downwardly closing check valve in the discharge conduit, an upper piston slidable in the upper cylinder below the upper end of the discharge conduit, a lower piston slidable in the lower cylinder, a connection uniting the pistons, a substantially vertical fluid pressure line communicating with the lower portion of the lower cylinder at a place below the lower piston, means for exerting operating pressure on the fluid in the fluid pressure line, a compression spring located in the upper cylinder and exerting downward thrust on the upper piston, and an abutment in the upper cylinder and receiving the upward thrust of the spring.

3. In a pumping mechanism, separate, substantially vertical upper and lower cylinders, the upper cylinder having an upper outlet, a discharge conduit communicating with the upper portion of the lower cylinder and with the upper cylinder at a place below the outlet, an inlet communicating with the upper portion of the lower cylinder, a downwardly closing check valve in the inlet and a downwardly closing check valve in the discharge conduit, an upper piston slidable in the upper cylinder below the upper end of the discharge conduit, a lower piston slidable in the lower cylinder, a connection uniting the pistons, a substantially vertical fluid pressure line communicating with the lower portion of the lower cylinder at a place below the lower piston, and means for exerting operating pressure on the fluid in the fluid pressure line, the means for exerting downward pressure on the fluid in the fluid pressure line comprises a master cylinder connected to the upper portion of that line, and a master piston mounted to reciprocate in the master cylinder.

4. In a pumping mechanism, separate, substantially vertical upper and lower cylinders, the upper cylinder having an upper outlet, a discharge conduit communicating with the upper portion of the lower cylinder and with the upper cylinder at a place below the outlet, an inlet communicating with the upper portion of the lower cylinder, a downwardly closing check valve in the inlet and a downwardly closing check valve in the discharge conduit, an upper piston slidable in the upper cylinder below the upper end of the discharge conduit, a lower piston slidable in the lower cylinder, a connection uniting the pistons, a substantially vertical fluid pressure line communicating with the lower portion of the lower cylinder at a place below the lower piston, and means for exerting operating pressure on the fluid in the fluid pressure line, the means for exerting downward pressure on the fluid in the fluid pressure line comprises a master cylinder connected to the upper portion of that line, and a master piston mounted to reciprocate in the master cylinder, a tank for pressure fluid, and connections communicating with the tank, and with the master cylinder at places spaced longitudinally of the travel of the master piston.

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