July 23, 1935. E. T. JÄDERBLOM 2,008,760

HYDRAULICALLY OPERATED PISTON PUMP

Filed May 8, 1934 2 Sheets-Sheet 1

Fig. 1.

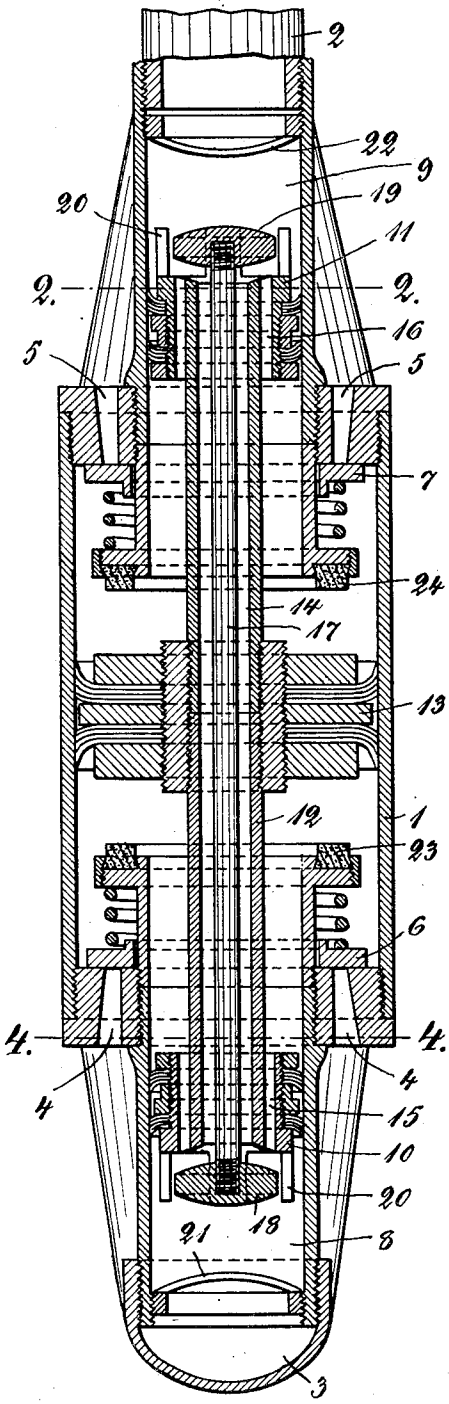


Fig. 2.

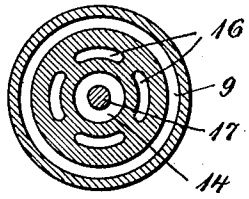


Fig. 3.

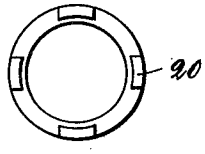
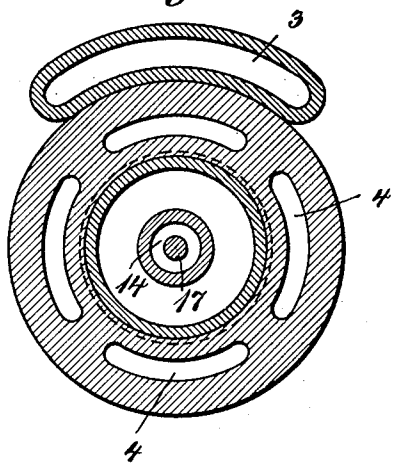


Fig. 4.



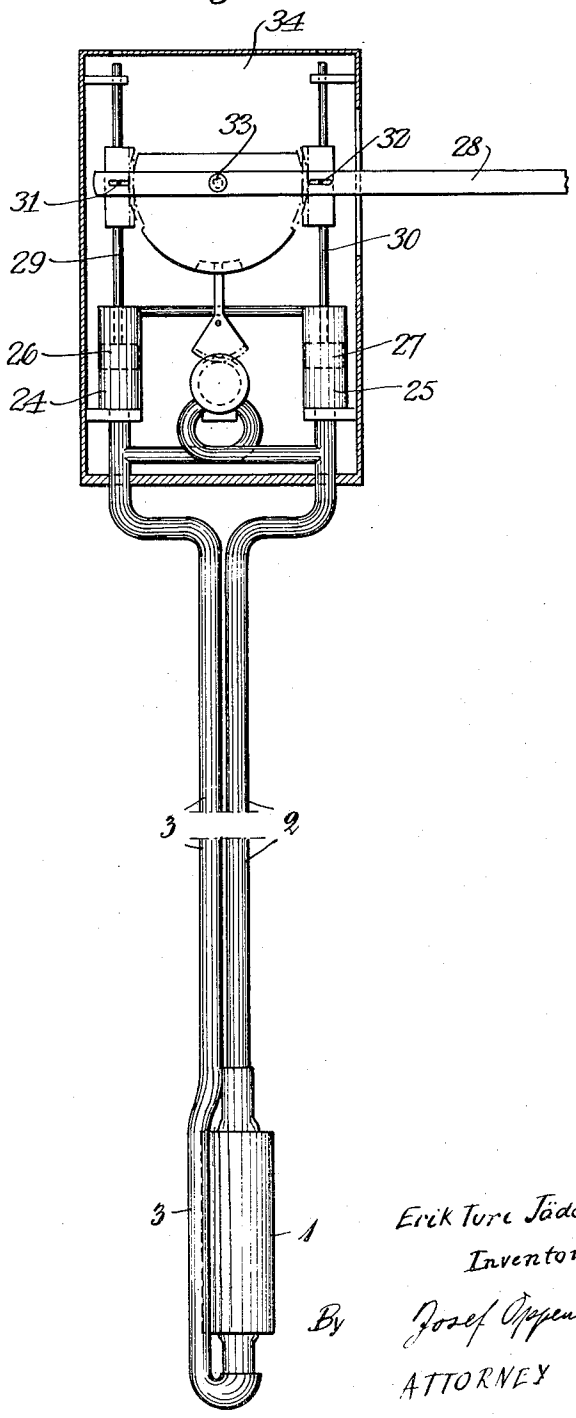
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Fig. 5.



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HYDRAULICALLY OPERATED PISTON PUMP

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Application May 8, 1934, Serial No. 724,473
In Sweden July 1, 1933

4 Claims. (Cl. 103—46)

The present invention relates to hydraulically operated piston pumps, especially adapted for great lifting heights, for instance for drawing up water from deep (bored) wells. In such plants a driving pump is arranged above ground and connected with the piston pump submerged in the well by two conduits or pipes which are alternately supplied with liquid under pressure for driving the piston pump. Hydraulically operated pumps of this kind are to have in the first place a small horizontal diameter in order to be capable of being submerged in a bored well having a diameter of f. i. 100 millimeters, and are to be provided with a regulating or setting device in order to adapt the piston stroke or the cycle of the driven pump to that of the driving pump.

The invention relates to a pump which complies with both said conditions and, moreover, is of extremely simple structure, which is a primary condition for reliability in operation. The pump according to the invention consists of a pump pumping fluid in each direction by means of a pump piston which is attached to the middle of a hollow piston rod which carries at each end a driving piston operating in a driving cylinder coaxial with the pump cylinder, each of the driving cylinders communicating with a raising-pipe.

Both ends of the piston rod, which forms for instance a tube, are valve controlled. The driving pistons are provided with outlet ports for the liquid to be pumped. Through the hollow piston rod both pipes may communicate with each other so that the fluid pressure be balanced. In normal operation, however, one of the ends of the piston rod is checked and the piston driven by the pressure fluid, whereby the pump piston, which is connected with the piston rod, is moved and sucks in, on one of its sides, the fluid to be pumped, while it presses the liquid collected on its other side by a preceding stroke into the pipe leading to the surface.

The invention will be described more in detail with reference to the drawings showing an embodiment of the invention. Figure 1 is a vertical section taken through the pump cylinder, showing the pump piston, the driving pistons as well as the valves. Figure 2 is a section taken on line 2—2 of Figure 1. Figure 3 shows the control device for the valve body. Figure 4 is a section taken on line 4—4 of Figure 1, showing suction orifices. Figure 5 shows a driving pump connected with the well pump.

The pump cylinder 1 is at is upper end connected with the raising-pipe 2 and by means of its lower end with the raising-pipe 3, which pipes are connected with the driving pump set 24, 25, Fig. 5. The pump cylinder is submerged so as to be located entirely below the level of the liquid. The latter can enter the pump cylinder 1 through suction inlets 4, 5 which are alternately closed and opened by spring-loaded ring valves 6 and 7, respectively. At each end of the pump cylinder a driving cylinder 8 and 9, respectively is provided in which a driving piston 10 and 11, respectively, reciprocates. The driving pistons are interconnected by means of a piston rod 12 to which the pump piston 13 is secured by means of a threaded joint or in other suitable manner. The piston rod 12 has the shape of a tube so that a connecting-duct 14 is formed between the driving cylinders. The driving pistons 10, 11 are provided with outlets 15 and 16, respectively, through which the pump cylinder communicates with the raising-pipes 2 and 3. Inside the duct 14, which according to the invention serves as a regulator duct, and coaxially therewith is arranged a valve stem 17 which is at each end provided with a valve body 18 and 19, respectively, controlled by valve-guides 20 provided on the driving pistons. The outer ends of the driving cylinders are provided with abutments 21, 22 for the valve bodies, said abutments serving to open said valves against the action of the hydraulic pressure when the driving pistons run over their normal end positions.

In the drawing, the pump piston 13 is shown in a mid-position. The suction orifices 4, 5 are closed by means of the ring valves 6, 7. The valves 18, 19 are shown in open position whereby the pump cylinder can communicate through the ducts 15, 16 with the driving cylinders 8, 9 which in turn communicate by the duct 14.

In the shown mid-position the valves do not, however, normally occupy these positions but only in case the pistons of the driving pump set have been checked in the corresponding mid-position. If by means of the driving pump set a hydrostatic pressure is produced in the raising-pipe 3, the valve body 18 is brought into shut-off position, and is then pressed against the lower end of the driving piston 10, forming a valve seat, and acts as a piston head. Due to said pressure the driving piston 10 is moved upwards together with the pump piston 13. In continuing the upward movement, the pump piston 13 produces a vacuum within the pump cylinder on the underside of the pump piston, so that liquid can enter through the suction

orifices 4 since the ring valve 6 is opened by the action of the outer hydraulic pressure. The liquid above the pump piston is raised by the upward movement of the piston, while the ring valve 7 is closed, and is forced through the ducts 16 into the raising-pipe 2.

The piston stroke of the driving pump is determined in such a manner that the pump piston is normally stopped before it arrives at stops 23 and 24, respectively, made for instance of rubber. Considering that, due to leakage, the position of the pump piston may change relative to the piston or pistons of the driving pump, means hereinafter described are used for obtaining corresponding positions of said pistons.

The pump piston arrives in abnormal cases at its uppermost end position in which it hits the stops 24 and 23, respectively, the valve body 19 then being checked by a stirrup 22 and 21, respectively, or the like, so that the valves 18, 19 are set in the mid-position shown in Figure 1, in which the ends of the duct 14 are open. Hence, liquid can pass freely from one raising-pipe to the other, and the pressure in the raising-pipes is equalized before the start of the next working stroke.

In the continuation of the operation of the driving pump a hydrostatic pressure is produced in the other raising-pipe 2, so that the valve body 19 is pressed against its seat on the driving piston 11, and the ducts 16 and 14 are shut off while the pump piston is moved into its lower end position. Then liquid is sucked in through the suction orifices 5 and fills the upper portion of the pump cylinder whereas the quantity of liquid previously sucked into the lower portion of the pump cylinder is forced upwards through the raising-pipe 3.

Fig. 5 shows more diagrammatically the entire pump connection. The pump 1 is connected by tubes 2, 3 with cylinders 24, 25 in which pistons 26, 27 are reciprocated by means of rods 29, 30 suitably connected by a slide and pin 31, 32 with a lever 28 which is pivotally held at 33 in the casing 34.

The lever 28 may be driven by hand or by another suitable source of power not shown. By moving up and down the lever 28, fluid under pressure is pressed alternately into the pump 2 and 3, causing the reciprocation of the pistons 10, 11 and thereby of the pump piston 13.

I claim:—

1. In well pumping apparatus a pump cylinder, valve controlled inlets to said pump cylinder at opposite ends thereof, cylinders arranged at each end of said pump cylinder coaxially thereto and communicating with it, fluid conduits connected to the outer ends of said cylinders, pistons reciprocating in said cylinders, and being provided with outlet ports for the liquid to be pumped, a tubular piston rod connecting said pistons, a pump-piston reciprocating in said pump cylinder and being connected with said piston rod, the ends of said piston rod being controlled by valves adapted to be closed by fluid pressure, said tubular piston rod connecting in the open position of its valves said fluid conduits.

2. In well pumping apparatus as claimed in claim 1, a single valve-body controlling both the outlet ports in the piston and the coordinated end of the tubular piston rod.

3. In well pumping apparatus as claimed in claim 1, a single valve-body controlling both the outlet ports in the piston and the coordinated end of the tubular piston rod, said bodies being connected by a rod traversing the hollow of the piston rod.

4. In well pumping apparatus as claimed in claim 1, a single valve body controlling both the outlet ports in the piston and the coordinated end of the tubular piston rod, said bodies being connected by a rod traversing the hollow of the piston rod, and abutments in said cylinders adapted to bring both valve bodies into an open position.

ERIK TURE JÄDERBLOM.