June 28, 1932. H. G. MUSOLF 1,864,609

PUMP

Filed Feb. 9, 1931

FIG. 1.

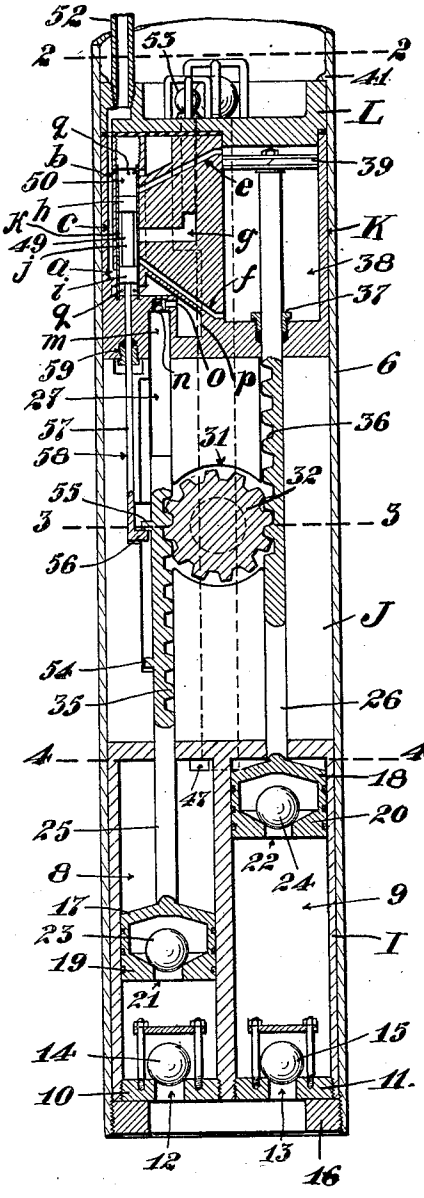



FIG. 2.

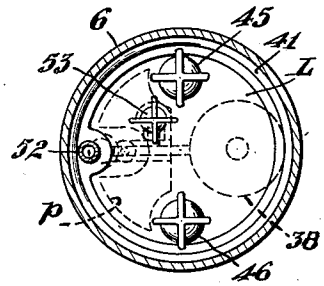



FIG. 3.

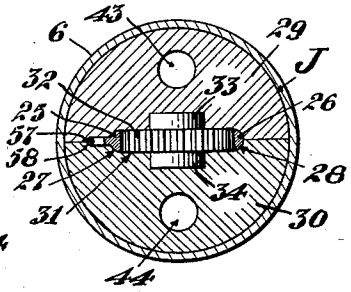



FIG. 4.

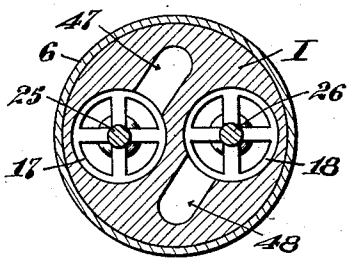
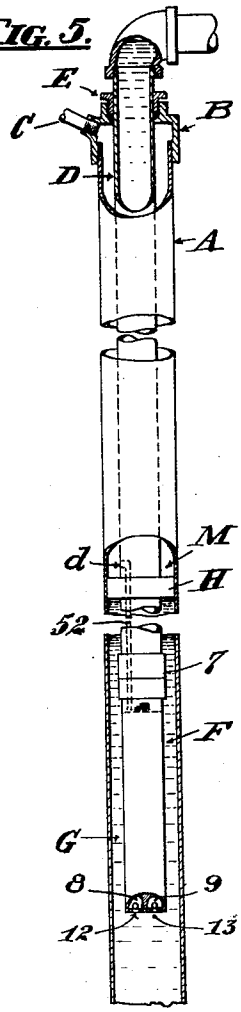



FIG. 5.




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# UNITED STATES PATENT OFFICE

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## PUMP

Application filed February 9, 1931. Serial No. 514,495.

This invention relates to a pump and has as its primary object the provision of a pump which is adapted to be actuated by fluid pressure supplied to the pumping mechanism from a remote point so that operation of the pump will be effected without the use of sucker rods and the like, thereby overcoming the objectionable features incident to the use of sucker rods.

Another object is to provide a pump which is especially advantageous for use for pumping liquid from deep wells such, for example, as in pumping oil from oil wells.

Another object is to provide a fluid pressure operated pump of the reciprocal piston type in which the motivating fluid may be directed through the well casing to the pump mechanism to effect actuation thereof and the exhausted fluid discharged through the usual liquid discharge pipe together with the liquid being pumped, thereby obviating the use of independent conduits for directing such motivating fluid to and from the pump, and whereby the exhausted motivating fluid will serve to assist in lifting the pumped liquid.

Another object is to provide a pump of the above character in which a single fluid operated piston will serve to actuate a plurality of pump pistons, and whereby a single control mechanism for the motivating fluid need be employed to effect operation of a multiple of pump pistons.

Another object is to provide a fluid pressure operated pump embodying a pair of reciprocal pump pistons and including a valve control for the fluid pressure, in which operation of the valve control will be positively effected by movement of the pump pistons and whereby the pistons will be rendered highly effective throughout the full lengths of their strokes.

Another object is to provide a pump of the type above set forth, which is so fashioned as to permit its being designed with a wide range of lengths of piston stroke and whereby it may be readily constructed to accommodate it to varying conditions, as, for example, where it is advantageous to employ a pump of short piston stroke, or where a pump having an extremely long piston stroke would be desirable.

Another object is to provide a pump embodying duplex pistons in which the parts are so assembled and arranged as to adapt it to be constructed for operation in a space of small diameter.

A further object is to provide a construction and arrangement of parts in a pump of the character referred to which will permit of ready assemblage and diassemblage of the pump so as to facilitate repairs and replacements of parts.

With the foregoing objects in view together with such other objects and advantages as may subsequently appear, the invention resides in the parts and in the combination, construction and arrangement of parts hereinafter described and claimed and illustrated by way of example in the accompanying drawing in which:

Figure 1 is a view of the pump as seen in vertical section with parts in elevation;

Figure 2 is a horizontal section and plan view taken on the line 2—2 of Figure 1;

Figure 3 is a view in horizontal section as seen on the line 3—3 of Figure 1;

Figure 4 is a view in section taken on the line 4—4 of Figure 1;

Figure 5 is a diagram in section and elevation illustrating the application of the pump.

Referring to the drawing more specifically, A indicates generally a well casing which is closed at its top by a cap B fitted with a fluid supply conduit C through which fluid under pressure may be delivered to the interior of the well casing A from any suitable source of supply as required and in any suitable manner. Extending downwardly into the well casing A is a liquid discharge pipe D which passes through a packing gland E on the cap B and has its upper end leading to any suitable point of discharge.

Mounted on the lower end of the pipe D is a pump F here shown as embodying a cylindrical shell 6 extending in continuation of the discharge pipe D and detachably connected thereto as through the medium of a coupling 7. The pump F has its lower end

submerged in the body of liquid G in the well casing and in which liquid the pump may be submerged to any desired extent.

Located at a suitable point in the well casing A above the normal level of the liquid G therein, is a packing H, here shown as carried by the discharge pipe D and which packing is so formed as to constitute a substantially fluid tight wall between the interior surface of the casing A and the exterior of the discharge pipe D throughout the peripheries thereof, whereby fluid under pressure directed into the casing A through the conduit C will be prevented from passing to the lower end of the pump, and also whereby pressures developed in the well will be prevented from passing directly to the space above the packing.

In carrying out the present invention, a pair of pump cylinders 8 and 9 are arranged in vertical parallel relation within the lower portion of the shell 6. The lower ends of the cylinders 8 and 9 are fitted with end walls 10 and 11 having intake openings 12 and 13 normally closed by upwardly opening foot valves 14 and 15; the openings 12 and 13 communicating with the well below the packing H through the lower end of the pump casing. The pump cylinders 8 and 9 are formed in a cylindrical block I which is fitted snugly within the lower end portion of the shell 6 and is here shown as held in place therein by a ring 16 screwed into the lower end of the shell to form an internally projecting flange against which the lower end of the block I abuts.

Reciprocally mounted within the cylinders 8 and 9 are tubular pistons 17 and 18 having lower end walls 19 and 20 formed with openings 21 and 22 normally closed by upwardly opening ball valves 23 and 24. The pistons 19 and 20 are fitted with piston rods 25 and 26 which project upwardly in parallel relation into guide channels 27 and 28 formed in a cylindrical block J seating on the block I and snugly fitting the inner periphery of the shell 6. The block J is formed in longitudinally extending halves 29 and 30 adapted to be assembled on opposite sides of the rods 25 and 26, and arranged in a cavity 31 intermediate the ends of the block J is a spur toothed pinion 32 fitted with axially aligned trunnions 33 and 34 journalled in the side walls of the cavity 31, as particularly shown in Figure 3. The rods 25 and 26 are formed with rack teeth 35 and 36 which engage the teeth on the spur toothed pinion 32 on diametrically opposite sides of the latter, as particularly shown in Figure 1, whereby reciprocation of the rod 26 will act through the pinion 32 to reciprocate the rod 25 in the opposite direction.

The upper end portion of the rod 26 is rounded and extends through a packing gland 37 into a cylinder 38 formed in a block K, and is fitted with a piston 39 which slidably fits the walls of the cylinder 38. The block K seats on the upper end of the block J and abuts against a disk L which in turn abuts against a flange 41 formed interiorly of the shell 6; the disk L forming a closure or head for the upper end of the cylinder 38.

The disk L and blocks K and J are formed with aligned bores 43 and 44 which communicate at their upper ends with the interior of the discharge pipe D through upwardly opening check valves 45 and 46 carried by the disk L, and which passages 43 and 44 communicate respectively at their lower ends with the upper end portions of the pump cylinders 8 and 9 through ports 47 and 48.

The block K is fitted with a suitable automatic fluid pressure control mechanism whereby fluid under pressure is alternately delivered and exhausted from opposite sides of the piston 39 in the cylinder 38, and which mechanism is here shown as embodying a reciprocal piston valve 49 arranged in a cylinder 50 formed in the block K. The cylinder 50 is provided at its opposite ends with intake ports *a* and *b* leading to a duct *c* communicating through the disk L with an intake pipe 52 which extends upwardly interiorly of the pipe D and opens exteriorly thereof through a port *d* at a suitable point above the packing H to afford a communication between the cylinder 50 and the space M enclosed by the pump cylinder A above the packing H.

Leading from the opposite end portions of the cylinder 38 are passages *e* and *f* which lead to the opposite end portions of the cylinder 50 in spaced relation to the ends of the latter, and leading from the cylinder 50 intermediate its ends is an exhaust passage *g* which communicates through an upwardly opening check valve 53, carried by the disk L, with the interior of the discharge pipe D. The ends of the piston valve 50 are formed with piston heads *h* and *i* for controlling the ports *b* and *e*, and *a* and *f*, respectively, and between which piston heads extend a stem *j* around which is provided a space *k* with which the exhaust passage *g* is always in communication.

Movement of the piston valve 49 is designed to be controlled by reciprocal movement of the piston rod 25 and for which purpose the latter is provided with a pair of suitably spaced projections 54 and 55 adapted to alternately engage an inturned flange 56 formed on the lower end of a reciprocal rod 57 guided in a bore 58 formed in the block J. The upper end portion of the rod 57 projects through a packing gland 59 carried by the block K and is connected to the piston valve 49.

The block K is formed with a bore *m* communicating with the upper end of the guide channel 27 into which the upper end of the

rod 25 extends when the later moves to its uppermost position, and arranged within the upper end of the bore *m* is an upwardly opening check valve *n*, constituting a relief valve, and which valve normally closes a passage *o* here shown as leading to a chamber *p* formed in the block K and partially surrounding the walls of the cylinder 50. The walls of the cylinder 50 are provided with small apertures *q* through which oil may pass from the chamber *p* to the interior of the cylinder 50.

In the operation of the invention fluid under pressure, which may comprise air or other gases is directed into the upper portion of the well casing A through the conduit C, and which fluid flows, when the parts are positioned as shown in Figure 1, through the port *b*, cylinder 50, and passage *e* into the upper end of the cylinder 38 above the piston 39 thereby forcing the latter downwardly and causing the rod 26 and piston 18 thereon to move downwardly in the cylinder 9. Downward movement of the piston 18 causes liquid in the cylinder 9 to pass through the opening 22 in the piston to occupy the space in the cylinder 9 above the piston; liquid having previously flowed into the cylinder 9 past the foot valve 15. Downward movement of the rod 26 acts through the rack teeth 36 thereon to rotate the pinion 32 and thereby effect upward movement of the rod 25 through the rack teeth 35 on the latter thereby elevating the piston 17 and lifting the body of liquid previously positioned above the piston 17 on down stroke thereof; the liquid lifted by the piston 17 being discharged through the port 47, passage 43 and valve 45 into the discharge pipe D and upwardly through the latter to discharge. On downward movement of the piston 39, fluid therebeneath will pass to exhaust through the passages *f*, *k* and *g*.

When the rod 25 approaches its uppermost position the projection 54 thereon will engage the flange 53 on the rod 57 thereby moving the latter upwardly so as to advance the piston valve 49 to its uppermost position and thereby close the port *b* and open passage *e* to the exhaust passage *g* when the piston 39 reaches its lowermost position, and at the same time cause the piston valve to open the port *a* so as to admit fluid under pressure beneath the valve whereupon the fluid under pressure will pass through the passage *f* into the cylinder 38 beneath the piston 39 and thereby cause the latter to move upwardly, thus causing the piston 18 to lift the liquid thereabove and effect its discharge through the port 48, passage 44, valve 46 and discharge pipe D. As the piston 39 moves upwardly the fluid thereabove will flow to the pipe D through the passages *e*, *k* and *g*.

Reversal of the direction of movement of the rod 26 operates through the pinion 32 to reverse direction of movement of the rod 25 thereby causing the piston 17 to move downwardly through the volume of liquid previously admitted to the cylinder 8 past the foot valve 14. As the rod 25 approaches its lowermost position the upper projection 55 thereon engages the flange 56 and effects advance of the stem 57 so as to pull the valve 49 downwardly to the position shown in Figure 1 thus closing the fluid pressure intake port *a* and opening the intake port *b* and at the same time placing the passage f in communication with the exhaust passage *g* through the space *k* so that on down stroke of the piston 39 the fluid therebeneath will be directed to exhaust into the discharge pipe D as before stated. The exhausted fluid on entering the discharge pipe D on both the up and down strokes of the piston 39 will assist in effecting elevation of the liquid in the pipe D as will be readily understood.

During operation of the piston rods 25 and 26 a small quantity of the oil in the upper part of the cylinders 8 and 9 will flow along the piston rods and will enter the cavity 31 and in so doing will afford lubrication of the piston rods and of the rack teeth 35, pinion 32 and rack teeth 36. The piston rods 25 and 26 and the pinion 32 thus work in oil so as to minimize friction and wear. A portion of the oil will pass to the space *p* and will be directed through the apertures *q* into the cylinder 50 from whence some of the oil will be carried by the fluid under pressure into the cylinder 38, thus affording lubrication of the valve 49 and piston 39.

It will now be seen that downward movement of the piston 39 will effect a lift of the oil being pumped by action of the upwardly moving piston 17, and that on upward movement of the piston 39 a lift of the oil will be effected through action of the piston 18, thus accomplishing a double acting pumping operation with separately operating pump pistons controlled through a single fluid pressure control valve mechanism.

While I have shown and described a specific embodiment of my invention, I do not limit myself to the exact details of construction and arrangement shown but may employ such changes in the construction and arrangement of the parts as occasion may require coming within the meaning and scope of the appended claims.

I claim:

1. In a pump, a pair of reciprocal pump pistons, fluid pressure operated means directly connected to but one of said pistons for effecting reciprocation thereof, means whereby movement of said last mentioned piston in one direction will effect movement of the other piston in the opposite direction, and means actuated by movement of one of said pistons for controlling operation of said fluid pressure operated means.

2. In a pump, a pair of reciprocal pump pistons, rods connected to said pistons extending in parallel relation to each other, rack teeth on each of said rods, a toothed pinion engaging each of said toothed racks, fluid pressure operated means directly connected to but one of said rods for effecting reciprocation thereof, and means actuated by the other of said rods for controlling said fluid pressure operated means.

3. In a pump, a pair of reciprocal pump pistons, rods connected to said pistons, rack teeth on each of said rods, a pinion engaging said rack teeth whereby movement of one of said rods in one direction will effect movement of the other rod in an opposite direction, fluid pressure operated means connected to but one of said rods for effecting reciprocation thereof, a piston valve controlling said last named means, a stem on said valve, and means on one of said rods engageable with said stem at predetermined points in the travel of said rod to effect movement of said valve at intervals.

4. In an oil pump, a pump piston, fluid pressure operated means for actuating said piston, a valve mechanism for controlling said last named means, and means for directing a portion of the oil being pumped to effect lubrication of said valve mechanism and said piston actuating means.

5. In a pump, a shell, a block in said shell formed with a pair of parallel pump cylinders, a piston in each of said cylinders, a rod affixed to each of said pistons, a divided block in said shell formed with guideways through which said rods extend, rack teeth on said rods, a pinion journalled in said divided block meshing with said rack teeth, a block in said shell seating on said divided block formed with a cylinder, a piston in said cylinder connected to one of said rods, fluid pressure control mechanism carried by said last named block for directing fluid under pressure to said last named cylinder on opposite sides of the piston therein, and means for actuating said control mechanism by movement of one of said rods.

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