Nov. 5, 1935. R. E. L. HOLMES 2,019,969

PUMP

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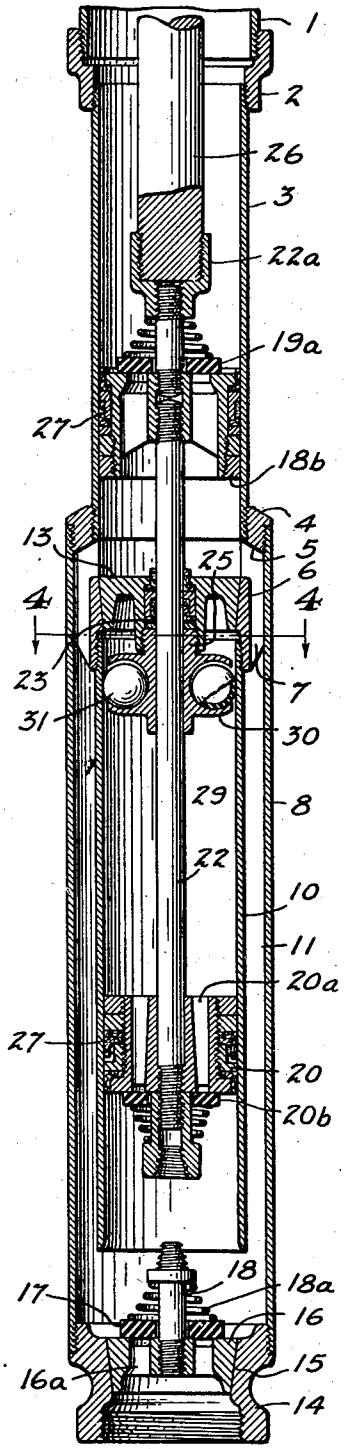

Fig. 1

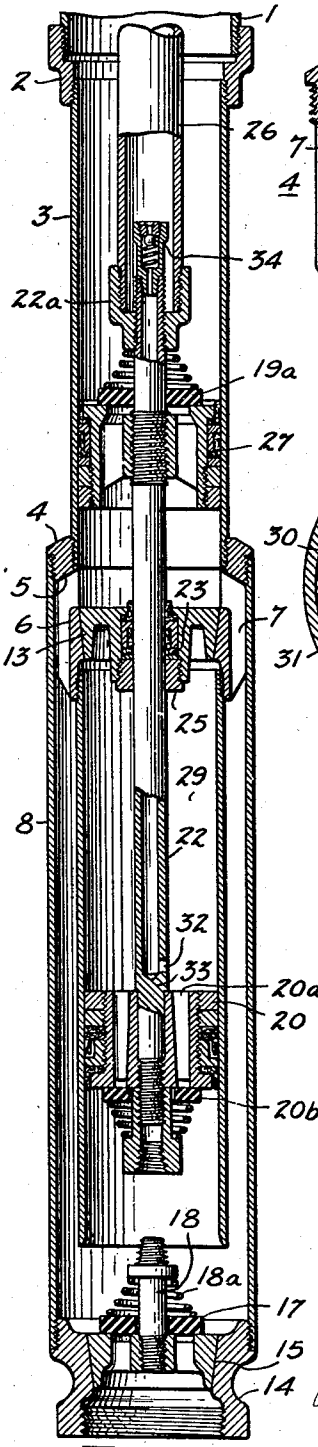

Fig. 2

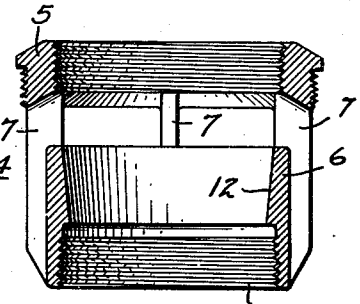

Fig. 3

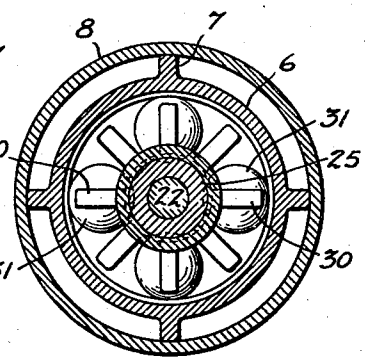

Fig. 4

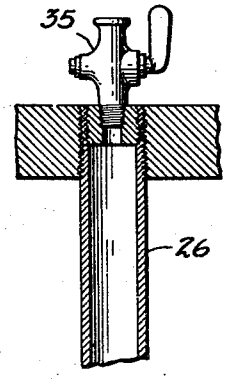

Fig. 5

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PUMP

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14 Claims. (Cl. 103—195)

This invention relates to double acting pumps of the aligned cylinder type, and has for its object the provision of new and improved means for minimizing jars and shocks resulting from the action of the liquid being pumped, whereby the pumps may be safely operated at higher speeds. Another object is to provide a double acting piston pump with pneumatic means for cushioning the action of water within the pump, whereby to minimize water hammer and to relieve the structure of shocks and jars.

With the above and other objects in view, the present invention consists in certain features of construction and combinations of parts to be hereinafter described with reference to the accompanying drawing, and then claimed.

In the drawing, which illustrates suitable embodiments of the invention,

Figure 1 is a longitudinal vertical section of a double acting deep well pump in the installed positon;

Fig. 2 is a section similar to Fig. 1 in which the pump is provided with a modified means for cushioning the action of the same;

Fig. 3 is a vertical section through the coupling to which the adjacent ends of the working barrels are connected;

Fig. 4 is a section taken approximately on the line 4—4 of Fig. 1; and

Fig. 5 is a sectional view through the top of the pump rod showing the air regulating valve.

Referring to the drawing, in which like numerals refer to like parts throughout the several views, the pump structures shown in Figs. 1 and 2 both include a vertical column pipe 1 having a coupling 2 at its lower end to which the upper end of working barrel 3 is secured, the barrel 3 constituting the upper barrel of the pump. The lower end of the barrel 3 carries a coupling 4 which comprises spaced rings 5 and 6 connected by circumferentially arranged spaced webs 7, the lower ring 6 being of less diameter than the upper ring 5. The ring 5 is provided with external screw threads which threadably receive the upper end of a casing tube 8 that surrounds the webs 7.

The ring 6 is provided with internal threads 9 which threadably receive the upper end 4 of a lower working barrel 10. The barrel 10 is of less length than the casing tube 8 and is concentric with the outer casing tube 8 and spaced therefrom to provide a circular chamber 11. The coupling 4 is of such diameter that the outer wall of the casing 8 coincides substantially in diameter with the exterior of the coupling 2, so that the column pipe and pump cylinder may be readily lowered into a well within the ordinary fixed well casing which, however, is not shown in the drawing.

The upper portion of the ring 6 is formed with a taper seat 12 for receiving a removable head 13 which forms the head for the lower working barrel 10. The seat 12 and the exterior of the head 13 are correspondingly tapered, with the taper at such an angle that the head may be tightly forced into the seat without liability of accidental displacement, but at the same time may be purposely displaced or removed.

Secured to the lower end of the casing tube 8 is a coupling 14 having a tapered seat 15 which receives a valve body 16. The valve body 16 has passages 16*a* therethrough and carries a valve 17 which constitutes a check or foot valve for the pump. The valve 17 is movable on a stem 18 against the resistance of a coil spring 18*a*. The seat 15 and valve body are suitably tapered so that the body 16 may be firmly seated against accidental displacement.

Mounted within the upper working barrel 3 is a plunger 18*b*, which is provided with a check valve 19*a*. The plunger may be of any suitable construction.

A second plunger 20 is positioned within the lower working barrel 10 and is provided with passages 20*a* therethrough, which are arranged to be closed on the down stroke of the plunger by means of a suitable check valve 20*b*. The two plungers 18*b* and 20 are connected by means of a pump rod 22 extending through the head 13, a suitable packing 23 being disposed in the head 13 to surround the pump rod 22, the packing being held in place by a nut 25 threaded into the head 13.

Secured to the upper end of the rod 22, which extends beyond the upper plunger 18*b* is an internally threaded coupling 22*a* for receiving the lower end of a rod 26, which may be assumed to extend to the top of the well for actuation by a suitable mechanism.

The two plungers are shown as provided with the usual cup leathers 27 or other suitable packing may be employed in accordance with the particular character of the plunger.

In the structure shown the upper or top working barrel 3 is of greater internal diameter than the lower or bottom working barrel, and the plungers 18*b* and 20 correspondingly differ in diameter. The head 13 is of such daimeter that it may be moved through the barrel 3 and the foot valve body 16 is of such diameter that it

may be moved through the barrel 10. In such a structure it is quite feasible to remove all the valves and plungers when necessary for inspection or repairs without disturbing the working barrels in any way, and the valve and plunger structures may be as readily introduced into the working barrels and the foot valves seated without disturbing the working barrels.

When the plungers are lifted, water is drawn through the foot valve into both working barrels, the plunger 20 drawing the water into the working barrel 10 through its lower open end and the plunger 18b drawing water into the barrel 3 by way of the chamber 11 and around the ring 6 through the passages defined by the webs 7, which passages open freely to the lower open end of the barrel 3 which is carried by the upper ring 5. The water is thus drawn into the pump on the up stroke of the plungers.

On the down stroke of the plungers the valve 17 is seated while the water in the barrel 10 is forced out through the lower end of the barrel into the chamber 11, and past the coupling 4 through the passage therein into the lower end of the barrel 3 with the water drawn into the barrel 3, together with the water forced therein by the plunger 20, finding its escape past the valve 19a, which moves to open position on the down stroke of the plunger.

All the water passages in the pump are large and offer a minimum of frictional resistance to the flow of water through them, wherefore the water moves with less speed than is usually the case where water must flow through a hollow pump rod.

With the structure described the water passages are all large in proportion to the area of the plungers, thus permitting the pump to be run at maximum speed while preventing excessive speed of travel of water through the passages so that, because of the reduced frictional resistance, there is a reduction of power necessary to force the water through the passages, with a consequent saving of power.

The structure permits the use of the ordinary disk valve or ball or conical valve at the suction entrance or in the top plunger, with practically no changes in their construction from such valves as are used in single acting working barrels.

There is a possibility of water leaking past the packing of the plunger 20 and becoming imprisoned in the cylinder 10 in the space 29 between the plunger 20 and head 13, and should this leakage of water occur, this water, on the up stroke of the plunger, when in sufficient quantity, will exert a greater pressure on the top of the piston than is exerted by the water on the under side of the piston, whereupon the valve 20b will open and the pressure on the water above the piston will cause it to pass through the passages 20a and escape through the plunger.

It has been found that in some instances a vacuum is formed in the space 29 between the plunger 20 and head 13, in which event, when the plunger moves through its up or suction stroke, the valve 20b remains closed and the leakage water within this space is drawn up by the vacuum and strikes the head 13 with considerable force. This action of the trapped water in striking the head 13 acts like a water hammer and in some instances causes a severe jar or shock, with the result that it is necessary to run the pump at a reduced speed.

It is the purpose of the present invention to minimize the jars and shocks caused by this action of the water within the space between the plunger 20 and head 13, and in Figs. 1 and 2 I have shown two different means for accomplishing this result.

In the construction shown in Fig. 1 the packing gland nut 25 is provided with a series of spaced fingers 30 and arranged between these fingers 30 are a number of pneumatic balls 31 or other containers which are airtight and preferably of rubber-coated fabric. These pneumatic balls are compressible and function during the operation of the pump to cushion the action of the water which may accumulate in the space 29 between the plunger 20 and head 13 so as to minimize or eliminate the jars which have heretofore occurred when the water strikes the head 13.

In the construction shown in Fig. 2 I have provided a means for introducing air or other gas into the space 29 between the plunger 20 and head 13. In this construction the plunger rod 22 is tubular and has an aperture 32 therein, opening into the space 29 between the plunger 20 and head 13. The lower end of this tubular plunger rod is closed in with a suitable plug, or is solid as shown at 33, and the upper end of the same projects through the coupling 22a. In this construction it is necessary that the sucker rod 26 be of tubular shape. The upper end of the tubular rod 22 is provided with a check valve 34 which opens on the down stroke of the plungers to allow air to be drawn into the space between the plunger 20 and head 13 and is closed on the up stroke.

A suitable regulating valve 35 may be provided in the sucker rod 26, as shown in Fig. 5, at the top of the well at which the head is located, so as to regulate the amount of air drawn into the space 29 between the plunger 20 and head 13. The regulating valve 35 may be relatively small, as it is necessary to open it only an amount sufficient to replace the small amount of air that is absorbed by the water and that is lost through leakage. The air which is permitted to enter the space 29 in this manner acts as a cushion for the water which may have accumulated within the space 29 and will prevent the same from striking the head 13 with any appreciable force and will minimize the liability of the production of shocks and jars through the action of the vacuum that may be present in the space 29.

In both constructions described pneumatic means is provided for cushioning the action of the water which may accumulate through leakage, within the space 29. This cushioning of the water materially adds to the successful operation of the pump, in that the pump may be operated at higher speeds without being subjected to severe shocks and jars arising from the water striking the head of the lower working cylinder.

Although several embodiments of the invention have been herein shown and described, it will be understood that numerous details of the construction shown may be altered or omitted without departing from the spirit of this invention, as defined in the following claims.

What I claim is:

1. In a double-acting reciprocating liquid pump, a cylinder having a head, a reciprocable plunger in said cylinder and spaced from said head, means for moving said plunger toward said head to create suction pressure within said cylinder, and means within the space between said

head and plunger for cushioning the action of leakage liquid in said space and preventing the said liquid from impacting against said head during the suction stroke of said plunger.

2. In a double-acting reciprocating liquid pump, a cylinder having a head, a reciprocable plunger in said cylinder and spaced from said head, means for moving said plunger toward said head to create suction pressure within said cylinder, and means within the space between said head and plunger for cushioning the action of leakage liquid in said space and preventing the said liquid from impacting against said head during the suction stroke of said plunger, said means comprising a plurality of compressible members disposed within said space.

3. In a double-acting reciprocating liquid pump, a cylinder having a head, a reciprocable plunger in said cylinder and spaced from said head, means for moving said plunger toward said head to create suction pressure within said cylinder, and means within the space between said head and plunger for cushioning the action of leakage liquid in said space and preventing the said liquid from impacting against said head during the suction stroke of said plunger, said means comprising a pneumatic cushion within said space.

4. In a double-acting reciprocating liquid pump, a cylinder having a head, a reciprocable plunger in said cylinder and spaced from said head, means for moving said plunger toward said head to create suction pressure within said cylinder, and means within the space between said head and plunger for cushioning the action of leakage liquid in said space and preventing the said liquid from impacting against said head during the suction stroke of said plunger, said means comprising a body of air within said space and means for admitting the said body of air into said space on the opposite stroke of the plunger.

5. In a double-acting reciprocating liquid pump, a cylinder having a head, said head having an opening therethrough, a reciprocable plunger having a sliding fit with said cylinder, said plunger being spaced from said head and providing a space which is normally free of the liquid being pumped, a plunger rod connected with said plunger, said rod extending through and having a sealed sliding fit with said opening, and means providing a pneumatic cushion within the space between said head and plunger, whereby to cushion the action of leakage liquid within said space and thereby prevent the leakage liquid from impacting against said head.

6. In a double-acting reciprocating liquid pump, a cylinder having a closed head, said head having an opening therethrough, a reciprocable plunger having a sliding fit with said cylinder, said plunger being spaced from said head and providing a space which is normally free of the liquid being pumped, a plunger rod connected with said plunger, said rod extending through and having a sealed sliding fit with said opening, and cushioning means within the space between said head and plunger, whereby to cushion the action of leakage liquid within said space and thereby prevent the leakage liquid from impacting against said head.

7. In a double-acting reciprocating liquid pump, a cylinder having a closed head, said head having an opening therethrough, a reciprocable plunger having a sliding fit with said cylinder, a plunger rod connected with said plunger, said rod extending through and having a sealed sliding fit with said opening, and cushioning means within the space between said head and plunger, whereby to cushion the action of leakage liquid within said space and thereby prevent the leakage liquid from impacting against said head, said cushioning means comprising a plurality of compressible members.

8. In a double-acting reciprocating liquid pump, a cylinder having a closed head, said head having an opening therethrough, a reciprocable plunger having a sliding fit with said cylinder, a plunger rod connected with said plunger, said rod extending through and having a sealed sliding fit with said opening, and cushioning means within the space between said head and plunger, whereby to cushion the action of leakage liquid within said space and thereby prevent the leakage liquid from impacting against said head, said cushioning means comprising a plurality of hollow airtight members.

9. In a double-acting reciprocating liquid pump, a cylinder having a closed head, said head having an opening therethrough, a reciprocable plunger having a sliding fit with said cylinder, a plunger rod connected with said plunger, said rod extending through and having a sealed sliding fit with said opening, and cushioning means within the space between said head and plunger, whereby to cushion the action of leakage liquid within said space and thereby prevent the leakage liquid from impacting against said head, said cushioning means comprising a plurality of hollow airtight balls circumferentially arranged within said space.

10. In a double-acting reciprocating liquid pump, a cylinder having a closed head, said head having an opening therethrough, a reciprocable plunger having a sliding fit with said cylinder, a plunger rod connected with said plunger, said rod extending through and having a sealed sliding fit with said opening, and cushioning means within the space between said head and plunger, whereby to cushion the action of leakage liquid within said space and thereby prevent the leakage liquid from impacting against said head, said cushioning means comprising a plurality of hollow airtight members, and a cage carried by said head for supporting said airtight members.

11. In a double-acting reciprocating liquid pump, a cylinder having a head, a reciprocable plunger having a sliding fit with said cylinder, a plunger rod connected with said plunger, and cushioning means within the space between said head and plunger, whereby to cushion the action of leakage liquid within said space and thereby prevent the leakage liquid from impacting against said head, said cushioning means comprising a plurality of hollow airtight balls circumferentially arranged within said space, and a cage for supporting said balls.

12. In a double-acting reciprocating fluid pump for wells, a cylinder having a head, a reciprocable plunger having a sliding fit with said cylinder, said plunger being spaced from said head and providing a space which is normally free of the liquid being pumped, means for reciprocating said plunger, and means for admitting air into the space in said cylinder between said head and plunger whereby to provide a pneumatic cushion for leakage liquid within said space.

13. In a double-acting reciprocating liquid pump for wells, a cylinder having a head, a reciprocable plunger having a sliding fit with said cylinder, said plunger being spaced from said

head and providing a space which is normally free of the liquid being pumped, a tubular plunger rod connected with said plunger, said rod being open to the atmosphere at one end and closed at its opposite end and having a passage opening into the space within said cylinder between said head and plunger whereby to admit air into said space for providing an air cushion for leakage liquid within said space, and check valve means in said rod to prevent passage of air through said rod from said space.

14. In a double-acting reciprocating liquid pump for wells, a cylinder having a head, a reciprocable plunger having a sliding fit with said cylinder, said plunger being spaced from said head and providing a space which is normally free of the liquid being pumped, a hollow plunger rod connected with said plunger, and means for admitting air through said rod into the space in said cylinder between said head and plunger whereby to provide a pneumatic cushion for leakage liquid within said space, and an air regulating valve for said hollow rod.

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