Feb. 28, 1939. F. C. GOLDSMITH 2,148,939

PUMP

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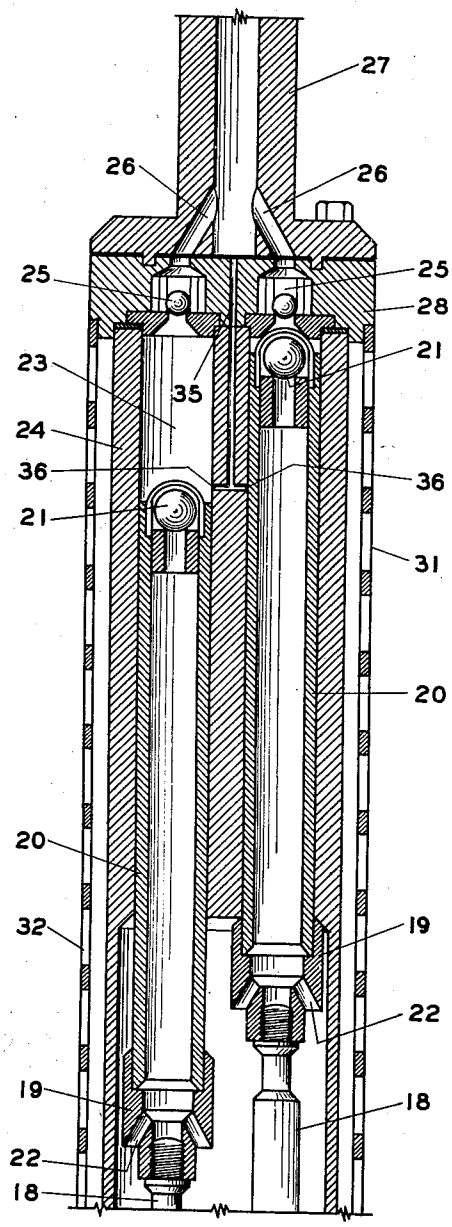

FIG. 1

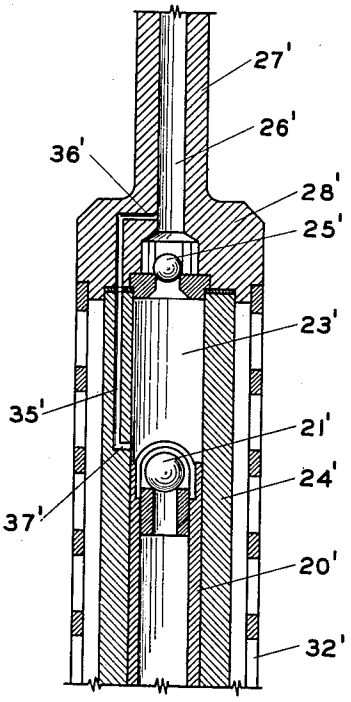

FIG. 2

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3 Claims. (Cl. 103—203)

This invention relates to pumps.

More particularly this invention relates to that type of pump which is subjected to fluid hammer or shock, such as reciprocating plunger type pumps.

In the pumping of oil and water wells, there is usually some gas mixed with the liquid and this is particularly true in the pumping of oil wells. In the pumping of these wells, the gas cannot be readily separated from the liquid, hence the pumping mechanism is forced to pump a mixture of liquid and gas. Sometimes, the gas content is so high that the pumps tend to gas lock. In the pumping of these wells with the reciprocating plunger type of pump, the liquid mixed with gas flows into the pump chamber when the plunger is at the bottom of its stroke. When the plunger moves upwardly, the liquid is displaced from the chamber into the well tubing and hence by successive operations of the plunger, the liquid is lifted to the ground level. If the liquid in the chamber is high in gas content, when the plunger starts on its upward movement, all the gas will be compressed before the plunger starts to lift any of the liquid. The gas offers less resistance to the upward movement of the plunger than the liquid, so the plunger tends to accelerate in its upward movement until the gas is compressed. The plunger then comes into contact with the liquid, and since the liquid is not compressible and the opening at the top of the cylinder is restricted, the plunger is decelerated with a sudden impact or shock being transmitted to the plunger. Since the plunger is connected to power actuating means, this shock is transmitted to them with resulting damage, sometimes sufficient to break the members and thus throw the pump out of operation.

It is further set forth that with a large gas content in the chamber, less liquid is pumped to the ground surface, which results in loss of efficiency for the pump's operation.

With the present device herein disclosed, a means has been provided whereby the liquid content of the chamber is increased for each stroke of the plunger thus increasing the volumetric efficiency of the pump and further minimizing the impact and shock loads on the pump equipment.

An object of the invention is the elimination of sudden impact and shock loads on the pump equipment.

Another object of the invention is to increase the volumetric efficiency of the pump.

With the above and other objects in view, which will appear as the description proceeds, this invention consists in the novel features herein set forth illustrated in the accompanying drawing and more particularly pointed out in the appended claims.

Referring to the drawing in which numerals of like character designate similar parts throughout the several views:

Fig. 1 is an enlarged sectional view of a double plunger reciprocating type pump embodying the present invention.

Fig. 2 is an enlarged sectional view of a single plunger reciprocating type pump embodying the present invention.

In Fig. 1 of the drawing is shown a double acting reciprocating plunger type of pump, with the upper end of the cylinders or displacement chambers connecting into a well pipe and the lower ends of the plungers being connected to crank-shaft members which transmit the reciprocating movement to the plungers. No power actuating means for the crank-shafts are disclosed, but the means shown by Brown in his Patent 2,032,000 of February 25, 1936, is an example of a power mechanism which could be employed with the pump here disclosed.

The members 18, disclosed in Fig. 1 of the drawing are pump stems whose lower ends are attached to crank-shafts, and the crank-shafts in turn are attached to any power means desired. By this means the pump stems are given a reciprocating movement. The pump stems 18 are connected at their upper ends to hollow plungers 20 by means of suitable adapters 19.

Each plunger 20 is equipped with a valve 21, preferably of the ball type, at its upper end and is open to communication with intake passageways 22 in the respective adapters 19. The plungers 20 are reciprocably mounted in a cylinder block 24 which is enclosed in a cylindrical screen-like casing 31. The casing 31 is perforated as at 32 throughout the greater portion of its area and is closed at its upper extremity by a discharge valve plate 28 connected in any suitable manner to a discharge connection 27, the latter being provided with valves 25 and discharge passageways 26 which converge in communication with a central discharge conduit. Passageways or channels 35 are bored in the cylinder block 24 leading from the discharge connection 27 to the chambers 23. Right angular passageways 36 connect the passageway 35 into the chambers 23.

In the operation of the pump, the pump stems 18 are reciprocated by any known means, and as

previously set forth, the mechanism disclosed in the Brown patent is ideally suited for the action. The screen casing **31** has openings **32** which allow the liquid to flow around the outside of the cylinder block **24**, which block is open at its bottom, which allows the liquid to enter inside the cylinder block, flow in the openings **22** in the adapter **19**, thence to fill the plunger **20**. With the plungers as shown in Fig. 1 of the drawing, the left hand plunger is at the bottom of its stroke while the right hand plunger is at the top of its stroke. The chamber **23** on the left, is loaded with oil, ready to be forced into the outlet connection by the upward movement of the plunger. When the plunger on the left starts upward, the weight of the oil in the chamber **23**, forces the ball valve **21** tightly on its seat, and lifts the oil out of the chamber. The ball valve **25** is lifted off its seat to allow the oil to pass to the outlet connection **27**. The ball valve **25** will not let any of the oil from the outlet connection pass back into the chambers. While the left hand plunger has been moving upwardly the right hand plunger has moved downwardly. This downward movement will unseat the valve **21** and allow the right hand chamber **23** to fill with liquid. By the time the plunger reaches the bottom of its stroke, the chamber is full of liquid and gas and ready to be lifted out by the upward movement of the plunger.

From the drawing it can be readily seen that the top edge of the left hand plunger has just uncovered the wall port **36**, letting a small amount of high pressure fluid from the discharge pipe short circuit through the by-pass channels to the pump cylinder. During this time the plunger is traveling at its slowest velocity and is also slowing up to a zero velocity at its lowest point.

By this means the cylinder is supplied at the proper instant with enough by-passed high pressure fluid to more nearly fill its volume, raise its pressure to a maximum and permit the beginning of outward or discharge flow of fluid while the crank-shaft is just beginning to accelerate the plunger and the plunger is almost at zero velocity. The high pressure fluid from the outlet compresses the gas in the chamber, when admitted thereto. Hence, by this by-pass it is assured that the chamber will always be filled with liquid for the up-stroke of the plunger, thus relieving impact stresses and increasing the volumetric efficiency of the pump. It is to be understood that the plunger, in its upward and downward movements, closes the by-pass opening **36** in the bottom of the chamber, and it is only when the plunger is approaching or has reached its lowermost position in the cylinder that the passageway **36** is opened and the liquid from the discharge pipe flows into the chamber.

Fig. 2 of the drawing shows the by-pass channels adapted to a pump structure with only one plunger. The plunger is indicated at **20'** with the ball valve **21'** on the top thereof. The pump chamber is shown at **23'** in the cylinder block **24'** with a ball valve **25'** at the top of the chamber. The outlet tubing **27'** has the passage **26'** into which the liquid from the pump chamber is discharged. By-pass **36'** connects with the outlet passage **26'**, extends through the head portion **28'** and cylinder block **24'** by means of passage **35'**, thence to the pump chamber by passage **37'**.

The operation of the one plunger pump is similar to the operation of the two plunger pump previously described. The plunger reciprocates in the same manner with the ball valves opening and closing in similar fashion. The by-pass **35'**, **36'** and **37'** operates to allow high pressure fluid to enter the pump chamber when the plunger approaches its lowermost position and when it starts up again in the same manner as previously discussed for the two-plunger pump.

While this by-pass arrangement has been illustrated and described as pertaining to deep well pumps of the reciprocating plunger type, it is to be understood that the by-pass is not limited to this type of pump but may be applied to any pump in which there is fluid hammer or shock.

From the foregoing it is believed that this invention may be readily understood by those skilled in the art without further description, it being borne in mind that numerous changes may be made in the details disclosed without departing from the spirit of the invention as set forth in the following claims.

I claim:

1. In a pump mechanism for pumping a liquid and gas mixture, a displacement chamber extending in a vertical direction for the collection of the liquid and gas being pumped having a discharge pipe connected thereto, means to force the liquid and gas out of said chamber into the discharge pipe and means to insure that the chamber is filled with the maximum amount of liquid comprising a by-pass connecting the discharge pipe with the bottom of the chamber to allow liquid to drain into the chamber.

2. In a pump mechanism for pumping a liquid and gas mixture, a displacement chamber extending in a vertical direction for the collection of the liquid and gas being pumped having a discharge pipe connected thereto, a reciprocating plunger to force the liquid and gas out of said chamber into the discharge pipe and means to insure that the chamber is filled with the maximum amount of liquid comprising a by-pass connecting the discharge pipe with the bottom of the chamber, the outlet end of the by-pass connecting with the chamber being in full open communication with the chamber when the plunger is in its lowermost position.

3. In a pump mechanism for pumping a liquid and gas mixture, a displacement chamber extending in a vertical direction for collection of the liquid and gas being pumped having a discharge pipe connected thereto, a reciprocating plunger to force the liquid and gas out of said chamber into the discharge pipe and means to insure that the chamber is filled with the maximum amount of liquid comprising a by-pass connecting the discharge pipe with the bottom of the chamber, the outlet end of the by-pass connecting with the chamber being closed by the plunger during its upward and downward movements in the chamber, and being in open communication with the chamber when the plunger is in the lowermost position of its stroke.

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