June 26, 1928.

1,675,100

F. W. HARRIS

FLUID PACKED PUMP

Filed March 30, 1927

Fig. 1.

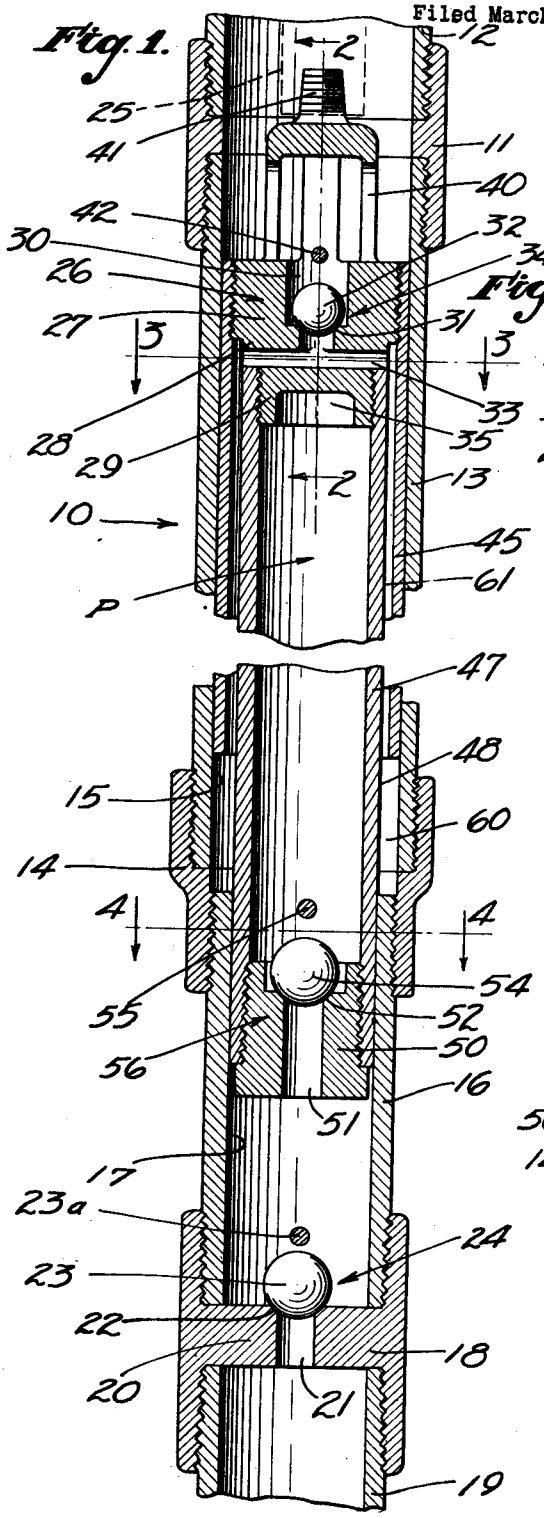


Fig. 2.

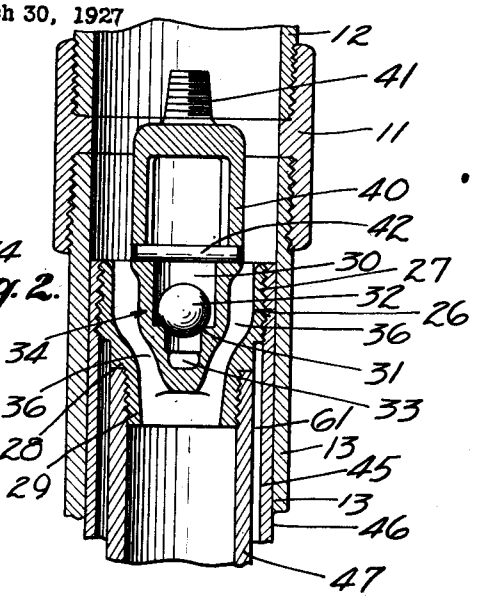


Fig. 3.

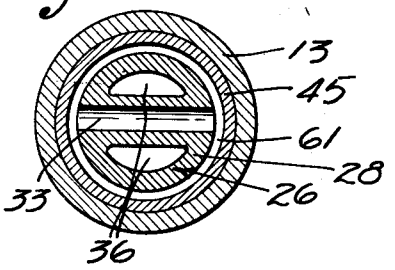
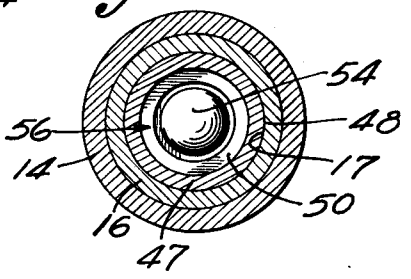


Fig. 4.



INVENTOR:

Fred W. Harris

Patented June 26, 1928. 1,675,100

UNITED STATES PATENT OFFICE.

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FLUID-PACKED PUMP.

Application filed March 30, 1927. Serial No. 179,468.

My invention relates to pumps and particularly to reciprocating plunger deep well pumps.

Deep wells which do not flow naturally are pumped, for the most part, by a reciprocating plunger pump which includes a barrel and a plunger slidably disposed in said barrel. The barrel is connected to the lower end of a string of pump tubing which extends from the top to the bottom of the well. The plunger is reciprocated in the barrel by a string of sucker rods which supports the plunger and extends upward through the pump tubing to the top of the well where it connects to a walking beam or other reciprocating mechanism.

The great head of liquid imposed upon the pump tends to force liquid downward around the plunger when it is making an upstroke, thus reducing the efficiency of the pump. A great may different packings have been devised to prevent this loss in efficiency.

One device with this object is the "fluid-packed pump" in which the liquid above the plunger is required to pass in a long and tortuous course in order to flow downward past the plunger. In most of these pumps a pair of concentric tubular sleeves telescopically receive a third sleeve so as to form a vacuum pocket between said pair of sleeves on the upstroke of the plunger. Either the pair of sleeves or the third sleeve acts as the plunger, the other acting as the pump barrel.

Several difficulties have been encountered in using these fluid-packed pumps which it is the object of my invention to overcome. In the first place, the immense fluid head of liquid presses in upon the sleeves, on the upstroke of the plunger, making the outer sleeve fit the intermediate sleeve so tightly as to cause excessive wear between these sleeves.

It is an object of my invention to provide a fluid-packed pump in which the head of pumped liquid is not transmitted to the external surface of a sleeve having internal engagement with another sleeve.

Several concentric telescopically related sleeves are extremely difficult to mount in a manner so that they will be accurately aligned and not bind during some portion of their axial movement relative to each other.

It is another object of my invention to provide a fluid-packed pump in which neither the plunger nor the barrel has a sleeve telescopically received between a pair of sleeves provided on the other.

When more than one cylindrical sliding surface is provided upon a single sleeve, it frequently happens that one of these surfaces becomes badly worn while the other still has considerable working life left in it. As the cost of these sleeves in a fluid-packed pump is mainly in the grinding of true cylindrical surfaces thereon, it represents a waste when a sleeve having such surfaces must be removed before the entire useful life of both internal and external cylindrical surfaces be utilized in the operation of the pump.

A further object of my invention is to provide a fluid-packed pump in which a separate sleeve is provided for each ground surface upon either the plunger or the barrel.

Other objects and advantages will be made manifest in the following description and in the accompanying drawings in which a preferred embodiment of my invention is shown and described.

In the drawings, Fig. 1 is a fragmentary vertical sectional view illustrating the pump of my invention.

Fig. 2 is a vertical medial sectional view taken on the line 2—2 of Fig. 1.

Figs. 3 and 4 are horizontal sectional views taken on the lines 3—3 and 4—4 of Fig. 1.

Referring specifically to the drawings, the pump 10 of my invention is secured by means of an upper threaded collar 11 to the lower end of a pump tubing 12 which is adapted to extend beneath the surface of the well liquid. A primary tubular barrel 13 is screwed into the lower end of the collar 11 and the lower end of this barrel is threadily received in the upper portion of a threaded intermediate collar 14. The primary barrel 13 has an internal cylindrical surface 15 which is of smaller diameter than the internal surface of the pump tubing 12. A secondary barrel 16 is threadedly received in the lower end of the intermediate collar 14, the barrel 16 having an internal cylindrical surface 17 which is smaller in diameter than the cylindrical surface 15 of the primary barrel 13. The lower end of the secondary barrel 16 is connected by a lower

threaded collar 18 to the upper end of a screen pipe 19. The collar 18 has a central radial wall 20 in which a vertical opening 21 is formed, having a valve seat 22 formed in its upper mouth. A ball 23 is adapted to rest upon the seat 22 and be retained against movement from the immediate proximity of the seat 22 by a bar 23ª mounted transversely within the lower end of the secondary barrel 16, the ball 23 and the seat 22 cooperating to form a standing valve 24.

A sucker rod (not shown) is adapted to extend downward through the pump tubing 12 and a lower coupling 25 of this sucker rod is indicated by dotted lines in Fig. 1.

A plunger head 26 preferably formed by casting, includes a cylindrical threaded body 27 which has a lower portion 28 of reduced diameter and a still lower portion 29 of still further reduced diameter, the portion 29 being externally threaded. A central recess 30 is formed in the plunger head body 27, this recess having a reduced diameter in its lower portion to form a valve seat 31 on which a valve ball 32 is adapted to rest. A transverse passage 33 connects the lower end of the recess 30 and the external faces of the body portion 28, the ball 32 and the seat 31 cooperating to form an inter-plunger pocket relief valve 34. A central cavity 35 is formed upwardly in the lower portion of the head body portion 29 and passageways 36 are formed upwardly through the body 27 to connect between the cavity 35 and the space above the plunger head 26. A cage 40 is formed upon the plunger body 27 so as to extend upward over the recess 30 and a threaded pin 41 projects centrally upward from the cage 40, the pin 41 being adapted to threadedly engage with the sucker rod coupling 25. A bar 42 is transversely mounted in the lower portion of the cage 40 so as to retain the ball 32 in the upper portion of the recess 30.

A primary tubular plunger 45 is internally threaded at its upper end so as to threadedly receive the plunger head body 27. The plunger 45 has an external cylindrical face 46 which is adapted to make a sliding fit in the internal cylindrical surface 15 of the primary barrel 13, preferably with a clearance of five to twenty thousandths of an inch.

A secondary plunger 47 is tubular in form and is internally threaded at its upper end so as to threadedly receive the portion 29 of the plunger head 26. When the primary and secondary plungers are thus screwed upon the plunger head 26 they form a plunger member P which is adapted to be reciprocated by the sucker rod when this is reciprocated in the pump tubing 12 by a walking beam or other suitable reciprocating mechanism at the top of the well.

The secondary plunger 47 has an external cylindrical surface 48 which is adapted to fit the internal cylindrical surface 17 of the secondary barrel 16 with a clearance of five to twenty thousandths of an inch. The lower end of the secondary plunger 47 is internally threaded and threadedly receives a plug 50 which has a vertical passage 51 extending therethrough having a seat 52 formed at the upper end thereof. A ball 54 is adapted to rest upon the seat 52 and a bar 55 is mounted in the lower portion of the secondary plunger 47 so as to retain the ball 54 in the vicinity of the seat 52. The ball 54 and the seat 52 cooperate to form a working valve 56.

The operation of my fluid-packed pump is as follows:

The plunger member P is reciprocated vertically in the barrels 13 and 16 by means of a string of sucker rods as previously mentioned. An annular pocket 60 is formed between the lower portion of the primary barrel 13 and the secondary plunger 47 as the plunger member P commences its upstroke. The pocket 60 is always in communication with the lower portion of the recess 30 in the plunger head 26 through an annular space 61 and the transverse passage 33. During the upstroke of the plunger member P the pocket 60 is constantly increased in size, thus reducing the fluid pressure in this pocket so as to close the pocket relief valve 34. The working valve 56 is at this time closed, causing the body of oil in the pump tube 12 to be lifted by the upward movement of the plunger member P. This imposes an exceedingly high pressure upon the upper end of the plunger member P and tends to force liquid downward through the capillary space between the primary plunger member 45 and the primary barrel 13. The pocket 60, due to its being constantly increased in size during the upstroke of the plunger member, receives all of the liquid which passes by the upper plunger 45 and maintains this liquid at such a low pressure that it is not forced downward between the secondary plunger 47 and the secondary barrel 16. In this manner, the liquid which would otherwise be forced entirely around the plunger is trapped in the pocket 60 and prevented from passing further downward around the plunger member P. During the upstroke the standing valve 24 is also open so as to admit a fresh charge of oil from the screen pipe 19 into the secondary barrel 16.

On the downstroke of the plunger member P, the standing valve 24 is closed and the liquid which was drawn in through this valve on the upstroke is forced upward through the working valve 56, the secondary plunger 47 and the passages 36, into the pump tubing 12. As the pocket 60 dimin-

ishes in size on the downstroke, the liquid which passed around the primary plunger 45 on the upstroke is now forced upward through the annular space 61, the passage 33 and the relief valve 34 into the pump tubing 12.

While fluid-packed pumps have been previously made which should operate on the same general principle as my pump, most of these have utilized both internal and external cylindrical surfaces on one or more members to slidingly engage similar surfaces formed on other members of the pump. The pairs of sliding surfaces in a fluid-packed pump never wear equally, it being generally true that the pair of surfaces submitted to the full pressure of the liquid in the well are worn out long before the other pairs of surfaces need to be replaced. Thus members need to be thrown away upon which certain ground surfaces still have considerable useful life merely because another surface on the same member has been worn to such extent that it no longer functions in the necessary manner. In my pump there is only one sliding surface formed on any one member of the pump and this obviates the necessity of throwing away a part having a good working surface because another surface on the same part has been worn out. In the operation of my pump the cylindrical surfaces 15 and 46 of the primary barrel and plunger members respectively will probably be the first to be worn out and the surfaces 17 and 48 of the secondary barrel and plunger members respectively will probably outwear two sets of primary barrels and plungers.

It is thus seen that considerable saving is accomplished by the structure of my fluid-packed pump.

The extending of the secondary plunger upward through the primary plunger so that the two are connected together at their upper ends and the connecting of the barrels end to end so that the secondary barrel extends downward from the primary barrel, places the connection between the primary and secondary plungers a considerable distance from the interacting surfaces of the secondary barrel and plunger. This obviates a great difficulty which has previously been encountered in the construction of fluid-packed pumps, which difficulty consists in forming the threads on a connecting member such as plunger head 26 so as to connect a pair of tubular members such as the primary and secondary plungers in accurate concentric relation. An absolutely accurate concentricity is not required in the structure of my pump as shown because of the distance from the cylindrical surface 17 of the secondary barrel 16 at which the secondary plunger 47 is connected to the primary plunger 45.

I claim as my invention:

1. In a deep well plunger pump, the combination of: a primary barrel; a secondary barrel of less diameter than said primary barrel and secured to the lower portion thereof to extend downward therefrom; a primary plunger slidably disposed in said primary barrel; a secondary plunger slidably disposed in said secondary barrel and connected to said primary plunger for reciprocation therewith; a working valve provided on said plungers; and a standing valve provided on said barrels, said primary plunger having a depending tubular portion surrounding and spaced from said secondary plunger.

2. In a deep well plunger pump, the combination of: a primary barrel; a secondary barrel of less diameter than said primary barrel and secured to the lower portion thereof to extend downward therefrom; a primary plunger slidably disposed in said primary barrel; a secondary plunger slidably disposed in said secondary barrel and connected to the upper portion of said primary plunger for reciprocation therewith; a working valve provided on said plungers; and a standing valve provided on said barrels.

3. In a deep well plunger pump, the combination of: a primary barrel; a secondary barrel of less diameter than said primary barrel and secured to the lower portion thereof to extend downward therefrom; a primary plunger slidably disposed in said primary barrel; a secondary plunger slidably disposed in said secondary barrel and connected to said primary plunger for reciprocation therewith; a working valve provided on said plungers; and a standing valve provided on said barrels, there being a space between said primary barrel and said secondary plunger which is enlarged by a pumping stroke of said plungers.

4. In a deep well plunger pump, the combination of: a primary barrel; a secondary barrel of less diameter than said primary barrel and secured to the lower portion thereof to extend downward therefrom; a primary plunger slidably disposed in said primary barrel; a secondary plunger slidably disposed in said secondary barrel and connected to the upper portion of said primary plunger for reciprocation therewith; a working valve provided on said plungers; and a standing valve provided on said barrels, there being a space between said primary barrel and said secondary plunger which is enlarged by a pumping stroke of said plungers.

5. In a deep well plunger pump, the combination of: a primary barrel; a secondary barrel of less diameter than said primary barrel and secured to the lower portion thereof to extend downward therefrom; a

primary plunger slidably disposed in said primary barrel; a secondary plunger slidably disposed in said secondary barrel and connected to said primary plunger for reciprocation therewith; a working valve provided on said plungers; a standing valve provided on said barrels, there being a space between said primary barrel and said secondary plunger which is enlarged by a pumping stroke of said plungers and which decreases in size during the suction stroke, there being a passage opening from said space into the space above said primary plunger; and a check valve in said passage, permitting fluid to leave but not to enter said space through said passage.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 24th day of March, 1927.

FORD W. HARRIS.