

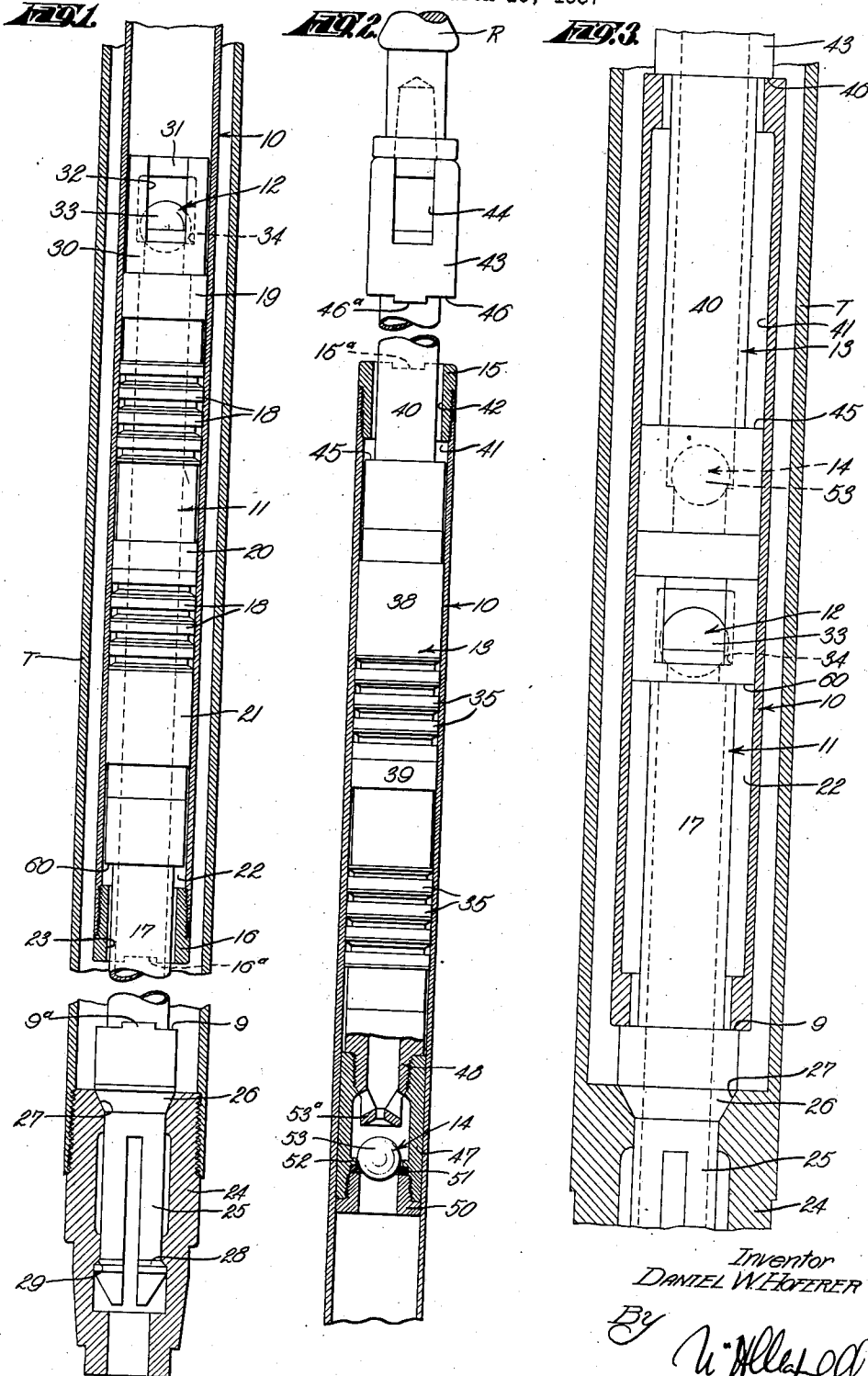
Nov. 1, 1938.

D. W. HOFERER

2,135,076

WELL PUMP

Filed March 10, 1937



Inventor
DANIEL W. HOFERER

By *W. H. Hoyer*
His Attorney

UNITED STATES PATENT OFFICE

2,135,076

WELL PUMP

Daniel W. Hoferer, Long Beach, Calif.

Application March 10, 1937, Serial No. 130,062

11 Claims. (Cl. 103—179)

This invention relates to pumps and relates more particularly to well pumps such as oil well pumps. A general object of this invention is to provide a practical efficient and very long wearing well pump.

Well pumps are usually quite efficient as long as a satisfactory seal is maintained between the barrel and the plunger. At present it is the common practice to move either the plunger or the barrel the full length of a given stroke so that the same parts of the plunger and the barrel receive the wear resulting from their sealing cooperating during each stroke. When the plunger or the barrel, or both, become worn at their points of sealing cooperation the pump is no longer efficient and must be repaired or replaced.

Another object of this invention is to provide a well pump in which the plunger wear is distributed in a manner to greatly prolong the efficiency and the life of the pump.

Another object of this invention is to provide a well pump in which the plunger sealing means or packing is subjected to only one-half as much wear as the plunger packing of a typical well pump, thereby greatly prolonging the life of the pump.

Another object of this invention is to provide an improved well pump embodying two plungers received in or operating in a single barrel in such a manner that the wear is substantially equally divided between the two plungers materially lengthening the life and efficiency of the pump.

Another object of this invention is to provide a well pump of the character mentioned in which one plunger is stationary and is quite short and is carried by a short, stationary column whereby the plunger and column assembly is very rigid.

Another object of this invention is to provide a pump of the character mentioned that requires only two simple valves.

A further object of this invention is to provide a well pump of the character mentioned that is simple and inexpensive and that is capable of operation by typical well pump jacks, etc.

The various objects and features of my invention will be fully understood from the following detailed description of a typical preferred form and application of the invention, throughout which description reference is made to the accompanying drawing, in which:

Fig. 1 is a longitudinal detailed sectional view of the lower portion of the pump provided by this invention anchored within a well tubing, illustrating the lower plunger in side elevation. Fig. 2 is a longitudinal detailed sectional view of the

upper portion of the pump with the tubing omitted, and illustrating the upper plunger in side elevation, and Fig. 3 is a diagrammatic longitudinal sectional view of the pump showing the barrel and the moving plunger at the lower ends of their strokes.

The present invention is capable of embodiment in well pumps for use in particular situations and under various operating conditions and in well pumps having various refinements such as special types of packing, valves, etc. In the present disclosure I prefer to disclose a simple, typical embodiment of the invention. The simple form of the invention illustrated in the drawing includes, generally, a floating or free barrel 10, a stationary plunger 11 entering one end of the barrel 10, a standing valve 12 on the plunger 11, a reciprocable plunger 13 entering the other end of the barrel 10 and a working valve 14 on the plunger 13.

The barrel 10 may be a simple, tubular member or structure, as illustrated. In practice the barrel 10 may be of substantial length, it being understood that the length of the barrel 10 depends upon the stroke of the pump. A puller nut 15 is provided on the upper end of the barrel 10. The nut 15 may be threaded into the upper end portion of the barrel 10. A similar nut 16 may be provided on the lower end of the barrel 10. In accordance with the invention the barrel 10 is floating or unsecured, that is, it is slackly connected or associated with the standing plunger 11 and the reciprocable plunger 13.

The plunger 11 is the stationary element of the pump. The plunger 11 is received in the lower portion of the barrel 10, being carried by a tubular column member 17 which enters the lower end of the barrel. Suitable sealing means is provided on the plunger 11 for slidably sealing with the interior of the barrel 10. In the illustrative form of the invention shown in the drawing the plunger 11 has two longitudinally spaced groups or sets of sealing rings 18 having sliding sealing cooperation with the internal surface of the barrel 10. The stationary plunger 11 preferably has longitudinally spaced portions which have sliding and guiding cooperation with the interior of the barrel 10. In the case illustrated there are three such guiding portions 19, 20 and 21 provided on the stationary column or plunger 11. The portion 19 is located adjacent the upper end of the column 11. The portion 20 is provided between the two spaced groups of sealing rings 18 and the portion 21 is located adjacent the lower end of the plunger 11. The longitudinally spaced por-

tions 19, 20 and 21 in addition to guiding the barrel 10 may assist in providing a sliding seal between the barrel and the plunger 11. The tubular column member 17 carrying the plunger 11 may be somewhat smaller in diameter than the plunger to extend into the barrel 10 with substantial clearance in which case it leaves an annular fluid space 22 in the barrel. The member 17 extends downwardly through the nut 16 on the lower end of the barrel 10, to be anchored in the well tubing T. The nut 16 may be formed to allow the free flow of fluid to and from the fluid space 22 when the pump is in operation. In the structure illustrated, the longitudinal opening 23 in the tubular nut 16 receives the column member 17 with substantial clearance to allow for the desired fluid flow. The nut 16 may have working tolerance on the member 17 to serve as a guide, in which case the barrel 10 may be ported to properly vent the fluid space 22. The lower end 60 of the plunger 11 proper may be engageable by the upper end of the nut 16 to limit relative longitudinal movement between the barrel 10 and the plunger 11 in one direction.

The pump is adapted to be arranged in the well tubing or oil tubing T and the lower end of the column member 17 is suitably releasably fixed or anchored in the tubing. In the typical installation shown in the drawing an anchor shoe 24 is provided on the lower end of the tubing T and an anchor 25 is provided on the lower end of the column member 17 to be received in the shoe 24. The anchor 25 may be of typical design having a tapered face 26 sealing with a tapered seat 27 on the shoe 24 and having a split lower end with a shoulder 28 removably latched under a shoulder 29 on the shoe 24. The upper end of the anchor 25 may form an upwardly facing shoulder 9 against which the nut 16 may engage to limit or stop the downward travel of the barrel 10 relative to the stationary plunger 11. The lower end of the nut 16 and the shoulder 9 are preferably provided with clutch parts for holding the barrel against rotation when the barrel is permitted to lower to its lowermost position. In practice the nut 16 may have notches 16^a for receiving tongues 9^a on the shoulder 9 to connect the nut and the anchor 25 against relative turning. The tubular column member 17 may be relatively short and in practice may have a length one-half the length of the intended stroke of the pump plus the length of its connections with the anchor 25 and the plunger 11. The lower end of the member 17 has communication with the well through the medium of the tubular anchor 25 and the tubular shoe 24.

The standing valve 12 is provided on the relatively stationary plunger 11 and in practice may be any selected or suitable type of pump valve. The valve 12 may be provided on or connected in the plunger 11 in any suitable position. In the form of the invention illustrated the valve 12 is a simple type of ball valve provided on the upper end of the stationary plunger 11. The valve 12 includes a cage 30 secured to the upper end of the plunger 11 to have communication with its interior. The upper end of the cage 30 is closed by a flat wall 31 and the cage has lateral fluid ports 32 extending to its upper end to communicate with the interior of the barrel 10. The standing valve 12 further includes a ball or valve 33 adapted to seat downwardly against a suitable seat 34 in the cage 30 to control communication between the interior of the plunger 11 and the interior of the barrel 10.

The plunger 13 operates in the upper portion of the barrel 10 and reciprocates in the barrel under certain conditions of operation and serves to carry and move the barrel 10. The plunger 13 is the positively reciprocated element of the pump. In accordance with the invention the plunger 13 is a tubular structure or assembly provided with suitable sealing means for slidably sealing with the interior of the barrel 10. In the case illustrated the plunger 13 has two longitudinally spaced sets or groups of sealing rings 35 slidably sealing with the internal surface of the barrel 10. The upper plunger 13 preferably has longitudinally spaced portions of enlarged diameter having sliding, guiding cooperation with the internal surface of the barrel 10. In the structure illustrated the plunger 13 has a guide portion 38 adjacent its upper end and a guide portion 39 between the groups of sealing rings 35, both of said portions having guiding engagement with the internal surface of the barrel.

The plunger 13 is adapted to be operated or reciprocated by a pump rod R. The pump rod R may be solid or non-tubular as illustrated. In practice a tubular member 40 may extend upwardly from the upper end of the plunger 13 for connection with the rod R. The tubular member 40 may be of less diameter than the plunger 13 to extend into the barrel 10 with substantial clearance leaving an annular fluid space 41 in the barrel. The nut 15 on the upper end of the barrel 10 is formed to permit the free flow of fluid into and from the said fluid space 41 during relative movement between the barrel 10 and the plunger 13. In the particular case illustrated the longitudinal opening 42 in the nut 15 receives the tubular member 40 with substantial clearance to provide for the desired fluid flow around the member. It is to be understood that the nut 15 may be made with a running tolerance on the member 40 to act as a guide in which event the barrel 10 may be ported to properly vent the fluid space 41. A connection 43 is provided to connect the upper end of the member 40 with the rod R. The lower portion of the connection 43 is tubular to communicate with the interior of the member 40 and the connection has lateral fluid ports 44 for putting its interior in communication with the interior of the well tubing T. It will be apparent that the plunger 13 connected with the rod R by the member 40 and the connection 43 is reciprocated by or with the rod.

The reciprocating plunger 13 is provided with a shoulder 45 adapted to engage against the lower end of the nut 15 or a similar downwardly facing shoulder on the barrel 10. In the simple structure illustrated this shoulder 45 is the upper end of the plunger 13 proper. The plunger 13 or the plunger assembly also has a downwardly facing shoulder 46 for cooperating with the barrel 10 to positively move the barrel downwardly with the plunger under certain conditions of operation or use. In practice this shoulder 46 may be the lower end of the connection 43 and may engage against the upper end of the nut 15. Cooperable clutch means are preferably provided on the shoulder 46 and the upper end of the nut 15. In the structure illustrated tongues 46^a are provided in the shoulder 46 to receive notches 15^a on the upper end of the nut 15. The tongues 46^a and the notches 15^a may cooperate to connect the connection 43 and the barrel 10 against relative turning when the plunger 13 is moved to its lowermost position. If desired, a stop may be provided on the barrel 10 midway 75

between its ends to cooperate with plunger parts to replace certain of the shoulders or parts above described for limiting relative movement between the barrel and plungers. The tubular member 40 interposed between the plunger 13 and the lower end of the rod R has a length equal to one-half the length of the pump stroke plus its connections with the plunger and the connection 43.

The working valve 14 is carried by or is movable with the working plunger 13. The position of the valve 14 may be varied as found most practical and the valve may be of any suitable type. In the construction illustrated the valve 14 is provided on the lower end of the plunger 13 and is of the ball type. The valve 14 illustrated includes a tubular cage 47 threaded on a pin 48 on the lower end of the plunger 13. A tubular nut 50 is threaded in the lower end of the cage 47 and a replaceable valve seat 51 is clamped between the upper end of the nut 50 and a shoulder 52 in the cage. The valve 14 further includes a ball 53 in the cage 47 adapted to seal downwardly against the seat 51 to control communication between the interior of the barrel 10 and the interior of the plunger 13. A baffle 53a may be provided on the lower end of the pin 48 to limit upward movement of the ball 53 so that the ball does not close off the opening in the pin 48 when there is an up-flow of fluid through the cage 47. The exterior or periphery of the tubular valve cage 47 may slidably engage the interior of the barrel 10 to constitute a third guide portion on the plunger 13 for guiding the barrel. With the parts in the extreme collapsed condition there is suitable space or working clearance between the opposing ends of the cages 30 and 47 of the valves 12 and 14.

In operation let it be assumed that the pump rod R is at the lower end of its stroke with the lower end of the barrel adjacent the upper end 9 of the anchor 25 and the lower end 46 of the connection 43 adjacent the upper end of the nut 15 so that the valve 14 on the lower end of the plunger 13 is adjacent to the valve 12 on the upper end of the plunger 11, as illustrated in diagrammatic Fig. 3. When the plunger 13 moves upwardly from the lower end of its stroke the valve 14 moves upwardly away from the valve 12 and a reduced pressure is created in the barrel 10 allowing or causing fluid to pass upwardly through the anchor shoe 24, the anchor 25, the member 17, the plunger 11 and the valve 12 into the barrel 10. This upward flow of fluid into the barrel 10 may continue throughout the entire upstroke of the rod R. When the plunger 13 begins its upward stroke it may move upwardly through the barrel 10 which may remain stationary until the shoulder 45 moves into cooperation with the lower end of the nut 15. Engagement of the shoulder 45 with the lower end of the nut 15 causes the barrel 10 to be picked up by the plunger 13 so that it moves upwardly with the plunger. Thus the traveling plunger 13 may move upwardly through the barrel until the middle of the up stroke is reached, whereupon it picks up the barrel 10.

During the upward movement of the plunger 13 through the barrel 10 the sealing rings 35 slidably seal with the interior of the barrel 10 so that the sealing rings and the interior of the barrel may wear during approximately one-half of the upstroke of the plunger. When the barrel 10 moves upwardly with the plunger 13 it travels upwardly over the relatively stationary plunger 11 so that the sealing rings 18 slid-

ably seal with the interior of the barrel. This upward movement of the barrel 10 with the plunger 13 continues during half of the upstroke until the rod and plunger 13 reach the upper end of the stroke. Thus during the final or second portion of the upstroke the wear is confined to the sealing rings 18 and the interior of a portion of the barrel 10. From the above it will be observed that wear resulting from the packing or sealing relation between the barrel 10 and the plungers 11 and 13 is divided between the two plungers, the plunger 13 receiving the wear during a portion of the upstroke and the plunger 11 receiving the wear during a portion of the same stroke.

During the above described upstroke of the barrel 10 the fluid trapped in the space 22 is freely discharged from or forced outwardly through the nut 16. As described above, the opening 23 receives the tubular member 17 with sufficient clearance to permit this escape of the trapped fluid. During the upward movement of the plunger 13 with respect to the barrel 10 the fluid in the space 41 is forced out through the opening 42 in the nut 15, there being sufficient clearance in the nut 15 to permit this relatively free escape of fluid.

The relative movement between the pump parts during the upstroke may differ somewhat from that described above. The relationship between the parts may be such that the barrel 10 moves upwardly with the plunger during the first portion of the upstroke at the same speed as the plunger or at a slower speed than the plunger. If this occurs the barrel 10 may simultaneously have sliding sealing engagement with both plungers 11 and 13 but at reduced relative speeds. In any event the wear resulting from the sealing engagement between the barrel and plungers is divided between the two plungers 11 and 13 and the portions of the barrel 10 engaged by the respective plungers.

At the start of the down stroke of the rod R the plunger 13 starts downwardly, the barrel 10 may move downwardly with it. The barrel 10 may move downwardly with the plunger 13 during the entire first half of the down stroke. If this occurs the barrel 10 moves downwardly on the stationary plunger 11 until its downward movement is stopped, whereupon the plunger 13 moves downwardly through the barrel. In actual operation, however, the barrel 10 may move downwardly with the plunger 13 but at a slower rate than the plunger to have movement relative to both plungers simultaneously, and this relative movement may continue throughout the major portion of the down stroke. During the entire down stroke of the pump, fluid is displaced upwardly out of the barrel 10 through the valve 14, the plunger 13, the member 40 and the connection 43 into the tubing T. This results from the relative movement between the plungers 11 and 13.

It is important to note that the barrel 10, free within limits as illustrated, may move relative to the plungers 11 and 13 at a speed less than the speed of the moving plunger 13. This may be true during both the up and down strokes. In operation the barrel 10 may move at a speed approximating one-half of the speed of the moving plunger 13 and the plungers 11 and 13 operate or engage in their respective halves or portions of the barrel 10. The reduced rate of motion of the free barrel 10 relative to the plungers

11 and 13 is important as it results in reduced wear.

During the down stroke of the pump the fluid capacity of the space 22 gradually increases to maximum. Fluid is free to flow inwardly through the opening 23 in the nut 16 to the space 22 so that substantially equal pressures are maintained in the space 22 and the interior of the tubing T. In a like manner the fluid capacity of the space 41 increases and fluid is drawn through the opening 42 in the nut 15 to maintain substantially equal pressures in the space 41 and the tubing T.

If it becomes desirable or necessary to tighten the threaded connections in the pump rod R the rod is lowered to bring the pump parts to positions where the notches 16^a may receive the tongues 9^a and the notches 15^a may receive the tongues 46^a. With the parts in this position the rods R may be turned in a direction to tighten its connections. It will be apparent how the clutch parts on the nut 16 and the shoulder 9 and the clutch parts on the shoulder 46 and the nut 15 hold the barrel 10 against rotation relative to the anchor 25 and hold the rod R against turning relative to the barrel 10 so that the above described rotation of the rod R may tighten its joints. When the pump is to be pulled from the well the rod R is raised or moved upwardly to bring the shoulder 45 against the nut 15 and to bring the nut 16 against the lower end 60 of the plunger 11 proper. An upward strain on the rod R will then pull the anchor 25 out of the shoe 24, freeing the pump for removal on the end of the rod R.

The present invention provides a well pump in which the wear resulting from sealing cooperation between the barrel and plunger is substantially equally divided between two plunger sections or plungers 11 and 13. Accordingly, the pump of the present invention will operate efficiently for a much longer period than the pumps heretofore in use where the plunger wear is confined to a single plunger and to a single position in the barrel. The pump is efficient and is operative throughout the entire stroke of the pump rod R. The barrel 10 is effectively guided by the guide portions 19, 20 and 21 of the plunger 11 and the guide portions 38 and 39 and the cage 47 of the plunger 13. The standing column 17 and the standing plunger 11 constitute a relatively short and, therefore, rigid assembly on which barrel 10 moves. The pump does not require special valves and is practical and effective when embodying two simple valves, as illustrated.

Having described only a typical preferred form and application of my invention I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims:

Having described my invention, I claim:

1. A well pump including an elongate tube of uniform diameter forming, a movable barrel, a stationary plunger entering one end of the barrel, a movable plunger entering the other end of the barrel, slack connections between the barrel and the plungers whereby the barrel may move with the said second mentioned plunger during a portion of each stroke of the same, and valves controlling fluid flow through the plungers.

2. A well pump including, a standing plunger, standing valve controlling flow through the standing plunger, a barrel of uniform internal diameter

movable on the standing plunger, a working plunger movable in the barrel, a working valve controlling flow through the working plunger, and means limiting relative movement between the working plunger and barrel.

3. A well pump including, a standing plunger, a standing valve connected with the standing plunger, a movable barrel of uniform diameter having sealing cooperation with the standing plunger, a working plunger operating in the barrel, a working valve connected with the working plunger, and means limiting movement between the barrel and the standing plunger whereby the wear resulting from the sealing cooperation between the barrel and the plungers may be divided between the plungers.

4. A well pump including, a standing plunger, a standing valve connected with the standing plunger, a length of tubing of uniform diameter forming a movable barrel having sealing cooperation with the standing plunger, a working plunger operating in the barrel, a working valve connected with the working plunger, means limiting relative movement between the barrel and the standing plunger in one direction, and means limiting relative movement between the barrel and the working plunger in the other direction.

5. A well pump including, two plungers of the same diameter, one a standing plunger, the other a working plunger, a length of tubing of uniform diameter forming a barrel surrounding and movable with respect to both plungers, valves connected with the plungers, means limiting relative movement between the barrel and the standing plunger and means limiting relative movement between the working plunger and the barrel.

6. A well pump including, two plungers of the same effective diameter, one a standing plunger, the other a working plunger, a length of tubing of uniform diameter forming a barrel surrounding and movable with respect to both plungers, valves connected with the plungers, a slack connection between the barrel and the working plunger whereby the barrel may move with the working plunger for portions of its stroke, and a slack connection between the barrel and the standing plunger whereby the barrel may move relative to the standing plunger through certain portions of the strokes of the working plunger.

7. A well pump including, two plungers of the same effective diameter, one a standing plunger, the other a working plunger, a barrel of uniform diameter surrounding and movable with respect to both plungers, valves connected with the plungers, a slack connection between the barrel and the standing plunger limiting movement of the barrel so that the barrel may move only one half the length of the pump stroke relative to the standing plunger, and a slack connection between the barrel and the working plunger so that the barrel may move relative to the working plunger substantially equal to one-half of its stroke.

8. A well pump including, two plungers of the same diameter, one a standing plunger, the other a working plunger, a barrel of uniform diameter surrounding and movable with respect to both plungers, valves connected with the plungers, and means limiting relative movement between the working plunger and the barrel so that such relative movement is approximately one-half the stroke of the working plunger whereby the barrel may move relative to the standing plunger a distance equal to approximately one-half of the stroke and may move relative to the working

plunger a distance equal to approximately one-half of the stroke.

9. A well pump including, two plungers, one a standing plunger, the other a working plunger, a barrel surrounding and movable with respect to both plungers, a valve on the upper end of the standing plunger, a valve on the lower end of the working plunger, and means limiting relative movement between the working plunger and the barrel so that such relative movement is approximately one half the stroke of the working plunger, said means including spaced cooperable parts on the barrel and the working plunger.

10. A well pump including, two plungers, one a standing plunger, the other a working plunger, a barrel surrounding and movable with respect to both plungers, a valve on the upper end of the standing plunger, a valve on the lower end of the working plunger, the valves controlling the fluid

flow to provide for the flow of fluid in one direction only, and means limiting relative movement of the barrel with respect to both plungers so that the barrel moves with the working plunger and relative to the standing plunger throughout only portions of the strokes of the working plunger so that the wear resulting from cooperation of the barrel with the plungers is substantially equally divided between the plungers.

11. A well pump including, two plungers, one a standing plunger, the other a working plunger, a barrel surrounding and movable with respect to both plungers, valves connected with the plungers, slack connections between the barrel and the plungers, a short column supporting the standing plunger, and an anchor releasably holding the column against movement.

DANIEL W. HOFERER.