Nov. 22, 1938. D. W. HOFERER 2,137,403

PUMP

Filed March 10, 1937 2 Sheets-Sheet 1

Fig. 1.

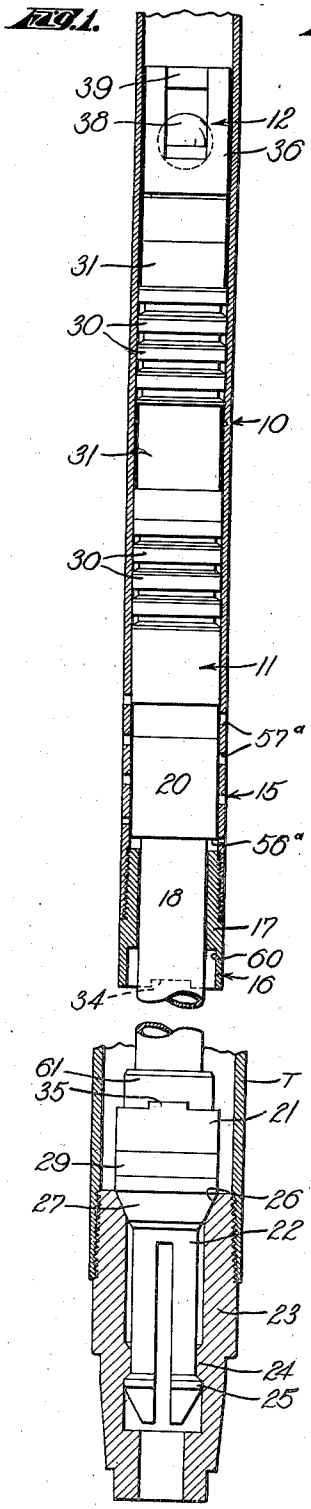

Fig. 2.

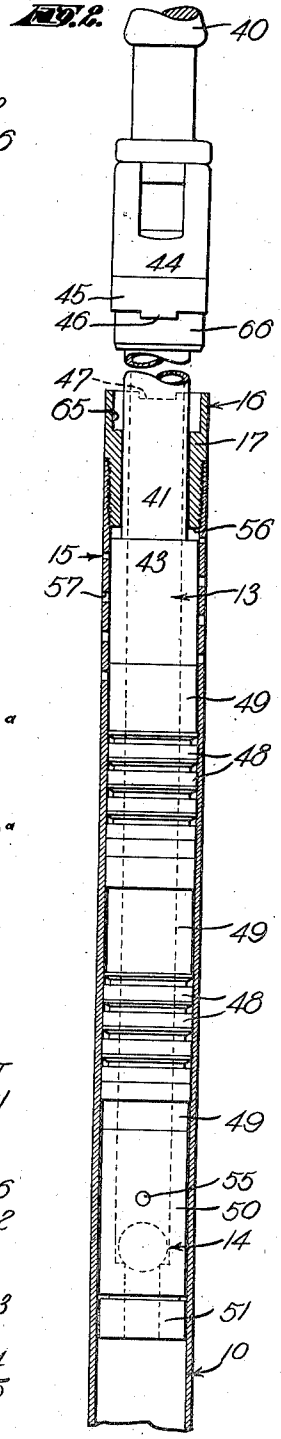

Fig. 3.

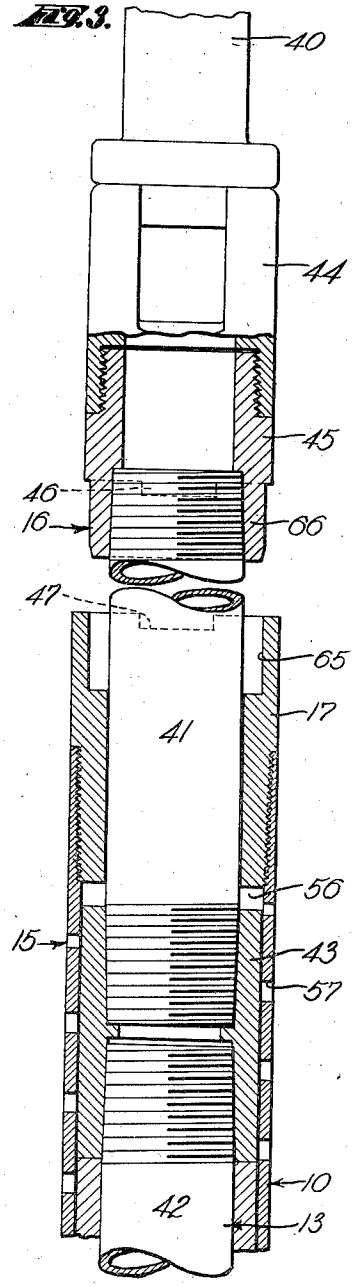

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Fig. 4.

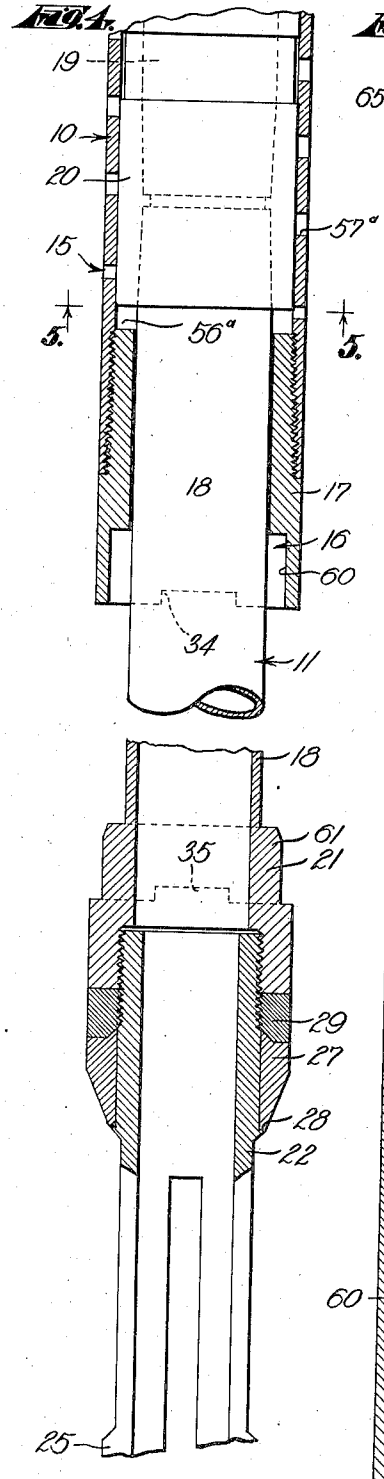


Fig. 8.

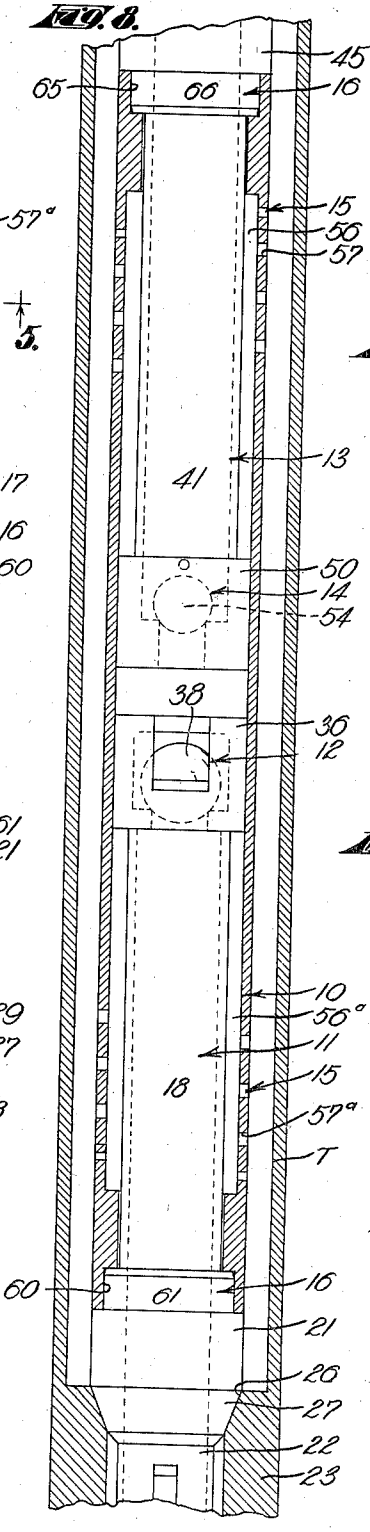


Fig. 5.

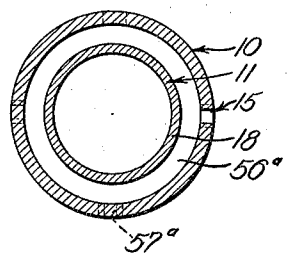


Fig. 6.

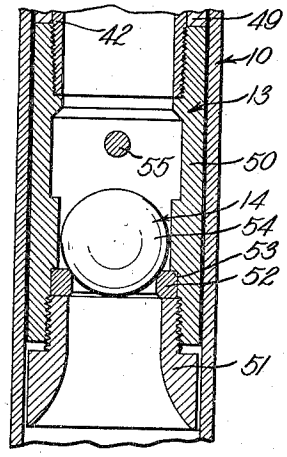
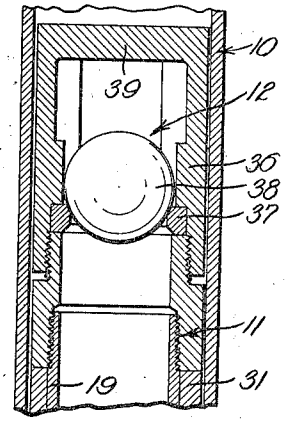


Fig. 7.



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Patented Nov. 22, 1938 2,137,403

UNITED STATES PATENT OFFICE

2,137,403

PUMP

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Application March 10, 1937, Serial No. 130,063

15 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 well pump embodying novel and effective means for preventing or reducing shock to the relatively movable parts.

In my co-pending application entitled Well pump, Serial No. 130,062, filed March 10, 1937, I have described and claimed a free barrel well pump embodying a free or movable barrel and two plungers extending into the barrel, one plunger being stationary, the other plunger being movable. Stop parts are provided on the barrel and plungers to limit relative movement between them and to prevent disassociation of the pump parts when the pump is run into and removed from the well. It is desirable to cushion or eliminate the shock to the barrel and plungers and the parts connected therewith when the stop parts come into contact during operation of the pump.

It is another object of this invention to provide a well pump of the free barrel type referred to above embodying cushioning means for materially reducing or eliminating the shock and jar that might otherwise result from the contact of the stop parts of the barrel and plungers.

Another object of this invention is to provide a well pump of the character referred to in which the cushioning means are hydraulic, employing the liquid around the pump as the shock absorbing or movement resisting medium.

Another object of this invention is to provide a pump of the character referred to in which the cushioning means are simple and sturdy, embodying a minimum number of parts and connections.

Another object of this invention is to provide a well pump of the character referred to in which the cushioning means may be easily modified to suit various conditions of operation, the specific gravity of the liquid handled, etc.

A further object of this invention is to provide an improved well pump of the character referred to in which the cushioning means are small and inexpensive and do not materially add to the cost of the pump.

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 drawings, in which:

Fig. 1 is a longitudinal detailed sectional view of the lower portion of the pump provided by this invention illustrating the tubing and the barrel in cross section. Fig. 2 is a view similar to Fig. 1 showing the upper portion of the pump. Fig. 3 is an enlarged, longitudinal detailed sectional view of a portion of the pump showing certain of the plunger parts in elevation and illustrating the cushioning means at the upper portion of the pump. Fig. 4 is an enlarged fragmentary vertical sectional view of the lower portion of the pump showing parts of the lower plunger in elevation and illustrating the cushioning means of the lower portion of the pump. Fig. 5 is a transverse detailed sectional view taken as indicated by line 5—5 of Fig. 4. Fig. 6 is an enlarged fragmentary vertical sectional view illustrating the valve on the movable plunger. Fig. 7 is a fragmentary vertical detailed sectional view illustrating the valve on the standing plunger, and Fig. 8 is a diagrammatic longitudinal sectional view showing the plungers in elevation and illustrating the barrel and the movable plunger at the lower ends of their strokes.

The well pump provided by this invention includes, generally, a free barrel 10, a standing plunger 11 entering the lower end of the barrel and carrying a valve 12, a working plunger 13 entering the upper end of the barrel 10 and carrying a valve 14, cushioning means 15 for preventing shock to the barrel and plungers when certain parts of the same move together to limit the relative movement and cushioning means 16 for preventing shock to the barrel 10 and plungers 11 and 13 when parts thereon move together to limit relative movement between the barrel and plungers.

The barrel 10 is an elongate, tubular structure or member. In the pump illustrated the barrel 10 is of uniform diameter throughout its length and is a simple tube of considerable length. The opposite ends of the barrel 10 are provided with fittings or parts that I will term puller nuts 17. The puller nuts 17 may be alike and may be threaded into the ends of the barrel 10. If desired one of the puller nuts 17 may be an integral part of the barrel 10. The puller nuts 17 are preferably shouldered to bear against the ends of the barrel 10 when threaded in place. The puller nuts 17 on the ends of the barrel 10 serve as bearings or guides for the plungers 11 and 13 and perform other functions as will be hereinafter described.

The standing plunger 11 is the stationary member of the pump and is adapted to be anchored in a well tubing T. The plunger 11 is an elongate tubular member extending into the lower end of the free barrel 10. In the construction

illustrated the plunger 11 comprises a lower tube 18 extending through the lower puller nut 17 and an upper tube 19 extending longitudinally in the barrel 10. The two plunger tubes 18 and 19 may be connected by a coupling 20 threaded to their adjacent ends. The plunger tube 18 may pass through the lower puller nut 17 with suitable tolerance or clearance, as illustrated. This relationship between the tube 18 and the lower puller nut 17 will be more fully described in connection with the cushioning means 15 and 16.

Anchor means is provided to releasably hold or anchor the standing plunger 11 in the tubing T. In the particular case illustrated the plunger tube 18 is provided with a nut part or enlargement 21 which is threaded on the upper end of an anchor mandrel 22. The enlargement 21 on the lower end of the plunger tube 18 is preferably integral with the tube. The anchor mandrel 22 extends into a shoe 23 secured to the lower end of the tubing T. The shoe 23 is provided with an internal flange 24 and the mandrel 22 is provided with an external annular flange 25 which is releasably latched under the flange 24. The mandrel 22 is longitudinally split so that its flange 25 may be latched under the flange 24 and may be freed from the flange 24. An inclined seat 26 is provided on the upper end of the shoe 23. A sealing member 27 of copper or the like surrounds the mandrel 22 to cooperate with the seat 26. The sealing member 27 is clamped between a shoulder 28 and a threaded nut 29 on the mandrel 22. The member 27 is shaped to tightly seal against the seat 26. With the parts related as illustrated in Fig. 4 the enlargement 21 of the plunger tube 18 clamps against the nut 29 to serve as a lock nut. The shoe 23 and the mandrel 22 are tubular so that the lower end of the standing plunger 11 is in communication with the well. The anchor mandrel 22 releasably held in the shoe 23, as described above, serves to rigidly support the standing plunger 11 in a vertical position.

The plunger 11 is provided with packing means for sealing with the interior of the barrel 10. In practice any suitable form of packing means may be provided. In the structure illustrated vertically spaced sets or series of packing rings 30 are provided on the plunger tube 19 to have sealing engagement with the inner wall of the barrel 10. The sets of packing rings 30 are spaced apart and are spaced from the coupling 20 and the parts at the upper end of the plunger 11 by spacing collars 31. It will be observed that under certain circumstances the lower end of the lower puller nut 17 may engage downwardly against the enlargement 21 on the tube 18 to limit the downward travel of the free barrel 10. Thus the lower puller nut 17 and the enlargement 21 serve as stop parts to limit movement between the barrel 10 and the plunger 11 in one direction. Clutch means are preferably provided on the lower puller nut 17 and the enlargement 21 to connect the lower end of the barrel 10 with the plunger 11 and anchor mandrel 22 to hold the barrel 10 against turning when it is desired to tighten the threaded connections in the pump rod. In the simple arrangement illustrated the clutch means comprise spaced notches 34 in the lower end of the puller nut 17 and clutch lugs 35 on the enlargement 21 for cooperating with the notches.

The valve 12 is the standing valve of the pump and in accordance with the broader aspects of the invention may be of any suitable construction and type and may be positioned on the standing plunger 11 as found most practical. In the form of the invention illustrated the valve 12 is in the nature of a ball valve comprising a cage 36 secured to the upper end of the upper plunger member 19, a seat 37 in the cage 36 and a ball 38 for cooperating with the seat 37. The cage 36 is perforated or ported to have communication with the interior of the barrel 10. A web 39 may be provided at the upper end of the cage 36 to limit upward travel of the ball 38 in the cage. The ball 38 is adapted to seat downwardly against the seat 37 to control communication between the interior of the tubular standing plunger 11 and the interior of the free barrel 10. The assembly of the spaced sets of packing rings 30 and the spacing collars 31 may be clamped between the valve cage 36 and the coupling 20 of the plunger 11.

The plunger 13 is adapted to be operated by a sucker rod or pump rod 40 and is the reciprocating plunger element of the pump. The plunger 13 is an elongate tubular member or assembly and may include an upper tube 41 extending through the upper puller nut 17 and a lower tube 42 within the barrel 10. The adjacent ends of the plunger tubes 41 and 42 may be connected by an integral coupling 43. The upper end of the upper plunger tube 41 is connected with the lower end of the rod 40. The rod 40 may be solid or nontubular. In the arrangement illustrated a ported coupling 44 is threaded on the lower end of the rod 40 and a tubular member 45 is provided on the upper end of the tube 41 and is threaded into the coupling 44. The ported coupling 44 places the interior of the reciprocating plunger 13 in communication with the tubing T. The member 45 may be integral with the plunger tube 41 or may be threaded on the tube 41, as illustrated. It will be observed that the upper puller nut 17 and the member 45 may cooperate to limit movement between the reciprocating plunger 13 and the barrel 10 and thus constitute stop parts on the plunger and barrel. Cooperating clutch parts are preferably provided on the member 45 and the upper puller nut 17 to connect the plunger 13 and the barrel 10 against rotation when it is desired to tighten the threaded joints of the pump rod 40. In the simple construction illustrated spaced clutch lugs 46 are provided on the member 45 and spaced notches 47 are provided in the upper end of the upper puller nut 17 to receive the lugs 46 to connect the plunger 13 and the barrel 10 against relative turning. The plunger 13 is provided with packing means for slidably sealing with the interior of the barrel 10. In the construction illustrated this packing means includes two vertically spaced groups or sets of packing rings 48 on the plunger tube 42 slidably engaging the interior of the barrel 10. The groups of rings 48 are spaced apart and are spaced from the coupling 43 and the valve 14 on the inner end of the plunger 13 by spacing collars 49.

The valve 14 is the working valve and controls communication between the pump chamber in the barrel 10 and the tubing T. The valve 14 may be of any suitable type and may be located as found most desirable. In the form of the invention illustrated the valve 14 is a simple ball type valve provided on the inner end of the plunger 13. The valve 14, illustrated in the drawings, includes a tubular cage 50 threaded on the lower end of the plunger tube 42. A tubular inlet fitting 51 is threaded on the lower end of the cage 50. A seat 52 is clamped between the upper

end of the fitting 51 and a shoulder 53 in the cage 50. The ball 54 is operable to cooperate with the seat 52 to govern communication between the interior of the barrel 10 and the interior of the reciprocating plunger 13. A pin 55 extends through the cage 50 to limit upward movement of the ball 54. The assembly of the spaced sets of packing rings 48 and the spacing collars 49 may be clamped between the coupling 43 and the valve cage 50.

One of the cushioning means 15 is provided to reduce or eliminate shock to the pump parts when upward movement between the plunger 13 and the barrel 10 is stopped and when downward movement of the barrel 10 relative to the plunger 13 is stopped. The other cushioning means 15 is provided to reduce or eliminate shock to the pump parts when upward movement of the barrel 10 relative to the plunger 11 is stopped. The cushioning means 15 here shown are hydraulic means, it being understood that the invention may be carried out with spring cushioning means, bumpers, or cushioning material, etc. The hydraulic cushioning means 15 are advantageous as they may be incorporated in the pump at little expense, may be regulated or varied to adapt the pump for use under various operating conditions and are very effective. The two cushioning means 15 are provided at or adjacent the opposite ends of the free barrel 10 and may be alike or very similar.

In Fig. 3 of the drawings I have illustrated in detail the cushioning means 15 at the upper end of the barrel 10 for reducing the rate of movement between the barrel and the plunger 13 when the upward movement of the plunger relative to the barrel is about to be stopped and when the downward movement of the barrel relative to the plunger 13 is about to be stopped. The inner end of the upper puller nut 17 and the upper end of the coupling 43 are adapted to cooperate to limit the upward movement of the plunger 13 relative to the barrel 10 and to limit downward movement of the barrel on the plunger 13. The hydraulic cushioning means 15 at the upper end of the barrel 10 utilizes or includes the annular fluid space 56 in the barrel 10 between the opposing ends of the upper puller nut 17 and the coupling 43. The volume or the capacity of this fluid space 56 is, of course, reduced when there is relative movement between the barrel 10 and the plunger 13 to cause the opposing ends of the puller nut 17 and the coupling 43 to move toward one another. The means 15 utilizes the fluid trapped in the space 56 to control the rate of this relative movement and thus cushion the shock that would otherwise result from the contact between the inner end of the puller nut 17 and the upper end of the coupling 43.

The means 15 provides for the controlled escape of the trapped fluid from the space 56. The tolerance or clearance between the plunger tube 41 and the interior of the tubular puller nut 17 may constitute a means of escape for the trapped fluid in the space 56 that is substantially constant or of uniform capacity throughout the operation of the cushioning means 15. Further, the clearance or working tolerance between the periphery of the coupling 43 and the interior of the barrel 10 may constitute another substantially constant path of escape for the fluid trapped in the space 56. In accordance with the invention the tolerance or clearance space between the interior of the tubular puller nut 17 and the plunger tube 41 may be small or great depending upon the specific gravity of the fluid handled and other factors. For similar reasons the tolerance or clearance between the periphery of the coupling 43 and the interior of the barrel 10 may be varied to suit the conditions of operation.

The cushioning means 15 at the upper end of the barrel 10 further includes controlled ports 57 for the escape of the fluid trapped in the space 56. In the form of the invention illustrated there are a multiplicity of longitudinally spaced ports 57 in the wall of the barrel 10 to communicate with the space 56 and to be controlled by a part on the plunger 13. The ports 57 are shown arranged in circumferentially spaced rows extending longitudinally of the barrel 10 to be controlled by the coupling 43 of the plunger 13. It will be apparent how the longitudinally spaced ports 57 are successively cut off by the coupling 43 when the coupling 43 and the puller nut 17 move toward one another. The ports 57 of the spaced vertical rows preferably occur in different vertical planes to be successively closed or cut off by the coupling 43. Further, it may be preferred to design the means 15 so that the spacing and/or the areas of the ports 57 provide a progressively increasing pressure in the space 56 and, therefore, a progressively increasing cushioning action. This may be accomplished by graduating the diameter or capacity of the ports 57 making the ports nearest the puller nut 17 of the smallest diameter and/or by varying the spacing of the ports. The invention contemplates the making of the ports 57 of selected capacity to provide for the proper operation of the means 15 under different operating conditions.

From the above it will be seen that the cushioning means 15 at the upper end of the barrel 10 provides a uniform capacity escape of fluid from the space 56 through the clearance between the interior of the upper puller nut 17 and the plunger tube 41, a similar constant capacity escape through the tolerance between the coupling 43 and the interior of the barrel 10, and a gradually decreasing escape through the ports 57. In this connection it is to be understood that there may be a clearance space of any reasonable capacity between the coupling 43 and the interior of the barrel 10 and that this space may be provided by reducing the diameter of the upper portion of the coupling 43 or by reducing the external diameter of the entire coupling. The fluid from the space 56 that escapes between the coupling 43 and the wall of the barrel 10 passes out through the ports 57 into the tubing T and does not reach or pass the packing rings 48 of the plunger 13.

When the inner end of the upper puller nut 17 and the upper end of the coupling 43 approach one another either due to movement of the plunger 13 relative to the barrel 10, or movement of the barrel 10 relative to the plunger 13, or the combined relative movement of the plunger and barrel, the space 56 is, of course, reduced in capacity and the fluid trapped therein is put under an increased pressure and displaced. The increase in pressure on the fluid in the space 56 is accompanied by increased resistance to relative movement between the barrel 10 and the plunger 13, this resistance being offered by the trapped fluid. As the relative movement progresses the fluid in the space 56 offers gradually increasing resistance to the movement. This results from the progressive cutting off of the ports 57 by the

coupling 43 and the upwardly diminishing fluid capacity of the ports 57 that remain open to the space 56. Thus the movement is gradually cushioned or retarded until the inner end of the nut 17 and the upper end of the coupling 43 come into close proximity, at which time a maximum pressure exists in the space 56 due to the fact that all or practically all of the ports 57 are cut off and the fluid in the space is obliged to escape from the tolerance spaces between the nut 17 and the plunger tube 41 and the coupling 43 and the interior of the barrel 10. This reduction of paths of escape for the fluid from the space 56 results in the reduction of the rate of speed between the barrel 10 and the plunger 13 to a minimum when the opposing ends of the coupling 43 and the puller nut 17 move into engagement so that even though these parts do come into contact there will be little or no jar or shock to the pump parts.

It is to be particularly noted that the increase in pressure in the fluid space 56 to a maximum is not accompanied by the leakage of fluid past the packing rings 48 of the plunger 13. The tolerance or clearance between the coupling 43 and the interior of the barrel 10 has communication with the ports 57 that are covered or cut off by the coupling 43 so that the fluid escaping through this clearance space from the space 56 is free to escape from the ports 57 and does not continue past the packing on the plunger 13. The ports 57 may be located so that they are all cut off from the space 56 when the opposing ends of the coupling 43 and the upper puller nut 17 come into contact. The tolerance or clearance between the interior of the nut 17 and the plunger tube 41 is such that the free barrel 10 may begin its downward movement relative to the plunger 13 with little resistance, there being a sufficient inlet of fluid to the space 56 and a minimum of friction between the tubing 41 and the nut 17.

The upper end of the lower puller nut 17 and the lower end of the coupling 20 may come into contact to limit the upward movement of the barrel 10 relative to the standing plunger 11 and the lower cushioning means 15 is provided to prevent shock to the pump parts when this occurs. The cushioning means 15 at the lower end of the barrel 10 may be substantially identical with the means 15 at the upper end of the barrel and which has just been described. The cushioning means 15 at the lower end of the barrel 10 includes the space 56a in the barrel 10 between the lower end of the coupling 20 and the upper end of the lower puller nut 17 and vertically spaced ports 57a in the wall of the barrel 10 communicating with the space 56a and controlled or cut off by the coupling 20 when the puller nut 17 approaches the coupling 20. The ports 57a may be arranged in spaced vertical rows and may be graduated in diameter and spacing so that the ports of the smallest capacity and of the greatest spacing are at the lower ends of the rows of ports. The means 15 at the lower end of the barrel 10 also utilizes the tolerance or clearance between the interior of the lower puller nut 17 and the plunger tube 18 and the tolerance between the coupling 20 and the internal wall of the barrel 10 as substantially constant paths for the escape of fluid from the space 56a. These tolerances or clearance spaces may have any selected or desired fluid capacities to provide for the desired escape of the trapped fluid from the space 56a.

The operation of the lower cushioning means 15 is the same as that of the upper cushioning means 15 described above. When the barrel 10 approaches the upper end of its upward movement relative to the plunger 11 the upper end of the puller nut 17 moves toward the lower end of the coupling 20. The fluid trapped in the space 56a resists the movement of the barrel 10 relative to the plunger 11 and this fluid is forced to escape from the relatively restricted ports 57a and the clearances between the interior of the puller nut 17 and the tube 18 and the coupling 20 and the interior of the barrel 10. Due to the fact that the ports 57a are graduated in diameter or spacing this resistance offered by the fluid in the space 56a increases as the barrel 10 continues to move upwardly and when the upper end of the nut 17 is in close proximity to the lower end of the coupling 20 the fluid resistance is maximum with all of the ports 57a cut off and the fluid escaping only through the tolerances between the tube 18 and the nut 17 and between the coupling 20 and the interior of the barrel 10. Fluid escaping between the coupling 20 and the interior of the barrel 10 does not reach the packing rings 30 but escapes from the ports 57a. The lower cushioning means 15 retards the upward movement of the barrel 10 as it approaches the upper end of its stroke in such a manner that there is little or no shock to the pump parts when the upper end of the nut 17 strikes the lower end of the coupling 20. When the barrel 10 begins to move downwardly relative to the plunger 11 there is space for the ample admission of fluid to the space 56a to the tolerances in the nut 17 and about the coupling 20 to permit of the desired movement of the barrel. As the downward movement of the barrel continues the ports 57a are successively uncovered to the space 56a permitting an increased admission of fluid to the space.

One of the cushioning means 16 is provided to prevent shock to the pump parts when the member 45 and the upper puller nut 17 come into cooperation to limit relative movement between the barrel 10 and the plunger 13 and the other cushioning means 16 is provided to prevent shock to the pump parts when the lower puller nut 17 moves into cooperation with the enlargement 21 to limit downward movement of the barrel 10 relative to the standing plunger 11.

Referring now to Fig. 4 of the drawings which illustrates the lower cushioning means 16 in detail it will be found that the said means includes cooperable plunger and socket parts on the lower puller nut 17 and the enlargement 21. In the particular form of the invention illustrated the lower end of the puller nut 17 has an annular socket 60 for receiving a plunger part 61 on the above described enlargement 21, it being obvious that the location of the socket 60 and the part 61 may be reversed if desired. The socket 60 is open to the lower end of the nut 17. The puller nut 17 may be lengthened to provide for the formation of a socket 60 of the desired length. The plunger part 61 is a portion of reduced diameter on the upper end of the enlargement 21. In the form of the invention illustrated the plunger part 61 is integral with the enlargement 21 and the tube 18. The upper corner of the plunger part 61 may be bevelled off. The plunger part 61 is proportioned to be received in the socket 60 when the barrel 10 approaches the lower end of its downward movement. The socket 60 and the part 61 are cylindrical, it being understood that they may be tapered or conical, if desired.

In accordance with the invention the part 61 is related to the socket 60 to be received in the socket with tolerance or clearance. This clearance and the clearance between the interior of the lower nut 17 and the plunger tube 18 constitute the means or paths of escape for the fluid trapped in the socket 60. The clearance spaces between the periphery of the part 61 and the wall of the socket 60 and between the interior of the nut 17 and the tube 18 may have any selected fluid capacities to assure the proper operation of the cushioning means 16 under the various conditions of pump operation.

When the barrel 10 approaches the lower end of its downward stroke relative to the standing plunger 11 the nut 17 may move downwardly over the part 61, that is, the part 61 may be received in the socket 60. The part 61 of course traps fluid in the socket 60 and the trapped fluid having only limited means of escape from the socket offers resistance to downward movement of the barrel. The fluid trapped in the socket 60 escapes through the tolerance space around the plunger part 61 and through the tolerance space in the nut 17 and these spaces may be proportioned so that the pressure on the trapped liquid increases as the downward movement of the barrel continues. Thus when the upper wall of the socket 60 approaches the upper end of the plunger part 61 the trapped fluid offers maximum resistance to movement of the barrel 10 and retards the barrel movement to such an extent that there is little or no shock when parts on the nut 17 contact parts on the enlargement 21.

The cushioning means 16 at the upper end of the barrel 10 for cushioning the engagement of the upper puller nut 17 with the member 45 comprises cooperable socket and plunger parts on the said puller nut and part 45. In the case illustrated an annular socket 65 is provided in the upper end of the upper puller nut 17 to receive a plunger part 66 on the lower end of the member 45. The part 66 may be integral with the member 45 and may be a reduced lower end portion of the member. The part 66 and the socket 65 are of the same character as the corresponding socket and plunger elements of the cushioning means 16 described above. The part 66 and the socket 65 are proportioned to provide any selected clearance between them and, therefore, any selected rate of escape of trapped fluid from the socket. In a like manner there may be any suitable tolerance or clearance between the plunger tube 41 and the interior of the nut 17 to permit the desired fluid escape from the socket 65.

The operation of the upper cushioning means 16 is substantially the same as that of the lower cushioning means. When the member 45 on the plunger 13 approaches the upper puller nut 17 the plunger part 66 enters the socket 65 to trap fluid therein which fluid offers resistance to the movement. The resistance offered by the fluid of course depends upon the rate of its escape from the socket and due to the very limited discharge capacity of the clearance spaces in the nut 17 and the socket 65 the fluid may offer appreciable resistance to movement so that the member 45 may be brought into engagement with the nut 17 with little or no jar to the pump parts.

In operation the pump rod 40 is reciprocated in the usual manner to reciprocate the plunger 13 secured to the rod. At the start of the downward stroke of the plunger 13 the barrel 10 may be in a position where its upper puller nut 17 is resting on or is adjacent the coupling 43. When the plunger 13 moves downwardly it may move downwardly through the barrel 10 which may tend to remain stationary or the barrel 10 may move downwardly together with the plunger. In practice it may be found that the barrel 10 moves downwardly with the plunger 13 but at an appreciably slower rate than the plunger. The action of the barrel 10 during this phase of operation depends upon various factors such as the pressure conditions, the friction conditions and the action of the packing rings 30 and 48. As the barrel 10 and the plunger 13 move downwardly the fluid within the barrel 10 is displaced therefrom and forced upwardly through the valve 14 and the plunger 13 to discharge into the tubing T from the coupling 44. The valve 12 remains closed during the downward stroke. The downward stroke may continue until the lower puller nut 17 approaches the enlargement 21 at the lower end of the plunger 11 at which time the plunger part 61 is received in the socket 60. The fluid trapped in the socket 60 serves to retard the downward movement of the barrel 10 so that the lower puller nut 17 does not jar against the enlargement 21. It is believed that the operation of the lower cushioning means 16 will be fully understood from the foregoing detailed description.

At the start of the upward stroke of the plunger 13 the barrel 10 may tend to remain stationary, may move upwardly with the plunger at the same rate as the plunger 13, or may move upwardly with the plunger at a slower rate. During the upward stroke of the pump fluid is drawn into the barrel 10 through the plunger 11 and the valve 12 and this action continues throughout the entire upward stroke. At some point during the upward travel of the plunger 13 the coupling 43 may approach the upper puller nut 17. When this occurs the upper cushioning means 15 operates to accelerate the movement of the barrel 10 so that the pump parts are not subjected to shock or jar even though the member 43 engages against the puller nut 17. It is believed that the operation of the upper cushioning means 15 will be understood from its foregoing detailed description.

The well pump provided by this invention embodies shock absorbing means or cushioning means that prevent jar and shock when the stop means or stops on the barrel and plungers come into engagement. The hydraulic cushioning means 15 and 16 are extremely simple and may be inexpensively embodied in the pump structure. It will be observed that most of the elements of the hydraulic shock absorbing means 16 and 15 do not in any way interfere with the normal functioning or operation of the pump and do not embody any special moving parts that require regulation or adjustment.

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, two plungers, one a standing plunger, the other a working plunger, a barrel surrounding and movable with respect to both plungers, valves in connection with the

plungers, stop parts on the barrel and working plunger for limiting relative movement between them, said parts defining a chamber in the barrel, and means progressively restricting the discharge of fluid from said chamber as the parts move together to cushion the engagement of the said parts.

2. 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 in connection with the plungers, stop parts for limiting relative movement between the barrel and the working plunger, means for offering progressively increasing resistance to relative movement between the barrel and the working plunger as said parts move toward one another to cushion the movement limiting cooperation of said parts, stop parts for limiting relative movement between barrel and the standing plunger, and means offering progressively increasing resistance to relative movement between the barrel and the standing plunger as the last mentioned stop parts move together to cushion the movement limiting cooperation of the last mentioned stop parts.

3. 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 in connection with the plungers, stop parts on the barrel and working plunger for limiting relative movement between them, and ported dash pot means for cushioning the movement limiting cooperation of said parts.

4. 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 in connection with the plungers, stop parts for limiting relative movement between the barrel and the working plunger, hydraulic means cushioning the movement limiting cooperation of said parts and offering progressively increasing resistance to movement between the barrel and the working plunger as the said parts move together, stop parts for limiting relative movement between the barrel and the standing plunger, and hydraulic means for cushioning the movement limiting cooperation of the last mentioned stop parts.

5. 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 in connection with the plungers, stop parts on the barrel and working plunger for limiting downward movement of the barrel relative to the working plunger, means associated with said parts for cushioning the cooperation of said parts, cooperable parts for limiting upward movement of the barrel relative to the standing plunger, and means for cushioning the cooperation of said cooperable parts.

6. In a well pump, a standing plunger, a working plunger, a barrel surrounding and movable with respect to both plungers, valves on the plungers, opposing parts on the barrel and the working plunger operable to limit relative movement between the barrel and the working plunger, said parts and the barrel defining a chamber, and means controlling the fluid flow from said chamber whereby the fluid trapped in the chamber resists relative movement between the barrel and the working plunger.

7. In a well pump, a standing plunger, a working plunger, a barrel surrounding and movable with respect to both plungers, valves on the plungers, opposing parts on the barrel and the standing plunger cooperable to limit relative movement between the barrel and the standing plunger, there being a fluid chamber in the barrel defined by said parts, and means controlling the fluid discharge from said chamber whereby the fluid trapped therein resists movement of the barrel when the part on the barrel approaches the part on the standing plunger.

8. In a well pump, a standing plunger, a working plunger, a barrel surrounding and movable with respect to both plungers, valves on the plungers, opposing parts on the barrel and the working plunger operable to limit relative movement between the barrel and the working plunger, there being a socket in one of said parts, and a piston on the other part adapted to enter the socket when said parts approach to resist relative movement between the barrel and the working plunger.

9. In a well pump, a standing plunger, a working plunger, a barrel surrounding and movable with respect to both plungers, valves on the plungers, opposing parts on the barrel and the working plunger operable to limit relative movement between the barrel and the working plunger, there being a socket in one of said parts, a piston on the other part adapted to enter the socket when said parts approach, and means controlling the fluid discharge from the socket.

10. In a well pump, a standing plunger, a working plunger, a barrel surrounding and movable with respect to both plungers, valves on the plungers, opposing parts on the barrel and the standing plunger cooperable to limit movement of the barrel relative to the standing plunger, there being a socket in one of said parts, and a piston on the other part adapted to enter said socket when the part on the barrel approaches the part on the standing plunger.

11. In a well pump, a standing plunger, a working plunger, a barrel surrounding and movable with respect to both plungers, valves on the plungers, opposing parts on the barrel and the working plunger operable to limit relative movement between the barrel and the working plunger, said parts and the barrel defining a chamber, and means controlling the fluid flow from said chamber whereby the fluid trapped in the chamber resists relative movement between the barrel and the working plunger, there being longitudinally spaced ports in the barrel communicating with the said chamber, said means including a surface on the working plunger operable to successively cover said ports.

12. In a well pump, a standing plunger, a working plunger, a barrel surrounding and movable with respect to both plungers, valves on the plungers, opposing parts on the barrel and the standing plunger cooperable to limit relative movement between the barrel and the standing plunger, there being a fluid chamber in the barrel defined by said parts, and means controlling the fluid discharge from said chamber whereby the fluid trapped therein resists movement of the barrel when the part on the barrel approaches the part on the standing plunger, said means including a surface on the standing plunger, the barrel having longitudinally spaced ports for communicating with said chamber and progressively covered by said surface when the part on the barrel approaches the part on the standing plunger.

13. In a well pump, a standing plunger, a working plunger, a barrel surrounding and mov-

able with respect to both plungers, valves on the plungers, opposing parts on the barrel and the working plunger operable to limit relative movement between the barrel and the working plunger, said parts and the barrel defining a chamber, and means controlling the fluid flow from said chamber whereby the fluid trapped in the chamber resists relative movement between the barrel and the working plunger, there being longitudinally spaced ports in the barrel of graduated fluid capacity communicating with the said chamber, said means including a surface on the working plunger operable to successively cover said ports.

14. In a well pump, a standing plunger, a working plunger, a barrel surrounding and movable with respect to both plungers, valves on the plungers, opposing parts on the barrel and the standing plunger cooperable to limit relative movement between the barrel and the standing plunger, there being a fluid chamber in the barrel defined by said parts, and means controlling the fluid discharge from said chamber whereby the fluid trapped therein resists movement of the barrel when the part on the barrel approaches the part on the standing plunger, said means including a surface on the standing plunger, the barrel having longitudinally spaced ports of graduated fluid capacity for communicating with said chamber and progressively covered by said surface when the part on the barrel approaches the part on the standing plunger.

15. 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 in connection with the plungers, stop parts for limiting relative movement between the barrel and the standing plunger, and cooperable cylinder and plunger elements on the barrel and the standing plunger for cushioning the cooperation of said parts.

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