Oct. 28, 1941. C. J. WOLFF 2,260,696

HYDRAULIC PUMP

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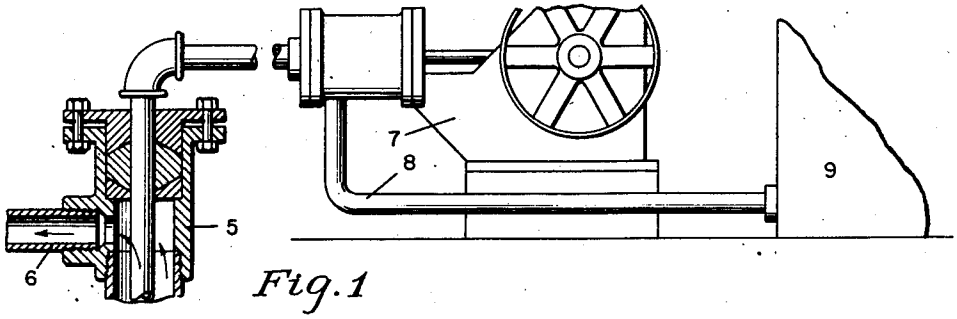
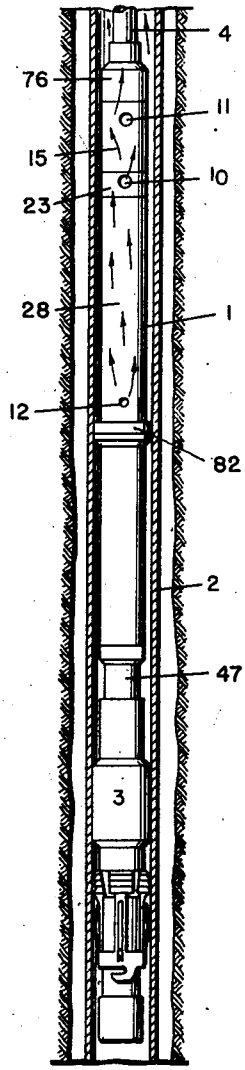


Fig. 1



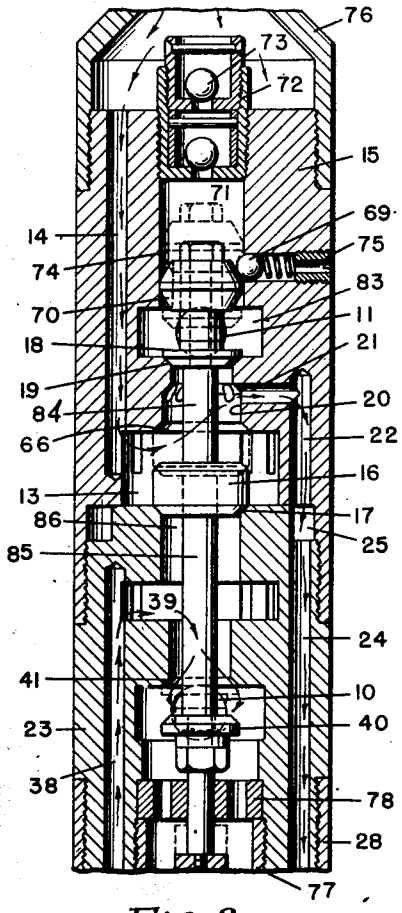


Fig. 2

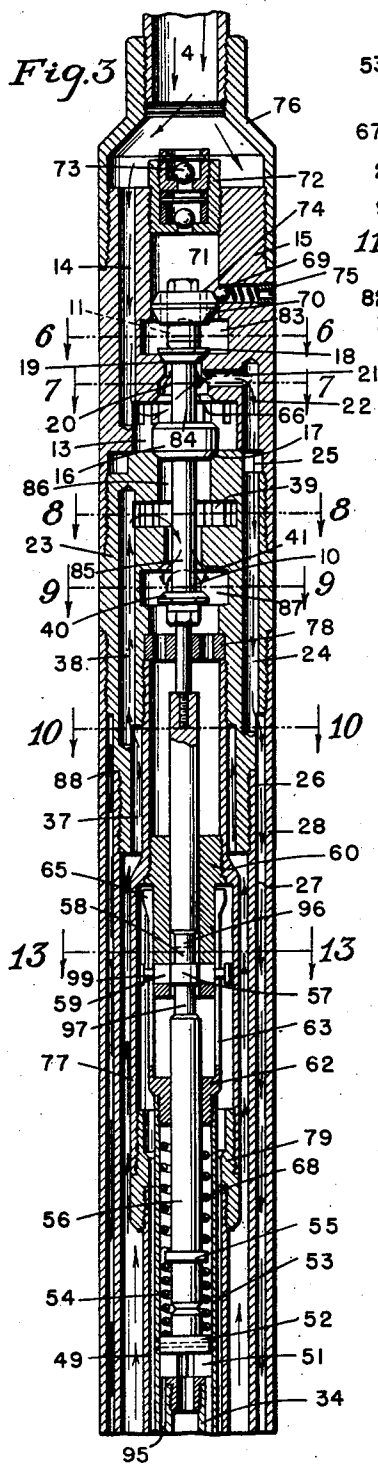
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HYDRAULIC PUMP

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Fig. 3



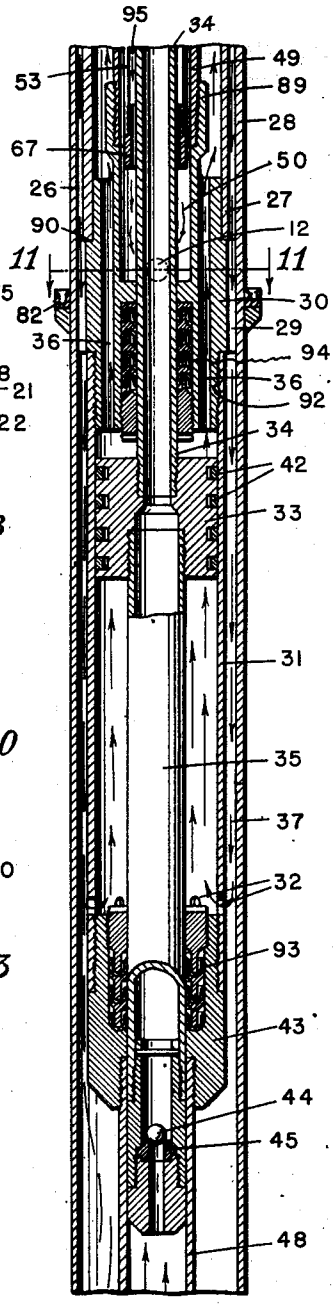


Fig. 4

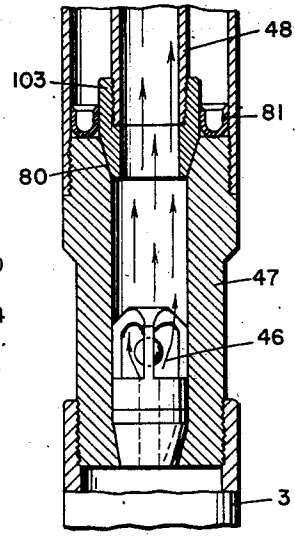


Fig. 5

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HYDRAULIC PUMP

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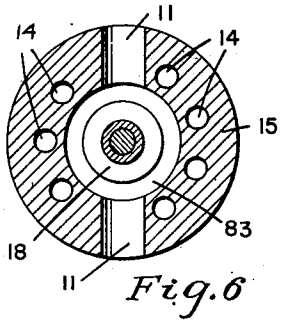


Fig. 6

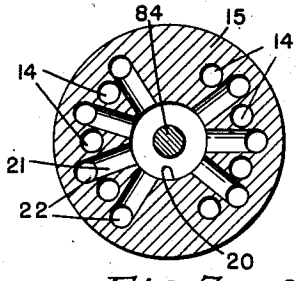


Fig. 7

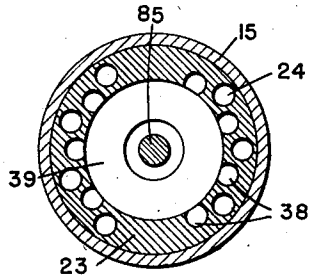


Fig. 8

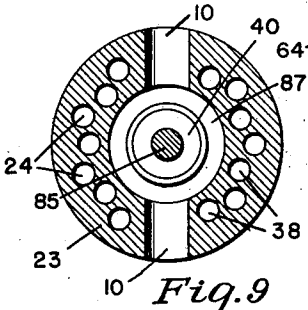


Fig. 9

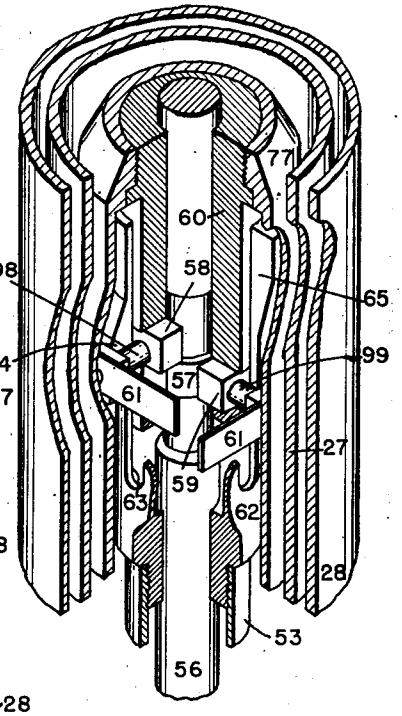


Fig. 12

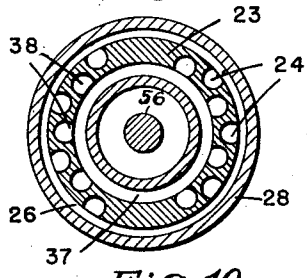


Fig. 10

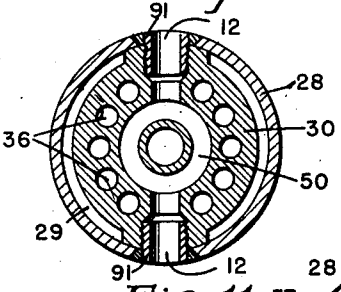


Fig. 11

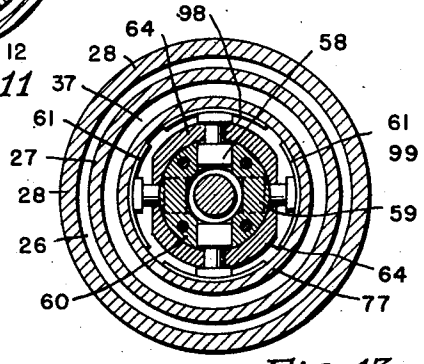


Fig. 13

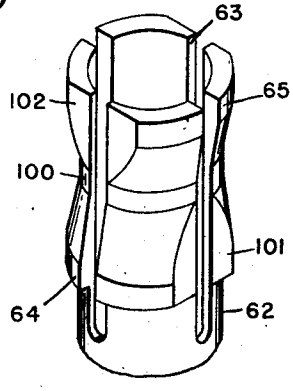


Fig. 14

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UNITED STATES PATENT OFFICE

2,260,696

HYDRAULIC PUMP

Charles J. Wolff, San Antonio, Tex.

Application August 5, 1938, Serial No. 223,310

13 Claims. (Cl. 103—46)

This invention relates to the art of pumps and is concerned particularly with fluid pumps of the hydraulic type employed in the pumping of oil or water wells.

Well pumps are commonly located near the well bottom and are operated by means of long strings of sucker rods. Such rods frequently become stretched under varying conditions of load, making it difficult to regulate the stroke of the pump. In practically all wells which run to any considerable depth the bore shifts from the vertical. As the sucker rods operate within the well tubing this means that the rods are in sliding contact with the tubing during operation. The rods sometimes become worn to the breaking point and the tubing is damaged. In order to effect replacements and repairs a well must be shut down. Furthermore, cumbersome mechanical installations are necessary at the well head in order to actuate the pump rods, and in a crowded field space is at a premium.

An object of the present invention is to provide lift pump means for wells of any depth automatically operable through the agency of fluid pressure supplied at the well head and conveyed to the pump through the well tubing.

Another object is to provide a novel hydraulically operable well pump having standing and traveling valves, in which the pressure above the valves is always the hydrostatic pressure in the well, irrespective of the degree of pressure of the operating fluid.

A further object is to provide a fluid pressure operated well pump in which the operating fluid is confined to an area located above the producing area of the well in which the pump is disposed, thereby preventing any extraneous pressure from contacting the producing area.

Other objects and advantages will be apparent as the description proceeds.

In the accompanying drawings wherein like characters of reference designate like parts throughout the several views:

Figure 1 is a vertical section through a well bore and casing having the pump located therein near the well bottom, the pump 10 being shown in elevation.

Figure 2 is an enlarged fragmentary vertical section through the upper end of the pump assembly, and illustrating the reversible valve means in elevation.

Figure 3 is a vertical section, partly in elevation, of the upper portion of the pump.

Fig. 4 is a section similar to Figure 3 but illustrating the intermediate portion, and forming a continuation of Figure 3.

Figure 5 is a similar section continuing that of Figure 4 and illustrating the lower end portion of the pump.

Figure 6 is a horizontal section on the line 6—6 of Figure 3.

Figure 7 is a horizontal section on the line 7—7 of Figure 3.

Figure 8 is a horizontal section on the line 8—8 of Figure 3.

Figure 9 is a horizontal section on the line 9—9 of Figure 3.

Figure 10 is a horizontal section taken on the line 10—10 of Figure 3.

Figure 11 is a horizontal section taken on the line 11—11 of Figure 4.

Figure 12 is a fragmentary sectional perspective view of a safety mechanism for the valve reversing means.

Figure 13 is a horizontal section on the line 13—13 of Figure 3.

Figure 14 is a fragmentary perspective of the safety releasing member shown in Figure 12.

Figure 1 illustrates the general assembly of the pump as positioned in a well; the pump 1 being disposed proximate the bottom of the well bore within the well casing 2. A packer 3 is mounted on the lower end of the working barrel 47 and at its upper end the pump is secured to the lower end of the well tubing 4. The liquid to be elevated, hereinafter termed the "production," is discharged from the pump into the casing 2 through diametrically opposite discharge ports 12 whence it passes up through the casing to the lead off 6 at the well head 5. Operating fluid for the pump, preferably a suitable liquid, is supplied from a surface reservoir 9 through a pipe 8 to a surface pump 7 from which it is forced under the required pressure down through the well tubing 4 to the pump 1, issuing from the well pump into the casing through the discharge ports 10 and 11 where it mingles with the production and is carried up to the surface. In those instances in which the operating fluid and the production are different, separator means (not shown) is associated with the lead off 6 whereby the operating fluid may be separated out and returned to the reservoir 9.

With reference to Figures 1, 3, 4, and 5, it will be seen that the pump 1 embodies an upper cylindrical head 15 threaded into the lower end of a bushing 76 which is in turn threaded onto the lower end of the well tubing 4. The head is provided with an axial bore 71 closed at its top

by a bushing 72 mounting a ball check valve assembly 73, the purpose of which will be later explained. As best seen in Figure 6, the head 15 is formed with a series of axial passages 14 disposed radially with respect to the central bore, which passages open at their lower ends into an annular valve chamber 13 in which the reversing valve 16 is mounted for axial reciprocation between an upper seat 66 in the head 15 and a lower seat 17 in a second and lower head 23.

The head 15, in the area of the valve 16, is provided with an axial central bore 20 registering with the bore 71, which bore 20 establishes communication between the valve chamber 13 and an upper chamber 83. The chamber 83 is open to the exterior of the head 15 by means of diametrically opposed ports 11 extending radially through the head, see Figure 6. The valve 16 has an integral upstanding stem 84 and a similar depending stem 85. The upper stem has secured thereon an upper closure valve 18 of smaller diameter than the reversing valve 16 and which is adapted to engage the seat 19 at the upper end of the bore 20 to cut off communication between the chambers 13 and 83.

As shown best in Figure 7, the head 15 is further provided with radial bores 21 leading from the bore 20 to the upper ends of a series of axially extending passages 22 which open at their lower ends to the bottom face of the head. These passages 22 are arranged radially of the bore 20, alternating with the passages 14 and somewhat radially outwardly thereof.

The upper valve stem 84 is guided and centered by means of a circular cross-head 70 working in the bore 71. The respective upper and lower halves of the cross-head are oppositely beveled inwardly for cooperation with a radially disposed spring projected ball detent 69 retained in the head 15 by the plug 75. The function of this detent is to hold the reversing valve 16 and the associated valves on its stem firmly against their seats.

The second and lower cylindrical head 23, detailed in Figures 2, 3, 8, 9, and 10 is of the same external diameter as the head 15. The upper end portion of this lower head 23 screws upwardly into the recessed lower end of the head 15, and is diametrically reduced to provide an annular chamber 25 around its upper end. The top of the head 23 provides the bottom wall of the valve chamber 13 and has the lower seat 17 for the reversing valve formed therein. A central axial bore 86 extends throughout the head, accommodating the valve stem 85 and providing communication between the working fluid inlet chamber 13 and an outlet chamber 87 which communicates through the diametrically opposed radial ports 10 to the exterior of the head. The stem 85 has secured thereon a lower cut off valve 40 adapted to engage upwardly against its seat 41 to close off the chamber 87 and the outlets 10.

With reference to Figures 2, 3, and 8 it is shown that the head 23 is formed with an internal chamber 39 as a lateral enlargement of the bore 86 intermediate the lower outlet chamber 87 and the top of the head, and that this chamber is in communication with the upper ends of a series of axially extending radially disposed passages 38. These passages 38 alternate with a series of axially extendng passages 24 arranged radially outwardly of the passages 38 and which open at their upper ends to the annular chamber 25. The lower ends of the passages 24 open to the outer face of the diametrically reduced lower end portion 88 of the head 23 while the lower ends of the passages 38 open to the inner face of this portion, as best indicated in Figure 10.

The head 23 supports an inner hollow tubular housing 77 which is threaded at its upper end into the head 23 beneath a stem guide 78. The upper end portion of this housing is reduced in diameter to provide an annular passage 37 between it and the inner face of the reduced end extension 88 of the head. The lower end of the reduced end portion 88 is externally threaded to take into the upper end of a tubular member 27 concentric with and of larger diameter than the larger lower portion of the housing 77 whereby to form a lower continuation of the annular passage 37. An outer pump casing 28 having an external diameter equal to the maximum external diameter of the head 23 is threaded at its upper end onto the head 23 and at its lower end onto the standing valve barrel 47, see Figure 5, which mounts in its axial production inlet bore the usual standing valve 46. The packer 3 is attached to the lower end of the standing valve barrel.

The housing 77, tube 27 and casing 28 are in concentric spaced relation, providing an annular passage 37 between the housing 77 and tube 27, and an annular passage 26 between the tube 27 and the casing 28.

With reference to the lower part of Figure 3 and the upper part of Figure 4, it is shown that the lower end of the inner tubular housing 77 threads onto a reducer 79 into which is threaded the upper end of a tube 49 which at its lower end threads into an upper extension 89 of a bottom head 30. The lower end of the tube 27 has a sliding fit over a correspondingly reduced portion of the head 30 and abuts an annular stop shoulder 90 on the head. In the assembly of the pump the lower end of the tube 27 is welded to the head where it abuts the shoulder 90.

Concentrically nested within the tube 49 and slidable axially thereof is a tube 53 whose lower end has threaded thereon a stop bushing 67 which plays axially within the bore 50 provided in the upper extension 89 of the head 30. This bore 50 constitutes a production outlet chamber which opens to the exterior of the pump casing 28 through a pair of diametrically arranged outlet ports 12 leading through hollow bushings 91 (Fig. 11) threaded radially into the body of the head and welded at their outer ends to the casing 28 which is countersunk at the points of weld. These bushings 91 provide the means by which the head 30 is fixed within and to the pump casing 28.

The head 30 is further provided with a reduced lower end extension 92 to which is threaded the upper end of a cylinder 31 attached at its bottom to a bottom pump head 43. The head 43 is axially bored to receive slidably therethrough the lower hollow tubular plunger 35 which is attached to a piston 33 and which communicates through the piston with a diametrically smaller upper hollow tubular plunger 34 also rigidly attached to the piston. Suitable packing 93 is provided in the head 43 to prevent leakage from the cylinder along the plunger 35, and similar packing 94 is provided in the head 30 to prevent leakage from the cylinder along the plunger 34. The lower end of the plunger 35 carries the traveling valve comprising a ball 44 and seat 45, which plunger and valve work within the working bar-

rel 48. The head 103 of the working barrel has a sealing fit against a tapered seat 80 located in the upper end of part 47 and as a further precaution against leakage a packing cup 81 is provided as shown in Figure 5. The piston 33 is provided with expansion rings 42. As all production contains sand and other foreign material which tends to pack in the well casing, and as the production outlet ports 12 are some distance above the packer 3, a packing cup 82 is fitted to the outer face of the pump casing 28 between it and the well casing 2 immediately below the ports 12, so that the moving stream of production issuing from the ports will prevent settling of sand and foreign matter on the the packer. Settling and packing of this sand, or other matter, in the annular space between the wall of the well casing 2 and the body of the pump 1, in the distance between the production ports 12 and the upper end of the packer 3 might cause difficulty in removing the packer when the pump and packer assembly is to be removed from the well. Since there is no movement of the liquid in this area during the operation of the pump, any material of greater density than the production issuing from the production ports would, unless checked, be free to settle and pack above the packer 3. The motion of the production, or operating liquid, above packing 82, will prevent such packing of sand, or other material, above the production ports 12.

The head 30, see Figure 11, is provided with a radially disposed series of axially extending passages 36 which constitute continuations of the annular passage 37 between the housing 77 with its tube 49 and the tubular member 27. Also, external channels 29 are formed in the outer face of the head as continuations of the annular passage between the tubular member 27 and the pump casing 28. Ports 32 are provided in the lower end of the cylinder 31.

The upper plunger 34 has attached to its top a radially slotted head 51 which, in the rising travel of the plunger, contacts an abutment 52 fixedly secured in and to the tube 53. The head 51 is axially bored in communication with its radial slots so that the production liquid may be discharged from the plunger into the space 95 between the plunger and tube, which space communicates with the bore 50 in the head 30 leading to the production discharge ports 12.

The reversing valve 16 is operated with a snap action and the means for effecting this operation will now be described. This means consists of an extension 56 attached to the lower valve stem 35 and which reciprocates axially through a bore provided in a stationary bushing 60 having a threaded attachment with the inner face of the housing 77 at the upper end of its larger lower half. As the housing 77 is secured to the head 23 its follows that the bushing 60 will remain stationary. In the zone of the bushing 60 the stem extension 56 is reduced at axially spaced portions 96 and 97 to provide therebetween an annular abutment shoulder 57. Shoulder engaging detents are provided as a means for latching the reversing valve in either its uppermost or lowermost position. These detents comprise an upper pair of diametrically opposed dogs 58 and a similar lower pair 59 arranged at right angles to the upper pair. Each dog plays in a radial housing slot provided therefor in the bushing 60 and is normally urged inwardly by tension of a leaf spring 61 compressed between the outer end of the dog and the wall of the housing 77. Each dog is formed intermediate its ends with a reduced shank, 98 and 99 respectively, which slidably engage in axially extending slots 63 provided in a tubular extension 62 attached to the upper end of the tube 53 and moving therewith as the tube is lifted and lowered.

At its upper end the extension 62 carries an hour glass cam 100 having a bottom riser 64 and a top riser 65 with an intermediate dwell. The top riser 65 acts on the downward movement of the cam to engage behind the outer end portion of each dog 59 to retract these dogs from the path of travel of the valve stem abutment shoulder 57, and in order that during the upstroke of the cam its bottom riser shall not influence the dogs 59 the bottom riser 64 is cut away adjacent each dog 59 to provide a planal dwell 101 as an axial continuation of the dwell 100. In a similar manner the bottom riser 64 acts on the upward stroke of the cam to retract the dogs 58. In order that the top riser 65 shall not influence the dogs 58 during the downstroke of the cam the top riser is cut away adjacent each dog 58 to provide a planal dwell 102 as an axial continuation of the dwell 100. The planal dwells 101 and 102 are disposed in relative right angular relationship on opposite ends of the cam.

Between the abutment 52 which is rigidly attached to the tube 53 and the extension 62 which is also attached to the tube 53 but which is axially slidable over the valve stem extension 56, the stem extension has affixed thereto an annular abutment 55 which provides a seat for one end of an expansion spring 54 coiled about the stem extension and bearing at its other end against the tube carried abutment 52. The abutment 55 also provides a seat for the lower end of an expansion spring 68 coiled about the stem extension and bearing at its upper end against the lower end of the tube extension 62. These springs in conjunction with the dogs 58 and 59 effect the requisite snap action of the reversing valve, as will be described.

The operation of the pump will now be explained, having particular reference to Figures 2, 3, 4, and 5 in which the arrows indicate the relative directional flow of the pump operating fluid and the production liquid.

In the position of the parts as shown in Figurges 3, 4, and 5 and in full lines in Figure 2 the pump is at the end of its upstroke just prior to reversal of the valve 16 to the dotted line position of Figure 2. Operating fluid is supplied under pressure from the surface pump 7 down through the well tubing 4 entering the pump 1 through the connecting bushing 76 above the head 15. The fluid pressure maintains the check valves 73 closed. The fluid passes down through the passages 14 to the inlet chamber 13 and as the valve 16 is closed against its lower seat 17 the fluid rises through the bore 20 and radial bores 21 to the passages 22, traveling down through these passages to the annular space 25 at the upper end of the head 23.

From the space 25 the fluid passes down through the passages 24 into the annular space 26 between the outer pump casing 28 and the inner tube 27 and continues down through the channels 29 of the head 30, see Figures 4 and 11, entering the casing below the head and filling it around the cylinder 31 and the working barrel 48.

From the lower portion of the pump casing interior the fluid enters the cylinder 31 through

the ports 32 beneath the piston 33 forcing the piston upwardly and thereby lifting with the piston the upper and lower plungers 34 and 35.

During the up-stroke, it should be explained, the valve 16 is latched in its closed position against the seat 17 by reason of the fact that the dogs 58 are projected into the reduced portion 96 of the valve stem extension over the shoulder 57, preventing any rise of the valve stem.

As the piston rises the plunger 34 moves upwardly and near the end of the up-stroke the plunger head 51 contacts the abutment 52 which is fixed in the tube 53. Continued upward movement of the plunger thus correspondingly elevates the tube 53 and its extension 62 carrying the dog release cam 100. During this upward movement the spring 54 is compressed beneath the valve stem abutment 55. The cam slots 63 permit the cam to ride up over the shanks 98 of the dogs 58 without influencing the dogs until the bottom riser 64 of the cam engages behind the outer ends of the dogs and retracts them radially, releasing them from engagement with the valve stem shoulder 57. This release is timed to occur at the end of the pump upstroke, and immediately upon release of the dogs the compressed spring 54 expands and snaps the valve stem upwardly, forcing the reversing valve 16 against its upper seat 66.

When this snap action reversal of the valve 16 takes place the upper valve 18 is opened and the lower valve 40 is closed against its seat 41. At the same time the cross-head 70 rises in the bore 71 to engage the detent 69 against its lower face to hold the valves in their respective positions.

During upward movement of the piston 33 the operating fluid in the cylinder above the piston is elevated through the passages 36 of the head 30 and through the annular passage 37 between the tube 49 and the tube 27 upwardly over the outer face of the housing 77 and through the passage 38 of the head 23 into the chamber 39. From chamber 39 the fluid passes down around the valve stem 85 into the outlet chamber 87 and through the discharge ports 10 into the well casing 2 where it mingles with the rising production liquid and is carried to the well head.

The production liquid entering the pump through the standing valve 46 fills the plungers 34 and 35 and is elevated with these plungers, the traveling valve 44 being closed on the upstroke. As the plunger 34 rises on the pump upstroke the production liquid beneath the abutment 52, which is a partition extending entirely across the bore of the tube 53, is displaced from the passage 95 between the plunger and tube and from the bore 50 of the head 30, see Figure 4, discharging from the pump through the outlet ports 12 into the well casing immediately above the packer 82, whereupon it is lifted to the well head as the pump continues to operate and is discharged together with the operating fluid through the lead off 6.

The reversal of valve 16 at the end of the upstroke immediately effects commencement of the downstroke without interruption to the flow of operating fluid to the pump. In its reversed position as shown in dotted lines in Figure 2 the valve 16 is closed against its upper seat 66, the upper valve 18 is opened, the lower valve 40 is closed against its seat 41, and the lower dogs 59 of the latch mechanism will be projected into the reduced portion 97 of the valve stem extension 56 to engage beneath the stem extension shoulder 57 and thus latch the valve stem in its reversed position.

The flow of operating fluid on the downstroke of the pump is the reverse of its flow on the upstroke. On the downstroke the fluid entering the chamber 13 in the head 15 is shifted by the closing of valve 16 against its upper seat so that it passes down through the bore 86 in the head 23 to chamber 39 thence down through the passages 38 to the annular passage 37 and down to the head 30. It passes down through the passages 36 in the head 30 and issues against the upper face of the piston 33, forcing the piston down in the cylinder 31 and carrying down the plungers 34 and 35.

Operating fluid on the discharge side of the piston is expelled from the cylinder 31 through the ports 32 and rises through the outer channels 29 of the head 30, up through the annular passage 26 between the tubular member 27 and the pump casing 28, through the passages 24 of the head 23 to the annular space 25 at the upper end of this head. From the space 25 the fluid passes up through the passages 22 in the head 15, through the radial bores 21 to the axial bore 20 and up through the open upper valve 18 to the outlet chamber 83 from which it discharges into the well casing through the ports 11.

On the down stroke of the piston the standing valve 46 is closed and the traveling valve 44 is held open whereby the production liquid trapped in the working barrel is forced into the lower plunger 35 to displace its contained production into the upper plunger 34 from which the production therein is in turn displaced through the radially slotted head 51 on its upper end into the space 95 beneath the partition 52 into the bore 50 of the head 30 and out through the discharge ports 12 to the interior of the well casing. As the cross-sectional area of the lower plunger is greater than that of the upper the capacity of the lower plunger exceeds that of the upper. In consequence, during the entire down stroke of the upper plunger the volume of production discharged from its upper end will exceed the volume of its capacity, and the rate of production discharge from the ports 12 will be approximately equal and continuous through both strokes of the pump.

As the upper plunger 34 moves down its head 51 contacts the stop bushing 67, see Figure 4, on the lower end of the movable tube 53 and pulls down this tube to compress the spring 68, Figure 3, against the valve stem abutment 55. As the plunger moves to the limit of its downstroke the extension 62, moving down with the tube 53, will move the top riser 65 of the cam 100 into engagement with the dogs 59 whereby to retract these dogs radially from their holding engagement with the valve stem shoulder 57. Immediately on release of the dogs 59 the expansion of spring 68 snaps the valve stem and valves to reverse position wherein they assume their positions as shown in full lines in Figures 2 and 3 and the upstroke of the pump begins.

The cycle of operations as described is automatically repeated and continued as long as operating fluid is supplied to the pump. The pressure of the operating fluid should be as high as is practicable with regard to the mechanical construction of the pump and the capacity of the well tubing 4. In a pump of the character disclosed herein the ratio between the volume of operating fluid used and the volume of the production varies inversely as the ratio between

the net pressure of the operating fluid and the static pressure in the well. In consequence, a pump designed to use low pressure operating fluid will require a greater volume of the fluid for a given volume of production than will a pump which is designed to use high pressure operating fluid. Conversely, proportioning the piston and plunger areas for the use of high pressure fluid will reduce the volume of operating fluid required for a given volume of production.

In very deep wells, where the operating fluid must travel a great distance through the tubing the friction loss, or drop in pressure, of the fluid in passing through the tubing is an important factor in determining the overall efficiency of the pump. As the drop in pressure due to the friction varies as the square of the velocity, it is evident that decreasing the volume of operating fluid required will decrease the velocity, and in consequence reduce the friction loss. In the performance of a given amount of work, if the volume is decreased the pressure must be increased.

In the practice of the invention the relations between the pressures and volumes of the operating fluid and the production will be determined before the pump is built, and the areas of the piston and plungers will be proportioned accordingly.

As a rule, the cross sectional area of the lower plunger will be approximately twice that of the upper, although in cases where considerable production pressure exists this ratio of areas may be varied depending upon the intensity of the production pressure. By varying the cross sectional areas of the plungers to correspond with the production pressure and the static head in the well, the pressure of the operating fluid on the up and down strokes may be equalized, thereby eliminating load fluctuations on the surface pump.

Also, the relation between the effective area of the piston and the plungers may be varied for different installations. In deep wells, where the static pressure against which the pump must operate is high, the area of the plungers will be small with relation to the effective area of the piston. In shallow wells the plunger areas can be made much larger with relation to the piston area.

A feature to be noted in the valve and seat arrangement is that the intake valve **16** is of larger diameter than the exhaust valves **18** and **40**. The object of this construction may be explained by reference to Figure 2, this description having particular reference to the valve positions shown by full lines. In this view, the valves **16** and **18** are seated on the seats **17** and **19** respectively, with the high pressure working fluid between the two valves. As the area of the valve **16** is greater than the area of the valve **18**, it is clear that the pressure of the working fluid will hold the valves against their seats, the force with which they are held in this position depending upon the difference in the valve areas.

While the pump is being run into the well casing, the casing is full of liquid, or partly so, and the tubing **4** is dry. Thus, as the pump is lowered into the well a high static pressure will be encountered acting inwardly through the exhaust ports **10** and **11**. The static pressure in the well as the pump is being lowered will then act on the large area of the valve **16** and the smaller area of whichever of the discharge valves **18** or **40** is seated. The pressure acting thus on the unbalanced valve areas will tend to raise the valves from their seats, permitting small leaks between the valves and their seats. Since the fluid in the well casing invariably contains sand or other abrasive materials, the valve seats and valves might be damaged by these leaks. In order to eliminate this objectionable condition the ball checks **73** are provided in the plug **72** which is inserted in the head **15** in the top of the bore **71**. The cross-head **70** has a series of holes **74** therethrough establishing communication with the discharge ports **11**. Any pressure exceeding the pressure in the tubing **4** will be relieved through the ports **11**, cross-head **70** and check valves **73** into the tubing **4** and the possibility of cutting the valves and seats during lowering of the pump will be eliminated.

Having thus described the invention, what is claimed is:

1. A fluid pressure operable pump for wells, comprising a cylindrical casing adapted to be supported on the lower end of a well tubing, a head on the upper end of said casing, said head having an axial bore, a valve stem guided in said head for reciprocal movement in the bore, a fluid pressure inlet chamber in said head and open at opposite sides to said bore, an inlet control valve on said stem in the chamber and movable with the stem to cut off the bore at either side of the chamber, a pasasge in said head for supplying a fluid pressure medium to said chamber, a piston reciprocal axially within said casing, a pressure medium passage leading from said bore at one side of the inlet valve to one side of the piston, a pressure medium passage leading from the bore at the other side of the valve to the other side of the piston, liquid elevating means carried by said piston and operable axially within said casing, and means carried by said liquid elevating means for engaging said valve stem to reverse said valve at each reciprocal limit of the piston.

2. In a fluid pressure operable well pump, a casing, a liquid lift member reciprocable therein, fluid pressure actuated means in the casing for reciprocating said lift member, means for supplying an operating fluid under pressure to the casing, a reversible valve in said casing for reversing the direction of flow of the operating fluid through the casing to the lift member reciprocating means, a stem on said valve, a tubular member slidable axially over said stem and having an abutment, an abutment on said stem, an expansion spring coiled on the valve stem within said tubular member and compressible between said abutments in one direction of movement of the tubular member, means on said lift member engageable with said tubular member to move the latter during reciprocation of the lift member, a latch carried by a stationary part of the pump and normally holding the valve stem against movement, and latch releasing cam means carried by said tubular member for releasing the latch at the reciprocal limits of said lift member.

3. A fluid pressure operable pump for wells, comprising in combination with a well casing, a cylindrical pump casing disposed therein, a cylindrical head at the upper end of the pump casing, a cylindrical head at the bottom thereof, a cylinder disposed axially in the lower portion of the pump casing, a piston reciprocable in the cylinder, a hollow tubular upper plunger carried by said piston and reciprocable through the upper end of the cylinder, a larger hollow tubu-

lar plunger carried by the piston and reciprocable through the lower end of the cylinder, a liquid inlet valve in the lower end of said lower plunger, said plungers being in communication through the piston, said head at the upper end of the pump casing having a central axial bore, means for supplying an operating fluid under pressure to said head, a reversible valve having a stem axially reciprocable in the head bore, said head and pump casing having fluid pressure supply and exhaust passages leading to opposite ends of said cylinder, an axial extension on said valve stem at the lower end thereof, a tubular member slidably engaging over both said valve stem extension and the upper plunger, a resilient operating connection between the stem extension and tubular member, cooperating means on said tubular member and upper plunger for reciprocating said tubular member in accordance with reciprocation of the plunger, whereby through said resilient connection the valve stem extension is shifted to effect a reversal of said valve at each reciprocal limit of the piston, and a discharge passage for liquid issuing from said upper plunger, said passage opening at the exterior of the pump casing into the well casing.

4. The structure of claim 3, including a packing ring disposed between said pump casing and well casing immediately below the liquid discharge opening through the pump casing.

5. The structure of claim 3, a barrel attached to the bottom head of the pump casing in axial alignment with said lower plunger, and a standing valve in said barrel.

6. In a fluid pressure operable well pump having a reversible fluid pressure inlet control valve, and a liquid lift member reciprocable by reversed application of fluid pressure controlled by the valve; a bushing carried by a stationary part of the pump, said valve having a stem extension slidable through said bushing and having an abutment thereon adjacent the bushing, spring pressed detents carried by said bushing and normally urged into the path of said stem abutment to restrain said stem and valve against axial movement, a tubular member slidable axially over the stem extension, means on said lift member for reciprocating said tubular member, said tubular member being longitudinally slotted to ride freely over said detents during a portion of its reciprocating travel, and cam risers on said member engageable with said detents to retract same at the reciprocal limits of travel of the tubular member.

7. In a fluid pressure operable well pump, a casing, liquid lift means including a fluid motor reciprocable therein, means for supplying an operating fluid under pressure to the motor to operate said lift means, a fluid pressure distributor head on said casing for distributing fluid for the operation of said lift means and having an interior inlet chamber for the operating fluid, a distribution conduit leading from the upper part of said chamber, a distribution conduit leading from the bottom part of the chamber, a reversing valve in said chamber operable to one position to close the upper conduit and to another position to close the lower conduit, a chamber above said inlet chamber and having a discharge outlet to the casing exterior, a chamber below said inlet chamber and having a discharge outlet to the casing exterior, said upper conduit from the inlet chamber communicating with said upper discharge chamber, a fluid passage leading from said upper conduit to one end of said fluid motor, said lower conduit from the inlet chamber communicating with the lower discharge chamber, a fluid passage leading from said lower conduit to the other end of said fluid motor, a stem on said reversing valve disposed through both said conduits, an upper valve on said stem closing off the upper discharge chamber when the reversing valve closes off the lower conduit, and a lower valve on said stem closing off said lower discharge chamber when the reversing valve closes off the upper conduit, and means operable on the valve stem to reverse the position of said valve at each limit of the reciprocal movement of said liquid lift means.

8. In a fluid pressure operable well pump, a casing, liquid lift means reciprocable therein, means for supplying an operating fluid under pressure to the casing for reciprocating the lift means, a fluid pressure distributing head assembly on said casing and having an inlet chamber for the operating fluid, an upper discharge chamber above the inlet chamber and open to the casing exterior, a lower discharge chamber below the inlet chamber and open to the casing exterior, said head assembly having an axial bore connecting all said chambers, a pressure fluid conduit leading from the upper part of said bore between the inlet and upper discharge chamber to a working element of the lift means, a pressure fluid conduit leading from the lower part of the bore between the inlet and lower discharge chambers to a working element of the lift means, a control valve in the inlet chamber movable in one direction to close off the lower part of the bore, a stem on said valve and disposed through both parts of said bore, an upper valve on said stem closing off the upper discharge chamber, a lower valve on said stem closing off the lower discharge chamber when the control valve closes off the upper part of said bore, and means for shifting the valve stem to reverse the valves at each limit of the reciprocal movement of said liquid lift means.

9. In a fluid pressure operable well pump, a casing, liquid lift means including a fluid motor reciprocable therein, means for supplying an operating fluid under pressure to the motor, a fluid pressure distributing head on said casing for distributing fluid for the operation of said lift means and having an interior inlet chamber for the operating fluid, a distribution conduit leading from the upper part of said chamber, a fluid passage between said upper conduit and one end of the fluid motor, a distribution conduit leading from the bottom part of said chamber, a fluid passage between said bottom conduit and the other end of the fluid motor, a reversing valve in said chamber operable to one position to close the upper conduit and to another position to close the lower conduit, a chamber above said inlet chamber and having a discharge outlet to the casing exterior, a chamber below said inlet chamber and having a discharge outlet to the casing exterior, said upper conduit from the inlet chamber communicating with said upper discharge chamber, said lower conduit from the inlet chamber communicating with the lower discharge chamber, a stem on said reversing valve disposed through both said conduits, an upper valve on said stem closing off the upper discharge chamber when the reversing valve closes off the lower conduit, a lower valve on said stem closing off said lower dis-

charge chamber when the reversing valve closes off the upper conduit, and said reversing valve being of a greater effective area than either the upper or lower valve.

10. In a fluid pressure operable well pump, a casing, liquid lift means reciprocable therein, means for supplying an operating fluid under pressure to the casing for reciprocating the lift means, a fluid pressure distributing head assembly on said casing and having an inlet chamber for the operating fluid, an upper discharge chamber above the inlet chamber and open to the casing exterior, a lower discharge chamber below the inlet chamber and open to the casing exterior, said head assembly having an axial bore connecting all said chambers, a pressure fluid conduit leading from said bore between the inlet chamber and the upper discharge chamber to a working element of the lift means, a pressure fluid conduit leading from said bore between the inlet chamber and lower discharge chamber to a working element of the lift means, a disc shaped control valve in the inlet chamber movable in one direction to close off the bore below the inlet chamber, a stem on said control valve and extending above and below the valve axially in said bore, said control valve being movable in an opposite direction to close off the bore above the inlet chamber, an upper disc valve arranged on said stem to close off the upper discharge chamber when the control valve closes the bore below the inlet chamber, a lower disc valve arranged on said stem to close off the lower discharge chamber when the control valve closes the bore above the inlet chamber, and the area of said control valve being geater than the area of the upper valve and greater than the area of the lower valve, whereby the differences in pressure of operating fluid against the valve disc faces retains the valves tightly closed when moved to their limits.

11. In a fluid pressure operable well pump, a pump casing, a cylinder supported therein, a piston reciprocable in said cylinder, a hollow tubular plunger secured in said piston and having portions communicating directly through the piston and extending from opposite sides thereof, liquid inlet valve means in one portion and that one portion having a capacity greater than the other, said other portion having a liquid outlet open to the casing interior, an outlet for liquid in a wall of the casing, and means operable by the plunger for supplying a fluid pressure medium alternately to opposite sides of the piston to reciprocate the plunger.

12. In a fluid pressure operable well pump, a casing, liquid lift means including a fluid motor reciprocable therein, means for supplying an operating fluid under pressure to the motor to operate said lift means, a fluid pressure distributor head on said casing for distributing fluid for the operation of said lift means and having an interior chamber for the operating fluid, a distribution conduit leading from the upper part of said chamber, a fluid passage between said upper conduit and one end of the fluid motor, a distribution conduit leading from the bottom part of said chamber, a fluid passage between said bottom conduit and the other end of the fluid motor, a reversing valve in said chamber operable to one position to close the upper conduit and to another position to close the lower conduit, a chamber below said inlet chamber and having a discharge outlet to the casing exterior, said lower conduit from the inlet chamber communicating with the lower discharge chamber, a chamber above said inlet chamber and having a discharge outlet to the casing exterior, said upper conduit from the inlet chamber communicating with said upper discharge chamber, said head being bored above said upper chamber in continuation thereof, a stem on said reversing valve disposed through all of said conduits, chambers and bore, an upper valve on said stem closing off the upper discharge chamber when the reversing valve closes off the lower conduit, a lower valve on said stem closing off said lower discharge chamber when the reversing valve closes off the upper conduit, means operable on the valve stem to reverse the position of said valves at each limit of the reciprocal movement of said liquid lift means, a cross-head on said stem and guided in the bore above said upper chamber, and detent means in a wall of said bore engaging said cross-head to latch same in either reciprocal limit position of the stem.

13. The structure of claim 12, and pressure relief valve means opening from said bore to the exterior of said head above the cross-head.

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