

Dec. 9, 1952

C. J. COBERLY

2,620,739

FLUID OPERATED PUMP HEAD

Filed Jan. 2, 1948

2 SHEETS—SHEET 1

Fig. 1.

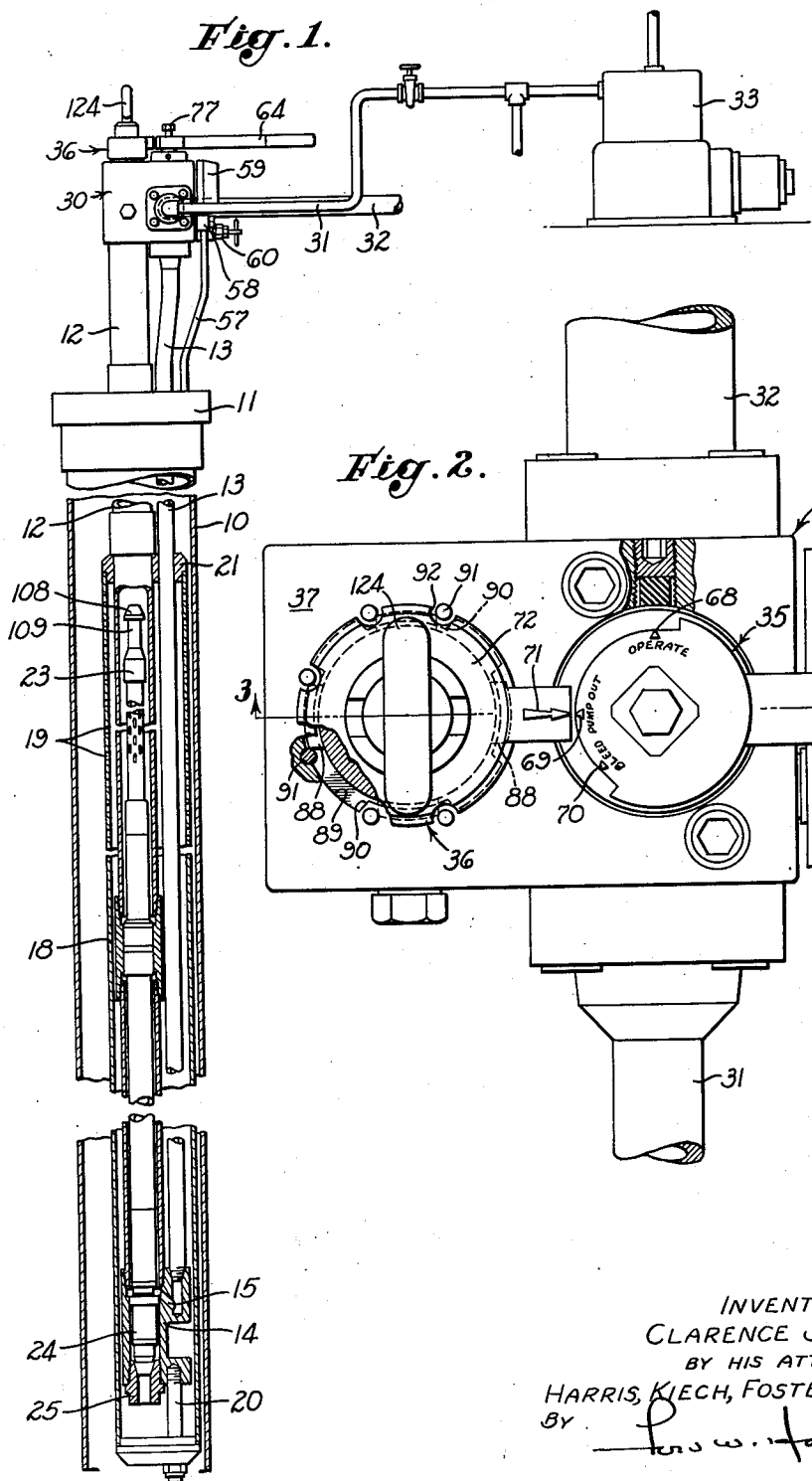
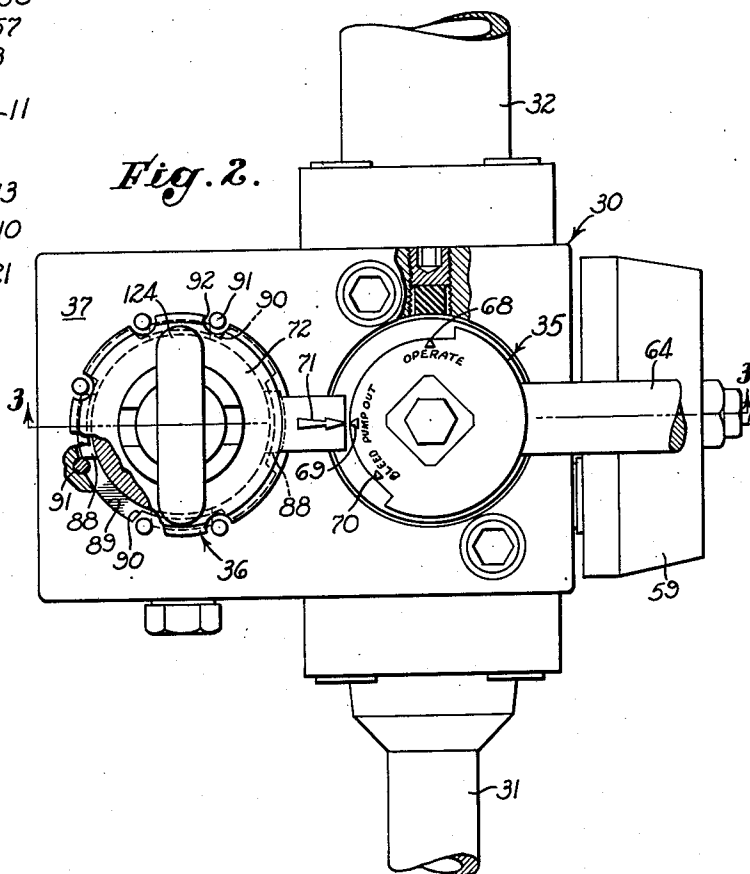


Fig. 2.



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BY *[Signature]*

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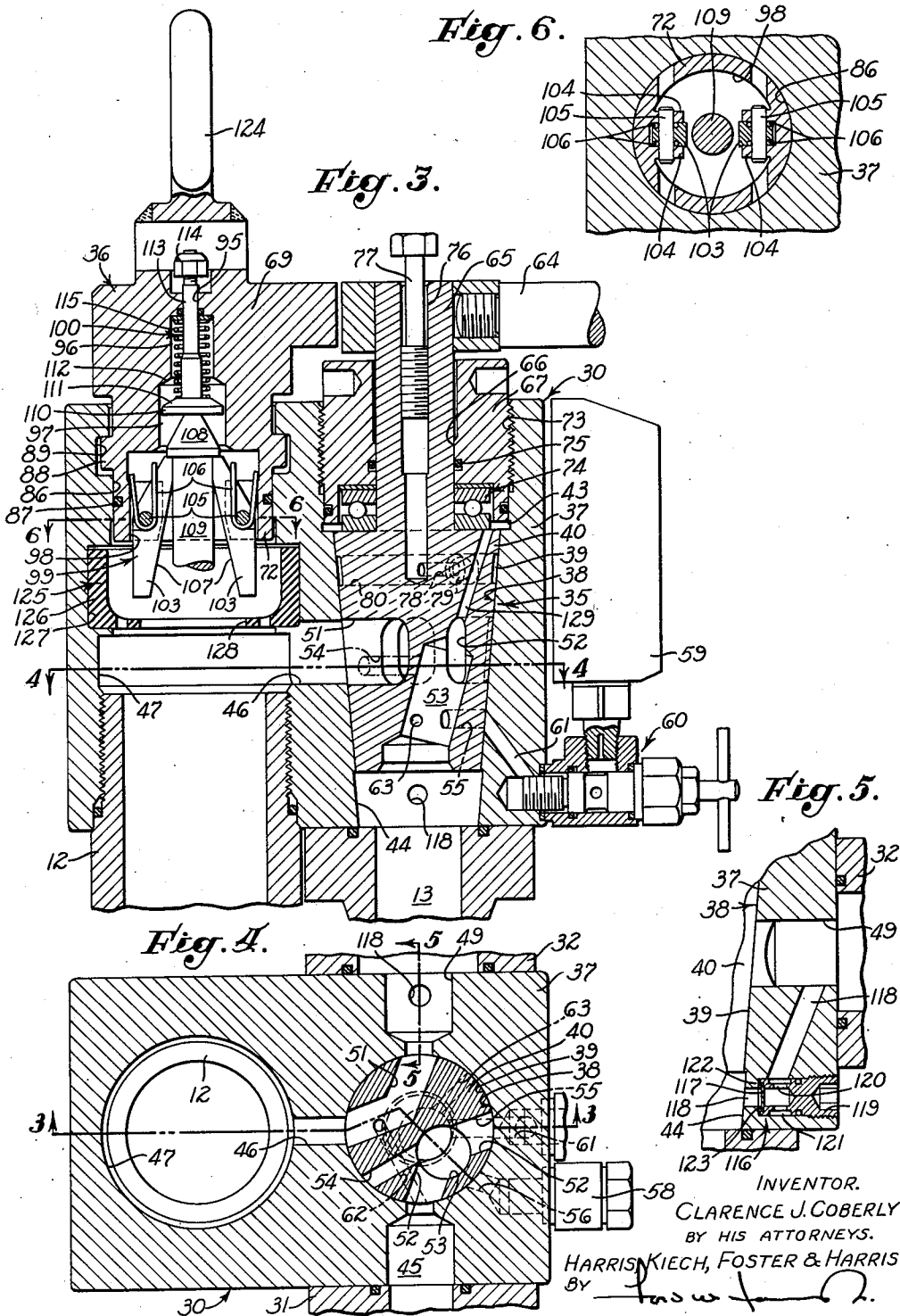
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2 SHEETS—SHEET 2



UNITED STATES PATENT OFFICE

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FLUID OPERATED PUMP HEAD

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Ohio

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12 Claims. (Cl. 103—228)

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My invention relates in general to apparatus for pumping fluids such as oil from wells and finds particular utility in installations in which free pumps of the fluid operated type are employed. For convenience in disclosing the invention, I prefer to consider such an installation herein, although it will be understood that the invention may in many instances be profitably incorporated in other installations.

Examples of installations incorporating free pumps of the fluid operated type may be found in my Patent No. 2,230,830 entitled "Deep Well Pump and Method of Installing and Removing the Same," issued February 4, 1941, and in my Patent No. 2,338,903, entitled "Fluid Operated Pump Assembly," issued January 11, 1944. In such installations two tubings are set in the well, either side-by-side, or with one tubing disposed within the other, and are interconnected at their lower ends to provide fluid communication therebetween. One of the tubings, hereinafter referred to as the first tubing, contains a fluid operated pump which is movable to and from an operating position at the lower end thereof, means being provided for admitting well fluid to the intake of the pump. The pump is operated by a clean fluid, such as oil, which is delivered thereto through the first tubing. The oil or other well fluid delivered by the pump enters the second tubing and flows upwardly therein to the surface and thence to a suitable point of discharge or storage.

Whenever it is necessary to remove such a free pump from the well for replacement or repair, this may be accomplished by reversing the flow of fluid through the system, i. e., by pumping fluid downwardly through the second tubing so that such fluid enters the first tubing and moves upwardly therein to move the pump to the surface. The pump may then be removed from the first tubing for repair, or may be removed and replaced by another pump of similar design.

A primary object of the present invention is to provide a pump head for use with an installation of the foregoing nature having improved valve means for controlling the flow of operating fluid and well fluid. More particularly, it is an object of the invention to provide a four-way selector valve, preferably of the tapered plug type, which, in one of its operating positions, conveys operating fluid from an inlet line into the first tubing and well fluid from the second tubing into an outlet line, and which, in another of its operating positions, is adapted to convey operating fluid from the inlet line to the second tubing and fluid from the first tubing into the outlet line.

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An important object of the invention is to provide a valve of this nature which is adapted to utilize the fluid flowing therethrough to keep it free in its seat so that it will not stick if it remains in one position for a protracted period of time.

More particularly, it is an object of my invention to provide a valve wherein the smaller end of the tapered plug is exposed to fluid pressure in the system so that such fluid pressure tends to unseat the plug.

Another object is to provide a valve wherein a portion of the larger end of the tapered plug is also exposed to fluid pressure in the system, the areas of the two ends of the plug which are exposed to such pressure being so related that a force tending to unseat the plug exists at all times.

Still another object of the invention is to provide means for relieving the fluid pressure in the first tubing above the pump prior to removal of the pump so as to prevent a "wet job" when pulling the pump. An important object in this connection is to provide an installation wherein this may be accomplished merely by rotating the tapered plug to a third operating position. More particularly, it is an object to provide a valve wherein the tapered plug, when rotated into its third operating position, vents the first tubing, and preferably also the second tubing, to atmospheric pressure.

A further object is to provide a pump head having wiping means therein for removing any fluid adhering to the pump as it is removed from the first tubing.

Another object is to provide pressure relieving means which permits fluid in the second tubing to escape into the outlet line in the event that the pressure in the second tubing rises above a predetermined value for any reason so as to prevent damage to the installation.

A further object is to provide means for measuring the operating fluid pressure in the system for any position of the selector valve.

Still another important object of my invention is to provide a pump head having improved pump catcher means associated therewith for receiving and retaining the pump when it is moved upwardly through the first tubing to the surface. A related object is to provide a pump head wherein the pump catcher means is readily detachable so that the pump may be removed readily with a minimum expenditure of time and effort.

An additional object is to provide a pump catcher means which includes yieldable means

for decelerating the pump as it reaches the upper end of the first tubing so as to avoid the development of any shock forces. An important object in this connection is to provide such a pump catcher means wherein the yieldable means comprises hydraulic means capable of offering increasing resistance to upward movement of the pump through the first tubing as it is being decelerated.

A further object is to provide an apparatus wherein the aforesaid valve means and pump catcher means are incorporated in a pump head which is adapted to be connected to the upper ends of the first and second tubings.

The foregoing objects of my invention and the advantages suggested thereby, together with other objects and advantages which will be evident hereinafter, may be attained through the employment of the exemplary embodiment which is illustrated in the accompanying drawings and which is described in detail hereinafter.

Referring to the drawings, which are for illustrative purposes only:

Fig. 1 is a view on a reduced scale showing a pumping apparatus which embodies the fundamental principles of my invention as installed in a well;

Fig. 2 is a plan view of a pump head forming part of the pumping apparatus shown in Fig. 1;

Fig. 3 is a sectional view taken generally along the broken line 3—3 of Fig. 2 and, more particularly, along the irregular broken line 3—3 of Fig. 4;

Fig. 4 is a sectional view which is taken along the broken line 4—4 of Fig. 3;

Fig. 5 is an enlarged fragmentary sectional view which is taken along the broken line 5—5 of Fig. 4; and

Fig. 6 is a fragmentary sectional view taken along the broken line 6—6 of Fig. 3.

Referring particularly to Fig. 1 of the drawings, I show a well casing 10 set in an oil well in the usual manner, the interior of the casing being open to an oil producing zone of the well so that oil and other fluids from such zone may enter the casing as is well known in the art. The upper end of the well casing 10 is provided with a casing head 11 from which a pump tubing 12 and an auxiliary tubing 13 depend, the tubings 12 and 13, which are referred to hereinafter as the first and second tubings, respectively, for convenience, being composed of a plurality of tubing sections as is the usual practice and being connected to the casing head 11 in any suitable manner well known in the art.

The lower ends of the first and second tubings 12 and 13 are interconnected by a foot member 14 having a passage 15 therethrough which provides fluid communication between the two tubings. The lower ends of the tubings 12 and 13 and the foot member 14 are enclosed by a gas anchor device 18 having perforations 19 therein through which well fluid may enter from the casing 10, the gas anchor device being suitably secured to the foot member, as by a bolt 20, and being sealed with respect to the tubings 12 and 13 as indicated at 21.

Disposed in the first tubing 12 is a free pump 23 of the fluid operated type, the dimensions of the pump being such that it may move downwardly through the first tubing 12 into an operating position at the lower end thereof, as shown in Fig. 1, or upwardly from such operating position to the surface. When in its operating position, the pump 23 seats on and receives

well fluid through a check valve device 24 carried by the foot member 14, well fluid being admitted to the check valve device through a tubular inlet plug 25 secured to the foot member. It will be noted that the passage 15 interconnecting the first and second tubings 12 and 13 communicates with the first tubing at a point intermediate the pump 23 and the check valve device 24 so that any fluid flowing downwardly through the second tubing 13 acts on the lower end of the pump in an obvious manner.

Such components of the pumping apparatus as the gas anchor device 18, the pump 23 and the check valve device 24 per se form no part of the present invention and are not described in detail herein. For a detailed description of such components reference is made to the aforesaid prior Patent No. 2,338,903. For the purposes of this disclosure, it is sufficient to say that the pump 23 is operated by fluid, such as clean oil, forced downwardly through the first tubing 12 and pumps well fluid admitted by the check valve device 24 upwardly through the second tubing 13, this being the flow pattern through the components of the apparatus thus far described when the pump 23 is in operation. As will be discussed in more detail hereinafter, when removal of the pump 23 is desired for any reason, the direction of flow is reversed so that fluid flows downwardly through the second tubing 13 and upwardly through the first tubing 12 to move the pump upwardly through the first tubing to the surface.

Attached to the upper ends of the first and second tubings 12 and 13 is a pump head 30 having a supply or inlet line 31 and a discharge or outlet line 32 connected thereto, the inlet line being connected to a suitable high pressure pumping mechanism 33 for delivering operating fluid to the pump head, and the outlet line being connected to a suitable point of discharge or storage (not shown) for well fluid. As will be discussed in more detail hereinafter, the pump head 30 includes valve means 35 for controlling the flow of operating fluid and well fluid through the tubings 12 and 13, and includes pump catcher means 36 in alignment with the first tubing 12 for receiving and retaining the pump 23 when it has been moved to the upper end of the first tubing.

Considering the valve means 35 in more detail, with particular reference to Figs. 3 and 4 of the drawings, the pump head 30 includes a housing or body 37 having a frusto-conical valve chamber 38 therein, the peripheral wall 39 of the valve chamber providing a seat for a tapered valve member or plug 40. It will be noted that the axial length of the valve member 40 is somewhat less than that of the valve chamber 38 so as to provide fluid-receiving spaces 43 and 44 adjacent the larger and smaller ends, respectively, of the valve member for a purpose to be discussed in detail hereinafter.

As best shown in Fig. 4, the pumphead body 37 is provided with a port or passage 45 which connects the valve chamber 38 with the inlet line 31, and is provided with a port or passage 46 which connects the valve chamber with a chamber 47 formed in the pump head body at the upper end of the first tubing 12, the pump head body also being provided with a port or passage 49 which connects the valve chamber with the outlet line 32. The fluid-receiving space 44 adjacent the smaller end of the valve member 40 communicates with the second tubing 13 and serves as a port or passage at the smaller end of

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the valve chamber 38. It will be noted that since the ports 45, 46 and 49 are located in the peripheral wall 39 of the valve chamber 38, the fluid pressure in the second tubing 13 always acts on the smaller end of the valve member 40 and tends to keep it free with respect to the peripheral wall or seat 39, as will be discussed in more detail hereinafter.

The valve member 40 is provided with a transverse passage 51 therethrough which is adapted to connect the passages 45 and 46 when the valve member is in a first operating position so as to convey operating fluid from the inlet line 31 into the first tubing 12, and which is adapted to connect the passages 46 and 49 when the valve member is in a second operating position so as to convey fluid from the first tubing to the outlet line 32, the second operating position being shown in Fig. 4 of the drawings. The valve member 40 is provided with another transverse passage 52 therethrough which communicates with the fluid-receiving space 44 through a generally axial passage 53 in the valve member, the transverse passage 52 being adapted to register with the passage 49 when the valve member is in its first operating position so that the passages 52 and 53 convey well fluid from the second tubing 13 into the outlet line 32, and being adapted to register with the passage 45 when the valve member is in its second operating position so that the passages 52 and 53 convey operating fluid from the inlet line 31 into the second tubing 13.

The valve member 40 is also provided with a pair of generally radial passages 54 and 55 which communicate with the axial passage 53, the passage 54 being adapted to register with the passage 46 leading to the first tubing 12 when the valve member is in a third operating position, i. e., when the valve member is rotated approximately 45° in the clockwise direction from the position shown in Fig. 4 of the drawings, and the passage 55 being adapted to register with a passage 56 in the pump head body 37 when the valve member is in its third operating position. The passage 56 communicates with a bleed line 57 which is connected to the pump head body 37 by a suitable fitting 58. Although the bleed line 57 may lead to any suitable point of discharge, it preferably leads into the well casing 10 through the casing head 11 as indicated in Fig. 1. It will be apparent that when the valve member is in its third operating position, so that the passages 54 and 55 in the valve member register with the passages 46 and 56, respectively, the first and second tubings 12 and 13 are vented to substantially atmospheric pressure, i. e., the pressure in the well casing 10. It will also be noted that when the valve member 40 is in its third operating position, any communication between the first and second tubings 12 and 13 and the inlet and outlet lines 31 and 32 is shut off.

The pump head 30 is provided with a gauge 59 for indicating the pressure of the operating fluid supplied through the inlet line 31 when the valve member 40 is in its first and second positions, the pressure gauge being carried by a valve 60 which may be opened to admit fluid to the gauge whenever an inlet pressure reading is desired. The valve 60 is mounted on the pump head body 37 and communicates with one end of a passage 61 in the body 37, the other end of the passage 61 communicating with the valve chamber 38, as best shown in Fig. 3 of the drawings. When the valve member 40 is in its second operating position, i. e., the one shown in Fig. 4 of the draw-

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ings, the passage 55 in the valve member registers with the passage 61 so that the pressure of the fluid in the inlet line 31 is applied to the gauge 59 by way of the passage 45 in the pump head body 37, the passages 52, 53 and 55 in the valve member 40, the passage 61 in the pump head body, and the valve 60. The valve member 40 is also provided with a passage 62 which communicates with the passage 51 therein and which is adapted to register with the passage 61 in the pump head body 37 when the valve member is in its first operating position, i. e., when the valve member is rotated approximately 90° in the counterclockwise direction from the position shown in Fig. 4. Consequently, when the valve member 40 is in its first operating position, the pressure of the fluid in the inlet line 31 is applied to the gauge 59 by way of the passage 45 in the pump head body 37, the passages 51 and 62 in the valve member, the passage 61 in the pump head body, and the valve 60. Thus, inlet pressure readings may be obtained irrespective of whether the valve member 40 is in its first or second position, which is a feature of the invention.

The valve member 40 is also provided with a passage 63 which communicates with the passage 53 therein and which is adapted to register with the passage 61 in the pump head body 37 when the valve member is in its third operating position so that pressure readings may also be obtained when the valve member is in this position. It will be noted that since the valve member 40 connects the first and second tubings 12 and 13 to the bleed line 57 when it is in its third operating position, the pressure gauge 59 will indicate the pressure to which the first and second tubings are vented.

The valve member 40 may be rotated into any of its three operating positions by means of a handle 64 which is suitably secured to a stem 65 extending axially from the larger end of the valve member through an opening 66 in a closure member 67. As best shown in Fig. 2, the handle 64 bears indicia 68, 69 and 70 which, when brought into registry with an arrow 71 carried by a cap member 72, indicate the first, second and third operating positions, respectively, of the valve member.

The closure member 67 is shown as being threaded into a counterbore 73 in the pump head body 37 and serves to retain the valve member 40 in the valve chamber 38, the closure member being separated from the valve member by a ball bearing assembly 74 which encircles the stem 65 of the valve member and is seated against the larger end thereof. The purpose of the ball bearing assembly 74 is to minimize frictional resistance to rotation of the valve member 40. A fluid-tight seal between the stem 65 of the valve member 40 and the closure member 67 is provided by an annular sealing ring 75 which encircles the stem 65 and is disposed in an annular groove in the closure member.

I prefer to provide means for lubricating the valve member 40 and, with this end in view, the stem 65 of the valve member is preferably tubular to provide a chamber 76 for a lubricant such as grease, for example, a screw 77, or the like, being threaded into the chamber 76 and being adapted to expel the lubricant therefrom through a passage 78 and past a ball check valve 79. The lubricant expelled past the ball check valve is distributed throughout the interface between the surface of the valve member 40 and the tapered

valve seat 39 by means of an annular groove 80 formed in the valve member.

Referring now to the pump catcher means 36, as best shown in Fig. 3, the pump head body 37 is provided with a bore 86 therein which is in axial alignment with the first tubing 12, and which communicates with the chamber 47 in the pump head body. The previously mentioned cap member 72 forms part of the pump catcher means 36 and is normally disposed in the bore 86, a fluid-tight seal between the cap member and the pump head body 37 being provided by an annular sealing element 87 which is formed of rubber or a similar material and which is disposed in an annular groove in the cap member. The cap member 72 is retained in the bore 86 by radial lugs 88 thereon which extend into an annular groove 89 in the pump head body 37, the lugs 88 being insertable into the annular groove 89 through longitudinally extending slots 90 in the pump head body which communicate with the annular groove. It will be apparent that the cap member 72 may be locked in place with respect to the pump head body 37 by inserting the lugs into the annular groove 89 through the longitudinally extending slots 90 and subsequently rotating the cap member so that the lugs are out of registry with the slots, as indicated in Fig. 2. In order to prevent rotation of the cap member 72 after it has been locked in this manner, dowel pins 91 may be inserted into suitable openings in the pump head body 37, the cap member being provided with notches 92 therein through which the dowel pins may be inserted. As shown in Fig. 2, each pair of dowel pins 91 receive one of the lugs 88 therebetween to prevent rotation of the cap member 72 so that it cannot become disengaged from the pump head body 37.

The cap member 72 is provided with a bore 95 and a series of counterbores 96, 97 and 98 therein, a pump catcher 99 for receiving and retaining the pump 23 being disposed in the counterbore 98, and a yieldable cushioning means 100 being disposed in the bore 95 and the counterbores 96 and 97. The pump catcher 99 includes a pair of latch elements 103 which are pivotable toward and away from each other, the latch elements being connected to lugs 104 extending into the counterbore 98 by parallel pivot pins 105, as best shown in Fig. 6. The latch elements 103 are normally urged inwardly toward each other by U-shaped springs 106 encircling the pivot pins 105 and engaging the latch elements and the wall of the counterbore 98. The adjacent surfaces 107 of the latch elements 103 converge upwardly and are adapted to be engaged by a conical head 108 on a rod 109 forming part of the pump 23 to force the latch elements apart so that the conical head may pass therebetween as the pump 23 moves upwardly through the first tubing 12 and reaches the upper end thereof. After the conical head 108 has passed between the latch elements 103, the springs 106 rotate the latch elements inwardly so that they engage the under side of the conical head to hold the pump 23.

The function of the yieldable cushioning means 100 is to decelerate the pump 23 gradually as it reaches the upper end of the first tubing 12 and as the conical head 108 on the rod 109 is received by the pump catcher 99 so as to avoid the development of shock forces. As best shown in Fig. 3, the yieldable means 100 includes a dash-pot member 110 which is movable in the counterbore 97, the diameter of the dash-pot member

being somewhat less than that of the counterbore 97 so that a clearance is provided therebetween. The upper surface of the dash-pot member 110 is tapered, as indicated at 111, and is adapted to engage a tapered seat 112 formed at the junction of the counterbores 96 and 97. The dash-pot member 110 is provided with a stem 113 which extends through the counterbore 95 and is slidable in the bore 95, a nut 114 being threaded on the stem of the dash-pot member to limit downward movement thereof. The dash-pot member 110 is normally urged downwardly by a compression spring 115 which encircles the stem 113. As will be discussed in more detail hereinafter, the dash-pot member 110 constitutes a hydraulic means for offering an increasing resistance to upward movement of the pump 23 so as to decelerate it to rest.

For convenience in considering the operation of the pumping apparatus, it will be assumed that the pump 23 is in its operating position at the lower end of the first tubing 12 as shown in Fig. 1 of the drawings. In order to operate the pump, it is necessary to rotate the valve member 40 into its first operating position by means of the handle 64, the valve member being in its first operating position when the indicium 68 on the handle registers with the arrow 71. Thus, the valve member 40 provides fluid communication between the inlet line 31 and the first tubing 12 via the passages 45, 51 and 46 and the chamber 47 so that operating fluid under pressure from the pumping mechanism 33 is delivered to the pump 23 to operate same. As previously mentioned, well fluid in the casing 10 enters the gas anchor device 18 through the perforations 19 therein and is admitted to the intake of the pump 23 through the tubular inlet plug 25 and the check valve device 24, the fluid delivered by the pump flowing through the passage 15 in the foot member 14 and into the second tubing 13. When in its first operating position, the valve member 40 provides fluid communication between the second tubing 13 and the outlet line 32 so that the fluid delivered by the pump 23 may flow from the second tubing into the outlet line via the passages 53, 52 and 49.

If removal of the pump 23 is desired for any reason, the valve member 40 may be rotated into its second operating position by moving the handle 64 until the indicium 69 thereon registers with the arrow 71. Moving the valve member 40 from its first operating position into its second operating position establishes fluid communication between the inlet line 31 and the second tubing 13 and between the first tubing 12 and the outlet line 32 so that flow through the system is reversed, operating fluid flowing from the inlet line into the second tubing by way of the passages 45, 52 and 53, and the fluid in the first tubing above the pump 23 flowing into the outlet line via the chamber 47 and the passages 46, 51 and 49.

The operating fluid flowing downwardly through the second tubing 13 when the valve member 40 is in its second operating position enters the first tubing 12 beneath the pump 23 by way of the passage 15 through the foot member 14 and tends to move the pump upwardly through the first tubing toward the surface. It will be apparent that if upward movement of the pump 23 through the first tubing 12 is prevented for any reason, for example, by sticking of the pump in its operating position at the lower end of the first tubing, or by the presence of an obstruction in the first tubing above the pump,

the pressure of the operating fluid in the pumping apparatus, and particularly in the second tubing 13, may rise to damaging proportions. In order to eliminate any possibility of damaging the pumping apparatus in the event that upward movement of the pump 23 is interrupted or prevented, a feature of the present invention is to provide pressure relieving means, indicated generally by the numeral 116 in Fig. 5 of the drawings, for by-passing the pumping apparatus by diverting the operating fluid into the outlet line 32 whenever the pressure of the operating fluid reaches a predetermined maximum value.

As best shown in Fig. 5 of the drawings, the pressure relieving means 116 includes a frangible disc 117 which is disposed in a passage 118 in the pump head body 37, the passage communicating at one end with the fluid-receiving space 44 and at its other end with the passage 49 leading to the outlet line 32. The disc 117 is designed to be ruptured whenever the pressure of the operating fluid in the second tubing 13 exceeds a predetermined value so that the operating fluid may flow from the second tubing into the outlet line 32 by way of the fluid-receiving space 44 and the passages 118 and 49, thus preventing damage to the pumping apparatus.

In the particular construction illustrated, the frangible disc 117 is retained in the proper position in the passage 118 by a member 119 having a passage 120 therethrough which registers with the passage 118, the member 119 being threaded into a bore 121 and being adapted to seat the disc against a shoulder 122 at the inner end of the bore. Preferably, an annular sealing element 123 is disposed between the disc 117 and the shoulder 122 to provide a fluid-tight seal between the disc and the pump head body 37.

As indicated, the disc 117 is designed to be ruptured only if the pressure of the operating fluid exceeds a predetermined value when excessive resistance to upward movement of the pump 23 in the first tubing 12 is encountered. Normally, the operating fluid introduced beneath the pump 23 in the manner hereinbefore described moves the pump upwardly through the first tubing 12 to the surface, the fluid in the first tubing above the pump being discharged into the outlet line 32. As the conical head 108 on the pump rod 109 enters the counterbore 98 in the pump head body 37, it passes between the latch elements 103 and engages the dash-pot member 110, the latch elements being spread apart by the conical head as it passes therebetween. The springs 106 rotate the latch elements 103 inwardly toward each other after the conical head 108 has passed therebetween so that the latch elements retain the pump 23.

The dash-pot member 110 serves to decelerate the pump 23 by virtue of the fact that fluid above the dash-pot member must escape downwardly through the clearance provided between the dash-pot member and the wall of the counterbore 97, such clearance being sufficiently small that the pump 23 is decelerated to rest. It will be noted that, to some extent, the spring 115 also serves to decelerate the pump, although the principal function of this spring is to maintain the dash-pot member 110 in its lowermost position.

In the event that the speed of upward movement of the pump 23 in the first tubing 12 is so high that the pump has not been brought to rest by the time the dash-pot member 110 approaches the upper end of its travel, the dash-pot member offers increasing resistance to movement of the

pump to complete the deceleration. Such increasing resistance results as the tapered surface 111 of the dash-pot member 110 approaches the tapered seat 112 therefor because the cross-sectional area of the passage through which fluid trapped above the dash-pot member may escape is reduced. Thus, as the dash-pot member 110 approaches the seat 112, the resistance to upward movement of the pump 23 increases rapidly to increase the rate of deceleration of the pump and bring it to rest.

After the pump 23 has been received by the pump catcher means 36 in this manner, the valve member 40 may be rotated into its third operating position by moving the handle 64 until the indicium 70 thereon registers with the arrow 71. When the valve member 40 is in its third operating position, the first tubing 12 above the pump 23 is vented to atmospheric pressure through the chamber 47, the passage 46, the bleed passage 54, the passage 53, the bleed passages 55 and 56 and the bleed line 57. Thus, the fluid pressure in the first tubing 12 above the pump 23, and incidentally the fluid pressure in the second tubing 13, is relieved so that subsequent removal of the cap member 72 in pulling the pump will not result in a surge of fluid from the pump head 30. It will be understood that the pressure relieved in this manner may result from a static head in the outlet line 32. Thus, the bleed system incorporated in the pump head 30 prevents a "wet job" in pulling the pump 23.

After the system has been bled in this manner, the pump 23 may be removed from the first tubing 12 by releasing the cap member and pulling it and the pump upwardly clear of the pump head 30, the cap member being provided with an eye 124 thereon for the reception of a suitable pulling means (not shown). In order to reduce further the amount of fluid which may be spilled in pulling the pump 23, it is a feature of the invention to provide means 125 for wiping most of the fluid from the pump 23 as it is being pulled. As best shown in Fig. 3, the wiping means 125 includes a wiping member 126 which may be formed of oil resistant rubber or other suitable material and which is seated in an annular groove 127 formed in the wall of the bore 86 in the pump head body 37. The wiping member 126 is provided with an opening 128 therethrough which is of smaller diameter than the pump 23 so that the bulk of any fluid adhering to the pump will be wiped therefrom as it is pulled through this opening.

It will be noted that in view of the presence of the fluid-receiving space 44 adjacent the smaller end of the valve member 40, this end of the valve member is always exposed to the pressure of the fluid in the second tubing 13. Although the fluid-receiving space 43 at the larger end of the valve member 40 may be vented to atmospheric or other suitable pressure if desired, I prefer to connect it to the fluid-receiving space 44 by means of a vent passage 129 in the valve member 40. In order that the force resulting from the net pressure differential across the valve member 40 will act in the proper direction to keep the valve member free in its seat 39, the diameter of the stem 65 of the valve member is such that the area of the larger end of the valve member which is exposed to fluid in the space 43 is less than the area of the smaller end of the valve member which is exposed to fluid in the space 44. Thus, since the end of the stem 65 is exposed to atmospheric pressure

and since the pressures obtaining in the spaces 43 and 44 will usually be substantially above atmospheric, the force resulting from the net pressure differential across the valve member will always act in a direction to unseat the valve member so as to minimize any tendency of the valve member to stick in its seat, which is an important feature of the invention.

Although I have disclosed an exemplary embodiment of my invention in connection with a specific pumping apparatus, it will be understood that I do not intend to be limited specifically thereto since various changes, modifications and substitutions may be incorporated in the embodiment disclosed and since various features of the invention may be incorporated in other apparatus, all without necessarily departing from the spirit of the invention. Consequently, I hereby reserve the right to the protection afforded by the full scope of the appended claims.

I claim as my invention:

1. In an apparatus of the character described, the combination of: a pump head; first and second tubings adapted to extend into a well and connected at their upper ends to said pump head; means providing fluid communication between the lower ends of said tubings; an inlet line connected to said pump head; an outlet line connected to said pump head; a bleed line connected to said pump head; and valve means associated with said pump head and movable between first, second and third operating positions, said valve means having passage means therethrough which provide fluid communication between said first tubing and said inlet line and between said outlet line and said second tubing when said valve means is in its first operating position, which provide fluid communication between said second tubing and said inlet line and between said outlet line and said first tubing when said valve means is in its second operating position, and which provide fluid communication between said bleed line and said first tubing when said valve means is in its third operating position.

2. An apparatus as set forth in claim 1 wherein said passage means provide fluid communication between said bleed line and said first tubing and between said bleed line and said second tubing when said valve means is in its third operating position.

3. In an apparatus of the character described, the combination of: a housing provided with an inlet passage, an outlet passage, first and second intermediate passages, and a bleed passage; and valve means disposed in said housing and movable between first, second and third operating positions, said valve means having passage means therethrough which connect said first intermediate passage to said inlet passage and said outlet passage to said second intermediate passage when said valve means is in its first operating position, which connect said second intermediate passage to said inlet passage and said outlet passage to said first intermediate passage when said valve means is in its second operating position, and which connect said bleed passage to said first intermediate passage when said valve means is in its third operating position.

4. In an apparatus of the character described, the combination of: a housing provided with a valve chamber therein and provided with an inlet passage, an outlet passage, first and second intermediate passages, and a bleed passage, all

of which communicate with said valve chamber; and a valve member rotatable in said valve chamber between first, second and third operating positions, said valve member having passages therein which connect and provide fluid communication between said first intermediate passage and said inlet passage and connect and provide fluid communication between said outlet passage and said second intermediate passage when said valve member is in its first operating position, which connect and provide fluid communication between said second intermediate passage and said inlet passage and connect and provide fluid communication between said outlet passage and said first intermediate passage when said valve member is in its second operating position, and which connect and provide fluid communication between said bleed passage and said first intermediate passage when said valve member is in its third operating position.

5. In an apparatus of the character described, the combination of: a housing provided with a frusto-conical valve chamber therein and provided with passages therein which communicate with said valve chamber; a frusto-conical valve member adapted to seat in said valve chamber and movable therein between operative and inoperative positions, said valve member being provided with a passage therethrough which connects said passages in said housing when said valve member is in its operative position; and means for exposing an area of the smaller end of said valve member and an area of the larger end of said valve member to fluid pressure in one of said passages in said housing, said area of said larger end being less than said area of said smaller end.

6. In an apparatus of the character described, the combination of: a housing provided with a frusto-conical valve chamber therein, the peripheral wall of said valve chamber and the smaller of the end walls thereof each being provided with a port; and a frustoconical valve member adapted to seat in said valve chamber and rotatable therein between operative and inoperative positions, said valve member being provided with a passage therethrough which connects said ports when said valve member is in its operative position, an area of the smaller end of said valve member and an area of the larger end of said valve member being exposed to fluid pressure in said port in the smaller end wall of said valve chamber, said area of said larger end being less than said area of said smaller end.

7. In an apparatus of the character described, the combination of: a housing provided with a frusto-conical valve chamber therein, the peripheral wall of said valve chamber being provided with an inlet port, a first intermediate port and an outlet port and the smaller of the end walls of said chamber being provided with a second intermediate port; and a frusto-conical valve member adapted to seat in said valve chamber and rotatable therein between first and second operating positions, said valve member having passages therein which connect and provide fluid communication between said inlet port and said first intermediate port and connect and provide fluid communication between said second intermediate port and said outlet port when said valve member is in its first operating position, and which connect and provide fluid communication between said inlet port and said second intermediate port and connect and provide fluid communication between said outlet port and said first intermediate

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ate port when said valve member is in its second operating position, the smaller end of said valve member being exposed to fluid pressure in said second intermediate port.

8. An apparatus as set forth in claim 7 having means for exposing a portion of the larger end of said valve member to fluid pressure in said second intermediate port, the area of said portion being less than the area of the smaller end of said valve member.

9. In an apparatus of the character described, the combination of: a housing provided with a valve chamber therein and provided with a plurality of flow passages and a pressure passage, all of which communicate with said valve chamber; a pressure gauge communicating with said pressure passage; and a valve member movable in said valve chamber between a plurality of operating positions, said valve member having passages therein which connect and provide fluid communication between selected ones of said flow passages when said valve member is in each of said operating positions, and which connect and provide fluid communication between said pressure passage and one of said flow passages when said valve member is in each of said operating positions.

10. In an apparatus of the character described, the combination of: a housing provided with a valve chamber therein and provided with an inlet passage, an outlet passage, first and second intermediate passages, and a pressure passage, all of which communicate with said valve chamber; a pressure gauge communicating with said pressure passage; and a valve member rotatable in said valve chamber between first and second operating positions, said valve member having passages therein which connect and provide fluid communication between said first intermediate passage and said inlet passage and connect and provide fluid communication between said outlet passage and said second intermediate passage when said valve member is in its first operating position, which connect and provide fluid communication between said second intermediate passage and said inlet passage and connect and provide fluid communication between said outlet passage and said first intermediate passage when said valve member is in its second operating position, and which connect and provide fluid communication between said pressure passage and said inlet passage when said valve member is in either its first or its second operating position.

11. In an apparatus of the character described, the combination of: a housing provided with an inlet passage, an outlet passage, first and second intermediate passages, and a by-pass passage, said by-pass passage connecting said inlet and outlet passages; valve means disposed in said housing and movable between first and second operating positions, said valve means having passage means therethrough for connecting said first intermediate passage to said inlet passage and

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said outlet passage to said second intermediate passage when said valve means is in its first operating position, and for connecting said second intermediate passage to said inlet passage and said outlet passage to said first intermediate passage when said valve means is in its second operating position; and frangible means obstructing said by-pass passage, said frangible means being adapted to be ruptured if the pressure in said inlet passage exceeds a predetermined value so as to provide fluid communication between said inlet and outlet passages.

12. In a valve apparatus of the character described, the combination of: a housing provided with a frusto-conical valve chamber therein, the peripheral wall of said valve chamber being provided with an inlet port, a first intermediate port and an outlet port, and the smaller of the end walls of said chamber being provided with a second intermediate port; and a frusto-conical valve member adapted to seat in said valve chamber and rotatable therein between first and second operating positions, said valve member having a lateral passage therethrough which registers with said inlet port and said first intermediate port when said valve member is in its first operating position, and which registers with said first intermediate port and said outlet port when said valve member is in said second operating position, said valve member having a general axial passage therein which continually registers with said second intermediate port, said valve member having another lateral passage therethrough which communicates with said generally axial passage, one end of said other lateral passage registering with said outlet port when said valve member is in said first operating position, and the other end of said other lateral passage registering with said inlet port when said valve member is in said second operating position.

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