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WELL PUMP CONSTRUCTION

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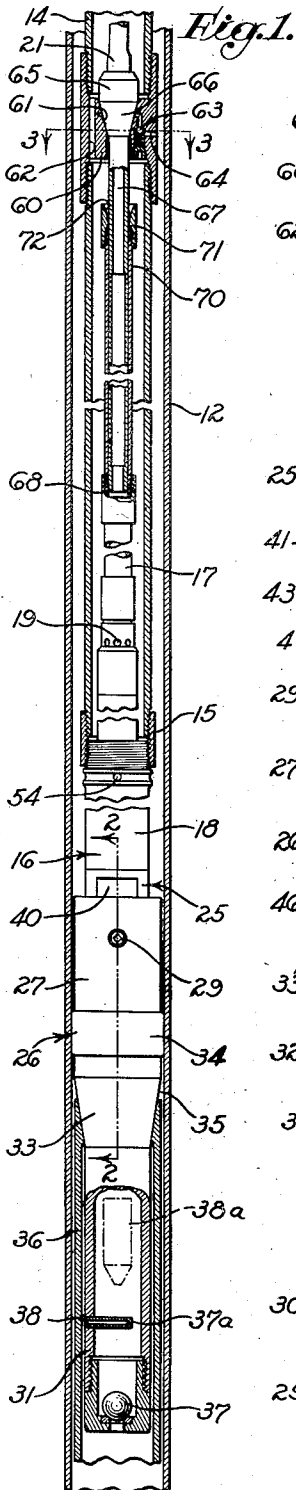
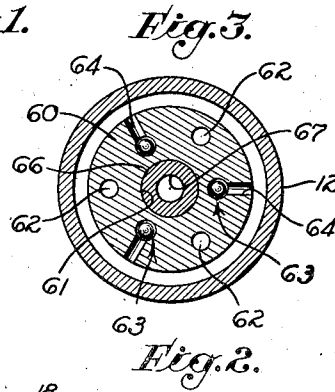
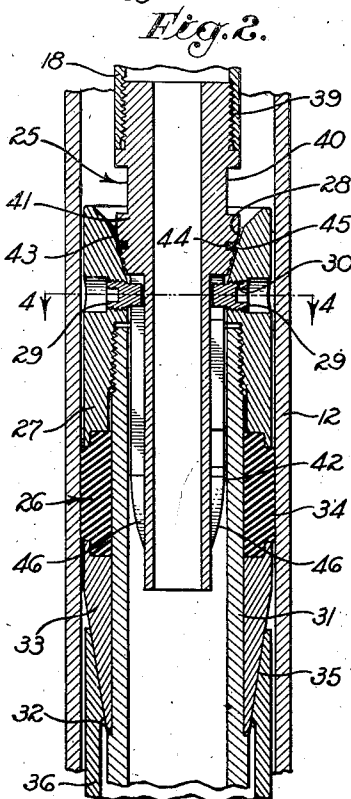
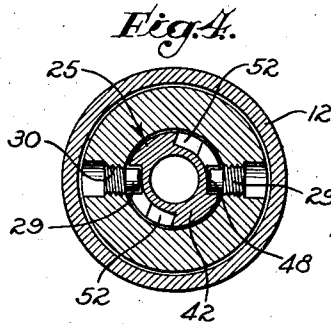


Fig. 5.

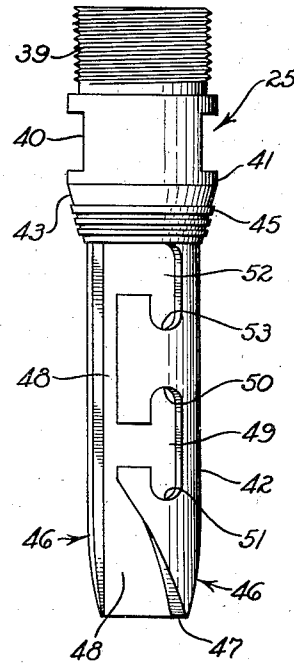
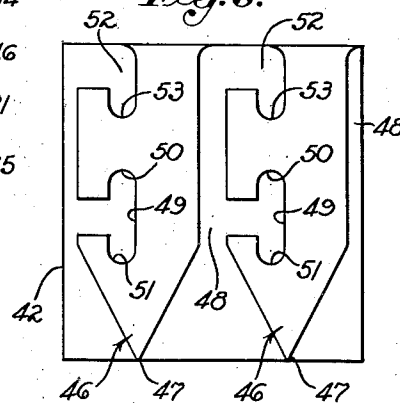


Fig. 6.



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WELL PUMP CONSTRUCTION

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7 Claims. (Cl. 103—219)

My invention relates to the pumping art, and more particularly to a pumping construction especially adapted for use in oil wells, and, consequently, will be described in connection therewith, although it is to be understood that my invention has other uses, and I do not intend to be limited to the specific embodiment described and claimed herein.

In the oil well pumping art it is common practice to utilize a fluid operated pump set in a well for the purpose of pumping well fluid therefrom. Such fluid operated pumps ordinarily include a fluid operated motor directly connected to a fluid pumping mechanism, the fluid operated motor being actuated by operating fluid conveyed thereto under high pressure. It is usual in such systems to discharge the spent operating fluid directly into the well production so that the used operating fluid is raised to the surface of the ground with the well production and is commingled therewith. The operating fluid for such systems is frequently obtained by diverting a portion of the production flow from the well and treating and cleaning the same to render it suitable for use as an operating fluid in the fluid motor of the fluid operated pump. Where, by reason of the characteristics of the well fluid, such cleaning or treating of the well fluid to render it suitable for use as an operating fluid in the fluid operated motor is unduly expensive or difficult, it is disadvantageous to commingle the spent operating fluid with the production flow, as this raises the operating cost of the pumping installation materially. Accordingly, it is a primary object of my invention to provide a pumping system for use in connection with a fluid operated pump, in which the spent operating fluid used therein is not discharged into the production flow from the well and commingled therewith but is separately conveyed to the surface of the ground through a separate tubing provided therefor, so that it may be reconveyed into the operating fluid tubing without material loss.

It is a further object of my invention to provide a well system for use in connection with a fluid operated pump in which a separate tubing is provided for conveying the spent operating fluid to the surface of the ground, and in which the parts thereof are so disposed and arranged as to occupy a minimum amount of space within the well, thus permitting the system to be used in wells of small diameter.

Another object of my invention is to provide a well system as described above, in which the casing of the well is used to convey pumped fluid to the surface of the ground, by providing a packer

between the fluid operated pump and the casing. This is a particular advantage, since it dispenses with the necessity of providing a separate production tubing for the pumped fluid, thus eliminating the expense of such a separate production tubing and reducing the space required for installation of the system.

In the well pumping art it is common to set a packer within the casing of a well on which a pump unit is adapted to seat, or to which the pump unit is directly attached, and various devices have been provided in the art for connecting the pump unit to the packer. Such prior art connecting devices have been costly to manufacture or inconvenient to use, or both, and, consequently, it is a further object of my invention to provide a pump installation in which a packer is set in a well, a pump unit is adapted to seat on the packer, and connecting means are provided whereby the pump can be removed from the well without removing the packer, or can be removed with the packer so as to withdraw the latter, as desired. My invention relates to the particular construction of such a connecting means, which is more fully described hereinafter and is not limited in its utility to a pump system as described, but may be used for connecting other devices in a well.

Still another object of my invention is to provide a novel type of bleeder construction for bleeding tubing in a well, and, particularly, a bleeder adapted to drain fluid from two concentric tubings set in a well, both of which normally contain a fluid. A further object of my invention is to provide such a bleeder which is adapted to drain one or both of two concentric well tubings, as may be desired.

Other objects and advantages will appear from the following specification and the drawing, which is for the purpose of illustration only and in which:

Fig. 1 is an assembly view, partly in section, showing my invention set in a well.

Fig. 2 is an enlarged vertical section of a fragment of the device shown in Fig. 1, taken on the line 2—2 of Fig. 1.

Fig. 3 is a cross section taken on the line 3—3 of Fig. 1.

Fig. 4 is a cross section taken on the line 4—4 of Fig. 2.

Fig. 5 is an elevational view of the packer connecting means of my device.

Fig. 6 is a development of the outer surface of the device shown in Fig. 5.

Referring to the drawing, I show a casing 12 set in a well in the conventional manner, having

an outer tubing 14 extending downwardly there-through, the lower end of which is connected by a collar 15 to a fluid operated pump unit 16. The fluid operated pump unit 16 is comprised, generally, of a fluid operated motor 17 and a pump 18 adapted to be operated by the fluid operated motor as is well known in the art. As shown in Fig. 1, the pump 18 is of considerably larger diameter than the fluid motor 17, in which case the outer tubing 14 is connected by the collar 15 directly to the pump so that the outer diameter of the outer tubing is approximately the same as the diameter of the pump, thus conserving space in the well and allowing the device to be used in wells requiring a casing of small diameter. It will be understood, however, that where the pump 18 and the fluid motor 17 are of substantially the same external diameter, the outer tubing 14 may be connected to the fluid operated pump unit 16 as may be desired. As will be noted, the fluid motor 17 is provided with discharge openings 19 which communicate with the interior of the outer tubing 14. The upper end of the outer tubing 14 communicates through a suitable discharge pipe to a point of discharge or storage (not shown).

Threaded into the string of outer tubing 14, between a pair of sections thereof, is a bleeder collar 60 having a conical seat 61 therein and being provided with a passage 62 affording open communication therethrough between the section of outer tubing above and below the bleeder collar. Also provided in the bleeder collar 60 is an outwardly opening check valve device 63 in the line of a bleeder passage 64 which communicates between the outside of the bleeder collar and the inner face of the conical seat 61.

Extending downwardly through the outer tubing 14 from a source of operating fluid under relatively high pressure (not shown) is an inner tubing 21, having adjacent its lower end a seat element 65 provided with a tapered seating surface 66 formed thereon adapted to seat in the conical seat 61 to form a fluid-tight joint therewith and to close the bleeder passage 64 when in seated position, as shown in Fig. 1. Connected to the lower end of the seat element 65 is a hollow skeeter bill 67 which extends a substantial distance below the bleeder collar 60 when the seat element is in its seated position shown in Fig. 1, the skeeter bill being provided at its lower end with an inwardly beveled face 68. The skeeter bill 67 is adapted to extend downwardly into a catcher tubing 70 having an upper collar 71 thereon provided with a flared opening 72 adapted to cooperate with the beveled face 68 on the skeeter bill to guide the latter into the catcher tubing. The skeeter bill 68 and the catcher tubing 70 are so designed that they form a slidable fluid-tight joint with each other when in the position shown in Fig. 1. The lower end of the catcher tubing 70 is threaded into the upper end of the fluid operated motor 17.

As best shown in Fig. 2, the lower end of the pump 18 is directly connected to a connecting means 25. The connecting means 25 is adapted to cooperate with a packer device 26. The packer device 26 is provided with an upper casing shoe 27 having a tapered seat 28 in the upper end thereof, and a pair of pins 29 screw-threaded through oppositely disposed threaded openings 30 in the upper casing shoe so as to project inwardly into the bore thereof, the lower portion of the upper casing shoe being threaded to the upper end of a sleeve 31. As will be noted, the pins 29

form fluid-tight joints with the upper casing shoe 27 to prevent leakage around the pins. The upper portion of the sleeve 31 is milled to a smaller outer diameter, providing a shoulder 32 on which is seated a lower casing shoe 33. Retained on the sleeve 31 between the upper and lower casing shoes 27 and 33 is a packer member 34, which is annular in form and preferably formed of rubber, neoprene, or other suitable resilient expansible material, which is adapted to make a sealing engagement with the inner wall of the casing 12. The lower portion of the lower casing shoe 33 is beveled as at 35 so as to seat on a liner 36 set on the bottom of the well. The lower end of the sleeve 31 is provided with an upwardly opening check valve 37 adapted to be closed by the weight of fluid thereabove, above which is provided a bleeder port 38 having a thin hollow plug tube 37a therein extending into the sleeve, the inner end of which is closed, the tube being formed of breakable material such as porcelain so that when it is desired to drain the sleeve 31, a relatively heavy weight, such as shown in dotted lines 38a, may be dropped through the sleeve to break the tube and permit the fluid in the sleeve to drain through the tube back into the well.

The connecting means 25 is provided at its upper end with threads 39 by means of which it is connected to the lower end of the pump 18, a flattened head portion 40 being provided to receive a wrench with which to thread the connecting means into the pump. The connecting means 25 is provided with an upper portion 41 and a lower portion 42, the lower end of the upper portion being beveled at 43 so as to seat in the tapered seat 28 of the upper casing shoe 27. An annular groove 44 is preferably formed annularly in the face of the beveled face 43, and an annular sealing ring 45, preferably formed of rubber or lead, is disposed therein so as to form a fluid-tight seal between the connecting member 25 and the upper casing shoe 27.

The lower portion 42 of the connecting means 25 extends downwardly into the sleeve 31 so as to provide clearance therebetween. Formed on the outer surface of the lower portion 42 of the connecting means 25 are projections 46 which are oppositely disposed thereon and which are shown projected in Fig. 5. The projections 46 are formed so as to provide a pointed lower end 47, a central slot 48 between the projections, and a T-shaped slot 49 connecting with the central slot. Also communicating with the central slot 48 is an upper slot 52 having a lower notch 53. Each T-shaped slot 49 has an upper opening 50 and a lower opening 51. The projections 46 are preferably formed by milling the outer surface of the connecting means 25, but any desirable means of forming the projections may be used.

In installation, the fluid operated pump unit 16 is attached to the lower end of the outer tubing 14, and the inner tubing 21 may also be attached to the fluid operated pump by seating the seat element 65 on the conical seat 61 so that the skeeter bill 67 extends downwardly into the catcher tubing 70, and the connecting means 25 is attached to the lower end of the pump, all as shown in Fig. 1. The packer device 26 is also assembled with the parts in the relation shown in Fig. 1, and the connecting means 25 is then run into the upper casing shoe 27 so that each pin 29 on the upper casing shoe enters into one of the central slots 48 of the connecting means, and the connecting means is rotated so as to

guide the pins 29 into the T-shaped slots 49, the pins then entering the upper or lower openings 50 or 51 of the T-shaped slots so as to maintain the packer device 26 against rotation relative to the connecting means 25 while the assembly is being run into a well. It will be noted that when the parts are set in this position, the beveled face 43 of the connecting means is out of engagement with the tapered seat 28 of the upper casing shoe 27, thus preventing injury to the sealing member 45 when the device is being run into the well. In this position, the unit may then be run into the well. In most installations, however, it is preferable to run the assembly into the well without the inner tubing 21 being connected therein, and to merely run the inner tubing into the well after the outer tubing 14 has been set therein, the skitter bill 67 and the catcher tubing 70 being adapted to simplify this operation. When the sleeve 31 seats on the top of the liner 36, the connecting means 25 is then raised, by raising the outer tubing 14, and rotated so as to permit the pins 29 to move back into the central slots 48, and the outer tubing is then lowered, causing the pins to move upwardly through the central slots until reaching the upper ends thereof, at which time the connecting means 25 may again be rotated to move the pins 29 into the upper slots 52. When the pins 29 reach the upper ends of the central slots 48, the beveled face 43 of the connecting means 25 seats in the tapered seat 28 of the upper casing shoe 27, causing the sealing member 45 to form a fluid-tight seat with the tapered seat 28. The unit is then left with the parts in this position during operation.

If it is desired to remove the fluid operated pump unit 16 from the well without removing the packer device 26 therefrom, the connecting means 25 is rotated, if necessary, so as to bring each of the pins 29 into alignment with a central slot 48 of the connecting means, thus freeing the connecting means from the packer device. When the parts are in this position, a straight upward pull on the outer tubing 14 will cause the pins 29 to move downwardly through the central slots 48 and free of the connecting means, relatively speaking, to free the pump assembly and connecting means attached thereto from the packer device. The packer device 26 will thus remain in the well permitting separate removal of the pump. It is also to be noted that the check valve 37 will then close, preventing the fluid above the packer device 26 in the casing 12 from flowing back into the well, which is an important feature.

When it is desired to remove both the fluid operated pump unit 16 and the packer device 26 from the well, the connecting means 25 is first adjusted, by rotating the outer tubing 14, so that the pins 29 project into either the upper slots 52 or the T-shaped slots 49 thereof, following which a straight upward pull on the outer tubing 14 will be transmitted through the pins 29 and the packer device 26 to raise the same off the liner 36. If, however, there is a column of fluid in the casing 12 above the packer device 26, the weight of the column of fluid may prevent removal of the packer device by a straight upward pull thereon unless the weight of such column of fluid is first taken off the packer device. I prefer to accomplish removal of the packer device 26 under such conditions by first removing the pump unit 16 and connecting means 25 from the well, and then dropping the weight 38a through the casing 12, which descends there-through and through the sleeve 31 to break the

plug tube 37a, thus permitting fluid in the casing to drain outwardly therethrough into the well. The connecting means 25 is then run back into the well and adjusted relative to the packer device 26, by movement of the outer tubing 14, so as to position the pins 29 in the upper slots 52, in which position the connecting means is raised off the conical seat 28 to permit the column of fluid in the casing 12 above the packer means to discharge downwardly around the lower portion 42 of the connecting means and through the sleeve 31 back into the well, thus equalizing the fluid pressures above and below the packer device and permitting removal of the packer device from the well by a straight upward pull on the outer tubing 14.

As will be apparent, during operation of the fluid operated pump unit 16, operating fluid under high pressure will normally be conveyed downwardly to the fluid motor 17 through the inner tubing, the skitter bill 67, and the catcher tubing 70, to operate the fluid motor, and when the operating fluid is spent it is discharged through the discharge openings 19 into the interior of the outer tubing 14 and is conveyed therethrough upwardly to the surface of the ground. The production flow of well fluid from the pump unit 16 is discharged through pump discharge ports 54 directly into the casing 12 above the packer device 26 and is conveyed upwardly to the surface of the ground through the casing. Thus, it will be apparent that the spent operating fluid is conveyed upwardly to the surface of the ground separately from the well production which is discharged through the casing 12 with the attendant advantages set forth above.

When it is desired to remove the fluid operated pump unit 16 from the well, either with or without the packer device 26, it is ordinarily desirable to drain from the inner or outer tubings 21 and 14, respectively, or both, any fluid therein, so as to prevent what is known in the oil industry as a "wet job." This may be readily accomplished by my invention. If it is desired to drain the outer tubing 14 without draining the inner tubing 21, the inner tubing is raised so as to lift the seat element 65 off its conical seat 61 on the bleeder collar 60, thus opening fluid communication therearound and through the bleeder passage 64 of the bleeder check valve 63 to permit fluid in the outer tubing 14 to drain therethrough into the casing 12. Since a slight raising of the inner tubing 21 will not break the fluid-tight connection between the skitter bill 67 and the catcher tubing 70, fluid in the inner tubing will not be drained therefrom. If it is desired to drain fluid from the inner tubing 21, it is raised until the skitter bill 67 disengages from the catcher tubing 70, at which time fluid can drain therefrom through the outer tubing 14 and the bleeder valve device 63 directly into the casing 12. Thus, I provide means whereby one or both of two concentric tubings set in a well may be drained of fluid therein, by manipulating the tubings from the surface of the ground.

Although I have shown and described a preferred embodiment of my invention, it will be recognized that certain parts and elements thereof are representative of other parts and elements which may be substituted therefor without the exercise of invention, and consequently I do not intend to be limited to the specific form shown but desire to be afforded the full protection of the following claims.

I claim as my invention:

1. In a pumping system, the combination of: a pump unit adapted to be positioned in a well; packer means adapted to form a seal with the walls of the well, said packer means having a seat member therein; connecting means between said pump unit and said packer means, there being a seat element on said connecting means adapted to seat on said seat member to form a fluid-tight joint between said packer means and said pump unit; and retaining means for holding said seat element out of seating engagement with said seat member while the pump unit and packer means are being lowered into the well, said retaining means being releasable so as to permit said seat element to be seated on said seat member.

2. In a pumping system, the combination of: a pump unit adapted to be positioned in a well; packer means adapted to form a seal with the walls of the well, said packer means having a seat member therein; connecting means between said pump unit and said packer means, there being a seat element on said connecting means adapted to seat on said seat member to form a fluid-tight joint between said packer means and said pump unit; retaining means for holding said seat element out of seating engagement with said seat member while the pump unit and packer means are being lowered into the well, said retaining means being releasable so as to permit said seat element to be seated on said seat member; and means for permitting said connecting means to be disengaged from said packer means while the latter is set in the well.

3. In a pumping system, the combination of: a pump unit adapted to be positioned in a well; packer means adapted to form a seal with the walls of the well, said packer means having a projection thereon; and connecting means for releasably connecting said pump unit and said packer means, said connecting means including a vertical slot adapted to receive said projection, and a horizontal slot communicating with said vertical slot and adapted to receive said projection so as to maintain said packer means in fixed vertical position relative to said connecting means when said projection is in said horizontal slot.

4. In a pumping system, the combination of: a pump unit adapted to be positioned in a well; packer means adapted to form a seal with the walls of the well, said packer means having a projection thereon; and connecting means for releasably connecting said pump unit and said packer means, said connecting means including a vertical slot adapted to receive said projection, and a substantially T-shaped slot communicating with said vertical slot and adapted to receive said projection so as to maintain said packer means in fixed vertical position relative to said connect-

ing means when said projection is in said substantially T-shaped slot.

5. In a pumping system, the combination of: a pump unit adapted to be positioned in a well; packer means adapted to form a seal with the walls of the well, said packer means having a projection thereon and having a seat member therein; and connecting means for connecting said pump unit and said packer means, said connecting means having a seat element thereon adapted to seat on said seat member to form a fluid-tight seal therebetween, said connecting means having a vertical slot adapted to receive said projection and a retaining slot communicating with said vertical slot and adapted to receive said projection to maintain said packer means in fixed vertical relation to said connecting means and said seat element out of engagement with said seat member when said projection is in said retaining slot, said connecting means being movable so as to move said projection out of said retaining slot to permit said connecting means to be detached from said packer means when the latter is set in the well or to permit said seat element to be seated on said seat member.

6. In a pumping system, the combination of: a pump unit adapted to be positioned in a well; packer means adapted to form a seal with the walls of the well, said packer means having a projection thereon and having a seat member therein; and connecting means for connecting said pump unit and said packer means, said connecting means including a tubular body adapted to extend into said packer means, a seat element formed on said body and adapted to seat on said seat member to form a fluid-tight joint therebetween, a vertical slot in said body adapted to receive said projection, guide means for guiding said vertical slot over said projection, and a retaining slot communicating with said vertical slot and adapted to receive said projection.

7. In a well packer device, the combination of: tubular packer means adapted to be set in a well so as to form a seal with the walls of the well, said packer means having a seat therein and a longitudinal bore communicating with said seat; a projection secured to said packer means and extending radially inwardly; and a tubular member adapted to seat on said seat, said member having connecting means adapted to cooperate with said projection to releasably secure said member to said packer means, said connecting means including a vertical slot adapted to receive said projection and a horizontal slot communicating with said vertical slot and adapted to receive said projection so as to retain said packer means in fixed vertical position relative to said connecting means when said projection is in said horizontal slot.

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