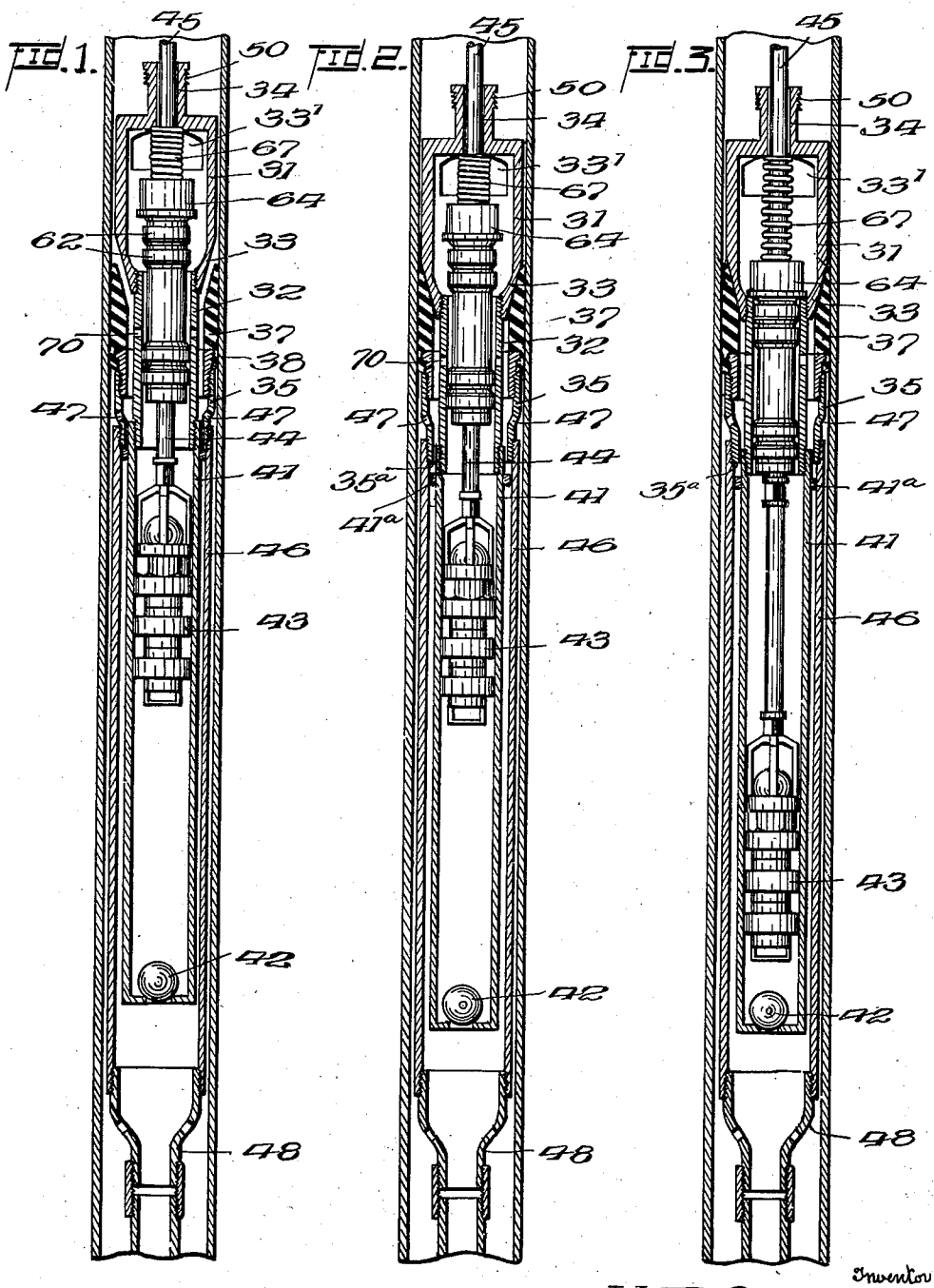
March 15, 1938. W. F. COX 2,111,173

OIL WELL PUMP

Original Filed Nov. 6, 1934 2 Sheets-Sheet 1



Inventor

W. F. COX

By Church & Church

His Attorneys

March 15, 1938. W. F. COX 2,111,173

OIL WELL PUMP

Original Filed Nov. 6, 1934 2 Sheets-Sheet 2

FIG. 4.

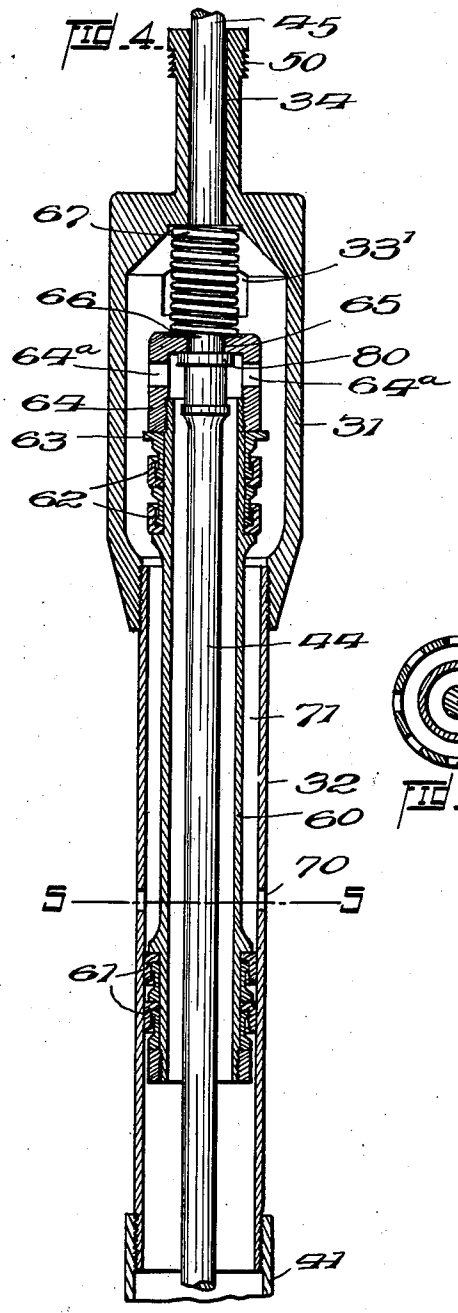


FIG. 5.

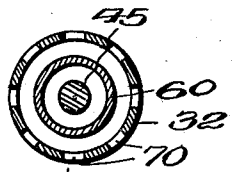
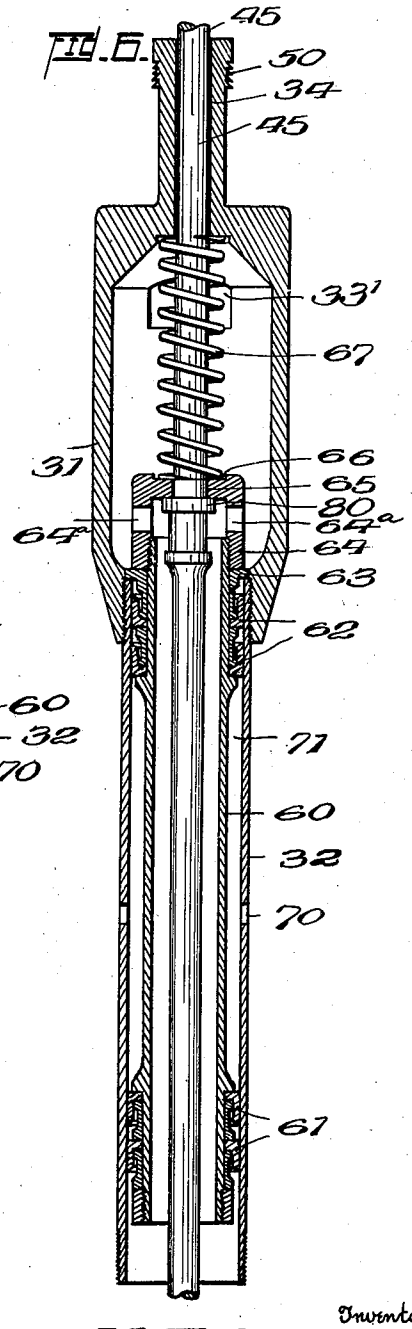


FIG. 6.



Inventor
W. F. COX,
By Church & Church
His Attorneys

Patented Mar. 15, 1938 2,111,173

UNITED STATES PATENT OFFICE

2,111,173

OIL WELL PUMP

William Fred Cox, Irving, Tex.

Application November 6, 1934, Serial No. 751,778
Renewed December 9, 1937

14 Claims. (Cl. 103—221)

This invention relates to improvements in oil well mechanisms, and particularly to those mechanisms or devices which require the use of packing elements for sealing-off oil wells at various points to facilitate raising the oil.

Primarily, the object of the invention is to provide such mechanisms or devices with means for releasing fluid pressure above the packing elements or equalizing the pressure above and below said elements while the mechanism is sealed in a well. More specifically, the invention contemplates a pump having packing elements for sealing the space between the pump cylinder and the well wall or casing and means for by-passing, so to speak, fluids from above the packing elements through the pump cylinder to a point below the seal whereby the pressure above the seal can be reduced and thus permit the packing elements to be more easily manipulated to break the seal when it is desired to raise the pump from the well.

A further object is to provide a pressure release mechanism operable from the surface of the ground, preferably by the operating rod of the pump piston or the rod by which the pump or other device is raised and lowered in the well.

While the invention is applicable to mechanisms other than pumps, it is illustrated in the present instance as applied to an oil well pump. The wall of the pump cylinder is provided with a plurality of ports located at a point below the packing elements and a tubular sleeve of less diameter than the bore of the cylinder is adapted to seal off the ports from both ends of the cylinder during pumping operations but by moving the sleeve longitudinally of the cylinder communication can be established between the ports and the upper end of the cylinder, under which conditions liquids above the packing elements can drain through the upper portion of the cylinder out through the ports into the well below the packing elements thus reducing the pressure above said elements whereby they can be manipulated comparatively easily to release the pump.

With these and other objects in view, the invention consists in certain details of construction and combinations and arrangements of parts, all as will hereinafter be more fully described and the novel features thereof particularly pointed out in the appended claims.

In the accompanying drawings,

Figure 1 is a longitudinal or vertical sectional view of a pump lowered in a well hole, portions of the pump being shown in elevation, and the packing elements in the relative positions they occupy before sealing;

Fig. 2 is a similar view illustrating the pump sealed in the well and the pressure release device positioned to relieve pressure above the packing elements;

Fig. 3 is a similar view showing the pump sealed and the pressure release device in the position it occupies during the pumping operation;

Fig. 4 is a vertical sectional view through the upper portion of the pump, including the pressure release device, the latter being shown in "open" position;

Fig. 5 is a transverse sectional view on the line 5—5 of Fig. 4;

Fig. 6 is a view similar to Fig. 4, showing the pressure release device in "closed" position.

The present improvements have been illustrated in connection with the devices, and particularly a pump, of the type disclosed in United States Letters Patent No. 1,698,797. But, of course, it is to be understood that the invention is susceptible of use in other oil well devices.

In the pump illustrated, there is a core comprising an upper conical member or mandrel 31 and a lower cylindrical member 32 which is, in effect, an extension of the pump cylinder 41. The conical outer surface of the upper member 31 tapers downwardly toward the cylindrical surface of the lower member, and these surfaces are coaxially arranged. The bore of cylindrical member 32 opens into the interior or chamber 33 of the upper conical member 31 and the latter is provided with a number of openings 33', through which access is had from the interior of the pump cylinder to the well casing. An axial cylindrical bore 34, of smaller diameter than the main bore 33, extends through the upper portion of the upper conical member 31. This bore 34 is for the accommodation of the rod 45 which extends from within the pump cylinder to a point above the ground surface whereby the pump may be raised and lowered in the well and the piston 43 can be reciprocated within the cylinder 41. Of course, other means may be utilized for raising and lowering the pump, if desired. Movably mounted upon the portion 32 is a cylindrical slide 35 and mounted on this slide is an expansible sleeve 37 of rubber or some similar substance, the lower end of said sleeve being interiorly grooved and receiving an annular flange 38 on the upper end of the slide whereby said expansible sleeve is firmly secured on the slide. The cylindrical slide 35 is limited in its movement downwardly on the pump cylinder by the cooperation of shoulders 35a, 41a, on said slide, and the pump cylinder respectively. At the lower end of the pump cylinder 41, there is a check valve 42 and the pump piston 43 within the pump cylinder, which may be of any well-known type, is adapted to be reciprocated by the pump rod 44 connected to the rod 45, the sections 44, 45, constituting parts of a standard string of pump rods. A shell 46 surrounding the pump cylinder, including the upper section 32, is attached to the lower end of slide 35 and is provided with a plurality of perforations 47 at its upper end and at any desired inter-

mediate points. The bottom end of shell 46, or a smaller extension 48 thereof, normally rests on the bottom of the well, or upon a suitable anchoring device (not shown). When the pump is in pumping position, the distance between the pump cylinder and the bottom of the well is determined by the length of the shell 48, unless some anchoring device is used. The entire pumping unit may be lowered by means of a cable or rods 45 and, when so suspended, shoulder 35a of the cylindrical slide 35 rests on shoulder 41a of the pump cylinder with the rubber sleeve and the conical surface of member 31 spaced from one another, as shown in Fig. 1. A pumping unit may be thus freely lowered until the lower end of shell 48 comes into contact with and rests upon the bottom of the well or an anchoring device, whereupon the downward movement of the shell is arrested while the pump cylinder and the conical member 31 continue and move relatively to the shell and rubber sleeve 37 to a point where the conical member expands the rubber sleeve into sealing engagement with the wall of the well casing. In other words, the conical member 31 and the rubber sleeve constitute packing elements which, when thus brought into engagement with each other, effectively seal the space which would otherwise exist between the pump cylinder and the wall of the well or the well casing. The pump piston is then lowered somewhat further for pumping operations, the piston working from a point near the lower end of the pump chamber, as shown in Fig. 3 to a point near the upper end. The oil entering the small aperture controlled by the check valve 42 is lifted upwardly by the piston and makes its way to the openings 33' into the well casing above the packing elements, and thence to the top of the well.

Upon discontinuance of the pumping operations, the piston is lifted by means of the cable or rods 45 to the position it occupied when the unit was being lowered into the well, this excessive movement of the piston raising the pump cylinder and the conical member 31 to break the seal between the packing elements. The entire unit may then be lifted to the top of the well for inspection, replacement, or repair, or removal to another well. In the event the cable or pump rod breaks, any ordinary type of fishing tool may be utilized to recover the unit, serrations 50 being provided for facilitating grasping of the unit by the fishing tool. When pumps such as disclosed in the patent above referred to are lifted through a column of oil, with the seal, of course, broken, the oil which stands above the pump either leaks around the contracted expansible sleeve 37, or passes downwardly interiorly of the sleeve 37 and slide 35 and out of shell 46 through the perforations 47. However, removal under such conditions as these is sometimes quite difficult, particularly when the well is of any appreciable depth. For instance, take the case of a well 2,500 feet deep, with a bottom hole pressure, or formation pressure that is very low. While such a well is being pumped, there will be a column of liquid within the well casing from the top of the pump to the top of the well casing at the surface of the ground, and the hydrostatic pressure at the bottom of this liquid column will be about 1,000 pounds per square inch, varying somewhat with the specific gravity of the oil and the amount of water or the amount of gas which is produced with the oil. Assuming that the upward pressure on the lower side of the pump is negligibly small, and that the working barrel 41 and the piston 43 are 2¼ inches in diameter, the sectional area would be about 4 square inches and the total fluid pressure downward against the piston would be about 4,000 pounds. This is the load that would be placed upon the rods 44 and 45 during the pumping operation. Assuming also that the pump is installed in a casing of 8⅝ inches in diameter, and that the outside diameter of the mandrel 31 at the point where it closes off against the rubber sleeve is 7 inches, the sectional area at that point will be approximately 38½ square inches and the total net fluid pressure downward upon the top of the mandrel will be about 38,500 pounds. This force, plus the force of friction and the gripping effect of the rubber upon the mandrel, will be the force which the rods 44 and 45 will have to work against in order to raise the mandrel 31 free from the rubber sleeve 37, before the pump can be opened or unsealed, preparatory to removing it from the well. These figures apply, as mentioned, where the well is 2,500 feet deep, and if the pump is installed in a well of greater depth, naturally the pressures and the forces to be overcome in breaking the seal between the packing elements are increased, the fluid pressure in a 5,000-foot well being approximately 77,000 pounds. Therefore, it can be seen that when the depth of the well or the pumping lift is very great, the forces encountered are apt to be greater than the rods 44 can carry when trying to break the seal between the mandrel 31 and sleeve 37 and that there is great danger of breaking the rods. The forces against which the rod must contend are also further increased in case sand, shale, gravel, or other sediment has been brought into the well with the oil and has settled in the casing above the pump. For these reasons, it is highly desirable to have the pump provided with means for releasing or relieving the fluid pressure on the packing elements, as by permitting the oil above the pump cylinder to drain back to a point below the packing before the packing members, i. e., the mandrel 31 and rubber sleeve 37, are disengaged with each other. To accomplish this purpose the present invention provides means for by-passing oil from above the packing elements to a point below said elements, while said elements are in their pump sealing positions. Preferably, the oil above the pump is by-passed through the upper portion of the pump cylinder. For this purpose, the cylindrical member 32 constituting, in effect, the upper part of the pump cylinder, is provided with a series of radial ports 70 and means operable from the surface of the ground are adapted to open communication between said ports through the cylinder to the upper end only of the latter, under which circumstances oil can flow from the interior of mandrel 31 down through the upper portion of the pump cylinder and out of the ports 70. While, on the other hand, said ports 70 can be sealed off from both the upper and lower ends of the pump cylinder, while still permitting free passage of oil upwardly through the pump cylinder under the influence of the piston 43.

More specifically, these control means for the radial ports 70 consist of a tubular sleeve 60 carried on the piston rod 45, being supported by a collar 80. The diameter of said sleeve 60 is less than the bore of the pump cylinder, but when fully inserted in the pump cylinder, as shown in Figs. 3 and 6, the annular space between the cylinder wall and the sleeve is closed at both ends by packing members 61, 62, preferably carried by the sleeve itself. A spring 67 interposed between the

top wall of the chamber or interior of mandrel 31 and an end or crown member 64 screwed on the upper end of sleeve 60 tends to force the sleeve into the upper end of the pump cylinder. In the present construction, this spring 67 is of such strength that when the pump is being raised or lowered in the well, the spring is held compressed, as shown in Fig. 4, and does not act to force the sleeve into the pumping cylinder until after the piston 43 has been lowered into the zone it normally occupies during the pumping operations. The crown member 64 is formed with a plurality of radial ports 64a, through which oil pumped upwardly may enter the interior of mandrel 31, from whence it will flow out through the ports 33' into the well casing. The crown member is also provided with a bore 65 for the piston rod and on its top surface with a seat 66 for the spring 67. Preferably, also, the packing members 62 on the sleeve are held in place by a collar 63 interposed between the packing member 62 and the crown 64 and the engagement of this collar 63 with the upper end of the pump cylinder functions as a stop for limiting the movement of the sleeve into the cylinder.

Referring to Figs. 4 and 6, the former view shows the positions of the parts when the pump is being lowered into the well, corresponding, in this respect, to the illustration of Fig. 1. Just as in the prior art structure, referred to, when the shell extension 48 is arrested in its downward movement, the pump cylinder will continue to advance until mandrel 31 engages and distends rubber sleeve 37 into sealing engagement with the well casing wall. After this has occurred, the pump piston is lowered in the pump cylinder whereupon spring 67 forces the sleeve 60 into the pump cylinder to the position shown in Fig. 6. With the parts in these positions, the piston is actuated in its normal zone with the result that oil is pumped upwardly through the pump cylinder and through the sleeve 60 due to the fact that the annular space 71 between the sleeve and cylinder is sealed off by the packing members 61, 62. After passing through the ports 64a in crown member 64, the oil thus elevated, escapes through the ports 33' and on up through the well casing. Should it be desired to remove the pump, it is only necessary to elevate the pump piston a distance sufficient to return the sleeve 60 from the position shown in Fig. 6 to the position shown in Fig. 4, whereupon the oil above the pump or above the packing elements 31, 37, will be free to flow through the annular space 71 and drain out through the ports 70 in the cylinder wall. This movement of the sleeve 60 out of the upper end of the pump cylinder can be accomplished without the necessity of manipulating or disengaging mandrel 31 from the rubber sleeve 37, which operation can be delayed until the oil above the packing elements has drained to a point below the pump, so that considerably less power or force is required to disengage the mandrel.

As before pointed out, the invention has been illustrated in connection with the devices, and particularly the pump of Patent No. 1,698,797, but, as will be readily appreciated, it is adaptable for use with other mechanisms.

What I claim is:

1. In an oil well pump, the combination of a pump cylinder of substantially uniform cross-section having ports in the wall thereof, a piston in said cylinder, a working rod for said piston, packing elements for sealing the space between said cylinder and the wall of a well at a point above said ports, a sleeve member of less diameter than the bore of the cylinder in said cylinder, and means on the exterior surface of said sleeve for effecting a liquid seal between the inner surface of the cylinder wall and the sleeve above and below said ports, said sleeve being slidable in said cylinder to a position partially without the cylinder to break the seal between the same and the cylinder above said ports whereby liquids in the cylinder above the ports can drain outwardly through the ports.

2. In an oil well pump, the combination of a pump cylinder having a series of ports in the wall thereof, a piston in the cylinder, a working rod for the piston, packing elements for sealing the space between the cylinder and the wall of a well at a point above said ports, a tubular sleeve of less diameter than the bore of the cylinder slidable into and out of the upper end of the cylinder, the space between the sleeve and cylinder forming a passage for liquid when said sleeve is moved to its position outwardly of the cylinder and projections on the exterior of said sleeve for effecting a liquid seal between the sleeve and cylinder above and below said ports when the sleeve is moved into the cylinder and at a point below the ports only when the sleeve is moved outwardly of the cylinder.

3. In an oil well pump, the combination of a pump cylinder having a series of ports in the wall thereof, a piston in the cylinder, a working rod for the piston, packing elements for sealing the space between the cylinder and the wall of a well at a point above said ports, a tubular sleeve of less diameter than the bore of the cylinder slidable into and out of the upper end of the cylinder, the space between the sleeve and cylinder forming a passage for liquid when said sleeve is moved to its position outwardly of the cylinder and projections on the exterior of said sleeve for effecting a liquid seal between the sleeve and cylinder above and below said ports when the sleeve is moved into the cylinder and at a point below the ports only when the sleeve is moved outwardly of the cylinder, and means for limiting movement of said sleeve into said cylinder.

4. In an oil well pump, the combination of a pump cylinder having a series of ports in the wall thereof, a piston in the cylinder, a working rod for the piston, packing elements for sealing the space between the cylinder and the wall of a well at a point above said ports, a tubular sleeve of less diameter than the bore of the cylinder slidable into and out of the upper end of the cylinder, and means on the exterior surface of said sleeve for effecting a liquid seal between the sleeve and cylinder above and below said ports when the sleeve is moved into the cylinder the space between the sleeve and cylinder forming a passage for liquid when said sleeve is moved to its position outwardly of the cylinder and at a point below the ports only when the sleeve is moved outwardly of the cylinder, means for yieldingly urging the sleeve into the cylinder and means for limiting movement of the sleeve into the cylinder.

5. In an oil well pump, a pump cylinder having a cylindrical bore, a piston in said cylinder, a piston rod supporting said cylinder and by which the cylinder may be raised and lowered in a well casing, sealing elements for sealing the well adjacent the cylinder, ports in the cylinder wall below said sealing elements communicating with said cylindrical bore and a sleeve for controlling flow of liquid through said ports, said

sleeve being movable to a position partially without the cylinder by said rod for establishing communication between said ports and the upper end of the cylinder.

6. In an oil well pump, a pump cylinder having a cylindrical bore with a port extending from said cylindrical bore through the wall of the cylinder, a piston therein, a working rod for the piston, said cylinder being suspended from the rod, packing elements movable relatively to each other to seal the well adjacent the cylinder, and means engageable with the inner wall of said cylinder and movable relatively to the port in said cylinder for controlling flow of fluid through the cylinder from a point above the seal to a point below said seal, said flow control means being movable by said rod to a position partially without said cylinder to establish said flow.

7. In an oil well pump, a pump cylinder having a cylindrical bore with a series of drain ports extending from said cylindrical bore through the wall of the cylinder, a piston in said cylinder, a piston rod supporting said cylinder and by which the cylinder may be raised and lowered in a well casing, sealing elements for sealing the well adjacent the cylinder, and a fluid release mechanism operating within the cylinder consisting of a cylindrical slide valve operating within the cylinder to cover and uncover said series of drain ports through the cylinder walls, said slide valve having a series of packing members engaging the wall of the cylinder, and a spring for forcing said slide valve into position to cover said drain ports, said slide valve being movable by the pump rod against the action of said spring when the pump rod is raised above the upper limit of its normal pumping stroke to position said valve partially without the cylinder to uncover the drain ports and permit the flow of fluid therethrough.

8. In an oil well pump adapted to be lowered into a well casing, a cylinder having a cylindrical bore with a drain port extending from said cylindrical bore through the wall of the cylinder, a pump piston in said cylinder, sealing elements for sealing the space between the well casing and pump above said port, and a side valve for controlling flow of liquid through said port, said valve being supported on the upper end of said cylinder when said port is sealed off, and said valve being movable partially out of said cylinder to open said port.

9. In an oil well pump adapted to be lowered into a well casing, a pump cylinder having a drain port therein, a pump piston in said cylinder, sealing elements for sealing the space between said well casing and the cylinder above said port, a sleeve of less diameter than said cylinder slidable in said cylinder, the space between said sleeve and cylinder forming a by-pass from the upper end of the cylinder to said port, means for closing said by-pass above and below said port, and means for moving said sleeve to remove said closing means above said port whereby fluid may drain from the upper end of the cylinder downwardly through said by-pass to said port.

10. In an oil well pump adapted to be lowered into a well casing, a pump cylinder having a cylindrical bore with a drain port extending from said cylindrical bore through the wall of the cylinder, a pump piston in said cylinder, sealing elements for sealing the space between the casing and the cylinder above said port, a sleeve of less diameter than said cylinder slidable in said cylinder, the space between said sleeve and cylinder forming a by-pass from the upper end of the cylinder to said port, and means movable into and out of said by-pass for controlling drainage of liquid through said port.

11. In an oil well pump adapted to be lowered into a well casing, a pump cylinder having a cylindrical bore with a drain port extending from said cylindrical bore through the wall of the cylinder and opening into the space between the pump and casing, a pump piston in said cylinder, sealing elements for sealing said space between the casing and the cylinder above said port, a sleeve of less diameter than said cylinder slidable in said cylinder, the space between said sleeve and cylinder forming a by-pass from the upper end of the cylinder to said port, and means carried by said sleeve for closing said by-pass above said port, said closing means being movable out of the cylinder for opening said by-pass.

12. In an oil well pump adapted to be lowered into a well casing, the combination of a cylindrical member having a bore of uniform diameter and having ports therein through which oil can drain from the interior of the pump to the exterior thereof, a pump piston in said cylindrical member, a piston rod connected to said piston, packing means for sealing the space between the pump and casing at a point above said ports, a valve movable in said cylindrical member for closing communication between said ports and the interior of the pump, and means comprising said piston rod for moving said valve to open said ports whereby fluid can drain from the interior of the pump outwardly through said ports.

13. In an oil well pump adapted to be lowered into a well casing, the combination of the working barrel of the pump, said barrel having a cylindrical portion with drain ports in the wall thereof, the wall of said cylindrical portion above and below said ports being of uniform diameter, a working piston in said barrel, a working rod for said piston, packing elements for sealing the space between the pump and well casing above said ports, a sleeve movable in said cylindrical portion and means carried by the sleeve engaging the cylinder wall of uniform diameter for closing communication between the interior of the cylinder and said ports, and means for moving said sleeve to open said ports whereby fluid can drain from the interior of the cylinder outwardly through said ports.

14. In an oil well pump adapted to be lowered into a well casing, means for sealing the space between the pump and well casing, a cylindrical member having ports therein through which oil can flow from a point above said sealing means through the pump into the well below said sealing means, said cylinder being of uniform cross-section adjacent said ports, a pump piston in said cylinder, a piston rod, a cylindrical, tubular valve carried by said rod and slidable in said cylindrical member and resilient packing material on the exterior surface of said valve engaging the inner surface of said cylindrical member adjacent said ports above and below the latter, said valve being movable in the cylindrical member by the piston rod to a position to open communication between the interior of pump and said ports.

WILLIAM FRED COX.