

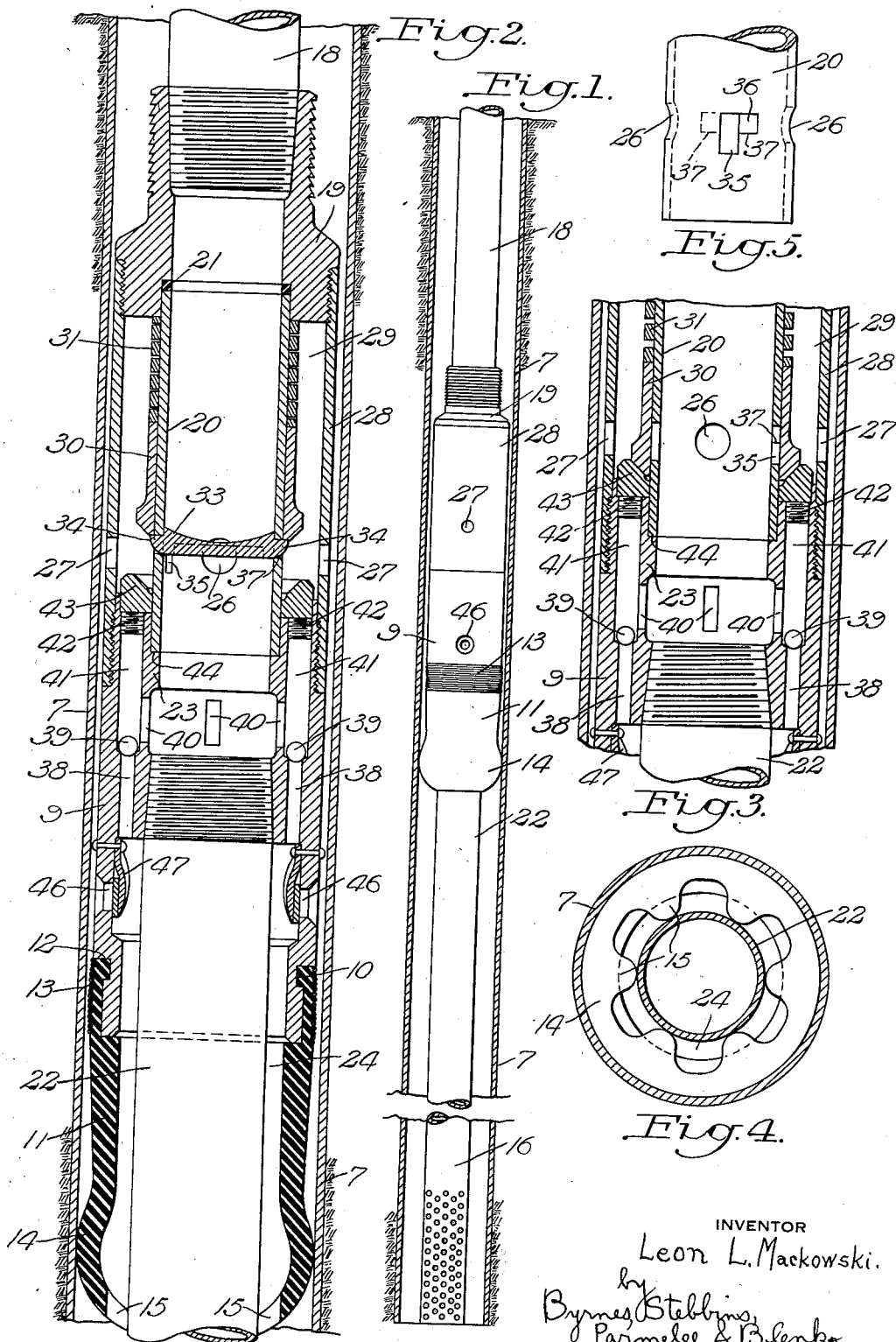
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FLOW PACKER

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FLOW PACKER

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This invention relates to a jet flow packer for oil wells.

A jet flow packer is of special usefulness in assisting the flow of oil upwardly within a well when the gas pressure has become so small that the flow has dwindled toward stopping altogether.

In accordance with the well known principles of the air lift, liquid may be caused to rise in a well if the same is aerated or mixed with tiny bubbles of gas so as to decrease the specific gravity of the fluid. In many oil wells, a certain amount of gas is available in or adjacent to the oil bearing sands; and if this gas is properly mixed with the column of rising oil, flow in accordance with the air lift principles is brought about.

In accordance with the principles of my invention, gas collecting within the casing on the outside of the tubing is employed for aerating the rising column of liquid. Inasmuch as the jet flow packer must, on some occasions, be lowered into a well from which fluid is flowing, I have provided a packer which permits gas and oil to discharge from the tubing while the packer is being lowered into place. The operator then operates a vent valve by removing a detent, or in other suitable manner; and as a result of this valve operation, the discharge of gas and oil from the tubing is stopped, thereby starting the flow of fluid upward within the tubing. So long as the gas pressure beneath the packer remains higher than the necessary aerating pressure, flow of oil is maintained.

In the accompanying drawing in which, not as limiting my invention but merely for purposes of illustrating the same, I have shown one illustrative embodiment which my invention may assume.

Figure 1 is a view principally in elevation of my improved jet flow packer in position in a well;

Figure 2 is a vertical sectional view on an enlarged scale of the jet flow packer shown in Figure 1;

Figure 3 is a central vertical sectional detail view of a part of the packer shown in Figure 2 with the sleeve valve in lowered or closed position;

Figure 4 is a bottom plan view of the packer, the tubing and casing being shown in section; and

Figure 5 is a fragmentary view in elevation of the valve guide.

In the embodiment illustrated in the drawing,

a casing 7 of conventional construction is shown, this casing forming the wall of the well. In Figure 1, a jet flow packer is shown in position in the well with its packing element in sealing engagement with the wall of the well.

As shown more in detail in Fig. 2, the jet flow packer includes a body member 9 which is cylindrical in shape, and is provided adjacent its lower end with an annular groove 10 surrounding the body at a slight distance above its bottom edge. A packing element 11 depends from the body 9 to form a seal between the body 9 and the casing 7. This packing element is, in the form shown, constituted by a sleeve having an annular bead or rim 12 extending inwardly from the upper portion thereof. This annular portion 12 is disposed in the groove 10 when the sleeve is assembled with the bottom of the body 9, and is held in assembled position by several turns of wire 13. The sleeve tapers downwardly and inwardly for a portion of its length, and then swells outwardly into a bulbous enlargement 14 adapted to peripherally engage the casing 7. The recurved lower portion of this enlargement 14 is formed with a scalloped lower edge, resulting in a fringe of inwardly sloped fingers 15. The peculiar formation and shape of the packing element 11 have advantages which will later be explained.

Below the packer is the working barrel 16 with which cooperates a standing valve (not shown). When the working barrel has been positioned at the proper level, for instance at the bottom of the well, pressure entering the space between the packing element 11 and the tubing will cause the packing element to expand, due to the fact that the packing element is supported at but one end. It is the purpose of the jet flow packer to promote the flow of oil into the working barrel and up the tubing to the top of the well. This tubing extends upwardly within the casing in the customary manner, the portion shown extending upwardly from the packer being indicated by the numeral 18. A connection 19 is threaded to the lower end of the portion 18. Depending therefrom is a section of tubing 20 forming a continuation of the tubing 18 and connection 19 which functions also as a valve guide. Packing 21 seals the joint between the tubing connection 19 and the valve guide 20. Aligned with the guide 20 within the packer is a lower section of tubing 22; and between the sections of tubing 20 and 22 is a partition member 23 into which the upper end of the section 22 is threaded. This partition mem-

ber 23 blocks off the top of the space 24 between the packing element 11 and the section of tubing 22. In the embodiment shown, this partition member 23 is formed integrally with the body member 9, although it might be formed separately and hermetically sealed to the body member 9. It is accordingly apparent that the section of tubing 22, the partition member 23, and the sections of tubing 20 and 18 cooperate to form the tubing whose function is to conduct the oil after flow has been started upwardly in the well.

When the tubing and packer are being lowered into the well, it is quite frequently desirable to vent the fluid flowing upwardly within the tubing at a point above the packer. As fluid is caused to flow upwardly in the well, due to the lowering operation, some vent is highly desirable, if not necessary, in order to make easier the lowering of the tubing and packer. Accordingly, I provide flow openings 26 through the section of tubing 20; and in order to permit the discharge of such fluid to the outside of the packer, I provide at substantially the same level one or more openings 27 through the outside shell 28 which joins the body member 9 to the tubing connection 19. In the embodiment shown, as previously mentioned, the partition member 23 is formed integrally with the body 9; and the shell 28 is threaded onto a reduced portion of the partition member 23. Within a chamber 29, enclosed between the shell 28 and the section of tubing 20, is housed releasable mechanism for closing the flow openings 26. The form of releasable mechanism which I find most suitable for the purpose is a sleeve valve 30 slidable vertically on the exterior of the section of tubing 20. A coil spring 31 urges this sleeve valve downwardly to closed position.

As previously mentioned, it is desirable to permit fluid within the tubing to vent through the flow openings 26 and 27 while the tubing and the packer are being lowered to operative position within the well. I make provision for retaining the sleeve valve 30 in the retracted position shown in Fig. 2 by positioning a control device transversely of the tubing at the level of the bottom of the valve 30. Such control device should be operable from the surface. While a connection between such control device and the top of the tubing might be maintained while the packer was being lowered in the well, I prefer to use as such control device a frangible disc 33 having extremities 34 which extend outwardly beneath the lower rim of the sleeve valve 30. The portion of the valve guide 20 which is shown in Fig. 5 pictures the arrangement for mounting the frangible disc in operative retaining position. Figure 5 shows an opening 26 at each side of the valve guide 20, and is a view taken nearly at right angles to Figs. 2 and 3. The disc 33 is elongated so that it may be passed through an opening in the side of the section of tubing 20. Such an opening is shown in Fig. 5 and includes a vertical slot 35 connected with a horizontally projecting leg 36. The section of tubing 20 is provided on the diametrically opposite side with a similar opening including a vertical slot 35 and horizontal portion 36. The disc is inserted through the slots 35 so as to extend transversely of the tubing and with its extremities 34 projecting. The disc is then elevated to the position shown in Figure 2, the disc being moved angularly about the axis of the tubing through a small angle to bring the extremities 34 upon the

shoulders 37. The extremities 34 extend beneath the lower rim of the sleeve valve 30. When the packer has been lowered to operative position within the well, a weight or some instrument for imparting a blow is dropped upon the disc 33 so as to fracture or otherwise collapse the same. The removal of the control device permits the sleeve valve 30 to close the flow openings 26.

As previously explained, the sleeve 11 becomes expanded to the position shown in Fig. 1 when the packer is in operative position within the well. Accordingly, gas under pressure accumulates within the chamber 24 beneath the partition member 23. Check valve controlled passageways 38 extend upwardly within the partition member 23. In the embodiment shown, the check valves take the form of balls 39 which prevent flow of fluid downwardly along the passageways 38. Ports 40 extend through the wall of the tubing so as to permit the fluid, such as gas under pressure, which flows upwardly through the check valve controlled passageways 38 to enter the tubing. The gas thus entering the tubing aerates the oil flowing upwardly within the tubing and so reduces the specific gravity of the oil that it is lifted by the pressure within the well to the surface.

In Fig. 3 are shown details of the construction of the packer adjacent the partition member 23. In order that the balls 39 may be inserted, bores 41 are drilled through the partition member from the top thereof. The upper ends of these bores are closed by plugs 42. A valve seat 43 rests on top of the partition member 23; and in Fig. 4 this valve seat is shown engaged by the sleeve valve 30, which has been lowered to closed position by the force of the coil spring 31. In the embodiment shown, the lower end of the valve guide 20 rests on a shoulder 44 formed by a counter-bore in the upper part of the partition member 23.

It may occur that the packing element 11 which is of flexible material may not pack off the gas initially. In such case, gas may be pumped down outside of the tubing from a point in the casing head. For admitting this gas under pressure to the chamber 24, I have provided ports 46 through the body 9, these ports being controlled by check valves 47 which permit flow inwardly through the ports 46 but prevent discharge outwardly therethrough. The pumping of gas into the chamber 24 through the ports 46 causes gas to flow upwardly through the passageways 38 so as to discharge through the ports 40 and produce a jetting action. This jetting action starts the flow of oil; and when sufficient pressure has accumulated below the packing element to entirely prevent leakage of gas past the same, the check valves 47 prevent discharge outwardly of fluid through the ports 46.

In constructing my improved jet flow packer, I have maintained the inner diameter of the tubing throughout sufficiently large to permit any object which can be lowered through the tubing to pass through the packer. If at any time, it is found that the jetting effect obtained by the action of the gas discharged from the ports 40 is insufficient to maintain the flow of oil, a pump operated by sucker rods may be lowered through the tubing to pump the well in the usual manner. In thus lowering the pump and sucker rods, it is not necessary to remove the packer, due to the uniform inner diameter of the tubing throughout.

It will be noted that a packer constructed in accordance with the principles of my invention is of assistance in continuing the flow from an oil well after the initial pressure which started the well to flowing has decreased to such a point that it can no longer raise the fluid. The jetting action brought about by the flow of gas into the tubing at the partition member of the tubing assists the natural pressure tending to force the oil to the surface. Thus the flow of oil is maintained after the oil would otherwise cease to flow.

The venting of the tubing during the lowering action is of importance, since it permits the tubing to fill as the packer is lowered, fluid entering the working barrel and passing upwardly within the tubing due to the vent afforded by the flow passages 26 and 27. Moreover, any gas accumulating within the chamber 24 is vented through the passages 38 and ports 40, since the latter discharge by way of the tubing and flow openings 26 and 27 to the outside of the shell 28.

As the packer is lowered in the well, the bulbous portion 14 of the sleeve 11 rides downwardly on the casing wall, and fluid pressure in the chamber 24 is vented as above pointed out. The shape of the packing element 11 is of advantage both during the lowering operation and when the pressure beneath the partition member causes expansion of this element to seal the packer in the well. The depending portion of the sleeve 11 which tapers downwardly and inwardly is flexible because of the thinning out of the sleeve, so that expanding of the lower portion of the sleeve is facilitated. Moreover, the bulbous enlargement of the sleeve causes the packing element to ride down the walls more readily. The fingers 15 prevent the bottom of the packing element from collapsing, while permitting fluid such as gas pressure to flow upwardly into the chamber 24. Should there be an obstruction in the casing, the fingers are caused to push downwardly into a more straightened position so as to permit the bulbous portion 14 to be forced inwardly by the obstruction. The fingers 15 tend to maintain the periphery of the depending portion of the sleeve 11 in operative engagement with the casing so as to prevent flow upwardly outside the packer body 9, while permitting fluid to readily enter the chamber 24 surrounding the tubing 22 by passing between the fingers 15. The building up of pressure within the packing element 11 forces the depending portion of the sleeve into firm sealing engagement with the casing 7.

The opening of uniform diameter which extends through the packer is of considerable importance, since by this construction it is possible to pass through the packer any mechanism which is of such size that it can be lowered through the tubing. By thus making the opening through the center of the packer as large or larger than the inside diameter of the tubing, it is possible to lower a pump through the packer for pumping oil, after flow by means of the air lift principle has ceased. Moreover, when thus resorting to the use of a pump, it is not necessary to remove the packer; and the latter may be left in the well to seal off the portion below the packer. Further advantages of my improved construction will be apparent, from the above description, to those skilled in the art to which such constructions pertain.

While I have illustrated and described one specific form of jet flow packer, it will be understood that the invention is not restricted to the

particular construction and arrangements shown, but may be variously modified within the contemplation of the invention and under the scope of the following claims.

I claim:

1. In a jet flow packer for oil wells, in combination, a packing element, tubing extending through said element, said tubing having a flow opening above said element for free outward flow of fluid and means operable to permanently and positively obturate said opening against flow of fluid therethrough.

2. In a jet flow packer for oil wells, in combination, a packer body, a packing element on said body, tubing within the packer body, said tubing including a partition member closing the upper end of an annular chamber between said packing element and said packer body, said tubing having a flow opening placing said annular chamber in communication with the interior of said tubing and an outflow opening placing the interior of said tubing in communication with the exterior thereof above said partition member, and means for stopping flow through said second mentioned flow opening.

3. In a jet flow packer for oil wells, in combination, a packer body, a packing element on said body, tubing within said packer body having an outflow opening to the space above said packer, releasable means movable upon release to position for obturating said opening, and a check valve controlled flow opening for admitting fluid to the tubing.

4. In a jet flow packer for oil wells, in combination, a packer body, a packing element on said body, and tubing spaced within and sealed to said packer body, said tubing having a flow opening for the admission of fluid from the space between said tubing and packing element to the interior of said tubing and a flow opening above said packer for the discharge of fluid from the interior of said tubing.

5. In a jet flow packer for oil wells, in combination, a packer body, a packing element on said body, tubing within said packer body, said tubing having a vent opening above said packing element, and releasable means for stopping flow of fluid through said vent opening, said means including a valve and a removable detent for retaining the valve in open position.

6. In a jet flow packer for oil wells, in combination, a packer body, a packing element on said body, tubing within said packer body, said tubing having a flow opening placing the interior of said tubing in communication with the exterior thereof, and means for controlling flow along said tubing and through said flow opening, said controlling means including a valve co-operating with said flow opening and a frangible detent for temporarily retaining the valve in open position.

7. In a jet flow packer for oil wells, in combination, a packer body, a packing element on said body, and tubing within said packer body, said tubing having a partition member closing the top of an annular chamber between said tubing and packing element, said tubing being provided with flow openings permitting flow of fluid from said chamber to the interior of said tubing and from the interior of said tubing to the exterior thereof above said partition member.

8. In a jet flow packer for oil wells, in combination, a packer body, a packing element on said body, tubing within said packer body, said tubing having a partition member defining a gas

chamber within packing element and surrounding said tubing, said tubing having flow openings for the discharge of fluid from said chamber into said tubing and from the interior of said tubing to the exterior thereof above said partition member, and releasable means for stopping such discharge from the interior to the exterior of the tubing.

9. In a jet flow packer for oil wells, in combination, a packer body, tubing within the body, said tubing having a flow opening placing the interior of said tubing in communication with the exterior thereof, and a sleeve valve for closing said flow opening.

10. In a jet flow packer for oil wells, in combination, a tubing connection, tubing extending downwardly from said connection, said tubing being provided with a vent packing for the joint between said connection and said tubing, and a sleeve valve slidable on said tubing for controlling discharge of fluid through said vent.

11. In a jet flow packer for oil wells, in combination, a packer body, a packing element on said body, tubing within said packer body, said tubing having a flow opening placing the interior of said tubing in communication with the exterior thereof, a releasable sleeve valve for closing said flow opening, and a frangible disc controlling release of said valve to close said flow opening.

12. In a jet flow packer for oil wells, in combination, a packer body, a packing element on said body, tubing within said packer body, said body having openings for admitting fluid from above said packing element to the space between said tubing and packer body and said tubing having openings for the admission of fluid from said space to the interior of said tubing, and a

check valve for preventing return flow out of said space through said body opening.

13. In a jet flow packer for oil wells, in combination, a packer body, a packing element on said body, tubing within and spaced from said packer body and sealed thereto, said body having flow openings for admitting fluid to the space between said tubing and packer body and openings for the admission of fluid from the space between said tubing and packer body to the interior of said tubing and for the discharge of fluid from said tubing above said packer body, a valve controlling such discharge of fluid from the tubing, and a frangible detent controlling closing of said valve.

14. In a jet flow packer for oil wells, in combination, a packer body, a packing element on said body, and tubing spaced within and sealed to said packer body, said tubing having a flow opening for the admission of fluid from the space between said tubing and packer body to the interior of said tubing and a flow opening placing the interior of said tubing in communication with the exterior thereof, above said packer body, releasable means for closing said second mentioned flow opening, said body having a check valve controlled opening for admitting fluid to said space between said tubing and packer body.

15. In a jet flow packer for oil wells, in combination, a packer body, a packing element on said body, tubing within said packer body, said tubing having a flow opening placing the interior of said tubing in communication with the exterior thereof, a sleeve valve slidable on said tubing for closing said flow opening, and a removable detent for holding said valve temporarily in open position.

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