

June 11, 1940.

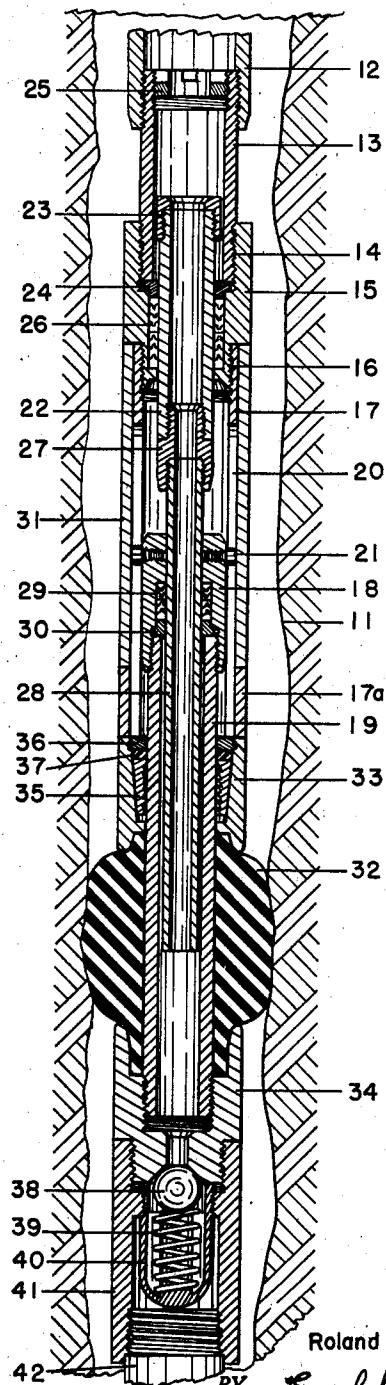
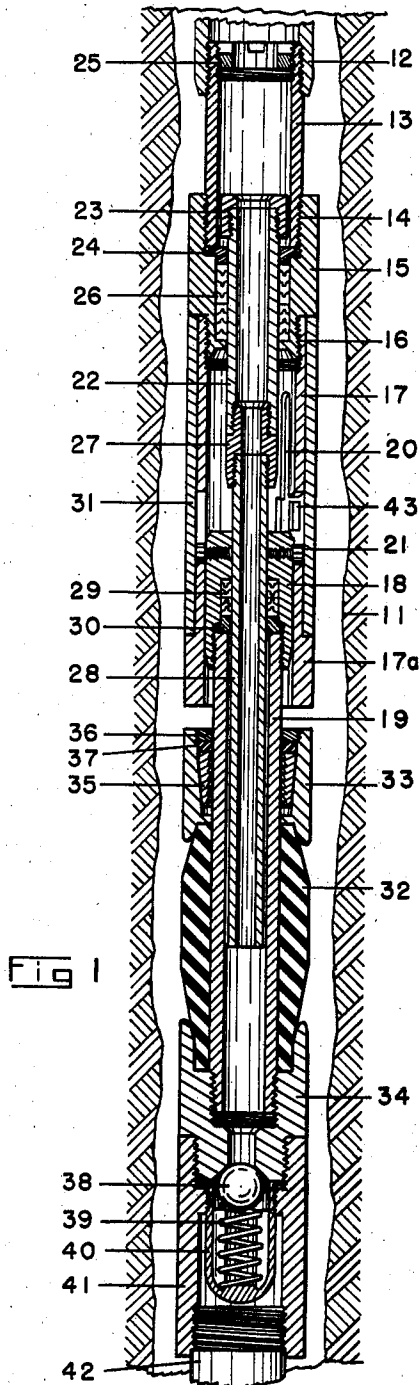
R. E. O'DONNELL

2,204,378

OPEN HOLE PACKER

Filed June 8, 1939

2 Sheets-Sheet 1



INVENTOR.
Roland E. O'Donnell

BY *Earl Babcock*
ATTORNEYS.

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R. E. O'DONNELL

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2 Sheets-Sheet 2

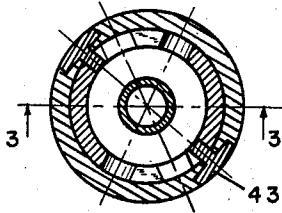


FIG 5

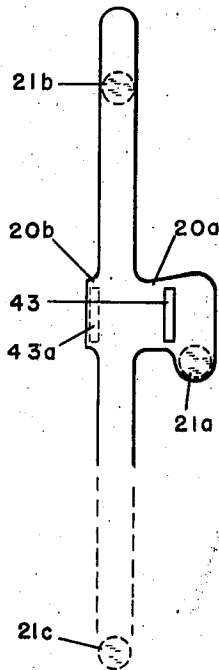


FIG 6

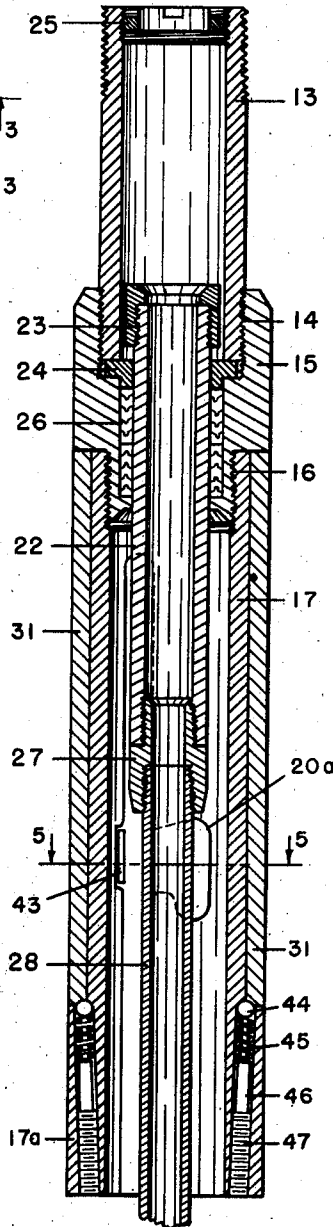


FIG 3

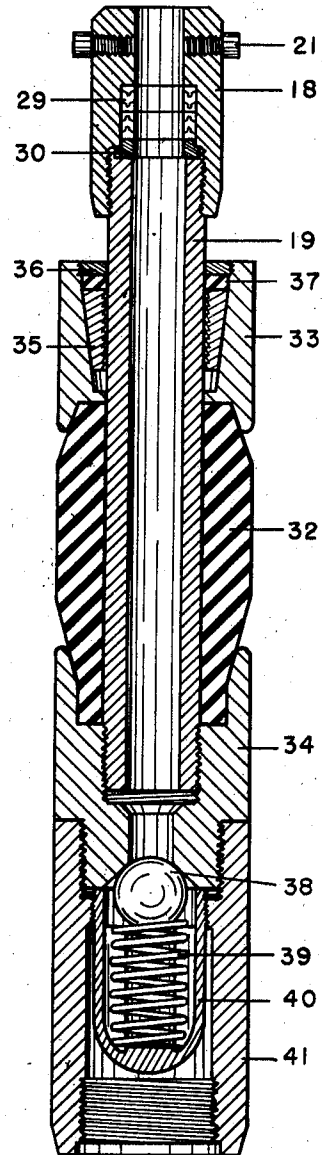


FIG 4 INVENTOR.

Roland E. O'Donnell

BY *Carl Babcock*
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,204,378

OPEN HOLE PACKER

Roland E. O'Donnell, Midland, Tex., assignor to
Halliburton Oil Well Cementing Company,
Duncan, Okla.

Application June 8, 1939, Serial No. 278,051

3 Claims. (Cl. 166—10)

This invention relates to packers adapted for use in oil wells, and more particularly to packers adapted to be secured in the open or uncased portion of an oil well to effect a seal therein and to prevent fluid under pressure from moving past the same.

It is often desirable in making an oil well to provide a packer in the open hole which will hold fluid under pressure. Thus, where the well is being cemented by what is known as a "squeeze job" in which the cement is forced under high pump pressure down through tubing and off into the formation of the well, it is necessary to prevent the cement from flowing upwardly on the outside of the tubing. As commonly practiced heretofore, the cement has been prevented from moving upwardly on the outside of the tubing by means of a cement retainer set by means of slips to casing in the well. It is sometimes desirable, however, to cement off a formation some distance below the shoe of the casing while preventing the flow of cement into another formation below the shoe of the casing but above the formation being cemented. The present arrangement, wherein the packer is set and secured in the open hole beneath the shoe of the casing and so arranged as to withstand considerable pressure, is intended to solve this problem.

Packers of the type herein shown and described may also be used to advantage in connection with the acidizing of oil wells. They are particularly adapted for use in connection with combination acidizing and cementing operations of the type shown, described and claimed in the United States patent to William D. Owsley, et al., No. 2,163,449, for "Method of treating a well", granted June 20, 1939.

Accordingly, it is one object of the invention to provide a packer which will be capable of withstanding high pressure when seated within the open portion of an oil well or the like.

It is another object of the invention to devise novel means for supporting and securing a packer in the open portion of an oil well and to provide novel means for connecting tubing or other conduit means thereto.

It is still another object of the invention to provide novel means for securing and sealing a valve in the open portion of an oil well.

It is still another object of the invention to provide novel means for setting a packer in a well and for detachably connecting tubing thereto.

Other objects and advantages reside in certain novel features of the arrangement and construction of parts as will be apparent from the follow-

ing description taken in connection with the accompanying drawings, in which:

Figure 1 is a vertical, cross-sectional view of a section of the open portion of an oil well showing apparatus constructed in accordance with the present invention being lowered therein;

Figure 2 is a vertical, cross-sectional view of the open portion of an oil well with the same apparatus as that shown in Figure 1 located therein, this figure showing the position of the parts when the packer is set;

Figure 3 is an enlarged, vertical, cross-sectional view of the packer setting apparatus shown in Figures 1 and 2, the view being taken at right angles to the section illustrated in Figures 1 and 2;

Figure 4 is an enlarged, vertical, cross-sectional view of the packer assembly of the apparatus of Figures 1 and 2, the view being taken at right angles to the sections shown in Figures 1 and 2;

Figure 5 is a transverse-sectional view of the apparatus shown in Figure 3, taken on the lines 5—5 thereof; and

Figure 6 is a diagram showing a development of the slot used in connecting the packer setting tool to the packer assembly and showing in dotted lines the positions of the connecting pins during various operations of the arrangement.

Referring to the drawings in detail, and first to the assembly of the apparatus shown in Figures 1 and 2, it will be seen that the open portion of an oil well is there illustrated at 11. Within the well, apparatus constructed in accordance with the present invention is lowered upon tubing or other pipe, as illustrated at 12. The apparatus of the present invention consists of two assemblies, one being the packer assembly and the other the assembly used in setting the packer, the packer setting assembly being connected to the tubing 12 and carrying the packer assembly at its lower end through pin and slot connections as will presently be described.

The packer setting assembly includes a section of pipe 13 screw threaded into the tubing 12 and which is called a neck. The lower end of this neck is connected by screw threads 14 to a collar 15, and the collar is in turn connected by screw threads 16 to a depending inner sleeve 17. The sleeve 17 extends down over a head 18 on a mandrel 19 which forms part of the packer assembly, and the sleeve 17 is connected to the head 18 by pin and slot connections, the slot being in the sleeve 17 as shown at 20 and the pins being secured to the head 18 as shown at 21.

Within the sleeve 17, there is a packing mandrel 22 mounted for limited longitudinal move-

ment. The upper end of this mandrel is provided with a head 23 which prevents the packing mandrel moving downwardly below the point where the head 23 contacts a packing ring 24.

Upward movement of the packing mandrel is limited by a stop ring 25 screw threaded into the upper end of the neck 13. The packing mandrel 22 extends through suitable packing, such as the chevron packing illustrated at 26 clamped within the collar 15 by the packing ring 24. The lower end of the packing mandrel 22 is connected to an adapter 27 to which a tail pipe 28 is connected, this tail pipe extending down through the head 18 and into the mandrel 19 of the packer assembly. Additional packing is provided between the tail pipe 28 and the head 18, this packing being illustrated at 29 and being shown as secured in place by means of a clamping ring 30.

The packer setting assembly also includes an outer sleeve 31 which is fitted over the sleeve 17 and which may be referred to as a locking sleeve, since it functions to hold the pins 21 in the proper positions in the slots 20 until it is desired to release the setting assembly from the packer assembly. The operation of the sleeve 31 to accomplish this will be described hereinafter in connection with a description of Figures 3, 5 and 6. The sleeve 31 is not as long as the inner sleeve 17, and the inner sleeve 17 is provided with an enlargement or shoulder 17a at its lower end to hold the outer sleeve 31 in place. It will be noted that there are no threads on the sleeve 31 and that it is free to rotate upon the sleeve 17.

In addition to the mandrel 19 with its head 18 previously described, the packer assembly includes a rubber sleeve or packer 32 mounted upon the mandrel 19 and provided with an upper shoe 33 and a lower shoe 34. The upper shoe 33 contains slips 35 having upwardly directed teeth on their inner surfaces adapted to grip and engage the mandrel 19 and prevent upward movement of the shoe 33 thereon when the shoe 33 is forced downwardly. The slips 35 are held in place by means of a slip retaining ring 36 screw threaded into the top of the shoe 33. A rubber compression ring 37 may be placed between the ring 36 and the slips 35, if desired.

The lower shoe 34 of the packer assembly is provided with a suitable valve, such as the ball 38 actuated under the influence of a coil spring 39 carried by a cage 40 mounted within an adapter 41 adapted to make connection with an anchor pipe 42, only a portion of which is shown in Figures 1 and 2. It will be understood that the anchor pipe 42 will extend to the bottom of the well and serve as means for supporting the lower shoe 34 of the packer against downward movement in the well. It will be understood that the anchor pipe may be provided with holes at various points throughout its length so that fluid may readily flow outwardly therethrough, and that it may be made of drillable material so that it may be easily removed from the well after the assembly has been used in cementing, acidizing, or otherwise treating the well.

Devices constructed in accordance with the present invention have been used in the field, the anchor pipe being made of wood or aluminum and the mandrel 19 of Bakelite or cast iron, and the shoes 33 and 34 of aluminum. The back pressure valve may be made up of the ball 38 of hard rubber, the valve cage 40 of aluminum, and the adapter 41 of aluminum.

Figure 2 shows the arrangement of Figure 1 with the parts in the position which they occupy

when the packer is set but before the packer setting assembly has been removed from the well. In order to set the packer, it is simply lowered into the well with the parts occupying the positions shown in Figure 1. When the anchor pipe 42 strikes the bottom of the well, the tubing 12 is rotated to bring the pins 21 into the proper portion in the slots 20 to permit the sleeve 17 to move downwardly under the influence of the weight of the tubing 12 and cause the shoulder 17a to force the upper shoe 33 downwardly so that the packer is expanded into the position shown in Figure 2 to form a tight seal with the wall of the well, the slips 35 latching the upper shoe 33 in place so that the packer assembly is firmly secured in the well. Cementing, acidizing, or other fluid treating operations may then be carried on since fluid may flow downwardly through the tubing 12, the neck 13, the packing mandrel 22, the tail pipe 28, the mandrel 19, and the back pressure valve 38 into the anchor pipe 42. After fluid has been forced downwardly in this manner, the back pressure valve 38 will close and prevent upward flow of fluid in the well after the tubing 12 and the packer setting assembly have been removed from the well.

As stated above, it is necessary to rotate the sleeve 17 with respect to the packer mandrel 19 in order to set the packer. In order to prevent accidental relative rotation between these parts while the apparatus is being lowered into the well, it is desirable to provide means which will offer some resistance to this relative movement. In the apparatus illustrated, this is provided by means of the outer sleeve 31 and its associated parts, this best being understood by referring to Figures 3, 5 and 6. As shown in Figures 3 and 6, the slots 20 are provided with longitudinal portions which extend from the very bottom of the sleeve 17 up to a point well above the lateral offset portions indicated at 20a. The pins 21 on the packer mandrel occupy the position illustrated in Figure 6 at 21a when the assembly is being lowered into the well. They occupy the position shown at 21b when the packer is being set by the packer setting assembly, and then move downwardly completely out of the slots as illustrated at 21c when the packer setting assembly is removed from the well.

When the apparatus is being lowered into the well, the pins 21 cannot move out of the lateral portion 20a of the slots until the sleeve 31 is rotated with respect to the sleeve 17. This is accomplished by means of pins 43 shown in Figures 3, 5 and 6, which pins are integral with the outer sleeve 31 and extend inwardly into the portion 20a of the slots 20 when the apparatus is being lowered into the well. When the sleeve 31 is rotated with respect to the sleeve 17, the pins 43 take the position shown in dotted lines at 43a in Figure 6, in which position the pins 21 may move into the longitudinal portion of the slots 20, there being a recess 20b in the slots opposite the lateral offset portion 20a to receive the pins 43.

Any suitable means may be provided which will prevent the sleeve 31 from rotating too easily upon the sleeve 17. In the arrangement illustrated in Figure 3, spring-pressed, ball detents are mounted in the shoulder portion 17a of the inner sleeve and fitted into the recess on the lower edge of the sleeve 31. The balls used for this purpose are shown at 44, and the springs for operating the balls are shown at 45. These may be mounted in vertically drilled holes 46 75

in the shoulder portion 17a of the inner sleeve and may be adjustably mounted by means of adjusting screws 47 mounted therein. It will thus be seen that in order to rotate the sleeve 31 with respect to the sleeve 17, the balls 44 must be pressed downwardly slightly against the action of the springs 45 so that considerable torque must be exerted between the pins 21 and the sleeve 17 in order to rotate the pins 21 into the longitudinally extending portions of the slots 20. The anchor pipe 42 prevents the mandrel 19 and the pins 21 from rotating while the tubing 12 and the packer setting assembly are rotated to move both sleeves 17 and 31 with respect to the pins 21, and to move the sleeve 17 relative to the sleeve 31 as just outlined above. If desired, other means for resisting rotation between the sleeve 17 and the sleeve 31 may be provided such, for example, as frictional washers.

After the pins 21 are in the longitudinal portions of the slots 20, the packer setting assembly may be moved downwardly to depress the upper shoe 33 and set the packer. The packer setting assembly may then be removed from the well at any time, leaving fixed in the well the portion of the apparatus shown in Figure 4, together with the anchor pipe.

While only one embodiment of the invention has been shown and described herein, it is obvious that various changes may be made in the construction and arrangement of parts without departing from the spirit of the invention or the scope of the annexed claims.

I claim:

1. In combination, an open hole packer assembly and a packer setting assembly for temporarily securing and sealing a conduit in a well, said packer assembly including a central hollow mandrel with a lower shoe fixed thereto and having a back pressure valve operatively connected therewith, an anchor pipe for preventing downward movement of said mandrel and lower shoe, a packer on said mandrel above said lower shoe, an upper shoe slidably mounted on said mandrel above said packer and having means for gripping said mandrel to prevent upward movement with respect thereto, and said packer setting assembly including means for detachably connecting a conduit to said hollow mandrel in fluid tight relation, means for depressing said upper shoe to set the packer and releasable means operable by manipulation of said conduit for holding said

upper shoe depressing means in inoperative position, to prevent the setting of said packer prematurely.

2. In combination, an open hole packer assembly and a packer setting assembly for temporarily securing and sealing a conduit in a well, said packer assembly including a central hollow mandrel, with a lower shoe fixed thereto and having a back pressure valve associated therewith, an anchor pipe for preventing downward movement of said mandrel and lower shoe, a packer on said mandrel above said lower shoe, an upper shoe slidably mounted on said mandrel above said packer and having means for gripping said mandrel to prevent upward movement with respect thereto, and said packer setting assembly including pin and slot connecting means for detachably connecting a conduit to said hollow mandrel in fluid tight relation, means for depressing said upper shoe to set the packer when the pin and slot connecting means are adjusted to one position and means for preventing accidental movement of said pin and slot connecting means to said packer setting position.

3. In combination, an open hole packer assembly and a packer setting assembly for temporarily securing and sealing a conduit in a well, said packer assembly including a central hollow mandrel, with a lower shoe fixed thereto and having a back pressure valve associated therewith, an anchor pipe for preventing downward movement of said mandrel and lower shoe, a packer on said mandrel above said lower shoe, an upper shoe slidably mounted on said mandrel above said packer and having means for gripping said mandrel to prevent upward movement with respect thereto, and said packer setting assembly including a sleeve adapted to make connection with a conduit and having slots therein adapted to receive pins on said mandrel to form a pin and slot connection with said mandrel, a tail pipe mounted for limited longitudinal movement in said sleeve and adapted to extend into said mandrel through a packing gland to make a fluid tight connection therewith and means for preventing accidental movement of said pins in said slots, the arrangement being such that by manipulation of said conduit, the sleeve may be moved downwardly with respect to said mandrel to depress the upper shoe thereon and set the packer in the well.

ROLAND E. O'DONNELL.