Oct. 15, 1940. R. K. HENDERSON 2,217,747

DRILLABLE PACKER

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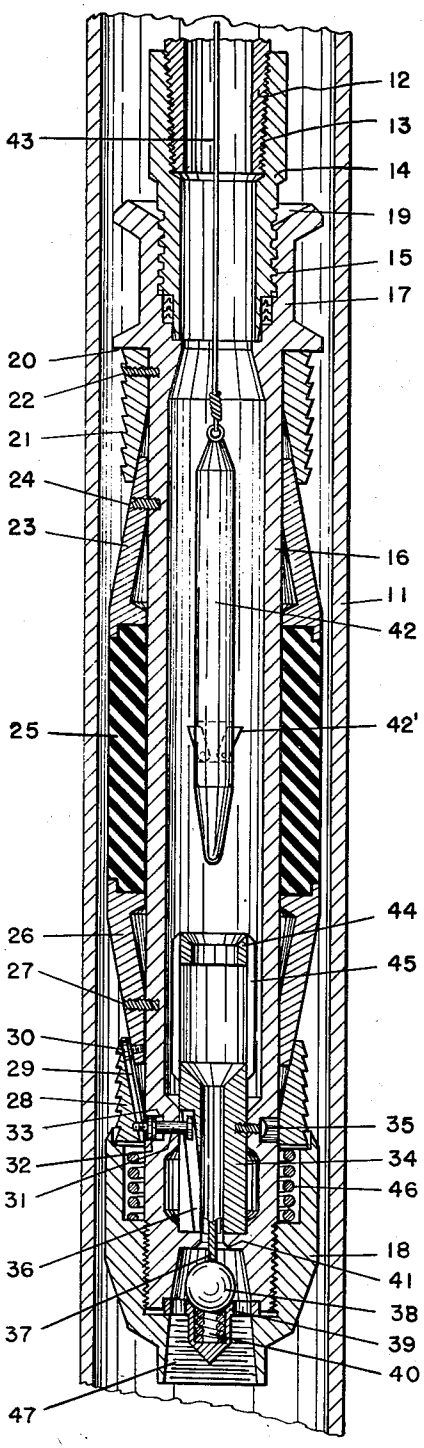


Fig 1

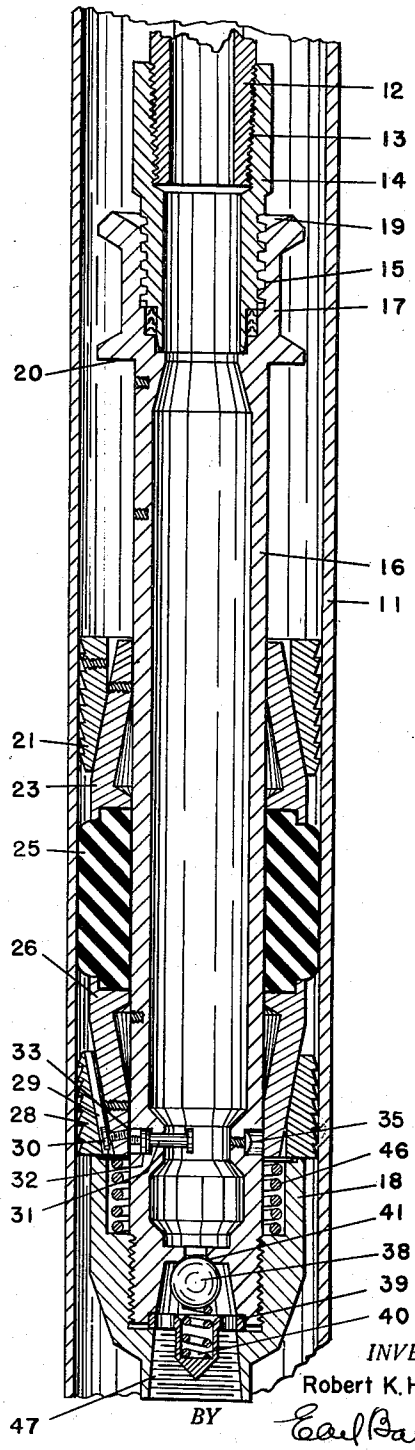


Fig 2

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DRILLABLE PACKER

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5 Claims. (Cl. 166—12)

This invention relates to apparatus adapted for use in oil wells, and more particularly to packers adapted to secure and seal the lower ends of conduits, such as tubing, within the casing of an oil well.

It is often desirable to fix and seal tubing or other structure in the casing of an oil well. For example, when a well is to be cemented by forcing cement slurry under pressure down into the well through the tubing and into the formation of the well, it is desirable to provide means at the bottom of the tubing which can be fixed to the casing thus holding the tubing in place against the fluid pressure exerted upon the cement. At the same time, it is desirable to provide a packer or other sealing means around the tubing so as to prevent the passage of cement slurry upwardly between the tubing and the casing.

It is an object of the present invention to devise novel means for setting a packer on tubing or other pipe in a well and for securing the packer in place to hold the same against movement either up or down in the casing.

It is another object of the invention to devise novel means for accurately measuring the depth of a packer in a well and then setting the same while assured that the packer is at the correct depth.

It is still another object of the invention to devise novel means for controlling the setting of slips associated with a conduit in a well and for measuring the depth of the slips in the well at the time when they are set.

It is still another object of the invention to devise novel means for controlling the operation of a back-pressure valve associated with a conduit in a well.

Other objects and advantages reside in certain novel features of the arrangement and construction of parts as will be more apparent from the following description taken in connection with the accompanying drawing, in which:

Figure 1 is a vertical cross sectional view of a packer constructed in accordance with the principles of the invention, the view illustrating the packer located in casing in a well and also showing apparatus used in setting the same; and

Figure 2 is a vertical cross sectional view of the packer and casing of Figure 1, this view illustrating the position of the parts when the packer is set and ready for use in a cementing operation.

Referring to the drawing in detail, it will be seen that an oil well casing is illustrated at 11. Within this casing is a string of tubing, the lower end of which is illustrated at 12. To this tubing is connected apparatus for securing and sealing the tubing to the casing.

As illustrated at 13, the lower end of the tubing is threaded and connected to a special bushing 14, the lower end of which is provided with dizzy or back-off threads 15 and threaded into the mandrel 16, which is of general tubular construction provided with an enlargement 17 at its upper end and connected to guiding collar 18 at its lower end. The enlargement 17 is provided with a conical recess 19 at its upper surface to aid in guiding the bushing 14 into the recess containing the dizzy threads, and is also provided with a lower shoulder 20 which provides an abutment for the upper set of slips 21. The slips 21 are of usual construction consisting of conical segments provided with teeth or serrations on their outer surface adapted to grip and bite into the casing. These slips are secured to the mandrel 16 by means of shear pins, one of which is shown at 22 in Figure 1. The lower end of the slips extend out over a cone shaped slip actuating member 23 which also serves as the upper shoe of the rubber packing 25. The slip actuating member 23 is also secured to the mandrel 16 by shear pins, one of which is shown in Figure 1 at 24. The slips 21 are preferably dove-tailed to the slip actuating member 23, but this is not necessarily so and has not been illustrated in the drawing.

The packing 25 is of usual construction and may consist merely of a heavy rubber sleeve having its upper and lower ends shaped to fit into recesses in the upper and lower shoes as illustrated.

Beneath the packing 25 a second slip actuating conical member is provided, this being illustrated at 26. Like the slip actuating member 23, it is secured to the mandrel 16 by means of shear pins, one of which is illustrated at 27. At its lower end the slip actuating member 26 carries a set of slips 28 similar to the slips 21, except that the teeth or serrations thereon are directed downwardly, whereas, those on the slips 21 are directed upwardly. The slips 28 are illustrated as being provided with slots 29 on their inner surfaces adapted to cooperate with bolts 30 connected to the slip actuating member 26, the slots 29 and the bolts 30 serving to guide the slips 28 upon the slip actuating body 26. Other arrangements, such as a tongue groove connection or the like, may be used in place of this special guiding arrangement.

An important feature of the invention is the means used to hold the lower set of slips 28 in position until it is desired to set the packer.

This consists of a number of pins, one for each slip segment, which are mounted for radial sliding movement in the mandrel 16, and which extend into holes in the slip segments. One of these pins is illustrated at 31 in Figure 1. It will be seen that the pin is provided with an enlargement 32 which fits into a hole 33 in the mandrel 16, and which with the head of the pin 31 limits the radial movement of the pin. As long as the pins 31 are in the position illustrated in Figure 1, the slips 28 cannot move with respect to the mandrel 16. To hold the pin 31 in the position illustrated in Figure 1 and also to perform other functions which will presently be described, an inner sleeve 34 is fitted within the lower portion of the mandrel 16 and held in place by a shear pin 35. The sleeve 34 is provided with a number of grooves 36 which receive the heads of the pins 31 and positively control movement of the pins as long as the heads of the pins are in the grooves. Thus, if the sleeve 34 is moved upwardly, the pins 31 are drawn inwardly.

The sleeve 34 is also provided with a depending rod 37 which holds a back-pressure valve open until the sleeve is moved upwardly. The back-pressure valve may consist of a ball 38 resting on a spider 39 which carries a coil spring 40 which tends to move the ball 38 upwardly against a seat 41 provided in the lower portion of the mandrel 16. As long as the sleeve 34 is in the position illustrated in Figure 1, fluid can pass either upwardly or downwardly through the mandrel 16, but, upon the sleeve 34 being pulled upwardly, the valve 38 engages the seat 41 and prevents passage of fluid upwardly through the mandrel while still permitting downward flow therethrough.

To shear the pin 35 and pull the sleeve 34 upwardly at the desired time, a special weight member 42 is connected to a measuring line 43 and lowered down through the tubing. The weight member 42 is provided with spring pressed latch dogs 42' which are adapted to secure the weight member 42 to a ring 44 secured to the sleeve 34 by means of bars 45. Figure 1 illustrates the position of the weight member 42 just before it engages the ring 44. Upon lowering the weight member 42 a sufficient distance below the position illustrated in Figure 1, it will eventually be latched to the sleeve 34, whereupon by taking tension in the measuring line 43 the sleeve 34 can be pulled upwardly. The operator will know by the amount of tension in the line when the weight 42 has been latched to the sleeve 34, and will also know when the pin 35 shears because of the sudden decrease in tension in the line. By means of suitable depth measuring apparatus, such as that illustrated in the patent to Halliburton, No. 1,692,037, granted November 20, 1928, for Well sounding device, the operator will know exactly where the packer is at the time when the inner sleeve 34 is moved upwardly.

Upon the sleeve 34 being pulled upwardly, the lower slip segments 28 will move upwardly and outwardly to engage the casing 11. This movement is caused by a coil spring 46 located within the guiding collar 18 and exerting upward pressure on the slips. As soon as the pins 31 are drawn inwardly by upward movement of the sleeve 34, the coil spring 46 moves the slip segments 28 upwardly and due to their relation to the slip actuating member 26, they must also move outwardly at that time. This position of the slips 28 is illustrated in Figure 2.

As illustrated in the drawing, after the measuring line and weight 42 are connected to the sleeve 34, the measuring line 43, the weight member 42 and the sleeve 34 are removed from the well. After the tension in the line 42 has sheared the pin 35, the sleeve 34 first draws the pins 31 inwardly and is then completely disconnected from the same, this being accomplished merely by leaving the lower ends of the grooves 36 open. At the same time, the back-pressure valve is closed as illustrated in Figure 2.

After the sleeve 34 has been pulled upwardly to release the lower slips 28, the packing 25 and the upper slips 21 are set by the simple operation of setting down or lowering the tubing. When the tubing is lowered, the slips 28 do not move downwardly other than perhaps a very slight distance due to the fact that they are already in engagement with the casing. As pressure is exerted downwardly by the weight of the tubing, the pins 22 securing the upper slips 21 to the mandrel, the pins 24 securing the slip actuating body 23, and the pins 27 securing the lower slip actuating body 26 to the mandrel, all shear and the slips and packing take the position illustrated in Figure 2. As illustrated in Figure 2, the mandrel 16 may be moved vertically through the slips and packer assembly to a certain extent, this movement being limited by the shoulder 20 near the upper portion of the mandrel and the collar 18 on the lower portion thereof. By "spudding" or moving the tubing up and down, the packer and slips can be securely fixed to the casing. Each time the tubing is lowered, the shoulder 20 abuts against the slips 21 and forces them downwardly. Each time the tubing is raised, the collar 18 abuts against the lower slips 28 and forces them upwardly. The teeth on the slips are of such a nature that this "spudding" operation works them closer together and compresses the packing 25.

The bottom of the collar 18 is preferably threaded as illustrated at 47 so that a tail pipe can be connected thereto as is sometimes desired in cementing operations.

After the slips, packing and back-pressure valve take the position shown in Figure 2, a cementing operation such as a "squeeze job" may be performed by forcing cement slurry downwardly through the tubing and back-pressure valve. The slips 21 and 28 hold the tubing against movement in either direction, and the packing 25 prevents passage of slurry upwardly between the tubing and the casing. After the cement has been forced downwardly past the back-pressure valve, the tubing may be disconnected from the mandrel at the dizzy threads 15 and the tubing removed from the well. The back-pressure valve 38 closes at that time, and the cement slurry is held in place under pressure until it hardens. The mandrel, slips, packer and associated parts may be drilled up as the well is completed.

Only one embodiment of the invention has been shown and described herein. Other embodiments have been constructed in which the upper set of slips 21 were released by movement of a sleeve controlled by the measuring line instead of controlling the lower set of slips by such an arrangement. Where the upper set of slips are set first, the remainder of the packer assembly is set by pulling up the mandrel against them rather than by setting down as in the arrangement il-

lustrated. Various departures from the arrangement illustrated may be made without departing from the spirit of the invention or the scope of the annexed claims.

I claim:

1. Apparatus for securing and sealing a conduit to the casing in a well, said apparatus including a mandrel, a packing mounted thereon, slips also mounted on the mandrel and mechanism for setting the slips and packing, said mechanism including a sleeve mounted within the mandrel and connected thereto by shear means, pins extending through said mandrel and operatively connected with said sleeve and said slips to hold the slips against movement relative to said mandrel when the sleeve is held in position by said shear means, and a flexible line with a latch adapted to engage and actuate said sleeve and shear said shear means and move said sleeve upwardly when desired to actuate said pins and release said slips to move relative to the mandrel and engage the casing in the well.

2. Apparatus for securing conduit means to the casing in a well including a member adapted to be connected to said conduit means, slips mounted on said member, latching means operatively connected with said slips and member for holding said slips in such position that they cannot grip the casing, a flexible line having a weight secured to its lower end, said weight having means for making connection to said latching means and for tripping the same upon tension being taken in said line to release the slips to grip the casing.

3. Apparatus for accurately locating a packing at a desired depth in a well and for securing the same to the casing in the well at that depth, said apparatus including a member carrying the packing, casing gripping means mounted on said member and adapted, when set, to secure the packing to the casing, latching means operatively connected with said member and said casing gripping means, and a measuring line having a weight thereon adapted to make connection to said latching means and trip the same to release said casing gripping means while indicating the depth of said weight in the well.

4. Apparatus adapted for use in the cementing of an oil well, said apparatus including a packing, a hollow member carrying the packing, said member being adapted to be connected to the lower end of a pipe through which cement slurry may be forced into the well, a back-pressure valve in said hollow member, latching means holding said valve open while said member is being lowered into the well and a flexible line having a weight secured thereon adapted to be lowered into the well through said pipe and engage and trip said latching means when desired to permit said valve to close.

5. Apparatus for securing and sealing a pipe in a well comprising, in combination, a hollow member adapted to be connected to the lower end of the pipe and lowered into the well thereby, said member having a back-pressure valve therein, gripping means carried by said member for engaging the wall of the well and preventing movement of said member when set, latching means operatively connected with said member for holding said gripping means out of wall engaging position and for holding said back-pressure valve open while the member is lowered into place in the well, and a flexible line having a weight secured thereto adapted to be lowered into the well through said pipe to engage and trip said latching means to release said gripping means and permit the same to engage the wall of the well and to permit said back-pressure valve to close.

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