April 22, 1941. E. P. HALLIBURTON 2,239,150

COMBINATION PACKER

Filed Sept. 14, 1939

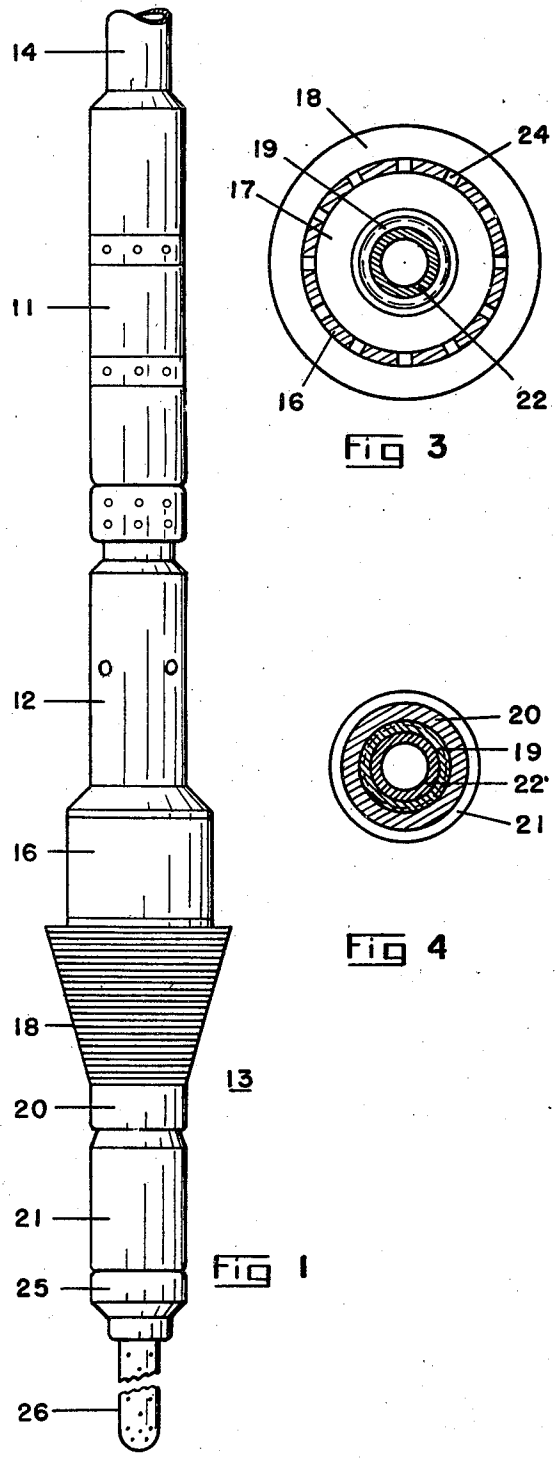


Fig 1

Fig 3

Fig 4

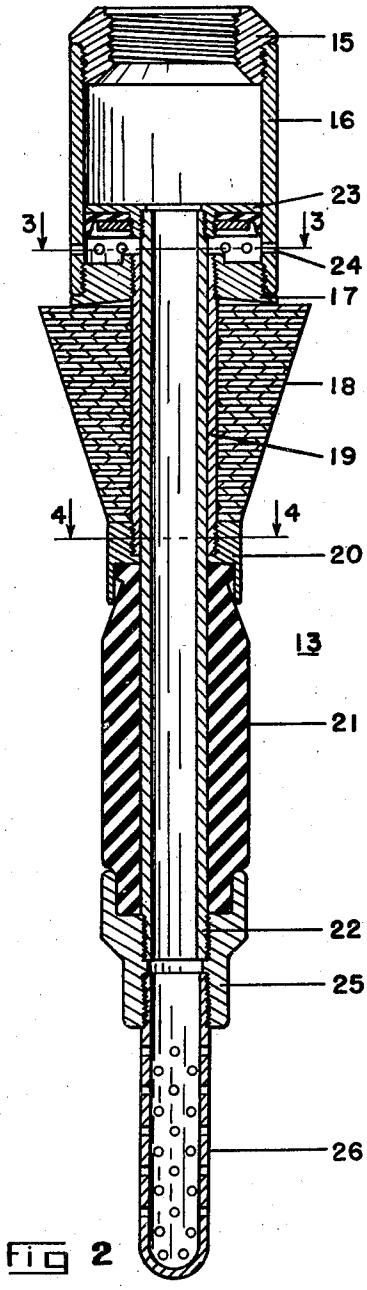


Fig 2

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Patented Apr. 22, 1941 2,239,150

UNITED STATES PATENT OFFICE

2,239,150

COMBINATION PACKER

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Application September 14, 1939, Serial No. 294,881

8 Claims. (Cl. 166—11)

This invention relates to oil well equipment and more particularly to means for setting packers in a rat-hole in a well.

It is often desirable to effect a seal between a conduit placed in an oil well and the wall of the well. For example, where it is desired to obtain a sample of the connate fluid in the well by means of a testing tool, a packer is placed on the bottom of the tool to effect a seal. An example of this is disclosed in the patent to Simmons, No. 1,930,987. In making a test a cone packer is commonly employed and is seated upon a rat-hole or hole of small diameter in the bottom of the well. The shoulder at the top of the rat-hole sometimes crumbles so that it is difficult to effect a seal with a cone packer and other difficulties sometimes arise as, for example, where the rat-hole is not exactly centered with respect to the main part of the bore hole.

In order to overcome these difficulties, it has already been proposed to mount a wall packer in a rat-hole in addition to the cone packer seated at the top of the rat-hole in order to effect a double seal. Apparatus for this purpose is described in United States patent to Weiler, No. 2,172,948, patented September 12, 1939, for "Rat-hole packer."

In the aforesaid Weiler patent, the wall packer is supported on the rat-hole packer. Where the shoulder at the top of the rat-hole is apt to crumble or where it is soft, the cone packer is sometimes forced a considerable distance down into the rat-hole before a seal is effected.

In accordance with the present invention, it is proposed to mount a wall packer beneath a cone packer and cause the wall packer to effect a seal without exerting any particular downward thrust upon the cone packer. In this way, a double seal can be effected without unduly drawing the cone packer into the rat-hole.

It is a further object of the present invention to mount a wall packer immediately below a cone packer and cause the wall packer to expand and set, thereby protecting the shoulders of the rat-hole and forming a double seal.

It is still a further object of the invention to provide novel and improved means operating in response to fluid pressure in an oil well for effecting a double seal between a conduit in the well and the wall of the well.

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

Figure 1 is a view in side elevation of a formation testing tool constructed in accordance with the principles of the present invention;

Figure 2 is a vertical cross-sectional view of the packers and operating means for the packers shown in Figure 1;

Figure 3 is a transverse cross-sectional view of the apparatus of Figure 2, the view being taken on the lines 3—3 thereof; and

Figure 4 is a transverse cross-sectional view of the apparatus of Figure 2, the view being taken on the lines 4—4 thereof.

Referring to the drawing in detail, it will be seen that a formation tester assembly is illustrated in Figure 1. This assembly includes a tester valve unit designated 11, an equalizing or bypass valve unit designated 12, and a packer unit designated generally at 13. The tester valve assembly 11 may consist of the conventional Halliburton J-type tool well known to those skilled in the art, the general features of which are described and claimed in the patent to Halliburton, Reissue No. 20,688, reissued April 5, 1938, for "Apparatus for testing oil wells." Since this unit is well known, it will be unnecessary to describe it here further than to say that it includes a valve which may be opened or closed by manipulation of a drill pipe or other conduit 14 by which the tool may be lowered into an oil well.

The equalizing or bypass unit 12 may be like that disclosed in the patent to Hanes, No. 2,144,842, patented January 24, 1939, for "Bypass assembly for packers," or like that disclosed in the application of H. B. Ziegler, Serial No. 212,265, filed June 7, 1938, for "Equalizing valve arrangement for packers." In the drawing, the unit 12 is shown as being essentially like that disclosed in the patent to Hanes. Any other equalizing valve unit may be employed so long as provision is made for permitting the flow of fluid or permit the equalizing of pressure from some point above the packer unit 13, when the same is in the well, to a point beneath the packer unit in response to manipulation of the drill pipe or other conduit used to lower the assembly into the well.

The present invention is particularly concerned with the packer unit 13, and this is shown in detail in Figures 2, 3 and 4. When using the bypass or equalizing unit of the type shown in the Hanes patent, it is customary to connect the lower end thereof directly to the upper shoe of a cone packer. In accordance with the present invention, instead of connecting the unit 12 directly to the upper shoe of a cone packer, it is threaded into a coupling nut 15 which is screw

threaded into the top of a cylinder 16. The lower end of the cylinder 16 is connected to the upper shoe 17 of a cone packer 18, and this shoe 17 further carries a depending sleeve 19 upon which the packer 18 is mounted.

The packer 18 may be made up of annular rings of belting in accordance with usual practice, these being clamped between the upper shoe 17 and the shoe 20 which is screw threaded onto the lower end of the sleeve 19. In order to conserve space and to mount a wall packer 21 as close as possible to the cone packer 18, the shoe 20 serves both as the lower shoe for the packer 18 and the upper shoe for the packer 21.

The wall packer 21 may consist of a cylinder of rubber or like material mounted upon an inner sleeve 22 mounted for vertical movement within the sleeve 19 of the cone packer assembly.

The inner sleeve 22 extends upwardly from the packer 21 to a point within the cylinder 16 where it is connected to a piston 23 slidably fitted within the cylinder 16 and normally occupying a position in the lower portion thereof as illustrated in Figure 2. Beneath the piston 23, the cylinder 16 is provided with a number of ports 24 so that the portion of the chamber 16 beneath the piston 23 is exposed to mud or other fluid in the well at all times.

The lower end of the inner sleeve 22 is screw threaded into the lower shoe 25 of the wall packer. A perforated tail pipe 26 may be connected to the lower shoe 25 in accordance with the usual practice.

In operating the apparatus just described to perform a testing operation in the rat-hole of a well, it is lowered into the well with the valve in the unit 11 closed. At this time the pressure in the cylinder 16 above the piston 23 will be the same as that below the piston and there will be no tendency for the piston to move. As the wall packer 21 enters the rat-hole and as the cone packer 18 is seated on the shoulders of the rat-hole, there will still be little, if any, tendency for the piston 23 to move, especially if a relief valve such as that shown at 37 in Figure 1 of the patent to Hanes, No. 2,144,842 is provided.

Let us assume that the cone packer is seated on the shoulder of a rat-hole with the wall packer 21 in the rat-hole but not yet expanded to effect any seal. The apparatus is in position for making a formation test to obtain a sample of fluid in the formation in the rat-hole. At this time, the drill stem 14 is empty, the valve in the tester unit 11 is closed, and the equalizing valve in the unit 12 is closed so that when the valve in the unit 11 is opened fluid will flow from the formation up through the inner sleeve 22, the upper portion of the cylinder 16, the equalizing valve unit 12 and the tester valve unit 11 and into the pipe 14. At this time, the pressure in the cylinder 16 above the piston 23 is equal to the hydrostatic head of the mud or other fluid in the well at that depth. If now the tester valve is opened, the pressure in the upper portion of the cylinder 16 drops immediately almost to atmospheric pressure. There is, thus, a large force tending to raise the piston 23, and the piston will move upwardly forcing the lower shoe 25 of the wall packer 21 upwardly and expanding that packer against the wall of the rat-hole effecting a seal whether or not the cone packer 18 has already made a seal between the main bore of the well and the rat-hole.

Where only a cone packer is employed in making the test in the rat-hole of a well, there is a rush of fluid down past the cone packer if it is not making a very effective seal, and this fluid will soon wash away some portion of the shoulder and prevent the obtaining of an uncontaminated sample of fluid from the formation. This is prevented by the apparatus of the present invention inasmuch as such downward flow of fluid past the cone packer will be immediately stopped upon the expansion of the wall packer, and this will take place just as soon as the tester valve is opened.

A further difficulty in the use of an ordinary cone packer is that the sudden change in pressure above and below the cone packer, when the tester valve is opened, jams or forces the cone packer down into the rat-hole and either causes the shoulder of the rat-hole to crumble or the packer to be so distorted that an effective seal is not maintained. In accordance with the present invention, this difficulty is overcome inasmuch as the expansion of the wall packer immediately beneath the cone packer serves in some measure to support the wall of the rat-hole and prevent it from crumbling and further resist downward movement of the cone packer into the rat-hole. In this connection, it is to be noted particularly that in expanding and setting the wall packer 21, the upper shoe 20 is held stationary while the lower shoe 25 is forced upwardly. In this way the wall packer is set without any downward thrust upon the cone packer.

After the packers have been set as explained above and a desired amount of fluid from the formation has passed upwardly into the drill stem 14, the valve in the formation tester 11 is closed and the drill pipe picked up. When this occurs, the equalizing valve unit 12 permits fluid to flow from a point exterior of the assembly into the cylinder 16 and down into the rat-hole beneath the packers. Upon equalizing of the pressure, there is no longer any tendency for the piston 23 to maintain the packer 21 expanded, and the entire assembly may then be easily removed from the well, thus completing the drill stem test.

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

I claim:

1. Apparatus for effecting a seal between a conduit and a rat-hole in a well, which includes a cone packer adapted to seat on the shoulder of a rat-hole, a wall packer located below the cone packer and adapted to enter the rat-hole, said wall packer having a shoe at its upper end and a shoe at its lower end, and an arrangement for expanding the wall packer to set the same in the rat-hole, said arrangement including means for holding the shoe at the upper end of said wall packer stationary and means for moving the shoe at the lower end thereof upwardly.

2. Apparatus for effecting a seal between a conduit and a rat-hole in a well, which includes a cone packer adapted to seat on the shoulder of a rat-hole, a wall packer located below the cone packer and adapted to enter the rat-hole, said wall packer having a shoe at its upper end and a shoe at its lower end, and an arrangement for expanding the wall packer to set the same in the rat-hole, said arrangement including means for holding the shoe at the upper end of said wall packer stationary and means for moving the shoe at the lower end thereof upwardly, said last mentioned means being operated hydraulically.

3. Apparatus for effecting a seal between a conduit and a rat-hole in a well, which includes a cone packer adapted to seat on the shoulder of a rat-hole, a wall packer located below the cone packer and adapted to enter the rat-hole, said wall packer having a shoe at its upper end and a shoe at its lower end, and an arrangement for expanding the wall packer to set the same in the rat-hole, said arrangement including two sleeves, one connected to each of said shoes, and hydraulic means for actuating said sleeves to move the shoes together.

4. Apparatus for effecting a seal between a conduit and a rat-hole in a well, which includes a cone packer adapted to seat on the shoulder of a rat-hole, a wall packer located below the cone packer and adapted to enter the rat-hole, said wall packer having a shoe at its upper end and a shoe at its lower end, and an arrangement for expanding the wall packer to set the same in the rat-hole, said arrangement including two sleeves, one connected to each of said shoes, a cylinder connected to one of said sleeves, a piston in the cylinder connected to the other of said sleeves and means for causing fluid to actuate said piston and the sleeve and shoe connected thereto, to move the shoe so connected toward the other of said shoes.

5. A combination packer unit for oil wells, consisting of a cone packer, a wall packer, and means for mounting the packers on a conduit, said wall packer being mounted immediately beneath said cone packer whereby the wall packer may serve to support the walls of the well in the vicinity of the cone packer and said mounting means including an arrangement for moving the lower end of the wall packer upwardly to expand the same whereby the cone packer and the upper end of the wall packer may remain stationary while the wall packer is expanded.

6. A combination packer unit for oil wells including a cone packer, a wall packer and hydraulically operable means for expanding the wall packer, said means including a cylinder and piston, said cylinder having ports therein adapted to admit mud or other fluid into said cylinder from a point in the well near said cone packer.

7. A combination packer unit for oil wells including a cone packer, a wall packer mounted immediately beneath said cone packer, and a single shoe serving as the bottom shoe for said cone packer and the top shoe of said wall packer.

8. A combination packer unit for oil wells including a cone packer, a wall packer mounted immediately beneath said cone packer, means for expanding said wall packer by lifting the lower end thereof upwardly and means for holding said cone packer and the upper end of said wall packer stationary while said expanding means moves the lower end of said wall packer upwardly.

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