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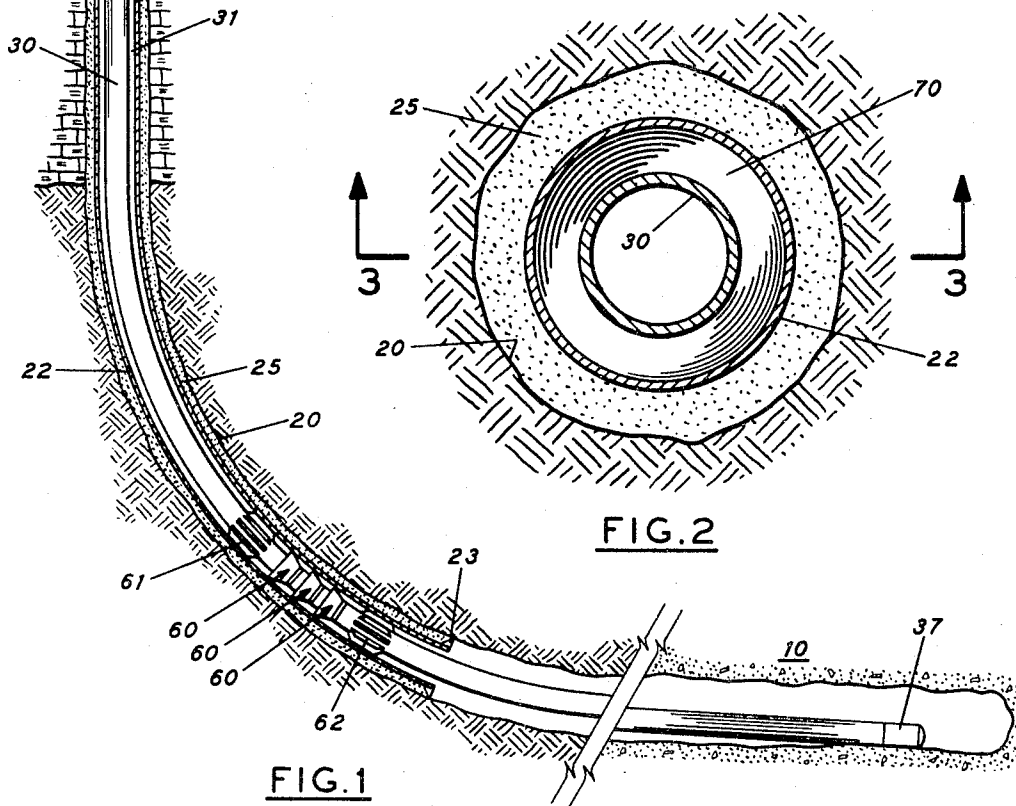
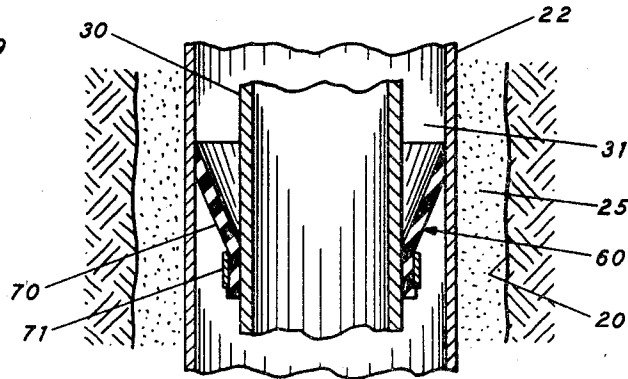
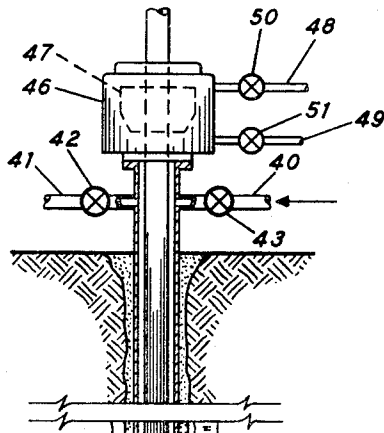
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METHOD FOR RUNNING TUBING USING FLUID PRESSURE

Filed July 18, 1966

2 Sheets-Sheet 1



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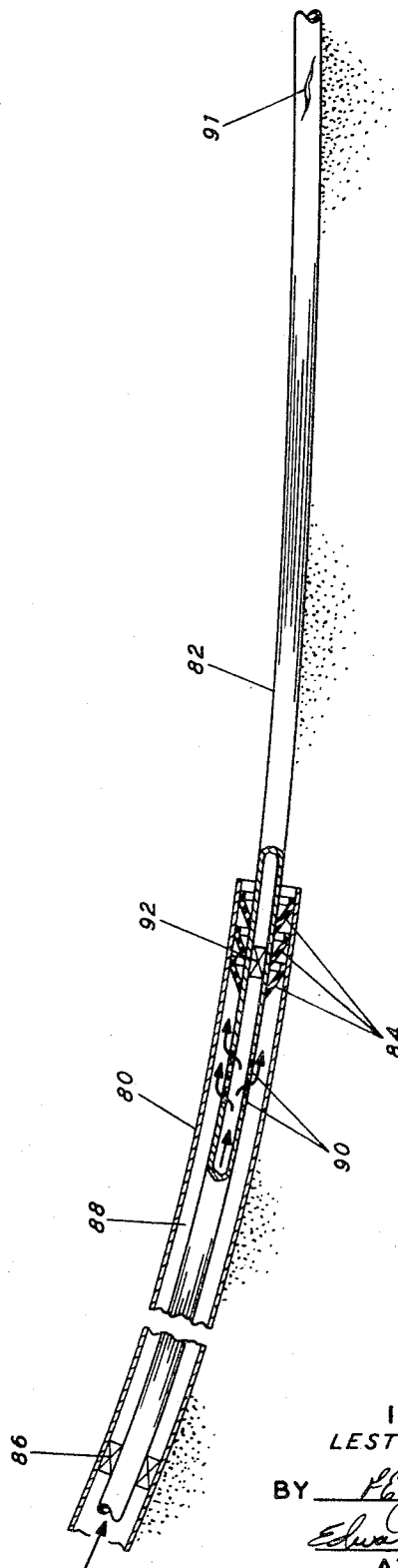
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METHOD FOR RUNNING TUBING USING FLUID PRESSURE

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4 Claims

ABSTRACT OF THE DISCLOSURE

The invention provides for running a second tubing string in concentric relationship with a first tubing string by sealing off the annulus between the tubing strings and injecting fluid into the annulus to assist in moving the second tubing string along the first tubing string.

This invention is directed to methods for running tubing; and, more particularly, this invention relates to methods for positioning tubing or the like in a remote location by utilizing drilling fluid or the like to assist in moving the tubing into the remote location.

There are many situations where it is desirable to insert tubing into a remote location. For example, in the production of oil from oil-bearing formations, it has become common to drill directional wells. This procedure involves diverting a well at some point below the earth's surface so that it forms an angle with the vertical. These high-angled wells are utilized so that a formation can be penetrated in a number of places from a relatively small surface location. Heretofore the completion of high-angled wells was difficult because of the problem of running and landing tubing or, in this instance, well casing in the high-angle portion of the hole.

In accordance with the present invention, the casing string is run and landed in the well by means of drilling fluid or the like applied on the casing string in a manner to assist in pushing the casing into proper position. The invention provides for suitable means for sealing off the annular chamber formed by an outside upper casing string and the inside casing string, said sealing means being fixedly attached to the inside casing and slidable along the outside casing. Pressure is then applied to the annulus by drilling fluid or the like on the sealing means to assist in pushing the inside casing down into the well and out into the high-angle portion of the well.

Another situation where the method of the present invention is useful is found in replacing or repairing pipelines and particularly pipelines from offshore well installations where the line covers a large horizontal and vertical span from start to finish. If the original pipeline tubing springs a leak, for example, a replacement tube can be run in accordance with the invention to repair the defective portion of the original tube.

Briefly, the present invention provides for assisting a second tubing string along a first tubing string after the first tubing string has been run to a predetermined location in a well. The second tubing string is of a different diameter than the first tubing string and the second tubing string is arranged in substantially concentric relationship with the first tubing string to form an annular chamber

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between the tubing strings. Sealing means are connected on the lower portion of the second tubing string to seal off the annular chamber between the first and second tubing strings. Fluid such as drilling mud, water or the like is injected into the annular chamber and against the sealing means to assist in moving the second moving string along the first tubing string.

It is a particular object of the present invention to provide methods for assisting in running a second string of tubing or the like through or past a first string of tubing or the like.

Further objects and advantages of the present invention will become apparent from the following detailed description read in light of the accompanying drawing, in which:

FIGURE 1 is a sectional view of a high-angled well penetrating the earth and illustrates a preferred embodiment of apparatus assembled in accordance with the invention;

FIGURE 2 is an enlarged plan view of sealing means assembled in accordance with the invention;

FIGURE 3 is a sectional view taken at line 3—3 of FIGURE 2; and

FIGURE 4 is a sectional view illustrating an alternative embodiment of apparatus assembled in accordance with the invention.

Referring now to FIGURE 1, the present invention will be described with special emphasis on running a casing string into a high-angle well. The well 20 has been partially cased by a first tubing or casing string 22 which is run in a conventional manner to a position 23 in the well. The lower portion of well 20 has been deviated from the vertical and extends into formation 10 at a high angle with the vertical. It is with running tubing to case the well and particularly with running and landing casing in the high-angle portion of the well that this invention is concerned.

The first casing string 22, as mentioned above, may be run in a conventional manner. The first casing string 22 is maintained in position partially by means of cement grout or the like placed between the wall of the borehole 20 and the outside of the first casing string 22.

In accordance with the invention, a second tubing string 30 which is to be used to case the lower high-angle portion of the well 20 is run interiorly of the first casing string 22. The respective casings are sized so that an annular chamber 31 will be formed inside of the first casing 22. The annular chamber must be of sufficient width dimension to provide adequate space for sealing means 60. It is preferred that the annular space be at least about 20 square inches in a horizontal plane. It is advantageous to have about 40 square inches of surface available between the two casing strings. As an example, about 40 square inches of annular surface are available when a 10¾-inch first casing is used with a 7-inch second casing.

The surface wellhead equipment of the well includes suitable flow lines 40 and 41 having valves 42 and 43 for controlling flow of drilling fluid or the like into and out of the annulus 45 between the two casing strings 22 and 30. A suitable means for selectably closing off the upper end of the annulus is provided by a blow-out preventer 46. Suitable types of blowout preventers

and the operation thereof are well known in the art. For example, series "GK" Blowout Preventers manufactured by the Hydrill Company and illustrated at pages 2566 et seq. of the Composite Catalog of Oil Field Equipment and Services, 1964-65, are a suitable type of blowout preventer. The blowout preventer is connected to the upper end of casing 22 and has a rubber liner 47 which can engage around the second casing string 30. By suitably adjusting the fluid pressure outside rubber liner 47 in the blowout preventer by means of flow lines 48 and 49 and valves 50 and 51, a desired amount of pressure can be put on the rubber liner 47 and this transferred to the second casing 30. In accordance with the invention, the pressure on the rubber liner 47 is adjusted to a value which allows the second casing 30 to slide up or down and which allows a minimum of fluid leakage past the liner 47.

The second casing string 30 which is to be used to case the high-angle portion of the well is fitted with sealing means 60 to seal off the annular chamber 31 between the first casing string 22 and the second casing string 30. The sealing means 60 are connected to the second casing string 30 and extend against the interior of the first casing 22. The sealing means are in one form inverted cups fixedly connected on the outside of the second casing 30. The sealing means are connected on the second casing 30 a predeterminable distance from the lower end of the casing 30. The sealing means should be spaced on the second casing 30 so that they are in contact with the first string 22 until the lower end of the second casing 30 is substantially at the lowest portion in the borehole that it is desired to case.

While one aspect of the present invention provides for running a second casing string inside of a first casing string, it is sometimes desirable, especially with pipelines, to reverse the procedure and run or assist the second tubing string along the outside of the first tubing string over a portion of the first string. Referring to FIGURE 4, an outside tubing string 80 is being assisted along an inside tubing string 82 in accordance with the present invention. This operation may be done, for example, when it is desired to repair a break 91 in an existing pipeline 82 by overlapping it with an outer tubing 80. This procedure requires fixing a set of sealing means 86 to the inside tubing 82 and also fixing a set of sealing means 84 to the outside tubing to form a closed annular chamber 88 between the tubings 80 and 82. The inside tubing 82 is then perforated 90 at a location to give access to the closed annular chamber and plugged off by suitable packing means 92 beyond the perforation. Liquid is then forced into the inside tubing 82 and out the perforation 90 into the annular chamber 88. As the liquid is forced into the annular chamber 88, it tends to enlarge the chamber by forcing the outside tubing 80 to move along the inside tubing 82 thus assisting in running the outside pipe.

In accordance with the invention in regard to well casing, the string is first run into the hole in a conventional manner and preferably cemented in as illustrated. The surface wellhead apparatus, which includes a blowout preventer 46, is operably connected to the first string. A second string of casing having a shoe 37 which can be open or closed is then inserted in the blowout preventer which is maintained in a wide-open position. The sealing means 60 are connected to the second casing 30 at a suitable location, and the sealing means are passed through the wide-open blowout preventer. It is also desirable to use stabilizing means 61 and 62 to assure that the sealing means 60 remain centralized in the annulus. After a time when it is desired to assist the second casing 30 down into the hole, the blowout preventer is closed and partially energized to a position that allows slippage of the second casing therethrough and which also keeps leakage of drilling fluid to a minimum. Drilling mud or another suitable fluid is then flowed into annular chamber 31 above the sealing means 60. Pressure is put on the mud in the annulus; and, since the sealing means prevent passage of

the mud, a downward force is exerted on the second casing string 30 which assists in running and landing the casing in the proper position in the well. After the second casing has been landed, cement can be forced down the inside of the second casing 30 and up the annulus between the lower part of the borehole 20 to cement off this annulus. If desired, the cement can also be forced into the annulus between the first casing string 22 and the second casing 30. The cement bypasses the sealing means 60 because they do not necessarily prevent flow up this annulus.

Referring now to FIGURES 2 and 3, sealing means assembled in accordance with the invention will be described in more detail. FIGURE 2 is an enlarged plan view of a sealing cup which is useful as a sealing means. The sealing cup is preferably formed from a reinforced resilient material, such as rubber. The smaller diameter of the cup 70 is substantially the same as the outside diameter of the second casing string 30. The larger diameter should desirably be at least as large as the inside diameter of the first casing string. The cup 70 is formed in the shape of an inverted truncated pyramid. The cup 70 is held fixedly in position by suitable means, such as band 71, which can be securely fastened around the lower part of the cup. The cup is formed so that when mud under pressure is forced down onto the inverted cup the sides of the cup will form a seal with the inside of the first casing to provide a sealing means on which force can be exerted. This force in turn helps to force the second casing down into the high-angle portion of the well.

A great amount of additional force can be put on the second tubing string along said first tubing string while this method. For example, with a 10 $\frac{3}{4}$ -inch first casing string 22 and a 7-inch second casing string 30, about 40 square inches of space is available in the annulus 31 for the mud to act on. Using a mud pressure of 500 p.s.i. in the annulus gives an additional push on the second casing of about 20,000 pounds.

Although only specific embodiments of the invention have been described in detail, the invention is not to be so limited but is rather to be limited only by the scope of the appended claims.

I claim:

1. A method of assisting a second tubing string along a first tubing string comprising providing a second tubing string of a larger diameter than said first tubing string, placing said second tubing string in concentric relationship around said first tubing string to form an annular chamber between said tubing strings, fixedly connecting sealing means on said second tubing string to seal off the annular chamber between said tubing strings, injecting fluid under pressure into said annular chamber and moving said second tubing string along said first tubing string while continuing to force fluid into said annular chamber to assist in moving said second tubing string along said first tubing string.

2. A method of casing a high angle portion of a well having said high angle portion at its lower end, comprising: running a first casing string into the upper portion of said high angle portion of said well, fixing said first casing string in said well by placing cement between the well and the outside of said first casing string, inserting a second casing string having a smaller diameter than the diameter of said first casing string into said well through said first casing string, fixedly connecting sealing means on the lower portion of said second casing string to seal off the annulus between said second casing string and said first casing string, injecting fluid under pressure into said annulus above said sealing means and running said second casing string down into said high angle portion of said well while continuing to force fluid down into said annulus to assist in pushing said second casing string down into said high angle portion of said well.

3. Method of claim 2 where the annulus between the casing strings provides at least 20 square inches of horizontal surface area.

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4. Method of claim 2 where centralizer means maintain the sealing means centered in said first casing string.

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61—72.7; 166—115, 202