Oct. 27, 1936. E. P. HALLIBURTON 2,058,688

APPARATUS FOR PLUGGING BACK OR BRIDGING WELLS

Original Filed April 10, 1934

Fig. 1

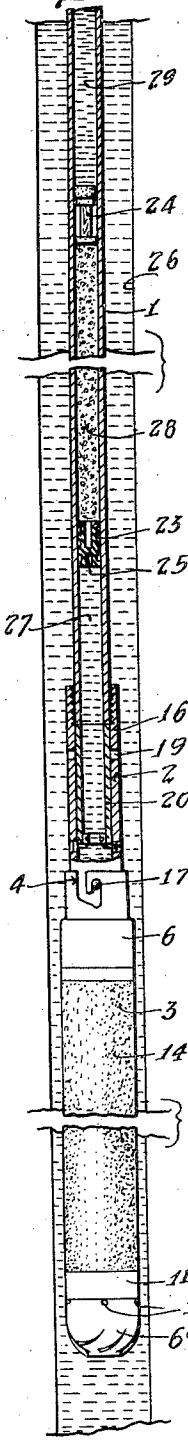
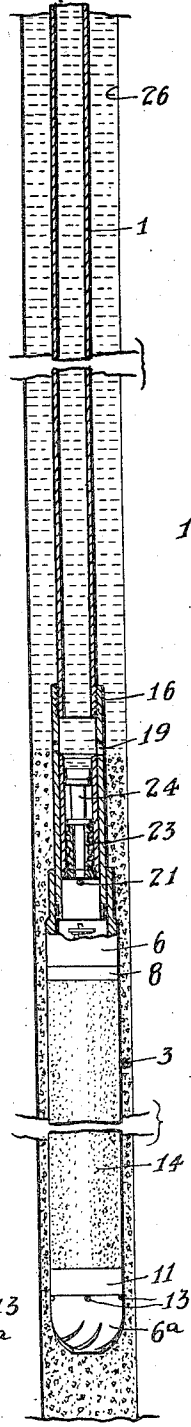


Fig. 2



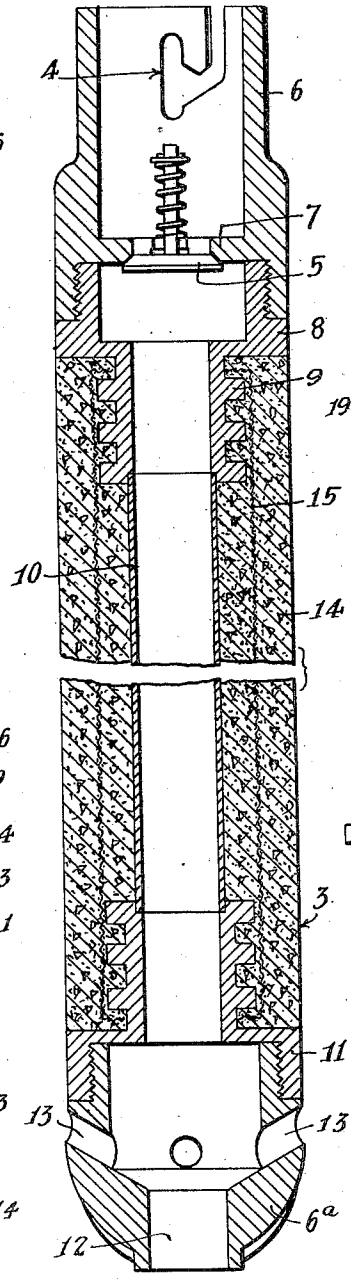
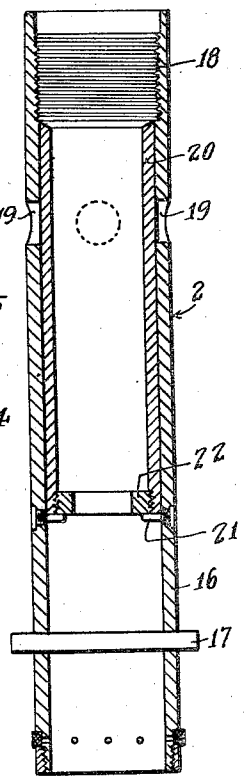


Fig. 3

Fig. 4



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APPARATUS FOR PLUGGING BACK OR BRIDGING WELLS

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Original application April 10, 1934, Serial No. 719,883. Divided and this application February 9, 1935, Serial No. 5,723

2 Claims. (Cl. 166—1)

This invention relates to an apparatus for plugging back or bridging wells, such as oil wells, by cement.

This application is a division of my copending application Serial No. 719,883, filed April 10, 1934, now Patent No. 2,014,563, granted September 17, 1935.

When a well, such as an oil well, has been drilled beyond an oil producing formation into a water sand therebelow, it is sometimes desirable to plug up the bottom of the oil well. This operation is termed the plugging back operation. There are various other reasons which may make it desirable to plug a well-hole at some desired point to shut off the formations below from the formations above.

Heretofore, when an oil driller has attempted to plug off or bridge the bottom of a well-hole, the operation has been accompanied by danger of sticking a pipe in the well-hole. The general practice has been to insert into the well a casing or tubing leading to near the bottom of the well. The fluid cement is then pumped through the tubing or casing to a height somewhat above the point where the well is to be shut off or plugged, and the casing has then been elevated to the desired shut-off point, whereupon the excess cement has been removed from the well-hole by circulating mud down the casing or tubing to wash out such excess cement. Quite frequently, it is found that the casing or tubing has been frozen at the bottom of the well-hole by the cement when it is desired to elevate the same.

It is the general object of the present invention to provide an apparatus which can be used for plugging back or bridging oil wells without danger of freezing the casing or tubing in the well hole.

It is a further object of the present invention to provide an apparatus for plugging back or bridging oil wells which is more easily operated and more certain in operation than apparatus heretofore used.

In general, the apparatus of the present invention comprehends that the danger of freezing the tubing in the well may be avoided by the provision at the end of the tubing of a special "plug back" device or section of tubing detachable from the remainder of the tubing, so that it may be intentionally left in the bottom of the well-hole after the plugging back or bridging operations. By constructing such "plug back" device or section of tubing of such material that it may be readily drilled from the well-hole, the plugging back operation will not interfere with future deepening of the well-hole, in case such operations are later found desirable.

The present invention further comprehends that the process of plugging back the oil well may be more readily and certainly accomplished if in the apparatus provision is made for circulation of mud fluid at the desired shut-off without disconnecting the tubing from the lower section or "plug back" device, and for this purpose the present apparatus makes special provision for such circulation.

A further feature of the present apparatus is the use of plugs and cooperating apparatus for catching or arresting the plugs at desired points by which the position to which the cement is forced in the operation is automatically determined so that it becomes unnecessary to judge when the cement is in the desired position by measuring the amount of fluid introduced into the well-hole. In the usual practice of plugging back or bridging a well-hole, the operator has to measure the amount of fluid introduced in the well-hole in order to estimate when the cement has been passed to the desired point. This measuring operation is accompanied by frequent errors, and as a result the well is frequently bridged or shut off at the wrong point.

Various further advantages and features of the present invention will be apparent from a description of a preferred form or example of an apparatus embodying the invention. For this purpose, one form or example of such an apparatus is hereafter described with reference to the accompanying drawing, in which,—

Figure 1 is a sectional view of an oil well with an apparatus installed therein illustrating the position of the apparatus and the stage of the process during the operation of pumping the cement into the well-hole;

Figure 2 is a similar view of the apparatus showing the position at the stage of the process after the cement has reached the desired position and the apparatus is in position for washing out the excess cement;

Figure 3 is an enlarged vertical section of the "plug back" device; and

Figure 4 is an enlarged vertical section of the releasing device and slide valve member, preferably included in the process and apparatus.

Referring to the drawing, the apparatus comprises a string of pipe or casing 1, which may be built of sections in any usual or preferred manner. The lower end of the string of pipe 1 is attached to a releasing device and slide valve member 2. The releasing device and slide valve

member 2, in turn, is detachably connected with the "plug back" device 3.

Now, referring more particularly to Fig. 3, the "plug back" device 3 may be any form of tubing provided with a suitable means, such as a J-slot 4, for readily detaching the same from the releasing member 2. In place, for example, of the J-slot connection, such as indicated at 4, other suitable connection means, such as a left-hand thread, may be employed. The "plug back" device is shown as including a back pressure valve 5 at near its upper end and with the distributing nozzle 6a at its lower end. The "plug back" device should be constructed of a material or materials which can be readily drilled out of the bottom of the well-hole, if later it should be desired to again drill out the bottom of the well-hole.

The preferred form of the "plug back" device illustrated comprises the upper collar 6, which contains the J-slot 4 and is provided with a seat 7 for the back-pressure valve 5. This collar, in turn, is threaded to a nipple 8, which is indicated as having a reduced portion 9, which in its lower end connects with a thin sleeve 10. The lower end of the sleeve 10 connects with a nipple 11 similar to the nipple 8, which, in turn, is threaded to the nozzle 6a, which is preferably provided with a lower discharge port 12 and a plurality of equally spaced apart lateral discharge ports 13.

Between the nipples 11 and 8 is the body of the "plug back" device, which may in practice be of various lengths, depending upon the distance that the oil well is to be plugged back in operation. In order to construct the device so that it may be most easily drilled out of the well-hole, a body of the device between the nipples 8 and 11 is formed of hardened cement or concrete 14, which may be suitably strengthened by a reinforcing screen 15, if desired. The other portions of the "plug back" device, such as the collar 6, nipples 8 and 11, and distributing nozzle 6a should be formed of a material easy to drill, such as aluminum or easily fractured cast iron.

The releasing and slide valve member 2 (Fig. 4) comprises a tube 16, preferably provided near its lower end with a cross-pin 17 adapted to enter J-slot 4 of the "plug back" device 3 for attaching such "plug back" device to the tubing 1. The upper end of the releasing device 2 is provided with a threaded socket 18 or other suitable means for attaching the same to the body of tubing 1. The process and apparatus may, if desired, rely upon detaching the "plug back" device from the tubing for the operation of washing out the excess cement, but preferably this releasing member 2 is made to include a slide valve. For this purpose, the tube 16 is provided with one or more lateral ports 19 normally closed by a sleeve 20 telescoped within tubing 16. This sleeve 20 at its lower end rests upon pins 21 which are constructed of a material readily sheared, so that in operation by shearing the pins 21 the sleeve 20 may be lowered to operate as a valve and uncover the ports or port 19. The sleeve 20 is preferably provided near its lower end with a restricted member 22 for the purpose of catching and holding plugs in the manner hereafter described.

The apparatus also preferably includes a lower plug 23 (Fig. 1) and an upper plug 24. The lower plug 23 may be composed of a material, such as rubber, and is provided with a diaphragm 25 which under pressure is adapted to blow out for the purposes hereinafter described. The upper plug 24 may be any usual customary form of plug for cementing purposes.

The process of plugging back or bridging wells in accordance with the present invention as carried out with the use of such apparatus is as follows:

The tubing 1 is attached to the releasing member 2 which, in turn, is attached to the "plug back" device 3, and the assembled apparatus then lowered into a well-hole, such as indicated at 26, until the top of the "plug back" device 3 is at substantially the point at which it is desired to bridge or plug back the well-hole. Circulating fluid, such as mud, is then introduced into the apparatus, as indicated at 27, and circulated down the apparatus to return up and around the apparatus to the top of the well-hole in order to insure that the bottom of the well-hole is free. There is then introduced the plug 23, the purpose of which is to keep the cement separated from the circulating fluid until this cement has been pumped down into the well-hole. After the introduction of the plug 23, fresh fluid and unset cement is introduced into the apparatus above the plug 23 in sufficient quantities to fill the bottom of the well-hole up to the desired bridging or plugging off point. In practical operation, it is found always necessary to introduce an excess amount of cement, as the exact requirements for plugging off the bottom of the well can not be determined. When the desired amount of cement 28 has been introduced, there is then inserted the upper plug 24, the purpose of which is to protect the cement from contamination with the fluid later to be inserted above the plug 24. Circulating fluid, such as mud, is then introduced into the apparatus, as indicated at 29, by means of a pump and by continued pumping the cement is forced down the apparatus.

The plug 23 descends until it encounters the restriction member 22. It is held from further descent by this member and the force of the pump introducing the circulating fluid 29 is sufficient to burst the diaphragm 25 of this plug and the cement 28 then passes downwardly through the "plug back" device out of the distributing nozzle 6a and rises again around the apparatus. The upper plug 24, in turn, descends until it strikes the lower plug 23, after which the continued pump pressure causes the pins 21 to shear which are holding the sleeve valve 20 closed. The sleeve valve 20 then descends until it strikes the pin 17, opening the slide valve ports 19. This checks the descent of the cement, which then remains in the apparatus from the pin 17 through the "plug back" device and up around the "plug back" device to a height somewhat above the ports 19. By further pumping down the tubing 1, the circulating fluid or mud is caused to pass out of the ports 19 and rise up around the tubing 1, carrying to the surface of the well the excess cement. In certain cases, it may be desirable at this point to reverse the circulation forcing fluid mud down the outside of the pipe 1 and cause the excess cement to be forced up inside of the pipe. After the excess cement has been removed from the well-hole, the "plug back" device is detached from the tubing 1 by lowering and turning tubing 1 to disengage the pin 17 from the J-slot 4. Leaving the "plug back" device in the well-hole, the remainder of the apparatus is then withdrawn to the top of the well. The back-pressure valve 5 operates to prevent the cement at the bottom of the well-hole from flowing out of the "plug back" device.

While the particular form of the apparatus herein described is well adapted to carry out the objects of the present invention, various modifications and changes may be made without departing from the principles of the invention, and this invention includes all such modifications and changes as come within the scope of the appended claims.

I claim:

1. An apparatus for plugging off the well-hole, comprising a section of pipe composed of spaced apart nipples, a main pipe portion extending between said nipples composed of hardened cement with a reinforcing lining, a back pressure valve at the upper end of said section, said nipples being formed of relatively soft or easily drilled metal, the upper end of such device being provided with a detaching means for attaching and detaching the same with a string of pipe.

2. An apparatus for plugging off the well-hole, comprising a section of pipe composed of spaced apart nipples, a main pipe portion extending between said nipples composed of hardened cement with a reinforcing lining, a back pressure valve at the upper end of said section, said nipples being formed of relatively soft or easily drilled metal, the upper end of such device being provided with a detaching means for attaching and detaching the same with a string of pipe, and a distributing nozzle at the lower end of such device.

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