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METHOD AND MEANS FOR TESTING WELLS

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Fig. 1.

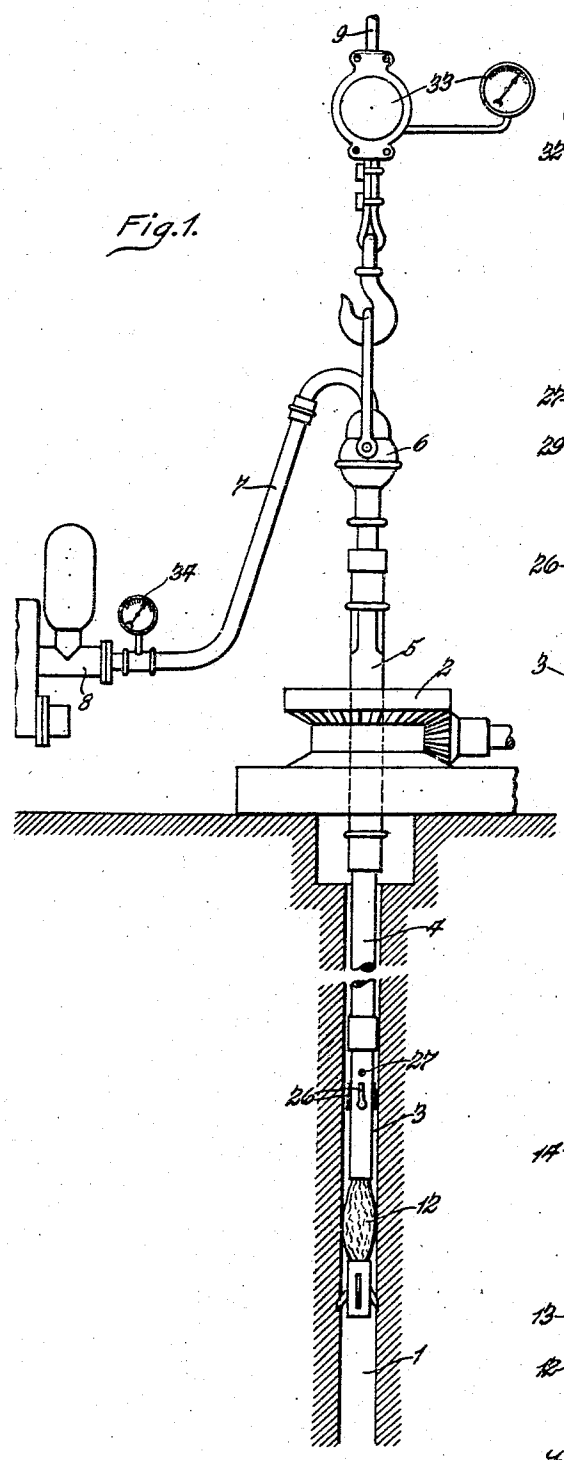
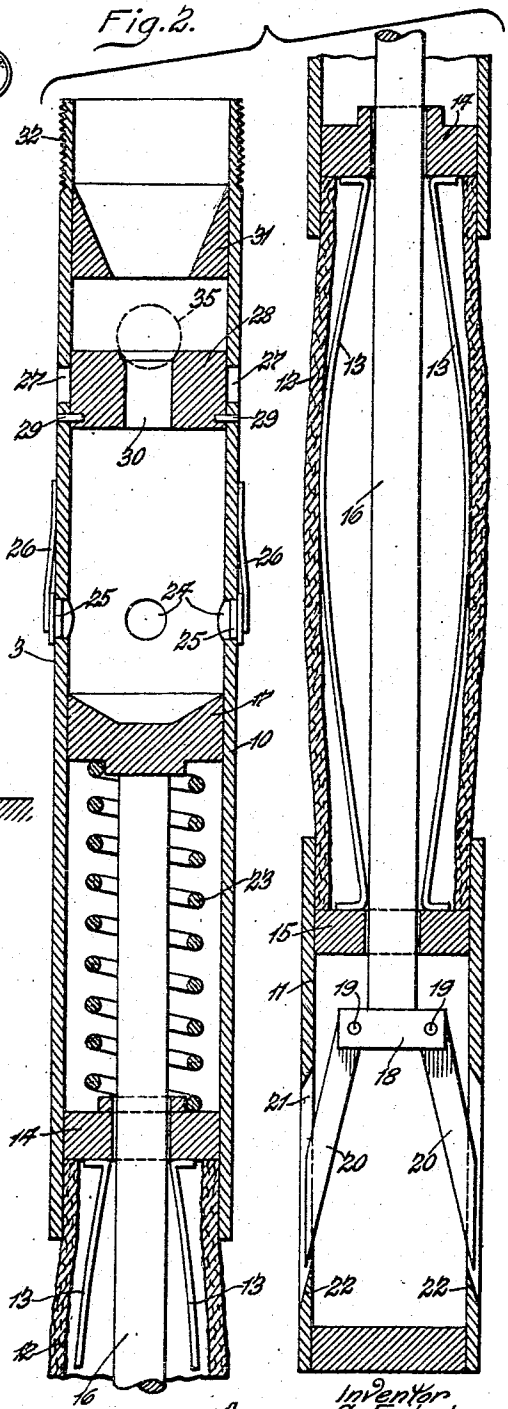


Fig. 2.



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METHOD AND MEANS FOR TESTING WELLS

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11 Claims. (Cl. ~~166—1~~) 73-155 - transport.

This invention pertains to a method and apparatus for testing wells, particularly deep drilled wells such as oil wells.

In the drilling of such a well it happens occasionally that strata are passed through which contain faults or fissures. In such cases it sometimes happens that the drilling fluid or mud escapes from the hole by the way of such faults. As the drilling fluid is often expensive it is important to provide means for preventing such escape of the fluid. Various operations such as cementing may be resorted to in order to seal up such openings. Before sealing operations may be carried out it is important to be able to determine with accuracy the depth at which the opening is located.

One of the objects of this invention therefore is to provide an effective method for testing the well in order to locate such faults.

Another object is to provide means whereby the well may be tested at various depths in a single run without withdrawing the device between tests.

Another object is to provide testing apparatus which may be operated in a simple manner and by means already at hand at the well.

Another object is to provide such a testing device which may be moved from point to point in the well and finally be withdrawn without being entirely destroyed so that it may be used again.

Further objects will appear from the following description taken in connection with the accompanying drawing in which:

Figure 1 is a sectional view of a well showing the manner of use of a testing device embodying this invention, and

Figure 2 is a sectional view of the testing device.

It will be understood of course that the device is shown broken in Figure 2, the left-hand portion being the upper portion and the right hand the lower portion.

Referring to the drawing 1 designates the well which is to be tested. This figure shows the device as used with rotary drilling equipment. It will be understood, however, that it may be used with other types of drilling apparatus. In Figure 1 drilling mechanism is shown at the head of the well, which mechanism may be of any well known type and which may provide a rotary table 2. In the embodiment illustrated the testing device, indicated generally at 3, is connected at the lower end of a drill stem 4, connected by the well known Kelly joint 5 to a swivel head 3 connected by means of a flexible hose 7 to a mud pump 8. The head 6 may be suspended in any usual manner from the hoisting dead line 9.

Referring now to Figure 2 the testing device comprises an upper casing section 10 and a lower section 11, between which sections there is arranged an expansible packer comprising a flexible rubber or fabric tube 12 and a plurality of expanding leaf springs 13.

Arranged to slide in guides 14 and 15, the former secured in the upper casing section 10 and the latter similarly secured in the lower section 11, there is a plunger or ram 16.

Secured to the upper end of the plunger 16 is a piston or ram table 17. The lower end of the plunger 16 is provided with a head 18, to which are pivoted at 19 a plurality of dogs 20 extending through suitable slots 21 in the casing section 11. The lower walls of these slots may be provided with cam surfaces 22, adapted to expand the dogs 20 when the head 18 is moved downwardly. A strong spring 23 bearing at its lower end upon the guide 14 and at its upper end upon the under surface of the piston 17, tends to retain the plunger 16 in its uppermost position as illustrated in Figure 2.

Just above the piston 17 the casing 10 is perforated to provide a plurality of exit ports 24. Each of these ports is closed by a valve 25, held in place by a spring 26 secured to outer walls of the casing 10. These spring operated valves will therefore retain the ports 24 closed until a predetermined pressure is established within the casing 10 sufficient to overcome the pressure of the springs 26.

At a convenient location above the ports 24 the casing 10 is again perforated to provide ports 27. These ports however are closed by a plug 28 fixed in the casing 10 by means of one or more shear pins 29. The plug 28 covers the ports 27 so as to close the latter so long as the plug remains in place. The plug 27 is provided with a central passage 30 so that fluid may pass therethrough.

Fixed in the casing 10 just above the plug 28 is a funnel-shaped guide 31, the purpose of which will be explained later. The usual screw thread 32 may be provided at the upper end of the section 10 in order to provide for connecting it to the stem 4.

In testing a well by means of this device, the latter is coupled to the lower end of a tube or stem 4 and lowered into the well to the depth at which a test is desired. When the proper depth has been reached, the mud pump 8 is started

slowly so as to pump fluid gently down the tube 4 and into the casing 10 via the passage 30. This fluid rests upon the piston 17, and by careful operation of the pump 8 a sufficient pressure is established to force the piston 17 downwardly in the casing 10 against the pressure of the spring 23. This moves the plunger 16 downwardly and thereby forces the dogs 20 outwardly against the sides of the well. By this operation therefore the lower section 11 is securely anchored in the well by means of the dogs 20. When such anchorage has been established the entire stem 4 is lowered by means of hoisting line 9. This moves the casing section 10 downwardly with respect to the section 11 and thereby expands the packer tube 12 into engagement with the sides of the well so as to plug the well. During this lowering operation it is desirable to have a sensitive weight-indicator 33 in the line 9 so that the degree of pressure placed upon the packer may be known.

The well is now plugged at the desired depth. The fluid pressure in the casing 10 is now increased to such a value as to overcome the pressure of the springs 26 and open the ports 24. When these ports are opened the fluid passes out of the casing 10 to the well above the point plugged by the packer 12. The pump 8 may now be operated so as to subject the well to any desired fluid pressure. By noting the indication of a pressure gage 34 on the pump 8 the operator may determine whether or not fluid is being lost in the well. If no fluid is lost at this depth, the device may be shifted to another depth and the test repeated. In order to shift the device the section 10 is raised by means of the hoisting line. This draws in the dogs 20 so as to release them from engagement with the walls of the well. At the same time the packer tube 12 is collapsed. The pump 8 is now stopped and the pressure in the casing 10 returned to a value such as to permit the spring 23 to raise the plunger 16 to its normal position. The device is now in its original condition and may be lowered or raised to any new depth and the above outlined procedure again carried out to obtain another test at the new location. In this manner the testing device may be shifted successively to any number of depths until that one is found at which a loss of fluid is indicated by the gage 34. In this way the fault at which the loss of fluid occurs may be located with accuracy so that suitable cementing operations may be carried out.

After the entire series of tests has been completed the device may be withdrawn from the well. It is desirable however to drain the tube 4 of fluid as it is raised. In order to accomplish this purpose, a ball 35 is pumped downward through tube 4. When this ball reaches the funnel guide 31 it is guided thereby so as to drop into a seat in the plug 28 at the upper end of the passage 30. The ball 35 thus seated closes the passage 30. The pump 8 is now operated to establish sufficient pressure in the casing 10 to shear off the pins 29 and force the plug 28 downwardly in the casing so as to uncover the ports 27. The fluid may now drain out of the tube through these ports as the tube is withdrawn from the well.

It will be seen that this invention provides simple and effective means for testing a well at any number of different points in a single run. It will be noted also that the device may be used with equipment usually at hand during the drilling of the well. In a rotary drilling installation the regular drill stem may be used. In other types of installations any suitable tube may be used to lower the device into the well, such tube being equipped at its upper end with any suitable connection to a fluid pump capable of establishing pressure as described. It will be noted that the only portion of the device which may be liable to damage is the packer tube 12, and it may of course be replaced.

While this invention has been described as embodied in a unitary device, it will be understood that individual features and sub-combinations may be useful by themselves without reference to other features or the complete combination, and that the employment of such individual features or sub-combinations is contemplated by this invention and within the scope of the appended claims.

It is further obvious that various changes may be made, within the scope of the appended claims, in the details of construction without departing from the spirit of this invention; it is, understood, therefore, that the invention is not limited to the specific details shown or described.

Having described the invention what is claimed is:

1. The method of testing the bore hole of a well, comprising, lowering into the well at the end of a string of tubing a releasable packer, expanding the packer against the walls of the bore hole at a predetermined depth to plug the well at that depth, applying fluid pressure to the plugged well above the packer, indicating the applied pressure in order to detect a loss of fluid, removing the applied pressure, and releasing and removing the packer from the well.

2. The method of testing the bore hole of a well, comprising, lowering into the well at the end of a string of tubing a releasable packer, expanding the packer against the walls of the bore hole at a predetermined depth to plug the well at that depth, applying fluid pressure to that portion of the plugged well between the packer and the top of the well, indicating the applied pressure in order to detect a loss of fluid, removing the applied pressure, releasing the packer, removing the same to another depth, and again applying and indicating fluid pressure in order to detect a loss of fluid.

3. Means for testing wells, comprising, a pipe extending into the well, means at the lower end of said pipe expandable into pressure engagement with the walls of the bore hole for plugging the well, means for pumping fluid into said pipe, valve means associated with said plugging means adapted to admit the pumped fluid into the well hole but to prevent its return to said pipe and means for indicating the fluid pressure.

4. Means for testing wells, comprising, a pipe extending into the well, means at the lower end of said pipe expandable into pressure engagement with the walls of the bore hole to plug the well, said plugging means being releasable from the well and reengageable at different depths in the well, means for pumping fluid into said pipe, and means associated with said plugging means adapted to admit the pumped fluid into the well.

5. A well-testing device, comprising, a casing adapted to be lowered into the well, means associated with said casing operable to plug the well, means operable by fluid pressure within said casing for supporting the device at any depth in the well, and means for admitting into the well fluid pumped into said casing, adapted to maintain sufficient fluid pressure in the casing to operate said supporting means.

6. A well-testing device, comprising, a casing adapted to be lowered into the well, means associated with said casing operable to plug the well, means for supporting the device at any depth in the well, means for admitting into the well fluid pumped into said casing, and means for draining the fluid from said casing.

7. A well-testing device, comprising, a casing adapted to be lowered into the well, means associated with said casing operable to plug the well, means for supporting the device at any depth in the well, means for admitting into the well fluid pumped into said casing and means adapted for operation from the top of the well to drain the fluid from said casing.

8. An implement for testing wells, comprising, a hollow stem, a casing supported at the lower end of said stem, an expandable packer on said casing, means associated with said casing operable to anchor said packer in the well, constructed and arranged to expand the anchored packer by manipulation of said casing in order to plug the well, and means for supplying fluid pressure to the plugged well.

9. An implement for testing wells, comprising, a hollow stem, a casing supported at the lower end of said stem, an expandable packer on said casing, means associated with said casing operable by fluid pressure therein to anchor said packer in the well, constructed and arranged to expand the anchored packer by manipulation of said casing in order to plug the well, and means for supplying fluid pressure to the plugged well.

10. An implement for testing wells, comprising, a hollow stem, a casing supported at the lower end of said stem, and expandable packer on said casing, and anchoring means associated with said casing yieldingly maintained in inactive position but operable by fluid pressure in said casing to active position to anchor said packer in the well, said casing being mounted for manipulation to expand the anchored packer in order to plug the well.

11. An implement for testing wells, comprising, a hollow stem, a casing supported at the lower end of said stem, an expandable packer on said casing, anchoring means associated with said casing yieldingly maintained in inactive position but operable by fluid pressure in said casing to active position to anchor said packer in the well, said casing being mounted for manipulation to expand the anchored packer in order to plug the well, and means for delivering fluid from said casing to the plugged well.

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