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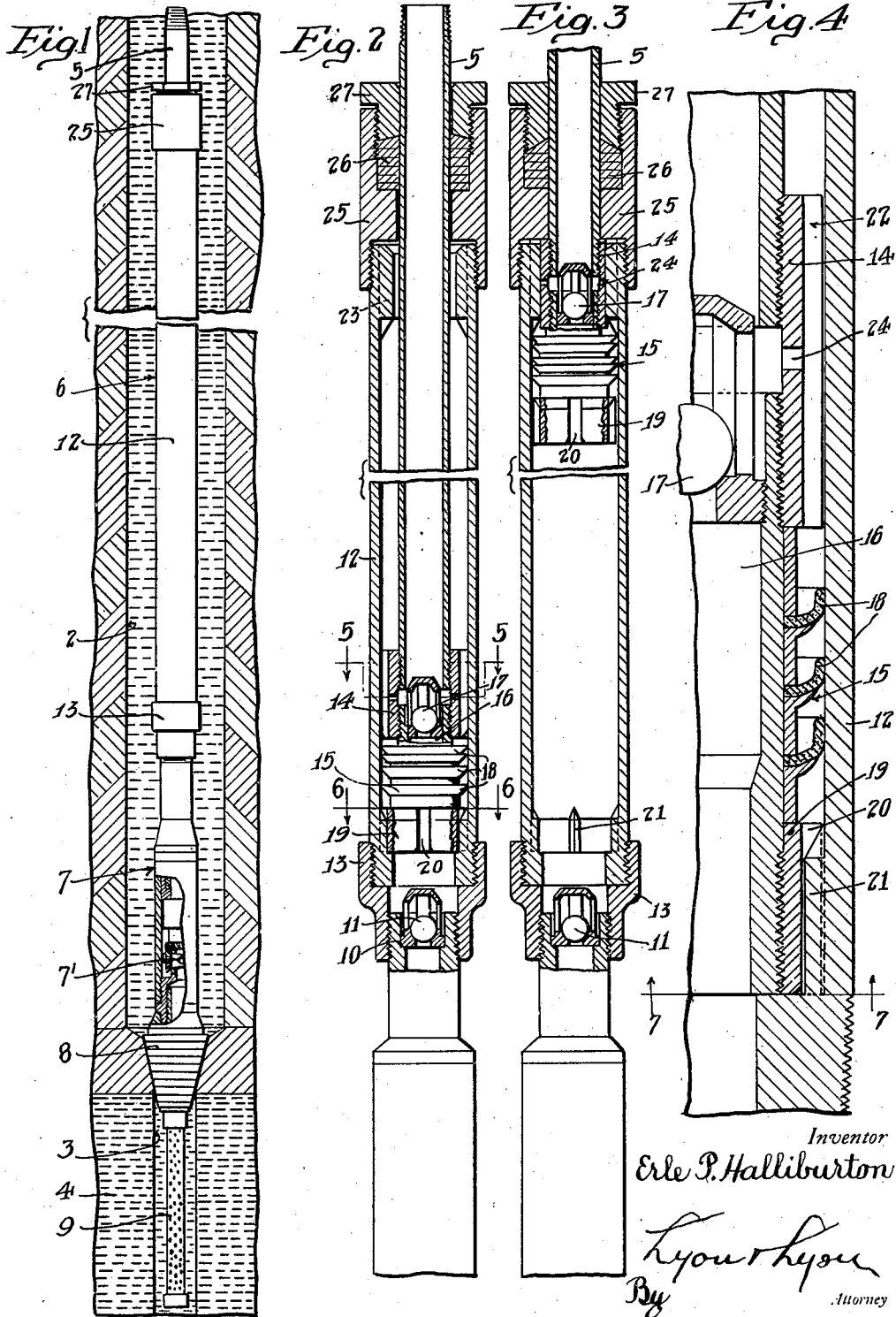
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2,085,972

APPARATUS FOR TESTING OIL WELL FORMATIONS BY PUMPING

Filed Aug. 29, 1934

2 Sheets-Sheet 1



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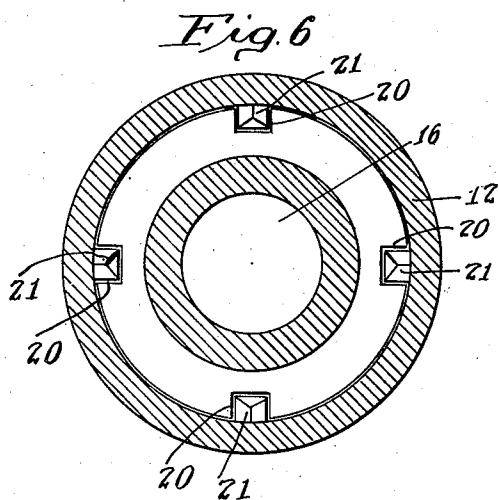
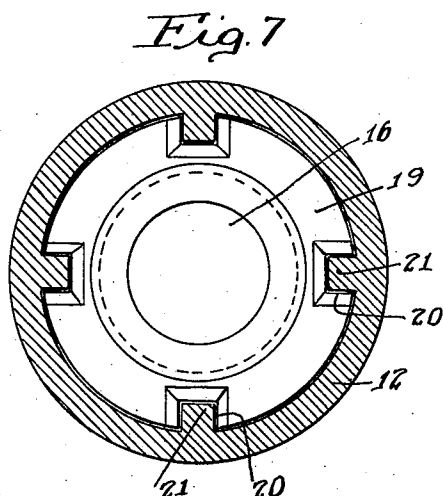
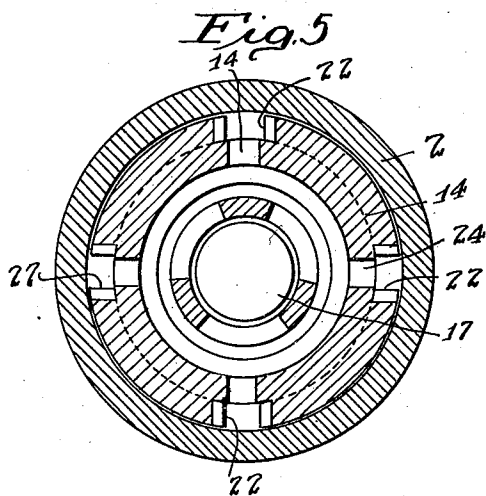
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2 Sheets-Sheet 2



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2,085,972

APPARATUS FOR TESTING OIL WELL FORMATIONS BY PUMPING

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6 Claims. (Cl. 166—1)

This invention relates to apparatus of the type employed for testing wells, such as oil wells, which apparatus includes a single string of pipe to be lowered into the well hole, which pipe carries a packer, which may be set in the bottom of the well, and also carries a valve which may be opened and closed by the manipulation of the pipe from the top of the well.

The present invention is directed particularly to providing such a well-testing apparatus with a pump, which is likewise lowered by the single string of pipe and which is operated by motion of this pipe.

When a well is to be tested by the type of apparatus now generally known as the single string tester, a string of pipe is lowered into the bottom of the well hole, which carries a valve at its lower end, closing the pipe from communication with the mud fluid in the well. The pipe is thus lowered empty to the bottom of the well-hole. The pipe also carries a packer, which may be set in a rat hole at the bottom of the well or may be expanded to make a seal with the side walls of the well. This seals off the well below the packer from the mud fluid within the well and by manipulation of the pipe, i. e. either turning or lowering the pipe, the valve is opened to permit fluid from below the packer to enter the string of pipe. In certain cases, sufficient fluid will not enter the testing apparatus in order for the operator to obtain a satisfactory knowledge of the condition of the well or formation being tested. Thus, for example, where the test is made upon oil formation in which the oil is under such low pressure that the well when finished will only produce by pumping, with testers of the aforementioned type, a sufficient sample of the oil from the formation may not be secured. Likewise, if the formation is of specially tight construction, and, particularly, if it has been heavily mudded it may not flow into the well tester. Also, in case the well testing apparatus is employed to test the tightness of casing for water leaking below the packer, a sufficient test may not be accomplished by merely opening the valve of the tester.

It has been suggested that in such cases a pump might be lowered through the testing pipe, but this would involve the insertion into the well of a second string of pipe, which is, at least from a practical standpoint, impossible.

It is the general object of the present invention to provide a well tester with a self-contained pumping unit, which pumping unit may be operated by reciprocations of the usual single string

of pipe, which carries also the packer and valve of the well tester.

Various further objects and advantages of the present invention will be understood from a description of the preferred form or example of the well-testing apparatus which embodies my invention.

In the drawings,—

Figure 1 is an elevation of a well hole showing the assembled apparatus in position.

Figure 2 is an enlarged elevation mainly in vertical section showing particularly the pump of the tester, the pumping elements being indicated in the bottom position.

Figure 3 is a similar elevation in section with the parts in the upper position.

Figure 4 is an enlarged fragmentary vertical section of portions of the pump.

Figure 5 is a section on the line 5—5 of Figure 2.

Figure 6 is a section on the line 6—6 of Figure 2.

Figure 7 is a section on the line 7—7 of Figure 4.

Referring to the drawings, 2 generally indicates a well hole having a rat hole 3 bored in its lower end into an oil producing formation 4. The testing apparatus is shown in testing position in the well hole and as comprising as its major elements a string of pipe 5 which leads from the apparatus to the top of the well hole, a pump 6, and a well tester of any desired or preferred form 7, which, as usual, is provided with a packer 8 and an inlet tube 9 below the packer. The particular tester shown may be identical with that shown in Figure 2 of my Patent No. 1,992,424, issued February 26, 1935, and has a rotating stop cock valve 7' and a rat hole packer 8, although it is to be understood that any other form of tester may be substituted for that shown.

The top of the tester is provided with a seat 10 for a standing valve 11 illustrated as preferably of the ball type. The pump 7 preferably includes a working barrel 12, the lower end of which is connected by a collar 13 to the top of the tester. The lower section of the string of pipe 5 is connected within the working barrel by a collar 14 with a plunger 15. The plunger 15 has a hollow bore 16 for passage of fluid, and at its upper end forms a seat for travelling valve 17, which is likewise of the ball type.

The plunger 15 is indicated as preferably provided with a number of packing cups 18 for engagement with the sides of the working barrel, and is likewise provided at its lower end with a

head 19, which is provided with a plurality of key-ways 20. The key-ways 20 are adapted to be engaged by splines 21 formed at the lower end of the working barrel 12 in order to lock the working barrel against rotation relative to the plunger and string of pipe 5 when these latter elements are in the lower position. The collar 14 which connects the plunger with a string of pipe 5 is provided with a number of key-ways 22, which are adapted to engage splines 23 formed at the upper end of the working barrel 12 so as to lock the working barrel, plunger and string of pipe 5 against relative rotation when the plunger is in the upper position of the working barrel. Ports 24 are indicated as leading to these key-ways from the bore of the pipe 5 in order to handle the fluid above the plunger 15, which is trapped between the working barrel and section of pipe 5.

At the upper end of the working barrel is indicated a collar 25, which carries packing 26 and a packing gland 27 for packing the section of pipe 5 against leakage of fluid from the working barrel 12.

In testing a well with the apparatus just described, the apparatus is attached to the lower string of drill pipe 5 with a plunger in the upper position, as indicated in Figure 3, and the apparatus lowered through the well hole with the valve 7' of the tester in the closed position and with the pipe 5 empty of fluid. When it reaches the position in the well at which the test is to be made, the packer 8 is caused to engage the formation. It is understood, of course, that in place of the rat hole type of packer a wall type of packer may be substituted, as is well understood in the art. If the rat hole type of tester is employed, when the packer 8 hits the top of the rat hole 3, the pipe 5 pushes the plunger 15 downwardly until it strikes the bottom of the working barrel 12, in which position it is again blocked from rotation relative to the working barrel and in which position the weight or a portion of the weight of the pipe may be used for pressing the packer against the formation to form a firm seat.

A portion of the weight of the pipe is then released from the packer and the pipe 5 rotated to open the stop cock valve 7' and permit fluid from the formation 4 to enter the inlet pipe 9 and rise upwardly through the testing apparatus. It is apparent that other types of valves may be employed rather than the stop cock valve, where desired. If the pressure of the fluids on the oil producing formation or other formation to be tested is sufficient, the fluid may rise through the apparatus by the standing valve 11 and traveling valve 17 up through the string of pipe 5 for a desired distance possibly to the top of the well hole. In other cases, where the fluid will not readily enter the apparatus the manipulation of the pump 6 is employed for drawing the fluid into the apparatus. For this purpose, the drill pipe 5 is reciprocated in the well hole, causing the plunger 15 to work up and down in the working barrel 12. In doing the up-stroke of the plunger 15, fluid is drawn into the working barrel by the standing valve 11. On the down-stroke of the working barrel the standing valve 11 closes and the fluid increased in the working barrel is forced by the plunger to pass through the bore of the plunger above the traveling valve 17 and up into the pipe 5 on its way to the top of the well hole.

With the apparatus thus described it has been found possible to obtain tests on formations

which are too tight to yield proper tests with ordinary testing apparatus or in which the pressure is too low for the ordinary apparatus to make a successful test. It has also been found possible to better test casings for leaks.

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

I claim:

1. An apparatus for testing oil wells, comprising a string of pipe carrying a valve adapted to be closed for maintaining the string of pipe empty while the apparatus is lowered into an oil well, a packer carried by said string of pipe and adapted to engage said well for sealing off the well below the packer from communication with drilling fluid above said packer, and a pump carried by said string of pipe adjacent said valve adapted to be operated by reciprocating said string of pipe relative to said valve.

2. An apparatus for testing a well by pumping, comprising a well tester including a packer adapted to seal a portion of the well below the packer from the mud fluid above the packer, a single string of pipe by which the apparatus is to be lowered into the well and operated, a valve having one part attached to said packer and another part attached to a member having means for rotatably locking the same to said string of pipe so that said valve is adapted to be opened and closed by rotary motion of said string of pipe upon which said valve and packer are lowered, and a pump including a standing valve connected to the tester above the first mentioned valve and a traveling valve adapted to be connected with the string of pipe whereby in operation reciprocation of the string of pipe will actuate said pump.

3. An apparatus for testing a well by pumping, comprising a well tester including a packer adapted to seal a portion of the well below the packer from the mud fluid above the packer, and a valve adapted to be opened and closed by motion of a string of pipe upon which said valve and packer are lowered, a pump including a standing valve connected to the tester and positioned above the first-mentioned valve and a traveling valve adapted to be connected with the string of pipe whereby in operation reciprocation of the string of pipe will actuate said pump, and means for locking the tester and string of pipe against relative rotation.

4. An apparatus for testing a well while leaving the mud fluid of the well in place, which comprises a packer, an inlet tube extending below the packer, a single string of pipe by which said apparatus is adapted to be lowered into the well hole and operated, a valve connected with the packer and operable by motion imparted at the top of the well to said string of pipe, a working barrel connected with the valve, a standing valve at the lower end of the working barrel, said string of pipe having its lower portion reciprocally mounted within said working barrel and carrying a plunger and traveling valve, means for packing the working barrel to said lower section of said string of pipe.

5. An apparatus for testing a well while leaving the mud fluid of the well in place, which comprises a packer, an inlet tube extending below

the packer, a valve connected with said packer and operable by motion imparted at the top of the well to a string of pipe, such string of pipe, a working barrel connected with the valve, a standing valve at the lower end of the working barrel, a string of pipe having its lower portion reciprocally mounted within said working barrel and carrying a plunger and standing valve, means for packing the working barrel to said lower section of said string of pipe, an interlocking means between said lower section of the string of pipe and said working barrel for locking said parts against relative rotation.

6. An apparatus for testing a well hole, comprising a string of pipe the lower end of which is reciprocally mounted in a working chamber,

means for packing the upper end of such working chamber to such string of pipe, a plunger and traveling valve carried by the lower end of such string of pipe and within said working barrel, a key for locking such lower end of said string of pipe to the upper end of said string of pipe against relative rotation when the apparatus is in the expanded position, a standing valve mounted at the lower end of said working chamber, a valve mounted below said standing valve and operable to open and close the passages to said string of pipe when actuated by rotary motion of said string of pipe, a packer below said valve, and an inlet tube below said packer.

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