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WELL TESTING DEVICE

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Fig. 1

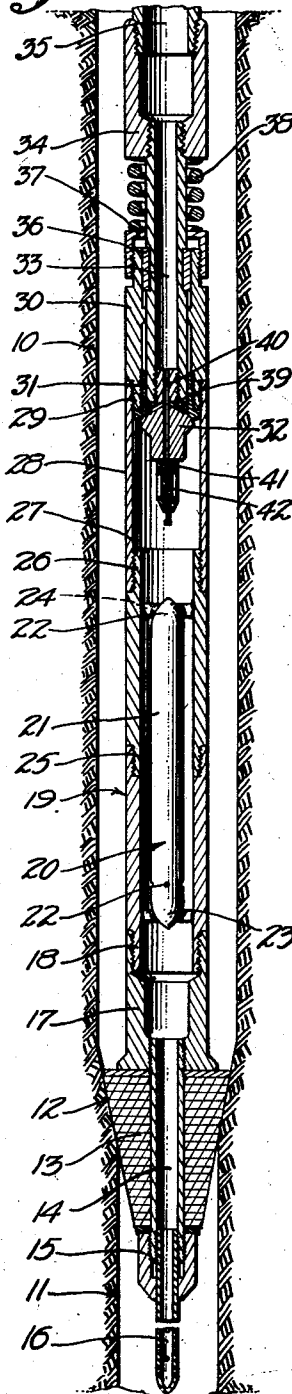


Fig. 2

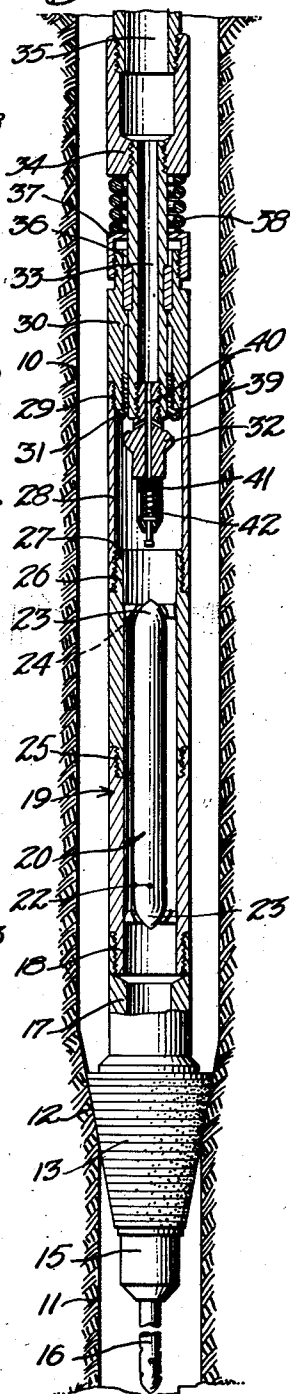
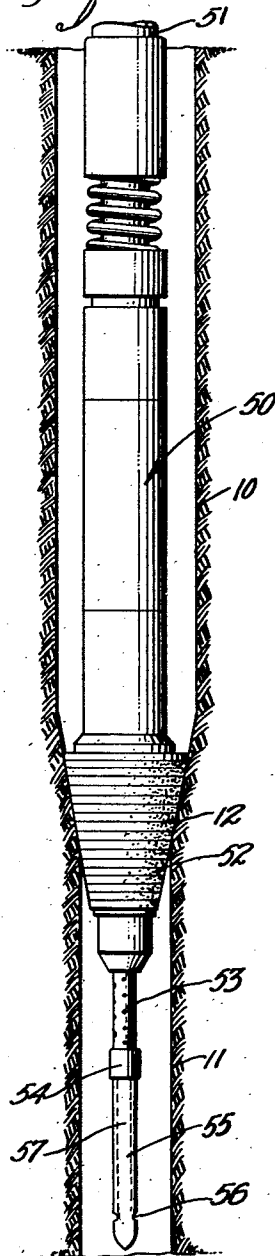


Fig. 3



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WELL TESTING DEVICE

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4 Claims. (Cl. 166—1)

This invention relates to testing apparatus, and particularly pertains to a well testing device.

In the drilling of oil wells it has been found desirable to ascertain the fluid pressure existing in the formation at a desired depth, and particularly in that portion of the well known as the rat-hole. Due to the fact that it is usual to maintain the well filled with drilling fluid during the testing operation, it is necessary that the column of fluid above the area to be tested shall be packed off so that the "shut-in" pressure of the native fluids in the formation can be measured. It is therefore necessary to provide some means, such as a packer, by which the upper column of fluid in the well may be sealed off from the zone to be tested. It is also common practice in making these tests to form a reduced bore at the lower end of the main bore which has been drilled. This reduced bore is commonly called a rat-hole and it is within this bore that a perforated anchor pipe is placed carrying the pressure recording means with which a test is made. It is obvious that when the perforated anchor pipe carrying a packer is lowered into the rat-hole and a flow of fluid is permitted to enter the perforated pipe and to pass upwardly through the drill string by which the structure is supported, that there is a tendency for the formation to cave so that the debris and heavy mud at the bottom of the hole will tend to clog the perforations at the lower end of the anchor pipe and through which the fluid pressure of which is to be measured passes. Thus it will be evident that the fluid which passes through the perforations to the pressure recording means will be restricted in its flow so that an accurate recording would not be obtained. It will also be evident that in the event the formation caves in around the perforated anchor pipe and the pressure bomb the pressure bomb might be lost in the hole. It is the principal object of the present invention therefor to provide a structure by which fluid pressure tests may be made in a well and in which structure the pressure responsive means is so positioned as to insure that its reading will be a direct and accurate index of the true pressure in the formation, and that the pressure responsive means will be so positioned as to be protected from caving formation and to be readily removed from the well even though the anchor pipe and the packer become stuck in the well and have to be disconnected.

The present invention contemplates the provision of a string of pipe to be lowered into a well at the lower end of which is carried a valve struc-

ture operable by movement of the string of pipe and beneath which valve structure is a cage carrying a fluid pressure recording device, the said cage being mounted above a well packer and a perforated anchor pipe extending downwardly therefrom.

The invention is illustrated by way of example in the accompanying drawing in which:

Figure 1 is a view in central vertical section showing a testing device embodying the present invention and disclosing it with its control valve opened.

Fig. 2 is a view in central vertical section showing the structure with the control valve closed.

Fig. 3 is a view drawn at reduced scale and showing a normal method in common practice at the present time for taking deep well fluid pressure recordings.

Referring more particularly to the drawing, 10 indicates a well bore at the bottom of which a reduced bore 11 occurs. This last named bore is known as the rat-hole. Between the rat-hole and the main bore 10 is a seat 12 against which and into which a rat-hole packer 13 is forced to form a seal between the main bore 10 above and the rat-hole 11 below. It is to be understood that while this invention is described as being used in connection with a rat-hole packer in an open well bore it is to be understood that under some circumstances it might be desirable to make fluid pressure tests in casings, at which time a sleeve packer or a hooked-wall packer might be used. The drawing here disclosed will, however, show a suitable application of the invention by way of example. The packer is formed with a central mandrel 14 which is threaded at its lower end and receives a nut 15. Threaded into the mandrel 14 is a perforated anchor pipe 16. Fluid from the rat-hole may flow into this pipe through the perforations and up through the mandrel 14. A body member 17 is threaded to the upper end of the tubular mandrel 14 and the upper end of the body member is threaded to receive the lower end 18 of housing 19 within which a fluid pressure recording device 20 is mounted. This device may be of any desired commercial design, such for example, as the structure shown in U. S. Letters Patent to H. N. Herrick et. al., No. 2,015,851, issued October 1, 1935, which structure is enclosed within a case 21 formed at its lower end with perforated fluid openings 22. The opposite ends of the case are each provided with a conical nose 23. It will thus be evident that fluid passing through the housing 19 and around the case 21 will have a stream-lined flow which will

insure a minimum amount of turbulence in the flowing fluid. The pressure recording device may be mounted within the housing 19 in any suitable manner. It is here shown as being supported in
 5 lower and upper spiders 24 which are formed with relatively narrow arms connecting with the wall of the housing 19. In order to provide accessibility to the pressure bomb 20 the housing 19 may be made in two sections and threaded together as indicated at 25. The upper end of the housing 19 is formed with a threaded pin 26 which engages a threaded opening 27 in the lower end of a tubular valve extension 28. The upper end of this extension is internally threaded at 29 to receive a valve packing member 30. Carried at the lower end of the member 30 is an annular valve seat 31 against which a tappet valve 32 may seat. The tappet valve is carried at the lower end of a tubular valve mandrel 33, the upper end of which mandrel is threaded into a sub 34 which is connected with the lower end of a string of drill pipe 35 by which the entire structure is supported and lowered into or raised from the well. The mandrel 33 and the packing element 30 are
 15 splined together as indicated at 36. An adjusting nut 37 is threaded on to the upper extension of the packing element 30 and provides a lower seat for a valve spring 38 which is interposed between the nut 37 and the lower face of the sub 34. This valve spring 38 acts to hold the valve 32 on its seat 31. Fluid openings 39 are radially made through the tubular portion of the valve 32 above its seating face so that fluid from the member 28 may flow into the valve and the tubular valve member 33 when the valve is opened. For purposes of emergency circulation a tubular passageway 40 is formed through the valve member 32 and is normally closed by a ball valve 41 disposed at the lower end of the passageway and held in place by spring 42.

In order that the operation, and the advantages of operation, may be fully appreciated in the present case, reference is first made to Fig. 3 of the drawing where a method of taking pressure tests as commonly practiced is shown. Here it will be seen that a valve structure 50 is provided as supported from a drill string 51. The valve structure carries a packer 52. Extending downwardly from the packer for a desired distance is a perforated anchor pipe 53 which is fitted with a blind coupling 54. Secured to this coupling is a casing 55 having perforations 56 adjacent its lower end and within which coupling a pressure recording device 57 is carried. Attention is directed to the fact that in the use of a pressure bomb as shown in Fig. 3 the pressure exerted upon the pressure recording device is pressure of fluid in a state of quiescence, since the fluid only enters the perforations 56 and exerts its pressure upon the pressure bomb 57, but cannot flow upwardly through the coupling 54 since there is no fluid passageway in the coupling which would connect it with the perforated anchor pipe 53. It will thus be seen that under such conditions the fluid from the zone being tested is drawn from the area above the pressure recording device and there will be a tendency for magnitude of fluid pressure to be decreased in the zone at the bottom of the well bore which would tend to produce a false reading and would, at the same time tend to make it possible for the formation to cave in around the member 55 so that the flow of fluid through the passageways 56 would be restricted, if not entirely interrupted. This also increases the hazard of getting the sec-

tion of pipe 55 carrying the pressure bomb, as well as the enlarged coupling 54 lodged within the hole so that it could not be removed. Such a condition is decidedly objectionable since pressure recording devices commonly used are quite expensive, as their cost ranges from \$500 to \$1000 each. If the pressure bomb is lost in the hole there is great difficulty in recovering it by a fishing operation and it may be necessary to "side track" the hole in order to pass it. In any event it will be evident that with the pressure bomb mounted at a point of stagnation below the area from which fluid is being withdrawn there is great possibility of obtaining an inaccurate fluid pressure test.

Referring now to Figs. 1 and 2 of the drawing the operation of the structure embodying the present invention will be explained. When the pressure bomb has been prepared for use it is placed within its housing 19 and assembled between the packer 13 and the valve structure above the packer. The spring 38 maintains the valve closed and the structure is then lowered into the well bore 10 through the accumulated fluid therein until the packer 13 seats on the shoulder 12 and the perforated anchor pipe 16 is extended downwardly into the rat-hole 11. The weight of the drill pipe 35 is then imposed upon the packer and will compress the spring 38 so that the valve 32 will move away from its seat 31. It will be understood that since the well is full of drilling fluid it will exert a hydrostatic pressure at the bottom of the hole in direct proportion to the depth of the hole. This pressure roughly amounts to one-half pound per running foot of hole. It will also be seen that as the packer 13 is forced down into its seat it will tend to increase the pressure in the rat-hole and to at least confine the liquid under a pressure substantially represented by the entire fluid column. When the valve 32 is moved to its opened position this pressure will be relieved and the confined fluid within the rat-hole will then be relieved to seek a level within the drill string 35 as determined by the volume of fluid within the rat-hole and the pressure of this fluid. The pressure in the rat-hole and the drill string will thus become equalized. After this is accomplished the weight of the drill string is relieved while the spring 38 tends to hold the packer on its seat and thus holds the valve seat 31 down so that the valve element 32 may move upwardly and rest against it. While the valve 32 is thus resting on its seat the fluid pressure exerted beneath the packer will be pressure of the native fluid within the formation. This is known as the "closed-in" pressure. As the pressure bomb is lowered into the well through the drilling fluid it will be understood that the pressure responsive means will be effected to indicate progressively the increased pressure due to the increased hydrostatic head of the fluid column above the pressure recording device. When the packer is set and before the valve is opened the pressure responsive means will record the pressure existing in the area below the packer. When the valve is opened the pressure below the packer will be relieved until the column of fluid which rises within the drill string represents a hydrostatic head equal to the pressure within the rat-hole below the packer. When the valve is then closed and held closed for a determined period of time the native fluids within the formation will flow into the rat-hole and upwardly through the perforated anchor pipe 16

until a maximum "closed-in" pressure has been reached. This pressure will be transmitted to the pressure recording device 20 and will thus give an accurate reading showing all of the pressures.

5 Attention is directed to the fact that since the fluid which passes into the lower end of the housing 19 can flow around the pressure recording device 20 in an unrestricted stream-line flow the fluid pressure which is recorded will be an accurate indication of conditions as they exist in the area below the packer. It will also be seen that due to the fact that the fluid may freely flow upwardly around the pressure recording device 20 and thereabove there will not be the possibility for the pressure recording device to be clogged to cause an inaccurate and unreliable pressure reading to be obtained. It is further to be pointed out that since the pressure recording device is disposed above the packer it is possible to unscrew the housing 19 from the packer in the event that the packer is lodged in the hole, thus making it possible to recover the expensive pressure recording device 20 with the drill string, after which an attempt may be made to withdraw the packer by the use of suitable fishing tools.

It will thus be seen that by the construction and arrangement of parts here shown, an accurate test may be made of the fluid pressure occurring within the confined area of a well bore without probability that the pressure recording instrument will become lodged in the well and with the assurance that the fluid pressure recording will correctly indicate the pressure conditions prevalent within the confined area, even though an accumulation of heavy mud or cavings from the formation will tend to accumulate around the bottom of the anchor pipe.

While I have shown the preferred form of my invention, as now known to me, it will be understood that various changes might be made in the combination, construction, and arrangement of parts, by those skilled in the art, without departing from the spirit of the invention as claimed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A well testing device comprising a packer adapted to be seated within a well bore and having a passageway therethrough, a perforated anchor pipe carried at the lower end of the packer and communicating with said passageway, a tubular housing connected to the packer and disposed thereabove, said housing having a fluid passage-

way therethrough in communication with the packer passageway, pressure recording means mounted within the fluid housing lowered therein and around which fluid may flow as it passes through the housing, a valve structure disposed above said pressure recording device and controlling the flow of fluid through the fluid housing, and a string of pipe connected to the valve structure and into which the valve controlled fluid flows.

2. In combination with a packer having a fluid passageway therethrough and a valve structure to control the flow of fluid, an intermediate unit comprising a tubular housing connecting the packer and the valve structure and providing a fluid passageway therebetween, and a pressure recording device detachably mounted therein and around which fluid will flow from the packer to the valve structure.

3. In combination with a packer having a fluid passage and a valve structure to control the flow of fluid therethrough, a tubular housing connecting between said valve structure and said packer, spider elements disposed adjacent the opposite ends of said housing, and a pressure recording device supported by and between said spider elements and around which will flow fluid from said packer to said valve structure.

4. An oil well tool comprising a packer adapted to seat in an oil well and create a fluid seal between an area below the packer and an area above the packer, a passageway through the packer from the lower area to the upper area, a tubular barrel secured to the upper end of the packer and having a central passageway in communication with the passageway through the packer, mounting means within the barrel, a pressure recording device removably secured within the barrel by said mounting means and supported thereby to permit the fluid passing upwardly through the packer and through the barrel to pass around the fluid pressure recording means, means permitting the pressure recording device to be removably secured in position, a string of pipe connected to the upper end of the barrel and through which fluid from the barrel may flow, and a valve element controlling the flow of fluid from the upper end of the barrel to the string of pipe, said valve element being disposed above the pressure recording means.

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