April 20, 1937. S. KNOERR 2,077,760

HYDRAULICALLY CONTROLLED SAND TESTING DEVICE

Filed Aug. 6, 1935

FIG. 1.

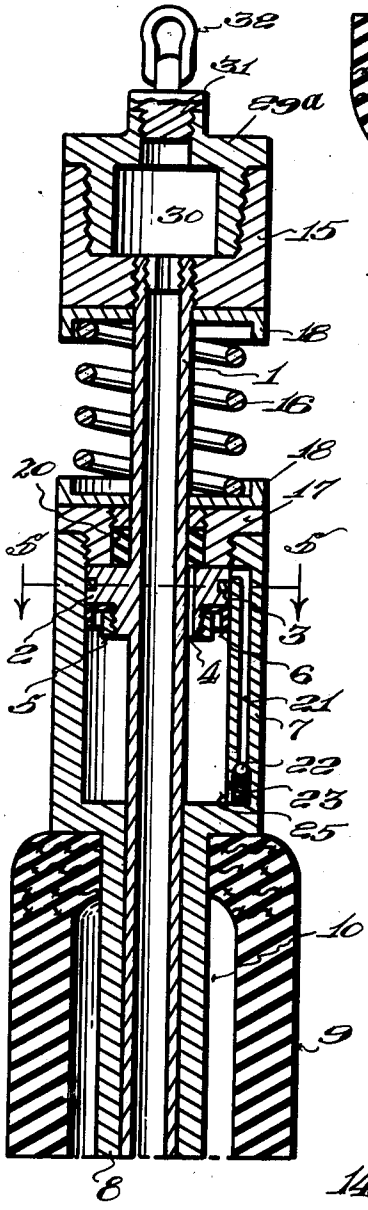


FIG. 2.

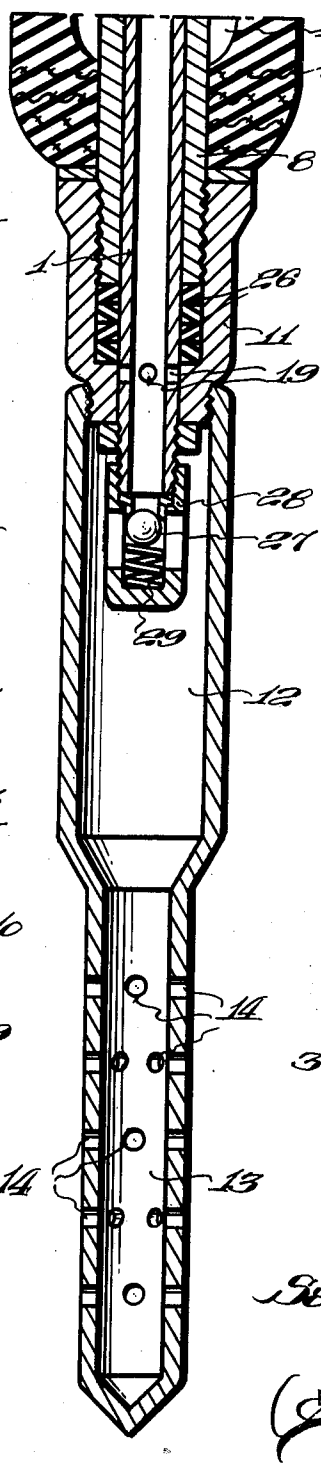


FIG. 3.

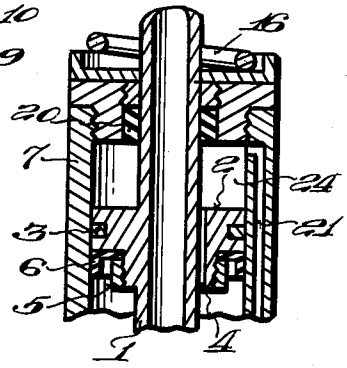


FIG. 4.

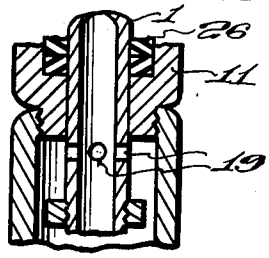
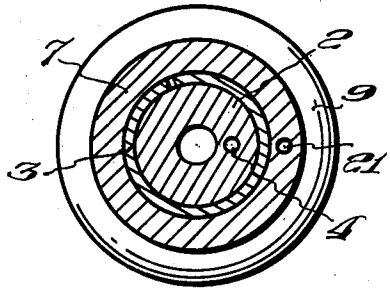


FIG. 5.



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HYDRAULICALLY CONTROLLED SAND TESTING DEVICE

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6 Claims. (Cl. 166—1)

This invention relates to sand testing tools and it has particular reference to a tool so arranged that an accurate sample of liquids at the bottom of a bore hole may be obtained when the tool is lowered into the well.

The principal object of the invention is to provide an hydraulic control means whereby the tool is rendered operative to receive a sample of liquid at a predetermined time after it has reached the bottom of the bore hole.

Another object of the invention is the provision of hydraulic means arranged to cooperate with the effective force of a spring in maintaining the tool in closed position during its lowering into the well.

Another object of the invention is the provision of means for automatically returning the various parts to normal position should they become slightly displaced upon the encountering of a tight place in the well.

Still another object is the provision of a sample receiving chamber which is sealed against influx of undesired liquids, and further arranged to cooperate with a valve assembly for admitting the desired sample at the bottom of the well.

With the foregoing objects as paramount, the invention has particular reference to its salient features of construction and arrangement of parts, to become manifest as the description proceeds, taken in connection with the accompanying drawing, wherein:—

Figure 1 is an elevational view in longitudinal section showing the sand tester with the piston in raised position.

Figure 2 is a continuation of Figure 1 showing the valves in closed position.

Figure 3 is a fragmentary view of the hydraulic cylinder showing the piston in a downward position.

Figure 4 is a fragmentary view of the sleeve valve shown in open position, and

Figure 5 is a view on the line 5—5 on Figure 1.

Continuing with a more detailed description of the drawing, 1 designates a hollow plunger which is preferably made integral with a piston 2. This piston is provided with a piston ring 3 and a longitudinal opening 4 as shown in Figures 1 and 3. A nut 5 serves to retain a flexible cup 6 on the underside of the piston 2.

The cylinder 7 is formed as shown in Figure 1, and is provided with an integral, depending sleeve 8 which surrounds the hollow plunger 1. This sleeve is of a diameter less than that of the cylinder 7 and surrounding the same is a packer 9 of a composition material which is in itself resilient to a certain degree but to lend to such resiliency, the packer is recessed at 10 and engages the sleeve 8 adjacent its top and bottom.

The sleeve 8 is threaded at its lower end to be receivable in a swaged connection 11, which latter, in turn is threaded into the barrel 12. This barrel is likewise swaged to define a depending tubular strainer 13, with perforations 14 admitting fluid from the well for passage upward through the tool into the drill stem assembly, not shown, but which is usually the medium by which the tool is introduced into and withdrawn from the well.

To the upper end of the stem 1 is secured the connection 15 to receive the lowest section of the drill stem assembly. An expansion spring 16 surrounds the stem 1 between the plug 17 in the top of the cylinder 7 and the connection 15. Retainers 18 in which the ends of the spring rest are provided are disposed directly against the elements 17 and 15. Obviously, the spring normally actuates the stem 1 longitudinally in the cylinder 7 and through the elements therebelow to open and close the valve, which is comprised of ports 19 near the lower end of the stem. When the tool is closed against influx of liquid the ports 19 are in the position shown in Figure 2 or above the lower end of the connection 11. When open, the ports are open to the liquid below the said connection. These facts will be reiterated in the course of the description of operation to follow.

Referring again to the cylinder 7, it will be noted that suitable packing 20 surrounds the stem 1 where it passes through the gland 17, immediately above the piston 2 and further, that a liquid passage 21 extends longitudinally through one side of the cylinder. This passage has a check valve 22 in its lower end and is held in closed position by a spring 23. This passage is open to downward passage of liquid, i. e. from a chamber 24, (see Fig. 3) formed by downward movement of the piston 2, within the cylinder 7, to a point below the piston. This opening is shown at 25 in Figure 1.

Within the connection 11 and also surrounding the stem 1 is a laminated packing element 26 and it is within the confines of this element that the ports 19 of the stem 1 repose to close the stem against influx of liquid in making a test of the oil producing sand.

Peculiar to the construction of the present invention, there is provided a valve 27, the cage 28 of which is threaded upon the lower end of the stem 1 and moves therewith. A spring 29

holds the valve in closed position, therefore it is operative only when fluid is pumped downward into the well to flush the tool or to dislodge the same in irregular holes, should it become lodged therein. This feature also will be mentioned in the description of operation.

Threaded into the connection 15 is a hollow plug 29a, defining a cavity 30. This cavity is adapted to receive a suitable fluid pressure gauge of conventional design, adapted to measure well pressure in the hole. Should it be desired to determine well pressure at the surface, the plug 31 is removed and a pipe or other tubular element may be threaded into the opening, and in the length of which a pressure gauge (not shown) is incorporated. A member 32 in the form of a loop provides a means by which the tool may be effectively handled.

In operation, a tool constructed according to the foregoing is secured to the lowermost section of a drill stem and lowered into the hole. It will be understood that a test or "rat hole" of a diameter smaller than the bore hole is first made and it is within this test hole that the perforated pipe 13 extends. The packer 12 functions to close the bore hole against exchange of liquids, i. e. passage of drilling fluid into the oil sand to be tested or upward passage of liquid from the oil sand. The packer 12 is set down upon the shoulder separating the bore and test holes, and due to its expansibility, it is urged outward in all directions against the walls of the bore hole.

The weight of the drill stem assembly overcomes the resistance of spring 16 and urges the stem 1 to its lowest position, since the companion elements are now stationary, due to the bore hole shoulder mentioned, on which the packer 9 is brought to rest. When thus urged to its lowest position, the stem 1 is open to liquid since the ports 19 are below the lower end of the connection 11. Fluid rising in the tubular members 12 and 13 has no alternative but to pass through openings 19 into the stem 1 and continue upward into the drill stem. Obviously, the valve 27, being closed by the action of spring 29, fluid cannot pass upward through the tool past the valve at any time. When a sufficient quantity of test liquid has been received in the device, it is elevated, the valve openings 19 closed and the tool is brought to the surface for a test of the entrapped liquid to determine further drilling procedure.

Most important among the features of the present invention is the hydraulic medium by means of which the valve is actuated. This medium which was explained during the structural description is operated slowly to open the valve and comparatively rapidly to close the same. This feature is of decided importance in this type of tool inasmuch as in passing downward in the bore, it is likely to strike protuberances sufficient to start a premature closing action of the inlet valve and it is necessary that this valve remain closed until a test is to be actually made. Therefore, should the valve be accidentally opened, it is immediately closed and no appreciable amount of undesirable liquid is entrapped.

However, when the packer 9 is set down upon the shoulder mentioned, the weight of the drill stem or any part thereof sufficient to actuate the tool is applied, whereupon the spring 16 is collapsed and the stem 1 lowered to expose the ports 19. Obviously, the relatively small diameter of the fluid passage 4 will require some time to admit passage of sufficient fluid to completely transfer the fluid from the lower portion of the cylinder 7 to the upper portion above the piston 2. Hence the slow opening action of the valve. Return of the fluid to its original chamber, i. e., below the piston 2 is accomplished in half the time since both the passage 4 and the passage 21 are open to the fluid.

Accordingly, it will be seen from the foregoing that many obstacles heretofore encountered are overcome by provisions for control of the valve admitting test liquid, without which the liquid would be adulterated with undesirable liquids and would be rendered incompetent as test fluids. In addition to this, the invention provides for flushing the tool occasionally in the hole to remove mud deposits and to dislodge the same should it become lodged on projecting stones, shoulders or the like or in irregular bores, and this without opening the valve to any effective degree.

Manifestly, the construction shown is capable of considerable modification and such modification as is considered within the scope and meaning of the appended claims is also considered within the spirit and intent of the invention.

What is claimed is:

1. A sand testing tool including a sample receiving tube having normally closed ports in its lower end, a fluid chamber having a depending sleeve surrounding said tube and through which the latter is movable to open position by weight imposed thereupon, a piston carried by said tube and operative within said chamber to displace fluid therein whereby to retard the opening movement of said tube, means for relieving said fluid of restriction upon reverse movement of said sample receiving tube, spring means for effecting rapid movement thereof to closed position, a normally closed valve below the ports in said sample receiving tube, yielding to a flushing fluid through said tube, and expansible packing means surrounding the sleeve below said fluid chamber.

2. A tool for testing producing sands in wells including a sample receiving tube actuated by weight imposed upon its upper end and having fluid inlet ports and a relatively movable concentrically disposed cylindrical fluid chamber, provided with a depending sleeve through which said tube slides and which sleeve normally closes the inlet ports of said tube, a piston carried by said tube and operative in said cylindrical chamber and having a fluid passage therein, spring means for normally holding said tube in retracted position to close its ports and capable of compression when said tube is slidingly moved through said sleeve by weight imposed thereon to expose its ports to well fluid, fluid means within said chamber to resist movement therein of said piston to retard the sliding action of said tube and means within said chamber to effect displacement of said fluid therein to relieve said piston upon its return to inoperative position when said tube is retracted by said spring means.

3. A tool for obtaining samples of oil bearing sands including a sample receiving tube slidingly actuated by weight imposed upon its upper end and having ports adjacent its lower end and carrying a normally closed flushing valve on its lower extremity, a fluid containing chamber surrounding said tube through which the latter moves, a sleeve depending from said chamber and surrounding said tube, means on the lower extremity of said sleeve for closing the ports in said tube, a piston carried by said tube and op-

erating in said chamber, means holding said tube in normally retracted position to hold its ports within the confines of said latter means, said means yielding to the movement of said tube to extended position to open its ports, means in said chamber through which fluid is forced by the action of said piston to retard the opening action of said tube, said means being effective in relieving restriction of said fluid during reverse movement of said piston to effect rapid closing action of said tube and well packing means below and in fixed relationship with said chamber.

4. A sand testing tool for wells including a test tube having a head threaded thereon and a series of perforations adjacent its lower end, a valve on the lower extremity of said tube, a fluid chamber surrounding said tube and having a tubular sleeve depending therefrom through which said test tube slides, said sleeve being effective in closing the ports in said tube, a perforate pipe operatively connected to and depending from said tubular sleeve and enclosing the valve on said test tube, a well packing means surrounding the sleeve of said fluid chamber between the latter and the upper end of said perforate pipe and arranged to expand when pressure is imposed upon the head of said test tube to expose the perforations thereof to well fluid, a piston carried by said test tube, operating in said fluid chamber and having a restricted fluid passage therein, a valved fluid by-pass for transferring fluid in said chamber to a point below said piston on the closing action of said tool and spring means for assisting said closing action.

5. A tool for testing productive formations in wells including a fluid receiving tube having ports in its lower end and a flushing valve on its lower extremity, a fluid containing chamber surrounding said tube and having a depending sleeve exteriorly of and in concentric relationship with said tube whereby to close the ports in said tube, a piston carried by said tube, operating in said fluid chamber and having a fluid passage therein, a valved fluid by-pass in said chamber for returning fluid to a point in said chamber below said piston when displaced by pressure imposed on said tube, a perforate pipe operatively connected to and depending below the sleeve of said fluid chamber and embracing the valve carried by said tube, expansible packing means surrounding said sleeve between said chamber and said perforate pipe and spring means for returning said tube to operative position when displaced by the opening action of said tool.

6. In a well sand testing tool having a perforate sample receiving tube arranged for sliding movement to open position by weight imposed on its upper end, with expansible well packing means surrounding the same, a fluid chamber above said packing means through which said tube passes, a piston carried by said tube having a fluid port therein to limit the transfer of fluid in said chamber from a point below to a point above said piston when said tube is subjected to opening pressure, thereby to prolong the opening action of its perforations to well fluid, and a valved by-pass in said chamber to return the displaced fluid to its original position upon the closing movement of said tube.

SAM KNOERR.