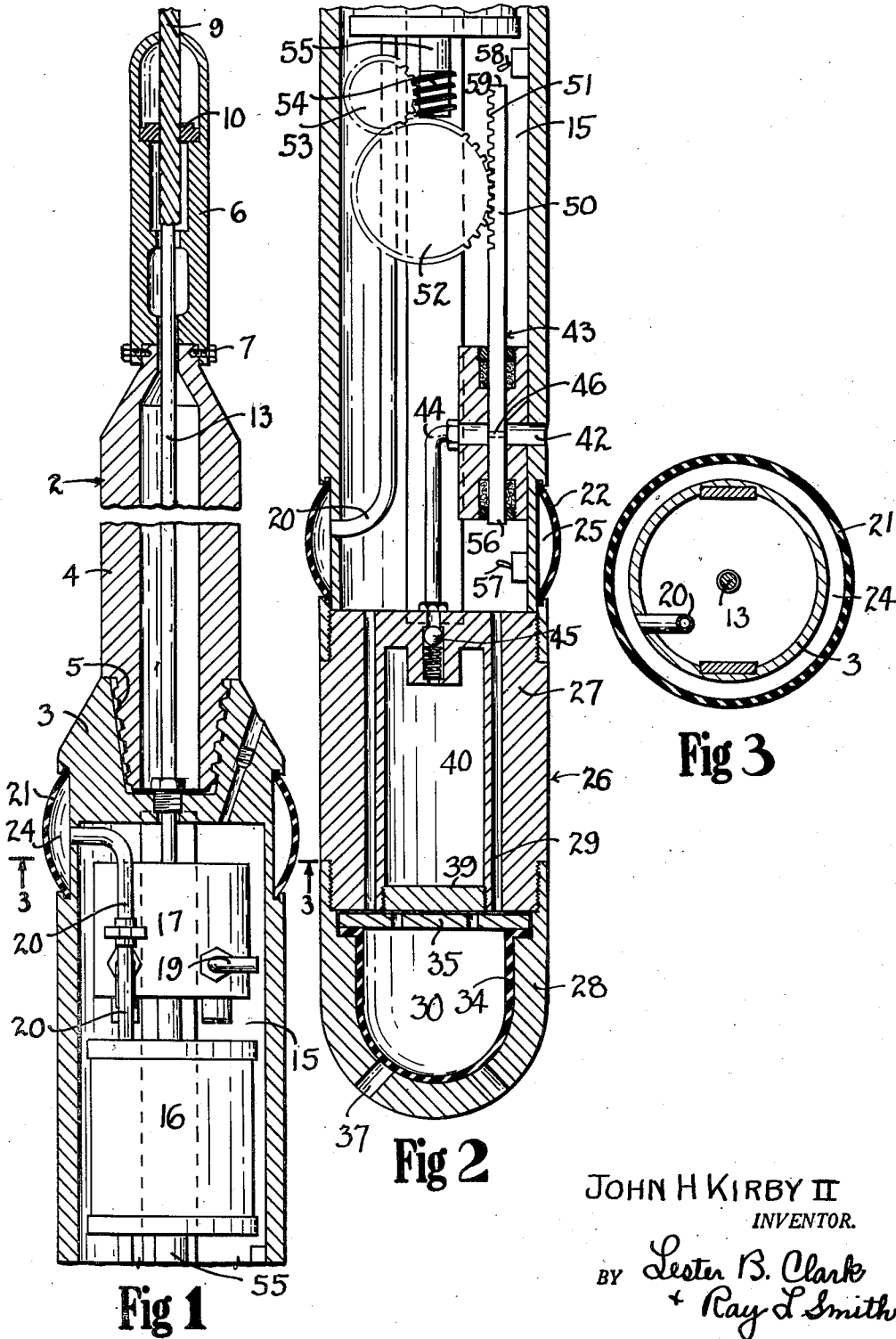


May 8, 1951

J. H. KIRBY, II
FORMATION TESTING TOOL

2,552,433

Filed May 7, 1946



JOHN H KIRBY II
INVENTOR.

BY *Lester B. Clark*
+ *Ray L. Smith*
ATTORNEYS

UNITED STATES PATENT OFFICE

2,552,433

FORMATION TESTING TOOL

John H. Kirby, II, Houston, Tex.

Application May 7, 1946, Serial No. 667,797

9 Claims. (Cl. 166—1)

1

The invention relates to a testing tool for formations encountered in the drilling of wells.

One of the objects of the invention is to provide a tool which will seal off a specific portion of a well bore and then open to receive a sample of the fluid from such formation.

Another object of the invention is to provide a testing tool having a motor and a hydraulic pump therein to inflate a pair of spaced packers and to thereafter positively open the tool to receive a sample of the formation fluid.

Another object is to provide an electric motor in a well testing tool when such motor operates a pump to inflate a pair of sealing packers and also operates a valve to open the tool after the packers are inflated and to close the valve and then deflate the packers.

Another object of the invention is to provide a testing tool having a pump and a supply of liquid therein so as to inflate a pair of spaced packers thereon where the diaphragm is adapted to move so as to compensate for the volume of liquid pumped to and from the packers.

Other and further objects of the invention will be readily apparent when the following description is considered with the accompanying drawing, wherein—

Figs. 1 and 2 taken together show the top and bottom respectively of the testing tool in vertical section.

Fig. 3 is a section taken on the line 3—3 of Fig. 1.

The tool 2 is made up of a body 3 which has the retrieving nipple 4 threaded at 5 thereto. A sealing cup 6 is connected to the nipple 4 by the set screws 7 and serves to form a seal about the cable 9 by means of the plate 10 therein.

The cable 9 is a combination support and electric cable in that the conductors of an electric circuit extend therethrough and downwardly through a conduit 13 into the body 3. In event the cable should break or the tool become lodged in the well bore a suitable fishing or retrieving tool could be lowered into the well to grapple the nipple 4.

The body 3 of the tool is hollow to provide a chamber 15 which has a motor 16 to drive a hydraulic pump 17. An inlet 19 to the pump will pick up liquid in the chamber 15 such as oil or other liquid and discharge such liquid into the pipes 20.

The body 3 has an upper packer 21 and a lower packer 22 positioned thereon. These packers are hydraulically inflatable and the pipes 20 are arranged to lead to the interiors 24 and 25 respec-

2

tively. It will be remembered that the tool is to be operated in a well bore which may be of considerable depth and pressure and any movement of liquid must be compensated for in order to equalize the pressures on the equipment. To provide for such equalization the body 3 is closed at its lower end by a guide shoe or plug 26 made up of a nipple 27 and the nose 28. The nipple has the passages 29 therethrough so that the area 30 in the shoe 28 is connected to the chamber 15. A diaphragm 34 of flexible material is disposed in the shoe and held in position by a plate 35 clamped between the nipple 27 and shoe 28. The ports 37 in the shoe allow pressure in the well to be exerted on the diaphragm so that the internal and external pressures on the tool will be equalized. When the pump displaces some of the liquid from the chamber 15 into the packers, it seems clear that the diaphragm will move inwardly to compensate for such volume change. When the liquid is withdrawn from the packers and returned to the chamber 15, the diaphragm will be forced back to its initial position, causing the well liquid to move out through the ports 37 into the well.

The nipple 27 has a sample chamber 40 therein to receive a sample of the formation fluid so that such sample may be retrieved and examined. An inlet orifice 42 in the body 3 is controlled by a slide valve 43 and a pipe 44 connects such orifice to the sample chamber 40. A check valve 45 retains the sample and pressure thereof in the chamber.

With a tool of this sort it is desirable to have the sample chamber at a lesser pressure than the pressure expected to be encountered in the formation so that the slide valve will have the choke 46 therethrough out of alignment with the orifice 42 when the tool is lowered into the well bore so as to prevent the entrance of any fluid to the chamber.

The rod 50 of the valve has a rack 51 of teeth thereon to be engaged by a gear 52 in turn operated by a pinion 53 from a worm wheel 54 on the motor shaft 55. The valve rod is so arranged relative to the gears and motor that the choke will not move into the orifice 42 until the motor and the pump 17 have operated for a predetermined period so as to inflate the packers and thus form a seal with the walls of the well bore. The valve then opens to the isolated area or formation between the spaced packers. The reduced pressure in the sample chamber encourages a flow of fluid from the well bore and the formation so that a sample is thus obtained.

3

In a short period the pressure in the chamber is equalized with that of the formation and then of course no more sample will be received. The movement of the valve rod continues until the lower end 56 thereof engages a switch 57 which is connected to reverse the motor and the pump as well.

The packers will now be deflated by the liquid returned to the chamber 15 and the extension of the diaphragm 34. Another switch 53 may be provided to be engaged by the upper end 59 of the valve rod to shut off the motor and pump or the current may be cut off at the surface. The entire tool is now raised to the surface. The removable base plug 39 permits access to the sample chamber.

It is believed that the operation will be readily understood and the invention contemplates that a power operated testing tool to inflate and deflate the packers and to open and close the tool.

What is claimed is:

1. In a formation testing tool a body, a sample receiving chamber therein, a fluid conduit from the outside of said body to said chamber, a valve to open and close said conduit, a power liquid chamber in said body, a motor and hydraulic pump in said liquid chamber, a pair of spaced packers on said body above and below said conduit, connections from said pump to said packers to effect inflation and deflation thereof by the injection and withdrawal of power liquid by said pump, and a mechanical connection from said motor to said valve including a rack and pinion to open said valve after said packers are inflated.

2. In a formation testing tool a body, a sample receiving chamber therein, a fluid conduit from the outside of said body to said chamber, a valve to open and close said conduit, a power liquid chamber in said body, a motor and hydraulic pump in said liquid chamber, a pair of spaced packers on said body above and below said conduit, connections from said pump to said packers to effect inflation and deflation thereof by the injection and withdrawal of power liquid by said pump, a mechanical connection from said motor to said valve including a rack and pinion to open said valve after said packers are inflated, and switch means operable by said valve to reverse said motor, close said valve and reverse said pump to deflate said packers.

3. A formation testing tool including a body, hydraulically inflatable packers thereon, a chamber in said body, a hydraulic pump in said chamber to draw liquid therefrom to inflate said packers, and a diaphragm carried by said body and exposed to said chamber and to the outside of said body so as to yield to compensate for the surge of the liquid pumped to and from said packers.

4. A formation testing tool including a body, hydraulically inflatable packers thereon, a chamber in said body, a hydraulic pump in said chamber to draw liquid therefrom to inflate said packers, a motor to operate said pump, and a diaphragm carried by said body and exposed to said chamber and to the outside of said body to yield to contract and expand respectively to compensate for the liquid pumped to and from said packers, and a sample chamber a valve thereon, a mechanical device connected to said motor to open said valve when said packers are inflated and close said valve when the packers are deflated.

5. A formation testing tool comprising a body, a combination support and electric cable to ma-

4

nipulate said tool in a well bore, a pair of spaced inflatable packers on said body, an electric motor in the body, a hydraulic pump in said body and directly connected to be operable by said motor, a power liquid chamber in said body to house said motor and pump and to contain a supply of power liquid, a connection for liquid flow between said packers and pump, a sample chamber also in said body, an admission valve for fluid from the formation between said packers, a pipe to conduct the sample from said valve to said sample chamber, and mechanical means operable by said motor to move said valve after a predetermined operation of said motor, said motor and pump moving the power liquid prior to said valve movement by said mechanical means to first effect the inflation or deflation of said packers by the discharge to or suction from said packers of power liquid by said pump.

6. A formation testing tool comprising a body, a combination support and electric cable to manipulate said tool in a well bore, a pair of spaced inflatable packers on said body, an electric motor in the body, a hydraulic pump in said body and directly connected to be operable by said motor, a power liquid chamber in said body to house said motor and pump and to contain a supply of power liquid, a connection for liquid flow between said packers and pump, a sample chamber also in said body, an admission valve for fluid from the formation between said packers, a pipe to conduct the sample from said valve to said sample chamber, mechanical means operable by said motor to move said valve after a predetermined operation of said motor, said motor and pump moving the power liquid prior to said valve movement by said mechanical means to first effect the inflation or deflation of said packers by the discharge to or suction from said packers of power liquid by said pump, and additional means operable by said valve to reverse said motor and pump to deflate said packers and close said valve.

7. A formation testing tool comprising a body, a combination support and electric cable to manipulate said tool in a well bore, a pair of spaced inflatable packers on said body, an electric motor in the body, a hydraulic pump in said body and directly connected to be operable by said motor, a power liquid chamber in said body to house said motor and pump and to contain a supply of power liquid, a connection for liquid flow between said packers and pump, a sample chamber also in said body, an admission valve for fluid from the formation between said packers, a pipe to conduct the sample from said valve to said sample chamber, mechanical means operable by said motor to move said valve after a predetermined operation of said motor, said motor and pump moving the power liquid prior to said valve movement by said mechanical means to first effect the inflation or deflation of said packers by the discharge to or suction from said packers of power liquid by said pump, additional means operable by said valve to reverse said motor and pump to deflate said packers and close said valve, and a diaphragm in said body exposed to the exterior of the tool and to said power liquid chamber for movement to compensate for the change of liquid volume in said chamber due to inflation and deflation of said packers.

8. A formation testing tool for wells comprising a body, spaced hydraulically inflatable packers thereon, a motor pump combination in said body, a power liquid chamber in said body, con-

5

nections for such liquid to and from the packers, pump and chamber, a sample reservoir in said body, a flow port to said reservoir from exterior of said housing between said packers, a valve controlling said port, and mechanical means connected to said combination to open said valve only after said packers are inflated, and to close said valve only after said packers are deflated, and switch means operable by movement of said valve to reverse said motor pump and mechanical means upon predetermined movement of said valve.

9. A formation testing tool for wells comprising a body, spaced hydraulically inflatable packers thereon, a motor pump combination in said body, a power liquid chamber in said body, connections for such liquid to and from the packers, pump and chamber, a sample reservoir in said body, a flow port to said reservoir from exterior of said housing between said packers, a valve controlling said port, and mechanical means connected to said combination to open said valve

6

only after said packers are inflated, and to close said valve only after said packers are deflated, and switch means operable by movement of said valve to reverse said motor pump and mechanical means upon predetermined movement of said valve, said chamber including a flexible means exposed exteriorly of said body to yield as the power liquid surges into and out of said packers.

JOHN H. KIRBY, II.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
31,567	Spooner	Feb. 26, 1861
2,161,557	Clark	June 6, 1939
2,249,815	Ennis	July 22, 1941
2,363,793	Johnson	Nov. 28, 1944
2,441,894	Mennecier	May 18, 1948
2,458,631	Parks	Jan. 11, 1949