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2,846,876

WELL TESTING DEVICE

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FIG. 1.

FIG. 2.

FIG. 5.

FIG. 6.

FIG. 7.

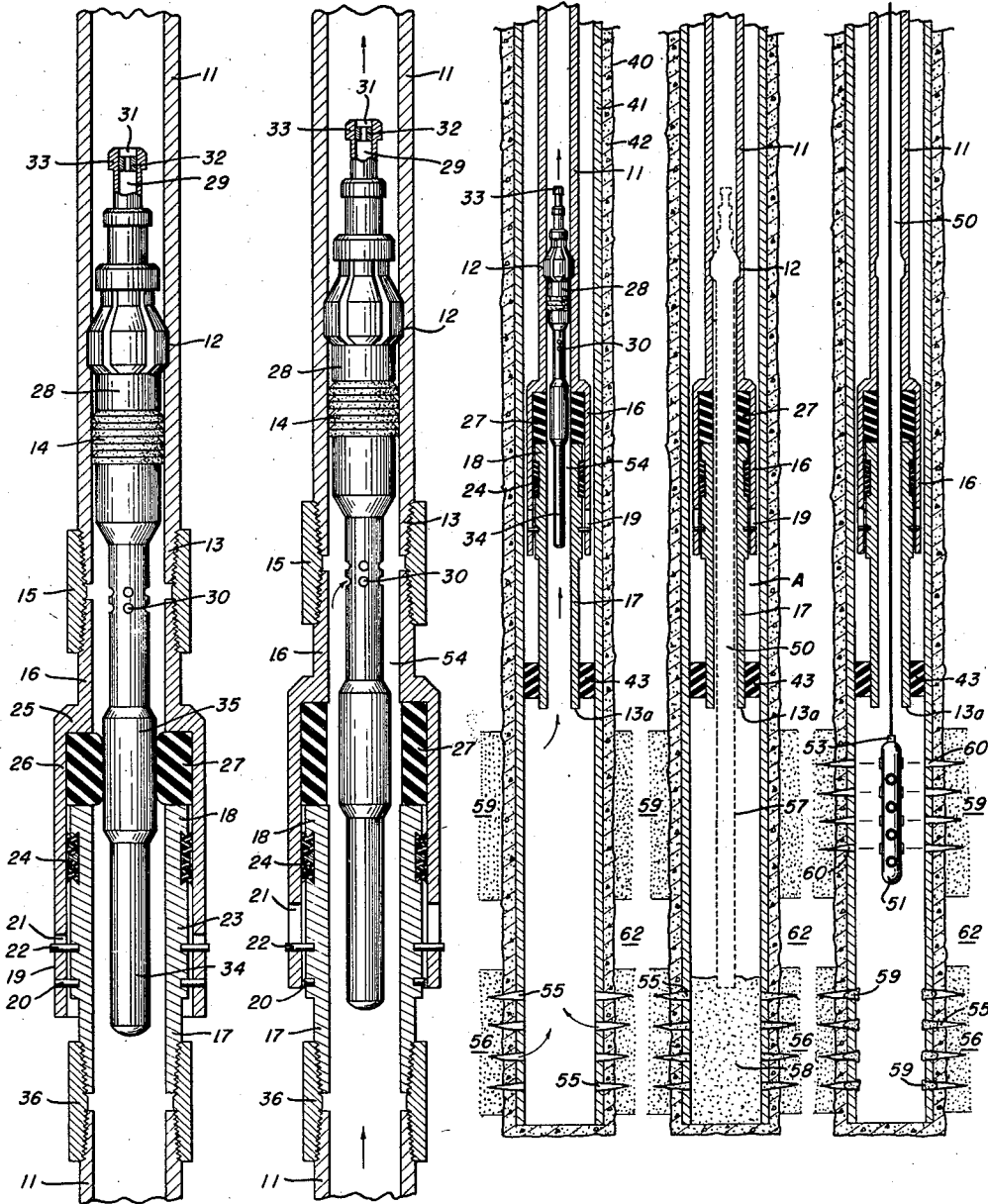


FIG. 3.

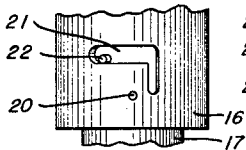
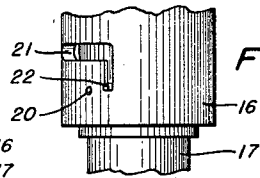


FIG. 4.



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## WELL TESTING DEVICE

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3 Claims. (Cl. 73—152)

The present invention is directed to a device for use in a well. More particularly, the invention is directed to a drill stem testing device. In its more specific aspects, the invention has to do with apparatus comprising a closure means for use in wells during drill stem testing operations.

The present invention may be briefly described as a well testing device for use in a cased well having a tubing arranged therein which comprises a tubular member provided with an inlet port and outlet port for passage therethrough. The outlet port may have a restriction means therein, such as a choke, to prevent exerting an excessive drawdown or differential pressure on the formation during the testing operation. A pressure recording means is attached or fixed to the lower end of the tubular member for recording the pressure from the formation. The tubing has means in the lower end thereof for supporting and sealing the tubular member therein. Attached to the lower end of the tubing below the supporting and sealing means is a mandrel having an inside diameter greater than that of the tubing. Arranged in the mandrel is a pipe member provided with an annular shoulder on its upper end. Means are provided for sealing between the mandrel and the pipe member. A compressible sealing element is arranged in the mandrel for sealing the pressure recording means from the inlet port, and attaching means releasably connects the mandrel and the pipe member for slidable movement of the mandrel with respect to the pipe member, the compressible sealing element sealing between the mandrel and the pipe member on movement of the mandrel from a first position to a second position. The tubular member has means on its upper end for retrieving the tubular member and the pressure recording means from the tubing by a wire line. The mandrel and the pipe member provide a passageway for wire line tools having a diameter at least as great as that of the tubing on retrieval of the tubular member and the pressure recording means from the tubing.

The present invention is particularly useful in well testing operations in that it allows the testing of formations and the subsequent sealing of same and reperforating of the casing as desired without requiring the necessity of round trips of pipe in and out of the well. By a round trip is meant the running in of a string of pipe to a selected depth in the well followed by pulling the pipe for replacement of well tools or for conducting a subsequent operation. In the present invention the well pipe or tubing is run into the well and thereafter all operations are conducted without removing the well pipe or tubing, thus allowing greater advantages and avoiding the possibility of damaging the formation and the well.

The present invention will be further illustrated by reference to the drawing in which:

Fig. 1 shows the device in a sealed position;

Fig. 2 shows the device of the present invention in an open position;

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Fig. 3 is an illustration of an attaching means in the closed position;

Fig. 4 is a view of an attaching means in a released position; and

Figs. 5 to 7 illustrate the device in a well tubing in a cased well and show subsequent use of the tubing after removal of a portion of the device.

Referring to Figs. 1 to 4 in which identical numerals will be employed to designate identical parts, numeral 11 designates a well tubing provided with a landing nipple 12 adjacent the lower end 13 of the tubing string. Attached to the tubing 11 below the landing nipple 12 by a collar or other connecting means 15 is a mandrel 16, the greater portion of which has an inside diameter substantially greater than the inside of the tubing 11. Arranged in the mandrel 16 for slidable movement therein is a pipe member 17 which has an annular shoulder 18 on its upper end and which is releasably attached to the mandrel 16 by a releasable attaching means generally indicated by the numeral 19 and comprising a shear pin 20 and a slot 21 and a pin arrangement 22.

Arranged below the shoulder 18 and above a shoulder 23 on the pipe member 17 is a packing means 24 which may be a Chevron packing to cause a seal in both directions as indicated by the Chevron from above and below.

Arranged above the shoulder 18 and bearing against upper end 25 of the enlarged portion 26 of the mandrel 16 is a compressible sealing element 27 which provides a seal as will be described.

Arranged in the tubing 11 and the mandrel 16 is a tubular member generally indicated by numeral 28 having internal passageway 29 and provided with inlet ports 30 and an outlet port 31 in which is arranged a choke member 32. The tubular member 28 is provided as shown with Chevron packing 14 for sealingly engaging within landing nipple 12.

The upper end of the tubular member 28 is provided with a fishing neck 33 for engagement with a suitable wire line fishing tool for retrieving same from the well.

Attached to the lower end of the tubular member 28 is a pressure recording bomb or means 34 which may be a pressure recording device of the nature described in U. S. Patent 2,189,919 issued February 13, 1940, to Thomas V. Moore. Other similar pressure recording devices may be used.

The tubular member 28 may have an intermediate enlarged section 35 to allow a seal to be made with the compressible sealing element 27 as will be described hereinafter although it is not absolutely necessary that the enlarged portion 35 be provided.

It is to be noted that the lower end of the pipe member 17 is connected by a collar or connecting means 36 to sections of tubing 11 as may be desired.

As shown in Fig. 5, the tubular member 28 having connected thereto a pressure recording bomb 34 is arranged in a well 40 drilled from the earth's surface, not shown, having a casing 41 cemented therein with primary cement 42. The tubing string 11 carries a production packer 43 which may be a packer, such as a Baker Oil Tool, Inc. Full-Bore Retrievable Set-Down Packer (Product 412).

In Fig. 6 the tubular member 28 and the pressure recorder 34 attached thereto have been removed from the tubing 11 to provide a full opening passageway 50 through the tubing 11, the mandrel 16 and the pipe 17.

In Fig. 7, which is a view similar to Fig. 6, a perforator, such as 51, is shown routed through the passageway 50 on a wire line, such as 52, connected by suitable means 53 to the perforator 51. The perforator 51 may be a conventional tubing-type bullet gun, or shaped charge perforator, as may be desired.

The device of the present invention may be employed as follows with reference to the drawing and particularly Figs. 1 to 7:

The device is lowered into the well with the sealing element 27 in the closed position, as shown clearly in Fig. 1, with the connecting means 19 closed as shown in Fig. 3.

As illustrated in Figs. 2 and 5, after the packer 43 has been set, application of weight on the tubing string 11 shears pin 20 and on rotation of the tubing 11 to place the pin 22 in a vertical portion of the slot 21, pipe 17 moves from a first position to a second position with respect to the mandrel 16. This results in expansion of the compressible sealing means 27 and provides a passageway 54 between the pressure recorder and the inlet ports 30. Thus fluid may pass from perforations 55 which have been formed in intervals or sands, strata or zones 56 prior to running in the tubing string 11. Thus fluids may flow from the perforations 55 up through the open end 13a of the tubing string and thence by passageway 54 into inlet 30 and by outlet 31 up to the surface of the earth through the tubing 11 and fluid pressure is exerted on the pressure recording device 34 and it is thus possible to obtain both visual effects of the presence of desirable earth fluids, such as oil and/or gas, at interval 56 and also a record of the pressure exerted thereby on recording means 34.

After the flow test has been made, as has been described, weight may be applied to the tubing 11 to compress the packing element 27 and form a seal between the pressure recording means and the inlet port. This will allow a shut-in pressure to be recorded on the pressure recorder 34.

On completion of the drill stem test, as has been described, cement may be deposited in the perforations 55 employing a suitable tubular extension member 57 which allows the cement slurry to be deposited as a body 58 in the regions of the perforations 55 in interval 56. This cement slurry may be a modified cement of the nature described in the Salathiel Patent No. 2,582,459 which results in the formation of buttons or plugs 59 in the perforations 55 and to seal same.

The excess fluid cement slurry may then be circulated out from the well through the extension member 57, shown in dotted lines, by opening the production packer 43 and allowing wash fluids, such as water, mud, and the like to be circulated down the annulus A and up through the tubing extension 57 and through the tubing 11 to the well head. Thereafter a gun perforator, such as shown in Fig. 7, may be lowered through the passageway 50 on withdrawal of the tubing extension member 57 and fired to form perforations, such as 60, in the interval, zone or stratum 61 which may be separated from the stratum 56 by a non-productive interval, stratum, zone, formation, sand, and the like 62. Thereafter the device as illustrated in Figs. 1 to 5 may be replaced in the tubing 11 and a test made from the interval 61, the arrangement thereof being similar to the showing in Fig. 5.

The particular feature of the present invention is provision of apparatus providing a full opening bore or passageway for use after one or more of a plurality of subsurface earth intervals have been tested for productivity. The device is of considerable importance in avoiding unnecessary round trips of pipe and also allowing work-over and servicing of wells with the use of wire line tools. By providing the device of the present invention in the tubing string and running same in with the compressible member 27 compressed to form a seal, the tubing may be run into the well with the fluids therein and precludes artificial lifting prior to initial drill stem testing.

The nature and objects of the present invention having been completely described and illustrated, what I wish to claim as new and useful and to secure by Letters Patent is:

1. A retrievable device for use in a cased well which

comprises, in combination with a tubing arranged in said casing, a tubular member in said tubing provided with an inlet port and an outlet port for passage of fluid therethrough, a pressure recording means attached to the lower end of the tubular member, said tubular member and pressure recording means being lowerable in and retrievable from said tubing, means in the lower end of the tubing for supporting and sealing said tubular member in the lower end of the tubing, a mandrel attached to the lower end of the tubing below the supporting and sealing means having an inside diameter greater than that of the tubing, a pipe member arranged in said mandrel having an inside diameter providing a full opening bore through the tubing on retrieval of said tubular member and pressure recording means, means for sealing between the mandrel and the pipe member, a compressible sealing element arranged in said mandrel for sealing the pressure recording means from the inlet port, attaching means releasably connecting the mandrel and the pipe member for slidable movement of the mandrel with respect to the pipe member, and means for anchoring the lower end of the tubing to the casing whereby relative movement between the mandrel and the pipe member may be achieved, said compressible sealing element sealing on movement of the mandrel from a first position to a second position.

2. A retrievable device for use in a cased well which comprises, in combination with a tubing arranged in said casing, a tubular member in said tubing provided with an inlet port and an outlet port for passage of fluid therethrough, a pressure recording means attached to the lower end of the tubular member, said tubular member and pressure recording means being lowerable in and retrievable from said tubing, means in the lower end of the tubing for supporting and sealing said tubular member in the lower end of the tubing, a mandrel attached to the lower end of the tubing below the supporting and sealing means having an inside diameter greater than that of the tubing, a pipe member provided with an annular shoulder on its upper end and arranged in said mandrel having an inside diameter providing a full opening bore through the tubing on retrieval of said tubular member and pressure recording means, means below said shoulder for sealing between the mandrel and the pipe member, a compressible sealing element arranged in said mandrel above said shoulder for sealing the pressure recording means from the inlet port, attaching means releasably connecting the mandrel and the pipe member for slidable movement of the mandrel with respect to the pipe member, means for anchoring the lower end of the tubing to the casing whereby relative movement between the mandrel and the pipe member may be achieved, said compressible sealing element sealing between said mandrel and said pipe element on movement of the mandrel from a first position to a second position, and means on the upper end of said tubular member for retrieving said tubular member and pressure recording means from the tubing.

3. A retrievable drill stem testing device for use in a cased well which comprises, in combination with a tubing arranged in said casing, a tubular member in said tubing provided with an inlet port and an outlet port for passage of fluid therethrough and having a restriction means in said outlet port, a pressure recording means attached to the lower end of the tubular member, said tubular member and pressure recording means being lowerable in and retrievable from said tubing, means in the lower end of the tubing for supporting and sealing said tubular member in the lower end of the tubing, a mandrel attached to the lower end of the tubing below the supporting and sealing means having an inside diameter greater than that of the tubing, a pipe member provided with an annular shoulder on its upper end and arranged in said mandrel, means below said shoulder for sealing between the mandrel and the pipe member, a compressible sealing

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element arranged in said mandrel above said shoulder for sealing the pressure recording means from the inlet port, attaching means releasably connecting the mandrel and the pipe member for slidable movement of the mandrel with respect to the pipe member, means for anchoring the lower end of the tubing to the casing whereby relative movement between the mandrel and the pipe member may be achieved, said compressible sealing element sealing between said mandrel and said pipe member on movement of the mandrel from a first position to a second position, and means on the upper end of said tubular member for retrieving said tubular member and pressure recording means from the tubing, said mandrel

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and said pipe member providing a passageway for passage of wire line tools having a diameter at least as great as that of the tubing on retrieval of said tubular member and pressure recording means from the tubing.

References Cited in the file of this patent

UNITED STATES PATENTS

2,217,043	Boynton -----	Oct. 8, 1940
2,229,635	Boynton -----	Jan. 28, 1941
2,702,474	Johnston -----	Feb. 22, 1955
2,760,578	Tausch -----	Aug. 28, 1956

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