Jan. 7, 1941. J. LYNES 2,227,729

PACKER AND SAMPLING ASSEMBLY

Filed Sept. 30, 1939 2 Sheets-Sheet 1

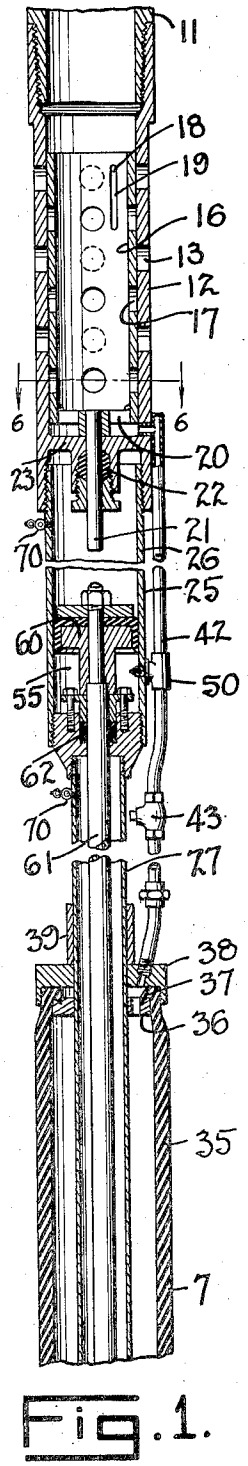

Fig. 1.

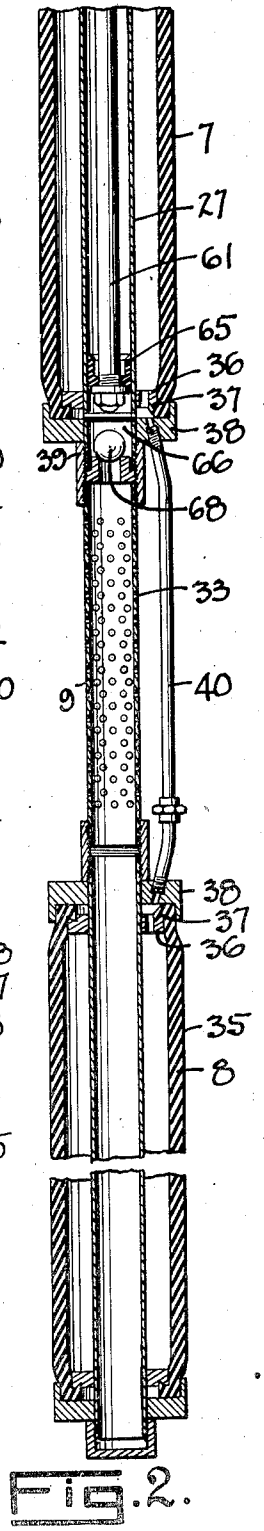

Fig. 2.

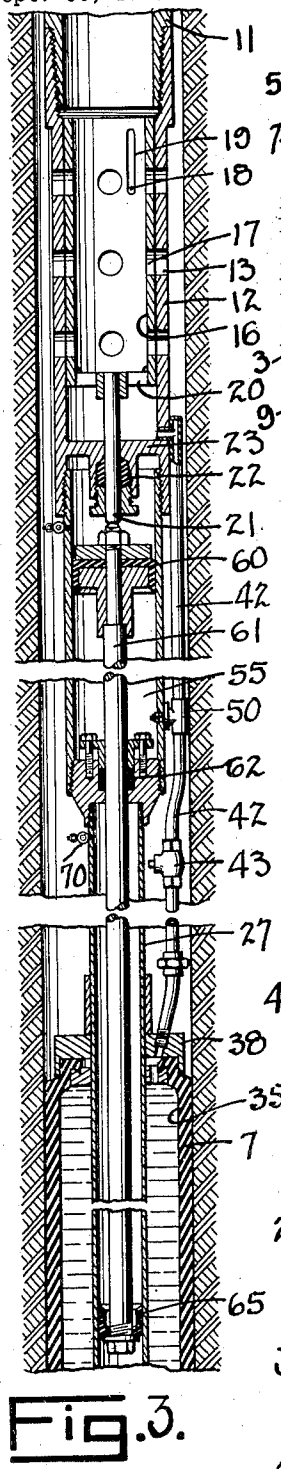

Fig. 3.

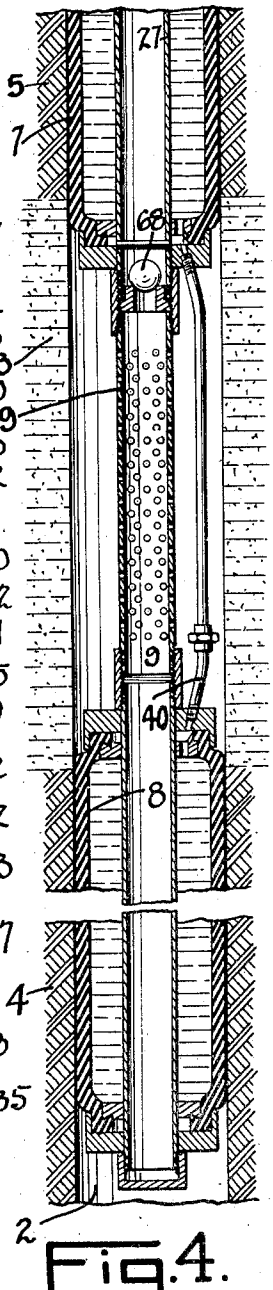

Fig. 4.

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Filed Sept. 30, 1939 2 Sheets-Sheet 2

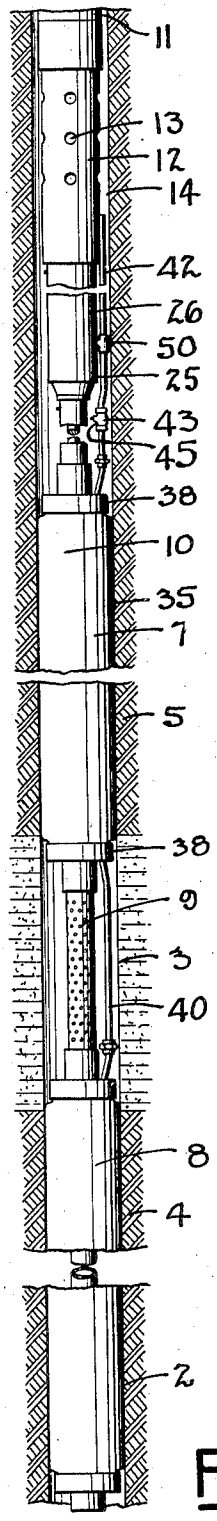

Fig. 5.

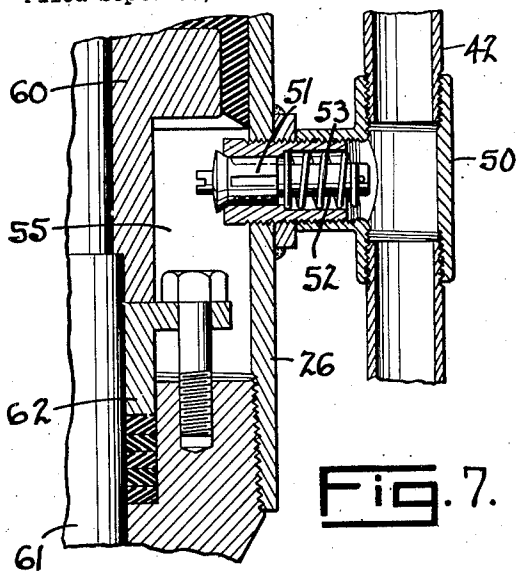

Fig. 7.

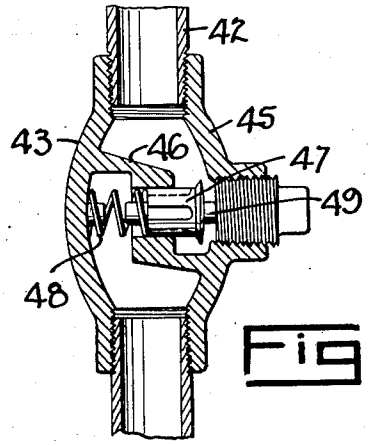

Fig. 8.

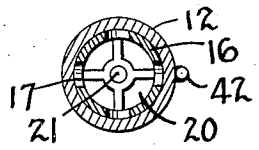

Fig. 6.

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PACKER AND SAMPLING ASSEMBLY

John Lynes, Houston, Tex.

Application September 30, 1939, Serial No. 297,257

10 Claims. (Cl. 166—1)

The invention relates to a packer and sampling assembly for wells.

In the drilling of wells by the rotary method where a heavy abrasive slush is circulated down into the well bore to carry away the cuttings from the bit during the drilling operation, it is obvious that a tremendous static pressure will be exerted upon the face of the formation. This drilling slush sometimes has a specific gravity as great as 2 and in the majority of instances has a specific gravity approaching 1.5 or a weight from 10½ to 12 pounds per gallon.

When the drill bit penetrates a porous formation very often the static pressure due to this column of heavy liquid in the well is greater than the pressure in the porous formation and the drilling mud or slush is thereby forced into the formation and the driller may not known that he has penetrated a valuable or productive formation.

The practice has therefore developed of sealing off a portion of the well bore to exclude this static pressure and to thereby take a sample of the formation desired. A majority of such testing tools have been devised to seat in the upper end of a rat hole or smaller diameter hole extending below the main well bore but in many instances it is desirable to test the formation at different elevations and it is therefore desirable to provide a pair of spaced packers to seal off an increment of the well bore so that a sample may be taken therefrom.

The present invention contemplates a packer and sampling assembly wherein the packers will be inflated and set by the application of hydraulic pressure and the tool will otherwise be operated by such pressure.

It is one of the objects of the invention to provide a packer to be set by hydraulic pressure in a deep well bore where the pressure in the packer must exceed the static pressure due to the weight of a column of liquid in the well.

Another object of the invention is to provide a pair of spaced packers which can be inflated and sealed against the well bore at spaced points so that a sample from the formation may be obtained in the area between the packers.

Another object of the invention is to set a pair of spaced packers with liquid pressure in a well bore and to thereafter operate a suction device to draw a sample of the formation into the tool from the area between the packers.

Another object of the invention is to provide a packer and sampling assembly wherein liquid pressure is utilized to first set the packers to form a seal, second to draw in a sample of the formation fluid from between the packers and thirdly to set up a circulation in the well bore above the tool so as to prevent the tool from becoming lodged in the well bore.

Another object of the invention is to provide a hydraulic setting packer for well bores wherein the liquid being forced into the packers is discontinued into the packers at a predetermined pressure.

Another object of the invention is to set the packers of a formation testing tool in the well bore by the use of liquid under pressure and to divert the liquid from the packers to actuate a suction device when a predetermined pressure has been applied to the packers.

Other and further objects of the invention will be readily apparent when the following description is considered in connection with the accompanying drawings wherein:

Fig. 1 is a vertical sectional view of the upper end of the tool as it is lowered into the well bore to be set.

Fig. 2 is a view similar to Fig. 1 showing the lower end of the tool.

Figs. 3 and 4 are vertical sections similar to Figs. 1 and 2 but illustrating the device with the packers set, the sample taken and the circulation established above the tool.

Fig. 5 is a side elevation showing the well bore in section and illustrating the entire hookup.

Fig. 6 is a section taken on the line 6—6 of Fig. 1 to illustrate the sleeve valve for controlling the circulation in the well bore.

Fig. 7 is a detail sectional view illustrating the valve which controls the flow of liquid into the suction device.

Fig. 8 is a sectional view of the check valve utilized to control the pressure applied to the packings.

Fig. 5 shows the well bore 2 as having been drilled into the earth formation and as having penetrated a porous formation 3 which is located between undesirable formations such as 4 and 5.

The present sampling and packer assembly is shown as having been lowered into the well bore and the packers 7 and 8 inflated so as to form a seal with the formations 5 and 4 respectively. In this manner the productive formation 3 is isolated so that a sample may be taken in thru the inlet 9 in the tool between the packers.

The tool is shown generally at 10 and is arranged to be operated or manipulated by an operating pipe or hose 11.

The structure is best seen in section in Figs. 1

and 2 where the parts are in the position in which they will be arranged when the tool is lowered into the hole. The operating pipe 11 is shown as connected to a nipple 12 which has the perforations 13 therein. These perforations are arranged to allow a flow of fluid from the inside of the operating pipe 11 into the well bore 14. Such flow is controlled however by a sleeve valve 16 which has the openings 17 therein and is slidably arranged within the nipple 12. A guide pin 18 is arranged to slip in the slot 19 so as to guide the sleeve and prevent rotation. The lower end of the sleeve 16 has the openings 20 therein so that a flow of fluid downwardly thru the operating pipe 11 can discharge into the nipple 12 below the valve member 16. A spindle 21 on the lower end of the valve 16 projects thru a stuffing box 22 in the partition 23 in the lower end of the nipple 12. The movement of this spindle 21 upwardly raises the valve 16 so as to move the ports 17 into alinement with the openings 13; thus liquid may discharge from the inside of the operating pipe and flow upwardly into the well bore to wash away any settlings or cuttings which might tend to wedge or lodge the tool in the well bore.

The nipple 12 forms a part of the body 25 of the tool, the housing 26 being connected to the lower end of the nipple 12 to continue the housing. A spacer pipe 27 connects to the lower end of the housing 26 and is arranged to carry the upper packer 7. An inlet pipe 9 having perforations 33 therein is joined to the lower end of the spacer pipe 27 and carries the lower packer 8 below the perforations 33.

The packer 7 is of a particular construction in that it has a resilient sleeve or packing 35 which fits about the upper and lower plates 36 and has an inwardly directed lip 37 at each end thereof which lips are arranged to be confined by the upper and lower caps 38. Each cap is in turn held in place by a coupling 39 so that the sleeve or packing 35 is firmly held in position.

A conduit 40 extends from the lower end of the upper packing 7 to the upper end of the lower packing 8 and is arranged to conduct the inflating liquid from the upper packer to the lower packer. The construction of the lower packer 8 is the same as described for the upper packer 7.

In order to conduct the liquid pressure which is to be used in inflating the packers 7 and 8 from the operating pipe 11 to the packers a pipe 42 is connected on to the lower portion of the nipple 12 to receive the liquid which passes thru the openings 20 in the base of the sleeve. This liquid will pass downwardly thru the pipe 42 thru a check valve 43 and into the upper packer 7. The check valve 43 is of a particular construction as best seen in Fig. 8 and includes the housing 45 which carries a partition 46 having a valve member 47 therein. This valve member is normally held open by a spring 48 which urges the valve member to the right upon the stem 49. It is intended that the spring 48 will be of a predetermined strength so that the valve will close when more than a predetermined pressure is exerted thereon. Thus if it is intended that a pressure of 4,000 pounds per square inch is to be exerted in the packers 7 and 8 then this valve will be set to close at 4,000 pounds so as to exclude any pressure greater than that amount and in this manner the packers will be prevented from rupture or from an excessive internal pressure.

In operation the device will be assembled with the parts as shown in Figs. 1 and 2 and will be gradually lowered into the well bore, it being the intention to fill the tool and the operating pipe 11 with the liquid such as water or oil which is to be used as the pressure liquid. In this manner the pressure on the inside of the tool will be equalized with the static pressure of the column of liquid in the well bore so that the tool will not collapse under the tremendous pressure encountered. When the tool has arrived at the elevation where the packers are to be set as in Fig. 5, suitable or additional pressure can be applied to the fluid at the upper end of the operating pipe 11 so as to insure that the packers will be properly inflated and when this pressure exceeds a predetermined pressure at which the valve 43 is to close that valve will close and prevent an excessive pressure on the packer.

A valve 50 has been illustrated in the pipe 42 above the valve 43 and leading into the housing 26. A detailed construction of this arrangement is best seen in Fig. 7 where the valve member 51 is slidable on a stem 52 and is normally urged to a closed position by a spring 53. This valve 50 will be so adjusted that it will remain closed at pressures less than the pressure at which the valve 43 will close. Thus when the valve 43 closes and the pressure is somewhat increased then the valve 50 will open and allow a flow of the liquid under pressure into the chamber 55 inside of the housing 26.

The housing 26 carries a piston 60 which is connected to a rod 61 extending thru the stuffing box 62 in the lower end of the housing 26. This rod extends downwardly inside of the spacer pipe 27 and as seen in the upper portion of Fig. 2 carries a plunger 65 which forms a seal on the inside of the spacer pipe. As the liquid under pressure enters the chamber 55 it will tend to force the piston 60 and the plunger 65 upwardly to create a suction in the area 66 in the lower end of the spacer pipe 27. This suction will tend to raise a ball or check valve 68 so that the suction will be available in the inlet pipe 9 to draw fluid from the formation 3 into the sample receiving portion of the tool by way of the ports or inlets 33. It will be seen therefore that a positive suction can be created due to the fact that the pressure liquid is diverted from the packers after they are inflated and is directed underneath the piston 60. In this manner a sample will be obtained from the formation 3 regardless of the pressure which may be available in that formation because a positive suction can be exerted upon the formation. The check valve 68 closes to trap a sample of fluid in the spacer pipe 27 when the movement of the piston 60 is discontinued.

A relief valve such as 70 can be applied to the housing 26 and also to the spacer pipe 27 so that as these pipes are filled with a liquid to prevent their collapse at the surface, the liquid may be discharged into the well bore as the piston and the plunger move upwardly.

It will be seen that the spindle 21 projects into the housing 26 above the piston 60 so that as the piston moves towards its uppermost position as seen in Fig. 3 the piston will contact the spindle 21, moving it upwardly so as to cause the ports 17 to move into alinement with the openings 13. When this function occurs the pressure liquid in the pipe 11 will be again diverted and flow into the well bore to prevent the tool from becoming lodged in position as has been previously described.

As the sleeve valve 16 opens there will be a reduction in the pressure in the operating pipe and accordingly in the pipe 42. This reduction in pressure allows the valve 50 to first close, trapping a body of the pressure liquid into the chamber 55 and retaining the piston in its uppermost position. As the pressure is further reduced and falls below the predetermined pressure at which the valve 43 has been set to close it permits this valve 43 to open. Inasmuch as the pressure in the operating pipe is less than the pressure in the packers the packers will become deflated and the tool is then ready to be removed from the well.

Broadly the invention contemplates a packer and sampling assembly which can be lowered to the well bore, the packers automatically inflated by hydraulic pressure, samples sucked into the tool by hydraulic pressure and a circulation maintained in the well bore after the sample has been taken and while the packer are being deflated.

What is claimed is:

1. A packer and sampling assembly for wells including a body, an operating pipe connected thereto, a pair of spaced packings on said body, means to direct a liquid under pressure into said packings to inflate them into sealing position in the well, an inlet into said body between said packings, additional means operable by the liquid when a predetermined pressure is applied in the liquid to said packings and said first-mentioned means to divert the liquid into said body, and a suction device in said body operable by the liquid diverted into said body to draw a sample from the well thru said inlet.

2. A packer and sampling assembly for wells including a body, an operating pipe connected thereto, a pair of spaced packings on said body, means to direct a liquid under pressure into said packings to inflate them into sealing position in the well, an inlet into said body between said packings, additional means operable by the liquid when a predetermined pressure is applied in the liquid to said packings and said first-mentioned means to divert the liquid into said body, a suction device in said body operable by the liquid diverted into said body to draw a sample from the well thru said inlet, and still additional means operable by said suction device to divert the liquid from the operating pipe outlets therefrom to circulate upwardly in the well.

3. A formation testing tool including a body, a pair of spaced packers thereon, a sample receiving portion in said body, and means to apply hydraulic pressure to expand said packers to isolate a section of the well bore between said packers and to exert a suction in said tool so that a sample of formation fluid may be received from such section in said sample receiving portion.

4. A formation testing tool including a body, a pair of spaced packers thereon, a sample receiving portion in said body with inlet means between the packers, means to apply hydraulic pressure to expand said packers to isolate a section of the well bore so that a sample of formation fluid may be received in said sample receiving portion, and additional means in said sample receiving portion operable by the hydraulic pressure to draw in a sample from the formation.

5. A formation testing tool including a body, a pair of spaced packers thereon, a sample receiving portion in said body with inlet means between the packers, means to apply hydraulic pressure to expand said packers to isolate a section of the well bore so that a sample of formation fluid may be received in said sample receiving portion, and additional means operable when the sample is received to divert the hydraulic pressure to the well bore above the tool.

6. A formation testing tool including a body, a pair of spaced packers thereon, a sample receiving portion in said body with inlet means between the packers, means to apply hydraulic pressure to expand said packers to isolate a section of the well bore so that a sample of formation fluid may be received in said sample receiving portion, additional means in said sample receiving portion operable by the hydraulic pressure to draw in a sample from the formation, and still additional means to divert the hydraulic pressure outwardly of the body above the upper packer when said additional means has obtained a sample so that such pressure will circulate in the bore above the tool to remove settlings from above the tool.

7. A formation testing tool including a body, a pair of spaced packers thereon, a sample receiving portion in said body with inlet means between the packers, means to apply hydraulic pressure to expand said packers to isolate a section of the well bore so that a sample of formation fluid may be received in said sample receiving portion, and additional means in said sample receiving portion operable by the hydraulic pressure to draw in a sample from the formation, including a piston and plunger structure.

8. A testing tool including a body, a packer thereon, a sample taking device therein, ports to be opened in said body to allow circulation of liquid into the well bore, and an operating pipe connected to said tool to apply liquid under pressure to first set said packer, next actuate said device to obtain a sample, and then discharge thru said ports.

9. A packer for wells including a body, a resilient packing sleeve supported on said body, means to conduct a liquid under pressure to said packing from said body so as to inflate said packing, a valve in said means which is set to close upon application of a predetermined pressure on the liquid so as to protect said packing against a greater pressure.

10. A packer for wells including a body, a resilient packing sleeve supported on said body, means to conduct a liquid under pressure to said packing from said body so as to inflate said packing, a valve in said means which is set to close upon application of a predetermined pressure on the liquid so as to protect said packing against a greater pressure, and additional means operable by the pressure after said valve closes to divert the liquid pressure into the well bore above the packer.

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