March 13, 1956 J. LYNES 2,738,016

CONTROL MEANS FOR OIL WELL TOOLS

Filed Jan. 29, 1953 2 Sheets-Sheet 1

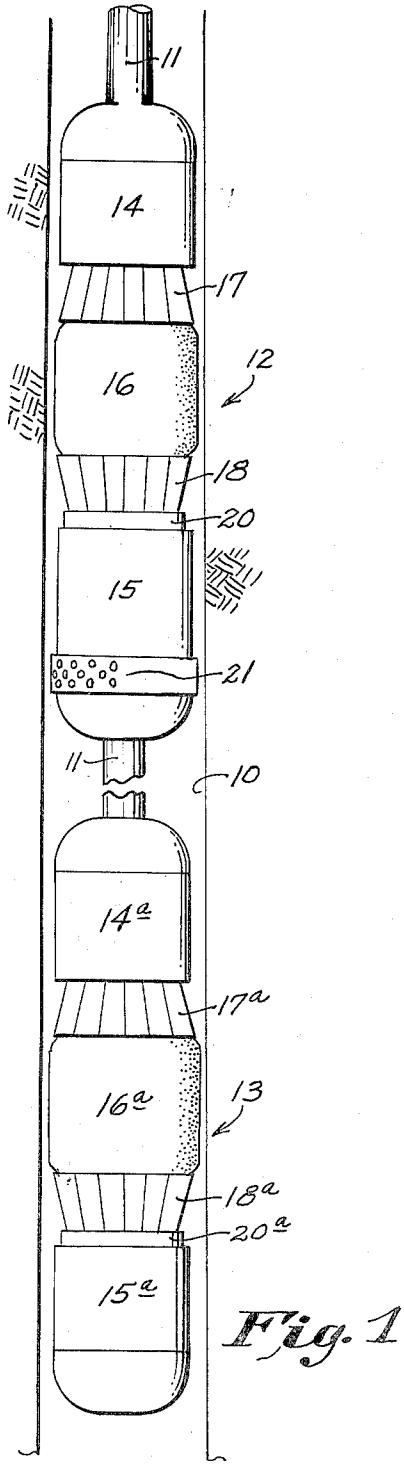


Fig. 1

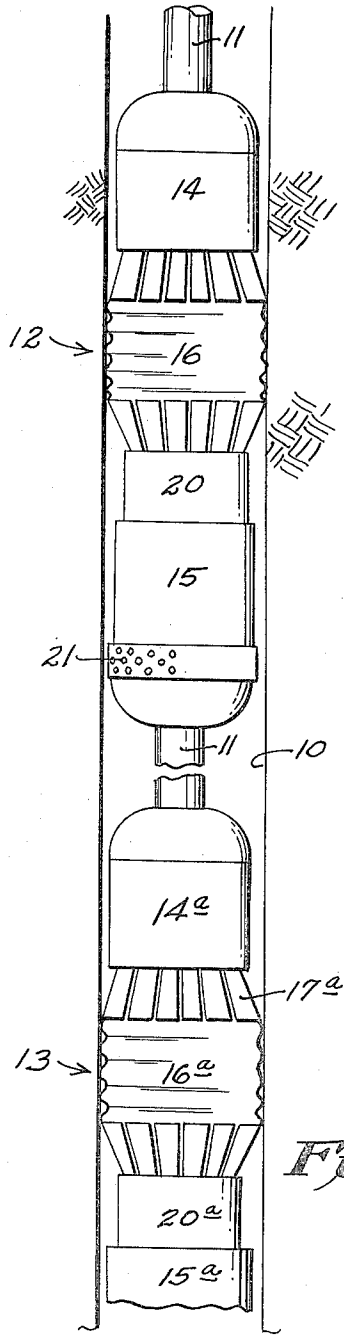


Fig. 2

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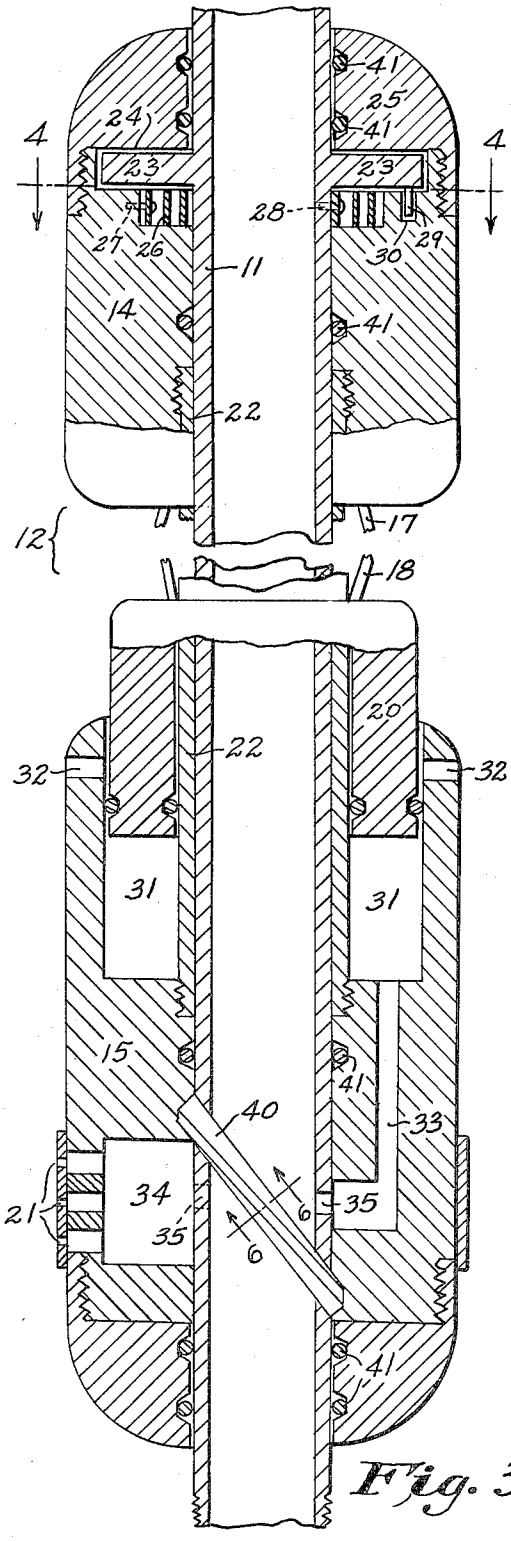


Fig. 3

Fig. 4

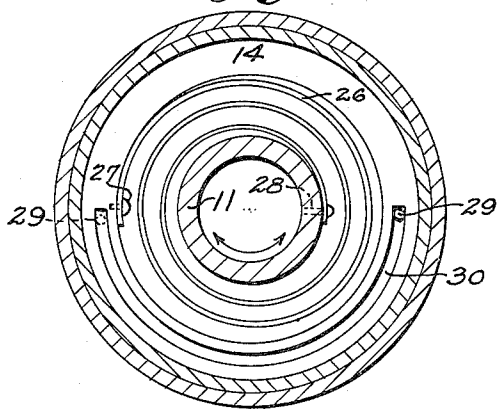


Fig. 5

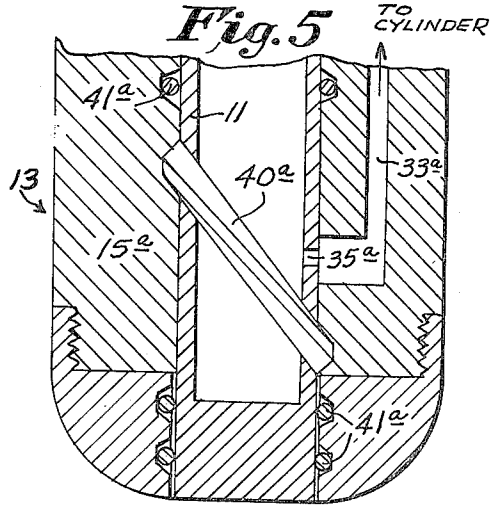
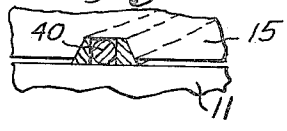


Fig. 6



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CONTROL MEANS FOR OIL WELL TOOLS

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Application January 29, 1953, Serial No. 334,025

5 Claims. (Cl. 166—187)

This invention relates to control means especially useful for oil well tools of the packer type. In such tools it is necessary to employ the supporting pipe or drill string for at least two purposes, first, to engage the tool in a fixed position to seal off a selected formation in the drill hole and, secondly, to open the supporting pipe into connection with the formation for treating and production operations. Most packer tools consist of one or more resilient packer members which are forced into expanding contact with the drill hole walls by the exertion, directly or indirectly, of hydraulic pressure delivered through the supporting pipe, thus accomplishing the first step.

The second step involves control means for connecting the same supporting pipe with port means in the tool leading to the formation or stratum thus sealed off for treating or production operations. The controls for oil well tools of this type usually require vertical movement of the drill pipe by the driller in order to shift ports in the tool to effect a change on the fluid line connection from the packer-operating position to the formation-treating position.

When operating with upwards of ten thousand feet of supporting pipe, as is common in modern deep wells, the string of pipe may have play or stretch in excess of over ten feet, hence vertical manipulations at the surface, imparted to the tool at the distant end in the well, often have inexact or unknown results. It will be appreciated that in view of the tremendous investment needed to drill such wells, the controls of the packer tool should be simple and sure to operate, otherwise damage to the well or failure to achieve production will result.

Accordingly, the invention contemplates a tool of the type described wherein control means are provided to retain the tool in packer-operating position while lowering into the well, and wherein the transfer from packer-operating position to well-treating position is simply and easily accomplished by a rotational movement of the supporting pipe.

The invention is more specifically characterized by the use of an elliptical seal angularly mounted in the walls of the tool housing surrounding a central pipe leading to the surface, which seal selectively opens a port in the pipe to either of the desired positions.

The invention is particularly well adapted for use as control means for the oil well tool described and claimed in my co-pending application Serial No. 307,958 filed September 5, 1952, wherein very powerful and rugged resilient packer members are forced by hydraulically driven pistons into formation-fracturing and sealing-off contact with the drill hole walls. Accordingly, the drawing illustrates the invention in connection with a tool of this preferred type.

Other further objects and advantages of the invention will be described in connection with the drawing, wherein:

Fig. 1 is an elevation of a two-packer tool in condition for lowering into the drill hole of an oil well;

Fig. 2 is a similar elevation with the tool in engagement with the drill hole walls in position for treating or production operations;

Fig. 3 is a fragmentary section on enlarged scale of the upper of the two-packer assemblies shown in Figs. 1 and 2, illustrating the invention in detail;

Fig. 4 is a section on lines 4—4 of Fig. 3;

Fig. 5 is a fragmentary section of the end of the lower of the two packer assemblies of Figs. 1 and 2, also illustrating the invention in detail; and

Fig. 6 is a section on lines 6—6 of Fig. 3.

In Figs. 1 and 2 the drill hole of an oil well is designated at 10. An inner communicating and supporting pipe 11 is provided for suspension of the tool from the usual string of supporting pipe or tubing (not shown). Supported on pipe 11 are the upper and lower packer assemblies 12 and 13. Upper assembly 12 is composed of upper and lower housings or body members 14 and 15 between which is mounted the expansible resilient packer member 16 whose ends are confined by the expansible metallic collars 17 and 18. As will be further described, packer member 16 is driven into contact with the bore 10 (Fig. 2) by the movement of hydraulically actuated ram or piston 20, contained in lower body member 15.

The preferred form of packer assembly for use with this invention may be further understood in detail by reference to my prior copending application Serial No. 307,958, the resilient packer members therein shown being formed of a plurality of plies of elastic material provided with longitudinal open seams. This type of construction provides a packer which, when compressed longitudinally by the pistons 20—20*a* is forced to expand laterally. The construction, as shown in Fig. 2, permits the packer material to fold upon itself in bellows-like manner, the folds producing a substantial increase in diameter of the packer body.

Lower body member 15 also contains the main treating and production port 21.

Spaced from upper packer assembly 12 on pipe 11, the lower packer assembly 13 is similarly constituted except for the omission of any treating or production port, and consists of upper housing 14*a*, lower housing 15*a*, packer member 16*a*, collars 17*a*—18*a*, and piston 20*a*.

It will be appreciated that with a general construction of this nature, control of the tool must be effected solely by means of the pipe 11 connected to the drill string. In the Fig. 1 position the packers 16—16*a* must positively be held in collapsed condition for lowering. In the Fig. 2 position, the stratum or formation extending between the packers 16—16*a* must be sealed off by operation of the packers. It is then necessary to maintain the packers in borehole-engaging position, and to connect pipe 11 with the main port 21 for treating or producing the selected formation.

In Fig. 3 the upper packer assembly 12 of Figs. 1–2 is shown in enlarged detail, the packer 16 having been omitted at the fragment line, and only portions of the collars 17—18 being shown. In this view it will be seen that the upper and lower body members 14 and 15 are held in spaced condition by means of sleeve 22 disposed on inner pipe 11 and that the assembly 12 is supported on pipe 11 by peripheral flange 23 formed on pipe 11. Flange 23 engages in a recess 24 formed in body member 14, the latter having a screw cap 25 for the purpose. Accordingly, packer assembly 12 is supported for rotational but not axial movement relative to pipe 11.

The aforesaid rotational movement is limited and spring-urged in a counter-clockwise direction by a heavy coil spring 26 (Figs. 3 and 4) contained in body 14, the springs ends being riveted or otherwise secured at 27 and 28 to the body member 14 and pipe 11. Flange 23 further carries a depending pin 29 which engages in an

arcuate slot 30 formed in body member 14, to further limit the movement of pipe 11 relative to body 14 and assembly 12.

The lower body member 15 carries a chamber forming the cylinder 31 in which cylindrical piston 20 is mounted, it being understood that vertical movement of piston 20 will cause packer member 16 to be longitudinally compressed or wadded together and to expand into contact with the borehole in the manner shown in Fig. 2. Safety vents 32 are provided to relieve fluid pressure and thus to limit excessive movement of piston 20 near the extremity of its stroke.

Cylinder 31 is supplied with hydraulic fluid through a supply channel 33 whose lower end terminates on the interior wall of body member 15 facing the inner pipe 11. Opposite the supply channel 33 a chamber 34 leads to the main treating and production port 21.

Connecting selectively with either channel 33 or with chamber 34, a control port 35 is formed in the wall of inner pipe 11. Seated in a recess in the walls of member 15 is the sealing ring 40, elliptical in shape, in such position that it lies in a plane at an angle to the axis of pipe 11. A detail of the construction of this sealing ring 40 is shown in Fig. 6. Arranged in other recesses formed in the body members 14 and 15 are additional sealing rings 41, each arranged on a plane perpendicular to the axis of pipe 11. Seals 40 and 41 provide fluid-tight joints at their respective locations.

Due to the eccentric or angular arrangement of seal 40 with respect to pipe 11, it will be seen that when pipe 11 is left free from rotation, as when the tool is lowered into the well, spring 26 will retain control port 35 on the right hand side of seal 40, in the full-line position shown in Fig. 3, the port 35 being sealed off from connection with chamber 34 and main port 21. In this position, due to the action of spring 26, the driller may lower the tool into the well with positive assurance that it will remain in condition for actuating piston 20 to force packer 16 against the selected borehole location. Fluid pressure delivered by pumping from the surface, will then pass through pipe 11, control port 35, channel 33 and cylinder 31 to actuate piston 20.

When packer 16 has thus been set at the selected locality, a clockwise rotation of the drill pipe of approximately 180 degrees will rotate pipe 11 relative to body 15 and move the port 35 to the left hand side of seal 40, in which position the cylinder 31 and piston 20 are sealed off, in actuated or locked condition, and in which position, also, control port 35 becomes connected with chamber 34 leading to the main treating and production port 21.

As mentioned previously, the rotational movement of pipe 11 relative to body 15 is limited by the extent of movement permitted to pin 29 by the arcuate slot 30. As shown in Fig. 4, in the full-line position, pin 29 is forced to the extreme right in slot 30 by action of coil spring 26, which is the position in which port 35 is connected with cylinder 31. In the dotted-line position pin 29 occupies the left end of slot 30, to which position it would move when clockwise rotation of pipe 11 overcomes the resistance of spring 26, effecting connection of control port 35 with main port 21.

In Figure 5 a fragmentary view is shown of the lower body member 15*a* of lower packer assembly 13, wherein a sealing ring 40*a* is employed in a similar manner to that described above for ring 40. Body member 15*a*, however, contains no main port corresponding to the port 21 of member 15, it not being desired with a two packer tool, to effect access to the well below the tool, but only to the formations isolated between the packers. Accordingly, in the full-line position shown in Fig. 5, port 35*a* is connected with channel 33*a* leading to the cylinder (not shown) of the lower packer. When rotated clockwise, port 35*a* is moved across seal 40*a* into the dotted-line position where it is completely sealed from any external connection between seal 40*a* and seal 41*a*.

The upper body member 14*a* is constructed and supported on pipe 11 in the same way as member 14 (Fig. 3).

The operating procedure for a two packer tool is therefore as follows: the tool is lowered into the well in the condition shown in Fig. 1, with the ports 35—35*a* of pipe 11 in registry with the channels 33—33*a* leading to pistons 20—20*a*. The spring mechanism 26 in body member 14 and its counterpart in member 14*a* will preserve this condition. At the desired location in the well, pumping from the surface will cause both packers 16—16*a* to engage the drill hole, thus sealing off the well space between. Rotation of the drill string (less than one-half turn is sufficient) will then seal off the pressure in the ram cylinders and connect port 35 with the treating and production port 21.

To maintain the tool in this condition, the driller needs only to secure the drill string in its rotated position. To release the tool from the well the drill string may be rotated oppositely or allowed to return to its original position, aided by the pressure of springs 26. With the ports 35—35*a* again in registry with channels 33—33*a*, the hydraulic pressure will be released and packers 16—16*a* will collapse.

With the foregoing illustration of the invention, it should be clear how the invention may be employed with a single unit packer tool or with a tool having two or more packer members. Furthermore, the control means here described and claimed are applicable to other well tools or to any device or structure where a selective multi-positional fluid line connection is required.

What is claimed is:

1. A well tool of the type described, comprising an operating pipe, packer supporting means enclosing a portion of said pipe and mounted thereon for rotational movement relative to said pipe, said supporting means carrying an expansible packer and containing an internal channel and fluid-actuated means connected with said internal channel for forcing said packer by hydraulic pressure into contact with the walls of a well borehole, a main port in said supporting means disposed in spaced relationship to said channel, a port in said operating pipe located for selective registry with said channel or with said main port, a sealing member carried by the inner wall of said packer supporting means in a plane lying between said channel and said main port, rotation of said pipe relative to said supporting means causing the port in the operating pipe to move across said sealing member to selectively communicate with said internal channel or said main port, and resilient means operatively connecting said supporting means to said operating pipe tending to urge said pipe and said packer supporting means into relative positions maintaining the port of said pipe in registry with said channel.

2. The tool according to claim 1, the sealing member consisting of a sealing ring diagonally disposed in the inner wall of the packer supporting means.

3. The tool according to claim 1, the resilient means connected to said operating pipe consisting of a spring carried between the operating pipe and packer supporting means.

4. The tool according to claim 1, with means limiting the rotation of said operating pipe relative to said packer supporting means, said limiting means consisting of a pin carried by said pipe movable in an arcuate slot carried by said packer supporting means.

5. A well tool of the type described, comprising an operating pipe, spaced packer supporting members enclosing spaced portions of said pipe and mounted for rotational movement relative thereto, each of said supporting members carrying an expansible packer and containing an internal channel connecting with fluid-actuated means for forcing said packers by hydraulic pressure into contact with the walls of a well borehole, a main treating

and production port located in one of the supporting members and located between said packers opposite to an internal channel, a sealing member carried by the inner wall of the same packer supporting member in a plane lying between said main port and the said opposite channel, a second sealing member disposed opposite said other channel in the other packer supporting member, and a pair of ports in said operating pipe located in the respective planes of said channels, rotation of said pipe relative to said supporting members causing said ports to connect with said channels, or selectively to cause one of said ports to move across the first sealing member into

communication with said main port and the other port of said operating pipe to become sealed off, and resilient means operatively connecting said supporting means to said operating pipe tending to urge said pipe and said supporting means into relative positions maintaining said ports in registry with said channels.

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