March 13, 1956 A. D. SPRINGER 2,738,012

STRADDLE TOOL

Filed March 25, 1954 2 Sheets-Sheet 1

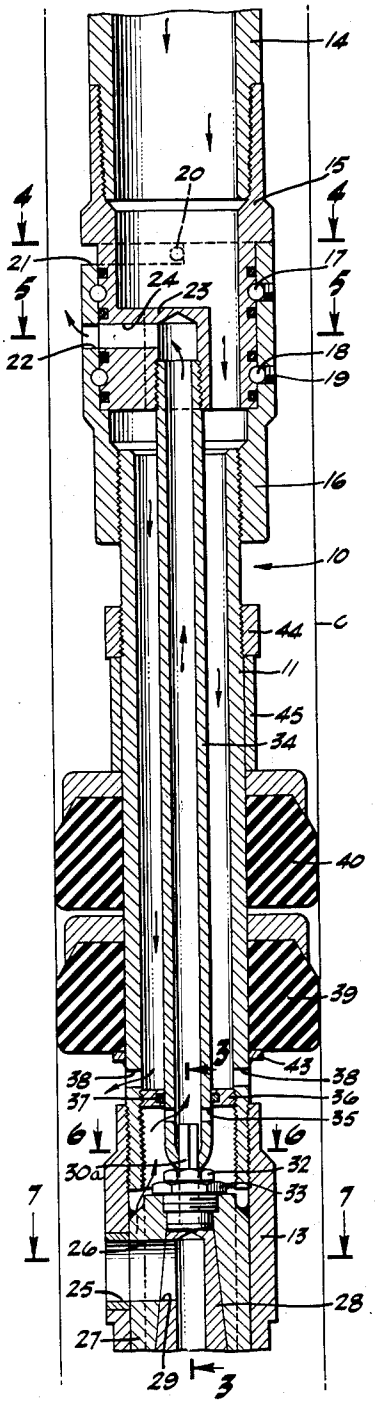


FIG. 1a.

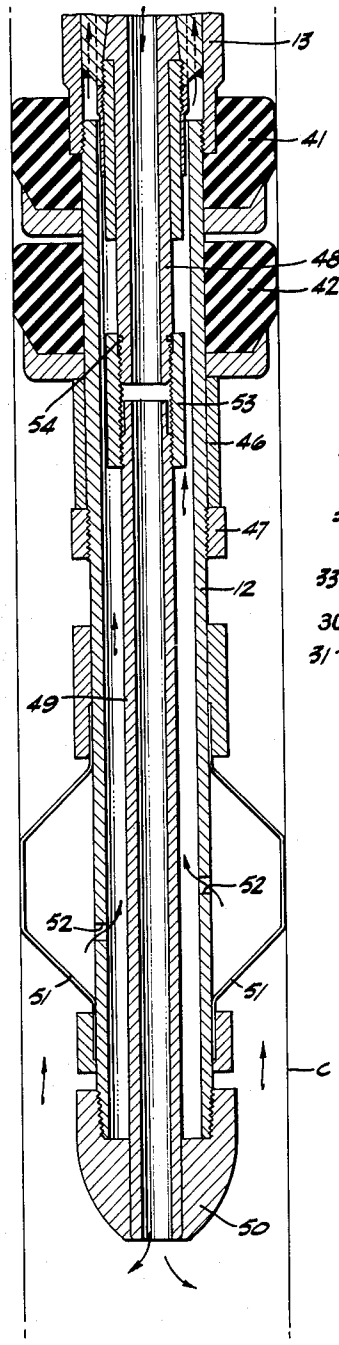


FIG. 1b.

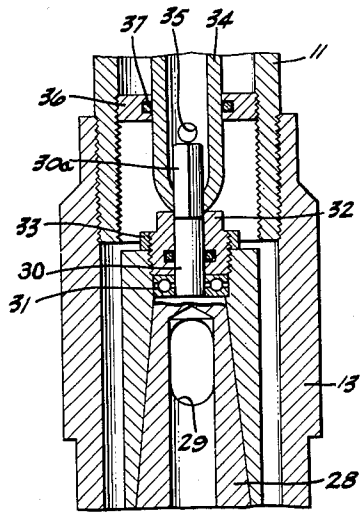


FIG. 3.

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STRADDLE TOOL

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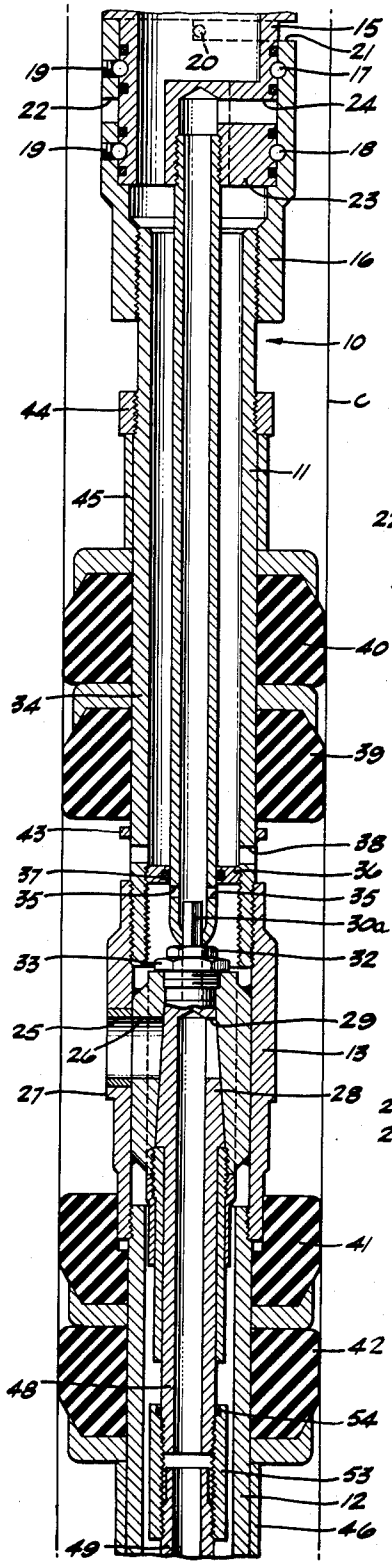


FIG. 2.

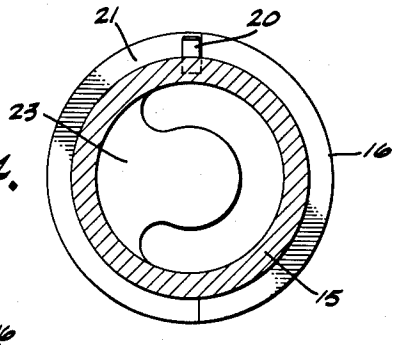


FIG. 4.

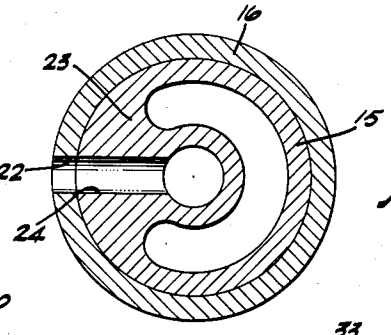


FIG. 5.

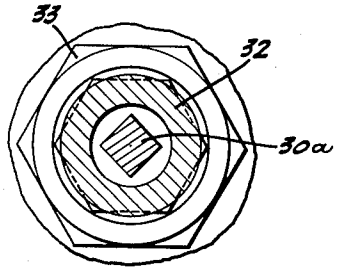


FIG. 6.

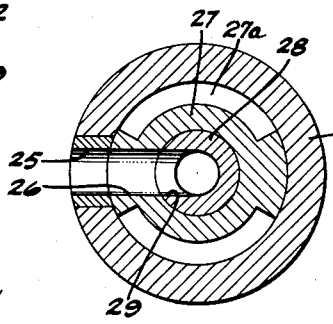


FIG. 7.

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STRADDLE TOOL

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Application March 25, 1954, Serial No. 418,550

7 Claims. (Cl. 166—146)

This invention relates to improvements in straddle tools and may be regarded as an improvement over the disclosure made in United States Letters Patent No. 2,569,026, issued September 25, 1951, to Arnold P. Springer.

An object of the present invention is to provide a tool suitable for use in cementing, washing, testing, acidizing, plasticizing and similar operations in the course of well drilling and producing oil wells and the like.

In the above-mentioned patent there is a tool of this general character consisting of a tubular body attachable to a string of pipe adapted to be lowered into a well. This body has upper and lower packers or sealing means adapted to form upper and lower seals between the body and a well casing or the like. Provision is made for egress from the body between the upper and lower packers and within the body between the upper and lower packers there is a rotary valve connected to a wash pipe that extends downwardly through the body and which is normally held stationary by means of friction or belly springs. A bypass is provided from the lower end of this body around the valve and upwardly through the upper packing or sealing means, which bypass is constantly open to the exterior above the upper packer. In order to open and close the rotary valve in the above-mentioned patent it has been necessary to rotate the entire body to which the upper and lower packers are connected. It sometimes occurs that when hydraulic pressure exists between the upper and lower packers that no pressure exists below the lower packer. This may occur while the rotary valve is in its closed position so that the tool becomes hydraulically locked in place within the casing, rendering it extremely difficult, if possible at all, to rotate the body to open the valve.

A primary object of the present invention is to provide an improved tool of this character wherein the rotary valve may be rotated into open and closed position by means of the run-in string of pipe without involving a rotation of the body of the tool or of the packers which may be hydraulically locked in place. Consequently, the body of the tool may be allowed to remain stationary due to the hydraulic lock and the rotary valve which controls the passage to the bottom of the body may be readily opened at all times.

Another object of the invention is to provide an improved construction wherein the bypass which runs from below the lower packer to a point above the upper packer is also susceptible of being opened and closed instead of being constantly open to the exterior as in the patent above mentioned.

Still a further object of the invention is to provide a tool having the above-mentioned characteristics wherein the valve which opens and closes the bypass will be simultaneously opened and closed with the rotary valve that is between the packers, both valves being openable and closeable by the run-in string of pipe while the body of the tool remains stationary.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention, wherein:

Figure 1A is a vertical section of the upper portion of the straddle tool embodying the present invention, the valves of the tool being shown in open position;

Fig. 1B is a vertical section of the lower portion of the tool;

Fig. 2 is a view similar to Fig. 1A but illustrating the valves in their closed positions;

Fig. 3 is a vertical section through the valve between the packers of the straddle tool and may be regarded as having been taken upon the line 3—3 upon Fig. 1A in the direction indicated;

Fig. 4 is a horizontal section taken substantially upon the line 4—4 upon Fig. 1A;

Fig. 5 is a horizontal section taken substantially upon the line 5—5 upon Fig. 1A;

Fig. 6 is a horizontal section taken substantially upon the line 6—6 upon Fig. 1A; and

Fig. 7 is a horizontal section taken substantially upon the line 7—7 upon Fig. 1A.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, the improved straddle tool comprises a tubular body generally indicated at **10**, which may be made up of sections **11** and **12** connected together by means of a collar **13**. This body is attachable to a run-in string of pipe **14** by means of a swivel joint made up of an upper member **15** and a lower member **16**. These members are threadedly attachable to the run-in string of pipe and to the body **10**, respectively. The upper member **15** telescopes within the lower member **16** and has a limited rotational movement relatively thereto.

In the opposed cylindrical surfaces of these members there are grooves or races for balls **17** and **18** which balls are inserted through an opening in the wall of the lower member **16** and are retained therein by plugs **19**. The limited rotational movement is governed by a pin **20** which is movable in a slot or rebated top edge **21** in the lower member **16**. Movement of the pin against the ends of the slot restricts rotation of the run-in string of pipe **14** relative to the body **10** to approximately 180°.

In the wall of the lower member **16** there is an outlet port **22** and on the interior of the upper member **15** there is a boss **23** in which there is formed a port **24** that is adapted to move into and out of registration with the port **22** when the run-in string **14** is rotated relatively to the body.

In the collar **13** there is a port **25** which is in registration with a port **26** in a valve body **27** which extends diametrically across the collar and is welded in position therein. The sides of this valve body are removed as indicated at **27***a*, see Fig. 7, so that fluid may bypass around the valve body from the lower section **11**. Within the valve body there is a rotary valve **28** having a port **29** adapted to move into and out of registration with the port **26**. This rotary valve has an upwardly extending cylindrical stem **30** terminating at its upper end in a squared portion **30***a*. A ball thrust bearing **31** is located about the cylindrical portion of the stem **30** against which a nut **32** may be tightened and held in adjusted position by means of a jamb nut **33**. The squared portion of the stem **30** slidably extends upwardly into a squared opening in the bottom of a pipe **34** that is threadedly connected to the boss **23** so as to be in communication with the port **24** therein. In this manner, there is in effect a splined or non-rotatable connection between the pipe **34** and the stem of the rotary valve **28** so that when the run-in string of pipe **14** is rotated relatively to the body the rotary valve **28** may be turned thereby.

Near the lower end of the pipe **34** there are ports **35** and immediately above these ports there is a barrier plate **36** in which an O-ring **37** is recessed which forms a seal between the interior of the section **11** and the exterior of

the pipe 34. Above the barrier there are ports 38 in the section 11. Above the ports 38 there are upper packers or sealing means indicated at 39 and 40 and below the collar 13 there are lower packers or sealing means indicated at 41 and 42. These are formed of rubber as indicated, and are adapted to be hydraulically expanded into sealing engagement with the interior of a casing C. The spacing between the upper packing means and the lower packing means is variable or adjustable in that on the exterior of the upper section 11 there is welded a shoulder 43. The packers may be tightened downwardly against this shoulder by means of a nut 44 which is tightened against a sleeve 45.

If it is desired to increase the spacing between the packers the nut 44 may be unscrewed from the body 10 and the sleeve 45 may be positioned between the shoulder 43 and the lowermost packer 39. A combination of sleeves may be employed if desired, one of which is interposed between the shoulder 43 and the packer 39 and the other of which is interposed between the upper packer 40 and the nut 44. In a similar manner, the lower end of the collar 13 provides a downwardly facing shoulder against which the packer 41 is positioned and held by means of a sleeve 46 which is tightened upwardly by a nut 47. This sleeve may be positioned between the bottom of the collar 13 and the packer 41 when it is desired to increase the spacing between the upper and lower packers.

A wash pipe made up of sections 48 and 49 is connected to the rotary valve 28 so as to be in communication with the port 29 therein. The lower section 49 slidably extends through a bullnose 50 on the bottom of the lower section 12. Friction or belly springs 51 are mounted on the lower section 12 above the bullnose 50 and ports 52 are formed in the lower section in the neighborhood of these belly springs. These belly springs merely frictionally engage the casing and will serve to hold the body 10 against rotation in the event that it is desired to rotate the run-in string 14 relatively thereto prior to the time that hydraulic pressure is applied.

The sections of the wash pipe 48 and 49 are connected by a collar 53 which is not made up tight. That is, the threaded connections between the sections 48 and 49 and the collar are such that it is still possible to partially screw one of the sections into or out of the collar. An O-ring 54 is used to prevent leakage through the threads.

The operation of the above-described construction is substantially as follows:

The tool is usually lowered into the well in the position shown in Fig. 1A wherein fluid may freely pass up through the wash pipe made up of sections 48 and 49, out through the ports 26 and 25, and back into the run-in string of pipe 14 through the ports 38. Fluid may also pass through the ports 52 up through the passages 28 through the ports 35 and out through the ports 24 and 22. When the tool has been lowered to the desired location the run-in string of pipe 14 may be given a half revolution. This has the effect of closing the ports 26 and 22. Fluid that is forced down the run-in string of pipe 14 may pass downwardly around the boss 23 and into the upper section 11 of the body. From this section the fluid finds egress through the ports 38 between the upper and lower packers expanding the upper and lower packers into firm sealing engagement with the casing C.

Under these circumstances, various operations such as cementing, testing, acidizing, or plasticizing may be performed and when the operation is completed if the external pressures are substantially equal to the internal pressures, it is frequently possible to reversely rotate the run-in string 14 to re-open the valves and recover the tool without difficulty. However, in some instances, the pressure below the lower packers becomes materially reduced while the operations are being performed and under these circumstances the hydrostatic pressure developed at the bottom of the run-in string 14 would become so great as to pressure-lock the tool in the casing. By means of the present construction, even if this occurs it is still possible to rotate the run-in string of pipe 14 while the body 10 and its packers remain stationary. This opens the ports 25 and 26 to relieve the pressure between the packers and allow such pressure to escape downwardly through the wash pipe 48 and 49. The escaping pressure can re-enter the body through the ports 52, and after passing upwardly through the passages 28 it may enter the ports 35 and escape to the exterior of the tool above the upper packer through the port 22. Thus danger of having the tool become pressure-locked in the casing is entirely avoided.

From the above-described construction it will be appreciated that an improved construction of straddle tool has been provided wherein the upper end of the bypass provided by the pipe 34 is openable and closable by the run-in string of pipe, and that the run-in string of pipe on rotation can also open and close the valve 28 without involving a rotation of the body of the tool. The body of the tool can be allowed to remain stationary at all times within the casing except during positioning and withdrawal. The opening and closing of the space between the upper and lower packers as well as the opening and closing of the bypass near the top thereof occurs simultaneously and is performed by the run-in string of pipe which is rotated from the surface.

In the event that the lower section of the wash pipe 49 becomes sanded up or frozen in the bullnose 50 it is still possible at all times to rotate the upper and lower valve means by the run-in string of pipe. Rotation of the valve 28 under these circumstances merely requires that the section 48 screw a little farther into the collar 53, or unscrew therefrom, depending upon the direction of rotation.

Various changes may be made in the details of construction without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. A device of the class described comprising a tubular body having upper and lower packers, connecting means having a limited rotatable connection with the top of the body for connecting the body to a run-in string of pipe, there being a wall port in the body between the packers, a rotary valve in the body having a port adapted to be moved into and out of registration with said wall port, a tube connected to the port in the rotary valve and extending downwardly therefrom and communicating with the exterior of the body below the lower packer, there being a wall port in the body above the upper packer, a port in the connecting means adapted to move into and out of registration with the last-mentioned wall port, a tube non-rotatably connected to the connecting means and in communication with the port therein, said tube being non-rotatably connected to the rotary valve so that the rotary valve may be rotated by the connecting means when the connecting means is rotated by the run-in string of pipe, there being one or more ports in the last-mentioned tube, sealing means between the body and the last-mentioned tube above the ports therein and above the wall port between the packers, there being a bypass-passage from below the lower packer past the rotary valve to the ports in the last-mentioned tube.

2. A device of the class described comprising a tubular body having upper and lower packers, connecting means having a limited rotatable connection with the top of the body for connecting the body to a run-in string of pipe, there being a wall port in the body between the packers, a rotary valve in the body having a port adapted to be moved into and out of registration with said wall port, a tube connected to the port in the rotary valve and extending downwardly therefrom and communicating with the exterior of the body below the lower packer, there being a wall port in the body above the upper packer, a port in the connecting means adapted to move into and out of registration with the last-mentioned wall port, a tube non-rotatably connected to the connecting means and in communication with the port therein, said tube

being non-rotatably connected to the rotary valve so that the rotary valve may be rotated by the connecting means when the connecting means is rotated by the run-in string of pipe, there being one or more ports in the last-mentioned tube, sealing means between the body and the last-mentioned tube above the ports therein and above the wall port between the packers, there being a bypass-passage from below the lower packer past the rotary valve to the ports in the last-mentioned tube, and a wall port in the body between the packers and above said sealing means, said connecting means having a passage therethrough in communication with the last-mentioned wall port.

3. A device of the class described comprising a tubular body having upper and lower packers, connecting means having a limited rotatable connection with the top of the body for connecting the body to a run-in string of pipe, there being a wall port in the body between the packers, a rotary valve in the body having a port adapted to be moved into and out of registration with said wall port, a tube connected to the port in the rotary valve and extending downwardly therefrom and communicating with the exterior of the body below the lower packer, there being a wall port in the body above the upper packer, a port in the connecting means adapted to move into and out of registration with the last-mentioned wall port, a tube non-rotatably connected to the connecting means and in communication with the port therein, said tube being non-rotatably connected to the rotary valve so that the rotary valve may be rotated by the connecting means when the connecting means is rotated by the run-in string of pipe, there being one or more ports in the last-mentioned tube, sealing means between the body and the last-mentioned tube above the ports therein and above the wall port between the packers, there being a bypass-passage from below the lower packer past the rotary valve to the ports in the last-mentioned tube, and a wall port in the body below the lower packer and above the lower end of the first-mentioned tube.

4. A device of the class described comprising a tubular body having upper and lower packers, connecting means having a limited rotatable connection with the top of the body for connecting the body to a run-in string of pipe, there being a wall port in the body between the packers, a rotary valve in the body having a port adapted to be moved into and out of registration with said wall port, a tube connected to the port in the rotary valve and extending downwardly therefrom and communicating with the exterior of the body below the lower packer, there being a wall port in the body above the upper packer, a port in the connecting means adapted to move into and out of registration with the last-mentioned wall port, a tube non-rotatably connected to the connecting means and in communication with the port therein, said tube being non-rotatably connected to the rotary valve so that the rotary valve may be rotated by the connecting means when the connecting means is rotated by the run-in string of pipe, there being one or more ports in the last-mentioned tube, sealing means between the body and the last-mentioned tube above the ports therein and above the wall port between the packers, there being a bypass-passage from below the lower packer past the rotary valve to the ports in the last-mentioned tube, and a wall port in the body between the packers and above said sealing means, said connecting means having a passage therethrough in communication with the last-mentioned wall port, and a wall port in the body below the lower packer and above the lower end of the first-mentioned tube.

5. A device of the class described comprising a tubular body having upper and lower packers on the exterior thereof adapted to sealingly engage a well casing, upper and lower wall ports in the body between the packers, a wall port in the body above the upper packer, spaced lower and upper rotary valve means in the body for opening and closing the lower wall port between the

packers and the wall port above the upper packer, respectively, upper and lower tubes connected to the upper and lower rotary valve means, respectively, and extending downwardly therefrom, the lower tube connecting the lower rotary valve means to the exterior of the body below the lower packer, the upper tube non-rotatably connecting the upper rotary valve means to the lower rotary valve means so that the lower rotary valve means may be rotated thereby, one or more ports in the upper tube adjacent the lower end thereof, sealing means between the interior of the body and the upper tube above the ports therein, there being a bypass-passage extending from the exterior of the body from below the lower packer around the lower rotary valve means to the ports in the upper tube.

6. A device of the class described comprising a tubular body having upper and lower packers on the exterior thereof adapted to sealingly engage a well casing, upper and lower wall ports in the body between the packers, a wall port in the body above the upper packer, spaced lower and upper rotary valve means in the body for opening and closing the lower wall port between the packers and the wall port above the upper packer, respectively, upper and lower tubes connected to the upper and lower rotary valve means, respectively, and extending downwardly therefrom, the lower tube connecting the lower rotary valve means to the exterior of the body below the lower packer, the upper tube non-rotatably connecting the upper rotary valve means to the lower rotary valve means so that the lower rotary valve means may be rotated thereby, one or more ports in the upper tube adjacent the lower end thereof, sealing means between the interior of the body and the upper tube above the ports therein, there being a bypass-passage extending from the exterior of the body from below the lower packer around the lower rotary valve means to the ports in the upper tube, the upper wall ports between the packers being disposed above said sealing means, a passage in the upper rotary valve means in communication therewith, and means for connecting the upper rotary valve means to a run-in string of pipe.

7. A device of the class described comprising a tubular body having upper and lower packers on the exterior thereof adapted to sealingly engage a well casing, upper and lower wall ports in the body between the packers, a wall port in the body above the upper packer, spaced lower and upper rotary valve means in the body for opening and closing the lower wall port between the packers and the wall port above the upper packer, respectively, upper and lower tubes connected to the upper and lower rotary valve means, respectively, and extending downwardly therefrom, the lower tube connecting the lower rotary valve means to the exterior of the body below the lower packer, the upper tube non-rotatably connecting the upper rotary valve means to the lower rotary valve means so that the lower rotary valve means may be rotated thereby, one or more ports in the upper tube adjacent the lower end thereof, sealing means between the interior of the body and the upper tube above the ports therein, there being a bypass-passage extending from the exterior of the body from below the lower packer around the lower rotary valve means to the ports in the upper tube, the upper wall ports between the packers being disposed above said sealing means, a passage in the upper rotary valve means in communication therewith, and means for connecting the upper rotary valve means to a run-in string of pipe, means forming a closure between the body and the lower end of the lower tube, and wall ports in the body between said closure and the lower packer.

References Cited in the file of this patent

UNITED STATES PATENTS

2,569,026 Springer ---------- Sept. 25, 1951