

Nov. 20, 1951

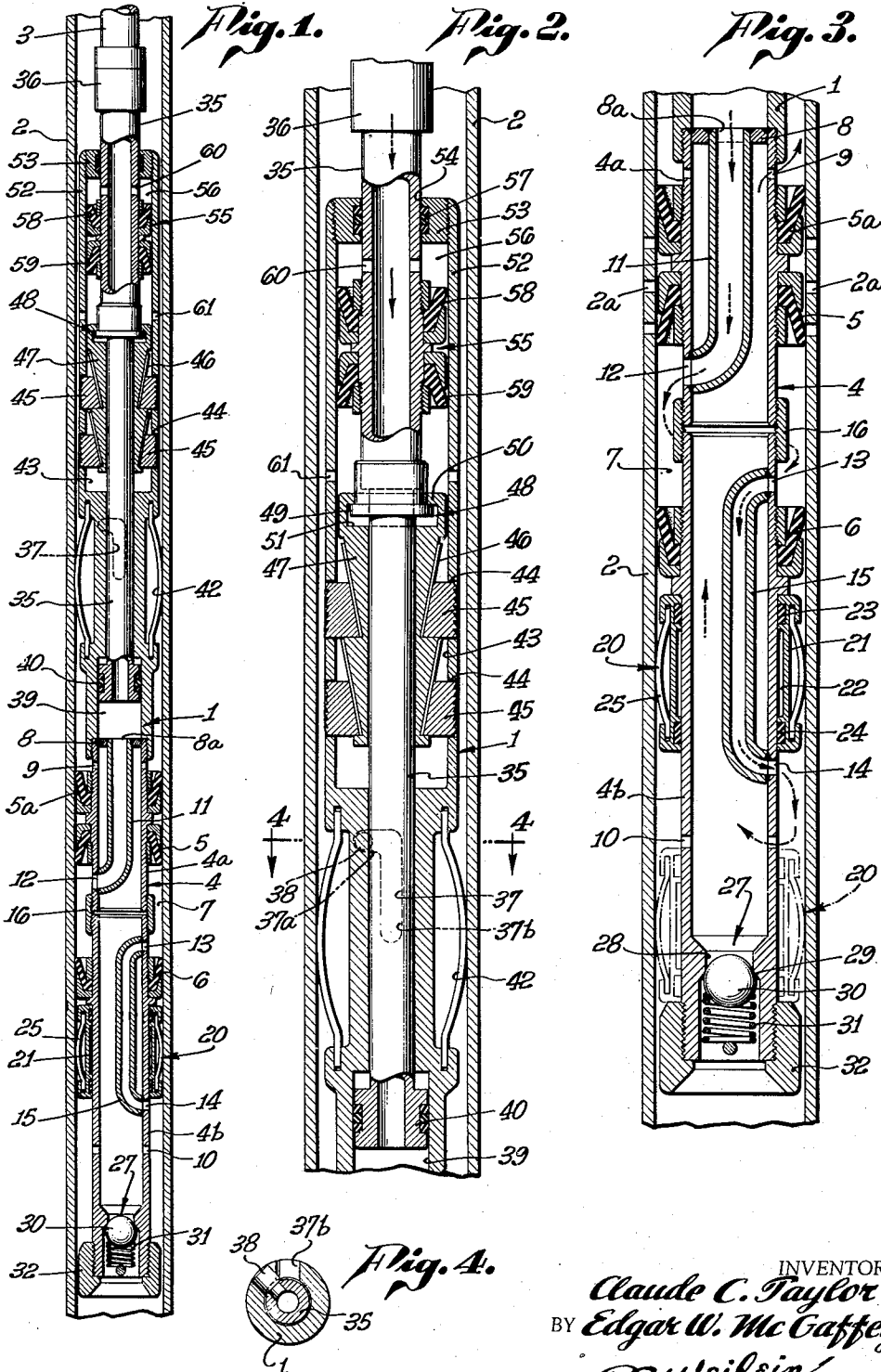
C. C. TAYLOR ET AL

2,575,603

CEMENTING TOOL

Filed Feb. 1, 1946

2 SHEETS—SHEET 1



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2 SHEETS—SHEET 2

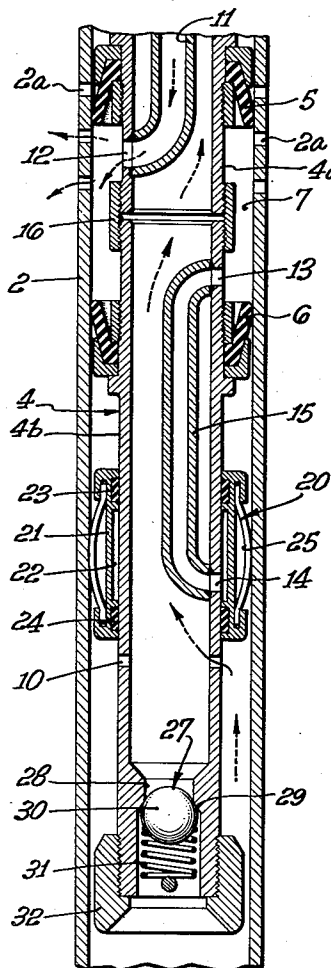


Fig. 5.

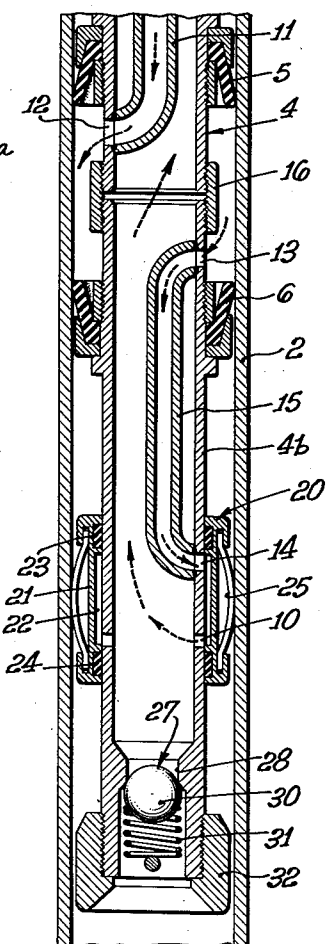


Fig. 7.

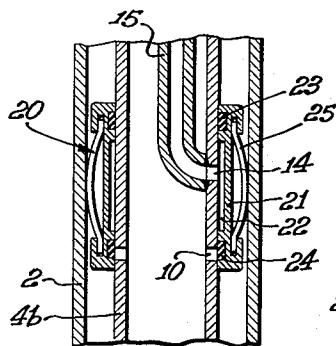


Fig. 8.

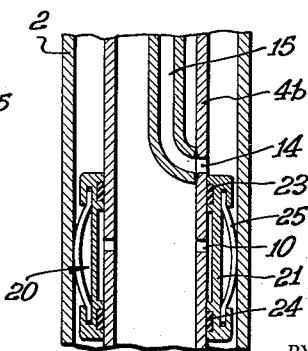


Fig. 9.

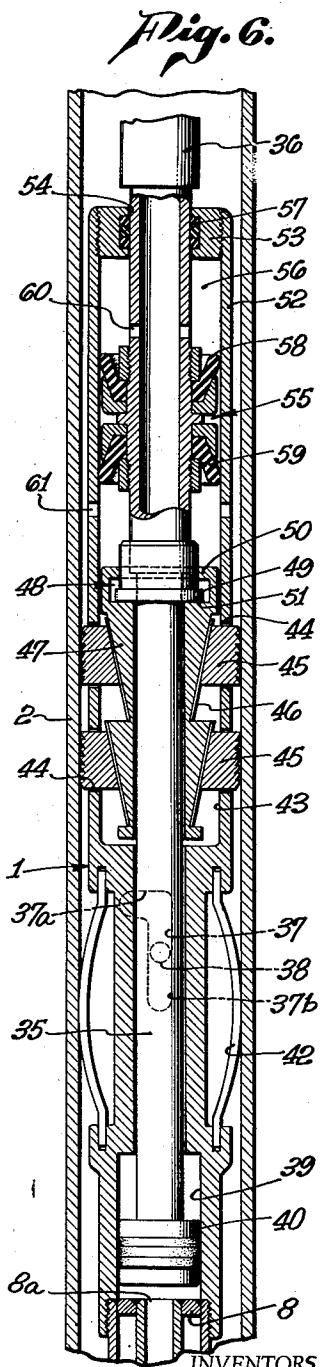


Fig. 6.

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2,575,603

CEMENTING TOOL

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18 Claims. (Cl. 166—11)

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This invention relates to a tool for use in connection with oil well cementing operations.

It is known to provide tools for such operations which comprise opposed spaced packers on a body carried by a tubing string, extending to the mouth of the well, for forming a pressure chamber in the well casing. Thus, cement slurry or other fluid may be pumped from the surface of the ground to the chamber and out through perforations or openings in that portion of the wall of the casing surrounding the chamber.

It is an object of this invention to provide such a tool having means forming a by-pass for well fluid to pass the tool either as the tool is run in the hole or as it is brought out of the hole.

It is another object of this invention to provide such a tool having means for optionally preventing passage of fluid upwardly past the tool.

It is another object of this invention to provide such a tool having means providing an opening from the pressure chamber to the space in the casing, outside this chamber which may optionally be opened or closed.

It is another object of this invention to provide such a tool having means for preventing release of fluid from the pressure chamber while permitting fluid to by-pass the tool in either direction.

It is another object of this invention to provide such a tool having means for preventing release of fluid from the pressure chamber and simultaneously preventing upward flow of fluid past the tool.

It is another object of this invention to provide such a tool having means for releasing fluid from the pressure chamber and simultaneously permitting fluid to by-pass the tool in either direction.

It is another object of this invention to provide such a tool arranged to be restrained against upward movement in the well due to excess pressure below the tool.

It is another object of this invention to provide a tool capable of performing cementing operations of the type known as "squeeze jobs."

It is another object of this invention to provide such a tool adapted to perform successively cementing operations at different zones in the well and under different conditions without the necessity of pulling the tubing string and the tool from the well between successive operations.

It is still another object of this invention to provide such a tool adapted for use in cleaning or washing surplus cement from the well and from the tool after a cementing job, optionally

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either by circulating down the tubing string and up the casing, or by reverse circulation down the casing and up the tubing string.

This invention possesses many other advantages, and has other objects which may be made more easily apparent from a consideration of one embodiment of the invention. For this purpose, there is shown a form in the drawings accompanying and forming part of the present specification. This form, which illustrates the general principles of the invention, will now be described in detail; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

In the drawings:

Figure 1 is an axial section of a tool incorporating the features of the invention, positioned in a well casing;

Figure 2 is a fragmentary section showing the upper portion of the tool, on an enlarged scale;

Figure 3 is a similar section showing the lower portion of the tool;

Figure 4 is a fragmentary detail section taken as indicated by line 4—4 on Figure 2;

Figure 5 is a view similar to Figure 3 but showing a different operating position of the parts;

Figure 6 is a view similar to Figure 2 but showing a different operating position of the parts; and,

Figures 7, 8 and 9 are views similar to Figure 3 but showing other operating positions of the parts.

Referring particularly to Figures 1 and 3, of the drawings, the tool is shown as comprising an elongated, generally cylindrical hollow body 1 supported for movement in the well casing 2 by means of a string of tubing 3 which extends to the mouth of the well. The body 1 has a downward tubular extension 4 to which are secured conventional packers 5 and 6, spaced axially along the extension 4 and cooperating with the casing 2 to form a confined space or pressure chamber 7 about the extension 4. A supplementary upwardly directed packer 5-a is provided on the extension 4 just above the upper packer 5, for a purpose to be later pointed out.

Means are provided forming a first passage or a by-pass to permit fluid in the casing to flow upwardly or downwardly in the casing 2 past the packers 5 and 6 and the confined space 7. For this purpose a wall or partition 8 is provided which separates the interior of the body 1 from the interior of the extension 4, and ports 9 and 10 are provided in the wall of the extension respectively above the uppermost packer

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5-a and below the lower packer 6. Thus, fluid in the casing 2 below the packer 6 is free to enter extension 4 through the port or ports 10, pass upwardly therein, and flow into the casing space above the packer 5 through the port or ports 9, or vice versa.

Means are also provided in the body extension 4 forming a second passage for establishing communication between the interior of the tubing string 3 and the restricted space or pressure chamber 7, as well as with the space in the casing 2 below the lower packer 6. For this purpose, the partition 8 is provided with an opening 8-a from which a tube or conduit 11 leads to a port 12 in the wall of the extension 4 below the upper packer 5 and opening into the space 7. Another port 13 is provided in the wall of the extension 4 above the lower packer 6 and communicates with a port 14 below the packer 6 and spaced above the ports 10, by a tube or conduit 15.

As is well understood, the use of such a tool involves the positioning of the pressure chamber 7 in the casing 2 so as to communicate with perforations provided in the casing wall. Since it may be desired to vary the space between the packers 5 and 6 to provide a pressure chamber 7 having a length in accordance with the length of the perforated portion of the casing, the body extension 4 is formed of an upper section 4-a and a lower section 4-b secured together as by a threaded coupling member 16. By substituting coupling members 16 of suitable lengths, the length of the chamber 7 may be altered as desired.

Valve means 20 are provided for controlling the first and second passages, and comprises a sleeve 21 freely slidable on the extension 4 below the lower packer 6. Thus, sleeve 21 has an annular space or chamber 22 surrounding the extension 4, sealed from the casing space by suitable packing means 23 and 24 at the opposite ends of the sleeve 21. The length of the sleeve 21 is such that, by appropriate positioning of the sleeve on the extension, either or both of ports 10 and 14 may be covered, thus interrupting communication between the first or second passage or both, and the casing space below the lower packer 6. Furthermore, the annular space 22 is such that the valve may serve optionally when communication between the first and second passages and the space below the packer is interrupted, to bridge the ports 10 and 14, thereby establishing communication between the first and second passages (see Figure 7).

The sleeve 21 carries a plurality of conventional friction or bow springs 25 adapted to frictionally engage the wall of the casing 2 and restrain axial movement of the sleeve 21 therein. In this way, appropriate movement of the body 1 with respect to the casing 2 serves to operate the valve 20 as desired.

A supplemental valve structure 27 is provided at the lower end of the extension 4 to permit discharge of fluid from the casing above packers 5 and 5-a down through the bypass to space below the packers independently of port 10. Thus, the lower end of the interior of the extension 4 is reduced to provide a port 28 surrounded by a downwardly facing valve seat 29 toward which a closure member 30 is urged by a compression spring 31. A conventional shoe 32 is threaded on the lower end of the extension 4.

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The tool as so far described is a complete operative structure which is perfectly satisfactory for many conditions of operation. However, it may be desirable to provide means insuring against the tool and the tubing string 3 being forced upwardly in the casing 2 as by pressure in the casing below the bottom packer. For this purpose, the body 1 is connected to a tubular mandrel 35 (see Figures 1 and 2) which in turn is connected to the tubing string 3 by means of a "sub" or coupling member 36. The body 1 and the mandrel 35 are connected for limited relative movement by means of an inverted L slot 37 formed in the body 1 and a pin 38 carried by the mandrel 35.

The body 1 just above the extension 4 has a bore 39 forming a cylinder for accommodating a packed head 40 formed on the lower end of the mandrel 35. In this way, leakage between the casing space and the interior of the body is prevented.

Conventional friction or bow springs 42 are provided on the body 1 for frictionally engaging the casing 2, thus restraining movement of the body 1 and enabling manipulation of the lock means 37 and 38 by appropriate movement of the mandrel 35.

The body 1 above the bow springs 42 is enlarged to provide a bowl 43, having a plurality of openings 44 extending through its wall, in which slips 45 are mounted for movement toward and away from the casing 2. The slips 44 are slidably attached in a known manner to upwardly and outwardly inclined surfaces 46 formed on a slip head 47, carried on the mandrel 35. The slip head 47 is mounted for free rotary movement and limited axial movement with respect to the mandrel 35, the axial movement being limited by means of lost motion connection 48 comprising means forming a flange 49 on the mandrel 35 confined between axially spaced shoulders 50 and 51 on the slip head 47.

This lost motion connection 48 insures locking of the body 1 and the mandrel 35 against relative rotation by means of the lock 37-38 before the slips 45 engage the casing. Thus, referring to Figure 2, it will be seen that relative axial motion between the body 1 carrying the slip bowl 43 and slip head 47 is prevented as long as pin 38 is in the horizontal part 37-a of the inverted L slot 37. After rotation of the mandrel 35 to align pin 38 with the vertical portion 37-b of the slot 37, relative movement of the mandrel 35 downwardly of the body 1 will not expand the slips 44 until such movement is sufficient to cause the flange 49 to engage the shoulder 51 on the slip head 47. Such movement of the mandrel 35, however serves to move the pin 38 into the vertical slot 37-b so that the mandrel 35 and the body 1 are locked against relative rotation. Further downward movement of the mandrel 35 with respect to the body 1 will then serve to expand the slips.

The bowl 43 is extended a substantial distance above the slip head 47 to provide a cylinder 52, closed at its upper end by a head 53, having an opening 54 for slidably accommodating the upper portion of the mandrel 35. A piston 55 is provided on the mandrel 35 for sealing against the walls of the cylinder 52 and cooperating with the cylinder to form an expansible pressure space 56. Conventional packing 57 is provided in opening 54 for sealing against the mandrel 35. The piston 55 is sealed against passage of fluid pressure either into or out of the space 56 as by a

pair of oppositely directed packers or cup leathers 58 and 59.

Fluid under pressure from the tubing string 3 enters the cylinder space 56 through one or more ports 60 provided in the mandrel 35 and is prevented from escaping past the piston 55 by the packer 58. The space below the piston 55 is in free communication with the casing space above the upper packer 5-a as by ports 61 provided in the slip bowl 43.

The operation of the tool may now be discussed. The tool is lowered in the casing 2 by means of the tubing 3, the body 1 and mandrel 35 being locked against relative axial movement by the engagement of the pin 38 in the horizontal portion 37-a of the slot 37. All parts are in the relative positions of Figures 1, 2 and 3, the valve 20 being urged upwardly to open ports 10 and 14 by the drag of the friction springs 25 on the casing. Fluid below the tool is thus permitted to enter the extension 4 through the port 10 below the lower packer 6, passing upwardly and out into the casing through the port 9 above the upper packer 5-a thus by-passing the packers 5-a, 5 and 6 by the previously described first passage, and as indicated by the full line arrows in Figure 3.

The tool is lowered to a point in the well casing 2 where the pressure chamber 7 is a suitable predetermined distance below the perforations 2-a provided in the casing 2 for establishing communication with the space in the well bore outside the casing, and circulation is established from the mouth of the well as by pumping cement slurry down the tubing string 3. This cement slurry passes downwardly through the tubular mandrel 35 and the previously mentioned second passage comprising port 8-a, conduit 11, port 12, pressure chamber 7, port 13, conduit 15, and port 14 into the casing below the packer 6 as indicated by the broken arrows in Figure 3. Well fluid is forced ahead of the cement slurry upwardly past the packers 5, 5-a, and 6 through the first passage. Thus, it enters the body extension 4, through port 10, flows upwardly in the extension 4 and returns to the casing space through port 9.

After circulation has been established and cement slurry has reached the tool as determined by appropriate measurements, the tubing 3 is turned to the right to locate pin 38 above the vertical slot 37-b of the L-slot 37. In this position, the pin 38 still prevents downward movement of the body 1 with respect to the mandrel 35. The tool is then raised by an amount equal to the previously mentioned predetermined distance, so that the pressure chamber 7 is over the casing perforations 2-a. The friction springs 25 restrain the valve 20 against movement with the tool, the extension 4 thus moving upwardly with respect to the valve 20 so that the valve closes the outlet 14 of the second passage. The relative positions of the parts are now as shown in Figure 5, the first passage, by-passing the packers 5, 5-a and 6 being open. Cement slurry may now be forced downwardly through the tubing 3, mandrel 35, conduit 11 and port 12 into the chamber 7, and thence through the perforations 2-a, since outlet 14 from the pressure space is closed by the valve 20. The well fluid displaced by the cement freely passes upwardly through the ports 10, body extension 4 and port 9, and under such conditions there is no pressure acting to force the tool upwardly in the casing.

If it is desired to close the by-pass and prevent upward flow past the tool, the tool is raised

an additional distance to cause the valve 20 to assume the position of Figure 8 and close port 10 as well as port 14 from communication with the interior of the casing below the packer 6, as well as preventing communication between the ports. Under such a condition, the cement passing through the perforations 2-a into the space surrounding the casing 2 may pass downwardly and reenter the casing at some point below the tool, thus exerting an upward force on the tool.

To lock the tool against upward movement, the pin 38 having been aligned with the vertical slot 37-b, the tubing 3 and the mandrel 35 are lowered with respect to the body 1, the body being restrained by the friction springs 42. This causes the slip head 47 to urge the slips 45 outwardly to grip the casing 2 (see Figure 6). Pressure built up below the tool urges the body 1, the slip bowl 43 and the slips 45 upwardly with respect to the tubing 3 and slip head 47, which are restrained against upward movement by the weight of the tubing string 3. This weight is augmented by the pressure of the cement slurry or other fluid in the tubing 3 which is effective in space 56 via ports 60 to urge the tube 35 downwardly against the slip head 47. The slips are thus caused to grip the casing 2 more tightly as the pressure below the tool increases.

After a cementing job it is necessary to remove the cement from within and about the tool before it hardens or sets. The usual method is by reverse circulation, sometimes called "back scuttling." To perform this operation, the tubing 3 and mandrel 35 are raised with respect to the body 1 until the pin 38 engages the top of the slot 37. This movement causes the slips 45 to be retracted and to release the casing. The mandrel 35 is then turned in a left hand direction to cause pin 38 to enter the horizontal slot 37-a, locking the slips 45 in released position. The tool is then raised or lowered until the pressure chamber 7 is out of communication with the perforations 2-a, which movement also serves to cause the valve 20 to uncover ports 10 and 14, since the valve is restrained from movement by the springs 25. If the tool is lowered, the valve 20 will be in the full line position of Figure 3; if the tool is raised the valve 20 will be in the broken line position.

Water or mud laden fluid is then forced down the casing 2 outside of the tubing 3, into ports 9 down extension 4, into the casing space below the packer 6 and thence into the port 14, through conduit 15, port 13, pressure chamber 7, port 12, conduit 11, port 8-a, mandrel 35 and tubing 3 to the mouth of the well.

The supplemental valve 27 insures clearing of the lower end of the extension 4, since sufficient circulation pressure as just described may be built up in the extension 4 to open this valve, permitting some of the circulation fluid to pass downwardly out of the extension and thence upwardly through port 14. This valve also permits a "back scuttling" operation in the event that the valve 20 should become stuck in a position closing ports 10 and 14. In such case, the circulation fluid would pass from extension 4, past the valve 27 and return between the extension 4 and the casing 2 past the lower packer 6, which is free to pass pressure from below, into the pressure chamber 7 and thence through port 12 upwardly in the tubing 3.

The piston 55 must be arranged to prevent flow upwardly as well as downwardly past the piston, otherwise reverse circulation could enter ports 61, flow upwardly past piston 55 and thence

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enter the tubing string 3, through ports 60. If this were permitted to occur obviously the tool would not be freed of cement. Similarly, the upwardly facing packing 5-a prevents reverse circulation from entering the pressure chamber 7 past the upper packer 5 thereof and returning to the tubing 3 via the port 12 without cleaning the lower portion of the tool.

If equipment is not available for such reverse circulation, the cleaning operation can be performed in the more conventional manner or circulating down the tubing 3 and up in the casing 2 outside the tubing. For such an operation, the tool must be manipulated in the casing 2 to position the valve 20 to connect ports 10 and 14 as shown in Figure 7. Circulation fluid is forced downwardly in tubing string 3, mandrel 35, thence through port 8-a, conduit 11, port 12, pressure chamber 7, port 13, conduit 15, and port 14 into the annular cavity 22 in valve 20. From this cavity 22 it enters the body extension 4 through the port 10, and through the port 9 into the casing 2, whence it returns to the mouth of the well.

The tool is also adapted for use as a squeeze tool. Thus, by setting the tool so that the valve 20 is positioned to cover the ports 10 but not port 14, as shown in Figure 9, the lower packer 6 is rendered inoperative by the by-pass tube 15. In this case, cement slurry can be pumped down the tubing 3 out port 12 into the pressure space 7, thence into port 13 down the bypass 15 and out the port 14 or what has been termed the second passage. Upward escape of the cement slurry via ports 10 and the first passage is prevented, since the ports 10 are closed. Excess cement can be washed either the long way or the short way as previously described.

We claim:

1. In a well tool: a body adapted for connection to a tubing string for positioning in a well casing; a pair of vertically spaced packing means carried by the body for sealing against the casing to form a pressure chamber extending about the body; means forming a passage extending through said body and opening into the interior of the casing outside the body above and below said chamber for by-passing said packing means; means on the body forming a pair of passages, one passage of said pair communicating with said tubing string and said chamber, the other passage of said pair communicating with said chamber and an opening through the wall of the body below the lower packing means; said pair of passages being sealed from each other, and from said by-pass passage, to prevent fluid flow therebetween within the body; said pair of passages being communicative with each other exteriorly of said body when said packing means are sealed against the well casing, to pass fluid between said tubing string and the interior of the casing outside the body below said chamber; and valve means shiftably mounted on said body for operation in response to the movement of the body in the casing for selectively controlling fluid flow through said by-pass and one of said pair of passages.

2. In a well tool: a body adapted for connection to a tubing string for positioning in a well casing; a pair of vertically spaced packing means carried by the body for sealing against the casing to form a pressure chamber extending about the body; means forming a passage extending through said body between an opening through the wall of the body above the upper packing

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means and a port in the wall of the body below the lower packing means for by-passing said packing means; means forming a pair of passages, one passage of said pair extending through said body for communicating said tubing string with an opening into said chamber, the other passage of said pair extending through said body for communicating another opening into said chamber with a port in the wall of the body below the lower packing means, said pair of passages being sealed from each other and from said by-pass passage, to prevent fluid flow therebetween within the body; said pair of passages being communicative with each other exteriorly of said body when said packing means are sealed against the well casing, to pass fluid between said tubing string and the interior of the casing outside the body below the lower packing means; said ports being axially spaced along said body; a valve member axially movable on said body for selectively controlling said ports; and means on said valve member for frictionally engaging the casing, whereby said valve member is adapted to be operated on response to the movement of said body in the casing.

3. In a well tool: a body adapted for connection to a tubing string for positioning in a well casing; a pair of vertically spaced packing means carried by the body for sealing against the casing to form a pressure chamber extending about the body; means forming a passage extending through said body between an opening through the wall of the body above the upper packing means and a port in the wall of the body below the lower packing means for by-passing said packing means; means forming a pair of passages, one passage of said pair extending through said body for communicating said tubing string with an opening into said chamber, the other passage of said pair extending through said body for communicating another opening into said chamber with a port in the wall of the body below the lower packing means, said ports being axially spaced along said body; said pair of passages being sealed from each other and from said by-pass passage, to prevent fluid flow therebetween within the body; said pair of passages being communicative with each other exteriorly of said body when said packing means are sealed against the well casing, to pass fluid between said tubing string and the interior of the casing outside the body below said lower packing means; a valve sleeve slidable on said body, having axially spaced portions sealing against said body, said sleeve forming with said body and between said spaced portions a chamber, said sleeve being optionally positionable with said chamber overlying said ports and providing communication therebetween or overlying either port and interrupting communication between such port and the interior of the casing outside the tool.

4. In a well tool: a body adapted for connection to a tubing string for positioning in a well casing; a pair of vertically spaced packing means carried by the body for sealing against the casing to form a pressure chamber extending about the body; means forming a passage extending through said body, between an opening through the wall of the body above the upper packing means and a port in the wall of the body below the lower packing means for by-passing said packing means; means forming a pair of passages, one passage of said pair extending through said body for communicating said tubing string with an opening into said chamber, the other passage of said

pair extending through said body for communicating another opening into said chamber with a port in the wall of the body below the lower packing means, said ports being axially spaced along said body; said pair of passages being sealed from each other and from said by-pass passage, to prevent fluid flow therebetween within the body, said pair of passages being communicative with each other exteriorly of said body when said packing means are sealed against the well casing, to pass fluid between said tubing string and the interior of the casing outside the body below said lower packing means; valve means shiftably mounted on the body for selectively controlling said by-pass and one of said pair of passages, operated in response to the movement of the body in the casing; and supplemental valve means positioned in and for discharging fluid under pressure from one of said passages.

5. In a well tool: a body adapted for connection to a tubing string for positioning in a well casing; a pair of vertically spaced packing means carried by the body for sealing against the casing to form a pressure chamber extending about the body; means forming a first passage extending through said body between an opening through the wall of the body above the upper packing means and a port in the wall of the body below the lower packing means for by-passing said packing means; means forming a pair of passages, one passage of said pair extending through said body for communicating said tubing string with an opening into said chamber, the other passage of said pair extending through said body for communicating another opening into said chamber with a port in the wall of the body below the lower packing means, said pair of passages being sealed from each other and from said by-pass passage, to prevent fluid flow therebetween within said body, said ports being axially spaced along said body; said pair of passages being communicable with each other exteriorly of said body when said packing means are sealed against the well casing, to pass fluid between said tubing string and the interior of the casing outside the body below said lower packing means; a valve member telescopically mounted on said body for sliding movement to cover and uncover said ports; and a plurality of bow springs on said valve member for frictionally engaging the casing and restraining said valve member against movement, whereby movement of said body relative to said valve member operates said valve member to control said ports.

6. In a well tool: a body; a tubular mandrel adapted for connection to a tubing string for positioning in a well casing, and to which said body is secured for limited vertical movement, said body and said mandrel forming relatively movable members; locking means on said members for optionally securing said members together against relative movement; a pair of vertically spaced packing means carried by the body for sealing against the casing to form a pressure chamber extending about the body; means forming a passage in said body extending from below the lower packing means to above the upper packing means for by-passing fluid past said spaced packing means; means forming a pair of passages, one passage of said pair extending through said body for communicating said tubing string with an opening into said chamber, the other passage of said pair extending through said body for communicating an opening into said chamber with an opening through the wall of

the body below the lower packing means; said pair of passages being sealed from each other and from said by-pass passage to prevent fluid flow therebetween within the body, said pair of passages being communicative with each other exteriorly of the body when said packing means are sealed against the well casing, to pass fluid between said tubing string and the interior of the casing outside the body below said lower packing means; valve means shiftably mounted on said body for operation in response to the movement of the body in the casing for selectively controlling one of said pair of passages and said by-pass passage; a slip head on one of said members; and slips carried by the other member for movement outwardly thereof in response to relative movement between the members in one direction to engage the casing and secure the tool against movement therein.

7. In a well tool: a tubular body adapted for connection to a tubing string for positioning in a well casing; said body including upper and lower sections detachably coupled in fluid tight relation; spaced packing means respectively carried by said upper and lower sections for sealing against the casing, to form a pressure chamber extending about said sections; there being an opening through the wall of said body above the upper packing means and a port through the wall of said lower section below the lower packing means, said opening and port being communicable with each other whereby said upper and lower sections provide a by-pass past the packing means; means in said upper section forming a passage between and communicating with the tubing string and said pressure chamber; means in said lower section forming a passage between and communicating with said pressure chamber and a second port in the wall of said lower section below said lower packing means, said passage forming means being sealed from each other and from said by-pass, to prevent fluid flow therebetween within the body; and valve means movably mounted on said body and operated in response to movement of said body in the casing for controlling said ports.

8. In a well tool: a body adapted for connection to a tubing string for positioning in a well casing; a pair of vertically spaced packing means carried by the body for sealing against the casing to form a pressure chamber extending about the body; means forming a first passage extending through said body having an opening communicating with the interior of the casing outside the body above the upper packing means, and communicating with the interior of the casing outside the body below the lower packing means through a first port in the wall of the body below the lower packing means; means forming a pair of passages, one of said passages extending through said body between and communicating with said tubing string and said chamber; the other of said pair of passages extending through said body from said chamber and opening into the interior of the casing outside the body below the lower packing means through a second port in the wall of the body, said ports being in spaced relation on said body, said pair of passages being sealed from each other and from said first passage, to prevent fluid flow therebetween within said body; said pair of passages being communicative exteriorly of said body when said packing means are sealed against the well casing, to pass fluid between said tubing string and the interior of the casing below said chamber; a valve mem-

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ber movably mounted on said body for selectively controlling said ports; and means on said member frictionally engaging the casing, whereby said member is operated in response to movement of said body with respect to the casing.

9. In a well tool: a body adapted for connection to a tubing string for positioning in a well casing; a pair of vertically spaced packing means carried by the body for sealing against the casing to form a pressure chamber extending about the body; means forming a first passage extending through said body having an opening communicating with the interior of the casing outside the body above the upper packing means and communicating with the interior of the casing outside the body below the lower packing means through a first port in the wall of the body below the lower packing means; means forming a pair of passages, one of said passages extending through said body between and communicating with said tubing string and said chamber; the other of said pair of passages extending through said body from said chamber and opening into the interior of the casing outside the body below the lower packer through a second port in the wall of the body, said ports being in spaced relation on said body, said pair of passages being sealed from each other and from said first passage, to prevent fluid flow therebetween within said body; said pair of passages being communicative exteriorly of said body when said packing means are sealed against the well casing, to pass fluid between said tubing string and the interior of the casing below said chamber; a valve sleeve slidable on said body having axially spaced portions sealing against said body, said sleeve being spaced from the body between said portions to provide therein between said portions a sealed chamber adapted to establish communication between said ports while said portions interrupt communication between said ports and the interior of the casing below said lower packing means in one position of said sleeve, said axially spaced portions in other positions of said sleeve interrupting communication between either or both of said ports and the chamber formed in said sleeve; and a plurality of elements on said sleeve frictionally engaging the casing, whereby said sleeve is operated to control said ports in response to movement of said body relative to said sleeve.

10. In a well tool: a body adapted for connection to a tubing string for positioning in a well casing; a pair of vertically spaced packing means carried by the body for sealing between the body and the casing to form a pressure chamber extending about the body; means forming a first passage extending through said body having an opening communicating with the interior of the casing outside the body above the upper packing means and communicating with the interior of the casing outside the body below the lower packing means through a first port in the wall of the body below the lower packing means; means forming a pair of passages, one of said passages extending through said body between and communicating with the tubing string and said chamber, the other of said pair of passages extending through said body from said chamber and opening into the casing outside the body below the lower packing means through a second port, said ports being in spaced relation on said body, said pair of passages being sealed from each other and from said first

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passage, to prevent fluid flow therebetween within said body; said pair of passages being communicative exteriorly of said body when said packing means are sealed against the well casing, to pass fluid between said tubing string and the interior of the casing below said chamber; a valve member movably mounted on said body for sliding movement to close and open said ports; and a plurality of bow springs on said valve member for frictionally engaging the casing and restraining said valve member against movement, whereby movement of said body relative to the valve member operates said valve member to control said ports.

11. In a well tool; a mandrel adapted for connection to a tubing string for positioning in a well casing; a body, means connecting said body and mandrel for relative vertical movement, a pair of vertically spaced packing means carried by the body for sealing against the casing to form a pressure chamber extending about the body; means forming a first passage extending through said body having an opening communicating with the interior of the well casing outside the body above the upper packing means and communicating with the interior of the casing outside the body below the lower packing means through a first port in the wall of the body below the lower packing means; means forming a pair of passages, one of said passages extending through said body between and communicating with said tubing string and said chamber, the other of said pair of passages extending through said body from said chamber and opening into the interior of the casing outside the body below the lower packing means, through a second port in the wall of the body, said ports being in spaced relation on said body; said pair of passages being sealed from each other and from said first passage, to prevent fluid flow therebetween within said body; said pair of passages being communicative exteriorly of said body when said packing means are sealed against the well casing, to pass fluid between said tubing string and the interior of the casing below said chamber; a valve member movably mounted on said body for selectively controlling said ports; means on said valve member frictionally engaging the casing, whereby said valve member is operated in response to movement of said body with respect to the casing; a slip head on said mandrel; and slips carried by the body for movement outwardly thereof to engage the casing in response to relative movement between the body and the mandrel in one direction, whereby to secure the tool against movement in the casing.

12. In a well tool: a body adapted for connection to a tubing string for positioning in a well casing; a pair of vertically spaced packing means carried by the body for sealing between the body and the casing to form a pressure chamber extending about the body; means forming a first passage extending through said body having an opening communicating with the interior of the casing outside the body above the upper packing means and communicating with the interior of the casing outside the body below the lower packing means through a first port in the wall of the body below the lower packing means; means forming a pair of passages, one of said passages of said pair extending through said body and communicating with the tubing string and said chamber, the other passage of said pair extending through said body from said cham-

ber and opening into the interior of the casing outside said body through a second port in the wall of the body, said ports being in spaced relation on said body; said pair of passages being sealed from each other and from said first passage, to prevent fluid flow therebetween within said body; said pair of passages being communicative exteriorly of said body when said packing means are sealed against the well casing, to pass fluid between said tubing string and the interior of the casing outside said chamber; and common valve means slidable on the body and operable in response to movement of said body in the casing for selectively controlling said ports.

13. In a well tool: a body adapted for connection to a tubing string for positioning in a well casing; a pair of vertically spaced packing means carried by the body for sealing against the casing to form a pressure chamber extending about the body; means forming a first passage extending through said body having an opening communicating the interior of the casing outside the body above the upper packing means and communicating with the interior of the casing outside the body below the lower packing means through a first port in the wall of the body below the lower packing means; means forming a pair of passages, one of said passages extending through said body and communicating with said tubing string and said chamber, the other of said passages of said pair extending through said body and communicating with said chamber and a second port in the wall of the body outside said chamber, said pair of passages being sealed from each other as well as from said first passage, to prevent fluid flow therebetween within said body; said pair of passages being communicative exteriorly of said body when said packing means are sealed against the well casing, to pass fluid between said tubing string and the interior of the casing without said chamber, said ports being in spaced relation on said body, a valve sleeve movable on said body, having axially spaced portions sealing against said body, said sleeve being spaced from the body between said portions to provide therein between said portions a sealed chamber adapted to establish communication between said ports while said portions interrupt communication between said ports and the interior of the casing in one position of said sleeve, said portions in other positions of said sleeve interrupting communication between either or both of said ports and the chamber formed in the sleeve; and a plurality of elements on said sleeve frictionally engaging the casing, whereby said sleeve is operated to control said ports in response to movement of said body relative to said sleeve.

14. In a well tool: a body adapted for connection to a tubing string for positioning in a well casing; a pair of vertically spaced packing means carried by the body for sealing against the casing to form a pressure chamber extending about the body; means on the body forming a first passage having openings communicable with the interior of the casing respectively above and below said chamber for by-passing said packing means; means forming a pair of passages, one of said passages extending through said body between and communicating with said tubing string and said chamber, the other of said passages of said pair extending between and communicating said chamber and an opening into the interior of said casing outside the chamber, said pair of passages being sealed from each other

and from said first passage to prevent fluid flow therebetween within the body; said pair of passages communicating with each other exteriorly of said body when said packing means are sealed against the well casing to pass fluid between said tubing string and the interior of the casing outside said chamber; and valve means slidable on the body between positions covering and uncovering said last mentioned opening in response to movement of said body in the casing.

15. A tool for connection with a tubing string for operation in a well casing; including a body carrying spaced upper and lower packing members for sealing with the casing to form a chamber exteriorly of the body, said body having a first passage means for conducting fluid between said string and the chamber formed between said packing members, said body having a second passage means sealed from the first passage means for conducting fluid between said chamber and a port in said body communicable with the interior of the casing outside said chamber, means in the body forming a by-pass passage extending from a port in the body communicable with the interior of the casing below the lower packing member to an opening in the body communicable with the interior of the casing above the upper packing member, and a valve member movable on the body for selectively opening and closing said ports, said by-pass passage being communicable with said first and second passage means when said ports are open.

16. In a well tool for connection with a tubing string for operation in a well casing, a body, upper and lower packing means spacedly carried by the body for sealing against the casing to form a chamber exteriorly of the body, said body having passage means forming a by-pass extending from below the lower packing means to above the upper packing means, a first passage means in the body for communicating said string with the chamber formed between the upper and lower packing means, a second passage means in said body independent of said by-pass for communicating said chamber with the interior of the casing outside said chamber, and a valve member movable on the body for selectively controlling said by-pass and said second passage means.

17. In a well tool adapted for use in a cased well: a body member having spaced packing means thereon for sealing against the casing to form a pressure chamber about said body; means in said body forming a by-pass passage for communicating an opening communicable with the interior of the casing spaced axially from one end of said chamber and without said chamber, with a pair of ports communicable with the interior of the casing without the chamber and spaced axially from the other end of said chamber; optionally operable means for closing one of said ports; and automatic means operable on the body for preventing fluid flow in one direction through the other port, whereby said optionally operable means is effective to prevent fluid flow through said by-pass in one direction only.

18. In a well tool, a tubular body adapted for connection with a tubing string for positioning in a well casing; upper and lower packing means secured in spaced relation on said body for sealing with the casing to form a chamber exteriorly of said body, means closing the bore in said body to prevent communication of said bore with the tubing string; said body having an opening in

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the wall thereof above said upper packing means and a port through the wall thereof below said lower packing means to form a by-pass past said upper and lower packing means, means forming a first passage in the body for communicating the tubing string with the chamber formed between said upper and lower packing means, means in the body forming a second passage independent of said by-pass for communicating said chamber with a port through the wall of the body located outside said chamber, and valve means movable on the body for selectively opening and closing said ports.

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