

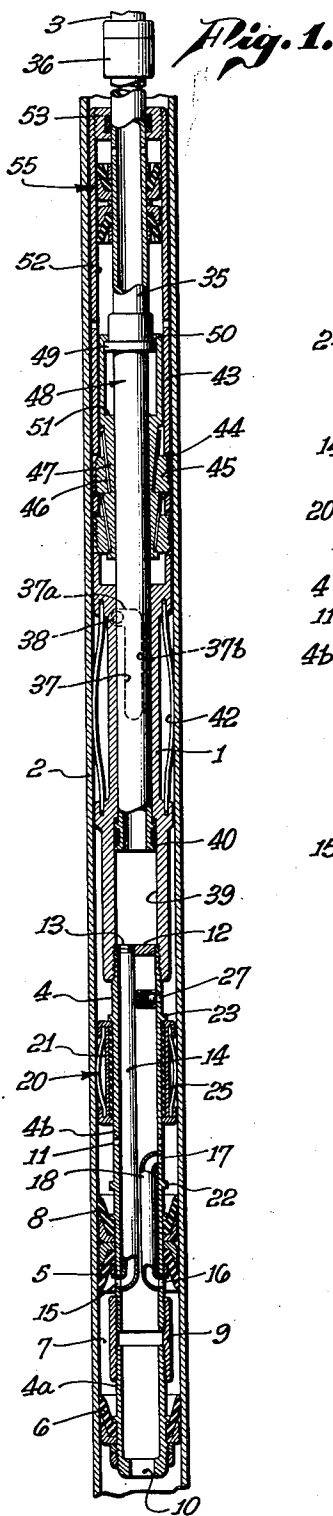
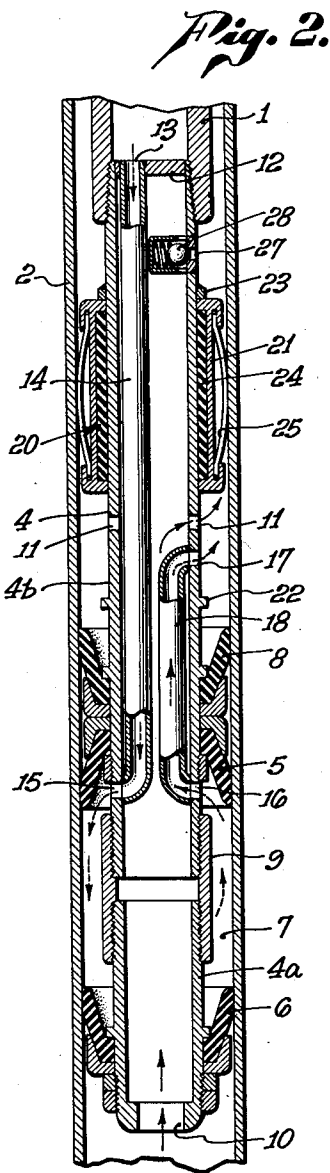
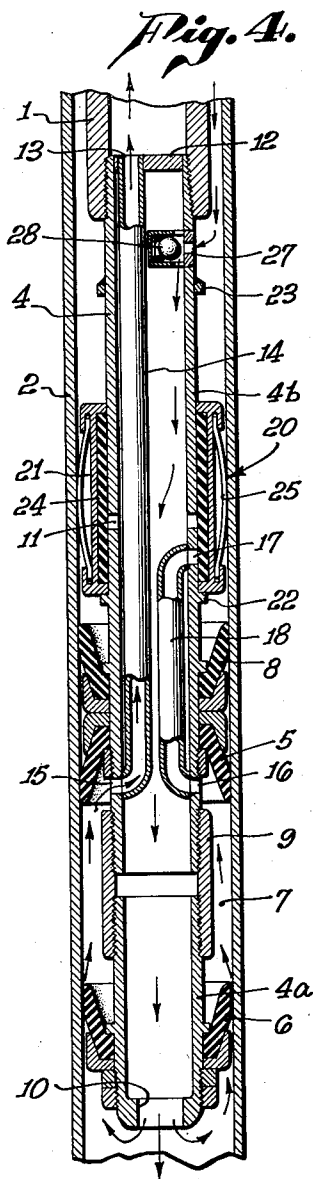
Aug. 19, 1952

C. C. TAYLOR
WELL PACKER

2,607,424

Filed April 13, 1946

2 SHEETS—SHEET 1



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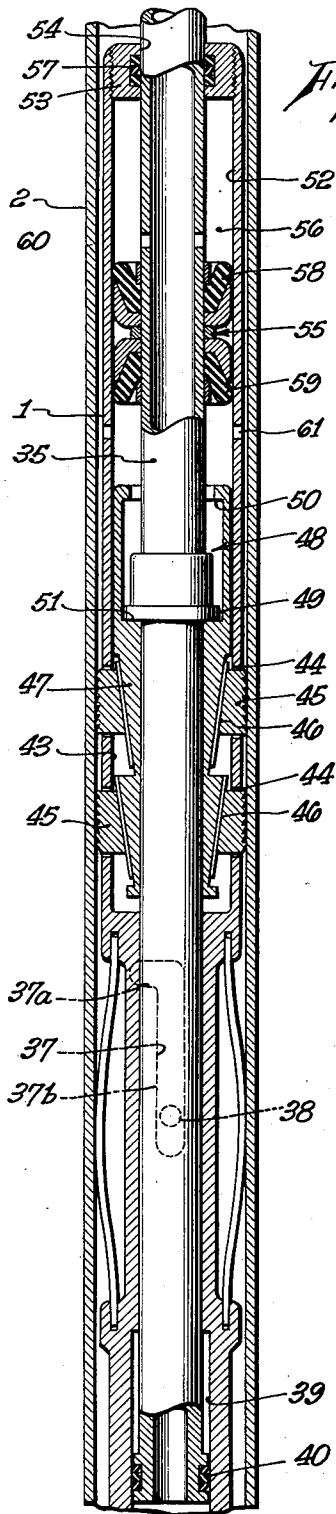
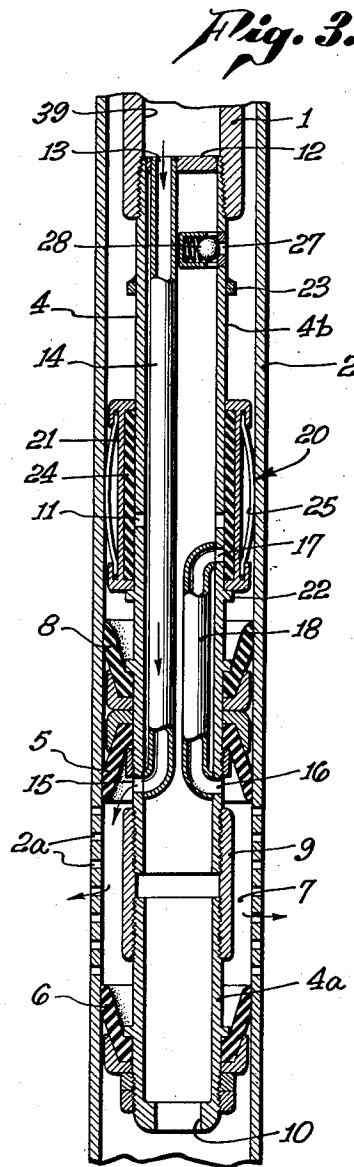
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WELL PACKER

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2 SHEETS—SHEET 2



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2,607,424

WELL PACKER

Claude C. Taylor, Long Beach, Calif., assignor, by direct and mesne assignments, to McGaffey-Taylor Corporation, Long Beach, Calif., a corporation of California

Application April 13, 1946, Serial No. 661,986

29 Claims. (Cl. 166—11)

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

Tools comprising opposed spaced packers on a body carried by a tubing string extending to the mouth of the well are known, the packers cooperating to form a pressure chamber in the well casing. Thus appropriate fluid may be pumped down the tubing string to the chamber from whence it passes through openings or perforations in that portion of the casing between the packers, into the well bore surrounding the casing. Such fluid may be for example, cement slurry for cementing the casing string, or it may be fluid for the purpose of washing and cleaning such perforations.

It is an object of this invention to provide a tool of this character having improved means adapted to by-pass well fluid past the packers in either direction.

It is another object of this invention to provide a tool of this character having means for optionally shutting off upward fluid flow through the by-pass.

It is still another object of this invention to provide a tool of this character having means for optionally releasing fluid from the pressure chamber into the casing space outside said chamber.

It is still another object of this invention to provide a tool of this character having means for preventing fluid release from the pressure chamber and at the same time preventing upward flow past the packers.

It is still another object of this invention to provide a tool of this character having means for restraining the tool against upward movement in the casing in response to excess pressure below the tool.

It is still another object of this invention to provide a tool of this character having means for permitting circulation to be established through the pressure chamber without entering the casing space below the bottom packer either while the tool is being run in the casing or is stationary therein.

It is still another object of this invention to provide a tool of this character arranged to facilitate cleaning of the casing space immediately below the bottom packer.

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 speci-

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fication. This form will now be described in detail, illustrating the general principles of the invention; 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 section showing the lower portion of the tool of Figure 1 on an enlarged scale;

Figures 3 and 4 are sections similar to Figure 2, but showing the parts in different operating positions; and,

Figure 5 is a section showing the upper portion of the tool of Figure 1 on an enlarged scale, and with the parts in a different operating position.

Referring to Figures 1 and 2, the tool is shown as comprising an elongated tubular body 1 supported for movement in a well casing 2 by means of a tubing string 3 extending to the mouth of the well. The body 1 has a downward tubular extension 4, to which are secured conventional packers 5 and 6, in axially spaced, opposed relation, and cooperating with the casing 2 to form a confined space or pressure chamber 7 about the extension 4. An additional packer 8, upwardly directed, is provided on the extension 4 above the upper packer 5, for a purpose to be pointed out later.

To permit the length of the pressure chamber 7 to be varied to suit different lengths of perforated casing or for other reasons, the lower end portion 4-a of the extension 4 is joined to the upper portion 4-b thereof by a threaded coupling member 9. By substituting coupling members of appropriate lengths, a chamber 7 of the desired length may be provided readily.

Means are provided for forming a first passage or by-pass to permit fluid in the casing 2 to flow in either direction past the packers 5, 6 and 8 and pressure chamber 7. For this purpose, an opening or port 10 is provided in the extension 4 below the bottom packer 6. As shown, the port 10 is an axial opening in the bottom of the extension 4. A port or ports 11 are also provided in the wall of the extension 4 above the uppermost packer 8. A partition or barrier 12 is provided at the upper end of the extension 4, separating the interior of the extension 4 from the interior of the body 1. Thus, well fluid in casing 2 below the bottom packer 6 may enter the extension 4 freely through the port 10, pass upwardly in the extension 4, and exit into the cas-

ing space above the packers 5 and 8 through ports 11, or vice versa.

Means are provided forming a second passage for establishing communication between the interior of the tubing string 3 and the pressure chamber 7 as well as with the casing space above the uppermost packer 8. For this purpose, partition 12 is provided with an opening 13 from which a passage 14, formed as by a tube or conduit, leads to a port 15 formed in the wall of the extension 4 below the upper packer 5 and opening into the pressure space 7. Another port 16 is also provided in the extension 4 below the packer 5 opening into the pressure chamber 7 and communicating with a port 17 opening into casing space above the packer and below the port 11 by means of a passage 18.

Valve means 20 are provided for controlling the first and second passages, and comprises a sleeve 21 freely slidable on the extension 4 above the uppermost packer 8. The length of the sleeve 21 is such that ports 11 and 17 both may be closed when desired by appropriately positioning the valve 20 (see Figure 3). For this purpose, a stop 22 is provided on the extension to limit downward movement of the valve. A similar stop 23 is provided to limit upward movement of the valve 20, after both ports 11 and 17 have been uncovered (see Figure 2). By positioning the valve intermediate its limits, ports 11 may be closed while port 17 is left open. The sleeve 21 is maintained in fluid tight relation with the extension 4 by suitable packing 24.

The sleeve 21 carries a plurality of conventional bow springs 25 which frictionally engage the inner surface of the casing 2 and restrain axial movement of the sleeve 21 therein. In this way, appropriate movement of the body 1 in the casing 2, operates the valve 20 as desired.

Means are provided for establishing communication between the casing space above the packers 5, 6 and 8 and the interior of the extension 4. This comprises a supplemental port 27 through the wall of the extension 4 at a point beyond the limits of movement of the valve 20 and controlled by a spring pressed closure 28 so as to admit fluid from the casing space above the packers, when pressure therein exceeds that within the extension 4 and below the packers, but to prevent fluid flow in the reverse direction.

A tool embodying the foregoing features is a complete operative structure which is entirely satisfactory for many conditions of operation. However, it may be desirable to provide means to insure against the tool and the tubing 3 being forced upwardly in the casing 2, as by pressure trapped below the tool. One form of mechanism for this purpose is shown in Figures 1 and 3, and is disclosed and claimed in a co-pending application entitled "Cementing Tool" and filed February 1, 1946, under Serial Number 644,900, in the name of Claude C. Taylor and Edgar W. McGaffey, now Patent No. 2,575,603, granted November 20, 1951.

The body 1 is connected to a tubular mandrel 35 which in turn is connected to the tubing string 3 by a "sub" or coupling member 36. The body 1 and 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 and engaging the slot.

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 45 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 1, 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 the 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 rotary movement of the mandrel 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 will 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 the 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 8 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 will now be in the relative positions of Figures 1 and 2, the valve 20 being urged to its upper position against the stop 23 by the fric-

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tion of the bow springs 25 on the casing, so that ports 11 and 17 are all uncovered. Well fluid below the tool is thus free to enter the extension 4 through the bottom port 10, passing upwardly and out through ports 11 into the casing space above the uppermost packer 8. Thus, the fluid by-passes the packers 5, 6 and 8 by the previously described first passage, indicated by the full line arrows in Figure 2.

Also the casing space above the packers 5, 6 and 8 and the interior of the tubing string 3 are in communication via opening 13, passage 14, ports 15 and 16, passage 18 and port 17. Thus, the fluid in the casing 2 and in the drill pipe 3 is in equilibrium.

When the tool has reached a point in the well casing 2 such that the pressure chamber 7 is a suitable distance below the perforations 2-a provided in the casing wall, circulation is established and cement slurry is pumped down the tubing string 3. From the tubing, the fluid passes downwardly through the tubular mandrel 35 and thence through the previously mentioned second passage, comprising opening 13, passage 14 and port 15 into the pressure chamber 7, thence via port 16, passage 18 and port 17 into the casing space above the packers. Well fluid in the tubing 3, pressure chamber 7, and the casing space above the packers will be forced ahead of the cement slurry, while well fluid in the casing space below the packers will not be disturbed. This circulation path is shown in Figure 2 by broken arrows.

After circulation has been established and it has been determined by appropriate measurements that the cement slurry has reached the tool, the tool is raised sufficiently to cause the pressure chamber 7 to straddle the perforations 2-a. This upward movement causes the valve 20 to move to its lower position, covering ports 11 and 17, as shown in Figure 3. Cement slurry is now pumped down the tubing 3, through the opening 13, passage 14 and port 15 into chamber 7, from whence it passes through the perforations 2-a into the space surrounding the casing 2.

Should the cement slurry outside the casing take a downward course and force well fluid into the casing 2 below the tool, the valve 28 will prevent such fluid flowing upwardly past the packers 5, 6 and 8 via supplemental port 27. This will result in a force being exerted, urging the tool upwardly in the casing.

To prevent such movement, the slips 44 are rendered operative. For this purpose, the tubing 3 and mandrel 35 are first turned to the right, placing the pin 38 over the vertical portion 37-b of the inverted L-slot 37, and then lowered, causing the slip head 47 to force the slips 44 outwardly to engage the casing 2 (see Figure 5).

Upon completion of the cementing operation, the cement must be removed from within and about the tool before it hardens or sets. This can be done in either of two ways. One way is by reverse circulation, frequently called "back scuttling." This may be done while the tool is still in the cementing position of Figure 3 or preferably by raising the tool above the cementing zone.

Appropriate liquid such as water, or water laden with mud, is pumped down the casing 2 outside of the tubing 3, past the body 1 and into the extension 4 via the supplemental port 27, thence out port 10 into the casing space below the bottom packer 6. This packer yields to pressure from below, so that the circulation from the port 10 flows upwardly past the packer 6 into the pressure chamber 7. From the chamber 7, the

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fluid flows through the port 15 into passage 14, through opening 13, into the body 1, and thence to the surface through tubing string 3. This flow path is indicated in Figure 4.

The upwardly facing packer 8 serves to prevent such reverse circulation from entering the chamber 7 from above, as would occur otherwise by the flexing of the upper packer 5, and returning to the surface through the port 15. In this case the tool and casing below the port 15 would not be washed.

The other method of removing the surplus cement, is by normal circulation, sometimes known as the "long way." In this case, if the slips have been set, the tool is raised to disengage the slips from the casing, and the tubing string 3 and mandrel 35 are then turned to the left to cause the pin 38 to enter the horizontal portion 38-a of the L-slot 37, locking the slips against further engagement. The tool is then lowered sufficiently to cause the valve 20 to uncover the port 17 while covering the ports 11.

Water, mud laden fluid, or the like is then pumped down the tubing 3, through the opening 13 to passage 14, and through port 15 into pressure chamber 7. From the chamber 7, the fluid enters the port 16, flows upwardly in the passage 18 through the port 17 into the casing space above the packer 8, and thence upwardly in the casing 2 to the mouth of the well.

The method of reverse circulation is very effective, since the fluid discharging downwardly through the central port 10 and thence passing upwardly between the packer 6 and the casing 2 removes all cement from in and about the lower end of the tool.

In order to provide equilibrium between fluid in the tubing and fluid in the casing when the tool is being removed from the well, each stand of tubing can be raised a few inches higher than necessary and then lowered into the slip at the casing head. In this way, port 17 is uncovered and fluid from the tubing equalizes down through the ports 13, passage 14, ports 15, 16, passage 18, port 17 to the area in the casing above the packer.

I claim:

1. In a well tool: a body adapted for connection to a tubing string for positioning in a well casing; vertically spaced packers carried by the body for sealing off a pressure chamber in said casing about the body; means in said body forming a passage for communication at one end thereof with said tubing string and at its other end with an opening into said pressure chamber; means in said body forming a passage for communicating a port in said body opening into said chamber with a port in the wall of said body opening into the interior of the casing above said packers; means in said body forming a by-pass comprising a passage for communicating an opening into the interior of the casing below the packers with a port in the wall of the body opening into the interior of the casing above the packers; and optionally operable valve means on the body for controlling the second mentioned passage and said by-pass.

2. 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 into the interior of the casing spaced axially from one end of said chamber and without said chamber, with a pair of

ports opening into the interior of the casing without the chamber and spaced axially from the other end of said chamber; optionally operable means on the body for closing one of said ports; and automatic means on the body above said packing means preventing fluid flow in one direction only through the other port, whereby said optionally operable means is effective to prevent fluid flow through said by-pass in one direction only.

3. In a well tool: a body adapted for connection to a tubing string for positioning in a well casing; vertically spaced packers carried by the body for sealing against the casing to form a pressure chamber in said casing about the body; means in said body forming a passage communicating with said tubing string at one end thereof and at its other end with an opening into said chamber; means in said body, forming a by-pass passage communicating with an opening into the interior of the casing, outside and spaced axially from one end of said chamber, and a pair of ports opening into the interior of the casing, outside and spaced axially from the other end of said chamber; valve means movable on the body above said packers for optionally controlling one of said ports; and means comprising a one way valve for automatically controlling the other port, rendering said optional control effective in one direction only.

4. In a well tool: a body adapted for connection to a tubing string for positioning in a well casing; vertically spaced packers carried by the body for sealing against said casing to form a pressure chamber in said casing about the body; means in said body forming a passage communicating with said tubing string at one end thereof and at its other end with an opening into said chamber; means in said body forming a passage for communication with an opening in said body communicating with said chamber and a port in the wall of the body opening into the interior of the casing above the packers; means in said body forming a by-pass, comprising a passage for communication with an opening into the interior of the casing below said packers and a port in the wall of the body opening into the interior of the casing above said packers, said ports being in spaced relation; and common valve means shiftable on said body and operated in response to movement of said body in the casing for optionally closing the by-pass port or both of said ports.

5. In a well tool: a body adapted for connection to a tubing string for positioning in a well casing; vertically spaced packers carried by the body for sealing against the casing to form a pressure chamber in said casing about the body; means in said body forming a passage communicating with said tubing string at one end thereof and at its other end with an opening into said chamber; means in said body forming a passage for communication with an opening in said body communicating with said chamber and a port in the wall of the body opening into the interior of the casing above the packers; means in said body forming a by-pass, comprising a passage communicating with an opening into the interior of the casing below said packers and a port in the wall of the body opening into the interior of the casing above said packers; valve means shiftable on said body for optionally controlling said ports; there being a supplemental port in the body, opening into the interior of the casing above the packers and connected with said by-pass; and

valve means controlling said supplemental port permitting fluid flow only from the interior of the casing to the by-pass.

6. In a well tool: a body adapted for connection to a tubing string for positioning in a well casing; a pair of vertically spaced packers carried by the body for sealing against said casing to form a pressure chamber in said casing about the body; means in said body forming a passage communicating with said tubing string at one end thereof and at its other end with an opening into said pressure chamber; means in said body forming a fluid passage communicating with an opening in the wall of said body communicating with said chamber and a port in the wall of the body opening into the interior of the casing above the packers; means in said body forming a by-pass, comprising a passage for communication with the interior of the casing below the packers and a port in the wall of the body opening into the interior of said casing above said packers and in spaced relation to the first mentioned port; a valve member on the body responsive to movement of said body in the casing for optionally closing one or both of said ports; means forming a supplemental port in said body opening into the interior of the casing above the packers and connected with said by-pass; and valve means controlling said supplemental port, permitting fluid flow in said by-pass from the casing interior above the packers to the interior of the casing below the packers, and preventing reverse flow through said port.

7. In a well tool adapted for use in a cased well: a body member having spaced packing means for sealing against the casing to form a pressure chamber about the body; means forming a passage in said body communicable with an opening into the interior of said casing below the packers, and a pair of openings into the interior of said casing above the packers for by-passing said packers, means in said body forming a passage communicable with said chamber and a port opening into the casing interior above said packers; and a pair of valves on said body above the packers, one of said valves being optionally operable to control both said passages, the other valve automatically controlling fluid flow through one of the by-pass openings to permit fluid flow in one direction only.

8. 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 mandrel said body is slidably secured for limited relative vertical movement, said body and said mandrel forming relatively movable members; locking means 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 in the casing extending about the body; means for passing fluid past said spaced packing means comprising a passage in said body communicating with an opening into the interior of the casing above the packing means and an opening into the interior of the casing below the packing means; means in said body forming a passage communicating with a port in said body opening into said chamber and a port opening into the interior of the casing above the packers; valve means carried by said body above the packers for controlling said passages; means forming a passage in said body communicating with said tubing string at one end thereof and at its other end with an opening into said chamber; a slip

head on one of said members; and slips carried by the other member, fixed against movement axially of said member and movable outwardly thereof by said slip head in response to relative movement between the members in one direction, to engage the casing and secure the tool against movement therein.

9. A tool for connection with a tubing string for operation in a well casing; including a body carrying spaced upper and lower packing means for sealing with the casing to form a chamber exteriorly of said body, said body having passage means for conducting fluid between said string and the chamber formed between the packing means, and also between said chamber and a port in said body for communication with the interior of the casing outside said chamber, said body having a by-pass for conducting fluid between the interior of the casing below the lower packing means and a port in the body communicable with the interior of the casing above the upper packing means, a valve member movable on the body for opening and closing said ports, said by-pass being communicable with said passage means when said ports are open, there being another port in the body for communicating said by-pass with the interior of the casing above said upper packing means, and valve means controlling the last mentioned port.

10. In a well tool: a body adapted for connection with a tubing string for positioning in a well casing; upper and lower packing means secured in spaced relation on the body for sealing against the casing to form a chamber exteriorly of said body, said body having a passage communicable with the interior of the casing below said lower packing means, said body having a port for communicating said passage with the interior of the casing above said upper packing means, said body having passage means sealed from said first named passage for conducting fluid between said string and the chamber formed between said upper and lower packing means, and also between said chamber and a port in the body above said upper packing means communicable with the interior of the casing, and valve means on the body for opening and closing said ports.

11. In a well tool: a body for connection with a tubing string for operation in a well casing; spaced packing means on said body for sealing with the casing to form a chamber exteriorly of said body, means in said body forming a permanently open passage for conducting fluid between the tubing string and the chamber formed between the packing means, means in the body forming a passage for conducting fluid between said chamber and a port opening exteriorly of the body above the packing means, valve means on the body for optionally closing the last named passage, and means in the body forming a passage for by-passing said packing means, including a port opening exteriorly of the body below said packing means and a port opening exteriorly of the body above said packing means, said last mentioned port being controlled by said valve means.

12. In a well tool: a body for connection with a tubing string for operation in a well casing; spaced packing means on said body for sealing with the casing to form a chamber exteriorly of said body, means in said body forming a passage for conducting fluid between the tubing string and the chamber formed between the packing means, means in the body forming a passage for

conducting fluid between said chamber and a port opening exteriorly of the body above the packing means, valve means on the body for optionally closing the last named passage, and means in the body forming a passage for by-passing said packing means, including a port opening exteriorly of the body below said packing means and a pair of ports opening exteriorly of the body above said packing means, one of the ports of said pair being controlled by said valve means.

13. In a well tool: a body for connection with a tubing string for operation in a well casing; spaced packing means on said body for sealing with the casing to form a chamber exteriorly of said body, means in said body forming a passage for conducting fluid between the tubing string and the chamber formed between the packing means, means in the body forming a passage for conducting fluid between said chamber and a port opening exteriorly of the body above the packing means, valve means on the body for optionally closing the last named passage, and means in the body forming independently of said passages a passage for by-passing said packing means, including a port opening exteriorly of the body below said packing means and a pair of ports opening at axially spaced points on the exterior of the body above said packing means.

14. In a well tool: a body for connection with a tubing string for operation in a well casing; spaced packing means on said body for sealing with the casing to form a chamber exteriorly of said body, means in said body forming a passage for conducting fluid between the tubing string and the chamber formed between the packing means, means in the body forming a passage for conducting fluid between said chamber and a port opening exteriorly of the body above the packing means, valve means on the body for optionally closing the last named passage, and means in the body forming a passage for by-passing said packing means including a port opening exteriorly of the body below said packing means and a pair of ports opening exteriorly of the body above said packing means, one port of said pair being controlled by said valve means, and automatic valve means controlling the other port of said pair.

15. In a well tool: a tubular body adapted for connection with a tubing string for positioning in a well casing; said body having a closure at its upper end to prevent communication with the tubing string and open at its lower end, upper and lower spaced packing means on said body for sealing with the casing to form a chamber exteriorly of said body, passage means in the body extending through said closure for maintaining free communication between the tubing string and said chamber, means forming a passageway in said body for communicating said chamber with a port through the wall of the body above said upper packing means; said body having a port through the wall of the body spaced above the first named port, and a valve on the body operable in response to movement of the body in the casing for closing and opening said ports.

16. 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 mandrel said body is slidably secured for limited relative vertical movement, said body and said mandrel forming relatively movable members; locking means for optionally securing said members together against relative movement; vertically spaced packers carried by the body for sealing

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off a pressure chamber in said casing about the body; passage forming means in said body for communicating a port in said body opening into said chamber with an opening in the body into the interior of the casing above the packers; a valve member movable on said body above the packers for controlling said passage, a slip head on one of said members; and slips carried by the other member fixed against movement axially of said other member and movable outwardly thereof by said slip head in response to relative movement between the members in one direction, to engage the casing and secure the tool against movement therein.

17. In a well tool for use in a cased well; a body having spaced upper and lower packing means for sealing against the casing to provide a chamber exteriorly of the body, means forming a by-pass passage in said body extending from below the lower packing means to above the upper packing means and opening exteriorly of said body, means forming a passage in said body sealed from said by-pass passage and extending between said chamber and a point exteriorly of the body above the upper packing means, and a common valve means shiftable on the body above the upper packing means for controlling said passages.

18. A well tool adapted for connection with a tubing string for operation in a well casing; including, a body, spaced upper and lower packing means on the body for sealing with the casing to form a chamber exteriorly of said body, means in said body forming a passage for conducting fluid between said tubing string and said chamber, means in said body independent of the first mentioned passage forming means, forming a second passage sealed from the first mentioned passage and extending between said chamber and a port opening exteriorly of said body above the upper packing means, valve means carried by said body for controlling flow of fluid through said second passage responsive to movement of the tubing string, and means on said body forming independently of the second mentioned passage, a by-pass extending from the exterior of said body below said lower packing means to the exterior of said body above said upper packing means.

19. A well tool adapted to be connected with a tubing string for operation in a well casing; including a body, spaced upper and lower packing means on said body for sealing with the casing to form a chamber exteriorly of said body, said body having a passage for conducting fluid between said tubing string and a point exteriorly of said body between said spaced packing means, said body having a second passage independent of the first mentioned passage and extending between a point between said packing means exteriorly of said body and a point exteriorly of said body above said upper packing means, valve means carried by said body for optionally opening and closing said second passage, and means forming independently of said second passage a by-pass extending from the exterior of said body below said lower packing means to the exterior of said body above said upper packing means.

20. A well tool adapted to be connected with a tubing string for operation in a well casing; including a body, spaced upper and lower packing means on said body for sealing against the casing to form a chamber exteriorly of said body, means in said body forming a first passage for conducting fluid between said tubing string and said chamber, means in said body independent

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of said first named passage forming means, forming a second passage sealed from the first named passage and extending between said chamber and a point exteriorly of said body above said upper packing means, valve means on said body above said upper packing means for controlling said second passage, and means in said body forming a third passage independent of said first and second passages and extending between points exteriorly of said body and located above said upper packing means and below said lower packing means, respectively.

21. A well tool adapted for connection with a tubing string for operation in a well casing; including, a body, spaced upper and lower packing means on said body for sealing with the casing to form a chamber exteriorly of said body, means in said body forming a passage for conducting fluid between the tubing string and said chamber; means in said body independent of the first mentioned passage forming means, forming a passage sealed from the first mentioned passage and extending between said chamber and a port opening exteriorly of said body above the upper packing means; said body having means forming a by-pass extending from the exterior of said body below said lower packing means to the exterior of said body above said upper packing means, and a sleeve valve slidable on said body between positions covering and uncovering said port responsive to relative movement between said body and said sleeve valve.

22. A well tool adapted for connection with a tubing string for operation in a well casing; including, a body, spaced upper and lower packing means on said body for sealing with the casing to form a chamber exteriorly of said body, means in said body forming a passage for conducting fluid between the tubing string and said chamber; means in said body independent of the first mentioned passage forming means, forming a passage sealed from the first mentioned passage and extending between said chamber and a port opening exteriorly of said body above said upper packing means; said body having means forming a by-pass extending from the exterior of said body below said lower packing means to the exterior of said body above said upper packing means, a sleeve valve slidable on said body between positions covering and uncovering said port, and means connected with said sleeve valve engageable with the casing to restrain movement of said valve.

23. A well tool adapted for connection with a tubing string for operation in a well casing; including, a body, spaced upper and lower packing means on the body for sealing with the casing to form a chamber exteriorly of said body, means in said body forming a passage for conducting fluid between said tubing string and said chamber, means in said body independent of the first mentioned passage forming means, forming a second passage sealed from the first mentioned passage and extending between said chamber and a port opening exteriorly of said body above the upper packing means, valve means on said body operable responsive to movement of the tubing string for permitting the flow of fluid in either direction through the second passage, and means on said body forming independently of the second mentioned passage a by-pass extending from the exterior of said body below said lower packing means to the exterior of said body above said upper packing means.

24. A well tool adapted to be connected with

a tubing string for operation in a well casing; including a body, spaced upper and lower packing means on said body for sealing against the casing to form a chamber exteriorly of said body, means in said body forming a first passage for conducting fluid between said tubing string and said chamber, means in said body independent of said first named passage forming means, forming a second passage sealed from the first named passage and extending between said chamber and a point exteriorly of said body above said upper packing means, valve means on said body operable responsive to movement of the tubing string for permitting the flow of fluid through said second passage from said chamber to said point exteriorly of the body above said upper packing means, and means in said body forming a third passage independent of said first and second passages and extending between points exteriorly of said body and located above said upper packing means and below said lower packing means, respectively.

25. A well tool, including a body adapted to be connected with a tubing string for positioning in a well casing, spaced upper and lower packing means on said body for sealing with said casing to form a chamber exteriorly of said body, a first tube carried by said body for conducting fluid between said tubing string and said chamber, a second tube carried by said body and extending between said chamber and a point exteriorly of said body above said upper packing means, means forming independently of said tubes a by-pass extending from the exterior of said body below said lower packing means to the exterior of said body above said upper packing means, and a sleeve valve slidable on the body operable responsive to movement of said body for controlling the flow of fluid through said second tube.

26. A well tool, including a tubular body adapted to be connected at one end with a tubing string for positioning in a well casing, a closure for said one end of said body, spaced upper and lower packing means on the body for sealing with the casing to form a chamber exteriorly of said body, a first tube carried by said body for conducting fluid between said tubing and said chamber past said closure, a second tube carried by said body and extending between said chamber and a point exteriorly of the body above said upper packing means, said body having a port above said upper packing means and a port below said lower packing means, said ports forming with the bore of said tubular body a by-pass, and a sleeve valve slidable on said body for controlling the flow of fluid through said second tube.

27. In a well tool: a body adapted for connection to a tubing string for positioning in a well casing; vertically spaced packers carried by the body for sealing off a pressure chamber in said casing about the body; means in said body forming a passage communicating with said tubing string at one end thereof and at its other end with an opening into said chamber; means in said body forming a passage between an opening in said body communicating with said chamber and a port in the wall of the body opening into the interior of the casing above the packers; means in said body forming a by-pass,

comprising a passage for communicating an opening into the interior of the casing below said packers with a port in the wall of the body opening into the interior of the casing above said packers, said ports being in spaced relation in said body; and common valve means on the body operated in response to movement of said body in the casing for optionally closing one or both of said ports.

28. In a well tool: a body for connection with a tubing string for operation in a well casing; spaced packing means on said body for sealing with the casing to form a chamber exteriorly of said body, means in said body forming a permanently open passage for conducting fluid between the tubing string and the chamber formed between the packing means, means in the body forming a passage for conducting fluid between said chamber and a port opening exteriorly of the body above the packing means, valve means on the body for optionally closing the last named passage, and means in the body forming a passage independently of said first and second named passages and extending from below said packing means to above said packing means and opening exteriorly of said body for by-passing said packing means.

29. In a well tool: a tubular body adapted for connection with a tubing string for positioning in a well casing; said body having a closure at its upper end to prevent communication with the tubing string and open at its lower end, upper and lower spaced packing means on said body for sealing with the casing to form a chamber exteriorly of said body, permanently open passage means in the body extending through said closure for maintaining free communication between the tubing string and said chamber, there being a port through the wall of the body above the upper packing means forming with the bore of the body and the open lower end of the body a by-pass around the upper and lower packing means, sealed from said permanently open passage means, means in the body forming a passage sealed from said permanently open passage means and said by-pass and extending between said chamber and a port opening exteriorly of the body above said upper packing means, and valve means carried by said body, cooperable with said ports for controlling fluid flow between said chamber and the interior of the casing above said upper packing means as well as fluid flow between said by-pass and the interior of the casing above said upper packing means.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,244,354	Boggs et al. -----	June 3, 1941
2,308,072	Granger -----	Jan. 12, 1943
2,326,940	Granger -----	Aug. 17, 1943
2,341,832	Verheul et al. -----	Feb. 15, 1944
2,404,876	Granger -----	July 30, 1946
2,426,164	Breukelman -----	Aug. 26, 1947