Jan. 3, 1939. R. DUUS 2,142,559

ORIENTING DEVICE

Filed Nov. 24, 1937

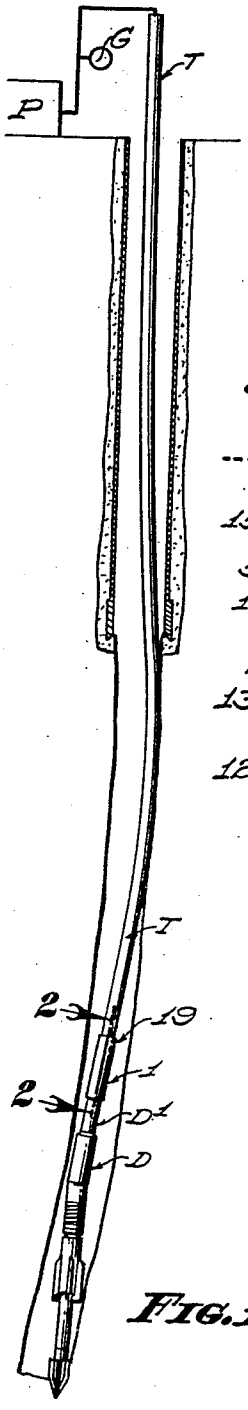


FIG. 1

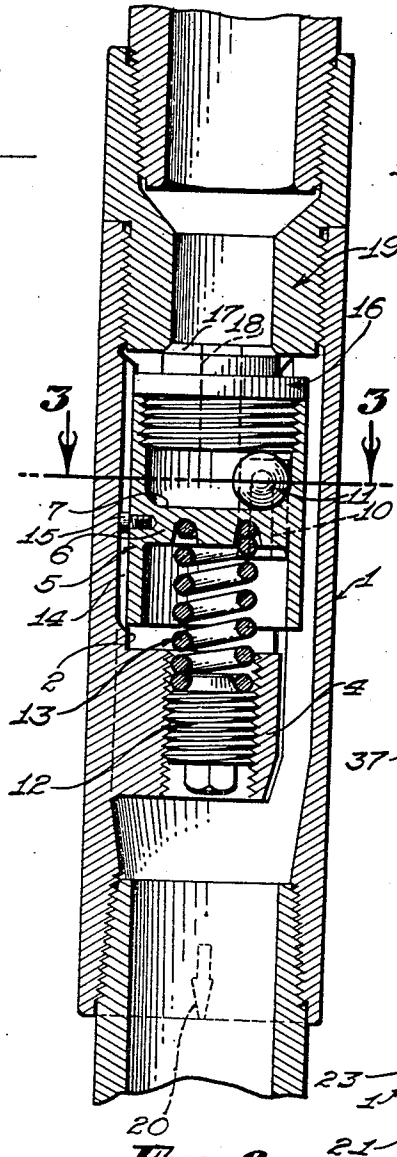


FIG. 2

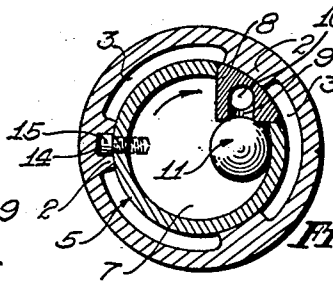


FIG. 3

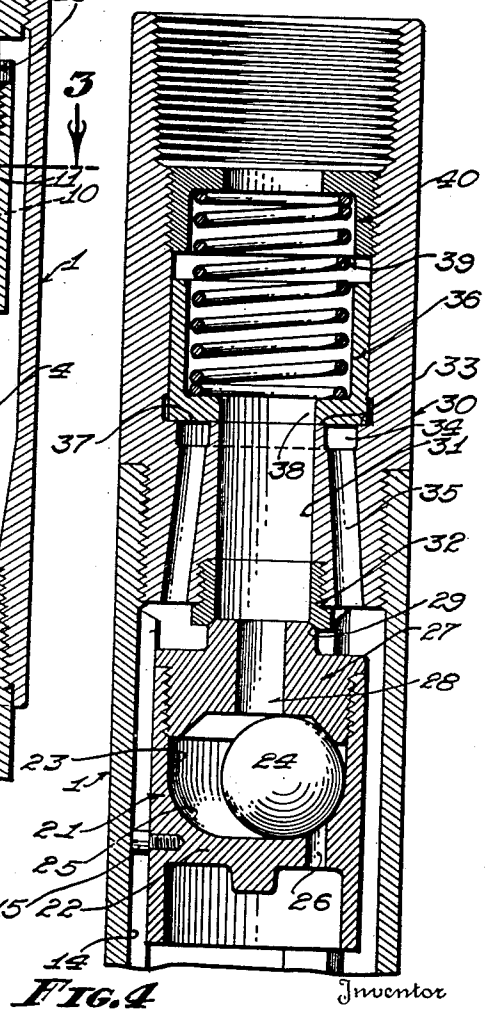


FIG. 4

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ORIENTING DEVICE

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11 Claims. (Cl. 255—1)

My invention relates to orienting devices, and among the objects of my invention are:

First, to provide an orienting device which is adapted to be incorporated in a tubing string adjacent a tool requiring orientation, said orienting device being so arranged that upon applying fluid pressure through the tubing string and slowly rotating the same, a rise in pressure occurs when said orienting device occupies a predetermined relation in azimuth to the direction of inclination of the well bore;

Second, to provide an orienting device which is capable of repeated operation while in the well bore whereby the apparent position of the orienting device and its associated tool may be checked and rechecked to insure proper orientation;

Third, to provide an orienting device which, although relying on a pressure increase in the circulating system for its operation, incorporates a circulation valve so arranged that full circulation may be had, if desired;

Fourth, to provide an orienting device employing pressure rise indication which may be used in conjunction with practically all types of deflecting tools, such as knuckle joints, through which circulation must be maintained during operation; whipstocks, whether of the permanent or removable type; as well as other tools, such as impression blocks;

Fifth, to provide an orienting tool which incorporates a back circulation valve to facilitate free entry of well fluid during insertion of the tubing string into the well bore;

Sixth, to provide an orienting device which is particularly compact in design and occupies a small diameter whereby the orienting tool may be used in well bores of small size;

Seventh, to provide an orienting device which may be employed in wells having only a slight inclination from the vertical, and which operates with increased accuracy as the inclination of the well bore increases;

Eighth, to provide an orienting device of this character which is particularly simple and rugged of construction, capable of continued use without servicing or repair, and which is positive and efficient in its operation.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawing, in which:

Figure 1 is a diagrammatical view of a well bore, a tubing string and deflecting tool with my orienting device incorporated therewith;

Figure 2 is an enlarged longitudinal sectional view of my orienting device taken through 2—2 of Figure 1, and showing the adjacent tubing string and a deflection tool stem fragmentarily;

Figure 3 is a transverse sectional view through my orienting device taken substantially through 3—3 of Figure 2; and

Figure 4 is a fragmentary, longitudinal sectional view, similar to Figure 2, showing a modified form of my orienting device.

The principal elements of my orienting device are contained within a body member 1, in the form of an elongated hollow cylinder internally threaded at its lower end to receive the stem D1 of a deflecting tool D. In the present instance the deflecting tool is in the form of a knuckle joint, but the stem D1, which forms no part of the present invention, may constitute a connecting link removably secured by a shear pin to a whipstock, or may constitute the collar of a bit retained by a removable whipstock, these various structures being well known in the art of directional drilling.

The body member 1 is provided with a plurality of longitudinally extending guide ribs 2 along its inner wall, which are separated by channels 3. Near their lower ends the ribs 2 merge into a spider 4, and the channels 3 form passages through the spider.

An orienting valve housing 5 is slidably mounted between the several guide ribs 2. The housing 5 is substantially cylindrical and is provided with a partition 6 intermediate its ends. The upper surface of the partition 6 is flat and forms a ball race 7.

The ball race 7 is intersected by a substantially radially-disposed abutment 8 having a vertical wall in which is formed a port 9. The port 9 communicates with a passage 10 leading downwardly through the abutment and partition 6, so as to discharge through the lower end of the housing 5. An orienting valve 11 in the form of a sphere is positioned freely upon the partition 6 so that it may roll over and about the ball race 7. The port 9 is so located that its axis intersects the center of the orienting valve 11 when the valve engages the abutment and is in contact with the adjacent side wall of the housing 5, as shown best in Figure 3. Operation of the orienting valve will be brought out in detail hereinafter.

The spider 4 is provided with a centered, internally threaded opening in which is mounted an adjusting plug 12. A spring 13 is interposed between the adjusting plug 12 and the partition 6 so as to hold the housing 5 in an upward position with respect to the guide ribs 2. The spider forms a stop, limiting downward movement of the housing. In order to prevent rotation of the

housing with respect to the body member 1, one of the guide ribs 2 is provided with a key-way 14 into which extends a key pin 15 extending radially from the housing 5. The key pin occupies a predetermined angular relationship with the abutment 8.

The upper end of the valve housing 5 is internally threaded to receive a circulation valve 16, which is in the form of a plug and the lower end of which forms a retainer wall to enclose the orienting valve 11. The circulation valve 16 is provided with a reduced upper end which is provided with a valve face 17. Also, the circulation valve is provided with a bore 18 communicating from its upper end into the orienting valve chamber.

The upper end of the body member 1 is internally threaded to receive the lower end of an adapter head 19 having a bore therethrough and a valve seat at its lower end adapted to coact with the circulation valve 16. The upper end of the adapter head 19 is internally threaded for connection to the tubing string T.

Operation of my orienting device, particularly as shown in Figures 2 and 3, is as follows: The body member 1 and adapter head 19 are made up with the deflecting tool on the lower end of the tubing string. Suitable indicia, designated 20, is provided on the outside of the body member 1 to indicate the position of the abutment 8 in the orienting valve housing. As shown in Figure 2, the abutment 8 is shown as occupying an offset relationship of 90 degrees with respect to the inclination of the deflecting tool, but may be any number of degrees. The approximate number of degrees of this offset is noted and the deflecting tool is run into the well bore. Prior to running the deflecting tool, a suitable inclinometer has been lowered, from the record of which has been determined the inclination and azimuth at the lower end of the well bore.

When the tool is lowered into position, fluid under pressure is introduced at the top of the tubing string from a suitable pump P, and the tubing string slowly rotated. With the arrangement illustrated, this rotation should be clockwise, as indicated by the arrow in Figure 3. Assuming that the well bore inclines from vertical, and this is most always the case, the orienting valve 11 tends to ride against the lower side of the ball race 7 with the result that as the abutment 8 rotates to the lower side, the port 9 moves into engagement with the ball or orienting valve 11. When this occurs the pump pressure rises, and this condition can be readily determined at the surface by means of a conventional gauge G. The driller, knowing that the rise in pump pressure indicated closure of the port 9; knowing that the ball and port must necessarily be on the lower side of the well bore; knowing, further, the direction in azimuth which the well bore inclines; and knowing, still further, the angular relationship of the port 9 with respect to the deflecting tool, it is merely necessary to turn the tubing string a few degrees one direction or the other to bring the deflecting tool into the desired position.

In order to insure proper orientation of the deflecting tool, it is preferable to rotate the tubing string several times and obtain several indications. By marking the position of the tubing string or the rotary table each time a pressure rise occurs, the driller may quickly determine whether or not the orienting device is functioning properly.

The circulation valve 16 is held in its closed position by the spring 13 with sufficient force that an appreciable rise in pump pressure occurs before the circulation valve 16 opens. When the pump pressure exceeds this amount, circulation is established through the deflecting tool, irrespective of the port 9, so that the tool may be operated.

Reference is now directed to Figure 4, in which is illustrated a modified form of my orienting device: With this arrangement the body 1 may be the same as previously described. An orienting valve housing 21, similar to the valve housing 5, is slidably mounted between the guide ribs 2. The valve housing 21 is provided with a partition 22, at the upper side of which is formed a valve chamber 23. The upper side of the partition 22 is flat, except for its margins which are rounded materially. An orienting valve 24 rests upon the partition 22. The orienting valve 24 is in the form of a relatively large, heavy ball, the radius of which is substantially equal to the radius of the curved margin of the partition 22. This curved margin forms a ball race 25 which is intersected by an orienting port 26. The axis of the orienting port 26 is preferably offset from the center of the partition 22 a distance equal to the radius of the orienting valve 24, whereby when the orienting valve 24 fits over the port 26 it substantially closes the same, as shown in Figure 4.

The valve housing 21 is provided with a key pin 15 which fits in the keyway 14, as in the first described structure. The orienting port 26 occupies a predetermined relationship with the indicia 20 appearing on the body member, so that the position of the port with respect to the deflecting tool may be determined.

The upper end of the valve housing 21 is covered by a circulating valve 27, similar to the circulating valve 16, having a bore 28 therethrough and a reduced upper end in which is formed a valve face 29. The upper end of the housing 1, in the modified construction, receives a back-flow valve shell 30 in place of the adapter head 19. The back-flow valve shell 30 is provided with a throat 31 at its lower end in which is secured a valve seat insert 32 adapted to coact with the valve face 29. Above the throat 31 the shell 30 is enlarged to form a shoulder which constitutes a back-flow valve face 33. The back-flow valve seat 33 is divided by an annular distributor channel 34 which is intersected by a plurality of passages 35 leading downwardly therefrom, around the throat 31 and intersecting the lower end of the shell 30 so as to communicate with the channels 3 of the body member 1.

The enlarged portion of the valve shell 30 above the back-flow valve face 33 receives a back-flow valve 36 in the form of a short cylinder having an internally flanged lower end, forming a valve element 37 adapted to engage the valve seat 33. The back-flow valve is provided with a central opening 38 which registers with the throat 31. A spring 39 fits within the back-flow valve 36 and rests against the internally flanged lower end thereof. The upper end of the spring 39 bears against a tension gland 40 in the form of an annular screw-threaded ring adjustably secured within the upper portion of the back-flow valve shell 30. Above the tension gland 40 the shell 30 is provided with additional internal threads adapted to receive the tubing T.

The construction shown in Figure 4 operates similarly to the construction shown in Figures 1,

2 and 3 in that, as the orienting port 26 is rotated to the lower side of the inclined well bore it moves under and is closed by the orienting valve 24. With this arrangement, continued movement of the tubing string past this position immediately opens the valve so that the tubing string may be turned first one way, then the other, until the driller is convinced, from the action of the pressure gauge associated with the pumping system, that the port 26 is truly opposite the lower side of the well bore.

The back-flow valve structure and the entire shell 30 may be employed in conjunction with either of the orienting valve structures, that is, the housing 30 may be mounted above the orienting valve housing 5 in place of the adapter head 19. The purpose of the back-flow valve is to permit ready inflow of the drilling mud, or the like, as the tool is lowered into the well bore. The back-flow valve, however, closes when the pressure within the tubing string exceeds the hydrostatic pressure of the well bore so that it in no manner interferes with the orienting valve.

Though I have shown and described certain embodiments of my invention, I do not wish to be limited thereto, but desire to include in the scope of my invention the constructions, combinations and arrangements substantially as set forth in the appended claims.

I claim:

1. The combination with a tubing string and a well tool requiring orientation, of an orienting device comprising: a body member having a valve chamber therein; a valve port intersecting said chamber eccentrically; and a gravity actuated valve member freely movable in said chamber adapted, when said body member is inclined and rotated, to close and open said valve port, whereby the position of said body member, when said port is closed, may be determined.

2. The combination with a tubing string, a means for introducing a pressure fluid into said tubing string, and a well tool suspended on said tubing string and requiring orientation, of an orienting device comprising: a body member; a gravity responsive valve element therein tending, when said body member is inclined and rotated, to assume an eccentric position indicative of the lower side of the body member; and a valve port incorporated in said body member adapted to coact with said valve element when a predetermined point on the periphery of said body member rotates to the lower side thereof.

3. The combination with a tubing string, a means for introducing a pressure fluid into said tubing string, and a well tool suspended on said tubing string and requiring orientation, of an orienting device comprising: a tubular body member interposed between said tool and tubing string; a first valve element incorporated in said body member and rotatable therewith, said first valve element positioned eccentrically with respect to said body member whereby when said body member is inclined and rotated, said first valve element changes its elevation; and a gravity responsive second valve element adapted to coact with said first valve element when said first valve element reaches an extreme elevation to indicate by alteration of fluid-flow through said body member the orientation of said body member and the tool therebelow.

4. The combination with a tubing string, a means for introducing a pressure fluid into said tubing string, and a well tool suspended on said tubing string and requiring orientation, of an orienting device comprising: a tubular body member interposed between said tool and tubing string and having an eccentric valve port oriented with respect to said tool; and a gravity actuated valve member for coaction with said port when said body member is rotated, while inclined to alter the fluid-flow in said tubing string, thereby to signal when said valve port bears a predetermined relation with the low side of said inclined body member.

5. The combination with a tubing string and a well tool requiring orientation, of an orienting device comprising: a body member having a valve chamber therein; a valve port intersecting said chamber eccentrically; a gravity actuated valve member freely movable in said chamber adapted, when said body member is inclined and rotated, to close and open said valve port, whereby the position of said body member, when said port is closed, may be determined; and relief valve means operative irrespective of said gravity actuated valve to permit circulation through said body member to said tool.

6. The combination with a tubing string, a means for introducing a pressure fluid into said tubing string, and a well tool suspended on said tubing string and requiring orientation, of an orienting device comprising: a tubular body member interposed between said tool and tubing string and having an eccentric valve port oriented with respect to said tool; a gravity actuated valve member for coaction with said port when said body member is rotated, while inclined to alter the fluid-flow in said tubing string, thereby to signal when said valve port bears a predetermined relation with the low side of said inclined body member; and a relief valve operative when pressure of said fluid exceeds a predetermined value to establish circulation through said body member to said tool, irrespective of said gravity actuated valve member.

7. The combination with a tubing string, the lower end of which is inclined, in a known direction, a tool suspended therefrom and requiring orienting, and means for introducing pressure fluid into said tubing string, of: a gravity responsive orienting valve incorporated in said tubing string to alter the flow of pressure fluid when said orienting valve is rotated into a predetermined relationship in azimuth with the inclination of said tubing string.

8. The combination with a tubing string, the lower end of which is inclined, in a known direction, a tool suspended therefrom and requiring orienting, and means for introducing pressure fluid into said tubing string, of: a gravity responsive orienting valve incorporated in said tubing string to alter the flow of pressure fluid when said orienting valve is rotated into a predetermined relationship in azimuth with the inclination of said tubing string; and a relief valve responsive to pressures above a predetermined value to establish circulation through said tubing string to said tool, irrespective of said orienting valve.

9. The combination with a tubing string, the lower end of which is inclined, in a known direction, a tool suspended therefrom and requiring orienting, and means for introducing pressure fluid into said tubing string, of: a gravity responsive orienting valve incorporated in said tubing string to alter the flow of pressure fluid when said orienting valve is rotated into a predetermined relationship in azimuth with the inclination of said tubing string; a relief valve responsive to

pressures above a predetermined valve to establish a circulation through said tubing string to said tool, irrespective of said orienting valve; and a bypass valve for permitting flow of fluid into the lower end of said tubing string, irrespective of said orienting valve.

10. A method of orienting well tools, characterized by: determining the direction of inclination of a well bore in the region at which deflection is desired; running a deflecting tool and a gravity responsive pressure operated orienting device therein, rotating said tool slowly; noting by change in pressure the position in azimuth of said device and tool; and thereupon operating said deflecting tool.

11. A method of orienting well tools, characterized by: determining the direction of inclination of a well bore in the region at which deflection is desired; running a deflecting tool and a gravity responsive pressure operated orienting device therein, rotating said tool slowly; noting at what point in the rotation of the drill pipe that the pressure changes therein; turning the tubing several times to verify the first reading; and thereupon operating said deflecting tool.

RAY DUUS.