March 24, 1953 L. W. STORM 2,632,630

AUTOMATICALLY OPERABLE ORIENTING TOOL

Filed July 16, 1949 2 SHEETS—SHEET 1

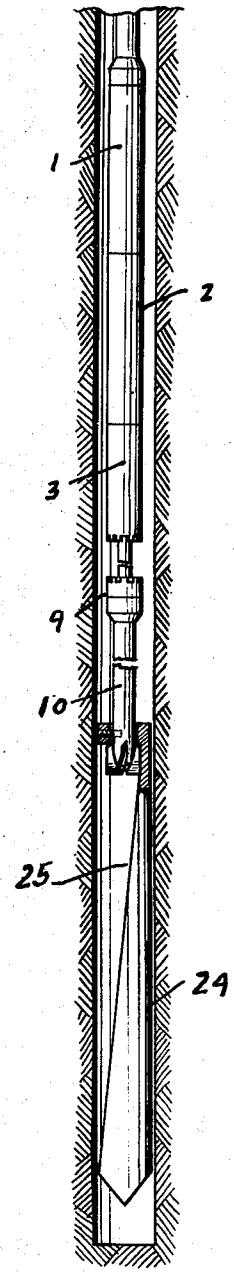


FIG. 1

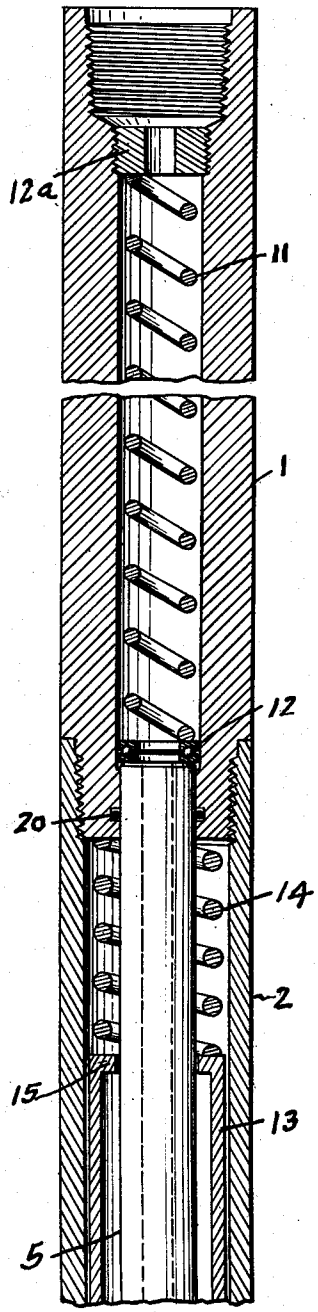


FIG. 2

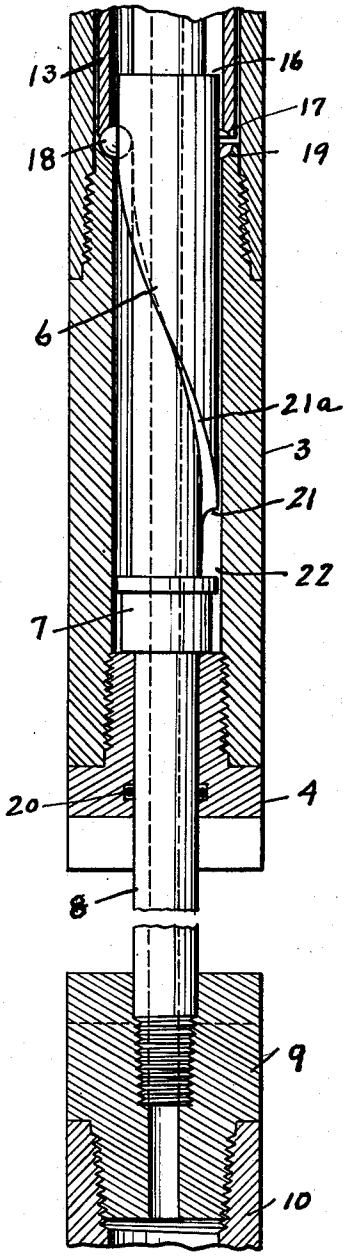


FIG. 3

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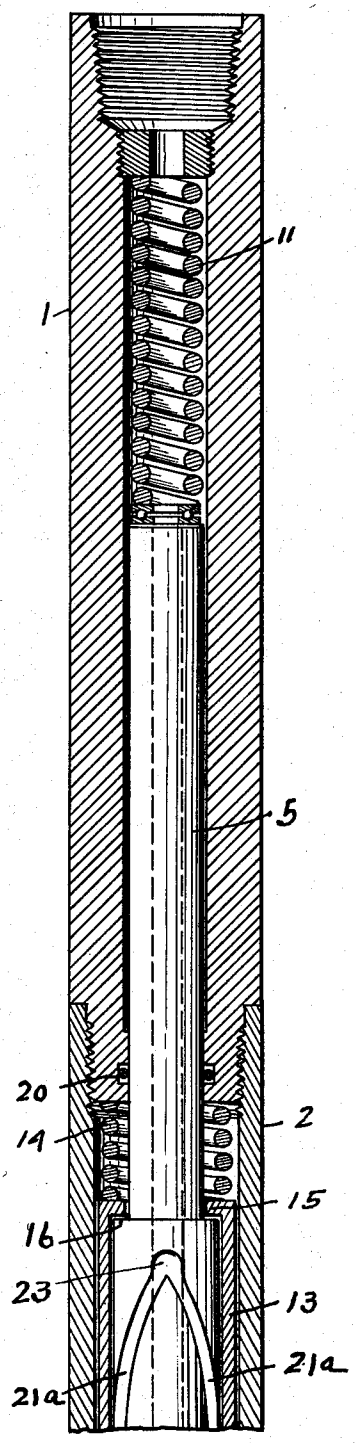


FIG. 4

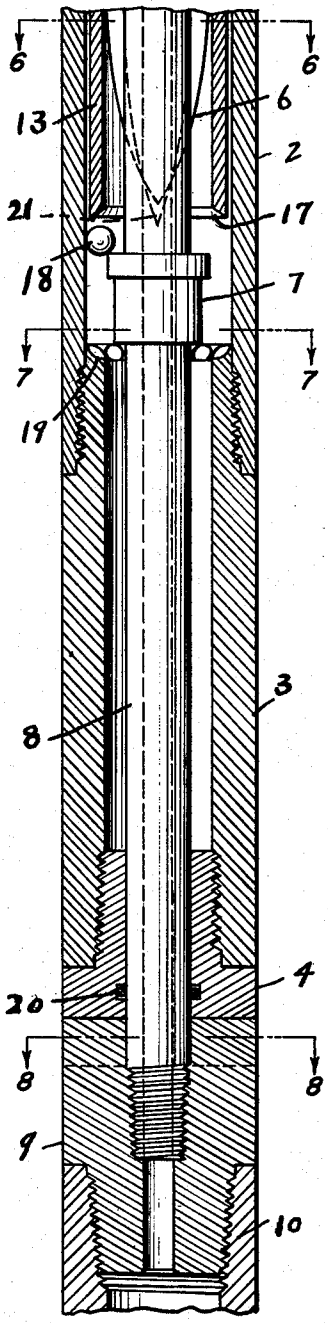


FIG. 5

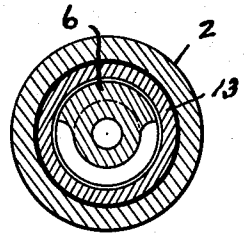


FIG. 6

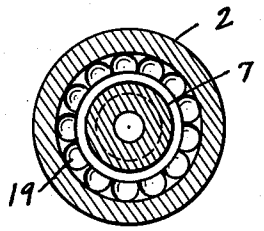


FIG. 7

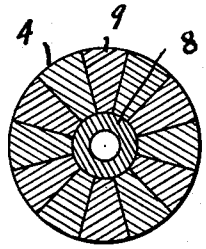


FIG. 8

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AUTOMATICALLY OPERABLE ORIENTING TOOL

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12 Claims. (Cl. 255—1.6)

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This invention relates to an automatically operable orienting tool.

An object of the invention is to provide a tool of the character described so designed that it will orient various types of well equipment when the same is lowered into the well.

In drilling a well the bore often becomes deflected from the vertical a sufficient amount to make it necessary, or desirable, to straighten the bore, that is to cause it to assume, more nearly, a vertical position, and this work is carried on by means of any selected type of tool which will accomplish the intended purpose, but the tool so selected must be properly set at the bottom of the bore so that the drilling tool used for straightening the bore will be properly oriented to accomplish the desired purpose. The orienting tool herein described is of such construction that when lowered into the bore hole to the well bottom it will automatically assume the desired position without the necessity of running a surveying tool through the pipe or orienting the pipe into the well.

It is a further object of the present invention to provide a tool of the character described which includes a spherical momentum weight which is mounted to freely move to seek the low side of the hole with means for locking said weight in position to co-act with a cam which is so mounted as to rotate the deflecting tool to a known angular relation with respect to said weight and with respect to the direction of the drift of the bore hole.

Other objects and advantages will be apparent from the following specification, which is illustrated by the accompanying drawings, wherein:

Figure 1 is a side elevation of the orienting device connected with a deflecting tool;

Figures 2 and 3 show upper and lower ends, respectively, of the tool, in section, and in extended position while hanging in the well off bottom;

Figures 4 and 5 show upper and lower ends of the tool, in vertical section, and in position to drill or with the tool resting on the bottom of the bore;

Figure 6 is a cross-sectional view taken on the line 6—6 of Figure 5;

Figure 7 is a cross-sectional view taken on the line 7—7 of Figure 5; and

Figure 8 is a cross-sectional view taken on the line 8—8 of Figure 5.

Referring now more particularly to the drawings, wherein like numerals of reference designate the same parts in each of the figures, there is an outer barrel which consists of a top section 1, an intermediate section 2, a lower section 3,

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and the upper clutch member 4. The parts of the outer barrel are, preferably, connected by threads.

There is an inner mandrel assembly extending axially through the outer barrel and slidable and rotatable relative thereto. From above downwardly this inner mandrel assembly comprises a wash pipe 5, a cam section 6, a piston 7, a lower mandrel 8, and a lower clutch member 9. The parts of the inner mandrel assembly may be united together in any preferred manner, and the lower end of the clutch member 9 may be threaded to receive any type of deflecting tool which may be suitable for the purpose intended, a drilling tool 10 being shown.

The wash pipe 5 is fitted snugly through the lower end of the top section 1 of the outer barrel, and the mandrel 8 is fitted snugly through the clutch member 4 of the outer barrel.

There is a compression spring 11 in the top section 1 of the outer barrel which rests on a thrust bearing 12 on the upper end of the wash pipe, and the upper end of this spring 11 abuts an inside, annular nut 12a screwed into the upper end of said top section 1.

Within the middle section 2 of the outer barrel there is an annular clamping member in the form of a locking sleeve 13 that is spaced beneath the upper section 1. Above said sleeve and within the middle section 2 of the outer barrel there is a coil spring 14 which is supported on the inwardly turned, annular flange 15 of the locking sleeve 13 and whose upper end rests against the lower end of the section 1 of the outer barrel. This spring 14 urges the locking sleeve downwardly.

The cam section 6, as will be noted, is of a greater transverse diameter than that of the wash pipe, thus forming an external, upwardly facing, annular shoulder 16 at its upper end, which will contact the flange 15.

The lower end face of the sleeve 13 is concaved, as at 17, on a spherical contour, which is of the same radius as the radius of a non-magnetic ball 18. As disclosed in Figure 5, this ball is in a free position.

There are a series of concaved pockets 19 which are spaced apart about the upper end of the lower section 3 and which are designed to provide a means for locking the ball 18.

The upper and lower ends of the inner assembly are sealed by the surrounding seals 20, 20, one located in the lower end of the upper section 1 of the outer barrel and the other located in the clutch member 4 thereof. Between said packing elements the orienting device is preferably filled

with a suitable fluid which damps, or retards, the movement of the ball and controls the speed of the extension of the mandrel.

The middle and lower sections 2 and 3 of the outer barrel form a cylinder 22 in which the piston 7 works.

The cam 6 terminates, at its lower end, in the point 21, which is downwardly directed, and this cam is provided with similar, opposed, spiralled faces as 21*a*, 21*a*, which merge at their upper ends forming a pocket 23 directly opposite the point 21.

In operation a deflecting tool such, for example, as a drilling tool 10 is attached to the clutch member 9, as shown in Figures 1 and 3. In the present illustration the deflecting tool includes a whipstock, as 24, whose upper end is pinned to the drill. This whipstock has the usual deflecting face 25. The radial angular relation between the face of the deflecting tool and the point 21 of the cam is then measured, and said tools, after being made up as stated, are lowered into the well to a few feet off bottom and circulation is established. The orienting tool, while going into the well, is extended, as shown in Figures 1 and 3. After sufficient circulation the tools are then lowered to bottom, and sufficient weight is applied to compress the spring 11 and cause the tool to telescope to the position shown in Figures 4 and 5.

It will be noted that, while in the position above indicated, the ball 18 is free to roll to the low side of the top surface of the piston 7.

For illustration purposes let it be assumed that the low side is at the left, as shown, and with the tool filled with a liquid which is retained by the packing 20 the motion of the ball will necessarily be damped, but after a short time the ball will come to rest and the tools should then be raised off of bottom for a short distance.

Upon lifting the tools off bottom, the combined effect of weight, pump action, and the spring 11 will operate to extend the mandrel to the position shown in Figure 3, in which position the mandrel is fully extended, and as this extension occurs the piston 7 will move downwardly into the cylinder 22 beneath, allowing the ball 18 to come to rest in one of the pockets spaced about the top of section 3. As the piston moves further down through the cylinder the sleeve 13 comes to rest on the top of the ball and secures the ball in its place. The speed at which the piston and mandrel travel is controlled by the resistance of the fluid escapement around the piston. As this movement progresses still further some part of the cam section 6 contacts the locked ball.

Further downward travel of piston 7 results in a rotation of the cam, the mandrel, and consequently the deflecting tool until the mandrel has reached its maximum extension. This is accomplished when the bottom of the piston 7 contacts the upper end of the clutch member 4, as shown in Figure 3.

At this point, as shown in Figure 3, the point 21 of the cam 6 has been rotated to a position which is in line with the direction of drift of the high side of the hole.

As a last step, it is only necessary to rotate the drill pipe at the surface through the proper angle to face the deflecting tool in the desired direction. The amount of rotation of the drill stem which is required depends upon the radial angular relationship, previously measured, between the face of the deflecting tool and the point 21 of the cam.

As an alternative procedure, and likely a preferable procedure, the face of the deflecting tool could be pre-set relative to the cam so that this last operation, above referred to, of rotating the drill pipe would not be necessary. In other words, the radial angular position of the deflecting tool relative to the point 21 of the cam may be adjusted by shims such as those indicated at 9', between the lower clutch member 9, and the drilling tool 10 so that the tool may be lowered directly to the bottom after the orienting cycle just described is completed.

When the tools are lowered to the bottom sufficient weight may then be applied to seat the deflecting tool and compress spring 11 and shear the pin connecting the whipstock 24 to the drilling tool 10, and the clutch members will become engaged automatically and drilling will proceed in the normal fashion.

What I claim is:

1. An orienting tool comprising, an outer barrel provided with inside pockets, an inner mandrel extending axially through the barrel and provided with a piston which works in the barrel, a cam on the mandrel in longitudinally spaced relation to said piston and having a camming surface opposed to the pockets, a locking sleeve on the mandrel in longitudinally spaced relation to the pockets and which is suspended from the cam when the mandrel is moved in a direction to move the cam away from the pockets, a non-magnetic ball in the barrel between the sleeve and the pockets and engageable with the piston, said ball being freely movable on the piston, when the piston is in a position between the sleeve and the pockets, and said ball being positioned to enter a pocket upon subsequent movement of the mandrel in the barrel in a direction to move the cam toward the pockets, yieldable means tending to force said sleeve toward the pockets to clamp the ball in place said camming surface being engageable with the ball to actuate the cam and orient the mandrel upon further movement of the mandrel in a direction to move the cam toward the pockets.

2. An orienting tool comprising, an outer barrel provided with inside pockets, an inner mandrel extending axially through the barrel and provided with a piston which works in the barrel, a cam on the mandrel in longitudinally spaced relation to the piston and movable with the mandrel toward and away from the pockets, a locking sleeve on the mandrel and which is supported by the mandrel in longitudinally spaced relation to the pockets when the mandrel is moved in a direction to move the cam away from the pockets, a non-magnetic ball in the barrel between the sleeve and the pockets, said piston having a supporting surface engageable with the ball to support the ball out of engagement with the sleeve and the pockets, when the piston is moved to a position between the sleeve and the pockets, said ball being freely movable on said surface of the piston when out of engagement with the sleeve and pockets, said ball being positioned to enter a pocket upon subsequent movement of the mandrel in the barrel in a direction to move the cam toward the pockets, yieldable means tending to force the sleeve toward the pockets to clamp the ball in place so that said ball will coact with the cam to actuate the cam and orient the mandrel upon further movement of the mandrel in a direction to move the cam toward the pockets.

3. An orienting tool comprising, an outer

barrel provided with inside pockets, an inner mandrel extending axially through the barrel and provided with a piston which works in the barrel, a cam on the mandrel in longitudinally spaced relation to the piston and movable with the mandrel toward and away from the pockets, a locking sleeve on the mandrel and which is supported by the mandrel in longitudinally spaced relation to the pockets when the mandrel is moved in the barrel in a direction to move the cam away from the pockets, a non-magnetic ball in the barrel between the sleeve and pockets and freely movable on the piston, when the piston is in a position between the sleeve and pockets, said ball being positioned to enter a pocket upon subsequent movement of the mandrel in the barrel in a direction to move the cam toward the pockets, yieldable means tending to force the sleeve toward the pockets against the ball to clamp the ball in place said cam being cooperable with the ball when the ball is clamped in place to actuate the cam and orient the mandrel upon further movement of the mandrel in a direction to move the cam toward the pockets, seals between the mandrel and barrel, at opposite ends of the barrel, and liquid filling the tool between said seals.

4. An orienting tool comprising, an outer barrel provided with an inside ball support, an inner mandrel extending axially through the barrel and provided with a piston which works in the barrel, a cam on the mandrel in longitudinally spaced relation to the piston and having a camming surface opposed to said support, a locking sleeve on the mandrel and which is supported by the mandrel in longitudinally spaced relation to the support when the mandrel is moved in a direction to move the cam away from the support, a non-magnetic ball between the sleeve and the support and freely movable on the piston, when the piston is moved to a position between the sleeve and the support, and positioned to land on said support upon subsequent movement of the mandrel in the barrel in a direction to move the cam toward the support, yieldable means tending to force the sleeve downwardly to clamp the ball in place on said support, said ball being engageable with said camming surface whereby the ball will actuate the cam and orient the mandrel upon further movement of the mandrel in a direction to move the cam toward the support.

5. An orienting tool comprising, an outer barrel provided with an inside ball support, an inner mandrel extending axially through the barrel and provided with a piston which works in the barrel, a cam on the mandrel in longitudinally spaced relation to the piston and movable toward and away from the support, said cam having a camming surface disposed in opposing relation to the support, a locking sleeve on the mandrel in longitudinally spaced relation to the piston and movable with the mandrel toward and away from the support and which is supported by the mandrel in longitudinal spaced relation to the support when the mandrel is moved in a direction to move the cam away from the support, a non-magnetic ball in the barrel between the sleeve and the support and freely movable on the piston, when the piston is in a position between the sleeve and the support, said ball being positioned to land on said support upon subsequent movement of the mandrel in the barrel in a direction to move the cam toward the support, yieldable means between the barrel and sleeve tending to force the sleeve toward the support to

clamp the ball in place on said support, said ball being engageable with the camming surface whereby the ball will actuate the cam and orient the mandrel upon further movement of the mandrel in a direction to move the cam toward the support, seals at opposite ends of the barrel between the mandrel and barrel, and liquid filling the tool between said seals.

6. An orienting tool comprising, an outer barrel provided with an inside support, an inner mandrel extending axially through the barrel and provided with a laterally extending annular surface, a cam on the mandrel in longitudinally spaced relation to said annular surface and having a camming surface opposed to said support, a locking sleeve on the mandrel in longitudinally spaced relation to said annular surface and means on the mandrel for supporting said sleeve in longitudinally spaced relation to said support when the mandrel is moved in a direction to move the cam away from the support, a ball in the barrel between the sleeve and support and freely movable on said annular surface, when said annular surface is moved with the mandrel to engage the ball and move the ball away from said support, said ball being positioned to land on said support upon subsequent movement of the mandrel in the barrel in a direction to move the cam toward the support, said ball being engageable with said camming surface, yieldable means acting against the sleeve to force the sleeve toward the support to clamp the ball in place on said support to position the ball to operatively engage the cam and orient the mandrel upon further movement of the mandrel in a direction to move the cam toward said support.

7. An orienting tool comprising, an outer barrel provided with an inside support, an inner mandrel extending axially through the barrel and provided with a laterally extending annular surface, a cam on the mandrel in longitudinally spaced relation to said annular surface and having a camming face opposed to said support, a locking sleeve on the mandrel in longitudinally spaced relation to said annular surface and means on the mandrel for supporting said sleeve in longitudinally spaced relation to said support when the mandrel is moved in a direction to move the cam away from said support, a ball in the barrel between the sleeve and support and freely movable on said surface, when the mandrel is moved in a direction to move the sleeve and annular surface away from the support, said ball being positioned to land on said support upon subsequent movement of the mandrel in the barrel in a direction to move the cam toward the support, said ball being engageable with said camming face, yieldable means between the barrel and sleeve tending to force the sleeve toward the support to clamp the ball in place on the support to position the ball to operatively engage the cam and rotate the mandrel upon further movement of the mandrel in a direction to move the cam toward the support, a deflecting tool on the mandrel which is oriented upon said rotation of the mandrel.

8. An orienting tool comprising, an outer barrel provided with an inside support, an inner mandrel extending axially through the barrel and provided with a laterally extended annular surface, a cam on the mandrel in spaced relation to said annular surface and having a camming face opposed to said support, a locking sleeve on the mandrel in spaced relation to said annular surface and means on the mandrel for supporting said sleeve in spaced relation to the support

when the mandrel is moved in a direction to move the cam away from the support, a ball in the barrel freely movable on said annular surface, when said surface is in a position between the sleeve and the support, said ball being positioned to land on said support upon subsequent movement of the mandrel in the barrel in a direction to move the cam toward the support, said ball being engageable with said camming face, yieldable means between the barrel and sleeve acting against the sleeve to force the sleeve toward the support to clamp the ball in place on said support to position the ball to operatively engage the cam and orient the mandrel upon further movement of the mandrel in a direction to move the cam toward the support, and clutch means on the barrel and mandrel which inter-engage upon relative movement between the barrel and the mandrel in a direction to move said sleeve away from said support.

9. An orienting tool comprising, an outer barrel having an inside annular support, an inner mandrel within the barrel and provided with a cam, a ball associated with the barrel and mandrel and free to move by gravity on the support, means for locking the ball stationary on the support in position to co-act with the cam, upon movement of the mandrel longitudinally, to cause rotation of the mandrel and orientation of a deflecting tool carried thereby.

10. An orienting tool comprising, an outer barrel having an inside annular support, an inner mandrel within the barrel and provided with a cam, a ball associated with the barrel and mandrel and free to move on the support, means for locking the ball stationary on the support in position to co-act with the cam, upon movement of the mandrel longitudinally, to cause rotation of the mandrel and orientation of a deflecting tool carried thereby and yieldable means cooperable with the barrel and mandrel and normally tending to cause such longitudinal movement of the mandrel.

11. An orienting tool comprising, an outer barrel having an inside annular ball support, an inner mandrel axially movable in the barrel, an annular member surrounding the mandrel in the barrel and axially movable therein, toward and away from the support, a non-magnetic ball in the barrel between the support and member, yieldable means acting against the member to force the member toward the support to hold the ball against movement on the support, means on the mandrel cooperable with the member upon movement of the mandrel in one direction to move the member away from the support to release the ball, and a cam on the mandrel cooperable with the ball upon movement of the mandrel in the other direction to actuate the cam and orient the mandrel.

12. An orienting tool comprising, an outer barrel having an inside annular ball support, means connecting the barrel to a string of drill pipe, an inner mandrel axially movable in the barrel, an annular member surrounding the mandrel in the barrel and axially movable therein toward and away from the support, a non-magnetic ball in the barrel between the support and member, yieldable means acting against the member to force the member toward the support to hold the ball against movement on the support, means on the mandrel cooperable with the member upon movement of the mandrel in one direction to move the member away from the support to release the ball, said mandrel being moveable in the other direction by the pressure of fluid from above in said drill pipe, and a cam on the mandrel cooperable with the ball upon movement of the mandrel in said other direction to actuate the cam and orient the mandrel.

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

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