

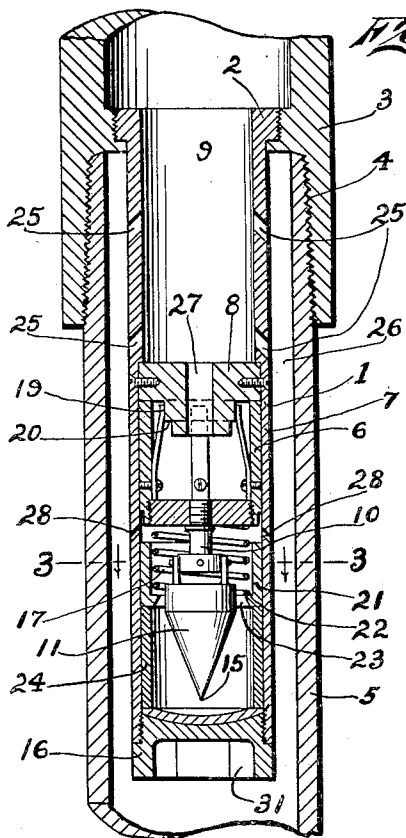
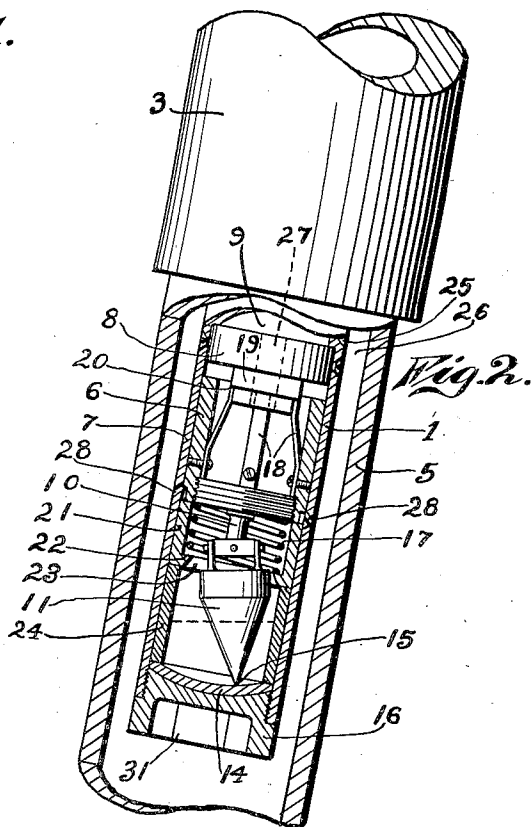
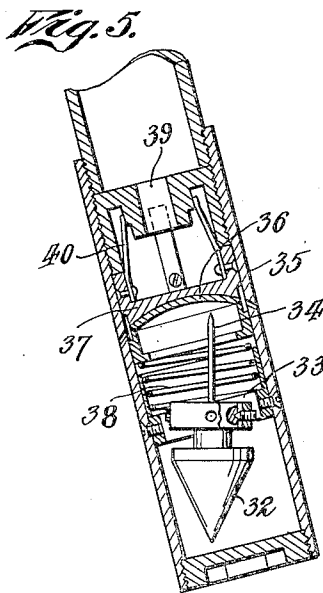
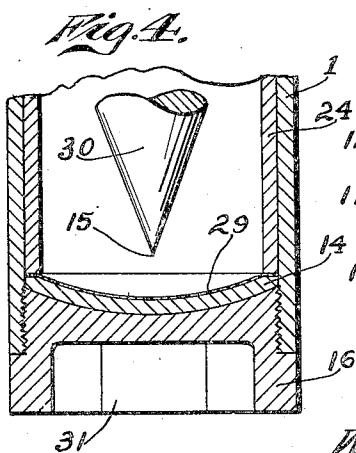
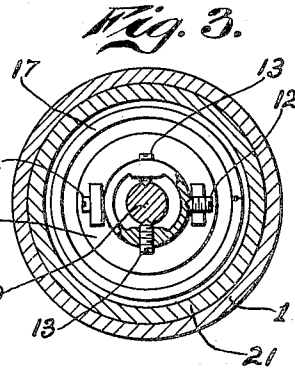
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CROOKED HOLE INDICATOR

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CROOKED HOLE INDICATOR

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This invention relates to indicating apparatus to be used by well drillers. It should be distinguished from apparatus such as has been used for surveying a well after it is drilled to indicate the inclination or "dip" of the well at different points in its depth.

The present invention concerns a device which is intended to be carried in the drill-string near the bit for the purpose of indicating to the drillers when the hole starts to "go crooked".

The general object of the invention is to provide a simple device for this purpose which can be carried in the drill-string near the bit, and which can be operated at will when desired to set it in an indicating position, indicating the inclination of the axis of the drill-string. One of the objects of the invention is to construct the apparatus in such a way that it can be actuated by different agencies.

A further object of the invention is to provide a device of this kind which will not interfere with the passage of circulating fluid past it, but which nevertheless, if desired, can be operated by fluid pressure such as could be developed in the circulating fluid.

Further objects of the invention will appear hereinafter.

The invention consists in the novel parts and combinations of parts to be described hereinafter, all of which contribute to produce an efficient crooked hole indicator.

A preferred embodiment of the invention is described in the following specification, while the broad scope of the invention is pointed out in the appended claims.

In the drawing:

Figure 1 is a vertical section through the device and showing a short portion of a drillstring in which the device is placed. This view shows the indicating apparatus in its normal position.

Figure 2 is a view also showing the apparatus in longitudinal section, the upper portion of the view being shown in elevation. This view shows the apparatus in an inclined position such as it would have in a crooked portion of a hole being drilled, and illus-

trates the apparatus in its "set" or actuated position.

Figure 3 is a horizontal section taken about on the line 3—3 of Figure 1 and further illustrating details of the preferred embodiment of the invention.

Figure 4 is a vertical section taken through the lower end of the device and illustrating another embodiment of the indicating member which may be used as a part of the device.

Figure 5 is a vertical section with some parts broken away upon a smaller scale and illustrating an embodiment of the invention in which the recording member is placed above the directional device instead of below it.

Before proceeding to a detailed description of the invention, it should be understood that it employs as an element of the combination a directional device, such as a plumb-bob, which is carried in such a way that it is free to move so as to maintain itself constantly in a certain relation.

Any device of this nature can be employed, but for simplicity I prefer to employ a plumb-bob which is mounted in such a way that it constantly maintains itself with its axis in a substantially vertical position. This directional device is mounted in the casing of the device in such a way that it can cooperate with an indicating member. Normally the directional device or plumb-bob is out of contact with the indicating member, but adjacent to it. In the normal position of the device, when the hole is straight, the plumb-bob is in a position such that its axis coincides with the axis of the tool string and with the central axis of the indicating member. If the hole being drilled starts to deviate the axis of the tool string and the casing of the instrument will become inclined, but the plumb-bob will maintain itself with its axis vertical. When the parts are in this relation, I develop a relative movement between the indicating member and the plumb-bob which brings them together, thereby forming an indication, or mark, by the plumb-bob on the indicating member. This mark will be off the center of

the indicating member, and the number of degrees that it is off from the center will indicate the inclination of the crooked portion of the hole. If the device is constructed so as to operate as indicated above, the indicating member is formed of some yielding material which can be punched or marked by the point of the plumb-bob when it strikes it. For this purpose I might employ a plate of soft material such as lead or any other suitable material.

If desired, the instrument may include means for holding the plumb-bob in its position of contact with the indicating member, in which case, if desired, the indicating member need not be constructed of a yielding material, but could be formed of any material which would operate to engage the point of the plumb-bob and hold it in a relatively fixed position. For this purpose I might employ a punctural diaphragm of any suitable material, or a diaphragm of wire gauze of fine mesh.

The contact between the plumb-bob and the indicating member or element can be accomplished in any desired way, for example, by a down-jar of the instrument such as would cause the point of the plumb-bob to strike the indicating element; or if desired, the contact between the plumb-bob and the indicating element may be accomplished by hydraulic pressure as will be described hereinafter. Where the indicating member is of such a nature as to produce a permanent mark when the plumb-bob strikes it, it will not be necessary to hold the plumb-bob in contact with the indicating member, but if desired, I may employ detents which operate when the plumb-bob is brought into contact with the indicating member to maintain it in its position of engagement. In other words, I may provide means for holding the plumb-bob relatively fixed in the casing in the position which it had when the device was operated to indicate the degree of inclination of the hole.

In the preferred embodiment of the invention, I provide a casing 1, which is preferably of tubular form and attached at its upper end by means of a threaded collar 2 in the lower end of a section 3 of the drill-string. Below this point the drill-string section 3 is provided with threads 4 to receive the upper end of another drill-string section 5 which may be the drill collar or attached to the drill collar carrying a drill bit of any type, for example, a fish-tail bit. This casing 1 carries the directional device or plumb-bob mounted in such a way that when the device is actuated by any suitable means it will come into engagement with a recording or indicating member. For this purpose I prefer to provide a movable carrier in the casing 1 which is capable of being moved to effect a relative movement between the marker, or plumb-bob, and the indicating member. In

the present instance, the carrier is in the form of a piston 6 mounted to slide in a barrel 7 formed in the lower portion of the casing 1 and below a fixed head 8 that is attached in the tubular casing, thereby forming a water chamber 9 in the casing above the head 8. The piston 6 is provided on its under side with means, such as a central post 10, for supporting a plumb-bob 11. This plumb-bob is supported on the post by pivotal means (see Figure 3) providing two pairs of pivot screws, 12 and 13, in alignment with each other to attain the effect of a gimbal joint, enabling the plumb-bob to move freely and maintain itself with its axis in a vertical position.

Cooperating with the plumb-bob, I provide an indicating element 14. In the present instance this indicating element cooperates with the point 15 of the plumb-bob which is at the lower end of the plumb-bob, and this point 15 is normally adjacent but out of contact with the indicating element 14. This indicating element 14 is mounted in a fixed position in the lower end of the casing 1 and maintained in position by screwing in a detachable head 16 secured by threads to the lower end of the casing 1. The device is preferably provided with means, such as a coil spring 17, for normally holding the plumb-bob and the indicating element 14 out of contact with each other. This spring is preferably mounted under the piston 6 so as to hold it in an extreme raised position.

A device having the parts described above can be operated by a down-jar when desired, the weight of the plumb-bob and piston operating to compress the spring 17 and enable the point 15 of the plumb-bob to engage and mark the indicating element 14. If it is desired to retain the plumb-bob in engagement with indicating element 14, this may be accomplished by providing a plurality of detents 18, which may be in the form of leaf springs attached at their lower ends to the inner face of the wall of the piston 6, their upper ends normally resting against the side of a neck 19 projecting down from the head 8.

If the piston 6 moves downwardly, these detents 18 will snap inwardly under an annular shoulder 20 on the neck, and thereby prevent return of the piston and the plumb-bob to their normal elevated position. In this way the plumb-bob will be maintained in contact with the indicating element.

The device is preferably constructed so that all of the parts can be put into the casing from below, for which purpose the spring 17 is mounted in a spring barrel 21, with an internal shoulder 22 upon which the spring seats. In this way a large opening 23 is formed at the lower end of the barrel to permit lateral swinging movement of the plumb-bob (see Figure 2). Below the spring barrel 21 a distance ring 24 is provided which fills

the space between the lower end of the spring barrel and the indicating member 14. As illustrated, the edge of the indicating member is clamped between the plug 16 and the lower end of the ring, or ferrule, 24.

The device is preferably constructed so that it will not interfere with the use of circulating water in the regular way. For this purpose the wall of the water chamber 9 is provided with a plurality of water ports 25, which preferably incline downwardly toward the annular chamber or water passage 26 that is formed in the tubular drill-string section 5 so that the circulating water can pass down around the casing 1.

The head 8 is provided with means for admitting fluid pressure into the casing 1 above the head of the piston 6. For this purpose a central opening or port 27 is formed in this head. In order to prevent the pressure of the circulating water above the piston 6 from actuating it before desired, a plurality of vents 28 are provided opening communication between the annular space 26 and the interior of the casing 1 below the piston head. If the pressure of the circulating water is gradually built up, water will fill the interior of the casing 1 below the piston, and the pressure above and below the piston will become equalized. The water below the piston surrounds the plumb bob and dampens its relative movement. These vents 28 also enable the piston 6 to be advanced if the pressure of the circulating water is quickly increased, by permitting the out-flow of the water in the casing 1 below the piston. In this connection it should be understood that if the pressure of the circulating water is suddenly increased, there would be sufficient pressure on the upper side of the piston to insure its downward movement. In other words, under these conditions the piston would be advanced by a differential pressure action.

It will be obvious, however, that if desired the device could be constructed in such a way that it could be operated directly by pressure admitted only in one side of the piston.

Instead of employing a recording or actuating member 14 of yielding material, I may employ an indicating element 29 (see Figure 4) formed of wire gauze of fine mesh or any other suitable material which could engage the point of the plumb-bob 30 (see Figure 4) to hold the same in a relatively fixed position.

The plug 16 may have an angular or hexagonal socket 31 to enable it to be screwed into place by means of a wrench.

The mode of operation of the apparatus will now be briefly described. If a yielding material, such as lead, is employed to form the indicating element 14, it will not be necessary to provide the device with the detents 18 because the point of the plumb-bob will form a small conical impression in the upper

face of the lead element or diaphragm 14. However, as it may be convenient to use the same lead element again and again, impressions made at different times might be confused with each other. For this reason it is desirable to provide the detents 18.

In using the device, a down-jar will cause the point 15 of the plumb-bob to engage the indicating element 14 and mark it. When the tool string is pulled, the position of this mark will indicate the inclination of the tool string at the time the mark was made.

If the detents 18 are present, they will lock the plumb-bob in engagement with the indicating element 14.

If desired, the recording disk may be placed above the plumb-bob instead of below it, see Figure 5 in which 32 represents a plumb-bob mounted on a gimbal joint 33 and having a sharp pin 34 projecting upwardly on its axis. Above the pin within the casing 35 of the instrument a recording disk 36 is mounted. This recording disk is carried on a movable piston 37 that may be moved down so as to compress the spring 38 either by jar or by fluid pressure admitted to the upper side of the head 37 through a port 39. The spring 38 normally holds the head 37 elevated so that the recording disk is out of contact with the point of the pin. If desired, springs 40 similar to the springs 18, may be employed to hold the recording member 36 in contact with the pin 34.

If it is desired to operate the device by fluid or hydraulic pressure, this can be accomplished by suddenly raising the pressure of the circulating water. This will produce a preponderance of pressure on the upper side of the piston or carrier 26 which will cause the plumb-bob to move down so that its point will engage the indicating element.

If desired, a viscous fluid, such as oil, could be employed in the lower end of the device as indicated by the dotted line in Figure 2. The function of this fluid would be to "dampen" the swinging movements of the plumb-bob and thereby insure an accurate placing of the mark on the indicating member.

It is understood that the embodiment of the invention described herein is only one of the many embodiments this invention may take, and I do not wish to be limited in the practice of the invention, nor in the claims to the particular embodiment set forth.

I claim:

1. In a crooked-hole indicator for well drillers, to cooperate with liquid pressure means at the mouth of the well, the combination of a casing having means for attaching the same to a drill string, and having a plumb-bob chamber, a plumb-bob with pivotal means for supporting the same in the plumb-bob chamber so that the plumb-bob is freely movable to maintain itself with its

axis in a substantially vertical position, an indicating member carried within the plumb-bob chamber to cooperate with the plumb-bob, means for conducting liquid under pressure from the drill string into the plumb-bob chamber to surround the plumb-bob and dampen its swinging movements, and a piston carrying the plumb-bob and operating upon a sudden increase of pressure, to move the plumb-bob into engagement with the indicating member while the casing is located at the crooked part in the hole.

2. In a crooked-hole indicator for well drillers, to cooperate with liquid pressure means at the mouth of the well, the combination of a casing having means for attaching the same to a drill string, and having a plumb-bob chamber, a plumb-bob with pivotal means for supporting the same in the plumb-bob chamber so that the plumb-bob is freely movable to maintain itself with its axis in a substantially vertical position, an indicating member carried within the plumb-bob chamber to cooperate with the plumb-bob, means for conducting liquid under pressure from the drill string into the plumb-bob chamber to surround the plumb-bob and dampen its swinging movements, and a piston carrying the plumb-bob and operating upon a sudden increase of pressure, to move the plumb-bob into engagement with the indicating member while the casing is located at the crooked part in the hole, a fixed head in the casing above the piston with a port therethrough for admitting the fluid under pressure from above, to the upper side of the piston, said fixed head having an annular shoulder on its under side, and said piston having resilient means for engaging the annular shoulder when the piston moves downwardly to hold the plumb-bob in engagement with the indicating member.

3. In a crooked-hole indicator for well drillers to cooperate with liquid pressure means at the mouth of the well, the combination of a tubular casing having a bore to communicate with the interior of the drill string and having a fixed head within the same with a port therethrough, a drill string section surrounding the tubular casing for conducting liquid downwardly past the fixed head, said tubular casing having ports therein for enabling water to pass outwardly through the wall of the tubular casing above the said fixed head, a piston mounted for movement in the tubular casing below the fixed head, and a spring normally holding the piston in an elevated position, a plumb-bob supported for free movement from the under side of the piston, so as to enable the plumb-bob to maintain itself with its axis in a vertical position, an indicating member held in the lower end of the tubular casing below the plumb-bob, said piston operating when the liquid pressure in the upper end

of the said tubular casing is suddenly increased to force the plumb-bob downwardly and into engagement with the indicating member.

4. In a crooked hole indicator for well drillers, the combination of a casing having means for attaching the same to the drill string, an indicating member in the form of a diaphragm carried within the casing, a plumb-bob within the casing above the indicating member, pivotal means for supporting the plumb-bob so that it is freely movable to maintain itself with its axis in a substantially vertical position, said plumb-bob having a point at its end lying adjacent said indicating member, a carrier for the plumb-bob in the form of a piston movable in the casing, means for admitting fluid under pressure to the upper and lower side of the piston operating so that when the pressure is suddenly increased, a differential pressure is developed greater above the piston, for moving the plumb-bob into contact with the indicating member, and means for holding the plumb-bob thereafter in contact with the said indicating member.

5. In a crooked hole indicator for well drillers, the combination of a casing having means for attaching the same to a drill-string, an indicating member in the form of a diaphragm carried within the casing, a piston movably mounted within the casing, a plumb-bob, pivotal means for supporting the plumb-bob from the piston so that the plumb-bob is freely movable to maintain itself with its axis in a substantially vertical position, said plumb-bob having a point at its end lying adjacent said indicating member, means for admitting fluid pressure to the upper and lower faces of said piston including a relatively small port for admitting the fluid to one side of the piston, so that when the fluid pressure is suddenly increased, a differential pressure is developed, operating to move the piston in a direction to bring the said point into contact with the indicating member while the casing is located at the crooked point in the hole, and detents carried by the piston with means cooperating with the same to hold the plumb-bob in contact with the indicating member.

6. In a crooked hole indicator for well drillers, the combination of a tubular casing closed below to enable it to hold a motion-dampening liquid, a piston mounted for movement in the upper part of the casing, a fixed head in the casing for limiting the upward movement of the piston, a plumb-bob with means for supporting the same from the lower end of the piston for free movement laterally in the motion-dampening liquid, a spring surrounding the plumb-bob, normally holding the piston in an elevated position within the casing and against said fixed head, the said means for supporting the plumb-bob

enabling the plumb-bob to maintain itself with its axis in a substantially vertical position, and an indicating member held fixed in the lower end of the casing below the plumb-bob.

7. In a crooked-hole indicator for well drillers, the combination of a tubular casing, a piston mounted for movement in the upper part of the casing, a spring normally holding the piston in an elevated position within the casing, a fixed head in the casing for limiting the upward movement of the piston under the action of the said spring, a plumb-bob with means for supporting the same from the under side of the piston for free movement, and enabling the plumb-bob to maintain itself with its axis in a substantially vertical position, an indicating member held fixed in the lower end of the casing below the plumb-bob, said fixed head having an annular shoulder on the same, and springs carried by the piston and operating upon a downward movement of the piston, to engage the annular shoulder and hold the piston down.

Signed at Los Angeles, Calif., this 3rd day of Sept. 1929.

WALTER ELLIOTT.

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