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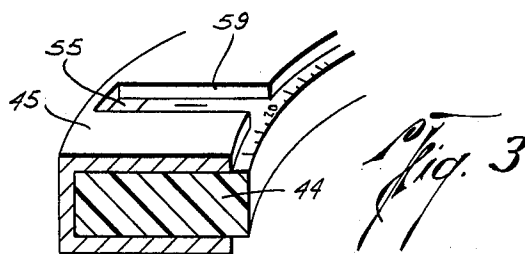
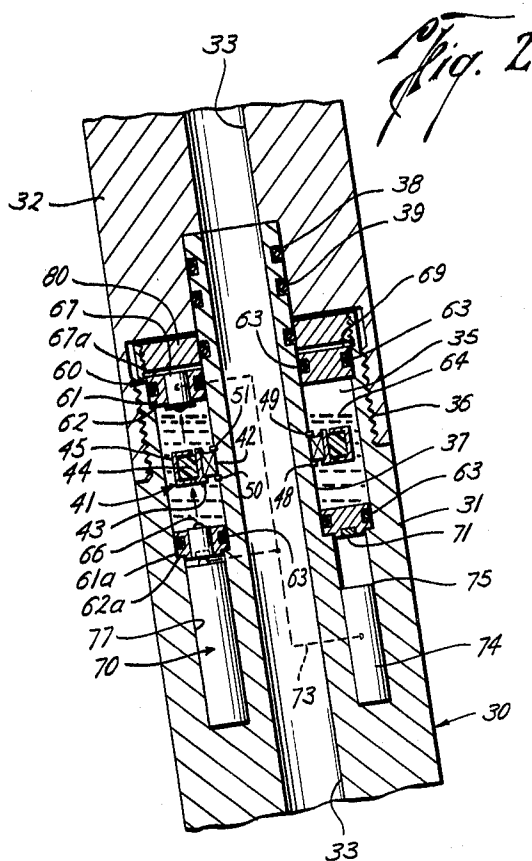
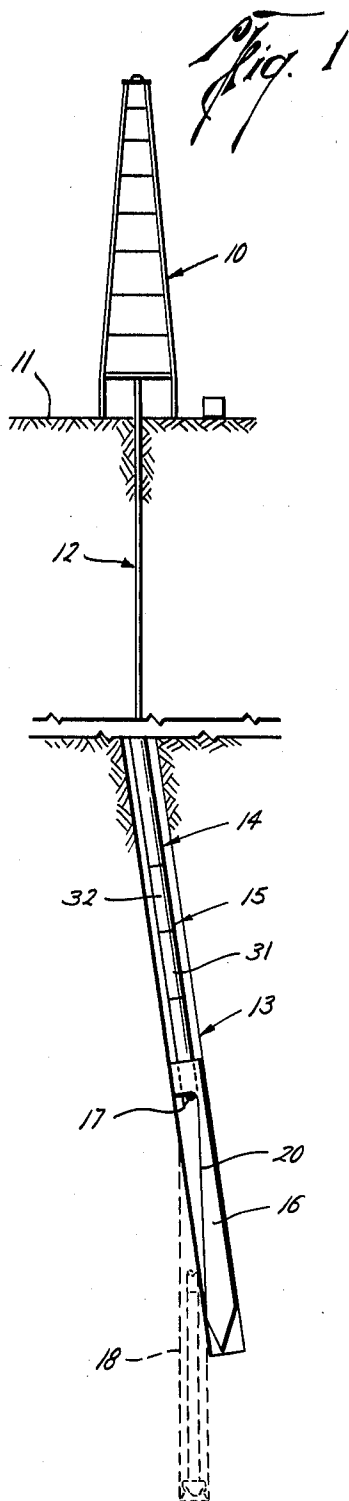
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APPARATUS FOR BOTTOM HOLE ORIENTATION

Filed Sept. 30, 1963

2 Sheets-Sheet 1

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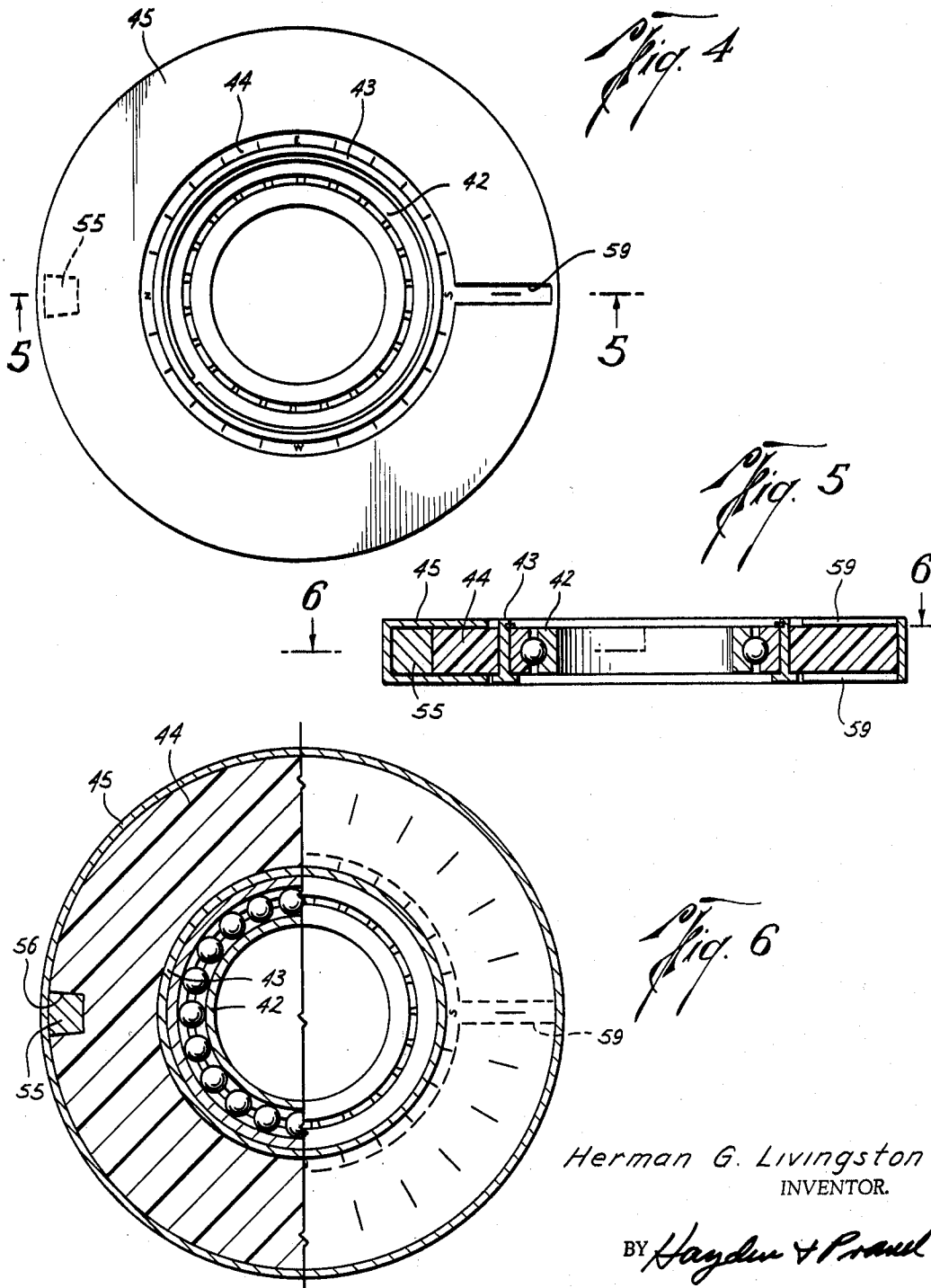
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APPARATUS FOR BOTTOM HOLE ORIENTATION
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The present invention relates to a new and useful apparatus for orienting devices in well bore.

There is described in United States Letters Patent No. 3,100,019 issued on August 6, 1963 a device for enabling a bottom hole orientation of a well bore to be accomplished, of which device I am one of the joint inventors. The present invention relates to an improvement on the device shown in said United States Letters Patent which enables the result and function to be accomplished non-magnetically.

In orienting a drill bit in a well bore, it is necessary to provide a means for guiding the drill bit in a predetermined direction; such means may be a whipstock or by other means, such as jets in the drill bit which move the bit laterally of the well bore in the predetermined or desired direction. Prior to continuing drilling operations, it has been heretofore necessary to take one or more surveys of the oriented bit to assure that it is facing in the proper direction. Such procedure has numerous disadvantages including the restriction of the normal flow of drilling fluids through the drill string, the loss of time and expense in repeatedly lowering a survey instrument into the well bore, and other disadvantages.

The device described and claimed in United States Letters Patent No. 3,100,019 above referred to solves many of the problems encountered in bottom hole orientation, and the present invention is provided to overcome certain problems arising as a result of the use of the structure described in said patent.

More particularly, the present invention provides an apparatus which may function without regard to magnetic effects and therefore can be used in ordinary drill string.

An object of the present invention is to provide a device for bottom hole orientation which can be used in any ordinary drill string and eliminates the necessity of providing a special collar or tubular member of nonmagnetic material.

Other objects and advantages of the present invention will become more readily apparent from a consideration of the following description and drawings wherein:

FIG. 1 is a schematic view of a well string in a well bore illustrating one possible arrangement in which the present invention may be employed;

FIG. 2 is an enlarged sectional view illustrating the central portion of the body of the present invention;

FIG. 3 is an enlarged fragmentary isometric view of a portion of the nonmagnetic assembly of the present invention;

FIG. 4 is a top plan view of the nonmagnetic assembly;

FIG. 5 is a sectional view on a line 5-5 of FIG. 4 of the nonmagnetic assembly; and

FIG. 6 is a sectional view on the line 6-6 of FIG. 5 showing further structural details of the nonmagnetic arrangement.

Attention is first directed to FIG. 1 of the drawings wherein a drilling rig is designated generally by the numeral 10 and shown as being positioned on the earth's surface 11 at the top of the well bore referred to generally by the numeral 12. In the lower part of FIG. 1, the bottom part of the well bore is shown enlarged as indicated generally at 13 to illustrate in greater detail the drill string referred to generally at 14 and the functioning of the present invention, such invention being referred to generally by the numeral 15. It can be appreciated that the well string 14 extends upwardly to the earth's surface through the well bore 12 and is supported by the derrick 10.

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The device of the present invention represented generally at 15 in FIG. 1 is connected into the well string 14. In FIG. 1, a whipstock 16 is shown as being the device to orient and guide the drill bit 17 in the desired direction so that the portion shown in dotted line at 18 of the well bore 12 may be drilled at a desired angle and a desired direction relative to the original direction of the portion of the well bore 12 illustrated in enlarged view at 13 in the bottom part of FIG. 1 as sloping generally to the right as viewed in FIG. 1. Of course, FIG. 1 serves merely for purposes of illustration as the relationship of the original well bore 14 to the portion to be drilled may assume any form.

The present invention accomplishes orientation of the whipstock 16 in a desired direction relative to the well bore 12 to enable the bit 17 to move in a desired direction. More particularly, the present invention accomplishes such results without the use of any magnetic or nonmagnetic sections in the tool or in the well string and enables the bit to be quickly and easily oriented without the necessity of repeated lowering of tools into the well string to determine whether or not the bit is properly oriented prior to downward movement thereof.

In order to insure that the bit 17 is guided by the face 20 of the whipstock 16 in the proper direction to drill the deflected portion of the well bore 18 as desired, it is necessary that the whipstock 16 be faced in the well bore 12 so that its guide surface 20 will guide the drill bit 17 as desired. When the well bore 12 is to be drilled as illustrated in FIG. 1, the whipstock will be faced as shown and subsequent downward movement of the bit 17 therealong will drill the portion 18.

When the well bore is to be deflected or when a deflected portion of the well bore is to be further deflected or straightened, a survey of the well bore is initially taken to obtain the angle and direction of the well bore. In prior orienting procedures, the relationship of the whipstock 20 to a survey mark or knife edge which is secured in the drill string is known, and after the whipstock is lowered on the well string into the well bore, an instrument is then lowered into the drill string 12 from the earth's surface when the whipstock is set on bottom and a survey taken. The survey instrument is withdrawn and its findings correlated with the initial survey. The drill string is then rotated if the survey comparison indicates such to be necessary, and after the drill string and whipstock have been reset, another survey is obtained. This is continued until the survey indicates the whipstock is properly oriented in the well string.

The present invention overcomes this problem in that it eliminates the necessity of obtaining repeated surveys and then removing the survey instrument to the earth's surface. More particularly, the instrument of the present invention enables the well string to be oriented in the well bore and enables the operator at the surface to know when the whipstock has been oriented in the proper direction with a minimum of effort.

The device referred to generally by the numeral 15 includes the body or housing 30 formed in two portions 31 and 32. The portions 31 and 32 are in turn provided with suitable threads whereby they may be engaged in the drill string 14 and form a part thereof.

The body 30 is provided with a bore 33 which extends through the portions 31 and 32 to enable fluid to be circulated through the drill string at all times as the orientation of the drill string is accomplished, thereby reducing the possibility of sticking of the drill string in the well bore. A void 35 is formed in the member 31, such void extending longitudinally of the portions 31 and surrounding the bore 33 formed in the portion 31 as shown in FIG. 2 of the drawings. The void 35 is ring shaped in cross section and thereby provides an inner por-

tion or projection 37 which separates the void 35 from the bore 33. The projection 37 extends upwardly into the counterbore 38 formed in the body portion 32 and is provided with suitable seals as shown at 39 for inhibiting leakage of fluid therearound. A rotatable assembly is provided and referred to generally by the numeral 41. The assembly 41 is adapted to be received within the void 35 and is shown in greater detail in FIGS. 3-6, inclusive, as including a bearing race 42, a retainer ring 43, an annular body 44 secured to the ring 43, and a U-shaped housing 45 slidably carried on the annular body 44.

In FIG. 2 it will be noted that the body portions 31 and 32 are provided with threads 36 for enabling the portions 31 and 32 to be secured together. Grooves 48 and 49 are provided on the portion 37 and in assembling the assembly 41 on the portion 37, a snap ring 50 is positioned in the groove 48 whereupon the bearing race, retainer plate 43, body 44, and U-shaped cover 45 are telescoped over the portion 37 and retained in position by the snap ring 51 within groove 49. The bearing race 42 supports the annular body 44 and cover 45 so that they may freely rotate about the mandrel or portion 37 of the body 31. As shown in FIG. 6, a weight 55 is inserted in the groove or slot 56 at one edge of the annular body 44 so that the annular body 44 will always seek the low side of the well bore, as will be explained in greater detail hereinafter. Also, a slot 59 is formed in the cover 45, it being contemplated that the annular body 44 will be formed of plastic or other suitable material which is transparent to accommodate the passage of light there-through. Preferably, the U-shaped housing or cover 45 is nontransparent to preclude the passage of light there-through for a purpose as will be described in greater detail.

Suitable means are provided for indicating the orientation of the whipstock 16 on the drill string when it is initially secured thereto, such means being shown in the drawings and referred to generally by the numeral 60, such means including the ring shaped member 61 which is supported on the shoulder 62 formed in the body portion 31. A second ring shaped member 61a is supported on shoulder 62a as shown in FIG. 2 of the drawings. It will be noted that the ring member 61 and the ring member 61a are each initially inserted in position on portion 37 to align each axially with the face 20 of the whipstock and for a purpose as will be described in greater detail. Each of the ring members 61 and 61a is provided with suitable seals as shown at 63 so that if a transparent liquid is contained within the void 35 as illustrated at 64, leakage of such fluid will be inhibited. Such seals also serve to lock or hold the ring members against movement relative to portion 37 during use of the device. The fluid 64 may be eliminated if desired.

It can be appreciated that when the whipstock 16 is made up on the well string 14 at the earth's surface, the ring 61a is inserted in the void 35 so that the light source 66 carried thereby is aligned axially with the face 20 of the whipstock 16. Similarly, the photoelectric cell illustrated at 67 is axially aligned with the light source 66, and a snap ring 67a then inserted in the groove 69 so as to further aid in holding the ring 61 in position whereby it will rotate with the body portion 31 and 32. Similarly, the ring member 61a will be constructed so that it forms a snug fit in the void 35 and the seals 63 abutting the walls of void 35 and portion 37 along with the fit of the member 61a in the void 35 inhibits relative rotation between the member 61a and housing portion 31 after it has been inserted in the void 35.

A suitable power source such as a battery represented generally by the numeral 70 is provided for the cell 67 and light source 66, and it will be noted that a circular contact 71 is formed on the bottom of the ring 61a so that when the ring 61a is initially inserted over the mem-

ber 37 in the void 35, it will make contact with the power source 70 regardless of its circumferential position in relation to the battery 70. The light source 66 may be of any suitable form such as a small incandescent bulb which functions in a well-known manner for the actuation of the electric eye or photoelectric cell 67 as will be described in greater detail.

The electric eye is electrically connected as schematically represented by the number 73 to a signaling device 74 so that actuation of the photoelectric cell 67 by light striking thereagainst from the light bulb 66 actuates the signaling device 74 to create a signal which can be transmitted to the earth's surface from the well string 14 and there picked up by a suitable receiver.

In initially assembling the device, the sound emitting device or signaling device 74 will be inserted in the void 75 extending from the bottom of the void 35 and the battery 70 will be inserted in its void 77 formed in the body portion 31 extending from void 35. The ring 61a with light bulb 66 therein will then be inserted in void 35 and axially aligned with the face 20 of the whipstock 16. The assembly 41 is next inserted in the manner as previously described, and the ring 61 with cell 67 being last inserted.

A retainer nut 80 may then be threadedly engaged against the ring 67a to hold the unit assembled and the body portion 31 and body portion 32 may next be threadedly engaged to secure them together.

The signaling device 74 may comprise an electromagnet, the core which is provided with a rod, and alignment of the slot 59 so as to enable light to pass from the bulb 66 to the photoelectric cell 67 creates an electrical impulse which causes longitudinal movement of the rod in the core of the electromagnet in a manner well known. Movement of the rod strikes housing 31 and causes a sound or vibration which is transmitted to the earth's surface through the well string 14.

In assembly of the unit in a well string, the light bulb 66 may be aligned with the face of the whipstock 16 in any manner such as by placing a mark longitudinally on the well string immediately below the body portion 31 but in axial alignment with the face of the whipstock 16. This enables the illuminating source 66 and the electric eye 67 to be visually and axially aligned with the face 20 of the whipstock 16 as the unit is assembled in the drill string.

As previously noted, the inclination and direction of a well bore is always known prior to the time that an orientation is to be accomplished, and accordingly, the tool face 20 of the whipstock 16 is aligned with the light source 66 and photoelectric cell 67 as above described as the whipstock and housing 30 are inserted in the well string.

Prior to inserting assembly 41 in void 35, the cover 45 on body 44 is rotated in relation to the known direction and inclination of the well bore as indicated by the initial survey and in relation to the direction in which it is desired to face whipstock 16. Therefore, when slot 59, light source 66, and cell 67 are aligned during use of the device, this will represent the desired orientation of the whipstock 16 in the well bore 12, and an indication of this fact will be relayed to the operator by the signal source 74.

In FIG. 1, the portion 18 to be drilled is indicated as originating on the low side of the well bore. Since the initial survey of the well bore has indicated the direction and inclination of the well bore, the groove 59 will be aligned with the weight 55 as shown in FIG. 3 of the drawings in the example in the drawings. The weight 55 causes the member 44 and housing 45 to always rotate in housing 30 to the low side of the well bore, and thus in the example shown in FIGS. 1 and 3, alignment of the light bulb 66 with the groove 59, which is in turn aligned with the weight 55 actuates the photoelectric cell 67 and indicates to the operator at the earth's surface

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that the whipstock 16 is in the proper direction so that its surface 20 will guide the drill bit to form the portion 18.

Of course, it can be appreciated that the slot 59 may be moved at any relationship relative to the weighted portion, and since the weighted portion always seeks the low side of the well bore and since the members 67 and 66 are always aligned with the tool face 20 of the whipstock 16, rotation of the housing 30 will align the bulb 66 and cell 67 with the groove 59 while weight 55 retains the body 44 and housing 45 in a predetermined position since the weight will always seek the low side of the well bore.

The body 44 is transparent, and cover 45 is nontransparent so that the light from bulb 66 will be blocked off from cell 67 until groove 59 is aligned with 66 and 67.

Thus, it can be seen that the well string can be rotated and the whipstock 20 oriented in the well bore to face in a desired direction in relation to the low side of the well bore.

It can be seen that the present invention provides a device for orienting the whipstock at the lower end of a well string without interfering with normal flow through the well string of mud fluid, and such orientation may be accomplished without the use of any special magnetic or nonmagnetic sections or other expensive arrangements.

Broadly, the present invention relates to an improved form of bottom hole orienting apparatus which accomplishes its function without the use of any special magnetic or nonmagnetic portions in the tubular drill string.

What is claimed is:

An apparatus for orienting a device on a well string in a well bore, comprising:

- (a) a housing
 - (1) adapted to be secured in a well string,
 - (2) said housing defining a longitudinal bore for circulating drilling fluids in the well string, and

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(3) said housing defining a circumferential void therein extending about but spaced from the bore in said housing,

- (b) a ring shaped transparent member mounted for rotation in a plane perpendicular to the longitudinal axis of said housing and in said circumferential void defined by said housing about said bore of said housing,
- (c) a slotted opaque member of circular shape coaxially mounted on said ring member, said slotted member being slidable on said ring member whereby said slotted member may be adjustably positioned on said ring member and will rotate therewith,
- (d) a weighted portion included in said ring member which rotates said ring member and maintains the low side of the well bore, said ring member rotating said slotted member therewith to a predetermined relationship to the low side of the well bore,
- (e) an optical system including:
 - (1) a source of light, and
 - (2) a light sensor, said system supported in predetermined alignment relative to the device to be oriented in the well bore,
- (f) said slotted member interposed between the light source and sensor of said optical system to control light falling on the sensor, and
- (g) signaling means operable by the light sensor to indicate a relationship between the object to be oriented and the low side of the well bore.

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