166-66

SEARCH ROOM

June 28, 1955 R. RING 2,711,879

APPARATUS FOR ORIENTING TOOLS IN A BORE HOLE

Filed Oct. 8, 1952 2 Sheets-Sheet 1

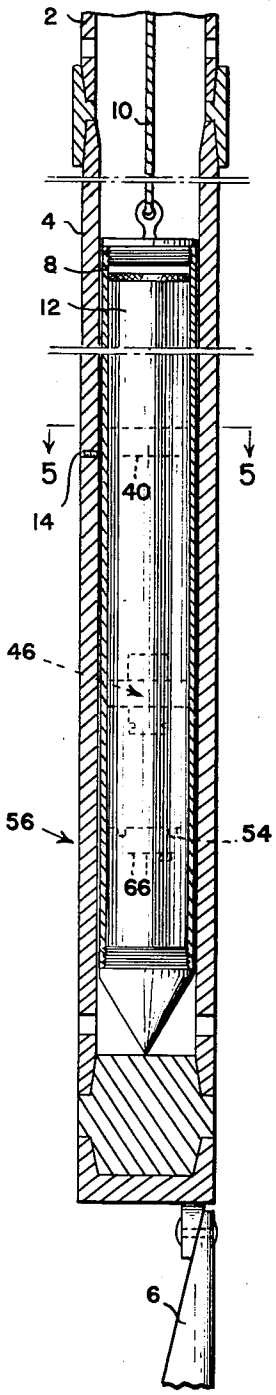


FIG. 1.

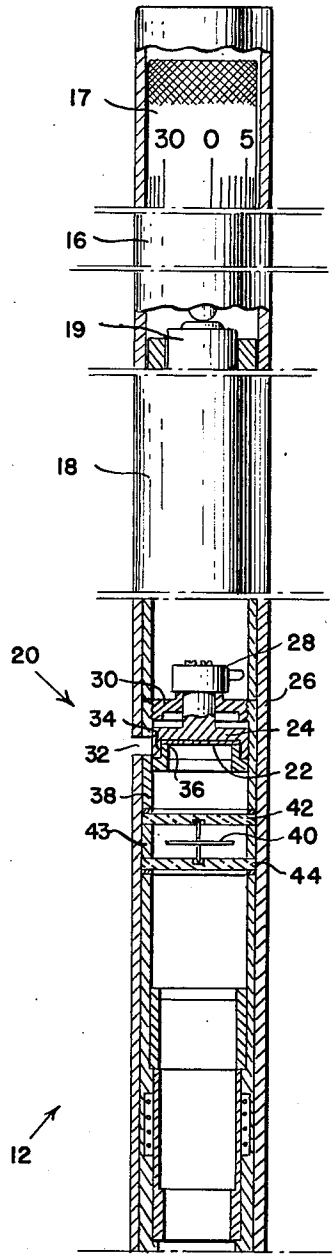


FIG. 2A.

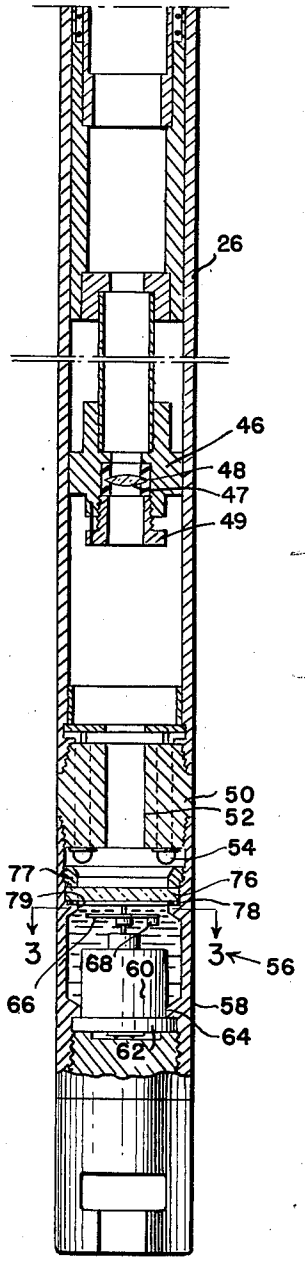


FIG. 2B.

T 166/61

X 33/205

INVENTOR.
ROLAND RING

BY Bacon, Smith & Hardy
ATTORNEYS

June 28, 1955 R. RING 2,711,879

APPARATUS FOR ORIENTING TOOLS IN A BORE HOLE

Filed Oct. 8, 1952 2 Sheets-Sheet 2

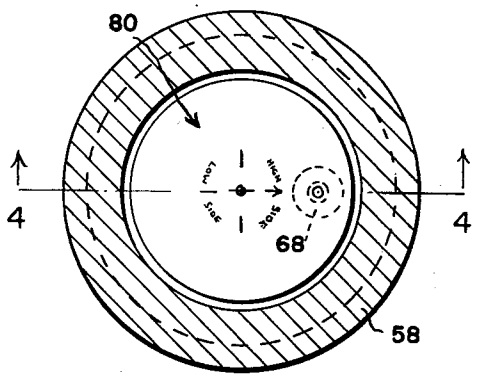


FIG. 3.

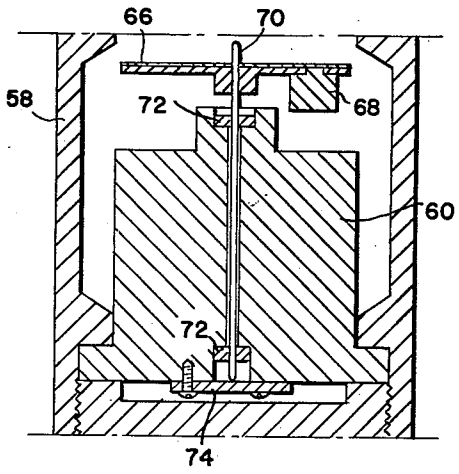


FIG. 4.

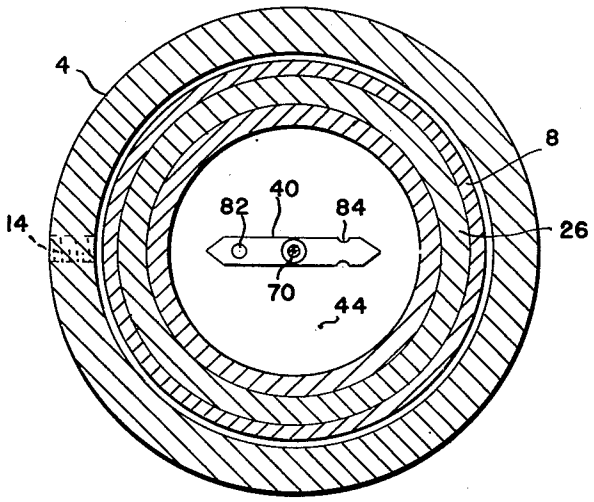


FIG. 5.

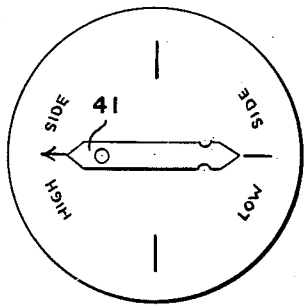


FIG. 6.

INVENTOR.
ROLAND RING
BY
Busser, Smith & Harding
ATTORNEYS

United States Patent Office 2,711,879
Patented June 28, 1955

2,711,879

APPARATUS FOR ORIENTING TOOLS IN A BORE HOLE

Roland Ring, Houston, Tex., assignor to Sperry-Sun Well Surveying Company, Philadelphia, Pa., a corporation of Delaware

Application October 8, 1952, Serial No. 313,699

3 Claims. (Cl. 255—1.6)

This invention relates to the drilling of wells and has particular reference to apparatus for orienting a tool, for example, a whipstock designed to guide a drill in a definite direction as is necessary, for example, in straightening a crooked bore hole.

As is well known, many bore holes deviate considerably from the vertical during drilling thereof. If a bore hole deviates to a substantial degree from the vertical, it may entirely miss the locality which is believed to contain oil. Accordingly, it is the practice to insert within the bore hole a whipstock having a guiding surface at an angle to the axis of the bore hole to direct the drill in the desired direction to reach its objective. Obviously, it is necessary ot properly orient the whipstock to insure that a proper correction for the direction of the bore hole will be made. For this and for other reasons which are well known in the art, it may be necessary to properly orient a tool which is to be located in a predetermined azimuthal position in a bore hole.

Heretofore various apparatus have been proposed for carrying out this purpose. These apparatus generally employ members floating on the surface of a liquid, bubbles which assume a position under a curved calibrated surface, suspended pendulous members which engage an electrochemical record disc in order to provide an indication of the position of the lower end of the pendulum at a time during which the apparatus is stationary, or the like. All of these various devices are of limited application due to the fact that they may be employed in bore holes having only a limited degree of inclination.

It is an object of the present invention to provide apparatus which will operate in a bore hole having a high degree of inclination, and which will operate to provide a reliable indication of the direction of inclination of the bore hole with respect to the position of a tool affixed to the lower end of a drill stem within the bore hole.

While the apparatus is described herein as being employed in connection with generally vertically extending bore holes or bore holes whose inclination is considered as being deviation from the vertical, it will be evident that the apparatus could be employed in orienting work in any kind of a bore hole. For example, the apparatus could be employed in checking the deviation of horizontal holes if the drill pipe is oriented in going into the hole.

The foregoing and other objects of the present invention will become apparent from the following description when read in conjunction with the accompanying drawings, in which:

Figure 1 is a sectional view showing a drill stem supporting a whipstock and having located therein a position checking instrument;

Figure 2A is an enlarged partly sectional view of the upper portion of the position checking instrument;

Figure 2B is an enlarged sectional view of the lower portion of the position checking instrument;

Figure 3 is a transverse sectional view of a portion of the checking instrument taken on the trace 3—3 of Figure 2B;

Figure 4 is a fragmentary vertical section of the instrument taken on the trace 4—4 of Figure 3;

Figure 5 is a transverse section of the checking instrument and drill stem taken on the trace 5—5 of Figure 1; and

Figure 6 is a plan view of the record obtained by use of the checking instrument.

Referring to the figures there is illustrated therein a drill stem 2 the lower portion of which takes the form of a non-magnetic catcher 4 to which there is secured, in any conventional fashion, a whipstock or other tool 6. This connection may take the form, for example, of a rivet which may be sheared when it is desired to fix the whipstock in final position in the bore hole. The whipstock may be of any suitable type designed to be finally held in position either by penetration of the soil or by cementing.

An instrument designed to indicate the position of the whipstock with respect to the inclination of the bore hole is arranged to be lowered into the non-magnetic catcher 4. This instrument may comprise an outer protective casing 8 carried by a line 10. Within the protective casing 8 is the instrument proper 12 which is illustrated in detail in Figures 2A and 2B. The instrument contains a magnetic compass and, consequently, it must be of non-magnetic construction to the extent of any parts which might affect the readings.

The non-magnetic catcher 4 carries a permanent magnet 14 arranged to cooperate with the compass. This magnet is sufficiently powerful so that the effect of the earth's field on the compass is negligible and so that the attracted end of the compass will be held adjacent thereto regardless of the degree of inclination of the instrument. The permanent magnet preferably takes the form of a threaded screw which can be inserted into a drilled and tapped hole in the non-magnetic catcher. It is made removable so that it can be remagnetized if it loses its magnetism.

The position recording instrument is shown in Figures 2A and 2B. The upper portion 16 of the instrument is adapted to contain timing mechanism 17 such as is described in detail in the patent to Ring No. 2,559,373, issued July 3, 1951. Below the timer containing portion 16 is a portion 18 which is adapted to contain batteries 19.

The timer is set prior to the lowering of the instrument within the drill stem in order to control the flow of current from the batteries to illuminating lamps for a predetermined recording time interval in order to produce a photographic record as will be described. The timer also controls the starting of this recording time interval which occurs a predetermined time after the instrument is inserted into the drill stem. Thus, by properly setting the timer, time is provided for the lowering of the instrument into position in the non-magnetic catcher and thereafter, while the instrument is at rest in position within the catcher, the timer provides a predetermined period of illumination during which recording is accomplished. The complete operation of this timer is fully described in the above mentioned Ring patent. This timer as well as other timers adapted to control the flow of currents in instruments which are lowered into a bore hole are well known and need not be described in detail herein.

Below the battery containing portion of the instrument there is provided a record member supporting apparatus generally indicated by the numeral 20. This apparatus includes a cup-shaped plunger 24 which is adapted to receive a record disc 22. The plunger is moved longitudinally within the casing 26 by rotation of the cap 28 mounted on helical grooves (not shown) in an upwardly extending sleeve portion of the member 30. A radially extending slot 32 is provided in the casing 26. Rotation of the cap 28 will draw the plunger 24 back

from an annular shoulder ring member **36** which is mounted in the sleeve **38**, raise the rim **34** of the plunger **24** and open the slot **32** to permit the insertion or removal of a record member. This type of record member supporting apparatus is more fully described in the patent to Hewitt No. 2,116,350, issued May 3, 1938.

A compass member **40** is pivotally mounted within the casing **26** below the record disc **22** and is supported on suitable jewelled bearings between a pair of transparent plates **42** and **44**. The plates are spaced apart by a sleeve **43** and are held in position thereagainst by the sleeve **38**.

A lens **47** is mounted within a central bore **48** passing through a member **46** which is supported within the casing **26**. The lens is held in position between suitable gaskets in the central bore **48** of the member **46** by means of a threaded sleeve **49**.

A member **50** is threaded onto the lower end of the sleeve **26** below the lens **48**. The member **50** contains a longitudinally extending central bore **52** and mounts lamps **54**. The lamps **54** extend below the lower surface of the member **50** but are so positioned that direct rays of light emanating therefrom cannot pass upwardly through the bore **52** through the member **50**. The lamps **54** are energized by current passing from the batteries within the section **18** of the instrument through suitable conductors passing downwardly through the casing **26** in the conventional fashion and not shown. The lamps are energized only during recording intervals as determined by the timing means **17**.

A pendulous unit, indicated generally by the numeral **56** in Figure 2B is mounted below the lamps **54**. The unit is enclosed within a lower casing portion **58** which is threaded to the member **50** and includes a mounting block **60** which is retained within the casing **58** by means of a plug **62** urging an outwardly extending lower flange of the block **60** against an inwardly extending flange **64** of the casing **58**.

The pendulous unit includes a rotatable disc **66** which extends transversely of the instrument casing and which is weighted on one side by a weight **68**. The disc **66**, as shown in Figure 4, is attached to a longitudinally extending shaft **70**. The shaft **70** is supported by suitable jewelled bearings **72** mounted within the member **60**, and the lower end of the shaft **70** is rounded and is supported by a plate **74** which is affixed to the lower surface of the member **60**. A transparent disc **76** is mounted in the casing **58** above the pendulous unit. The disc **76** is held in position by a threaded ring **77** which enters the casing **58** and urges the disc downwardly against a gasket **78** resting upon an inwardly extending flange **79** of the casing **58**. The upper end of the shaft **70** projects above the rotatable disc **66** and is also rounded. The bottom side of the transparent disc **76** just clears the upper end of the shaft **70** allowing some play in the shaft but preventing it from slipping out of the bearings if the instrument should be turned upside down. To reduce friction, the sealed space surrounding the pendulous unit is filled with a suitable fluid. The fluid also provides a desirable damping action.

In operation of the instrument, the instrument is assembled with a record member **22** placed within the record member holder and with the timer adjusted to provide the necessary time interval to permit the instrument to be lowered into the drill stem and come to rest in the catcher and thereafter to provide for a flow of current through the illuminating lamps for a sufficient period to provide for a record to be made upon the photographic record member as will be described.

When the position checking instrument has been lowered in a bore hole by means of the cable **10** and comes to rest in the non-magnetic catcher **4**, the compass **40** will be positioned in the radial plane alignment with the magnet **14** mounted in the catcher **4** and thus one end of the compass **40** will be attracted to the magnet **14** the end depending, of course, upon the polarity of the magnet **14**.

The pendulous disc will assume a position as is determined by the inclination of the hole, namely, with the weight member **68** on the low side of the disc. A predetermined time after the insertion of the instrument within the drill stem the timing mechanism will cause an electric current from the batteries to pass through the illuminating lamps **54** for a period of time sufficient to record upon the photographic record member **22** the positions of the pendulous unit disc **66** and the compass **40** in the following manner.

Light emanating from the lamps **54** illuminates the upper surface of the pendulous disc **66**. Light is reflected therefrom upwardly through the passage **52** and through the lens **48**, and an image of the upper surface of the pendulous disc **66** is thereby projected upon the photographic record member **22**. The compass **40** being positioned relatively close to the record disc **22** will cast a shadow upon the record member **22** and will thereby provide a recording of the position of the compass **40**. As indicated generally by the numeral **80** in Figure 3, the pendulous disc bears indicia indicating the high side and low side of the disc. When an image of this indicia is projected upon the record member **22**, the image is considerably enlarged and is also reversed. Accordingly, the disc is marked "High side" on its weighted or low side. The final record, as shown in Figure 6, includes, by means of the "High side" and "Low side" indications on the pendulous disc, an indication of the direction of inclination of the instrument. The compass **40** is provided with a bore at **82** adjacent to one end thereof and notches **84** adjacent to the other end thereof. These markings provide an indication of the polarity of the compass and thus an indication on the photographic record of which end of the compass was adjacent to the magnet **14** in the catcher **4** when the instrument was in recording position.

The desired position of the whipstock will have been determined from preliminary bore hole survey data. The azimuthal position of the whipstock within the bore hole may be ascertained from the superimposed records of the compass and the pendulous unit since the relationship between the shadowgraph compass record and the image of the pendulous unit is dependent upon the direction of maximum inclination of the bore hole and the position of the magnet **14** within the catcher **4** with respect to that direction of inclination. After the azimuthal position of the whipstock has been determined from this record, the drill stem may then be rotated a sufficient amount to bring the whipstock into a desired and predetermined position. The degree of rotation of the drill stem required to place the whipstock in the desired position can readily be determined from the relative angular positions of the shadowgraph recording and the image of the pendulous unit upon the record member. Before the whipstock or other tool which may be involved is set in its final position, the checking instrument may be lowered with a second film and a second exposure made, and the instrument brought to the surface and opened, whereupon an examination of the new record will determine whether the whipstock has been located in the desired position. If not, suitable correction may be made and the process repeated until finally the whipstock has been fixed in the desired position.

It will be evident that this apparatus permits the orientation of a tool within a bore hole even when high angles of inclination exist and that this orientation may be accomplished without undue delay or difficulty in the manipulation of the position checking instrument. It will be noted that both the compass member and the pendulous unit lie at all times parallel to each other and parallel to the photographic record member. This parallel plane alignment of the elements involved in-

sures the production of clear and undistorted records regardless of the position of the instrument or, in other words, regardless of the degree of inclination of the bore hole. It will be clear that changes in the specific embodiment of the invention may be made without departing from the scope thereof as set forth in the following claims.

What is claimed is:

1. Apparatus for orienting a tool carried by a drill stem in a bore hole comprising a magnetic element carried by the lower portion of the drill stem, an instrument arranged to pass through said drill stem and to come to rest in a predetermined longitudinal position therein, a magnetic compass mounted for rotation on a radial plane within said instrument and positioned to be in the immediate vicinity of said magnetic element carried by the drill stem when the instrument has come to rest in said predetermined position, a pendulous unit responsive to inclination of the bore hole, said pendulous unit including a member pivotally mounted for rotation on a radial plane within said instrument in response to inclination of said instrument, and means for recording the relative positions of said compass and said member after the instrument has come to rest in said predetermined position.

2. Apparatus for orienting a tool carried by a drill stem in a bore hole comprising a magnetic element carried by the lower portion of the drill stem, an instrument arranged to pass through said drill stem and to come to rest in a predetermined longitudinal position therein, a magnetic compass mounted for rotation on a radial plane within said instrument and positioned to be in the immediate vicinity of said magnetic element carried by the drill stem when the instrument has come to rest in said predetermined position, a pendulous unit responsive to inclination of the bore hole, said pendulous unit including an indicia bearing disc pivotally mounted for rotation on a radial plane within said instrument in response to inclination of said instrument, and means for recording on a single record element the relative positions of said compass and said disc after the instrument has come to rest in said predetermined position.

3. Apparatus for orienting a tool carried by a drill stem in a bore hole comprising a magnetic element carried by the lower portion of the drill stem, an instrument arranged to pass through said drill stem and to come to rest in a predetermined longitudinal position therein, a light sensitive record member carried by said instrument, a magnetic compass mounted for rotation on a radial plane within said instrument below said record member and positioned to be in the immediate vicinity of said magnetic element carried by the drill stem when the instrument has come to rest in said predetermined position, a pendulous unit responsive to inclination of the bore hole, said pendulous unit including a member pivotally mounted for rotation on a radial plane within said instrument below said compass in response to inclination of said instrument, and means for projecting an image of said pendulous unit on said record member with only a portion of said image being blocked out by said compass to produce on said record member a recording of the relative positions of said compass and said member after the instrument has come to rest in said predetermined position.

References Cited in the file of this patent

UNITED STATES PATENTS

2,120,670	Hyer	June 14, 1938
2,187,367	Smith	Jan. 16, 1940
2,313,168	Opocensky	Mar. 9, 1943
2,489,788	Knudsen	Nov. 29, 1949