

March 23, 1937.

B. GRANVILLE

2,074,692

DEVIATION FINDER

Original Filed June 15, 1932

2 Sheets-Sheet 2

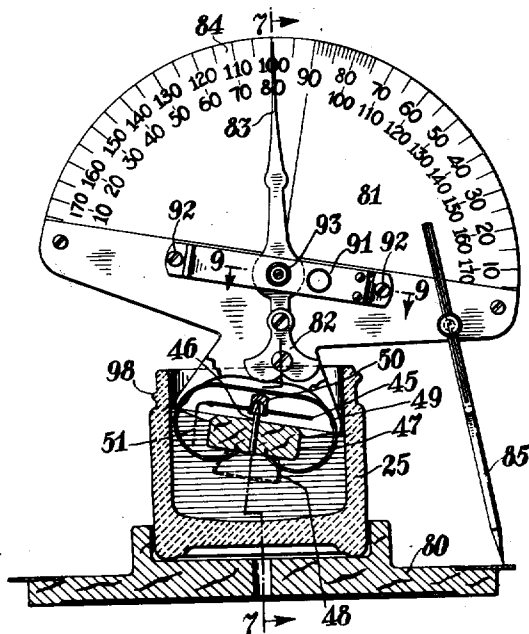


Fig. 5

Fig. 6

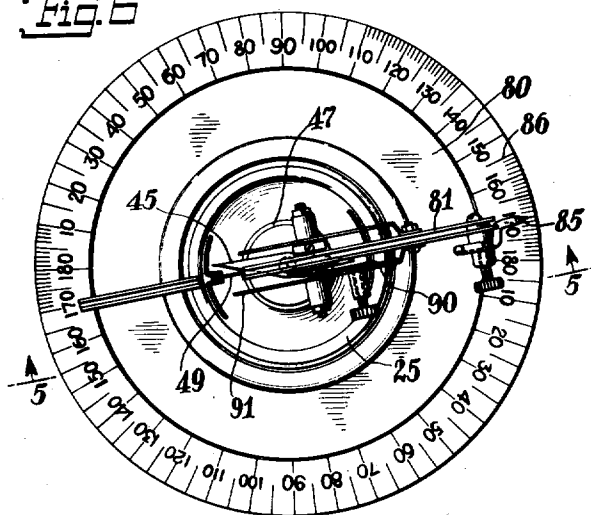


Fig. 7

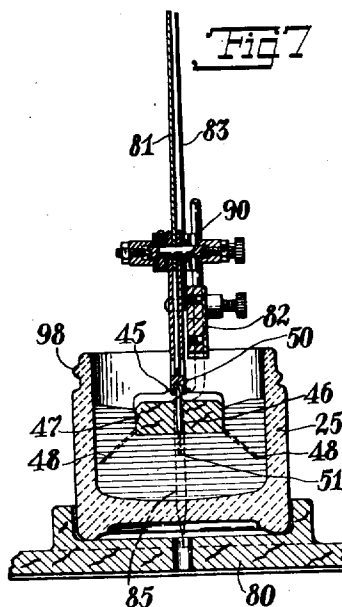
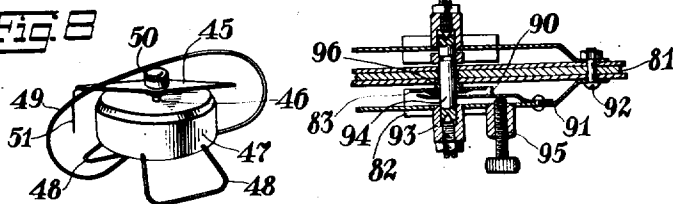


Fig. 8

Fig. 9



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2,074,692

DEVIATION FINDER

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Application June 15, 1932, Serial No. 617,302
Renewed August 8, 1936

6 Claims. (Cl. 33-205.4)

This invention relates to devices for indicating deviation in well drilling operations, or bore holes. With regard to certain more specific features it relates to devices by which the operation of drilling a relatively deep well or hole may be checked periodically, to determine whether there has been a deviation, either from the vertical or from the angle chosen at which to bore the hole, and if so the amount and direction of such deviation.

The invention aims to produce a simple, durable and highly efficient device by which the deviation of a bore in the earth may be determined, both with respect to the amount of deviation from the vertical and the direction of such deviation with reference to the magnetic meridian, and which shall give quickly and conveniently accurate information, and give such information even of slight deviations.

Other objects will be in part obvious, and in part pointed out particularly, as this description proceeds.

The invention accordingly consists in the various features of construction, combinations of elements and arrangements of parts, which will be exemplified by the construction and mode of operation hereinafter set forth, and which will be pointed out particularly in the appended claims.

In the accompanying drawings wherein is shown one of various possible embodiments of the invention:

Fig. 1 is a vertical central section through an oil well in process of construction, showing the improved deviation indicator in position therein and also in vertical central section.

Fig. 2 is a vertical central section of certain operating parts of the deviation indicator shown in Fig. 1 indicating a position assumed by these parts when there is deviation in the hole being drilled.

Fig. 3 is a view in cross section, taken on the line 3-3 of Fig. 1.

Fig. 4 is a view in cross section, taken on the line 4-4 of Fig. 1.

Fig. 5 is a view partly in vertical section, showing the application of the recording part of the device that is lowered into the well, after it has been removed from the well and associated with protractors.

Fig. 6 is a plan view of the mechanism shown in Fig. 5.

Fig. 7 is a view in cross section, taken on the line 7-7 of Fig. 5.

Fig. 8 is a view in perspective of a portion of the recording unit; the float, and the magnetic needle arranged thereon.

Fig. 9 is a view in cross section, taken on line 9-9 Fig. 5.

Referring now more particularly to the drawings, an exterior cylindrical jacket or tube is indicated at 10. This tube may be twelve or fourteen feet or more in length. It has a screw-threaded upper end closure cap 11, formed with a grip 12 by which it may be associated with a cable C for insertion and withdrawal of the tube 10 relatively to the well. The lower end of the tube is closed by a quick-detachable cap 13, connected by a bayonet joint 14. The tube is guided and centralized in its movement into and out of the well W by a series of upper rollers 15, carried on spring fingers 16, and a series of lower rollers 17, carried on spring fingers 18.

The tube 10 encloses and supports the improved recording device and its actuating mechanism, which are enclosed in a barrel 20, having quick-detachable end closures 21 and 22. The bayonet joint connections are indicated at 23 and 23'. The barrel is provided with an upper universal mounting 24, for a removable cup 25. The mounting comprises gimbals 26, carrying a metal holder 27, which is fitted with an asbestos jacket 28. The cup 25 is preferably of glass and is quickly detachably held in the asbestos jacket and holder 27 by spring clips 29 secured to the holder 27 at 30. The clips may be spread to permit introduction and removal of the glass cup.

The barrel 20 has also a lower universal mounting comprising gimbals 31, within which a ball portion 32 of the rigid arm 34 of a pendulum or plumb, 33 is arranged for universal movement relative to the barrel. The pendulum arm 34 extends above the ball joint 32 and has at its upper end a ball 35 which extends into and engages the bore of a depending bored projection 36 on holder 27. By reason of the much greater distance between the ball joint 32 and the connection between the upper end of the arm 34 and holder 27 than between such connection and the universal mounting 24, there is a multiplication of the movement imparted to the holder 37, preferably in the proportion of 5 to 1. This results in pronounced tilting of the cup 25 even though the deviation of the barrel 20 from the vertical may be only slight. To advantage, the holder 27 and cup 25 are, as shown, so positioned with relation to the gimbals 24 that the center of gravity of these parts together is coincident with or near the point about which the cup turns in its mounting. So positioned, the holder and cup have little or no restraining action on the pendulum 33.

The cup 25 is adapted to contain the recording

medium, which may be wax or any other suitable material adapted to be introduced in fluid form and subsequently congealed or solidified at prevailing temperatures in the well. Preferably, what is known in the trade as "scale wax", having a melting temperature of 120° Fahrenheit, is used. This wax is furnished in pellets containing a certain number of ounces, and one of these pellets is placed in the glass container 25 and heated to approximately 200° Fahrenheit, or above. The wax in its fluid form is indicated at 40.

A magnetic needle 45 is loosely mounted on a pin 46, which projects from a float 47, preferably of balsa wood. The float has diametrically opposed ball-shaped wire pieces 48. It has also a central wire loop 49 the ends of which are embedded in the wood of the float and the loop of which passes over a cap 50 on the needle 45 thereby holding the needle against vertical displacement from its pin 46.

After the wax in the glass cup 25 has been heated as described, the float 46 is deposited in the wax. The wire pieces 48 tend to locate the float centrally in the cup and the magnetic needle has a small depending wire 51 at its north end, which dips substantially into the fluid wax. This engagement is not, however, sufficient to prevent the needle from assuming its true magnetic position while the wax remains fluid.

The cup is then deposited in the upper universal mounting of the barrel 20, and the upper end closure 21 is bayonet-locked in position. Both end closures of the barrel have projecting stems 60 and 61. The upper stem 60 is inserted through an aperture in a partition 62 in the tube 10. The lower stem 61 is embraced by an upwardly extending sleeve 65 on the lower end closure 13 of the tube 10. Coil springs 66 and 67 surround stems 60 and 61 and both are compressed slightly as the barrel 20 is arranged in position within the tube 10. The lower closure 13 of tube 10 has a downwardly extending sleeve 68 loosely receiving the upper end of a pin 69 surrounded by coil spring 70 acting between the lower end of the sleeve 68 and a flange 71 at the bottom of pin 69. Suitable sleeves and pin and slot connections are provided for the purpose of allowing the pin 69 to yield upwardly against the action of spring 70 thereby cushioning the drop of the device into the well. Springs 66 and 67 also serve to relieve the barrel 20 and its contained mechanism from the shock of impact.

In the operation of the device, the outer jacket or tube 10 is first dropped down to the bottom of the well, without the barrel 20 but with a recording thermometer fastened on the inside of the tube. In a few moments the tube is withdrawn and the temperature noted. This will determine the type of wax or other solidifying material which is to be used. Then the tube is equipped with all its parts, as shown in Fig. 1 and lowered to the bottom of the well as far as the drilling operation has progressed. The speed of lowering the instrument into the well may be about eight hundred to one thousand feet per minute, requiring not more than five or six minutes' time to send the device down to the depth of one mile. The device is left in its lowered position for approximately twenty minutes. The asbestos jacket acts as a heat insulator, retarding the solidifying of the wax and allowing for free play of the magnetic needle. Gradually the wax solidifies and confines the magnetic needle by solidification around the depending wire 51. If there is deviation

in the bore the cup 25 will assume a position inclined from the horizontal due to the retention of its vertical position by the pendulum 33 as indicated in Fig. 2 but the gradually solidifying wax and the float 47 will retain their horizontal levels. The device is then removed from the well, the barrel extracted from the tube and the glass cup removed from the barrel. The cup is then placed in a protractor stand 80 on a perfectly level table and the needle is aligned with diametrically opposed 180° graduation marks on a scale graduated in degrees from 0° to 180° on the two halves thereof. A large vertical protractor instrument 81 with a swinging pendulum 82 is then placed diametrically of the cup on the upper surface of the solidified wax, in the vertical plane and moved angularly until the point is reached where the dip appears to be the greatest. (See Fig. 5 of the drawings.) The dip may be determined in degrees by reading the index pointer 83 against the scale 84. If the deviation appears as 10° as shown in Fig. 5 of the drawings, the reading is corrected for the amplification due to the elongated pendulum arm and the actual deviation is determined as 2°. The direction of maximum dip with respect to the magnetic meridian is determined by the relation of a pointer 85 with a horizontal index 86.

It thus appears that the cup 25 and its solidified wax containing a magnetic needle, constitute an exact and permanent record of conditions in the well, not only in respect to the amount of deviation from the vertical but also in respect to the geographical direction of the deviation.

Means are provided on the vertical protractor for frictionally setting the pointer 83 in the position which it is caused to assume by its application to the inclined upper surface of the solidified wax. This means is shown in Fig. 9 of the drawings as constituting the spring finger 90 riveted to a metal strap 91 which is spaced from the face of the protractor and bolted at either end, as indicated at 92. This strap serves also as a support for an outer bearing 93 for the pivot shaft 94 of the indicator finger. A set screw 95 may be turned up against the spring finger 90 causing it to bear against a hub 96 of the indicator, thereby forcing the hub against the vertical face of the protractor and setting it frictionally in position.

The barrel and tube and all associated parts are constructed of non-magnetic material so as not to interfere with or prevent the proper operation of the needle 45. Preferably the material is brass and the lower end of the operating cable C may be of strong manila hemp.

The glass cup 25 may be formed with a thread 98 on its wall near the upper edge, to receive a threaded closure cap 99 having a central knob 100. After the material in the cup is heated the closure cap may be threaded in position on the cup and thereafter the assembly may be handled by the knob 100 to introduce and remove it from the universal mounting. The closure cap has the additional advantage of confining the heat in the cup and insuring against premature solidification of the material therein.

Any substantial deviation in a drill hole can be readily detected by the use of the present device. In practice the drilling may be checked every two or three hundred feet of depth. If it is found that the bore is commencing to deviate, a whipstock, which is cam-shape, may be inserted in the well and the drill turned back into correct position.

What is claimed is:

1. In a device for testing a drilling operation to determine deviation of the bore, a barrel mounted for coaxial arrangement in the bore, a pendulum universally mounted in the barrel, a container for solidifiable fluid, said container being universally mounted in the barrel, and said pendulum and container being so connected that movement of said barrel relative to the pendulum is amplified in transmission to said container.
2. A deviation indicator for use with well drilling apparatus, comprising a barrel and means for lowering the barrel into the well, a cup universally mounted in the barrel, a pendulum universally mounted in the barrel and controlling the position of said cup on its mounting, and a fluid material in said cup having the capacity of becoming solid at well temperatures; the said pendulum comprising a relatively long arm above its mounting engaging the universal mounting for the cup.
3. In a device for testing a drilling operation to determine deviation of the bore, a removable container for liquid solidifiable at bore temperatures, a universal mounting for said container, means for lowering the mounting into a bore and removing it therefrom, and means for amplifying the movement of said container as the bore deviates from the vertical.
4. In a device for testing a drilling operation to determine deviation of the bore, a barrel mounted for coaxial arrangement in the bore, a pendulum universally mounted in the barrel and provided with an arm extending vertically upwards from the pivotal mounting thereof, a container for solidifiable fluid, said container being universally mounted in the barrel, and the upper end of said

arm engaging the lower part of said container at a point much nearer the point about which the container turns than the pivotal mounting of the pendulum, whereby the angular movement of the barrel due to inclination of the bore produces an amplified angular movement of the container.

5. In a device for testing a drilling operation to determine deviation of the bore, a barrel mounted for coaxial arrangement in the bore, a pendulum universally mounted in the barrel and provided with an arm extending vertically upwards from the pivotal mounting thereof, a container for solidifiable fluid, said container being universally mounted in the barrel with its center of gravity adjacent the point about which the container turns, and the upper end of said arm engaging the lower part of said container at a point much nearer the point about which the container turns than the pivotal mounting of the pendulum, whereby the container has substantially no pendulum action of its own and the angular movement of the barrel due to inclination of the bore produces an amplified angular movement of the container.

6. In a device for testing a drilling operation to determine deviation of the bore, a cup mounting, a cup universally mounted in said mounting and containing a material adapted to solidify at bore temperatures, a pendulum, and connections between the cup and the pendulum, the pivotal point of the pendulum being chosen with respect to its length so that upon slight movement of the cup mounting relative to the pendulum amplified movement is transmitted to the cup.

BERNARD GRANVILLE.

CERTIFICATE OF CORRECTION.

Patent No. 2,074,692.

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 32, after the word "pendulum" insert a comma; page 2, first column, line 2, for "from" read form; line 11, for "for" read form; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 24th day of August, A. D. 1937.

(Seal)

Leslie Frazer
Acting Commissioner of Patents.

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