Sept. 19, 1939. J. R. HOARD 2,173,745

DEVIATION RECORDING DEVICE

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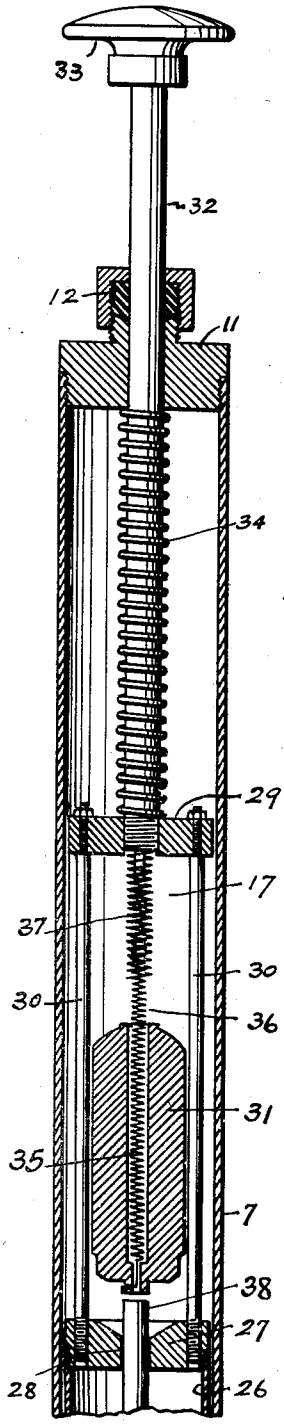


Fig. 1.

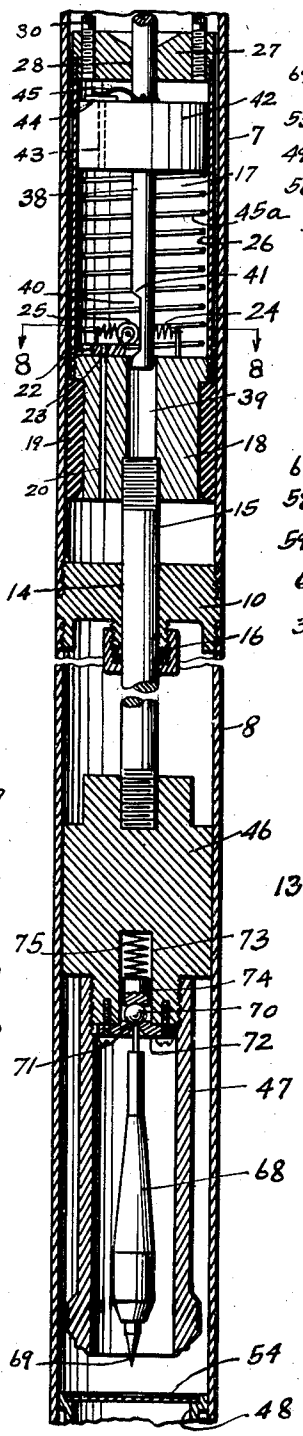


Fig. 2.

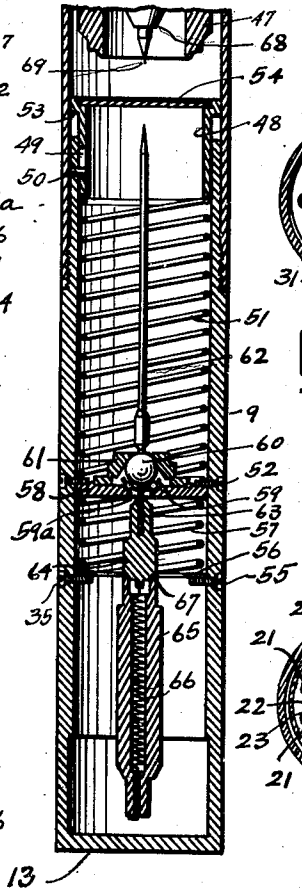


Fig. 3.

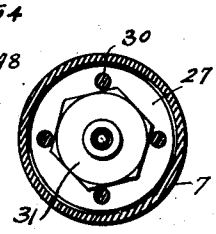


Fig. 7.

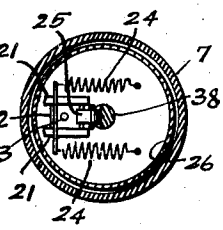


Fig. 8.

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DEVIATION RECORDING DEVICE

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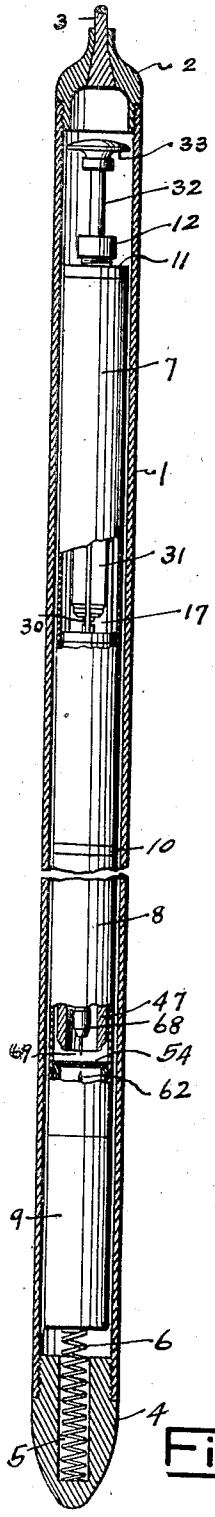


Fig. 4.

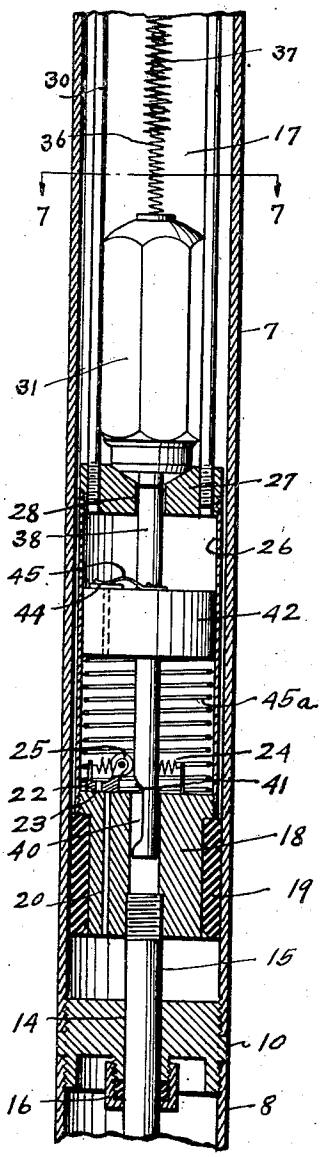


Fig. 5.

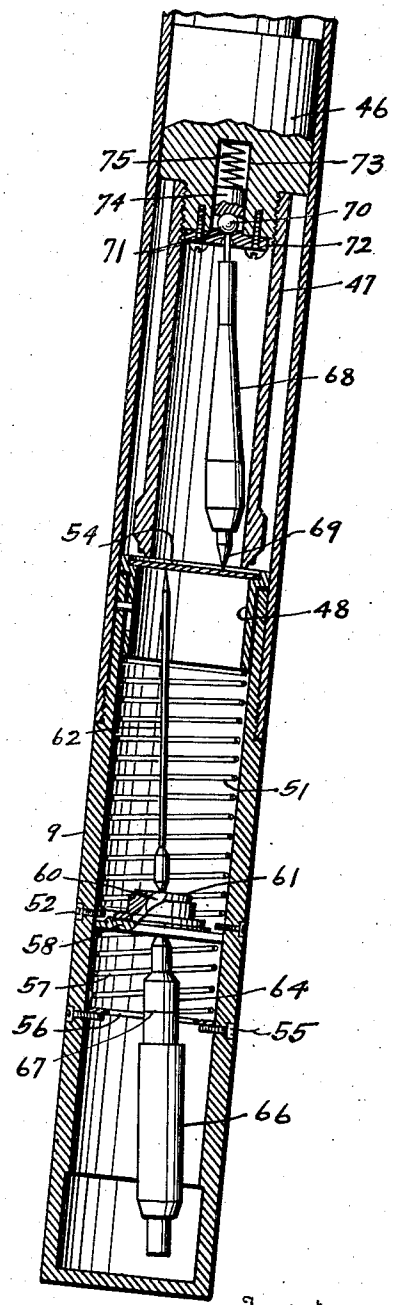


Fig. 6.

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UNITED STATES PATENT OFFICE

2,173,745

DEVIATION RECORDING DEVICE

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Application July 26, 1937, Serial No. 155,678

5 Claims. (Cl. 33—205.5)

This invention relates to a deviation recording apparatus.

The invention embodies certain improvements over that type of apparatus disclosed in the copending application of this applicant filed August 14, 1936, under Serial No. 95,993.

An object of the invention is to provide apparatus of the character described shaped to be lowered into a well bore and containing means which are maintained inoperative while the apparatus is being lowered but which become active when the apparatus reaches the selected place in the bore, and is maintained stationary at said location, whereby a record is made of the inclination of the bore at the selected point.

As is well known the bore of a well, rarely, if ever, follows a true vertical course, but usually is sinuous on account of varying inclinations of the strata pierced, as well as from other causes.

It is desirable to know the course followed by the bore so that the bore can be straightened, if desired, at the point of deviation. The invention herein disclosed has been particularly designed for the purpose of ascertaining the inclination of the well bore at a selected point therein.

The invention also embodies a novel timing arrangement.

It is another object of the invention to provide a novel record making means.

With the above and other objects in view the invention has particular relation to certain novel features of construction, operation and arrangement of parts, an example of which is given in this specification and illustrated in the accompanying drawings, wherein:

Figure 1 shows a fragmentary, vertical, sectional view, showing the upper end of the apparatus.

Figure 2 shows a fragmentary, vertical, sectional view, showing an intermediate portion thereof.

Figure 3 shows a fragmentary, vertical, sectional view showing the lower end portion of the apparatus.

Figure 4 shows a side elevation of the apparatus, partly in section, as mounted in the housing, said housing being shown in section.

Figures 5 and 6 show, respectively, fragmentary, vertical sectional views of an intermediate and lower end portion of the apparatus.

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 2.

Referring now more particularly to the drawings wherein like numerals of reference designate the same parts in each of the figures, the numeral 1 designates an elongated tubular housing shaped to be lowered into a well. The upper end of this housing is closed by the cap 2 to which the lower end of the cable 3 is connected. The cable is used for lowering the apparatus into and withdrawing it from the well.

Attached to the lower end of the housing there is a guide point 4 having a deep socket 5 therein in which is located the coil spring 6.

Enclosed within the housing there is a cylindrical casing which is formed of upper, intermediate, and lower sections 7, 8 and 9, the sections 7 and 8 being connected by an inside coupling 10. The upper end of the casing is closed by a cap 11 having a stuffing box 12 thereon and the lower end 13 of the casing is closed as shown in Figure 3 and is seated on the upper end of the coil spring 6, which forms a shock absorber.

The coupling 10 is inwardly thickened and has an axial bearing 14 therethrough through which the connecting rod 15 is slidably fitted and this rod is closely surrounded by the stuffing box 16 carried by said coupling. A fluid tight chamber 17 is thus formed between the cap 11 and the coupling 10 and this chamber is filled with a suitable liquid.

Fitted within the section 7 there is a plunger 18 which is attached to the upper end of the rod 15 and which is surrounded by suitable packing 19. The plunger has the vertical duct 20 therethrough and slidably mounted between the guides 21, 21 on the upper end of said plunger there is a valve 22 having a port 23 therethrough. This port is normally held in alignment with the duct 20 by means of pull springs 24, 24 suitably connected at one end to the valve and at the other end to the plunger. The inner end of the valve carries a roller 25 for a purpose to be hereinafter explained.

There is a cylinder 26 whose lower end is attached to the upper end of the plunger 18 and attached to the upper end of this plunger there is a guide plug 27 having an axial bearing 28 therethrough. This guide plug 27 forms also the lower end of a cage, said cage comprising also the upper end disc 29 and the guide rods 30 which connect the upper end disc 29 with the guide plug 27. Within the cage, and guided by said rods, there is an impact member 31 which is also held against turning by the rods, as illustrated in Figure 7.

There is a rod 32 which works through, and extends above, the stuffing box 12 and whose

lower end is attached to the upper disc 29 of said cage. The upper end of this rod carries the grip member 33 and a coil spring 34 surrounds the rod and is interposed between the upper end cap 11 and the upper disc 29 of said cage.

The impact member 31 has an axial bore 35 containing a coil spring 36 whose lower end is attached to said impact member and whose upper end is extended upwardly and attached to the upper end of the cage, said upper end of the spring 36 being surrounded by a coil spring 37 which depends from the top of the cage and whose lower end is free and normally spaced above the impact member as shown in Figure 1 and which acts as a shock absorber to limit the upward movement of the impact member.

A valve actuating rod 38 is mounted with its upper end working through the bearing 28 and with its lower end working in the axial bore 39 of the plunger 18. This lower end of the rod 38 has an elongated side notch 40 whose upper end is upwardly and outwardly beveled forming a cam face 41. When the apparatus is inoperative the roller 25 rests in said notch.

On the rod 38 and located within the cylinder 26 there is a plunger 42 having a duct 43 therethrough from its lower to its upper end, the upper end of said duct being normally closed by the upwardly opening valve 44, which is normally held closed by the pressure spring 45. The plunger 42 and the rod 38 whereon it is mounted are normally held elevated by the coil spring 45a which is enclosed within the cylinder 26 and is supported by the plunger 18 and supports the plunger 42.

In the intermediate section 8 of the casing there is a cross-head 46 which is attached to the lower end of the rod 15 and depending from said cross-head there is a tubular skirt 47.

The recording mechanism proper will now be described; there is a tubular anchor 48 slidably fitted into the upper end of the lower section 9 of the casing and provided with a longitudinal slot 49. A key 50 is anchored to the section 9 and extending inwardly into the slot. This anchor is supported on a coil spring 51 which is fitted within the section 9 and which is supported on the inwardly extended pins 52 which are anchored to said casing.

The upper end of the anchor 48 is enlarged and fitted closely within the intermediate section 8 of the casing providing a downwardly facing external stop 53 which limits the downward movement of the anchor. Said anchor is normally held in its upper position by the coil spring 51.

There is a disc-like record receiving element 54 whose margin is suitably attached to the upper end of the anchor 48. This record receiving element is preferably, though not necessarily, transparent and is formed of any suitable material adapted for the purpose. Preferably it is slightly flexible and of sufficient softness to receive a mark or impression and will not be liable to be broken or mutilated.

Spaced beneath the pins 52 are the inwardly extended pins 55 which support a ring 56. Supported on this ring there is a coil spring 57 which supports a plate 58 and normally holds it against the pins 52. The plate 58 has a central opening 59 and surrounding said opening on the plate are the antifriction bearings 59a on which the ball 60 is mounted. This ball is retained in place by the retainer plate 61 which is secured on the plate 58. The retainer plate 61 has a central opening and a post 62, is attached to, and upstands from, the ball 60 through said opening and its upper end is pointed and spaced beneath record receiving element 54.

An externally threaded stem 63 depends from the ball 60 through the opening 59 and a pendulum is attached to and depends from said stem. This pendulum includes the head 64 and the weight 65. This weight encloses a coil spring 66 whose upper end is connected to the head and whose lower end is connected to the weight. This pendulum maintains the pointed post 62 in vertical position. The head and weight have a ball and socket joint connection 67 whereby the shock of the lateral swing of the pendulum will be absorbed to prevent breakage or bending of parts, particularly when the pointed end of the post 62 is engaged with the record receiving element 54, as shown in Figure 6. Depending from the cross-head 46 there is an upper pendulum 68 which is located within the skirt 47. The lower end of this pendulum is provided with a pointed marker 69. The upper end of the pendulum 68 is formed with a spherical head 70 forming a ball joint member which is normally supported in the socket 71 formed in the upper face of the bearing plate 72 which is secured to the lower end of the cross-head 46. The lower end of this cross-head has a deep vertical socket 73 in which there is located a bearing block 74 and a coil spring 75 is enclosed within the socket 73 and presses downwardly against the ball joint member 70 and maintains it firmly seated in the socket member 71. The pressure of the bearing block 74 against the ball joint member 70 is sufficient to prevent vibration or an undue oscillation of the pendulum 68 but permits said pendulum to assume a true vertical position.

In use the apparatus is set by vibrating, or jarring, the same to cause the impact member 31 to drive the rod 38 downwardly to cause the cam face 41 to move against the roller 25 to close the valve 22 and place the spring 45a under compression. The rod 32 and plunger 18 are then pulled upwardly placing the spring 34 under compression and the liquid above leaking past the cylinder 26 and plunger 18 and into the chamber 17 beneath said plunger 18. The apparatus is then enclosed in the housing 1 and the cap 2 attached thereto, and the apparatus is lowered into the well.

As the apparatus is lowered it may be vibrated, or jarred, to cause vertical reciprocation of the impact member 31 and this continued jarring, or vibration, of the device, as it is being lowered, will continue successive impacts of the member 31 against the upper end of said rod 38 so as to maintain the rod 38 in its lowermost position against the pressure of the spring 45a in the opposite direction and to maintain the valve 22 closed.

When the apparatus has reached the desired location in the well and becomes stationary, the timing apparatus will begin to operate, that is, the constant pressure of the spring 45a upwardly against the plunger 42 will gradually elevate said plunger, the liquid in the cylinder 26 above gradually leaking between the plunger 42 and the walls of the cylinder 26 until the notch 40 registers with the roller 25 permitting the valve 22 to open and thereupon the plunger 18 will move downwardly under the influence of the spring 34 thus moving the pendulum 68 downwardly until the pointed marker 69 engages, and forms a mark on, the record receiving element 54, as shown in Figure 6. The spring 75 will thereafter yield to

prevent the marker from unduly mutilating the record receiving element.

The downward movement of the plunger 18 continues until the lower end of the skirt 47 comes into contact with and moves the record receiving element 54 downwardly into engagement with the pointed upper end of the post 62, placing the spring 51 under compression and said post will make a mark on the under side of said receiving element and thereafter the spring 57 will yield to prevent undue mutilation of the record receiving element by said post.

The springs 75, 51 and 57 will yield sufficiently to prevent the record receiving element 54 from being unduly mutilated but at same time have sufficient resistance to cause said markers to make visible marks on the record receiving element.

When the apparatus is lowered to the desired place in the well where a record of the inclination is to be made, a sufficient time should be allowed to lapse to give the timing device time to operate to make the record and the apparatus may then be withdrawn for an inspection of the record receiving element.

If the markers 62, 69, make marks exactly at the center of the element 54 it will be known that the well bore was exactly vertical at the point where the record was made.

As shown in Figure 6 the apparatus is shown inclined to the vertical and in such case the marks on the record receiving element will each be off center and on opposite sides of the center of the record receiving element. The distance the marks so made are from the center of the receiving element indicates the amount of inclination of the bore. In other words the data furnished by the marks made by the markers 62, 69 furnish sufficient data to enable the amount of the inclination of the bore at a point where the record is made to be readily ascertained, and if the inclination of the bore at that point makes it necessary the bore can be straightened in any approved manner.

As shown the markers operate on a common record receiving element 54. Separate record receiving elements, however, may be provided for the respective markers and the same result and information thus obtained.

The drawings and description disclose what is now considered to be a preferable form of the invention by way of illustration only, while the broad principle of the invention will be defined by the appended claims.

What I claim is:

1. A deviation recording device shaped to be lowered into a well and comprising, means effective, upon operation thereof, to make a record of the inclination of the well bore, said record making means comprising a record receiving element and a pair of gravity actuated markers one above and one below said element adapted to penetrate into, and to make separate records on, said element, and a timing device operative at a predetermined interval after the initial movement of the apparatus into the well and effective to actuate the record marking means.

2. A deviation recording device shaped to be lowered into a well comprising a casing, a yieldably mounted record receiving disc longitudinally movable in the casing, means for limiting the range of movement of the disc, a pendulum support in the casing above the disc, a pendulum depending from said support and whose lower end terminates in a marker, a tubular skirt depending from said support around the pendulum whose lower end is adapted to engage the disc upon downward movement of the support, a yieldably mounted support in the casing beneath said disc, an upstanding post pivoted to said last mentioned support and whose upper end terminates in a marker and a timing device operative at a predetermined interval after the initial movement of the apparatus into the well and effective to move the pendulum support downwardly to cause the pendulum, marker and the skirt to engage said disc and to effect the downward movement of the disc into engagement with the marker on said post, whereby said markers will make separate records on said disc.

3. A deviation recording device shaped to be lowered into a well comprising a casing, a yieldably mounted record receiving disc longitudinally movable in the casing, means for limiting the range of movement of the disc, a pendulum support in the casing above the disc, a pendulum depending from said support and whose lower end terminates in a marker, a tubular skirt depending from said support around the pendulum whose lower end is adapted to engage the disc upon downward movement of the support, a yieldably mounted support in the casing beneath said disc, an upstanding post pivoted to said last mentioned support and whose upper end terminates in a marker and a timing device operative at a predetermined interval after the initial movement of the apparatus into the well and effective to move the pendulum support downwardly to cause the pendulum, marker and the skirt to engage said disc and to effect the downward movement of the disc into engagement with the marker on said post, whereby said markers will make separate records on said disc and a swinging weight depending from the lower end of said post.

4. A deviation recording device shaped to be lowered into a well and comprising means effective, upon operation thereof, to make a record of the inclination of the well bore, said record making means comprising a yieldably mounted, record receiving element and a pair of gravity actuated markers one above and one below said element adapted to penetrate into, and to make separate records on, said element, said markers being mounted to yield upon coming into contact with the element and a timing device operative at a predetermined interval after the initial movement of the apparatus into the well and effective to actuate the record making means.

5. A deviation recording device shaped to be lowered into a well and comprising means effective, upon operation thereof, to make a record of the inclination of the well bore, said record making means comprising a record receiving element, a gravity actuated marker at one side of said element, a marker on the other side of said element, said markers being adapted to penetrate into, and to make separate records on, said element and a timing device operative at a predetermined interval after the initial movement of the apparatus into the well and effective to actuate the record making means.

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