March 25, 1930. H. J. MORGAN 1,751,594

APPARATUS FOR DETERMINING DEVIATION OF WELL HOLES FROM THE VERTICAL

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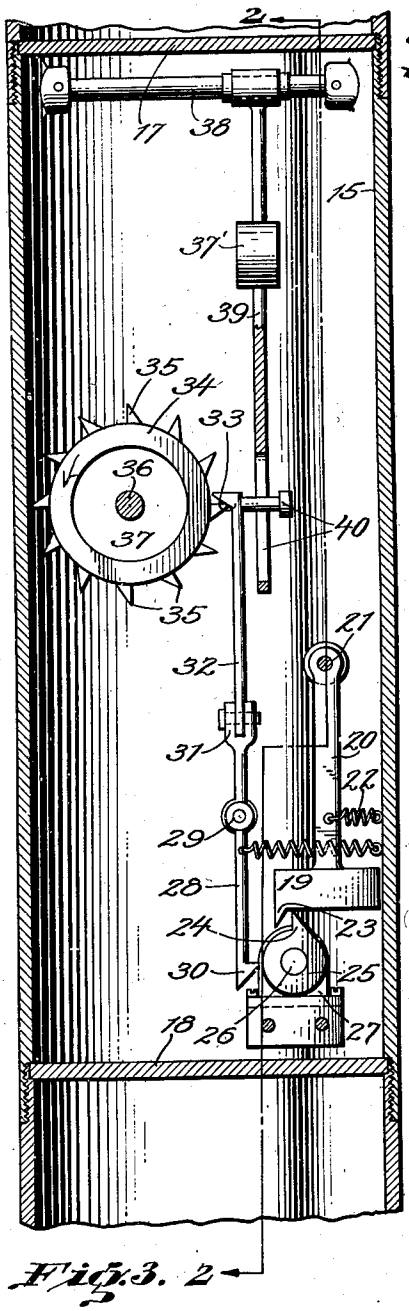
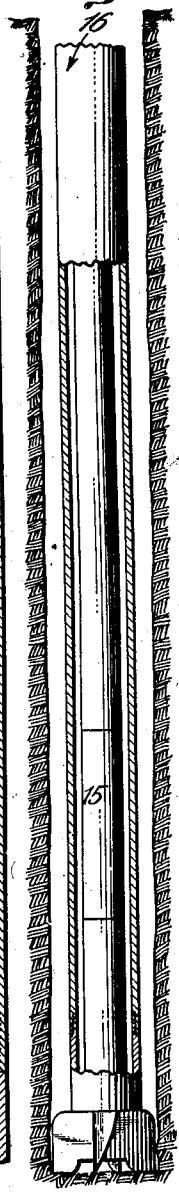


Fig. 1.



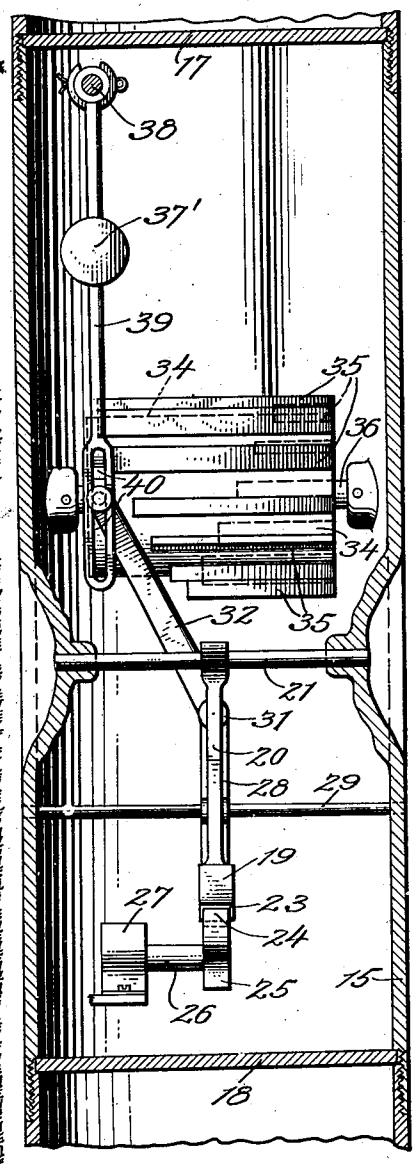


Fig. 2.

Fig. 3. 2

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UNITED STATES PATENT OFFICE

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APPARATUS FOR DETERMINING DEVIATION OF WELL HOLES FROM THE VERTICAL

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My invention relates to well drilling, and it has for a purpose the provision of an apparatus for determining deviation of well holes from the vertical so that such deviation may be corrected and the hole rendered perpendicular.

It is also a purpose of my invention to provide an apparatus by which audible signals are produced automatically within a drill pipe to indicate deviation of the well hole from the vertical, and in which the character of the signal given is varied to indicate the degree of deviation so that suitable corrective methods may be employed.

I will describe only one form of apparatus for determining deviation of well holes embodying my invention, and will then point out the novel features thereof in claims.

Fig. 1 is a view showing in vertical section a portion of a drill pipe having applied thereto one form of apparatus for determining deviation of well holes embodying my invention.

Fig. 2 is an enlarged vertical sectional view of the barrel shown in Fig. 1 illustrating the apparatus in front elevation.

Fig. 3 is a view similar to Fig. 2 showing the apparatus in side elevation.

In carrying out my invention, I provide a barrel 15 for housing the apparatus, and which is positioned within a drill pipe 16 so as to be disposed axially therein in order to provide the necessary space therearound for the free circulation of mud fluid downwardly through the drill pipe. The lower end of the barrel 15 is closed and secured to the drill pipe in the manner illustrated, its upper end being likewise closed so as to prevent the admittance of any mud fluid into the barrel and to thereby maintain the parts of the apparatus free of any obstructions, to insure proper operation thereof at all times. In the present instance I have shown screw plugs 17 and 18 for closing the opposite ends of the barrel after the parts of the apparatus have been once applied.

The apparatus includes a sound producing means which comprises a hammer or tapper 19 mounted on the lower end of an arm 20 and pivoted at the point indicated at 21 upon the barrel 15. The mounting of the hammer is such, that when actuated it will strike the barrel 15 and thus produce molecular vibration of the barrel, which by reason of the physical connection between the barrel and the drill pipe, produces molecular vibration of the latter which is transmitted throughout the length of the drill pipe so as to produce at the upper end of the latter a signal capable of being readily detected. A spring 22 connects the arm 20 to the barrel 15 so as to urge the hammer 19 toward the adjacent wall of the barrel and to yieldingly maintain a lug 23 fixed on the hammer in the path of movement of a lug 24 fixed on the periphery of a wheel 25. The wheel 25 is secured to a shaft 26 of a spring motor 27 which constantly tends to rotate the wheel 25.

The actuating means for the hammer 19 is controlled in its actuation by a control means which includes a lever 28 fulcrumed on an axle 29 so as to be mounted for oscillation to move a latching lug 30 into or out of engagement with the lug 24. The latching lug 30 is positioned on the lower end of the lever 28, and in the normal position of the lever it engages the lug 24 so as to restrain the wheel 25 against rotation and to thereby prevent actuation of the hammer 19. The upper end of the lever 28 is bifurcated as indicated at 31, and in this bifurcated portion the lower end of an arm 32 is pivoted to swing about an axis at right angles to the axle 29. The upper end of the arm 32 is provided with a dog 33 which bears against the periphery of a drum 34 under the urging action of a spring 28^a connected to the lever 28 as shown, and so as to be disposed in the path of movement of any one of a plurality of series of protuberances or teeth 35, formed on the periphery of the drum. The drum 34 is rotatable on the shaft 36 of a spring motor 37, the motor being contained within the drum, and its shaft suitably fixed in the barrel 15. The motor 37 operates to drive the drum 34 in a counter clockwise direction as when viewed in Fig. 3, so as to cause the teeth 35 of any one series to successively engage the dog 33, depending upon the position of the arm 32 in respect to the several

series of teeth. The teeth of any one series extend circumferentially of the drum, and as will be clear from a consideration of Fig. 2, the teeth of the several series progressively increase in number from the left to the right hand end of the drum. By reason of the mounting of the arm 32 upon the lever 28, the arm is capable of adjustment to dispose the dog 33 in the path of movement of any one series of teeth 35, and in consequence, when the drum 34 is rotated, the arm 32 will be oscillated a number of times, corresponding to the number of teeth of the particular series. The mounting of the arm 32 on the lever 28 causes oscillation of the arm to be transmitted to the lever and to thereby move the latching lug 30 into and out of the path of movement of the lug 24. As the lever 28 is oscillated each time the dog 33 is engaged by a tooth 35, it will be clear that the number of oscillations of the lever is dependent upon the position of the arm 32. The apparatus is designed so that with each oscillation of the lever 28, the wheel 25 is released to complete one revolution, thereby actuating the hammer 19 to produce a single striking of the barrel 15. Consequently, the number of times that the hammer 19 strikes the barrel 15 is directly determined by the number of oscillations of the lever 28, and as the oscillation of such lever is in turn controlled by the teeth 35, it will be apparent that the operations of the hammer are varied in accordance with the adjustment of the arm 32. As an illustration, if the arm 32, is adjusted to position the dog 33 in the path of movement of the second series of teeth 35, the lever 28 will be oscillated twice to permit double rotation of the wheel 25 and to thereby operate the lug 24 to cause the hammer 19 to twice strike the barrel 15 and thus produce two sounds or signals.

A plumb bob 37 is provided for the purpose of adjusting the arm 32 in accordance with the degree of deviation of the barrel 15 from the vertical, and to thereby indirectly control operation of the hammer 19 to produce signals varying in number in accordance with the degree of deviation. The plumb bob 37′ is pivoted on an axle 38 secured within the barrel 15 so as to permit the necessary swinging movement of the plumb bob in response to deviation of the barrel from the vertical. An arm 39 is fixed to the weighted end of the plumb bob and by means of a pin and slot connection 40, is operatively connected to the arm 32 so that as the plumb bob is actuated the arm 32 will be adjusted over the periphery of the drum 34 to shift the dog 33 in accordance with the degree of movement of the plumb bob. That is to say, in accordance with every degree of movement of the plumb bob, the dog 33 is moved a distance corresponding to one tooth 35. Thus, for example, if the plumb bob shifts 10° from the vertical, the arm 32 will be adjusted to position the dog 33 in the path of movement of the tenth series of teeth 35, and under rotative movement of the drum 34, the ten teeth of this series will oscillate the lever 28 ten times to permit ten revolutions of the wheel 25, whereby, the hammer 19 will be operated to produce ten separate and distinct signals, which under the molecular vibration of the barrel and drill pipe will be transmitted to the top of the drill pipe for audible detection in any suitable manner.

In practice, the parts of the apparatus normally occupy the positions shown in solid lines in Fig. 2 as long as the drill pipe maintains a true vertical and the resultant hole being bored remains vertical. However, concurrent with any deviation of the drill pipe or hole from the vertical, the plumb bob in maintaining the vertical position produces relative movement of the drum 34 and the arm 32 which results in movement of the dog 33 to the right so as to be disposed in the path of movement of one of the series of teeth 35 whence, the lever 28 is oscillated to release the wheel 25 and thus effect operation of the hammer. Just which series of teeth 35 engages the dog 33 depends upon the amount of movement of the arm 32 as determined by the degree of deviation of the drill pipe from the vertical, and inasmuch as the number of signals produced by the hammer is dependent upon the number of teeth of the series engaging the dog 33, it should be apparent that the degree of deviation may be determined by noting the number of signals sounded. In actual practice, the drill pipe is rotated very slowly once the operator detects the signals, and by noting the greatest number of signals sounded at any one time during one complete rotation of the drill pipe, he may readily ascertain the degree of deviation so that suitable methods may be employed to straighten the hole.

I do not wish to be restricted or limited in the form of apparatus herein illustrated and described nor to a mechanical apparatus, as it will be apparent that an electrical apparatus may be employed to actuate the hammer or other sound producing instrument in accordance with the deviation of a drill pipe from the vertical, and without departing from the spirit of my invention, and the spirit and scope of the appended claims.

I claim:

1. An apparatus for determining deviation of well holes from the vertical, comprising sound producing means, means for actuating said means, and means operatively connected to the actuating means to permit operation thereof only when the well hole deviates from the vertical.

2. An apparatus for determining deviation of well holes from the vertical, compris-

ing sound producing means, means for actuating the first means, means for controlling the actuating means, and means for operating the control means in response to deviation of a drill from the vertical in such manner that the actuating means operates the sound producing means only when the drill deviates from the vertical.

3. An apparatus for determining deviation of well holes from the vertical, comprising sound producing means, means for actuating the first means, and mean controlling the actuating means in a manner to effect operation of the sound producing means a predetermined number of times variable in accordance with the amount of deviation of a well hole from the vertical.

4. An apparatus for determining deviation of well holes from the vertical, comprising sound producing means, and means so correlated with the first means as to be responsive to deviation of a drill from the vertical for controlling actuation of said means in a manner to vary the characteristics of the sound produced by the first means to indicate the degree of deviation of the drill from the vertical.

5. An apparatus for determining deviation of well holes from the vertical, comprising sound producing means, means for actuating the sound producing means, and means so correlated with the actuating means and a drill as to control actuation of the sound producing means in accordance with deviation of a drill from the vertical and in a manner to indicate the amount of deviation from the vertical.

6. An apparatus for determining deviation of well holes from the vertical, comprising sound producing means, means for actuating the first means to produce a series of sounds, means controlling the actuating means to vary the number of sounds produced by the first means, and means responsive to deviation of a drill from the vertical for governing the control means so that the number of sounds produced by the first means varies in accordance with the degree of deviation.

7. An apparatus for determining deviation of well holes from the vertical, comprising sound producing means, means for actuating the first means to produce a series of sounds, means controlling the actuating means to vary the number of sounds produced by the first means, and a plumb bob adapted to be mounted upon a drill and operatively connected to the control means so that the number of sounds produced by the first means varies in accordance with the degree of deviation of the drill from the vertical:

8. An apparatus for determining deviation of well holes from the vertical, comprising a hammer, means for mounting the hammer within a drill pipe for movement to strike the pipe and produce molecular vibration thereof, means for actuating the hammer, means controlling the actuating means to cause the hammer to strike the drill pipe a predetermined number of times, and means responsive to deviation of the drill pipe from the vertical and governing said control means in such manner that the number of times the hammer strikes the drill pipe varies in accordance with the degree of deviation of the drill pipe from the vertical.

9. An apparatus for determining deviation of well holes from the vertical as embodied in claim 8, wherein said governing means comprises a plumb bob.

10. An apparatus for determining deviation of well holes from the vertical, comprising sound producing means, means constantly acting to operate the first means, a latch for restraining the second means against operation, means for actuating the latch to secure predetermined and variable movements of the actuating means for operating the sound producing means predetermined and variable numbers of times, and means responsive to deviation of a drill pipe from the vertical for controlling the latch actuating means.

11. An apparatus for determining deviation of well holes from the vertical, comprising a hammer, means for mounting the hammer within a drill pipe to strike the latter and produce audible signals through molecular vibration thereof, means for operating the hammer to produce audible signals varying in number, and means operatively connected to the operating means for controlling operation of the hammer in accordance with deviation of a drill pipe from the vertical in such manner that the number of signals produced indicates the degrees of deviation.

12. An apparatus for determining deviation of well holes from the vertical, comprising a hammer, means for mounting the hammer within a drill pipe to strike the latter and produce audible signals through molecular vibration thereof, means for operating the hammer to produce audible signals varying in number, and means operatively connected to the operating means for controlling operation of the hammer in accordance with deviation of a drill pipe from the vertical.

13. An apparatus for determining deviation of well holes from the vertical, comprising a striking element, rotatable means for actuating the striking element, control means for the actuating means including a pivoted member and a rotatable member for oscillating the pivoted member, means for rotating the rotatable member, said rotatable member having protuberances thereon arranged in groups, the protuberances of each group varying in number and positioned on the rotatable member to oscillate the pivoted

member successively and for a number of times corresponding to the number of the protuberances when the member is rotated, and means operatively connected to the pivoted member for moving the latter so as to be engaged by any one of said groups of protuberances, the last means having a mounting adapted for association with a drill pipe so as to render said means responsive to deviation of the drill pipe from the vertical, whereby, said pivoted member will be operated in accordance with the degree of deviation of the drill pipe from the vertical and in a manner to vary the number of oscillations of the pivoted member in accordance with the degree of deviation.

14. An apparatus for determining deviation of well holes from the vertical, comprising a striking element, rotatable means for actuating the striking element, control means for the actuating means including a pivoted member and a rotatable member for oscillating the pivoted member, means for rotating the rotatable member, and means for urging the pivoted member into an inoperative position with respect to the rotatable member, and means responsive to deviation from the vertical for moving the pivoted member into operative position with respect to the rotatable member.

HARRY J. MORGAN.