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SOUNDING DEVICE FOR LIQUID LEVELS

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3 Sheets-Sheet 1

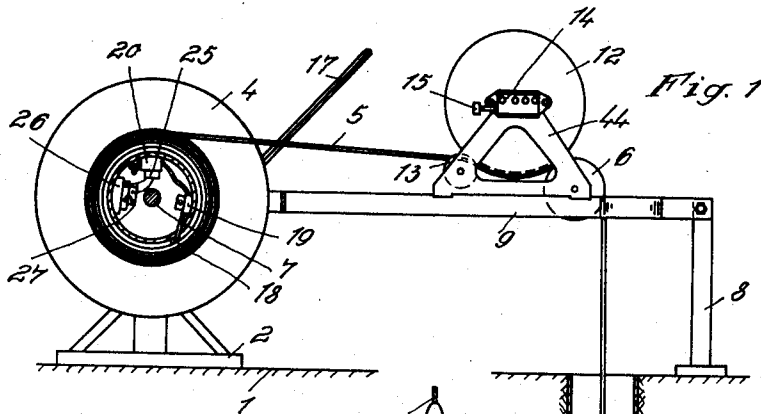


Fig. 3

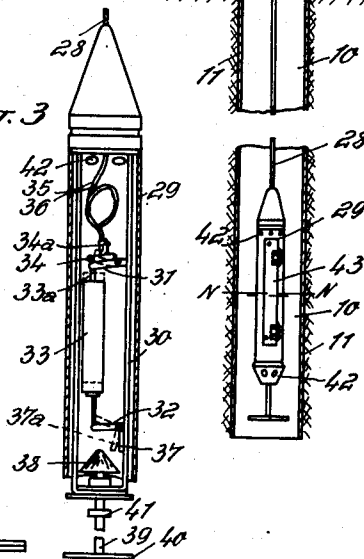
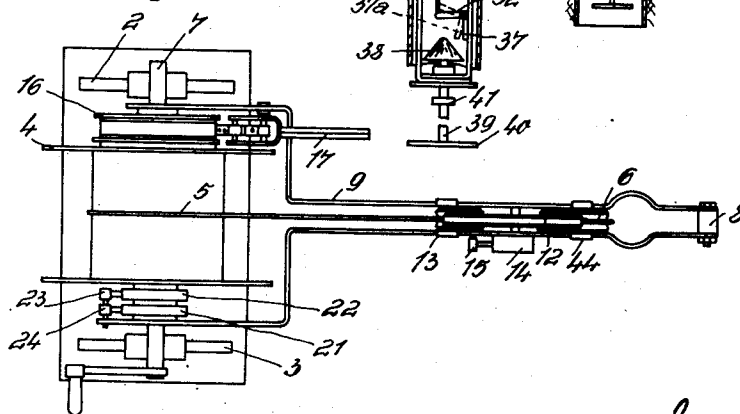


Fig. 2



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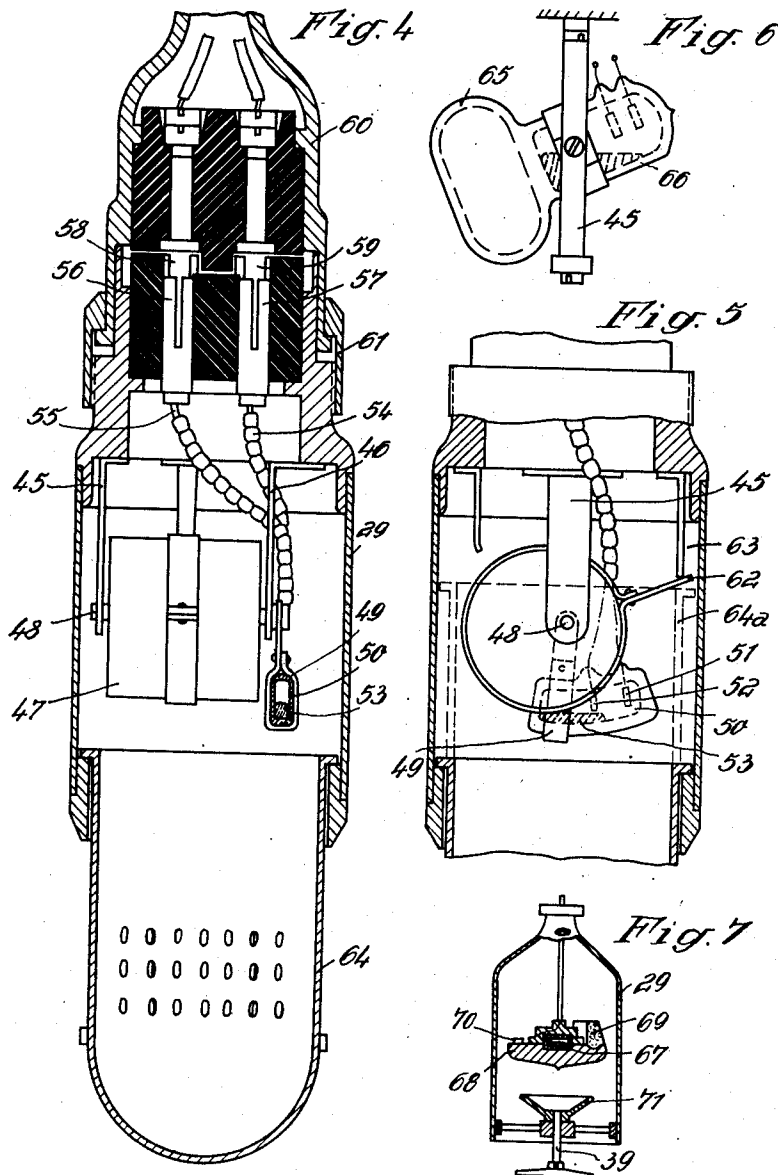
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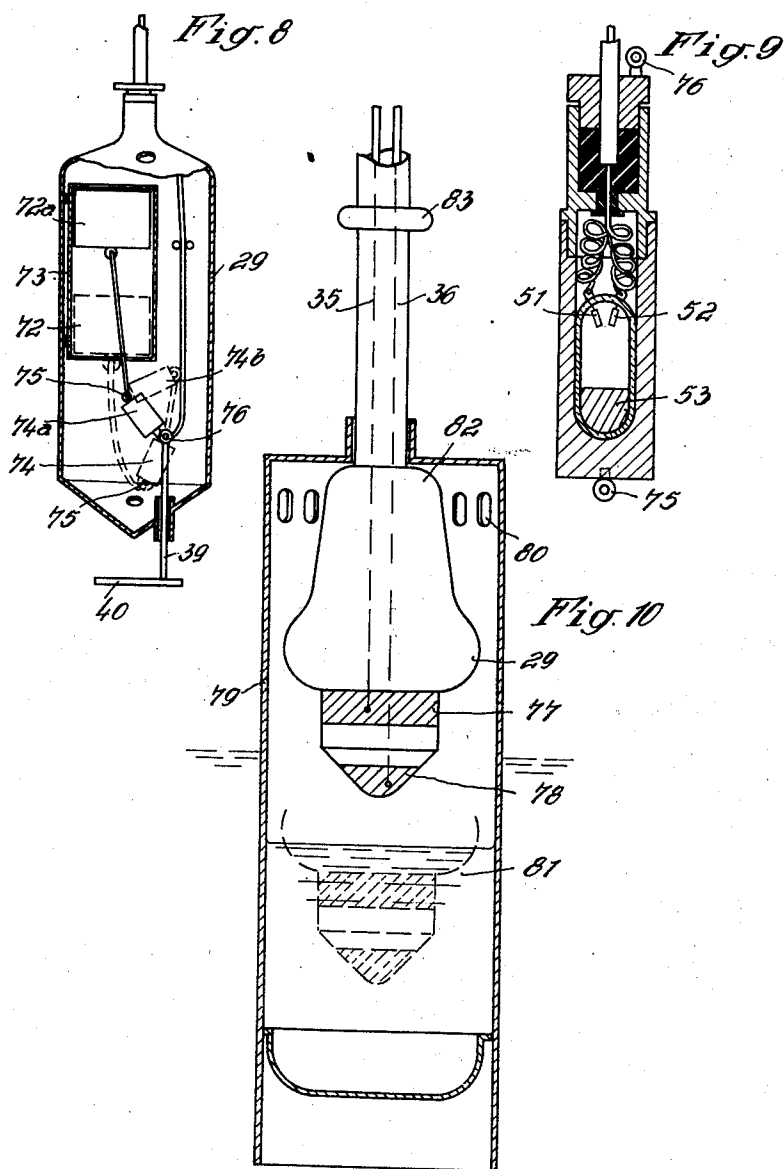
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SOUNDING DEVICE FOR LIQUID LEVELS

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

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SOUNDING DEVICE FOR LIQUID LEVELS.

Application filed May 31, 1927, Serial No. 195,514, and in Germany May 17, 1926.

Our invention relates to a sounding device for liquid levels which is particularly suitable for determining the character of oil wells.

An oil well generally supplies besides the oil also brine, gas and sand or sludge. These substances are located in layers above one another in the bore hole. Directly upon the bore hole sole settles the sand or sludge carried along by the inflowing liquid, above it collects the brine and above the layer of brine the specifically lighter oil which contains more or less gas. Above the oil is located a froth-like mixture of oil and gas from which gas continually ascends. When the pumping of the oil is to be started, it is necessary to ascertain the correct immersion depth before the pump is lowered into the well. The suction member of the pump must not be immersed too deeply, because it then raises sand and sludge only, so that the pump becomes choked up in a short time. To permit continuation of service it is then necessary to dismantle the pump and to clean it thoroughly. The pump must, furthermore, not be located just above this layer of sand and sludge, because it then raises only the brine existing there. On the other hand it is necessary that the pump should not be placed too high within the bore hole as it then raises gas or foam only. It is necessary that the pump should dip into the layer of oil and, if a high degree of efficiency is to be obtained should dip into the lower portion of this layer which contains less gas.

The depth of immersion was hitherto determined either by a spoon lowered by means of a sounding line or by rods joined together. Both measuring methods are inconvenient and require much time. The measurement by means of the sounding line gives furthermore approximate values only. The time spent on measurements is, furthermore, a loss of production. With inaccurate measurement a subsequent adjustment of the plant after the lowering into the well is unavoidable, which constitutes a further loss of time.

The object of our invention is to eliminate these drawbacks and to permit an accurate determination of the liquid level in a short time.

According to a further modification of our invention the sounding device is so equipped that with it other values characteristic of oil wells may be ascertained, for instance the

depth of the bore hole and the location of the boundary level between the oil and the brine. By periodically repeated measurements also the inflow velocity of the various substances discharged by the well may be determined.

Of highest importance is, furthermore, the determination of the so-called exploitation level, i. e., of that oil level, which sets itself in continuous production after stationary conditions have been arrived at. Its determination is possible then only if the measurement can be carried out immediately after repeated spoonings of a certain quantity of oil, as otherwise the level rises again. This level also can be determined by the sounding device according to our invention, since our device permits a quick execution of the measurement.

According to our invention a sounding weight is attached to a cable. Upon the sounding weight is journaled a member adapted to be moved from its normal position into a deflected position by the pressure of the liquid. At a place above the level of the liquid means are provided for paying out the cable and for indicating the length of cable paid out. A source of current, a switch connected with the movable member in such a manner that switching takes place, if the member moves from one of the said positions into the other, and a current indicating device, preferably located at a place above the liquid level are joined in circuit by the conductor or the conductors of the cable.

In the drawings affixed hereto an embodiment of our invention is illustrated by way of example. These drawings represent in:

Fig. 1 a sectional side-elevation of the complete sounding device,

Fig. 2, a plan of Fig. 1,

Fig. 3, one construction of the sounding weight in longitudinal section,

Fig. 4, another construction of the sounding weight,

Fig. 5, a view at right angles to Fig. 4,

Fig. 6, another construction of the movable member journaled upon the sounding weight according to Figs. 4 and 5,

Figs. 7 and 8 further modifications of a sounding weight,

Fig. 9, a detail of Fig. 8, and in

Fig. 10, a still further modification of the sounding weight.

On the surface 1 is journaled in the standards 2, 3 the cable drum 4 with the two-core cable 5. The cable is passed over the pulley 6 of the swinging jig 9 journaled upon the drum shaft 7 and held in position by the support 8 with respect to the bore hole 10 which is lined with tubes 11. The cable 5 is led along the measuring wheel 12. In order to enable it to adapt itself better to the circumference of the measuring wheel there is provided a special guide pulley 13. The measuring wheel 12 is coupled with the counter 14 returnable into the zero position by a handle 15.

At the side of the cable drum 4 is provided the band brake 16 with the brake lever 17 pivoted upon the jig 9. One end 18 of the cable, which is passed into the interior of the drum 4 and clamped in position by the strap 19, is connected with the terminal box 20 from which the current is led to the slip-rings 21, 22 by means of the brushes 23, 24 located at the side of the drum. With the terminal box 20 is connected by a plug 25 the pocket lamp battery 26 connected in series with the buzzer 27.

At the other end 28 of the cable is attached the hollow sounding weight 29. It forms a housing for the movable parts journaled in its interior. On the frame 30, Fig. 3, is arranged the cork float 33 by means of the connecting link 31 and the bell-crank lever 32. On the connecting link 31 is mounted the mercury switch 34 which is connected with the two conductors 35, 36 of the cable 28. With the arm 37 of the bell-crank lever 32 cooperates the cone 38 which is mounted on the feeler 39 slideably arranged in the frame 30 and provided with the base-plate 40. Its stroke is limited on the one hand by the cone 38 on the other hand by the collar 41. The housing 29 is provided with a plurality of perforations 42 to enable the liquid to reach the float 33. The movable parts within the casing are accessible through the door 43, Fig. 1.

To permit the easy handling of the device the rollers 6, 12, 13 and the counting mechanism 14, Fig. 1, are journaled in a special frame 44 which is detachably connected with the jig 9.

The device functions in the following manner: Assuming that the position of the liquid level N—N in the drill hole 10 is to be determined. For this purpose the sounding weight 29 is lowered into the drill hole by releasing the band-brake 16 by means of the lever 17. The counting mechanism 14 records the paid out length of cable. As soon as the sounding weight 29 is lowered into the liquid below the level N—N, the liquid penetrates into the housing through the openings 42 and raises the float 33 into the position 33^a. Hereby the mercury switch 34 is moved into the position 34^a by means of the con-

necting link 31 and thus the circuit closed across the conductors 35, 36 of the cable, the terminal box 20, the plug 25, the buzzer 27 and the source of current 26. The buzzer calls the measuring attendant's attention to the fact that the liquid level has been reached. Now the drum 4 is brought to rest by applying the band-brake and by repeated pulling up and lowering of the cable the point is determined where the buzzer just responds. The distance of the level from the surface 1 is then equal to the paid out length of cable and may be read off on the counting mechanism 14.

For determining the depth of the drill hole the sounding weight 29 is lowered still further until the base-plate 40 encounters the sole of the drill hole. The feeler 39 is forced into the housing 29 if the sounding weight is lowered still further and returns by means of the cone 38 one arm of the bell-crank lever 32 from the position 37^a into the initial position 37. The float 33 is thereby returned against its natural buoyancy from the position 33^a into the initial position 33 and the mercury switch likewise returns from the closing position 34^a into the opening position 34 and the circuit is opened. The silence of the buzzer indicates to the attendant that the sole of the drill hole has been reached. The depth of the drill hole can be read off on the counting mechanism 14.

Now the cable is reeled in again and the sounding weight is drawn up. During the traversal of the level N—N the first measurement can be checked. As soon as the sounding weight has reached the surface the jig 9 is swung around the shaft 7 of the drum clear of the hole and the mouth of the drill hole made accessible for the introduction of the oil pump.

Referring to the Figs. 4 and 5 of the drawings, it will be observed that in the interior of the sounding weight 29 the cylindrical float 47 is rotatably and eccentrically journaled in the brackets 45 and 46 by means of trunnions 48. Upon one of these trunnions is fixed by means of the strap 49 the mercury switch 50 containing the contact terminals 51, 52 and the drop of mercury 53. These contacts are connected by the flexible conductors 54, 55 with the bushings 56, 57 in the upper part of the sounding weight into which the pins 58, 59 of the plug 60 at the lower end of the cable are inserted. The plug is held to the sounding weight 29 by the cap nut 61.

In the normal position the float 47 rests with the arm 62 against the abutment 63. As soon as liquid penetrates into the housing, the float is rotated clockwise, the arm 62 moves away from its abutment and the mercury switch 50 closes. The lower part 64 of the housing is designed as feeler. It is pushed into the interior of the housing when the weight reaches the sole of the drill hole

and thus takes up the position 64^a, Fig. 5. It thereby encounters arm 62 of the float and returns it into its normal position shown in Fig. 5.

Referring to Fig. 6 of the drawings, it will be observed that the float together with the mercury switch 66 constitutes an integral body of glass. It is pivoted and operated in a manner similar to that shown and described with reference to Figures 4 and 5.

Referring to Fig. 7 of the drawings, it will be observed that the mercury switch 67 is suspended in a bowl-shaped body 68 within the housing 29. Upon one side of the body 68 is mounted the piece of cork 69 balanced by a counterweight 70. As soon as the body 68 dips into the liquid its right-hand side is raised by the float 69 and thus the mercury switch 67 closed. When the implement contacts with the sole of the drill hole the body 68 is returned into the horizontal position by the hollow cone 71 of the feeler 39 and thus the mercury switch opened.

Referring to Fig. 8 of the drawings, it will be noted that the float 72 is guided in the sleeve 73 in the interior of the housing 29. The mercury switch 74, shown in detail in Fig. 9, is attached at its end 75 to float 72. The other end 76 is hinged to the feeler 39. As long as the sounding weight is outside the liquid the float is in the dotted position 72 which permits the mercury switch to open. When the float on immersion in the liquid is raised from the position 72 into the position 72^a, the mercury switch reaches the position 74^a in which the mercury 53 connects its contacts 51, 52. When the weight encounters the drill hole sole the switch is placed into the position 74^b by the feeler 39 whereby the switch is opened again.

Referring to Fig. 10 of the drawing, it will be observed that on the sounding weight 29 are provided insulated the immersion electrodes 77, 78 which are connected with the conductors 35, 36. Axially slideable on the neck of sounding weight 29 is provided the float vessel 79 with the flushing perforations 80. It contains the well conducting contact liquid 81. The stroke of the float vessel 79 is limited by the collars 82, 83 on the sounding weight 29.

The implement operates in the following manner: During the lowering of the sounding weight the float vessel 79 rests upon the collar 82 and the electrodes 79, 78 are not immersed. As soon as the implement comes in contact with the liquid level the float vessel 79 is detained by the force of buoyancy. When still more cable is paid out the electrodes 77, 78 dip into the electrolyte 81. This closes the signalling circuit. The attendant is thus informed that the oil level has been reached. For the purpose of ascertaining the boundary level between the oil and the brine the float vessel 79 is immersed

in the oil by further lowering the sounding weight 29. The oil penetrates through the flushing openings 80 into the float. By repeatedly raising and lowering of the sounding weight 29 the contact liquid 81 is expelled or washed out of the float until the oil which is a poor conductor breaks the current between the electrodes 77, 78. Now the implement is further lowered while the cable is continuously played short distances up and down until the level of the brine has been reached. This is recognized by the signalling device responding again since the current between the electrodes 77, 78 is re-established by the brine, being a good conductor, penetrating into the float.

It is also possible to measure the conductivity of the liquid in the bore hole by the aid of our improved implement. For this purpose the plug 25, Fig. 1, is withdrawn from its socket and the buzzer 27 and the pocket lamp battery 26 disconnected and instead of it another source of current and a measuring instrument connected with the conductors of the cable across the brushes 23, 24, Fig. 2, and the slip-rings 21, 22.

Various modifications and changes may be made without departing from the spirit and the scope of the invention, and we desire, therefore, that only such limitations shall be placed thereon as are imposed by the prior art.

We claim as our invention:—

1. A sounding device for liquid levels, comprising in combination, a cable, a sounding weight attached to said cable, a member movably mounted on said sounding weight and adapted to be moved by the pressure of the liquid from a normal position into a deflected position, means for paying out said cable from a place above the level of the liquid, means for indicating the paid out length of said cable, an electric circuit containing a source of current, a switch connected with said movable member in such a manner that a switching operation takes place when said movable member is moved from one of its said positions into the other, and a current indicating device, said parts of the circuit being connected together by the conductor or conductors of said cable.

2. A sounding device for liquid levels, comprising in combination, a cable, a sounding weight attached to said cable, a float movably mounted on said sounding weight and adapted to be moved by the pressure of the liquid from a normal position into a deflected position, means for paying out said cable from a place above the level of the liquid, means for indicating the paid out length of said cable, an electric circuit containing a source of current, a switch connected with said float in such a manner that a switching operation takes place when said float is moved from one of its said positions into the other, and a current indicating device, said parts of the circuit being

connected together by the conductor or conductors of said cable.

3. A sounding device for liquid levels, comprising in combination, a cable, a sounding weight attached to said cable, a member movably mounted on said sounding weight and adapted to be moved by the pressure of the liquid from a normal position into a deflected position, means for paying out said cable from a place above the level of the liquid, means for indicating the paid out length of said cable, an electric circuit containing a source of current, a switch connected with said movable member in such a manner that a switching operation takes place when said movable member is moved from one of its said positions into the other, and a current indicating device, said parts of the circuit being connected together by the conductor or conductors of said cable, a feeler slidably mounted in the bottom of said sounding weight and adapted to be moved from an initial position into an operative position when encountering a solid resistance, in such connection with said movable member that it returns said member from the deflected position into the normal position against the pressure of the liquid while passing into the operative position.

4. A sounding device for liquid levels, comprising in combination, a cable, a hollow sounding weight attached to said cable, a member movably mounted on said sounding weight and adapted to be moved by the pressure of the liquid from a normal position into a deflected position, means for paying out said cable from a place above the level of the liquid, means for indicating the paid out length of said cable, an electric circuit containing a source of current, a switch connected with said movable member in such a manner that a switching operation takes place when said movable member is moved from one of its said positions into the other, and a current indicating device, said parts of the circuit being connected together by the conductor or conductors of said cable.

5. A sounding device for liquid levels comprising in combination a cable, a hollow sounding weight attached to said cable, a member movably mounted on said sounding weight and adapted to be moved by the pressure of the liquid from a normal position into a deflected position, means for paying out said cable from a place above the level of the liquid, means for indicating the paid out length of said cable, an electric circuit containing a source of current, a switch containing electrodes and a contact liquid in a vessel and connected with said movable member in such a manner that a switching operation takes place when said movable member is moved from one of its said positions into the other, and a current indicating device, said parts of the circuit being connected together by the conductor or conductors of said cable.

6. A sounding device for liquid levels, comprising in combination, a cable, a hollow sounding weight attached to said cable, a member movably mounted on said sounding weight and adapted to be moved by the pressure of the liquid from a normal position into a deflected position, means for paying out said cable from a place above the level of the liquid, means for indicating the paid out length of said cable, an electric circuit containing a source of current, a switch containing electrodes and a contact liquid in a vessel and connected with said movable member in such a manner that a switching operation takes place when said movable member is moved from one of its said positions into the other, and a current indicating device, said parts of the circuit being connected together by the conductor or conductors of said cable, and flushing openings in said vessel of the contact liquid of the switch.

7. A sounding device for liquid levels, comprising in combination a cable, a sounding weight attached to said cable, a member movably mounted on said sounding weight and adapted to be moved by the pressure of the liquid from a normal position into a deflected position, a winch for paying out said cable from a place above the level of the liquid, means for indicating the paid out length of said cable, an electric circuit containing a source of current mounted within the drum of said winch, a switch connected with said movable member in such a manner that a switching operation takes place when said movable member is moved from one of its said positions into the other, and a current indicating device mounted in the drum of said winch, said parts of the circuit being connected together by the conductor or conductors of the cable.

8. A sounding device for liquid levels comprising in combination, a cable, a sounding weight attached to said cable, a member movably mounted on said sounding weight and adapted to be moved by the pressure of the liquid from a normal position into a deflected position, a winch for paying out said cable from a place above the level of the liquid, slip-rings mounted on the drum of said winch and connected with the ends of the conductors of said cable, means for indicating the paid out length of said cable, an electric circuit containing a source of current, a switch connected with said movable member in such a manner that a switching operation takes place when said movable member is moved from one of its said positions into the other, and a current indicating device, said parts of the circuit being connected together by the conductor or conductors of said cable.

In testimony whereof we affix our signatures.

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VICTOR GUTMANN.