April 25, 1939. H. H. JONES 2,155,552

WELLHOLE INCLINOMETER

Filed June 5, 1929

Fig. 1

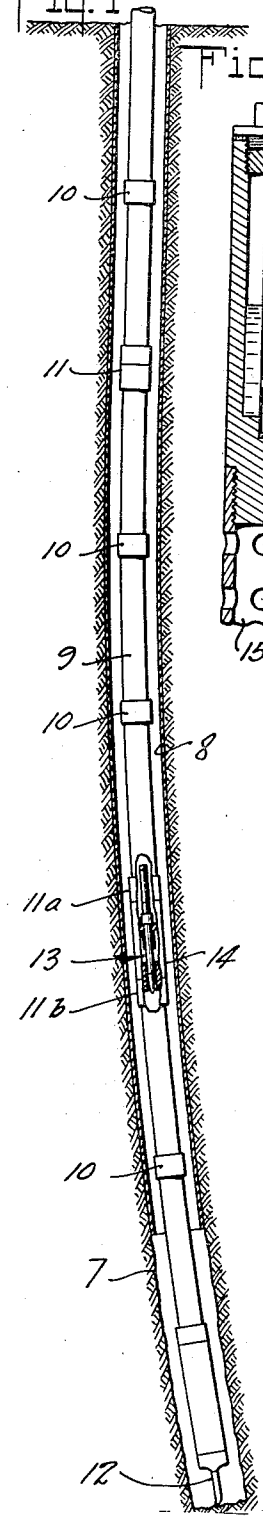


Fig. 2

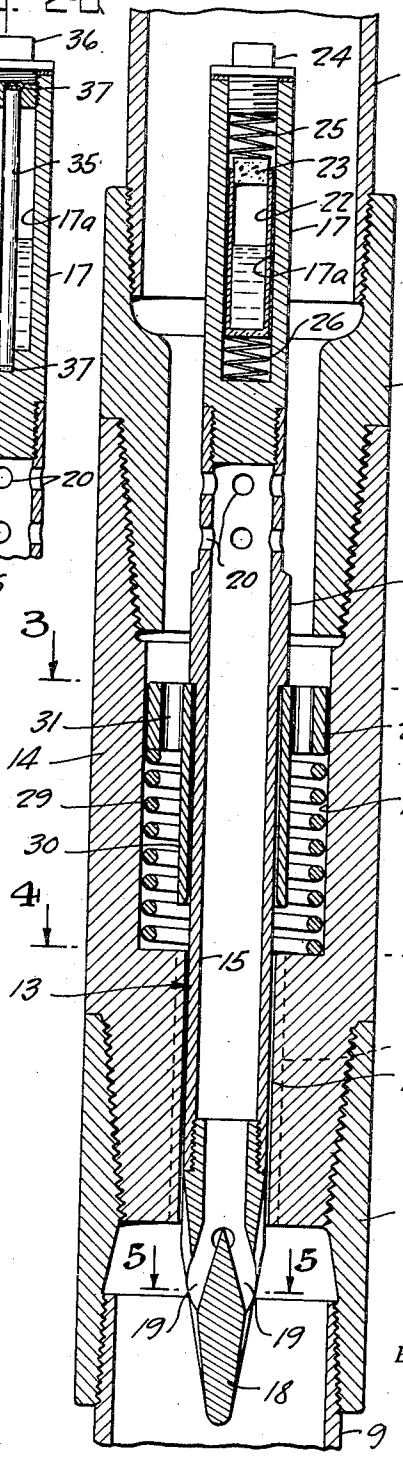


Fig. 2-a

Fig. 3

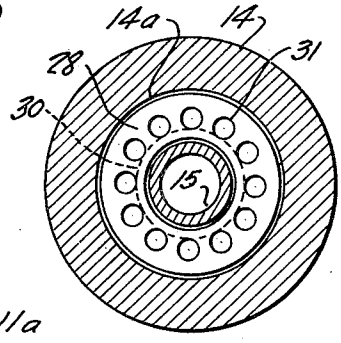


Fig. 4

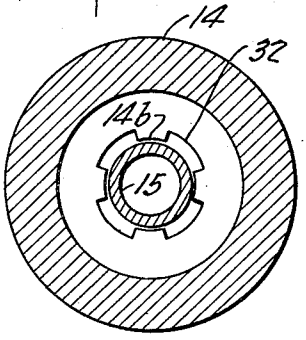
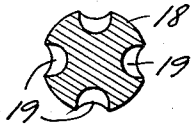


Fig. 5



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WELLHOLE INCLINOMETER

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Application June 5, 1929, Serial No. 368,728

10 Claims. (Cl. 33—205.6)

This invention relates to a method and means for determining the inclination of well holes. It is often of great importance to know the amount by which deep well bores, especially oil wells, depart from the vertical. One method of determining this has been to lower a glass container, partly filled with hydrofluoric acid, in the well by means of the sand line, allow it to remain for an interval at a predetermined depth, and then bring it back to the surface. The acid etches the glass and as the surface of the acid remains horizontal, the inclination of the well at the point where the container was stopped may be readily determined. This method has various drawbacks, the principal one being that of the time consumed in the special operation of running the container in and out of the hole.

It is a primary object of this invention to provide a means for lowering a container, as just described, to any predetermined depth with great rapidity without the use of a special line and by which it can be brought back to the surface when the drill string is withdrawn. Another object is the provision of means whereby the container may be stopped at any desired point in the well, without damage to the container.

A preferred form of my invention is illustrated in the accompanying drawing, in which:—

Fig. 1 is a diagrammatic axial section of a well much enlarged in diameter; Fig. 2 is an axial section through a portion of the drill pipe with the acid container disposed therein; Fig. 2*a* is a similar section showing the upper portion of a slightly different form of container; Figs. 3, 4, and 5 are sections as seen on the correspondingly numbered planes of Fig. 2.

Referring with more particularity to the drawing, a well bore 7 is shown, the lower portion of which is considerably inclined from the vertical. It has the usual casing 8 and string of drill pipe 9, the latter having couplings 10, tool joints 11, and the drilling tool 12 at the bottom. A cartridge or holder 13, holding the acid container is shown stopped in the receiving member 14. The cartridge consists of a tube 15, having an intermediate shoulder or collar 16 of enlarged diameter, a head 17 with space for the acid container at the upper end, and a conical pilot piece 18 at its lower end. The pilot piece is fluted and provided with several ports 19, and the tube has also a number of ports 20. Thus circulation can be maintained at all times from the drill pipe through the cartridge. Head 17 has a bore 17*a* to receive a cylindrical glass acid container 22 which is closed with a plug or cork 23. Bore 17*a* is closed with a threaded plug 24, which should seat on a gasket to insure tightness. Above and below the container are springs 25 and 26, which serve to float the container between the bottom of the bore and the plug and thereby isolate it from shocks.

The receiving member 14 is adapted to be inserted between the pin end 11*a* and the box end 11*b* of a tool joint and is usually termed a sub. It may be inserted at any tool joint in the string. It has a large bore 14*a* in which is slidably disposed an abutment member or thimble 28 adapted to be engaged by collar 16 and arrest the downward travel of the cartridge. Thimble 28 is resiliently supported on a spring 29 and has a skirt 30 designed to guide the cartridge and assist in keeping it in alinement with the drill pipe. A number of ports 31 are provided to pass the circulation. Member 14 has also a smaller bore 14*b* to guide and axially aline the cartridge with the drill pipe 9. Recesses 32 are provided to permit the circulation to pass.

The method of operation is as follows: The drill pipe with the drilling tool at its lower end is run in the hole, a tool joint with the receiving member 14 being inserted in the string of drill pipe at the point where it is desired to measure the inclination of the hole. The string is then rotated and drilling progresses in the usual manner. When the string is to be pulled, because of the drill becoming dull or for any other reason, the Kelly is set back and the cartridge is dropped into the drill pipe. It falls by gravity until the collar 16 encounters thimble 28 which brings it to a stop. The friction of the cartridge passing through the mud laden fluid with which the drill pipe is at all times filled serves to reduce the speed of its fall, and particularly at tool joints, which have a bore substantially less than that of the drill pipe. Its downward progress will be indicated by a clicking noise as it passes each tool joint, clearly audible on the derrick floor, and the cessation of this noise will show that the cartridge has stopped falling. The mud in the drill pipe will show pulsations also as the cartridge passes the tool joints, which cease when cartridge stops and also serves as an indicator. The spring under the thimble serves to absorb the shock of the abrupt stop and prevent breakage of the container. The string is left idle a sufficient time to allow the acid to etch the glass container, and it is then pulled from the hole in the regular manner. If desired the receiving member can be omitted, and the cartridge al-

lowed to fall clear to the bottom of the string and stop on top of the bit.

From the foregoing it will be readily seen that the only additional time required to measure the inclination of a well, is that for the acid to etch the container, as, other than dropping in the cartridge nothing but the regular drilling operations are required. Thus a great saving of time is made over the older methods in which the container was lowered and raised with the sand line or a special string of pipe, either of which were special operations not connected with actual drilling.

It will be noted that ports and passages for the circulation of fluid have been provided, so that there is no possibility of the cartridge stopping circulation whether the pilot is in a round hole or resting on the top of the bit. It is of vital importance to maintain circulation at all times, and while not vital it is of great advantage to not have to pull a wet string.

Should it be desired to use the cartridge in drill pipe of small diameter, spring 29 may be replaced with a rubber sleeve, or the thimble may be omitted entirely and a seat integral with the sub 14 used. The design of the cartridge may be modified as shown in Fig. 2*a*. In this form the glass container is omitted and the acid placed directly in the bore 17—*a*, the acid used having but slight action as metal. A glass rod or tube 35 is placed in a suitable opening in the body, and the bore closed with a plug 36 which has a similar opening to receive the top of the rod, cushions 37 of rubber or other material being inserted. The rod will be etched by the acid to indicate the inclination from the vertical in the same way as the bottle.

What I claim is:

1. A device as described comprising a holder having an intermediate shoulder thereon and arranged to contain an instrument capable of recording its position with respect to the vertical, said holder being adapted to fall by gravity through a string of pipe, an abutment in said string of pipe adapted to register with said shoulder and yielding means interposed between said shoulder and abutment to yieldingly arrest the fall of said holder.

2. A device as described comprising a holder with a shoulder thereon and arranged to contain an instrument capable of recording its position with respect to the vertical, said holder being adapted to fall by gravity through a string of pipe, and an abutment yieldingly supported in said string of pipe adapted to engage said shoulder, and thereby arrest the fall of said holder.

3. A device as described comprising a holder with a shoulder thereon and arranged to contain an instrument capable of recording its position with respect to the vertical, said holder being adapted to fall by gravity through a string of pipe, a sub secured in said string at a predetermined depth, a shoulder in said sub, an abutment yieldingly supported on said shoulder and adapted to engage the shoulder on said holder, and thereby arrest the fall of said holder and support it at said predetermined depth.

4. A device as described comprising a holder with a shoulder thereon and arranged to contain an instrument capable of recording its position with respect to the vertical, said holder being adapted to fall by gravity through a string of pipe, a sub secured in said string at a predetermined depth, an annular shoulder in said sub, an abutment having spring means yieldingly supporting it on said annular shoulder and adapted to engage the shoulder on said holder, and thereby arrest the fall of said holder and support it at said predetermined depth.

5. A device as described comprising a tubular holder formed with a conical portion at its lower end to serve as a guide and a head at its upper end with a chamber arranged to contain an instrument capable of recording its position with respect to the vertical, a closure for said chamber, an annular shoulder on said holder, said holder being adapted to fall by gravity through a string of pipe, a sub secured in said string of pipe with a bore having a shoulder therein, a thimble having spring means resiliently supporting it on said shoulder and adapted to engage the shoulder on said holder and thereby arrest the fall of the holder.

6. The combination of a string of pipe including a member with a substantially cylindrical bore of reduced diameter, a holder having a cylindrical portion of diameter corresponding to the reduced bore of said member and having an outstanding shoulder, said holder being insertable into said bore from one end to insure axial alinement therewith, said member having an outstanding seating ledge at one end for coaction with said shoulder, an instrument in said holder capable of recording its position with respect to the vertical, and cushioning means supporting said container in said holder.

7. The combination of a string of pipe including a member with a substantially cylindrical bore of reduced diameter, a holder having an outstanding shoulder and a cylindrical portion with a pointed end, the cylindrical end being of a diameter corresponding to said reduced bore and insertable into said bore to insure axial alinement therewith, and said pointed portion acting as a pilot guide to register said holder with the bore of said member, said member having an outstanding seating ledge at one end for coaction with said shoulder, an instrument in said holder capable of recording its position with respect to the vertical, and cushioning means supporting said container in said holder.

8. The combination of a string of pipe having a sub with a cylindrical bore of reduced diameter interposed in said string, said sub having a shoulder at the upper end, a free falling holder having a cylindrical portion of a diameter corresponding to said bore with an outstanding shoulder for seating on the shoulder of said sub whereby the fall of said holder will be arrested and said holder supported by said sub in axial alinement therewith, said sub having a pointed end to pilot it into said bore, an instrument capable of recording its position with respect to the vertical, and cushioning means supporting said container in said holder.

9. The combination of a string of pipe having a sub with a cylindrical bore of reduced diameter interposed in said string, the wall of said bore being fluted to by-pass liquid, a free falling holder having a cylindrical portion of a diameter corresponding to said bore with an outstanding shoulder for seating on said sub whereby the fall of said holder will be arrested and said holder will be supported by and in axial alinement with said sub, an instrument capable of recording its position with respect to the vertical, and cushioning means supporting said container in said holder.

10. The combination of a string of pipe having a sub with a cylindrical bore of reduced diameter interposed in said string, the wall of said bore

being fluted to by-pass liquid, said sub having a shoulder at its upper end, a free falling holder having a cylindrical portion of a diameter corresponding to said bore with an outstanding shoulder for seating on the shoulder of said sub whereby the fall of said holder will be arrested and said holder will be supported by said sub in axial alinement therewith, said sub having a pointed end to pilot it into said bore, an instrument capable of recording its position with respect to the vertical, and cushioning means supporting said container in said holder.

HARRY H. JONES.