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Richter, Jr. et al.

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[45] **March 6, 1973**

[54] **UP-HOLE SIGNALING DEVICE**

[75] Inventors: **Albert P. Richter, Jr.**, Houston, Tex.; **James D. Bruner**, Englewood, Colo.; **Percy T. Cox**, Houston, Tex.

[73] Assignee: **Texaco Inc.**, New York, N.Y.

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[52] **U.S. Cl.** **175/50**, 73/152

[51] **Int. Cl.** **E21b 47/12**

[58] **Field of Search** 73/151, 152; 175/40, 48, 50; 166/254, 250

[56] **References Cited**

UNITED STATES PATENTS

3,062,302	11/1962	Toth et al.	175/39
2,787,759	4/1957	Arps	175/50 X
2,380,520	7/1945	Hassler	73/151

Primary Examiner—Richard C. Queisser
Assistant Examiner—John P. Beauchamp
Attorney—Thomas H. Whaley et al.

[57] **ABSTRACT**

In borehole drilling which employs a bit having at least one passage for drilling fluid under pressure, there is apparatus to release a resilient ball that will temporarily block the passage. The blocking will cause a pressure increase that may be observed at the surface.

6 Claims, 2 Drawing Figures

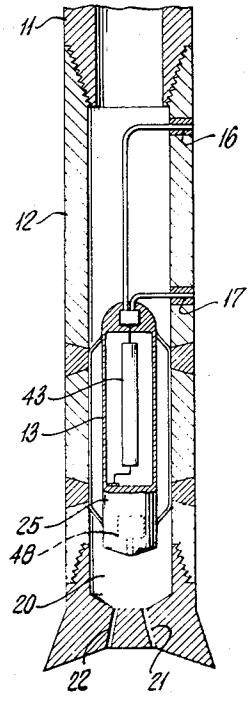


Fig. 1.

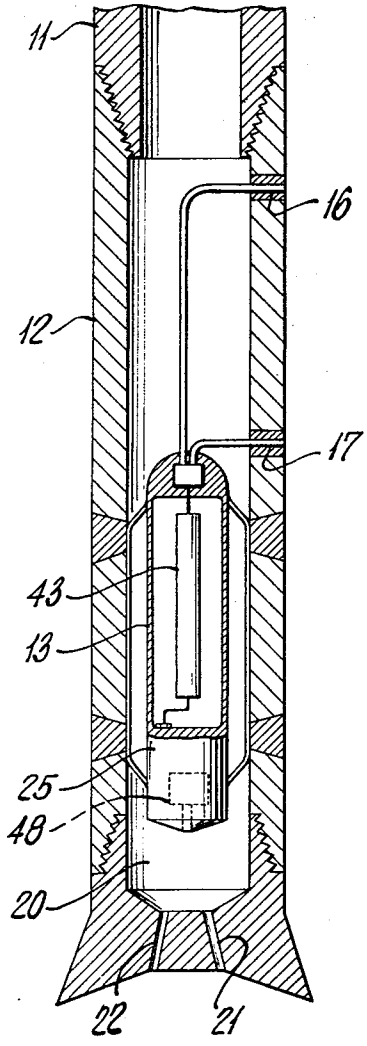
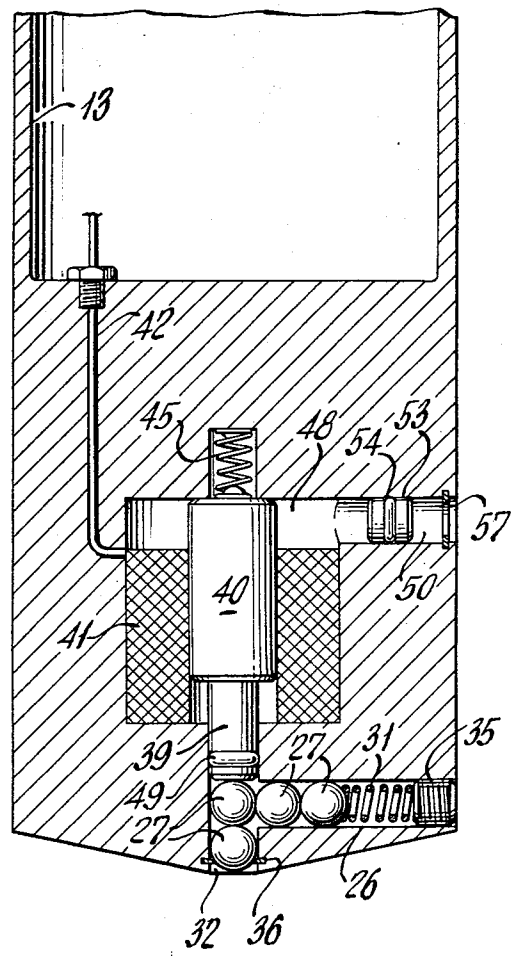

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Fig. 2.


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UP-HOLE SIGNALING DEVICE

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

This invention relates to borehole drilling generally, and more specifically concerns apparatus for use down-hole to signal to the surface. It is particularly applicable to drilling which employs a circulating fluid that is pumped through the drill bit.

2. DESCRIPTION OF THE PRIOR ART

While there have been various drilling instrumentation proposals, particularly where it has been desired to obtain signals from the drill bit directly to the surface without delay, such proposals have involved rather complex and expensive equipment. Consequently, it is an object of this invention to provide notably simple and inexpensive equipment which can provide a signal from down-hole at the drill bit, that is readable substantially instantaneously at the surface.

SUMMARY OF THE INVENTION

Briefly, this invention concerns borehole drilling wherein a drill bit is employed which has at least one passage for drilling fluid to flow through under pressure. It concerns means for signaling to surface which means comprises in combination a means for temporarily blocking said passage in order to cause an increase in said drilling fluid pressure.

Once more, briefly, the invention concerns borehole drilling which employs a drill bit having at least one passage for drilling fluid to flow through under pressure. It concern apparatus for signaling the surface adjacent to the top of the said borehole. It comprises, in combination, an internal housing supported adjacent to said bit and located upstream relative to said passage. It also comprises a plurality of resilient plastic material spheres having a smooth surface and an outside diameter greater than the minimum inside diameter of said passage, and a magazine located inside the housing for storing a plurality of said spheres. The said magazine comprises a cylindrical chamber for holding said plurality of spheres and a cylindrical opening located transversely and connected with one end of said chamber. The magazine also comprises a resilient lip detent near the outer end of said opening for holding the outermost one of said spheres ready to be ejected into said drilling fluid, and a first spring for biasing said spheres in said chamber toward said opening. The invention also comprises a reciprocating plunger aligned with said cylindrical opening, an armature carried by said plunger, and a coil surrounding said armature. It also comprises an filled chamber in said housing for holding said plunger and armature, and a second spring for biasing said plunger into its retracted position. It also comprises a connection between said oil-filled chamber and the exterior of said housing, with a floating piston in said connection for retaining said oil in the chamber and for equalizing the pressure between said oil and the drilling fluid surrounding said housing.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects and benefits of the invention will be more fully set forth below in connection with the best mode contemplated by the inventor of carrying out the invention, and in connection with

which there are illustrations provided in the drawings, wherein:

FIG. 1 is a schematic section illustration showing a drill bit with accompanying apparatus according to the invention; and

FIG. 2 is an enlarged cross-section illustrating the details of apparatus according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, it will be noted that this invention is applicable to rotary drilling operations in particular. Thus, there is shown a drill pipe 11 to which there is attached a subsection 12 that contains a capsule 13 which may have therein any of various types of instrumentation for determining a downhole condition. For example, this capsule might be one such as that shown in U.S. Pat. No. 3,465,582 A. P. Richter, Jr., et. al., dated Sept. 9, 1969.

In the aforementioned patent, the sensing of a desired parameter of down-hole conditions for detecting a significant change, relates to pressure differential between two vertically spaced points along the drill string. Consequently, in the FIG. 1 illustration, there is a pair of apertures 16 and 17 which are spaced longitudinally apart along the subsection 12. These apertures provide for measuring the pressure differential between the two points where they are located, i.e., vertically spaced apart when the drill string and bit are in the hole.

The pressure-differential-measuring instrumentation that includes the schematically indicated elements within capsule 13, form no part, per se, of this invention. They are merely illustrated to show one type of condition-measuring apparatus that ma control the up-hole signaling apparatus of this invention.

It will be noted that, during drilling operations, drilling fluid will be circulated down through the interior of the drill string or pipe 11, and it will flow around the capsule 13 to a chamber 20 that is associated with the bit. From the chamber 20 it flows out under pressure through a plurality of passages 21 and 22. It then recirculates around the cutting surface of the bit and returns to the surface in the borehole annulus (not shown) which surrounds the drill string 11.

The foregoing fluid circulation is accomplished by applying relatively high pressure to the circulating fluid which pressure is monitored at the surface. Consequently, whenever one or more of the passages 21 or 22 are blocked so as to stop the flow of the drilling fluid therethrough, such condition is immediately reflected at the surface by an increase in the pressure of the drilling fluid. It is this pressure increase that is employed to provide an up-hole signal that indicates a predetermined condition at the bit, in accordance with this invention.

To accomplish the blocking of one of the bit passages 21 or 22 on order whenever a predetermined condition occurs, there is an internal housing 25 that is part of the lower end of capsule 13. This housing is illustrated schematically in greater detail in FIG. 2. It contains a cylindrical magazine 26 that is loaded with a plurality of resilient plastic spheres 27. There is a coil spring 31 located behind the spheres in the magazine to apply pressure toward the open end of the magazine 26

where it joins a transverse cylindrical opening 32. Opening 32 is connected to magazine 26 and it has the same diameter. The spring 31 is held in place under compression by a threaded plug 35.

There is a resilient ring or lip 36 located near the open end of the opening 32 which acts as a detent for holding the outermost one of the spheres in place, as illustrated in FIG. 2.

For ejecting one of the spheres from the magazine, there is a plunger 39 that carries an armature 40 attached thereto. The armature 40 is surrounded by a coil 41 that is energized by electrical conductors 42 which lead to elements 43 which are schematically indicated in FIG. 1. These elements are located within capsule 13 and they act in sensing a predetermined condition, as indicated above.

The plunger 39 and armature 40 are mounted for reciprocating action with a coil spring 45 attached to the top of the armature 40 so as to act under tension and bias the plunger (with armature attached) to the position illustrated in FIG. 2. Whenever the predetermined condition is sensed by the equipment in capsule 13, it will energize coil 41 and, thus, draw armature 40 down into alignment with the coil. This, of course, causes plunger 39 to be reciprocated downward (when viewed as illustrated in FIG. 2) and eject the lowermost one of the spheres 27. Then, when coil 41 is de-energized the plunger 39 and armature 40 will return to the upper position illustrated. Thereafter, the coil spring 31 will cause the next one of the spheres 27 to replace the one just above the ejected sphere. The latter will, of course, be now positioned where the ejected sphere was formerly located. Then the apparatus will be ready for another sphere ejection upon determination of the predetermined condition.

When a sphere 27 is ejected from the housing 25, it will go directly into the drilling-fluid stream. Consequently, it will immediately block one of the passages 21 or 22, and this blockage will cause a pressure increase that is reflected to the surface where the pressure is being monitored.

It may be noted here that the spheres 27 are designed with an outside diameter that is somewhat greater than the minimum inside diameter of the passages 21 and 22. Consequently, when a sphere 27 is carried into one of the passages 21 or 22, it will block the drilling-fluid flow therethrough and cause a consequent increase in pressure to be reflected at the surface, as just described above. Such increase in pressure will force the resilient sphere 27 to move through the passage that is blocked and, after a short time, the passage will again be cleared as the sphere is pushed out of the passage. It is this blocking of one of the passages and consequent increase in drilling-fluid pressure, that provides an immediate signal at the surface. Such signal indicates the predetermined condition that was the cause of actuation of the apparatus to eject one of the spheres 27.

There is an oil-filled chamber 48 that contains the plunger 39 and armature 40. The oil is sealed into the chamber by having an O-ring seal 49 near the extremity of the plunger 39. Also, an exterior connecting passage 50 that is located near the upper end of the chamber 48, has a floating piston 53 therein that includes an O-ring seal 54 on its surface. This completes the sealing-in of the oil in chamber 48.

The connecting passage 50 has a snap ring 57 located near the open end thereof in order to stop piston 53 from being moved out of the housing 25 unless the ring is removed. It will be clear that the floating piston 53 and its O-ring 54 act, in addition to retaining the oil in chamber 48, to equalize the pressure between the oil and the drilling fluid (which surrounds housing 25).

It will be appreciated that this invention provides relatively simple apparatus which may have wide use because of its ability to signal instantaneously, at the surface, a predetermined condition down-hole. This eliminates costly and none-too-reliable equipment needed for electronically transmitting information from down-hole to the surface, particularly in deep borehole drilling operations.

The particular application of this invention that is described above could be very beneficial in permitting use of water as the drilling fluid. One problem that might be encountered in the use of water is that if a high-pressure gas zone is penetrated, the gas will invade the borehole and can result in a blowout. However, by making use of this invention, there would be an almost instantaneous signal at the surface when such invasion occurred. Then blowout preventers could be closed and the drilling fluid would be weighted up sufficiently to control the gas pressure. Thereafter, the signaling could be repeated as long as the blocking spheres 27 lasted.

While the foregoing embodiment of the invention has been described above in considerable detail in accordance with the applicable statues, this is not to be taken as in any way limiting the invention, but merely as being descrptive thereof.

What is claimed is:

1. An illuminating device for a display frame, which comprises an adjustable bracket disposed for engagement with the frame for support thereby, a lamp adjustable relative to said bracket, a flexible conduit connected to said bracket and connected to said lamp to adjustably support same from said bracket, and a rechargeable battery pack electrically connected to the lamp by conductors extending through said conduit to energize said lamp for illuminating the display frame.

2. The invention according to claim 1, wherein

said magazine comprises a spring-loaded cylindrical chamber, and

said ejecting means comprises a reciprocating plunger.

3. The invention according to claim 2, wherein

said plunger moves transversely to said chamber, and

said ejecting means also comprises electromagnetic means for actuating said plunger.

4. The invention according to claim 3, wherein

said electromagnetic means comprises an armature carried by said plunger, and

a coil surrounding said armature.

5. The invention according to claim 4, wherein

said ejecting means also comprises an oil-filled chamber for holding said plunger and armature,

a spring for biasing said plunger into its retracted position, and

means for equalizing the pressure between said oil-filled chamber and the drilling fluid surrounding said retaining means.

6. In borehole drilling employing a drill bit having at least one passage for drilling fluid to flow through under pressure, apparatus for signaling the surface adjacent to the top of said borehole, comprising in combination:

an internal housing supported adjacent to said bit and located upstream relative to said passage,

a plurality of resilient plastic material spheres having a smooth surface and an outside diameter greater than the minimum inside diameter of said passage,

a magazine located in said housing for storing a plurality of said spheres in said magazine, comprising

a cylindrical chamber for receiving said plurality of spheres,

a cylindrical opening located transversely and connected with one end of said chamber,

a resilient lip detent near the outer end of said opening for holding the outermost of said spheres ready to be ejected into said drilling fluid, and

a first spring for biasing said spheres in said chamber toward said opening;

a reciprocating plunger aligned with said cylindrical opening,

an armature carried by said plunger,

a coil surrounding said armature,

an oil-filled chamber in said housing for holding said plunger and armature,

a second spring for biasing said plunger into its retracted position,

a connection between said oil-filled chamber and the exterior of said housing, and

a floating piston in said connection for retaining said oil in the chamber and for equalizing the pressure between said oil and the drilling fluid surrounding said housing.

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PO-1050
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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,719,239 Dated March 6, 1973

Inventor(s) Albert P. RICHTER, Jr., James D. BRUNER, Percy T. COX

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1	line 54	"an filled" should read -- an oil-filled --
Column 2	line 3	"schematic section" should read -- schematic cross-section --
Column 4	Claim 1	Wrong claim has been printed as Claim 1. Claim 1 (Claim 11 in Application Serial No. 169,014, filed August 4, 1971) should read as follows:

-- In borehole drilling, wherein a drill bit is employed having at least one passage for drilling fluid to flow through under pressure, means for signaling the surface comprising, in combination:

a plurality of spherical resilient bodies having outside diameters greater than the minimum inside diameter of said passage for temporarily blocking said passage while being squeezed through by said drilling fluid,

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,719,239 Dated March 6, 1973

Inventor(s) Albert P. Richter, Jr., et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

a magazine for holding said plurality of spherical bodies, and

means for ejecting one of said spherical bodies at a time from said magazine. --

Signed and sealed this 10th day of July 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

Rene Tegtmeyer
Acting Commissioner of Patents

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.