March 11, 1969 R. L. CALDWELL 3,432,667

BOREHOLE FLUID EXCLUDER RELEASABLY COUPLED TO BOREHOLE TOOL

Filed April 12, 1965

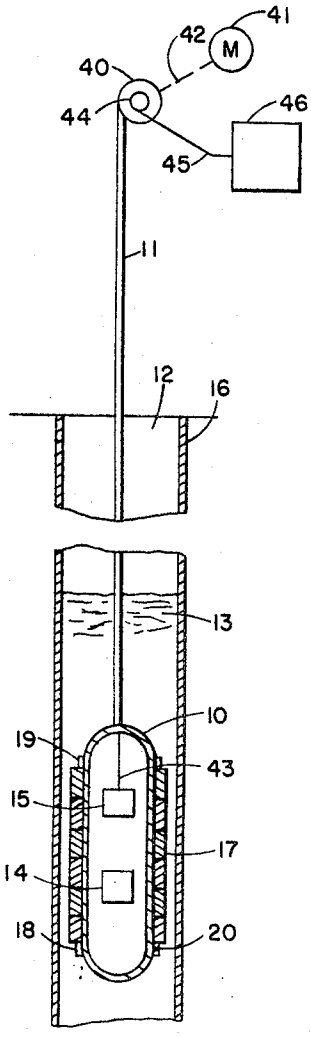



FIG I

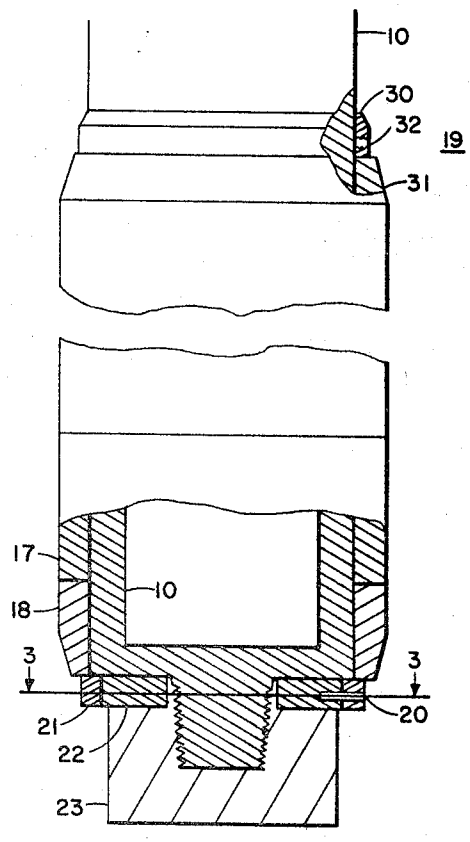



FIG III

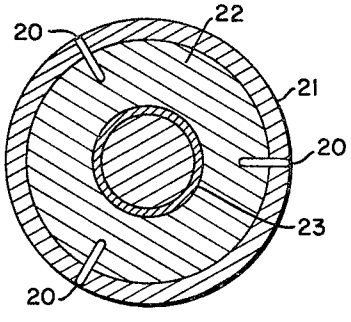



FIG IIII

INVENTOR.
RICHARD L. CALDWELL
BY Arthur F. Zobal
ATTORNEY.

United States Patent Office 3,432,667
Patented Mar. 11, 1969



3,432,667

# BOREHOLE FLUID EXCLUDER RELEASABLY COUPLED TO BOREHOLE TOOL

Richard L. Caldwell, Dallas, Tex., assignor to Mobil Oil Corporation, a corporation of New York

Filed Apr. 12, 1965, Ser. No. 447,263
U.S. Cl. 250—108 5 Claims
Int. Cl. G21f 5/00, 7/00, 9/00

## ABSTRACT OF THE DISCLOSURE

The specification discloses a borehole fluid excluder releasably coupled to a borehole tool to allow the tool to be retrieved from the borehole in the event the excluder becomes lodged therein. In the emobdiment disclosed, the fluid excluding system is supported by a lower member which is coupled to the tool by shear pins. In the event the excluder becomes lodged in the borehole, an upward force on the tool causes the pins to break, thereby allowing the tool to be pulled through the excluder and out of the borehole.

This invention relates to a borehole fluid excluder for use around a well logging tool and more particularly to a borehole fluid excluder which may be detached from the tool to allow the tool to be retrieved from the borehole in the event the excluder becomes lodged therein.

In well logging operations, borehole liquid affects the measurements desired in that it reduces the sensitivity of the measurements to formation properties. This is particularly true in radioactive well logging operations employing neutrons. It has been found that the effect of the borehole fluid may be reduced by employing excluding means around the exploratory tool to fill substantially the space between the tool and the borehole whereby substantially all of the fluid between the tool and the borehole wall may be displaced. In practical applications, however, such an excluding means may easily become lodged in the borehole thereby making it difficult to retrieve the logging tool from the borehole.

In accordance with the present invention, there is provided a borehole fluid excluding system which will readily allow the exploratory tool to be retrieved in the event the excluding means becomes lodged in the borehole. The excluding system comprises a means having a low absorption coefficient for radiation energy employed in the exploratory operation. The excluding means is employed for surrounding the tool, at least around a zone containing exploratory means wherein radiation energy passes between the tool and the formations, and has dimensions whereby it substantially fills the space between the tool and the borehole wall. Coupling means is provided for releasably attaching the excluding means to the tool. The coupling means at least allows the tool to be detached from the excluding means and to be moved upwardly out of the borehole in the event the excluding means becomes lodged in the borehole.

In a more specific aspect, the coupling means allows the tool to become detached from the excluding means upon application of an upward force of a predetermined amount to the tool. In the embodiment disclosed, the coupling means comprises supporting means located below the excluding means for supporting the excluding means and having shear means coupling the supporting means to the tool. In the event the excluding means becomes lodged in the borehole, continued upward force applied to the borehole tool will cause the shear means to break whereby the borehole tool may be withdrawn through the excluding means and out of the borehole.

In a preferred embodiment, the excluding means is



utilized with a radioactive well logging tool employing neutrons for exploratory operations. In this embodiment, the excluding means is of solid graphite which is relatively transparent to both fast and slow neutrons as well as to gamma rays. Solid graphite also has advantages for use as a borehole excluder in that it is relatively fragile and hence may be cleared from the borehole passageway, when lodged therein, by simple drilling operations carried out after the tool has been detached from the excluder and removed from the borehole. In addition, the solid graphite is unaffected by high fluid pressures encountered in deep wells.

For further objects and advantages of the present invention and for a more complete understanding thereof, reference now may be had to the following detailed description taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 represents a borehole tool employing the borehole fluid excluding system of the present invention;

FIGURE 2 is an enlarged showing of the system of FIGURE 1 illustrating the manner in which the excluding means is attached to the borehole tool; and

FIGURE 3 is a cross section of FIGURE 2 taken along the lines 3—3 thereof.

Referring now to FIGURE 1 of the drawings, there is illustrated a borehole exploratory tool **10** supported by a cable **11** and employed for investigating the formations traversed by a borehole **12**. As shown, the borehole **12** contains borehole liquid **13**. The tool **10** contains exploratory means including an energy source **14** for directing radiation energy into the formations and a radiation detector **15** for detecting radiation passing from the formations into the borehole. In applications wherein logging operations are carried out in boreholes cased with iron casing, illustrated at **16**, the source **14** preferably is a source of neutrons and the detector **15** is either a gamma ray detector or a neutron detector. It is thus desirable to reduce the effects of the borehole liquid as much as possible. This is accomplished by providing a fluid excluder, illustrated at **17**, which surrounds the tool **10** and hence displaces much of the liquid between the tool **10** and the borehole wall. Preferably, the excluder surrounds the tool, at least around the zone containing the neutron source, and, in addition, may also surround the zone containing the detector. The excluding means has a low absorption cross section or coefficient at least for neutrons and comprises a plurality of solid graphite cylinders. These cylinders are slidably positioned around the tool **10** and are supported by a releasable coupling arrangement comprising a lower supporting means **18** and an upper coupling means **19**. The lower supporting means **18** is coupled to the tool **10** by way of a plurality of shear pins, one of which is illustrated at **20**. The shear pin attaching arrangement is of special importance in the present system in that it allows the tool to be retrieved in the event the borehole fluid excluder **17** becomes lodged in the borehole. More particularly, in the event the borehole fluid excluder becomes lodged, an upward force upon the logging cable **11** will cause the pins **20** to shear or break. When this occurs, the support **18** will be released and will be free to slide relative to the tool **10**. Thus, the tool **10** may be drawn through the borehole fluid excluder **17** and retrieved from the borehole. The graphite excluder **16** may then be cleared from the borehole passageway by drilling operations.

Reference may be had to FIGURES 2 and 3 for a detailed illustration of the shear pin connecting arrangement. Like elements have been given like reference characters as those employed in FIGURE 1.

As illustrated, the supporting means **18** comprises a metal ring slidably positioned around the tool **10** and

supported by a second metal ring **21**. Ring **21**, in turn, is coupled to a third ring **22** by three shear pins **20**, as illustrated in FIGURE 3. Ring **22** is securely attached to the borehole tool **10** by cup-shaped member **23**, which is threadedly attached to the lower end portion of the tool **10**. In the event the excluder **17** becomes lodged in the borehole, upward force to the tool will cause a shearing action or force on the shear pins **20** at the juncture of rings **21** and **22**. After a predetermined upward force is applied, the pins **20** will shear or break thereby allowing ring **22** to move relative to ring **21**. Further upward force thus will allow the tool **10** to be moved upward relative to rings **21** and **18** and the borehole excluder **17** comprising the plurality of graphite cylinders.

The upward coupling arrangement **19** comprises sleeves **30** and **31**. A plurality of nylon set screws, one of which is illustrated at **32**, secures the sleeve **30** to the tool **10**.

In one embodiment, the sleeves comprising the fluid excluder were obtained from U.S. Graphite Company, Saginaw, Mich. The material of the sleeves consisted substantially of graphite and is identified as "Graphitar—grade 80." Each graphite sleeve comprising the excluder **17** has an outside diameter of 4.25 inches, an inside diameter of 3.38 inches, and a length of 8 inches. The outside diameter of the borehole tool **10** is such that the graphite sleeves are slidable around the tool. With the upper set screw coupling arrangement, the number of graphite sleeves employed may be varied. The excluder arrangement disclosed is capable for use in boreholes having an inside diameter one-fourth of an inch greater than the outside diameter of excluder **17**. The outside diameter of the ring **18** is the same as that of the graphite sleeves forming the excluder **17**. The supporting rings **21** and **22** were of stainless steel having a thickness of three-eighths of an inch. The outside diameter of ring **22** and hence the inside diameter of ring **21** was about 3.25 inches. The outside diameter of ring **21** was of the order of 3⅝ inches. The shear pins **20** were of stainless steel having a diameter of 0.1 inch and a length of five-eighths of an inch.

In the embodiment shown in FIGURE 1, the borehole cable **11** is wound and unwound upon drum **40** driven by motor **41** and mechanical connection **42**. The output of detector **15** is applied to cable conductor **43** for transmission to the surface where signals are taken therefrom by slip ring **44** and brush **45** and applied to a readout **46**.

Now that the invention has been described, modifications will become apparent to those skilled in the art, and it is intended to cover such modifications as fall within the scope of the appended claims.

I claim:

**1.** A well logging system comprising:

a borehole tool adapted to be inserted into a borehole, said tool having a zone containing energy source and detecting means for investigating the formations traversed by said borehole,

borehole liquid excluding means surrounding said tool for displacing borehole liquid from between said tool and the borehole wall,



said borehole liquid excluding means including:

upper and lower annular members adapted to be coupled to said tool above and below said zone respectively,

at least said lower member being a rigid member, shear means releasably coupling at least said lower rigid member to said tool,

means including annular liquid displacing means surrounding said tool and located and supported between said upper and lower members for displacing borehole liquid from between said tool and the borehole wall at least around said zone,

said annular liquid displacing means presenting less interference than said borehole liquid to the investigation operations to be carried out with said source and detecting means,

said annular liquid displacing means having an internal diameter of a size sufficient to allow said tool to be pulled upward through said annular liquid displacing means,

said shear means allowing said tool to be detached at least from said lower rigid member upon the application of an upward force of a predetermined amount to said tool in the event said excluding means becomes lodged in said borehole whereby said tool may be pulled upward through said annular liquid displacing means to allow said tool to be pulled upward and out of said borehole.

**2.** The system of claim **1** wherein:

said source is a neutron source and said detecting means is a neutron detector.

**3.** The system of claim **1** wherein:

said source is a neutron source and said detecting means is a gamma ray detector.

**4.** The system of claim **1** wherein:

said source is a neutron source,

said excluding means being of graphite.

**5.** The combination of claim **1** wherein:

said borehole tool is employed for radioactive well logging wherein neutrons are employed in exploratory operations,

said excluding means having a low absorption coefficient for neutrons.


**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 2,509,908 | 5/1950 | Crumrine. | |
| 2,652,496 | 9/1953 | Herzog et al. | |
| 2,747,100 | 5/1956 | Wyllie et al. | 250—108 X |
| 3,065,346 | 11/1962 | Dewar et al. | 250—108 X |
| 3,097,696 | 7/1963 | Orr | 166—123 X |
| 3,211,230 | 10/1965 | Stone | 166—123 X |
| 3,288,210 | 11/1966 | Bryant | 166—35 X |
| 3,294,171 | 12/1966 | Kelley | 166—123 X |



RALPH G. NILSON, *Primary Examiner.*

SAUL ELBAUM, *Assistant Examiner.*

U.S. Cl. X.R.

250—83.6; 166—123

# UNITED STATES PATENT OFFICE

# CERTIFICATE OF CORRECTION

Patent No. 3,432,667 March 11, 1969

Richard L. Caldwell

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 15, "emobdiment" should read -- embodiment --; line 48, "operation" should read -- operations --. Column 4, lines 1 to 7 should appear in the following form:

said borehold liquid excluding means
including:
upper and lower annular members adapted
to be coupled to said tool above
and below said zone respectively,
at least said lower member being a
rigid member,
shear means releasably coupling at
least said lower rigid member to
said tool,

Column 4, line 51, "Dewar et al." should read -- Dewan et al. --; line 53, "Stone" should read -- Stone, Jr. --.

Signed and sealed this 31st day of March 1970.

(SEAL)
Attest:

EDWARD M.FLETCHER, JR.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents