Aug. 31, 1954 A. B. HILDEBRANDT 2,688,115

OPEN SLEEVE ELECTRODE ASSEMBLY FOR WELL LOGGING

Filed Oct. 8, 1952

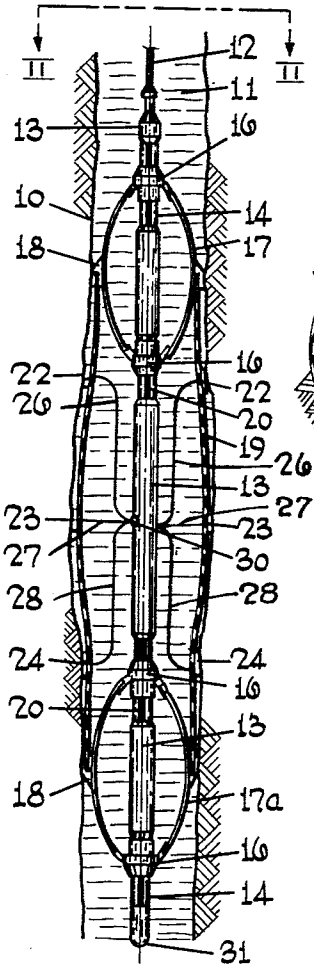


FIG. -1

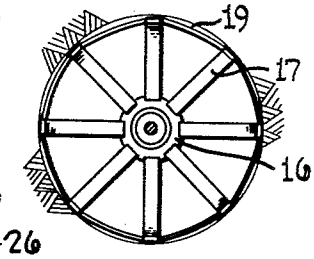


FIG. -2
(ENLARGED)

Alexander B. Hildebrandt INVENTOR.

BY W. O. Heilman

ATTORNEY

Patented Aug. 31, 1954

2,688,115

UNITED STATES PATENT OFFICE

2,688,115

OPEN SLEEVE ELECTRODE ASSEMBLY FOR WELL LOGGING

Alexander B. Hildebrandt, Tulsa, Okla., assignor to Standard Oil Development Company, a corporation of Delaware

Application October 8, 1952, Serial No. 313,694

6 Claims. (Cl. 324—10)

1

The present invention relates to apparatus for obtaining an electric log of a bore hole in the earth and more particularly to an improved and simplified electrode assembly to be used in the electric logging of a well bore to determine the probable nature of strata traversed by the bore hole.

It is well known to log a bore hole by measuring the electrical properties of the various strata penetrated by the bore hole. These properties include impedance, self-potentials, resistance and the like and their measurement involves lowering one or more electrodes into the bore hole while it is filled with water or with drilling mud, sending currents into the formation and observing the various electrical phenomena produced.

One of the procedures commonly used in electrical well logging involves measurement of the difference in apparent resistivity of the various types of rocks encountered as the electrodes are raised or lowered in the bore hole. A disadvantage in this procedure is that a source of error exists inasmuch as the resistivity of the drilling mud or of the water in the bore hole enters into the measurement. To overcome this source of error an electrode assembly in which the electrodes are substantially shielded electrically from the mud column in the well bore has been devised and is described and claimed in U. S. Patent 2,552,428 of Alexander B. Hildebrandt. The apparatus of the patent comprises an open elongated flexible sleeve provided with means for supporting the sleeve in the bore hole and for pressing its upper edge against the walls of the bore hole so that as the sleeve is pulled up through the bore hole substantially all of the drilling mud will pass through the sleeve. The well logging electrodes are supported by the sleeve so as to contact the bore hole wall and yet be insulated from the main column of mud. This sleeve is of limited usefulness in that it enables a log to be run only in one direction and in addition requires a complicated release mechanism to place the sleeve into operating position after the apparatus has been lowered into the bore hole.

It is an object of the present invention to provide an electrode assembly in which the electrodes will be effectively shielded electrically from the mud column in the bore hole and yet the assembly will be of simple design and have essentially no mechanical working parts.

It is another object of the invention to provide an assembly of shielded electrodes which will permit an electric log of the bore hole to be made

2

both while the electrodes are travelling down into the bore hole and while they are being raised up through the bore hole.

Other objects and advantages of this invention will become apparent when consideration is taken of the ensuing description in conjunction with the accompanying drawing in which:

Fig. 1 is a vertical elevational view, partly in section, of the electrode assembly of this invention in position in a bore hole; and

Fig. 2 is a top plan view of the assembly of Fig. 1 looking downward in the direction II—II.

Referring to the drawing, reference numeral **10** designates a bore hole filled with drilling mud **11** and into which is placed a conducting cable **12** extending to suitable instruments at the surface. Suspended from the cable is a long rod or mandrel **13** which serves as the supporting member for the assembly of this invention. Mandrel **13** has a number of narrow portions on which are arranged collars **16**, pairs of which are attached to a plurality of bowed leaf springs **17** arranged radially about the mandrel. The wider portions of mandrel **13** serves as stops or shoulders limiting the vertical travel of the collars. In addition, grooves or keyways **20** are provided in the narrow portions of the mandrel to receive keys fastened to the collars so as to prevent rotation of the collars on the mandrel. Limited vertical travel of at least one of the collars in each pair is necessary in order that the leaf springs will be free to adjust themselves to varying hole size. Prevention of rotation of the collars is necessary so that there will be no twisting of the sleeve in the borehole as well as to ensure positive orientation of the electrodes with respect to the mandrel **13** when a log is to be made for the purpose of obtaining dip and strike information.

Adjacent the middle of each of the springs **17** is a fastening means **18** which serves to support a flexible sleeve **19** between the two sets of springs **17** and **17***a*. Sleeve **19** is open at both ends and is made of non-conducting material such as rubber or rubberized fabric. Embedded in the wall of sleeve **19** are a plurality of sets of electrodes **22, 23** and **24**. It will be noted that the electrodes in each set are carried by the sleeve about a horizontal periphery of the sleeve. These electrodes are insulated from the interior of the sleeve **19** but are electrically accessible from the exterior of the sleeve. All of the electrodes **22** are electrically connected and all of the electrodes **23** and **24** are separately electrically connected. Insulated leads **26, 27** and **28** connect the electrodes **22, 23** and **24** respectively with equipment at the

surface through conductors in cable 12. Conveniently the leads are run into an inner bore in rod 13 and to cable 12 through an opening 30 which is sealed against the entrance of fluid.

Depending upon the particular use which is to be made of the electrode assembly, only a single set of the electrodes such as set 23 might be employed or any two sets, or all three sets might be utilized. In addition, depending upon the nature of the log to be made, another electrode 31, mounted on the lower end of rod 13 may also be used. Electrode 31 is connected electrically to surface equipment by means of an additional lead (not shown) running up through rod 13. Rod or mandrel 13 is preferably constructed of or covered with insulating material and in either case electrode 31 is electrically insulated from rod 13. It is contemplated that the various electrodes will be used in the same manner as taught in the aforementioned Patent 2,552,428, including the making of measurements indicative of dip and strike of subsurface strata.

It will be seen that the electrode assembly described is of simplified construction and yet provides for effective insulation of the logging electrodes from the main column of mud in the bore hole. When the device is being lowered into the well bore the lower springs 17*a* will press substantially the entire lower edge of the open sleeve 19 against the bore hole walls so that the major portion of the drilling mud in the bore hole will be by-passed through the sleeve. Thus the electrodes 22, 23 and 24 will be pressed into substantial contact with the walls of the bore hole and will be insulated from the main column of mud so that the resistivity readings obtained will not be seriously affected by variations in hole size nor by the mud in the hole. Likewise on the return trip up the hole the upper springs 17 will press substantially the entire upper edge of sleeve 19 against the bore hole walls and ensure that the major portion of the drilling mud will be by-passed through the sleeve. It is thus seen that the apparatus can be lowered rapidly through the well bore to obtain a log of the entire well and on the return trip up the hole sections of particular interest as noted on the first log can be logged with more precision to obtain desired information. Alternatively, different types of electrical logs can be run in the two traverses of the well bore.

It is of course obvious that the weight of the mandrel or rod 13 and of the springs 17 will be so selected as to overcome the frictional drag of the sleeve 19 on the walls of the bore hole so that the device can be lowered into the well. The springs 17 should be equally distributed radially about the apparatus and preferably there should be 8 to 10 such springs at each end of the sleeve. If less than 8 springs are used there will be less effective pressing of the entire leading edge of the sleeve against the bore hole and if more than 10 or 12 springs are used the resistance to mud flow through the sleeve will increase markedly due to the cross-sectional area covered by the springs.

The specific embodiment described herein is by way of example and is not intended to limit the scope of the invention.

What is claimed is:

1. An electrode assembly for the electric logging of a bore hole comprising an open elongated flexible insulating sleeve adapted to contact substantially the entire periphery of the bore hole, supporting means for said sleeve, means carried by said supporting means pressing substantially the entire upper edge of said sleeve into contact with the periphery of the bore hole, means carried by said supporting means pressing substantially the entire lower edge of said sleeve into contact with the periphery of the bore hole, and at least one electrode carried by said sleeve in a section intermediate its ends, said electrode being insulated from the interior of said sleeve but electrically accessible from the exterior of said sleeve.

2. An electrode assembly according to claim 1 wherein said supporting means comprises a rod extending lengthwise of said sleeve and including an additional electrode supported on and insulated from said rod adjacent one end of said sleeve.

3. An electrode assembly according to claim 1 in which a plurality of electrically connected electrodes are carried by said sleeve about a horizontal periphery thereof.

4. An electrode assembly for the electric logging of a bore hole comprising an elongated mandrel, a plurality of bowed leaf springs arranged radially around said mandrel with their ends held by said mandrel, a second plurality of bowed leaf springs arranged radially around said mandrel with their ends held by said mandrel in a region spaced vertically from said first plurality of springs, an open, elongated flexible insulating sleeve enveloping said mandrel with one end fastened to said first plurality of leaf springs and with the remaining end fastened to said second plurality of leaf springs, and at least one electrode carried by said sleeve in a section intermediate its ends, said electrode being insulated from the interior of said sleeve but electrically accessible from the exterior of said sleeve.

5. An electrode assembly according to claim 4 including pairs of collars associated with each of said sets of leaf springs and mounted on said mandrel, at least one of said collars in each pair being adapted for limited slidable movement lengthwise of said mandrel but fixed against rotational movement of said mandrel.

6. An electrode assembly according to claim 4 including an additional electrode supported on and insulated from said mandrel adjacent one end of said sleeve.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
Re. 23,621	Hildebrandt	Feb. 24, 1953
2,242,612	Leonardon	May 20, 1941
2,427,950	Doll	Sept. 23, 1941
2,564,861	Sherborne	Aug. 21, 1951
2,632,795	Baucher	Mar. 24, 1953

FOREIGN PATENTS

Number	Country	Date
643,531	Great Britain	Sept. 20, 1950