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APPARATUS FOR DETECTING HYDROCARBONS IN DRILLING MUD AND CUTTINGS

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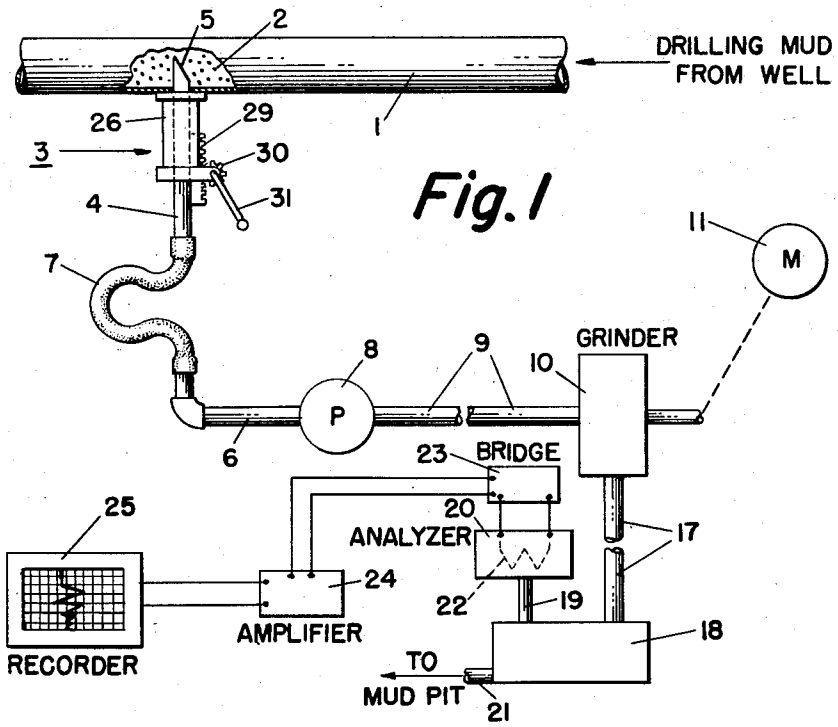


Fig. 1

Fig. 2

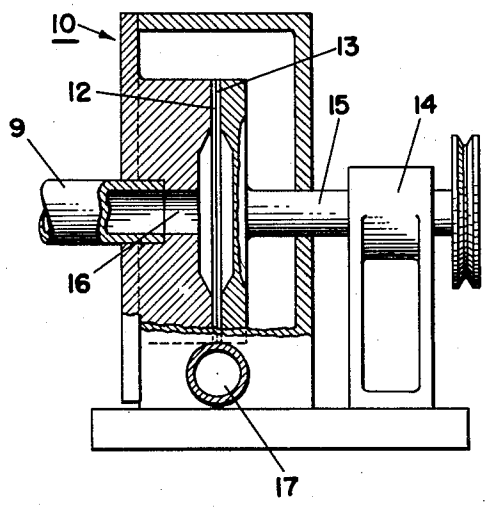
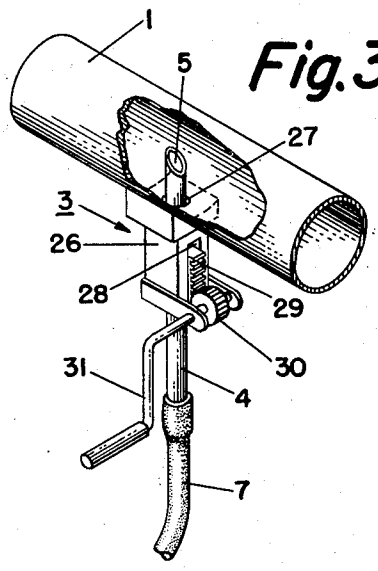


Fig. 3



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APPARATUS FOR DETECTING HYDROCARBONS IN DRILLING MUD AND CUTTINGS

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This invention relates to apparatus for accurately detecting the presence of hydrocarbons in the return mud stream of a rotary drilling system.

In drilling oil wells for the purpose of producing oil or gas it is, of course, of prime importance that the presence of petroliferous material in the formations traversed by the borehole be determined. It is very unusual to be able to determine the presence of such petroliferous material by ordinary visual or sensual means; therefore, several methods have been developed by which the presence of minute quantities of petroliferous material can be detected. One of these methods, known as chemical logging, has been employed for some time and involves collecting a sample of the fluent of the return stream after it has circulated in the well and before it has returned to the mud pits and thereafter analyzing the fluent for the presence of any hydrocarbon gas. In another method the cuttings which are carried to the surface of the earth by the fluent and thereafter separated from the mud by means of a shale shaker at the mud pit, are collected and later analyzed for their hydrocarbon content.

Regardless of the success which has been experienced in the use of the above two methods, in many cases it has been found that neither of the two methods have proven to be satisfactory. In the first case, the mud frequently doesn't carry enough petroliferous material to evolve sufficient quantities of hydrocarbon gases for detection. In the second case, the cuttings in being separated from the mud often lose a great deal of their hydrocarbon content. As a result, neither the mud or cuttings analyses have proven to be completely satisfactory for indicating "hydrocarbon shows," the term used when one of the methods indicates the presence of petroliferous material in a zone traversed by a borehole. Therefore, many oil producing zones have been drilled through and completely undetected.

An object of this invention is to provide a novel apparatus for more accurately detecting the presence of petroliferous material in a zone traversed by a borehole drilled by a rotary drilling method.

Another object of this invention is to provide apparatus for detecting the presence of hydrocarbons in the return mud stream of a rotary drilling system by simultaneously and additively analyzing the hydrocarbon gas content of both the mud and the cuttings carried by the mud.

Another object of this invention is to provide apparatus for detecting the presence of hydrocarbons in the mud stream of a rotary drilling system by grinding the cuttings without separating them from the mud and thereafter additively analyzing the hydrocarbon gas evolved from both the mud and the cuttings.

Still further objects and advantages of this invention will become apparent upon reading the following description in conjunction with the appended drawing therein:

Figure 1 shows a schematic diagram of the apparatus of this invention.

Figure 2 shows a cross section of a preferred grinder to be used in this invention.

Figure 3 shows a view of the preferred adjustable sampling tube assembly to be employed in the method of this invention.

Briefly, this invention is concerned with a novel apparatus for simultaneously and additively detecting hydrocarbon gases present in both the mud and cuttings of a rotary drilling system. This is accomplished by simultaneously catching both the mud and the cuttings in the return stream and thereafter pumping the mud and the cuttings to a grinder where the cuttings are comminuted in the presence of the mud with which they were collected and in the same order as they were collected. The gas evolved from both the mud and the cuttings is continuously analyzed to thereby determine whether a particular zone traversed by the bore hole contains petroliferous material in sufficient quantities for producing hydrocarbons.

Referring specifically to Figure 1 there is shown a block diagram which discloses my method and represents the system and apparatus for practicing my method. Conduit **1** is shown representing the return line for the mud stream which comprises a fluent normally containing drilling mud and cuttings **2** dispersed in said mud. Sampling tube **4** which is a part of the preferred adjustable sampling tube assembly **3**, shown in more detail in Figure 3 and described more specifically hereinafter, is provided with an oblique opening **5** facing into the flow of the stream. The position of opening **5** is adjustable in order to control the proportion of cuttings to mud caught by tube **4** and eventually passed to pump **8**. Rubber coupling **7** provides a flexible connection between tube **4** and the conduit **6** leading into pump **8** to allow for such adjustment. Pump **8**, which is any conventional type pump capable of handling both the mud and cuttings, is adapted for pumping the fluent through conduit **9** into grinder **10** which is the preferred grinder to be employed in the method of this invention for the purpose of comminuting the cuttings in the presence of the mud with which they were collected.

Grinder **10** as shown in Figure 2, very briefly described, comprises two grinding plates having serrated surfaces facing each other with one grinding plate **12** stationary and another grinding plate **13** rotatably mounted for rotation by motor **11** of Figure 1. This rotatable mounting is accomplished by means of any conventional journal bearing box **14** in which shaft **15** is journaled and also axially adjustable for the purpose of adjusting the clearance between grinding plates **12** and **13**. In the preferred apparatus shown, an aperture **16** is provided through the center of stationary grinding plate **12** thus allowing the fluent containing both mud and cuttings to pass into the space between the serrations of the plates where comminution of the cuttings takes place while in the presence of the mud with which it was collected. After comminution both the mud and comminuted cuttings pass into conduit **17**, in the same order in which the cuttings and mud were collected by tube **4**.

Referring again to Figure 1, conduit **17** is shown leading into trap **18** where the hydrocarbon gases present in the comminuted fluent are released and eventually passed through conduit **19** into analyzer chamber **20**. The fluent is returned to the mud pits through line **21**. Filament **22** located in analyzer chamber **20** is any conventional type of filament, preferably made of platinum, whose resistance varies in response to the concentration of combustible hydrocarbons in chamber **20**. Thus, filament **22** connected in the electrical bridge **23**, controls the reading of recorder **25** which is electrically connected to amplifier

24 and bridge 23 in any well-known manner. Accordingly the reading of recorder 25 indicates the amount of hydrocarbon gases present in the comminuted cuttings and mud.

Referring more specifically to the preferred means employed in the method of this invention for controlling the proportion of cuttings and mud pumped into grinder 10, there is shown in Figures 1 and 3 the sampling tube assembly 3 for adjusting the height of opening 5 in the return stream. This assembly is shown in more detail in Figure 3.

Figure 3 shows housing 26 which is welded or fastened in any well-known manner to conduit 1. The interior of housing 26 communicates with conduit 1 through aperture 27. Tube 4 is adjustably mounted in housing 26 and extends through aperture 27. Any type of sealing means (not shown) is preferably located in housing 26 to prevent mud leaking out of the unit. Housing 26 has a slot 28 on one side thereof in which rack 29, which is rigidly attached to tube 4, is adapted to slide. The position of tube 4 is thereby adjusted (either up or down) by movement of rack 29 in slot 28, such movement being accomplished by means of the conventional rack and pinion arrangement shown, which comprises the pinion 30, rack 29 and crank 31. It should be apparent from the drawing that tube 4 can be either raised or lowered by turning crank 31, thereby providing means for adjusting the proportion of cuttings to mud entering opening 5 and eventually passing to grinder 10. As has been pointed out heretofore, opening 5 is preferably an oblique opening facing into the flow of the fluent stream, as shown in Figures 1 and 3. However, opening 5 may have various other forms without departing from the spirit of the instant invention. For example, opening 5 may be the end of an L-shaped member and form a 90° angle with the flow of the fluent stream or the end of a linear member with the opening parallel to the flow of the fluent stream. Other geometric forms of opening 5 will be obvious to those skilled in the art. In addition, opening 5 may be further modified, if desired, to control the size of cuttings particles entering sampling tube 4 by placing various mesh-size screens or the like over opening 5.

In practicing the method of this invention, sampling tube 4 is first adjusted so that opening 5 catches the correct proportion of cuttings and mud which grinder 10 is capable of handling. Thus the cuttings will always be comminuted in the presence of the mud with which they were collected. After entering opening 5 the cuttings and mud flow through tube 4, coupling 7 and conduit 6 to pump 8. From pump 8 the fluent is pumped through conduit 9 into grinder 10 where the comminution of the cuttings takes place in the presence of the drilling mud and in the same order as they were collected by tube 4. Thereafter both the drilling mud and comminuted cuttings pass through conduit 17 into trap 18. At trap 18 hydrocarbon gases present in the comminuted cuttings and mud are evolved and pass through conduit 19 into analyzer chamber 20. As stated previously, the hot wire filament 22, whose resistance varies with the concentration of the hydrocarbon gases present in chamber 20, varies the balance of bridge 23 which in turn affects

the reading of the recorder 25. Thus recorder 25 gives an indication of the combined hydrocarbon gas content of both the mud and the cuttings.

Thus, it is evident that in the apparatus of this invention I have provided means for accurately detecting the presence of petroliferous material in the fluent of the return stream of a rotary type drilling system. In accordance with this apparatus the proportion of cuttings to mud which are collected from the return stream and the comminution of such cuttings in the presence of the mud with which they were collected is controlled so that the combined hydrocarbon gas present in both the cuttings and the mud can be analyzed together in substantially the same order as they enter opening 5.

It should be apparent that in accordance with the apparatus of this invention the cuttings and the mud which are returned to the well are simultaneously analyzed in order to give an indication of the combined petroliferous material which is present in both the cuttings and mud. With this apparatus it is possible to detect those hydrocarbon deposits which heretofore have not been possible to detect by means of the conventional chemical logging apparatus or by means of separately analyzing the cuttings collected in a shale shaker.

It should be understood that although I have shown and described a preferred form of my invention, it should not be limited by such description except in accordance with the scope of the following claims.

I claim:

1. Apparatus for detecting the presence of hydrocarbons in the return stream of a rotary type drilling system having a pipe line through which the fluent of said return stream flows, comprising means for simultaneously collecting drilling mud and cuttings of said fluent, means for adjusting the proportion of cuttings to mud collected from said return stream, means for grinding said cuttings in the presence of said drilling mud, and means for simultaneously and additively analyzing the total amount of any gas evolved from both said mud and said cuttings.

2. Apparatus for detecting the presence of hydrocarbons in the return stream of a rotary type drilling system having a pipe line through which the fluent of said return stream flows, comprising a standpipe extending into the interior of said pipe line and having an opening facing into the flow path of said fluent, means for adjusting the depth of said opening in said return stream in order to control the proportion of cuttings to mud collected by said standpipe, a grinder communicating with said standpipe and adapted to grind said cuttings while in the presence of said mud, and means for simultaneously and additively analyzing the total amount of any gas evolved from both said mud and said cuttings.

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