

Nov. 29, 1955

S. E. BUCKLEY ET AL

2,725,282

WELL LOGGING APPARATUS

Filed April 30, 1952

4 Sheets-Sheet 1

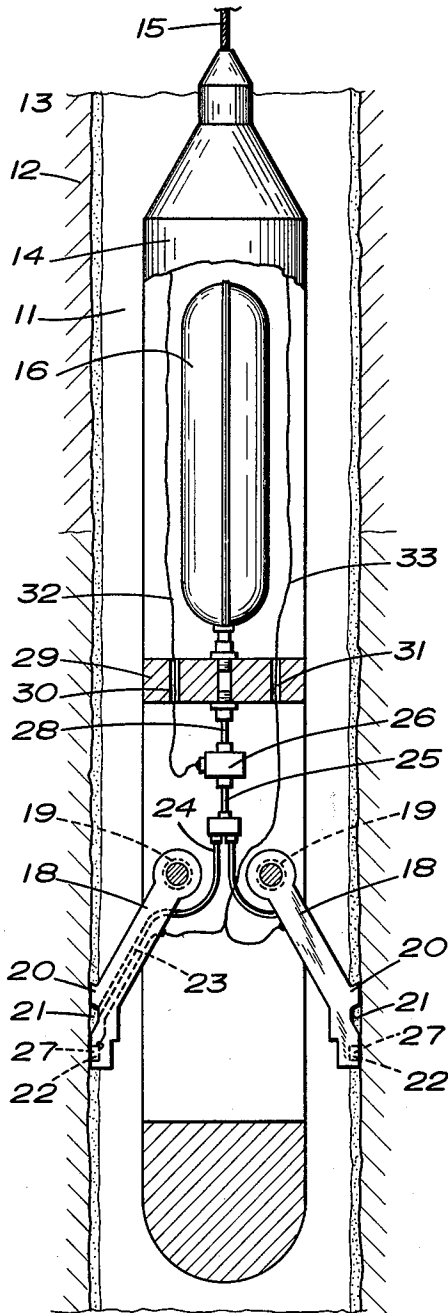


FIG. 1.

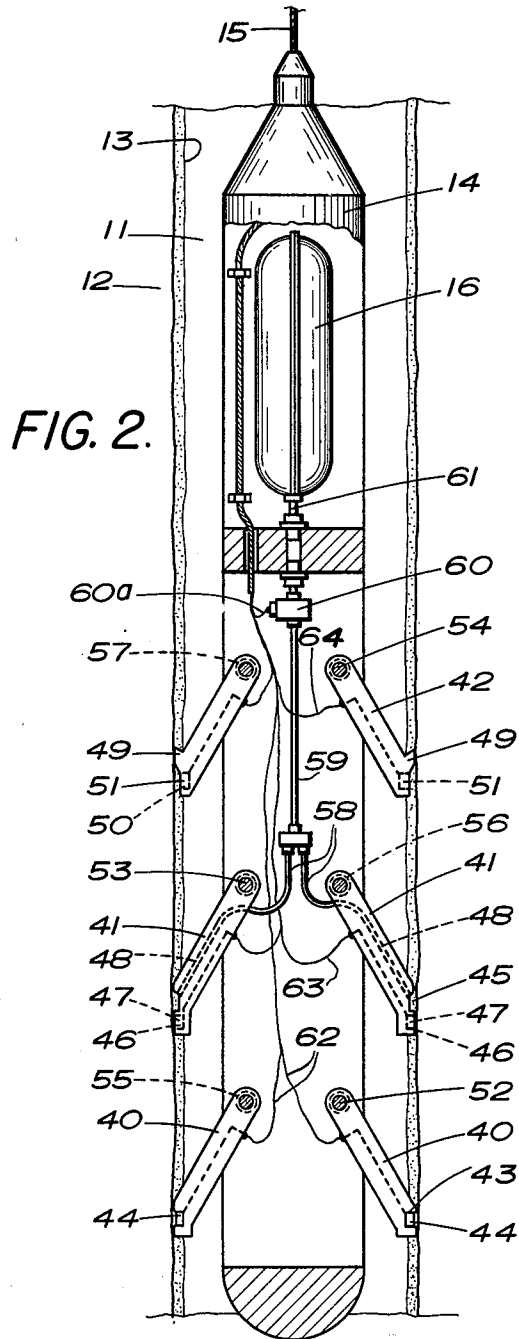


FIG. 2.

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4 Sheets-Sheet 2

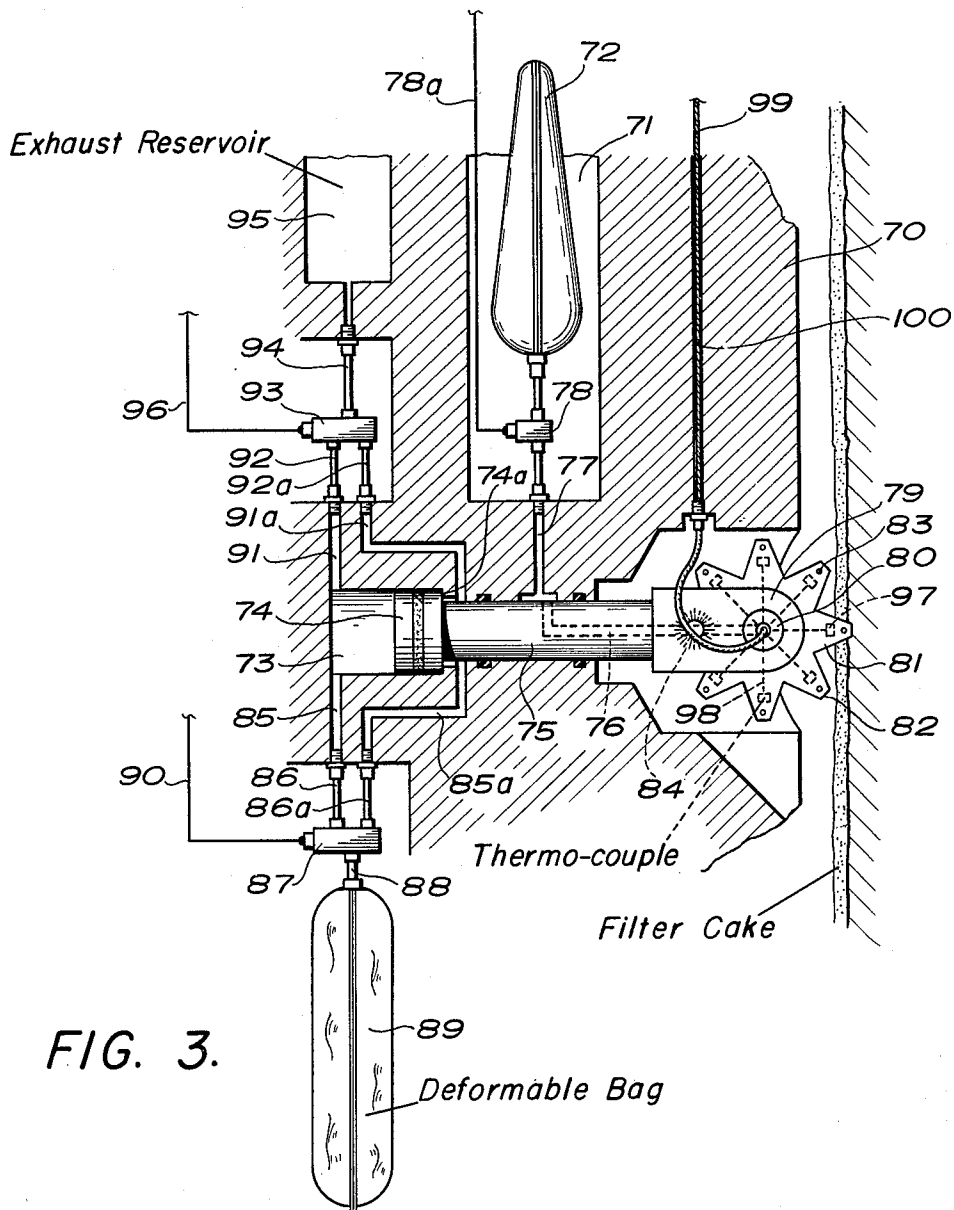


FIG. 3.

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4 Sheets-Sheet 3

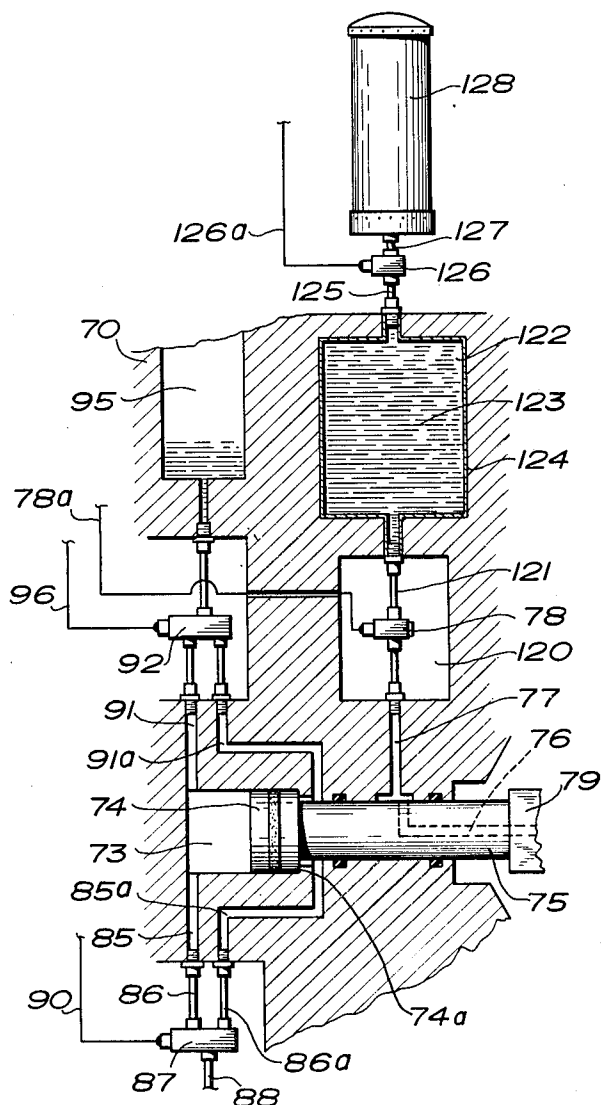


FIG. 4.

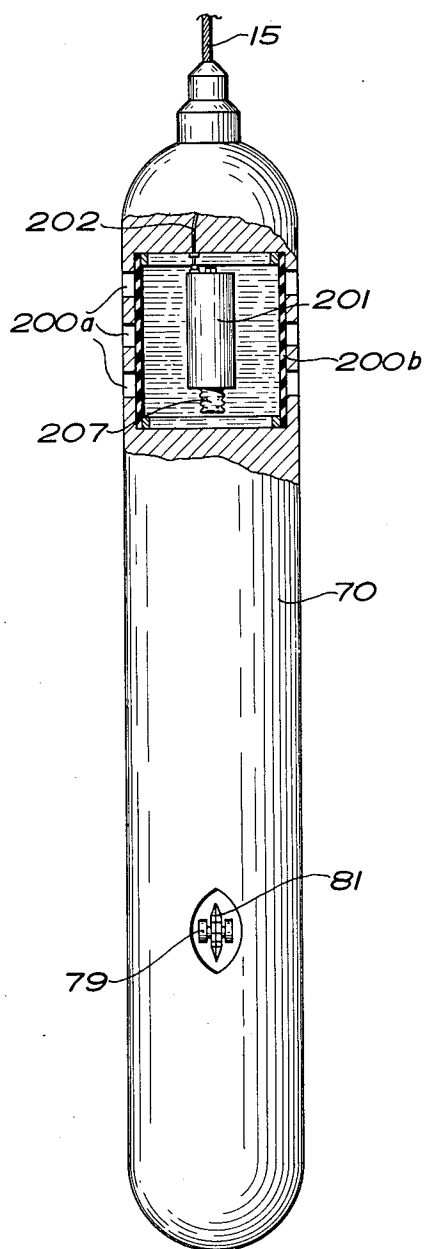


FIG. 5.

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4 Sheets-Sheet 4

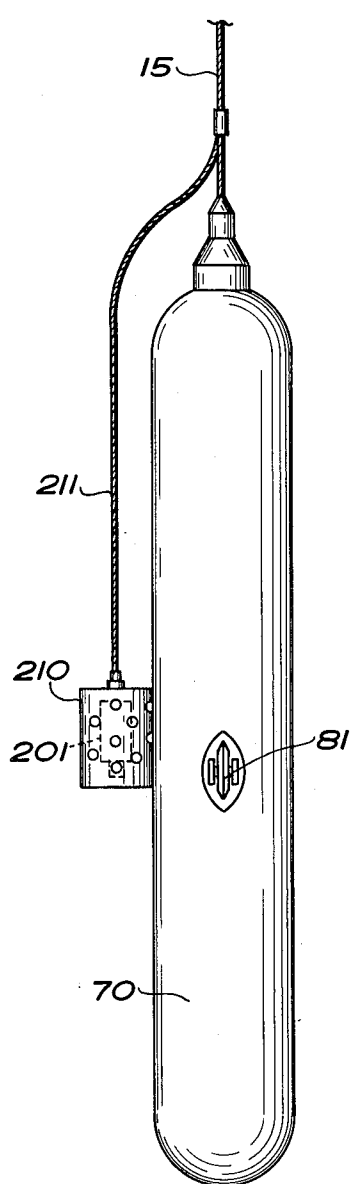


FIG. 8.

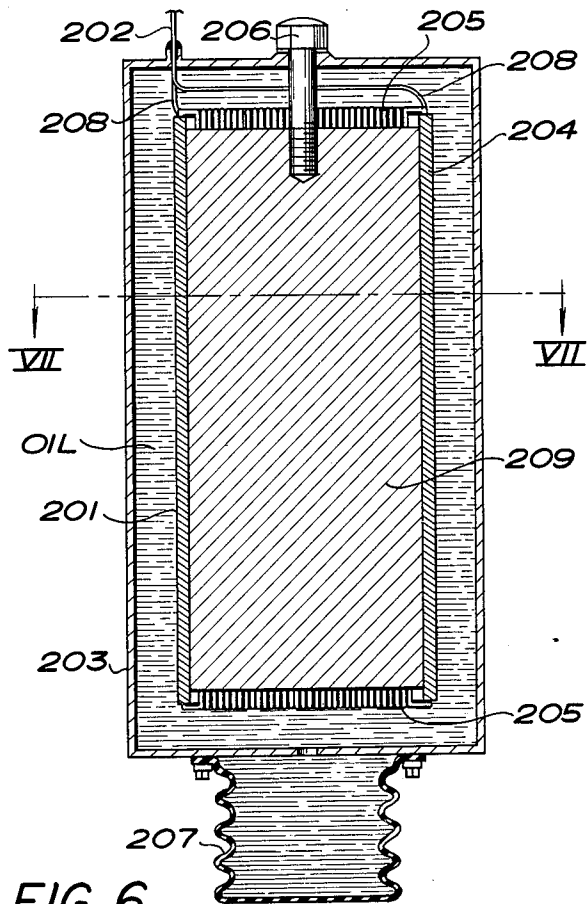


FIG. 6.

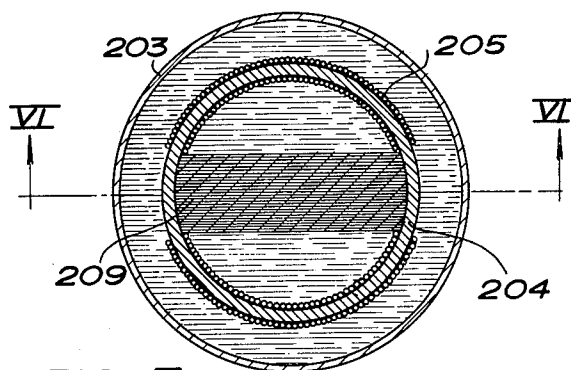


FIG. 7.

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2,725,282

WELL LOGGING APPARATUS

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Application April 30, 1952, Serial No. 285,222

15 Claims. (Cl. 23—253)

The present invention is directed to apparatus for indicating the presence of petroliferous substances in an earth formation penetrated by a well bore. More particularly, the invention is directed to apparatus for logging boreholes whereby the presence of hydrocarbons and the like in the formation is indicated directly.

The invention may be briefly described as involving apparatus including a body member adapted to be lowered and raised in a well bore penetrating an earth formation. The body member is provided with a chamber or a reservoir which is adapted to contain a fluid oxidizing agent. The body member has attached to it or carries at least an extension arm or an extensible member which is adapted to disrupt a filter cake on the wall of a well bore and to contact a formation penetrated by the well bore. The extension arm or extensible member carries injection means which communicates with the reservoir for introducing oxidizing agent into contact with the earth formation. A detection means such as a thermocouple or a sound or pressure detection means is carried by the body member and/or the means for lowering same in the well bore either interiorly or exteriorly to the body member or on the extension arm for detecting a reaction effect of the oxidizing agent with petroliferous substances or hydrocarbons in the formation penetrated by the well bore.

In the apparatus of our invention it is possible to employ as oxidizing agents, oxidizing agents from a large number of materials which are known to react with hydrocarbons. Among these known oxidizing agents reactable with hydrocarbons are chlorine, perchloric acid, liquid oxygen, air, hydrogen peroxide, chlorosulfonic acid and the like. It is also possible to use the other perhalogen acids, such as perfluoric acid, per-iodic acid and perbromic acid. Other oxidizing agents which are suitable in the practice of the present invention are a mixture of nitrogen dioxide and aniline, potassium permanganate and chlorine, aqua regia, and the like. When chlorine is employed, it will be necessary to employ a catalyst therefor. For example, red phosphorous in a finely divided condition may be dispersed in the liquefied chlorine. Likewise when the perhalogen acids are employed, it may be desirable to use a catalyst to cause the oxidation reaction to proceed spontaneously at a temperature such as that encountered in a well bore. For example, it is possible to employ perchloric acid having a strength in the range from 70% to 84% HClO_4 and temperatures down to as low as 40° C. by using a catalyst such as ceric ammonium nitrate. Other catalysts may be employed such as, for example, ammonium vanadate and osmium tetroxide.

The reservoir in the apparatus of the present invention may be defined by the body member itself or there may be arranged in a cavity defined by the body member a deformable bag member which in turn is exposed to the pressure sufficient to force the oxidizing agent from it. It is desirable to incorporate in our apparatus means for imposing pressure and the like on the oxidizing agent

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arranged in the reservoir. This may conveniently be done by employing an inert gas as a fluid piston or it may be desirable to employ a mechanical piston to urge the oxidizing agent from the reservoir and into contact with the formation.

The extension arm or extensible means may be carried by the body member such that at least an arm is depending or extending therefrom and which may be biased outwardly from the body member. For example, a plurality of arms may be used and on the free end of each of said arms may be arranged a cutting or knife edge for disrupting the filter cake on the wall of a well bore, injection means communicating with the reservoir or deformable bag member, and detection means carried by the free end of the extension arm to allow a determination of a reaction effect of the reaction caused by the oxidizing agent coming in contact with petroliferous substance or hydrocarbons in the formation.

The extension arm or extensible means may suitably be a piston having on a free end thereof means for disrupting a filter cake on a wall of a well bore. Such means may include a single or a plurality of knife edges which are provided with ports communicating with a passage-way in the piston arm and, in turn, with a conduit connecting to the bag member.

The detection means may be a thermocouple or it may be a pressure or sound detection means. When a thermocouple is employed it may be desirable to arrange the thermocouple on a free end of the extension arm so that it may be adjacent the reaction area. When the detection means is a sound or pressure detection means the detection means may be arranged on the free end of the extension arm or it may be arranged in the body member. It is contemplated, however, that the detection means may be carried by the conductor cable which is used to lower and raise the body member. For example, a pressure detection means may be arranged in a separate body member and connected to the cable employed to suspend the body member or it may be made integral with the body member.

The present invention will be further described by reference to the drawing in which

Fig. 1 shows an embodiment for logging the well of a well bore;

Fig. 2 is a modification of the apparatus of Fig. 1;

Fig. 3 is a fragmentary view showing a further embodiment of our invention in which different extension means are employed;

Fig. 4 is a modification of the apparatus of Fig. 3;

Fig. 5 illustrates a modification of our apparatus in which a pressure pickup is employed integral with the body member;

Fig. 6 is a sectional view of a suitable pressure pickup;

Fig. 7 is a view in section taken along line VII—VII of Fig. 6 on the apparatus of Fig. 6; and

Fig. 8 is a further modification of our invention in which a separate chamber including a pressure pickup is used.

Referring now to the drawing and particularly to Fig. 1, numeral 11 designates a well bore penetrating a permeable earth formation 12. Sheathing the well bore is a filter cake 13 which is formed in the permeable sections of the well during the drilling operations by circulation of drilling mud in the well bore, as is well known. Arranged in the well bore 11 is a body member 14 which is suspended from the earth's surface by a conductor cable 15. Body member 14 has arranged therein a pressure chamber or vessel 16 adapted to contain a fluid oxidizing agent of the type previously mentioned. The body member 14 is provided with a plurality of extension arms 18 which are biased outwardly by biasing means or springs 19. Extension arms 18 define with a free end thereof a cutting or knife edge 20, a first recess 21, and

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a second recess 22. Extension arms 18 are also provided with internal passageways 23 having an outlet in recess 21. The internal passageways 23 of arms 18 communicate with conduits 24 which connect by a conduit 25 to a solenoid valve 26.

Arranged in the recess 22 is a thermocouple 27. Thermocouple 27 may be replaced by sound indicating means or a pressure indicating means, as may be desired.

A solenoid valve 26 is connected to bag member 16 by a conduit 28. A support plate 29 is provided which forms a support for conduit 28. This support plate is provided with passageways 30 and 31. A first electrical lead 32 passes through passageway 30 and connects solenoid valve 26 with a source of energy at the earth's surface, the electrical lead 32 being carried to the earth's surface through electrical conductor 15. Similarly, thermocouple 27 is connected electrically by electrical lead 33 to a temperature or pressure indicating means at the earth's surface, not shown, the electrical lead 33 passing through passageway 31 in plate 29 and being carried to the earth's surface through electrical conductor cable 15.

In the embodiment of Fig. 2, identical numerals will be employed to designate identical parts as in Fig. 1. In this embodiment of our invention, body member 14 has a pressure vessel 16 arranged therein. The body member 14 is provided with a plurality of depending arms 40, 41, and 42. Depending arms 40 define with a lower end thereof recesses 43 in which are arranged thermocouples 44. Depending arms 41 define on a free end thereof recesses 45 and 46. Arranged in recess 46 is a thermocouple 47. The arms 41 are provided with internal passageways 48 which have an outlet in recesses 45. The depending arms 42 define on a free end thereof a cutting or knife edge 49 and a recess 50 in which is arranged a thermocouple 51. Each of the arms 40, 41, and 42 is attached to the body member 14 pivotally at points 52, 53, and 54 and is biased outwardly from the body member 14 by biasing means or springs 55, 56, and 57.

The internal passageways 48 are connected by conduits 58 to a conduit 59 which connects to a solenoid valve 60 which, in turn, connects by conduit 61 to the bag member 16. Solenoid valve 60 may be energized through electrical leads 60a which are carried to a source of energy at the earth's surface by cable 15.

The thermocouples 44 in recesses 43 are connected by electrical lead 62 to a temperature indicating means at the earth's surface, and this electrical lead is carried thereto by electrical conductor cable 15. The thermocouples 47 are also connected to a temperature indicating device, which may be the same temperature indicating device to which thermocouple 44 is connected, by electrical lead 63. Lead 63 is likewise carried to the earth's surface by electrical conductor cable 15.

The thermocouples 51 are also connected to a temperature indicating device at the earth's surface, which may be the same temperature indicating device to which thermocouples 44 and 47 are connected, by electrical lead 64, which is also carried to the earth's surface by electrical conductor cable 15.

The apparatus of Fig. 3 is another embodiment of our invention and consists of a body member 70 which defines a cavity 71 in which is arranged a pressure vessel 72 adapted to contain a fluid oxidizing agent of the type mentioned before. The body member 70 defines a cylinder 73 in which is arranged a piston 74 which is connected to a piston arm 75. Piston arm 75 has an L-shaped passageway 76 which communicates with conduit 77 when the piston 74 is moved to the right to its greatest extent. The conduit 77 connects through solenoid valve 78 which, in turn, connects to bag member 72. The valve 78 is electrically connected by leads 78a through cable 15 to a source of energy at the earth's surface.

The piston arm 75 carries a clevis arrangement 79 which is provided with an axle or pin 80. Mounted within the clevis 79 is a spur-like attachment 81 which defines

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a plurality of knife or cutting edges 82. Each of the knife edges 82 has outlets 83 which communicate through the hollow member 81 and through pin 80 with passageway 76. Arranged within the clevis 79 is a brush or brushes 84 which serves to clean the knife edges 82 on rotation of the member 81.

The cylinder 73 connects by a passageway 85 in the body member 70 to a conduit 86 which connects to a double acting solenoid valve 87. The piston cylinder is also connected to valve 87 by conduits 85a and 86a, as shown. Valve 87, in turn, connects by conduit 88 to a deformable bag member 89 which is adapted to contain a hydraulic fluid, such as oil or the like. The solenoid valve 87 is connected to a source of electric energy by electrical lead 90 which is carried to the earth's surface through an electrical conductor cable, not shown.

Leading into cylinder 73 is a second passageway 91 which is attached to a conduit 92 which, in turn, connects with a double acting solenoid valve 93. Solenoid valve 93 connects by conduit 94 with an exhaust reservoir 95 which is adapted to contain exhaust hydraulic fluid from the cylinder 73. Valve 93 also connects to cylinder 73 by passageway 91a and conduit 92a. Solenoid valve 93 is connected to a source of electrical energy at the earth's surface by electrical lead 96, the electrical lead being carried to the earth's surface through an electrical conductor cable, not shown.

The member 81 is provided with a plurality of thermocouples 97 which are arranged adjacent the free ends thereof of the knife edges 82. The thermocouples 97 are connected by electrical lead 98 to an electrical lead 99 which is carried through body member 70 to a passageway 100 and thence to the earth's surface through an electrical conductor cable, not shown.

The vessel 72 in cavity 71 may be a deformable bag on which pressure may be exerted from a source of pressure contained within the body member 70, as may be desired, or it may be a pressure vessel under pressure.

In the description of the embodiment of Fig. 3, it will be noted that the piston arm 75 with the clevis arrangement 79 and the member 81 are arranged to move to the right in a cavity 102 in the body member 70. It will also be noted that the piston 74 is provided with means for urging it to the left, by introducing hydraulic fluid through conduits 85a and 86a, and to retract the member 81 from contact with formation 12. Since this device is adapted for obtaining a continuous log of a well bore, it is usually unnecessary to retract same until the log is completed. It is to be noted that cylinder 73 is provided with an annular stop means 74a to provide space for introduction of hydraulic fluid against the right hand end of piston 74.

Referring to Fig. 4, which is a modification of Fig. 3, the solenoid valve 78 is arranged in a cavity 120 in the body member 70. The solenoid valve 78 may be energized through leads 78a and is connected by a conduit 121 to a reservoir 122 in which is arranged an oxidizing agent 123. The reservoir 122 is enclosed completely by the body member 70 and is held under pressure. The reservoir 122 is internally lined with a liner 124 which is constructed of a non-corrosive material, such as tantalum or other non-corrosive material which is not subject to attack by powerful oxidizing agents. The reservoir 122 has a conduit 125 leading therein to which is connected to a solenoid valve 126 which, in turn, is connected by conduit 127 to a source of pressure, such as a nitrogen tank 128 containing nitrogen or other inert gas under high pressure. The solenoid 126 is connected by electrical lead 126a to a source of electrical energy at the earth's surface. The electrical lead 126a, like electrical lead 78a, is conducted to the earth's surface, through an electrical conductor cable, not shown.

Referring now to Fig. 5, numeral 70 designates a body member, such as illustrated in Figs. 3 and 4. The body member 70 is provided with a chamber 200 which contains a suitable hydraulic oil exposed to pressure in the hole through acoustic windows 200a which are covered

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by a flexible member such as a diaphragm member 200b to prevent fouling by mud. Arranged in the chamber 200 is a pressure indicating tube 201 embodying a magnetostriction tube which may suitably be constructed of nickel or permendur. While the chamber 200 is shown adjacent the piston 74 in piston cylinder 73, it is to be understood that the chamber 200 may be arranged in any convenient place in the body member 70. The magnetostriction device 201 is connected electrically by electric leads 202 to the earth's surface by an electric conductor cable 15 to a suitable sound or pressure indicating device.

The device of Fig. 5 is shown in more detail in Figs. 6 and 7. The pressure indicating device per se 201 is contained in a brass cylinder 203 which is filled with a suitable oil. The magnetostriction tube 204 is provided with a toroidal winding 205 and is held in the brass cylinder 203 by a threaded bolt 206. The cylinder 203 is provided on its lower end with expansion bellows 207. At its upper end the toroidal winding is connected by electrical leads 208 to electrical lead 202 which carries an impulse caused by pressure to the earth's surface and to a suitable display or pressure recording instrument. The magnetostriction tube 204 is provided with a laminated core 209 which is shown in more detail in Fig. 7.

The device of Fig. 8 is similar to that of Fig. 5 with the exception that the pressure pickup member 201 is arranged in a chamber separate from body member 70. In this embodiment of our invention the pressure pickup chamber 210 is carried by an auxiliary cable or suspending means 211 adjacent to the knife edged member 81. In this apparatus of our invention the pressure pickup mechanism 201 is identical to that described in Figs. 5, 6, and 7.

The several embodiments of our invention are operated in the following manner: With reference to Fig. 1, the body member 14 may be lowered into the borehole 11 by electrical conductor cable 15, the electrical conductor cable carrying the electrical leads 32 and 33 being connected to suitable indicating devices. As the device is lowered to the lowest depth desirable in the well bore 11, the extension arms 18 are then released by operation of a suitable tripping mechanism, not shown, which causes the arms 18 to be biased outwardly against the wall of the well bore, allowing the knife edge 20 to pierce the filter cake 13 and allowing a free end of the extension arm 18 to come into contact with the formation 12. Since the oxidizing agent is contained in the pressure vessel under a high pressure, it is possible by energization of the valve 26 and opening same to release oxidizing agent through the conduit 28 and through conduits 24 into recesses 21 and thence into contact with the formation 12 to react with any hydrocarbons present therein. The body member 14 is raised in the well bore and as it is raised the reaction of the oxidizing agent with hydrocarbons or petroliferous substances encountered in the formations traversed by the well bore allows a log of the hydrocarbons to be obtained. This log may be a measure of the temperature increase caused by reaction of hydrocarbons with the oxidizing agents, or it may be a log of an elastic wave, such as a pressure or a sound wave. When the latter effects are employed, the thermocouple 27 may be replaced by suitable pressure indicating or sound recording means, as shown in Figs. 5, 6, 7 and 8. This device when exposed to a pressure impulse will by compressibility thereof, even slight, generate an electric impulse which may be transmitted to the earth's surface.

The apparatus of Fig. 2 is operated somewhat similarly to that of Fig. 1. In this apparatus, however, as the member 14 is raised in the well 11, the cutting edges 49 disrupt the filter cake 13. At the same time the thermocouples 51 cause a temperature trace to be obtained at the well head which is the temperature of the formation. As oxidizing agent is introduced into the recess 45, it comes into contact with the formation 12 and causes a reaction

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with hydrocarbons contained therein which in turn causes a temperature rise which may be recorded by thermocouples 47 or by thermocouples 44 carried by arms 40. Thus, two or three temperature traces may be obtained, the first being a temperature trace of the temperature of the formation and the second and third temperature traces being the result of the oxidizing reaction caused by contact of the oxidizing agent with hydrocarbons in the formations traversed by the body member 14. The thermocouples in recesses 44 indicate the formation temperature after the oxidizing reaction has been allowed to proceed.

In the device of Fig. 3, the deformable bag member 89 is exposed to the drilling mud pressure in the borehole 11. By energizing solenoid 87 through electrical lead 90, hydraulic fluid, such as oil, is introduced by conduits 88, 86, and 85 into piston cylinder 73 which causes the piston 74 to move to the right and extend the member 81 such that the knife or cutting edges 82 pierce the filter cake 13 and contact the formation 12.

By energizing solenoid valve 78 through electrical lead 78-a, oxidizing agent under pressure in vessel 72 is conducted into conduit 77 and thence into L-shaped passageway 76 which terminates in outlets 83. As the body member 70 is raised in the well bore 11, the member 81 rotates and the oxidizing agent is introduced into contact with formation 12. If hydrocarbons are present, a reaction immediately ensues which causes a temperature rise or generation of a pressure or sound wave. Assuming that a temperature rise is effected, by virtue of thermocouples 97 the temperature effect is carried to the earth's surface through leads 98 and 99 through electrical conductor cable 15.

The device of Fig. 4 operates similarly to that of Fig. 3 with the exception that after the piston 74 has been moved to the right, solenoid valves 78 and 126 are open in reverse order to allow pressure to be built up on reservoir 122 and thus cause the oxidizing agent to be introduced into contact with formation 12.

Thus, in the foregoing embodiments of our invention, it is possible to obtain a continuous trace of the formations traversed by the well bore 11 and a continuous indication of the presence or absence of hydrocarbons therein.

The nature and objects of the present invention having been completely described and illustrated, what we wish to claim as new and useful and to secure by Letters Patent is:

1. Well logging apparatus for detecting the presence of petroliferous substances in an earth formation penetrated by a well bore which comprises, in combination, a body member adapted to be lowered and raised in said well bore having a reservoir adapted to contain a fluid oxidizing agent, at least one extension arm carried by said body member for disrupting a filter cake on a wall of a well bore and for contacting said formation; means communicating said extension arm with said reservoir for introducing oxidizing agent into contact with said formation; and detection means arranged adjacent said communication means for detecting a reaction effect of said oxidizing agent with petroliferous substances in said formation.

2. Well logging apparatus for detecting the presence of petroliferous substances in an earth formation penetrated by a well bore which comprises, in combination, a body member adapted to be lowered and raised in said well bore; a chamber in said body member adapted to contain a fluid oxidizing agent; extensible means carried by said body member for disrupting a filter cake on a wall of said well bore and for contacting said formation; means carried by said extensible means communicating with said chamber for introducing oxidizing agent into contact with said formation; and detection means carried by said body member for detecting a reaction effect of said oxidizing agent with petroliferous substances in said formation.

3. Well logging apparatus for detecting the presence of petroliferous substances in an earth formation penetrated by a well bore which comprises, in combination, a body member adapted to be lowered and raised in said well bore; a chamber in said body member adapted to contain a fluid oxidizing agent; extensible means carried by said body member for disrupting a filter cake on a wall of said well bore and for contacting said formation; means carried by said extensible means communicating with said chamber for introducing oxidizing agent into contact with said formation; detection means carried by said body member for detecting a reaction effect of said oxidizing agent with petroliferous substances in said formation; and means for transmitting the effect of said reaction to the earth's surface.

4. Well logging apparatus for detecting the presence of petroliferous substances in an earth formation penetrated by a well bore which comprises, in combination, a body member; a chamber in said body member adapted to contain a fluid oxidizing agent reactable with petroliferous substances; extensible means carried by said body member having a free end defining at least one outlet port and adapted to pierce a filter cake on a wall of said well bore and to contact said formation; a conduit in said body member connecting said chamber with said outlet; and detection means carried by said body member for detecting a reaction effect of said oxidizing agent with said petroliferous substances in said formation.

5. Well logging apparatus for detecting the presence of petroliferous substances in an earth formation penetrated by a well bore which comprises, in combination, a body member; means attached to said body member for lowering and raising said body member in a well bore; a cavity defined by said body member adapted to contain a fluid oxidizing agent reactable with petroliferous substances; extensible means carried by said body member having a free end defining at least one outlet port and adapted to pierce a filter cake on a wall of said well bore and to contact said formation; a conduit in said body member connecting said cavity with said outlet; and detection means carried by said lowering and raising means adjacent the outlet port of said extensible means for detecting a reaction effect of said oxidizing agent with said petroliferous substances in said formation.

6. Well logging apparatus for detecting the presence of petroliferous substances in an earth formation penetrated by a well bore which comprises, in combination, a body member; a chamber in said body member adapted to contain a fluid oxidizing agent reactable with petroliferous substances; extensible means carried by said body member having a free end defining at least one outlet port and adapted to pierce a filter cake on a wall of said well bore and to contact said formation; a conduit in said body member connecting said chamber with said outlet; detection means carried by said body member for detecting a reaction effect of said oxidizing agent with said petroliferous substances in said formation; and means for transmitting the effect of said reaction to the earth's surface.

7. Well logging apparatus for detecting the presence of petroliferous substances in an earth formation penetrated by a well bore which comprises, in combination, a body member adapted to be lowered and raised in said well bore; a chamber in said body member adapted to contain a fluid oxidizing agent; at least one extension arm carried by said body member for disrupting a filter cake on a wall of a well bore and for contacting said formation; means carried by said extension arm communicating with said chamber for introducing oxidizing agent into contact with said formation; and detection means carried by said extension arm for detecting a reaction effect of said oxidizing agent with petroliferous substances in said formation.

8. Well logging apparatus for detecting the presence of petroliferous substances in an earth formation pene-

trated by a well bore which comprises, in combination, a body member adapted to be lowered and raised in said well bore; a chamber in said body member adapted to contain a fluid oxidizing agent; extensible means carried by said body member defining with a free end thereof a knife edge for disrupting a filter cake on a wall of said well bore and for contacting said formation; means carried by said extensible means communicating with said chamber for introducing oxidizing agent into contact with said formation; and detection means carried by said extensible means on a free end thereof for detecting a reaction effect of said oxidizing agent with petroliferous substances in said formation.

9. Well logging apparatus for detecting the presence of petroliferous substances in an earth formation penetrated by a well bore which comprises, in combination, a body member adapted to be lowered and raised in said well bore; a chamber in said body member adapted to contain a fluid oxidizing agent; extensible means carried by said body member defining with a free end thereof a knife edge for disrupting a filter cake on a wall of said well bore and for contacting said formation; means carried by said extensible means for introducing said oxidizing agent into contact with said formation comprising a conduit communicating with said chamber; and detection means carried by said body member for detecting a reaction effect of said oxidizing agent with petroliferous substances in said formation.

10. Well logging apparatus for detecting the presence of petroliferous substances in an earth formation penetrated by a well bore which comprises, in combination, a body member adapted to be lowered and raised in said well bore defining a reservoir adapted to contain a fluid oxidizing agent; at least one extension arm carried by said body member provided with a conduit communicating with said reservoir; a knife edge on a free end of said arm defining at least one outlet port for said conduit, and detection means carried by said body member for detecting a reaction effect of said oxidizing agent with petroliferous substances in said formation.

11. Well logging apparatus for detecting the presence of petroliferous substances in an earth formation penetrated by a well bore which comprises, in combination, a body member adapted to be lowered and raised in said well bore defining a reservoir adapted to contain a fluid oxidizing agent; at least one extension arm carried by said body member provided with a conduit communicating with said reservoir; a knife edge on a free end of said arm defining at least one outlet port for said conduit, and a thermocouple carried by said arm on said free end for detecting a temperature increase caused by reaction of said oxidizing agent with petroliferous substances in said formation.

12. Well logging apparatus for detecting the presence of petroliferous substances in an earth formation penetrated by a well bore which comprises, in combination, a body member adapted to be lowered and raised in said well bore defining a reservoir adapted to contain a fluid oxidizing agent; at least one extension arm carried by said body member provided with a conduit communicating with said reservoir; a knife edge on a free end of said arm defining at least one outlet port for said conduit, and a pressure indicating means carried by said body member for detecting a pressure impulse caused by reaction of said oxidizing agent with petroliferous substances in said formation.

13. Well logging apparatus for detecting the presence of petroliferous substances in an earth formation penetrated by a well bore which comprises, in combination, a body member adapted to be lowered and raised in said well bore defining a reservoir adapted to contain a fluid oxidizing agent; at least one extension arm carried by said body member provided with a conduit communicating with said reservoir; a knife edge on a free end of said arm defining at least one outlet port for said conduit, and

a sound indicating means carried by said body member for detecting a sound wave caused by reaction of said oxidizing agent with petroliferous substances in said formation.

14. Well logging apparatus for detecting the presence of petroliferous substances in an earth formation penetrated by a well bore which comprises, in combination, a body member adapted to be lowered and raised in said well bore defining a reservoir adapted to contain a fluid oxidizing agent; at least one extension arm carried by said body member provided with a conduit communicating with said reservoir; a knife edge on a free end of said arm defining at least one outlet port for said conduit; means for extending said arm from said body member; and detection means carried by said body member for detecting a reaction effect of said oxidizing agent with petroliferous substances in said formation.

15. Well logging apparatus for detecting the presence of petroliferous substances in an earth formation pene-

trated by a well bore which comprises, in combination, a body member adapted to be lowered and raised in said well bore; a deformable bag member arranged in a closed cavity defined by said body member adapted to contain a fluid oxidizing agent; at least one extension arm carried by said body member provided with a conduit communicating with said bag member; a knife edge on a free end of said arm defining at least one outlet port for said conduit; biasing means for extending said arm from said body member; and detection means carried by said arm on said free end for detecting a reaction effect of said oxidizing agent with petroliferous substances in said formation.

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