July 12, 1955 L. F. BONNER 2,713,010

METHOD OF CONDITIONING HOT WIRE GAS DETECTORS

Filed Oct. 19, 1953

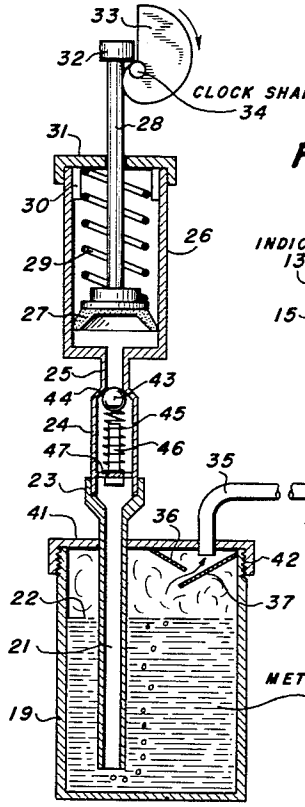


FIG. 1.

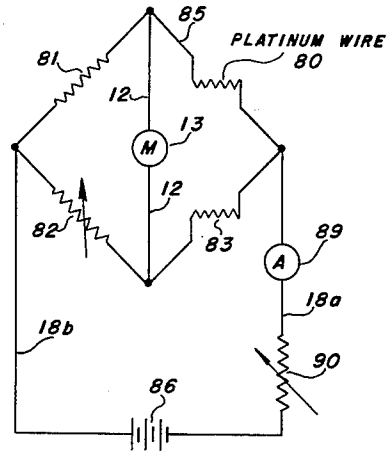
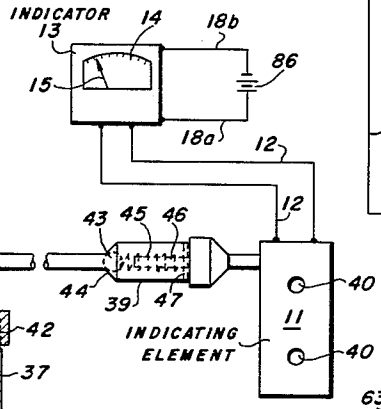


FIG. 3.



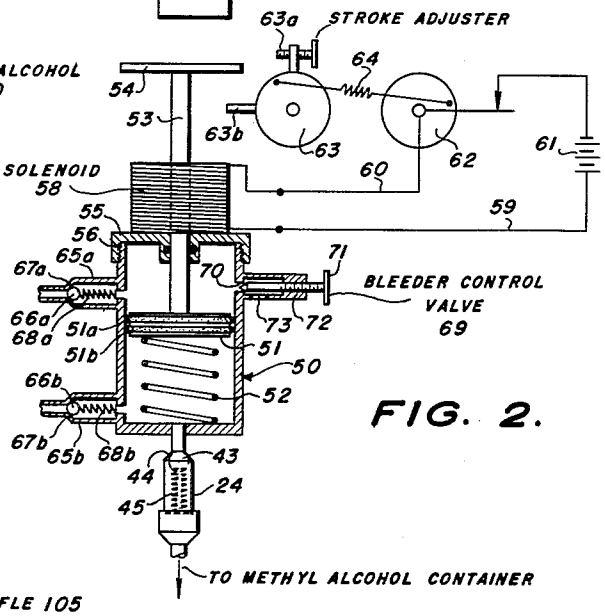


FIG. 2.

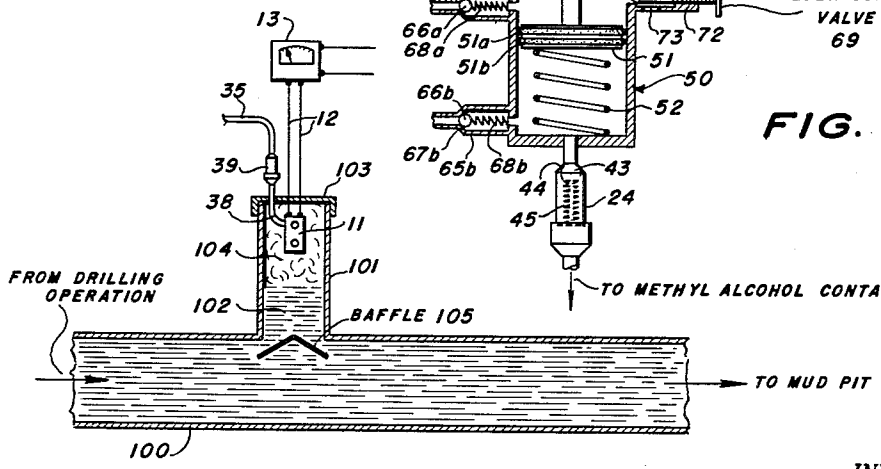


FIG. 4.

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United States Patent Office 2,713,010 Patented July 12, 1955

2,713,010

METHOD OF CONDITIONING HOT WIRE GAS DETECTORS

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Application October 19, 1953, Serial No. 386,845

3 Claims. (Cl. 134—2)

The present invention is directed to a method conditioning a hot wire gas detector. In its more specific aspects, the invention is concerned with a method of removing combustible deposits from a hot wire gas detector used in logging operations in which oil-emulsion muds are employed.

The present invention may be briefly described as a method for conditioning a hot wire gas detector employed in formation sample and in mud logging operations in which an oil-emulsion mud and/or formation samples are tested to determine the presence of hydrocarbons from subsurface earth formations. The specific feature of the invention is contacting the hot wire with vapors of a volatile oxygenated organic compound such as the aliphatic alcohols, aliphatic ketones and aliphatic ethers, these oxygenated compounds having a carbon chain in which there are no more than three carbon atoms. The vapors are then ignited whereby any deposits on the hot wire are removed by combustion of the volatile oxygenated organic compounds.

The present invention also is concerned with apparatus for use in mud and sample logging in which oil-emulsion muds are employed comprising a housing defining a chamber having an electrical element arranged in the chamber. This element becomes fouled with combustible deposits on use in said mud logging operations where oil-emulsion muds are employed. The apparatus comprises a container adapted to receive a body of a volatile oxygenated organic compound selected from the group consisting of the aliphatic alcohols, ketones and ethers having a carbon chain of no more than three carbon atoms. The container is provided with means for injecting air thereinto at a lower point in the container below the surface of the body. A conduit is connected to the container at an upper point remote from the lower point and above the surface of the body. This conduit projects into the container and is partially or substantially enclosed by baffle members in the container which prevent entry of the liquid into the conduit. The conduit is connected to an introducing means for introducing the combustible mixture into the chamber. The chamber is provided with means for energizing the electrical element to ignite the mixture and burn off combustible deposits. The air injection means may comprise a plunger and a biasing means, such as a spring, for causing the plunger to inject air in the container. Likewise, the air injection means may comprise a solenoid operated plunger which is electrically energized.

The invention will be further illustrated by reference to the drawing in which:

Fig. 1 is an illustration of a preferred embodiment showing the biased plunger for injecting air into the container;

Fig. 2 is an illustration of a solenoid operated plunger;

Fig. 3 is a wiring diagram of the hot wire detector; and

Fig. 4 shows the application of the apparatus of the present invention to mud logging.

Referring now to the drawing and particularly Fig. 1, numeral 11 designates a hot wire detecting device which

is provided with electrical leads 12 connected to a recorder or indicator 13 of the balanced-bridge type. The indicator 13 has a scale 14 and an indicating means 15 to show the deflection of the instrument. The indicator 13 is provided with electrical leads 18*a* and 18*b* for energizing the hot wire from a battery such as 86.

The apparatus includes a container 19 in which is arranged a body of the volatile oxygenated organic compound 20. The container is provided with an inlet pipe 21 which leads to a lower point in the container below the surface 22 of the body of volatile oxygenated organic compound. The pipe 21 is connected by a coupling 23 to a check valve 24 which, in turn, is connected by conduit 25 to a plunger mechanism generally indicated by the numeral 26 and including a piston or plunger 27, a plunger shaft 28 and a biasing means, such as spring 29, which normally urges the plunger 27 downwardly. The lower end of the spring 29 bears against the plunger 27 while the upper end is confined by an annular sleeve 30. The plunger mechanism generally indicated by 26 has a cover 31 through which the shaft 28 loosely projects. The shaft 28 is provided with a shoulder 32. Arranged adjacent the shoulder 32 is a cam or eccentric 33 connected by means of a shaft 34 to a clock mechanism or suitable other energizing means.

Connected to the container 19 is a conduit 35 which projects into the container 19. The projection of the conduit 35 in the container 19 is partially or substantially enclosed by baffle members 36 and 37 which serve to prevent entry of liquid in the conduit 35. The conduit 35 is connected to a check valve 39 for introducing gaseous mixture into the indicating element 11. The indicator element is provided with ports 40 to allow the gaseous mixture to circulate freely over the hot wire or detecting element and for withdrawal of the combustion products.

The container 19 is provided with a closure member 41 which is threadably connected by threads 42 to the container, the conduit 35 passing through the closure member 41.

The check valves 24 and 39 are constructed similarly and are comprised of spheres or balls 43 which are designed to seat against seats 44. The spheres 43 are biased against the seats 44 by means of a biasing means or spring 45 arranged on a spring member 46, the spring 45 and the spring member 46 being mounted on a plate 47 arranged in the check valves 24 and 39.

Referring now to Fig. 2 in which the air injecting means is a solenoid operated plunger, the numeral 50 designates generally the solenoid operated mechanism in which is arranged a plunger 51, provided with O-ring seals 51*a* and 51*b* which is normally biased in an upward position by a spring 52. The plunger 51 is provided with a shaft 53 on which is arranged a shoulder 54. A closure member 55 through which the shaft 53 projects is threadably connected by threads 56 to the solenoid member 50, the shaft 53 being slidably sealed by an O-ring 57. Wound around the upper end of the member 50 is a solenoid winding 58 which is connected by electrical connections 59 and 60 to a source of power illustrated by a battery 61. Arranged in the circuit is a solenoid switch 62 which is connected to a snap switch assembly 63 which carries a stroke adjustment assembly 63*a* and which has a projecting means 63*b*, the snap switch assembly and the solenoid switch being connected by a spring 64.

The solenoid assembly 50 is provided with first and second air intake check valves 65*a* and 65*b*, respectively, having spheres 66*a* and 66*b* biased against the seats 67*a* and 67*b* by means of springs 68*a* and 68*b*. A bleeder control valve 69 is provided to fit against the seat 70 which is actuated manually by a valve wheel 71, the valve housing 72 being provided with a port 73. Thus bleeder

valve **69** controls the rate of return of plunger **51** and, therefore, the time cycle of injection.

Referring now to Fig. 3, it will be seen that the hot wire gas detector is a Wheatstone bridge **85** having a platinum wire **80** arranged in a circuit. The Wheatstone bridge comprises the platinum wire **80**, a fixed resistor **81**, a balancing resistor **82** and a compensating element **83** being connected by means of electrical connections **12** to the recorder or detector element **13**. The Wheatstone bridge, which is generally indicated by the numeral **85**, is provided with a source of power, such as battery **86**, and connected thereto by means of electrical connections **18***a* and **18***b*. An ammeter **89** is arranged in electrical connection **18***a* and is provided with ampere control means, such as a resistor **90**.

The apparatus of the present invention may suitably be used in mud logging operations, such as illustrated in Fig. 4, in which a mud line **100** is connected to a drilling operation, not shown, and delivers mud to a mud pit, not shown. The mud line **100** is provided with a standpipe **101** which allows the mud to rise therein as a column **102** due to the pressure head. Above the mud column **102** in standpipe **101** there is a vaporous atmosphere **104** in which the indicator element **11** is arranged as shown. The standpipe **101** is provided with a closure member **103**.

Carried through the closure member **103** are the electrical connecting means **12** leading to the recorder **13** which has been described. Also carried through the closure member **103** is a conduit **38** including the check valve **39** which is connected to the conduit **35**. The electrical connections **12** may be carried either through the closure member **103** or through the wall of the standpipe **101**. Baffle **105** diverts mud from the line **100** through the standpipe **101** and assures continuous mud supply to the system.

The device of the present invention works in the following manner with respect to Figs. 1 and 3:

For the purpose of this description, it will be assumed that the hot wire element **80** which may be a fine platinum wire having an overall coiled length of ¼ to ⅜ of an inch has become fouled with deposits resulting from well logging operations. The device of Fig. 1 is connected to the indicating element **11** including a platinum wire **80** and air is injected into the container **19** by operating the shaft **34**; as the eccentric or cam **33** rotates in the direction indicated by the arrow, the cam bears against the shoulder **32** raising the shaft **28** embracing the spring **29**. As the cam or eccentric continues the rotation, the collar **32** is released allowing air to be forced downwardly by the plunger **27**, the air being sucked or drawn past the plunger **27** as it is raised by the rotation of the cam. When the plunger is released from the high part of the cam, the plunger is forced downwardly and the air is forced through the check valve **24** causing the sphere **43** to bear against the spring **45**. The air bubbles upwardly through the body **20** of the volatile oxygenated organic compound and thence into the conduit **35**; the baffles **36** and **37** prevent any liquid due to breaking bubbles or from entrainment from passing into the conduit **35** and thence through the check valve **39** into the indicator **11** into contact with the hot wire **80** which is energized by electrical connections **18** and **18***a* by battery **86**. As the combustible deposits are removed from the wire, the indicating means **15** will become deflected and then returned to zero.

The device of Fig. 2 operates in a similar manner to supply air to the container **19**. With reference to Fig. 2 with the plunger down and the spring **52** compressed, the switch **62** controlling the solenoid is open allowing the plunger to be forced upwardly by the pressure of the spring. The speed of the retreating plunger is controlled by the opening and closing of the bleeder control valve **69** which allows air to be exhausted by the port **73**. As the plunger shaft **53** approaches the top of the assembly **50**, air is drawn in below piston **5**, through second check valve **65***b* by the sphere **66***b* moving off seat **67***b* and the stroke adjustment screw **63***a* is then contacted and caused to rotate. As this adjustment rotates past the center of the spring **64**, the snap switch assembly **63***b* will snap the solenoid switch **62** into a closed position thereby actuating the solenoid again and pulling the plunger shaft **53** downwardly compressing the spring **52**, air having been trapped below the plunger **51** on the upstroke of the plunger **51** causing air to pass through the first check valve **65***a* forcing the sphere **66***a* off the seat **67***a*. The operation with respect to Fig. 2 thereafter is similar to that of Fig. 1.

In the operation with respect to Fig. 4, the mud flowing through the mud line **100** will rise as a column **102** in standpipe **100** and provide a vaporous atmosphere **103**. The detector element **11** including the platinum wire **80** is in contact through ports **40** with the vaporous atmosphere. By energizing the hot wire, the presence of combustible vapors in the atmosphere **104** may be determined on the scale **14** by the indicating means **15**.

When the hot wire **80** becomes fouled with combustible products, volatile oxygenated organic compounds are introduced by introducing means **38** as has been described and the combustible deposits removed from the wire **80**. Thereafter the mud logging operation may be resumed, the removal of combustible deposits being conducted periodically and automatically as occasion requires.

The present invention is particularly adaptable for use in mud logging operations where a hot wire gas detector is used and where the wire becomes fouled with deposits. This is sometimes encountered in mud logging where a normal drilling mud, such as an aqueous mud, is employed but more frequently is encountered where oil-emulsion muds are used. In fact, heretofore it has been substantially impossible to conduct mud logging operations where oil-emulsion muds have been used. Efforts have been made to remove deposits from platinum wires using hot wire detectors by injecting vapors of gasoline and light hydrocarbons into the detector element and then energizing the hot wire to burn off the deposits. This has been unsuccessful in that the long chain hydrocarbons either do not burn with a sufficiently hot flame or leave in themselves a deposit which interferes with the accuracy of the device.

In mud logging where a well is drilled with oil-emulsion mud, the hot wire gas detector rapidly becomes inoperative due to the coating formed on the element. Prior to the present invention, the remedy was to remove the element or either replace it or clean it by burning out using hydrocarbon vapors. As will be clear, this requires considerable time and had to be performed many times a day, such as possibly every 15 minutes. The present invention obviates this difficulty since the device of the present invention may be connected to the hot wire detector and automatically and periodically employed to condition the element without removing it from the gas collection chamber. Thus the cam, such as described in Fig. 1, may be run at a controlled speed by a suitable gear which may be variable from one revolution in 5 minutes to 1 revolution an hour and likewise with respect to the solenoid actuated embodiment.

While especially useful in operations involving oil emulsion muds, the present invention is also applicable to use in logging drill cuttings, examination of bottom hole and side wall cores, aqueous drilling mud, and any media which comes into contact with subsurface formations which may contain hydrocarbons.

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

1. A method for conditioning a hot wire gas detector for use in well logging operations in which said hot wire becomes fouled with combustible deposits, which com-

prises contacting said hot wire with vapors of a volatile oxygenated organic compound selected from the group consisting of the aliphatic alcohols, ketones, and ethers having a carbon chain of no more than 3 atoms, and igniting said vapors whereby said deposits are removed from said hot wire.

2. A method for conditioning a hot wire gas detector for use in well logging operations in which said hot wire becomes fouled with combustible deposits, which comprises contacting said hot wire with vapors of a volatile oxygenated organic compound selected from the group consisting of the aliphatic alcohols, ketones, and ethers having a carbon chain of no more than 3 carbon atoms, igniting said vapors whereby said deposits are removed from said hot wire, and removing products formed by igniting said vapors.

3. A method for conditioning a hot wire gas detector

for use in logging of well samples in which said hot wire becomes fouled with combustible deposits which comprises forming a combustible mixture of air and vapors of a volatile oxygenated organic compound selected from the group consisting of the aliphatic alcohols, ketones, and ethers having a carbon chain of no more than 3 carbon atoms, contacting said hot wire with said mixture, igniting said mixture to burn off said deposits, and removing products formed by igniting said mixture and burning off said deposits.

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