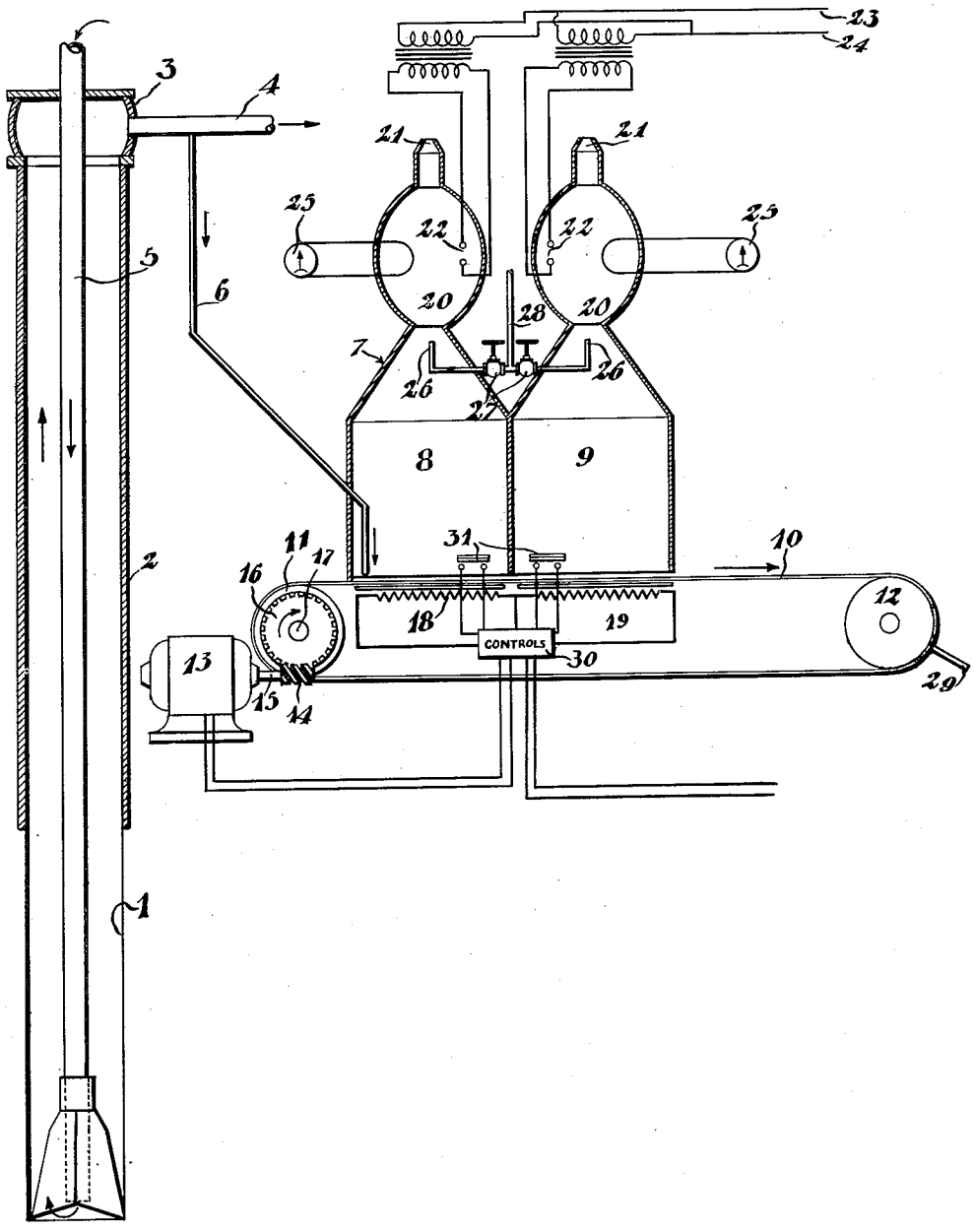
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OIL AND GAS DETECTOR APPARATUS

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OIL AND GAS DETECTOR APPARATUS

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11 Claims. (Cl. 23—232)

This invention relates to a method and apparatus for detecting the presence of oil and gas in the sludge, as removed from a drill hole in the process of boring a well.

The improvement is primarily directed to the rotary system of drilling or boring, in which a tubular drill rod is employed through which liquid is supplied under pressure, or otherwise, to the base of the hole and mixed with the cuttings, the mass agitated by the revolving cutter or boring bit, into a sludge, and elevated in the well bore and casing for discharge at the earth's surface.

It frequently occurs, in oil field exploration or exploitation drilling, that an oil or gas bearing strata is unknowingly penetrated by the boring bit, and the casing, with the progress of the boring, advanced through such strata, so that knowledge of its value is lost.

Various direct methods have been attempted for indicating or disclosing the presence of gas and oil without undue delay in boring, as is occasioned by periodically taking samples from the sludge and making an analytical test thereof, which, however, have not been reliable or satisfactory because of failure to distinguish between oil and gas, nor to indicate the presence of either when actually present in the bore hole.

The improvement primarily consists in either continuously, intermittently, or periodically withdrawing or draining a small quantity of the circulating sludge or mud from the drill hole of a well during the process of drilling and depositing the same upon a belt or conveyor, as a traveling or movable base for one or a plurality of consecutively arranged chambers, and in heating the mud upon the belt to a predetermined temperature while sustained in relation to a chamber, to liberate the gas or vaporizing hydrocarbon product occluded in the mud for collection into the chamber, so that its presence can be readily and definitely determined or indicated.

The travel of the conveyor may be either continuous or intermittent and under automatic control, governed by the temperature of the material when within a chamber, or internal temperature of the chamber receiving the gas or vapor, to insure that the mud is heated to a sufficient degree to liberate the gas or vapor therefrom, so that a definite and satisfactory test can be made.

An object of the invention is to provide a method and means for determining when the bit of a rotary well drilling device has penetrated a deposit of oil or gas, or a mixture of these hydrocarbon substances or strata bearing the same, by continuously withdrawing or draining a small quantity of the circulating mud or sludge from the well hole and heating the same within a chamber for liberating the gas or hydrocarbon vapors and igniting the liberated gas or vapor in said chamber.

Another object of the invention is to pass the mud or sludge withdrawn or taken from the circulating mud stream of a well in the process of boring successively into several chambers, with the mud heated to a different degree of temperature for each chamber, in which it is successively disposed, to separately and distinguishably determine whether gas or other hydrocarbon products are occluded therein.

Another object of the invention is to provide means for continuously indicating and measuring the products of combustion, or other chemical reactions of hydrocarbons in the circulating mud fluid, instituted in the drilling of a well by a rotary bit drilling method.

Another object of the invention is to provide a simple and effective means for readily determining the presence of an oil or gas bearing strata or deposit, when penetrated by the bit of a rotary well drilling apparatus, by withdrawing or draining a small quantity of the circulating sludge or mud developed in the process of drilling into a chamber and heating the same to a determined degree of temperature to drive off the gas or vapor from the product and into the chamber, wherein the flow or any function of the flow of the gas or vapor can be ascertained and measured.

Various other features and advantages of the invention will be more fully apparent from a description of the accompanying drawing, which diagrammatically illustrates apparatus adapted to the practice of the invention.

The drawing, in diagram, illustrates only such fundamentals of a convention rotary well boring system, or appliances, as is of aid to the explanation of the present improvement, or as it is effectively combined or associated therewith. No change in the conventional boring system or equipment is made or acquired, except that provision is made for a take-off, continuously or periodically, of a small quantity of the circulating or flowing sludge, preferably at the head end of the well, at which the take-off can be more conveniently made, necessary for a continuous or periodical determination of the presence of any oil or gas in the sludge. Therefore, referring to the drawing, in which 1 indicates a bore or well

hole, protected with a casing 2 in the usual manner to a required depth, which is increased in length and descended as necessary as the boring depth progresses. The upper end of the casing, usually above the earth's surface, has a head 3 representative of a T-pipe fitting, to which a lateral pipe connection 4 is made, as a discharge outlet connection. A tubular drill rod 5 extends centrally through the head 3 and guidingly sustained thereby, the rod at its lower end carrying a bit of any preferred type most suitable for the strata penetrated. The tubular drill rod is rotated by power driven transmission means, not shown, and being tubular, provides a conduit for the conduction and circulation of a fluid, as water, to the base of the bore, to aid in cutting the earth material and for the removal of the cuttings.

The cuttings are mixed with the liquid under the agitation of the drill bit, into a sludge which is circulated upwardly in the well bore, about the tubular drill rod under the pressure of the descending liquid supplied within the tubular drill rod, to the head 3, thence through the lateral branch or pipe 4 to discharge the sludge upon the earth's surface or into a mud pit, in the latter instance for settling out the mud, if it is desired to reclaim the liquid for reuse.

A small quantity or portion of the circulating sludge is delivered or conveyed to an oil and gas detector through an offtake pipe 6, connecting either as shown with the lateral sludge discharge branch 4 or directly to the head 3. In this manner, a continuous or periodic sampling quantity of the sludge is delivered to the detector for immediate testing. The detector, in diagram, comprises an enclosure 7, subdivided to provide two independent adjoining compartments or chambers 8 and 9, one for detecting gas, and the other for oil. The chamber 8 primarily is employed for detecting gas in the sludge, deposited therein, while the chamber 9 is utilized for detecting oil.

The takeoff pipe 6, at its outlet end, is arranged to discharge or deposit the sludge upon a belt, and, as illustrated, upon the upper forward run of an endless metal belt or conveyor 10, traversing the bottom of the chambers 8 and 9, providing a movable base therefor. The belt 10, as its opposite end loops respectively, engages over a drive pulley 11 and an idler pulley 12, the pulleys are suitably journalled and supported exterior of the detector chambers. The drive pulley 11 is propelled by a suitable transmission mechanism, preferably through the medium of an electric motor 13, in transmission connection with the drive pulley, by a worm 14, fixed to the armature shaft 15 of the motor and in mesh with the worm-wheel 16, fixed upon the shaft 17, carrying the drive pulley 11.

The forward run of the belt, which traverses the chambers 8 and 9 of the detector, is heated by heater elements 18 and 19, respective for the chambers 8 and 9 for heating the sludge deposited upon the belt to a degree required to expand the hydrocarbon gas and oil occluded in the sludge deposit, the heating being relatively at different degrees for the several detector chambers employed. Electric heating is preferably employed for the reason that provision for automatic control and regulation can be more conveniently made. The heating element 18, for heating the sludge deposit upon the belt while conveyed and for the period that it is translated through the gas chamber at 8, is set or regulated for the lowest degree of temperature required to expand the gas occluded in the sludge, and cause it to leave the deposit and flow from the gas holder chamber 8 into a combustion chamber 20 located immediately above the gas or vapor collecting chamber 8. The upper end of the collecting chamber 8 is shown as contracted or tapering, for leading the gas into the lower end of the combustion chamber 20. The upper end of the combustion chamber is provided with a vent or draft flow 21, to aid in the circulation and combustion of the gas products and provide for an escape thereof. The gas in the combustion chamber 20 is ignited by an electric arc or spark issued by an electric igniter or spark gap 22 installed within the combustion chamber, and in suitable electric circuit connection with an electric service supply, as indicated by the electric circuit lines 23 and 24.

Igniting the gas in the combustion chamber effects a change in the temperature thereof, so that the resulting temperature change may be measured by means of a carbon dioxide detector, thermo couple or by the thermo-electric means indicated at 25 having a circuit junction within the combustion chamber.

If the drilling fluid or sludge does not yield enough oxygen to support combustion of the hydrocarbon gases in the combustion chamber, a supply of oxygen may be forced into the chamber through an air intake 26 represented by a length of pipe or tubing extending through the upper conical or tapering top of the gas collecting chamber, and bent at an angle to provide a vertically extended end or nozzle, centrally and axially of the collecting chamber for an upward discharge into the combustion chamber.

The exterior end of the air line 26 is provided with a valve 27 in connection with a supply line or pipe 28.

The structures of the several detectors employed are the duplicate of one another which similarly follows for the various metering and recording instruments and electric control devices either mounted directly upon the unit or upon a switch board and in circuit connection with the terminals or elements within the chambers of a unit, and this also applies for the circuit control of the heaters and other electrically operated apparatus located exterior of the unit.

In addition, the equipment of each unit may include a recording thermometer or other suitable instruments for indicating the passage of hydrocarbon gases through the combustion chamber and from their record when platted with reference to the depth of the bore hole, after making correction for the progress of the bore hole during the time the hydrocarbons were in circulation from the bit to the combustion chamber of the detector, the source of the hydrocarbon in the bore hole can be very accurately determined.

The detection and measurement of the hydrocarbon gases in the combustion chamber may alternately be accomplished by other chemical and physical means than those heretofore described, if such a choice is desirable, but, in either case the result will be to measure the flow or presence of hydrocarbon gases in the combustion chamber, or to measure any function of the flow of hydrocarbon gases passing through said combustion chamber.

After the mud sample has been tested in the first detector unit, it is by the translation of the belt conveyed or transferred to a second unit wherein it will be heated to a temperature sufficiently high to volitize the petroleum and effect

liberation of the petroleum vapor from the mud within the collecting chamber of the second unit and thence circulated into the combustion chamber thereof, wherein the process as previously described for the first unit is duplicated in all fundamental respects, and the recorded data of the second unit will indicate the presence and the source of petroleum in the bore hole.

The process may be continued or carried on in a third or additional number of units depending upon the distillation characteristics of the petroleum or oil in the region under exploitation.

The mud, after it has passed from within the last detector unit of the series, is removed from the belt. The removal is preferably accomplished by some type of mechanical means as indicated by an inclined scraper 29 contacting against the belt preferably along a horizontal line in the return arc of travel of the belt about the pulley.

In the drawing, the electric motor is shown as in transmission connecting with motor control switch 30, and the control switch may be interconnected with thermostats 31 respectively, for the heater of each unit for regulating and governing the transmitting speed of the belt.

Having described my invention, I claim:

1. In an apparatus for detecting and determining the presence of oil, gas and other distillable products when penetrated by the rotary well drilling apparatus, the drillings being converted into a sludge by a continuous stream of liquid, a gas collecting and combustion chamber, an endless conveyor providing a movable base for said chamber, means for delivering a small quantity of circulating sludge from a well bore for deposit upon said conveyor, and means for heating the sludge upon the conveyor and while within said chamber to effect a fractional distillation of the sludge and collect in said chamber the volatile parts thereby liberated from the sludge for a detection thereof.

2. In an apparatus for detecting and determining the presence of oil, gas and other distillable products when penetrated by the rotary well drilling apparatus, the drillings being converted into a sludge by a continuous stream of liquid, a plurality of gas collecting and combustion chambers, an endless conveyor providing a movable base for said chambers respectively, means for delivering a small quantity of circulating sludge from a well bore for deposit upon said conveyor, and means for heating the sludge upon the conveyor and while within each chamber respectively, for liberation into the chamber the gas or vapor from the oil occluded in said sludge.

3. In an apparatus for detecting and determining the presence of oil, gas and other distillable products when penetrated by the rotary well drilling apparatus, the drillings being converted into a sludge by a continuous stream of liquid, a gas collecting and combustion chamber, means for continuously delivering a small quantity of circulating sludge from the well bore for deposit within said chamber, a movable support for receiving and advancing the sludge within said chamber, and means for heating the sludge on said movable support within said chamber to effect a fractional distillation of the sludge and collect in said chamber the volatile parts liberated from the sludge.

4. In an apparatus for detecting and determining the presence of oil, gas and other distillable products when penetrated by the rotary well drilling apparatus, the drillings being converted into a sludge by a continuous stream of liquid, a gas collecting and combustion chamber, an endless conveyor providing a movable base for said chamber, means for draining a small quantity of circulating sludge from the well bore for deposit upon said conveyor, means at the base of the chamber and beneath the conveyor for heating the sludge upon the conveyor and while within said chamber to effect a fractional distillation of the sludge and collect in said chamber the volatile parts separated from the sludge, and gas igniting means within said chamber for igniting the volatile parts liberated from the sludge.

5. In an apparatus for detecting and determining the presence of oil, gas and other distillable products when penetrated by the rotary well drilling apparatus, the drillings being converted into a sludge by a continuous stream of liquid, a gas collecting and combustion chamber, means for delivering a small quantity of circulating sludge from the well bore for deposit within said chamber, means at the base of the chamber for heating the sludge for effecting a fractional distillation of the sludge within said chamber and therein collect the volatile parts separated from the sludge for ignition thereof, and gas igniting means within said chamber.

6. The method of detecting and determining the presence of oil, gas and other distillable products present while penetrating the earth in the drilling of a well with the bit of a rotary drilling apparatus, which consists in converting the drillings with the aid of a continuous supply of fluid, administered to the bottom of the well bore, and agitation by the drill bit into an upwardly circulating sludge, continuously conducting a small quantity thereof into and through a chamber, and therein heating the same to a determined temperature to effect a fractional distillation thereof, collecting in said chamber the volatile parts liberated from the sludge, and igniting the volatile parts liberated in said chamber by a constantly active ignition means for the detection thereof.

7. The method of detecting and determining the presence of oil, gas and other distillable products present while penetrating the earth in the drilling of a well with the bit of a rotary drilling apparatus, which consists in converting the drillings with the aid of a continuous supply of fluid, administered to the bottom of the well bore and agitation by the drill bit into an upwardly circulating sludge, continuously conducting a small quantity of circulating sludge into and through a chamber, heating, while transporting the same through the chamber, to a determined temperature to effect a fractional distillation of the sludge, collecting in said chamber the volatile parts separated therefrom for ignition, and igniting the volatile parts liberated in said chamber by a constantly active ignition means for the detection thereof.

8. The method of detecting and determining the presence of oil, gas and other distillable products present while penetrating the earth in the drilling of a well with the bit of a rotary drilling apparatus, which consists in converting the drillings with the aid of a continuous supply of fluid, administered to the bottom of the well bore and agitation by the drill bit into an upwardly circulating sludge, continuously conducting a small quantity of the circulating sludge through a chamber, heating the sludge in said chamber to a determined temperature for ef-

fecting a fractional distillation, collecting the volatile constituents, and thence causing ignition thereof by a constantly active ignition means disposed in the chamber.

9. The method of detecting and determining the presence of oil, gas and other distillable products present while penetrating the earth in the drilling of a well with the bit of a rotary drilling apparatus, which consists in converting the drillings with the aid of a continuous supply of fluid administered to the bottom of the well bore and agitation by the drill bit, into an upwardly circulating sludge, continuously conducting a small quantity of the circulating sludge into and through a chamber, heating the same while within the chamber to a determined temperature for effecting a fractional distillation of the sludge within said chamber, collecting the volatile constituents, causing the ignition of said volatile constituents by a constantly active ignition means disposed in the chamber, thence conducting the heated sludge from the first chamber to a second chamber and heating the same to a higher degree of temperature for a successive fractional distillation corresponding to the first, for liberation of gaseous products not liberated by a lower temperature and igniting the gases liberated in said second chamber by a constantly active ignition means.

10. The method of detecting and determining the presence of oil and other distillable products present in the earth while penetrated in drilling a well, and in which a continuous circulation of sludge is maintained for removal of the cuttings, which consists in continuously withdrawing a testing quantity of circulating sludge, passing the sludge continuously through a chamber, heating the advancing sludge to a determined degree of temperature for fractional distillation to liberate the more volatile products into the chamber, and igniting the liberated volatile products within said chamber by a constantly active ignition means for detection thereof when present.

11. The method of detecting and determining the presence of oil and other distillable products present in the earth while penetrated in drilling a well, and in which a continuous circulation of sludge is maintained for removal of the cuttings, which consists in continuously withdrawing a testing quantity of circulating sludge, passing the sludge continuously through a chamber, heating the advancing sludge to a determined degree of temperature for fractional distillation to liberate the more volatile products into the chamber and igniting the volatile matter by a constantly active ignition means, thereby increasing the chamber temperature and influencing thermo-electro means for signal indication.

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