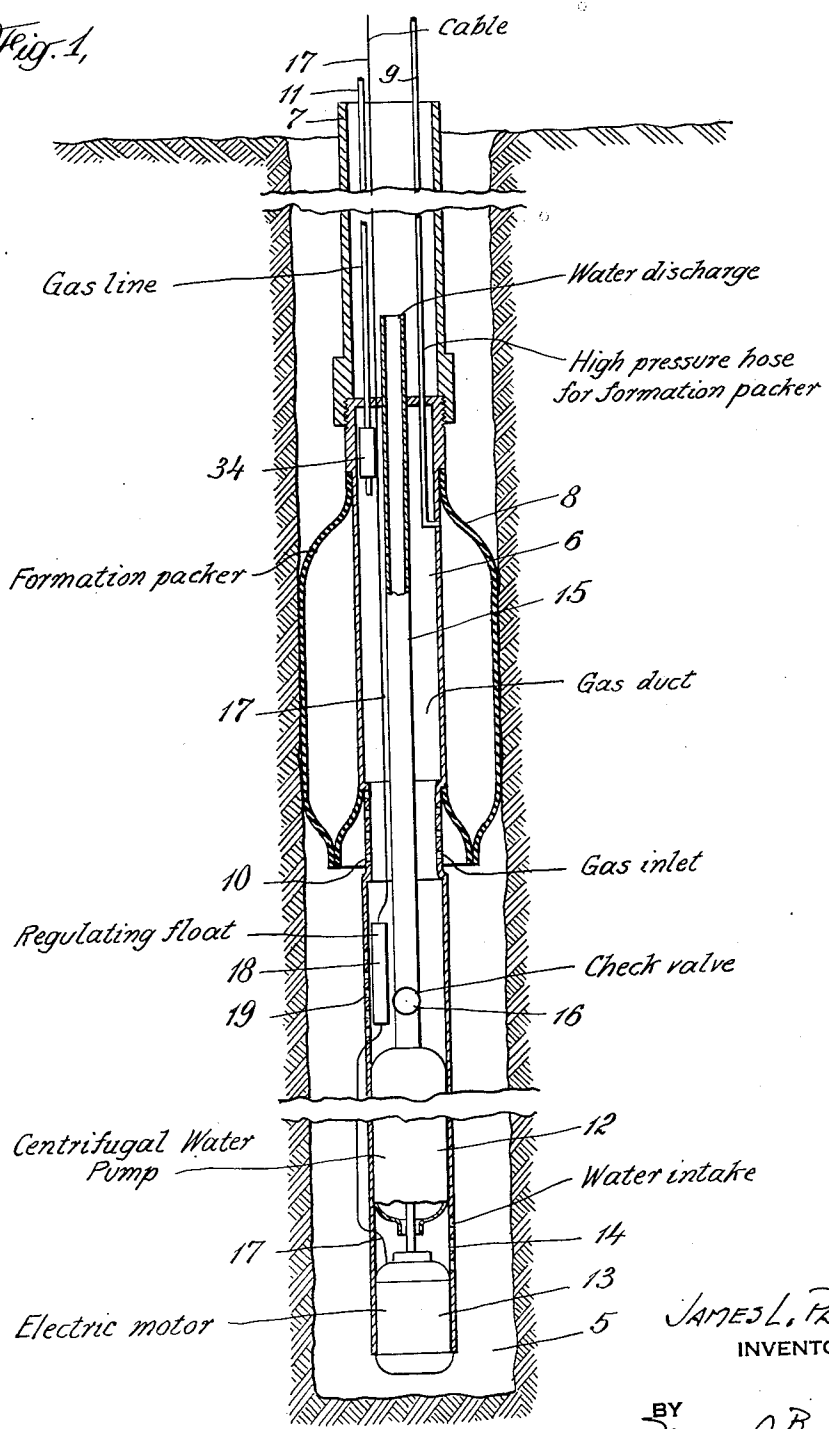
Jan. 2, 1945. J. L. PATTON 2,366,351

MEASUREMENT OF THE RATE OF SOIL GAS EVOLUTION

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Fig. 1.



JAMES L. PATTON
INVENTOR

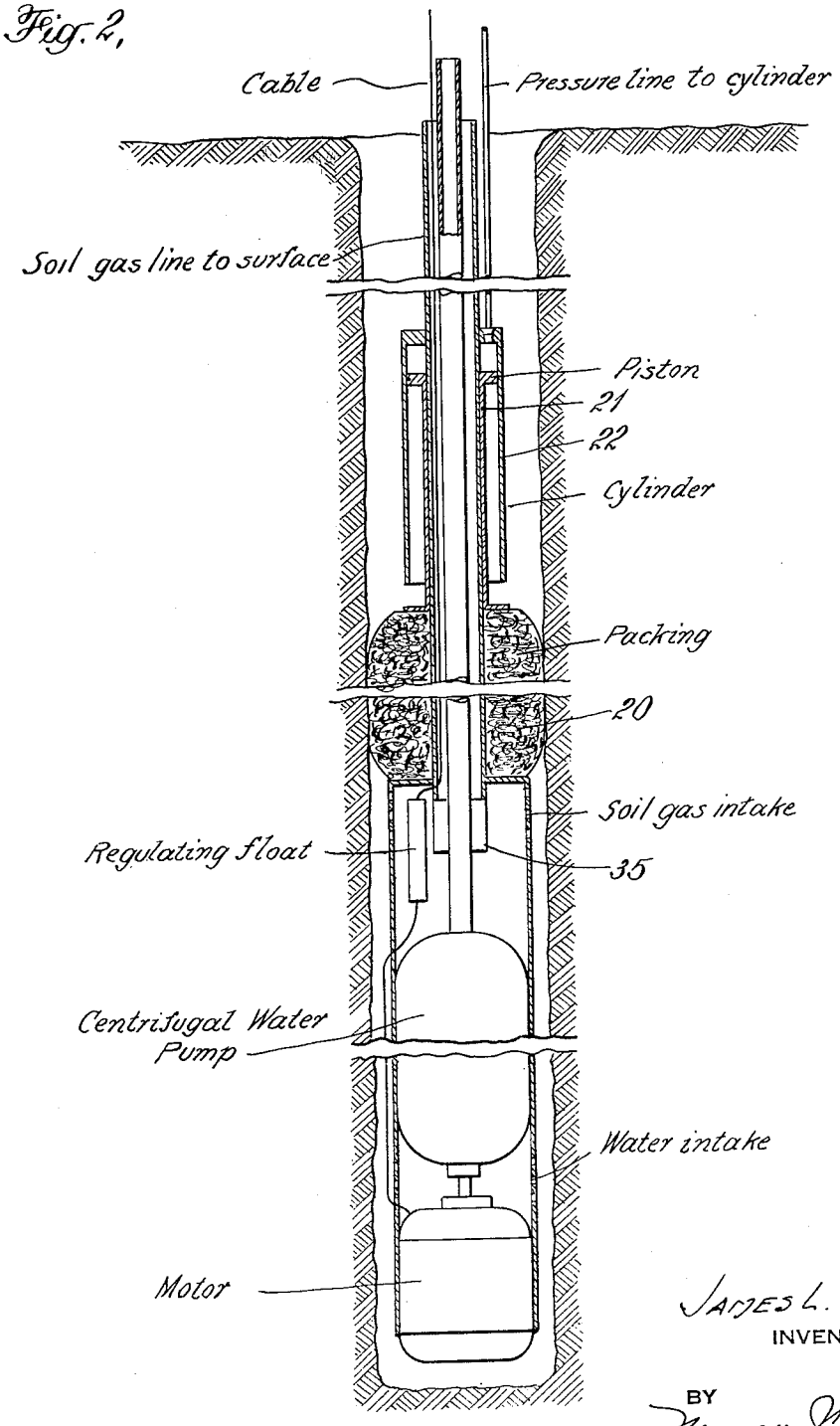
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MEASUREMENT OF THE RATE OF SOIL GAS EVOLUTION

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Fig. 2,



JAMES L. PATTON
INVENTOR

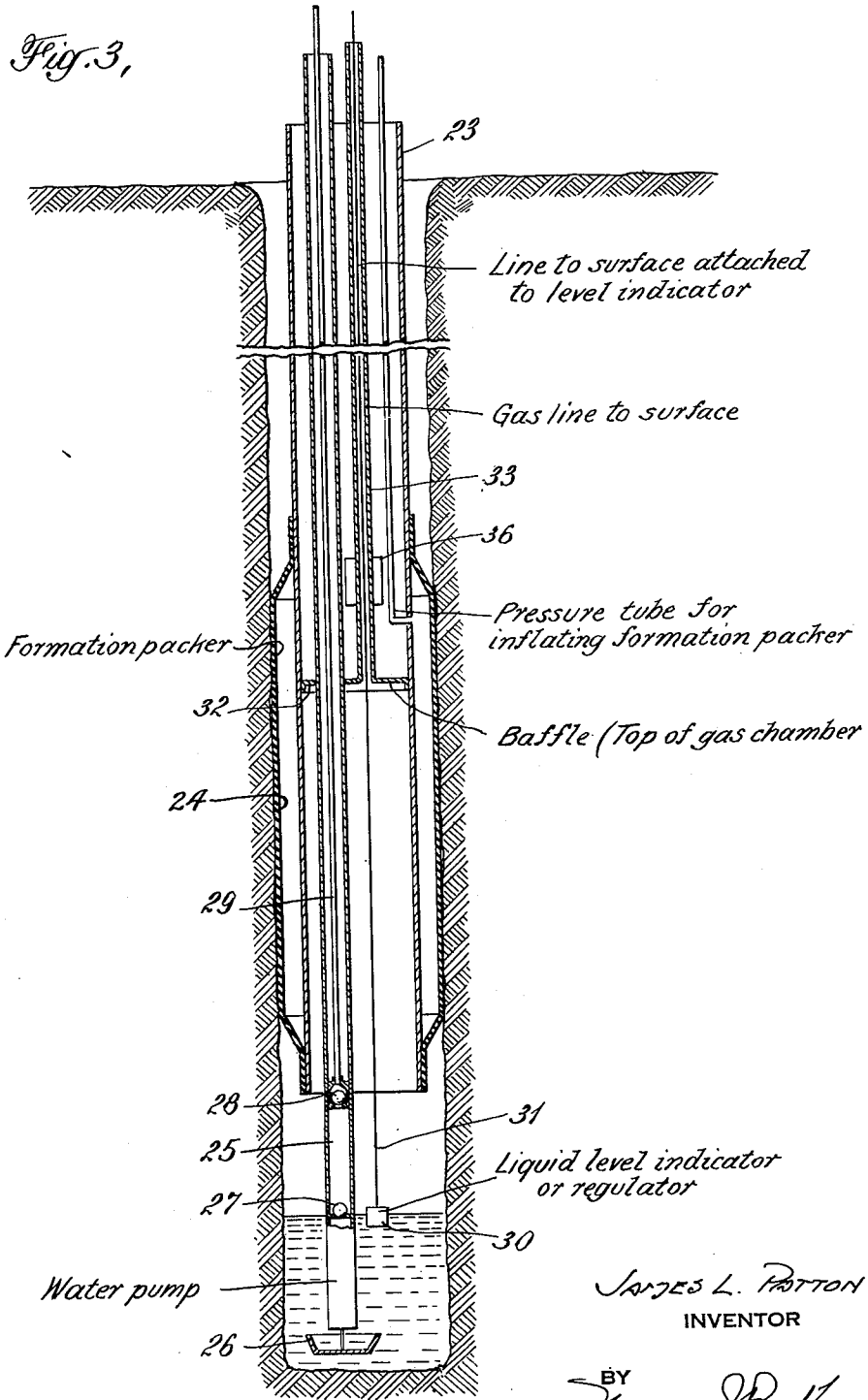
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MEASUREMENT OF THE RATE OF SOIL GAS EVOLUTION

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Fig. 3,



JAMES L. PATTON
INVENTOR

BY
ATTORNEY

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UNITED STATES PATENT OFFICE

2,366,351

MEASUREMENT OF THE RATE OF SOIL GAS EVOLUTION

James L. Patton, Dallas, Tex., assignor to Socony-Vacuum Oil Company, Incorporated, New York, N. Y., a corporation of New York

Application August 7, 1940, Serial No. 351,718

2 Claims. (Cl. 73—155)

This invention is directed to the method of prospecting for subterranean deposits, particularly hydrocarbon deposits such as petroleum, which comprises sampling, measuring and/or analyzing gaseous material emanating from or found in the earth.

In particular, this method is concerned with the recent discovery that the rate of emanation of subterranean gases into a borehole drilled into the earth to a depth below that at which the "breathing" or other influence of variations of atmospheric temperature and pressure extend is quite readily measurable, and that a most promising method of subsurface exploration or prospecting may be based upon observation of anomalies in this rate of flow over an area to be prospected.

Since the examination of rate of gas emanation, to be valid, must be performed at a level below the "breathing" zone, and such levels are usually below the local water table, or in formations containing water, it becomes necessary to devise a means and method whereby the rate of gas emanation at that level may be observed independently of and uninfluenced by the invasion of water into the borehole. This invention is particularly directed to the solution of this problem.

This invention has for its major object the provision of a method whereby the rate of gas emanation from earth formations surrounding a borehole may be determined without such determinations being influenced by water which flows into that borehole.

It has as a further object the provision of method and means whereby a fluid free space is maintained into which earth gases may emanate at a point below the water-table, or in water-logged earth. A further object is the provision of a method whereby reasonably continuous observation of gas emanation from earth in the presence of water may be maintained.

This invention may be more readily understood by reference to the drawings forming a portion of this specification, in which drawings Figure 1 shows in diagram form the apparatus assembly utilized. Figures 2 and 3 are similar diagrams of modified forms of the apparatus.

Turning to Figure 1, there is shown, in diagram, partially in section, a borehole 5, extending from the surface of the earth to a point sufficiently deep therein that the flow of gases in the earth is not substantially influenced by the effect of variations of atmospheric temperature or pressure. This borehole 5 will probably extend at least below the water table to a substantial distance, and may be from ten to twenty feet and upwards in depth. Since soil-gas surveys may frequently be coordinated with seismograph surveys the borehole may well be one of those intended for later use as a seismograph shot hole.

Depending within the borehole 5 there is an assembly of apparatus built about a core 6, and suspended within the hole by a tubing 7. About the upper exterior portion of the casing 6 there is disposed a formation packer 8, here shown as an inflatable or balloon packer, which, upon the admission of fluid pressure medium to its interior through pipe 9 may be expanded to press against the walls of the borehole and prevent the access to the bottom thereof of surface water or water from portions of the hole higher than the location of the packer. It will be seen that the packer is so shaped that when deflated, its passage through the borehole will be relatively easy. Below the level of the packer 8, the core 6 is provided with a slotted area 10 whereby gas may pass into the hollow interior of the core 6 and thence by pipe 11 to the surface. Further down, the core 6 merges with the body of and supports a centrifugal or other type of pump 12, from which there is in turn supported a motor 13, the motor serving to drive the pump. The supporting members between the pump and motor are so formed as to provide intake passages 14 whereby water may be led to the pump, and discharge pipe 15, provided with check valve 16 leads upward through core 6 to discharge water into the interior of tube 7 through which it may pass to the surface for disposal. A current supply cable 17 runs down through tube 7 and core 6, and through a suitable protective slot or other arrangement around pump 12 to supply motor 13. At a suitable point, preferably interiorly of core 6 near the bottom thereof, there is inserted in cable 17 a float controlled switch 18 of any suitable type whereby the operation of pump 12 may be initiated and stopped by suitable fluctuations in the level of water in the borehole 5. To facilitate this, core 6 is provided with suitable liquid access slots 19 near and below switch 18.

In operation, it will be seen that packer 8 substantially prevents the entry of water from any point above the packer, and pump 12 serves to withdraw bottom water as fast as it enters, and maintains, around slots 10 an open space, free of water, into which the gas contained in the formation around the borehole may pass and from which it can be collected and measured.

It is obvious that other modifications of this

basic assembly of apparatus may be made. For example in Figure 2, a similar assembly of core, pump, motor, etc., is associated with a pressure expansible packer, of rubber, or the like, designated by 20, which may be forced out to engage the borehole walls by pressure fluid induced motion of the piston 21 within the cylinder 22.

In Figure 3 there is shown a slightly different form of assembly, consisting of a tube or core 23 upon the exterior of which there is an inflatable formation packer 24, and through which there extends a reciprocating deep well type of pump consisting of working barrel 25, footpiece 26, standing valve 27, piston 28, and rod 29. There is also provided float 30, suspended upon rod or line 31. The float may be interconnected to the power source for pump 25 or may be merely indicating. Gas may pass into the open lower end of core 23 to collect therein below partition 32 and pass out through pipe 33, through which, if convenient rod 31 may also be led to the surface.

It will be seen that in all of these devices there are assembled three essential elements, viz., a packer to isolate the bottom portion of the hole and prevent escape of gas upward therefrom or water flow downward thereinto, second a pump and control to maintain a liquid level spaced from and below said packer, and third a means of egress of gas emanating from the exposed earth surface into said space.

It will be noted that in the devices disclosed, as expained so far herein, the measurement of the rate of gas emanation may be made at the surface, by means of the gas flow tube provided in each case. Certain methods of measuring gas flow such as hot-wire electrical flow meters, absorption traps wherein the flowing gas is absorbed in a liquid, or in a liquid-impregnated porous solid, and other types of flow meters capable of being so constructed as to occupy small space, exist. Any one of these devices may be inserted in the gas flow line in or adjacent the mechanism already described, such as at 34 in Figure 1, at 35 in Figure 2, or at 36 in Figure 3. In such cases, there are presented an association of four essential elements, viz., the three above named, and in addition thereto, a device for measuring the rate of gas emanation, all in one device suitable for lowering into a borehole.

It will be recognized, however, that the measuring of the gas emanated, and its analyzing, if desired, may be accomplished by the use of meters, or other volume measuring devices, and analysis devices, applied at the surface to the gas issuing from the gas flow tube. Since the present device and method, even when using gas measuring and analyzing equipment located at the surface, is, in effect, carrying out that measurement and analysis at the level reached in the borehole, such set-ups are likewise within the purview of this invention.

I claim:

1. The method of determining the rate of soil gas emanation from earth into a bore hole at an elevation below the water table and into which seepage of water is characteristic, comprising sealing off a section of the bore hole at a depth below the water table to form below the seal a gas collecting chamber defined by the seal and the walls of the bore hole below the seal, providing a passage for water through the seal with an inlet spaced from and below the seal, providing a second passage in the seal with an inlet below the seal but above the inlet of the first passage whereby soil gases emanating from the walls of the bore hole defining the collecting chamber may pass through said seal, discharging seepage water through said first passage in said seal as required to maintain the level of the surface of the water in said collecting chamber substantially constant and below the opening of the second passage through the seal, whereby the soil gas collecting in said chamber may have free access to the second passage under uniform conditions of water head in said chamber, and measuring the rate of emanation of soil gas from the second passage as a measure of the rate of emanation from the earth into the collecting chamber.

2. The method of determining the rate of soil gas emanation from earth below the water table into a bore hole into which soil gas flows and into which the seepage of water is characteristic which comprises, sealing off a section of the bore hole at a depth below the water table to form below the seal a gas collecting chamber defined by the seal and the walls of the bore hole below the seal, providing a passage for gas through the seal whereby soil gases emanating from the walls of the bore hole defining the collecting chamber may pass through the seal and a separate passage for water with its inlet below the inlet of the passage for gas, maintaining the level of seepage water in the bottom of said bore hole collecting chamber substantially constant and below the opening of the gas passage by discharging seepage water tending to raise the level of the pool through the separate water passage in the seal thereby maintaining a constant volume gas chamber whereby the soil gas collecting in said chamber may have free access to the gas passage, and measuring the rate of emanation of soil gas from the second passage as a measure of the rate of emanation from the earth into the collecting chamber.

JAMES L. PATTON.