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METHOD AND APPARATUS FOR COLLECTING SOIL GAS SAMPLES

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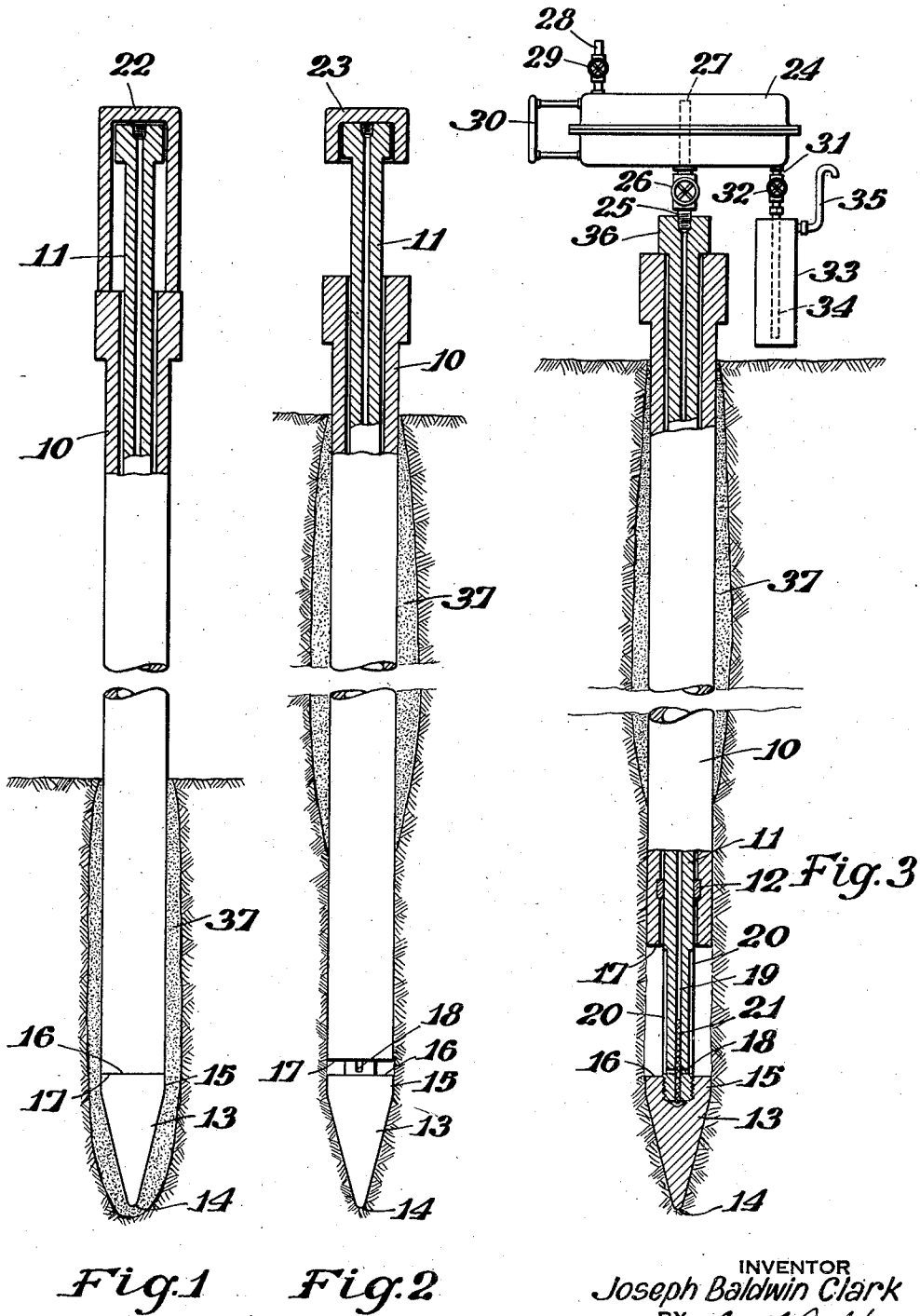


Fig. 1

Fig. 2

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METHOD AND APPARATUS FOR COLLECTING SOIL GAS SAMPLES

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This invention relates to geophysical prospecting and particularly to an improved method and apparatus for conducting the same by removing samples of soil gas from beneath the earth's surface and quantitatively analyzing the same for the presence of hydrocarbon.

It has been found that minute traces of hydrocarbons present in soil gases are an index of the presence of coal, oil or gas at greater depths.

10 In collecting soil gases for analysis it must be assured that results can be duplicated and that all conditions are reproducible since a survey depends on relative results at a large number of points.

15 One of the chief difficulties encountered in practicing heretofore known methods with available apparatus has been the contamination of the gas sample by surrounding gases which gain access thereto. This contamination may be in the form of air which has the effect of reducing the concentration of hydrocarbons to a non-reproducible degree or it may be in the form of stray hydrocarbon vapors, as for example, gasoline vapors which are always present in thickly populated areas.

20 It is an object of this invention to provide a method and apparatus for removing samples of gas from below the earth's surface, particularly at relatively small depths, wherein the sample of gas is maintained free from contamination by surface or other foreign gases, and in which the sample is truly representative of the gas at and below the point from which it is removed.

25 The above and other objects, advantages and uses of my invention will become more apparent from a reading of the following specification and claims taken in connection with the appended drawing which forms a part of this specification, and wherein:

30 Figure 1 is a diagrammatic elevation partially in cross-section showing the relative positions of the parts of my improved apparatus at an early stage of its installation;

35 Figure 2 is a diagrammatic elevation partially in cross-section showing the relative positions of the parts of my improved apparatus at a subsequent stage of its installation; and

40 Figure 3 is a diagrammatic elevation partially in cross-section showing a complete assembly of parts following the final stage of its installation.

45 In accordance with my invention, I have provided an improved arrangement of apparatus and method of installing the same, by means of which a true sample of gas is obtained uncon-

taminated by surface gases such as other hydrocarbons or air.

5 An outer tubular sleeve 10 of a length slightly greater than the depth from the surface of the earth to the point at which a sample is to be removed receives telescopically an inner tube 11, the outside of which is sealed relative to the inside of the tubular sleeve by means of a packing seal 12.

10 Inner tube 11 has a very narrow bore, preferably approaching capillary dimensions, so that it will hold as little of the sample as possible.

15 The lower end of inner tube 11 has attached thereto, as by a threaded connection, spear head 13, having a point 14 and an enlarged head portion 15. The outer diameter of the enlarged head portion 15 corresponds to the outer diameter of the tubular sleeve 10 and includes a shoulder 16 against which the lower end 17 of the tubular sleeve 10 rests in the telescoped position of the parts. While I have shown spear head 13 threaded on the lower end of inner tube 11, and prefer this form since it is easier and cheaper to manufacture and facilitates cleaning, I also contemplate as coming within the scope of my invention an arrangement wherein head 13 is integral with inner tube 11. In this case the upper enlarged head 36 of inner tube 11 must necessarily be threaded onto tube 11 rather than an integral part of it as shown in the drawing.

20 Inner tube 11 is provided with ports 18 formed by a lateral passage therethrough in communication with the inner periphery 19 thereof. Formed in the outer periphery of inner tube 11 are gas-collecting grooves 20 parallel with the axis of the tube and in communication at their lower ends with ports 18. A wick 21 is received within the lower end of tubular member 11 for the purpose of keeping foreign material out of the inner bore 19. It will thus appear that with tubular sleeve 10 and inner tube 11 in telescoped position, ports 18 are covered by the lower end of the tubular sleeve 10 and that by relative movement between these two members ports 18 are uncovered.

25 As a particular arrangement of means for effecting the lowering into the ground of tubular sleeve 10 together with inner tube 11 while in telescoped relation to each other, I provide large cap 22 (Figure 1) which fits over the upper end of inner tube 11 and engages the upper end of outer tubular sleeve 10. The assembly is then driven down as by means of a hammering operation. When the telescoped assembly has been lowered to the desired depth large cap 22 is replaced by small cap 23 (Figure 2) fitting over

the upper end of inner tube 11 out of engagement with the outer tubular sleeve 10 and the hammering operation is continued to effect the further lowering of the inner tube 11 relative to the outer tubular sleeve 10, thereby uncovering gas entry ports 18.

Referring particularly to Figure 3 it will be seen that by further lowering inner tube 11 relative to tubular sleeve 10, the large portion 15 of spear head 13 produces an annular space about the lower portion of the inner tube 11 between the lower end 17 of the outer tubular sleeve 10 and the shoulder 16 of the spear head 13. As a further assurance that the gas will have ample space in which to collect, vertical grooves 20, above referred to, are provided in the side walls of inner tube 11 in communication with ports 18.

Arranged for attachment to the upper end of the inner tube 11 is a sample receiver 24 connected thereto through conduit 25 and valve 26. Conduit 25 terminates in nipple 27 which extends within sample receiver 24 adjacent to but short of the top thereof. Filler conduit 28 containing valve 29 provides means for filling sample receiver 24 with water or other suitable liquid as will appear. Gauge glass 30 or equivalent means is provided for determining the level of the liquid within the sample receiver 24. This sample receiver is connected through conduit 31 and valve 32 with trap 33. An extension nipple 34 passes down within trap 33 to a point adjacent to but short of the bottom thereof. An efflux tube 35 having a pivotal connection with trap 33 is provided to control the flow of liquid from sample receiver 24.

As a means for additionally sealing the entry ports 18 of inner tube 11 from surface gases, I employ a sealing mud or gel such as a bentonite mud slurry 37. This sealing material is used about the upper portion of the outer periphery of the tubular sleeve 10 and is introduced in accordance with my novel method as will appear. Other plastic or viscous fluid sealing materials can, of course, be used.

Method of installation and operation

A hole is first formed in the earth as indicated in Figure 1. This hole is made sufficiently large to receive the outer tubular sleeve 10 and of a depth which is only a fraction—preferably from one-fourth to one-half of the depth to the point at which a sample is to be removed. This hole is next filled at least partially with a sealing material such as gel mud, preferably a bentonite mud slurry 37. The tubular sleeve 10 and inner tube 11 are then introduced into the hole and lowered while in telescoped relation to a point adjacent that from which the gas sample is to be removed. This lowering is preferably effected by a hammering operation; however, any other means such as pressing can be employed. In effecting the lowering of the members by a hammering operation, the large driving cap 22 shown in Figure 1 is first employed.

When the tubular sleeve 10 and the inner tube 11 have been lowered in unison to the desired point, the enlarged cap 22 is removed and is replaced by small driving cap 23 fitting about the head of inner tube 11. The inner tube 11 is then driven to an additional depth below the end of the tubular sleeve 10, thus exposing gas entry ports 18 to the entry of gas therethrough and into the inner bore 19 of the inner tube 11.

The sample container 24 together with the trap 33 is next attached in place on the upper end of

inner tube 11, as indicated (Figure 3). Next valves 26 and 32 are closed and water is introduced into sample container 24 through conduit 28 and valve 29 to fill the container completely, following which valve 29 is closed.

Alternatively, the sample container can be filled by the use of valves 26 and 32, before the sample container is attached to inner tube 11, and filler conduit 28 and valve 29 can be omitted.

Valve 32 is then opened and the water in sample receiver 24 is allowed to run out slowly through trap 33 and efflux tube 35, thus creating a partial vacuum within sample receiver 24 and causing the soil gases to be sucked up through inner bore 19. The rate of flow is controlled by the position of efflux tube 35 and a standardized rate of flow is used to insure reproducible conditions. When the soil gas sample has been collected valves 26 and 32 are closed and sample receiver 24 is removed with the valves from the top of inner tube 11 and taken to the laboratory for quantitative analysis of the sample contained therein.

While I have described the introduction of the sealing material prior to placing the tubular sleeve and inner tube in the hole, and prefer this order of procedure, it is to be understood that it may be deviated from without departure from the spirit and teaching of my invention, as for example, the tubular sleeve and inner tube may be introduced first into the hole shown in Figure 1 and then the sealing mud added either prior to the beginning of the hammering operation or shortly thereafter.

Although a particular form of spear head is shown, and I prefer this form as being the more efficient, I nevertheless contemplate other equivalent forms such for example as a spear head, the large end 15 of which is slightly larger than the outside diameter of the tubular sleeve 10. Basically the important thing to note is that the relative movement of the inner tube with respect to the tubular sleeve uncovers a gas entry port and thereby provides a most efficient means of removing a gas sample. The relative movement need not be a sliding movement, although this is preferred, but may for instance be a rotational movement to uncover the ports.

While I have described my invention in relation to one embodiment thereof, I desire it to be understood that I contemplate all equivalents and intend to be limited only as indicated by the appended claims which should be construed as broadly as the prior art will permit.

I claim:

1. An improved method of installing an elongated apparatus for removing a sample of soil gas from below the earth's surface, said apparatus including a hollow gas-collecting member open at or near its lower end; said improved method comprising first forming a hole in the earth of sufficient cross-section to receive said elongated apparatus but of a depth which is only a fraction of that to the point at which the sample of gas is to be taken, at least partially filling said hole with a sealing agent, placing within said hole said elongated apparatus, driving said elongated apparatus to a depth at which a sample of gas is to be taken, and withdrawing through said hollow gas-collecting member a sample of soil gas to be analyzed, said sealing agent serving to prevent the contamination of said soil gas sample with atmospheric air.

2. An improved method of installing apparatus for removing a sample of soil gas from below the earth's surface, including an outer tubular sleeve,

and an inner tube telescopically received within the tubular sleeve, at least one opening through the wall of the inner tube communicating with the bore thereof, this opening being normally covered by the lower portion of the tubular sleeve when the parts are in telescoped relation but being uncovered upon relative movement between the sleeve and inner tube; said improved method comprising first forming a hole in the earth of sufficient cross-section to receive the tubular sleeve but of a depth which is only a fraction of that to the point at which the sample of gas is to be taken, at least partially filling said hole with a sealing agent, placing within said hole said tubular sleeve and inner tube contained therein in telescoped relation, driving said sleeve and tube while in telescoped relation to a point adjacent which a sample of gas is to be taken, driving said inner tube to a still further depth thereby exposing said opening therein to the entry of gas, and removing a sample of gas to be analyzed from the upper portion of said inner tube.

3. Apparatus for removing a sample of soil gas from beneath the surface of the earth comprising a gas-collecting tube adapted to be driven into the earth, said tube having at least one port for the entrance of soil gases into its interior, means to cover said port while said tube is being driven into the earth, means operable from above the surface of the earth for uncovering said port after said tube has been driven into the earth, means for collecting a sample of said soil gas at the top of said tube, and means for preventing the intrusion of atmospheric air into said tube.

4. Apparatus for removing a sample of soil gas from beneath the surface of the earth comprising, an outer protective member, an inner hollow gas-collecting member received within said outer protective member, said inner hollow gas-collecting member being provided at or near its lower end with at least one opening through the wall thereof communicating with its interior, said opening being covered by said outer protective member when said two members are in one relationship to each other, but uncovered by relative movement between said two members, said two members being arranged to be lowered together through the earth's surface to a point adjacent which a sample of gas is to be taken, and means for moving said two members relative to each other to uncover said opening.

5. Apparatus for removing a sample of soil gas from beneath the surface of the earth comprising, an outer tubular sleeve, an inner tube received within said tubular sleeve, said inner tube having its lower end closed and provided with at least one opening through the wall thereof communicating with its interior, said opening being covered by said tubular sleeve when the inner tube and outer tubular sleeve are in one relationship to each other, but uncovered by relative movement between said sleeve and said inner tube, said sleeve and said tube being arranged to

be lowered through the earth's surface to a point adjacent which a sample of gas is to be taken, and means for moving said tubular sleeve and said inner tube relative to each other to uncover said opening.

6. Apparatus according to claim 5 including a gas-tight seal between said tubular sleeve and said inner tube located above said opening.

7. Apparatus for removing a sample of soil gas from beneath the surface of the earth comprising, an outer tubular sleeve and an inner tube telescopically received within said tubular sleeve, said inner tube having its lower end closed and provided with at least one opening through the wall thereof communicating with its interior, said opening being covered by said tubular sleeve when the inner tube is in telescoped relation with said outer tubular sleeve, but uncovered by relative movement between said sleeve and said inner tube, said sleeve and said tube being arranged to be lowered through the earth's surface to a point adjacent which a sample of gas is to be taken and said inner tube then lowered through said tubular sleeve to a still further depth thereby uncovering said opening for the entrance of gas to the interior of said inner tube to be removed therethrough and analyzed.

8. Apparatus for removing a sample of soil gas from beneath the earth's surface for analysis comprising an outer tubular sleeve, an inner tube telescopically received within said tubular sleeve, and a spear head, said inner tube being closed at its lower end by said spear head, said spear head in the telescoped position of said parts presenting a shoulder against which the lower end of said tubular sleeve rests, said inner tube having at least one opening therein in communication with its interior, said opening being covered by said tubular sleeve in the telescoped position of said parts but uncovered upon relative movement thereof, said tubular sleeve and said inner tube being adapted to be lowered to the desired depth in telescoped relation following which said inner tube is lowered relative to said tubular sleeve to a still further depth, thus defining an annular chamber about said inner tube and thus exposing said opening to the entry of gas into the interior of said inner tube for removal and analysis.

9. Apparatus for removing a sample of soil gas from beneath the surface of the earth comprising, a gas withdrawal tube driven into the earth and open at or near its bottom, means for sealing said tube against the admission of surface air, a sample receiving container in communication with said tube at a point near the top of said tube, said container being adapted to be filled with liquid, means for draining said liquid to draw a soil gas sample into said container through said tube, means for controlling the draining of said liquid from said container, and means for sealing and disconnecting said container after a sample has been collected.

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