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 [21] Appl. No. **628,974**
 [22] Filed **April 6, 1967**
 [45] Patented **Dec. 15, 1970**
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3,027,951	4/1962	Knapp et al.....	175/10
3,032,105	5/1962	Reistle.....	175/7X
3,160,850	12/1964	Dudley.....	166/.5X
3,189,105	6/1965	Bates et al.	175/5
3,191,695	6/1965	Bates et al.	175/5
3,199,613	8/1965	Malott et al.....	175/5
3,215,202	11/1965	Pollard et al.....	166/.5
3,222,634	12/1965	Foster.....	166/.5
3,336,572	8/1967	Paull et al.....	166/.5X

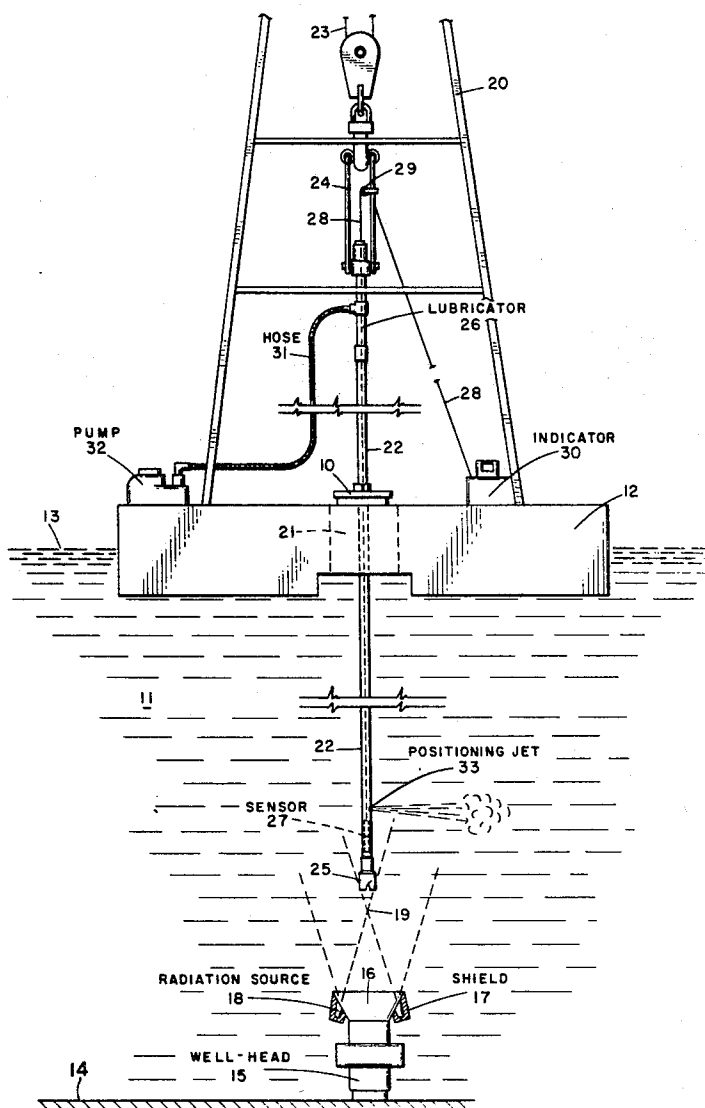
[54] **LOCATING UNDERWATER WELLS**
14 Claims, 1 Drawing Fig.

[52] U.S. Cl..... **166/.5,**
175/41
 [51] Int. Cl..... **E21b 7/12,**
E21b 47/00
 [50] Field of Search..... **166/.4, .5,**
4, 75, 46; 175/5-10

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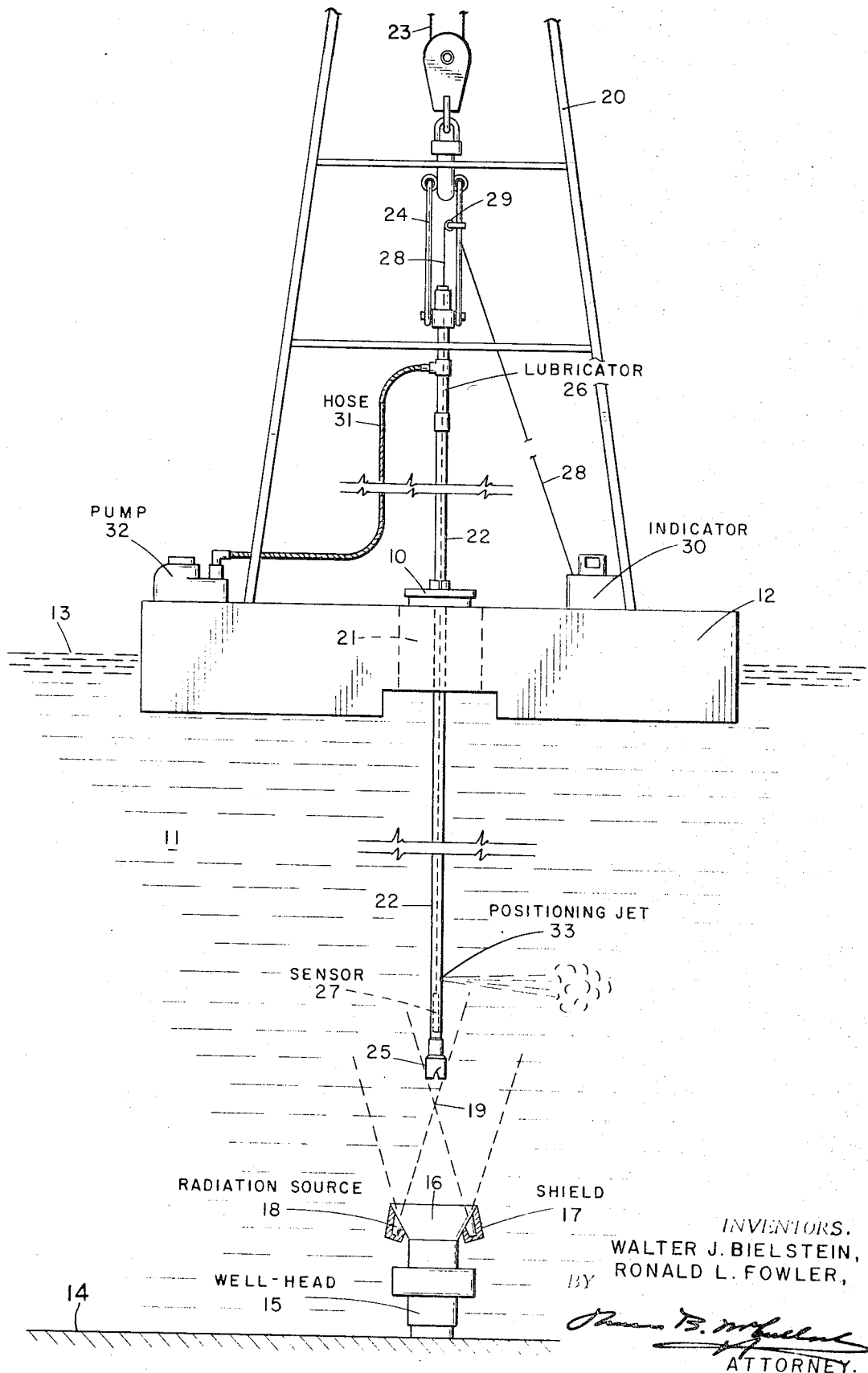
[56] **References Cited**
UNITED STATES PATENTS
 2,476,137 7/1949 Doll..... 166/4
 2,545,179 3/1951 Voorhees.....

ABSTRACT: An underwater wellhead is located from a floating vessel by providing a radiation source on the underwater wellhead and a radiation detection means in a drill string lowered from the vessel such that the drill string is moved responsive to radiation picked up by the detection means to engage the drill string with the wellhead.



PATENTED DEC 15 1970

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LOCATING UNDERWATER WELLS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is directed to locating a selected location on water bottom. More particularly, the invention is concerned with method and apparatus for locating an underwater wellhead from a floating vessel. In its more specific aspects the invention is concerned with locating an underwater wellhead from a floating vessel and providing for reentry into the well from the underwater well head.

2. Description of the Prior Art

It has been known to locate underwater wellheads by using seismic and acoustic signals. It has also been known to locate underground objects by placing on or next to the underground objects radioactive material. Thus during the last war explosive mines were located by radioactivity. It has also been known to mark formations pierced by a well bore with radioactive materials by firing bullets containing radioactive material into the wall of the well. However, the prior art for locating underwater wells depend on an energy source which must be arranged on the wellhead to provide an acoustic or seismic signal. Heretofore it has not been known and it is unobvious from the prior art to locate an underwater location such as an underwater wellhead by providing a self-contained source of radiation on the wellhead. The following listed U.S. Pat. Nos. have been considered with respect to the present invention: 2,401,723; 2,545,179; 2,550,004; 2,728,554; 2,770,736; 2,857,843; 3,103,976; 3,160,850; 3,179,176; 3,189,105; 3,191,695; 3,199,613; 3,215,202; and 3,222,634.

BRIEF DESCRIPTION OF THE DRAWING

The present invention will be further illustrated by reference to the drawing in which the sole figure is a schematic showing of a preferred mode and embodiments.

DESCRIPTION OF THE PREFERRED MODE AND EMBODIMENTS

Referring now specifically to the drawing, numeral 11 designates a body of water having a drilling ship or vessel 12 floating at or adjacent water level 13. Drilling ship or vessel 12 may be any type of drilling vessel and it may be one of the "Seadrome" type or a conventional type of ship suitably modified for drilling operations. Although not shown, the drilling ship or vessel 12 may be supported suitably by buoyancy means located at a substantial level below water level 13 such that the motion and movements of the vessel 12 are not substantially affected by wind and wave action.

On the ocean floor 14 is a wellhead 15 having an upwardly facing cone member, cone means 16. It will be understood that wellhead 15 includes all auxiliary means usually associated with an underwater wellhead and may include blow out preventor means, valves, flow lines, control mechanisms, and the like. Arranged below the funnel means 16 are shield members 17 containing sources of radiation 18 which are upwardly focused to provide radiation beams which converge at a common point 19 as shown by the dotted lines.

The source of radiation may be a natural source of radiation having a suitably long half life to be effective. As examples of naturally radioactive material may be mentioned by way of illustration and not by way of limitation:

Radium, 226
Uranium, 235
Thorium, 232
Plutonium, 239
Protactinium, 231
Polonium, 210.

The source of radiation may also be artificially radiated material which then becomes radioactive. As examples of such materials may be mentioned:

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Beryllium
Cesium
Nickel, 63
Cobalt, 60
Zinc, 65
Sodium, 22
Rubidium, 103
Silver, 110
Cesium, 137.

When an artificially radioactive material is employed, it may be placed and shielded as indicated when a connection is made with the wellhead originally and then artificially radiated by exposure to a beam of high energy neutrons which may be generated by an electrically powered device lowered through the tubing string when the wellhead is initially installed or preferably the irradiation may be conducted before the source is installed on the wellhead which allows this to be performed at water surface or onshore as may be desired. In any event the radiation source 18 is upwardly focused as shown.

Suspended from a derrick 20 arranged over a drilling slot 21 of the vessel 12 is a drill string 22 which is suspended from the derrick 20 by a cable or line 23 connected to the drill string 22 by suitable elevators or suspending means 24. A rotary table or rotating device 10 is embracingly arranged on drill string 22 for rotating same. The drill string 22 carries on its lower end a drill bit 25 which may be a rock bit of the cone type or a fish-tail bit as may be desired. The drill string 22 has at its upper end a lubricator device 26 for introduction into drill string 22 of a radiation detecting means or sensor 27 which is lowered into the drill string 22 by cable 28 which is run in over a sheave or pulley 29 arranged in the derrick 20 and which connects to an indicating means 30. Connected to the lubricator 26 by a flexible hose 31 is a pump 32 for pumping fluid into the drill string 22. The drill string 22 may suitably be provided with a jet or nozzle 33 for jetting fluid laterally from the drill string 22. The drill bit 25 is suitably provided with nozzles or water courses not shown for circulation of drilling fluid during drilling operations but means may be provided to close these nozzles when the radiation detecting means or sensor 27 is lowered into the drill string 22 as shown.

In the practice of the present invention it is desirable to use a source of radioactive material which may have a strength of at least 450 millicuries although lesser or greater strengths may be employed. The radiation source may have an intensity within the range from about 0.00001 to about 4500 Roentgens/hour at a distance from about 5 to about 0.03 feet respectively in fresh or sea water.

The radiation detecting means must be sensitive to the radiation having an energy level of the source. Such radiation detecting means is available on the market and need not be described here.

In practicing the present invention the drill string such as 22 is run to within one joint, usually within about 30 feet of the wellhead 15. Equipment is assembled to run the radiation detecting means or sensor into the drill pipe as illustrated. A joint of drill pipe is made up and threadily attached into the top of the drill string 22. The sensing or detecting tool is introduced through the lubricator into the drill string and lowered into a position just above the drill bit 25 as shown while the lower end of the drill string 22 is within about 30 feet of the wellhead 15. Thereafter, the drill string 22 is then lowered preferably to within about 5 feet or less of the wellhead 15. The pump 32 is activated to provide a source of fluid or pressure to move the drill string laterally by the jet 33 as desired. The angular orientation of the drill string 22 is noted and the behavior of the indicating means for detecting gamma ray radiation is also noted. If the indicating means indicates a decrease in radiation or is maintained constant, the drill pipe may be slowly rotated by supplying power to rotary table 10 until the level of radiation intensity begins to increase. The drill string is rotated until the reading is at or near its maximum for the particular position of the drill string 22 and the jet 33 may be discontinued by stopping the pump or by closing a valve to close the jet 33. Thus, the lower end of the drill

string 22 is deflected horizontally relative to its point of suspension and rotated to cause the detecting means 27 to move relative to the source of radiation to obtain maximum intensity of detection for the particular position. The drill string 22 is then lowered until radiation intensity on the indicating means 30 reaches a selected maximum value. At this point the drill string 22 may be lowered to or adjacent the ocean floor until the lubricator 26 is just above the pipe slips (not shown) on the drilling vessel 12. The jetting system will be closed at this point if not closed before. At this time the drill string 22 has engaged the cone 16 which allows the drill string to be lowered through the wellhead 15 and into the well. The detection means or radiation sensor 27 may then be removed from the drill string. The drill string 22 may be further lowered into the well for normal drilling operations. Alternately, this procedure may be performed by adjusting the position of the ship to cause the drill string to move laterally in a manner similar to the above procedure.

In practicing the present invention the engagement of the wellhead 15 by the drill string 22 may be controlled automatically by computer means not shown. Once the wellhead 16 has been located such computer means may also maintain the drill string 22 in a position of maximum gamma ray intensity. Lowering of the drill string 22 may be controlled either manually or by such computer means.

While the present invention has been described and illustrated in relation to locating an underwater wellhead, it is susceptible to locating any underwater location which has been previously marked with radioactive material which may be artificially introduced radioactivity or natural radioactivity.

The present invention is quite advantageous and useful in that it allows location of an underwater wellhead and reentry into the wellhead without depending on outside sources of energy.

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

We claim:

1. A method for locating an underwater wellhead from a floating vessel which comprises:
 - arranging on an underwater wellhead a radioactive material providing an upwardly focused source of radiation;
 - lowering a hollow drill string from said floating vessel until its lower end is at least in the vicinity of said wellhead;
 - lowering in said drill string to a point adjacent the lower end thereof a detection means for said radiation operatively connected to indicating means accessible from water level; and
 - moving said hollow drill string responsive to radiation picked up by said detection means from said source of radiation to engage said lower end with said wellhead.
2. A method in accordance with claim 1 in which said source of radiation has a strength of at least 500 millicuries.
3. A method in accordance with claim 1 in which the radiation source is gamma radiation.
4. A method in accordance with claim 1 in which said hollow drill string is moved at least vertically and horizontally in any order.
5. A method in accordance with claim 1 in which the upwardly focused source of radiation is arranged to provide maximum radiation intensity along a line coaxial with the wellhead.
6. A method in accordance with claim 1 in which:
 - a. the source of radiation is gamma radiation having a strength of at least 500 millicuries; and
 - b. the hollow drill string is moved at least vertically and horizontally in any order.
7. A method in accordance with claim 6 in which the source of radiation is focused upwardly to provide maximum radiation intensity along a line coaxial with the wellhead.
8. Apparatus for locating an underwater wellhead from a floating vessel which comprises:

a focused shielded radioactive source of radiation on said wellhead;

a hollow drill string dependently carried from said vessel;

detection means for said radioactive source of radiation removably arranged in said drill string adjacent the lower end of said drill string;

indicating means on said vessel for said radiation; and

means for moving said hollow drill string responsive to said radiation picked up by said detection means from said source of radiation to engage said lower end with said wellhead.

9. Apparatus in accordance with claim 8 in which the moving means comprises:

- a. means on said vessel for moving said drill string vertically and rotatably; and
- b. means adjacent the lower end of said drill string for moving same horizontally.

10. A method for locating a selected location on water bottom from water surface which comprises:

- arranging at said selected location a radioactive material providing an upwardly focused source of radiation;
- lowering a detection means for said radiation from water surface operatively connected to indicating means accessible from water surface to the vicinity of said selected location; and
- moving said radiation detecting means responsive to radiation picked up by said detection means to engage said detection means with said selected location.

11. A method in accordance with claim 10 in which the detection means is moved at least vertically and horizontally in any order.

12. A method in accordance with claim 10 in which:

- a. the selected location is an underwater well;
- b. the radiation detection means is lowered in a pipe string dependently carried from water surface; and
- c. the radiation detection means is moved vertically and horizontally in any order by moving the pipe string.

13. A method for locating an underwater wellhead from a floating vessel which comprises:

- arranging on an underwater wellhead an upwardly focused source of radiation;
- lowering a hollow drill string from said floating vessel until its lower end is at least in the vicinity of said wellhead;
- lowering in said drill string to a point adjacent the lower end thereof a radiation detection means operatively connected to indicating means accessible from water level;
- moving said hollow drill string to deflect its lower end horizontally and to detect said source of radiation with said detection means;
- rotating said drill string responsive to radiation detected by said detection means from said source of radiation until a maximum level of radiation intensity is indicated on said indicating means for the particular position of the the lower end of said drill string; and
- then moving said drill string vertically and horizontally in any order as radiation intensity reaches a maximum intensity to engage said lower end with said wellhead.

14. A method for locating a selected location on water bottom from water surface which comprises:

- arranging at said selected location an upwardly focused source of radiation;
- lowering a radiation detection means from water surface operatively connected to indicating means accessible from water surface to the vicinity of said selected location;
- moving said radiation detection means to deflect it horizontally and to detect said source of radiation;
- rotating said detection means responsive to radiation detected by said detection means from said source of radiation until a maximum level of radiation intensity is indicated on said indicating means for the particular position of the detection means; and

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moving said radiation detecting means horizontally and vertically in any order responsive to radiation picked up by said detection means as radiation intensity reaches a max-

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imum value to engage said detection means with said selected location.

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