

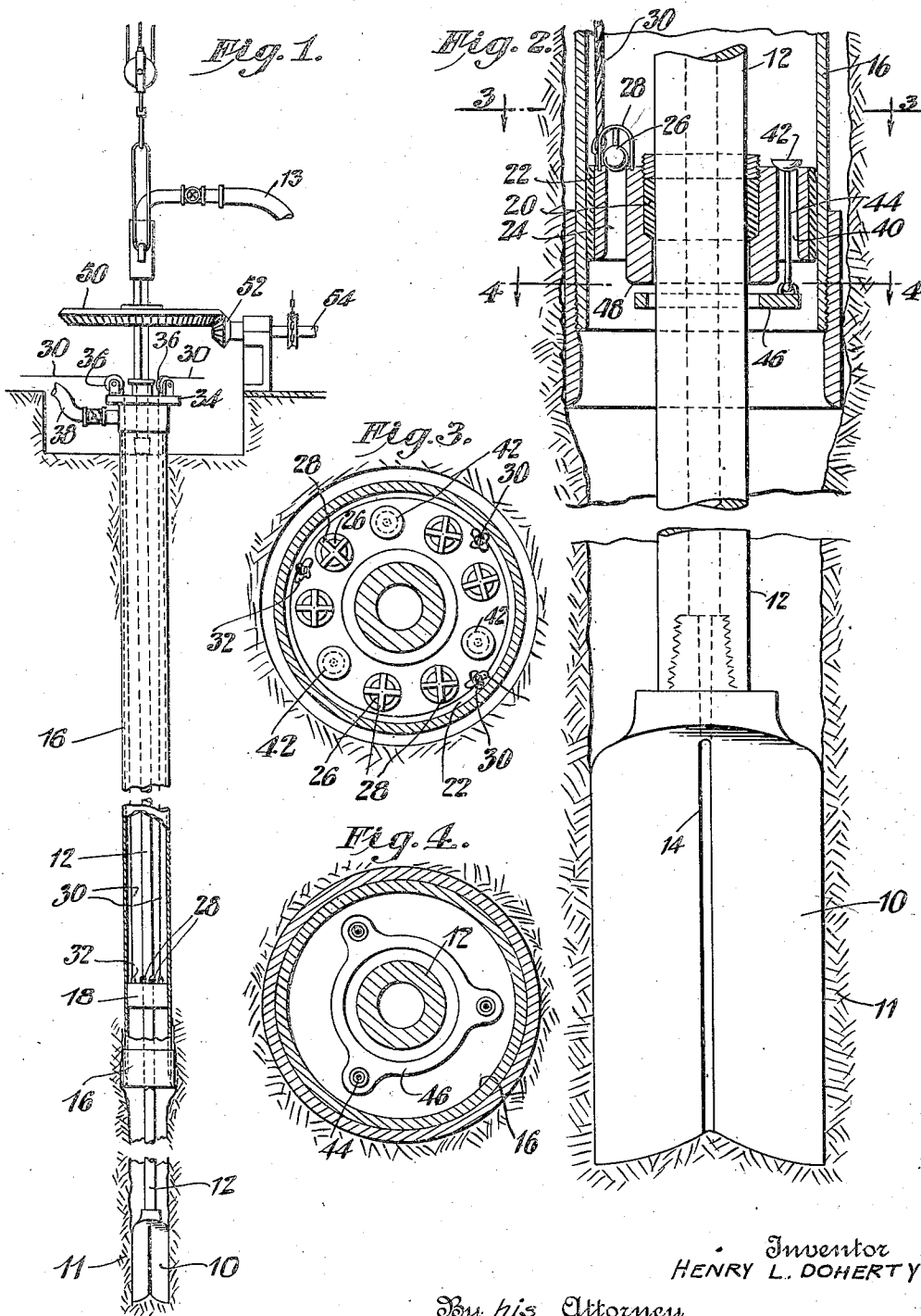
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H. L. DOHERTY

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METHOD AND APPARATUS FOR OBTAINING INDICATIONS OF EARTH FORMATIONS

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Inventor
HENRY L. DOHERTY

By his Attorney

Edmund G. Borden

UNITED STATES PATENT OFFICE

HENRY L. DOHERTY, OF NEW YORK, N. Y.

METHOD AND APPARATUS FOR OBTAINING INDICATIONS OF EARTH FORMATIONS

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This invention relates to the development of oil fields and more particularly to a method and apparatus by means of which the operator may be made aware of the existence of oil, gas and water in the strata which is being drilled.

The two general systems employed in drilling wells are the cable drilling system and the rotary system. Where the formations through which the well is to be drilled are not sufficiently consolidated to permit the sides of the hole to "sand up" or to prevent caving when drilling very deep wells, it is customary to use the rotary system of drilling. In this system a mud laden fluid is kept constantly circulating down through the inside of the drill stem and through a hole in the bit at the bottom of the well and up the outside of the stem, the pulverized material loosened by the bit being carried up out of the well by the circulating medium. One of the disadvantages of the rotary system is that smaller oil and gas sands and important reservoirs may be passed through in prospecting due to the fact that the heavy column of water or mud fluid which must be used in a rotary hole puts so much pressure upon the formations that oil or gas under lower pressure will not flow into the well.

The present invention aims to provide a method and apparatus whereby the well may be readily tested to ascertain whether or not oil or gas formations have been reached.

Briefly stated the method consists in elevating the column of mud fluid in the well in such a manner that the pressure of the same at the bottom of the well is sufficiently reduced to permit the fluids naturally occurring in the earth formations which have been penetrated to flow into the well in the region of reduced pressure, and bringing the fluids which have flowed into the well to the top thereof by circulating the mud fluid.

Generally stated, the apparatus for practicing the method consists of a piston which is placed in the well as near the bottom thereof as practicable, means being provided for elevating the piston and the column of mud fluid thereabove.

In the practise of the invention, it is contemplated that a piston shall be placed in the annular space between the drill pipe and walls or casing of the well hole, means being provided in the piston to permit the mud laden fluid which has reached the bottom of the well to pass upwardly therethrough to the top of the well, such means including one-way valves to prevent the flow of the fluid downwardly through the piston. When it is desired to ascertain if oil and gas formations have been reached, the piston is moved upwardly in the well a suitable distance by cables leading from the piston to a hoisting mechanism at the top of the well. When the piston is lifted it will also lift the column of mud laden fluid thereabove. While the piston is being raised the flow of mud laden fluid through the drill pipe is preferably stopped. The piston is raised sufficiently far to reduce the pressure at the bottom of the well below that occurring in the oil or gas formations or is lifted sufficiently far to create a vacuum in the bottom of the well to induce the oil and gas to flow into the region of reduced pressure. When the piston has been elevated as stated and a sufficient time has elapsed to permit oil and gas from the formations, if they should be present, to flow into the region of reduced pressure below the piston, circulation of mud fluid is again started in order to force or carry to the top of the well, any oil and gas which may have flowed into the well.

After the oil and gas which have flowed into the region of reduced pressure below the piston have been forced out of the well by the circulation of the mud fluid, the piston may again be lowered by reversing the direction of circulation of the mud fluid, that is to say, by forcing mud fluid into the annular space between the drill pipe and walls of the well from the top of the well to force the piston downwardly, the mud fluid in the drill pipe being forced upwardly by the piston as it moves downwardly.

When the piston has been lowered to the desired position, the well is operated as before by forcing mud fluid down through the drill pipe to the bit and into the bottom of

the well from whence it flows upwardly on the outside of the drill pipe, as will now be readily understood. The piston may be raised as frequently as may be found desirable to obtain information concerning the formations which are being drilled, and may obviously be lowered just as frequently. The piston is readily lowered in the well, even though there may be considerable pressure in the gas and oil formations, due to the weight of the column of mud-laden fluid thereabove. It will also be appreciated that due to the weight of the mud-laden fluid above the piston, there is little or no danger of the gas and oil blowing the piston through the well and thus wrecking the equipment.

The distance through which the piston and the column of mud-laden fluid thereabove must be raised to induce a flow of oil into the bottom of the well will obviously depend on the pressure existing on the oil or gas. However it will seldom be necessary to move the piston through a distance greater than 30 feet in order to create a sufficiently reduced pressure in the well to get the desired samples.

The above and other features of the invention will more fully appear from the detailed description taken in connection with the accompanying drawings, and will be set forth in the appended claims, it being premised that various changes may be resorted to without departing from the spirit of the invention.

For further understanding of the invention, reference is made to the detailed description taken in connection with drawings forming part of this specification.

Referring to the drawings:

Fig. 1 is a view partly in elevation and partly in section of a well showing the equipment for drilling the well by the rotary method, the piston and elevating means therefore being also shown;

Fig. 2 is an enlarged vertical section through the lower part of the well showing more in detail the construction of the piston and its position with respect to the drill pipe and casing;

Fig. 3 is a transverse section on line 3—3 of Fig. 2 showing the top of the piston; and

Fig. 4 is a transverse section on line 4—4 of Fig. 2 showing the ring which is connected to a set of valves which are adapted to be opened by the drill bit when the drill pipe is to be withdrawn from the well.

In the drawings, numeral 10 indicates a rotary bit of any preferred or approved construction, 11 the strata being drilled, 12 the drill pipe or stem to which the bit is connected and through which a mud laden fluid is adapted to be passed by a suitable conduit 13 at the top of the pipe, the bit having a hole or opening 14 through which the mud fluid passes into the well. 16 indicates a casing with which the well hole is preferably, though

not necessarily, cased as the drilling proceeds. Located in the casing as near to the lower end thereof as practical is a piston 18 which is provided with a central opening through which the drill pipe passes in as fluid-tight manner as possible, but not sufficiently tight to prevent the pipe from rotating or from having the necessary longitudinal movement therein. A suitable packing generally indicated at 20 is preferably provided between the drill pipe and piston to more readily enable a satisfactory fluid-tight joint to be maintained therebetween. A suitable packing is also provided between the piston and the well casing to enable the fluid-tight joint to be maintained therebetween, said packing being generally indicated at 22.

In order to permit the mud laden fluid which has reached the bottom of the well to pass upwardly, the piston is provided with a plurality of ports or passages 24, at the tops of which are suitable valves to prevent back flow of the fluid. These valves may be of any suitable or preferred form but for convenience of illustration they have been shown as ball valves 26, the same being held in place by suitable cages 28.

Connected to the piston for the purpose of raising the same are a plurality of cables 30, preferably three in number, suitable anchors 32 being affixed to the piston to facilitate the securing of the cables thereto. The cables 30 pass through the well cap 34 and over pulleys 36 suitably supported on the cap and lead to a suitable hoisting mechanism, not shown.

As previously indicated, the well is preferably, though not invariably or necessarily, cased as the drilling proceeds. When a casing is employed, as is preferable, the piston is lowered with the casing. When no casing is employed, the piston may be secured to the drill pipe in such a manner that it will be carried down into the hole as the drilling proceeds. The piston in either case will serve as a centering device for the drill with the result that a straighter and rounder hole may be made. While the drill is in operation, mud fluid is being forced through the drill pipe and bit to the bottom of the well, the mud fluid passing upwardly from the bottom of the well through the passages 24 and by the valves 26 in the piston as will now be readily understood.

When it is desired to ascertain if oil or gas formations have been reached by the drill, the flow of mud fluid through the drill pipe is stopped and the piston raised a sufficient distance to create a suction or to reduce the pressure in the bottom of the well. If any oil or gas is present in the surrounding formations, the same will flow into the well by reason of reduced pressure therein. In order to bring the oil and gas to the surface, circulation of the mud fluid is again started

with the result that the oil or gas or water will be carried along with the mud fluid through the piston and to the top of the well and out through the conduit 38 connected thereto. The oil or gas will usually or probably be quite thoroughly mixed with the mud laden fluid by the time it reaches the top of the well, but the presence of the same may be readily ascertained by careful observation as will be readily appreciated.

When it is desired to withdraw the drill pipe from the well, as when it is necessary to change the bit, it also becomes necessary to withdraw the piston. However, it will usually be desirable to leave the mud fluid in the well during such operation. To effect this, the piston is provided with passages 40 having valves 42 at the top thereof, each of said valves having a stem 44 extending downwardly through the passage and below the piston. Flexibly connected to the lower end of the stems is a ring 46 through which the drill pipe passes. When the drill pipe is lifted the top of the bit 10 will strike the ring 46 and thus lift the valves 42 and thus permit the mud fluid to flow through the piston as the piston is carried upwardly with the drill pipe and bit. In order that the ring may not close the passages 40, the bottom of the piston is preferably provided with a downwardly extending annular lug or shoulder 48 against which the ring will abut without closing the passages 44 as will be readily understood.

The turntable for rotating the drill pipe is indicated at 50 the turntable being driven in the usual or any preferred manner as by a pinion 52 on a shaft 54 which in turn is driven in any suitable manner. The turntable is supported above the well cap 34 in such a manner as not to interfere with the cables passing through the latter.

Various changes in the details of construction of the apparatus may obviously be resorted to without departing from the spirit of invention. Furthermore the term "drilling tool" is not to be understood as meaning necessarily a rotary drill but is intended to be a term of description applying to any drilling tool capable of use with a mud fluid method of drilling.

The invention having been described, what is claimed as new is:

1. The step in a method of determining the presence of hydrocarbon fluids during drilling operations in a well wherein the pressure of a circulating mud fluid employed during drilling operations normally prevents the entrance of surrounding hydrocarbon fluids into the well, which comprises temporarily reducing the mud fluid pressure at the foot of the well sufficiently to permit inflow of said hydrocarbon fluids, while continuing the drilling operation.

2. In determining the presence of hydrocarbon fluids in a well wherein the pressure of a circulating mud fluid employed during drilling operations normally prevents the entrance of surrounding hydrocarbon fluids into the well the step comprising temporarily reducing the mud fluid pressure at the foot of the well sufficiently to permit influx of said hydrocarbon fluids while leaving the drilling tool within the well, said pressure being reduced by bodily elevating a substantial part of the mud fluid within the well, and temporarily reversing the direction of circulation of the mud fluid preparatory to a new determination.

3. The step in a method of determining the presence of hydrocarbon fluids during drilling operations in a well wherein the pressure of a circulating mud fluid employed during drilling operations normally prevents the entrance of surrounding hydrocarbon fluids into the well, which comprises temporarily reducing the mud fluid pressure at the foot of the well sufficiently to permit inflow of said hydrocarbon fluids, said pressure being reduced by bodily lifting a substantial part of the mud fluid within the well, while leaving the drilling tool in place in the bottom of the well.

4. A method of determining the presence of hydrocarbon fluids during drilling operations in a well wherein the pressure of a circulating mud fluid employed during rotary drilling operations normally prevents the entrance of surrounding hydrocarbon fluids into the well, comprising leaving the drilling tool in place within the well, reducing the pressure of the mud fluid at the foot of the well and bringing entered hydrocarbon fluids to the top of the well by circulating fluid through the well.

5. A method of determining the presence of hydrocarbon fluids during drilling operations in a well wherein the pressure of a column of circulating mud fluid employed in the well during rotary drilling operations normally prevents the entrance of surrounding hydrocarbon fluids into the well, comprising leaving the drilling tool in place within the well, reducing the pressure of the mud fluid at the foot of the well by bodily elevating the column of mud fluid, and bringing entered hydrocarbon fluids to the top of the well by circulating fluid through the well.

6. In combination, a well drilling tool, a piston between the drilling tool and walls of the well arranged to support the weight of a column of fluid in the well, and means connected to the piston for moving it in the well independently of the drilling tool.

7. In combination, a drilling tool through which mud fluid may be passed to the bottom of a well, a piston through which the drilling tool extends, the latter being movable in the piston, means associated with the piston per-

mitting the mud fluid to pass upwardly there-through from the bottom of the well, and means for elevating the piston to create a region of reduced pressure between the piston

5 and bottom of the well.

8. In combination, a drilling tool for drilling a well, a piston through which the drilling tool passes, means associated with the drilling tool permitting mud fluid to be passed

10 to the bottom of the well, means associated with the piston permitting mud fluid reaching the bottom of the well to pass upwardly through the piston but not back therethrough, and elevating means secured to the piston

15 whereby the same may be raised to create a region of reduced pressure in the lower part of the well.

9. In combination, means for drilling a well comprising a hollow drill stem and bit

20 through which a mud fluid may be passed to the bottom of a well, a well casing, a piston surrounding the drill stem and being slidably engaged with the casing, valves in the piston through which the mud fluid reaching the

25 bottom of the well may pass through on its way to the top of the well, and lifting means secured to the piston for raising the piston in the casing to create a region of reduced pressure in the bottom of the well.

30 10. In combination, means for drilling a well comprising a tool having means through which mud fluid may be passed to the bottom of the well, a casing, an annular piston filling the space between the drilling tool and casing, said tool being movable with respect to

35 the piston and the latter being slidably mounted with respect to the casing, valves in the piston through which mud fluid may pass in an upward direction from the bottom of the well, and means for raising the piston

40 in the well to create a region of reduced pressure in the bottom of the well to induce oil and gas from the surrounding strata to flow into said region.

45 11. The combination with a drilling tool adapted for drilling a well which is filled with mud fluid, of a piston in the annular space between the walls of the well and the drilling tool, means permitting the piston to

50 be carried upwardly with the drilling tool without elevating the column of mud fluid, said means comprising valves in the piston which are adapted to be opened to permit the mud fluid to flow therethrough as the piston

55 is elevated by the drilling tool.

vated by the drilling tool, said valves when opened permitting the piston to be moved through the mud fluid without elevating it.

13. The combination with a drilling tool adapted for drilling a well which is filled

70 with mud fluid, of a piston in the annular space between the walls of the well and the drilling tool, means permitting the piston to be carried upwardly with the drilling tool without elevating the column of mud fluid, said means comprising valves in the piston

75 and a floating ring suspended below the piston by said valves, said ring adapted to be elevated by the drilling tool to open said valves before the drilling tool elevates the piston, said valves when opened permitting

80 mud fluid to flow through the piston as the latter is elevated.

In testimony whereof I affix my signature.

HENRY L. DOHERTY.

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