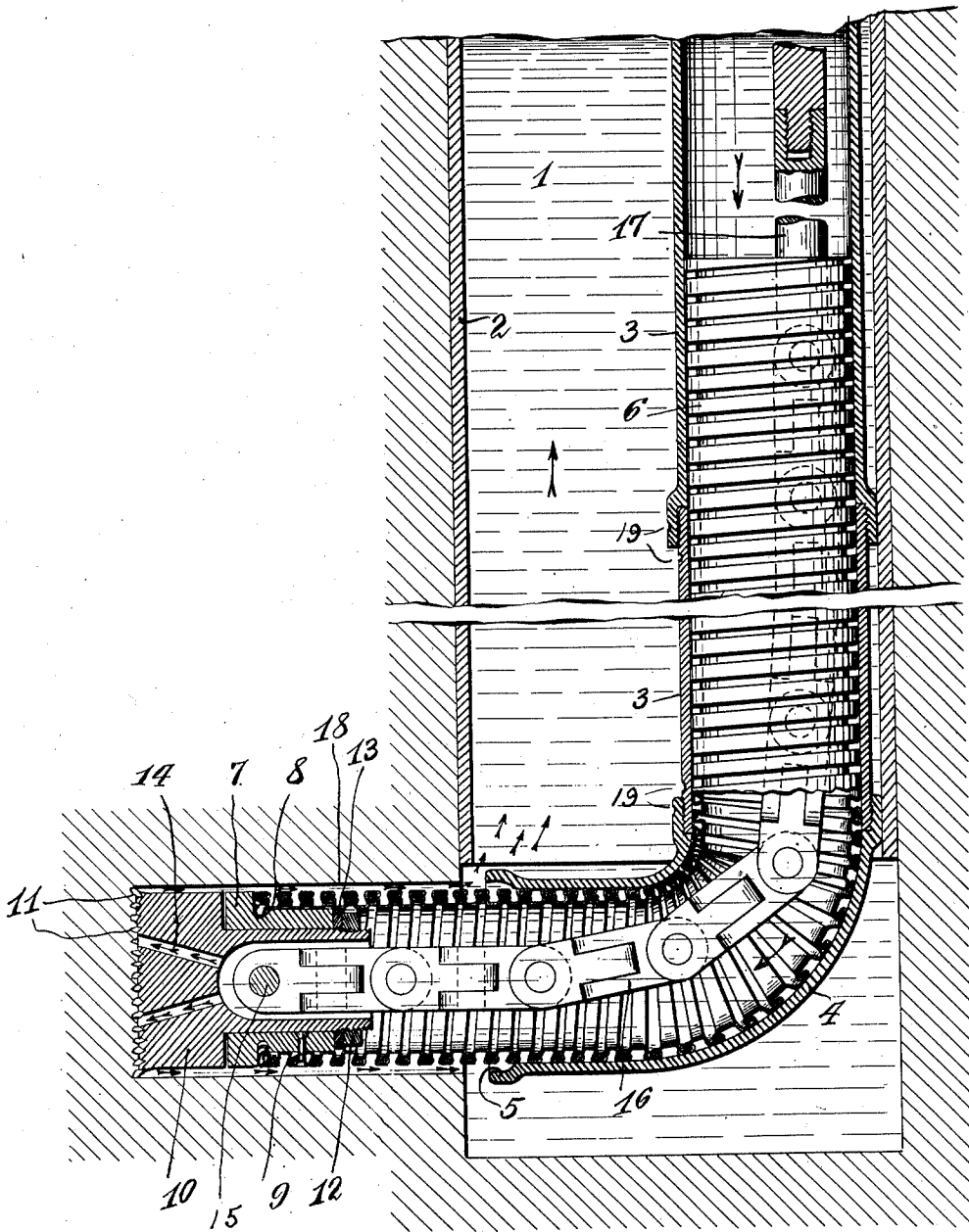


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DRILLING APPARATUS.
APPLICATION FILED DEC. 8, 1919.

1,367,042.

Patented Feb. 1, 1921.



WITNESS:
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BERNARD GRANVILLE, OF NEW YORK, N. Y.

DRILLING APPARATUS.

1,367,042.

Specification of Letters Patent.

Patented Feb. 1, 1921.

Application filed December 8, 1919. Serial No. 343,388.

To all whom it may concern:

Be it known that I, BERNARD GRANVILLE, a citizen of the United States, residing at New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Drilling Apparatus, fully described and represented in the following specification.

This invention relates to drilling apparatus and has for an object to provide a means for drilling of a hole at an angle with a hole already drilled.

A further object of my invention is to provide a drilling apparatus in which a force to feed the drill forward is applied independently of the means for rotating the drill.

Prior to my invention many forms of drills for boring straight holes into the earth were known. By the use of these instruments it has been customary to drill holes sometimes to a depth of 3000 ft. or more in search for oil, gas or other minerals or liquids. If, as not infrequently happens, such a hole is drilled without striking a source of oil or gas, the hole becomes entirely worthless and the expense of boring it is lost even though there may be a source of oil or gas quite near the bottom of the hole; for in order to reach this source or even to find out its location, it has been necessary to drill another hole of the same depth beside the first hole.

By means of my invention a hole may be drilled substantially at right angles from the bottom of a deep well. Thus a horizontal hole may be extended several hundred feet from the bottom of any well in any desired direction. By use of my device, therefore, all sources of oil or gas within a radius of several hundred feet of a well may be reached without the boring of additional wells.

My invention thus provides not only a means for extensive prospecting from a single well, but also a means rendering useful dry wells which have heretofore been considered a total loss. Another use of my invention is to increase the yield of wells already in use, for my drilling apparatus may be used to bore horizontal holes from the bottom of a well from which oil, gas or water is flowing. My invention is applicable to many other uses beside that spe-

cifically mentioned. One of its advantages is that the drill may be fed forward by fluid pressure so that the feeding force is entirely independent of the shaft, or other means used to operate the drill. My invention incorporating this advantage may be used for drilling straight holes as well as holes at an angle to a hole already drilled.

In order that my invention may be clearly understood, I will describe in detail the specific embodiment of it which is shown in the accompanying drawing.

The drawing is a vertical cross-section of the lower portion of a well showing my drilling apparatus in the position which it occupies shortly after beginning the drilling of a horizontal hole from the bottom of the well.

The well 1 is provided with a metal casing 2 such as is customarily driven into oil wells. The lining 2 does not extend to the bottom of the well 1. My drilling apparatus is shown in the process of boring a horizontal hole from a point near the bottom of the well.

Within the well 1 is a set of rigid pipe sections 3 screwed one into another. To the lower pipe section is screwed an elbow 4. In the outer end of the elbow 4 is a recess or flare 5. The set of pipe sections is of sufficient length to reach from the ground to the point in the well from which it is desired to bore a horizontal hole. Fitting within the pipe sections is a flexible metal tube 6. The length of this flexible tube is slightly greater than the distance to which it is desired to extend the horizontal hole. The lower end of the flexible tube 6 is securely attached to a bearing 7. The end of the flexible tube is bent in to enter an annular groove 8 in the external surface bearing 7, and in addition rivets 9 are used to attach the pipe to the bearing. Within the bearing is mounted a diamond drill 10. On the outer face of the drill 10 diamonds 11 are mounted in the usual manner. The diameter of the cutting surface of the drill is greater than the diameter of the body of the drill and greater than the outside diameter of the flexible pipe 6. A screw collar 12 retains the drill within the bearing 7. A thrust washer 13 is inserted between the collar 12 and the bearing 7.

The rigid bearing surface of the drill

within the hole which it cuts extends from the cutting surface of the drill to the plane of the rear surface of the bearing washer 13, as the portion of the tube 6 which is attached to the bearing ring 7 is held rigidly in position so that it cannot bend. The rigid outer bearing surface of the drill is longer than the diameter of the drill. For the reason hereinafter explained it is preferably made as long as the lower portion of the elbow 4, whose length is determined by the width of the well 1, in which the drilling apparatus is to be used.

To a pin 15 passing through the interior of the drill is attached a flexible drive shaft 16. This shaft is constructed in the known manner and consists of a set of links whose connections form a series of universal joints. The length of the flexible shaft is as great as the distance to which it is desired to extend the horizontal hole. To the upper end of the flexible shaft is attached a rigid shaft formed from a series of sucker rods 17 screwed together in the usual manner.

The method of using my drilling apparatus is as follows:—

The drill 10 is placed within the elbow 4. The cutting surface of the drill fits into the recess 5. The elbow 4 and the pipe sections 3 containing within them the flexible pipe 6 and the flexible shaft 16 are lowered into the well. As the drill is lowered additional pipe sections 3 and additional sucker rods 17 are screwed on. Each of the pipe sections 3 has a mark or lock at each of its ends as, for example, the punch marks 19. In screwing the sections together the marks on the two ends screwed together are brought into alinement. The mark upon the uppermost section, therefore, serves to indicate in which direction the elbow 4 is pointed.

The drill is lowered into the well to the depth to which it is desired to bore the horizontal hole. The direction in which the horizontal hole is to be bored is then determined by turning the pipe sections 3 in the well 2 until the mark on the uppermost section indicates that the elbow 4 points in the direction in which it is desired to drill the horizontal hole. The upper pipe section is then attached to a standard hydraulic head. The upper sucker rod passes through a stuffing box in the usual manner, and is connected to a standard rotary drilling machine.

The sucker rods, the flexible shaft and the drill are then rotated while water under pressure is forced into the pipe sections 3. The water pressure forces the drill 10 out from the elbow 4 and against the side of the well 1. As the drill is rotated its cutting surface enters the wall of the well 1 under the forward pressure of the water. The long rigid outer bearing surface of the drill within the hole which it cuts prevents any ma-

terial change of direction of the drill. The drill will, therefore, bore a substantially straight hole. As the drill is fed forward by the water pressure it drags with it the flexible tube 6. The fit between the flexible tube 6 and the pipe sections 3 is sufficiently tight to prevent any substantial amount of the water pumped into the pipe sections from passing outside the flexible pipe. If a little of the water does pass between the pipe sections and the flexible pipe, however, it has the beneficial effect of serving as a lubricant so that the pipe 6 may be pulled downward the more easily. Substantially all the water which is pumped into the pipe sections passes inside the flexible pipe 6 into the central cavity of the drill, and out through the holes 14 to the boring surface of the drill. The water flows outwardly across the boring surface of the drill carrying with it the detritus produced by the boring. The water returns through the hole 18 bored by the drill outside the drill and the flexible pipe 6 to the well 1, and is drawn off at the top of the well.

The drilling is stopped from time to time for the attachment of an additional sucker rod as is customary in the drilling of straight vertical holes.

When the drilling is completed, the flexible tube 6 and the drill 10 are drawn back into the elbow 4 and the pipe sections 3 by an upward pull exerted upon the sucker rods. The flare 5 at the end of the elbow 4 tends to prevent the flexible tube 6 from catching in the mouth of the elbow, and facilitates drawing it back. When the drill 10 has been drawn completely back into the elbow 4 the entire apparatus may be hoisted from the well 1.

If my drilling apparatus is used to penetrate comparatively soft earthy material, it may be desirable to introduce with the water a binder such as clay or cement. This binder will be deposited by the water in its return through the hole 18 and will serve to prevent the walls of the hole 18 from caving in. In drilling rock or hard material, however, no such binder is necessary.

Modifications may be made in the specific device described without departing from my invention. Among them are the following:—

The elbow 4 need not form a right angle. By varying the angle of this elbow, holes may be driven at various angles from the horizontal. The sharpness of the angle of the elbow 4 is, however, limited by the flexibility of the tube 6, it being necessary to make the elbow 4 of such angle that the flexible tube may be drawn through it by the drill.

Other sorts of flexible tubes or hose may be substituted for the flexible metal tube shown.

In place of the type of flexible shaft shown in the drawings, a wire rope or chain may be substituted.

Other types of drills may be substituted for the diamond drill shown.

Some of the features of my invention are of value in the drilling of straight holes, and my invention may be incorporated in apparatus for this purpose.

What is claimed is:

1. In drilling apparatus, a rigid pipe having an elbow, a flexible tube fitting within said rigid pipe and passing through said elbow, a drill rotatably mounted at the outer end of said flexible tube, a flexible driving shaft attached to said drill lying within said flexible tube and adapted to pass through said elbow, and means for rotating said shaft.

2. In drilling apparatus, the combination of a flexible tube open at its rear end, a drill rotatably mounted in the forward end of said flexible tube having a cutting surface of greater diameter than the outer diameter of said flexible tube and having holes from its rear surface to its cutting surface, means surrounding said tube for introducing fluid under pressure into said flexible tube, and means for rotating said drill.

3. Means for drilling a substantially horizontal hole from the bottom of a deep well, comprising a rigid pipe adapted to be connected to a hydraulic head and extending from the surface of the ground to the bottom of the well and terminating in an elbow, a flexible tube fitting within said rigid pipe passing through said elbow and of a length equal to the distance to which it is desired to extend the horizontal hole, a drill rotatably mounted in the end of said flexible tube, a flexible shaft within said flexible tube attached to said drill and of a length substantially equal to that of the flexible tube, and a rigid shaft extending from the upper end of said flexible shaft to the surface of the ground and adapted to be connected to a rotor.

4. In drilling apparatus, the combination of a rigid pipe adapted to be connected to a source of fluid pressure and terminating in an elbow having a flare at its outer edge, a flexible tube fitting closely within said rigid pipe and passing through said elbow, a drill rotatably mounted in the end of said flexible tube having a cutting surface of greater diameter than the outer surface of said flexible tube and having holes from its rear surface to its cutting surface and being greater in length than in diameter, and means for rotating said drill.

5. In a drilling apparatus, the combination of a rotatable drill, a flexible shaft attached to said drill, means for rotating said shaft, means for directing the drill at an angle from a hole already drilled, and means

for applying fluid pressure to the rear of said drill.

6. In drilling apparatus, the combination of a rotatable drill having an external bearing surface greater in length than the cross-section of said drill and having a cutting surface greater in diameter than its bearing surface and having holes from its rear surface to its cutting surface, a flexible shaft attached to said drill, means for rotating said shaft, means for directing the drill at an angle from a hole already drilled, and means for applying fluid under pressure to the rear end of said drill.

7. In drilling apparatus, the combination of a rigid pipe terminating in an elbow, a flexible tube fitting within said rigid pipe and passing through said elbow, a drill attached to the end of said flexible tube and means for operating said drill.

8. In drilling apparatus, the combination of a rigid pipe adapted to be connected to a source of fluid under pressure, a flexible tube open at its rear end fitting within said rigid pipe, a drill mounted in the forward end of said flexible tube so that fluid introduced under pressure into said rigid pipe will feed said drill forward, the drill dragging the flexible tube after it in its forward movement, and means for operating said drill.

9. In drilling apparatus, the combination of a pipe, adapted to be connected to a source of fluid under pressure, a tube fitting within said pipe, a drill mounted in the end of said tube, said tube having a piston action within said pipe, whereby the tube and the drill are fed forward by the introduction of fluid under pressure into said pipe, and means for operating said drill.

10. In drilling apparatus, the combination of an outer pipe adapted to be connected to a source of fluid under pressure, an inner tube fitting within said outer pipe, a drill rotatably mounted in the end of said inner tube, said tube having a piston action within said pipe so that said tube and said drill are fed forward by the introduction of fluid under pressure into said pipe, and means for rotating said drill.

11. In drilling apparatus, the combination of a rotary drill, a shaft adapted to transmit torque to said drill, and means for applying continuous fluid pressure to the rear of said drill to feed it forward.

12. In drilling apparatus, the combination of a rotary drill having a longitudinal bearing surface greater in length than in cross-section and having a cutting face greater in cross-section than said bearing surface and having holes from its rear surface to its cutting surface, a shaft attached to said drill and arranged to apply torque thereto, and means for applying fluid under pressure to the rear surface of said drill.

13. In drilling apparatus, the combination

- tion of a rotary drill having a hole from its rear surface to its cutting surface, a shaft attached to said drill and adapted to apply torque thereto, and means for applying fluid under pressure to the rear of said drill so as to cause said fluid to force the drill forward and to pass through said hole and across the cutting surface of the drill to remove the detritus produced by boring.
14. In drilling apparatus, the combination of a tube open at its rear end, a drill rotatably mounted in the forward end of said tube and having a hole from its rear surface to its cutting surface, means surrounding said tube for introducing fluid under pressure into the rear end of said tube, and means for rotating said drill.
15. In drilling apparatus, the combination of a drill having a hole from its rear surface to its cutting surface, means for operating said drill, and means for applying fluid under continuous pressure to the rear of said drill so as to cause said fluid to feed the drill forward and to pass through said hole and across the cutting surface of the drill to remove the detritus produced by the action of the drill.
16. In drilling apparatus, the combination of a tube open at its rear end, a drill mounted in the forward end of said tube and having a hole from its rear surface to its cutting surface, means for operating said drill, and means surrounding said tube for

introducing fluid under pressure into the rear end of said tube.

17. Means for drilling a substantially horizontal hole from the bottom of a deep well, comprising an elbow to be lowered to the bottom of the well, a series of pipe sections forming a rigid pipe from said elbow to the surface of the ground, a mark upon the uppermost pipe section serving to indicate the direction in which the elbow is pointed, and means for drilling a hole in line with the outer end of said elbow.

18. Means for drilling a substantially horizontal hole from the bottom of a deep well, comprising an elbow adapted to be placed near the bottom of the well, a series of pipe sections adapted to be screwed together to form a rigid pipe extending from said elbow to the surface of the ground, a set of marks near each end of each pipe section indicating the angular relation of each pipe section to the succeeding section, so that the mark upon the uppermost section indicates the direction in which the elbow is pointed, and means for drilling a hole in line with the outer end of said elbow.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

BERNARD GRANVILLE.

Witnesses:

ETHEL JOHNES,
A. L. KENT.