June 23, 1953 R. G. PETER 2,643,094

DRILLING METHOD AND APPARATUS

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Fig. 1

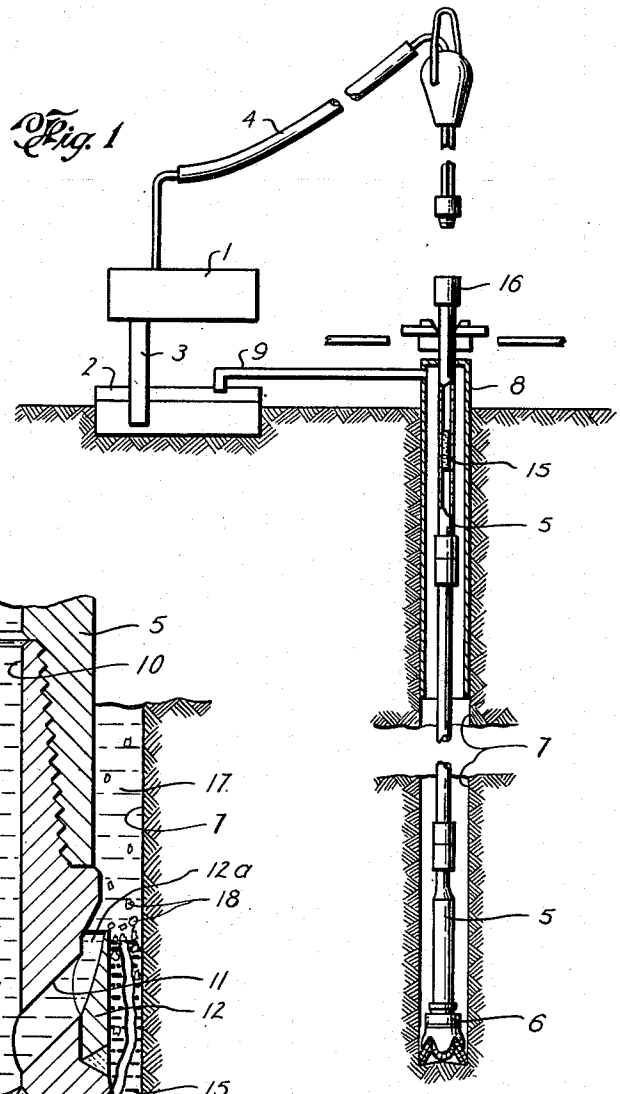
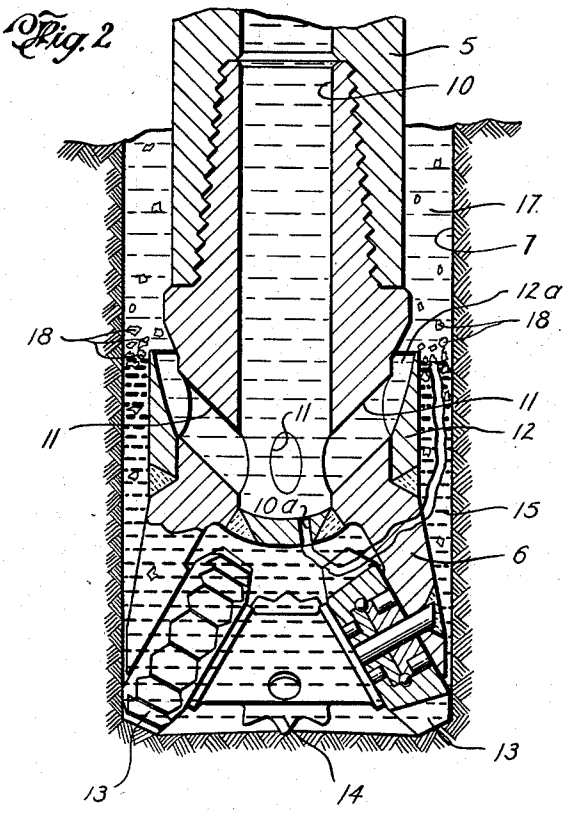


Fig. 2



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DRILLING METHOD AND APPARATUS

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5 Claims. (Cl. 255—1.8)

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This invention relates generally to drilling methods and apparatuses and particularly to methods and apparatuses for drilling deep wells in the earth.

Conventional deep well drilling equipment includes a drill stem to the lower end of which is connected a bit having blade cutters, diamond cutters or roller cutters mounted on bearings. As the bit is rotated, mud laden drilling fluid is pumped down through the drill stem and through nozzles in the bit, and it rises upwardly in the space between the drill stem and the wall of the hole to carry the cuttings to the surface.

The cuttings of the bit should be removed as quickly as possible in order that the cutters will operate directly upon the bottom of the hole rather than upon an accumulation of cuttings in the bottom of the hole. A fluid, such as mercury, heavier than the formation being drilled, may be placed in the bottom of the bore so that the cuttings will quickly float upwardly in the mercury away from the bottom of the hole. The circulating drilling fluid will then carry the cuttings to the surface of the earth where they may be removed from the drilling fluid by well-known conventional means.

This invention has for one of its general objects the provision of a new and improved method whereby drilling fluid and a heavier fluid such as mercury or the like may be efficiently employed in the drilling of a well.

Another object of the invention is the provision of a new and improved apparatus with which drilling fluid and a heavier fluid such as mercury or the like may be efficiently employed in the drilling of a well.

A specific object of the invention is the provision of a new and improved drill bit.

Other objects will hereinafter appear.

In the accompanying drawings,

Fig. 1 is a view illustrating diagrammatically one form of conventional drilling equipment with which this invention may be used, and

Fig. 2, an enlarged detail sectional view of the preferred embodiment of the new and improved bit provided by this invention.

In rotary drilling with the conventional equipment diagrammatically illustrated by Fig. 1, the pump 1 pumps drilling fluid from the slush pit 2 through the pipe 3 and hose connection 4 into the drill stem 5. The drilling fluid flows downwardly through the drill stem 5 and the bit 6 at the bottom, thence upwardly about the drill stem in the bore of the well 7 and the casing 8 from

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which it is discharged by the pipe 9 into the slush pit 2. The conventional function of the drilling fluid is to keep the bit 6 cool, to remove the cuttings, and to form a coating on the wall of the bore 7.

In Fig. 2, the bit is shown at 6 connected to the drill stem 5 and having an internal passageway 10 in communication with the interior of the drill stem 5. The passageway 10 is centrally disposed and leading upwardly and outwardly from this passageway are ports 11. A ring 12 may be welded on the bit 6 to form an annular upwardly directed discharge nozzle 12*a*. In the bottom of the bit are roller cutters 13 and 14, and the bottom of the drilling fluid passageway 10 may be provided with a relatively small port 10*a* through which a small quantity of the drilling fluid will be directed downwardly toward the cutters to assist in keeping the cutters cool.

In the bottom of the bore 7 of the well and extending upwardly to a point just below the opening of the nozzle 12*a* is a heavy fluid 15 such as mercury or the like. The numeral 17 indicates the drilling fluid circulating above the mercury 15. The mercury 15 may be poured into the drill stem 5 at the surface when one of the tool joints such as that indicated at 16 is disconnected, as shown by Fig. 1. Since the mercury 15 is very heavy it will descend to the bottom of the hole. When the tool joint 16 is connected again and the pump 1 is operated the drilling fluid will move downwardly through the drill stem 5 and internal passageway 10 in the bit 6. The major portion of the drilling fluid will pass outwardly through the ports 11 and upwardly through the annular nozzle 12*a* to carry the cuttings 18 upwardly in the space between the drill stem 5 and the wall of the hole 7 and casing 8 and discharge the same into the slush pit 2 in which the cuttings will be removed from the drilling fluid. A small amount of the drilling fluid will pass through the port 10*a* and through the mercury 15 to assist in keeping the mercury 15 cool.

It will be apparent from the foregoing that during drilling operations the roller cutters 13 and 14 of the bit 6 will cut into the formation as the bit 6 is rotated. The cuttings 18 will float upwardly to the top of the column of mercury 15. The drilling fluid 17 issuing upwardly from the annular nozzle 12*a* will carry the cuttings 18 upwardly to the surface. And if the port 10*a* is provided it will direct a small part of the drilling fluid downwardly toward the cutters to assist in keeping the mercury 15 cool and the mercury

15 will in turn assist in keeping the roller cutters 13 and 14 cool.

The diameter of the hole being but slightly greater than the diameter of the bit, the volume of mercury required to occupy the space to a predetermined height from the bottom of the hole can readily be estimated, since the space occupied by the bit is known. Fig. 2 illustrates the addition of a volume of mercury sufficient to cause it to rise on the outside of the bit to a point just below the opening of the nozzle 12*a* when the pump 1 is operated. It will be understood that the level of the mercury may be varied.

It will also be understood that the invention is not limited to the preferred embodiment of the bit herein disclosed. For example the port 10*a* may be omitted, and the structure of the drilling fluid passageways serving to direct the drilling fluid upwardly at a point above the bottom of the bit may be varied, and various types of cutting elements may be employed. Such variations and others will occur to those skilled in the art within the scope of the following claims.

I claim:

1. The method of drilling earth bore holes which consists in depositing a fluid in the bottom of the hole having a specific gravity higher than the specific gravity of the formation being drilled, circulating a drilling fluid having a specific gravity lower than the specific gravity of the fluid within the bottom of the hole, jetting the major portion of said drilling fluid upwardly just above the level of the bottom hole fluid to accelerate the removal of the cuttings therefrom, and discharging a small portion of said drilling fluid downwardly into the lower portion of said bottom hole fluid to provide cooling of the bottom hole fluid.

2. A drill bit including, a bit body having cutting elements thereon and having an axial passageway therein with the lower end of the passageway closed, said body having a plurality of upwardly directed passages extending through the wall thereof and having their lower ends in communication with the lower portion of the passageway and their upper end communicating with the area exteriorly of the bit, and an annular ring mounted on the exterior of the body and encompassing the open upper ends of said passages, the upper portion of the bore of the ring being spaced from the body to form an annular discharge passage about the body and with which the upwardly directed passages communicate.

3. A drill bit as set forth in claim 2, wherein

the bit body is also formed with a discharge port extending from the lower end of the passageway for discharging a portion of the fluid circulating through the passageway downwardly below the bit.

4. The method of drilling a deep well in the earth with a drill stem and a bit on the end of said stem which consists in, depositing a fluid having a specific gravity greater than the formation being drilled in the bottom of a well in a volume to substantially submerge the drill bit therein, then circulating a drilling fluid of less specific gravity than the fluid in the bottom of the well downwardly through the drill stem and bit, discharging the major portion of the drilling fluid from within the bit in an upward direction into the body of heavier fluid within the bottom of the well, and discharging a minor portion of the drilling fluid from within the bit in a direction downward of the bit into the lower end of the body of heavier fluid within said well to cool the heavier fluid.

5. The method of drilling a deep well in the earth with a drill stem and a bit on the end of said stem which consists in, depositing mercury in the bottom of a well in a volume to substantially submerge the drill bit therein, then circulating a drilling fluid of less specific gravity than the mercury through the well bore and stem, discharging the major portion of the drilling fluid from within the drill bit in an upwardly directed annular path and into the area exteriorly of the bit, and discharging a minor portion of the drilling fluid from within the bit into the lower end of the body of mercury to cool the mercury.

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