

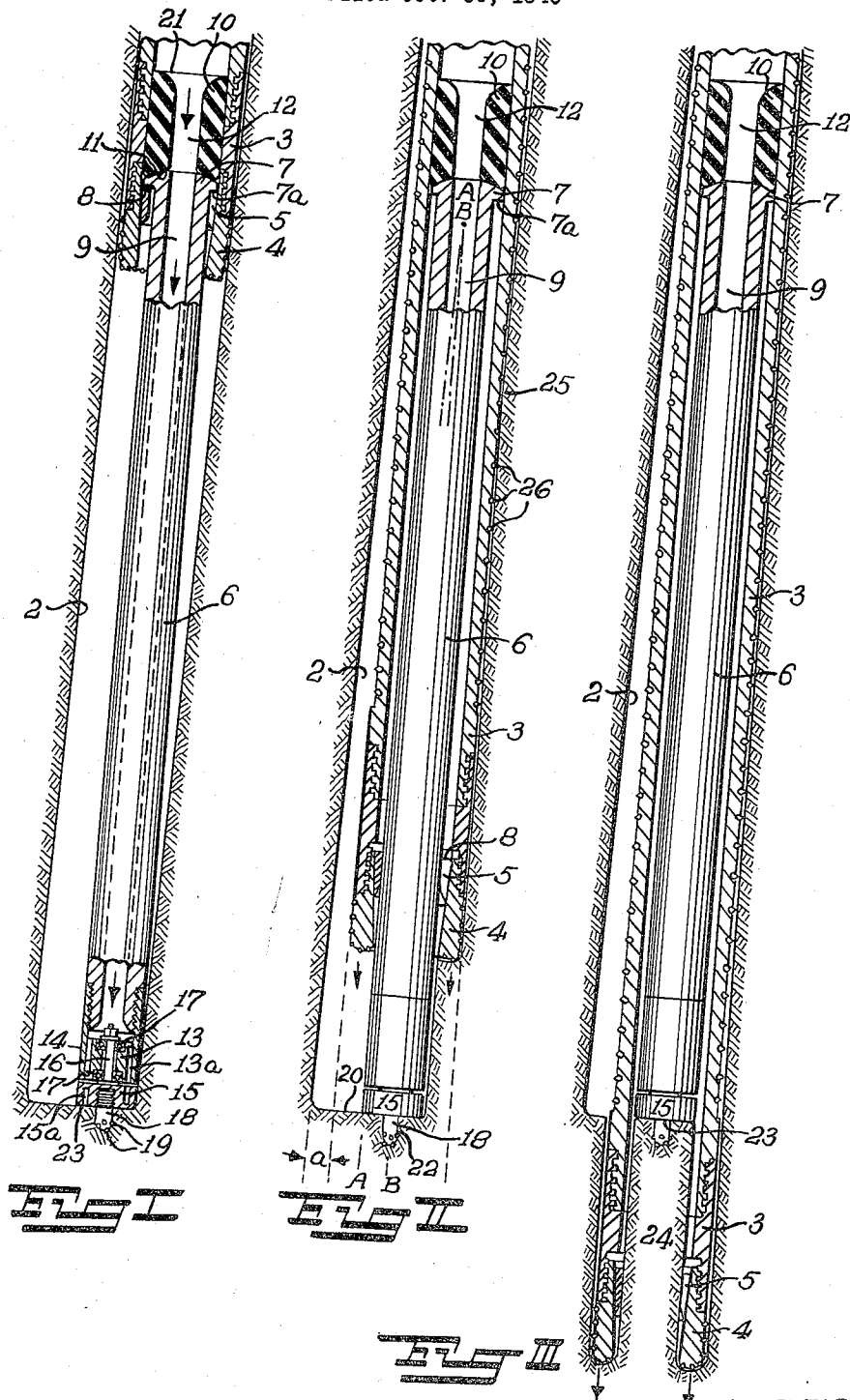
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REDIRECTING DEFLECTED BOREHOLES

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REDIRECTING DEFLECTED BOREHOLES

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1 Claim. (Cl. 255—1.6)

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This invention relates to the re-direction of bore holes with the object of guiding them nearer to the vertical position.

For this purpose it is known to provide a core drill with a pilot consisting of a rigid round rod extending from the mouth of the annular crown. Said pilot is loosely supported by the crown so that, when allowed to hang freely from the latter, it gravitationally assumes a position in which its length is more vertical than the axis of the crown, assuming the latter to be inclined. The lower end of the pilot is adapted to be anchored to the bottom of the bore hole.

In the process of re-directing a bore hole by means of the pilot described, the drill rods are held stationary near to the existing bottom of the bore hole but sufficiently above said bottom as to enable the pilot to hang in a position in which its lower end is eccentric to the axis of the hole and on the low side of the hole. Said lower end of the pilot is thereupon anchored to the bottom of the hole in such eccentric position, by the means provided for that purpose. Thereupon the drill is rotated and fed downwardly. With its lower end thus eccentrically anchored and its upper end in the mouth of the crown, the pilot constitutes a guide over which the drill travels and which coerces the drill first to ream out the wall of the hole on the low side of the latter and to reposition the drill with the axis of the crown positioned to intersect (or approximately intersect) the eccentric point at which the lower end of the pilot is anchored. During the lowering of the drill, the pilot relatively passes into the core barrel and remains therein at the top of any core that passes into said barrel.

It is an object of the present invention to provide a process and apparatus of this kind, in which the anchoring of the lower end of the pilot rod is more positive and reliable than heretofore. Another object is to enable the deviation to be made without substantial loss of core, and without the diminution of the core diameter which is unavoidable in other somewhat similar deviating methods.

According to this invention, a process of redirecting a bore hole nearer to verticality comprises the steps of suspending a straight guide rod from the lower end of a hollow drill rod line, to hang gravitationally more nearly vertical than is said lower end, lowering the drill rod line to bring a rotary pilot drill at the lower end of the guide rod against the bottom of the bore hole at a point eccentric to the axis of the lowermost

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part of the existing bore hole and on the low side of the hole, rotating the pilot drill while the drill rod line and the drill bit are held against rotation and simultaneously pressing the guide rod downwardly so that a pilot hole is drilled by the pilot drill; with the pilot drill anchored within the pilot hole and held against rotation, resuming drilling with said drill bit along a new axis to which the drill bit is coerced by the guide rod, which axis is materially that of the anchored guide rod, while the guide rod relatively enters the bore of the drill rods; and recovering the core drilled by the drill bit with the pilot drill embedded therein and the guide rod extending upwardly therefrom.

It is a feature of the invention that the rotary drill is driven by means of a water turbine actuated by a stream of water passed down the drill rod line, said turbine being mounted on said pilot, the water being exhausted from the turbine into the bore hole.

Apparatus according to the invention comprises a hollow guide rod adapted to be suspended from the lower end of a hollow drill rod line and when so suspended capable of limited swinging movement relatively to the drill bit; a rotary pilot drill axially mounted at that end of the guide rod which in use is lowermost, said pilot drill being considerably smaller in diameter than the bore hole; and means to rotate said pilot drill independently of the drill bit.

An example of apparatus suitable to carry out the method of the invention is illustrated in the accompanying drawings, in which:

Figure I is a partly sectioned elevation showing the pilot and the lower part of the drill rod line, the pilot being shown in the position at the bottom of the bore hole that it occupies after its lower end has been anchored at the bottom of the hole.

Figure II is a similar view, showing the drill in its new alignment and reaming out the side of the bore hole; and

Figure III is a similar view at the stage at which the drill has been redirected and is in the process of drilling out a fresh core.

In all the figures the lowermost part of the existing bore hole is shown and is numbered 2. Such lowermost part of the bore hole is inclined to the vertical, as is shown by the relationship of such part to the edges of the drawing sheet.

The core barrel is numbered 3, and the drill bit or crown, which is numbered 4, is attached to the lower end of it.

Comprised within the bore of the crown is the core lifter 5.

The guide rod is numbered 6. Its upper end is formed as a head 7 which, when the drill with the rod 6 is being brought into position within the bore hole, bears against the upper face 8 of the core lifter 5, so that the rod 6 projects downwards out of the mouth of the crown.

The undersurface 7a of the head 7 approximates to spherical shape, so that the head 7 and the said upper face 8 of the core lifter operate as elements of an universal joint between the crown 4 and the rod 6, and since the diameter of the pilot is materially less than that of the crown, permit the rod 6 limited swinging movement relatively to the crown.

The rod 6 is formed with a central bore 9 for passage of water from the core barrel 3 downwards through the rod 6, and a rubber sleeve 10 is provided within the bore of the core barrel 3 and above the rod 6, to divert water into the bore 9 of the rod 6 and to prevent substantial leakage between the head 7 of the rod 6 and the inner wall of the crown 4. The lower face 11 of the sleeve is formed complementarily to the shape of the upper surface of the head 7, and the passage 12 through the sleeve is substantially equal in diameter to the bore 9 of the rod 6.

In the lower end of the bore 9 of the pilot is accommodated the stator 13 of a water turbine 14, the rotor 15 of the turbine being fast with a spindle 16 mounted in bearings 17 provided by the stator 13. The co-operating passages of the stator 13 and the rotor 15 are respectively numbered 13a and 15a.

Screwed axially into the rotor 15 is a rotary pilot drill 18, constructed to drill the kind of rock in which the bore hole for the time being terminates. In the drawings, the body of the drill 18 is shown as set with diamonds 19.

In the use of the apparatus, the drill rod line is held stationary near to the bottom 20 of the bore hole, but sufficiently above it to allow the rod 6 to hang from the crown in a position in which it is more vertical than the core barrel 3, with the pilot drill 18 eccentric to the axis of the hole and on its low side.

Full water is thereupon applied. Pressure on the upper surface 21 of the sleeve 10 forces the sleeve downwardly on to the head 7 of the rod 6, assists the mass of the pilot to hold the rod 6 against rotation, and tends to lock the pilot in the angular position it occupied relatively to the crown when water pressure was applied.

The water stream actuates the rotor 15 of the turbine 14, and the rotor with the pilot drill 18, commences to rotate. Sediment, if present, is cleared away from the bottom 20 of the bore hole by the water evacuated from the turbine.

The drill rod line is then lowered without rotation, whereupon the pilot drill 18 bores the pilot hole 22 in the bottom 20 of the bore hole.

When the pilot drill has penetrated to its full depth, that is to say when the lower face 23 of the rotor is in contact with the bottom 20 of the bore hole, the lower end of the rod 6 is firmly anchored in the pilot hole 21 and resumption of drilling causes the crown to be coerced by the anchored rod 6 to follow the new axis B—B (Figure II) initiated by the pilot drill 18, which axis is nearer to verticality than is the axis A—A (Figure II) of the bore hole 2 by an angular extent which is indicated by α , while the rod 6 relatively enters the core barrel 3.

While following such new axis B—B, the

crown reams out the wall of the bore hole on the low side of the latter, as is shown in Figure II.

After the crown has reached the bottom 20 of the bore hole 2, continued drilling forms a new core at 24 (Figure III), the axis of which is coincident with the axis B—B. This core is recovered in the usual way, with the rod 6 attached to the top of it.

The operation above described is repeated if and as often as may be necessary to bring the bore hole to the required degree of verticality, a convenient procedure being to drill some two and one half feet past the anchored pilot drill 18 at each operation.

Re-direction of the crown 4 results in a shoulder or hump 25 being formed in the wall of the bore hole at about the point of re-direction. In order to eliminate this hump, the core barrel may, for a few feet above the crown, be set with cutting formations, for instance diamonds 26, to ream out the hump. The core barrel may be slightly reduced in diameter to make room for such cutting formations.

A particular feature of the operation of the invention is, as has been above stated, that there is no loss of core after re-direction of the bore hole. By this is meant that the core 24 is of the usual core diameter. Obviously, during the initial process of re-direction, that is to say when the crown is reaming out the wall of the bore hole, the material reamed out is not recovered.

We claim:

The process of re-directing an inclined bore hole nearer to verticality, which comprises the steps of suspending a straight guide rod from the lower end of a hollow drill rod line to hang gravitationally more nearly vertical than is said lower end, lowering the drill rod line to bring a rotary pilot drill at the lower end of the guide rod against the bottom of the bore hole at a point eccentric to the axis of the lowermost part of the existing bore hole and on the low side of the hole, rotating the pilot drill while the drill rod line and the drill bit are held against rotation and simultaneously pressing the guide rod downwardly so that a pilot hole is drilled by the pilot drill; with the pilot drill anchored within the pilot hole and held against rotation, resuming drilling with said drill bit along a new axis to which the drill bit is coerced by the guide rod, which axis is materially that of the anchored guide rod, while the guide rod relatively enters the bore of the drill rods; and recovering the core drilled by the drill bit, with the pilot drill embedded therein and the guide rod extending upwardly therefrom.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
140,357	Frisbee	July 1, 1873
292,888	Baker	Feb. 5, 1884
1,784,886	Baker	Dec. 16, 1930
1,902,174	Lewis	Mar. 21, 1933
1,941,723	Stroud	Jan. 2, 1934
2,061,317	Brack	Nov. 17, 1936
2,227,233	Scott et al.	Dec. 31, 1940
2,251,916	Cross	Aug. 12, 1941
2,266,383	Quintrell	Dec. 16, 1941