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DRILLING DEVICE FOR LARGE BORES

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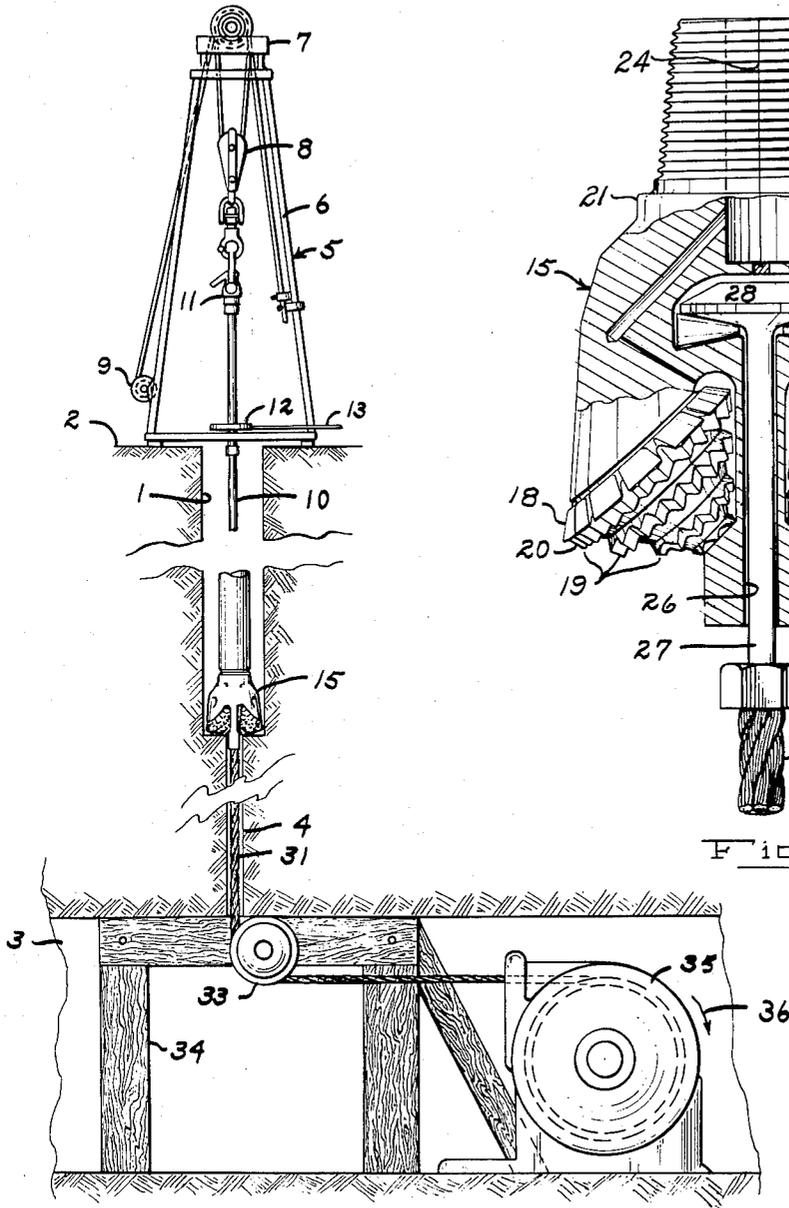


Fig. 1

Fig. 2

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DRILLING DEVICE FOR LARGE BORES

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2 Claims. (Cl. 255—19)

This invention relates to the production of large diameter bores in the earth and is of particular utility in the sinking of mine shafts from the surface of the earth to a predetermined level or to a tunnel therebeneath.

In the past it has been customary, when sinking mine shafts, or tunnel-to-tunnel shafts, to progressively disintegrate the earth materials penetrated along the selected route for the shaft and to periodically remove loosened material so that the disintegrating operations may proceed.

The present invention is intended to capitalize upon the advantages, when making large earth bores, of the rotary method of drilling and it is the primary object of the invention to provide an improved method and apparatus utilizing the rotary method of producing large diameter earth bores.

The invention also comprehends, and has for an object, the production of an earth bore, or shaft, by first providing a pilot hole or bore and thereafter enlarging such bore by steps until a shaft of the desired diameter is had.

When drilling large bores by the rotary method unusually large weights upon the drill bit are required in order to produce a satisfactory rate of penetration. Both portable and stationary rotary rigs are incapable, particularly at shallow depths, of exerting sufficient weight upon the bit to effect a satisfactory drilling rate. Also, even if adequate weight could be approximated, buckling of the drill stem would result. It is therefore an additional object of the invention to provide a novel technique and apparatus for overcoming these difficulties.

Still another object is to provide a drilling device which includes a pull-down mechanism to apply sufficient force on the drill bit that a satisfactory rate of penetration is obtained.

Another and more specific object of the invention, in one form, is to initially provide a pilot hole or bore from one level to another level and to thereafter enlarge such bore by utilizing a reaming bit to which a downward force is applied by means of a pull-down extending downwardly into the pilot bore.

Still another object is to provide, by the rotary method of drilling, a pilot bore from one level to a tunnel therebeneath, or between a point and a tunnel horizontally spaced, pull-down equipment being provided in such tunnel to exert necessary force upon a drill bit rotatably driven from said level or point, whereby the bore is enlarged to form a shaft to the tunnel.

Other and further objects of the invention will be apparent from the following description and claims, and will be understood by reference to the accompanying drawing which, by way of illustration, shows a preferred embodiment of the invention.

Fig. 1 is a view partly in section through the earth showing one form of the invention and its use in forming a shaft from the earth's surface to a tunnel to be served by the shaft.

Fig. 2 is an enlarged view, partly in section, of a rotary drill bit used in accordance with the invention and provided with the pull-down structure by means of which

sufficient force axially of the bit may be applied to effectively cut the desired shaft.

My invention as illustrated in the drawing seeks to provide a shaft 1 from the surface 2 of the earth to a lower level shown as the tunnel 3 to be served by the shaft. In practicing the invention I first form a pilot bore 4 by conventional drilling operations, such operations using the drill rig 5 which comprises derrick 6 having crown block 7, travelling block 8 and draw works 9 to control movements of the drill string 10 to which flushing fluid is supplied by means of the hydraulic swivel 11. The drill stem or string 10 is rotated, as is well known in the art, by means of the rotary table 12 driven through shaft 13 from a suitable source of power (not shown).

After the pilot bore 4 has been completed an enlarging bit 15 is attached to the drill string 10. A suitable bit, as best seen in Fig. 2, comprises a head 16 which carries roller cutters 17 and 18 having cutting elements 19 thereon. These cutting elements are so arranged in the group of cutters that they cut the entire bottom of the shaft formed about the pilot bore 4 as drilling progresses. It is intended that the outermost elements 20 on the cutters will both cut and maintain gage of the shaft. The cutters 17 and 18 are rotatably mounted on the head 16 in spaced relation with the axis of the bit so that the downward extension 25 on the bit head may pass between the innermost ends of the cutters. This extension is enlarged at its lower end and is intended to enter the pilot bore 4 and to serve as a pilot for the bit as it progresses along the line determined by the pilot bore.

The head 16 of the enlarging bit 15 may be fabricated in any manner well known in the art as for example as shown in U. S. Letters Patent No. 959,540. Preferably, as shown in Fig. 2 the head 16 comprises complementary bit head segments 21, 22 threaded at their upper ends at 23 for attachment to the drill string. These head segments, when assembled, abut on the line 24 as clearly shown in Fig. 2. Each segment has an upper or main portion 24', upon which one of the cutters is mounted, and a lower portion 25' which forms a portion of the downward extension 25.

The extension or pilot 25 has a circular bore 26 to rotatably receive the spindle 27 having an enlargement 28 at its upper end within the cavity 29 in the bit head. The enlargement 28 serves as a roller race for rollers 30 which engage an opposed roller race in the bottom of the cavity 29. A pull-down force is applied to the bit assembly by means of the cable 31 secured to the lower end of the spindle as by means of the anchor lug 32.

In practicing the invention the pilot bore 4 is first drilled from the surface 2 to a point spaced therefrom and shown as the tunnel 3, the line of this bore being the axis of the access shaft to extend from the surface 2 to the tunnel 3. Drilling of the pilot hole, or bore, may be effected in the usual manner as relatively small weight upon the bit is sufficient to provide the desired rate of penetration when making this small diameter bore. As the drill string is rotated by power applied to the rotary table 12, flushing fluid is pumped through the hydraulic swivel 11 and thence through the drill string and the bit whereby cuttings are removed from the pilot bore as it is formed.

Thereafter the drill bit used in drilling the pilot hole is removed and is replaced by a larger bit of the type shown in Fig. 2 and already described. The cable 31 is threaded downwardly through the pilot bore 4 where it passes beneath the sheave 33, mounted on staging 34 and thence to the drum 35 within the tunnel 3. Again, the drill stem is rotated by means of the rotary table 12. Flushing fluid is forced through the hydraulic swivel 11, the drill string 10 and the bit 15 so that cuttings will be removed from the enlarged bore or shaft 1 which is being formed. Portions of these cuttings may move both

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upwardly, through the shaft 1, and downwardly through the pilot bore 4. The latter portion of the cuttings may be received in the tunnel 3 by conveyors or mine cars (not shown) for removal.

While some weight is being applied to the bit 15 by the drill stem 10 which may comprise one or more drill collars, additional weight or force upon the bit is required if a desirable rate of drilling is to be maintained. This additional weight or force is effected by application of tension upon the cable 31 by driving the drum 35 in the direction indicated by the arrow 36. It is to be understood that sufficient power will be available that desired torque may be produced upon the drum 35, that effective cutting action will be had.

Inasmuch as large size bits of the type shown at 15 require large weights for effective drilling action it may be impractical to provide a desired size of shaft 1 through a single enlarging step from the pilot bore 4. Hence, it may be desirable to provide the ultimate diameter of shaft by using successively larger bits of which each uses the preceding bore as a pilot hole. The invention, therefore, comprehends the production of a shaft 1 by the rotary method of drilling by using a single bit to enlarge from the pilot bore 4 to the desired diameter, or, by using a series of successively larger bits, the exact number in a particular instance depending upon the size of the shaft desired, characteristics of the equipment available and the nature of formations to be penetrated during the drilling operations.

Obviously the invention is not confined to the precise mechanism for effecting the pull-down force upon the bit or the precise form of bit shown and described, the only requisite for such mechanism being that adequate force be applied to the cable 31 to effect desired cutting action by the bit.

The invention claimed is:

1. A rotary shaft drilling machine for enlarging to

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shaft proportions a pilot hole drilled between points to be connected by the shaft comprising in combination, a drill rig including a drill stem and bit to be rotated thereby and to move axially of and to progressively enlarge the hole, a swivel connection with said drill stem and bit, and means operable through said connection for exerting a force axially of the drill stem and bit to effect disintegrating action of the earth formations about the pilot hole whereby a cylindrical shaft is formed along the line traversed by the pilot hole.

2. A rotary shaft drilling machine for enlarging to shaft proportions a pilot hole drilled between points to be connected by the shaft comprising in combination, a drill stem, means for rotating said drill stem, a drill bit attached to said drill stem, said drill bit including a pilot extension adapted to enter and to guide the bit along said pilot hole, a swivel connection on said bit, and means attached thereto and extending downwardly into the pilot hole for exerting a pull-down force upon the bit so that advancement of the bit forms a shaft along the line traversed by the pilot hole.

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