H. R. HUGHES.

ROTARY BORING DRILL.

APPLICATION FILED OCT. 29, 1918.

1,322,696.

Patented Nov. 25, 1919.

2 SHEETS—SHEET 1.

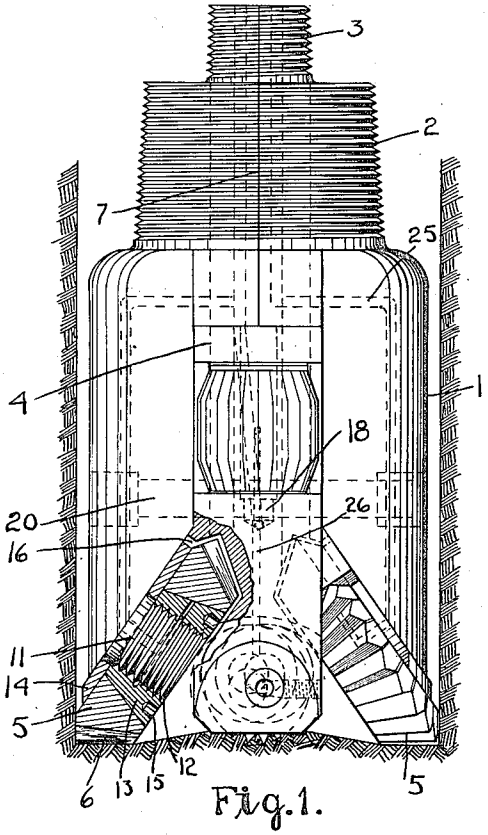


Fig. 1.

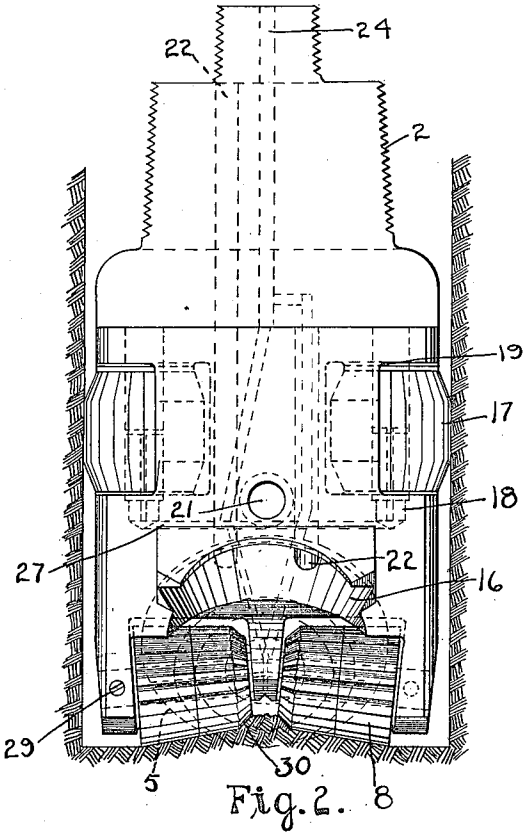


Fig. 2.

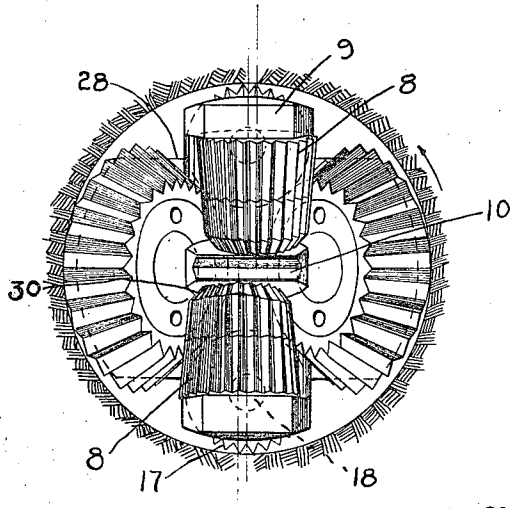


Fig. 3.

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By His Attorney Jesse R. Stone

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2 SHEETS—SHEET 2.

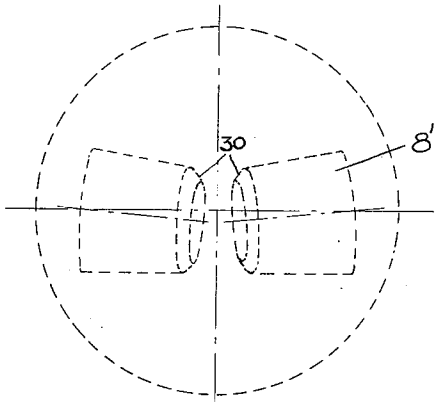


Fig. 4.

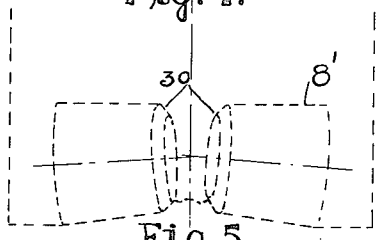


Fig. 5.

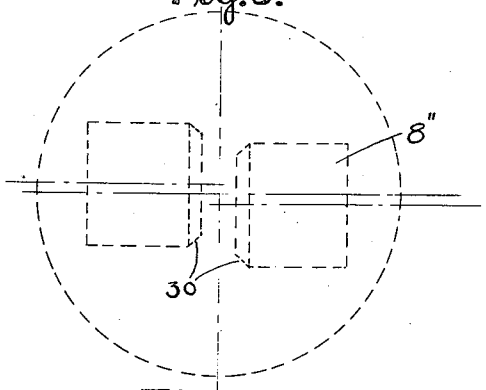


Fig. 6.

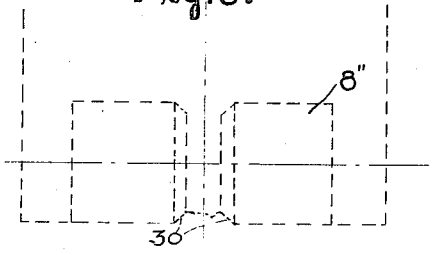


Fig. 7.

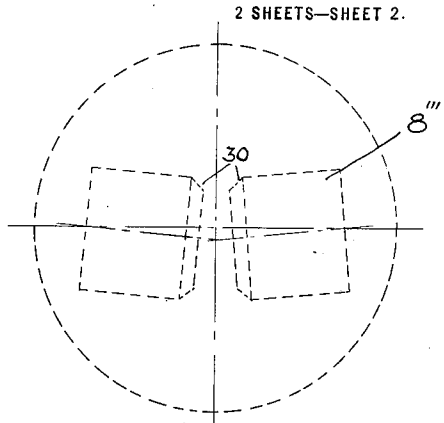


Fig. 8.

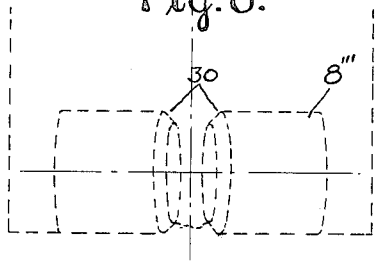


Fig. 9.

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By His Attorney Jesse R. Stone

UNITED STATES PATENT OFFICE.

HOWARD R. HUGHES, OF HOUSTON, TEXAS.

ROTARY BORING-DRILL.

1,322,696. Specification of Letters Patent. Patented Nov. 25, 1919.

Application filed October 29, 1918. Serial No. 260,087.

To all whom it may concern:

Be it known that I, HOWARD R. HUGHES, a citizen of the United States, residing at Houston, Harris county, Texas, have invented a certain new and useful Improvement in Rotary Boring-Drills, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to rotary boring drills for use in drilling wells or mines in earth or rock. It has particular application to drilling in hard formations but will also operate efficiently in soft material.

My device is of the type of rotary drills usually included under the term roller bits, wherein the disintegration of the material is brought about by the rolling of toothed cutters upon the bottom of the hole, thus serving to break up and pulverize the material which is then washed away and carried in suspension to the surface by means of a current of flushing water. This flushing water is pumped down to the bit through a hollow drill stem and through channels in the bit and finds an outlet upwardly around the sides of the bit and the drill stem carrying with it all disintegrated material.

An object of my invention is to provide a roller bit of the character described which will operate in both hard and soft formations and which will be particularly efficient in grinding up and disintegrating the material in such manner that it may be carried from the hole by a stream of flushing water.

Another object is to construct a drill bit which will cut rapidly and which will not easily be reduced in gage so as to cause the head of the drill to lodge in the hole.

Other objects and advantages will be pointed out with more particularity in the specifications which follows and the points of novelty will be set forth in greater detail in the claims.

Referring to the drawings forming a part of this specification and wherein like numerals are applied to like parts throughout the several views: Figure 1 is a side elevation of my invention, one of the side cutters being shown in section. Fig. 2 is an elevation taken at right angles to the position shown in Fig. 1, with one of the side sections of the bit removed. Fig. 3 is a bottom plan view of my invention.

Figs. 4 to 9 inclusive are diagrammatical views illustrating several different formations of cross cutters and also illustrating different ways of inclining the said cutters from the central axis of the bit.

The head of my improved bit is approximately cylindrical in outline and has a reduced upper threaded shank 2 for attachment to the drill stem not shown. The threaded shank 2 is further reduced in diameter to form a threaded nipple 3 to which a lubricator, not shown, may be attached. The head of my bit is split longitudinally along a central dividing line 7. The inner faces of the longitudinal sections are recessed for a distance approximately the length of the lower half of the bit, to receive a central removable web 4.

The lower end of the bit is provided with two sets of cutters; one set of cutters 8 are mounted in an offset position between an outer supporting lug 9 and a central support 10 in the central web 4. These cutters are preferably frusto-conical in shape, as shown particularly in Fig. 3 and provided with longitudinal teeth for cutting purposes, the inner ends being beveled at 30.

On each side of the two central cross cutters 8, I have provided an inclined side cutting disk 5. These cutters are mounted upon pins integral with the side sections of the head. Each of the cutters 5 is frusto-conical in shape and provided with teeth 6 on the outer cutting periphery thereof. The pins 11 upon which said disks are mounted are threaded as shown at 12 to receive a central bearing member 13, which is frusto-conical in shape and threaded upon the shaft 11 with the smaller end toward the bearing face of the side sections. Between this bearing member and the face of the head are provided the usual non-friction washers 14. When these cutters are assembled upon the side of the head the threading of the central bearing member 13 upon the shaft 11 is accomplished by the use of a spanner wrench which is adapted to rotate the bearing member 13 by means of the countersunk recesses 15 in the outer face of the said bearings. Referring particularly to Figs. 1 and 2, it will be seen that the cross cutters 8 are

mounted upon the removable web 4 of the head. This web is recessed at 16 on opposite sides above the cross rollers, providing a housing for the side cutters.

Mounted in the central web 4 above the pilot cutters 5 and 8 are two opposite reaming cutters 17. These cutters are mounted on vertical axes 18 and are housed within recesses 19 in the sides of the web. The cutters are approximately barrel-shaped, being cylindrical along the central portion and tapered toward each end. When thus mounted, it will be noted that the side cutters are reversible and are adapted to bear at all times upon the sides of the hole with a rolling action. Should the inclined side cutters 5 be reduced in diameter through wear, thus tending to reduce the gage of the hole, the reamers 17 will serve to ream out the sides of the hole about the pilot cutters thus preserving at all times the proper diameter. The three sections of the head, including the two side sections and the central web, are retained in proper assembled position by means of a locking bolt or pin 20 which passes through an opening 21 in the head at right angles to the flat side of the web 4. The head is further retained in assembled position by the threading of the upper shank 2 into the drill stem and further by the threading of the nipple 3 into the lubricator. Flushing water is conducted from the upper end of the drill bit downwardly through channels 22 to each of the side disk cutters and from the housing thereof to the cross rollers. The channels 22 are so arranged that they will discharge the flushing water into the housing above the cutters at a point slightly to the front of the axis of the cutter as it rolls upon the bottom of the hole.

Lubrication for the bearings of the cutters is conducted downwardly from the lubricator through channels 24 in the head, said channels having branching ducts 25 leading to the bearings of the two side cutters and through ducts 26 to the cross cutters. Lateral branching ducts 27 also conduct lubrication to the bearings of the two reaming rollers 17.

By referring to Fig. 3 it will be seen that the two cross roller cutters 8 are offset from an opposite position in such manner that the forward advancing face of the cutters, as the bit is rotated in a counter clockwise direction as viewed in Fig. 3, will be set somewhat inwardly from the edge of the web in which it is mounted in such manner that it will not readily scrape the sides of the hole. The purpose of offsetting these cutters, as shown, is to obtain a slipping or scraping action due to the fact that the cutters are not diametrically arranged and also due to the fact that they do not have a true rolling motion of the cutters on the bottom of the hole. To obtain a true rolling action the sides of the same would have to be formed so that if extended, they would terminate in the central axis of the bit. This is not the case in this structure. It is desired however, that the two side cutters 5 have a true rolling motion on the bottom of the hole and for this purpose they are arranged exactly opposite each other and also have the cutting periphery formed with such an angle that, if the sides were extended, they would terminate in the axis of the bit.

In the operation of such a drill the two cross rollers 8 will serve to cut away the central portion of the hole and the fact that they are inclined will serve to cut a hole with a somewhat conical-shaped bottom, thus assisting in centering the bit in the hole and preventing any tendency of the drill to slip in a lateral direction thereby producing a crooked hole. The inclined side cutters 5 will cut away the outer portion of the bottom of the hole and will serve to maintain the gage of the hole of such diameter that the head of the bit may easily rotate therein. The opposite sides of both of the side sections of the head are somewhat flattened as shown at 28 to provide recesses or grooves in the side of the head for the purpose of providing an upward passage for the flushing water carrying away the disintegrated matter.

While I have shown in Figs. 1 to 3 a preferred manner in which the cross cutters 8 are to be placed, there are several alternative modifications which may be made without departing from the spirit of my invention and in Figs. 4 to 9, I have shown diagrammatically several of these contemplated modifications. In Figs. 4 and 5, the cross cutters 8′ are frusto-conical in shape and inclined upwardly in the same manner as those shown in Figs. 1 to 3 and instead of being staggered, are inclined slightly toward one side of the central axis of the head in the manner shown in Fig. 4 so that their axes are offset relative to the axis of the head. By thus setting the cutters, a conical-shaped bottom will be provided in the hole, and a true rolling action of the cutters 8′ will also be avoided. When inclined in the manner described the rotation of the head will allow a certain amount of slippage in the cutting parts so as to obtain a scraping, as well as a chisel action of the teeth upon the bottom of the hole in an obvious manner. Figs. 6 and 7 show a cutter 8″ shaped like a cylinder, but beveled at the inner end, instead of frusto-conical and offset from each other as shown in Fig. 6, but not inclined. In this modification no conical-shaped bottom to the hole is obtained, but by offsetting of the cutters from a diametrical position in the bottom of the head a partial scraping action

is obtained in a very efficient manner. In Figs. 8 and 9 I have illustrated how cutters such as shown in Figs. 6 and 7 may be inclined laterally from a central axis of the head but are not staggered or offset as shown in the previous modification. This position of the cutters will obtain the same effect as though offset in that it will produce the desired cutting and scraping action upon the bottom of the hole.

In assembling my improved drill the two inclined side cutters 5 will be properly secured upon the lower end of the two side sections of the head. The reaming cutters 17 will be then mounted within the recesses 19 in the sides of the web and the axis 18 will be inserted longitudinally in each of the said rollers, the pin being of proper length to come flush with the top of the web, when thus inserted. The two cutters 8 will be then placed in position and the removable pins on which they are mounted will be inserted in the sides of the web into the central supporting member 10 and secured in position by means of the set screws 29. The three parts will then be set together in registered position and secured in that position by means of the locking bolt 20.

Having thus described my invention, the objects and advantages of which will be apparent without further description what I claim as new and desire to protect by Letters Patent is:

1. In a rotary boring drill, a head comprising two side sections and a central web fitting in recesses in the lower half of said side sections, side cutters on said side sections, and cross cutters and reaming rollers mounted in said web.

2. In a rotary boring drill, a head, a central longitudinal recess in the lower part of the head, a removable web in said recess, two outer supports and a central support on said web, two offset inclined cutters mounted in said supports, means to retain said web in said recess and outer cutters to cut clearance for said outer supports.

3. In a rotary boring drill, a head comprising two side sections and shorter central section fitting removably in recesses in said side sections, two opposite side cutters mounted on pins integral with said side sections, two offset cross rollers mounted in said central section, said central section being recessed on each side to provide a housing for said side cutters.

4. In a rotary boring drill, a head comprising two side sections recessed for the lower half of their length, a central web in said recess, two cross roller cutters on said web, said cutters being so arranged as to have a combined sliding and rolling action on the bottom of the hole.

5. In a rotary boring drill, a head comprising two side sections recessed for the lower half of their length, a central web in said recess, a side cutting disk on each of the side sections and a cross roller mounted on said web comprising two offset inclined frusto-conical shaped cutters.

6. In a rotary boring drill, a head comprising two side sections recessed on their inner faces for a portion of their length, a central web in said recesses, inclined disk shaped cutters rotatable on pins integral with said side sections and a series of cross roller cutters mounted on bearings in said web.

7. In a rotary boring drill, a head comprising two side sections recessed on their inner faces, a web in said recesses, opposite disk shaped cutters on said side sections, a cross roller mounted on said web comprising two cutters each mounted on an outer support and a central support and offset laterally relative to the central axis of the bit to give a scraping action thereto.

In testimony whereof, I hereunto affix my signature this the 26th day of October, 1918.

HOWARD R. HUGHES.