H. R. HUGHES.

ROLLER DRILL.

APPLICATION FILED MAR. 11, 1909.

959,539. Patented May 31, 1910.

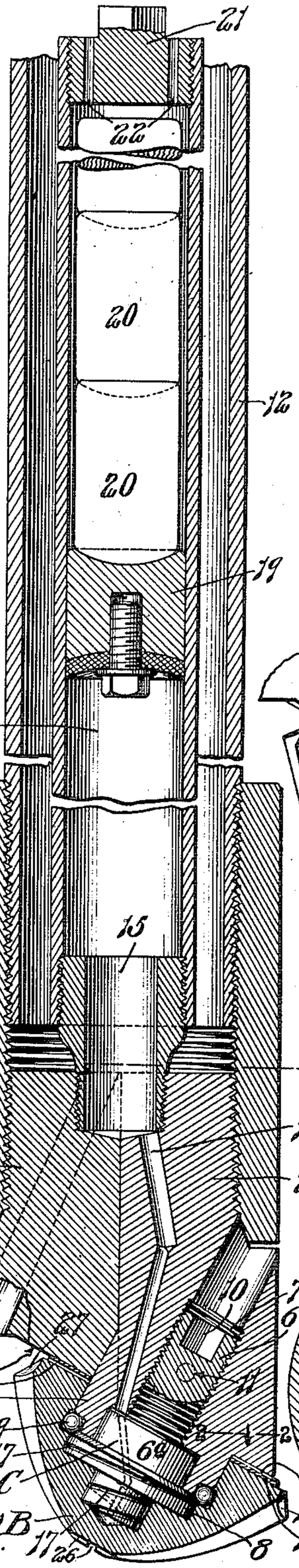

Fig. 1.

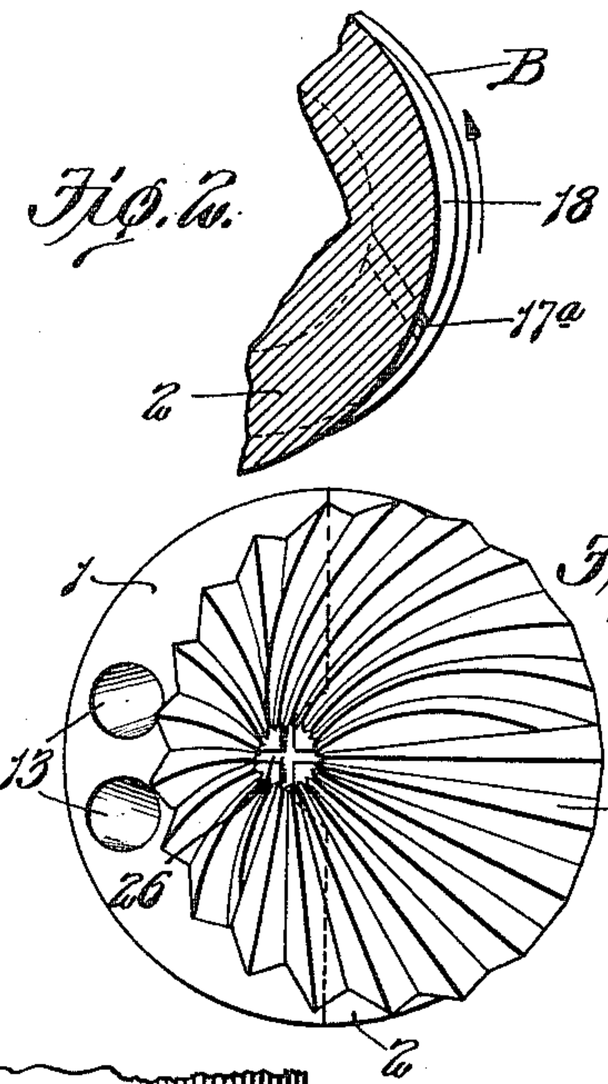

Fig. 2.

Fig. 3.

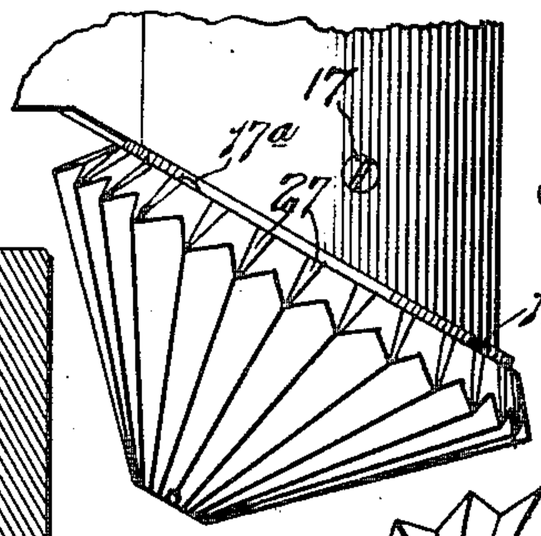

Fig. 6.

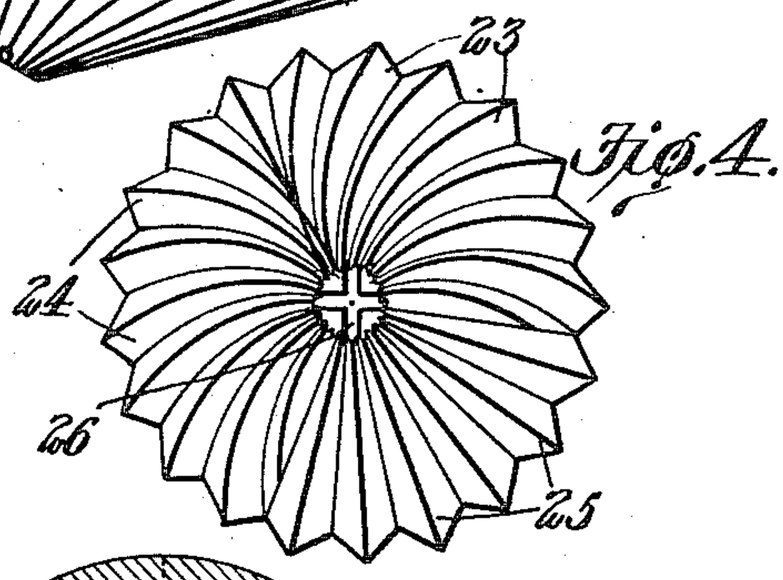

Fig. 4.

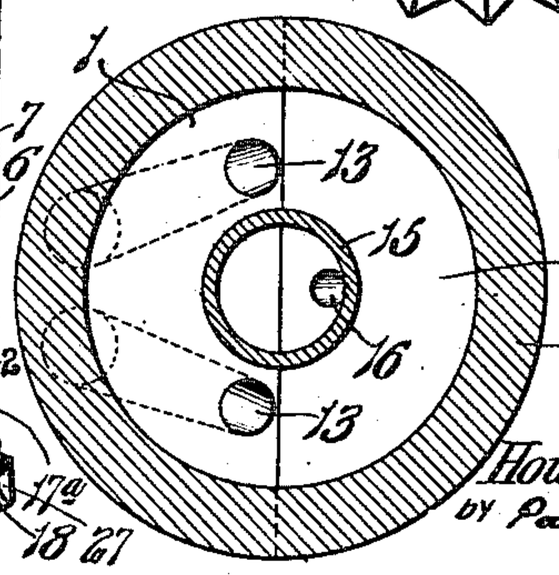

Fig. 5.

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UNITED STATES PATENT OFFICE.

HOWARD R. HUGHES, OF HOUSTON, TEXAS.

ROLLER-DRILL.

959,539. Specification of Letters Patent. Patented May 31, 1910.

Application filed March 11, 1909. Serial No. 482,655.

To all whom it may concern:

Be it known that I, HOWARD R. HUGHES, a citizen of the United States, residing at Houston, Texas, have invented a certain new and useful Improvement in Roller-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.

This invention relates to boring drills, and particularly to roller drills such as are used for boring deep holes in earth, rock and other hard substances.

One object of my present invention is to provide a roller drill that will bore deep holes of comparatively small diameter, and to this end I have designed a drill which comprises so few parts that said parts can be made large and strong enough to withstand the excessive strains to which they are subjected, and also prevent them from being crushed or broken by the weight of the long operating member to which the head of the drill is connected.

Another object is to provide a roller drill having a novel form of means for lubricating the bearings of the cutting member.

Another object is to provide a drill in which the cutting roller is retained in position in a novel manner; and still another object is to provide a cutting roller which is so formed that it will accomplish the same results as a plurality of independent cutting rollers.

Figure 1 of the drawings is a vertical sectional view of a roller drill embodying my invention; Fig. 2 is a detail horizontal sectional view taken on approximately the line 2—2 of Fig. 1 to illustrate the construction of the washer that is interposed between the head of the drill and the cutting roller; Fig. 3 is a bottom plan view of the drill; Fig. 4 is a bottom plan view of the cutting roller removed from the head; Fig. 5 is a horizontal sectional view taken on the line 5—5 of Fig. 1; and Fig. 6 is a side elevational view of a portion of the drill head provided with a cutting roller of slightly different form from that shown in Fig. 1.

Referring to Fig. 1 of the drawings which illustrates the preferred form of my invention, A designates the head of the drill which preferably consists of two members 1 and 2 that are connected together by some suitable means such, for example, as a sleeve 3, that surrounds screw-threaded extensions on the upper ends of the members 1 and 2. Some means, separate and distinct from the sleeve 3, is preferably provided for preventing the members 1 and 2 from moving laterally relatively to each other, and in the construction herein shown said means consists of a cylindrical-shaped projection 4 on the member 2 that fits in a socket on the inner face of the member 1, as shown in Fig. 1, this projection 4 forming part of the spindle of the cutting roller as hereinafter described. The head A is provided with only a single cutting roller B which is of approximately frusto-conical-shape, and said roller is mounted on the head in such a manner that the base or inner end face of the roller bears against the flat angularly disposed end face 5 of the head A, the axis of said cutting roller extending at an angle to the longitudinal center of the head, and said roller being of sufficient dimensions so that it will form a hole of greater diameter than the head of the drill. The spindle on which the cutting roller is rotatably mounted, is formed partly by the projection 4 on the drill head member 2 and partly by a device C that is connected to the member 2. This device C has a screw-threaded shank 6 that enters a screw-threaded bore 7 in the drill head member 2, and said shank is provided with an enlarged portion 6^a that enters a socket in the end of the projection 4. A flange 8 projects laterally from the shank of said device adjacent the enlarged portion 6^a of said shank so as to form a ball-retaining member, the end of the projection 4 being provided with a raceway in which a number of ball-bearings 9 are mounted.

In assembling the parts of the drill I first lock the head members 1 and 2 together and then insert the device C in the internal bore of the roller B and also place the ball-bearings in the raceway provided for them in the roller. The shank 6 of the device C is then inserted in the screw-threaded bore 7 of the drill head member 2 and screwed into same until the flange 8 on the device C bears against the end of the spindle projection 4, the end of the shank 6 being provided with a socket 10 for receiving a suitable tool or wrench that is inserted in the opposite end of the bore 7 of the head. The device C is prevented from rotating by means of a clamping screw 11, shown in Fig. 6 that engages the shank of said device, as shown in dotted lines in Fig. 1. After the parts have

been assembled in the manner above described it will be impossible for the cutting roller to drop off its spindle for the flange 8 on the device C projects laterally over the ball-bearings 9.

Although the ball-bearings 9 reduce the friction between the cutting roller and its spindle, the main function of said ball-bearings is to lock the roller on its spindle, and while I have herein shown ball-bearings as used for this purpose, I do not wish it to be understood that my broad idea is limited to such a construction, for the same result could be accomplished with roller bearings.

A construction of the character above described is very strong and is not liable to break when it is subjected to excessive strains because the spindle of the roller is large and contains a great deal of metal, and as the base or inner end face of the cutting roller bears against the end face of the head, and the shoulders on the internal bore of said roller bear against coöperating shoulders on the spindle, ample means is provided for taking up the end thrusts to which the roller is subjected.

The head A of the drill is connected to a long pipe or tubular-shaped operating member 12 that is rotated by some suitable means, not shown, so as to force the drill head downwardly into the material in which the hole is to be formed. This pipe 12 is also used to introduce water into the hole so as to flush out the disintegrated material, the water being forced through said pipe 12 by a pump or some other suitable means, not shown. In the construction herein shown, the head of the drill is provided with a plurality of water passageways 13 that lead from the interior of the pipe 12 and terminate at one side of the cutting roller, as shown in Figs. 1 and 3.

A lubricant holder 14, which preferably consists of a long tube, projects upwardly into the hollow operating member 12, and the lower end of said tube is connected to the head of the drill by means of a nipple 15 so as to enable the lubricant in said holder to enter a distributing duct 16 in the drill head which communicates with grooves 17 formed either on the periphery of the roller spindle or on the internal bore of said roller. The grooves 17 preferably extend spirally around the spindle so as to distribute the lubricating medium to all of the surfaces on which the roller bears, and said grooves communicate with grooves 17^a that are formed in a washer 18 which is interposed between the end face of the head and the base of the roller B. A plunger 19 is arranged in the tube 14 above the mass of lubricant, and said plunger is subjected to pressure which causes the lubricating medium to be forced continually through the distributing ducts and grooves until it finally escapes through the grooves 17^a in the washer 18. The plunger 19 can either be actuated entirely by the force of the water in the hollow operating member 12, or one or more weights 20 can be arranged in the tube 14 above said plunger so that the vibratory motion of the drill head will cause said weights to tamp the lubricating medium and thus positively force it through the distributing ducts and grooves. In the preferred form of my invention, as herein shown, the plunger 19 is subjected to the action of some propelling force, such as the weights 20, and is also subjected to the pressure of the water in the hollow operating member 12, the upper end of the tube 14 being closed by a removable plug 21 having slots or openings 22 that permit the water to enter said tube and thus exert downward pressure on the weights and plunger. It will, of course, be understood that the pressure of the water in the operating member 12 is greater than the pressure of the water after it has escaped from the drill into the hole being formed, owing to the fact that the passageways 13 through which the water escapes are smaller than the diameter of the operating member. Consequently, there will be no tendency for the lubricant to back up or fail to flow through the distributing ducts and grooves for the mass of lubricant in the holder is always under a greater pressure than that of the water which flushes the disintegrated material out of the hole. When the drill is in operation the lubricating medium will be supplied continually and automatically to the surfaces of the head on which the roller bears, and as the lubricant holder extends up into the hollow pipe 12 said holder can be made long enough to hold a sufficient quantity of lubricant to enable the drill to continue in operation for an extended period. The vibratory motion of the head tends to cause the weights to hammer the lubricating medium, and the water that is forced through the hollow operating member also tends to cause said weights to hammer or tamp down the lubricant, owing to the fact that the piston of the pump imparts quick impulses to the water in the operating member.

The cutting roller B herein shown is provided with a plurality of separate cutting surfaces which are so disposed that they will cross-cut and finally disintegrate the material in the bottom of the hole. Said roller is provided with one set of chisel teeth 23 that extend spirally in one direction, and with an independent set of chisel teeth 24 that extend spirally in the opposite direction so that they will form cross-cuts in the grooves which the teeth 23 form in the bottom of the hole. The third set of chisel teeth 25 are straight or are so disposed that

they will not enter the grooves which the two sets of teeth 23 and 24 form in the material, this third set of teeth cross-cutting the material or disintegrating the particles of material that the other sets of teeth have left standing. The roller B is of such dimensions that the apex thereof will extend past the longitudinal center of the head so that a core will not be left in the bottom of the hole. In other words, the cutting face of the roller B extends from the side of the hole to a point beyond the center of the hole instead of extending only from the side of the hole to the center or to a point at one side of the center. I also prefer to make the roller slightly convexed, as shown in Fig. 1, instead of in the form of a true cone or frustum of a cone so that the bottom of the hole being formed will be concave and thus cause the roller to have an even bearing surface on the material in which the hole is being formed. The roller would be just as efficient, however, if it were made perfectly frusto-conical-shaped, as shown in Fig. 6, so that I do not wish it to be understood that my invention is limited to the exact construction shown in Fig. 1. The lower end face of the roller is provided with a number of grooves or recesses 26, as shown in Fig. 4, so as to produce cutting edges which disintegrate or cut down the material, and said roller is also provided at its outer edge with cutting teeth 27 that shear off the material from the side of the hole, thus producing a hole of greater diameter than the head of the drill so that the water and disintegrated material can pass upwardly around the head.

The main advantage of a drill of the construction above described is that it can be used for drilling deep holes of comparatively small diameters, such, for example, as a four-inch hole of several thousand feet in depth. This is due to the fact that the drill comprises only a few parts which are large and strong enough to prevent them from being crushed or broken by the excessive weight of the long hollow operating member 12 or the strains to which the roller is subjected when it comes in contact with very hard and flinty substances. Only one cutting roller is used but as the teeth of said roller are so arranged that they form cross-cuts in the material the same results will be accomplished as if several rollers were mounted on the head. The means for automatically lubricating the bearings of the roller and forcing the lubricating medium through the distributing ducts and grooves continually, also contributes greatly to the efficiency of the drill for if the lubricant was not forced continually over the surfaces of the head against which the roller bears, the friction and weight of the head on the roller would soon cause the oil to lose its cohesiveness. In other words, if the lubricating medium was not forced continually over the contacting faces of the head and roller the excessive weight or downward pressure that the head exerted on the lubricant would soon separate the molecules thereof and thus cause the lubricant to lose its viscosity. By providing an outlet for the lubricant in the manner above described I prevent this from occurring and I also prevent the lubricant from gumming up. Although the outer ends of the distributing grooves are open, grit cannot work into same for the centrifugal force throws the lubricant outwardly, the spirally arranged grooves acting in practically the same manner as a centrifugal pump and thus causing the lubricating medium to flow through same continually.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A boring drill comprising a head, a spindle on said head arranged at an angle to the longitudinal axis of the head, and a single roller of approximately frusto-conical shape mounted on said spindle and covering the end of same, said roller projecting slightly beyond the side face of the head so that it will form a hole of greater diameter than the head when the head is rotated.

2. A boring drill comprising a head provided with an angularly disposed bearing surface, an inclined spindle projecting from said surface, and an approximately frusto-conical-shaped roller on said spindle that covers the end thereof and bears against said angularly disposed surface, said roller being of such size that it will form a hole of greater diameter than the head of the drill.

3. A boring drill comprising a head provided with an angularly disposed end face, an inclined spindle projecting from said end face, and an approximately frusto-conical-shaped cutting roller on said spindle that covers the end thereof and bears upon the angularly disposed end face of said head, the peripheral edge of said roller terminating adjacent the periphery of the drill head and the apex or lower end of said roller terminating beyond the longitudinal center of the head.

4. A boring drill provided with a head having an angularly-disposed end face, a spindle projecting from said face, and an approximately frusto-conical-shaped cutting roller rotatably mounted on said spindle and covering the end of same, said roller having a cutting surface which is of great enough dimensions to form a hole of greater diameter than the head of the drill.

5. A boring drill provided with a head that is composed of a plurality of parts or members one of which is provided with a

socket, means for holding said members together, a spindle projection on one of said members that lies in the socket in the other member, and a cutting roller rotatably mounted on said spindle projection.

6. A boring drill provided with a head which comprises a plurality of parts, one of said parts having a spindle projection that engages the other part of the head to prevent relative lateral movement, and a cutting roller rotatably mounted on said spindle projection.

7. In a drill, a head comprising a plurality of parts or members having angularly disposed end faces, a spindle projection on one of said members that engages the other member of the head to prevent relative lateral movement, and an approximately frusto-conical-shaped cutting roller rotatably mounted on said spindle and bearing against the angularly disposed end faces of said members.

8. A drill provided with a head having an angularly disposed end face, a single cutting roller of approximately frusto-conical-shape arranged with its base bearing against the angularly disposed end face of the head and provided with a cutting surface that forms a hole of greater diameter than said head, and a cutting surface on said roller that shears off the material from the side of said hole.

9. In a boring drill, a head provided with a spindle consisting of a plurality of parts that are detachably connected together, a cutting roller rotatably mounted on said spindle, and friction bearings arranged between the coöperating parts of said spindle and engaging a shoulder on said roller for retaining it in operative position.

10. In a drill, a head provided with a spindle projection, a removable device that forms an extension of said projection, a cutting roller rotatably mounted on said parts, and means interposed between said removable device and spindle projection and engaging a shoulder on the roller for retaining said roller in operative position.

11. In a drill, a head provided with a spindle projection, a cutting roller rotatably mounted in said projection, coöoperating grooves formed in said projection and on the internal bore of the roller for forming a raceway, friction bearings arranged in said raceway, and a removable device connected to the head for holding said bearings in their raceway and also retaining the roller in operative position.

12. In a drill, a head provided with a spindle projection, a cutting roller rotatably mounted on said projection, said projection and roller being provided with a raceway, friction bearings arranged in the raceway formed in said projection and roller, and a removable spindle member projecting into the roller and having a flange that holds said friction bearings in their raceway and thus retains the cutting roller in position.

13. A boring drill having a head, a stationary spindle projecting from said head, a cutting roller rotatably mounted on said spindle and covering the end of said spindle, and friction bearings arranged in a raceway formed in said spindle and in the internal bore of said roller.

14. In a drill, a head provided with a spindle extension having an internal bore, a device having a shank that is screwed into said bore, a flange on said device that coöperates with said spindle extension to form a raceway, a cutting roller surrounding said device and spindle extension, and friction bearings interposed between the flange on said device and said spindle extension and engaging said roller for retaining it in position.

15. A drill comprising a head which consists of a plurality of parts, a spindle projection on one of said parts arranged at an angle to the longitudinal center of the head, an open-ended bore in said part that extends through the center of said spindle projection, a spindle extension having a shank that is screwed into said bore, a flange on said spindle extension that coöperates with the end of the spindle projection to form a raceway, an approximately frusto-conical-shaped cutting roller rotatably mounted on said spindle, and ball-bearings mounted in said raceway and engaging a shoulder on said roller for retaining it in operative position.

16. A boring drill comprising a head, a single cutting roller of approximately frusto-conical-shape rotatably mounted on said head and being of such dimensions that it forms a hole of greater diameter than the head, said roller operating on the material which forms the bottom of the hole, a tubular-shaped operating member to which the head is connected, said member being adapted to serve as a water conduit, and water passageways in the head that permit the water to escape from said operating member into the hole which the roller forms and thus flush out the disintegrated material.

17. A boring drill comprising a head, and an approximately frusto-conical-shaped cutting roller on said head that forms a round hole when the head is rotated, said roller being provided with a plurality of independent cutting surfaces which consist of sets of chisel teeth that extend longitudinally of the axis of the roller, the teeth of one set being arranged at an angle to the teeth of the other sets.

18. A cutting roller for boring drills, the body of said roller being approximately conical-shaped and the outer surface of said roller consisting of independent sets of chisel teeth that extend in a direction sub-

stantially longitudinally of the axis of the roller, one set of teeth being straight and the adjacent set being inclined relatively thereto.

19. A cutting roller for boring drills provided with an approximately conical-shaped exterior that is composed of a set of straight chisel teeth and sets of spiral chisel teeth arranged adjacent thereto, all of said teeth extending in a direction substantially longitudinal of the axis of the roller.

20. A cutting roller for boring drills, said roller being substantially frusto-conical-shaped and provided on its exterior with independent sets of spirally arranged chisel teeth that extend longitudinally of the axis of the roller, the teeth of one set being inclined oppositely to the teeth of the other set.

21. A cutting roller for boring drills having an approximately conical-shaped body that is provided with a spindle socket which extends through only a portion of said body, a set of straight chisel teeth on the exterior of said body, and two sets of oppositely inclined spiral teeth on either side of said straight chisel teeth.

22. An approximately frusto-conical-shaped cutting roller for boring drills provided with a plurality of straight chisel teeth and a plurality of spirally arranged chisel teeth, the peripheral edge of said roller being provided with teeth that shear off the material from the sides of the hole which the roller forms.

23. A boring drill comprising a head provided with a cutting roller, a tubular-shaped operating member connected to said head for introducing water into the hole which the roller forms, a lubricant holder arranged adjacent the head, means for conducting the lubricating medium to the bearing surfaces of said roller, and a weight arranged in said lubricant holder for exerting pressure on the lubricant so as to force it onto said bearing surfaces, the vibration of the drill head causing the weight to exert a tamping action on the lubricant.

24. A boring drill comprising a head provided with a rotatable cutting roller, a tubular-shaped operating member connected to said head for introducing water into the hole that the roller forms in the material, a lubricant holder arranged inside of said operating member and provided with a weight that exerts pressure on the lubricating medium, and means for conducting said lubricating medium to the surfaces of the head on which said roller bears, the pressure of the water in the operating member being exerted on the weight in said lubricant holder and thus causing the lubricating medium to be supplied continually to the bearing surfaces for the roller.

25. A boring drill provided with a head having a cutting roller mounted thereon, a tubular-shaped operating member connected to said head for introducing water into the hole which the roller forms, a lubricant holder arranged inside of said operating member and connected to the head for containing a lubricating medium, a plunger in said holder, weights arranged inside of the holder and acting on said plunger, a plug in the upper end of said holder provided with perforations that permit the water on the operating member to exert pressure on said weights and plunger, and means for permitting the lubricating medium in said holder to lubricate the surfaces on which the roller bears.

26. A boring drill provided with a head, a spindle on said head, an approximately frusto-conical-shaped roller mounted on said spindle and having its base arranged parallel to a flat angularly disposed surface on the head, a washer interposed between said head and roller and provided with grooves that communicate with grooves on the exterior of said spindle, a hollow operating member connected to said head for introducing water into the hole which the roller forms, and a lubricant-holder carried by the head and projecting upwardly into said operating member, said head having a duct which leads from said lubricant-holder to the grooves on said spindle so that the water in said operating member which exerts pressure on the lubricating medium in said holder will force said lubricating medium continually through the distributing ducts in said head and the grooves in said washer.

27. In a boring drill, a head, a stationary spindle on said head, a roller loosely mounted on said spindle and covering the end thereof so that it will form a round hole of greater diameter than said head, and friction rollers interposed between the roller and the end of the spindle.

28. A drill comprising a head, an approximately frusto-conical-shaped roller mounten on said head, a washer interposed between said head and the base end of said roller, grooves in said washer, and means for causing a lubricating substance to travel through said grooves so as to lubricate the surfaces of the head and roller between which the washer is arranged.

29. A drill comprising a head, a spindle on said head, an approximately frusto-conical-shaped roller mounted on said spindle, a washer interposed between the head and the base end of said roller, and a lubricant-holder on said head, said head spindle and washer being provided with grooves for permitting the lubricant to flow over the surfaces on the head with which the roller contacts.

30. A boring drill comprising a head provided with a rotatable cutting device, a tubular-shaped operating member connected

to said head for introducing water into the hole being formed, a lubricant-holder arranged inside of said tubular-shaped member for containing a lubricating medium for said cutting device, and means for permitting the water in said member to exert pressure on the lubricating medium in said holder.

31. A boring drill comprising a head provided with a rotatable cutting device, a tubular-shaped operating member connected to said head for introducing water into the hole being formed, a lubricant-holder arranged inside of said tubular-shaped member for containing a lubricating medium for said cutting device, and a closure for said holder provided with an opening which permits the water in said tubular-shaped member to exert pressure on the lubricating medium in said holder.

In testimony whereof I hereunto affix my signature in the presence of two witnesses, this 10th day of March 1909.

HOWARD R. HUGHES.

Witnesses:
WELLS L. CHURCH,
E. C. OWEN.