H. R. HUGHES.

ROLLER DRILL.

APPLICATION FILED MAR. 27, 1909.

959,540.

Patented May 31, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

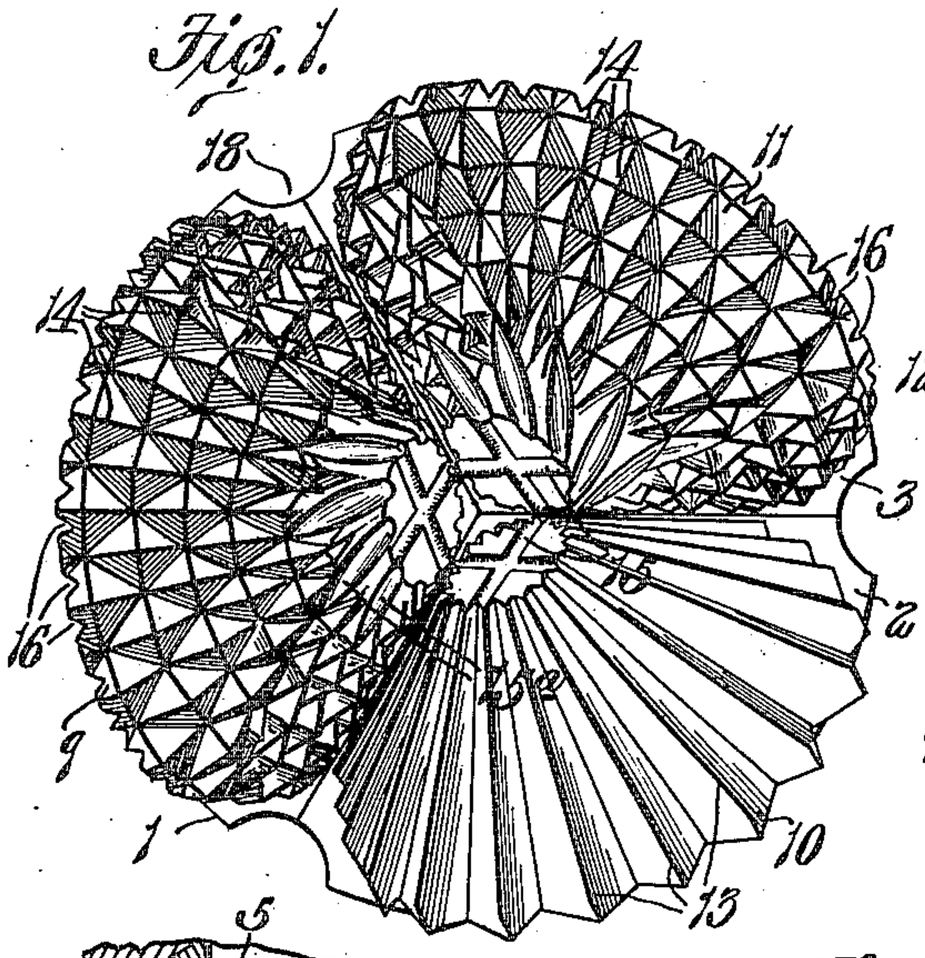
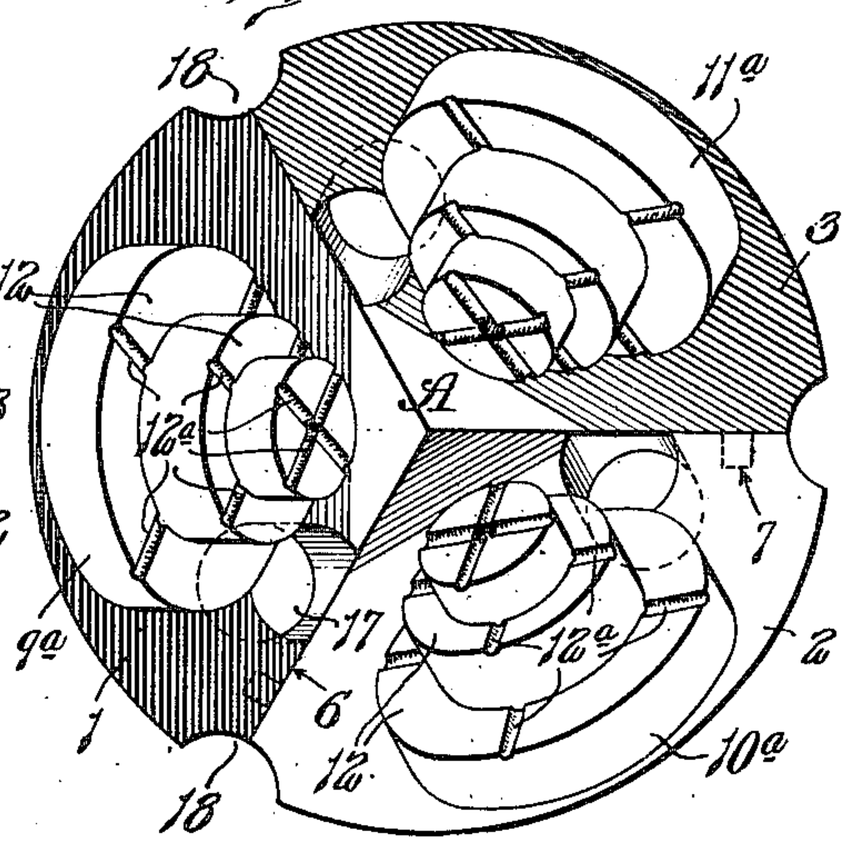


Fig. 3.



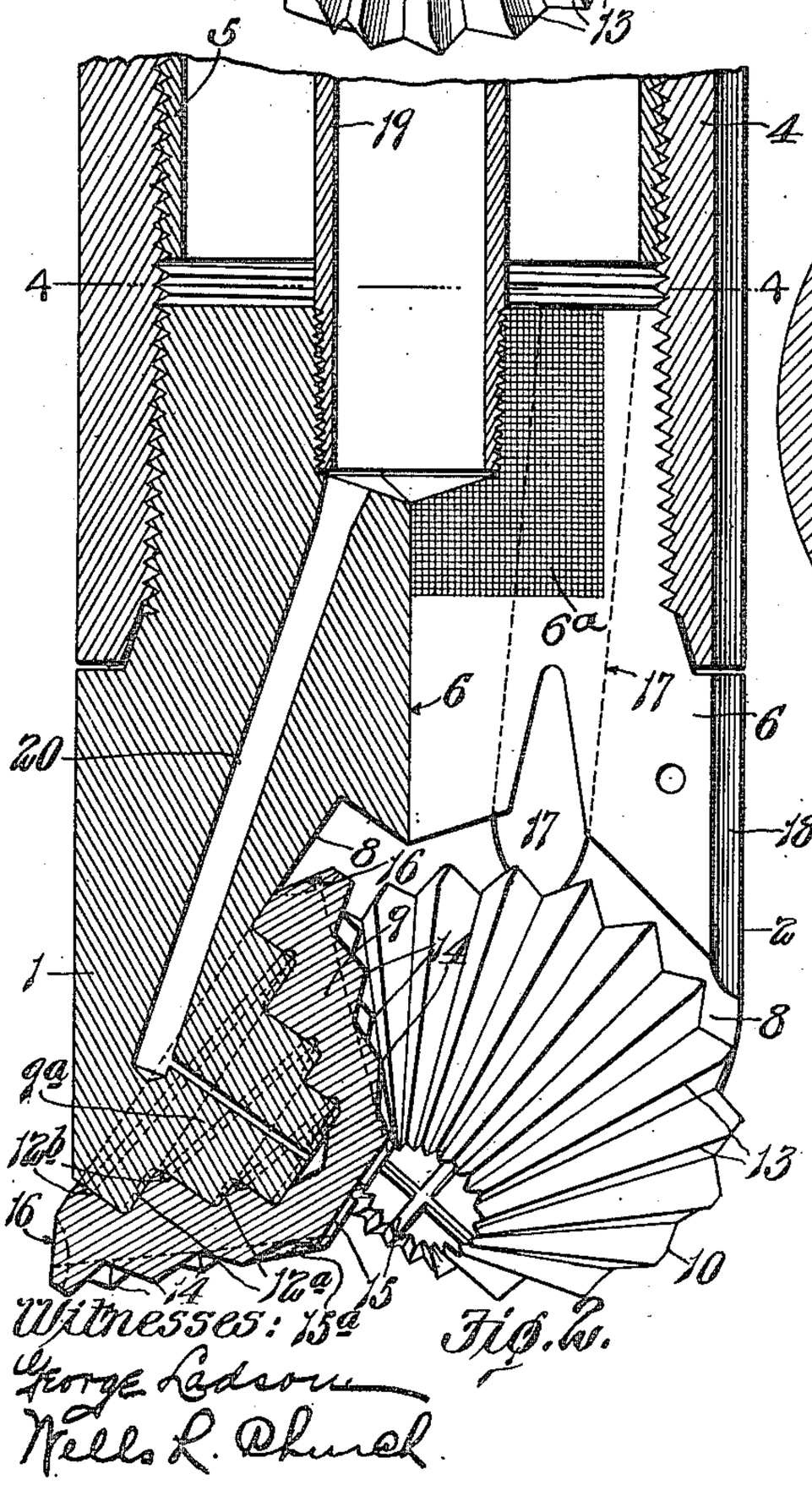


Fig. 2.

Fig. 4.

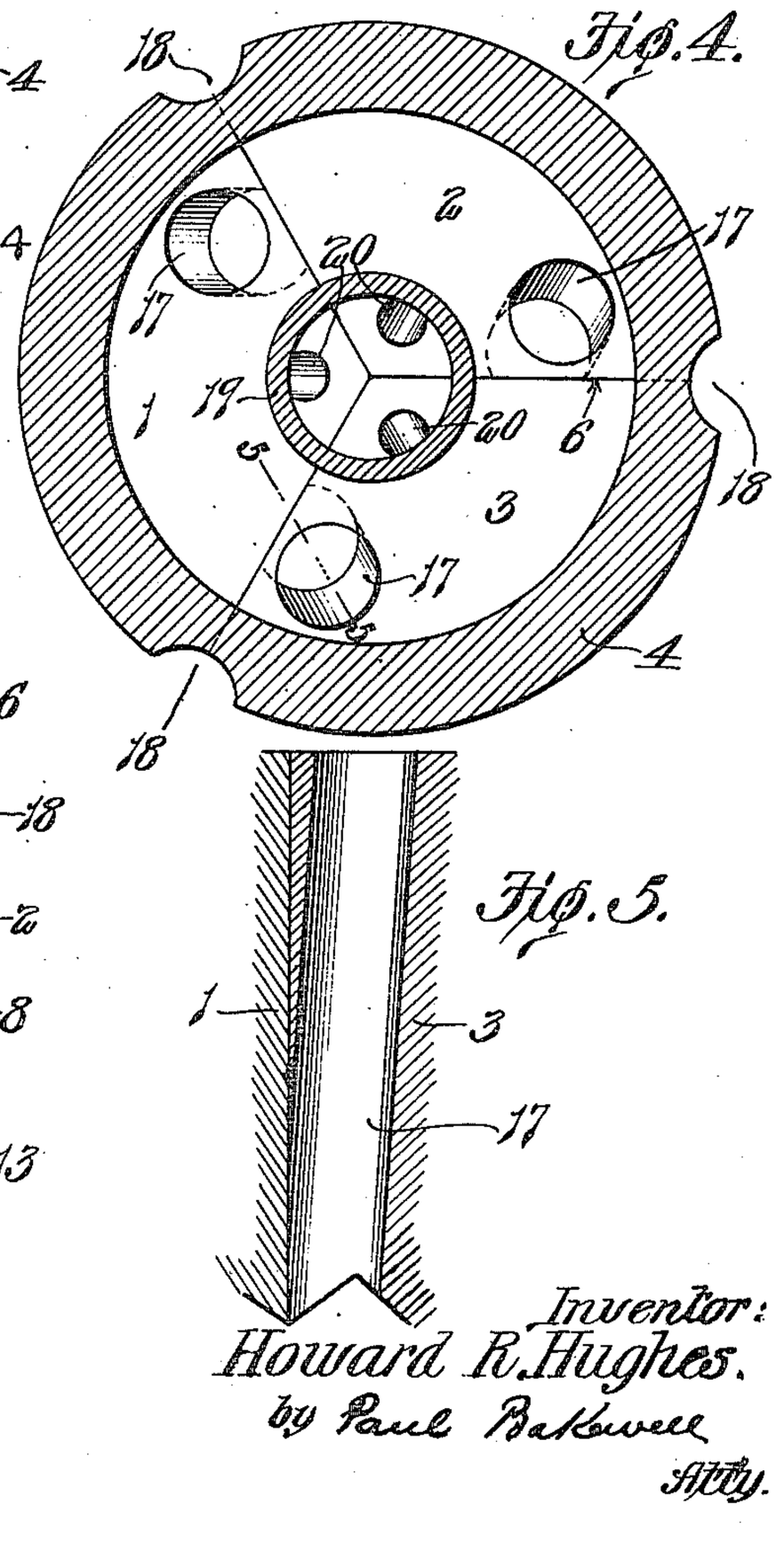


Fig. 5.

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2 SHEETS—SHEET 2.

Fig. 6.

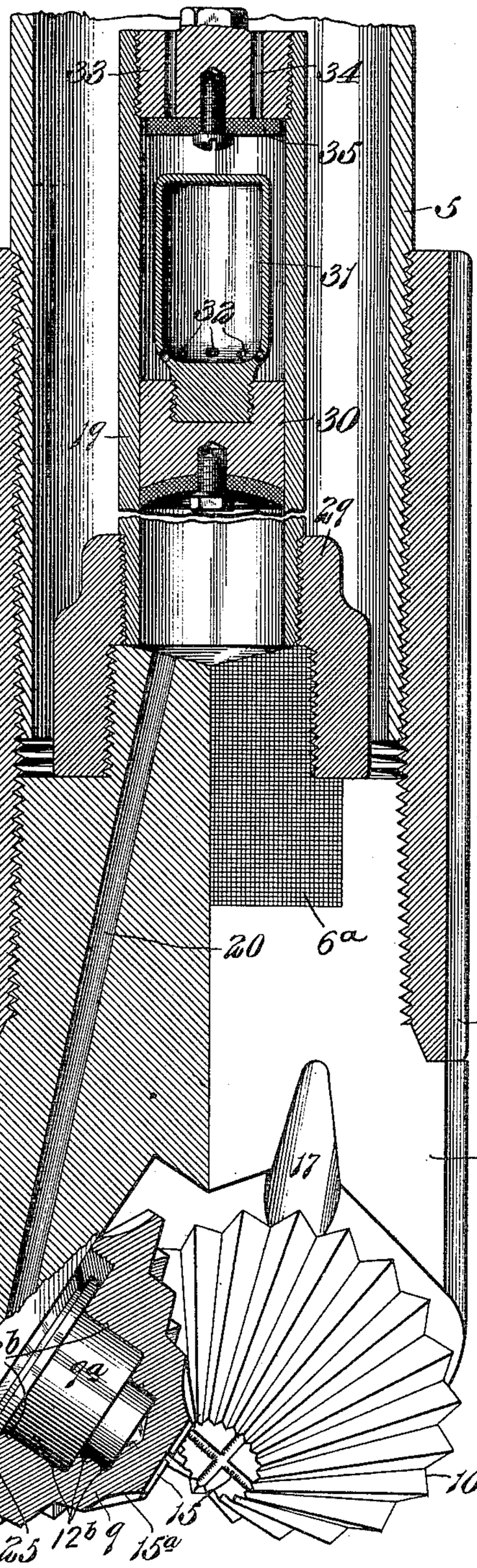


Fig. 1.

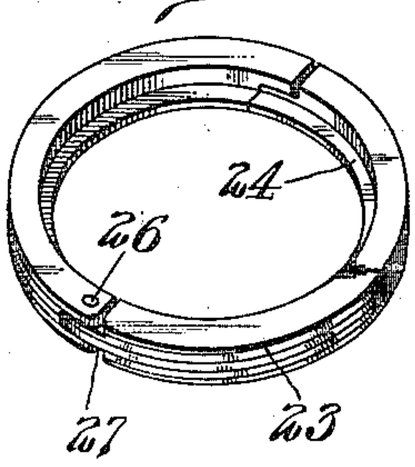


Fig. 8.

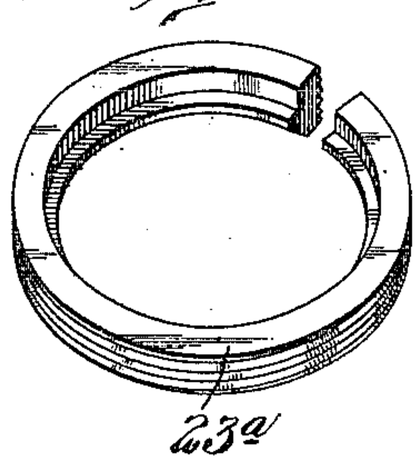
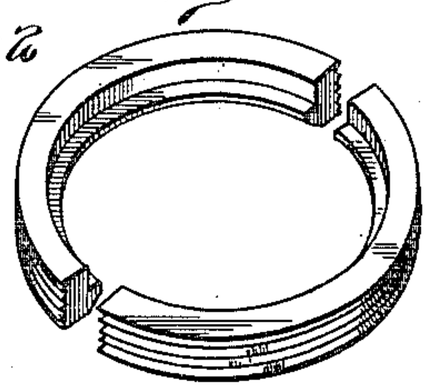


Fig. 9.



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UNITED STATES PATENT OFFICE.

HOWARD R. HUGHES, OF HOUSTON, TEXAS.

ROLLER-DRILL.

959,540. Specification of Letters Patent. Patented May 31, 1910.

Application filed March 27, 1909. Serial No. 486,166.

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; namely, drills of that type in which the head is provided with rollers that disintegrate the material on which the drill operates when the head is rotated.

One object of my present invention is to provide a drill of novel construction which comprises few parts that are large and strong enough to withstand the weight and strains to which they are subjected.

Another object is to provide a roller drill in which the cutting rollers are of novel construction.

Another object is to provide a novel form of device for lubricating the rollers. And still another object is to provide a novel means for retaining the rollers in position.

Figure 1 of the drawings is a bottom plan view of a drill constructed in accordance with my invention; Fig. 2 is a vertical sectional view of said drill; Fig. 3 is an end view of the head of the drill with the rollers removed; Fig. 4 is a horizontal sectional view taken on approximately the line 4—4 of Fig 2; Fig. 5 is a vertical sectional view taken on approximately the line 5—5 of Fig. 4; Fig. 6 is a vertical sectional view of a slightly modified form of my invention; Fig. 7 is a perspective view of one form of device that can be used for retaining the rollers on their spindles; and Figs. 8 and 9 are perspective views of other forms of devices that can be used for retaining the rollers on their spindles.

The drill herein shown embodies some of the features claimed in my pending application Serial No. 463,643, filed November 20, 1908, but the specific construction of the drill herein shown is different from that described in the application above referred to.

Referring to the drawings which illustrate the preferred form of my present invention, A designates the head of the drill which is composed of three members, 1, 2 and 3, that are clamped together, preferably by an internally screw-threaded sleeve 4 that surrounds extensions on said members, as shown in Fig. 2, said sleeve being provided with internal screw-threads that coöperate with screw-threads on the lower end of a long pipe or tubular-shaped operating member 5 through which water is introduced to flush out the disintegrated material as the drill advances into the material in which the hole is being formed. The members 1, 2 and 3 are provided with coöperating vertically disposed faces 6 that contact with each other when said members are assembled, as shown in Figs. 2 and 3, and, if desired, said members can be provided with coöperating dowel-pins 7 and recesses for preventing one member from moving relatively to the other. Any other suitable means than dowel-pins, however, could be employed for this purpose so that I do not wish it to be understood that my invention is limited to the exact construction herein shown. I also prefer to mill portions 6^a of the coöperating faces 6 of the drill head members so as to secure a tight fit between said parts. Each member of the head is provided with an angularly disposed face 8 that inclines outwardly and downwardly from the longitudinal center of the head toward the lower edge of the head, thus forming a tapered pocket of approximately triangular shape in cross section in the lower end of the head. Three approximately conical-shaped rollers 9, 10 and 11, are arranged in this pocket, and each of said rollers is mounted on a downwardly inclined spindle that projects inwardly toward the longitudinal center of the head, as shown in Fig. 2. The spindle 9^a for the roller 9, is carried by the part 1 of the head, the spindle 10^a for the roller 10 is carried by the part 2 of the head, and the spindle 11^a for the roller 11 is carried by the part 3 of the head. These spindles are preferably integrally connected to the parts or members of the head which carry them, and only the inner ends of the spindles are connected to the head, the rollers being provided with internal bores or sockets into which the spindles project so that each roller can bear directly upon the end face of its supporting spindle and thus cause said spindle to take up some of the end thrusts to which the roller is subjected. The bases or inner end faces of the rollers bear against the inclined faces 8 on the head so that a

substantial bearing is provided for each roller to take up the end thrusts on same.

As shown in Fig. 3, each spindle has a comparatively large base portion, an adjacent portion of less diameter, and an end portion of still less diameter, thus forming a number of shoulders 12 that coöperate with shoulders on the internal bore of the roller mounted thereon so as to provide an extended end thrust bearing surface for the roller. Spindles of this construction not only take up end thrusts to which the rollers are subjected, but they also contain enough metal to prevent them from being broken or bent by the excessive strains on the rollers and also by the great weight which the long pipe or operating member 5 imposes on the head of the drill. After the rollers have been mounted on their spindles and the parts of the drill head have been assembled and clamped together, it will be impossible for any of the rollers to drop off their spindles because said rollers occupy practically all of the space in the triangular-shaped pocket in the end of the drill head.

The rollers may be provided with cutting surfaces of any preferred design but I prefer to provide the roller 10 with a plurality of approximately straight chisel teeth 13, and the rollers 9 and 11 with pyramidal-shaped projections 14 that cut and disintegrate the material with which they come in contact. These projections are preferably arranged in rows that extend spirally from the apex of the roller to its outer edge, said projections being produced by forming intersecting spiral grooves in the surface of the roller. The end faces of the rollers are provided with cross grooves 15, as shown in Figs. 1 and 2, whose edges form cutting surfaces that shear off the material in the bottom of the hole and thus leave an approximately cone-shaped core at the center of the bottom of the hole. The peripheral edges of the rollers are also preferably provided with teeth 16 that shear off the material from the sides of the hole and thus provide a clearance for the head of the drill. I also prefer to form inclined or substantially spirally arranged cutting grooves 15^a in the rollers 9 and 11 adjacent the end faces thereof, the edges of said grooves having a shearing action on the material in the bottom of the hole.

The water that is forced down through the pipe 5 or hollow operating member escapes therefrom through ducts 17 formed in the head, said ducts being so arranged that the water is introduced between the rollers, as shown in Figs. 2 and 3. If desired, grooves 18 can be formed in the outer surface of the sleeve 4 and the drill head members so as to provide additional space for the water and disintegrated material to pass upwardly between the sides of the hole and the drill head. A lubricant-holder 19, similar to that described in my pending application above referred to, is connected to the head of the drill, and said head is provided with ducts 20 that lead from the lower end of said lubricant-holder to the outer ends of the spindles on which the rollers are mounted, grooves being formed in the internal bores of the rollers and on the outer faces of said spindles so that the lubricating medium will be distributed to the surfaces of the head on which the rollers bear. These distributing grooves can be formed in various ways but I prefer to provide the end-thrust-resisting surfaces 12 of the spindles with grooves 12^a that coöperate with spirally arranged grooves 12^b on the internal bores of the rollers, as shown in Fig. 2.

A boring drill of the construction above described comprises few parts so that the drill can be made small enough to drill deep holes of small dimensions, all the various parts of the drill being large and strong enough to withstand the strains to which they are subjected. The three rollers are so disposed that the weight of the head and the long tubular-shaped operating member are distributed equally on said rollers, and the cutting rollers are so formed that they will cross-cut or finely disintegrate the material with which they come in contact.

The drill shown in Fig. 6 is of the same general design as that shown in Fig. 2 except that devices are employed for connecting the rollers to their supporting spindles. The drill shown in Fig. 6 is also provided with a lubricator of novel construction which will be hereinafter described.

Briefly described, the means for connecting each of the rollers to its spindle consists of a flange on the roller that engages a collar on the spindle or projects into a circular groove on the spindle so as to prevent the roller from dropping off the spindle. In the form of my invention illustrated in Fig. 6, the rollers are provided adjacent their base ends with rings 23 having inwardly projecting flanges 24 that coöperate with collars 25 on the spindles, said collars being produced by forming circular grooves in the spindles to receive the flanges 24. One of the rings 23 is shown in detail in Fig. 7, and by referring to said figure it will be seen that the ring is composed of two sections or parts that are pivotally connected together by a pin 26, one section having a lug or ear 27 that projects into the bifurcated end of the other section. I also prefer to form the free ends of the ring sections so that they overlap or interlock with each other. The ring 23 fits in a socket in the inner end face or base end of the roller and said socket is provided with internal screw-threads that coöperate with external screw-

threads on the periphery of the ring to retain said ring in position.

In assembling the parts of the drill, I first place the ring on the spindle so that the flange 24 on the ring projects into the groove provided for it in the spindle. I then insert a pin or sharp pointed tool, not shown, in a notch or hole 28 in the ring so as to hold said ring from turning, and then screw the roller onto the ring, thus securely locking the roller in position. It is not absolutely necessary that the ring 23 should be hinged or formed in two separate parts for, if desired, the ring 23^a could be merely split, as shown in Fig. 8, so that it could be sprung over the spindle. It could also be formed in two separate parts that are not connected together, as shown in Fig. 9.

The lubricant-holder 19 of the drill shown in Fig. 6 is screwed into a collar 29 that surrounds screw-threaded extensions on the upper ends of the drill-head members, and the plunger 30, which is mounted in said holder for forcing the lubricating medium through the distributing ducts and grooves, has a hollow member 31 connected to the upper side thereof to form an air chamber, said member being provided with ports 32 adjacent the lower end thereof. A plug 33 is screwed into the upper end of the lubricant-holder, and said plug is provided with a plurality of perforations 34 that permit the water which is forced through the hollow operating member to enter the lubricant-holder and thus exert pressure on the plunger 30. A valve 35, of leather or some other suitable flexible material, is connected to the under side of the plug 33 so as to prevent the water which enters the lubricant-holder from escaping through the holes 34 in the plug. In operation, the water, that is forced through the pipe 5 to flush out the disintegrated material in the hole, enters the lubricant-holder through the holes 34 and exerts pressure on the plunger 30, thereby causing said plunger to force the lubricating medium to the bearings of the rollers. The quick and sudden impulses of the pump that forces the water through the pipe 5 causes small charges of water to be forced into the lubricant-holder intermittently, said water entering the hollow member 31 through the ports 32 and thus compressing the air in said member.

From the foregoing it will be seen that with a construction of this character the water in the upper portion of the lubricant-holder is constantly subjected to the pressure of the compressed air in the air chamber 31 so that the plunger 30 is always subjected to a downward pressure even when the pump is not operating.

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 having a tapered triangular-shaped pocket formed in the lower end thereof, three frusto-conical-shaped rollers arranged in said pocket with their bases or inner ends bearing against the side walls of said pocket, and supporting spindles for said rollers which terminate inside of the rollers.

2. A boring drill comprising a head provided at its lower end with three bearing surfaces which are arranged at an angle to each other and also at an angle to the longitudinal axis of the head, three approximately frusto-conical-shaped rollers arranged with their bases or inner ends in engagement with the angularly disposed bearing surfaces of the head, and spindles which project into said rollers but do not pass clear through the rollers.

3. A boring drill comprising a head composed of three members, an inclined spindle carried by each of said members and projecting toward the longitudinal axis of the head, and an approximately frusto-conical-shaped roller mounted on each of said spindles and bearing against the member that carries the spindle, said rollers being so formed that they cover the ends of said spindles.

4. A boring drill comprising a head composed of three members, means for holding said members together, said members having inclined faces that form a triangular-shaped pocket in the end of the head, and three approximately frusto-conical-shaped rollers arranged in said tapered triangular-shaped pocket and bearing against the members which form the head.

5. A drill comprising a head composed of three members each of which has a flat face that is disposed at an angle to the longitudinal center of the head, means for clamping said members together, a spindle projecting inwardly from each of said flat faces toward the longitudinal center of the head, and an approximately frusto-conical-shaped cutting roller mounted on each of said spindles and covering the end thereof.

6. A boring drill comprising a head, and a plurality of approximately frusto-conical-shaped rollers journaled on said head and arranged with their axes inclined relatively to the longitudinal center of the head, one of said rollers having straight chisel teeth that extend longitudinally of its axis and the other rollers having spirally arranged rows of pyramidal-shaped projections that extend in a direction longitudinally of their axes.

7. A boring drill provided with an approximately frusto-conical-shaped roller having rows of pyramidal-shaped projections that extend spirally in a direction longitudinally of its axis.

8. A boring drill provided with an approximately frusto-conical-shaped cutting

roller, the surface of said roller having oppositely inclined spiral grooves formed therein which intersect each other and thus produce approximately pyramidal-shaped projections.

9. A boring drill provided with an approximately frusto-conical-shaped roller, pyramidal-shaped projections on said roller, and inclined grooves arranged adjacent the apex of the roller and forming cutting edges which have a shearing action on the material with which the roller comes in contact.

10. A boring drill provided with an approximately frusto-conical-shaped roller, cutting edges on the end face of said roller, and pyramidal-shaped projections and inclined grooves on the side faces of said roller.

11. A boring drill comprising a head, and an approximately frusto-conical-shaped roller arranged with its base or inner end bearing against the inclined face on said head, said roller being provided with pyramidal-shaped projections that disintegrate the material on the bottom of the hole being formed and also means for shearing off the material from the sides of said hole.

12. A boring drill comprising a head having a tapered pocket formed in the lower end thereof, and three approximately frusto-conical-shaped rollers arranged in said pocket and provided with cutting surfaces that remove the material from the sides of the hole being formed, two of said rollers having spirally arranged rows of projections and the other roller having straight chisel teeth.

13. A boring drill comprising a head composed of a plurality of members and means for clamping said members together, said head being provided in its end face with a tapered pocket, a tubular-shaped operating member to which said head is connected, said tubular-shaped member serving as a conduit for introducing water into the hole being formed, a duct formed in each of the members that constitute the head for permitting the water to escape from said tubular-shaped member, three approximately frusto-conical-shaped cutting rollers arranged in the tapered pocket in the end of said head, and downwardly inclined spindles projecting inwardly toward the longitudinal center of the head for supporting said rollers.

14. A boring drill provided with a head, a spindle on said head having a number of end-thrust-resisting faces, a roller journaled on said spindle, a lubricant-holder carried by said head, a duct in said head leading to the end of said spindle, and coöperating grooves on the exterior of the spindle and on the internal bore of said roller for distributing the lubricating medium over the surfaces on which the roller bears.

15. In a drill, a spindle, a ring mounted on said spindle and being narrower or of less thickness than the length of the spindle, coöperating means on said ring and spindle for preventing the ring from moving longitudinally of the spindle, and a roller connected to said ring.

16. In a drill, a spindle, a roller mounted on said spindle, and coöperating flanges or collars on said spindle and roller for preventing the roller from moving longitudinally of the spindle, one of said collars being detachably connected to the member which carries it.

17. In a drill, a spindle provided with a groove, a ring on said spindle provided with a flange that projects into the groove in the spindle, and a roller connected to said ring.

18. In a drill, a spindle provided with an integral collar, a ring loosely mounted on said spindle and coöperating with said collar, and a roller mounted on said spindle and connected to said ring.

19. In a drill, a spindle provided with a circular groove, a roller mounted on said spindle, and a split ring screwed into said roller and provided with a flange that projects into the groove in the spindle.

20. A boring drill comprising a head provided with rollers, a lubricant-holder adapted to contain a lubricating medium, a plunger in said holder for forcing the lubricating medium to the bearings of the rollers, a hollow operating member connected to said head for introducing water down into the hole being formed, a closure for the upper end of the lubricant-holder provided with ports that permit said water to enter the lubricant-holder and exert pressure on the plunger therein, and a check valve for preventing the water from escaping from the lubricant-holder.

21. A boring drill comprising a head provided with cutting rollers, a tubular-shaped operating member connected to said head for introducing water down into the hole being formed, a lubricant-holder adapted to contain a lubricating medium, a closure for the upper end of said lubricant-holder having an opening that permits the water which is forced down through the operating member to enter the lubricant-holder and exert pressure on the lubricating medium therein, and means for preventing the water from escaping from the lubricant-holder.

22. A boring drill comprising a head provided with rotatable cutting devices, a lubricant holder carried by said head, a plunger in said holder for forcing the lubricating medium to the bearings of said cutting devices, a hollow member connected to said plunger to form an air chamber, said member being provided with openings, means for permitting water to enter the

lubricant-holder and compress the air in said air chamber, and means for trapping the water in the lubricant-holder.

23. A boring drill comprising a head provided with cutting rollers, a tubular-shaped member connected to said head for introducing water into the hole being formed, a lubricant-holder carried by said head and provided with a closure having ports formed therein so as to permit the water that is forced down through the operating member to enter the holder, a check valve for preventing the water from escaping from the holder, a plunger in the holder for exerting pressure on the lubricating medium therein, and a device connected to the upper side of said plunger to form an air chamber.

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

HOWARD R. HUGHES.

Witnesses:

W. L. HOLMES,

W. L. THOMAS.