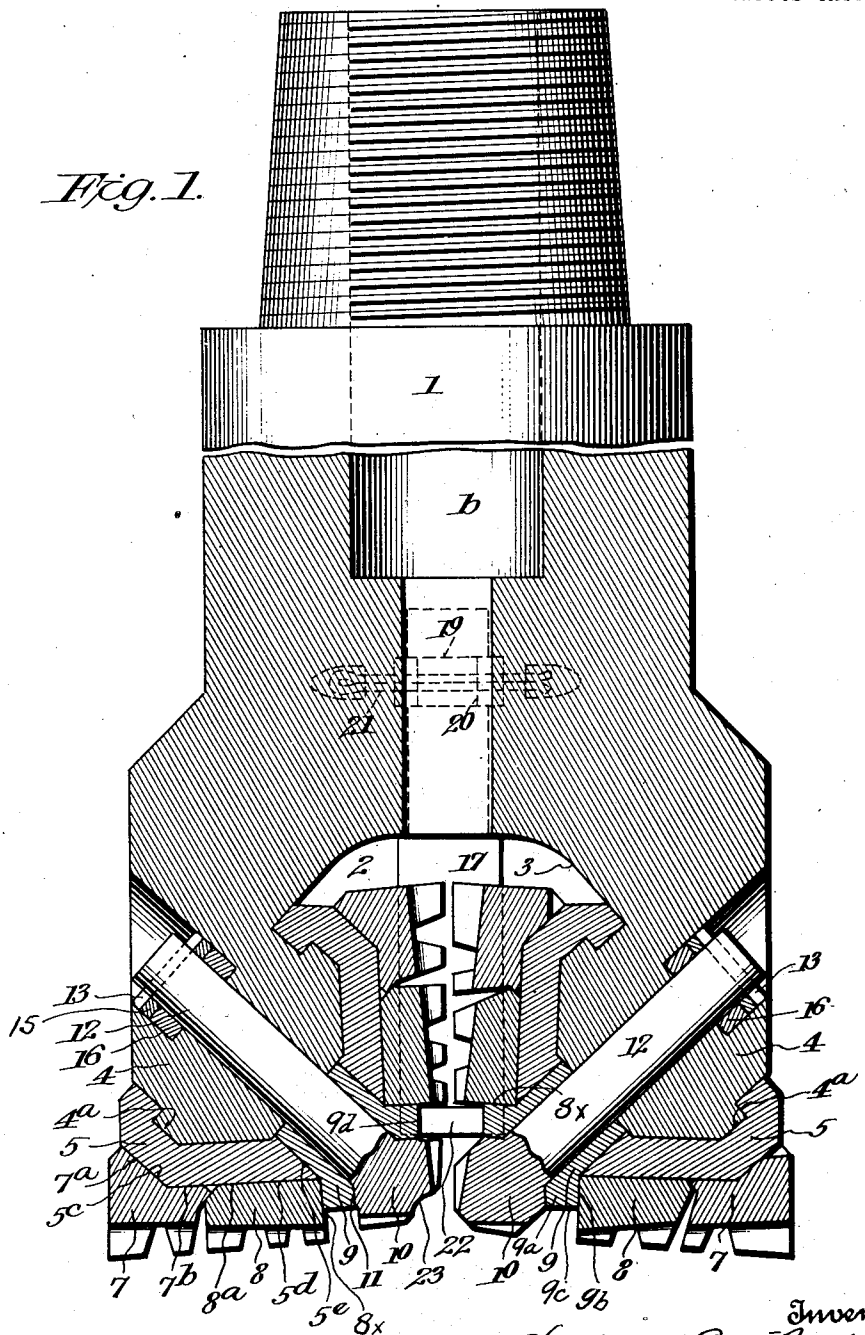
Nov. 22, 1927. 1,649,858

C. E. REED

DEEP WELL DRILLING APPARATUS

Filed Feb. 18, 1927 4 Sheets-Sheet 1

Fig. 1.



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Attorney

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C. E. REED

DEEP WELL DRILLING APPARATUS

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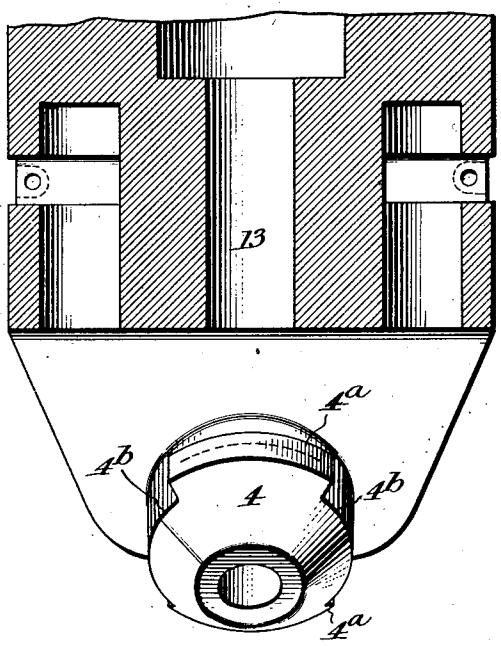


Fig. 2.

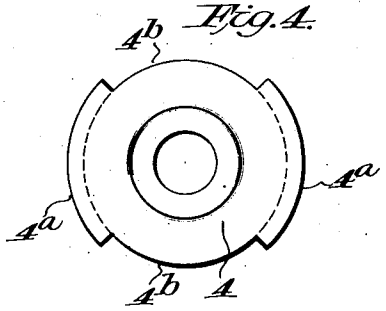
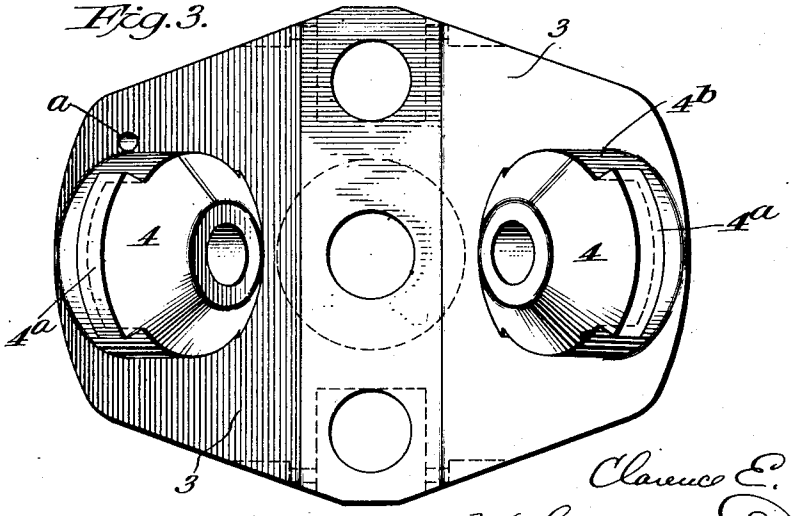


Fig. 4.

Fig. 3.



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DEEP WELL DRILLING APPARATUS

Filed Feb. 18, 1927 4 Sheets-Sheet 3

Fig. 5.

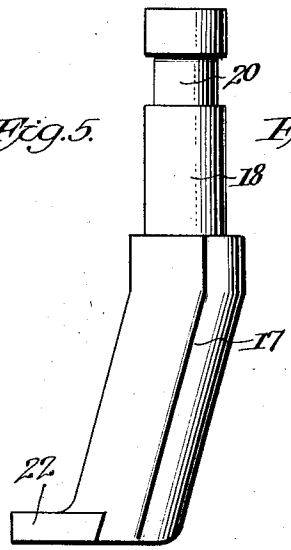


Fig. 6.

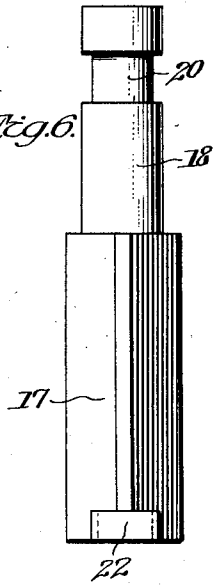


Fig. 5a.

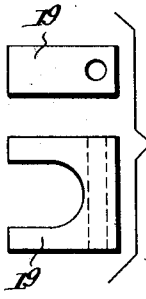


Fig. 7.

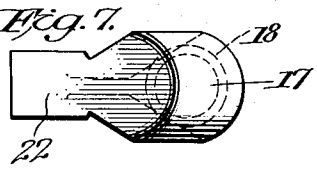


Fig. 10.

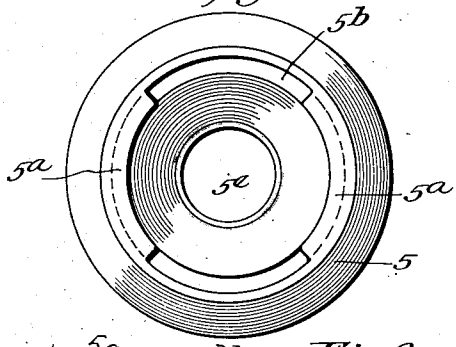


Fig. 8.

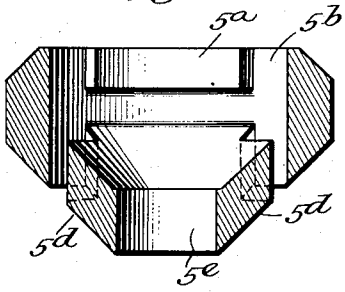


Fig. 9.

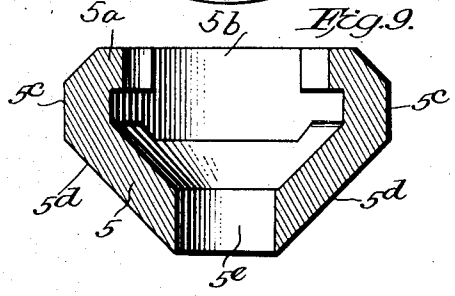


Fig. 11.

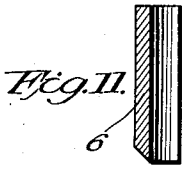
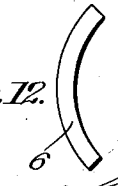


Fig. 12.



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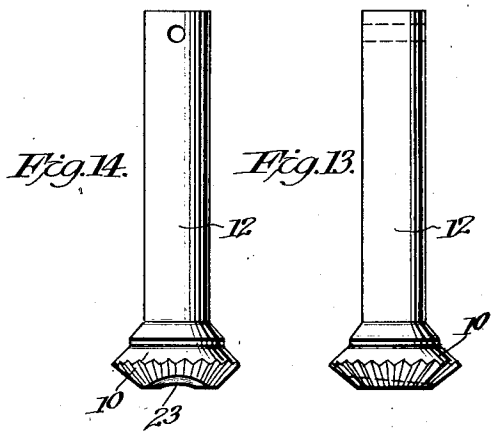
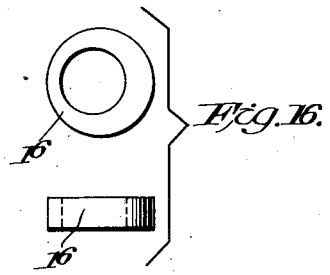
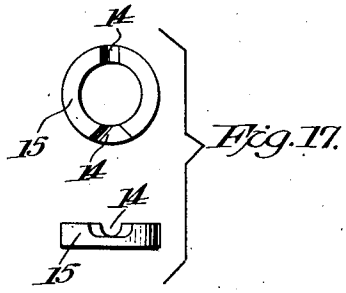
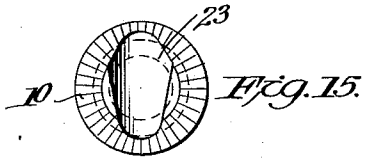
DEEP WELL DRILLING APPARATUS

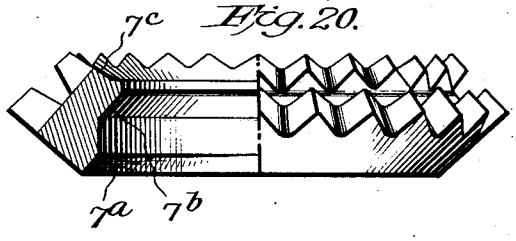
Filed Feb. 18, 1927 4 Sheets-Sheet 4

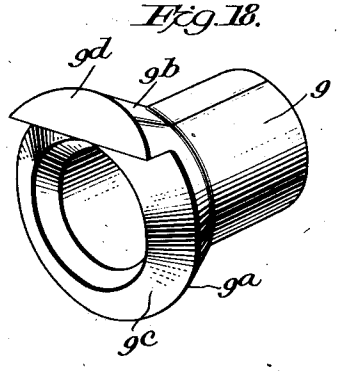


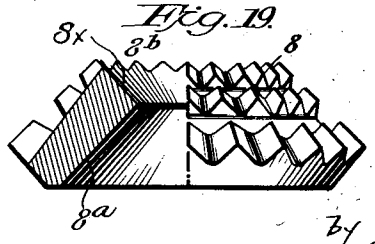












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UNITED STATES PATENT OFFICE.

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DEEP-WELL-DRILLING APPARATUS.

Application filed February 18, 1927. Serial No. 169,242.

This invention includes a two cone rotary cutter organization in a one piece bit head, each cutter organization being made up of a plurality of conical cutter sections coaxially disposed, and which jointly cut substantially the whole area at the bottom of the hole. With each rotary sectional cone cutter is combined a thrust bearing for holding said sections in place, said thrust bearings being held in position by the innermost member of the sectional cutters, which in turn are supported in the head. Crushing strains and collapse of the head are resisted by members bearing on the thrust bearings and which with said bearings and the bearing pins of the cutters provide bracing means from side to side of the head. This means constitutes parts of baffles for the flushing fluid to direct it against the rotary toothed cutters for clearing the same of the accumulated material.

Other features of the invention will be clear from the following description.

In the accompanying drawings:

Figure 1 is a vertical sectional view of the drill, the plane of section being through the axes of the frusto-conical cutters.

Fig. 2 is a vertical sectional view in a plane at a quarter turn from that of Fig. 1. The cutters and other detachable parts are omitted from this view.

Fig. 3 is a bottom plan view of the bit head with the detachable parts removed.

Fig. 4 is a face view of one of the bearing pins or projections.

Figs. 5 and 6 are views of a hanger.

Fig. 5ª shows a lock for the hanger.

Fig. 7 is a bottom plan view of the hanger.

Figs. 8, 9 and 10 are views relating to a bushing.

Figs. 11 and 12 are views of means for locking the bushing in place.

Figs. 13 and 14 are views of one of the small toothed cutters.

Fig. 15 is a face view of said cutter.

Fig. 16 shows a bearing for the small cutter.

Fig. 17 shows a retaining washer for the small cutter.

Fig. 18 shows the thrust bearing member.

Figs. 19 and 20 are views of the cutters forming the elements of the roller cutter assembly.

In these drawings 1 indicates a one piece bit head having a recess 2 in its lower end with upwardly converging opposing walls 3. Projecting inwardly from these walls and inclining downwardly are the pins 4 on which are mounted the bushings 5. The bushings and pins are of frusto-conical form and the bushings are held on the pins by providing the pins with circumferentially extending lugs or flanges 4ª, separated by gate-ways 4ᵇ, and providing the bushings with complementary lugs or flanges 5ª and spaces 5ᵇ. In placing the bushing on the pin or projection, its lugs or flanges 5ª are made to register with the gateways 4ᵇ of the pins 4 and after the lugs 5 are passed through said gateways, the bushing is turned so that its lugs or flanges will locate themselves in rear of the lugs or flanges on the pins. Then the bushing is locked in place by a locking member 6 in the form of a segment adapted to fill the gateways in the bearing pin and bushing and thus lock the bushing against turning back to the position in which its lug would align with the gateway in the bearing pin.

The locking member 6 is provided with a bevelled edge to fit the inclined inner side of the bushing. The head is provided with an opening at *a* through which a suitable implement may be inserted to knock the locking member out of place in disassembling the apparatus. The opening *a* need not be provided in the structure shown in Figs. 1 and 3 since the locking member lying against the inclined wall 3 and against the end wing 4ª is partially exposed at its upper end so that it may be pushed inwardly and out by a small rod or the like. Fig. 1 being a central sectional view does not show the locking member.

This locking member is inserted into place from the inside of the head before the sections of the roller cutters are placed in position on the bushing. Referring to Fig. 8, the locking member 6 is inserted in the gateways upwardly through slot 5ᵇ. When the sections 7 and 8 of the cutters are assembled on the bushings, they will cover the slot 5ᵇ of the bushing and will hold the locking members in place. In disassembling the apparatus, the cutters are removed and the locking member drops or is knocked out.

This bushing has a cylindrical bearing surface at 5ᶜ, and a conical bearing face at 5ᵈ. On the bushing a rotary frusto-conical cutter organization is mounted composed of a comparatively large diameter base mem-

ber or cutter 7 and a smaller diameter cutter 8. The larger diameter rotary cutter has an interior cylindrical surface 7^a to fit the cylindrical bearing portion 5^c of the bushing and also a conical interior surface 7^b to fit a part of the conical surface of the bushing. This large diameter cutter is relatively thin, as compared with the height or length of the conical bushing measured in the direction of its axis, so that sufficient of the conical surface of said bushing is left to afford a bearing for the second member of the rotary cutter assembly and this second and smaller diameter member 8 is provided on its interior with a conical bearing surface 8^a, to fit said bearing surface of the bushing. The second or intermediate diameter cutter member fits into the countersink 7^c of the cutter member 7. The teeth of these cutters may be of chisel form extending continuously along their frusto-conical surfaces or said teeth may be divided into circumferential rows by grooves extending about the members.

The pair of rotary cutters on one of the bearing pins may be of different dimensions from those on the other to give different lengths of cutting teeth, so that said cutters will not track in their cutting operation on the bottom of the well, and for this purpose I show the large diameter cutter on the left thinner than the large diameter cutter on the right of Fig. 1. The smaller diameter cutter on the left is thicker than that on the right for the same purpose of non-tracking.

The bushing is provided with an opening 5^e at its smaller or inner end disposed axially thereof, and this receives a thrust block 9 which is provided with a cylindrical portion fitted to said opening and bearing on the end of the projection 4. It is provided also with an enlarged head portion 9^a, flaring outwardly at 9^b and tapered at 9^c. This thrust bearing fits in the countersunk or recessed face 8^x of the intermediate member of the three-part rotary cutter organization 7, 8 and 10 and serves to hold said intermediate diameter cutter in place on the bushing, and this intermediate cutter in turn serves to hold the larger diameter cutter member in place. The thrust bearing is retained in place by the innermost member 10 of the frusto-conical roller cutter assembly, which is seated at 11 within the countersink of the thrust bearing. This small cutter section has a spindle 12 passing through the thrust bearing and through the bearing pin or projection and it is held in place in the head at its outer end by a cotter pin 13 passing through the spindle and lying in a recess 14 of a washer 15. Bearing members 16 surround the spindles of these small cutter members. These are of eccentric form relative to the opening through them, so that when seated in the head they will be held against rotation. These small cutters act upon the bottom of the hole near the vertical axis of the apparatus. Their spindles turn in the thrust bearing, the bearing projection and in the eccentric collar 16, and in the turning movement the washer 15 turns on the outer face of this collar, and maintains the spindle with its small cutter in position to retain the cutter assembly in place.

I provide means for directing flushing fluid to the cutters. This flushing fluid, as usual, is supplied down through a central bore of the head. The fluid directing means is in the form of baffles consisting of hangers 17 whose shanks 18 are seated in the bit head and held by U-shaped locking members 19 fitting the reduced neck 20 of the shank of the hanger, said locking members being held in the head by cotter pins 21.

These hangers have their lower portions inclining downwardly and inwardly toward the vertical axis of the drill head and they form shields or directing means for the flushing fluid, to insure effective action of said fluid in clearing the rotary toothed cutters of accumulated material.

They baffle the free escape of the fluid and confine it to work on the faces of the cutters adjacent the center line of the head and cause it to pass from the axis of the apparatus along the toothed area of the cutters. This manner of clearing the toothed cutters of accumulations will make them efficient in cutting soft material which otherwise is liable to gum up the rollers and prevent their rotation. The flushing fluid reaches the space between these hangers through the central port or bore of the head at *b*. It will be observed that these hangers lie in a vertical plane at right angles to the vertical plane in which the axes of the rotary toothed cutters lie and therefore they extend down at each side of the convergent upper portions of the rotary cutters and inwardly beneath these portions. They confine and direct the flushing fluid to act upon the toothed cutters for clearing them. At their lower ends the said hangers are provided with horizontally extending portions 22 which reach in under the convergent upper ends of the larger roller cutter sections, where they obstruct the free direct downward flow of the flushing fluid and cause it to flow along the toothed surfaces to clear the same of accumulations. These horizontal portions 22 of the two opposite baffles meet at the center line of the bit head. They serve as bracing means to resist crushing strains exerted on the walls of the bit head and for this purpose they bear on the thrust bearings 9. These thrust bearing members are provided with a surface at 9^d affording an extended contact between them and the strut or brace portion 22 of the hangers.

These portions 22 of the two baffles, together with the thrust bearings and the bearing pins or projections, constitute the bracing means extending between the opposing walls of the recess of the bit head and prevent collapse of said walls under the crushing strains to which the head is subjected, while working at the bottom of the hole.

Reverting to the small frusto-conical cutters, it will be seen that one of these is provided with a gateway 23 in the end of its head portion so that after this cutter is inserted into place the other small cutter can be passed into its position through this gateway.

In placing the large diameter sections of the cutters in position this is done by making their teeth intermesh at their convergent inner or upper edges so that these sections can be inserted up into the recess of the bit head until their openings are brought into line with the conical bushings over and along which these sections can be moved. Then the intermediate diameter sections of the cone cutters can be placed in a similar manner, and thereafter the other parts are placed in position.

When, however, the assembly of the large and intermediate diameter sections is complete, their teeth do not intermesh with the opposite cutters but are juxtaposed at their upper convergent ends.

It will be noticed that practically the entire area at the bottom of the well will be cut, the frusto-conical roller cutter organization practically filling the recess at the bottom of the head. Clearance at the side of the well will be cut by the large diameter frusto-conical cutter sections.

I claim:

1. A rotary deep well boring apparatus comprising a one piece bit head with a recess in its lower end and with projections integral with said head and extending from the walls in said recess and inclining downwardly, bushings on said projections, and a roller cutter organization on each projection, each organization comprising a base section and a smaller diameter section, said base sections being convergent upwardly and with their upper portions juxtaposed but out of contact and adapted to be placed in position or removed therefrom by making their teeth intermesh at their point of convergence, substantially as described.

2. A rotary deep well drilling apparatus comprising a bit head having a recess in its lower end with downwardly and inwardly inclined integral projections on its opposite walls, and rotary cutter organizations, one for each side of said recess, comprising each a base section of large diameter and a section of intermediate diameter mounted on said projections and a third section of small diameter having a spindle journalled in said projection, said sections cutting substantially the entire area at the bottom of the well, substantially as described.

3. In combination in a rotary deep well drilling apparatus, a bit head having a recess in its lower end with projections extending downwardly and inwardly, each provided with a gateway and a locking flange, a bushing having a complementary gateway and flange, a locking member inserted into the aligned gateways from within the recess, and a rotary cutter section mounted on the bushing and holding said locking member in place, substantially as described.

4. In combination in a rotary deep well drilling apparatus, a bit head having a recess in its lower end, with integral projections inclining downwardly and inwardly from opposite sides of said recess, bushings mounted on said projections, said bushings having their inner ends open, rotary cutters mounted on the bushings, thrust bearings seated in the openings in the bushings and bearing on the ends of the integral projections and means connected with the bit head located between and contacting with the thrust bearings for taking the crushing strains exerted upon the sides of the drill.

5. A deep well drilling apparatus according to claim 4, in which a small cutter has a spindle passing through the thrust bearing and cutting the bottom of the well near the axial line thereof, said cutter engaging the thrust bearing which in turn engages the rotary cutter on the bushing, substantially as described.

6. A deep well drilling apparatus according to claim 4, in which the means for taking the crushing strains consists of portions of hangers supported in and depending from the bit head within the recess of said head, substantially as described.

7. In a deep well drilling apparatus, a bit head having a recess in its lower end with upwardly convergent opposite walls, projections extending from said walls and inclining downwardly, rotary toothed cutters mounted on said projections and converging upwardly towards the vertical axial line of the drill head, and baffles mounted in the head and depending on each side of said cutters, said baffles having horizontally disposed portions at their lower ends extending towards each other beneath the overhanging upper portions of said cutters, each of said baffles being removable independently of the other, said head having a conduit therethrough to discharge flushing fluid between the said baffles to clear the toothed cutters of accumulations, substantially as described.

8. A deep well drilling apparatus according to claim 7, in which the baffles incline downwardly and inwardly towards the center line of the drill head, substantially as described.

9. A deep well drilling apparatus according to claim 4, in which the means for resisting the crushing strains consists of hangers extending down from the bit head into the recess on each side of the point of convergence of the rotary toothed cutter sections and reaching under said sections to a point between the thrust bearings, substantiantially as described.

10. In combination in a rotary deep well drilling apparatus, a bit head having a recess in its lower end with projections extending downwardly and inwardly, each provided with a gateway and a locking flange, a bushing having a complementary gateway and flange, a locking member inserted into the aligned gateways from within the recess, upwardly and outwardly, and a rotary cutter section mounted on the bushing and holding said locking member in place, substantially as described.

11. In combination in a rotary deep well drilling apparatus, a bit head having an inverted V shaped recess in its lower end, with integral projections inclining downwardly and inwardly from opposite sides of said recess, bushings mounted on said projections, said projections having bores therethrough, said bushings having bores in their ends of larger diameter than those in the projections and aligning therewith, rotary cutters mounted on the bushings, thrust bearings seated in the bores in the bushings, and thrust bearings having bores of the same diameter as those of the projections and aligning therewith, rotary spindles mounted in the bores, and cutters on the ends of the spindles bearing on the thrust bearings.

12. In combination in a rotary deep well drilling apparatus, a bit head having an inverted V shaped recess in its lower end, with integral projections inclining downwardly and inwardly, one from each opposite wall of said recess, said projections each having an axial bore therethrough terminating in a recess at the outer wall of the bit head, bushings mounted one on each projection, each of said bushings having a bore in its inner end of larger diameter than the bore in the corresponding projection and aligning therewith, thrust bearings seated one in each of the bores in the bushings, and bearing on the ends of the projections, said thrust bearing having bores of the same diameter as those of the projections and aligning therewith, rotary spindles mounted in the bores, cutters on the ends of the spindles bearing on the thrust bearings and means in the terminal recesses of the bores for securing the spindles against longitudinal movement in the bores.

13. In combination in a deep well drilling apparatus, a drill head having an inverted V-shaped recess in its lower end with a hollow spindle projecting from each of its inclined walls downwardly and inwardly, a roller cutter organization of frusto-conical form composed of sections divided from each other in a plane transverse to the axis of the roller cutter, one section being mounted on the outside of the hollow spindle, and an apex section having an axial extension supported in the interior of the hollow spindle.

14. In combination in a deep well drilling apparatus, a drill head having an inverted V-shaped recess in its lower end with a hollow spindle projecting downwardly and inwardly from each of its inclined walls, frusto-conical roller cutter organizations mounted one on each spindle, said cutter organizations each comprising a frusto-conical cutter section mounted on the outside of its corresponding spindle, and an apex cutter section at the apex of the roller cutter organization, said apex section having a spindle mounted to turn within said hollow spindle, and said apex section being adapted to hold the first mentioned cutter section in place on the hollow spindle.

15. In combination in a deep well drilling apparatus, a bit head having an inverted V-shaped recess in its lower end with projections extending downwardly and inwardly from the walls of said recess, frusto-conical roller cutters on said projections, each made in sections including a section at the apex of the roller, having a spindle mounted in said projection, and means including thrust bearings arranged axially of the said frusto-conical cutters about the spindles of the apex sections of the cutters for taking the crushing strains from the side walls of the drill head.

In testimony whereof, I affix my signature.

CLARENCE E. REED.