July 19, 1938. C. F. WILLIAMS ET AL 2,124,521

DEEP WELL DRILL BIT

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Fig. 1.

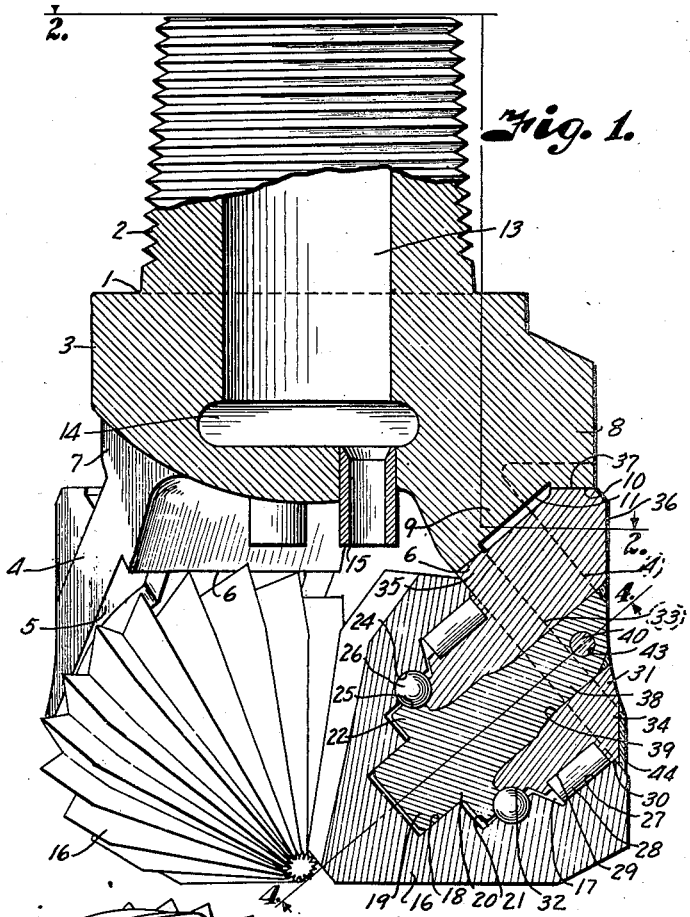

Fig. 2.

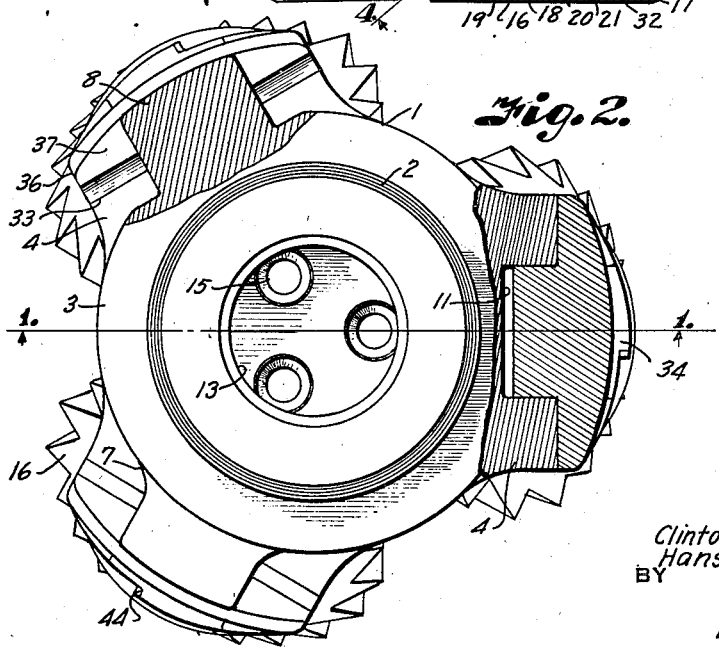

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Fig. 3.

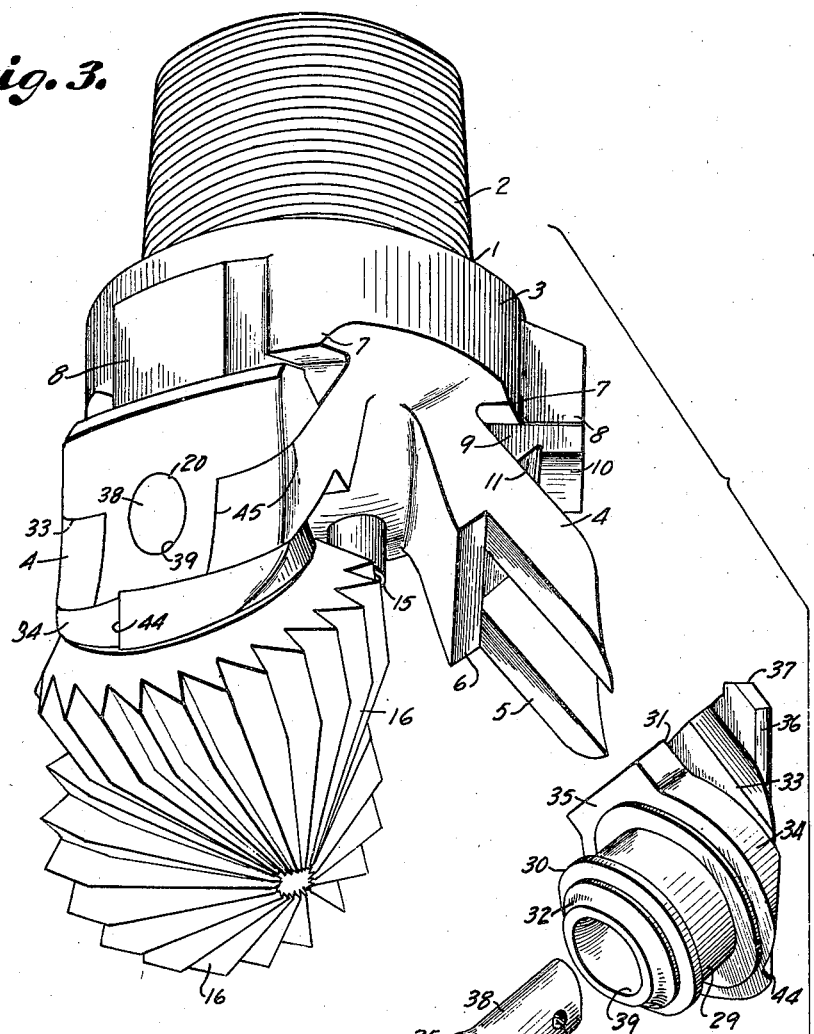

Fig. 4.

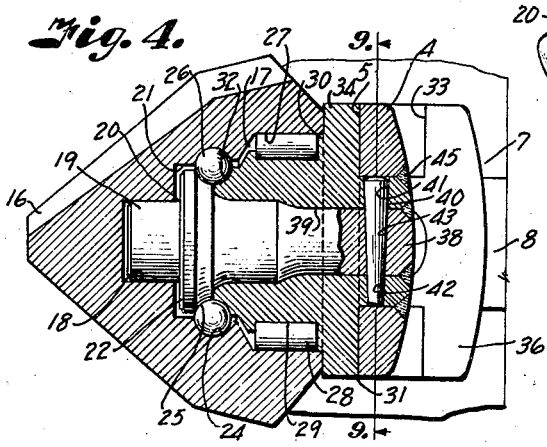

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Fig. 5.

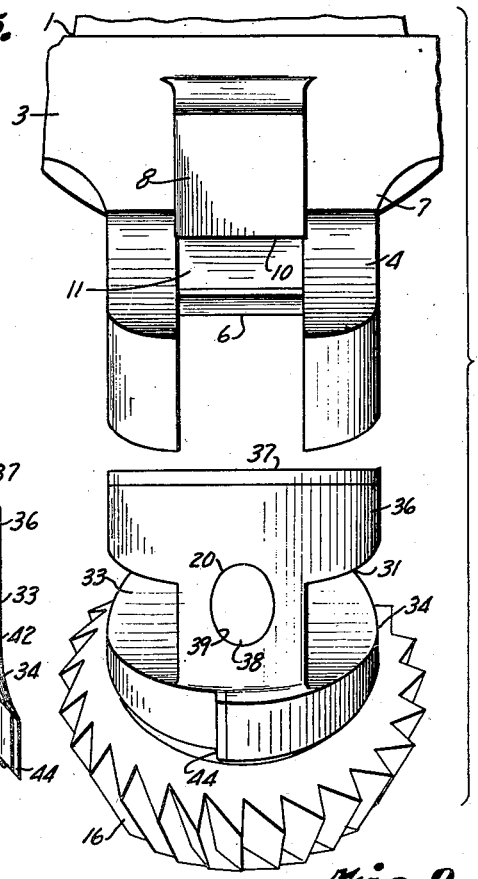


Fig. 6.

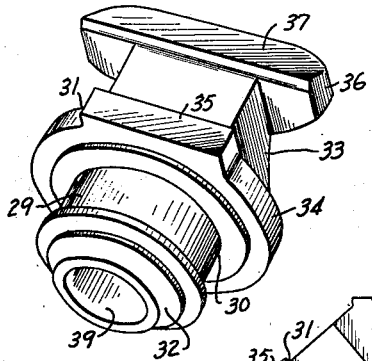


Fig. 7.

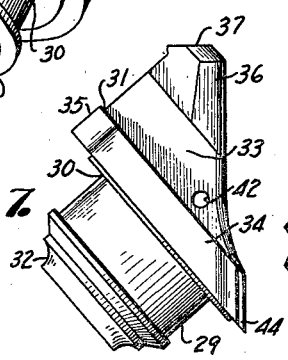


Fig. 8.

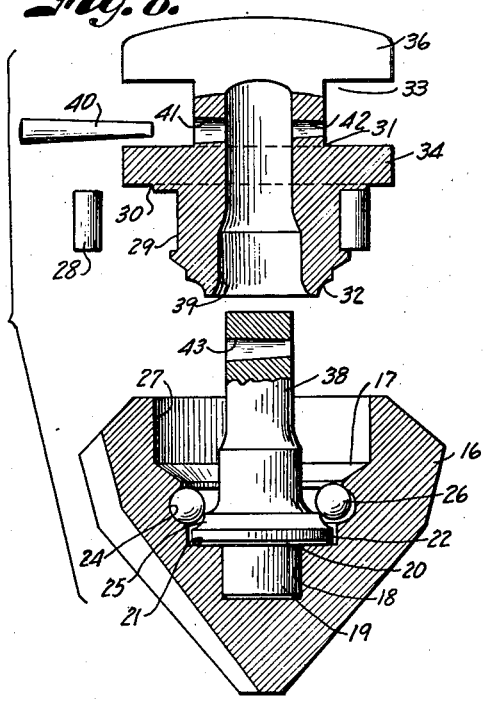
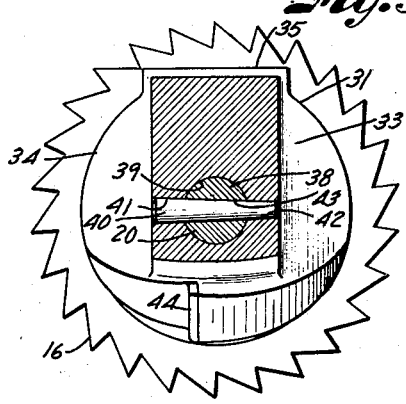


Fig. 9.



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DEEP WELL DRILL BIT

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Fig. 10.

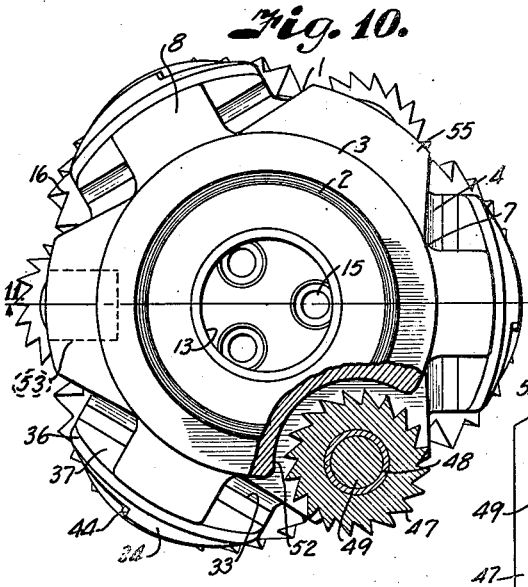


Fig. 11.

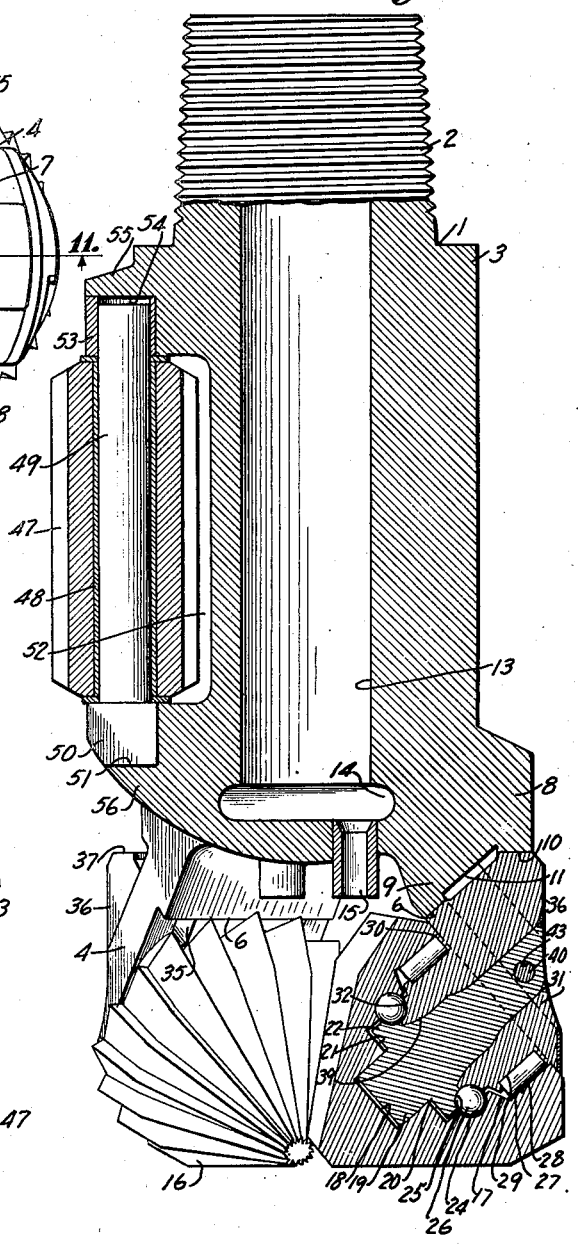
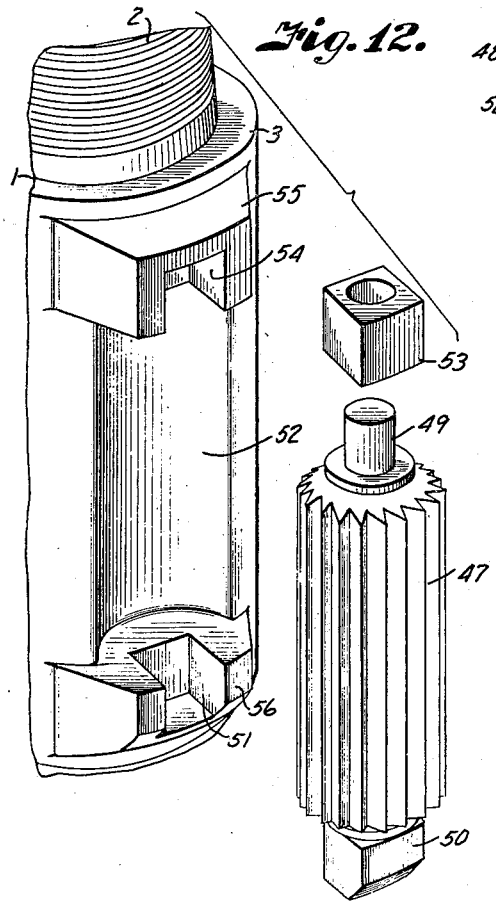


Fig. 12.



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Patented July 19, 1938 2,124,521

UNITED STATES PATENT OFFICE

2,124,521

DEEP WELL DRILL BIT

Clinton F. Williams and Hans Gruner, Tonkawa, Okla., assignors to Williams Iron Works Company, Tonkawa, Okla., a corporation of Oklahoma

Application June 17, 1936, Serial No. 85,712

10 Claims. (Cl. 255—71)

Our invention relates to deep well drill bits of cone cutter type and has for its principal object to provide a device of that character wherein the cutter members, each including a cutter cone, a spindle with its head or attaching member and antifriction bearings, may be assembled independently of the bit head and attached thereto and removed therefrom as units.

It is also an object of our invention to provide a cutter unit in which the antifriction members are so related to the cone and its spindle and the units so combined with the bit head as to avoid torsional thrusts and excess wear of the bearings.

In accomplishing these and other objects of the invention, we have provided improved details of structure, the preferred forms of which are illustrated in the accompanying drawings, wherein:

Fig. 1 is a longitudinal sectional view of a drill bit embodying our invention, on the line 1—1, Fig. 2.

Fig. 2 is an irregular cross section on the line 2—2, Fig. 1, part of one of the spindle head abutments on the bit head and a part of the bit head flange being broken away for better illusrtation.

Fig. 3 is a detail perspective view of the bit head, one of the cutter units being removed and its parts disassembled.

Fig. 4 is a sectional view of one of the cutter members on the line 4—4, Fig. 1.

Fig. 5 is an enlarged side elevation of part of the bit head flange, one of the spindle abutment bosses and a mounting fork, showing a cutter member in position for assembly on the mounting fork.

Fig. 6 is a detail perspective view of a spindle head.

Fig. 7 is a side elevation of the spindle head.

Fig. 8 is a central longitudinal section of a cutter member showing the parts disassembled in relative positions with the cone and spindle head in central, longitudinal section and a part of the spindle broken away.

Fig. 9 is a section on the line 9—9, Fig. 4, particularly illustrating attachment of the spindle to its attaching head.

Fig. 10 is a plan view of the bit modified to include side reamers in addition to the parts illustrated in the principal figure; part of the bit head being broken away to illustrate one of the side reamers and the side reamer being shown in transverse section to illustrate its mounting.

Fig. 11 is a longitudinal section on the line 11—11, Fig. 10.

Fig. 12 is a perspective view of the head member of the modified form of bit, showing the side reamer disassembled from the bit head.

Referring more in detail to the drawings:

1 designates a bit head of conventional type, except as hereinafter stated, including a tapered, threaded shank 2 for attaching the head to a drill stem in accordance with common practice.

The head has the usual flange 3 at the base of the shank 2 and extending downwardly from the bottom of the head at spaced points about and inset slightly from the periphery of the flange are forks 4 for mounting a cutter member as hereinafter described, the base ends of the forks being thickened as they merge into the bottom of the bit head, to provide mass at the joints for resisting working strains and each fork having a downwardly and outwardly facing recess at its free end forming a seat 5 and shoulder 6 for receiving the spindle head of a cutter unit as presently described. The flange 3 of the bit head has a lug or thickened portion 7 extending downwardly over each fork 4 and extending outwardly and downwardly from the flange, centrally of each lug 7, is a boss 8, having a backwardly extending portion 9 filling the recess between the base of the fork and the bottom of the lug 7 and having a downwardly facing portion 10 at its forward end and an inclined face 11 at the rear, backset, as at 12, to limit area of contact of the spindle head to the face 10. The bit head is provided with the usual fluid channel 13, terminating in a manifold 14 having outlet through downwardly directed conduits 15 for distribution of drilling fluid over the cutter cones for cleaning the cones as the fluid is delivered to the well hole.

Each of the cutter cones 16 is of conventional type, except for contouring of its base socket 17 to receive a bearing of the particular form and structure which we have devised. So formed, the socket 17 includes a cup-shaped recess 18 at its upper end for receiving the cylindrical end 19 of a spindle 20, and a circular recess 21 of larger diameter than the recess 18 for receiving a collar 22 on the spindle. The socket 17 also has a ball race 24 cooperative with a race 25 in the spindle collar for seating the ball bearings 26, and a recess 27 of substantially greater diameter than the ball race 24, opening outwardly through the base of the cone, the recess 27 being coaxial with the spindle when the parts are assembled to provide a circular track-

way for roller bearings 28 carried in a race 29 in the side wall of an extension 30 on the spindle head 31.

The end of the extension 30 is provided with a ball race 32 cooperating with the races 24 and 25, previously described. The races 24, 25 and 32 are preferably formed by arcuate shaped grooves in the respective parts, which, when aligned, form a ball track having substantially circular cross-section to accommodate the balls 26.

The spindle head 31 has opposite, parallel grooves 33 adapted to receive the arms of a fork 4 on the bit head to hold the spindle head firmly in the fork, a collar 34 adapted to seat in the recess 5 in the inner face of the fork and having a squared boss 35 bearing flat against the shoulder 6 to restrain twisting of the head in the fork and a cap portion 36 outwardly of the grooves 33, having a flat top face 37 adapted for bearing against the downwardly exposed face 10 on the extension of the boss 8 on the bit head flange; the contacting surfaces on the spindle head, the fork and boss being preferably machined to provide smooth, even seating of the spindle head against the bit head and thereby distribute thrust loads even from one member to the other.

The spindle shank 38 fits snugly within a central channel 39 in the head 31 and is held against rotation or longitudinal movement therein by a tapered pin 40, driven through tapered apertures 41—42 in the grooved portion of the spindle head, and 43 in the spindle. The extension 30 on the spindle head snugly fits the portion of the spindle outwardly of the ball groove 25 to maintain proper relation of the mating ball grooves but is otherwise spaced from the inner wall of the cone when the parts are assembled to avoid frictional contact of the cone with the spindle or its extension, and insures transfer of its thrust from the cone to the spindle and its mounting through the antifriction balls.

The cone 16, the spindle 20 and the spindle head 31 are so dimensioned that when the spindle is dropped into the cone socket 17 as the first step in assembly, the groove 25 in the spindle is out of round with the groove 24 in the cone to provide space through which the balls 26 may be dropped into the groove in the cone (Fig. 8). The apertures in the spindle and its head are so related that as the wedge pin 40 is driven to place the spindle is lifted and its head drawn into the cone to register the grooves 24, 25 and 32 (Figs. 1 and 4).

While the base of the cone terminates in close proximity to the lower face of the collar 34 of the spindle head, it is not our intention that there should be any load transfer at this point.

To assist the base teeth of the cones in reaming the hole and delivering cuttings to the circulating fluid, we provide the collars 34 on the spindle heads with teeth 44, facing in the direction of rotation of the drill and preferably upwardly and backwardly beveled to conform to the contour of the outer face of the spindle head; the cutting faces of the teeth being preferably case hardened or surfaced with wear resisting material to avoid dulling and wear of the metal from contact with the wall of the well.

In assembling a cutter unit the spindle is seated in the socket of the cone and the bearing balls dropped into the grooves in the cone and spindle (Fig. 8). The spindle head, with the bearing rollers 28 in their grooves 29, is then fitted over the spindle. The spindle is then pinned to its head, wedge action of the pin drawing the spindle outwardly and its head extension inwardly to complete the circular contour of the composite ball race and confine the balls therein.

Each unit is assembled on the bit head by projection of the spindle head over one of the forks on the bit head at an angle of approximately 45° to the axis of the bit head until the squared portion of the collar 34 engages the shoulder 6, at the upward end of the fork recess, and the flat face 37 on the top of the spindle head engages the corresponding flat face 10 at the bottom of the bit head flange 3. The spindle is then anchored permanently to the bit head by welding the spindle head to the fork and to the boss on the bit head, as at 45. With the parts so assembled the cutter cones 16 are grouped beneath the bit head with their apices adjacent the extended axis of the bit head to roll on the bottom of a well hole and chip or cut material from earth or rock formation for removal by the circulating fluid in accordance with well known practice. When a cone becomes worn, it may be removed with its mounting from the bit head and replaced without necessity for shut-down of the drilling operation except for the time necessary for such replacement.

The modified form of the invention illustrated in Figs. 10, 11 and 12 corresponds to the preferred form heretofore described except for addition thereto of reaming cutters 47. The cutters 47 are rotatably mounted on bushings 48 on pins 49, each having a squared head 50 seated in a corresponding socket 51 at the bottom of a vertical recess 52 in the side of the bit head, the upper end of the pin being mounted in a nut 53 seated in a squared socket 54 at the top of the recess directly above the socket 51, the sockets 51 and 54 being preferably located in bosses 55 and 56 built away from the face of the head and accommodating a cutter of substantial diameter in a relatively shallow recess in the bit head.

Except for the reaming elements just described and elongation of the bit head to accommodate the reamers, the bit shown in the modified form corresponds in structure and operation to that of the preferred form.

What we claim and desire to secure by Letters Patent is:

1. A drill bit including a bit head, a bracket arm extending from the bit head, a spindle head secured to the bracket arm, an extension on the spindle head having roller and ball bearing races respectively, a spindle carried by the spindle head having a ball bearing race, a cutter having ball and roller bearing races cooperating with the ball and roller bearing races of the spindle head extension, roller bearings mounted in the roller bearing races, and ball bearings in said ball bearing races for rotatably retaining the cutter on said extension.

2. A drill bit including a bit head, a bracket arm depending from the head, a spindle head secured to the bracket arm, a spindle carried by the spindle head, an extension on the spindle head concentric with the spindle and having a bearing race, a collar on the spindle having a bearing race cooperating with the bearing race on the spindle head extension, a cutter mounted on the spindle and having a bearing race cooperating with the first named bearing races, and antifriction bearings in said races to rotatably retain the cutter.

3. A drill bit including a bit head, a bracket depending from the head, a spindle head secured

to said bracket, a spindle carried by the spindle head, an extension on the spindle head having spaced bearing races, a collar on the spindle having a bearing race cooperating with one of the first named bearing races, antifriction bearings in said races, and a cutter rotatably mounted on the antifriction bearings.

4. A drill bit including a bit head, a fork depending from the head and having spaced arms, a spindle head secured between said arms, a spindle carried by the spindle head, an extension on the spindle head having spaced bearing races, a collar on the spindle having a bearing race cooperating with one of the first named bearing races, antifriction bearings in said races, and a cutter rotatably mounted on the antifriction bearings.

5. In combination with a drill bit including a bit head having a depending bracket for supporting a cutter unit, a cutter unit including a spindle head secured to said bracket and having a tapering spindle bore, a spindle having a shank corresponding to the shape of the bore, a bearing collar on the spindle having a bearing race, an extension on the spindle head having a race corresponding to the collar race, a cutter having a bearing race cooperating with the first named bearing races, ball bearings mounted in said races, and wedge means extending through the spindle head and through the spindle shank to draw the spindle into wedging contact with the spindle head and the bearing races in alignment to rotatably retain the cutter on the spindle.

6. In combination with a drill bit including a bit head having a fork depending downwardly from the head and having spaced arms, a cutter unit including a spindle head adapted to be secured between said arms and having a tapering spindle bore, a spindle having a shank corresponding to the shape of the bore, a bearing collar on the spindle having a bearing race, an extension on the spindle head having a race corresponding to the collar race, a cutter having a bearing race cooperating with the first named bearing races, ball bearings mounted in said races, and wedge means extending through the spindle head and through the spindle shank to draw the spindle into wedging contact with the spindle head and the bearing races in alignment to rotatably retain the cutter on the spindle, said arms of the fork forming means for retaining the wedging means.

7. In combination with a drill bit including a bit head having a fork depending from the head and having spaced arms, a cutter unit including a spindle head secured between said arms and having a tapering spindle bore, a spindle having a shank corresponding to the shape of said bore, a bearing collar on the spindle having a bearing race, an extension on the spindle head having a race corresponding to the collar race, a cutter having a bearing race cooperating with the first named bearing races, ball bearings mounted in said races, wedge means located between said arms of the fork and extending through the spindle head and through the spindle shank to draw the spindle into wedging contact with the spindle head and the bearing races in alignment to rotatably retain the cutter on the spindle, and roller bearings mounted between said head extension and the cutter.

8. A drill bit including a bit head, a fork projecting downwardly from the bit head, a spindle head mounted in said fork and provided with a tapered bore, a spindle having a shank conforming to the shape of said bore, wedging means retained by said fork for drawing the spindle shank into said bore, a rotary cutter, and means on the spindle cooperating with said wedging means to retain the cutter.

9. In combination with a drill bit including a bit head having a bracket depending downwardly from the head, a cutter unit including a spindle head carried by the bracket and having a bore, a spindle having a shank mounted in said bore, a bearing collar on the spindle having a bearing race, an extension on the spindle head having a race corresponding to the collar race, a cutter having a bearing race cooperating with the first named bearing races, ball bearings mounted in said races, wedge means extending through the spindle head and through the spindle shank to align the bearing races for rotatably retaining the cutter on the spindle, and roller bearings mounted between said head extension and the cutter.

10. A drill bit including a bit head, spaced forks depending radially from the head and having spaced arms, spindle heads secured between the arms of the forks, spindles carried by the spindle heads and arranged with their axes converging toward the axis of the bit head, extensions on the spindle heads concentric with the spindles and having bearing races, collars on the spindles having bearing races cooperating with the bearing races on the spindle head extensions, cone cutters having bearing races cooperating with the first named bearing races, and antifriction bearings in said races to rotatably retain the cutters.

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