March 18, 1941. J. F. BOZEMAN 2,235,548

BIT FOR DRILLING WELL BORES

Filed April 1, 1940 3 Sheets-Sheet 1

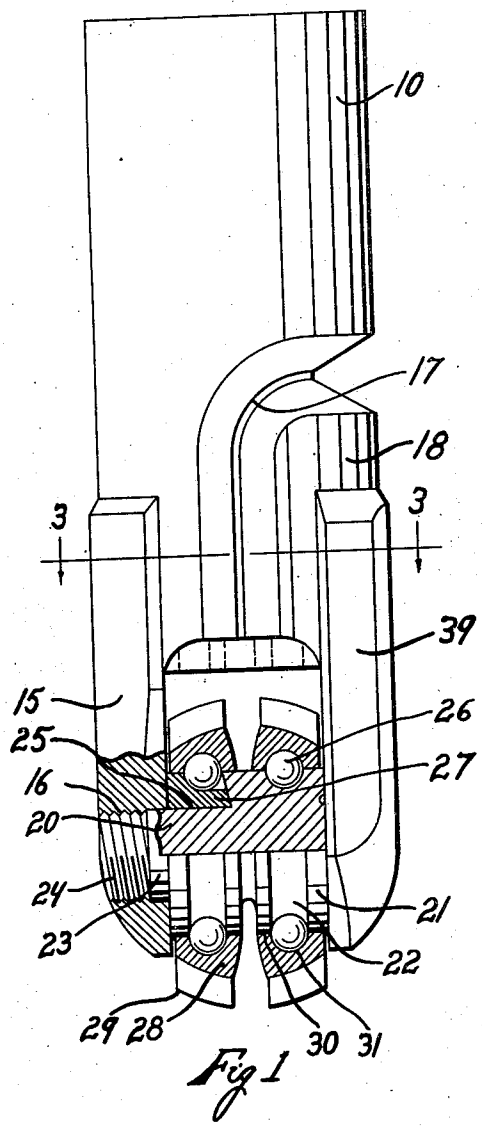


Fig 1

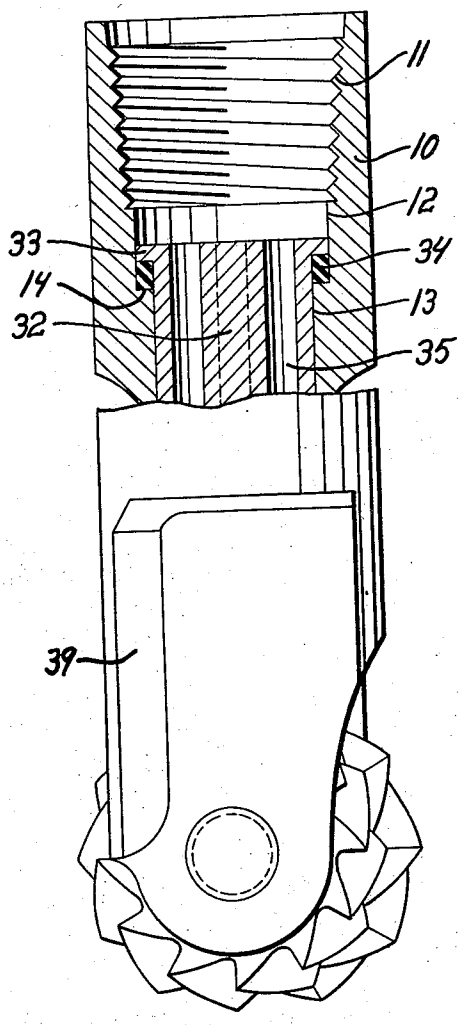


Fig 2

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March 18, 1941. J. F. BOZEMAN 2,235,548

BIT FOR DRILLING WELL BORES

Filed April 1, 1940 3 Sheets-Sheet 2

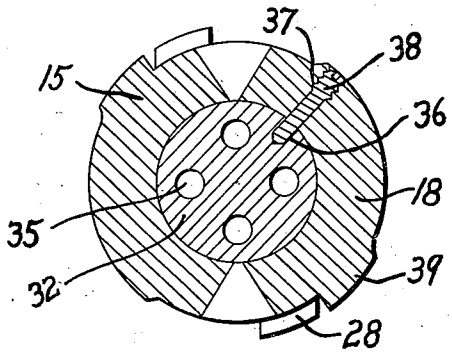


Fig 3

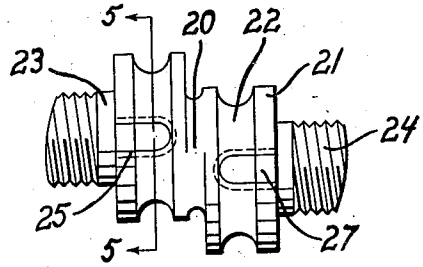


Fig 4

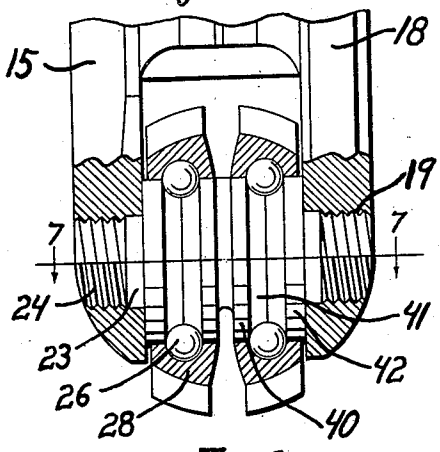


Fig 6

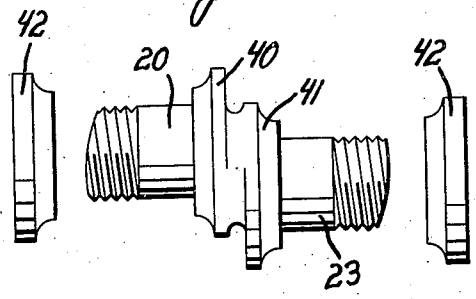


Fig 8

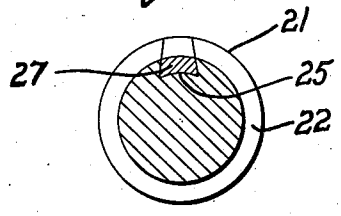


Fig 5

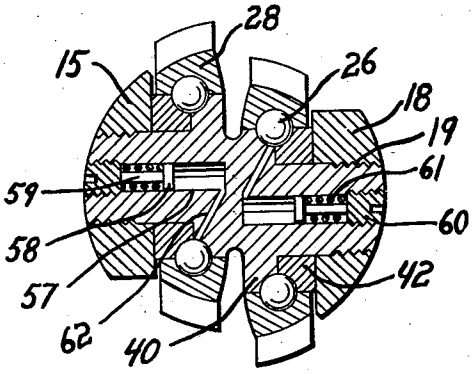


Fig 7

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March 18, 1941. J. F. BOZEMAN 2,235,548

BIT FOR DRILLING WELL BORES

Filed April 1, 1940 3 Sheets-Sheet 3

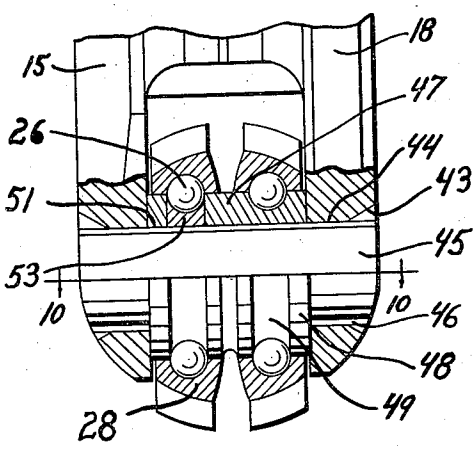


Fig 9

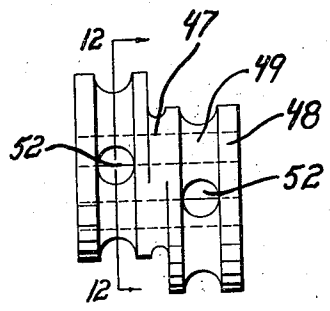


Fig 11

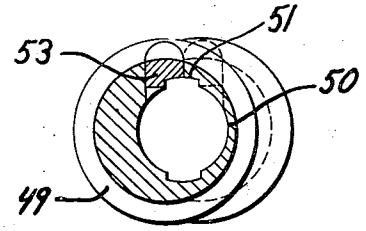


Fig 12

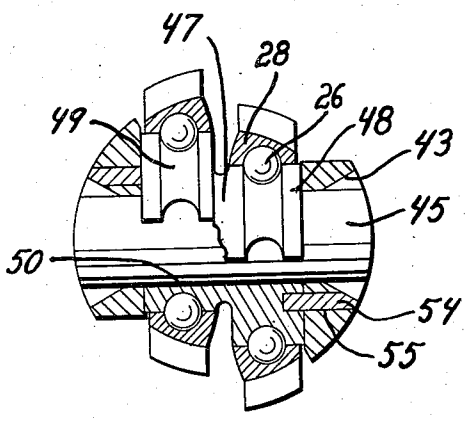


Fig 10

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Patented Mar. 18, 1941

2,235,548

UNITED STATES PATENT OFFICE

2,235,548

BIT FOR DRILLING WELL BORES

John F. Bozeman, Houston, Tex., assignor of five per cent to B. C. Connell, five and sixty-two and one-half one-hundredths per cent to Glen Myers, seventeen and twenty-five one-hundredths per cent to C. W. Hotchkiss, Jr., and twenty-nine and one hundred and twenty-five thousandths per cent to W. T. Touchton, all of Houston, Tex., and five per cent to T. C. Ward, Pittsburgh, Pa.

Application April 1, 1940, Serial No. 327,185

11 Claims. (Cl. 255—71)

This invention relates to new and useful improvements in bits for drilling well bores.

It is one object of this invention to provide an improved bit wherein bearing means are disposed between the cutter disks and the axle, thereby facilitating the rotation of the disks and reducing the wear and frictional resistance incurred by the rotation of said disks.

Another object of this invention is to provide an improved bit which is so constructed as to allow the insertion of the anti-friction elements during the process of assembling the bit, and having means for securely holding said elements in position within the bit, whereby the said elements will not become dislodged.

A still further object of this invention is to provide an improved bit wherein the disks may be assembled with the bearing balls or anti-friction elements upon the axle and the assembly placed in the body of the bit as a unit, said unit being welded or otherwise suitably fastened in position within the bit body.

A further object of the invention is to provide a drill bit having an improved watercourse member mounted in the bit body so as to direct the drilling fluid onto the disks and being formed as a separate unit which may be removed from the body of the bit and replaced as may be necessary.

Another object of the invention is to provide an improved bit having means disposed therein for lubricating the cutter disks, said lubricating means being so constructed and designed as to render it inoperative until the bit has been lowered into the well bore and has encountered the high temperatures usually present in such locations.

A construction designed to carry out the invention will be hereinafter described, together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings, in which an example of the invention is shown, and wherein:

Figure 1 is a view, partly in elevation and partly in section, of a drill bit constructed in accordance with the invention,

Figure 2 is a view, partly in elevation and partly in section, taken at right angles to Figure 1,

Figure 3 is a horizontal cross-sectional view taken on the line 3—3 of Figure 1,

Figure 4 is a plan view of the axle and bearing raceways as constructed in accordance with the first form of the invention,

Figure 5 is a transverse cross-sectional view taken on the line 5—5 of Figure 4,

Figure 6 is a view, partly in section and partly in elevation, of the lower portion of a drill bit, and showing a modified form of the invention,

Figure 7 is a horizontal cross-sectional view taken on the line 7—7 of Figure 6, and showing the lubricating means,

Figure 8 is a plan view of the axle and ball bearing raceways as constructed in accordance with the second form of the invention,

Figure 9 is a view in elevation, partly broken away so as to show the axle and bearing raceway construction of a third form of the invention,

Figure 10 is a horizontal cross-sectional view taken on the line 10—10 of Figure 9,

Figure 11 is a plan view of the bearing raceways used in the third form of the invention which is shown in Figure 9, and

Figure 12 is a transverse cross-sectional view taken on the line 12—12 of Figure 11.

In the drawings, the numeral 10 designates an elongate cylindrical bit body having an internally screw-threaded box 11 formed in its upper portion. The body 10 is provided with an enlarged axial bore 12 extending downwardly from the box 11 and an axial counterbore 13 extending downwardly from the bottom thereof; an annular shoulder 14 thus being formed at the junction of said bores. The body has an offset shank 15 depending from one side of said body, having its lower end reduced and provided with an internally screw-threaded opening 16 which extends transversely through said shank. Under the overhanging bit body, the shank 15 is curved at its upper end as shown at 17 in Figure 1. A cheek plate or hanger 18, having its inner face complementary to the adjacent side of the shank and its upper curved end, is fastened to the shank and body. The lower end of the cheek plate is reduced and is provided with a screw-threaded opening 19, offset laterally with relation to the opening 16, as shown in Figure 6 of the drawings. The cheek plate 18 is fastened to the shank and body by means of welding, or by any other suitable means.

An axle 20, having laterally offset annular collars 21, is provided with raceway grooves 22. Trunnions 23 extend coaxially from the collars. The outer ends of the trunnions 23 carry screw threads 24 which engage in the screw-threaded openings 16 and 19. Each of the raceway grooves 22 has a transverse recess 25 formed therein. The recesses 25 terminate short of the inside rim of each of the grooves, and are of sufficient depth

and width as to accommodate a bearing ball 26 which is designed to ride or roll within the raceway grooves. The recesses are given a dovetailed cross-section for receiving dovetailed plugs 27. Each plug has a snug sliding fit in its recess, and its upper surface is formed contiguous with the surfaces of the collar and groove.

Cutter disks 28, having any desirable type of teeth or cutting edge 29 formed upon their outer peripheries, are provided with central openings 30 so as to fit over the collars 21. The openings 30 have annular grooves 31 formed about their inner walls, said grooves abutting and being complementary to the grooves 22. When the cutter disks are in position upon the collars, the annular grooves 31 register with the grooves 22 of the collars 21 so that the bearing balls 26 may be inserted between the cutter disks and the collars to form a ball bearing mounting for the cutter disks.

One of the important features of the invention is the method and means by which the cutter disks are mounted within the body 10 of the drill bit. In assembling the bit, one of the cutter disks 28 is placed in position upon one of the collars 21 with the plug 27 removed from the recess 25. The bearing balls 26 are then inserted through the recess into the annular space formed by the groove 22 and the groove 31 until the latter space is completely filled with the balls. The plug 27 is then placed in the recess, and it will be noted that the plug will be held against all but outward movement by the inclined walls of said recess. The plug serves to hold the bearing balls within the groove 22 and in engagement with the annular groove 31 provided upon the cutter disk 28. At this stage of assembly, the trunnion 23 is screwed into the screw-threaded opening 16 provided in the shank 15 until the collar 21 substantially abuts the inner wall of said shank and the two collars have their centers alined in a vertical plane. As is shown in Figure 1, when the axle has been screwed into this position, the shank 15 will hold the plug 27 against outward movement, thereby preventing the plug from becoming dislodged and allowing the bearing balls 26 to come out of the grooves 22 and 31. Also the other collar 21 and trunnion 23 are displaced downwardly from the first collar so as to allow the cheek plate 18 to be placed thereupon.

The next step in the assembling operation is the positioning of the other cutter disk 28 upon the other collar 21. The bearing balls 26 are inserted in the same manner as before, and the cheek plate 18 is threaded upon the trunnion 23. The cheek plate or hanger is screwed onto the trunnion to the proper position, wherein its upper end is directly below the overhanging portion of the body 10. At this point the other trunnion is screwed further into the opening 16 until the two trunnions are alined in the same horizontal plane. This action raises the upper end of the cheek plate 18 into engagement with the upper curved end of the shank 15, and the entire bit is in the position desired. Next the joint between the cheek plate and the body 10 is welded, or otherwise suitably fastened, so that the cheek plate becomes an integral portion of said body. It will be noted, that the plug 27 is held by the cheek plate so that the bearing balls 26 are held between the collar 21 and the cutter disk 28. In this manner, the bearing balls on both of the cutter disks are secured in position quickly and easily, and are prevented from becoming dislodged or from getting out of their normal position. If it ever becomes desirable or necessary to dismantle the bit, the cheek plate may be cut loose by a welding torch, or any other suitable means, and the bit dissembled in much the same manner as it was assembled.

A cylindrical insert or core 32, having an annular flange 33 formed on its upper extremity, is positioned within the counterbore 13 so that the flange 33 engages the shoulder 14 formed between the bore 12 and the counterbore 13. If desired, a suitable packing ring 34 may be positioned below the flange and above the shoulder 14 so as to pack off around the outer wall of the core 32. A plurality of longitudinal water passages or courses 35 extend throughout the length of the core and communicate between the box 11 and the bore 12, and the space above the cutter disks 28. Drilling fluids may be pumped down the bore of the tubing (not shown) to enter into the longitudinal water passages 35 and discharge onto the upper portion of the cutter disks and in the spaces between the latter. A recess 36 is provided in the wall of the core 32 and is adapted to be alined with a screw-threaded opening 37 provided in the side wall of the body 10, whereby a screw-threaded set screw 38 may be screwed onto the opening 37 so that the inner end of said set screw will engage in the recess 36, and thereby hold the core 32 securely in position within the counterbore 13. Also a plurality of lugs or reamers 39 are provided upon the outer wall of the body 10 so as to ream and clean up the well bore as the drill bit passes therethrough.

A modified form of the invention is shown in Figures 6, 7, and 8. In this form of the invention, the plugs 27 are eliminated, and, instead, offset collars 40 are formed upon the axle 20, each of said collars being provided with one half of a raceway groove 41. A bearing core 42, being formed with the other half of the raceway groove 41, is adapted to slide over each of the trunnions 23 into position against the other half of the raceway groove formed upon the collar 41. Thus the raceway grooves 41 are split along their transverse axes as is shown in Figures 6, 7, and 8, so that one half of each of the raceway grooves is provided as a bearing core 42. This form of the invention is assembled in much the same manner as the first form, in that one of the cutter disks 28 is placed upon one of the collars 40, and the bearing balls 26 placed in position about the raceway groove 41. The core 42 is then placed over the trunnion 23 into engagement with the bearing balls and the collar 40. The axle 20 is then threaded into the screw-threaded opening 16 and the operation of assembling the bit carried out the same way as with the first form of the invention.

In Figures 9, 10, 11, and 12, a third form or modification of the invention is shown. In this form, the cheek plate 18 is formed integral with the body 10 in the same manner as the shank 15. However, the screw-threaded openings 16 and 19 are replaced with tapered or outwardly flared openings 43. Diametrically opposed female splines 44 are formed in the wall of each of the openings, the splines in the two openings 43 being in horizontal alinement with each other. A cylindrical shaft 45, provided with diametrically opposed male splines 46, is adapted to engage within the openings 43 with the splines 46 engaging the splines 44, whereby the shaft 45 is securely held against rotation within said openings. A raceway member 47, provided with a pair

of offset collars 48 having annular grooves 49 formed therein, has a central transverse opening 50, so as to receive the shaft 45. Female splines 51, similar to the splines 44, are formed in the wall of the opening 50, so as to receive the male splines 46 formed upon the shaft 45. Circular radial openings 52 are provided in the collars 48, and extend from the grooves 49 to the opening 50. Plugs 53 are adapted to fit within the openings 52, and have their upper ends formed so as to conform to the shape of the grooves 49 and the collars 48.

In assembling the bit as disclosed in this invention, the cutter disks 28 are positioned upon the collars 48, and the bearing balls 26 are placed between the cutter disks and the collars by placing them in the openings 52 and allowing them to enter into the space betwen the disks and the collars. When the proper number of balls have been placed betwen the disks and collars, the openings 52 are closed by means of the plugs 53 and the assembly is placed between the shank 15 and the cheek plate 18. While the assembly is in this position, the shaft 45 is passed through the openings 43 so as to extend through the opening 50 and both of the openings 43, while the splines 46 engage the splines 44 and the splines 51, thereby securing the raceway member 47 between the shank 15 and the cheek plate 18 within the bit and holding the raceway member against rotation. While the assembly is in this position, the space between the shaft 45 and the flared walls of the openings 43 may be welded, or otherwise suitably filled, so as to secure the shaft to the shank and the cheek plate. In this manner, the cutter disks are secured within the bit in such a fashion as to prevent their coming loose or becoming out of alinement. If desired, suitable pins 54 may be passed through openings 55 provided in the shank 15 and the cheek plate 18, so as to engage in recesses 56 provided in each side of the raceway member 47. The engagement of the pins 54 with the recesses 56 and the openings 55 further serves to hold the raceway member 47 against rotation within the bit body 10. As will be noted, the plugs 53 are securely held in position by the shaft 45 which abuts their lower extremities and prevent their becoming dislodged.

Both the second and the third modified forms of the invention employ the watercourse insert or core 32 and the reamers 39 similar to those disclosed in the description of the first form of the invention. All three forms of the invention provide simple and efficient means of placing bearing balls in the space between the cutter disks and the axle of a disk drill bit.

In Figure 7, there is shown a structure for providing lubrication for the raceway grooves and the bearing balls. An axial bore 57 is provided in each of the trunnions 23, and a piston plunger 58 has a sliding fit therein. Each piston plunger 58 is provided with an axial stem 59. A screw plug 60 closes the outer end of each of the bores 57, and a compression spring 61 is confined upon each of the stems 59 between the plunger 58 and the plug 60. It is pointed out, that the engagement of the stem 59 with the plug 60 limits the outward travel of each of the plungers 58. A restricted passage 62 extends from the inner end of each of the bores 57 to the groove formed in each of the collars 21. A suitable high viscosity lubricant may be placed in each of the bores 57 and held therein by the piston plungers 58 which are acted upon by the compression springs. As the drill bit is lowered into the well bore, the increased temperatures encountered will cause the high viscosity lubricant to soften and become fluid. When the lubricant has softened sufficiently and attained a sufficiently low viscosity, the springs 61 will force the piston plungers 58 inwardly, thereby forcing lubricant through the restricted passages 62 to the grooves 22 and 31 and the bearing balls 26, and thereby lubricating the same. In this manner, an efficient lubricating means is had, which is held inoperative until the drill bit has reached a temperature sufficiently high as to allow the lubricant to flow through the restricted passages 62.

It is pointed out, that the structure and methods of assembly disclosed herein may be used in many other instances besides the particular instance disclosed.

Various changes, alterations, and modifications may be made in the size, shape, and arrangement of the herein described elements, within the scope of the appended claims.

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

1. A drill bit including, a body having a cutter support thereon, a hanger secured to the body, an axle disposed transversely between and carried by the cutter support and the hanger, annular bearing members carried by the axle, cutter disks mounted on said members, bearing balls interposed between said members and disks, and means for inserting said balls between the members and disks after the disks have been mounted on said members.

2. A drill bit including, a body having a cutter support thereon, a cheek plate secured to the body, an axle disposed transversely between and carried by the cutter support and the cheek plate, annular bearing members carried by the axle in laterally offset relation to each other, cutter disks mounted on said members, bearing balls interposed between said members and disks, and means for inserting said balls between the members and disks after the disks have been mounted on said members.

3. A drill bit including, a body having a cutter support theron, a cheek plate secured to the body, an axle disposed transversely between and carried by the cutter support and the cheek plate, grooved collars carried by the axle in laterally offset relation to each other, cutter disks mounted on said collars, said cutter disks being provided with internal grooves, bearing balls interposed between said collars and disks in the grooves formed in said collars and disks, and means for inserting said balls between the collars and disks after the disks have been mounted on said collars.

4. A drill bit including, a body having a cutter support thereon, a hanger secured to the body, an axle disposed transversely between and carried by the cutter support and the hanger, annular bearing members carried by the axle in laterally offset relation to each other, said axle having lubricant storage cavities and ducts leading therefrom to the bearing members, cutter disks mounted on said members, bearing balls interposed between said members and disks, and means for inserting said balls between the members and disks after the disks have been mounted on said members.

5. A drill bit including, a body having a cutter support thereon, a cheek plate secured to the body, an axle disposed transversely between and carried by the cutter support and the cheek plate, grooved collars carried by the axle in later-

ally offset relation to each other, said axle having lubricant storage cavities and ducts leading therefrom to the bearing members, cutter disks mounted on said members, said cutter disks being provided with internal grooves, bearing balls interposed between said collars and disks in the grooves formed in said collars and disks, and means for inserting said balls between the collars and disks after the disks have been mounted on said collars.

6. A drill bit including, a body having a shank thereon, said shank having its lower end reduced so as to form a cutter support, a cheek plate secured to the body and having its lower end reduced and spaced from the cutter support, an axle disposed transversely between and carried by the cutter support and the cheek plate, annular bearing members carried by the axle in laterally offset relation to each other, cutter disks mounted on said members, bearing balls interposed between said members and disks, and means for inserting said balls between the members and disks after the disks have been mounted on said members.

7. A drill bit including, a bit body having spaced cutter supports at its lower end, an axle carried by said supports and extending therebetween, cutter disks journaled on said axles, bearing balls supporting said disks, said axle having an opening for inserting the balls whereby said balls retain the disks in position on said axle, and closures for said openings confined by the cutter supports.

8. A drill bit including, a bit body having spaced cutter supports at its lower end, an axle carried by said supports and extending therebetween, said axle having lubricant storage cavities and ducts leading therefrom to the bearing surfaces of the axle, cutter disks journaled on said axles, bearing balls supporting said disks, said axle having an opening for inserting the balls whereby said balls retain the disks in position on said axle, and closures for said openings confined by the cutter supports.

9. As a subcombination in a drill bit, an axle having laterally offset bearing collars thereon provided with ball raceways, and ball inserting recesses extending transversely thereof.

10. As a subcombination in a drill bit, an axle having offset bearing collars thereon provided with portions of ball raceways for coacting with bearing cones.

11. A drill bit including, a body having a shank thereon, said shank having its lower end reduced so as to form a cutter support, a cheek plate secured to the body and having its lower end reduced and spaced from the cutter support, an axle disposed transversely between and carried by the cutter support and the cheek plate, annular bearing members carried by the axle in laterally offset relation to each other, said axle having lubricant storage cavities and ducts leading therefrom to the bearing members, cutter disks mounted on said members, bearing balls interposed between said members and disks, and means for inserting said balls between the members and disks after the disks have been mounted on said members.

JOHN F. BOZEMAN.