

June 8, 1943.

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2,321,484

DRILL BIT

Filed March 4, 1940

3 Sheets-Sheet 1

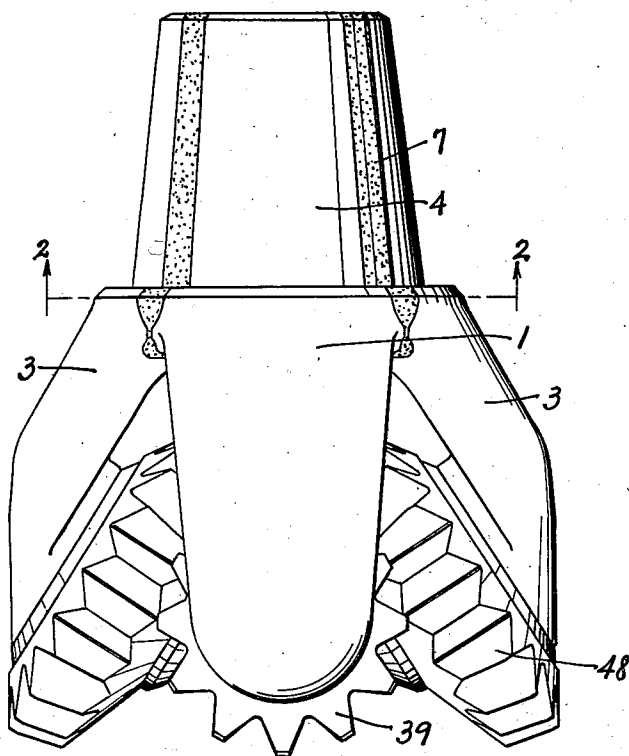


Fig. 1.

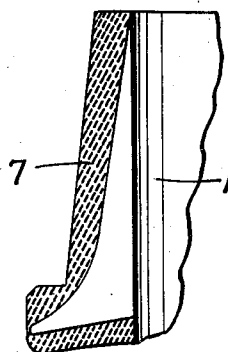


Fig. 3.

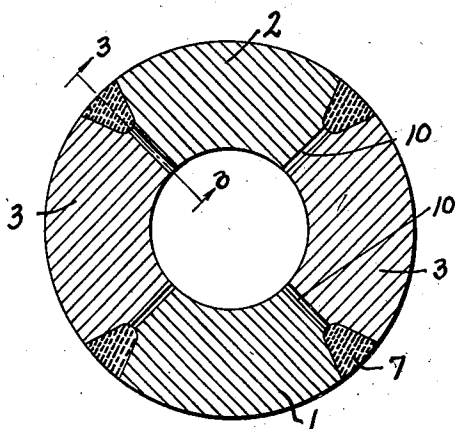


Fig. 2.

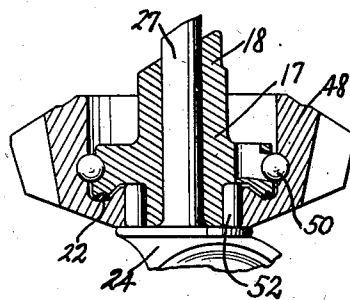


Fig. 12.

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3 Sheets-Sheet 2

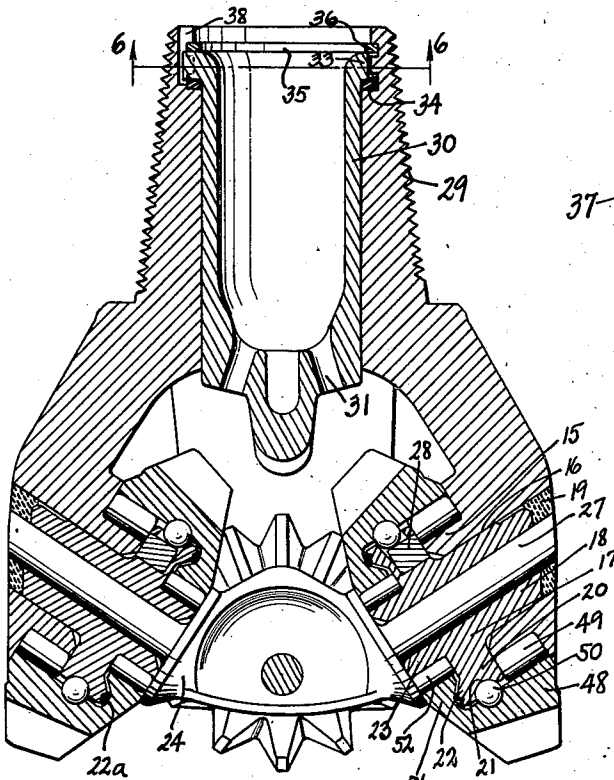


Fig. 4.

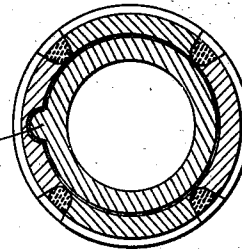


Fig. 6.

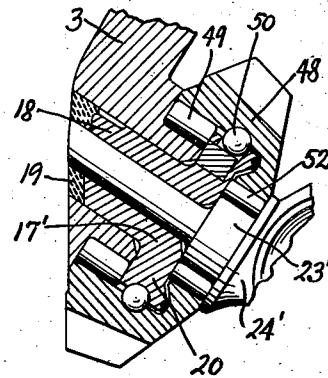


Fig. 7.

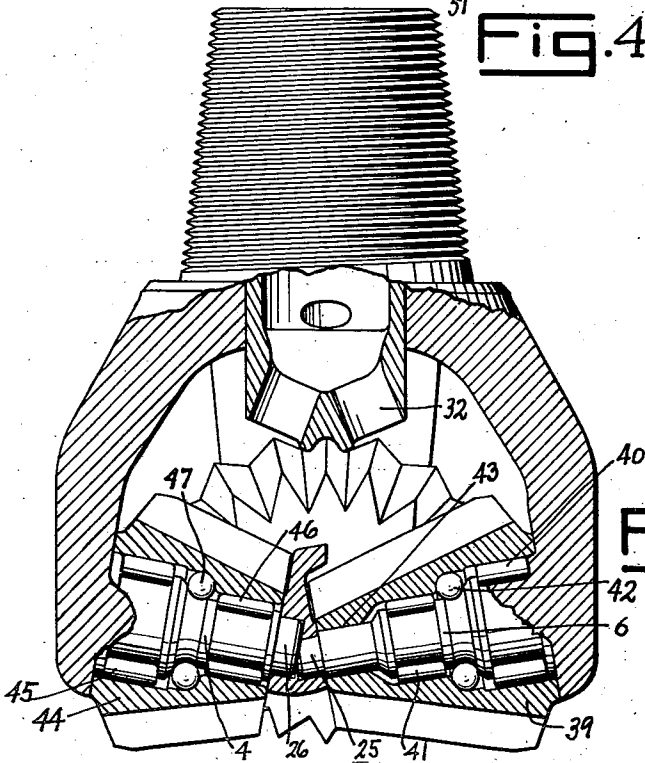


Fig. 5. G. G. Harrington.
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3 Sheets-Sheet 3

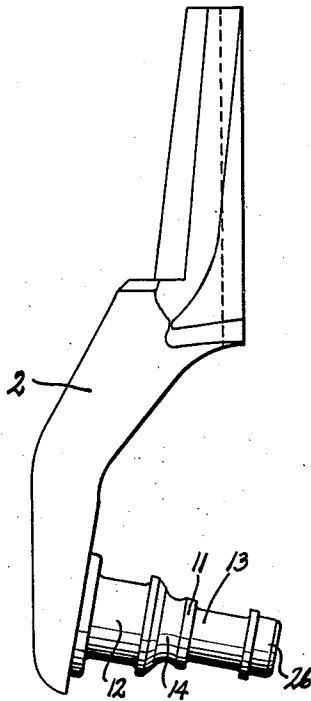


FIG. 8.

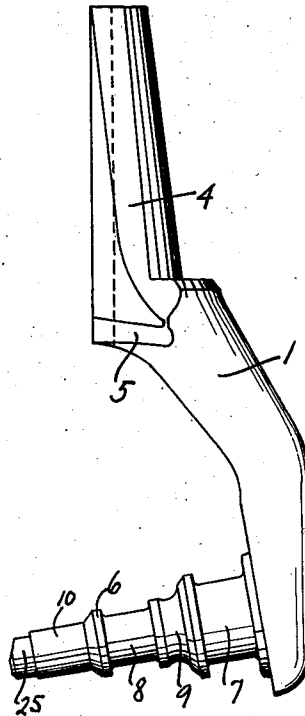


FIG. 9.

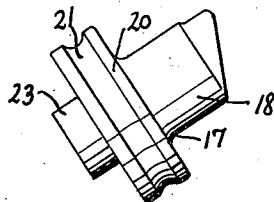


FIG. 10A.

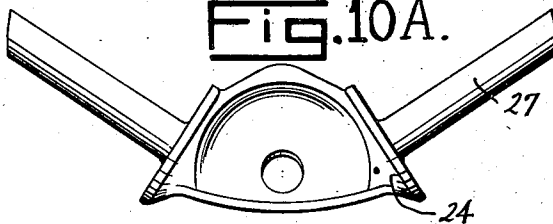


FIG. 11.

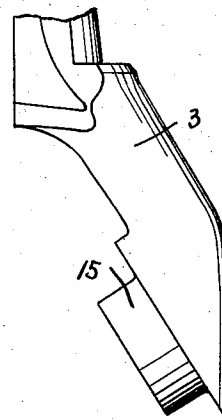


FIG. 10.

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UNITED STATES PATENT OFFICE

2,321,484

DRILL BIT

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Application March 4, 1940, Serial No. 322,052

16 Claims. (Cl. 255-71)

This invention relates generally to deep well drill bits and particularly to cross roller bits. It has for its general object the provision of a bit which will be cheaper to manufacture and more durable and efficient in service than those heretofore employed.

A specific object of the invention is to provide a new and improved assembly of cutters and bearings therefor and mechanical construction of the head, to the end that the bit will embody support parts which are few in number and need not be precisely fitted together.

Another object is to provide such a structure in which the cutter bearings will be able to withstand greater loads than those heretofore known, without breaking down.

Another object of this invention is to provide a bit head having cutter bearing parts thereon, mounted in such a manner as to positively prevent them from becoming disconnected from, or broken off of, the main portion of the bit while the same is in use.

Other objects and advantages will become apparent from the following description and the accompanying drawings wherein is illustrated a preferred embodiment of this invention.

In said drawings:

Fig. 1 is a side elevation of a bit constructed in accordance with this invention.

Fig. 2 is a horizontal cross-section through the body of said bit taken along the line 2-2 of Fig. 1.

Fig. 3 is a partial vertical cross-section through said body taken along the line 3-3 of Fig. 2.

Fig. 4 is a vertical cross-section of the entire bit taken along the side cutter axes thereof.

Fig. 5 is a vertical cross-section of the bit taken substantially along the cross-cutter axes thereof.

Fig. 6 is a horizontal cross-section of said bit taken along the line 6-6 of Fig. 4.

Fig. 7 is a view similar to the lower portion of Fig. 4 but showing a slightly modified form of side cutter bearing construction.

Figs. 8 and 9 are side elevations of the respective segments of the drill body which carry the bearing shafts of the cross cutters.

Fig. 10 is a view similar to the lower portion of Figs. 8 or 9 but illustrating one of the segments which provides the bearing support for one of the side cutters.

Fig. 10A is a side elevation of a bushing forming part of the side cutter bearing.

Fig. 11 is a side elevation of the bridge construction forming a part of this invention.

Fig. 12 is a view in longitudinal cross section illustrating the manner of assembling the bear-

ing bushing and bridge within one of the side cutters.

As shown in Fig. 1, the bit head body is formed of four parts or segments. These are indicated in Figs. 8, 9 and 10 by the numerals 1, 2 and 3, respectively. There are one each of the segments 1 and 2, and two of the segments 3. Each of these four segments has an upper portion adapted to form one-fourth of the shank of the bit head. These are adapted to fit together and have beveled portions adjacent their outer surfaces as indicated at 4 and 5, for the purpose of welding the parts together, as will be hereinafter described.

The segment 1, at its lower end, has a downwardly and inwardly extending bearing supporting shaft 6, with a pair of roller bearing races 7 and 8 thereon, and a thrust ball bearing race 9 between the two. Toward its free end this shaft is also supplied with a friction bearing surface 10.

The segment 2 is provided with a downwardly and inwardly extending shaft 11 at its lower end, the same being provided with roller races 12 and 13, with a ball thrust race 14 between them. The segment 3, at its lower end, is provided with a short downwardly and inwardly extending bearing support comprising an axially extending annular flange 15 and has a passage therethrough axially of said support, as shown at 16 in Fig. 4.

Extending into the opening 16 of each of the segments 3 is a bearing bushing 17 having an outer extension 18 for that purpose. This extension 18 is secured in place by welding 19. The bushing 17 is provided with a radial flange 20, which abuts the end of the bearing support 15 and extends outwardly to provide a ball bearing race 21. This flange is wider at its outer periphery so as to form an overhanging part 22 and provide sufficient width for the ball race 21. This bushing is also provided with an inner extension 23 adapted to provide a roller race. It is noted that this roller race partly underlies the overhanging portion 22 of the flange, thus making for a longer and stronger effective side cutter bearing without increasing the overall length thereof. This construction also provides a tortuous path through the bearing as a whole and retards flow of the gritty and destructive drilling mud therethrough. In order to further hinder any tendency of mud to flow through the bearing, a sealing ring 22a is carried on the overhanging part 22 of the flange and is in contact with the adjacent inner wall of the cutter. Extending between the inner ends of the bushings 17 is a bridge 24 having sockets therein to receive the inner ends 25 and 26 of the shafts 6 and 11,

respectively, which substantially meet each other in the form shown and having projecting end portions 27 extending outwardly through the bushings 17 and held in place by the same welding 19 that holds said bushings.

Each of the bushings 17 has its flange bored adjacent the upper side thereof in a substantially axial direction to provide a channel through which balls may be inserted into the ball races 21. These channels are then closed by means of plugs 28 and when the bushings are in place within the segments 3, the plugs 28 will be held in place by contact with the bearing supporting portions 15 of the segments 3.

In a slight modification illustrated in Fig. 7, the bushing 17' is not provided with the inner extension 23, but instead, the bridge 24' is provided with an enlargement 23' which forms the roller bearing race provided in the other modification by the extension 23. In all other respects the two forms are identical, and it will be noted that in this form also the inner roller race 23' underlies the overhanging part of the flange.

After the bit has been assembled and the segments welded together, the outer surface of the shank thereof is threaded as shown at 29, and there is inserted into the inner portion thereof a slush nozzle assembly 30, having openings 31 and 32 at its lower end for the distribution of slush to the respective cutters of the bit. This tube is formed with a flange 33 at its upper end and adapted to seat within the upper end of the shank against a sealing ring 34 provided for the purpose of preventing leakage of slush between the tube 30 and the interior of the bit shank. The tube is held in place by means of a snap ring 35 inserted in a slot 36 in the upper inner wall of this shank above the flange 33. The flange 33 on one side is provided with a lateral extension 37 forming an integral key which engages within the key way 38 in the bit head.

The cutters and bearings therefor which complete the bit illustrated by the drawings, are illustrated in Figs. 4 and 5. Mounted on the cross cutter shaft 6 is a cross roller cutter 39 having formed on its interior races for two sets of roller bearings 40 and 41 and a set of thrust ball bearings 42. These bearings cooperate with the said races within the cutter 39 and with the races 7, 8 and 9, respectively, on the shaft 6. The cutter 39 also has its inner portion formed with an inwardly extended friction bearing surface 43 in contact with the friction bearing surface 10 on the shaft 6.

The other cross roller cutter 44 is provided on its inner surface with races for the two sets of roller bearings 45 and 46 and a set of ball thrust bearings 47. These bearings co-operate with the said races on the roller cutter 44 and with the races 12, 13 and 14, respectively on the cross cutter shaft 11.

Each of the side roller cutters 48 has the major portion of its length formed with a relatively large inner diameter, a part of which is adapted to provide a race for the outer roller bearings 49 and a part of which is formed with a ball race to receive the ball bearing 50. Extending around the overhanging part 22 of the flange 20 is an inwardly extending flange 51 which is widened at its inner end so that it is substantially the same width as the race for the roller bearings 52. It will thus be seen that the roller bearing 52 may be made relatively long without increasing the overall length of the bearing portion of the cutter and cutter support.

The bearing construction just referred to provides a ball bearing for taking the end thrust upon the cutter and provides two spaced roller bearings which not only serve to take the radial load upon the cutter, but also serve to take such loads as would tend to tilt the cutter about an axis transverse to its own axis. They thus provide a very durable and stable bearing and by virtue of the fact that the inner roller bearing 52 partly underlies the ball bearing 50, this result is accomplished within the cutter which is relatively short, and is short enough to lie within the available space to one side of the cross roller cutters.

In assembling the bit above described, the bushings 17 will first be placed in the side cutters 48, as shown in Fig. 12, and the balls forming the bearing 50 will be dropped into place. The plug 28 will also be inserted. Next the rollers 49 will be placed upon the part 15 of the segment 3 and the assembled cutter and bushing placed over these rollers. The rollers 52 will then be slipped into place and the bridge 24 will be assembled with respect to the two side cutter assemblies, as shown in Fig. 4.

The cutters 39 and 44 will be assembled upon the parts 1 and 2 by first placing the respective roller and ball bearings 40, 41 and 42, and 45, 46 and 47 in place on their shafts and then placing the cutters 39 and 44 over said shafts. The elements 1 and 2 will then be assembled with their inner ends fitted into the openings provided therefor in the bridge and suitable means will be placed between the upper ends of these segments to properly position said upper ends. The parts will be clamped together with suitable clamping means and the various welding operations performed after which the threads 29 will be cut on the shank, and the upper portion of the bit bored to receive the nozzle assembly 30. The insertion of this nozzle assembly and then the snap ring 35 for holding it in place completes the drilling bit. The result is a composite bit body formed of the segments welded together, and the lower end of each segment provides a downwardly projecting bearing extension carrying the bearings for the respective cutters.

The structure above described constitutes a means whereby a very durable and effective drilling bit is provided, and whereby all of the various objects and advantages sought by this invention are attained.

Having described our invention, we claim:

1. In a drill bit, a bit head comprising four segmental sections integrally joined together adjacent their upper ends, each of said sections having an inwardly extending cutter bearing supporting part, two of said parts substantially meeting each other and together extending across the lower portion of said bit head, a pair of cross roller cutters on said parts respectively, a bridge extending between the other two of said parts and having openings receiving the inner ends of said first parts, a bushing extending into each of said other two parts and providing a portion of each side cutter bearing support, each of said bushings having a radial flange thereon formed with a thrust ball race, said flange being undercut to provide an inner roller race of smaller diameter than said thrust ball race and underlying said ball race, a side cutter on each of said bushings having a corresponding race opposite each of said races on said bushing, and balls and rollers in said races respectively for supporting said side cutters against thrust and radial loads.

2. In a drill bit, a bit head comprising four segmental sections integrally joined together adjacent their upper ends, each of said sections having an inwardly extending cutter bearing supporting part, two of said parts substantially meeting each other and together extending across the lower portion of said bit head, a pair of cross roller cutters on said parts respectively, a bridge extending between the other two of said parts and having openings receiving the inner ends of said first parts, a bushing extending into each of said other two parts and providing a portion of each side cutter bearing support, each of said bushings having a radial flange thereon formed with a thrust ball race, said flange being undercut to provide an inner roller race of smaller diameter than said thrust ball race and underlying said ball race, each of said other two parts providing an outer roller race adjacent said radial flange, a side cutter on each of said second mentioned bearing supporting parts and its corresponding bushing, and having ball and roller races opposite each of said races on said bearing supporting parts and bushing respectively, and balls and rollers in said races respectively for supporting said side cutters against thrust and radial loads.

3. In a drill bit, a bit head comprising a plurality of segmental sections integrally joined together adjacent their upper ends, each of said sections having an inwardly extending cutter bearing supporting part, a bushing extending into one of said parts and providing a portion of a side cutter bearing support thereon, said bushing having a radial flange formed with a thrust ball race in its outer periphery, said flange being undercut to provide an inner roller bearing race of smaller diameter than said thrust ball race and underlying said ball race, a side cutter on said bushing having a corresponding race opposite each of said races on said bushing and balls and rollers in said races respectively for supporting said side cutter against thrust and radial loads.

4. In a drill bit having a body with downwardly projecting bearing extensions, and cutters carried thereby, a downwardly and inwardly extending cutter bearing on each of said extensions, a portion of each of said bearings being integral with its extension and providing a roller race, each of said roller races and the portions of said extensions with which they are integral having a bore therethrough coaxial with the corresponding bearing, and a portion of each of said bearings consisting of a bushing extending into said bore and having a ball thrust bearing race thereon, balls and rollers in said races, and a member extending between the inner ends of said bearings and having parts extending through said bushings, and means securing said parts and bushings rigidly to each other and to said extensions.

5. In a drill bit having a bit head with downwardly projecting side cutter bearing extensions, and side cutters carried thereby, a side cutter bearing extending downwardly and inwardly from each of said extensions, a portion of each of said bearings being integral with said extensions respectively, and providing an outer roller bearing race, each of said roller races and the portions of said extensions with which they are integral having a bore therethrough coaxial with the corresponding bearing, a second portion of each of said bearings comprising a bushing extending into said bore, and formed with a thrust ball bearing race, and a bridge member extend-

ing between the inner ends of said bushings and having parts extending through said bushings and rigidly secured to said bushings and extensions, a third portion of each of said bearings being formed on said bridge member inwardly from the inner ends of said bushings and providing a second roller bearing race and rollers and balls in said roller and ball bearing races respectively.

6. In a drill bit having a body with downwardly projecting bearing extensions, and cutters carried thereby, a downwardly and inwardly extending cutter bearing on each of said extensions, a portion of each of said bearings being integral with its extension and providing a roller race, and a portion of each of said bearings consisting of a bushing rigidly secured to said extension and having a radial flange with a ball thrust bearing race formed in its outer edge, said flange having an opening therein extending longitudinally with respect to the axis of said bushing from the outward and upward surface of said flange into communication with said ball thrust bearing race, whereby the balls may be inserted into said race, means for plugging said opening and adapted to be held in place in said opening by contact with the adjacent portion of said extension when said bushing is in place on said extension, balls and rollers in said races, and a member extending between the inner ends of said bearings and having parts extending through said bushings, and means securing said parts integrally to said extensions.

7. In a drill bit having a body with a downwardly projecting side cutter bearing extension, and a side cutter carried thereby, a downwardly and inwardly extending bearing on said extension, a portion of said bearing being integral with said extension and providing an outer roller race, and a portion of said bearing consisting of a bushing rigidly secured to said extension and having a ball thrust bearing race formed in its outer periphery, the portion of said bushing supporting said ball thrust bearing race being undercut, and means providing an inner roller race partly in said undercut portion and underlying said ball thrust bearing race, said side cutter having a race opposed to each of said races above mentioned with the race opposing said inner roller race extending into said undercut portion, and balls and rollers in said races respectively to form inner and outer roller bearings and an intermediate ball thrust bearing for said cutter.

8. In a drill bit having a bit head with a downwardly projecting side cutter bearing extension thereon and a side cutter carried thereby, a side cutter bearing extending downwardly and inwardly from the lower portion of said extension, said side cutter bearing comprising an outer roller bearing race, an intermediate ball thrust bearing race, and an inner roller bearing race, said outer roller bearing race and said ball thrust bearing race being of larger diameter than said inner roller bearing race, said inner roller bearing race extending outwardly beneath said ball thrust bearing race, said side roller cutter being mounted on said bearing and having a part of larger diameter forming races for said outer roller bearing and said ball thrust bearing respectively, and a part of smaller diameter extending radially inwardly and overlying said inner roller bearing race and extending outwardly beneath said ball thrust bearing race, and rollers and balls in said roller and ball races respectively.

9. In a drill bit, a side cutter bearing compris-

ing outer and inner radial roller bearings and an intermediate ball thrust bearing, one of said roller bearings being of smaller diameter than and having both its inner and outer races and its rollers partly underlying said ball thrust bearing.

10. In a drill bit, a side cutter bearing comprising outer and inner radial roller bearings and an intermediate ball thrust bearing, said inner radial bearing being of smaller diameter than and having both its inner and outer races and its rollers partly underlying said ball thrust bearing.

11. In a drill bit, a bit head having a depending arm, an integral bearing element extending downwardly and inwardly from the lower portion of said arm and having a bore therethrough, an attached bearing element, a cutter on said bearing element, cooperating ball races within said cutter and on said attached bearing element, a passageway extending from an outwardly facing portion of said bearing element into the said bearing race thereon, balls in said race adapted to be inserted through said passageway into said race while said cutter is on said element and before said element has been secured to said head, means extending into said passageway and closing the same, said element having a part inserted into said bore and said head having a part adapted to hold said means in place when said element is in place within said bore, and means securing said element within said bore.

12. In a drill bit, a side cutter bearing comprising axially spaced inner and outer radial bearing portions, a thrust ball bearing between said radial bearing portions, one of said radial bearing portions being of a diameter smaller than said thrust ball bearing and having opposed bearing surfaces both lying partly within said thrust ball bearing.

13. In a drill bit, a side cutter bearing comprising axially spaced inner and outer radial bearing portions, a thrust ball bearing between said radial bearing portions, one of said radial bearing portions being of a diameter smaller than said thrust ball bearing and having opposed bearing surfaces, said ball thrust bearing having a part formed with a ball race in its peripheral surface, said part having a portion overlying a portion of both opposed bearing surfaces of said one radial bearing.

14. In a drill bit, a side cutter bearing comprising a pair of opposed bearing surfaces of larger diameter and an axially aligned pair of opposed bearing surfaces of smaller diameter, the space between the opposed bearing surfaces of one pair communicating with the space be-

tween the opposed bearing surfaces of the other pair to provide a path open at one end of one pair of bearing surfaces and extending therefrom through both pairs of bearing surfaces to and opening at one end of the other pair of bearing surfaces, said pair of bearing surfaces of smaller diameter partly underlying said pair of bearing surfaces of larger diameter to make said path tortuous to oppose the flow of fluid into either end of and through said path.

15. A drill bit head comprising a plurality of segmental parts divided along lines extending from one end to the other end of the head, said parts each having an inwardly extending bearing portion at its lower end and a shank portion at the upper end, means for connecting the bearing portions of said segmental parts to properly position said bearing portions with respect to each other, weld metal joining the shank portions of the segments together while in positions determined by the connections between the bearing portions of the respective segmental parts without disturbing the correlation of the interconnected bearing portions to form a complete bit shank remote from said bearing portions while said bearing portions are so positioned, said shank formed of joined segmental portions having its surface threaded adjacent its upper region to provide a connection for a drill string.

16. A drill bit head comprising a plurality of segmental parts divided along lines extending from one end to the other of the head, said parts each having an inwardly extending bearing portion at its lower end and a shank portion at its upper end, a bridge extending between and interconnecting the inner ends of certain of said bearing portions to correlate the same with respect to each other, means carried by said bridge for engaging the inner ends of other of said bearing portions to correlate all of said bearing portions with respect to each other, weld metal joining the shank portions of the segments together while in positions determined by the connections between the bearing portions of the respective segmental parts without disturbing the correlation of the interconnected bearing portions to form a complete bit shank remote from said bearing portions while said bearing portions are so positioned, said shank formed of joined segmental portions having its surface threaded adjacent its upper region to provide a connection for a drill string.

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