May 2, 1939. A. C. CATLAND 2,156,676

CUTTER MOUNTING

Original Filed Nov. 5, 1937

Fig. 1.

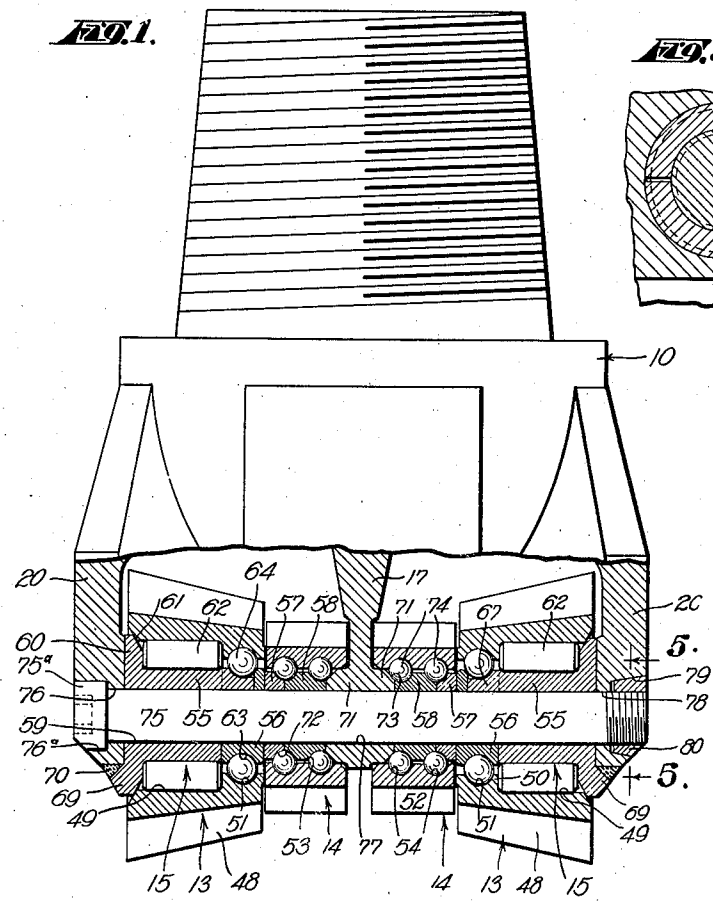


Fig. 5.

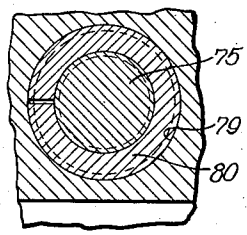


Fig. 2.

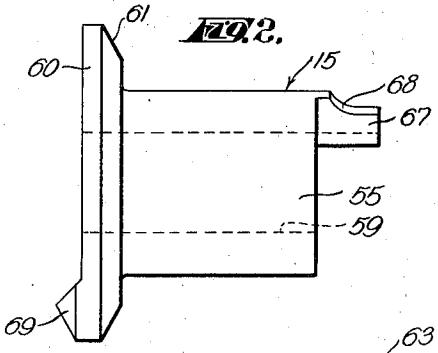


Fig. 3.

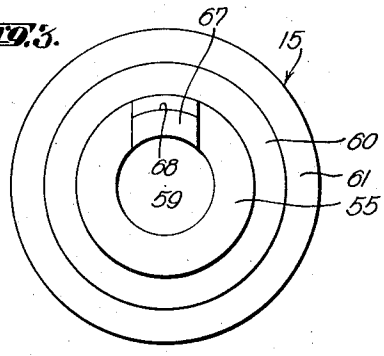
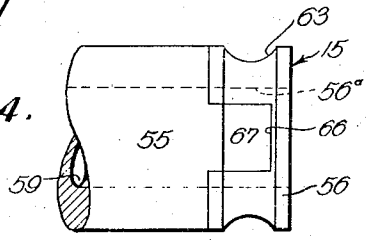


Fig. 4.



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CUTTER MOUNTING

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9 Claims. (Cl. 255—71)

This invention relates to well drilling tools and relates more particularly to the bearings or mountings for the rotatable cutters of well bits.

A general object of this invention is to provide a dependable long-wearing anti-friction bearing assembly or bearing means for the cross cutters or inner cutters of a rotary rock bit.

This application is a division of my application for Letters Patent entitled Rock bit, Serial No. 172,967, filed November 5, 1937.

Another object of this invention is to provide an improved anti-friction bearing for a cutter of a well bit in which a series of balls assumes the end thrusts in both directions and assists in taking the radial thrusts from the cutter and a series of rollers assumes the radial thrusts, throughout the major portion of the cutter's length.

Another object of this invention is to provide a cutter mounting of the character mentioned in which the parts are related so that the anti-friction rollers may extend to a point adjacent an end of the cutter to assure a better distribution of the forces transmitted between the cutter and its bearing.

Another object of this invention is to provide a cutter mounting of the character mentioned including a bearing member on which the rollers bear and revolve and a tongue on said member occupying and closing the ball admitting passage in the race member on which the balls bear and revolve.

A further object of this invention is to provide a well bit construction in which a single shaft or pin carries the bearing means of the two sets of inner cutters and is secured to the bit body by a novel dependable retaining means.

The various objects and features of my invention will be fully understood from the following detailed description of a typical preferred form and application of the invention, throughout which description reference is made to the accompanying drawing, in which:

Fig. 1 is a side elevation of a bit embodying the present invention with its lower portion broken away to illustrate the cutters and their bearing means in transverse cross section. Fig. 2 is an enlarged side elevation of the bearing member for one of the large cutters. Fig. 3 is an end view of the member shown in Fig. 2. Fig. 4 is a top elevation of the race for one of the large cutters showing a portion of an adjacent bearing member, and Fig. 5 is an enlarged fragmentary vertical detailed sectional view taken as indicated by line 5—5 on Fig. 1.

The cutter assemblies and bearing means of the present invention may be employed on well bits varying considerably in type and construction. In the drawing the invention is illustrated as applied to a rotary rock bit having a body 10 provided with a substantially central depending web 17 and two diametrically opposite legs 20. The web 17 and the legs 20 are shown as integral parts of the body 10 and are substantially vertical. The inner sides of the depending legs 20 have suitable raised bearing surfaces.

The construction of the present invention may be said to comprise, generally, two sets or pairs of roller cutters 13 and 14 and bearing means 15 for rotatably supporting the sets of cutters 13 and 14 on the bit body 10.

The cutters 13 are frusto-conical roller cutters supported by the means 15 at the inner sides of the legs 20. The cutters 13 are arranged with their small ends facing inwardly toward the central longitudinal axis of the bit. Peripheral cutting teeth 48 are provided on the cuters 13. Each cutter 13 has a central longitudinal opening 49. The openings 49 are of substantial diameter and are provided at their inner ends or inner portions with inwardly projecting annular flanges 50. A ball race or groove 51 is provided in the inner surface of each flange 50. The flanges 50 provide the walls of the openings 49 with abrupt annular shoulders.

The cutters 14 are substantially cylindrical roller cutters rotatably supported by the means 15 to act on the formation at the inner portion of the well bore. There are two cutters 14, one being arranged at each side of the web 17. The cutters 14 may be alike. Each cutter 14 is provided with peripheral cutting teeth 52 and a central longitudinal opening 53. Two axially spaced ball races or grooves 54 are provided in the wall of each cutter opening 53. The cutters 14 are preferably shorter and smaller in diameter than the frusto-conical cutters 13.

The bearing means 15 for the inner cutters 13 and 14 comprises two like bearing assemblies and a single support member or pin 75 carried by the web 17 and the legs 20. The two bearing assemblies just mentioned each include a bearing member 55 and a race 56 within a cutter 13 and races 57 and 58 within a cutter 14.

The bearing members 55 are elongate cylindrical parts having central longitudinal openings 59. Radial flanges 60 are provided on the outer ends of the members 55 to bear against the inner sides of the adjacent legs 20. The flanges 60 are beveled off at 61 to be partially received in beveled

outer portions of the cutter openings 49. The members 55 are received in the openings 49 with substantial clearance and series of rollers 62 are arranged in the openings 49 to rotatably support the cutters 13 on the bearing members 55. The rollers 62 are arranged between the flanges 50 and 60 which flanges hold them against endwise movement.

The races 56 are generally cylindrical spool-like members having central longitudinal openings 56a. The races 56 may be of the same diameter as the members 55 and are arranged against the inner ends of the members. The races 56 are proportioned to have their inner ends in the same planes as the inner ends of the cutters 13. A peripheral ball groove 63 is provided in each race 56. The grooves 63 directly oppose the grooves 51 in the flanges 50. Series of balls 64 are arranged in the opposing grooves 51 and 63. The grooves 51 and 63 are of such depth that the balls 64 transmit end thrusts in both directions between the cutters 13 and the races 56 and assist in transmitting the radial thrusts.

In accordance with the invention the races 56 have notches 66 entering their outer ends and joining or intersecting their grooves 63 to admit the balls 64 to the opposing grooves 51 and 63 when the bearing means is being assembled. The inner ends of the bearing member 55 are provided with projecting tongues 67 which occupy the notches 66. The tongues 67 have curved concave surfaces 68 on their outer sides for completing the grooves 63 in the races 56. The tongues 67 occupying the notches 66 prevent the loss of the balls 64 from the sets of opposing grooves 51 and 63. It is preferred to position the parts so that the notches 66 and the tongues 67 are at the upper sides of the assemblies where the tongues and the adjacent edge parts of the races 56 are subjected to a minimum of wear.

Means is provided to prevent rotation of the bearing members 55 and the races 56 to retain them in the positions where the notches 66 and the tongues 67 are at the upper sides of the assemblies. Lugs 69 project outwardly from the flanges 60 at the lower ends of the legs 20. Welds 70 secure the lugs 69 to the legs 20 to hold the bearing members 55 against rotation. The tongues 67 cooperating with the notches 66 of course hold the races 56 against turning. It is to be noted that each of the cutters 13 is supported by a series of rollers 62 of substantial length and by annular series of balls 64. The rollers 62 assume the radial thrusts from the cutters 13 throughout the major portions of the cutters 13 and have their outer ends adjacent the outer ends of the cutters. The balls 64 assuming the end thrusts in both directions are effective in preventing endwise movement of the cutters 13 and in preventing the cutters from engaging against the legs 20.

The races 57 and 58 for the inner cutters 14 are generally cylindrical members having central longitudinal openings. The races 57 and 58 are arranged in end to end relation and the outer ends of the races 57 engage the inner ends of the races 56. The races 57 and 58 are received in the openings 53 of the cutters 14 with substantial clearance. In accordance with the invention the web 17 is provided at its opposite sides with bearing bosses 71 projecting into the cutter openings 53. The inner ends of the races 58 may bear against the ends of the bosses 71. The opposing peripheral corners of the engaging pairs of races 57 and 58 are provided with grooves of partially circular cross section which register to form ball grooves 72. The grooves 72 directly oppose the outermost grooves 54 in the cutters 14. The opposing peripheral corners of the races 58 and the bosses 71 are shaped to form annular ball grooves 73 to directly oppose the inner grooves 54 in the cutters 14. Series of balls 74 are arranged in the sets of opposing grooves 54 and 72 and 54 and 73 to rotatably support the cutters 14. The grooves 54 and 72 and 54 and 73 are of such depth that both series of balls 74 take the end thrusts in both axial directions as well as the radial thrusts imposed on the cutters 14.

The bearing members 55 and the races 56, 57 and 58 are carried by the single shaft or pin 75. The pin 75 is passed through an opening 76 in one of the legs 20 and an opening 77 in the web 17 and has an end portion received in an opening 78 in the other leg 20. The pin 75 may be substantially horizontal. The opening 77 in the web 17 extends centrally through the bosses 71 so that the web has extensive supporting engagement with the pin 75. The opening 78 is provided at its outer end with a tapered socket 79 for receiving a frusto-conical nut 80. The nut 80 is longitudinally split to be flexible and resilient. The pin 75 is threaded into the nut 80. The pin 75 has a head 75a received in a socket 76a in the opening 76 to engage against the leg 20 having the said opening. Threading or tightening of the pin 75 draws the tapered split nut 80 into the tapered socket 79. The taper of the socket 79 and the nut 80 causes the nut to be tightly contracted onto the pin 75 so that the nut cannot become displaced or lost. The supporting pin 75 passes through the openings 59 of the bearing members 55, the openings 56a of the races 56 and the openings of the races 57 and 58 to support these parts and the sets of cutters 13 and 14.

It is believed that the utility and practicability of the improved cutter and bearing assembly of the invention will be understood from the foregoing detailed description. In the operation of the bit the body 10 is secured to the lower end of a well drilling string and the said string is rotated and fed downwardly in the usual manner. The sets of inner cutters 13 and 14 act on the inner portion of the well bore and the cutters rotate about substantially horizontal axes. The cutters 13 are supported by the rollers 62 which are effective in taking the heavy radial loads or thrusts. The cutters 13 are also rotatably supported by the balls 64 which assume the end thrusts in both directions so that the cutters 13 need not bear on thrust washers or body surfaces. The cutters 14 are rotatably supported by spaced sets of balls 74 which take the axial thrusts in both directions, as well as the radial thrusts. The bearing means 15 for the inner cutters 13 and 14 is such that the several parts may be easily and quickly assembled. The several cutters 13 and 14 of the bit may be easily removed from the body 10 for replacement and to permit the reconditioning of the bearing means, etc.

Having described only a typical preferred form and application of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims:

Having described my invention, I claim:

1. A well bit comprising a body having a depending leg, a support projecting from the leg, a

roller cutter having an opening receiving the support, there being a ball groove in the wall of the opening, a tubular bearing member arranged on the support having a ball groove opposing the first mentioned groove, balls in the grooves assuming end thrusts in both directions from the cutter, a second tubular bearing member arranged on the support between the leg and the first bearing member, and rollers rotatably supporting the cutter on the second bearing member.

2. A well bit comprising a body having a depending leg, a support projecting from the leg, a roller cutter having an opening receiving the support, there being a ball groove in the wall of the opening, a bearing member on the support having a ball groove opposing the first mentioned groove, balls in the grooves assuming end thrusts imposed on the cutter, a shoulder on the wall of said opening adjacent said grooves and facing the leg, a second bearing member on the support between the leg and the first bearing member, a radial flange on the second member bearing against said leg, and a series of rollers between the shoulder and the flange rotatably supporting the cutter on the second member.

3. A well bit comprising a body having a depending leg, a support projecting from the leg, a roller cutter having an opening receiving the support, there being a ball groove in the wall of the opening, a bearing member on the support having a ball groove opposing the first mentioned groove, balls in the grooves assuming end thrusts imposed on the cutter, the member having a notch in its end opposing the leg for admitting the balls to the grooves, a second bearing member between the leg and the first bearing member, a tongue in the said second bearing member occupying the notch, a shoulder on the wall of said opening adjacent the grooves, a flange on the said second member bearing on the leg, and rollers between the shoulder and flange rotatably supporting the cutter on the said second member.

4. In a well bit, a cutter having an opening, a support extending through the opening, a bearing member on the support having a radial flange at one end, the wall of said opening having a shoulder spaced from and opposing the flange and having a ball race, a series of rollers in the opening between the flange and the shoulder bearing on the member to support the cutter for rotation, a race member on the support at the other end of the bearing member having a ball race opposing the first named race, and balls in the opposing races transmitting end thrusts in both directions.

5. In a well bit, a cutter having an opening, a support extending through the opening, a bearing member on the support having a radial flange at one end, the wall of said opening having a shoulder spaced from and opposing the flange and having a ball race, a series of rollers in the opening between the flange and the shoulder bearing on the member to support the cutter for rotation, a race member on the support at the other end of the bearing member having a ball race opposing the first named race and having a notch extending from one end to the race, balls inserted through the notch into the opposing races to transmit end thrusts in both directions, and a tongue on the bearing member occupying the notch.

6. In a well bit, a cutter having an opening, a support extending through the opening, a bearing member on the support having a radial flange at one end, the wall of said opening having a shoulder spaced from and opposing the flange and having a ball race, a series of rollers in the opening between the flange and the shoulder bearing on the member to support the cutter for rotation, the rollers having a length greater than one-half the length of the cutter, a race member on the support at the other end of the bearing member having a ball race opposing the first named race, and balls in the opposing races transmitting end thrusts in both directions.

7. In a well bit a frusto-conical cutter having a longitudinal opening, a cutter support extending through the opening, a bearing member on the support having a radial flange adjacent the large end of the cutter, the wall of said opening having a ball groove adjacent the small end of the cutter and a shoulder adjacent the groove and opposing the flange, a series of rollers between the flange and the shoulder bearing on said member to rotatably support the cutter, a race member on the support and having a ball groove opposing the first named groove, and balls in the opposing grooves, the cooperation between the balls and the grooves being of such extent that the balls take the axial thrusts from the cutter in both directions.

8. In a well bit, a body, a depending web on the body having an opening, a boss on a side of the web, a cutter having an opening, a supporting pin carried in the opening and projecting from the boss to extend through the cutter opening, a bearing member on the pin having an end engaging against the boss, there being a ball race in the wall of the cutter opening and a ball race formed in the abutting peripheral corners of the member and boss and balls in the races rotatably supporting the cutter.

9. In a well bit, a body, a depending web on the body having an opening, a boss on a side of the web, a cutter having an opening, a supporting pin carried in the opening and projecting from the boss to extend through the cutter opening, a bearing member on the pin having an end engaging against the boss, there being a ball race in the wall of the cutter opening and a ball race formed in the abutting peripheral corners of the member and boss opposing the first named race, and balls in the opposing races rotatably supporting the cutter, the races being formed and related so that the balls assume end thrusts from the cutter in both directions.

ALFRED C. CATLAND.