Feb. 8, 1938. A. C. CATLAND 2,107,626

WELL BIT

Filed April 13, 1936 2 Sheets-Sheet 1

Fig. 1.

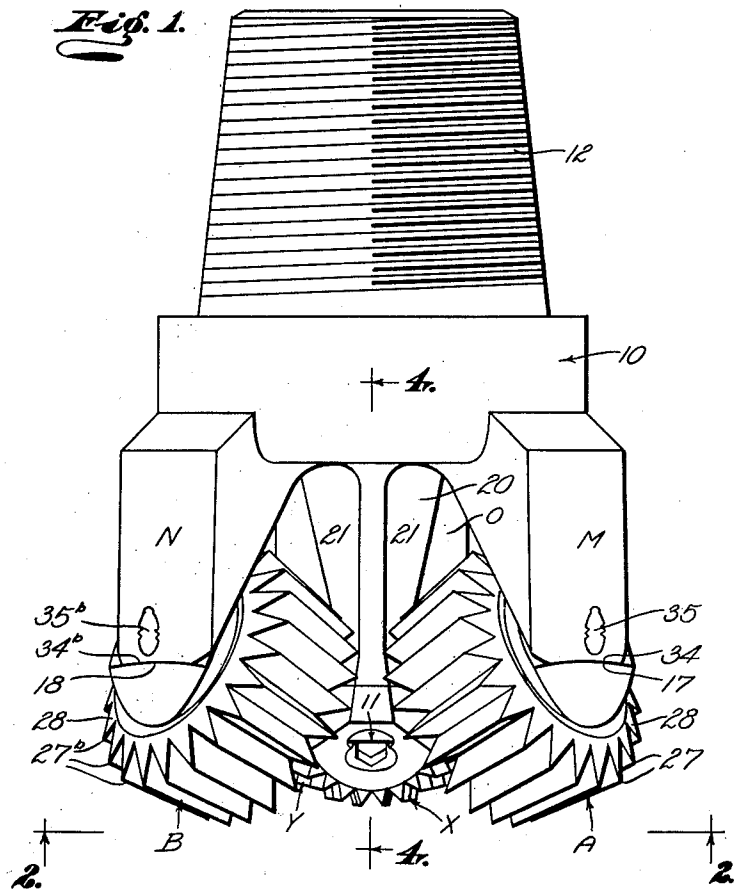
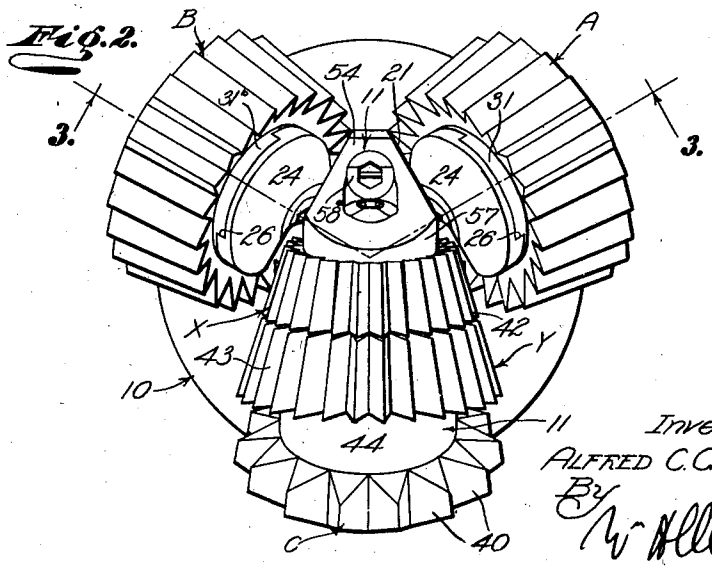


Fig. 2.



Inventor
ALFRED C. CATLAND
By
His Attorney

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Fig. 3.

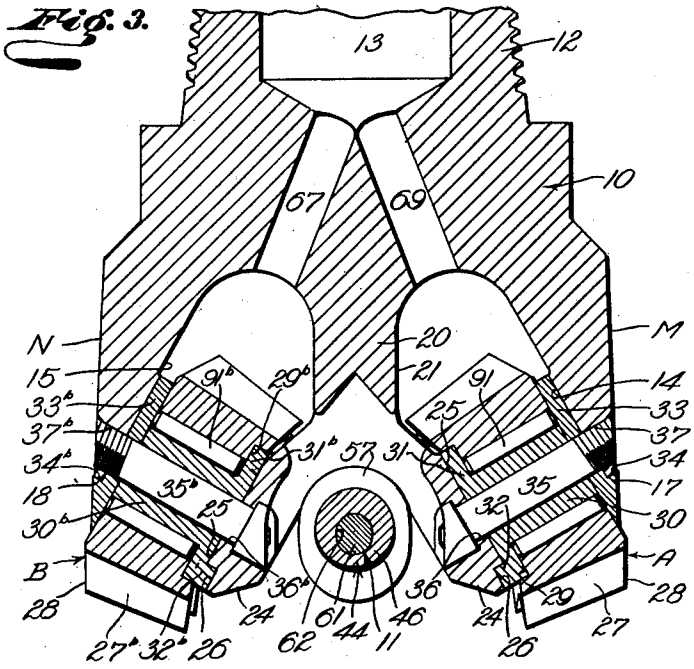


Fig. 4.

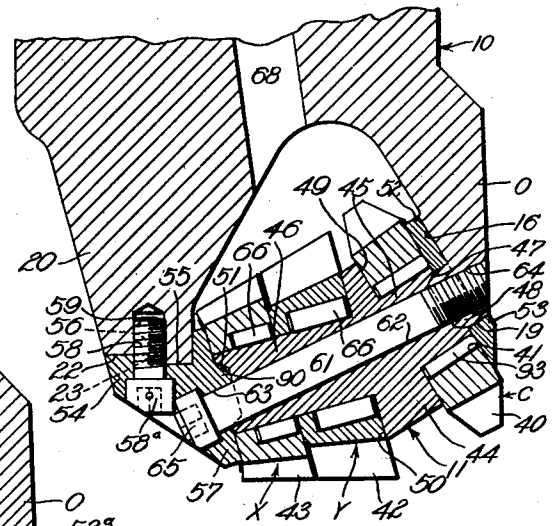


Fig. 6.

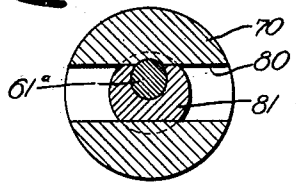
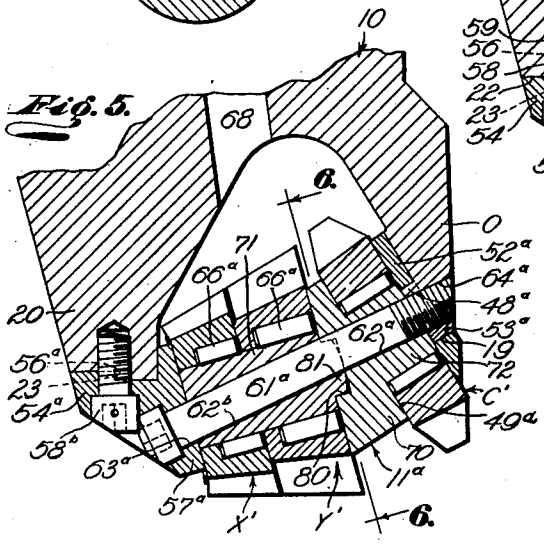


Fig. 5.



Inventor
ALFRED C. CATLAND
By
His Attorney

Patented Feb. 8, 1938 2,107,626

UNITED STATES PATENT OFFICE

2,107,626

WELL BIT

Alfred C. Catland, Alhambra, Calif., assignor to Globe Oil Tools Company, Los Nietos, Calif., a corporation of California

Application April 13, 1936, Serial No. 74,164

11 Claims. (Cl. 255—71)

This invention relates to a well drilling tool and relates more particularly to a roller rock bit. A general object of this invention is to provide an improved, simplified and very efficient roller rock bit.

Another object of this invention is to provide an improved roller bit embodying three circumferentially spaced outer roller cutters operable to cut the well bore to gauge and a pair of inner roller cutters for acting on the inner portion of the well bore, said cutters being related to be particularly rapid and efficient in their drilling action.

Another object of this invention is to provide a roller bit of the character mentioned in which two of the outer roller cutters are mounted or supported entirely independently of the mounting of the inner cutters.

Another object of this invention is to provide a well bit of the character mentioned in which two of the three outer cutters are substantially longer or thicker than the third outer cutter.

Another object of this invention is to provide a roller bit of the character mentioned in which the cutters are dependably supported for rotation and for easy replacement without the embodiment or inclusion of a large removable spider or mounting member.

Another object of this invention is to provide a roller bit of the character mentioned in which the inner ends of the cutter carrying bushings or bearings are supported by integral parts of the shank. Well bits embodying inner and outer roller cutters have usually included a comparatively large removable spider or mounting member for mounting the cutters on the shank and for carrying the inner ends of the cutter bearings or mountings. The improved bit of the present invention is stronger and more rigid than the typical bits embodying such mounting members or spiders, as it embodies parts integral with the shank for supporting the cutter mountings.

Another object of this invention is to provide a roller bit of the character mentioned in which all the wear receiving parts may be easily and quickly replaced.

A further object of this invention is to provide a roller bit of the character mentioned embodying novel and particularly effective mounting means or supporting means for the cutters.

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

Fig. 1 is a side elevation of the roller bit provided by this invention. Fig. 2 is a bottom elevation view of the bit being a view taken as indicated by line 2—2 on Fig. 1. Fig. 3 is a vertical detailed sectional view being a view taken substantially as indicated by line 3—3 on Fig. 2. Fig. 4 is a fragmentary vertical detailed sectional view taken substantially as indicated by line 4—4 on Fig. 1. Fig. 5 is a view similar to Fig. 4 showing a modified form of cutter mounting means and Fig. 6 is a transverse detailed sectional view taken substantially as indicated by line 6—6 on Fig. 5.

The roller bit of the present invention illustrated in Figs. 1 to 4, inclusive, of the drawings, includes, generally a shank 10, spaced outer cutters A and B rotatably supported on the lower end of the shank 10, an outer cutter C at the lower end of the shank spaced between the cutters A and B, inner cutters X and Y, and means 11 for rotatably mounting the cutters C, X and Y on the lower end of the shank 10.

The shank 10 is adapted to be connected with the lower end of a well drilling string. Suitable means is provided on the upper end of the shank 10 for facilitating its connection with the drilling string. In the case illustrated in the drawings a screw threaded pin 12 is provided on the upper end of the shank 10 to thread into a socket in the lower end of a drill collar or connecting member of the drilling string. A socket or fluid passage 13 enters the shank 10 through the upper end of its pin 12 to communicate with the fluid passage in the drilling string. The lower portion of the shank 10 is formed to receive and carry the cutters A and B and the mounting means 11 of the cutters C, X and Y. Three circumferentially spaced legs M, N and O project from the lower end of the shank 10. The legs M, N and O are substantially equally spaced and project downwardly and slightly outwardly from the lower end of the shank. The inner sides or surfaces 14, 15 and 16, respectively, of the legs M, N and O, are substantially flat and inclined downwardly and outwardly relative to the longitudinal axis of the shank. Flat downwardly and inwardly inclined faces 17, 18 and 19 are provided on the lower ends of the respective legs M, N and O. In accordance with the invention the legs M, N and O are integral with the shank 10.

The invention provides a leg or projection 20 on the shank 10 projecting downwardly within the series of spaced legs M, N and O. The pro-

jection 20 is integral with the shank 10 and is substantially vertical. In the preferred construction the projection 20 is offset from the central longitudinal axis of the shank 10 being closer to the legs M and N than to the leg O. The projection 20 may have a flat substantially vertical inner side and outwardly flared or diverging side surfaces 21. The side surfaces 21 of the projection 20 oppose the inner surfaces 14 and 15 of the legs M and N leaving spaces or pockets which carry the cutters A and B. A flat bearing surface 22 is provided on the lower end of the projection 20. The surface 22 may be substantially normal to the longitudinal axis of the shank 10 and has a vertical or substantially axial shoulder 23.

The lower end portion of the projection 20 is bifurcated having two arms or branches 24 projecting downwardly and outwardly as well as horizontally from the projection. The branches 24 have flat substantially disc-shaped bearing surfaces 25 spaced from and opposing the inner surfaces 14 and 15 of the opposing legs M and N. The surfaces 25 are substantially parallel with the inner surfaces 14 and 15 of the legs. Flat walled notches 26 intersect the lower end portions of the surfaces 25. It is to be understood that the projection 20 and its branches 24 are integral parts of the shank 10.

The outer cutters A and B are in the nature of rotatable roller cutters for acting on the peripheral or outer portion of the well bore to cut the bore to gauge. The roller cutters A and B are of the same size and are frusto-conical having pitched or tapered peripheries. The cutters A and B have peripheral cutting parts or teeth 27 and 27^b respectively for acting on the formation. In the case illustrated in the drawings the teeth 27 and 27^b are straight and extend axially of the cutters, it being understood that the teeth may be pitched or spiralled if desired. The outer ends of the teeth 27 and 27^b are preferably bevelled off as at 28 and the inner ends of the teeth 27 and 27^b may extend or project inwardly from their respective cutters A and B. The opposite ends of the cutters A and B may be flat and normal as illustrated in Fig. 3 of the drawings. A cylindrical concentric socket 29 is provided in the inner end of the cutter A and a similar socket 29^b is provided in the inner end of the cutter B.

The cutters A and B are supported between the legs M and N and the branches 24 to rotate about downwardly and inwardly inclined axes. The means for rotatably supporting the outer cutters A and B comprise a bearing or bushing 30 extending through and rotatably carrying the cutter A and a similar bushing 30^b extending through and rotatably carrying the cutter B. An annular flange 31 is provided on the inner end of the bushing 30 and fits in or cooperates with the socket 29 in the cutter A. An annular flange 31^b is provided on the inner end of the bushing 30^b and cooperates with the socket 29^b in the cutter B. The flanges 31 and 31^b are adapted to directly bear on the surfaces 25 of the branches 24 and lugs 32 and 32^b are provided on the flanges 31 and 31^b respectively to cooperate with the notches 26. The cooperation of the lugs 32 and 32^b with the notches 26 holds the bushings 30 and 30^b against rotation. A replaceable wear taking washer 33 is provided between the outer end of the bushing 30 and the inner surface 14 of the leg M. The washer 33 has a shoulder 34 which cooperates with the face 17 to hold the washer against rotation. A replaceable wear taking washer 33^b is provided between the outer end of the bushing 30^b and the inner side 15 of the leg N. The washer 33^b has a shoulder 34^b cooperating with the face 18 whereby it is held against rotation. A suitable bearing 91 may support the cutter A on the bushing 30 and a similar bearing 91^b may rotatably support the cutter B on the bushing 30^b.

A pin or screw 35 is provided to support the bushing 30 between the leg M and the opposing branch 24. The screw 35 is passed outwardly through an opening 36 in the branch 24 to extend through the bushing 30 and its outer end portion is threaded in an opening 37 in the leg M. A screw 35^b is passed outwardly through an opening 36^b in the branch 24 opposing the leg N and extends through the bushing 30^b to thread into an opening 37^b in the leg N. In accordance with the invention the openings 36 and 37 and the openings 36^b and 37^b are inclined downwardly and inwardly whereby the cutters A and B are rotatable about downwardly and inwardly inclined axes. The cutters A and B mounted as just described project downwardly beyond the lower ends of the legs M and N and the branches 24 and the cutting edges of their respective teeth 27 and 27^b are inclined downwardly and inwardly as they come into engagement with the earth formation at the bottom of the bore.

The cutter C is provided to act on the outer portion of the well bore to assist the cutters A and B in cutting the bore to gauge and is spaced between the cutters A and B to stabilize the bit. The cutter C is in the nature of a roller cutter and in accordance with the invention is considerably shorter or of less axial extent than the cutters A and B. The cutter C is provided with spaced peripheral cutting parts 40. The cutting parts 40 may be straight and axial, as illustrated. A central longitudinal opening 41 is provided in the cutter C.

The inner cutters X and Y are provided to act on and cut away the formation at the inner portion of the well bore. The cutters X and Y are frusto-conical cutters having pitched or inclined peripheries. The cutter Y is provided with suitable peripheral cutting parts 42 and suitable teeth or cutting parts 43 are provided on the periphery of the cutter X. In the case illustrated in the drawings the cutting parts 42 and 43 are straight and axial, it being understood that they may be pitched or spiralled as desired. The opposite ends of the cutters X and Y may be flat and normal to the axes of the cutters. In accordance with the invention the cutter X is somewhat smaller in diameter than the cutter Y.

The means 11 removably supports the cutter C and the cutters X and Y for rotation about inclined axes between the leg O and the projection 20. In the embodiment of the invention being described the means 11 comprises an integral or one piece bushing member 44 rotatably carrying the cutters C, X and Y. The member 44 is elongate and is arranged between the inner side of the leg O and the projection 20. The bushing member 44 is provided with a cylindrical bearing part 45 for rotatably carrying the cutter C and a cylindrical bearing part 46 for rotatably carrying the cutters X and Y. The outer end of the bearing part 45 is preferably flat and substantially parallel with the inner side

16 of the leg O. A socket 47 is provided in the outer end of the bearing part 45 and receives a boss 48 on the inner side of the leg O. An annular shoulder 49 occurs on the member 44 at the inner end of the bearing part 45. The shoulder 49 is flat and normal to the longitudinal axis of the bearing part 45.

The bearing part 46 of the member 44 is appreciably longer than the bearing part 45 and is inclined downwardly and inwardly at a lesser angle than the part 45. An annular thrust shoulder 50 is provided on the member 44 at the outer end of the bearing part 46. The portion of the member 44 occurring between the shoulders 49 and 50 forms a spacer between the cutters C and Y. A socket 51 is provided in the inner end of the bearing part 46. A replaceable thrust washer 52 is provided on the boss 48 between the inner surface 16 of the leg O and the outer end of the bearing part 45. The outer cutter C rotates on the bearing part 45 between the shoulder 49 and the washer 52 and the washer receives the end thrusts from the cutter. A leg or shoulder 53 on the washer 52 cooperates with the face 19 of the leg O to hold the washer against rotation. A suitable anti-friction bearing 93 may rotatably support the cutter C on the bearing part 45.

The cutter mounting means 11 includes a removable block or cap 54 on the lower end of the shank projection 20. The cap 54 has a flat upper face 55 cooperating with the surface 22 of the projection 20 and has a shoulder 56 bearing against the shoulder 23. A flange 57 on the inner side of the cap 54 bears against the inner side of the shank projection 20. A cap screw 58 is passed upwardly through an opening in the cap 54 and is threaded into an opening 59 in the projection 20 to removably secure the cap 54 to the projection 20. A boss 90 on the cap 54 cooperates with the socket 51. A head 58^a on the screw 58 is received in a socket or enlargement of the opening in the cap 54. The cutter mounting means 11 includes a pin or screw 61 for holding the bushing member 44 between the leg O and the projection 20 and for connecting the leg O with the cap 54. A longitudinal opening 62 is provided in the bushing member 44 to receive the screw 61. The opening 62 is eccentric and inclined with respect to the longitudinal axes of the bearing parts 45 and 46. The screw 61 is passed outwardly through an opening 63 in the cap 54 to extend through the opening 62 and its outer portion is threaded into an opening 64 in the leg O. The openings 63 and 64 are inclined downwardly and inwardly with respect to the longitudinal axis of the shank. A head 65 is provided on the screw 61 and is received in a socket or enlargement of the opening 63 in the cap 54.

The cutters X and Y are rotatably carried by the bearing part 46 of the member 44 and suitable roller bearings 66 may be provided to rotatably support the cutters on the bearing part 46. In accordance with the invention the cutter Y surrounds the outer portion of the bearing part 46 and its outer end may bear on the shoulder 50. The cutter X is arranged on the inner portion of the bearing part 46 and its inner end may bear on the flange 57 of the block 54. The inclination of the bearing part 46 is such that the cutting parts 42 and 43 of the cutters X and Y are substantially horizontal as they come into engagement with the formation at the bottom of the well bore. The parts are proportioned and related so that the inner end of the cutter X is adjacent or spaced a slight distance outwardly from the central vertical axis of the shank.

In assembling the cutters C, X and Y on the shank 10 the washer 52 is first arranged on the boss 48. The cutters C, X and Y are then assembled on the bushing member 44 and the cap 54 is arranged against the inner end of the member 44 so that the socket 51 receives the boss 90. This assembly is then arranged in position so that the boss 48 projects into the socket 47 and so that outer end of the member 44 engages against the washer 52. The assembly may be swung on the boss 48 to bring the cap 54 into proper contact with the projection 20. The screw 61 is passed outwardly through the openings 63 and 62 and is threaded into the opening 64. The screw 58 is then threaded into the opening 59 to secure the cap 54 to the projection 20. As illustrated in the drawings the head 58^a of the screw 58 cooperates with the head 65 of the screw 61 to positively prevent unthreading of the screw 61.

The invention includes means for flushing the cutters A, B, C, X and Y and for providing a suitable turbulence in the well bore. A port 69 extends downwardly through the shank 10 from the passage 13 and discharges into the space between the leg M and the projection 20 to effectively flush the cutter A. A similar port 67 communicates with the passage 13 and discharges into the space between leg N and the projection 20 to flush the cutter B. The shank 10 is provided with a port 68 which extends downwardly from the passage 13 and discharges into the pocket or space between the leg O and projection 20. The circulation fluid discharged from the port 68 flushes the cutters C, X and Y.

Figs. 5 and 6 of the drawings illustrate a modified form of means 11^a for rotatably supporting cutters C^1, X^1 and Y^1 on the shank 10. The shank 10, the cap 54^a and the cutters C^1, X^1 and Y^1 may be substantially identical with the corresponding elements of the previously described form of the invention. The cutter mounting means 11^a rotatably supports the cutters C^1, X^1 and Y^1 between the body leg O and the body projection 20. The means 11^a comprises a cutter mounting bushing having two sections 70 and 71. The section 70 carries the cutter C^1 while the bushing section 71 rotatably carries the cutters X^1 and Y^1. The bushing section 70 has a downwardly and inwardly inclined cylindrical bearing part 72 rotatably supporting the outer cutter C^1. The outer end of the bearing part 72 is flat and adapted to bear outwardly against the boss 48^a on the inner side of the leg O. A replaceable thrust washer 52^a is arranged on the boss 48^a and is held betwcen the inner side of the leg O and the outer end of the bearing part 72. The washer 52^a has a surface 53^a cooperating with a lower face 19 of the leg O to hold the washer against turning. An annular thrust shoulder 49^a is provided at the inner end of the bearing part 72. The cutter C^1 rotates on the bearing part 72 between the shoulder 49^a and the washer 52^a.

The inner section 71 of the means 11^a is cylindrical to rotatably carry the two cutters X^1 and Y^1. A lug and groove connection is provided between the sections 70 and 71. In the case illustrated a flat-walled groove 80 is provided in the inner end of the section 70 and a lug 81 on the outer end of the section 71 cooperates with the groove 80. The end of the lug 81 may be rounded to facilitate the assembling of the sections 70 and 71. The adjacent or opposing ends of the sec-

tions 70 and 71 may be in direct abutment as illustrated in Fig. 5. The inner end of the section 71 is flat and normal and bears against the flange 57^a of the cap 54^a. The cutters X^1 and Y^1 are arranged in end to end relation on the section 71 between the end of the section 70 and the flange 57^a. Suitable bearings 66^a may rotatably support the cutters X^1 and Y^1 on the bushing section 71. The block or cap 54^a is removably secured to the shank projection 20 by a screw 58^b. Aligned openings 62^a and 62^b are provided in the sections 70 and 71 to receive a pin or screw 61^a. The screw 61^a is passed outwardly through an inclined opening 63^a in the cap 54^a and extends through the openings 62^b and 62^a to thread into an inclined opening 64^a in the leg O. The head of the screw 58^b cooperates with the head of the screw 61^a to prevent unthreading of the screw 61^a. As the openings 62^a and 62^b are eccentric and inclined with respect to the bearing surfaces of the sections 70 and 71 the sections are positively prevented from turning on the screw 61^a.

In operation, the shank 10 is connected with the lower end of a drilling string which is rotated and fed downwardly in the usual manner. The cutters A, B and C project downwardly and outwardly beyond the body legs M, N and O to cut the well bore to gauge and to form the outer portion of the bore. The inner cutters X and Y act to cut away the inner portion of the well bore. The cutters A, B, C, X and Y are mounted and related to be particularly rapid and efficient in their engagement with the formation. The spacing of the cutters A, B and C is such that the drill is stabilized or steadied. The screw 35 in addition to retaining the bushing 30 dependably ties the leg M to one of the branches 24. The screw 35^b supports the bushing 30^b and securely ties the leg N to the other branch 24. The screw 61 carries the bushing member 44 and ties together the leg O and the shank projection 20. Thus the pins or screws of the cutter mountings serve to dependably tie together the spaced parts of the integral shank. The cutters are mounted so that they may be easily and quickly removed for replacement and all the wearing parts of the bit may be easily replaced. The mounting of the several cutters does not necessitate a large spider or cutter supporting member and the bit structure is particularly simple and inexpensive.

Having described only typical preferred forms and applications 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 shank, three circumferentially spaced outer roller cutters at the lower end of the shank, two of the outer cutters being of greater axial extent than the third outer cutter, separate means supporting said two outer cutters for rotation, an inner roller cutter, and a single removable member rotatably carrying said third outer cutter and the inner cutter.

2. A well bit comprising, a shank, three circumferentially spaced outer roller cutters at the lower end of the shank, two of said outer cutters having cutting parts of greater length than the cutting parts of the third outer cutter, removable members removably secured to the shank and each rotatably carrying one of the said two outer cutters, inner roller cutters, and a single removable member on the shank rotatably supporting the inner cutters and said third outer cutter for rotation about inclined axes.

3. A well bit comprising, a shank having a series of circumferentially spaced legs on its lower end and an integral projection extending downwardly within the series of legs, removable members between the legs and the projections, screws extending through the members and tying together the legs and the projection, and roller cutters rotatably carried by said members to cut the well bore to gauge, and an inner roller cutter carried by one of said members.

4. A well bit comprising, a shank having a series of circumferentially spaced legs on its lower end and an integral projection extending downwardly within the series of legs, inclined bushings arranged between the legs and the projection, connecting members extending through the bushings connecting the legs and the projection and removably supporting the bushings, and roller cutters rotatable on the bushings.

5. A well bit comprising, a shank having a series of circumferentially spaced integral legs on its lower end and an integral projection within the series of legs, a block removably secured to the lower end of the projection, bushings arranged between and supported by two of the legs and the projection, a bushing arranged between and supported by a third leg and the block, and roller cutters rotatable on the bushings.

6. A well bit comprising, a shank having a series of circumferentially spaced integral legs on its lower end and an integral projection within the series of legs, a block removably secured to the lower end of the projection, bushings arranged between the projection and two of the legs, connecting members extending through the bushings and connecting the legs and the projection, a bushing arranged between a third leg and the block, a connecting member extending through the said bushing and connecting the block and said third leg, an outer cutter rotatable on each of said bushings, and an inner cutter rotatable on the last mentioned bushing.

7. A well bit comprising, a shank having a series of three spaced integral legs on its lower end and an integral projection within said series, integral branches on the projection, removable bushings arranged between the branches and two of said legs, outer roller cutters rotatable on the bushings, a block removably secured to the projection, a removable bushing supported between the block and the third leg, an outer roller cutter rotatable on the last mentioned bushing, and an inner roller cutter rotatable on the said last mentioned bushing.

8. A well bit comprising, a shank having a series of three spaced integral legs on its lower end and an integral projection within said series, integral branches on the projection, removable bushings arranged between the branches and two of said legs, outer roller cutters rotatable on the bushings, a block removably secured to the projection, a removable bushing arranged between the block and the third leg, a connecting member extending through the last mentioned bushing and connecting the said third leg and the block, an outer roller cutter on the last mentioned bushing, and an inner roller cutter on the last mentioned bushing.

9. A well bit comprising, a shank having a series of three spaced integral legs on its lower end and an integral projection within said series, integral branches on the projection, removable bushings arranged between the branches and two

of said legs, outer roller cutters rotatable on the bushings, a block removably secured to the projection, a removable bushing arranged between the block and the third leg, a connecting member extending through the last mentioned bushing and connecting the said third leg and the block, an outer roller cutter on the last mentioned bushing, and an inner roller cutter on the last mentioned bushing, said last mentioned bushing being sectional comprising a section carrying the last mentioned outer cutter, and a section carrying the inner cutter.

10. A well bit comprising, a shank having a series of three spaced integral legs on its lower end and an integral projection within said series, integral branches on the projection, removable bushings arranged between the branches and two of said legs, outer roller cutters rotatable on the bushings, a block removably secured to the projection, a removable bushing arranged between the block and the third leg, a connecting member extending through the last mentioned bushing and connecting the said third leg and the block, an outer roller cutter on the last mentioned bushing, and an inner roller cutter on the last mentioned bushing, said last mentioned bushing being sectional comprising a section carrying the last mentioned outer cutter, and a section carrying the inner cutter, and a lug and groove connection between the said sections.

11. A well bit comprising, a shank having a series of three spaced integral legs on its lower end and an integral projection within said series, integral branches on the projection, removable bushings arranged between the branches and two of said legs, connecting members extending through the bushings to retain the same and connecting said two legs with the branches, outer roller cutters rotatable on the bushings, a block removably secured to the projection, a removable bushing arranged between the block and the third leg, a connecting member extending through the last mentioned bushing and connecting the said third leg and the block, an outer roller cutter on the last mentioned bushing, and an inner roller cutter on the last mentioned bushing.

ALFRED C. CATLAND.