Jan. 5, 1937. A. C. CATLAND 2,066,671

ROLLER BIT

Filed Oct. 5, 1935 2 Sheets-Sheet 1

Fig 1

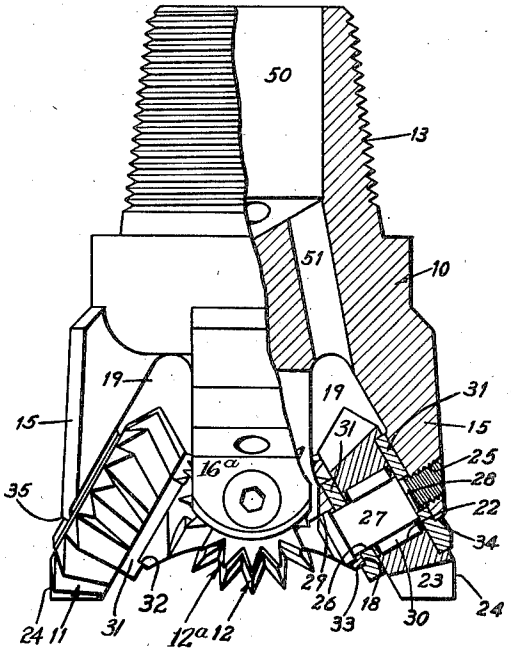


Fig 3

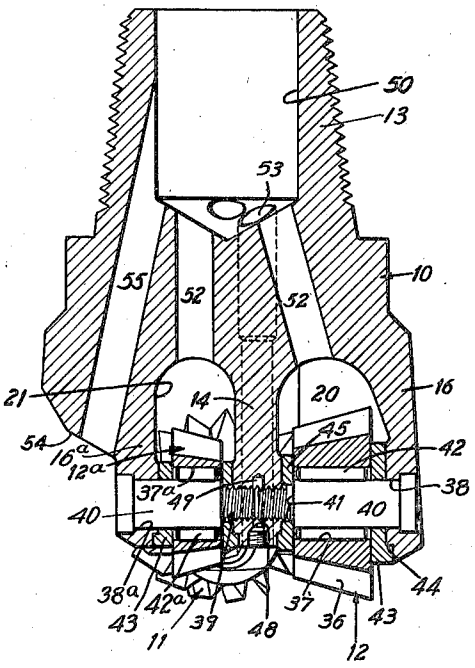
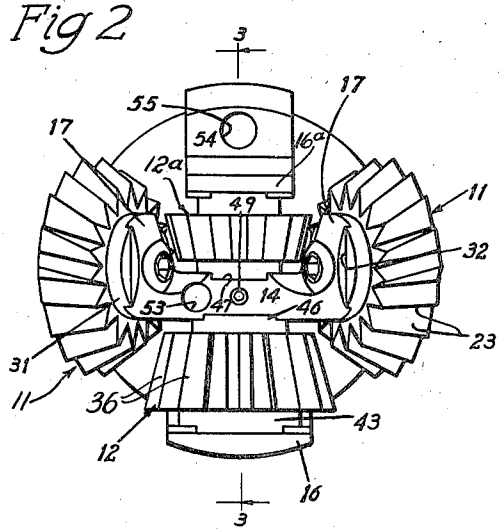


Fig 2



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Fig. 4

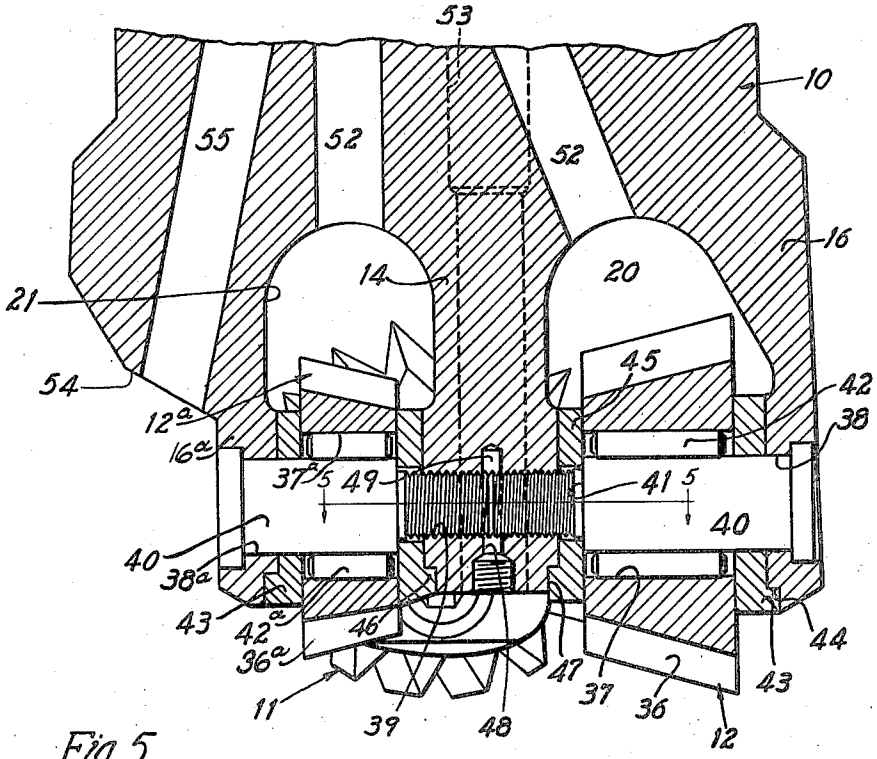
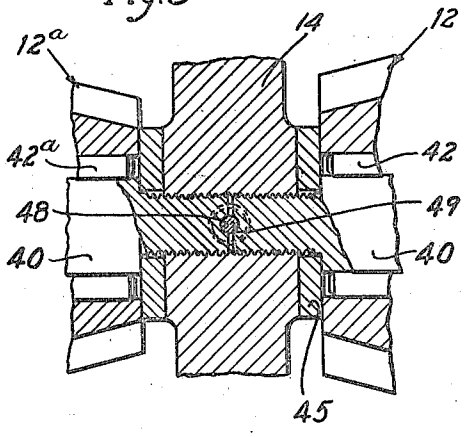


Fig. 5



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Patented Jan. 5, 1937 2,066,671

UNITED STATES PATENT OFFICE

2,066,671

ROLLER BIT

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Application October 5, 1935, Serial No. 43,711

14 Claims. (Cl. 255—71)

This invention relates to a well tool and relates more particularly to a well drilling bit. A general object of the present invention is to provide a simple, practical and particularly effective roller type well drilling bit.

Another object of this invention is to provide a well bit that embodies a simple, inexpensive, one piece body or shank carrying a plurality of roller cutters.

Another object of this invention is to provide a well bit of the character mentioned in which the roller cutters are independently mounted for rotation by simple dependable mounting means.

Another object of this invention is to provide a roller bit in which the roller cutters are formed and positioned to properly act on the entire bottom wall of the well during each rotation of the bit and yet present a minimum number of cutting edges so that heavy feeding pressures are applied per linear unit of cutting edges to produce a rapid efficient cutting action.

Another object of the invention is to provide a roller bit that includes means for directing the circulation fluid downwardly from a point adjacent the bottom of the well and from other points to erode the formation and thus assist in the drilling action and to effectively flush the cutters and maintain turbulence in the lower portion of the well.

A further object of this invention is to provide a roller bit of the character mentioned that is simple and sturdy in construction.

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 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 with a portion appearing in central vertical cross section to illustrate the rotatable mounting of an outer cutter. Fig. 2 is a bottom plan view or elevation. Fig. 3 is a central longitudinal detailed sectional view taken as indicated by line 3—3 on Fig. 2. Fig. 4 is an enlarged fragmentary detailed sectional view illustrating the mountings of the inner cutters, and Fig. 5 is an enlarged fragmentary detailed sectional view taken as indicated by line 5—5 on Fig. 4.

The well bit of the present invention includes, generally, a body or shank 10, two outer roller cutters 11 rotatably supported on the lower end of the shank 10 to act on the outer portion of the bottom wall of the well bore and two inner roller cutters 12 and 12a rotatably mounted on the lower end of the shank 10 to act on the inner portion of the bottom wall of the well bore.

In accordance with the invention the body or shank 10 is an integral or one-piece member as shown throughout the drawings. The shank 10 includes means at its upper end for connecting with a drill stem. In the typical form of the invention illustrated a tapered screw threaded pin 13 is provided on the upper end of the shank to facilitate connection of the shank with a drilling string. The major portion of the shank below the pin 13 is of enlarged diameter. The shank 10 is provided with legs or projections for carrying the four cutters 11, 12 and 12a. In the preferred construction the shank 10 has a central or inner projection 14, two outer projections 15 spaced from the opposite ends of the inner projection 14 and two projections 16 and 16a spaced from the opposite sides of the inner projection 14. The projections 14, 15, 16 and 16a are all integral with the shank 10 and project downwardly from its lower end. The central or inner projection 14 is elongate in horizontal cross section and its opposite sides may be substantially flat and vertical. The inner side of the projection 14 may be in or adjacent a diametric vertical plane of the shank 10. Laterally projecting bosses 17 are provided on the opposite ends of the projection 14. The bosses 17 are disc shaped or partially disc-shaped and project from the lower end of the projection 14 as well as from the side of the projection 14. Each boss has a downwardly and outwardly inclined outer bearing surface 18.

The outer projections 15 project downwardly and outwardly from the lower end of the shank. The projections 15 are spaced outwardly from the bosses 17 leaving sockets or recesses 19 for receiving the outer cutters 11. The inner sides or surfaces of the projections 15 are inclined downwardly and outwardly being substantially parallel with the surfaces 18 of the bosses 17. The outer surfaces or sides of the projections 15 may be slightly downwardly and outwardly inclined and may be curved about the central vertical axis of the shank. The shank projections 16 and 16a are substantially equally spaced from the opposite sides of the inner projection 14. The projection 16 is a greater distance from the central vertical axis of the shank 10 than the projection 16a. The projection 16a has straight vertical side surfaces being substantially rectangular in horizontal cross section. The projection 16 has a flat vertical inner surface and has a downwardly and outwardly inclined outer

surface which may be concentrically curved about the vertical axis of the shank. The projections 16 and 16a are spaced from and related to the inner projection 14 to leave recesses 20 and 21 for receiving the inner cutters 12. The lower ends of the several projections 14, 15, 16 and 16a may be in or adjacent a common horizontal plane.

The outer cutters 11 are mounted to act on the outer portion of the bottom wall of the well and to engage and trim the side wall of the bore. In accordance with the invention the outer cutters 11 are substantially frusto-conical roller cutters and are of the same size. Each cutter 11 has a central longitudinal opening 22 and peripheral cutting teeth 23. The cutting teeth 23 are preferably spiralled in opposite directions so that they do not track in their engagement with the earth formation. The outer cutters 11 are positioned with their smallest ends facing inwardly toward the central vertical axis of the shank and the outer corners of their teeth 23 are bevelled away at 24. The bevelled outer corners 24 of the cutting teeth 23 are substantially vertical as they come into engagement with the earth formation so that they are effective in trimming or reaming the wall of the well bore.

The invention provides simple and particularly effective means for rotatably supporting the outer cutters 11 in the recesses 19. The outer projections 15 have downwardly and inwardly inclined openings 25 and the bosses 17 have correspondingly inclined openings 26 longitudinally aligned with the openings 25. The longitudinal axes of the openings 25 and 26 preferably lie in a vertical plane which is diametric relative to the central vertical axis of the shank 10. Pins 27 are passed outwardly through the openings 26 and the cutter openings 22 and have reduced portions threaded into the openings 25. The reduced threaded portions of the pins 27 provide the pins with outwardly facing annular shoulders 28. Recesses or counter bores 29 are provided in the inner sides of the bosses 17 to receive the heads of the pins 27. When the pins 27 have been tightened down their heads may be peened into the counter bores 29 to lock the screws against displacement. Rollers 30 are preferably provided to rotatably support the outer cutters 11 on the pins 27.

Thrust washers 31 are provided on the pins 27 at the opposite ends of the cutters 11. The inner thrust washers 31 have shoulders 32 cooperating with shoulders 33 on the lower ends of the bosses 17 whereby they are held against rotation. The outer thrust washers 31 may have cooperation with the shoulders 28 and are provided with shoulders 34 which cooperate with shoulders 35 on the lower ends of the projections 15 so that they are held against turning. The frusto-conical cutters 11 rotatably mounted on the pins 27 as just described rotate about downwardly and inwardly inclined axes and project downwardly from the recesses 19 to act on the formation at the bottom of the well bore and extend outwardly beyond the lower ends of the projections 15 to act on the formation at the side wall of the well bore. The principal edges of the cutting teeth 23 are substantially horizontal as they come into active engagement with the formation on the bottom of the well.

The inner cutters 12 and 12a are substantially frusto-conical roller cutters rotatably supported in the recesses 20 and 21 to project beyond the lower ends of the projections 14, 16 and 16a and engage the central portion of the bottom wall of the well. The cutters 12 and 12a are similar in shape but the cutter 12 is larger in diameter and of greater thickness than the cutter 12a. The cutters 12 and 12a are arranged with their small ends facing inwardly or toward the inner projection 14. Axially extending peripheral cutting teeth 36 and 36a are provided on the cutters 12 and 12a. The cutter 12 has a central longitudinal opening 37 and the cutter 12a has a similar opening 37a.

Simple dependable means are provided for independently mounting the cutters 12 and 12a for rotation. The projections 16 and 16a of the shank have substantially horizontal transverse openings 38 and 38a and the inner projection 14 has threaded sockets or openings 39 in its opposite sides which are longitudinally aligned with the openings 38 and 38a. Pins 40 are passed inwardly through the openings 38 and 38a and the openings 37 of the cutters 12 and their inner portions are threaded into the openings 39. The threaded inner portions of the pins 40 may be reduced in diameter whereby the pins have inwardly facing annular shoulders 41. Rollers 42 and 42a are preferably provided to rotatably support the cutters 12 and 12a on the pins 40. The openings 38 and 38a are co-axial or in alignment. Thrust washers 43 are provided on the pins 40 and are positioned between the outer ends of the cutters 12 and 12a and the inner surfaces of the projections 16 and 16a. The washers 43 have shouldered engagement with the projections 16 and 16a as illustrated at 44, which engagement holds them against turning or rotating. Similar thrust washers 45 are arranged on the pins 40 between the inner ends of the cutters 12 and 12a and the projection 14. The washers 45 have lugs or keys 46 extending into flat walled grooves 47 in the opposite sides of the projection 14, whereby they are prevented from rotating on the pins 40.

Novel and particularly effective means is provided for locking or securing the cutter carrying pins 40 against rotation and displacement. When the pins 40 have been fully threaded down or tightened an opening 48 is drilled into the lower end of the shank projection 14 to intersect the inner end portions of the openings 39. As the reduced portions of the pins 40 are in the openings 39 when the opening 48 is bored, the opening 48 has portions in each of the pins 40. The lower portion of the opening 48 is threaded and a lock pin 49 is inserted in the opening 48 and has a head threaded in the lower portion of the opening. The lock pin 49 cooperates with the notches or portions of the opening 48 in the cutter carrying pins 40 to positively lock the pins against turning. Thus the lock pin 49 effectively prevents unthreading and displacement of both pins 40. The cutters 12 and 12a rotatably mounted as just described project downwardly beyond the lower ends of the shank projections to act on the bottom wall of the well. Due to the configuration of the cutters 12 and 12a the teeth 36 and 36a are inclined downwardly and outwardly as they come into engagement with the earth formation.

The smaller inner cutter 12a being located in the recess 21 is relatively close to the central vertical axis of the shank and, therefore, follows an annular or circular path around and relatively close to the central vertical axis of the well bore. The larger inner cutter 12 is spaced a greater distance from the central vertical axis

of the shank 10 and follows an annular path surrounding that of the other cutter 12. The cutters 12 and 12a preferably overlap in their action on the earth formation while the outer cutters 11 preferably overlap the large inner cutter 12 in their engagement with the earth formation whereby substantially the entire bottom wall of the well bore is engaged or acted upon by the cutters during each complete rotation of the bit.

The invention provides means for handling the circulation fluid in a manner so that it materially assists in the drilling of the well. A central socket or opening 50 enters the shank 10 from the upper end of its pin 13 and thus has communication with the opening of the drilling string. Ports 51 extend downwardly from the opening 50 to the upper ends of the recesses 19 to conduct circulation fluid downwardly to discharge against the outer cutters 11. Similar ports 52 extend downwardly from the opening 50 to the recesses 20 and 21 to discharge the circulation fluid downwardly to discharge against the inner cutters 12 and 12a. In accordance with the invention a stream of circulation fluid is discharged downwardly from the center of the bit immediately adjacent the bottom wall of the well. A port 53 extends through the shank 13 from the opening 50 to the projection 14 and continues downwardly through the projection to discharge from its lower end. The discharging end of the port 53 is relatively close to the central vertical axis of the bit and fluid discharging from the port 53 impinges directly against the formation on the bottom of the bore. The shank projection 16a at the outer side of the recess 21 is shouldered, having a downwardly and inwardly inclined shoulder 54 some distance above its lower end. A fluid discharge port 55 extends downwardly and outwardly from the opening 50 to the shoulder 54 where it discharges the circulation fluid downwardly and outwardly adjacent the side wall of the well bore. The circulation fluid under pressure discharging from the ports 51 and 52 fully flushes the cutters 11, 12 and 12a. The circulation fluid discharging from the inner port 53 and the outer port 55 washes away or erodes the formation and produces a desirable turbulence in the lower end of the well.

It is believed that the operation of the well bit of the present invention will be readily understood from the foregoing detailed description. The shank 10 is connected with the lower end of a drilling string and the string is rotated and fed downwardly in the usual manner so that the cutters 11, 12, and 12a act on the formation to form the well bore. Circulation fluid is passed downwardly through the drilling string to discharge from the ports 51, 52, 53, and 55. The cutters 11, 12, and 12a are positioned and related to rapidly and effectively cut away the formation. The improved cutter mountings support the cutters for free-independent rotation. The cutter carrying pins are simple threaded parts threaded into openings in the shank 10. The cutter carrying pins are dependably locked against unthreading and displacement so that the cutters cannot be lost. The cutters 11, 12, and 12a are mounted so that they may be easily and quickly removed for replacement, 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 including a shank having an inner projection projecting from its lower end adjacent its central axis and projections on its lower end spaced outwardly from the opposite sides of the inner projection, pins extending between and supported on the projections, and frusto-conical cutters rotatably supported by the pins with their smaller ends facing inwardly, one cutter being shorter than the other, said short cutter being adjacent the central vertical axis of the shank, the said other being spaced outwardly from the said axis.

2. A well bit including a shank having an inner projection projecting from its lower end adjacent its central axis and projections on its lower end spaced outwardly from the opposite sides of the inner projection, aligned substantially transverse openings in the projections, pins entered inwardly in the openings in the last mentioned projections and threaded in the opening in the inner projection, roller cutters rotatably supported on the pins, other projections on the lower end of the shank spaced outwardly from the opposite ends of the inner projection, pins extending between and supported on the inner projection and the last named projections, and cutters rotatable on the last mentioned pins.

3. A well bit including a shank having an inner projection projecting from its lower end adjacent its central axis and projections on its lower end spaced outwardly from the opposite sides of the inner projection, aligned substantially transverse openings in the inner projection and the second mentioned projection, pins inserted inwardly through the openings in said second mentioned projections and threaded in the opening in the inner projection to tie the legs together, frusto-conical cutters rotatably supported by said pins and having their smaller ends facing inwardly, other projections on the lower end of the shank spaced outwardly from the opposite ends of the inner projections, downwardly and inwardly inclined openings in the inner projection and the last named projections, pins passed outwardly through the inclined openings in the inner projection and threaded in the inclined openings in the said last named projections to tie together said projections, and frusto-conical roller cutters rotatably supported on the last named pins with their smaller ends facing inwardly and projecting downwardly and outwardly from the lower end of the shank.

4. A well bit including a shank having an inner projection on its lower end adjacent its central vertical axis and two pairs of projections on its lower end spaced outwardly from the inner projection, the projections of each pair being substantially diametrically opposite, threaded pins extending between and connecting the inner projection and the projections of one of said pairs, inner roller cutters rotatable on the pins, threaded pins extending between and connecting the inner projection and the projections of the other pair, and outer roller cutters rotatable on the last mentioned pins.

5. A well bit including a shank having an inner projection on its lower end adjacent its central vertical axis and two pairs of projections on its lower end spaced outwardly from the inner projection, the projections of each pair being threaded substantially diametrically opposite, substantially horizontal pins extending between

and tying together the inner projection and the projections of one of said pairs, inner roller cutters rotatable on the pins, downwardly and inwardly inclined threaded pins extending between and tying together the inner projection and the projections of the other pair, and outer roller cutters rotatable on the last mentioned pins.

6. A well bit including a shank having an inner projection on its lower end adjacent its central vertical axis and two pairs of projections on its lower end spaced outwardly from the inner projection, the projections of each pair being substantially diametrically opposite, headed pins inserted inwardly through openings in the projections of one of said pairs and threaded in openings in the inner projection to tie said projections together, means on the inner projection for locking the pins against unthreading, inner roller cutters rotatable on said pins, pins extending between and carried by the inner projection and the projections of the other pair, and outer roller cutters rotatable on the last named pins.

7. A well bit including a shank having an inner projection on its lower end adjacent its central vertical axis and two pairs of projections on its lower end spaced outwardly from the inner projection, the projections of each pair being substantially diametrically opposite, the projections of said pairs each having an opening, pins passed inwardly through the openings of the projections of one of said pairs and threaded into openings in the inner projection, inner roller cutters rotatable on the pins, pins passed outwardly through openings in inner projection and threaded into the openings of the projections of the other pair, and outer roller cutters rotatable on the last named pins.

8. In a well bit, a shank having an inner projection and two outer projections on its lower end, the inner projection having two aligned threaded openings, the outer projections each having an opening, cutter carrying pins passed inwardly through the openings of the outer projections and threaded into the openings of the inner projection to tie the projections together, and a single means locking the pins against unthreading.

9. In a well bit, a shank having an inner projection and two outer projections on its lower end, the inner projection having an opening entering its lower end and having two aligned transverse threaded openings, the outer projections each having an opening, and cutter carrying pins passed inwardly through the openings of the outer projections and threaded into the threaded openings of the inner projection, and a single means locking the pins against unthreading, said means including a pin inserted in the first mentioned opening of the inner projection and cooperating with the cutter carrying pins.

10. A well bit including a shank having an inner projection projecting from its lower end adjacent its central axis and projections on its lower end spaced outwardly from the opposite sides of the inner projection, pins extending between and supported on the projections, and roller cutters rotatably supported on the pins, there being a fluid passage in the shank and the inner projection discharging from the lower end of the inner projection and a fluid passage in the shank discharging downwardly and outwardly adjacent the side wall of the well bore.

11. A well bit including a shank having an inner projection projecting from its lower end adjacent its central axis and projections on its lower end spaced outwardly from the opposite sides of the inner projection, pins extending between and supported on the projections, and roller cutters rotatably supported on the pins, the shank having fluid passages discharging against the cutters, a fluid passage discharging from the lower end of the inner projection, and a fluid passage discharging downwardly and outwardly adjacent the side wall of the well.

12. In a well bit, a shank having an inner projection and two outer projections on its lower end, the inner projection having two aligned threaded openings, the outer projections each having an opening, and cutter carrying pins passed inwardly through the openings of the outer projections and threaded into the openings of the inner projection, and a single means locking the pins against unthreading, said means including a pin threaded in an opening in the inner projection and engaging the cutter carrying pins to hold them against turning.

13. A well bit including a shank having an inner projection on its lower end adjacent its central vertical axis and two pairs of projections on its lower end spaced outwardly from the inner projection, the projections of each pair being substantially diametrically opposite, a separate removable pin extending between and carried by the inner projection and each of the projections of one of said pairs, inner roller cutters rotatable on the pins, the inner cutters being substantially frusto-conical and having their small ends facing inwardly, pins extending between and carried by the inner projection and the projections of the other pair, and outer roller cutters rotatable on the last named pins, the outer cutters being substantially frusto-conical with their small ends facing inwardly.

14. A well bit including a shank having an inner projection on its lower end adjacent its central vertical axis and two pairs of projections on its lower end spaced outwardly from the inner projection, the projections of each pair being substantially diametrically opposite, a separate removable pin extending between and carried by the inner projection and each of the projections of one of said pairs, inner roller cutters rotatable on the pins, the inner cutters being substantially frusto-conical and having their small ends facing inwardly, downwardly and inwardly inclined pins extending between and carried by the inner projection and the projections of the other pair, and outer roller cutters rotatable on the last named pins, the outer cutters being substantially frusto-conical with their small ends facing inwardly.

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