

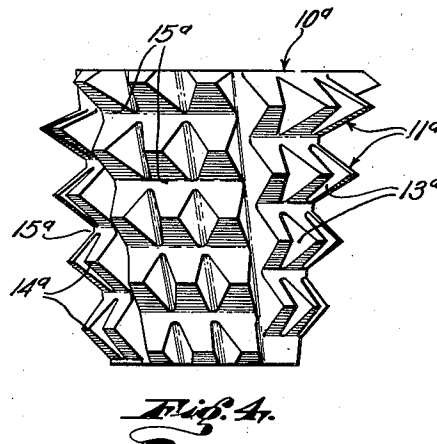
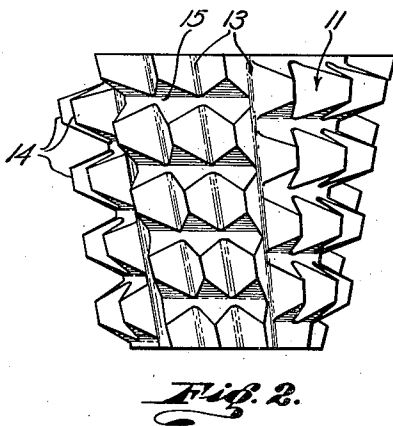
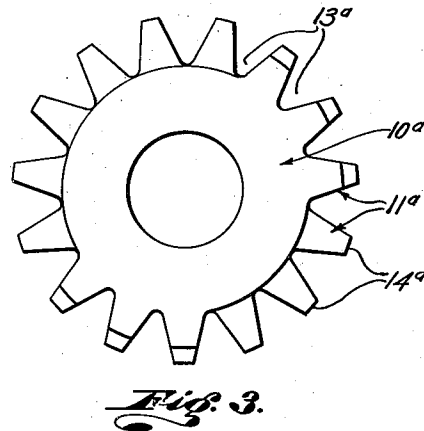
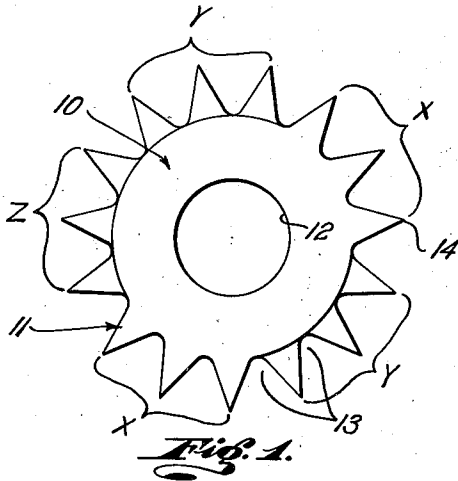
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ROLLER CUTTER

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ROLLER CUTTER

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This invention relates to cutting elements and relates more particularly to roller cutters for use on rotary well drilling tools. A general object of this invention is to provide a readily flushed and highly efficient roller cutter.

Another object of this invention is to provide a roller cutter in which the teeth are formed and related so that the circulation fluid has free access to the spaces between the teeth throughout substantially the entire length of the rows of teeth to prevent mud, cuttings, etc. from accumulating between the teeth. In the operation of rock bits in rotary well drilling it is essential that the cutters be kept free of accumulations of cuttings and mud. The circulation fluid is usually discharged under pressure from nozzles in the bit body to wash the mud and cuttings from the cutters. It has been a somewhat general practice to form or arrange the teeth of the cutters in helical rows. With the teeth arranged in helical rows it is difficult, if not impossible, to arrange the discharge nozzles in such a manner that the jets of circulation fluid have full access to the helical serrations throughout substantial parts of the rows of teeth. In the cutter of the present invention the teeth are not arranged in helical series but are positioned in such a manner that the jets of circulation fluid have substantially free access to the serrations between them to assure the complete flushing of the several teeth.

Another object of this invention is to provide a roller bit in which the cutting teeth are formed and related so that they cannot track in their engagement with the earth formation at the bottom of the well. In the improved cutter of the present invention the teeth are arranged in longitudinal rows and in circumferentially extending sets of these rows and the teeth in these sets are offset longitudinally from the teeth of adjacent sets so that the teeth cannot track as the cutter rolls against the earth formation at the bottom of the well.

Another object of this invention is to provide a roller cutter in which the teeth are related in such a manner that they have a very desirable chipping action and yet have a minimum of longitudinal cutting edge in engagement with the bottom of the well at any one time, so that the feed pressures are concentrated on the edges to assure a rapid cutting action.

Another object of this invention is to provide a roller cutter of the character mentioned that is capable of wide variation to adapt it for practically any use or application.

The various objects and features of my inven-

tion 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 drawing, in which:

Fig. 1 is an end view of one form of cutter of the invention. Fig. 2 is a side view of the cutter illustrated in Fig. 1. Fig. 3 is an end view of another form of the cutter and Fig. 4 is a side elevation of the cutter illustrated in Fig. 3.

The form of the invention illustrated in Figs. 1 and 2 may be said to comprise, generally, a cutter body 10 and a plurality of teeth 11 on the body 10 arranged in series of longitudinal rows X, Y and Z with the teeth of the adjacent series longitudinally offset.

The body 10 of course may be varied in size and proportions to adapt the cutter for the intended use. The cutter body 10 is a frusto-conical member provided with a central longitudinal opening 12 to facilitate its rotatable mounting on the bit body. The opposite ends of the body 10 may be flat and at right angles to the longitudinal axis of the cutter. The cutter is formed from a frusto-conical body or blank and the teeth 11 are formed by making grooves and cuts in this blank.

The groups or series X, Y and Z of the longitudinal rows of teeth 11 are circumferentially distributed around the body 10 and the teeth 11 of correspondingly designated series are of the same shape and longitudinal disposition. There may be as many teeth 11 as required and as many longitudinal rows of teeth as found most desirable. In the construction illustrated there are fifteen longitudinal rows of teeth 11, there being two series X, two series Y and one series Z with three longitudinal rows of teeth 11 in each of these series. In constructing the teeth 11 a plurality of equally spaced longitudinal cuts or grooves 13 are made in the blank or cutter body 10. The grooves 13 are of like size, shape and circumferential spacing and extend throughout the length of the body 10. In accordance with the invention the grooves 13 are pitched or angularly related to radial longitudinal planes of the body 10 and have the same or equal pitch. The degree of pitch or angularity of the grooves 13 may be varied but it is preferred to form the grooves at substantially the pitch illustrated in Fig. 2 for the reason to be hereinafter described. The side walls of the longitudinal grooves 13 are flat and inwardly convergent. In the form of the invention illustrated in Figs. 1 and 2 of the drawing the grooves 13 are spaced and pro-

portioned so that the side walls of adjacent grooves 13 join to provide the teeth 11 with longitudinally extending cutting edges 14.

The individual teeth 11 of the longitudinally extending groups or series X, Y and Z are formed or defined by circumferentially extending serrations or grooves 15. The grooves 15 are straight and normal, that is, they lie in planes at right angles to the longitudinal axis of the cutter body 10 as distinguished from the helical serrations or grooves found in most cutters. The grooves 15 cross or interrupt the longitudinal grooves 13 and their side walls form the upper and lower ends of the teeth 11. It is a feature of the invention that the grooves 15 defining the teeth 11 of one series X, Y or Z are longitudinally offset from the serrations separating or defining the teeth of an adjacent series so that the teeth 11 of the adjacent series X, Y and Z throughout the circumference of the cutter are longitudinally offset. In making the grooves 15 a series of cuts or grooves of equal size and spacing are formed to pass through three adjacent longitudinal ridges as left by the longitudinal grooves 13. The cut is then offset longitudinally a distance equal to one third of the spacing of the individual grooves and the three adjacent longitudinal ridges are then cut and so on. Thus the grooves 15 defining or separating the teeth 11 in a group or series X may be first formed and the grooves 15 defining or separating the teeth 11 in the adjacent series Z may then be formed in an offset relation to the first grooves a distance equal to one third the spacing of the individual grooves and a set of grooves 15 may then be formed in the adjacent series Y with the last named grooves longitudinally offset a distance equal to one third the spacing of the individual grooves. It is preferred to form each set of grooves 15 in a number of longitudinal rows of teeth which will evenly divide into the total number of longitudinal rows of teeth 11. Thus, where there are fifteen longitudinal rows of teeth 11 each set of grooves 15 may intersect three adjacent longitudinal grooves 13 to define the teeth 11 in a series X, Y or Z. By reason of the longitudinal offsetting of the grooves 15 described above the teeth 11 in one series X, Y or Z are in the same circumferential planes as the teeth in the other correspondingly designated series X, Y or Z.

The above mentioned pitch of the longitudinal grooves 13 is preferably such that the cutting edges 14 of the teeth 11 of adjacent longitudinal rows of teeth in any one series X, Y or Z, and at the opposite ends of the cutter lie in substantially the same longitudinal or radial plane. This pitching of the longitudinal grooves 13 assures the necessary chipping action of the teeth 11 with a most effective distribution of the feed pressures throughout the length of the cutter. It will be observed that the longitudinal offsetting of the transverse grooves 15 occurring in the adjacent series X, Y and Z may leave or form teeth at the ends of the body 10 that are excessively narrow. These excessively narrow end teeth may be cut off or broken off as desired. Further, due to the straight angular pitch of the longitudinal grooves 13 formed in the substantially true conical body 10, the cutting edges 14 of the teeth 11 at the ends of the longitudinal rows may be somewhat thicker than the edges of the intermediate teeth. This inequality in the thickness of the cutting edges 14 may be compensated for by making the cutter blank or body 10 of hyperboloid shape to follow or generally correspond

to the form of the bases of the longitudinal grooves 13 or, if desired, the grooves 13 may be formed in a substantially true conical body 10 and the narrow cutting edges 15 of the intermediate teeth may be built up following the cutting operation, so that the several cutting edges are of substantially uniform thickness. While I have illustrated and described the grooves 13 as straight inclined grooves, it is to be understood that they may be helically pitched, if desired.

In the use or operation of the cutter illustrated in Figs. 1 and 2 the cutter body 10 is rotatably supported on the bit or well tool so that it may rotate about its own axis through contact with the earth formation. As the bit or well tool is rotated in the well the teeth 11 of the cutter act on and cut away the earth formation. As the cutter body 10 rotates the series X, Y and Z of the teeth 11 successively come into cutting engagement with the earth formation. The teeth 11 in the successive series X, Y and Z are longitudinally staggered and, therefore, cannot track in their action on the earth formation. The teeth 11 arranged in the pitched longitudinal rows cannot simultaneously cooperate with the earth formation throughout the length of any given row and the feed pressures are, therefore, concentrated on the cutting edges 14 as the teeth successively come into contact with the earth formation. However, the teeth 11 are arranged in rows which extend approximately longitudinally of the cutter body 10 so that the cutting edges 14 of the teeth have an efficient chipping action. The serrations or grooves 15 defining the ends of the teeth 11 are straight and lie in planes normal to the axis of rotation of the cutter so that jets of circulation fluid directed at right angles to said axis may fully flush out the grooves to prevent balling up of the cutter.

The form of cutter illustrated in Figs. 3 and 4 comprises, generally, a cutter body 10^a and cutting teeth 11^a projecting from the body 10^a.

The body 10^a may be of the same shape as the body 10. The teeth 11^a differ from the teeth 11 in that their cutting edges 14^a extend circumferentially of the body 10^a. The teeth 11^a are arranged in longitudinal rows which are pitched relative to the longitudinal axis of the body 10^a and said rows of teeth 11^a occur in series, with the teeth in the adjacent series offset longitudinally of the body.

The teeth 11^a are formed by making a plurality of like uniformly spaced longitudinal grooves 13^a and sets of transverse or circumferential serrations or grooves 15^a intersecting the grooves 13^a. The grooves 15^a are spaced and proportioned to provide the teeth 11^a with the circumferentially extending cutting edges 14^a, that is, the side walls of adjacent grooves 15^a converge to define the cutting edges 14^a. In accordance with the invention the grooves 15^a are straight and lie in planes normal to the longitudinal axis of the cutter body 10^a. The transverse grooves 15^a are made in sets or groups with the grooves of each group intersecting a number of longitudinal grooves 13^a. The grooves 15^a of one group are offset longitudinally from the grooves 15^a of the adjacent groups so that the longitudinal grooves 13^a and the circumferential grooves 15^a form or define series X, Y and Z of longitudinal rows of teeth with the teeth 11^a in adjacent series longitudinally offset. In this respect the teeth 11^a are related in the same manner as the teeth 11 described above. The longitudinal grooves 13^a forming the ends or longitudinal limits of the

teeth 11^a may be straight as illustrated, or if desired may be helically pitched.

The cutter shown in Figs. 3 and 4 operates in substantially the same manner as the cutter shown in Figs. 1 and 2 except that the cutting edges 14^a of the teeth 11^a have a slightly different engagement with the earth formation. The teeth 11^a in the adjacent series X, Y and Z are longitudinally offset and the cutting edges 14^a of the adjacent groups of teeth cannot track in their engagement with the earth formation. The straight circumferential serrations or grooves 15^a assure the full flushing of the cutter by jets directed at right angles to the cutter.

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 roller cutter comprising a body, longitudinally extending circumferentially spaced rows of teeth on said body extending around the entire periphery thereof, said rows of teeth being pitched relative to the longitudinal axis of the body, the individual teeth being separated by intersecting grooves, some of which extend longitudinally of and others of which extend circumferentially of the body and lie in planes substantially normal to the longitudinal axis of the body, cutting edges on the teeth which extend circumferentially of the body, said rows occurring in contiguous groups each of which includes several of said rows, the corresponding teeth in each group occupying like positions in the several rows

and occupying like positions on the body, the correspondingly positioned teeth in the contiguous groups being progressively offset longitudinally of the body in the same direction so that the cutting edges of the teeth in the different groups do not track in their engagement with the earth formation.

2. A roller cutter comprising a body, longitudinally extending circumferentially spaced rows of teeth on said body extending around the entire periphery thereof, said rows of teeth being pitched relative to the longitudinal axis of the body, the individual teeth being separated by intersecting grooves, some of which extend longitudinally of and others of which extend circumferentially of the body and lie in planes substantially normal to the longitudinal axis of the body, cutting edges on the teeth which extend circumferentially of the body, said rows occurring in contiguous groups each of which includes several of said rows, the corresponding teeth in each group occupying like positions in the several rows and occupying like positions on the body, the correspondingly positioned teeth in the contiguous groups being progressively offset longitudinally of the body in the same direction so that the cutting edges of the teeth in the different groups do not track in their engagement with the earth formation, said rows being pitched relative to radial planes of the body so that the cutting edge of a tooth at one end of the body lies in substantially the same radial plane of the body as the cutting edge of a tooth at the other end of the body occurring in an adjacent row in the same group.

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