Jan. 25, 1944. F. A. GILL 2,340,216

CUTTER FOR DREDGES

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Fig. 1

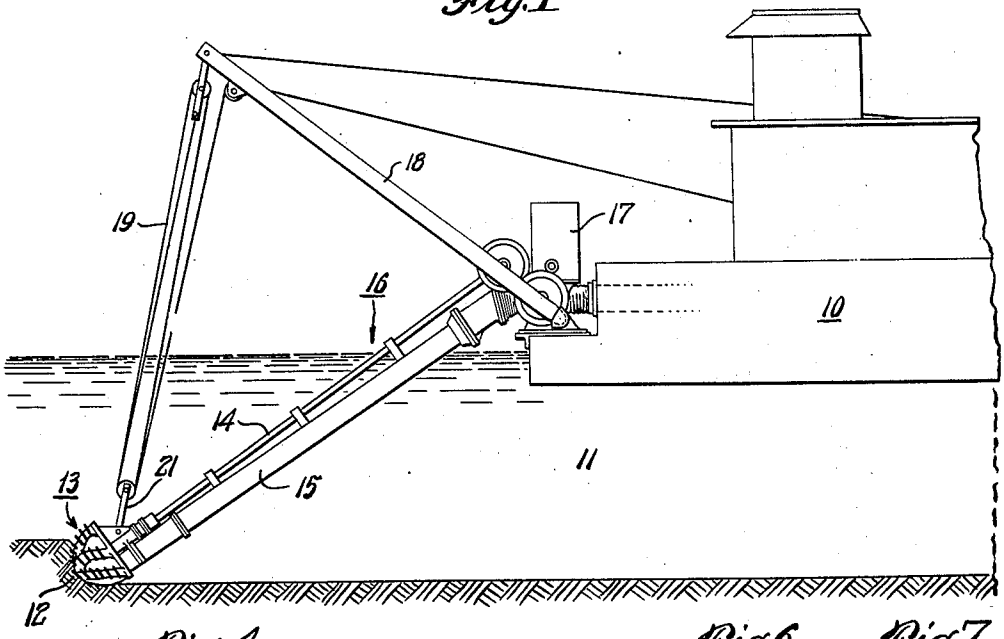


Fig. 4

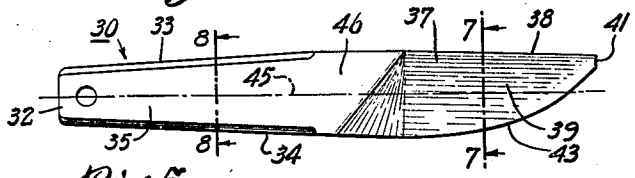


Fig. 6

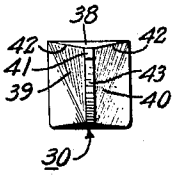


Fig. 7

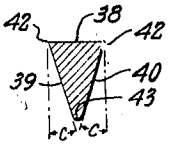


Fig. 5

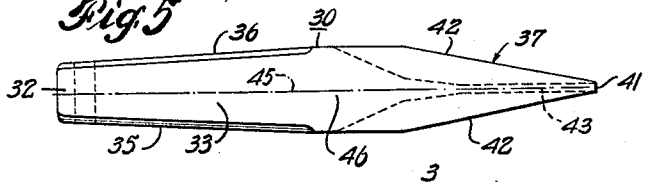
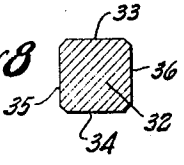


Fig. 8



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Fig. 9

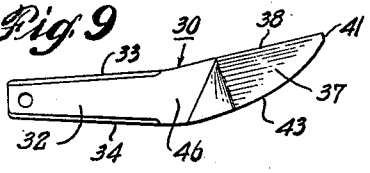


Fig. 11

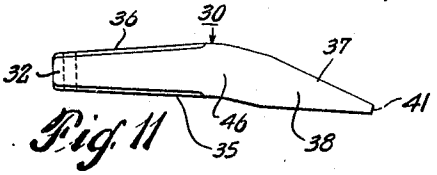


Fig. 10

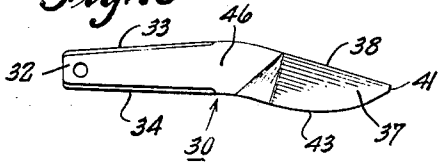
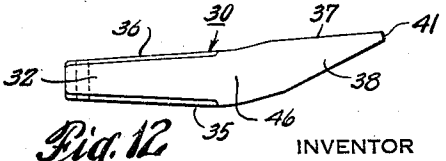


Fig. 12



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Fig. 3

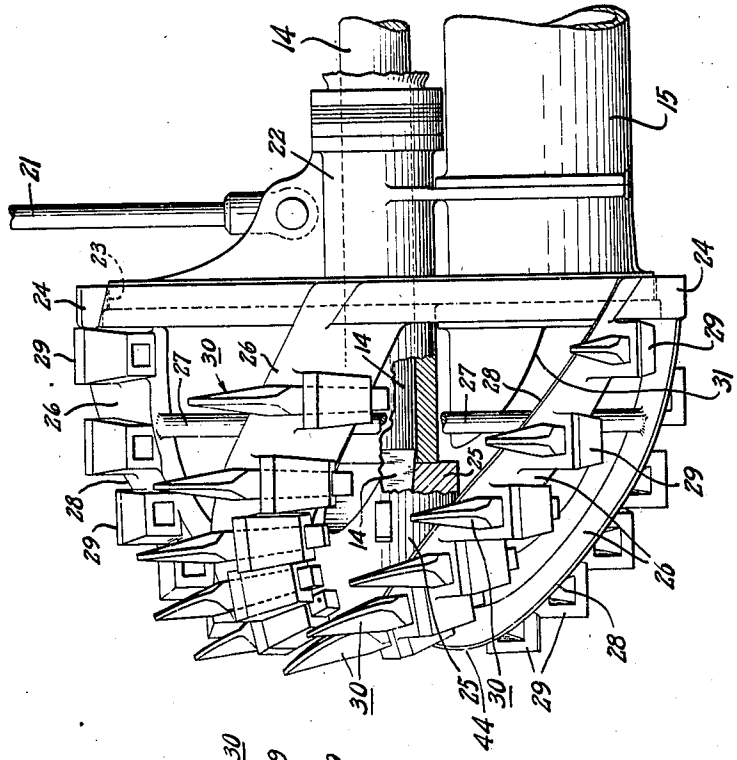
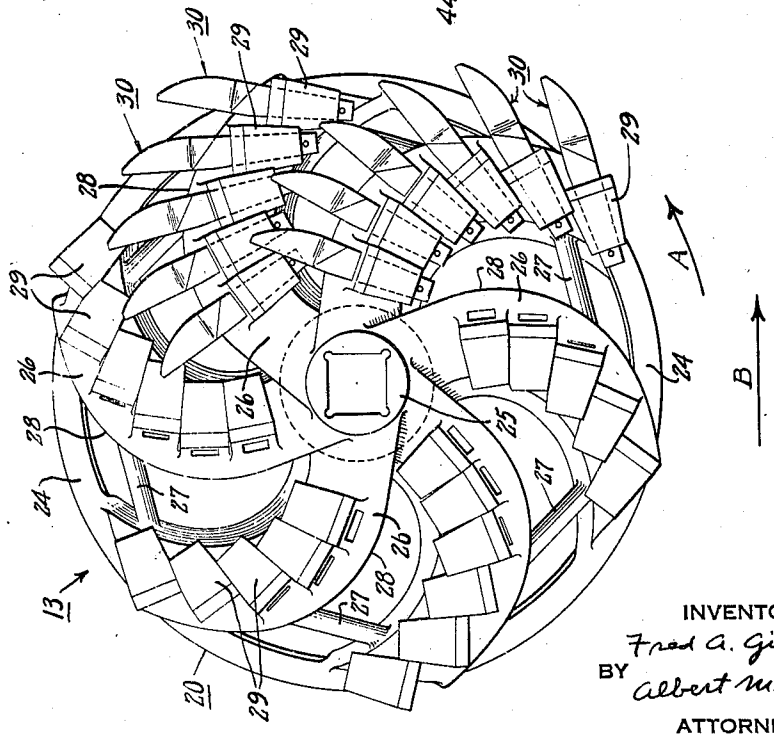


Fig. 2



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Fig. 13

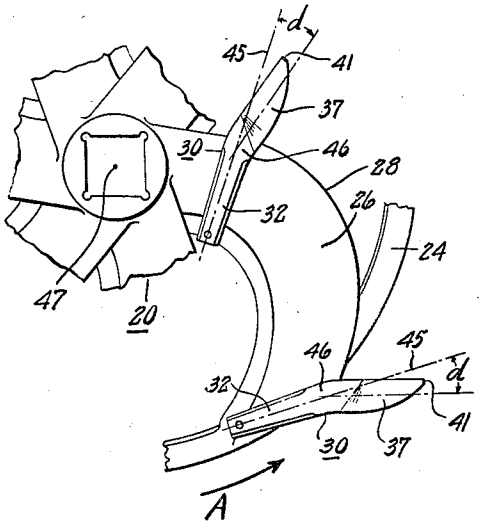
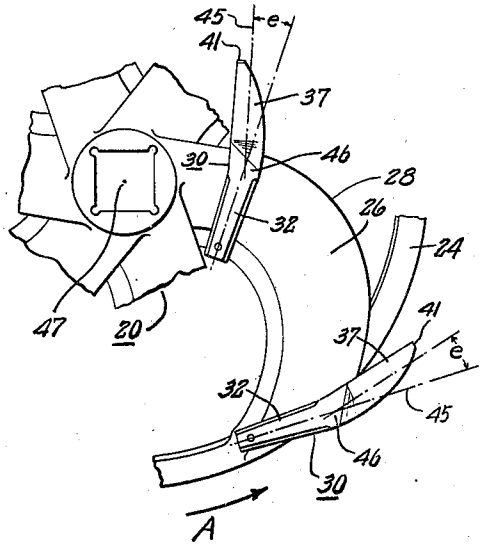


Fig. 14



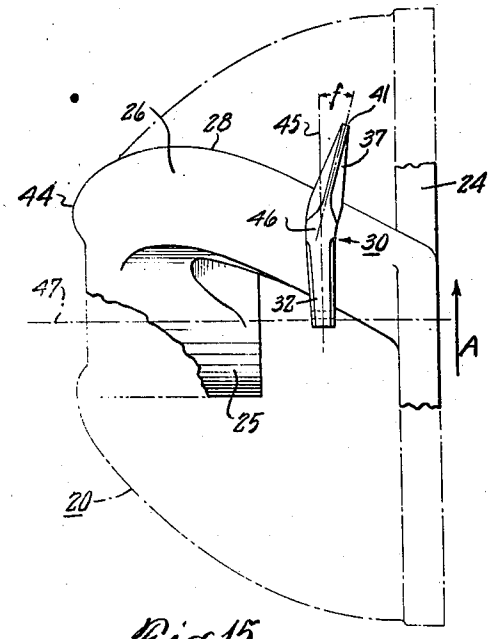


Fig. 15

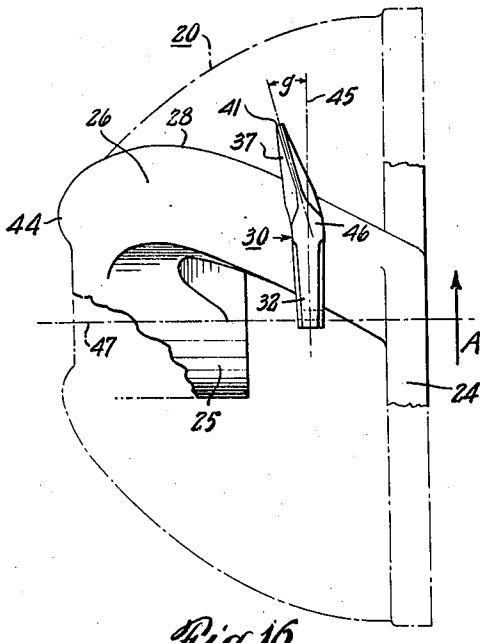


Fig. 16

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UNITED STATES PATENT OFFICE

2,340,216

CUTTER FOR DREDGES

Fred A. Gill, Lebanon, Pa., assignor of one-half to Guy W. Sackett, Christiansburg, Va.

Application May 27, 1941, Serial No. 395,337

3 Claims. (Cl. 37—67)

The invention relates to cutters for suction dredges and more particularly to cutters of the type disclosed in Sackett Patent No. 1,226,386, dated May 15, 1917.

The present invention constitutes an improvement over the cutter disclosed in the above-mentioned Sackett patent, although its principles are not necessarily limited to cutters of the Sackett type. The Sackett cutter comprises a cutter head generally in the shape of a crown comprising a rim or base at one end and a nose or hub at the other end united by curved helical-like blades, the edges of which constitute cutting edges. Secured to these blades are sockets in which are located cutting teeth for enhancing the cutting effect of the blades, particularly when working on harder materials, such as hard pan, coral, soft rock, etc. While the Sackett cutter has gone into extensive commercial use, its cutting teeth are subject to considerable wear, necessitating frequent sharpening and replacement.

The present invention provides a cutter which not only increases the speed of cutting but also greatly increases the life of the cutter head and cutter teeth, increasing the length of the periods between sharpenings and greatly increasing the overall life of the cutter teeth. According to the present invention, the teeth are made more slender, increasing the length of their cutting edges and providing a positive relief or clearance along the depth or width of the tooth which provides more of a cutting or splitting action and reduces friction and wear on the teeth.

The teeth, as shown in the Sackett patent and as heretofore used, are in the nature of picks and are made comparatively thick and heavy and provide points which do most of the cutting action. These teeth are subject to considerable wear because they shatter and break the rock rather than split or cleave it.

The invention also provides for the bending of the cutter teeth either circumferentially or axially of the cutter axis of rotation in order to reduce wear on the cutter teeth. Provision is made whereby all straight teeth may be first used on a given job and the wear on these teeth noted from time to time before the first sharpening. During this first working shift, a second cutter head and set of teeth may be put in readiness for the second shift, some or all of the teeth being bent, if necessary, in accordance with the results noted in the cutter in use.

The present invention also locates the teeth on the several cutter blades in staggered relation so that the teeth on successive blades do not trail each other.

The invention also consists in certain new and original features of construction and combinations of parts hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, and the manner in which it may be carried out, may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof, in which

Fig. 1 illustrates a common form of dredge of which the invention is applied.

Fig. 2 is an end view of the cutter head looking axially thereof, teeth being shown in some of the sockets and omitted in others for purposes of illustration.

Fig. 3 is a side elevation with parts broken away of the new cutter head, some of the teeth being omitted.

Fig. 4 is a side elevation of a new tooth according to the invention.

Fig. 5 is a top plan view of the tooth in Fig. 4.

Fig. 6 is an end elevation of the tooth looking from nose toward the shank of the tooth.

Fig. 7 is a section on the line 7—7 of Fig. 4 through the blade of the tooth.

Fig. 8 is a section on the line 8—8 of Fig. 4 through the shank of the tooth.

Figs. 9 and 10 are side elevations of the tooth, corresponding to Fig. 4, showing the blade bent upwardly and downwardly respectively with respect to the shank.

Figs. 11 and 12 are top plan views of the tooth, corresponding to Fig. 5, but showing the blade of the tooth bent to the right and to the left respectively with respect to its shank looking from shank to nose.

Figs. 13 and 14 are semi-diagrammatic views looking axially of the cutter and illustrating the bending of the tooth blades downwardly and upwardly respectively, and

Figs. 15 and 16 are semi-diagrammatic side elevations of a cutter illustrating the blades of the tooth bent to the right and left respectively, as viewed in these figures.

In the following description and in the claims, various details will be identified by specific names for convenience, but they are intended to be as generic in their application as the art will permit.

Like reference characters denote like parts in the several figures of the drawings.

In the drawings accompanying and forming part of this specification, certain specific disclosure of the invention is made for purposes of explanation, but it will be understood that the details may be modified in various respects without departure from the broad aspect of the invention.

Referring now to the drawings and more particularly to Fig. 1, my invention is shown applied to one form of suction dredge, this figure showing the parts somewhat diagrammatically. The water or stream is denoted by 11 and the bed or deposit it is desired to remove is indicated by 12. The barge or float upon which the dredging apparatus is mounted is denoted by 10. The cutter denoted by 13 is driven by drive shaft 14 which in turn is driven by a suitable prime mover 17 in such manner that the shaft 14 may have universal movement with respect to the dredge 10. The suction pipe 15 extends from a point within the cutter 13 and has suitable universal connection with suitable pumping apparatus located on the dredge 10. The drive shaft 14 and suction pipe 15 are assembled together and provided with a suitable means for permitting a workman to climb out to the cutter 13 when it is raised out of the water. This assembly indicated by 16 is commonly known as a ladder and this ladder together with the cutter 13 is movable both vertically and horizontally by a suitable derrick including tackle 19 and beams 18 as will be understood by those skilled in the art.

Referring now to Figs. 2 and 3 the cutter 13 comprises a head or spider 20 connected to drive shaft 14 which is suitably journaled in a cutter head bearing 22 suspended from a link 21 connected to the tackle or ladder fall 19. The bearing 22 has a bearing surface 23 for supporting the rim or back ring 24 of the spider 20. The spider 20 has a hub 25 to which shaft 14 is suitably secured. Hub 25 and rim 24 are connected by warped blades 26 which are connected or braced by circular rods or braces 27 to limit the size of the openings between the exterior and interior of the head 20. The bearing 22 also supports the lower end of suction pipe 15 which has an opening 31 communicating with the interior of the head 20.

The blades 26 have sharp cutting edges 28 on the sides facing in the direction of rotation, i. e., their leading edges are sharp, and are provided with sockets 29 to receive the teeth 30 which are suitably keyed thereto.

The blades 26 extend generally helically from the central hub 25, in a direction opposite to the direction of rotation of the head indicated by A in Fig. 2, to the rim or base 24 of the crown-shaped cutter head 20. Every other blade 26 has six teeth while the intermediate blades have five teeth, the teeth on alternate blades being staggered axially of the cutter so that the teeth on the immediately following blades do not follow directly in the paths cut by the teeth immediately preceding. As in the Sackett patent, the blades 26 are shaped to provide a nose 44 projecting axially of the hub 25 and to insure there being always some part of some blade in cutting action.

Referring now to Figs. 4 to 8, the teeth 30 are made up of a tapered shank 32 having top surface 33, bottom surface 34 and side surfaces 35 and 36, this shank engaging a similarly shaped interior surface of the several sockets 29. Integral with the shank 32 is a blade 37 having a top surface 38 and converging side surfaces 39 and 40 forming relief angles c (Fig. 7). The intersection of top surface 38 and side surfaces 39 and 40 form cutting edges 42 for which the relief angles c are provided. The side faces 39 and 40 meet in a comparatively narrow bottom edge or surface indicated by 43 which partakes of a gentle curve from the nose 41 merging into the bottom surface 34 of shank 32. The blade 37 and shank 32 are joined by a portion indicated by 46 which will be termed the neck, at which the blade may be bent with respect to the shank 32 for certain purposes as will hereinafter be described more in detail.

The approximately median line through the shank and blades of a straight tooth will be called the axis for convenience and is indicated by 45. When the teeth are mounted in their sockets this line or axis is located in a plane substantially perpendicular to the axis of rotation for teeth near the rim 24, while the sockets for those teeth nearer the nose 44 locate the axes of the teeth at increasingly greater angles with respect to planes perpendicular to the axis of revolution as indicated particularly in Fig. 3. In all cases the tooth axes are located at positions between radii from the axis of rotation passing through the teeth and tangents to said radii, which indicate the direction of tooth movement at any particular instant. Thus, the top surface 38 and cutting edges 42 of the tooth blades 37 are leading surfaces and edges while the bottom edges 43 are trailing.

Before explaining the use of the invention some idea of size will be given. It will be understood that we are dealing with heavy machinery. For example, the cutter head may weigh about 15,000 lbs. and each individual tooth may weigh between 80 and 90 lbs. In the particular installation illustrated, there are 33 teeth so the teeth alone will weigh considerably over a ton. The cutter head may be five or six feet in diameter at its rim or open end and may be five or six feet in length, that is, axially. The cutter teeth may run over two feet in length and may be 4 inches wide at the top and 4 inches in depth (from top 38 to bottom 43). The cutter head may rotate at a speed of 20 revolutions per minute. It will be understood that the above figures are illustrative only and the various sizes, weights and other values will vary with the particular installation.

To use the above invention, new and sharp straight teeth 30 having substantially the shape indicated will be mounted in the cutter head sockets 29 and keyed or locked in. The cutter head 13 will of course have been detached from drive shaft 14, the work of mounting the teeth 30 being done on the deck of barge 10 as will be understood by those skilled in the art. The head or spider 20 will then be mounted in position on the end of the drive shaft 14, the ladder 16, of course, being in raised position to permit this operation. The ladder will then be lowered into the water and we are ready for dredging.

The dredging procedure will depend upon the technique of the particular operator and also upon conditions or the nature of the bed to be removed. The dredge will be moved to place the cutter head 13 up against the bed it is desired to cut illustrated by 12 in Fig. 1, the cutter head will be started rotating in the direction indicated by the arrow A in Fig. 2 and the ladder 16 will be moved in a long horizontal sweep, cutting in the direction indicated by the arrow B. At the end of each horizontal sweep, the ladder 16 will be returned, no cutting being done on the return trip. Upon the next cutting trip in the direction of the

arrow B, a further line or path will be cut in the rock 12. The cutting blades 26 having cutting edges 28 will cut the softer materials such as clay, etc. The teeth 30 will cleave the rock into comparatively small pieces which must pass through the openings in the cutter head whence they are sucked by the suction pipe 15 and discharged in accordance with well-known suction dredge practice.

After a given cutting period, which again will depend upon cutting conditions but which may be three or four hours, the ladder 16 is raised, the cutter stopped and a man crawls out on the ladder to look at the teeth. If the teeth are not too dull, the cutting may be resumed until it is decided that the teeth are too dull for further work.

While the cutting operation is going on, a spare cutting head will be conditioned to replace the cutting head in use when it must be removed after becoming dull. The cutting teeth 30 will be mounted in the spare head 20 in a manner similar to mounting them on the first head, but some or all of the new teeth, or resharpened teeth, as the case may be, instead of all being straight, will be bent to overcome the wear as indicated by an inspection of the teeth on the first head. Thus, when the first head must be removed for further sharpening of its teeth, the spare head will be ready to be put in place. The length of a cutting period will vary with conditions, running for example from 18 to 20 hours. For hard rock, the period may be as short as 12 hours before the head must come off for the resharpening of the teeth. For soft rock, the period may be as long as 48 hours before it is necessary to remove the head for resharpening.

For bending the teeth a special bending press may be provided. The bodies of the teeth will be bent at their necks 46 with respect to their shanks 32, either up as in Fig. 9; down as in Fig. 10; right as in Fig. 11; or left as in Fig. 12, considering the surfaces 33 and 38 as the top of the tooth and looking from shank 32 to nose 41. Generally speaking, the side bending will be in the direction of wear. For example, if a tooth in use shows more wear on the right side (surface 39), the corresponding tooth of the spare job will be bent toward the right side to the shape shown in Fig. 11. If the wear is on the left side (surface 40) the corresponding tooth will be bent toward the left side to the shape shown in Fig. 12.

The up and down bending will be dependent upon the amount of wear on the lower edge 43 of the teeth. If the wear on lower edge 43 is too great, indicated by the depth or width (distance from upper surface 38 to lower edge 43) being too small, generally speaking, the tooth will be bent downwardly as indicated in Fig. 10; if the wear on lower edge 43 is too little, the tooth will be bent upwardly as shown in Fig. 9.

The relationship of the teeth with respect to the axis of rotation indicated by 47 and the effect of bending will be better understood by referring to Figs. 13–16. Here the sockets are omitted to better illustrate the tooth angles. In Fig. 13 the tooth blade 37 is bent with respect to its original axis 45 downwardly, or oppositely to the direction of rotation A, through the angle *d*, thus corresponding to Fig. 10. In Fig. 14 the tooth blade 37 is bent upwardly, or into the direction of rotation A, through the angle *e*, corresponding to Fig. 9. In Fig. 15 the tooth blade is bent laterally toward the rim 24 through angle *f*, corresponding to Fig. 12. In Fig. 16 the tooth blade is bent laterally toward the nose 44 through angle *g*, corresponding to Fig. 11.

The uneven distribution of wear on the several teeth is caused by a number of factors, among which are the kind and condition of the deposit, the direction of stratification, etc. In any event, whatever the cause of uneven wear on the several teeth, the teeth are bent either sideways or up and down to lessen this wear so that, when the spare cutter head is placed in cutting position, it will cut more efficiently and its teeth will last longer.

When the first cutting head is removed from its drive shaft, its teeth are removed and they are sharpened by heating and pounding under a steam hammer to replace the cutting edges 42 and to provide the relief *c* as indicated in Fig. 7. The sharpening or hammering action draws the teeth, using the stock in the body to form the cutting edges and the relief angle similar to the original teeth, but as the tooth is repeatedly sharpened, the blade 37 becomes thinner, although its cutting edges and relief angles will be kept constant. As the teeth become thinner, they naturally become more efficient in their cutting or splitting action. As an example, an average tooth may take four or five sharpenings before it must be discarded, but the use of the invention will double the tooth life between sharpenings.

The tooth according to the invention is highly efficient in that it provides more efficient cutting or splitting action and less pulverizing or hammering action. The comparatively thin blade 37 provides splitting efficiency and the depth or width of the blade provides sufficient strength to permit the blade to be narrow and the relief angle *c* or clearance reduces friction and resistance of the teeth as they pass through the rock. The repeated scraping of the rock on the teeth acts as abrasive which gradually wears the teeth away, but the narrower teeth acting as blades, become more efficient in use due to the increased splitting action. The tapering of the upper surface 38 of the tooth blade and the more uniform thickness of the lower edge 43 provides a variable relief angle *c* increasing from nose 41 to shank 32.

It will be found that the bending of the teeth not only increases the life of the teeth but also increases the life of the sockets 29. It is customary to replace the metal scraped from the sockets by the abrasion of the rock, by adding metal by welding. The bending of the teeth protects these sockets and reduces the amount of the material it is necessary to add to the sockets.

Thus, a cutting tooth for suction dredges is provided which has higher cutting efficiency and longer life. The relief angle reduces the friction of the teeth as they pass through the rock. The narrowness of the teeth makes it more blade-like and its depth gives it strength. The bending of the teeth reduces uneven wear by causing the teeth to bite into the rock rather than to merely scrape it. A scraping tooth does no cutting and yet adds friction and wears out prematurely.

While certain novel features of the invention have been disclosed herein, and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes may be made by those skilled in the art without departing from the spirit of the invention.

What I claim is:

1. In hydraulic suction dredging, a rotary cut-

ter having sockets of generally rectangular internal cross section, teeth in said sockets, each tooth having a relatively heavy tapered shank of generally rectangular cross section seated in its socket and a cutting and wedging blade comparatively deep or wide in the direction of cutting movement and comparatively thin in the direction transverse to said cutting movement, said tooth blade having a comparatively flat leading surface merging into the top surface of said shank, said leading surface converging in width outwardly to a blunt nose of restricted dimension, said tooth blade having side surfaces converging to a relatively small blunt trailing edge, the intersection of said leading surface and said side surfaces forming cutting edges, said converging side surfaces providing relief for said cutting edges, said trailing edge merging into the bottom surface of said shank, said trailing edge extending from shank to nose and forming a relatively small angle with said leading surface near said shank and for a substantial part of length of the blade, and partaking of a protuberant outline toward the outer end of the blade and forming a relatively large acute angle with said leading surface at said nose, the general tapering nature of said tooth blade from shank to nose providing wedging action as the tooth enters the rock, the comparatively thin and deep or wide blade and its relieved cutting edges providing cutting action as the tooth cuts a swath through the rock.

2. In hydraulic suction dredging, a rotary cutter having sockets of generally rectangular internal cross section, teeth in said sockets, each tooth having a relatively heavy tapered shank of generally rectangular cross section seated in its socket and a cutting and wedging blade comparatively deep or wide in the direction of cutting movement and comparatively thin in the direction transverse to said cutting movement, said tooth blade having a comparatively flat leading surface substantially coextensive with the adjacent top surface of said shank, said leading surface converging in width outwardly to a blunt nose of restricted dimension, said tooth blade having side surfaces converging to a relatively small blunt trailing edge, the intersection of said leading surface and said side surfaces forming cutting edges, said converging side surfaces providing relief for said cutting edges, said relief becoming increasingly larger from said nose toward said shank, said trailing edge being substantially coextensive with the adjacent bottom surface of said shank, said trailing edge extending from shank to nose and forming a relatively small angle with said leading surface near said shank and for a substantial part of length of the blade; and partaking of a protuberant outline toward the outer end of the blade and forming a relatively large acute angle with said leading surface at said nose, the general tapering nature of said tooth blade from shank to nose providing wedging action as the tooth enters the rock, the comparatively thin and deep or wide blade and its relieved cutting edges providing cutting action as the tooth cuts a swath through the rock.

3. In hydraulic suction dredging, a rotary cutter comprising a crown-shaped head having a hub and a back ring, a plurality of helicoidal blades connecting said hub and back ring, sockets of generally rectangular internal cross-section on said blades, teeth in said sockets, each tooth having a relatively heavy tapered shank of generally rectangular cross section seated in its sockets and a cutting and wedging blade comparatively deep or wide in the direction of cutting movement and comparatively thin in the direction transverse to said cutting movement said tooth blade having a comparatively flat leading surface substantially coextensive with the adjacent top surface of said shank, said leading surface converging in width outwardly to a blunt nose nose of substantial but restricted dimension, said tooth blade having side surfaces converging to a relatively small blunt trailing edge, the intersection of said leading surface and said side surfaces forming cutting edges, said converging side surfaces providing relief for said cutting edges, said relief becoming increasingly larger from said nose toward said shank, said trailing edge being substantially coextensive with the adjacent bottom surface of said shank, said trailing edge extending from shank to nose and describing a relatively small angle with said leading surface near said shank and for a substantial part of length of the blade, and describing a gentle curve toward the outer end of the blade ending in a relatively large acute angle with said leading surface at said nose, the general tapering nature of said tooth blade from shank to nose providing wedging action as the tooth enters the rock, the comparatively thin and deep or wide blade and its relieved cutting edges providing cutting action as the tooth cuts a swath through the rock.

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