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Hamm

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[54] **ROTARY DREDGE CUTTER-HEAD HAVING SPACED GUARD MEMBERS**

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[51] **Int. Cl.** **E02f 3/92,** E02f 3/94

[58] **Field of Search** 37/67, 189, 57

[56] **References Cited**

UNITED STATES PATENTS

2,340,216	1/1944	Gill	37/67
2,029,816	2/1936	Ewing	37/67
2,702,437	2/1955	Cushing	37/67
1,226,386	5/1917	Sackett	37/67

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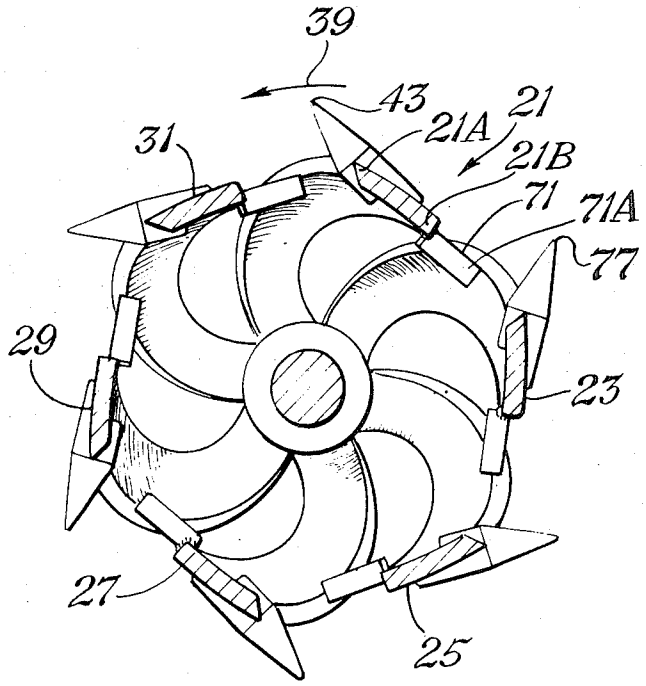
[57] **ABSTRACT**

Cutter-head for use in a dredging system for dredging sand and gravel which has a plurality of spaced guard members extending from the trailing edge of each support member toward an adjacent support member but spaced therefrom. The guard members are located inward of cutting teeth coupled to the leading edge of each support member. The guard members block the passage of large rocks into the interior of the head but to allow the passage of roots and clay along with the sought after sand and gravel thereby preventing the roots and clay from blocking the openings of the cutter-head.

12 Claims, 4 Drawing Figures



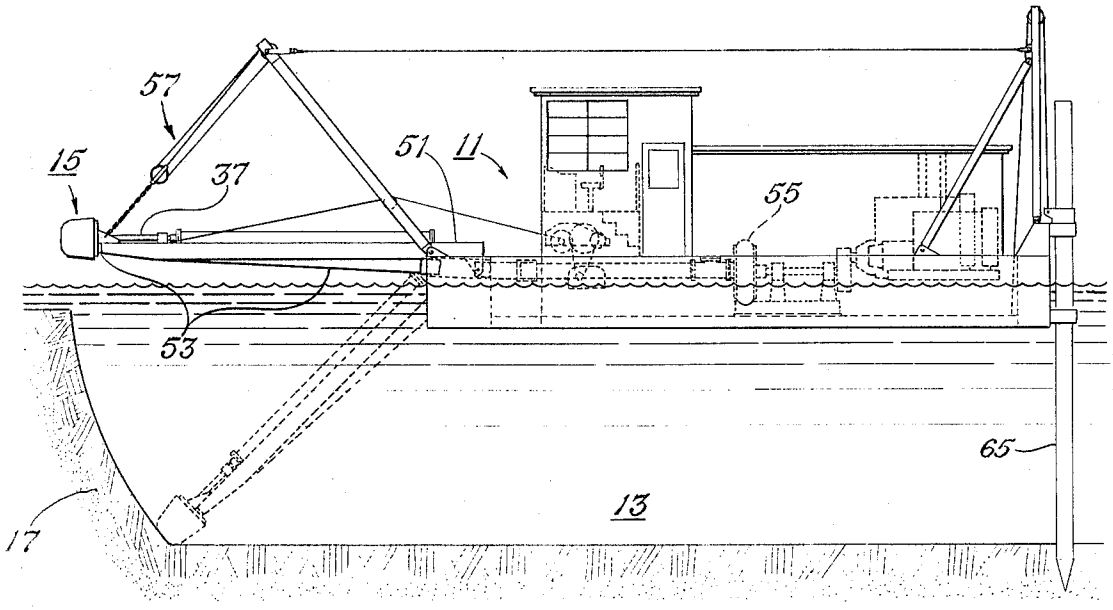


Fig. 1

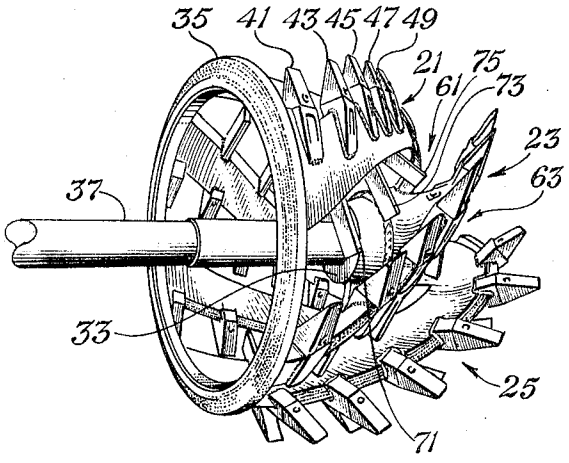


Fig. 2

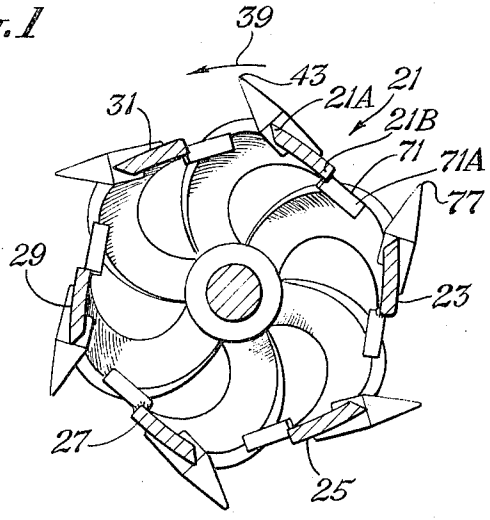


Fig. 3

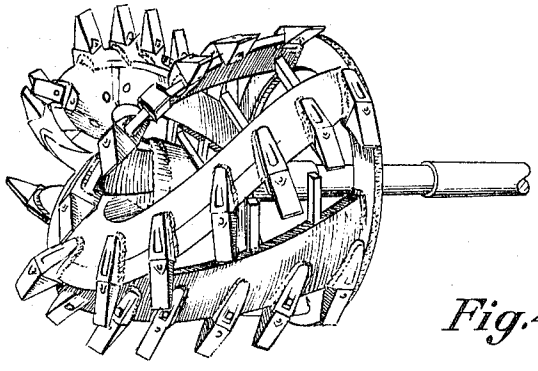


Fig. 4

ROTARY DREDGE CUTTER-HEAD HAVING SPACED GUARD MEMBERS

BACKGROUND OF THE INVENTION

This invention relates to an improved cutter-head for use in a dredging system to allow more efficient dredging operations to be carried out in old sand and gravel pits.

In the processing of sand and gravel for commercial purposes, strip mining operations have been carried out in the past to select and remove only the best grade of material. These operations have resulted in large amounts of desirable sand and gravel still remaining in the pits. Due to the methods employed originally in the strip mining operations, the sand and gravel remaining in these old pits are mixed with other soils and debri such as clay and roots. Hence selective mining operations now cannot be carried out to remove only the sought after sand and gravel. From a practical standpoint, if these old pits are to be reclaimed, all of the material must be removed.

In my operations, I use a dredge equipped with a rotating cutter-head to remove the material from the pits. The cutter-head includes a plurality of spaced support members curving outward from a forward central hub and backward to an annular shaped frame. Outwardly extending cutting means which may be spaced teeth are coupled to the leading edge of each support member. A shaft extends through the annular shaped frame and is coupled to the interior side of the hub for rotating the head in a given direction to allow the teeth to carry out their cutting operation. The sand and gravel and other material loosened by the cutter-head is pumped through the head to the dredge by way of a conduit and pump located on the dredge. From the dredge, the material is conveyed or transported to a sand and gravel washing plant.

Heretofore difficulties were experienced in the dredging operations in that large rocks would either pass through the head to the pump or be lodged between the openings of the head which would require a shut-down operation in order to remove or dislodge the rocks. An attempt was made to remedy the situation by welding spaced guards or rods to adjacent support members and which completely bridged the opening between adjacent support members. These guards did block the passage of larger rocks however they contributed to the problem in that roots would become tangled around these bridging guards which would result in the openings becoming blocked especially when loose clay and soil would build up or collect on the entangled roots. When this occurred the entire cutter-head would become a solid mass of clay and roots thereby requiring shut-down operations to remove the clay and roots from the cutter-head.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided a cutter-head for a dredging system which eliminates the above mentioned problems. The cutter-head includes a plurality of spaced support members curving outward from a forward central hub and backward to an annular shaped frame. Cutting means is coupled to the leading edge of each support member. A central shaft extends through the frame and is coupled to the interior side of the hub. In addition, a plurality of spaced guard members are coupled to each support member. These guard members have trailing ends which extend toward an adjacent or following support member but are spaced therefrom and from its cutting means. The outer extremities of each guard member are spaced substantially inward from the circle of revolution made by the closest cutting edge of the cutting means coupled to the adjacent support member. The top surfaces of the trailing edges of the support members also are free and clear of the guard members.

In the embodiment disclosed, a plurality of spaced teeth are coupled to the leading edge of each support member and extend outward and away from the axis of the shaft. The guard members are coupled to the trailing edges of the support members and the trailing ends of the guard members are located substantially inward of the cutting edges of the closest teeth coupled to the following support members. With this arrangement the guard members will block the passage of the larger rocks but allow the passage of sand and gravel as well as the passage of clay and roots into the interior of the cutter-head. Due to the arrangement and position of the guard members, roots will slide off of the guard members and into the interior of the head as it rotates rather than becoming entangled around the guard members.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a dredge equipped with a rotary cutter-head for carrying out dredging operations;

FIG. 2 is a rear-side view of the cutter-head of the present invention;

FIG. 3 is a cross-section of FIG. 2 taken through a plane extending perpendicular to the axis of the shaft looking toward the front end of the cutter-head and illustrating the rearmost guard members of a cutter-head; and

FIG. 4 is a front-side view of the cutter-head of the present invention.

DETAIL DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, there is illustrated a barge 11 floating on a body of water 13 and equipped with a rotary cutter-head 15 for removing sand, gravel and other material from the body or earth formation 17 which may form part of an old sand and gravel pit.

Referring to FIGS. 2–4, the cutter-head comprises a plurality of spaced support members 21, 23, 25, 27, 29, and 31 curving outward from a forward central hub 33 and spiraling backward to an annular shaped frame member 35. A shaft 37 extends through the annular shaped frame and is coupled to the interior side of the hub 33 for rotating the head in a given direction to allow the head to carry out its cutting operations. In FIG. 3, the direction of rotation is counterclockwise as illustrated by the arrow 39. Each support member has a leading edge to which a plurality of spaced teeth are coupled for cutting and dislodging the material. Referring to the support member 21, the leading edge is identified by reference character 21A while its trailing edge is identified by reference character 21B. Teeth 41, 43, 45, 47, and 49 are illustrated as being coupled to the leading edge of the support member 21. They are welded to the leading edge in such a manner that they extend outward from the axis of the shaft. In a given plane perpendicular to the axis of shaft 37, for example, as illustrated in FIG. 3, the distance from the axis

of the shaft 37 to leading edge 21A of support member 21 is greater than the distance from the axis of the shaft 37 to the trailing edge 21B. The other support members and their teeth have the same relationship.

The cutter-head 15 is rotated by way of shaft 37 and a rotary drive illustrated at 51 on the barge. Extending to the lower portion of the interior of the cutter-head and below the shaft 37 is a suction tube 53 which has its other end extending to a suction pump 55 located on the barge.

In operation, the cutter-head is lowered or raised by the hoist arrangement illustrated at 57 while it is rotated and while the suction pump 55 is operating. As the cutter-head rotates, the teeth of the head cut and loosen the material. The loosened material falls or is forced in between the support members through the openings, for example as illustrated at 61 and 63, and into the interior of the cutter-head where the material is impelled or drawn into the conduit 53 by way of the suction force. The material then is conveyed by way of the tube 53 onto the barge and from the pump 55 conveyed to a gravel washing plant by way of another conduit not shown. The barge may be rotated to different positions around a pivot axis 65 extending from the barge and imbedded in the earth.

The cutter-head employed is a commercially available cutter-head which has been modified to solve the problem presented by large rocks, roots and clay present in the pits.

As indicated previously large rocks tended to become caught in the openings of the cutter-head or else were forced through the openings where they became lodged in the pump. Attempts to remedy the situation were made by welding elongated rods or guards completely across the openings and to adjacent support members to bridge the openings. This caused roots to become tangled around the bridging guards and which provided a mass upon which clay would collect and completely clog or block the openings of the cutter-head.

The situation was solved by modifying the cutter-head by welding to each support member at its trailing end and on the underside thereof a plurality of spaced guard members which extend toward an adjacent support member but spaced therefrom. In the embodiment disclosed, three guard members welded to the trailing edge of each support member were found to be sufficient to solve the problem. In FIG. 2, the three guard members welded to the trailing edge of support member 21, are identified by reference characters 71, 73, and 75. In FIG. 3, only the rearmost guard members are illustrated. Referring to the guard members illustrated in FIG. 3, it can be seen that their outer extremities are spaced substantially inward from the tips of the cutting teeth. Moreover, each guard member generally follows the same contour of its support member in a direction transverse to the shaft axis. The trailing end of each guard member extends to a point nearly below the tip of the closest following tooth relative to the shaft axis. In addition, the trailing end of each guard member is spaced from the leading edge of the adjacent or following support member. The other guard members located toward the forward hub also have the same relative relationship. In addition, the top surfaces of the support members at their trailing edges also are free and clear of protruding structure. Thus, as the cutter-head rotates, sand and gravel and other material such as roots and clay are allowed to pass below the teeth through the openings and through the spaces between the guard members and into the interior of the cutter-head. The guard members, however will block the passage of the larger rocks. Since the guard members on a given support member extend away from the direction of rotation of the support member and are spaced from the adjacent support member and its teeth, roots will slide off of the guard members as the head rotates and pass into the interior of the cutter-head rather than becoming entangled around the guard members. Thus a mass of roots will not be able to collect on the cutter-head thereby eliminating the collection of clay on the roots and hence on the cutter-head which would otherwise block the openings of the cutter-head.

Instead of six support members, as illustrated in FIGS. 2–4, the cutter-head may have five support members. In the following example, dimensions will be given for a cutter-head having five equally spaced support members rather than six. In this example, reference will be made to support members 21 and 23 and guard member 71 shown in FIG. 3, but with the assumption that these members are part of the cutter-head having five support members.

In the plane of FIG. 3, for a five support member head, the leading edge of each support member is about 18 inches from the shaft axis, while their trailing edges are about 16 inches from the shaft axis. In this head, the tip of tooth 77 is about 23 inches from the shaft axis. The leading end of guard member 71, where it is coupled to the trailing end of support member 21, is less than 16 inches from the shaft axis. In addition, the trailing edge 71A of guard member 71 is about 15 ½ inches from the shaft axis. Thus the outer extremities of guard member 71 are about 7 inches radially inward from the maximum radius of the tip of tooth 77. The trailing edge 71A and guard member 71 extends to a point spaced about 7 or 8 inches from the leading edge of support member 23. In the plane of FIG. 3, for a five support member cutter-head, the other guard members have the same relationship. In addition the other guard members toward the forward end of the head also have similar relationships.

The frame 35 for the five support member cutter-head, has a maximum diameter of about 42 inches and the head has a length of about 48 inches. On a head having five support members, the support members at the rear end of the head have a width of about 12 inches and taper to a narrower width toward the front of the cutter-head. The openings between adjacent support members also taper from a wide opening to a narrower opening going from the rear end to the forward end of the cutter-head. On the head having five support members, the openings at the rear end of the cutter-head between adjacent support members are about 15 inches from support member to support member. For a head having five support members, the guard members 71, 73, and 75 are spaced about 8 or 9 inches apart and have lengths of about 9 inches, 7 inches, and 5 inches respectively. Guard member 71 is spaced about 10 inches from frame 35.

Since the lengths of the guard members of each support member decrease progressively towards the front end of the head, the distance between the trailing ends of the three guard members of a given support member and the adjacent or following support member remains about constant. This is also true with respect to the dis-

tance between their trailing ends and the top cutting edge of the closet tooth of an adjacent or following support member.

The cutter-head having five support members described above, may allow rocks up to 6 inches in diameter to pass through the head but will block the passage of larger rocks, for example those having diameters of 9, 10, or 12 inches.

In operation, the cutter-head may be rotated at a speed of about 30 revolutions per minute to carry out its cutting and dislodgement operations.

Instead of spaced teeth, a continuous cutting blade may be coupled to the leading edge of each support member. Each blade would have the same relationship to the various components of the head as the set of teeth that it replaces. Blades instead of teeth may be employed when dredging in softer material.

I claim:

1. A cutter-head for a dredging system comprising:
a plurality of spaced support members curving outward from a forward central hub and backward to an annular shaped frame,
said members each having a leading edge and a trailing edge,
cutting means coupled to the leading edge of each support member,
said cutting means having cutting edges for carrying out cutting operations,
a shaft extending through said annular shaped frame and coupled to the interior side of said hub for rotating the head in a given direction to allow said cutting means to carry out their cutting operations, and
a plurality of spaced guard members coupled to each support member and having trailing ends extending toward a following support member but spaced therefrom and from its cutting means,
the outer extremities of each guard member being spaced substantially inward from the circle of revolution made by the closest cutting edge of said cutting means coupled to the following support member,
each extending guard member generally following the same contour of its support member transverse to the shaft axis.

2. The cutter-head of claim 1 wherein:
said cutting means coupled to each support member extend outward and away from the axis of said shaft.

3. The cutter-head of claim 2 wherein:
said cutting means comprises a plurality of spaced teeth coupled to the leading edge of each support member, and extending outward and away from the axis of said shaft,
the trailing ends of each guard member being located inward of the cutting edge of the closest tooth coupled to an adjacent following support member.

4. The cutter-head of claim 2 wherein:
said guard members are connected to the trailing edges of said support members.

5. The cutter-head of claim 4 wherein:
said guard members are connected to the underside of said support members.

6. The cutter-head of claim 4 wherein:
the top surfaces of said support members at their trailing edges have a smooth and continuous surface from said hub to said frame.

7. The cutter-head of claim 4 wherein:
said guard members are connected only to the trailing edges of said support members.

8. The cutter-head of claim 4 wherein:
the top surfaces of said support members are free and clear of said guard members.

9. The cutter-head of claim 1, wherein said cutter-head is for use in dredging sand and gravel mixed with clay, roots, and large rocks,
the outer extremities of each guard member being spaced inward about one-third of the radius of the circle of revolution made by the closest cutting edge of said cutting means coupled to the following support member.

10. The cutter-head of claim 9, wherein:
each guard member, in a plane transverse to the axis of said shaft and extending through the guard member and through the support member to which it is coupled, has its outer extremities spaced inward from the outer extremities of its support member.

11. A cutter-head for a dredging system comprising:
a plurality of spaced support members curving outward from a forward central hub and backward to an annular shaped frame,
said members each having a leading edge and a trailing edge,
cutting means coupled to the leading edge of each support member,
said cutting means having cutting edges for carrying out cutting operations,
a shaft extending through said annular shaped frame and coupled to the interior side of said hub for rotating the head in a given direction to allow said cutting means to carry out their cutting operations, and
a plurality of spaced guard members coupled to the trailing edge of each support member and having trailing ends extending toward an adjacent support member but spaced therefrom and from its cutting means,
the outer extremities of each guard member being located at a distance from the axis of said shaft less than the distance from said axis of the closest cutting edge of said cutting means coupled to an adjacent following support member,
the leading edges of said support members being further from the axis of said shaft than their trailing edges,
the top surfaces of said suport members being free and clear of said guard members.

12. A cutter-head for a dredging system for use in dredging sand and gravel mixed with clay, roots, and large rocks, comprising:
a plurality of spaced support members curving outward from a forward central hub and backward to an annular shaped frame,
said members each having a leading edge and a trailing edge,
cutting means coupled to the leading edge of each support member,
said cutting means having cutting edges for carrying out cutting operations,
a shaft extending through said annular shaped frame and coupled to the interior side of said hub for rotating the head in a given direction to allow said cutting means to carry out their cutting operations, and

a plurality of spaced guard members connected only to the trailing edge of each support member and having trailing ends extending toward an adjacent support member but spaced therefrom and from its cutting means,

the outer extremities of each guard member being located at a distance from the axis of said shaft less than the distance from said axis of the closest cutting edge of said cutting means coupled to an adjacent following support member,

the leading edges of said support members being further from the axis of said shaft than their trailing edges.

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