J. F. CUSHING.

CUTTER FOR HYDRAULIC DREDGES.

APPLICATION FILED JAN. 7, 1921.

1,436,015. Patented Nov. 21, 1922.

2 SHEETS—SHEET 1.

Fig. 1.

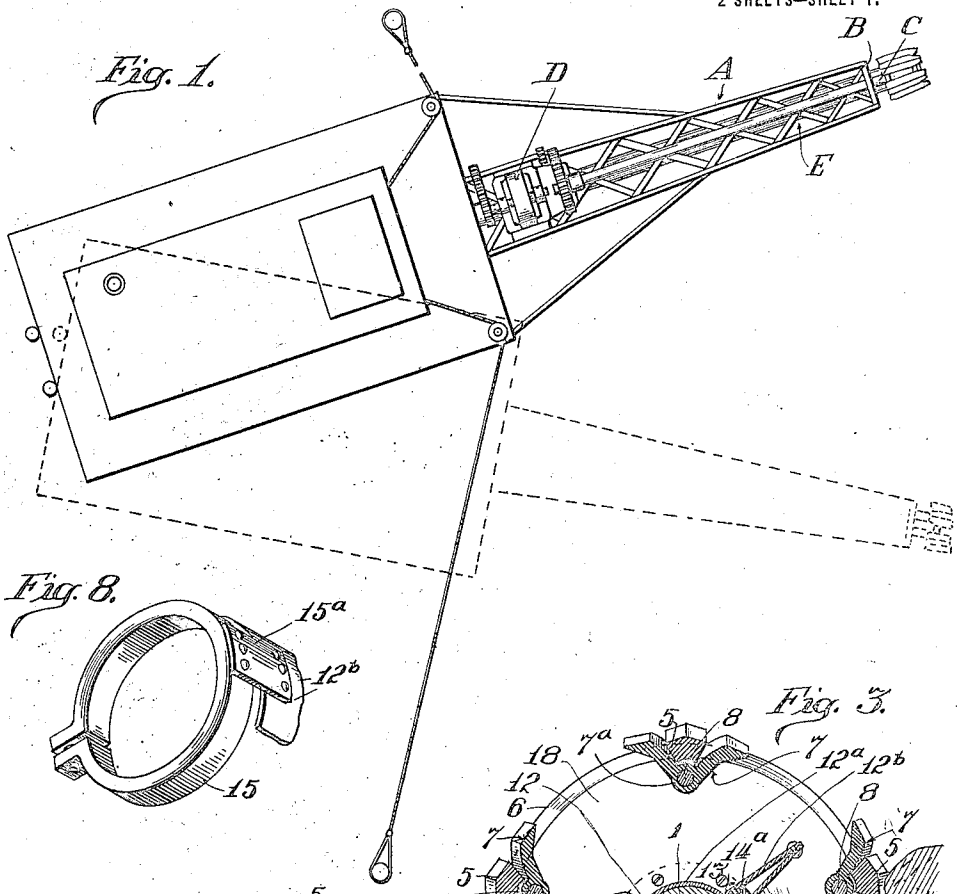


Fig. 8.

Fig. 2.

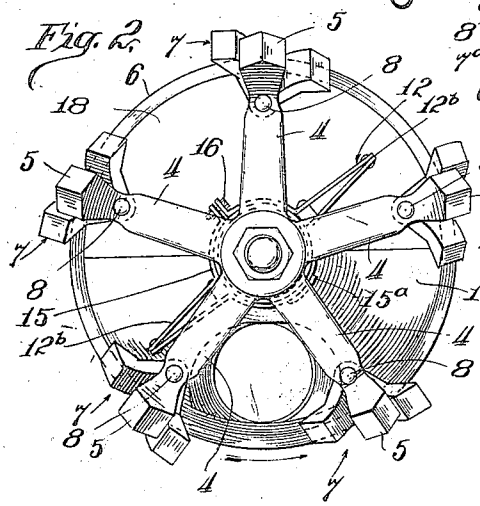
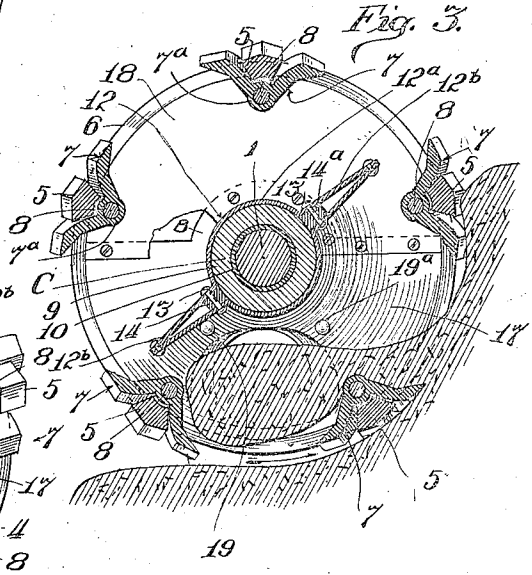


Fig. 3.



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2 SHEETS—SHEET 2.

Fig. 4.

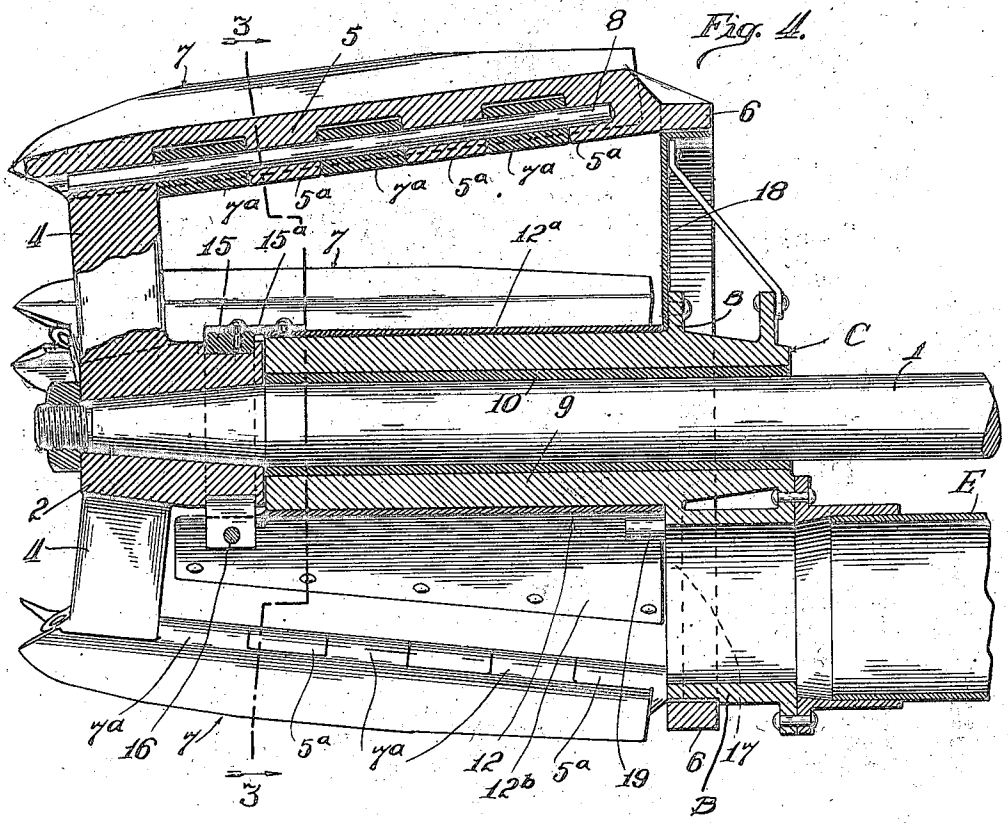


Fig. 5.

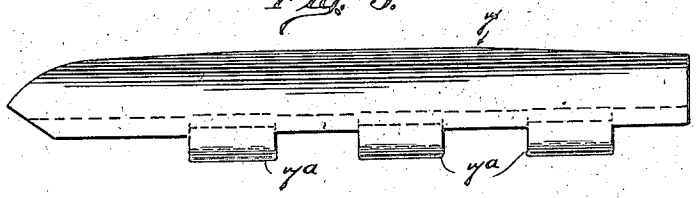


Fig. 7.

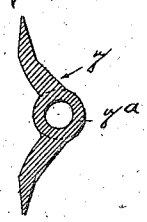
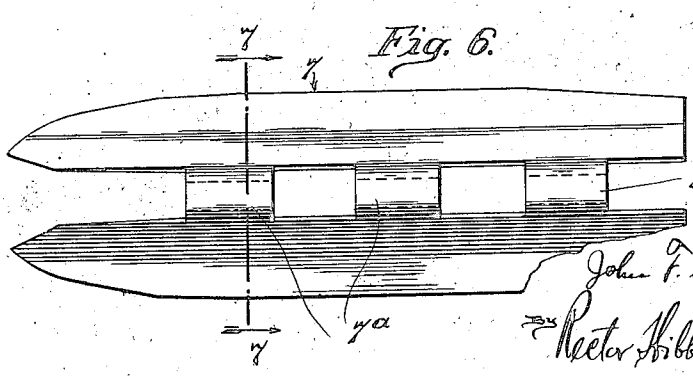


Fig. 6.



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UNITED STATES PATENT OFFICE.

JOHN F. CUSHING, OF CHICAGO, ILLINOIS.

CUTTER FOR HYDRAULIC DREDGES.

Application filed January 7, 1921. Serial No. 435,602.

To all whom it may concern:

Be it known that I, JOHN F. CUSHING, a citizen of the United States, residing at Chicago, State of Illinois, and county of Cook, have invented certain new and useful Improvements in Cutters for Hydraulic Dredges, of which the following is a specification.

My invention relates to improved cutters designed for use in dredging out dirt from the bottom of any body of water by the well known hydraulic process in which the earth is dislodged from its bed by a rotating cutter and sucked up through a large suction pipe by means of a powerful pump, and discharged through a delivery pipe by which it is conducted to the spot where it is to be deposited, the earth settling and the water draining away through gravity. The object of my invention is to improve the efficiency of such a dredging apparatus by providing a cutting tool and associated guide plate which will require less power than other types of cutter heads now in use, will remove the excavated material more completely continuously and cleanly, and in general will exhibit greater efficiency and be more desirable than any tools of the prior art designed for a similar use known to me. With the foregoing objects and advantages in view I have invented and designed the novel cutting implement hereinafter described and which is illustrated in the drawings forming part of this application, and my invention consists in the combination, arrangement and organization of cooperating parts of the described structure, the essential elements thereof being more particularly pointed out in the appended claims.

In the drawings Figure 1 is a plan view showing somewhat diagrammatically a dredging boat to which my invention is applied; Fig. 2 is an end elevation of the cutter head; Fig. 3 is a cross-section of the same on the line 3—3 of Fig. 4; Fig. 4 is a vertical diametrical section of the same; Fig. 5 is a side view of one of the cutter members or blades detached; Fig. 6 is a bottom view of the same viewed at right angles to the position shown in Fig. 5; Fig. 7 is a cross-section of the same on the line 7—7 of Fig. 6; and Fig. 8 is a detailed view showing in perspective a portion of the brake band acting yieldingly on the oscillating guide plate.

The same reference characters indicate the same parts in all the figures of the drawing.

It may first be explained, in order to give a better understanding of my invention, that in carrying out the hydraulic dredging operation in which my invention is designed to be used, the dredging boat is flexibly secured at its stern, to one or the other of a pair of posts or anchors which are alternately sunk in the bed of the sheet of water and serve as pivots upon which the front end of the boat is swung from one side to the other of the channel being dredged, usually by means of laterally extending cables which are secured to anchors on opposite sides of the channel and which extend around sheaves at opposite sides of the bow of the boat and are arranged to be taken up and paid out by winding drums, the drums being operated and controlled by mechanism well known in the art and unnecessary to be described. According to ordinary practice, one anchor or post is raised while the other is used as a pivot, and the swinging of the boat permits the raised post to be sunk slightly in advance of its previous position so that it may then be used as a pivot and the boat thus stepped forward, swinging first on one post and then on the other, as the work proceeds.

In the particular and well known form of dredging apparatus illustrated in the drawings, the front end of the boat is provided with a vertically swinging ladder frame A consisting of I-beams hinged at opposite sides of the front and converging towards and secured to an end plate B at their front ends, this plate being a casting of irregular shape provided with a bearing C for a rotating cutter shaft 1 pivotally supported by the frame and rotated by means of an engine or motor D mounted upon the rear end of such frame. The I-beams are connected with diagonally arranged cross-members to secure them together and form a rigid frame structure capable of being raised and lowered by suitable mechanism to carry on the excavating at the proper level. The ladder frame also supports a suction pipe E arranged immediately below the cutter shaft, the intake end of such pipe being secured to and terminating at the end plate, just at the rear of the lower portion of the cutting tool secured to the front end of the cutter shaft.

In dredging operations, as heretofore

conducted, as the boat was oscillated in the manner described to swing the cutter back and forth over and across the bottom of the channel to excavate the material, the cutter has always been continuously rotated in one direction only, from which it resulted that upon a swinging movement of the boat in one direction the cutting members were cutting from beneath upwardly, whereas when the boat was swung in the opposite direction the cutting members would be cutting downwardly into the layer of earth being removed.

My improved cutting tool is designed to be rotated in a clockwise direction when the ladder frame and shaft are swinging from right to left (as viewed from the dredging boat) and in a counter-clockwise direction when the shaft is swinging in the opposite direction, and provision must therefore be made for reversing the direction of rotation of the cutter shaft. The frame of the cutting tool, in the particular embodiment illustrated, consists of a spider frame having a hub 2 secured to the rotatable shaft 1 and radial arms 4 which are formed with rearwardly extending pivot bars or blade supports 5 continuous with a ring 6 at the rear end of the frame, all the parts of the frame mentioned being preferably formed integrally. Pivoted to each bearing bar is a rocking double-edged cutting blade 7, the two wings of which project at an obtuse angle from orificed connecting pivot lugs 7^a, as will be understood by reference to Figs. 6 and 7. The front ends of the blades are arranged to straddle the corresponding arms 4 and the blades are orificed to receive inwardly projecting orificed pivot lugs 5^a formed upon the bearing bars 5. A pivot pin 8 extending through the orifices of the pivot lugs 7^a and 5^a serves to hingedly connect each blade to the associated bearing bar. The sides of the body of each bar 5 are arranged to serve as opposite stops which cooperate respectively with the adjacent inner faces of the associated blade to permit such blade to assume the position shown in Fig. 3, or a similar opposite position when the blades are rotating and cutting in the opposite direction.

Secured to, or, as in the present instance, formed integral and continuous with the bearing portion C of the end plate B of the ladder frame is a hub 9, lined with a bushing 10, which forms a journal bearing in which the forward end of the shaft 6 is rotatably mounted. The hub 9 is formed with a cylindrical outer surface, to form a bearing upon which is mounted an oscillating guide plate 12, arranged to have a limited rocking movement within the space surrounded by the cutter blades 7. This guide plate in the present instance is formed of a pair of similar sheet metal members having approximately semi-circular hub portions 12^a and connected outwardly extending flat portions 12^b, the ends of which meet at diametrically opposite points, these members being clamped together by screw bolts 13 against a pair of spacing bars 14—14^a which are arranged adjacent the hub of the plate. Forwardly of the hub portions 12^b of the oscillating plate is arranged a brake band consisting of metal ring 15 which is riveted to one of said hub portions by means of a laterally extending tongue 15^a and which encircles a seat formed to receive it on the adjacent end of the hub 2 of the cutter frame. The tension of the band 15 is regulated by a clamping nut 16 arranged to draw the opposite ends of the band together and thus give any required degree of frictional drag between the cutter shaft and oscillating plate.

Within the plane of the ring 6 of the cutter a portion of the end plate B of the ladder frame extends to form a transverse partition 17 extending laterally around the opening into the suction pipe and above the hub 9 before mentioned, which is integral with it. Secured to the upper edge of the portion 17 of the plate and extending to a line adjacent the inside of the ring 6 is a flanged segmental plate 18 which, together with the partition 17, forms a circular shield serving to prevent the flow of water from the rear side of such parts forwardly into the space within the cutter blades 7. At opposite sides of the opening into the suction pipe the partition 17 of the end plate is provided with stops 19—19^a arranged to cooperate with the under side of the oscillating plate 12, so that the latter may assume either the position shown in Figs. 2 and 3 when stopped by the stop 19, or an opposite inclined position when cooperating with the stop 19^a.

It is obvious that when the cutter is cutting in the direction indicated by the arrow in Figs. 2 and 3, the tool being swung at the same time from left to right (as viewed in those figures) the cutter blade will automatically assume the position shown and dislodge the material by undercutting, the blade traveling upwards towards the point of least resistance, in which direction the tool requires a minimum amount of power to rotate it and operates more effectively than if it were cutting from the top downwardly, as is the case one-half the time with a one-way cutter. The oscillating guide plate 12 automatically assumes the position indicated in the two figures, as soon as the cutter is rotated in the direction indicated, due to the drag exerted on the hub of such plate by the cutter shaft operating through the brake band 15, assisted by the whirl of the water which is caused by rotation of the blades, and the plate is further held to its

seat by the suction through the pipe E, which acts most effectively on the lowermost wing of the plate. When the boat is swung in the opposite direction and the direction of rotation of the cutter shaft is reversed, the same forces, acting in the opposite direction, will cause a reversal of the position of the guide plate, and the cutter blades will at the same time assume the opposite position in the cutter frame before described.

With the parts of my novel cutting device constructed as above described, it will be readily seen that the suction exerted by the pump through the suction pipe will be relieved by water flowing from above around the edges of the oscillating plate (none coming directly from the rear end), and that the flow will take place in such manner as to wash into the pipe practically all the material excavated by the cutter. The amount of "spilled material"— i. e. material dislodged and carried over the top of the cutter and not entering the suction pipe,—is therefore greatly reduced as compared with forms of cutter in ordinary use.

I claim:

1. In hydraulic dredging apparatus having a cutter shaft arranged to be rotated in opposite directions, a cutting tool comprising a frame secured to said shaft, and two sets of peripheral rocking cutter blades, one series being arranged to excavate the material when the frame is rotated in one direction, and the other to excavate the material when the frame is rotated in the opposite direction.

2. In hydraulic dredging apparatus having a cutter shaft arranged to be rotated in opposite directions, a cutting tool comprising a frame secured to said shaft, and a series of two-winged rocking cutter blades, the cutting edges on corresponding wings of said blades being arranged to excavate the material when the frame is rotated in one direction, and the cutting edges on the opposite wings being arranged to excavate the material when the frame is rotated in the opposite direction.

3. In hydraulic dredging apparatus having a cutter shaft adapted to be rotated in opposite directions, a cutting tool comprising a frame secured to shaft and having terminal radial arms and peripheral pivot bars connected therewith, and cutter blades pivoted on said bars and having a limited rocking movement on their pivots.

4. In hydraulic dredging apparatus, a cutting tool according to claim 3 in which the rear ends of the peripheral pivot bars are connected by a ring.

5. In hydraulic dredging apparatus having a cutter shaft arranged to be rotated in opposite directions and a suction pipe having an inlet opening adjacent the front end of said shaft, a cutting tool fixed to the front end of said shaft and having a series of peripheral cutter blades arranged to rotate in front of said inlet opening, and a guide plate mounted axially of said shaft within the field enclosed by said cutter blade, said guide plate being arranged to have a limited rocking movement.

6. In hydraulic dredging apparatus having a vertically swinging frame including a transverse shield at its front end and a suction pipe having an inlet opening in said shield and a hub bearing arranged above said inlet opening, a cutter shaft arranged to be rotated in opposite directions and journaled adjacent its front end in said bearing, a cutting tool secured to the front end of said shaft, and an oscillating guide plate pivotally mounted on said hub bearing and arranged to cooperate with stops arranged on opposite sides of the suction pipe opening.

7. In hydraulic dredging apparatus, a structure according to claim 6 in which said oscillating guide plate has a slipping frictional connection with said cutter shaft.

8. In hydraulic dredging appartus, a structure according to claim 6 in which said cutting tool includes a spider frame having a peripheral series of rearwardly-extending blade supports and a connected ring at the rear end of said supports, and in which said shield is circular in shape and arranged inside of said ring.

JOHN F. CUSHING.