March 12, 1929. W. H. TWIFORD 1,705,428

DREDGING APPARATUS

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Fig. 1.

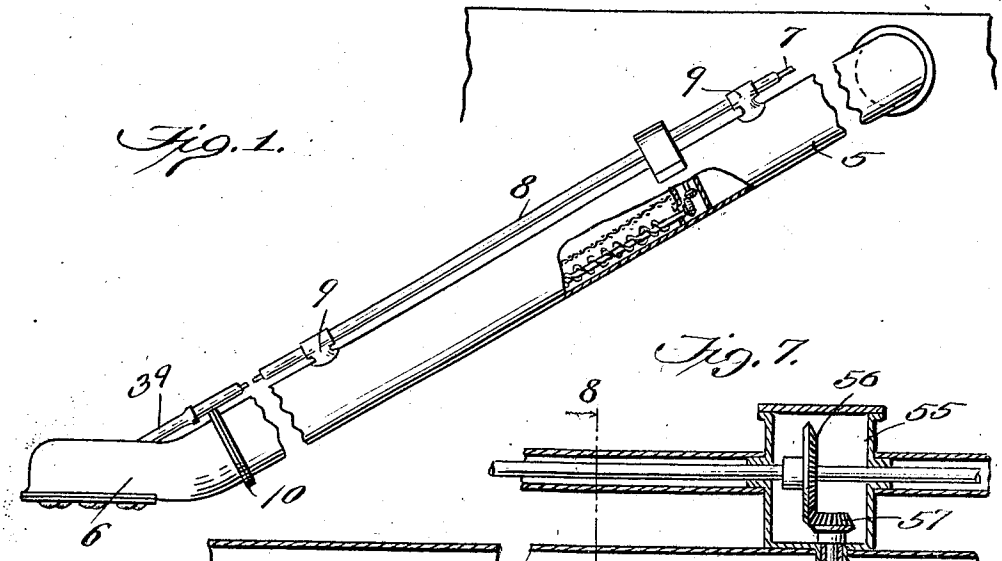


Fig. 7.

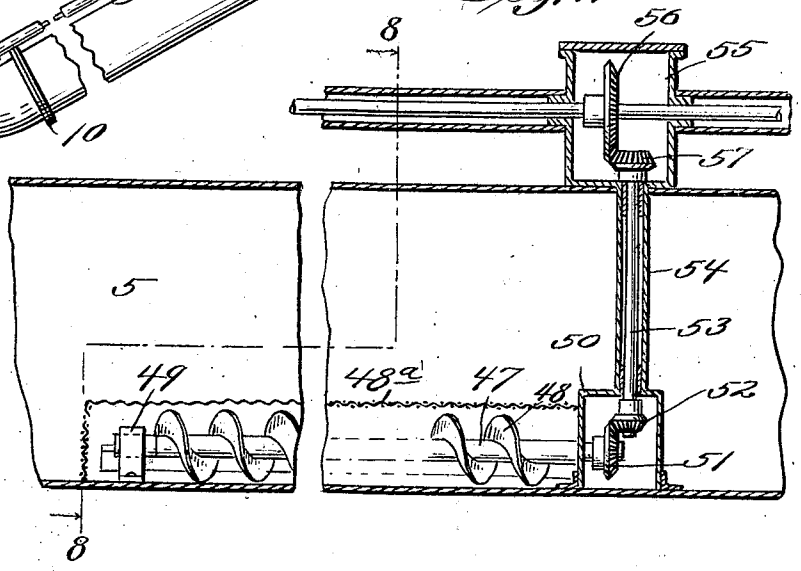
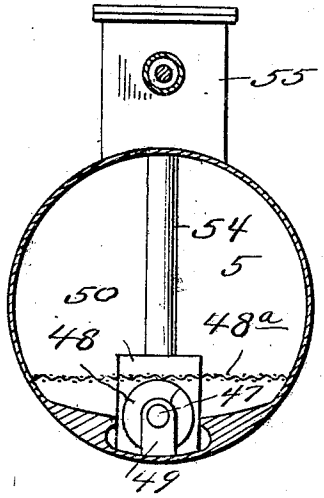


Fig. 8.



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Fig. 2.

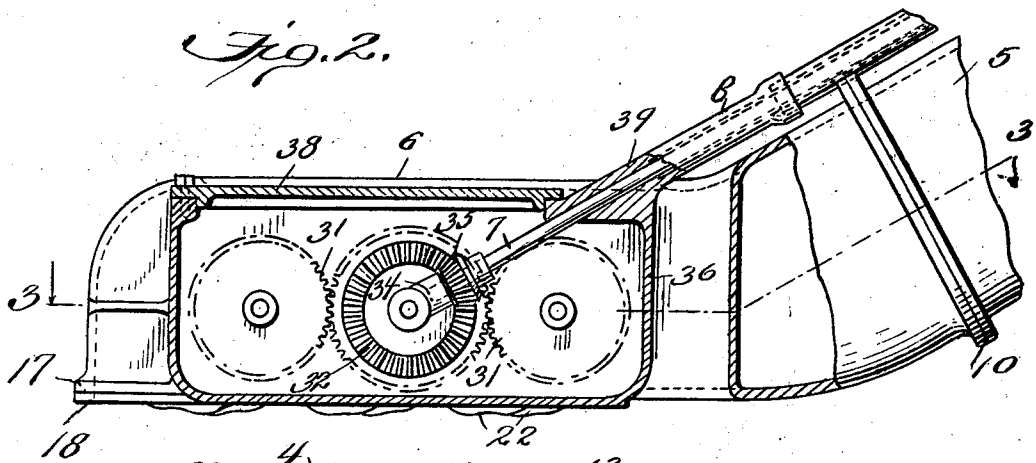
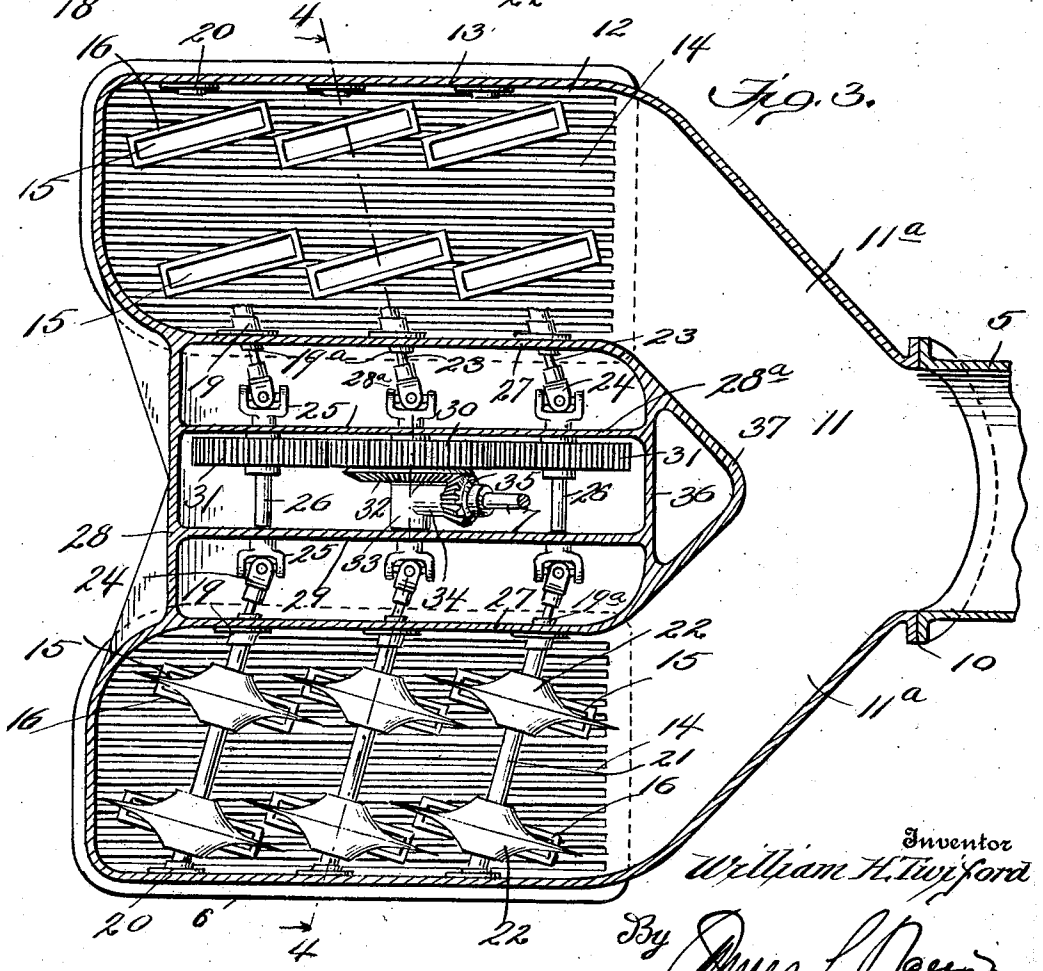


Fig. 3.



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DREDGING APPARATUS

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Fig. 4.

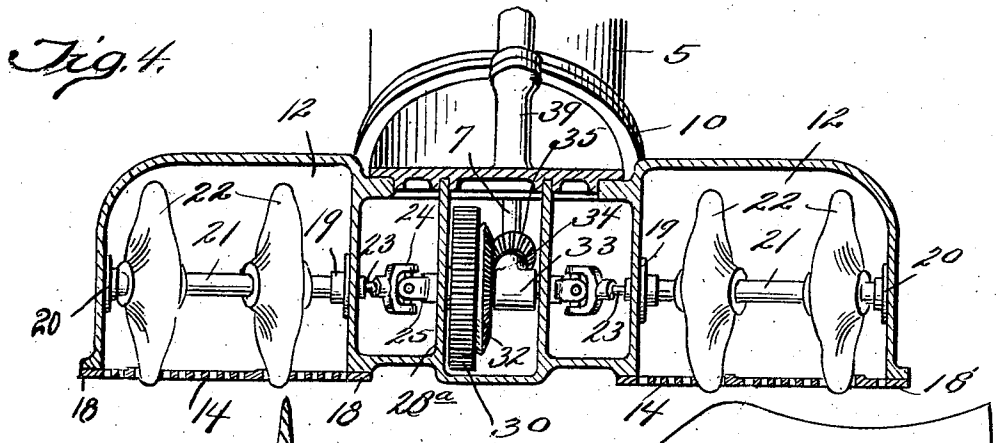


Fig. 5.

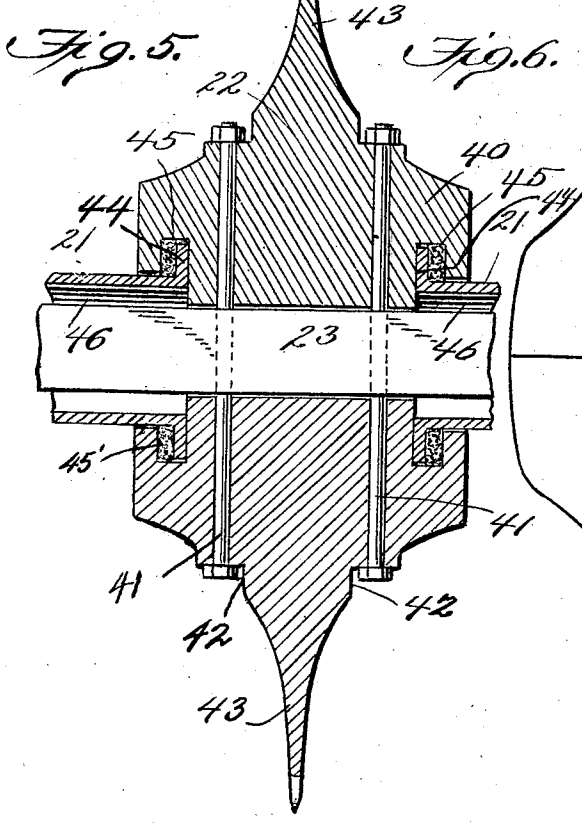
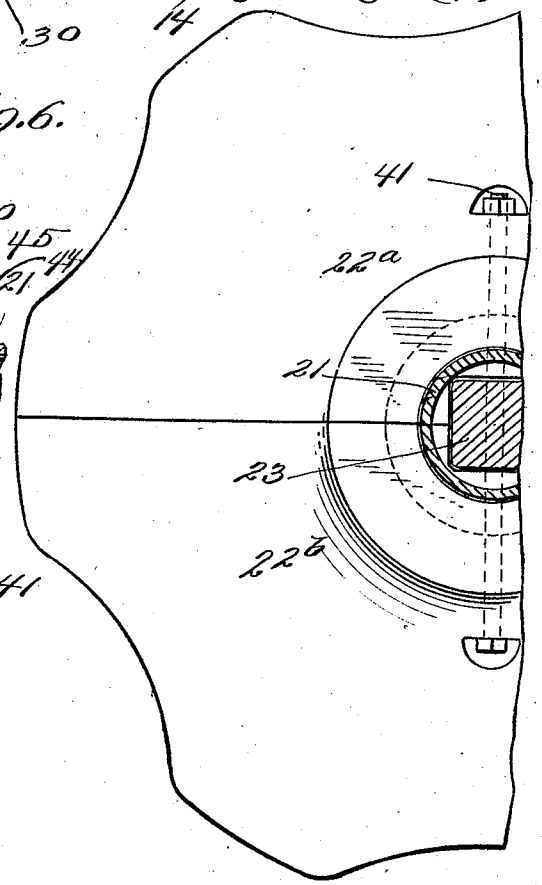


Fig. 6.



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UNITED STATES PATENT OFFICE.

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DREDGING APPARATUS.

Application filed December 9, 1926. Serial No. 153,626.

This invention relates to dredging apparatus and particularly to a suction head and endless booster for the uptake pipe of seagoing hopper dredges.

The primary object of the invention is to make dredges of the class specified more effective in their dredging operation, by providing the suction head with means which will loosen hard sand and like sediment and thus make it possible to more easily convey such material upwardly through the uptake pipe than has heretofore been possible in the operation of suction heads now commonly used.

A further object of the invention is to install in, or as a part of, the uptake pipe means for overcoming the tendency of the dredged sand, silt or other material to settle or lodge in the lower portion of said uptake pipe and thus make the latter more effective as a conveying means with the usual suction force, thus avoiding occlusion of the uptake pipe and interference with the usual suction force and maintaining a thorough clearance of the uptake pipe, with material advantages in the dredging operation generally.

A further object of the invention is to construct a suction head for an uptake pipe which will give a greater area thereof relatively to the surface engaged.

A still further object of the invention is to generally improve dredging apparatus of the class specified and compactly associate the specific active mechanism thereof in a protective manner without impairing the efficiency of the several parts in performing their desirable functions.

With the foregoing and other objects and advantages in view, the invention consists in the preferred construction and arrangement of parts which will be more fully hereinafter described and claimed.

In the drawings:

Figure 1 is a side elevation, partially broken away, of an uptake pipe of a dredging apparatus and a suction head associated therewith embodying the features of the invention.

Fig. 2 is a longitudinal sectional elevation of a portion of the lower end of the uptake pipe and gear box or enclosure;

Fig. 3 is a horizontal section on the line 3—3, Fig. 2;

Fig. 4 is a transverse section on the line 4—4, Fig. 3;

Fig. 5 is a section, on an enlarged scale, taken transversely through one of the cutter disks and a portion of the shaft therefor and particularly illustrating the contour of the cutter disk and the manner of securing the same to the shaft;

Fig. 6 is a side elevation of a portion of one of the cutter disks, showing the contour of the shaft therethrough in transverse section;

Fig. 7 is a longitudinal sectional view, on an enlarged scale, of a portion of the uptake pipe and illustrating a novel form of booster and the gearing connection with the main drive shaft for operating the same; and

Fig. 8 is a section on the line 8—8, Fig. 7.

The numeral 5 designates an uptake pipe, which may be of any length, having a suction head 6 at an angle to the free terminal thereof. This suction pipe may be used with any kind of self-propelled hopper dredge or any type of movable dredge, whether self-propelled or towed, and provided with the usual mud or sand hoppers built in the hull, or built in sand or mud scows attached to the dredging plant to receive the dredged material. The invention may also be used in connection with other dredging and engineering apparatus now commonly used in this country. As will be understood, the uptake pipe 5 is mounted for adjustment as desired and in the present instance the drive shaft 7 running from the engine or motor installed in the dredge or dredging apparatus is shown as supported on the upper portion of the uptake pipe by a shaft-enclosing tube 8 in which the said shaft has free rotation, the tube being secured in fixed position on the intake pipe by brackets 9 of suitable character. The suction head is coupled or joined to the free extremity of the uptake pipe 5 by a suitable tight joint construction 10 as shown on an enlarged scale by Figs. 2 and 3, said suction head comprising a Y-pipe 11, the members 11^a of which continue into or form parts of sand boxes 12, each having a surrounding wall 13 of suitable dimensions. Each sand box 12 has a longitudinally slotted bottom 14 with angularly disposed openings or slots 15 therethrough and arranged in longitudinal sequence on opposite sides of the longitudinal center of the box. Each of the openings 15 is surrounded by a marginal frame 16 and all of the openings 15 and their frames 16 have the same angular disposition with relation to the outer and inner side walls of the sand boxes. Around the lower side or bottom of each box is a flange 17 secured to the marginal

side and end edge portions 18 of the slotted bottom 14, as shown by Fig. 4, and by this means the bottom 14 is firmly and reliably secured in applied position. Diagonally opposed in the inner and outer side walls of each sand box at about a central position are bearings 19 and 20, the inner bearings 19 having portions 19ª extending through the inner side wall of the box. These bearings are diagonally opposed, as just noted, and at approximately right angles to the length of the openings 15 and marginal frames 16 thereof, to receive shafts 23 carrying sleeves 21 between which are mounted disk cutters 22 of a novel form of construction. The sleeves 21 enclose the solid shafts 23, which are angular in cross section and having the disk cutters secured thereto. The shafts 23 project through the bearings 19 inwardly from the inner wall 27 of each box and are provided with yokes 24, which extend over and are disposed at right angles and pivoted to corresponding yokes 25 of laterally extending counter-shafts 26, which are driven from the main drive shaft 7. Each sand box is a duplicate of the other in construction and these boxes are disposed on opposite sides of the longitudinal center of the shaft tube or sleeve 8 and at equal distances from the latter. The shafts 23 extend through the outer side walls 27 of a gear box 28 located between the sand boxes 12, the inner side walls of the sand boxes forming the outer side walls of the gear box. Extending longitudinally through the center of the gear box 28 are two partitions 28ª and 29, which are spaced apart a requisite distance, and against the one partition 28ª central and outer spur or analogous gears 30 and 31 are mounted, the intermediate or central gear 30 being in the form of a drive gear and having a bevel gear 32 at its inner face mounted on a collar 33, to which a bearing collar 34 is secured at an angle and carries a bevel pinion 35, the drive shaft 7 being secured to the bevel pinion 35 and extending downwardly into the bearing collar 34, so that rotation of the shaft 7 will cause a positive drive of the bevel gear 32 and the intermediate or central drive gear 30. The collar 33 is mounted on one of the counter-shafts 26 between the gear 32 and the partition 29 and keyed to said counter-shaft the other two counter-shafts 26 extending through and being keyed to the gears 31. The yokes 24 and 25 form a universal coupling between the shafts 23 and counter shafts 26. The gears 30 and 31 are held in continual mesh and therefore transmit motion from the shaft 7 to the shafts 23 and the discs 22 carried by the latter. The edges of the discs 22 project through the openings 15 in the bottoms 14 of the sand boxes and serve to loosen the hard sand, clay or other material with which the suction head engages, the loosened material being drawn upwardly through the slots in the bottoms of the sand boxes, the members 11ª of the Y-pipe 11 into the uptake pipe 5 and discharged from the upper end of the latter as in ordinary dredging constructions. By angularly disposing the cutter disks 22 and causing the latter to rapidly rotate, the hardened sand, clay or other material is more effectively loosened or cut and drawn upwardly through the slotted bottoms 14 of the sand boxes. The inner terminal wall 36 of the gear box intersects the arched inner wall 37 of the members 11ª of the Y-pipe 11 at a distance from the forward extremity of the said wall 37, to strengthen the attachment and mounting of the gear box in place between the sand boxes. The gear box 28 also has a removable cover 38 for convenient access to the gearing, and, where the shaft 7 extends upwardly through the rear central portion of the gear box, a suitable elongated bearing 39 for said shaft is provided as clearly shown by Fig. 2.

The foregoing details of construction and arrangement of the several parts, however, may be varied, as it is intended to use various mechanical devices for conveniently assembling the parts and also to modify the gearing as may be desired to best adapt the same for the purpose.

The construction of each disk cutter and its mode of attachment to its shaft 23 is shown particularly by Figs. 5 and 6. Each disk cutter is composed of two sections 22ª and 22ᵇ, of equal dimensions, and formed with a central or inner, materially enlarged, hub section 40, which hub sections, when united, provide a strong and resistful reinforcement against breakage or fracture and also make it possible to secure the complete disk cutter to the shaft 23 by headed cross bolts 41 with nutted ends bearing against annular shoulders 42, the said headed and nutted bolts passing transversely of the hub sections 40 and the shaft 23, as shown by Fig. 5, to positively yet removably secure each disk to its shaft. From the center of the enlarged hub sections 40 the disk cutter is reduced and gradually tapered into a sharp cutting edge or blade 43, which is preferably of scalloped contour as shown by Fig. 6 and indicated by Fig. 4, to render the disk cutters more effective in their operation of loosening the hardened sand or like material with which they may engage. In accordance with the present arrangement, two of the disk cutters 22 are associated with each shaft 23 and driven by the latter, and while a sand box with this equipment is ample for all practical services, it will be understood that the number of disk cutters may be increased as desired. The sleeves 21 between the disk cutters vary in length in accordance with the distance between the cutters and the sectional hubs 40 and bearings 19 and 20. The sleeves 21 which extend into the bearings 19 and 20 have at their ends which bear against

the disk cutters 22 angular flanges 44 which project outwardly and extend into annular seats 45 formed in the ends of the hub sections 40, and between these flanges and the adjacent end walls of the said seats suitable packing material 45′ is introduced, whereby a sand-tight joint is provided which will prevent wear on the hub sections and cutter disks, especially at the points where they surround the shafts 23. As shown by Fig. 5, there is a material space, as at 46, between the shafts 23 and sleeves 21 so that there is no interference with the free rotation of each shaft 23 and its complement of disk cutters. This manner of applying the disk cutters to the shafts 23 makes it possible to clean the cutters and maintain them in practical operating condition, and also to separate the sections 22^a and 22^b of each disk cutter from its shaft so that the reduced edge or blade 43 may be readily sharpened when required.

The improved dredging apparatus also includes what is termed a booster or means for keeping the lower portion or extremity of the uptake pipe 5 clean, which means comprises a screw mounted at the center of the bottom wall of said pipe and mounted on a longitudinally-disposed shaft 47. The screw is formed of a spiral blade 48, so disposed as to approximately contact with the bottom portion of the uptake pipe and prevent sediment from accumulating at this point in the uptake pipe during the suction operation. The shaft 47 is mounted at one end in a suitable bearing 49 supported in the uptake pipe 5 and at the opposite or upper end extends through a gear box 50 located in the lower portion of the uptake pipe. The end of the shaft within the gear box is provided with a beveled pinion 51, held in continual mesh with a smaller similar pinion 52 on the lower end of a transmitting shaft 53 enclosed within a tubular casing 54 extending through the uptake pipe and also through the bottom of an exterior gear box 55 on the upper portion of the uptake pipe directly opposite the gear box 50. The gear box 55 intersects the sleeve or tubular covering 8 for the shaft 7, and on the shaft 7 within the said gear box 55 is a beveled pinion 56 which is held in continual mesh with a pinion 57 on the upper end of the shaft 53, as clearly shown by Fig. 7. The shaft 47 with its screw blade 48 is covered by a protective wire screen 48^a of suitable mesh and is regularly rotated from the shaft 7 by the mechanism explained and the removal by the screw blade 48 of the central portion of any matter that may tend to accumulate in the uptake 5 will loosen the remaining portions above and below said blade sufficiently to be influenced by the suction force and such loosened material will be carried up through the uptake pipe and discharged with the other material passing through the said pipe.

From the foregoing the operation of the improved dredging apparatus will be readily understood. When the uptake pipe is lowered so as to effect a contact of the slotted bottoms 14 of the sand boxes 12 with the bed of material desired to be loosened and suction force is applied through the said pipe 5 and the mechanism is actuated through the shaft 7 from the dredger or vessel to which the apparatus is attached, the disk cutters 22 will loosen or release the hardened sand, clay or other material from the water bed and such loosened material will be drawn upwardly through the slotted bottoms 14 of the sand boxes 12 by way of the members 11^a of the Y-pipe 11 through the uptake pipe 5 in regular quantities in accordance with the amount of material loosened by the disk cutters 22. The booster or cleaning apparatus is at the same time kept in motion to prevent accumulation of sediment at the bottom of the uptake pipe, as hereinbefore noted.

It will be seen that all of the parts of the gearing and drive shaft are enclosed and rendered water-tight, that the gear box is also positioned so as to add materially to the strength and successful operation of the sand boxes, and that the bottom of the said gear box between the sand boxes is closed as indicated at 28^a so as to protect the gearing. Where the bearing brackets 19 are located, moisture is prevented from seeping through the joints into the coupled shafts 23 and gear shafts 26, and it will be understood, if necessary, the operating parts may be further protected by such devices as may be expedient to accomplish the end sought. The improved structure, including the suction head with the cutters and endless booster or cleaning device in the uptake pipe, may be associated with uptake pipes now in use without modifying to any material extent the construction of the latter. The apparatus as a whole may also be used in connection with any form of seagoing or self-propelled hopper dredge or any type of movable dredge, and the suction head and booster attachment will generally increase the efficiency of a dredging plant without any changes of the pumps and the pumping engines.

What is claimed as new is:

1. A dredging apparatus of the class specified, comprising an uptake pipe and a suction head carried thereby, said suction head having rotary means on opposite sides of the center thereof for loosening the material to be dredged, enclosures for said rotary means in communication with the uptake pipe, mechanism including gears and shafts located at the center of the head and extending outwardly in opposite directions and connected for rotation of the said cutter disks, and a drive shaft carried by the uptake pipe and operatively associated with the said gears.

2. In a dredging apparatus, an uptake pipe having a suction head, cutter disks rotatably mounted in said head, the said disks being made in two sections having enlarged hubs and provided with tapered cutting members, said hubs having recesses in their opposite ends, a shaft extending through the hubs and removably secured to the latter, and sleeves mounted over the said shafts and having their inner ends extending into the recesses at the opposite ends of the hubs, and packings in said recesses forming tight joints between said sleeves and said hubs.

3. A dredging apparatus comprising a suction head, partitions extending longitudinally of said suction head and dividing said head into a pair of sand boxes and an intermediate gear box, an uptake pipe connected to said suction head and communicating with said sand boxes, said gear box having a closed bottom, rotatable shafts extending through said partitions transversely of said sand boxes, disc-like cutters secured to each of said shafts and projecting beyond the lower ends of said sand boxes, gears rotatable in said gear box on axes at right angles to the longitudinal axis of said gear box, universal joint connections in said gear box between each of said gears and one of the shafts in each of said sand boxes, a rotatable shaft extending longitudinally of said uptake pipe and into said gear box, and driving means in said gear box between said last-named shaft and said gears.

4. A dredging apparatus according to claim 3, wherein each of the transverse shafts rotates on an axis at an acute angle to the longitudinal axis of the sand box in which it rotates.

5. A dredging apparatus according to claim 3, wherein each of the transverse shafts rotates on an axis at an acute angle to the longitudinal axis of the sand box in which it rotates, and wherein each sand box has a bottom provided with a plurality of openings below and at right angles to the axes of rotation of the transverse shafts and through each of which openings one of the rotatable cutters projects.

6. A dredging apparatus according to claim 3, wherein each of the transverse shafts rotates on an axis at an acute angle to the longitudinal axis of the sand box in which it rotates, and wherein each sand box has a bottom provided with a plurality of longitudinal slots and also with a plurality of openings below and at right angles to the axes of rotation of the transverse shafts and through each of which latter openings one of the rotatable cutters projects.

In testimony whereof I have hereunto set my hand.

WILLIAM H. TWIFORD.